U.S. Department
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National Highway
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Emergency Medical Technician — Paramedic: National Standard Curriculum

Instructor's Lesson Plans

1985

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Contents

Foreword

There are more than 35,000 Emergency Medical Technician-Paramedics (EMT-P) currently State certified or Nationally Registered in the United States. Of the total, almost 85% are paid professionals. Approximately 70% of all EMT-P's reside in six states. The rest are spread out over the other 44 states, most of which have prehospital advanced life support (ALS) capabilities.

Since the inception of Emergency Medical Service (EMS), great strides have been made. Death tolls on the nation's highways, as well as deaths from sudden illness, have decreased because of the number of rescue personnel working in an organized EMS system. The typical EMT-P is a paid employee of a municipal or hospital based system, and mobile communications afford enhanced scene-hospital interaction. For training consistency throughout the nation, the National Standard Training Curriculum (NSTC) for the EMT-Paramedic is the accepted minimum training standard.

It has become clear in the 1980's that the basic body of knowledge that should be taught to the EMT-P must be expanded. In the early 1970's a task force of the National Academy of Science and the National Research Council arrived at a list of minimum skills that must be achieved by each EMT-P. This reflected, to a large extent, what was already being taught in the majority of programs. In 1982, a Department of Transportation (DOT) support committee was created to ensure that evolutionary changes in prehospital care were included in the paramedic curriculum on an ongoing basis.

The Committee conducted a formal study, questioning the majority of EMT-P training programs, all 50 State's training coordinators, and a sampling of field EMT-P's regarding the initial EMT-P curriculum. It was found that support of the curriculum existed; however, suggestions were made to alter the curriculum to reflect the actual needs of the field EMT-P's. It was noted that some areas of peripheral background material could be de-emphasized (e.g., blood gases) while other areas needed more emphasis, such as geriatrics, hypothermia, and crisis intervention. Additionally, anatomy and physiology were requested to be tied more directly to disease processes and the occurrence of injury rather than being fragmented, as in the initial curriculum.

The update of the National Standard Training Curriculum is based upon the following six factors:

(1) The EMT-P is a health care professional. While much of the material in the curriculum is peripheral to many of the psychomotor skills, this knowledge is essential for EMT-P's to know if they are to continue working under the written and/or verbal standing orders of physicians as most services presently function. This knowledge is also vital should telecommunications be interrupted and to provide a long-term academic base for continuing education.

(2) The overall knowledge and skills defined in the original curriculum still have validity in 1985. The previously mentioned study called for a restructuring and updating of the curriculum based upon the evolutionary changes that have occurred since 1976.

(3) The NSTC for the EMT-P is being restructured to resemble more clearly how most EMT-P programs present their course material and to reflect how EMT-Paramedics apply this skill and knowledge.

(4) The updated curriculum (all six divisions) is considered essential and should be presented in its entirety to any field level provider who performs all the advanced life support skills.

Division 1: Prehospital Environment

Section 1. Roles and Responsibilities

TOPIC	CONTENT OUTLINE
Introduction	The EMT-Paramedic has a variety of duties. It is imperative that, as a health care professional, he understand his legal, moral and ethical responsibilities. These responsibilities occur during training and in the practice of patient care.
Overview	Section I Medical Ethics and Professionalism Section II Post Graduation Responsibilities Appendix
Objectives	At the conclusion of Subsection 1, the instructor will have provided sufficient information, demonstration and practice to the student, to ensure his/her ability to:

1.1.1 Identify and describe those activities performed by an EMT-Paramedic in the field.

1.1.2 Define the role of an EMT-Paramedic.

1.1.3 Describe and contrast the difference between an EMT-Ambulance, EMT-Intermediate, and EMT-Paramedic training program.

1.1.4 Define the terms "ethics" and "professionalism."

1.1.5 Describe the differences between ethical behavior and legal requirements.

1.1.6 State specific activities that are most appropriate to ethical behavior.

1.1.7 Identify whether a particular activity is unethical and/or illegal, given certain patient care situations.

1.1.8 Identify whether a particular activity is ethical or unethical given certain patient care situations.

1.1.9 Define the term "professional."

1.1.10 Define the term "health care professional."

1.1.11 Identify whether a particular activity is professional or unprofessional given certain patient care situations.

1.1.12 State certain activities that are most appropriate to professional behavior.

1.1.13 List current state requirements for EMT-Paramedic continuing education.

1.1.14 Define and discuss at least three reasons why continuing education is important for the EMT-Paramedic.

1.1.15 Define the terms "certification, licensure, and registration."

1.1.16 Name and describe current state legislation outlining the scope of pre-hospital Advanced Life Support.

1.1.17 State the reason that it is important to keep one's EMT-Paramedic certification current.

1.1.18 State the major purposes of a national association.

1.1.19 State the major purposes of a national registration agency.

1.1.20 State the major benefits of subscribing to professional journals.

1.1.21 State the benefits of EMT-Paramedics teaching in their community.

TOPIC	CONTENT OUTLINE
Medical Ethics & Professionalism	A. Introduction

A. Introduction
   1. This section is one of the most important sections in the curriculum, not because of the medical information, but because of its long-term value post graduation.
   2. Even though much of this section is intangible, accepting and implementing these concepts into their professional lives will ultimately separate the excellent from the average EMT-P.

B. Ethics
   1. Ethics are principles governing the conduct of an EMT-P. They deal with the relationship of an EMT-P to his or her patients, the patient's family and to peers and society at large.
   2. The word ethics comes from the Greek word meaning "character."
   3. Ethics set standards of rightness and wrongness of human conduct, but do not address morality.
   4. The Oath of Geneva, EMT Oath and the Code of Ethics for EMT's.
   5. Examples relating to standing vs. written orders, professional indiscretions, meeting patients medical needs who are unable to pay, and interactions with other members of the health care team.
   6. Contrast ethical and unethical behavior vs. legal requirements and/or illegal activities.
   7. If EMT-P places the patient above all else when providing medical care, he or she will rarely have to worry about committing an unethical act.

C. Professionalism
   1. A professional is a person who has certain special skills and knowledge in a specific area and conforms to the standards of conduct and performance in that area.
   2. Professionalism in health care is necessary to:
      a. Promote *quality* patient care
      b. Instill pride in profession
      c. Promote high standards
      d. Earn respect of medical team
   3. Examples of professional and unprofessional behavior based upon activities of D, 1–7.

D. Role
   1. Recognizing a medical emergency; assessing the situation; managing emergency care and, if needed, extrication; coordinating their efforts with those of other agencies that may be involved in the care and transportation of the patient; and establishing rapport with the patient and others to decrease their state of crisis.
   2. Assigning priorities of emergency treatment and recording and communicating data to the designated medical command authority.
   3. Initiating and continuing emergency medical care under medical control including the recognition of presenting conditions and initiation of appropriate invasive and noninvasive treatments, e.g., surgical and medical emergencies, airway and respiration problems, cardiac dysrhythmias, cardiac standstill, and psychological crises; and assessing the response of the patient to that treatment and modifying

Explain the difference between morality and ethics.

medical therapy as required under the direction of a physician or other authorized personnel.

4. Exercising personal judgment in case of interruption in medical direction caused by communication failure or in cases of immediate life-threatening conditions (under these circumstances, provides such emergency care as has been specifically authorized in advance).
5. Directing and coordinating the transport of the patient by selecting the best available method(s) in conjunction with medical command authority.
6. Recording in writing or dictation the details related to the patient's emergency care and the incident; and
7. Directing the maintenance and preparation of emergency care equipment and supplies.

E. EMT-A vs. EMT-Intermediate vs. EMT-Paramedic

1. An EMT-A (Basic) should have successfully completed the National Standard Training Course (NSTC) for EMT-A's. He should be competent in all phases of BLS; including the pneumatic anti-shock garment.
2. An EMT-Intermediate should be a state or national certified EMT-A, have successfully completed the National Standard Training Course for EMT-I's, be competent and knowledgeable in all phases of BLS, including the pneumatic anti-shock garment, and in those phases of ALS including EOA or EGTA and intravenous therapy.
3. An EMT-P is defined under D above.

Post Graduation Responsibilities

A. Introduction

1. Once graduated and practicing, there are a multitude of personal responsibilities that go with calling oneself a health care professional.
2. Credentialing is a state function that may take one or more of the following forms (i.e., use of National exams as a basis to grant state licensure.)
   a. Registration or certification—The process by which an agency or association grants recognition to an individual who has met certain pre-determined qualifications specified by that agency (common method used in medicine, nursing and allied health).
   b. Protects the public from incompetence and provides for professional identification.
   c. Licensure—Process by which a governmental agency grants permission to an individual to engage in a given occupation upon finding that the applicant has attained the minimal degree of competency necessary to ensure that the public will be reasonably protected.
3. Current state statutes and/or other pertinent information on the lead state EMS agency governing ALS.
4. It is legally essential to attain and maintain certification/registration under state law as long as one works as an EMT-P.
5. Definitions
   a. Recertification/relicensure—process by which an individual's technical competence ia periodically reaffirmed.

While over 30 additional levels of EMT's exist in the U.S., only the EMT-I described in #2 is nationally recognized.

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States have different continuing education requirements for recertification/relicensure.

   b. Reciprocity—The mutual exchange of privileges or licenses by two certifying agencies.
6. Current state/national continuing education requirements or EMT-P recertification/relicensure.
7. Continuing education is important because:
   a. A lot of the skill and knowledge learned in the course may not be used with great frequency. Skill decay can occur very quickly.
   b. The public and medical community need to be continually assured that quality patient care is being delivered.
   c. It is a basis for reciprocity between many states that can allow for the potential advantages of vertical and horizontal mobility.
   d. New knowledge, skills and equipment will continue to be a part of this relatively new profession.
8. The major purpose of a national association includes:
   a. That models of required competencies are developed for various roles in the profession.
   b. To provide learning experiences to help the EMT's acquire the skills of self-directed learning and to help instructors acquire the necessary skills as facilitators of learning.
   c. To stimulate and/or provide the development of study programs, workshops, in-service programs, multi-media packages, and other learning resources accessible to all EMT's.
   d. To instill awareness among its members regarding the need for continuing professional development and to reward self-development efforts.
   e. To assure that its members are engaging in continuing professional development, preferably voluntarily but under compulsion if necessary.
   f. To inform its members about modern concepts of adult learning and to apply those concepts in its own educational activity.
9. The major purpose of a national registration agency includes:
   a. To promote the improved delivery of Emergency Medical Services by:
      i. Assisting in the development and evaluation of educational programs to train EMT-Ps.
      ii. Establishing qualifications for eligibility to apply for registration.
      iii. Preparing and conducting examinations designed to assure the competency of EMT-P.
      iv. Establishing a system for biennial re-registration (every two years).
      v. Establishing procedures for revocation of certificates of registration for cause.
      vi. Maintaining a directory of Registered Emergency Medical Technicians-Paramedic.
   b. To develop guidelines and programs to assist individuals who have completed Emergency Medical Technician–Paramedic

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programs to raise their level of competence to assure the provision of improved Emergency Medical Services and

c. To do any and all things necessary or desirable for the attainment of the stated purposes.

10. Major benefits of subscribing to professional journals include:
    a. They are a source of continuing education.
    b. They provide an opportunity for the EMT-P to publish articles.
    c. They are an informational source whereby EMT-P's can learn about other local, state, regional or national advancements and/or issues.
    d. They encourage professional growth and awareness.
11. The benefits of EMT-P's teaching in their communities include:
    a. It can be a source of continuing education credit.
    b. It can provide a review of material and/or skills not commonly used in the field.
    c. Setting up the EMT-P as a leader and resource person in his community.
    d. It can fill a much needed void in having BLS and/or BCLS qualified individuals trained in the community.
    e. Providing supervision, direction and evaluation of student EMT-P's during their field internship.

The Oath of Geneva, drafted by the World Medical Association in 1948, provides a good example. It is the oath taken by many medical students upon completion of their studies, at the time of being admitted to the medical profession.

I solemnly pledge myself to consecrate my life to the service of humanity; I will give to my teachers the respect and gratitude which is their due; I will practice my profession with conscience and dignity; the health of my patient will be my first consideration; I will respect the secrets which are confided in me; I will maintain by all the means in my power the honor and noble traditions of the medical profession; my colleagues will be my brothers; I will not permit considerations of religion, nationality, race, party, politics, or social standing to intervene between my duty and my patient; I will maintain the utmost respect for human life from the time of conception; even under threat, I will not make use of my medical knowledge contrary to the laws of humanity. I make these promises solemnly, freely and upon my honor.

CODE OF ETHICS OF THE NATIONAL ASSOCIATION OF EMT's

Professional status as an Emergency Medical Technician and Emergency Medical Technician-Paramedic is maintained and enriched by the willingness of the individual practitioner to accept and fulfill obligations to society, other medical professionals, and the profession of Emergency Medical Technician. As an Emergency Medical Technician at the basic level or an Emergency Medical Technician-Paramedic, I solemnly pledge myself to the following code of ethics.

A fundamental responsibility of the Emergency Medical Technician is to conserve life, to alleviate suffering, to promote health, to do no harm, and to encourage the quality and equal availability of emergency medical care.

The Emergency Medical Technician provides services based on human need with respect for human dignity, unrestricted by considerations of nationality, race, creed, color, or status.

The Emergency Medical Technician does not use professional knowledge and skills in any enterprise detrimental to the public well-being.

The Emergency Medical Technician respects and holds in confidence all information of a confidential nature obtained in the course of professional work unless required by law to divulge such information.

The Emergency Medical Technician, as a citizen, understands and upholds the law and performs the duties of citizenship. As a professional, the Emergency Medical Technician has the never ending responsibility to work with concerned citizens and other health care professionals in promoting a high standard of emergency medical care to all people.

The Emergency Medical Technician shall maintain professional competence and demonstrate concern for the competence of other members of the Emergency Medical Services health care team.

An Emergency Medical Technician assumes responsibility for individual professional actions and judgement, both in dependent and independent emergency functions, and knows and upholds the laws which affect the practice of the Emergency Medical Technician.

An Emergency Medical Technician has the responsibility to be aware of and participate in matters of legislation affecting the Emergency Medical Technician and the Emergency Medical Services System.

The Emergency Medical Technician adheres to standards of personal ethics which reflect credit upon the profession.

Emergency Medical Technicians, or groups of Emergency Medical Technicians, who advertise professional services, do so in conformity with the dignity of the profession.

The Emergency Medical Technician has an obligation to protect the public by not delegating to a person, less qualified, any service which requires the professional competence of an Emergency Medical Technician.

The Emergency Medical Technician will work harmoniously with, and sustain confidence in, Emergency Medical Technician associates, the nurse, the physician, and other members of the emergency medical services health care team.

The Emergency Medical Technician refuses to participate in unethical procedures, and assumes the responsibility to expose incompetence or unethical conduct of others to the appropriate authority in a proper and professional manner.

THE EMT OATH

Be it pledged as an Emergency Medical Technician, I will honor the physical and judicial laws of God and man. I will follow that regimen which, according to my ability and judgement, I consider for the benefit of my patients and abstain from whatever is deleterious and mischievous, nor shall I suggest any such counsel. Into whatever homes I enter, I will go into them for the benefit of only the sick and injured, never revealing what I see or hear in the lives of men.

I shall also share my medical knowledge with those who may benefit from what I have learned. I will serve unselfishly and continuously in order to help make a better world for all mankind.

While I continue to keep this oath unviolated, may it be granted to me to enjoy life and the practice of the art, respected by all men, in all times. Should I trespass or violate this oath, may the reverse be my lot. So help me God.

Charles Gillespie, M.D.

Division 1: Prehospital Environment

Section 2. EMS Systems

TOPIC	CONTENT OUTLINE
Introduction	This section will provide the EMT-P student with an overview of the EMS System and its components and their relationships. I. Division I, Sections I, Roles and Responsibilities
Overview	I. Introduction II. Prospective III. Immediate IV. Retrospective
Objectives	At the completion of this section, the student will be able to:

1.2.1 Discuss citizen access and the various mechanisms of obtaining it.

1.2.2 Discuss prehospital care as an extension of hospital care.

1.2.3 Define stabilization of patients.

1.2.4 Define and describe medical control.

1.2.5 Describe physician responsibility for Medical Control.

1.2.6 Describe the relationship between the physician on the scene, the EMT-P and the physician on the radio.

- a. Physician who is with the patient when the EMT-P arrives.
- b. The physician who arrives on the scene after the EMT-P's have started evaluating and treating the patient.

1.2.7 Describe the benefits of EMT-P follow-up on patient condition, diagnosis, and retrospective review of prehospital care.

1.2.8 Describe KKK Ambulance standards.

1.2.9 Define the American College of Surgeons Essential Equipment List and how it relates to local state laws.

1.2.10 Define the national standard levels of prehospital provider as defined by curriculum, respectively.

- a. Discuss ambulance placement and the parameters that should be utilized in its development, include the differences in urban, suburban and rural settings.

1.2.11 Discuss the medical community role in overseeing prehospital care.

1.2.12 Define protocols and standing orders.

1.2.13 Describe the development of protocols.

1.2.14 Define local training standards.

1.2.15 Describe the legislation in the EMT-P's state as regards prehospital care.

1.2.16 Describe integration of prehospital care into the continuum of total patient care with the Emergency Department phase of hospital care.

1.2.17 Discuss replacement of equipment and supplies.

1.2.18 Discuss the EMT-P's initial responsibilities when arriving on the scene.

1.2.19 Describe the relationship between the physician on the radio and the EMT-P at the scene.

1.2.20 Discuss the varying philosophies between the management of medical patients and trauma patients, prehospital.

1.2.21 Describe the transition of patient care from the EMT-P, including:

- a. Transfer of responsibility (legal and medical).

b. Reporting of patient status to physician or nurse.

1.2.22 Describe the ability of physician run critique based on documentation.

1.2.23 Describe retrospective evaluation of patient care including run report review, continuing education, skill practice and skill deterioration.

TOPIC	CONTENT OUTLINE

Introduction

A. Citizen System Overview
   1. Care available from EMS.
   2. What EMS is
   3. Cost of service
   4. Access
   5. First Aid
      a. CPR
      b. Hemorrhage control
      c. Do not move patient.
      d. Other

B. Pre-Hospital Care
   1. Extension of hospital care
   2. Initiation of patient stabilization
      a. Definitive patient care must be provided as soon as possible. This can be started, and to a great measure, completed in the field, as in many medical patients.
      b. When the need is blood replacement and definitive hemorrhage control, as in the trauma patient, this must be provided in the operating room. For these patients, the resuscitation measures must be initiated in the field or during transport with rapid movement to the appropriate hospital.
      c. Recognition of the difference between A and B above, and correct action by the EMT-P, is critical to increasing long-term survival and reducing complications and disability.
   4. Medical Control
      a. Physician development of patient care protocols
         i. Overall patient care
         ii. Standing orders
         iii. Relationship between Medical Command Authority and On-scene Physician
            (a) Arrives before EMT-P's
            (b) Arrives after the EMT-P's
      b. On-line medical control to direct patient care
         i. Physician
         ii. Physician designee
      c. Physician review of run

C. Hospital Care
   1. Emergency Department
   2. Admission
   3. In-hospital care
   4. Discharge follow-up

D. Preparation, management and review
   1. Pre-incident planning
   2. Immediate field care
   3. Incident follow-up

TOPIC	CONTENT OUTLINE
Prospective	A. Vehicles

A. Vehicles
   1. KKK Standards
   2. Equipment
      a. American College of Surgeons Committee on Trauma Essential Equipment List
      b. Additional equipment as per service needs
         i. Environment
         ii. Rescue
         iii. Geographic
         iv. Special services
   3. Placement strategy
      a. Associated services which may provide first response
      b. Location of ambulances for primary response

B. Personnel
   1. EMT-Ambulance
      a. National Standard Curriculum
      b. Skills and knowledge
         i. CPR
         ii. Airway and ventilation
         iii. Hemorrhage control
         iv. Fracture stabilization
         v. Emergency child birth
         vi. Extrication
         vii. Special rescue skills
         viii. Diagnosis and management
         ix. PASG
         x. Communication
   2. EMT-Intermediate
      a. National Standard Curriculum
      b. Skills and knowledge
         i. All of EMT-A Curriculum content
         ii. Patient assessment and initial management
         iii. Esophageal obturator airway
         iv. Optional skill
            (a) Endotracheal intubation
            (b) Defibrillation
         v. Recognition and management of shock
         vi. Ventilation management
         vii. Intravenous fluid therapy
   3. EMT-Paramedic
      a. National Standard Curriculum
      b. Skills and knowledge
         i. All of EMT and EMT-I
         ii. Advanced Airway Management
         iii. Medical

TOPIC

Response for major cardiac, medical and trauma emergencies should be as short as possible to increase salvage. Urban responses should average 3–5 minutes while rural responses will necessarily be longer due to terrain, obstructions, and density of population.

(a) Cardiac (AHA-ACLS)
(b) Other medical emergencies
iv. Trauma. Advanced trauma management as identified by the American College of Surgeons and American Academy of Orthopedic Surgeons
v. Optional skill and therapeutics

C. Citizen Access
1. Telephone
a. 911
b. Well-publicized telephone number
2. Citizen education

D. Dispatch
1. Training: Department of Transportation (DOT)
a. Knowledgeable of EMT-skills
b. Telephone first aid until unit arrives.
2. Dispatch of appropriate unit
a. Distance
b. Time
c. Appropriate level of care

E. Communication
1. Dispatcher to ambulance
a. Availablility at all times
b. Two-way communication
2. Medical
a. Two-way
b. Frequencies
—UHF
—VHF
c. Physician to EMT-P
d. Type
i. Simplex
ii. Duplex
iii. Multiplex
e. Telemetry (local option)
f. Telephone

F. Medical Standards
1. Medical Society role
a. EMS Committee
b. Medical Director
c. Associate Medical Director
2. Patient Care Protocols
a. Patient management guidelines
b. Standing orders
c. Verbal orders
d. Major incident protocols

3. Training Standards
    a. Initial training
    b. Continuing education
4. Legislation regarding prehospital care
5. Role of EMS System and its interface with hospitals
    a. Drug and Supply Exchange
    b. Housing for unit
    c. Emergency Department (ED) observation
    d. Education

Immediate

A. EMT arrival on scene
    1. Scene assessment
    2. Patient(s) evaluation
    3. Management of life-threatening conditions
B. EMT-P physician contact
    1. Description of situation
    2. Description of patient
    3. Description of care instituted
    4. Physician instruction for additional care.
C. EMT-P management
    1. Completion of physician instructions for patient care
    2. Preparation for transportation
    3. Transportation
        a. Trauma—as soon as possible
        b. Medical—usually after initial stabilization

Retrospective

A. Run critique
    1. Adequate
        a. Assessment
        b. Care
        c. Communication
        d. Documentation
B. Continuing education
    1. Based on run critiques
    2. Review of original training
    3. New information
        a. Skills
        b. Procedures
        c. Devices
        d. Drugs
C. Skill Review
D. Changes in protocols and standing orders

Division 1: Prehospital Environment

Section 3. Medical/Legal Considerations

TOPIC	CONTENT OUTLINE

Introduction

The student must have successfully completed the following Divisions and Sections prior to participating in this Section:

Division I, Sections I and II

Pre-Hospital Environment

Overview

I. Introduction
II. Essential Principles
III. Standard of Care
IV. Medical Liability
V. Areas of Potential Medical Liability
VI. Medical Liability Protection

Objectives

At the completion of this section, the student will be able to:

1.3.1 Discuss the significance and scope of the following in relationship to EMT practice:
- a. State Medical Practice Act
- b. Good Samaritan Act/Civil Immunity
- c. State EMS Statutes
- d. State Motor Vehicle Codes
- e. State and local guidelines for "Do Not Resuscitate"

1.3.2 Define the following:
- a. Negligence
- b. Medical Liability
- c. Tort
- d. Duty to Act
- e. Battery
- f. Slander
- g. Informed Consent
- h. Expressed Consent
- i. Implied Consent
- j. Abandonment
- k. Liable
- l. Assault
- m. False Imprisonment

1.3.3 Describe the significance of accurate documentation and record keeping in substantiating incident.

1.3.4 Identify those situations that require the EMT-P to report those incidents to appropriate authorities.

1.3.5 Describe the four elements to prove medical liability.

1.3.6 Describe the significance of obtaining expressed consent.

1.3.7 Describe the extent to which force and restraint may be used to protect the EMT, the patient and the third party.

TOPIC	CONTENT OUTLINE
Introduction	A. Appropriate emergency medical care and accurate recording of patient condition and treatment rendered is the best protection if medical legal questions are asked. B. Practically every EMT at one time or another has asked about medical liability. C. Often damages can be recovered only by action through a court of law. D. The EMT must have a basic knowledge of terms and legal process and a working knowledge of applicable local laws and regulations.
Essential Principles	A. Classification of laws. 1. Criminal law. 2. Civil (tort) law. B. Medical Practice Act 1. Differs somewhat from state to state. 2. EMT must understand purpose of the legislation. 3. EMT must be familiar with appropriate state act, particularly the delegation of practice. C. Good Samaritan Act 1. Refer to the origin of concept. 2. Differ from state to state. 3. EMT must understand limitation of such acts. 4. Must be familiar with the appropriate state act. D. State EMS legislation 1. Actual statutes promulgated by legal process to provide for the practice of emergency care. a. Usually define scope of practice. b. Licensure, regulations, certification. c. Deals with medical control. d. Deals with protocols and communications. 2. Motor vehicle laws a. Vary considerably from state to state. b. Mandatory for EMT to be familiar with appropriate state statutes regarding operation of emergency vehicles 3. Other significant laws a. Obligation to Report: i. Abuse or neglect of the elderly ii. Abuse or neglect of children iii. Rape iv. Gunshot Wounds v. Animal Bites vi. Other b. Laws dealing with specific privileges/responsibility i. Use of restraint and degree of force allowed ii. Access to restricted areas iii. Living wills iv. Obtaining blood samples for alcohol or narcotic testing

Defines crimes and associated punishments.
Deals with civil wrongs committed by one individual against another.

Bible: Luke 10:30–35.

Copies of state documents should be made available to each student.

Age, speed, use of siren and lights.

Airports, military installations, prisons.

Request not to be resuscitated.

TOPIC	CONTENT OUTLINE
	c. Interface with other agencies who have statutory responsibility i. Law enforcement ii. Fire/fire scenes iii. Search and rescue agencies iv. Military/restricted areas
Standard of Care	A. The level of practice identified as common and accepted by law B. Provider held to the standard of care of others with similar training and experience 1. Basic EMT vs. EMT-P, etc. 2. May be defined by protocols
Medical Liability	A. Neglect/Omission 1. Conduct failing to meet standard of care 2. Four elements must be proven a. Duty to perform b. Breech of duty c. Damages d. Proximate cause
Areas of Potential Medical Liability	A. Consent 1. Elements of consent a. Informed consent—patient knows and agrees b. Expressed consent—patient gives verbal or written consent c. Implied consent—patient's condition or status implies consent 2. Document/record refusal of consent or treatment 3. Who can give consent? a. Parent or legal guardian b. State may give consent for wards of the state B. Abandonment 1. Termination of the provider/patient relationship without making certain that equal services are available a. Do *not* begin providing care and then discontinue such care. b. Do not release care of patient to a lesser level provider if the patient's condition warrants the higher level. C. Assault 1. Creating apprehension of immediate bodily harm without consent a. May be criminal or tort b. Most easily avoided by informing the patient and then obtaining consent D. Battery 1. Touching the patient without consent 2. May be either criminal or tort 3. Avoided by obtaining consent E. False imprisonment 1. Intentional and unjustifiable detention

a. Often raised in conjunction with psychiatric cases
b. Circumstances may justify the detention
i. Evidence of medical necessity
ii. Avoided by obtaining consent
iii. Actions consistent with protocol strengthens your position

F. Liable
1. Injuring a person's character, name or reputation by false and malicious writings
2. Written record must be accurate and confidential
a. Avoid slang terms.
b. Describe behavior; avoid labels.

G. Slander
1. Injuring a person's character, name or reputation by false and malicious spoken words
2. Limit oral reporting to appropriate personnel.
a. Avoid slang terms
b. Describe behavior; avoid labels.

Medical Liability Protection

A. Municipal service immunity/institution/agency coverage
1. May not cover individual not on duty
2. Often very limited in coverage

B. Individual medical liability insurance
1. Policy written for specific needs
2. Advocate for policy holder
3. Essential that the EMT understands the contract
4. Essential that report to carrier be prompt/accurate

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Division 1: Prehospital Environment

Section 4. EMS Communications

TOPIC	CONTENT OUTLINE

Introduction

The student must have successfully completed the following Divisions and Sections prior to participating in this Section:

I. Division I, Prehospital Environment

Section I Roles and Responsibilities

Section II EMS Systems

Section III Medical/Legal Considerations

There are many ways in which the EMT-P communicates. This section of the curriculum is meant to deal specifically with communication through written or spoken words, as this is the form of communication by which information is transmitted all along the EMS chain. This section covers knowledge of technical aspects of communication equipment and rules governing radio transmission as well as actual content and techniques of written and verbal communication of patient information.

Overview

I. Communications Systems: Technical Aspects.
   A. Communications System Components
   B. Radio Communications
   C. Equipment Maintenance
II. Rules and Operating Procedures
   A. Regulatory Agencies
   B. Rules and Regulations
   C. Dispatch Procedures
   D. Radio Communications Techniques
III. Communication of Medical Information
   A. Medical Protocols
   B. Communication of Patient Information by the EMT
IV. Techniques of Management: Communications Skills
   A. Use of Mobile and Portable Transmitter/Receiver
   B. Use of a Digital Encoder
   C. Transmission of Patient Assessment Information and Telemetry

Objectives

At the completion of this section, the student will be able to:

1.4.1 Describe the phases of communications necessary to complete a typical EMS event.

1.4.2 Name the possible components of an EMS communications system and explain the function of each.

1.4.3 Define base station.

1.4.4 Name factors that affect the coverage of mobile transmitter/receivers.

1.4.5 Describe the position of the antenna on a portable transmitter/receiver that will deliver maximum coverage.

1.4.6 Describe an advantage of a repeater system over a non-repeater system.

1.4.7 Describe the vehicular repeater system.

1.4.8 Describe the purpose of a remote console.

1.4.9 Describe the function of a satellite receiver.

1.4.10 Describe the function of an encoder and decoder.

1.4.11 Define hertz, kilohertz, and megahertz.
1.4.12 Define the terms UHF and VHF and distinguish between the two.
1.4.13 Describe the most common causes of interference in biotelemetry communications.
1.4.14 Describe simplex, duplex, and multiplex radio systems.
1.4.15 Describe functions and responsibilities of the FCC.
1.4.16 Describe the responsibilities of an EMS dispatcher.
1.4.17 Name information items that *must* be gathered from a caller by the dispatcher.
*1.4.18 Describe the ten-code used in the local community.
1.4.19 Describe three communications techniques that influence the clarity of radio transmissions.
1.4.20 Describe three communications techniques that influence the content of radio transmissions.
1.4.21 Describe the importance of written medical protocols.
1.4.22 Describe two purposes of verbal communication of patient information to the hospital.
1.4.23 Describe information that should be included in patient assessment information verbally reported to the physician.
1.4.24 Organize a list of patient assessment information in the correct order for radio transmission to the physician according to the format used locally.
1.4.25 Name five uses of the written EMS run form.
S1.4.26 Demonstrate the proper use of a mobile transmitter/receiver to receive and transmit information.
S1.4.27 Demonstrate the proper use of a portable transmitter/receiver to receive and transmit information.
S1.4.28 Demonstrate the proper use of a digital encoder.
1.4.29 Demonstrate the proper use of a mobile or portable transmitter in a real or simulated patient situation to:
a. Organize and transmit patient assessment information, using a standardized format; and;
b. Transmit an ECG.
S1.4.30 Properly complete a written EMS form based on a real or simulated patient situation.

* Indicates optional
(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Introduction	A. Steps in the progression of a typical EMS event include: 1. Occurrence 2. Detection 3. Notification and response 4. Treatment and preparation for transport 5. Transport and delivery 6. Preparation for next event B. Communications links in the EMS chain necessary to accomplish the above steps include: 1. Communications between party requesting help and the dispatcher a. Via the public telephone system—preferably 9-1-1 or some other widely publicized emergency number b. Via non-public telephone or radio from another emergency agency (police, fire) 2. Communications between the dispatcher and the EMT team a. Alert response personnel and direct to scene. b. May be telephone notification, voice radio communication, or radio paging (tone, digital) 3. Communication between the dispatcher and public safety units, local hospitals, and other community agencies 4. Communications between EMT in the field and receiving hospital and/or medical control physician a. Early alert of hospital to incoming patients b. Receiving advice regarding transport and orders for medical treatment c. Telemetry transmissions C. Purpose of this section: to make the EMT-P knowledgeable and proficient with the equipment and procedures used in all the stages of EMS communications to maximize emergency medical care of the patient.
	Communications Systems: Technical Aspects
Communications System Components	A. Communications systems vary greatly in complexity 1. Simple systems may include: a. Self-contained desk top transmitter/receiver b. Speaker c. Microphone d. Antenna e. One piece dashboard-mounted vehicle radio with single channel capabilities 2. Complex systems may include: a. Remote consoles b. High power transmitters c. Repeaters d. Satellite receivers e. Tower mounted antennas

Including notification of medical facility.

Especially important in rescue and multiple casualty situations.

f. High power, multi-frequency vehicle radios
g. Mobile transmitter steering
h. Vehicular repeaters
i. Mobile encode-decode capabilities
j. Mobile digital terminals
k. Microwave

B. Base Station
1. Usually implies a transmitter and receiver housed in the same cabinet
2. May be controlled by a remote console, or by a speaker and microphone attached directly to it
3. Geography and terrain should be considered when installing
4. Base station transmitters usually have a power output of 45 to 275 watts.
5. Maximum allowable base station power, determined by the Federal Communications Commission (FCC), is printed on the radio station license.
6. In a multiple channel radio system, the base station can only transmit on one channel at a time.

C. Mobile Two-way Radios (transmitter/receiver)
1. Implies a vehicular mounted device
2. Mobile transmitters usually operate at lower power than base stations (typically 20–50 watts).
3. Typical transmission range is 10–15 miles over average terrain.
   a. Flat land or transmissions over water increase range
   b. Mountainous terrain, dense foliage, or urban areas with tall buildings decrease range.
4. May be single channel or multiple channel units (8–12 channels)
5. Operational controls of the mobile radios in use locally

D. Portable Radios (transmitter/receiver)
1. Implies a hand-held device
2. Typically have power output of 1–5 watts, limiting their range.
3. May be single channel or multiple channel units (typically as many as 8 channels).
4. Operational controls of the portable radios in use locally

E. Repeater/Base Station
1. Receives a transmission from a low-power portable or mobile radio on one frequency and retransmits it at a higher power on another frequency.
2. Important in a large geographical area because low-power portable or mobile radios may not have enough range to communicate with one another.
3. Higher antenna allows it to pick up low-power transmissions and retransmit at high power.

   Advantages:
   a. Allows two low-power units to "hear" each other communicate.

Holding the radio so the antenna is in a vertical and elevated position will maximize coverage.

b. Allows low-power mobiles and portables to hear when another radio is transmitting a message, to avoid "doubling" with that unit.

4. Can also be vehicular mounted to retransmit to low-power portable radio signals at higher mobile radio power.

F. Remote Consoles

1. Not always possible or desirable to locate dispatcher in same location as base station.
2. Extends all operating controls (microphone, speaker, transmit button, channel selector) to a remote site.
3. Connected to base station by dedicated telephone lines, microwave or other radio

G. Satellite Receivers

1. Low-power mobiles or portables do not always have enough range to reach the base station antenna
2. Additional receivers strategically located about the area of desired radio coverage insure that a low-power unit will always be within range of the system
3. Satellite receivers are connected to the repeater by dedicated telephone lines or microwave relay

H. Encoders and Decoders

1. The encoder resembles a telephone dial or the buttons of a push button telephone.
2. When activated, the encoder sends pulses or tones over the air.
3. Receivers with decoders can recognize unique codes or tones sent over the air.
4. When a receiver with a decoder receives the correct "code," the audio circuits of the receiver are turned on
5. Pagers work in much the same fashion.
6. Operational controls of the units to be used by the students

Radio Communications

A. Radio frequencies

1. Designated by cycles per second or megahertz per second
2. Common terms and abbreviations for frequencies:
   a. Hertz (Hz) = cycles per second
   b. Kilohertz (KHz) = 1,000 cycles per second
   c. Megahertz (MHz) = 1,000,000 cycles per second
   d. Gigahertz (GHz) = 1,000,000,000 cycles per second
3. Radio communications typically confined between 100 KHz and 3,000 GHz
4. Radio "band"
   a. Refers to a small segment of the total frequency spectrum and is usually assigned a specific use by the FCC.
   b. For public safety radio, VHF (very high frequency) may be defined as *VHF Lo Band 30–50 MHz*, and *VHF Hi Band 150–170 MHz*.

c. For public safety radio, UHF (ultra high frequency) may be defined as *UHF 450–470 MHz.*

d. UHF has a somewhat shorter range than VHF and somewhat better penetration in dense urban areas than VHF.

5. 10 UHF frequencies allocated by the FCC nationwide for EMS use: two intended for dispatch, eight intended for paramedic to physical communications

	Base Transmit	Base Receive	Recommended Use
med 1	463.000 MHz	468.000	EMT to M.D.
med 2	463.025 MHz	468.025	EMT to M.D.
med 3	463.050 MHz	468.050	EMT to M.D.
med 4	463.075 MHz	468.075	EMT to M.D.
med 5	463.100 MHz	468.100	EMT to M.D.
med 6	463.125 MHz	468.125	EMT to M.D.
med 7	463.150 MHz	468.150	EMT to M.D.
med 8	463.175 MHz	468.175	EMT to M.D.
med 9	462.950 MHz	467.950	Dispatch
med 10	462.975 MHz	467.975	Dispatch

6. The FCC controls all licensing and frequency allocations.

B. Radio equipment used for EMS communications typically employs FM (frequency modulation); less susceptible to interference than AM (amplitude modulation) radios.

C. Biotelemetry of ECG's

1. ECG voltage changes are converted to audio tones by the telemetry equipment and sent over the air.
2. The receiver at the hospital converts the audio signal back to voltage changes to reproduce the ECG.
3. Voice degradation may occur when transmitting telemetry and voice simultaneously.
4. Telemetry interference can be caused by:
   a. Loose ECG electrodes
   b. Muscle tremor
   c. 60 cycle hum
   d. Fluctuations in transmitter power

D. Additional Terms

1. Simplex — one frequency (non-repeat)
2. Duplex — simultaneous two-way communications. Works much like a telephone conversation (requires two frequencies).
3. Multiplex — the combination of the signals (ECG/voice) for transmission simultaneously on one channel.

Equipment Maintenance

A. Handling

1. Do not subject radio equipment to harsh environments if possible.
2. Dusty conditions, damp or wet conditions, and dropping radio equipment are among the most frequent causes of equipment failure.

B. Cleaning

1. Frequent cleaning of radio equipment will improve appearance and life expectancy.

2. Use only a slightly damp rag with very mild detergent (no cleaning solvents) on exterior surfaces of radio equipment

C. Repair

Malfunctioning radio equipment must be referred to a radio technician

1. When malfunctioning, radio equipment must be referred to a licensed technician

D. Batteries

1. Rechargeable batteries in portable equipment (monitor/defibrillators included) must be used properly to maximize life and power output.
2. Nicad rechargeable batteries must be properly "exercised" for best results

Rule and Operating Procedures

Regulatory Agencies

A. Federal Communications Commission (FCC)

1. Federal agency established to control and regulate all radio communications in the U.S.
2. Primary functions are:
   a. Licensing and frequency allocation
   b. Establishing technical standards for radio equipment
   c. Establishing and enforcing rules and regulations for radio equipment operation
      i. Monitor frequencies for appropriate usage
      ii. Spot-check base stations and dispatch centers for appropriate licensing, records, etc.

B. State and local governments may have additional requirements for radio operators

1. Regional plans to ensure cooperation of all radio users
2. Minimum equipment standards for ambulance licensure

Rules and Regulations

A. Part 90, subparts A,C,G,H,I,J,N,O, and P of the FCC rules and regulations relate in whole or part to EMS systems.

1. Although all regulations are pertinent, the following excerpts are among the most important to the EMS dispatcher or EMT:
   a. Part H-90.173, a: (paraphrase) stations granted frequencies for EMS purposes do not have exclusive right to those frequencies and must coordinate use with other users in the area.
   b. Part N-90.403, c: (paraphrase) all transmissions are limited to minimum practical transmission time and agencies shall employ an efficient operating policy to maximize utilization of frequencies.
   c. Part N-90.425, a: (paraphrase) station shall transmit assigned call sign once every 30 minutes during periods of continuous transmission or at the end of each transmission or exchange of transmissions. Call signs shall be given in plain English or international Morse code.
   d. Part N-90.425, d (1): (paraphrase) mobiles need not identify with call sign if listed on the base station license.

Refer to manufacturer recommendations for proper exercising methods and intervals.

TOPIC	CONTENT OUTLINE

e. Part N-90.433: (paraphrase) no license or permit is required by individuals operating an EMS station (dispatcher, paramedic, physician, etc.).

2. Other specific questions regarding rules and regulations can best be answered by referring to the FCC's Part 90 publication.
3. Other rules and regulations promulgated by local or state agencies that may pertain to EMS radio systems.

Dispatch Procedures

A. All procedures used must fall within Federal, State and local guidelines.
B. Responsibilities of the dispatcher include:
   1. Obtaining as much information as possible about the emergency (often from a distraught caller)
   2. Directing the appropriate emergency vehicle(s) to the correct address
   3. Monitoring and coordinating communications among everyone in the system
   4. In some instances, instructing the caller in measures that should be taken until assistance arrives
   5. Maintaining written records
C. Dispatch personnel may be responsible for EMS events only or may dispatch for police, fire, and EMS in any combination.
D. Dispatcher must make appropriate decisions regarding which response vehicles to send.
   1. Must know location of all vehicles
   2. Must know capabilities of various vehicles (ALS vs. BLS)
   3. Must determine if any support services necessary
E. Dispatcher must know what information is essential to gather from caller prior to dispatching vehicle.
   1. Location and nature: Vehicle can be dispatched as soon as these are known
   2. "Call back" number; also high priority in case of accidental telephone disconnect
   3. Sample of logical order for questioning caller about an EMS event to insure adequate information:
      a. Caller's name and call-back number
      b. Address of event
      c. Nature of event

<u>DISPATCH FIRST AMBULANCE</u>

      d. Is victim unconscious, not breathing, or bleeding severely?
      e. Is victim trapped, is there a fire or other hazard?

<u>UPDATE AMBULANCE CREW AND DISPATCH SUPPORT HELP</u>

      f. Determine whether caller needs to, and is competent to, carry out immediate emergency care measures.

F. Complete dispatcher training for the EMT-P available in the EMS Dispatcher National Standard Curriculum.

Codes

A. Used by some EMS systems alone or in combination with clear English
B. Advantages of codes

Available from Government Printing Office.

See Emergency Medical Services Dispatcher National Standard Curriculum (Second Edition) 1983.

Follow local protocols.

See bibliography.

1. Can shorten radio air time
2. Provide unambiguous information
3. Enables transmission of information in a format not understood by patient, family, or bystanders

C. Disadvantages of codes
1. Useless unless everyone in system understands
2. Medical information is often too complex to use codes.

D. Ten-code
1. A system of codes utilizing the number 10 plus another number to indicate a specific message.
2. Numbers are brief and easily understood and therefore speed up communications.
3. Local decision must be made about which specific list of 10-codes will be used, if any.
4. APCO (Associated Public Safety Communications Officers) publishes a widely used ten-code, recommended primarily for dispatcher use.
5. Codes discouraged for communication of medical information

E. Review of codes used by local EMS (if any)

F. Remember: Plain English often works as well or better than codes

Radio Communications Techniques

A. Proper radio use results in efficient, professional communications.
1. Transmissions must be clear.
2. Content of transmission should be concise and professional.

B. General guidelines regarding clarity of transmissions
1. Listen to the channel before transmitting to be sure it is not in use.
2. Press the transmit button for one second before speaking.
3. Speak at a close range (2–3 inches) directly into or across the face of the microphone.
4. Speak slowly and clearly. Attempt to pronounce each word distinctly, avoiding words that are difficult to hear.
5. Speak in a normal pitch, keeping your voice free of emotion.
6. Be brief. Know what you are going to say before pressing the transmit button.
7. Avoid codes unless they are part of your system.
8. Do not waste air time with superfluous phrases.

C. General guidelines regarding content of transmissions
1. Protect the privacy of the patient. When appropriate:
   a. Use codes.
   b. Use telephone rather than radio.
   c. Turn off external speaker or radio.
   d. Avoid use of patient's name.
2. Use proper unit numbers, hospital numbers, proper names and titles.
3. Do not use slang or profanity.
4. Use standard formats for transmission.
5. Utilize the "echo" procedure when receiving directions from the dispatcher or physician orders.

May be acceptable in some localities.

The immediate repetition of information to assure accuracy.

6. When completing a transmission, obtain confirmation that your message was received

Communication of Medical Information

A. Written protocols
1. Predetermined guidelines for the EMT-P on prehospital medical care
2. Should be developed by the medical group responsible for medical control
3. Varys greatly from system to system:
    a. Obviously ill patient refusing treatment/transport
    b. Uncertainty if continuation or termination of resuscitation is appropriate (i.e., questionable "DNR")
    c. Difficulty with non-EMS physician who is interfering at the scene

Communication of Patient Information by the EMT

A. Verbal communication
1. May occur via radio or landline
2. Purpose:
    a. To provide hospital with enough information regarding patient's condition to begin preparations for care
    b. To obtain medical orders for patient treatment in the field
3. Use of standard format for transmission of patient assessment information
    a. Allows efficient use of medical communications system, i.e., limits radio air time
    b. Allows physician to quickly receive and assimilate information regardng patient's condition
    c. Assures no significant information is omitted
4. Format should be brief and concise. Should include:
    a. Unit call name and number or name of EMT-P
    b. Description of scene
    c. Patient's age, sex, and approximate weight. (If pertinent for drug orders)
    d. Patient's chief complaint
    e. Associated symptoms
    f. Brief, pertinent history of the present illness
    g. Pertinent past medical history, medications and allergies
    h. Physical exam findings, including:
        i. Level of consciousness
        ii. Vital signs
        iii. Neuro exam
        iv. General appearance and degree of distress
        v. ECG (if applicable)
        vi. Trauma index or Glasgow Coma Scale (if applicable)
        vii. Other pertinent observations, significant positive and negative findings
    i. Treatment given so far
    j. Estimated time of arrival at hospital

Per local protocol.

Location, number of victimes (always describe the worst first).

Order of information varys depending on severity of patient's condition. Length of report and amount of information may vary depending on problem, situation, or number of victims.

k. Name of private medical physician
l. Await further questions and orders from base physician.

5. Remember: When communicating with the physician from the field, the EMT should:
   a. Be accurate and complete in reporting
   b. Provide additional information when requested
   c. "Echo" back orders given by physician
   d. Question orders that are not clear or do not seem appropriate for the patient's condition.
   e. Report back when orders have been carried out and indicate patient response.
   f. Keep physician informed of any changes in patient condition.
   g. Consult with physician when transport of the patient is not deemed necessary.
   h. Protect patient privacy.
   i. In addition to usual base communication contact procedures consult with physician *any* time you are uncertain of what course to take.
6. Verbal communications also include brief report of patient information to person assuming care of patient at hospital.

B. ECG telemetry
   1. Extent of use of telemetry varies—determined by medical control personnel in a given system.
   2. Use of telemetry alone without field interpretation of ECG not appropriate.
      a. EMT-P should always verify his interpretation with base physician—ECG may be distorted during transmission.
      b. Field interpretation alone without telemetry *is* acceptable
   3. Continuous telemetry transmission not advisable
      a. Uses excessive air time
      b. Depletes batteries
      c. 15–30 seconds of telemetry is usually adequate

C. Written communications (EMS Forms)
   1. A document developed by state of local EMS
   2. Purpose:
      a. Written record of patient's initial condition that remains at hospital after EMT's have left
      b. Legal record of medical treatment rendered patient in prehospital phase of care
      c. Documentation of patient's refusal of care and/or transport
      d. Other uses:
         i. Medical audits
         ii. Quality control
         iii. Data collection
         iv. Billing
   3. EMS forms must be:

Local option.

According to local protocols.

Separate release forms may be used in some localities.

TOPIC	CONTENT OUTLINE
	a. Complete b. Legible c. Signed by EMT
Techniques of Management: Communication Skills	A. Use of a mobile and portable transmitter/receiver 1. Turn the unit on. 2. Adjust the squelch (if available). 3. Listen to be sure the airways are free of other communications. 4. Hold the microphone within the unit at a proper distance from the mouth and maintain a vertical antenna position. 5. Push the transmit button and pause before speaking. 6. Call another unit using proper unit I.D. numbers. 7. Upon termination of communication, state that you are clear of the channel so other users may transmit. B. Use of a digital encoder 1. Turn the unit on. 2. Adjust the squelch. 3. Listen to be sure the airways are free of other communications. 4. Select the address code to be dialed. 5. Dial the selected code numbers. 6. Hold the microphone at a proper distance from the mouth. 7. Push the transmit button and pause before speaking. 8. Call the unit dialed using assigned unit I.D. numbers. 9. Upon termination of communication, state that you are clear of the channel so other users may transmit. C. Transmission of patient assessment information and telemetry 1. Turn the unit on. 2. Adjust the squelch. 3. Listen to be sure the airways are free of other communications. 4. Hold the microphone a proper distance from your mouth. 5. Push the transmit button and pause before speaking. 6. Call the physician, using proper unit I.D. numbers. 7. Connect the patient ECG electrodes to the telemetry transmitter using the proper cable. 8. Following local procedures and protocols, relay patient assessment information to the physician. 9. Transmit ECG for the minimum amount of time required by the receiving physician (approximately 15 seconds). 10. Verify the physician's reception and quality of transmission. 11. Verify physician's interpretation of ECG.

Due to the vast number of manufacturers and models of equipment, the steps below provide only general guidelines for operation. Variations in procedure and specific explanations are expected.

The patient ECG electrodes may be connected to the telemetry transmitter and then to the monitor *or* first to the monitor and then to the transmitter.

Under no circumstances should the EMT rely solely on telemetry for ECG interpretation.

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Division 1: Prehospital Environment

Section 1. Roles and Responsibilities

Foreword

There are more than 35,000 Emergency Medical Technician-Paramedics (EMT-P) currently State certified or Nationally Registered in the United States. Of the total, almost 85% are paid professionals. Approximately 70% of all EMT-P's reside in six states. The rest are spread out over the other 44 states, most of which have prehospital advanced life support (ALS) capabilities.

Since the inception of Emergency Medical Service (EMS), great strides have been made. Death tolls on the nation's highways, as well as deaths from sudden illness, have decreased because of the number of rescue personnel working in an organized EMS system. The typical EMT-P is a paid employee of a municipal or hospital based system, and mobile communications afford enhanced scene-hospital interaction. For training consistency throughout the nation, the National Standard Training Curriculum (NSTC) for the EMT-Paramedic is the accepted minimum training standard.

It has become clear in the 1980's that the basic body of knowledge that should be taught to the EMT-P must be expanded. In the early 1970's a task force of the National Academy of Science and the National Research Council arrived at a list of minimum skills that must be achieved by each EMT-P. This reflected, to a large extent, what was already being taught in the majority of programs. In 1982, a Department of Transportation (DOT) support committee was created to ensure that evolutionary changes in prehospital care were included in the paramedic curriculum on an ongoing basis.

The Committee conducted a formal study, questioning the majority of EMT-P training programs, all 50 State's training coordinators, and a sampling of field EMT-P's regarding the initial EMT-P curriculum. It was found that support of the curriculum existed; however, suggestions were made to alter the curriculum to reflect the actual needs of the field EMT-P's. It was noted that some areas of peripheral background material could be de-emphasized (e.g., blood gases) while other areas needed more emphasis, such as geriatrics, hypothermia, and crisis intervention. Additionally, anatomy and physiology were requested to be tied more directly to disease processes and the occurrence of injury rather than being fragmented, as in the initial curriculum.

The update of the National Standard Training Curriculum is based upon the following six factors:

(1) The EMT-P is a health care professional. While much of the material in the curriculum is peripheral to many of the psychomotor skills, this knowledge is essential for EMT-P's to know if they are to continue working under the written and/or verbal standing orders of physicians as most services presently function. This knowledge is also vital should telecommunications be interrupted and to provide a long-term academic base for continuing education.

(2) The overall knowledge and skills defined in the original curriculum still have validity in 1985. The previously mentioned study called for a restructuring and updating of the curriculum based upon the evolutionary changes that have occurred since 1976.

(3) The NSTC for the EMT-P is being restructured to resemble more clearly how most EMT-P programs present their course material and to reflect how EMT-Paramedics apply this skill and knowledge.

(4) The updated curriculum (all six divisions) is considered essential and should be presented in its entirety to any field level provider who performs all the advanced life support skills.

(5) This curriculum identifies the minimum body of knowledge that one needs in order to be competent in the performance of prehospital ALS. The additional knowledge and skills that are necessary to function in any particular locale must be added by each individual instructor/coordinator.

(6) The integration and intermeshing of the knowledge and skills necessary to be an EMT-Paramedic is a very individualized process that cannot completely be defined or met in a curriculum. However, it is a necessary part of the "art and the science" of emergency medicine that each instructor must strive toward.

Contents

Division 1: Prehospital Environment

Section 5. Rescue

TOPIC	CONTENT OUTLINE
Introduction	The student must have successfully completed the following Divisions and Sections prior to participating in this Section: **Division 1, Prehospital Environment Sections 1–4** Rescue as defined by Webster's: to free from confinement, danger or evil. This definition describes the actions of many rescuers whether they be from a mine rescue team in Vermont, to a rescue and extrication unit in Burley, Idaho. The methods used by each of these response units may be different but the motivation and concepts are the same. The intent of this lesson plan is to make the student aware of the concepts of rescue. Because of the diverse nature of "rescue" we will not attempt to teach the students specific rescue techniques, rather the concepts behind all rescue. It is imperative that a description of the rescue capabilities of your geographic area be discussed. It is also suggested that the students be exposed to these types of rescue units in your area; i.e., fire department rescue extrication units, farm rescue units, dive rescue, search and rescue or any other type of rescue units in your area.
Overview	I. Safety II. Assessment III. Gaining Access IV. Emergency Care V. Disentanglement VI. Preparation for, and Removal
Objectives	At the completion of this section, the student will be able to: 1.5.1 List the equipment utilized for personal and patient safety during a rescue. 1.5.2 Identify safety hazards that may be encountered in a rescue operation. 1.5.3 Describe the pre-planning phase of a safe rescue. 1.5.4 Describe the elements and resources involved in the assessment phase of a rescue operation. 1.5.5 Define safe patient access. 1.5.6 List the types of equipment available to access an entrapped patient. 1.5.7 Describe the EMT-P's patient assessment and management responsibilities during a rescue operation. 1.5.8 Identify the special expertise for special rescue resources available in the EMT-P's response area. 1.5.9 Identify the difficulties that maybe encountered in the patient removal phase of a rescue operation. 1.5.10 Explain the need for a coordinated effort during the removal phase of a rescue operation. 1.5.11 Discuss removal of the patient from the rescue scene.

TOPIC	CONTENT OUTLINE
Safety	

A. Safety during any rescue effort must be a paramount issue in dealing with the situation. The safety of the rescuer and his or her patient from the environment and the hazards that surround the scene must be considered prior to any action on the part of the rescuer.

B. Personal Safety
   1. Protective head gear
   2. Protective coats and pants or coveralls
   3. Gloves
   4. Eye protection
   5. Protective boots or shoes
   6. Breathing apparatus

C. Patient Safety
   1. Protective blankets
   2. Protective shields
   3. Breathing aids
   4. Fire protection
   5. Climatic protection
      a. Hypothermia
      b. Hyperthermia

D. Hazards
   1. Hazardous materials
      a. Chemical spills
      b. Radiation
      c. Gases
   2. Possibilities of fire
      a. Gas spill
      b. Electrical hazards
      c. Spark causing hazards
   3. Environmental Hazards
      a. Ice, snow, avalanche, and other extremes of cold
      b. Hot environment, hot pavement
   4. Other Scene Hazards
      a. Sharp cutting objects
      b. Electrical hazards
      c. Compartment collapse
      d. Vehicle stability
      e. Traffic scene
      f. Control of non-emergent personnel

E. Managing the safety operations of a rescue situation will require pre-planning
   1. Know how to get the help necessary to operate in a safe environment.
      a. Review local communication system.
      b. The communication center must know the resources available.
      c. Review local major incident plans.
   2. Safe operation must also include crowd or bystander control.

NIOSH approved.

Cutting tools.

Downed wires, cave in, rock slides.

Police, fire, power, rescue, back up units.

a. Bystanders can be assigned tasks.
b. Give them specific instructions.

F. Because of the nature of any rescue it should be emphasized that for the overall safety of those involved in the situation, an EMS Major Incident Plan should be initiated. (Review Division I, Section VI, Major Incident Response.)

Assessment

A. The Assessment phase of a rescue requires the EMT-P to size up the situation. Determining the needs for each situation may be different, depending on the type of rescue that the EMT-P is responding to. The elements of assessment are as follows:

B. Response
1. The information received about the call
   a. Exact location
   b. Number of victims
   c. Type of situation
   d. Are there hazards
   e. Weather conditions

C. Other Factors
1. Location
   a. At a school or other highly populated area
   b. Road conditions
   c. The need for other types of response vehicles
2. Time of day
   a. Is there a concern for rush-hour traffic?
   b. Darkness
   c. Are there high concentrations of people in the area during the response time period?

D. Resources: Type of situation will help determine the resources needed.
1. Can the responding units handle the situation at hand?
   a. Call for a major incident response.
   b. Ask for the specific type of resource.
2. Hazard control
   a. Call for the appropriate response.
   b. Control the scene.
3. Victim assessment
   a. Quick check for the number of victims
   b. Quick check of severity of injuries
4. Other special resources
5. Other ALS or types of transport units

Gaining Access

A. This phase of the rescue situation enables the rescuer to access the patient. Quite often this phase can become inefficient because of the disentanglement problems of the situation. It is imperative that the patient or patients are accessed as soon as possible

B. Access to the patient safely

Traffic control, assist with moving patient. Clear communications techniques.

Limited information, obtain situation description.

Helicopters, snowmobiles.

Ditch rescue auto extrication

Scuba teams, hazardous materials.

Airbags, wreckers, search teams, buses.

Caution: Be careful not to become so involved in the disentanglement process that the rescuer fails to gain access as soon as possible.

1. Will the doors open, can the rescuer be lowered to the patient in the mine shaft safely, are the windows open, etc.?
2. Assess the resources the rescuer has at hand.
3. The EMT-P may not be able to gain access to the patient or patients and may need to stand back and let the other special rescuers gain the access to the patient.

Emergency Care

A. This phase of the rescue operation is the primary reason for the EMT-P's response to the situation. The type of situation will dictate how the EMT-P will be able to carry out their tasks.
B. Assessment
   1. Airway, breathing, circulation (ABCs), hemorrhage control, cervical spine (C-spine) management
   2. Secondary assessment head to toe, including assessment of vital functions and system assessment
   3. Rapidly identify critical patient or patients who may require rapid removal and transportation to a Trauma Center.
C. Management
   1. The management of the patient's injuries should be started as soon as possible
      a. Initial care while entrapped
   2. Basics of emergency care
      a. Spinal management
      b. Wound care
      c. Fraction care
      d. Patient packaging
   3. Basic and Advanced Life Support System may need to be continued in the confinement of the situation until the disentanglement phase can be completed.

Disentanglement

A. The disentanglement phase of any rescue, whether it be from an aircraft accident, collapsed building or a cave-in, is the most technical of the phases of rescue and requires a great deal of training for the specific types of rescue.
B. The types of technical expertise available in the local area
   1. Mountain Search and Rescue
   2. Extrication units
   3. Dive teams
   4. Cave and mine rescue teams
   5. Other rescue units

Preparation for, and Removal

A. The final phase of a rescue may be the most difficult to accomplish. This phase may require special rescue capabilities, not required to accompany the patient over hazardous terrain or lifted to a helicopter by a hoist
B. Coordination of the Removal Phase. All activities dealing with the removal of a patient from a situation will require coordination with other rescues
   1. Make certain that the patient is packaged for removal
      a. Wounds—bandaged

Ropes, stokes litter, air tanks, pry bars, jacks, wedge, spreader, vehicle winches.

The EMT-P must not forget the basics of emergency care. The monitors, drugs, etc., may not help the patient who has a C-spine injury or is bleeding profusely. Safety for the patient and the EMT-P needs to be reviewed as the situation progresses.

Have members of each organization demonstrate their skills in disentanglement.

Review with the assistance of these special units, the types of equipment they use for disentanglement.

b. Fractures—splinted
c. IV solutions free from entanglement
d. Patient secured
e. All basic and advanced care provided prior to removal if possible
2. Work with other rescuers
3. Is the exit pathway secure?

C. Removal—once the method of preparation has been accomplished and the patient or patients can be removed from their confinement, consideration for other equipment for patient care needs to be made
1. Patient transported to the ambulance
a. Wheeled stretcher
b. Flat or breakdown stretcher
c. Other
2. Patient Care Equipment
a. Oxygen
b. Advanced airway care
c. Advanced fluid management
d. Drugs
3. Patient Environment
a. Is the transport vehicle warm or cooled sufficiently?
b. Blankets
4. While transferring patient(s) from the scene to the vehicle, evaluate:
a. Terrain
b. Personnel
c. Equipment
d. Techniques

D. Transporting: The rescue is completed once the patient is enroute to the hospital, but the care for the patient must continue.
1. Patient's status must be updated.
2. Information on patient condition must be communicated to the trauma center.
3. Additional therapy may be necessary while enroute

Scoops, spineboards, stokes litters

Are there enough personnel to remove the patient(s)?

Stokes litter, scoop, etc.

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Division 1: Prehospital Environment

Section 6. Major Incident Response

TOPIC	CONTENT OUTLINE
Introduction	The student must have successfully completed the following Divisions and Sections prior to participating in this Section: I. Division 1, Pre-Hospital Environment Sections I-V
Overview	I. Introduction II. Preparation for Response III. Scene
Objectives	At the completion of this section the student will be able to: 1.6.1 Define the term "major incident" 1.6.2 Identify the local "communication" system 1.6.3 Describe when a major "incident" should be declared 1.6.4 Describe the "pre-planning phase" function 1.6.5 Describe area "response planning" 1.6.6 Describe the components of special resources 1.6.7 Describe the function of "scene command" 1.6.8 Describe the function of "scene triage" 1.6.9 Describe the "transferring command function" 1.6.10 Describe section and staging management 1.6.11 Describe a system for patient identification 1.6.12 Describe scene medical control 1.6.13 Identify "who's in charge"

TOPIC	CONTENT OUTLINE
Introduction to Major Incident Response	A. A major incident is described as any situation that will stress the local EMS resources

   1. Situations involving more patients than can be handled by the responding units
   2. Taxes the total pre-hospital response system
   3. Multiple sites
   4. Community wide

B. One of the key functions during a major incident is the communication system

   1. Communication components utilized in the EMS system in the local area
      a. Review state/regional or local communication system
         i. The controls for activating the communication system
         ii. Frequencies in the system
         iii. Portable equipment
         iv. Mobile equipment
         v. Frequencies assigned to major incidents
   2. Communication must be clear and concise
      a. Speaking speed: 60 words per minute
      b. Messages should be thought out in advance.
      c. Speak clearly and enunciate each word.
      d. Identify yourself on your unit in a known manner.
      e. If necessary, use "phonetic alphabet" in your description.
      f. Listen carefully; good communication includes "listening."
   3. Communication with medical control during a major incident must be brief and as accurate as possible.
      a. Utilize a code system to identify numbers and severity of the patient(s).
         i. Triage tags with color coding
         ii. Trauma scoring system
         iii. Coma scales, etc.
         iv. Caution on the use of any code
      b. Receiving hospitals will want accurate information as soon as possible.
         i. Advisable to let medical control know your response to a "possible major incident."
         ii. Advise dispatcher or medical control of the numbers and severity as soon as possible.
      c. Declaration of a major EMS incident or possible EMS incident is an extremely important phase of the total EMS response
         i. If an EMS unit is dispatched to an incident that appears, on the basis of the information provided to the local dispatcher, to be a major incident, the EMS unit should not hesitate to DECLARE THAT IT IS RESPONDING TO A POSSIBLE MAJOR EMS INCIDENT AND WILL CONFIRM UPON ARRIVAL

Dispatch centers may assign responding units these frequencies.

Caution: Be careful not to overmodulate. "Don't yell."

E.g., City Ambulance 52.

Codes may be confusing. Use plain English.

This information allows other resources to be contacted and placed on "stand-by" and time to determine if special resources such as helicopters are available at the time. Experience has shown that most aircraft accidents develop into a major

ii. Any situation that will require more than two ambulance units for adequate treatment *should be declared a major EMS incident*, particularly in rural areas where most communities only have one ambulance vehicle.

iii. Any situation involving hazardous/radioactive materials, chemicals, etc.

iv. Any situation that will require special EMS resources, e.g., one or more helicopters, rescue teams, or multiple rescue/extrication units

v. When in doubt, declare an EMS major incident

Preparation for Response

A. The pre-planning process should provide the necessary information on the various emergency response resources.

1. Each EMS agency/system needs to work jointly with other EMS agencies/systems, hospitals and other agencies in the immediate and surrounding areas to insure that all of their major incident plans are coordinated
2. Each EMS agency/system needs to be exercised periodically to ensure its effectiveness and to familiarize the unit's personnel with the plan.
3. Drills should frequently be held.
4. Area response should include EMS units within a specific response time area.
   a. Area (30)—30 minute response
   b. Area (60)—60 minute response
   c. Area (90)—90 minute response
5. As the major incident progresses, it may be necessary to upgrade the major incident resource area.
   a. Copies of this and other components of the response plan should be in each EMS unit involved in the major incident area plan
6. Special resources need to be identified during the pre-planning phase to ensure their access during a major incident.
   a. *AIR EVACUATION RESOURCES*—Include both helicopter, fixed-wing aircraft resources for rescue and emergency medical air transport.
   b. *AERONAUTICAL RESCUE*—Includes state aeronautics and military search and rescue capabilities for aeronautical type major EMS incident response.
   c. *DISASTER SERVICES*—Other assistance can be mobilized for major incidents.
   d. *PUBLIC HEALTH EMERGENCY*—Certain major incidents, immediate public health emergency consultation and assistance
   e. *HAZARDOUS MATERIALS EMERGENCY RESPONSE*—Chemical spill team, state environment, health district environmental resources and other hazardous materials respond capabilities available for assistance.
   f. *SEARCH AND RESCUE*—Cave and mine rescue teams, water rescue, avalanche rescue, available for certain situations.
   g. *HEAVY EQUIPMENT*—Includes location of cranes, loaders, dump trucks, and other heavy equipment.

situation. This included aircraft with only a pilot on board, e.g., cases when upon arrival of emergency units, it was found that the aircraft was loaded with pesticide which had spilled all around the crash and contaminated the badly injured pilot and posed a threat to rescuers.

Area rescue/extrication units, etc.

In a move-up process, area (60) may be required to cover area (20).

For moving, digging, shoveling in the event of a cave-in, building collapse.

TOPIC	CONTENT OUTLINE

The Scene

A. First arriving EMS unit at a major incident may not be aware of the magnitude of the situation until arrival at the scene.

B. Prior to arriving at the scene of any emergency, there should be an understanding on which of the personnel on the call will function in the role of field EMS command.

1. *FIELD EMS COMMANDER*—One individual should always be ready to function in this role if necessary. This person's first responsibility is to decide that this is indeed a "major incident" and declare it as such.
   a. Including activating the "major EMS incident response plan," e.g., using the EMS radio to communicate that the unit is declaring a "major incident"
   b. Responsible for requesting appropriate other EMS assistance
   c. Coordinating the overall actions at the scene
   d. Communication/coordination at the scene
      i. All medical communications from scene to medical control must go through EMS field command
   e. Field EMS command officer must be identified
2. *SCENE TRIAGE OFFICER*—Responsibilities are to coordinate with the field "EMS Commander" to determine:
   a. Number of patients, types and magnitude of their injury/illness. This information needs to be passed on as soon as possible to the "field EMS commander" so that the additional assistance needed can be determined and requested.
   b. After the "scene triage officer" makes the initial determination of the number/type/severity of the patients, it will be this person's responsibility to "triage" patients on the basis of their priority for field treatment and for transport purposes.
   c. Scene triage officer must be identified in some manner; a vest will allow mobility.
3. *TRANSFER OF FIELD COMMAND*—In some instances, it may be most appropriate to transfer FIELD EMS COMMAND (and triage) to another EMS unit from the EMS unit that arrived first on the scene.
   a. The first Basic Life Support unit to arrive at the incident takes field EMS command. However, area pre-planning for major EMS incidents has included a provision that an advanced life support (ALS) unit will assume FIELD EMS COMMAND when it arrives on the scene of any major incident. Thus, upon arrival of the first ALS unit, the BLS personnel who have assumed COMMAND AND TRIAGE responsibilities transfer these responsibilities to the ALS personnel. They remove their vests as the ALS personnel put theirs on, and quickly brief the ALS personnel on the overall situation, i.e., number/types/severity of the patients and other factors that exist at the scene
   b. When a combination of first responders, basic and advanced life-support ambulances, etc., exist in an area, it is essential that the issue of transferring COMMAND AND TRIAGE responsibilities be addressed when each EMS unit develops it's major EMS incident plan.

Brightly colored vest or a cone identifying "command" location.

c. In certain instances, especially when advanced life-support personnel may have to leave the scene to transport the most critical patients in a multi-patient situation, a decision may be made to have the basic life-support personnel who were first to arrive at the scene and undertook the COMMAND AND TRIAGE functions, remain in COMMAND.

4. *ON-SCENE SECTOR/STAGING MANAGEMENT*—In many instances it will be difficult to use the concept of sector and staging management, due to narrow roads, canyons, etc. This concept should be used when appropriate as it will help provide effective on-scene management.
   a. When multiple EMS units are responding to a major EMS incident it may just confuse the situation if all the units park haphazardly as they arrive.
   b. In these cases, the SCENE EMS COMMANDER should request the assistance of a law enforcement officer at the scene to locate an appropriate "staging area" to park the vehicles as they arrive. The EMS units can then be parked in a suitable manner for maximum effectiveness in using the equipment from the vehicles, loading patients, and to easily leave the scene. In certain cases, it may be necessary to have ambulance vehicles move one or two at a time from the staging area to a loading area closer to the center of the scene.
   c. When appropriate, at a major EMS incident scene, the SCENE COMMANDER should designate SECTORS to more effectively and safely perform the necessary rescue and patient care functions.
      i. *INCIDENT EXTRICATION SECTOR*—In many instances, the ectrication sector will present certain hazards.
      ii. *TREATMENT SECTOR*—Patient care equipment may be removed from the EMS units at the scene and organized within a suitable area where the patients can be moved for field treatment away from the hazards of the EXTRICATION SECTOR.
   d. If possible, each "Sector" and "Area" should have a coordinator.
5. PATIENT INFORMATION—As outlined previously, it is the responsibility of the SCENE TRIAGE OFFICER to determine, as soon as possible after arrival at the scene, the total number and severity of injury/illness problems. This information needs to be passed on immediately to the SCENE EMS COMMANDER to permit this individual to communicate the need for additional assistance, to notify area hospitals of the magnitude of the situation, etc.
   a. In a major incident, it is usually not feasible to rapidly obtain detailed information on each patient, (e.g., vital signs and exact injuries). Therefore, a rapid overall assessment needs to be made and the patient information put in specific categories.
   b. It is important to realize that any coding system must be known by all involved in the major and is an important part of the planning phase of the major incident response.
6. EMS MEDICAL CONTROL/PRE-HOSPITAL SCENES—Focus of the EMS system is on the critically ill or injured patient.

a. Medical decisions need to be made; the EMS system concept of "EMS MEDICAL CONTROL" must be activated.

b. In most day-to-day EMS responses, EMS MEDICAL CONTROL is from the hospital that is the usual medical control point for an EMS unit

c. In all situations, including major EMS incidents involving Communications Center, the EMS Command Center, must contact the EMS unit's medical control point to determine what action the local physician handling the medical control wishes to have carried out.

d. In some situations, especially major EMS incidents that overwhelm local EMS and hospital resources, the local medical control physician may decide to have EMS Communications Center work through the designated trauma center.

e. In most situations, an appropriate law officer will assume overall command of the scene.

f. In some cases, such as major flammable liquid incidents, the pertinent fire chief will usually be in charge of the overall scene, at least until the fire hazard is under control.

g. If an EMS unit is the first emergency response unit to arrive at a major EMS incident scene, the EMS unit should take overall command of the scene until a law enforcement officer arrives and overall command is transferred to the officer.

h. The SCENE EMS COMMANDER is in charge of all the medical aspects of the scene and, of course, needs to coordinate closely with the law officer who is in overall command of the scene.

   i. The SCENE EMS COMMANDER'S decision as to how many more EMS units need to be requested to respond to the scene to provide adequate field treatment and transport for the patients

   ii. Special EMS resource

   iii. Often in conjunction with the medical control physician to request this resource

i. In most major EMS incidents, EMS personnel, including the SCENE EMS COMMANDER and the FIELD TRIAGE OFFICER, will be virtually committed to providing patient care, arranging transportation priorities for patients, etc. It will most often be most appropriate for the SCENE EMS COMMANDER to let the overall scene (law enforcement) officer handle all arrangements for special resources, such as heavy equipment, jet boats, snowcats and other special items. These arrangements, particularly as they impact patient care, should obviously be coordinated between the overall scene command officer and the SCENE EMS COMMANDER.

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Division 1: Prehospital Environment

Section 7. Stress Management

TOPIC	CONTENT OUTLINE
Introduction	The student must have successfully completed the following Divisions and Sections prior to participating in this Section: I. Division 1: Prehospital Environment Section I: Roles and Responsibilities Section II: EMS Systems Section III: Medical/Legal Considerations Section IV: EMS Communications Virtually all human activity involves stress of one kind or another, pleasant or unpleasant, mild or intense, of short duration or long-lived. Although stress can be a positive factor in our work and personal lives, excessive or unvaried stress becomes distress and can result in mental and/or physical problems. All those involved in a critical illness or injury—the patient, the family, bystanders, and the EMT-P respond to the stresses that are inherent to such emergencies. The purpose of this section is to familiarize the EMT-P with the causes and manifestations of stress in others and in themselves and to teach the EMT-P to anticipate and manage stress effectively to avoid its detrimental effects.
Overview	I. Introduction to stress II. Reactions to stress III. Anxiety IV. Paramedic job stress V. Dealing with death and dying
Objectives	At the conclusion of this section, the student will be able to: 1.7.1 Define the term stress. 1.7.2 Name the causes of stress. 1.7.3 Describe the three phases of the stress response. 1.7.4 Name and describe at least five defense mechanisms commonly used to deal with stress. 1.7.5 Describe factors that determine whether anxiety is a positive or negative response. 1.7.6 Describe the common physiologic effects of stress. 1.7.7 Describe behavior that is a manifestation of stress in: a. patients b. patient's families, and c. the EMT-P 1.7.8 Name common causes of job stress for the EMT-P. 1.7.9 Describe various techniques the EMT-P may use to manage stress. 1.7.10 Describe the stages of the grief process. 1.7.11 Describe common needs of a) the patient, b) the family, and c) the EMT-P in dealing with death and dying. 1.7.12 Describe common management techniques used by the EMT-P when a patient is dead or dying. 1.7.13 Identify issues of controversy in pre-hospital care involving death and dying.

TOPIC	CONTENT OUTLINE
Introduction to Stress	A. Stress: Non-specific response of the body to any demand made upon it 1. In addition to specific actions, all agents to which we are exposed produce a *non-specific* increase in need to adapt and re-establish normalcy. 2. Always present to some degree B. Stressor: Any agent or situation that causes stress 1. May be physical or emotional 2. Agent or situation faced may be pleasant or unpleasant; immaterial in response. C. Causes of psychological stress 1. Loss of something that is of value to an individual 2. Injury or threat of injury to the body 3. Poor health, nutrition 4. Frustration of drives 5. Ineffective coping D. Stages of stress (use general adaptation curve) 1. Alarm reaction a. Occurs at first exposure to stressor b. Resistance is diminished, physiologic and emotional response is great 2. Stage of resistance a. Individual begins to adapt. b. Physiologic parameters return to normal. c. Resistance rises above normal. 3. Stages of exhaustion a. Follows long, continued exposure to same stressor b. Adaptation energy is exhausted. c. Signs of alarm reaction reappear, but are now irreversible.
Reactions to Stress	A. Defense mechanisms 1. Adaptive functions of the personality that assist us in adjusting to stressful situations that confront us 2. Used continuously— healthy unless overused to degree that they distort reality 3. Many are unconscious and automatic; some may be conscious efforts. 4. Employed to seek relief B. Common defense mechanisms 1. Repression: Involuntary banishment of unacceptable ideas or impulses into the unconscious a. Unconscious forgetting b. Repressed conflicts are unchanged in quality and intensity— constantly seek expression 2. Regression: The return to an earlier level of emotional adjustment 3. Projection: Attributing to another person/object those thoughts, feelings, motives, or desires which are really one's own unacceptable traits

See Bibliography.

Important to give real life examples and to encourage students to volunteer examples to describe each of the defense mechanisms.

   a. May be seen as aggression toward others
   b. Is actually anger with self
4. Rationalization: Process of ascribing acceptable or worthwhile motives to feelings, thoughts, or behavior which really have other unrecognized motives
   a. A commonly employed defense mechanism
   b. An unconscious, retrospective process
   c. A way of "explaining" our behavior; may be self-deceiving
5. Compensation: A conscious or unconscious attempt to overcome real or imagined shortcomings by developing individual skills/traits to compensate for those deficiencies
6. Reaction formation: The direction of overt behavior or attitudes in precisely the opposite direction of the individual's underlying, unacceptable impulses
7. Sublimation: The diversion of unacceptable, instinctual drives into socially acceptable channels
8. Denial: The unconscious disavowal of thoughts, feelings, wishes, or needs which are consciously unacceptable—closely related to rationalization
9. Substitution: The replacement of an unattainable or unacceptable activity by one which is attainable or acceptable or the redirection of an emotion from the original object to a more acceptable substitute object
10. Isolation: The separation of an unacceptable impulse, act, or idea from its memory origin, thereby removing the associated emotional charge; conscious retention of the memory, but not the feeling that accompanied it

Anxiety

A. Definition:
   1. An emotional state caused by stress that is a key ingredient in the coping process
      a. Alerts person to impending danger
      b. Maintains all potential resources (body and mind) in readiness for emergencies
   2. Anxiety is the consequence of:
      a. Each individual's personal perceptions of environment
      b. Each individual's internalized psychologic processes
   3. Sources of anxiety
      a. Internal: conflicts between learned personal expectations and current motivations
      b. External: people and events around us—can be very helpful
B. Normal anxiety:
   1. Whether anxiety is "normal" is determined by what we get anxious about; it is relative in intensity.
   2. Is warning system to put us on guard so we won't be overwhelmed by sudden stimulation or helpless in critical situations.
   3. Is adaptive: helps us cope by narrowing and focusing our field of attention.

Often referred to as displacement.

4. Can produce emotional innoculation, i.e., mild anxiety enables us to increase tolerance for stress by developing coping mechanisms and defenses.

C. Detrimental reactions to anxiety/stress:
   1. When warning anxiety fails to stimulate coping behavior, reaction to threat is disproportionate to actual danger
   2. Plays negative role in coping behavior when:
      a. Interferes with thought processes
      b. Interferes with performance
      c. Causes physical problems

D. Common physiologic effects of anxiety/stress:
   1. Mediated by autonomic nervous system
      a. Intense sympathetic discharge and norepinephrine release
      b. Increased corticosteroid production
   2. Effects that may be felt consciously
      a. Heart palpitations
      b. Difficult/rapid breathing
      c. Dry mouth
      d. Chest tightness/pain
      e. Anorexia, nausea, vomiting, abdominal cramps, flatulence, "butterflies"
      f. Flushing, diaphoresis, body temperature fluctuation
      g. Urgency and frequency in urination
      h. Dysmennorhea, decreased sexual drive/performance
      i. Aching muscles, joints
      j. Backache, headache
   3. Effects that are not felt consciously
      a. Increased BP and heart rate
      b. Blood shunting to muscles
      c. Increased blood glucose
      d. Epinephrine production by adrenals
      e. Reduced GI peristalsis
      f. Pupil dilation

E. Reaction of individuals to anxiety/stress:
   1. Patient and family
      a. Anger—toward God, themselves, or anyone around
      b. Guilt
      c. Indecisiveness: Don't give too many alternatives when anxiety level high
   2. EMT-P
      a. Impatience
      b. Fear
      c. Anger
      d. Important to maintain professional attitude despite these emotions; remain non-judgmental.

TOPIC	CONTENT OUTLINE
Paramedic Job Stress	A. Job Stressors: 1. Multiple role responsibilities 2. Unfinished tasks 3. Angry and/or confused citizens 4. Meeting continuous time lines 5. Absence of challenge 6. Overdemand on time, energy, ability, or emotional control 7. Necessary restrictions placed on scope of practice 8. Unpredictable changes in work pace 9. Lack of recognition 10. Lack of upward mobility in career 11. Abusive patients and dangerous situations 12. Critical and dying patients B. Managing stress: 1. Must recognize early warning signs of anxiety. 2. Must be aware of own optimal stress levels and try to maintain. a. Certain amount of stress is good. b. Mild stress is protective and improves performance. 3. Must have adequate perception of stressful situation. a. Do you see what's really happening? b. Are you blaming yourself unjustly? c. Try to sort events into categories of importance, urgency, and degree of actual threat. 4. Use situational support. a. Talking situation out with someone else (often peers) as soon as possible b. Group discussions of difficult situations c. Critical incident stress debriefing 5. Get enough sleep and rest. 6. Get involved in pursuing positive activities with others; balance work and recreation. 7. Learn to accept what cannot be changed if it's beyond your control. 8. Use adequate coping mechanisms. a. Evaluate if your defense mechanisms are effective for you—adopt those most apt to reduce stress. b. Physical exertion good way to relieve stress. c. Coping requires energy—must learn the right amount of energy required for a certain activity.
Dealing With Death and Dying	A. Most important factor is attitude: 1. About death 2. About the patient and his/her significant others B. Stages of grief process: 1. Denial and isolation a. Used by almost all patients b. Healthy—acts as buffer between the shock and dealing with it

c. Temporary stage—soon comes partial acceptance
d. Happens all through illness

2. Anger
   a. Patient/family asks "why me?"
   b. Anger at loss—displaced and projected to anything and everything
   c. Has little to do with people around or those who become targets
      i. Difficult for the EMT-P to deal with
      ii. EMT-P must not personalize anger.
      iii. Show tolerance
      iv. Don't be afraid of anger or become defensive.
      v. Listen to patient or family.
3. Bargaining—entering into some type of agreement which may postpone the inevitable
4. Depression
   a. Great sense of loss
   b. Reactive depression: reacting to needs of particular life situation (example: Who will care for children?)
   c. Preparatory depression:
      i. Patient is very silent.
      ii. Reassurance not meaningful
5. Acceptance (disengagement)
   a. Not a happy stage
   b. Without fear or despair; void of feelings
   c. Patient less involved with people; preparing to face it alone
   d. Family in more need of help, understanding and support than patient

C. Needs of individuals in dealing with death/dying:
   1. Possible patient needs
      a. Sharing, communications
      b. Hope
      c. Privacy
      d. Respect and dignity
      e. Control
   2. Family/significant other needs:
      a. Go through same stages as patient
      b. Illness in widows and widowers may be precipitated by failure to work through grief and guilt.
      c. Need to express feelings of rage, anger, despair
      d. May need to reduce feelings of guilt
   3. EMT-P needs
      a. May go through same grief stages
      b. Use a lot of energy to cover feelings; must ventilate at some later time

D. Management guidelines:

1. How EMT-P deals with death with others reflects his own thought processes and activities immediately after the death.
2. It is natural to feel uncomfortable in situation.
3. Don't approach the subject yourself—let it come from patient or family.
4. Don't falsely reassure patient or family.
5. Don't be afraid to tell the patient he is dying if the question is asked.
6. If patient reluctant to talk, ask what he is afraid of.
7. Use nonverbal communication
   a. Tone of voice
   b. Facial expression
   c. Touching
8. If patient DOA
   a. "Patient" is the family
   b. Comfort the family with kind deeds, i.e., call neighbors, family, or clergy to come over
9. Family needs to hear the word "dead"—not "expired" or "passed away," etc.
10. Recognize that family will cope with death the same way they cope with day-to-day stresses.

E. Issues for the EMT involving death and dying
   1. Feelings regarding resuscitating a patient who is terminal (either family's or physician's wishes.)
   2. Feelings regarding resuscitation of patients primarily for training
   3. Deciding how much energy EMT uses to cover up true feelings

This is designed to be a group discussion; other topics can be added.

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Division 2: Preparatory

Section 1. Medical Terminology

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment Sections 1–7
Overview	I. Medical Terminology II. Prefixes and Suffixes III. Medical Dictionary IV. Appendix A: Handout Medical Terminology
Objectives	At the completion of this section, the student will be able to: 2.1.1 Define and contrast medical terms. 2.1.2 Identify various medical terms given one or more anatomical parts of the body. 2.1.3 Identify common medical abbreviations. 2.1.4 Identify common root words and determine their meaning. 2.1.5 Identify and define common prefixes and suffixes. 2.1.6 Locate one or more medical terms in a medical dictionary.

TOPIC	CONTENT OUTLINE
Medical Terminology	A. Needed to understand what is said in class B. Needed to communicate with: 1. Doctors 2. Nurses 3. Other Emergency Medical Technician Paramedics (EMT-P's) C. Used in international languaage
Prefixes and Suffixes	A. Prefixes 1. Beginning of words 2. Examples: a. A = without or lack of, e.g., apnea = without breath b. Derma = skin, e.g., dermatitis inflammation of skin c. Macro = large, e.g., macroblast = abnormally large cell B. Suffixes 1. Ends of words 2. Examples: a. Cyte = cell, e.g., leukocyte = white cell b. Ectomy = cutting out, e.g., tonsillectomy = cutting out of tonsils c. Phasia = speech, e.g., aphasia = loss of speech power C. If basic prefixes and suffixes are known, medical terminology becomes less difficult D. Root words
Medical Dictionary	A. Exercise: discussion of selected words 1. Pronunciation 2. Spelling 3. Definition 4. Subtopics 5. Medical synonyms 6. Word variation 7. Capital letters B. Contents and use of the appendix 1. Glossary 2. Signs and symbols

Handout list

APPENDIX A
MEDICAL TERMINOLOGY
COMMON ABBREVIATIONS

ABBREVIATION	MEANING
aa	of each
ad lib	as much as desired
aq.	water
ASA, APC	aspirin; aspirin, phenacetin, caffeine
b.i.d.	twice a day
BP	blood pressure
CA	cancer
c	with
CAD	coronary artery disease
CBC	complete blood count
c.c.	cubic centimeter (equal to ml)
C.C. or C/C	chief complaint
CCU or MICU	coronary care unit, medical intensive care unit
CHF	congestive heart failure
c/o	complains of
CO_2	carbon dioxide
CPR	cardiopulmonary resuscitation
COPD	chronic obstructive pulmonary disease
CVA	cerebrovascular accident
CVP	central venous pressure
D.C.	discontinue
DOA	dead on arrival
DOE	dyspnea on exertion
Dx	diagnosis
EEG	electroencephalogram
EKG, ECG	electrocardiogram
ER/ED	emergency room/emergency department
ETOH	alcohol
fl.	fluid
Fx	fracture
GB	gall bladder
GI	gastrointestinal
Gm.	gram
gr.	grain
GU	genitourinary
h,hr.	hour
H, (H)	hypodermic
Hb.,Hgb	hemoglobin
Hct.	hematocrit

H & H	hemoglobin and hematocrit
Hg.	mercury
Hx.	history
H & P	history and physical
IC	intracardiac
ICU	intensive care unit
IM	intramuscular
IV	intravenous
L.	liter
LOC	level of consciousness
MAE	moves all extremities
mEq	milliequivalent
mg.,mgm	milligram
MI	myocardial infarction
MICU	mobile intensive care unit
	medical intensive care unit
ml.	milliliter
MS	morphine sulfate
MS	multiple sclerosis
$NaHCO_3$	sodium bicarbonate
NPO	nothing by mouth
NTG	nitroglycerin
O_2	oxygen
OB	obstetrics
O.D.	overdose
O.R.	operating room
p	after
p.c.	after meals
P.E.	physical exam
p.o. or PND	by mouth
pt.	patient
PT	physical therapy
PTA	prior to admission
PERL	pupils equal and react to light
q	every
q.h.	every hour
q.i.d.	four times a day
qtt	drop
RBC	red blood cells
RHD	rheumatic heart disease
R/O	rule out
Rx	take; treatment
ROM	range of motion
s	without
S.C., S.Q.	subcutaneous

SICU	surgical intensive care unit
S.L.	sublingual
S.O.B.	shortness of breath
ss	half
stat.	immediately
SubQ	subcutaneous
t.i.d.	three times a day
TPR	temperature, pulse, respiration
V.S.	vital signs
WBC	white blood cells
W/	with
WNL	within normal limits
y.o.	year old

MEDICAL TERMINOLOGY

(Prefixes and Suffixes)

	PREFIXES	MEANING	EXAMPLE
1.	a-, an-	without, lack of	Apnea—without breath; Anemia—lack of blood.
2.	ab-	away from	Abnormal—away from the normal.
3.	abdomi(n)	abdomen	Abdominal—pertaining to abdomen.
4.	acr-	pertaining to extremity	Acromegaly—enlargement of extremity.
5.	ad-	to, toward	Adhesion—something stuck to/remaining in close proximity to.
6.	aden-	pertaining to gland	Adenitis—inflammation of gland.
7.	ana-	up, back, again	Anastomosis—joining of two parts.
8.	angio-	blood vessel	Angiogram—study of vessels.
9.	ante-	before, forward	Antenatal—occuring or formed before birth.
10.	anti-	against, opposed to	Antipyretic—against fever.
11.	arter-	artery	Arteriogram—study of arteries.
12.	arthro-	pertaining to joint	Arthroscopy—inspection of joint.
13.	auto-	self	Auto-intoxication—poisoning by a toxin generated within the body.
14.	bi-	two	Bilateral—both sides.
15.	blast-	germ or cell	Blastoma—a true tumor of cells.
16.	bleph-	pertaining to eyelid	Blepharotomy—surgical cutting of lid an eyelid.
17.	bio-	life	Biology—study of life.
18.	brady-	slow	Bradycardia—slow heart rate.
19.	calc-; lith-	stone	Renal calcubes—kidney stone; Pyelolithotomy—removal of stone from kidney by surgical incision.
20.	cardi-	pertaining to heart	Cardiography—recording of the movements of the heart.
21.	cerebr-	brain	Cerebral—pertaining to brain.
22.	cerv-	neck	Cervical—pertaining to neck.
23.	cephal-	pertaining to head	Cephalopathy—any disease of the head.
24.	chole-	pertaining to bile	Cholelithiasis—stones in the gall bladder.
25.	chondr-	cartilage	Costochondral—junction of ribs and cartilage.
26.	circum-	around, about	Circumoral—around the mouth.
27.	contra-	against, opposite	Contrastimulant—against stimulating.
28.	cost-	pertaining to rib	Costal margin—margin of lower limits of ribs.
29.	cyan-	blue	Cyanotic—bluish discoloration.
30.	cyst-	pertaining to bladder or any fluid containing sack.	Cystitis—inflammation of urinary bladder.
31.	cyt-	cell	Cytology—study of cells.
32.	derma-	skin	Dermatitis—inflammation of the skin.
33.	di-	twice, double	Diplopia—double vision.
34.	dia-	through, completely	Diagnosis—knowing completely.
35.	dys-	with difficulty	Dyspnea—difficulty breathing.
36.	ecto-	out from	Ectopic—out of place.

37.	edem-	swelling	Edema—swelling.
38.	electr-	electricity	Electroencephalogram—electric record of brain activity.
39.	endo-	within	Endometrium—within the uterus.
40.	enter-	pertaining to the intestines	Enteritis—inflammation of the intestines.
41.	epi-	upon, on	Epidermis—on the skin.
42.	erythro-	red	Erythrocyte—red blood cells.
43.	exo-	outside	Exogenous—produced outside the body.
44.	febr-	fever	Afebrile—without fever.
45.	gastr-	pertaining to the stomach	Gastritis—inflammation of the stomach.
46.	glyco-	sugar	Glycosuria—sugar in urine.
47.	gynec-	pertaining to women	Gynecology—study of diseases of women.
48.	hem-, hemat-	pertaining to blood	Hemoglobin—coloring matter of red cells.
49.	hemi-	half	Hemiplegia—paralysis of one side of the body.
50.	hepat-	liver	Hepatitis—inflammation of liver.
51.	hydr(o)-	water	Hydrocele—water tumor of testicle.
52.	hyper-	over, excessive in	Hyperplasia—excessive formation.
53.	hypo-	under, deficient in	Hypotension—lower blood pressure.
54.	hyster-	pertaining to uterus	Hysterectomy—removal of the uterus.
55.	infra-	below, after	Infrascapular—below the scapular bone.
56.	inter-	between	Intercostal—between ribs.
57.	intra-	within	Intralobar—within the lobe.
58.	iso-	equal	Isotonic—having equal tension.
59.	later(o)-	side	Lateral—pertaining to side.
60.	leuk-	pertaining to anything white	Leukocyte—white blood cells.
61.	macro-	large	Macroblast—abnormally large cell.
62.	mal-	bad abdominal disorder	Malaise—general discomfort, unease.
63.	mening(o)-	meninges	Meningitis—inflammation of meninges.
64.	micro-	small	Microplasia—dwarfism.
65.	mono-	one	Monocular—one eye.
66.	my-	pertaining to muscle	Myeloma—muscle tumor.
67.	mas(o)-	nose	Nasopharynx—pertaining to nose and pharynx.
68.	neo-	new	Neoplasm—new growth.
69.	nephr-	pertaining to kidney	Nephrectomy—surgical excision of kidney.
70.	neur(o)-	nerve	Neurogenic—caused by nerve.
71.	olig-	little	Oliguria—little outpour of urine.
72.	oophor-	pertaining to ovary	Oopherectomy—surgical excision of ovary.
73.	opthal-	pertaining to eye	Exophthalmos—protruding eyeballs.
74.	orchi-	testicle	Orchitis—inflammation of testicle.
75.	ortho-	straight	Orthopnea—unable to breathe lying down.
76.	os-	mouth	Cervical os—mouth of cervix.
77.	osteo-	pertaining to bone	Osteoblast—bone cells.

78.	ot-	pertaining to ear	Otitis media—inflammation of middle ear.
79.	para-	by the side of	Parathyroids—along side of the thyroid.
80.	per-	through	Perforation—a breaking through.
81.	phago-	to eat	phagocyte—cells that eat debris.
82.	pharyng-	throat	Pharyngitis—inflammation of pharynx.
83.	peri-	surrounding	periosteum—covering of bone.
84.	phleb-	vein	Phlebitis—inflammation of vein.
85.	pneum-	pertaining to lung	Pneumococcus—organism causing pneumonia.
86.	poly-	many	Polycystic—containing many cysts.
87.	post-	after, behind	Postpartum—after childbirth.
88.	pre-	before	Prediastolic—before diastole.
89.	pro-	before, in front of, forward	Prognosis—forecast as to result of disease.
90.	pulmo-	lung	Pulmonary thrombosis—clot in lung.
91.	proct-	pertaining to rectum	Proctoscopy—inspection of rectum.
92.	pseudo-	false	Psedoanemia—condition of paleness without true anemia.
93.	psych-	pertaining to the mind	Psychiatry—treatment of mental diseases.
94.	py-	pertaining to pus	Pyorrhea—discharge of pus.
95.	pyel-	pertaining to kidney pelvis	Pyelitis—inflammation of pelvis of kidney.
96.	quadr-	four	Quadrilateral—four sides.
97.	rhin-	pertaining to nose	Rhinitis—inflammation of nose.
98.	retro-	backward	Retroflexion—bending backward.
99.	salping-	pertaining to a tube	Salpingectomy—excision of oviduct.
100.	sclero-	hard	Sclerosis—hardening.
101.	semi-	half	Semilunar—half-moon, or crescent-shaped.
102.	sub-	under, moderately	Subacute—moderately sharp.
103.	super-; supra-	above	Supraventricular—above the ventricles.
104.	sym-	with, together	Symphysis—grow together.
105.	tachy-	fast	Tachycardia—fast pulse.
106.	thorac(o)-	chest	Thoracotomy—cutting into chest.
107.	trans-	across	Transfusion—pour across.
108.	tri-	three	Tricuspid—having three cusps.
109.	uni-	one	Unilateral—one sided.
110.	vaso-	vessel	Vasoconstriction—constriction of vessel.

MEDICAL TERMINOLOGY

(Prefixes and Suffixes)

SUFFIXES	MEANING	EXAMPLE
1. -algia	pertains to pain	Neuralgia—pain along a nerve.
2. -asthenia	weakness	Myosthenia—muscle weakness.
3. -blast	germ of immature cell	Myeoblast—bone marrow cell.
4. -cele	tumor, hernia	Exterocele—hernia of the intestine.
5. -centesis	puncturing	Thorocentesis—puncturing and drainage of pleural space.
6. -cyte	cell	Leukocyte—white cell.
7. -ectomy	a cutting out	Tonsillectomy.
8. -emia	blood	Anemia.
9. -esthesia	sensation	Anesthesia—without sensation.
10. -genic	causing	Carcinogenic—cancer causing.
11. -gram; -graph	record	Angiogram—record of graph.
12. -itis	inflammation	Tonsillitis.
13. -lysis	gradual decline; weakening	Lysis of adhesions.
14. -megaly	enlargement of	Hepatomegaly—enlargement of liver.
15. -ology	science of	Biology—science or study of life.
16. -ostomy	creation of an opening.	Gastrostomy—artificial opening.
17. -oma	tumor, swelling	Neuroma.
18. -osis	condition of	Psychosis—condition of the mind.
19. -paresis	weakness	Hemiparesis—one-sided weakness.
20. -phagia	eating	Polyphagia—excessive eating.
21. -plegia	paralysis	Heliplegia—one-sided paralysis.
22. -pnea	breathing	Apnea—no (or without) breathing.
23. -pathy	disease	Neuropathy.
24. -phasia	speech	Aphasia—loss of speech power.
25. -phobia	fear	Hydrophobia—fear of water.
26. -plasty	repair of; tying of	Nephroplasty—suturing up of a kidney.
27. -ptosis	falling	Enteroptosis—falling of the intestine.
28. -rhythmia	rhythm	Arrhythmia—variation from normal rhythm.
29. -rrhagia	bursting forth	Hemorrhage—flowing of blood.
30. -rrhaphy	suture of; repair of	Herniorrhaphy—repair of a hernia.
31. -rrhea	flowing	Pyorrhea—discharge of pus.
32. -scope	instrument for examination.	Bronchoscope.
33. -scopy	exam by inspection	Bronchoscopy.
34. -taxia	order, arrangement of	Ataxia—failure of muscle coordination.
35. -trophia	nourishment	Atrophy—wasting.
36. -uria	to do with urine	Polyuria—excessive secretion of urine.

Division 2: Preparatory

Section 2. General Patient Assessment

TOPIC	CONTENT OUTLINE

Introduction

Prior to participating in this section, the student must have successfully completed:

Division 1: Prehospital Environment
All sections

Division 2: Preparatory
Section 1

Although it would be ideal to evaluate the patient completely then go back and manage those conditions found, this is impossible in the acutely ill or injured patient. Many things must be managed when found (e.g., Airway Compromise). This section on Patient Assessment and Management tries to combine those areas in which simultaneous management and assessment are required. The EMT, upon completion of this section, should have enough knowledge to identify when such simultaneous evaluation and management are required and when they are not.

The EMT-P should not attempt to memorize the skill and the condition for which it is used. The pre-hospital care phase of emergency patient care contains so many variables (e.g., location of the accident, weather, attitude of bystanders, possible contamination or fire), that to match one for one would be an impossibility. For this reason, the EMT must acquire a wide spectrum of knowledge and skills to be applied when and how the situation dictates.

The principles, however, are that life-threatening conditions are treated first, access to definitive care is as rapid as possible, and evaluations which will not alter prehospital management do not extend prehospital on-the-scene time.

The middle principle of access to definitive care as soon as possible will differ in the trauma patient as opposed to the medical patient. In the latter, especially at the EMT-P level, definitive care can be started at the scene (defibrillation for ventricular fibrillation, or glucose for insulin shock). In the trauma patient, the blood loss must be stopped, the injury repaired and oxygen carrying whole blood replaced. These cannot be carried out at the scene nor in some instances even in the Emergency Department. Delay for inappropriate evaluations or unnecessary IV's should not be allowed in the field or in the Emergency Department. There is a finite period for each patient between the time the injury occurs and the time when the hemorrhage must be controlled or the injury repaired.

Overview

I. Introduction
II. Scene Survey
III. Primary Survey
IV. Resuscitation
V. Secondary Survey
VI. History
VII. Definitive Field Management
VIII. Re-evaluation

Objectives

Upon the completion of this section, the student will be able to:

2.2.1 Establish priorities of care based on threat to life conditions.

2.2.2 Describe the four phases of patient assessment.

2.2.3 Discuss the possible environmental hazards that the EMT may encounter and the means of protecting him in this environment.

2.2.4 Describe the environmental hazards which a patient might encounter.

2.2.5 Describe the mechanisms of stabilizing an automobile to prevent injury while extricating the patient.

2.2.6 Describe the problems an EMT-P might encounter in a hostile situation and describe mechanisms of management.

2.2.7 Describe the various types of protective equipment available to the EMT-P for self protection and patient protection.

2.2.8 Discuss the appropriate methods of patient protection in each situation.

2.2.9 Describe the emergency situations the EMT may encounter and describe the management of each.

2.2.10 Discuss backup personnel, transportation and equipment.

2.2.11 Define and describe the various classifications of emergencies which an EMT will encounter. Base this on medical needs.

2.2.12 Discuss how the assessment and management differs.

2.2.13 Describe the primary survey and what areas are critical to evaluate.

2.2.14 Describe the anatomy of the following: upper airway, tongue, hypopharynx, nasopharynx oropharynx, larynx, vocal cords.

2.2.15 Describe the function of the vocal cords.

2.2.16 Describe the flow of air from outside the body into the trachea.

2.2.17 Describe the reasons for and mechanism of humidification and warming of the air as it passes through the naso and oral pharynx.

2.2.18 Describe the pathological conditions that can occur in the nose, pharynx and larynx to obstruct or retard air flow and identify the complications of laryngeal fracture.

2.2.19 Describe the methods of airway management.

2.2.20 Describe the methods and management of an obstructed airway.

2.2.21 Describe the mechanical methods of airway management including the benefits and limitations. Oral, nasal and EOA.

2.2.22 Describe the trans-tracheal mechanisms of airway ventilation, including the benefits and limitations.

2.2.23 Describe how the cervical spine is protected throughout these maneuvers.

2.2.24 Describe the anatomy of the following:

a. Lungs
b. Trachea
c. Alveolus
d. Diaphragm
e. Thoracic wall
f. Pleural space.

2.2.25 Describe how pulmonary ventilation (inhalation and exhalation) is accomplished.

2.2.26 Describe the gaseous exchange across the alveoli-capillary membrane (O_2 and CO_2)

2.2.27 Describe the pulmonary problems that can complicate exhalation and inhalation, the mechanisms by which they reduce ventilation and management of each problem, including:

a. Open pneumothorax
b. Diaphragmatic injury
c. Closed pneumothorax (Simple and Tension)
d. Flail chest.

2.2.28 Describe the problems of ventilation.
2.2.29 Define mouth to mask ventilation, its benefits and limitations.
2.2.30 Discuss the bag-valve mask, its benefits and limitations.
2.2.31 Discuss the techniques for evaluating the effectiveness of ventilation.
2.2.32 Describe the anatomy of the heart and the cardiovascular system.
2.2.33 Describe the problems that occur with decreased perfusion.
2.2.34 Describe the pathophysiology of cardiac arrest.
2.2.35 Describe the mechanisms of evaluating the effectiveness of perfusion, including pulse, skin color, capillary refill.
2.2.36 Discuss ventilation with an E.O.A. (benefits and limitations).
2.2.37 Discuss ventilation with an endotracheal tube (benefits and limitations) (optional EMT-I).
2.2.38 Describe the equipment and method of suctioning the airway, pharynx and endotracheal tube (optional).
2.2.39 Describe the anatomy of the skin, bones, vessels, subcutaneous tissue as it relates to hemorrhage control.
2.2.40 Discuss the benefits and complications of hemorrhage control by the following means:

a. Direct pressure
b. Tourniquets
c. Hemostats.

2.2.41 Define a mini-neurological examination (level of consciousness).
2.2.42 Describe exposing the patient's body for total evaluation.
2.2.43 Discuss when this should and should not be carried out.
2.2.44 Define shock.
2.2.45 Describe the reasons for and mechanisms of patient reassessment in the resuscitation phase.
2.2.46 Define the components of secondary survey and its benefits for patient evaluation.
2.2.47 Describe the assessment of the head, neck, thorax, abdomen, extremities and nervous system.
2.2.48 Describe the trauma score, define its usefulness and how it is accomplished.
2.2.49 Discuss the important components which must be identified in taking an appropriate history from a patient.
2.2.50 Describe which laboratory studies drawn in the field when the IV is started and their usefulness.
2.2.51 Define the definitive care phase.
2.2.52 Describe how a patient is packaged and stabilized for transportation to the hospital, including airway ventilation, IV fluids, pneumatic anti-shock garment, fracture stabilization, bandaging.
2.2.53 Describe how the patient is immobilized to the backboard.

2.2.54 Describe how the patient is immobilized to the stretcher, and to the ambulance.

2.2.55 Describe patient extrication.

2.2.56 Describe how the patient is monitored enroute to the hospital.

2.2.57 Describe how the hospitals are selected for receipt of patients based on patient need and hospital capability.

2.2.58 Describe the benefits and complications of lights and sirens and when this should be used.

2.2.59 Describe the interaction between the EMT and Medical Command Authority in regard to: receiving hospital, family physician on the scene, bystander physician on the scene, orders for patient care, needs of the family and needs of the patient.

2.2.60 Describe the usefulness of a run report.

2.2.61 Describe the mechanisms of continued evaluation of the patient en route to the hospital.

S2.2.62 Perform a rapid assessment of the patient to identify priorities for care.

S2.2.63 Demonstrate the assessment of the head, neck, thorax, abdomen, extremities and neurological system.

S2.2.64 Demonstrate effective mouth-to-mask ventilation.

S2.2.65 Demonstrate effective bag valve

a. Mask
b. EOA
c. ET

S2.2.66 Demonstrate effective cardiopulmonary resuscitation.

S2.2.67 Demonstrate the manual methods of airway management.

S2.2.68 Demonstrate the methods of management of an obstructed airway.

S2.2.69 Demonstrate the mechanical methods of airway management.

a. Nasal
b. Oral
c. EOA
d. ET (Optional at EMT-I level)

S2.2.70 Demonstrate the use of self-protection equipment such as air pack (breathing apparatus), etc.

S2.2.71 Demonstrate the use of various types of portable and fixed suction devices.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Introduction	A. Priorities

A. Priorities
   1. Establish priorities of evaluation and care based on threat-to-life
   2. Rapid assessment (primary survey) identifies conditions which potentially involve threat to life
   3. Simultaneous management on these conditions

B. Initial assessment
   1. Step-wise evaluation of patient to determine priorities of care
   2. Steps are:
      a. Scene survey
      b. EMT-P and patient protection
      c. Primary survey
      d. Resuscitation
         i. Initiate airway management
         ii. Control hemorrhage
         iii. Initiation of shock management
         iv. Reassessment of threat to life conditions identified in primary survey
         v. Continued management of these conditions
      e. Secondary survey
      f. Definitive field management
         i. Stabilization of fractures
         ii. Packaging for transport
      g. Re-evaluation

Scene Survey

A. Hazards
   1. EMT-P safety precautions
      a. Environment
         i. Location of emergency
            (a) Fire (or risk of fire)
            (b) Wilderness
            (c) Height
         ii. Physical scene
            (a) Environmental
            (b) Movement (fire, auto, building)
         iii. Weather
      b. Hostile situation
         i. Perpetrator(s) location known or captured
         ii. Bystanders mood
            (a) Hostile
            (b) Supportive
         iii. Law enforcement assistance available
      c. Special equipment
         i. Self-contained breathing apparatus
         ii. Protective clothing
            (a) Chemical

The EMT-P is no benefit to the patient if he is injured or otherwise incapacitated. This only increases number of victims which must be cared for by the remaining rescue personnel. Therefore a prime concern of a EMT-P must be self protection.

Do not assume only one perpetrator.

(b) Gas
(c) Fire
(d) Environmental extremes
(e) Decontamination suit
iii. Aerial access equipment
iv. Water rescue protection
2. Patient
a. Environment
i. Patient protection
(a) Rain, snow, heat, cold
(b) Air or fluid chemical contamination
ii. Preserve modesty as much as possible
iii. Protection against further injury
b. Hostile situation
i. Perpetrator
ii. Crowd
c. Special protection equipment
i. Blankets
ii. Breathing apparatus
B. Type of situation
1. Urgency of situation
a. Acute emergency
b. Urgent situation
c. Nonurgent situation
2. Environment
a. Temperature
b. Atmosphere
c. Weather
3. Home
C. Back-up
1. Personnel
2. Transport vehicle
3. Equipment for patient removal
4. EMT protection
5. Patient protection
D. Classification
1. Medical
2. Trauma
3. Behaviorial
4. OB/GYN
5. Major incident
E. History of emergency
1. Events preceding emergency
a. Accident
i. Type of trauma—blunt or penetrating

Radiation.

Falls, glass, fire, noise, etc.

Need for such backup must be recognized and requested immediately on arriving on the scene. Additional help needs to be enroute as soon as possible.

ii. Mechanism of injury
b. Medical
c. Change in environment
2. Pertinent medical history
F. Access to patient
1. Special equipment
2. Special personnel

Primary Survey

A. Airway
1. Anatomy
a. Tongue/hypopharynx
b. Nasal air passages
i. Hemorrhage
(a) Spontaneous
(b) Traumatic
c. Oral air passages
d. Pharynx
e. Larynx
f. Vocal cord function
2. Physiology
a. Flow of air
b. Humidification of air
3. Pathophysiology
a. Pharyngeal
b. Larynx
4. Management
a. Manual
i. Hyperextension
ii. Chin lift
iii. Jaw lift
iv. Jaw thrust
b. Obstructed airway
i. Block blows
ii. Manual thrust
iii. Laryngoscope/McGill forceps
c. Mechanical
i. Nasal airway
(a) Construction
(b) Benefits
(c) Limitations
(d) Method of insertion
ii. Oral airway
(a) Construction
(b) Benefits
(c) Limitations

Medical alert tags

Brief summary, allergies

See Division 2, Section 3

Oropharynx

See Division 2, Section 3

See Division 2, Section 3

(d) Method of insertion
(e) Contraindications
iii. Esophegeal intubation
(a) Construction
(b) Benefits
(c) Limitations
(d) Method of insertion
(e) Contraindications
iv. Endotracheal intubation
(a) Construction
(b) Benefits
(c) Limitations
(d) Method of insertion
(e) Contraindications
d. Transtracheal ventilation
i. Jet insufflation
ii. Cricothyreotomy
iii. Tracheostomy
e. Ventilation
i. Bag valve
(a) Assessment of effective ventilation
(i) Rise in chestwall
(ii) Auscultation of lungs
(iii) Auscultation of stomach
(iv) Skin color
(v) Heart rate
ii. Demand valve
(a) Construction
(b) Method of operation
(c) Connection to airway
(d) Assessment of effective operation
(i) Rise in chestwall
(ii) Auscultation of lungs
(iii) Auscultation of stomach
(iv) Skin color
(v) Heart rate
g. Protection of C-spine
i. Indication of C-spine trauma
(a) Identify injury above clavicle
(b) Unconscious
(c) Mechanism of injury

B. Breathing
1. Anatomy
a. Lungs, trachea, alveoli
b. Diaphragm

Optional Skill

Optional Skill

Bilaterally

Bilaterally

- c. Thoracic wall
- d. Pleural space

2. Physiology
   - a. Pulmonary expansion (inhalation/exhalation)
     - i. Diaphragm action
     - ii. Rib action
     - iii. Accessory muscles of respiration
     - iv. Inhalation by negative pressure, not positive
     - v. Pleural space effect
   - b. Gas exchange
     - i. Alveolar capillary membrane
     - ii. O_2 across membrane
     - iii. O_2 into red blood cells
     - iv. O_2 into solution
     - v. CO_2 across membrane
     - vi. CO_2 out of RBC
     - vii. CO_2 in solution
3. Pathophysiology
   - a. Chest wall
     - i. Open pneumothorax
       - (a) Air follows easiest pathway
       - (b) Collapse of lung
       - (c) Decreased air exchange
   - b. Diaphragm
     - i. Paralysis
     - ii. Injury
     - iii. Rupture
   - c. Lung-rupture/perforation
     - i. Pneumothorax (simple)
       - (a) Mild decreased exchange
       - (b) No field treatment
       - (c) Observation
     - ii. Pneumothorax (tension)
       - (a) Marked decreased air exchange
       - (b) Signs and symptoms
         - (i) Unilateral absent breath
         - (ii) Deviated trachea
         - (iii) Distended neck veins
         - (iv) Cyanosis
         - (v) Decreased blood pressure and pulse changes
   - d. Flail chest
     - i. Paradoxical chest wall movement
     - ii. Pain-producing decreased chest expansion
     - iii. Pulmonary contusion
4. Assessment

a. Auscultation
b. Respiratory effort
c. Retraction
d. Abdominal/thoracic respirations
e. Exposure of chest
f. Technique of exam

5. Management
   a. Mechanisms
      i. Mouth-to-mouth
      ii. Mouth-to-mask
      iii. Bag-valve-mask
      iv. Esophegeal intubation device
      v. Endotracheal intubation
   b. Evaluation of effectiveness
      i. Chest movement
      ii. Auscultation
         (a) Left lung field
         (b) Right lung field
         (c) Stomach (espgastrium)
   c. Trauma
      i. Thoracic wall stabilization
         (a) Reduction of movement of flail segment
         (b) Methods of achieving
         (c) Limitations
      ii. Evacuation pleural space
         (a) Needle
         (b) Dart
      iii. Open chest wound
         (a) Hand occlusion
         (b) Vaseline gauze
         (c) Plastic taped on three or four sides

C. Circulation
   1. Profusion
      a. Anatomy
         i. Circulation
         ii. Heart
         iii. Thorax
         iv. Vascular system
      b. Pathophysiology
         i. Decreased perfusion
         ii. Cardiac arrest
      c. Evaluation
         i. Pulse
            (a) Rate
            (b) Character

See Division 3, Section 2

See Division 2, Section 4.

ii. Capillary refill
iii. Location of pulse
(a) Radial
(b) Femoral
(c) Carotid
iv. Skin color
(a) Pink
(b) Pale
(c) Cyanotic
(d) Mottled
d. Management
i. Cardiac compressions
ii. Hemorrhage
(a) anatomy
(i) Skin
(ii) Bone
(iii) Vessels
(iv) Subcutaneous fat
(b) Evaluation—massive hemorrhage versus minor hemorrhage
(c) Management
(i) Direct pressures
(ii) Tourniquets
(iii) Hemostats
D. Disability: Mini-neuro exam
1. Level of consciousness
a. A—Alert
b. V—Vocal stimuli response
c. P—Painful stimuli response
d. U—Unresponsive
E. Expose
1. Expose entire body for exam, limited only to environment, bystanders, and situation.

Resuscitation

A. Shock Resuscitation
1. Physiology
a. Shock-tissue anaerobic metabolism. The Fick Principle has two components.
i. Oxygenation of RBC
ii. RBC delivery to tissue cells
2. Evaluation
a. Heart rate
b. Diastolic pressure
c. Systolic pressure
d. Capillary refilling

(BP >80 mm Hg)
(BP >70 mm Hg)
(BP >60 mm Hg)

Any changes developed by the American Heart Association for Basic or Advanced Cardiac Life Support should be reflected in the objectives and outline of the instructor.

Hand, 4x4, and pneumatic splints are effective if correctly used. Ischemic distal to side. May force amputation at that point. Seldom if ever required.

Appropriately/ Inappropriately
Appropriately/ Inappropriately

The patient's modesty and comfort should be taken into consideration along with severity of possible injury when deciding when and where to expose the entire body.

If either of these components is not adequate, RBC will receive inadequate oxygen and be forced from aerobic to anaerobic.

e. Skin color
f. Skin temperature
3. Management
a. Oxygenation
b. Pneumatic antishock
c. Fluid replacement
B. Maintain stability of items in primary survey

Secondary Survey

A. Technique
1. Look
2. Listen
3. Feel
4. Smell
B. Regional Evaluation
1. Step-wise organized evaluation
2. Redefine priorities
C. Head
1. Skin, scalp
2. Eyes
3. Nose
4. Mouth
5. Bones
a. Facial
b. Mandible
c. Skull
D. Neck
1. Skin
2. Soft tissue
3. Trachea
4. Vessels
5. Cervical spine
E. Thorax
1. Skin
2. Chest wall
a. Bones
b. Muscles
3. Lungs
a. Auscultation
b. Palpation
4. Heart
a. Auscultation
b. Palpation
c. Electrocardiogram
F. Abdomen
1. Structures

Inspection
Auscultation
Palpation

Organized by body region.
Evaluate only those problems that are field treatable, that should be stabilized in the field or that will influence transportation.

a. Skin
b. Muscles
c. Peritoneal contents
d. Retroperitoneal
e. Lumbar spine
f. Pelvis
g. Genetalia

2. Technique
   a. Inspection
   b. Palpation
3. Objective

G. Extremities
   1. Structures
      a. Skin
      b. Soft tissue
      c. Vessels
      d. Bones
   2. Technique
      a. Inspection
      b. Palpation

H. Neurological
   1. Level of consciousness
   2. Seizure activity
   3. Motor
   4. Sensory
   5. Pupils
   6. Range of motion

I. Trauma Score
   1. Technique
      a. Capillary return
      b. Respiratory effort
      c. Eye opening
      d. Verbal response
      e. Motor response
   2. Significance

History

A. Chief complaint
   1. Verbal complaint
   2. Nonverbal complaint

B. Present illness
   1. Symptoms as related to chief complaint
   2. Associated symptoms
   3. Referred symptoms

C. History mnemonic
   1. A = Allergies

Evaluate only that which affects field management.

Deviation, swelling, discoloration. Range of motion, circulation, sensation, crepitation, bone deformation, pain.

At the time of the development of curricula, Trauma Scores are under revision. Consult current literature.

History obtained at appropriate opportunity.

AMPLE

Ample

TOPIC	CONTENT OUTLINE
	2. M = Medications 3. P = Past history 4. L = Last oral intake 5. E = Events leading up to emergency
Definitive Field Management	A. Packaging for transportation 1. Airway 2. Ventilation 3. IV fluids 4. PASG 5. Cardiac monitoring 6. Fracture stabilization 7. Bandaging 8. Immobilization to stretcher 9. Additional drugs prior to transport 10. Blood a. Glucose b. Samples for hospital i. Type and match ii. CBC iii. Chemistries 11. Extrication from emergency situation B. Loading 1. Placement of vehicle 2. Movement of patient into vehicle C. Transportation 1. Hospital a. Patient choice b. Closest appropriate 2. Speed a. Light and sirens b. Patient comfort c. EMT-P access to patient i. Re-evaluation ii. Treatment 3. Delay at scene for inappropriate evaluation/treatment should not occur D. Communication 1. Family 2. Patient reassurance 3. Medical control a. Medical command authority i. Physician ii. Nurse with physician backup b. Procedure i. Situation

aMple
amPle
ampLe
amplE

To be drawn based on local desires.

< than 5% occurrence.

This system enables the EMT-P and the physician at the hospital to objectively assess the severity of the patient's injury. This will provide appropriate transportation to the appropriate hospital where appropriate care is given en route and appropriate preparations made to receive and care for the patient and the hospital.

ii. Category
(a) Medical
(b) Trauma
(c) Behavioral
(d) OB/GYN
iii. Sex and age
iv. Chief complaint
v. Trauma score
vi. Brief present illness
vii. Physical findings
viii. AMPLE history
ix. Clinical impression
x. Treatment to present
xi. Requests further treatment
xii. Estimate time of arrival at hospital
4. Run report
a. Completeness
b. Medical/legal
c. Signatures

Re-evaluation

A. Need
1. Rapid change in condition
a. Continuing blood loss
b. Airway compromise
c. Decreased ventilation
2. Missed injuries
a. Poor environment for initial evaluation
b. Improved status of patient allows identification by additional areas of injury
3. Change in methods by life support as condition changed

B. Parameters
1. Airway
2. Ventilation
3. Pulse
4. Skin color
5. Blood pressure
6. Electrocardiogram
7. Neurological status
8. Circulation distal to fracture
9. Intravenous rate
10. Oxygenation
11. Lung sounds

ETA

Division 2: Preparatory

Section 3. Airway and Ventilation

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed all sections of: Division 1: Prehospital Environment Division 2: Preparatory Although emphasis has been placed on airway management in the specific segments of the first curriculum as well as this one, as to the methods of airway management, extra training and time should be allotted as lack of adequate airway and ventilation is the major cause of non-survival and/or neurological, cardiac and pulmonary complications of both medical and trauma prehospital disease processes. Management of almost any medical emergency requires adequate oxygenation, according to the Fick Principle is dependent upon two parameters: 1. Red blood cell oxygenation; 2. Delivery by the red blood cells to the tissue and off-loading of the oxygen. This section will address the first step, that of oxygenation of the red cell. Since it is impossible to measure red cell oxygenation in the prehospital setting, the outcome of that process will be addressed. This is identified by color of the skin and by the function (or lack of function) of the specific organ in question. (For example, level of consciousness and cerebration of the patient or cardiac rage, rhythm and if available, EKG). Short of evaluating organ function, which also requires oxygenated red cell delivery, adequacy of air movement into the lungs is another method of checking on the completeness of ventilation. If any specific areas of inadequacy in prehospital care could be identified, these would be: 1. Lack of mask/face seal 2. Inadequate volume of pulmonary ventilation 3. Delay time in instituting airway management (or during the change of methods, e.g., B.V.M. ventilation to ventilation via ET tube) 4. Low FiO_2 These and other airway ventilation parameters will be addressed in this section. Before starting this section, the student should have completed the following sections: General Patient Assessment and Management.
Overview	I. Introduction II. Airway Anatomy and Physiology III. Assessment IV. Management V. Ventilation VI. Suction
Objectives	At the conclusion of this lesson, the student will be able to: 2.3.1 Describe anatomy of the mouth, hypopharynx, trachea, larynx. 2.3.2 Describe the relationship between: a. Cords and larynx b. Esophagus and larynx c. Epiglottis and larynx d. Tongue and larynx e. True cords and false cords

f. Pharynx and larynx

2.3.3 Describe laryngoscope, suction, endotracheal tube and bag-valve mask

2.3.4 Discuss indications and contraindications of endotracheal intubation

2.3.5 Discuss alternatives to endotracheal intubation

2.3.6 Discuss skill deterioration and methods of prevention.

2.3.7 Discuss need for rapid placement of ET tube

2.3.8 Discuss methods of assuring and maintaining correct placement of ET tube

2.3.9 Demonstrate ventilation with bag-valve-mask.

S2.3.10 Demonstrate placement of ET tube (45 seconds).

S2.3.11 Demonstrate ventilation with bag valve and endotracheal tube

S2.3.12 Demonstrate method by assuring and maintaining correct placement of ET tube.

S2.3.13 Demonstrate reventilation for missed intubation.

S2.3.14 Demonstrate skills described above both on mannikin and live patient.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Introduction	A. Need for oxygenation B. Major prehospital causes of death C. Most neglected of prehospital skills D. Fick Principle (Aerobic Metabolism = RBC Oxygenation + RBC Delivery)

Airway Anatomy and Physiology

Anatomy of Upper Airway

A. Nasopharynx
   1. Nares
   2. Cartilage
   3. Nasal bones
   4. Maxilla
   5. Vascular supply

B. Oropharynx
   1. Lips
   2. Cheeks
   3. Tongue
   4. Hard palate
   5. Soft palate
   6. Tonsillar pillows
   7. Teeth
   8. Vascular supply
   9. Mandible
   10. Mandible tongue relationship and association

C. Hypopharynx
   1. Epiglottis
   2. Tongue—epiglottis relationship
   3. Posterior pharyngeal wall
   4. Lateral pharyngeal wall
   5. Anterior pharyngeal wall
   6. Pyriform sinus

D. Larynx
   1. Thyroid cartilage
   2. Cricothyroid cartilage
   3. Trachea
   4. Esophagus
   5. Trachea—esophagus relationship
   6. Vocal cords
   7. Arytenoid folds

Anatomy of Lower Airway

A. Trachea
   1. C-shaped, incomplete rings
   2. 10-12 centimeters
   3. Respiratory epithelium contains ciliated and mucus producing cells

4–5 inches long

B. Right and left mainstem bronchi
   1. Carina
   2. Length and position of bronchi
C. Secondary bronchi
D. Bronchioles
E. Respiratory bronchioles (contain only connective muscular tissue)
F. Alveolar ducts
G. Alveolar sacs
H. Alveoli
   1. Most important functional unit of system
   2. O_2, CO_2 exchange occur
   3. Hollow, thin-walled
   4. Capillary system covers the outer surface via terminal branches of the pulmonary artery
I. Lungs
   1. Comprised of the respiratory bronchioles and alveoli
   2. Position in thoracic cavity
   3. Visceral pleura
   4. Parietal pleura
   5. Pleural space
   6. Right lung
      a. Upper lobe
      b. Middle lobe
      c. Lower lobe
   7. Left lung
      a. Upper lobe
      b. Lower lobe
   8. Blood supply
      a. Pulmonary artery and veins
      b. Bronchial artery and veins

Mechanics of Respiration/ Ventilation

A. Definition
   1. Respiration—exchange of gases between a living organism and its environment
   2. Pulmonary ventilation— process that moves air into and out of the lungs
B. Respiratory cycle
   1. Involves respiratory system, central nervous system, musculoskeletal system
   2. Begins from midpoint or position of thorax after a normal expiration; air pressure inside lungs is equal to atmospheric pressure
   3. Inspiration
      a. Initiated by contraction of diaphragm and intercostal muscles
      b. Flattening of diaphragm toward the abdomen with resulting increase in the vertical dimensions of the thoracic cavity

Oxygen and carbon dioxide across membranes.

c. Elevation of the ribs upward and outward to increase the horizontal and transverse dimension of the thoracic cavity
d. The highly elastic lungs assume the contour change resulting in larger lung dimensions
   i. The same air volume in the lung occupies a larger space
   ii. Air pressure in the lung decreases rapidly
   iii. Air flows in through respiratory passage since pressure in the airways is less than atmospheric pressure

4. Expiration
   a. Occurs as inspiratory muscles relax
   b. Decreasing thoracic volume and increasing intra-thoracic pressure
   c. Air is thereby forced out of the lungs
   d. Normal expiration is a passive process
5. In respiratory inadequacy accessory muscles aid inspiration and expiration
   a. Abdominal wall muscles
   b. Neck muscles

C. Pulmonary circulation
1. Body cells take oxygen from the blood (arterial system) and return carbon dioxide to the blood (venous system)
2. The venous system returns oxygen-poor, carbon dioxide-rich blood to the right side of the heart
3. The right ventricle pumps that blood into the pulmonary artery
   a. The artery bifurcates into left and right bronchi supplying the respective lungs
   b. Both branches rapidly split into smaller vessels and eventually into microscopic pulmonary capillaries that:
      i. Spread over the surface of the air sacs, where the blood picks up oxygen
      ii. Recombine into sequentially larger vessels forming the pulmonary veins
4. Pulmonary veins empty into the left atrium and then into the left ventricle from which oxygen-rich blood is pumped and circulated through the systemic arterial system

D. Gas exchange in the lungs
1. Process opposite to that normally occurring in the body, i.e., blood returning from the body is low in oxygen, high in carbon dioxide
2. Measurement of oxygen and carbon dioxide
   a. Definition
      i. Partial pressure describes the amount of gas in a mixture
         (a) Sum of all gases present must equal the total gas pressure
         (b) Any partial pressure of any one gas is a fractional concentration of the total gas mixture
   b. Total gas pressure (sea level) equals atmospheric pressure or 760 mmHg
      i. Torr equals 1 mmHg

Above atmospheric pressure.

ii. One atmosphere equals 14.7 lb/sq. in.

c. Concentrations

i. Room air equals 21% oxygen and 0.03% carbon dioxide

ii. Breathing room air produces PO_2 (PaO_2) of 140 torr and PCO_2 ($PaCO_2$) close to zero in the alveoli

iii. Venous blood from tissues contains PO_2 of 40 torr and PCO_2 of 46 torr

iv. Room air also contains 79% nitrogen

(a) No metabolic function

(b) Necessary for maintaining inflation of body cavities that are gas filled

d. Diffusion

i. Gases diffuse from areas of higher partial pressure concentrations to areas of lower partial pressure concentrations

ii. Rate of gas diffusion across pulmonary membranes depends on solubility in water

iii. Oxygen diffuses into blood plasma and combines with hemoglobin

(a) Each gram of saturated hemoglobin carries 1.34 ml of O_2

(b) Hemoglobin is close to being fully saturated at PO_2 of 50-100 mHg

(c) Normal arterial PO_2 (sea level) is 80-100 mmHg

e. Carbon dioxide concentrations

i. Carried as:

(a) 66% bicarbonate

(b) 33% combines with hemoglobin

(c) Small amount dissolves in plasma

ii. Arterial PCO_2 35-40 torr

E. Regulation of respiration

1. Voluntary control vs. involuntary control

a. Action is mainly involuntary

b. Chemical, physical and nervous reflexes monitor body oxygen needs

2. Respiratory center located in the brainstem (pneumotaxic center)

a. Nerve impulses sent to the diaphragm and intercostal muscles

b. Inspiration initiated

3. Microscopic stretch receptors (located in the lung and pleura) stop inspiration

a. Inspiratory stretching activates the stretch receptors

b. Nerve impulses follow afferent pathways and return to the brainstem

c. Inspiratory act is curtailed, allowing elastic recoil of the lung

d. Stretch receptors of the lung cease to send impulses to the brainstem

CO_2 is 21 times more soluble in water than O_2.

e. The cycle begins again with inspiratory impulses originating in the brainstem

4. Regulation by chemoreceptors
   a. Central chemoreceptors located in the medulla: peripheral chemoreceptors located in the aortic arch and carotid bodies
   b. Chemoreceptors are stimulated by increased PO_2, decreased PCO_2 or decreased pH
5. Carbon dioxide concentration in the blood results in a decrease or increase in respiratory activity
   a. High CO_2 concentration increases respiratory activity
   b. Low CO_2 concentration decreases respiratory activity
   c. Hypoxemia is the most profound stimulus to respiration in the normal individual
6. Hypoxic drive
   a. Individuals with chronic respiratory disease have decreased ability to eliminate CO_2 and respiratory centers accomodate to high PCO_2 levels
   b. Respiratory rate and depth respond to PO_2 levels below 60 torr
   c. Dominant control of respiration in these individuals are changes in PO_2

F. Modified forms of respiration
1. Coughing—forceful exhalation of a large volume of air; serves protective function
2. Sneezing—a sudden forceful exhalation from the nose, usually caused by nasal irritation
3. Hiccough—sudden inspiration caused by spasmodic contraction of the diaphragm, serves no useful purpose
4. Sighing—slow, deep inspiration followed by prolonged expiration, hyperinflates lungs reexpanding atelectasic areas

G. Measures of respiratory function
1. Respiratory rate
   a. Normal adults, 10-14 per minute
   b. Infants, 40-60 per minute
   c. Children, 24 per minute
2. Factors affecting respiratory rate
   a. Fever—increases
   b. Anxiety—increases
   c. Insufficient oxygen—increases
   d. Depressant drugs—decreases
   e. Sleep—decreases
3. Lung capacity—adult male, 6 liters
4. Tidal volume—volume of gas inhaled or exhaled during a single respiratory cycle—500 cc normally
5. Dead space air—air remaining in air passageways, unavailable for gas exchange—approximately 150 cc
6. Alveolar air—the air reaching the alveoli for gas exchange—approximately 350 cc

Expirations against partially closed glottis in neonates

7. Minute volume—the amount of gas moved in and out of the respiratory tract per minute. Determined by:
    a. The tidal volume times
    b. The respiratory rate
8. Vital capacity—forced exhaled volume

H. Factors altering carbon dioxide levels in the blood
1. Arterial carbon dioxide ($PaCO_2$) represents a balance between CO_2 produced during metabolism and CO_2 eliminated through respiration
2. Causes of elevated $PaCO_2$
    a. Increased CO_2 production
        i. Fever
        ii. Muscular exertion
        iii. Shivering
        iv. Metabolic processes resulting in formation of acids
    b. Decreased CO_2 elimination (hypoventilation)
        i. Respiratory suppression by drugs
        ii. Airway obstruction
        iii. Mechanical problems
3. Cause of decreased $PaCO_2$—hyperventilation

I. Factors altering oxygen levels in the blood
1. Causes of decreased oxygen levels in the blood
    a. Fluid in alveolar interstitial spaces
    b. Alveolar collapse causing atelectasis
        i. I.e., pneumothorax
        ii. Poor coughing
    c. Shunting—blood flow to nonfunctional alveoli
2. Management
    a. Supplemental oxygen
    b. Intermittent positive pressure ventilation (IPPV)

PATHOPHYSIOLOGY

A. Obstruction
1. Tongue
    a. Accluding posterior pharynx
    b. Most common cause of obstruction
2. Foreign body
    a. Aspirated while eating
    b. From mouth
        i. Loose teeth
        ii. Child "eating" inanimate object
    c. Trauma
        i. Facial bones
        ii. Teeth
        iii. Nasal bones
        iv. Clotted blood
3. Laryngeal spasm

a. Cord edema
d. Cord spasm
4. Fractured larynx
a. Non-support of cords
b. Collapse into tracheal/laryngeal lumen

B. Aspiration
1. Vomitus
2. Blood
3. Liquid drink

C. Inadequate ventilation
1. Rate
a. Hyperventilation
b. Hypoventilation
2. Depth
a. Shallow
b. Deep
3. Trauma
a. Fail chest
b. Open pneumothorax
c. Other obstructions
4. Disease
a. Chronic obstructive pulmonary disease
b. Asthma
c. Other

Assessment

Visual Techniques

A. Rise and fall of chest
B. Color of skin
C. Flaring of nares
D. Retraction
1. Intracostal
2. Suprasternal notch
3. Supraclavicular fossa
4. Subcostal

Auscultation Techniques

A. Air movement at mouth and nose
B. Bilateral lung field
1. Most accurate method
2. Anterior and lateral chest wall
a. Excellent for pneumothorax
b. Experience necessary to prevent confusion of tracheal sounds from paryenchymal sounds

Palpation Techniques

A. Air movement at mouth and nose
1. Back of hand

Viral pneumonia

Listen

Feel

2. Cheek

B. Chest wall
   1. Direct palpation
   2. Practice required

C. Bag
   1. Rate of emptying
   2. Compliance of lungs
   3. Air leak (no resistance)

D. Pulse Technique
   1. Tachycardia occurs with hypoxemia
   2. Bradycardia—severe anoxia cardiac arrest imminent

History Technique

A. Past medical history

B. History of present complication

C. Mechanism of injury

Management

Manual

A. Chin lift
   1. Thumb on anterior mandible
   2. Index finger on inferior mandible
   3. Anterior traction lift

B. Jaw-lift
   1. Thumb on lower incision
   2. Index finger on inferior mandible
   3. "Thrust" jaw anteriorly

C. Jaw-Thrust
   1. Two hands
   2. Thumbs on zygoma bilaterally
   3. Fingers beneath symphysis of mandible
   4. "Thrust" jaw anteriorly

D. Head tilt
   1. Head hyperextended backward
   2. Hand on forehead
   3. Hand on cervical neck-left
   4. Should not be done on trauma patient

Mechanical

A. Nasal airway
   1. Description of devices
      a. Length 17-20 cm
      b. Diameter 20-36 french
      c. Gentle curve
      d. Flair at outer end
   2. Advantages
      a. Rapid insertion

Without changing neutral neck position

Without changing neutral neck position

Without changing neutral neck position

Not on trauma patient

b. Bypasses tongue
c. May be used when gag reflex present

3. Disadvantages
   a. Small size
   b. May not go behind tongue
   c. Difficult to insert if nasal damage (old or new) present
   d. Does not isolate trachea
   d. Difficult to suction through
4. Method
   a. Insert into nares
   b. Convex side caudad
   c. Gentle pressure
   d. If unable to pass use other nares
   e. Do not force

B. Oral airway
1. Description of device
   a. Length
   b. Shape
      i. Hollow oblong cylinder
      ii. "H" shape
   c. Gentle curve
   d. Flair on outside end
2. Advantages
   a. Holds tongue forward and down
   b. Large suction will pass on either side
   c. Effective bite block
      i. Convulsions
      ii. Protection for ET tube
3. Disadvantages
   a. Does not isolate trachea
   b. May obstruct airway with tongue if not properly inserted
   c. Cannot be inserted when:
      i. Gag reflex present
      ii. Teeth tightly clenched
4. Size selection
   a. Device measurement
      i. Corner of mouth
      ii. Tip of earlobe
5. Method
   a. Straight insertion
      i. Convexity caudad
      ii. Tongue blade pushes tongue caudad and anterior
      iii. Airway slips along tongue into hypopharynx
   b. Reverse insertion
      i. Convexity cephalad

ii. Airway inserted gently to soft palate
iii. Airway rotated 180 degrees into hypopharynx
c. Evaluate placement
i. Air movement from mouth
ii. Skin color
iii. Pulse
iv. Auscultation

C. Espohageal intubation device
1. Description of device
a. Approximately 15 inches flexible tube
b. Mask adaptor at proximal end
c. Closed distal end
d. Detachable face mask
e. Mask has one port
f. Perforations in upper third of tube
2. Necessary equipment
a. 35 cc syringe
b. Lubricant
c. Bag-valve-mask or Demand valve
d. Oxygen source with O_2 tubing
e. Suction equipment/device
f. Stethoscope
g. Oral airway
3. Advantages
a. Rapid insertion
b. Prevents regurgitation/aspiration
c. High concentration O_2 delivery
d. Blind insertion
e. Allows endotracheal intubation placement
f. Requires less training than endotracheal intubation
g. Insertion without neck flexion/hyperextension
4. Disadvantages
a. Requires patient to be unresponsive/gag reflex absent
b. Removal when patient becomes responsive
c. Esophageal laceration
d. Tracheal intubation
e. Used for short periods of time
f. Requires tight seal with mask
5. Contraindication
a. Known/suspected esophageal disease
b. Caustic poisoning ingestion
c. Gag reflex present
d. Height under 5.0 feet/over 7.0 feet
6. Insertion method
a. Suction equipment/device available

5–20 seconds

2.0 hours

Esophageal varices, esophageal strictures or diverticuli

b. Test balloon cuff/inlet port integrity
c. Assemble mask and tube
d. Lubricate tube
e. Maintain patient's head in neutral position
f. Preoxygenate
g. Grasp tongue and lower jaw and pull forward
h. Advance tube into esophagus until mask flush against face
i. Establish mask seal
j. Auscultate lung fields bilaterally with oral ventilation
k. Auscultate over epigastrium
l. Inflate 35cc cuff if positioned properly
m. Ventilate and check for chest rise
n. Reauscultate lung fields bilaterally/epigastrium
o. Reoxygenate

7. Removal method
    a. Not indicated in the field with unconscious patient
    b. Have suction available/working
    c. Turn patient on side
    d. Detach mask from tube
    e. Deflate cuff
    f. Gently and quickly remove tube
    g. Expect regurgitation
    h. Suction oropharynx/mouth well
    i. Assess respiratory status
    j. Oxygenate

D. Esophageal gastric tube
1. Description of device
    a. Modification of esophageal obturator
    b. Approximately 15 inch flexible tube
    c. Mask adaptor at proximal end
    d. Mask has two ports
    e. Distal end of tube has one-way valve
    f. Interior accomodates nasogastric tube
2. Necessary equipment
    a. Same equipment as esophageal obturator
    b. Nasogastric tube
3. Advantages
    a. Same as esophageal obturator
    b. Permits passage of nasogastric tube
    c. Permits gastric decompression
4. Disadvantages
    a. Same as for esophageal obutrator
    b. Requires suction equipment application
5. Contraindications
6. Insertion method

Chin-lift, maneuver, do not force

15–20 seconds maximum time lapse for insertion between ventilations

If patient intubated, turning is not necessary

Ventilation and suction ports

Further reduces opportunity for regurgitation

Same as for esophageal obturator device

a. Same as for esophageal obutrator
b. Measure proper length of nasogastric tube
c. Lubricate end of nasogastric tubing
d. Preoxygenate patient
e. Insert to measured length
f. Reoxygenate
g. Apply suction to nasogastric adaptor

7. Removal method
a. Same for esophageal intubation
b. Expect regurgitation/suction
c. Reassess respiratory status
d. Oxygenate

E. Pharyngeal Tracheal Multiple Balloon System

F. Endotracheal intubation (ET)

1. Device description
a. Endotracheal tube
i. Flexible tube
ii. Balloon cuff on distal end
iii. 15 mm adaptor on proximal end
iv. Tube length proportioned to internal diameter

2. Necessary equipment
a. Laryngoscope/blade
i. Used to expose glottis
ii. Interchangeable handles
iii. Curved blades placed in vallecula
iv. Straight blades placed under epiglottis
v. Light on blade or handle
vi. Traction is extended upward on handle
b. Stylet
i. Flexible/malleable
ii. Types of construction
iii. ET conforms to desirable configuration
iv. Tip recessed at least 2 cm from tip of ET
v. Right angle hook over adaptor end
vi. Lubricate to assure removal
c. Magell forceps
i. Scissor style clamp
ii. Circle shaped tips
d. Suction
i. Flow rate
ii. Mechanism of creating suction
iii. Types
e. Bag-Valve-Device
i. Attachment to ET tube adaptor
ii. Accumulator

Extend tubing from tip of nose to ear lobe to xiphoid. Note proper length

This device has not been adequately researched at the time of this curriculum.

Childen up to 8 years w/o cuff

Average adult takes 8 mm ET

Hockey stick

Removed foreign bodies

Patient must be adequately hyperventilated prior to intubation attempt

iii. Methods of squeezing bag
iv. Construction and cleaning of valve

f. Mask
   i. Construction
   ii. Face mask seal
   iii. Connection to valve

g. Lubricant
h. Stethoscope
i. Oral airway
j. Syringe
k. Oxygen source/tubing

3. Advantages
   a. Complete control of airway
   b. Prevents aspiration
   c. Intermittent positive pressure
   d. Tracheal suctioning
   e. Prevents gastric distention
   f. High volume ventilation
   g. Medication administration
   h. Placement around esophageal intubation devices

4. Disadvantages
   a. Requires training/experience
   b. Requires direct visualization
   c. Requires equipment
   d. Tissue damage
   e. Esophageal intubation
   f. Laryngospasm upon attempt
   g. Intubation of pyriform sinus
   h. Foreign body
   i. Delays in oxygenation prior to success

5. Contraindications
   a. Trauma: hyperextension of flexion required
   b. Prolonged attempt increases hypoxemia

6. Method of insertion
   a. Establish ventilation
      i. Mouth to mask
      ii. Bag-valve-mask
      iii. FiO_2 0.90-1.0
      iv. Assure adequate ventilation
         (a) Chest rise
         (b) Auscultation lungs
         (c) Auscultation stomach
         (d) Color
   b. Estimate correct ET size
      i. Adult

Used as bite block

Vocal cords, trachea, teeth, clips, pharynx

Foreign body must be removed

Neutral positioning AHA/ ACLS 15–20 second for attempt

90–100% oxygen

- ii. Pediatric
- c. Check balloon
  - i. Inflation
  - ii. Leaks
  - iii. Inlet port integrity
- d. Hyperventilate patient with bag-valve-mask (BMV)
- e. Position head and neck
  - i. Non-trauma
    - (a) "Sniffing" position
    - (b) Flex at C5 C6
    - (c) Extend at C1 C2
  - ii. Trauma
    - (a) Inline stabilization by partner
    - (b) Maintain neutral position
    - (c) Mandible and tongue only move during intubation
    - (d) Patient frequently flat on ground or asphalt
    - (e) Proper body position of the EMT-P to see cords with patient on the ground
- f. Remove B.V.M
- g. Insert laryngoscope, right side of mouth, tongue to the left
- h. Visualize epiglottis, larynx, and vocal cords
  - i. Lift tongue and mandible with scope
  - ii. Do not rotate scope
  - iii. Do not touch teeth with scope
  - iv. Pressure on larynx sometimes helpful
- i. Insert ET tube between cords, visulalize passage
- j. Remove laryngoscope
- k. Connect bag valve to ET adaptor
- l. Ventilate lungs
  - i. Assure chest rise
  - ii. Auscultate lungs
  - iii. Auscultate stomach
- m. Inflate cuff
- n. Secure tube to head and face
- o. Reassess lungs sounds/epigastrium
- p. Continue ventilation
- q. Return to B.V.M. ventilation when
  - i. ET tube in esophagus
  - ii. No breath sounds in lungs
  - iii. Air into stomach
  - iv. Unable to get ET tube in place
- r. Suction may be necessary
- s. Breath sounds on right only
  - i. Auscultate

5–10 seconds
hyperventilation

Prone or straddling patients
head

Upper incisor

Stylette may be necessary
for insertion of ET.

AHA/ACLS 15–20 seconds
placement time

ii. Withdraw tube slowly until breath sounds heard on laryngescope

t. Removal

i. Spontaneous respirations
ii. Patient intolerance of tube
iii. Gag reflex present
iv. Suction available
v. Deflate cuff completely
vi. Withdraw on inspiration
vii. Suction airway
viii. Assess respiratory status
ix. Oxygenate patient

Ventilation

A. Mouth to mouth

1. Benefits
   a. No equipment required
   b. Immediate ventilation
2. Limitations
   a. Difficult to clear obstruction
   b. Disease
   c. Training required
3. Method of administration
   a. Mouth to mouth
   b. Mouth to nose
   c. Mouth to stoma

B. Mouth to mask

1. Construction
   a. Pocket type flexible mask
   b. Oxygen port
2. Benefits
   a. Ease of use
   b. Rapid oxygenated ventilation
3. Limitations
   a. Inadequate seal
   b. Training required
4. Method of use
   a. Position of patient
   b. Open/clear airway
   c. Oxygen applied
   d. Position mask/seal

C. Bag-valve-mask

1. Construction
   a. Bag with one-way valve and mask
   b. Oxygen port
2. Benefits

Not indicated in field unless

For this section review current American Heart Association ACLS standards

a. High oxygen concentration delivery
b. Provides positive pressure ventilation
c. Assists slow respiratory rates

3. Limitations
    a. Training/skill
    b. Difficult to use
    c. Inadequate seal
4. Method of use
    a. Position patient
    b. Open clear airway
    c. Placement oral pharyngeal airway
    d. Oxygen source attached
    e. Position mask on face
    f. Create seal
    g. Grasp mask between web of thumb and fingers
    h. Fingertips grasp mandible
    i. Deflate bag, manually squeezing

D. Demand valve
1. Benefits
    a. Connects to mask, ET or esophageal intubation device
    b. Provides 100% oxygenation
    c. Can ventilate past minor obstruction
    d. Ease of operation
    e. Slight inspiratory triggering
2. Limitations
    a. Gastric distension
    b. Non-humidified oxygen
    c. Potential pulmonary rupture
    d. Adult patients only
    e. Dependent on oxygen source
    f. Compliance of lungs not detectable
    g. Effectiveness gauged by chest expansion only
    h. Inspiratory volume control
3. Method of administration
    a. Explain to conscious patient
    b. Appropriate mask size
    c. Position head
    d. Seal mask
    e. Manually/automatic triggering
    f. Assess chest rise
    g. Expiration passive

D. Evaluation of effectiveness
1. Chest movement
2. Auscultation
    a. Left lung field

b. Right lung field
c. Stomach (epigastrium)

Suction

A. Airway
B. Physiology (See airway and ventilation)
C. Pathophysiology
  1. Vomitus
    a. Contents
      i. Partially digested chunks of food
      ii. Protein dissolving enzymes
      iii. Hydrochloric acid
    b. Results
      i. Increased interstital fluid
      ii. Obliteration of Alveolae
      iii. Marked increased alveolar-opillary distance partial aeroation of segments of extracting O_2 or off-loading CO_2
      iv. Bronchular obstruction by food particles
      v. Several types of respiratory initiators
      vi. 50%–80% probability rate
  2. Saliva
    a. Contents
      i. Digestive enzymes for starches
    b. Results
      i. Fill alveolus
      ii. Reduction of alveolar for ventilation
  3. Food
    a. Contents
    b. Results
  4. Blood
    a. Contents
      i. Protein
      ii. Fibrin
      iii. Water
      iv. Electrolytes
    b. Results
      i. Clogging of alveolar and bronchae
      ii. Chemical reaction to hypertonic fluid
D. Assessment
  1. Visualization
  2. Auscultation
    a. Lungs
    b. Trachea
E. Management
  1. Whistle-tip suction
    a. Construction

See airway

Varies
Large particles obstruct airways

Presence of liquid and solid particles in hypopharynx and mouth

i. Flexible tube
ii. Thumb hold

b. Advantages
i. Small
ii. Easy to use

c. Disadvantages
i. Unable to move large volumes of fluid quickly
ii. Unable to retrieve even small food particles
iii. Long suction periods will deplete inspired O_2 available for the lungs

d. Method
i. Insert into:
(a) Nasal airway or endotracheal tube
(b) Close side hole with thumb
(c) Aspiration for 20 seconds while removing tube slowly
ii. Insert beside oral airway
(a) Use above technique

2. Tonsil tip suction
a. Construction
i. Rigid
ii. Large tip

b. Advantages
i. Large size
ii. Can remove food particles that are sucked onto tip

c. Disadvantages
i. Size will only fit beside oral airway
ii. Vigorous insertion can produce lacerations or other injuries to oropharynx

d. Method
i. Insert along side of oral airway into mouth and back into hypopharynx
ii. Slowly remove while suction still activated to remove large particles

Division 2: Preparatory

Section 4. Pathophysiology of Shock

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment (All sections) Division 2: Preparatory Sections 1-3 Shock or lack of cellular oxygenation, its understanding and its management is the essence of all patient care. If treatment performed inadequately or too late, the patient will die immediately from cardiac failure or in a few days to a few weeks from other organ failure such as lung, kidney or liver, or may survive but without brain function. The problem is not mystic either in etiology, pathophysiology or management, but the EMT must understand it and make this understanding work for him, not against him. For example: At times the best treatment may be airway, fluids, Pneumatic AntiShock Garment (PASG) and rapid transportation to a hospital. At other times this may be intensive on the scene care.
Objectives	At the completion of this section, the student will be able to: 2.4.1 Define shock based on aerobic and anaerobic metabolism. 2.4.2 Define management based on the Fick Principle. 2.4.3 Discuss the prevention of anaerobic metabolism. 2.4.4 Discuss red blood cell oxygenation in the lungs based on alveolar O_2 levels and transportation across the alveolar capillary wall. 2.4.5 Discuss tissue oxygenation based on tissue profusion and off-loading of oxygen. 2.4.6 Discuss the role played by respiration, inadequate ventilation in the management of shock. 2.4.7 Describe perfusion and the mechanisms of improvement of cardiac output based on the strength and rate of contractions. 2.4.8 Discuss the role of preload in improving cardiac output. 2.4.9 Discuss the fluid component of the cardiovascular system and the relationship between the volume of the fluid and the size of the container. 2.4.10 Discuss afterload (systemic vascular resistance), the relationship of diastolic pressure to the SVR and the effect of diastolic pressure on coronary circulation. 2.4.11 Discuss the container size in its relationship to the fluid volume and the effect on pre-load. 2.4.12 Discuss body fluids based on total body water, intracellular fluid, and extracellular fluid. 2.4.13 Identify the significant anions and cations in the body. 2.4.14 Describe the role of protein. 2.4.15 Discuss osmosis. Define semi-permeable membranes, and discuss their function. 2.4.16 Define isotonic fluids, hypotonic fluids, and hypertonic fluids. 2.4.17 Define and discuss diffusion. 2.4.18 Define active transport. 2.4.19 Describe the mechanisms of concentration of electrolytes.

2.4.20 Define Acid-Base balance.
2.4.21 Discuss Acid-Base balance based on hydrogen ion concentration, pH, buffer systems.
2.4.22 Define and discuss the following:
a. Respiratory acidosis.
b. Respiratory alkalosis.
c. Metabolic acidosis.
d. Metabolic alkalosis.
2.4.23 Describe the mechanism of the body response to perfusion change.
2.4.24 Identify the role of the baroreceptor.
2.4.25 Describe how the actions of the baro-receptor affect blood pressure and perfusion.
2.4.26 Describe compensated shock.
2.4.27 Describe uncompensated shock, both cardiac and peripheral effects.
2.4.28 Describe how anaerobic metabolism at the cellular level can lead to death several days later.
2.4.29 Discuss the effects of decreased perfusion at the capillary level, both on the capillary lining as well as the cell; include a discussion of increased interstitial fluid.
2.4.30 Describe the three phases in the capillary cellular relationship (ischemia, stagnant, and washout).
2.4.31 Discuss the evaluation of the patient's perfusion status, based on physical observations within the primary survey, including pulse, skin, temperature, capillary refill.
2.4.32 Discuss the relationship of the neurological exam to evaluation of hypoperfusion and oxygenation.
2.4.33 Describe the information provided by the following in physical examination: pulse, blood pressure, diastolic pressure, systolic pressure, skin color, appearance, temperature, and respiration.
2.4.34 Discuss resuscitation of a shocky patient. Include red cell oxygenation, tissue ischemic sensitivity, IV fluids, the Pneumatic Anti-Shock Garment.
2.4.35 Describe the beneficial and detrimental effects of the Pneumatic Anti-Shock Garment.
2.4.36 Describe the indication and contraindications for the Pneumatic Anti-Shock Garment.
2.4.37 Discuss fluid replacement, the types of fluid that are available, the benefits and detrimental effects of each.
2.4.38 Discuss how fluid replacement is monitored and controlled.
2.4.39 Discuss the routes of fluid replacement and the advantages and disadvantages of each.
S2.4.40 Demonstrate in order of priority the steps of shock resuscitation.
S2.4.41 Demonstrate the use of the Pneumatic AntiShock Garment
S2.4.42 Describe the indications and contraindications of the Pneumatic Anti-Shock Garment and how it affects the patient in each.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Definition	A. Parameters of measurement are not an adequate definition 1. Blood pressure, pulse or respiration B. Inadequate cellular oxygenation produces anaerobic metabolism. Anaerobic metabolism equals shock. Fick Principle = Tissue Oxygenation = (RBC O_2 On-loading) + Tissue Perfusion (RBC Transportation) 1. Aerobic metabolism (prevention of anaerobic metabolism) is dependent upon: a. RBC oxygenation i. Alveolar O_2 levels (a) Airway (b) Ventilation (c) FiO_2 b. Transport to RBC, transport across alveolar/capillary wall. This is dependent on no edema to reduce passage, presence of RBC in capillary and ventilation of the alveolus 2. Tissue oxygenation a. Adequate number of RBC b. Adequate tissue perfusion c. Adequate off-loading of oxygen
Physiology of Perfusion	A. Pump (heart output or effectiveness is dependent on three components) 1. Strength of contractions 2. Rate of contractions 3. Preload (volume and pressure available to atrium for cardiac pumping) B. Fluid 1. Preload 2. Fluid volume 3. Afterload (resistance to pumping of blood throughout the system). Systemic vascular resistance (SVR) is another name for this component. The diastolic pressure is an estimate of SVR and is a measurement of afterload. The amount of back pressure during diastole also determines the flow of blood through the coronary circulation C. Container 1. Fluid volume versus container size a. 5 liter container vs 5 liters of fluid = full container (good preload) b. 5 liters container vs 3 liters of fluid = partially full container (inadequate preload) c. 3 liter container vs 3 liters of fluid = full container (good preload) d. 7 liter container vs 5 liters of fluid = partially full container (inadequate preload) D. Cellular Physiology 1. Body fluids a. Total body water 60% adult weight divided into two components:

Volume/size of container.

Standard normovolemic adult.

Hypovolemic Adult. Blood loss from acute hemmorhage or severe dehydration.
Hypovolemic adult with reduced cardiovascular volume (relative normovolemia)

Increased intravascular space with standard volume of fluid i.e., septic shock (relative hypovolemic).

(TBW)

   i. Intracellular fluid inside the cell membrane—40% body weight
   ii. Extracellular fluid outside the cell—20% body weight
2. Electrolytes (salt) ions
   a. Cations (positive charge) sodium (NA+) potassium (K+) calcium (CA++)
   b. Anions (negative charge) cloride (CL-) bicarbonate (HCO_3-)
3. Protein
   a. Albumin
   b. Plasma
   c. Lymph
   d. Other
4. Osmosis
   a. Semipermeable membrane
      i. Water, freely interchangable on both sides
      ii. Electrolytes cannot actively cross to other side
      iii. Water crosses to equalize the concentration—higher concentration pulls fluid from lower concentrations,
   b. Isotonic fluids. Osmotic pressure is equal to normal body fluid
   c. Hypotonic. Osmotic pressure less than that of normal body fluids
   d. Hypertonic. Osmotic pressure greater than that of normal body fluids
5. Diffusion. Solute molecules can cross membranes but at a slower rate than water.
6. Active transport
   a. Larger molecules can be moved across membranes
   b. Molecules can move toward higher concentrations
   c. Energy is required
   d. Faster than diffusion
7. Concentration of electrolytes
   a. Water follows sodium
   b. Potassium (K+) is the chief intracellular ion
   c. Sodium (NA+) is the chief extracellular ion
   d. Changes in ion concentrations affect skeletal and cardiac muscle cells' ability to function (K+,CA+,Mg+)
8. Acid-Base balance
   a. Definition: Concentration of hydrogen ions in body fluids [H]+
   b. pH expression of [H+] (hydrogen ion cone)
   c. pH = Negative log of hydrogen ion concentration [H+] = 10 (-7) pH = -(-7) = 7 normal pH in body fluids is 7 7.40+ 0.5 = 7.35 to 7.45 pH below 7.35 is acidosis (excess [H+]) pH above 7.45 is alkalosis (low [H+])
   d. Buffer system tends to offset changes in pH
   e. Carbonate buffer system can absorb 20/1 H+ without a noticeable change in pH

ICF, water and electrolytes.

ECF water & electrolytes.

Osmotic pressure

Small molecules cross much faster than do larger (NACL vs. protein)

f. Change is as follows: $CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H+ = HCO_3$—this process can proceed in either direction $H + HCO_3$— $\rightarrow H_2CO_3 \rightarrow CO_2 + H_2O$
g. If the lungs cannot release CO_2, the shift is toward $H + HCO_3$ or an excess [H+] (acidosis); if too much CO_2 is released from the lungs the [H+] is below normal (alkalosis); when the lungs are responsible for this change it is called respiratory alkalosis or acidosis
h. If the etiology is built up at [H+] because of increased production of H+ in the cells it is known as metabolic acidosis (result of anaerobic metabolism)
i. If the etiology is excessive loss of [H+] from the kidney or GI tract, the result is called metabolic alkalosis

Pathophysiology

A. Mechanism
  1. Baroreceptors
    a. Detection
    b. Transmission
  2. Response to baroreceptors discharge
    a. Sympathetic nervous system
      i. Cardiac effects
        (a) Increased strength of contractions
        (b) Increased rate of contractions
      ii. Peripheral effects
        (a) Arteriolar constriction
        (b) Decreased container size
        (c) Increased peripheral resistance
    b. Adrenal
      i. Cardiac
      ii. Peripheral
B. Compensated Shock
  1. Increased strength of contractions
  2. Increased rate of contractions, increase in heart rate
  3. Increased systemic peripheral resistance, increase in diastolic pressure
C. Uncompensated shock
  1. Pump unable to maintain pressure
    a. Cardiac effects
      i. Decreased preload
        (a) increased strength of contractions
        (b) increased rate contractions
      ii. Decreased myocardial strength
        (a) Ischemia
          (i) Decreased RBC oxygenation
          (ii) Decreased cardiac perfusion
            (aa) Coronary blood flow
            (bb) Diastolic pressure

Carotid artery
Low pressure
To brain

Norepinephrine

Epinephrine

Maintenance of systolic B/P
Not detectable by field evaluation
Pulse
Narrowing of pulse pressure
Decrease in systolic and diastolic pressure
Availability of fluid

(b) Necrosis of myocardium
  (i) Infarction
  (ii) Increased size of infarction secondary to decrease perfusion

2. Peripheral effects
   a. Peripheral vascular change
      i. Relaxation of precapillary sphincters
      ii. Peripheral pooling
   b. Cellular changes
      i. Decreased perfusion means decreased oxygenation of tissue cells
      ii. Decreased available O_2 changes aerobic metabolism to anaerobic metabolism
      iii. Anaerobic metabolism produces increased [H+] "acidosis" and increased extracellular [K+] "hyperkalemia"

D. Irreversible
   1. Cellular anaerobic metabolism = cellular necrosis
   2. Cellular necrosis = organ failure
   3. Organ failure = organism death
   4. Total system failure
   5. Results of early ischemia may not be identified as organ death for several years.

E. Capillary—cellular relationship
   1. Peripheral resistance
      a. Pre-capillary sphincter contraction
      b. Post-capillary sphincter contraction
   2. Ischemia phase
      a. Capillaries contain minimal blood
      b. Minimal blood flow
      c. No oxygen supply to tissue cells perfused by these capillaries
      d. Aerobic metabolism changed to anaerobic metabolism
      e. Increased production of K+ and [H+]
   3. Stagnant phase
      a. Relaxation of precapillary sphincter
      b. Continued contraction of post-capillary sphincter
      c. Capillary engorgement with fluid (RBC and plasma)
      d. Continued minimal blood flow
      e. Continued anaerobic metabolism
      f. Capillary leakage of plasma
         i. Interstitial fluid increased
         ii. Increased capillary/cellular distance
         iii. Decreased oxygen transport because of increased capillary/cellular distance
      g. Continued [H+] and K+ buildup
      h. Rouleaux formation of RBC
   4. Washout phase

Stagnant flow

Optional in depth discussion of cellular physiology presented at instructor's discretion

Sequelae of shock

Appropriate management of the patient in first hour frequently determines the outcome several days or 1–2 weeks later.

Leaky capillary syndrome

a. Post-capillary sphincter relaxation
b. Washout of accumulated products
   i. [H+]
   ii. K
   iii. Rouleaux RBC
   iv. CO_2
c. Rouleaux RBC's become microemboli to lungs
d. Systemic metabolic acidosis

Evaluation

A. Primary survey
   1. Airway ventilation adequacy
   2. Circulation
      a. Pulse
         i. Rate
         ii. Character
         iii. Location
      b. Skin
         i. Color
         ii. Appearance
            (a) Pale
            (b) Cyanotic
            (c) Mottled
         iii. Temperature
            (a) Warm
            (b) Cool
         iv. Moist/dry
      c. Capillary refill
         i. Less than 2 seconds
         ii. More than 2 seconds
   3. (D) Disability
      a. Confusion, disorientation, agitation, may result from decreased cerebral perfusion and decreased oxygenation of brain cells
      b. Mini-neurological survey
B. Secondary survey
   1. Blood pressure
   2. ECG
C. Monitoring
   1. Pulse
      a. Normal rate even with 10% to 15% volume deficit
      b. Detection altered by peripheral resistance
         i. Radial pulse absent: systolic pressure <80
         ii. Femoral pulse absent: systolic pressure <70
         iii. Carotid systolic pressure <60
      c. Character of pulse may reflect circulatory status
   2. Diastolic pressure

Good profusion
Inadequate profusion

As cause of shock

a. Increase initially with increased peripheral resistance
b. Coronary blood flow
c. Normal with 15% to 20% volume deficit

3. Systolic pressure
   a. Normal with 20% volume deficit
   b. Reflects cardiac contractility
4. Skin
   a. Color—RBC oxygenation
   b. Appearance
      i. Pale—decreased perfusion (ischemic)
      ii. Cyanotic—pooling
      iii. Mottled—combination most common
   c. Temperature
      i. Perfusion
      ii. Heat retention
5. Respiration. Acidosis produces increased [H+]. The body responds by increasing the respiratory rate to remove CO_2. Removal of CO_2 reduces [H+] $[H^+] + HCO_3 \rightarrow H_2O + CO_2$

Resuscitation

A. RBC Oxygenation
   1. Airway
   2. Breathing
   3. Transport

B. Tissue ischemic sensitivity
   1. Heart, brain, lung—four to six minutes of warm ischemia (length of time an organ can survive without sustaining damage when O_2 is not present)
   2. GI, liver, kidneys—45 to 60 minutes of warm ischemia
   3. Muscle, skin—two to three hours of warm ischemia
   4. Critical tissues are resuscitated first

C. Pneumatic anti-shock garment
   1. Container size reduction and/or increased vascular resistance beneath device
   2. Perfusion of very ischemia-sensitive tissues
   3. Effects
      a. Capitance vessels
         i. 80% of total blood volume in such vessels
         ii. Container volume reduction by a factor of the change in the square of the radius
         iii. Increased upper body blood
         iv. Part of blood volume translocated to upper portion of body
         v. Increased preload
      b. Peripheral resistance increased
         i. Decreased blood flow to ischemic resistance tissues
         ii. No change in peripheral resistance of ischemic sensitive tissues

Stagnant

Warm ischemia is the length of time.

PASG
At time of printing, the exact mechanism of action is under investigation.

Selective
Muscles and skin of legs

c. Diaphragmatic excursion
    i. 50% movement reduction
    ii. Increased intrathoracic pressure
    iii. $Pa, O_2, Ph, PaCO_2$ not compromised
d. Tissue pressure (deep) (hemorrhage control) Indirectly transmitted through the skin subcutaneous, and muscle tissue surrounding muscle
e. Rigid external stabilization
    i. Pelvic fracture reduction/stabilization
    ii. Femur stabilization traction splint superior when shock like state not present

4. Clinical consequences
    a. Increased upper body blood volume
        i. Increased preload
            (a) Increased cardiac output
            (b) Distended neck veins
        ii. Increased pulmonary blood volume
            (a) Increased cardiac output with intrapulmonary pressure
        iii. Increased lower body peripheral resistance
            (a) Increased flow to upper body organs
            (b) Decreased perfusion to lower body organs if systolic pressure is less than 80 mmHg
        iv. Increased tissue pressure
            (a) Reduction of intraabdominal hemorrhage
            (b) Reduction of pelvic fracture hemorrhage
            (c) Reduction of lower abdomen retroperitoneal hemorrhage
        v. Decreased diaphragmatic excursion
            (a) Observation for ventilation and oxygenation inadequacy
            (b) Increased intrathoracic pressure
                (i) Increased cardiac output with CPR
                (ii) Increased cardiac output with respiration
5. Clinical applications
    a. Shock resuscitation
        i. Increased preload
        ii. Increased vascular resistance (lower extremities and abdomen)
        iii. Increased blood pressure
        iv. Decreased heart rate
        v. Increased profusion of organs in upper half of body
    b. Hemorrhage control
        i. Intra-abdominal
            (a) Aorta
            (b) Liver, spleen
            (c) Retroperitoneal
            (d) Pelvic

ii. Lower extremities
(a) Skin, muscle
(b) Femur
c. Fracture stabilization
i. Rigid external immobilization
ii. Femur
iii. Pelvis
d. Cardiac arrest
i. Increased cardiac output
(a) Increased preload
(b) Increased intrathoracic pressure
(c) Increased pulmonary blood volume
ii. Increased carotid blood flow
(a) Increased cardiac output (2x)
(b) Selective increased peripheral resistance
iii. Increased cerebral blood flow
(a) 3% to 10%
(b) Increased but still deficient
D. Fluid replacement
1. Whole blood
2. Crystalloid
a. Ringer's lactate
i. Isotonic
ii. Buffer when metabolized
b. Normal saline
i. Isotonic
ii. No buffer
c. Volume expansion
i. Immediately effective
ii. 2/3 lost to intrastitial space in one hour
d. 2 to 3 liters maximum
3. Glucose
a. Immediate volume expansion
b. Rapid loss
c. Resultant free H_2O increase
4. Plasma
a. Volume expansion not presently a pre-hospital fluid
b. Storage and cost reduce pre-hospital usefulness
5. Dextran
a. Volume expansion
b. Type and cross-match abnormality
c. Bleeding abnormalities
E. Rate of replacement
1. Monitoring parameters
a. Pulse

Controversial at time of printing.

Most desirable because of O_2 carrying; however, is not a fluid which is available for prehospital use.

Because of rapid loss of crystalloid from the cardiovascular space the patient should be transported to the hospital as rapidly as possible.
5 to 15 min as glucose metabolized

Not a prehospital technique

b. Blood pressure
c. Skin—color, temperature, capillary refill time

F. Routes of fluid replacement
1. Theory
a. Replacement as rapid as possible may be necessary
b. Rate of administration determined by
i. Length of catheter (inverse relationship)
ii. Internal diameter of cathether (direct relationship)
(a) Area = (pi) R^2
(b) Small increase in radius equals large increase in area
(c) Area inside of lumen determines the rate of flow
(d) Maximum rate
22 gauge = mil/min
20 gauge = mil/min
18 gauge = mil/min
16 gauge = mil/min
14 gauge = mil/min
iii. Size of vein has no relationship to flow
iv. Central line has no pre-hospital use
2. Peripheral
a. 14–16 gauge preferred
b. Advantages
i. Rapid identification
ii. Minimal equipment
iii. Rapid insertion
iv. Can be accomplished while other things going on
v. Maintenance good
vi. Easily accessible
c. Disadvantages
i. In severe volume depletion, is difficult to locate vessels
ii. Collapse and roll easily
3. Central
a. 16 gauge 20 cm catheter required
b. Advantages
i. Available when peripheral vessels are collapsed
ii. Provides access to central pressure measurement
c. Disadvantages
i. Excessive time (5-10 min) requirement for placement
ii. Sterile techniques necessary (gloves, drapes, prep, solution, etc.)
iii. Special equipment required (catheter, large needle, syringe)
iv. Skill deterioration is great; much practice required
v. High complication rate (pneumothorax, arterial injury, abnormal placement)
vi. Chest X ray should be obtained immediately after placement
(a) Insure correct position

(b) Evaluate for complications

vii. Other parts of patient care must wait

d. Summary of above: Central placement is not a useful pre-hospital technique

G. Steps in shock resuscitation for severely injured patients

1. Extrication
2. Pneumatic AntiShock Garment application
3. Stabilization
4. Load for transportation
5. Administration of IV fluids (en route to hospital)

a. Ambulance en route to hospital

i. Preliminary steps for IV

(a) Tourniquet

(b) Vein identified

(c) Tape torn

(d) IV set up

(e) Skin prepped

(f) Ambulance stopped

(g) Needle taped down

(h) Ambulance en route again

(i) Fluid rate adjusted

Time required to start IV before rolling ambulance toward hospital includes setup time for the administration set, tearing the tape, etc. If all of this is accomplished while the ambulance is en route and stopped only long enough to insert the needle the patient will arrive at the hospital several minutes faster.

Division 2: Preparatory

Section 5. General Pharmacology

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment Sections 1–7 Division 2: Preparatory Sections 1–4
Overview	Five subsections: Drug Information Action of Drugs Weights and Measures Administration of Drugs Techniques of Administration

Objectives

At the conclusion of this section, the student will be able to:

2.5.1 Name and differentiate the sources of various drugs.

2.5.2 Name and contrast the various names of a drug (i.e., generic vs. trade name vs. official vs. chemical).

2.5.3 State why drug standards are necessary.

2.5.4 Identify those agencies that are responsible for regulating drugs and provide examples.

2.5.5 Define the following terms:

—capsules	—vials
—fluid extracts	—powders
—suppositories	—tinctures
—pills	—ointments
—spirits	—tablets
—lozenges	—suspensions
—ampules	—solutions

2.5.6 Identify those pharmaceutical preparations used internally.

2.5.7 Identify and state the given dosage of prepackaged pharmaceutical preparations.

2.5.8 State the purpose and use(s) of the *Physician's Desk Reference* (PDR).

2.5.9 Identify local and general or systemic effects of drugs.

2.5.10 List and compare the following factors on the action of drugs:
—age of patient
—condition of patient
—dosage
—absorption rate
—distribution
—elimination (excretion)

2.5.11 Rank the five methods of absorption from fastest to slowest.

2.5.12 Name the five routes in which drugs are absorbed.

2.5.13 Define the following terms:

—depression
—physiological
—therapeutic
—untoward
—initiation
—antagonism
—idiosyncrasy
—indication
—side effect
—cumulative effect
—tolerance
—synergism
—potentiation
—additive
—habituation
—hypersensitivity
—contraindication

2.5.14 Select the term that best describes a specific drug from the terms in number 13.

2.5.15 Identify and discuss the following nine items as they relate to the administration of any drug:

—dose
—dilution
—action
—contraindications
—antidotes
—indications and use
—precautions
—imcompatibility
—side effects

2.5.16 List the two systems of weights and measures being used today.

2.5.17 Determine which weights and measures belong to the apothecary system or to the metric system.

2.5.18 State three advantages of the metric system.

2.5.19 Demonstrate the conversion of various measures between milligrams to grams.

2.5.20 Given a drug dose in milligrams and its specific concentration in tablet form, calculate how many tablets should be given to a patient.

2.5.21 Demonstrate the conversion of various measures between milliliters to liters.

2.5.22 Given a desired dose and concentration of a drug, calculate the volume of a drug to be administered.

2.5.23 Demonstrate the conversion of various measures between pounds to kilograms.

2.5.24 Given the weight of a patient in pounds and a drug dose in milligrams per kilogram, calculate the appropriate drug dosage for the patient.

2.5.25 State the number of macro and micro drops/cc.

2.5.26 State the formula used to determine the flow rate.

2.5.27 Given a rate of infusion for a IV fluid, determine the number of micro and/or macro drips per minute.

2.5.28 State four routes of drug administration.

2.5.29 Name at least eight safety considerations to remember when administering drugs.

2.5.30 Identify and describe local guidelines for drug administration.

2.5.31 Describe the different types and sizes of syringes and needles and the advantages and disadvantages of each.

2.5.32 Identify four routes of parenteral drug administration.

2.5.33 Describe the proper approach and explanation that should be given to a patient prior to the administration of a medication.

2.5.34 State what information should be elicited from a patient prior to administration of a medication.

2.5.35 State why ampule tops should be tapped before they are used.

2.5.36 State why air must be taken into the syringe when drawing a solution from a vial.

2.5.37 State why the IV tube is pinched off above the injection site when performing an IV push.

2.5.38 State the advantages and/or disadvantages of:
- —IV injections
- —Subcutaneous injections
- —Intramuscular injections

2.5.39 Describe why the skin is pinched when administering a subcutaneous injection.

2.5.40 Describe why the skin is stretched when administering an intramuscular injection.

S2.5.41 Withdraw a given amount of solution, given the dose, from an ampule or vial.

S2.5.42 Assemble a prepackaged syringe.

S2.5.43 Perform an IV push and inject a specified dose of medication into an already established IV line.

S2.5.44 Perform subcutaneous and intramuscular injections at any one of several locations.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Drug Information	A. Introductory remarks 1. The importance of medications and dangers associated with drug administration 2. Definition of a drug 3. Advantages and disadvantages of using drugs in the field 4. Discussion a. Effects of drugs b. Proper dosages c. Contraindications d. Side effects e. Administration techniques (mode and rate) B. Major sources of drugs 1. Animal a. Examples (thyroid, insulin, epinephrine) b. Locations of sources 2. Vegetable a. Sources (medicinal plants) b. Examples 3. Mineral a. Sources b. Examples 4. Synthetic a. The process b. It is a newer source than the others c. Most medicines can now be made synthetically d. Examples C. Drug names 1. Official name 2. Chemical name 3. Generic name 4. Trade or proprietary name D. Drug standards and legislation 1. Legal standard (USP) set forth by Federal Food, Drug, and Cosmetic Act of 1938 2. Drug legislation a. Purpose. b. Brief history i. Pure Food Act of 1906 ii. Federal Food, Drug, and Cosmetic Act of 1938, 1952, 1962 3. Explain Harrison Narcotic Act of 1914 4. Federal regulatory agencies which enforce the Narcotic Control Act of 1956. a. Drug Enforcement Act (DES) b. Food and Drug Administration c. Public Health Service

Provide examples of each.

Have the publication available.

d. Federal Trade Commission

E. Drug forms
   1. Solid drugs (most drugs are prepared in solid forms)
      a. Extracts
      b. Powders
      c. Pills
      d. Capsules
      e. Tablets
      f. Pumex
   2. Not solids or liquids
      a. Ampule (or ampoule)
      b. Vial
      c. Suppositories
         i. Types
         ii. Examples
      d. Ointments
         i. Effects
         ii. Examples
      e. Troches or lozenges
   3. Liquid drugs—definitions and examples
      a. Fluid extracts
      b. Tinctures
      c. Spirits
      d. Syrups
      e. Elixirs
      f. Milks
      g. Emulsions
      h. Liniments
      i. Lotions
         i. Usually aqueous preparations that contain suspended matter
         ii. Applications (usually applied to the skin by patting)
         iii. Uses
            (a) Cleansing
            (b) Astringent (drawing action)
         iv. Need to shake well before using, e.g. calamine.

F. References—Purpose—Uses
   1. *Physician's Desk Reference* (PDR)
   2. Hospital formulary purpose
   3. Uses

Action of Drugs

A. Introduction
   1. Action
      a. When to administer a drug
      b. What to observe after administration
   2. Sites of action

Provide examples.

a. Local effects
b. General or systemic effects

B. Factors that influence action of drugs
1. Age of the patient
2. Condition of the patient
3. Dosage (define each)
 a. Minimal
 b. Maximal
 c. Toxic
 d. Lethal
4. Absorption
 a. Process whereby drugs enter the blood stream
 b. Examples:
  i. Direct injection into the blood stream or vein (intravenous injection)
  ii. Injection into a muscle (intramuscular injection)
  iii. Injection into subcutaneous tissue or under the skin (subcutaneous injection)
  iv. Administration of drug orally—drug enters the digestive system and eventually the bloodstream
  v. Rectal administration of a drug across mucous membrane
  vi. Administration of a drug across the respiratory mucosa
 c. Speed of absorption (listed in order)
  i. Intravenous
  ii. Transtracheal
  iii. Rectal
  iv. Intramuscular
  v. Subcutaneous
  vi. Oral
   (a) Sublingual
   (b) Intralingual
   (c) Ingestion
5. Distribution
6. Detoxification (metabolism)
7. Elimination
 a. Process whereby a drug is eliminated from the body by some or all of the excreting organs
 b. Examples:
  i. Skin
  ii. Urinary Bladder
  iii. Lungs
  iv. Bowels

C. Terms used to describe nature of drug action
1. Depression
2. Physiological

3. Therapeutic
4. Untoward reaction
5. Irritation
6. Antagonism
7. Cumulative action
8. Tolerance
9. Synergism
10. Potentiation
11. Additive
12. Habituation
13. Idiosyncrasy
14. Hypersensitivity

D. Drugs affecting parts of the body (brief discussion)
   1. Nervous system
   2. Respiratory system
   3. Skeletal and muscular systems
   4. Circulatory system
   5. Urinary system
   6. Digestive system
   7. Reproductive system
   8. Drugs affecting the endocrine system
   9. Drugs affecting the eyes, skin and mucous membranes

E. The autonomic nervous system
   1. Purpose of autonomic nervous system (review)
      a. Parasympathetic nervous system
         i. Vegetative function
         ii. Vagus nerves
         iii. Chemical mediator acetylcholine
         iv. Example: heart reaction to acetylcholine
         v. Drug
            (a) Atropine
            (b) Parasympathetic blocker
      b. Sympathetic nervous system
         i. Function-stress
         ii. Norepinephrine—chemical mediator
         iii. Example: heart reaction to norepinephrine
         iv. Others (hormone)
            (a) Adrenal gland-adrenalin
            (b) Epinephrine
   2. Sympathetic nervous system responses
      a. Classified according to receptors
      b. Alpha and beta receptors/agents
      c. Effects
         i. Alpha
         ii. Beta

d. Some drugs are both alpha and beta
e. Sympathetic blockers

F. When studying a drug
1. Dose
a. Usual dose
b. Precision in computation
c. Patient history
2. Dilution (amount and type)
3. Action
4. Indications and uses
5. Precautions
6. Contraindications
7. Incompatibility with other drugs
8. Side effects
9. Antidotes

Weights and Measures

A. Two systems
1. Apothecary system
a. Solid measures (weight limits)
b. Liquid measures (fluids-volumes, units)
2. Metric system
a. Advantages
b. Solid (weight unit)
c. Liquid (volume-capacity)
3. Exchange or conversion of units from the metric system to the apothecary system and vice versa

B. Metric System
1. Decimals (review)
a. Decimals are based on the number 10 (or some power of 10)
b. Examples
c. Parts of a decimal
d. Place value of whole numbers and decimal fractions
i. The place value (or position) of the number in relationship to the decimal point gives the number its place name
ii. To eliminate the confusion of overlooking the decimal point and reading the decimal fraction as a whole number, a zero is placed to the left of the decimal when there is no whole number (e.g., 0.14)
e. Annexing or adding of zeros to the right of the decimal fraction
f. Addition and subtraction of decimals
i. Rule—line up the decimal points and annex the zeros to the right of the decimal fraction
ii. Example—addition
iii. Example—subtraction
g. Multiplying decimals
i. General multiplication information

Example—ask students to read 0.5 (5 tenths).

ii. Rule—add the number of decimal places in the number to be multiplied and count from the right of the product to locate the decimal point
iii. Examples
iv. Rule—when multiplying a decimal by 10, move the decimal point one place to the right
v. Examples
vi. Rule—when multiplying a decimal by 100, move the decimal point two places to the right
vii. General rule—when multiplying a decimal by a multiple of 10, move the decimal point to the right by the number of zeros found in the multiple

h. Division on decimals
i. Brief review of division with whole numbers
ii. Example
iii. Rule—divisor must always be a whole number
iv. Example

2. Metric Units
a. Review (from previous discussion)
i. Primary units-grams
ii. Secondary unit-milligrams

b. Secondary units are derived from primary units
c. Milligrams to grams
d. Grams to milligrams
e. Liters and milliliters: If milli means thousandth, then milliliters (ml) mean one-thousandth of a liter (l) (i.e., there are 1,000 ml in 1 liter)
i. Converting milliliters to liters. Rule: Move the decimal point three places to the left
ii. Converting liters to milliliters. Rule: Move the decimal point three places to the right

f. Cubic centimeters (cc) (relationship between liters, grams, and centimeters)
i. Relationship
ii. Problems

g. Pounds to kilograms
i. 2.2 lbs = kg
ii. Examples

h. Macro and micro drops/cc
i. 15 macro drops = 1.0cc
ii. 60 micro drops = 1.0cc

i. Flow rate
i. gtt/min = Volume to be infused x gtt/ml of administration or set. Total time of infusion in minutes
ii. Problems

C. Drug concentration (liquids)

1. Proper dosage depends upon drug concentration
2. Examples

Drug Administration

A. Safety considerations and procedures
   1. Concentrate on the task
   2. Assure base physician understands the situation
   3. Assure base physician's orders are clearly understood
   4. Repeat orders back to physician to confirm before administering a drug
   5. Read labels carefully
   6. Double-check all calculations before administering (especially for prepackaged drugs)
   7. Use correct, properly operating equipment
   8. Handle drugs (medications) carefully to avoid dropping or breaking
   9. Exercise aseptic procedures
   10. Check incompatibility problems
   11. Monitor the symptoms of overdose and take corrective measures, as necessary

B. Local guidelines

Techniques of Administration

A. Syringe and scales
   1. Description (have a syringe for each student to look at)
   2. Description of the scale
   3. Different types of syringes

B. Withdrawal of medications from vials and ampules
   1. Three containers
      a. Vials
      b. Ampules
      c. Preloaded/packaged containers
   2. Demonstrations
   3. Practice Session 1

C. Parenterel administration
   1. IV injections
      a. It is given directly into vein
      b. Directly into IV container (demonstration and practice)
   2. Subcutaneous injections, intramuscular injections, and transtracheal
      a. Definitions
      b. Absorption rates
      c. Location site for each

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Division 3: Trauma

Section 1. Trauma

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed all sections of: Division 1: Prehospital Environment Division 2: Preparatory The development of a sophisticated EMS system at the EMT-Paramedic level allows for the immediate intervention into the pathologic process by experienced and trained personnel capable of advanced level care. It is the goal of emergency care of the acutely ill or injured patient to stabilize the ongoing pathologic process and reverse it as soon as possible. In many medical patients this reversal can begin in the field with drugs to counteract the process. In the injured patient, however, reversal cannot be started in the field as this requires oxygen carrying IV fluids at the very least (blood) and usually operative correction of the injury. A well-trained and experienced EMT-P can begin the process by stabilizing the injury and providing rapid transportation to a facility where the capabilities by reversal exist. These steps include: removal of the victim from the site of injury (extrication), assuring adequate oxygenation of the remaining red blood cells (airway management and ventilation), improving perfusion of the ischemic sensitive tissues in the brain, heart and lung (PASG and IV fluids), prevention of further injury (stabilization of possible fractures), and transportation of the patient rapidly to a facility that has the equipment and personnel immediately available to intervene in the pathologic process (operating room, intensive care unit and emergency department.) Rapid transportation does not mean fast, hazardous driving; it means extrication and initiation of transportation as soon as possible. Delays in the field for unnecessary diagnostic maneuvers (abdominal examination, in-depth neurological evaluation or otoscopic visualization of the tympanic membrane), initiation for IV fluids at the scene rather than en route to the hospital in the ambulance, or transportation to a hospital that does not have available when the patient arrives, emergency department physicians and surgeons and equipment to provide immediate care. A facility in which the surgeons remain at home until after the patient is evaluated, is inappropriate. The system should have enough confidence in the training of the EMT-P's that if the surgeons are not "in-house," they respond based on initial field evaluation provided by the radio to the physicians in the emergency department. This division is set up to provide the EMT-P with the capabilities to provide the level of care described above and to instill in the physicians of the community a feeling of confidence that prehospital care is carried out to the level of sophistication. The material included is based on, and is compatible with, the material contained in the Advanced Trauma Life Support of the American College of Surgeons and their pre-hospital protocol document, The Pre-Hospital Trauma Life Support program by the National Association of EMT's, the training curriculum developed by the American Academy of Orthopaedic Surgeons, the EMT-A curriculum developed for the U.S. Department of Transportation by the National Council of State EMS Instructor-Coordinators and as reviewed by members of the American College of Emergency Physicians involved in the care of the trauma patient. Because so much of the outcome of a trauma patient is dependent on the information gathered, decisions made and treatment rendered on life-threatening conditions found in the primary survey, much emphasis is placed on this part of the curriculum. Even though this does not represent the totality

of the problems the injured patient can have, these few represent a disproportionate amount of the reasons a patient does not survive.

Overview

This section contains the following subsections:

I. Introduction
II. Kinematics
III. Primary Survey
IV. Resuscitation
V. Secondary Survey and Management
VI. Monitoring
VII. Transportation

Objectives

At the conclusion of Section 1, the instructor will have provided sufficient information, demonstration and practice to the student, to ensure his/her ability to:

3.1.1 Describe the general needs of the trauma patient and the steps within each area of need which must be addressed.
3.1.2 Describe the areas in which trauma care is rendered and a general overview of care in each of those areas.
3.1.3 Define the priorities of trauma management.
3.1.4 Describe triage with multiple patients.
3.1.5 Describe the steps in the general assessment of patient care.
3.1.6 Describe the steps in the primary survey of patient care.
3.1.7 Describe the anatomy of the airway.
3.1.8 Describe the anatomy of the cervical spine.
3.1.9 Describe the physiology of the airway.
3.1.10 Describe pathophysiological problems that occur in the airway.
3.1.11 Describe the management of the airway in relationship to the individual pathophysiological problems that occur.
3.1.12 Describe the relationship of the cervical spine to airway management.
3.1.13 Describe how the airway is managed protecting the cervical spine.
3.1.14 Describe the construction of the various devices used in airway management.
3.1.15 Describe the advantages and disadvantages of each.
3.1.16 Describe those steps in airway management that are hospital techniques and not prehospital techniques and why.
3.1.17 Describe the anatomy of the chest.
3.1.18 Describe the physiology of pulmonary expansion.
3.1.19 Describe those pathophysiological conditions that limit ventilation and pulmonary expansion.
3.1.20 Describe the assessment of ventilation and the various pathological conditions that can compromise this ventilation.
3.1.21 Describe the management of compromised ventilations.
3.1.22 Describe the management of conditions that compromise pulmonary expansion.

3.1.23 Describe the advantages and disadvantages of the various ventilation techniques and devices.
3.1.24 Describe a pneumothorax and its three variations.
3.1.25 Describe the management of circulatory and hemorrhage problems.
3.1.26 Describe the anatomy of the heart and cardiovascular system.
3.1.27 Describe the physiology and pathophysiology of shock.
3.1.28 Describe the assessment of circulatory sufficiency.
3.1.29 Describe those components of assessment which are most easily obtained in the primary survey and their individual significance.
3.1.30 Describe the management of perfusion problems.
3.1.31 Describe the pathophysiology of shock and its management in relationship to the Fick Principle.
3.1.32 Describe the methods of hemmorhage control that should be used in the prehospital setting and those that should not and why.
3.1.33 Describe the mini-neurological exam.
3.1.34 Describe the mini-neurological exam in relationship to perfusion and cerebral injury and the management steps that must be taken to solve these problems.
3.1.35 Describe how a patient is exposed for examination.
3.1.36 Describe when a patient should and should not be exposed for such assessment.
3.1.37 Describe how assessment can be completed with only a partially exposed patient.
3.1.38 Describe resuscitation of the trauma patient based upon the Fick Principle.
3.1.39 Describe the various steps in the assessment of the effectiveness of resuscitation techniques.
3.1.40 Describe the components of a complete prehospital history and the significance of each.
3.1.41 Describe the components of the history that are important prehospital and those that are not.
3.1.42 Describe the general overview of a physical examination.
3.1.43 Describe the physical examination as it relates to the head.
3.1.44 Describe the anatomy of the head and face.
3.1.45 Describe those pathophysiologic conditions that require prehospital assessment and management.
3.1.46 Describe the assessment of the head.
3.1.47 Describe the management of the pathophysiologic conditions of the head.
3.1.48 Describe the specific head injuries that compromise the airway and why.
3.1.49 Describe specific head injuries that produce hemmorhage and how they are managed.
3.1.50 Describe the physical examination of the neck.
3.1.51 Describe the anatomy of the neck.
3.1.52 Describe the pathophysiology of neck injuries.
3.1.53 Describe the assessment of the neck.

3.1.54 Describe the management of the neck.
3.1.55 Describe the general examination of the thoracic cavity.
3.1.56 Describe the anatomy of the thoracic cavity.
3.1.57 Describe the physiology of the thoracic cavity including ventilation, respiration, and Acid-Base Balance.
3.1.58 Describe the assessment of the thoracic cavity.
3.1.59 Describe the stethoscope, how it works and its uses in the physical examination.
3.1.60 Describe how the physical examination of the thoracic cavity is conducted in steps, and the various pathophysiologic processes that each step can identify.
3.1.61 Describe the prehospital management of a pneumothorax, tension pneumothorax, and an open pneumothorax.
3.1.62 Describe the pathophysiology of each of the above.
3.1.63 Describe the management of a flail chest.
3.1.64 Describe the pathophysiology of a flail chest.
3.1.65 Describe a hemothorax and the prehospital significance of such a condition.
3.1.66 Describe a pulmonary contusion and its prehospital significance and management.
3.1.67 Describe cardiac tamponade based on anatomy, physiology, pathophysiology, and management.
3.1.68 Describe the need/non-need of prehospital management of a cardiac tamponade.
3.1.69 Describe cardiac contusion, including anatomy, pathophysiology, methods of assessment, significance of dysrthymias that occur, and its management.
3.1.70 Describe the abdominal examination and the significance of the abdominal pathology in the prehospital phase.
3.1.71 Describe the anatomy of the abdomen.
3.1.72 Describe the physiology of the abdomen.
3.1.73 Describe the pathophysiologic processes of the abdomen that affect prehospital care.
3.1.74 Describe the assessment of the abdomen.
3.1.75 Describe the management of these pathological processes.
3.1.76 Describe the management of extremity injuries, both upper and lower.
3.1.77 Describe the anatomy of the upper and lower extremities.
3.1.78 Describe the pathophysiological processes that affect the upper and lower extremities.
3.1.79 Describe the management of fractures.
3.1.80 Describe the management of dislocations, explaining which should be reduced prehospital, which should not and why.
3.1.81 Describe the management for lacerations.
3.1.82 Describe the various types of splints which can be used for the immobilization of fractures, and list the advantages and disadvantages for each.

3.1.83 Desrcribe in detail the short backboard, the various types on the market, and the principles of immobilization of the cervical spine.

3.1.84 Describe the management of pelvic fractures.

3.1.85 Describe the significant pathophysiology of pelvic fractures.

3.1.86 Describe the anatomy of the spine including the cervical, thoracic, lumbar, and coccygeal regions.

3.1.87 Describe the anatomical differences in the various regions.

3.1.88 Describe the construction of the vertebrae in the various regions.

3.1.89 Describe the pathophysiologic processes that affect the spine including both the bony structures and the neurological structures.

3.1.90 Describe the assessment of the spine including the differences in the bony assessment and neurological assessment.

3.1.91 Describe continued monitoring of a patient.

3.1.92 Describe the various scores for assessing the severity of trauma injuries that have prehospital significance and those that do not.

3.1.93 Describe how a patient is monitored.

3.1.94 Describe transportation of a patient to a hospital.

3.1.95 Describe communication with a hospital.

3.1.96 Describe the procedure for the EMT-P-to-physician communication, the steps and the important information included in each step and the priority in each of the steps.

S3.1.97 Mouth-to-mask ventilation.

S3.1.98 Mouth-to-mouth ventilation.

S3.1.99 Bag-valve mask ventilation.

S3.1.100 Demand-valve ventilation.

S3.1.101 Oral airway insertion.

S3.1.102 Nasal airway insertion.

S3.1.103 Endotracheal tube.

S3.1.104 Esophageal obturator airway.

S3.1.105 PTL airway.

S3.1.106 Assessment of adequate ventilations.

S3.1.107 Management of an open pneumothorax.

S3.1.108 Decompression of a tension pneumothorax.

S3.1.109 Insertion of an IV line.

S3.1.110 Application of MAST trousers.

S3.1.111 Assessment of reestablishment of perfusion.

S3.1.112 A mini-neurological examination.

S3.1.113 Exposure of a patient for physical exam.

S3.1.114 Physical examination of the head.

S3.1.115 Physical examination of the neck.

S3.1.116 Physical examination of the thorax.

S3.1.117 Physical examination of the abdomen.

S3.1.118 Physical examination of the upper extremities.

S3.1.119 Physical examination of the lower extremities.

S3.1.120 Physical examination of the pelvis.

S3.1.121 Neurological examination.

S3.1.122 Application of the short backboard.
S3.1.123 Application of a long backboard.
S3.1.124 Splinting techniques for the upper extremities.
S3.1.125 Splinting techniques for the lower extremities.
S3.1.126 Immobilization of the cervical spine.
S3.1.127 Rapid extrication.
S3.1.128 Application of a cervical collar.
S3.1.129 Insertion of ET tube in the trauma patient.
S3.1.130 Insertion of an ET tube in the nontrauma patient.
S3.1.131 Reduction of a knee dislocation.
S3.1.132 Reduction of a shoulder dislocation.
S3.1.133 Reduction of a finger dislocation.
S3.1.134 Reduction of a fracture/dislocation of the ankle.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Needs of the Trauma Patient	A. Oxygenation of red blood cells 1. Airway 2. Ventilation B. Perfusion of tissue 1. Pump 2. Container 3. Fluid C. Control of hemorrhage 1. Temporary a. Direct pressure b. Indirect pressure 2. Definitive (operating room) D. Closure of tissue defect 1. Temporary 2. Definitive E. Bone injury 1. Temporary stabilization 2. Definitive alignment 3. Restoration of vascular flow 4. Restoration of innervation F. Abnormal organ position 1. Outside body cavity 2. Into another body cavity G. Infection 1. Protection 2. Cleansing 3. Antibiotics H. Psychological 1. Reassurance 2. Modesty I. Environmental protection 1. Weather 2. Emergency scene 3. Bystanders
Location of Management	A. Accessibility of patient 1. Scene survey 2. Access 3. Extrication 4. Transportation problems B. Scene hazards 1. EMT self-protection 2. Patient protection C. Prehospital 1. Mostly temporary

2. Control and stabilization not definitive care

D. Emergency department
   1. Some definitive control and repair
   2. Body cavities not accessible
   3. O_2 carrying blood volume replacement

E. Operating room
   1. Accessibility of body cavities
   2. Anesthesia
   3. Control of hemorrhage
   4. Repair of tissue defects
   5. Replacement of organs into proper compartments
   6. Removal of devitalized tissue
   7. Infection control
   8. Stabilization of bony defects
   9. Removal of unwanted hematoma or foreign bodies
   10. Fluid replacement

F. Transportation
   1. To site of definitive care (usually operating room) via emergency department
   2. Rapidity of transporation
      a. Delay in starting transportation
         i. Unnecessary physical exam
         ii. Unnecessary history
         iii. Prolonged attempts at fluid replacement
         iv. Unnecessary diagnostic maneuvers
      b. Rate of vehicle's speed
         i. Traffic conditions
         ii. Road conditions
         iii. Driver's experience
         iv. Comfort of patient
         v. Attendant's ability to provide en route patient care and evaluation
      c. Receiving hospital
         i. Capability of providing definitive care
         ii. Transport time to level I vs level II hospital
      d. Patient outcome
         i. Prehospital patient care vs emergency department patient care vs operating room patient care
         ii. Definitive care and hemorrhage control within one hour of accident or mortality and morbidity increase rapidly

Priorities

A. Life-threatening versus non-threatening injuries

B. Limb-threatening versus non-limb-threatening injuries

C. Prehospital manageable versus non-prehospital manageable conditions

D. Triage
   1. Multiple patient

See ACS, COT hospital categorzation document

a. Treatable with personnel available
b. Quick assessment of all patients
c. Treat most critical patients first
d. Proper utilization of resources

2. Major incident
a. Assessment of treatment ability
b. Back-up personnel
c. Quick assessment of all patients
d. Management of patients most likely to survive first

Kinetics of Trauma

A. Definition of trauma
1. Energy transfer producing tissue damage
2. Blunt trauma
3. Penetrating trauma

B. Physical laws
1. Newton's first law of motion
2. Momentum mass x acceleration

C. Physical laws
1. $KE = \frac{M}{2} \times V^2$
2. Energy is neither created nor destroyed but changed in form

Blunt Trauma

A. Newton's first law of motion
1. Definition
2. Description of effects
a. Auto
i. Absorption of energy of motion by deformation of vehicle
ii. Motion of car stopped by bending of frame
iii. Deviation of forward motion attained by second force
iv. Types of impact
(a) Head on
(b) Lateral
(c) Rear
(d) Rotational
(e) Roll over
b. Occupant
i. Motion continues until energy is absorbed by bending of occupant or bending by restraining force
ii. Energy absorption
iii. Continuum of force: compression bend fracture based on tensile strength of particular tissues involved
c. Organ
i. Compression
ii. Decceleration
(a) Restriction of motion

Blunt

Penetration

Three impacts occur in a collision
Auto Occupant Organ

Bend, fracture

(b) Resistance of tissue
(c) Disruption of tissue

B. Frontal impact
   1. Effects on auto
      a. Forward motion
      b. Frame and body disruption
   2. Effects on occupant
      a. Down and under
         i. Momentum
            (a) Amount of energy
            (b) Absorption of energy
         ii. Knees impacting dash
            (a) Knee injuries
            (b) Femur shaft injuries
            (c) Posterior fracture, dislocation of hip
      b. Forward rotation of body
      c. Head impact
         i. Skull injury, depressed
      d. Neck injury
         i. Skull stops forward motion
         ii. Trunk continues forward
         iii. Energy absorption C-spine
            (a) Body compression
            (b) Hyperextension
            (c) Hyperflexion
      e. Chest impact
         i. Sternal compression
         ii. Rib fracture
         iii. Flail chest
   3. Up and over
      a. Head impacts windscreen
         i. Simple skull fracture
         ii. Depressed skull fracture
      b. Neck energy absorption
         i. Arrest of skull forward motion
         ii. Continued forward motion of trunk
         iii. Energy absorption on C-spine
            (a) Compression
            (b) Hyperflexion
            (c) Hyperextension

C. Lateral impact
   1. Auto
      a. Impact
      b. Compartment intrusion
      c. Lateral auto motion

Windscreen or dash
simple fracture

Steering wheel or dash

Newton's first law of motion

2. Occupant
   a. Chest
      i. Impact on door
      ii. Thoracic lateral compression
      iii. Lateral flail chest
   b. Pelvis
      i. Acetabulum
         (a) Impact greater trochanter
         (b) Head of femur through acetabulum
      ii. Pelvic girdle
         (a) Fracture ilium
         (b) Fracture pubis and ischium
         (c) Head and neck
            (i) Head remains in place
            (ii) Trunk pushed out
            (iii) Newton's first law
            (iv) Head impacts window
            (v) Contralateral ligament damage

D. Rear impact (sequence of events)
   1. Energy imparted from rear to front auto
   2. Acceleration of front auto
   3. Acceleration of everything touching impacted auto
   4. Acceleration of body in seat
   5. No change in head motion without head support
   6. Motion imparted to head by its attachments to the neck
   7. Injuries occur to muscular and ligamentus attachments of spine
   8. Forward motion of occupants occurs at same rate
   9. Rear auto stops on impact with front auto
   10. Unrestrained occupant moves forward
   11. Occupant impacts interior of passenger compartment
   12. Additionally occupant sustains same injuries as in a frontal impact

E. Off-center impact causing rotation
   1. Effects on auto
      a. Off-center impact occurs
      b. Portion of vehicle impacted loses forward motion
      c. Remainder of vehicle remains in forward motion
      d. Auto pivots around point of impact
   2. Effects on occupant
      a. Continued forward motion
      b. Moves in a diagonal direction across passenger compartment
      c. Results in combination of both lateral and frontal injury pattern

F. Roll over
   1. Effects on auto
      a. Tumbling motion
      b. Rapid change in direction of vehicle occurs in relation to roadway

2. Effects on occupant
   a. Change of direction occurs with each change of auto direction
   b. Impact with passenger compartment causes change in direction

G. Restrained vs unrestrained occupant
1. Unrestrained occupant
   a. 87% of the US population (1983)
   b. Motion stopped by a part of vehicle or by impact following ejection
   c. Ejected
2. Restrained occupant
   a. Lap belts
      i. Properly positioned
         (a) Below iliac spine/above femur
         (b) Kinetic energy absorbed by pelvis
         (c) Trunk continues in forward motion
      ii. Improperly positioned
         (a) Applied above iliac crest
         (b) Occupant submarines beneath belt
         (c) Belt may compress ribs
         (d) Forward motion absorbed by T12, L1, L2
         (e) Soft abdominal parts compressed between belt and lumbar spine
   b. Diagonal shoulder strap
      i. Absorbs forward motion of trunk
      ii. Without strap, head and trunk are stopped by dash and steering wheel
   c. Airbags
      i. Cushions forward motion of occupant
      ii. Absorbs most of energy slowly
      iii. Works only in forward collisions
      iv. Works only on first collision
      v. Most effective if used with lap belt

H. Organ collision injuries
1. Injuries resulting from compression
   a. Head
      i. Open fracture
      ii. Closed fracture
      iii. Bone fragment penetration
   b. Face
      i. Soft tissue injuries
      ii. Facial bone fractures
   c. Neck
      i. C-spine fracture
      ii. Soft tissue injuries
   d. Thorax

Review Newton's first law of motion

300 x greater mortality rate

Ineffective in lateral or roll over impact

Expensive replacement

Airway compromise possible

Neurological dysfunction

i. Lungs
(a) Paper bag compression with alveolar rupture
(b) Puncture by rib
ii. Heart
(a) Momentum compresses thorax
(b) Heart trapped between sternum and T-spine
(i) Myocardial contusion
(ii) Dysrhythmias
2. Injuries resulting from decceleration
a. Abdomen
i. Liver
(a) Downward motion
(b) Restrained by ligamenta teres
(c) Tears around ligament attachment
ii. Kidney
(a) Forward motion
(b) Restrained by vascular pedicles
(c) Tear of artery/vein
iii. Small intestine
(a) Forward motion
(b) Restrained by mesentary
(c) Tear of mesentary
iv. Spleen
(a) Forward motion
(b) Restrained by diaphragm and abdominal wall attachment
(c) Tear of splenic capsule

Penetrating Trauma

A. $KE = \frac{M}{2} \times V^2$
1. KE = Kinetic Energy
2. M = Mass
3. V = Velocity
a. With velocity being squared it is most important factor determining KE
B. Energy is neither created nor destroyed
1. Can be changed in form
2. Motion changed into tissue damage
a. Shock wave pattern
C. Drag
1. Dissipation of energy
2. Frontal area of missile is proportionate to the amount of drag
a. Profile of missile
b. Tumbling or yaw of missile
c. Fragmentation

V-fib, A-fib Multiple PVC

At kidney, aorta or Vena Cava

At small bowel, along length, or aorta

Slowing a missile

3. Energy of entry into tissue minus energy of exit equals energy dissipated into tissue

D. Energy dissipated equals tissue destruction
   1. Low velocity
      a. Damage mainly by sharp edge or point
      b. Slow insertion has very little energy to be dissipated
   2. Medium velocity (<1200 ft/sec)
      a. All handguns, most rifles
      b. Injury tract 2-3 x diameter of missile
      c. Surrounding area of hemorrhage variable
   3. High velocity (2000-5000 ft/sec)
      a. Military rifles (M-15, M-16), some deer rifles
      b. Permanent injury 2-3 x diameter
      c. Variable area of hemorrhage

E. Wound of entrance
   1. Implosion
      a. Skin and subcutaneous tissue pushed in
      b. Abrasion on skin externally as missile passed
      c. Small through hole
   2. Close range
      a. Tattoo marks by burning powder
      b. Very close range burns due to flash

F. Wound of exit
   1. Explosion
      a. Wound edges ragged, stellate
      b. Exit larger than entrance

Primary Survey

A. Airway with C-spine control
   1. Nasopharynx
      a. Nares
      b. Cartilage
      c. Nasal bones
      d. Maxilla
      e. Vascular supply
   2. Oropharynx
      a. Lips
      b. Cheeks
      c. Tongue
      d. Hard palate
      e. Soft palate
      f. Tonsillar pillows
      g. Teeth
      h. Vascular supply
      i. Mandible
      j. Mandible tongue relationship and association

Knife, needle icepick

Pathway of missile not always in straight line

3. Hypopharynx
   a. Epiglottis
      i. Tongue—epiglottis relationship
      ii. Posterior pharyngeal wall
      iii. Lateral pharyngeal wall
      iv. Anterior pharyngeal wall
      v. Pyriform sinus
4. Larynx
   a. Thyroid cartilage
   b. Cricothyroid cartilage
   c. Trachea
   d. Esophagus
   e. Trachea—esophagus relationship
   f. Vocal cords
   g. Arytenoid folds
5. Trachea
   a. Trachea rings
      i. Size
      ii. Shape
      iii. Construction
   b. Tracheal ring interspace
      i. Construction
      ii. Distance
   c. Esophageal-tracheal relationship
6. Cervical spine
   a. Body
   b. Neural arch
   c. Facets
   d. Spinal canal
   e. Foramen magnum
   f. Spinal cord
   g. Spinal cord-spinal diameter canal relationship
   h. Nerve fiber progression through cord

B. Physiology
   1. Pathway of air through
      a. Nasopharynx
      b. Oropharynx
      c. Hypopharynx
      d. Larynx
   2. Humidification of air

C. Pathophysiology
   1. Tongue in hypopharynx
      a. Occlusion of airway
      b. Head position
   2. Hemorrhage

a. Fragments
   i. Bone
   ii. Teeth
3. Foreign bodies
4. Fractured larynx
5. Laryngeal edema/spasm
6. Cervical spine fracture
   a. Most common fractures
      i. C5 C6
      ii. C1 C2
   b. Type of fractures
      i. Hyperflexion
      ii. Hyperextension
      iii. Compression
   c. Types of injuries
      i. Fracture without dislocation
      ii. Fracture with dislocation
         (a) Without neurological deficit
         (b) With neurological deficit

Management

A. Neutral cervical spine position
   1. Return head to neutral position
   2. Stabilize with palms of hands over ears
   3. Maintain neutral position without traction
   4. Cervical collar will not hold neutral position
   5. Backboard, side pieces for stabilization
   6. Immobilize above (head) and below (torso) the possible fracture
   7. Hand stabilization until airway is secure
   8. Indications of possible C-spine injury
      a. History of accident
      b. Blunt trauma above clavicle
      c. Absence of physical findings
         i. Bony injury vs nerve injury
         ii. Absence of neurological findings
         iii. Comparison with other fractures, such as broken arm, as regards significance of no neurological involvement
   9. Consequences of movement
      a. Stabilization of C-spine
      b. Size of cervical canal versus size of cervical cord
      c. Intrusion by bone
      d. Dislocation
   10. Medical/legal implications
B. Manual manipulations
   1. Chin lift
      a. Fingers above chin

Do not use chin strap

b. Thumb below chin
c. Anterior traction without changing neutral neck position

2. Jaw lift
   a. Thumb behind lower incisor
   b. Fingers beneath symphysis of mandible
   c. Anterior traction without changing neutral neck position
3. Jaw thrust
   a. Two hands
   b. Thumb on zygoma bilaterally
   c. "Thrust" jaw anteriorly

C. Mechanical
   1. Without tracheal/esophageal separation
      a. Oral airway
         i. Construction
         ii. Advantages
         iii. Disadvantages
         iv. Method of insertion
      b. Nasal airway
         i. Construction
         ii. Advantages
         iii. Disadvantages
         iv. Method of insertion
   2. With tracheal/esophageal separation
      a. Esophageal obturator airway
         i. Construction
         ii. Advantages/disadvantages
         iii. Method of insertion
      b. EGTA
      c. PTL
      d. Endotracheal tube
         i. Construction
         ii. Advantages/disadvantages
         iii. Method of insertion
            (a) Without C-spine fracture, "sniffing" position, hyperextension C5-C6, hyperextension C1-C2
            (b) With C-spine fracture stabilization in neutral position, oral, digital equipment

D. Transtracheal
   1. Jet insufflation
      a. Anatomy(review)
         i. Tracheal airway
         ii. Location intact neck (surgical anatomy)
         iii. Esophageal tracheal relationship
      b. Location
         i. Rings 1 and 2

Refer to Div II Sec 3

ii. Rings 2 and 3
c. Indications
i. Laryngeal obstruction
ii. Unresponsive to other treatment modalities
(a) Endotracheal intubation
(b) Foreign body removal attempts
(c) Epinephrine
d. Contraindications
i. Other routes possible
ii. Inadequate training and experience
e. Equipment
i. 14 gauge needle with plastic sheath
ii. Oxygen extension catheter
iii. 50 psi O_2 source
(a) Valve
(b) Mechanical
(c) Side hole in O_2 tube
(d) "T" or "Y" connection
(e) 10cc syringe
f. Technique
i. Insertion into trachea
(a) 45 degree angle posterior and caudad
(b) Do not penetrate esophagus
ii. Aspirate air from trachea
iii. Remove needle canulae
iv. Connect hub to O_2 extension tube
v. Ventilate
(a) Inflation 1 second
(b) Deflation 4 seconds
g. Benefits
i. Maintenance of PaO_2 prolonged period
ii. Blow out foreign body
iii. Disadvantages
(a) $PaCO_2$ buildup after 30-45 minutes
(b) Possible subcutaneous emphysema

E. Cricothyroidotomy
1. Anatomy
a. Laryngeal anatomy
b. Cricoid cartilage
c. Thyroid cartilage
d. Location in intact neck
2. Indications
a. Laryngeal obstruction
b. Unresponsive to other treatment modalities
i. Foreign body removal attempts

MacGill
Cord Edema

100% Oxygen

Optional skill

Review Surgical anatomy

3. Contraindications
   a. Other routes possible
   b. Inadequate training and experience
4. Equipment
   a. #11 blade/handle
   b. Pediatric endotracheal tube or tracheostomy tube
   c. Adaptor
   d. Bag-valve
   e. O_2 supply
   f. Dressings
   g. Technique
      i. Incision through skin and cricothyroid membrane
      ii. Insertion of needle into incision
      iii. Rotate handle 90 degrees
      iv. Insertion of tube
      v. Inflation by cuff
      vi. Connect bag-valve and ventilate with FiO_2 of 1.0
   h. Benefits
      i. Maintenance of airway and FiO_2
      ii. Blow out foreign body
   i. Disadvantages
      i. Injury to:
         (a) Larynx
         (b) Uncontrollable hemorrhage
            (i) Thyroid
            (ii) Carotid
            (iii) Jugular
      ii. Practice and experience required to maintain competence

F. Tracheostomy

Breathing

A. Ventilation
1. Anatomy
   a. Ribs
   b. Intracostal muscle
   c. Accessory muscles of breathing
   d. Diaphragm
   e. Trachea
   f. Bronchea
   g. Alveoli
   h. Capillary
   i. Capillary-alveolar membrane
   j. Pleural space
2. Physiology
   a. Thoracic cavity expansion
      i. Action of intracostal muscles

If present

Not a prehospital technique

ii. Action of accessory muscles
iii. Action of diaphragm
b. Thoracic cavity evaluation
i. Action of intracostal muscles
ii. Action of accessory muscles
iii. Action of diaphragm
c. Air movement
i. Larynx
ii. Trachea
iii. Bronchea
iv. Into alveoli
d. O_2-CO_2 exchange
i. Across alveolar capillary membrane
ii. Into red blood cell
iii. Out of red blood cell
iv. Attachment to hemoglobin molecule
e. Esophageal opening threshold
i. Below this pressure produces pulmonary expansion
ii. Above this pressure produces gastric distension
3. Pathophysiology approximately 40 psi
a. Inadequate expansion
i. CO_2 retention
ii. O_2 insufficiency
b. Inadequate ventilation
i. CO_2 retention
ii. O_2 lack
c. Pneumothorax
i. Air into pleural space
ii. Defect in chest wall
iii. Defect in lung parenchyma
iv. Simultaneous injuries to chest wall and parenchyma
d. Tension pneumothorax
i. Ingress of air into pleural space with egress
ii. Complete collapse of lung on side of injury
iii. Mediastinum pushed into opposite side
iv. Reduction of ventilation in opposite lung
v. Reduction of cardiac output
(a) Increased intra-pleural pressure
(b) Kinking of vena cava
e. Flail chest
i. Two or more ribs fractured in two or more places
ii. Decreased ventilation
(a) Paradoxical movement of involved segment of thoracic wall
(b) Pain

Oxygen
Carbon dioxide
Oxygen

Approximately 30 PSI

Etiology same as
pneumothorax

(c) Pulmonary contusion
4. Assessment
a. Pneumothorax
i. Decreased breath sounds
ii. Reduced ventilation
b. Tension pneumothorax
i. Unilateral decreased breath sounds
ii. Distended neck veins
(a) Indicates increase preload and decreased cardiac output
(b) Not present with significant hypovolemia and hypotension
iii. Tracheal deviation
(a) Away from affected side
(b) Difficult to identify
(c) Late sign
iv. Cyanosis
(a) Difficult to identify
c. Flail chest
i. Paradoxical movement
ii. Pain
iii. Decreased air movement

Management

A. Ventilation
1. Oral
a. Benefits
i. Both hands can be used on mask
ii. Greater volume of ventilation easier
iii. Immediate ventilation
b. Disadvantages
i. Esophageal seal more easily exceeded
ii. Stomach ventilated at the expense of the lungs
iii. Eyes must remain on chest wall to access adequate ventilation
2. Pocket Mask
a. Benefits
i. Mask seal easier
ii. Effect by ventilation "self" by operator's lungs
b. Disadvantages
i. 17% FiO_2
ii. Possible contagious disease contamination from patient
iii. Hyperventilation of operator
c. Technique
i. Mask seal
(a) Mask placement
(b) Hand placement

Most serious pathophisiology

Usually not significant prehospital

Requires good ausculatory techniques

- ii. Ventilation
  - (a) Length of ventilation
  - (b) Method of ventilation
  - (c) Auscultation of lungs
  - (d) Auscultation of stomach

3. Bag-valve-mask ventilation
   - a. Priorities and need for oxygenation
     - i. Auscultation of lungs bilaterally
     - ii. Auscultation of stomach
     - iii. Skin color
     - iv. Chest rise
   - b. Assessment
     - i. Feel of bag compliance
     - ii. Air leak
     - iii. Volume by ventilation
     - iv. Auscultation
   - c. Benefits
     - i. Eyes can survey the scene
     - ii. Assess the ventilation with periodic auscultatory and visual checks
     - iii. Ventilation pressure can be maintained below esophageal opening threshold
   - d. Disadvantages
     - i. Mask seal
     - ii. Skill required
     - iii. Hand strength
     - iv. Over confidence as to outcome
     - v. Aspiration of blood with facial injuries
     - vi. Gastric distension
     - vii. Inadequate ventilation
     - viii. Aspiration of vomitus
   - e. Technique
     - i. Mask-face seal
       - (a) Mask placement
       - (b) Hand placement
     - ii. Valve attachment to mask
     - iii. Bag ventilation
       - (a) One-hand technique
       - (b) Hand/leg technique
     - iv. Accumulator
       - (a) Types
       - (b) FiO_2
4. Demand valve
   - a. Valve open or closed
   - b. Pressure 40-50 psi

Chin on valve

- i. Mask-face seal
  - (a) Need to maintain two hands
- ii. Chest rise must be observed
  - (b) Eyes need to remain on patient at all times

c. Benefits
- i. FiO_2 100%
- ii. Mask held with both hands

d. Disadvantages
- i. Exceed esophageal seal pressure and inflate stomach
- ii. Unable to "feel" air on inhalation phase
- iii. O_2 cylinder must always be available

e. Technique
- i. Mask seal
  - (a) Mask placement
  - (b) Hand placement
- ii. Valve
  - (a) Attachment to mask
  - (b) Hand operation
  - (c) Chin operation
- iii. Ventilation
  - (a) Chest rise
  - (b) Auscultation of lungs
  - (c) Auscultation of stomach

B. Pulmonary Expansion

1. Pneumothorax
   - a. No prehospital management required
   - b. Close observation for tension pneumothorax pulmonary contusion
2. Tension pneumothorax
   - a. Evacuation of pleural cavity
   - b. Location for decompression
     - i. Second intracostal space
     - ii. Midclavicular line
   - c. Management
     - i. Equipment
       - (a) Needle catheter/dart
       - (b) One-way valve
       - (c) Flutter valve
       - (d) Heimlich valve
       - (e) Disc valve
       - (f) Water seal
     - ii. Management
       - (a) Prep site
       - (b) Insert over third rib
       - (c) Connect to one-way valve
3. Open pneumothorax

a. Occlusion of hole
    i. Vaseline gauze
    ii. Flutter-valve dressing
    iii. Aluminum foil
b. Complications
    i. Development of tension pneumothorax

4. Flail Chest
    a. Stabilize segment
        i. Hand on segment
        ii. Sand bags
    b. Assisted ventilation
        i. Without ET tube
        ii. With ET tube

Circulation/ Hemmorhage Control

A. Anatomy
    1. Heart
        a. Location
        b. Pericardium
        c. Chambers
    2. Vessels
        a. Arteries
        b. Veins
B. Physiology
    1. Pressure
        a. Intravascular
        b. Extravascular
        c. Poiseuille's Law
    2. Pump
        a. Rate
        b. Contractibility
C. Pathophysiology
    1. Pump failure
    2. Container failure
    3. Fluid failure
    4. Hemorrhage
        a. To outside
        b. Into body cavity
        c. Into extremity
        d. Into pelvis
D. Assessment
    1. Perfusion
        a. Pulse
        b. Skin color
            i. Pink
            ii. Cyanotic

Review Shock

Tissues

Review Shock Section

Review Shock Section

- iii. Mottled
- c. Capillary refilling
  - i. <2 seconds = normal
  - ii. >2 seconds = decreased perfusion
- 2. Hemorrhage
  - a. To outside
  - b. Into body cavity
  - c. Into extremity

E. Management
- 1. Perfusion
  - a. PASG
    - i. Restoration by upper body perfusion
    - ii. Stabilization of fractured pelvis
    - iii. Stabilization of fractured femur
  - b. Intravenous fluids
  - c. Restoration of lost cardiovascular volume
    - i. Cardiovascular volume
- 2. Hemorrhage
  - a. Direct pressure
    - i. Hand
    - ii. Bandage
    - iii. Elevation
  - b. Indirect pressure
    - i. PASG
  - c. Contraindicated
    - i. Tourniquet
    - ii. Hemostats

A. Anatomy
- 1. Cerebrum
- 2. Cortex
- 3. Brainstem
- 4. Carotid artery
- 5. Cerebral vessels

B. Physiology
- 1. Cerebral oxygenation
- 2. Perfusion of brain

C. Pathophysiology
- 1. Cerebral anoxia
- 2. Cerebral hypoperfusion
- 3. Most common cause of death in head injury
  - a. Hypoperfusion
  - b. Anoxia
  - c. Hyperapnea
  - d. Cushing response

PASG/see shock section

Intra-abdominal, pelvis

Increasing hemorrhage if improperly applied, damage to associated structures.
Mini neurological exam

TOPIC | **CONTENT OUTLINE**

- i. Brainstem pressure
- ii. Hypertension
- iii. Reflex bradycardia

D. Assessment
   1. Vital signs
   2. Level of consciousness
      a. A—Alert
      b. V—Responds to VOCAL stimuli
      c. P—Responds to PAINFUL stimuli
      d. U—Unresponsive

E. Management
   1. Oxygenation
   2. Airway
   3. Ventilation
   4. FiO_2 0.90
      a. Perfusion
      b. Maintain B/P
      c. Hyperventilation

Expose

A. Undress patient for complete examination
   1. Environment
   2. Modesty
   3. Need for rapid transportation
   4. Bystanders
   5. Evaluation in ambulance when possible
   6. Partial exposure for primary survey
      a. Expose front of chest
      b. Look at chest wall
      c. Auscultate anterior chest
      d. Palpate laterally and posteriorally

Resuscitation

A. Physiology

B. Pathophysiology

C. Assessment
   1. Begin numerical assessment
      a. Pulse
      b. Blood pressure
      c. Respiratory rate
   2. Repeat non-numerical assessment
      a. Skin color
      b. Skin temperature
      c. Capillary refilling

D. Management
   1. PASG
   2. Fluid replacement

AVPU
Avpu
aVpu
avPu
avpU

Review Shock section
(Fick Principle)

Review Shock section

a. Peripheral
b. Two lines
c. Large-bore
d. Central line
    i. Sterility required
    ii. Time required for insertion
    iii. Fluids administered more rapidly peripheral route

Secondary Survey

A. History obtained simultaneously with examination or en route to hospital
1. Allergies (A)
    a. Medication (major)
    b. Food (minor)
    c. Animals (minor)
2. Medications (M)
    a. Acute—recent illness
        i. How prescribed
            (a) Antibiotics
            (b) Antihistamine
        ii. Over the counter
            (a) ASA
            (b) Antipyretics
            (c) Pain medication
            (d) Decongestants
            (e) Antidiarrheals
            (f) Antinausea
    b. Chronic
        i. Endocrine
            (a) Insulin
            (b) Thyroid
            (c) Cortisone
        ii. Cardiac
            (a) Digitalis
            (b) Diuretics
            (c) Antihypertensive
            (d) Antiarrhythmias
        iii. Antibiotics
        iv. Other
3. Past Medical History (PMH)
    a. Operations
        i. Type
        ii. Diagnosis
        iii. Date
        iv. Complications
    b. Anesthetics
        i. Complications

Usually not indicated prehospital

Nmeumonic for history is AMPLE

Ample

aMple

amPle

ii. Type
c. Hospitalization
i. Diagnosis
ii. Complications
iii. Date
d. Other serious illnesses
4. Last meal (LM)
a. Last intake of any kind
5. Events leading up to (E) incident
a. Kinetics of accident
i. Type, direction, and distance of weapon, if penetrating trauma
ii. Extrication
iii. Ejection of occupants
iv. Occupants DOA
v. Medical history contributing to present emergency
b. Physical exam
i. Look
(a) Contusions
(b) Abrasions
(c) Lacerations
(d) Swelling
(i) Edema
(ii) Hemorrhage
(e) Deformity
(i) Angulation
(ii) Shortening
(iii) Abnormal position
(f) Ecchymosis
(g) Hemorrhage
ii. Listen
(a) Breath sounds
(b) Bruits
(c) Bowel sounds
(d) Subcutaneous emphysema
iii. Feel
(a) Palpation
(b) Deformities
(c) Masses
(d) Edema
(e) Crepitation
(i) Subcutaneous air
(ii) Boney

ampLe

amplE

TOPIC	CONTENT OUTLINE
Head	A. Anatomy

A. Anatomy
   1. Skin and subcutaneous tissue
      a. Epidermis
      b. Dermis
      c. Subcutaneous fat
   2. Muscles
      a. Facial expression
      b. Eyes
      c. Mastication
   3. Bones
      a. Skull
         i. Temporal
         ii. Frontal
         iii. Partial
         iv. Occipital
         v. Face
            (a) Zygomatic arch
            (b) Maxilla
            (c) Nasal
               (i) Mandible
               (ii) Tempero mandibular joint
               (iii) Angle
B. Pathophysiology
   1. Hemorrhage
      a. Total blood volume
      b. Rate
         i. Intraluminal pressure vs extraluminal pressure
         ii. $A = (Pi)\ R^2$
   2. Infection
      a. Necrotic tissue
      b. Contamination
      c. Time
   3. Pain
      a. Cutaneous innervation
      b. Modificating factors
         i. Shock
         ii. Blunt trauma
         iii. Cellular damage
         iv. Psychological factors
      c. Muscle innervation
      d. Periosteal innervation
C. Assessment
   1. Abrasions
      a. Few cell layers of epidermis
      b. Painful

Major groups

c. Hemorrhage
d. Contamination

2. Ecchymosis
   a. Cuticular
   b. Subcutaneous
   c. Hemorrhage
      i. Amount
      ii. Local effects
         (a) Nasal
         (b) Eye
   d. Lacerations
      i. Hemorrhage
      ii. Contamination
      iii. Foreign bodies
      iv. Careful examination of hairy areas
      v. Depth of extusion
         (a) Muscle
         (b) Fascia
         (c) Vessels
         (d) Underlying structure
            (i) Eye
            (ii) Mouth
            (iii) Nose
   e. Fractures
      i. Open vs closed
      ii. Associated structure damage
      iii. Deformity
      iv. Crepitation
      v. Abnormal mobility
      vi. Palpation
      vii. Specific bones
         (a) Mandible
            (i) Occlusion of teeth
            (ii) Movement of anterior portion
            (iii) Pain
         (b) Face
            (i) Laforte I vs II vs III
            (ii) Zygomatic mobility
            (iii) Diplopia
            (iv) Maxillary mobility
         (c) Skull
            (i) Depression
            (ii) Bony protrusion
            (iii) Spinal fluid leak
            (iv) Ears

(v) Nose, nasal discharge, halo sign
(vi) Cribiform plate fracture
(v) External canal hemorrhage

f. Special considerations
  i. Airway compromise
    (a) Oro/nasopharynx hemorrhage
    (b) Foreign body
    (c) Tissue
    (d) Teeth
    (c) Skin, tongue, etc.
  ii. Nose
    (a) Septum or bone fracture
    (b) Hemorrhage
    (c) Obstruction
  iii. Ears
    (a) Hemorrhage
    (b) Defects
    (c) Foreign bodies
  iv. Eyes
    (a) Cornea
    (b) Lens
    (c) Conjunctivae
    (d) Retina

g. Salivary glands

h. Teeth

D. Management
1. Airway
2. Hemorrhage
  a. Direct pressure
  b. Reduce pressure over suspected depressed skull fractures
  c. Packing in mouth around ET tube as necessary
  d. Pressure points not helpful because of extensive cross circulation
  e. Restoration of lost blood volume
  f. Careful examination of scalp
3. Eyes
  a. Protect from further injury
  b. Protect from light
  c. Reassurance of patient with loss of vision
4. Fractures
  a. Skull
    i. Clean dressing
    ii. Protect from further injury
  b. Facial bones
    i. No specific prehospital Rx
  c. Mandible

Review

i. Stabilize
ii. Protect airway
5. Special considerations
a. Shotgun
i. Necessary gun alignment for suicide attempt usually produces facial injury—jaw, tongue, mouth, nose and eyes—but frequently does not produce fatality
ii. Airway maintenance
(a) Endotracheal tube through open mandible, tongue, mouth
(b) Packing to reduce mouth and facial hemorrhage
(i) Airway secured with ET tube through mouth
(ii) Hemorrhage control by packing
(c) Penetrating injuries to check/remove foreign bodies

Neck

A. Anatomy
1. Skin
2. Muscles
3. Vessels
4. Bones
a. Vertebrae and body
b. Articulation
c. Intravertebral disc
d. Spinal cord
i. Cord/canal relationship
e. Support for vertebrae
i. Alignments
ii. Tendons
iii. Facets
B. Pathology
1. Blunt
a. Mechanisms of energy transfer
i. Total body motion
ii. Sudden cessation of skull motion
iii. Continued torso motion
iv. Energy absorption C-spine
(a) Flexion
(b) Compression
(c) Extension
2. Fractures and dislocations
a. Facet fracture
b. Loss of ligamentus support
c. Subluxation
d. Dislocation
e. Stable vs unstable

Gross

Review

f. Cord lesions
   i. Motor-sensory
   ii. Vascular-skin pressure mechanism
3. Penetrating
   a. Mechanisms of injury
   b. Management
      i. Hemorrhage
         (a) Direct pressure
         (b) Packing wound
         (c) Caution with carotid pressure

C. Assessment
   1. Maintain C-spine alignment
   2. Visualize
   3. Palpate

D. Management
   1. In-line stabilization
   2. Principle of
      a. Joint above and joint below
      b. Head and thorax
      c. Thoracic and pelvis
   3. Neutral position
      a. Avoid flexion or extension
      b. Palms of hands over ears
   4. C-collar
      a. Soft
      b. Hard
      c. Provide minimal to no support and should not be used alone
   5. Short backboard
      a. Accomplish joint above and below immobilization
      b. Stabilization of head with chin strap
      c. No slippage when moving patient
      d. Use mainly for extrication
      e. Method of application
      f. Method of lifting
   6. Long backboard
      a. Immobilization with straps, not simply lying on board
      b. Transportation function
      c. Extrication function
   7. Advantages and disadvantages of various types of immobilization stress use of sandbags or towels and rolls and tape

Thorax

A. Anatomy
   1. Skin
   2. Bones
      a. Ribs

Review

For specific needs

For specific needs

b. Sternum
c. Thoracic spine
3. Muscles
a. Intracostal
b. Trapezius
c. Latisissimus dorsi
d. Rhomboids
e. Pectoralis major
f. Diaphragm
4. Lungs
a. Trachea
b. Bronchi
c. Parienchymal
d. Alveola
e. Alveolar-capillary interface
f. Pleural space
5. Vessels
a. Arteries
i. Aorta
ii. Carotid
iii. Subclavian
iv. Intracostal arteries
v. Innominate
vi. Internal mammary
vii. Ligamentum arteriosum
b. Veins
i. Superior vena cava
ii. Inferior vena cava
iii. Subclavian
iv. Internal jugular
c. Pulmonary
i. Arteries
ii. Veins
d. Heart
i. Ventricles
ii. Atrium
iii. Valves
iv. Circulation
e. Esophagus
i. Thoracic inlet
ii. Course through chest
iii. Esophageal foramen through diaphragm
B. Physiology
1. Ventilation
a. Expansion and contraction

b. Intracostal muscles
c. Diaphragm
d. Accessory muscles
e. Air pathway into alveolae

2. Respiration
a. O_2 exchange
b. CO_2 exchange
c. Pulmonary circulation
d. Cardiac circulation

3. Acidosis/alkalosis
a. Henderson-Hasselbach equation
b. Respiratory alkalosis
c. Respiratory acidosis
d. Compensation for metabolic acidosis and alkalosis

C. Pathophysiology

D. Assessment

1. Look
a. Defects
b. Airflow
c. Intracostal, supraclavicular, sternal notch, subcostal retraction or protrusion
d. Contusions or abrasions

2. Listen
a. Hissing of air through defect
b. Auscultation
i. Use of stethoscope
ii. Sounds
(a) Bronchial
(b) Parienchymal
(c) Absent
(d) Decreased
(e) Rales
(f) Rhonchi
(g) Wheezes
c. Placement of stethoscope
i. Supraclavicular decreased sounds in pneumothorax distinguish between bronchial and parienchymal
ii. Anterior chest decreased breath sounds here when pneumothorax exists, poor area for other pathology
iii. Base—decreased breath sounds here with hemothorax, good area for other pathology except pneumothorax
iv. Auscultation triangle—best area for general pulmonary pathology

3. Percussion
a. Method of percussion—finger placement—wrist motion

Pneumothorax

3rd ICS

b. Results—hyporesonance
c. Significance—hyporesonance hollow air in pleural space pneumothorax hyperexpanded lungs large alveolae, normal hyporesonance, dull blood accumulation consolidation of lung

E. Feel
1. Air leaks in chest wall
2. Defects
a. Crepitation
b. Abnormal chest wall movement
c. Subcutaneous air
d. Loss of tissue
3. Chest sounds by palpation
a. Parienchymal sounds
b. Decreased or absent sounds
4. Pathology

Pneumothorax

A. Review anatomy of chest wall and lungs
B. Review physiology of pulmonary expansion
C. Hole in chest wall
1. Air enters pleural space during decreased intrathoracic pressure
2. Air exits pleural space during increased intrathoracic pressure
3. Less resistance to air movement through normal nasal, hypopharynx, tracheal, laryngeal and bronchial pathways
4. One way flap valve lets air in but not out
5. May have lung injury

D. Types
1. Simple pneumothorax
a. Lung 1-3 cm away from chest wall
b. Stable amount of accumulation of air
c. Good pulmonary function
d. Management prehospital, given O_2 observation for progression to tension
2. Open pneumothorax
a. To and fro air motions
b. Defect in chest wall
c. One-way flap
d. Management—stop flow of air with hand, non-porous material, vaseline, or plastic three-side flap valve
e. Observation for tension pneumothorax
3. Tension pneumothorax
a. Compression of lungs on side of pathology
b. Mediastinum forced into opposite hemithorax
c. Compression of opposite lung
d. Decreased ventilation
e. Decreased cardiac output, decreased return vena cava, increased intrapulmonary pressure

Hollow

Bullous

Inhalation

Hypoxia

f. Management—relief of pressure, 2nd ICS, mid-clavicular line, aspiration, one-way valve, water seal
  i. Devices
    (a) Needle
    (b) Large decompression device relief of symptoms

4. Mechanism of injury
  a. Review of kinetics
    i. Rupture of bleb—paper bag effect of compression
    ii. Blunt trauma rib laceration of lung from compression
    iii. Chest wall and lung injury from penetrating injury

Hemothorax

A. Review anatomy of chest wall vessels, great wall vessels, pulmonary vessels, heart
B. Mechanisms of injury
C. Sources of blood
D. Tissue pressure effects of legs, arms and abdomen vs thorax
  1. La Place law
  2. Extraluminal pressure in legs
  3. Extraluminal pressure in thorax
E. Volume loss into chest
  1. Thoracic cavity volume
  2. Total blood volume
  3. Hypovolemic effect of this volume of blood loss
F. Intrapulmonary hemorrhage
  1. Bronchus
  2. Parinchymia
G. Assessment
  1. Minimal Dx in field
  2. Hypovolemia
  3. Decreased value of auscultation in field evaluation
H. Management (prehospital)
  1. Ventilation
  2. High FiO_2
  3. Hypovolemia
  4. Rapid transport

Cardiac Tampanade

A. Review anatomy and physiology
  1. Heart size and stroke volume
  2. Pericardial sac volume
  3. Cardiac refilling
B. Pathology
  1. Mechanisms of injury
    a. Penetration
      i. GSW
      ii. Knife
    b. Blunt

Spontaneous

i. Compression
ii. Rupture
2. Myocardial leak into sac
a. Compromise of cardiac refilling
b. Reduction in cardiac output
C. Assessment
1. Paradoxical pulse
2. Narrow pulse pressure
3. Increase preload
a. Distended neck veins
b. Absent with hypovolemia
4. Cardiac sounds
5. Hypotension
D. Management
1. Pericardiosynthesis
2. Subzyphoid approach
a. Same as intracardiac injection
b. Angle either to right or left shoulder
c. Device—needle (10 cm) and empty intracardiac epinephrine pre-load needle
d. Continuous aspiration
e. "V" lead of ECG—current of injury—when myocardium touched
f. Relief of symptoms, instantaneously with as little as 25 cc
3. Rapid transport to hospital

Cardiac Contusion

A. Review of anatomy
1. Sternum
2. Vertebral column
3. Heart
B. Mechanisms of injury
C. Pathophysiology
1. Contusion
a. Cellular death
b. Hemorrhage intercellular
2. Decreased contraction strength
3. ECG
a. Conduction changes
b. Multiple P.V.C.
c. Atrial fibrillation
d. Bundle branch block
D. Assessment
1. Pulse
2. ECG
3. Chest contusion

Review

4. Bent steering wheel
5. High index of suspension in frontal impact

E. Management
1. As cardiac condition indicates
2. High FiO_2
3. Continuous monitoring

Flail Chest

A. Review anatomy of chest wall
B. Review physiology of ventilation
C. Review mechanism of injury
D. Assessment
1. Paradoxical movement
   a. Minimal because of muscle spasm
   b. Must be large to compromise ventilation
2. Pain
   a. Reduces thoracic expansion
   b. Decreases ventilation
3. Pulmonary contusion
   a. Produces most serious pathology
   b. Intra alveolae-capillary hemorrhage
   c. Alveolar hemorrhage
   d. Blood not oxygenated when passing through apex

E. Management
1. Stop chest wall motion
   a. Hand
   b. Rolled sheet, sand bag, IV bag, taped to chest wall
2. Ventilatory support
   a. Positive pressure ventilation
   b. High FiO_2
   c. Intubation if necessary
3. Rapid transport to hospital
4. Bundle branch block

Abdomen

A. Anatomy
1. Anterior abdominal wall
   a. Skin
   b. Subcutaneous
   c. Muscle
   d. Fascia
2. Intra-abdominal
   a. Diaphragm
   b. Perineum floor
   c. Solid organs
      i. Spleen
      ii. Liver

iii. Pancreas

d. Hollow organs

i. Stomach

ii. Small intestine

iii. Colon

iv. Urinary bladder

v. Vascular

(a) Aorta

(b) Vena cava

(c) Iliac vessels

3. Retroperitoneal and posterior abdomen
   a. Kidney
   b. Ureters
   c. Lumbar spine
   d. Paraspinal muscles
4. Pelvis
   a. Structure
   b. Support

B. Physiology
   1. Gastric contents
   2. Small bowel—colon contents
   3. Pancreatic enzymes

C. Pathology
   1. Solid organ hemorrhage
   2. Vascular organ hemorrhage
   3. Peritonitis
      a. Peritoneal inflammation
      b. Signs and symptoms
      c. Innervation and abdomen organs
      d. Protection guarding by muscle

D. Assessment
   1. Minimal pre-hospital treatment; therefore minimal assessment required
   2. Tenderness
      a. Pain produced by peritonitis
      b. Noted by patient with pressure by the hand
   3. Guarding
      a. Resistance by abdominal muscles to deep pressure
      b. Varies with severity of peritoneal inflammation

E. Management
   1. Restoration of volume depletion
   2. Reduction of continued hemorrhage by pressure
   3. Ventilatory support as necessary
   4. Rapid transport to hospital

PASG

TOPIC	CONTENT OUTLINE
Upper Extremities	A. Anatomy

A. Anatomy
  1. Skin
     a. Layer
     b. Thickness
  2. Subcutaneous
     a. Fat
     b. Fascia
  3. Vessels
     a. Arteries
        i. Axillary
        ii. Bracheal
        iii. Radial
        iv. Ulnar
        v. Hand arcade
        vi. Digital
  4. Muscles
     a. Latissimus dorsae
     b. Trapezius
     c. Rhomboids
     d. Deltoid
     e. Triceps
     f. Biceps
     g. Forearm flexors
     h. Forearm extensors
     i. Intrinsic muscles of hand
  5. Tendons
     a. Extensors
     b. Flexors
  6. Bones
     a. Scapulae
        i. Upper division
        ii. Lower division
        iii. Glenoid fossa
     b. Clavicle
        i. Clavicle/sternal joint
        ii. Acromiar clavicular joint
     c. Humerus
        i. Head
        ii. Shoulder joint
        iii. Neck
        iv. Shaft
        v. Medial condyle
        vi. Lateral condyle
        vii. Elbow
     d. Radius

i. Elbow
ii. Head
iii. Shaft
iv. Wrist

e. Ulna
i. Elbow
ii. Olecernon
iii. Shaft
iv. Wrist

f. Carpals
i. Articulations
ii. Wrist
iii. Metacarpal joint

g. Metacarpals
i. Articulations
ii. Shaft

h. Phalanges
i. Metacarpal-phalange joint
ii. Proximal intraphalange joint
iii. Distal intraphalange joint

i. Surface anatomy

7. Function
a. Flexion
b. Extension
c. Rotation

B. Pathology
1. Fractures
a. Types
i. Open
ii. Closed

b. Location
i. Humerus
ii. Radius
iii. Ulna
iv. Metacarpal
v. Phalange

2. Dislocations
a. Acromeo clavicular
b. Shoulder
c. Elbow
i. Adult
ii. Infant

d. Wrist
e. Metacarpal-phalange
f. Phalange

3. Lacerations
   a. Protection
   b. Hemostasis
   c. Dressing
4. Hematoma
   a. Immobilization techniques
      i. General principles
         (a) Joint above and below
         (b) Immobilize open and closed fracture the same
         (c) Cover open fracture
         (d) Check neurovascular supply before and after splinting
         (e) Stabilize with in-line traction to position of normal alignment
         (f) Immobilize in this position
         (g) Immobilize dislocations in position of comfort and good vascular supply
         (h) Do not attempt to differentiate between fracture and sprain; immobilize both

C. Assessment
   1. Look
      a. Position
      b. Deformation
      c. Hematoma
      d. Swelling
      e. Discoloration
      f. Cyanosis
      g. Motion
      h. Tenderness
   2. Listen
      a. Stethoscope on sternum
      b. Percussion of acronium bilaterally
      c. Sound progression equal, no fracture
      d. Sound progression unequal, fractured humerus or clavicle ipsilateral side of diminished sound
   3. Feel
      a. Tenderness
      b. Deformation
      c. Crepitation
      d. Swelling
      e. Pulses
      f. Capillary refilling
      g. Innervation
   4. Special sports considerations
      a. Mechanism of injury
         i. Football

ii. Basketball
iii. Skiing
iv. Wrestling
v. Soccer

5. Special sports injuries
   a. Shoulder
   b. Elbow
   c. Wrist
   d. Clavicle

D. Management

1. Splints
   a. Cardboard
   b. Wood
   c. Air
   d. Traction
   e. Vacuum
   f. Short backboards
      i. Immobilization without chin strap
      ii. Immobilization of trunk first
      iii. Patient should not slip when moved
      iv. Extrication needs pelvic support
   g. Long backboard
      i. Immobilize patient to board
      ii. Immobilize joint above and below suspected fracture
2. Dislocations
   a. One attempt at realignment
   b. Specific techniques for specific joints

Lower Extremities

A. Anatomy

1. Skin
2. Subcutaneous tissue
   a. Fat
   b. Fascia
3. Vessels
   a. Arteries
      i. Femoral
      ii. Popleteal
      iii. Dorsalis pedus
      iv. Posterior tibial
      v. Anterior tibial
      vi. Foot arcade
      vii. Digital
4. Muscles
      i. Hamstring group
      ii. Quadraceps group

iii. Adductor group
iv. Gastrocenemius Solius
v. Interosseous
5. Tendons
a. Extensors
b. Flexors
6. Bones
a. Pelvic
i. Ilium
ii. Ishum
iii. Pubis
iv. Acetabulium
b. Femur
i. Head
ii. Neck
iii. Greater tuberosity
iv. Shaft
v. Medial and lateral condyles
vi. Hip joint
c. Tibia
i. Articular surface
ii. Shaft
iii. Medial malleolus
iv. Knee joint
d. Fibula
i. Shaft
ii. Lateral malleolus
e. Talus
i. Articulation
ii. Ankle joint
f. Calcaneous
i. Heel
ii. Articulation
g. Tarsals
i. Articulations
ii. Arch
h. Metatarsals
i. Arch
ii. Articulations
i. Phalanges
i. Shaft
ii. Joints
7. Function
a. Flexion
b. Extension

c. Rotation

B. Pathophysiology

1. Fractures

a. Types

i. Open

ii. Closed

b. Locations

i. Pelvis

(a) Complications

(i) Hemorrhage

(ii) Associated organs

(iii) Associated dislocations

ii. Femur

(a) Neck

(b) Shaft

(c) Supra condular

iii. Tibia

(a) Plateau

(b) Shaft

(c) Ankle

iv. Fibula

(a) Shaft

(b) Isolated

(c) Ankle

v. Ankle

(a) Fracture/dislocation

(b) Malleal fracture

(c) Tri malleolar

iv. Foot

(a) Calcanei

(b) March fracture

(c) Phalanges

2. Dislocations

a. Locations

i. Hip

(a) Posterior

(b) Anterior

(c) Association with fracture

ii. Knee

(a) Posterior

(b) Anterior

(c) Patella

iii. Ankle

(a) Posterior

(b) Fracture association

Bladder, Vagina, rectum, etc.

Special considerations

(c) Blood association

3. Sprain
4. Special sports consideration
    a. Mechanism of injury
        i. Football
        ii. Basketball
        iii. Skiing
        iv. Wrestling
        v. Soccer
    b. Specific injuries
        i. Knee
        ii. Ankle
        iii. Foot
        iv. Tibia/fibula

C. Assessment
1. Look
    a. Position
    b. Deformation
    c. Hematoma
    d. Swelling
    e. Discoloration
    f. Cyanosis
    g. Motion
2. Listen
    a. Stethoscope on synthesis pubis
    b. Percuss patella bilaterally
    c. Sound progression means no fracture if equal bilaterally
    d. Sound progression unilaterally decreased means an ipsilateral fracture
3. Feel
    a. Tenderness
    b. Deformity
    c. Crepitation
    d. Swelling
    e. Pulses
    f. Capillary refilling
    g. Innervation

D. Management
1. Fractures
    a. Pelvis
        i. Backboard
        ii. PASG device
    b. Femur
        i. Traction device
        ii. PASG device

General considerations see upper extremity

iii. Long backboard
iv. Long board
v. Opposite extremity
c. Tibia/fibula
i. Traction device
ii. Pneumatic splint
iii. Long board
iv. Opposite leg
v. Cardboard
vi. Other
d. Ankle—same as tibia/fibula fractures, generally involves distal tibia and fibula
e. Foot
i. Pneumatic
ii. Cardboard
iii. Ladder
iv. Other
2. Dislocations
a. Hip
i. Assessment
ii. Realignment
(a) One attempt
(b) As soon after injury as possible
(c) Do not attempt if associated with other severe injury(s)
(d) Analgesia NO_2, Valium if no other injuries
(e) Procedure
(i) Traction
(ii) Hip 90 degrees
~~(iii) Knee 90 degrees~~
(iv) Along shaft of femur
(v) Steady and slow to relax muscle spasm
(vi) Success, "pop" into joint, sudden relief of pain, leg can be returned to 180 degrees
(vii) Immobilization, 180 degrees, long backboard, reevaluation of pulses and innervation
(viii) Immobilization, 90 degrees, pillows, chair, cardboard, supine position of patient
B. Knee
1. Assessment
a. Position
i. Anterior
ii. Posterior
b. Distal pulses
c. Innervations
2. Realignment

Anterior posterior leg position

Look, listen feel

Posterior only

Non-aligned

- a. One attempt only
- b. As soon as possible

3. Analgesic
   - a. NO_2
   - b. Valium if no other injury
4. Procedure
   - a. Traction
   - b. 180 degrees
   - c. Steady pull to relax muscle spasm
5. Success
   - a. "Pop" into joint
   - b. Relief of pain
   - c. Normal alignment
   - d. Knee mobile
6. Immobilize
   - a. 180 degrees
   - b. Backboard
   - c. Long board
   - d. No traction
   - e. Pulses
7. Immobilize
   - a. Position of greatest comfort

C. Ankle
1. Assessment
   - a. Usually posterior
   - b. Pulse and innervation
2. Realignment
   - a. One attempt
   - b. As soon after injury as possible
   - c. Do not attempt if associated with other severe injuries
   - d. Analgesia
     - i. NO_2
     - ii. Valium if no other injuries
   - e. Procedure
     - i. 180 degrees
     - ii. Traction on tibia
     - iii. Slow and steady to relax spasm
   - f. Success
     - i. Sudden rotation to normal position
   - g. Immobilization
     - i. As per fracture
     - ii. Check distal pulse

Neurological

A. Anatomy
1. Skull

Aligned

Nonaligned

a. Shape
b. Bones
i. Frontal
ii. Parietal
iii. Occipital
iv. Temporal
2. Brain
a. Cerebral hemispheres
b. Cerebellum
c. Midbrain
d. Brain stems
e. Frontal lobe
f. Occipital lobe
3. Vessels
a. Arteries
i. Cartoid
ii. Vertebrae internal/external
iii. Circle of Willis'
iv. Anterior cerebral artery
v. Posterior cerebral artery
vi. Middle cerebral artery
vii. Meningeal arteries
4. Veins
a. Jugular vein
b. Vertebral vein
5. Vertebrae
a. Shape
i. Body
ii. Pedicle
iii. Lamina
iv. Arch
v. Facet
vi. Transverse process
vii. Spiness process
b. Cervical
i. Canal vs cord size
ii. Curve
iii. Atlas
iv. Axis
v. Contour
vi. Foruanae
c. Thoracic
i. Contour
ii. Canal vs. cord size
iii. Foraming

d. Lumbar
  i. Contour
  ii. Canal vs cord size
  iii. Pelvic attachment
e. Sacral
  i. Position
  ii. Shape

6. Spinal cord
  a. Shape
  b. X-section
  c. Spinal nerves
  d. Dermatoma innervation
    i. C-2
    ii. C-3
    iii. C-7
    iv. T-4
    v. T-10
    vi. S-1
    vii. Phrenic nerve
  e. Cauda equina

B. Assessment
  1. Primary Survey
    a. Pupil
      i. Size
      ii. Equality
      iii. Reactivity
  2. Level of consciousness
    a. Alert vocal
    b. Vocal stimuli response
    c. Painful stimuli response
    d. Unresponsive
  3. Secondary survey
    a. Motor function
    b. Flexor groups
    c. Extensor functions
    d. Sensory functions
      i. Skin sensation
      ii. Location
  4. Glasgow Coma Scale

Monitoring Techniques

A. Trauma score
  1. Anatomical scoring
    a. Abbreviated injury scale
      i. Developed by American Association of Automotive Medicine

ii. Revised each 4 years
iii. Accepted by Society of Automotive Engineers
iv. Initial development done in cooperation with AMA
v. Not prehospital tool
vi. Based on autopsy or discharge diagnosis

2. Injury Severity Score
   a. Based in AIS
   b. Sum of the squares of three most severely injured anatomic body regions
   c. $ISS = A^2 + B^2 + C^2$
      i. A = body region with most severe injury
      ii. B = body region with second most severe injury
      iii. C = body region with third most severe injury
3. Physiological
   a. Based on clinical findings
   b. Similar to Apgar Score for newborns
   c. Trauma Score (T.S.)
      i. Most widely used
      ii. Validated by thousands of patients
      iii. Defines severity of injury
      iv. Early scores more reliable for blunt trauma

B. Utilization of Trauma Scoring
   1. Indications of severity of injuries
      a. To determine need for Level I Trauma Center
      b. To determine speed necessary to access medical facility
      c. To identify change in patient status
   2. Identification of patients who should not be resuscitated due to trauma
      a. Trauma Score of 1 for ten (10) minutes
   3. Communication of severity of patient injuries to Medical Command Authority
   4. Research tool to identify types of patients handled and outcome of treatment
   5. Quality assurance tool to identify the care given to the patient by the EMT or the EMS Service

C. Methodology
   1. Determine numerical value of each category
   2. Add all five categories to determine Trauma Score

D. Results
   1. Estimated

Survival T.S.	% Survival
16	99
15	98
14	96
13	93
12	87
11	76

1980-84, etc.

ISS

If available

Survival T.S.	% Survival
10	60
9	42
8	26
7	15
6	8
5	4
4	2
3	1
2	0
1	0

2. Patients who respond favorably to prehospital care have T.S. between 12 and 4

Reassessment and Monitoring

A. Initial vital signs, neurological status, respiratory efforts, color, temperature, ECG, should be reevaluated and recorded at least every five (5) minutes while on the scene and en route to the hospital
B. Areas of abnormality should be recorded with greater frequency
C. Status of fluid replacement
   1. IV rate
   2. Response to Rx etc.
D. Amount and rate of O_2 flow every five minutes
E. Repeat primary survey every five minutes
F. Reassess areas of injury for adequacy of stabilization
G. Repeat physical exam to identify missed injuries or complications by present Rx.

Transportation

A. Move from scene as rapidly as possible
   1. Definitive care of injury is in hospital
   2. Injury (specifically) and patient (generally) will continue to deteriorate on the scene
   3. Golden Hour from time of injury definitive treatment
   4. Unnecessary delay allows progression of pathophysiology associated with injury
B. Severely injured patient packaged as single unit to backboard. Time required to immobilize injuries or to start a field IV will delay treatment
C. IV started en route
   1. Setting up IV (tearing tape, getting administration set up, tourniquet, prepping skin, etc.), done with unit rolling
   2. If IV difficult to start, stop unit until needle inserted
   3. Unit rolling again
   4. Delay time 0-2 minutes to initiate IV by this method. Delay time 5-10 minutes if IV started before patient is loaded
   5. Patient taken to closest appropriate hospital
      a. As identified by previously established protocols
      b. As identified by Medical Command Authority while call is in progress

Every 5 min.

Usually O.R.

Division 3: Trauma

Section 2. Burns

TOPIC	CONTENT OUTLINE
Introduction	The burn injury is too often treated as a single organ injury with other organs, systems and structures of the body overlooked in initial care. The magnitude of the injury can be reduced by aggressively extinguishing the burn process, providing appropriate life support and transporting to the appropriate medical facility. This section defines parameters and discusses anatomy and physiology as related to a burn injury; presents pathophysiology related to specific source of burn injury; and presents patient-related detail assessment and specific management of burns.
Overview	I. Introduction II. Anatomy and Physiology III. Pathophysiology of Burn Shock IV. Major Sources of Burn Injury V. Classifications of Burn Injury VI. Categories of Burn Injury by Severity VII. Factors Altering Severity of Injury VIII. Calculation of Body Surface Area IX. Fluid Resuscitation Formulas X. Management XI. Management of Electrical Burns XII. Management of Chemical Burns XIII. Inhalation Injuries
Objectives	At the completion of this section, the student will be able to: 3.2.1 Describe the structure of the integumentary system. 3.2.2 Describe the function of the integumentary system. 3.2.3 Define the movement of body fluids between plasma and interstitial compartments. 3.2.4 Define the movement of body fluids between interstitial and intercellular compartments. 3.2.5 Describe the pathophysiology of burn shock. 3.2.6 State the four major sources of burn injury. 3.2.7 Describe the four classifications of burn injury. 3.2.8 Describe the three categories of burn injury by severity. 3.2.9 List the factors altering severity of burn injury. 3.2.10 Given a diagram, calculate the percentages of body surface areas burned. 3.2.11 List and describe one of two fluid resuscitation formulas. 3.2.12 Describe assessment and management of burn injury by source. 3.2.13 Describe management of burn injury when associated with other injuries or when medical conditions are present. 3.2.14 List factors contributing to inhalation injury. 3.2.15 Describe assessment and management of inhalation injury.

TOPIC	CONTENT OUTLINE
Introduction	A. Prehospital care reduces morbidity/mortality B. Beneficial in minimizing size and depth of injury C. Appropriate medical facility 1. Burn facility D. Prevention

Anatomy and Physiology	A. Structure of the integumentary system
	    1. Epidermis
	        a. Stratified squamous epithelium
	            i. Stratum basale
	            ii. Stratum spinosum
	            iii. Stratum granulosum
	            iv. Stratum lucidum
	            v. Stratum corneum
	    2. Dermis
	        a. Papillary layer
	            i. Dermal papillae
	        b. Reticular layer
	        c. Connective tissue
	            i. Collagenous fibers
	            ii. Elastic fibers
	        d. Embedded structures
	            i. Blood vessels
	            ii. Nerve endings
	            iii. Sebaceous glands
	            iv. Sweat glands
	            v. Hair follicles
	B. Function of the integumentary system
	    1. Protection of underlying tissues
	        a. Bacteria
	        b. Dehydration
	    2. Body temperature regulation
	    3. Maintenance of chemical compounds
	        a. Water
	        b. Salts
	        c. Organic material
	        d. Inorganic material
	    4. Receive environmental stimuli
	    5. Excretory gland
	    6. Produces vitamin D
	    7. Determines identity
	    8. Exfoliate

TOPIC	CONTENT OUTLINE
Pathophysiology of Burn Shock	A. Normal mechanisms of hemostasis 1. Intravascular hydrostatic pressure 2. Interstitial hydrostatic pressure 3. Intervascular osmotic pressure 4. Interstitial osmotic pressure 5. Capillary sphincter a. Arterial b. Venous B. Effective filtration pressure C. Alterations from burn injury 1. Pain and psychic injury 2. Hypovolemic shock a. Transudation b. Sequestration c. Sodium translocation d. Plasma volume e. Hematocrit elevation 3. Vascular bed leakage 4. Evaporation from damaged surface 5. Cardiac output a. Drop of 30-50% b. Critical initial decrease 6. Equilibrium in 24 hours
Major Sources of Burn Injury	A. Thermal 1. Radiation of heat 2. Conduction of heat a. Hot liquids b. Hot solids c. Hot gases 3. Flame B. Electrical 1. Flash 2. Contact C. Chemical D. Radiation
Classifications of Burn Injury	A. First degree 1. Loss of epidermis 2. Erythemia only 3. Hyperalgesia 4. Healing time: 3-7 days B. Superficial second degree 1. No loss of dermis 2. Erythemia with bullae

Starling's law.

Edema.

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3. Moist, weeping
4. Hyperalgesia
5. Healing time: 6-14 days

C. Deep second degree
1. Loss of deep dermis; skin appendages preserved
2. Pink, white or tan color
3. Hyperalgesia to analgesia
4. Healing time: 14-21 days
   a. May require grafting

D. Third degree
1. Loss of all epidermis and dermis
2. White, charred, tan color
3. Analgesia
4. Requires grafting

Categories of Burn Injury by Severity

A. Critical burns
1. Second degree burn involving more than 30% of the body surface area
2. Third degree burn involving more than 10% of the body surface area
3. Burns complicated by respiratory injury
4. Almost all burns of the face, hands, feet or genitalia
5. Burns complicated by fracture or major soft tissue injury
6. Electrical and deep acid burns
7. Burns occurring in patients with underlying physical or medical conditions

B. Moderate burns
1. Second degree burns involving:
   a. 15-30% body surface area
   b. Excluding hands, feet or face
2. Second degree burns involving
   a. 15-25% body surface area in adults
   b. 10-20% body surface area in children
3. Third degree burns involving 2-10% of body surface area

C. Minor burns
1. Second degree burns involving:
   a. Less than 15% body surface area in adults
   b. Less than 10% body surface area in children
2. Third degree burn involving less than 2% body surface
3. First degree burn involving less than 20% body surface area excluding hands, feet and face

Factors Altering Severity of Injury

A. Incident related factors
1. Confinement in area of fire
2. Associated injuries
3. Time elapsed prior to intervention
4. Nature of injury

Burn patients usually die from hypovolemic shock or severe infection.

Caution of areas involving flexion; elbow, neck & axilla.

TOPIC	CONTENT OUTLINE
	B. Patient related factors 1. Age 2. Pre-existing diseases 3. Nutritional status 4. Area and classification of injury 5. Injury to face, hands, feet or genitalia 6. Extent of burn 7. Associated injuries
Calculation of Body Surface Area	A. Rule of nines 1. Head: 9% 2. Arm: 9% 3. Chest and abdomen: 18% 4. Back and buttocks: 18% 5. Leg: 18% each 6. Genitalia: 1% B. Lund and Browder 1. Chest and abdomen: 13% 2. Back: 13% 3. Buttocks: 2.5% each 4. Upper arm: 4% each 5. Forearm: 3% each 6. Hand: 3% each 7. Foot: 3.5% each 8. Areas affected by growth: head, thigh, leg C. Area equivalent measurement 1. Surface of patient's hand
Fluid Resuscitation Formulas	A. Parkland formula 1. First 24 hours: 4 ml lactated Ringer's/kg body weight/% body surface area burned a. Give 50% of this amount first 8 hours post-burn b. Give 50% in next 16 hours post-burn 2. Second 24 hours: continue lactated Ringer's as needed a. Begin giving 2000 ml 5% dextrose in water b. Add plasma or blood as indicated 3. Objective a. Maintain heart rate below 110/min b. Maintain sensorium normal c. Maintain urine output at 30-50 ml/hr B. Brooke formula 1. First 24 hours: 2.0 ml lactated Ringer's/kg body weight/% body surface burned a. Give 50% of amount in first 8 hours post-burn b. Give remaining 50% in next 16 hours post-burn 2. Second 24 hours

In children under 2 years and in adults over 60 years of age, the mortality with even small burns rises sharply

Estimation is sufficient for emergency situations.

Charting of relative percentages of areas as affected by growth.

An area equivalent to the patient's hand is approximately 1% of the body surface area.

Local protocols on fluid resuscitation.

Local protocol on fluid resuscitation.

a. Give 2000 ml 5% dextrose in water
b. Give plasma or blood as indicated

3. Objective
   a. Maintain pulse rate below 110/min
   b. Maintain normal sensorium
   c. Maintain urine output between 30-50 ml/hr
4. Second 24 hours
   a. Give dextrose in water sufficient to maintain serum sodium level at 140 mEg/liter
   b. Potassium chloride supplements to maintain serum level potassium within normal limits
   c. Plasma or plasmanate substitutes to return plasma volume to normal

Management of Thermal Burns Injury

A. History
   1. How long ago did the burn occur
   2. What, if any, has been done by the patient or bystander for the injury
   3. Was the patient in a closed space
      a. Involving steam, smoke, or combustive products
      b. For what period of time
      c. With loss of consciousness
   4. What was the specific source of burn
   5. Does patient's past medical history include:
      a. Heart disease that might complicate fluid therapy
      b. Pulmonary problems that may cause more severe reaction to smoke inhalation
      c. Other serious underlying illness
   6. Does the patient have any allergies

B. General management of the burn injury
   1. Remove the patient from source of heat
      a. Initiate cooling if seen within 30 minutes of event
      b. Extinguish and remove clothing/jewelry
      c. Do not cause a drop in core temperature
   2. Secure airway breathing and circulation
      a. Esophageal obturator airway
      b. Endotracheal intubation
   3. Assess level of consciousness
   4. Oxygen therapy
      a. Simple mask
      b. Bag-valve-mask, ventilations assisted
   5. Secondary assessment
   6. Monitor ECG; document rhythm
   7. Initiate IV therapy
      a. IV fluid solution
      b. IV site selection
      c. IV fluid rate

Diabetes, pregnant, epilepsy.

Discuss precautions with the use of ice, icewater and snow when used in cooling burns

Airway management as indicated

Vital signs, pupils skin, head, face, neck, chest, abdomen, ext.

Parkland, Brooke, Baxter formulas, or local Protocols

8. Dress burn injury
   a. Dry sterile dressing
   b. Do not apply ointment, salves or sprays
   c. Maintain body temperature
9. Definitive care of associated injuries
   a. Suspected injuries
   b. Obvious injuries

C. Specific therapeutic management process
1. Analgesics
   a. Morphine sulfate
      i. Intravenously only
      ii. 2.0 mg/minute
      iii. 10.0 mg maximum
   b. Nitronox
      i. 50:50/oxygen/nitrous oxide
      ii. Patient administered
      iii. Intermittent administration
      iv. Supplemented with oxygen
2. Pnuematic Antishock Garment
   a. Shock due to injuries other than burn injury
   b. Should accompany fluid resuscitation
3. Cardiopulmonary resuscitation
   a. Performed regardless of injury
   b. Chemical ingestion requires mechanical airway management

Management of Electrical Burn Injury

A. Electrical damage
1. Generation of heat
2. Interference with electrical activity of organs having neurological conduction system
3. Damage to blood vessels endothelium
4. Unpredictable course from entrance to exit surfaces
5. Variation in tissue response to current
6. Thermal burn injury as a result of flames

B. Electrical current
1. Direct current and alternating current
2. Amount of current
3. Duration of exposure
4. Dry or moist skin resistance
5. Resistance of skin versus interior body
   a. Current flow along blood vessels, nerves
   b. Low voltage and vessel resistance
   c. High voltage and shortest path
6. Tetanic spasm, immobilization, muscle condition

C. Types of burn injury
1. Contact burns

(MS04)

Repeat as needed.

(PASG) See Division 2, Section 4.

See AHA current standards.

Burning of clothing

100 milliamperes can cause ventricular fibrillation

Individual unable to release contact with electrical source if milliampes exceed 22.

a. Entrance and bull's eye exit
b. Charred zone of third-degree
c. Peripheral gray, dry skin region
d. Outer red zone of coagulation necrosis

2. Flash burns
   a. Arc associated
   b. Intense heat
   c. Craterlike appearance
   d. Minimal deep internal damage
3. Flame burns
   a. Ignition of wearing apparel
   b. Internal and external damage

D. Electrical burn injury
   1. Disengagement from source
      a. Patient contact
      b. Metal objects in contact
      c. Presence of moisture
      d. Insulated devices
   2. Remove the patient from source of heat
      a. Initiate cooling if seen within 30 minutes of event
      b. Extinguish and remove clothing/jewelry
      c. Do not cause a drop in core temperature
   3. Secure airway breathing and circulation
      a. Esophageal obturator airway
      b. Endotracheal intubation
   4. Assess level of consciousness
   5. Oxygen therapy
      a. Simple mask
      b. Bag-valve-mask, ventilations assisted
   6. Secondary assessment
   7. Examine for entrance and exit wound
   8. Monitor ECG; document rhythm
   9. Initiate IV therapy
      a. IV fluid solution
      b. IV site selection
      c. IV fluid rate
   10. Dress burn injury
      a. Dry sterile dressing
      b. Do not apply ointment, salves or sprays
      c. Maintain body temperature
      d. Do not attempt bullae rupture
   11. Analgesia
      a. Medication route; IV
      b. Respiratory depression
   12. Definitive care of associated injuries

Rescuer protection.

Contact power company.

Rubber gloves wooden pole, lasso

Clothing adhered to skin should not be removed. Discuss precautions with the use of ice, ice water & snow when used cooling the burn.

Airway management as indicated.

Vital signs, pupils, head, face, neck, chest, abdomen, extremities.

Parkland, Brooke or Local Protocol

a. Suspected injuries
b. Obvious injuries

Management of Chemical Burn Injury

A. Chemical injury
1. Coagulation of proteins
2. Burn continues as long as contact is present
3. Dry/wet chemicals
4. Wet chemicals not removable by water
5. Dry chemicals brushed
6. Dry chemicals lavaged
7. Removal of all wearing apparel
8. Exposure
a. Contact
b. Ingestion
c. Inhalation
d. Injection
9. Irrigate for 20 to 30 minutes
10. Depth of tissue change determines:
a. Nature of substance
b. Concentration of chemical
c. Temperature of chemical
d. Duration of contact

B. Special consideration
1. Sodium metal
a. Oil base coverage
b. Rapid hydrogen release in water
2. Concentrated sulfuric acid
a. Copious amount of water usage
b. Sodium bicarbonate lavage or as water additive
3. Muriatic acid
a. Copious amounts of water lavage
b. Sodium biocarbonate lavage or as water additive

C. Other management considerations
1. Avoid water with sulfuric acid, hydrochloric acid, muriatic acid
2. Use oil with mustard gas, sodium metal, phenol, white phosporous
3. Soda and water for gasoline
4. Hydrofloric acid burns—copious amounts of water
5. Phenol is not water soluble
6. Sulfuric acid—use soap, avoid water

D. Eye injuries
1. Remove contact lens
2. Flush with copious amounts of water for 5 minutes
a. Acid burn: 5 minutes minimum
b. Alkali burn: 15 minutes minimum
c. Flush under eyelid

Coagulation by: Reduction, oxidation, salt formation, corrosion, proto plasmic poisoning, metabolic competition/inhibition, dessication, ischemic accompanying blistering.

Lime.
Caution personal exposure

Eye injury. Caution: Contact lens.

Chemical to water ratio of 1:100 parts lavage.

TOPIC	CONTENT OUTLINE
	3. Do not use antidote 4. Cover both eyes with sterile dressing E. Chemical burn injury 1. Remove patient for source of injury a. Avoid personal contamination 2. Extinguish burning process a. Initiate cooling if seen within 30 minutes of event b. Extinguish and remove clothing/jewelry c. Do not cause a drop in core temperature 3. Secure airway breathing and circulation a. Esophageal obturator airway b. Endotracheal intubation 4. Assess level of consciousness 5. Oxygen therapy a. Simple mask b. Bag-valve-mask, ventilations assisted 6. Secondary assessment 7. Monitor ECG; document rhythm 8. Ingestion procedures a. Procedures for poisoning b. Stabilize, basic life support 9. Initiate IV therapy a. IV fluid solution b. IV site selection c. IV fluid rate 10. Dress burn injury a. Dry sterile dressing b. Do not apply ointment, salves or sprays c. Maintain body temperature d. Do not attempt bullae rupture 11. Analgesia a. Medication route; IV b. Respiratory depression 12. Definitive care of associated injuries a. Suspected injuries b. Obvious injuries
Inhalation Injuries	A. History 1. Flames in closed space 2. Explosions 3. Combustion within respiratory tract 4. Chemical; toxic combustion a. Wood, cotton, paper b. Petroleum products c. Wool, silk

Clothing adhered to skin should not be removed.
Discuss precautions with the use of ice, icewater and snow when used in cooling burns.
Airway management, as indicated.
Contraindicated, in caustic ingestion

Vital signs, pupils skin, head, face, neck, chest, abdomen, ext.

Parkland, Brooke or local Protocol

d. Polymer plastics
5. Toxin in smoke
 a. Oxides of sulphur nitrogen
 b. Ozone
 c. Carbon monoxide
6. Thermal injury to the lung
 a. Steam
  i. Increased latent heat
 b. Dry heat
  i. Upper airway damage
  ii. Limited lower airway damage
7. Pre-existing respiratory problem
8. History of smoking

B. Physical examination
1. External findings
 a. Deep facial burns
 b. Singed nasal hair
 c. Blistering around mouth
 d. Sooty tongue/pharynx
 e. Restlessness, confusion
 f. Labored or rapid breathing
 g. Continued exhalation of smoke
 h. Coughing
 i. Fractured ribs
2. Breath sounds
 a. Usually normal first 1-2 hours
 b. Onset of rales ominous sign

C. Physical complication
1. Upper airway injuries
 a. Upper airway edema
 b. Upper airway collapse
2. Membrane damage
 a. Cilia damage
 b. Mucosal slough
3. Surfactant loss
4. Chemical bronchitis
5. Chestwall musculature damage
 a. Decreased chest wall movement
 b. Muscular burden
6. Physical fatigue

D. Physiological response
1. Bronchospasm
 a. Irritating chemicals
 b. Smooth muscle reflexes
2. Tidal volume breathing

Produces most serious thermal burn

Nose, lips, tongue, pharynx, larynx.

20%

a. Alveolar collapse
b. Decreased compliance
c. Decreased lung volume
d. Atelectasis
e. Shunting

3. Pulmonary edema
   a. Fluid infusion in acute phase
   b. Myocardial decompensation
   c. Changes in capillary periability

E. Management
1. Inhalation injury
2. Secure patient airway
3. Fowler's position
4. Humidified 100% oxygen
5. Cough and deep breathe
6. Bronchodilators

Suction, airway EOA,
intubation

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Division 4: Medical

Section 1. Respiratory Section

TOPIC	CONTENT OUTLINE

Introduction

The student must have successfully completed the following divisions and sections prior to participating in this section:

Division 1: Prehospital Environment (Sections 1–7)

Division 2: Preparatory (Sections 1–5)

The respiratory section discusses the anatomy and physiology of the normal respiratory function and mechanics of respiration. Assessment of the respiratory system is emphasized. The pathophysiology of problems leading to respiratory distress are explored and the management of these disorders detailed. Evaluation and management of respiratory distress due to medical or trauma-related problems is of utmost importance in the EMT-P's total patient management. Compromise of the respiratory system greatly reduces the patient's chance for survival and may negate management of insult or injury to other body systems. This section will deal with medical problems complicating respiratory status. Traumatic insults are covered in the Trauma Division.

Overview

I. Anatomy and Physiology

II. Assessment

III. Pathophysiology and Management of Respiratory Disorders

- A. Upper Airway Obstruction
- B. Obstructive Airway Disease
- C. Pneumonia
- D. Toxic Inhalations
- E. Carbon Monoxide Inhalation
- F. Pulmonary Embolism
- G. Hyperventilation Syndrome
- H. CNS Dysfunction
- I. Dysfunction of Spinal Cord, Nerves or Respiratory Muscles
- J. General Principles and Management of Acute Respiratory Insufficiency

Objectives

At the completion of this section, the student will be able to:

4.1.1 Identify and describe the function of the structures of the upper respiratory tract.

4.1.2 Identify and describe the function of the structures of the lower respiratory tract.

4.1.3 Define the terms respiration and pulmonary ventilation.

4.1.4 Describe the physiology of the respiratory cycle.

4.1.5 Describe the pulmonary circulation.

4.1.6 Describe the process of gas exchange in the lungs.

4.1.7 Identify the normal partial pressures of oxygen and carbon dioxide in:

- a. The alveoli
- b. Venous blood
- c. Arterial blood

4.1.8 Identify the systems involved in the process of regulation of respiration.

4.1.9 Describe the difference between the normal respiratory drive and the respiratory drive of the patient with chronic obstructive pulmonary disease.

4.1.10 Define and describe the following modified forms of respiration.
- a. Cough
- b. Sneeze
- c. Hiccough
- d. Sigh
- e. Grunting

4.1.11 List normal respiratory rates for adults, infants and children.

4.1.12 Identify factors that affect respiratory rates.

4.1.13 Define the following terms:
- a. Dead space
- b. Tidal volume
- c. Minute volume
- d. Vital capacity

4.1.14 Identify factors that alter carbon dioxide levels in the blood.

4.1.15 Identify factors that alter oxygen levels in the blood.

4.1.16 Define the following terms:
- a. Hypoxia
- b. Hypoxemia
- c. Hypercarbia
- d. Respiratory failure
- e. Cyanosis
- f. Dyspnea
- g. Tachypnea
- h. Hyperpnea
- i. Orthopnea
- j. Apnea
- k. Hypoventilation
- l. Hyperventilation
- m. Tracheal tugging
- n. Nasal flaring

4.1.17 Identify the historical factors to be ellicited when evaluating the respiratory system.

4.1.18 Identify specific observations and physical findings to be evaluated in the patient with a respiratory complaint.

4.1.19 Describe the the techniques of inspection, auscultation, and palpation of the chest.

4.1.20 Define the following terms:
- a. Snoring respirations
- b. Stridor
- c. Wheezing
- d. Rhonchi
- e. Rales
- f. Friction rub

4.1.21 Identify the basic principles of airway management.

4.1.22 Identify the causes of upper airway obstruction, the pathophysiology, assessment and management of each.

4.1.23 For the following drugs, identify the pharmacology and actions, the indication, precaution, administration and side effects for the adult and pediatric patient:
- a. Oxygen
- b. Epinephrine

c. Bronksol
d. Racemic epinephrine
e. Aminophylline
f. Diphenhydramine

4.1.24 Discuss the pathophysiology, assessment and management of the following:
a. Emphysema
b. Chronic bronchitis
c. Asthma
  i. Adult
  ii. Pediatric
d. Pneumonia
e. Toxic inhalation
f. Pulmonary embolism
g. Hyperventilation syndrome
h. Central nervous system dysfunctions

S4.1.25 Demonstrate the technique of direct laryngoscopy.

S4.1.26 Demonstrate the upper airway obstruction protocol according to American Heart Association standards.

S4.1.27 Demonstrate the techniques of inspection, auscultation, and palpation in examining the thorax.

S4.1.28 Identify the following abnormal lung sounds:
a. Stridor
b. Wheezes
c. Rales
d. Rhonchi

S4.1.29 Demonstrate the ability to obtain an appropriate history when evaluating patients with respiratory complaints.

S4.1.30 Demonstrate the ability to perform an appropriate assessment when evaluating patients with respiratory complaints.

S4.1.31 Demonstrate the ability to appropriately administer the following drugs for the adult and pediatric patient:
a. Oxygen
b. Epinephrine
c. Bronksol
d. Racemic epinephrine
e. Aminophylline
f. Diphenhydramine

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE

Anatomy and Physiology of the Respiratory System: Upper Airway

A. Upper respiratory tract
  1. Nasal cavities
     a. Nasal septum
     b. Turbinates
     c. Palate
  2. Pharynx
     a. Nasopharynx
     b. Oropharynx (including uvula)
     c. Laryngopharynx
     d. Tonsils/adenoids
  3. Larynx
     a. Thyroid cartilage
     b. Arytenoid cartilage
     c. Vocal cords
     d. Cricoid cartilage
     e. Epiglottis
  4. Function of upper respiratory tract
     a. Warm the air before reaching the lungs
     b. Provides humidification of air
     c. Cleans the airway
        i. Turbinates create a turbulent air flow
        ii. Foreign matter precipitates to the mucus membrane of the nose and nasopharynx
        iii. Cilia move foreign particles toward the pharynx

Lower Airway

A. Lower respiratory tract
  1. Trachea
     a. C-shaped, incomplete rings
     b. 10-12 centimeters
     c. Respiratory epithelium contains ciliated and mucus-producing cells
  2. Right and left mainstem bronchi
     a. Carina
     b. Length and position of bronchi
  3. Secondary bronchi
  4. Bronchioles
  5. Respiratory bronchioles (contain only connective muscular tissue)
  6. Alveolar ducts
  7. Alveolar sacs
  8. Alveoli
     a. Most important functional unit of system
     b. O_2, CO_2 exchange occur
     c. Hollow, thin-walled
     d. Capillary system covers the outer surface via terminal branches of the pulmonary artery

4-5 inches long

9. Lungs
   a. Comprised of the respiratory bronchioles and alveoli
   b. Position in thoracic cavity
   c. Visceral pleura
   d. Parietal pleura
   e. Pleural space
   f. Right lung
      i. Upper lobe
      ii. Middle lobe
      iii. Lower lobe
   g. Left lung
      i. Upper lobe
      ii. Lower lobe
   h. Blood supply
      i. Pulmonary artery and veins
      ii. Bronchial artery and veins

Mechanics

A. Mechanics of respiration/ventilation
1. Definition
   a. Respiration—exchange of gases between a living organism and its environment
   b. Pulmonary ventilation—process that moves air into and out of the lungs
2. Respiratory cycle
   a. Involves respiratory system, central nervous system, musculoskeletal system
   b. Begins from midpoint or position of thorax after a normal expiration; air pressure inside lungs is equal to atmospheric pressure
   c. Inspiration
      i. Initiated by contraction of diaphragm and intercostal muscles
      ii. Flattening of diaphragm toward the abdomen with resulting increase in the vertical dimensions of the thoracic cavity
      iii. Elevation of the ribs upward and outward to increase the horizontal and transverse dimensions of the thoracic cavity
      iv. The highly elastic lungs assume the contour change resulting in larger lung dimensions
         (a) The same air volume in the lung occupies a larger space
         (b) Air pressure in the lung decreases rapidly
         (c) Air flows in through respiratory passage since pressure in the airways is less than atmospheric pressure
   d. Expiration
      i. Occurs as inspiratory muscles relax
      ii. Decreasing thoracic volume and increasing intra-thoracic pressure

Oxygen and carbon dioxide across membranes.

Above atmospheric pressure.

iii. Air is thereby forced out of the lungs
iv. Normal expiration is a passive process

e. In respiratory inadequacy, accessory muscles aid inspiration and expiration
i. Abdominal wall muscles
ii. Neck muscles

3. Pulmonary circulation
a. Body cells take oxygen from the blood (arterial system) and return carbon dioxide to the blood (venous system)
b. The venous system returns oxygen-poor, carbon dioxide-rich blood to the right side of the heart
c. The right ventricle pumps that blood into the pulmonary artery
i. The artery bifurcates into left and right bronchus supplying the respective lungs
ii. Both branches rapidly split into smaller vessels and eventually into microscopic pulmonary capillaries that:
(a) Spread over the surface of the air sacs, where the blood picks up oxygen
(b) Recombine into sequentially larger vessels forming the pulmonary veins
d. Pulmonary veins empty into the left atrium and then into the left ventricle from which oxygen-rich blood is pumped and circulated through the systemic arterial system

4. Gas exchange in the lungs
a. Process opposite to that normally occuring in the body, i.e., blood returning from the body is low in oxygen, high in carbon dioxide
b. Measurement of oxygen and carbon dioxide
i. Definition
(a) Partial pressure—describes the amount of gas in a mixture
(i) Sum of all gases present must equal the total gas pressure
(ii) Any partial pressure of any one gas is a fractional concentration of the total gas mixture
ii. Total gas pressure (sea level) equals atmospheric pressure or 760 mmHg
(a) Torr equals 1 mmHg
(b) One atmosphere equals 14.7 lb/sq in
iii. Concentrations
(a) Room air equals 21% oxygen and 0.03% carbon dioxide
(b) Breathing room air produces PO_2 (PaO_2) of 140 torr and PCO_2 ($PaCO_2$) close to zero in the alveoli
(c) Venous blood from tissues contains PO_2 of 40 torr and PCO_2 of 46 torr
(d) Room air also contains 79% nitrogen

(i) No metabolic function

(ii) Necessary for maintaining inflation of body cavities that are gas filled

iv. Diffusion

(a) Gases diffuse from areas of higher partial pressure concentrations to areas of lower partial pressure concentrations

(b) Rate of gas diffusion across pulmonary membranes depends on solubility in water

(c) Oxygen diffuses into blood plasma and combines with hemoglobin

(i) Each gram of saturated hemoglobin carries 1.34 ml of O_2

(ii) Hemoglobin is close to being fully saturated at PO_2 of 50-100 mHg

(iii) Normal arterial PO_2 (sea level) is 80-100 mmHg

v. Carbon dioxide concentrations

(a) Carried as:

(i) 66% bicarbonate

(ii) 33% combines with hemoglobin

(iii) Small amount dissolves in plasma

(b) Arterial PCO_2 35-40 torr

5. Regulation of respiration

a. Voluntary control vs involuntary control

i. Action is mainly involuntary

ii. Chemical, physical and nervous reflexes monitor body oxygen needs

b. Respiratory center located in the brain stem (pneumotaxic center)

i. Nerve impulses sent to the diaphragm and intercostal muscles

ii. Inspiration initiated

c. Microscopic stretch receptors (located in the lung and pleura) stop inspiration

i. Inspiratory stretching activates the stretch receptors

ii. Nerve impulses follow afferent pathways and return to the brain stem

iii. Inspiratory act is curtailed, allowing elastic recoil of the lung

iv. Stretch receptors of the lung cease to send impulses to the brain stem

v. The cycle begins again with inspiratory impulses originating in the brainstem

d. Regulation by chemoreceptors

i. Central chemoreceptors located in the medulla: peripheral chemoreceptors located in the aortic arch and carotid bodies

ii. Chemoreceptors are stimulated by increased PO_2, decreased PCO_2 or decreased pH

CO_2 is 21 times more soluble in water than O_2.

e. Carbon dioxide concentration in the blood results in a decrease or increase in respiratory activity
   i. High CO_2 concentration increases respiratory activity
   ii. Low CO_2 concentration decreases respiratory activity
   iii. Hypoxemia is the most profound stimulus to respiration in the normal individual
f. Hypoxic drive
   i. Individuals with chronic respiratory disease have decreased ability to eliminate CO_2 and respiratory centers accomodate to high PCO_2 levels
   ii. Respiratory rate and depth respond to PO_2 levels below 60 torr
   iii. Dominant control of respiration in these individuals are changes in PO_2

6. Modified forms of respiration
   a. Coughing—forceful exhalation of a large volume of air, serves protective function
   b. Sneezing—a sudden forceful exhalation from the nose, usually caused by nasal irritation
   c. Hiccough—sudden inspiration caused by spasmodic contraction of the diaphragm, serves no useful purpose
   d. Sighing—slow, deep inspiration followed by prolonged expiration, hyperinflates lungs reexpanding atelectatic areas
   e. Grunting
7. Measures of respiratory function
   a. Respiratory rate
      i. Normal adults, 10-14 per minute
      ii. Infants, 40-60 per minute
      iii. Children, 24 per minute
   b. Factors affecting respiratory rate
      i. Fever—increases
      ii. Anxiety—increases
      iii. Insufficient oxygen—increases
      iv. Depressant drugs— decreases
      v. Sleep—decreases
   c. Lung capacity—adult male, 6 liters
   d. Tidal volume—volume of gas inhaled or exhaled during a single respiratory cycle—500 cc normally
   e. Dead space air—air remaining in air passageways, unavailable for gas exchange—approximately 150 cc
   f. Alveolar air—the air reaching the alveoli for gas exchange—approximately 350 cc
   g. Minute volume—the amount of gas moved in and out of the respiratory tract per minute. Determined by:
      i. The tidal volume times
      ii. The respiratory rate
   h. Vital capacity—forced exhaled volume

Expirations against artially closed lottis in neonates

8. Factors altering carbon dioxide levels in the blood
   a. Arterial carbon dioxide ($PaCO_2$) represents a balance between CO_2 produced during metabolism and CO_2 eliminated through respiration
   b. Causes of elevated $PaCO_2$
      i. Increased CO_2 production
         (a) Fever
         (b) Muscular exertion
         (c) Shivering
         (d) Metabolic processes resulting in formation of acids
      ii. Decreased CO_2 elimination (hypoventilation)
         (a) Respiratory suppression by drugs
         (b) Airway obstruction
         (c) Mechanical problems
      iii. Causes of decreased PCO_2—hyperventilation
9. Factors altering oxygen levels in the blood
   a. Causes of decreased oxygen levels in the blood
      i. Fluid in alveolar interstitial spaces
      ii. Alveolar collapse causing atelectasis
         (a) i.e., pneumothorax
         (b) Poor coughing
      iii. Shunting—blood flow to nonfunctional alveoli
   b. Management
      i. Supplemental oxygen
      ii. Intermittent positive pressure ventilation (IPPV)

Definitions

A. Definition of terms
1. Hypoxia—state in which insufficient oxygen is available to meet the oxygen requirements of the cell of a particular tissue
2. Hypoxemia—reduced oxygen or reduction in the partial pressure of oxygen in the arterial blood below normal limits
3. Hypercarbia (hypercapnea)—increased CO_2 or increase in the partial pressure of CO_2 in the arterial blood above normal limits
4. Respiratory failure—when the tension of the respiratory gases in the blood is no longer within physiologic limits
5. Cyanosis—bluish discoloration of the skin due to an increase in carboxyhemoglobin in the blood
6. Dyspnea—difficult or labored breathing
7. Tachypnea—rapid respiration
8. Hyperpnea—deep inhalation
9. Orthopnea—increase labored breathing when lying flat
10. Apnea—complete cessation of respiration
11. Hypoventilation—a reduced rate and depth of breathing resulting in a rise in arterial carbon dioxide pressure
12. Hyperventilation—an increased rate and depth of breathing resulting in an abnormal lowering in arterial carbon dioxide pressure

13. Tracheal tugging—tissue at the neck pulls inward due to airway obstruction
14. Nasal flaring—excessive widening of nostrils on inspiration due to airway obstruction
15. FiO_2—percentage of oxygen in inspired air

Assessment of the Respiratory System

A. History
   1. Chief complaint
   2. When chief complaint is dyspnea, ascertain:
      a. How long dyspnea has been present
      b. Onset gradual or abrupt
      c. Is dyspnea made better or worse by position? Orthopnea?
      d. Has the patient been coughing?
         i. If so, is the cough productive?
         ii. Character of sputum
         iii. Hemoptysis
      e. Is there associated pain?
   3. Past medical history
   4. Identify medications the patient takes regularly (including oxygen)
   5. Allergies

B. Physical exam
   1. Observations
      a. Anxiety, discomfort, distress
      b. Difficulty in speaking due to dyspnea
      c. Distraction from symptoms by questioning
      d. Coherent replies vs confusion
      e. Position
      f. Obesity
   2. Vital signs
      a. Rate, depth, character of respirations
      b. Abnormal respiratory patterns
   3. Inspection—observe for signs of respiratory distress
      a. Nasal flaring
      b. Tracheal tugging
      c. Retraction of inter-costal muscles
      d. Use of accessory muscles
      e. Cyanosis
   4. Inspection of the chest
      a. Anterior—posterior dimensions
      b. Symmetrical movement of chest wall
      c. Chest scars or deformities
   5. Auscultation
      a. Listen to patients breathing with unaided ear
      b. Listen with stethoscope for at least one respiratory cycle at each base first and then the apex

Location, radiation, duration, onset.

May be indication of hypoxia. Does the patient need to sit and/or lean forward to breathe, or can he comfortably recline?

Obesity may contribute to respiratory dysfunction resulting in hypoventilation. Hypoventilation in this circumstance is caused by decreased disphragamatic excursion. Pickwickian syndrome refers to the massively obese patient with cronic hypoventilation. These patients are subject to acute respirator failure and pneumonia.

Kyphosis scolosis.

i. Have patient breathe deeply through the mouth when possible
ii. Have patient sit up if possible
iii. Patient cannot sit up, listen anteriorly and laterally
iv. Compare similar fields on opposite sides

c. Abnormal sounds
i. Snoring—occurs when the upper airway is partially obstructed
ii. Stridor—harsh, high-pitched sound heard on inspiration, characteristic of upper airway obstruction
iii. Wheezing—whistling sound due to narrowing of airways by constriction, edema or foreign materials
iv. Rhonchi—rattling noises in the throat or bronchi
v. Rales—fine, moist sounds associated with fluid in the smaller airways
vi. Friction rub—heard with pleural disease. Sounds like dried leather rubbing together

6. Palpation
a. Feel for tenderness and instability over the ribs
b. Palpate for subcutaneous emphysema
c. Assess symmetry by placing thumbs on the xiphoid and spreading hands over the anterior chest wall
i. Hands should move symmetrically as patient breathes
ii. Vocal fremitus—vibrations felt during speech. Should be equal
d. Evaluate for at least 2 respiratory cycles

Airway Evaluation

A. Evaluation of airway problems
1. Basic airway management is crucial to the patient's survival
2. The paramedic must be rapid and accurate in his assessment and expert in the management of airway problems
3. The following basic principles must be kept in mind in patient assessment and management
a. Noisy breathing always means obstruction (partial)
b. Obstructed breathing is not always noisy (i.e., when the obstruction is complete)
c. The brain can survive only a few minutes of asphyxia
d. Artificial respiration is useless if the airway is blocked
e. A patient's airway is useless if the patient is apneic
f. Do not waste time looking for help

Pathophysiology and Management of Respiratory Disorders

A. Upper airway obstruction
1. Pathophysiology
a. Most common source of upper airway obstruction is the tongue
b. Foreign bodies, i.e., "cafe coronary"
i. Usually middle-aged or elderly
ii. Often wears dentures

iii. Often has had a few alcoholic drinks

c. Swelling of upper airway tissue in children (i.e., croup, epiglottitis). See Pediatric Section

d. Laryngeal edema in adults

i. Burns

ii. Allergic reactions

e. Trauma of the face and neck. (See Trauma Section)

2. Assessment

a. Varies depending on physical evidence of cause of obstruction and history of event

b. Evaluate for snoring respirations in the comatose patient—indicates tongue obstruction

c. When "cafe coronary" is suspected, ascertain if the victim can speak

d. If victim is unresponsive and has been eating, suspect a bolus of food lodged in the trachea

e. When the mechanism of burns is present, suspect laryngeal edema until proven otherwise

f. Patients with food allergies will usually report:

i. An itching sensation in the palate, followed by a lump in the throat

ii. Progresses to hoarseness

iii. Inspiratory stridor

iv. Urticaria may be present

v. Retraction of intercostal and neck muscles becomes evident

3. Management

a. Varies with the cause of the obstruction

b. Obstruction by the tongue

i. Open the airway

(a) Backward tilt of head

(b) Chin lift

(c) Triple airway maneuver

ii. Airways

(a) Nasopharyngeal

(b) Oropharyngeal

c. Foreign bodies—See American Heart Association recommendations

d. Laryngeal edema

i. Establish an airway

ii. Administer oxygen

(a) Pharmacology and actions

(i) Oxygen added to the inspired air raises the amount of oxygen in the blood, and therefore the amount delivered to the tissues. Tissue hypoxia causes cell damage and death

Especially with burns of the face, head neck upper chest.

Drugs in this section will be detailed according to general actions, indications, precautions, administration & side effects, the first time they are encountered in the outline. When utilized in

(ii) breathing in most persons is regulated by small changes in acid/base balance and CO_2 levels. It takes relatively large drops in blood oxygen concentration to stimulate respiration

(b) Indications

(i) Suspected hypoxemia or respiratory distress from any cause

(ii) Acute chest pain in which myocardial infarction is suspected

(iii) Shock from any cause

(iv) Major trauma

(v) Carbon monoxide poisoning

(c) Precautions

(i) If the patient is not breathing adequately on his own, the treatment of choice is ventilation, not just oxygen. A nasal cannula without a breath is a waste of oxygen

(ii) A small percentage of patients with chronic lung disease breathe *because* they are hypoxic. Administration of O_2 will shut off their respiratory drive. Initial oxygen flow should be no greater than 2 L/min in these patients

(d) Administration

(i) Dosage—low flow 1-2 L/min

(ii) Moderate flow—4-6 L/min

(iii) High flow—10-15 L/min

(e) Side effects and special notes

(i) Non-humidified O_2 is drying and irritating to mucous membranes

(ii) Restlessness may be an important sign of hypoxia

(iii) On the other hand, some persons become more agitated when a nasal cannula is applied, particularly when it is not needed

(iv) Oxygen supports combustion

(v) Oxygen toxicity—is not a hazard from short-term, acute administration

(vi) Nasal prongs work equally well on nose and mouth breathers

iii. Start an IV line with crystalloid solution

iv. Give epinephrine

(a) Pharmacology and actions

(i) Cathecholamine with alpha and beta effects

(ii) In general, the following cardiovascular responses can be expected

(aa) Increased heart rate

(bb) Increased myocardial contractile force

(cc) Increased systemic vascular resistance subsequent pathologies, the reader should refer back to the drug detail.

Decreased oxygenation of tissues.

Oxygen administration without adequate respiratory effort is ineffective.

Do not withold oxygen because of this possibility. Be prepared to assist ventilation if needed.

Patients with chronic lung disease.

Precautionary use for trauma, chest pain, etc.

Severe respiratory distress, either trauma or medical

Acquiesce to your patient if it is reasonable.

(dd) Increased arterial blood pressure
(ee) Increased myocardial O_2 consumption
(ff) Increased automaticity
(iii) Potent bronchodilator
(b) Indications for respiratory management
(i) Systemic allergic reactions
(ii) Asthma in patients under 40
(c) Precautions
(i) Should not be added directly to bicarbonate infusion, since catecholamines may be partially inactivated by alkaline solution
(ii) When used for allergic reactions, increased cardiac work can precipitate angina and/or MI in susceptible individuals
(iii) Due to peripheral vasoconstriction, should be used with caution in patients with peripheral vascular insufficiency
(iv) Wheezing in an elderly person is pulmonary edema or pulmonary embolus until proven otherwise
(d) Administration
(i) Adult allergic reaction—0.3 mg (0.3 ml of 1:1,000 solution or 3 cc of 1:10,000 solution IV) SQ, IM or injected sublingually
(ii) Pediatric allergic reaction—0.01 mg/kg (0.01 ml/kg of 1:1,000 solution) SQ, IM or injected sublingually
(e) Side effects and special notes
(i) Anxiety, tremor, palpitations, tachycardia and headache not uncommon side effects
(ii) *Relatively* contraindicated in patients with hypertension, hyperthyroidism, ischemic heart disease or cerebrovascular insufficiency
v. Give diphenhydramine (Benadryl)
(a) Pharmacology and actions
(i) An antihistamine which blocks action of histamines released from cells during an allergic reaction
(ii) Direct CNS effects, which may be stimulant or (more commonly) depressant, depending on individual variation
(iii) Anticholinergic, antiparkinsonism effect which is used to treat acute dystonic reactions to antipsychotic drugs. These reactions include: Oculogyric crisis, acute torticollis and facial grimacing
(b) Indications

Anaphylactic shock, laryngeal edema, severe asthma.

e.g., Haldol, Thorazine, Compazine.

(i) The second line drug in anaphylaxis and severe allergic reactions
(ii) To counterract acute dystonic reactions to antipsychotic drugs
(c) Precautions
(i) Children may demonstrate excitation rather than drowsiness
(ii) May depress respirations
(iii) Do not give subcutaneously due to irritating effects
(iv) May have additive effect with alcohol or other depressants
(d) Administration
(i) Adults—usual dose is 50 mg slow IV push or deep IM
(ii) Children—up to age 12 1-2 mg/kg body weight should not exceed 50 mg per single dose
(e) Side effects and special notes
(i) Diphenhydramine is *rarely* necessary in the field. It is *not* the first-line drug for severe allergic reactions, but may be useful for long transports. It may also be useful for acute dystonic reactions; but these, while emotionally and physically trying, are not life-threatening and do not *require* treatment in the field
(ii) Drowsiness, sedation, headache
(iii) Blurred vision, dizziness, nausea, vomiting
(iv) Tremors, palpitations, convulsions
(v) May cause shortened diastole, atrial tachycardia and changes in T-wave electrocardiographic readings
(vi) Side effects vary greatly between individuals
(vii) Do not use in COPD patients
(viii) Solution is light sensitive—keep in dark container
vi. Transtracheal ventilation may be required if the patient does not respond to the preceding treatments
B. Obstructive airway disease
1. Emphysema
a. Pathophysiology
i. Etiology
(a) More common in men than women
(b) More common in urban vs rural
(c) Most important contributing factor is cigarette smoking
ii. Pathology
(a) Destruction of alveolar walls
(i) Increased ratio of air to lung tissue in the lung
(ii) Weakening of walls of small bronchioles

After epinephrine.

(iii) Decreases alveolar membrane area thus decreasing area available for gas exchange
(iv) Decreases number of pulmonary capillaries in lung, increasing resistance to pulmonary blood flow

(b) Residual volume increases
(c) Vital capacity remains fairly normal
(d) As disease advances, arterial PO_2 decreases, which may lead to increased RBC production
(e) Carbon dioxide retention occurs
(f) Increased resistance to blood flow leads to right heart failure
(g) Other complications include acute respiratory infection and cardiac arrhythmias

b. Assessment—emphysema
i. History
(a) May have recent weight loss
(b) Increasing shortness of breath on exertion
(c) Progressive limitation of physical activity
(d) Coughing not usually prominent and when occurs produces small amounts of whitish gray mucus-like sputum

ii. Physical exam
(a) May have decreased chest excursion
(b) Hypertrophied accessory respiratory muscles
(c) Breathes with pursed lips
(d) May have clubbing of the fingers
(e) Decreased breath sounds and heart sounds
(f) Expiration lengthened
(g) May have signs of right heart failure (distended neck veins, enlarged liver, ankle edema)

2. Chronic Bronchitis
a. Pathophysiology
i. Increased numbers of mucus-secreting cells in the respiratory epithelium produce characteristically large amounts of sputum
ii. Alveoli not seriously affected - diffusion remains normal
iii. Alveolar hypoventilation affects respiratory gas exchange
iv. Arterial hypoxia and CO_2 retention occur
v. Hypoxia may cause increased RBC production
vi. Increased $PaCO_2$ levels constrict the pulmonary circulation leading to right heart failure
vii. Increased $PaCO_2$ levels may lead to irritability, decreased intellectual abilities, headaches, personality changes
viii. Acute and chronic infections produce scarring in the lungs
ix. Vital capacity is decreased

x. Residual volume is normal or decreased

b. Assessment—History
   i. History of heavy cigarette smoking
   ii. History of frequent respiratory tract infections
   iii. Between infections, produce at least 10cc of green or yellow sputum daily

c. Management of emphysema and chronic bronchitis
   i. Aimed at relieving hypoxia
      (a) Supplemental O_2 may decrease respiratory drive
      (b) Be prepared to assist ventilation
   ii. Establish an airway
   iii. Place the patient in a sitting or semi-sitting position
   iv. Administer O_2, monitor respiratory rate and depth
   v. IV TKO D5W
   vi. Administer aminophylline by order
      (a) Pharmacology and actions
         (i) Aminophylline is a xanthine derivative, composed of theophylline and and ethylene diamine
         (ii) Aminophylline is a smooth muscle relaxant which relieves bronchospasm and constriction. Stimulates respiratory drive
         (iii) Increases coronary blood flow and cardiac output
         (iv) Limited diuretic effect by removing excess extracellular fluid by dilating glomerular arterioles to increase glomerular filtration rate and excretion of sodium
         (v) Relaxes smooth muscles of blood vessels, causing vasodilation
         (vi) Stimulates CNS
      (b) Indications—respiratory distress due to:
         (i) Asthma
         (ii) Bronchitis
         (iii) Emphysema
         (iv) Status asthmaticus
         (v) Congestive heart failure
      (c) Precautions
         (i) Do not use in infants under 6 mo. of age
         (ii) Some children may be unusually sensitive to aminophylline
         (iii) Use with extreme care in patients who are already taking oral theophylline preparations. Many patients with asthma and COPD regularly take theophylline. Ascertain when last dose was taken, and how much. Relay information to base physician
         (iv) If infused too rapidly, may cause arrhythmias, ventricular fibrillation and circulatory collapse.

The active ingredient.

Monitor constantly. IV administration should take at least 20 minutes

d. Administration

i. Adults—usual dose 6 mg/kg added to 100 cc D5W and titrate to run in 15-20 min or to patient response

ii. Children—same as adults

iii. Side effects and special notes

(a) Transient hypotension, headache, nervousness, rash, palpitations, dizziness, anxiety, excitement, confusion, change in pulse rate

(b) Nausea and vomiting are frequent

(c) May cause an initial drop in arterial oxygen concentration.

(d) Always use a microdrip chamber

(e) Clearly label bottle immediately with name and amount of drug

(f) Clear history as to recent use of medihalers, aminophylline preparations should be obtained

vii. Do not give sedatives or tranquilizers

viii. Encourage the patient to cough up secretions

ix. Monitor cardiac rhythm

3. Asthma (adult)

a. Pathophysiology

i. Characterized by increased reactivity of the trachea, bronchi and bronchioles to some stimuli with widespread reversible narrowing of the airways

ii. Incidence

(a) Affects 6 million Americans

(b) 4-5 thousand deaths/year

(c) Begins before age 10 in 50% of cases

(d) Before age 30 in another 33% of cases

(e) Often familial tendency

iii. Acute attack

(a) Airway obstruction due to bronchospasm

(b) Swelling of mucus membranes in bronchial walls

(c) Plugging of bronchi by thick mucus

iv. Causes

(a) Allergic reaction to inhaled irritants

(b) Respiratory infection

(c) Emotional stress

v. Changes in pulmonary function

(a) Airway constriction and increased amounts of sputum result in progressive hyperinflation of the chest

(b) Reduced vital capacity

(c) Abnormal gas exchange with hypoxemia

(d) Hypoventilation (hypercarbia)

Monitor pulse, B.P., cardiac arrhythmia, nausea.

Always have patient on O2 before administration.

b. Assessment
  i. History
    (a) History of previous attacks, how often, how severe
  ii. Physical exam
    (a) Patient usually sitting, leaning forward
    (b) May be coughing, unproductive
    (c) Prominent use of accessory muscles
    (d) Wheezing may be audible or may be absent if attack is severe
    (e) Prolonged expiratory time
    (f) Tachycardia
    (g) Tachypnea
    (h) Caution - all wheezing is not asthma

c. Management
  i. Aimed at relieving bronchospasm and improving ventilation
  ii. *Always* find out what medications the patient has taken prior to administering any drug
  iii. Establish an airway
  iv. Administer humidified oxygen
  v. IV crystalloid TKO or per order for hydration
  vi. Ephinephrine (1:1,000) 0.3 to 0.5 cc SC per order may be repeated in 30 minutes if necessary
  vii. Aminophylline per order
  viii. Do not give sedatives or aspirin
  ix. Monitor cardiac rhythm
  x. Maintain a calm reassuring attitude

d. Status asthmaticus
  i. Defined as a severe prolonged asthmatic attack that cannot be broken with epinephrine. Considered a serious medical emergency
  ii. Chest appears distended greatly
  iii. Breath sounds and wheezes may be absent
  iv. Patient is usually exhausted, severely acidotic and dehydrated
  v. Management is the same, but greater urgency

e. Asthma in children
  i. Assessment
    (a) History
      (i) How long has the patient been wheezing?
      (ii) How much fluids has the patient had to drink during this time?
      (iii) History of recent infection, particularly involving the respiratory tract
      (iv) What if any medications has the patient taken for this attack? When taken and how much?
      (v) Any known allergies?

Use with caution in patients with cardiac disease. D5W may be more appropriate.

(vi) Has the patient been hospitalized for an acute asthmatic attack? How recently? How often?

(b) Physical exam

(i) General appearance —position

(ii) Level of consciousness

(iii) Vital signs

(iv) Skin and mucus membranes (dehydration, cyanosis, pallor)

(v) Respiratory movement

(aa) Increased to absent

(bb) Rales and wheezes

(cc) Breath sounds may be absent

ii. Management

(a) Humidified oxygen by mask

(b) IV D5WNS or D5LR

(c) Epinephrine 1:1,000, 0.01 mg/kg SC per order

(d) Bronkosol

(i) Pharmacology and actions

(aa) Asympathomimetic amine

(bb) Action in symptomatic relief of bronchospasm is rapid and and of relatively long duration

(cc) By relieving bronchospasm, vital capacity is increased

iii. Indications

(a) Bronchodilator for bronchial asthma

(b) Reversing bronchospasm occurring with bronchitis and emphysema

iv. Precautions

(a) Do not administer with epinephrine since excessive tachycardia may occur

(b) Inquire as to medications the patient may already have received. If patient has been using a Bronkometer determine frequency and last application and consult with base station

v. Administration 1/4 cc of Bronkosol in nebulizer with 5cc of normal saline (respiratory type) connected to oxygen at a flow rate of 5/L min

vi. Side effects and special notes

(a) Side effects are those of other sympathometic amine and include tachycardia, nausea, headache, anxiety, restlessness, dizziness

(b) Racemic epinephrine

(i) Pharmacology and actions

(ii) Racemic epinephrine is an epinephrine preparation in a 1:1,000 dilution for use by oral inhalation *only*

Pulse-increase B/P-decrease.

Rate per order, rehydration may be indicated.

Bronchosol is available in prepackaged dilutions for single use

Effects are those of epinephrine.

(iii) Inhalation causes local effects on the upper airway as well as systemic effects from absorption
(iv) Vasoconstriction may reduce swelling in the upper airway and beta effects on bronchial smooth muscle may relieve bronchospasm
(v) Indications
(aa) Life threatening airway obstruction due to croup
(bb) Asthma
(vi) Precautions
(aa) Mask and noise may be frightening to small children. Agitation will aggravate symptoms of respiratory obstruction. Try to enlist the support of parents and child for administration
(bb) Racemic epinephrine is heat and light sensitive. It should be stored in dark cool place
(vii) Administration
(aa) One cc racemic epinephrine (2.25% solution) in 4 ccs of normal saline. Both solutions placed into the nebulizer connected to oxygen at a flow rate of 5-8 liters per minute to create a fine mist and to be inhaled via the mouthpiece
(viii) Side effects and special notes
(aa) Tachycardia and agitation are the most common side effects
(bb) Nebulizer treatment may cause blanching of the skin in the mask area due to local epinephrine absorption.

f. Monitor cardiac rhythm

C. Pneumonia
1. Pathophysiology
a. Caused by bacteria, virus or fungus
2. Assessment
a. History
i. History of fever
ii. Weakness
iii. Productive cough
iv. May have chest pain worsened by coughing
b. Assessment
i. Fever
ii. Cough
iii. May have respiratory distress
iv. Rales and rhonchi

As alternative to SQ epineph-
Use caution in patients over 40 years of age and a history of cardiac disease.

Discoloration is an indication for discarding it.

Respiratory type

Other side effects of parenteral epinephrine may also be present.

3. Management
   a. Oxygen
   b. Transport in position of comfort

D. Toxic inhalation
1. Pathophysiology
   a. Causes
      i. Superheated air
      ii. Toxic combustion products
      iii. Chemical irritant
      iv. Steam inhalation
   b. Effects
      i. Upper airway obstruction due to edema
      ii. Bronchospasm
      iii. Damage to pulmonary aveolar capillaries membranes
2. Assessment
   a. History
      i. The nature of the inhalant or the combusted material
         (a) Products that form corrosive acids or alkalis
            (i) Ammonia (ammonium hydroxide)
            (ii) Nitrogen oxide (nitric acid)
            (iii) Sulphur dioxide (sulfurous acid)
            (iv) Sulphur trioxide (sulfuric acid)
      ii. The duration of the exposure
      iii. Whether or not patient was in a closed area during exposure
      iv. Loss of consciousness producing loss of airway protective mechanism
   b. Physical exam
      i. Examine face and mouth of burns
      ii. Auscultation of chest for rales and wheezes
      iii. Examine throat
3. Management
   a. Get the victim out of the exposure environment
   b. Establish and maintain an airway
   c. Laryngeal edema may require endotracheal intubation (observe for hoarseness, brassy cough, stridor)
   d. High concentration O_2
   e. IV line, crystalloid

E. Carbon monoxide inhalation
1. Pathophysiology
   a. Properties of carbon monoxide
      i. Colorless, odorless gas
      ii. Produced during incomplete burning of organic fuels
   b. Physiology
      i. Binds to hemoglobin more strongly than oxygen
      ii. Inhibits oxygen delivery to cells

iii. Leads to hypoxia at the cellular level
c. Incidence
i. Poisoning most commonly from automobiles and home heating devices
ii. Common method of suicide
iii. Common problem for firefighters
2. Assessment
a. History
i. Potential source of exposure
ii. Length of exposure
iii. Signs and symptoms
(a) Headache
(b) Irritability
(c) Errors in nudgement
(d) Vomiting
(e) Chest pain
(f) Confusion
(g) Agitation
(h) Loss of coordination
(i) Loss of consciousness
(j) Seizures
2. Physical exam
a. Skin color
i. Cyanosis may be present
ii. Cherry red coloration rarely seen
b. Other signs of hypoxia
3. Management
a. Remove patient from exposure site
b. Administer oxygen. Increase FiO_2 as high as possible
c. Assist respirations if necessary
d. Treat as necessary for shock
F. Pulmonary embolism
1. Pathophysiology
a. Clot or other particle blocks a pulmonary artery
i. Sources
(a) Air emboli
(b) Fat emboli
(c) Clot
(d) Amniotic fluid
b. Factors favoring development of emboli
i. Prolonged immobilization
ii. Thrombophlebitis
iii. Use of certain drugs (esp. oral contraceptives)
c. Physiology
i. Pulmonary circulation is blocked

Hyperbaric oxygen therapy may be indicated for acute carbon monoxide poisoning. This consideration may affect patient transport.

ii. Right heart pumps against increased resistance
iii. Pulmonary capillary pressure increases
iv. Shunting

2. Assessment
   a. Signs and symptoms will vary depending on size of the obstruction
   b. History
      i. Sudden onset of severe, unexplained dyspnea
      ii. May be no other symptoms
      iii. May present with sharp chest pain made and deep breathing
   d. Physical exam
      i. Tachycardia
      ii. Labored breathing
      iii. BP may be falling
      iv. May have signs of right heart failure (distended jugular veins)
3. Management
   a. Establish an airway
   b. Assist ventilations as needed
   c. Administer O_2 in the highest concentration possible
   d. Establish IV D5W TKO
   e. Monitor cardiac rhythm

G. Hyperventilation syndrome
1. Pathophysiology
   a. Occurs in anxious patients
   b. Fall in arterial PCO_2 may cause significant elecrolyte imbalance leading to respiratory alkalosis
2. Assessment
   a. History—other characteristic symptoms
      i. Fatigue
      ii. Nervousness
      iii. Dizziness
      iv. Numbness and tingling around the mouth and in hands and feet
   b. Physical exam
      i. Tachypnea
      ii. May have carpopedal spasm
      iii. If history of seizure disorder—may exhibit seizure activity
3. Management
   a. Try to have patient control respirations (breath holding)
   b. Provide calm reassurance

H. Central nervous system dysfunction
1. Pathophysiology
   a. Head trauma
   b. CVA

Avoid overdiagnosis of hyperventilation and therefore withholding oxygen therapy. Do NOT overlook medical causes for hyperventilation.

c. Drugs (including narcotics and barbiturates)
   i. Makes respiratory center less responsive to increase $PaCO_2$
   ii. Depresses areas that control respiratory rhythms

2. Management
   a. Establish an airway
   b. Determine if the patient is breathing
   c. If apneic or slow, shallow respirations, assist ventilations
   d. Administer O_2
   e. IV line TKO D5W
   f. Endotracheal intubation
   g. Management of underlying problem

I. Dysfunction of spinal cord, nerves or respiratory muscles
   1. Pathophysiology
      a. Trauma or disease of the respiratory muscles or the nerves that supply them
         i. Injuries producing quadriplegia
         ii. Polio
         iii. Myasthenia gravis
      b. Causes inability of respiratory muscles to contract normally in response to the respiratory drive
      c. Tidal volume is shallow and minute volume is decreased
   2. Management
      a. Establish an airway
      b. May require ventilatory support

Management Principles

A. General principles of management: Acute respiratory insufficiency
   1. The airway always receives first priority. In trauma victims who may have associated cervical spine injuries, the airway should be protected without extending the neck
   2. Any patient in respiratory distress should receive O_2
   3. Any patient whose illness or injury suggests the possibility of hypoxia should receive O_2
   4. If there is a question whether O_2 should be administered or withheld (as in chronic hypoxia) administer O_2. Know which patients will respond to O_2 therapy with respiratory depression and be prepared to assist ventilation. *Never withhold O_2 therapy from a patient suspected of hypoxia*

Method	Flow Rate	Oxygen % Inspired Air—FiO_2 (Approx.)
Room air		21%
Nasal cannula (prongs)	1 L/min	24%
	2 L/min	28%
	8 L/min	40%
Face mask	6 L/min	50-60%

Oxygen reservoir (mask) non—rebreathing	10-15 L/min	90%
Mouth to mask	10 L/min	50%
	15 L/min	80%
	30 L/min	100%
Bag-valve-mask	Room air	21%
	12 L/min	40%
with 100% valve	High flow regulated to inflate bag at proper rate	90% +

Note: Most hypoxic patients will feel quite comfortable with an increase of inspired O_2 from 21% to 24%.

Flow rate should be adequate to maintain bag expansion

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Division 4: Medical

Section 2. Cardiovascular Section

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment Sections 1–7 Division 2: Preparatory Sections 1–5 Division 4: Medical Section 1: Respiratory System Because of the high number of prehospital deaths attributed to coronary artery disease, this is a subject that continues to receive great emphasis in the training of the EMT-P. This section prepares the EMT-P to assess and manage those cardiac emergencies that result from coronary atherosclerosis, along with a number of conditions involving pathology of the peripheral circulation. The interpretation of cardiac dysrhythmias receives much emphasis in this section, but this skill must co-exist with the knowledge that the ECG should always be interpreted and treated in the light of the patient's entire clinical picture. Since drug therapy is a major factor in the management of cardiovascular emergencies, a large number of the paramedic drugs will also be covered in this section.
Overview	I. Anatomy and Physiology of the Cardiovascular System A. Anatomy of the Heart B. Anatomy of the Peripheral Circulatory System C. Physiology of the Heart D. Electrophysiology (Basics) II. Assessment of the Cardiac Patient A. Common Chief Complaints and History B. Significant Past Medical History C. Physical Examination Pertinent to the Cardiac Patient III. Pathophysiology and Management A. Pathophysiology of Atherosclerosis B. Specific Conditions Resulting from Atherosclerotic Heart Disease 1. Angina Pectoris 2. Acute Myocardial Infarction 3. Left Ventricular Failure and Pulmonary Edema 4. Right Ventricular Failure 5. Cardiogenic Shock 6. Cardiac Arrest/Sudden Death C. Peripheral Vascular Emergencies and Other Cardiovascular Related Conditions 1. Aneurysm 2. Traumatic Thoracic Aortic Rupture 3. Acute Arterial Occlusion 4. Acute Pulmonary Embolism 5. Non-critical Peripheral Vascular Conditions 6. Malignant Hypertension IV. Pharmacologic Intervention

Complete outlines of actions, indications, precautions, administration (including pediatric dosages), and side effects of all paramedic drugs.

A. Antidysrhythmics
B. Sympathomimetic agents
C. Electrolyte solutions
D. Drugs for myocardial ischemia/pain
E. Other prehospital cardiac drugs
F. Important cardiac drugs not used in the prehospital setting

V. Dysrhythmia Recognition

A. Introduction to ECG Monitoring
B. Rhythm Strip Analysis
C. Introduction to Dysrhythmias
D. Dysrhythmias Originating in the SA Node
E. Dysrhythmias Originating in the Atria
F. Dysrhythmias Originating in the AV Junction
G. Dysrhthmias Originating in the Ventricles
H. Dysrhythmias That Are Disorders in Conduction

VI. Techniques of Management

A. CPR
B. ECG Monitoring
C. Precordial Thump
D. Defibrillation
E. Emergency Synchronized Cardiocersion
F. Rotating Tourniquets (optional content)
G. Carotid Massage (optional content)
H. Intracardiac Injections (optional content)
I. Mechanical CPR Devices (optional content)

Objectives

At the completion of this section the student will be able to:

4.2.1 Describe the size, shape, and location/orientation (in regards to other body structures) of the heart muscle.

4.2.2 Identify the location of the following structures on a diagram of the normal heart.

—Pericardium
—Myocardium
—Epicardium
—Right and left atria
—Interatrial septum
—Right and left ventricles
—Intraventricular septua
—Superior and inferior vena cava
—Aorta
—Pulmonary vessels
—Coronary arteries
—Tricuspid valve
—Mitral valve
—Aortic valve
—Pulmonic valve
—Papillary muscles
—Chordae tendinae

4.2.3 Describe the function of each structure listed in Objective 4.2.2.

4.2.4 Describe the distribution of the coronary arteries and the parts of the heart supplied by each artery.

4.2.5 Differentiate the structural and functional aspects of arterial and venous blood vessels

4.2.6 Name and describe the location of 5 major arteries and 5 major veins.

4.2.7 Describe the structure and function of capillaries.

4.2.8 Describe the course of blood flow through the normal heart and lungs.

4.2.9 Describe the cardiac cycle in terms of mechanical function and relative position of heart valve.

4.2.10 Describe the effects of increased heart rate on the contraction and relaxation phases of the cardiac cycle.

4.2.11 Describe the functional differences between the right heart and left heart pumps.

4.2.12 Define the following terms that refer to cardiac physiology:

—Stroke volume
—Starling's law
—Preload
—Afterload
—Cardiac output
—Blood pressure

4.2.13 Describe nerve innervation of the heart.

4.2.14 Name the chemical mediator of the parasympathetic nervous system and describe its primary effect on the heart.

4.2.15 Name the chemical mediator of the sympathetic nervous system and describe the mechanical, cardiac, and peripheral effects of:

—Alpha receptor stimulation
—Beta receptor stimulation

4.2.16 Name major electrolytes that affect cardiac function

4.2.17 Describe the electrical properties of the heart.

4.2.18 Describe the normal sequence of electrical conduction through the heart and state the purpose of this conduction system.

4.2.19 Describe the location and function of the following structures of the electrical conduction system:

—SA Node
—Internodal and interatrial tracts
—AV Node
—Bundle of His
—Bundle branches
—Purkinje fibers

4.2.20 Define cardiac depolarization and repolarization and describe the major electrolyte changes that occur in each process.

4.2.21 Name three areas of the heart possessing pacemaking capabilities and state the intrinsic (inherent) rates of each area.

4.2.22 Describe an ECG.

4.2.23 Define the following terms as they relate to the electrical activity of the heart:

—Isoelectric line
—P wave
—QRS complex
—T wave
—PR intercal
—ST segment
—Absolute and relative
—Refractory period

4.2.24 Describe how electrical activity of the heart is affected by:

—Sympathetic stimulation
  —Alpha receptors
  —Beta receptors
—Parasympathetic stimulation

4.2.25 Name the common chief complaints of cardiac patients.

4.2.26 Describe why the following occur in patients with cardiac problems:

—Chest pain or discomfort
—Shoulder, arm, neck, or jaw pain/discomfort
—Syspnea
—Syncope
—Palpitations/abormal heart beat

4.2.27 Describe those questions to be asked during history taking for each of the common cardiac chief complaints.

4.2.28 Describe the four most pertinent aspects of the past medical history in a patient with a suspected cardiac problem.

4.2.29 Identify, in a list of common prescription drugs, those that a patient may be taking for cardiovascular problems.

4.2.30 Describe those aspects of the physical examination that should be given special attention in the patient with suspected cardiac problems.

4.2.31 Describe the significance of the following physical exam findings in a cardiac patient:

—Altered level of consciousness
—Peripheral edema
—Cyanosis
—Poor capillary refill
—Cool, clammy skin
—Jugular vein distension
—Pulmonary rales/wheezes
—Carotid artery bruit
—Pulse irregularity

4.2.32 Describe the pathophysiology of atherosclerosis.

4.2.33 List the three major modifiable risk factors for atherosclerosis.

4.2.34 Describe the common characteristics of the pain/discomfort that occurs in angina pectoris and acute myocardial infarction.

4.2.35 Describe the pathophysiology, signs and symptoms, and prehospital management (including drug therapy) of each of the following conditions:

—Angina pectoris
—Acute myocardial infarction
—Right ventricular failure
—Left ventricular failure/pulmonary edema
—Cardiogenic shock
—Cardiac arrest
—Abdominal aortic aneurysm
—Dissecting aortic aneurysm
—Acute arterial occlusion
—Acute pulmonary embolism
—Venous thrombophlebitis
—Ruptured varicose veins
—Chronic peripheral arterial insufficiency
—Malignant hypertension

4.2.36 Describe 3 causes of cardiac arrest other than ASHD and describe how medical management of these situations differs.

4.2.37 Describe and contrast the etiology of cardiac arrest in infants and children from that of adult patients.

4.2.38 Describe the action, pre-hospital indications, side effects, adult and pediatric dosages, contraindications, special considerations, and precautions for each of the following drugs:

1. Atropine sulfate
2. Lidocaine hydrochloride
3. Bretylim tosylate
4. Verapamil
5. Epinephrine
6. Norepinephrine
7. Isoproternol
8. Dopamine
9. Sodium bicarbonate
10. Calcium chloride
11. Oxygen
12. Nitrous oxide
13. Nitroglycerin
14. Morphine sulfate
15. Furosemide
16. Aminophylline
17. Diazepam

4.2.39 Describe the action, uses, and side effects of the following drugs that are not used in the field but commonly taken by cardiac patients:

1. Digitalis
2. Propanolol

4.2.40 Describe the basic concept of ECG monitoring.

4.2.41 Define a monitoring lead and describe how it differs from a 12-lead ECG.

4.2.42 Describe what type of information can and cannot be obtained from a monitoring lead.

4.2.43 Describe information obtained from the vertical and horizontal axes of the ECG graph paper.

4.2.44 State the numerical values assigned to each small and each large box on the ECG graph paper for each axis.

4.2.45 Define ECG artifact and name the causes.

4.2.46 State the steps in the analysis format of ECG rhythm strips.

4.2.47 Describe the normal parameters for the following aspects of an ECG rhythm strip:

—Rate
—Rhythm
—P waves
—PR interval
—QRS complex duration

4.2.48 Describe two common methods for calculating heart rate on an ECG rhythm strip and the indications for using each method.

4.2.49 Name 8 causes of dysrhythmias.

4.2.50 Describe the mechanisms of electrical impulses formation.

4.2.51 Describe the etiology, Lead II ECG characteristics, clinical significance, and emergency treatment of each of the following dysrhythmias:

—Sinus bradycardia
—Sinus tachycardia
—Sinus arrhythmia
—Sinus arrest
—Wandering pacemaker
—Premature atrial complexes
—Atrial tachycardia (PSVT)
—Atrial flutter
—Atrial fibrillation
—Premature junctional complexes
—Junctional escape complexes and rhythm
—Accelerated junctional rhythm
—Paroxysmal junctional tachycardia (PSVT)
—Ventricular escape complexes and rhythm
—Premature ventricular complexes
—Ventricular tachycardia
—Ventricular fibrillation
—Asystole
—Artificial pacemaker rhythm
—First degree AV block
—Second degree AV block, Type I and Type II
—Third degree AV block
—Bundle branch block/aberrant ventricular conduction

*4.2.52 Describe the indications for use of rotating tourniquets.

4.2.53 Describe the indications for use of a precordial thump.

4.2.54 Describe the indications for use of synchronized cardioversion.

4.2.55 Describe energy recommendations for defibrillation of adult and pediatric patients.

*S4.2.56 Describe the indications and complications of intracardiac injections.

S4.2.57 Demonstrate the correct procedure for obtaining a history and performing a physical exam for cardiac-related problems.

S4.2.58 Demonstrate assessment techniques and emergency management of patients with any of the conditions listed in Objective 4.2.35.

S4.2.59 Demonstrate preparation and proper administration of a prescribed dose of any of the cardiac drugs listed in Objective 4.2.38.

S4.2.60 Identify the following on any rhythm strip:

—P waves
—QRS complexes
—P-P intervals
—R-R intervals
—PR intervals
—ST segments
—T waves
—Isoelectric line

S4.2.61 Recognize each of the dysrhythmias listed in Objective 4.2.51 on Lead II rhythm strips or ECG monitor.

S4.2.62 Demonstrate appropriate clinical assessment and management of a cardiac patient having any of the dysrhythmias listed in Objective 4.2.51.

S4.2.63 Demonstrate on an adult mannequin, the techniques for single and two-person CPR according to American Heart Association standards.

S4.2.64 Demonstrate on an infant mannequin, the technique for infant CPR according to American Heart Association standards.

S4.2.65 Demonstrate proper application of ECG chest electrodes and obtain a sample Lead II or MCL1 rhythm strip.

S4.2.66 Demonstrate the proper use of the defibrillator paddle electrodes to obtain a sample Lead II rhythm strip.

S4.2.67 Demonstrate how to properly assess the cause of poor ECG tracing.

*S4.2.68 Demonstrate the proper application of rotating tourniquets.

S4.2.69 Demonstrate the proper technique for administering a precordial thump.

S4.2.70 Demonstrate correct operation of a monitor-defibrillator to perform defibrillation on an adult and infant.

S4.2.71 Demonstrate the correct technique for performing synchronized cardioversion.

*S4.2.72 Demonstrate on a mannequin the proper procedure for patient assessment and performance of cartoid massage.

S4.2.73 Demonstrate the correct technique for performing non-invasive (external) cardiac pacing.

*S4.2.74 Demonstrate correct preparation and administration of an intracardiac injection.

*S4.2.75 Demonstrate proper application and operation of mechanical CPR adjunctive device.

(S) Indicates Skill Objective

(*) Indicates an optional objective to be addressed according to the local protocol

TOPIC	CONTENT OUTLINE
Anatomy of the Heart	A. Location, orientation

B. Size and dimensions

C. Shape
   1. Base—top part
   2. Apex—bottom pointed part

D. Organ layers
   1. Pericardium—double-walled protective sac surrounding heart
      a. Visceral—(inner) serous layer
      b. Parietal—(outer) fibrous layer
      c. Pericardial fluid is lubricant
   2. Epicardium—outermost layer of heart wall muscle
   3. Myocardium—thick middle layer of heart wall muscle
   4. Endocardium—smooth, inner layer of connective tissue

E. Myocardial muscle
   1. Specialized muscle cells found only in the heart
   2. Striated like skeletal muscle, but similar electrical priorities as smooth muscle
   3. Composed of contractile proteins arranged in parallel bands—slide together to cause contraction
   4. Very dependent on calcium for contraction

F. Heart chambers
   1. Atria
      a. Right and left superior chambers of heart
      b. Less muscular collecting chambers
   2. Ventricles
      a. Right and left inferior chambers of heart
      b. More muscular; left thicker than right
   3. Separation of chambers internally
      a. Interatrial septum separates atria
      b. Intraventricular septum separates ventricles
      c. Both composed of connective tissue as well as muscle

G. Heart valves
   1. Two sets composed of endocardial and connective tissue
   2. Artioventricular (AV) valves
      a. Tricuspid valve: Between left atrium and ventricle
      b. Bicuspid (mitral) valve: Between left atrium and ventricle
      c. Controlled by papillary muscles at apex of ventricles
      d. Chordae tendinae: String-like fibers connecting valve leaflets to papillary muscles
   3. Semilunar valves
      a. Pulmonic valve: Between right ventricle and pulmonary artery
      b. Aortic valve: Between left ventricle and aorta

H. Great vessels: Collective name for large vessels that attach to base of heart
   1. Vena cava—inferior, superior
   2. Pulmonary artery—main artery and two branches

3. Pulmonary veins—four
4. Aorta

I. Coronary arteries
1. Exclusive arterial blood supply to heart muscle and electrical conduction system
2. Originate in aorta just above leaflets of aortic valve
3. Left coronary artery
    a. Supplies left ventricle, intraventricular septum, and part of right ventricle
    b. Anterior descending branch
    c. Circumflex branch
4. Right coronary artery
    a. Supplies right atrium and ventricle and part of left ventricle
    b. Posterior descending branch
5. Many anastamoses exist between arterioles of coronary arteries, allowing for development of collateral circulation
6. Coronary veins
    a. Correspond to arterial distribution and drain into right atrium
    b. Coronary sinus: Major vein draining left ventricle

Anatomy of the Peripheral Circulation

A. Structures common to all blood vessel walls
1. Intima—smooth, single-cell layer, inner lining
2. Media—middle layer of elastic fibers and muscle
    a. Give strength amd recoil to vessels
    b. Thicker in arteries than in veins
3. Adventitia
    a. Protective fibrous tissue covering
    b. Provides vessel with strength to withstand high pressures within
4. Lumen—cavity within a blood vessel, diameter of which varies greatly

B. Arteries
1. Carry blood away from the heart
2. Muscular layer much more predominant
3. Under high pressure
4. Arterioles
    a. Smallest branches of arterial tree
    b. Control blood flow to various organs by their degree of resistance
5. Major arteries (relate to locations)
    a. Aorta (ascending, thoracic, and abdominal)
    b. Subclavian
    c. Internal and external carotid arteries
    d. Axillary artery
    e. Brachial artery
    f. Radial artery
    g. Common iliac artery
    h. Femoral artery

C. Capillaries
   1. Termination of arterioles: Connection between arterial and venous system
   2. Walls of single-layer cells: Microscopic in size
   3. Structure in which all fluid, gas, and nutrient exchange occurs

D. Veins
   1. Carry blood back to heart
   2. Under low pressure: Blood flow aided by surrounding muscles and valves within
   3. Venules
      a. First vessels leading away from capillaries
      b. Smallest branch of venous tree
   4. Major veins (Relate to locations)
      a. Superior and inferior vena cava
      b. Internal and external jugular veins
      c. Subclavian vein
      d. Axillary vein
      e. Innominate vein
      f. Iliac veins
      g. Femoral vein

E. Systemic circuits

Physiology of the Heart

A. Normal blood flow
   1. Superior and inferior vena cava return blood to
   2. Right atrium, through tricuspid valve to
   3. Right ventricle, through pulmonary valve to
   4. Pulmonary artery, to
   5. Pulmonary capillaries in lungs to
   6. Pulmonary veins to
   7. Left atrium, through mitral valve to
   8. Left ventricle, through aortic valve to
   9. Aorta, coronary arteries, and peripheral circulation

B. The cardiac cycle
   1. Right and left atria contract together
   2. Atrial contraction serves to fill ventricles to maximum
   3. Ventricular contraction pumps blood to pulmonary or systemic circulation: Pressure of contraction produces closure of AV valves and opens aortic and pulmonic valves
   4. Systole: contraction phase, usually referring to ventricular contraction
   5. Diastole: relaxation phase, usually referring to ventricles
      a. Much longer than systole (.52 seconds vs .28 seconds)
      b. As rate increases, length of diastole decreases with less reduction in length of systole
      c. Phase during which most coronary artery filling occurs (about 70%)

C. Pumping action

1. Right vs left-sided pump
   a. Right atria and ventricles pumping against pulmonary resistance—low pressure system
   b. Left atria and ventricles pumping against systemic resistance—high pressure system
2. Stroke volume—amount of blood ejected from ventricle with one contraction
   a. 60-100 milliliters; however capacity to increase is great in healthy heart
   b. Starling's Law of the Heart: up to a limit, the more a myocardial muscle is stretched (by chamber filling), the greater will be its force of contraction (and therefore, stroke volume)
   c. Influenced by:
      i. Preload: pressure under which ventricle fills, influenced by venous return
      ii. Afterload: resistance against which ventricle contracts, determined by arterial resistance
3. Cardiac output—the amount of blood pumped through the circulatory system per minute
   a. Cardiac output = heart rate x stroke volume
   b. Normal heart rate = 60-100 beats/minute
   c. Normal heart can increase cardiac output three times by increasing rate alone
4. Systemic blood pressure = cardiac output x peripheral resistance

D. Nervous system control
1. Autonomic nervous system influences rate, conductivity, and contractility
2. Heart innervated by fibers of both sympathetic and parasympathetic systems
3. Parasympathetic stimulation
   a. Vagus nerve
   b. Primarily innervates atria, but some fibers to ventricles also
   c. Chemical mediator: acethycholine
   d. Effect: slows heart rate and AV conduction
   e. Methods of stimulation: Valsalva maneuver, carotid sinus pressure
4. Sympathetic stimulation
   a. Nerves arising in thoracic and lumbar ganglia
   b. Innervate both atria and ventricles
   c. Chemical mediator: norepinephrine
   d. Receptor sites: alpha, beta
   e. Effect of alpha stimulation:
      i. No effect on heart
      ii. Peripheral vasoconstriction
   f. Effect of beta stimulation:
      i. Increased rate and conduction
      ii. Increased contractility

iii. Bronchodilation

iv. Peripheral vasodilation

E. Role of Electrolytes

1. Cardiac function, electrical and mechanical, influenced by electrolyte imbalances

2. Major electrolytes influencing cardiac function

a. Sodium (Na+): major role in depolarization phase of myocardial cells

b. Calcium (Ca+ +): major role in depolarization phase of myocardial pacemaker cells and in myocardial contractility

i. Hypercalcemia: increased myocardial contractility

ii. Hypocalcemia: decreased myocardial contractility and increased electrical irritability

c. Potassium (K+): major role in repolarization phase

i. Hyperkalemia: decreased automaticity and conduction

ii. Hypokalemia: increased irritability

Electrophysiology

A. Electrical properties of the heart

1. Automaticity: ability to generate an electrical impulse without stimulation from another source—property of pacemaker cells

2. Excitability: ability to respond to an electrical stimulus—property of all myocardial cells

3. Conductivity: ability to propagate an impulse from cell to cell

B. Electrical conduction system of the heart

1. Function: allows electrical impulses to spread through the heart six times faster than through muscle alone

2. Sequence of normal electrical conduction

a. SA node

b. Internodal and interatrial tracts

c. AV node

d. Bundle of His

e. Bundle branches

f. Purkinje fibers

C. Function of electrical conduction structures

1. Sinoatrial (SA) node

a. Located in right atrium near entrance of superior vena cava

b. Usually heart's dominant pacemaker

2. Internodal and interatrial tracts

a. Pathways that carry impulse between SA node and AV node and spread it across atrial muscle

b. Impulse travel time: 0.08 seconds

3. Atrioventricular (AV) node:

a. Part of area called the "AV junctional tissue" along with some surrounding tissue and the non-branching portion of the Bundle of His

b. Responsible for creating slight delay in conduction before sending impulse to ventricles
c. Impulse travel time: 0.08–0.16 seconds
d. No pacemaking properties in node itself

4. Bundle of His
   a. Bundle of fibers coming off AV node, located at top of interventricular septum
   b. Considered part of the AV junction
   c. Makes electrical connection between atria and ventricles
5. Bundle branches
   a. Created by bifurcation of Bundle of His into right and left
   b. Carry electrical impulse at high velocity to interventricular septum and each ventricle simultaneously
6. Purkinje fibers
   a. Terminal ends of bundle branches
   b. Network of fibers helping to spread impulse throughout ventricular walls
   c. Rapid impulse spread through ventricles: 0.08–0.09 seconds

D. Depolarization
1. Definition: process by which muscle fibers are stimulated to contract by the alteration of electrical charge of the cell—accomplished by changes in electrolyte concentrations across the cell membrane
2. Depolarization at the cellular level
   a. Chemical pumps in cell wall maintain certain concentrations of electrolytes within and outside the cell
   b. Resting (polarized) cell normally more electrically negative inside cell wall than outside (-90 millivolts (mv) in working cells)
   c. Electrical stimulation of cell wall changes its permeability to sodium ($Na+$)
   d. $Na+$ rushes into cell, causing inside to become more positive
   e. Slower influx of calcium ($Ca++$) also causes cell to become positive
   f. Muscle contraction is response to depolarization
   g. Depolarization wave is passed from cell to cell along the conduction pathway to reach the muscle cells
3. Spontaneous diastolic depolarization of pacemaker cells
   a. Pacemaker cells capable of self-initiated depolarization (automaticity)
   b. Found throughout conduction system except in AV node
   c. During diastole, become less and less negative until a certain threshold reached, then rapidly and fully depolarize
   d. Location of cells with pacemaker capabilities and rates of spontaneous discharge (inherent or intrinsic rates)
      i. SA node: 60-100/minute intrinsic rate
      ii. AV junctional tissue: 40-60/minute intrinsic rate
      iii. Ventricles (bundle branches and Purkinje fibers): 20-40/minute intrinsic rate

e. SA node usual pacemaker because it discharges the fastest; pacemaker cells below SA node normally suppressed by it

E. Repolarization
1. Process by which cells re-establish internal negativity and are readied for stimulation—return to resting or polarized state
2. Caused by rapid escape of potassium (K+) from the cell
3. Proper distribution of electrolytes re-established by cell wall pumps (Na+ pumped out of cell,potassium pumped back into cell)
4. Cell returns to -90 mv. internal charge—repolarized

F. Relationship of ECG to electrical activity
1. ECG is record of electrical activity of heart as sensed by electrodes on body surface
2. Gives information only about electrical activity—tells us nothing about pump function
3. Isoelectric line: a flat line on the ECG indicating absence of net electrical activity
4. P wave
   a. Rounded wave preceding QRS; usually upright (positive) in Lead II
   b. Indicates depolarization of atrial muscle
5. QRS complex
   a. Collective term for three deflections following the P wave
      i. Q wave—first negative deflection after P wave
      ii. R wave—first positive deflection after P wave
      iii. S wave—first negative deflection after R wave
   b. All three waves not always present—QRS has many shapes
   c. Indicates depolarization of the ventricular muscle
6. T wave
   a. Rounded wave following QRS complex; usually in same direction as QRS
   b. Indicates repolarization of ventricles
   c. Atrial T wave (atrial repolarization) usually not visible—buried within QRS complex
7. P-R interval
   a. Distance between beginning of P wave and the beginning of QRS complex
   b. Indicates length of time it takes depolarizatin wave to go from atria to ventricles
8. S-T segment: distance between the S wave of the QRS complex and the beginning of the T wave—usually in isoelectric line
9. Refractory period
   a. Period of time when cells have been depolarized and not yet returned to polarized state—unable to be stimulated again
   b. On ECG, includes, QRS complex and T wave
      i. Absolute refractory period: time when stimulation will produce no depolarization whatsoever—from beginning of QRS complex to apex of T wave

ii. Relative refractory period: time when a sufficiently strong stimulus may produce depolarization. Corresponds to down slope of T wave

G. Nervous control of electrical activity
1. Sympathetic (adrenergic) control
a. Effects of alpha stimulation: no direct effect on heart
b. Effects of beta stimulation: increased rate, increased conduction velocity in atria and ventricles, increased irritability, (increased contractility—mechanical effect)
2. Parasympathetic (cholinergic) control
a. Effects of parasympathetic (vagal) stimulation: decreased firing rate of SA node, decreased AV conduction, little effect on ventricles

Assessment of the Cardiac Patient

Common Chief Complaints and History

A. Chest pain/discomfort
1. Most common symptom of myocardial infarction
2. Significant history of the chief complaint (history of present illness)—try to determine:
a. Location of pain
b. Radiation, if present
c. Duration
d. Factors that precipitated
e. Type or quality of pain
f. Associated symptoms
g. Anything that relieves or aggravates pain (including meds)
h. Previous episodes
3. Many causes of chest pain besides cardiac—history important

B. Shoulder, arm, neck, or jaw pain/discomfort
1. May occur with or without any chest pain
2. Significant history of chief complaint—same as for chest pain

C. Dyspnea
1. Often an associated symptom of myocardial infarction or primary symptom of pulmonary fluid congestion due to failing pump
2. Is subjective—difficult to assess severity
3. Significant history of chief complaint—try to determine:
a. Duration, circumstances of onset
b. Anything that aggravates or relieves (including meds)
c. Previous episodes
d. Associated symptoms
e. Prior cardiac problems
4. Many causes of dyspnea besides cardiac—attempt to determine history of COPD, cold, fever, etc.

D. Syncope

1. May be the only symptom of cardiac problems, particularly in elderly patients
2. May be caused by transient or prolonged decrease in heart rate causing drastic reduction in cardiac output and cerebral perfusion
3. Significant history of chief complaint—try to determine:
   a. Circumstances of occurrence (position, etc.)
   b. Duration
   c. Any symptoms prior to syncope
   d. Other associated symptoms
   e. Previous episodes

E. Abnormal heart beat/palpitations
   1. Patient's awareness of own heartbeat—usually related to irregularity ("skipping beats") or rapid heart rate
   2. Significant history of chief complaint—try to determine:
      a. Circumstances of occurrence
      b. Duration
      c. Associated symptoms
      d. Previous episodes/frequency

Significant Past Medical History in the Cardiac Patient

A. Do not waste a lot of time with past history, as patient is treated based on his/her current symptoms regardless of past history
B. Attempt to determine the following:
   1. Is patient taking prescription medications regularly, particularly cardiac medications?—examples:
      a. Nitroglycerine
      b. Propranolol (Inderal)
      c. Digitalis (digoxin, Lanoxin)
      d. Diuretics
      e. Antihypertensives
      f. Other antidysrhythmics
   2. Is the patient being treated for any serious illness?
   3. Has the patient ever been known to have:
      a. A heart attack or angina
      b. Heart failure
      c. Hypertension
      d. Diabetes
      e. Chronic lung diseases
   4. Does the patient have any allergies?

Physical Examination of the Cardiac Patient

A. Primary survey
B. Vital signs and mini-neuro exam:
   1. Blood pressure
   2. Respiratory rate
   3. Rate and regularity of pulse; may be first indication of dysrhythmia
   4. Level of consciousness
      a. Determine what is normal for this patient, if possible

b. Alteration may indicate decresed brain perfusion due to poor cardiac output

C. Secondary survey

1. Look—special attention to:
   a. Skin color, capillary refill
      i. Indication of adequacy of RBC oxygenation
      ii. Indication of pump adequacy (peripheral perfusion)
   b. Jugular vein distention
      i. Pump failure causes back pressure in systemic venous circulation; reflected early in neck vein engorgement
      ii. Examine patient with head elevated 45 degrees—not flat
      iii. May be difficult to assess in obese patient
   c. Peripheral/presacral edema
      i. Caused by chronic back pressure in systemic venous circulaton
      ii. Most obvious in dependent parts—check sacral region in bedridden patients
      iii. Mild vs pitting edema
   d. Be observant for things that indicate patient is being treated for cardiac problems
      i. Nitro patch on skin
      ii. Implanted pacemaker
2. Listen—special attention to
   a. Lung sounds
      i. Assess for equality
      ii. Assess for adventitious sounds (rales, wheezes) that may indicate pulmonary congestion/edema
   b. Heart sounds
      i. May be unable to auscultate in-field
      ii. May discover pulse deficit
      iii. S1—first heart sound produced by closure of AV valves during ventricular systole
      iv. S2—second heart sound produced by closure of aortic and pulmonic valves during ventricular diastole
      v. S3—extra heart sounds heard after S2; compatible with heart failure, but not always present
   c. Carotid artery bruit
      i. Pulse related sound heard during auscultation of carotid arteries
      ii. Should be assessed if contemplating carotid massage

e. Feel—special attention to
   a. Peripheral/presacral edema (as above)
   b. Pulse
      i. Rate
      ii. Regularity
      iii. Equality

Not recommended spending much time in the field for heart ausculatiòn—will not alter your management of patient.

See Techniques of Management-optional skill.

iv. Pulse deficit

c. Skin

Pathophysiology and Management

Pathophysiology of Atherosclerosis

A. Progressive, degenerative disease of medium and larger arteries; affects:
   1. Aorta and its branches
   2. Cerebral arteries
   3. Coronary arteries

B. Deposition of fats, lipids, and cholesterol under intima of blood vessels
   1. Stimulates injury response in vessel wall, and damage to media occurs
   2. Over time, deposition of calcium occurs with resultant plaque formation
   3. Small hemorrhages into the plaque may occur followed by more scarring and fibrosis
   4. Collateral circulation may develop to compensate

C. Major risk factors
   1. Modifiable
      a. Hypertension
      b. Smoking
      c. Elevated blood lipids
   2. Non-modifiable
      a. Diabetes mellitus
      b. Male gender
      c. Advanced age
      d. Family history of early atherosclerosis

D. Results of atherosclerosis
   1. Disruption of intimal surface and loss of vessel elasticity
   2. Reduction of blood flow, i.e., oxygen supply to tissue
   3. Frequent incidence of thrombosis and total obstruction

Specific Conditions Resulting From Atherosclerosis of Coronary Arteries

A. Angina pectoris
   1. Pathophysiology: oxygen demands of heart transiently exceed what is able to be delivered through atherosclerotic coronary arteries, causing ischemia; may also be caused by spasm of coronary artery with or without atherosclerosis
      a. Stable angina
      b. Unstable or preinfarction angina
   2. Signs and symptoms
      a. Are result of build-up of lactic acid and CO_2 in ischemic myocardium
      b. Substernal chest or epigastric discomfort/pain
         i. Pain, pressure, squeezing, or tightness
         ii. Frequently mistaken for indigestion
         iii. Approximately 1/3 of angina patients feel pain *only* in chest

c. Pain may radiate
   i. Shoulder(s)
   ii. Arm(s)
   iii. Neck and jaw
   iv. Through to back
d. Associated symptoms may or may not be present
   i. Anxiety
   ii. Shortness of breath
   iii. Diaphoresis
e. Stable angina usually precipitated by physical and/or emotional stress; unstable angina can occur at rest
f. Stable angina of short duration 3-5 minutes, sometimes up to 15 minutes
   i. Relieved by rest, nitroglycerine, and/or oxygen
   ii. Unstable angina may not respond as readily
g. Dysrhythmias—may be precipitated by ischemia
h. History—if history of angina attacks, determine if nitroglycerine taken, how much, and if effective

3. Management
   a. Place patient at rest physically and emotionally to decrease oxygen demand of myocardium
   b. Administer oxygen (high FiO_2) to increase oxygen delivery to myocardium
   c. Administer nitroglycerine gr. 1/150 or 1/200 sublingually
   d. Whenever symptoms persist, must presume something worse than angina
   e. First-time attacks or attacks unresponsive to treatment need hospital evaluation

B. Myocardial infarction (MI)
   1. Pathophysiology: an area of heart muscle dies (necrosis) either due to prolonged deprivation of arterial blood or when oxygen demand exceeds supply for too long; most often associated with ASHD
      a. Precipitating events
         i. Coronary thrombosis - most common
         ii. Coronary artery spasm
         iii. Microemboli
         iv. Acute volume overload
         v. Hypotension from any cause
         vi. Acute respiratory failure/acute hypoxia
      b. Location, size of infarct dependent on site of obstruction
         i. Majority involve left ventricle
         ii. Anterior, lateral, septal wall infarcts—usually left coronary artery occlusion
         iii. Inferior wall infarcts—usually right coronary artery occlusion

Patient may be asymptomatic by ambulance arrival if nitro taken.

See Pharmacologic Intervention of Cardiovascular Section.

ASHD = Atherosclerotic heart disease.

iv. Extent: subendocardial—involves only subendocardial muscle; Transmural—full thickness of ventricular wall

c. Ring of ischemic myocardium surrounds necrotic tissue—site of origin of many dysrhythmias

d. Death secondary to MI:

i. Fatal dysrhythmias/sudden death—most common cause

ii. Pump failure—with extensive myocardial damage

2. Signs and symptoms

a. Substernal or epigastric discomfort/pain

i. Same location and characteristics as anginal pain

ii. May be severe (crushing) but not necessarily; often mild-to-moderate

iii. Frequently radiates—same location as anginal pain

iv. Often occurs at rest—not necessarily precipitated by exertion

v. Persists for long periods—may wax and wane

vi. Not relieved by nitroglycerine or other meds

vii. Pain not influenced (better or worse) by anything patient does

viii. AMI without symptoms called "silent" MI

ix. All patients with chest pain and compatible history should be presumed to have AMI until proved otherwise—age is not a good discriminator

b. Patients occasionally present with atypical pain—shoulder, arm, neck, or jaw pain *without* chest pain

c. Associated symptoms are common:

i. Diaphoresis

ii. Anxiety/apprehension

iii. Shortness of breath

iv. Nausea and/or vomiting

v. Pallor

vi. Generalized weakness/malaise

d. Patients occasionally present with no pain whatsoever, but with general malaise or history of syncope

e. Denial of seriousness of problem is great—delays obtaining medical assistance during most critical phase of illness

f. Vital signs vary with extent of pump damage and degree of autonomic nervous system response

i. BP: may be normal, elevated (sympathetic discharge), or low (parasympathetic discharge or pump failure)

ii. Pulse: dependent on presence or absence of dysrhythmias; rate may be normal, too fast, or too slow; rhythm may be regular or irregular

iii. Respirations: normal or increased

g. Dysrhythmias are most common complication in first few hours

i. Life-threatening: usually ventricular fibrillation

Documented by ECG.

Patient is admitted to hospital based on history of the present illness, not ECG findings

ii. Non-life-threatening: may not require prehospital intervention

iii. Warning dysrhythmias: may be forerunners of life-threatening dysrhythmias—require prehospital intervention

3. Prehospital management of the uncomplicated MI

a. Goals

i. Relief of pain and apprehension

ii. Prevention of serious dysrhythmias

iii. Limit size of infarct

b. Obtain full history *while* conducting physical exam and initiating treatment

c. Place patient physically at rest and reassure to decrease anxiety

i. Reduces heart rate and therefore myocardial oxygen demand

ii. Position of comfort - ideally reclining with head elevated at least 30 degrees - do not allow to walk

d. Administer oxygen (high FiO_2) to increase oxygen delivery to myocardium

e. Take vital signs for baseline reading—repeat frequently

f. Establish IV as soon as possible with D5W and microdrip to keep vein open

g. Attach ECG electrodes and document initial rhythm

h. Complete the history and physical exam including lung auscultation

i. Administer medications according to written protocol or obtain orders

j. Drugs for pain relief:

i. Nitroglycerine: dilates peripheral arteries and veins to reduce preload, afterload, and myocardial oxygen demand; possibly increases flow in collaterals

ii. Morphine sulfate: reduces myocardial oxygen demand by reducing venous return and systemic arterial resistance; relief of pain; reduces sympathetic system discharge

iii. Consider nitrous oxide for analgesia

iv. Diazepam: may be appropriate if patient extremely agitated or apprehensive, but having little pain

k. Drugs for management of dysrhythmias

i. Lidocaine: suppresses so-called "warning dysrhythmias" and may be given in absence of dysrhythmias as prophylactic measure

ii. Other drugs for slow heart rates—atropine, isoproterenol, epinephrine

iii. Other drugs for fast heart rate and ventricular irritability—bretylium, verapamil

l. Calm transport without lights or siren if patient stable

4. In-hospital management of MI

C. Left ventricular failure and pulmonary edema

Slow, fast, or irregular pulse may be first indication of dysrhythmias.

Rales may be indicative of early heart failure.

See details in Pharmacologic Intervention of Cardiovascular Section.

Reduced preload and afterload.

See details in Pharmacologic Intervention of Cardiovascular Section.

See Dysrhythmia and Pharmacologic Intervention of Cardiovascular Section

Discuss inhospital diagnosis and treatment in general.

1. Pathophysiology: failure of left ventricle as an effective forward pump causing back-pressure of blood into pulmonary circulation, resulting in pulmonary edema
   a. Caused by various types of heart disease including MI, valvular disease, chronic hypertension, and dysrhythmias
   b. Left ventricle not able to eject all blood delivered to it from right heart
   c. As left ventricle fails, left atrial pressure rises and is transmitted to pulmonary veins and capillaries
   d. When pulmonary capillary pressure becomes too high, serum portion of blood forced into alveoli, resulting in pulmonary edema
   e. Progressive fluid accumulation in alveoli will lead to death from hypoxia unless intervention occurs
   f. Since MI is common cause of left ventricular failure, all patients in pulmonary edema must be presumed to also have MI
2. Signs and symptoms
   a. Severe respiratory distress
      i. Orthopnea
      ii. Spasmodic coughing may be productive of pink, foamy sputum
      iii. May have history of paroxysmal nocturnal dyspnea (PND)
   b. Severe apprehension/agitation/confusion
   c. Cyanosis—if severe
   d. Diaphoresis
   e. Adventitious lung sounds
      i. Rales—fluid in alveoli; usually bilateral; may be in bases only or up to scapulae; do not clear with coughing
      ii. Rhonchi—fluid in larger airways
      iii. Wheezes—reflex airway spasm; sometimes referred to by confusing term "cardiac asthma"
   f. Jugular vein distention
      i. May be present if back-pressure reflected all the way through right heart to venous system
      ii. Observe patient with head elevated at least 45 degrees
   g. Vital signs: intense sympathetic discharge attempts to help body compensate
      i. BP—usually very elevated
      ii. Pulse—rapid to compensate for low stroke volume; may be irregular if dysrhythmias present
      iii. Respirations—tachypneic, labored
   h. Level of consciousness varies; may be anxious, agitated, uncooperative, or obtunded due to poor cerebral perfusion
   i. Chest pain may or may not be present depending on whether infarct occurring and/or pain masked by respiratory distress
3. Prehospital management

Increased pre-load.

Pulmonary congestion.

Characteristic.

a. True emergency—patient can decompensate rapidly and unpredictably
b. Goals of management
   i. Decrease venous return to heart
   ii. Decrease myocardial oxygen demands
   iii. Improve ventilation and oxygenation
c. Obtain full history and complete exam *while* initiating treatment
d. Sit patient up with feet dangling to enhance venous pooling. DO NOT LIE FLAT AT ANY TIME
e. Administer high flow oxygen—positive pressure assist is ideal if patient can cooperate or if very obtunded
f. Rotating tourniquets may be applied to enhance venous pooling, especially if unable to establish IV
g. Establish IV of D5W with microdrip to keep vein open—crucial to limit fluid
h. Attach ECG electrodes—document initial rhythm
i. Administer medications according to written protocols or obtain orders:
   i. Morphine sulfate
      - Decreases venous return
      - Reduces myocardial work
      - Reduces anxiety
   ii. Nitroglycerine may be useful for its peripheral vasodilation
   iii. Furosemide:
      - Direct relaxant effect on venous system within 5 minutes
      - Diuretic effect—reduces intravascular volume
   iv. Aminophylline
      - Bronchodilation
j. Rapid transport to hospital

D. Right ventricular failure
   1. Pathophysiology: failure of right ventricle as an effective forward pump causing back-pressure of blood into systemic venous circulation, resulting in venous congestion
      a. Most common cause is left ventricular failure; other etiologies:
         i. Chronic hypertension
         ii. Chronic obstructive pulmonary disease (COPD)—Cor pulmonale
         iii. Pulmonary embolus
         iv. Infarct of right atrium or ventricle
      b. Right ventricle unable to keep up with venous return
      c. As stroke volume lessens, right atrial pressure rises and back-pressure transmitted to vena cava and rest of venous system
      d. When systemic venous pressure becomes too high, serum portion of blood forced out into interstitial tissue of body, resulting in edema

Decrease preload.

Optional Skill.

Remember: Very rapid dysrhythmia may have precipitated the failure. See Pharmacologic Intervention of Cardiovascular Section.

2. Signs and symptoms:
   a. Tachycardia—compensatory
   b. Venous congestion
      i. Organ engorgement: tender right upper quadrant from liver engorgement
      ii. Vein distention: jugular venous distention, pulsation
   c. Peripheral edema
      i. Lower extremities
      ii. Sacral region in bedridden patient
      iii. "Pitting"
      iv. Entire body—anasarca
   d. Fluid accumulation in serous cavities
      i. Abdominal cavity—causes ascites
      ii. Pleural space—pleural effusions
      iii. Pericardium—pericardial effusion/rub
   e. History:
      i. Often previous MI's in patient with chronic pump failure
      ii. Frequently give history of taking digitalis and diuretic to control heart failure
      iii. Patients may use lay terms to describe their heart failure
3. Management
   a. Usually not a medical emergency in itself—more important to realize relationship to left ventricular failure and potential for acute decompensation
   b. Place at rest with head elevated
   c. Administer oxygen (high FiO_2)
   d. Take baseline vital signs
   e. Start IV D5W with microdrip to keep vein open
   f. Monitor ECG
   g. Treat symptoms of left ventricular failure if present

E. Cardiogenic shock
   1. Pathophysiology: most extreme form of pump failure; occurs when left ventricular function so compromised that heart cannot meet metabolic needs of the body
      a. By definition, it is shock that persists after correction of existing dysrhythmias, hypovolemia, or altered vascular tone
      b. Usually due to extensive myocardial infarction or diffuse ischemia
      c. Compensatory mechanisms exhausted
   2. Signs and symptoms:
      a. Signs and symptoms of acute myocardial infarction
      b. Hypotension: systolic BP usually less than 80 mmHg
      c. Altered level of consciousness—may be anywhere from restless and apprehensive, to confused, to unconscious
      d. Sinus tachycardia is usual heart rhythm

See Trauma Division.

TOPIC	CONTENT OUTLINE

i. Present in 75-80% of cases; if absent may be due to paresthesia
ii. Sudden, excruciating
iii. Peaks within several hours

b. Pallor
i. May also be mottled, cyanotic
ii. May also have decreased temperature in limb

c. Shock may be present, particularly in mesenteric occlusion

d. Pulselessness distal to occlusion

3. Prehospital management
a. Mesenteric occlusion
i. Treat shock with oxygen and IV fluids
ii. Pain relief with morphine sulfate

b. Extremity occlusion
i. Serious but not life-threatening
ii. Must re-establish flow in 4-8 hours
iii. Protect affected limb—don't allow patient to walk

D. Acute Pulmonary Embolism

E. Non-critical peripheral vascular conditions:
1. Deep vein thrombophlebitis
a. Thrombosis and inflammation of a vein—commonly occurs in calf or thigh
b. Predisposing factors:
i. History of trauma
ii. Inactivity—bedridden patients
iii. Pregnancy
iv. Varicose veins
c. Signs and symptoms
i. Gradually increasing pain—calf tenderness
ii. Swelling of leg and foot
iii. Signs and symptoms improved with leg elevation
iv. May be asymptomatic
d. Prehospital management
i. Not a medical emergency, but prone to developing pulmonary emboli
ii. Palpate calf gently
iii. Do not allow patient to walk
iv. Elevate leg

2. Varicose veins
a. A noncritical condition caused by dilation of superficial veins, usually in lower extremities
b. Predisposing factors include genetic predisposition, pregnancy, obesity
c. Signs and symptoms
i. Visible distention of leg veins

INSTRUCTOR'S NOTES

See Respiratory Section.

ii. Lower leg discomfort and swelling, especially at end of day
iii. Skin color and texture changes in legs and ankles
iv. May develop stasis ulcers

d. Severe bleeding from rupture is the only associated emergency—control hemorrhage with direct pressure

3. Peripheral arterial atherosclerotic disease
   a. Chronic disease caused by atherosclerosis of abdominal aorta and its tributaries to lower extremities
   b. A gradual, progressive disease—not a medical emergency
   c. Common in diabetics
   d. Signs and symptoms
      i. Characterized by intermittent claudication
      ii. Trophic changes in feet
      iii. Skin rubor on dependency
      iv. May develop ulcers, gangrene
   e. Only associated medical emergency is development of acute arterial occlusion in these patients

F. Malignant hypertension
1. Occurs in less than 1% of patients with hypertension, usually poorly controlled or untreated
2. Signs and symptoms:
   a. Rapid increase in diastolic BP (usually ≥ 130 mm Hg)
   b. Restlessness, confusion, or somnolence
   c. Blurred vision
   d. Headache
   e. Nausea and vomiting
   f. "Hypertensive encephalopathy": name given to the syndrome of blurred vision, focal neuro deficit, and seizure, stupor, or coma
   g. May also develop left ventricular failure and pulmonary edema or stroke syndrome
3. Prehospital management:
   a. Care is supportive rather than definitive
   b. Keep patient quiet
   c. Oxygen therapy
   d. Treat symptomatically, especially if heart failure present
   e. Rapid transport to hospital for definitive drug therapy
4. Hypertension—related emergencies:
   a. Examples:
      i. Pulmonary edema from left ventricular failure
      ii. Dissecting aortic aneurysm
      iii. Toxemia of pregnancy
      iv. Cerebral Vascular Accident (CVA)
   b. Hypertension in these conditions is usually the result of the primary problem
   c. Treat the primary problem rather than the hypertension

INSTRUCTOR'S NOTES

Stasis dermatitis.

TOPIC	CONTENT OUTLINE

Pharmacologic Intervention

Anti-dysrhythmics

A. Atropine Sulfate
   1. Pharmacology/actions: parasympathetic (vagal) blocking actio
      a. Accelerates sinus node discharge rate
      b. Improves AV conduction
      c. By increasing sinus rate, may reduce chances of ectopic ventricular activity
      d. *May* restore cardiac rhythm in asystole
   2. Indications:
      a. Any bradycardia accompanied by:
         i. Hemodynamically significant hypotension, and/or;
         ii. Ventricular ectopic beats, or;
         iii. Any other signs or symptoms of hemodynamic decompensation
      b. May be indicated for ventricular asystole
   3. Precautions:
      a. Should not be used for bradycardia unless signs of poor perfusion or ventricular ectopy are present
      b. Increased myocardial oxygen demand by excessive rate acceleration
      c. Ventricular tachycardia/fibrillation reported after IV administration
      d. Should *not* be pushed slowly or in smaller than recommended doses, as paradoxical slowing of rate can occur
      e. Be alert to history of glaucoma
   4. Administration
      a. Initial adult dosage: 0.5 mg. IV repeated at 5-minute intervals as needed, not to exceed total dose of 2.0 mg.
      b. 1.0 mg. can be given as initial dose for asystole
      c. Pediatric dosage: 0.01–0.03 mg./kg. (0.1 mg. minimum)
      d. May be administered through endotracheal
   5. Side effects/special notes
      a. Side effects: decreased CI motility, urinary retention, pupil dilation
      b. Less likely to be effective than beta stimulators in complete block, but should be tried first to increase AV conduction

B. Lidocaine hydrochloride
   1. Pharmacology/actions:
      a. Suppresses dysrhythmias of ectopic ventricular origin
      b. In ischemic tissue, thought to further depress conduction and interrupt re-entry pathways
      c. Doesn't significantly alter conduction or contractility in healthy tissue
      d. Elevates ventricular fibrillation threshold
      e. Little effect with normal doses on atrial muscle
   2. Indications:
      a. PVC's, especially in the setting of myocardial ischemia

INSTRUCTOR'S NOTES

b. Ventricular tachycardia
c. Refractory or recurrent ventricular fibrillation
d. Prophylactic administration in the setting of acute MI
e. Following successful defibrillation

3. Precautions:
   a. Reduce dose by 1/2 in presence of reduced cardiac output (CHF, shock) or reduced hepatic clearance (cirrhosis) to prevent toxicity
   b. Use with caution with conduction system disorders and/or bradycardia
   c. Administer slowly by IV bolus—50 mg/minute
4. Administration:
   a. Adult dosage options:
      i. Initial bolus 1 mg/kg followed by IV drip at 1-4 mg. minute; additional half-dose boluses if ectopy continues; or
      ii. Initial bolus of 75 mg. and IV drip at 2 mg/minute; then if ectopy persists, additional 50 mg. boluses every 5 minutes to total of 225 mg.; drip increased 1 mg./minute with each bolus to maximum of 4 mg./minute
   b. For prophylaxis: similar bolusing and drip
   c. Pediatric dosage: bolus of 1 mg/kg.
   d. May be administered through ET tube
5. Side effects/special notes:
   a. Most adverse reactions are manifestations of toxicity and are CNS related:
      i. Muscle twitching
      ii. Slurred speech
      iii. Alter consciousness
      iv. Decreased hearing
      v. Numbness
      vi. Seizures
      vii. Hypotension
   b. Bolus administration must precede a drip; drip alone takes 30-60 minutes to obtain effect

C. Bretylium Tosylate (Bretylol)
1. Pharmacology/actions: actions are complex and not completely understood
   a. Elevates ventricular fibrillation threshold
   b. May terminate re-entry pathways
   c. Sometimes an initial increase in rate and arterial pressure
   d. Subsequent decrease in rate and arterial pressure
   e. Conductivity and contractility not affected
2. Indications:
   a. Primarily used in-field for ventricular fibrillation
   b. Refractory ventricular tachycardia, unresponsive to standard therapy measures
3. Precautions:

Or if patient taking medication known to reduce hepatic clearance

Catecholamine release

a. Use with caution if digitalis toxicity suspected
b. Catecholamine dosages should be reduced when bretylium used
4. Administration:
a. Dosage for ventricular fibrillation:
i. Initial: 5 mg/kg Bolus (350-500mg.) followed by defibrillation
ii. Subsequent: 10 mg/kg.—may be repeated at 15–30 minute intervals
iii. Onset of action within a few minutes in ventricular fibrillation
b. Dosage for ventricular tachycardia:
i. Initial: 5–10 mg/kg over 8–10 minutes; dilute to avoid nausea and vomiting
ii. Subsequent: in 1–2 hours may give 5–10 mg/kg
iii. Onset of action 20 minutes or more with ventricular tachycardia
5. Side effects:
a. Possible transient tachycardia and hypertension following injection
b. Postural hypotension later
c. Nausea and vomiting after rapid injection

D. Verapamil (Isoptin, Calan)
1. Pharmacology/actions:
a. Inhibits slow-channel calcium activity in cardiac and vascular smooth muscle
b. Reduces contractility and myocardial oxygen consumption
c. Dilates coronary and peripheral blood vessels, reducing systemic vascular resistance
d. Slows conduction and prolongs refractory period in AV node
2. Indications:
a. To terminate paroxysmal supraventricular tachycardias due to AV nodal re-entry
b. To control ventricular response (rate) in atrial fibrillation and flutter
3. Precautions:
a. Monitor BP closely—may cause hypotension
b. Obtain history of digitalis if possible—risk of precipitating AV block
c. Contraindicated in patients with AV block, sick sinus syndrome, or cardiac failure
d. Contraindicated in patients with known WPW with atrial fibrillation or flutter
e. Not to be used concomitantly with intravenous beta blockers
4. Administration:
a. Adult dosage: 0.075–0.15 mg/kg; may be repeated in 30 minutes in 0.15 mg/kg dose; 10 mg. maximum single dose
b. Pediatric dosage: 0.1–0.2 mg/kg; total single dose: 0.75–2.0 mg

In perfusing patient

c. Administer over one minute
d. Peak effect occurs within 3-5 minutes
5. Side effects/special notes:
a. Transient hypotension
b. Heart failure
c. AV block

Sympathomimetic Agents

A. Drugs which duplicate or mimic sympathetic nervous system stimulation
1. Effects of drugs may be on different receptor sites:
a. Alpha receptor sites:
i. Alpha 1 and alpha 2 receptors located in peripheral vascular smooth muscle
ii. Stimulation causes vasoconstriction; no direct effect on heart
b. Beta receptor sites:
i. Beta 1 receptors located primarily in heart—stimulation causes increased heart rate and force of contraction
ii. Beta 2 receptors located in smooth muscle of peripheral blood vessels, bronchial tree, and GI tract—stimulation causes dilation
c. Dopaminergic receptors:
i. Located in renal and mesenteric blood vessels
ii. Stimulation causes dilation

B. Epinephrine
1. Pharmacology/actions: both alpha and beta effects
a. Increased heart rate
b. Increased myocardial contractility
c. Increased arterial BP
d. Increased systemic vascular resistance
e. Increased myocardial oxygen demand
f. Increased automaticity of ectopic foci
g. Bronchodilation
2. Indications:
a. First-line drug in cardiac arrest secondary to:
i. Ventricular fibrillation
ii. Asystole
iii. Electromechanical dissociation
b. Severe bradycardias unresponsive to atropine
3. Precautions:
a. Avoid mixing with bicarbonate, as may inactivate epinephrine
b. Intramyocardial injection may produce intractable V-fib
4. Administration:
a. Adults: 0.5–1.0 mg of 1:10,000 solution IV initially, repeated at 5-minute intervals as needed
b. May be given through endotracheal tube if IV line placement delayed—1 mg. (10 ml.) 1:10,000
c. Avoid intracardiac injection due to numerous complications

See Techniques of management—optional skill.

d. May be given by drip to increase and sustain BP and heart rate—1 mg Epinephrine in 250 ml 5% dextrose in water to infuse at 1–4 mcg./minute
e. May also be titrated by administering small (.5–1 ml) increments of 1:10,000 bolus, repeated if necessary
f. Pediatric dosage: 0.1 ml/kg. of 1:10,000 IV bolus

5. Side effects/special notes:
   a. Ventricular dysrhythmias
   b. Be aware of increased myocardial oxygen demand

C. Norepinephrine (Levophed)
1. Pharmacology and actions: both alpha and beta properties
   a. Potent peripheral vasoconstriction
   b. Increased myocardial contractility (beta 1)
   c. Variable response in cardiac output
   d. Renal and mesenteric constriction
   e. Raises BP promptly—more rapid response than other catecholamines
2. Indications:
   a. Hemodynamically significant hypotension/cardiogenic shock
   b. May be particularly effective when total peripheral resistance is low
3. Precautions:
   a. Not indicated in cases of hypovolemia or hypotension secondary to bradycardia—correct primary problem first
   b. BP must be monitored closely while titrating drip
   c. May precipitate dysrhythmias—monitor EKG closely
   d. IV infiltration causes tissue necrosis and sloughing
4. Administration:
   a. Adult dosage: IV drip only
      i. Mix 4 mg Levophed in 250 ml D5W with microdrip (16 mcg/ml)
      ii. Initial dose of 2–3 ml./minute, adjusted to maintain BP at 90–100 systolic
   b. Pediatric dosage: start drip at 0.1 mcg/kg/minute
5. Side effects/special notes:
   a. Reflex bradycardia
   b. Extreme hypertension
   c. Dysrhythmias
   d. Local tissue necrosis

D. Isoproterenol
1. Pharmacology and actions: pure beta stimulator
   a. Increased heart rate
   b. Increased contractility
   c. Increased myocardial oxygen consumption
   d. Decreased peripheral vascular resistance
   e. Bronchodilation

Check for IV patency before and during administration.

2. Indications:
   a. Hemodynamically significant bradycardia refractory to atropine
3. Precautions:
   a. Avoid using unless bradycardia accompanied by symptoms
   b. Use with caution in presence of ventricular dysrhythmias—watch for development of new dysrhythmias
   c. BP may decrease due to vasodilation—monitor closely
4. Administration:
   a. Adult dosage:
      i. Mix 1 mg. isoproterenol in 250 D5W with microdrip for concentration of 4 mcg./ml.
      ii. Infuse at 2-20 mcg/minute, titrated to heart rate and BP response
   b. Pediatric dosage: start drip at 0.1 mcg/kg/minute; usual effect at 0.1–1.0 mcg/kg/minute
5. Side effects/special notes:
   a. Ventricular dysrhythmias—slow or stop infusion
   b. Tachycardia
   c. Infarct extension: secondary to increased oxygen consumption and decreased coronary artery perfusion if diastolic pressure drops

E. Dopamine (Intropin)
1. Pharmacology and actions:
   a. Chemical percursor of epinephrine, naturally occurring in man
   b. Stimulates alpha, beta, and dopamine receptor sites
   c. Actions depend on dose level:
      i. 1–2 mcg/kg/minute—dilates renal and mesenteric blood vessels with no effect on heart rate or BP
      ii. 2–10 mcg/kg/minute—increased cardiac output due to beta effects on heart
      iii. 10–20 mcg/kg/minute—peripheral vasoconstriction (alpha effect) and increased BP—may begin to cause renal vasoconstriction
      iv. Above 20 mcg/kg/minute—alpha effect reverses dilation of renal and mesenteric vessels and decreases flow through these vessels
2. Indications:
   a. Primary indication is cardiogenic shock
   b. May be useful in treating other hypotension except that secondary to hypovolemia
3. Precautions:
   a. May be inactivated if mixed with sodium bicarbonate
   b. Contraindicated for hypovolemic shock
   c. Infusion rate must be regulated carefully to obtain desired effects—may be hazardous in the field
   d. Tissue necrosis and sloughing can occur from IV infiltration (like Levophed)

TOPIC	CONTENT OUTLINE
	e. Potentiated by MAO inhibitors—dosage must be decreased

4. Administration:
   a. Adult dosage: by IV drip only
      i. Mix 200 mg dopamine in 250 ml D5W with microdrip for a concentration of 800 mcg/ml.
      ii. Begin infusion at 2–5 mcg/kg/minute—adjust according to clinical response
   b. Pediatric dosage: 2–10 mcg/kg/minute
5. Side effects/special notes:
   a. Tachydysrhythmias/ectopy
   b. Nausea and vomiting
   c. Excessive vasoconstriction at higher dosages
   d. Serious acute hypertension in patients with pheochromocytoma

Electrolyte Solution

A. Sodium Bicarbonate ($NaHCO_3$)
1. Pharmacology and actions:
   a. An alkalinizing agent used to treat the acidosis that results from metabolism by hypoxic body tissues:
      i. $HCO_3^- + H^+ \leftarrow H_2CO_3 \leftarrow CO + H_2O_2$
      ii. Carbon dioxide is generated by this reaction and must be eliminated by the lungs
   b. Given to correct the following effects of acidosis:
      i. Depression of normal cardiac electrical activity
      ii. Lowering of fibrillation threshold to facilitate defibrillation
      iii. Depression of cardiac contractility
      iv. Depressed response to catecholamines
2. Indications:
   a. Cardiac arrest
   b. Treat acidosis of other causes
3. Precautions:
   a. Should not be allowed to mix or given in too rapid succession with catecholamines (inactivates) or calcium (precipitates)
   b. Overcorrection of pH (alkalosis) with too much bicarbonate more difficult to treat than acidosis; blood gases needed as soon as possible
   c. Good ventilation must occur along with administration of bicarbonate to correct acidosis
   d. May not be indicated if arrest time very short or respiratory arrest occurs without cardiac arrest
4. Administration:
   a. Adult dosage: 1 mEq/kg initially followed by one-half this dose every 10–15 minutes of arrest if blood gases not available
   b. Pediatric dosage: 1–2 mEq/kg
5. Side effects/special notes:
   a. Metabolic alkalosis
   b. Acute hypokalemia

INSTRUCTOR'S NOTES

Examples: Parnate, Marplan
Nardil

c. Carbon dioxide retention if patient not well ventilated
d. Salt and water overload with high doses

B. Calcium Chloride ($CaCl_2$)
1. Pharmacology and actions: direct myocardial effect
   a. Increases cardiac contractility (positive inotropic)
   b. May increase myocardial excitability
2. Indications: second or third-line drug for
   a. Electromechanical dissociation
   b. Asystole
3. Precautions:
   a. Use with caution in patients on digitalis—additive effects
   b. Precipitates when mixed with bicarbonate
   c. Rapid injection may slow heart rate—administer over 2–3 minutes if heart is beating
   d. Causes tissue irritation and necrosis if infiltrated at IV site
4. Administration
   a. Adult dosage: 5–7 mg/kg (about 500 mg or 5 ml of 10% solution) repeated if needed at 10 minute intervals
   b. Calcium chloride preferred over calcium gluceptate or gluconate because of more immediately available ionized calcium
   c. Pediatric dosage: 0.3 ml/kg of 10% solution
5. Side effects/special notes:
   a. May increase cardiac irritability in presence of digitalis
   b. See precautions for other side effects

Drugs for Myocardial Ischemia/Pain

A. Oxygen
1. Pharmacology and actions:
   a. An odorless, tastless, colorless gas necessary to sustain all cellular life and proper cellular metabolism
   b. Adding oxygen to inspired air raises the amount of oxygen in the blood and, therefore, the amount delivered to tissues
2. Indications: Any hypoxic patient or situation where it appears hypoxia might soon ensue including:
   a. Cardiac arrest
   b. Pain from myocardial ischemia/necrosis
   c. Congestive heart failure, pulmonary edema
   d. Shock (of any etiology)
   e. Peripheral vascular obstruction/insufficiency
   f. Pulmonary embolism
3. Precautions: Ascertain if patient has history of COPD before administering high concentrations and begin with lower FiO_2's in these patients increasing as necessary
4. Administration:
   a. High FiO_2 usually indicated for cardiovascular problems—may be administered by simple face mask, partial rebreathing, or nonrebreathing masks

INSTRUCTOR'S NOTES

Refer to Respiratory System Section for further details on oxygen administration

b. Nasal cannula at liter flows up to 6 liters/minute may be used if patient cannot tolerate face mask or lower liter flow settings for patients with chronic obstructive pulmonary disease (COPD)

c. Positive pressure ventilation with 100% oxygen indicated for cardiac arrest and desirable in pulmonary edema if patient will tolerate

5. Side effects and special notes:

a. Non-humidified oxygen may be drying and irritating to mucous membranes

b. Reassure patients who are anxious about face mask but are in need of high concentrations of oxygen before reverting to lower flow nasal cannula

c. There is no danger of oxygen toxicity from short-term administration in emergencies

d. Nasal cannulas are equally effective on nose and mouth breathing patients

B. Nitrous Oxide (Nitronox)

1. Pharmacology and actions:

a. Nitronox is a combination of nitrous oxide and oxygen, blended at a 50:50 ratio

b. Produces CNS depression and decreases sensitivity to all types of pain

c. Effects dissipate within 2–5 minutes after cessation of administration

2. Indications: for pain of any etiology including pain of myocaridal infarction

3. Contraindications:

a. Decreased or impaired level of consciousness

b. Inebriation

c. Chest trauma

d. Abdominal distension

e. Respiratory problems (COPD, pulmonary edema, pneumothorax, severe distress)

f. Cyanosis with nitronox administration

g. Inability to comply with instructions (senility, mental retardation)

h. Pregnancy

4. Administration:

a. Must always be self-administered by the patient

b. Intermittently inhaled through a demand valve via mask or mouth piece as needed for pain relief or until drowsiness occurs

c. Patient must be given oxygen during intervals that nitronox not being used

5. Side effects/special notes:

a. Side effects may include any of the following:

i. Drowsiness (common)

ii. Nausea

iii. Headache

iv. Amnesia, euphoria, or confusion

v. Numbness, tingling, light-headedness, or slurred speech

b. The ventilation fan in the ambulance must be running during Nitronox administration to avoid inhalation by EMT-P; use of an exhalation scavenger also recommended

c. Patients with myocardial pain should always be given oxygen by face mask during intervals that Nitronox is not being used and at termination of administration

C. Mitroglycerine

1. Pharmacology and actions:
   a. Relaxes smooth muscle, particularly vascular smooth muscle
   b. May increase coronary blood flow, by coronary artery dilation
   c. Relieves coronary artery spasm
   d. May decrease left ventricular work and oxygen demand by dilation of peripheral vascular bed and reduction of preload and afterload
2. Indications:
   a. Ischemic myocardial pain (angina pectoris, acute MI)
   b. May be used for pulmonary edema for its peripheral vasodilatory effect
3. Precautions:
   a. Monitor BP closely before and after administration as it may cause hypotension leading to decreased coronary artery flow
   b. Contraindicated in hypotension/shock
   c. Drug is unstable and deterioration hastened by exposure to air, light, and temperature extremes. Store in dark glass bottles and limit opening and closing
4. Administration:
   a. 0.3 mg (grains 1/200) or 0.4 mg (grains 1/150) sublingually
   b. May be repeated at 3–5 minute intervals
   c. Should be dissolved under the tongue as it is less effective when swallowed
5. Side effects/special notes:
   a. Common side effects: headache, dizziness, flushing, burning under tongue
   b. Hypotension and reflex tachycardia
      i. Serious in possible MI patient
      ii. May respond to lowering patient's head, elevating legs, or anti-shock garment

D. Morphine Sulfate

1. Pharmacology and actions:
   a. Potent narcotic analgesic
   b. Dilates peripheral vasculature (arterial and venous)
      i. Reduction of preload and afterload
      ii. Reduces cardiac work anjd oxygen consumption
   c. Reduces respiratory rate and tidal volume

Indicate potency of pills.

d. Constricts pupils
e. Reduces anxiety/apprehension
2. Indications:
a. Acute myocardial infarction
b. Acute pulmonary edema
3. Precautions:
a. Must be administered slowly. IV—2 mg/minute
b. Monitor BP closely before and after administration
c. Contraindicated in hypotension
d. Must be used cautiously in patients with COPD or respiratory depression
4. Administration
a. IV only in cardiac emergencies
b. 2–5 mg increments IV titrated to pain relief or desired hemodynamic effect
c. May be repeated every 5-30 minutes as needed
5. Side effects/special notes:
a. Respiratory depression—be prepared to assist ventilations
b. Hypotension—often if patient hypovolemic or has decreased cardiac output
c. Nausea and vomiting
d. Decreased level of consciousness
e. Side effects reduced by administering small doses and administering slowly
f. All side effects reversible with Naloxone if necessary

Other Pre-Hospital Cardiac Drugs

A. Furosemide (Lasix)
1. Pharmacology and actions:
a. Inhibits sodium reabsorption in the kidneys promoting diuresis; also causes increased potassium excretion
b. Thought to cause venous dilation, decreasing venous return (preload)
c. Rapid onset of action (5 minutes), peaking in 1/2–1 hour, with short duration of effect (2 hours)
2. Indications: Acute pulmonary edema
3. Precautions:
a. Can cause profound diuresis—monitor BP closely
b. Should not be administered to pregnant women
c. Contraindicated in hypovolemic states
4. Administration:
a. Adult initial dose, 0.5 to 2.0 mg/kg IV bolus (40 mg) administer over 2 minutes
b. Pediatric dosage: 1 mg/kg IV bolus
5. Side effects/special notes:
a. Nausea and vomiting
b. Later—volume depletion and dehydration

c. Potassium depletion—of special concern in patients on digitalis

B. Aminophylline
   1. Pharmacology and actions:
      a. A combination of theophylline and ethylene diamine
      b. Acts mainly as a bronchodilator by relaxing smooth muscle of bronchial airways
      c. Dilates peripheral blood vessels
      d. Causes diuresis
      e. Cardiac, cerebral, and skeletal muscle stimulation
   2. Indications: bronchospasm and respiratory distress due to
      a. Cardiac PND and congestive heart failure
      b. Asthma/status asthmaticus
      c. Emphysema
   3. Precautions:
      a. Use with caution in patients with severe cardiac or hepatic disease—decrease dose
      b. Must be administered slowly to avoid toxic and side effects—usually given as an IV drip
      c. Monitor ECG during administration
      d. Ascertain if patient already taking oral theophylline preparations—how much and when last taken
   4. Administration:
      a. Initial adult dosage: 250–500 mg. (5–6 mg/kg) added to 50–100 ml. of D5W with microdrip and administered IV over 20 minutes
      b. Pediatric dosage: 6 mg/kg
   5. Side effects/special notes:
      a. Most serious side effects are cardiovascular—tachycardia and other dysrhythmias frequent
      b. Hypotension
      c. Nausea and vomiting frequent
      d. CNS—headache, nervousness, dizziness, agitation, light-headedness

C. Diazepan (Valium)
   1. Pharmacology and actions:
      a. Tranquilizes, calms patient
      b. Terminates seizure activity
      c. Relaxes skeletal muscle
   2. Indications:
      a. To sedate conscious patients when synchronized cardioversion is required
      b. To sedate possible AMI patients who have little pain, but high anxiety level
   3. Precautions:
      a. Monitor respiratory status closely
      b. Use with caution in COPD patients or patients with respiratory depression from any source

Physician may order reduced dosage in CHF or history of recent theophyiline ingestion.

Cardiac indications only

c. Use with caution in hypotensive patients
d. Effects pronounced in patients who have taken depressant drugs

4. Administration:
   a. 2.5–10 mg IV bolus slowly (5 mg/minute)
   b. Give until desired degree of sedation obtained
5. Side effects/special notes:
   a. Respiratory depression/arrest
   b. Dizziness, ataxia
   c. Transient hypotension
   d. Should not be mixed with other drugs or IV solutions—pinch tubing well and administer right at IV site rather than higher up tubing

Important Cardiac Drugs Not Used Pre-Hospital

A. Digitalis (digoxin, Lanoxin)
   1. Pharmacology and actions
      a. Increases force of ventricular contraction
      b. Slows impulse conduction through AV node
      c. Decreases ventricular response to certain supraventricular tachycardias; slows cardiac rate
      d. Increases cardiac output
   2. Uses:
      a. Treatment of congestive heart failure
      b. Treatment of rapid supraventricular dysrhythmias such as atrial fibrillation, atrial flutter, and paroxysmal supraventricular tachycardias
   3. Mode of administration:
      a. Patients take daily oral dose at home
      b. May be given IV, but the indications in the emergency care setting are limited due to the problems of digitalis toxicity
   4. Side effect/precautions:
      a. Most adverse effects are a reflection of toxicity
      b. Anorexia, nausea and vomiting, diarrhea
      c. Yellow vision, blurred vision
      d. Almost any cardiac dysrhythmia—may be life-threatening and unresponsive to traditional antidysrhythmic drugs

B. Propranolol (Inderal):
   1. Pharmacology and actions: beta 1 and beta 2 blocker:
      a. Decreases automaticity throughout the heart
      b. Decreases conductivity
      c. Decreases ventricular contractility (decreased stroke volume)
      d. Decreases cardiac work and oxygen consumption
      e. Causes bronchoconstriction
   2. Uses:
      a. Treatment of both atrial and ventricular dysrhythmias
      b. Prevention of angina pectoris

c. Treatment of hypertension in patient with ASHD

3. Mode of Administration:

a. Most frequently encountered as an oral medication taken by patient at home

b. May be used IV for refractory ventricular tachycardia and fibrillation not controlled by other antidysrhythmics, but generally not used pre-hospital

4. Side effects/precautions:

a. May precipitate acute heart failure

b. Contraindicated in asthma, COPD

c. Toxic levels may cause severe sinus bradycardia and various degrees of AV block

Dysrhythmia Recognition

Introduction to ECG Monitoring

A. Review electrical conduction pathway of normal heart

1. SA node
2. Internodal and interatrial tracts
3. AV node
4. Bundle of His
5. Bundle branches
6. Purkinje fibers

B. Basic concepts of ECG monitoring

1. ECG is graphic display of heart's electrical activity
2. Body acts as a giant conductor of electrical current
3. ECG obtained by applying electrodes on body surface which detect changes in voltage of cells between sites of the electrodes

a. Voltage may be positive going (upward deflection) or negative going (downward deflection)

b. These changes are input to ECG machine, amplified, and displayed visually on scope and/or graphically on ECG paper

c. Recorded as a continuous curve of waves and deflections called the electrocardiogram

4. ECG machine can provide many "views" of heart's electrical activity by monitoring voltage changes between any number of electrodes applied in various places (with respect to heart) on the body

a. Each "view" called a lead

b. Bipolar lead: combination of one electrode influenced by negative voltages, the other by positive voltages

i. Any electrical impulse moving directly towards positive electrode will create the largest upright (positive) deflection

ii. Any electrical impulse moving directly towards negative electrode will create the largest downward (negative) deflection

iii. No deflection (isoelectric line) indicates either absence of electrical impulse or impulse moving perpendicular to electrodes

Other beta blockers: timolol atenolol nadolol (Eorgard), metoprolol (Lopressor), Labetalol

TOPIC	CONTENT OUTLINE

c. In-the-field, usually use a single bipolar lead versus the 12 views of the full 12-lead ECG
d. Monitoring lead: any non-calibrated lead that shows very clear wave forms, very often Lead II
e. Information that can be gained from a monitoring lead or rhythm strip:
  i. How fast the heart is beating
  ii. How regular the heartbeat is
  iii. How long conduction is taking to occur in different parts of the heart
f. Things a monitoring lead or rhythm strip cannot tell you:
  i. Presence or location of an infarct
  ii. Axis deviation and chamber enlargement
  iii. Right to left differences in conduction or impulse formation
  iv. Quality of pumping action

4. ECG graph paper
  a. Standardized to allow comparative analysis of ECG wave patterns; paper moves past stylus at constant, standard speed
  b. Horizontal lines on graph measure time:
    i. 1 small box = .04 seconds
    ii. 1 large box (5 small) = .20 seconds
    iii. Used to measure duration of complexes and intervals
  c. Vertical lines on graph measure voltage
    i. 1 small box—1 millivolt
    ii. Only pertinent in evaluating calibrated tracings, such as from 12-lead ECG
5. Review of relationship of ECG to electrical events in the heart
  a. Single cardiac cycle on ECG includes everything from depolarization of atria up to and including repolarization of ventricles
  b. P wave
  c. QRS complex
  d. PR interval
  e. T wave
  f. Artifact: deflections on the ECG display produced by factors other than the heart's electrical activity such as:
    i. Standardization (calibration) mark
    ii. Muscle tremors/ shivering
    iii. Patient movement
    iv. Loose electrodes
    v. 60-cycle interference
    vi. Machine malfunction

Rhythm Strip Analysis

A. The process:
  1. Use a consistent approach (format)
  2. Memorize the rules for each dysrhythmia

A rhythm strip is the paper tracing obtained from a non-calibrated monitoring lead.

Usually 25 mm/sec

See previous Anatomy and Physiology in Cardiovascular Section.

Review refractory period—relative and absolute.

3. Analyze a given rhythm strip according to format
4. Compare analysis information to rules for each dysrhythmia
5. Identify dysrhythmia based on similarity to established rules

B. The analysis format:
1. Rate
2. Rhythm
3. P-waves
4. PR interval
5. QRS complexes

C. Step 1—Analyze rate
1. Usually means ventricular rate, but if atrial and ventricular rate different, must calculate both
2. Normal: 60–100
   a. <60 = bradycardia
   b. >100 = tachycardia
3. Methods of rate calculation
   a. Count number of large boxes between two R waves and divide into 300: 1 box = 300, 2 boxes = 150, 3 boxes = 100, etc.; good method only if rhythm regular
   b. Count the number of small squares between two R waves and divide into 1500
   c. Count number of R waves in 6-second strip and multiply by 10; least accurate, but good for irregular rhythms to obtain an average rate
4. Step 2—Analyze rhythm:
   a. Determined by measuring the R-R interval across entire strip
   b. If not regular, note whether it is:
      i. Regularly irregular—patterned irregularity or group beating
      ii. Occasionally irregular—only one or two R-R intervals unequal
      iii. Totally irregular
5. Step 3—analyze the P waves
   a. Are they regular? (Do they "march out"?)
   b. Is there one P wave for each QRS?
   c. Are they upright or inverted
   d. What is the relationship to the QRS?
   e. Do they all look alike?
6. Step 4—Analyze the PR intervals
   a. Should be constant across the strip
   b. Normal: 0.12–0.20 seconds (3–5 small boxes)
7. Step 5—Analyze the QRS complex
   a. Do they all look alike?
   b. Normal duration: less than .12 seconds (less than 3 small boxes)
8. Analysis of normal sinus rhythm using format (Lead II rhythm strip)
   a. Rate: 60–100/minute
   b. Rhythm: regular (both P-P and R-R)

A variety of analysis formats could be used. Important to use one consistently.

c. P waves: normal and upright, one P wave before each QRS
d. PR interval: .12–.20 seconds and constant
e. QRS: less than .12 seconds
f. Interpretation: normal sinus rhythm

Introduction to Dysrhythmias

A. Etiology of dysrhythmias—many causes:
1. Myocardial ischemia or necrosis
2. Autonomic nervous system imbalance
3. Distention of heart chambers
4. Blood gas abnormalities
   a. Hypoxia
   b. Abnormal pH
5. Electrolyte imbalances
6. Drug effects/toxicity
7. Electrocution
8. Hypothermia
9. CNS damage
10. Normal occurrence
11. NO MATTER WHAT THE ETIOLOGY OR TYPE OF DYSRHYTHMIA, THE PATIENT AND HIS SYMPTOMS ARE TREATED, NOT MERELY THE DYSRHYTHMIA

B. Mechanism of impulse formation
1. Enhanced automaticity
   a. The initiation of electrical impulses in cells other than those that usually have an inherent rate or spontaneous depolarization
   b. Often responsible for premature beats and tachycardias
2. Re-entry (use diagram):
   a. May be responsible for isolated premature beats or tachydysrhythmias
   b. Mechanism by which two branches of conduction pathway are altered by ischemia
      i. One branch has slowed conduction
      ii. The other branch has a unidirectional block
   c. The depolarization wave conducts slowly through the one branch and is able to conduct retrogradely back through the branch that was initially blocked
   d. By the time the impulse gets back to origin of the branch, tissue is no longer refractory and stimulation occurs again
   e. May develop very rapid rhythms due to the circus movement that develops around the branch

C. Methods of classifications of dysrhythmias
1. For study purposes, it is possible to categorize dysrhythmias in a number of different ways
2. Methods of classification:
   a. Changes in automaticity vs disturbances in conduction
   b. Major vs minor dysrhythmias

Occurs especially in atria, often secondary to CHF

Dysrhythmias that occur in the healthy heart may have little significance and not require the same treatment as those occuring in the patient with cardiac ischemia

TOPIC	CONTENT OUTLINE
	c. Life-threatening vs non-life-threatening dysrhythmias d. Tachy-dysrhythmias vs brady-dysrhythmias e. Site of origin of dysrhythmia or site of conduction disturbance
Dysrhythmias Originating in the SA Node	A. Include:

A. Include:
   1. Sinus bradycardia
   2. Sinus tachycardia
   3. Sinus arrhythmia
   4. Sinus arrest
B. ECG features common to all sinus rhythms:
   1. Upright P waves in Lead II all similar in appearance
   2. Normal duration PR interval
   3. Normal duration QRS complex
C. Sinus Bradycardia
   1. Description: manifestation of slowing of the SA node
   2. Etiology:
      a. Intrinsic sinus node disease
      b. Increased para-sympathetic vagal tone
      c. Drug effects
   3. Rules of interpretation:
      a. Rate: less than 60/minute
      b. Rhythm: regular
      c. P waves: normal and upright; one P wave before each QRS
      d. PR interval: .12–.20 seconds and constant
   4. Clinical significance: Decreased rate may compromise cardiac output (C.O.) and result in hypotension, angina, or CNS symptoms
   5. Treatment:
      a. Unnecessary unless hypotension or ventricular irritability present
      b. Atropine drug of choice
      c. In-hospital pacing may be necessary
D. Sinus tachycardia
   1. Description: manifestation of increase in rate of sinus node discharge
   2. Etiology: may be due to multiple factors including:
      a. Exercise
      b. Fever
      c. Anxiety
      d. Hypovolemia
      e. Anemia
      f. Pump failure
   3. Rules for interpretation
      a. Rate: greater than 100/minute
      b. Rhythm: regular
      c. P waves: normal and upright; one before each QRS
      d. PR interval: .12–.20 seconds
   4. Clinical significance:

These patients may tolerate large chronic affusions without compromise.

i.e., "enlarged heart", "Water build-up", etc.

Involving approximately 40% or more of left ventricle.

- i. When serious dysrhythmia exists, may be difficult to know if it is the cause of the hypotension or the result of cardiogenic shock
- ii. Major dysrhythmias must be corrected

e. Skin cool and clammy; may be cyanotic or dusky

f. Tachypnea

3. Management

a. Prolonged stabilization in-the-field not recommended—expedite transport

b. Secure open airway and administer oxygen (high FiO_2)

c. Place patient in supine position

d. Start IV D5W with microdrip to keep vein open

e. Apply ECG electrodes— document initial rhythm

f. Auscultate lungs, observe for jugular venous distention

g. Administer medications according to written protocols or obtain orders:

- i. Dopamine
- ii. Norepinephrine

h. Anti-shock garment may be ordered as fluid challenge if no symptoms of pulmonary edema present—*controversial*

i. Transport rapidly—prolonged periods of observation for effects of drugs not indicated

- i. Mortality rate for cardiogenic shock 80-90% with any kind of treatment

E. Cardiac arrest/sudden death

1. Pathophysiology:

a. One of the major clinical syndromes of coronary artery disease; accounts for 60% of all deaths from this disease

b. Sudden death defined as death within one hour of onset of symptoms

c. Actual infarction often not present, but severe atherosclerotic disease common

d. Risk factors for sudden death same as for atherosclerotic heart disease (ASHD)

e. Cardiac arrest may be the first manifestation of cardiac disease in significant number of patients

f. Causes of cardiac arrest other than ASHD:

- i. Drowning
- ii. Electrocution
- iii. Electrolyte imbalance
- iv. Hypothermia
- v. Trauma
- vi. Acid-base imbalance
- vii. Drug toxicity
- viii. Hypoxia

g. Dysrhythmias associated with cardiac arrest

Oropharyngeal airway if patient unconscious.

May be difficult to establish due to cardiovascular collapse

See Pharmacologic Intervention of Cardiovascular Section.

Unknown if benefits of increased coronary artery perfusion by increased afterload outweigh detrimental effects of increased left ventricular work

- i. Ventricular fibrillation (V-fib)—majority of cases (60-70%)
  - — Primary
  - — Secondary
- ii. Ventricular tachycardia
- iii. Asystole
- iv. Severe bradycardias/heart blocks
- v. Electromechanical dissociation

2. Basic considerations in management of cardiac arrest
   - a. Basic life support is essential; paramedic must monitor performance of CPR if delegated to others
   - b. Primary V fib easier to abolish than secondary V-fib
   - c. Defibrillate patient in V-fib as soon as possible—best chance for successful resuscitation
   - d. External pacing may be utilized for bradycardias, asystole or immediately post defibrillation of V-fib
   - e. Airway can be managed by a number of methods—most sophisticated not always needed immediately
   - f. Bicarbonate useless unless combined with adequate ventilation
   - g. Some cardiac arrests manage differently from those secondary to ASHD:
     - i. Drownings
     - ii. Hypothermia
     - iii. Traumatic arrest
   - h. Anti-shock garment may be useful in cardiac arrests other than those secondary to trauma
   - i. Cardiac arrest in infants and children rarely a primary event
     - — often due to hypoxia
3. Management of unwitnessed arrest—ventricular fibrillation
4. Management of cardiac arrest secondary to ventricular tachycardia
5. Management of cardiac arrest secondary to asystole
   - a. Prognosis for resuscitation poor
   - b. May be the end result of V-fib or electromechanical dissociation
   - c. Presence of asystole usually indicates
     - i. Extensive myocardial damage and/or
     - ii. Severe metabolic deficit, or;
     - iii. High parasympathetic tone
   - d. If any question of whether rhythm is asystole or fine V-fib, defibrillation is indicated
6. Management of cardiac arrest secondary to electromechanical dissociation (EMD)
   - a. Defined as any organized rhythm without a pulse
   - b. Carries a grave prognosis for resuscitation
   - c. Various etiologies of EMD
     - i. Massive myocardial damage
     - ii. Hypovolemia
     - iii. Cardiac rupture

See American Heart Association's current ACLS protocols for ventricular fibrillation.

See American Heart Association's current ACLS protocols for ventricular tachycardia

See American Heart Association's current ACLS protocol for asystole.

See American Heart Association's current ACLS protocol for EMD.

Some treatable in-hospital.

iv. Cardiac tamponade
v. Acute pulmonary embolism
d. Consider anti-shock garment
e. Consider IV fluid challenge
f. Consider beginning transport much earlier if any suspicion of treatable etiology, such as hypovolemia

Peripheral Vascular and Other Cardiovascular Emergencies

A. Aneurysm
1. A non-specific term meaning dilation of a vessel
2. Types:
   a. Atherosclerotic
   b. Dissecting
   c. Traumatic
3. Abdominal aneurysm
   a. Caused by atherosclerosis weakening the wall of the aorta, causing it to balloon out
   b. Most common site below renal arteries near bifurcation; may involve iliac and renal arteries
   c. Ten times more common in men; most prevalent in ages 60-70
   d. Signs and symptoms of rupture:
      i. Abdominal pain
      ii. Back (flank) pain
      iii. Hypotension
      iv. Urge to defecate caused by retroperitoneal leaking of blood
      v. Pulsatile mass—can be palpated when greater than 5 cm; palpate gently
      vi. Decreased femoral pulse
      vii. May present as GI bleed if erodes into duodenum
   e. Prehospital management:
      i. High index of suspicion is important—get history
      ii. Treat shock with O_2, anti-shock garment, IV volume replacement
      iii. Transport rapidly
4. Dissecting aortic aneurysm
   a. Small tear in inner wall of aorta allows blood to go under and create false passage; hematoma forms
      i. 60-70% involve ascending aorta
      ii. Once begun, may extend to involve all of thoracic and abdominal aorta as well as tributaries, coronary arteries, aortic valve, carotids subclavian
      iii. Can rupture at any time—usually into pericardial or pleural cavity
   b. Etiology: degenerative disease of connective tissue—cystic medial necrosis
   c. Predisposing factors:
      i. 75-85% of cases have hypertension

ii. Some familial tendency
iii. Usually patients greater than 40-50 years
iv. Pregnancy

d. Signs and symptoms:
i. Pain—characteristic ripping, tearing, substernal—may radiate, often to back between scapulae
ii. Elevated BP, yet patient looks "shocky" due to impaired perfusion
iii. Dissection into other arteries and structures may cause:
- syncope
- stroke
- absent or reduced pulses
- differences in arm blood pressure
- heart failure
- pericardial tamponade
- acute MI

e. Prehospital management
i. Keep patient quiet
ii. Oxygen (high FiO_2)
iii. Start IV of crystalloid—en route, if possible, to expedite transport
iv. Morphine sulphate if diagnosis fairly definite
v. Transport rapidly

f. Possible outcomes:
i. May rupture into another cavity
ii. Occasionally heal; creates double lumen
iii. In-hospital treatment may be medical or surgical
iv. Survival good if treated promptly

B. Traumatic thoracic aortic rupture

C. Acute arterial occlusion
1. Sudden occlusion of arterial flow by one of the following mechanisms:
a. Trauma
b. Thrombosis
c. Embolus
i. Mural thrombus in left ventricle
ii. Atrial thrombi—secondary to atrial fib
iii. Thrombus from abdominal aortic atherosclerosis
d. Idiopathic
2. May involve vessels in:
a. Abdomen
b. Extremities
3. Signs and symptoms:
a. Pain

This is the method that will utilized in this curriculum.

Providing no ventricular conduction disturbance present

Such as digitalis, propranolol.

Rules apply to a Lead II monitoring lead.

QRS: less than .12 seconds Providing no ventricular conduction disturbance present

See Pharmacologic Intervention of Cardiovascular Section.

Rules apply to a Lead II monitoring lead.

QRS: less than .12 seconds. Providing no ventricular conduction disturbance present

a. May be benign
b. May be compensatory mechanism for decreased stroke volume
c. Increases myocardial oxygen consumption

5. Treatment: treat underlying cause

E. Sinus arrhythmia

1. Description: phasic variation of R-R interval greater than .16 seconds
2. Etiology:
   a. May be related to respiratory cycle—normal phenomenon
   b. Non-respiratory influenced—normal phenomenon
   c. Enhanced vagal tone
3. Rules for interpretation
   a. Rate: usually 60–100/minute; in respiratory form, rate increases with inspiration, decreases with expiration
   b. Rhythm: regularly (cyclically) irregular
   c. P waves: normal and upright; one before each QRS
   d. PR interval: .12–.20 seconds and constant
4. Clinical significance: normal phenomenon, particularly in young or aged
5. Treatment: none required

F. Sinus arrest

1. Description: an episode of failure of sinus node discharge resulting in short periods of cardiac standstill until:
   a. Lower latent pacemakers discharge (escape beats); or
   b. Sinus node resumes discharge
2. Etiology:
   a. Sinus node ischemia
   b. Digitalis toxicity
   c. Excessive vagal tone
   d. Degenerative fibrotic disease
3. Rules for interpretation:
   a. Rate: normal to slow, depending on frequency and duration of sinus arrest
   b. Rhythm: irregular
   c. P waves: normal to slow depending on frequency and duration of sinus arrest
   d. PR interval: .12–.20 seconds and constant
4. Clinical significance:
   a. Frequent or prolonged episodes may compromise cardiac output by decreasing rate
   b. Danger of complete cessation of sinus node activity
5. Treatment:
   a. Observe only, if patient asymptomatic
   b. Atropine if patient bradycardic and symptomatic

Dysrhythmias Originating In the Atria

A. Include:

1. Wandering pacemaker

Prolonged sinus tachycardia is poor pronostic sign in acute II

Rules apply to a Lead II monitoring lead.

QRS: less than .12 seconds Providing no ventricular conduction disturbance present

Rules apply to a lead II monitoring lead.

QRS: less than .12 seconds Providing no conduction disturbance present

See Pharmacologic Intervention of Cardiovascular Section.

2. Premature atrial complexes
3. Atrial tachycardia
4. Atrial flutter
5. Atrial fibrillation

B. ECG features common to all atrial dysrhythmias
1. P waves differ in appearance from sinus P waves
2. QRS complexes of normal duration

C. Wandering pacemaker
1. Description: passive transfer of pacemaker sites from sinus node to other latent pacemaker sites in the atria and AV junction
2. Etiology:
   a. A variant of sinus arrhythmia
   b. Often a normal phenomenon in the very young or the aged
   c. May be associated with underlying heart disease
3. Rules for interpretation:
   a. Rate: usually 60–100/minute
   b. Rhythm: slightly irregular
   c. P waves: morphology changes from beat to beat and may disappear completely
   d. PR interval: varies and may become less than .12 seconds
   e. QRS: less than .12 seconds
4. Clinical significance: no detrimental effects
5. Treatment: none required

D. Premature atrial complex (PAC)
1. Description: a single electrical impulse originating in atria outside sinus node which creates a premature complex occurring before the next expected sinus beat; it usually depolarizes the SA node and creates a noncompensatory pause
2. Etiology:
   a. Use of caffeine, tobacco, alcohol
   b. Sympathomimetic drugs
   c. Hypoxia
   d. Digitalis toxicity
   e. Organic heart disease
   f. No apparent cause
3. Rules for interpretation
   a. Rate: depends on underlying rhythm
   b. Rhythm: depends on underlying rhythm: usually regular except for PAC
   c. P waves
      i. P wave of PAC differs in shape from sinus P wave
      ii. Occurs earlier than next sinus P would be expected
      iii. May be hidden in preceding T wave
   d. PR interval: usually normal but may be greater than .20 seconds
   e. QRS: usually less than .12 seconds, but may be:

Providing no ventricular conduction disturbance present

Rules apply to a Lead II monitoring lead.

Providing no ventricular conduction disturbance present

Rules apply to a Lead II monitoring lead.

Described as occasionally irregular.

i. Greater than .12 seconds if PAC abnormally conducted through partially refractory ventricles, or;
ii. Absent, if PAC nonconducted due to absolute refractoriness

4. Clinical significance:
   a. Isolated PAC's of minimal significance
   b. Frequent PAC's may suggest organic heart disease and may be forerunners of other atrial dysrhythmias
5. Treatment: none in the field

E. Paroxysmal atrial tachycardia (a form of Paroxysmal Supraventricular Tachycardia— PSVT)
1. Description:
   a. Rapid atrial depolarization overrides the SA node; often occurs in paroxysms with sudden onset (lasting minutes to hours) and abrupt termination
   b. May be caused by increased automaticity of single atrial focus or re-entry at the AV node
   c. Often termed "paroxysmal supraventricular tachycardia" since may be indistinguishable from AV junctional tachycardia
2. Etiology:
   a. May occur at any age unassociated with heart disease
   b. Frequently associated with underlying ASHD and rheumatic heart disease
   c. May be result of accessory pathway conduction (Wolff Parkinson-White syndrome)
   d. May be precipitated by stress, overexertion, smoking, coffee
   e. Rare in the setting of acute MI
3. Rules for interpretation:
   a. Rate: 150–250/minute
   b. Rhythm: characteristically regular except at onset and termination
   c. P waves
      i. Atrial P wave looks different than sinus P wave;
      ii. Frequently buried in preceding T waves
   d. PR interval: may be normal or prolonged
   e. QRS: less than .12 seconds
4. Clinical significance:
   a. May be tolerated well for short period of time or in young hearts with good cardiac reserve
   b. Rapid rates may cause significant compromise of C.O. and coronary artery perfusion in patients with underlying heart disease
   c. May precipitate angina, hypotension, or congestive heart failure
   d. Often sensed by patient as palpitations
5. Treatment:
   a. Vagal maneuvers
      i. Valsalva maneuver: forced expiration against a closed glottis (bearing down)

Rules apply to a Lead II monitoring lead.

May be impossible to see P waves

Providing no ventricular conduction disturbance present

ii. Carotid massage

b. Verapamil

F. Atrial Flutter

1. Description: rhythm resulting from a rapid atrial re-entry circuit and an AV node which physiologically cannot conduct all impulses; AV junction conducts impulses in 1:1 (rare), 2:1, 3:1, 4:1 or more ratio resulting in a discrepancy between atrial and ventricular rates. AV block may be consistent or variable
2. Etiology:
   a. May occur in normal hearts, but usually associated with organic heart disease
   b. Rarely occurs as direct result of acute MI
3. Rules for interpretation
   a. Rate: atrial 250–350/minute; ventricular rate varies
   b. Rhythm: atrial rhythm regular, ventricular rate usually regular but can be irregular if block varies
   c. P waves: flutter (F) waves resemble "sawtooth" or "picket fence" pattern. May be difficult to identify in 2:1 flutter. Suspect 2:1 flutter when rhythm is regular and ventricular rate is 150
   d. PR interval: F-R interval usually constant but may vary
   e. QRS: less than .12 seconds
4. Clinical significance:
   a. Normal ventricular rates usually tolerated well
   b. Rapid ventricular rates may compromise cardiac output and precipitate associated symptoms
5. Treatment:
   a. Indicated only for rapid ventricular rates with hemodynamic compromise
   b. Synchronized cardioversion—responds well to low energies
   c. Consider verapamil
   d. Vagal maneuvers rarely convert, just transiently increase AV block

G. Atrial fibrillation

1. Description: rhythm resulting from multiple areas of re-entry within the atria or from multiple ectopic foci (increased automaticity) bombarding an AV node which physiologically cannot handle all the impulses; AV conduction is random and ventricular response highly variable
2. Etiology: Often chronic and associated with underlying heart disease
   a. Rheumatic heart disease
   b. Congestive heart failure
   c. Atherosclerotic heart disease
3. Rules for interpretation:
   a. Rate: atrial rate 350–700/minute (cannot be counted), ventricular rate varies greatly
   b. Rhythm: irregularly irregular

See Pharmacologic Intervention of Cardiovascular Section.

Rules apply to a Lead II monitoring lead.

Providing no ventricular conduction disturbance present

See Verapamil precautions in Pharmacologic Intervention

Rules apply to a Lead II monitoring lead.

c. P waves: no discernible P waves; chaotic atrial activity, referred to as "F" waves may be seen
d. PR interval: none
e. QRS: Less than .12 seconds

4. Clinical significance:
   a. No contraction of atria as whole—C.O. decreased by 20–25%
   b. Frequently produces a pulse deficit
   c. If rate of ventricular response normal (often in patients on digitalis), rhythm usually tolerated well
   d. Ventricular response less than 60 may compromise cardiac output; suspect digitalis toxicity
   e. Rapid ventricular response coupled with loss of atrial kick may cause cardiovascular decompensation, i.e., angina, infarct, CHF, shock
5. Treatment for rapid ventricular rates with patient decompensation:
   a. Synchronized cardioversion
   b. Consider verapamil

Dysrhythmias Originating in the AV Junction

A. Includes:
   1. Premature junctional complexes
   2. Junctional escape complexes and rhythm
   3. Accelerated junctional rhythm
   4. Paroxysmal junctional tachycardia

B. ECG features common to all junctional rhythms:
   1. P waves will be inverted in Lead II because of retrograde depolarization of atria
      a. Relationship of P wave to QRS dependent on timing of atrial depolarization to ventricular depolarization; P wave may occur:
         i. Before QRS—atria depolarized first
         ii. After QRS—ventricles depolarized first
         iii. During QRS—atria and ventricles depolarize simultaneously
      b. Note that some low atrial impulses can also create inverted P waves
   2. QRS complexes are of normal duration
   3. PR intervals will frequently be less than .12 seconds

C. Premature junctional complex (PJC)
   1. Description: A single electrical impulse originating in the AV junction, occurring before the next expected sinus impulse; a pause follows the PJC which may be:
      a. Noncompensatory—if the SA node is depolarized by the premature beat; or
      b. Fully compensatory—if the SA node discharged before it was reached by the premature impulse
   2. Etiology: similar to those outlined for PAC's
   3. Rules for interpretation
      a. Rate: depends on rate of underlying rhythm

Baseline may appear isoelectric if F waves very fine.

Providing no ventricular conduction disturbance present

The difference between the apical and peripheral pulse rates

See verapamil precautions in Pharmacologic Intervention

Impulse moving towards negative electrode

No P waves apparent.

Providing no ventricular conduction disturbance present

Rules apply to a Lead II montoring lead.

b. Rhythm: depends on underlying rhythm; usually regular except for PJC
c. P waves: inverted before or after QRS or absent
d. PR interval: if P wave precedes QRS, usually less than .12 seconds
e. QRS: usually less than .12 seconds
4. Clinical significance:
a. Isolated PJC's of no significance
b. Frequent PJC's may be forerunners of more serious junctional dysrhythmias
5. Treatment: none required

D. Junctional escape complexes and rhythm
1. Description: complex or rhythm that results when the rate of the primary pacemaker (usually SA node) becomes less than that of the AV junctional region
a. Called an escape beat or rhythm (if series of complexes)
b. Serves as a safety mechanism
c. Discharges at intrinsic rate of AV junctional tissue—40–60/minute
d. If single beat, the distance from the last normal beat to the escape beat is greater than the normal R-R interval
2. Etiology:
a. Increased vagal tone causing SA slowing
b. Pathologic slow sinus discharge or heart block
3. Rules for interpretation:
a. Rate: 40–60/minute
b. Rhythm
i. Irregular if single junctional escape complex
ii. Regular if junctional escape rhythm
c. P waves: inverted before or after QRS or absent
d. PR interval: if P wave precedes QRS, usually less than .12 seconds
e. QRS: usually less than .12 seconds
4. Clinical significance: slow rate can cause decreased cardiac output and associated symptoms, although may be well tolerated
5. Treatment:
a. If patient stable, none required
b. Atropine
c. Isoproterenol or epinephrine

E. Accelerated junctional rhythm
1. Description: rhythm that results from increased automaticity of the AV junction causing it to discharge faster than its intrinsic rate, overriding the primary pacemaker. Technically a junctional tachycardia, but not truly in the rate range for tachycardias
2. Etiology: often ischemia of the AV junction

Described as occasionally irregular.

Providing no ventricular conduction disturbance present

Rules apply to a Lead II monitoring lead.

Providing no ventricular conduction disturbance present

See Pharmacologic Intervention of Cardiovascular Section.

3. Rules for interpretation: same as for junctional escape rhythm except rate 60–100/minute
4. Clinical significance: normal rate usually means it is a well-tolerated rhythm
5. Treatment: none required

F. Paroxysmal junctional tachycardia (a form of Paroxysmal Supraventricular Tachycardia—PSVT)
1. Description: rhythm produced by increased automaticity or a re-entry circuit in the AV junction which results in a rapid tachycardia
   a. Often has sudden onset and termination
   b. Usually indistinguishable from PAT in ECG characteristics and presentation so termed "paroxysmal supraventricular tachycardia"
2. Rules for interpretation
   a. Rate: 100–180/minute
   b. Rhythm: regular
   c. P waves: if visible, inverted; occur before or after QRS
   d. PR interval: if P wave precedes QRS, usually less than .12 seconds
   e. QRS: usually less than .12 seconds
3. Clinical significance: same as for PAT
4. Treatment: same as for PAT

Dysrhythmias Originating in the Ventricles

A. Include:
1. Ventricular escape complexes and rhythm
2. Premature ventricular complex
3. Ventricular tachycardia
4. Ventricular fibrillation
5. Asystole
6. Artificial pacemaker rhythm

B. ECG features common to all ventricular rhythms
1. QRS complexes will be .12 seconds or greater in duration
2. P waves will be absent

C. Ventricular escape complexes and rhythm (idioventricular rhythm)
1. Description: a complex or rhythm that results when impulses from higher pacemakers fail to reach ventricles or when rate of discharge of higher pacemakers becomes less than that of the ventricles
   a. Called a ventricular escape beat or rhythm (if series of complexes)
   b. Serves as a safety mechanism
   c. Ventricles discharge at intrinsic rate of 20–40/minute
   d. If single beat, distance from last normal beat to escape beat is greater than the normal R-R interval
2. Etiology:
   a. Slowing of supraventricular pacemaker sites
   b. High degree of AV block
   c. Frequently seen as first organized rhythm following de[illegible]illation

Rules apply to a Lead II monitoring lead.

Rules apply to a Lead II monitoring lead.

Providing no ventricular conduction disturbance present

3. Rules for interpretation of ventricular escape rhythm:
   a. Rate 20–40/minute (occasionally less)
   b. Rhythm:
      i. If single escape beat—makes rates underlying rhythm irregular
      ii. If escape rhythm—usually regular, but low pacemaker site can be unreliable
   c. P waves: none
   d. PR interval: none
   e. QRS: .12 seconds or greater; bizarre
4. Clinical significance:
   a. Cardiac output can be severely compromised based on slow rate alone
   b. Serves as a safety mechanism—do not attempt to suppress
   c. If escape rhythm, may be perfusing or nonperfusing
5. Treatment:
   a. If perfusing, increase rate
      i. Atropine
      ii. Isoproterenol or epinephrine
      iii. Lidocaine contraindicated
   b. If non-perfusing
      i. Epinephrine
      ii. Sodium bicarbonate
      iii. Calcium chloride
      iv. Possibly dexamethasone and/or anti-shock garment
      v. External pacing

D. Premature ventricular complex (PVC)
1. Description: a single ectopic impulse arising from an irritable focus in either ventricle which occurs earlier than the next expected sinus beat
   a. May be due to increased automaticity or a reentry mechanism
   b. Altered sequence of ventricular depolarization results in wide, bizarre QRS
   c. Altered sequence of repolarization often results in T wave in opposite direction of QRS
   d. Usually does not depolarize SA node and interrupt its rhythm, so pause following PVC is fully compensatory
      i. Distance between R waves of normal beats flanking PVC equals two R-R intervals of underlying rhythm
      ii. Occasionally PVC falls between two sinus beats without interrupting rhythm - called interpolated PVC
   e. May be uniform or multiform
      i. Arising from one focus vs many foci
      ii. All the same appearance vs different shapes
      iii. Coupling intervals usually constant if PVC's uniform, can vary if multiform
   f. Frequently occur in patterns of grouped beating:

Rules apply to a Lead II monitoring lead.

Ventricles also capable of developing increased automatically and discharging at rates up to 100/minute; called accelerated idioventricular rhythm.

See Pathopsychology & Management Cardiac Arrest (EWD) of Cardiovascular Section.

Usually but not always.

Distance between the preceding beat and the PVC

i. Bigeminy: every other beat is a PVC
ii. Trigeminy: every third beat is a PVC
iii. Quadrigeminy: every fourth beat is PVC

g. Repetitive PVC's
  i. Couplets
  ii. Triplets
h. Can trigger lethal, repetitive firing of ventricles if occur during relative refractory phase of cardiac cycle (vulnerable period)

2. Etiology—one or more of the following:
   a. Myocardial ischemia
   b. Hypoxia
   c. Acid-base and electrolyte imbalances
   d. Increased sympathetic tone
   e. Normally occurring
3. Rules for interpretation
   a. Rate: depends on underlying rhythm and number of PVC's
   b. Rhythm: interrupts regularity of underlying rhythm (occasionally irregular)
   c. P waves: none although the normal sinus P wave may be seen near PVC
   d. PR interval: none
   e. QRS: .12 seconds or greater; frequently look bizarre
4. Clinical significance:
   a. PVC's in patients without organic heart disease may be of no significance
   b. In patients with myocardial ischemia, indicate ventricular irritability and may trigger lethal ventricular dysrhythmias
   c. Incompletely filled ventricle may produce little or no pulse—frequent occurrence may compromise C.O.
   d. May be sensed by patient as "skipped beats"
5. Treatment:
   a. No history or symptoms of cardiac disease— none required
   b. In patients with cardiac history and/or symptoms—lidocaine

E. Ventricular tachycardia
1. Description: a rhythm created by three or more ventricular complexes in succession at a rate in excess of 100/minute, which overrides the primary pacemaker
   a. Atria and ventricles are asynchronous;
   b. Sinus P waves may occasionally be seen dissociated from QRS complexes
2. Etiology: same as for PVC's
3. Rules for interpretation:
   a. Rate: 100–250 approximately
   b. Rhythm: can be regular or slightly irregular
   c. P waves: none associated with QRS complexes although some may be visible

INSTRUCTOR'S NOTES

These terms can also describe patterns of PAC's and PJC's.

R - on - T phenomenon.

Rules apply to a Lead II monitoring lead.

Pulse deficit

See Pharmacologic Intervention.

Rules apply to a Lead II monitoring lead.

d. PR interval: none
e. QRS: .12 seconds or greater; bizarre

4. Clinical significance:
   a. Usually results in poor stroke volume; this coupled with rapid rate may severely compromise cardiac output and coronary artery perfusion
   b. May be perfusing or non-perfusing
   c. Eventually may deteriorate to ventricular fibrillation
5. Treatment:
   a. If patient perfusing and conscious:
      i. Lidocaine
      ii. Synchronized cardioversion
   b. If patient decompensating or nonperfusing:
      i. Synchronized cardioversion or defibrillation
      ii. Antidysrhythmic vascular drugs

F. Ventricular fibrillation
   1. Description: chaotic ventricular rhythm, probably due to many re-entry circuits in the ventricles, with absence of any organized ventricular depolarization or contraction
   2. Etiology:
      a. Wide variety of causes
      b. Most commonly associated with advanced coronary artery disease
   3. Rules for interpretation: totally chaotic undulations of varying amplitude and shape with no discernible waves or complexes
   4. Clinical significance: produces no organized contraction or pulse, resulting in cardiac arrest
   5. Treatment:
      a. CPR
      b. Immediate defibrillation
      c. Drug therapy
         i. Sodium bicarbonate
         ii. Epinephrine
         iii. Lidocaine
         iv. Bretylium

G. Asystole (cardiac standstill)
   1. Description: absence of all ventricular electrical activity
   2. Etiology:
      a. May be primary event in cardiac arrest; usually associated with massive myocardial ischemia and necrosis
      b. End result of ventricular fibrillation
      c. In the presence of complete heart block when there is no functional escape pacemaker
   3. Rules for interpretation: no discernible waves or complexes; only an isoelectric line
   4. Clinical significance:
      a. Produces cardiac arrest

See Pharmacologic Intervention of Cardiovascular Section.

See Pathophysiology and Management: Cardiac Arrest of Cardiovascular Section

See Pathophysiology and Management: Cardiac Arrest of Cardiovascular Section.

See Pathophysiology and Management: Cardiac Arrest, Techniques of Management, & Pharmacologic Intervention of Cardiovascular Section.

To be discussed later

b. Prognosis for resuscitation dismal

5. Treatment:
   a. CPR
   b. Drug therapy
      i. Sodium bicarbonate
      ii. Epinephrine
      iii. Calcium chloride
      iv. Atropine

H. Artificial pacemaker rhythms

1. Description: a rhythm generated by regular electrical stimulation of the heart through an electrode implanted in the heart and connected to a power source
   a. Pacemaker may be implanted in several locations in heart, but most common are:
      i. Ventricular pacemaker
      ii. Dual chambered pacemaker
   b. May be preset to fire constantly or variably
      i. Fixed rate: fires continuously at a preset rate without regard to patient's own electrical activity
      ii. Demand: contains a sensing device and only fires if patient's own rate drops below the pacemaker's preset rate (acts as escape rhythm)
   c. Stimulates the ventricle or the atrium and ventricle, thus an artificially produced idioventricular rhythm is created
   d. Implanted most frequently for patient with complete heart block or episodes of severe bradycardia
2. Rules for interpretation:
   a. Rate: varies according to preset rate of pacemaker
   b. Rhythm: regular if pacing constantly; irregular if pacing only on demand
   c. P waves:
      i. None produced by ventricular pacemaker—sinus P waves may be seen but unrelated to QRS complexes
      ii. Dual chambered pacemakers produce a P wave following each atrial spike
   d. Pacemaker spike: a spike going upward or downward from the baseline which is an artifact created each time the pacemaker fires; tells you only that the pacemaker is discharging
   e. QRS complexes:
      i. .12 seconds or greater and bizarre; appears identical to ventricular escape rhythm (idioventricular rhythm)
      ii. Each time ventricular pacemaker spike is seen, QRS should follow; pacemaker is said to be "capturing" when spike ellicits QRS
      iii. With demand pacemaker, some of patient's own QRS's may be seen (different contour); no pacemaker spike should then be seen

See Pathophysiology and Management: Cardiac Arrest & Pharmacologic Intervention of Cardiovascular Section.

Asynchronous

Synchronous

Dual chambered pacemakers are most beneficial for patients who need synchronized atrial/ventricular contraction to maintain cardic output.

Rules apply to a Lead II monitoring lead.

3. Problems with pacemaker rhythms:
   a. Battery failure
      i. Results in no pacing
      ii. Patient's own rhythm may be bradycardic or asystolic
   b. Runaway pacemaker
      i. Rarely seen with newer pacemakers
      ii. Result of low battery power—develops very rapid discharge rate
      iii. With newer power sources, rate gradually increases as battery runs low
   c. Failure of sensing device in demand pacemakers:
      i. Pacemaker fails to shut off when patient has adequate rate of his own—competes with natural pacemaker
      ii. May discharge during vulnerable period of cardiac cycle
   d. Failure to capture
      i. Pacemaker spikes present but not followed by P waves or QRS complexes
      ii. Bradycardia
4. Considerations for management of pacemaker patient
   a. When examining unconscious patients, be alert for battery packs implanted under skin
   b. Bradydysrhythmias, asystole, or V-fib resulting from pacemaker failure treated as usual
   c. Ventricular irritability may be treated as usual with lidocaine without fear of suppressing response of ventricles to pacemaker
   d. Patient with pacemaker may be defibrillated as usual but do not discharge paddles directly over battery pack
   e. Expedite transport of patient with pacemaker failure; needs new pacemaker implanted, not prolonged in-field stabilization

Dysrhythmias That Are Disorders of Conduction

A. AV blocks
   1. Description: delay or interruption in conduction of impulses through the AV junction
      a. Caused by pathology of the AV junctional tissue vs physiologic block seen in atrial fibrillation or flutter
      b. Causes:
         i. AV junctional ischemia
         ii. AV junctional necrosis
         iii. Degenerative disease of the conduction system
         iv. Drug toxicity (especially digitalis)
   2. Methods of classification
      a. According to site of block
         i. At level of AV node
         ii. At level of Bundle of His
         iii. Below bifurcation of Bundle of His
      b. According to degree of block

Often in shoulder or axillary region.

Traditional Classification.

i. First degree AV block
ii. Second degree AV block Type I
iii. Second degree AV block Type II
iv. Third degree AV block

3. First-degree AV block
   a. Description: not an actual block, but a delay in conduction usually at the level of the AV node
      i. Not a rhythm in itself, but a condition superimposed on another rhythm—must identify the underlying rhythm
      ii. Usually caused by ischemia of the AV junction
   b. Rules for interpretation: only alteration in EKG is PR interval prolonged greater than .20 seconds
   c. Clinical significance:
      i. Of no danger in itself as all atrial impulses are conducted to the ventricles
      ii. A newly developed first-degree block may be a forerunner of more advanced block
   d. Treatment: monitor closely; no definitive treatment required
4. Second-degree AV block Type I
   a. Definition: an intermittent block usually at the level of the AV node, producing a characteristic cyclic pattern in which PR intervals get progressively longer until one P wave does not conduct (blocked) to the ventricles resulting in absent (dropped) QRS; this cycle is repetitive
      i. P-P interval constant, but R-R interval decreases until dropped beat; produces grouping of QRS complexes
      ii. Ratio of conduction (P waves to QRS's) commonly 5:4, 4:3, 3:2, 2:1—may be constant or variable pattern
      iii. May be caused by increased parasympathetic tone, drug effects, AV junctional ischemia
   b. Rules for interpretation
      i. Rate: atrial rate unaffected; ventricular rate may be normal or slightly slow
      ii. Rhythm: atrial regular; ventricular irregular— characteristic grouped beating
      iii. P waves: upright and uniform; some P waves not followed by QRS complexes
      iv. PR interval: progressively lengthening prior to non-conducted P wave
      v. QRS: less than .12 seconds
   c. Clinical significance:
      i. If frequently dropped beats compromise rate, may cause decreased cardiac output and associated problems
      ii. Often only a transient phenomenon; often seen in patients with inferior myocardial infarction
   d. Treatment: none if patient stable; atropine if excessive slowing occurs

Also called Mobitz I or Wenckebach block.

Rules apply to a Lead II monitoring lead.

5. Second-degree AV block Type II
   a. Description: an intermittent block characterized by P waves that are not conducted to the ventricles (blocked) but with no progressive lengthening of the PR interval prior to the dropped beats
      i. Ratio of conduction (P waves to QRS's) commonly 4:1, 3:1, or 2:1, may be constant ratio block or variable
      ii. Block located below Bundle of His so impulses conducted to ventricles encounter bundle branch block
      iii. Causes: usually associated AMI and septal necrosis
   b. Rules for interpretation
      i. Rate: atrial rate unaffected; ventricular rate usually bradycardia
      ii. Rhythm: regular or irregular depending on whether conduction ratio constant or variable
      iii. P waves: upright and uniform; more than one P wave for each QRS
      iv. PR interval: constant for conducted beats; may be greater than .20 seconds
      v. QRS: may be normal but often .12 seconds or greater due to abnormal ventricular depolarization sequence
   c. Clinical significance:
      i. Slow rates compromise cardiac output and produce associated problems
      ii. Since associated with cell necrosis (often due to anterior myocardial infarction) considered a more serious block than Type I
      iii. Frequently progresses to third-degree block
   d. Treatment: temporizing measures only in field—usually needs pacemaker
      i. Atropine
      ii. Isoproterenol or epinephrine
6. Third-degree AV block (complete heart block)
   a. Description: the absence of conduction between the atria and ventricles due to complete electrical block at or below the AV node
      i. Atria and ventricles pace heart completely independently of each other
      ii. Sinus node is one pacemaker—functions normally
      iii. Second pacemaker (escape pacemaker) located below block either in junctional tissue or ventricles
      iv. Causes: acute myocardial infarction, digitalis toxicity, degenerative conductive system disease (in elderly)
   b. Rules for interpretation
      i. Rate: Atrial rate unaffected; ventricular rate: 40–60 if escape focus is junctional, less than 40 if escape focus in ventricle
      ii. Rhythm: both atrial and ventricular usually regular

Also called Mobitz II.

2:1 Type II block may not be distinguishable from 2:1 Type I block.

Rules apply to a Lead II monitoring lead.

See Pharmacologic Intervention

AV dissociation.

Rules apply to a Lead II monitoring lead.

iii. P waves: upright and uniform; more P waves than QRS complexes

iv. PR interval: no constant PR interval; P waves may be superimposed on QRS complexes or T waves

v. QRS: less than .12 if escape focus is junctional; .12 seconds or greater if escape focus is ventricular

c. Clinical significance: severe compromise of cardiac output due to slow rate plus unsynchronized action of atria and ventricles

d. Treatment:

i. Field treatment can only temporize— needs pacemaker insertion

ii. May try atropine to stimulate some AV conduction or increase rate of a junctional escape rhythm

iii. Usually requires isoproterenol or epinephrine to increase ventricular rate

iv. External pacing

B. Disturbance of ventricular conduction

1. Terms used to describe

a. Aberrant conduction: used to describe a single supraventricular beat that is conducted through the ventricles in a delayed manner

b. Bundle branch block (BBB): used to describe a rhythm when all supraventricular beats in that rhythm are conducted through ventricles in a delayed manner

c. These terms only used to describe complexes that originate above the ventricles

2. Etiology: two causes

a. Ischemia or necrosis of either right or left bundle branch makes it unable to conduct impulses to the ventricle it supplies

b. A premature impulse (PAC or PJC) reaches the ventricles when one of the bundle branches (usually the right) is still refractory and cannot conduct

3. ECG features:

a. QRS complex

i. Becomes .12 seconds or greater

ii. Due to blocked side of the heart being depolarized much slower through myocardial muscle than through the more rapid electrical conduction pathway

b. QRS morphology (shape)

i. May be notched or slurred

ii. Demonstrates rapid depolarization via normal bundle branch followed by slower depolarization of side with bundle branch block

4. Problems posed in rhythm interpretation

a. Important merely to realize that supraventricular beats or rhythms at times may have abnormally wide QRS complexes

b. May be impossible to distinguish on Lead II rhythm strip between

Commonly seen in atrial fibrillation due to varying speed of repolarization related to irregular rhythm

Presence of bundle branch block or aberrantly conducted beats does not alter management of patients.

i. PVC's and aberrantly conducted PAC's or PJC's
ii. Supraventricular tachycardia with BBB or aberrant conduction and ventricular tachycardia

c. When in doubt, treat all premature beats or rhythms with abnormally wide QRS complexes as ventricular in origin
i. Do more harm by not treating as ventricular than by treating
ii. Need a 12-lead ECG for more definitive diagnosis

Techniques of Management

Basic Life Support (CPR)

A. Single person adult unwitnessed arrest
B. Two-person adult unwitnessedd arrest
C. Infant resuscitation

ECG Monitoring

A. Review parts of portable monitor/defibrillator:
1. Paddle electrodes
2. Controls for defibrillator
3. Synchronizer switch
4. Oscilloscope
5. Paper strip recorder
6. Patient cable and lead wires
7. Controls for monitoring
8. Any special features

B. Monitoring lead uses three electrodes
1. Positive
2. Negative
3. Ground

C. Two most common monitoring leads
1. Lead II—best view of P waves, most common in field
2. Lead MCL1—best for determining site of origin of ectopics

D. Monitoring through paddle electrodes
1. Used for "quick-look" in cardiac arrest
2. May be used when patient cable inoperable
3. Picks up more artifact than chest electrodes; place chest electrodes at earliest convenience
4. Procedure
a. Turn on oscilloscope power
b. Apply conducting medium liberally to paddle surfaces or position saline or gel pads
c. Hold paddles firmly on chest wall at right upper chest (negative electrode) and left lower chest (positive electrode)
d. Observe monitor and obtain tracings if desired

E. Monitoring using chest electrodes
1. Review type of electrode used locally
2. Chest electrode placement for Lead II
a. Positive—left lower chest wall
b. Negative—right upper chest wall

See current American Heart Association BLS Protocols.

c. Ground—variable—placement not critical—place away from other electrodes
3. Chest electrode placement for Lead MCL1
a. Positive—right lower chest wall
b. Negative—left upper chest wall
c. Ground—variable; placement not critical
4. Avoid placing electrodes over large muscle masses, over large quantities of chest hair, or any place that prohibits electrode from lying flat on skin
5. Avoid placing electrodes in same spot that you would place paddles for defibrillation
6. Cleanse skin with alcohol swab and/or abrasive pad
a. Removes dirt and body oil for better adhesion, better electrode-to-skin contact (clearer tracing)
b. Shave small areas of chest hair if necessary
c. Dry skin well—alcohol breaks down electrode adhesive
7. Apply electrodes to skin surface
8. Attach ends of lead wires to electrodes
a. Explain marking of lead wires for proper placement
9. Plug in patient cable to monitor
10. Adjust gain or sensitivity to proper level
11. Use of audio control optional—be sensitive to patient's response to QRS "beeper"

F. Causes of poor ECG signal
1. Most common cause is poor electrode contact with skin; check for:
a. Excessive hair
b. Loose or dislodged electrode
c. Dried conductive gel on disposable electrodes
d. Poor placement over bony area
2. An initially poor tracing may improve with time as conductive gel breaks down skin resistance
3. Other causes of poor tracing:
a. Patient movement or muscle tremor
b. Broken patient cable
c. Broken lead wire
d. Faulty grounding
e. Faulty monitor

G. Obtaining a paper write-out
1. Technique for placing graph paper in strip writer
2. Adjustment of stylus heat
3. Purpose of calibration or standardization mark; 1 mv signal should produce 10 mm rise on ECG tracing (2 large boxes)
4. Indications for obtaining rhythm strip documentation (unless done by telemetry)

Precordial Thump

A. Sometimes effective in causing ventricular depolarization and resumption of organized rhythm

Select desired lead if monitor has lead selector

Especially in diaphoretic patients.

Demonstrate specifics on equipment used locally or a variety of equipment.

Local protocols.

B. Recommended in two specific situations
  1. At onset of ventricular tachycardia or fibrillation
  2. In ventricular asystole due to heart block when pulse can be produced with rhythmic thumps until pacemaker can be inserted
C. Not recommended in pediatric patients
D. Technique
  1. Delivered to mid-sternum with fist (thumb up) at height of 10–12 inches
  2. Thump delivered with fist and arm parallel to long axis of sternum to avoid injuring ribs

Defibrillation

A. Definition: The process of passing a current through a fibrillating heart to depolarize the cells and allow them to repolarize uniformly, restoring organized, coordinated contractions
  1. "Critical mass" of myocardium must be depolarized, not necessarily entire heart
  2. Critical mass related to size of heart, but cannot be calculated for a given individual or situation
B. Components of the defibrillator
  1. Adjustable, high-voltage DC power supply
  2. Energy storage capacitor
  3. Capacitor connected to paddles by current-limiting inductor
  4. Paddles
C. Characteristics of the electrical charge
  1. Alternating current defibrillators no longer in use
  2. Direct current (DC)
     a. More effective
     b. Less muscle damage
     c. DC defibrillators more portable
  3. On the order of several thousand volts
  4. Lasts 4–12 milliseconds
  5. Strength of shock commonly expressed in energy (joules or watt seconds); Energy (joules) = power (watts) x duration (seconds)
D. Chest wall resistance to electrical charge
  1. Lowers the electrical charge actually delivered to heart
  2. Important to lower resistance pathway between defibrillator paddles
  3. Factors that influence/vary chest wall resistance:
     a. Paddle pressure
     b. Paddle-skin interface
     c. Paddle surface area
     d. Number of previous countershocks
     e. Inspiratory vs expiratory phase at time of defibrillation
E. Factors that influence success of defibrillation
  1. Duration of ventricular fibrillation
  2. Condition of the myocardium

Eisenberg study: CPR in <4 minutes [illegible]fibrillation in <8 minutes [illegible]ls significantly higher re[illegible]scitation rate.

TOPIC | CONTENT OUTLINE

a. More difficult to defibrillate in presence of hypoxia, acidosis, hypothermia, electrolyte imbalance, drug toxicity

b. Secondary V-fib (from pre-existing pathology) more difficult to treat

3. Heart size and body weight

   a. Pediatric and adult energy requirements different

   b. Controversial whether size/energy requirement direct relationship exists in adults

4. Previous countershocks

   a. Transthoracic resistance decreases with repeated countershocks

   b. Possible to deliver more energy to heart at same energy setting

5. Paddle size

   a. Larger paddles thought to be more effective and cause less myocardial damage

   b. Ideal size for adults not established; recommended have equivalent surface area of 10–13 cm diameter circular paddles

   c. Infants: 4.5 cm diameter paddles are adequate; may desire a larger size for older children

6. Paddle placement

   a. Transthoracic placement recommended for emergency situation for adult and pediatric patients

   b. One paddle positioned to the right of upper sternum just below clavicle

      i. Do not place directly over sternum

      ii. Placement over large vessels facilitates current flow

   c. Other paddle positioned to the left of left nipple in anterior axillary line (over apex of heart)

   d. Paddles may be marked for placement

      i. Apex (positive electrode) and sternum (negative electrode)

      ii. Reversing polarity of paddles does not affect defibrillation. only inverts resulting ECG tracing

   e. Anterior-posterior placement:

      i. One paddle positioned anteriorly over precordium, other behind heart under back

      ii. No evidence of superiority of this method at present in emergency situations

      iii. May be useful when defibrillating infants with adult-sized paddles

7. Paddle-skin interface:

   a. Many types of interface material acceptable

      i. Cream

      ii. Paste

      iii. Saline-soaked pads

      iv. Pre-packaged gelled pads

   b. Studies available to show degree of impedance reduction by various products; use of low-impedance substance recommended

Pediatric size paddles are preferable.

c. Creams must be those made specifically for defibrillation, not for ECG monitoring
d. Exercise care with creams and saline pads to avoid "bridging" of charge due to smearing/running of conductive medium

8. Paddle contact pressure
a. Use firm downward pressure to maximally decrease transthoracic resistance
b. Do not lean on paddles. They may slip
c. Pressure also helps to deflate lungs, decreasing resistance

9. Proper functioning of defibrillator
a. Must actually be delivering energy indicated by machine; routine checks with suitable testing equipment mandatory
b. Routine exercising of nicad batteries if applicable

F. Energy recommendations for defibrillation
1. Optimum amount of delivered energy not established—probably varies for individual situation
2. Generally agreed that 360 joules sufficient to terminate V-fib in most patients
3. Initial defibrillation attempt should be at 200–300 joules; Should be repeated immediately if unsuccessful due to lowered resistance with second shock
4. After initiation of drug therapy, energy setting for third defibrillation attempt increased, not to exceed 360 joules
5. Pediatric energy dose recommendations
a. Initial: 2 joules/kg
b. Second attempt: 4 joules/kg
c. Further energy increases only after increased attention to patient oxygenation and acid-base status

G. Procedure for defibrillation
1. To be accomplished at earliest opportunity in V-fib
2. Delegate CPR responsibilities, but monitor effectiveness throughout
3. Use "quick-look" paddles with conductive medium to evaluate rhythm; stop CPR while observing monitor—5 seconds only
4. If V-fib present, continue CPR while preparing to defibrillate
5. Turn on defib power, select energy setting, and charge paddles
6. Place paddles on chest in correct positions with slight twisting motion to distribute conductive medium
7. Stop CPR and re-verify rhythm
8. Clear area and check that no personnel (including self) in direct or indirect contact with patient
9. Apply firm pressure on paddles
10. Deliver shock by depressing both paddle discharge buttons simultaneously— observe for skeletal muscle contraction
11. Leave paddles on chest and immediately reassess rhythm
12. If any kind of organized rhythm appears on monitor, immediately check carotid pulse

Equivalent to 25 lbs.

See current American Heart Association ACLS standards.

See current American Heart Association standards.

Use additional conductive medium if necessary.

7. Quickly withdraw needle and continue CPR

C. Complications
   1. Major hazard is long interruptions in CPR during procedure
   2. Less common but serious complications
      a. Pneumothorax
      b. Pneumo—or hemopericardium
      c. Myocardial or coronary artery laceration
      d. Intramyocardial injection (resulting in intractable V-fib)

***Mechanical CPR Devices**

A. Not a substitute for manual chest compression but an adjunct to optimize blood ejection by reducing human variables of application
   1. Frees up people when trained personnel limited
   2. May improve quality of compressions during transport
   3. Delivers proper and consistent compression-to-relaxation ratio
   4. May have future role in increasing blood flow and pressure by timing compressions to ventilation

B. Types of compressors
   1. Cardiac press
      a. Simple, hinged, manually operated chest compressor; provides adjustable stroke of 1 1/2 to 2 inches
      b. Advantages
         i. Applicable with minimal interruption CPR
         ii. Relatively modest cost
         iii. Ease of storage and transport
         iv. Minimal possibility of mechanical breakdown
      c. Problems in use
         i. Tendency for compressor head to shift p[illegible]
         ii. Tendency for tightening device to loosen r[illegible] in inadequate chest compression
      d. Demonstration of procedure for:
         i. Placing board under patient
         ii. Placing frame into position
         iii. Adjustment of plunger knob
         iv. Operation of handle
         v. Trouble shooting
   2. Automatic chest compressor
      a. Powered by compressed gas
      b. Plunger mounted on a backboard; adjustable to vary depth of compression
      c. Automatically ventilates lungs and controls ratio of compressions to ventilations
      d. Advantages
         i. Optimizes flow by proper compression-to-relaxation ratio
         ii. Delivers optimal rate and depth of compressions consistently
         iii. No interruption in compression needed for defibrillation
      e. Problems in use

TOPIC	CONTENT OUTLINE
	13. If no pulse or V-fib persists, continue CPR and prepare to repeat defibrillation
Emergency Chronized Cardioversion	A. Definition: delivery of electrical shock timed to the heart's electrical activity to avoid the relative refractory period 1. Synchronizing circuit in defibrillator allows delivery of countershock to be programmed to occur during specific part of QRS complex—often the R wave 2. Synchronization has been shown to reduce energy requirements and secondary complicating dysrhythmias B. Indications. supraventricular and ventricular tachydysrhythmias that are causing decompensation of the patient and require rapid correction; examples: 1. Perfusing ventricular tachycardia 2. Non-perfusing ventricular tachycardia 3. Paroxysmal supraventricular tachycardias 4. Rapid atrial fibrillation 5. 2:1 atrial flutter C. Energy requirements based on 1. Type of dysrhythmia a. 200 joules recommended for ventricular tachycardia b. Recognize that some rhythms convert with as little as 10 joules 2. Urgency to terminate dysrhythmia (patient's clinical condition) D. Procedure for synchronized cardioversion 1. Same as for defibrillation with following exceptions a. Premedication with Valium may be indicated in conscious patients b. Must use lead placement to obtain maximal height R wave on most machines i. Set gain high enough to insure sensing ii. Observe machine for indication of proper synchronization c. Press and hold discharge buttons until countershock delivered d. If V-fib occurs, must manually turn off synchronizer switch on some machines to accomplish defibrillation
***Rotating Tourniquets**	A. Used to decrease venous return to the heart (decrease preload) by trapping venous blood in extremities B. Used for treatment of acute left ventricular failure early in course of treatment and/or when unable to attain venous access C. Constricting bands or blood pressure cuffs may be used D. Applied snugly to three extremities as high up on extremity as possible E. Arterial pulses distal to tourniquets should be palpable after application F. Rotated every 5–10 minutes by releasing one extremity and reapplying to another extremity G. Contraindicated in shock
***Carotid Massage**	A. Used to convert paroxysmal supraventricular tachycardias into sinus rhythm by stimulation of the baroreceptors (pressure receptor) in the carotid artery resulting in increased vagal tone

Ventricular tachycardia is most common in-field indications.

Use non-synchronized defibrillation if synchronization will cause delay in treatment.

See current American Heart Association ACLS standards.

Treatment intervention is still primarily pharmacologic, but rotating tourniquets may be of some benefit until drugs can be given.

Never place on IV arm.

Use care to avoid tourniquets inadvertantly releasing all at once.

B. Technique
   1. Initiate O_2, IV line, and ECG monitoring
   2. Position patient on back, hyperextending the neck
   3. Gently palpate each carotid pulse separately and/or auscultate for bruits; massage contraindicated if pulses unequal, carotid bruits present, or patient has history of stroke
   4. Tilt head to either side and place index and middle fingers over artery below angle of jaw and as high up on neck as possible
   5. Firmly massage artery by pressing it against vertebral column and rubbing
   6. Monitor ECG and obtain write-out continuously and terminate massage at first signs of slowing or heart block
   7. Maintain pressure no longer than 15–20 seconds
   8. May repeat if ineffective or attempt procedure on other side

C. Complications
   1. Production of dysrhythmias
      a. Asystole
      b. PVC's
      c. Ventricular tachycardia and fibrillation
   2. Interference with cerebral circulation resulting in
      a. Syncope
      b. Seizure
      c. CVA
   3. Increased parasympathetic tone resulting in
      a. Hypotension
      b. Nausea
      c. Vomiting

***Intracardiac Injections**

A. Indicated for administration of epinephrine directly into the left ventricular cavity in the setting of cardiac arrest when IV or endotracheal routes are not possible

B. Technique
   1. Attach 3 1/2 inch (8.9 cm) 18 gauge needle to syringe containing epinephrine
   2. Locate insertion site
      a. Subziphoid approach preferred—avoids pleura and coronary vessels
      b. Alternate approach; fifth left intercostal space one to two finger's breadth from sternal border
   3. Quickly cleanse area of insertion with alcohol or other suitable antiseptic
   4. Stop CPR and insert needle at 20 to 30 degree angle with frontal plane below tip and 1 cm to left of patient's xiphoid
   5. Maintain suction on syringe while advancing and stop when blood appears; if no blood appears after full advancement and withdrawal, completely withdraw needle and re-attempt
   6. Inject medication—do not pull back on needle while injecting

Need mannekin
'emonstration

Never massage both carotids
simultaneously.

Demonstrate on mannekin.
Parasternal approach: insert
needle perpendicular to
frontal plane.

Automatic type
Automatic type

i. Risk of sternal fracture (see below)
ii. Expensive
iii. Size and weight may restrict mobility
iv. Risk of not recognizing improper positioning

f. Demonstration of procedure for:
i. Placing base under patient
ii. Mounting and positioning chest compressor
iii. Set up switching to ventilation equipment
iv. Trouble shooting

3. Complications using mechanical CPR devices
a. All the same complications can occur as with manual chest compression, including sternal fracture
b. In studies, major complications not more frequent than with manual technique
c. Use should be limited to adults pending further study

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Division 4: Medical

Section 3. Endocrine Emergencies

TOPIC	CONTENT OUTLINE

Introduction

This section discusses normal anatomy and physiology as related to the endocrine system, diabetes mellitus—including pathophysiology, assessment (history and physical exam), and management.

Objectives

At the end of this section, the student will be able to:

4.3.1 Define hormone

4.3.2 Discuss hormone production, including function and the single-most factor influencing production

4.3.3 Discuss the pituitary gland, including:
- a. Location
- b. Function
  - i. Anterior pituitary gland
  - ii. Posterior pituitary gland

4.3.4 Discuss the thyroid gland, including:
- a. Location
- b. Function
- c. Parathyroid gland

4.3.5 Discuss the adrenal glands, including:
- a. Location
- b. Function
  - i. Adrenal cortex
  - ii. Adrenal medulla

4.3.6 Discuss the pancreas, including:
- a. Structure
- b. Location
- c. Function

4.3.7 Discuss the ovaries, including:
- a. Location
- b. Function
  - i. Estrogen
  - ii. Progesterone

4.3.8 Discuss the testes, including:
- a. Location
- b. Function

4.3.9 Discuss the function of insulin, including the cycle:
- a. Absorption of glucose/insulin secretion to glucose
- b. Insulin secretion
- c. Glucose metabolism
- d. Return to homeostasis

4.3.10 List and briefly discuss the two functions of the islets of Langerhans

4.3.11 Discuss the function of glucogen, including the cycle:
- a. Lowering blood glucose concentration
- b. Secretion of glucogen
- c. Increase of blood glucose concentration
- d. Return to homeostasis

4.3.12 Define diabetes mellitus
4.3.13 Discuss juvenile onset of diabetes mellitus
4.3.14 Discuss adult onset of diabetes mellitus
4.3.15 Discuss osmotic diuresis in diabetes
4.3.16 Discuss the mechanism of ketone body formation and ketoacidosis
4.3.17 Discuss kidney excretion of ketoacids and potassium
4.3.18 Discuss the pathophysiology of hypoglycemia, including:
  a. Insulin and the relationship to serum glucose levels
  b. Epinephrine and glycogen
4.3.19 Discuss the precipitation of hypoglycemia
4.3.20 As related to hypoglycemia, list 8 resulting signs/symptoms
4.3.21 Describe the compensating mechanism in a hypoglycemic patient
4.3.22 Describe the onset of hypoglycemia
4.3.23 Discuss the effects that low insulin levels have on the body
4.3.24 Discuss the effects that increased glucose levels have on the body
4.3.25 Discuss the pathophysiology of diabetic ketoacidosis, including:
  a. Blood sugar level
  b. Insulin level
4.3.26 Discuss the precipitation of diabetic ketoacidosis
4.3.27 As related to diabetic ketoacidosis, list 8 signs/symptoms
4.3.28 As related to the ketoacidotic patient, discuss the body's compensating mechanism
4.3.29 Discuss the general management of the hypoglycemic patient or hyperglycemic patient who is conscious, including:
  a. Airway management
  b. Intravenous therapy
  c. Drug therapy
  d. Circulation
4.3.30 Discuss the general management of the hypoglycemic patient who is unconscious, including:
  a. Airway management
  b. Intravenous therapy
  c. Drug therapy
  d. Circulation
4.3.31 Discuss the general management of the ketoacidotic patient who is unconscious, including:
  a. Airway management
  b. Intravenous therapy
  c. Drug therapy
  d. Circulation

TOPIC	CONTENT OUTLINE
Anatomy and Physiology	A. Hormone: 1. A substance secreted by an endocrine gland that has effects upon other glands or systems of the body 2. Hormone production 3. Greatly influenced by stress B. Pituitary gland 1. Location: base of brain 2. Function: contains 2 endocrine glands (regulatory) a. Master gland of body b. Regulates function of most other endocrine glands by hormone secretion c. Secretes ADH d. Secretes oxytocin C. Thyroid gland 1. Location: in neck (2 lobes) a. Anterior and lateral to trachea b. Below larynx 2. Function: secretes thyroid hormones which regulate metabolic rate D. Parathyroid glands 1. 4 small (pea sized) glands located on posterior surface of thyroid glands 2. Controls metabolism of calcium and phosphorus E. Adrenal glands 1. Location: top of kidneys 2. Function: 2 glands; 2 components which function as separate endocrine glands a. Adrenal cortex: secretes glucocorticoids, mineral corticoids and small amounts of sex hormones b. Adrenal medulla: produces epinephrine and norepinephrine (part of autonomic nervous system) F. Ovaries 1. Location: paired, in pelvic cavity 2. Function a. Reproduction (see Gynecology Section) b. Estrogen i. Promotes monthly formation of inner uterine lining ii. Promotes breast development during adolescence c. Progesterone i. Aids in promotion of monthly formation of inner uterine lining ii. Causes sodium/water retention G. Testes 1. Location: outside body cavity in scrotum 2. Function: secretes testosterone a. Promotes growth b. Develops and maintains secondary sexual characteristics

TOPIC	CONTENT OUTLINE

H. Pancreas
  1. Location: located retroperitoneally adjacent to the duodenum on the right and extends to the spleen on the left
  2. Function
    a. Endocrine and exocrine gland
    b. Islets of Langerhans secretes regulating hormones
      i. Insulin
      ii. Glucagon
  3. Insulin
    a. Descriptions
    b. Function
  4. Glucagon
    a. Description and effects of secretion
    b. Function

I. Insulin
  1. Secretion stimulated by high blood sugar
  2. Function
    a. Increases glucose transport into cells
    b. Increases glucose metabolism by cells; increases liver glycogenesis
    c. Decreases blood glucose concentration toward normal levels

J. Islets of Langerhans: Secretes 2 regulating hormones
  1. Insulin from beta cells— Decreases blood glucose level
  2. Glucagon from alpha cells— Increases blood glucose level

K. Role of glucagon
  1. Fasting for a few hours
  2. Moderate decrease in blood glucose concentration below normal midpoint
  3. Stimulates alpha cells of islets of Langerhans to secrete glucagon
  4. Increases liver glycogenolysis
  5. Increases blood glucose concentration
  6. Back toward normal blood glucose concentration

Pathophysiology of Diabetes

A. Diabetes mellitus:
  1. Pancreas cannot secrete at all or not enough insulin to control blood glucose levels
  2. Diabetes mellitus, Type I (insulin dependent)
    a. Diabetes: Occurs anytime after birth
    b. Juvenile may suffer more severe consequences/effects, i.e., deteriorates eyesight; shortens life span
  3. Diabetes mellitus, Type II (insulin dependent)
    a. Normally occurs in adults
    b. May control with diet
    c. May be some insulin production by pancreas
  4. Effects of diabetes
    a. Osmotic diuresis

i. Glucose filtered in urine
ii. High blood glucose levels cause high glucose concentration in urine
iii. Secretion of glucose molecules leads to increased urine output and eventual dehydration

b. Ketone body formation
i. Fat breakdown increases to provide alternate energy source for cells that can no longer use glucose
ii. Fat breakdown products are called ketoacids/ketone bodies

c. Renal excretion of ketoacids
i. When more ketoacids are produced than the kidneys can excrete, they accumulate and produce metabolic acidosis (ketoacidosis)

5. Signs/symptoms of diabetes
   a. Polydipsia
   b. Polypuagia
   c. Polyuria

Diabetic Emergencies

A. Hypoglycemia
1. Pathophysiology of hypoglycemia
   a. Insulin lowers serum glucose by enhancing transfer into cells and by stimulating deposit of glycogen
   b. Epinephrine and glycogen tend to cause hypoglycemia by stimulating the breakdown of glycogen; interfering with the utilization of glucose at the cell level
   c. Hypoglycemia can occur with excess insulin or lack of hormones that maintain critical levels
   d. Glucose cannot enter muscle and fat cells
   e. Glucose accumulates in blood
   f. Increases blood osmotic pressure
   g. Kidneys—increased urine output

B. Precipitating factors
1. Hypoglycemia can occur after fasting or after food intake
2. Chronic alcoholism
3. Tumor of pancreas; overdose of insulin

C. Onset of hypoglycemia
1. Develops rapidly
2. Onset of diabetic ketoacidosis; progresses slowly 12--24 hours

D. Signs/symptoms in hypoglycemic patient
1. Weak, rapid pulse
2. Cold, clammy skin
3. Weakness and incoordination; headache
4. Irritable, nervous or bizarre behavior
5. May appear drunk; seizures
6. Coma in severe cases

E. Compensatory mechanism in hypoglycemic patient: normal/shallow respirations

Hyperglycemia/ Ketoacidosis

A. Pathophysiology of diabetic ketoacidosis
   1. Occurs when the blood sugar level becomes too high
   2. Insulin dose too small
   3. Patient has not taken insulin dose
   4. When insulin level is low, glucose cannot enter the cell—accumulates in the blood
   5. Ketoacidosis

B. Precipitation of diabetic ketoacidosis:
   1. May be triggered by stress on patient metabolism by:
   2. Infection, excess alcohol, pregnancy, trauma

C. Onset of hyperglycemia progresses slowly; 12–24 hours

D. Signs/symptoms in ketoacidotic patient
   1. Polyuria, polydypsia, polyphagia
   2. Nausea/vomiting
   3. Tachycardia, deep rapid respirations
   4. Warm dry skin; fruit odor—breath
   5. Sometimes fever, abdominal pain, falling blood pressure
   6. Decreased level of consciousness

E. Compensatory mechanism in the ketoacidotic patient: Deep/rapid respirations in an attempt to blow off excess acids by CO_2 elimination (Kussmaul breathing)

Assessment of Diabetic Patient

A. Primary/secondary survey
   1. Physical assessment
   2. Medical alert tag

B. History taking
   1. Recent food intake
   2. Alcohol intake
   3. Exercise
   4. How controlled
      a. Insulin
      b. Diet
      c. Other medications

Management of Diabetes

A. Management of the conscious diabetic patient
   1. Airway management, oxygen
   2. IV therapy, as indicated, necessary
   3. If IV established, draw blood (red top) for glucose analysis
   4. Glucose reagent stick
   5. Oral glucose
   6. Monitor vital signs/cardiac signs

B. Management of unconscious diabetic patient
   1. Airway management, oral airway, oxygen; intubate, bag

Instant glucose in mouth on mucous membranes if IV cannot be started

2. Draw blood (red top) for glucose analysis
3. Start IV—D5W TKO
4. Glucose reagent stick (Dextrostik or Chemstik)
5. If stick is less than 50 or patient is symptomatic: 50 ml D50
6. Other drugs
   a. Narcan .04 mg
   b. Thiamine may be indicated for alcoholic patient
7. Monitor cardiac signs/vital signs

C. Management of the unconscious hyperglycemic patient
1. Airway management, oral airway, oxygen; intubate, bag
2. Draw blood (red top) for glucose analysis
3. Glucose reagent stick (Dextrostik or Chemstick)
4. Start IV lactated ringers
5. If stick is less than 50 or patient is symptomatic—50 ml D50
6. Monitor cardiac signs/vital signs
7. Transport

Because etiology of unconsciousness is often unknown, these drugs may be indicated. See Division 4, Section 4, Nervous System

Sharply peaked T wave may indicate administration of bicarbonate.

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Division 4: Medical

Section 4. Nervous System

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment Sections 1–7 Division 2: Preparatory Sections 1–5 Division 3: Medical Sections 1–2 This section discusses the anatomy and physiology of the nervous system and assessment of the patient suffering a neurological insult. Medical disorders are covered in this section while traumatic injuries are reviewed in the Trauma Division. Acute disorders of the central nervous system may have serious sequela and require rapid assessment and treatment.
Overview	I. Anatomy and Physiology II. Assessment III. Pathophysiology and Management of Central Nervous System Disorders a. Coma b. Seizures c. Status epilepticus d. Stroke
Objectives	Upon completion of this section, the student will be able to: 4.4.1 Identify the parts of a neuron and describe their function. 4.4.2 Describe the process of impulse transmission for nerve cells. 4.4.3 Describe the types of nerve cells by function. 4.4.4 Identify and describe the protective mechanisms of the brain. 4.4.5 Describe the arterial and venous circulation to the brain. 4.4.6 Locate the following areas of specialization in the brain for: a. Speech b. Vision c. Personality d. Balance and coordination e. Sensory f. Motor 4.4.7 List the parts of the brain. 4.4.8 Identify the functions of the spinal cord. 4.4.9 Describe the protective mechanisms for the spinal cord. 4.4.10 Identify the divisions of the spinal column. 4.4.11 Identify the divisions of the spinal cord. 4.4.12 Identify the location of the brachial plexus and the lumbar-sacral plexus. 4.4.13 Identify the divisions of the autonomic nervous system and describe the functions and effects of each. 4.4.14 Identify the historical factors to be elicited when evaluating the nervous system including trauma-related and nontrauma-related problems.

4.4.15 Identify specific observations and physical findings to be evaluated in the patient with a nervous system disorder including:
  a. Primary survey
  b. Vital signs
  c. Neurologic evaluation
  d. Head to toe survey
    i. Pupils
    ii. Extraocular movements
    iii. Spinal evaluation

4.4.16 Describe the rating system for the Glasgow Coma Scale.

4.4.17 Describe the pathophysiology, assessment and management of the following:
  a. Coma
  b. Seizures
  c. Status epilepticus
  d. Stroke
  e. Transient ischemic attacks

4.4.18 For the following drugs, identify the pharmacology and actions, the indications, precautions, administration and side effects, for the adult and pediatric patient.
  a. Glucose 50%
  b. Naloxone
  c. Diazepam

4.4.19 List possible causes of coma.

4.4.20 Differentiate between syncope and seizures.

4.4.21 Describe and differentiate the major types of seizures.

4.4.22 Describe the phases of a generalized seizure.

S4.4.23 Demonstrate the ability to obtain an appropriate history when evaluating patients with nervous system disorders.

S4.4.24 Demonstrate the ability to perform an appropriate assessment when evaluating patients with nervous system disorders.

S4.4.25 Demonstrate a complete neurologic examination.

S4.4.26 Demonstrate the ability to appropriately evaluate a patient utilizing the Glasgow Coma Scale.

S4.4.27 Demonstrate the ability to appropriately administer the following drugs for the adult and pediatric patient.
  a. Dextrose 50%
  b. Naloxone
  c. Diazepam

S4.4.28 Demonstrate the ability to appropriately manage a patient with a nervous system disorder.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Anatomy and Physiology of the Central Nervous System	A. Central nervous system

A. Central nervous system
   1. Nerve cells
      a. Neuron
         i. Cell body, contains nucleus
         ii. Dendrites, carry impulse to the cell body
         iii. Axons, carry impulse away from the cell body
      b. Gray matter—collection of cell bodies
      c. White matter—contains myelinated axons
      d. Types
         i. Sensory or afferent
         ii. Motor or efferent
         iii. Connector neurons or interneurons
      e. Impulse transmission
         i. Electrical—synapses
         ii. Chemical—neurotransmitter
   2. Brain
      a. Skull or cranium, protective boney covering
      b. Suspension—ligaments
      c. Meninges
         i. Dura mater
         ii. Arachnoid mater
         iii. Pia mater
      d. Potential spaces formed by meninges
         i. Epidural space
         ii. Subdural space
         iii. Subarachnoid
      e. Cerebrospinal fluid, appearance and function
      f. Circulation
         i. Vertebrals
            (a) Basilar artery
            (b) Posterior cerebral arteries
            (c) Circle of Willis
         ii. Internal carotids
            (a) Ophthalmic artery
            (b) 3 major branches
         iii. Venous drainage
            (a) Venous sinuses
            (b) Internal jugular veins
      g. Areas of specialization
         i. Speech center—temporal lobe
         ii. Vision—occipital cortex in cerebellum
         iii. Personality—frontal lobe
         iv. Balance and coordination—cerebellum
         v. Sensory—parietal
         vi. Motor—frontal lobe

Acetylcholine &
epinephrine.

vii. Crossover of tracts

h. Parts including location and function

i. Cerebrum

ii. Cerebellum

iii. Brain stem

(a) Medulla

(b) Pons

(c) Midbrain

iv. Ventricles

3. Spinal cord

a. Functions

i. Reflex center

ii. Pathway for conducting impulses

b. Length 17–18 inches long, average

c. Diameter—10 mm vs 15 mm of spinal canal

d. Covered by meninges as is the brain

e. Boney covering—vertebrae

i. Vertebral body

ii. Pedicle

iii. Spinous process

iv. Transverse process

v. Articular facets

f. Connections of joint and ligament

g. Divisions of spinal column

i. Cervical

ii. Thoracic

iii. Lumbar

iv. Sacral

v. Coccygeal

h. Functions of spinal cord

i. Afferent impulses

ii. Efferent impulses

i. Divisions of spinal cord

i. Cervical

ii. Thoracic

iii. Lumbar

j. Series of 31 segments give rise to paired spinal nerves

i. Dorsal root contains afferent fibers

ii. Ventral root contains efferent fibers

iii. Dermatomes

k. Level of injury or disease of spinal cord

i. More serious the closer to the brain stem they occur

ii. Dynamics of neurogenic shock

l. Nerve root control

i. Cervical (shoulder girdle C5)

From foramen magnum to lower border of first lumbar vertebrae

7 vertebrae, 8 nerves.
12 vertebrae, and nerve roots.
5 vertebrae, and nerve roots.
1 made of 5 fused segments, 5 nerve roots.
1 made of 4-5 fused segments, 1 nerve root

Impulses from body to brain.
Impulses from brain to body.

Sensory.
Motor

ii. Thoracic
(a) Sensation at nipple level (T4)
(b) Sensation at the umbilicus level (T10)
iii. Lumbar
iv. Sacral

B. Peripheral nervous system
1. Cranial nerves—origins in the brain and innervate structures outside the brain
2. Peripheral Nerves
a. Categories
i. Somatic sensory
(a) Pain
(b) Temperature
(c) Touch
(d) Pressure
(e) Position or muscle sense
ii. Somatic motor
iii. Visceral sensory—from glands and structures composed of somatic or cardiac muscle
iv. Visceral motor
b. Brachial plexus
i. Collection of nerves at the posterior triangle of the neck
ii. May be injured at birth, or in accidents causing permanent disability
iii. Major nerves
c. Lumbar-sacral plexus—formed by union of lumbar, sacral and coccygeal nerves

C. Autonomic nervous system
1. Function—beyond conscious control
2. Division and effects of each
a. Sympathetic
i. More widespread effects
ii. Stimulation causes increased heart rate, increased BP, rise in blood sugar, bronchodilation
iii. "Fight or flight"
b. Parasympathetic
i. Effects more apparent in quiet state
ii. Body conservation processes, i.e., digestion and storage of materials for well-being
iii. Complementary effects

Assessment of the Nervous System

A. History
1. May be difficult to obtain because of impaired mental functioning
2. Differentiate between traumatic and nontraumatic CNS problems
3. Obtain information from bystanders
4. If trauma suspected

Hip extension L4, L5
Toe movement L5, S1, S2

Visceral motor system.

Thoracolumbar Division.

Craniosacral Division.

a. When accident occurred
b. How accident occurred and mechanism of injury
c. Loss of consciousness
d. Chief complaint and any change in symptoms
e. Complicating factors

5. Nontraumatic CNS problems
   a. Chief complaint and details of present illness
   b. Underlying medical problems
      i. Cardiac
      ii. Chronic seizures
      iii. Diabetes
      iv. Hypertension
      v. History of same symptoms previously
   c. Environmental clues
      i. Evidence of current medications
      ii. Medic alert
      iii. Alcohol bottles or drug paraphernalia

B. Physical examination
   1. Primary survey, treat life-threatening problems
      a. In unconscious patients, give special attention to maintaining an open airway
      b. If patient is unconscious, assume cervical injury and treat appropriately. Use:
         i. Chin lift
         ii. Oral or nasal airway
      c. Observe for:
         i. Respiratory arrest due to increased intracranial pressure
         ii. Vomiting and aspiration of stomach contents
         iii. Aspiration of blood from facial injuries
         iv. Absent gag reflex
   2. Vital signs
      a. May change rapidly
      b. Check and record frequently
   3. Respiratory patterns
      a. May be normal
      b. Cheyne-Stokes respiration
      c. Central neurogenic hyperventilation
      d. Ataxic respirations
      e. Apneustic respirations
      f. Observe for evidence of intercostal muscle dysfunction (diaphragmatic breathing)
   4. Blood pressure/pulse/temperature changes
      a. Early stages of increased intracranial pressure, pulse slows, BP and temperature rise
      b. Later, pulse increases, BP falls, temperature remains elevated

Including pain numbness, tingling paralysis.

Underlying medical problems alcohol or other drugs.

Jerky.

Dysrhythmias are common with increased intracranial pressure
Treatment is aimed at decreasing ICP.

C. Neurologic evaluation
   1. Level of consciousness
      a. Most important sign in evaluation
      b. Use descriptive behavioral terms
      c. Orientation to person, time, place
      d. Recall of event
      e. Note speech pattern
      f. Note if patient responds appropriately to questions
      g. Responds to commands in a rapid or sluggish manner
      h. Purposeful vs. uncoordinated movements
      i. If not alert, note degree of stimulation required for response
         i. Sternal rub
         ii. Squeeze trapezius muscle
         iii. Pin prick
      j. Posturing
         i. Flexion (decorticate)—flexion of any or all the extremities
         ii. Extension (decerebrate)—arms and legs extended
      k. Glasgow Coma Scale (GCS)
         i. Eye opening
            (a) Spontaneous eye opening (4)
            (b) Eye opening on command (3)
            (c) Eye opening to painful stimulus (2)
            (d) No eye opening (1)
         ii. Best motor response
            (a) Follows command (6)
            (b) Localizes painful stimuli (5)
            (c) Withdrawal to pain (4)
            (d) Responds with abnormal flexion to painful stimuli (decorticate) (3)
            (e) Responds with abnormal extension to pain (decerebrate) (2)
            (f) Gives no motor response (1)
         iii. Best verbal response
            (a) Answers appropriately (oriented) (5)
            (b) Gives confused answers (4)
            (c) Inappropriate (3)
            (d) Makes unintelligible noises (2)
            (e) Makes no verbal response (1)
   2. Head to toe survey
      a. Pupil size
         i. Equality
         ii. Abnormal dilation, constriction
         iii. Reaction to light and reacts consensually
         iv. Note—check for contact lenses
      b. Extraocular movements

AVPU System of evaluation
A—Alert
V—Vocal stimuli response
P—Painful stimuli response
U—unresponsive.

Mid-upper brain or lower diencephalon injury.

Mid-brain and upper pons level injury.

The highest possible score is 15, lowest score 3, value of less than 7 is consistent with the definition of coma.

Note position in which patient is found.

Slight inequality normal.

Conscious patient.

i. Follow finger to extreme left, then
ii. Up and down, then
iii. Extreme right, then
iv. Up and down

c. Evaluation for spinal injury
   i. Evaluate for pain and tenderness
   ii. Observe for bruises
   iii. Observe for deformity
   iv. Check for motion, sensation and position sense (proprioception), both arms and legs
      (a) Have patient move toes, raise legs, pull toes against resistance
      (b) Grip strength
   v. If patient unconscious, pin prick soles of feet, palms of hands

Pathophysiology and Management of Central Nervous System Disorders

A. Coma
1. Pathophysiology
   a. Definition—an abnormally deep state of unconsciousness from which the patient cannot be aroused by external stimuli
   b. Causes of coma
      i. Structural—intracranial bleeding, skull trauma, brain tumor, other space occupying lesions
      ii. Metabolic—anoxia, hypoglycemia, thiamine deficiency, diabetic ketoacidosis, kidney and liver failure
      iii. Drug causes—barbiturates, narcotics, hallucinogens, depressants, alcohol
      iv. Cardiovascular causes—hypertensive encephalopathy, shock, arrhythmias, stroke
      v. Respiratory causes—COPD, toxic inhalations,(CO poisoning)
      vi. Infectious process, i.e., meningitis
   c. Mnemonic for common causes of coma
      i. A Acidosis, alcohol
      ii. E Epilepsy
      iii. I Infection
      iv. O Overdose
      v. U Uremia
      vi. T Trauma
      vii. I Insulin
      viii. P Psychosis
      ix. S Stroke
2. Assessment
   a. History
      i. Need information from bystanders, family members
      ii. Observe environment

iii. Specific questions
   (a) Length of coma
   (b) Sudden or gradual onset
   (c) History of recent head trauma
   (d) Under medical care
   (e) Alcohol or other drug use or abuse
   (f) Complaints of symptoms before becoming comatose
iv. Check area for medications
v. Medic-alert
vi. Indications of alcohol or other drug abuse

b. Physical exam
   i. Primary survey—special attention to airway
   ii. Neurologic exam
   iii. Secondary survey
      (a) Vital signs observe for:
         (i) Hypertension
         (ii) Bradycardia
         (iii) Abnormal respiratory patterns
         (iv) Elevation or depression of temperature
      (b) Observe for physical evidence of:
         (i) Fruity odor to breath
         (ii) Laceration of tongue
         (iii) Cyanosis
         (iv) Alcohol on breath
         (v) Rigidity of neck
         (vi) Flaccid extremities on one side
         (vii) Posturing
         (viii) Needle tracks on arms
         (ix) Jaundice
         (x) Head trauma

3. Management
   a. Airway
      i. Open airway
      ii. Oropharyngeal or nasopharyngeal airway
      iii. Endotracheal intubation in absence of cervical trauma
   b. Support ventilation as needed
   c. Cervical immobilization if neck injury is suspected
   d. IV D5W TKO
   e. Draw blood for blood glucose determination
   f. Reagent strip for blood glucose determination
   g. Glucose 25 g IV
      i. Pharmacology and actions
         (a) Glucose is the body's basic fuel. It produces most of the body's quick energy. Its use is regulated by insulin, which stimulates storage of excess glucose from the

In the last four weeks.
i.e., hypertension seizures.

i.e., headache, dizziness.
Include refrigerator for insulin.

ICCP.
ICCP.

Infection, dehydration, intoxication.
Diabetic ketoacidosis.
Evidence of seizure.

May not, however, be the cause of coma.
Meningitis
CVA

Reagent strips should not be dipped into blood collection container. Fluoride preservatives used in some containers will cause results to be inaccurate.

bloodstream, and glucagon, which mobilizes stored glucose into the bloodstream

ii. Indications
   (a) Hypoglycemic states usually associated with insulin shock in diabetes
   (b) The unconscious patient on whom a history is unobtainable
   (c) CPR patients when cause of the arrest is not known
   (d) In patients with a reagent strip (Dextrostix) reading of 45 mg or less, with any focal or partial neurologic deficit or altered state of consciousness
   (e) Hypothermia, generalized

iii. Precautions
   (a) Draw one tube for blood glucose determination prior to administration
   (b) Test blood with reagent strip if feasible prior to administration of glucose
   (c) Use with caution in patients with suspected low potassium levels. Hypokalemia becomes more severe with administration of glucose. This should not be a contraindication to use, however
   (d) Extravasation of glucose can cause necrosis of tissue. IV should be secure and free return of blood into syringe or tubing should be checked 2-3 times during administration. If extravasation does occur, elevate extremity and promptly report the infiltration to the receiving physician

iv. Administration
   (a) Draw one tube for blood glucose determination
   (b) 50cc amp (1cc/kg) IV into secure vein (adults and children)
   (c) Give the solution orally if patient awake

v. Side effects and special notes
   (a) 50% glucose is remarkably free of side effects and should be used whenever a question exists
   (b) If the patient is unconscious, blood should be drawn and glucose given before the results of the reagent strip are known. If the patient is conscious, the situation is less urgent—await results of reagent strip before administering glucose
   (c) One bolus should be sufficient to raise the blood sugar 50-100 mg% and, therefore, will be adequate, at least for temporary therapy
   (d) Effect is delayed in elderly people with poor circulation
   (e) Do not draw glucose tubes from site proximal to an IV containing glucose

h. Administer Naloxone

   i. Pharmacology and actions

Or sugared juice honey, molasses, Karo syrup.

(a) Naloxone is a narcotic antagonist which competitively binds to narcotic sites but which exhibits almost no pharmacologic activity of its own

(b) Duration of action: 1-4 hours

ii. Indications

(a) Reversal of narcotic effects, particularly respiratory depression, due to narcotic drugs either ingested, injected or administered in the course of treatment. Narcotic drugs include morphine, Demerol, heroin, Dilaudid, Percodan, codeine, Lomotil, Propoxyphene pentazocine (Talwin)

(b) Diagnostically in coma of unknown etiology to rule out (or reverse) narcotic depression

iii. Precautions

(a) In patients physically dependent on narcotics, frank withdrawal symptoms may be precipitated

(b) Be prepared to restrain your patient. May become violent as the Narcan reverses the narcotic effect. Titrating the dose so as to keep the patient awake, responsive and free from respiratory depression, but somewhat groggy and (hopefully) docile may be warranted

iv. Administration

(a) Adult: 0.8 mg IV, IM or SQ. If no response is observed this may be repeated at 2-3 min intervals for 2-3 doses. Darvon overdoses may require larger doses. Pediatric: 0.01 mg/kg

v. Side effects and special notes

(a) This drug is remarkably safe and free from side effects. Do not hesitate to use it if indicated

(b) The duration of some narcotics is longer than Narcan and the patient *must* be monitored closely. Repeated doses of Narcan may be required. Patients who have received this drug must be transported to the hospital because coma may reoccur when Narcan wears off

(c) With an endotracheal tube in place and assisted ventilation, narcotic overdose patients may be safely managed without naloxone. Think twice before you wake your patient up; you may lose this airway control, or your patient may refuse transport if you reverse narcotic effects.

i. In the suspected alcoholic patient, administration of thiamine may be considered

i. Pharmacology and actions:

(a) Thiamine is a B-vitamin (B1) found in adequate amounts in the normal diet, but frequently deficient in alcoholics. In alcoholics the deficiency causes Wernicke's syndrome, an acute and reversible encephalopathy characterized by ataxia, eye muscle

Darvon.

Administration of thiamine may be a local consideration.

weakness (diplopia and nystagmus), and mental derangements. Of more serious concern is Korsakoff's psychosis, also caused by thiamine deficiency, and characterized by memory disorder. Korsakoff's psychosis may be irreversible once it becomes established. For this reason, treatment with thiamine is indicated if Wernicke's or Korsakoff's syndrome is recognized in an alcoholic. Since thiamine is utilized in carbohydrate metabolism, the syndromes may be precipitated by the administration of dextrose in the alcoholic, who often has already depleted thiamine stores.

ii. Indications
 (a) In suspected alcoholics with the administration of dextrose
 (b) In suspected Wernicke's or Korsakoff's syndrome

iii. Precautions
 (a) Allergic reactions occur but are extremely rare
 (b) Rapid IV administration has been associated with hypotension

iv. Administration
 (a) 100 mg IV (IM if necessary)

v. Side effects and special notes
 (a) Incidence of Wernicke's syndrome varies markedly in different regions. Urban emergency departments are particularly sensitive to the dangers of dextrose administration in the alcoholic. Use by standing or direct order of your base physician.

j. Monitor
k. Protect eyes by gently taping shut if necessary
l. Transport lateral recumbent or coma position

B. Seizures
 1. Pathophysiology
  a. Result from the massive electrical discharge of one or more groups of neurons in the brain
  b. Conditions that increase instability or irritability of brain and lead to seizures
   i. Stroke
   ii. Head trauma
   iii. Toxins including alcohol or other drug withdrawal
   iv. Hypoxia
   v. Hypoglycemia
   vi. Infections
   vii. Other metabolic abnormalities
   viii. Brain tumors
   ix. Vascular disorders
   x. Eclampsia

Recent or past.

Meningitis.

c. Idiopathic epilepsy most common cause of seizures
d. Major types of seizures
   i. Grand mal: characterized by loss of consciousness, tonic-clonic movements and sometimes tongue biting, incontinence, mental confusion. Followed by a period of coma or drowsiness
   ii. Focal motor seizures: characterized by twitching of one part of the body. May progress to generalized seizures.
   iii. Psychomotor seizures: characterized by altered personality state, often preceded by dizziness or a peculiar metallic taste. May cause sudden, unexplained attacks of rage or are manifested by automatic behavior
   iv. Petit mal seizures: occur in children and are characterized by a brief loss of motor tone
      (a) Because these are not true pathological seizures, they may not respond to normal treatment modalities. Aromatic ammonia may help differentiate a hysterical seizure from a true seizure
e. Hysterical seizures stem from psychological disorders
   i. Movements sharp and bizzare and can be interrupted by sharp command
   ii. Patients rarely injure themselves
f. Progression of grand mal seizures
   i. Aura—peculiar sensation preceding seizure activity; may be auditory, visual, olfactory, taste or "odd" feeling in part of the body
   ii. Loss of consciousness
   iii. Tonic phase—continuous motor tension
   iv. Hypertonic phase—extreme muscular rigidity and hyperextension of back
   v. Clonic phase—rigidity alternates with relaxation
   vi. Massive autonomic discharge with hyperventilation, salivation and tachycardia
   vii. Post seizure coma
   viii. Confusion, fatigue and headache, may have transient neurological deficit

2. Assessment
   a. History
      i. History of seizures including frequency, prescribed medications and compliance in taking meds
      ii. Description of seizure activity including length of seizure, generalized or focal, aura, incontinence, biting tongue
      iii. Recent or past history of head trauma
      iv. Abuse of alcohol or drugs including the last time they were used
      v. Recent fever, headache, stiff neck
      vi. History of diabetes, heart disease, stroke

Generalized motor seizures.

Jacksonian seizure—seizure activity limited to certain muscle groups, or one side of the body.

Temporal lobe seizures.

Involuntary.

Child stares off into space for a few seconds, then returns immediately to consciousness without demonstrating any motor symptoms.

List common anticonvulsant medications.

Meningitis.

b. Physical exam
   i. Signs of head trauma, injury to tongue
   ii. Evidence of alcohol or drug abuse
   iii. Arrhythmias
c. Differentiation of syncope vs. seizure
   i. Syncope
      (a) Usually starts in a standing position
      (b) Patient usually remembers a warning of fainting
      (c) Regains consciousness almost immediately upon becoming supine
      (d) Initially has a slow, weak pulse and is clammy and pale
   ii. Seizures
      (a) Start in any position
      (b) Without warning
      (c) Result in jerking movements during unconsciousness

3. Management
   a. Maintain airway
      i. Do *not* force objects between teeth
      ii. Padded tongue blade or bite block often unnecessary, may evoke vomiting, aspiration or spasm of larynx
   b. Administer oxygen
   c. Never attempt to restrain patient
   d. Protect from objects in the environment
   e. Protect body temperature
   f. Position on side after clonic-tonic phase is over
   g. Suction if necessary
   h. Monitor cardiac rhythm if indicated
   i. Provide quiet reassuring atmosphere
   j. Transport supine or in coma position

C. Status epilepticus
   1. Definition: 2 or more seizures without an intervening period of consciousness
   2. Considered a major emergency, may lead to aspiration, brain damage, fracture of long bones and spine, necrosis of heart muscle, severe dehydration
   3. Most common cause in adults is failure to take prescribed medications
   4. Management
      a. Maintain airway
      b. Oxygen
      c. Assist ventilations if necessary
      d. IV D5W TKO
      e. Glucose 25 Gm IV
      f. Diazepam IV
         i. Pharmacology and actions
            (a) Acts as a tranquilizer

Nasopharyngeal.

Secure well.

(b) An anticonvulsant
(c) A skeletal muscle relaxant

ii. Indications—the only emergency indication is status epilepticus in the field.

iii. Precautions
(a) Since diazepam can cause respiratory depression and/or hypotension the patient must be monitored closely. Respiratory arrest may occur. Very rarely cardiac arrest may occur
(b) For the above reasons diazepam should be given only with a good IV line in place and a bag-valve-mask available

iv. Administration
(a) Adults: 5–10 mg slow IV push
(b) Infants 30 days to children 5 years: 0.2–0.5 mg slow IV every 2–5 minutes up to maximum of 2.5 mg. Children 5 years or older; 1 mg IV every 2–5 minutes to a maximum of 5 mg

v. Side effects and special notes
(a) Common side effects include drowsiness, dizziness, fatigue and ataxia. Paradoxical excitement or stimulation sometimes occur
(b) Should not be mixed with other agents or diluted with intravenous solutions. Turn off IV flow while administering and give through the near end of IV tubing
(c) Most likely to produce respiratory depression in patients who have taken other depressant drugs, especially alcohol and barbiturates

D. Stroke (cerebrovascular accident)

1. Pathophysiology

a. Definition: sudden catastrophe caused by
i. Thrombus
ii. Embolus
(a) Atherosclerotic plaque
(b) Air
(c) Tumor tissue
(d) Fat
iii. Hemorrhage in the brain
(a) Vessel rupture from hypertension
(b) Subarachnoid hemorrhage
(i) Aneurysm
(ii) Arteriovenous malformation

b. Occurrence
i. Third most common cause of death
ii. Frequent cause of disability in older population

c. Symptoms depend on area of the brain that is damaged

Each 5 mg over at least 1 minute

Not to exceed 5 mg total dose.

Consult base station for further orders.

- d. Areas commonly affected
  - i. Motor centers
  - ii. Speech centers
  - iii. Sensory centers
- e. Predisposing factors
  - i. Hypertension
  - ii. Diabetes
  - iii. Abnormal blood lipid levels
  - iv. Oral contraceptives
  - v. Sickle cell disease
  - vi. Some cardiac arrhythmias

2. Transient ischemic attacks (TIA)
   - a. Definition: episodes of focal cerebral dysfunction that last minutes or occasionally up to an hour, but always less than 24 hours
   - b. Symptoms may be the same as a CVA
   - c. Common manifestation of carotid artery disease
   - d. Complete recovery often within 24 hours
   - e. May fortell of eventual stroke
3. Assessment
   - a. History
     - i. Previous neurological symptoms (TIA's)
     - ii. History of hypertension, cardiac disease, sickle cell disease or previous stroke
     - iii. Oral contraceptives
     - iv. When patient was last noted alert
     - v. Initial symptoms and have they progressed
     - vi. Changes in level of consciousness
     - vii. Precipitating factors to event
     - viii. Dizziness or palpitations
     - ix. Right or left handed
   - b. Physical exam
     - i. Neurologic exam—note hemiparesis or hemiplegia
     - ii. Speech disturbances including dysarthria, motor aphasia, receptive aphasia
     - iii. Confusion, agitation
     - iv. Gait disturbances or incoordination of fine motor movements
     - v. Vision disturbances
     - vi. Inappropriate effect with excessive laughing or crying
     - vii. Coma in massive stroke
4. Management
   - a. Keep patient supine with head elevated 15 degrees
   - b. Establish and maintain airway (head tilt)
   - c. Assist ventilations if necessary

d. Oxygen
e. IV TKO, draw blood for glucose determination
f. Consider glucose 25 Gm IV if hypoglycemia may be a factor
g. Monitor for cardiac arrhythmias
h. Reassurance
i. Protect paralyzed extremities
j. Explain procedures, even if patient cannot speak, he can understand
k. Transport

Choice of IV fluid may vary at local option.

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Division 4: Medical

Section 5. Acute Abdomen

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: PreHospital Environment Sections 1–7 Division 2: Preparatory Sections 1–5 Division 3: Medical Sections 1–3 This section discusses the anatomy and physiology of the abdomen, genitourinary system and reproductive system. Detailed patient assessment and specific management are presented as related to conditions which produce acute abdominal emergencies, genitourinary disorders, complications associated with hemodialysis, and disorders of the reproductive system. Detailed evaluation and management of the patient presenting with an acute abdominal emergency must be efficiently and expediently completed. When a patient presents with an acute abdominal emergency, his condition may rapidly deteriorate unless quickly identified and appropriately treated.
Objectives	At the end of this section, the student will be able to: 4.5.1 Describe and discuss the function of the primary gastrointestinal organs, including: a. Mouth b. Pharynx c. Esophagus d. Stomach e. Intestines (large/small) f. Rectum g. Peritoneum. 4.5.2 Describe and discuss the function of the gastrointestinal accessory organs, including: a. Salivary glands b. Teeth c. Liver d. Gallbladder e. Pancreas f. Veriform appendix. 4.5.3 Name the organs located: a. Right upper quadrant b. Left upper quadrant c. Right lower quadrant d. Left lower quadrant. 4.5.4 Describe the borders of the abdominal cavity. 4.5.5 Name the two major blood vessels in the abdomen. 4.5.6 List solid organs in the abdominal cavity and retroperitoneal space. 4.5.7 List hollow organs in the abdominal cavity and retroperitoneal space. 4.5.8 Discuss the following non-hemorrhagic causes of acute abdominal pain.

a. Local inflammation: edema, local obstruction.
b. Peritoneal inflammation: edema, pain secondary to edema.
c. General inflammation: edema, significant fluid loss.

4.5.9 List disease processes as related to nonhemorrhagic abdominal pain.

4.5.10 Define:
a. Hematemesis
b. Melena.

4.5.11 List hemorrhagic causes of acute abdominal pain.

4.5.12 Discuss the specific questions you would ask to obtain a history in a patient with abdominal pain.

4.5.13 Discuss signs and symptoms of:
a. Local inflammation
b. Peritoneal inflammation
c. General inflammation.

4.5.14 Describe signs and symptoms of:
a. Upper gastrointestinal bleed
b. Lower gastrointestial bleed.

4.5.15 Discuss management of the patient with acute abdominal pain.

4.5.16 Discuss general causes of genitourinary disorders.

4.5.17 Discuss pathophysiology, including causes and complications of:
a. Acute renal failure
b. Chronic renal failure
c. Kidney stones
d. Urinary tract infection.

4.5.18 Discuss pathophysiology of urinary assessment, including signs and symptoms of renal failure.

4.5.19 Describe management of renal failure.

4.5.20 Discuss assessment, including signs and symptoms of a kidney stone.

4.5.21 Describe management of the patient with a kidney stone.

4.5.22 Discuss assessment, including signs and symptoms related to a urinary tract infection.

4.5.23 Describe management of the patient with urinary tract infection.

4.5.24 Discuss types of dialysis.

4.5.25 Discuss complications related to dialysis.

4.5.26 Discuss the assessment and management of the dialysis patient.

4.5.27 Define:
a. Testes
b. Prostate
c. Penile urethra
d. Epididymis
e. Vas deferens

4.5.28 Discuss signs and symptoms of:
a. Epididymitis
b. Torsion of testes

4.5.29 Discuss the assessment and management of the male patient.

S4.5.30 Demonstrate the ability to take a relevant history from the patient with:

a. Acute abdomen
b. Genitourinary disorder
c. Dialysis related disorders
d. Reproductive system disorders

S4.5.31 Demonstrate the ability to perform a complete physical assessment on the patient with:

a. Acute abdomen
b. Genitourinary disorder
c. Dialysis related disorders
d. Reproductive system disorders

S4.5.32 Demonstrate competency in effectively treating the patient with: (including drug therapy)

a. Specific acute abdominal emergency
b. Specific genitourinary disorders
c. Specific dialysis related disorders
d. Specific reproductive system disorders.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Anatomy and Physiology of Abdomen	A. Primary gastrointestinal structures: 1. Mouth—oral cavity; consists of lips, cheeks, gums, teeth, tongue 2. Pharynx—portion of airway between nasal cavity and larynx 3. Esophagus—portion of digestive tract between pharynx and stomach 4. Stomach—hollow digestive organ; receives food from esophagus 5. Intestines a. Small—portion of digestive tube between stomach and cecum; composed of duodenum, jejunum and ileum b. Large—portion of digestive tube from ileocecal valve to anus; composed of cecum, colon, rectum 6. Rectum—distal portion of large intestine 7. Peritoneum—abdominal cavity lining B. Accessory gastrointestinal organs: 1. Salivary glands—produce and secrete saliva; connect to mouth by ducts 2. Teeth—in oral cavity; used for chewing food 3. Liver—large solid organ in right upper quadrant; secretes bile; produces essential proteins; detoxifies many substances; stores glycogen 4. Gallbladder—sac located beneath liver; stores and concentrates bile 5. Pancreas—intro-abdominal gland; secretes insulin and digestive enzymes 6. Veriform appendix—a hollow appendage; attached to large intestine C. Location of abdominal cavity: 1. Superior border—diaphragm; inferior border—pelvis 2. Posterior border—spine; anterior border—muscular abdominal wall D. Major blood vessels in abdomen: 1. Aorta 2. Inferior vena cavae E. Solid organs in abdominal cavity and retroperitoneal space: 1. Liver 2. Spleen 3. Pancreas 4. Kidneys F. Hollow organs in abdominal cavity and retroperitoneal space: 1. Stomach 2. Intestines 3. Gallbladder 4. Urinary bladder 5. Uterus (female) G. Organs in right upper quadrant: 1. Liver 2. Gallbladder 3. Duodenum H. Organs in left upper quadrant: 1. Stomach—where protein digestion begins

2. Liver (portion)
3. Pancreas
4. Spleen—destroys old red blood cells

I. Organs in right lower quadrant:
1. Ascending colon
2. Transverse colon (part)
3. Veriform appendix
4. Ovary (female)

J. Organs in left lower quadrant:
1. Transverse colon (part)
2. Descending colon
3. Ovary (female)

K. Components of urinary system:
1. Kidneys—located in retroperitoneum; filters blood, produces urine
2. Ureter—tube leading from kidney to bladder
3. Bladder—located in pelvis (behind pubic bone); stores urine produced by kidneys
4. Urethra—tube leading from bladder to outside body

L. Male reproductive system:
1. Testes—located outside body cavity in sac/scrotum; secretes testosterone
2. Prostate—gland at base of male bladder; may become enlarged causing obstruction to urine flow
3. Penile urethra—tube in penis leading from bladder to outside body
4. Epididymis—small organ behind testes; reservoir for sperm cells
5. Vas deferens—small muscular tube; conducts sperm from epididymis to urethra

M. Female reproductive system
1. Ovaries—small walnut size; located on each side of uterus; secretes estrogen
2. Fallopian tubes—tubes extend from ovary to uterus; egg travels from ovary to uterus through fallopian tube
3. Uterus—in pelvis; muscular organ; houses developing fetus
4. Vagina—extends from uterus to vulva (birth canal)
5. Vulva—external genitalia

Pathophysiology of the Abdomen

A. Nonhemorrhagic causes of acute abdominal pain
1. Local inflammation: edema, local obstruction
2. Peritoneal inflammation: edema, pain secondary to edema
3. General inflammation: edema, significant fluid loss

B. Disease process related to nonhemorrhagic abdominal pain
1. Peptic ulcer
2. Appendicitis
3. Diverticulitis
4. Ureteral calculus
5. Pelvic inflammatory disease

6. Pyelonephritis
7. Ovarian cyst

C. Disease process related to hemorrhagic causes of acute abdominal pain
   1. Esophageal varices
   2. Peptic/duodenal ulcer
   3. Diverticulitis
   4. Carcinoma of colon
   5. Ectopic pregnancy
   6. Aortic aneurysm

Assessment of the Acute Abdomen

A. History taking related to hemorrhage and nonhemorrhage causes of acute abdominal pain
   1. Chief complaint
   2. History of present illness: type of problem, character, onset, location, duration, alleviation or aggravation
   3. Past medical history—previous medical history, medications, hospitalizations (surgeries, etc.)
   4. Consider length and severity
   5. Determine fluid loss
      a. External: vomiting/diarrhea
      b. Internal: Ascites/edema

B. Physical examination

C. Signs/symptoms of nonhemorrhagic abdominal pain
   1. Local inflammation
      a. Pain—referred to somatic region
      b. Vomiting
      c. Diarrhea
      d. Guarding
   2. Peritoneal inflammation
      a. Localized pain
      b. Vomiting
      c. Diarrhea
      d. Specific guarding
   3. General inflammation
      a. Pain throughout abdomen
      b. Rigid abdomen
   4. Vital signs
      a. Heart rate increase
      b. Blood pressure decreased (orthostatic changes)
      c. Respirations normal/increased

D. Signs/symptoms of hemorrhagic abdominal pain
   1. Upper gastrointestinal bleed
      a. Hematemesis: Vomiting blood (volume and frequency depends on hemorrhage rate)
      b. Stomach may accumulate large amounts of blood before vomiting
      c. Color: Bright red, fresh coffee ground, old

Especially anticoagulants.

Heart rate increased; blood pressure decreased; respirations normal/ increased.

2. Lower gastrointestinal bleed
   a. Bloody stool
   b. Volume and appearance depends on bleeding rate and location
      i. Bright red: low location (hemorrhoid/rectum)
      ii. Wine color: colon or rapid upper GI bleed
      iii. Melena (black, tarry stool): upper GI bleed
3. Vital signs
   a. Heart rate increased
   b. Blood pressure decreased (orthostatic changes)
   c. Respirations normal/increased

Management of the Acute Abdomen

A. Oxygen therapy
B. IV crystalloid
C. Monitor vital signs and cardiac dysrhythmias
D. Position—shock
E. PASG
F. Transport immediately

Pathophysiology of Urinary System

A. Causes of genitourinary disorders
   1. Inflammation
   2. Infection
   3. Obstruction
   4. Hemorrhage
B. Renal failure
   1. Results in uremia (chemical formed with breakdown of protein)
   2. Acute and chronic forms
   3. Etiology
      a. Acute
         i. Kidneys maintain hemostasis of volume, blood pH, composition of body fluids; eliminates metabolic waste products
         ii. Renal failure: metabolic waste accumulates; has toxemic effect on organs; produces uremic symptoms
         iii. Uremia is produced and is increased in blood when urea is not excreted by kidneys
      b. Chronic
         i. Irreversible
         ii. Associated with loss of nephron mass
   4. Causes:
      a. Shock
      b. Dehydration
      c. Trauma
      d. Infection
      e. Obstruction of urine flow
      f. Prostate enlargement
   5. Complications:

May not tolerate.

a. Susceptible to toxic buildup of drugs (normal doses)
b. Fluid retention
c. Hypertension
d. Heart failure
e. Hyperkalemia
f. Metabolic acidosis

C. Kidney stones/urinary infections
1. Define calculi formation in kidneys. May obstruct genitourinary tract at any point during passage
2. Causes unknown in kidney stone formation, introduction of bacteria in genitourinary tract
3. Complications
a. Inflammation
b. Infection
c. Obstruction

Assessment of Genitourinary System Emergencies

A. Primary survey
B. History
1. Chief complaint
2. History of present illness
a. When occurred/how occurred
b. Character
c. Onset
d. Location
e. Duration
f. Alleviation/aggravation
g. Urination problems (frequency/pain)
3. Past medical history
a. Similar incident
b. Recent illness
c. Medications
d. Renal dialysis
e. Kidney transplant
4. Problems related to medical disorder/trauma
C. Vital signs—variables
D. Secondary survey
1. Airway
2. Inspect/auscultate/palpate abdomen
3. Palpate for flank pain
4. Neurological examination
E. Signs/symptoms of renal failure
1. Edema
2. Jaundice
3. Low urine output
4. Possible signs/symptoms of heart failure

As appropriate.

F. Signs/symptoms of renal calculi
   1. Excruciating flank pain—may radiate to groin—severe pain
   2. Difficult urination/hematuria

G. Signs/symptoms of urinary tract infection
   1. Pain/burning/difficult urination
   2. Urine discoloration
   3. May have lower abdominal pain, especially on urination

Management of Genitourinary Disorders

A. Renal failure
   1. Treat pulmonary edema if present
   2. Treat dysrythmias
   3. Transport to appropriate facility—may need dialysis
   4. Control shunt bleeding, if present

B. Renal calculi: Transport only, unless orders for medication are received

C. Urinary tract infections: No pre-hospital care indicated

Renal Hemodialysis

A. Basic principle of dialysis is diffusion of water and solutes

B. Types of dialysis
   1. Hemodialysis via external shunt
   2. Peritoneal dialysis

C. Complications
   1. Related to dialysis
      a. Hypotension
      b. Chest pain
      c. Disequilibrium syndrome—may cause lethargy, convulsions
      d. Air embolism—dyspnea, cyanosis, hypotension
   2. Related to vascular access
      a. Clotting—no emergency
      b. Hemorrhaging

D. Management of dialysis patient
   1. IV
      a. Access may be difficult to obtain
      b. Administer fluids cautiously
      c. Treat medical emergencies same as any patient
      d. Monitor ECG
   2. To remove patient from dialysis machine
      a. Turn off machine
      b. Clamp shunt ends
   3. Control shunt bleeding—internal or external
      a. Direct pressure and/or
      b. Pinch shunt ends

E. Assessment
   1. Chief complaint
      a. Inspect, auscultate, palpate abdomen appropriately
      b. Guarding/rigidity of abdomen

See Cardiovascular Section.

See Hemodialysis below.

Physician may modify drug doses.

Use special non-cutting clamps.

c. Position of patient

F. Management

1. Maintain airway and respirations
2. Monitor vitals
3. Follow check protocols as indicated
4. Transport in position of comfort

Division 4: Medical

Section 6. Anaphylaxis

TOPIC	CONTENT OUTLINE

Introduction

Prior to participating in this section, the student must have successfully completed:

Division 1: Prehospital Environment
Sections 1–7

Division 2: Preparatory
Sections 1–5

Division 3: Trauma
Section 1—Respiratory
Section 2—Cardiovascular

This section discusses anatomy and physiology as related to anaphylaxis; presents the pathophysiology leading to an anaphylactic reaction and presents in detail related patient assessment and specific management of anaphylaxis. Rapid assessment and management of the patient suffering from an anaphylactic reaction is of crucial importance to the patient's survival.

Overview

I. Anatomy and Physiology
II. Pathophysiology
III. Assessment
IV. Management

Objectives

At the completion of this section, the student will be able to:

4.6.1 Discuss antigens, including:
   a. Definition
   b. Examples
   c. Four ways antigens are introduced.

4.6.2 Define antibody and discuss production.

4.6.3 Define anaphylaxis.

4.6.4 Describe the pathophysiology of anaphylaxis.

4.6.5 Discuss effects that anaphylaxis may have on the following body systems:
   a. Respiratory
   b. Cardiovascular
   c. Gastrointestinal tract
   d. Central nervous
   e. Skin.

4.6.6 In a patient with anaphylaxis, identify signs and symptoms as related to:
   a. Respiratory system
   b. Cardiovascular system
   c. Gastrointestinal system
   d. Nervous system
   e. Skin

4.6.7 Describe the assessment and management of anaphylaxis.

4.6.8 Describe the pharmacology/actions; indications; precautions; administration (adult and pediatric); side effects/special notes for the following drugs:
   a. Oxygen

b. Epinephrine: 1:1000; 1:10,000

c. Diphenhydramine (Benedryl)

d. Aminophylline.

S4.6.9 Demonstrate the ability to take a relevant history from the patient with anaphylaxis.

S4.6.10 Demonstrate competency in effective assessment and management of the patient with anaphylaxis, including drug therapy.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Anatomy and Physiology	A. Antigen: 1. A substance that induces the formation of antibodies which interact with antigen; may be introduced into or formed within body 2. Examples: a. Drug molecules b. Serum from animals c. Blood from individuals of different blood types 3. Antigens are introduced by: a. Injection: drug, insect sting b. Ingestion: ingestion of an allergen c. Inhalation: inhalation of antigenic material d. Absorption: absorption of substance B. Antibody: 1. Protein substance developed in response to and interacting with antigen 2. Produced to eliminate antigens from body 3. Antibodies attach to antigen that caused formation
Pathophysiology	A. Anaphylaxis: Massive allergic reaction; develops in seconds to minutes after injection; ingestion; inhalation; absorption of a drug, sting, antigenic material B. Pathophysiology: 1. Antigen enters body 2. Antibody production 3. Antibodies attach to antigen 4. During sensitization, antibodies specific to sensitizing antigen attach to mast cells that contain histamine and heparin 5. Second time antigen enters body, antigen attaches to antibody on mast cells, causes release of histamine and heparin 6. Effect release of histamine has on: a. Arterioles—dilates b. Capillaries—increases permeability c. Muscles (including bronchial muscles)—constriction, causing bronchospasm/laryngospasm/narrowing of airway C. Systems affected by interstitial edema: 1. Respiratory 2. Cardiovascular 3. Gastrointestinal 4. Nervous 5. Skin
Assessment	A. Signs/symptoms related to: 1. Respiratory system: a. Dyspnea b. Sneezing, coughing c. Respiratory distress

Penicillin, bee, wasp sting
eggs, milk, seafood, nuts
pollen.

Contact with plant.

d. Complete obstruction
2. Cardiovascular system:
   a. Vasodilation
   b. Increased heart rate
   c. Decreased blood pressure
3. Gastrointestinal system:
   a. Cramping
   b. Nausea/vomiting
   c. Diarrhea
4. Nervous system
   a. Headache
   b. Convulsions
5. Skin
   a. Itching—urticaria
   b. Swelling—site, facial
   c. Flushed face/urticaria
   d. Cyanosis

B. Primary survey—treat life-threatening problems
C. History
   1. Chief complaint
   2. When occurred
   3. Past medical history (previous reactions, hospitalization)
D. Monitor vital signs frequently
E. Secondary survey
   1. Reassess airway/respirations
   2. Skin: Itching/red/inflamed
   3. Constantly assess level of consciousness

Management

A. Airway management
   1. Oxygen
   2. Bag mask—100% oxygen
   3. Endotracheal intubation or transtracheal ventilation if necessary
B. Mild constricting band
C. Intravenous therapy
   1. Crystalloid volume expander
   2. .3–.5 epinephrine SQ 1:1000 (mild)
   3. 3–5 ml epinephrine IV 1:10,000 (severe)
D. Additional drug therapy, as ordered
   1. Diphenhydramine (Benadryl) 50 mg
   2. Aminophylline, if symptoms persist
E. Cardiac monitor
   1. Frequently obtain vital signs
   2. Pneumatic anti-shock garment, as indicated
   3. Rapid transport
F. Drugs related to management of anaphylactic reaction

According to local protocol for insect sting.

Cautious administration in patient with underlying cardiovascular disease.

Administration of epinephrine is highest priority in treating airway obstruction.

1. Oxygen: goal to increase level of oxygen in body; administer by mask; bag; through endotracheal tube; transtracheal ventilation as indicated for appropriate management of patient; 100% oxygen; 10-15 liters/minute
2. Establish an airway
3. Administer oxygen
   a. Pharmacology and actions
      i. Oxygen added to the inspired air raises the amount of oxygen in the blood, and therefore the amount delivered to the tissues. Tissue hypoxia causes cell damage and death
      ii. Breathing in most persons is regulated by small changes in acid/base balance and CO_2 levels. It takes relatively large drops in blood oxygen to stimulate respiration
   b. Indications
      i. Suspected hypoxemia or respiratory distress from any cause
      ii. Acute chest pain in which myocardial infarction is suspected
      iii. Shock from any cause
      iv. Major trauma
      v. Carbon monoxide poisoning
   c. Precautions
      i. If the patient is not breathing adequately on his own, the treatment of choice is ventilation, not just oxygen
      ii. A small percentage of patients with chronic lung disease breathe because they are hypoxic. Administration of O_2 will shut off their respiratory drive. Initial oxygen flow should be no greater than 2 L/min in these patients
   d. Administration
      i. Dosage—low flow 1-2 L/min
      ii. Moderate flow—4-6 L/min
      iii. High flow—10-15 L/min
   e. Side effects and special notes
      i. Non-humidified O_2 is drying and irritating to mucous membranes
      ii. Restlessness may be an important sign of hypoxia
      iii. On the other hand, some persons become more agitated when a nasal cannula is applied, particularly when it is not needed
      iv. Oxygen supports combustion
      v. Oxygen toxicity is not a hazard from short-term acute administration
      vi. Nasal prongs work equally well on mouth breathers
4. Epinephrine
   a. Pharmacology and actions
      i. Cathecholamine with alpha and beta effects
      ii. In general, the following cardiovascular responses can be expected:

Drugs in this section will be detailed according to general actions, indications, precautions, administration, & side effects the first time they are encountered in the outline. When utilized in subsequent pathologies, the reader should refer back to the drug detail.

Decreased oxygenation of tissues.

Oxygen administered without adequate respiratory effort is ineffective.

Do not withhold oxygen because of this possibility. Be prepared to assist ventilation if needed.

Patients with chronic lung disease.

Precautionary use for trauma, chest pain, etc.

Severe respiratory distress, either trauma or medical.

Acquiesce to your patient if it is reasonable.

(a) Increased heart rate
(b) Increased myocardial contractile force
(c) Increased systemic vascular resistance
(d) Increased arterial blood pressure
(e) Increased myocardial O_2 consumption
(f) Increased automaticity

iii. Potent broncho dilator

b. Pharmacology and actions
c. Indications
d. Precautions
e. Administration
f. Side effects—palpitations, headache

5. Diphenhydramine (Benedryl)
   a. Pharmacology and actions
      i. An antihistimine which blocks action of histamines released from cells during am allergic reaction
      ii. Direct CNS effects, which may be stimulant or (more commonly) depressant, depending on individual variation
      iii. Anticholinergic, antiparkinsonism effect which is used to treat acute dystonic reactions to antipsychotic drugs. These reactions include: Oculogyric crisis, acute torticollis and facial grimacing
   b. Indications
      i. The second-line drug in antipsychotic drugs
      ii. To counter-react acute dystonic reactions to antipsychotic drugs
   c. Precautions
      i. Children may demonstrate excitation rather than drowsiness
      ii. May depress respirations
      iii. Do not give subcutaneously due to irritating effects
      iv. May have additive effect with alcohol or other depressants
   d. Administration
      i. Adults—usual dose is 50 mg slow IV push or deep IM
      ii. Children up to age 12—1-2 mg/kg body weight. Should not exceed 50 mg per single dose
   e. Side effects and special notes
      i. Diphenhydramine is rarely seen in the field. It is not the first-line drug for severe allergic reactions, but may be useful for long transports. It may also be useful for acute dystonic reactions; but these, while emotionally and physically trying, are not life-threatening and do not require treatment in the field
      ii. Drowsiness, sedation, headache
      iii. Blurred vision, dizziness, nausea, vomiting
      iv. Tremors, palpitations, convulsions

e.g., Haldol, Thorazine, and compazine.

After epinephrine.

v. May cause shortened diastole, atrial tachycardia and changes in T-waves electrocardiographic readings
vi. Side effects vary greatly between individuals
vii. Do not use in COPD patients
viii. Solution is light sensitive—keep in dark container

f. Transtracheal ventilation may be required if the patient does not respond to the preceding treatments

g. Side effects—sedation, blurred vision, headache, palpitations

6. Aminophylline
   a. Administer aminophylline by order
   b. Pharmacology and actions
      i. Aminophylline is a xanthine derivitive, composed of theophylline and ethylene
      ii. Aminophylline is a smooth muscle relaxant which relieves broncho-spasm and constriction. Stimulates respiratory drive
      iii. Increases coronary blood flow and cardiac output
      iv. Limited diuretic effect by removing excess extra-cellular fluid by dilating glomerular arterioles to increase glomerular filtration rate and excretion of sodium
      v. Relaxes smooth muscles of blood vessels, causing vasodilation
      vi. Stimulates CNS
   c. Indications—respiratory distress due to:
      i. Asthma
      ii. Bronchitis
      iii. Emphysema
      iv. Status asthmaticus
      v. Congestive heart failure
   d. Precautions
      i. Do not use in infants under 6 months of age
      ii. Some children may be unusually sensitive to aminophyllin
      iii. Use with extreme care in patients who are already taking oral theophylline preparations. Many patients with asthma and COPD regularly take theophylline. Ascertain when last dose was and how much; Relay information to base station

7. If infused too rapidly, may cause arrhythmias, ventricular fibrillation and circulatory collapse. Monitor constantly; IV administration should take at least 20 minutes
   a. Administration
      i. Adults—usual dose 6 mg/kg added to 100 cc D5W and titrate to run in 15-20 minutes or to patient response
      ii. Children—same as adults
   b. Side effects and special notes
      i. Transient hypotension, headache, nervousness, rash, palpitations, dizziness, anxiety, excitement, confusion, change in pulse rate
      ii. Nausea and vomiting are frequent

The active ingredient.

iii. May cause an initial drop in arterial oxygen concentration
iv. Always use a microdrip chamber
v. Clearly label bottle immediately with name and amount of drug
vi. Clear history as to recent use of medihalers; aminophylline preparations should be obtained

c. Do not give sedatives or tranquilizers
d. Encourage the patient to cough up secretions
e. Monitor cardiac rhythm
f. Pharmacology/actions
g. Indications
h. Precautions
i. Administration

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Division 4: Medical

Section 7. Toxicology, Alcoholism and Drug Abuse

TOPIC	CONTENT OUTLINE

Introduction

Prior to participating in this section, the student must have successfully completed:

Division 1: Prehospital Environment
Sections 1–7

Division 2: Preparatory
Sections 1–5

This section discusses the etiology and treatment of toxicological emergencies. The environment in which we live contains a large number of potentially harmful substances both natural and synthetic, which may be accidentally or deliberately introduced into the body. These substances include animal and plant toxins, industrial and domestic chemicals, therapeutic pharmaceuticals and drugs of abuse. Emergency medical personnel have an important role in the management of toxicological problems, since early identification and prevention of absorption are crucial to the successful treatment of the patient.

Overview

I. Introduction
II. Poisonings
III. Drug Overdose
IV. Drug Abuse
V. Alcohol

Objectives

At the completion of this section, the student will be able to:

4.7.1 Discuss the relative importance of toxicologic emergencies in prehospital care.

4.7.2 Describe the routes of entry of toxic substances into the body.

4.7.3 Discuss the role of Poison Control Centers in the EMS system and in the management of patients with toxicological emergencies.

4.7.4 Describe the aspects of the patient's history that are relevant in the management of a patient with ingested poison.

4.7.5 Describe the general principles of management of a patient with ingested poison.

4.7.6 Discuss the factors affecting the decision to induce vomiting in a patient with ingested poison.

4.7.7 Describe the signs, symptoms and management of the following specific cases of ingested poisons:

a. Strong acids or alkalies
b. Hydrocarbon products
c. Methyl alcohol or ethylene glycol
d. Cyanide
e. Food poisoning
f. Poisonous plants

4.7.8 Describe the general principles of management of a patient with inhaled poison.

4.7.9 Describe the signs, symptoms and management of the following specific cases of inhaled poisons:

a. Carbon monoxide
b. Freon
c. Ammonia

d. Chlorinated hydrocarbons

e. Methyl chloride

4.7.10 Describe the general principles of management of a patient with injected poison.

4.7.11 Describe the signs, symptoms and management of the following specific cases of injected poison:

a. Bees, hornets, wasps or yellow jackets

b. Brown recluse spider

c. Black widow spider

d. Scorpion

e. Rattlesnakes, cooperhead or cotton-mouth water mocassin.

f. Coral snake

g. Marine animals.

4.7.12 Describe the general principles of management of a patient with a surface absorbed poison.

4.7.13 Describe the signs, symptoms and management of the following specific cases of surface absorbed poison:

a. Organophosphate chemicals

b. Cyanide

4.7.14 Describe the general principles of management of a patient with an overdose.

4.7.15 Describe the signs, symptoms and management of the following specific cases of overdose:

a. Narcotics

b. Sedatives/depressants

c. Aspirin

d. Acetaminophen.

4.7.16 Discuss the incidence of drug abuse in the U.S.

4.7.17 Define the following terms:

a. Substance or drug abuse

b. Substance or drug dependence

c. Tolerance

d. Withdrawal

e. Addiction.

4.7.18 List the most commonly abused drugs (both by chemical name and "street names") and describe their physiological and psychological effects.

4.7.19 Describe the management of emergencies stemming from the use of the following

a. Hallucinogens (LSD, mescaline, DMT, psilocibin)

b. Phencyclidine (PCP)

c. Cocaine

d. Cannabis (marijuana)

e. Amphetamine.

4.7.20 Discuss the incidence of alcoholism in the U.S.

4.7.21 Discuss the signs, symptoms and management of acute alcohol overdose.

4.7.22 Discuss the signs and symptoms of chronic alcohol use.

4.7.23 Discuss the signs, symptoms and management of alcoholic withdrawal (delirium tremens or "DT's").

S4.7.24 Demonstrate the application of a constricting band.

S4.7.25 Demonstrate the procedures for incising a snake bite wound.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Introduction	A. Types of toxic emergencies 1. Poisonings 2. Overdose 3. Drug Abuse 4. Alcoholism B. Scope of the problem 1. Poisonings a. Over one million poisonings reported in the U.S. each year b. 75% in children under age 5 c. Most caused by household products d. 10% of all emergency room visits 2. Overdose a. Intentional i. Suicide attempts—70-90% through drug ingestion ii. Abuse of therapeutic drugs b. Accidental i. Overuse of prescribed medication ii. Combinations of prescribed medications with other substances 3. Drug abuse a. Increased use of "recreational" drugs over past two decades b. Wide range of behavioral and physiological effects c. Associated "street vocabulary"
Poisonings	A. Definition—any substance which produces harmful physiological or psychological effects B. Routes of entry 1. Ingestion a. Most common type of poisoning i. Household products (a) Petroleum based agents (b) Cleaning agents (c) Cosmetics ii. Medications iii. Toxic plants iv. Food poisoning b. Toxic effects i. Delayed (a) Dependent on absorption from GI tract (b) Stomach absorps only a small amount—most absorption from small intestine (c) Poisons may remain in the stomach up to several hours, since a large bolus of drug retards absorption ii. Immediate (a) Corrosive substances—strong acids and alkalis (b) Burns to lips, tongue, throat and upper GI tract

2. Inhalation
    a. Rapid absorption of toxic agent through alveoli
    b. Toxic gases
        i. Carbon monoxide
        ii. Ammonia
        iii. Chlorine
        iv. Freon
    c. Toxic vapors, fumes or aerosols
        i. Solvents
            (a) Carbon tetrachloride
            (b) Methyl chloride
        ii. Chemical warfare agents
            (a) Tear gas
            (b) Mustard gas
3. Injection
    a. Immediate local and delayed systemic effects
    b. Occasional anaphylactic reaction
    c. Insect stings and bites
        i. Bees, hornets, wasps and yellow jackets
        ii. Spiders
        iii. Fire ants
        iv. Ticks
        v. Scorpion stings
    d. Animal bites and stings
        i. Snake bites
        ii. Marine animals
            (a) Jellyfish and Portuguese men-of-war
            (b) Stingrays
            (c) Anemones
            (d) Coral and hydrae
            (e) Spiny fish
4. Surface absorption
    a. Immediate and delayed local and systemic effects
    b. Plant toxins
        i. Poison ivy, poison sumac and poison oak
        ii. Poison mushroon

C. Poison Control Centers
1. Based in major medical centers or teaching hospitals
2. Serve large population (1-10 million)
    a. Call volume sufficient to maintain expertise
    b. Access to many toxicological resources
3. Information provided 24 hours/day, 7 days/week
    a. Staffed by medical professionals
    b. Toxicological consultations are primary duties of these medical professionals

c. Advice provided immediately; follow-up calls placed to determine effectiveness and confirm desired outcome
d. Information on over 300,000 toxic substances
   i. Drugs (legal, illicit, foreign, veterinary)
   ii. Chemicals (household, industrial)
   iii. Plants
   iv. Animals, insects, fish and snakes
   v. Cosmetics
   vi. Hazardous materials

4. Reasons why paramedics should call Poison Control Center
   a. Immediate determination of potential toxicity based on type of agent, amount, time of exposure, age/weight/medical condition of patient, prior treatment
   b. Definitive treatment can be initiated in 80-85% of all poison exposures.
   c. Poison Control Center can notify Emergency Department (ED) of appropriate current treatment while ambulance is en route
   d. Data analysis
      i. Poison Control Center can spot trends, notify other centers and/or media about potential public health problems
      ii. Evaluation of current treatment protocols

D. Ingested poisons
   1. General principles of assessment and management
      a. Relevant history
         i. What was ingested?
            (a) Obtain poison container and remaining contents
            (b) Obtain sample of ingested substance
            (c) Obtain sample of vomitus
         ii. When was substance taken?
            (a) Affects decisions as to emesis, gastric lavage, activated charcoal and antidote administration
         iii. How much of the substance was taken?
         iv. Has attempt been made to induce vomiting?
         v. Has an antidote or activated charcoal been administered?
         vi. Does the patient have a psychiatric history (pertinent to suicide attempts)?
      b. Perform usual primary and secondary surveys
         i. Note color of skin
         ii. Note odor on breath
         iii. Check lips, mouth and tongue for corrosive burns
         iv. Check clothing for evidence of contamination
      c. Management
         i. Maintain an open airway
            (a) Intubate, if indicated
            (b) A sleepy or comatose poisoning patient has a high risk of vomiting and aspiration

ii. Decide whether to induce vomiting
 (a) Vomiting should be induced if poison was ingested within the past 3-6 hours
 (b) Never induce vomiting in the following circumstances:
  (i) Stuporus or comatose patient
  (ii) In the presence of seizures
  (iii) Pregnant patient
  (iv) Patient with a possible acute myocardial infarction
  (v) The patient who has ingested corrosive substances (strong acids or alkalis)
  (vi) The patient has ingested hydrocarbon substances
  (vii) EXCEPTIONS: (**DO** induce vomiting)
   (aa) Pesticides, heavy metals halogenated hydrocarbons, camphor-based hydrocarbons, aromatic hydrocarbons
   (bb) These substances have such high toxicity the risk of aspiration is justified
   (cc) Contact Poison Control Center if in doubt

iii. Induction of vomiting
 (a) Syrup of ipecac
  (i) For a child over one year; 15 cc followed by 2–3 glasses of water
  (ii) For an adult 30 cc followed by 2–3 glasses of water
 (b) Position patient appropriately to prevent aspiration
 (c) Repeat Ipecac dose in 20 minutes if vomiting does not occur
 (d) Activated charcoal
  (i) Rarely given in pre-hospital, wait until vomiting stops
  (ii) 2 tbsps in a slurry with tap water
  (iii) Should not administer simultaneously with Ipecac—charcoal inactivates Ipecac!
 (e) Start IV with D5W (or crystalloid if cardiovascular compromise occurs)

2. Management of specific ingested poisons
 a. Strong acids—e.g., toilet bowl cleaners, rust remover, phenol
  i. Signs and symptoms predominantly due to burns to upper respiratory tract
  ii. Never induce vomiting
  iii. Dilute with water or milk—do not use alkaline substances to neutralize because the heat generated may cause internal thermal burns
  iv. Start IV with D5W
 b. Strong alkali—e.g., drain cleaner, ammonia, bleach
  i. These agents produce corrosive burns to the lips, mouth, tongue and upper GI tract

Depending on toxic effects of ingested substance.

ii. Never induce vomiting
iii. Dilute with water or milk—do not use acidic substances to neutralize because the heat generated may cause internal thermal burns
iv. Start IV with D5W

c. Hydrocarbon products
   i. Account for 7% of ingestions in children under 5
   ii. Signs and symptoms
      (a) Wide variation, depending on type of compound ingested
      (b) Respiratory—cough, dyspnea, tachypnea, cyanosis
      (c) GI—mucous membrane irritation; nausea; vomiting
      (d) CNS—lethargy, seizures, coma
      (e) Systemic—fever, malaise
   iii. Management or inducement of vomiting is recommended for the following, if more than 1 ml/kg is ingested:
      (a) Halogenated hydrocarbons (carbon tetrachloride, trichloroethane, trichlorethylene, methylene chloride)
      (b) Aromatic hydrocarbons (toluene, xylene, benzene)
      (c) Turpentine
      (d) Gasoline, kerosene, lighter fluid, petroleum ether, mineral spirits
      (e) Any hydrocarbon with heavy metals, insecticides, nitrobenzene or aniline

d. Vomiting is never indicated in ingestion of mineral seal oil, signal oil or furniture polish oils
   i. No absorption of these from GI tract
   ii. Highest risk of aspiration pneumonitis

e. Vomiting is usually unnecessary in the following:
   i. Asphalt or tar
   ii. Lubricants such as motor oil, transmission oil, household oils
   iii. Mineral oil, baby oil, suntan oil
   iv. Fuel oil or diesel oil

f. Administer 100% oxygen
g. Start IV with D5W
h. Monitor cardiac rhythm

E. Methyl alcohol and ethylene glycol
   1. Present in paints, paint removers, varnishes and antifreeze
   2. Sometimes used by destitute alcoholics as a substitute for ethanol
   3. Signs and symptoms
      a. Hyperpnea
      b. Hypotension
      c. Alcohol smell on breath
   4. Management
      a. Maintain patient's airway

b. Induce vomiting if patient is conscious
c. Administer 100% oxygen
d. Monitor cardiac rhythm
e. Administer 1 oz. of 80 proof ethanol (e.g., whiskey) every hour—this inhibits methanol and ethylene glycol metabolism
f. Cyanide poisoning
   i. Ingestion of bitter almonds; seeds of cherries, apricots, peaches, apples or pears; laetrile
   ii. Blocks cellular use of oxygen; rapid development of cellular anoxia
   iii. May produce rapid onset of respiratory arrest
   iv. Signs and symptoms
      (a) Odor of bitter almonds on breath
      (b) Early hyperpnea and dyspnea, followed by bradypnea and gasping
      (c) Tachycardia and hypotension
      (d) Vomiting
      (e) Seizures
      (f) Coma
      (g) Occasional bright red skin color—cyanosis is rare except in terminal stages
   v. Management
      (a) Maintain patient's airway
      (b) Administer 100% oxygen
      (c) Use commercially available cyanide antidote kit. If unavailable, break amyl nitrite ampules into sponge and hold over patient's nose for 20-30 seconds every minute
      (d) Treat for shock
      (e) Start IV with crystalloid
      (f) Monitor cardiac rhythm and transport ASAP
   vi. Food poisoning
      (a) Staphylococcus toxin producing bacteria
      (b) Clostridia—spore-forming bacteria
      (c) Salmonella—bacteria
      (d) Botulism—most severe toxin producing bacteria * 60% fatality rate * Can cause respiratory paralysis
   vii. Signs and symptoms:
      (a) Nausea, vomiting
      (b) Abdominal cramping, diarrhea
      (c) Dehydration
      (d) Oxygen and respiratory systems
   viii. Management
      (a) Maintain airway
      (b) Oxygen and respiratory systems as needed
      (c) Control dehydration with IV crystalloid
g. Poisonous plants

Onset and severity variable depending upon organism.

i. Wide variety of common household and garden plants are poisonous if ingested
ii. Signs and symptoms—wide variety
iii. Management
(a) Induce vomiting
(b) Bring plant and vomitus to emergency department
(c) Follow general care guidelines for ingested poisons

F. Inhaled poisons
1. General principles of management
a. Remove patient from poison environment
i. Wear appropriate respiratory protective apparatus
ii. Wear protective clothing to prevent chemical burns (e.g., ammonia and chlorine)
iii. Remove contaminated clothing
b. Perform usual primary and secondary survey
c. Management
i. Assist ventilations and perform CPR, if necessary
ii. Use mechanical resuscitator, if available
iii. Administer oxygen
iv. Intubate unconscious patient
2. Management of specific inhaled poisons
a. Carbon monoxide
i. Colorless, odorless gas
ii. Produced during incomplete burning of organic fuels
iii. Poisoning most commonly from automobiles and home heating devices
iv. Half of all adult suicides are from carbon monoxide
v. Physiology
(a) Binds to hemoglobin more strongly than oxygen
(b) Inhibits oxygen delivery to cells
(c) Leads to hypoxia at the cellular level
vi. Signs and symptoms
(a) Headache
(b) Roaring sensation in the ears
(c) Confusion
(d) Vomiting
(e) Seizures
(f) Bounding pulse
(g) Dilated pupils
(h) Cyanosis
(i) Cherry-red coloration rarely seen
vii. Management
(a) Remove patient from exposure site
(b) Administer 100% oxygen
(c) Assist respirations, if necessary

INSTRUCTOR'S NOTES

See attached list.

See attached list.

(d) Treat for shock

b. Freon
   i. Used as a refrigerant and propellant
   ii. Abused by some as intoxicant
   iii. Primary danger is cardiotoxicity and subsequent dysthrhythmias
   iv. Management
      (a) Remove patient from exposure
      (b) Administer 100% oxygen
      (c) Start IV with D5W (or crystalloid for cardiovascular collapse)
      (d) Monitor cardiac rhythm
      (e) Lidocaine for PVC's

c. Ammonia
   i. Combines with water in tissue to produce a highly caustic, alkaline compound
   ii. Signs and symptoms
      (a) Watering and irritation of eyes
      (b) Irritation of upper and lower respiratory tract producing coughing, choking and respiratory collapse
      (c) Nausea, vomiting, diarrhea, abdominal pain
      (d) Seizures
   iii. Management
      (a) Remove patient to a well-ventilated space
      (b) Protect self during rescue
      (c) Maintain open airway—intubate and suction as required
      (d) 100% oxygen

d. Chlorinated hydrocarbons (e.g., carbon tetrachloride)
   i. CNS, liver and kidney damage may result from acute high dose or chronic low dose exposure
   ii. Signs and symptoms of acute poisoning
      (a) Irritation of eyes and of mucous membranes of respiratory tract
      (b) Nausea and vomiting
      (c) Headache, mental confusion
   iii. Management
      (a) Remove patient to a well-ventilated space
      (b) Protect self during rescue
      (c) Remove patient's contaminated clothing
      (d) Maintain airway—intubate and suction as necessary
      (e) 100% oxygen

e. Methyl chloride
   i. Colorless, combustible gas with ether-like odor
   ii. Easily absorbed through skin, adding to its toxicity
   iii. Signs and symptoms

(a) Nausea and vomiting
(b) Drowsiness, mental confusion
(c) Seizures and coma

iv. Management
(a) Remove victim from exposure
(b) Protect self during rescue
(c) Avoid sparks, open flames or use of electrical equipment during rescue
(d) Remove contaminated clothing
(e) 100% oxygen
(f) Maintain airway—intubate if necessary

G. Injected poisons
1. General principles of management
a. Remove patient from danger of repeated injection
b. Identify insect or animal; bring it with patient, if possible
c. Perform usual primary and secondary surveys
d. Watch for anaphylactic reactions
e. Prevent or delay absorption of poison

2. Insect bites and stings
a. Bees, hornets, wasps and yellow jackets
i. Signs and symptoms produced by injection of toxin through sting
ii. Major potential problem is anaphylaxis
iii. Signs and symptoms
(a) Localized pain, redness, swelling
(b) Allergic reactions—itchy rash, anaphylaxis
iv. Treatment
(a) Remove stinger without squeezing venom sac
(b) Apply ice
(c) Observe for and treat allergic reactions

b. Brown recluse spider bite
i. Signs and symptoms
(a) Localized pain, redness and swelling 2-8 hours after bite
(b) May progress to localized tissue necrosis
(c) Systemic reactions include chills, fever, nausea, vomiting, joint pain and bleeding disorders
ii. Treatment
(a) No specific antivenin
(b) May require surgical excision of necrotic tissue in wound area

c. Black widow spider bite
i. 5% fatality rate
ii. Signs and symptoms
(a) Immediate localized pain and swelling

See section on anaphylaxis for management

(b) Progressive muscle spasms, usually in back and abdomen
(c) Progressive spasms of all large muscle groups
(d) Elevation of temperature and blood pressure
(e) Nausea, vomiting, sweating, abdominal pain
(f) Seizures, paralysis

iii. Treatment
(a) Apply ice
(b) Administer muscle relaxant parenterally (diazepam 5-10 mg or calcium gluconate, 10 ml of a 10% solution, IV) if muscle spasms are severe
(c) Transport to emergency department for administration of antivenin

d. Scorpion stings
i. Stinger located at end of long tail
ii. Stings only if provoked
iii. Signs and symptoms
(a) Immediate sharp, localized pain, which progresses to numbness
(b) Systemic symptoms
(i) Restlessness
(ii) Slurred speech; drooling
(iii) Muscle twitching; abdominal pain and cramps
(iv) Nausea, vomiting, seizures
iv. Treatment
(a) Apply ice to wound
(b) Constricting band above wound site
(c) Transport if systemic signs or symptoms develop
(d) Avoid use of analgesics; increases venom toxicity

3. Snake bites
a. Types
i. Pit vipers—rattlesnakes, copperheads and cottonmouth water moccasins
ii. Coral snake
b. Pit vipers
i. Found almost everywhere in U.S. Rattlesnake is most common
ii. Venom is necrotizing and hemorrhagic
iii. Signs and symptoms
(a) Fang marks
(b) Swelling and pain
(c) Weakness, dizziness or faintness
(d) Sweating and/or chills
(e) Nausea and vomiting
(f) Tachycardia and hypotension
(g) Bloody urine and GI bleeding (late)

(h) Shallow respirations progressing to respiratory failure

vi. Management

(a) Primary goal is to slow absorption of venom

(i) Apply constricting band between bite and heart, close to the bite

(ii) Immobilize limb with splint

(iii) Keep patient supine

(b) Start IV with crystalloid in uninvolved extremity

(c) Transport to emergency department for administration of antivenin

(d) *DO NOT*

(i) Apply ice, cold pack or freon spray to wound

(ii) Apply venous or arterial tourniquet

(e) ONLY if emergency care is more than 1 hour away:

(i) Make parallel incisions (one through each fang mark) 1/8″ deep and 1/4″ long

(ii) Apply suction to these incisions for one hour

(iii) Other management as above

c. Coral snake

i. Found primarily in Florida and Southwest U.S.

ii. Contiguous red and yellow bands on body. Snakes with contiguous red and black bands are not poisonous

iii. Venom is potentially more toxic than pit viper's—neurotoxic

iv. Signs and symptoms

(a) Localized numbness and weakness

(b) Ataxia

(c) Slurred speech and excessive salivation

(d) Paralysis of tongue and larynx

(e) Drooping of upper eyelids

(f) Dilated pupils

(g) Loss of consciousness, seizures and respiratory failure

v. Management

(a) Wash wound with copious amounts of water

(b) Apply constricting band as per pit viper wound

(c) Immobilize limb with a splint

(d) Start IV with crystalloid in uninvolved extremity

(e) Transport to emergency department for administration of antivenin

(f) *DO NOT*:

(i) Apply ice, cold packs or freon sprays

(ii) Incise wound

4. Marine animal injection

a. Jellyfish, sea urchins, sting-rays, coral

b. Signs and symptoms

i. Intense local pain and swelling

Band should be loose enough to slip finger underneath.

Methods to inactivate or remove mematocysts include applying 95% alcohol, meat tenderizer, scrape wound site.

ii. Nausea, vomiting, weakness
iii. Tachycardia and dyspnea

c. Management
i. Maintain airway
ii. Apply constricting band
iii. Inactivate or remove nematocysts

H. Surface absorbed poisons
1. Organophosphate chemicals
a. Used in insecticides and in some chemical warfare agents
b. Extremely toxic—can be fatal if not treated promptly
c. Most signs and symptoms due to chronologic stimulation
d. Signs and symptoms
i. Salivation, nausea, vomiting, diarrhea, sweating
ii. Bradycardia, hypotension
iii. Blurred vision, constricted pupils
iv. Abdominal pain
v. Seizures
e. Management
i. Remove patient from continued exposure, wear adequate protective clothing
ii. Ensure open airway—suction copious bronchial secretions
iii. Flush patient with copious amounts of water
iv. Remove contaminated clothing
v. Reflush patient with copious amounts of water
vi. Start IV with crystalloid
vii. Monitor cardiac rhythm
viii. Administer atropine, 2 mg IV push—repeat every 3-8 minutes as required—attempt to induce relative tachycardia and decreased secretions

2. Cyanide
a. May be absorbed through the skin
b. Same systemic effects as from ingestion
c. Management as per ingestion protocol

Drug Overdose

A. General
1. Refers to poisoning or toxic effects, caused by a larger dose of a drug than is customarily used.
a. Accident
b. Miscalculation
c. Changes in drug strength
d. A suicide attempt
e. Polydrug abuse

2. Many overdose cases (OD's) seen by paramedics are in habitual drug abusers. In these cases, obtaining a history is often difficult. However, the EMT-P who is non-judgemental and conversant with

Important to remember the risk of not enough atropine far exceeds its overdosage. If there is no response to I.V. atropine, continue to push until there is.

The distinction between poisoning & overdose is an arbitrary one, & is made primarily for convenience; the principles of treatment are the same as for poisoning.

Provide student, if possible, with list of drugs of abuse; classifications, generic street drug slang may be able to obtain a good history and thus be able to help the OD victim.

B. Specific overdose syndromes
   1. Opium—narcotic overdose
      a. Heroin, morphine, demerol, codeine, methadone, Darvon, and Dilaudid
      b. Taken orally, "snorted," or injected intravenously
      c. OD's tend to occur in clusters, when a supply of unusually pure heroin hits the streets
      d. Clues to OD include "tracks" and skin ulcers from infected IV sites
      e. Classic signs of intoxication are:
         i. Euphoria;
         ii. "Nodding," a state of easily arousable somnolence;
         iii. Nausea, and;
         iv. Pinpoint pupils (except with Demerol, or in combination with other types of drug)
      f. Causes of overdose:
         i. Respiratory depression; apnea
         ii. CNS depression, stupor or coma;
         iii. Hypotension, profound shock
      g. Management
         i. Maintain airway and respirations
         ii. Draw blood
         iii. IV D5W
         iv. 50% dextrose, 50 cc
         v. Naloxone
            (a) Pharmacology and actions:
               (i) Naloxone is a narcotic antagonist which competitively binds to narcotic sites but which exhibits almost no pharmacologic activity of its own, duration of action: 1-4 hours
            (b) Indications:
               (i) Reversal of narcotic effects, particularly respiratory depression, due to marcotic drugs either ingested, injected or administered in the course of treatment. Narcotic drugs include morphine, Demerol, heroin, Dilaudid, Percodan, codeine, Lomotil, Propoxyphene (Darvon), pentazocine (Talwin)
               (ii) Diagnostically in coma of unknown etiolgy to rule out (or reverse) narcotic depression
            (c) Precautions
               (i) In patients physically dependent on narcotics, frank withdrawal symptoms may be precipitated
               (ii) Be prepared to restrain your patient. May become violent as the Narcan reverses the narcotic effect. Titrating the dose so as to keep the patient awake,

names, trade names, & street drug slang.

Lines of puncture scars along arm and leg veins.

Primarily used on unconscious patients in coma of unknown origin

Certain drug overdoses (Darvon) may require 10 or more amps of Naloxone responsive and free from respiratory depression, but somewhat groggy and (hopefully) docile may be warranted

(d) Administration:

(i) Adult: 0.8 mg IV, IM or SQ. If no response is observed, this may be repeated at 2–3 min. intervals for 2–3 doses. Darvon overdoses may require larger doses. Pediatric: 0.01 mg/kg.

(e) Side effects and special notes:

(i) Naloxone is remarkably safe and free from side effects. Do not hesitate to use it if indicated

(ii) The duration of some narcotics is longer than Naloxone and the patient **must** be monitored closely. Repeated doses of Naloxone may be required. Patients who have received this drug must be transported to the hospital because coma may reoccur when Naloxone wears off. With an endotracheal tube in place and assisted ventilation, narcotic overdose patients may be safely managed without Naloxone.

2. Sedative—hypnotic overdose
   a. Types
      i. Benzodiazepines; Valium, Librium
      ii. Barbiturates; phenobarbital, amobarbital, secobarbital
   b. Individually benzodiazepines are relatively non-toxic. Benzodiazepines may accentuate the respiratory depression and coma caused by other drugs.
   c. Overdose of barbiturates exhibits the following signs and symptoms
      i. Pupils may initially be constricted, but later are fixed and dilated, even in the absence of brain damage.
      ii. Respiration is depressed
      iii. Hypotension occurs, which may progress to shock
      iv. Hypothermia may result from exposure to even mild cold stress
      v. Blisters may appear on legs or feet of a comatose patient with barbiturate overdose; although not common, it is an important clue.
3. Stimulant overdose
   a. The stimulant drugs include
      i. The amphetamine family: Benzadrine, Desadrine, Meta-amphetamine, and others
      ii. Caffeine and similar mild stimulants which act much like the amphetamines in very large doses
      iii. Cocaine
   b. Amphetamines are usually taken orally, and cocaine intranasally ("snorted"), though both are sometimes injected intravenously.

Think twice before you wake your patient up, you may lose this airway control, or your patient may refuse transport if you reverse narcotic effects.

Indeed, there is evidence that barbiturate coma protects the brain from hypoxic damage.

Cocaine is usually used in brief "binges," whereas amphetamines are often used in many-day stretches culminating in a "crash."

c. Intoxication with stimulant drugs causes euphoria, excitement, and a decrease in appetite and need for sleep; heart rate and blood pressure are increased.

d. Signs and symptoms

   i. Nausea, vomiting, chills, sweating, increased temperature, dilated pupils, and a general increase in metabolic rate

   ii. Significant increases in pulse and blood pressure

   iii. Irritability, which may progress to hallucinations, seizures or to a violent form of paranoid psychosis

   iv. Cardiac dysrhythmias

4. Phencyclidine (PCP) overdose

   a. Phencyclidine (PCP) has become a major drug problem. Chronic use results in permanent memory impairment and loss of higher brain functions

   b. PCP is snorted, smoked with marijuana, or injected intravenously

   c. Signs and symptoms

      i. A zombie-like state of disassociation and stumbling gait

      ii. Tachycardia, tachyepnea, sweating, salivation

      iii. It commonly causes outbursts of incredible aggression and violence, with an apparent increase in physical strength and an insensitivity to pain that poses a hazard to all in the area

      iv. Muscle spasms, seizures and coma

   d. Management

      i. Maintain airway and respirations

      ii. Monitor for cardiac dysrhythmias

      iii. Consider Inderal for excessive heart rate and blood pressure and consider Valium for seizures

      iv. Violent psychotic behavior—see section "Behavioral Emergencies"

5. Tricyclic antidepressant (TCA's) overdose

   a. Tricyclic antidepressants (TCA's) Elavil, and Tofranil.

      i. Oral drugs are used in the treatment of depression, often used for suicide attempts

   b. Signs and symptoms

      i. Tachycardia, increased temperature, restlessness and anxiety; later, convulsions, cardiac dysrhythmias, and coma develop.

      ii. A characteristic ECG finding is the widening of the QRS complex

   c. Management

      i. Ipecac-induced emesis and cardiac monitoring

      ii. Intravenous sodium bicarbonate for seizures and dysrhythmias

6. Hallucinogens and marijuana overdose

The "three C's"

Some physicians might also order physostigmine or Valium

a. Hallucinogens include LSD, psilocybin, morning glory seeds, mescaline, and peyote
b. Signs and symptoms
    i. Hallucinations and distortions of sensory perception
    ii. Nausea, vomiting
    iii. Generally no major medical effects, psychological reactions may lead to bizarre behavior
c. Management
    i. Talk-down the patient in a friendly voice, in a quiet, secure place, providing contact with reality and reassurance
    ii. Manage other physical injuries which may have occurred secondary to the overdose

7. Salicylate (aspirin) overdose
    a. Description; many cold preparations, and oil of wintergreen contain a form of salicylate.
        i. Mild allergic reaction to salicylate is common especially with certain asthmatics
        ii. Chronic salicylate abuse may lead to bleeding ulcers and kidney failure
    b. Common salicylate overdoses
        i. Children's aspirin are both colorful and tasty and lead to overdose in children
        ii. Suicide attempts
    c. Signs and symptoms
        i. Faintness, tinnitus deafness, and visual disturbances;
        ii. Nausea, vomiting, and GI bleeding;
        iii. Fever, dehydration, and increased respiratory rate (sometimes leading briefly to a respiratory alkalosis before acidosis develops);
        iv. Eventually, severe acidosis, convulsions, delirium, and coma ensue
    d. Management
        i. Maintain airway and respirations
        ii. Ipecac-induced emesis
        iii. IV of normal saline
        iv. Comatose patient should receive sodium bicarbonate to correct acidosis
8. Acetaminophen overdose
    a. Acetaminophen (Tylenol, Datril, Tempra) is an analgesic, antipyretic agent like aspirin
    b. As with aspirin, poisoning of children is a particular problem
    c. As few as 30 standard size (325 mg) acetaminophen tablets will be toxic in an average adult
    d. Signs and symptoms
        i. Nonspecific at first
        ii. Malaise, loss of appetite, diaphoresis, nausea, and vomiting
        iii. With severe overdoses, coma may occur

Fatal liver damage often follows acetaminophen poisoning.

Antibiotics.
Caffeine, hallucinogens,
Morphine.

Demoral.
PCP.

Intoxication throughout the day, continuation of substance despite exacerbation of a serious medical problem.

These drugs are associated only with abuse since dependence on them has not been demonstrated.

Combined with prevalence of denial, the EMT-P must have a high index of suspicion.

Advise the patient you only deal with the medical issues & are not involved in the legal issues.

Reference: Diagnostic and Statistical manual of Mental Disorders (DMS-III) American Psychiatric Association.

TOPIC	CONTENT OUTLINE

Alcohol

A. Effects
   1. Depressant
   2. Mild doses depress inhibitions
   3. Large doses depress consciousness and respiration, may be fatal
   4. Abuse and dependence called *alcoholism*

B. Alcoholism
   1. Description
      a. Alcoholism is a major problem because of its extent
      b. Involved in many fatal auto accidents
      c. Same as other drug dependence: Withdrawal and tolerance occur
      d. Denial of dependence is very strong
      e. Barbiturates may be substituted for alcohol

C. Profile of alcoholic
   1. Drinking early in the day
   2. Prone to drinking alone or secretly
   3. Periodic binges, heavy drinking over several days or weeks
   4. Partial or total loss of memory for period of heavy drinking
   5. Unexplained history of repeated gastrointestinal problems, especially bleeding
   6. The "Green Tongue Syndrome"
   7. Cigarette burns on clothing due to falling asleep with lit cigarette
   8. Chronically flushed face and palms
   9. Tremulousness
   10. Odor of alcohol on breath under inappropriate conditions

D. Medical consequences of chronic alcohol ingestion:
   1. Poor nutrition: poor intake, plus direct alcohol effect
   2. Alcoholic hepatitis and liver cirrhosis
   3. Loss of sensation in hands and feet
   4. Loss of cerebellar function (loss of balance and coordination)
   5. Pancreatitis
   6. Upper GI bleeding; often fatal
   7. Hypoglycemia
   8. Subdural hematomata and rib/extremity fractures due to recurrent falls

E. Withdrawal syndrome
   1. Time factor—comes on several hours after sudden abstinence, lasting five to seven days
   2. Signs and symptoms: Coarse tremor of hands, tongue, eyelids; nausea/vomiting; weakness; increase in sympathetic tone: tachycardia, sweating, increased BP, anxiety; depressed mood and irritability; and orthostatic hypotension. Sleep is poor, and there may be brief hallucinations
   3. Delirium tremens usually develops on the second or third day of withdrawal. The alcoholic may develop the "DT's," or Delirium Tremens, which is characterized by a decreased level of consciousness where the patient is hallucinating and misinterpreting nearby events

One survey, 16% of the American public report some alcohol related problems within 3 years prior to survey

"Blackouts"

Comes from chlorophyll containing compounds used to disguise the odor of alcohol on the breath

At work or early in the morning.

e.g., the sound of the ambulance door closing becomes someone shooting at the patient.

4. Seizures ("rum fits") may occur, usually within the first 24–36 hours of abstinence
5. Seizures or delirium tremens are bad signs. There is a significant mortality from the DT's. Physicians may order Valium

F. Methanol/ethylene glycol poisoning: Poor alcoholics will drink methanol (wood alcohol; sterno; "squeeze") or ethylene glycol (antifreeze) which may cause blindness or death. (These poisons are in a previous section)

G. General management
1. Maintain airway and respirations
2. Ipecac-induced emesis may be considered dependent on age, amount consumed and vital signs
3. Local protocols may include the administration of thiamine
4. Firm but reassuring demeanor should be used

General treatment of seizures is covered elsewhere.

Refer to Management of the unconscious patient in Div. 4, Sec. 4, for material on thiamine.

COMMON POISONOUS PLANTS

HOUSE PLANTS

Plant	Toxic Part	Symptoms
Hyacinth narcissus	Bulbs	Nausea, vomiting, diarrhea, May be fatal.
Oleander	Leaves branches	Extremely poisonous. Produces severe digestive upset and has caused death.
Poinsettia	Leaves	Fatal. One leaf can kill a child.
Dieffenbachia (Dumb Cane) Elephant Ear	All parts	Intense burning (Dumb Cane) and irritaion of Elephant Ear the mouth and tongue. Death can occur if base of the tongue swells enough to block the air passage of the throat.
Rosary pea castor bean	Seeds	Fatal. A single rosary pea seed has caused death. One or two castor bean seeds are near the lethal dose for adults if crushed or chewed.
Mistletoe	Berries	Fatal. Both children and adults have died from eating the berries

FLOWER GARDEN PLANTS

Plant	Toxic Part	Symptoms
Larkspur	Young plant, seeds	Digestive upset, Seeds nervous excitement, depression May be fatal.
Monkshood	Fleshy roots	Digestive upset and nervous excitement
Autumn crocus, star-of Bethlehem	Bulbs	Vomiting and nervous excitement.
Lily-of the Valley	Leaves, Flowers	Irregular heart the beat and pulse, usually accompanied by digestive upset and mental condition.
Iris	Underground stem	Severe, but not usually serious, digestive upset.
Foxglove	Leaves	One of the sources of the drug digitails, used to stimulate the heart. In large amounts, the active principles cause dangerously irregular heart beat and pulse, usually digestive upset and mental confusion. May be fatal.
Bleeding heart (Dutchman's breeches)	Foliage	May be poisonous heart in large amounts. Has proved fatal to cattle.

VEGETABLE GARDEN PLANTS

Plant	Toxic Part	Symptoms
Rhubarb	Leaf blade	Fatal. Large amounts of raw or cooked leaves can cause convulsions, coma, followed rapidly by death.

ORNAMENTAL PLANTS

Plant	Toxic Part	Symptoms
Daphne	Berries	Fatal. A few berries can kill a child.

Patient may feel euphoric & jump out a third floor window believing it is only a few feet down.

Marijuana leads to perceptual disorders & mild anxiety reactions but seldom true hallucinations.

Talk-down should occur in a quiet secure place in a friendly manner.

Parents may attempt to treat fever with greater quantities of aspirin which compounds the overdose.

Emesis should be encouraged even if the poisoning occured many hours ago.

e. Management
   i. Ipecac-induced emesis
   ii. Activated charcoal is contraindicated since it will also absorb the antidote (n-acetylcysteine) will be administered in the emergency department

Drug Abuse

A. Background
   1. Some drugs are used solely for medical reasons; some are almost solely self-administered for their effects on mood or behavior; and some are used for both
   2. *Drug abuse* refers to the use of prescription drugs for non-prescribed purposes, or the use of drugs which have no prescribed medical uses.

B. Problems from substance abuse
   1. Medical problems:
      a. Glue sniffing may lead to blindness or liver damage
      b. Intravenous injection of drugs with unsterile equipment may lead to life-threatening infections
      c. Drugs cut with talcum powder may lead to lung or brain infarcts.
   2. Psychological problems
      a. Substance abuse is distinguished from nonpathological substance use by three criteria:
         i. A pattern of pathological use
         ii. Impairment in social or work function caused by the pattern of pathological use
         iii. Duration of more than one month
      b. Substance dependence more severe than substance abuse, and almost invariably there is also a pattern of pathological use
         i. Tolerance
         ii. Withdrawal

C. Common drugs of abuse
   1. Alcohol
   2. Barbiturates and similar sedatives and hypnotics
   3. Opioid narcotics: heroin, morphine, Demerol, codeine, etc.
   4. Amphetamines or similar CNS stimulants
   5. Cannabis (marijuana)
   6. Cocaine
   7. Phencyclidine (PCP) and similar drugs
   8. Hallucinogens: LSD, mescaline, and similar drugs

D. Implications of drug abuse for the EMT-P
   1. Widespread and common among ALL socioeconomic classes
   2. The EMT-P's drug box is an ideal target for drug addicts
   3. Patients should be questioned about recreational drug use, not addiction; if asked about, the result will be a "no" answer
   4. Recreational drug use is common and should be considered whenever the EMT-P is confronted by seizures, behavioral changes, stupor or coma.

Wisteria	Seeds Pods	Mild to severe digestive upset. Many children are poisoned by this plant.
Golden chain	Bean-like capsules in which the seeds are suspended.	Severe poisoning. Excitement, staggering, convulsions and coma. May be fatal.
Laurels Rhododendron Azaleas	All parts	Fatal. Produces nausea and vomiting, depression, difficult breathing, prostration and coma.
Jessamine	Berries	Fatal. Digestive disturbance and nervous symptoms.
Lantana camara (red sage)	Green Berries	Fatal. Affects lungs, kidneys, heart and nervous system. Grows in the southern U. S. and in moderate climates.
Yew	Berries, Foliage	Fatal. Foliage more toxic than berries. Death is usually sudden without warning symptoms.

TREES AND SHRUBS

Wild and cultivated cherries	Twigs Foliage	Fatal. Contains a compound that releases cyanide when eaten. Gasping, excitement, and prostration are common symptoms that often appear within minutes.
Oaks	Foliage Acorns	Affects kidneys gradually. Symptoms appear only after several days or weeks. Takes a large amount for poisoning. Children should not be allowed to chew on acorns.
Elderberry	Shoots, Leaves, Bark	Children have been poisoned by using pieces of the pithy stems for blowguns. Nausea and digestive upset.
Black Locust	Bark, sprouts foliage	Children have suffered nausea, weakness and depression after chewing the bark and seeds.

PLANTS IN WOODED AREAS

Jack-in-the pulpit	All parts, especially roots	Like dumb cane, pulpit contains small needle-like crystals of calcium oxalate that cause intense irritation and burning of the mouth and tongue.
Moonseed	Berries	Blue, purple color, resembling wild grapes. Contains a single seed (true wild grapes contain several small seeds). May be fatal.
Mayapple	Apple, foliage, roots	Contains at least 16 active toxic principles, primarily in the roots. Children often eat the apple with no ill effects, but several apples may cause diarrhea.

PLANTS IN SWAMP OR MOIST AREAS

Water hemlock	All parts	Fatal. Violent and painful convulsions. A number of people have died from hemlock.

PLANTS IN FIELDS

Buttercups	All parts	Irritant juices may severely injure the digestive system.

Nightshade	All parts, especially the unripe berry	Fatal. Intense digestive disturbances and nervous symptoms.
Poison hemlock	All parts	Fatal. Resembles a large wild carrot. Used in ancient Greece to kill condemned prisoners.
Jimson weed (thorn apple)	All parts	Abnormal thirst, distorted sight, delirium, incoherence and coma. Common cause of poisoning. Has proved fatal.

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Division 4: Medical

Section 8. Infectious Diseases

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment All sections Division 2: Preparatory All sections This section will emphasize safety of the Emergency Medical Technician as related to infectious diseases, including: cross contamination, responsibility of EMT-P for personal hygiene, personal care, cleaning emergency equipment, notifying authorities. Even though the primary focus of this section is on EMT-P safety, this section will also include a discussion of interventions as related to management of patients who have an infectious disease in conjunction with a life-threatening emergency. This section defines medical terminology and discusses the anatomy and physiology as related to the body's immune system and the lymphatic system. The pathophysiology of infectious diseases, including: tuberculosis, hepatitis, meningitis, sexually transmitted diseases, scabies and lice and childhood diseases is presented. Prehospital assessment and management will include basic life support. Primary management of the patient with an infectious disease will be done in the hospital setting.
Overview	This section contains: Anatomy and Physiology I. Assessment of Tuberculosis II. Assessment of Hepatitis III. Assessment of Sexually Transmitted Diseases IV. Assessment of Scabies/Lice V. Assessment of Childhood Diseases VI. Followup after Exposure
Objectives	Upon the completion of this section, the student will be able to: 4.8.1 Define virus. 4.8.2 Define bacteria. 4.8.3 Define fungus. 4.8.4 Briefly discuss the body's immune system. 4.8.5 Define antigen. 4.8.6 Define antibody. 4.8.7 Define antigenic determinants. 4.8.8 Define clone cells. 4.8.9 Define leukocyte. 4.8.10 Discuss the major components of the immune system. 4.8.11 Define lymph. 4.8.12 Define interstitial fluid. 4.8.13 Discuss composition of lymph and interstitial fluid. 4.8.14 Discuss the lymphatic system. 4.8.15 Discuss lymph circulation. 4.8.16 Discuss the function of: a. Lymph b. Antibody

c. Thymus
d. Spleen.

4.8.17 Discuss the formation and types of lymphocytes.
4.8.18 Discuss the development, activation and function of B cells.
4.8.19 Discuss the development, activation and function of T cells.
4.8.20 Identify and discuss the location of lymphocytes.
4.8.21 Describe the structure and types of antibodies.
4.8.22 Discuss agammaglobulinemia.
4.8.23 Define autoimmune diseases.
4.8.24 Define infectious disease and the general cause.
4.8.25 List 3 examples of infectious diseases and the general cause.
4.8.26 Discuss how infectious diseases are transmitted.
4.8.27 Define communicable disease.
4.8.28 Give an example of a highly communicable disease caused by a virus.
4.8.29 Give an example of a communicable disease caused by bacteria.
4.8.30 Give an example of a communicable disease caused by fungi.
4.8.31 Discuss how stress may be related and affect disease.
4.8.32 Refer also to anatomy and physiology of specific body systems, which are affected by specific diseases.
4.8.33 Identify the pertinent history-related questions to be asked when evaluating the patient with an infectious disease.
4.8.34 Identify signs and symptoms to be evaluated in a patient with an infectious disease, including:
a. Primary survey, including level of consciousness
b. Vital signs
c. Secondary survey (head-to-toe survey)
d. Neurological evaluation.

4.8.35 Define tuberculosis.
4.8.36 Discuss the pathophysiology of tuberculosis, including:
a. Acute generalized form
b. Chronic localized form.

4.3.37 Discuss the body systems commonly affected by tuberculosis.
4.8.38 Discuss signs and symptoms related to the patient with tuberculosis.
4.8.39 Discuss assessment and management of the patient with tuberculosis.
4.8.40 Discuss EMT safety as related to handling the patient with tuberculosis.
4.8.41 Define hepatitis.
4.8.42 Discuss the pathophysiology of hepatitis.
4.8.43 Discuss the body systems commonly affected by hepatitis.
4.8.44 Discuss symptoms related to the patient with:
a. Hepatitis acute anicteric
b. Hepatitis cholangiolitic
c. Hepatitis fulminant
d. Infectious hepatitis (include: how transmitted)
e. Serum hepatitis (include: how transmitted)

f. Toxic hepatitis
g. Viral hepatitis
1. Type A
2. Type B

4.8.45 Discuss assessment and management of the patient with hepatitis.
4.8.46 Discuss EMT safety as related to handling the patient with hepatitis.
4.8.47 Define meningitis.
4.8.48 Discuss the causes of meningitis.
4.8.49 Discuss the pathophysiology of meningitis.
4.8.50 Discuss the body systems commonly affected by meningitis.
4.8.51 Discuss signs and symptoms related to the patient with meningitis
4.8.52 Briefly discuss the following:
a. Acute meningitis
b. Cerebral meningitis
c. Cerebrospinal meningitis
d. Pneumococcal meningitis
e. Spinal meningitis
f. Traumatic meningitis
g. Tuberculous meningitis.

4.8.53 Discuss assessment and management of the patient with meningitis.
4.8.54 Discuss EMT safety as related to handling the patient with meningitis.
4.8.55 Define syphilis.
4.8.56 Discuss the types of syphilis.
4.8.57 Discuss the pathophysiology of syphilis.
4.8.58 Discuss the body systems commonly affected by syphilis.
4.8.59 Discuss the signs and symptoms related to the patient with syphilis.
4.8.60 Define gonorrhea.
4.8.61 Discuss the pathophysiology of gonorrhea.
4.8.62 Discuss the body systems commonly affected by gonorrhea.
4.8.63 Discuss the signs and symptoms related to the patient with gonorrhea.
4.8.64 List two types of herpes simplex
4.8.65 Discuss the pathophysiology of herpes simplex type 2.
4.8.66 Discuss the body systems commonly affected and incubation period of herpes simplex type 2.
4.8.67 Discuss the signs and symptoms related to the patient with herpes simplex type 2.
4.8.68 Define Acquired Immune Deficiency Syndrome (AIDS).
4.8.69 Discuss the pathophysiology of AIDS.
4.8.70 Discuss the body systems commonly affected and incubation period of AIDS.
4.8.71 Discuss the signs and symptoms related to the patient with AIDS.
4.8.72 Discuss assessment and management of the patient with a sexually transmitted disease.
4.8.73 Discuss EMT safety as related to handling the patient with a sexually transmitted disease.

4.8.74 Define and discuss the pathophysiology of scabies.

4.8.75 Define and discuss the pathophysiology of lice.

4.8.76 Discuss the body systems commonly affected by scabies/lice.

4.8.77 Discuss the signs and symptoms related to the patient with scabies/lice.

4.8.78 Discuss assessment and management of the patient with scabies/lice.

4.8.79 Discuss EMT safety as related to handling the patient with scabies/lice.

4.8.80 Define measles.

4.8.81 Discuss the pathophysiology of measles.

4.8.82 Discuss the signs and symptoms related to the patient with measles.

4.8.83 Define mumps.

4.8.84 Discuss the pathophysiology of mumps.

4.8.85 Discuss the signs and symptoms related to the patient with mumps.

4.8.86 Define chickenpox.

4.8.87 Discuss the pathophysiology of chickenpox.

4.8.88 Discuss the signs and symptoms related to the patient with chickenpox.

4.8.89 Discuss the assessment and management of the patient with a childhood disease.

4.8.90 Discuss EMT safety as related to handling the patient with a childhood disease.

4.8.91 Discuss follow-up after exposure

a. Notification procedures by hospital

b. Notification procedures by EMT

4.8.92 Discuss EMT personnel hygiene.

4.8.93 Discuss vehicle cleaning procedures.

S4.8.94 Demonstrate the ability to take a history from the patient with an infectious disease.

S4.8.95 Demonstrate the ability to perform a complete physical assessment on the patient with an infectious disease.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Anatomy and Physiology	A. Virus: A minute organism not visible with ordinary light microscopy and a parasite dependent on nutrients inside cells for metabolic and reproductive needs

B. Bacteria: Any micro-organism of the class schizomycetes
   1. Three principal forms
      a. Spherical or ovoid
      b. Rod shaped
      c. Spiral
   2. Varies in size
   3. May produce poisonous substances called toxins

C. Fungus
   1. A vegetable cellular organism that subsists on organic matter
   2. Sponge-like morbid growth on the body that resembles fungi

D. Immune system
   1. Body's defense against bacteria and virus

E. Antigen
   1. Foreign macromolecules
   2. Usually proteins that, when introduced into the body, induce it to make certain responses
   3. Antigens are macromolecules located in surface membranes of microorganisms

F. Antibody
   1. Proteins of the class called immunoglobulins
   2. Antibodies are natives of body
   3. Are present at birth

G. Leukocyte
   1. White blood cell
   2. Destroys disease germs

H. Major components of immune system
   1. Lymphocytes are main cells
   2. Antibodies are chief molecules
   3. Leukocytes and macrophages—cells which interact in immune system

I. Interstitial fluid
   1. Material that fills space between cells
   2. Interstitial fluid and blood together constitute extracellular fluid

J. Lymph
   1. Clear, watery fluid found in lymphatic vessels

K. Composition of lymph and interstitial fluid
   1. Similar to that of blood plasma
   2. Plasma contains higher concentration of proteins
   3. Lymph in thoracic duct has twice as high protein concentration as most interstitial fluid

L. Lymphatic system
   1. A specialized component of circulatory system: Consists of moving fluid derived from blood, tissue fluid, and lymphatic vessels that

return lymph to the blood; lymph nodes located along the paths of collecting vessels; lymphatic organs (tonsils, thymus, spleen)

M. Lymph circulation
   1. Water and solutes filter out of capillary blood into interstitial fluid, enter lymphatics and return to blood
   2. Vessels serve as a transport network returning tissue fluid, proteins, fats, and other substances to general circulation

N. Function of:
   1. Lymph nodes
      a. Defense formation of lymphocytes and monocytes
   2. Antibody
      a. Recognition and binding to antigens to form antigen-antibody complex
   3. Thymus
      a. Forms of lymphocytes before birth
      b. Serves as part of body's defense against microbes and foreign proteins
   4. Spleen
      a. Defense, forms plasma cells
      b. Red blood cells and platelet destruction
      c. Blood reservoir

O. Identify and discuss the location of lymphocytes: Lymphocytes in bone marrow, thymus, lymph nodes, spleen, other lymphatic tissues, blood, lymph, tissue spaces

P. Structure and types of antibodies
   1. Structure: Immunoglobulin molecule composed of heavy and light polypeptide chains
   2. Types
      a. IgM—predominant antibody produced after contact of B cells with its specific antigen
      b. IgC—75% of antibodies in this type; antibody produced after subsequent exposure to same antigen
      c. IgA—chief antibody in lining mucosa of intestines, bronchi, saliva, tears
      d. IgE—antibody responsible for allergic effects
      e. IgD—small amounts in blood

Q. Infectious disease
   1. Illness caused by an organism (virus, bacteria, fungus)

R. Three examples of infectious disease
   1. Pneumonia—bacteria, virus, fungi
   2. Meningitis—virus, bacteria, fungi
   3. Peritonitis—caused by organisms of the intestines which penetrate the peritoneal cavity

S. Infectious diseases are transmitted
   1. Directly or indirectly
      a. Some diseases are congenital

TOPIC	CONTENT OUTLINE

b. Through the air (droplets from the respiratory tract)
c. Animal/human/insect carriers
d. Soil or water

T. Communicable disease
1. Disease process caused by an organism that can be transmitted from one human to another
2. Highly communicable disease by virus: common cold
3. Communicable disease by bacteria: staph, strep, pneumonia
4. Communicable disease by fungus: Skin fungi

U. Stress/disease: Stress may cause body's adaptive mechanisms to fail, thus disease results
1. Hypertension
2. Arthritis
3. Ulcers
4. Herpes zoster

Pathophysiology/ Assessment of Hepatitis

A. Define hepatitis: An inflammatory condition caused by infectious agents, toxins, drugs, metabolic aberration or hypersensivity or immune mechanisms

B. Types
1. Hepatitis A, virus most common
2. Hepatitis B (serum hepatitis)
3. Symptoms
   a. Fever
   b. Weakness
   c. Loss of appetite
   d. Nausea
   e. Abdominal pain
   f. Jaundice
   g. Dark colored urine
   h. Light colored stools
4. Incubation period
   a. Hepatitis A: 25-40 days
   b. Hepatitis B: 42-160 days
5. Mode of transmission: Contact with stools, blood or urine of an infected individual
6. EMT safety
   a. Wash hands following contact with excretions. Use disposable gloves
   b. Follow up only if protective measures were not used; immunization with ISG (Immune Serum Globulin) after exposure
   c. Heat sterilization of all instruments used
   d. Blood specimens and linens should be bagged and labeled

Pathophysiology/ Assessment of Tuberculosis

A. Define tuberculosis:
1. An infectious disease caused by tubercle bacillus

Reference to anatomy and physiology of specific body systems

B. Signs and symptoms related to tuberculosis
 1. Cough
 2. Fever
 3. Night sweats
 4. Weight loss
 5. Fatigue
 6. Hemoptysis
C. Incubation period: 4-12 weeks
D. Mode of transmission
 1. Droplets in air from respiratory tract (sneezing, coughing, talking)
E. EMT safety
 1. Protection
  a. Mask
  b. Fresh air
  c. Avoid prolonged contact with a patient who has an active case of tuberculosis
  d. Avoid contact with thick, coughed-up sputum
 2. Follow-up
  a. PPD skin test or chest X ray following contact
  b. Repeat PPD or chest film 2-3 months after exposure
  c. If previous skin test was negative and is positive following exposure: Tuberclulosis organism is present but not causing disease; may be prescribed INH (isoniazid) drug for one year

Pathophysiology/ Assessment of Meningitis

A. Define meningitis: inflammation of the membranes of the spinal cord or brain
B. Causes of meningitis
 1. Common organisms (meningococcus; bacteria)
 2. Viruses or other organisms that reach the meninges
C. Types: Bacterial meningitis; Viral meningitis
 1. Symptoms: Fever, headache, nausea and vomiting, stiff neck, rash
 2. Incubation period: 2-10 days; varies depending on strain
 3. Mode of transmission: Direct contact with discharges from nose/throat
 4. EMT safety
  a. Mask (place on patient or yourself)
  b. Follow-up: Necessary to seek medical care if you were involved in resuscitating, intubating, or suctioning patient

Pathophysiology/ Assessment of Sexually Transmitted Diseases

A. Syphilis
 1. An infectious, chronic venereal disease
 2. Transmitted by contaminated material
B. Symptoms
 1. Lesions in the genital area
 2. Lymph node enlargement
 3. Inflammation of the mouth
 4. Headache

5. Fever
6. Heart/blood vessels/central nervous system frequently involved—observes for related signs and symptoms

C. Mode of transmission
1. Direct sexual contact between humans

D. EMT safety
1. Avoid direct contact

E. Define gonorrhea
1. Specific, contagious inflammation of the gential mucous membrane of either sex

F. Symptoms
1. Male
a. Yellow mucopurulent discharge from penis resulting from inflammation of the urethra
b. May affect prostrate, painful urination
2. Female, may be asymptomatic
a. Urethral or vaginal discharge
b. Painful or frequent urination
c. Lower abdominal pain, tenderness in the area
d. Acute pelvic inflammatory disease

G. Mode of transmission
1. Direct sexual contact between humans

H. EMT safety
1. Avoid direct contact

Pathophysiology/ Assessment of Herpes

A. Types
1. Herpes simplex, Type 1
2. Herpes simplex, Type 2

B. Herpes simplex (genital herpes)
1. Symptoms: Burning, itching, tingling, tenderness at site, fever, swollen glands, thin white discharge, lesion which becomes ulcerated on the penis, vulva, buttocks, thighs
2. Incubation period: 2–12 days
3. Mode of transmission
a. Direct contact with lesions (sexual or skin to lesion contact) where virus enters through breaks in the skin
b. Virus is not airborne (cannot be contracted from toilet seats, pools, hot tubs or sheets)
4. EMT safety
a. Handwashing/gloves
b. Follow-up: None, document exposure

Assessment of AIDS (Acquired Immune Deficiency Syndrome)

A. Symptoms
1. Fever with profuse night sweats
2. Weight loss (10–20 lbs. per month)
3. Red/purple skin lesions

Cold sore, fever blister.
Genital herpe

4. Pneumonia

B. Incubation period: 2 months–2 years

C. Mode of transmission
1. Blood contact
2. Contact with bodily secretions
3. Sexual contact

D. EMT safety
1. Use disposable gloves when in contact with blood or body fluids
2. Wash hands following care of patient

Pathophysiology/ Assessment of Scabies/ Lice

A. Define scabies
1. Highly communicable skin disease caused by arachnid (itch mite)

B. Define lice
1. A small sting insect that lives as an ectoparasite on birds and mammals
2. Human lice are primary transmitters of epidemic typhus, trench fever

C. Symptoms related to patients with scabies/lice:
1. Scabies: Papules and intense itching resulting in eczema (hands, fingers, wrists, axille, genitalia, inner aspect of thighs)
2. Lice: Itching, small white specks in hair (similar looking to dandruff)

D. Mode of transmission: Direct contact with affected patient

E. EMT safety
1. Avoid direct contact with affected patient
2. Follow-up
   a. Wash thoroughly after contact
   b. Discard used linens/clothing
   c. Wash personal clothing
   d. Be aware of signs and symptoms

Assessment of Childhood Diseases

A. Measles (red measles, rubeola, hard measles)
1. Definition: Measles virus
2. Symptoms: Fever, dusky or blotchy rash which usually starts on the face and spreads to the rest of the body
3. Incubation period: 8–13 days
4. Mode of transmission: By droplet or direct contact with secretions/urine
5. EMT safety
   a. Wear gloves/mask when in close contact with secretions/urine
   b. EMT may receive live vaccine

B. Mumps
1. Definition: Mumps virus
2. Symptoms: Fever, swelling and tenderness of salivary glands; inflammation of testes in adult males
3. Incubation period: 12-26 days
4. Mode of transmission: Direct contact with saliva of an infected person
5. EMT safety

a. Use disposable gloves
b. Good handwashing
c. May receive mumps vaccine

C. Chickenpox
1. Definition: Varicella zoster virus
2. Symptoms: Fever, skin eruptions that cover the entire body
3. Incubation period: 10-21 days
4. Mode of transmission: Through droplet/airborne secretions from infected person's respiratory tract
5. EMT safety
a. Use disposable mask/gloves
b. May receive VZIG (Verisicullar Immune Globulin)

Follow-Up

A. Follow-up
1. Notification
a. Notify hospital personnel of patient's history
b. Hospital will verify patient's disease
c. Hospital personnel (Infection Control Practitioner) will recommend follow up care for EMT

B. EMT personnel hygiene
1. Handwashing/use of handcleaning agents
2. Remove soiled clothing/clean

C. Vehicle cleaning routine
1. Blood spillage: wear disposable gloves; clean up blood with disposable linens; use cleaning agent (Clorox/bleach)
2. Needle and syringe disposal: dispose appropriately (Sharp's container)
3. Respiratory equipment: dispose or sterilize after each use
a. Disassemble equipment and place in cold liquid sterilization solution for 20 minutes
b. Air dry for at least 1 hour
4. Suction equipment
a. Disposable equipment should be bagged for incineration
b. Tubing/bottle should be cleaned; air dry
5. General cleaning: Use household bleach
a. Routine cleaning daily (especially to high patient contact areas—oxygen equipment, ECG monitor, suction equipment, stretcher, bench
b. Air vehicle with doors/windows open for 5 minutes daily
c. Properly dispose of soiled linens, needles, dressings, gloves

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Division 4: Medical

Section 9. Environmental Injuries

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in the section, the student must have successfully completed: Division 2: Preparatory Section 1–5 Division 4: Medical Sections 1–9 This section covers the etiology and management of a number of emergencies that result from physical exposure to elements that may be encountered in the external environment. These include hyperthermia, hypothermia, frostbite, near-drowning, exposure to ionizing radiations and diving emergencies. The EMT-P is prepared to recognize and manage these conditions by developing an understanding of their causative factors and underlying pathophysiologies and by applying this understanding in the field when presented with the specific clinical pictures associated with these emergencies.
Overview	I. Thermoregulation II. Hyperthermia III. Hypothermia IV. Frostbite V. Near-Drowning VI. Nuclear Radiation VII. Diving Emergencies
Objectives	At the completion of this section, the student will be able to: 4.9.1 Define steady-state metabolism and identify the oral and rectal temperatures associated with a metabolic steady state. 4.9.2 List the two terms associated with bodily temperature extremes. 4.9.3 List and define the function of two structures in the body's primary thermoregulatory mechanism. 4.9.4 List two mechanisms of thermal generation within the body and the basic mechanism associated with each. 4.9.5 Describe the body's compensatory mechanism for excess thermal gain. 4.9.6 Describe four ways in which the body dissipates heat into the external environment. 4.9.7 Describe the body's compensatory mechanism for excess thermal loss. 4.9.8 State three common forms of heat disorder. 4.9.9 Define the role of sodium in heat cramps. 4.9.10 List the signs and symptoms associated with heat cramps. 4.9.11 Describe the treatment of heat cramps. 4.9.12 Define the role of sodium in heat exhaustion. 4.9.13 List the signs and symptoms associated with heat exhaustion. 4.9.14 Describe the treatment of heat exhaustion. 4.9.15 List two environmental factors associated with heat stroke. 4.9.16 Describe the role of the body's primary thermoregulatory mechanism in heat stroke.

4.9.17 State the critical upper range temperature at which cellular deterioration begins.

4.9.18 Differentiate the following parameters among heat cramps, heat exhaustion and heat stroke:

a. Pathophysiology
b. Cramping
c. Mental status
d. Skin condition
e. Internal temperature
f. Pulse
g. Blood pressure

4.9.19 State the treatment modality that is common to heat cramps, heat exhaustion and heat stroke besides the ABC's of basic life support.

4.9.20 List predisposing factors and preventative measures associated with heat disorders.

4.9.21 Define fever (pyrexia) and identify the pathophysiological mechanisms causing the disorder.

4.9.22 Define hyperpyrexia and identify pathophysiological mechanisms.

4.9.23 State the field treatment of pyrexia.

4.9.24 State the causative factor associated with acute systemic hypothermia.

4.9.25 State the temperature range, signs and symptoms associated with mild systemic hypothermia.

4.9.26 State the temperature range, signs and symptoms associated with severe systemic hypothermia.

4.9.27 Describe the metabolic responses to both mild and severe systemic hypothermia and the implications of these responses to pharmacotherapy and defibrillation.

4.9.28 Discuss the treatment of hypothermia.

4.9.29 State conditions under which rewarming should be initiated in the field.

4.9.30 Define "afterdrop phenomenon" and its prognostic implications.

4.9.31 List two metabolic factors that may be associated with chronic hypothermia.

4.9.32 List individuals who are at greatest risk for hypothermia.

4.9.33 Differentiate between frostnip, superficial frostbite and deep frostbite.

4.9.34 State the steps in the field management of frostbite.

4.9.35 State the immersion rewarming temperature for frostbitten extremities and the rationale for this temperature.

4.9.36 State the importance of near-drowning as a leading cause of accidental death in the U.S.

4.9.37 Describe the usual physiologic sequence of events in a near-drowning episode.

4.9.38 Describe the pulmonary and systemic pathophysiology in near-drowning patients.

4.9.39 State the factors affecting survival times and probability of successful resuscitation in near-drowning patients.

4.9.40 Describe the management of the near-drowning patient.

4.9.41 Identify the common types and sources of ionizing radiation.
4.9.42 Identify sources of normal background radiation.
4.9.43 Describe the pathophysiology of ionizing radiation received over acute and/or chronic exposure.
4.9.44 Describe the signs, symptoms and management of the radiated patient.
4.9.45 Describe the relative risks to the paramedic in handling the radiated patient.
4.9.46 Describe the anatomy and physiology of breathing gas under pressure.
4.9.47 List the common medical problems associated with diving accidents.
4.9.48 Describe the various major physiologic factors which may predispose a diver to decompression sickness.
4.9.49 Describe the pathophysiology of decompression sickness.
4.9.50 Describe the signs, symptoms and management of decompression sickness.
4.9.51 Describe the pathophysiology of pulmonary overpressure accidents.
4.9.52 Describe the signs, symptoms and management of pneumomediastinum.
4.9.53 Describe the signs, symptoms and management of subcutaneous emphysema.
4.9.54 Describe the signs, symptoms and management of air embolism.

TOPIC	CONTENT OUTLINE
Thermo-Regulation	A. Steady state metabolism

A. Steady state metabolism
   1. Normal cellular metabolism functions within narrow temperature range
   2. Extrinsic thermal stressors (heat and cold) may exceed thermal compensatory mechanisms causing thermal disorders
      a. Hyperthermia
      b. Hypothermia
B. Thermoregulatory control mechanism
   1. Hypotholamus
      a. Central thermoreceptor
      b. Thermal controller
         i. Hypothalmic "pointer"
         ii. Negative feedback mechanism
   2. Peripheral thermoreceptors
      a. Afferent receptors in skin
      b. Afferent receptors in mucosa
C. Thermal generation
   1. Cellular metabolism
   2. Thermogenesis
D. Thermal gain
   1. Intrinsic sources
      a. Metabolic
      b. Thermogenetic
   2. Extrinsic (environmental) sources
      a. Thermal gradient
         i. Environmental matter is at different temperatures
         ii. Heat flows from higher temperature matter to lower temperature matter
      b. Factors affecting thermal gradient
         i. Ambient air temperature
         ii. Infrared radiation
         iii. Relative humidity
E. Thermal loss
   1. Radiation
   2. Conduction
   3. Convection
   4. Evaporation
   5. Respiration
F. Compensatory mechanisms
   1. Hyperthermic compensation
      a. Peripheral vasodilation
      b. Sweating
      c. Increased cardiac output
      d. Increased respiratory rate
   2. Hypothermic compensations

Glycolysis and ATP production produce intracellular heat.

Increase in basal metabolic rate by shivering.

See I,C, 1&2

Heat flows from higher temperature matter to lower temperature matter. Law of thermodynamics if ambient air temperature is higher than skin temperature than heat flows from air to skin.

Heat conducted from body in sweat which then evaporates. This mechanism is not effective if relative humidity is 75% or greater because sweat does not evaporate at $< 75\%$ r. h.

a. Peripheral vasodilation
b. Thermogenesis (shivering)

3. Metabolic response
a. Metabolic rate and heat production increased in hyperthermia
b. Metabolic rate and heat production decreased in hypothermia

Hyperthermia

A. Hyperthermia caused by external environment

1. Heat cramps
a. Pathophysiology
i. Hot environment induces profuse sweating
ii. Sodium is lost with sweat
iii. Lack of sodium causes muscle cramping
b. Assessment
i. History of profuse sweating in hot environment without sodium replacement
ii. Cramps of fingers, arms, legs, abdominal muscles
iii. Patient is mentally alert with hot, sweaty skin; tachycardia; normotensive; core temperature normal
c. Treatment
i. Remove patient from hot environment
ii. Increase fluid and sodium intake

2. Heat exhaustion
a. Pathophysiology
i. Hot environment induces salt/fluid loss due to sweating
ii. Excess salt/fluid loss causes related symptoms
b. Assessment
i. History of profuse sweating in hot environment without fluid and sodium replacement
ii. Weakness, vertigo, nausea, syncope, pallor, thirst
iii. Patient anxious or apathetic; profuse sweating; tachycardiac; blood pressure may be elevated or depressed; respiratory rate may be elevated or depressed; core temperature normal to 1 or 2 degrees high
c. Treatment
i. Remove patient from hot environment
ii. Replace fluid and sodium

3. Heat stroke
a. Pathophysiology
i. Hot humid environment without evaporation gradient makes cooling by sweating ineffective
ii. Core temperature rises, causing increased metabolism
iii. Fluid and electrolyte loss decreases blood volume
iv. Pyrexia causes generalized vasodilation leading to complete cardiovascular collapse
v. Pyrexia causes cellular necrosis

Stroker's cramps. Can be i L/hour

Sodium is essential for proper muscle function.

Relative humidity > 75%

Hypothalmic regulation is lost.

vi. Erythrocytic permeability is increased by heat; potassium leakage causes hyperkalemia

b. Assessment

i. History of exposure to hot, humid (>75%) environment

ii. Pyrexia

iii. Decreased mentation to coma; flushed or sweating skin; early tachycardia followed by bradycardia; hypotension with low or nil diastolic reading; early tachypnea followed by decreased respirations.

c. Treatment

i. Cool patient immediately

ii. Administer oxygen

iii. Establish 1-2 normal salines or 1-2 Ringer's IV; administer full flow

iv. Monitor ECG; do not use vasopressors

B. Hyperthermia caused by internal environment

1. Fever

a. Pathophysiology

i. Pathogen causes infection which stimulates production of pyrogens

ii. Pyrogens reset hypothalmic pointer to higher level

iii. Hypothalmic control increases metabolism to raise temperature to higher "thermostat" setting

iv. Hypothalmic pointer resets to normal level

b. Assessment

i. History of illness associated with fever

ii. Temperature elevated above 98.6 degrees F. oral/99.6 degrees F. rectal

c. Treatment

i. Underlying cause must be treated

ii. Fevers above 105 degrees F. should be actively cooled with tepid water

iii. Extreme febrile states may precipitate seizures/coma.

2. Hyperpyrexia

a. Pathophysiology unknown

b. Assessment

i. Acute onset of fever > 106 degrees F

ii. Within 24 hours post surgery

c. Treatment

i. Symptomatic treatment

ii. Condition is extremely rare and not seen in the field.

Hypothermia

A. Hypothermia caused by external environment

1. Acute systemic hypothermia

a. Pathophysiology

106 degrees F

Ice packs, cold bath, wet sheets and fan massage extremities to stimulate return of cooled peripheral blood

i. Heat loss to environment at a rate faster than the body can produce heat
ii. Drop in core temperature
iii. Metabolism slows down reducing heat production
iv. Eventual cell ischemia and necrosis result in death
v. May be gradual in onset or rapid

b. Typology
i. Mild—core temperature of 90-95 degrees F
ii. Severe—core temperature below 90 degrees F

c. Assessment
i. History of exposure to elements
ii. Rectal temperature 95 degrees F or lower
iii. Fatigue and mental confusion to coma; cold skin; shivering in mild cases

d. Treatment
i. Mild hypothermia
(a) Handle patient gently
(b) Insulate from cold
(c) Add heat to head, neck, chest and groin (respiratory warmers may also be used)
(d) Withhold alcohol, coffee and nicotine
(e) Warm fluids and sugar sources P.O. after uncontrolled shivering stops and patient exhibits evidence of rewarming

ii. Severe hypothermic with vital signs
(a) Handle patient gently
(b) Insulate from cold
(c) Add heat to head, neck, chest and groin (respiratory rewarmers may be used)
(d) N.P.O.
(e) Do **not** administer oxygen unless heated to > 99 degrees F.
(f) Establish D5W IV at 75 cc/hr.
(g) Monitor ECG
(h) Do not administer medications

iii. Severe hypothermia with absence of vital signs
(a) Assess pulse and respirations for 1–2 minutes
(b) If no pulse or respiration, start CPR
(c) Observe ECG rhythm if patient is in V-fib defibrillate once at 400 ws.
(d) Measure rectal core temperature
(e) Repeat defibrillation attempt only if core temperature is 85 degrees or greater
(f) If defibrillation is successful, administer lidocaine 1 mg/kg IV followed by .5 mg/kg IV in 15 minutes

Cool wet air as opposed to immersion in very cold water

Myocardium becomes extremely irritable at and below 85 degrees F V-fib may result. Pulse and respirations must be assessed for 1-2 minutes in unresponsive severely hypothermic patients

Medications are poorly metab- olized in hypometabolic states Administration of medication may cause them to be present in toxic levels upon rewarming

Mouth to mask. Do not use cold oxygen < 99.6 degrees F.

Shivering can mimic V-fib. Do not defibrillate asystole

Low reading thermometer must be used.

(g) Warm oxygen and intubation are appropriate for the pulse less/apneic hypothermic
(h) Pneumatic antishock garment may be used for hypovolemia
(i) Rewarming should not be attempted unless you are more than 15 minutes from a medical facility

iv. Patient movement in the severely hypothermic patient can stimulate the return of cool extremity blood and acids to the core resulting in an "afterdrop" core temperature decrease, and acidosis and ventricular fibrillation.

B. Metabolic factors in hypothermia
1. Hypothermia precipitated by underlying conditions
a. Pathophysiology
i. Hypothyroidism depresses metabolic heat-producing mechanisms
ii. Brain tumor, head injuries depress hypothalmic control
iii. Other conditions—M.I. diabetes, hypoglycemia, drugs, undernutrition, old age and other factors that contribute to metabolic and circulatory disorders can be predisposing factors in hypothermia
2. Assessment
a. History that includes precipitating factors
b. Additional assessment as Hypothermia, A., 1., c.
3. Treatment
a. As in Hypothermia, A., 1., d.

Frostbite

A. Environmentally induced freezing of tissues
B. Types
1. Superficial frostbite
a. Dermis
b. Shallow subcutaneous layers
2. Deep frostbite
a. Dermal and subdermal layers
b. Deep tissues
C. Pathophysiology
1. Cold stressor causes vasoconstriction in body part
a. Reduced circulation
b. Accelerated heat loss
2. Ice crystal formation in extra and intracellular fluid
a. Freezing sequelae
i. Micro and macro structural damage due to ice crystal growth
ii. Destructive biochemical changes
b. Eventual thawing sequelae
i. Circulatory deficiency
ii. Edema

iii. Anoxia/ischemia of tissues
iv. Tissue necrosis may result

D. Assessment
1. History of exposure to freezing environment
2. Appearance
a. Cold stressor initially causes reddened skin
b. Skin becomes mottled white or gray with continued cooling
c. Skin appears white or gray with full freezing
3. Frozen part will feel cold and hard
a. Some compliance may be felt beneath the frozen layer in superficial frostbite
b. Frozen part will be hard and non-compliant with deep frostbite
4. Functional deficit
a. Loss of sensation in frozen part
b. Loss of function in frozen part

F. Management
1. Do not thaw part if there is any possibility that it will be refrozen
2. Do not massage frozen part or rub with snow
3. Administer analgesia prior to thawing
4. Thaw frozen part by immersion rewarming in a 100-106 degree fahrenheit water bath
5. Cover thawed part with loosely applied dry, sterile dressings
6. Elevate thawed part
7. Do not puncture or drain blebs

Near-Drowning

A. Introduction
1. Approximately 8,000 deaths annually
2. Second leading cause of accidental death between ages 4–44
3. 85% of near-drowning victims are male
4. Two-thirds of victims do **not** know how to swim

B. Pathophysiology
1. Sequence of events
a. Breath-holding
b. Panic
c. Inhalation of water
i. Spasm of epiglottis and larynx occurs in 10% of cases, leading to "dry drowning"
ii. Water enters lower respiratory tract
d. Hypoxia and asphyxia
e. Loss of consciousness
f. Reflex swallowing
i. Gastric distension
ii. Increased risk of vomiting and aspiration
2. Fresh-water vs salt-water near-drownings
a. Only minor electrolyte changes in both

b. Fresh water causes decreased surfactant, increased airway resistance and possible hemodilution

c. Salt water causes extravasation of fluid into alveoli

3. Pulmonary pathophysiology secondary to near-drowning
   a. Intrapulmonary shunting
   b. Hypoxemia
   c. Respiratory and metabolic acidosis
      i. CO_2 retention
      ii. Anaerobic metabolism
4. Other factors
   a. Temperatures of water
      i. The colder the water, the longer the possible survival times and the greater the probability of successful resuscitation
      ii. Protective effects of rapid onset of cerebral hypothermia
      iii. Possible contribution of mammalian diving reflex
   b. Cleanliness of water
   c. Length of submersion
   e. Age of victim

C. Management of Near Drowning
1. General points
   a. Anyone submerged long enough (up to one hour) to be unconscious or to require artificial ventilation should be hospitalized
   b. There is no difference in treatment outcome between fresh-water and salt-water near-drownings
2. Remove the victim from the water as soon as possible
3. If there will be any delay in recovering the victim, a rescue swimmer should be used
   a. The rescue swimmer should initiate mouth-to-mouth resusciation **while the victim is still in the water**
   b. If the rescue swimmer is so trained, full CPR should be initiated **while the victim is still in the water.**
   c. In cold water (below 70 degrees F), rescue personnel should wear wet suits or other thermal protective clothing
   d. A safety line should be attached to the rescue swimmer
   e. Wild water rescue demands that personnel be specifically trained for that environment
4. Suspect a head or neck injury if there is suspicion of a fall or diving accident.
   a. Slide the patient **quickly** onto a backboard
   b. Remove quickly from the water
5. Examine the patient for airway patency, breathing and pulse
6. Begin CPR
7. Airway management
   a. Endotracheal or esophageal intubation
   b. Suction

Beyond 60 minutes, resuscitation unlikely. Children have longer survival times and greater probability of successful resuscitation.

High incidence of "secondary drowning" in these patients.

This technique is difficult and requires a flotation device (life vest) for the swimmer and a rescue line around the swim—for retrieval of and patient

c. 100% oxygen
d. Respiratory rewarming if available, if patient is hypothermic and transport is greater than 15 minutes
e. Heimlich maneuver contraindicated

8. IV D5W at 75 cc/hr
9. Defibrillation
   a. Non-hypothermic as per AHA-ACLS protocols
   b. Hypothermic as per subsection III. Hypothermia (III.A.1.d.iii.)
10. Pharmacotherapy
   a. Non-Hypothermic as per AHA-ACLS protocols
   b. Hypothermic as per subsection III. Hypothermia (III.A.1.d.iii.)
11. Resuscitation not indicated
   a. Evidence of putrefaction
   b. Immersion was known to be for a protracted length of time > 1 hour

Nuclear Radiation

A. Introduction
1. Atomic and nuclear structure
   a. Protons, neutrons and electrons
   b. Isotopes
2. Radioactivity
   a. Half-life
   b. Emission of particles and/or radiation.
3. Ionizing radiation
   a. Alpha particles
      i. Low energy—can only penerate skin a few cells deep
      ii. Can be stopped by clothing, paper or even a few inches of air
      iii. Can be harmful if inhaled or ingested
   b. Beta particles—electrons
      i. Slightly more penetrating energy than alpha particles
      ii. Can be harmful if inhaled or ingested
   c. Gamma rays and X-rays
      i. Rays of energy, not particles
      ii. Highly penetrating
      iii. Causes direct damage to tissues
      iv. Causes indirect damage by causing internal tissue to emit alpha and/or beta particles
   d. Neutrons
      i. High energy particles
      ii. Penetrate several inches of tissue
      iii. Cause direct tissue damage
      iv. Not normally a problem for paramedics in nuclear accidents because they are normally present only near a reactor core
4. Units of measurement
   a. Roentgen

Requires lead shielding for protection

b. Rads
c. Rems
5. Background radiation in the U.S.
  a. Natural sources external to the body
    i. From cosmic radiation
    ii. From terrestrial radionucleides
  b. Natural sources inside the body
    i. Elements found naturally in human tissues (K-40, C-14, RA-226, etc.)
  c. Total, natural sources
  d. Medical sources
    i. Diagnostic X rays
    ii. Radiotherapy and radiopharmaceuticals
  e. Subtotal for medical
  f. Atomic energy industry, laboratories
  g. Consumer products
  h. Radioactive fallout
  i. Subtotal for man-made, not medical
  j. Total, man-made sources
  k. Overall total

B. Pathophysiology of ionizing radiation
1. Radiation damages genetic material
  a. Cellular reproduction is impaired
  b. Rapidly reproducing tissue is most seriously affected
2. Exposure over long periods of time
  a. Damage is cumulative over a lifetime
  b. Decrease in number of white cells
  c. Impaired reproduction
    i. Sterility
    ii. Genetic defects in offspring
  d. Increased incidence of cancer
  e. Bone damage
3. Short-term exposure
  a. Dose dependent
    i. The greater the volume of body exposure, the greater the damage
    ii. The higher the dose, the greater the damage
  b. Acute radiation syndrome
    i. 150 rads—whole body
      (a) Usually asymptomatic.
    ii. 400 rads—whole body
      (a) Transient nausea and vomiting
      (b) Mild decrease in white cells.
    iii. 500–600 rads—whole body
      (a) Severe blood disorders

Millirad/year
50
50
50
150
75
15
90
1
2
4
7
97
247

(b) GI damage
(c) 50% mortality within 30 days
iv. 600–1500 rads—whole body
(a) Accelerated GI and blood disorders
(b) Death within 2 weeks
v. 2000 or more rads—whole body
(a) Severe CNS effects
(b) Death within a few hours

C. Management of radiation emergencies
1. Normal principles of emergency care
a. ABC's
b. Shock management
c. Trauma care
2. Externally radiated patient
a. No danger to paramedic
b. Normal care procedures for injuries other than radiation
3. Internally radiated patient
a. Ingested or inhaled radioactive material
b. No danger to paramedic
c. Normal care procedures
d. Collect body wastes
e. Use bag-mask or gas-powered resuscitator if artificial respiration required
f. If inhaled radiation, take a sample by swab or nasal passage
4. Externally contaminated patients
a. Liquids, dirt particles or radioactive smoke particles.
b. Use normal emergency care procedures.
c. Decontamination of patient required.
d. Decontamination of paramedic required after emergency care is completed.
5. Patient with open, contaminated wounds
a. Normal emergency care procedures.
b. Avoid cross-contamination of wounds

Diving Emergencies

A. General physiology
1. Breathing of gas under pressure (SCUBA)
2. Dissolution of gases in blood and tissue upon descent
3. Release of gases upon ascent
a. Circulatory system
b. Tissues

B. General Assessment
1. Time relationship of signs and symptoms
a. Before surfacing
b. During surfacing
c. After surfacing

Henry's Law.

2. Type of breathing apparatus
3. Type of hypothermia protective garment
   a. Wet suit
   b. Dry suit
4. Dive parameters
   a. Depth of dives
   b. Duration of dives
   c. Number of dives
   d. Type of ascent
      i. Controlled
      ii. Panic
5. Previous medical diseases
6. Previous decompression illness
7. Ascents to altitude (aircraft) following dives
8. Medications

C. Decompession sickness
1. Pathophysiology
   a. Dissolution of inert gas(es) from tissues
      i. Intravascular bubbles
      ii. Extravascular bubbles
   b. Effects of bubbles
      i. Direct
         (a) Intravascular: Decrease in blood flow leading to ischemia or infarct
         (b) Extravascular: Tissue displacement, pressure on neutral tissue
         (c) Audiovestibular
      ii. Indirect
         (a) Surface of air emboli initiate platelet aggregation and intravascular coagulation
         (b) Extravascular: Plasma loss leading to edema and hemoconcentration and hypocolemia
         (c) Electrolyte imbalances
         (d) Release of lipid emboli
   c. Complications
      i. Cardiovascular and respiratory effects
         (a) Tachypnea
         (b) Pulmonary and myocardial emboli
      ii. Neurological effects
         (a) Mechanical restriction in epidural vertebral venous system
         (b) Cerebral emboli
         (c) Spinal emboli
2. Predisposal factors
   a. Dehydration

- b. Exercise both at depth and during decompression
- c. Gas partial pressure
- d. Obesity
- e. Local injury or trauma
- f. Thermal
- g. Alcoholism
- h. Age
- i. Previous history of decompression sickness (DCS)
- j. Rapid change of gases (light to dense)
- k. Compression arthralgia
- l. Stress
- m. Equipment effects

3. Signs and symptoms
   - a. Type I
     - i. Localized musculoskeletal pain, particularly in the joints
     - ii. Skin changes—puritis erythema, spotted pallor or cyanosis, pitting edema
   - b. Type II
     - i. Any of the above (See Type I) plus any one or more of the following:
     - ii. Paresthesis
     - iii. Dizziness or vertigo
     - iv. Nausea
     - v. Auditory disturbances
     - vi. Vestibular disturbances
     - vii. Paralysis
     - viii. Headache
     - ix. Other—DCS also called "Great Imitator"
     - x. Dyspnea and chest pain "chokes"
     - xi. Loss of consciousness
     - xii. Hemoptysis
4. Management
   - a. ABC's
   - b. Oxygen by non-rebreathing mask at 12 liters/min
   - c. IV fluids for fluid replacement
     - i. Ringer's lactate
     - ii. Normal saline
   - d. Medications
     - i. Dexamethasone, IV
     - ii. Heparin
     - iii. Dextran
     - iv. Valium
   - e. Frequent monitoring of vital signs and sequential neurological assessments
   - f. Transport to recompression chamber ASAP

Under direction of physician familiar with diving medicine.

i. If air transportation is used, low altitude flight must be maintained

D. Pulmonary overpressure accidents
  1. Physiology
    a. Causes
      i. Rapid ascent
      ii. Breath holding on ascent
      iii. Disease etiology—bullae, local gas trapping
    b. Gas expansion on ascent
      i. Rupture of alveolar membranes
        (a) Hemorrhage
        (b) Reduced O_2 and CO_2 transport
        (c) Capillary and alveolar inflammation
      ii. Air escape into pulmonary and then into systemic circulation, leading to air embolism
        (a) Emboli from lungs to heart
        (b) Emboli from heart to brain and other organs
        (c) Ischemia and infarction
      iii. Pneumothorax and tension pneumothorax
      iv. Pneumomediastinum
      v. Subcutaneous emphysema
  2. Air embolism
    a. Signs and symptoms
      i. Onset usually rapid and dramatic
      ii. Sharp, tearing pain
      iii. Paralysis, frequently hemiplegic
      iv. Cardiac and/or pulmonary collapse
      v. Unequal pupils
      vi. Wide pulse pressure
      vii. Hemostasis
    b. Management
      i. ABC's
      ii. O_2 by non-breathing mask (a) liters/min.
      iii. Left lateral Trendelenburg position
      iv. Frequent monitoring of vital signs and sequential neurological assessments
      v. IV fluids at keep-open rate
      vi. Decadron, IV on order of physician
      vii. Transport to recompression chamber ASAP
  3. Pneumothorax and tension. (See sections on pulmonary diseases)
  4. Pneumomediastinum
    a. Rupture with release of gas through visceral pleura into mediastinum and/or pericardial sac
    b. Signs and symptoms
      i. Substernal pain

If air transportation is used, low altitude must be maintained

ii. Change in voice
iii. Irregular pulse as asystole
iv. Reduced blood pressure and/or narrow pulse pressure
v. Mild cyanosis, if any
vi. Abnormal heart sounds

c. Management
i. Treatment ranges from observation to recompression to relieving acute symptoms
ii. Oxygen
iii. Lactated Ringers or normal saline
iv. Transport to hospital

Division 4: Medical

Section 10. Geriatrics/Gerontology

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment Sections 1–7 Division 2: Preparatory Sections 1–5 Division 3: Trauma Sections 1–2 Division 4: Medical Sections 1–9 This section is specifically related to the geriatric patient. Nationwide, over 30% of all patients transported by ambulance are over age 65. The organ function of these elderly patients may be significantly reduced as a result of normal aging and chronic illness, and symptoms masked by various psychiatric/neurological disorders. Any delay in recognizing health care needs and providing care may have devastating and irreversible consequences.
Overview	I. Introduction II. Anatomy and Physiology III. Assessment of the Geriatric Patient IV. Pathophysiology and Management V. Pharmacology in Geriatrics VI. Geriatrics Abuse/Neglect
Objectives	At the completion of this section, the student will be able to: 4.10.1 Discuss statistics on aging, including increased life expectancy, percent of population over 65 years old, and leading causes of death in geriatric population. 4.10.2 Discuss at least 6 factors which contribute to the elderly being at high risk for increased medical care. 4.10.3 Discuss general decline in organ systems, including: a. Respiratory system b. Cardiovascular system c. Renal system d. Nervous system e. Musculoskeletal system f. Gastrointestinal system g. Response to emotions/stress. 4.10.4 List at least 12 diseases/disorders common in the elderly. 4.10.5 List 4 factors that complicate clinical evaluation of the geriatric patient. 4.10.6 As related to the geriatric patient's history, discuss the following considerations: a. Common complaints of the geriatric patient (not specific to any one disorder). b. 4 considerations which may mask the patient's ability to communicate significant signs/symptoms.

4.10.7 As related to the physical examination of a geriatric patient, discuss the following considerations:

a. Fatigue

b. Excessive clothing

c. Disguised signs/symptoms.

4.10.8 Define syncope.

4.10.9 Define pre-syncope.

4.10.10 Discuss the pathophysiology of syncope.

4.10.11 Discuss the following types of syncope:

a. Vasodepressor syncope

b. Orthostatic syncope

c. Cardiac syncope.

4.10.12 Define seizure and discuss the progression of events.

4.10.13 Define vertigo and discuss the progression of events.

4.10.14 Define dementia:

a. Discuss the etiologies of chronic senile dementia

b. Discuss the etiologies of acute organic brain syndrome.

NOTE: Important to distinguish between acute and chronic dementia.

4.10.15 Define delirium.

4.10.16 Define Alzheimer's Disease.

4.10.17 Discuss 6 signs/symptoms of Alzheimer's Disease and the progression of events.

4.10.18 Define:

a. Stroke

b. TIA

4.10.19 Discuss 4 causes of other focal neurological deficits.

4.10.20 List 4 drugs which may produce adverse reactions in the geriatric patient and that may culminate in cerebral dysfunction.

4.10.21 Discuss the general management of neurological disorders.

Refer to Cardiovascular Section

4.10.22 Discuss signs/symptoms of cardiovascular conditions, specific to the geriatric patient.

4.10.23 Discuss syncope as related to cardiovascular conditions:

a. Vasodepressor

b. Orthostatic

c. Vasovagal

d. Cardiac

4.10.24 Discuss congestive heart failure as related to the elderly.

4.10.25 List 2 causes of dysrhythmias in the elderly.

Discuss the following as related to the geriatric patient:

4.10.26 Aortic dissection.

4.10.27 Abdominal aortic aneurysm.

4.10.28 Peripheral arterial and venous conditions.

4.10.29 General management. (See also Cardiovascular Section)

a. As related to general management, list 4 conditions which may cause the physician to alter cardiac drug therapy
b. Discuss precautions as related to administration of fluids.

Refer to Respiratory Section for pathophysiology and management.

4.10.30 As related to the elderly patient, list 6 conditions that may be associated with respiratory distress.
4.10.31 Discuss findings which may be specific to the geriatric patient suffering from pulmonary embolism.
4.10.32 Discuss findings that may be specific to the geriatric patient suffering from respiratory tract infection.
4.10.33 Discuss chronic bronchitis with reference to the geriatric.
4.10.34 Discuss management of respiratory distress.
4.10.35 Discuss the pathophysiology of carcinoma, in general.
4.10.36 List 4 kinds of cancer directly attributable to high mortality rate.
4.10.37 List 6 signs/symptoms of carcinoma.
4.10.38 Discuss general management of the cancer patient.
4.10.39 Discuss GI bleed as related to geriatric patients.
4.10.40 Discuss 2 causes of upper intestinal hemorrhage.
4.10.41 Discuss 4 causes of massive lower intestinal hemorrhage.
4.10.42 Discuss 6 significant signs of blood loss.
4.10.43 Discuss cholecystitis/biliary disease as related to the elderly patient.
4.10.44 Discuss small bowel obstruction and 2 causes.
4.10.45 Discuss large bowel obstruction, including:
a. Main cause
b. Main signs/symptoms
4.10.46 Discuss diverticulitis, including signs/symptoms.
4.10.47 Discuss appendicitis, including:
a. Signs/symptoms
b. Complications
4.10.48 Discuss pancreatitis, including common cause and symptoms.
4.10.49 Discuss peptic ulcer disease/perforation, including:
a. Common cause
b. Signs/symptoms
4.10.50 As related to the elderly, list related signs and symptoms as associated with gastrointestinal disorders.
4.10.51 Discuss the general management of critical GI bleed in the elderly.
4.10.52 Refer to Environmental Emergencies Section. Discuss tolerance of temperatures.
4.10.53 Discuss 6 predisposing factors for hypothermia common in geriatric patients.
4.10.54 Discuss 3 predisposing factors for hyperthermia common in geriatric patients.
4.10.55 Discuss general management of environmental emergencies.
4.10.56 List at least 6 reasons that the elderly are more prone to falls.
4.10.57 List 3 reasons that the elderly are more prone to head injuries.

4.10.58 List 3 reasons that the elderly are more prone tp cervical spine injuries.

4.10.59 Prehospital priorities of care for trauma in elderly are similar to those for all trauma patients; list 2 considerations.

4.10.60 Discuss trauma management considerations in the elderly for the following systems:

a. Cardiovascular system
b. Respiratory system
c. Renal system

4.10.61 Discuss positioning, immobilization and packaging of the elderly trauma patient (with consideration of physical deformities).

4.10.62 List at least 6 factors which contribute to adverse drug reactions in the elderly.

4.10.63 List at least 10 drugs which commonly cause toxicity in the geriatric patient.

4.10.64 As related to digitalis intoxication, discuss:

a. Symptoms
b. Drug interactions
c. Management

4.10.65 As related to diuretic use, discuss:

a. Symptoms of adverse reaction
b. Drug interaction
c. Management.

4.10.66 As related to antihypertensive drug use, discuss:

a. Symptoms of adverse reaction
b. Drug interaction
c. Management.

4.10.67 As related to antiarrhythmic drug use, discuss:

a. Symptoms of adverse reaction
b. Drug interaction
c. Management.

4.10.68 As related to psychotropic drug use, discuss:

a. Symptoms of adverse reaction
b. Drug interaction
c. Management.

4.10.69 As related to antidepressant use, discuss:

a. Symptoms of adverse reaction
b. Drug interaction
c. Management.

4.10.70 As related to salicylate use, discuss:

a. Symptoms of adverse reaction
b. Drug interaction
c. Management.

4.10.71 Discuss geriatric abuse and factors which precipitate abuse.

4.10.72 Discuss signs and symptoms as related to geriatric abuse.

4.10.73 Discuss the profile of a potential geriatric abuser.

4.10.74 Discuss at least 2 considerations as related to obtaining a history from the abused geriatric.

4.10.75 Discuss, in general gerontology program services, including objectives of the program.

4.10.76 Discuss the following components of a gerontology program:

a. In-home assessment

b. Family conference.

TOPIC	CONTENT OUTLINE
Introduction	A. Statistics on aging

1. With increased mean survival of older persons, declining birth rate, and absence of major wars or other catastrophies, the fraction of the population over 65 years grows each year
2. Percent of population 65 years and over increased from 3% in 1900 to 10% in 1970
3. Life expectancy: 48% increase for all persons in average number of years of life at birth; 49 years in 1900; almost 73 years in 1976
4. Leading causes of death in geriatric population:
    a. Heart disease
    b. Cancer
    c. Stroke

Anatomy and Physiology

A. General decline in organ systems

1. Respiratory system (from age 30 to 80):
    a. Vital capacity decreases 50%
    b. Maximum breathing capacity decreases 60%
    c. Maximal work rate and maximum oxygen uptake decreases 70%
2. Cardiovascular system:
    a. Stroke volume declines
    b. Heart contraction slows
    c. Heart's conduction system degenerates
    d. Left ventricle hypertrophies up to 25%
    e. Fibroses increases throughout heart and peripheral vascular system
3. Renal system:
    a. 30–40% decrease in number of functioning nephrons
    b. Renal blood flow decreases 50%
4. Nervous system:
    a. As much as 45% brain cell loss in certain cortical areas (6–7% reduction in brain weight)
    b. Decreased cerebral blood flow/increased resistance
    c. Decreased cerebral oxygen consumption rate
    d. 15% reduction in nerve conduction velocity
5. Musculoskeletal system
    a. Decrease in height of 2–3 inches due to narrowing of vertebral disks
    b. Posture changes—slight flexion of knee and hip joints, spine deterioration
    c. Decrease in total skeletal muscle weight
    d. Widening and weakening of certain bones
6. Gastrointestinal (GI) system
    a. Volume of saliva decreased 1/3 and gastric secretions diminish 1/5 volume of youth
    b. Structural changes occur throughout GI tract
    c. Esophageal motility decreases

See applicable sections for major body systems.

B. General changes
   1. Total body water decreased
   2. Total body fat decreases 15%–30%
   3. Progressive loss of capacity of homeostatic systems to adjust following displacement by illness or injury
   4. No evidence of decline in metabolic activity, but total number of body cells decreased 30% by age 65

Assessment of the Geriatric Patient

A. Factors that complicate clinical evaluation
   1. Difficult to separate effects of aging from consequences of disease
      a. Chief complaint may be trivial
      b. Patient may fail to report important symptoms
      c. EMT may fail to note important symptoms
   2. Geriatric patient likely to suffer from more than one disease at a time
      a. Chronic problems may make assessment for acute problems difficult
      b. Symptoms of chronic illness may be confused with symptoms of acute problem
   3. Aging changes individual's response to illness or injury
      a. Pain may be diminished or absent; patient or EMT may underestimate severity of condition
      b. Temperature regulated mechanism may be depressed
         i. Minimal or absent fever with severe infection
         ii. Prone to environmental thermal syndromes
      c. Social and emotional factors may have greater impact on health than in any other age group
   4. Communication problems are common in aged
      a. Diminished sight: glaucoma, cataracts, blindness
      b. Diminished hearing
      c. Diminished mental facilities
      d. Depression

B. History taking
   1. Common complaints of the geriatric patient (not specific to any one disorder)
      a. Fatigue and weakness
      b. Dizziness/vertigo/syncope
      c. Falls
      d. Headache
      e. Insomnia
      f. Dysphagia
      g. Loss of appetite
      h. Inability to void
      i. Constipation/diarrhea
   2. Must remember to probe for significant symptoms as chief complaint may be trivial and patient may not volunteer significant information
   3. Dealing with communication problems in history taking:

i.e., constipation

Example: silent MI

a. Diminished sight:
   i. Increased anxiety in blind—inability to exert control over situation compounded by inability to see surroundings
   ii. Talk to patient calmly
   iii. Position yourself so patient can best see you
b. Diminished hearing or deafness:
   i. Can make obtaining history virtually impossible if patient cannot hear questions
   ii. Don't assume patient is deaf without inquiring
   iii. Don't shout—distorts sounds if patient has some hearing (and doesn't help if patient is deaf)
   iv. Write notes if necessary
   v. If patient can lip read, speak slowly and directly towards patient
   vi. Whenever possible, verify history with reliable friend or relative or seek assistance from these individuals to communicate with patient
c. Diminished mental status:
   i. Patient often confused and unable to remember detail
   ii. Noise of radios, ECG, strange voices add confusion—attempt to diminish and/or explain
   iii. Both senility and acute organic brain syndrome may manifest themselves similarly: delirium, confusion, distractibility, restlessness, excitement, or hostility
   iv. Attempt to determine if patient's mental status represents a significant change from normal
   v. Don't assume confused, disoriented patient is "just senile" and fail to assess for underlying physiological abnormality
   vi. Alcoholism is more common in elderly than generally realized—may further hamper history taking
d. Depression
   i. Common—may mimic senility/organic brain syndrome
   ii. May inhibit patient's cooperation
   iii. Patient may be malnourished, dehydrated, overdosed, contemplating suicide, or simply imagining physical ailments for attention
   iv. Question regarding drug ingestion and suicidal thoughts—suicide is fourth leading cause of death among elderly in U.S.

4. Past medical history
   a. May be complicated—try to determine what is significant
   b. Obtaining medication history is important
      i. Usually on multiple drugs
      ii. Medication errors and noncompliance are common
      iii. Find all drugs and take to hospital with patient
      iv. Try to establish old vs current drugs—including over-the-counter medications

5. Information from environment
   a. Attempt to verify patient history with reliable family/neighbors (less offensive if done out of patient's presence
   b. Observe surroundings for indication of patient's ability to care for self
   c. Observe for evidence of drug/alcohol ingestion
   d. Look for medic alert tags, Vial of Life, etc.
   e. Observe for signs of violence/abuse

C. Physical exam considerations in the geriatric patient
   1. Patient may be easily fatigable
   2. Patient commonly wears excessive amounts of clothing—may hamper examination
   3. Explain actions clearly before initiating exam in patient with diminished sight
   4. Be aware that patient may minimize or deny symptoms due to fear of being bedridden, institutionalized, or losing self-sufficiency
   5. Peripheral pulses may be difficult to evaluate
   6. Must distinguish symptoms of chronic disease from acute, immediate problems; examples:
      a. Elderly may have nonpathological rales
      b. Loss of skin elasticity and mouth breathing may give false appearance of dehydration
      c. Dependent edema may be secondary to varicose veins and inactivity/position vs. congestive heart failure (CHF)
   7. Need experience and practice to differentiate acute from chronic physical findings

Pathophysiology and Management

A. Trauma in elderly
   1. Biologically more at risk from trauma, especially falls
   2. Contributing factors:
      a. Slower reflexes
      b. Failing eyesight and hearing
      c. Arthritis
      d. Blood vessels less elastic, more subject to tearing
      e. Tissues and bones more fragile
   3. At high risk for trauma from criminal assault
   4. Head injury:
      a. More prone to head injury, even from relatively minor trauma
      b. Difference in proportion between brain and skull
      c. Signs of brain compression may develop more slowly, sometimes over days or weeks—patient may have forgotten he was injured
   5. Cervical spine injury associated with cervical spondylosis
      a. Elderly often have significant degree of this disease
      b. Arthritic changes of spine gradually compress existing nerve roots to arms or even spinal cord
      c. If injury occurs to cervical spine, spinal cord is more likely to be injured

See Trauma Section.

d. Sudden neck movement, even without fracture, may cause spinal cord injury; patient may have less than usual amount of pain in absence of fracture

7. Trauma management considerations in the geriatric patient
   a. Priorities of care are similar to those for all trauma patients, but require consideration of:
      i. Organ system decline, especially cardiopulmonary and renal
      ii. Concomitant chronic illness
   b. Cardiovascular system
      i. Recent or past myocardial infarctions (MI) contribute to risk of dysrhythmias, CHF in trauma patient
      ii. There may be decreased response of the heart to hypovolemia in terms of adjustment of rate and stroke volume
      iii. May require higher arterial pressures than usual for perfusion of vital organs due to increased peripheral vascular resistance and hypertension
      iv. Care must be taken in IV fluid administration due to decreased myocardial reserve; conversely, hypovolemia and hypotension are poorly tolerated
      v. Response to drugs may be altered
   c. Respiratory system
      i. Physical changes decrease chest cage movement and vital capacity
      ii. Higher PO_2 required with each passing decade
      iii. All organs have less tolerance to anoxia
      iv. Chronic obstruction pulmonary disease (COPD) common—airway management and ventilation must be carefully attuned to provide appropriate oxygenation and CO_2 removal
         (a) Danger of resultant alkalosis with positive pressure ventilation (PPV)
         (b) Danger of rupture of bullae with PPV
   d. Renal system
      i. Decrease in ability of kidney to maintain normal acid/base balance and to compensate for fluid changes
      ii. Any pre-existing renal disease further decreases kidney's ability to compensate
      iii. Decrease in renal function (along with decreased cardiac reserve) places the injured elderly patient at risk for fluid overload and pulmonary edema secondary to IV therapy
8. Positioning, immobilization, and packaging of elderly trauma patient may have to be modified to accomodate physical deformities (arthritis, spinal abnormalities, frozen limbs)

B. Respiratory distress in the generic patient
   1. Etiologies
      a. Pulmonary embolism
      b. Silent MI—dyspnea may be primary symptom

50% nitrous oxide may be more of a depressent in elderly patient than in young patient.

See Respiratory and CV Section.

See CV Section.

c. Pulmonary edema
d. Asthma/COPD
e. Respiratory infections—classic symptoms may not be present early
f. Carcinoma

2. Management
   a. Techniques identical for all age groups

C. Cardiovascular conditions in geriatric patients
1. Generally more common in elderly due to progressive atheroscolerotic disease
2. Syncope: Carries higher incidence of morbidity in patients over 60 years
   a. Vasodepressor (common faint)
   b. Orthostatic
   c. Vasovagal
   d. Cardiac
      i. Primary symptoms in silent MI
      ii. Stokes-Adams attack
      iii. Tachydysrhythmias
      iv. Sick sinus syndrome
3. Myocardial infarction
   a. Elderly patients less likely to present with classic symptoms
   b. Atypical presenting symptoms include: syncope, dyspnea, abdominal or epigastric pain, fatigue
4. Stroke
   a. Occlusive stroke statistically more common in elderly and relatively uncommon in younger individuals
   b. At higher risk because of atherosclerosis, hypertension, immobility, limb paralysis, CHF, and atrial fibrillation
   c. Transient Ischemic Attacks (TIA) common—1/3 of patients will have a major, permanent stroke once TIA's begin
   d. TIA is a common cause of syncope in elderly
5. Congestive heart failure—acute and chronic
6. Dysrhythmias
   a. Degeneration of conduction system
   b. Rate extremes not well tolerated
7. Aortic dissection
8. Abdominal aortic aneurysm
9. Peripheral arterial and venous conditions
10. General management
    a. Management techniques similar for all age groups
    b. CHF, renal disease, liver disease, and metabolic problems of the elderly may lead physician to modify drug therapy/dosages
    c. Use special care in administering IV fluids

D. Neurologic disorders in the geriatric patient
1. Coma

INSTRUCTOR'S NOTES

See CV Section.

See Respiratory Section.

See Respiratory and Cardiovascular Section.

Heart block.

See Cardiovascular section.

See Nervous System Section.

2. Stroke
   a. Occlusive stroke statistically more common in elderly and relatively uncommon in younger individuals
   b. At higher risk because of atherosclerosis, hypertension, immobility, limb paralysis, CHF, and atrial fibrillation
   c. Transient Ischemic Attacks (TIA) common—1/3 of patients will have major, permanent stroke once TIA's begin
   d. TIA is a common cause of syncope in elderly
3. Seizures
   a. May be mistaken for stroke in elderly; conversely, first-time seizure may result from previous stroke
   b. Are not all major motor—may be more subtle
   c. Consider vast number of etiologies including:
      i. Seizure disorder
      ii. Recent or past head trauma
      iii. Mass lesion
      iv. Alcoholic withdrawal
      v. Diabetic hypoglycemia
      vi. Stroke
4. Dizziness
   a. Common complaint of elderly—may refer to syncope, presyncope, lightheadedness, vertigo, etc.
   b. Many major and minor causes of dizziness, including impairment of any of the systems that orient the body to its environment
      i. Visual impulse impairment
      ii. Inner ear impairment
      iii. Peripheral sensory impairment
      iv. Central nerve impairment
   c. Common causes are alcohol and other drug effects
   d. Vertigo: A specific sensation of motion perceived by patient as spinning or whirling as opposed to simple dizziness
      i. Accompanied by sweating, pallor, nausea, vomiting
      ii. Ménière's disease causes classic vertigo attacks
   e. May be difficult to distinguish between dizziness, syncope, and pre-syncope
5. Senile dementia
   a. The process of mental and physical deterioration that occurs with aging
      i. Other related conditions include "senility,""senescence," "dementia," "organic brain syndrome"
      ii. Pathologically and clinically all alike
   b. Loss of neurons begins slowly in the 40's and 50's and continues at progressive rate into the later decades
   c. Etiologies of chronic organic senile dementia:
      i. Aging
      ii. Neurologic diseases

More likely to affect partially paralyzed limb.

iii. Hereditary diseases

d. Etiologies of acute organic brain syndrome:

i. Subdural hematoma

ii. Other mass lesions—tumors

iii. Drug or alcohol intoxication

iv. CNS infections

v. Nutritional deficiencies

vi. Electrolyte abnormalities

vii. Cardiac failure

viii. Excessive drug doses or interactions

e. Important to distinguish between acute and chronic dementia

5. General management of neurological disorders

a. Management techniques similar for all age groups

b. Determine duration of confused, dangerous, or violent behavior to distinguish between acute and chronic events

c. Historical information may help determine type of syncope or distinguish from seizures, Stokes-Adams, etc.

i. Position of patient at time of attack

ii. Associated symptoms

iii. Duration of attack

iv. Vital signs, including evaluation of orthostatic changes

d. Emotional disorders are common due to isolation, loneliness, loss of self-dependence, loss of strength, and fear of the future—may present as physical disorders

E. Psychiatric disorders in the geriatric patient

1. Psychiatric problems are common

a. Less schizophrenia and alcoholism in the elderly

b. More dementia and depression

2. Simple classification of psychiatric disorders of old age:

a. Organic brain syndrome

b. Affective disorders, particularly depression

c. Neurotic disorders: anxiety, hypochondriasis, phobia

d. Personality disorders

e. Paranoid disorders

f. Alcoholism

3. Individuals over 65 account for 25% of all suicides reported

4. Management techniques are similar for all age groups

F. Environmental emergencies

1. Constant high or low temperatures poorly tolerated by elderly

2. Predisposing factors for hypothermia:

a. Accidental exposure

b. Drugs that interfere with heat production

c. CNS disorders

d. Endocrine disorders

e. Chronic illness, debilitation

Alzheimer's, Huntington's

Refer to Nervous Section.

Conversely, physical problems may present as psychological disorders in elderly

See Psychiatric Emergencies Section.

f. Low/fixed income
3. Predisposing factors for hyperthermia:
    a. Decreased functioning of thermoregulatory center
    b. Commonly prescribed medications which inhibit sweating
    c. Low/fixed income
4. Management techniques similar for all age groups

G. Gastrointestinal disorders in the geriatric patient
1. GI bleed most common problem
2. Major causes of GI hemorrhage:
    a. Upper GI
        i. Peptic ulcer gastritis
        ii. Esophageal varices
        iii. Mallory-Weiss syndrome
    b. Lower GI hemorrhage (less common than upper)
        i. Diverticula (70% of life-threatening lower bleeds)
        ii. Tumors
        iii. Ischemic colitis
        iv. A-V malformations
3. Signs of significant blood loss:
    a. "Coffee ground" emisis or stool
    b. Melena
    c. Frankly bloody emesis or stool
    d. Orthostatic hypotension
    e. Pulse >100 (unless on beta blockers)
    f. Confusion
4. Complications of GI bleeding in the elderly
    a. Recent increase in angina symptoms
    b. CHF
    c. Weakness
    d. Dyspnea
5. General management of GI bleed
    a. Hypotension is less well tolerated
    b. Administer high flow oxygen
    c. Pneumatic anti-shock garment
    d. IV volume replacement—crystalloid
    e. No delay in transport if patient decompensating

H. Pharmacology in geriatrics—general considerations
1. Factors contributing to adverse drug reactions
    a. Drug interactions common
        i. Elderly use 25% of all prescribed and over-the-counter drugs sold in the U.S.
        ii. Reactions may be more easily missed in elderly due to overall increase in medical disorders or ascribing symptoms to aging in general

i.e., phenothiazines.

See environmental Emergencies section.

Low hemoglobin precipitates.

b. Absorption, distribution, metabolism, and excretion of drugs altered
    i. Cumulative effects with prolonged use of some drugs
    ii. Decreased responsiveness of beta adrenergic system to beta blockers may cause exaggerated response
c. Compensatory mechanisms to help buffer against side effects less effective
d. Overdose may be accidential (confusion, vision impairment, self selection of drugs, forgetfulness) or intentional
e. Underdose also a common problem
    i. Account for about half of all medication errors
    ii. Forgetfulness
    iii. Limited income

2. Approximately 30% of all hospital admissions are related to drug-induced illnesses; more than 30% of these in people 60 years or older
3. Drugs commonly causing toxicity in elderly:
    a. Digitalis (leading cause)
    b. Antiparkinsonian drugs
    c. Diuretics
    d. Anticoagulants
    e. Lidocaine
        i. Significant to prehospital care
        ii. Significantly increased plasma half-life
    f. Quinidine
    g. Propranolo
    h. Theophylline
    i. Narcotic analgesics and acetaminophen
    j. Sedative and hypnotic drugs
    k. Phenothiazines
    l. Tricyclic antidepressants

Geriatric Abuse/ Neglect

A. Definition syndrome in which elderly persons have received serious physical (or psychological) injury from their children or their care providers
    1. Elderly abuse knows no socio-economic bounds
    2. Older person is no longer able to be totally independent; family has difficulty upholding commitment to care of elder parent

B. Signs and symptoms of geriatric abuse
    1. Average age is 80
    2. Patient may have chronic (multiple) diseases/disorders (congestive heart failure, cancer, incontinence, heart disease)
    3. Unexplained trauma is primary finding

C. Profile of potential geriatric abuser
    1. Potential abuser is stressed—
        a. Sleep deprivation
        b. Marital discord

INSTRUCTOR'S NOTES

Valium, Dalmane.

Check to see that history of fall is consistent with patient complaint.

c. Work related, etc.

2. Life may be in disarray; as patient deteriorates, abuse may be outcome

D. Obtain complete patient and family history; particularly note any inconsistencies

INSTRUCTOR'S NOTES

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Division 4: Medical

Section 11. Pediatrics

TOPIC	CONTENT OUTLINE

Introduction

Prior to participating in this section, the student must have successfully completed:

Division 1: PreHospital Environment
All sections

Division 2: Preparatory
All sections

The ill or injured child presents special problems for health care providers. This section will focus on special considerations for the pediatric patient and on processes and problems specific to this special age group. Few problems encountered by the EMT-P pose the same degree of stress and anxiety as the pediatric emergency. Relativelyinfrequent exposure to these cases and therefore infrequent opportunity to practice assessment and management skills is a major source of anxiety. It is therefore important that the EMT-P frequently review the management of these problems as well as practice the skills essential for rapid and effective intervention. Pediatric equipment and medications should be available and stored separately for ease of patient management.

The EMT-P must be particularly observant in caring for the pediatric patient. Margin for error is slight in managing the airway, respiratory and circulatory systems in these patients. The EMT-P must be clinically astute in determining when intervention should be undertaken in the field and when rapid transport is the most wise alternative.

Overview

I. Approach to the Pediatric Patient
II. Developmental Stages
III. Problems Specific to the Pediatric Patient
   A. Sudden Infant Death Syndrome
   B. Child Abuse and Neglect
   C. Seizures
   D. Dehydration
   E. Infectious Processes
   F. Reyes Syndrome
   G. Respiratory Emergencies
      1. Obstructed Airway
      2. Bronchiolitis
      3. Croup
      4. Epiglottitis
IV. Special Techniques for the Pediatric Patient
   A. CPR in Children
   B. Defibrillation
   C. Endotracheal Intubation
   D. Intravenous Techniques

Objectives

Upon the completion of this section, the student will be able to:

4.11.1 Define the terms growth and development.
4.11.2 Identify the general goals of management of the pediatric patient.
4.11.3 Discuss the sources of historical information in the pediatric patient.
4.11.4 List the principles in the general approach to the pediatric patient.

4.11.5 Identify normal age-related vital signs in the pediatric patient.

4.11.6 Describe the normal and abnormal appearance of the anterior fontanelle in the infant.

4.11.7 For each of the following age groups identify the relevant aspects of normal growth and development, personality development, relationship to parents, history factors, common illnesses and accidents and approach.

a. Neonate

b. 1 to 5 months

c. 6 to 12 months

d. 12 to 36 months

e. 3 to 5 years

f. 6–12 years

g. 12 to 15 years

4.11.8 Define Sudden Infant Death Syndrome (SIDS).

4.11.9 Describe the incidence of SIDS.

4.11.10 Discuss the current theories on SIDS.

4.11.11 Describe the assessment and management of SIDS cases.

4.11.12 Identify the immediate needs of the SIDS family.

4.11.13 Describe the characteristics of the child abuser.

4.11.14 Describe the characteristics of the abused child.

4.11.15 Discuss the assessment of the potentially abused child including important historical information.

4.11.16 Describe the management of the victim and family in the child abuse situation.

4.11.17 Discuss legal requirements of health professionals to report suspected child abuse.

4.11.18 Describe the pathophysiology, assessment and management of pediatric seizures.

4.11.19 Describe the pathophysiology, assessment and management of dehydration in the pediatric patient.

4.11.20 Describe the pathophysiology, assessment and management of the child with suspected meningitis.

4.11.21 Describe the pathophysiology, assessment and management of the child with suspected septicemia.

4.11.22 Describe the pathophysiology, assessment and management of the child with suspected Reyes Syndrome.

4.11.23 Identify the steps in relieving airway obstruction in the infant and child accord ing to American Heart Association standards.

4.11.24 Discuss the pathophysiology, assessment and management of the following respiratory disorders:

a. Bronchiolitis

b. Croup

c. Epiglottitis

4.11.25 Using AHA ACLS Standards, identify the correct pediatric dosage for the following:

a. Atropine sulfate

b. Calcium chloride
c. Dopamine
d. Epinephrine
e. Epinephrine infusion
f. Furosemide
g. Isoproterenol
h. Lidocaine
i. Lidocaine infusion
j. Naloxone
k. Sodium bicarbonate

4.11.26 Describe the technique for endotracheal intubation in the pediatric patient.

4.11.27 Identify appropriate blade sizes and endotracheal tube sizes for the pediatric patient.

4.11.28 Describe the site selection for intravenous infusions in the pediatric patient.

4.11.29 Describe the equipment selection for intravenous therapy in the pediatric patient.

S4.11.30 Demonstrate the ability to assess vital signs in the pediatric patient utilizing the appropriate equipment.

S4.11.31 Demonstrate the ability to obtain an appropriate history when evaluating the pediatric patient.

S4.11.32 Demonstrate the ability to perform an appropriate assessment when evaluating the pediatric patient.

S4.11.33 Demonstrate the ability to manage airway obstruction in the infant and child.

S4.11.34 Demonstrate the ability to perform CPR on the pediatric patient according to American Heart Association standards.

S4.11.35 Demonstrate the ability to perform endotracheal intubation in the pediatric patient.

S4.11.36 Demonstrate the ability to perform intravenous therapy on the pediatric patient including selection of appropriate equipment, solutions and anatomical sites.

(S) Indicates Skill Objective

TOPIC	CONTENT OUTLINE
Approach to the Pediatric Patient	

A. General considerations
   1. Age group approach vs systems approach
      a. Newborn
      b. 1–5 months
      c. 6–12 months
      d. 1–3 years
      e. 3–5 years
      f. 6–9 years
      g. 10–12 years
      h. 13–15 years
   2. Definition of growth: increase in body size or mass
   3. Definition of development: physiological and psychological maturity of function
   4. Goal of management
      a. Perform an accurate patient assessment
      b. Identify patient problem(s)
      c. Treat the problem(s)
   5. Patience and understanding paramount

B. General history assessment
   1. Goals
      a. Gather information as quickly and accurately as possible
      b. Establish a relationship with patient
   2. Parents as a source of information
   3. The child as a source of information
      a. Children can be accurate in descriptions
      b. Allow the child to express his opinion

C. General approach
   1. Questioning must be specific and direct
   2. Focus on observed behavior, not what child or parent says
   3. Approach slowly and gently to encourage cooperation, gain confidence
   4. Remember that if the child did something he felt was forbidden, he may distort facts
   5. Children may imagine fantasy as real
   6. Visual assessment very important
   7. Avoid touching injured or painful areas until the child's confidence has been gained
   8. Begin examination without instruments
   9. *Always* be honest with the patient
   10. Children respond to calm reassurance—converse with the patient
   11. If possible, allow child to determine the order of exam
   12. Respect the child's modesty, undress slowly, keep warm
   13. Approach should be kind, but firm
   14. Avoid separating child from parents unnecessarily
   15. If possible, get on the same physical level as the child

This is the general approach that is recommended if life threatening problems are not present. As always priorities are established on threat to life.

TOPIC	CONTENT OUTLINE
	D. Physical examination 1. Pediatric vital signs a. Normal age, related vital signs i. Values used as guidelines ii. Wider variations in temperature than adults b. Proper method and eq ipment for vital signs in the pediatric patient c. Observe respiratory rate, difficulty, etc., before beginning the exam. If child begins to cry, evaluation becomes difficult 2. May be wide variations in level of consciousness and activity 3. Evaluation of anterior fontanelle a. Normal state—level with surface of skull or slightly sunken. May pulsate b. With increased intracranial pressure feels tight and may bulge. Pulsations decrease or disappear c. With dehydration, falls below level of skull and feels sunken 4. Evaluation of vomiting a. GI disturbances common with many disorders in children b. May also indicate viral syndrome, intestinal obstruction, septicemia, etc. c. History may be helpful
Developmental Stages	A. Neonate 1. Normal growth and development a. Gestation age affects early development b. Loss of weight c. Normal reflexive behavior present 2. Personality development, psychological a. Close to mother b. Stares at faces, smiles 3. Relationship to parents a. Mother—and perhaps father—can usually quiet b. Knows parents, but others OK to hold 4. History from parents but observe child 5. Common illnesses, accidents a. Respiratory distress b. Jaundice c. Vomiting 6. Approach a. Keep warm b. Observe skin tone, color, respiratory activity c. Auscultate lungs early in the exam d. Use pacifier or finger e. Have child lie in mother's lap B. 1 month to 4–5 months 1. Normal growth and development

Full term.

Recovers generally in 10 days.

Rooting, sucking, grasp, motor response.

a. Weight gain—twice birth weight
b. Follows movement of others with eyes
c. Cephalo-caudal development-muscular control proceeds from head to tail and from center of body to periphery

2. Personality—development, psychological
   a. Parents important
   b. Doesn't like strangers
3. Relationship to parents—close to mother and father
4. History from parents, but observe child
5. Common illnesses and accidents
   a. SIDS
   b. Vomiting and diarrhea, dehydration
   c. Meningitis
   d. Child abuse
   e. Accidents
6. Approach
   a. Keep warm
   b. Have child lie in mother's lap
   c. Use pacifier or bottle

C. 6 months to 12 months
1. Normal growth and development
   a. Cephalo-caudal development—may stand, walk with help
   b. Active
   c. Explores world with mouth
2. Personality development, psychological
   a. Stranger anxiety
   b. Fear of lying on back
3. Relationship to parents
   a. Clings to mother
   b. Father OK most of the time
4. Common illnesses and accidents
   a. Febrile seizures
   b. Vomiting, diarrhea with dehydration
   c. Bronchiolitis
   d. Car accidents
   e. Croup
   f. Child abuse
   g. Ingestions
   h. Falls
   i. Foreign bodies
   j. Meningitis
5. Approach
   a. Examine in mother's lap
   b. Conduct exam in toe-to-head order

The child will be less disturbed if you begin the exam away from his face.

c. If time and condition permit, allow child to become accustomed to you

D. 12 months–36 months
1. Normal growth and development
a. Great strides in gross motor development
b. Up, on, or under everything
b Runs, walks, always moving
d. Receptive language—becoming more expressive
2. Personality and psychological development
a. May cling to mother or stray
b. May be brave, curious or stubborn
c. Temper tantrums
3. Relationship to parents
a. Cling or stray
b. Parent's comfort problems
4. History
a. May use mother, father or child
b. Can ask child some questions
5. Common illnesses and accidents
a. Auto accidents
b. Vomiting, diarrhea, febrile seizures
c. Ingestions
d. Falls
e. Child abuse
f. Croup
g. Meningitis
h. Foreign bodies
6. Approach
a. Try to gain child's confidence; approach slowly
b Conduct exam in toe-to-head order
c. May be difficult to examine and may resist being touched
d. Avoid asking questions that allow the child to say no
e. Tell child if something will hurt

E. 3 years to 5 years
1. Normal growth and development
a. Increasing skill of *all* fine and gross motor development
b. Language closer to perfect
2. Personality and psychological development
a. May know how to talk, but won't
b. May be afraid
c. Vivid imagination
d. Has temper
e. Fear of mutilation
3. Relationship to parents
a. Close to each one on different occasions

"No", period.

Accidents of all types are the leading cause of death between the ages [illegible] & 15 years.

May view treatment procedures as hostile.

      b. Sticks up for parents
      c. Openly loving, looks to them for support
   4. History
      a. Ask child first, imagination may interfere with facts
      b. Child's time frame is off, parents need to fill in gaps
   5. Common illnesses and accidents
      a. Croup
      b. Asthma
      c. Ingestions
      d. Auto accidents
      e. Child abuse
      f. Burns
      g. Foreign bodies
      h. Drowning
      i. Epiglottitis
      j. Febrile seizures
      k. Meningitis
   6. Approach
      a. Use their doll to examine the child
      b. Allow them to hold on to equipment and use it
      c. Let them sit on your lap
      d. Start with chest; do head last
      e. Don't trick or lie
      f. Explain what you are going to do

F. 6 to 12 years
   1. Normal growth and development
      a. 6–8, lanky
      b. 9–12, puberty, lots of changes and new fears
      c. Growth spurts, loses some spatial orientation and must relearn it
   2. Personality and psychological
      a. Concept formation vs abstract thinking
      b. Concrete operations
   3. Relationship to parents
      a. Protective and proud
      b. Likes parent's attention
      c. Peers important, but needs home support
   4. History
      a. Give the child the responsibility for the history
      b. Mother and father perceptions may interfere
   5. Common illnesses and accidents
      a. Drowning
      b. Auto accidents
      c. Bicycle accidents
      d. Fractures
      e. Falls

If an injury is sustained while doing something forbidden, the child may be reluctant to give information.

f. Sports injuries
g. Child abuse
h. Burns

6. Approach
a. Be honest
b. Protect modesty
c. Tell child what is wrong and what you hear and see

G. 12 years to 15 years

1. Normal growth and development: some fully mature, others are not; therefore wide variation
2. Personality and psychological growth
a. Not necessarily adults, but believe that they are
b. Want to be liked and included
c. Concerned with body image
3. Relationship to parents
a. Cord cutting
b. Peers important, interest in opposite sex
4 History
a. Good historians
b. Parent's perception may differ
5. Common illnesses and accidents
. Mononucleosis
b. Asthma
c. Auto accidents
d. Sports injuries
e. Drugs/alcohol suicide gestures
f. Sexual abuse
g. Pregnancy
6. Approach
a. Be honest
b. Listen to what they are saying and are not saying
c. Some are very comfortable with body, others are not
d. Provide support and reassurance
e. Be factual and address the patient's questions
f. May wish to question child without parents

Problems Specific to the Pediatric Patient

A. Sudden Infant Death Syndrome (SIDS)

1. Pathophysiology
a. Definition: the sudden death of an infant or young child which is unexpected by history and in which a thorough postmortem examination fails to reveal an adequate cause for death
b. Incidence
i. Leading cause of death between 1 week and 1 year of age in U.S.
ii. 90% of deaths between 1 month and 6 months of age
iii. Peak incidence 2–4 months of age

INSTRUCTOR'S NOTES

iv. 2 deaths per 1000 live births
v. Generally occurs during sleep
vi. Incidence greatest in.
(a) Winter months
(b) Males (60%)
(c) Young mothers
(d) Low birth weight infants
(e) Families from lower socioeconomic groups
(f) Babies with URI's

c. SIDS is *not:*
i. External suffocation (i.e., from a pillow or blanket)
ii. The result of regurgitation and aspiration of vomitus
iii. Child abuse
iv. Hereditary
v. Caused by an allergy to cow's milk

d. Current theories
i. Chronic hypoxia theory
ii. Airway obstruction at level of posterior pharynx theory
(a) Pharyngeal relaxation during sleep
(b) Hypermobile mandible
(c) Enlarged tongue
iii. Apnea theory
iv. Neurologic immaturity

2. Assessment
a. External appearance of infant
i. Normal state of nutrition/hydration
ii. Frothy fluids in and around mouth and nostrils
iii. Fluids may sometimes be blood tinged
iv. Vomitus sometimes present
v. Infant may be in unusual position due to muscle spasm at time of death
vi. Mottling

b. Internal appearance of infant on autopsy
i. Intrathoracic—petechia in 90% of cases
ii. Pulmonary congestion and edema
iii. Microscopic inflammatory changes in the trachea
iv. Sometimes stomach contents found in trachea

c. SIDS confirmed by excluding:
i. Pneumonia by chest X ray
ii. CNS hemorrhage by lumbar puncture
iii. Septicemia by blood cultures

3. Management
a. Expect normal grief reaction from parents
i. Shock, disbelief, denial
ii. Anger, rage, hostility

SIDS may however, recur in families.

iii. Blame
iv. Guilt, self reproach
v. Feelings of inadequacy as a parent
vi. Helplessness
vii. Confusion
viii. Fear
ix. Duration of normal grief 1–2 years

b. Immediate needs of the SIDS family
i. Active care of infant to assure parents everything possible was done
ii. Unconditional support from first responder
iii. Information about what was done
iv. Closure
(a) Allow family to see infant
(b) Do not force if they choose not to
v. An advocate
vi. A private place to react
vii. Autopsy results as soon as possible

c. SIDS has major long-term effects on family relationships

B. Child abuse and neglect
1. Dynamics
a. Suspect multiple injuries with victims of abuse
b. Elements necessary for abuse to occur
i. Parent/adult with the potential
ii. A particular child at risk
iii. A crisis
c. Some characteristics of abuser
i. Usually a parent or individual in the role of a parent
ii. May come from any geographic, religious, ethnic, occupational, educational, or socioeconomic group
iii. Mother is most frequently identified abuser when she spends the most time with the child
iv. Has often been abused physically, emotionally as a child punishment
d. Characteristics of abused child
i. Seen as "special," seen as different from others
ii. Tends to be a young child
iii. Handicapped, ill or child with special needs at greater risk
iv. Boys involved more often than girls
v. Illegitimate children
vi. Uncommunicative children
vii. Children who are not what parents wanted
e. Common crises that may precipitate abuse
i. Financial stress
ii. Marital or relationship stress

Refers to continued management in Emergency Department.

Under 5 years old.

Also a premature infant or a twin is at higher risk.

At greater risk.

i.e., girl instead of a boy.

iii. Physical illness in parent or child

2. Assessment
   a. Indicators of possible abuse
      i. Any obvious or suspected fractures in a child under 2 years of age
      ii. Injuries in various stages of healing, especially burns, bruises
      iii. More injuries than usually seen in children of the same age
      iv. Injuries scattered on many areas of the body
      v. Bruises or burns in patterns which suggest intentional infliction
      vi. Increased intracranial pressure in an infant
      vii. Suspected intra-abdominal trauma in a young child
      viii. Any injury that does not fit with the description of cause given
   b. History
      i. History does not match with nature or severity of injury
      ii. Parents account may be vague or change
      iii. "Accident" beyond developmental capabilities of child
      iv. Accusation that child injured himself intentionally
      v. Delay in seeking help
      vi. Child dressed inappropriately for situation
   c. Severe forms of physical neglect
      i. Extreme malnutrition
      ii. Multiple insect bites
      iii. Longstanding skin infections
      iv. Extreme lack of cleanliness
   d. Sexual abuse
      i. Examine for serious genital injury
      ii. Approach must be supportive
3. Management
   a. Treat injuries as appropriate
   b. Obtain information in a nonjudgemental manner
   c. Do not "cross examine" patient or parents
   d. Assure accompanied transportation to hospital
   e. Maintain a supportive, nonjudgemental attitude toward parents
   f. Goals of management
      i. Treat injuries
      ii. Protect child from further abuse
      iii. Long-term—treat the family and reduce potential for further abuse
   g. All states have laws requiring reporting of abuse by health care professionals
   h. EMT-P should discuss any suspicions of abuse with receiving ED staff

The EMT-P should suspect abuse when any of these circumstances are present.

Example: cigarette burns in a ring.

Example: hot water burns when the child is too young to turn the water on.

Injury is not necessary for sexual abuse to have occurred.

If abuse is suspected, do not allow suspected abuser to transport patient.

Responsibility of Social Services.

i. Document all factual information on agency trip reports, abuse reporting forms if appropriate
j. EMT-P must recognize and deal with his own feelings

C. Seizures
1. Pathophysiology
a. Causes
i. Fever
ii. Head trauma
iii. Hypoxia
iv. Hypoglycemia
v. Infections
vi. Toxic ingestions and exposure
vii. Idiopathic epilepsy
viii. Tumors
ix. Electrolyte abnormalities
x. CNS malformations
b. Febrile seizures
i. Occur between 6 months and 6 years
ii. Suspect fever as cause of seizure if temperature above 103 degrees F (39.2 degrees C)
iii. Caused by the rapid rise in temperature
c. Status epilepticus: a prolonged seizure or multiple seizures without a lucid interval between seizures
2. Assessment
a. History
i. Previous seizures—idiopathic
ii. Previous seizures associated with fever
iii. Number of seizures this incident
iv. Condition when first found
v. Any head trauma
vi. History of diabetes
vii. History of recent headache or stiff neck
viii. Present medications or possible ingestions
ix. Description of seizure activity
x. History of irritability or lethargy prior to seizure may indicate CNS infection
xi. Recent illness
b. Physical examination
i. Evaluate adequacy of respirations
ii. Level of consciousness
iii. Neurologic evaluation
iv. Signs of injury
v. Examine for dehydration
vi. Evaluate anterior fontanelle in infants
3. Management

The diagnosis of "febrile seizures" should not be made in the field. All pediatric patients must be transported for evaluation & to rule out other causes of seizures.

a. Place patient on floor or bed away from furniture. Position on side
b. Prevent injury
c. Do not restrain
d. Maintain an airway but do *not* force anything between the teeth
e. Administer oxygen
f. Vital signs
g. If febrile, remove excess layers of clothing
h. If status epilepticus
    i. IV D5NS or D5RL
    ii. Diazepam infants 30 days—children 5 years: 0.2–0.5 mg slowly IV every 2–5 minutes up to maximum of 2.5 mg. Children 5 years or older: 1 mg every 2–5 minutes to a maximum of 5 mg. Contact base station for further orders.
i. Draw blood tube for glucose determination
j. Glucose 25% 2 cc/kg diluted glucose 50% 1:1 with saline or sterile water
k. A trial of 5% Dextrose IV solution may also be used. Administer 4 cc/kg of 5% D5NS or LR

D. Dehydration
1. Pathophysiology D5NS
    a. Child can dehydrate quickly
    b. May be caused by fever, vomiting, diarrhea, burns
2. Assessment
    a. History
        i. Sources of fluid loss
        ii. Fever
        iii. Decreased urination
    b. Physical exam
        i. Poor skin turgor
        ii. Weight loss
        iii. Thick secretions, concentrated urine
        iv. Eyes dull and sunken looking
        v. Infant has depressed fontanelle
3. Management
    a. Airway/breathing/circulation
    b. Monitor vital signs
    c. IV D5NS or D5LR if in shock
    d. Transport

E. Infectious processes
1. Meningitis
    a. Pathophysiology
        i. Infection of tissues covering the brain and spinal cord
        ii. Infants and young children at higher risk than adults
        iii. May be bacterial or viral
    b. Assessment

Sponging with tepid water enroute to the hospital or applying cool, moist towels is indicated. However, do not delay in transport for this treatment.

May be given rectally if IV cannot be established.

See Drug Outline Nervous System Section.

Se : drug outline. Be careful to check for potency of IV before and during glucose administration. Extravasation causes tissue sloughing.

Starting an IV in a young child may be difficult & should not delay transport.

i. History
(a) Ill for one to several days
(b) History of ear or respiratory infection
(c) High fever
(d) Lethargic and/or irritable
(e) Severe headache and stiff neck
ii. Examination
(a) Appears very ill
(b) Fontanelle full or bulging
c. Management
i. Supportive care
ii. Transport
2. Septicemia
a. Pathophysiology
i. Generalized infection of the bloodstream
ii. More common in children than adults
b. Assessment
i. History
(a) May become ill
(b) May have been ill for several days
ii. Physical exam
(a) Fever
(b) Lethargy, irritability
(c) May be in shock
(d) Fontanelle is usually normal
c. Management
i. Supportive care
ii. Transport
iii. IV D5NS or D5LR if patient is in shock
F. Reyes Syndrome
1. Pathophysiology
a. Recognized as a disease in 1963
b. Incidence
i. Younger children at greater risk
ii. More cases in fall and winter
iii. After 1 year of age, higher incidence in suburban and rural population
iv. Affects all ages but peak incidence is 5–15 years
c. Etiology
i. No single etiological factor identified
ii. Outbreaks tend to cluster during influenza B epidemics
iii. Possible toxic and metabolic causes have been identified
iv. Sometimes related to resolving chickenpox
v. History of gastroenteritis, especially in infants
2. Assessment

Monitor ABC's, make child comfortable.

Child may have associated ear infection, pneumonia, or meningitis.

The diagnosis of Reyes will not be made in the field. The EMT-P will be presented with a delerious child, cause unknown. It is important to consider and rule out other causes of delerium such as alcohol or other drug ingestion.

The diagnosis of Reyes will be based on clinical & laboratory findings after admission to the hospital.

a. History
   i. Many cases have history of minor URI of short duration
   ii. Sudden onset of vomiting often marks the early stages of the disease
   iii. Irrational behavior
   iv. Hyperexcitability
   v. Progressive stupor
   vi. Restlessness and convulsions
   vii. Coma—may demonstrate decerebrate or decorticate posturing
   viii. History of chickenpox in 10–20% of cases
   ix. Other history of URI
   x. Infants may have history of gastroenteritis
b. Physical exam
   i. Rapid, deep respirations
   ii. Irregular respirations
   iii. Dilated, sluggish reacting pupils
   iv. Other signs of increased intercranial pressure

3. Complications
   a. Respiratory failure common
   b. Most patients die of cerebral complications
   c. Cardiac arrhythmias may develop
   d. Acute pancreatitis may develop
4. Management
   a. Airway management
   b. Oxygen
   c. Support ventilation if necessary
   d. Rapid transport

G. Respiratory emergencies
1. Obstructed airway in children. Child is not breathing.
2. Bronchiolitis
   a. Pathophysiology
      i. Viral infection of bronchioles
      ii. Occurs in children under 2 years
      iii. Characterized by prominent expiratory wheezing
      iv. Produces same symptoms as asthma
   b. Assessment
      i. History
         (a) Family history of asthma or allergies
         (b) Patient history of allergies
         (c) Presence of low-grade fever
         (d) Age of patient (asthma rare under 1 year, bronchiolitis common)
      ii. Physical exam

Earlier symptoms include irritability, lethargy, confusion, personality changes.

Signs will vary depending on the progression of the disease process.

i.e., herniation of the brain stem.

See AHA recommendations.

(a) Observe for evidence of infection and respiratory distress

(b) Auscultate chest for rales and wheezes

c. Management

i. Humidified oxygen by mask

ii. Assist ventilation as necessary

iii. Position semisitting

iv. Epinephrine SC per order if bronchospasm is severe

v. Racemic epinephrine per order

(a) Pharmacology and actions

(i) Racemic epinephrine is an epinephrine preparation in a 1:1,000 dilution for use by oral inhalation *only*. Effects are those of epinephrine

(ii) Inhalation causes local effects on the upper airway as well as systemic effects from absorption

(iii) Vasoconstriction may reduce swelling in the upper airway and beta effects on bronchial smooth muscle may relieve bronchospasm

(b) Indications

(i) Life-threatening airway obstruction due to croup

(c) Precautions

(i) Mask and noise may be frightening to small children. Agitation will aggravate symptoms of respiratory obstruction. Try to enlist the support of parents and child for administration

(ii) Try to differentiate from croup epiglottitis by history. Do not use a tongue blade to examine the back of the throat. The diagnosis is frequently difficult in the field, but a critical patient deserves a trial of racemic epinephrine. Although it is specific therapy for croup, it may also buy some time in patients with epiglottitis

(iii) In the less-than-critical patient, saline alone via nebulizer may bring marked symptomatic relief from croup

(iv) Racemic epinephrine is heat and light sensitive. It should be stored in dark cool place. Discoloration is an indication for discarding it

(d) Administration

(i) One cc of Vaponefrin (2.25% solution) in 4 ccs of normal saline. Both solutions placed into the nebulizer connected to oxygen at a flow rate of 5–8 liters per minute to create a fine mist to be inhaled via the mouthpiece

(e) Side effects and spec'al notes

(i) Tachycardia and agitation are the most common side effects. Other side effects of parenteral epinephrine may also be seen

- Refer to epinephrine outline in Respiratory Section

Beta effects.

Respiratory type of normal saline.

(aa) Nebulizer treatment may cause blanching of the skin in the mask area due to local epinephrine absorption. Reassure parents

(bb) Clinical improvement in croup can be dramatic after administration of racemic epinephrine, and presentation in the ED may be markedly altered. Rebound worsening of airway obstruction can occur, however, in 2–4 hours. For this reason many physicians admit any patient whom they treat with racemic epinephrine

(cc) If respiratory arrest occurs, it is usually due to patient fatigue or laryngeal spasm. Complete obstruction is not usually present; ventilate the patient, administer O_2 and transport rapidly. If you can ventilate and oxygenate the patient adequately intubation is best left to a specialist in a controlled setting

(f) Be prepared to intubate

(g) Monitor cardiac rhythm

3. Croup
   a. Pathophysiology
      i. Viral infection of upper airway
      ii. Occurs between 6 months and 4 years of age
      iii. Infection causes edema beneath the glottis and progressively narrows the airway
   b. Assessment
      i. History
         (a) History of cold or other infection
         (b) Child generally well during the day
         (c) At night a harsh, barking cough develops
         (d) Mild attack may subside in a few hours, but may recur for 2 or 3 nights
      ii. Physical exam
         (a) Child usually sitting upright, refuses to lie down
         (b) May have nasal flaring, tracheal tugging and retraction
         (c) As progresses, develops restlessness, tachycardia, cyanosis
   c. Management
      i. Maintain airway
      ii. Give humidified oxygen by mask
      iii. Racemic epinephrine per order
      iv. Position of comfort
      v. Transport
4. Epiglottitis
   a. Pathophysiology
      i. Usually occurs in older children

Field administration should be limited to .hose critically ill patients who are in danger of imminent respiratory arrest.

Laryngotracheobronchitis.

Children with respiratory distress usually suffer respiratory arrest due to exhaustion or spasm. You will still be able to ventilate with mouth to mouth, pocket mask, or bag valve mask technique.

Above 4.

ii. Caused by bacterial infection
iii. Characterized by swollen cherry red epiglottis
b. Assessment
i. History
(a) Pain on swallowing
(b) High fever
(c) Shallow breathing, dyspnea, stridor
(d) Shallow breathing dyspnea, stridor
ii. Physical assessment
(a) Child appears very ill and anxious
(b) Never attempt to visualize the airway. Severe laryngospasm and swelling may result
(c) Refuses to swallow
(d) Shallow breathing
(e) Retractions
c. Management
i. Administer humidified oxygen by mask
ii. Position of comfort
iii. Rapid transport
iv. Intubation contraindicated unless TOTAL airway obstruction
v. Transtracheal ventilation may be indicated

Special Techniques for the Pediatric Patient

A. CPR in children
B. Defibrillation in children
1. Dosage: two joules per kilogram
2. If unsuccessful, double the dose
3. If unsuccessful, correct hypoxia and acid base
C. Endotracheal intubation
1. Technique similar to adult
2. Anatomical difference with children
a. Tongue is relatively larger
b. Glottis is higher
c. Vocal cords slant upward and backward
3. Equipment
a. Size of blades
b. Size of tubes
i. Noncuffed and cuffed
ii. Size of tube per age
4. Special notes
a. Precede intubation with oxygenation with 100% oxygen by face mask and bag
b. Monitor heart rate carefully during intubation for dysrhythmia
c. Following intubation, auscultate breath sounds bilaterally
D. Intravenous techniques
1. Procedure the same as for adults

Frequently, mask not tolerated.

Refer to AHA recommendations

Infants and children possess a greater ability to recover fully from cardiopulmonary arrest. Therefore CPR should be started if there is any chance for salvage.

Cardiac arrest in the pediatric patient is usually a primary respiratory problem, careful attention to airway and ventilation is of paramount importance.

Blades and tube sizes by age are contained as an appendix to this lesson plan.

2. Site selection
   a. May use neck, arms, hands, feet, scalp
   b. Use largest accessible vein
   c. Secure extremities with armboard
   d. Limit use of external jugular veins to life-threatening situations
   e. Veins of hands and feet usually permit a 21 or 23 gauge scalp vein needle
   f. Veins of forehead and temporal areas in infants less than 1 year of age
      i. Use a rubber band for a tourniquet
      ii. Point bore of needle toward face or neck
3. Equipment
   a. Scalp vein needles
      i. Use 21 or 23 gauge
      ii. Flush needle prior to insertion
   b. Over the needle cannulas—22 gauge useful for smaller children
   c. Solutions should contain electrolytes and glucose. Use:
      i. D5NS
      ii. D5LR
   d. Volume control
      i. Use microdrip apparatus routinely
      ii. If large volumes are needed, use macrodrip
      iii. Use volume control chamber if possible

Monitor infusion rate closely. It may be very easy to overload the pediatric patient.

Drugs Used in ACLS for Infants and Children

Drug	Dose	How Supplied	Remarks
Atropine sulfate	0.01–0.03 mg/kg	0.1 mg/ml	I.V. fast push
Calcium chloride	20 mg/kg	100 mg/ml (10%)	I.V. slow push
Dopamine hydrochloride	2–10 mcg/kg/min.	200 mg/5ml	Alpha receptor dominate at ≥ 10 mg/kg/min.—titrate to effect
Epinephrine	0.01 mg/kg	1:10,000 (1.0 mg/10 ml)	1:1000 must be diluted
Epinephrine infusion	Start at 0.1 mg/kg/min.	1:1,000 (1 mg)	Usual effect infusion less than 1.5 mg/kg/min.
Furosemide	1 mg/kg	10 mg/ml	I.V. Slow—every 2 hours
Isoproterenol hydrochloride	Start at 0.1 mcg/kg/min.	1 mg/5ml	Usual effect 0.1–1.0 mg/kg/min.—Titrate to effect
Lidocaine	1 mg/kg/dose	10 mg/ml (1%) 20 mg/ml (2%)	I.V. slow push
Lidocaine infusion	0.02-0.03 mg/kg/min.	10 mg/ml (1%) 20 mg/ml (2%) 40 mg/ml (4%)	Start at 20 mcg/kg/min.——titrate up to 30 mcg/kg/min.
Naloxone hydrochloride	0.01 mg/kg 10 mcg/kg neonatal	0.4 mg/ml 0.02 mg/ml	Repeat every 3-5 minutes as needed——Darvon overdose may require 0.1 mg/kg
Sodium bicarbonate	1–2 mEq/kg	1 mEq/ml	Repeat dose in 10 minutes or by ABG's

Adapted from *Textbook of Advanced Cardiac Life Support*, 1981

Blade and Tube Sizes for Pediatric Intubation

Age	Blade size
Premature	No. 0 straight Miller
Term newborn to 3-year old	No. 1 straight Miller
3-year old to adolescent	No. 2 straight Miller or curved Macintosh
Adolescent	No. 3 curved Macintosh

Age	Endotracheal Tube, mm	Suction Catheter
Premature	2.5	6E
Newborn	3.0	6F
6 month	3.5	8F
18 month	4.0	8F
3 years	4.5	8F
5 years	5.0	10F
6 years	5.5	10I
8 years	6.0	10F
12 years	6.5	10F

Normal Vital Signs at Different Ages

Age	Respiratory Rate	Blood Pressure	Pulse
Newborn	50	70-75 systolic	120
12 weeks	60	85 systolic	120
6 months	35	90/60	110
1 year	30	95/65	110
2 to 4 years	24	100/65	100
5 to 7 years	21	95/65	100
8 to 10 years	20	95/65	90
12 years	16	105/70	85
14 years	16	110/75	80
16 years	16	120/70	75

Age—Related Weights

Age	Kilograms	Pounds
Newborn	3-5	6-11
1 year	10	22
3 years	15	33
5 years	20	44
8 years	25	55
10 years	30	66
15 years	50	110

These weights are strictly estimates. Whenever possible when a weight is indicated, try to obtain from a parent the child's present weight.

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Division 5: OB/GYN/Neonatal

Section 1. OB/GYN/Neonatal

TOPIC	CONTENT OUTLINE

Introduction

Prior to participating in this section, the student must have successfully completed:

Division 1: Prehospital Environment
Sections 1–7

Division 2: Preparatory
Sections 1–5

This Division discusses the etiology and treatment of gynecologic emergencies, the normal and abnormal events in pregnancy and childbirth and the care of the neonate. Female patients with abdominal pain or injury should be evaluated by the EMT-P for gynecologic disorders and in the appropriate age group, for possible pregnancy and its complications. Gynecologic and obstetric emergencies may develop acutely and prove to be life threatening.

Overview

SECTION 1:

I. Anatomy and Physiology of the Female Reproductive System
II. Assessment of the Gynecologic Patient
III. Gynecologic Emergencies

SECTION 2:

I. Anatomy and Physiology of the Obstetric Patient
II. Assessment of the Obstetric Patient
III. Complications of Pregnancy
IV. Deliveries
  A. Normal
  B. Abnormal
  C. Complications

SECTION 3:

I. Routine Care of the Neonate
II. Care of the Distressed Infant
III. Neonatal Transport

Objectives

Upon completion of this section, the student will be able to:

5.1.1 Identify and describe the location and functions of the following:
  a. Ovaries
  b. Fallopian tubes
  c. Uterus
  d. Vagina
  e. Cervix
  f. Perineum
  g. Labia
  h. Endometrium

5.1.2 Describe the normal menstrual cycle.

5.1.3 Identify specific details of history that should be obtained in the gynecologic patient.

5.1.4 Identify specific physical findings that should be assessed in the gynecologic patient.

5.1.5 List the side effects of commonly used contraceptives.

5.1.6 Describe the typical signs, symptoms and management of pelvic inflammatory disease.
5.1.7 Identify sources of nontraumatic abdominal pain.
5.1.8 Identify potential sources of trauma to the external genitalia and management of injuries.
5.1.9 Discuss the assessment of a sexual assault victim and identify the ways in which it differs from usual assessment.
5.1.10 Identify principles of management for the sexual assault victim.
5.1.11 Identify the normal site of:
- a. Ovum fertilization
- b. Ovum implantation

5.1.12 Identify and describe the functions of the following:
- a. Placenta
- b. Umbilical cord
- c. Amniotic sac and fluid

5.1.13 Describe fetal development and circulation.
5.1.14 Define the following terms:
- a. Antepartum
- b. Postpartum
- c. Natal
- d. Prenatal
- e. Primigravida
- f. Primipara
- g. Multigravida
- h. Multipara

5.1.15 Identify specific details of history that should be obtained in the obstetric patient.
5.1.16 Identify specific physical findings that should be assessed in the obstetric patient.
5.1.17 List early signs and symptoms of pregnancy.
5.1.18 Discuss the possible effects of trauma on both mother and fetus.
5.1.19 Discuss the effect of pregnancy on the following pre-existing diseases:
- a. Diabetes
- b. Essential hypertension
- c. Neuromuscular disorders
- d. Cardiac disorders

5.1.20 Define the following terms:
- a. Spontaneous abortion
- b. Criminal abortion
- c. Therapeutic abortion

5.1.21 Describe the pathophysiology, assessment and management of the patient who has had, or is having an abortion.
5.1.22 Describe the pathophysiology, assessment and management of the following:
- a. Ectopic pregnancy
- b. Abruptio placenta

c. Placenta previa

5.1.23 Describe Braxton-Hicks contractions and their significance.

5.1.24 Describe the pathophysiology, assessment and management of eclampsia and preeclampsia

5.1.25 Describe the signs, symptoms and management of supine hypotensive syndrome.

5.1.26 Define the stages of labor and the length of each.

5.1.27 Describe the progression of labor.

5.1.28 Define the following terms:

a. Effacement

b. Cervical dilatation

c. Crowning

d. Presenting part

5.1.29 Discuss factors that influence transport decisions for the patient in labor.

5.1.30 List and describe steps for a normal delivery.

5.1.31 Describe the management during delivery when the cord is wrapped around the baby's neck.

5.1.32 Describe the pathophysiology, assessment and management of cephalopelvic disproportion (CPD).

5.1.33 List factors that may cause a large fetus.

5.1.34 List and describe 5 abnormal positions or presentations of the fetus during delivery and the general management principles.

5.1.35 Describe the pathology and management of a prolapsed umbilical cord.

5.1.36 Describe the management of the multiple birth delivery.

5.1.37 Describe the occurrence, complications and management of a precipitate labor.

5.1.38 Describe the pathophysiology, assessment and management of postpartum hemorrhage.

5.1.39 Discuss the indications for and technique of fundal massage.

5.1.40 Describe the pharmacology and actions, indications, precautions, administration and side effects of oxytocin.

5.1.41 Describe the pathophysiology, assessment and management of uterine rupture.

5.1.42 Identify the pathophysiology, assessment and management of uterine inversion.

5.1.43 Identify the pathophysiology, assessment and management of pulmonary embolism during the antepartum or postpartum period.

5.1.44 Describe the routine care of the newborn.

5.1.45 List 4 means by which heat loss occurs in infants.

5.1.46 Describe methods of heat conservation in the newborn.

5.1.47 Discuss the effects of hypothermia on the newborn infant.

5.1.48 Define the parameters of Apgar scoring and the numerical values utilized.

5.1.49 Describe resuscitation for the distressed infant.

5.1.50 Describe 2 methods of stimulating the distressed infant.

5.1.51 Describe the appropriate administration of oxygen to the newborn.
5.1.52 Describe methods of ventilatory assistance for the newborn infant.
5.1.53 Identify the rate of ventilation to be used in the nonbreathing newborn.
5.1.54 Describe the technique for cardiac compressions on the newborn.
5.1.55 Identify the significance of meconium staining.
5.1.56 Identify the major problems that occur during transport of the neonate.
5.1.57 Identify heat sources that may and may *not* be utilized to warm the neonate.
S5.1.58 Demonstrate the ability to properly assess the patient with a possible gynecologic disorder.
S5.1.59 Demonstrate the ability to properly assess the pregnant patient.
S5.1.60 Demonstrate the ability to obtain an appropriate history when evaluating the patient with an obstetric chief complaint.
S5.1.61 Demonstrate the ability to perform an appropriate assessment when evaluating an obstetric patient.
S5.1.62 Demonstrate the ability to appropriately administer oxytocin.
S5.1.63 Demonstrate the technique of fundal massage.
S5.1.64 Demonstrate the ability to use bulb syringe suction, and DeLee suction.
S5.1.65 Demonstrate the ability to clamp and cut an umbilical cord.
S5.1.66 Demonstrate the ability to calculate an accurate Apgar score.
S5.1.67 Demonstrate the ability to appropriately manage a newborn infant.
S5.1.68 Demonstrate the ability to perform infant CPR according to AHA standards.

(S) Indicates Skill Objective

Introduction

Gynecologic problems reviews the anatomy and physiology of the female reproductive system, the assessment of the patient presenting with a gynecologic problem and several gynecologic emergencies that may be encountered by the EMT-P. Abdominal complaints in the female patient may be related to medical causes, may be gynecologic in origin or may be obstetric in nature. This division between gynecologic and obstetric problems may be artificial, but the material is presented in this manner for simplicity

Anatomy and Physiology of the Female Reproductive System

A. Anatomic location, functions and physiology of:
   1. Ovaries
   2. Fallopian tubes
   3. Uterus
   4. Cervix
   5. Vagina
   6. Perineum
   7. Endometrium
   8. Labia

B. Relationship of the previously listed organs of the reproductive system to the following urinary and GI tract structures:
   1. Urethra
   2. Rectum

C. The normal menstrual cycle
   1. Onset of menses at approximately age 12–14
   2. Controlled by hormone secretion
   3. Occurs in a 28-day cycle
   4. Phases
      i. Proliferative phase—thickness of endometrium increases to prepare for implantation of fertilized ovum
      ii. Secretory phase—estrogen and progesterone secreted to prepare endometrium for gestation
      iii. Menstrual phase—discharge of menstrual flow when ovum is not fertilized
   5. Menstrual periods absent during pregnancy

D. Menopause: permanent cessation of ovarian function and menstrual activity

Assessment of the Gynecologic Patient

A. History
   1. Pain/Discomfort
      a. Character
      b. Onset—gradual/sudden
      c. Location/radiation
      d. Duration/evolution with time
      e. What makes it better/worse
   2. Current general health including preexisting diseases
   3. Obstetric history
      a. Gravida—the number of pregnancies the individual has had

There are wide variations.

Spotting may occur during pregnancy.

50% of the time occurs between ages 45-50.

Pain descriptors dull, aching, cramping, constant radiating.

Diabetes, hypertension, other cardiovascular disease, etc.

b. Para—the number of pregnancies that have produced an infant of viable age
c. Previous cesarean sections
4. Last menstrual period
a. Date
b. Normalcy
c. Bleeding between periods
d. Regularity of periods
5. Possibility of pregnancy—signs of early pregnancy
a. Breast tenderness
b. Urinary frequency
c. Nausea, vomiting
6. History of previous gynecologic problems
a. Infections
b. Bleeding
c. Miscarriage
7. Current blood loss
a. Color
b. Amount—number of pads/tampons used
c. Duration of bleeding
8. Vaginal discharge
a. Color
b. Amount
c. Odor
9. Use of contraceptives
a. Type of contraceptive
b. Side effects of commonly used contraceptives
i. Birth control pills
(a) Hypertension
(b) Acute myocardial infarction (AMI)
(c) Pulmonary embolism
(d) CVA
ii. Intrauterine device
(a) Perforation of uterus
(b) Uterine bleeding and pain
(c) Infection
iii. Foams and jellies—allergic reaction (uncommon)
10. History of trauma to reproductive system
11. Associated symptoms
a. Fever and/or chills
b. Diaphoresis
c. Syncope
d. Diarrhea/constipation
12. Allergies and/or medications
13. Evaluation of degree of emotional distress

Relate amount of present bleeding to usual period.

Especially in patients over 35 years of age who smoke. Risk is increased four times. Risk is increased 3 times.

B. Physical exam
  1. Level of consciousness
  2. General appearance
  3. Skin and mucous membrane color—cyanosis, pallor, flushed
  4. Vital signs—include orthostatic vital signs if blood loss is suspected
  5. Bleeding or discharge
     a. Color
     b. Amount
     c. Evidence of clots or tissue
  6. Abdominal exam
     a. Masses
     b. Areas of tenderness
     c. Guarding
     d. Distention

Gynecologic Emergencies

A. Abdominal pain—nontraumatic
  1. Pelvic Inflammatory Disease (PID)
     a. Pathophysiology
        i. Acute or chronic infection that may involve uterus, ovaries, tubes and adjacent structures (peritoneum and intestines)
        ii. Causative organisms include gonorrhea, staph, strep, others
        iii. Sepsis in late stages
     b. Assessment
        i. History
           (a) Pain
              (i) Diffuse lower abdominal pain
              (ii) May be moderate to severe
              (iii) May localize to one of the lower quadrants and/or radiate to right shoulder
              (iv) Onset of pain near menstrual period, often following menses
              (v) Often made worse by sexual intercourse
           (b) Associated symptoms
              (i) Fever, chills
              (ii) Nausea
              (iii) Vomiting
              (iv) Vaginal discharge
              (v) Erratic menstrual periods
        ii. Physical exam
           (a) Patient appears ill
           (b) Blood pressure normal
           (c) Pulse elevated
           (d) Fever may be present
           (e) Palpation of abdomen elicits moderate to extreme pain
           (f) Abdomen tense with rebound tenderness

Patients who present with Gyn or OB complaints may be embarrassed, apprehensive and if pregnant, concerned for the life of the unborn child. They may also be concerned as to how their present condition will affect future childbearing. Tact, understanding and a caring and supportive attitude from the EMT-P are important in the management of the patients.

c. Management
   i. Position of comfort
   ii. Transport
2. Other sources of abdominal pain
   a. Ectopic pregnancy
   b. Ruptured ovarian cyst
   c. Appendicitis
   d. Cystitis
   e. Postabortal infection
   f. Mittelschmertz—abdominal pain occurring at the time of ovulation
   g. Endometritis—inflammation of lining of uterine wall

B. Vaginal Bleeding—Trauma to the female genitalia
1. May be caused by the following:
   a. Straddle injuries
   b. Blows to the perineum
   c. Foreign bodies inserted into vagina
   d. Abortion attempts
   e. Obstetric lacerations
   f. Sexual assault
2. Management
   a. Injuries to the external genitalia—apply direct pressure over the laceration
   b. Internal bleeding
      i. DO NOT pack dressings into the vagina
      ii. IV(s) crystalloid solution
      iii. Pneumatic antishock garment if indicated
      iv. Monitor vital signs

C. Sexual Assault
1. Incidence
   a. One of the fastest growing crimes in U.S.
   b. Adults
      i. Estimated that less than 40% are reported
      ii. No "typical victim"
   c. Sexual child abuse reported even less frequently
2. Background
   a. Crime of violence
   b. Motivation of rapist—aggression, humiliation, control and infliction of pain
   c. Includes any sexual contact without permission
3. History
   a. Approach is different in that the victim should *not* be questioned regarding the details of the event
      i. Do not ask if penetration took place
      ii. Do not inquire as to sexual history or practices

This information is irrelevant to field care & only adds to emotional stress

b. Do not ask questions that may lead to guilt feelings
c. Reactions may range from anxiety to withdrawal and silence. Both are normal
d. Other reactions include denial, anger, fear

4. Physical exam
   a. Examine genitalia only if severe injury is present
   b. Explain all procedures *before* proceeding
   c. Avoid touching the patient without her permission
   d. Maintain patient modesty
   e. Question regarding other physical injury
5. Management
   a. Psychological support is most important, reduce victim's anxiety and fear. Provide a safe environment
   b. Respond to the victims feelings
   c. Unless injuries are life threatening, obtain the patient's permission to treat
   d. Do not utilize invasive procedures unless life-threatening situation is present
   e. Be aware of preservation of evidence
      i. Handle clothing as little as possible
      ii. Do not use plastic bags for blood stained articles
      iii. Each item must be bagged separately
      iv. Ask victim not to change clothes or bathe
      v. Do not disturb the crime scene
   f. DO NOT clean wounds
   g. Maintain a nonjudgemental attitude
   h. If available, it *may* be preferable for female personnel to attend the patient. Go on clues from patient or ask her directly
   i. Confidentiality is very important
   j. Be aware of own feelings and prejudices regarding rape

Introduction

A. The Obstetric Patient reviews the anatomy and physiology relating to the normal events in pregnancy from conception through labor and delivery. Included are the process of fetal development, assessment of the obstetric patient complications of pregnancy, the delivery process and complications of the labor and delivery. As always, a high index of suspicion by the EMT-P is important in evaluating the pregnant patient to differentiate normal and abnormal occurrences

Anatomy and Physiology of the Obstetric Patient

A. Normal events of pregnancy
   1. Ovulation—growth and discharge of an unimpregnated ovum, usually coincidental with menstrual period
   2. Fertilization—the fusion of the spermatozoon with the ovum. Occurs in the fallopian tube, and the fertilized ovum remains in the tube approximately 3 days
   3. Implantation—the fertilized ovum embeds in the epithelium of the uterus

Assault victims need to begin to regain control over their lives

Be flexible. If victim wishes to talk, respond accordingly; if she is withdrawn & does not wish to share her feelings, respect her wishes.

Reactions will vary. Don't assume the victim prefers a female attendant. She may feel more safe in a male's presence.

Victim may be concerned that others will "find out". Provide reassurance

B. Accessory structures of pregnancy
   1. Placenta—fleshy, disk-like organ that performs the following functions:
      a. Transfer of gases
      b. Transport of nutrients
      c. Excretion of wastes
      d. Transfer of heat
      e. Hormone production
   2. Umbilical cord—cord connecting the placenta with the umbilicus of fetus. Contains 2 arteries, 1 vein
   3. Amniotic sac and fluid—the bag of membrane that contains the fetus and waterlike fluid to protect the fetus—approximately 1,000 cc at term

C. Fetal growth process
   1. Fetal development
      a. End of third month—sex can be distinguished
      b. End of fifth month
         i. Fetal heart tones can be detected
         ii. Fetal movement felt by mother
      c. End of sixth month—may be capable of survival if born prematurely
      d. End of seventh month—excellent chance of survival if born prematurely
      e. Middle of tenth month—term
   2. Maintenance of fetal vital processes
      a. Oxygen and nutritional needs supplied via the placenta and umbilical vessels
      b. Fetal circulation
         i. Differs from extrauterine circulation
         ii. Blood is shunted around lungs
         iii. Umbilical vein carries oxygenated blood
         iv. Umbilical arteries carry arteriovenous blood to placenta
         v. Fetal structures that cause congenital defects if not closed at birth
            (a) Ductus venosus connects umbilical vein and inferior vena cava
            (b) Foramen ovale connects right atrium auricle to left atrium auricle
            (c) Ductus arteriosus connects the pulmonary artery and the aorta
      c. Changes in fetal circulation and respiratory function that occur at birth
         i. Lungs begin to function
         ii. Foramen ovale closes
         iii. Ductus arteriosus and ductus venosus shrivel up

D. Obstetric terminology

1. Antepartum—before delivery
2. Postpartum—referring to the maternal period following childbirth
3. Prenatal—existing or occurring before birth
4. Natal—connected with birth
5. Primigravida—a woman who is pregnant for the first time
6. Primipara—a woman who has given birth to her first child
7. Multigravida—a woman who has been pregnant several, or many times
8. Multipara—a woman who has borne several or many children

Assessment of the Obstetric Patient

A. History
   1. Obstetric history
      a. Length of gestation
      b. Para and gravida
      c. Previous cesarean sections
      d. History of gynecologic or obstetric complications in the past
   2. Presence of pain
      a. Onset—gradual/sudden
      b. Character
      c. Duration/evolution with time
      d. Location/radiation
   3. Presence, quantity and character of any vaginal bleeding
   4. Presence of other discharge
   5. Current general health and prenatal care, complications
   6. Allergies and/or medications
   7. Maternal urge to push
   8. Anticipation of multiple births
B. Physical exam
   1. Recognition of pregnancy—early signs and symptoms
      a. Breast tenderness
      b. Urinary frequency
      c. Missed period
      d. Nausea, vomiting
   2. Evaluation of uterine size
      a. Between 12–16 weeks—above sympyhsis pubis
      b. At 24 weeks—level of umbilicus
      c. At term—near xiphoid process
   3. Presence of fetal movements (approximately 20th week of gestation)
   4. Presence of fetal heart sounds (approximately 20th week. Normal 120–160 beats per minute)
   5. Vital signs—orthostatic if other than normal labor
      a. For orthostatic vital signs the patient should be in a recumbent position for 5 minutes
      b. Take BP and pulse
      c. Sit or stand patient up; repeat vitals

If mother has had prenatal care she will be aware of multiple birth.

d. A rise in pulse rate of greater than 20 beats/min or BP drop of greater than 15 mmHg is considered significant
e. Be prepared for syncope
f. Do not do orthostatic vitals if patient is obviously in shock

6. If indicated, examine for crowning, vaginal bleeding
7. NEVER perform a vaginal exam

Complications of Pregnancy

A. Conditions unrelated to pregnancy
1. Trauma
a. Minor injuries common due to syncopal episodes, lack of coordination, loosening of joints
b. Major trauma victims more susceptible to life threat due to increased vascularity of pregnant uterus
c. With abdominal trauma, the following may occur:
i. Premature separation of the placenta
ii. Premature labor or abortion
iii. Rupture of the uterus
iv. Fetal death
d. Causes of death of the fetus with maternal trauma
i. Death of the mother
ii. Separation of the placenta
iii. Maternal shock
iv. Uterine rupture
v. Fetal head injury
2. Medical
a. Acute appendicitis
b. Acute cholecystitis
c. Infectious disease
d. Other maternal medical conditions

B. Aggravation by the pregnancy of prior disease processes
1. Diabetes
a. Becomes unstable during pregnancy
b. Hypo or hyperglycemic coma may occur
2. Essential hypertension
a. May be complicated by preeclampsia or eclampsia
b. Complications include cerebral hemmorhage, cardiac or renal failure
3. Neuro-muscular disorders—may be aggravated by pregnancy
4. Cardiac disorders
a. Cardiac output increased
b. Additional strain of cardiac function is already compromised

C. Bleeding
1. Abortion
a. Pathophysiology
i. Definition—the termination of pregnancy at any time before the fetus has attained a stage of viability

The major cause of fetal death.

- ii. Classifications:
  - (a) Spontaneous—an abortion that starts of its own accord. Commonly called a miscarriage
  - (b) Criminal—an abortion performed illegally often under less than desirable aseptic conditions by an unskilled person
  - (c) Theraputic—termination of pregnancy for maternal health reasons or by choice of mother
- iii. Includes (spontaneous)
  - (a) Usually occurs before the 12th week
  - (b) Occurs approximately 1 in every 10 pregnancies
- iv. Predisposing factors to spontaneous abortions
  - (a) Imperfect embryos
  - (b) Severe acute infections
  - (c) Common if mother was treated with DES

b. Assessment
- i. History
  - (a) History of passing tissue
  - (b) Abdominal pain and cramping—slight to severe
  - (c) Evidence of infection
- ii. Physical exam
  - (a) Orthostatic vital signs
  - (b) Examine for amount of vaginal bleeding, presence of tissue (bleeding may vary from spotting to profuse hemorrhage)
  - (c) Evaluation for volume depletion

c. Management
- i. Oxygen
- ii. IV(s) crystalloid solution
- iii. If shock present, pneumatic antishock garment
- iv. Reassure patient psychological support
- v. Transport

2. Ectopic pregnancy

a. Pathophysiology
- i. Definition: fertilized ovum implants anywhere other than uterine cavity (tube, 95% ovary, cervix, or abdominal cavity)
- ii. Incidence—1 of every 200 pregnancies
- iii. Predisposing factors
  - (a) Previous tubal infections
  - (b) Adhesions from previous surgery
  - (c) Tubal ligations
  - (d) Presence of IUD

b. Assessment
- i. History

Despite legalization of abortion some individuals still utilize unskilled abortionists. The EMT-P may later see these patients presenting with sepsis.

(a) Symptoms of early pregnancy nausea, vomiting, breast fullness, fatigue
(b) Lower abdominal pain—mild to severe, usually diffuse
(c) Last normal menstrual period—may have been 6–8 weeks prior with intermittent spotting
(d) Shoulder pain (present in 15–20% of cases)
(e) History of previous ectopic pregnancy
(f) History of previous pelvic infection

ii. Physical exam
(a) Vital signs may deteriorate rapidly
(b) Abdominal/rebound tenderness may be present
(c) Vaginal bleeding may be absent, spotty or profuse

c. Management
i. Oxygen
ii. IV(s) large bore crystalloid solution
iii. Careful monitoring of vital signs and cardiac rhythm
iv. Consider pneumatic anti-shock garment
v. RAPID early transport

3. Abruptio placenta
a. Pathophysiology
i. Premature separation of placenta from its uterine attachment
ii. Degrees of premature separation
(a) Partial—concealed or obvious hemorrhage
(b) Complete—concealed hemorrhage
iii. Predisposing factors
(a) Preeclampsia
(b) Hypertension of any cause
(c) Multiple pregnancies (multiparity)
(d) Trauma
(e) Short umbilical cord

b. Assessment
i. History
(a) Pain may be sudden, constant and severe
(b) Abdomen very tender
(c) Vaginal bleeding may be absent to heavy
(d) May have past history of abruption
ii. Physical exam
(a) Uterus is tender and may feel tightly contracted
(b) Fetal heart tones may be absent
(c) Character of bleeding—usually dark blood

c. Management
i. Oxygen
ii. IV(s) large bore, crystalloid solution
iii. Careful monitoring of vital signs
iv. Pneumatic antishock garment if indicated

It has been said that any female in child bearing years has an ectopic pregnancy until proven otherwise. Have a high index of suspicion—ectopic pregnancy is a significant cause of maternal death.

Occurs in every 400 deliveries.

Occult hemorrhage occurs if the fetal head is engaged or the placenta is partially separated but the margins are intact.

25-60% of all abruptions occur in preeclamptic mothers.

Shock is often out of proportion to blood loss.

Inflate legs first, consult base regarding inflation of abdominal section.

v. RAPID, early transport
vi. Definitive treatment—cesarean section if fetus is viable

4. Placenta previa
   a. Pathophysiology
      i. Placenta implants in the lower uterine segment—placenta partially or completely covers the internal cervical os
      ii. Previa may be:
         (a) Total—placenta completely covers os
         (b) Partial—placenta partially covers os
         (c) Marginal—placenta is adjacent to but does not extend beyond the margin of os
      iii. Incidence
         (a) Total placenta previa—rare
         (b) Partial or marginal occur in one of every 200 deliveries
      iv. Bleeding usually begins in third trimester as cervix begins to efface
      v. Predisposing factors
         (a) Multiple pregnancies (multiparity)
         (b) Rapid succession of pregnancies
         (c) Age over 35 years
   b. Assessment
      i. History
         (a) Patient generally a multigravida
         (b) Placenta can be traumatized by intercourse or examination
         (c) May have history of vaginal bleeding during early pregnancy
         (d) History of previous placenta previa
      ii. Physical exam
         (a) Bleeding may be profuse and painless, bright red
         (b) May be associated with uterine contractions
         (c) On palpation, uterus may be soft with no tenderness
         (d) Baby may be in an abnormal position
   c. Management
      i. Oxygen
      ii. IV(s) large bore crystalloid solution
      iii. Careful monitoring of vital signs
      iv. Pneumatic antishock garment if indicated
      v. RAPID, early transport
      vi. Definitive treatment, cesarean section

D. Medical Complications
   1. Braxton-Hicks contractions
      a. Physiology and incidence
         i. Begin during early weeks of pregnancy and occur throughout
         ii. Painless—patient may or may not be conscious of them

Fetal mortality is 100% in complete abruption and 30-60% in partial abruption.

Any painless bleeding late in pregnancy is considered placenta previa until proven otherwise

Leg sections may inflate. Contact base regarding inflation of abdominal section.

Braxton-Hicks are benign phenomena that may simulate labor.

iii. Account for false labor near term

b. Assessment—differentiate from progressive labor

c. No special management techniques necessary

2. Eclampsia/preeclampsia

a. Pathophysiology

i. Hypertensive disorder specific to pregnancy that occurs late in pregnancy or soon after delivery

(a) Preeclampsia—nonconvulsive state

(b) Eclampsia—convulsive state/coma

ii. Characterized by:

(a) Sudden hypertension

(b) Sudden excessive weight gain

(c) Edema, usually most pronounced in hands and face

(d) Protein in the urine and

(e) Decreased urinary output

iii. Cause unknown

iv. Predisposing factors

(a) Occurs most often in first pregnancy

(b) Multiple pregnancy

(c) Chronic hypertension

(d) Diabetes mellitus

v. Differentiation from epilepsy

(a) History of epilepsy or previous seizures with pregnancy

(b) Eclamptic seizure has no aura

vi. Complications

(a) Cerebral hemorrhage

(b) Renal failure

(c) Pulmonary edema

b. Assessment

i. History

(a) Excessive weight gain

(b) Headaches

(c) Visual problems

(d) Epigastric pain

(e) Apprehension

(f) Seizures with eclampsia

ii. Physical exam

(a) Edematous

(b) Pale

(c) May be hyperreflexic

(d) Elevated BP

c. Management

i. If seizure has not occurred

(a) Keep patient calm and quiet

(b) IV line TKO D5W

Preeclampsia and eclampsia occur in 5% of all pregnancies, mortality in eclampsia patients is 5-15%. It is the 2nd leading cause of maternal death.

Usually occur after the 20th week of pregnancy.

Evaluation made on basis of pre-pregnancy BP. Since young adults normally demonstrate relatively low

(c) Darken the environment if possible
(d) Position on side
ii. If seizure has already occurred in addition to the preceding:
(a) Maintain airway
(b) Oxygen
(c) Diazepam 5–10 mg IV
iii. Definitive treatment may be induction of delivery
3. Supine-hypotensive syndrome
a. Pathophysiology
i. Occurs near term when abdominal mass is large
ii. Abdominal mass compresses inferior vena cava when patient supine, reducing venous return thereby reducing cardiac output
iii. May be related to marginal volume in some patients
b. Assessment
i. History
(a) Generally occurs when the mother lies supine
(b) Question for signs and symptoms of blood loss
ii. Physical exam
(a) Evaluate for volume depletion
(b) Obtain orthostatic vital signs
c. Management
i. If volume depletion is not present
(a) Place patient left lateral recumbent position
ii. If volume depletion is suspected
(a) Oxygen
(b) IV(s) large bore crystalloid solution
(c) Monitoring of vital signs and cardiac rhythm
(d) If indicated, pneumatic antishock garment (inflate legs only)
(e) Transport

Deliveries

A. Normal
1. Stages of labor
a. First—from onset of regular contractions to complete dilatation of cervix
b. Second—from full dilatation of cervix to delivery of baby
c. Third—from delivery of baby to delivery of placenta
2. Characteristics of labor
a. Signs of true labor
i. Discomfort in back and abdomen
ii. Contractions occur at regular intervals
iii. Progressive increase in frequency and intensity of contractions
b. Progression of labor

pressures, preeclampsia may exist without high readings. In general an elevation of 30 mmHg systolic or 15 mmHg diastolic is considered hypertensive in these patients.

Transport without lights & sirens. Lights & loud noises may precipitate a seizure.

Treatment of choice in hospital is magnesium sulfate 2-4 gm IV of 10% solution.

Length varies with number of deliveries. Averages 6-12 hours.

Also varies 20-90 minutes.

Averages 10 minutes, may be longer.

Contractions are timed from the beginning of one cycle to the beginning of the next.

i. During first stage contractions begin as short, slight and 10–15 minutes or more apart
ii. During second stage, contractions are strong and longer, last 50–70 seconds and occur at intervals of 2–3 minutes
iii. Membranes frequently rupture during second stage
iv. Toward end of second stage the urge to bear down or push becomes very strong

3. Processes relating to labor and delivery
   a. Effacement—the thinning and shortening of the cervix
   b. Cervical dilatation—stretching of the opening of the cervix to accomodate birth of the fetus
   c. Crowning—phase in the second stage of labor when a large part of the top of the fetal head is visible in the vaginal opening
   d. Presenting part—the part of the infant that presents first at the os of the cervix
4. Management decisions regarding transport
   a. Decision to expedite transport or remain for delivery related to imminence of delivery
      i. Number of pregnancies—shortened labor with multiple pregnancies (multiparity)
      ii. Frequency of contractions—contractions less than 2 minutes apart may signal imminent delivery
      iii. Maternal urge to push
      iv. Crowning
   b. Also related to presence of complications
      i. Prior rupture of amniotic sac; potential for fetal infection increased, delivery may be more difficult
      ii. Abnormal presentations
      iii. Fetal distress
5. Management if delivery is imminent
   a. Prepare a delivery area
   b. Consider maternal O_2 administration
   c. Establish an IV route for volume expansion
   d. Position the patient on her back and drape appropriately if possible
   e. Monitor fetal heart rate
   f. Coach mother in breathing techniques, pushing with contractions
   g. Don sterile gloves
   h. Control of fetal head by gentle pressure
   i. If membrane covers the baby's head as it emerges, tear the sac with the fingers to permit escape of amniotic fluid
   j. Examine infant's neck for presence of umbilical cord wrapped around neck
      i. If possible slip over head
      ii. If cord is tight, clamp cord in 2 places and cut between clamps. Avoid excessive tension on the cord
   k. Suctioning of infant's mouth and nose with a bulb syringe

Occurs during first stage of labor.

Occurs during first stage of labor.

These steps presume that time is available.

Panting helps prevent bearing down, deep breathing between contractions encourages relaxation. Avoid contamination by fecal material.

l. Support as the head rotates
m. Support shoulders as they deliver
n. Delivery of baby—do not lower baby below level of vagina
o. Clamp umbilical cord twice approximately 4 inches from baby and cut between clamps
p. Resuction infant, wipe dry, inspect cord, wrap baby warmly in a dry blanket and position on side with head lowered 10–15 degrees
q. Note time of birth
r. Delivery of placenta. Transport with mother
s. Fundal massage to stimulate contraction of the uterus if bleeding is excessive
    i. Support the lower uterine segment with the edge of one hand
        (a) Little above the symphysis
        (b) Massage the fundus with the other hand
        (c) This procedure allows the uterus to be cupped between the two hands and supported as it is massaged
        (d) Massage should be continued until the uterus assumes a woody hardness
        (e) Avoid overmassage
t. Manage perineal tears by direct pressure
u. Continue to observe the mother for signs of hemorrhage, check vital signs

B. Abnormal
  1. Cephalopelvic disproportion
    a. Pathophysiology
        i. Causes
            (a) Contracted pelvis
            (b) Oversized baby
            (c) Fetal abnormalities
        ii. Implications for mother and fetus
            (a) Fetal demise
            (b) Uterine rupture
    b. Assessment
        i. History
            (a) Primigravida—frequently
            (b) Having strong, frequent contractions for a prolonged period of time
        ii. Physical exam
            (a) Fetus may appear to be large on abdominal exam
            (b) Labor not progressing normally
    c. Management
        i. O_2 administration
        ii. IV line for volume expansion
        iii. Transport

This prevents over or under transfusions of blood to or from the placenta altering the infants optimal blood volume.

Positioning helps expedite drainage and prevent aspiration.

There is no need to delay transport for delivery of placenta. Placenta may be placed in a plastic bag to keep intact for later examination.

iv. Definitive treatment—cesarean section
2. Fetal abnormalities that complicate labor
   a. Fetus too large due to:
      i. Maternal diabetes
      ii. Large size of parents
      iii. Multiparity
      iv. Post maturity
   b. Congenital abnormalities
      i. Hydrocephalus
      ii. Conjoined twins
      iii. Fetal tumors
3. Abnormal fetal positions and their management
   a. Breech presentation
      i. Pathology
         (a) Presentation is buttocks or feet
         (b) More common in premature infants
         (c) Increased risk for delivery trauma and anoxia
         (d) High incidence of cord prolapse
      ii. Management
         (a) Delivery best accomplished in the hospital
         (b) If field delivery is required:
            (i) Position mother with buttocks on edge of bed
            (ii) Assist mother to hold legs in flexed position
            (iii) Do not pull on infant's legs
            (iv) Allow the body to be delivered with contractions only
            (v) Support body once the arms are delivered to prevent injury
            (vi) When head is past the pubis, gentle traction may be applied until mouth appears over the perineum
            (vii) If head is not delivered and baby is breathing spontaneously with face pressed against vaginal wall
               (aa) Place gloved hand in vagina, palm facing infant face
               (bb) Form V with the fingers on either side of the baby's nose
               (cc) Push vaginal wall away from face
   b. Other abnormal presentations
      i. Presentations
         (a) Occiput posterior presentation
            (i) Face looks up instead of down
            (ii) Will spontaneously deliver in most multiparous patients
            (iii) Commonly delays labor in primigravidas
         (b) Face presentation

In general the field management of delivery of abnormal presentations should be to support the infant as it is delivered.

Occurs in approximately 3.5% of breech presentation deliveries a term. Increases with prematurity

Most common position

Incidence is 1 in 600 deliveries.

- (i) Face presents rather than vertex
- (ii) May require cesarean section
- (c) Brow presentation
  - (i) Brow presents rather than vertex
  - (ii) Vaginal delivery usually not possible
- (d) Transverse presentation
  - (i) Fetus lies transversely or across the width of the uterus
  - (ii) Fetus cannot enter the pelvis for vaginal delivery
  - (iii) If membranes rupture, umbilical cord may prolapse
  - (iv) Condition may be assessed by observing/palpating the unusually large width of the uterus
- ii. Management
  - (a) Early recognition of complication
  - (b) Provide reassurance for mother
  - (c) Rapid transport for definitive management

4. Prolapsed cord
   - a. Pathology
     - i. Cord is compressed between the presenting part and the bony pelvis, shutting off fetal circulation
     - ii. Predisposing factors
       - (a) Abnormal presentations
       - (b) Multiple birth
       - (c) Premature birth
       - (d) Premature rupture of membranes when presenting part is not sufficiently engaged
   - b. Management
     - i. If umbilical cord is seen or felt in vagina, insert 2 fingers to elevate presenting part of cord, distribute pressure evenly when occiput presents
     - ii. Check for pulsations of cord
     - iii. Position mother in knee chest position or Trendelenberg
     - iv. High flow O_2
     - v. Immediate transport
     - vi. DO NOT attempt to push the cord back
     - vii. Definitive treatment may be cesarean section
5. Other complications
   - a. Multiple births
     - i. Assessment
       - (a) Mother may suspect or know
       - (b) Abdomen remains large after delivery of first baby
     - ii. Management
       - (a) May be one or two placenta
       - (b) Tie cord of first baby

Incidence is 1 in 2,000 deliveries.

Incidence 1 in 300 deliveries.

If assistance is available, the exposed cord should be kept moist with a saline dressing. However, keeping pressure off the cord is the EMT-P's primary concern.

The incidence of multiple pregnancy is 1 in 90.

(c) Infants in multiple births are generally smaller and have special needs for warming

6. Precipitous delivery
   a. Pathology
      i. A rapid spontaneous delivery of less than 3 hours from onset of labor to birth
      ii. Mother is usually grand multipara
      iii. Primary danger is to the baby from cerebral trauma or tearing of umbilical cord
      iv. Mother may suffer lacerations of tissues
   b. Management
      i. Have an index of suspicion
      ii. Do not turn your attention from the mother
      iii. Be prepared for rapid delivery
      iv. Keep baby warm—infant may have difficulty with temperature regulation

C. Maternal complications of labor and delivery
   1. Post partum hemorrhage
      a. Pathophysiology
         i. Definition—loss of more than 500 cc of blood in the 24 hours after giving birth
         ii. Incidence—fairly common complication/at least 5% of deliveries
         iii. Causes
            (a) Lack of uterine tone
            (b) Vaginal or cervical tears
            (c) Retained pieces of placenta
            (d) Clotting disorders
            (e) Uterus fails to return to normal size following delivery—late postpartum hemorrhage
      b. Assessment
         i. History and predisposing factors
            (a) Large infant
            (b) Multiple birth
            (c) Multiple pregnancies
            (d) Placenta previa
            (e) Abruptio placentae
            (f) Precipitate labor
            (g) Prolonged labor
         ii. Physical exam
            (a) Must rely heavily on patient's clinical appearance and vital signs
            (b) Uterus feels soft on palpation
            (c) Continued blood loss
         iii. Late hemorrhage—date of delivery
      c. Management

Process requires 5-6 weeks.

It is difficult to accurately estimate blood loss.

i. Fundal massage
ii. Oxygen
iii. Place infant at mother's breast if just delivered
iv. IV(s) large bore crystalloid
v. Pneumatic antishock garment
vi. Oxytocin per order
  (a) Pharmacology and actions
    (i) Hormone which increases electrical and contractile activity in uterine smooth muscle. Oxytocin can initiate or enhance rhythmic contractions at any time during pregnancy, but the uterus is most sensitive at term
    (ii) Exhibits rapid onset (minutes), very short half-life, rapid inactivation and excretion
  (b) Indications
    (i) Stimulate immediate postpartum contraction of uterus
    (ii) Control postpartum uterine bleeding, especially if uterine massage is ineffective or patient is in shock
    (iii) Labor augmentation (in hospital only)
  (c) Precautions
    (i) Prior to its administration, the presence of a second fetus must be considered. Administration with utero in utero can cause rupture of uterus and/or death of fetus
    (ii) Administraition should follow delivery of placenta whenever possible
  (d) Administration
    (i) Injectable oxytocin (Pitocin) contains 10 USP units (20 mg) per ml
    (ii) Intravenous dose: 10–20 USP units in 1,000 ml crystalloid. Flow rate of 20–30 drops/min titrated to severity of hemorrhage and uterine response
    (iii) Intramuscular dose: 10 USP units (1 ml) IM only if unable to start IV
  (e) Side effects and special notes
    (i) In large amounts oxytocin exhibits a transient but marked vasodilating effect and reflex tachycardia
    (ii) Cardiac arrhythmias may be precipitated or aggravated by oxytocin
    (iii) Uterine spasm, uterine tetanic contraction uterine rupture
vii. *Do not* attempt to force delivery of placenta
viii. *Do not* pack vagina
ix. Immediate transport

2. Uterine rupture
  a. Pathophysiology

Rare complication. When it occurs there is a high

i. Occurrence before or after onset of labor (most frequent)
ii. Predisposing factors
(a) Trauma
(b) Previous cesarean section
(c) Prolonged or obstructed labor
(d) Abnormal presentations

b. Assessment
i. History
(a) Abdominal pain continuous, becoming progressively worse
(b) May start with normal labor then contractions cease as uterus ruptures
ii. Physical exam
(a) Profound shock
(b) External blood loss may be minimal (concealed hemorrhage)
(c) Fetal heart tones absent
(d) Abdominal tenderness with rebound

c. Management
i. Oxygen
ii. IV(s) large bore crystalloid solution
iii. Monitoring of vital signs, cardiac rhythm
iv. Pneumatic antishock garment, leg compartments
v. RAPID, early transport
vi. Definitive treatment if occurs before delivery cesarean section with repair/removal of uterus

3. Uterine inversion
a. Pathophysiology
i. After birth of infant, uterus turns inside out
ii. Produces profound shock
iii. Causes
(a) Pulling on umbilical cord
(b) Attempt to express placenta when uterus is relaxed

b. Management
i. Position patient supine
ii. O_2 administration
iii. DO NOT attempt to detach placenta or pull on cord
iv. IV(s) large bore crystalloid solution
v. Try once to replace the uterus manually, exerting pressure on area surrounding the cervix. If this does not work, pack all protruding tissue with moist towels.
vi. RAPID, early transport

4. Pulmonary embolism
a. Pathophysiology
i. Cause—usually venous thromboembolism
ii. Incidence

mortality rate for mother and infant.

Rupture may be complete or incomplete.

(a) One of most common causes of maternal death
(b) More common following cesarean section

b. Assessment
   i. History
      (a) May occur anytime during pregnancy, labor or in postpartum period
      (b) Sudden onset of dyspnea
      (c) Sudden onset of sharp, focal chest pain
   ii. Physical exam
      (a) Tachycardia
      (b) Tachypnea
      (c) Hypotension

c. Management
   i. Oxygen
   ii. IV line TKO D5W
   iii. Monitor vital signs and cardiac rhythm
   iv. Rapid transport

Introduction

Care of the neonate reviews the routine care of the newborn infant including those with special needs, care of the distressed infant and neonatal transport. Care of the neonate is compounded by the fact that the EMT-P now has two patients—mother and infant. When complications or life-threatening problems are not present, the EMT-P should remember that this is a very important time psychologically for both mother and child, and should provide a supportive environment for them to become acquainted

Care of the Neonate

A. Routine care of the newborn
   1. Clamping the cord
      a. Do not strip or milk the cord
         i. Increases RBC destruction leading to hyperbilirubinemia
         ii. Polycythemia increases blood viscosity leading to cardiopulmonary problems
      b. Hold infant at level of vagina following delivery
      c. Cord may be clamped 30–45 seconds after birth
      d. Inspect cord at intervals for blood loss
   2. Position head to the side and slightly lower than body to facilitate drainage of fluid and prevent aspiration
   3. Airway management
      a. Suction
         i. Use bulb syringe or DeLee suction unit
         ii. Suction mouth and nose
         iii. Further suction as required
   4. Stimulation
      a. If infant does not cry and stimulation is needed, gentle rubbing along the back will usually be sufficient
      b. Avoid vigorous spanking or rubbing

Take care not to oversuction & deprive infant of oxygen & irritate mucus membranes.

5. Heat loss
   a. Occurs normally in all newborns and can endanger the infant. Management aimed at minimizing loss
   b. Heat loss occurs by
      i. Evaporation—most extensive form of heat loss
      ii. Convection—dependent on temperature and velocity of air in the room
      iii. Conduction—occurs between infant and surfaces he contacts
      iv. Radiation—infants lose heat to colder surfaces or objects
   c. General management of heat loss
      i. Rapid drying of infant
      ii. Keep environment temperature at 23–24 degrees C (74–76 degrees F)
      iii. Prevent air drafts
      iv. Keep warm, dry blankets on infant
      v. Do not keep towel on infant that was used to dry him
      vi. Well insulated hot water bottles or rubber gloves filled with warm water
6. Evaluation
   a. Vital signs
      i. Pulse 150–180 at birth, slows to 130–140 per minute
      ii. If pulse is below 100 per minute, asphyxia is present and resuscitation indicated
      iii. Crying indicates good respiratory effort
      iv. Respiratory rate 40–60 per minute
   b. Apgar scoring chart
      i. Purpose to identify and differentiate infants who require routine care and those needing further assistance
      ii. Performed at:
         (a) One minute following birth
         (b) Five minutes following birth
      iii. 2 scores help to:
         (a) Identify infants who need intervention
         (b) Observe whether or not intervention has the desired effect
      iv. Parameters
         (a) Heart rate
         (b) Respiratory effort
         (c) Muscle tone
         (d) Reflex response to stimulation
         (e) Color
      v. Scoring system for each parameter
         (a) 0
         (b) 1
         (c) 2
      vi. Scoring ranges

Hypothermia can cause acidosis which leads to shock. Hypothermia predisposes pre-mature infants to respiratory distress syndrome.

If available, a stockinet cap for the infants head will retard heat loss.

See "Care of the Distressed Infant"

(a) 7–10 = active, vigorous infant, routine care
(b) 4–6 = moderately depressed infant, requires stimulation to breathe and O_2
(c) 0–3 = severely depressed infant, immediate ventilatory assistance

B. The premature infant
  1. Assessment
    a. Less than 5.5 pounds (2500 grams)
    b. Born before 38th week of gestation
    c. Are at risk for:
      i. Hypothermia
      ii. Volume depletion
      iii. Respiratory problems
      iv. Cardiovascular problems related to hypoxia
  2. Management
    a. Keep warm
    b. Keep airway clear
    c. Prevent bleeding from umbilical cord
    d. Prevent contamination

C. Care of the distressed infant
  1. Resuscitation—concerned primarily with
    a. Ventilation
    b. Oxygenation
  2. IV's, drugs and cardiac care are generally not indicated
  3. Suctioning, drying and keeping infant warm are especially important in the distressed neonate
  4. Stimulation
    a. Gentle rubbing along the back
    b. Gently slapping soles of feet
  5. Oxygen
    a. 4–5 L/min from tubing or mask held near the face
    b. Guideline for administration—if infant is pale or cyanotic, give O_2 until pink
    c. Toxicity in field delivery unlikely since administration time is short
  6. Ventilatory assistance
    a. Mouth-to-mouth and nose if bag and mask are not available
    b. Bag and mask
      i. Use only infant resuscitation bag, DO NOT use adult equipment
      ii. Monitor chest expansion closely
    c. Avoid use of oral airways—impossible to keep in place
    d. Use clear infant size masks—allows visualization of nose and mouth
    e. Bagging techniques
      i. Maintain head in sniffing position

Premature infants have particular difficulty maintaining body temperature and have special needs for warming.

Blowing oxygen directly into the trigeminal area of the face causes apnea.

Gastric distension will occur with either of these procedures

- ii. Pull chin upward
- iii. Avoid hyperinflation
- f. DO NOT use mechanical resuscitators—may lead to over inflation
- g. Endotracheal intubation
- h. Rate
  - i. 30–40 breaths/minute
  - ii. Observe for decreased respiratory drive with hyperventilation
7. Cardiac compressions—refer to AHA recommendations
8. Meconium staining
   - a. Presence of meconium in amniotic fluid may indicate distress
   - b. May be due to
     - i. Placental insufficiency
     - ii. Obstruction of cord
   - c. If inhaled may cause severe lung inflammation
   - d. Management
     - i. Frequent and vigorous suctioning before first breath
   - e. Report presence of meconium staining to physician

D. Neonatal transport
1. Major problems during transport:
   - a. Maintenance of body temperature
   - b. Controlled O_2 administration and ventilatory assistance
2. Heat sources
   - a. Keep ambulance warm
   - b. Hot water bottles or rubber gloves; temperature of water less than 40 degrees C (104 degrees F); protect infant from hot water bottles with several layers of blanket
   - c. Aluminum foil wrap
   - d. DO NOT use chemical heat packs
   - e. Commercial heat sources available
     - i. Radiant heating units
     - ii. Heated mattress

Fresh meconium is bright green in color. Old meconium is less bright in color.

Infants in shock are more susceptible to burns.

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Division 6: Behavioral

Section 1. Behavioral Emergencies

TOPIC	CONTENT OUTLINE
Introduction	Prior to participating in this section, the student must have successfully completed: Division 1: Prehospital Environment All sections Division 2: Preparatory All sections
Overview	This section contains 1 subsection:
Objectives	Upon the completion of this section, the student will be able to:

6.1.1 Define the term "Behavioral Emergency."

6.1.2 List factors that may alter the emotional status of the ill or injured.

6.1.3 List those factors specific to the pediatric patient experiencing emotional crisis.

6.1.4 List the techniques of management of all children who are emotional.

6.1.5 List those factors specific to the elderly patient experiencing crisis.

6.1.6 Define the following terms:
- a. Anxiety
- b. Confusion
- c. Anger
- d. Emotional crisis
- e. Conversion reaction
- f. Fear
- g. Depression.

6.1.7 List the proper verbal communication techniques useful in managing the emotionally disturbed patient.

6.1.8 List the reasons for taking appropriate means to insure the safety of the paramedic.

6.1.9 Describe the reason for reassuring the patient experiencing an emotional crisis.

6.1.10 Describe the circumstances when bystanders and relatives should be removed from the scene

6.1.11 List those factors that increase the risk of suicides.

6.1.12 Describe those behaviors that are indirect indicators of an impending suicide attempt.

6.1.13 Describe those overt behavioral modifications associated with:
- a. Rage
- b. Hostility
- c. Suicide
- d. Violence
- e. Depression
- f. Hyperactivity
- g. Paranoia.

6.1.14 Define the following terms:
- a. Facilitation
- b. Confrontation

c. Open-ended questions
d. Affect
e. Posture
f. Mental status.

6.1.15 Describe the techniques that facilitate the systematic gathering of information from the disturbed patient.

6.1.16 Describe the techniques that are useful in managing the effects of crisis situations on the EMT-P.

6.1.17 Define the term "debriefing" as a technique for controlling EMT-P stress following a stress situation.

6.1.18 Describe the techniques that may be useful in redirecting anxiety in relatives and bystanders.

6.1.19 Describe the appropriate action of the EMT-P when confronted by the uncontrollable armed patient.

6.1.20 Describe the appropriate techniques used in restraining the patient.

6.1.21 Describe those techniques useful in protecting the EMT-P when attacked by a violent patient.

6.1:22 List those situations in which the EMT-P is expected to restrain or transport a patient forcibly and against his will.

6.1.23 List the appropriate communications of significant findings to the resource hospital.

6.1.24 Describe the techniques that are useful in managing the effects of crisis situations on the RMT-P.

6.1.25 Define the term "debriefing" as a technique for controlling EMT-P stress following a stress situation.

TOPIC	CONTENT OUTLINE
Introduction	A. Understanding why this area of paramedic practice is stressful 1. Feelings of "uncertainty" by paramedic due to: a. Difficulty in determining cause of crisis b. Lack of scientific tools to assess situation i. Very few protocols developed for pre-hospital care ii. Protocol approach to care does not insure positive outcome c. Final outcome not as predictable as physical injury or illness B. Paramedic response to stress covered by "uncertainty" 1. Avoidance of behavioral situations 2. Disbelief that intervention affects outcome 3. Reluctance to learn more about intervention 4. General lack of confidence in ability to deal with and make a difference in outcome C. Purpose of this section is to teach that: 1. Intervention is possible 2. Intervention is essential or crisis may get worse 3. Paramedics can make the significant difference 4. Psychiatric situations can be evaluated in an organized manner
Understanding Behavioral Emergencies	A. Definition: Change in a person caused by intrapsychic, environmental, situational, or organic alterations resulting in behavior that cannot be tolerated by person or others and requires immediate attention B. Key elements: 1. Change in person resulting in change in behavior a. Intrapsychic b. Environmental/situational c. Organic 2. Inability to deal with change 3. Reaction by person or others to change in behavior 4. Immediate intervention required
Intrapsychic Causes Expanded	A. Behavioral changes must result from within the person 1. Wide range of behavior can be manifested 2. May be result of an acute episode of an underlying psychiatric condition 3. Behavior may result in: a. Depression b. Withdrawal c. Catatonic state d. Violence e. Suicidal acts f. Homicidal acts g. Paranoid reaction h. Phobia i. Hysterical conversion j. Disorientation/disorganization

B. Aberrant behavior resulting from acute stage of an underlying psychiatric condition is not as common as other causes in the pre-hospital setting

Interpersonal/ Environmental Causes Expanded

A. Reaction to stimuli from outside the person
B. Often described as overwhelming incidents
   1. Death of a loved one
   2. Rape
   3. Natural disaster (flood)
   4. Manmade disaster (war)
C. Change in behavior can frequently be linked to a specific incident or series of incidents
D. Range of behavior very broad and often related to type of incident

Organic Causes Expanded

A. Disturbance in physical/biochemical state can cause significant changes in behavior
   1. Drugs
   2. Alcohol
   3. Trauma
   4. Illness (diabetes-electrolyte imbalance)
   5. Dementia
B. Area of brain affected by disturbances determines change in behavior
C. Substance abuse-pathologic use of substances that significantly interfere with normal activities
   1. Alcohol abuse very common
      a. Often complicates an underlying problem
      b. CNS depressant
      c. Assessment:
         i. Etoh odor
         ii. Slurred speech
         iii. Unsteady gait
         iv. Often slow to respond
         v. Frequently evidence of consumption (i.e., empty bottles, reports from bystanders, etc.)
   2. Drug abuse-either prescription or street drugs
      a. Much more difficult to evaluate due to variety of drugs
      b. Assessment should include:
         i. Vital signs
         ii. Pupil reaction
         iii. Observe the scene for evidence of drugs taken, i.e., containers
         iv. Route of administration—IV, PO, Resp., Nasal
         v. Behavior with substance is unpredictable from one patient to another
            (a) Withdrawal
            (b) Suicidal
            (c) Violent

(d) Homicidal
(e) Hysterical

D. Trauma may cause significant changes in behavior
   1. Abnormal intracranial pressure
   2. Decreased circulation to brain
   3. Hypoxia due to hypo-perfusion

E. Medical illness resulting in psychological imbalance may cause changes in behavior
   1. Diabetes—patient may exhibit:
      a. Confusion
      b. Slurred speech
      c. Unsteady gait
   2. Electrolyte imbalance
      a. Confusion
      b. Violence
      c. Extreme anxiety

F. Dementia—organic brain syndrome
   1. Actual damage to brain cells
      a. Caused by poor circulation or lack of oxygen
      b. Often associated with aging
      c. Patient often experiences:
         i. Loss of recent memory
         ii. Impaired judgement
         iii. Poor insight
      d. Onset usually slow and gradual

G. Important to consider the possibility of organic causes in all behavioral emergencies
   1. Physical assessment is a normal routine in all patients
   2. Assessment may uncover an unsuspected drug substance
   3. Important to rule out physiologic causes

Assessment of Behavioral Emergencies

A. Because of the high incidence of emergency-medical-provider injury, evaluating the scene for possible danger must be the highest priority

B. If paramedic has additional responsibilities as a law enforcement officer or firefighter, this description of situation assessment may not apply

C. Paramedics must realize they cannot assist or render medical care if they become victims

D. Avoid—unless you are adequately trained or have appropriate backup:
   1. Patient with weapons
   2. Riot scenes
   3. Fire scenes
   4. Hostage situations
   5. Radioactive sites

E. If potential danger is minimal then the scene should be observed for possible evidence of patient care information
   1. Evidence of violence

2. Evidence of substance abuse
3. Evidence of suicidal attempt

Patient Assessment

A. Gather pertinent information necessary for immediate management of life-threatening conditions
   1. Sources of information
      a. Observation
      b. Information volunteered by patient
      c. Information gained by interviewing patient
      d. Information by family, bystanders, and/or first responders
   2. Use of systematic approach to gather information is critical
      a. Personal items
      b. Precipitating situation/problem
      c. Current life situations
      d. Recent history
      e. Past history
      f. Mental status
      g. Affect and physical signs
      h. Behavior
      i. Draw conclusions from assessment

Techniques for Obtaining Information

A. Checklist is usually not practical
B. Much of the required information can be both direct and indirect questioning
C. Patient should be allowed to take the lead in the assessment situation unless:
   1. Essential information must be obtained before it will be lost
   2. The patient is depressed or minimally responsive
   3. Patient is suicidal
D. If a patient is reluctant to respond to some questions, EMT-P should not press, or patient may withdraw completely
E. EMT-P must not be judgemental

Interviewing Techniques

A. Limited interviews may be conducted in the field
   1. The situation will dictate the scope of the interview
   2. Only information critical to the field management and transportation of the patient should be gathered (unless volunteered by the patient)
   3. The patient's emotional condition will affect what information can be obtained
   4. Any interview should be open-ended, unless:
      a. Essential information must be gathered immediately, (i.e., "What did you take?")
      b. The patient will not talk at all
   5. An EMT-P should be prepared to spend whatever time may be required in the management of such a patient (s/he should not rush), unless physical condition dictates it or patient is in imminent danger to himself or someone else

TOPIC	CONTENT OUTLINE
Guidelines [for] Management of the Interview	A. Remove the person from the crisis situation and exclude disturbing persons and objects B. Communicate confidence in yourself, honesty, firmness, and reasonableness on important issues C. Rather than agree or disagree on distortions of reality, realize that these distortions are real for him D. Encourage the person to sit and relax E. Encourage the person to speak freely in his own words F. When the person begins talking, interrupt as little as possible G. Do not be afraid of long silent periods—remain relaxed and attentive H. If the patient stops talking to express emotion (i.e., cry), do not forestall such expressions by talking I. Facilitate the patient's effort to relate his story by encouraging nods of your head and an occassional phrase such as "I see; tell me more" J. Try to build a sense of structure if the patient views the total situation as chaotic and unexplainable K. Do not argue with the patient if he disagrees with you L. If you must ask questions to keep the interview moving, avoid yes-no questions M. Position yourself so as not to intimidate the patient N. Do not attempt to outyell a disturbed patient O. Do not touch patient unless he indicates this is allowable
Crisis in the Pediatric Patient	A. Carefully consider the child's developmental stage. Children respond differently at each stage B. Children under six 1. Become concerned when separated from the parent 2. Fear pain 3. Fear disapproval 4. Do not usually understand description of treatment C. Children 7–12 1. Tolerate limited separation from parents 2. Become more independent 3. Cooperate and understand simple instructions 4. Have begun to develop defenses for coping D. Children 12–18 1. Strive for independence 2. Have potential conflicts with parents 3. Body image very important
Management of the Emotionally [Di]sruptive Child	A. Avoid separating the younger child from the mother B. Attempt to prevent the child from seeing things that will increase emotional responses C. Explanations should be brief, simple, and repeated often D. Be calm and speak slowly E. Identify yourself with both your name and your function

F. Telling the child the truth will develop trust. For example, if a procedure is going to hurt, it is best to tell the child
G. Encourage the child to help with the procedure. Example, holding the tape
H. Touching is important and is reassuring. Example, holding a hand
I. Do not discourage the child from crying
J. If there is to be separation between you and the child, be sure to introduce the other person who will be taking over
K. Allow the child to take a favorite blanket or toy
L. Do not leave the child alone even for a short period

Crisis in the Elderly Patient

A. Chronological age is not an adequate indication of the patient's physical or mental status
   1. Avoid categorizing by numerical age
   2. Many elderly people are still independent
B. Problems associated with aging
   1. Physical
      a. Organic brain syndrome
      b. Chronic conditions
      c. Decrease in eyesight, hearing, etc.
   2. Emotional
      a. Depression
      b. Death
      c. Retirement
      d. Loneliness

Crisis Management

A. Assess their ability to communicate
B. Continual reassurance is important
C. The loss of sight and hearing can often be compensated for by reassuring physical contact
D. Treat them with respect. Call them by name and proper title. Do not use "Dear" or "Honey"
E. Avoid medicating
F. Describe what you are going to do
G. Take the time necessary to reduce the "hurry up" feeling
H. Allow family and friends to remain with the patient if possible
I. Constant orientation. Asking where you are is assessing. Telling where you are is orienting

Psychiatric Disorders

A. Common disorders
   1. Depression—external causes:
      a. Grief reactions
      b. Situational reactions
   2. Depression—internal causes:
      a. Frozen anger
      b. Guilt
   3. Symptoms: The patient usually seems sad

a. The person may exhibit persistent pessimism—"It'll never be better"
b. The person may exhibit a tendency to cry easily
c. The person may exhibit feelings of hopelessness, worthlessness, and isolation
d. The person may exhibit withdrawal from social relationships
e. The person may be agitated and overly active, or may be very lethargic and slow
f. The person may exhibit a loss of appetite

B. Suicide—primary motivations
1. Loss of effective communication/feelings of hopelessness
   a. Attempts may be made to communicate directly—"I don't want to live"
   b. Indirect communication—"I am angry with you"
   c. Manipulation or relationships
      i. The person attempts to arouse sympathy or anxiety in others
      ii. The paramedics response must not depict anxiety
2. Ambivalence—survival is man's strongest instinct
   a. This person cannot decide to live or die and the suicide drive ebbs and flows
   b. In management of this type of patient, an EMT-P should make use of the patient's own desire to live
3. Assessment of suicide potential—risk factors
   a. Age and sex as factors
      i. More men are successful at committing suicide than women
      ii. Men use more violent means (guns, knives) than women, (pills, razors)
   b. The suicide plan
      i. Assess how relatively lethal the method selected is (i.e., gun vs a few pills)
      ii. Assess how available the method selected is (i.e., is the gun in the patient's hand or in his possession)
      iii. Assess how specific the plan is—the more specific and detailed, the greater the suicide potential
      iv. Prior attempt
   c. Stress precipitates suicidal behavior
      i. An EMT-P should evaluate stress from the patient's point of view
      ii. If stress and symptoms are high, the suicide potential is high
      iii. If symptoms are severe and stress is low, either the facts are incomplete or the patient is chronically unstable
   d. Symptoms
      i. Most symptoms relate to depression
      ii. Agitation is exhibited through tension, guilt, feelings of anger, or revenge
      iii. Agitation may occur in alcoholics and drug addicts

iv. Agitation may occur with psychotic states

4. Resources
    a. Inquire as to what resources are available to help lend support in the suicidal crisis (e.g., family, close friends, physicians, or clergy)
    b. Consider aspects of the patient's life that may provide a resource (e.g., his job or other aspects providing self-esteem)
    c. Remember that with no support available or all sources exhausted, the suicide potential is great
5. Lifestyle
    a. Two basic life-styles of a suicidal person are:
        i. A previously stable life-style with no history of suicidal behavior
        ii. Unstable life-style with a history of poor adjustment and repeated difficulties with major situations
    b. Response to an acute suicidal situation in a stable individual must be responsive and active
    c. In dealing with an unstable person, the paramedic must be slower, brief and consistent
6. Communication
    a. Determine if communication still exists between the suicidal person and others
    b. Note that communication may be either verbal or nonverbal, direct or indirect
    c. Note that communication among everyone involved must be open and clear
7. Management of a suicidal crisis
    a. Gain access to the patient
        i. Breaking in may be necessary
        ii. An EMT-P should not break in if the patient is conscious and willing to talk through the barrier
    b. Consider armed individuals as potentially homicidal, as well as suicidal
    c. Give emergency care, if required, first priority
    d. Conduct a brief interview to assess the situation and determine further action
    e. Remember, every attempted suicide must be evaluated by a physician; summon police help if needed

C. Rage, hostility, and violent behavior—the disruptive patient
1. These behaviors are not specific to psychiatric emergencies, but symptoms of an underlying problem
    a. May be a response to an illness
    b. May be a way of dealing with feelings of helplessness
2. The paramedic must not respond with anger or defensiveness
    a. A one-to-one discussion should occur in a separate room, if conditions permit
        i. Tell the patient what he can expect from you and your crew

ii. Tell the patient what you expect from him
iii. If the patient is angry with you, ask him why
iv. Tell the patient you are there to help him
v. Tell the patient what you want him to do then allow him to comply

b. If hostility and violent behavior cannot be circumvented through "talking him down," restraint may be necessary
   i. Don't threaten and then not follow through
c. Understanding and professionalism are most important in this type of situation
d. If the situation cannot be controlled by the paramedic, appropriate law enforcement personnel must be notified quickly

D. Paranoid reactions may be present in patients with otherwise normal personality traits
   1. Patient may function normally under most circumstances
   2. Acute anxiety may result in an emergence of paranoid reactions
   3. Greatest need is to check the *validity* of the patient's observations
      a. Development of the patient's trust in others is necessary
      b. The paramedic may provide a cooler, more objective point of view
   4. Disabling paranoid reactions may appear in psychotic patients
   5. Paranoia—onset may occur in several ways:
      a. Sudden and dramatic
         i. Sudden internal or external crisis overwhelms adaptive and defensive systems
         ii. Prolonged period of increasing stress suddenly causes a conscious paranoid reaction
      b. Preceded by a well-marked incubation period
         i. The patient's first reactions to stress are marked by partial or complete withdrawal
         ii. The patient tries to privately seek a unifying "explanation"
         iii. Suddenly, everything becomes "clear"
      c. Gradual, insidious onset, without sudden crystallization
   6. In management of paranoid reactions the paramedic should:
      a. Clearly identify himself and explain what he is trying to do
      b. Showing kindness and warmth may be interpreted as an attempt to gain the patient's confidence in order to "get" the patient
      c. Show an attitude that is friendly, yet somewhat distant and neutral
      d. Never respond to any patient's anger
      e. Do not speak with informants in hushed, secretive tones; this will reinforce paranoid delusions
      f. Interview informants in the patient's presence and with his permission if possible
      g. Use tact and firmness in persuading the patient to go to a hospital
      h. Do not lie to any patient, especially the paranoid patient

E. Hysterical conversion reaction

1. The displacement and projection of some inner conflict to a specific part of the body or function (give examples)
   a. Point out that the patient passively accepts his altered function as the evidence that he is ill or disabled
   b. Point out that the conversion reduces tension and anxiety
   c. Point out that when a patient realizes his symptom is emotional in origin, he becomes overly anxious
   d. Management of hysterical-conversion-reaction patients
      i. Do not try to convince the patient that his problem is "all in his head" even though it might be
      ii. Treat the symptoms as if they are real since they may be
      iii. Inform the receiving institution staff of any evidence that the patient may be experiencing a conversion reaction

F. The disorganized and disorientated patient
   1. Uncontrolled and disconnected thoughts characterize a *disorganized* patient
      a. Usually incoherent or rambling in his speech
      b. May be wandering aimlessly
      c. May be dressed inappropriately
   2. Disorganized patients require structure
      a. The paramedic should explain what he is trying to do
      b. The paramedic should explain the patient's role
   3. Disoriented patients usually do not know where they are, what day it is, or even their own name
      a. This situation is common among the elderly
      b. This situation may be complicated by regression
      c. Head injury, drug ingestion, and metabolic disorders may cause disorientation
   4. The disoriented patient should be oriented as to time, place, and person by the paramedic
      a. The paramedic should tell the patient who he is and what he is doing
      b. The paramedic should be patient; several explanations may be required

Management and Intervention Techniques for Behavioral Emergencies

A. Attitude
   1. A professional attitude must be maintained while the paramedic should possess:
      a. Warmth
      b. Sensitivity
      c. Compassion
   2. In dealing with emotionally disturbed patients, an EMT-P should:
      a. Intervene in the situation to the extent he feels capable
      b. Be aware of his own professional limitations
      c. Note that if he is not capable of dealing with the situation, he should seek professional assistance
      d. Not overreact to the patient's behavior or emotional attacks

e. Assess the patient's needs and try to meet them

B. Management: the EMT-P must first assess the risk to his own safety. An injured paramedic is not able to care for others
   1. Remember, life-threatening injuries receive first priority
   2. Take command of the situation
   3. Control the spectators
   4. Assign the bystanders to perform some tasks when appropriate
   5. Accept the patient's feelings; do not tell him how to feel
   6. Use a calm, reassuring attitude as a sedative
   7. Severe anxiety reactions may be avoided in family, friends, and bystanders by good scene management, which might include:
      a. Removal of unnecessary persons from disturbing situations
      b. Unfamiliar people and situations may magnify the problems present
   8. Patient may require support from familiar persons
   9. A physical examination may heighten anxieties in an otherwise stable person
      a. Develop some rapport prior to the examination
      b. Remember, privacy, professionalism, and efficiency must be maintained
   10. Note that in an anxious or confused patient, meticulous explanations of procedures may be required

C. Use of local resources (ask class to list local resources)
   1. Paramedics are members of a team that treats disturbed patients
      a. Paramedics are often the first to see the patient
      b. If paramedics are the first involved, it is their responsibility to facilitate the involvement of the other members of the team
   2. Field crisis workers may be available in some communities
      a. They are specially trained in the field management of emotional crisis-professionals and paraprofessionals
      b. They may be summoned to the scene with a relatively rapid response time
      c. An EMT should contact these individuals to discuss:
         i. Their training
         ii. Their availability
         iii. Situations in which they should be contacted
         iv. The procedures for contacting them
         v. Respective responsibilities at the scene with a relatively rapid response time
      d. Most states have established bureaus of mental health
         i. Often provide referral services for patients
         ii. May be responsible for the administration of involuntary commitment procedures
         iii. May be consulted for specific training requests
      e. Local law enforcement personnel are useful and important in the management of a limited number of emotionally disturbed patients

i. Some emotionally disturbed patients may be transported under arrest
   (a) If so, remember you are acting as an agent of the police
   (b) Require a police officer to accompany you in the vehicle, if possible

ii. A good rapport should always be maintained between ambulance providers and police, especially important in the management of:
   (a) Violent patients
   (b) Homicidal patients

iii. Good communication links are critical to the rapid response of law enforcement personnel when needed

Controlling the Violent Situation

A. Severely disturbed patients who pose a threat to themselves or others may be hospitalized against their will, with legal authorization only
   1. Each state has a statute covering the criteria for involuntary commitment
   2. The paramedic must have a clear understanding of all applicable laws
   3. A standard set of procedures must be developed by every organization providing ambulance service
      a. Seek legal counsel in its development
      b. Follow those procedures closely
      c. The premise upon which most state laws are based suggests that one person may restrain another to protect life or prevent injury

B. If, in the EMT-P's assessment of the patient, he feels the patient may be homicidal, an EMT-P should not attempt restraint
   1. If he is armed, move everyone out of range
   2. Contact law enforcement personnel
   3. Stand by
   4. Avoid heroic efforts

C. If violent behavior must be contained, "reasonable force" may be used in restraining the patient
   1. Seek police authorization
   2. Plan your restraining actions
   3. Use only that force necessary to restrain the patient—do not be overly zealous
   4. Be sure you have adequate manpower (at least four strong individuals)

Methods of Restraint

A. Consider range of motion of joints
   1. Arms cannot flail backward
   2. Legs cannot kick backward
   3. Spinal column does not allow patient to double over backward

B. Consider muscle groups and which motions are achieved with greater power
   1. The flexing of the arm vs straightening of the arm

C. Whenever possible position the patient in such a way that the effectiveness of his strength and range of motion is limited

D. The paramedic must familiarize himself with restraint devices available in his system
   1. Commercially manufactured leather restraints
   2. Improvised restraints using common materials
      a. Small towels or face cloth wrapped around wrist and ankle with strong tape over cloth and secured to cot
      b. Cravats and clove hitch
      c. Webbed straps ordinarily used to secure patient to long boards
      d. Roll bandage
      e. Simple blanket roll

E. When it becomes necessary to restrain a patient the paramedic should not attempt to simply hold the patient for long periods
   1. Sets up a confrontation and may aggravate the situation
   2. Does not allow paramedic the freedom to consider other significant matters (i.e., too busy holding patient to treat)
   3. Continuous physical restraint requires more than one paramedic or assistant per patient

F. Sequence of actions in dealing with an unarmed patient requiring restraint
   1. Make certain you have adequate assistance
      a. Reduces likelihood of injury to patient
      b. Reduces likelihood of injury to paramedic
   2. Offer the patient one final opportunity to cooperate
   3. If there is no response to this statement at least two persons begin to move swiftly toward the patient
      a. Patient can not focus on both paramedics
      b. Swiftness minimizes the accuracy of a potential kick or blow
      c. One paramedic should continue talking with the patient
   4. Both paramedics move close and slightly behind the patient
      a. The paramedics must be cautious and not assume they have complete control at this point
      b. The patient can still kick, bend forward and bite as well as spit and jerk about
   5. If the patient does in fact calm down, the paramedic may decide to transport without restraints (i.e., leather tie-downs of velcro)
      a. Continue to reassure patient
      b. Have the patient lie down
      c. Position himself between the patient and the doors
      d. If the patient becomes dangerous to himself or others, restrain him en route

G. Sequence of actions if the patient continues to resist
   1. The paramedics position their inside leg in front of the patient's leg and forces the patient forward into the prone position
      a. The prone position prevents the patient from using strong abdominal muscles to sit up

b. The arms are more easily restrained
c. The legs are less effective kicking
d. Biting and spitting are effectively controlled

H. Sequence of action to maintain control
1. Paramedic continues to reassure patient
2. Each paramedic maintains grip on the patient's outstretched arm while leaning their weight on the patient's back

I. Positioning and restraining patient on cot for transport
1. Position patient either prone or on his side
a. Allow continual assessment and maintenance of airway
b. Dramatically reduces effective resistance
2. Adjust the cot in its lowest position
a. Improves stability
b. Does not require lifting
c. Short distance if fall occurs
3. Do not allow large muscle groups to complement one another
a. Restrain one arm at the patient's side and the other over his head
4. Place webbed strap directly across lumbar region—do not tighten too tight
5. After applying restraints to ankles and securing the cot, secure the ankle restraints to one another
6. Do not remove restraints until there are adequate resources to control the situation

J. Methods of avoiding injury to the paramedic
1. Positioning in room with hostile patient
a. Remain at safe distance
b. Do not allow the patient to block your exit
c. Keep furniture between you and the patient
d. Avoid threatening statements
e. If there are two paramedics, separate an adequate distance
2. Protection against thrown objects
a. Hold folded blanket in front of arm with foot holding bottom of blanket to the floor
b. Hold blanket out away from your body
c. Blanket will absorb impact of thrown objects and fall to floor
d. Same blanket can be used to wrap the violent patient

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