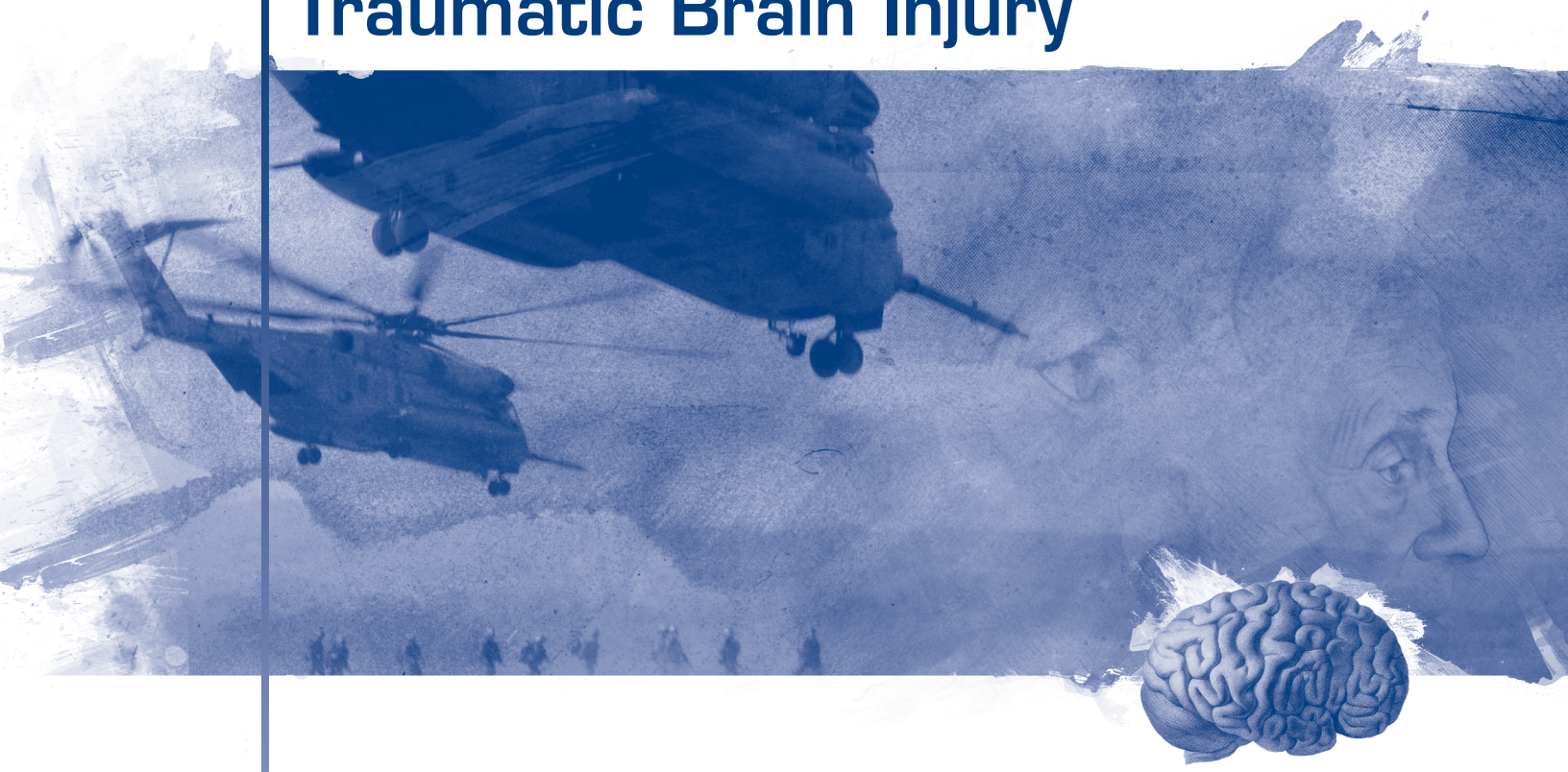
Veterans Health Initiative

Traumatic Brain Injury



Independent Study Course Released: April 2010

Sponsored By:
Department of Veterans Affairs
Employee Education System

This is a Veterans Health Administration System-Wide Training Program sponsored by the Veterans Affairs Employee Education System and the Office of Public Health and Environmental Hazards, Department of Veterans Affairs. It is produced by the Employee Education System.

Department of Veterans Affairs

Employee Education System

Table of Contents

Introductory Material

Content Materials

Appendices

Independent Study Outline

Purpose

This independent study presents an overview of Traumatic Brain Injury (TBI) issues that Primary Care practitioners may encounter when providing care to Veterans and active duty military personnel.

Background

This independent study module is a part of the Veterans Health Initiative (VHI). This VHI is a comprehensive program of continuing education designed to improve recognition and treatment of health problems related to traumatic brain injury.

Objectives

After completing this independent study, participants will be able to:

1. Identify the epidemiology and the nature of TBI;
2. Describe concussion management and treatment of mild TBI;
3. List the rehabilitation process for a Veteran with TBI;
4. Identify medical and physical problems of Veterans with TBI;
5. Identify cognitive problems for Veterans with TBI;
6. Recognize emotional and behavioral problems for Veterans with TBI;
7. Explain TBI in the Elderly and Aging with TBI;
8. List the issues and impact on the TBI survivor and their family;
9. Describe the issues related to driving for a TBI survivor; and
10. Describe the VA TBI System of Care

Outcome

As a result of this program, clinicians will have a broader base of knowledge with which to provide effective care to patients with TBI and a better understanding of patients who experience this condition. Drug treatments and dosages provided in this study guide should be double-checked prior to prescribing therapy.

Target Audience

This independent study is primarily designed for Department of Veterans Affairs clinicians and interested VA staff. Other health care providers, especially those working in Veterans and military health care facilities in the U.S., also are encouraged to complete this study module.

Program Implementation and VA Application Procedures

The estimated study time for this program is 5 hours.

To receive CME credit for this course:

1. Read the independent study materials in this booklet.
2. Complete the CME test questions (located at the back of this booklet) by placing answers on the Independent Study Registration /Answer/ Evaluation Scantron Form (two-sided), which is located at the back of the independent study booklet. A passing score of 70% or higher on the CME test is required to receive credit. For more information on CME credits, please see the AMA and ANCC Continuing Education Credits section located in **Appendix A**.
3. Complete the program evaluation using the Scantron form.
4. Submit the completed Independent Study Registration /Answer/Evaluation Scantron Form to:

Employee Education Resource Center

ATTN: Evaluation Processing Center (EPC)
Medical Forum Suite, 500
950 North 22nd Street
Birmingham, AL 35203-5300

Note: Scantron forms cannot be photocopied. For additional copies of this independent study module, please contact your facility education contact person.

If you have attained a passing score of 70% or higher, a certificate will be mailed to you approximately 6-8 weeks after your test has been graded. The test may be retaken.

If you have questions or special needs concerning this independent study, please contact:

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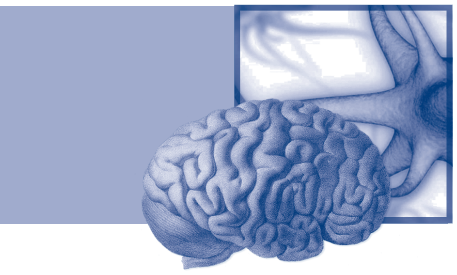


CHAPTER 1: A Conceptual Framework for TBI Assessment and Management

Learning Objectives

- Describe the importance of having a conceptual framework for managing patients with TBI
- State important questions to address in the initial assessment of an individual with TBI

Introduction

Over the last several years, traumatic brain injury (TBI) has been thrust into the forefront of the consciousness of the medical community and the general public. This is in large part due to recent combat operations and subsequent recognition of this potentially "silent injury." Fortunately, TBI has been studied for decades in the academic medical world. This foundation of knowledge guides current diagnostics and interventions.

TBI produces a complex constellation of medical consequences including physical, emotional, behavioral and cognitive deficits. The impact is heterogeneous given the varied types of injury (closed, penetrating, blast), severity, comorbid conditions, and premorbid characteristics. Furthermore, when assessing and supporting recovery, the practitioner must consider the profound impact psychosocial factors have on recovery.

The practitioner managing patients in the federal or private sector must acknowledge the impact of comorbidities that affect successful community re-entry. In particular, the combat experience may contribute to significant and sustained exposure to both physical and psychological trauma. In turn, these experiences can evolve into puzzling comorbidities which blur the diagnostic picture and care plan. The effects of the psychological burden and somatic dysfunction share similar symptom constellations as TBI, which complicates the diagnostic process. Establishing a proper diagnosis is important and can help drive clinical management, though this may not always be a clear-cut option. When complexities exist, referrals should be made to mental health and TBI rehabilitation resources.

Appropriate outcomes and recovery expectations must be integrated early into management strategies. Conceptually, TBI is not a disorder with a hallmark symptom complex. Rather, it is a set of impairments that ultimately affect successful community re-entry. Management strategies of the impairments should be holistic in nature and driven by patient centered goals.

Framework for Developing a Management Plan

Developing a management plan for patients with a historical diagnosis of TBI can be a challenging endeavor. The complex of cognitive, behavioral and physical symptoms is non-specific to TBI. It is shared with numerous other disorders and many symptoms are prevalent in the general population. Furthermore, when seeking care, these individuals tend to be in distress and to possess poor health literacy.

Numerous factors must be considered when an individual with TBI-related concerns presents to a health care provider. The amount of prior treatment and services received varies significantly. Understanding the patient's treatment history will provide valuable information regarding potential first treatment steps. Given the heterogeneity of TBI, it is helpful to establish a conceptual and historical framework for each patient who presents for medical evaluation. Answering the following questions during the assessment process helps to determine patient needs and to formulate management strategies:

01. What brings the patient to seek services at this time?

The reasons the patient gives for seeking services can provide important information regarding the primary factors at play as well as the most appropriate treatments and/or referrals. For example, if the patient is five months post-injury and seeking services for the first time, it becomes critical to understand why the patient is presenting now versus two weeks ago, or two weeks after the injury.

02. What was the medical severity of the initial injury?

Establishing the severity level of the TBI (i.e., severity of the original injury) is a key initial step in evaluating impairments and charting a treatment course. The severity of TBI closely prognosticates the outcome over time and the nature of long term sequelae. For example, the issues encountered with postconcussive syndrome (headaches, balance and working memory deficits) are markedly different from those due to severe TBI (spasticity, hemiplegia, behavioral disinhibition). There is also growing evidence that multiple injuries may negatively affect prognosis. Determining the severity of TBI and recovery patterns is discussed in detail in **Chapters 2 and 4**.

03. What has been the course of recovery from the event?

As a general rule, patients with TBI gradually improve and stabilize over time. A scalloping or stepped recovery course or an acute change in the patient's well being should raise red flags. Specifically, this may indicate

a secondary medical complication specific to TBI (e.g., seizures) or a behavioral change (e.g., depression). An improving course followed by a generalized decline in cognitive and behavioral health is rarely attributable solely to TBI. In particular, anxiety and pain disorders produce unstable patterns of recovery. If these confounders are apparent, multidisciplinary care and referral to specialty services is recommended (see **Chapters 5, 6, & 7**).

04. What services and interventions have been utilized?

The interventions and services received vary greatly among those with a diagnosis of TBI. A detailed history of types and effectiveness of therapeutic and pharmacologic interventions greatly increases the efficiency of care delivery along the continuum of care. The history of previous interventions undoubtedly leads to more appropriate diagnosis and management plans.

05. What is the severity and duration of the symptom complex?

After consultation with TBI clinics, patients with isolated or mild symptoms can generally be effectively managed in primary care settings. When TBI severity and symptom duration increase, practitioners should rely more on specialty services for both diagnostics and care coordination. It is also important to note that these factors undoubtedly affect prognosis for recovery (see **Chapters 5, 6 & 7**).

06. What is the global impact of the patient's current symptoms?

The assessment of the severity of the patient's current impairments should not be limited to a review of systems and reporting of symptoms. They should include assessment of any personality or mood changes, new onset of interpersonal difficulties, and the impact of injury on academic, vocational, and social aspects of current functioning (see **Chapter 4**).

07. Is there a root cause to the current impairment?

Though not always present, establishing the primary driving force behind the impairment can significantly affect recovery. As an example, severe post combat anxiety can present primarily as cognitive and somatic dysfunction. Without aggressive and timely management of this root cause, recovery is highly unlikely (see **Chapter 4**).

08. What is the patient's readiness to change?

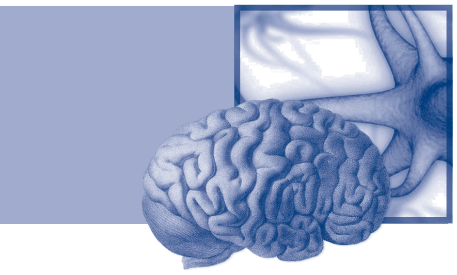
Assessing the patient's readiness to change can assist in establishing effective use of support and consultation services. Application of services that are incongruous with the patient's perceived needs may result in less effective outcomes. Similarly, missing "windows" of readiness can negatively affect outcomes. Establishing a therapeutic alliance with the patients provides the optimum environment to encourage readiness to change.

09. Are there comorbidities that add to the complexity of the presentation?

The TBI diagnosis is often historical based on medical record review or patient self-report. The diagnosis may be supported by non-specific symptoms or made complicated by psychosocial challenges. Other diagnoses have similar presentations to TBI. In particular, post traumatic anxiety disorders and pain syndromes can mimic postconcussive syndromes. It is important to note that "all that is cognitive or behavioral dysfunction is not TBI." When faced with these confounding factors, referral to consultant services is highly recommended (see **Chapters 6 & 7**).

10. How should disability compensation and status affect care?

Individuals with a history of TBI often receive a rating and compensation for "disability". The concept of "disability" can be perceived as both a financial and psychological disincentive to recovery. It is very important to stress that despite a determination of disability, most patients with TBI can improve with appropriate management. It is incumbent upon the practitioner to dispel the myth of "disability" and to attempt to motivate their patients toward wellness.



CHAPTER 2: Epidemiology and the Nature of Traumatic Brain Injuries

Learning Objectives

- Define traumatic brain injury
- State why traumatic brain injury is a significant health problem
- List three common causes of traumatic brain injury
- Describe four indices for classifying severity of brain injury
- Describe the main types of physiological changes in the brain resulting from trauma
- Describe the course of recovery following traumatic brain injury

Traumatic Brain Injury Definition

The Department of Defense and the Department of Veterans Affairs (May 2007), by consensus, have defined traumatic brain injury (TBI) as any traumatically induced structural injury and/or physiological disruption of brain function as a result of an **external force** that is indicated by new onset or worsening of at least one of the following clinical signs, immediately following the event:

1. Any period of loss of or a decreased level of consciousness;
2. Any loss of memory for events immediately before or after the injury;
3. Any alteration in mental state at the time of the injury (e.g., confusion, disorientation, slowed thinking);
4. Neurological deficits (e.g., weakness, balance disturbance, praxis, paresis/plegia, change in vision, other sensory alterations, aphasia.) that may or may not be transient;
5. Intracranial lesion.

External forces. Forces causing brain injury include the head being struck by an object, the head striking an object, the brain undergoing an acceleration/deceleration movement without direct external trauma to the head, a foreign body penetrating the brain, forces generated from events such as a blast or explosion, or other force yet to be defined.

Open Versus Closed TBI. A TBI resulting from something passing through the skull into brain, such as a bullet or fragments from an explosion, is called a penetrating or open head injury. A TBI that results from either an object hitting the head or from the head hitting something forcefully, such as the dashboard of a car, is referred to as a nonpenetrating or closed head injury.

The above criteria define the historical event of a TBI. If a person meets these criteria, they should be diagnosed as having sustained a TBI.

TBI Sequelae. Sequelae of TBI may resolve quickly, within minutes to hours after the event, or may persist longer. Some sequelae of TBI, particularly after moderate or severe injury may be permanent. Most signs and symptoms will manifest immediately following the event, but following more severe injury, other symptoms or complications may be delayed from hours to days (e.g., subdural or epidural hematoma) or even many months (e.g., seizures, hydrocephalus, spasticity, etc.). Signs and symptoms may occur alone or in varying combinations and may result in significant functional impairments. New or worsening signs and symptoms appearing after TBI should only be attributed to the TBI if not better explained by pre-existing conditions or other medical, neurological, or psychological causes. Symptoms generally fall into one or more of the three following categories:

1. Physical: headache, nausea, vomiting, dizziness, blurred vision, sleep disturbance, weakness, paresis/plegia, sensory loss, spasticity, aphasia, dysphagia, apraxia, balance disorders, disorders of coordination, and seizure disorder.
2. Cognitive: difficulties or impairments in attention, concentration, new learning, memory, speed of mental processing, planning, reasoning, judgment, executive control, self-awareness, language, and abstract thinking.
3. Emotional/Behavioral: depression, anxiety, agitation, irritability, impulsivity, and aggression.

Points to Remember

- Traumatic Brain Injury (TBI) is a historical diagnosis
- Sequelae of TBI may resolve quickly, but some impairments may be permanent
- Delayed onset of symptoms or worsening of symptoms over time is uncommon following TBI

Epidemiology of TBI

TBI is a leading cause of death and disability in the United States. One and a half million Americans incur a traumatic brain injury (TBI) each year (CDC, 2007) and approximately 5.3 million individuals have enduring disabilities as a direct result of a TBI (CDC, 2007). These figures likely underestimate the true incidence as military injuries and those with mild injuries may not seek healthcare. Direct costs for hospital care, extended care, and other medical care and services, coupled with indirect costs such as lost productivity were estimated at $60 billion annually in 2000 (CDC 2007; Finkelstein et al., 2006). These figures do not include the physical, emotional, and social costs to the injured person and their family from TBI-related disability. For fiscal year 2009, there were 1,313 Veterans who received VA inpatient hospital care for TBI.

From April 2007 through fiscal year 2009, 66,023 Veterans were identified as possibly having a TBI through outpatient screening of individuals presenting to the VA for health care following deployment in Operation Enduring Freedom or Operation Iraqi Freedom. Of those identified through screening, 24,559 were confirmed to have sustained a TBI.

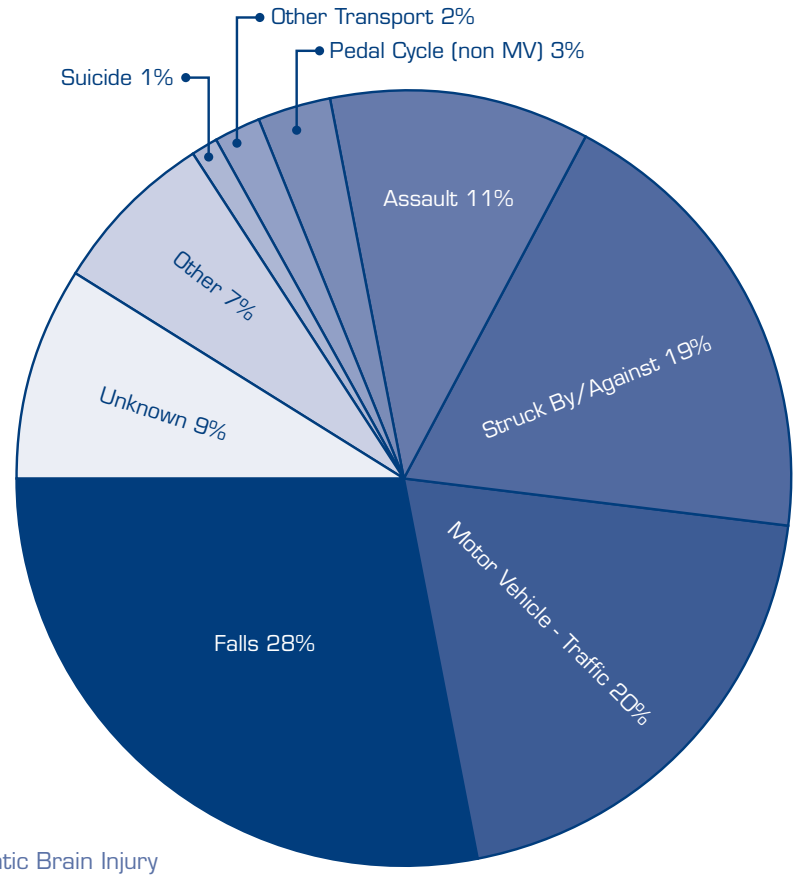
Mortality

Research studies indicate an annual mortality of 50,000 from TBI-related causes (IOM, 2008, Table 3.6). Australian studies found mortality rates of 65% in patients with an admission GCS of 3 decreasing to 10-15% in those with a GCS of 7-13. Older age at time of injury also contributes significantly to mortality. Teasdale et al. (1979) found mortality rates of 39% in a young adult population (21-30 years) versus 95% in patients > 80 years of age who sustained a severe TBI.

Causes of TBI

In the civilian sector the most common means of sustaining a TBI is through falls. Data from the CDC indicate falls account for 28% of all reported TBIs (see Figure 1). Following falls are motor vehicle-related incidents (20%). These include all incidents involving motor vehicles, bicycles, pedestrians, and recre ational vehicles. Firearm use is the leading cause of death related to TBI (CDC, 1999). Blasts in combination with other mechanisms are a leading cause of TBI for active duty military personnel in war zones (DVBIC, 2005).

Figure 1. Most Common Causes of TBI (from http://www.cdc.gov/ncipc/factsheets/tbi.htm)

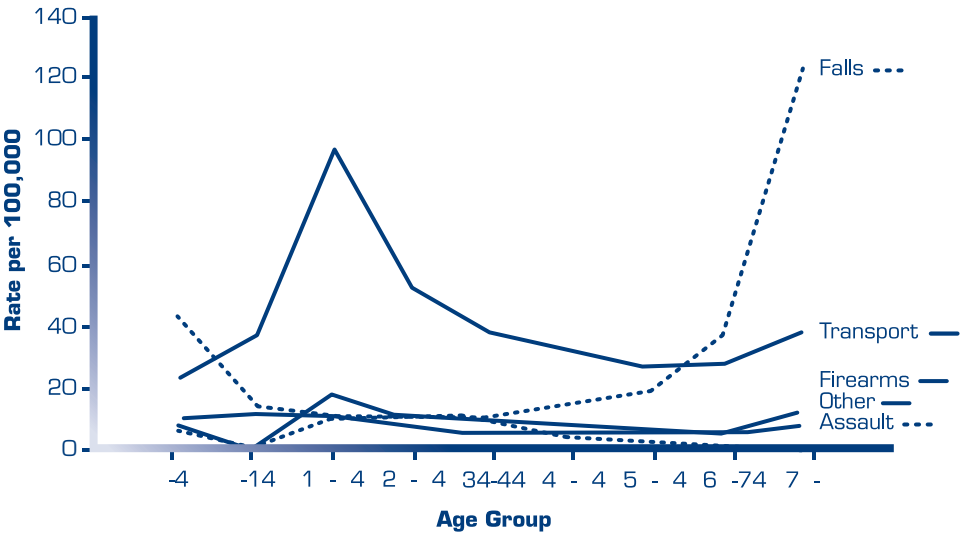


Who sustains a TBI?

Civilians

Males outnumber females by at least 2:1 in frequency of TBIs (Langlois, Rutland-Brown, & Thomas, 2004). Individuals between the ages of 0 to 4 and those 15 to 19 are at high risk for TBI, as are the elderly (see Figure 2). Adults aged 75 and older have the highest rates of TBI-related hospitalization and death (CDC, 2007; Langlois et al., 2004).

Figure2. TBI and Age (from http://www.cdc.gov/ncipc/images/figure10.gif)
Traumatic brain injury rates by age group and cause of injury–Arizona, Colorado, Minnesota, Missouri, New York, Oklahoma, and South Carolina, 1994



Individuals who abuse substances are at increased risk for TBI. Prevalence for alcohol intoxication at the time of injury is about 37 to 51% (Parry-Jones, Vaughan & Miles Cox, 2006). Other risk factors of TBI include lower socioeconomic status and prior TBI (Annegers et al., 1980).

Military

TBI has been called a "signature injury" of Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF). Thirty-three percent of all patients with combat-related injuries and 60% of the patients with blast-related injuries seen at Walter Reed Army Medical Center have sustained a TBI (Okie, 2005). Mild TBI or concussion is one of the most common forms of combat-related injury. Based on self-report data, approximately 15% of troops engaged in active combat in Afghanistan and Iraq may have suffered a mild TBI (Hoge et al., 2008). Additionally, a recent study of the Navy-Marine Corps Combat Trauma Registry revealed that battle-injured were more likely than those injured outside of battle to have multiple TBIs (Galarneau et al., 2008).

Points to Remember

Primary Care providers in the VA and DOD healthcare settings are very likely to encounter individuals who have sustained a TBI because:

- The majority of Veterans and individuals on active military duty are male
- Many active duty service members fall within the age ranges of greater risk
- Recent cohorts of active duty Service Members have undergone multiple deployments with increased exposure to blast or blast-related events.
- The risk of falls increases in the aging Veteran population

Severity of Brain Injury

Severity of TBI is determined at the time of injury. Though severity level has prognostic value it does not necessarily predict the patient's likelihood of functional recovery. Severity of TBI is a continuum and the particular classification used to designate a patient as having mild, moderate or severe injury is somewhat arbitrary. The severity grades, i.e., mild, moderate, and severe, are defined by using one of four indexes:

- Glasgow Coma Scale (GCS)
- length of coma (duration of unconsciousness)
- length of period of altered consciousness or mental status and
- length of posttraumatic amnesia (PTA).

Glasgow Coma Scale (GCS)

The GCS is a 15-point scale based upon ratings of the patient's best eye opening, motor, and verbal responses following an injury (see **Table 1**). Distribution of hospitalized trauma patients diagnosed with TBI based on GCS severity has generally been found to have a ratio of mild to moderate to severe of 8:1:1 (IOM, 2008). While the GCS is recognized as a reliable measurement tool, it is influenced by factors unrelated to the TBI itself such as intoxication, intubation and other injuries, and length of time between the injury and measurement. The GCS is not particularly useful in the assessment of mild TBI/concussion.

Table 1. Glasgow Coma Scale (GCS)

Glasgow Coma Scale	Score
Motor Responses:	
Obeys commands	6
Localizing responses to pain	5
Generalized withdrawal to pain	4
Flexor posturing to pain	3
Extensor posturing to pain	2

Glasgow Coma Scale	Score
No motor response to pain	1
Verbal Responses:	
Oriented	5
Confused conversation	4
Inappropriate speech	3
Incomprehensible speech	2
No speech	1
Eye opening:	
Spontaneous eye opening	4
Eye opening to speech	3
Eye opening to pain	2
No eye opening	1
Total (Add above 3 scores)	Range = 3-15

Coma

Coma or unconsciousness is the time a patient is non-responsive after injury. The duration of coma is one parameter used to determine injury severity; the longer the coma, the more severe the TBI. Although this may appear to be an easy and objective measure, often patients are unaware of whether or not they have had a period of unconsciousness (Levin et al., 1987). In addition, the injury may have been unwitnessed or the patient may have regained consciousness by the time of evaluation.

Alteration of Consciousness (AOC)

Following a TBI an individual may not be rendered unconscious but may nonetheless be confused, disoriented, feels mentally dazed, have difficulty mentally tracking events, and may respond in a confused manner to questions. However, later when questioned about this period of altered consciousness they can recall events from the accident forward to the present.

Posttraumatic amnesia (PTA)

PTA is the time interval from when the person regains consciousness until he or she is able to consistently form memories for ongoing events (Whyte, Rosenthal & Zuccarelli, 2000). During PTA, the individual is neither fully oriented nor able to remember information after a period of distraction. PTA can be influenced by medications that are given in routine trauma care (i.e., pain meds). Retrospectively, PTA can be assessed by asking the patient about the first event which they can remember following the injury, always distinguishing

between what the patient actually remembers and what they have been told by family members. Asking family members how long it was before the patient remembered events of a visit from one day to the next may help establish the duration of PTA. In sports concussions it is not uncommon for an athlete to have an alteration of consciousness (feeling dazed and having a confused response to questions), but not have memory gaps. If this is the case, they would have had an alteration of consciousness, but no period of PTA.

Table 2 presents the severity grades and defining criteria for these indices, as well as neuroimaging findings. If different indices result in different classifications, the most severe classification is typically assigned.

Table 2. TBI Severity Indices

Severity Index	Mild TBI/Concussion	Moderate TBI	Severe TBI
Neuroimaging Findings	Normal structural imaging	Normal or abnormal structural imaging	Normal or abnormal structural imaging
Initial GCS	13-15	9-12	< 9
Loss of Consciousness (LOC)	0-30 min	> 30 min and < 24 hours	> 24 hrs
Length of Alteration of Consciousness (AOC)	a moment up to 24 hours	AOC > 24 hours (use other criteria)	
Length of Posttraumatic Amnesia (PTA)	0 – 1 day	> 1 and < 7 days	> 7 days

DoD/DVA consensus based classification of Closed TBI Severity

Approximately 75% of patients who sustain TBIs have had a mild TBI (CDC, 2003). In mild TBI, there is often no evidence of structural injury on clinical neuroimaging. Mild TBI is believed to result when a traumatic force to the brain triggers a pathologic neurochemical cascade, but is insufficient to produce widespread neuronal dysfunction or the axonal disruption that characterizes more severe brain injuries. The American Congress of Rehabilitation Medicine's (1993) formal definition of mild TBI is presented in **Table 3**.

Table 3. American Congress of Rehabilitation Medicine Criteria for Mild Traumatic Brain Injury

Diagnostic Criteria for Mild Traumatic Brain Injury
I. Traumatically induced physiologic disruption of brain function as indicated by at least one of the following: a. Any period of loss of consciousness b. Any loss of memory for events immediately before or after the accident c. Any alteration in mental state at the time of the accident d. Focal neurologic deficits that may or may not be transient

Diagnostic Criteria for Mild Traumatic Brain Injury

II. Severity of the injury does not exceed:
   a. Loss of consciousness of 30 min
   b. GCS score of 13-15 after 30 min
   c. Posttraumatic amnesia of 24 hr

Unlike moderate to severe TBI, diagnosis of mild TBI often cannot be corroborated with objective diagnostic tools. Furthermore, there is a lack of evidence regarding the long-term impact of mild TBI on functioning. Issues of mild TBI are discussed more fully in **Chapter 4**. The majority of patients with a mild TBI make excellent neurobehavioral recovery (Belanger et al. 2005), but some have persistent symptoms (Luis et al., 2003; Vanderploeg et al., 2007).

When neuroimaging findings or positive signs on an acute neurological examination are present, following what otherwise would be classified as a mild TBI, the classification changes to "complicated mild TBI". "Complicated mild TBIs" have a 6-month outcome more similar to moderate TBI than to an uncomplicated mild TBI (Williams, Levin, & Eisenberg, 1990).

Points to Remember

- Brain injury severity is classified by signs and symptoms at the time of the original injury
- The Glasgow Coma Scale (GCS), duration of coma, and length of post traumatic amnesia (PTA) are common measures of severity of brain injury
- The majority of brain injuries are mild
- A number of nontrauma-related factors (e.g., intoxication or medications) can complicate severity assessment

Cumulative Concussion (Mild TBI)

Most of the data regarding the impact of multiple concussions (multiple mild TBIs) is derived from the sports literature which suggests a possible cumulative effect from multiple concussions (Guskiewicz et al., 2003). With regard to residual adverse effects, any threshold for frequency and severity of concussions has yet to be established. However, there is concern that a second concussion prior to complete recovery from the first may pose increased risk. This is of particular concern in the military and Veteran population given their exposure to multiple training and combat related events that can increase the risk for sustaining a concussion.

Pathophysiology of Injury

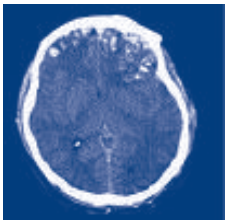
TBI can result in both primary and secondary brain injury. Primary brain injuries are classified as focal, diffuse, or mixed depending on the mechanism of injury and the brain's response. Focal damage, such as contusion or hema-

toma, can be appreciated by standard neuroimaging studies such as CT or MRI. Focal lesions are usually the result of direct impact of the brain against the cranium, most often from impact with the frontal, temporal or occipital bones, but may also occur in penetrating injuries such as gunshot wounds. Widespread disruption of neuronal circuitry or *diffuse axonal injury* (DAI) can be difficult to detect on standard neuroimaging. It is possible to have both types of injury (i.e., focal and diffuse) from a single traumatic event.

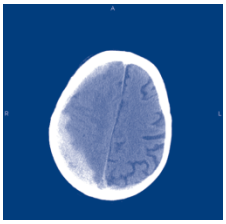
Primary Injuries

Focal Lesions

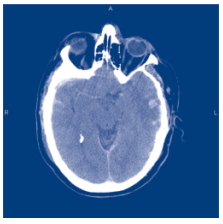
Focal lesions occur primarily in moderate to severe TBI, but should always be a consideration in any head trauma. Focal lesions may include subdural hematoma (SDH), epidural hematoma (EDH), subarachnoid hemorrhage (SAH), intracerebral hemorrhage (ICH), and cortical contusion. Subdural hematomas result when small bridging veins between the skull and the dura are torn resulting in bleeding into the subdural space. This can occur following motor vehicle accidents, falls and other types of trauma. These patients may not always be evaluated at the time of the injury or may not be evaluated for subsequent TBI symptoms when they do receive acute intervention. Elderly individuals are at particular risk for this type of injury following a fall and the primary care physician may be the first to see and evaluate these patients for their symptoms. Epidural hematomas result from damage to dural veins and arteries and can result in rapid deterioration and death if not treated promptly. Subarachnoid hemorrhages result from damage to microvessels in the subarachnoid space and are often associated with cerebral contusions. Intracerebral hemorrhage results from brain laceration and typically occurs in the frontal and temporal areas. Cortical contusions result from direct trauma to the brain parenchyma from impact with boney prominences of the skull. Typical areas of contusions are the frontal, orbital frontal, anterior temporal and lateral temporal areas.



Frontal Contusions



Subdural Hematoma



Traumatic SAH

Diffuse Axonal Injury (DAI)

DAI results from rotational acceleration-deceleration forces. DAI has been observed in pathology studies following mild injuries (Blumbergs et al., 1994). Historically it was thought that the disconnection of axons observed after TBI resulted from the direct tearing and disruption of axons at the time of injury, referred to as primary axotomy. However, it has been shown that primary axotomy is rare, even in severe TBI (Maxwell, Povlishock, & Graham, 1997). Rather, axonal disconnection seems to occur several hours after injury as a

result of events in the axonal membrane and cytoskeleton (Povlishock, Becker, Cheng, & Vaughan, 1983). There may be changes in functional deficits over time as a result of this ongoing process. These pathophysiological changes are observed diffusely throughout the subcortical white matter, corpus callosum, fornix, internal capsules, cerebellum and brain stem (Adams et al., 1989).

Secondary Injury

Following the initial injury to the brain, mechanisms of secondary injury including cellular response and neurochemical and metabolic cascades are set in motion. Contributing to secondary cellular injury are increased excitatory amino acids such as glutamate, neurotoxic free radicals and oxidants, lipases, arachadonic acid, and increased calcium (Graham, 1999; Meythaler, Peduzzi, Eleftheriou, & Novack, 2001). Hypoventilation or elevated intracranial pressure (ICP) can lead to secondary brain injury. Secondary ischemic insults can occur in the form of focal cerebral infarcts or diffuse watershed brain injury from circulatory failure. Secondary brain injury may also result from extracranial causes including hypotension, hypoxia, hyperthermia all of which can exacerbate neurologic injuries.

Points to Remember

- Brain injuries can result in diffuse axonal injuries, focal lesions, or both depending on the mechanism of injury and the brain's response
- Diffuse axonal injury results from inertial (rotational acceleration-deceleration) forces and is thought to be a result of calcium influx and subsequent cytoskeletal damage
- Focal injuries are typically due to a direct blow to the head or penetrating head injury (e.g., GSW) and include subdural hematoma, epidural hematoma, subarachnoid hemorrhage, intracerebral hemorrhage, and cortical contusion

TBI in the Military Context: Blast, Polytrauma, and Psychiatric Comorbidities

Recent military conflicts have increased the likelihood of exposure to high energy blasts and explosions. Currently in OEF/OIF upwards of 78% of combat injuries are the result of explosive munitions (Owens et al., 2008). As a result of this increasingly common mechanism of injury, more Service Members wounded in war are returning with multiple complex injuries. Common injuries in multiple combinations include open wounds, traumatic amputations, TBI, spinal cord injuries, eye injuries, musculoskeletal injuries, and mental health problems. The term "polytrauma" has been introduced to encompass injuries to more than one physical region or organ system that result in physical, cognitive, psychological, or psychosocial impairments and functional disability. These injuries — sometimes called "blast injuries"—occur almost daily in Iraq and Afghanistan as a result of rocket-propelled grenades, improvised explosive devices, explosively formed projectiles, and land mines. Other sources of blast injury during combat are from artillery, rocket and mortar shells, and aerial

bombs. Brain injury is common following blasts and can occur from multiple mechanisms–possibly from direct exposure to the over-pressurization wave, from the impact of blast-energized debris (both penetrating and non-penetrating), from the individual being physically thrown into environmental hazards or from motor vehicle accidents triggered by the blast, and from inhalation of gases and vapors or from anoxic injuries. Non-penetrating concussive injuries may go undiagnosed and untreated as attention is focused on the more "visible" injuries.

The same combat exposure that causes TBI may also result in other comorbidities. Common post-deployment issues, such as posttraumatic stress disorder (PTSD), pain conditions, amputations, acute stress reactions, and substance use/abuse also can result in numerous symptoms overlapping with TBI. **Table 4** presents data from series of patients seen by Scott et al. (2006) illustrating common sequelae of those with blast-related injuries.

Table 4. Common sequelae of those with blast-related injuries from Scott et al. (2006).

Table Commonly Overlooked Blast-Related Conditions in Patients With Polytrauma (N=50)*	
Condition	No. (%)
Concussion	33 (66)
Soft-tissue damage	31 (62)
Posttraumatic stress disorder/acute stress reactions	26 (52)
Nerve damage	21 (42)
Acute or chronic pain	21 (42)
Hearing loss	14 (28)
Chronic infections (eg, sinus)	13 (26)
Vision changes	11 (20)
Lung injury	10 (20)
Vestibular problems	9 (18)
Undiscovered fragments	4 (8)

*From a consecutive sample of patients with blast-related injuries seen at the Polytrauma Rehabilitation Center at the Veterans Affairs Medical Center in Tampa, Fla.

Mental health comorbidities are common in this patient population including PTSD, depression, anxiety, and somatoform disorders. It is recognized that the symptoms associated with PTSD may overlap with symptoms of mild TBI. Disentangling the symptoms of brain injury and PTSD is challenging. PTSD has an estimated prevalence of 13 to 17% in mild TBI (Hoge et al., 2004; 2007)

compared to 5% pre-deployment (Hoge et al., 2004). Hoge et al. (2008) report that more than 40% of soldiers who had symptoms associated with mild TBI with loss of consciousness also met criteria for PTSD. These mental health conditions may account for symptom complaints and clinical presentation. Indeed, some studies have suggested that PTSD and depression may account for most symptom complaints in the chronic phases after mild TBI (Hoge et al., 2008; Chamelian & Feinstein, 2006), though this remains an area of controversy.

Active duty Service Members returning from OEF/OIF are screened for TBI and PTSD as part of the routine military Post-Deployment Health Assessment (PDHA). The TBI screen consists of identifying any injury that resulted in an alteration of consciousness with current symptomology. Patients with positive TBI screens are evaluated with a clinical interview to determine the diagnosis of TBI and appropriate referrals are provided. This screening process identifies Service Members at risk for complications from undiagnosed TBI. For OEF/OIF patients entering the VA healthcare system, similar screening occurs regardless of entry portal. The purpose of this screening is to identify those in need of ongoing TBI-related services. VA TBI screening, evaluation and treatment programs for this patient population are described in **Chapter 3**.

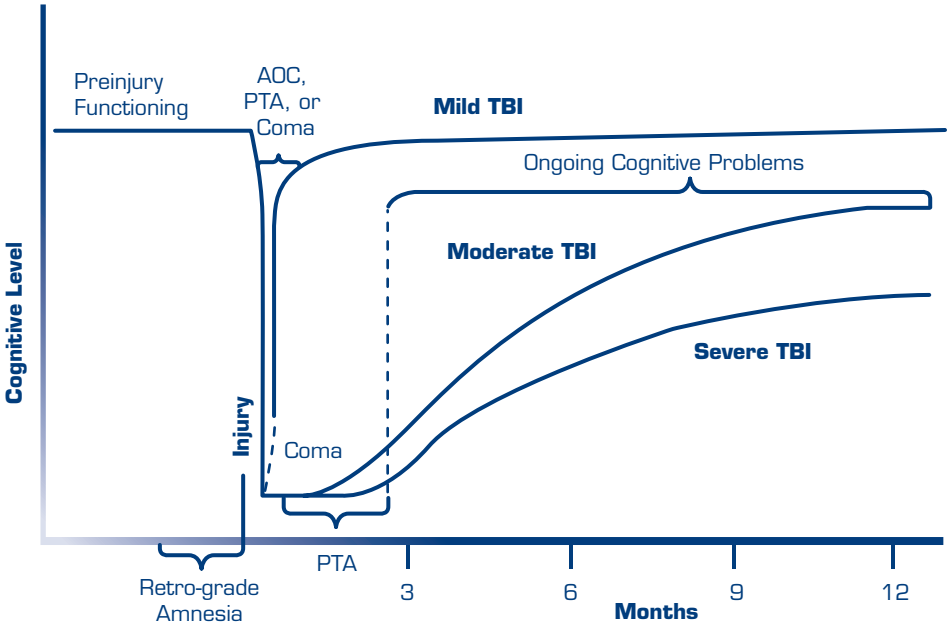
Points to Remember

- The term "polytrauma" has been introduced to encompass injuries to more than one physical region or organ system and which result in ongoing disability.
- Patients who screen positive for mild TBI may have mental health and other physical comorbidities.
- Common post-deployment issues, such as PTSD, pain conditions, acute stress reactions, depression, and substance use/abuse can result in numerous symptoms overlapping with mild TBI sequelae.

Course of Recovery

For those with mild TBI/concussion, the majority recover fully in a short time period (days to weeks). Once medically stabilized, those with more severe injury show the most rapid improvement in the first six months after injury. However, additional recovery can occur for up to 36 months or longer. **Figure 3** illustrates hypothetical recovery paths of cognitive functioning following different severities of TBI.

Figure 3: Hypothetical recovery paths of cognitive functioning.



Mild TBI Recovery

Individuals with mild TBI/concussion typically recover fully in a short time period, particularly in terms of cognitive performance (Belanger et al., 2005; Schretlen & Shapiro, 2003). Nevertheless, about 10-15% continue to report distressing symptoms for months (Alves, Macciocchi, & Barth, 1993; Dikman, McLean, & Temkin, 1986; Powell, Collin & Sutton, 1996) or years post injury (Vanderploeg et al., 2007; Hartlage et al., 2001; Deb et al., 1999). Individuals with repeated mild TBI have an increased potential for persistent symptoms.

Without appropriate interventions, patients who continue to exhibit symptoms for more than 1-3 months are more likely to experience:

- Functional difficulties when trying to return to previous living patterns
- Depression and anxiety, which has an impact on the person's capacity to function
- A tendency to isolate and significantly limit themselves to the comfort of familiar surroundings and routines
- Activity avoidance
- Estrangement from his/her spouse, children, family, and friends

- Suicidal ideations and attempts
- Problems with the law
- A tendency for re-injury

Moderate to Severe TBI Recovery

Persisting functional limitations are common in those with moderate to severe TBI. At one year follow-up, self reported functional limitations were found in up to 47% in hospitalized patients (Pickelsimer, Selassie, Gu, & Langlois, 2006). In another study (Whiteneck et al., 2004) 24% of patients hospitalized with moderate or severe TBI failed to return to work by one year follow-up. Similarly, in a cohort of Vietnam Veterans with penetrating brain injuries, when followed-up 15 years later, only 56% of those with TBI were employed compared with 82% of the uninjured controls (Schwab, Grafman, Salazar & Kraft, 1993). TBI patients also have been found to have higher rates of depression than similar controls (Fann et al., 2004; Jorge & Robinson, 2003; Vanderploeg, Curtiss, Luis & Salazar, 2007).

Recovery from TBI is influenced by multiple factors. These include:

- Age
- Overall general health
- Premorbid functional status (Raymont et al., 2008)
- Psychiatric comorbidities
- Supportive environment (family, work, friends)

Severity of TBI

In the acute phase of recovery (initial several months) rehabilitation professionals frequently use the Rancho Los Amigos Level of Cognitive Function Scale (Hagen, Malkmus, Durham, & Bowman, 1979) to characterize the level of functioning and track the course of recovery. It is a descriptive instrument that characterizes the level of cognitive and behavioral deficits after moderate to severe TBI. Ratings range from Level I, indicative of no response (comatose), to Level VIII, indicative of a person whose behavior is purposeful and appropriate, although not necessarily functioning independently or at premorbid levels. **Table 5** presents the range of Rancho levels and brief descriptions of the characteristics for each level.

Table 5. Rancho Los Amigos Level of Cognitive Function Scale

Rancho Los Amigos Level		Description
I	No Response	Unresponsive to sound, light, touch, or pain. The individual appears to be in a deep sleep.
II	Generalized Response	Individual reacts inconsistently in a nonspecific manner to stimulation. May be gross body movements, unintelligible vocalizations, etc. Earliest response is frequently to deep pain. Responses to stimuli often are delayed.
III	Localized Response	Reacts to specific stimuli (e.g., eye blink to strong light, turns toward sound, etc.). Responses are often inconsistent. May inconsistently follow simple, direct commands (e.g., close your eyes, squeeze my fingers, etc.).
IV	Confused - Agitated	Alert and active but has severely limited ability to process information. Disoriented to circumstances and responds primarily to internal stimuli. Behavior is not purposeful or is bizarre and the ability to focus and sustain attention is extremely limited. Does not differentiate among people or things. Verbalizations may not be coherent or may be patently bizarre. Short-term memory and recall are impaired and may confabulate.
V	Confused - Inappropriate	Alert and active and can respond consistently to simple commands. Disoriented to circumstances and requires redirection but is not responding primarily to internal stimuli. Short-term memory and recall are impaired and may confabulate. May be able to perform self-care activities with assistance and supervision.
VI	Confused – Appropriate	Alert and inconsistently oriented to time and place. Follows simple directions consistently and begins to show carry-over of new learning. Recognizes staff and has increased awareness of self, family, and others.

Rancho Los Amigos Level		Description
VII	Automatic – Appropriate	Alert and oriented to person, place, and time but shows a shallow awareness of medical condition. Performs self-care and daily routines with supervision but in a robot-like manner. Performance may deteriorate in unfamiliar circumstances. Shows carry-over of new learning but at a reduced rate. Judgment and problem-solving remain impaired.
VIII	Purposeful - Appropriate	Alert and oriented. Can recall and integrate past and current events. Shows carry-over of new learning and is independent, within physical limitations, at home and in the community. Cognitive abilities may still be lower than premorbid levels.

Adapted from Hagen et al., 1979.

Points to Remember

- For those with mild TBI/concussion, the majority recover fully in a short time period (days to weeks)
- Once medically stabilized, those with more severe injury show the most rapid improvement in the first six months after injury
- Ongoing recovery can continue for at least 18-36 months following moderate to severe TBI
- Individuals who have sustained moderate to severe TBI frequently never recover to pre-injury functional levels and may have ongoing behavioral difficulties
- The Rancho Los Amigos scale is frequently used to track cognitive recovery from moderate to severe TBI

CHAPTER 3: VA Care and Rehabilitation for TBI and Polytrauma

Learning Objectives:

- The participant will be able to describe the Polytrauma/TBI continuum of care in the VA.
- The participant will be able to make referrals to the most appropriate component in the Polytrauma/TBI System of Care based on Veteran's needs.
- The participant will identify which Veterans are eligible for TBI screening and which Veterans require comprehensive evaluation for TBI following screening.

Introduction

The Department of Veterans Affairs (VA) recognizes traumatic brain injury (TBI) as a priority condition for healthcare services. With the initiation of combat in Afghanistan and Iraq, the impact of TBI was raised to a new level of awareness resulting in the need for an organized system of care to provide initial and life-long services. Because TBI sustained in combat is frequently associated with other injuries, the system of care was designed to provide services for those with isolated TBI as well as multiple injuries or polytrauma. Besides providing services for Veterans, a long-standing national agreement between the Department of Defense and VA provides for transfer of active duty Service Members who have incurred a brain injury to VA medical centers for care.

VA has implemented an integrated nationwide system of care for Veterans and active duty Service Members recovering from TBI and polytrauma. This system is designed to provide care for persons with TBI as an isolated condition or in the context of polytrauma or other comorbidities. It consists of more than 100 VA medical centers; each offering specialized rehabilitation care by an interdisciplinary team. Due to the range in severity and complexity of injuries, Veterans and active duty Service Members with TBI and polytrauma require a specialized model of care coordination and integration of clinical and other support services.

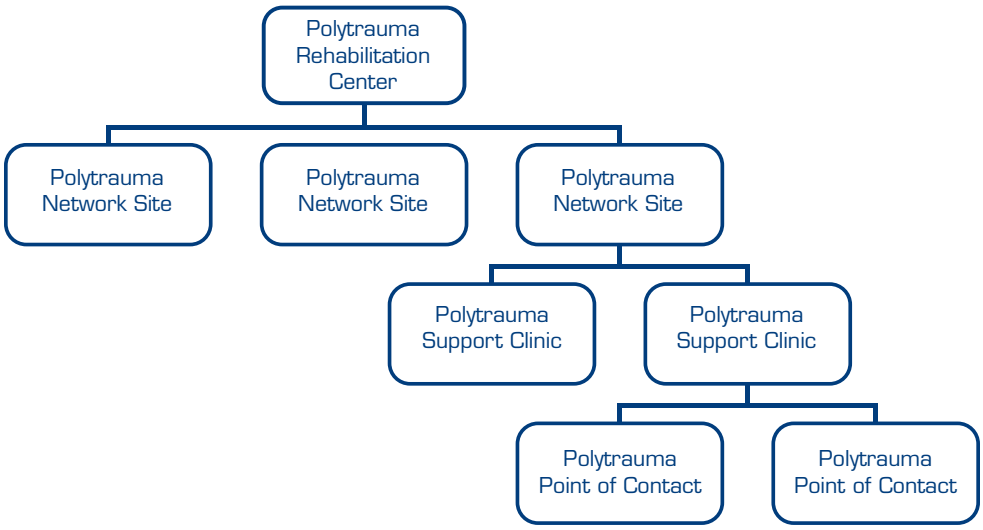
The polytrauma system of care (PSC) balances access and expertise to provide specialized lifelong care. Specialized TBI and polytrauma care is provided at the facility closest to the individual's home with the expertise necessary to manage his/her rehabilitation, medical, surgical, and mental health needs. For highly specialized care, travel likely will be required.

The hallmark of rehabilitation care provided in the PSC is the collaboration of specialists from different disciplines as an interdisciplinary team in the evaluation and treatment of Veterans and Service Members with TBI and polytrauma. Dedicated interdisciplinary teams (IDTs) participate in the assessment, planning and implementation of the plan of care for each patient served in the PSC. The IDT for each patient is determined by their rehabilitation and medical needs. Close interaction and integration among the disciplines on the team ensure that all members interact to achieve the Veteran's goals.

Polytrauma/TBI System of Care (PSC) Components

The VA PSC provides an integrated and coordinated continuum of services for eligible Veterans and Service Members with polytrauma and TBI. The PSC either directly provides, or formally links with, key components of care that address the lifelong needs of individuals with impairments resulting from polytrauma and TBI. The tiered PSC integrates specialized rehabilitation services at regional centers, network sites and local VA medical centers:

POLYTRAUMA SYSTEM OF CARE



Polytrauma Rehabilitation Centers (PRC)

PRCs are located at the VA medical centers in Minneapolis, MN; Palo Alto, CA; Richmond, VA; and Tampa, FL. The PRCs serve as regional referral centers for acute medical and rehabilitation care, and as hubs for research and education related to polytrauma and TBI. They provide a continuum of rehabilitation services that include: specialized "emerging consciousness" programs,

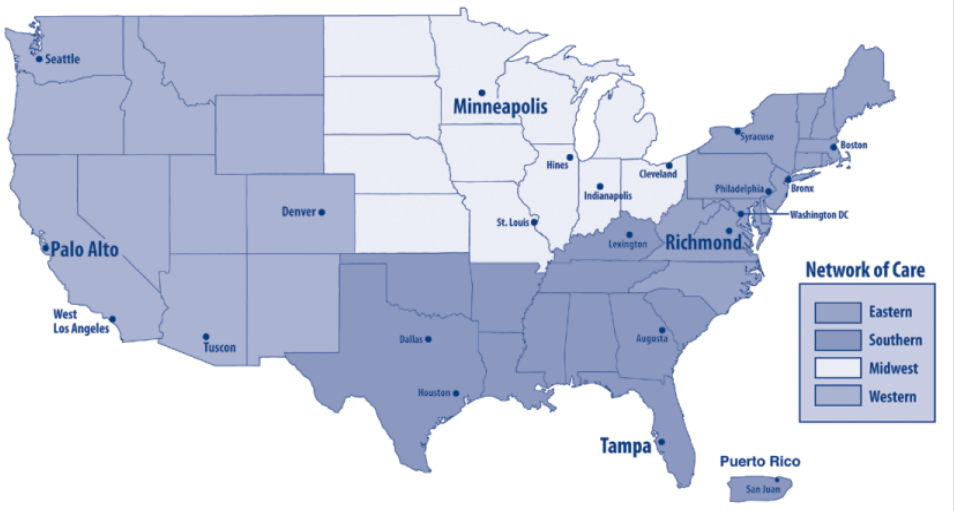
comprehensive acute rehabilitation care for complex and severe polytraumatic injuries, outpatient programs, and assistive technology evaluation and training, and residential transitional rehabilitation programs (PTRP).

Polytrauma Network Sites (PNS)
Polytrauma Network Sites (PNS) provide post-acute rehabilitation for Veterans and active duty Service Members with polytrauma and TBI who reside within their VISN catchment area. This includes inpatient rehabilitation for those transitioning closer to home, comprehensive outpatient TBI evaluations, a full range of outpatient therapy services; evaluations for durable medical equipment (DME) and assistive technology, access to other consultative specialists, and follow-up care and case management for ongoing rehabilitation needs. There is one PNS in each VISN, except VISN 8 which has two. In VISNs with a PRC, the PRC facility also operates as the PNS.

Polytrauma Support Clinic Team (PSCT)
Polytrauma Support Clinic Teams (PSCT) provide interdisciplinary outpatient rehabilitation services in their catchment areas for Veterans and Service Members with mild and/or stable impairments from polytrauma and TBI. Services include comprehensive TBI evaluations, outpatient therapy services, management of stable rehabilitation plans referred from PRCs and PNSs, coordinating access to VA and non-VA services, and follow-up care and case management for ongoing rehabilitation needs.

Polytrauma Point of Contact (PPOC)
A PPOC is identified in every VA facility that is not otherwise designated as one of the PSC components described above. The PPOC ensures that patients with polytrauma and TBI are referred to a facility and/or program capable of providing the level of rehabilitation services required. PPOCs commonly refer to the PNS and PSCTs within their VISN

Polytrauma/TBI Regional Centers and Network Sites



Points to Remember

- VA has a Polytrauma/TBI national system of care composed of four components:
  - Polytrauma Rehabilitation Centers (PRCs) are regional referral centers for acute and complex medical and rehabilitation Polytrauma/TBI care
  - Polytrauma Network Sites (PNS) provide post-acute rehabilitation, help transition patients closer to home, and provide outpatient TBI evaluations and treatment
  - Polytrauma Support Clinic Teams (PSCT) provide outpatient interdisciplinary rehabilitation evaluation and treatment services
  - Polytrauma Point of Contact (PPOC) at each VA facility ensures that patients with polytrauma and TBI are referred to an appropriate program for their care

PSC Scope of Services

Persons having sustained a TBI may require different levels of TBI specific and other supportive care throughout their lives. The typical treatment course begins with evaluation and acute rehabilitation and progresses to post-acute care in the community for ongoing sequelae. For patients who are unable to return home, long term care settings, such as assisted living, medical foster home or nursing home care, may be required. Care is provided in the least restrictive setting possible. Ongoing follow-up assessment of the TBI survivor is key to managing sequelae and preventing development of secondary conditions.

Comprehensive Interdisciplinary Inpatient Evaluations

Short-term admissions are scheduled to inpatient rehabilitation programs for comprehensive interdisciplinary evaluations for patients with varying levels of acuity and severity. These evaluations typically occur at PRCs or PNSs and help determine the range and types of services needed to manage the full scope of medical, rehabilitation, and psychosocial sequelae resulting from injuries and the most appropriate setting in which to deliver those services.

Acute Comprehensive Interdisciplinary Inpatient Rehabilitation

This is highly specialized rehabilitation care provided at PRCs as soon as patients are medically stable to tolerate rehabilitation programming. The primary emphasis is on intensive interdisciplinary rehabilitation services in the

early months after the injury. These include cognitive, physical, emotional, and behavioral interventions. Education and support for family or other care givers are also important elements of the care provided.

Emerging Consciousness Program (ECP)
The ECPs are located at the PRCs and are designed for individuals with severe TBI who are not yet ready to actively participate in acute rehabilitation programs. These individuals require specialized treatments for their medical conditions as well as specialized rehabilitation services. The ECPs provide the necessary interdisciplinary medical, nursing, and rehabilitation program and services to: 1) optimize long term functional outcomes after severe brain injury; 2) improve responsiveness/return to consciousness; and 3) facilitate advancement to the next phase of rehabilitation care. The interconnected components of the program include comprehensive rehabilitation nursing and medical services; individualized stimulation program; active therapy involvement; intensive social work and case management; inclusive family programming; and research and program evaluation.

Polytrauma/TBI Assistive Technology Labs (AT Labs)
The AT Labs are designed to effectively support patients with cognitive, sensory, and physical disabilities to reach their highest potential at home, school, work, and play through appropriate assistive technologies. The AT Labs at PRCs serve as regional referral centers for Veterans and active duty Service Members with disabilities that would benefit from specialized AT services. Clinical services and supports provided at the AT Labs include evaluation, selection of technological devices, acquisition, trial use, follow up, and maintenance of assistive technology devices.

Polytrauma Transitional Rehabilitation Program (PTRP)
The PTRPs located at the four PRCs are designed to provide rehabilitation services to Veterans and Service Members to allow them to live independently in their home communities. PTRPs offer a progressive return to independent living through a structured program focused on restoring home, community, leisure, psychosocial and vocational skills in a controlled, therapeutic setting. The transitional rehabilitation program functions to optimize physical abilities through graduated exercise, and to normalize cognitive, communication, and behavioral abilities by employing these skills in a challenging, "real world" setting.

Post-acute Comprehensive Interdisciplinary Inpatient Rehabilitation
Post-acute rehabilitation, provided by the PNSs, is clinically appropriate for patients who have completed initial inpatient rehabilitation, but continue to have significant deficits or medical conditions which make them unsafe or difficult to be cared for at home and can be more effectively treated in an inpatient setting. Post-acute rehabilitation typically includes treatment and management by an interdisciplinary treatment team, with an emphasis on functional goals and prevention of further impairment. This service is usually offered as a transition to the home environment, or other less restrictive care environment.

Comprehensive Interdisciplinary Outpatient Evaluation

Comprehensive outpatient TBI evaluations are provided by the PNSs or PSCTs. They include a detailed history of the patient's injury, assessment of common symptoms or sequelae of TBI, physical examination targeted to the veteran's reported symptoms and physical impairments, and a comprehensive treatment plan.

Outpatient Interdisciplinary Rehabilitation

Outpatient interdisciplinary rehabilitation is provided by the PNSs or PSCTs and is designed for persons who are able to reside in the community, but continue to need rehabilitation services to meet their ultimate goals. Interdisciplinary teams led by a rehabilitation physician provide individualized, coordinated, and outcome focused outpatient services including rehabilitation medicine services, therapy services, education, and psychosocial treatment and support to patients who live in their local service areas.

Individualized Rehabilitation and Community Reintegration Care Plan

VHA mandates that an Individualized Rehabilitation and Community Reintegration Care Plan is provided to Veterans and active duty Service Members with TBI who receive inpatient or outpatient rehabilitation services. A physiatrist is responsible for establishing the plan and monitoring response to treatment services. The care plan should be developed by an interdisciplinary team with TBI expertise and with input from the patient and family (as appropriate). It should include goals for improving the physical, cognitive, and vocational functioning and for maximizing the independence and reintegration of the individual into the community. Contact information for the physician and case manager, treatment services recommended and the date when the plan will be reviewed by the team are also contained in the plan. Documentation of the rehabilitation and reintegration plan is entered in the progress note section of the patient's medical record under the title, TBI/Polytrauma Individualized Rehabilitation/ Reintegration Plan Of Care.

Follow-up

Regular follow-up for individuals with ongoing rehabilitation needs is provided, at intervals as determined by the physiatrist responsible for the plan of care at the PRCs, PNSs or PSCTs.

Consultation across the Polytrauma System of Care

The PRCs serve as regional consultants to other components of the PSC, the VA, the military healthcare system, and non-VA care providers. PNSs serve as consultants to PSCTs and PPOCs within their VISNs. Consultations are often provided through telerehabilitation. (See **Appendix B** for the Polytrauma referral patterns among the four tiered components of care).

Polytrauma/TBI System of Care Scope of Services Referral Guideline

PSC Rehabilitation Programs and Services	PRC	PNS	PSCT	PPOC
Acute Comprehensive Interdisciplinary Inpatient Rehabilitation	▲			
Emerging Consciousness Program	▲			
Residential Polytrauma Transitional Rehabilitation Program	▲			
Post-Acute Comprehensive Interdisciplinary Inpatient Rehabilitation	▲	▲		
Comprehensive Outpatient Interdisciplinary Evaluation		▲	▲	▲*
Outpatient Interdisciplinary Rehabilitation		▲	▲	
Community Reintegration	▲	▲	▲	
Isolated Outpatient Therapy				▲*
Evaluation And Management Of Emerging Problems	▲	▲	▲*	
Management Of Stable Problems		▲	▲	▲
Follow-Up Specialty Care	▲	▲	▲	
Driver Rehabilitation	▲	▲	▲*	▲*
Consultation	▲	▲		
Polytrauma Telehealth Network	▲	▲	▲	▲

Note: *Dependent on local resources. When VA is unable to meet TBI specific care needs, or the care is geographically unavailable, VA utilizes private sector sources through fee for service arrangements to meet the needs of eligible Veterans. The PSC case managers are responsible for being familiar with sources for various types of specialty care and are a resource to assist when these services are needed.

PSC Case Management and Care Coordination

PSC case management is a distinct and customized approach to managing care for Veterans or Service Members. When individuals are diagnosed with a severe impairment, their physical, emotional, and psychosocial responses vary significantly. Because healthcare circumstances will differ, a tailored and customized approach to coordinating care is required. Additionally, extensive monitoring and care coordination are often required to meet the needs of these individuals.

PSC case management and care coordination is provided to TBI and polytrauma patients across the continuum and amongst various systems of care, such as military, civilian, and state and community services. This involves acting as the lead case manager for emerging medical, psychosocial, or reha-

bilitation problems; managing the continuum of care; and assessing clinical outcomes and satisfaction. An **intensity model** based on clinical and psychosocial needs is the framework used for providing case management services. As the patient's recovery continues and their physical and psychosocial needs stabilize, less intensive case management services are required, leading to discharge from specialized case management when rehabilitation needs have been met. Conversely, some patients may need to return to more intensive case management services due to changes in health or psychosocial support.

Polytrauma/TBI System of Care Case Management Intensity Based Model of Care

Intensive Case Management (Daily/Weekly)

Intensive case management is provided to all patients receiving inpatient rehabilitation and those outpatients who have a high level of care management needs. It might also be provided during times of transition or when there is significant change in the patient's clinical, psychosocial, functional, or mental health status.

Progressive Case Management (Monthly +/-)

Progressive case management is provided for patients in the post acute rehabilitation phase. A rehabilitation plan of care is in place and services are being provided to address specific goals; support systems are in place. This type of case management is also employed whenever there is a change in rehabilitation needs.

Supportive Case Management (Quarterly +/-)

Supportive case management requires at least quarterly contact and is recommended when medical, rehabilitation and psychosocial issues are stable and the patient is well established in the PSC. In such cases, the patient and/or caregivers have developed the knowledge and skills to apply appropriate level of care and the focus of rehabilitation is community reintegration, independent living, supported employment, or vocational rehabilitation.

Screening and Evaluation of Possible TBI in OEF/OIF Veterans

Beginning in April 2007, VA began screening all OEF/OIF Veterans receiving medical care in the VA for possible TBI. A TBI Clinical Reminder within the computerized medical record was developed and implemented throughout the VA Healthcare System. The Clinical Reminder (1) identifies who needs screening, (2) presents the screening tool to the provider, and (3) enters results into a progress note and into the electronic health record. Those identified by the screen as potentially benefiting from further evaluation are referred to clinicians with expertise in the area of TBI.

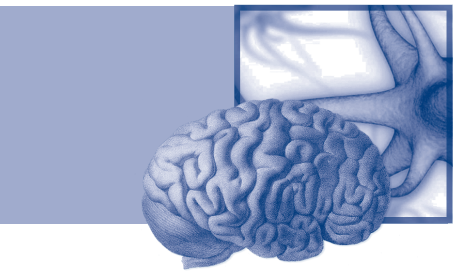
The TBI screening instrument is composed of four sections designed to identify exposure to high risk TBI events, signs or symptoms associated with alteration

in consciousness at the time of the event, symptoms immediately following this event, and current symptoms. If the Veteran responds positively to one or more questions in each of the four sections, the clinician discusses the results of the screen with the patient, and offers referral for further evaluation. The reminder prompts the user to place a consult for further evaluation, or to document refusal.

VA policy (VHA Directive 2010-012) requires that Veterans who screen positive on the TBI screening tool be offered a follow-up evaluation with a specialty provider who can determine whether the Veteran has sustained a TBI. The comprehensive TBI evaluation includes a detailed history of the patient's injury, assessment of the neurobehavioral symptoms or sequelae of TBI, a physical examination targeted to the Veteran's reported symptoms and physical impairments, and a comprehensive treatment plan. Given the expertise required to establish the TBI diagnosis and implement appropriate treatment, the TBI evaluation is optimally conducted by specialists in the PSC. If a PSC team is not available in the facility, the medical center has the option of having the evaluation completed by a specialist with appropriate background and skills, such as a physiatrist, neurologist, or neuropsychatrist who has also had training in the evaluation protocol.

Points to Remember

- VA has a TBI Clinical Reminder in place to screen OEF/OIF Veterans for possible TBI
- The CPRS note entitled "TBI/Polytrauma Individualized Rehabilitation Plan of Care" is the best source for finding:
    - Contact information for a patient's TBI physician and case manager
    - A patient's current TBI treatment plan, and
    - The date when the plan will be updated by the team



CHAPTER 4: Initial Assessment and Management of TBI

Learning Objectives:

- Formulate an assessment approach for acute TBI
- Describe the levels of severity for TBI
- Contrast the role of mechanism of injury on TBI presentation
- Compare the indications for acute neuroimaging after TBI
- Describe factors complicating the acute assessment of TBI
- Review the typical course of recovery from TBI based on severity of initial injury
- Outline common symptoms after TBI
- Discuss medical sequelae seen after TBI

Introduction

This chapter will discuss the evaluation, management and treatment of the individual with traumatic brain injury (TBI), including the approach to individuals who present with symptoms potentially related to a remote TBI. Because of unique factors in the evaluation of mild TBI, particularly in the returning OEF/OIF cohort, a special section will be devoted to this topic. This chapter is divided into the following sections:

- TBI assessment
- Factors complicating the assessment of mild TBI
- Symptoms and management of mild TBI
- Symptoms and management of moderate to severe TBI
- Appropriate referrals of patients with TBI

TBI Assessment

In the evaluation of an individual with an acute traumatic event, particularly one that has resulted in bodily injury, a high degree of suspicion for co-occurring TBI is required. TBI may be easy to recognize in individuals who have readily observed persistent neurologic deficits, including ongoing alterations of mental status (i.e., confusion) or loss of consciousness at the time of acute evaluation. However, determining that a TBI occurred is more challenging when these overt sequelae have improved or are more subtle. With acute triage focused on urgent care, health care providers at each stage of care must question whether a concomitant brain injury may have occurred. Identification of an indi-

vidual with TBI allows for symptom management as indicated, rehabilitation if required, educating the individual and their family on the natural course of TBI recovery, and monitoring for return of full function.

Primary care providers are essential in the evaluation of patients who have been injured in trauma, but may have been inadequately assessed or not assessed at all for TBI. The use of a screening tool for possible TBI for all patients seeing a primary care provider who may have been exposed to trauma is recommended. A positive screen should prompt a referral to a qualified TBI specialist for definitive diagnosis and initiation of care. Primary care providers will play a collaborative role during the initial assessment and acute post-injury rehabilitation care for individuals with TBI; therefore they should be familiar with these components of their patient's care to provide needed support and co-management of non-TBI related issues.

Assessing an individual who has not had recent trauma, but is presenting for the first time to a primary care provider with symptoms that may be potentially related to a remote TBI, especially in the case of a mild TBI, presents a unique challenge to the clinician. However many of the same principles used for evaluation of an acute injury apply.

History and Physical

In the assessment of an individual after TBI, either acutely or remotely, completing a history and physical is the first step. Ideally, this should be performed by a TBI specialist to identify many of the subtleties and unique aspects of TBI. The goal of the history and physical is to establish the nature and severity of the TBI, define current impairments and functional limitations and to identify all disability related factors. A detailed history of current, as well as past, functional and psychosocial status and previous treatment are important. Physical examination should focus on the neuromusculoskeletal systems and include a careful mental status examination and cognitive assessment. Pertinent elements of the history and physical are listed in **Table 1**.

Table 1: Comprehensive Assessment of Acquired Brain Injury

History	Physical
Trauma related facts	Neurological
Initial neurologic presentation	Cranial nerves 1-12
Pre-Injury information	Deep tendon & pathological reflexes
Past medical and surgical history	Sensory exam
Substance abuse	Cerebellar exam
Developmental history	Motor exam

History	Physical
Educational history	Mental status exam
Prior Head Trauma	Behavioral assessment
Military and legal record	Emotional/Psychological status
Vocational history	Musculoskeletal
Psychosocial history	Head
Life stressors	Face and temporomandibular joints
Family history	Extremities
Post-injury treatment interventions	Axial structures (neck, back, pelvis)
Current functional status	

Obtaining, reviewing and distilling all available supporting documentation (e.g., medical records, service records, emergent/urgent care records) is critical. Necessary information includes relevant past medical, social, vocational and behavioral history, indicators of severity of injury, mechanism and context of injury, symptom presentation (type, timing, severity), neurologic (acute alteration of consciousness, coma, duration of coma, amnesia), and medical (including Glasgow Coma Scale) and functional status.

This information is also of use when evaluating symptoms potentially linked to a distant TBI. When records supporting a remote injury are limited, a greater emphasis must be placed on the time course (i.e., symptom onset should be temporally related to injury) and intensity of symptoms (i.e., symptom intensity is expected to stabilize or decline post-injury), and on the physical examination.

Severity of Injury

Severity of TBI is discussed in detail in **Chapter 2**. Injury severity is based on the initial assessments of alteration of consciousness (from dazed and confused to comatose), presence of neurologic deficits (e.g., command following, focal weakness, sensory deficits, abnormal motor stretch reflexes), and neuroimaging results. The Glasgow Coma Scale (GCS), length of coma, and length of posttraumatic amnesia (PTA) are common measures used to assess severity (see **Chapter 2**). Injury severity may be reclassified in 24 hours after injury to account for the impact of intoxicants or behavioral components (e.g., acute stress reaction), however once it is established it should not be modified based on recovery. Initial severity of TBI has been shown to correlate with short- and long-term functional and vocational outcomes.

Mechanism and Context of Injury

Mechanism of injury may provide insight into the likelihood of acute medical needs, severity and presentation of sequelae, and short- and long-term outcome. Injury mechanism may include: acceleration-deceleration (e.g., a motor vehicle accident), blunt trauma (e.g., assault), penetrating (e.g., gun shot to head), blast, and secondary ischemic or hypoxic events.

Included in the context of the injury are circumstances of injury and whether drugs or alcohol were involved. Circumstances that should be considered include whether the injury occurred while in combat, while in duty status, while on the job, or during a leisure or recreational activity. All these factors may assist in evaluating the severity of the injury, as well as in understanding the lifestyle and expectations of the injured person, which will be relevant to recommendations of how treatment may fit into the individual's routine.

Assessment of Symptoms

While individuals with TBI may have unique symptom presentations and recovery patterns, type of injury, injury severity, mechanism of injury, secondary injuries, premorbid physical and psychosocial factors and patient demographics have an impact. Individuals with severe TBI are likely to have obvious diffuse and focal neurologic sequelae (e.g., hemiplegia, spasticity, aphasia), as well as profound cognitive, behavioral, and functional deficits. Somatic complaints (e.g., headache, dizziness) are less common acutely and may be overshadowed by the severity of neurologic and functional deficits. Individuals with moderate TBI will often have non-focal neurologic deficits (e.g., dizziness and imbalance) with overt but less severe cognitive, behavioral, and functional deficits. Individuals with a single mild TBI are unlikely to have persistent neurologic deficits, and more commonly have somatic complaints interfering with cognitive and functional skills. As a rule of thumb, somatic symptoms, such as headache or dizziness, will arise within 48 hours of injury and cognitive symptoms, such as poor attention or concentration within a couple weeks. Behavioral and sleep-related symptoms may take longer to present (given the complex nature of these issues), perhaps as long as 1-2 months. Thorough assessment of post-concussive symptoms can be accomplished utilizing one of the validated scales for this purpose, such as the Neurobehavioral Symptom Inventory (Cicerone & Kalmar, 1995).

For individuals who have had previous assessment, diagnosis, and treatment for TBI, it is important to understand prior treatment interventions and their effectiveness, the patient's beliefs about brain injury and long-term prognosis, whether the patient has been provided with education about TBI and the typical course of TBI, and whether or not the patient has pending litigation related to TBI.

While individuals with stable symptoms and management programs after TBI may be confidently managed by a primary care provider, new or worsening symptoms are best evaluated and managed by a TBI specialist.

Neuroimaging in TBI

Neuroimaging methods are of considerable value for the acute assessment and management of TBI, although their role in classifying the degree of injury and in predicting outcomes remains more of an open question. Two of the most widely used techniques are computerized tomography (CT) scans and magnetic resonance imaging (MRI). A head CT is the imaging study of choice in acute brain injury because it will reveal acute bleeding, either within the brain tissue, within the ventricles, or involving the dura (i.e., epidural or subdural hematoma). Availability, cost, and sensitivity to acute bleeding, offers significant advantages of CT over the MRI scan in the acute phase. The likelihood of intracranial pathology identified by CT varies depending on the initial or Emergency Department GCS score. While intracranial abnormalities on CT scan are seen in all individuals with moderate or severe TBI, there is controversy about the use of CT in mild TBI. Studies have found that less than 10% of patients that are considered to have minor head injuries have positive findings on CT and less than 1% require neurosurgical intervention (Jeret et al., 1993). Serial or repeat CT scanning is indicated during the initial several days to weeks for individuals who have sustained a moderate or severe TBI to monitor the course of the injury and assess for hydrocephalus. The only indication for a repeat CT scan in an individual with a mild TBI would be evidence of acute neurological decline.

Forty-eight to 72 hours after injury, MRI is generally considered to be superior to CT (Lee & Newburg, 2005). MRI may be used in the subacute and chronic phases if persistent and unexplained disabilities remain. Although CT is better at detecting bony pathology and certain types of early bleeds, the ability of MRI to detect hematomas improves over time as the composition of the blood changes. MRI can depict nonhemorrhagic and hemorrhagic contusions and is more sensitive for detection of diffuse axonal injury (Doezema et al., 1991; Mittl et al., 1994). However, for mild TBI, MRI findings are frequently negative.

New and evolving MRI technologies such as Diffusion Tensor Imaging (DTI) and Magnetization Transfer Imaging are more sensitive to structural changes following mild TBI (Smith, Meaney et al. 1995; McGowan, Yang et al. 2000; Rugg-Gunn, Symms et al. 2001), but are currently being used more for research than clinical purposes. DTI can reveal injury to the axons and may allow us in the future to better detect subtle injury to white matter tracts in the brain. Another frequently used experimental neuroimaging technique is functional MRI (fMRI), which allows researchers to measure markers of neuronal activity while patients carry out various mental tasks in the scanner. Other experimental measures of brain functioning include single photon emission computed tomography (SPECT) and positron emission tomography (PET), both of which measure brain metabolism as a marker of function. It is important to note that these techniques, due to their still experimental nature, are not currently recommended for clinical use.

Points to Remember

- Symptom presentation varies with severity of injury; however, specific patterns exist for mild, moderate, and severe injury.
- Assessment of mechanism and context of injury assists in understanding acute medical needs, sequelae, and outcomes.
- Although not always necessary, a head CT scan is preferable to an MRI scan following a mild TBI because of its sensitivity to acute bleeding.

Other Testing

In the assessment of acute TBI, individuals who have neurologic or medical problems that warrant either over night hospital observation or inpatient admission should be managed by TBI specialists. During their acute care stay individuals with moderate to severe TBI often receive additional diagnostic testing (e.g., electrophysiologic, serial neuroimaging) and may be re-assessed at regular intervals in the first 1-5 years post-injury (e.g., neuroimaging, neuropsychological testing, and computerized posturography). These specialized ongoing evaluations should be managed by the TBI specialist who follows these individuals.

Individuals with mild TBI who do not require hospital-based monitoring or who may have never even been seen in the Emergency Department or clinician's office and who are demonstrating progressive recovery do not require additional testing of any type. Advanced diagnostic testing to qualify and/or quantify persistent symptoms or deficits (e.g., cognitive, behavioral, balance) is occasionally useful, but its usage should be directed by TBI specialists.

Factors Complicating Assessment of Mild TBI

Acute assessment of mild TBI may demonstrate some easily recognizable cognitive, behavioral, or somatic difficulties (e.g., poor attention, irritability, dizziness), however these are almost always self-reported problems and more often the problems are subtle and not well described. While a referral to a TBI specialist (i.e., specially trained physician or team) can help in verifying the diagnosis or clarifying the management plan, it is vital for the primary care clinician to understand both the recommended diagnostic approaches and tools, and the factors that may complicate making the diagnosis. Occasionally, similar difficulties may occur in individuals who have had a remote moderate or severe TBI, have limited medical records available for review, and who have experienced a near total recovery. The approach to these patients parallels mild TBI.

Although many of the neurological symptoms following TBI can be associated with structural brain injury, association does not prove causation. The same holds true for psychological symptoms, such as anxiety, depression, lability, irritability, and aggression. Moreover, many of these symptoms are common in healthy individuals, and increase under stressful situations or when sustaining other, non-brain related trauma (e.g., extremity fracture). Thus, whether the symptoms following a TBI are caused by the injury, a consequence of adjust-

ment to the accident, associated with comorbidities, secondary to dealing with the medical-legal environment, or related to a combination of these factors can be difficult to determine.

Unique Assessment Complications in the Returning OEF/OIF Population

There are multiple factors that complicate accurate assessment and diagnosis of OEF/OIF Veterans presenting to healthcare professions. These include:

- both Veteran and healthcare provider misinformation regarding TBI
- delayed presentation for evaluation or treatment
- exposure to multiple potentially injurious events
- multiple symptoms common across various diagnoses or simply associated with stress
- multiple mental health comorbidities in addition to a history of mild TBI.

Misinformation about Blast Exposure. There appears to be a common misconception among soldiers, the news media, and some healthcare providers that exposure to a blast event means that a person sustained a TBI. This is incorrect. Exposure can mean multiple things. Unless a Service Member experiences the direct force of a blast and that force is sufficient to cause a physiological disruption of brain functioning (e.g., seeing stars, being disoriented, being in-and-out or being knocked unconsciousness for several minutes) the Service Member did not sustain a TBI no matter how traumatic the event may have been to them or others.

Self-expectations and Iatrogenic Factors. Research indicates that many of the symptoms following mild TBI are the result of psychological mechanisms, such as expectations following a mild TBI (Mittenberg, DiGiulio, Perrin, & Bass, 1992), poor coping styles (Bohnen & Jolles, 1992; Marsh & Smith, 1995), or emotional reactions to an adverse event. This research suggests that the information provided by medical personnel to individuals who experienced a mild TBI can either amplify and increase their symptomology and distress (iatrogenic factors), or can minimize and normalize their symptoms. Mittenberg and colleagues demonstrated minimization of symptoms when individuals who sustained a mild TBI were provided with basic psychoeducational information about mild TBI symptoms and their typical course of resolution.

Delayed Presentation for Evaluation or Treatment. VA screening for possible TBI in the returning OEF/OIF population typically occurs from several months to as long as a year or more following deployment. Patients' memories have faded and merged with many other deployment-related experiences. Veterans often describe multiple historical events in which a TBI may have occurred, most of which are also psychologically traumatizing. Within the Veteran's mind, physically traumatic events and psychologically traumatic events are often merged and overlapping. Under these circumstances, it is extremely difficult to get an accurate history regarding details of the potentially injurious events and the subsequent onset and course of symptoms. However, this history is essential to making the correct assessment.

Pre-existing Factors with Overlapping Clinical Symptoms. Comorbidities are also a challenge when evaluating and/or treating a patient with mild TBI. Many factors that tend to co-occur with mild TBI complicate both assessment and treatment, including preexisting stress and social difficulties (Fenton et al., 1993; Ponsford et al., 2000; Bohnen & Jolles, 1992), learning disabilities (Dicker, 1992), history of previous neurologic or psychiatric disorders (Ponsford et al., 2000; King, 1996), and preinjury alcohol or drug abuse (Dikmen & Levin, 1983). These factors complicate the clinical picture and make it difficult to know which issues to address first.

Individuals with poor psychological coping or increased psychological distress have a higher rate of prolonged postconcussive symptoms compared to those with uncomplicated recoveries (Karzmark, Hall, & Englander, 1995). Other research suggests that persistent (i.e., lasting more than 1-3 months), post-concussive syndrome reflects, in part, anxiety regarding the experience of an adverse event perceived as life-threatening (i.e., post-traumatic stress response; DiGallo, Barton, & Parry-Jones, 1997; Bryan & Harvey, 1999).

Differential Diagnosis. In those individuals reporting long-term postconcussive symptoms following mild TBI, their clinical presentation may be very similar to related disorders, including PTSD or major depression. For instance, individuals may report sleep difficulties, memory problems, irritability and anxiety that fit any of these diagnoses. Mittenberg and Strauman (2000) suggest the following considerations in differential diagnosis:

Postconcussive Syndrome versus Post-Traumatic Stress Disorder. Postconcussive syndrome is not associated with persistent re-experiencing of the accident or numbing of general responsiveness, whereas PTSD is. In contrast, PTSD is not characterized by dizziness, generalized memory problems, headaches, or subjective intellectual impairment, while PCS is.

Postconcussive Syndrome versus Major Depression. Postconcussive syndrome is not associated with changes in appetite or weight, psychomotor agitation or retardation, suicidal ideation, or a history of depressive disorder.

Points to Remember

- Post-concussion symptom complaints are complicated by overlap with other conditions
- Referral to a TBI specialist for careful evaluation may be helpful in difficult diagnostic cases

Symptoms And Management of Mild TBI

Mild TBI Symptoms

During the week or two following mild TBI, the vast majority of patients recover fully without any noticeable symptoms. During this period individuals often have initial cognitive symptoms of slowed information processing speed and difficulty with attention. Eight out of 10 patients with a mild head injury show at least some symptoms outlined in **Table 2** during the first several weeks or months after the accident. These symptoms are part of the normal recovery process and are not signs of permanent brain damage or medical complications.

Immediate postconcussive symptoms, such as nausea, vomiting, drowsiness, and dizziness are typically short-lived (Rutherford 1989; Bohnen and Jolles 1992). Headaches are commonly reported within the first few days and may continue for several weeks. Other possible symptoms include decreased concentration, difficulty maintaining attention, fatigue, irritability, and depression. A cluster of symptoms common following mild TBI, labeled postconcussive syndrome (PCS), includes complaints of poor concentration, memory difficulty, intellectual impairment, irritability, fatigue, headache, depression, anxiety, dizziness, blurred vision, light sensitivity and sound sensitivity (American Psychiatric Association, 1994; World Health Organization, 1992). This symptom complex typically occurs without demonstrable structural changes to the brain (Eisenberg & Levin, 1989) or neuropsychological dysfunction (Dikman et al., 1986; Levin, Mattis et al., 1987). The most commonly documented persistent PCS symptoms are noted in the **Table 2** below. Although many of these symptoms are common in normal individuals (e.g., difficulty concentrating, irritability, anxiety, memory complaints, headaches), the incidence of the symptoms increases acutely following mild TBI.

Table 2: Frequency of PCS symptoms following mild TBI and in the General Population

	Mild TBI PCS Symptom Frequency	Frequency in the General Population	PCS Symptom Increase after Mild TBI
Symptom	% of Patients	% of People	Increase over base rate
Poor concentration	71%	14%	57%
Irritability	66%	16%	50%
Tired a lot more	64%	13%	51%
Depression	63%	20%	43%
Memory problems	59%	20%	39%
Headaches	59%	13%	46%

	Mild TBI PCS Symptom Frequency	Frequency in the General Population	PCS Symptom Increase after Mild TBI
Symptom	% of Patients	% of People	Increase over base rate
Anxiety	58%	24%	34%
Trouble thinking	57%	6%	51%
Dizziness	52%	7%	45%
Blurry or double vision	45%	8%	37%
Sensitivity to bright light	40%	14%	26%

Table adapted from: Mittenberg, W., DiGiulio, D. V., Perrin, S. & Bass, A. E. (1992). Symptoms following mild head injury: Expectation as aetiology. Journal of Neurology, Neurosurgery, and Psychiatry, 55, 200-204.

Management and Treatment after Mild TBI

The majority of our current research and information about mild TBI is based on non-combat mechanisms and circumstances, and single events. Knowledge about combat and blast-related mild TBI and multiple mild TBI is currently evolving.

The data from sports concussion studies demonstrates that impaired cognitive performance follows concussion acutely and that there is an increased risk for second injuries indicating the need for a period of rest (Macciocchi, Barth et al. 1996; Warden, Bleiberg et al. 2001). This period of rest varies (from hours to months) based on the severity of the concussion. As noted above, second TBIs can result in everything from sudden death (i.e., Second Impact Syndrome), to worse long-term functional outcomes, to protracted symptoms.

Treatment for mild TBI includes education, a period of rest and observation, and treatment of persistent or disabling symptoms (e.g., headache). Validating the patient's symptoms (i.e. that postconcussive symptoms derive from the physical injury) and setting the expectancy of resolution of these symptoms over time are mainstays to management of mild TBI (Salazar & Warden, 1999). Cost-effective interventions (e.g., giving the patient an information booklet about symptoms and coping strategies, a telephone follow-up, or "as-needed services") are effective in alleviating chronic symptom development (Mittenberg et al., 1996; Paniak et al., 2000; Ponsford et al., 2002). **Appendix C** is a patient treatment manual for individuals with mild TBI, Recovering from Head Injury: a Guide for Patients. It is intended to educate patients and their families about mild TBI, support the reattribution of symptoms to normal transient responses to stress, selective attention to symptoms, and resulting adjustment anxiety. Finally, depending on the speed of recovery, recommendations regarding return to partial or full work should be tailored to the individual.

TBI specialists are valuable resources in assisting with return to work/activity recommendations and in directing vocational rehabilitation programs.

Pharmacologic and nonpharmacologic interventions are used to treat specific symptoms following mild TBI, especially when those symptoms, e.g., headache and sleep disorder, are disabling or not improving. The VA-DoD Joint Clinical Practice Guidelines for Concussion/mild TBI is a valuable tool in the structured management of these individuals, under the direction of TBI specialists. A crucial and often omitted component of mild TBI management is the provision of education to individuals with TBI regarding fatigue, irritability, and mood lability that may occur during mild TBI recovery. Mittenberg and colleagues (1996) demonstrated that patients with mild TBI who met with a therapist who reviewed the nature and incidence of expected symptoms experienced significantly less symptom duration, significantly fewer symptoms and significantly lower average symptom severity levels at 6 months follow up.

Points to Remember

- Symptoms following mild TBI may be physical (e.g., headaches and dizziness), emotional (e.g., anxiety and depression), or cognitive (e.g., attention and memory problems)
- There are significant long-term residual neurological symptoms in a small proportion of individuals who sustained a mild TBI (about 10-15%), with consequent psychosocial, employment, and relationship problems
- Psychoeducational intervention, combined with support and cognitive-behavioral interventions can significantly reduce the extent of postconcussive symptoms
- Pharmacologic and nonpharmacologic interventions can be used to treat specific symptoms following MTBI such as headaches, insomnia, depression, irritability, or emotional dysregulation

Symptoms and Management of Moderate to Severe TBI

Common Medical Complications and Problems following Moderate and Severe TBI in the Acute and Post-Acute Period

Following a moderate to severe TBI, Veterans often need continued care in a variety of settings. TBI is characterized by substantial heterogeneity in its pathophysiology and ongoing cognitive deficits and emotional/behavioral problems are common. The most prominent **cognitive sequelae** following moderate to severe TBI are: (a) attention and concentration problems, (b) deficits in new learning and memory, and (c) executive control dysfunction. Common **emotional difficulties and behavioral problems** include: (a) emotional adjustment difficulties, (b) emotional dysregulation (i.e., difficulty controlling ones emotional responses), (c) irritability, (d) interpersonal intrusiveness or withdrawal, (e) relationship problems, and (f) problems with impulse control. Assessment and treatment of these two sets of problems are dis-

cussed in **Chapters 6 and 7**. Acute and post-acute **medical problems and complications** will be discussed below, while more chronic medical sequelae are discussed in **Chapter 5**.

Following moderate or severe TBI, the following acute or post-acute medical complications may develop.

Seizures. All patients with TBI are at increased risk for new-onset seizures, termed post-traumatic seizures, proportionate to their severity of initial injury, the presence of dural penetration, and their age. The risk of seizure following a mild TBI is extremely low. The epileptic episodes may be due to direct damage of brain tissue which has resulted from shearing forces, infarction, or due to secondary irritation caused by hemorrhage. Seizures may also be triggered by secondary insults including metabolic disturbances and hypoxic episodes.

Most studies have failed to demonstrate the benefit of anticonvulsant prophylaxis for posttraumatic seizures after the first week following head injury. Therefore, seizure prophylaxis is not recommended for an extended duration (Liebert, 2000). When late (occurring beyond the first week post injury) posttraumatic seizures present, investigation for possible underlying triggers should ensue (metabolic, substance abuse, structural). If no correctable sources are uncovered, or if a second seizure occurs, treatment with anticonvulsant medication is warranted. New onset of late posttraumatic seizures can occur at any time, but the likelihood diminishes over time. Patients experiencing the onset of posttraumatic seizures should be referred to a neurologist for thorough evaluation and management.

Spasticity. TBI, like other upper motor neuron diseases, is associated with spasticity. The degree of spasticity usually correlates with the degree of motor weakness in the effected extremity. Spasticity must be distinguished from other causes of resistance to passive movement including anxiety, pain, heterotopic ossification, and contractures. Spasticity, by impeding normal physiologic range of motion, can both interfere with functional activities and lead to joint contractures. Contracture presents a formidable obstacle to treatment once it develops. Spasticity can also lead to pain syndromes, skin breakdown, problems with hygiene, positioning, and cosmesis. On the other hand spasticity can provide benefits, as when extensor tone in the leg aids standing activities. Sudden worsening of spasticity warrants a search for potential triggers including infection, ulcers, and metabolic disturbance.

A myriad of treatment options are available for spasticity including physical modalities, splinting, neurolytic or botulinum injections, oral medications, and surgical procedures. The decision to employ them is based on careful evaluation of the severity of the spasticity, the distribution of involved joints, the functional status, and risk-benefit analysis of each individual treatment option. Management of spasticity is often best accomplished by physiatrists or other TBI specialists. Occupational therapists and physical therapists also provide important expertise in the treatment of spasticity and resulting complications.

Neuroendocrine Dysfunction. Dysfunction of the endocrine system can occur anywhere along the hypothalamic-pituitary-end-organ axis. For patients with TBI, the most likely source of dysfunction is in the central aspect of this axis. Skull fracture, hemorrhage, ischemia, and brain edema can all cause damage to the hypothalamus or pituitary gland. The most common resulting endocrine abnormalities are SIADH and diabetes insipidus (Watanabe & Sant, 2001). Because endocrine dysfunction is so common in TBI (affecting up to 20%), it is important to be able to determine the underlying cause of any electrolyte abnormalities. This will allow for the use of appropriate methods for correction of imbalances in a given patient.

Hydrocephalus. Non-obstructive hydrocephalus is a frequent complication after severe TBI. The usual cause is disruption of the absorptive capability of the arachnoid villae. The classic clinical signs are similar to normal pressure hydrocephalus (imbalance, incontinence, and dementia), though a high index of suspicion is required of the treating physician because the onset in the severely injured is typically slow, with the earliest indication often a vague decline or plateau in functioning and/or subtle mental status changes. Head CT is the investigative study of choice, and when enlarged ventricles are seen, true hydrocephalus must be distinguished from hydrocephalus ex vacuo. In hydrocephalus ex-vacuo, loss of parenchymal volume allows the ventricular system, which is under pressure, to expand, giving the appearance of hydrocephalus on imaging studies (Bigler, 2001). If the CT findings are inconclusive, serial CT scans and sometimes CSF tapping tests may be needed.

Heterotopic Ossification. The formation of new bone in non-boney tissue can be seen in the acute recovery period following TBI occurring in 11-77% of cases (Watanabe & Sant, 2001). Risk factors include prolonged coma (> 2 weeks), immobilization, skeletal trauma, and spasticity. The most commonly affected joints include the hip, knee, shoulder, and elbow. Complications include decreased range of motion, nerve and/or vascular compression, lymphedema, and ankylosis. The early signs of heterotopic ossification (HO) typically present with pain, erythema, warmth, swelling and fever, and can resemble local trauma, fracture, cellulitis, or DVT. Therefore, it is important to keep HO in the differential when a patient with TBI presents in this manner. Heterotopic ossification typically begins within the first 2-3 weeks following injury, but onset can occur from 1 to 7 months post TBI (Watanabe & Sant, 2001). Treatment remains controversial, with options including etidronate, non-steroidal anti-inflammatory drugs, range of motion, and surgery. Referral to a physiatrist for recommendations regarding treatment is recommended.

Urinary Incontinence. Urinary incontinence is common acutely after TBI, and in some may continue chronically. The usual etiology is loss of normal cerebral inhibition and control over bladder and sphincter activity, secondary to frontal or diffuses cognitive injury. Detrusor hyperreflexia and urinary retention can also occur, particularly early on. In the absence of hyperreflexia, retention, or obstruction, the preferred treatment is bladder "training" with scheduled timed

voiding attempts. New incontinence in the previously continent patient should elicit a search for inciting causes such as urinary tract infection or a new structural insult like hydrocephalus.

Management and Treatment after Moderate or Severe TBI

Inpatient Rehabilitation Setting. Following acute emergency evaluation and medical stabilization, the individual with a moderate to severe TBI usually requires a period of inpatient rehabilitation. These services are best provided in an established interdisciplinary brain injury program. These interdisciplinary programs are staffed with TBI-trained specialists and directed by physiatrists, physicians specially trained in physical medicine and rehabilitation. The interdisciplinary team includes the patient and family as well as the physician, nurses, therapists, social workers and psychologists. The team communicates regularly and works toward common goals. Better outcomes have been shown in interdisciplinary compared to multidisciplinary programs, and in TBI dedicated programs.

During this phase of treatment, the individual with TBI requires frequent contact with a physician to monitor new or ongoing complications of the brain injury and the services of nurses specializing in rehabilitation care. There should be a reasonable expectation for functional improvement. The focus in the early rehabilitation phase is to restore the individual to maximal functional independence. To be eligible for admission to an inpatient brain injury program, the individual should be medically stable and able to participate in rehabilitation therapies. The exception to this is that VA Polytrauma/TBI Rehabilitation Centers, and a few private sector hospitals, have specialized programs for individuals who are minimally responsive and not yet ready to actively participate in rehabilitation. The focus of these emerging consciousness programs is to optimize medical management, undo any reversible causes of reduced consciousness, and provide trials of controlled stimulation and pharmacological interventions as indicated. Family support and education are also a critical component of these programs.

The benefits of rehabilitation after TBI have been well documented in the medical literature. Short-term outcomes are better when structured rehabilitation interventions begin in the ICU. Principles of early rehabilitation include controlled mobilization out of bed, sensory regulation (avoiding over or under-stimulation), avoiding cognitively impairing medications, regular pain assessment, and early removal of urinary catheter with implementation of timed voids.

Individuals who do not reach a level at which they are able to function relatively autonomously after reaching maximum benefit from inpatient rehabilitation can be transitioned to other treatment settings based on their need for medical care, nursing care and supervision. Some individuals may require long term care in a setting able to provide total care, rather than an acute rehabilitation

facility. These individuals should have rehabilitation monitoring and evaluation available on a long-term basis to address problems and complications that may arise as a result of their brain injury. Others may require long term supervision that their families are unable to provide. These services can be provided through group homes or supervised apartments. Identification of such facilities or programs can be facilitated through contact with specialized TBI case managers.

For patients who have progressed beyond, or did not require acute inpatient rehabilitation, a variety of other services can be accessed for specific impairments. These services include transitional rehabilitation, outpatient therapies, community programs, and vocational rehabilitation.

Long term monitoring and management by rehabilitation professionals is generally recognized as beneficial to individuals who have sustained a moderate to severe brain injury. Individuals with acute and/or persistent neurologic sequelae or medical complications after moderate to severe TBI should be closely managed by TBI specialists in close collaboration with the individual's primary care provider. Once the individual's status has stabilized and their rehabilitation care plan goals have been met, the primary care provider may resume much of the care and the TBI specialist may be utilized for specialized problems (spasticity management, symptom management), formal re-evaluations (e.g., annual re-assessments) and for new problems related to brain injury.

Appropriate Referrals of Patients with TBI

The short- and long-term management for individuals with TBI, regardless of injury type or severity, should be directed by the TBI specialist or specialty team in close collaboration with the primary care provider.

Although a thorough physical examination and history are the initial elements of a postconcussion clinical workup, a variety of other tools are available to the TBI specialist and TBI teams to clarify examination findings. The TBI specialists' assessments could entail repeat neuroimaging, electrophysiological testing, computerized posturography, neurologic or neurosurgical consultation, pain specialist referral, neuropsychological testing or other evaluations. These referrals are best coordinated by the TBI specialist.

Individuals with stable symptoms, sequelae, function and management programs can be managed by primary care providers with problem specific management (spasticity, etc.) and annual re-evaluation by the TBI specialists. However, individuals with new, variable or worsening symptoms and/or sequelae or with fluctuating management strategies are best managed with more frequent visits to their TBI specialists. This referral should be made for individuals who continue to report persistent or worsening difficulties with spasticity, seizures, headaches, sleep, concentration, attention, memory, irritability and other common issues.

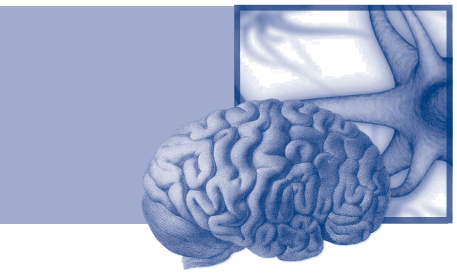
Clinically-directed appropriate referrals for additional assessment may include consults to the following disciplines:

- Physiatrist
- Neurologist
- Psychiatrist
- Neuro-ophthalmologist
- Neuro-optometrist
- Neurosurgeon
- Endocrinology
- Audiologist
- Neuropsychologist (psychologist)
- Clinical Psychologist
- Speech and Language Pathologist
- Physical therapist
- Kinesiotherapist
- Occupational therapist
- Recreation Therapist
- Social Worker (counselor)
- Vocational Rehabilitation Counselor
- Case Manager

A more detailed description about each of these disciplines is provided in **Appendix D**.

Points to Remember

- Serious medical sequelae can result from the moderate or severe TBI; management by a TBI specialist is recommended
- Most patients with moderate to severe TBI will require a period of inpatient specialized interdisciplinary TBI rehabilitation
- TBI specialists or specialty teams should be involved in the short- and long-term assessment and management of TBI
- Long-term medical management of the stable moderate to severe TBI patient can be done by primary care providers, with TBI specialty consultation as needed



CHAPTER 5: Post-Acute/Chronic Sequelae: Medical and Physical Problems

Learning Objectives:

- Identify common post-acute medical sequelae following TBI
- Define persistent postconcussive syndrome
- List common visual impairments and dysfunction following TBI
- Describe principles for prescribing treatment for post TBI issues
- Identify types of headache following TBI and potential treatment options

Introduction

A variety of issues can persist following the acute management of moderate to severe TBI. TBI typically involves a complex interplay of brain injury, extra-cranial tissue injury of the head and neck, and secondary or reactive symptoms. The resulting symptomatology can have somatic, cognitive, and affective/psychological/behavioral components. Common post-TBI medical and physical problems are discussed below, while the common cognitive and affective/psychological problems are discussed in **Chapters 6 and 7**, respectively.

When to Suspect TBI Related Issues

Patients with prior TBI may present in a variety of ways and in a variety of clinical settings. Rarely would a patient present noting that a symptom was directly related to prior brain injury. Providers should consider possible relation to TBI if a patient presents with the following complaints:

- Complaints of inability to stay on task/easy distractibility
- Headaches that have started after trauma or have worsened after trauma
- Problems with work performance following trauma
- Identification of behavioral or personality changes after a fall or motor vehicle accident.
- Complaints of vision changes or balance/coordination with recent history of trauma
- Complaints of fatigue or sleep disturbance with recent trauma

Guiding Principles for Treating TBI Patients

A Team Approach to Address Multiple Persistent Symptoms.
Patients who have sustained TBI often feel misunderstood by family, friends, and colleagues. While patients are keenly aware of post-injury changes, lay persons may perceive that they "look and sound normal." Conversely, treating professionals during the course of assessment and therapy sometimes focus exclusively on patients' symptoms. Thus, many people with brain injury experience significant frustration and failure.

A "dose effect" understanding of head trauma suggests that higher levels of long-term impairment are associated with greater initial severity of injury (Levin, Benton, Grossman, 1982). However, research has shown that patients with mild TBI may report problems at equivalent or even greater rates than patients with more severe TBI (Larrabee, 1997, 1999). As a rule of thumb, regardless of the severity of the initial injury, patients with multiple sustained and severe symptoms are likely to require a team approach in order to increase the chance of successful remediation of their symptoms; an interdisciplinary, holistic approach is preferred (Prigatano, 1989; Ben-Yishay & Prigatano, 1990; Prigatano, 1999). This holistic framework emphasizes not only the treatment of specific physical and cognitive symptoms, but attending to the patients' individual needs which might include providing information, helping to motivate, instilling hope, and taking environmental factors into account.

Developing a successful TBI treatment framework is not limited to just attending to the patients' cognitive and physical symptoms. Successful treatment will often include multiple additional interventions including educating, advocating, counseling, and support. Providing caring attention, helping the patient to feel understood, providing accurate information on symptoms and outcomes, and instilling hope contribute to symptom improvement and return to pre-injury functioning. Team treatment necessitates effective and ongoing communication between both team members and with the patient and family.

General Rules of Thumb When Prescribing Treatments
At the risk of oversimplifying the diagnosis and treatment of TBI sequelae, it is often helpful to have a general starting point from which to individualize approaches and treatment plans. The following four rules of thumb provide a general compass for directing treatment of TBI sequelae.

1. The relationship between initial injury severity and current symptom presentation should guide the general approach to prescribing interventions.
   - More severe injury / severe, diffuse symptoms » Multidisciplinary care
   - More severe injury / few or focal symptoms » Symptom-specific interventions and Monitor Progress
   - Less severe injury / more severe, diffuse symptoms » Psychological coping interventions
   - Less severe injury /few or focal symptoms » Provide Education and Monitor

2. Investigate prior treatments to avoid repeating ineffective strategies.
3. Don't take on the "savior" role. If several other physicians haven't "fixed" the symptoms from a relatively mild TBI, then you won't either.
4. If the patient has not responded to initial interventions, a comprehensive interdisciplinary approach to treatment coordinated by an experienced TBI-case manager or physiatrist is highly recommended. If this is not available at your facility, then the patient should be referred to the next higher level within the VA PSC as outlined in **Chapter 3**.

Addressing Specific Symptomatology

Common Problems post-TBI

There are a number of common somatic medical problems that occur following TBI. Treatment for these conditions is similar regardless of severity or acuteness of the original brain injury. Listed below are common acute medical complications that usually present during the hospitalization or acute rehabilitation phase and were discussed in **Chapter 4**:

- Seizures
- Spasticity
- Neuroendocrine Dysfunction
- Hydrocephalus
- Heterotopic Ossification
- Urinary Incontinence

This chapter discusses common somatic complaints that the post-acute or chronic TBI patient may present with regardless of initial TBI severity.

Post-Traumatic Headaches (PTHA)

Post-Traumatic Headaches (PTHA) can be present in 30-90% of patients following TBI and can be very challenging to manage. Numerous types of headaches can present following TBI but headache patterns are often divided into tension-like, migraine-like, and mixed tension/migraine (Lew et al., 2006). Treatment should be based on the category of headache as determined during the assessment and should target not only the physical pain but also the person's reaction to pain in daily life. Specific treatment options include short-term use of medication, conventional physical therapy, biofeedback, and psychotherapy for the development of coping techniques. Counseling sessions should include gradual exposure to the cause of the anxiety, cognitive reinterpretation, and systematic desensitization. "Habit reversal" involves detection, interruption, and reversal of maladaptive habits. These include jaw clenching/tension, head posture, and negative cognition or thinking. Awareness training and deep breathing exercises are also beneficial.

Tension headaches. Tension headache, including the cervicogenic variety, is the most common form. Directed treatments include physical therapy, relaxation techniques, medications, and myofascial trigger point injections. Choice of analgesic medications is based on the principle of avoiding side effects that

might precipitate or exacerbate cognitive or behavioral symptoms. Thus the analgesic of choice is acetaminophen, followed by non-steroidal anti-inflammatory drugs, which occasionally cause neuropsychiatric effects.

Migraine headache. The treatment of migraine type headaches involves prevention and abortive strategies and pharmacologic interventions include a variety of classes of medications. There is minimal literature evidence, especially randomized controlled clinical trials, verifying treatment and prevention of posttraumatic migraine headache. Therefore it is recommended that standard evidence based pharmacologic interventions for migraine headache in the general population be used.

Temporomandibular joint pain. For post-traumatic TMJ syndrome, dental management is recommended with possible treatment by a physical therapist.

Headache treatments. Botulinum toxin has been used for treatment of various headaches, both tension and migraine. Recent studies have indicated that Botox may be more effective in treating those patients describing their headache as imploding (crushing/clamping/stubbed by external forces) than exploding (buildup of pressure inside their head) headaches (Jakubowski et al., 2006). Neuralgic headache types including occipital neuralgia may respond to nerve injections or neuropathic pain medications (anticonvulsants-especially gabapentin or topiramate, and tricyclic antidepressants). The following classes of medication may be used to manage headaches: pain relievers, anti-epileptic agents, antidepressants, beta blockers, ergotamines, therapeutic injections (nerve blocks, Botulinum toxin). Please refer to **Appendix E** on pharmacology for further details.

Persistent Postconcussive Syndrome (PCS)

As discussed in **Chapter 4** a small subset of patients with mild TBI (10-15%) will exhibit ongoing symptoms several months post injury consisting of some combination of physical, cognitive, and emotional symptoms. Those patients with PCS lasting greater than 12 months are classified with persistent postconcussive syndrome (persistent PCS). These patients can be very challenging to manage due to the multiplicity of symptoms and a team approach may be beneficial. Focus should include the patient and how symptomatology affects their function rather than focusing on merely treating symptoms. A variety of medications can be utilized to treat symptoms of persistent PCS. The reader is referred to **Appendix E** for general prescribing rules and to the remainder of this chapter for specific symptoms/impairments.

Pain (Acute and Chronic)

Both acute and chronic pain may develop following TBI. Headache is the most common pain complaint in this patient population but other pain sources are also frequent. Given the traumatic mechanism of the brain injury, it is likely that other areas of the body are also injured. Fractures, nerve injuries, and internal organ injury can also occur and may not have been diagnosed in the

acute care setting. Pain should be classified into either musculoskeletal or neuropathic, if possible. Treatment depends on the etiology of the pain and should focus on interventions that are least likely to cause cognitive side effects and abuse. A thorough work-up should be completed and non-pharmacological treatments should be maximized before starting medications. Physical modalities that may be helpful include heat, ultrasound, transcutaneous nerve stimulation, and cyrotherapy. Other options such as relaxation training and cognitive behavioral therapy may be more difficult to utilize in patients with TBI due to cognitive demands, but can still be very effective.

When choosing a pharmacologic agent one must consider concomitant symptoms. For instance, if a patient has neuropathic pain and mood instability then carbamazapine, gabapentin, or duloxetine could be considered as a means to treat both problems. As a general rule, narcotics should only be used for the treatment of acute pain and used for the shortest duration possible. Analgesic balms, acetaminophen, and NSAIDS should be considered as a first line treatment choice for most types of pain. Physical therapy is beneficial for many pain syndromes. For non-responders, referral to a specialized pain program should be entertained.

Dizziness

Dizziness and balance problems, while common immediately after mild TBI, will often spontaneously subside. Persistent dizziness and vertigo require careful evaluation to find the true cause. This could include hypertension/hypotension, medication effects, alcohol/drug use, visual dysfunction, or other medical conditions. In one of the few long term studies on untreated patients with mild head injury, vertigo persisted in 59% of patient's after five years of recovery (Berman & Fredrickson, 1978). The most common cause of dizziness following mild TBI is related to post-trauma vestibular system dysfunction, also known as benign paroxysmal positioning vertigo (BPPV). BPPV is characterized by brief (a few seconds or a minute) severe vertigo associated with changing head positions such as looking up or rolling over in bed. Treatment is complex (Furman & Cass, 1999) and is covered below under **Vestibular Impairment**. Cervical vertigo symptoms often respond to multiple therapeutic interventions provided by a physical therapist. Often, medications are ineffective at treating posttraumatic dizziness and may actually delay spontaneous resolution.

Sleep disturbances

Insomnia is common following TBI. Poor sleep often leads to progressive problems with daytime fatigue that contribute to increased irritability and reduced cognitive performance. Treatment should begin with removal, when feasible, of all medications with stimulant properties, both prescription and non-prescription (including caffeine and alcohol). Once other confounding factors like sleep apnea, nocturnal seizures, and pain are ruled out, behavioral strategies should be implemented (avoiding daytime naps, avoiding caffeine after the morning, avoiding late night snacks, avoiding alcohol, and avoiding use of bed for activities other than sleep). Sleep inducing medications can be judiciously added with

the understanding that their effects can carry over into the daytime contributing further to memory impairment, increased irritability and depression. Some individuals can also react with paradoxical worsening of insomnia. The following classes of medication may be used to manage insomnia: sleep agents, antidepressants. The following classes of medication are not recommended to manage insomnia after TBI: antihistamines, narcotics, benzodiazepines. Please refer to **Appendix E** on pharmacology for further details.

Fatigue

Fatigue is a common complaint of patients who have sustained a brain injury and the complete differential diagnosis is extensive. Potential medical causes such as sleep disturbance, endocrine dysfunction and anemia should be considered as well as psychological causes such as frustration, depression, and vocational, family, and social demands. For patients with multiple social stressors, a reduction in environmental demands may be a practical first step intervention. Occasionally rehabilitation providers may prescribe medication for treatment of fatigue but only after treatable causes have been ruled out. These medications have significant potential adverse side effects and addiction risk and should only be used after non-pharmacologic options have been exhausted. The following classes of medication may be used to manage fatigue; traditional antidepressants, stimulants, and Parkinsonism agents. Please refer to **Appendix E** on pharmacology for sleep problems for further details.

Spasticity, Hydrocephalus, and Seizures

The post-acute TBI patient, especially in cases of moderate-severe injuries, may present with signs or symptoms related to spasticity, seizure, or hydrocephalus. Occult seizures or hydrocephalus should be considered for patients with deteriorations in functional status. For further discussion of these conditions, refer back to **Chapter 4**.

Visual Impairments/Dysfunctions

Visual impairments and dysfunctions frequently go undetected following brain injury, in part because of the patient's unawareness of visual changes or inability to communicate their altered experience (Gianutsos, Ramsey, & Perlin, 1987). The primary visual impairments associated with TBI include visual acuity loss and visual field loss (Goodrich et al. 2007; Suchoff et al., 2008). Visual dysfunctions, including disorders of accommodation, oculomotor control, and binocularity also occur (Lew, Poole et al. 2007; Brahm et al 2009). Impairment may negatively impact the individual's mobility and ability to engage in education, employment, and activities of daily living. Comprehensive eye and vision examinations in Polytrauma Rehabilitation Centers are mandated (VHA Directive 2008-065) and rehabilitation for these conditions should be integrated into the over-all rehabilitation plan for patients having these conditions. The following are various types of visual impairments which may occur following TBI:

- **Visual Acuity Loss**: Acuity is the eye's ability to distinguish the details and shapes of objects, with impairments typically involving central vision.
- **Visual Field Loss**: Visual field refers to the entire area than can be seen when looking straight ahead, with impairments resulting in reduction or disruption in visual field.
- **Accommodative Dysfunction**: Accommodation is the ability to focus on an object at various distances with impairments resulting in blurred vision.
- **Oculomotor Dysfunction**: Oculomotor function refers to control of eye movements with impairments resulting in difficulty with fixation, saccades and pursuits, and consequent functional problems with scanning, tracking, and nystagmus.
- **Binocular Dysfunction**: Binocular vision refers to the ability to align the two eyes so that they focus on the same point in space. Impairments result in double vision, eyestrain, and headaches.

Visual Impairment Treatments. The remediation of visual acuity loss generally includes the prescription of magnification, lighting (optical or electronic), and eccentric viewing training which teaches the individual to use a preferred retinal locus adjacent to damaged central area.

Prisms and augmented-vision displays have been used to compensate for the field loss (Bowers et al. 2008; Apfelbaum et al. 2008). Other visual rehabilitation strategies include scanning training which teaches more effective use of remaining visual fields (Bouwmeester et al. 2007). Field loss is also treated in rehabilitation programs for the blind and visually impaired through training paradigms that combine scanning and Orientation and Mobility training (Verlander et al. 2000).

Vision therapy can be used to treat accommodative and oculomotor dysfunction and is typically conducted by optometrists or occupational therapists (Suchoff et al., 2001). An eye patching regimen can be used to treat binocular dysfunction, although Fresnel prisms (stick-on prisms), vision therapy, corrective surgery, or any combination of these may be necessary (Falk, & Aksionoff, 1992).

Vestibular Impairment

Vestibular injuries manifest as complaints including dizziness, vertigo, balance problems, disorientation, or visual disturbances. Vestibular injury can occur to one or both ears and may affect the sensory organs, the vestibular nerve, or other components of the vestibular pathway. BPPV is commonly identified following TBI, occurring in 10-25% of head trauma patients (Barber, 1964; Cohen et al., 2004; Davies & Luxon, 1995). Patients with mild TBI and symptoms of dizziness and imbalance often experience a slower recovery and are less likely to return to work than patients without dizziness (Chamelian & Feinstein, 2004). However, that does not mean these symptoms necessarily indicate underlying vestibular impairment. Non-vestibular causes of dizziness can include visual impairment, central pathology, medications and proprioceptive changes.

A formal vestibular function evaluation may be indicated for patients reporting sustained symptoms of dizziness, vertigo or unsteadiness. Screening tests, typically administered by physical therapists during the vestibular portion of the TBI evaluation, include a cervical assessment, oculomotor evaluation, postural stability, gait assessments and vertebral artery test to assess for potential vertebral insufficiency and vascular causes of dizziness.

Vestibular Impairment Treatments. Treatment of balance problems is patient and deficit specific and is typically provided in collaboration with physicians and physical therapists. Those with a bilateral complete loss of function may benefit from an exercise program that focuses upon compensatory strategies for postural control. Emphasis upon the remaining visual and proprioceptive systems and balance control may optimize therapeutic outcome. Those with unilateral lesions often respond to a program of habituation exercises, patient education, and postural/balance retraining. Otolith disorders are more difficult to treat as little is known regarding the adaptation process that occurs following otolith damage. Traditional vestibular rehabilitation therapy is not effective for many patients with otolith disorders (Basta et al, 2008).

Auditory and Mixed Sensory Impairments

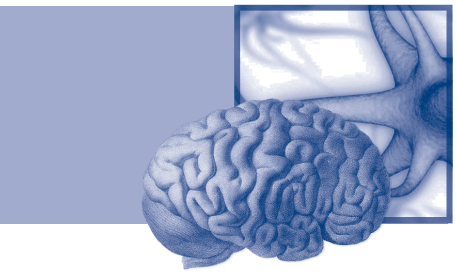
Damage to the auditory system from trauma can occur anywhere from the outer ear, middle ear, and inner ear to the auditory cortex. The resultant disruption of peripheral and central auditory systems can combine to produce complex symptoms. Audiometry is indicated as head injury can also cause auditory dysfunction and a thorough neuro-ontologic evaluation may also be indicated. In studies of patients with TBI, hearing impairments were reported in approximately 30% of patients, and complaints of tinnitus were reported in approximately 25% (Jury et al, 2001, Lew, Jerger, & Guillory, 2007). Although there are anecdotal reports of dual sensory impairment (both auditory/vestibular and visual/ocular) in the TBI population, its prevalence and effect on functional recovery remain to be described.

Transitioning Medical Management Along the Continuum

Caring for patients with TBI along the healthcare continuum can be challenging. As patients move from one level of care or location to another, the new clinician has the challenge of assessing the patient for needed interventions as well as assessing for any functional decline. In the acute and post-acute phase of TBI recovery, it is not uncommon for there to be a temporary functional decline as a patient moves from one familiar structured setting to an unfamiliar setting. However, outside such environmental changes, functional decline following stabilization of the initial injury is **not** the normal course of recovery after TBI. If a patient experiences a functional decline, they should undergo a thorough evaluation to determine the cause of the decline. Potential causes of functional decline may include infection, medication, substance abuse, psychological issues, sleep disturbance, pain, and other medical issues such as endocrine disturbance or seizure activity.

Points to Remember

- Treatment for medical conditions following TBI is similar regardless of severity or acuteness of the original brain injury.
- Patients with physical, emotional, and/or cognitive symptoms persisting 12 months post brain injury are classified as having persistent Postconcussive Syndrome(persistent PCS).
- Due to multiple problems, a team approach may be beneficial for managing patients with persistent PCS.
- Treatment focus should be the patient and how symptomatology affects their function rather than focusing on merely treating symptoms.



CHAPTER 6: Assessment and Management of Cognitive Problems

Learning Objectives:

- Identify common cognitive problems of TBI
- Understand the effects of cognitive problems on the daily functioning of individuals with TBI
- Identify the basic elements of cognitive rehabilitation and pharmacological management of cognitive problems
- Understand the role of the primary care physician in managing cognitive problems

Introduction

As used in this section, cognition refers to the intellectual or mental processes through which information is acquired and processed to mediate behavior and achieve goals. It includes the ability to attend to and process information (attention), acquire new information (memory), and use information strategically in planning, problem-solving, and self-monitoring (executive functions). Cognitive impairment denotes a decline in cognitive function caused by injury or disease process.

Cognitive difficulties are common during the time immediately following TBI. The severity of cognitive difficulties tends to correlate with the severity of the injury. Therefore, concussions generally cause mild transient cognitive symptoms, while more severe injuries may have more persistent and pervasive cognitive consequences. The long-term cognitive impairments associated with TBI are variable. Severity of trauma, neuroanatomical location of injury, age, and time since injury affect the rate and degree of recovery, along with other individual and environmental factors.

Cognitive difficulties in TBI occur as a result of the physiological events associated with brain trauma, specifically fronto-temporal damage superimposed on more diffuse pathology. Orbitofrontal and anterior temporal regions are particularly susceptible to contusional injuries secondary to impact with the skull during acceleration/deceleration motor vehicle accidents. Although a variety of other problems may be present depending upon injury specifics and premorbid factors, the following symptoms are the most prominent cognitive sequelae

following TBI:

- Attention and concentration problems
- New learning and memory deficits
- Executive control dysfunction

Characteristics of TBI-Related Cognitive Problems

Cognitive effects following TBI often co-exist with other psychological conditions such as adjustment difficulties, depression, interpersonal conflicts, and PTSD. As a result, the functional consequences of this interface on the individual can greatly exceed the cognitive effects of the TBI alone. The combination of emotional and cognitive symptoms, particularly unawareness of deficits, irritability, impulsivity, and emotional reactivity, can negatively affect cognitive recovery and the potential benefits of cognitive rehabilitation. The overlap of cognitive and emotional symptoms is best addressed through collaborative interventions by rehabilitation and mental health specialists.

Cognitive effects similar to those of TBI may occur as a result of other organic and mental health conditions. Moreover, there is some evidence that cognitive difficulties may also occur in healthy individuals in the post-deployment period (Vasterling et al., 2006). In cases where there is historical evidence of TBI, it may be very difficult to attribute which cognitive effects are due to direct brain trauma and which are due to other mental health or physical conditions. It is important in such cases to intervene in order to reduce the level of functional disability caused by the presenting cognitive symptoms irrespective of whether the underlying etiology has been definitively determined.

There is preliminary evidence from the research literature that the cognitive and functional effects of blast-related TBI are similar to those of non-blast TBI, e.g., motor vehicle accidents (Belanger et al., 2009; Sayer et al., 2008). These findings give us some level of confidence that the therapies found to be efficacious for non-blast TBI will have the same effects on TBI from blast injuries.

Cognitive Recovery Following TBI

In the days and weeks following TBI, many aspects of cognition improve, some quite rapidly. In fact, rapid improvement in the first few months is considered the rule. Cognitive symptoms of mild TBI typically resolve within a few weeks after the injury. Early education after injury about possible cognitive symptoms and expectations for full recovery have been shown to have a positive impact on the resolution of cognitive problems (Mittenberg, 1996). A small minority of individuals who sustain mild TBI may develop cognitive symptoms that persist beyond 12 months following injury. Some of these individuals have a constellation of other problems that contribute to the persistence of the cognitive symptoms including pain, sleep disorders, emotional distress, psychosocial issues, and financial problems. Intervention should first focus on managing the key factors that contribute to the overall picture of disability. For example, initial stabilization of pain and sleep issues may improve the individual's ability

to concentrate on cognitive interventions and facilitate successful treatment outcomes.

Many patients with moderate injuries can and, for the most part do, recover cognitive skills to a level of independent function so that they can return to work or resume their usual responsibilities. However, they tend to differ from how they were prior to the brain injury in that most continue to experience cognitive problems associated with frontal and temporal lobe damage. Common cognitive problems are impaired memory, decreased initiation, diminished spontaneity and difficulty managing unplanned activities. Problems related to frontal lobe damage, in particular, tend to show up in subtle ways and may not be recognized as a consequence of the brain injury

Fewer patients with severe injuries return to work or independent living. Persistent long-term cognitive problems include cognitive slowness, poor memory, and executive control dysfunction. Fluctuations in performance are common in patients with impaired executive functions, which reflects the lack of internal stability and self-regulation in this population. Physical impairments may be prominent early in the recovery process; however cognitive and behavioral impairments are more persistent and make greater contribution to long-term disability (Brooks et al, 1986; Jennett et al, 1981).

The rate of cognitive recovery tends to slow down at 1-2 years post injury, but there is increasing evidence that functional cognitive improvements may continue 5-10 years post injury (Draper & Ponsford, 2008). Long-term gains are related to increased adaptability to the environment through compensation. Compensation training has been shown to be effective when used in cognitive rehabilitation delivered long after the initial injury.

Points to Remember

- Concussions generally cause mild transient cognitive symptoms, while more severe injuries may have more persistent and pervasive cognitive consequences
- In the first few months post-TBI, rapid improvement is considered the rule
- Compared to patients with mild to moderate TBI, fewer patients with severe injuries return to work or independent living

Common Cognitive Symptoms of TBI

Attention Problems

Attention problems after TBI are seen particularly with novel and timed tasks, and in part are due to slowed information processing speed associated with diffuse axonal injury. Injury to the dorsolateral aspects of the frontal lobes is also responsible for difficulties with controlling and allocating attentional resources. Common functional complaints related to attentional problems include:

- Difficulty completing tasks, reading longer materials, or following the plot line of a movie – may indicate problems with sustained attention
- Distractibility or poor concentration when other activities are going on in the immediate environment–may be related to impaired selective attention
- Decreased ability to shift from task to task – may indicate impaired alternating attention;
- Difficulty responding to two tasks simultaneously – may be due to impaired divided attention

Memory Difficulty

Difficulty learning new information, retaining, and then retrieving it at a later time are the most common memory complaints. Memory problems are typically associated with medial inferior temporal lobe damage, but may also be secondary to problems with attention and concentration. Recall of overlearned facts and of autobiographical information prior to the injury event tends to be relatively spared after TBI. Memory problems are a major reason for failure to return to work or school, or for difficulty performing complex activities of daily living. Common functional complaints related to memory problems include:

- Difficulty following directions or passing on messages–may be indicative of deficits in working memory
- Difficulty retaining information about specific events that occur in the person's life since the injury–may be related to problems with episodic memory
- Difficulty remembering to go to appointments or to complete household chores–may be indicative of difficulties with prospective memory

Executive Dysfunction

Executive functions are those capacities, most commonly linked to the frontal cortex, that guide complex behavior over time through planning, decision-making and response control. Individuals with executive dysfunction may perform well on familiar, highly structured tasks but are likely to have difficulty functioning independently. Deficits associated with frontal lobe injury often are the most handicapping as they interfere with the ability to use otherwise intact skills adaptively. Patients with executive dysfunction may present with problems including:

- Loss of initiative and drive
- Difficulty moving flexibly from task to task
- Diminished awareness of deficits
- Inability to monitor performance properly.
- Difficulty planning and organizing complex activities
- Poor reasoning, problem-solving and conceptualizing

Communication Problems

After a TBI, problems communicating effectively with others are a result of the cognitive deficits underlying these processes. They may include problems with organizing and integrating language in order to comprehend and express complex concepts, difficulty with finding words in conversation, problems understanding abstract language and figures of speech, and poor adherence

to conventional rules of social communication. Aphasia is relatively rare in TBI, but can occur with focal lesions in the left frontal and/or temporal lobes.

Assessment of Cognitive Problems After TBI

The purpose of the assessment by specialists with expertise in cognitive rehabilitation is to:

- Determine if there is a cognitive problem
- Establish the nature and characteristics of the problem
- Evaluate the implications of the cognitive symptoms on the ability to carry out functional everyday activities
- Estimate the individual's capacity to participate in rehabilitation services
- Determine the most effective means to facilitate learning
- Plan rehabilitation interventions
- Measure recovery and treatment progress

Neuropsychological evaluations are assessments of cognitive and psychological functioning vis-à-vis an individual's brain injury. They may entail assessments of overall intellectual capacity, attention and concentration, learning and memory, language, visual cognitive abilities, executive functions, psychological adjustment, and personality. These evaluations may take 2-5 hours and consist of variety of measures. A neuropsychologist, by taking a careful history from the patient, may be helpful in diagnosing mild TBI. Unlike moderate to severe TBI which typically is self-evident due to abnormalities on neuroimaging (e.g., MRI) and initial prolonged loss of consciousness, the diagnosis of mild TBI often may be based on solely on self-report. In those cases, eliciting a detailed history of the patient's experience of the injury may help determine if there was an alteration or loss of consciousness (and hence, a mild TBI).

However, it is important to realize that neuropsychological tests do not determine whether or not a brain injury occurred. Rather, they help ascertain overall dysfunction due to brain injury and assess cognitive and psychological functioning. Other functions of a neuropsychological assessment include:

- Establishing a baseline level of cognitive functioning (for comparison purposes later)
- Assisting with decision-making with regard to degree of independence and level of care required
- Assisting with vocational and educational planning
- Assisting with treatment planning

Evaluations by rehabilitation specialists, including speech-language pathologists, occupational therapists, and vocational counselors, focus on the effects of cognitive impairments on the individual's daily function and participation in community activities. These evaluations use a combination of standardized tests, structured observations in functional settings, and standardized ratings by the client, family, and caregivers to yield accurate and complete information about the individual's functional capacity.

Points to Remember

- Memory problems are among the most commonly reported deficits after brain injury
- Neuropsychological evaluations assess cognitive and psychological
- functioning vis-à-vis an individual's brain injury, but do not determine weather a brain injury occurred.
- If patients present with cognitive and/or emotional complaints post-TBI, consider referring them to rehabilitation specialists

Treatment Interventions for Cognitive Problems After TBI

Common interventions for the cognitive symptoms of TBI fall into two broad categories: cognitive rehabilitation and pharmacologic interventions. The evidence for the effectiveness of both types of interventions is growing in the specialty literature.

Cognitive Rehabilitation

Cognitive rehabilitation is one component of a comprehensive brain injury rehabilitation program. It focuses not only on the specific cognitive deficits of the individual with brain injury, but also on their impact on social, communication, behavior, and academic/vocational performance. Some of the interventions used in cognitive rehabilitation include modeling, guided practice, distributed practice, errorless learning, direct instruction with feedback, paper-and-pencil tasks, communication skills, computer-assisted retraining programs, and use of memory aids. The interventions can be provided on a one-on-one basis or in a small group setting.

Treatment of Attention. Treatment employing direct attention training in conjunction with metacognitive training (i.e., feedback, self-monitoring, and strategy training) is a practice guideline in cognitive rehabilitation following brain injury (Sohlberg et al, 2003; Cicerone et al., 2000 & 2005).

Direct attention training involves repeated stimulation of attention processes with the goal of strengthening the underlying neural processes. Exercises are organized hierarchically according to theoretically grounded models of attention. Direct attention training is rooted in the concept of neuroplasticity. Key mechanisms involve unmasking of existing circuits, modification of synaptic connectivity and inter-hemispheric competition. Sufficient repetition is essential to ensure generalization of gains achieved in therapy.

Metacognitive training consists of teaching the individual behaviors that facilitate information processing, including self-monitoring and self-instruction. Frequently mentioned strategy "tips" include:

- pace yourself
- frequently check work for errors
- work on one task at a time
- take regular breaks to refocus attention
- work in a quiet environment with minimal noise and few interruptions

It is important to recognize that providing a list of strategies does not constitute cognitive rehabilitation. In order for strategies to work, they need to be individualized, goal-directed, practiced repeatedly, and have measurable outcomes that can be monitored by the individual. Without the appropriate training, the probability of the compensatory strategies being adopted and used consistently is very small.

Treatment of Memory. Recent reviews of the evidence for memory training conclude that strategy training for mild memory impairment should be a practice standard after brain injury (Cicerone et al, 2000 & 2005). The use of memory aids with direct application to functional activities is recommended as a practice guideline (Sohlberg et al, 2007; Cicerone et al, 2000 & 2005).

Strategy training in memory rehabilitation targets behaviors or sequences of behaviors that facilitate the individual's information processing, retention, and retrieval. Examples include rehearsal, self-questioning, mnemonics, etc. Strategies provide alternative ways of learning and require adaptation to the specific needs of the individual, systematic training, and evaluation/modification based on the level of success and acceptance. Again, strategy training must be individualized, goal-directed, practiced repeatedly, and monitored and adjusted for maximal effectiveness.

Compensatory techniques for memory problems may involve training in the use of memory aids such as timers, pocket computers, personal organizers, and digital recorders. Among the demonstrated benefits of memory aids are support for completion of functional activities, flexibility of treatment options, and high consumer acceptance. It is important that these devices be prescribed by professionals with specialized expertise in cognitive technology. These professionals have the skill to conduct the individualized needs assessment, prescribe the device that matches the needs, and provide the training necessary to ensure successful and consistent use of the device.

Executive Function Treatment. Reviews of the evidence-based practice for executive function problems conclude that interventions using problem-solving strategies with application to everyday situations are a practice standard and that interventions to promote and practice internalization of self-regulation strategies, self-instruction, and self-monitoring are a practice guideline (Cicerone et al, 2005).

Many of the same strategies that assist with attention and memory problems are useful in managing executive function difficulties. Interventions using these strategies should emphasize the need for patients to anticipate and monitor the outcomes of their behaviors. In most cases, the goal of remediation should not be limited to training a task-specific performance, but rather the training and internalization of regulatory cognitive processes (Cicerone et al., 2006).

Specific interventions for executive dysfunction may include:

- Treatment of unawareness using educational components and controlled experiential tasks aimed at enhancing awareness of problems
- Environmental modifications, particularly setting up routines that circumvent the difficulties of initiating and planning activities
- Use of external cueing and monitoring to increase the probability of successful initiation and completion of certain tasks

Treatment of Social Communication. Interventions directed at improving pragmatic communication and conversational skills after TBI are recommended as a practice standard based on the review of existing literature (Cicerone et al., 2000; Struchen, 2005).

Changes in social communication skills are thought to be a major contributor to problems with social isolation following TBI. They co-occur with cognitive and personality changes and are affected by premorbid and environmental factors. Consequently, treatments for social communication need to address these factors concurrently. Some of the techniques used for the treatment of social communication include:

- Developing active listening skills
- Group treatments
- Videotaped interactions
- Modeling and rehearsal
- Training of self-monitoring strategies

Pharmacological Treatments

Medications to help improve cognitive functioning after TBI should be tried only after medical and behavioral factors have been mitigated (e.g., poor sleep hygiene, stabilizing medical issues that impact arousal, discontinuing centrally-acting medications, reducing environmental distractions, and managing depression). The efficacy of medications to improve cognition has been limited. However, evidence exists to support the use of stimulating agents to enhance arousal and attention after brain injury. These stimulating agents can include true stimulants, antidepressants and dopaminergic agents. Little evidence exists to support the use of memory enhancing agents (e.g., cholinesterase inhibitors) following TBI or medications to promote awakening from coma. The sections below describe the following categories: (1) neurostimulants, (2) antidepressants, (3) dopaminergic agents, and (4) other agents.

Neurostimulants. (Methylphenidate (MPH or Ritalin), dextroamphetamines, pemoline (Cylert)). There have been mixed reports addressing the effects of methylphenidate on memory and attention after traumatic brain injury (TBI). Several review articles have been published (Challman & Lipsky, 2000; Kraus, 1995; Siddall, 2005). The authors concluded that neurostimulants have some utility for certain types of cognitive symptoms following brain injury. The most consistent and robust findings have been for MPH resulting in improved speed of mental information processing (Whyte et al., 1997, 2004; Willmott &

Ponsford, 2009). Findings are consistent in that there is a state-dependent beneficial effects on mental processing speed in the post-acute period, and a suggestion of potential carryover effects after discontinuation of MPH. However, these same studies found that MPH was not effective at improving working memory abilities.

Antidepressants.
Tricyclic antidepressants (TCA's). The tricyclic antidepressants which seem to have the best potential for the brain injury population are those with a stimulant effects, such as protriptyline, nortriptyline, and desipramine (Joseph & Wroblewski, 1995; Reinhard, Whyte, & Sandel, 1996).

SSRI's (Sertraline (Zoloft) and Fluoxetine (Prozac)). Fann et al. (2001) reported improvements with sertraline in recent verbal memory, recent visual memory, and general cognitive efficiency in patients with depression after mild TBI. However, Meythaler et al. (2001) failed to show any significant improvement in arousal and alertness following SSRI intervention in 11 individuals with severe TBI

Dopaminergic Agents. Amantadine (Symmetrel), Seligiline/Deprenyl (Eldepryl), Bromocriptine (Parlodel), Pergolide (Permax), L-Dopa/Carbidopa (Sinemet), Ropinirole, and Pramipexole.

There is some evidence from non-controlled studies or case studies that these medications may provide some benefit for cognitive problems following TBI (Sawyer, Mauro, Ohlinger, 2008; McDowell et al., 1998; Lal et al., 1988); however, there are also negative findings (Schneider et al., 1999). Similarly, there are a limited number of animal studies demonstrating some cognitive benefits from these medications (Kline et al., 2002).

Other Pharmacological Agents.
There are a number of other agents which are actively being studied for potential recovery post-brain injury; many are still in the animal model stages. The nootropics (nefiracetam, piracetam, pramirecetam) potentially increase the glucose and oxygen consumption in the ischemic nervous tissue and increases blood flow through cerebral terminal vessels. McLean (1991) reported that pramirecetam improved memory in young males with head injury or anoxic injury.

In conclusion, there are a number of pharmacologic agents that show potential to improve cognitive sequelae post brain injury. However, the number of clinical trials for these agents in head injury has been limited to date. With the newer, more specific neuronal agents now available, there is potential for targeted use of such agents in both acute and possibly subacute stages of brain injury. **Table 1** provides suggestions for medications for various cognitive problems.

Table 1. Pharmacotherapy and Associated Treatments for Behavioral and Cognitive Symptoms following TBI (Adapted from the VA/DoD Mild TBI Clinical Practice Guidelines)

Common Symptoms Post Concussion/mild TBI	Job Review	Pharmacologic Treatment	Non-Pharmacologic Treatment	Referral after failed response to initial intervention
• Fatigue • Loss of energy • Getting tired easily	✓	• Stimulant*	• Sleep hygiene Education • Reassurance • Encourage regular scheduled aerobic exercise • Activity restriction adjustment • Sleep study	• Mental Health
• Cognitive difficulties • Concentration • Memory • Decision-making	✓	• SSRI • Stimulant*		• TBI specialist for cognitive rehabilitation or mental health
• Feeling anxious	✓	• Anxiolytic • SSRI		• Mental Health • Social support
• Emotional difficulties • Feeling depressed • Irritability • Poor frustration tolerance	✓	• Anti epileptics • SSRI		

* Consider in the specialty care setting after ruling out a sleep disorder

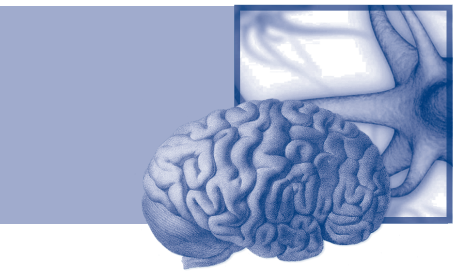
Appendix F provides information about potential side effects, contraindications, and dosing suggestions for various medications used to manage cognitive issues, particularly following mild TBI.

Role of The Primary Care Physician In The Management of Cognitive Deficits

Patients and their families often present to the primary care physician with complaints related to cognitive problems following TBI. These may be new problems, worsening problems, or stable problems that can no longer be managed adequately due to social or environmental changes. Common symptom complaints are likely to be memory problems, behavioral changes, failure at work or school, as well as social and familial stressors. The assessment of symptoms, physical exam, and review of the patient's treatment history will provide the roadmap for initial treatment steps. Depending on prior medical workups and previous rehabilitation interventions, first steps may include referrals to rehabilitation specialists with expertise in cognitive rehabilitation. Providing patients and families with education materials and supportive listening are likely to be useful interventions.

Points to Remember

- Common interventions for the cognitive symptoms of TBI fall into two broad categories: cognitive rehabilitation and pharmacologic interventions
- Providing a list of strategies does not constitute cognitive rehabilitation
- Cognitive rehabilitation should address the impact of cognitive deficits on social, communication, behavior, and academic/vocational performance.



CHAPTER 7: Emotional and Behavioral Sequelae and Treatment

Learning Objectives

- Recognize common neuropsychiatric sequelae of TBI
- Understand the interplay of cognitive and emotional problems following TBI
- Identify the assessment data needed to prescribe efficacious treatments for TBI
- Recognize symptoms and problems that may require referral to mental health professionals
- Learn basic pharmacological treatment for these sequelae

Introduction

Emotional difficulties, adjustment issues, and behavioral problems are common following moderate to severe brain injury (Morton & Wehman, 1995; Sohlberg & Mateer, 2001). Furthermore, premorbid psychiatric problems, such as impulse control difficulties, substance abuse, and family problems increase the risk for brain injury (Vassallo et al., 2007). Psychiatric Risk Factors for Head Injury. Brain Injury, 21, 567 – 573.), and are unlikely to improve following brain injury (Bennett & Raymond, 1997; Hanks, Temkin, Machamer, & Dikmen, 1999; Kersel, Marsh, Havill, & Sleigh, 2001; McCauley, Boake, Levin, Contant, & Song, 2001; Sarapata, Herrmann, Johnson, & Aycock, 1998). Following a brain injury, one has to deal with both pre-injury characteristics as well as the emergence of new post-injury emotional/behavioral problems.

The vast majority of individuals with concussion/mild TBI will have no difficulties or complaints beyond a few weeks following injury. Early educational interventions, reassurances regarding an expected positive recovery, and instructions to gradually resume activities have been shown to enhance the recovery process (Ponsford et al, 2002; Mittenberg et al., 1996). However, the term "mild TBI" refers only to the initial injury severity and should not be interpreted unequivocally as suggesting mild ongoing problems. In fact, the relationship between original severity of TBI and long-term emotional and behavioral problems is not linear. Some individuals with a concussion may have significant adjustment issues and long-term functional impairments, while someone who was in a coma for weeks may show minimal long-term emotional problems. Each patient with TBI, regardless of severity, is unique.

A minority of individuals who sustained a mild TBI may develop persistent postconcussive symptoms. Sleep disturbance is particularly under appreciated as a problem following mild injuries (Kelly, 2002). Sleep problems can worsen other acute problems that frequently occur in mild head injuries such as headaches, poor concentration, depression, relationship difficulties, and decreased problem solving abilities. For a small percentage of individuals this becomes a self-perpetuating cycle with a somatic focus. As a result, a minority have been found to change or lose their jobs within six months of the injury (Gasquoine, 1997) and are at risk for not understanding why they now are having problems in their life (Prigatano & Schacter, 1991).

Following moderate to severe brain injury emotional problems are common. Damage to the frontal lobes in severe motor vehicle accidents can cause specific behavioral problems including difficulty tolerating frustration or higher levels of stimulation. This in turn can lead to agitation, excessive use of profanity, aggression, and potentially destructive behavior. In addition, behavior problems can be the result of an impaired ability to process information or understand situations accurately. Finally, post-TBI behavior problems can also occur because individuals become fatigued much more easily, increasing irritability and lowering frustration tolerance. As a result, emotional sequelae following a brain injury often include increased anger, lowered frustration tolerance, increased anxiety, depression, and low self-esteem.

Behavioral and emotional problems may be long-lasting following moderate to severe brain injury and take a tremendous toll on family members, caregivers, and friends. In addition, they tend to lead to social problems including over-dependency, tangential or excessive talking, immature behavior, inappropriate use of humor, inappropriate sexual behavior, poorly controlled spending, self-centeredness, and/or general difficulty appropriately reciprocating in social interactions. Although more recent studies show less frequent divorce rates (Kreutzer, 2007), divorce is common. This is often accompanied by a loss of social group membership for the person injured, further resulting in long-term obstacles for a successful recovery (Wood & Yardukal, 1997).

Resources (e.g., emotional, physical, financial, social, etc.) are much more likely to be exhausted in the recovery of someone with a more severe injury. The family burden can be substantial and may result in family disintegration. The loss of family and other social supports is paramount because these supports play a major role in obtaining a successful outcome for the person injured.

Points to Remember

- Damage to the frontal lobes is common in serious motor vehicle accidents and can cause specific behavioral problems or changes in personality
- Behavioral and emotional problems may be long-lasting and take a tremendous toll on the family
- The relationship between original severity of injury and long-term outcomes is not one-to-one

Interplay of Cognitive and Emotional Problems

It is important to realize that cognitive deficits (e.g., mental slowness, memory problems, inattention, impaired problem-solving skills, etc.) can impact emotional reactions. Similarly, emotional reactions such as anger and irritability can interfere with attention, memory, and thinking abilities. Impaired self-awareness (i.e., difficulty seeing one's strengths and deficits) is common in moderate to severe injuries and typically results in the person having unrealistic goals and expectations. It can also lead to difficulties with getting services and maintaining the injured person's involvement or willingness to participate in needed services.

Sometimes, emotional symptoms are the direct result of neurological damage rather than psychological reactions, despite similar clinical appearance. **Table 1** illustrates this point by comparing mental health symptoms with similarly appearing neurologic-based problems.

Table 1: Mental Health and Neurogenic Symptoms of TBI

Mental Health Symptoms	Neurogenic Symptoms
Denial of problems	Anosognosia (lack of awareness of impairment)
Anger and irritability	Agitation
Depression	Apathy, impaired emotional expressiveness, lowered crying threshold, pseudobulbar palsy
Emotional lability	Lability of emotional expressiveness (not the underlying feeling state), pseudobulbar palsy
Social withdrawal	Lack of initiative, Apathy
Thought disorder	Cognitive impairments and thinking problems
Personality or conduct disorder	Impulsivity, social disinhibition

Points to Remember

- Impaired self-awareness is common in moderate to severe injuries and often results in the person having unrealistic goals and expectations
- Emotional and behavioral problems can be the result of either neurological damage due to the TBI or psychological reactions secondary to having a brain injury

Context of TBI and Mental Health Comorbidities

When TBIs occur within a military context, combat-related mental health issues are common, regardless of the original severity of the TBI. PTSD, anxiety, and depressive symptoms are common even if individuals do not meet full diagnostic criteria for these disorders (Hoge et al., 2006, 2008; Tanielian,& Jaycox, 2008).

Returning military personnel may have sustained one or more concussions/mild TBIs while in theatre, and now present months later to medical providers with multiple symptoms such as insomnia, fatigue, irritability, headaches, and memory and concentration complaints. Many of these symptoms are consistent with both mental health conditions (PTSD, depression, and anxiety) and possible postconcussion residuals (Nampiaparampil, 2008). Disentangling primary etiologies for various symptoms is almost impossible and typically not helpful. However, determining whether or not mental health conditions are present is possible, and if so referral to mental health professionals for ongoing treatment is indicated.

Following TBI in the civilian context, PTSD is less common than in military combat population (Creamer, 2005). In the combat context, military personnel frequently have multiple traumatic exposures prior to their TBI and comorbid PTSD is not unusual (Hoge, 2008; Tanielian,& Jaycox, 2008). When presenting in the postacute or chronic phase of TBI recovery, particularly after a more severe TBI, the PTSD may be become apparent for the first time. When this occurs, referral to mental health professionals for treatment is indicated. As individuals who have had a moderate to severe TBI return home, they may be faced with the consequences of their residual deficits for the first time and may develop adjustment reactions, depression, anxiety, or higher levels of irritability and frustration.

Emotional and Behavioral Assessment

Obtaining information from both the patient and a collateral source (family or caregiver) is important to get a more balanced understanding of the reporting by the patient. A sample of structured interview questions to assess emotional and behavioral issues include:

- How has your injury changed your life?
- Have you experienced changes in frustration level or anger control?

- Have you experienced increased difficulties in interpersonal relationships with your spouse or friends?
- What resources (e.g., family, friends, doctors) have been the most helpful for you?

Consider a referral to psychology if a more detailed diagnostic mental health interview, psychological testing, and/or psychotherapy appear to be warranted. Consider a referral to psychiatry for a diagnostic interview, medication management of emotional or behavioral difficulties, and/or psychotherapy. Etiology of particular symptoms frequently cannot be determined, and are therefore best approached in an interdisciplinary team manner. Consultation with neurology, neuropsychology, and/or mental health is recommended if it is uncertain whether the emotional/behavioral problems are neurologic versus psychogenic in origin. The more information provided to consultants about the problems for which one is seeking analysis and recommendations, the more likely the referral will provide useful information and a targeted answer that will assist future decision-making.

Suicidality and Depression

Depression and suicidality should always be assessed in TBI patients. Post-injury, as individuals attempt to return to their prior roles, physical and cognitive difficulties may become more apparent and, consequently, psychological adjustment problems develop. Depression may develop and suicidal thoughts are possible. Lower levels of impulse control and impaired judgment increase suicidality concerns. Sample questions to assess these issues include:

- Have you experienced changes in your mood such as sadness, depression, or anxiety?
- Do you ever feel like harming yourself or anyone else? (If yes, assess current thoughts regarding active suicidal or homicidal intent)
    - Do you have a plan?
    - Do you feel like killing yourself right now?

Substance Abuse

Pre-injury alcohol and drug abuse increases the risk for sustaining a TBI (Vassallo et al., 2007). In the ongoing management of individuals who sustained a TBI, careful assessment of substance use is essential. This should include not only alcohol and illegal drug use/abuse, but also overuse of caffeinated beverages and "power drinks" which can increase irritability and impair sleep. Counseling regarding abstinence should be encouraged. If clear substance abuse or dependence is apparent, referral to substance abuse program should be made.

Irritability

Increased irritability and lower frustration tolerance are common following TBI. Complaints may come from the patient but sometimes they may come primarily from caregivers and/or family members because these problems typically

result in increased difficulties in interpersonal relationships. Irritability can be increased with higher levels of stimulation (group activities, parties, shopping, etc.), substance use/abuse, and sleep problems. Assessing and monitoring these symptoms and their interactions should be a part of ongoing care management. Referral to mental health professionals may be indicated if problems persist and are causing significant day-to-day functional difficulties.

Severe Neurobehavioral Disorders

A small number of individuals who sustained a more severe TBI will have significant ongoing problems with impulse control, anger management, and behavioral self-control. Such individuals are likely to have episodes on a weekly or monthly basis of "acting out" or getting into verbal or physical altercations. Although they may be able to obtain jobs and function for short periods of time, they often get fired and move from job to job. This may become a chronic pattern and management on an outpatient basis is difficult. Such individuals should be referred to mental health or TBI rehabilitation professionals and may require a neurobehavioral residential program. Currently such programs are not available within the VA but contract providers may be available.

Point to Remember

- Obtaining collateral information from family is important due to the frequent lack of self-awareness or denial of impairments common following moderate to severe TBI
- Mood, suicidality, and substance use should always be assessed in the ongoing management of individuals who sustained a TBI
- Irritability is a common post-TBI symptom and can interfere with day-to-day functioning

Therapies to Address Emotional and Behavioral Issues

The main goal of this section is to increase understanding of the common neurobehavioral disorders affecting TBI patients and appropriate treatment strategies. General principles to the management of psychological and behavioral sequelae include:

- Patient and caregiver education and support
- Interdisciplinary approach
- Psychotherapy/behavioral management
- Pharmacotherapy

Common Non-Pharmacological Behavioral Interventions

Mild TBI with Persistent Emotional and Behavioral Complaints or Problems

Some individuals with mild TBI present months after injury with multiple physical, cognitive, and emotional complaints. Treating prevailing symptoms such as insomnia and headaches may result in a significant reduction in emotional and behavioral complaints (http://www.healthquality.va.gov/management_of_con-

cussion_mtbi.asp). However, if emotional or behavioral problems continue after several weeks of treatment, a referral to a TBI or mental health specialist may be indicated. Common therapeutic approaches used by these specialists might include:

- Cognitive-behavioral psychotherapy including teaching self-monitoring, self-instruction, and relaxation techniques may be particularly useful for treatment of:
  - Irritability and low frustration tolerance
  - Anger management
  - Adjustment difficulties
  - Depression
  - Anxiety
  - Inappropriate or disinhibited behaviors
  - Social skills deficits
- Group Therapy to address issues of interpersonal interactions
- Family or Marital Therapy to help families deal with the common post-injury issues such as change in family roles, caretaker burden, relationship conflicts including sexuality, and expenditure of family resources for the injured person
- Spiritual guidance to provide hope, comfort, and support
- Education regarding brain injury, what to expect, and how to handle difficult circumstances

Moderate to Severe TBI with Emotional and Behavioral Problems

In the postacute phase of care following a moderate to severe TBI psychological adjustment issues are common, as are increased rates of depression, anxiety, anger control problems, and other interpersonal and relationship problems. If patients present to the primary care setting and are not receiving services for these issues through mental health or TBI specialty care providers, a referral for mental health services at any time post injury is appropriate.

Providing patients and families specific information about available resources is also helpful:

- Contact information for state and national brain injury organizations
- Information about local self-help and support groups

Points to Remember

- There are multiple psychological interventions that can be helpful in dealing with the emotional and behavioral problems following mild TBI
- Information and education to patients and families are potentially powerful interventions

Psychopharmalogical Treatment - Post-Acute Symptom Management

The following recommendations are based on available research base and expert consensus. The use of pharmacologic agents has become standard

practice in the treatment of emotional and behavioral sequelae of TBI (Arciniegas & McAllister, 2008; Warden et al., 2006). While few FDA indications exist for the treatment of TBI-related symptoms, many medications are commonly used for these conditions. When possible, treatment should be based on a specific diagnosis, however often clinicians must use a symptom-based approach.

The pharmacologic approach is based on the severity and acuity of the predominant symptoms. As with any medication, decision one should consider balancing the risks and benefits. The use of a single agent for treatment of multiple symptoms or conditions is preferred. Medication selection should take into account other symptoms, other medical and/or psychiatric conditions, presumed etiology of the symptom, compliance, and medication side effect profiles. **Table 2** adapted from Arciniegas, Topkoff, & Silver, (2000) provides useful information about medications potentially useful in treating various symptom profiles.

Common principles for prescribing medications for individuals with TBI include:

- Begin medications after non-pharmacologic interventions have been unsuccessful
- Obtain a detailed medication profile (including over the counter agents)
- Start low and go slow
- Make only one medication change at a time
- Provide an appropriate therapeutic drug trial
- Allow adequate time for one drug to clear out of the person's system before changing to another medication
- Be aware of confounding comorbidities (e.g. substance abuse, PTSD)
- Individuals with TBI are at higher risk for health illiteracy-related medication issues
- Check for medication compliance in non-responders
- All providers and caregivers should be aware of current medications and any medication changes
- Don't prescribe what already hasn't worked or has had negative effects
- The following classes of medication are not generally recommended in the management of TBI-related symptoms: antihistamines, narcotics, benzodiazepines

Acute Agitation/Aggression

This problem is seen most commonly during the early phase of recovery from moderate to severe brain injury during the Rancho Level IV (see **Chapter 2** for a review of Rancho Levels) and can severely affect the patient's ability to participate in therapy. Post-traumatic agitation is a diagnosis of exclusion. This means that provoking or aggravating medical (infection, pain, drug withdrawal, hypoxia), neurological (seizure, hydrocephalus, etc.), or pharmacological factors should be investigated and treated before attributing agitation to post-traumatic causes.

Table 2: Medications and their Potential Usages for Emotional and Behavioral Problems following TBI

Medication	Depression	Affective lability or Irritability	Mania	Psychosis	Agitation or Aggression	Anxiety	Apathy
Nortriptyline	++	++	0	0	++	+	0
Desipramine	++	+	0	0	+	+	0
Amitriptyline	++	+	0	0	++	+	0
Protriptyline	++	+	0	0	+	+	0
Fluoxetine	++	+++	0	0	++	0	0
Sertraline	+++	+++	0	0	++	0	0
Paroxetine	+++	+++	0	0	++	0	0
Citalopram	++	+++	0	0	++	0	0
Lithium	+	+	++	0	++	+	0
Carbamazepine	+	++	++	0	+++	+	0
Valproate	+	++	+++	0	+++	+	0
Benzodiazepines	-	+	+	0	++	++	0
Buspirone	+	++	+	0	+	++	0
Typical antipsychotics	0	+	+	++	+	+	0
Atypical antipsychotics	0	+	+	+++	++	+	0
Methylphenidate	+	++	-	-	+	-	++
Dextroamphetamine	+	0	-	-	+	-	++
Amantadine	+	++	+	-	++	0	0
Bromocriptine	0	0	0	-	0	0	++
L-dopa/carbidopa	0	0	0	-	0	0	+
Beta blockers	-	0	0	0	+++	+	-
Donepezil	0	0	0	0	0	0	0

Key Item	Key Description
+	Mild positive effects seen
++	Moderate positive effects seen
+++	Marked positive effects seen
0	No effects seen
-	Mild negative effects seen
-	Moderate negative effects seen
- -	Marked negative effects seen

Only medications for which there are reports in the literature are listed here. Additional adverse events include increased likelihood of seizures (antidepressants), neurotoxicity (lithium), impaired cognition (mood stabilizers and benzodiazepines), and psychosis (bromocriptine and L-dopa/carbidopa).

Medications that should be used with caution in TBI patients include benzodiazepines, antispasticity drugs, typical antipsychotics, narcotics, H2 blockers, certain anticonvulsants, anti-hypertensives, clonidine, and steroids, as they can all contribute to agitation or restlessness. Nevertheless, benzodiazepines and antipsychotic medications may be useful for the rapid resolution of acute agitation. However, they should be used for the shortest period of time at the lowest possible dose. Benzodiazepines are known to impair memory/attention, prolong post-traumatic amnesia, and can result in a paradoxical reaction while typical antipsychotics (haldol, thorazine) can lower the seizure threshold, delay motor recovery, and impair cognitive recovery.

The following classes of medication may be used to manage acute agitation/aggression: anti-epileptics (e.g., valproate, carbamazepine), beta blockers, antipsychotics, antidepressants (e.g., SSRIs), sleep agents, and anxiolytics. The following classes of medication are not recommended to manage acute agitation/aggression: antihistamines, narcotics. Please refer to **Table 2** on pharmacology for further details.

Chronic Agitation/Aggression

To date there is no FDA approved drug for agitation or aggression. Most of current treatment practice has been modified from psychiatric research with non-TBI patients.

The following classes of medication may be used to manage chronic agitation/aggression: anti-epileptics, beta blockers, atypical antipsychotics, antidepressants, sleep agents, anxiolytics (Yudofsky & Hales, 2002). The following classes of medication are not recommended to manage chronic agitation/aggression: antihistamines, narcotics, benzodiazepines. Please refer to **Table 2** on Pharmacology for further details.

Mood Disorders/Apathy

Depression occurs in 25-50% of TBI patients and risk factors include prior psychiatric history, prolonged PCS, left hemisphere damage, and psychosocial factors (loss of social support, work, etc.; Jorge, Robinson, Arndt, Starkstein, Forrester, & Geisler, 1993). Studies report an increased risk of suicide following TBI (Yudofsky & Hales, 2002). Treatment for depression following TBI includes supportive psychotherapy and pharmacologic treatment. Drug choice is guided by side effect profiles but dictated by clinical presentation and history. SSRIs and SNRIs are most frequently used. Mania and emotional lability are treated similarly. Mania occurs in 4-10% of TBI patients and risk factors include right hemisphere damage and family history of mood disorders. The treatment of choice for mania in the TBI population are the anticonvulsants.

Apathy presents as a lack of initiation, motivation, appropriate affect and pleasure. Depressed mood, feelings of hopelessness or worthlessness, identifiable stressor, and changes in sleep are generally not present (Rao & Lyketsos, 2000). Treatment of choice is use of dopaminergic agents such as amantadine and neurostimulants.

The following classes of medication may be used to manage depressive symptoms after TBI: traditional antidepressants (e.g., SSRIs and SNRIs), stimulants, anti-epileptics, anti-psychotics. Please refer to **Table 2** on Pharmacology for further details.

Irritability

Irritability is one of the post prevalent neurobehavioral complaints following TBI of any severity (Deb & Burns, 2007; Rapoport, 2002). Caregivers and families of patients with prior TBI of all severities also often note that irritability is a frequent issue. This can adversely affect many aspects of life including interpersonal relationships and community re-entry. A thorough assessment of psychosocial stressors should be investigated and psychological evaluation and intervention should be initiated prior to considering pharmacologic treatment options. Ensuring adequate sleep and stress control may decrease the overall presentation of irritability. Counseling the patient to reduce exposure to known irritants may be useful in limiting episodes.

The following classes of medication may be used to manage irritability: anti-epileptics, beta blockers, antipsychotics, antidepressants, sleep agents, anxiolytics. The following classes of medication are not recommended to manage irritability: antihistamines or narcotics. Please refer to **Table 2** on Pharmacology for further details.

Anxiety Disorders

TBI often impairs the ability to understand or adapt to external and internal stimuli. Approximately 29% of TBI patients have measurable levels of anxiety (Yudofsky & Hales, 2002). This occurs most commonly with lesions involving the right orbital-frontal region. Treatment should include a review of all factors that might possibly play a role in provoking or maintaining symptomatology such as work, family dynamics, and environment. Medications that can be effective include SSRIs, buspar, SNRIs, and propranolol.

The following classes of medication may be used to manage anxiety: anti-epileptics, beta blockers, antipsychotics, antidepressants, sleep agents, anxiolytics. The following classes of medication are not recommended to manage anxiety: antihistamines or narcotics. Please refer to **Table 2** on Pharmacology for further details.

Disinhibited Behavioral Control Disorders

Personality changes frequently occur following TBI and empirically we see this as one of the most difficult adjustment issues. These are frequently a consequence of frontal and temporal lobe damage and treatment depends on the subtype of the personality change. DSM IV classifies the following personality change subtypes: labile, disinhibited, aggressive, apathetic, paranoid, combined, and unspecified. The disinhibited personality subtype may respond to anticonvulsant or SSRI medications, whereas the apathetic type may respond to psychostimulant medication.

The following classes of medication may be used to manage disinhibited behavioral control disorders: anti-epileptics, beta blockers, antipsychotics, antidepressants, sleep agents, anxiolytics. The following classes of medication are not recommended to manage disinhibited behavioral control disorders: antihistamines, narcotics. Please refer to **Table 2** on Pharmacology for further details.

Psychotic Disorders

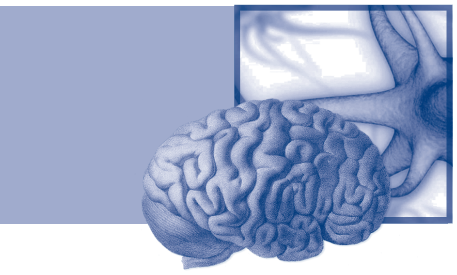
The incidence of post-traumatic psychosis ranges for 0.7 to 20% (Ahmed & Fujii, 1998). Risk factors include left hemisphere injury, specifically left temporal lobe damage, and can occur early (during PTA) or after a long latency. Interestingly, there is a higher incidence of head trauma in schizophrenic patients. Treatment includes the use of atypical antipsychotics or anticonvulsants.

Points to Remember

- To effectively treat neuropsychiatric disorders following TBI, one must be sure to rule out confounding medical and neurological factors as well as alcohol or drug induced symptoms.
- Polypharmacy should be minimized. An attempt to minimize unnecessary medications should occur prior to initiating new medications to treat symptoms.
- Familiarity with medication side effects is crucial, and helps guide medication selection.
- Family/Caregiver education and support are key for the effective treatment and management of neuropsychiatric disturbances following TBI.

Role of The Primary Care Physician

In the post-acute phase, TBI patients and their families are most likely to present to their primary care physician with various emotional or behavioral complaints. The family may well report problems with irritability, anger control, and disinhibition, while the patient is more likely to report general life dissatisfaction, poor mood, or low self-esteem. Once the history of TBI has been clarified and the onset of the reported symptoms dated to the TBI, the primary care physician may well consider referrals to psychiatry, psychology, or neuropsychology for further evaluations and treatment intervention. However, the primary care physician is likely to remain the primary provider and is likely to follow the patient on their medication regimen once an effective regimen is determined by the specialists.



CHAPTER 8:
TBI in the Elderly and Aging with TBI

Learning Objectives

- Identify unique aspects of traumatic brain injury (TBI) epidemiology in the elderly
- List strategies to prevent falls (and TBI) in the elderly
- Explain the influence of age on outcome after TBI
- Identify indications for head CT after TBI in the elderly
- Describe the relationship between physiological changes in the elderly and adverse cognitive medication side effects
- Describe the link between TBI and Neurodegenerative Disease

Epidemiology of TBI in the Elderly

Individuals 65 and older have among the highest annual incidence rates of TBI at 524 per 100,000, exceeded only by 0-4 yrs and 15-25 yrs age groups (Langlois et al., 2004.) Moreover, adults aged 75 years or older have the highest rate of all age groups for hospitalization and death from TBI. Falls, the leading cause of medically attended TBI overall, is by far the most common etiology in the elderly. Being struck as a pedestrian is a more common etiology in the elderly compared with other adults. Men account for a higher percentage of TBI in the young elderly group, whereas in those over 80 year old, greater female longevity leads to a female preponderance (Englander et al., 1999). People surviving TBI for 6 months have the same 10-year lifespan as the general population; so regardless of age at onset they and their residual impairments will age along with their noninjured peers (Brown et al., 2008). Given current demographic and longevity trends in United States, the number of older adults with TBI sequelae should continue to increase over the next several decades.

Prevention of TBI in the Elderly

Despite the important connection between falls and TBI among the elderly, relatively little research has been done on fall prevention. Approximately 30% of persons over 65 fall each year and may sustain injuries requiring hospitalization (Englander et al., 1999). The cause is usually multifactorial, with weakness, poor balance and medication side effects frequently contributing. One study showed a reduction of falls and head trauma in subjects compared

with controls using gait training by physical therapist, assistive devices, and balance and resistive exercises (Tinnetti et al., 1994). A recent comprehensive critical analysis of the literature concluded that multifactorial programs including patient evaluation and therapy home visits were best for those at higher fall risk and that exercise by itself is effective for reducing falls among the elderly; the exercise should include a comprehensive program combining muscle strengthening, balance, and/or endurance training for a minimum of 12 weeks (Costello et al., 2008.). Physician input is a critical component of fall prevention in the elderly as outlined in **Table 1**.

Table 1: Fall Prevention in the Elderly (Adpated from Brown et al., 2008)

Potential Problem	Intervention
Polypharmacy	Parsimony of medication prescription
Sedating medication	Avoiding both prescription and nonprespription sedating medications (e.g., tricyclics, sedative/hypnotics benzodiazepines, neuroleptics, diphenhydramine, etc.)
Gait dysfunction	Physical therapy, prescription of appropriate assistive device
Visual disturbance	Addressing cataracts, refraction
Physical frailty	Strength training
Decreased balance	Physical therapy
Medical conditions that can affect consciousness	Medical management of arrhythmia, seizures
Postural hypotension	Close medical monitoring, avoiding medications that lower blood pressure, compressive hose, hydration
Environmental hazards	No throw rugs, proper footwear, grab bars, tub chairs, proper lighting , avoiding slippery surfaces
Poor safety awareness	Education and supervision

Prognosis Following TBI in the Elderly

Age is an important factor in functional and cognitive outcomes after TBI. In short, the probability of poor outcome increases with advanced age (Braakman et al., 1980; Jennet et al., 1979; Stablein et al., 1980; Chestnut et al., 2000). Individuals sustaining a severe TBI after age 65 are unlikely (<10% chance) to reach Good Recovery on the Glasgow Outcome Scale (Brown et al., 2008). Possible explanations include reduced reserves with which to tolerate brain injury and/or a more fragile physiologic status in the elderly resulting in a more destructive injury (Rothweiler et al., 1998). Despite slower recovery rates and longer lengths of stay, the majority of elderly TBI survivors undergoing rehabilitation achieve functional improvement and community discharges (Cifu et al., 1996).

When assessing the impact of TBI on the older adult, one must take into account significant accumulated chronic comorbidities (e.g., arthritis, cardiopulmonary, diabetes, atherosclerosis, renal failure, cancer). In addition, one needs to consider chronic premorbid conditions that could reduce cerebral functional reserve at baseline (e.g., cerebrovascular disease, chronic alcoholism, advanced liver or renal disease, dementia) and potentially impede or prolong the recovery process. Another impediment to rehabilitation is higher levels of psychosocial limitation seen with advanced age (Rothweiler et al., 1998).

Assessment of TBI in the Elderly

Older individuals are more likely to have "complicated" mild TBI, a term used for patients meeting clinical criteria for mild TBI (i.e. concussion), but who also have abnormal findings on head CT. Thus, when an individual with mild TBI presents to the clinic or emergency department (ED), age should be considered in the decision whether to obtain a head CT. Based on retrospective review of 1448 patients seen in ED with mild TBI, Borczuk (1995) recommends CT scan for patients after TBI when age is greater than 60 years, or if any of the following is present: focal neurologic deficit, evidence of basilar skull fracture, or cranial soft tissue injury. Major trauma in individuals over 70 is 6 times more likely to cause intracerebral lesions than severe chest, abdominal, or pelvic injury. Many elderly are also on coumadin or other anticoagulation therapy, further increasing the risk. The physician should order a cranial CT and INR (International Normalized Ratio measuring clotting time) in all elderly patients with suspected TBI after trauma (Callaway & Wolfe, 2007). Multiple studies have supported the liberal use of cranial CT in the elderly with trauma as cost effective and clinically appropriate.

For the elderly TBI survivor with significant functional limitations, a full medical rehabilitation evaluation by a physiatrist is strongly recommended, when available. An estimation of physiological reserve allows more specific structuring of the rehabilitation program, and is made possible by delineating preinjury activity level and pertinent acute and chronic medical issues. Impairments (e.g., hemiparesis, dysphagia, incontinence, and cognitive deficits) and functional deficits (mobility status, activities of daily living) should likewise be fully delineated. The evaluation should also seek to identify any of the potential medical complications after TBI which will be discussed further below.

Management Behavioral and Cognitive Problems in the Elderly

Due to the physiological and pathological changes that accompany aging, older adults experience more frequent and more severe cognitive impairment when compared to younger adults with similar severity of TBI (Rosenthal, Griffith, Kreutzer, & Pentland, 1999). This is primarily due to lower cognitive reserve capacity and a higher incidence of premorbid dementia. Significant premorbid memory deficits are present in nearly 10% of community-dwelling older adults (Beard et al., 1995), and greater than 20% of those over 85 (Skoog et al., 1993).

Older individuals with TBI also have slower rates of drug metabolism and excretion, which creates a greater propensity for cognitive side effects from medications including agitation, somnolence, and increased confusion. To complicate matters, most elderly are chronically on regular prescription medications, with more than 90% of the entire population over age 65 taking at least one prescription medication daily, and most taking two or more (Chutka et al., 1995). After TBI, thorough review of both prescription and non-prescription medications is imperative; and all non-essential medications should be stopped or tapered. General principles for TBI pharmacology should be applied. For example, acetaminophen is the preferred medication for pain syndromes; proton-pump inhibitors are favored over H2 blockers for peptic ulcer disease or reflux; beta-blockers that cross the blood-brain barrier should be avoided; benzodiazepines and metoclopromide should especially be avoided; and low-dose trazodone is the preferred medication for insomnia.

Although major depression is less common, depressive symptoms are more common in elderly TBI patients compared to younger adults (Rosenthal et al., 1999). When pharmacological treatment of depression is indicated, selective serotonin reuptake inhibitors (SSRIs) are the recommended first line in elderly patients with TBI. Although generally safe, SSRI induced hyponatremia can occur in older adults; so checking electrolytes soon after initiation is prudent (Jacob & Spinler, 2006). In elderly patients with mild TBI, the development of a significant post-traumatic dementia with transient psychotic symptoms at night can be seen in association with increased nighttime agitation and disorientation (Goldberg, 2001). This can be viewed as stemming from a disorganized circadian sleep-wake cycle and an exaggeration of the effects of aging on circadian physiology. The use of low doses of risperidone, olanzapine, or quetiapine at bedtime can be helpful in reducing these disturbing symptoms and re-establishing a normal circadian rhythm.

Common Comobidities

Common medical complications after TBI are discussed in **Chapters 4 and 5**. As previously mentioned, polypharmacy should be avoided, and non-essential medications should be eliminated. Compared to younger individuals with TBI, the elderly have a higher risk for DVT and a higher risk for urinary retention and incontinence especially while hospitalized. Those who remain sedentary will continue to be at risk for complications of immobility such as decubitus ulcers, DVT, pneumonia, and deconditioning weakness. Seizures can occur both early and late. A recent large case-control study showed the risk of developing new onset seizures in the elderly is doubled by a history of TBI (Pugh et al., 2009)

Motor and balance functions tend to recover more slowly in the older adult with TBI because of premorbid limitations in cognition, sensation, strength and balance, along with decreased tolerance for intensive therapy sessions, and increased levels of joint and musculoskeletal pain. Special mobility considerations in the older adult with TBI include alterations in vision, decreased peripheral sensation, imbalance, decreased strength, and limited physical

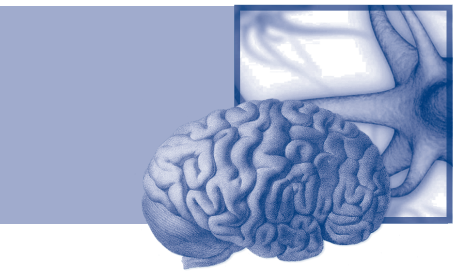
endurance. Many elders have a difficult time comprehending and adjusting to these limitations and therefore pose a significant risk in safety, judgment, and fall propensity. Comprehensive caregiver education and training are paramount. A home evaluation by the rehabilitation team can optimize household level mobility.

TBI and Neurodegenerative Disease Link

Evidence is accumulating that moderate or severe, but not mild TBI increases the risk for neurodegenerative diseases in later life. Post-mortem evaluations after severe TBI demonstrate beta-amyloid peptides, which are associated with both Alzheimer's disease (AD) and Parkinson's disease (PD), and increased amyloid precursor protein immunoreactivity, which represents plaque-like formation and may be an early maker for axonal injury. In one large epidemiologic study, a history of documented TBI increased the risk of dementia of the Alzheimer's type for moderate TBI by a hazard ratio [HR] of 2.3; (CI = 1.04 to 5.17) and for severe TBI by a HR of 4.51 (CI = 1.77 to 11.47) (Plassman et al., 2000). However specificity for AD pathophysiology was not established as the authors reported only 53% specificity for AD on their prior autopsies of those categorized as Alzheimer's type dementia. Other potential causes for dementia and the possible role of any residual dementia from the TBI itself are confounding factors. Other studies have demonstrated an association between moderate and severe TBI and Parkinson's syndrome (Bower et al., 2003; Goldman et al., 2006.). Of note, the presence of Apolipoprotein E gene with E 4 allele is associated with the onset of AD and has been studied in TBI. Earlier studies suggested an association with poorer outcome in TBI, but more recent studies have not replicated this finding. Further research is needed on genetic predictors of prognosis before definitive conclusions can be made (Graham, 1999).

Points to Remember

- Falls are the leading cause of TBI in the elderly
- Gait training, the use of assistive devices, and balance and resistive exercises can decrease the rate of falls and therefore prevent TBIs in the elderly
- For the same type of injury, the elderly are more likely to have intracranial findings (e.g., bleeds) than younger individuals
- Elderly patients benefit from interdisciplinary rehabilitation but have poorer outcomes than younger adults given similar injury severity
- Elderly patients are more susceptible to cognitive side effects of medications than younger adults
- In the elderly, a relatively mild TBI can disrupt the normal circadian sleep-wake cycle and result in a reversible post-traumatic dementia accompanied by transient psychotic symptoms at night



CHAPTER 9:
The Impact of TBI on the Family System

Learning Objectives:

- Describe potential effects of TBI and related sequelae on the family system
- Assess how the family system is adapting to TBI
- Learn effective strategies to assist family adjustment to TBI
- Address FAQs from family members using a validation and education approach

Introduction

The effects that a traumatic brain injury (TBI) may have on family members and caregivers have been well documented (Kreutzer et al., 1992; Sander et al., 1997; Collins and Kennedy, 2008). The cognitive, emotional, and physical changes in survivors of TBI can be quite significant, depending on the extent and severity of injury. As such, living with a family member who has sustained a TBI can be stressful and sometimes overwhelming for the family system as a whole. In other cases, individuals with a history of TBI and their families may find that the injury leads to new opportunities such as increased communication and understanding, and a rearrangement of family priorities.

Familiarity with common sequelae of TBI as well as common family concerns regarding recovery and prognosis will prepare the provider to address the family's salient issues. Healthcare providers working in primary care settings, such as physicians, nurse practitioners, and social workers, are well positioned to assess the health of the Veteran's family system, promote family wellness to offer reassurance and support. Although a specialized system of care for Veterans with TBI is available within the VA healthcare system (see Polytrauma System of Care, **Chapter 3**), a large proportion of Veterans with TBI are seen by VA providers in other settings (e.g., Primary Care, Mental Health or other clinics).

It is important for healthcare providers to understand the effects of TBI within the context of a pre-existing family structure. Family members vary significantly in their ability to cope with life after TBI. Furthermore, the degree of physical and cognitive disability of the individual with TBI does not entirely account for a

family member's ability to effectively cope with the demands of providing care and support. (Verhaeghe et al., 2005). Following injury to a loved one, premorbid stressors and tensions often become exacerbated and new problems or challenges can emerge. Pre- and post-injury factors play an important role in determining the psychological adjustment and quality of life of family members.

Pre-existing factors that place caregivers at higher risk for stress and maladaptive coping include a history of psychiatric illness in the caregiver, fewer socio-economic resources, lack of cultural or spiritual identity and support, and the presence of several young children in the home. The latter risk factor is especially salient in the new generation of Veterans, many of whom have relatively young families for whom early identification and assistance is crucial. In cases where the injured family member is a combat Veteran, the family's homeostasis may have already been disrupted by the stress related to multiple deployments (Collins and Kennedy, 2008). Moreover, females in a caregiving role typically report higher levels of stress and depression than their male counterparts (Verhaeghe et al., 2005).

Relationship factors also contribute to the adjustment of caregivers. For example, spouses who provide support or care report more health and psychological problems than parents (Verhaeghe et al., 2005). Also, parental stress is greatest when the injured adult must return home to live.

Post-injury factors affecting family adjustment to TBI include financial burden associated with the injury (i.e., costs of treatment or the subsequent loss of income for the patient and/or family member; McMordie et al., 1988). In contrast, satisfaction with social support and the types of coping mechanisms utilized contribute to the psychological health and adjustment of family members who offer support or care (Sander et al., 1997). Lastly, in family members of injured Service Members, separation from the military can be associated with the loss of security and support specific to the military culture (Collins and Kennedy, 2008).

Family Adjustment to TBI

Psychological distress is common in family members of individuals with TBI and may persist for several years following the onset of the injury (Kreutzer et al., 1994). Lezak (1986) and others have described a series of nonlinear, overlapping stages of family adjustment to TBI that may span two to three years or longer, depending on the severity of the injury. Each stage is defined by a series of emotional reactions.

The range of emotional reactions characterizing each stage of family adjustment to TBI is summarized in the following table.

Table 1. Adapted from Lezak, 1986

Stage	Time Since Injury	Expectation	Family Reaction
I	0-1 to 3 months	Full recovery by one year	Relief, shock, denial, depression, avoidance regarding the injury
II	1-3 months to 6-9 months	Full recovery if the patient just tries harder	Bewildered, anxious, begin to realize the severity of the situation, frustrated, loss, realize they lack adequate knowledge about the injury or recovery process
III	6 to 24 months or can continue indefinitely	Patient can become independent if family knows how to help	Impatient with survivor because they are not trying hard enough, recognize the person is more impaired than was first thought, feel discouraged, guilty; seek additional information about living with TBI
IV	9 months or later, can continue indefinitely	Little or no change	Depressed, feel "trapped", exhausted and need respite, begin to realize the impact of the injury. Experience emotions similar to bereavement, patient's disability or behaviors may bother family immensely
V	12 months or later, usually time-limited	Little or no change	Sadness and mourning, begin to understand the full impact of the injury, begin the process of accepting the losses
VI	18 months to 3 years post injury	Little or no change	Reorganization and change in the family system, become creative in helping injured family member, begin to address the needs of the entire family unit, become well-versed about TBI, invest time and money on accommodations, become empowered to advocate on behalf of patient

Although Lezak's stage theory was initially meant to describe family reactions to changes following moderate to severe TBI, this conceptualization may also prove useful in describing the reactions of family members of Veterans whose recovery from mild TBI has been complicated by significant comorbid mental health conditions such as PTSD or depression (Hoge et al 2006, 2008). Family members of Veterans with a history of mild TBI may quickly pass through the first few adjustment stages because mild TBI is less frequently associated with life-threatening injuries. During all stages, family members tend to focus their energy and care on the injured Veteran and may not attend to their own self care needs. While it can be difficult to persuade family members to take time for themselves, healthcare providers are in a unique position to encourage and support the importance of self care. Encouraging family members to get adequate rest, nutrition, exercise and relaxation, helps to ensure that they are able to provide assistance to their loved one, as needed.

Points to Remember:

- Psychological distress is common in family members of individuals with TBI and may persist for several years following the onset of the injury
- Family adjustment to TBI can be described as a series of nonlinear, overlapping stages. Each stage is defined by a series of emotional reactions which call for different types of intervention by healthcare providers

Assessing the Wellness of the Family System

Given the importance of family involvement and support in the outcome of Veterans with a history of TBI, periodically assessing the health and adjustment of the family system is good practice and strongly recommended, as studies suggest that caregiver distress may remain at elevated levels for 10-15 years post-injury (Verhaeghe et al., 2005). A brief assessment will allow the health-care provider to make an informed decision about the level of support that may be required to assist the Veteran and their family. Establishing the well being and adjustment of the family requires the healthcare provider to determine if the support system is coping effectively and able to meet the needs of the Veteran. This information can be obtained from the patient or, preferably collaterally from a family member.

Veterans with a history of TBI may draw support from a range of individuals including spouses, parents, grown children, friends and various healthcare providers. The ability of the support system to meet the needs of the Veteran is determined by a multitude of factors, including the depth of the support system, the level of investment in providing support, financial resources, and competing family responsibilities (e.g., child rearing responsibilities, careers, etc.). The healthcare provider can elicit information about the how well the family is coping and meeting the needs of the individual with TBI by asking questions such as:

Questions for the Veteran:

1. Who provides you with the most support?
2. Do you feel that you are receiving enough support?

Questions for the Family Member:

1. Are you and your family able to manage all of the needs of loved one with TBI?
2. Do you have needs or concerns for which you need help or guidance?"

Being able to provide support to an individual with TBI does not mean, however, that every member of the support system is coping well. If left unchecked, poor coping could lead to a break down in the provision of essential support for the Veteran who experienced TBI. Determining **how effectively the family is coping** is best accomplished by asking questions such as:

1. How are you managing these days as a family?
2. How have changes in your family affected you?

Points to Remember:

- The best way to determine how a family system is functioning after a TBI is to ask direct questions of the family members and/or Veteran
- It is important to assess both the family's ability to manage the needs of the Veteran post-TBI and how well family members are coping with changes in the family system

Helping the Family Adjust to Changes After TBI

Successful reintegration of a person with a history of TBI into their previously existing family structure is essential to maximize the quality of life and independence of these individuals (Sander et al., 2002). Family members and friends provide a host of psychosocial and physical supports throughout the recovery process and serve as extremely important collaborators with the injured person's treatment team. As the individual with TBI transitions from an acute inpatient setting to post-acute outpatient care, family members often assume a range of care and/or support activities that can include assistance with rehabilitation tasks (i.e., instrumental activities of daily living, cognitive remediation). Changes in the behavior and personality of an individual following TBI, including low frustration tolerance, poor social judgment, disorganization and apathy can be especially distressing for family members. Unrealistic expectations about recovery by the patient, family or both serve to compound this distress (Lezak, 1986). New responsibilities frequently overlap with emerging family adjustment issues related to changes in family structure and functioning. Family members of TBI patients require both emotional support and education to help them meet the many challenges they face as a result of the injury to their loved one.

When the Veteran or family shares information about the health of the support system, the following steps can be used as a guide to assess the situation and offer assistance:

1. **Validate and Normalize.** Family members will benefit from someone listening to their concerns and feelings and validating their experience. This can be as simple as listening carefully, reflecting what they say, and normalizing the family's reaction to common TBI sequelae.
2. **Educate.** Psychoeducation regarding the typical course of recovery often serves to reduce distress and anxiety. Information about how to adjust to post-injury changes in the person with TBI has been identified as one of the most commonly expressed needs by caregivers (Sinnakaruppan & Williams, 2001). It has been noted that the majority of family members and caregivers of Veterans with TBI demonstrate remarkable resilience in the face of adversity. For these individuals accurate information and psy-

choeducation appear to be the most appropriate interventions (Sammons & Batten, 2008).

3. **Collaborate and Refer.** Consulting with other healthcare professionals is an important step in determining what services might be needed and available. The needs of individuals with TBI and their family can be complex and may possibly require more specialized intervention. Should that be necessary, referral to providers with specialized knowledge of TBI may be warranted to assist with issues related to recovery (e.g., adjustment, logistical needs, community re-integration, training).

Points to Remember

- The role of the VA provider when presented with issues related to family adjustment after TBI is to assess the situation and,
  - Validate and normalize the family's concerns and their reactions
  - Educate the family about TBI and the recovery process
  - **Collaborate** with TBI specialists and other providers within the system
  - **Refer** for specialized intervention, when necessary

Responses to Frequently Asked Questions (FAQs) by Families

The following are frequently asked questions that may be encountered when working with Veterans with a history of TBI and their family members. Many questions are related to certain themes that commonly concern family members. These themes include: 1) course of recovery, 2) etiology, or the cause of problems and symptoms, 3) changes in personality, 4) changes in relationships, and 5) how to best help and support the individual who experienced the TBI.

For each theme, a prototypical question is provided followed by a response that demonstrates the application of the strategies described above (i.e. validate/normalize, educate, collaborate/refer).

1. **Course of Recovery.** ***"When is our life going to get back to normal?"***
   - **Validate and Normalize -** Acknowledge that the ambiguity of not knowing the definite course of recovery can be stressful for family members and others supporting a patient who experienced a TBI. Express that it is normal to feel anxious and scared when family life is disrupted by an injury, especially when the timeline of recovery is unclear. Reassure the family member that his/her reaction is understandable given the nature of the circumstances.
   - **Educate –** Provide the family with information regarding the expected recovery course following TBI (see **Chapter 2**). Explain that the course of recovery is different for each individual depending on the nature and severity of the injury. Although recovery is most rapid and noticeable in the first 12 months post injury, reassure the family that improvements

in cognition, mood, behavior, and independence typically occur with time and appropriate treatment (Christensen et al., 2008; Millis et al., 2001).

- **Collaborate / Refer –** Collaborate with other healthcare providers to help determine the best course of intervention for the injured Veteran or his family. Make appropriate referrals to providers within the VA system who can assist with complicated diagnostic problems or with family support needs (i.e., family education or psychotherapy, respite care, etc). Consider a referral to a community partner if other resources are needed to meet the needs of the family member or injured Veteran.

2. **Etiology.** ***"Did the TBI cause all of these problems (depression, anger, memory problems, headaches)?"***

   Family members of Veterans with a history of TBI may want to know to what extent the Veteran's problems are related to the TBI. This can be a complicated question to answer as past and present physical and psychosocial problems also contribute to the Veteran's current clinical picture.

   - **Validate and Normalize -** Acknowledge that it can feel overwhelming when someone seems to have a host of problems that are not clearly explained. Listen to the family's concerns and convey that their feelings are important and can be managed. Share with the family that it is common for people who experience a TBI to have numerous changes directly and indirectly related to the TBI.
   - **Educate** – Provide the family with information about the common comorbidities in Veterans recovering from TBI and the frequency of symptom overlap. For example, co-occurring physical problems and significant emotional distress are not uncommon in Veteran's recovering from TBI (Hoge et al., 2006; Sayer et al., 2008). Further, indicate that symptoms associated with conditions such as TBI, PTSD, and chronic pain can be very similar and that current environmental conditions such as job-related stress or parenting responsibilities cause symptom exacerbation. Although it is not always possible to establish a single "source" for each symptom, an empirical and collaborative approach to treatment usually results in successful reduction in symptoms.
   - **Collaborate / Refer** – As necessary, collaborate with other healthcare providers within your facility, and consider an interfacility consult to a TBI specialist if necessary. This may include a physiatrist or a neuropsychologist with experience treating patients with a history of TBI. If the Veteran is experiencing chronic pain such as headache or neck pain, referral to a pain clinic may be warranted. If the Veteran is struggling with psychological issues such as acute stress or depression, referral to a mental health provider may be useful. Similarly, a referral to a substance abuse trained counselor or a substance abuse treatment program may be important for a Veteran who discloses problems with alcohol or drugs.

3. **Changes in Mood or Personality.** ***"Why does she overreact to little things now and say things that are embarrassing?" "Why does he just want to stay in his room all the time?"***

Family members are especially sensitive to the changes in the mood and personality of their loved one following TBI (Ponsford et al., 2003). Problems such as isolating oneself from others, irritability or inappropriate behavior can be misinterpreted as intentional by family members, causing feelings of resentment. In an attempt to avoid embarrassing social situations resulting from inappropriate behavior, family members may opt to bypass community activities available to them and the Veteran. Individuals with a history of TBI may also show a lack of initiation for formerly enjoyed activities or lack of interest in interpersonal interaction, which also can result in decreased social opportunities.

- **Validate and Normalize –** Acknowledge the frustration and hurt feelings family members may express. They may feel that mood or personality changes are directed at them personally or feel angry that they are not being treated the same way as they were before the injury. In addition, family members may feel a loss of the pre-injury person they knew. Share with the family that changes in mood, personality, and social skills are commonly reported following TBI and that these changes, depending on the severity of the injury, may be temporary or long-standing.
- **Educate** – It is often helpful for the family to hear that the frontal lobes of the brain help to inhibit impulsive responses (i.e., anger, inappropriate verbalizations), select appropriate behaviors, and engage in social endeavors. Simple strategies such as distracting the injured Veteran or ignoring inappropriate behavior (i.e., avoiding reinforcement) are typically effective in reducing unwanted behaviors. If family is concerned about lack of initiation it may be helpful to suggest that they engage the Veteran in planning social activities.
- **Collaborate / Refer** – In addition to seeking collaboration with other providers, a referral to a mental health professional may be especially helpful for mood and personality related concerns. Such a referral may include training in anger management strategies and other cognitive behavioral-based therapies for depression and anxiety. Additionally, referral to vocational rehabilitation may be useful in promoting community re-integration. For family members who are struggling to understand changes in their injured loved one, a referral to a support group for caregivers and supporters of individuals with a history of TBI may be helpful.

4. **Relationship Issues / Intimacy –** ***"Why is he less interested in sex?" " Why is she so impatient with the children?"***

Spouses typically report more distress related to caregiving than parents (Verheaghe et al., 2005). This is likely due in part to the significant role change experienced by the spouse. A spouse may begin to feel more like a parent, should they need to take on responsibilities for providing

physical and psychological care and support to the injured individual. Furthermore, TBI-related changes in the injured individual's personality and libido may have a significant impact on the relationship. The stress of caring for a spouse with brain injury can be further magnified by the presence of young children in the household and other competing demands such as work and elder care.

- **Validate and Normalize –** Listen to the spouse or family members' concerns and acknowledge feelings expressed, such as confusion, frustration, and anger. The spouse may feel offended or rejected if they do not understand the distressing behavior is a result of the TBI and not purposeful nor intentional. Acknowledge that providing care and support while maintaining a romantic relationship with an injured partner can be difficult. Share with the spouse that these changes may be temporary, especially in the case of mild TBI, but can be challenging even in the short term.
- **Educate** – Acknowledge that providing care and ongoing support can be a tremendous burden, especially when the spouse has other responsibilities. Encourage the spouse to participate in activities outside the home as a way to reduce stress and maintain social support. Stress the importance of self care (Kreutzer et al., 2002).
- **Collaborate / Refer** - For more severe TBI, consider referral for respite or adult day care services to allow the spouse time to engage in other activities outside the home. Referral to community based TBI family support groups may provide an important source of caring and insight for spouses and family members. Referral for couples and family counseling may be helpful, especially for individuals with a history of mild TBI who retain strong cognitive abilities and primary partner and parenting roles in the family system.

5. Helping and Supporting. *"What can I do to help?"*

Many family members and other supportive persons are extremely invested in the recovery of their injured loved one and derive considerable satisfaction from working collaboratively with healthcare providers. These family members may ask to assist in helping the Veteran with a history of TBI to overcome problems such as forgetfulness, poor organization/planning, sleep disturbance, and irritability. In addition to providing validation and education regarding the frequency of these problems following TBI, a few suggestions regarding modifications to the Veteran's environment and daily routine may help to build a stronger collaborative relationship with the family member and may lead to improvement in the Veteran's daily functioning.

- **Forgetfulness and Organization / Planning.** Regardless of the initial severity of the TBI or the current stage of recovery, reducing distractions in the environment and developing compensatory strategies may help improve the functioning of the individual recovering from TBI (Cicerone et al, 2005). Reducing distractions and clutter can help the injured person focus more easily on relevant stimuli or information.

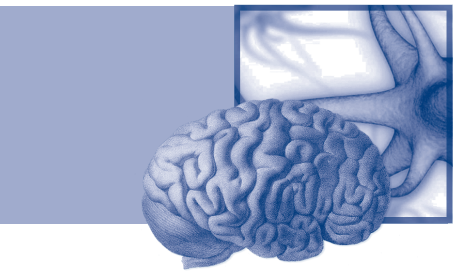
Use of a memory notebook is helpful to keep track of appointments, notes, phone numbers, etc. Family members can play an instrumental role in encouraging the person with a history of TBI to use their memory notebook throughout the day. Initial referral to a rehabilitation professional (e.g., neuropsychologist, speech pathologist, occupational therapist) for training in the use of such compensatory strategies is encouraged. Routine use of these strategies fosters independence in a person recovering from TBI, thus reducing the burden on family and others to provide these supports.

- **Sleep Disturbance –** Developing a consistent sleep hygiene routine and creating an environment that is conducive to sleep can improve the sleep disturbances (Bootzin & Perlis, 1992). Referral to a rehabilitation professional or sleep specialist may initially be necessary to develop an appropriate sleep routine. Regardless of who initially develops this plan with the injured individual, a family member or other supportive person can be instrumental in monitoring and encouraging the injured person's adherence to the sleep hygiene plan.
- **Irritability –** Irritability may be the manifestation of one or more conditions related to a history of TBI including lowered frustration tolerance, disturbed sleep, and confusion. Family members should be encouraged to set boundaries with the person, ignore inappropriate or disruptive behaviors and avoid escalating stressful situations.

Internet Resources for Families and Caregivers

The following is a list of internet resources that caregivers and persons with a history of TBI may find helpful:

Brain Injury Association, Inc – www.biausa.org
Brain Injury Resource Center – www.headinjury.com
The Perspective Network – www.tbi.org
Recovery Awareness Foundation – www.tbinet.org/raf
Family Caregiver Alliance – www.caregiver.org
Rosalynn Carter Institute for Caregiving – www.rosalynncarter.org
Defense and Veterans Brain Injury Center – www.dvbic.org



CHAPTER 10: Community Integration and Extended Care: Services and Resources

Learning Objectives

- Recognize the life long issues that may impact the Veteran with brain injury.
- Identify resources to meet community and extended care needs

Introduction

Community integration refers to resumption of appropriate roles in the family, community and workplace. Survivors of TBI may require support well beyond the initial course of rehabilitation, in order to maximize function, reduce barriers and assist the Veteran to live in the community of his/her choice.

Observations of individuals who sustained a TBI and returned to their respective communities without adequate transitional preparation reveal progressive isolation due to inappropriate social skills, poor impulse control, disturbed sleep patterns that exacerbate inadequate decision making and problem solving, difficulties to form and maintain meaningful relationships, and pervasive inability to cope effectively. (Dikmen at al., 2003; Lew et al., 2006) Injured persons may fail to thrive in communities without interventions to facilitate skills development.

Statements like the following should be recognized as expressions of difficulties with community reintegration: “I got kicked out of my apartment”; “ I have no friends, I can’t get along with my family”; “ I don’t have anything to do with my time”; “I can’t get to the grocery store”; and, “ I ran out of my medications two weeks ago.” More often than not, appropriate action from the person’s healthcare team is required to remedy these situations and to prevent further problems.

At the same time, community participation has been shown to promote continued gains in functional recovery and quality of life in individuals with TBI, and to reduce family/caregiver stress (Inzaghi et al., 2005). Education and reinforcement of the benefits of community reintegration may facilitate functional improvements through adaptation to environment overtime. Referral should be considered to a specialty team within the Polytrauma/TBI System of Care for

evaluation and recommendations regarding:

- Independent living skills (ability to care for personal needs as well as maintain the household)
- Community access (driving, transportation)
- Vocational and leisure activities (work, school, recreation)
- Social networks and connections (community activities, support groups)
- Safety
- Health and wellness
- Individual and family supports

Recreation/Leisure, Driving, and Vocational Issues

Recreation and Leisure

Participation in recreation and leisure activities is an important part of the recovery from TBI. Recreation and creative arts therapy can be especially meaningful for persons with brain injury who are unable to continue with work activities. Without adequate interventions that integrate Veterans who have TBI into their home communities, they are likely to become isolated from others avoiding many or all activities within or outside the home.

Referral to recreation therapy should be considered in order to promote community participation, life satisfaction and overall health and well-being of individuals with TBI. Clinical practice in recreational and creative arts therapies involves the deliberate and purposeful use of specifically designed interventions that contribute to quality of life of Veteran in his or her community. The interventions are activity-based and require the development, strengthening, and maintenance of physical and cognitive skills that transfer readily to "real world" experiences.

Activities included in recreational and creative arts therapy interventions affect change, a process that begins with the Veteran's desire to participate - a critical pre-requisite to therapeutic engagement. Activities are crafted around Veteran's interests and desires with adaptations that support existing skills and abilities. These activities serve as strong motivators for enduring participation in interventions that are designed to facilitate skill strengthening and new skill development that transfer readily to family and community life. Furthermore, these activities are delivered in supportive environments in which therapeutic relationships with professionally trained practitioners help Veterans learn, adapt, and develop in ways that contribute to their well-being.

Driving after TBI

Driving is an essential activity of daily living for most individuals and is one determinant of level of independence. Driving requires a complex set of skills and abilities including vision, visual-motor coordination, memory, appropriate reactivity, and planning, many of which may be impaired following TBI. Guidelines to determine fitness to drive in patients with TBI have not yet been established, leaving physicians with the difficult task of deciding how to ascer-

tain driving capacity. However, it is the physician's responsibility to determine when and how to return the individual to driving. **Appendix G** provides further detail about driving following TBI, and driving assessment and rehabilitation in the VA.

Vocational Rehabilitation

Vocational rehabilitation services prepare individuals to achieve a lifestyle of independence and integration within their workplace, family and local community. This transition is accomplished through work evaluation and job readiness services, job counseling services, education, and training. Medical and therapeutic services are sometimes necessary to support the achievement of vocational goals. Vocational services may include, but are not limited to:

- Vocational evaluation
- Vocational training
- Functional capacity evaluation
- Work hardening
- Job site evaluation
- Job coach
- Supported employment

Vocational rehabilitation services may be provided through VA or through other state and government agencies, as presented below.

VA's Vocational Rehabilitation and Employment (VR&E) Services assists Veterans with service-connected disabilities to become suitably employed, maintain employment, or achieve independence in daily living. Eligible Veterans may receive rehabilitation services, independent living services, educational or vocational training, employment services, or a combination of theses. Services provided vary depending on the needs of the Veteran. A comprehensive vocational evaluation assists in determining the Veteran's skills, aptitudes, and abilities and forms the basis for vocational planning. This may include training in a college or university, technical school, on-the-job training or in a specialized rehabilitation program (for individuals with severe disabilities). For more information go to: http://www.vba.va.gov/bln/vre/vrs.htm

Each state offers vocational rehabilitation services for individuals with disabilities that meet their eligibility requirements. Vocational rehabilitation is a joint federal-state program administered by each state; therefore services vary from state to state. Services may include evaluation, job training, assistance with job placement, supported employment and independent living services. In some states, vocational rehabilitation agencies may also pay for therapies, technical/vocational training and post-secondary education. The following is a link to vocational services by state. https://secure.ssa.gov/apps10/oesp/providers.nsf/bystate

Neurobehavioral Programs

Severe and persistent neurobehavioral problems following TBI sometimes require admission to a specialized neurobehavioral program. Such programs are tailored to manage the needs of patients with behavioral excesses that cannot be managed safely in a traditional rehabilitation setting. (Uomoto & McLean, 1988) Neurobehavioral problems are common in acute rehabilitation of patients with TBI at Rancho Levels IV and V (Arciniegas & McAllister, 2008). Problems such as agitation, disinhibition, and even aggression can generally be managed competently by a trained team using appropriate environmental and therapeutic modifications. However, persistent behavioral excesses may become an obstacle for the person with TBI to be engaged in rehabilitation therapies. Specialized programs are sometimes required that target the reduction of behavioral excesses, improve behavioral deficits, and facilitate social functioning.

Neurobehavioral programs are designed for patients with significant maladaptive behaviors or for those who are unsafe due to suicidal, homicidal, or violent behavior and cannot be treated in less restrictive environments (Trudel, Nidiffer, & Barth, 2007). Such programs can be physically located in secured hospital units, or community-based programs. They generally use an interdisciplinary approach that may include interventions such as behavior modification, medication management, socialization skills training, substance abuse treatment, family therapy, and physical management programs, in addition to traditional interdisciplinary treatment. Length of stay can greatly vary depending on etiology and severity of the behavioral disorders; it typically ranges from 1-6 months (Malec & Ponsford, 2000). Patients can be discharged from neurobehavioral programs to a variety of settings including inpatient acute rehabilitation, post-acute residential programs, outpatient programs, supported living programs, or home and community-based programs. Use of psychiatric hospitals that are not experienced in brain injury rehabilitation is not recommended for the treatment of neurobehavioral sequelae of TBI. Neurobehavioral programs are also appropriate for severe behavioral problems due to other concomitant diagnoses, such as alcohol or substance abuse (Trudel, Nidiffer, & Barth, 2007).

Extended Care

VA offers a spectrum of extended care services in institutional and non-institutional settings, with the goal of maintaining the maximum level of independence in the least restrictive setting.

OEF/OIF Veterans with polytrauma and TBI are significantly younger than the current cohort of Veterans in VA's extended care programs. Younger Veterans and their loved ones typically wish to receive care near their homes, and often prefer community based services to institutional settings. If an institutional setting is needed, the environment of care should be age appropriate and providers should be familiar with the complexities of brain injury.

In order to ensure a comprehensive array of services, VA may purchase care that cannot be provided within the VA system from community agencies. In addition to purchased care for Veterans, VA lends family support through information and referral services. These resources are particularly important in rural areas or areas that are geographically distant from a VA medical center.

VA Extended Care Programs

Home Based Primary Care (HBPC). HBPC provides services for persons with complex chronic disabling conditions. These include comprehensive, longitudinal primary care by an interdisciplinary team in the homes of Veterans. The HBPC team addresses medical, functional, social and behavioral aspects of chronic disabling conditions. They may also facilitate structural adaptations in the home and provide training to the Veteran and family caregivers to promote maximal independence and maintain the Veteran in his or her home.

Purchased Skilled Home Care (PSHC). PSHC is for Veterans who are homebound and require intermittent, short-term, or long-term skilled nursing services, transitional rehabilitation services, or transitional social work services. Homemaker/Home Health Aid services are provided when necessary to assist the Veteran to live at home. Homemaker services include assistance with daily living needs such as light housekeeping, meal preparation, laundering, grocery shopping, etc. On the other hand, Home Health Aid services typically address basic needs such as bathing, dressing, eating, toileting, and mobility.

Respite Care. Respite care is a distinct VA program with the unique purpose of providing temporary relief for unpaid caregivers from routine caregiving tasks, thus supporting caregivers in maintaining the chronically ill Veteran in the home. Respite care services may include various VA and non-VA programs or contracts. The focus and purpose of respite care is providing relief for the caregiver. Eligible Veterans/caregivers are entitled to 30 days of respite per calendar year. Respite care may be provided through VA programs (e.g., Community Living Centers or VA Adult Day Health Care). VA may also purchase respite in the community using home respite services, Homemaker/Home Health Aid, Community Nursing Homes, or Assisted Living facilities.

Adult Day Health Care (ADHC). VA ADHC services are located near medical centers and community based outpatient clinics. Day care services can also be purchased from other community providers. ADHC is a therapeutically oriented outpatient day program that provides health maintenance and rehabilitative services to persons in a protective, congregate setting. ADHC is less than 24-hour care. Health professionals and support staff deliver individualized programs of care, with an emphasis on helping participants and their caregivers to develop the knowledge and skills necessary to manage care requirements in the home. The primary goal of ADHC is to maintain or improve the health of participants so they may remain in the community, enabling families and other caregivers to continue home care for an impaired family member. NOTE:

VA ADHC is typically provided to an elderly population; however some non-VA programs may serve special populations such as TBI.

Community Residential Care (CRC). CRC is a form of enriched housing which provides health care supervision to eligible Veterans who do not require hospital or nursing home care, but are not able to live independently and have no suitable family or significant others to provide the necessary level of supervision and supportive care. Individuals qualify for CRC placement if it is determined (through a statement of needed care) that they have significant medical, psychiatric and/or psychosocial limitations to living independently. Examples of CRC's enriched housing may include, but are not limited to: Medical Foster Homes, Assisted Living Homes, Group Living Homes, Family Care Homes, and psychiatric CRC Homes. Care must consist of room, board, assistance with activities of daily living (ADL), and supervision, as determined, on an individual basis. The cost of residential care is financed by the Veteran's own resources. Veterans may be eligible to receive enhanced VBA benefits to assist with the cost of this level of care. Placement is made in residential settings inspected and approved by the appropriate VA facility, but chosen by the Veteran (VHA Handbook 1140.01, Community Residential Care Program, March 29, 2007).

Medical Foster Home (MFH). MFH is a non-institutional long-term care option for Veterans with chronic disabling conditions who are unable to safely live in their own homes. A MFH caregiver is a person or family in the community who is willing to take a Veteran into their private homes and provide personal assistance and supervision, with medical and rehabilitation support from a specialized VA HBPC team. This is an alternative to nursing home care, allowing the Veteran to remain safely in a home environment within his or her community while working toward maximally independent living.

Community Living Centers (CLC). VA operates its own nursing home care units, which have been re-designated as CLCs to emphasize the transformation to a more home-like environment. VA also funds Veteran costs for State Veterans Homes, and contracts with nursing homes in the community to provide care for Veterans. Both VA and community nursing homes, as well as other locations such as assisted living facilities, provide inpatient respite care (VHA Handbook 1142.01, Criteria And Standards For VA Community Living Centers (CLC), August 13, 2008).

Medicaid's Home and Community-Based Services (HCBS) TBI Waiver. The HCBS TBI Waiver program is for individuals with traumatic or acquired brain injury having a cognitive or behavioral condition that requires specialized TBI treatment in a nursing home or neurobehavioral facility. Twenty-five states currently offer this program as an alternative to institutional care. Services may vary from state to state and may range from behavioral interventions to independent living skills training and from respite care to extended home care services.

Financial Management and Life Care Planning Issues

In addition to medical care for a brain injury, Veterans and their caregivers may need assistance with a variety of non-medical issues that can significantly impact their ability to function in the community setting. These may include but are not limited to:

- Guardianship
- Fiduciary
- Representative Payee
- Advanced Directives

Typically, a referral to Social Work service can initiate addressing these issues, if needed. Brief description of each service follows.

Guardianship

If a Veteran is felt to lack the capacity and/or judgment to make decisions regarding themselves or personal affairs, the state may assign a guardian. The guardian can be a family member, other interested party or professional chosen by the family or state. States differ on mechanisms of determination and assignment. Court fees may apply.

Fiduciary

If a Veteran lacks the capacity or judgment to manage their VA monies, a fiduciary may be assigned through the local VA Regional Office. The fiduciary may be a family member or professional. The fiduciary manages only VA monies such as compensation or pension benefits.

Representative Payee

If a Veteran lacks the capacity to manage their Social Security benefits, the Social Security Administration (SSA) may assign someone as their representative payee. This can be a family member, other interested party or a guardian. For further information visit the SSA website at www.ssa.gov

Additional Resources

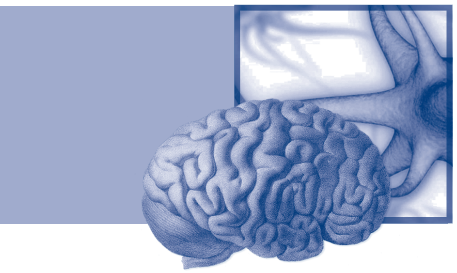
The Brain Injury Association (BIA)

BIA partners with many federal, state, and other agencies to promote awareness, education, prevention, public policy, and research related to brain injury. BIA is an excellent resource for healthcare providers, families and survivors. Their website (http://www.biausa.org/aboutus.htm) contains educational materials, links to state chapters, support groups, and many other resources. They also maintain a toll-free Family Help line (800) 444-6443.

TBI State Grant Programs

The Health Resources and Services Administration (HRSA), an agency of the U.S. Department of Health and Human Services, is the primary Federal agency for improving access to health care services for people who are unin-

sured, isolated or medically vulnerable. HRSA in conjunction with the Traumatic Brain Injury Act (1996) provides grant funding to states to develop community based programs and services for TBI survivors and families. The following web address contains information about programs and services available by state; http://www.nashia.org/programs/states/index.html



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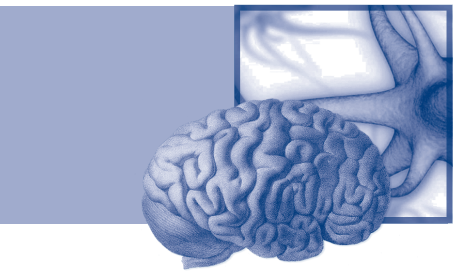


Appendix A: AMA and ANCC Continuing Education Credits

Accreditation:

Accreditation Council for Continuing Medical Education (ACCME)
The VA Employee Education System is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

American Nurses Credentialing Center (ANCC)
VA Employee Education System is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

American Psychological Association (APA)
The VA Employee Education System (EES) is approved by the American Psychological Association to sponsor continuing education for psychologists. The Employee Education System maintains responsibility for this program and its contents.

Association of Social Works Board (ASWB)
VA Employee Education System, Provider Number 1040, is approved as a provider for continuing education by the **Association of Social Works Boards 400 South Ridge Parkway, Suite B, Culpeper, VA 22701. www.aswb.org. ASWB Approval Period: 4/7/10 – 4/7/13.** Social workers should contact their regulatory board to determine course approval. Social workers will receive **4.0** continuing education clock hours in participating in this course.

Continuing Education Credit:

Accreditation Council for Continuing Medical Education (ACCME)
The VA Employee Education System designates this educational activity for a maximum of **4.0** *AMA PRA Category 1 Credit(s)* ™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

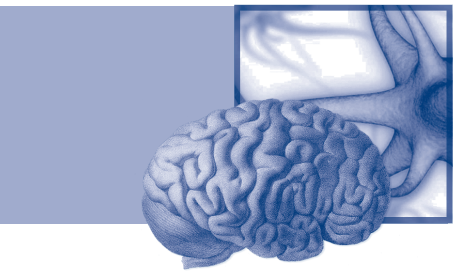
American Nurses Credentialing Center (ANCC)
VA Employee Education System designates this educational activity for **4.0** contact hours in continuing nursing education.

Association of Social Work Boards (ASWB)
VA Employee Education System, Provider Number 1040, is approved as a provider for social work continuing education by the Association of Social Work Boards (ASWB), (1-800-225-6880) through the Approved Continuing Education (ACE) program. VA Employee Education System maintains responsibility for the program. Social workers will receive **4.0** continuing education clock hours in participating in this course.

American Psychological Association (APA)
As an organization approved by the American Psychological Association, the VA Employee Education System is sponsoring this activity for **4.0** hours of continuing education credit. The Employee Education System maintains responsibility for this program and its content.

The Employee Education System maintains responsibility for this educational activity. **A certificate of attendance will be awarded to participants and accreditation records will be on file at the Employee Education System.**

Report of Training:
It is the participant's responsibility to ensure that this training is documented in the appropriate location according to his/her locally prescribed process.



Appendix B: Polytrauma System of Care Referral Regions and Facility Designation

Polytrauma System of Care Referral Regions and Facility Designation

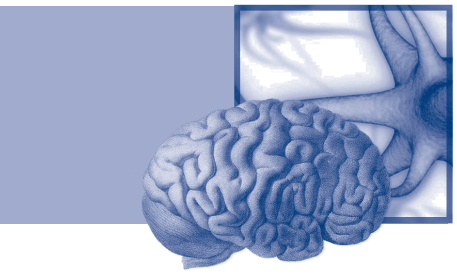
Regional Polytrauma/TBI Rehab Center (PRC)	VISN	Polytrauma/TBI Network Site (PNS)	Polytrauma/TBI Support Clinic Teams (PSCT)	Polytrauma/TBI Point of Contact (PPOC)
Richmond	VISN 1	Boston	West Haven	Bedford
			Togus	Manchester
			White River	Providence
			North Hampton	
	VISN 2	Syracuse	Albany	
			Buffalo	
			Bath	
			Canandaigua	
	VISN 3	Bronx	Hudson Valley HCS/Montrose	
			Hudson Valley HCS/CastlePoint	
			NJHCS/East Orange	
			NJHCS/Lyons	
			NY Harbor HCS/New York	
			NY Harbor HCS/Brooklyn	
			NY Harbor HCS/St Albans	
			Northport VAMC	
	VISN 4	Philadelphia	Pittsburgh	Clarksburg
			Wilmington	
			Erie	
			Lebanon	
			Coatesville	
			Altoona	
			Butler	
			Wilkes-Barre	

Regional Polytrauma/TBI Rehab Center (PRC)	VISN	Polytrauma/TBI Network Site (PNS)	Polytrauma/TBI Support Clinic Teams (PSCT)	Polytrauma/TBI Point of Contact (PPOC)
Richmond	VISN 5	Washington DC	Baltimore	
			Martinsburg	
	VISN 6	Richmond	Hampton	Ashville
			Salisbury	Beckley
			Durham	Fayetteville
				Salem

Regional Poly-trauma/TBI Rehab Center (PRC)	VISN	Polytrauma/TBI Network Site (PNS)	Polytrauma/TBI Support Clinic Teams (PSCT)	Polytrauma/TBI Point of Contact (PPOC)
Tampa	VISN 7	Augusta	Tuscaloosa	Dublin
			Columbia	Tuskegee
			Charleston	
			Atlant	
			Birmingham	
	VISN 8	Tampa	Bay Pines	Orlando
		San Juan	Gainesville	
			Miami	
			West Palm	
	VISN 9	Lexington	Huntington	
			Louisville	
			Memphis	
			TVHC-Nashville	
			TVHC-Murfreesboro	
			TVHC-Mountain Home	
	VISN 16	Houston	Alexandria	New Orleans
			Jackson	
			Central Arkansas-Little Rock	
			Gulf Coast (Biloxi)	
			Fayetteville AR	
			Oklahoma City	
			Muskogee	
			Shreveport	
	VISN 17	Dallas	Temple	Waco
			San Antonio	Kerrville

Regional Polytrauma/TBI Rehab Center (PRC)	VISN	Polytrauma/TBI Network Site (PNS)	Polytrauma/TBI Support Clinic Teams (PSCT)	Polytrauma/TBI Point of Contact (PPOC)
Palo Alto	VISN 18	Southern Arizona HCS (Tucson)	New Mexico HCS-Albuquerque	Amarillo
			Phoenix	West Texas HCS (Big Spring)
				El Paso
				Northern Arizona HCS (Prescott)
	VISN 19	Denver	Salt Lake	Cheyenne
			Grand Junction	Montana HCS- Ft. Harrison
				Sheridan
	VISN 20	Seattle	Portland	Alaska
			Boise	American Lake
				Roseburg
				Spokane
				Walla Walla
				White City
	VISN 21	Palo Alto	Sacramento	Sierra Nevada HCS
			San Francisco	Honolulu
				Manila
				Central California HCS (Fresno)
	VISN 22	West LA	Long Beach	Southern Nevada HCS
			San Diego	Sepulveda
			Loma Linda	

Regional Polytrauma/TBI Rehab Center (PRC)	VISN	Polytrauma/TBI Network Site (PNS)	Polytrauma/TBI Support Clinic Teams (PSCT)	Polytrauma/TBI Point of Contact (PPOC)
Minneapolis	VISN 10	Cleveland	Cincinnati	Columbus
			Dayton	Chillicothe
Minneapolis	VISN 11	Indianapolis	Detroit	Battle Creek
			Danville (Iliana)	NICHS-Marion
			Ann Arbor	Saginaw
	VISN 12	Hines	Milwaukee	Iron Mountain
			North Chicago	
			Tomah	
			Madison	
			Chicago HCS (Jesse Brown)	
	VISN 15	St. Louis	Kansas City	Poplar Bluff
			Wichita	Columbia MO
				Eastern Kansas/Topeka
				Marion
	VISN 23	Minneapolis	Sioux Falls	Fargo
			Black Hills	
			Iowa City	Greater Nebraska-Grand Island
			Central Iowa-Des Moines	Greater Nebraska-Lincoln
			St Cloud	Omaha



Appendix C: Recovering From Mild Brain Injury: A Guide For Patients

Recovering From Mild Brain Injury: A Guide For Patients

What happens in a mild brain injury?

A mild traumatic brain injury (mild TBI) or concussion may result from a blow or jolt to the head that briefly knocks you out (loss of consciousness) or makes you confused or "see stars" (change in consciousness, getting your "bell rung").

A blow to the head can occur in a motor vehicle accident, a fall, when the skull is struck by a blunt or heavy object, in combat injuries, or in other ways. In most cases, there are no lasting symptoms or ill effects from an injury to the head. This is because the brain is surrounded by shock absorbing liquid and covered by the skull. Often these are enough to protect the brain from damage.

Sometimes the force of impact is severe. Some impacts cause the skull to break or fracture. Some impacts penetrate the brain, for example, a gun shot to the head. Some lead to long periods of loss of consciousness or periods of amnesia (failure to lay down new memories). These would be considered more severe brain injuries, not a mild TBI/concussion.

When the head is hit, the brain may be shaken around inside the skull, leading to bruising of the brain. The brain may swell inside the skull. The brain is made of many thousands of long, thin nerve fibers. Some of these nerves can stretch or become damaged following injury. Like any other part of the body the brain has blood vessels in it. Some of these blood vessels can tear and bleed soon after injury. The bleeding often stops on its own and the blood vessels heal as in any cuts. Bruises, swelling, snapped and stretched nerve cells, and broken blood vessels are the causes of symptoms after a more serious brain injury. Again, these types of injuries do not occur in mild TBI/concussion.

Your doctors have examined you for any signs of injury to the brain and prescribed treatment if you need it. Initial symptoms are common after mild TBI/concussion, but most individuals who suffer mild TBI/concussion recover completely within a few days to a couple of weeks. This guide primarily addresses mild TBI/concussion. Research has shown that individuals with mild TBI recover faster and more completely if they understand the usual course and recovery of symptoms after concussion.

How serious was the brain injury?

One way to tell if a brain injury is serious is the amount of time the individual is unconscious afterwards. Another sign of more serious brain injury is if the patient has a long period of time where he or she cannot recall things that just happened. If you were not knocked out at all or if you were unconscious for less than half an hour, or if the time it took for you to be able to recall ongoing events after the injury was less than a day, then the injury was most likely mild. Although you may have some symptoms, there was probably little injury to the brain and **complete recovery is expected**. Most people who have a brain injury fall into this category.

If you had loss of memory for more than 24 hours, or loss of consciousness longer than half an hour, your injuries were most likely in the moderate or severe range. Recovery may take longer. Even patients who suffered a severe injury are likely to make a good recovery, although symptoms can last a long time, and ability to function can be affected. Treatment at a rehabilitation hospital by TBI specialists is usually recommended and can help recovery.

How long will the symptoms last?

If you had a mild TBI/concussion, you have probably gotten a lot better over the last few days. Most patients will be back to normal by a couple of weeks.

If you still have symptoms after 6 months, these still are likely to disappear altogether or be greatly improved by a year after the injury. Not everyone recovers at the same rate. People who are under 40 recover faster and have fewer symptoms as they are recovering. If you are over 40 or have had more than one brain injury, you may take longer to recover and you may have more symptoms at first.

Most doctors who treat mild TBI/concussion agree that recovery is faster when the patient gets enough rest during the weeks after their injury. Work, exercise, social activities, and family responsibilities should be started gradually, not all at once.

What symptoms can I expect?

The most common symptoms after a mild TBI/concussion are known as postconcussive symptoms. Eight out of 10 patients with a mild brain injury report one or more of these symptoms after their injury. These symptoms are typical, and usually resolve within weeks after the injury. They are not signs of permanent brain damage or medical complications. Some patients develop symptoms a few days after their accident, but typically, symptoms begin soon after the injury.

A list of symptoms you may have after mild TBI/concussion are shown in **Table 1**, along with the percent of mild TBI patients who experience each symptom after their injury.

Table 1: Symptoms of Postconcussive Syndrome

Symptom	Percent of Patients
Poor concentration	71%
Irritability	66%
Tired a lot more	64%
Depression	63%
Memory problems	59%
Headaches	59%
Anxiety	58%
Trouble thinking	57%
Dizziness	52%
Blurry or double vision	45%
Sensitivity to bright light	40%

What Can I Do About the Symptoms?

Postconcussive symptoms should be expected. Most patients will be back to normal by 2-3 weeks after their injury without special treatment. Symptoms are not a sign of relapse or permanent brain damage. Few patients will experience all the symptoms, but even one or two of the symptoms can be unpleasant.

Some patients find that at first, postconcussive symptoms make it hard to work, get along with family members, or relax. The best way to deal with this is to resume activities and responsibilities gradually, a little at a time. The time you spend at work, getting together with friends, with your family, or exercising is determined by what you are comfortable with. You should **pace yourself** and be sure to **get all the rest you need**. If your symptoms get worse, or if you notice new symptoms, this may be a sign that you are pushing yourself too hard.

Treatments are available. If your symptoms are interfering with your usual activities or are not improving within several weeks of your injury, consult with your care provider. He or she may be able to provide guidance as to self care that will get you back on the track to recovery. Or, he or she may decide that care provided by TBI specialists is needed.

Ignoring your symptoms and trying to "tough it out" often make the symptoms worse. Symptoms are your body's way of giving you information. A broken bone or a torn muscle hurts so that you won't use it and it has time to heal. Post-

concussive symptoms are your brain's way of telling you that you need to rest. Most doctors who treat brain injuries agree that recovery is faster when the patient gets enough rest and resumes responsibilities gradually.

Thinking and worrying about your symptoms can make them seem worse. It is important to remember that the symptoms are normal after mild TBI/concussion and usually go away on their own. Of course, we all have some of these symptoms once in a while, anyway. After a concussion it can be easy to forget that we were sometimes irritable, tired, had headaches, couldn't concentrate, or forgot things before the accident. Try to deal with these symptoms the same way you did before.

Some symptoms may actually have nothing to do with your mild TBI/concussion. Ordinary day to day stress can cause many of the same symptoms or worsen symptoms typical after mild brain injury. A list of postconcussion symptoms is shown in **Table 2**, along with the percent of people who experience each symptom even though they didn't have a mild TBI.

Having a mild TBI/concussion adds more stress to your life, and symptoms may result from a combination of the added stress as well as mild and temporary disruption of normal brain functioning. The accident itself, being hospitalized, going back to work or school after injury are all things that add stress to most patients' lives. Bills can pile up, time is lost from work or school, and there may be injuries to other parts of your body. You may have some trouble with work or school at first, and this is stressful also, even though it is normal. Trying to do your regular work right after a brain injury is something like trying to play baseball or swim with a pulled muscle. You can't see the injury, it isn't permanent, but it takes some time to get better.

Table 2: Symptoms in people without mild TBI/Concussion

Symptom	Percent of People
Poor concentration	14%
Irritability	16%
Tired a lot more	13%
Depression	20%
Memory problems	20%
Headaches	13%
Anxiety	24%
Trouble thinking	6%
Dizziness	7%

Symptom	Percent of People
Blurry or double vision	8%
Sensitivity to bright light	14%

Talking to your doctor about your symptoms is also important. Your doctor can prescribe medication that can help you, if you need it. You can also talk about your problems to the person who gave you this booklet.

More about specific symptoms

Headaches

Headaches are common after brain injury, but that does not make them less troublesome. Headaches can be a cause of irritability and concentration problems after mild TBI/concussion. This guide cannot replace the medical advice that you should get if you are bothered by headaches. Headaches can have many causes, and your doctor will want to diagnose the problem and prescribe medication that can help, if you need it.

One of the most common causes of headaches after a head injury is stress or tension. This is usually the cause when the headaches start for the first time a week or two after the injury. If this is the cause, these headaches may mean you are trying to do too much. They will probably disappear if you take a break and relax. Your work day, class schedule, or daily routine should be temporarily shortened if you continue to have headaches.

Stress or worry cause tension headaches by increasing muscle tension in your neck or forehead. These muscles become tense and can stay tight without you realizing it. They can become even tighter once a headache starts, because muscles automatically tense in reaction to pain. This muscle tension makes the headaches worse.

Occasionally, medication may be needed to treat your headache. Take the medicines exactly as prescribed. Avoid taking over the counter medications frequently as this can lead to worse, more frequent headaches.

Fatigue

It is normal to be more tired after a injury. The only sensible treatment for being tired is rest. Avoid wearing yourself out. Gradually increase your activity level. Be patient with your recovery, and give yourself the rest that you need. Most patients have more energy in the morning than later in the day. You may benefit from scheduled work breaks or daytime naps. If your symptoms get worse, this means that you are pushing yourself too hard. You may be tempted to use energy drinks to overcome your fatigue, however, this may only worsen your symptoms. If fatigue continues to be a problem and interferes with your daily activities, discuss solutions with your primary care provider.

Poor Concentration

The main cause of poor concentration is tiredness. When it becomes difficult to concentrate on what you are doing, take a break and relax. Between 15 to 30 minutes should be enough. If you continue to have problems, your work day, class schedule, or daily routine should be temporarily shortened. Trying to "stick to it" won't help, and usually makes things worse.

Reducing distractions can help. Turn off the radio or try to work where it's quiet. Don't try to do too many things at once. Watching TV while doing homework is an example of multi-tasking or doing more than one thing at a time. It may be difficult to concentrate on more than one thing at first. You will be able to concentrate better when you have had enough rest.

Irritability

A frequent cause of irritability is fatigue. People lose their tempers more easily when they are tired or over worked. Adjust your schedule and get more rest if you notice yourself becoming irritable.

Everyone gets angry from time to time, often with good reason. Being irritable only becomes a problem when it interferes with your ability to get along with people from day to day. If you find yourself getting into arguments that cause trouble at home or at work, try to change the way you think about things. When something makes you angry, ask yourself what caused this situation. Family, friends, or co-workers can do things that bother us at times. Try to think of why they did whatever it was that irritated you. What would they say the reason was? Thinking about what caused a problem is the first step to solving it.

Problems can usually be solved better if you stay calm and explain your point of view. The steps you need to solve a problem will be the same when you are calm as they would be if you were irritated. Try to remind yourself of this when you find yourself becoming irritable. You can usually come up with several ways to solve a problem. Try to think of at least 3 different ways, and then decide on which is best. Just realizing that there are several things you can do to solve a problem will make it a lot less irritating. Sometimes, you may find it best to walk away from the situation and re-address it later, after you have had time to cool down.

If you find that irritability continues to be more of a problem for you than before your injury, and the steps listed above to do not help you, discuss your irritability with your primary care provider.

Depression

People become depressed when unpleasant things happen to them, and a brain injury is unpleasant. We feel good when good things happen to us. An effective way to treat depression is to make sure that good things happen. One way to do this is to plan to do something enjoyable for yourself each day. Make

your plan specific, and then be sure to stick to it. Decide on something you like and exactly when you're going to do it. That way you can look forward to it. Anticipating and doing enjoyable things each day will improve your mood.

Thinking that things are bad or terrible can make us more depressed. Bad situations are often not as terrible as they may seem at first. Think back to an unpleasant moment in your own life, and you will see that this is so. Thinking that the situation is terrible, that there is no end to it in sight, that you aren't able to do anything about it, and that it is your fault are all depressing things to tell yourself. Thinking this way can become a bad habit if you do it enough.

Usually, when people tell themselves unpleasant things all the time, it is out of habit, not because those things are really true. If you find yourself thinking depressing thoughts, stop and replace it with a good thought. Simply stopping a depressing thought can make you feel better. See if what you are telling yourself is really true. Depression usually gets better over time. If depression continues to be a problem for you, or interferes with your daily activities, discuss it with your primary care provider.

Memory Problems

Memory difficulties have several causes. Most memory problems patients notice after a mild TBI/concussion are caused by poor concentration and being tired. In order to remember something, you have to pay attention to it first. If you don't concentrate long enough, the information is not stored in your memory. Concentration problems are a normal part of recovering from mild TBI/concussion, and some memory trouble is a side effect of this.

You will probably be able to concentrate and remember better when you get enough rest. Memory problems can be a sign that you are pushing yourself too hard. Writing things down or using a pocket tape recorder, or hand held communication devices are other excellent ways of coping with temporary memory difficulties. These devices will help recovery.

Of course, no one has perfect memory. After a brain injury it can be easy to forget that we sometimes had trouble remembering things even before the accident. Some of the symptoms you notice may actually have nothing to do with your mild TBI/concussion. A list of common memory problems reported by people without TBI is shown in **Table 3**.

Table 3: Things We Normally Forget

Symptom	Percent of People
Forgets telephone numbers	58%
Forgets people's names	48%
Forgets where car was parked	32%
Loses car keys	31%
Forgets groceries	28%
Forgets why they entered a room	27%
Forgets directions	24%
Forgets appointment dates	20%
Forgets store locations	20%
Loses items around the house	17%
Loses wallet or pocketbook	17%
Forgets content of daily conversations	17%

Worrying about remembering things can make your memory seem worse to you. People with serious memory difficulties are usually not upset by these symptoms since they don't remember that they have memory problems.

If you are concerned about your memory, have it tested. Your doctor can send you for these tests if you need them. You can also ask the person who gave you this booklet, or your case manager.

Anxiety

Worry about symptoms and problems at work are the main cause of anxiety for most patients. Anxiety should not be a problem for you if you understand that symptoms after mild brain injury will resolve with time, if you get enough rest, and increase your responsibilities at work gradually.

If you are anxious, chances are you are telling yourself things that are making you that way. Usually when people worry all the time it is out of habit, and not because the things they are telling themselves are really true. The steps you need to solve a problem will be the same whether you are calm or anxious. If you find yourself thinking anxious thoughts, stop. Stopping an anxious thought can make you feel better. See if what you are telling yourself is really true. If your anxieties cannot be reduced with these strategies, talk to your health care provider about additional ways to reduce your anxieties.

Trouble Thinking

This problem is usually a side effect of other symptoms. Concentration problems, being tired, headaches, and anxiety can all make it hard to think clearly. As with these other symptoms, trouble thinking is probably a sign that you are doing too much too soon.

Dizziness, Visual Difficulties, and Light Sensitivity

Dizziness and visual difficulties should be checked by your doctor. These symptoms usually go away by themselves in several weeks in most patients. If you find these symptoms troublesome, your doctor may prescribe exercises or eyeglasses to help improve dizziness or vision problems. Work with your doctor on finding treatments that work for you.

You may notice some increased sensitivity to bright light or loud noise, particularly if you have headaches. Some increased sensitivity is normal after a mild TBI/concussion. Adjusting the level of indoor lighting and wearing sunglasses when outside may help make light sensitivity more tolerable. Paying attention to these symptoms can make them seem worse. The less you think and worry about your symptoms, the faster they will usually go away.

Summary

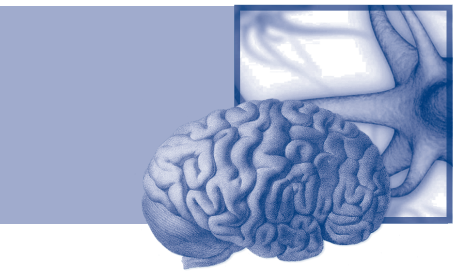
The most common symptoms after a mild brain injury are known as postconcussive symptoms. These symptoms get better as part of the normal recovery process and are not signs of permanent brain damage or medical complications. They are not cause for concern or worry.

Most patients have one or more of these symptoms, but very few will experience all of them. Symptoms are often present immediately following the injury but sometimes develop several days after the accident, especially if the body is over-stressed. Most patients will be back to normal in 2 - 3 weeks without any special treatment. However, if your symptoms are interfering with your daily life and/or are not getting better, discuss them with your health care provider. He or she will discuss strategies and treatments that will help your recovery.

Most doctors who treat mild TBI/concussion agree that recovery is faster when the patient gets enough rest and resumes responsibilities gradually. If your symptoms get worse, or you notice new postconcussion symptoms, this is probably a sign that you are under too much stress. Your work day, class schedule, or daily routine may need to be modified in order to reduce stress, get sufficient rest, and help your recovery.

About This Guide

This guide was adapted by The Defense and Veterans Brain Injury Center at Wilford Hall Medical Center, Lackland AFB, Texas, from: Mittenberg, Zielinski & Fichera, (1993). *Psychotherapy in Private Practice*, 12, 37-52.



Appendix D: Interdisciplinary TBI Specialists for Possible Consultation

Interdisciplinary TBI Specialists for Possible Consultation

Physiatrist is the rehabilitation physician who treats physical, cognitive, and behavioral sequelae of TBI and provides leadership for the interdisciplinary rehabilitation team. The physiatrist coordinates treatment to maximize the level of function and is responsible for medical evaluations and plans of care most suitable for the individual and his/her family. Physiatrists are actively involved with planning the patient's rehabilitation program, including team meetings and family conferences.

Neurologist assesses and treats neurological sequelae of TBI, with emphasis on physical, such as movement disorders, seizures, and pain, as well as neurobehavioral sequelae, such as mood problems and memory complaints. The primary goal of the neurological evaluation is to rule out the presence of conditions requiring neurosurgical attention (hematomas, skull fractures, elevated intracranial pressure, etc.) and to consider differential diagnosis of mild TBI and other neurogenic disorders with similar symptoms.

Psychiatrist can prescribe pharmacological and behavioral interventions for the treatment of psychiatric disturbances occurring as a result of brain injury. The range of psychiatric disturbances which may follow brain injury is extensive and embraces most of what can be found in psychiatric symptomatology. Premorbid personality, pre-existing psychiatric disturbance and genetic predisposition also play a part in psychiatric complications after brain injury, but the contribution of the physical and neurochemical disruption to the brain should not be underestimated.

Neuro-ophthalmologist may address double vision, blurry vision and/or other visual deficits following brain injury. Deficits in the visual system are often overlooked in the mild TBI patient. A common visual deficit found after mild TBI is convergence insufficiency, which is often described by the person as "blurry" vision. The neuro-ophthalmology evaluation should rule out potential eye damage involving the cornea, retina, vitreous fluids, as well as occipital lobe (visual cortex) and optic nerve functioning. Therapeutic intervention may involve prism glasses and/or eye exercises.

Audiologist evaluates hearing deficits and defines the type of hearing loss. Hearing changes after TBI may be include tinnitus or loss of acuity especially in noisy environments. Hearing aids may or may not be prescribed, depending upon the nature and severity of the problem. Audiologists may also be involved in diagnosing vestibular deficits that may lead to balance problems.

Neuropsychologist (psychologist) is the key player in diagnosing cognitive impairments and emotional and behavioral sequelae of TBI. The neuropsychological assessment evaluates the areas of intellectual functioning: attention and concentration; problem solving and judgment; memory and learning; flexibility of thought and speed of information processing. Evaluations of disorders in these areas are provided to help patients and families understand the nature and severity of deficits and to assist other team members when planning patient treatment programs. Treatment services provided by neuropsychologist (psychologist) are designed to help patients achieve maximum benefit from the rehabilitation program and to help them manage adjustment related problems. Counseling may be offered to patients and family members who wish to know more about brain injury and who may be having difficulty coping with family and/or work related stress.

Speech and Language Pathologist will evaluate and treat communication and cognitive deficits that may impact a person's everyday functioning. Speech pathologists assist patients who have speech, language, and cognitive problems to gain optimal communication skills. Communication problems may include difficulty understanding complex and abstract written or verbal information, difficulty finding words and expressing coherent ideas, and problems with the use of language in interpersonal relations. Cognitive problems, such as difficulty paying attention, learning and remembering information, organizing ideas, reasoning, and solving problems also interfere with communication skills. Academic skills may also be assessed to rule out potential deficits that may have an impact upon the person's return to community participation, including work and school. Training using memory strategies and memory aids may be recommended to improve daily function and community reintegration.

Physical therapist provides assessment and treatment for balance disorders, dizziness, functional mobility, physical problems, and pain. Physical therapists can evaluate and address peripheral nerve and musculo-skeletal injuries related to brain trauma, along with balance issues that may be centrally caused. Treatment goals include improving mobility, increasing strength, decreasing joint stiffness, improving static and dynamic balance, decreasing vertigo and dizziness, and managing pain and discomfort. The physical therapist also evaluates a patient's needs for equipment, such as, canes or braces to improve safety and endurance of ambulation.

Kinesiotherapist can recommend a cardiovascular conditioning program that promotes wellness and reduces the risk of injury or further disability. Fitness can have a positive impact upon the person's mental and physical stamina,

reduce pain, and elevate his/her feeling of well-being. The physical conditioning program should be initiated in the health care facility and gradually transferred to a community gym as the person becomes more independent.

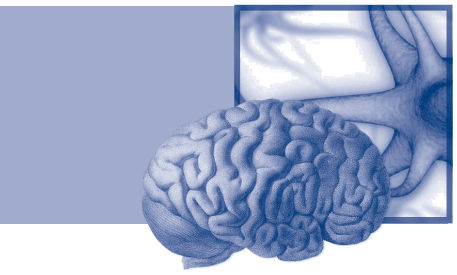
Occupational therapist is the function expert who works with the brain-injured person to improve everyday function in daily routines. A thorough occupational therapy evaluation can provide a window into the ways that TBI impacts an individual's daily life. The occupational therapist will assess the patient's skills, which include visual, cognitive and perceptual abilities to perform tasks in complex and multi-stimuli environments. Treatment goal is to enable patients to best manage their daily tasks, including self-care (feeding and dressing) and managing tasks in the community (shopping, driving, school and work activities). To be able to do these tasks, patients may need to use special techniques, modify their physical environment or use equipment ranging from simple memory aids to more advanced technology such as computers and environmental controls.

Recreation Therapist assists persons with brain injury to resume community life by helping them participate in play and leisure activities, which enrich life. Through leisure counseling, leisure education, leisure skills development, aquatic education, adaptive sports, resocialization programs and community readjustment outings, the person with brain injury learns how to participate in community life.

Social Worker (counselor) helps patients and their families respond to social, emotional or financial problems resulting from physical disability or chronic illness. Treatment modalities include individual and group psychotherapy, crisis intervention, family counseling and family support groups. The social worker explores community resources and entitlement programs that are available to the patient and family.

Vocational Rehabilitation Counselor may act as a treatment coordinator for patients who are having difficulty returning to work after a brain injury. This specialist may be asked to provide assistance in returning to work, collaborating with employer, patient and co-workers to build a successful working relationship.

Case Manager provides effective coordination of patient care and appropriate utilization of resources. Whenever possible, one may consider bringing in a case manager who specializes in brain injury, to assist in coordinating medical care and keeping open lines of communication between the various specialists and the patient and family. The case manager is an advocate for, and an active participant in, the treatment process.



Appendix E: Pharmacotheray and Associated Treatments for Physical/Somatic Symptoms following TBI

Table 1. Pharmacotheray and Associated Treatments for Physical/Somatic Symptoms following TBI (Adapted from the VA/DoD Mild TBI Clinical Practice Guidelines)

Common Symptoms post-concussion/mild TBI	Pharmacologic Treatment	Non-Pharmacologic Treatment	Referral after failed response to initial treatment
Headaches	• Non narcotic pain meds • NSAIDs • Triptans (migraine type)	• Sleep hygiene education • Physical therapy • Relaxation	• Neurology • Pain clinic
Feeling dizzy	• Antibiotics, decongestants for infections and fluid		• Dizzy: ENT/Neurology after ENT interventions
Loss of balance Poor coordination		• Physical therapy	• Balance: PT, PM&R • Coordination: PT, Neurology
Nausea	• Antiemetics	• Sleep hygiene education	• GI
Change in appetite			• Consider Mental Health
Sleep disturbances • Difficulty falling or staying a sleep (insomnia)	• Sleep Meds	• Sleep hygiene education	• Mental health • PM&R • Neurology
Vision problems • Blurring • Trouble seeing • Sensitivity to light		• Sleep hygiene education • Light desensitization • Sunglasses	• Optometry • Ophthalmology**
Hearing difficulty • Sensitivity to noise			• Audiology • ENT

** Depends upon the local resources, impaired vision may be referred in some facilities to neuro-ophthalmologists. Note that such may be due to problems with oculomotility as well as due to disorders of the retina and visual pathways.

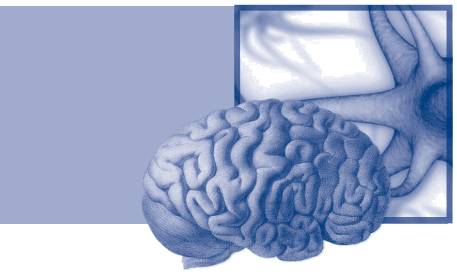
Table 2. Pharmacotherapy in Concussion/mTBI – List of Selected First Line Agents

	Potential side effects	Contraindications/ Comments	Common issues in concussion/mTBI
Non-benzodiazepine Sleep Agents			
First line agent: Zolpidem 5 mg at night, if poor results after 3 nights of therapy increase to 10 mg nightly			
Prazosin initiate therapy with 1 mg at bedtime for three days. May increase to 2 mg at bedtime through day 7. If patients continued to have nightmares, the dosage may be increased to 4 mg at bedtime through day 14. The dosage could be increased to 6 mg at bedtime through day 21 and to 10 mg at bedtime through day 28.The maximum daily dose is 10 mg at bedtime.	• Orthostatic hypotension		For patients with nightmares and/or violent or outburst or agitation during sleep
NSAIDS for headache			
ibuprofen 400-600 mg TID-QID **Naproxen** 500 mg BID	• GI upset • Dizziness • Vertigo		• Potential renal impairment with long term use • Rebound headache may occur with continuous use

	Potential side effects	Contraindications/ Comments	Common issues in concussion/mTBI
Abortive agents for mirgraine/migraine-like headaches			
Zolmitriptan oral 5-10 mg at onset of headache, may repeat once if headache is not resolved in 2 hours **Zolmitriptan nasal** one spray of 5 mg for the treatment of acute migraine. If the headache returns the dose may be repeated after 2 hours. The maximum daily dose should not exceed 10 mg in any 24-hour period **Sumatriptan oral** 50-100 mg at onset of headache, may repeat once if headache is not resolved in 2 hours **Sumatriptan nasal** 10 mg spray in one nostril, may repeat in 2 hrs not to exceed 40 mg/day **Sumatriptan injectable** 6 mg injected subcutaneously may repeat in 1 hour. Not to exceed 12 mg/day	• unusual taste (nasal formulation), paresthesia, hyperesthesia, dizziness, chest tightness • Dizziness, vertigo, tingling, hypertension, injection site reactions		Serious cardiac events, including myocardial infarction, have occurred following the use of zolmitriptan and sumatriptan tablets and nasal spray. These events are extremely rare and most have been reported in patients with risk factors predictive of CAD
Prophylactic headache agents			
First line agents: **Divalproex sodium extended release** 250 mg twice daily, increase by 250 mg/day every week to a maximum of 1000 mg/day	• Asthenia, dizziness, somnolence, tremor, nausea, diplopia	Hepatic failure resulting in fatalities has occurred in patients receiving valproic acid and its derivatives	• May take up to 3 months to receive the full benefit from any of the prophylactic medications • Association with teratogenecity, neural tube effects. Caution in women of childbearing potential
Topiramate 25-100 mg twice daily	• Anorexia, sedation, ataxia, dizziness		• May worsen cognitive dysfunction • May cause renal stones

	Potential side effects	Contraindications/ Comments	Common issues in concussion/mTBI
Metoprolol initiate with 25 mg twice daily, increase dose up to 100 mg twice daily if needed, wait 3-4 weeks between dose increases	• Somnolence • Cold extremities • bradycardia	There are two for mulations- tartrate is immediate release, dosed 2 times daily and succinate is sustained release, dosed one time daily.	• Use with caution in asthmatic and diabetic patients
Vestibular Suppressants			
Meclizine 12.5-50 mg every 4-6 hours	• Hallucinations, blurred vision	All of the agents may cause sedation and require caution when driving or operating machinery	
Scopolamine 0.5 mg patch every 3 days	• Dry mouth • Topical Allergy • Tachyarrhythmia		
Dimenhydrinate 50 mg every 4-6 hours orally	• Dry mouth		
Lorazepam 0.5 mg twice a day orally **Clonazepam** 0.25 -0.5 mg twice a day orally **Diazepam** 2-10 mg orally, IM, or IV	• Drug dependence • Respiratory depressant		• Avoid use of benzodiazapines in mTBI if at all possible

(Adapted from the VA/DoD Mild TBI Clinical Practice Guidelines)

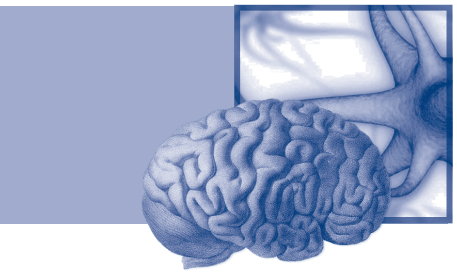


Appendix F: Pharmacotherapy in Concussion/mTB –List of Selected First line Agents

Pharmacotherapy in Concussion/mTBI – List of Selected First line Agents

	Potential side effects	Contraindications/ Comments	Common issues in concussion/mTBI
Stimulants (In specialty care after ruling out sleep disorder.)			
First line agents: **Methylphenidate** 5 mg q (every) 8 am and 1 pm, increasing total daily dose by 5 mg every 2 weeks to a maximum of 20 mg twice daily	• Insomnia • Decreased appetite • GI upset • Headaches • Dizziness • Motor tics • Irritability • Anxiousness • Tearfulness	Ongoing substance abuse.	• Possible addiction potential • Requires additional prescription regulation under federal/ state law. • Cannot be refilled, only one month of therapy at a time may be written for
Modafanil start with 100 mg q am (morning). Increase in 100 mg amounts, using split daily dosing up to maximum of 400 mg/day	• Headache, asthesia		
Amantadine 100-400 mg daily	• Nausea • Dizziness • Dry mouth		
Antidepressants			
First line agents: **Citalopram** 10 mg QD (daily) for 1 week, then 20 mg QD if toler ated (up to 80 mg QD if needed) **Sertraline** 25 mg QD increasing weekly in 25 mg increments to maximum dose of 200 mg/day	• Nausea • Insomnia • Agitation • Asthesia • Nausea • Insomnia • Dry mouth • Headache	Do not initiate concomitant therapy with a benzodiazepine	May cause sexual dysfunction

(Adapted from the VA/DoD Mild TBI Clinical Practice Guidelines)



Appendix G: Driving Issues after TBI

Learning Objectives

- Describe the effects of physical, cognitive, and neurobehavioral TBI sequelae on driving abilities.
- State how medications can affect driving abilities.
- Describe the components of a pre-driving assessment.

Introduction

Driving is an essential activity of daily living for many individuals and is one determinant of level of independence. Individuals lacking this mobility have decreased opportunity to receive healthcare and reduced ability to participate in educational, vocational, recreational, social, cultural, and community events. Driving is a key component of self-sufficiency in American culture. Furthermore, loss of driving skills is also a major obstacle to continued rehabilitation (Lew et al., 2009).

Driving requires a complex set of skills and abilities including mobility, vision, and visual-motor coordination, as well as multiple cognitive and neurobehavioral abilities and functions. It is well known that individuals with traumatic brain injury (TBI) have varying degrees of physical impairments, cognitive dysfunction, and neurobehavioral problems that can impede the integrated operation of neuropsychological and physical capacities necessary for safe driving. However, disabled Veterans, including those undergoing rehabilitation, are entitled by Public Law 93-538 to have the opportunity to pursue a return to driving.

An unprecedented number of Operation Enduring Freedom/ Operation Iraqi Freedom (OEF/OIF) Veterans are seeking DOD and VA medical and rehabilitative care for TBI suffered during wartime (Lew et al., 2007), and many will attempt to resume driving. In fact, it has been estimated that 38% to 78% of individuals with TBI seek and obtain driving privileges after their injury (Katz, 1990; Oliver, 1996; Priddy, 1990). A history of TBI does not always necessitate a permanent loss of driving privileges. One study suggests that individuals with TBI who successfully pass a driving evaluation and complete a comprehensive driving program are able to reintegrate into the driving community with minimal difficulty (Schultheis, 2002). Importantly, it is the physician's responsi-

bility to determine when and how to return the individual to driving.

Unfortunately, guidelines to determine fitness to drive in patients with TBI have not yet been established, leaving physicians with the difficult task of deciding how to measure driving safety. Even in the more studied area of driving and aging/dementia, a survey of Canadian primary care physicians found that 55% of physicians felt unqualified to determine driving safety and 88% felt that they would benefit from additional training in this area (Jang et al., 2006). In terms of TBI, it is clear that developing a plan for training and treatment requires understanding of the impact of the individual's physical, cognitive, and neurobehavioral factors on driving.

Effects of Physical Impairments

Deficits in basic visual skills are common following TBI and can directly impact driving capabilities. For instance, in a sample of 50 OIF/OEF Veterans with a history of TBI approximately 24% had visual field deficits, 20% had pursuit/saccade impairments, 22% accommodation dysfunction, and 30% convergence dysfunction (Goodrich et al., 2007). Overall, approximately 25% of TBI participants had visual impairments that could negatively affect driving safety. Underscoring the importance of visual acuity and visual field integrity for driving, the American Medical Association's (AMA) recommended Assessment of Driving Related Skills (ADReS) identified acuity and visual field integrity as the two primary areas for visual screening in older adults (Wang, 2003). Therefore, visual screening prior to TBI patients' return to driving is necessary and should include a visual acuity test and visual field evaluation.

Another important visual skill for driving is contrast sensitivity (CS), which is defined as the difference in luminance needed to detect a target from its background. Many driving situations involve low contrast conditions such as fog, rain, and dusk/nighttime driving. CS has been found to be a strong predictor of driving skills in several neurological conditions (for a review, see Uc & Rizzo, 2008). Although CS has not been well examined in patients with TBI, these patients are at risk for CS deficits, which can result from injury at many different points along the retinocalcarine pathway. Measurement of CS should also be considered as an adjunct to standard visual acuity and visual field evaluation prior to TBI patients return to driving.

Following TBI, some individuals are also known to have auditory and/or vestibular dysfunction, causing hearing impairment and/or vertigo/dizziness, which may also interfere with driving performance. For example, Lew and colleagues (2007) report that 44% of OIF/OEF Veterans with non-blast related TBI and 62% of OIF Veterans with blast-related TBI had hearing impairments primarily of the sensorineural type. Refer to **Chapter 5** for more detail about visual and vestibular dysfunction.

Motor disturbances, such as paresis of the limbs, neuropathy, spasticity, and ataxia can obviously interfere with the visual-motor coordination and motor

skills requisite for driving. It is thus essential to evaluate motor strength, range of motion, sensation, and proprioception prior to a driving evaluation. For interested readers, the ADReS describes how to measure the motor functions necessary for driving in the primary care setting. It should be noted that the guidelines for interpreting impairment may not be applicable for younger TBI patients.

Primary care physicians may wish to consult ophthalmology, audiology, otolaryngologists, or physical medicine and rehabilitation to assist with evaluation of these physical dysfunctions. For a more detailed description of physical changes following TBI, refer to **Chapter 5**.

Effects of Cognitive Impairments

Because driving places high demands on the brain's ability to rapidly integrate a number of cognitive functions simultaneously with incoming sensory information, possession of driving knowledge and driving skills are insufficient to guarantee safe driving performance. Cognitive impairments commonly seen after TBI can influence driving performance in several ways.

Arousal and Attention

Following TBI, individuals often suffer from impairments in arousal, sustained and divided attention, as well as slowed information processing speed, all of which can impair driving abilities.

Executive Abilities

Changes in executive abilities as a result of TBI were presented in **Chapter 6**. Dysfunction in mental flexibility, sequencing ability, monitoring and allocation of cognitive resources, and problem solving can impede the individual's driving performance. These dysfunctions may be expressed as difficulties in navigation planning, the ability to handle unexpected road conditions, the ability to consider multiple decision alternatives and their consequences, the ability to suppress distracting non-driving related stimuli, and the ability to perform multiple simultaneous tasks.

Visuospatial Perception and Skilled Motor Abilities

The ability to see accurately, to judge depths and speed, and to perceive changes in the environment are important for safe driving. Impairments in visuospatial perception, visual scanning ability, perception of focus, spatial relations, color perception, and perceiving figure-ground relationships can obviously interfere with driving performance and safety.

In sum, cognitive abilities such as attention, executive function, and visual spatial ability are essential for driving safety, but more research is necessary to demonstrate their relative contribution to safe driving, specifically in patients with TBI. Emphasizing the importance of these cognitive skills, studies involving patients with other neurological conditions (such as Alzheimer's disease and Parkinson's disease) have found that executive functions and visual spatial

abilities are the best predictors of driving safety (for reviews see Amick et al., 2007; Uc & Rizzo, 2008). Therefore, as part of assessing and developing a remediation plan for driving safety, primary care providers may want to refer their patients with suspected or known cognitive impairments for more thorough neuropsychological assessment.

Effects of Neurobehavioral Dysfunction

Neurobehavioral changes frequently include impulsivity, aggression, lack of insight, and substance abuse as detailed in **Chapter 7**. These behaviors can lead to risky driving behaviors, which may endanger the safety of the driver, passengers, pedestrians, and other vehicles and property.

Other Factors Affecting Driving Capabilities

Seizures

A seizure occurring during driving can impose a great threat to public safety. Some investigators have shown a 40% increased risk in serious injuries due to automobile accidents in patients with seizure disorder (Taylor, 1996). However, there is no common nation-wide law that restricts driving for patients with epilepsy. Most states require people with epilepsy to be seizure-free for a certain period, ranging from 3 to 12 months. Other states have more flexible restrictions, basing the required seizure-free period on clinical factors (Krauss, 2001). Thus, it is the responsibility of the physician to help determine when their patients may drive, the intent being to protect the public and patient safety optimally while permitting patients with controlled seizures to drive.

Medications

Psychotropic medications, commonly prescribed for individuals who have sustained a TBI, include benzodiazepines, neuroleptics, narcotics, hypnotic sedatives and barbiturates, and antidepressant medications such as SSRIs and tricyclics (see **Chapters 5, 6, and 7** for more details on pharmacological treatments). Psychotropic medications can influence driving capabilities by affecting visual abilities; causing fatigue, drowsiness, and slowed reaction time; and decreasing attention and multitasking abilities (Hopewell, 2002). Other agents, frequently prescribed in the TBI population to treat general medical problems, may also affect the above driving abilities (e.g. beta-blockers, anti-convulsants, sedating antihistamines, etc.) or interact with the primarily "psychotropic" medications. As always, physicians should be aware of potential interactions and the effects of multiple prescribed medications and monitor or assess side effects.

Pre-Driving Assessment

There is no universally accepted standardized driving evaluation for individuals who have sustained a TBI. Current pre-driving assessment methods typically include neuropsychological evaluation, behind-the-wheel evaluations, reaction time measures, and assessment of visual abilities including acuity, night vision, and depth perception (Schultheis, 2000). The Department of Veteran's Affairs

offers a Driver Rehabilitation for Veterans with Disabilities Program, which provides both assessment and rehabilitation of driving skills. See final page of this Appendix for a list of VA Driver Rehabilitation Programs and the website listed in the references (VA, 2010). To determine driving safety and inform remediation, the program recommends review of: physical health (medications, fatigue), driving history, driver's license status, motor functioning (range of motion, strength, balance, coordination, and spasticity), and perception and sensation screening (vision, hearing, and proprioception).

For a physician not geographically near or able to refer to a VA Drivers Rehabilitation Center, the AMA has published a guide for physicians to assess and counsel older drivers (AMA, 2003), some of which may be applicable to assessing patients with TBI. The recommended office-based assessment battery (ADReS) includes methods for measurement of vision, cognition, and motor functioning. Unfortunately, the ADReS has not been uniformly accepted due to limited measurement validation (Molnar et al., 2006). Although, the older driver literature indicates a lack of consensus for how to determine driving safety, existing guidelines suggest that driving safety should not be determined by performance on a single measure, but rather based on the consideration of many patient characteristics. Importantly, compared to physical examinations or neuropsychological tests, a road test conducted by a professional driving instructor or other certified occupational therapist is considered the gold standard for determining driving safety.

Computer-based driving simulators are emerging as a valid alternative to road testing. Performance on simulated driving courses has been found to be correlated with actual road test assessment and driving simulators can discriminate safe and unsafe drivers across a range of physical/cognitive disorders (for a review, see Lew et al., 2009). Most importantly, simulator performance has been found to have predictive utility for determining long-term driving outcome. A recent pilot study reported that pass/failure on the driving simulator correctly classified 82% of moderate to severe TBI drivers' performance when assessed ten months later, via standardized observer-rating by a passenger (Lew, et al., 2005).

A significant strength of driving simulator assessment is that it offers a safe means of replicating actual driving conditions including hazardous situations (emergency vehicles, surprise pedestrians) and poor weather and lighting conditions (rain, glare) that would be difficult, if not unethical, to test with a live road test. Furthermore, the computer-administered assessment can precisely and simultaneously measure multiple aspects of driving performance (speed, positioning, and obeying rules of the road), which cannot be as carefully monitored during most road tests (for a review, see Lew et al., 2009). Unlike traditional paper and pencil cognitive assessments, simulators can also evaluate the dynamic cognitive abilities necessary for safe driving such as spatial orientation updating, sustained and divided attention, planning, and route learning, which are often impaired following TBI (Bieliauskas, 2005). Driving

simulators are now widely being used and it is expected that research will soon be available to verify driving simulator's reliability and validity in predicting driving capabilities.

Driver Rehabilitation Programs

Changes in sensory, motor, or cognitive functioning do not always mean that the TBI patients should cease driving. Evaluation and training can help many TBI patients return to safe driving. A driver rehabilitation program for individuals who have cognitive and/or physical deficits secondary to brain injury should include a pre-driving assessment, a behind-the-wheel assessment, education, and training. These components are necessary to ensure that they are safe to operate a motor vehicle on public roads. This multi-faceted rehabilitation approach is initiated by referral from a physician, who has determined that the patient is medically stable and able to receive this comprehensive evaluation.

The Driver Rehabilitation for Veterans with Disabilities Program provides four phases of in-car instruction. The first phase focuses on helping the Veteran develop skills to transfer in and out of the car, adapting the car for the Veteran's physical limitations, and practicing basic rules of the road/driving skills. Phases two through four involves supervised driving in increasingly more complex settings (e.g., residential neighborhood, downtown area, and freeway). Completion of the in-car training is recognized by a certificate. Other services offered include assistance with appropriate vehicle selection and documentation of the assessment and training program in the patient's medical chart (VA, 2010).

Simulators are also being used as training devices that allow patients to rehearse driving skills in challenging situations such as merging with heavy traffic, negotiating left hand turns, poor weather conditions, and unexpected events (such as being cut off) without the potential risk to safety. It has also been proposed that practice with the driving simulator may "treat" the cognitive deficits that frequently accompany TBI. That is, repeated practiced driving could potentially improve sustained attention, planning, route learning, and affect regulation as these cognitive skills are engaged during safe driving (Lew et al., 2009). Another potential benefit of simulator training is the opportunity for immediate review of critical driving mistakes through the replay feature (Stern & Schold, 2006). Anasognosia (lack of awareness of deficits) is frequent following TBI, and can be a significant impediment to rehabilitation. Immediate confrontation with actual driving mistakes may increase self-awareness and improve compliance with driving safety recommendations (for a review, see Lew et al, 2009).

Though simulator training has been found to improve rate of return to driving in stroke patients (Akinwuntan et al., 2005), driving intervention research has yet to be conducted in patients with TBI. Kua and colleagues (2007) performed a systematic review of the older driver rehabilitation literature and found that only eight studies demonstrated sufficient internal validity to be

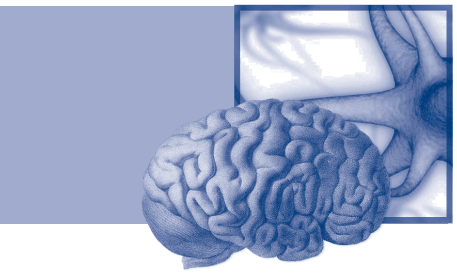
included in the review. Limited benefits of physical (range of motion exercises or at home physical therapy exercises) and vision interventions (speed of information processing training or visual perception exercises) were reported. Driver education programs were associated with increased driving avoidance and greater self-regulatory behaviors but not reduced crash risk.

Until these programs are empirically validated it is difficult to judge the relative benefit of the intervention as well as which elements of the treatment are associated with the best remediation of driving skills. The limited research on rehabilitation programs, however should not dissuade clinicians from recommending these services as clinical experience has shown these programs can be helpful to individual drivers.

VA Driver Rehabilitation Centers

1. VA Upstate New York, Albany, NY
2. VA New Mexico HCS, Albuquerque, NM
3. VA Medical Center Ann Arbor, MI
4. VA Medical Center Atl., GA (Decatur)
5. VA Medical Center Augusta, GA
6. VA Gulf Coast HCS, Biloxi, MS
7. VA Medical Center Bronx, NY
8. VA Hudson Valley, Castle Point, NY
9. VA Medical Center Cleveland, OH
10. VA Medical Center Columbia, SC
11. VA North Texas HCS, Dallas, TX
12. 12. VA Medical Center Denver, CO
13. VA New Jersey HCS, East Orange, NJ
14. VA Baltimore HCS, MD
15. VA Medical Center Hampton, VA
16. VA Medical Center Hines, IL
17. VA Medical Center Houston, TX
18. VA Medical Center Indianapolis, IN
19. VA Central Iowa, Knoxville, IA
20. VA Medical Center Long Beach, CA
21. VA Medical Center Butler, PA
22. VA Medical Center Little Rock, AR
23. VA Medical Center Philadelphia, PA
24. VA Medical Center Syracuse, NY
25. VA Medical Center Washington, DC
26. VA Medical Center Memphis, TN
27. VA Medical Center Miami, FL
28. VA Medical Center Milwaukee, WI
29. VA Medical Center Minneapolis, MN
30. VA Medical Center Palo Alto, CA
31. VA Medical Center Phoenix, AZ
32. VA Medical Center Portland, OR
33. VA Medical Center Richmond, VA
34. VA Medical Center Salisbury, NC
35. VA Medical Center Salt Lake City, UT
36. VA South Texas HCS, San Antonio, TX
37. VA Medical Center San Juan, PR
38. VA Puget Sound HCS, Seattle, WA
39. VA Greater L.A. HCS, Sepulveda, CA
40. VA Medical Center St. Louis, MO
41. VA Medical Center Tampa, FL
42. VA Medical Center Topeka, KS
43. VA Boston HCS, Brockton, MA
44. VA Medical Center West Palm Beach, FL
45. VA Medical Center Lexington, KY
46. VA Medical Center Oklahoma City, OK
47. VA Medical Center Sheridan, WY
48. VA Medical Center Tucson, AZ

VHA Handbook 1173.16: Driver Rehabilitation for Veterans with Disabilities Program Procedures: http://vaww1.va.gov/vhapublications/ViewPublication.asp?pub_ID=2148



APPENDIX H: Disclosure[s]

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Each faculty and planning committee member (author, facilitator, moderator) reported having no relevant financial relationships with any commercial interest. This activity includes no discussion of uses of FDA regulated drugs or medical devices which are experimental or off-label.*

*****The ACCME defines "relevant financial relationships" as financial relationships in any amount occurring within the past 12 months that create a conflict of interest.

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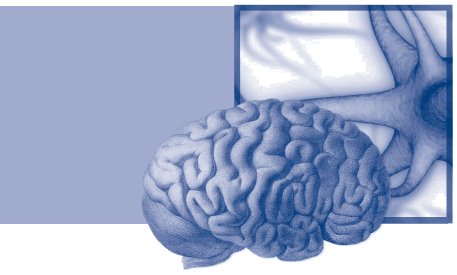
The Employee Education system wishes to ensure no individual with a disability is excluded, denied service , segregates, or otherwise treated with a differently from other individuals participating in this independent study because of the absence of auxiliary aids and services. If you request any special arrangements to fully participate in this independent study, please contact Constance L. Singleton, MHR, Program Manager, at 205-731-1812 extension 317, or email constance.singleton@va.gov.



CME Test

01. Severity of TBI means:

a. Severity of injury at the time of injury
b. Severity of outcomes and symptoms after injury
c. A combination of (a) and (b)
d. A Glasgow Coma score of 6 or less

02. Which of the following is Not a defining characteristic of mild TBI?

a. Some alteration in mental state at the time of the accident
b. Glasgow Coma Scale score of 13-15
c. Indication that a physically traumatic event occurred
d. Positive CT or MRI findings

03. The single most common cause of civilian TBI is:

a. Falls
b. Firearms
c. Motor vehicle accidents
d. Sports injuries

04. One of the most commonly used scale to quantify initial severity of brain injury is the:

a. American Academy of Neurology guidelines for grading level of concussion
b. Glasgow Coma Scale (GCS)
c. Post-concussion Symptom Checklist
d. Rancho Los Amigos Scales of Functioning

05. TBI occurs most frequently among:

a. Babies/toddlers, teenagers, and the elderly
b. Men in their 40s and 50s
c. Middle aged women who are stressed from multiple roles and have higher than average rates of motor vehicle accidents
d. Women of all ages compared to men

06. Which if the following is not a component of the VA's Polytrauma/TBI system of care?

a. Polytrauma Rehabilitation Centers (PRCs)
b. Polytrauma Support Clinical Teams (PSCTs)
c. Polytrauma Mental Health Centers (PMHCs)
d. Polytrauma Network Sites (PNSs)

07. Which of the following statements is false?

a. The VA has a program to screen all patients for possible TBI
b. The VA has a program to screen for possible TBI only for OEF/OEF Veterans presenting for medical care
c. Polytrauma Network Sites (PNSs) should complete a comprehensive TBI evaluation following a positive TBI Clinical Reminder (i.e., following a positive TBI screen)
d. Polytrauma Network Sites (PNS) have an interdisciplinary team of TBI providers

08. The CPRS note entitled "TBI/Polytrauma Individualized Rehabilitation Plan of Care" should contain:

a. Contact information for the TBI patient's parents
b. The patient's responses to the TBI Clinical Reminder
c. Contact information for a patient's TBI physician and case manager
d. The number of the VHA Directive mandating this care plan

09. Initial medical assessment in the post-acute of chronic phase of TBI should include all of the following except:

a. A CT or MRI scan of the head
b. An assessment of what education the patient has received about TBI and recovery
c. An understanding of the patient's beliefs about brain injury and their beliefs about their long-term prognosis
d. Whether or not the patient has pending litigation related to TBI Traumatic Brain Injury

10. Which of the following is Not a common medical symptom or problem in the individual with an acute mild TBI?

a. Dizziness and balance problems
b. Headache is the most common pain complaint
c. Post-injury fatigue, which can have several contributing factors, including depression and environmental demands
d. Spasticity usually emerges in the acute phase of mild TBI

11. **Most individuals with a moderate to severe traumatic brain injury require a period of inpatient rehabilitation. Which of the following is true regarding this rehabilitation:**
    a. These services are best provided in an established interdisciplinary program
    b. To be eligible for admission to most inpatient brain injury program, the individual should be medically stable and able to participate in rehabilitation therapies
    c. There should be a reasonable expectation for functional improvement
    d. All of the above are true

12. **Which of the following is Not True about post-TBI Spasticity?**
    a. Spasticity can lead to pain syndromes and skin breakdown
    b. Spasticity is best treated on an outpatient basis through primary care clinics
    c. Spasticity must be distinguished from other causes of resistance to passive movement including anxiety, joint pain, heterotopic ossification, and contractures
    d. Whenever spasticity develops, a stretching, positioning, and range-of motion program should be instituted

13. **Which of the following is Not True about hydrocephalus following moderate to severe TBI:**
    a. The usual cause of post-TBI hydrocephalus is disruption of the absorptive capability of the arachnoid villae
    b. Post-TBI hydrocephalus is characterized by the classic clinical signs (imbalance, incontinence, and dementia)
    c. True post-TBI hydrocephalus must be distinguished from hydrocephalus ex vacuo
    d. All of the above are true

14. **Which of the following is Not a general rule of thumb when prescribing medical treatments following TBI?**
    a. The relationship between initial injury severity and current symptom presentation should guide the general approach A CT or MRI scan of the head
    b. One should investigate prior treatments to avoid repeating ineffective strategies
    c. Start fresh with treatment approaches from a new perspective unbiased by what has happened before
    d. If the patient does not responded to initial interventions, a referral to an experienced TBI- physiatrist should be considered

15. **Which of the following is Not True regarding post-traumatic headaches (PTHA)?**
    a. Post-Traumatic Headaches (PTHA) can be present in a large percentage of patients following TBI and can be very challenging to manage
    b. Psychological interventions such as "habit reversal" involving detection, interruption, and reversal of maladaptive habits are not effective in headache treatment
    c. Botulinum toxin may be effective for both PTHA tension and migraine headaches if other treatment approaches have not been successful
    d. Post-Traumatic Headaches (PTHA) can be of the tension or migraine headache type

16. **Which of the following is Not True about regarding sleep disturbance following TBI?**
    a. Sleep disturbance rarely occurs following TBI
    b. If sleep problems are present they can result in fatigue and increased levels of irritability
    c. Treatment for sleep problems should begin with removal when feasible of all medications with stimulant properties, both prescription and non-prescription
    d. Both sleep agents and antidepressants may be effective in treating insomnia

17. **All of the following statements are false except:**
    a. Visual impairments and dysfunctions rarely go undetected following brain
    injury because they are obvious to both patients and family members
    b. Although problems with visual field cuts and accommodative dysfunction may occur following TBI, binocular dysfunction is extremely rare
    c. Oculomotor dysfunction following TBI can result in difficulty with fixation, saccades and pursuits, and consequent functional problems with scanning, tracking, and nystagmus
    d. Visual impairment rarely have a negatively impact a person's mobility or ability to engage in education, employment, and activities of daily living

18. **Which of the following is the least common cognitive problem following moderate to severe TBI?**
    a. Attention and concentration problems
    b. New learning and memory problems
    c. Problems with visuospatial abilities such as drawing
    d. Problems with executive functioning such as self-control and problem-solving

19. **Which of the following statements is false?**
    a. Cognitive effects similar to those of TBI may occur as a result of other organic and mental health conditions
    b. Neuropsychological evaluations definitively determine whether or not a brain injury occurred
    c. Neuropsychological evaluations assess current cognitive and psychological functioning
    d. Emotional responses (e.g., irritability or emotional reactivity) can amplify the functional limitations of cognitive impairments

20. **Which of the following statements is false regarding effective interventions for cognitive deficits?**
    a. Cognitive enhancing medication should be tried only after medical and behavioral factors have been mitigated (e.g., poor sleep hygiene or the adverse side effects of other centrally-acting medications)
    b. Strategy training for severe memory problems is a practice standard after brain injury
    c. Direct attention training in conjunction with metacognitive training (i.e., feedback, self-monitoring, and strategy training) is a practice guideline for attention problems after TBI
    d. Problem-solving strategy training is helpful for the treatment of executive dysfunctions such as problems with problem-solving and self-monitoring

21. **Which of the following statements is false?**
    a. In the days and weeks following TBI, many aspects of cognition improve, some quite rapidly
    b. Cognitive symptoms of mild TBI typically resolve within a few weeks after the injury
    c. Preliminary evidence from the research literature indicates that the cognitive effects of blast-related TBI are substantially different from those from non-blast TBI, such as motor vehicle accidents
    d. A sizable proportion of individuals who sustain a severe TBI have difficulty returning to work or independent living because of persistent cognitive problems

22. **Which of the following statements is false?**
    a. Damage to the frontal lobes is common in serious motor vehicle accidents and can cause specific behavioral problems or changes in personality
    b. Behavioral and emotional problems may be long-lasting and take a tremendous toll on the family
    c. The relationship between original severity of injury and long-term outcomes is not one-to-one
    d. Following a brain injury, pre-injury personality characteristics no longer play a significant role because of the TBI behavioral changes

23. Which of the following psychological issues is less likely in a combat-related TBI compared to a civilian-related TBI?

a. PTSD
b. Depression
c. Anxiety
d. Actually all of these conditions are more likely in combat-related TBI

24. Which of the following statements is Not an important general principle in the management of psychological and behavioral sequelae following TBI?

a. Patient and caregiver education and support is not important
b. Interdisciplinary approach is very useful due to the complexities in this patient population
c. Psychotherapy/behavioral management play important roles in treatment
d. Appropriate pharmacotherapy may provide significant benefits

25. Which of the following in Not an important principle for prescribing medications for individuals with TBI?

a. Make only one medication change at a time
b. Allow adequate time for one drug to clear out of the person's system before changing to another medication
c. Be aware of confounding comorbidities (e.g. substance abuse, PTSD)
d. Medication compliance is not an important factor to consider in non-responders

26. All of the following are True except:

a. Falls are the leading cause of TBI in the elderly
b. Men generally account for a higher percentage of TBI than women, except in individuals over the age of 65
c. A TBI secondary to being struck as a pedestrian is more common in the elderly than in younger adults
d. Motor vehicle accidents continue to account for a high proportion of TBIs in the elderly

27. In terms of prognosis or outcomes, all the following are True for the elderly except:

a. The probability of poor outcome increases with advanced age
b. The elderly have a more fragile physiologic status which can result in a more destructive injury
c. The elderly have slower recovery rates and longer lengths of stay than younger adults
d. The majority of elderly TBI survivors undergoing rehabilitation do not achieve functional improvements

28. **Which of the following statement is not True:**
    a. Older adults experience more frequent and more severe cognitive impairment when compared to younger adults with similar severity of TBI
    b. Older individuals with TBI have slower rates of drug metabolism and excretion, which creates a greater propensity for cognitive side effects from medications
    c. Acetaminophen is the preferred medication for pain syndromes in the elderly with TBI
    d. All of the above statements are true

29. **Compared to younger adults, the following statements are true for elderly individual with TBI the except:**
    a. The elderly have a higher risk for DVT
    b. The elderly have a higher risk for urinary retention and incontinence
    c. Special mobility considerations in the older adult with TBI include alterations in vision, decreased peripheral sensation, imbalance, decreased strength, and limited physical endurance
    d. All of the above statements are true

30. **All of the following are True except:**
    a. Psychological distress is common in family members of individuals with TBI
    b. Family adjustment to living with a loved who had a TBI is usually back to normal after a few months
    c. Family adjustment to TBI can be described as a series of nonlinear, overlapping stages
    d. Each stage is defined by a series of typical emotional reactions by family members

31. **All of the following are questions that may be useful in evaluating how well a family is coping and meeting the needs of the individual with TBI, except:**
    a. Are you and your family able to manage all of the needs of loved one with TBI?
    b. Do you have needs or concerns for which you need help or guidance?"
    c. Do you have friends or a support system for yourself when you feel overwhelmed?
    d. All of these are useful questions to assess family coping.

32. **Which of the following is Not a useful step/intervention to use with family members of individuals with TBI?**
    a. **Validate and normalize** the family's concerns and their reactions
    b. **Educate** the family about TBI and the recovery process
    c. **Collaborate** with and **Refer** when necessary to TBI specialists and other providers within the VA system of care
    d. Instruct the family that there is always one best way to handle every situation

33. Which of the following is Not an example of community reintegration:

a. Resumption of parental role
b. Receiving physical therapy
c. Volunteering at the animal shelter
d. Taking classes at the local community college

34. The following types of interventions may be considered to support community integration of individuals with TBI:

a. Vocational rehabilitation
b. a, c, and d
c. Driving rehabilitation
d. Cognitive rehabilitation

35. All the following are True about extended care except:

a. Environment of care should be age appropriate
b. Extended care is always provided in institutionalized settings
c. VA may purchase community extended care service
d. Community Living Centers emphasize care in a home-type environment

Long Description Figure 3: Hypothetical recovery paths of cognitive functioning

This graph shows typical recovery of cognitive function following mild, moderate, and severe TBI. Those who have sustained a mild TBI typically return to baseline within 3 months while those with more severe injuries show gradual recovery but no return to baseline. As shown, recovery is the rule rather than the exception and extent of recovery depends on injury severity. However, it is important to note that recovery is highly individualized and depends on many other factors.

Long Description Polytrauma/TBI System of Care (PSC) Components

A generic organizational chart depicting the Polytrauma/TBI System of Care Components, the chart reads as follows:

1) One Polytrauma Rehabilitation Center block centered as the top tier.
2) Three Polytrauma Network Site blocks branch off the Polytrauma Rehabilitation Center block.
3) Two Polytrauma Support Clinic blocks branch off the third Polytrauma Network Site to the right.
4) Two Polytrauma Point of Contact blocks branch from the Polytrauma Support Clinic on the right.