

HOLTER ISCHEMIA/RHYTHM

1 Background and Rationale

Ambulatory ECG (AECG) recording and analysis permits the documentation of transient events which may not be detected during short recording periods. Episodes of ventricular and supraventricular ectopic activity as well as ST depression and elevation can be monitored and evaluated with this technique. The Heart Disease Research Centre in Halifax (HDRC) will measure the frequency and complexity of these events.

2 Definitions and Alerts

Ambulatory ECG data will be analyzed and classified on a beat by beat basis and all ECG complexes will be classified to identify normally conducted complexes, ventricular and supraventricular ectopic complexes. Transient ischemic episodes will be identified. The total duration of ischemic episodes over 24 hours will be reported.

These analyses will be performed off line. Clinics will be notified of participants experiencing ventricular tachycardia (runs of three or more successive ventricular complexes).

2.1 Equipment and Supplies

- Dynacord 420 Holter Recorder
- Carrying case
- Belt or shoulder harness
- Participant cable
- Test cable
- MAC/PC
- New 9-volt alkaline battery
- Alcohol swabs
- New package (unopened) silver/silver chloride electrodes
- Hypoallergenic tape
- Razor

3 Methods

3.1 Participants are randomly selected at the ECG station and explanations of the procedure are given either at the ECG station or at a subsequent point during the clinic visit.

3.2 Checking Equipment

- Check participant cable and lead wires for any breaks and check connectors for corrosion.

- Replace any damaged cables.
- Remove corrosion with acetone, alcohol or sandpaper.

3.3 Identification Information

- Participant ID - Enter the 6 digit number previously assigned to this participant.
- Field Center Number - assigned as follows:
 - Bowman Gray Field Center
 - UC-Davis Field Center
 - Johns Hopkins Field Center
 - Pittsburgh Field Center
- Technician Code - Enter technician code which was assigned by the Halifax ECG Centre following certification.
- Current Date/Time - Enter as month/day/year and 2400 clock time.
- Record serial number - located inside the recorder in area of battery placement

3.4 Electrode Positioning and Marking (Figure 1)

- Locate the ground, (green) electrode on a flat surface on the lower right of the rib cage.
- Locate the upper electrodes, white and blue, slightly to the right (white) and left (blue) of the sternum at the junction of the second rib and sternum. Mark these sites.
- Locate the positive V5 (red) electrode for channel 1 at the V5 position.
- Locate the left 4th intercostal space and the left 4th rib above. Mark this site for the V2 (orange) electrode.
- Positioning V2 (orange) and V5 (red) electrodes on women:
 - The positions of the V2 (orange) and V5 (red) electrodes may need to be modified on women in order to find flat surfaces for good electrode adhesion.
 - Do not place electrodes on the breast or in contact with the bra.
 - When the V5 (red) electrode must be moved down from the 5th intercostal

space, move it along the axis of the lead, not straight down. That is, visualize a straight line between the left upper sternum and the V5 (red) electrodes and move the V5 (red) electrode down and to the left along that line. This maintains the same electrical signal.

- In general, placing the V2 (orange) electrode on the sternum works best. However, when the resulting signal amplitude is too low, move the electrode left beneath the breast until good amplitude is obtained.

3.5 Skin Preparation and Electrode Application

- Carefully shave the area.
- Clean the area with acetone or alcohol pads and mark the correct locations with a felt tip pen.
- Use a new, unopened package of electrodes.
- Check that each electrode has a complete cup of moist gel at the center.
- Place the electrodes on the prepared skin areas, seating the electrode gel cups over the center of the prepared skin sites.
- Do not press the cup into the skin.
- Press firmly around the adhesive border.
- Ensure the adhesive pad is stretched smoothly with no wrinkles or pockets.
- Connect the white wire to the upper right (white) electrode (participants right).
- Connect the red wire to the V5 (red) electrode.
- Connect the blue wire to the upper left (blue) electrode.
- Connect the orange wire to the V2 (orange) electrode.
- Connect the green (ground) to the lower right electrode.

3.6 Securing cable and wires

- Tape the patient lead cable and its wires to the patient's skin creating stress loops (bottom of figure 1)
 - Optimum wire routine and taping varies somewhat with individual body

size and type. Figure 1 shows a configuration that generally works well. Follow Figure 1 to create effective stress loops. In general 2 inch loops are appropriate.

- The loops should provide enough slack to allow the participant to move freely without causing wires to pull on electrodes or cable yoke.
- Be sure the loops do not cross themselves or each other.
- Do not put tape over the electrodes.

3.7

Pretesting

- Connect the participant cable to the recorder input.
- Install a new 9 volt alkaline battery. Do not insert a cassette at this time.
- Verify electrode applications and plot ECG reference strip as follows:
 - Connect the test cable to the recorder at the test cable connector.
 - Connect the test cable to the input connector of the MAC/PC ECG recorder.
 - After pressing the RHYTHM button to start the paper, gently tap each electrode and observe the ECG waveform.

The electrodes are operational and properly applied when the waveform remains clean without noise, artifact or baseline shift.

- Remove, reapply and retest electrodes that display significant artifact. Confirm proper electrode placement. Both channels should display a mainly positive QRS complex of greater than 0.5 mV.
- Record a ten second strip in the standing position. This strip should be mailed to the Halifax ECG Center along with the tape.
- Disconnect the test cable from the MAC/PC and the Model 420 Recorder.
- Unplug the participant cable from the recorder.
- Remove the battery.

3.8

Recording

- Insure gain settings for channel 1 and channel 2 are on "Full".
- Check the cassette label to ensure the proper information has been recorded as described in Section 3.3.
- Press the pivot arm release button. The pivot arm will swing out.
- Insert the back of the cassette under the lip of the cassette spring, label facing up and gently ease down the front of the cassette over the spindles and capstan (Before inserting the cassette, take up the slack on both reels and center the start of the dark tape in the middle window.)
- Make sure the cassette is pressed flat against the deck surface and the tape is between the pinch roller and capstan. When the tape is properly installed, the full side of the tape will be on the right spindle.
- Swing the pivot arm closed.
- Firmly press the participant cable into the participant cable connector.
- Re-install battery. This starts the recording of the calibration on the tape. The calibration is vital for later ST segment analysis.
- Insert the recorder into the carrying case.
- Fasten remaining strap over the recording and participant cable to immobilize the cable connector.
- Position the recorder at the participant's side using shoulder strap or the participant's belt.

3.9 Instructions to Participant

- Show the participant how to reconnect a wire when one should become loose.
- Show the participant how to reattach any loose electrode or tape.
- After the monitor is attached, review the information sheet emphasizing:
 - The date and time to be removed
 - The equipment is entirely safe.
 - The pointers to improve data quality including:

- When an electrode pad comes off, tape it back on in the same place.
 - When a connector becomes loose, snap it back together.
 - Wear cotton underwear when possible, to minimize static in the recording.
 - Do not get the equipment wet. Sponge baths are fine, but not swimming.
 - Electric blankets and heating pads are safe but should not be used because they cause static on the recording.
- The plan for return. This will vary by Field Center .

3.10 Post-Test Procedures

- Remove the recorder from the participant by unplugging the participant lead cable from the recorder.
- Remove the cassette from the monitor and verify that the proper ID information, time, date and serial number have been properly recorded.
- Gently detach the cable and electrodes from the participant.
- Clean the electrode sites thoroughly but gently with soap and water. Do not use acetone or alcohol to clean the sites.
- Remove and discard the battery.