LEARNING MODULE

For

REMOVAL OF TEMPORARY EPICARDIAL PACING WIRES

{Post-Entry Level Competency for Cardiovascular Associates, and Nurse Practitioners in Cardiac Surgery (as part of Collaborative Practice Agreement)}

(CC 10-077)

Developed by: Betty Hodgson, RN MSc CCN(C) Marta Smith RN BN

Date: July, 2009

Revised by: Jackie Frew
Date: May, 2012
<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose .............................................</td>
<td>2</td>
</tr>
<tr>
<td>Learning Objectives ...................................</td>
<td>2</td>
</tr>
<tr>
<td>Method ...............................................</td>
<td>2</td>
</tr>
<tr>
<td>Theory ...............................................</td>
<td>3</td>
</tr>
<tr>
<td>Self Test ..........................................</td>
<td>6</td>
</tr>
<tr>
<td>Answers .............................................</td>
<td>8</td>
</tr>
<tr>
<td>Proficiency Standards Skills Checklist ..........</td>
<td>9</td>
</tr>
</tbody>
</table>
PURPOSE

This learning module will provide the Cardiovascular Associate (CV Associate) and Nurse Practitioner (NP) in Cardiac Surgery with theory to guide practice to safely perform epicardial pacing wire removal; and to anticipate and respond appropriately to possible complications arising from this procedure. After completing the learning objectives, the CV Associate or NP will demonstrate competency by completing the proficiency standards checklist.

LEARNING OBJECTIVES

Upon completion of the learning package, the CV Associate or NP will be able to:

1. Discuss the surgical placement of epicardial pacing wires with reference to cardiac anatomy, atrial and ventricular chamber orientation and wall thickness, bypass graft placement and sternal wiring.
2. Identify the criteria for determining the chamber of origin of epicardial pacing wires.
3. Identify criteria for the removal of epicardial pacing wires.
4. Discuss the potential complications associated with removal of epicardial pacing wires.
5. Discuss the nursing implications following removal of temporary epicardial pacing wires.

METHOD

2. Successful completion of Self Test of Theory
3. Successful completion of the Proficiency Checklist with demonstration and return demonstration.

THEORY

Cardiac Anatomy:

The heart is a hollow, muscular, four chambered organ which lies in the mediastinal space in the centre of the chest. The atria receive blood from the low pressure central venous and pulmonary circulations, and discharge their blood into the ventricles during the low pressure period of ventricular diastole. As a result the walls of the atria are quite thin. The ventricles contract against higher resistance during systole and have thicker walls.

The need for temporary cardiac pacing is not uncommon in the immediate post operative period following open heart surgery. Cardiac pacing may be needed to treat a brady-dysrhythmia or asystole; or to increase heart rate to suppress arrhythmias or increase cardiac output. In some cases synchronized pacing of both the atria and ventricles may be...
required to maximize cardiac output. Atrial epicardial wires may also be used to record an atrial electrocardiogram.

To facilitate temporary pacing in post operative patients, one or more small Teflon coated wires are loosely sutured to the epicardial surface of the right ventricle or the right atrium or both, at the end of surgery and are tunneled out to the skin surface before the chest is closed. A small bare metal section of the wire remains in contact with the epicardium and the external bare metal tip of the wire forms an electrode which can be inserted into the pacing cable to allow pacing. EPWs are placed in the right atria and right ventricle because they are anterior and closer to the incision. The pericardium and chest wall are closed over the EPWs, and although it happens very rarely, it is possible for the EPW to get “caught” or “trapped” by the position of a graft as the pericardium is closed or by pericardial suturing or the placement of the sternal wires.

Epicardial pacing wires are always unipolar, meaning that a second positive or ground electrode is necessary to complete the pacing circuit. A second epicardial pacing wire, either atrial or ventricular, may be used as the positive or ground electrode, or more commonly a ground electrode is placed through the skin with a metal hypodermic needle. Occasionally an epicardial wire may be placed through the skin into the subcutaneous tissue for use as a ground wire. By convention, atrial pacing wires are positioned through the skin to the right of the sternal incision and ventricular wires are positioned to the left side. (AACN p 286). Ventricular wires are usually white, and atrial wires may be a different colour, orange or red, and may be a smaller gauge wire, but may also be exactly the same as the ventricular wire. Position of the wire with reference to the sternal incision is the best indicator of the chamber of origin. If there is only one wire it is always ventricular.

**Removal of Epicardial Pacing Wires**

A physician’s order is required to remove EPWs.

If cardiac pacing is required it must be maintained until the need for pacing no longer exists or a permanent device is placed.

INR must be assessed and should be less than 1.8 prior to attempting EPW removal. If the INR is greater than 1.8, notify the physician. Patients requiring oral anticoagulants should have their EPWs removed before the oral agents are started. Oral anticoagulants like dabigitran that are used for full anticoagulation should be stopped for as long as required to return coagulation profile to normal. Heparin drips should be stopped 4 hours prior to pacing wire removal, check ptt value and restart or adjust as per protocol post removal. There is no need to hold subcutaneous low molecular weight heparin or other subcutaneous anticoagulants-antithrombotics given for the purpose of thromboprophylaxis.

Epicardial pacing wires must be removed prior to discharge from the hospital. Retained EPWs present a risk of infection since they create an open wound through the skin which communicates with the pericardial space. Evidence of infection at the skin exit site, (redness, swelling, purulent drainage,) is an indication for immediate removal of the
epicardial wires. Epicardial pacing wires are usually removed within the first week post-op, but may be in place longer if prolonged pacing is required. Prolonged presence of foreign materials in the body is associated with development of a fibrin tissue sheath, which may make removal more difficult and increases the risk of tearing the epicardial surface with removal.

When both atrial and ventricular EPWs are present, the atrial wire(s) are removed first and the ventricular wire(s) last. This allows pacing of the ventricle to restore cardiac output in the event of dysrhythmia following removal of the atrial wire(s).

Removal of epicardial pacing wires is accomplished by freeing the wire from the skin surface and applying gentle traction to the wire until it is released from the epicardium and can be pulled free of the body. This is an aseptic procedure; however the use of sterile gloves is not necessary. Examination gloves must be worn when handling epicardial wires to avoid the risk of micro-shock. Epicardial pacing wires are often stabilized on the skin surface by sutures which should be removed aseptically. Occasionally the epicardial wire itself is looped or sutured through the skin, so that there is more than one exit wound. In this case it will be necessary to cut the pacing wire to minimize the amount of exposed, contaminated wire that is pulled back through the skin. If it is necessary to cut the wire, maintain a firm grip on the proximal (cardiac) end of the wire and remove it immediately to avoid the risk of the wire being pulled under the skin by a sudden movement or coughing. Forceps may be used to stabilize the proximal end of the wire and to apply gentle traction. The distal portion of the wire may then be removed. Examine the removed wire for completeness and presence of retained tissue fragments.

**COMPLICATIONS**

1. **Entrapment of the wire.** The wire can not be removed with reasonable, gentle traction. Do not apply excessive force or jerk on the pacing wire. The wire may have been trapped when the sternum was closed, or it may be caught by one of the bypass grafts. Applying excess force may result in fracture of the wire, myocardial damage, disruption of a graft and bleeding resulting in tamponade. Consult the surgeon.

2. **Bleeding at the skin exit site.** Occasionally a small subcutaneous blood vessel may be damaged by removal of the epicardial wire. Bleeding can usually be controlled with direct pressure over the skin exit site. Patients who are anticoagulated are at greater risk of bleeding. Patients in atrial fibrillation, who will require oral anticoagulants, should have their EPWs removed before initiating oral anticoagulants. INR should be less than 1.8 before removing epicardial pacing wires. The surgeon should be consulted for excessive or prolonged bleeding, not controlled by direct pressure within 10 – 15 minutes.

3. **Cardiac tamponade** is the greatest risk associated with removal of epicardial pacing wires. Tamponade can occur as a result of tearing of the epicardium, tearing an epicardial blood vessel, or disruption of a coronary graft. Rapid collection of blood within the pericardium, increases pericardial pressure, compresses the heart and limits
blood return and cardiac output and results in chest and neck pain, engorgement of the neck veins, decreased blood pressure and circulatory collapse. Monitor the patient for signs of complications for four hours after removal of epicardial wires. Vital signs should be recorded and assessed for signs of developing tamponade (increasing heart rate, hypotension, pulsus paradoxus), at intervals of 5 minutes, 30 minutes and 2 hours following removal of the EPWs. Rapid collection of blood in the pericardium results in rapid onset of symptoms; however blood collection can occur more slowly, resulting in more gradual onset of symptoms of cardiac tamponade.

4. **Cardiac arrhythmia** is a potential complication that can occur as a result of microshock or mechanical irritation of the epicardium resulting in generation of PVCs or arrhythmia such as atrial or ventricular fibrillation. Record and assess vital signs at intervals of 5 minutes, 30 minutes and 2 hours following removal of EPWs for signs of arrhythmia, irregular heart rate, low blood pressure, weakness or dizziness. Remind patients to report any unusual symptoms.

5. **Infection** is a potential complication that may be noted prior to EPW removal. Purulent drainage noted at the time of removal of EPWs should be reported to the physician, swabs obtained and sent to the lab. Echo or CT of the chest may be needed to rule out deep infection or abscess.

6. **Retained wire fragment** can occur if the EPW is broken either before or during the removal process. Occasionally a trapped wire may be cut off under traction and the retained portion allowed to retract under the skin surface. Retained wire fragments may carry a greater risk of infection. The decision to leave a wire fragment insitu is the responsibility of the surgeon.
Self Test

1. Epicardial pacing wires (EPWs) are usually placed:
   a) right atrium and left ventricle
   b) both right and left ventricles
   c) on any cardiac chamber
   d) right atrium and right ventricle

2. Before removing EPWs, the nurse must assess the patient for:
   a) A stable rhythm, INR less than 1.8, length of time post—op.
   b) INR greater than 1.8, signs of infection, support for discharge
   c) Normal electrolytes and CBC, INR less than 3
   d) Past history of arrhythmia, INR less than 1.8, ready for discharge

3. Bleeding at the skin site post EPW removal should be managed by:
   a) Applying direct pressure and reviewing the INR
   b) Notifying the physician and administering 1000IU Vitamin K s/c
   c) Applying direct pressure and notifying the physician if bleeding is excessive or
      persistent for longer than 10 – 15 min
   d) Apply a pressure dressing, cancel planned discharge

4. Mr. Smith has two white EPWs to be removed. How would the nurse determine
   which wire to remove first and why?
   a) atrial wires are positioned to the right of midline and should be removed first
   b) ventricular wires are positioned to the right of midline and should be removed
      first
   c) either wire may be removed first, chamber of origin doesn’t matter
   d) atrial wires are to the left of midline and should be removed last

5. You removed Mrs. Sangster’s EPWs ≈ an hour ago. She rings c/o chest pain, SOB,
   neck pain and feeling weak. BP is 90/50, HR 132. Most likely diagnosis and your
   response would be:
   a) Anxiety attack: reassure, sedate and monitor
   b) Cardiac tamponade: notify physician, ensure IV access, prepare to infuse
      fluid
   c) Myocardial ischemia: call for ECG, start IV Nitro, transfer to CCU
   d) Chest wall pain: ensure rest, offer pain medication, reassure.


________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

This is a CONTROLLED document for internal use only. Any documents appearing in paper form are not controlled and
should be checked against the electronic file version prior to use.
7. Removal of a EPW that is knotted through the skin involves:
   a) Cutting the wire and removing the distal portion first
   b) Cutting the wire and removing the proximal portion first
   c) Not cutting the wire and pulling the distal portion through the skin first
   d) Not cutting the wire and pulling the proximal portion through the skin first
Answers

1. D
2. A
3. C
4. A
5. B
6. bleeding, tamponade, arrhythmia, infection, damage to vein graft, wire fracture and retention
7. B
<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Checks physician order; patient ready for discharge or appropriate interval post-op.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Checks current INR.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Assesses cardiac rhythm, ensures no need for pacing.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Ensures availability of emergency equipment and supplies.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Ensure that the patient has IV access.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Notifies the RN/LPN of wire removal before removing the wire</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Explains procedure to patient and family; places patient supine in bed during removal and on bed rest for one hour following.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Gathers supplies and equipment.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Removes dressing and tape securing EPWs.</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Cleanses exit site with antiseptic swab</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Removes sutures using aseptic technique.</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>If wire is knotted through skin, secures proximal end of wire (may use forceps) and cuts wire to minimize pulling contaminated wire through the skin.</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Uses a smooth continuous pulling motion with gentle traction until release from the epicardium is felt, and wire is removed from the skin.</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>If wire has been cut, proximal portion is removed first, followed by distal portion.</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Inspects tip of wire for completeness and presence of tissue fragments.</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>If resistance is met, leaves wire in place and notifies physician.</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>If bleeding occurs, applies direct pressure to site until resolved. If bleeding is excessive or prolonged (greater than 15 min.), notifies physician.</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Observes the patient for signs of complications over next four hours. Patient should rest in bed for 20 minutes to an hour before mobilizing.</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Records vital signs and assesses for signs of developing tamponade at least twice during the four hours following EPW removal.</td>
<td></td>
</tr>
</tbody>
</table>