PROCEDURE

49

Temporary Transcutaneous (External) Pacing

Valerie Spotts

PURPOSE: Transcutaneous or external pacing stimulates myocardial depolarization through the chest wall. External pacing is used as a temporary measure when normal cardiac conduction fails to produce myocardial contraction and the patient experiences hemodynamic instability.

PREREQUISITE NURSING KNOWLEDGE

- Knowledge of cardiac anatomy and physiology is needed.
- Knowledge of cardiac monitoring is necessary.
- The ability to interpret dysrhythmias is needed.
- Knowledge of temporary pacemaker function and expected patient responses to pacemaker therapy is necessary.
- Clinical and technical competence in the use of the external pacing equipment (Fig. 49-1) is needed.
- Indications for transcutaneous pacing are as follows:
  - Symptomatic bradycardia unresponsive to medications
  - In standby mode for the following rhythms in the acute myocardial infarction setting:
    - Symptomatic sinus node dysfunction
    - Mobitz type II second-degree heart block
    - Third-degree heart block
    - Newly acquired left, right, or alternating bundle-branch block or bifascicular block
- Temporary transvenous pacing is indicated when prolonged pacing is needed.
- Contraindications for transcutaneous pacing are as follows:
  - Severe hypothermia
  - Asystole (as presenting rhythm)
- Pacing is contraindicated in severe hypothermia because cold ventricles are more prone to ventricular fibrillation and are more resistant to defibrillation.
- External cardiac pacing is a temporary method of stimulating ventricular myocardial depolarization through the chest wall via two large pacing electrodes (patches). The electrodes are placed on the anterior and posterior chest wall (Figs. 49-2 and 49-3) or anterior and lateral chest wall (Fig. 49-4) and are attached by a cable to an external pulse generator. The external pulse generator delivers energy (milliamps) to the myocardium based on the set pacing rate, output, and sensitivity. Some models of external pulse generators are combined with an external defibrillator, and the electrodes of these models may be used for pacing and defibrillation.
- Sensitivity refers to the ability of the pacemaker to detect intrinsic myocardial activity.
- In the nondemand or asynchronous mode, pacing occurs at the set rate regardless of the patient's intrinsic rate. In the demand or synchronous mode, the pacemaker senses intrinsic myocardial activity and paces when the intrinsic cardiac rate is lower than the set rate on the external pulse generator.
- Pacing occurs when the external pulse generator delivers enough energy through the pacing electrodes to the myocardium, which is known as pacemaker firing and is represented as a spike on the electrocardiograph (ECG) tracing.
- Electrical capture occurs when the pacemaker delivers enough energy to the myocardium so that depolarization occurs. Capture is seen on the ECG with a pacemaker spike followed by a ventricular complex. The ventricular complex occurs after the pacemaker spike, and the QRS is wide (greater than 0.11 seconds), with the initial and terminal deflections in opposite directions. In Figure 49-5, complexes 2 and 3 begin with a downward (negative) deflection and end with an upward (positive) direction. Mechanical capture occurs when a paced QRS complex results in a palpable pulse.
- Standby pacing is when the pacing electrodes are applied in anticipation of possible use but pacing is not needed at the time.

EQUIPMENT

- Nonsterile gloves
- Blood pressure monitoring equipment
- External pulse generator
- Pacing cable
- Pacemaker electrodes (patches)
- ECG electrodes
- ECG monitor
- ECG cable
Additional equipment, to have available as needed, includes the following:
- Emergency cart
- Medications including sedatives and analgesics
- Scissors
- Transvenous pacing equipment
need further instruction about possible lifestyle modifications and follow-up visits, and information about the pacemaker to be implanted.

PATIENT ASSESSMENT AND PREPARATION

Patient Assessment

- Assess the patient’s cardiac rate and rhythm for the presence of dysrhythmias that indicate the need for external cardiac pacing. Rationale: Recognition of a dysrhythmia is the first step in determining the need for external cardiac pacing or placing the external pacemaker on standby.
- Determine the patient’s hemodynamic response to the dysrhythmia, such as the presence or absence of a pulse; presence of hypotension; altered level of consciousness; dizziness; shortness of breath; nausea and vomiting; cool, clammy, diaphoretic skin; or the development of chest pain. Rationale: The decision to initiate pacing depends on the effect of the dysrhythmia on the patient’s cardiac output.

Patient Preparation

- Verify that the patient is the correct patient using two identifiers. Rationale: Before performing a procedure, the nurse should ensure the correct identification of the patient for the intended intervention.
- Ensure that the patient and family understand preprocedural teaching. Answer questions as they arise, and reinforce information as needed. Rationale: This communication evaluates and reinforces understanding of previously taught information.
- Maintain bedside ECG monitoring. Rationale: External pacing units do not provide central monitoring or dysrhythmia detection.
- Establish or ensure patency of intravenous access. Rationale: Medication administration may be necessary.
- Assist the patient to the supine position and expose the patient’s torso while maintaining modesty. Rationale: This positioning prepares for electrode (patch) placement.
**Figure 49-4** Location of anterior-lateral pacing electrodes. (Aehlert B: ACLS study guide, ed 3, St Louis, 2007, Mosby, 229.)

**Figure 49-5** Electrocardiograph tracing of external pacing. (From Zoll Medical Corporation, Burlington, MA.)

### Procedure for Temporary Transcutaneous (External) Pacing

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<th>Steps</th>
<th>Rationale</th>
<th>Special Considerations</th>
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<td>2.</td>
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<tr>
<td>3. Administer sedative or analgesic medications as prescribed.</td>
<td>Decreases discomfort associated with external cardiac pacing.</td>
<td>Not indicated for patients who are unconscious with hemodynamically unstable conditions. Not indicated for standby because pacing may not be needed.</td>
</tr>
<tr>
<td>4. Turn on the pulse generator and monitor.</td>
<td>Provides the power source.</td>
<td>Many devices work on battery or alternating current (AC) power. Optional step in an emergency. Dry thoroughly.</td>
</tr>
<tr>
<td>5. Prepare the skin on the patient’s chest and back by washing with nonemollient soap and water.</td>
<td>Removal of skin oils, lotion, and moisture improves electrode adherence and maximizes delivery of energy through the chest wall.</td>
<td>Avoid use of flammable liquids to prepare the skin (e.g., alcohol, benzoin) because of the increased potential for burns. Avoid shaving the chest hair because the presence of nicks in the skin under the pacing electrodes can increase patient discomfort. Remove any medication patches applied to the chest area.</td>
</tr>
<tr>
<td>6. Apply the ECG electrodes to the ECG leads.</td>
<td>Prepares the equipment.</td>
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*Procedure continues on following page*
### Procedure for Temporary Transcutaneous (External) Pacing—Continued

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| 7. Connect the ECG cable to the monitor inlet of the pulse generator.  
(Level M*) | Prepares the equipment.                                                                       | Follow the manufacturer’s recommendations.                                                                                                               |
|                                                                      | Attachments of the ECG electrodes to the ECG leads and the ECG cable to the pacemaker monitor is optional for some manufacturers in an emergency. If the ECG leads are not placed, the pacemaker may function in the asynchronous mode. The pacemaker may not function unless both the ECG monitoring connection and the pacing electrode connection are both connected to the pacemaker. |
| 8. Apply the ECG electrodes to the patient (see Procedure 54).        | Displays the patient’s intrinsic rhythm on the monitor.                                       | Lead II usually provides the most prominent R wave.                                                                                                |
| 9. Adjust the ECG lead and size to the maximum R wave size. Look for an indicator that the pacemaker is sensing the QRS complexes on the intrinsic rhythm, usually seen as a marker above each native QRS complex. | Detection of the intrinsic rhythm is necessary for the demand mode of pacing.                   |                                                                                                                                                       |
| 10. Apply the back (posterior, +) pacing electrode between the spine and left scapula at the level of the heart (see Fig. 49-2). | Placement of the pacing electrodes in the recommended anatomical location enhances the potential for successful pacing. | Avoid placing the pacing electrodes over bone because this increases the level of energy needed to pace, increases patient discomfort, and increases the possibility of noncapture. For women, adjust the position of the pacing electrode below and lateral to breast tissue to ensure optimal adherence. Avoid placement of the pacing electrodes over the bedside monitor ECG electrodes and permanently placed devices, such as implantable cardioverter-defibrillators or permanent pacemakers. Pacing may be less effective with this method of electrode placement. |
| 11. Apply the front (anterior, –) pacing electrode at the left, fourth intercostal space, midclavicular line (see Fig. 49-3).  
(Level M*) | Placement of the pacing electrodes in the recommended anatomical locations enhance the potential for successful pacing. |                                                                                                                                                       |
|                                                                      |                                                                                                                                 |                                                                                                                                                       |
| 12. If the patient’s condition is hemodynamically unstable, the back (posterior) electrode may be placed over the patient’s right sternal area at the second or third intercostal space. The front (anterior) electrode is maintained at the apex (fourth or fifth intercostal space, midclavicular line; see Fig. 49-4). | Facilitates ease of electrode placement for emergent pacing.                                      |                                                                                                                                                       |
| 13. Connect the pacing electrodes to the pacemaker cable and connect the pacemaker cable to the external pulse generator.  
(Level M*) | Necessary for the delivery of electrical energy.                                               |                                                                                                                                                       |

*Level M: Manufacturer’s recommendations only.*
Procedure for Temporary Transcutaneous (External) Pacing—Continued

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<td>14. Set the pacemaker rate, level of energy (output, mA) (Fig. 49-6).</td>
<td>Each patient needs different pacemaker settings to provide safe and effective external pacing.</td>
<td>Follow institutional standards regarding who can initiate external cardiac pacing. The demand mode is used as long as the ECG leads are attached to the pacemaker monitor.</td>
</tr>
<tr>
<td>A. Set the demand or the synchronous mode.</td>
<td>The demand mode is used to prevent competition from the patient’s intrinsic rhythm.</td>
<td>In the asynchronous mode, the pacemaker fires regardless of the intrinsic rhythm and rate.</td>
</tr>
<tr>
<td>B. Set the rate.</td>
<td>Pacing should be at a rate that maintains adequate cardiac output but does not induce ischemia.</td>
<td>The pacemaker may have a default setting (e.g., 80 bpm) that can be adjusted as needed.</td>
</tr>
<tr>
<td>C. Set the mA.</td>
<td>Use the lowest amount of energy that consistently results in myocardial capture and contraction to minimize discomfort.(^1)</td>
<td>The pacemaker may have a default setting that can be adjusted as needed, or the pacemaker may turn on at 0 mA and will need to be increased for pacing to occur. The average adult usually can be paced with a current of 40–70 mA.</td>
</tr>
<tr>
<td>i. Slowly increase the mA setting (output) until capture is present.</td>
<td></td>
<td></td>
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<tr>
<td>ii. Set the mA slightly higher than the capture threshold (an additional 2 mA).(^1,7)</td>
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Figure 49-6 Controls for external pacemaker settings.
### Procedure for Temporary Transcutaneous (External) Pacing—Continued

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<td>15. When the pacemaker fires, observe that each pacemaker spike is followed by a wide ventricular complex and a T wave in the opposite deflection of the QRS (see Fig. 49-5).</td>
<td>Identifies appropriate functioning of the pacemaker.</td>
<td>If a pacemaker spike occurs and is not followed by a ventricular complex, slowly increase the energy (mA) level. Artifact from skeletal muscle twitching may make an ECG tracing difficult to interpret. Skeletal muscle twitching occurs at lower mA settings, before capture of the myocardium. 1,7 Confirm mechanical capture by assessing pulse. The carotid pulses usually are not palpated because the electrical stimulation from the pacemaker may mimic a pulse. 1,2</td>
</tr>
<tr>
<td>16. Palpate the patient’s pulse (e.g., femoral pulse, right brachial pulse, radial pulse).</td>
<td>Ensures adequate blood flow with paced complexes.</td>
<td>If symptoms do not improve with pacing, assess for other causes such as electrolyte abnormalities.</td>
</tr>
<tr>
<td>17. Evaluate the patient’s vital signs and hemodynamic response to pacing.</td>
<td>The patient’s hemodynamic response should improve with pacing if symptoms were related to bradycardia. 1,3</td>
<td></td>
</tr>
<tr>
<td>18. Remove PE and discard used supplies in appropriate receptacles.</td>
<td>Reduces the transmission of microorganisms; Standard Precautions.</td>
<td></td>
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<tr>
<td>19.</td>
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### Expected Outcomes

- Adequate systemic tissue perfusion and cardiac output as evidenced by blood pressure greater than 90 mm Hg systolic (or resolution of hypotension), return to baseline mental status, absence of dizziness or syncope, absence of shortness of breath, absence of nausea and vomiting, and absence of ischemic chest pain
- Stable cardiac rate and rhythm
- Appropriate sensing, pacing, and capture present

### Unexpected Outcomes

- Failure of the pacemaker to sense the patient’s underlying rhythm with the possibility of R-on-T phenomenon (initiation of ventricular tachydysrhythmias as a result of an improperly timed spike on the T wave)
- Failure of the pacemaker to capture the myocardium
- Failure of the pacemaker to pace
- Discomfort, including skin burns from the delivery of high levels of energy through the chest wall, painful sensations, and skeletal muscle twitching

### Patient Monitoring and Care

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</tr>
</thead>
<tbody>
<tr>
<td>1. Monitor vital signs every 15 minutes until stable, then hourly or more frequently as needed.</td>
<td>Ensures adequate tissue perfusion with paced beats. Adjustments in the pacing rate may need to be made based on vital signs. Continuous assessment is needed because pacing thresholds may change and response to the pacemaker settings can change over time.</td>
<td>These conditions should be reported if they persist despite nursing interventions.</td>
</tr>
</tbody>
</table>
| | | • Change in vital signs
| | | • Hemodynamic instability |
## Patient Monitoring and Care — *Continued*

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<tr>
<td>2.</td>
<td>Continue to monitor the patient’s cardiac rate and rhythm through the central monitoring system. The pacing spike may obscure or mimic the QRS complex, making ventricular capture difficult to see. Select a lead that minimizes the size of the pacing spike and maximizes the QRS complex. Set the pacemaker option on the central monitoring system. Provides an alarm system. Of note, if ECG leads are disconnected from the pacemaker monitor, pacing reverts to asynchronous, which could compete with the native rhythm.</td>
<td>- Changes in capture or sensing - Dysrhythmias</td>
</tr>
<tr>
<td>3.</td>
<td>Monitor level of comfort and sedation level: A. Assess the patient’s level of comfort and sedation level following institution standard. B. Administer prescribed analgesic and sedative medications as needed. C. Adjust the level of energy to the lowest level for capture. D. Evaluate the patient’s response to interventions. The external delivery of energy through the chest wall may cause varying degrees of discomfort.</td>
<td>- Continued pain despite interventions to alleviate pain - Patient intolerance of the prescribed medications (e.g., nausea, hypotension, decreased respirations)</td>
</tr>
<tr>
<td>4.</td>
<td>Obtain an ECG recording strip to document pacing function on initiation of pacing, every 4–8 hours, and as needed or according to institutional standards. Documents cardiac rate, rhythm, and pacemaker activity.</td>
<td>- Dysrhythmias - Failure to capture - Failure to pace</td>
</tr>
<tr>
<td>5.</td>
<td>Obtain blood samples for laboratory analysis as prescribed. Acidosis and electrolyte abnormalities need to be corrected for an effective response to pacing.</td>
<td>- Electrolyte abnormalities - Acidosis</td>
</tr>
<tr>
<td>6.</td>
<td>Evaluate pacemaker function (capturing and sensing) with any change in patient condition or vital signs. Ensures continued functioning of the pacemaker.</td>
<td>- Inability to maintain appropriate sensing and capture - Changes in patient condition that affect appropriate pacemaker function - Worsening of the baseline cardiac rate and rhythm (e.g., change from symptomatic second-degree heart block to complete heart block)</td>
</tr>
<tr>
<td>7.</td>
<td>Monitor the patient’s cardiac rate and rhythm for resolution of the dysrhythmia that necessitates pacemaker intervention. A. This monitoring may necessitate turning the pacemaker off, if prescribed, to assess the patient’s underlying rate and rhythm. Do not turn the pacemaker off if the patient is 100% paced. B. When assessing the patient’s intrinsic rate and rhythm, reduce the pacing rate slowly. Determines whether the dysrhythmia has subsided. A sudden cessation of pacing can lead to asystole because the intrinsic rate and rhythm may be suppressed by continuous pacing.</td>
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<td>8. Check the adherence of the pacing electrodes to the skin at least every 4 hours. If pacing is not occurring, assess the skin integrity under the pacing electrodes.</td>
<td>Changes in skin integrity caused by burns or skin breaks significantly alter the patient’s level of comfort and exposes the patient to possible infection. Pacing electrodes should not be used once they have been out of the package for 24 hours.</td>
<td>• Changes in skin integrity</td>
</tr>
<tr>
<td>9. Change the electrodes at least every 24 hours or after 8 hours of continuous pacing. (Level M*)</td>
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*Level M: Manufacturer’s recommendations only.

**Documentation**

*Documentation should include the following:*

- Patient and family education
- Patient preparation
- Date and time external cardiac pacing is initiated
- Description of events that warranted intervention
- Vital signs and physical assessment before and after external cardiac pacing
- ECG recordings before and after pacing
- Pain assessment, interventions, and effectiveness
- Medications administered
- Pacing rate, mode, mA
- Percentage of the time the patient is paced if in the demand mode
- Status of skin integrity when the pacing electrodes are changed
- Unexpected outcomes
- Additional interventions

**References and Additional Readings**

For a complete list of references and additional readings for this procedure, scan this QR code with any freely available smartphone code reader app, or visit http://booksite.elsevier.com/9780323376624.