PURPOSE

Guidelines for caring for and monitoring patients with a temporary external epicardial pacemaker. Epicardial pacemaker monitoring is performed on a continuous basis by a nurse to evaluate the effectiveness of epicardial pacing.

Expected outcomes of epicardial pacemaker monitoring include:
- Adequate heart rate and rhythm to maintain adequate cardiac output
- Appropriate pacemaker function and capture
- Appropriate sensing of a child’s intrinsic electrical cardiac activity and inhibition of a paced beat when there is an appropriate intrinsic beat.

POLICY STATEMENTS

Epicardial pacing requires a prescriber’s order. The order must include mode, rate, output, and A-V interval settings.

Children’s Heart Unit Admission Considerations
- Patients requiring rate augmentation who are considered medically stable by the most responsible physician
- A patient no longer considered medically stable will require readmission to PICU
- A patient dependent on a pacemaker for medical stability must remain in PICU

A back-up pacemaker must be readily available on the unit at all times when there is a patient on the unit who requires temporary epicardial pacemaker monitoring.

In case of pacemaker malfunction or failure, the faulty pacemaker must be replaced and settings re-entered as per most recent settings.

This policy does not apply to children with permanent implanted pacemakers.

SITE APPLICABILITY

- Pediatric Intensive Care Unit
- Inpatient unit – Children’s Heart Unit (CHU)

PRACTICE LEVEL/COMPETENCIES

External pacemaker monitoring is considered an advanced nursing skill and must only be practiced after the RN has attended the required advanced cardiac science education and had his/her learning validated at the bedside with the appropriate clinical support person.

DEFINITIONS

Undersensing: indicates a failure of the pacemaker to sense the P or R waves which may cause the pacemaker to emit inappropriate timed impulses. The result on the cardiac monitor will be an atrial or ventricular pacing artifact that should have been inhibited by the preceding (unsensed beat). Undersensing can often be corrected by programming increased generator sensitivity, but this can also lead to oversensing.

Oversensing: indicates inappropriate pacemaker inhibition and may result from detection of myopotentials (muscular activity) or sensing the other chamber’s electrical activity. This can be seen when a lead is damaged and the insulation of the lead is suboptimal, but can also occur without lead damage. It may be correctable by decreasing generator sensitivity.

PROCEDURE

| 1. CONFIRM the cardiorespiratory monitor default settings are changed to indicate child has a pacemaker. ENSURE alarm limits are set as per most recent settings as noted in the Pacemaker | Ensures appropriate monitoring. Establishing alarm settings and limits is essential to patient safety. |
Settings Log and patient is attached to the monitoring system. **ENSURE** patient is admitted and information is visible on the central monitor.

**NOTE:** If no alarm setting or parameters prescribed, consult cardiologist on call (PICU fellow or intensivist if patient in PICU).

2. **IDENTIFY** patient and **EXPLAIN** process of hourly site to source safety check of external epicardial pacing system to patient and family. **ENSURE** patient and family understand procedure and questions are answered.

| Ensures identification mechanism is present to ensure treatments, medications, and procedures are provided to the correct patient. |
| Reduces child and family’s anxiety. Evaluates and reinforces understanding of previously taught information and confirms consent for medication administration. |

3. **VERIFY** battery has been changed within the previous 7 days.

| Reduces risk of pulse generator failure related to failed energy source. |

**NOTE:** Document date battery last changed on back of pacemaker. When the battery is low, an indicator will flash on the pacemaker generator during operation. Change battery if low battery level is indicated. A second health care provider with advanced pacemaker competencies must be present for pacemaker generator battery change. This may include but is not limited to a cardiologist, cardiac surgeon, cardiac NP, cardiac nurse educator, PICU nurse, CHU nurse.

**Bring back-up pacemaker to bedside and ensure it’s working.** Set the parameters to the patient’s current settings and leave on in room ready for emergency use should the patient’s pacemaker fail.

The following are recommendations for changing batteries for Medtronic pacemakers. The pacemaker generator is able to hold a charge for up to 30 seconds (with certain pacing parameters) to maintain pacing while a battery is replaced.

- Lock the screen (backlights should be off)
- Use two (2) LR6-sized (AA-sized) alkaline, hospital-supplied batteries
- Open the battery drawer
- Remove and recycle the old batteries
- Insert new batteries as shown on the diagram inside the battery drawer and close drawer
- Utilize the backup pacemaker if the procedure fails
- Tape spare batteries to the side of the pacemaker with waterproof tape

The back-up pacemaker will have factory default settings and it may be unsettling to reset them if the battery change doesn’t go well.
4. **VERIFY** that patient connector cables are secured into appropriate receptacles (atrial and ventricular).

**NOTE:** Typically ventricular wires exit through left side of sternum and atrial wires exit through right side of sternum; verify wire placement with surgeon if in doubt (e.g. If the child has dextrocardia or another potential reason for a variation in the surgical placement of leads).

Pacing wires must be correctly and securely inserted into the pulse generator for optimal function.

5. **COMPARE** pacemaker settings with the prescriber’s order/pacemaker settings log (mode, rate, output, and A-V interval).

**NOTE:** Settings are based on age and hemodynamic status of child to optimize cardiac output.

Ensures that pacemaker settings have not been inadvertently altered without knowledge of health care team.

6. Should the pacemaker malfunction, **REPLACE** it with the back-up device and **ENTER** settings as per most recent settings on Pacemaker Settings Log.

The pacemaker will reset to default settings if equipment malfunctions – these settings are based on adult populations.

7. **OBTAIN** a printout of the child’s paced heart rhythm from the cardiorespiratory monitor at least every 12 hours. **CONFIRM** that palpable heart rate (mechanical cardiac function) correlates with heart rate (electrical cardiac function) on monitor.

Verifies that atrial and/or ventricular pacemaker capture is present. Electrical capture (pacing spikes and QRS complex) may be present without mechanical capture (pulse and blood pressure).

8. **ASSESS** for atrial or ventricular capture. If non-capture evident, contact cardiologist on call (PICU fellow or intensivist if patient in PICU). Milliampere (mA) output settings may require adjustment by the physician. **DOCUMENT** any changes in threshold values.

Non capture indicates that more output is needed to pace the heart. This increase is inversely related to lead function longevity. Inappropriate pacing can cause patients to become symptomatic because of a decrease in their cardiac output. Symptoms range from fatigue and dizziness to syncope and collapse.

9. **VERIFY** that appropriate sensing is present. If **undersensing** or **oversensing** is occurring, contact the responsible physician to adjust the sensitivity. For descriptions of Abnormal Pacemaker Functioning, refer to Descriptions of Abnormal Pacemaker Functioning Chart.

Assesses the effectiveness of current pacemaker setting.

10. **ASSESS** pacing wire exit site for signs of infection or possible lead/catheter tension. The wires are fixed to the skin with tape or other securement device to prevent traction or displacement. **SECURE** pulse generator to prevent tension, disconnection and potential tampering of device.

Attention to the exit site condition reduces potential for infection or wire fracture.

**NOTE:** If tampering is not a concern, pulse generator may be pinned to the bed or child’s gown or taped to an infant’s diaper.

If tampering is a concern, utilize attached ring to hang on IV pole as shown. A plastic safety cover is also available to prevent inadvertent changes to programming.
11. If wires are not in use, **ISOLATE** exposed wire tips and **SECURE** to skin. When selecting method for isolating wire tips, consider patient’s age (small items are a choking hazard in infants and young children if they fall off) and activity level (ensure device used is secure and will not fall off easily when patient ambulates).

**NOTE:** The following photographs show some examples of methods used for isolating and securing wire tips.

| a. styrofoam tips applied to exposed wire tips | b. styrofoam tips covered with gauze and taped to chest | c. exposed wire tips wrapped with gauze, covered with rubber glove finger and taped to chest | d. exposed wire tips inserted into thermometer probes and taped to chest |

Prevents injury to exposed ends of lead tips and potential for oversensing when not attached to a temporary pulse generator.

12. **The child’s rhythm will be evaluated daily by a physician(s).** The underlying intrinsic rhythm will be documented, a heart rhythm strip will be obtained from the cardiac monitor and the pacemaker may be adjusted. **Evaluates need for continued therapy. Facilitates adjustments of pacing parameters on the basis of hemodynamic status and determines duration of pacing required.**

13. **Post-Wire Removal:** **MONITOR** vital signs (HR, RR and BP) every 15 minutes for 1 hour and **OBSERVE** child for possible complications for at least 4 hours following epicardial pacer wire removal. If complications occur (such as unexplained tachycardia, tachypnea, hypotension, poor peripheral perfusion, decreased urinary output, change in LOC, muffled heart sounds), immediately notify physician/NP and begin appropriate measures to stabilize patient’s condition. **To allow early identification of potential complications. In rare circumstances, serious adverse events that result in hemodynamic compromise may occur, such as ventricular fibrillation or significant bleeding.**
DOCUMENTATION

Physician to DOCUMENT changes to pacemaker settings on Pacemaker Settings Log.

RN to:

DOCUMENT site to source safety check hourly and more often as clinically indicated including:

- verification that current settings correlate with pacemaker settings log (co-sign pacemaker settings log beside physician signature/initials on “initials” column)
- child’s response to pacemaker therapy if a change in rhythm is noted
- condition of wire exit site and connector/lead sites
- any evidence of inappropriate pacemaker activity
- HR, RR, SpO₂

DOCUMENT every 12 hours and more often as clinically indicated:

- verification of pacemaker settings and any adjustments to these setting
- alarm setting parameters
- heart rate and rhythm interpretation
- unexpected outcomes and related treatment

DOCUMENT daily:

- underlying rhythm when pacemaker was turned off
- any reported symptoms during check of intrinsic rhythm

REFERENCES


