Perioperative Management of Patients With Cardiac Implantable Electronic Devices

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Crossley GH et al: Heart Rhythm 2011; 8: 1114-54

PREOPERATIVE CONSIDERATIONS
• The CIED should be checked as part of routine care (in-person or remote evaluation) within the past 12 months for pacemakers and within the past 6 months for implantable cardioverter defibrillator (ICD), cardiac resynchronization therapy (CRT),
• Most patients will not need a de novo preoperative evaluation by the CIED management team (or cardiologist) because the information necessary to give such a recommendation will reside in the records of the CIED clinic.

Preoperative Evaluation
Sources of information - medical record, patient registration card, manufacturer, chest radiograph
• Date of last device interrogation
• Identify the type of device: pacemaker, ICD, CRT, etc.
• Manufacturer and model
• Indication for device:
  o Pacemaker: e.g., sick sinus syndrome, AV block, syncope
  o ICD: primary or secondary prevention
  o Cardiac resynchronization therapy
• Battery longevity at least 3 months
• Are any of the leads less than 3 months old?
• Programming
  o Pacing mode and programmed lower rate
  o ICD therapy
    ▪ Lowest heart rate for shock delivery.
    ▪ Lowest heart rate for antitachycardia pacing (ATP) delivery.
  o Rate-responsive sensor type, if programmed on
• Is the patient pacemaker-dependent, and what is the underlying rhythm and heart rate?
• Pacemaker spikes in front of all or most P wave and/or QRS complexes
• What is the response of this device to magnet placement?
  o Magnet pacing rate for a pacemaker
o Pacing amplitude response to magnet function
o Will ICD detections resume automatically with removal of the magnet? Does this device allow for magnet application function to be disabled? If so, document programming of patient’s device for this feature.
• Any alert status on CIED generator or lead
• Last pacing threshold—document adequate safety margin with the date of that threshold.

Other Information
• Procedure venue (Hospital, Ambulatory surgery center, operating room, procedure suite, etc)
• Anticipated postprocedural arrangements (anticipated discharge to home - 23 hours, inpatient admission to critical care bed, telemetry bed)
• Type of procedure
• Anatomic location of surgical procedure
• Patient position during the procedure
• Will monopolar electrosurgery be used?
• Will other sources of EMI likely be present?
• Will cardioversion or defibrillation be used?

INTRAOPERATIVE CONSIDERATIONS
Pacemakers (PM)
• Keep a magnet immediately available for all patients with a CIED if EMI is likely.
• Rendering PM asynchronous, even in PM-dependent patients, is not always necessary.
• It is best to make a PM asynchronous only if significant inhibition is observed.
• PM may be made asynchronous by programming or by placement of a magnet applied over the pulse generator, provided the pulse generator is accessible.
• Because of interactions with monitoring, ventilation, and other impedance monitoring operative devices, inactivating minute ventilation sensors can be considered. However, no reprogramming is usually needed if the electrocautery is applied below the level of the umbilicus.

Implantable Cardioverter Defibrillator (ICD)
• Inactivation of ICD is not always necessary, even in pacemaker dependent patients.
• ICDs may be inactivated by placement of a magnet over the pulse generator, provided the pulse generator is accessible.
• Magnet placed over an ICD generator will not render pacemaker function asynchronous.
• For procedures above the umbilicus, inactivation of ICD is recommended if EMI is likely.
• For procedures below the umbilicus, no intervention may be necessary.

Intraoperative Monitoring
• External defibrillation equipment is required in the OR and immediately available for all patients with CIEDs having procedures where EMI may occur.
• Some patients may need to have transcutaneous pacing/defibrillation pads placed prophylactically during surgery (e.g. high-risk patients and patients in whom pad external placement will be difficult due to surgical site).
• Use an ECG monitor with a pacing mode set to recognize pacing stimuli.
• Monitor plethysmography or arterial waveform.
• For central line placement using the Seldinger technique from the upper body, caution should be
exercised to avoid causing false detections and/or shorting the RV coil to the SVC coil.

**Reduce EMI**
- Place return pad as close to the surgical site as possible.
- Use bipolar or ultrasound diathermy.
- For monopolar electrosurgical cautery use short bursts.

**POSTOPERATIVE CONSIDERATIONS**
- It is reasonable to have the CIED interrogated no more than one month from the time of the procedure, and it can be performed remotely, except of situations below.

**Interrogation of CIEDs prior to patient discharge or transfer**
- CIEDs reprogrammed prior to the procedure that left the device nonfunctional.
- Logistical limitations that would prevent reliable device evaluation within one month of the procedure.*
- Hemodynamically challenging surgeries such as cardio-thoracic surgery or significant vascular surgery (e.g., abdominal aortic aneurysmal repair).*
- Significant intraoperative events including cardiac arrest requiring temporary pacing or cardiopulmonary resuscitation and those who required external electrical cardioversion.*
- Emergent surgery where the site of EMI exposure was above the umbilicus.
- Procedures that emit EMI with a greater probability of affecting device function.

*The general purpose of this interrogation is to assure that reset did not occur. In these cases a full evaluation including threshold evaluations is suggested.

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**Preoperative Considerations**

<table>
<thead>
<tr>
<th>Is EMI likely</th>
<th>No</th>
<th>Proceed With Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Is the Procedure below umbilicus</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>Is the patient pacemaker dependent?</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>Use a Magnet</td>
<td></td>
</tr>
</tbody>
</table>

**Postoperative Considerations**

<table>
<thead>
<tr>
<th>Was ICD reprogrammed preoperatively?</th>
<th>Must interrogate and reprogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No EMI</td>
</tr>
<tr>
<td>No</td>
<td>No Magnet</td>
</tr>
<tr>
<td>+ EMI</td>
<td>No clinical issues</td>
</tr>
<tr>
<td></td>
<td>Vital Signs OK</td>
</tr>
<tr>
<td>Clinical Problems Introp</td>
<td>Must interrogate</td>
</tr>
</tbody>
</table>

*Modified From Crossley GH et al: Heart Rhythm 2011; 8: 1114-54
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