Perioperative Management of Cardiac Pacing/Defibrillation Devices

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Disclosure

• Nothing relevant to disclose

EMI is most common operative concern

Improvements in shielding and lead insulation have helped OTOH, the devices have become increasingly complex.
How pacing devices generally work:

- Pacemakers are simply a series of timers that may be programmed to be triggered or reset by cardiac events.
- Pacing occurs when one or more specified timers has been activated and then runs out without being reset.

LOTS of timers on modern devices - allows for complex pacing behavior:

How pacing devices generally work:

Pacemaker dependent patient with complete AV block
Ventricular pacing inhibited by noise
Electrocautery or other non-cardiac electrical signals can:
• Inappropriately cause a timer to be reset (inhibits pacing)
• Inappropriately trigger a timer to start (triggers pacing)
• Activate certain rate response sensors
• Cause confusing mode-switching
• Cause electrical reset of the device (rare)

How ICDs (implantable cardioverter defibrillators) generally work:
• All transvenous ICDs are also pacemakers
• ICDs categorize ventricular events as VT/VF primarily based on rate
• ICDs can immediately deliver anti-tachycardia pacing (ATP) once VT/VF is detected
• ICDs
  – 1. charge up (with or without ATP)
  – 2. reassess that VT/VF is still present
  – 3. deliver a shock
  – 4. assess for success
  – 5. repeat if necessary

How ICDs generally work:
How ICDs generally work:

- Atrial signal
- Ventricular signal
- "Lead II" signal

Markers:

- Noise detection resulting in ICD shock (non-pacemaker dependent patient)

Why did the noise stop with the shock? Probably the shock stopped the surgeon or patient — whoever was causing the noise — and they stopped what they were doing.
Electrocautery or other non-cardiac electrical signals can:

- Have all the same effects on an ICD as on pacemakers
- In addition, cause inappropriate ATP or shocks that can:
  - Induce VT/VF
  - Cause a patient to move suddenly if not paralyzed (shock only)
  - Cause pain if patient not sedated (shock only)
  - Surprise/alarm medical personnel
  - Cardiovert AF inadvertently, causing risk of CVA

Types of cautery and effect on pacing devices/defibrillators

Unipolar/Monopolar Cautery
- Unlikely to be detected by pacemakers/ICDs when used below the femoral head (if the grounding patch is also below the hip joint)

Bipolar Cautery
- Unlikely to be detected by pacemakers/ICDs unless used directly on or over the device generator or exposed leads.
Asynchronous pacing
• To make pacemaker “blind” to noise, their ability to sense events is turned off.
• This is usually indicated as VOO or DOO pacing.
• As a consequence, the pacemaker also cannot sense intrinsic cardiac activity.
• Thus the pacemaker blindly paces, no matter what.
• It will pace on top of QRS complexes, T-waves, through AF, VF, etc.

Tachy detections/therapies
• ICD detection of arrhythmias is separate from pacing functions and programming.
• ICD detections must be separately disabled to prevent detection of noise.

Pacemaker/ICD management options for procedures with cautery
• Do nothing – proceed with surgery
• Short bursts of cautery < 5 seconds each
• Magnet over device (remove after procedure)
  – pacemakers -> asynchronous
  – ICDs -> inhibits shocks (except in some Biotronik devices) but doesn’t alter pacing
• Reprogram device for procedure and restore settings after procedure
Cautery mode programming

• Advantages:
  – No ICD shocks or ATP
  – Paces, no matter what

• Disadvantages:
  – No ICD shocks or ATP
  – Paces no matter what

Cautery mode programming

• Asynchronous pacing = AV dissociation, possible “R-on-T” induction of VT/VF
• No shocks = potential delay to treatment of actual VT/VF
• Possibility that baseline device settings will not be restored properly or promptly
• Internal Medicine M&M on patient who had symptomatic asynchronous pacing post-op
• Two patients a couple years ago presented to post-op clinic follow-up with ICDs still off
Peri-operative considerations

- On what part of the body will the operative procedure be performed? Is magnet use practical?
- Will cautery be used and, if so, unipolar (monopolar) or bipolar?
- Is the patient dependent on pacing to maintain an adequate heart rate, particularly given suppressive effects of anesthesia?
- Does the patient have a device with ICD functions?

Guidelines


This document was developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS)

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Guidelines - Caveats

- No randomized trials
- Case reports, case series, expert opinion, input from device manufacturers/engineers
- No “level of evidence”
- A moving target
Guidelines – Overview

- Obtain a pre-operative “prescription” from EP whenever possible – may be by record review.
- Reprogramming is only necessary in some cases (dependent patients with ICDs, or dependent patients when magnet not practical) and should not be performed routinely as can cause harm.
- If an emergency, use short bursts of cautery and, if an ICD is in place, use a magnet if available.
- *Routine* use of a magnet on pacing devices (that aren’t ICDs) is not recommended.

Guidelines – Overview

- Minimize EMI to the device:
  - Place ground patch so that CIED is not between ground and site of cautery.
  - Use bipolar cautery when possible.
  - Avoid cautery directly over the can and leads when possible.
  - Avoid placing R2 defibrillation pads directly on the pulse generator.
- Keep patient on telemetry until magnet removed and any program settings are restored.

Take-away points

- While it seems safer/more robust to reprogram pacing devices for surgery, such changes are an opportunity for harm:
  - Fairly intelligent device function is replaced by simplistic function or no function (in the case of ICD therapies).
  - Risk that functions may not be restored correctly (or at all).
  - What is often perceived as greater control by reprogramming is actually relinquishing control as the simplistic function can now only be manipulated using a programmer.
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<thead>
<tr>
<th>Take-away points</th>
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<td>– for non-emergency procedures, pre-op review for patient- and procedure-specific device management recommendations by EP team (guideline driven) prior to patient arriving in OR.</td>
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<td>– for true emergencies (and EP unavailable for consultation): if unipolar cautery used above the hips use</td>
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<td>• a magnet on ICDs</td>
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<td>• a magnet on dependent patients with a pacemaker</td>
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<td>• short bursts of cautery in dependent patients with ICDs or pacemakers.</td>
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