A Guide to Perioperative Pacemaker and AICD Management

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Pacemaker Basics

• Provides electrical stimuli to cause cardiac contraction when intrinsic cardiac activity is inappropriately slow or absent
• Sense intrinsic cardiac electric potentials
ICD Basics

• Designed to treat a cardiac tachydysrhythmia
• Performs cardioversion/defibrillation
  – Ventricular rate exceeds programmed cut-off rate
• ATP (antitachycardia pacing)
  – Overdrive pacing in an attempt to terminate ventricular tachycardias
• Some have pacemaker function (combo devices)
Pacemaker and ICD Basics

- Pulse generators
  - Placed subcutaneously or submuscularly
  - Connected to leads
- Battery
  - Most commonly lithium-iodide type
  - Life span 5-8 years
  - Output voltage decreases gradually
    - Makes sudden battery failure unlikely
Pacemaker and ICD Basics

• Synchronous
  – Demand mode
  – Sensing circuit searches for intrinsic depolarization potential
  – If absent, a pacing response is generated
  – Can mimic intrinsic electrical activity pattern of the heart
# Pacemaker Nomenclature

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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</thead>
<tbody>
<tr>
<td>Chamber Paced</td>
<td>Chamber Sensed</td>
<td>Response to Sensing</td>
<td>Rate Modulation, Programmability</td>
<td>Anti-tachycardia Features</td>
</tr>
<tr>
<td>A=Atrium</td>
<td>A=Atrium</td>
<td>T=Triggered</td>
<td>P=Simple</td>
<td>P=Pacing</td>
</tr>
<tr>
<td>V=Ventricle</td>
<td>V=Ventricle</td>
<td>I=Inhibited</td>
<td>M=Multi-programmable</td>
<td>S=Shock</td>
</tr>
<tr>
<td>D=Dual</td>
<td>D=Dual</td>
<td>D=Dual</td>
<td>R=Rate Adaptive</td>
<td>D=Dual</td>
</tr>
<tr>
<td>O=None</td>
<td>O=None</td>
<td>O=None</td>
<td>C=Communicating</td>
<td>O=None</td>
</tr>
</tbody>
</table>
Pacemaker Nomenclature

- 1st letter – chamber paced
- 2nd letter – chamber sensed
- 3rd letter – response to chamber sensed
EMI is not our Friend

- Can interfere with function of pacemaker or ICD
- Device misinterprets the EMI causing
  - Rate alteration
  - Sensing abnormalities
  - Asynchronous pacing
  - Noise reversion
  - Reprogramming
Electromagnetic Interference

- Examples
  - Metal detectors
  - Cell phones
  - High voltage power lines
  - Some home appliances (microwave)
Electromagnetic Interference

- Intensity of electromagnetic field decreases inversely with the square of the distance from the source.
- Newer pacemakers and ICDs are being built with increased internal shielding.
Electromagnetic Interference

Monopolar Cautery

Bipolar Cautery
Pacemaker Sensing Abnormalities

• Oversensing
  – Senses noncardiac electrical activity and is inhibited from correctly pacing
  – Etiology
    • Muscular activity (diaphragm or pecs), EMI, cell phone held within 10cm of pulse generator

• Undersensing
  – Incorrectly misses intrinsic depolarization and paces
  – Etiology
    • Poor lead positioning, lead dislodgement, magnet application, low battery states, MI
ICD Inappropriate Cardioversion

- Most frequent complication
- Provokes pain and anxiety in patients
- Consider when
  - Patient is in Afib
    - With ventricular response > programmed cut off
  - Received multiple shocks in rapid succession
- Etiology – Afib, T-wave oversensing, lead fracture, insulation breakage, MRI, EMI
ICD Inappropriate Cardioversion

- **Treatment**
  - Magnet over ICD inhibits further shocks
  - Does NOT inhibit bradycardic pacing

- **Note**
  - Some older devices produce beep with each QRS
  - If left on for >30 seconds, ICD disabled and continuous beep
  - To reactivate, lift off magnet and then replace for >30 seconds, beep will return with each QRS
Asynchronous Mode

- Asynchronous
  - Fixed rate
  - Impulse produced at a set rate
  - No relation to patients intrinsic cardiac activity
  - Susceptible to Torsades if impulse coincides with t wave (R on T phenomenon)
Magnet Inhibition

• Closes an internal reed switch
  – Causes sensing to be inhibited
  – Temporarily turns pacemaker into “asynchronous” mode (set rate)
• Does NOT turn pacemaker off
• Rate can confer info regarding battery life
  – Distinct rates for BOL, ERI, EOL
Asynchronous Mode Enabled

Magnet Reprogrammed
My Patient has a CRMD of Some Kind. Where do I Start?

- Identify the device
- Is it an AICD or a pacemaker?
- What is the brand and model?
  - Patient history
  - Device information carried by the patient on an ID card
  - Chest x-ray will reveal the device maker on the circuit board (in up to 60% of devices)
My Patient has a CRMD of Some Kind. Where do I Start?

- Call the manufacturer of the device
- They are open 24/7 and want to help you
  - Medtronic [www.medtronic.com](http://www.medtronic.com)
    - 800-505-4636
  - Guidant [www.bostonscientific.com](http://www.bostonscientific.com)
    - 800-328-9634
  - St. Jude [www.stjudemedical.com](http://www.stjudemedical.com)
    - 651-582-4000
My Patient has a CRMD of Some Kind. Where do I Start?

- Manufacturer will be able to tell you important details
  - AICD or pacemaker
  - Current settings
  - Response to external magnet placement
  - Expected remaining battery life
  - Last date of interrogation
  - If there is a question with the device they will send a representative
Additional Questions

• Find out why device was placed – have a healthy respect for a patient with no underlying rhythm (pacemaker dependent)
• Ideally, get the device interrogated prior to the procedure
Standard of Care According to Rozner

- Interrogate all devices prior to elective procedures.
- Re-program all devices for any elective procedure requiring monopolar cautery.
- Beta-block patients who have been re-programmed to asynchronous mode to prevent myocardial competition.
- Make sure EKG monitor will show (and not filter) pacer spikes.
- Have device tested in PACU to ensure settings are back to normal and no EMI-related damage took place.
Consider reprogramming any device in a patient who:

- Must have monopolar electrocautery
- Has a minute ventilation sensor
- Is chronotropically incompetent with anticipated need for higher cardiac output (Whipple, blood loss, etc.)
- Test device after procedure if monopolar cautery is used
If Monopolar Cautery Must be Used

• Place the grounding pad far away from the pacing circuit
• Keep the flow of the bovie current perpendicular to the pacing circuit
• Ask surgeon to
  – Limit the current setting
  – Use bovie judiciously
  – Use only short bursts that are well spaced in time
What about R2 Pads?

- Consider placing pads on any AICD that is disabled either by magnet or by programming.
- Position pads anterior to posterior and try not to position ICD generator between the line of the pads.
Impact on ALS Protocols

• Not many
  – Can defibrillate
  – Sternal paddles should be placed a safe distance (10 cm) from pulse generator
  – In case of MI
    • May require temporary transcutaneous pacing
References


