

# Pacemakers and ICDs

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**“CIEDs”**

# Disclosure

- None

# Lots of CIEDs

- >3 million pacemakers (USA)
- >500,000 ICDs (USA)



# **The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the Perioperative Management of Patients with Implantable Defibrillators, Pacemakers and Arrhythmia Monitors: Facilities and Patient Management: Executive Summary**

*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)*

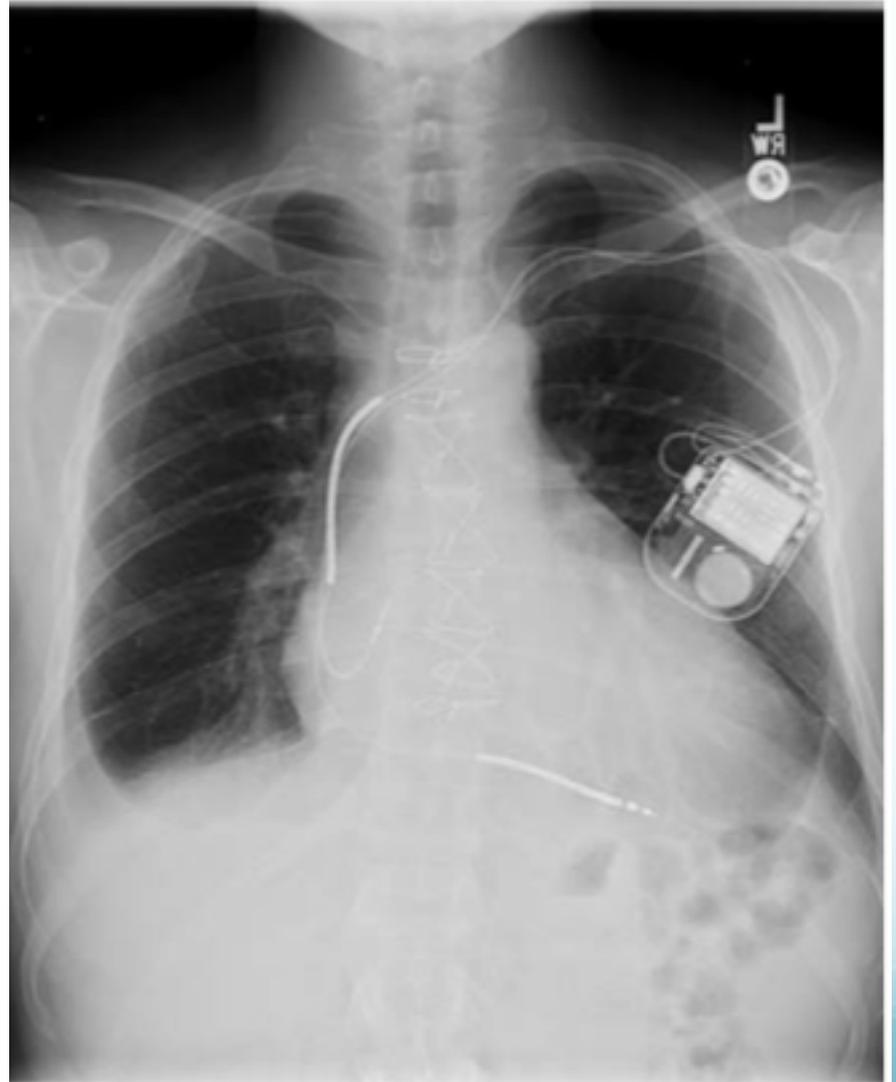
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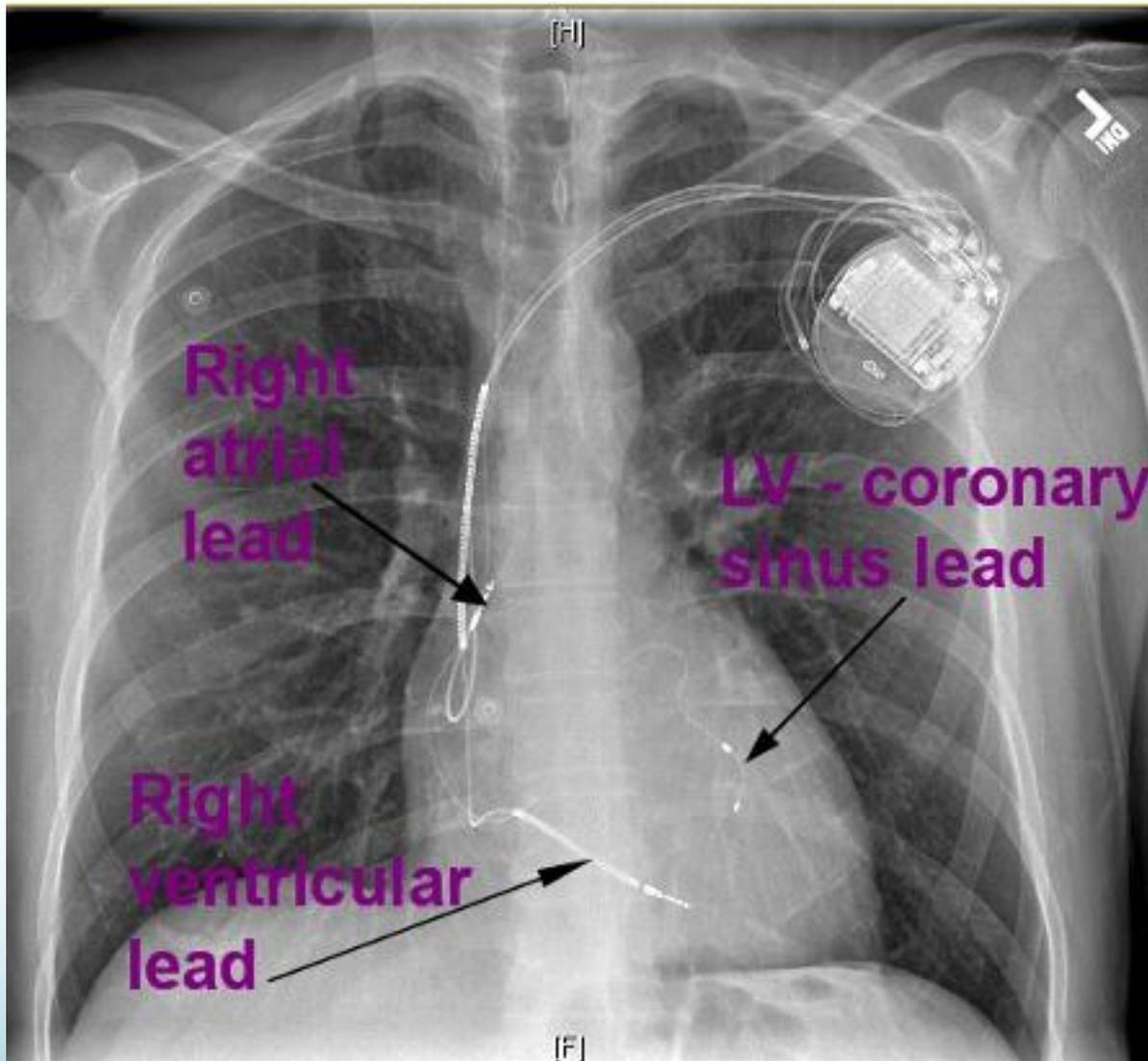
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**Is it a pacemaker or ICD?**

**Why was it placed?**

**Does it give you shocks?**





# What is the device?

- History:
  - Why was it placed? Does it give shocks?
- Device Card
- Patient's cardiologist
- Chest X-ray
- Device Manufacturer 1-800 number
- Recent/current evaluation of device in medical record

# Device Manufacturers

- **1. Boston Scientific: 1-800-CARDIAC**
- **2. Medtronic: 1-800-328-2518**
- **3. St. Jude: 1-855-4STJUDE**
- **4. Biotronik: 1-800-547-0394**

# Features of evaluation:

- How long implanted, how old are leads
- Battery longevity
- Pacing mode, programmed lower rate (pacing) or rate for ATP or shock therapy (ICD)
- Rate responsiveness type
- Response to magnet placement
- “Alert” status on generator or lead
- Pacing threshold

# Is the patient pacemaker dependent?

- **History:** reason for device placement
- **ECG:**
  - Place ECG leads and look at monitor
  - Perform 12-lead ECG

# What is the pacemaker “mode?”

- Patient's cardiologist
- Recent device interrogation
- Chest Xray: how many leads?
- Review ECG if paced

**Table 2** The NASPE/BPEG generic code for antibradycardia, adaptive rate, and multisite pacers<sup>10</sup>

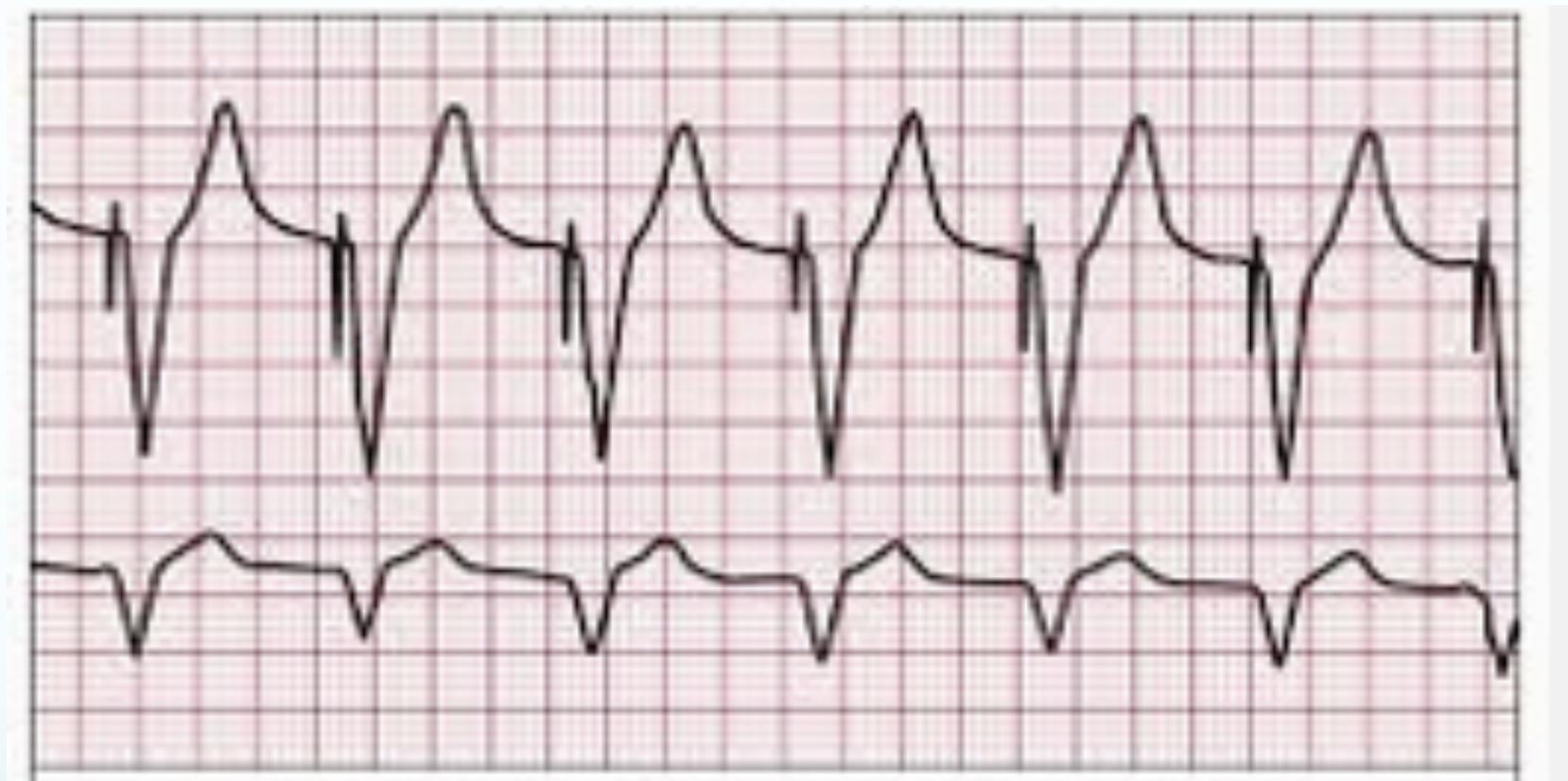
Pacing	Sensing	Response	Rate modulation	Multisite pacing
A=atrium	A=atrium	I=inhibited	R=rate modulating	V=ventricle
V=ventricle	V=ventricle	T=triggered	O=none	A=atrium
D=dual (A & V)	D=dual (A and V)	D=dual (I and/or T)		D=dual (A and V)
	O=none	O=none		O=none

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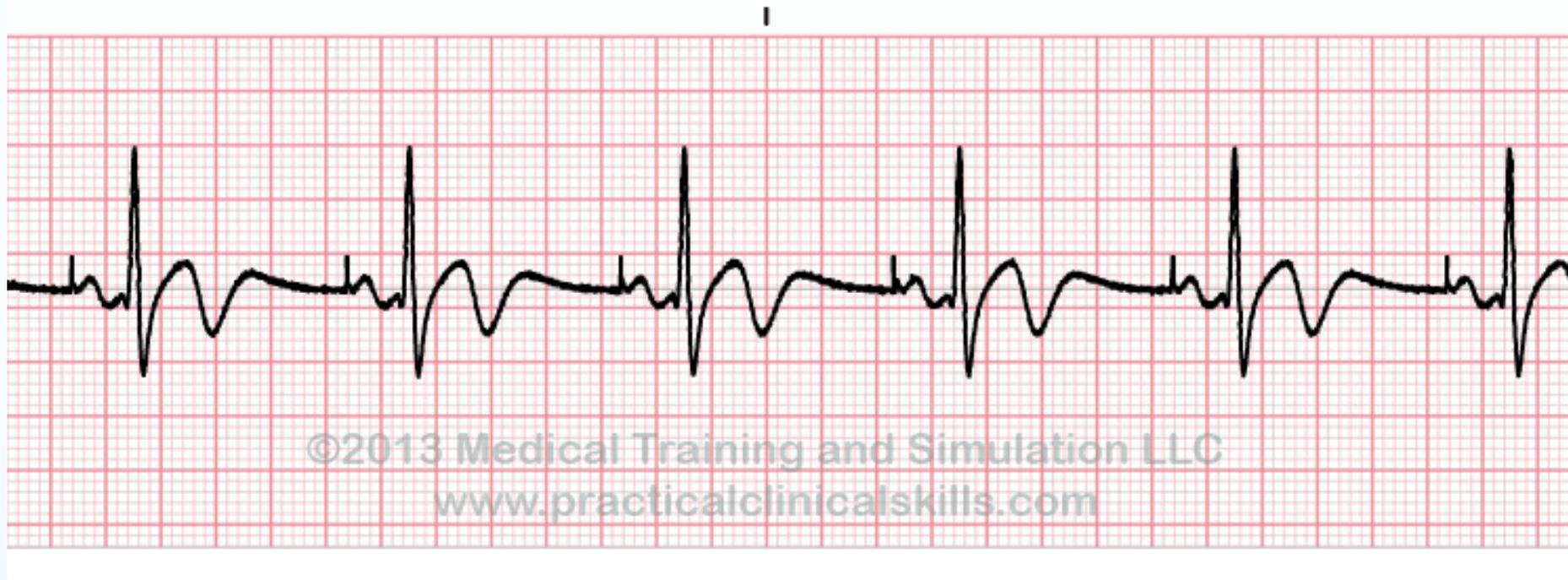
V            V            I            R

D            D            D            R

V            O            O



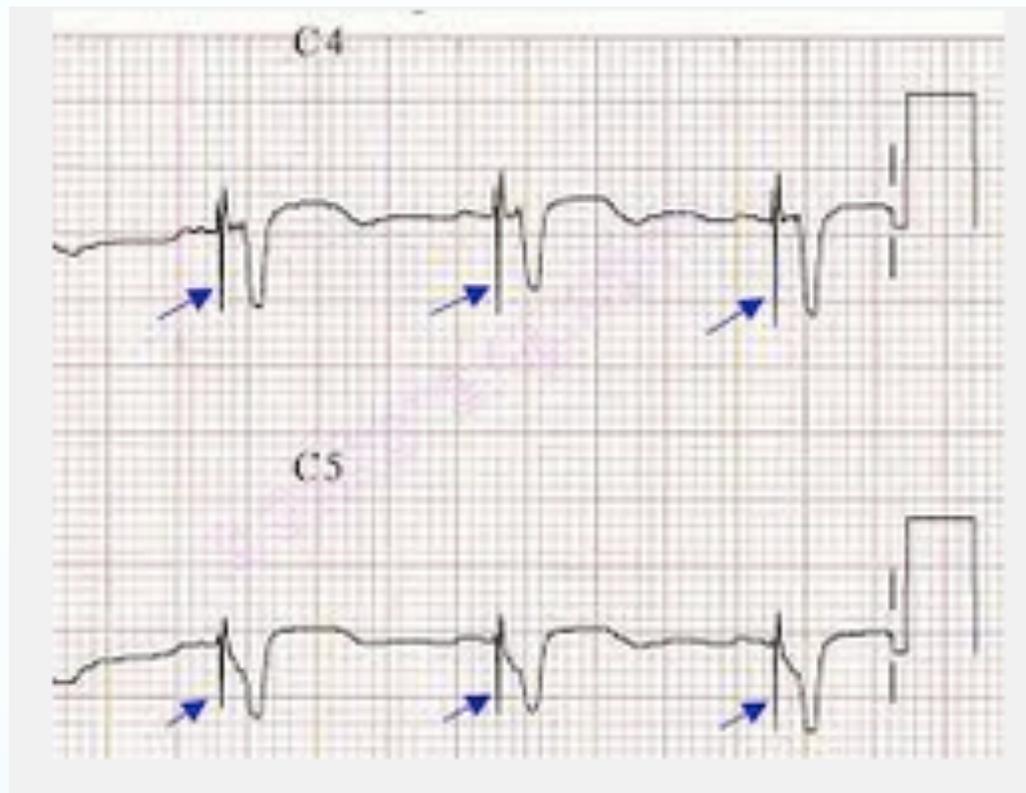
VVI or VOO



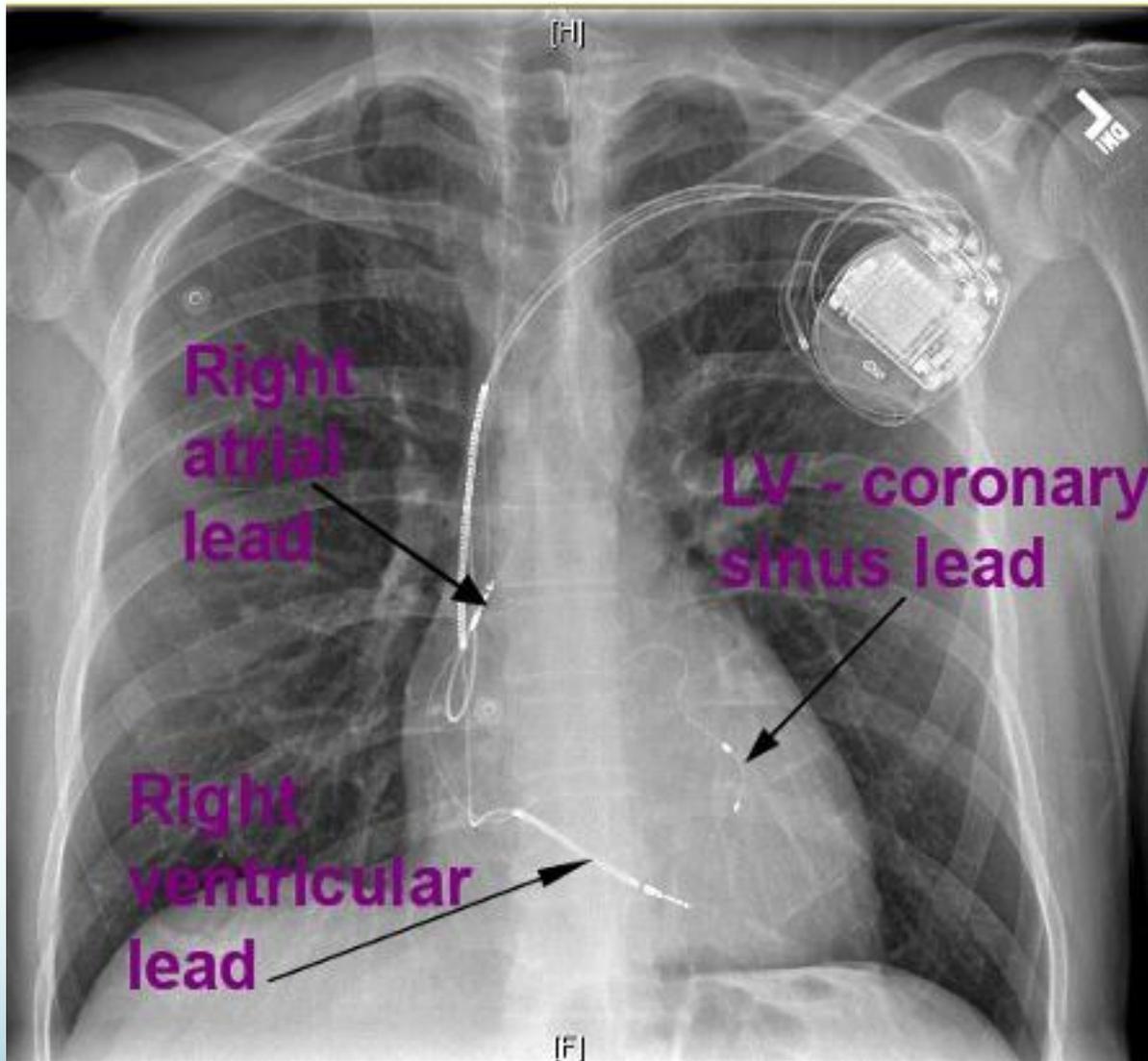
AAI or DDD



DDD or DDO



DDD



# Cardiac Resynchronization Therapy or “CRT”

- Use of a “biventricular” pacing system
- Indicated for patients with symptomatic HF + widened QRS and Reduced LVEF (<35%)
- Also for patients expected to need frequent pacing
- Results in more physiologic left ventricular contraction
- Can reverse/prevent “remodeling” and improve EF and symptoms of heart failure
- CRTD-P vs CRTD-D



## CRT devices



600 x 400 - medgadget.com

# Pacemakers and Magnets



Converts to a “fixed rate” (asynchronous) mode

# Device Vendors & Magnet Rates for Pacemakers

<b>Magnet Rate (bpm)</b>	<b>Vendors</b>			
	Medtronic	St. Jude	Boston Scientific	Biotronik
Normal	85	100	100	90
ERI*	65	85	85	80

\*ERI refers to elective replacement interval (battery is low and should be replaced within approximately 1-3 months)

Is a magnet the answer to all  
pacemaker problems?

**NO!!**

# Problem with magnets and pacemakers

- Programming is patient-specific; fixed rate pacing is “generic” and may be too high or low
- Competition with native rate
- Asynchronous pacing could cause “R on T”
- Sensing of appropriate atrial activity (rate) then pacing the ventricle is more physiologic than asynchronous fixed – rate pacing
- Magnet may not be able to be placed (position)
- Pacemakers may be programmed not to respond to magnets (**rare**)

## ■ CASE REPORT

# Use Caution When Applying Magnets to Pacemakers or Defibrillators for Surgery

Peter M. Schulman, MD\* and Marc A. Rozner, PhD, MD†

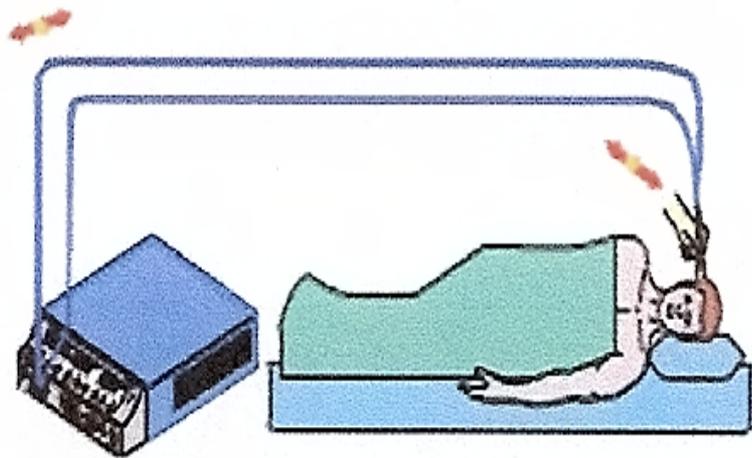
The application of a magnet to a pacemaker (intended to cause asynchronous pacing) or implanted cardioverter defibrillator (intended to prevent shocks) during surgery without a clear understanding of actual magnet function(s) or precautions can have unexpected, untoward, or harmful consequences. In this report, we present 3 cases in which inadequate assessment of cardiac implanted electronic device (CIED) function, coupled with magnet application, contributed to or resulted in inappropriate antitachycardia pacing or shocks, CIED damage, or patient injury. Although these cases might be rare, they reinforce the need for a timely, detailed preoperative review of CIED function and programming as recommended by the American Society of Anesthesiologists and the Heart Rhythm Society. (Anesth Analg 2013;117:422–7)

# However:

- Major advantages of magnet:
  - Readily available 24/7
  - Does not require programmer
  - “Guarantee” of fixed rate pacing
  - *Reversible*

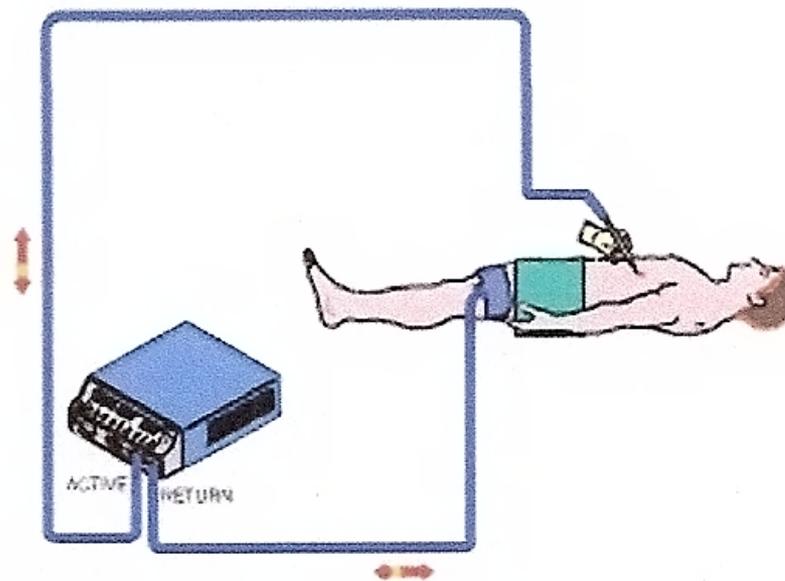
# What can happen in a procedure setting?

- **Electromagnetic Interference (EMI)**
  - **Bipolar vs Unipolar**
- Cardioversion
- Radiofrequency Current (“RF ablation”)
- Therapeutic Radiation
- Electroshock therapy
- Electrosurgery during GI procedures
- TENS units



“Bipolar”

“Unipolar”



# What can happen in a procedure setting?

- The pacemaker senses activity it interprets as cardiac in origin and is **inhibited**
- The pacemaker senses muscle activity (“rate responsive”) and increases pacing rate
- The pacemaker **fails to capture**
- The pacemaker is **reprogrammed**
  - “noise reversion mode” or “reset”
- The device or lead(s) is **damaged**

# Prevention of pacemaker problems related to cautery

- Use bipolar cautery (ophth, neuro)
- Use unipolar cautery in short bursts
- Place grounding pad such that current is deflected away from device and leads
- Place magnet on device to convert to fixed-rate (asynchronous) mode – bearing in mind possible issues with magnets

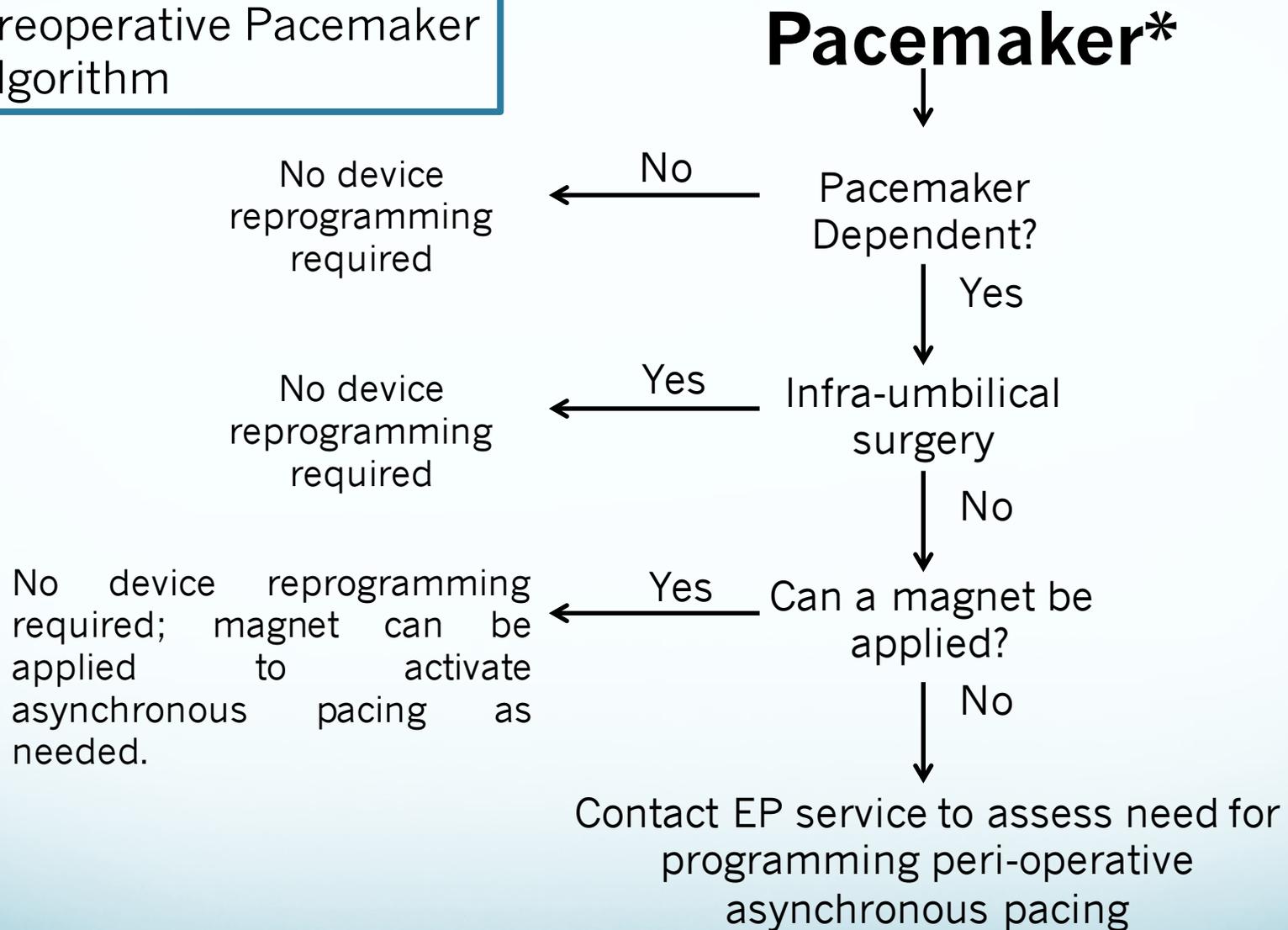
# Monitoring

- Set ECG monitor to detect pacing spikes
  - “Filter”
  - Monitor may “dual count”
- **Always have pulse verification: pulse oximeter or arterial line**

# **“Six inch rule” vs Infra-umbilical**

**External pacing, shocking, cautery  
“out of plane” with CIED leads**

## Preoperative Pacemaker Algorithm



Courtesy of JD Roberts, UCEP

\*Have a magnet in the room and external pacing readily available

# ICDs vs Pacemakers

- ICDs are placed to **terminate tachycardias**
  - Ventricular: VTACH or VFIB
  - Atrial: flutter
- **All** ICDs have a pacemaker function
- **MAGNETS** placed over ICDs affect **ONLY** the tachycardia sensing function
- The only way to affect pacemaker function on an ICD is with a **programming device**

# EMI and ICDs

- EMI may be interpreted as tachyarrhythmia and cause inappropriate shock to be delivered
- Similar to pacemakers, the more remote the surgery is from the device/leads, the less likely EMI will be sensed, **however** all ICDs should still be disabled before surgery

# ICDs and Magnets



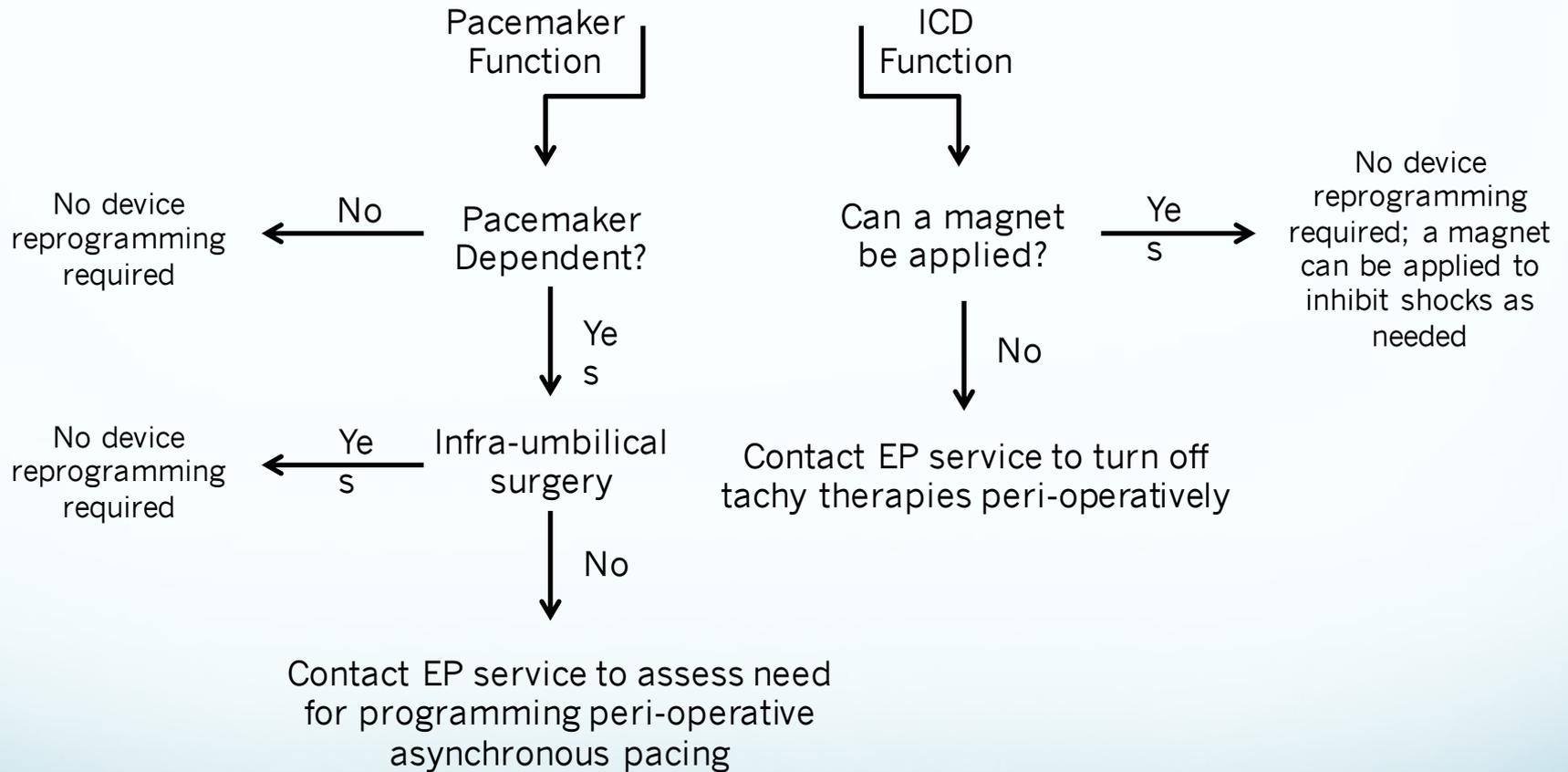
Suspends sensing of tachyarrhythmias

# Problems with magnets and ICDs

- **Some devices emit tones with a magnet and some do not**
- Response to a magnet can be disabled
- When battery is low response to magnet may be less reliable

# Preoperative ICD Algorithm

## ICD\*



\*Have magnet and external therapy in room/applied

# Intra-procedural Suggestions:

**all** patients with CIEDs where EMI is possible

- Have a magnet in the room
- Have transcutaneous pacing/shocking pads placed (high risk or difficult to place once positioned/draped)
  - “A-P” position of pads preferred
- Discuss electrocautery use and grounding pad placement with the surgical/nursing team
- Correlate ECG complexes with a pulse (pulse oximeter or arterial line)

# Monitoring and CIEDs

- Set ECG monitor to detect pacing spikes
  - “Filter”
  - Monitor may “dual count”
- **Always have pulse verification: pulse oximeter or arterial line**
- Concern for placement of central line, esp PA catheter with lead < 6 weeks old
- For rate responsive devices using impedance device emits current which may affect ECG monitor and appear like rapid pacing

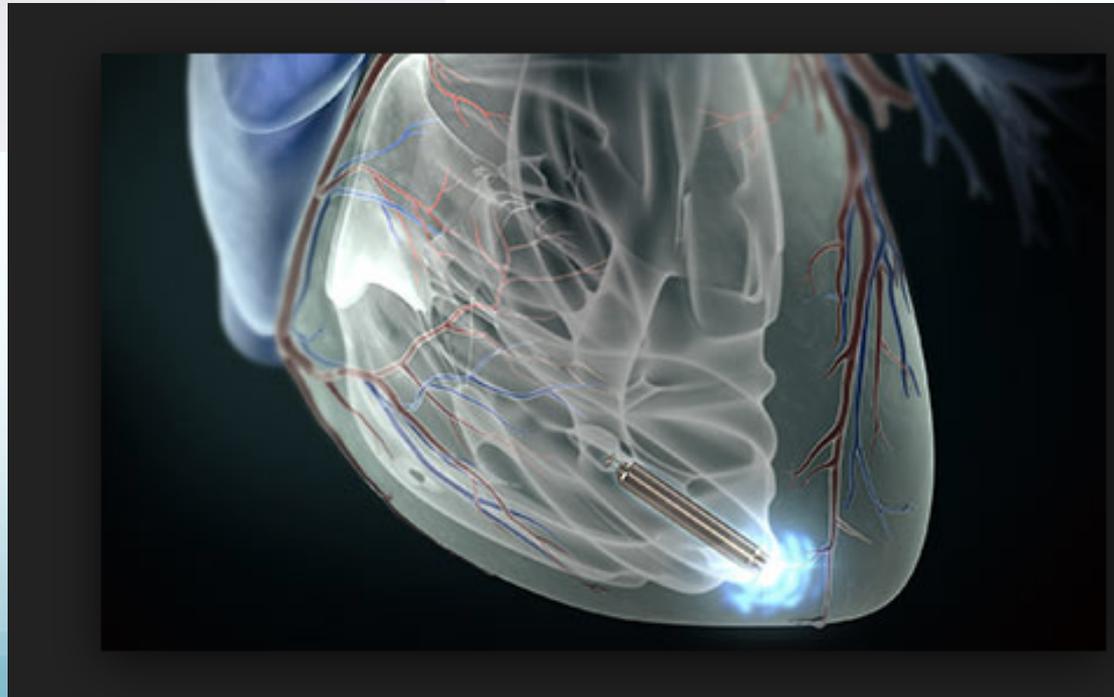
# Requirement for post-procedure interrogation before transfer from monitored setting

- Device reprogrammed before surgery
- Intraoperative CPR
- Intraoperative cardioversion
- Procedure/cautery within 6" of device
- Radiation/RF ablation above umbilicus
- Patients unable to have device evaluated within 1 month

# The CIED “Team”



“Leadless Pacemaker”



B



“Subcutaneous ICD”

