Perioperative Considerations for Patients with Cardiac Implantable Electronic Devices (CIEDs)

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Current Evidence-based Reference Materials used in this Curriculum:

- 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: http://content.onlinejacc.org/article.aspx?articleid=1893784
- 2011 HRS/ASA Expert Consensus Statement on the Perioperative Management of Patients with Implantable Defibrillators, Pacemakers, and Arrhythmia Monitors: http://www.hrsonline.org/Clinical-Guidelines/-Perioperative-Management-of-Patients with CIEDs

Reference Materials, con't:

☞ **I wish I could say the content of this PowerPoint is from my brain, but it's not . . . I stole it from the experts. Here are my favorites. Download these pearls of wisdom and keep them in your iPad. Or print them out. Have them handy. It's like having the Chief of Electrophysiology at your fingertips!**

- http://anesthesia.ucsf.edu/shapiro/Pacemakers_and_ICDs-2012.pdf
- http://www.cardiacengineering.com/pacemakers-wallace.pdf

Other Helpful References:

- **Heart Rhythm Society** (HRS) Directory of Scientific Papers: http://www.hrsonline.org/Practice-Guidance/Clinical-Guidelines-Documents?SearchText=&seeall=1
- **Anesthesia Patient Safety Foundation (APSF) – 2013 paper on Management of CIEDs During Perioperative Care:** http://www.apsf.org/newsletters/html/2013/fall/01_cieds.htm

Abbreviation Housekeeping!

ACC	American College of Cardiology
AHA	American Heart Association
ASA	American Society of Anesthesiologists
CIED	Cardiac Implanted Electronic Device
CRT-D	Cardiac Resynchronization Therapy - Defibrillator
CRT-P	Cardiac Resynchronization Therapy - Pacemaker
CXR	Chest X-Ray
EF	Ejection Fraction
EMI	Electromagnetic Interference
EP	Electrophysiology
HRS	Heart Rhythm Society
ICD	Implantable Cardioverter-Defibrillator
LBBB	Left Bundle Branch Block
LV	Left Ventricle / Left Ventricular
PM	Pacemaker
TdP	Torsades de Pointes
SVT	Supraventricular Tachycardia
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

Recipe for DISASTER !

+

= DISASTER

#1 Perioperative CIED Problem:

ELECROSURGERY. The "Bovie."

"The flow of electrons (EMI) from the Bovie tip to the grounding pad interferes with CIED function."

EMI and PACEMAKER function

- **OVERSENSING: EMI can be interpreted by a pacemaker as intrinsic cardiac activity; in this setting it will not trigger a paced rhythm even though the patient may need to be paced. (In other words, in PACEMAKER DEPENDENT PATIENTS, the HEART will STOP BEATING!)**

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To quote Arthur Wallace, ***"Many experts agree that a chronic beating heart is a good thing !"***

EMI and ICD FUNTION:

-ICDs may misinterpret EMI as a lethal (shockable) rhythm (e.g.: V-Tach, V-Fib, Torsades) and ADMINISTER DEFIBRILLATION or CARDIOVERSION.

-Inappropriate shock may then RESULT in Cardiac Arrest (R-on-T).

Other EMI induced dysfunctions:

-Device reset occurs infrequently with electrosurgery
-Pulse generator damage from electrosurgery can occur, but is uncommon
-Impedance based rate responsive systems may go to upper rate behavior with electrosurgery exposure

Electrosurgery vs. Electrocautery

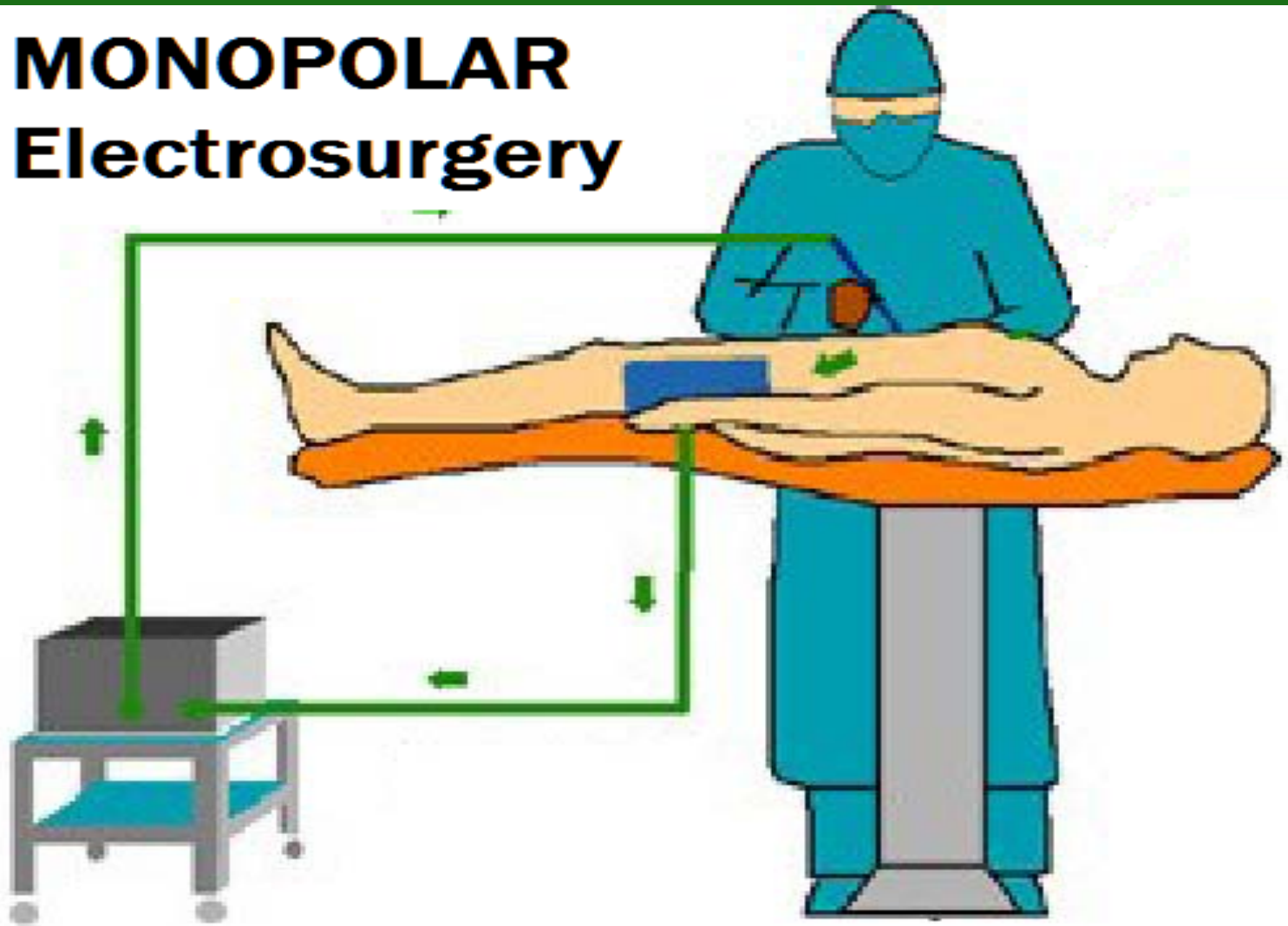
- **Electrosurgery:** Uses **Alternating Current (AC).** This is used in today's operating rooms. With MONOPOLAR Electrosurgery, the ***patient's BODY*** is part of the electrical circuit.

- **Electrocautery:** Uses **Direct Current (DC).** The patient's body is NOT part of the circuit. Rarely used in today's surgical suites.

Two types of Electrosurgery:

- **MONOPOLAR**
- **BIPOLAR**

MONOPOLAR Electrosurgery



patient's body is part of circuit.


Bovie
5115 Ulmerton Road
Clearwater, FL 33760 USA
CHANGE-A-TIP™
Power Handle
Replaceable Tip &
Replaceable Battery

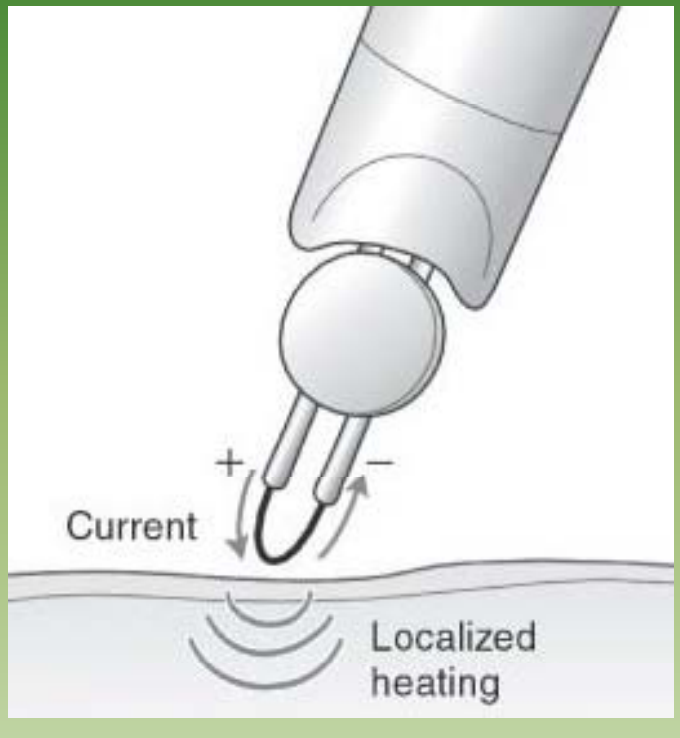
problem ?

NO problem !

Because . . . . .

BIPOLAR Electrosurgery

- **Patient's body is not part of circuit.** This method of electrosurgery reduces problems with CIED interference to nearly zero. BIPOLAR ELECTROSURGERY ***works BEST for patients with CIEDs.***



However most of today's surgeries use MONOPOLAR ELECTROSURGERY for a number of reasons. So in most instances, we must accept it, and DEAL with it!

CIED Management in the Perioperative Setting

2011 HRS/ASA Statement:

" The perioperative management of CIEDs must be individualized to the patient, the type of CIED and the procedure being performed. A single recommendation for all CIED patients is not appropriate."

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Cardiovascular Implantable Electronic Devices

Recommendation	COR	LOE
Before elective surgery in a patient with a CIED, the surgical/procedure team and clinician following the CIED should communicate in advance to plan perioperative management of the CIED.	I	C

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

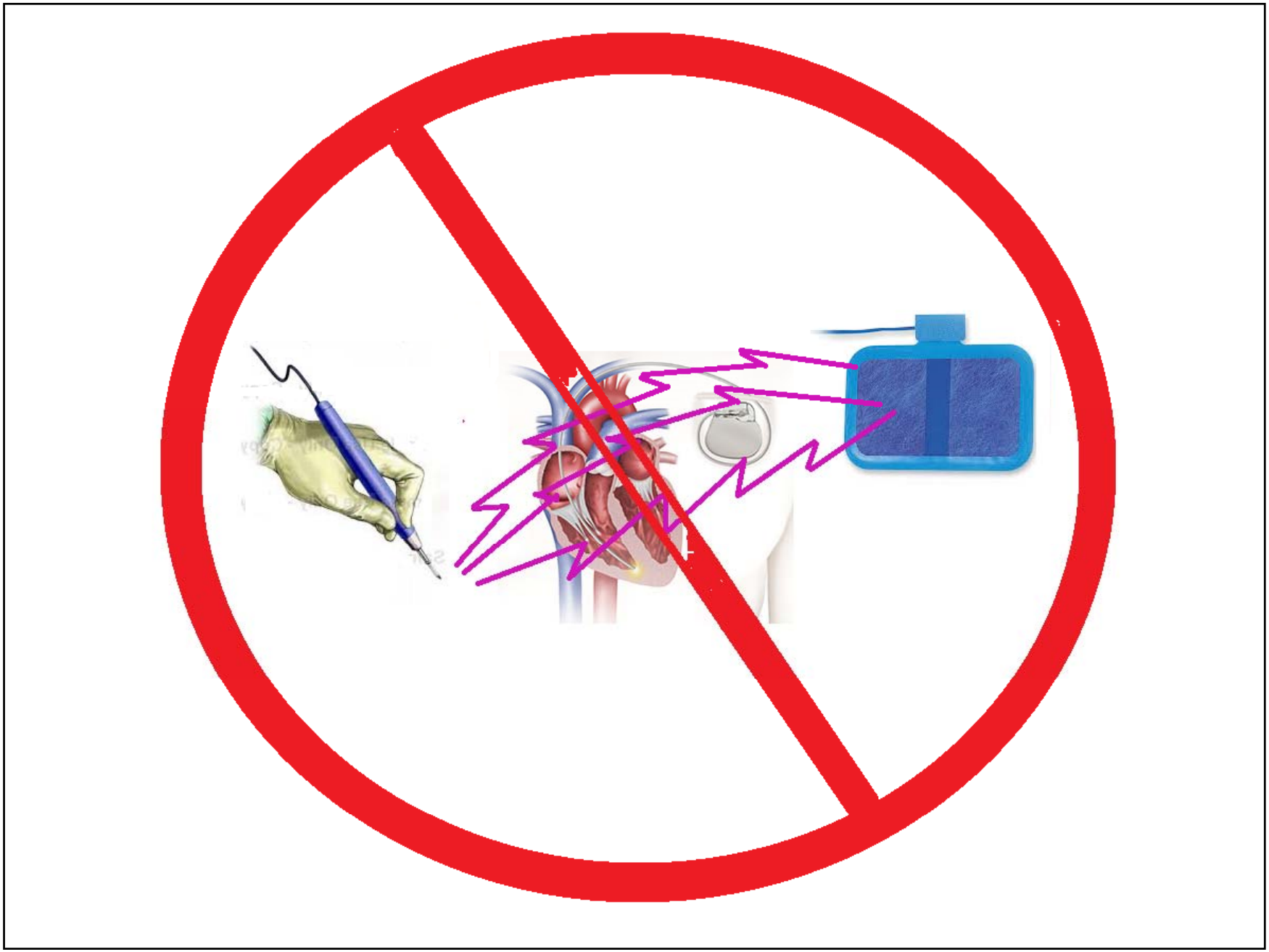
Perioperative Management of Patients With CIEDs

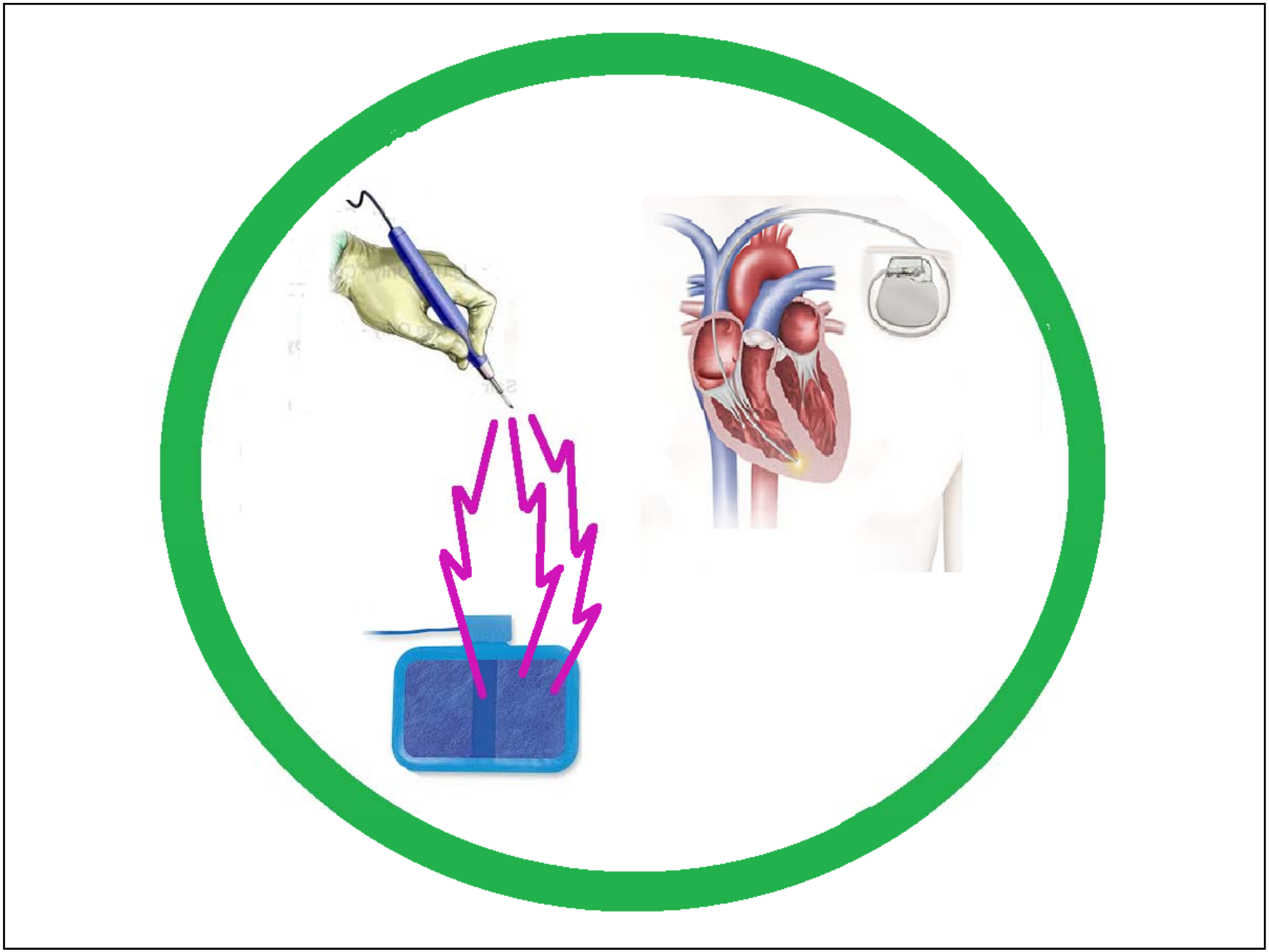
Recommendation	COR	LOE
Patients with ICDs who have preoperative reprogramming to inactivate tachytherapy should be on cardiac monitoring continuously during the entire period of inactivation, and external defibrillation equipment should be readily available. Systems should be in place to ensure that ICDs are reprogrammed to active therapy before discontinuation of cardiac monitoring and discharge from the facility.	I	C

NEXT, a few BOVIE-RELATED rules:

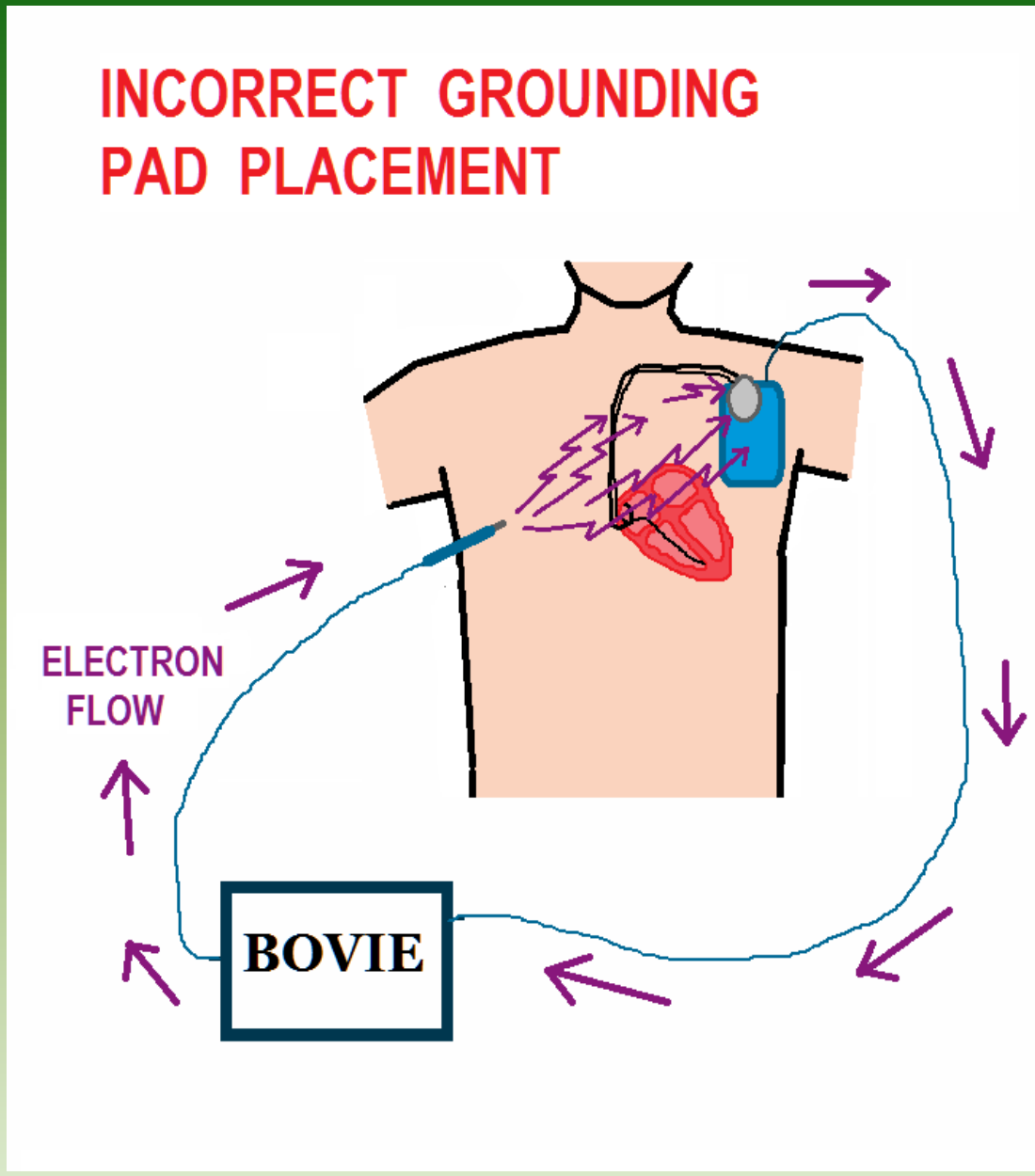
Surgeries BELOW the UMBILICUS rarely interfere with CIED function.

DO NOT place the GROUNDING PAD in a location where the FLOW OF ELECTRONS (EMI) will cross the CIED, the CIED Lead Wires or Heart . . . .

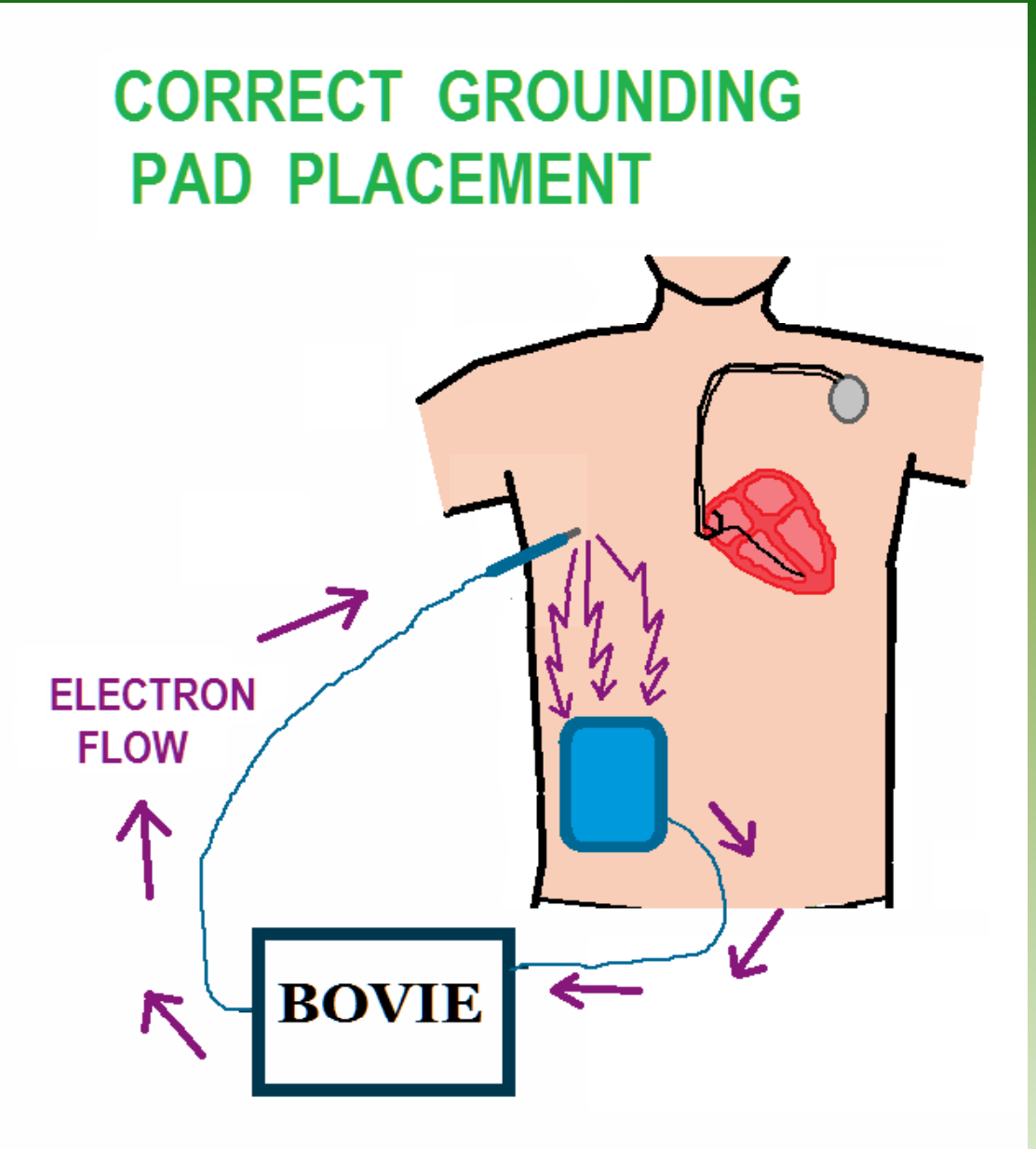




Heart, CIED & Lead Wires should NOT be between SURGICAL SITE and GROUNDING PAD !



Position GROUNDING PAD so the Heart, CIED & Lead Wires are NOT in the pathway of the FLOW of ELECTRONS



AVOID using ELECTROSURGERY tip within 15cm (6 in) of CIED.

If you are UNABLE to manage the CIED prior to SURGERY, use the ELECTROSURGERY in short (4-5 second) bursts.

Types of CIEDs:

- **Pacemaker** (stimulate, adjust heart rate)
- **ICD** (Implantable Cardioverter-Defibrillator)
  - ICDs can also pace!
- **CRT-P (Cardiac Resynchronization Therapy - Pacemaker** (former: "Bi-V Pacemakers").
- **CRT-D (Cardiac Resynchronization Therapy – Defibrillator)** (former: "Bi-V ICDs").
- **S-ICD** (Subcutaneous Implantable Cardioverter-Defibrillator)

Most Common CIED Placement:

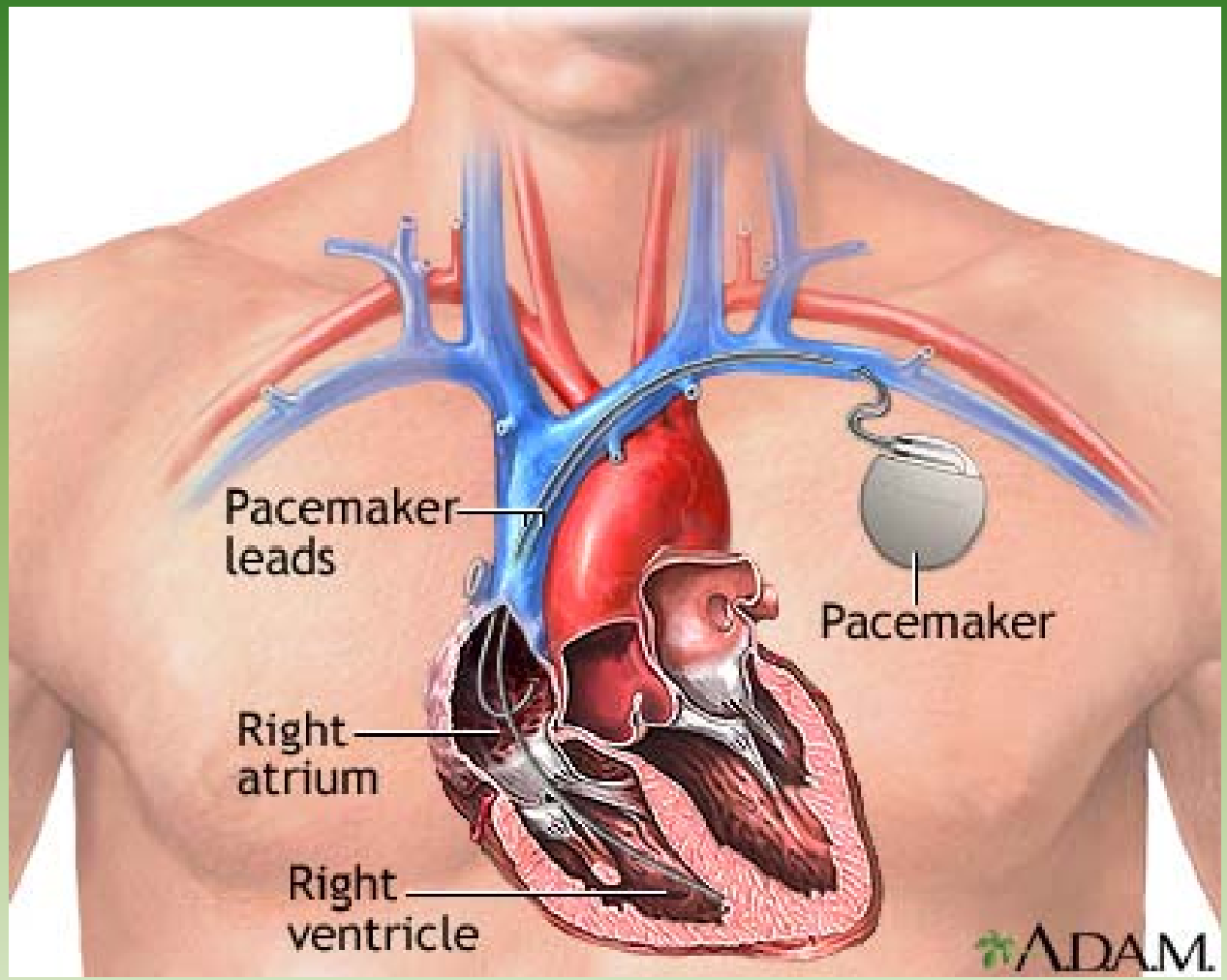


Image from National Institutes of Health

Common CIED Locations:

- MOST COMMON: LEFT SUBCLAVICULAR
- LESS COMMON:
  - RIGHT SUBCLAVICULAR
  - ABDOMINAL

Pacemakers

Some pace a single chamber (R atrium or R ventricle), but most are dual chamber and can pace the R atrium and/or the R ventricle as needed.

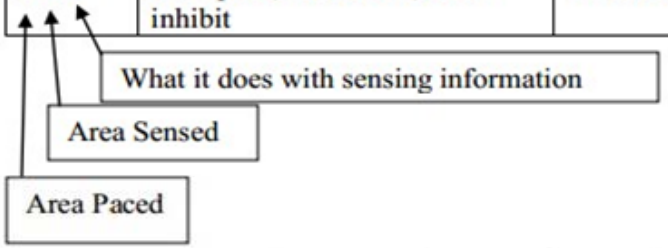
Pacemaker - INDICATIONS

- **Symptomatic Bradycardia** (Sick Sinus Syndrome / SA Nodal Disorders)
- **High Grade Heart Block** (2nd degree type II, 3rd degree heart block)
- **Symptomatic recurrent tachycardias** (SVT / A Flutter not responsive to medications / ablation). (overdrive pacing)
- **Pause-depended Ventricular Tachycardia**

NOTE: Patient's dependence on pacing varies from "occasional" to those who are 100% pacemaker dependent.

You now get to learn the secret code.

Code	What is it?	Who gets it?
AOO	Atrial pace, no sense, no inhibitions	Sick sinus syndrome with intact conduction in the operating room with bovie. Ie Cardiac case, in OR, with bovie, with heart rate low from narcotics.
AAI	Atrial pace, atrial sense, inhibited by atrium	Sick sinus syndrome with intact conduction system.
VOO	Ventricular pace, no sense, no inhibit	Third degree heart block in OR with atrial fibrillation. Why atrial fibrillation? Because you can't effectively pace the atrium if it is fibrillating.
VVI	Ventricular pace, ventricular sense, ventricular inhibit	Third degree heart block with atrial fibrillation.
DOO	Dual pace, no sense, no inhibitions	Third degree heart block in OR with bovie.
DVI	Dual pace, ventricular sense, ventricular inhibit	Third degree heart block with supraventricular tachycardias
DDD	Dual pace, dual sense, dual inhibit	Third degree heart block.



From: "Pacemakers for Anesthesiologists Made Incredibly Simple,"
By: Arthur Wallace, MD, Ph.D

http://www.cardiacengineering.com/pacemakers-wallace.pdf

CIED Codes

Position I	Position II	Position III	Position IV	Position V
Pacing Chamber(s)	Sensing Chamber(s)	Response(s) to Sensing	Programmability	Anti-Tachycardia Function(s)
O= None	O= None	O= None	O= None	O= None
A = Atrium	A = Atrium	I = Inhibited	P = Programmable	P = Pacing
V = Ventricle	V = Ventricle	T = Triggered	M= Multiprogrammable	S = Shock
D = Dual (A+V)	D = Dual (A+V)	D = Dual (I+T)	C = Communicating	D = Dual (P+S)
			R = Rate Modulation	

Pacemaker types & who gets them:
AAI Pacemakers

- AAI = Atrial Pace, Atrial Sense, Atrial Inhibits
- Clinical indications: **SA nodal disease with intact (normal) conduction system**
- IDEAL Perioperative Setting: AOO (atrial pace, No sensing, no inhibitions)

Pacemaker types & who gets them:
VVI Pacemakers

- VVI = Ventricular Pace, Ventricular Sense, Ventricular Inhibits
- Clinical indications: **Third degree heart block with atrial fibrillation.**
- IDEAL Perioperative Setting: VOO (Ventricular pace, No sensing, no inhibitions)

Pacemaker types & who gets them:
DDD Pacemakers

- DDD = Dual pace, dual sense, dual inhibit
- Clinical indications: **Third degree heart block**
- IDEAL Perioperative Setting: DOO (Dual chamber pace, No sensing, no inhibitions)

ICDs (Implantable Cardioverter-Defibrillators)

Used to **defibrillate** deadly rhythms (V-Fib, Torsades) and provide **synchronized cardioversion** to other deadly rhythms (V-Tach, SVT). ICDs can also **pace**, if the patient needs pacing!

ICDs - INDICATIONS

- Patient history of sudden cardiac death
- Patient history of, and/or EP study which reveals the patient is **highly susceptible to VF, VT, TdP** or other **lethal tachyarrhythmia**. There is usually a history of:
  - **Severe LV Dysfunction** and/or
  - **Channelopathy**
    - Long QT Syndrome
    - Brugada Syndrome
    - Hypertrophic Cardiomyopathy
    - Arrhtymogenic Right Ventricular Dysplasia

CRT-Ps (Cardiac Resynchronization Therapy – Pacemakers)

Formerly known as "Bi-Ventricular Pacemakers," these devices are used in patients who have both:

a) **Low EF** (usually below 35)

b) **Wide QRS** (wide LBBB pattern)

A CRT device will simultaneously pace the R and L ventricles. This will cause the L ventricle to depolarize faster, shorten the QRS duration.

A CRT device will IMPROVE the patient's EF by 10-15% !

CRT-Ps and CRT-Ds

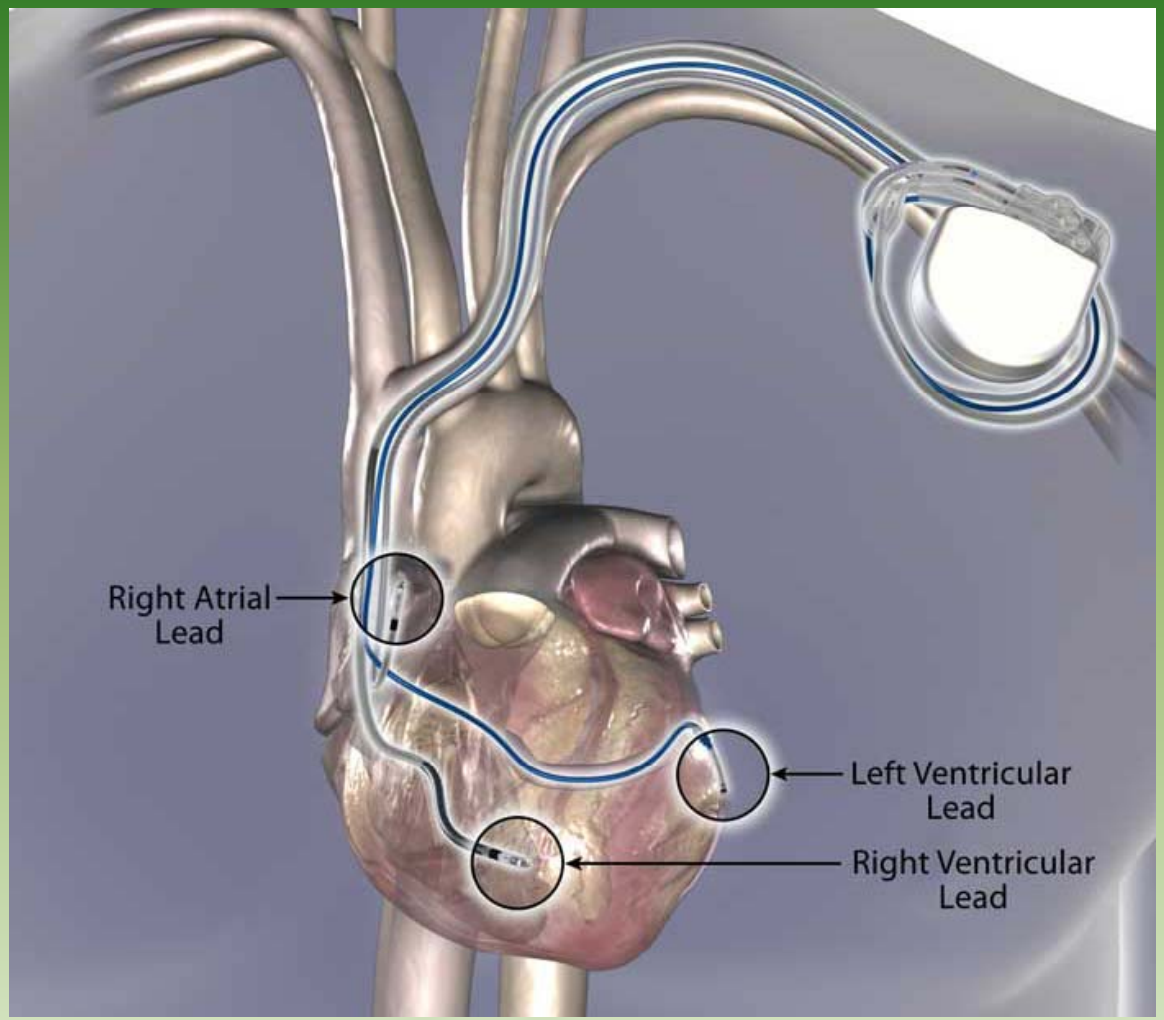


Image compliments of Medtronic Corporation

CRT-Ds (Cardiac Resynchronization Therapy – Defibrillators)

Formerly known as "Bi-Ventricular ICDs," these devices do everything CRT-Ps do (described in the last slide), PLUS they can Defibrillate and Cardiovert! They're used for patients with:

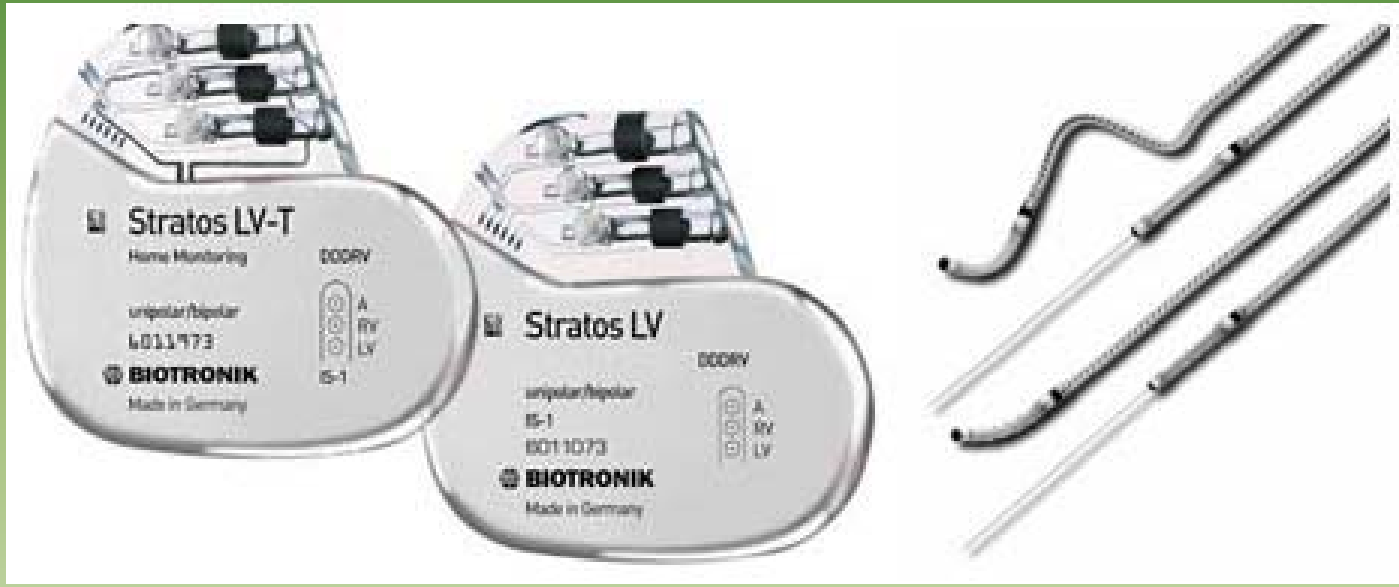
a) Low EF (usually below 35)

b) Wide QRS (wide LBBB pattern)

c) History of - and/or - high risk of SUDDEN CARDIAC DEATH from V-fib, V-Tach and/or Torsades de Pointes

CRT-Ps and CRT-Ds

Yes, they look just like pacemakers and ICDs!



Chest X-ray hint: a device with 3 lead wires is nearly always a CRT!

CRT-P / D INDICATIONS:

- **CRT-P**: Severe LV dysfunction (EF <35%) combined with slow/delayed ventricular depolarization (QRS wider than 120ms, LBBB pattern), when patient is not at risk for Sudden Cardiac Death.
- **CRT-D**: Same as above, (severe LV dysfunction) however patient is at risk for Sudden Cardiac Death from VF, VT, TdP or other lethal tachycardia.

S-ICDs (Subcutaneous Implantable Cardioverter-Defibrillators)

The latest in ICD technology. ALL HARDWARE is located just beneath the patient's skin. **There are NO lead wires in the patient's vasculature or in the heart.**

Used in patients with a history of or at high risk for Sudden Cardiac Death (VF, VT, TDP) *who DO NOT need a pacemaker.*

S-ICD

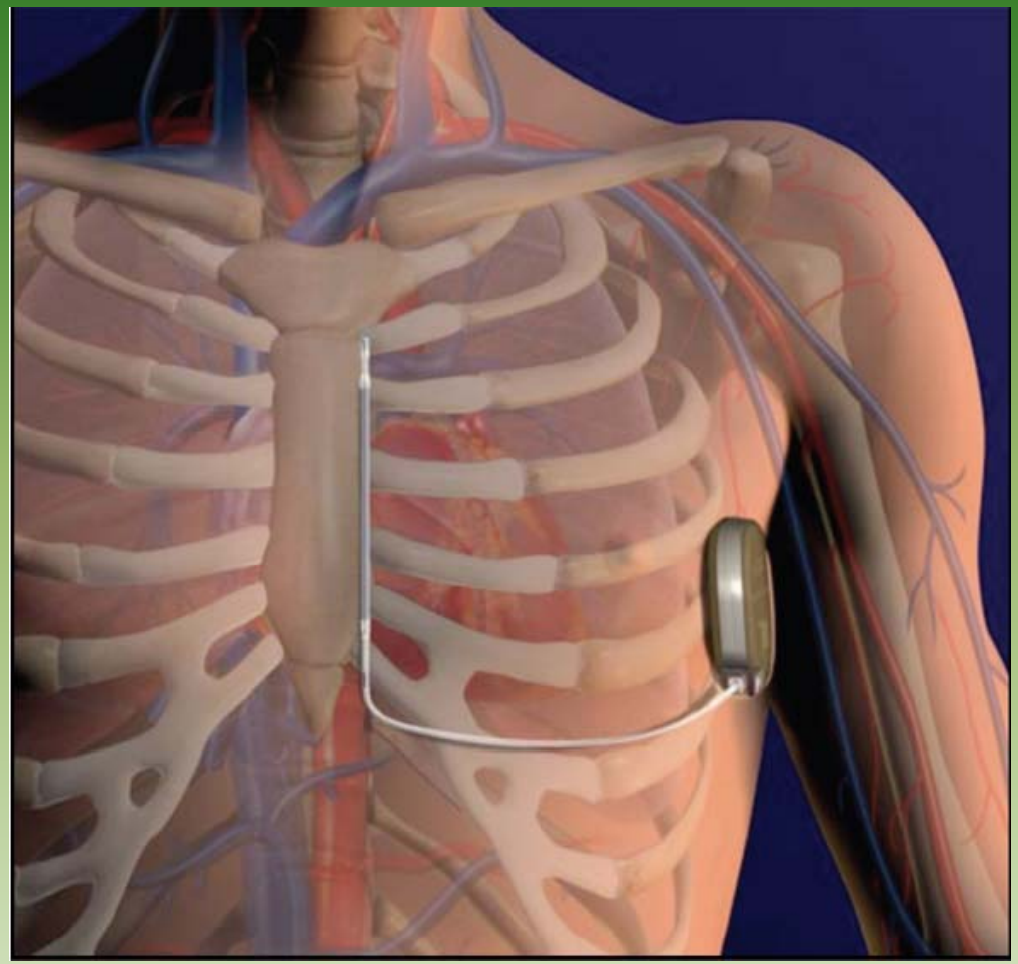


Image from Mayo Clinic

Pre-Operative Evaluation

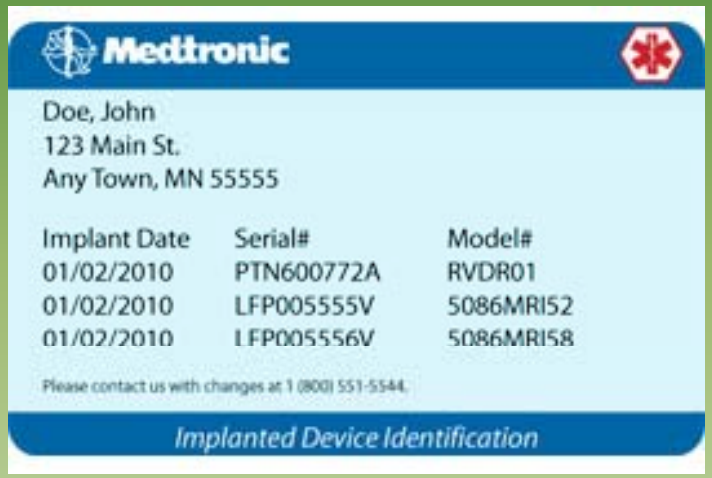
1. You learn about the CIED from:

- **History:** patient / family tells you about device
- **Physical Exam:** you see and/or palpate the generator, usually subclavicular
- **Chest X-ray:** you visualize the device (and leads) on the x-ray
- **ECG:** you identify pacemaker spikes

Preoperative Evaluation:

a. What is the device? (PM, ICD, CRT, S-ICD)
b. What brand and model?

CIED Identification Card



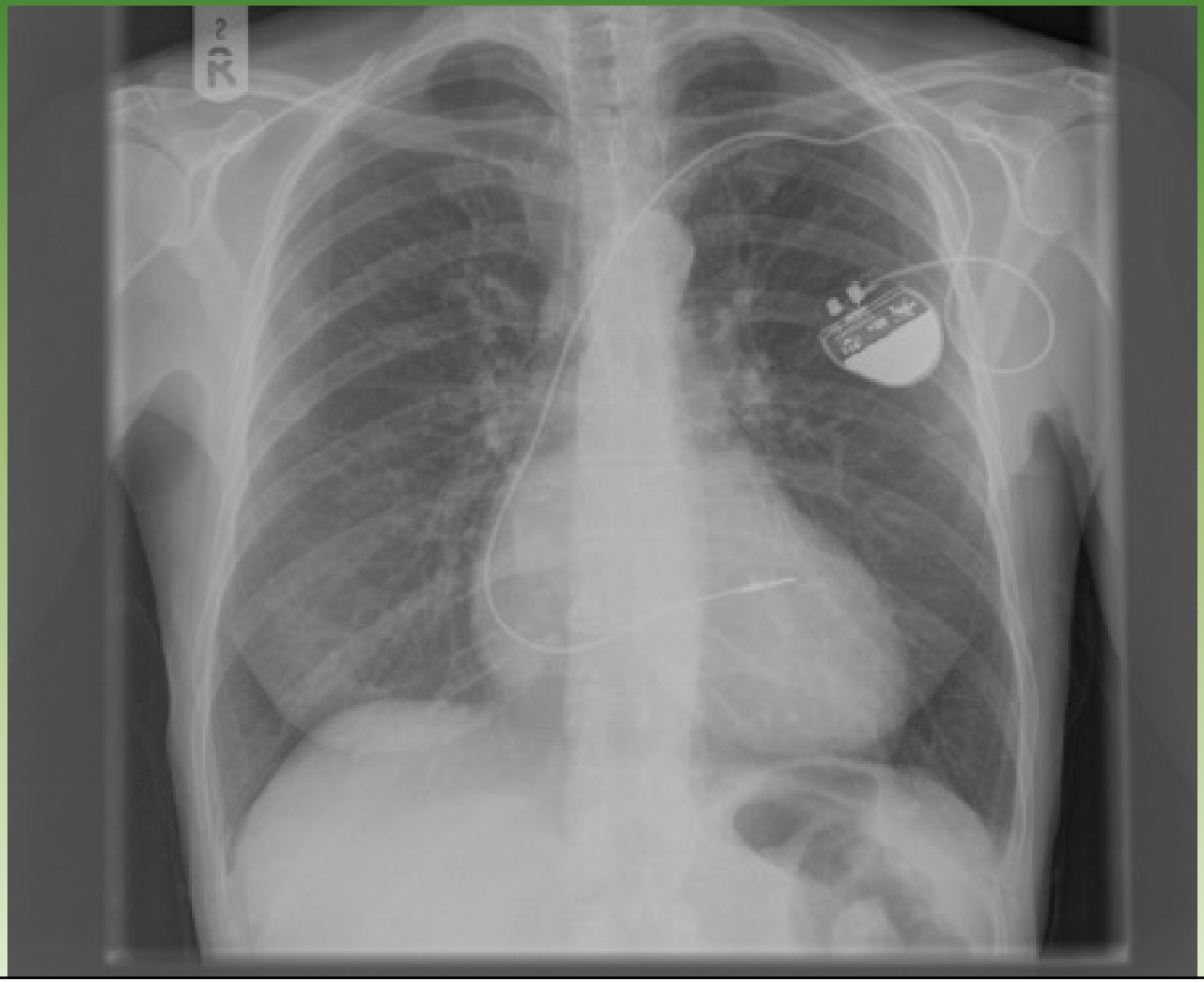
If no information is available …

Chest X-Ray ID of CIED:

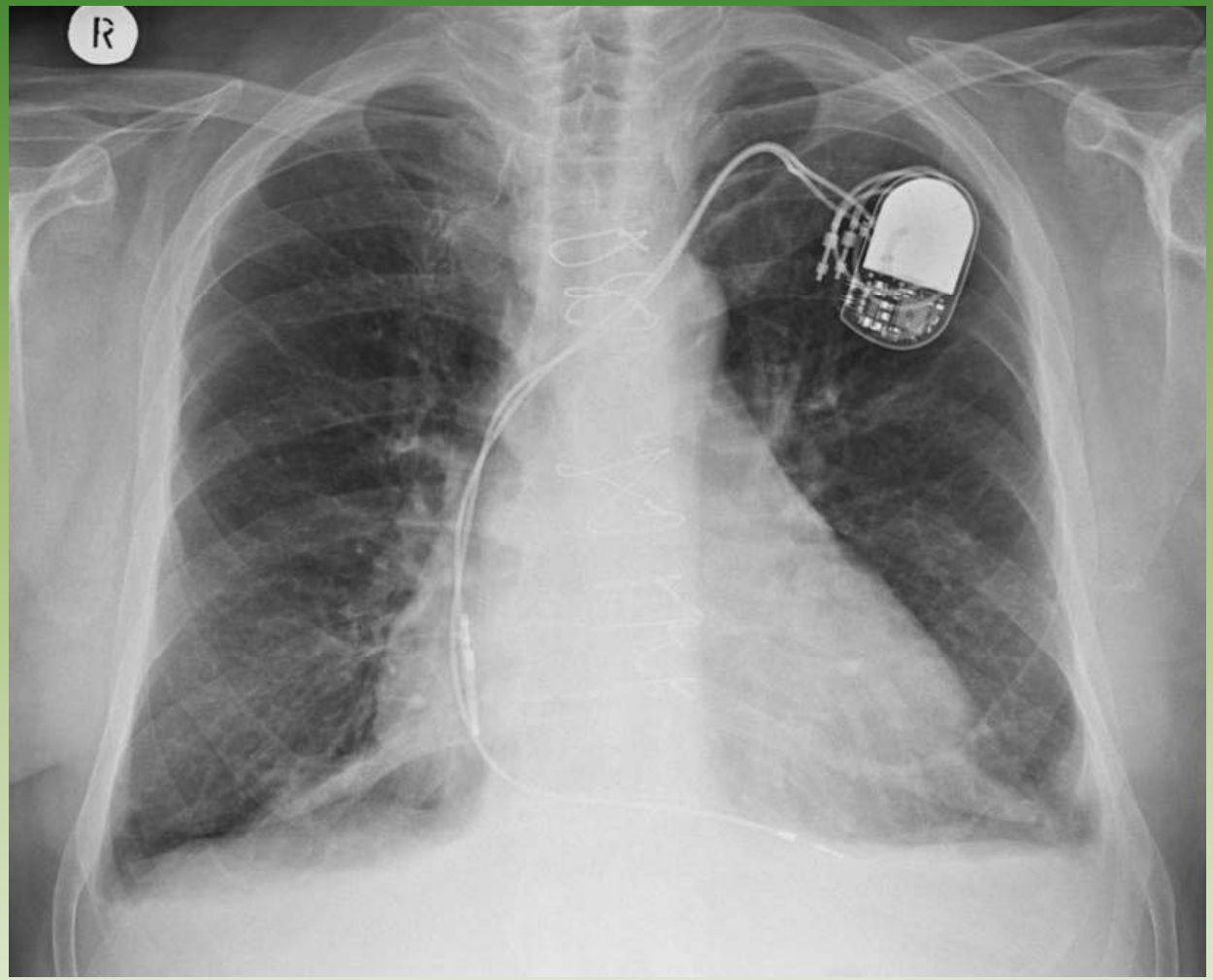
Typically have 1-3 lead wires originating at Generator:

- **1 wire:** single chamber device, distal lead may be located in R atrium or R ventricle.
- **2 wires:** usually dual chamber Pacemaker or ICD. 1 lead to R atrium, 1 lead to R ventricle
- **3 wires:** usually Bi-Ventricular pacemaker or ICD. 1 lead to R atrium, 1 lead to R ventricle, 1 lead in Coronary Sinus (to pace L Ventricle).
- **COIL** noted on Lead Wires indicates device is an ICD

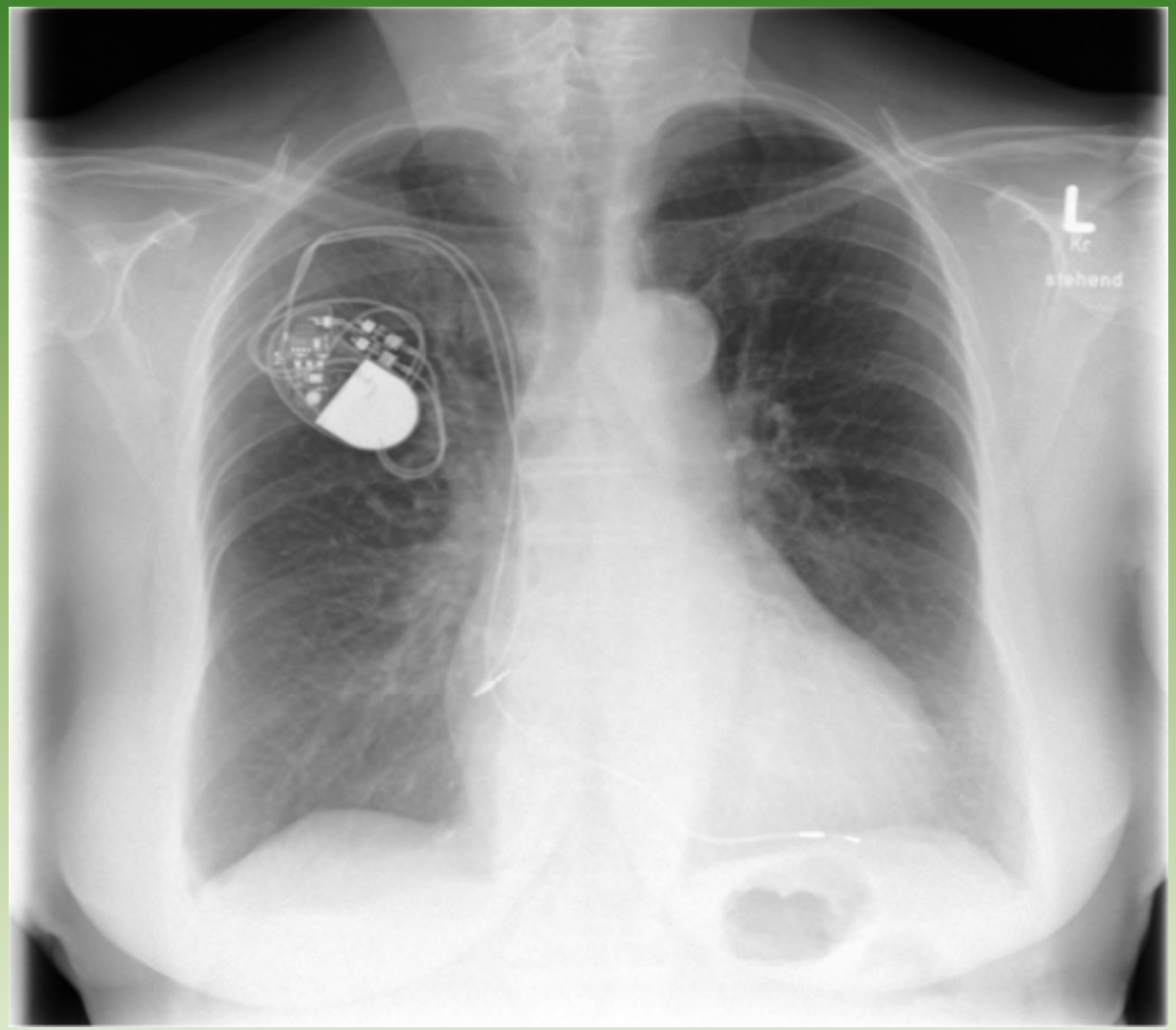
Single chamber (V) Lead (septum)



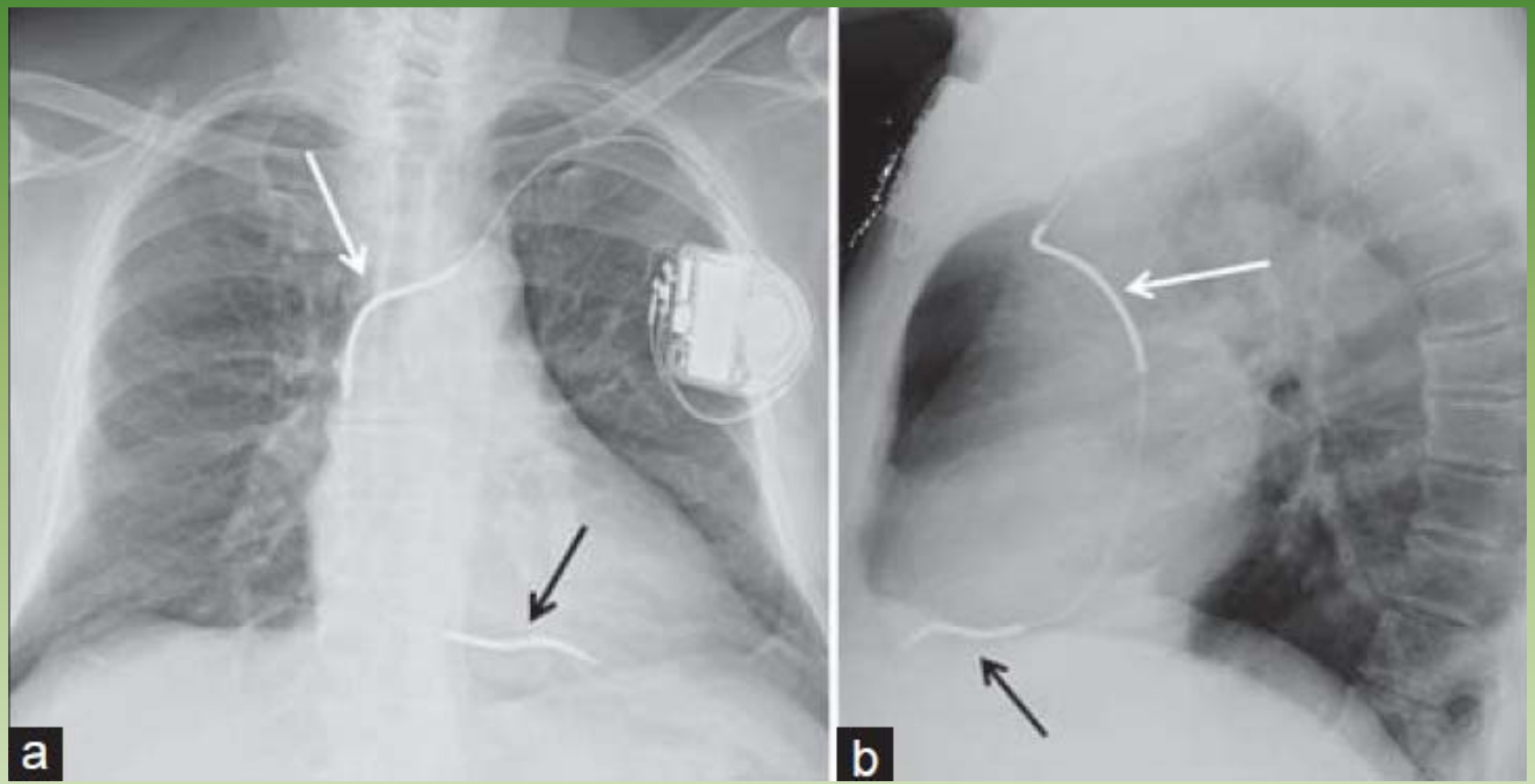
Dual Chamber (A-V) CIED



R subclavicular implanted CIED

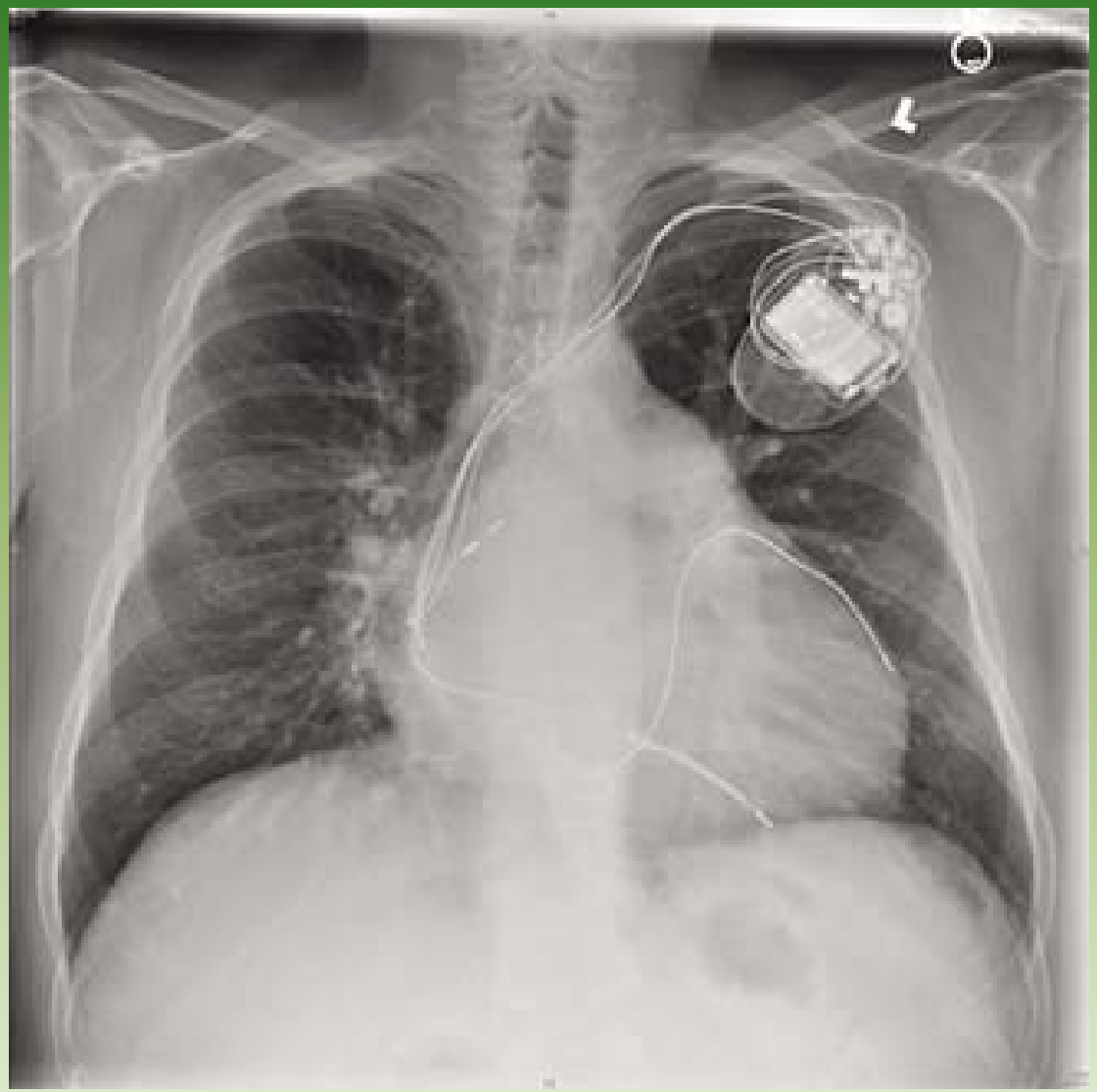


COIL noted on LEAD WIRE indicates the device is an ICD (dual chamber in this case):

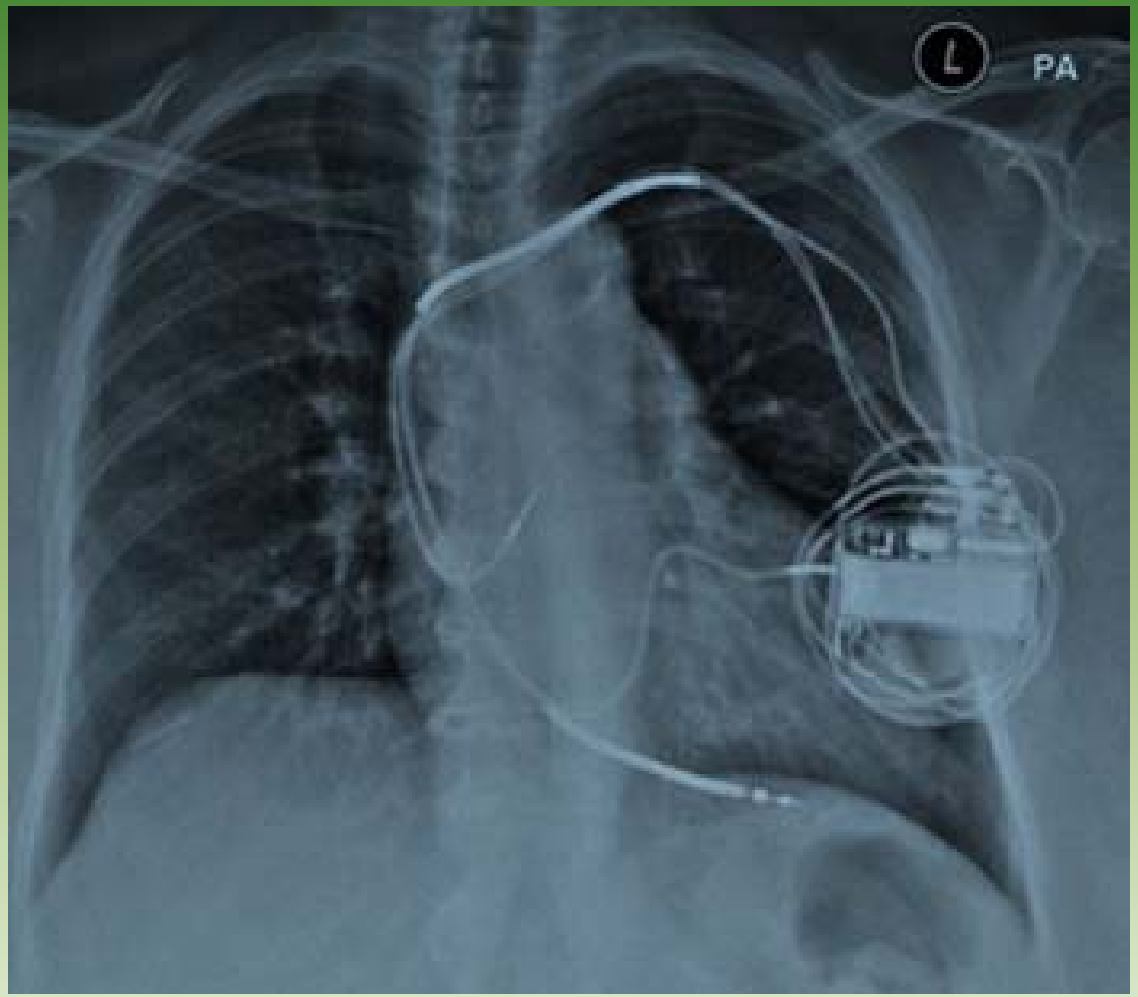


ICD COILS are HEAVIER, BRIGHTER segments on a LEAD WIRE

CRT-D (LV lead + coils present)

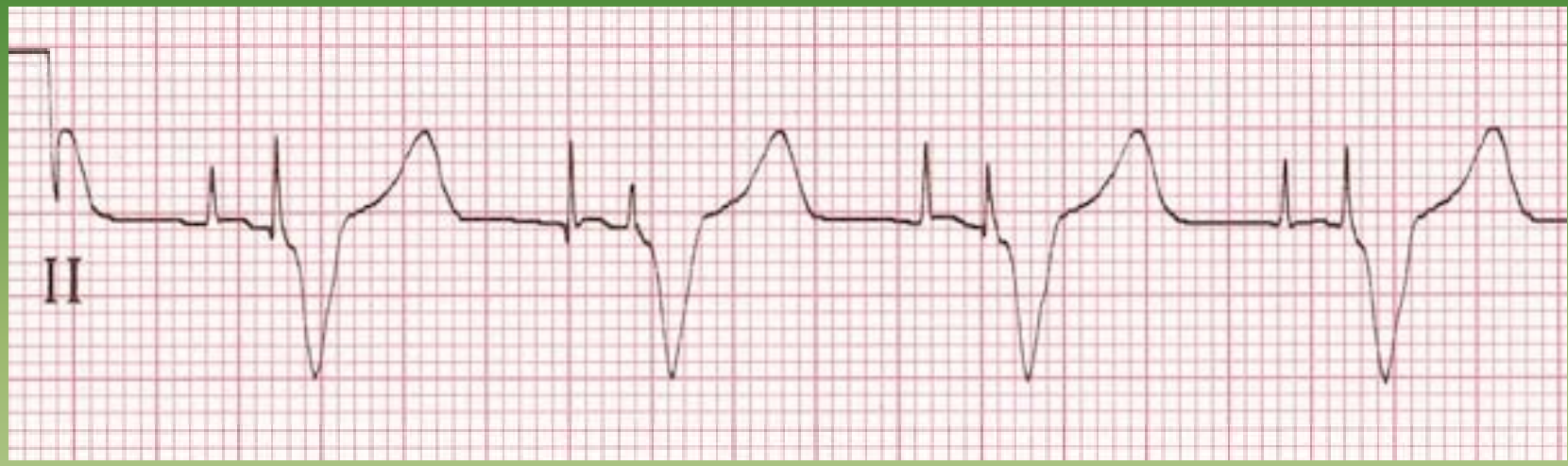


Older ones are often BIGGER!



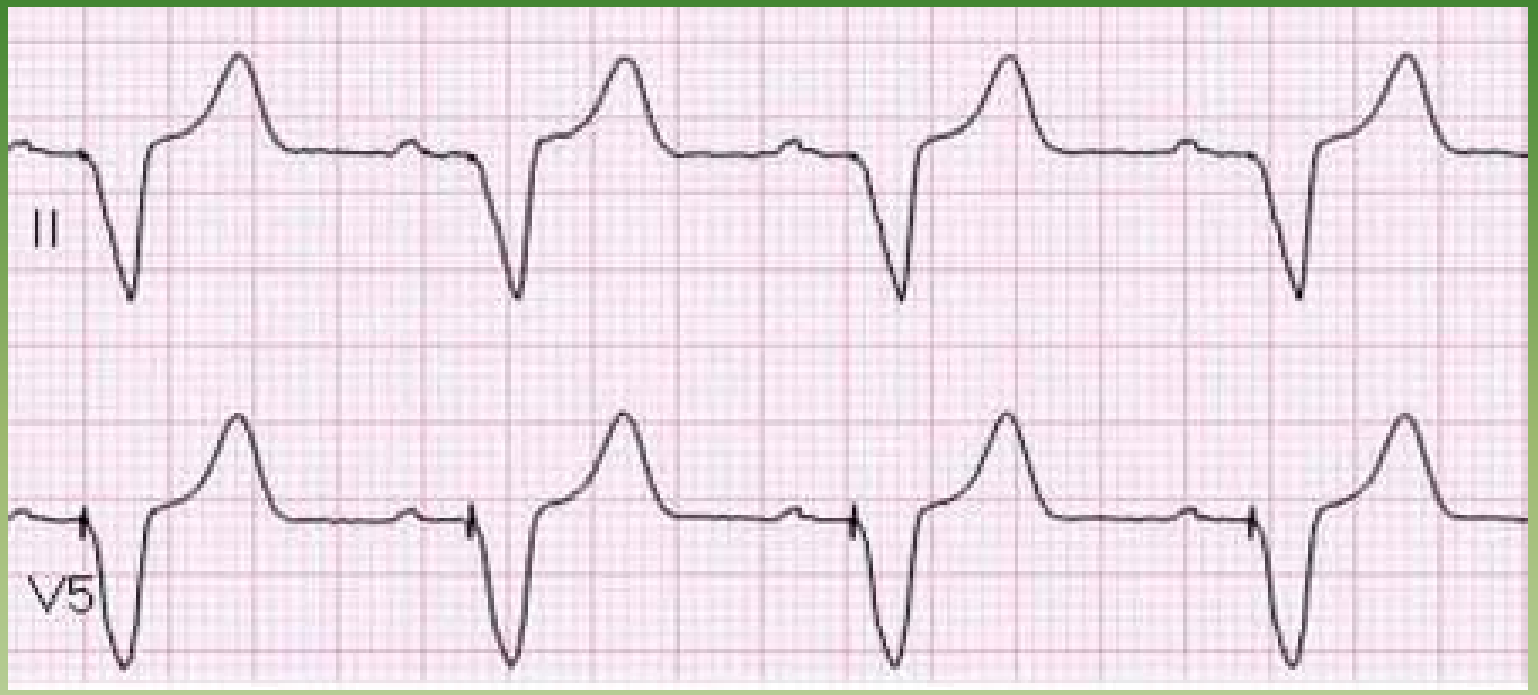
ECG ID of CIED FUNCTION

Dual chamber pacing



Used for patients with both SA NODE FAILURE and IMPULSE PROPOGATION FAILURE (high grade heart block).

A-sensed, V-paced



- **Used in cases of IMPULSE PROPAGATION FAILURE (e.g.: complete heart block)**

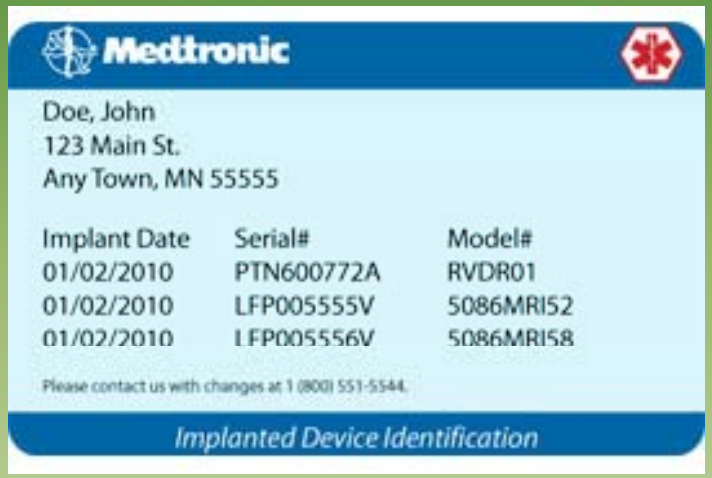
Atrial Paced (single chamber)

- **Used for SINUS NODE DYSFUNCTION.**
- **Single Lead Atrial pacing has no risk of pacer induced R-on-T (VT/VF) in Asynchronus mode!**

Preoperative Evaluation:

a. What is the device? (PM, ICD, CRT, S-ICD)
b. What brand and model?
c. Who controls it? (Pacer Rep? EP Lab Doc/Staff?)

CIED Identification Card



CIED Manufacturers 24hr Phone Numbers for Medical Professionals:

- **Boston Scientific: 1-800-CARDIAC (227-3422)**
- **Guidant** (Boston Scientific): **1-800-CARDIAC (227-3422)**
- **St. Jude Medical: 800-722-3774**
- **Medtronic: 800-633-8766 or 800-505-4636**
- **Vitatron** (Medtronic)**: 800-633-8766 or 800-505-4636**
- **Biotronik: 800-547-0394**

Directory of CIED Manufacturers:

- http://www.pacemakerclub.com/public/jpage/1/p/WebLinks/content.do

CIED Manufacturer WEBLINKS for MEDICAL PROFESSIONALS:

- Boston Scientific: http://www.bostonscientific.com/en-US/customer-service.html
- St. Jude Medical: http://professional.sjm.com/resources/emi/dental-medical

Preoperative Evaluation:

a. What is the device? (PM, ICD, CRT, S-ICD)
b. What brand and model?
c. Who controls it? (Pacer Rep? EP Lab Doc/Staff?)
d. Does your hospital have a programmer for this make and model?

CIED Programmers

Preoperative Evaluation:

a. What is the device? (PM, ICD, CRT, S-ICD)
b. What brand and model?
c. Who controls it? (Pacer Rep? EP Lab Doc/Staff?)
d. Does your hospital have a programmer for this make and model?
e. What is the magnet mode set to do?

The "Magical Magnet" . . . .

=

pacemaker magnet is just a switch. Do you know what it turns on/off ? ? ?

Most common functions the "magnetic switch" may regulate:

- **Pacemaker:** put device in ASYNCHRONUS Mode (A00/V00/D00) at rate of 99 beats per minute. The device will pace at the set rate (99) regardless of patient's inherent heart rhythm. (The rate of 99 is USUALLY greater than the patient's inherent rate – which is critical!).
- **CRT (ICD):** TURN OFF SHOCK THERAPY. The device may still pace (if patient needs pacing) but it will not sense or shock lethal dysrhythmias.

Less common functions the "magnetic switch" may regulate:

- **Magnet Mode may be TURNED OFF – so the magnet will do NOTHING.**
- **Pace at a fixed rate BASED ON DEGREE OF REMAINING BATTERY LIFE. So if the battery is nearing END OF LIFE, the "paced rate" may be LOWER than the patient's inherent Heart Rate; which can trigger "R on T" and VT/VF !**
- **Turn the device off / on**
- **Turn on mode to listen for RF controller**
- **Change modes to another function**

APPLYING THE MAGNETIC "SWITCH" . . .

- Applying a magnet to a pacemaker will initiate the magnet mode.
- This mode varies with pacemaker set-up and manufacturer.
- Usually initiates an asynchronous pacing mode – AOO, VOO, or DOO. Common set rate is 99.
- Asynchronous modes deliver constant rate paced stimuli regardless of native rate of rhythm.
- In asynchronous ventricular pacing there is a risk of pacemaker-induced ventricular tachycardia/ VF.
- Note this differs from magnet application to an Implantable Cardioversion Defibrillator (ICD) which results in DEFIBRILLATOR DEACTIVATION.

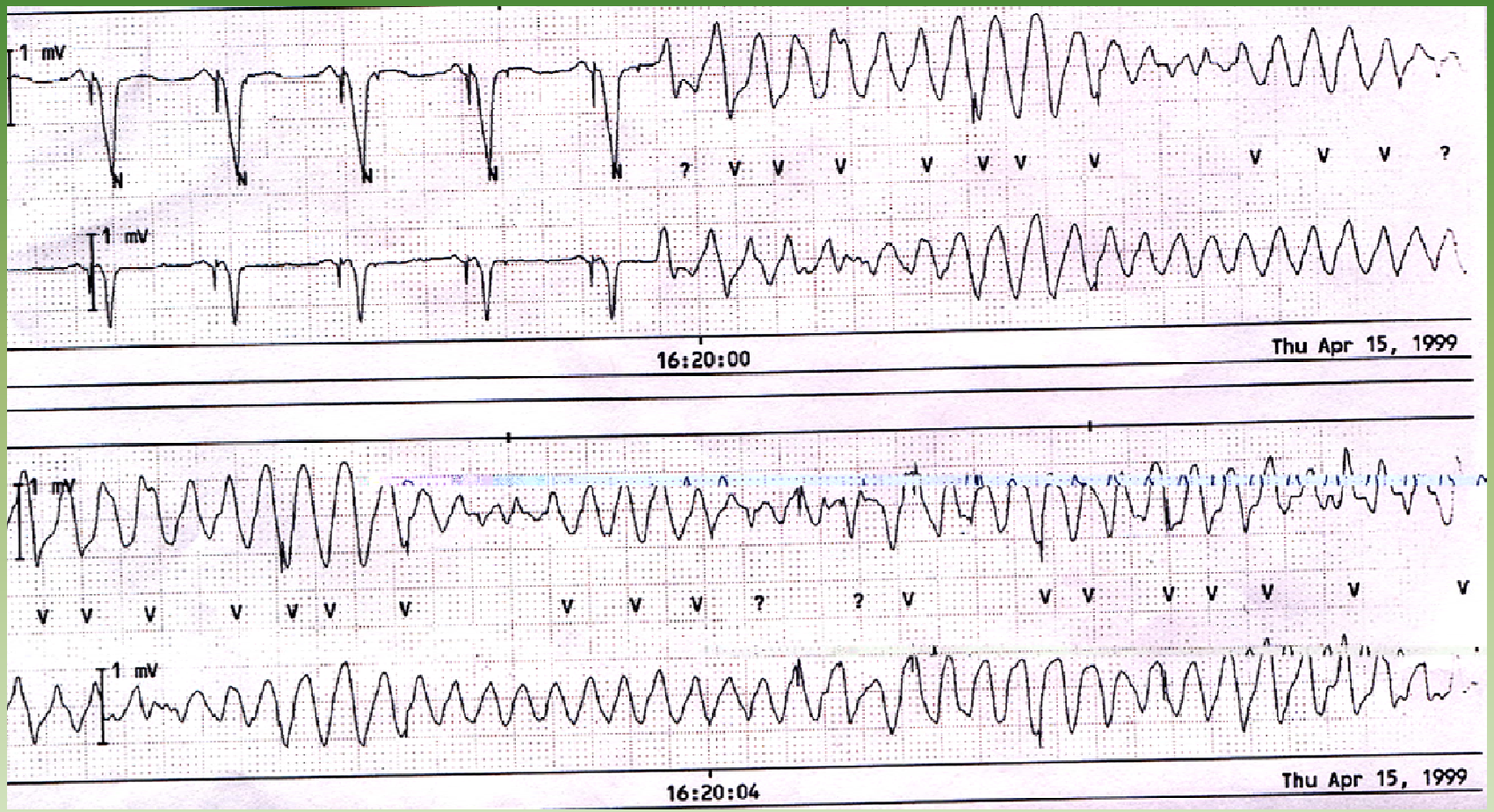
CRITICAL POINT:

IF the patient's INTRINSIC HEART RATE is GREATER THAN the PACEMAKER's ASYNCHRONUS HEART RATE, then SWITCHING the PACEMAKER to ASYNCHRONUS MODE will likely result in VT / VF and CARDIAC ARREST. (sooner or later there will be "R on T").

CRITICAL POINT:

IF you have activated ASYNCHRONUS PACING (e.g. placed a MAGNET on a PACEMAKER) of a patient who is NOT 100% pacer dependent, and the INTRINSIC HEART RATE goes ABOVE the PACING RATE, your patient may very likely experience R-on-T induced V-Tach / V-Fib.

Pacemaker Induced "R-on-T" and VF (TdP?)



Source: William Shapiro, MD USCF Dept. of Anesthesia

MAGNETS – Boston Scientific STAT Access Web Links

- CLICK HERE for Boston Scientific Pacemakers and CRT-Ps
- CLICK HERE for Boston Scientific ICDs and CRT-Ds
- CLICK HERE for Boston Scientific SUB-Q ICDs (S-ICDs)

Preoperative Evaluation:

a. What is the device? (PM, ICD, CRT, S-ICD)
b. What brand and model?
c. Who controls it? (Pacer Rep? EP Lab Doc/Staff?)
d. Does your hospital have a programmer for this make and model?
e. What is the magnet mode set to do?
f. Why does the patient have this CIED?

Preoperative Evaluation:

a. What is the device? (PM, ICD, CRT, S-ICD)
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d. Does your hospital have a programmer for this make and model?
e. What is the magnet mode set to do?
f. Why does the patient have this CIED?
g. What rhythm does the patient have when the pacemaker is shut off?

Pre-Operative Evaluation

PACEMAKERS:

CRITICAL QUESTIONS:

a) **Why does the patient have a pacemaker? (What is the patient's UNDERLYING RHYTHM and RATE?)**

b) **What is the patient's degree of PACEMAKER DEPENDENCE?**

"What will happen to the patient's HEART RATE and RHYTHM if the PACEMAKER is DISABLED?"

Pre-Operative Evaluation

ICDs:

CRITICAL QUESTIONS:

a) **What is the patient's diagnosis requiring an ICD?** ***If ICD therapy is deactivated for the procedure, patients are intrinsically more susceptible to perioperative ventricular dysrhythmias.***

b) **Is the patient ALSO DEPENDENT on the ICD's PACEMAKER function?**

Pre-Operative Evaluation
ALL CRT-P devices:

CRITICAL QUESTIONS:

a) **What is the patient's diagnosis which requires CRT-P therapy?**

b) **What is the patient's EF both WITH and WITHOUT CRT-P therapy?**

c) **Is the patient dependent on the device for HEART RATE / Rhythm control or just for ventricular resynchronization? (increasing EF)**

Pre-Operative Evaluation
ALL CRT-D devices:

CRITICAL QUESTIONS:

a) **ALL OF THE QUESTIONS IN THE PREVIOUS SLIDE (for patients with CRT-P Devices) PLUS:**

b) **What is/are the patient's condition(s) which require Defibrillation/Cardioversion?**

CRT-P and CRT-D considerations:

- **All patients who have underlying conditions which require an ICD are at higher risk for LETHAL DYSRYTHMIAS in the Operative Setting.**
- **All patients who have underlying conditions which require a CRT-D (BOTH an ICD *and* Ventricular Resynchronization) have a low EF (=REDUCED CARDIAC RESERVE) and are at increased for HEMODYNAMIC INSTABILITY and LETHAL DYSRHYTHMIAs in the Operative Setting.**
- **CONSIDER an ART LINE for CONTINUOUS HEMODYNAMIC MONITORING.**

2011 HRS Recommendations: Use of Electrosurgery

During the procedure

- Monitor the patient's pulse and/or ECG during electrosurgery.
- Keep the electrosurgery tip more than 15 cm (6 inches) away from the implanted device and pacing lead(s).
- Use short-duration, (4-5 seconds) intermittent and irregular bursts at the lowest feasible energy levels.
- Position the electrosurgery system's ground plate so that the current pathway does not pass through or near the pacemaker and lead(s).
- Where possible, use a bipolar electrosurgery system.
- Have temporary pacing and defibrillation equipment available.

Pacemaker Dependent and ICD Patients:

- Whenever possible have ECG Defib/ Cardioversion/Pacing pads attached to patient and be monitoring patient's ECG through this system.
- ALTERNATE methods of pacing to consider:
  - Transvenous
  - Transesophageal

EMERGENCY SURGERY

1. **Identify type of device (Pacemaker, ICD, CRT)**
   - **patient/ family**
   - **CIED Identification Card**
   - **Medical Records**
   - **Chest X-Ray**
     - **COILS = ICD**
     - **Wire on L side of heart / LV = CRT device**
2. **Place defib/pacing pads on patient, attach to Monitor/Defibrillator. ALWAYS be prepared to Defib, Cardiovert or Pace !**

EMERGENCY SURGERY

3. **Run ECG Strip: is patient PACER Dependent? (pacer spikes visible?) NOTE that some ECG monitors DO NOT pick up PACER SPIKES. A 12 Lead ECG is PREFERABLE if there is time. If there are no pacing spikes, one can proceed to surgery with a magnet in the room in case inappropriate sensing occurs.**
4. **If there is time, have DEVICE REP come to OR STAT.**
5. **If device is CRT, have ART LINE in place**

EMERGENCY SURGERY

6. **If CIED is an ICD, and the SURGERY SITE is ABOVE the umbilicus, place a magnet over the device to deactivate DEFIB/Cardioversion functions – BUT ONLY after patient has been attached to ECG MONITOR/Defibrillator with PACING capabilities.**
7. **ALWAYS position Bovie grounding pad so EMI current pathway does not pass through CIED, leads or heart.**
8. **Monopolar electrosurgery should be used in short (4-5 second) bursts.**

2011 HRS Recommendations: Use of Electrosurgery

After the procedure

- **A thorough pacing system evaluation by the patient's following physician should be considered, especially in dependent patients or if a change in pacing performance is suspected.**
- **If the device was programmed to an asynchronous pacing mode or to higher outputs, reprogram the device to the desired settings.**

AFTER THE SURGERY - ALWAYS

- ***MAKE SURE THE DEVICE IS PROGRAMMED TO APPROPRIATE THERAPIES.***
- ***FAILURE TO RESTORE CIED DEVICE THERAPY (or therapies) TO APPROPRIATE SETTINGS HAVE RESULTED IN PATIENT MORTALITY.***

SUMMARY: HRS 2011 General principles of CIED management

- The perioperative management of CIEDs must be individualized to the patient, the type of CIED and the procedure being performed. A single recommendation for all CIED patients is not appropriate
- A CIED team is defined as the physicians and physician extenders who monitor the CIED function of the patient
- The surgical or procedural team should communicate with the CIED team to identify the type of procedure and likely risk of EMI
- The CIED team should communicate with the procedure team to deliver a prescription for the perioperative management of patients with CIEDs.
- For most patients, the prescription can be made from a review of the records of the CIED clinic. A small percentage of patients may require consultation from CIED specialists if the information is not available.
- It is inappropriate to have industry employed allied health professionals independently develop this prescription

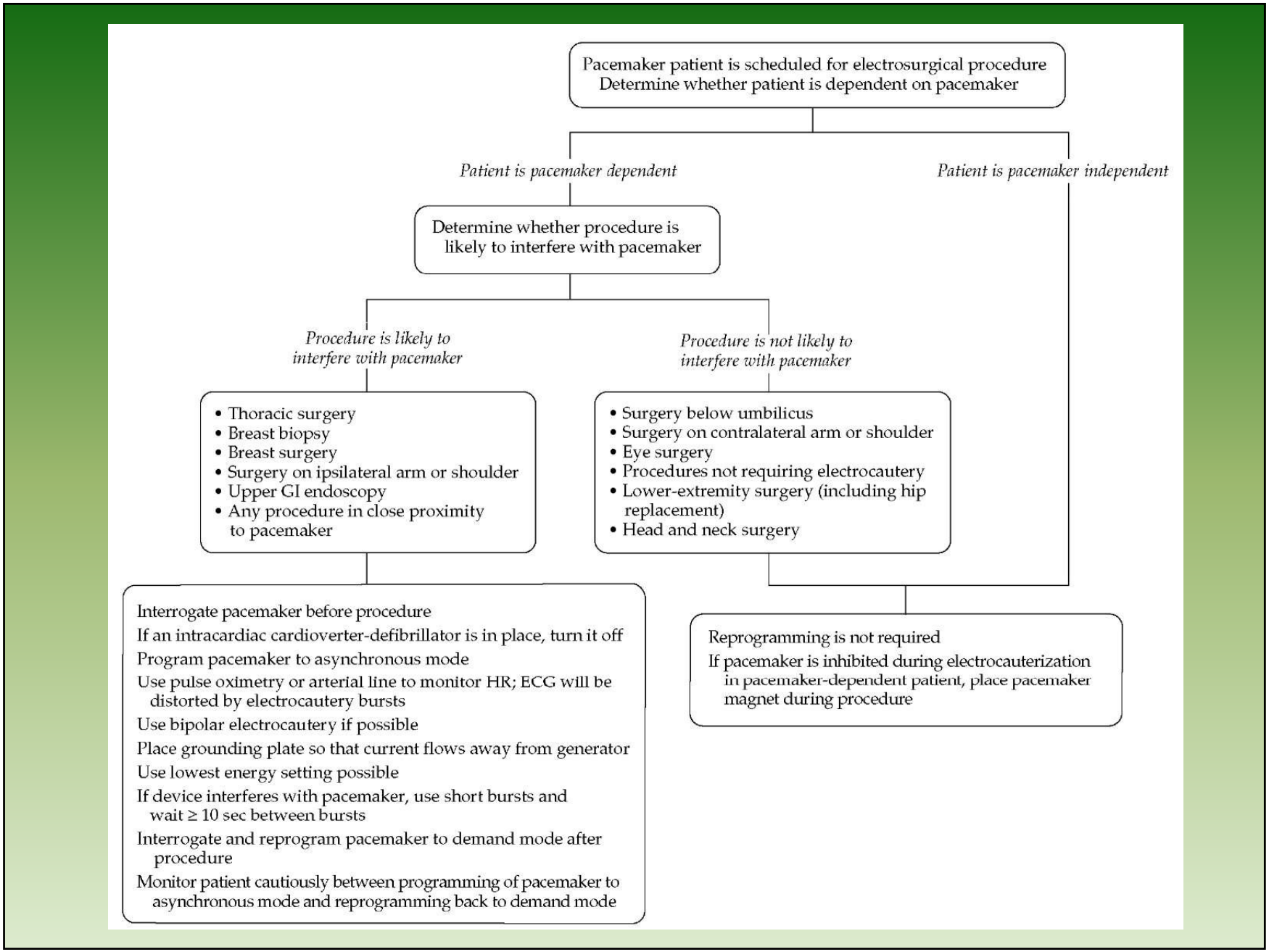
Some extra, helpful info:

Sources of Electromagnetic Interference That Can Affect Pacemakers

	Source	Safe with Pacemaker	Specific Recommendations
	MRI	No	Rarely done; restricted to life-threatening situations with close monitoring
	CT scanning	Yes	Pacemaker may interfere with images of thorax
	Lithotripsy	Yes	Activity sensors should be disabled Pacemaker-dependent patients should be programmed to asynchronous mode Shocks should be synchronized to R wave Contraindicated in patients with abdominal implants
	External direct current cardioversion	Yes	Avoid placing patches or paddles directly over pacemaker Have transcutaneous pacing available Use lowest possible energy and biphasic waveform when possible Interrogate pacemaker after procedure

Medical sources	Neurostimulation	Yes	Test at highest output for pacemaker inhibition before discharge
	Peripheral nerve stimulation	Yes	Nerve conduction studies below the elbow or knee are safe
	Transcutaneous electric nerve stimulation (TENS)	Yes	May require increasing sensing threshold Avoid placing TENS electrodes parallel to pacing vector
	Radiation therapy	Yes	Avoid direct irradiation; maximize shielding If total dose is expected to exceed 10 Gy, device may have to be relocated out of field Reprogram to asynchronous mode if patient is pacemaker dependent Initiate continuous monitoring if patient is pacemaker dependent Check device function after each session and for first few weeks after therapy

	Diagnostic ultrasonography, including echocardiography	Yes	No precautions needed
	Surgical electrocautery	Yes	[See Figure 5]
	Microwave ovens, TV remote-control devices, cordless telephones, other household appliances	Yes	All devices considered safe; controlled studies lacking
	Slot machines	Yes	May cause interaction and spurious shocks with ICDs
	Walk-through metal detectors	Yes	Do not dwell in scanner; device will probably set off alarm Patients should be advised to carry pacemaker ID card as proof
Household and industrial sources	Handheld security wand	Yes	Patient should instruct person conducting search not to put wand directly over pacemaker generator
	Cellular telephones	Yes	Keep phone at least 10 cm from pacemaker; do not keep phone in shirt pocket above pacemaker; try to use contralateral ear when using phone
	Electronic article surveillance devices	Yes	Do not dwell in scanner
	Industrial sources, including large electric motors, magnets, and high-voltage power	Yes/No	Depends on source and proximity of pacemaker; site visit may be needed to determine safety
	Arc-welding equipment	No	Cannot be used because of magnetic field of cable


Pacemaker patient is scheduled for electrosurgical procedure
Determine whether patient is dependent on pacemaker
Patient is pacemaker dependent
Patient is pacemaker independent
Determine whether procedure is likely to interfere with pacemaker
Procedure is likely to interfere with pacemaker
Procedure is not likely to interfere with pacemaker
• Thoracic surgery
• Breast biopsy
• Breast surgery
• Surgery on ipsilateral arm or shoulder
• Upper GI endoscopy
• Any procedure in close proximity to pacemaker
• Surgery below umbilicus
• Surgery on contralateral arm or shoulder
• Eye surgery
• Procedures not requiring electrocautery
• Lower-extremity surgery (including hip replacement)
• Head and neck surgery
Interrogate pacemaker before procedure
If an intracardiac cardioverter-defibrillator is in place, turn it off
Program pacemaker to asynchronous mode
Use pulse oximetry or arterial line to monitor HR; ECG will be distorted by electrocautery bursts
Use bipolar electrocautery if possible
Place grounding plate so that current flows away from generator
Use lowest energy setting possible
If device interferes with pacemaker, use short bursts and wait ≥ 10 sec between bursts
Interrogate and reprogram pacemaker to demand mode after procedure
Monitor patient cautiously between programming of pacemaker to asynchronous mode and reprogramming back to demand mode
Reprogramming is not required
If pacemaker is inhibited during electrocauterization in pacemaker-dependent patient, place pacemaker magnet during procedure

?? QUESTIONS ??

Thank you,

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For a color PDF version of this program and other cardiac resources click here