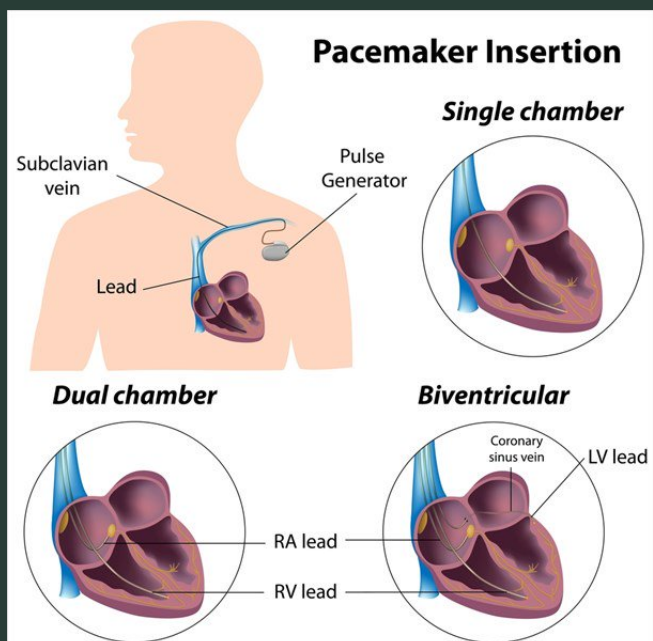


# PACEMAKERS AND IMPLANTABLE CARDIOVERTER DEFIBRILLATORS

## Coding

Chamber(s) paced	Chamber(s) sensed	Response to sensing	Programmability/Rate modulation	Multisite pacing
A→Atrium V→Ventricle D→Dual chamber O→None	A→Atrium V→Ventricle D→Dual chamber O→None	T→Triggered I→Inhibited D→(Dual triggered and inhibited) O→None	P→Simple programmable M→Multi-programmable C→Communicating R→Rate modulation O→None	A→Atrium V→Ventricle D→Dual chamber O→None



## Chest X-ray Considerations

- # of leads and location
- Continuity of leads
- Manufacturer code
- Extra leads may indicate an old device with capped leads

## ECG Considerations

- **Atrial Pacing:** spike before P wave
- **Ventricular Pacing:** spike before QRS
- **Dual Pacing:** spike before P wave and spike before QRS
- Ventricular pacing complicates MI evaluation as it interferes with QRS and ST-T changes
  - Compare to previous tracings
  - Atrial pacing does not interfere



Stimulus resulting in altered QRS morphology.



Stimulus not resulting in QRS changes.

**Fusion beats:** device is failing to pick up intrinsic activity and thus will stimulate and affect QRS morphology.

**Pseudofusion:** same as fusion except the myocardium is refractory so QRS is not affected

## COMPLICATIONS

### <6 WEEKS FROM IMPLANTATION?

Infection  
Upper Extremity thrombosis  
SVC Syndrome  
Hemothorax  
Pneumothorax  
Hematoma

### PATHOLOGY

Infarction/Ischemia  
Electrolyte Disturbance  
New BBB  
Battery Life  
Malfunction

# Medtronic Alarm Recognition

**"English Ambulance" = malfunction**

\*occurs at the same time each day until device interrogation

**Intermittent beep = low battery (2-6 months remaining)**

\*occurs the same time each day until device interrogation

**10 second long solid tone = magnet alert**



3 tone alarms exist for Medtronic Pacemaker/Defib units

Vibrations for St. Jude/Abbott devices

One tone type for Boston devices

## MALFUNCTION OR PATHOLOGY?

**Failure to Capture:** appropriate device stimulus with no resultant myocardial activation



**Causes:**

- Ischemia/Infarct
- Electrolyte disturbance (hyperkalemia)
- Electrode displacement
- Lead fracture

**Failure to Pace:** lack of intrinsic activity failing to provoke pacing stimulus from device

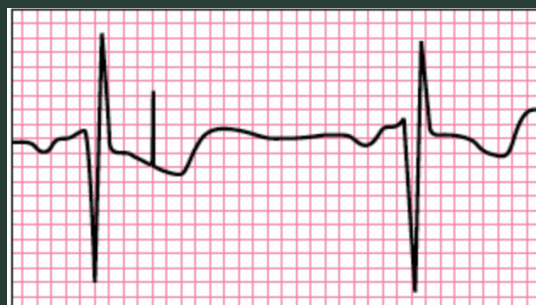


**Causes:**

- Oversensing
- Insulation Defect
- Lead fracture

**Oversensing:** device senses abnormal intrinsic activity (e.g. not true P waves) that inhibits it leading to *underpacing*. Could be due to skeletal muscle activity being picked up.

**Undersensing:** device fails to sense adequate intrinsic activity (e.g. true P waves) leading to *overpacing*



**Causes:**

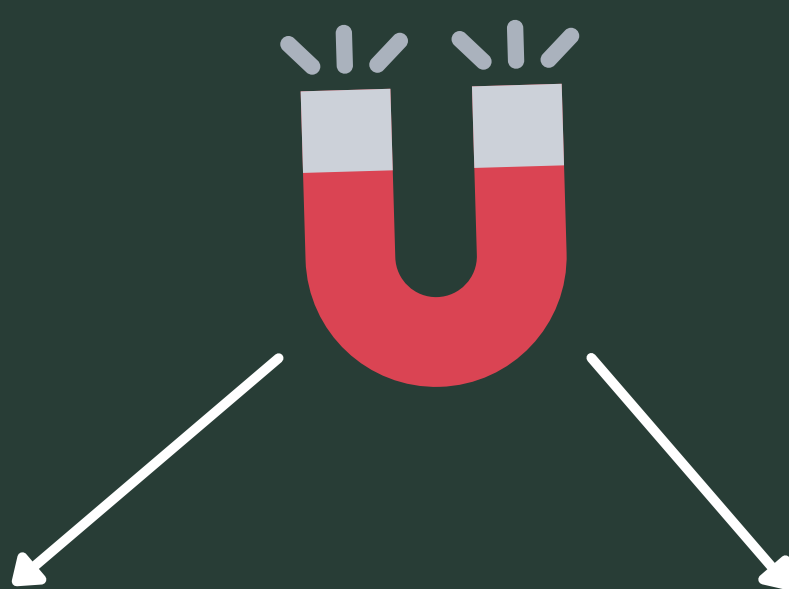
- New Bundle Branch Block
- Electrolyte disturbance
- Class 1C antiarrhythmics
- Insulation Defect

**Pacemaker-Mediated Tachycardia:** a reentrant pathway through the pacemaker. Occurs only in dual pacers.



Treat with adenosine or magnet

# Magnet Medicine



## Pacemaker

Asynchronous fixed rate  
pacing ~80bpm

**Tx:** Pacemaker-mediated  
Tachycardia

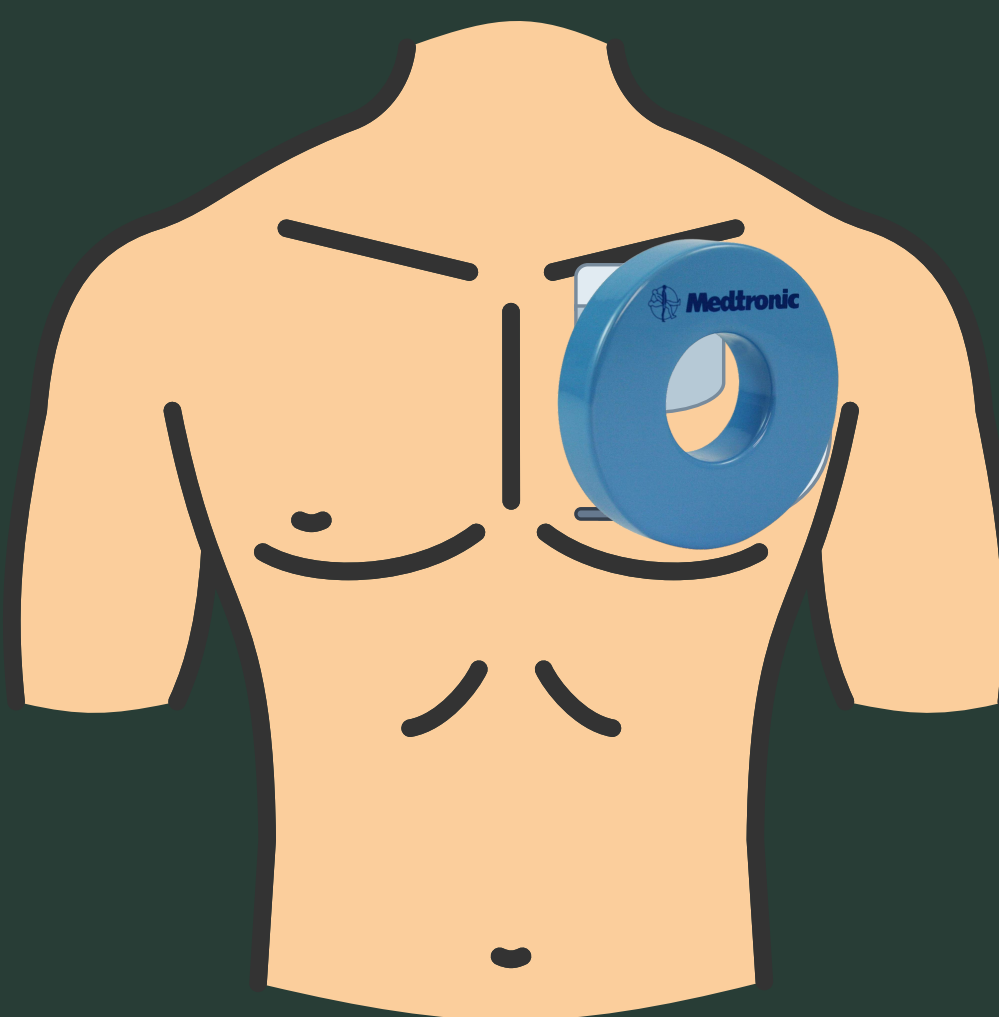
## ICD

Disables Anti-Tachycardia  
Pacing /Defibrillation  
function temporarily

**Tx:** Continuous Device  
Shocking of Inappropriate  
Rhythm

*Uncertain if the tachycardia is pacemaker-mediated?* Does not hurt to try the magnet as normal settings of pacemaker are restored as soon as the magnet is removed

Simply place magnet over housing unit  
-usually located on crash cart  
-watch EKG for changes



Jerrard, G., Berberian, J., & Zeserson, E. (2019, February 5). Pacemaker basics for the emergency physician. EMRA. <https://www.emra.org/emresident/article/pacemaker-basics/>.

Interpretation of pacemaker ecg. ECG & ECHO. (2020, September 9). <https://ecgwaves.com/topic/ecg-pacemaker-rhythm-malfunction-failure-tachyarrhythmia/>.

White, J. L. (n.d.). Don't Be Shocked -Pacer/Icd Issues. Department of Emergency Medicine. Philadelphia; Thomas Jefferson University Hospital. Presentation Slides