

OVERVIEW

- Pacemaker function and troubleshooting
- ICD function
- ICD Therapy: The good the bad and the ugly
- Urgencies and Emergencies
- Who and when to call

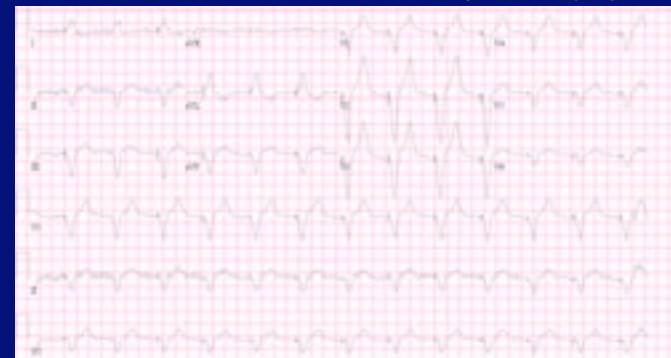
Device Evolution

Note: All defibrillators have pacemaker capabilities but pacemakers do not have defibrillator capabilities.

The slide titled 'Device Evolution' features three images: a schematic diagram of a heart with a single lead, a cross-sectional diagram of a heart with a dual-chamber pacemaker, and a chest X-ray showing a dual-chamber pacemaker with two leads. A note at the bottom states: 'Note: All defibrillators have pacemaker capabilities but pacemakers do not have defibrillator capabilities.'

ECG during pacing

- During pacing from the right ventricular apex, most of right ventricle captured first, then left ventricle: *Left bundle branch block with superior axis (-V6)*



Note: this is not true for biventricular pacing!

Pacemaker Troubleshooting

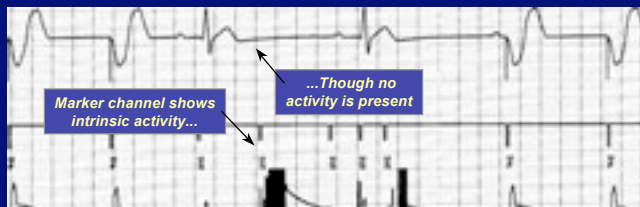
- 4 main types of problems:
 - **Over-sensing**
 - **Under-sensing**
 - Non-capture
 - No Output
- Can occur in any chamber where a pacemaker lead exists:
 - Atrium
 - Ventricle

Undersensing

- An intrinsic depolarization that is present, yet not seen or sensed by the pacemaker



Oversensing



Ventricular Oversensing

- The sensing of an inappropriate signal
 - Can be physiologic or nonphysiologic

Advanced Pacing Parameters

- **Magnet response**
- Hysteresis
- **Mode switching**
- Upper rate behaviour
- PMT/PMT intervention
- Safety pacing
- Noise reversion

Magnet Operation

- Magnet application causes asynchronous pacing at a designated “magnet” rate



DDD(R) → DOO

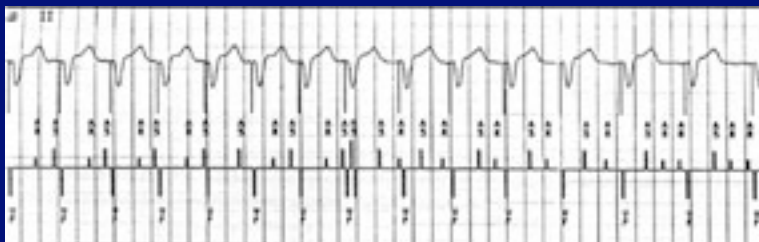
VVI(R) → VOO

Magnet Operation in ICD's

- All ICD's have pacemaker capability
- No effect on the pacemaker in the ICD
- Suspends all therapies (ATP and shocks) for the time that the magnet is maintained over the ICD generator.
- Sensing and storage of events will continue.

Mode Switching

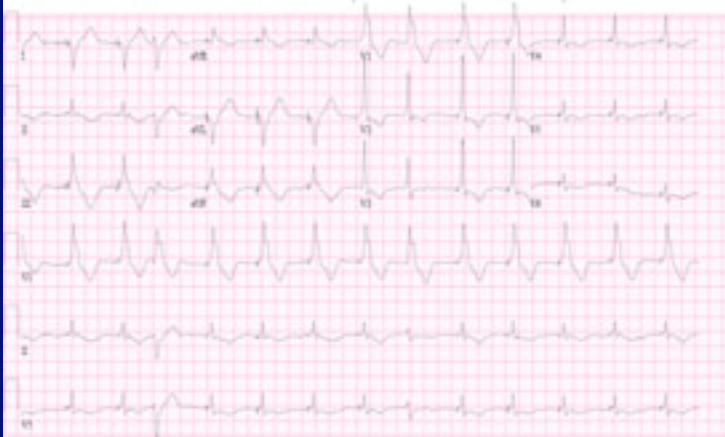
- Device switches from tracking (DDDR) to nontracking (DDIR) mode



Case 1

- You are asked to assess your patient, a 65 year old man, prior to discharge. He just had a single lead VVIR pacemaker inserted.
- He feels well and wants to go home.
- His nurse presents you with the following ECG to clear him for discharge.

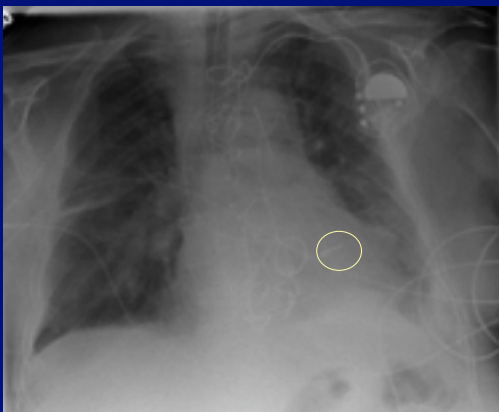
Case 1 Pacemaker patient post-op ECG



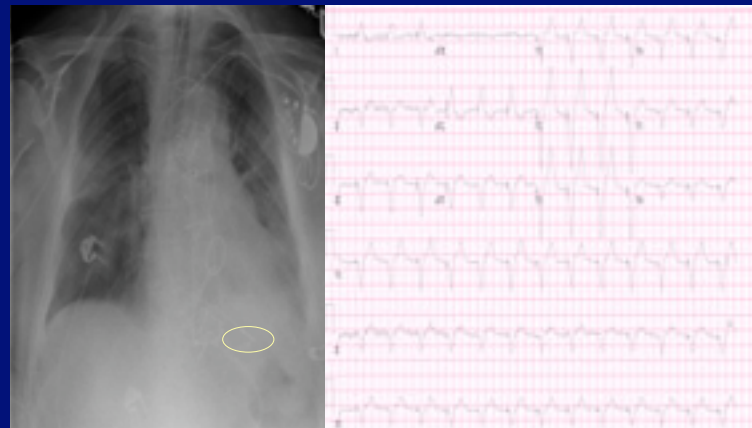
Case 1 Question: What do you do?

- 1. Discharge the patient with follow up in pacemaker clinic.
- 2. Get a CXR.
- 3. Call the surgeons STAT.
- 4. Get a TEE.

CXR in Recovery



CXR and ECG after reoperation

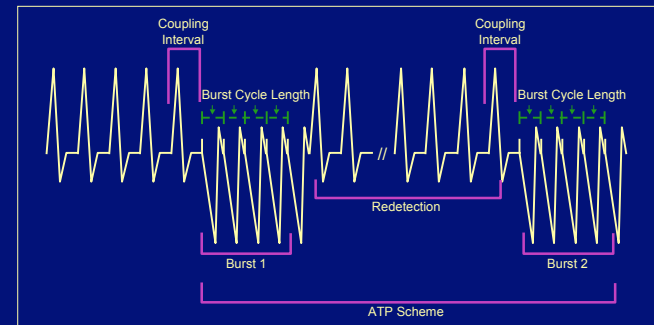


RV apical pacing: LBBB, superior axis, neg V6

ICD Function

- Implanted to treat VT or VF
- May detect other fast rhythms
 - atrial fibrillation (irregular ventricular response)
 - sinus tachycardia (gradually increases in rate)
 - atrial tachycardia (may begin suddenly)
 - other noise (EMI, lead problems)
- Treats using anti-tachycardia pacing (a short train of paced beats at rates faster than the rhythm) or shocks.

Anti-tachycardia Pacing



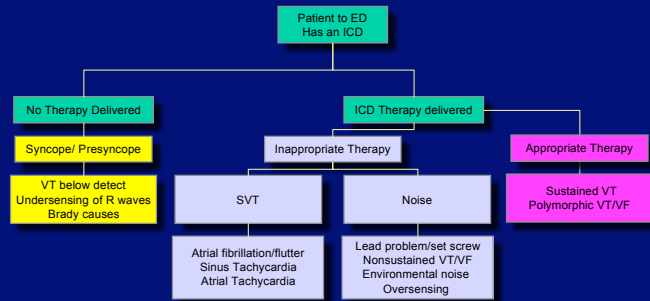
Case #2

- 55 yr old male
- Grade I LV
- Has a secondary prevention ICD for idiopathic VF. While playing squash, he received 49 shocks. (yes 49!)
- You are called to assess him in the ED.

Question 1: what do you do?

- A Amiodarone IV
- B Metoprolol IV
- C Get external defibrillator
- D Place a magnet over the ICD
- E Call for psychiatric consult

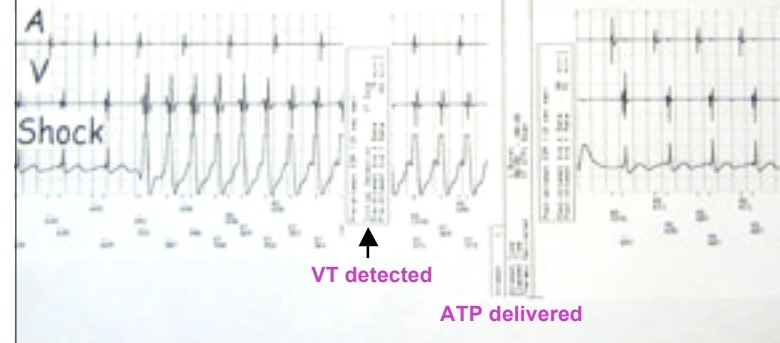
ICD Troubleshooting Algorithm



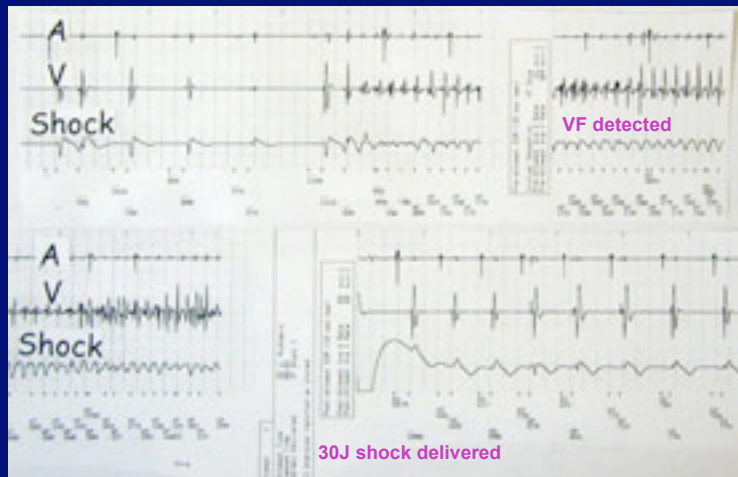
SMH 2007/ICD troubleshooting

VT Treated With ATP

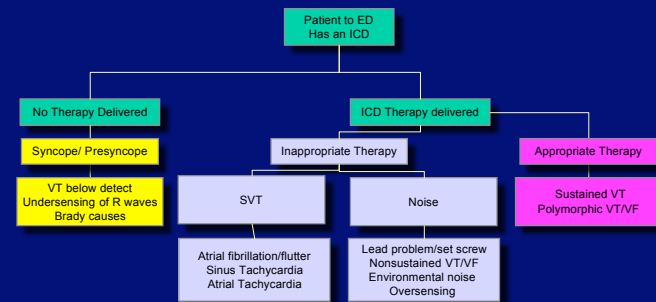
• 3 months post implant episode of VT in ICD datalog



Patient E.R. watching TV

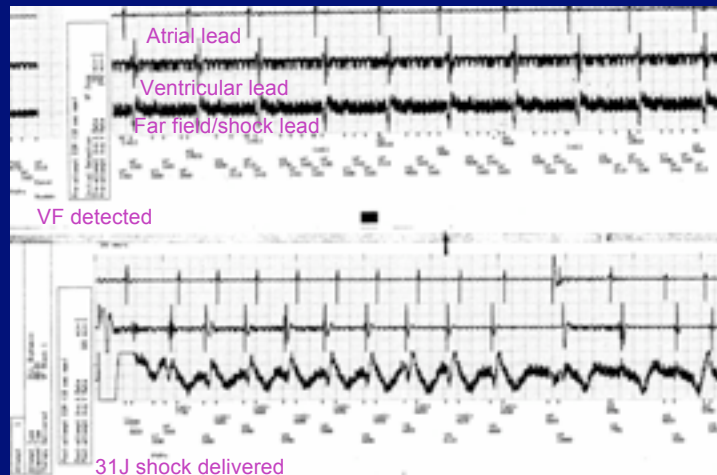


ICD Troubleshooting Algorithm



SMH 2007/ICD troubleshooting

EMI caused by TENS



Urgencies/ Emergencies

- **Multiple ICD shocks**
 - **Appropriate**
 - Electrical storm
 - Assess secondary causes - sepsis, ischemia, hyperthyroidism
 - Treat VT/VF - Amiodarone, BB, correct electrolytes
 - Call for interrogation of ICD

Urgencies/ Emergencies

- **Multiple ICD shocks**
- **Inappropriate**
 - Sinus/ Atrial Tachycardias
 - Atrial Fibrillation
 - Lead issues (# or dislodgement)
 - Noise
- **Tx: MAGNET, MAGNET, MAGNET**

Urgencies/ Emergencies

- Patient in VT/VF with an ICD but not receiving therapy
 - VT at rates < ICD rate cut off
 - Lead issues
 - Small signal amplitude
- Treat VF/VT
 - Amiodarone, BB, External Defib

