Getting Into the Rhythm: Pacemakers and ICDs

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Devices

- Pacemakers
- Defibrillators
- Bi-Ventricular pacemakers or ICDs
- Loop Recorders

A Little History

- 1930-1940's external pacemakers developed
- 1960's Successful pacemaker implant, success with external defibrillation and development of implanted defibrillator
- 1980's Automated Implantable Cardioverter defibrillator implant
- 1996-MADIT trial
- 2000's Remote monitoring

Reference=http://www.hrsonline.org/news/ep-history/timeline/ accessed September 6, 2012

Indications for Pacemakers and Defibrillators

Pacemakers:

- Bradycardia-symptomatic
  - Ex. Sinus node dysfunction, Chronotropic incompetence, AV block
- TachyBrady syndrome
- Neurocardiogenic syncope
- Asystole/pauses
  - Ex. Carotid hypersensitivity

Defibrillators:

- Primary prevention of sudden cardiac death
  - ICM, NICM, HCM, Genetic abnormality
- Secondary prevention of sudden cardiac death
  - Inducible sustained VT on EP study

Indications for Bi-Ventricular devices aka Cardiac Resynchronization Therapy (CRT)

- CRT-P- Bi-VPacing only; CRT-D-Defib capabilities with Bi-V pacing
- Criteria: Ejection fraction,QRS duration, NYHA functional class

Class	Patient Symptoms
Class I (Mild)	No limitation of physical activity. Ordinary physical activity doesnot cause undue fatigue, palpitation, or dyspnea (shortness of breath).
Class II (Mild)	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in fatigue, palpitation, or dyspnea.
Class III (Moderate)	Markedlimitation of physical activity. Comfortable at rest, but less than ordinary activity causes fatigue, palpitation, or dyspnea.
Class IV (Severe)	Unable to carryout any physical activity without discomfort.Symptomsof cardiac insufficiency at rest. If any physical activity is undertaken, discomfort is increased.

Image: Heart Failure Society of America, 2002

All the Pieces

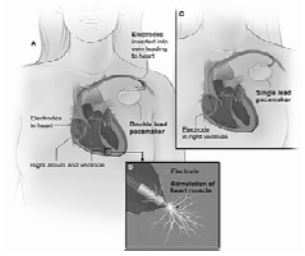


Image: http://www.nhlbi.nih.gov/health/health-topics/topics/pace/howdoes.html accessed 12/7/11

Before Device Implant

- NPO after midnight
- Medication instructions (Often procedures done on coumadin or pradaxa. Continue plavix, aspirin and other medications. Adjust/hold diabetes medications).
- Labs (CBC, platelet, Chem 8, PT/INR if indicated)

The Procedure

- Moderate sedation/ Local anesthetic
- Some with general anesthesia
- New pacemaker or defibrillator implant= overnight stay
- Generator ("battery") change= same day for pacemaker, overnight for ICDs (DFT testing)

Following Implant

- Discharge instructions- dressing
- Antibiotics
- If new system/lead no lifting that arm above shoulder level for 6 weeks to allow the leads to heal
- Lifting/weight restrictions
- Red flags-- fever, drainage, pain, hematoma
- First appointment 6 weeks post-implant for wound check and initial interrogation.

Follow-up

- Establish follow up schedule (in-office vs. telephone checks)
- Pacemakers-Dual chamber- in office every 6 months with transtelephonic monitoring every 2-3 months
- Pacemakers- Single chamber- in office every year with transtelephonic monitoring every 2-3 months
- ICDs- Follow up every 3 months in-office OR every 3 months remote monitoring with in-office checks every year

Basics of Pacing Modes

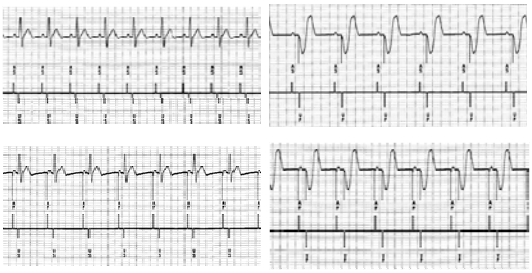
- Single, dual, Bi-ventricular

The NASPE/BPEG Generic (NBG) Pacemaker Code (Revised 2002)

Position	I	II	III	IV	V
Category:	Chamber(s) paced	Chamber(s) sensed	Response to sensing	Rate modulation	Multisite pacing
	O = None A = Atrium V = Ventricle D = Dual (A+V)	O = None A = Atrium V = Ventricle D = Dual (A+V)	O = None T = Triggered I = Inhibited D = Dual (T+I)	O = None R = Rate modulation	O = None A = Atrium V = Ventricle D = Dual (A+V)
Mnemonic only:	S = Single (A or V)	S = Single (A or V)			

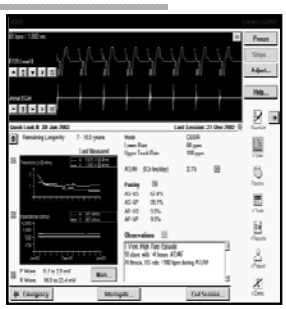
Image: www.hrsonline, accessed May 7, 2010

Intracardiac electrogram (aka IEGM or EGM)

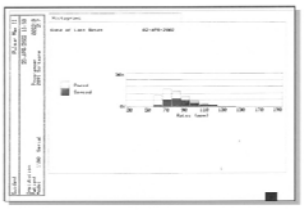


Interrogating what?

- Battery status
- Sensing (p waves and R waves)
- Impedance (lead integrity)
- Threshold (pacing capture)
- Alerts
- Episodes (atrial and/or ventricular)

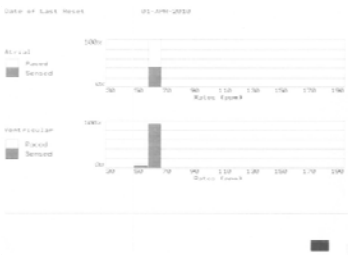


Histograms-heart rate variability



Ventricular heart rates- what we like to see…

Blunted heart rate variability



What we don't like to see…

Special features

- Rate response (4th position in NBG code)- allows heart rate to adjust to meet metabolic demands
  - CO= HR x SV
  - Sensors- minute ventilation, accelerometer, blended

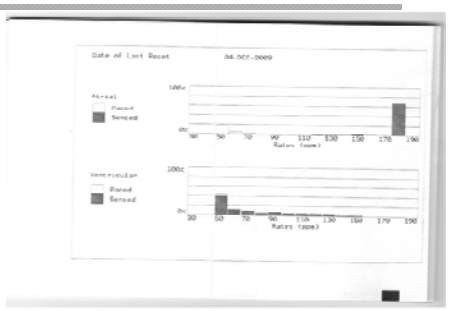
Special features

- Mode Switch
  - Device changes mode in response to rapid, intrinsic atrial activity
  - Only in dual chamber devices
  - Eliminates tracking of high atrial rates to prevent rapid (paced) ventricular rates
  - Can monitor atrial arrhythmia burden

Mode Switch

Dual chamber pacemaker-atrial fibrillation

Mode Switch

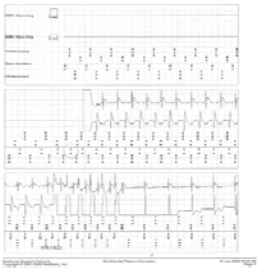


ICD therapy

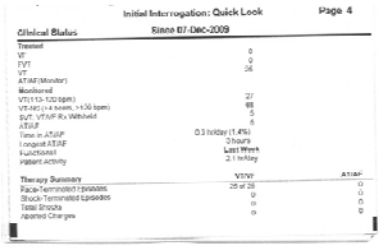
- Programmable "zones"
  - Can have a monitor only zone (no therapy), ATP and shocks

ATP vs. Shock

- ATP-Anti-Tachycardia Pacing
- ATP can be programmed for stable/slower VT
  - Less painful (some patient's unaware) and can prevent shocks
- VF zone- no ATP.
- Shock-"Kicked in the chest by a horse"



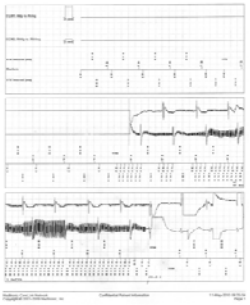
ATP for VT



More about ICDs

- Appropriate vs. inappropriate shock
- VT vs SVT discriminators
  - Device evaluates morphology, onset, presence of atrial activity (if dual chamber device), stability (regular vs. irregular)
  - Not used in VF zone
  - Programmable algorithms
  - Morphology template

Shock due to "noise"



What to do in the event of a shock?

- We always want to know!!
- One shock and feel ok after- call during business hours
  - We will ask that a remote transmission be done or that the patient come into the office to evaluate if shock appropriate or inappropriate
- One (or more) shock and feel badly, call 911 and go to the emergency room
- More than one shock (even if feeling well), call 911 and go to the emergency room

A word about the magnet…

- Placing a magnet over the device causes asynchronous pacing (converting to a DOO or VOO mode (no sensing)).
- For ICDs, magnet placement inhibits tachy therapies
- Removing the magnet restores previous settings- no re-programming necessary

Other considerations

- Type of work- No commercial driving with ICDs, welding restrictions
- Repetitive movements- weight lifting restricted. Longer healing time for swimming, golf.
- At the airport show ID card
- EMI (Electromagnetic interference)
- No MRI
- Hunting-left or right side
- Household appliances/cell phones generally ok
- Radiation therapy
- Surgery

Problems

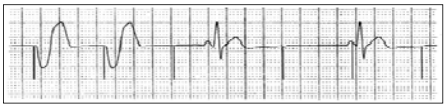
- Sensing issues
- Failure to capture
- Inappropriate shock
- Lead fracture
- Lead dislodgment
- Infection
- Pacemaker syndrome
- Reduced Bi-V pacing
- Pacemaker Mediated Tachycardia (PMT)

Sensing issues

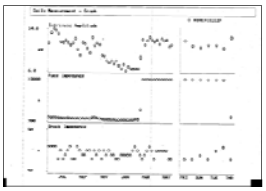
Undersensing= overpacing
Oversensing= underpacing

Ex. Atrial undersensing

Failure to capture



Possible lead fracture



Dramatic increase in impedance

Device Deactivation

- End of Life/Withdrawal of therapy
- ICD or pacemaker therapies can be turned off at patient request
- Ethical and legal principles

Questions?????

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