

Introduction to Cardiac Devices

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Disclosures

- ▶ None



Agenda

▶ Pacemakers

- ▶ Indications
- ▶ Contraindications
- ▶ Device components

▶ Implantable Cardioverter Defibrillators (ICD)

- ▶ Indications
- ▶ Contraindications
- ▶ Device components

Pacemaker vs Defibrillator

▶ Pacemaker

- ▶ Increase heart rate through electrical impulses to cause myocardial contraction
- ▶ Treat slow heart rates
- ▶ Do not affect fast heart rates
- ▶ Monitor for VT/VF

▶ Defibrillator

- ▶ Shocks the heart in the setting of VT/VF to restore sinus rhythm
- ▶ Transvenous defibrillators can ALSO pace the heart

Case 1

- ▶ 70F presents with fatigue and inability to exercise as she could previously. When prompted she also states episodes of dizziness.
- ▶ Exam notable for HR 44bpm
- ▶ Not on AV nodal blocking agents
- ▶ Labs including electrolytes and TSH WNL
- ▶ Home monitoring reveal sinus pause of 4.2 seconds.

Does this person need a pacemaker?

Meets pacemaker indications!

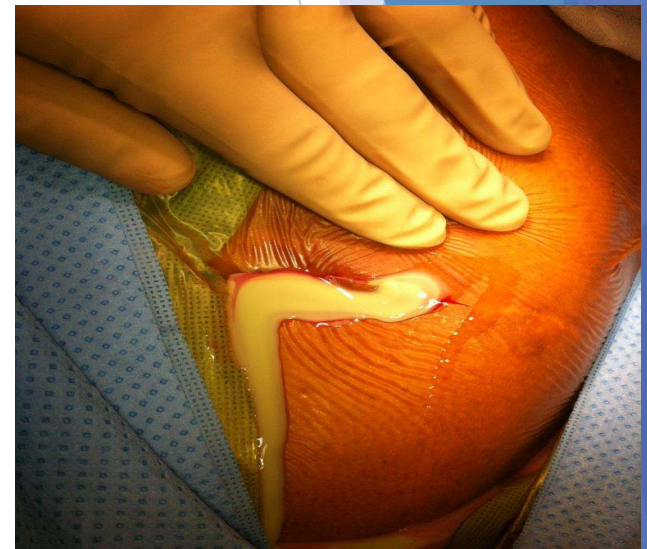
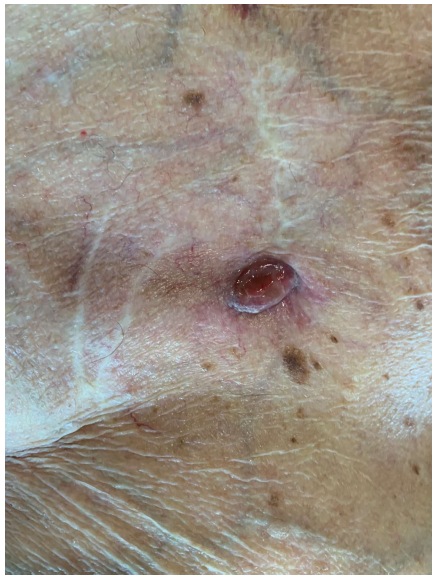
The background features abstract, overlapping geometric shapes in various shades of blue, ranging from light to dark. The shapes are primarily triangles and polygons, creating a dynamic, layered effect. The text is centered in a bold, dark blue font.

Pacemaker Indications

- ▶ Sinus node dysfunction
 - ▶ Sinus Bradycardia
 - ▶ Includes guideline driven medical therapy
 - ▶ Sinus Pauses
 - ▶ Tachy-brady Syndrome
 - ▶ Isorhythmic Disassociation
 - ▶ Sinoatrial Exit Block
 - ▶ Sinus Node Arrest
 - ▶ Chronotropic Incompetence
- ▶ High degree AV Block
 - ▶ Mobitz Type II
 - ▶ Complete Heart Block
- ▶ Heart Failure/ LBBB
 - ▶ Cardiac Resynchronization Therapy

Contraindications

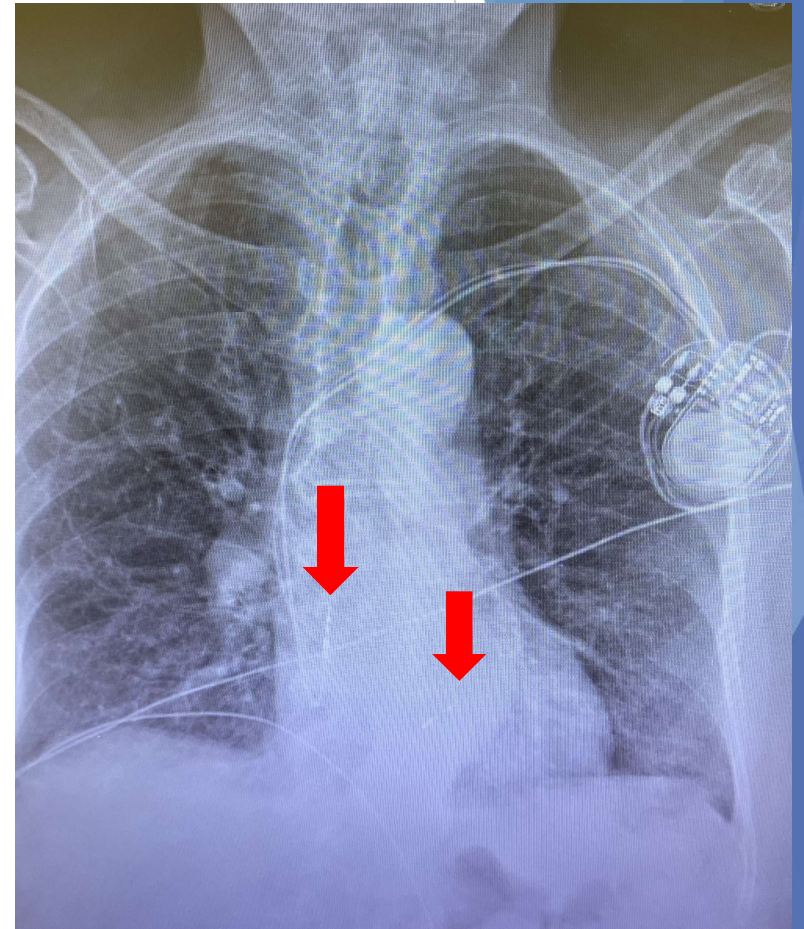
- ▶ Active infection
 - ▶ Temporary pacemaker as needed



Photos courtesy of Dr. Andrew Beaser

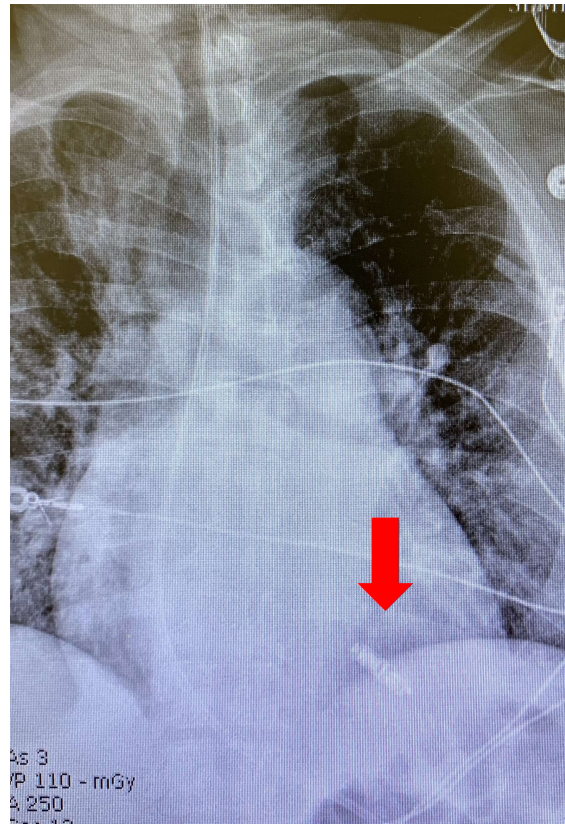
Parts to a device

- ▶ Generator
 - ▶ “Can”
 - ▶ “Brains”
 - ▶ Programming
 - ▶ Battery lasts 8-12 years
 - ▶ Placed on non-dominant side
- ▶ Lead
 - ▶ Screws into the myocardium
 - ▶ “Wire”



Leadless Pacemaker

- ▶ Indication
 - ▶ Lower pacing burden
 - ▶ High infection risk
- ▶ Advantages
 - ▶ Low infection risk/ No pocket
 - ▶ No arm restrictions
- ▶ Disadvantages
 - ▶ Large delivery sheath
 - ▶ 6 hour bedrest
 - ▶ RV pacing only



Pacemakers

SC-PM single chamber pacemaker	<ul style="list-style-type: none">• 1 lead/device in RA or RV
DC-PM dual chamber pacemaker	<ul style="list-style-type: none">• 1 lead in RA• 1 lead in RV
CRT-P Cardiac resynchronization therapy pacemaker or biventricular pacemaker	<ul style="list-style-type: none">• 1 pacemaker lead in RA• 1 pacemaker lead in RV• 1 pacemaker lead in coronary sinus (LV)

Case 2

- ▶ Patient wore monitor for atrial fibrillation
- ▶ Results show 5 seconds of high degree block at 3am. Confirmed with patient they were sleeping at this time.

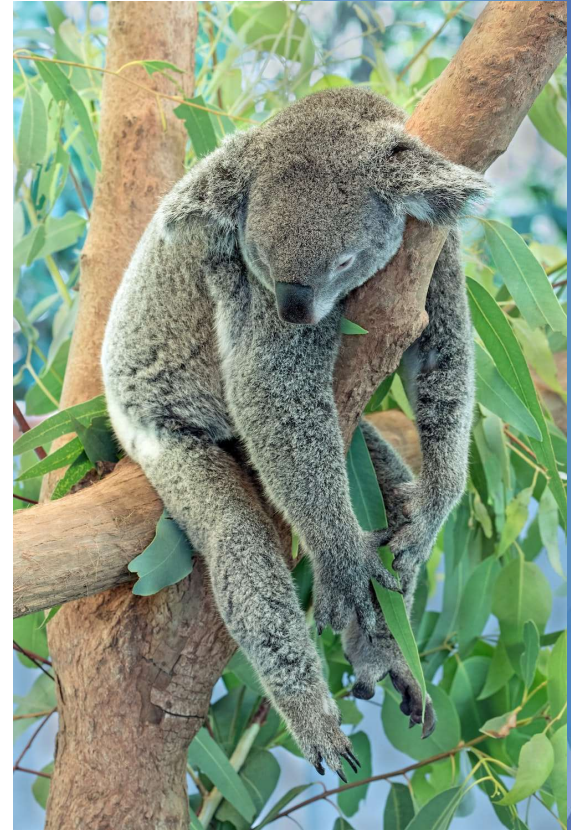
Does this person need a pacemaker?

No pacemaker indicated!



Nocturnal Arrhythmias

- ▶ Not sole reason for pacemaker
- ▶ Need symptoms
- ▶ Assess and treat obstructive sleep apnea



Case 3

- ▶ Patient presents with STEMI and receives PCI. EF was 25% and started on GDMT
- ▶ Continues on GDMT for 3 months with persistent EF of 29%

Should this person receive an implantable cardioverter defibrillator?

Meets indication for ICD!

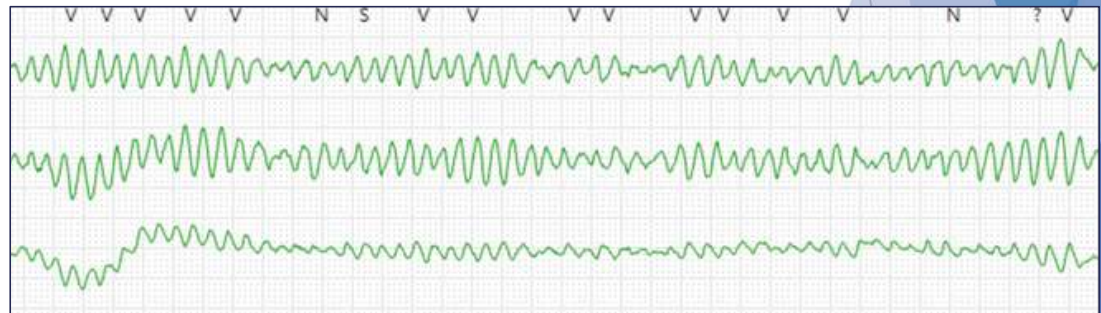
Implantable Cardioverter Defibrillator Indications

▶ Primary prevention ICD

- ▶ Those at risk of SCD
- ▶ EF <35% after 3 months of GDMT
- ▶ 40 days after MI LVEF <30%
- ▶ Congenital long QT
- ▶ Hypertrophic cardiomyopathy with high risk features
- ▶ Sarcoidosis
- ▶ High risk channelopathies

▶ Secondary prevention ICD

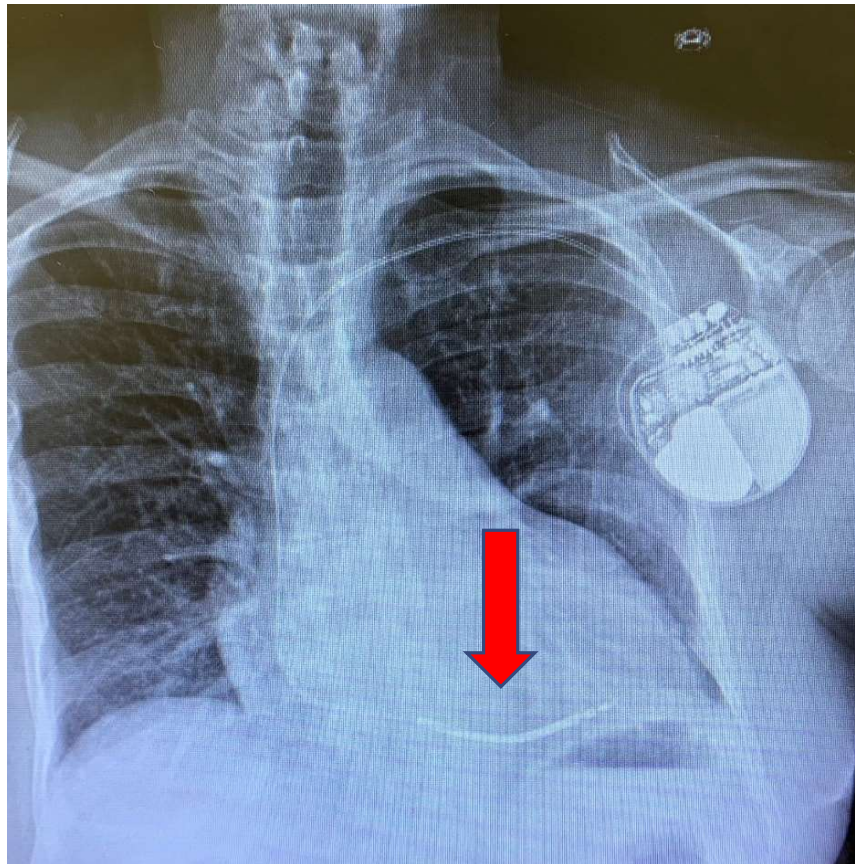
- ▶ Individuals who had prior VT/VF without reversible causes
- ▶ VT/VF NOT within 48 hours of MI



ICD contraindications

- ▶ Less than 1 year life expectancy
- ▶ Incessant VT/VF
- ▶ Severe psychiatric illness
- ▶ Syncope without inducible VT/VF or structural heart disease
- ▶ Active infection
 - ▶ Wearable defibrillator

Single Chamber Defibrillator



Subcutaneous defibrillator

▶ Indications

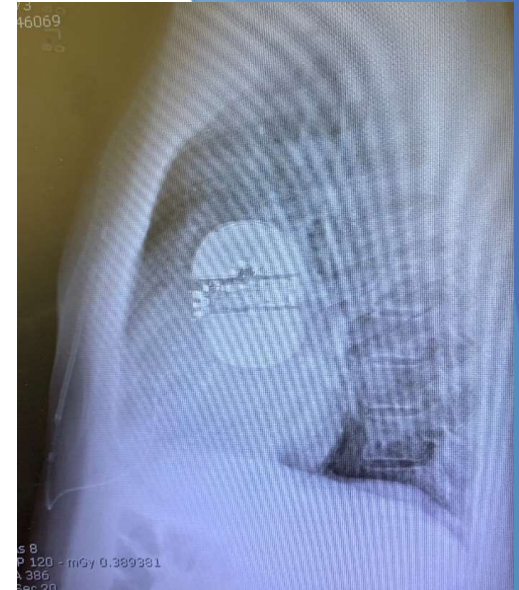
- ▶ Young/ active
- ▶ IVDU
- ▶ Dialysis patient

▶ Advantages

- ▶ Not in the vasculature; minimize infection risk

▶ Disadvantages

- ▶ Only pacing capability is post-shock
- ▶ Requires passing screening tool



Implantable Cardioverter Defibrillator - ICD

SC-ICD single chamber defibrillator	<ul style="list-style-type: none">• 1 defibrillator lead in RV
DC-ICD dual chamber defibrillator	<ul style="list-style-type: none">• 1 pacemaker lead in RA• 1 defibrillator lead in RV
CRT-D cardiac resynchronization therapy defibrillator or biventricular defibrillator	<ul style="list-style-type: none">• 1 pacemaker lead in RA• 1 defibrillator lead in RV• 1 pacemaker lead in coronary sinus (LV)
S-ICD subcutaneous defibrillator	

Case 4

- ▶ 50F with PMH of alcohol abuse has an echo with EF 32%
- ▶ Labs, TSH, SPEP/UPEP all normal
- ▶ Undergoes LHC without obstructive coronary disease
- ▶ MRI without LGE
- ▶ Pt starts GDMT
- ▶ Repeat echo in 3 months shows EF 50%

Does this person need an ICD?

No ICD indicated!



Summary

▶ Pacemakers

- ▶ Increase heart rate for sinus node dysfunction, heart block, or HFrEF
- ▶ Infection is a lifelong risk

▶ Defibrillators

- ▶ Shock the heart to restore sinus rhythm in the setting of VT/VF
- ▶ Given as primary or secondary prevention
- ▶ Transvenous defibrillators also pace the heart
- ▶ Infection is a lifelong risk

References

- ▶ Al-Khatib, S. (2018). 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death: Executive Summary. *Circulation*, 138, 210-271.
- ▶ Babcock O'Connell, C & Cogan-Drew, T. 'A comprehensive review for the certification and recertification examinations for PAs 7th Edition'. Wolters Kluwer. 2022.
- ▶ Dakkak W, Doukky R. Sick Sinus Syndrome. [Updated 2021 Jul 21]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-.
- ▶ Glikson M, Nielsen JC, Kronborg MB, Michowitz Y, Auricchio A, Barbash IM, Barrabés JA, Boriani G, Braunschweig F, Brignole M, Burri H, Coats AJS, Deharo JC, Delgado V, Diller GP, Israel CW, Keren A, Knops RE, Kotecha D, Leclercq C, Merkely B, Starck C, Thylén I, Tolosana JM; ESC Scientific Document Group. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. *Eur Heart J*. 2021 Sep 14;42(35):3427-3520. doi: 10.1093/eurheartj/ehab364. Erratum in: *Eur Heart J*. 2022 May 1;43(17):1651. PMID: 34455430.
- ▶ Kusumoto, F. et al (2018). 2018 ACC/AHA/HRS Guideline on the Evaluation and Management of Patients With Bradycardia and Cardiac Conduction Delay: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *Circulation*, 140(8), 382-482.
- ▶ Scherbak D, Hicks GJ. Left Bundle Branch Block. [Updated 2021 Aug 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK482167/?msckid=4a9baa18a61111ec887814fcd2b3154c>
- ▶ Strauss DG, Selvester RH, Wagner GS. Defining left bundle branch block in the era of cardiac resynchronization therapy. *Am J Cardiol*. 2011 Mar 15;107(6):927-34. doi: 10.1016/j.amjcard.2010.11.010. PMID: 21376930.