

MANAGING TEMPORARY EPICARDIAL PACEMAKERS WITH CONFIDENCE

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©

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- No disclosures
- No COI

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A BIT ABOUT.....



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LEARNING OBJECTIVES



- By the end of this presentation the learner will be able to:
 - identify the components of a temporary epicardial pacemaker system.
 - discuss the steps for trouble-shooting common temporary pacemaker malfunctions.
 - describe how temporary epicardial atrial wires can be used to identify post-operative atrial dysrhythmias.

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PRIMARY FUNCTION OF PACEMAKER

To deliver enough energy to consistently depolarize the heart (capture)

To correctly sense intrinsic cardiac activity

Increase HR to provide adequate CO

Coordinate AV conduction to increase CO

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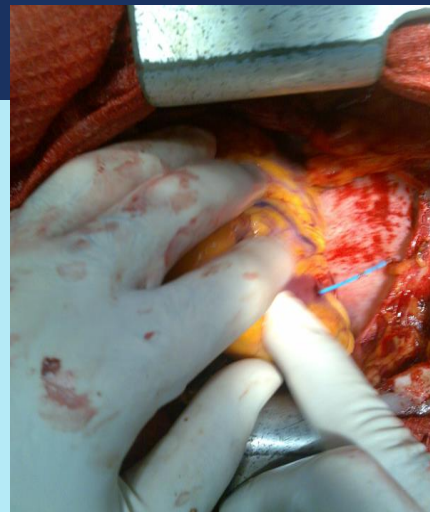
COMPONENTS OF PACING SYSTEMS

Pacemaker Generator

- Provides electrical stimulus
- Depolarization
- Contraction
- Ability to program impulse delivery

Lead or Electrode

- In *direct contact* with myocardial tissue
- Epicardium of atria or ventricles

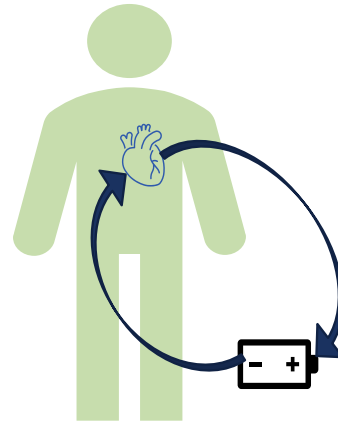


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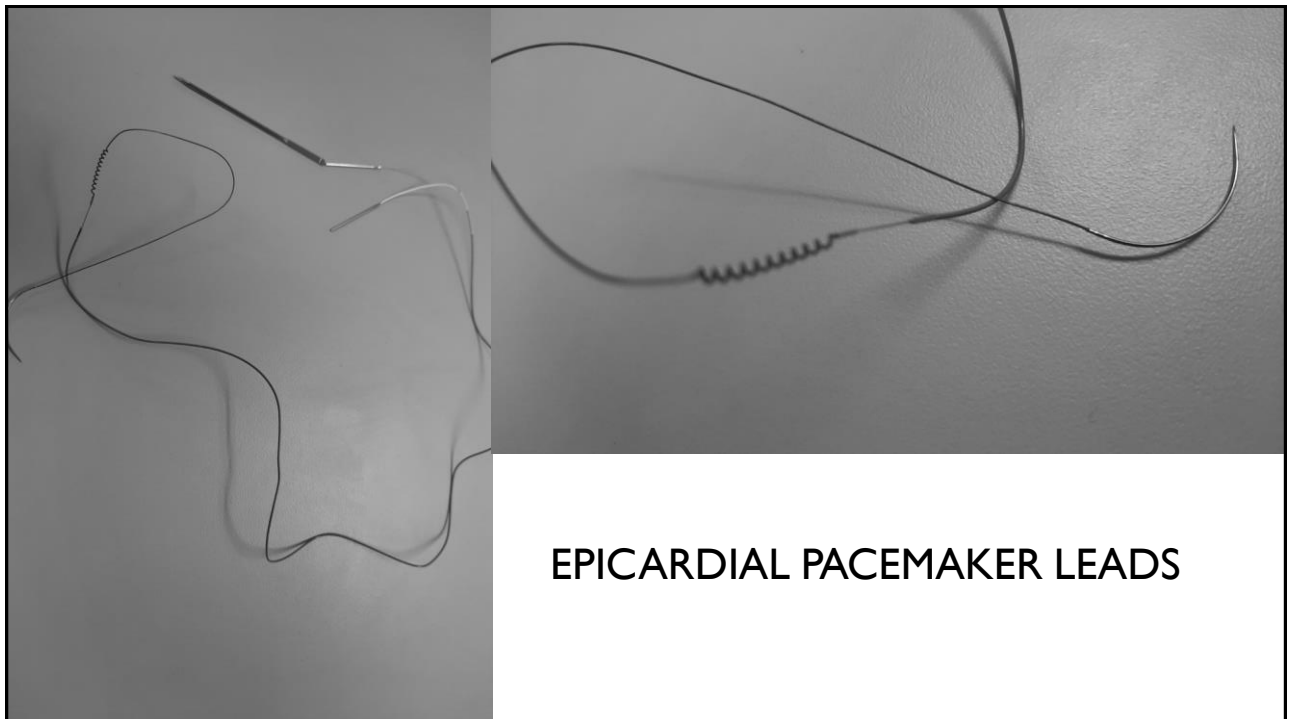
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LEAD SYSTEMS

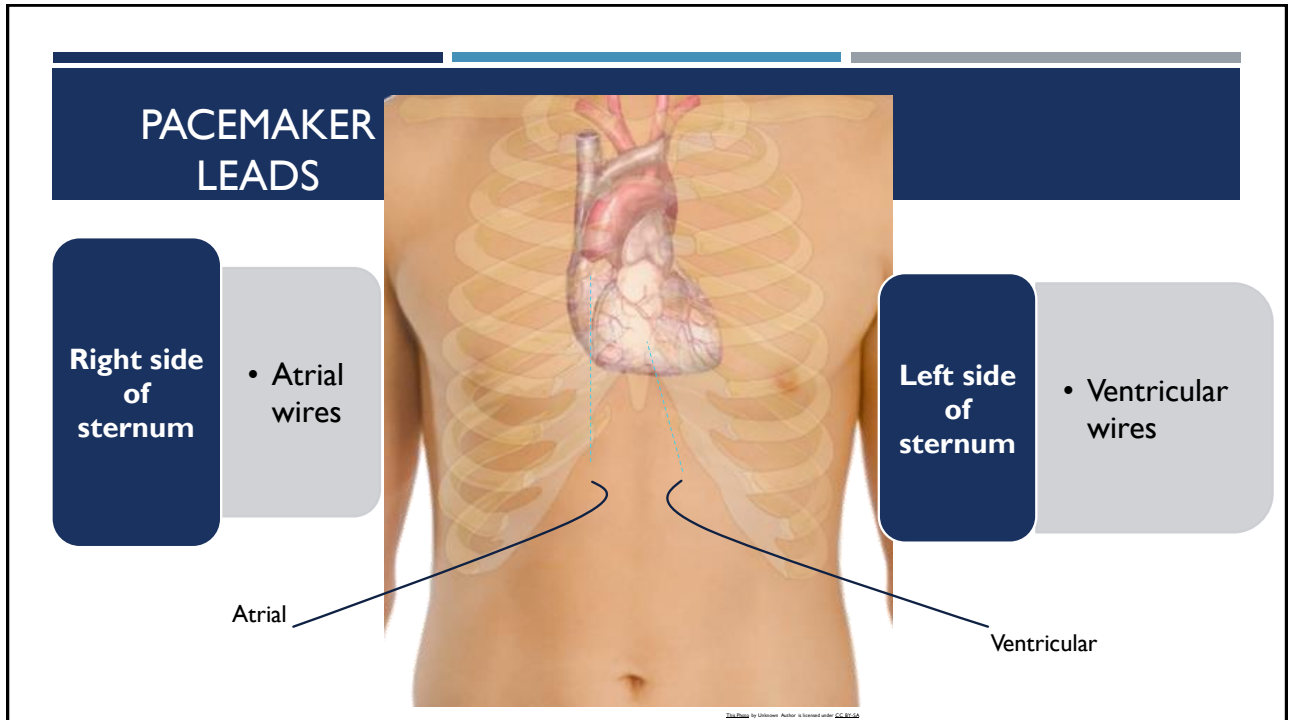
- Circuit
- Electrical current flows
 - from **Negative** pole
 - Anode
 - to **Positive** pole
 - Cathode
 - Ground



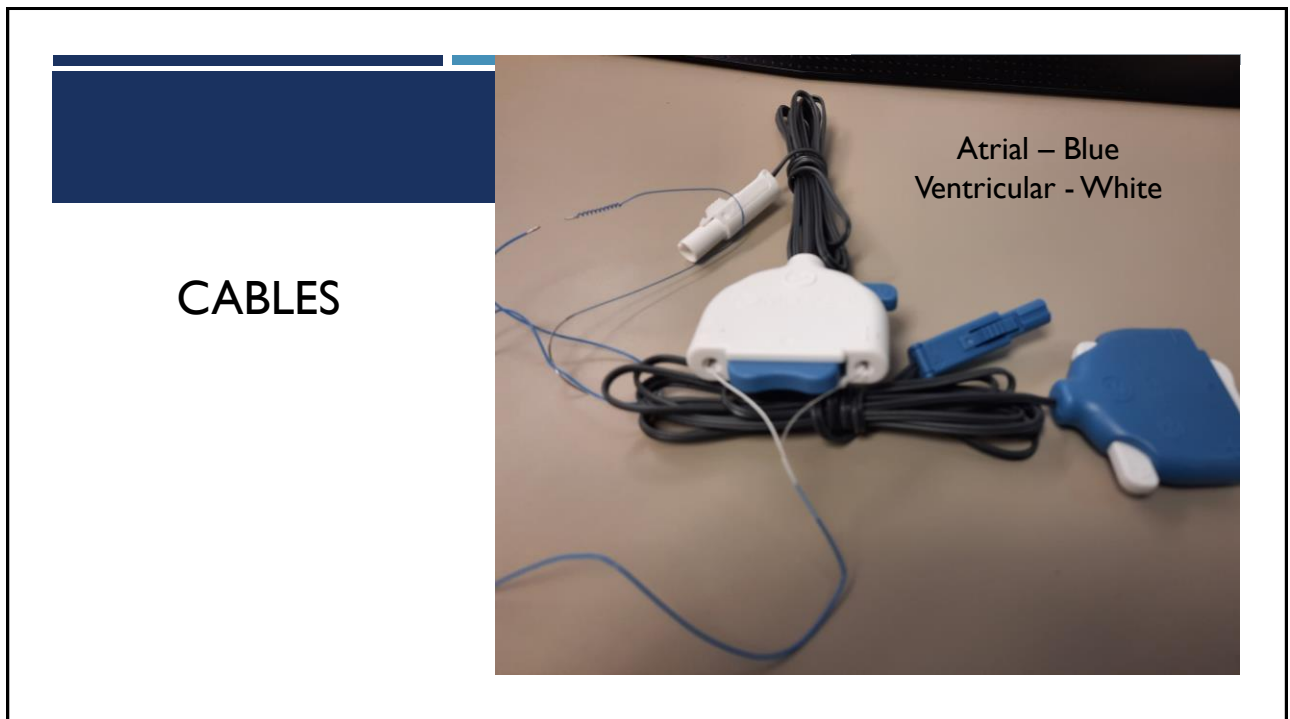
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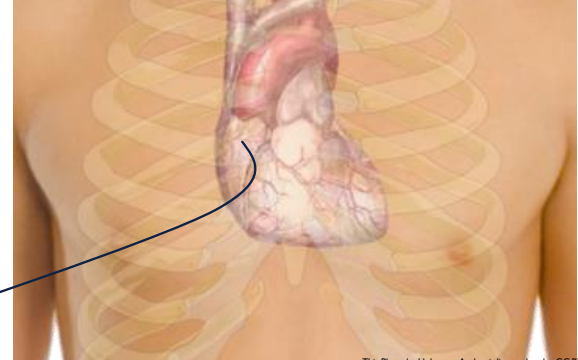
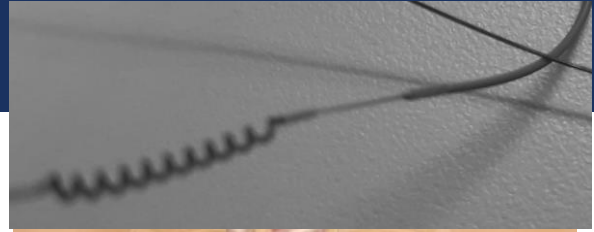
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BIPOLAR LEADS

- Both electrodes in *same chamber*
- Small sensing current
- Small pacing spikes
- Either lead can serve as the negative pole
 - Can change polarity

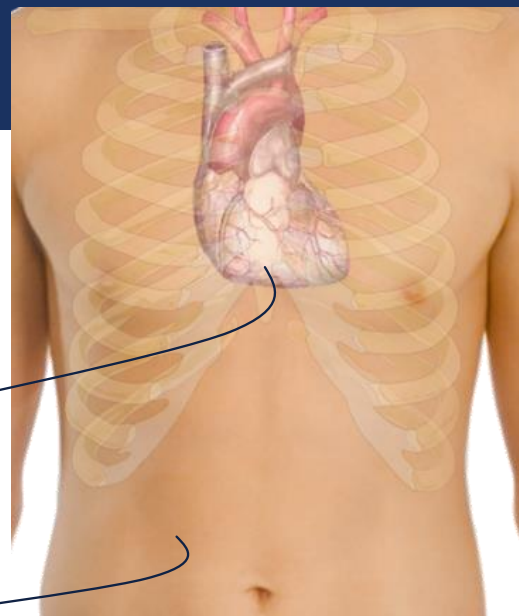


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UNIPOLAR LEADS

- Only one electrode *in* chamber
- Second pole in subcutaneous tissue
 - Ground wire
- Large sensing current
- Large pacing spikes
- Must connect neg lead to neg pole of generator
 - Cannot switch polarity
 - Cannot pace skin lead!



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PACEMAKER CODES

Chamber Paced	Chamber Sensed	Response to Sensing
O = none	O = none	O = none
A = atrium	A = atrium	T = triggered
V = ventricle	V = ventricle	I = inhibited
D = dual (A + V)	D = dual (A + V)	D = dual (T + I)

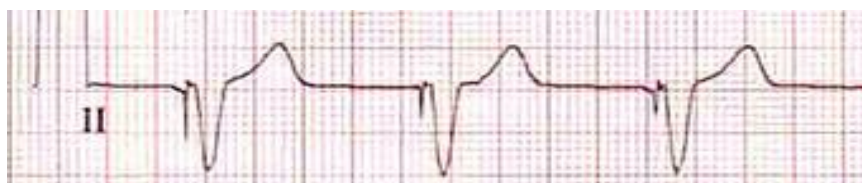
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SINGLE CHAMBER PACING MODES

AAI



VVI



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DUAL CHAMBER PACING MODES

A and V pacing



A pacing and V sensing



A sensing and V pacing



A sensing and V sensing



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PACEMAKER GENERATOR

Emergency = DOO

Battery Indicator

ENTER Key

On/Off

Rate Dial

A Output (mA)

V Output (mA)

Lock/Unlock

Up/Down Arrow Keys

Menu Dial

Pause Key



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GENERATOR SETTINGS

Setting	Default	Range
Rate	80 bpm	30 - 200
Atrial Output	10 mA	0 - 20
Ventricular Output	10 mA	0 - 25
AV Interval	170 msec	20 - 300
Atrial Sensitivity	0.5 mV	0.4 – 10 mV
Ventricular Sensitivity	2.0 mV	0.8 – 20 mV



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SELECTING A PACING MODE



1. Navigate to the Mode Selection menu.

2. Press the Up or Down Arrow keys to highlight a pacing mode.

3. Press the Enter key to select the pacing mode.

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PACING RATE

- Optimal rate 80-100bpm
- Remember: $CO = SV \times HR$
- Pacing > 10bpm above intrinsic rate can reduce the incidence of AF (when combined with antidysrhythmics)

White MC, Caron MF, Kalus JS, et al. AFISTIII. Circulation 2003;108:II-200-II-206.



Sets rate

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ATRIAL MILLIAMPS

- Amount of electricity sent to the atrium
- Measured in mA



Sets mA output delivered via atrial wires

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VENTRICULAR MILLIAMPS

- Amount of electricity sent to ventricles
- No dangerously high level
- Use for A-V conduction block



Sets mA output delivered via ventricular wires

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A-V INTERVAL



Normal AV delay
120-170ms
Rate dependent



1st degree heart
block >200ms



Preferably use native
A-V conduction
vs V pacing



Increase AV
interval to
promote sensing
instead of V pacing
(QRS narrows)

Sets timing delay between atrial
and ventricular impulses



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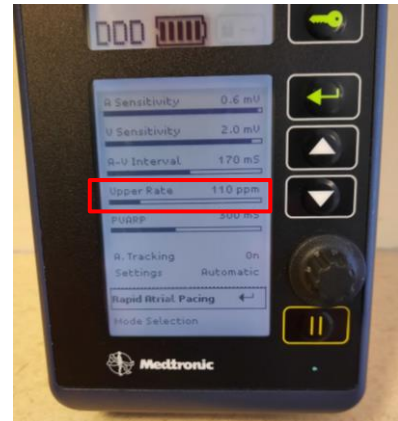
UPPER RATE LIMIT

Max atrial rate pacer will provide 1:1 ventricular pacing

Prevents pacer from responding to rapid atrial rhythm

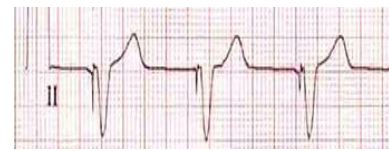
Default = 110

Only for DDD



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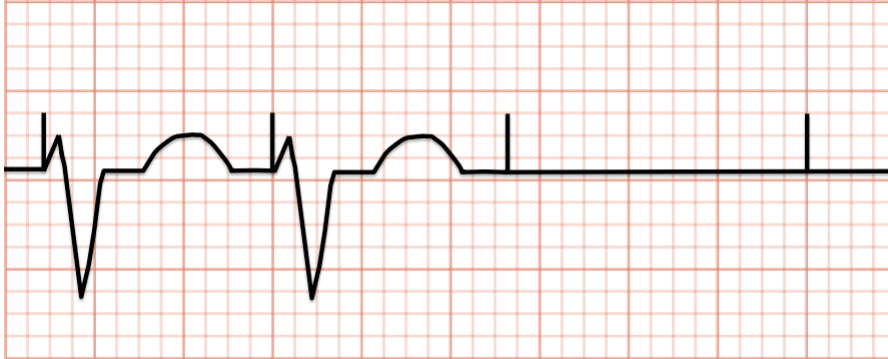
RHYTHM ANALYSIS



- Is there appropriate stimulation?
- P wave after every atrial spike
- QRS complex after every ventricular spike
- Do pacer spikes occur at the set rate
- Appropriate sensing

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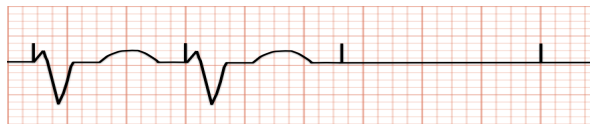
FAILURE TO CAPTURE



Electrical pacemaker stimuli does not result in depolarization

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FAILURE TO CAPTURE



Possible Causes	Corrective Actions
Threshold rise	Check threshold & ↑ mA
Fractured or dislodged leads	Replace or reposition lead
Small QRS	Increase gain
Battery depletion	Replace battery
Faulty cable or connections	Check connections Change polarity








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THE CAPTURE THRESHOLD IS NOT CONSTANT

	Capture	Sensing
Fluid status changes	X	X
Pericardial effusion	X	X
Electrolyte or metabolic abnormalities	X	
Medications	X	
Tissue inflammation, fibrosis, or necrosis	X	X
Generator battery failure	X	X
Development of endothelial sheaths	X	X
Disconnection, dislodgment, or fracture of leads	X	X

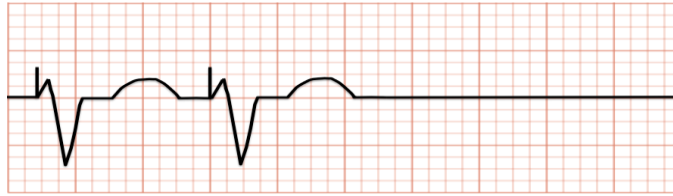
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STIMULATION THRESHOLD

-  Determines minimum amount of energy needed to reliably pace
-  Paced rhythm must be present & patient stable
-  Set rate 10 bpm above intrinsic rate
-  Gradually *decrease output* until capture lost
-  Gradually increase output until 1:1 capture returns → stimulation threshold
-  Set mA 2 -3 times threshold value
-  Restore rate to previous setting

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FAILURE TO PACE



Possible Causes	Corrective Actions
Battery depletion	Change the battery
Pacemaker not turned on	Turn on pacemaker generator
Faulty cable connections	Secure all connections
Fracture/dislodged leads	Replace/reposition leads
Oversensing	Adjust sensitivity

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PACEMAKER DYSFUNCTION DIAPHRAGMATIC PACING

Pacemaker stimulates diaphragm

Hiccups, chest wall muscle twitching, or pulsating diaphragm, pain

mA set too high

Pacer wires dislodged from epicardium

Treatment: ↓ mA, Reposition pt. on side

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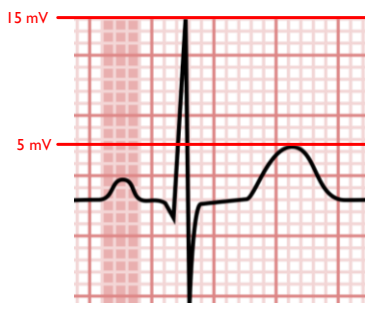
SENSITIVITY

- Ability of Pacer to sense intrinsic beat
- Amplitude of the ECG complex required for the pacemaker to recognize patient's intrinsic cardiac activity
 - mV of complex
- Failure to sense → DOO or VOO mode
- R on T may occur



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SENSITIVITY

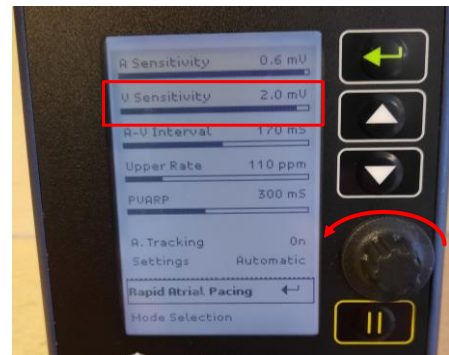
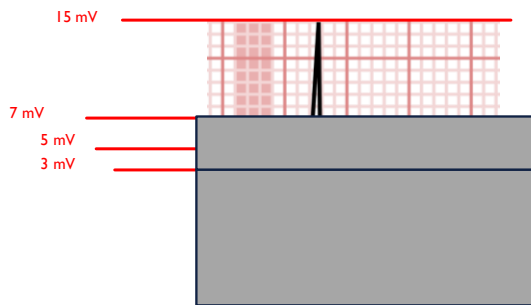


- Sets the amplitude (height) of complex pacemaker requires to detect an intrinsic beat
- Measured in millivolts (mV)
- **High Sensitivity = Low Number**
- **Low Sensitivity = High Number**

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OVERSENSING TURN SENSITIVITY DOWN

- Detect complexes inappropriately
- Does not pace when it should
- Turn knob counterclockwise
- Raise the mV number
- Cover up the complexes that you do not want sensed
- Higher mV → pacemaker less sensitive

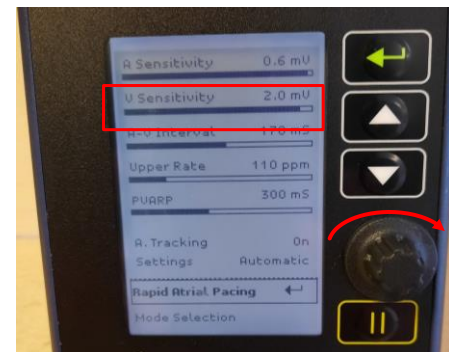
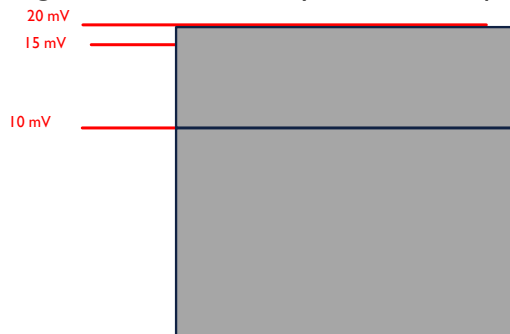


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UNDERSENSING TURN SENSITIVITY UP

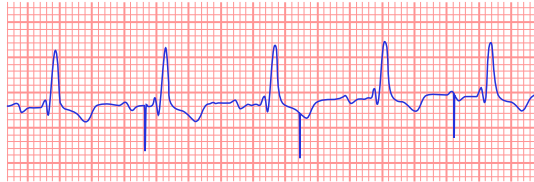
- Does not detect complexes
- Paces when it should not
- Turn knob clockwise
- Smaller number - lower the mV
- Recognizes electrical activity of smaller amplitude

← Pacing
Asynchronously



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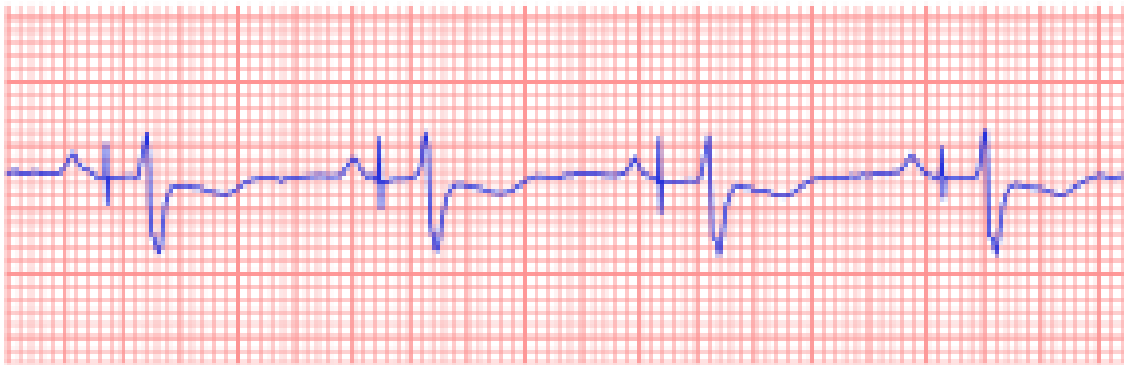
UNDERSENSING



Possible Causes	Corrective Actions
Decreased QRS size	Increase sensitivity
Fractured/dislodged lead	Replace/reposition lead
Battery depletion	Replace battery
Inappropriate sensitivity setting	Increase sensitivity - ↓ mV number

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ATRIAL UNDERSENSING



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WHAT COULD GO WRONG?



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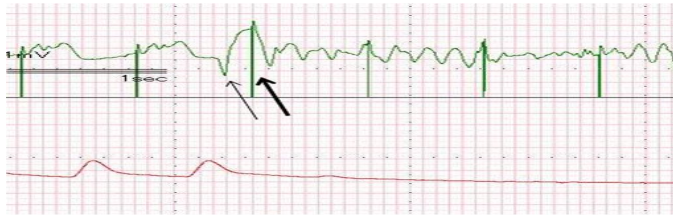
PACEMAKER INDUCED R ON T PHENOMENON



Anesthesiology, 132(2), 374

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PACEMAKER INDUCED R ON T PHENOMENON



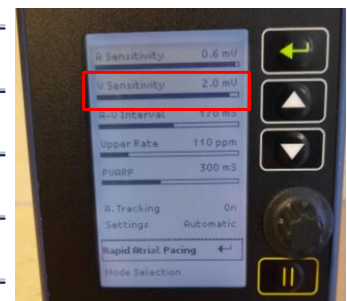
Possible Causes	Corrective Actions
Inappropriate sensitivity setting	Increase sensitivity - ↓ number
Loose connection Fractured lead	Check and secure connections

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SENSING THRESHOLD

Patient must have an underlying rhythm and tolerate a brief period without pacing

Set	RATE 10 bpm below intrinsic heart rate
Set	Set mA at 0.1 mA
Highlight	Highlight SENSITIVITY menu
Decrease	Decrease SENSITIVITY: Slowly turn dial counter-clockwise until pace indicator flashes continuously (asynch)
Increase	Increase SENSITIVITY: Slowly turn dial clockwise until sense indicator flashes again (when sensing resumes=sensing threshold)
Set	Set SENSITIVITY < half this value
Restore	Restore previous rate



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OTHER USES OF ATRIAL PACING WIRES

Identification of SVT rhythm

Enhances visualization of “hidden” atrial activity

Rapid atrial (overdrive) pacing

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75 –YEAR OLD FEMALE 2 DAYS AFTER CARDIAC SURGERY
HR 147, BP 110/70, ASYMPTOMATIC



What is this rhythm?

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ATRIAL ELECTROGRAM

- Records electrical activity from atria
- Atrial pacing wires connected to ECG cables
- Enhanced tracing of atrial activity
- Allows comparison of atrial & ventricular events
- Narrow complex SVT
 - AF/FL vs. ST
- Wide complex tachycardia
 - VT versus SVT w/ aberrant conduction

AACN advanced critical care, 26(3), 275-280

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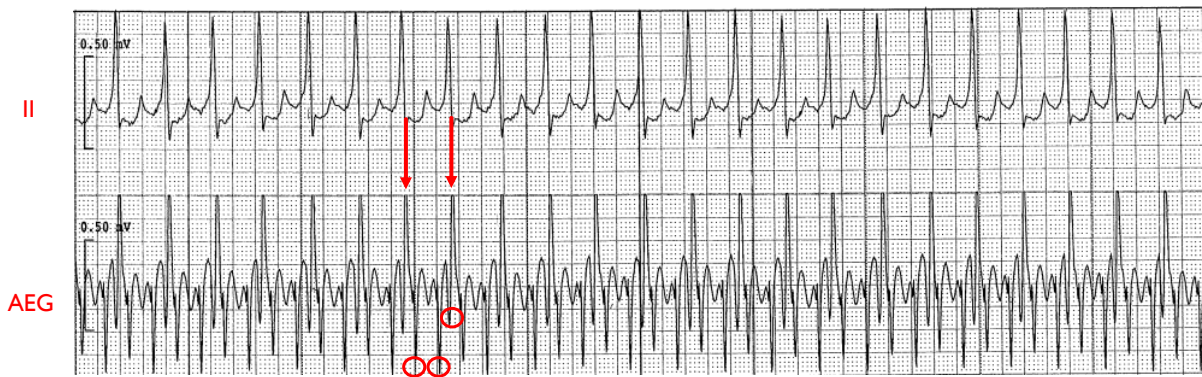
ATRIAL ELECTROGRAM

- Wear gloves
- Locate atrial wires to R side of chest
- Atrial wire to brown lead
 - Monitor V lead
- Run long strip of V₁ & another lead
- Evaluate for accentuated P waves



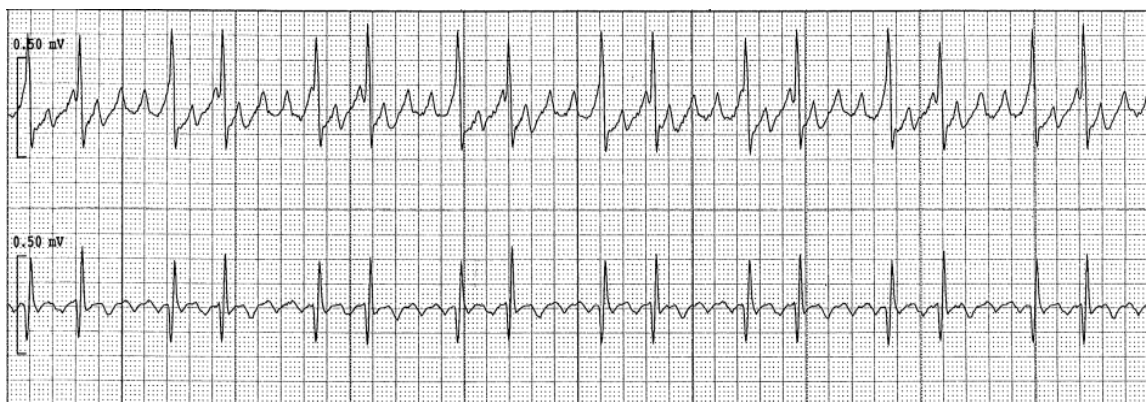
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ATRIAL ELECTROGRAM (AEG)



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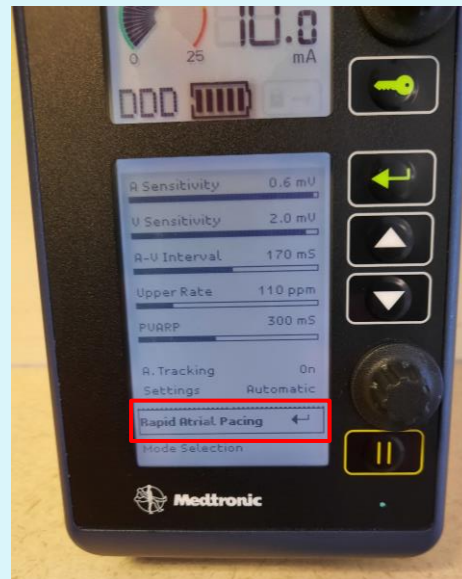
SAME PATIENT AFTER DILTIAZEM GIVEN



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RAPID ATRIAL PACING

- Atrial burst pacing
- AOO
- Delivery of rapid electrical stimuli to atrium
- To interrupt rapid atrial tachydysrhythmias
- RAP rate must be $>$ intrinsic rate
- Range 100 to 800



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RAPID ATRIAL PACING

Verify atrial leads connected to atrial cable

Press the Up or Down Arrow key to highlight **Rapid Atrial Pacing**

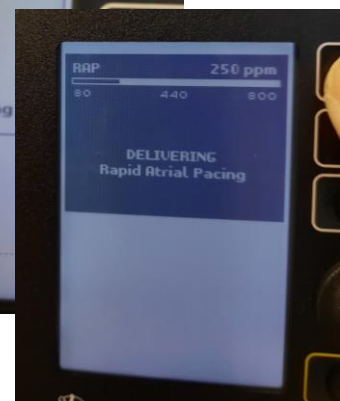
Press the Enter to open the RAP screen.

Adjust RAP rate as needed;
Range 80 ppm to 800 ppm

Press and hold the Enter key to deliver RAP burst

AOO pacing begins

To stop pacing - release ENTER or stops after 1 min



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NURSING RESPONSIBILITIES

Ensure

- Appropriate pacing mode

Determine

- Underlying rhythm if stable

Assess

- Appropriate capture
- Appropriate sensing

Troubleshoot

- Troubleshoot as needed

Obtain

- Obtain ECG tracing
- Paced rhythm
- Underlying rhythm

Prevent

- Prevent microshock

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Check battery



Check connections



Check site of wire insertion



Change dressing every 24 hours



Secure wires & cables to prevent dislodgement



Where is back-up generator?

NURSING CARE

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Epicardial Pacemaker Wire Dressings

1. Wear gloves
2. Cut off the tip of fingers from another glove
3. Place the pacer wires inside the cut fingertips
 - Atrial wires in one finger
 - Ventricular wires in the other
 - Insulates wires - protect from microshock
4. Place a gauze 4X4 on the patient's chest
5. Coil pacemaker wires and glove finger on top
6. Cover the pacemaker wires with another 4X4
7. Tape it in place.
 - Do not put tape directly on wires!
8. Label wires to identify atrial and ventricular



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EPICARDIAL PACING WIRE REMOVAL

Sutures removed

Wires removed with *gentle* pulling action

Monitor for ectopy

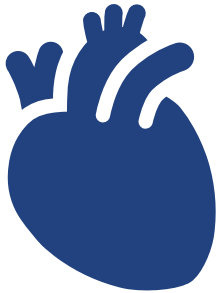
Bedrest for 30 minutes after removal

Observe for cardiac tamponade

Annals of Cardiac Anaesthesia. 2017; 20(4): 459–461
Journal of Cardiac Surgery. 2020; 35(6): 1247–1252

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SIGNS OF CARDIAC TAMPONADE



- Tachycardia
- Hypotension
- Tachypnea
- Chest pain
- Sense of foreboding
- Notify Surgeon

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CONCLUSIONS



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