



# Temporary Pacemakers

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# Peace be upon them



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# Temporary pacemakers

- Objectives
  - Explain the situations when temporary pacemakers are indicated.
  - Illustrate normal and abnormal pacemaker behavior.
  - Discuss the steps to be taken in troubleshooting a temporary pacemaker.

# Indications for Temporary

## Pacing

- Bradyarrhythmias
- AV conduction block
  - Congenital complete heart block (CHB)- normal or abnormal heart structure
  - L-Transposition (corrected transposition)
    - Bundle of His long; AV node anterior
    - Prone to CHB
  - Trauma- surgical or other
- Slow sinus or junctional rhythm
- Suppression of ectopy
- Permanent pacer malfunction
- Drugs, electrolyte imbalances
- Sick Sinus Syndrome
  - Secondary to pronounced atrial stretch
  - Old TGA s/p Senning or Mustard procedure

# Principles of Pacing

- Electrical concepts
  - Electrical circuit
    - Pacemaker to patient, patient to pacemaker
  - Current- the flow of electrons in a completed circuit
    - Measured in milliamperes (mA)
  - Voltage – a unit of electrical pressure or force causing electrons to move through a circuit
    - Measured in millivolts (mV)
  - Impedance- the resistance to the flow of current

# Principles of Pacing

- Temporary pacing types
  - Transcutaneous
    - Emergency use with external pacing/defib unit
  - Transvenous
    - Emergency use with external pacemaker
  - Epicardial
    - Wires sutured to right atrium & right ventricle
    - Atrial wires exit on the right of the sternum
    - Ventricular wires exit on the left of the sternum

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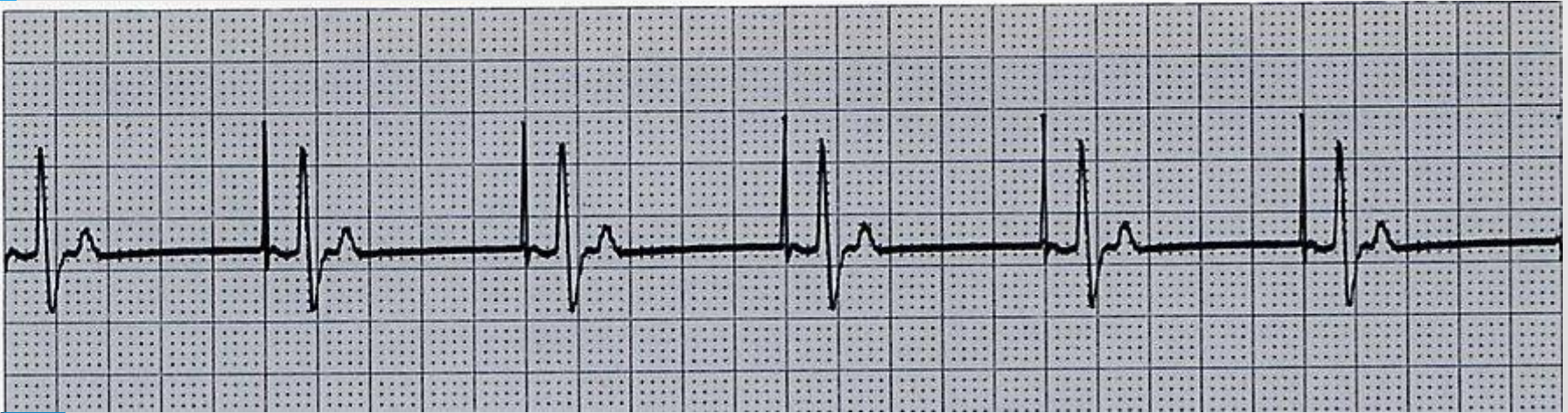
# Pacemaker ECG Strips

- Assessing Paced EKG Strips
  - Identify intrinsic rhythm and clinical condition
  - Identify pacer spikes
  - Identify activity following pacer spikes
  - Failure to capture
  - Failure to sense
- EVERY PACER SPIKE SHOULD HAVE A P-WAVE OR QRS COMPLEX FOLLOWING IT.



# Normal Pacing

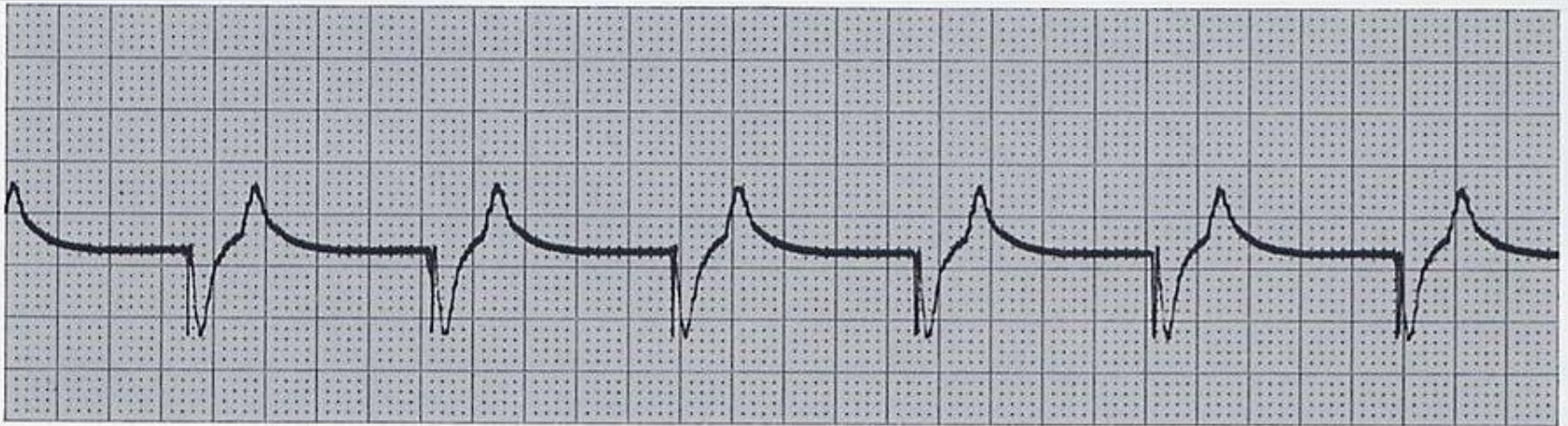
- Atrial Pacing
  - Atrial pacing spikes followed by P waves





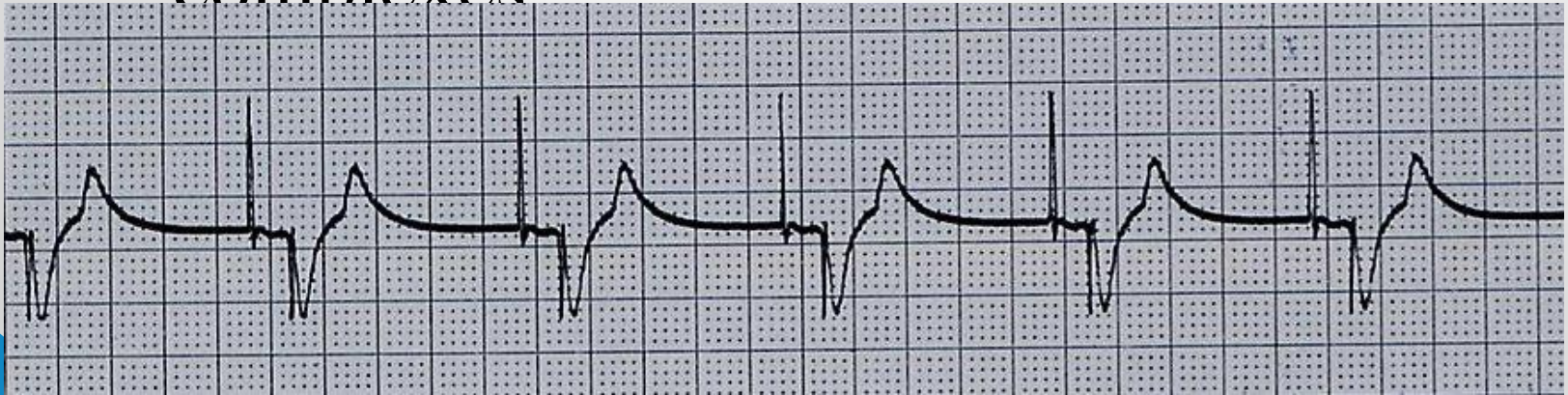
# Normal Pacing

- Ventricular pacing
  - Ventricular pacing spikes followed by wide, bizarre QRS complexes



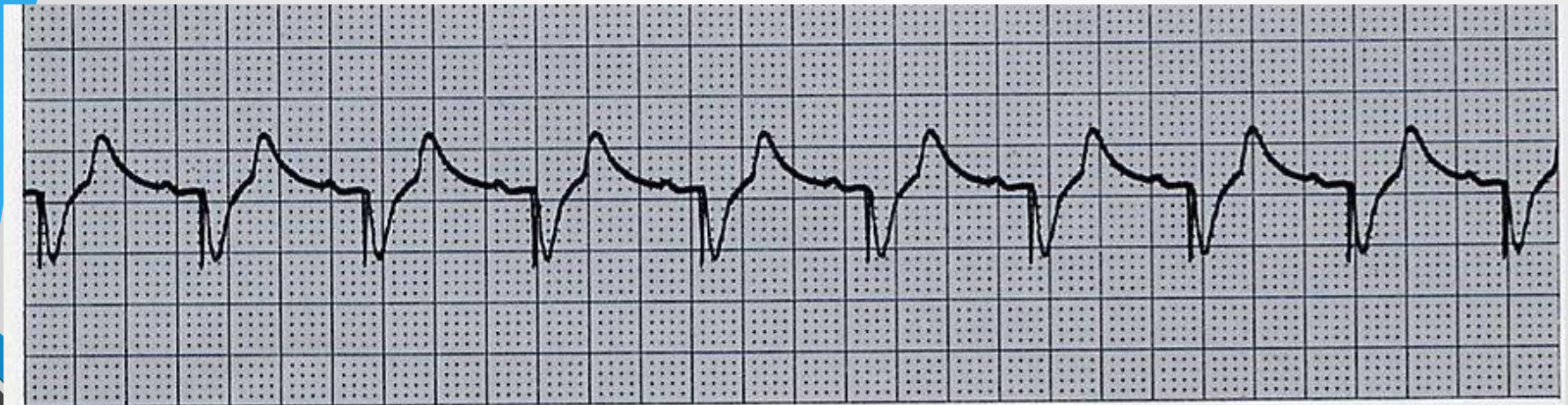
# Normal Pacing

- A-V Pacing
  - Atrial & Ventricular pacing spikes followed by atrial & ventricular complexes



# Normal Pacing

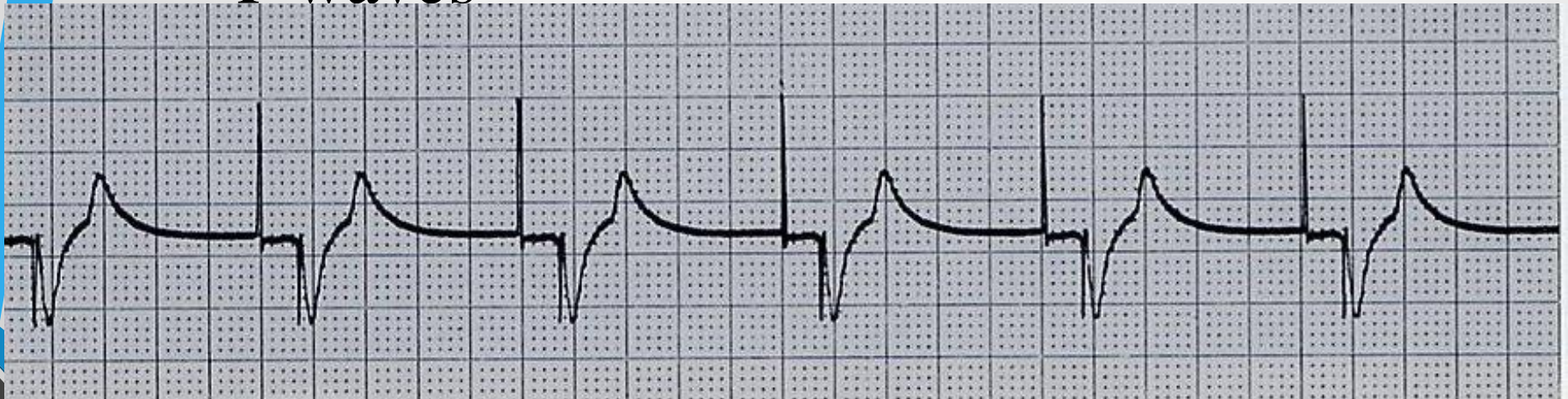
- DDD mode of pacing
  - Ventricle paced at atrial rate





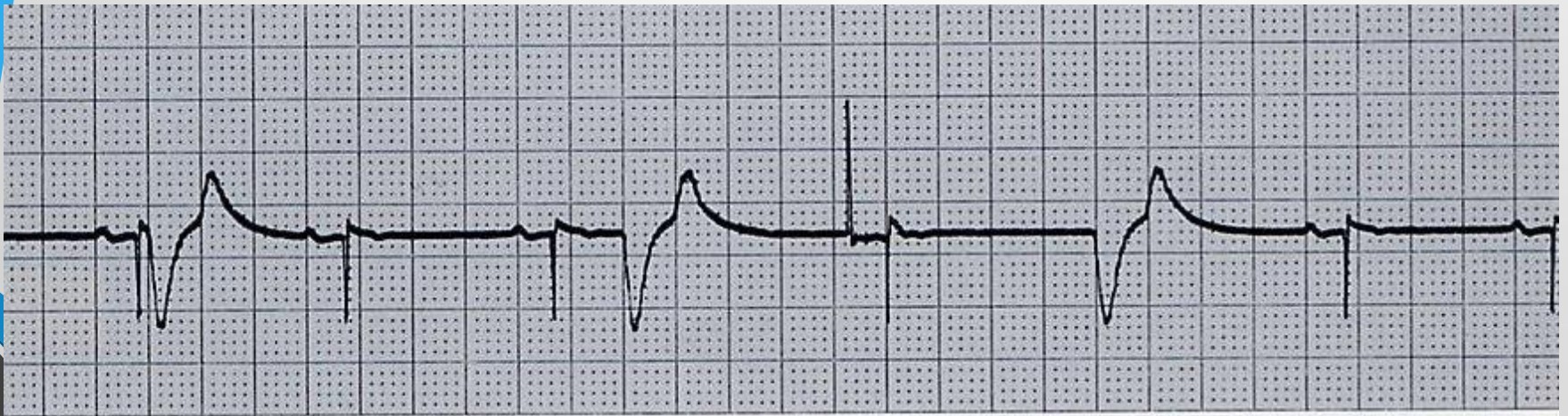
# Abnormal Pacing

- Atrial non-capture
  - Atrial pacing spikes are not followed by P waves



# Abnormal Pacing

- Ventricular non-capture
  - Ventricular pacing spikes are not followed by QRS complexes



# Failure to Capture

- Causes
  - Insufficient energy delivered by pacer
  - Low pacemaker battery
  - Dislodged, loose, fibrotic, or fractured electrode
  - Electrolyte abnormalities
    - Acidosis
    - Hypoxemia
    - Hypokalemia

Danger - poor cardiac output

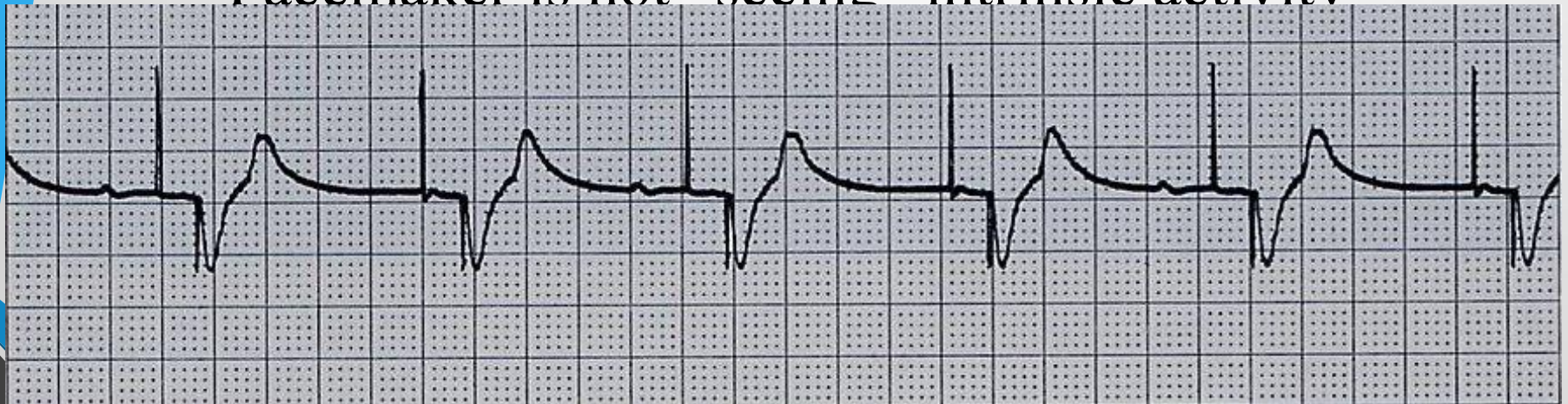
# Failure to Capture

- Solutions
  - View rhythm in different leads
  - Change electrodes
  - Check connections
  - Increase pacer output ( $\uparrow$ mA)
  - Change battery, cables, pacer



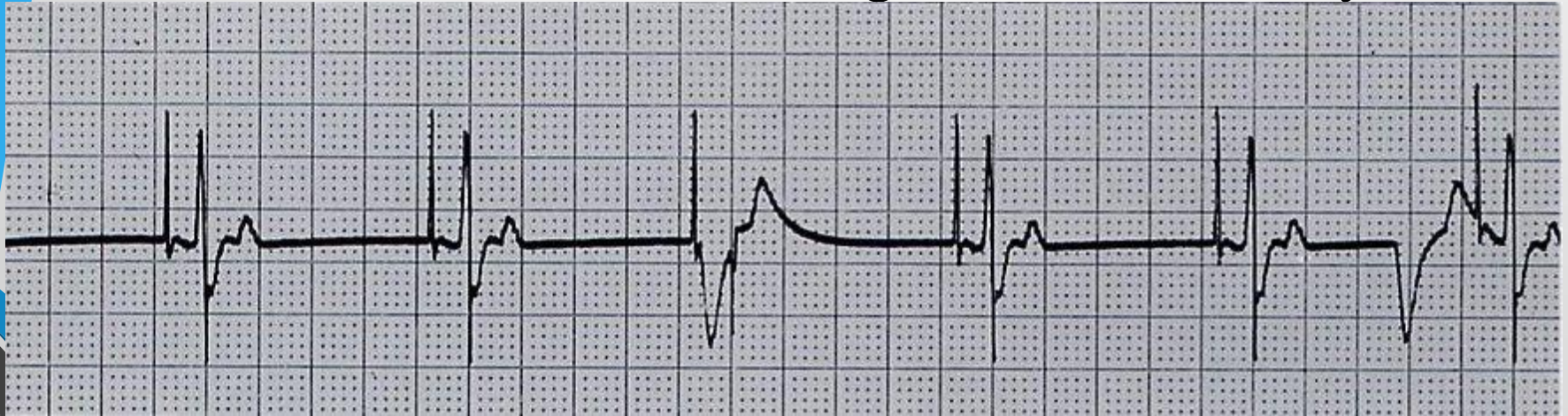
# Abnormal Pacing

- Atrial undersensing
  - Atrial pacing spikes occur irregardless of P waves
  - Pacemaker is not “seeing” intrinsic activity



# Abnormal Pacing

- Ventricular undersensing
  - Ventricular pacing spikes occur regardless of QRS complexes
  - Pacemaker is not “seeing” intrinsic activity



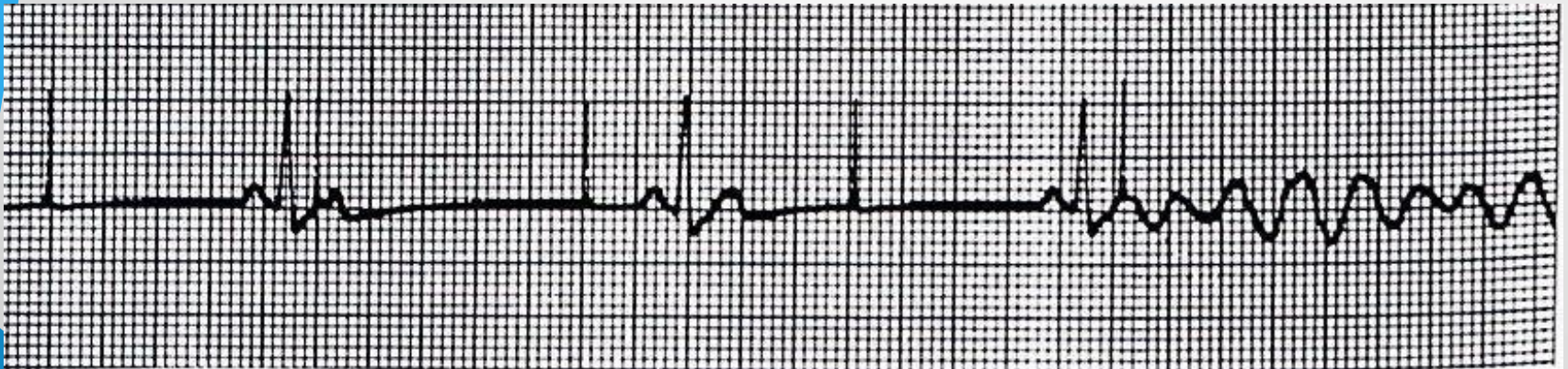
# Failure to Sense

- Causes
  - Pacemaker not sensitive enough to patient's intrinsic electrical activity (mV)
  - Insufficient myocardial voltage
  - Dislodged, loose, fibrotic, or fractured electrode
  - Electrolyte abnormalities
  - Low battery
  - Malfunction of pacemaker or bridging cable



# Failure to Sense

- Danger – potential (low) for paced ventricular beat to land on T wave

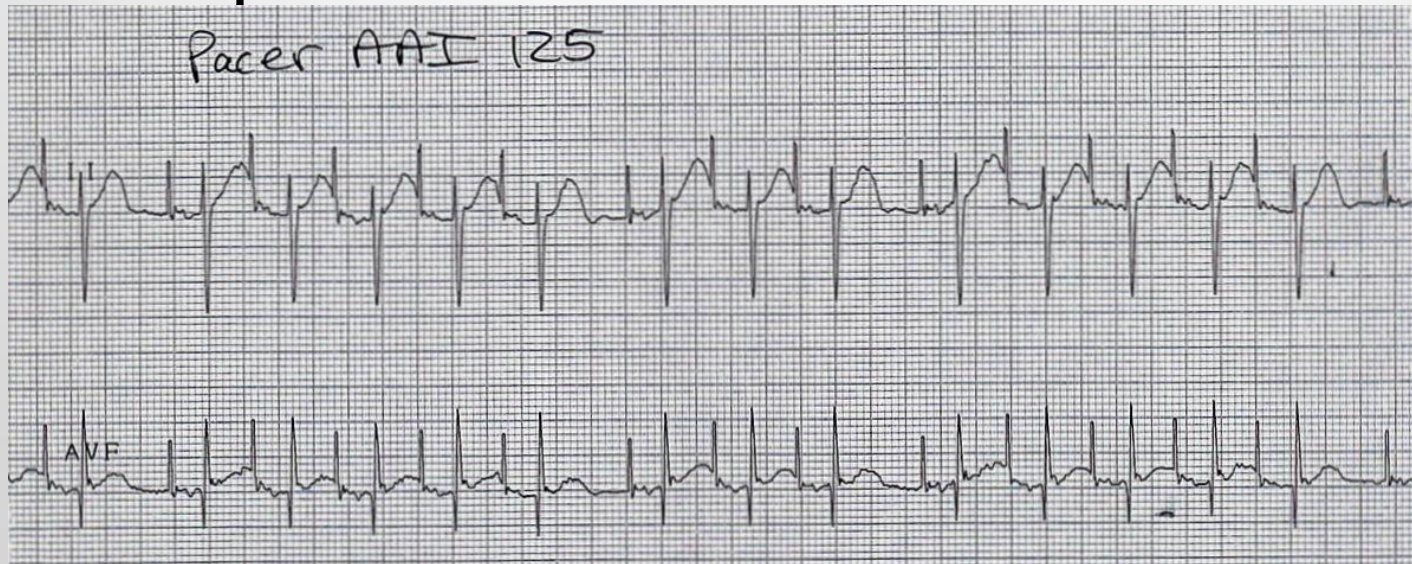


# Failure to Sense

- Solution
  - View rhythm in different leads
  - Change electrodes
  - Check connections
  - Increase pacemaker's sensitivity ( $\downarrow$ mV)
  - Change cables, battery, pacemaker
  - Reverse polarity
  - Check electrolytes
  - Unipolar pacing with subcutaneous “ground wire”

# Oversensing

- Pacing does not occur when intrinsic rhythm is inadequate



# Oversensing

- Causes
  - Pacemaker inhibited due to sensing of “P” waves & “QRS” complexes that do not exist
  - Pacemaker too sensitive
  - Possible wire fracture, loose contact
  - Pacemaker failure
- Danger - heart block, asystole

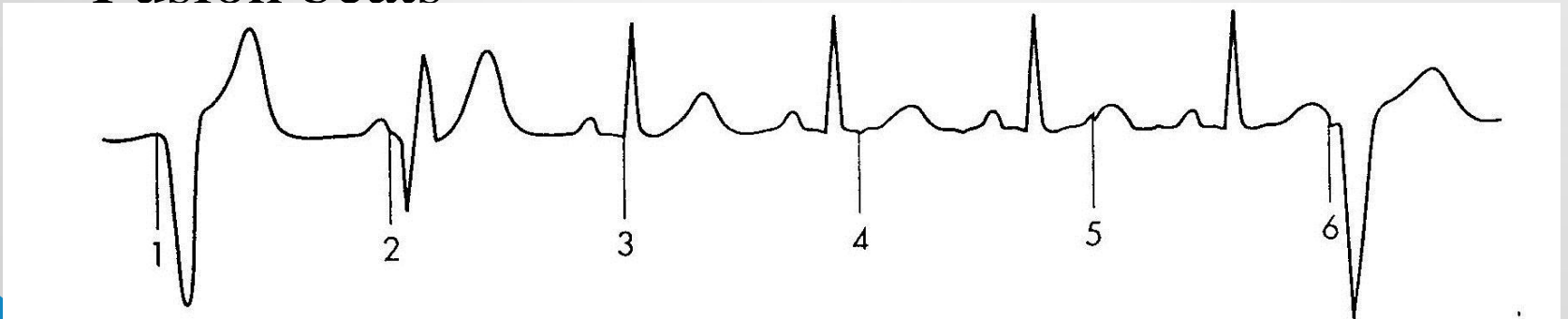


# Oversensing

- Solution
  - View rhythm in different leads
  - Change electrodes
  - Check connections
  - Decrease pacemaker sensitivity ( $\uparrow$ mV)
  - Change cables, battery, pacemaker
  - Reverse polarity
  - Check electrolytes
  - Unipolar pacing with subcutaneous “ground wire”

# Competition

- Assessment
  - Pacemaker & patient's intrinsic rate are similar
  - Unrelated pacer spikes to P wave, QRS complex
  - Fusion beats



# Competition

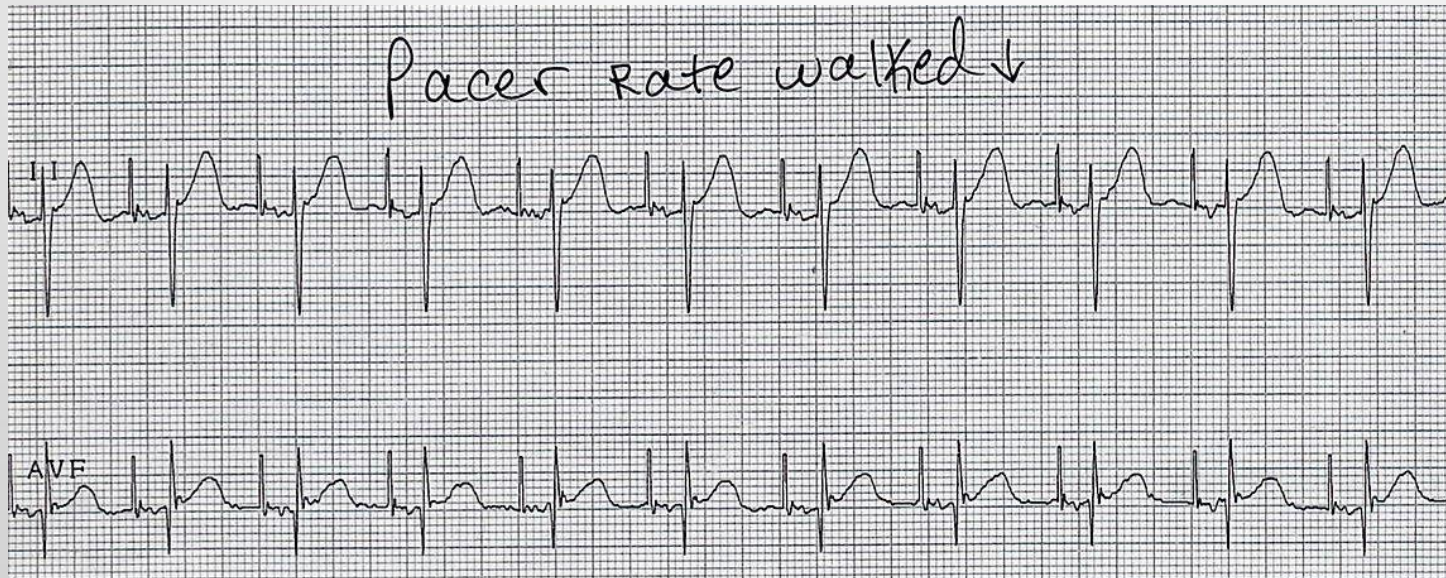
- Causes
  - Asynchronous pacing
  - Failure to sense
  - Mechanical failure: wires, bridging cables, pacemaker
  - Loose connections
- Danger
  - Impaired cardiac output
  - Potential (low) for paced ventricular beat to land on T wave

# Competition

- Solution
  - Assess underlying rhythm
    - Slowly turn pacer rate down
  - Troubleshoot as for failure to sense
  - Increase pacemaker sensitivity ( $\downarrow$ mV)
  - Increase pacemaker rate

# Assessing Underlying Rhythm

- Carefully assess underlying rhythm
  - Right way: slowly decrease pacemaker rate





## Assessing Underlying Rhythm

- 
- ECG tracing showing a pacemaker (DDD) paused intentionally. The tracing displays four leads: Lead I, aVR, Lead II, and aVF. The pacemaker is paused, and the heart rate is approximately 100 bpm.

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# Threshold testing

- Stimulation threshold
  - Definition: Minimum current necessary to capture & stimulate the heart
  - Testing
    - Set pacer rate 10 ppm faster than patient's HR
    - Decrease mA until capture is lost
    - Increase output until capture is regained (threshold capture)
    - Output setting to be 2x's threshold capture
      - Example: Set output at 10mA if capture was regained at 5mA



# Sensitivity Threshold

- Definition: Minimum level of intrinsic electric activity generated by the heart detectable by the pacemaker

- # Sensitivity Threshold Testing
- Testing
    - Set pacer rate 10 ppm slower than patient's HR
    - Increase sensitivity to chamber being tested to minimum level (0.4mV)
    - Decrease sensitivity of the pacer ( $\uparrow$ mV) to the chamber being tested until pacer stops sensing patient (orange light stops flashing)
    - Increase sensitivity of the pacer ( $\downarrow$ mV) until the pacer senses the patient (orange light begins flashing). This is the *threshold* for sensitivity.
    - Set the sensitivity at  $\frac{1}{2}$  the threshold value.
      - Example: Set sensitivity at 1mV if the threshold was 2mV

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# Questions



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