

# Basics of EKG Interpretation

## Session 3

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FALU, FLMI, CLU, ARS, ACS

# Review of Sessions 1 and 2

- Complex: PQRST, paper speed, voltage
- Leads and lead placement
  - 6 limb and 6 chest
    - 1,2,3, R,L and F
    - V1-6
    - Lead Groupings: 1&L, 2,3,&F, V1&2 and V3-6
- Heart rate
  - Remember 300, 150, 100, 75, 60, 50
- Heart rhythm: regular or irregular
  - If irregular, PAC's, PVC's, or AF
- Intervals: PR, QRS, QT, RR and PP

# Review Sessions 1 and 2

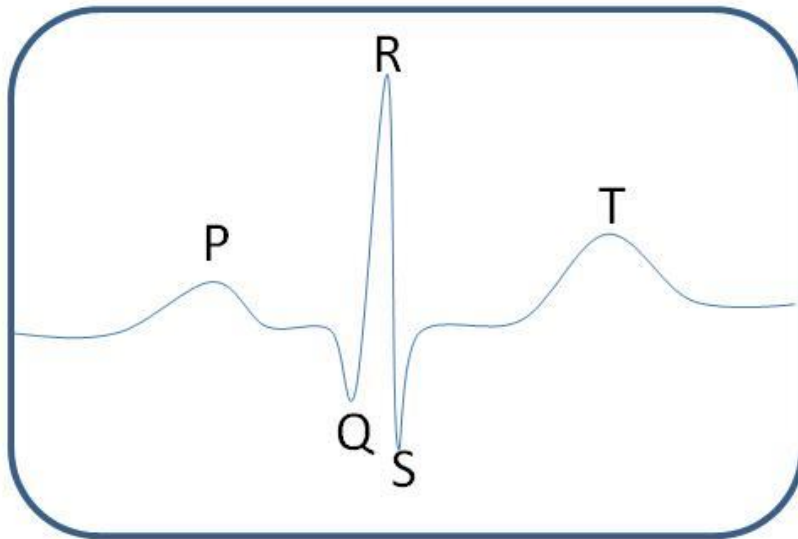
- Intervals: PR, QRS, QT, RR and PP
- Axis: normal, right, left, or indeterminate
  - Transition of V leads
- Conduction abnormalities
  - Heart blocks: 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>
  - Is the QRS interval  $<$  or  $>$  0.12?
  - RBBB and LBBB: rabbit ears
- Hypertrophy: atrial and ventricular
  - LVH with strain

# Ischemia, Injury, Infarction

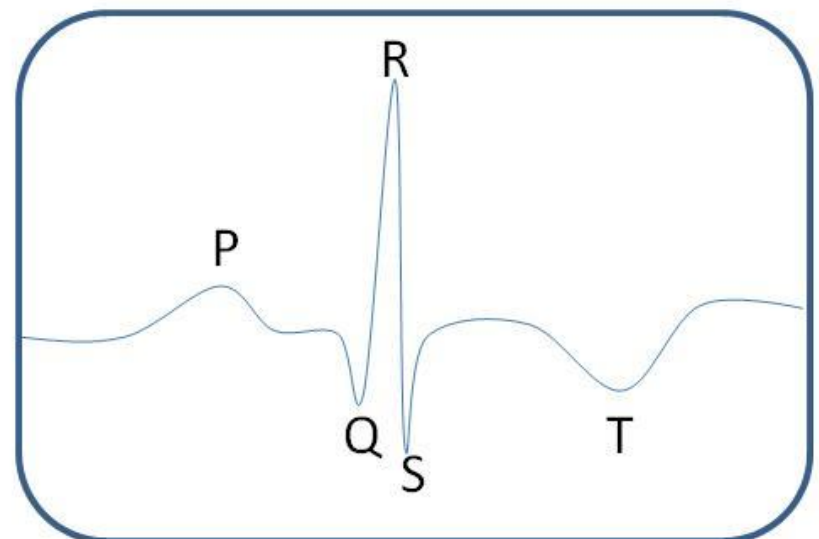
- Most commonly due to CAD and thrombosis
- Pattern: ischemia → injury → infarction
- Infarction represents cell death and may not be reversible unless treated promptly
- Thrombolytics have greatly reduced infarct size and EKG changes

# Ischemia

- Associated with symmetrically inverted T waves in leads where the T wave is normally upright
  - 1, 2, L, V3-6



An ECG showing the normal P Q R S T waves

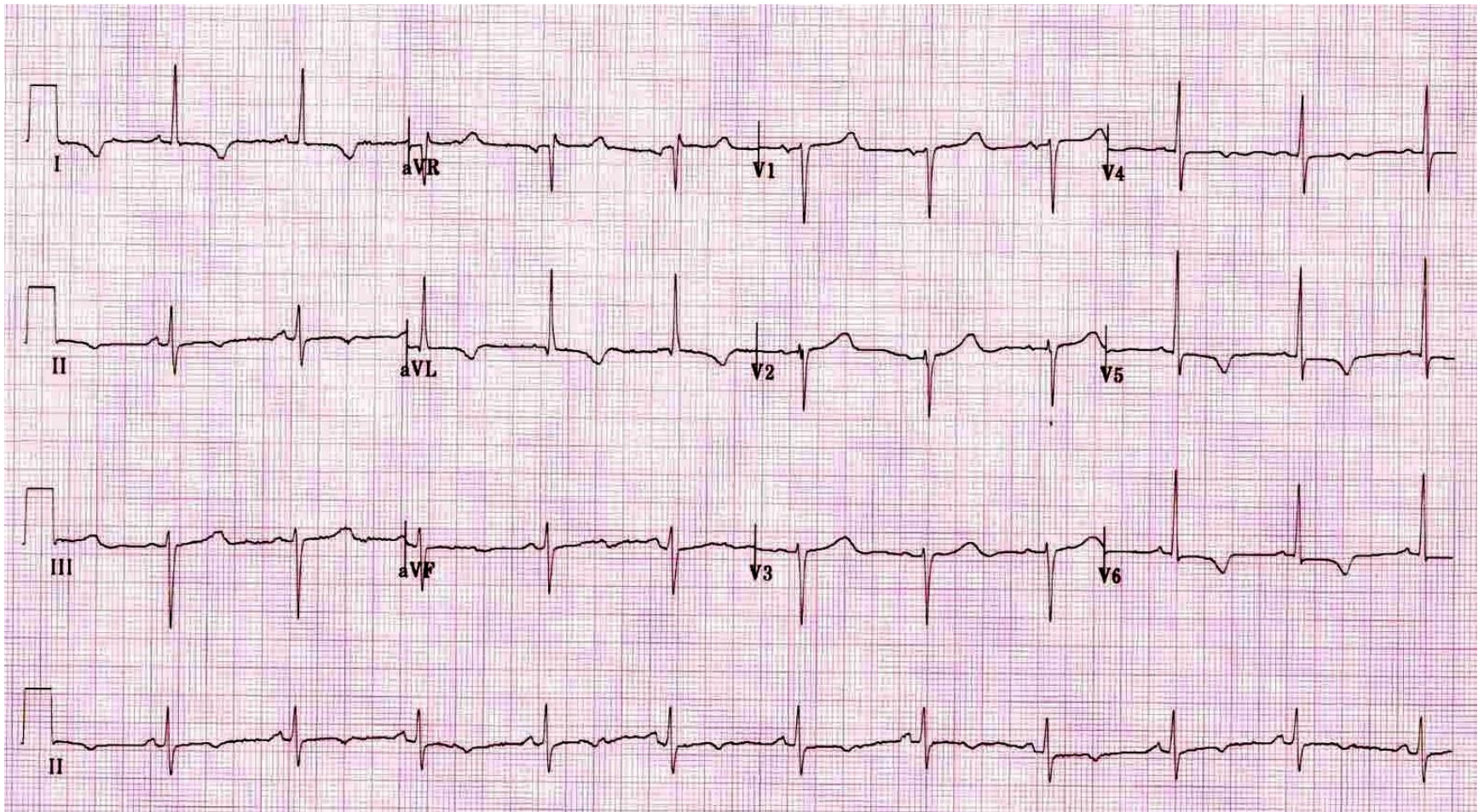


An ECG showing an inverted T-wave

# Ischemia

- Isolated T wave inversion or change is usually ok
- Look for groupings
  - 2,3,F: inferior wall: RCA
  - 1, L: lateral wall: L circumflex
  - V1-2: Septum: 1<sup>st</sup> diagonal
  - V2-5: LV anterior wall: LAD

# Ischemia

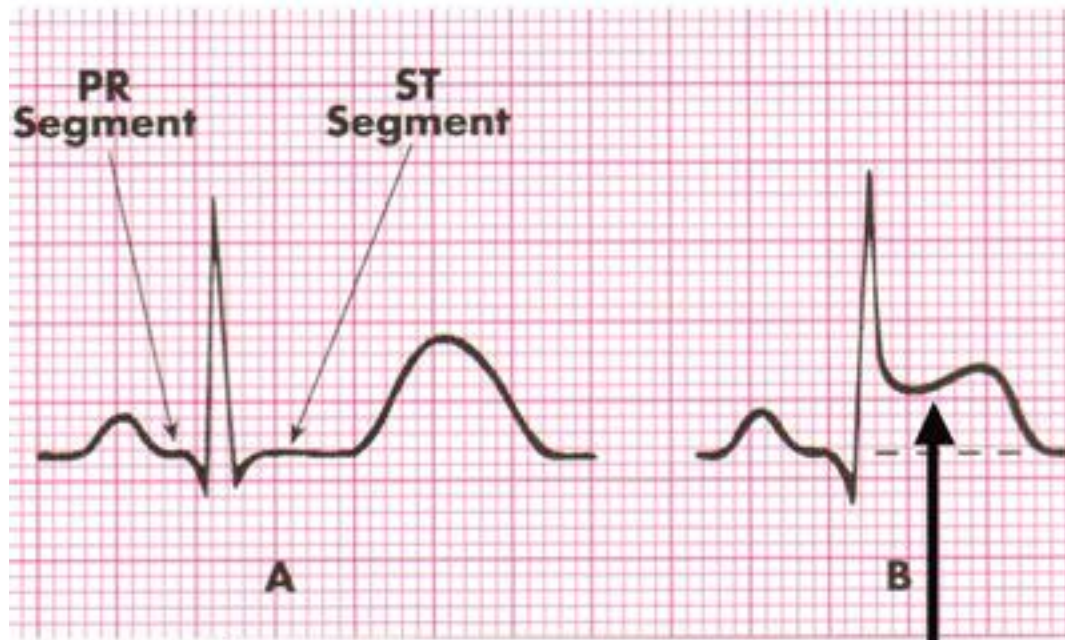


# Injury

- Acute
- Will usually see in tracings in APS
- Associated with ST segment elevation
- See with acute MI and pericarditis
- Often see reciprocal ST inversion in opposite area



# ST Segment Elevation (injury)



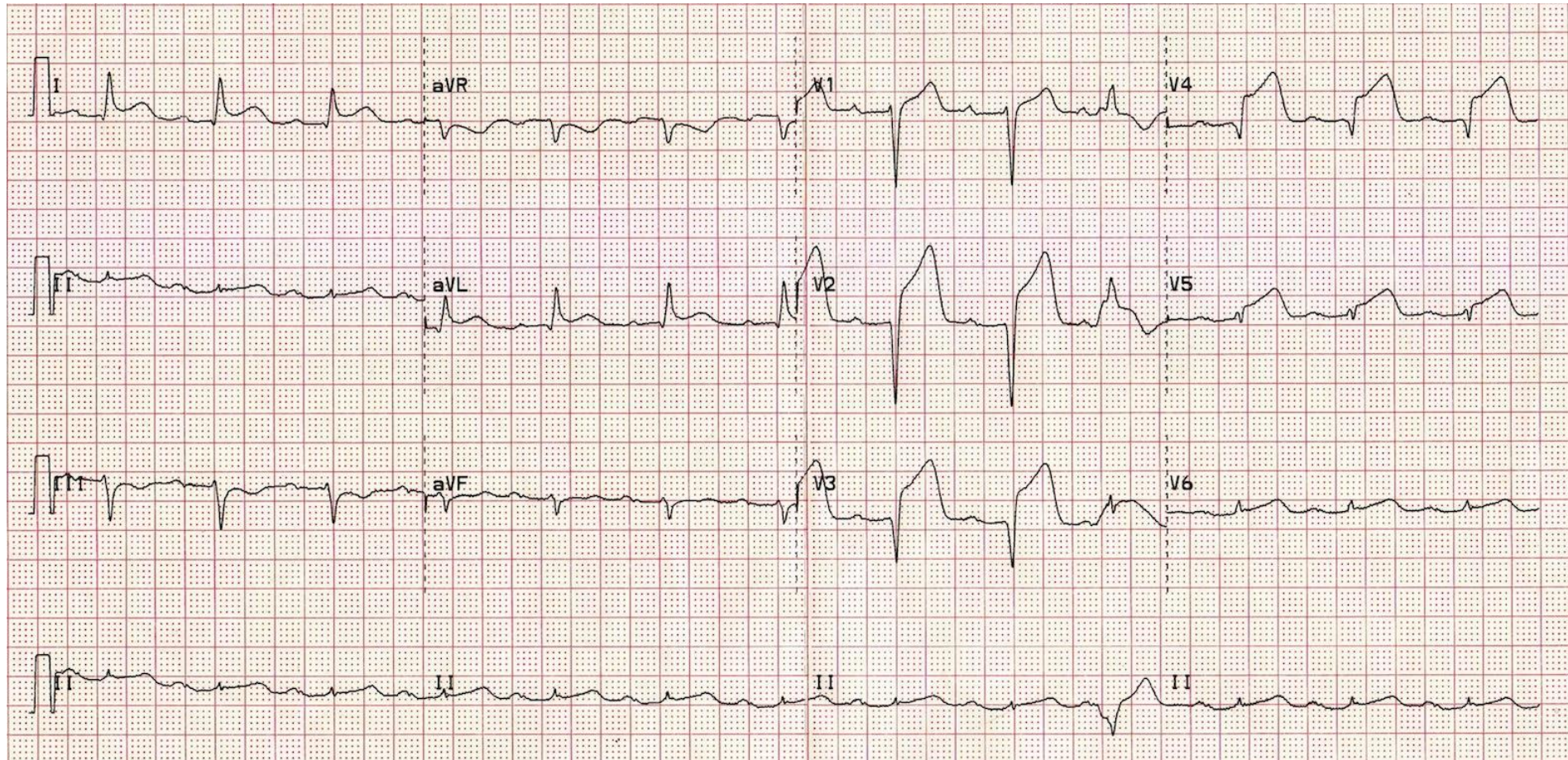
- ↑ 1 mm above baseline (limb)
- ↑ 2 mm above baseline (chest)
- .08 sec to right of J point
- Look for in two or more leads facing same area (if have a 12-lead)

**3 consecutive beats**

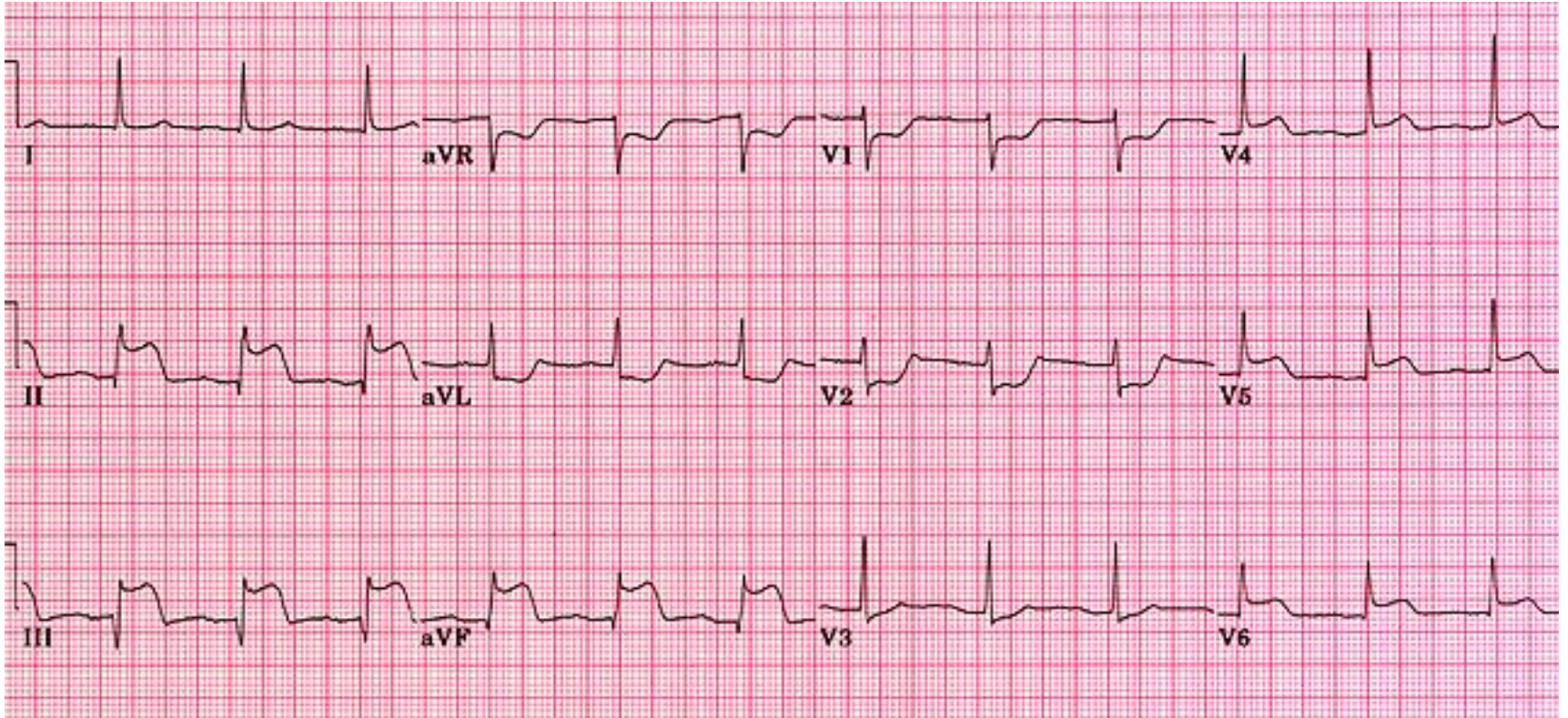
# Acute MI

- Transmural
  - ST elevation
- Subendocardial: non ST seg elevation MI or NSTSEMI
  - ST depression
  - No Q wave
  - See elevated enzymes

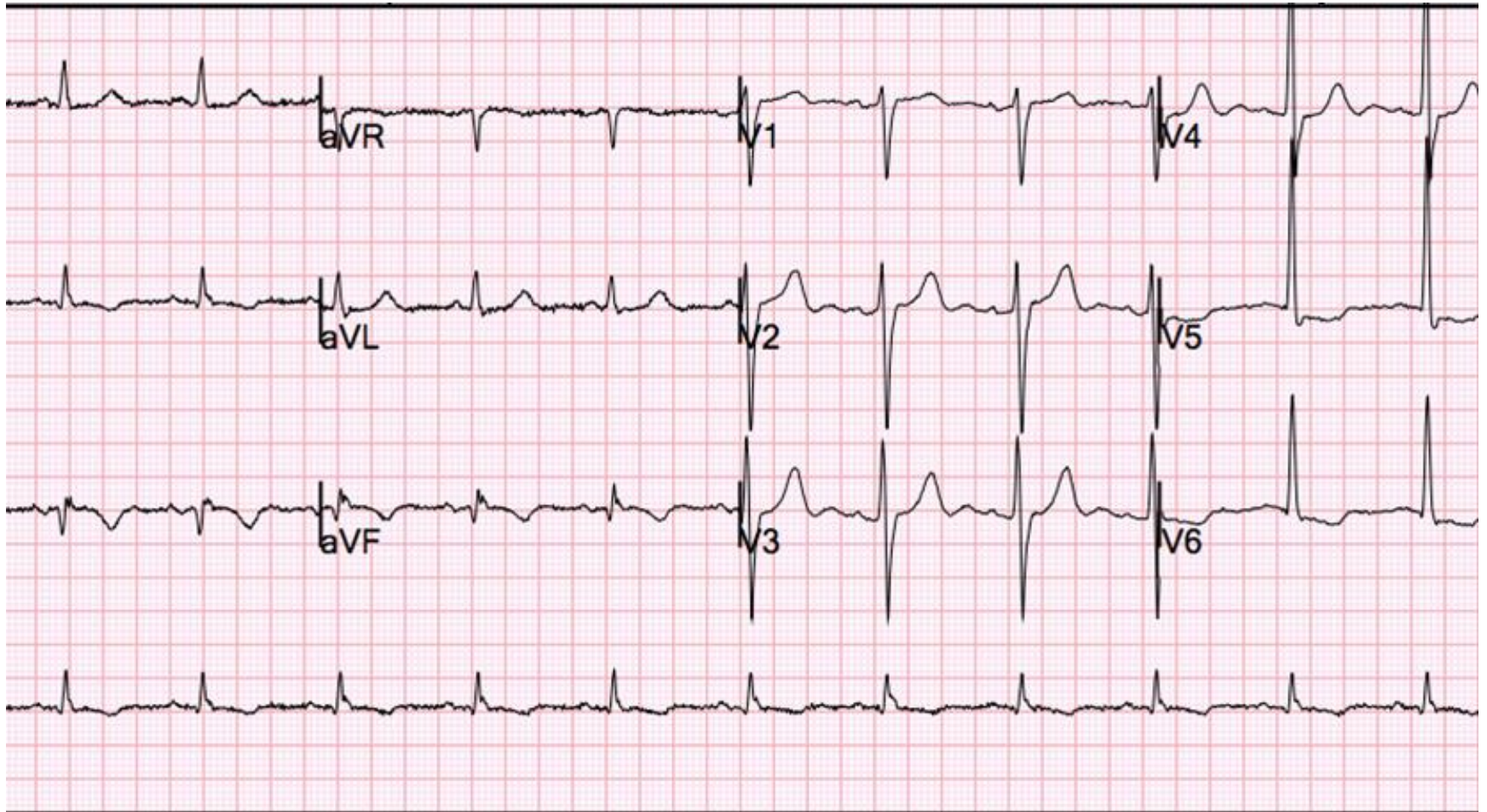
# Acute Anterior-Lateral MI



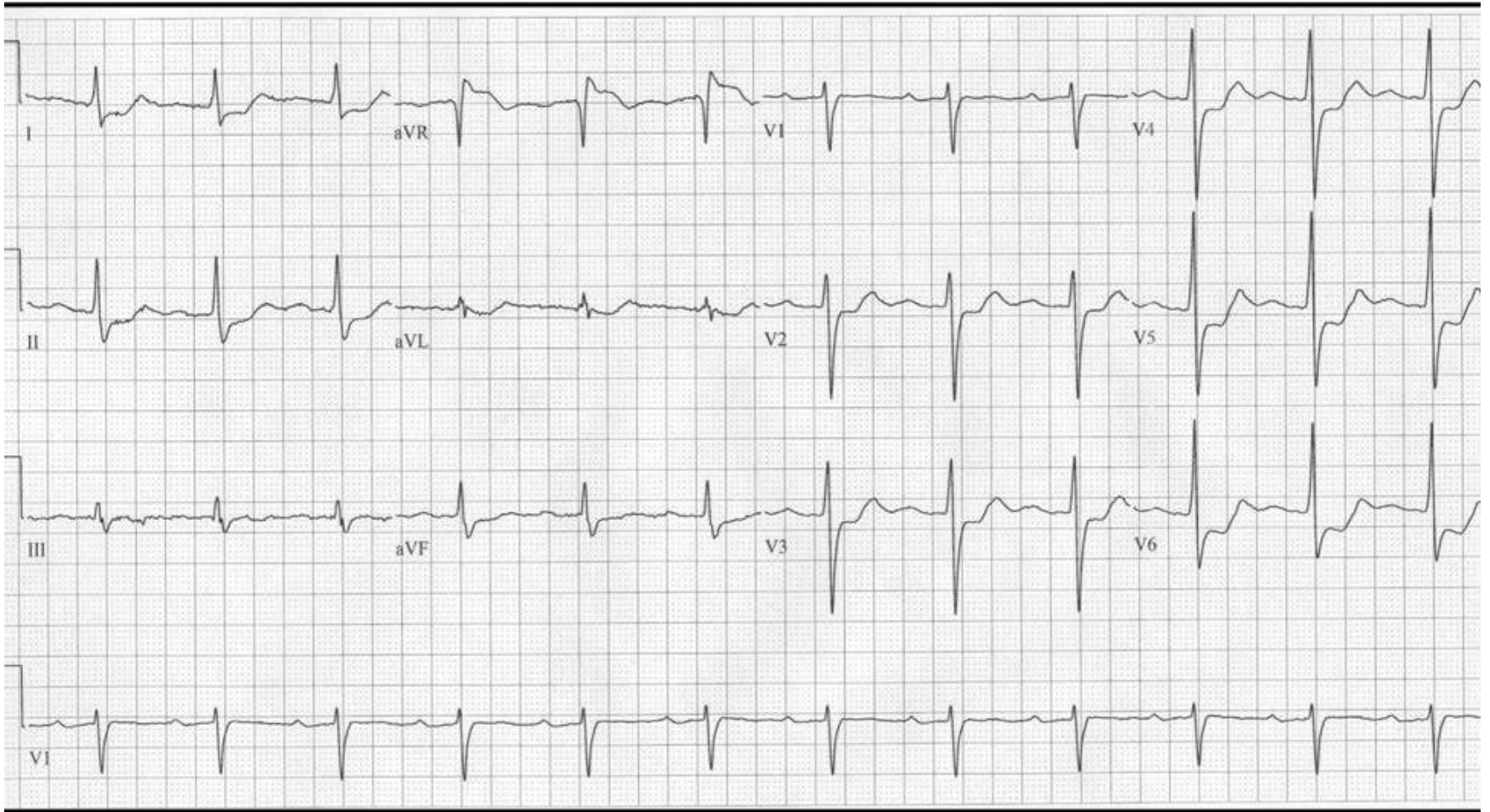
# Acute Inferior MI



# Subendocardial MI

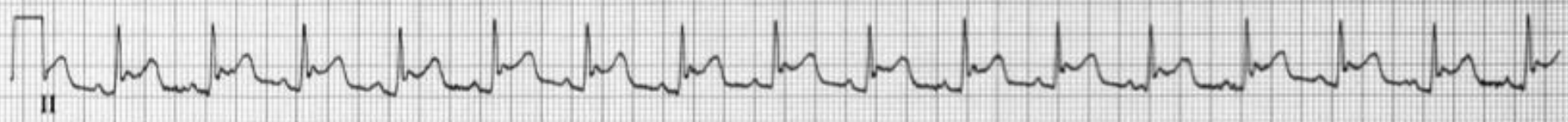
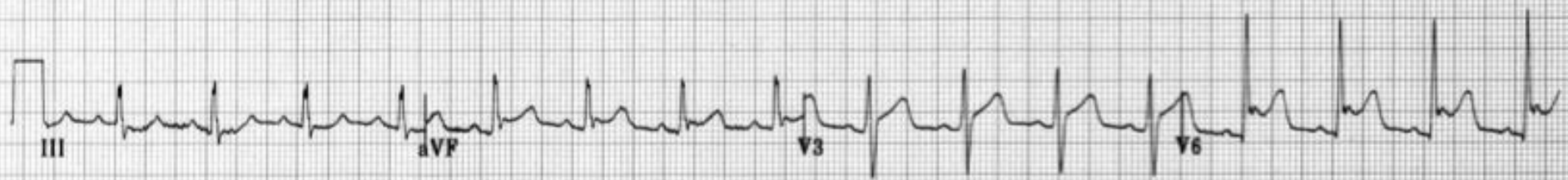
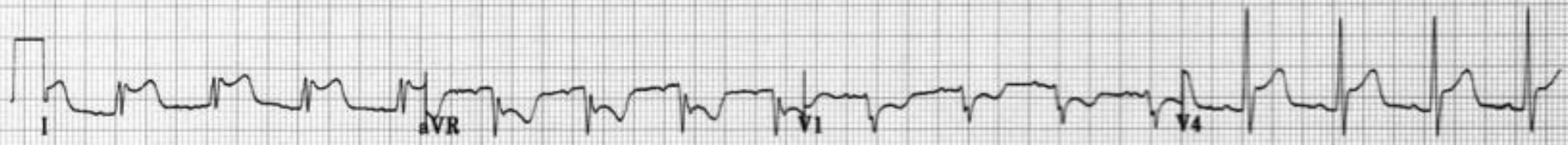


# Subendocardial MI



# Pericarditis

- Inflammation of pericardium
- Usually see all leads with ST elevation
- With MI usually in particular grouping
  - Inferior, anterior or lateral
- Sometimes hard to differentiate
- Echo may help
- Cardiac enzymes may or may not be elevated
  - If myocarditis also present, enzymes will elevate





# Types of ST Depression

Horizontal



Downsloping



Upsloping

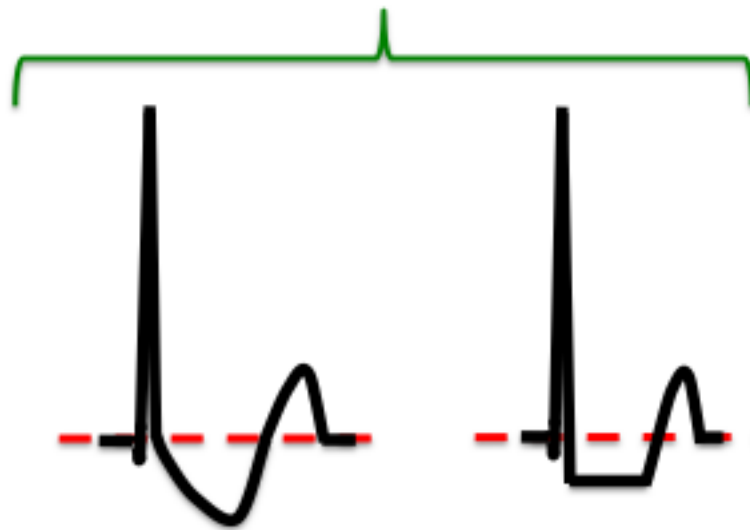


# Subendocardial Ischemia

# Transmural Ischemia

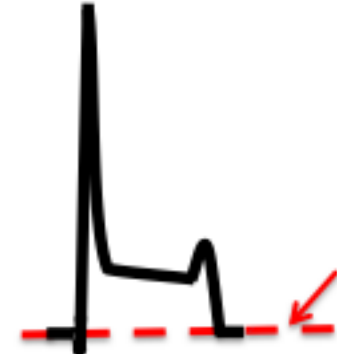


Normal



ST depression (downslope)

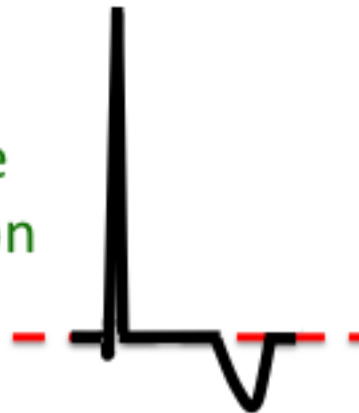
ST depression (horizontal)



Isoelectric line

ST elevation

T wave Inversion



# Q Waves

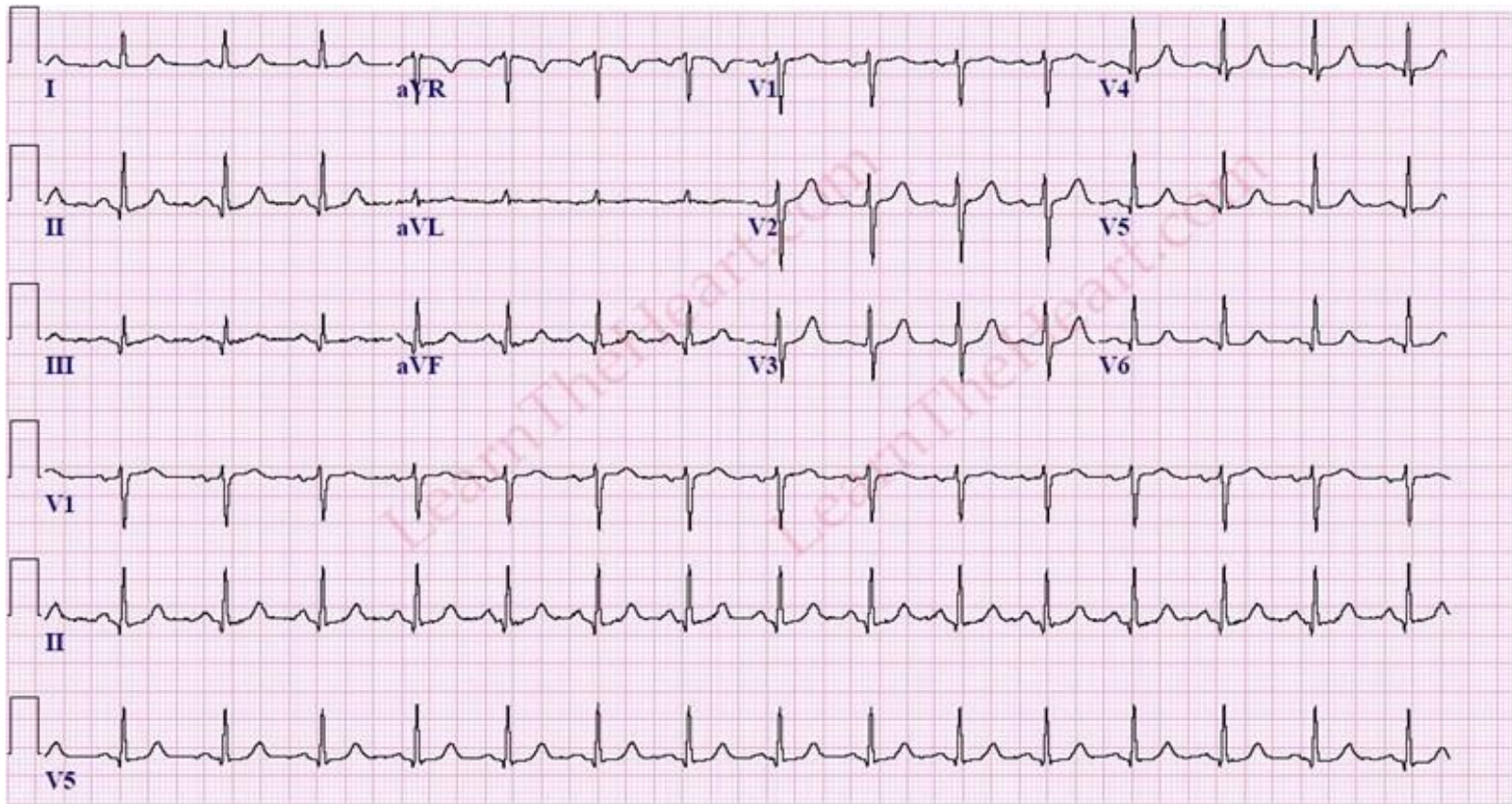
## Cell Death

- If acute injury not treated, myocardial cell death occurs and Q waves develop
  - In transmural MI
  - Q waves don't develop with subendocardial MI
- Less common today with thrombolytic therapy
- Look for Groups
  - Inferior, anterior, lateral

# Q waves

- Cannot determine if LBBB present
- Difficult with RBBB
- Significant Q waves
  - 1/3 the size of the QRS amplitude
  - At least 1 mm wide
- More than 1 lead

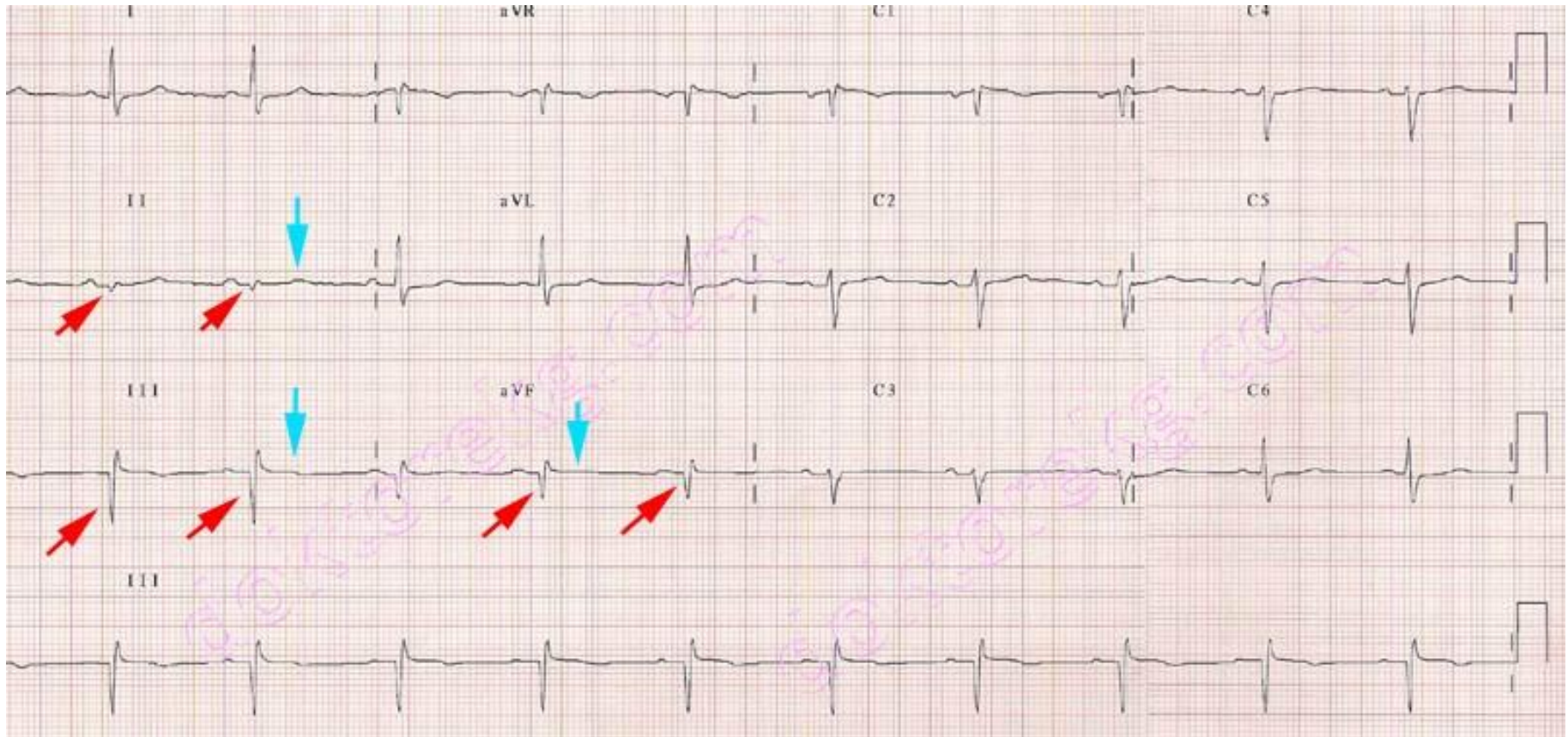
# Insignificant Q wave



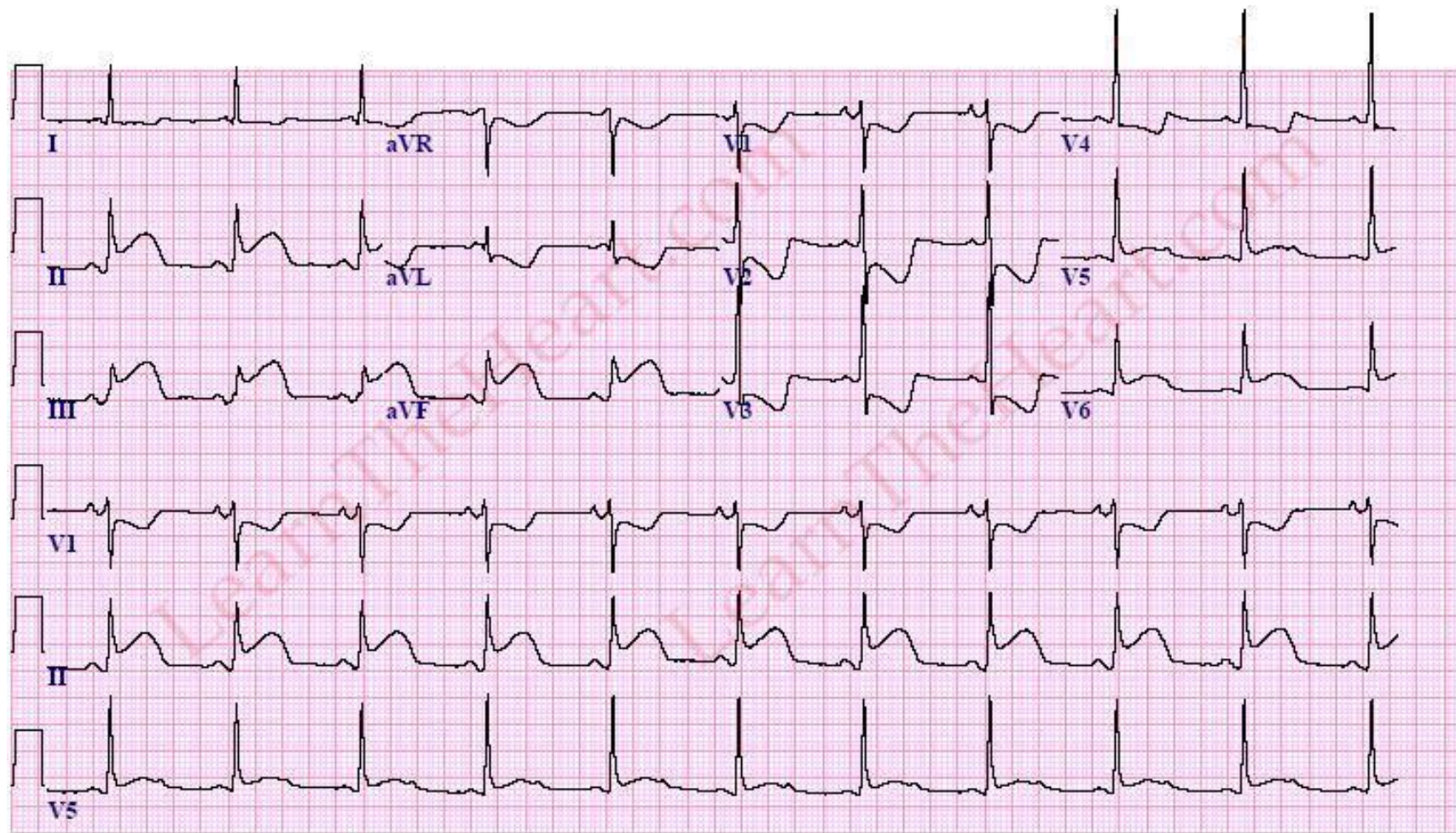
25mm/s 10mm/mV 100Hz 005C 12SL 250 CID:1

EID:609 EDT: 15:25 13-APR-1999 ORDER:

# Significant Q waves



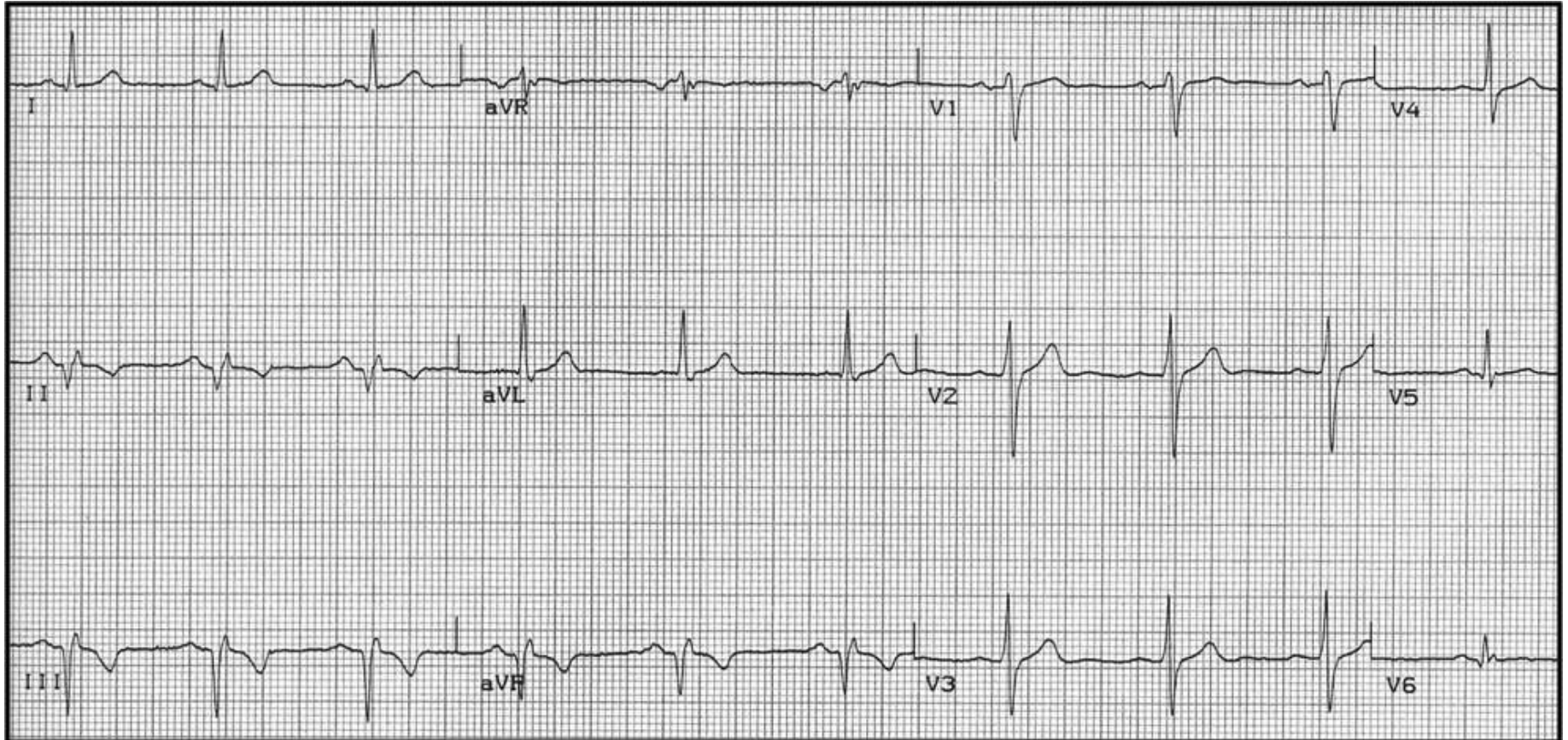
# Inferior MI: Acute



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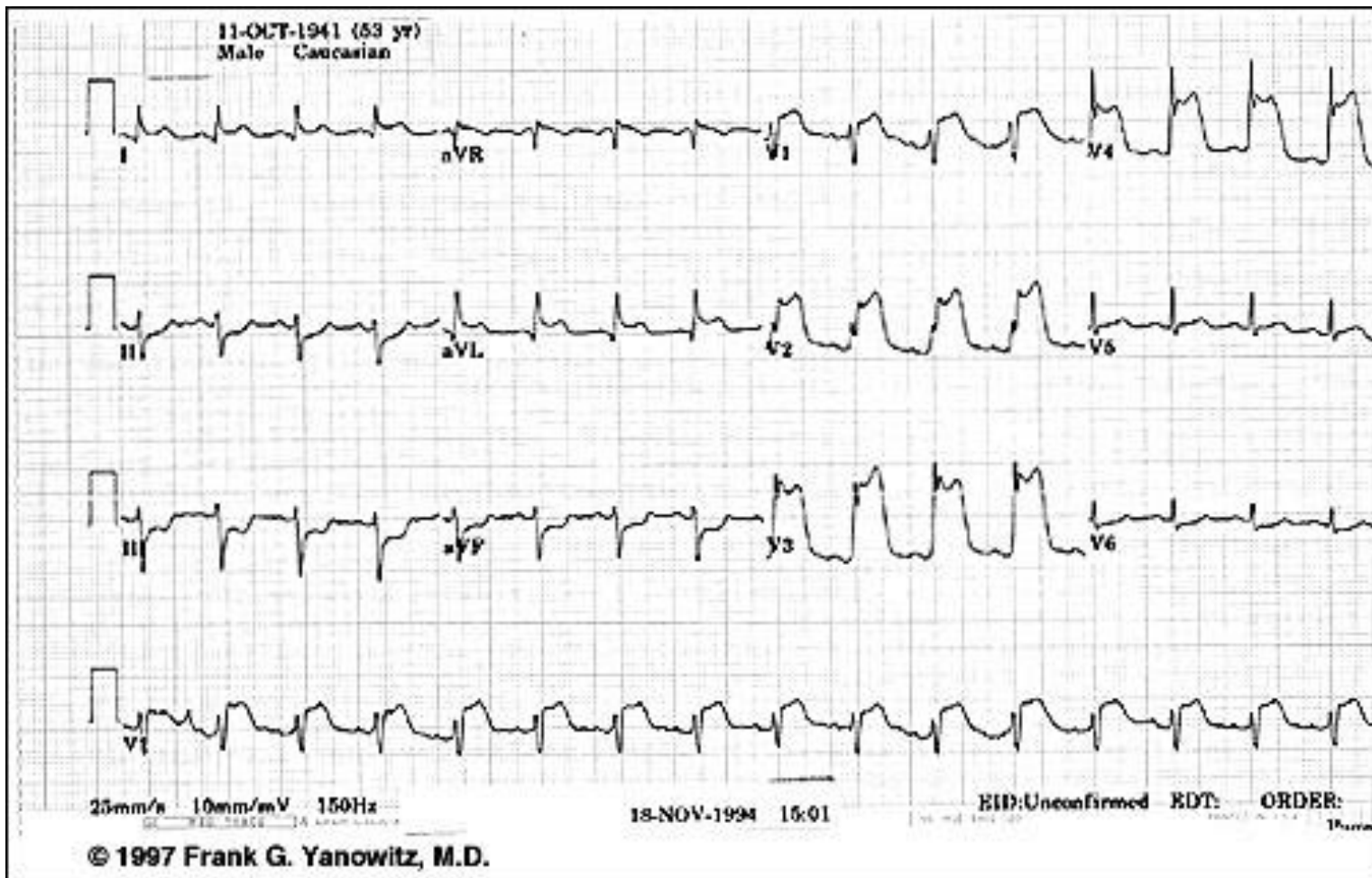
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# Inferior MI: Old

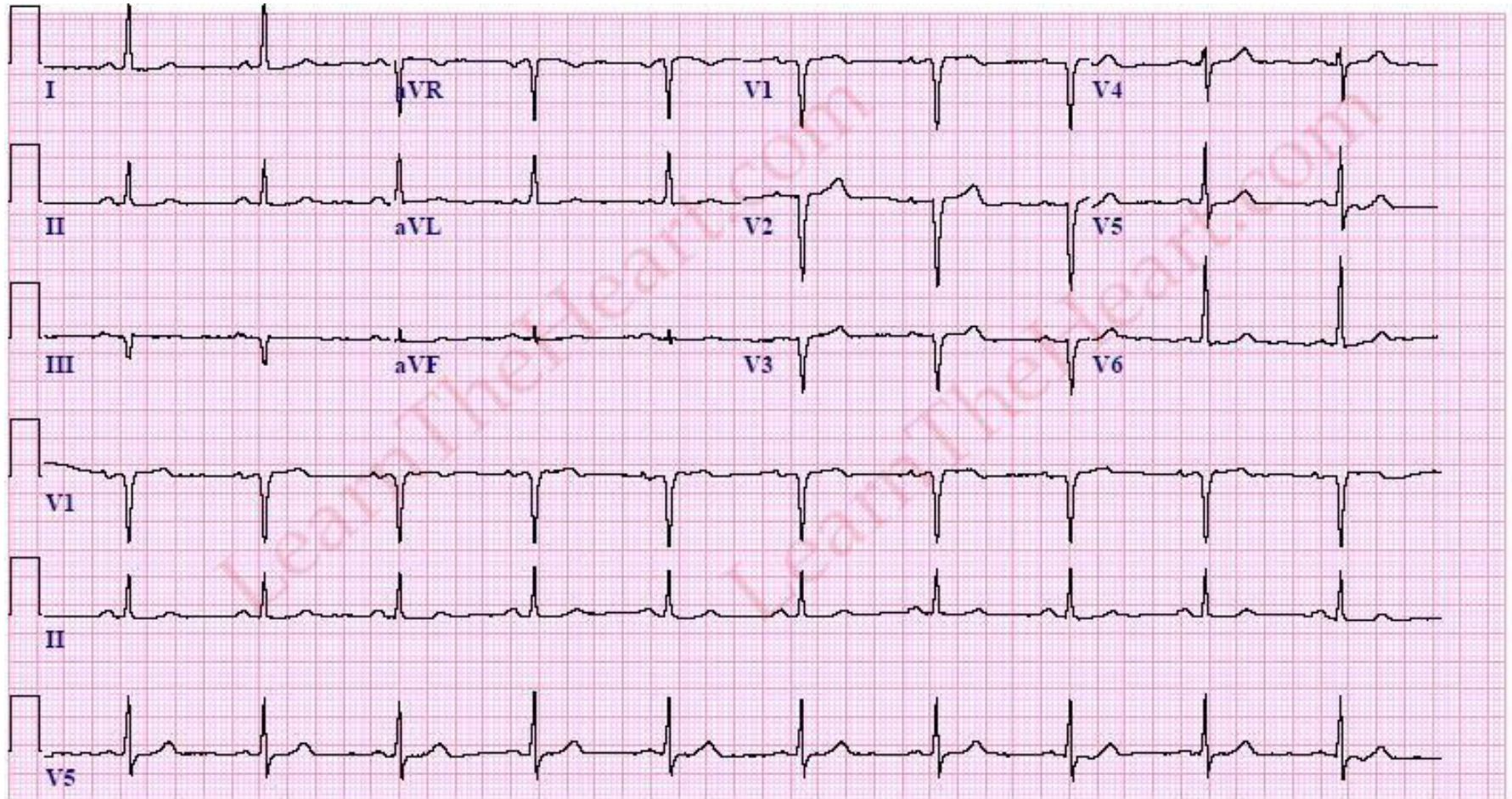




# Anterior MI: Acute



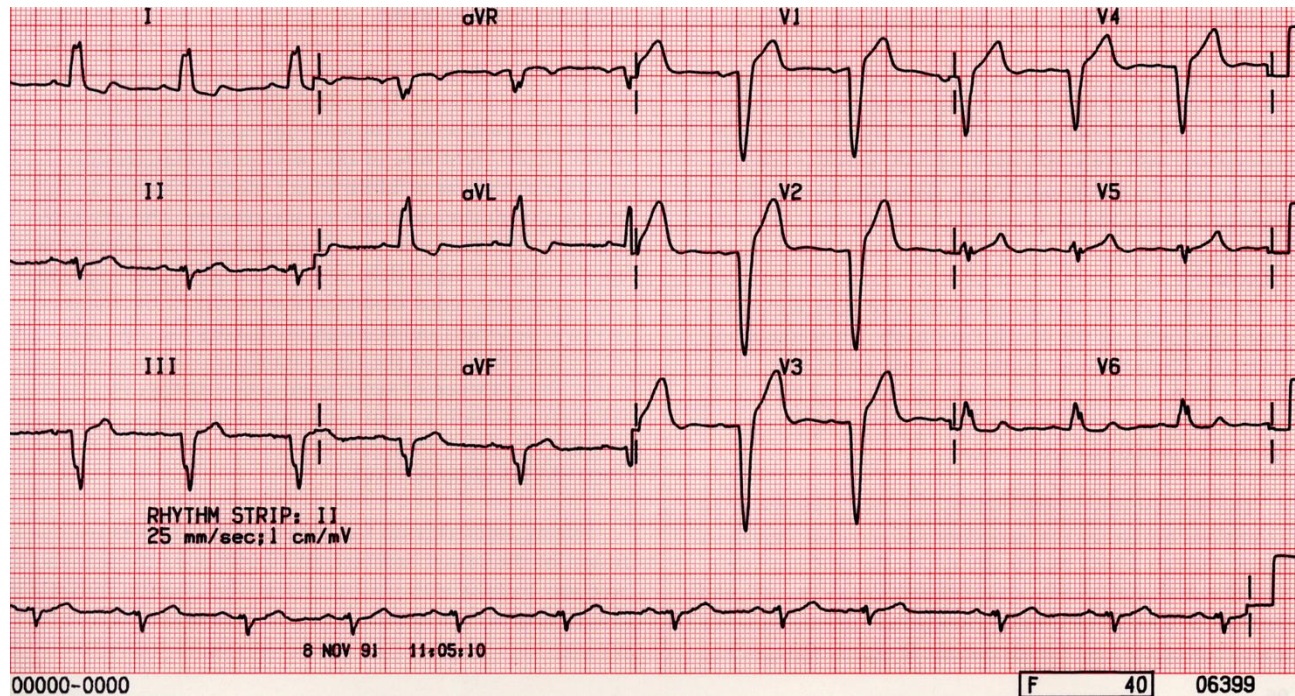
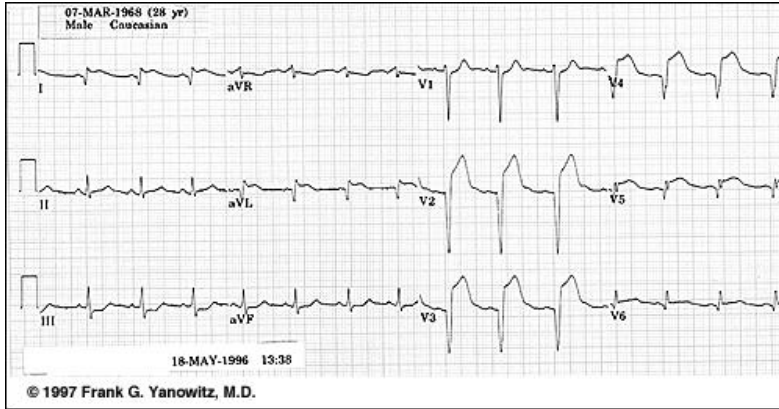
# Anterior MI: Old



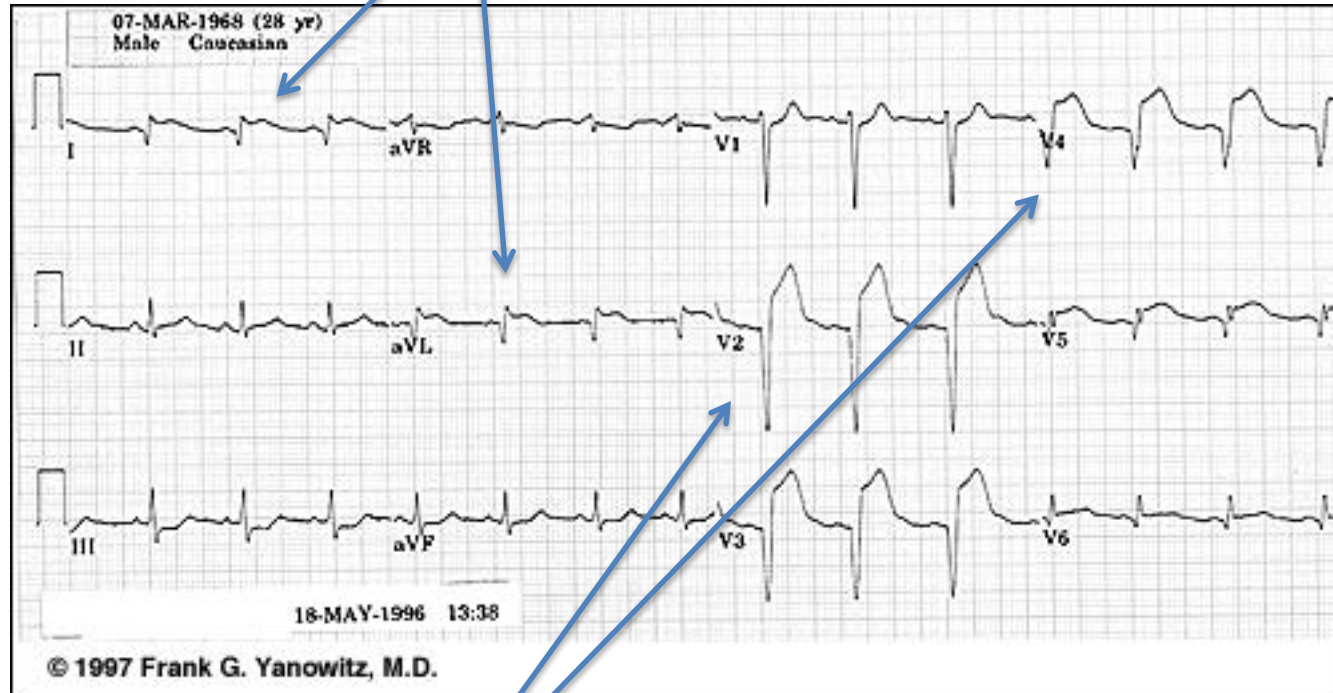
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# Anterior MI v LBBB



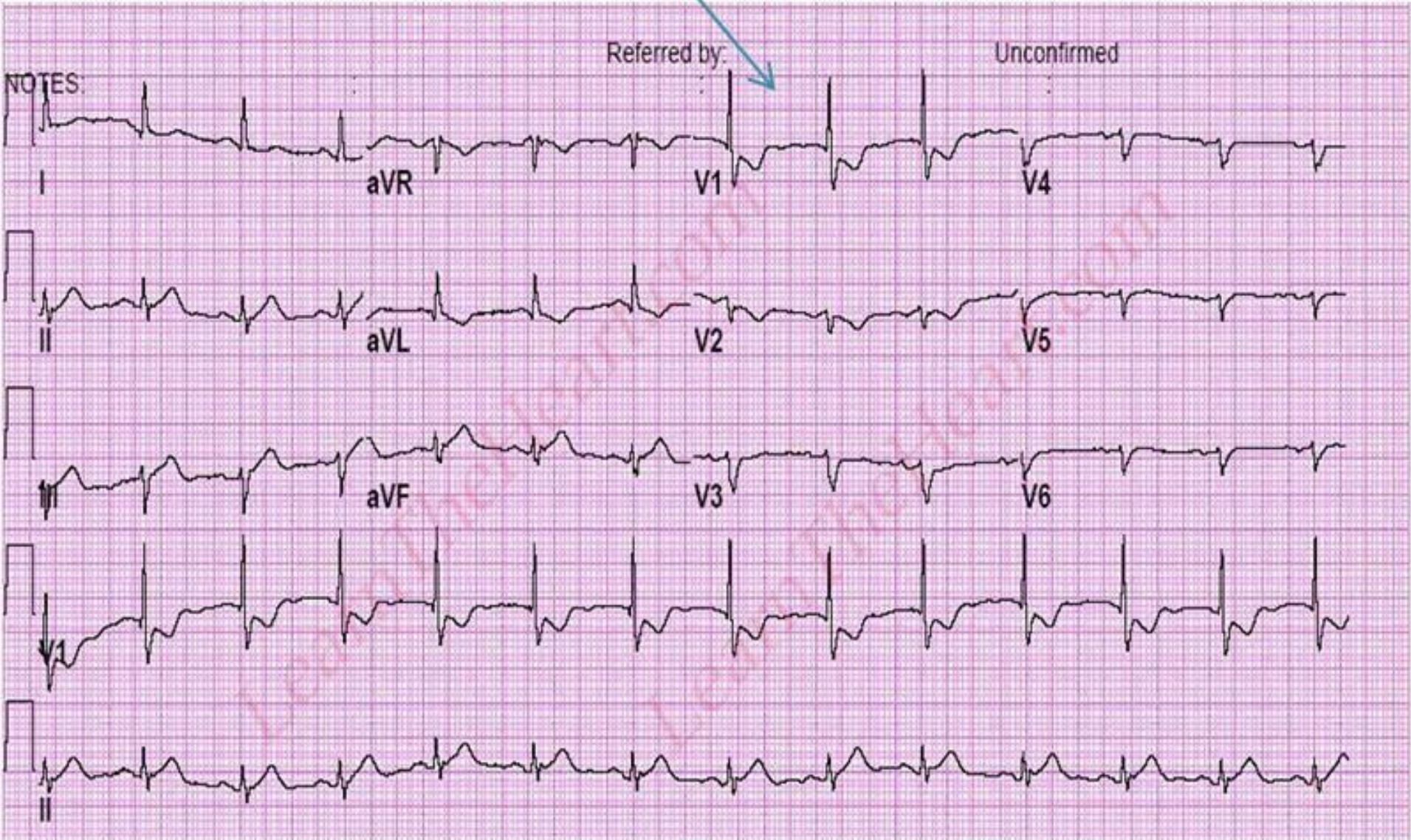
# Lateral MI: Old



Also see old anterior MI

# Posterior MI

- Not common
- Associated with ST depression in V1-2
- Large R wave in V1-2
  - In a mirror, it looks like a Q wave
- Can be hard to differentiate from RVH
  - Clinical hx, enzymes and echo important



# V1-2

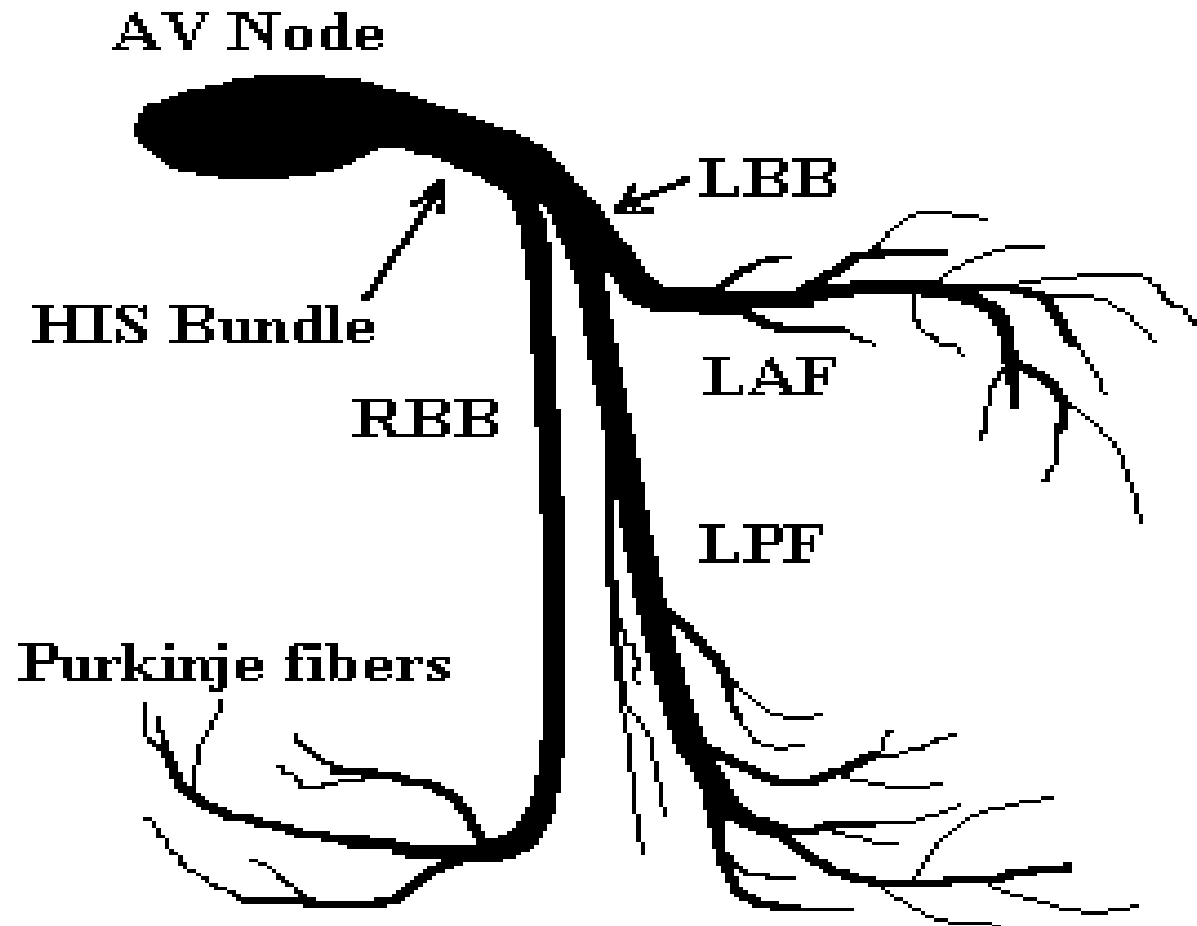
- ST elevation and Q wave = anterior (septal) MI
- ST depression and large R wave = posterior MI
- Depression alone: anterior ischemia

# Hemiblocks

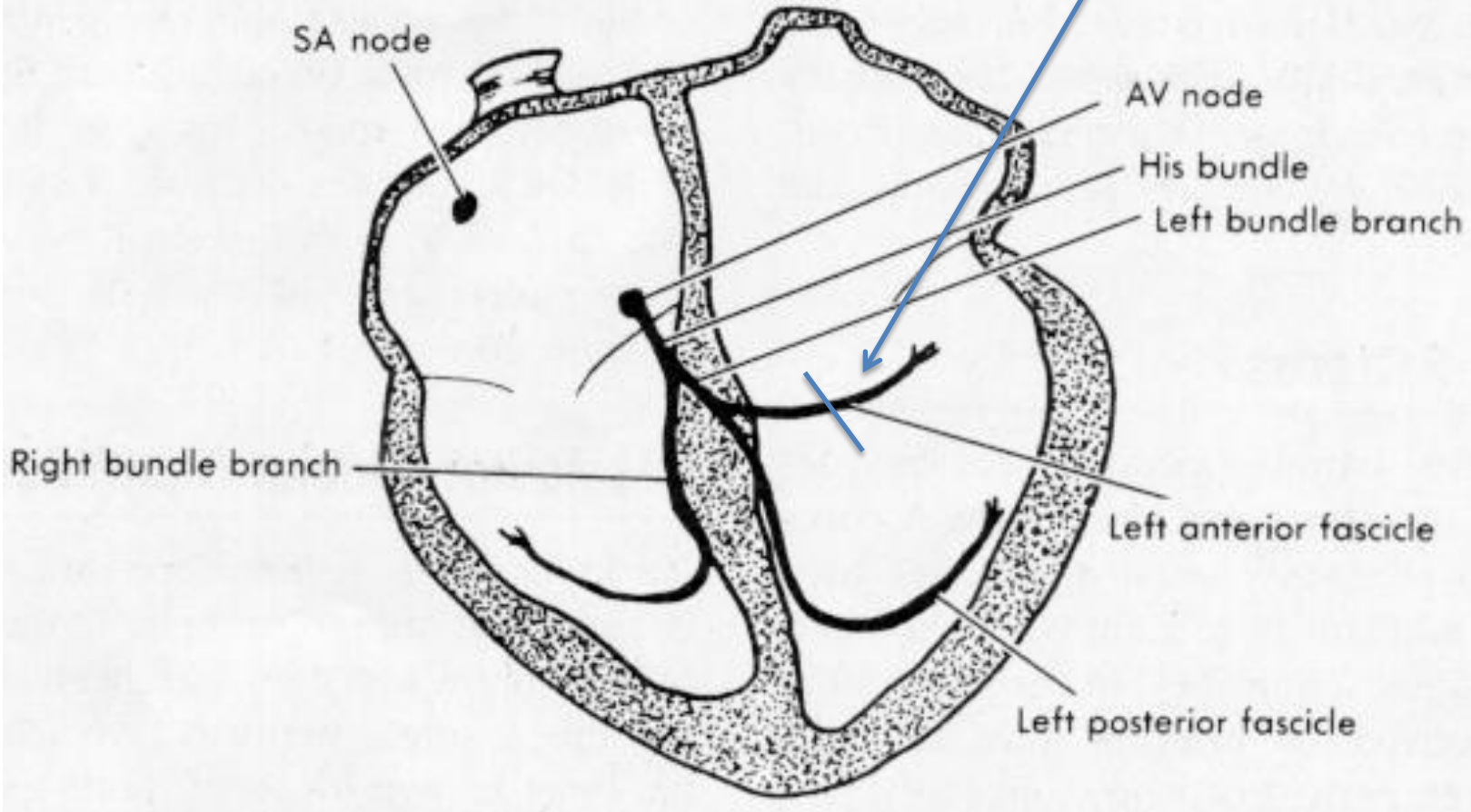
- Left Bundle divides into 2 divisions
  - Left anterior fascicle
  - Left posterior fascicle
- The Right bundle does not have any significant subdivisions
- In most cases hemiblocks are synonymous with axis deviation
  - LAD=LAHB
  - RAD=RPHB



# Hemiblocks or Fascicular Blocks



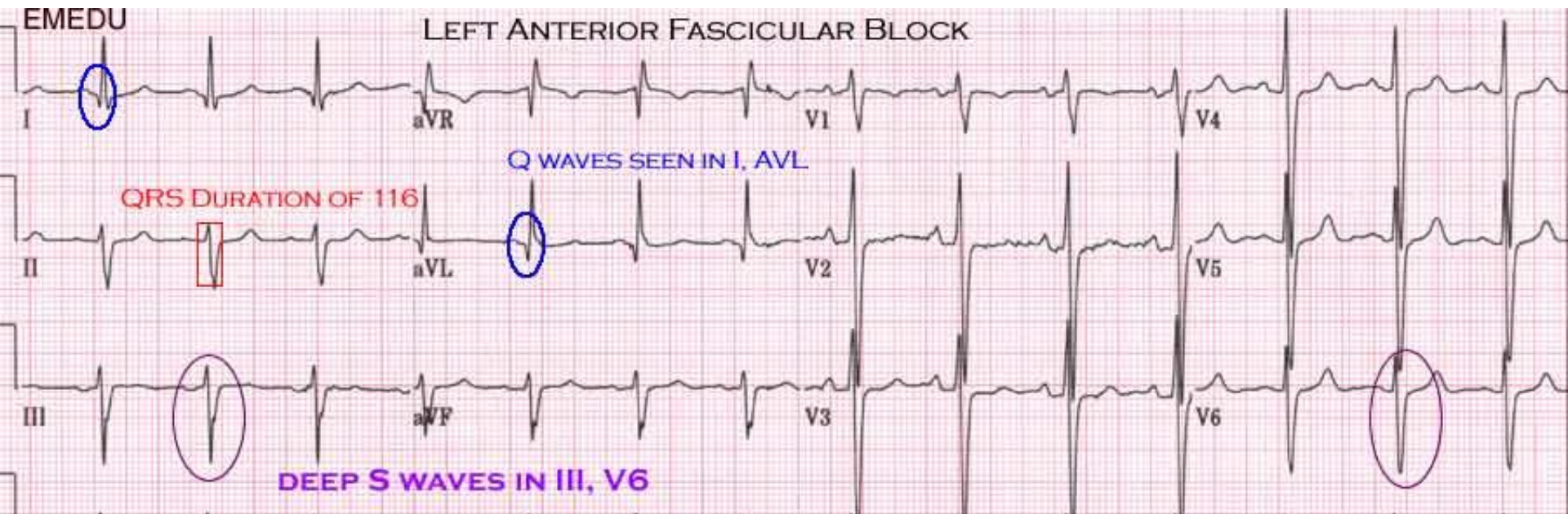
# LAHB (LAFB)



# Left Anterior Hemiblock

- Left Anterior Fascicular Block
- LAHB
- Common
- EKG changes
  - LAD
  - Normal or slightly wide QRS
  - Q1 and S3

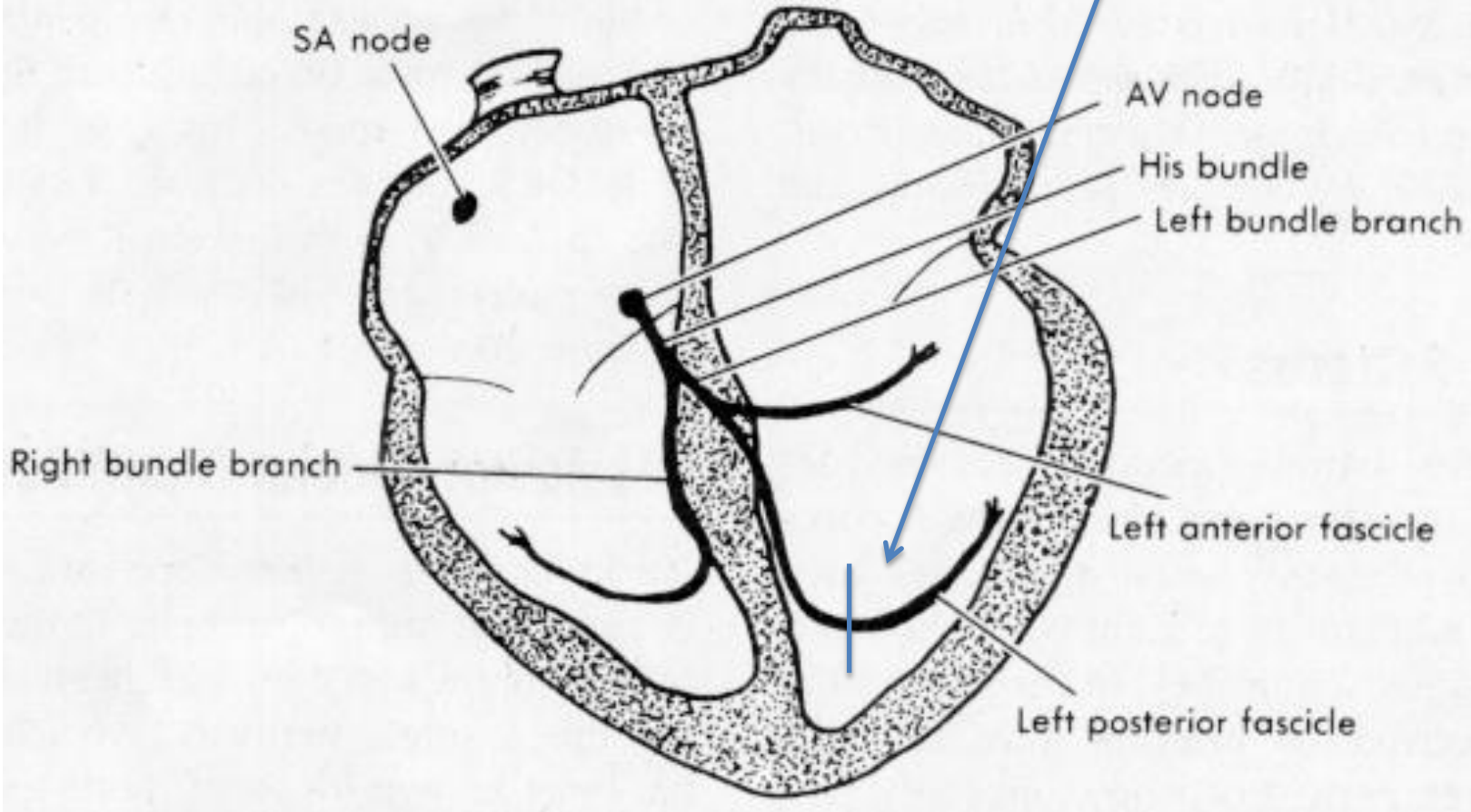
# LAHB



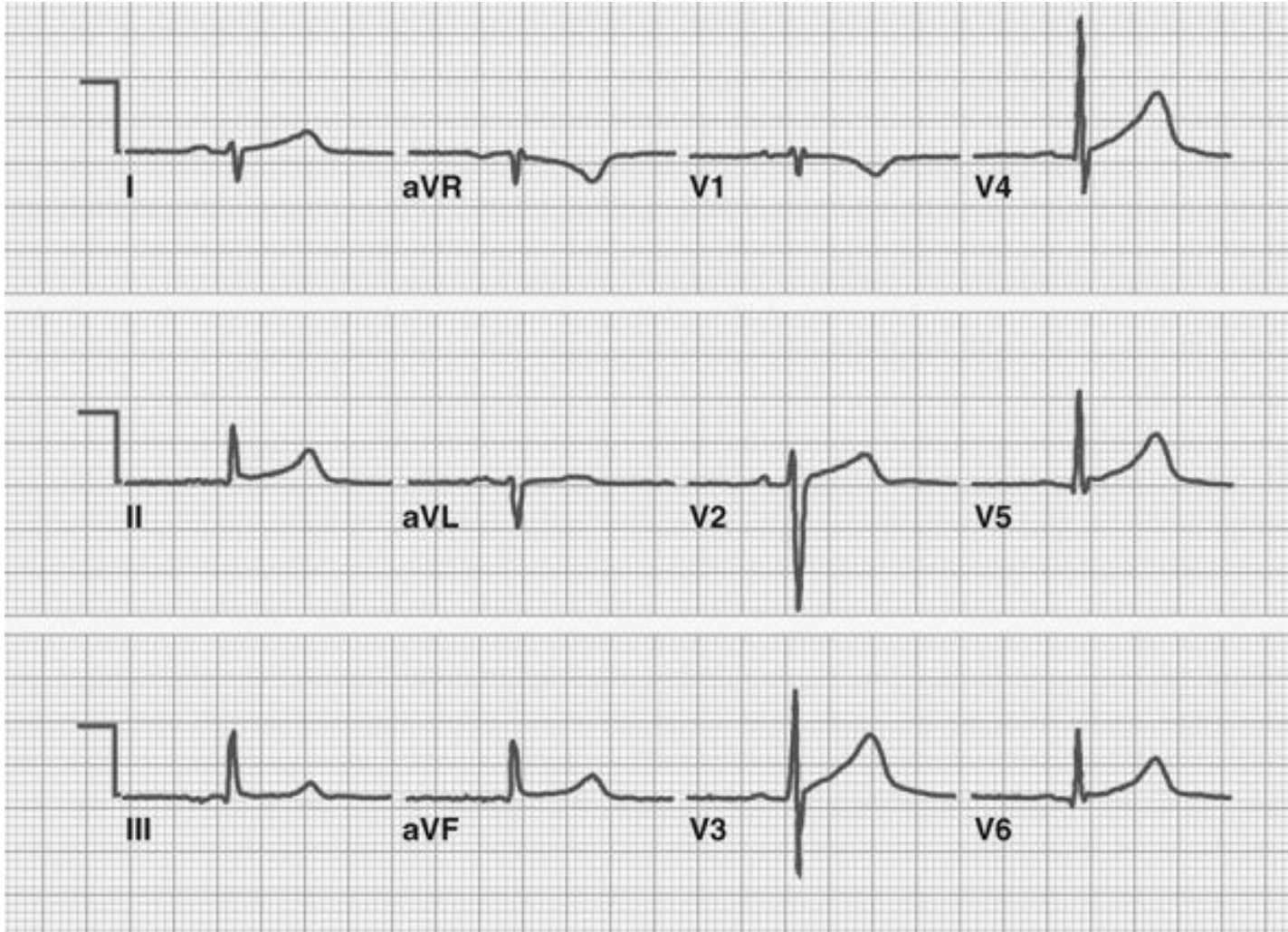
# Left Posterior Hemiblock

- Rare
- Usually associated with significant MI
- EKG changes
  - RAD
  - Normal or slightly wide QRS
  - S1 and Q3

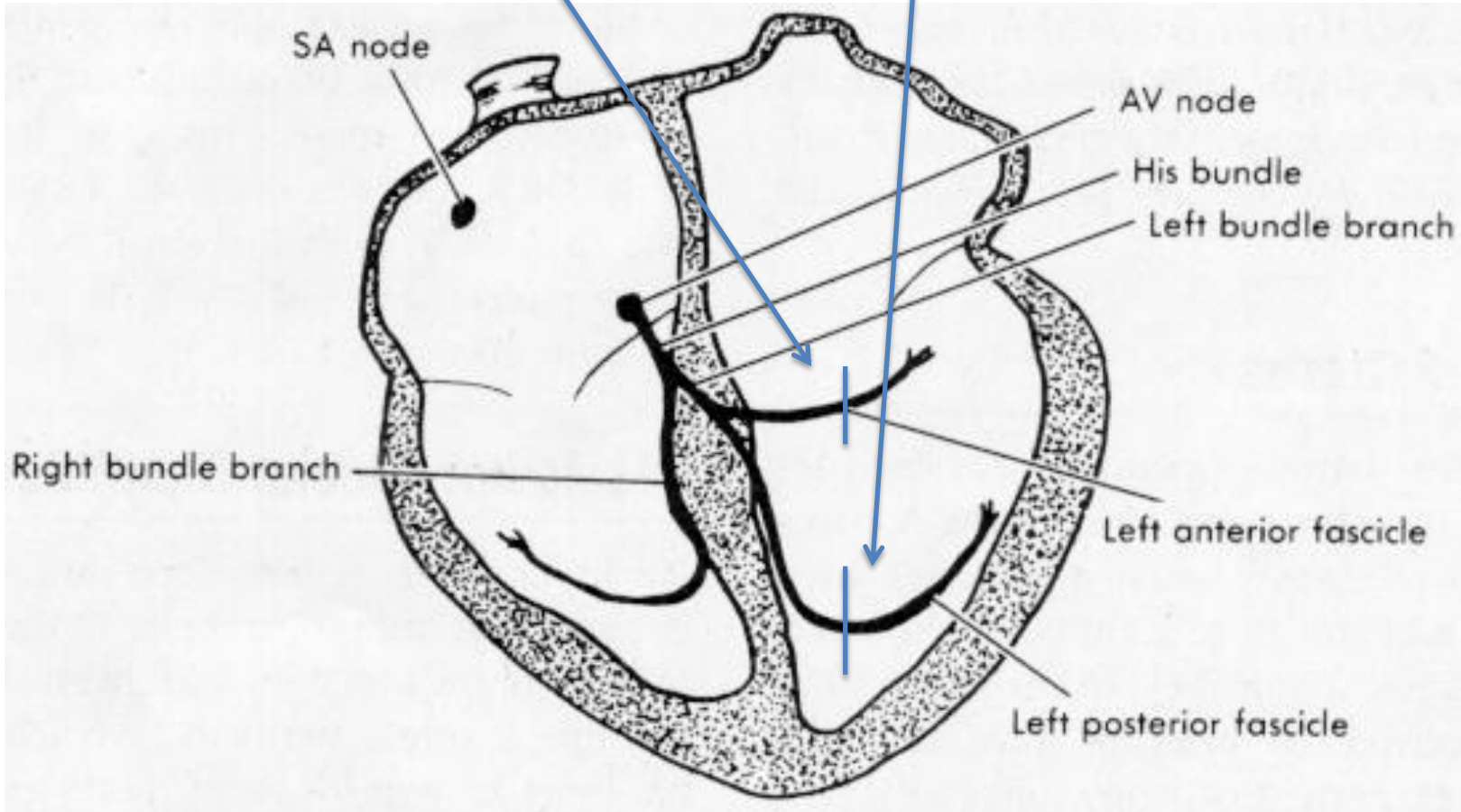
# LPHB (LPFB)



# LPHB



**LAHB + LPHB = LB**

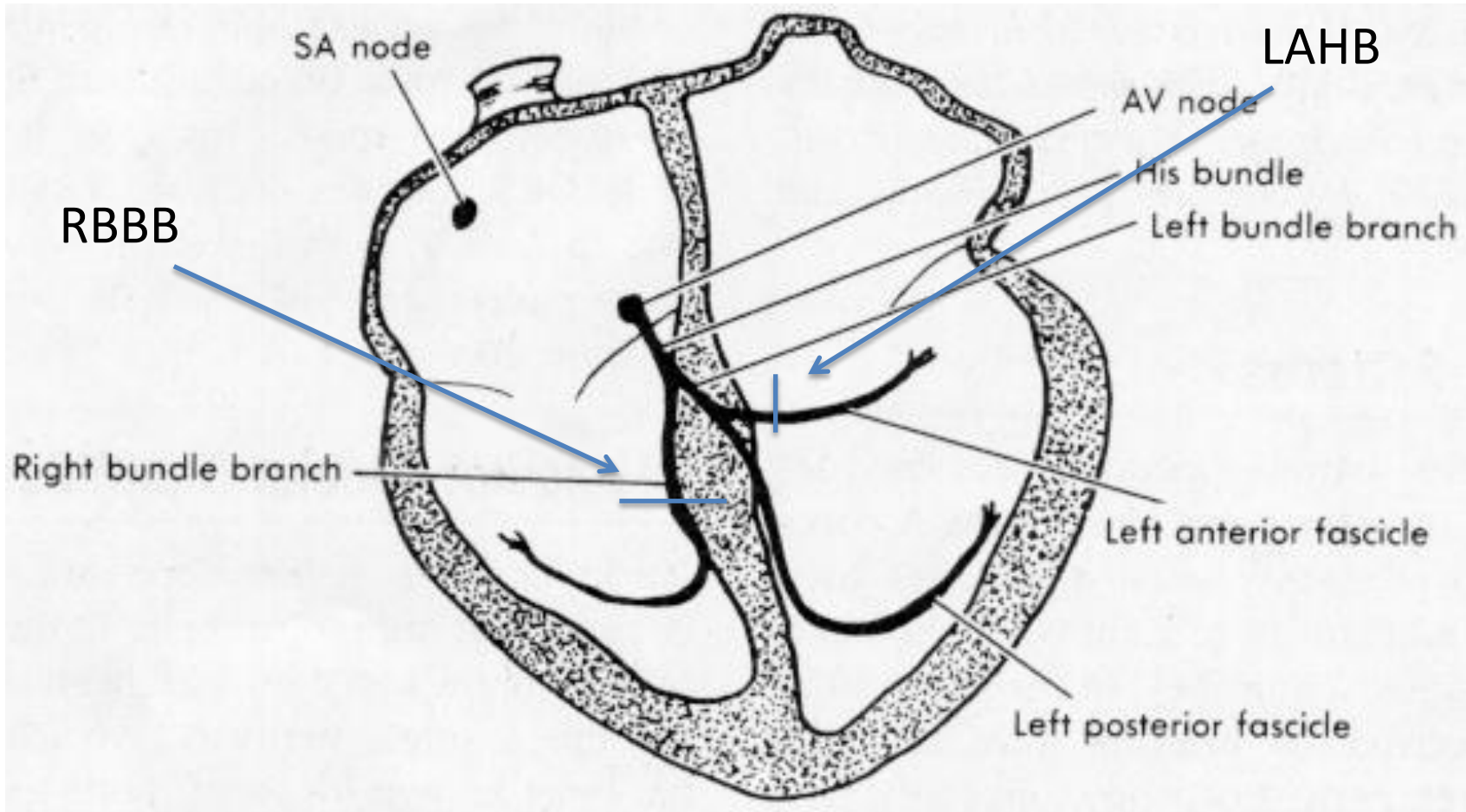




# Bifascicular Blocks

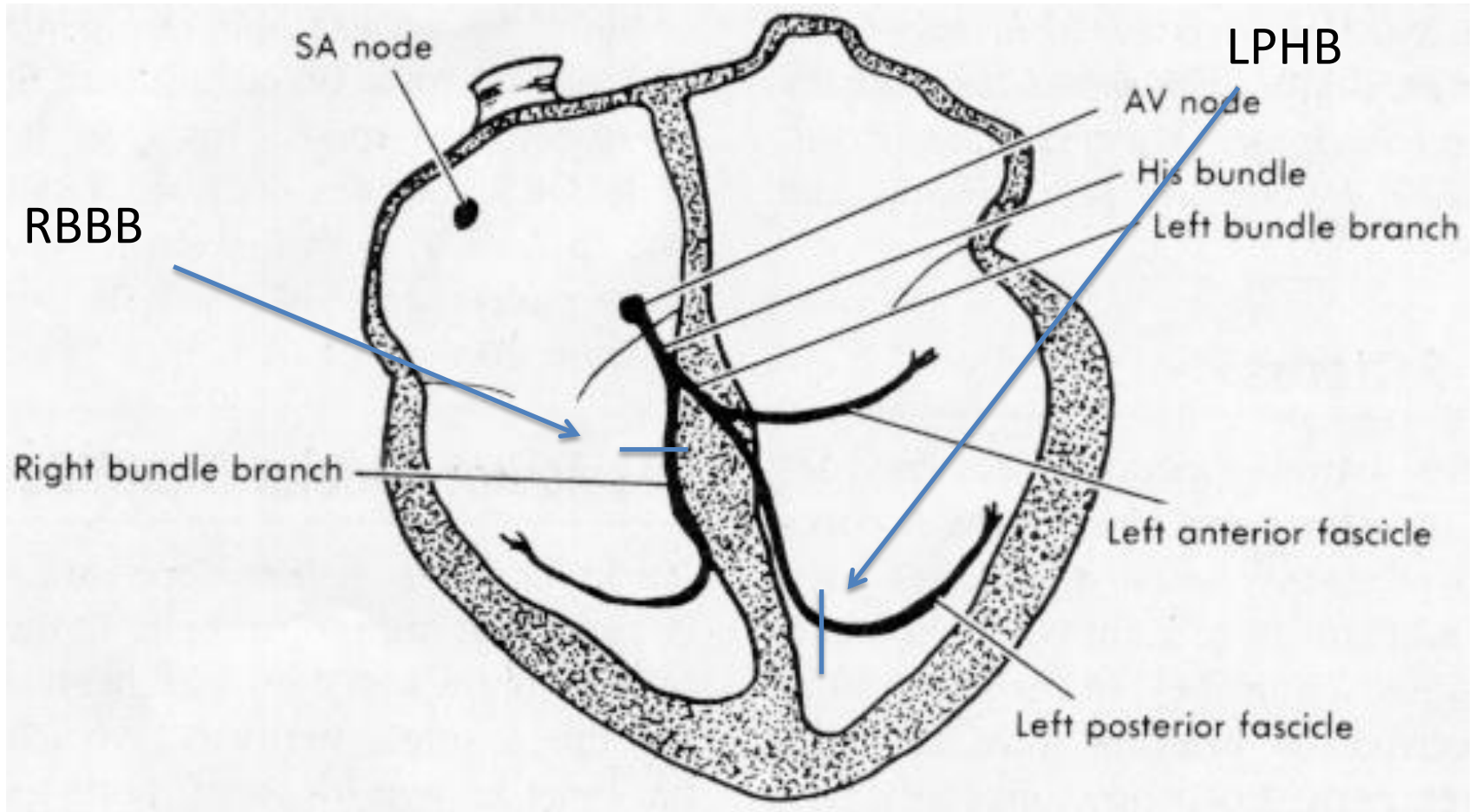
- RBBB + LAHB
  - We see these regularly
- RBBB + LPHB
  - Very rare

# LAHB + RBBB



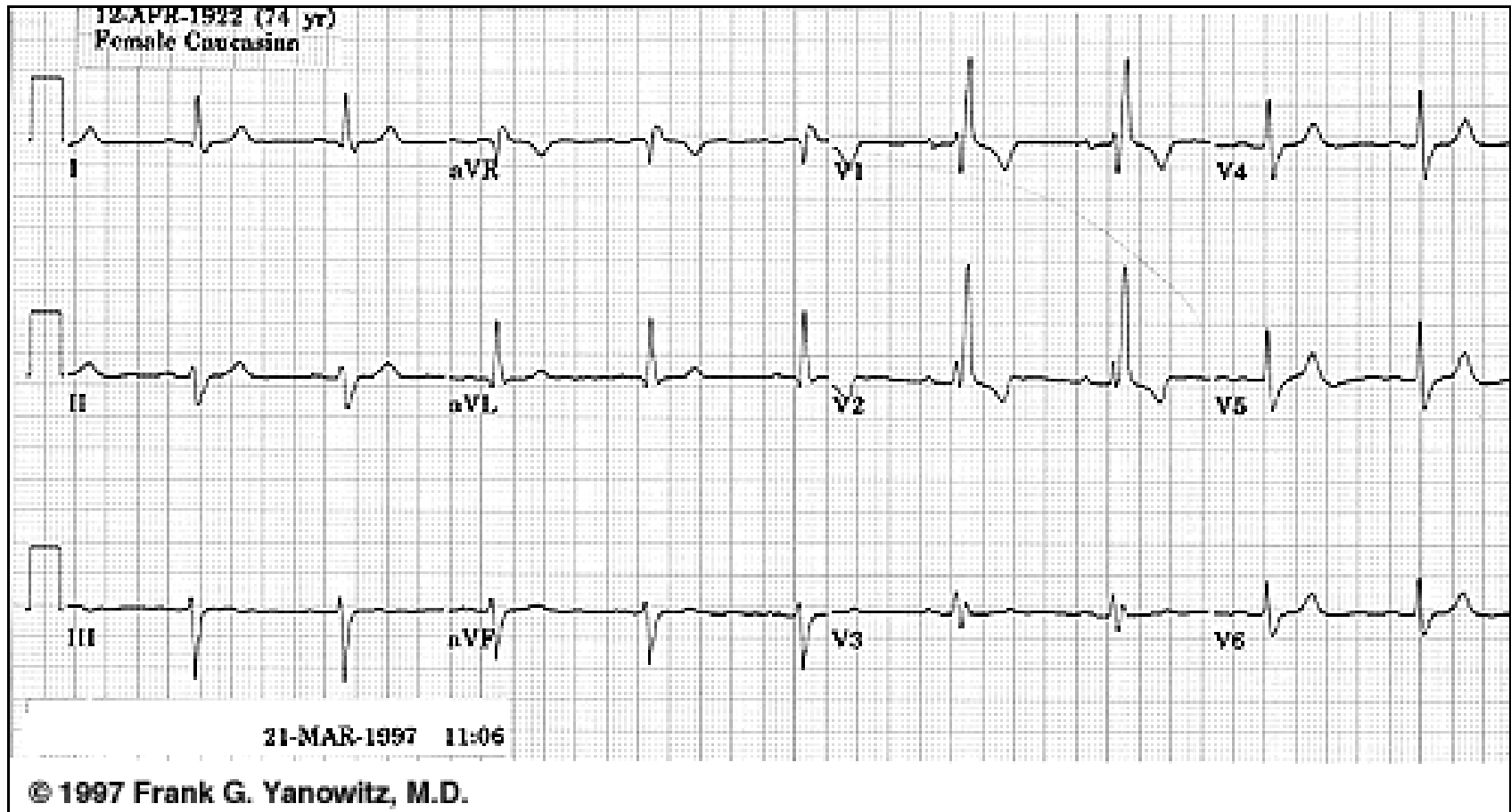
Bifascicular Block

# LPHB + RBBB

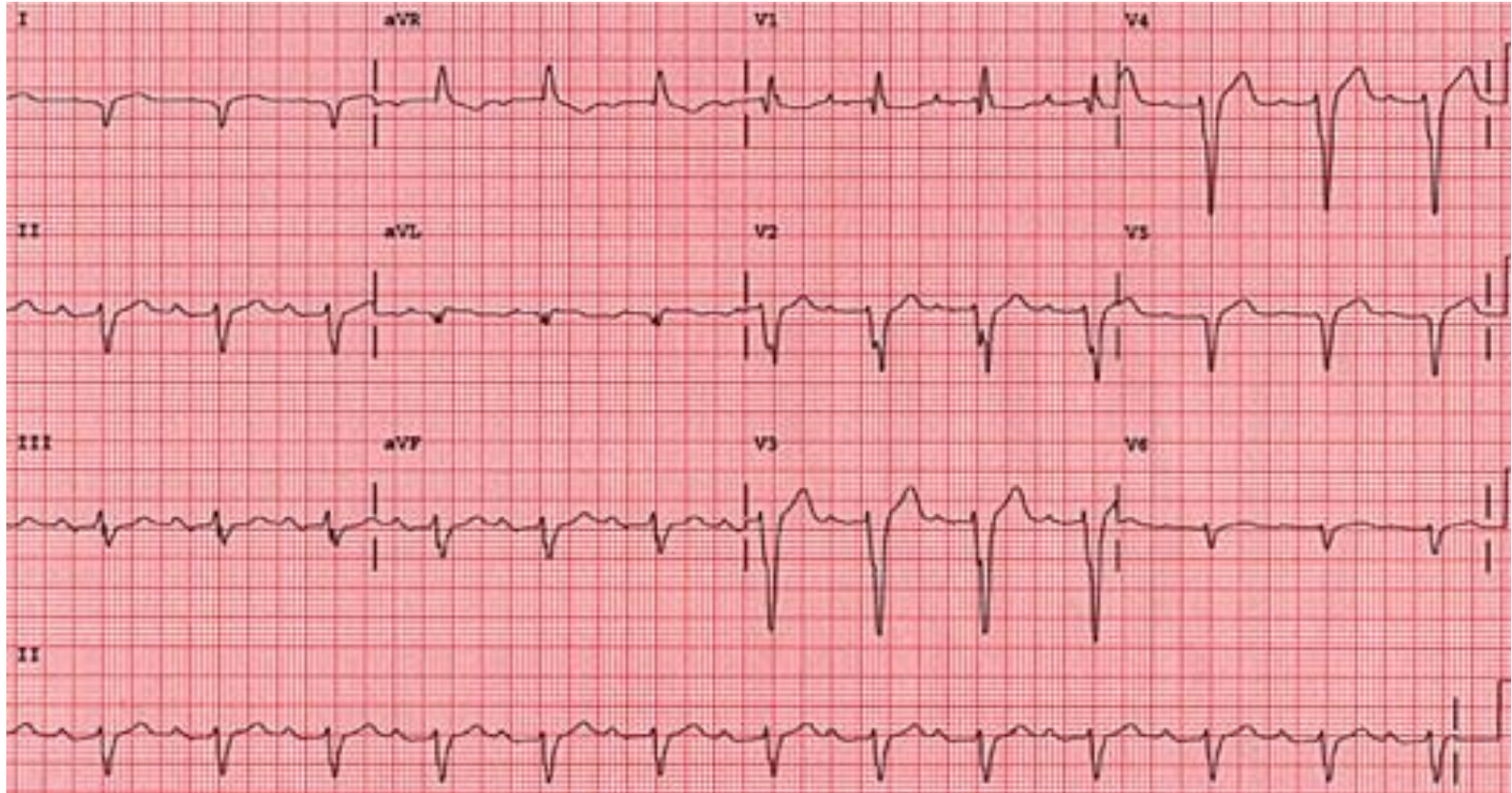


Bifascicular Block

# LAHB + RBBB



# LPHB + RBBB



# Blocks

- Incomplete RBBB
  - $QRS < 0.12$
  - RSR' in V 1-2 like complete RBBB
  - Common and of no consequence
    - No longer coded by MIB
- RBBB and LBBB can be intermittent or exercise related

# Misc Abnormalities

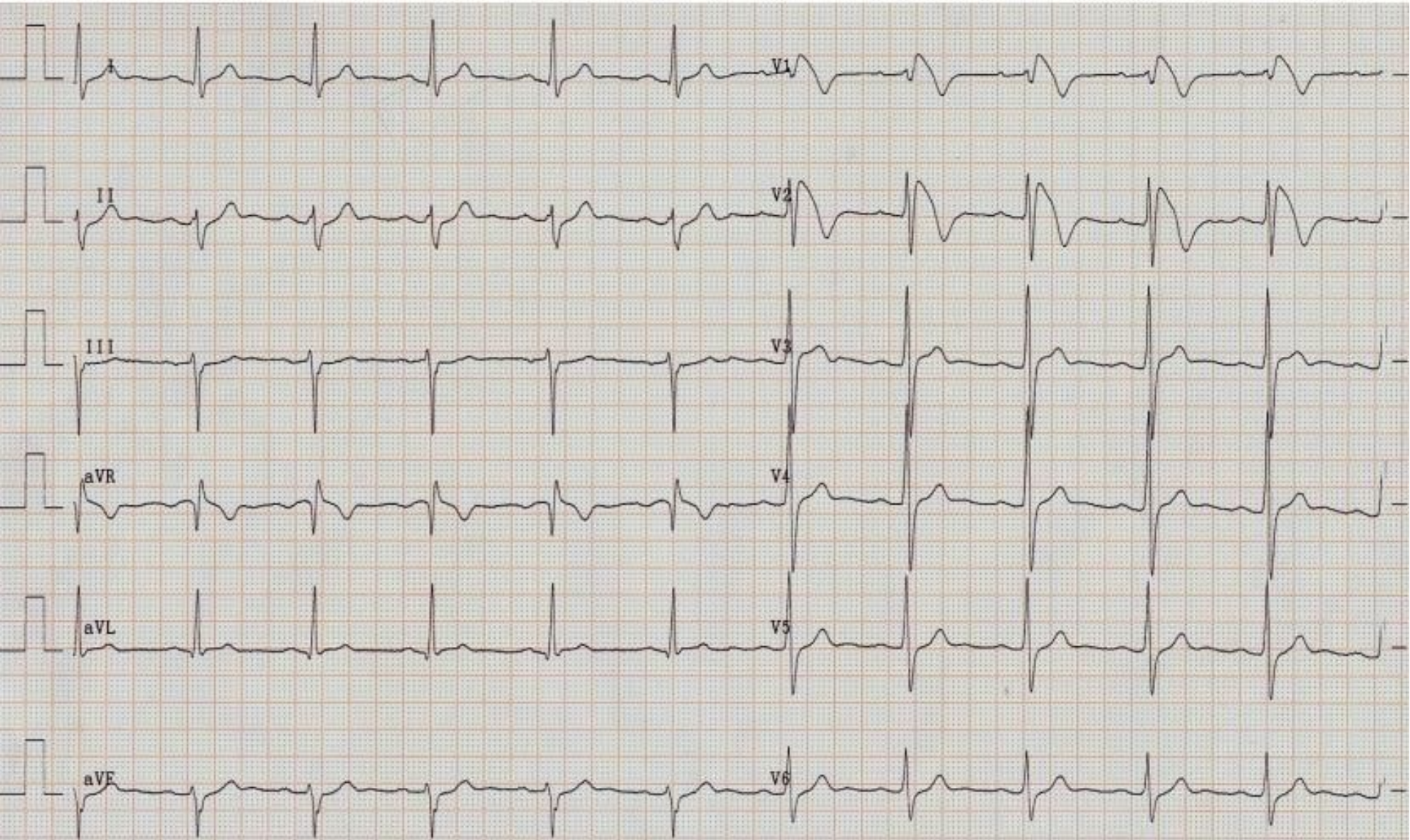
- Syndromes
  - Brugada, Long QT
- Pacemakers
- Electrolytes changes
- Medication
- Pulmonary disease
- WPW
- Lead reversal

# Brugada Syndrome

- Hereditary condition associated with sudden death
- Not common but would like to identify
- See a RBBB with ST elevation in leads V1-3
  - Could look like septal MI
- Most treated with ICD



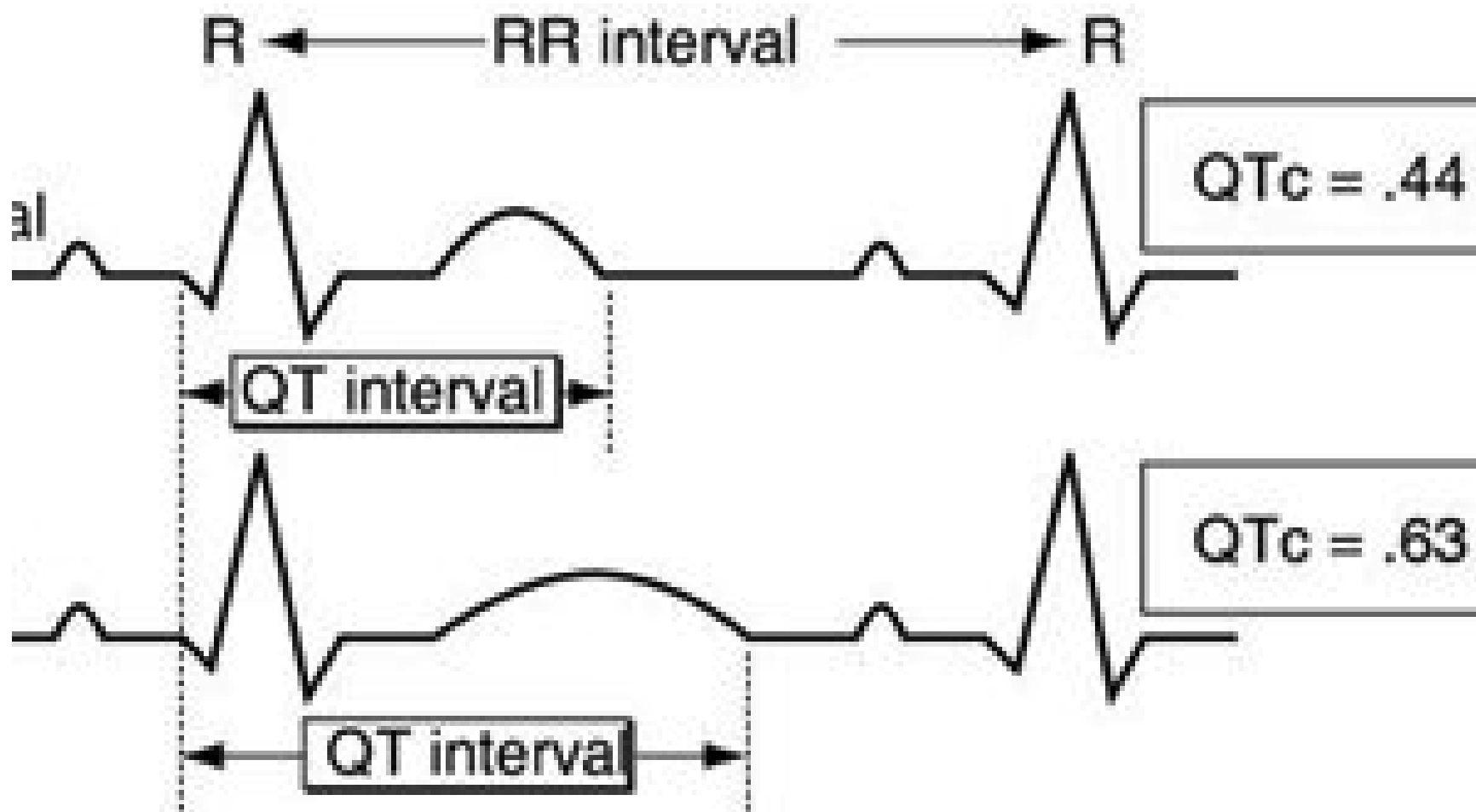
# Male 39 years

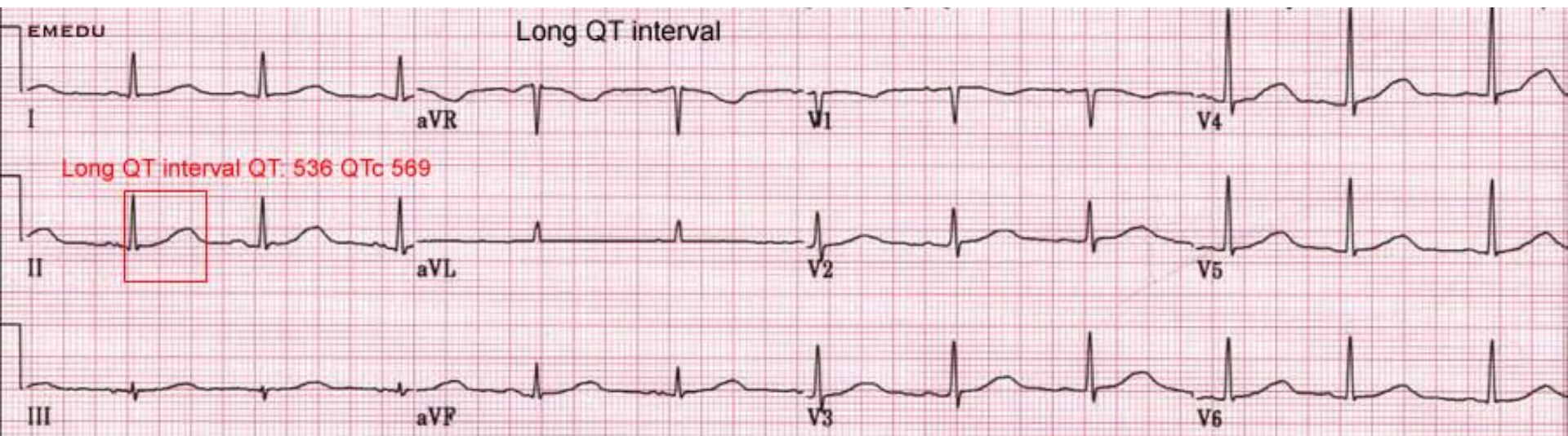


# Long QT

- Associated with sudden death and cardiac arrest
- Most often familial
- Always measure the QT
  - 1 of 3 intervals to always measure
    - PR, QRS and QT
  - QT prolonged if interval  $> \frac{1}{2}$  the cardiac cycle
    - QT is  $> \frac{1}{2}$  the R-R interval
    - QTc: corrected for heart rate extremes
      - Computer usually does this

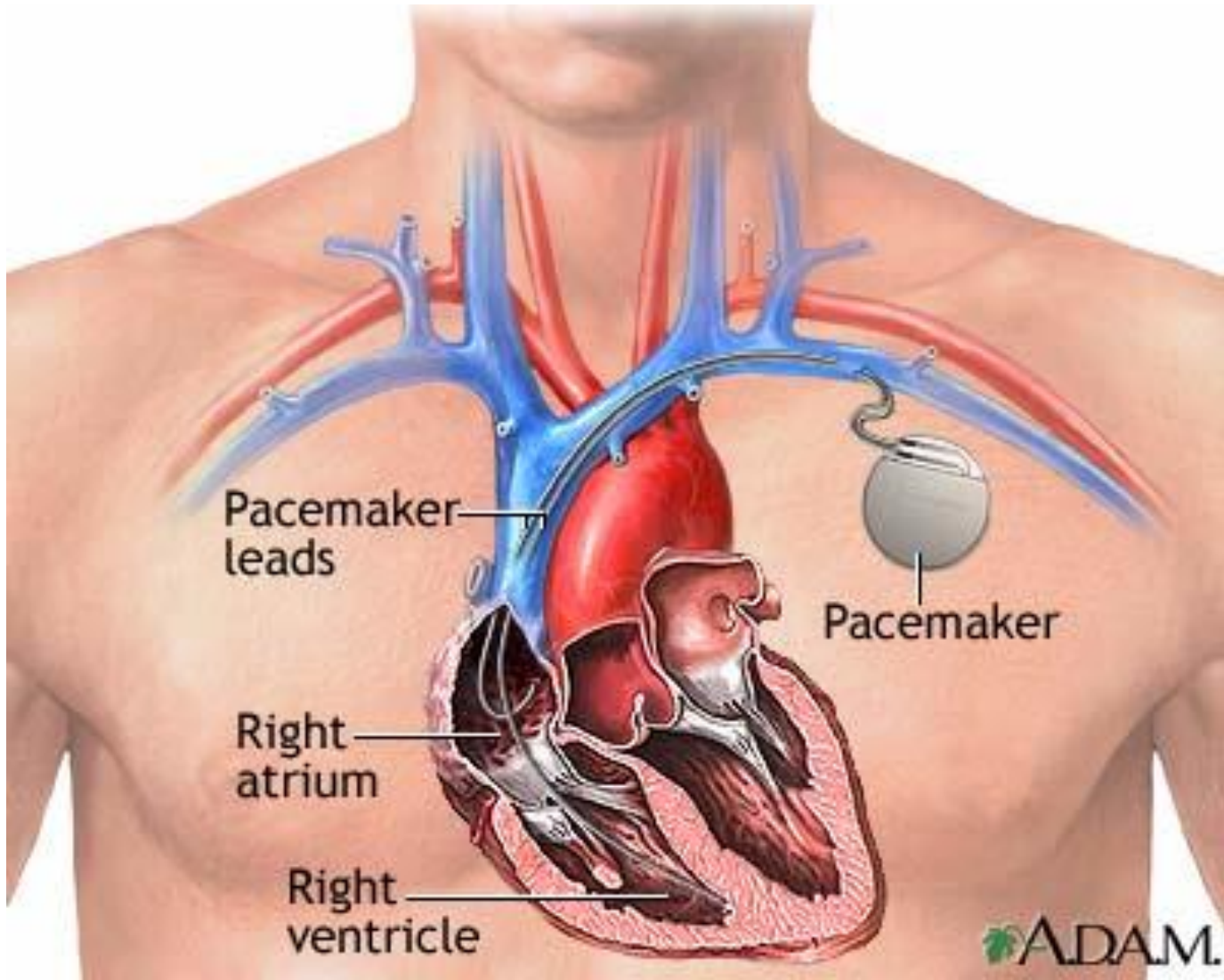
# Prolonged QT





# Pacemakers

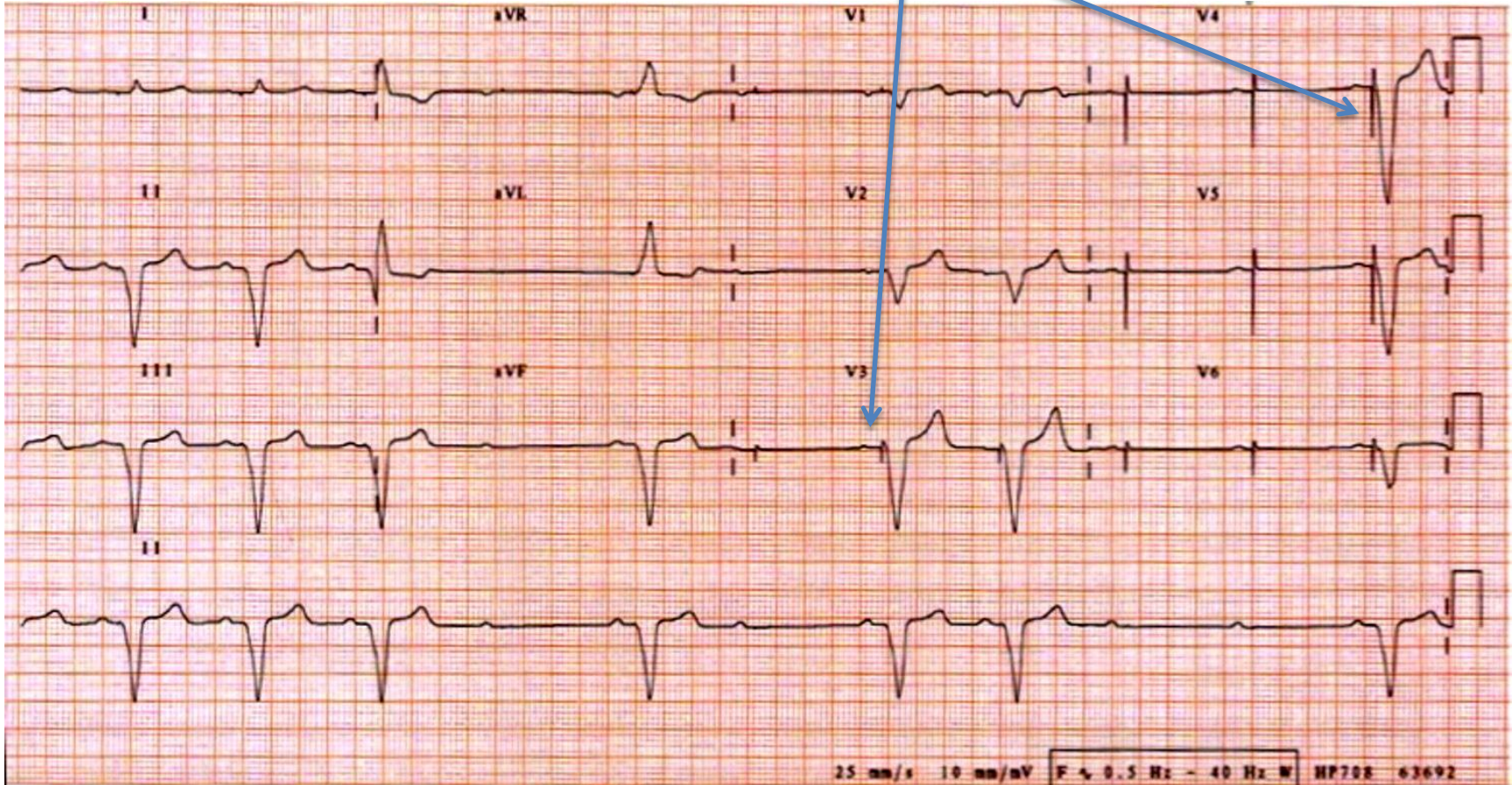
- Many types
  - Ventricular, AV sequential
- Need to differentiate pacemaker from implantable defibrillator (ICD)
- Can have both a pacer + ICD



# Pacemaker

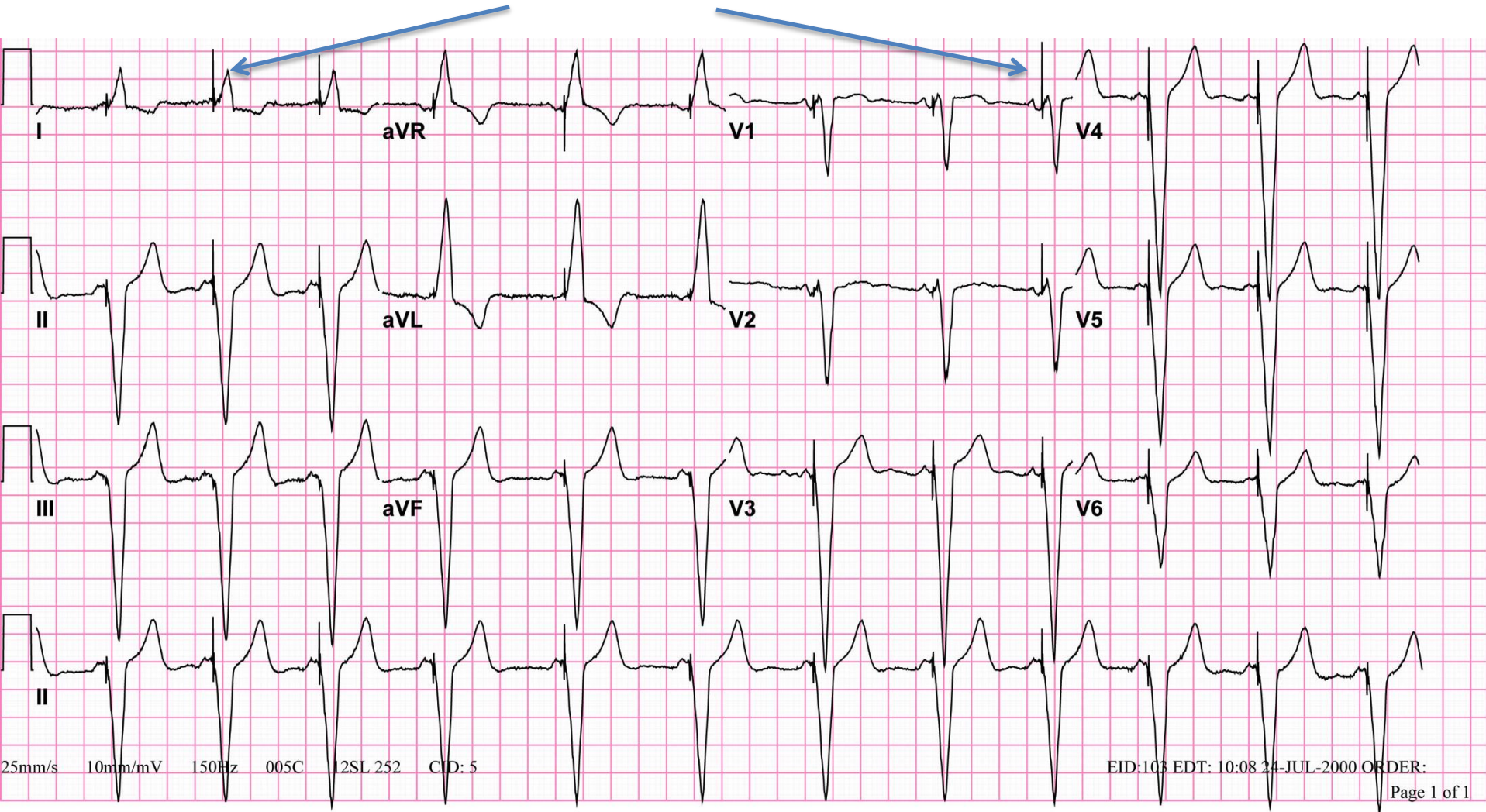
- Look for pacing spike
  - Atrial and ventricular or just ventricular
- Rate should be regular if firing all the time
  - Can be intermittent
- EKG looks bizarre
  - EKG may look like a LBBB pattern or large MI

# Pacer spikes





# Pacer spikes



25mm/s 10mm/mV 150Hz 005C 12SL 252 CID: 5

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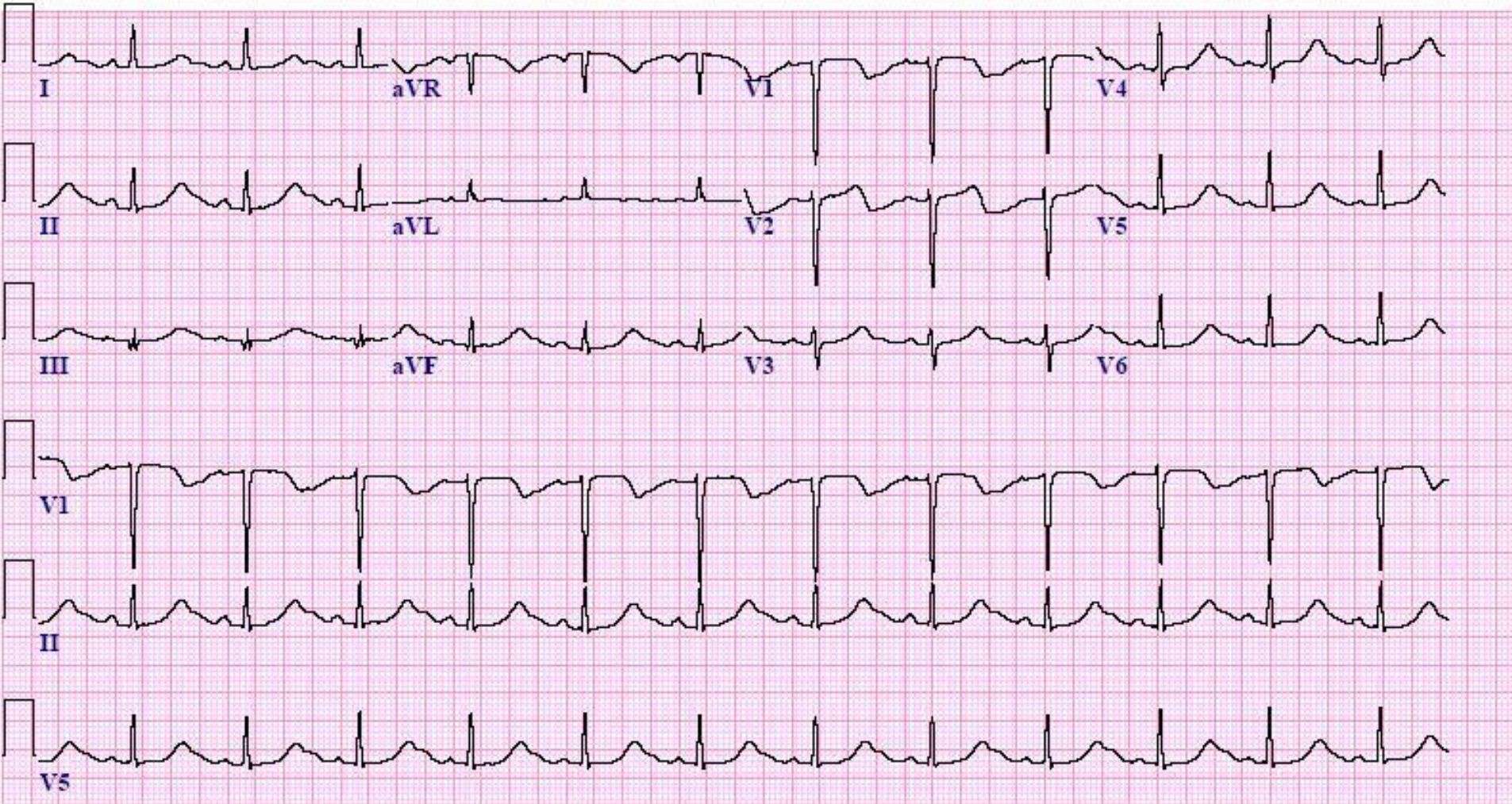
# AV Sequential Pacemaker



# Electrolyte Changes

- Potassium
  - Low: look for U waves
  - High: peaked T waves
- Calcium
  - Low: prolonged QT interval
  - High: short QT interval

# Low K+

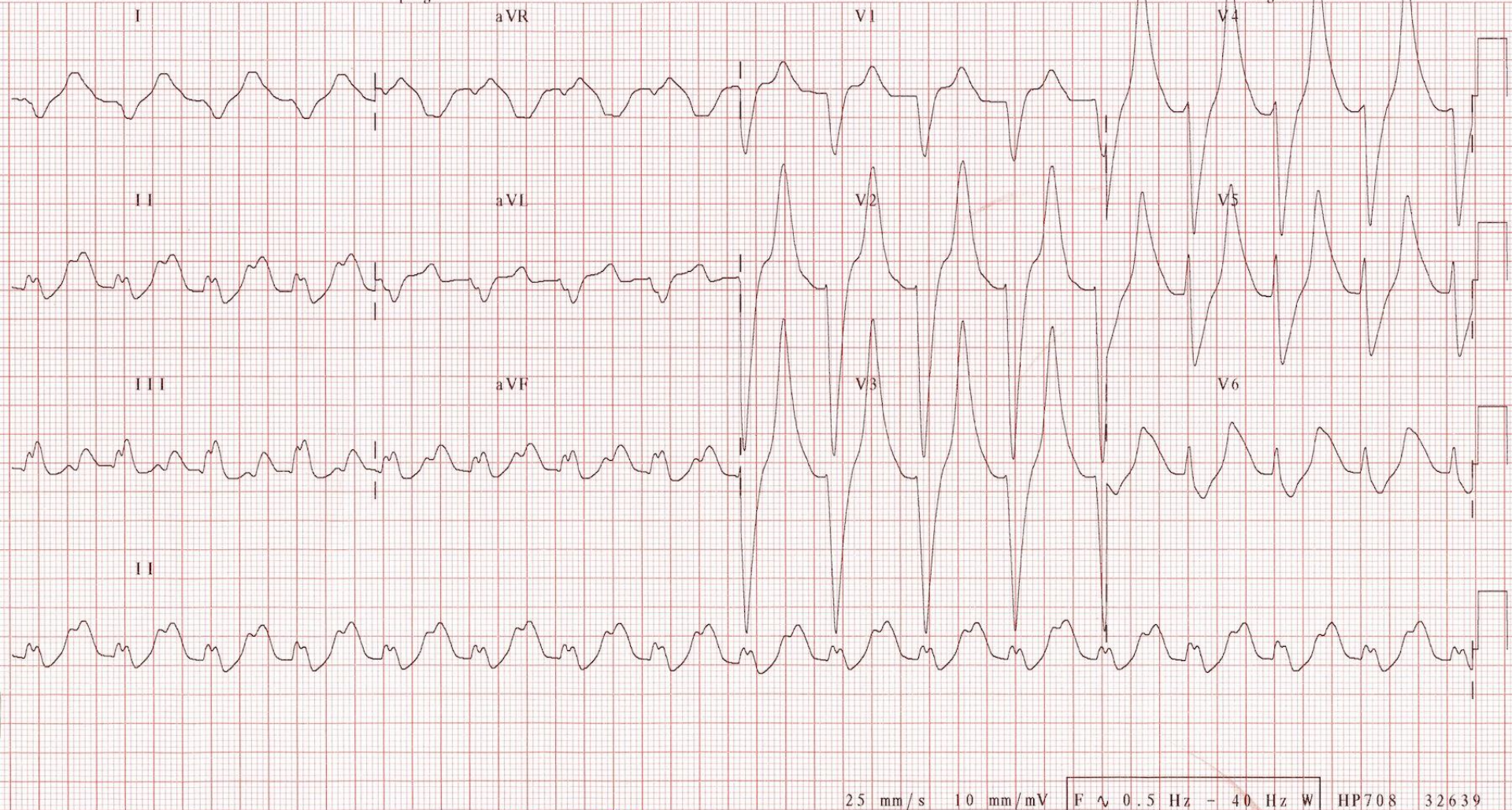


# High K+

QRS 128 . Junctional ST depression  
T 38 Continued on next page

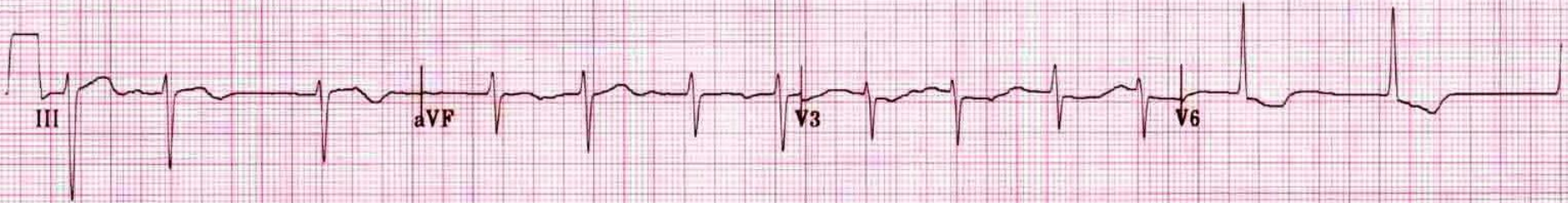
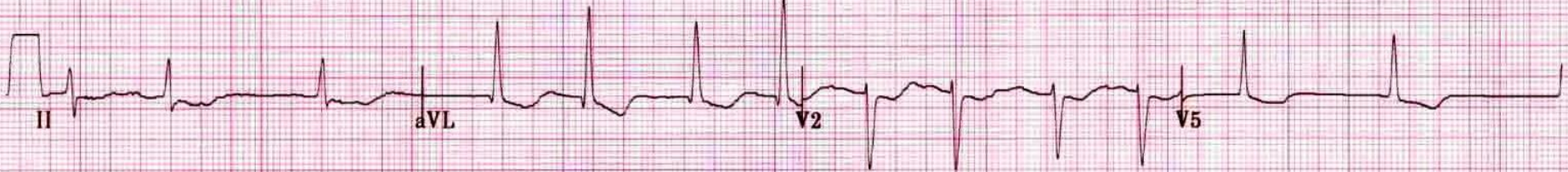
- ABNORMAL ECG -

Unconfirmed diagnosis.



# Digitalis

- Produces a classic ST segment depression
  - Referred to as Dig effect
- Often see if patient has atrial fib
- Less common today



# COPD and other Chronic Lung Diseases

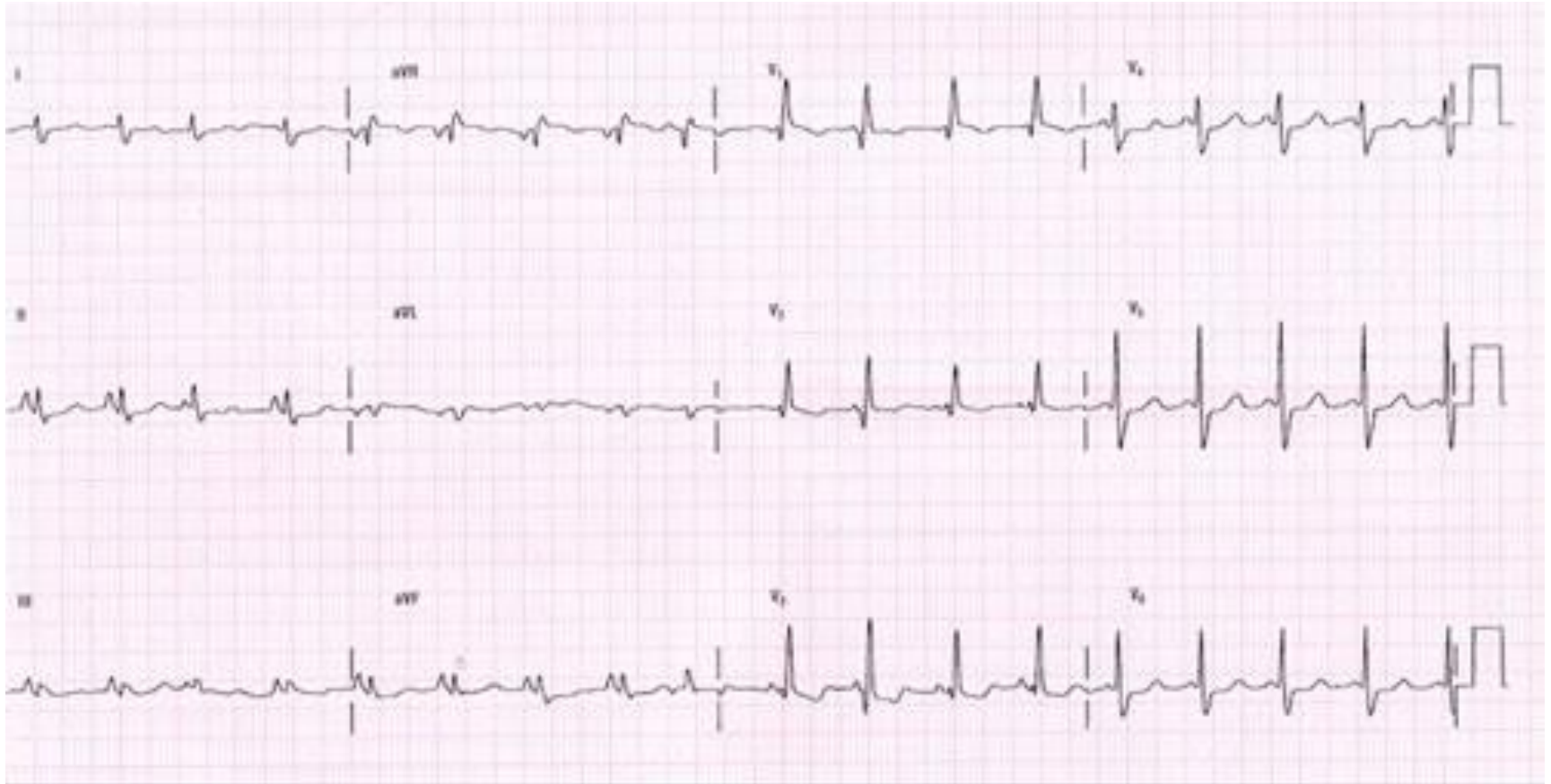
- Produces low voltage
  - Always look for the voltage standard on the EKG
  - 10mm (2 large boxes) equals 1mv
- In COPD the voltage amplitude may be < 1 large box (5mm)
- Often see RAD and RVH
- May see large P waves
  - P pulmonale



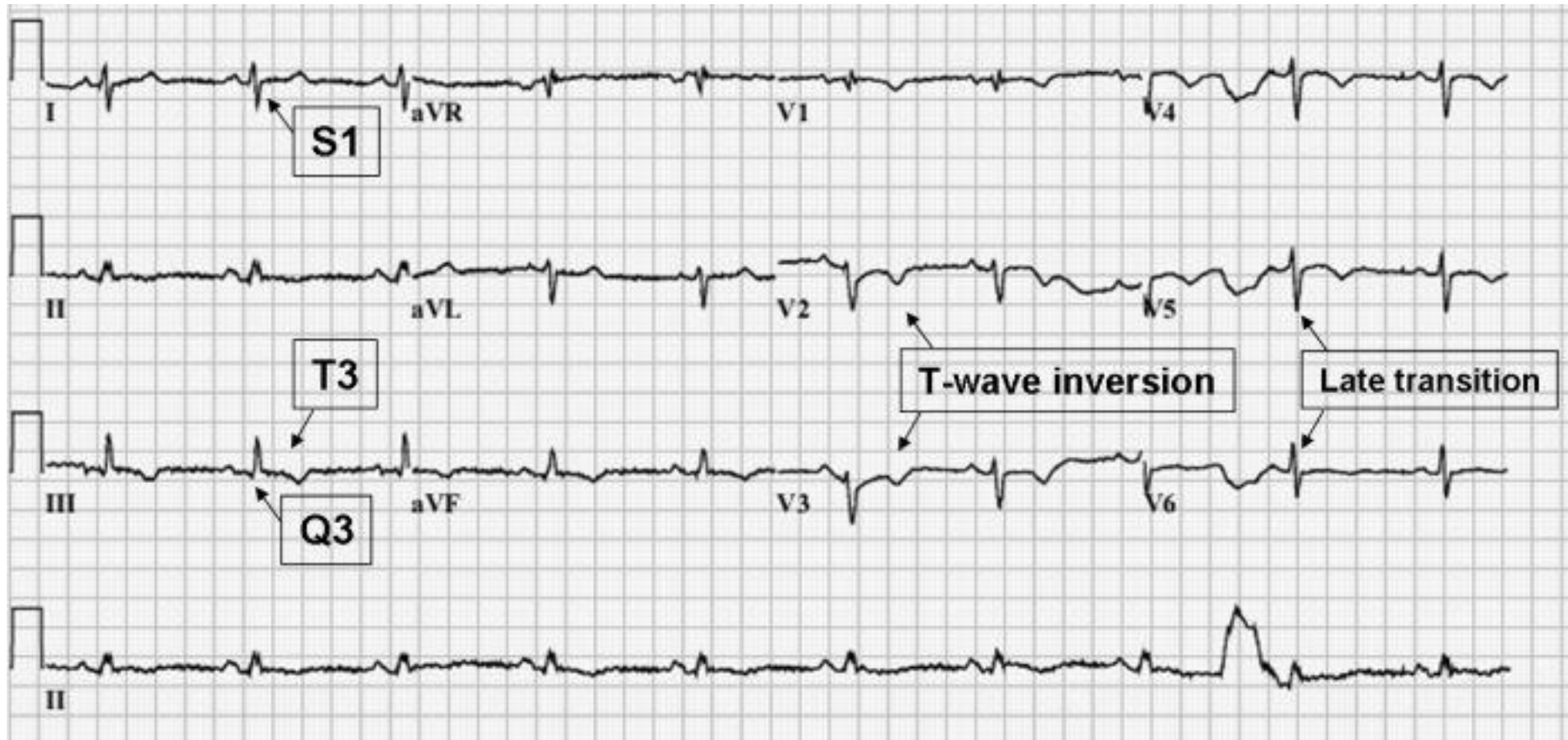
# Pulmonary Embolism

- Acute PE can produce right heart strain
- See large S wave in lead 1
- ST depression in lead 2
- Large Q in 3 with inverted T wave
- S1, Q3, T3
- May see RBBB

# COPD



# Acute PE

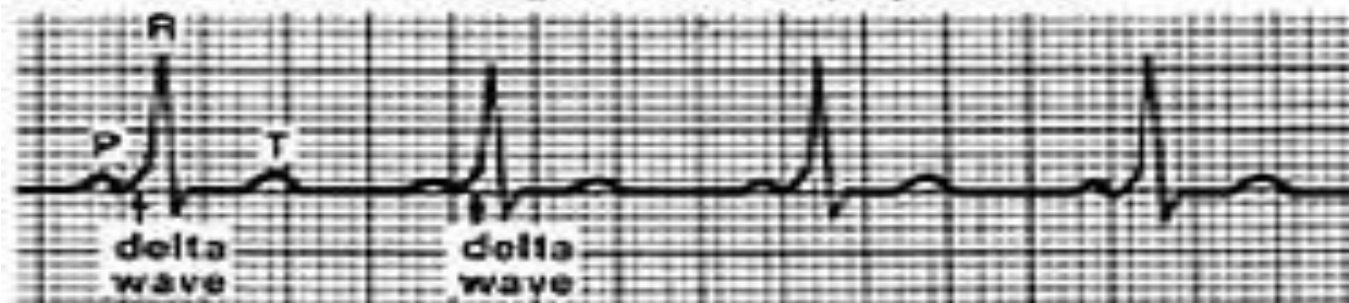


# WPW

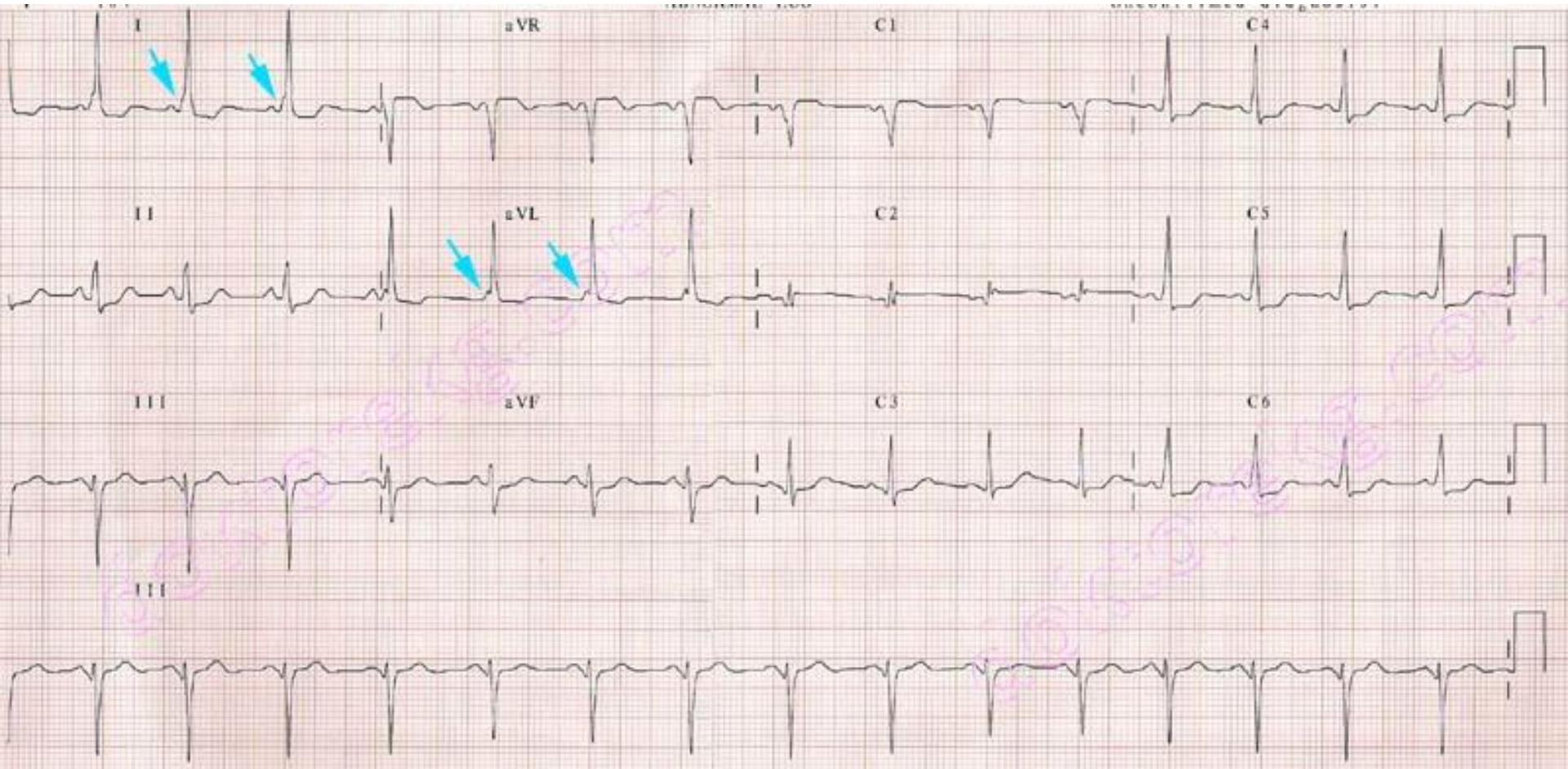
- Wolff Parkinson White
- Pre-excitation syndrome
  - Abnormal conduction pathway from SA node to AV node
- EKG findings
  - Short PR interval  $<0.12$
  - May see a delta wave
- Associated with tachydysrhythmias
  - Syncope



### Wolf-Parkinson-White (preexcitation) Syndrome



# WPW

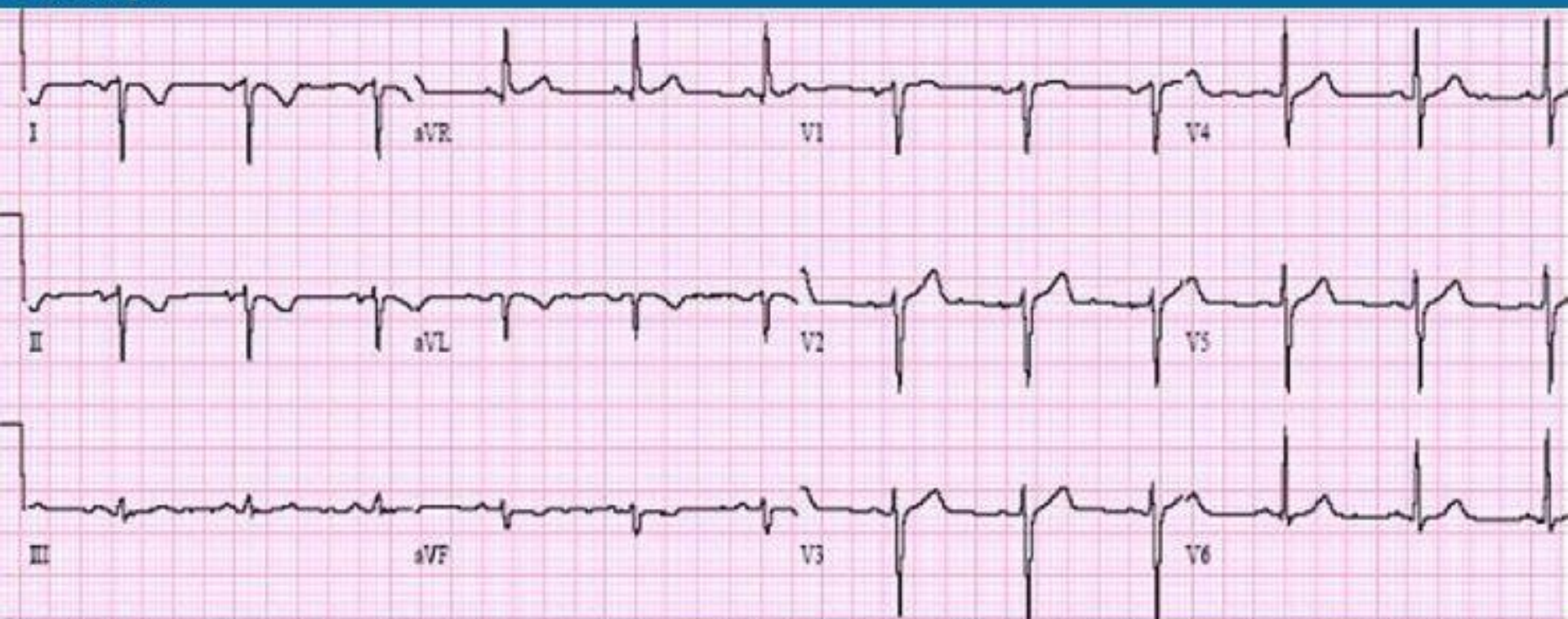


# Lead Reversal and Improper Chest Lead Placement

- Very common in insurance world
- Is it lead reversal or dextrocardia?
- Look at leads 1 and R
  - If AVR is positive refer!
- Chest lead placement
  - common

# Lead Reversal

Medscape



Source: Jrl Emerg Med © 2012 Elsevier, Inc



# Lets Review

- EKG
  - 12 leads? Partial?, Rhythm strip
  - Paper speed: 25mm/sec
  - Voltage: 2 big boxes = 1mv
- Rate: 300, 150, 100, 75, 60, 50
- Intervals
  - PR, QRS, QT
- Rhythm
  - Regular or irregular

# Review

- Axis
  - Normal, RAD, LAD, or indeterminate
    - Look at leads 1 and 2.
      - 1 up 2 down: LEFT
      - 1 down 2 up: RIGHT
      - Both up: Normal
      - Both down: Indeterminate
- Blocks
  - 1<sup>st</sup>, 2<sup>nd</sup>, or 3<sup>rd</sup> degree AV block
  - RBBB or LBBB
  - LAHB or LPHB
  - Bifascicular block
  - Combination

# Review

- Hypertrophy
  - Atrial: P waves
  - RVH or LVH
- Ischemia, Injury or Infarction
  - ST segments
  - T waves
  - Q waves
  - Groupings: 2,3,F; 1 and L, V1-6

# Review

- Misc abnormalities
  - K<sup>+</sup>
  - Ca<sup>++</sup>
  - Meds
  - Pulmonary disease
  - Pacemakers
- Next session we put it all together and interpret EKG's