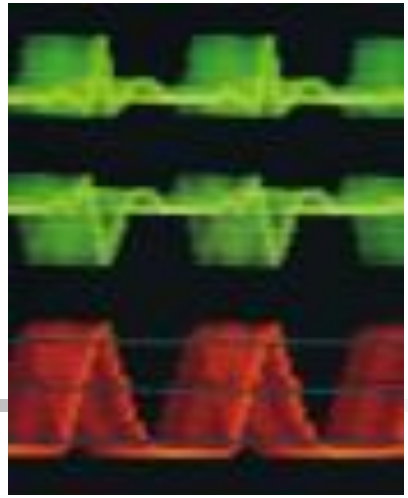
EKG Interpretation



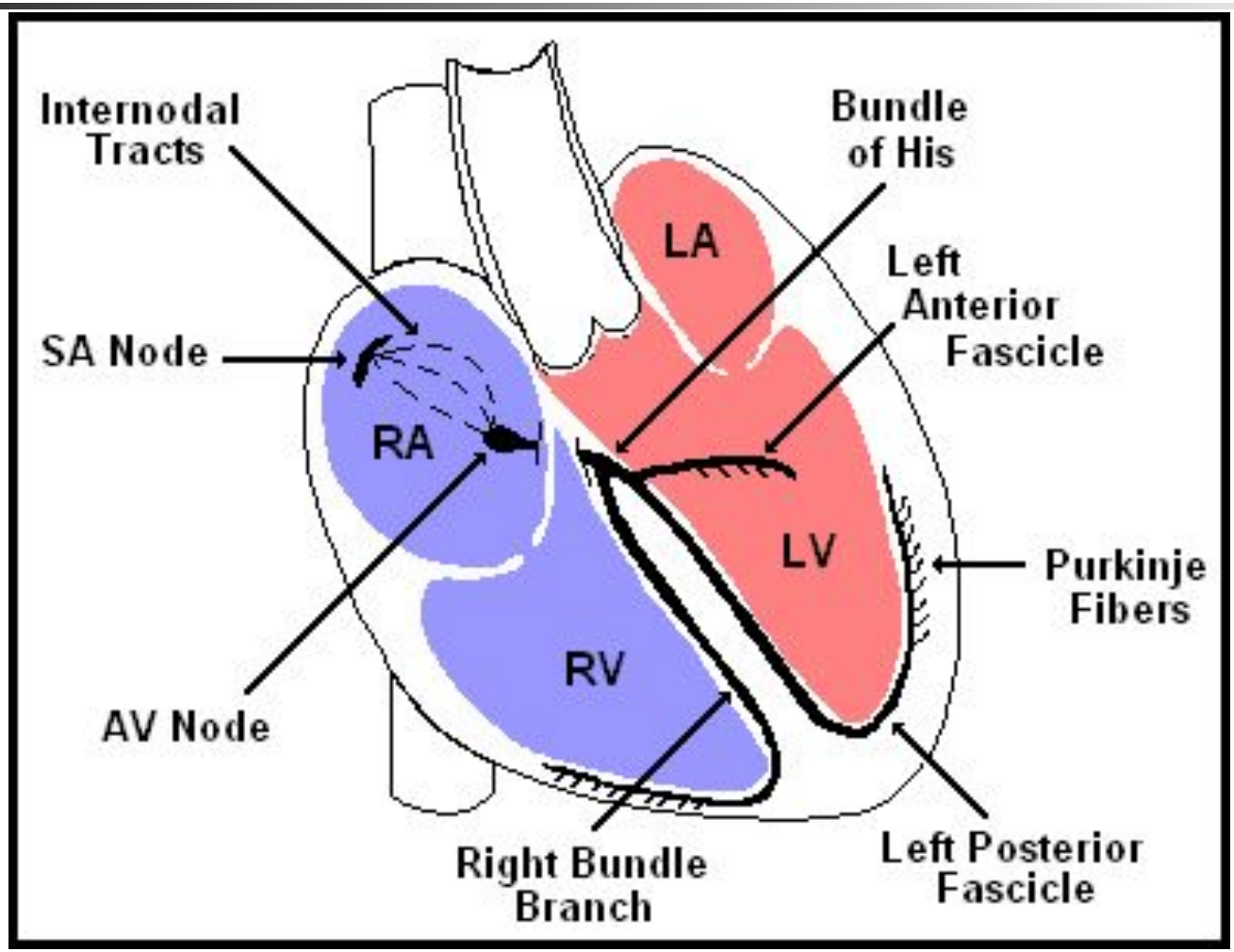
UNC Emergency Medicine

Medical Student Lecture Series

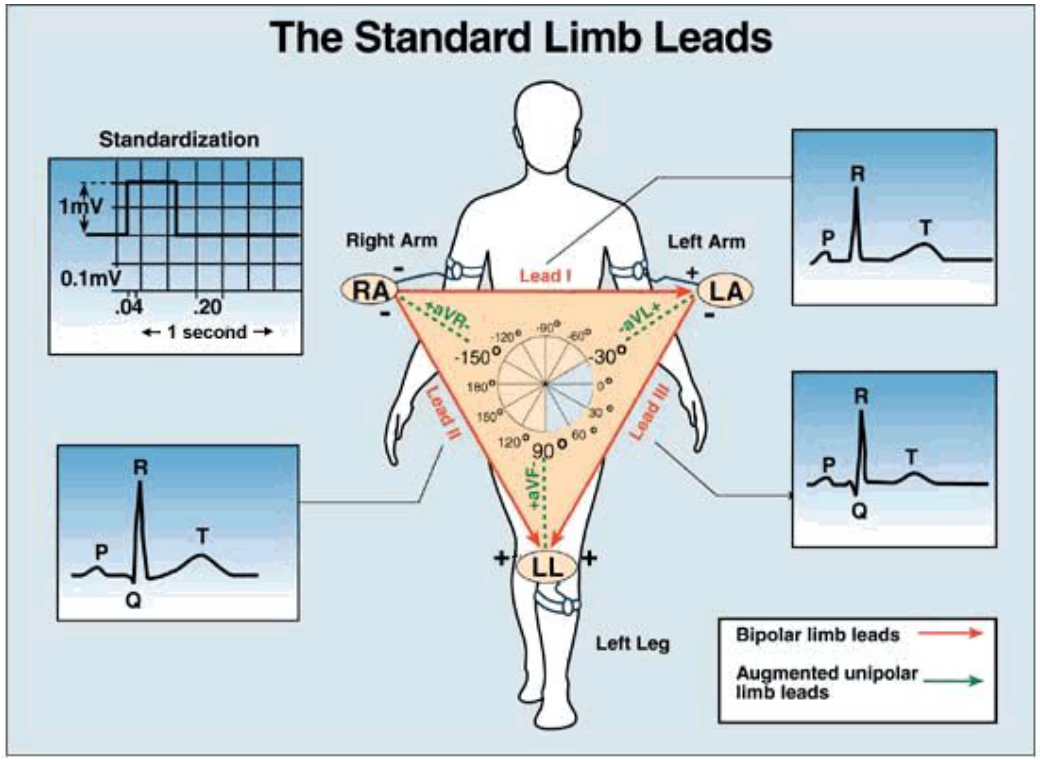
Objectives

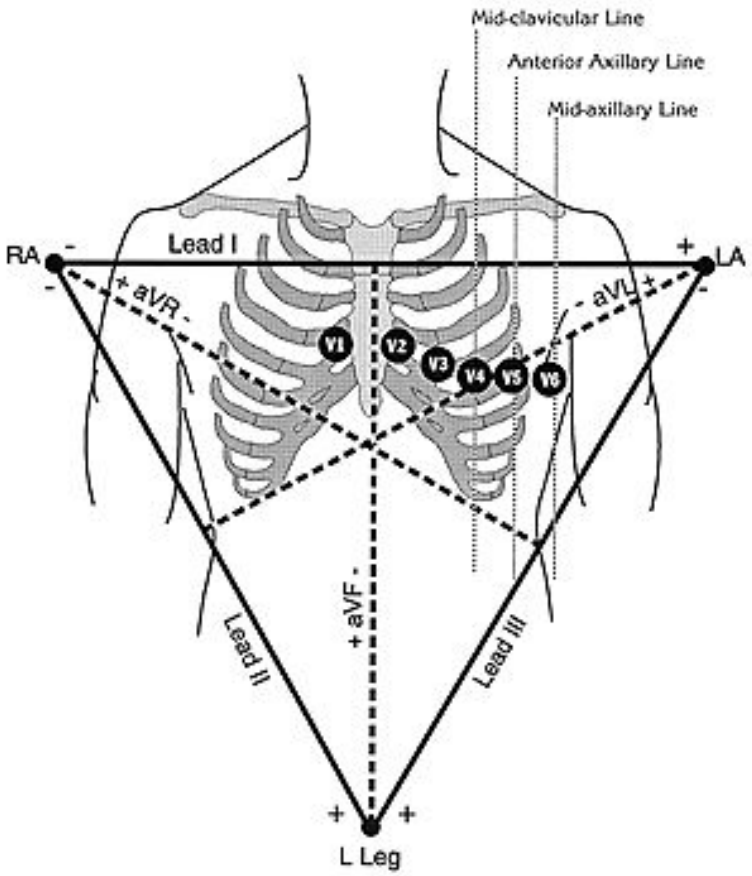
- The Basics
- Interpretation
- Clinical Pearls
- Practice Recognition

The Normal Conduction System

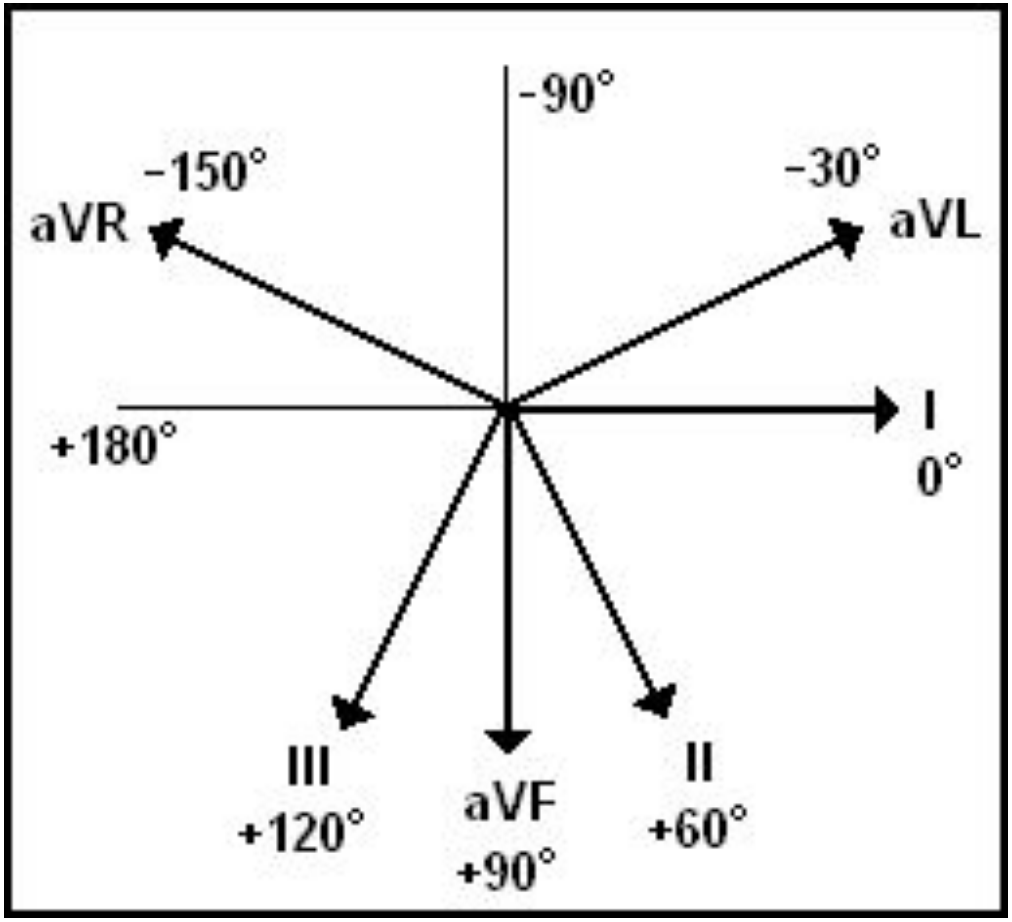


Lead Placement

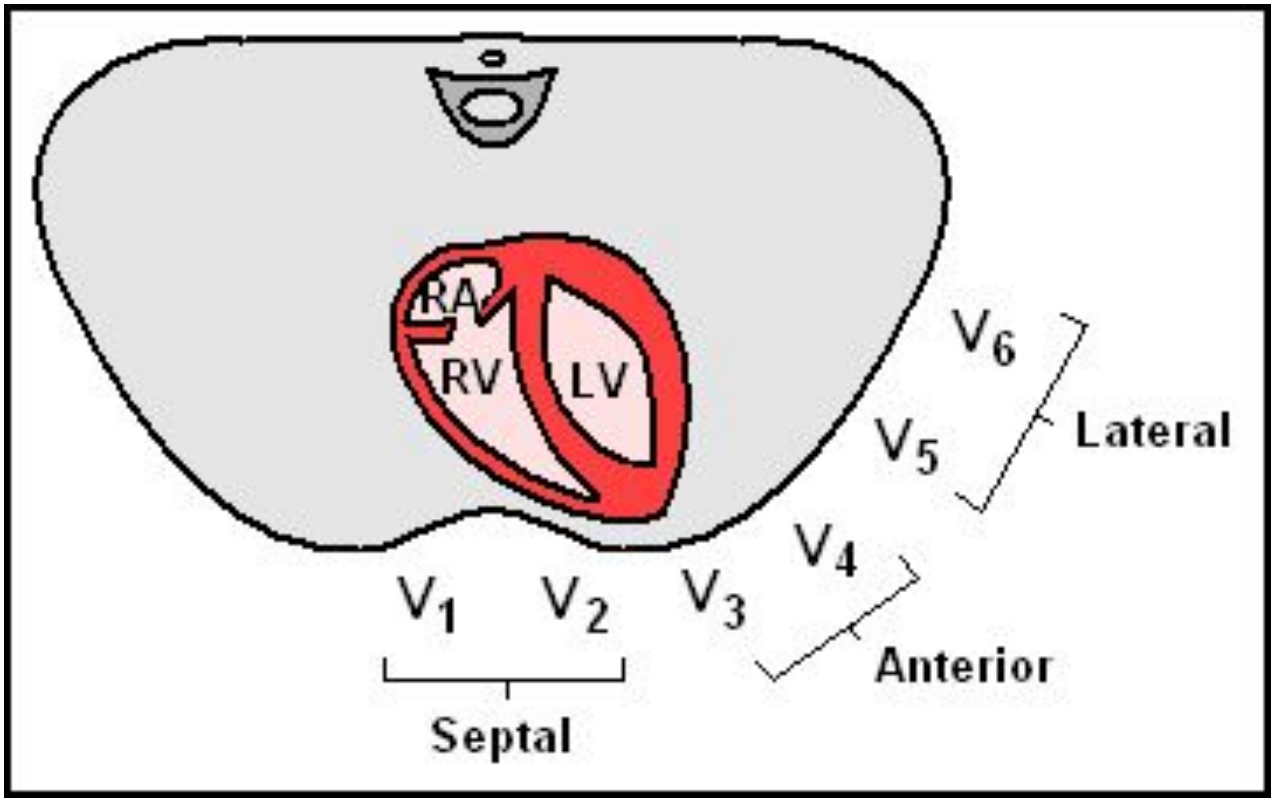




All Limb Leads

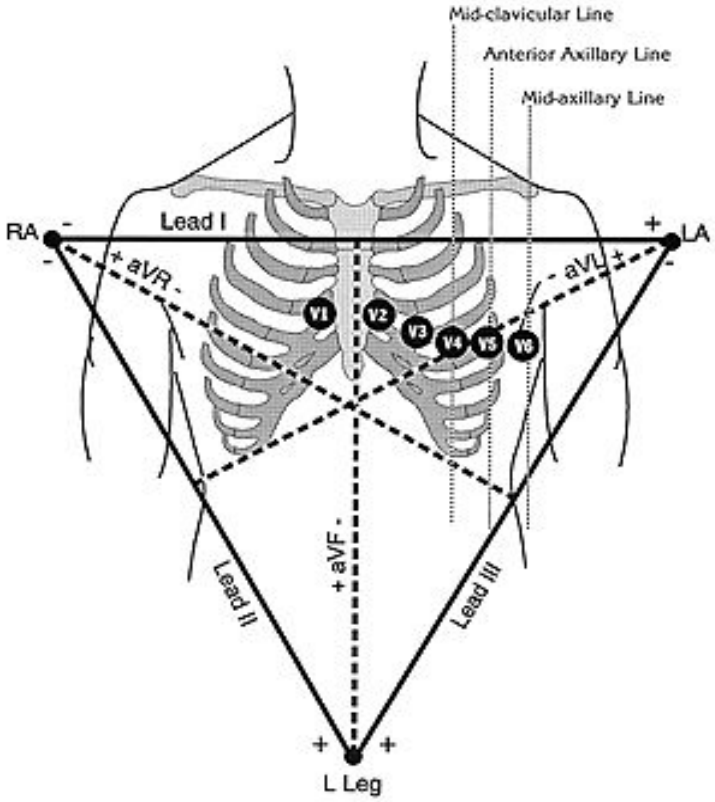


Precordial Leads

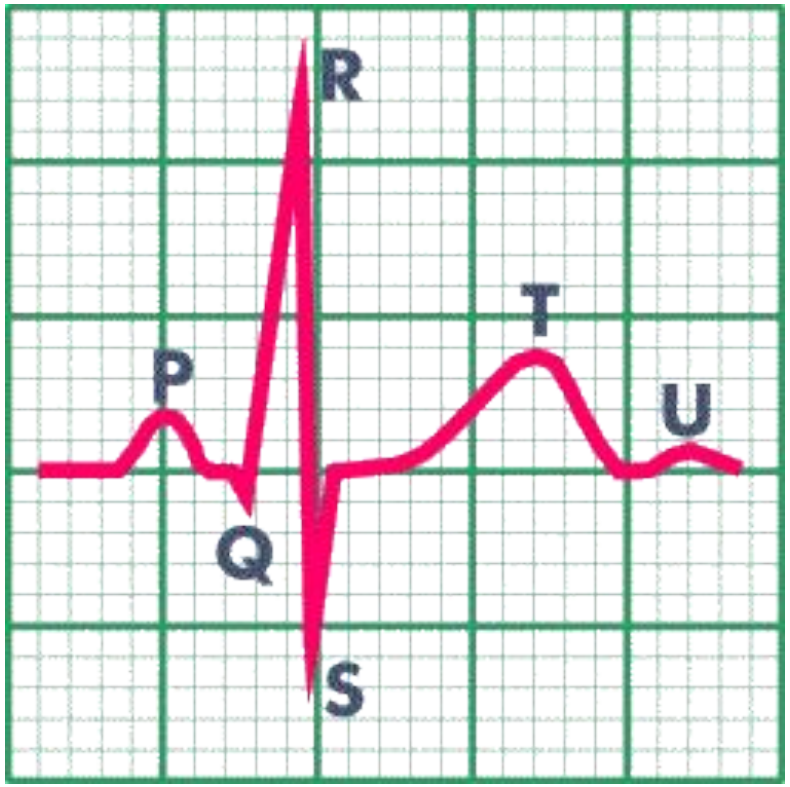


EKG Distributions

- Anteroseptal: V1, V2, V3, V4
- Anterior: V1–V4
- Anterolateral: V4–V6, I, aVL
- Lateral: I and aVL
- Inferior: II, III, and aVF
- Inferolateral: II, III, aVF, and V5 and V6



Waveforms



Interpretation

- Develop a systematic approach to reading EKGs and use it every time
- The system we will practice is:
  - Rate
  - Rhythm (including intervals and blocks)
  - Axis
  - Hypertrophy
  - Ischemia

Rate

- Rule of 300- Divide 300 by the number of boxes between each QRS = rate

Number of big boxes	Rate
1	300
2	150
3	100
4	75
5	60
6	50

Rate

- HR of 60-100 per minute is normal
- HR > 100 = tachycardia
- HR < 60 = bradycardia

Differential Diagnosis of Tachycardia

Tachycardia	Narrow Complex	Wide Complex
Regular	ST SVT Atrial flutter	ST w/ aberrancy SVT w/ aberrancy VT
Irregular	A-fib A-flutter w/ variable conduction MAT	A-fib w/ aberrancy A-fib w/ WPW VT

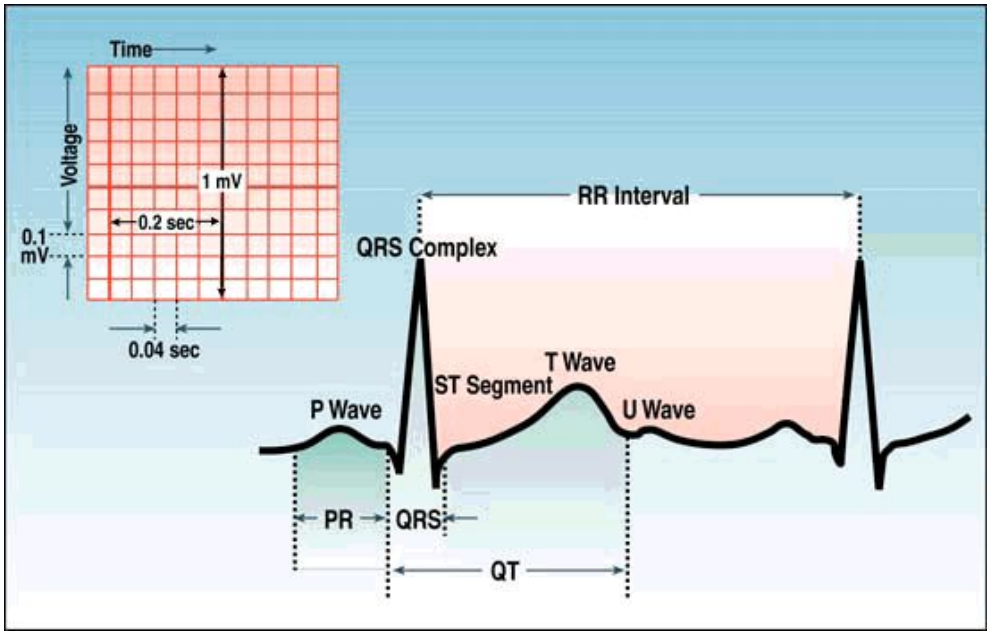
What is the heart rate?

www.uptodate.com

(300 / 6) = 50 bpm

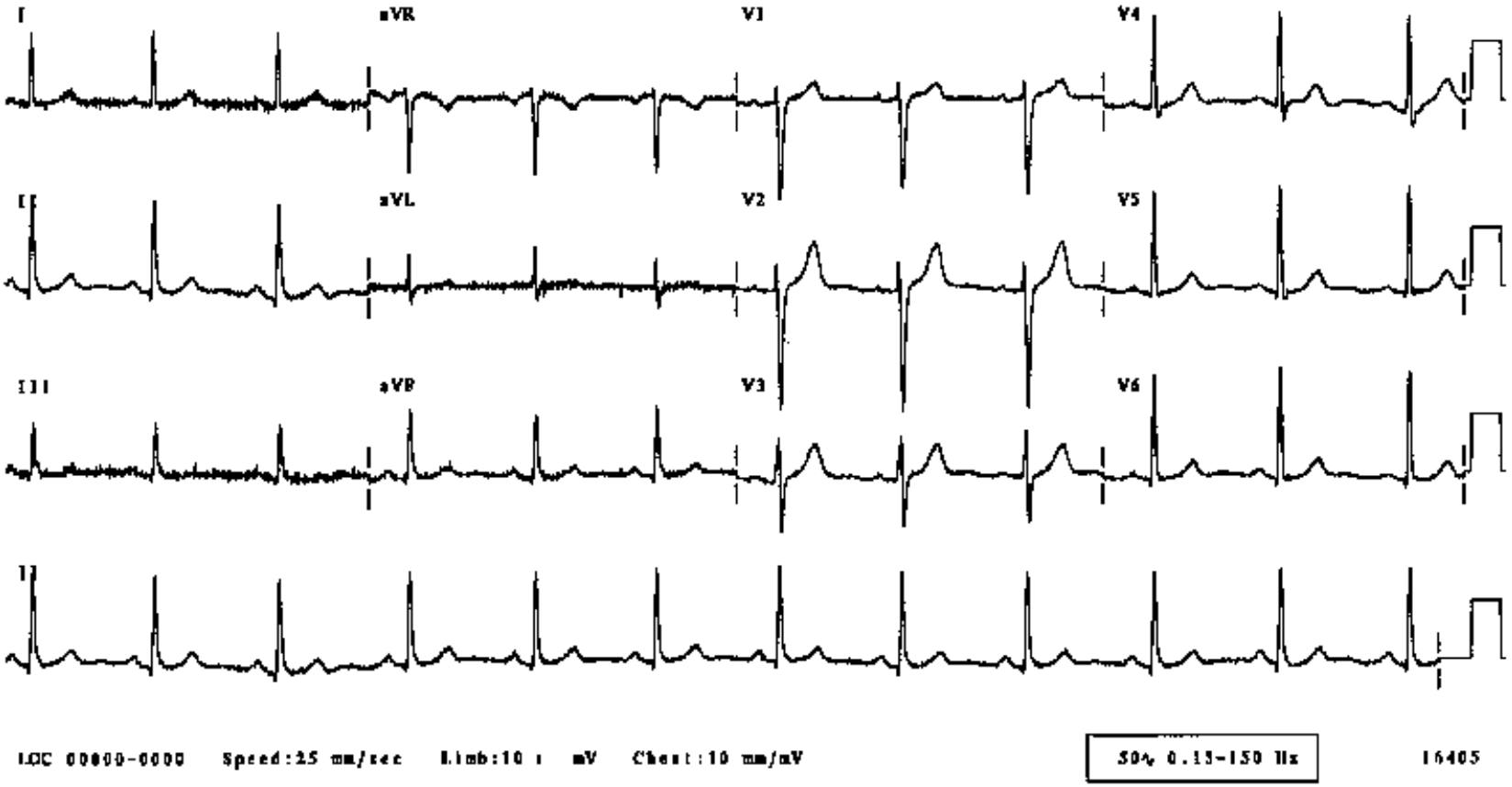
Rhythm

- Sinus
  - Originating from SA node
  - P wave before every QRS
  - P wave in same direction as QRS



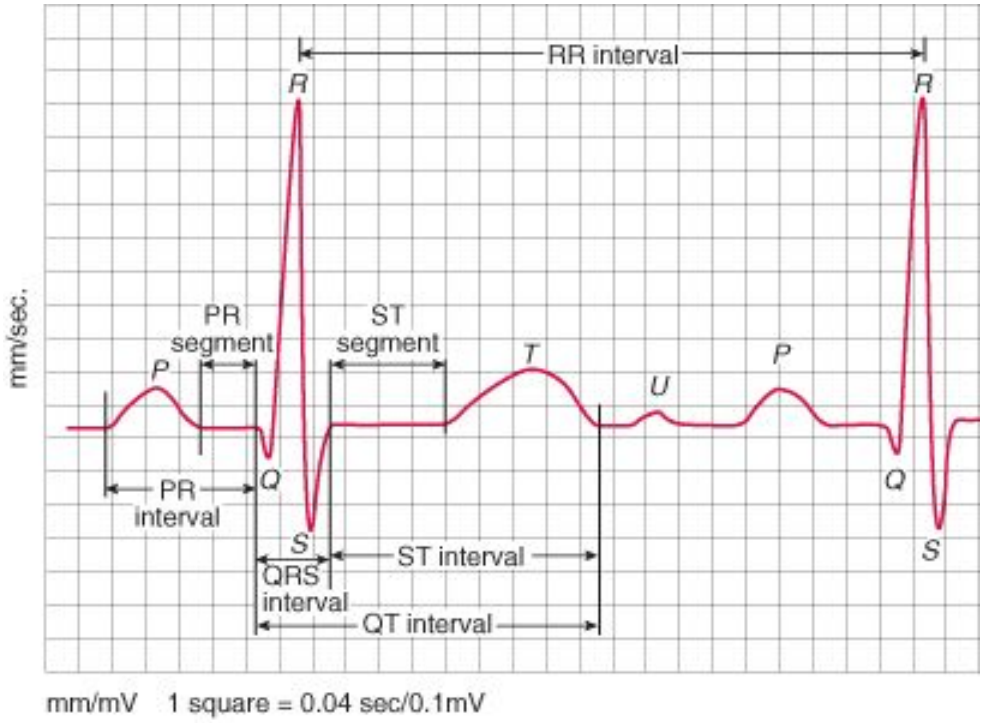
What is this rhythm?

Normal sinus rhythm



Normal Intervals

- PR
  - 0.20 sec (less than one large box)
- QRS
  - 0.08 – 0.10 sec (1-2 small boxes)
- QT
  - 450 ms in men, 460 ms in women
  - Based on sex / heart rate
  - Half the R-R interval with normal HR



Prolonged QT

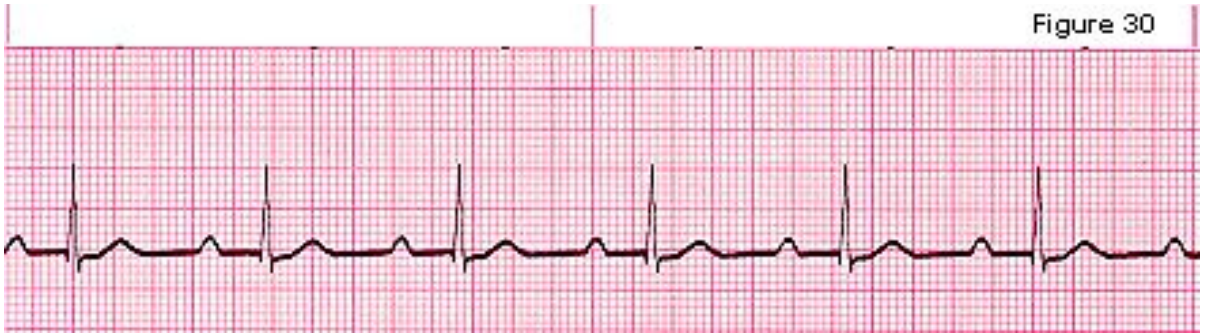
- Normal
  - Men 450ms
  - Women 460ms
- Corrected QT (QTc)
  - QTm/√(R-R)
- Causes
  - Drugs (Na channel blockers)
  - Hypocalcemia, hypomagnesemia, hypokalemia
  - Hypothermia
  - AMI
  - Congenital
  - Increased ICP

Blocks

- AV blocks
  - First degree block
    - PR interval fixed and > 0.2 sec
  - Second degree block, Mobitz type 1
    - PR gradually lengthened, then drop QRS
  - Second degree block, Mobitz type 2
    - PR fixed, but drop QRS randomly
  - Type 3 block
    - PR and QRS dissociated

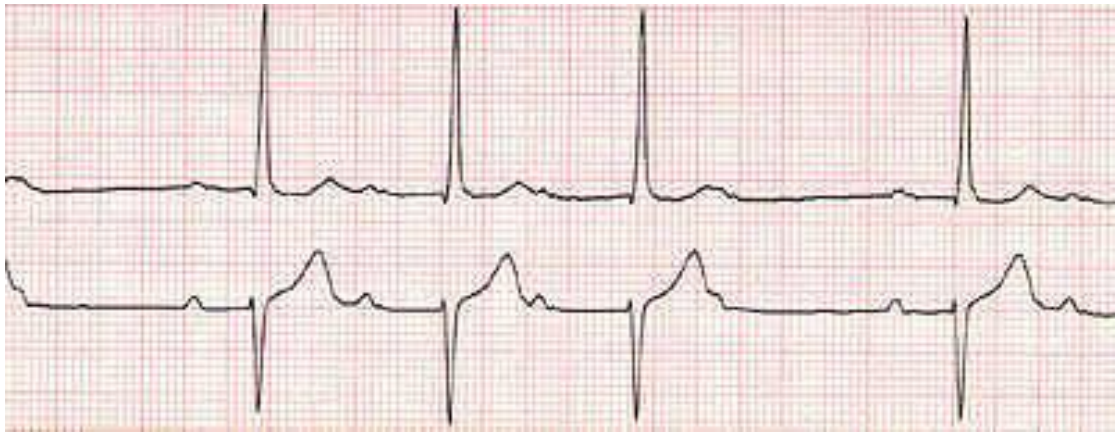
What is this rhythm?

First degree AV block
PR is fixed and longer than 0.2 sec



What is this rhythm?

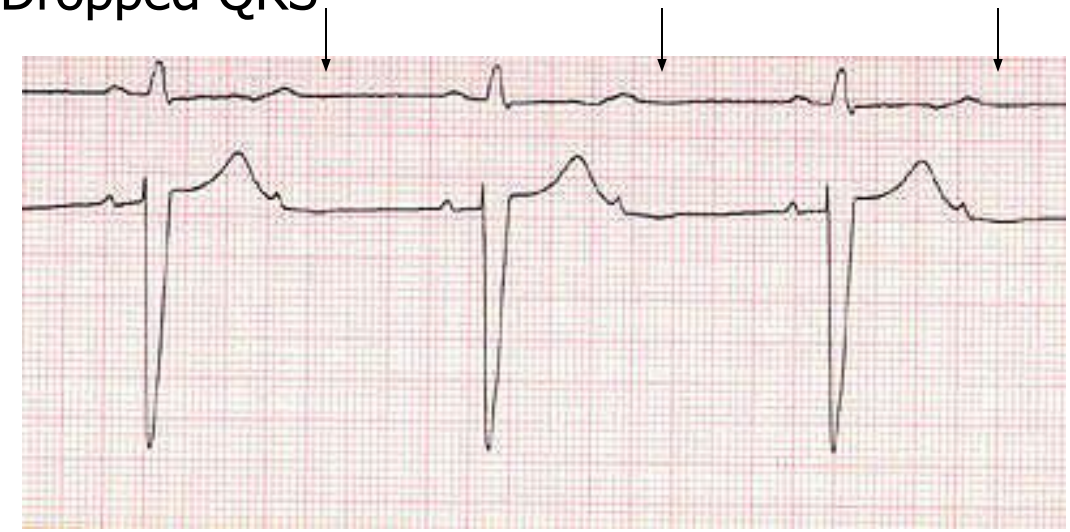
Type 1 second degree block (Wenckebach)



What is this rhythm?

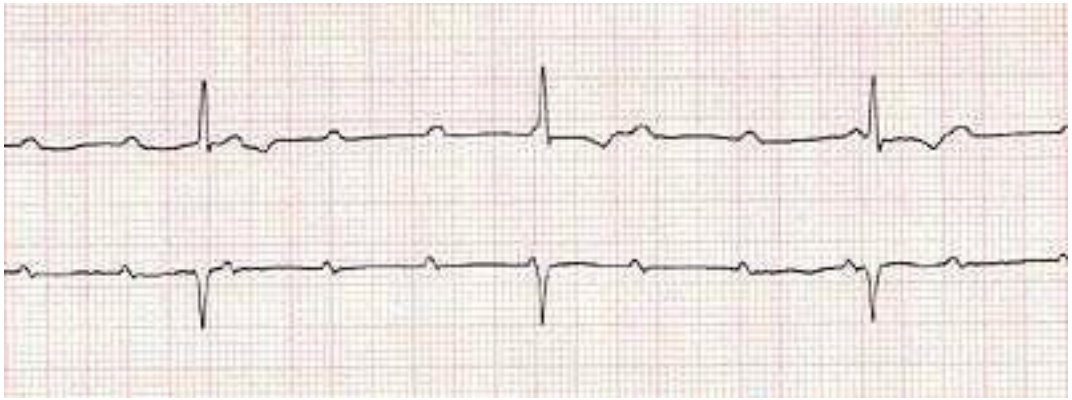
Type 2 second degree AV block

Dropped QRS



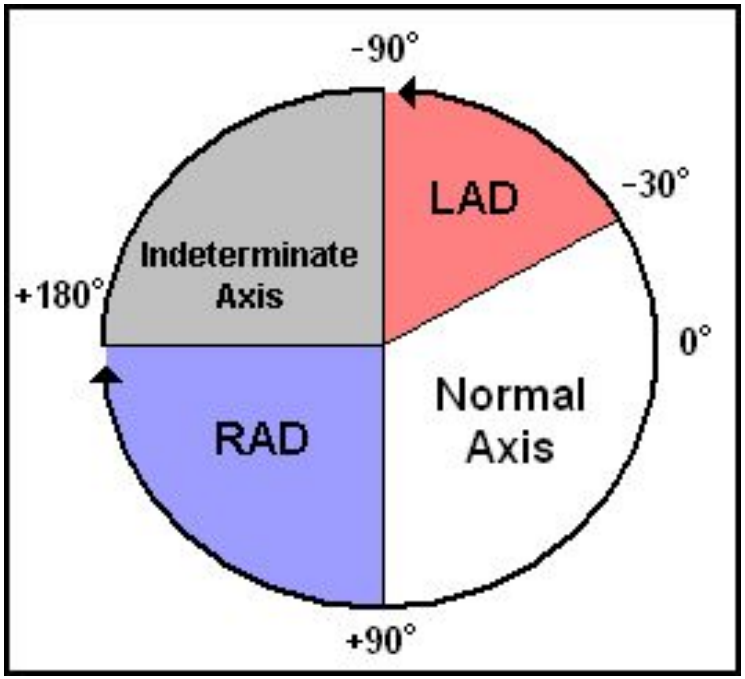
What is this rhythm?

3rd degree heart block (complete)



The QRS Axis

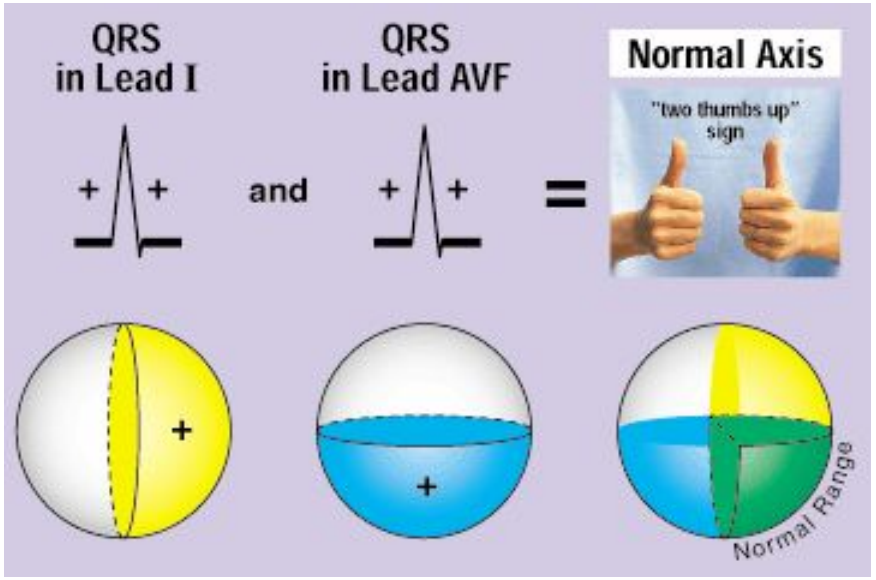
- Represents the overall direction of the heart's activity
- Axis of –30 to +90 degrees is normal



The Quadrant Approach

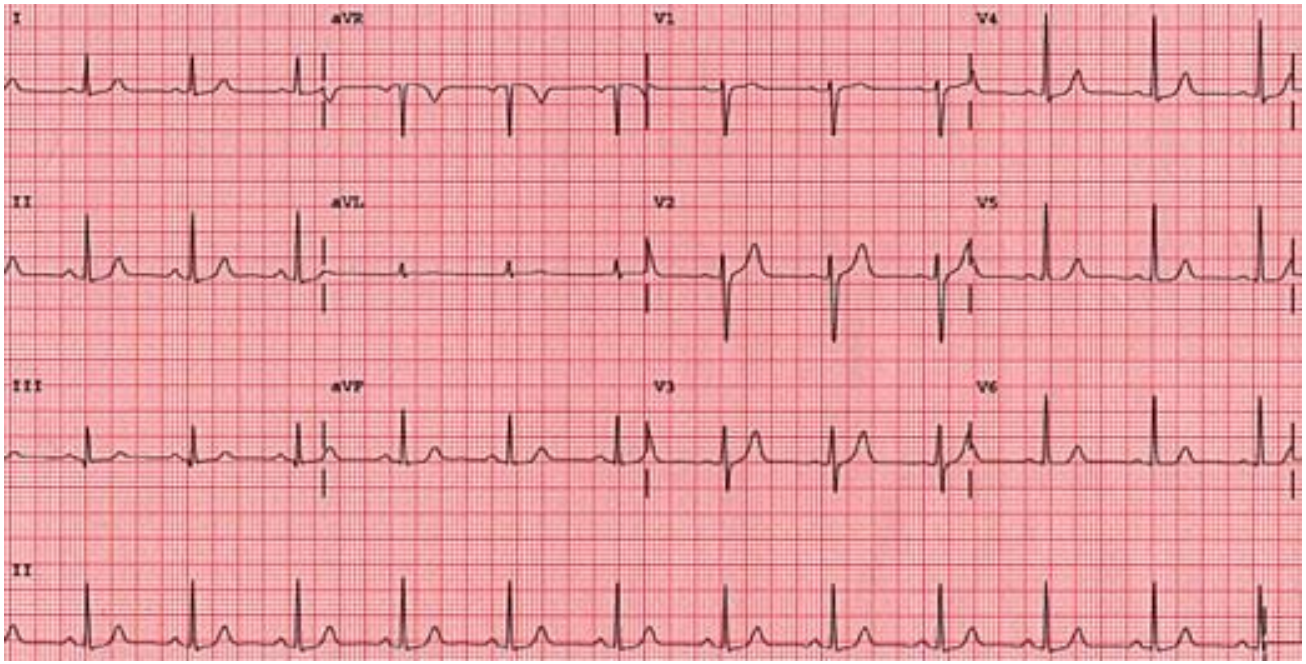
- QRS up in I and up in aVF = Normal

		Lead aVF: Positive	Lead aVF: Negative
Lead I	Positive	Normal Axis	LAD
Lead I	Negative	RAD	Indeterminate Axis



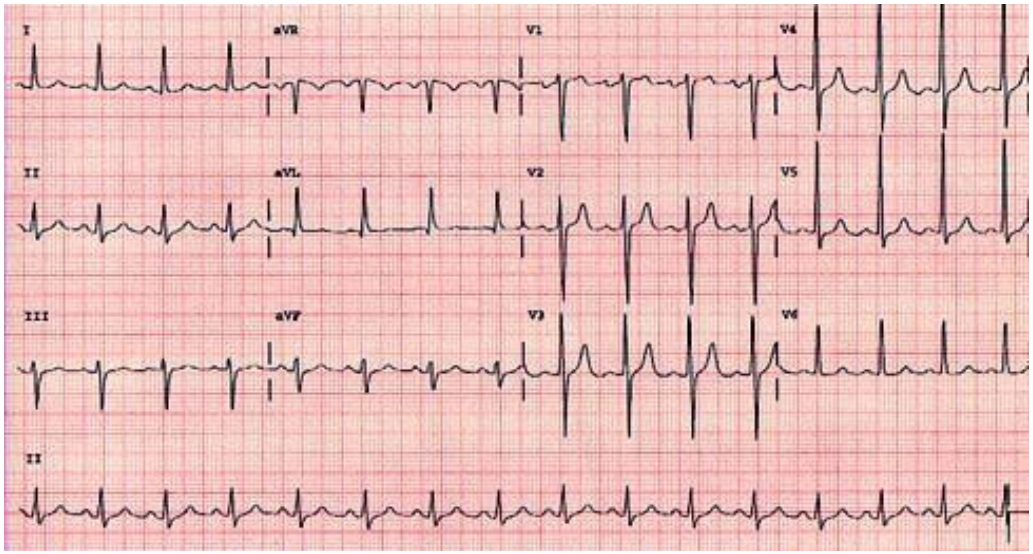
What is the axis?

Normal- QRS up in I and aVF



Hypertrophy

- Add the larger S wave of V1 or V2 in mm, to the larger R wave of V5 or V6.
- Sum is > 35mm = LVH

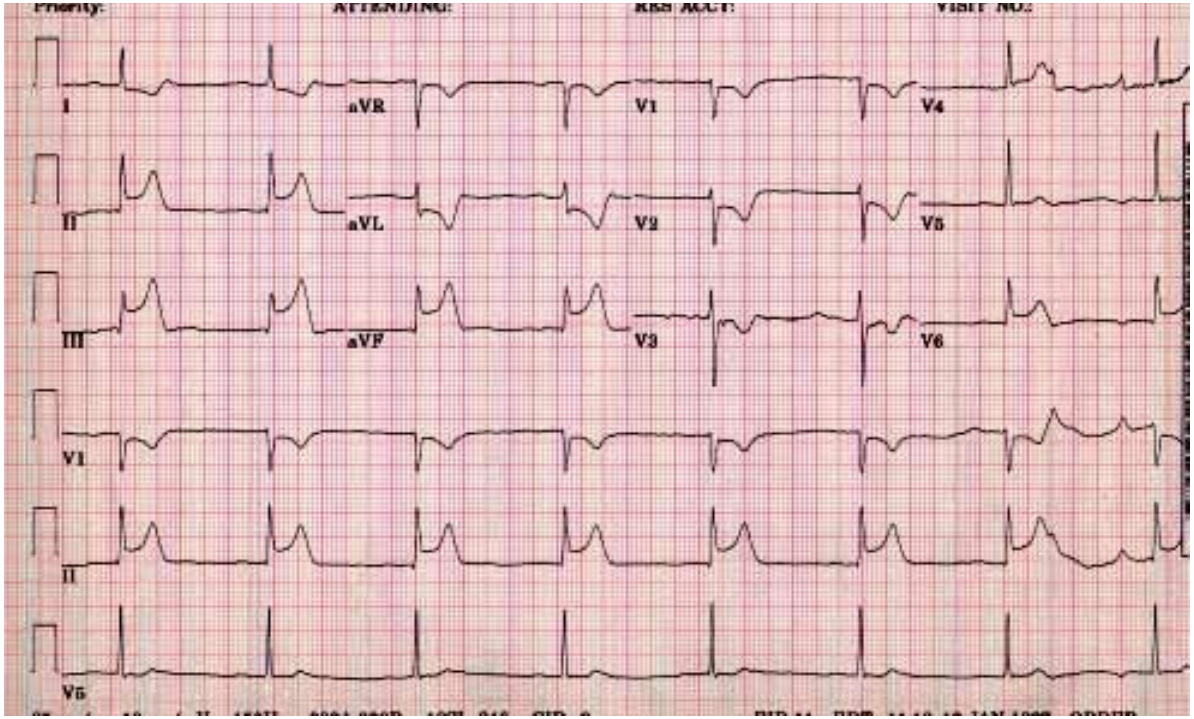


Ischemia

- Usually indicated by ST changes
  - Elevation = Acute infarction
  - Depression = Ischemia
- Can manifest as T wave changes
- Remote ischemia shown by q waves

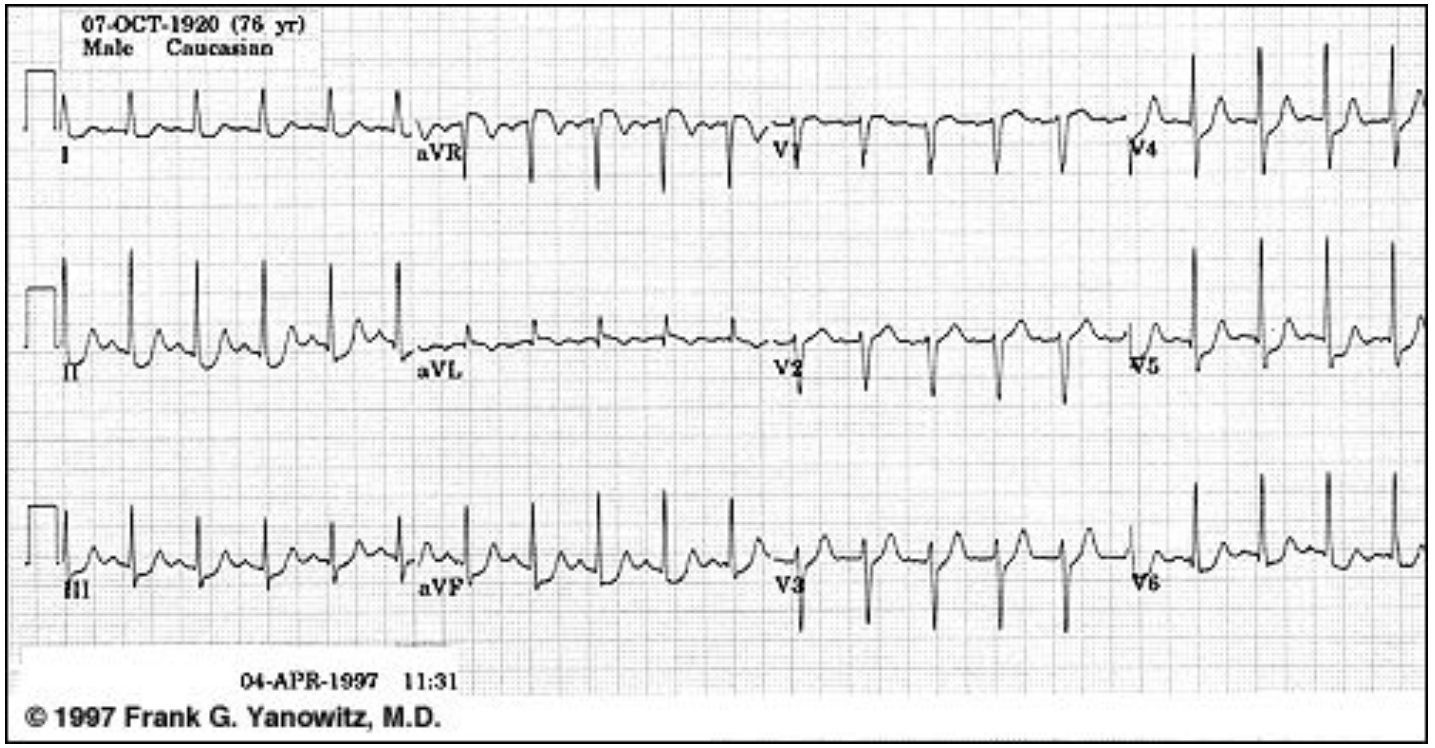
What is the diagnosis?

Acute inferior MI with ST elevation in leads II, III, aVF



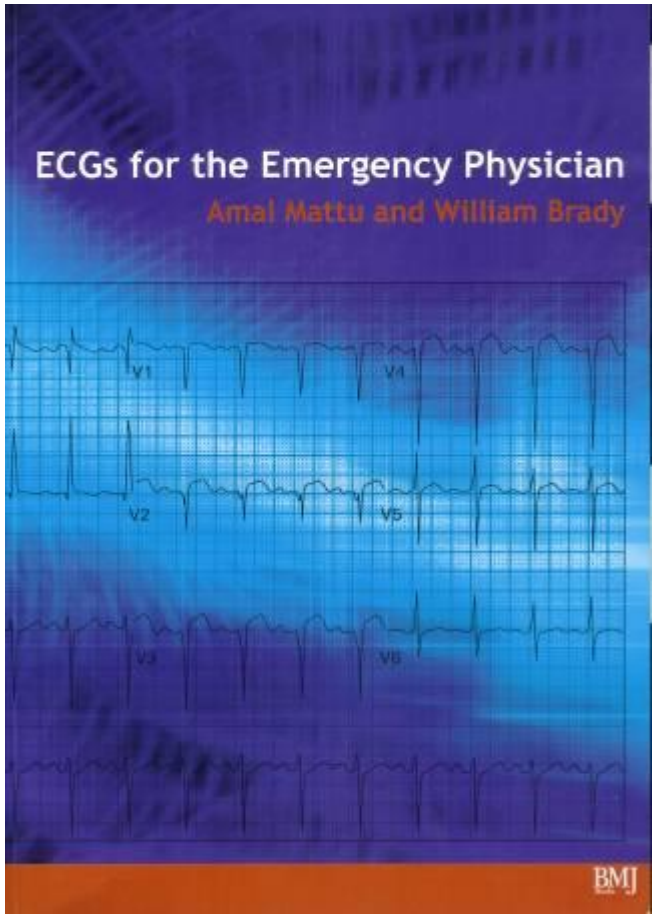
What do you see in this EKG?

ST depression II, III, aVF, V3-V6 = ischemia

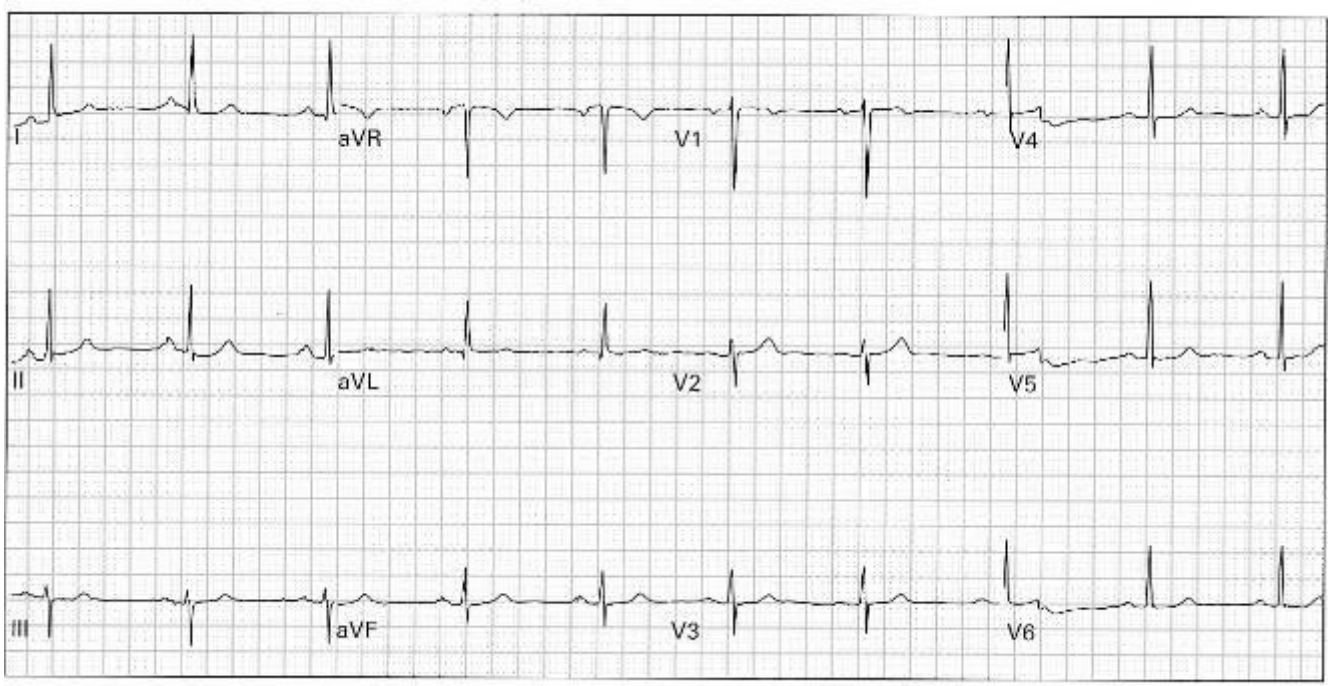


Let's Practice

The sample EKGs were obtained from the following text:



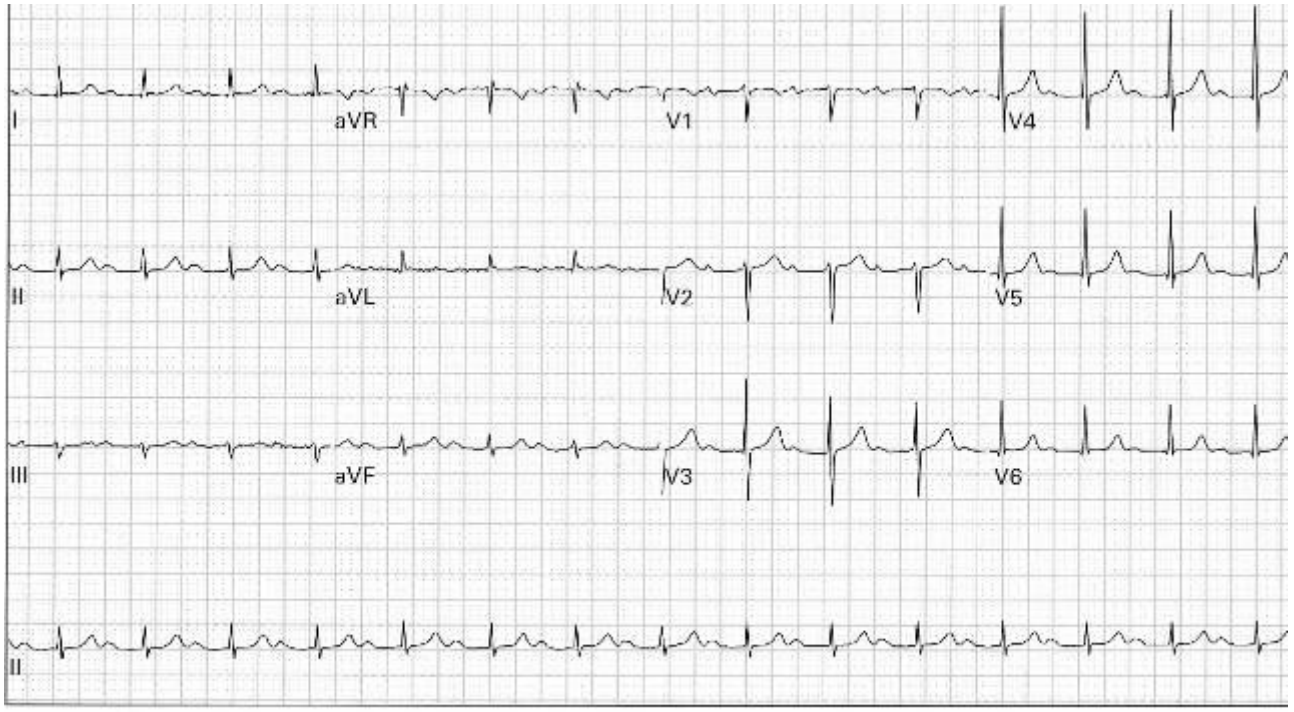
Normal Sinus Rhythm



1. 45 year old woman, asymptomatic

Mattu, 2003

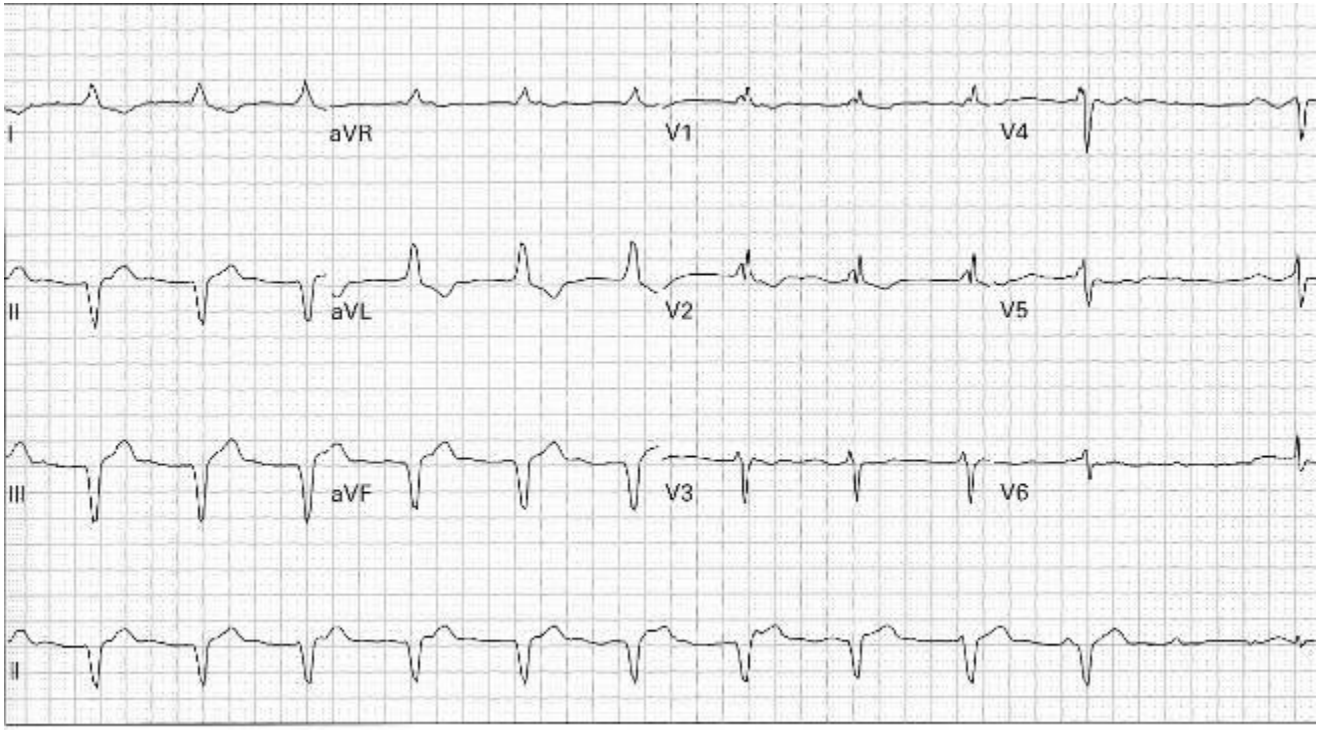
First Degree Heart Block



3. 76 year old man with dyspnea

PR interval >200ms

Accelerated Idioventricular

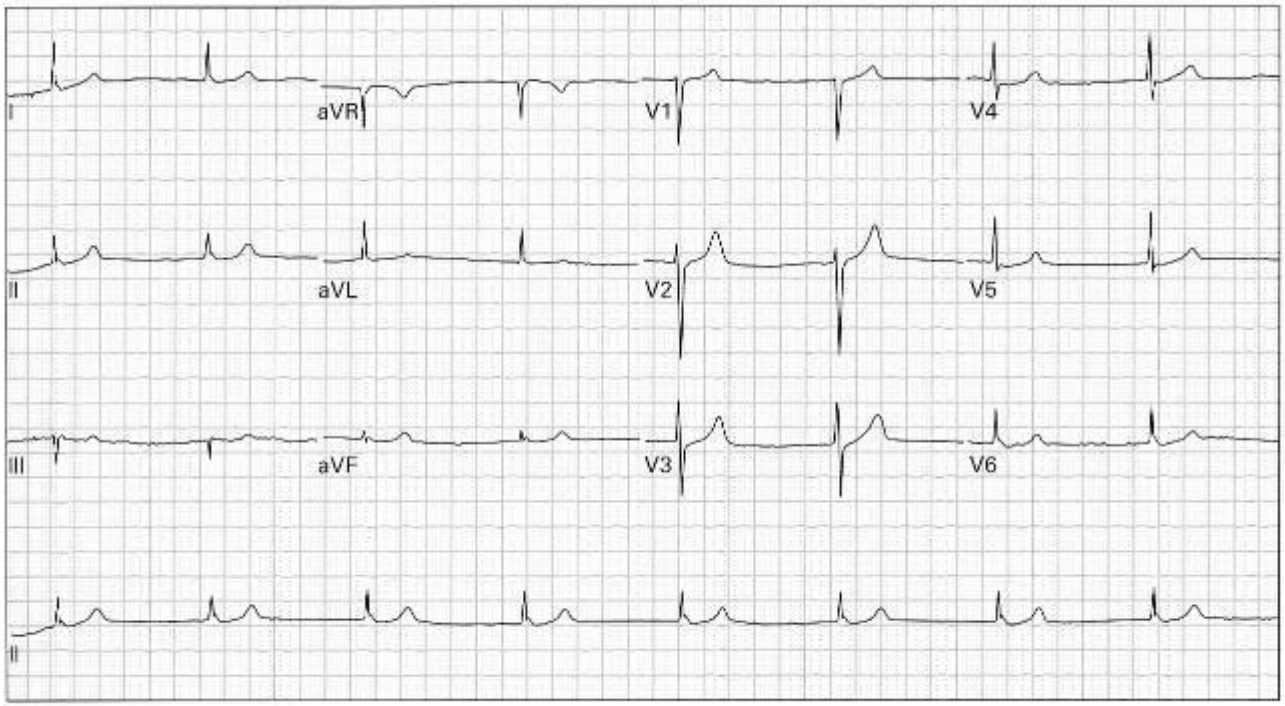


6. 79 year old man 45 minutes after receiving thrombolytic therapy for acute myocardial infarction; currently pain-free

Ventricular escape rhythm, 40-110 bpm

Seen in AMI, a marker of reperfusion

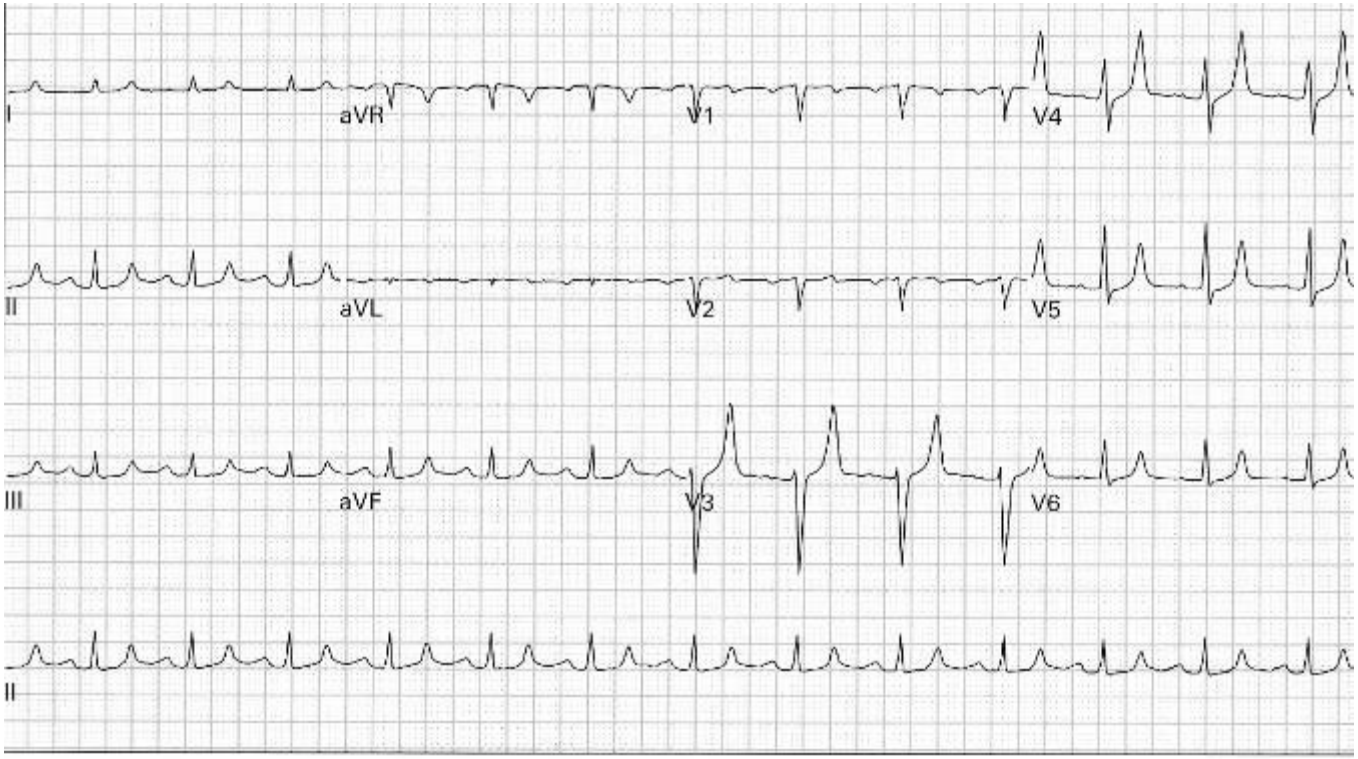
Junctional Rhythm



5. 48 year old woman reports severe lightheadedness with walking; she recently started a new medication for hypertension

Rate 40-60, no p waves, narrow complex QRS

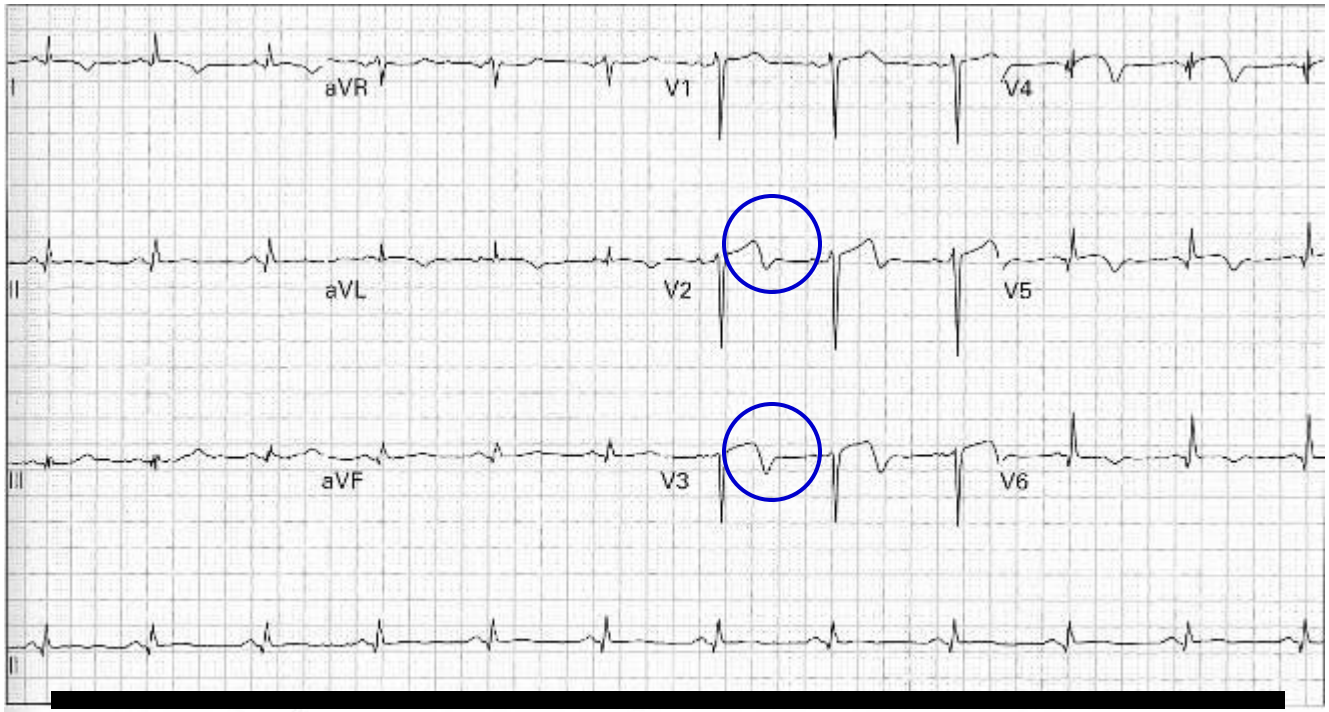
Hyperkalemia



52. 62 year old man with renal failure complains of progressive dyspnea and orthopnea after missing his last two hemodialysis sessions

Tall, narrow and symmetric T waves

Wellen's Sign

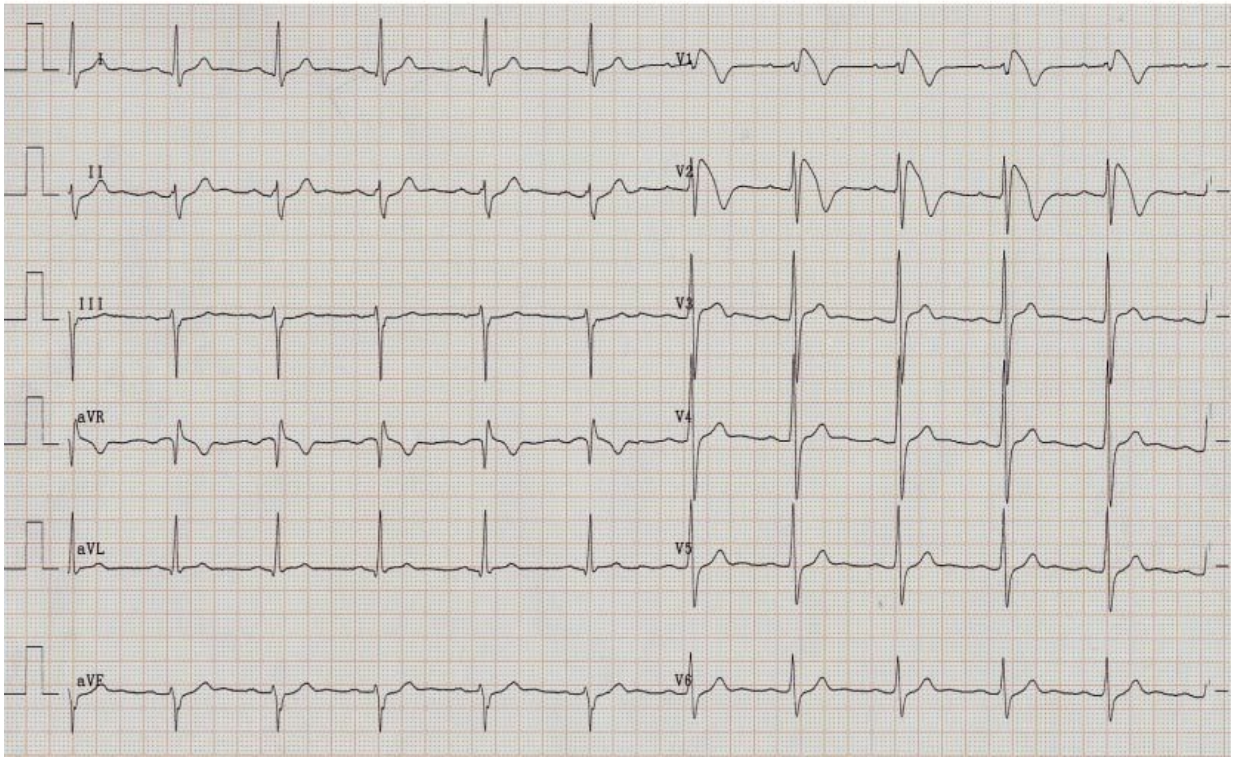


33. 54 year old man 24 hours after receiving thrombolytic therapy for acute myocardial infarction; currently asymptomatic

ST elevation and biphasic T wave in V2 and V3
Sign of large proximal LAD lesion

Brugada Syndrome

Male 39 years

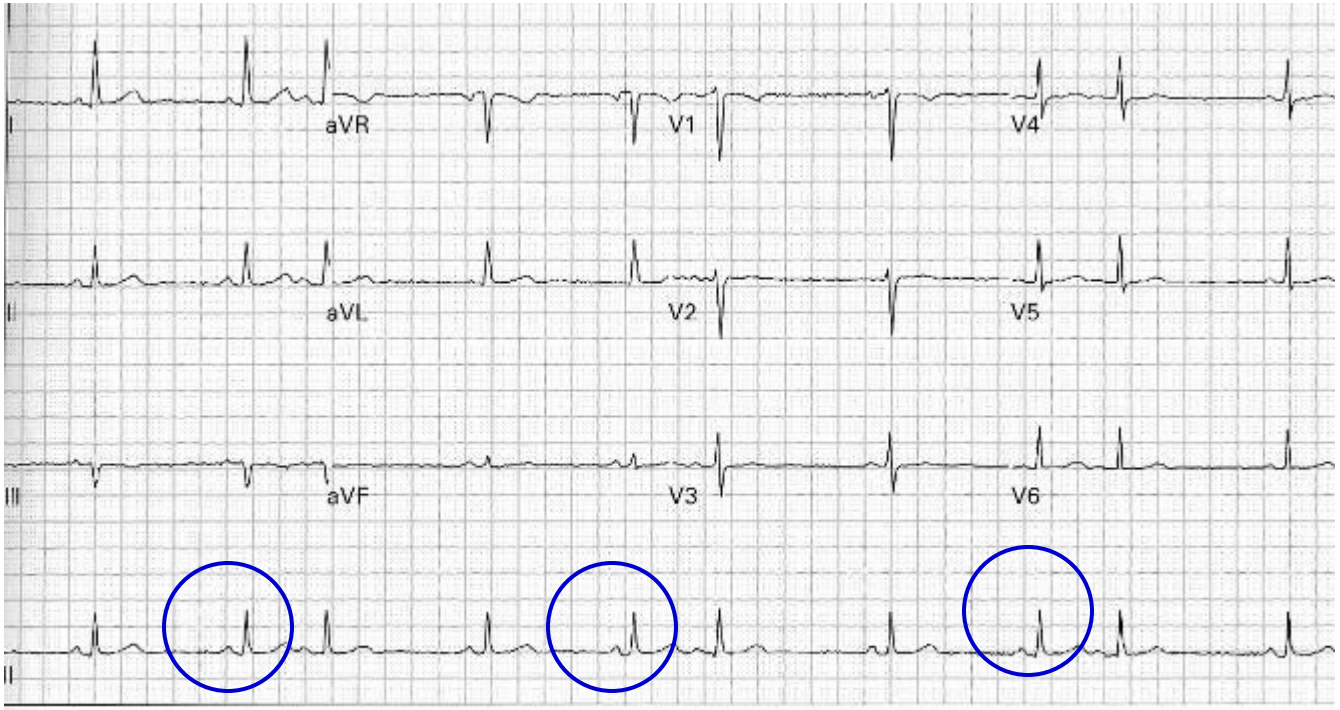


RBBB or incomplete RBBB in V1-V3 with convex ST elevation

Brugada Syndrome

- Autosomal dominant genetic mutation of sodium channels
- Causes syncope, v-fib, self terminating VT, and sudden cardiac death
- Can be intermittent on EKG
- Most common in middle-aged males
- Can be induced in EP lab
- Need ICD

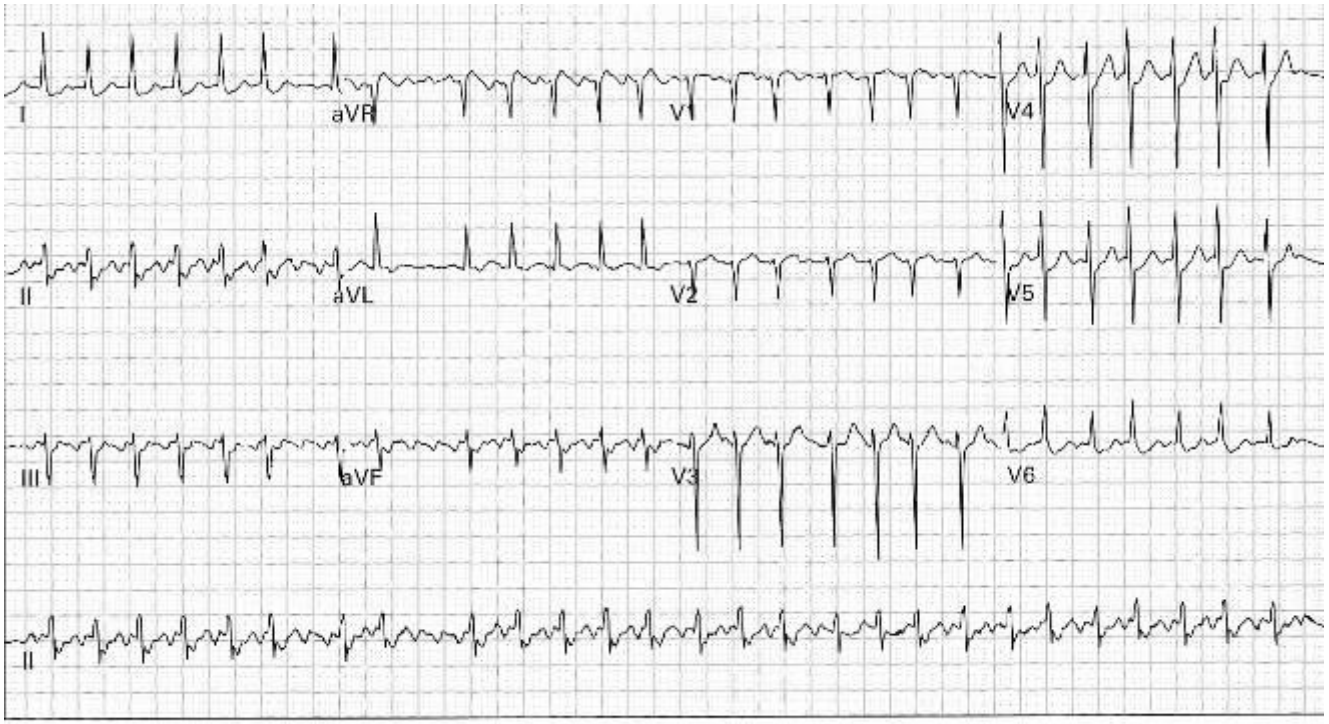
Premature Atrial Contractions



34. 41 year old woman with nausea and vomiting

Trigeminy pattern

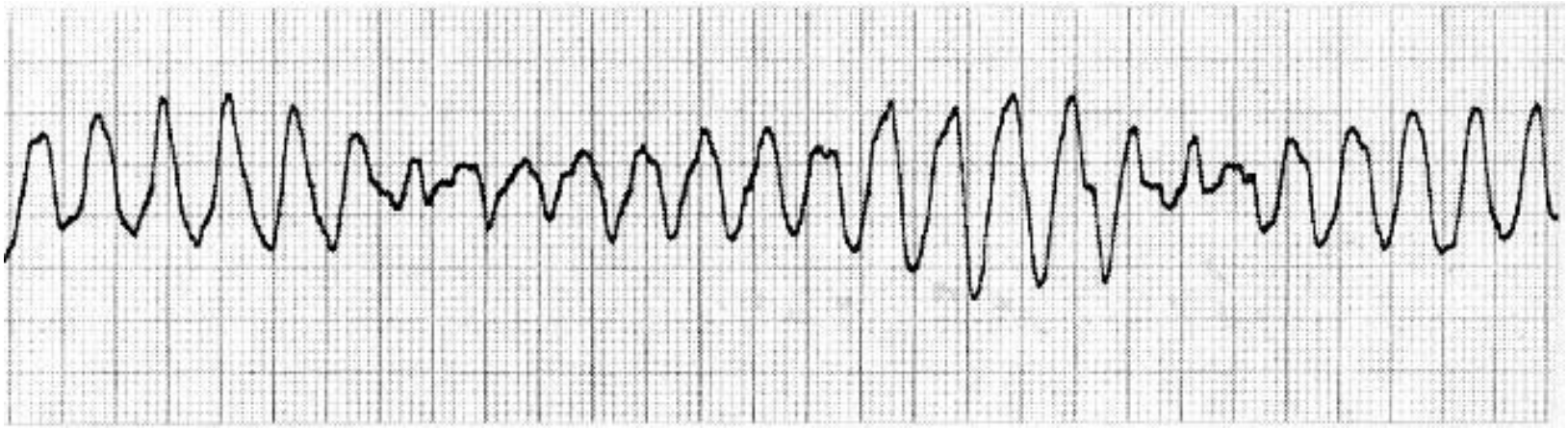
Atrial Flutter with Variable Block



36. 68 year old man with palpitations and generalized weakness

Sawtooth waves
Typically at HR of 150

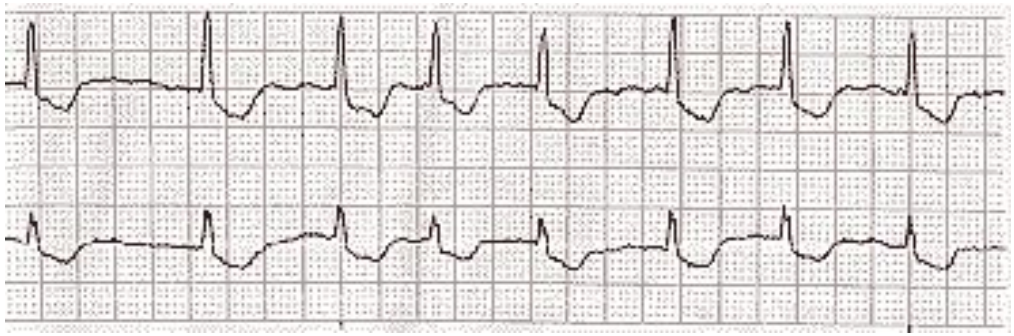
Torsades de Pointes

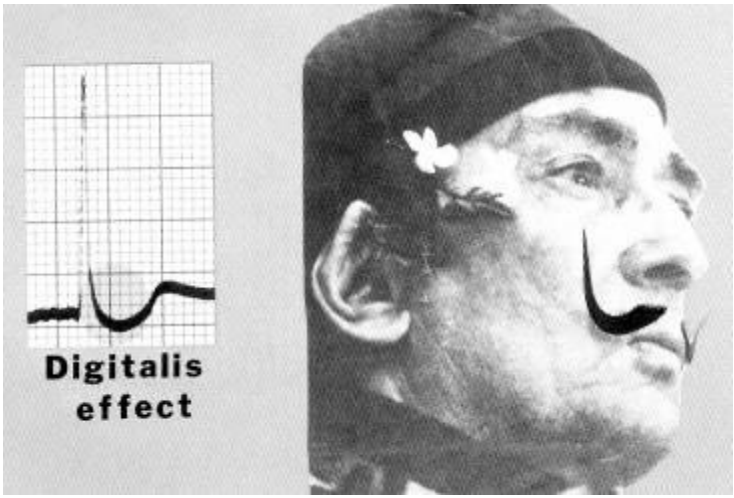


Notice twisting pattern

Treatment: Magnesium 2 grams IV

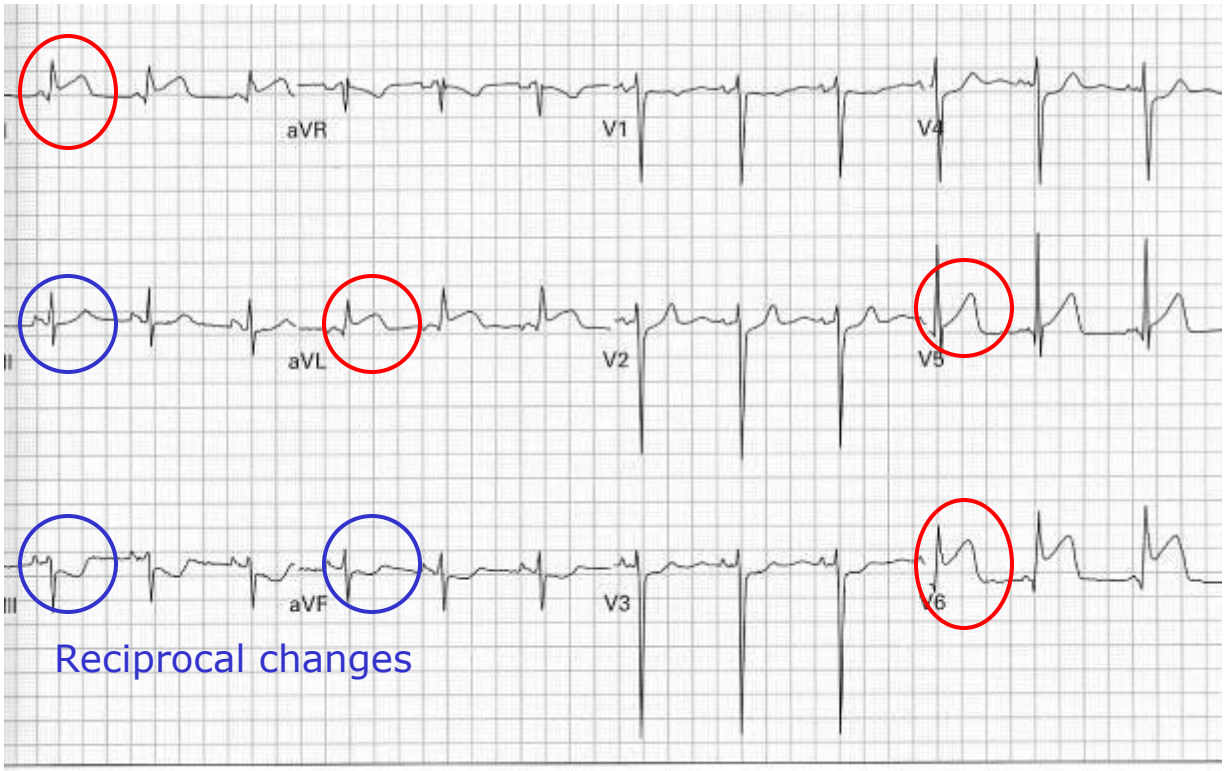
Digitalis





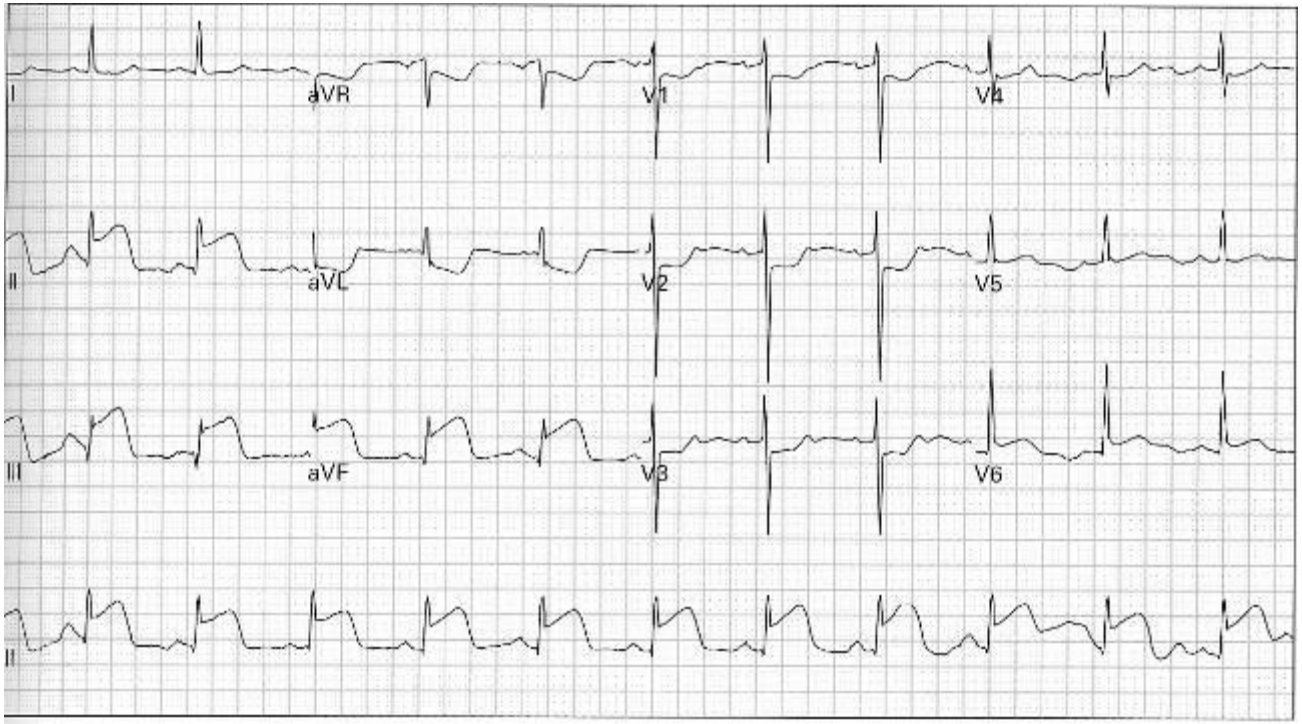
Dubin, 4th ed. 1989

Lateral MI



0. 43 year old man reports eight hours of left chest and arm pain

Inferolateral MI

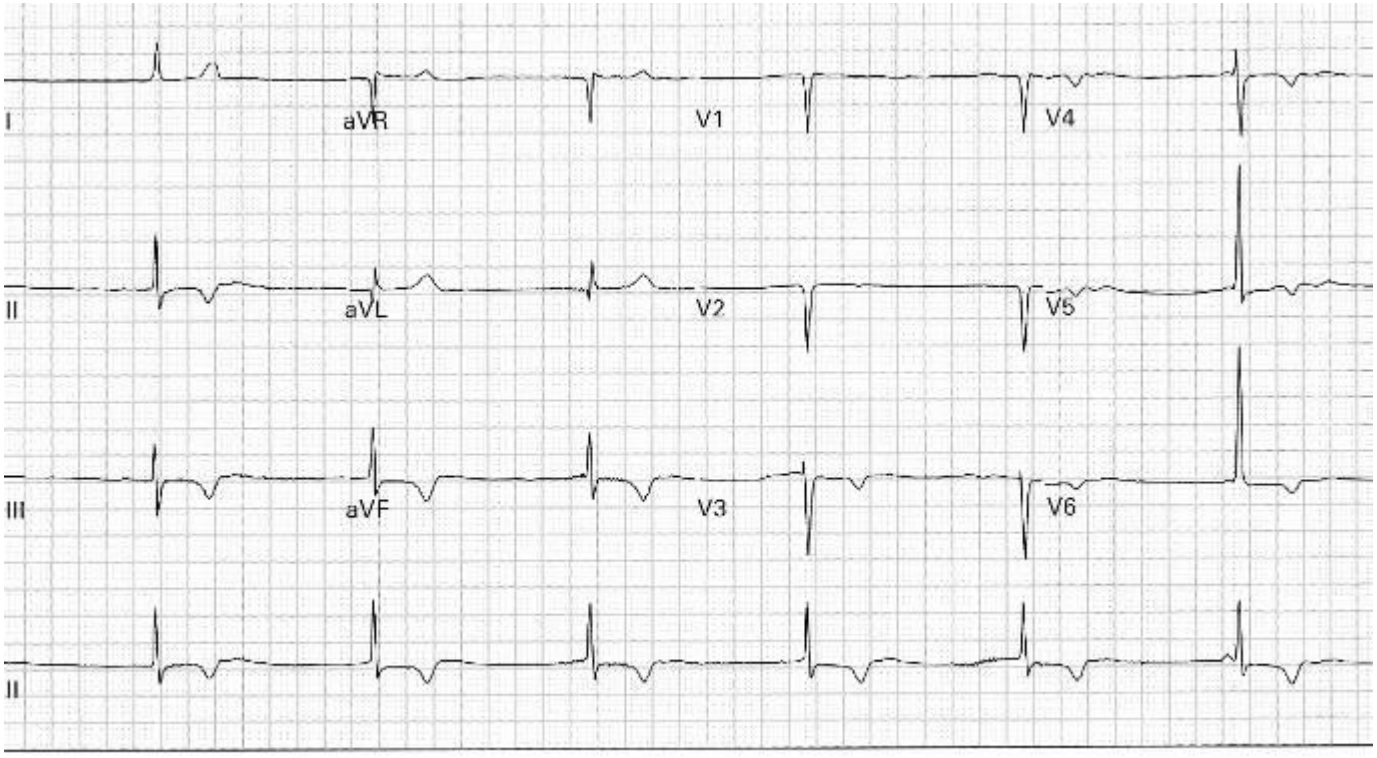


37. 38 year old man with chest pain, nausea, and diaphoresis

ST elevation II, III, aVF

ST depression in aVL, V1-V3 are reciprocal changes

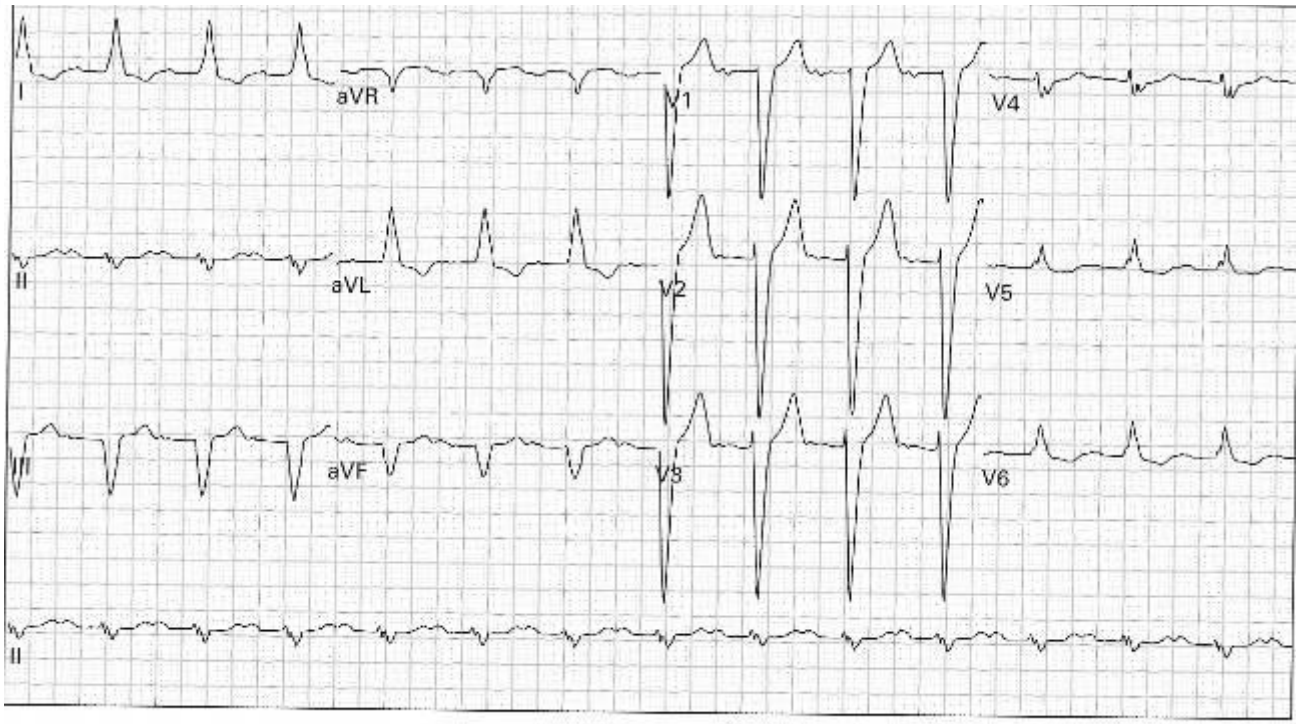
Anterolateral / Inferior Ischemia



35. 75 year old woman accicentally took too many of her beta-blocker tablets

LVH, AV junctional rhythm, bradycardia

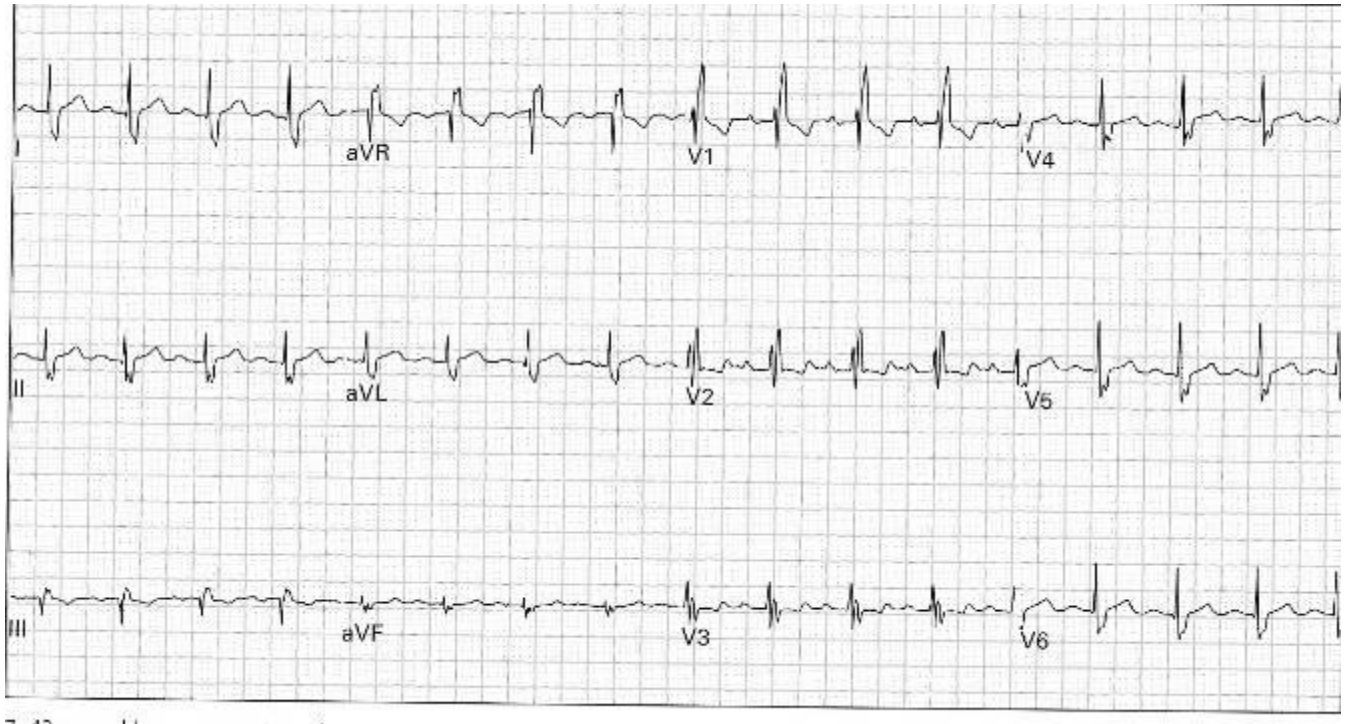
Left Bundle Branch Block



8. 82 year old man recently increased his dose of a beta-receptor blocking medication; he now reports exertional lightheadedness

Monophasic R wave in I and V6, QRS > 0.12 sec
Loss of R wave in precordial leads
QRS T wave discordance I, V1, V6
Consider cardiac ischemia if a new finding

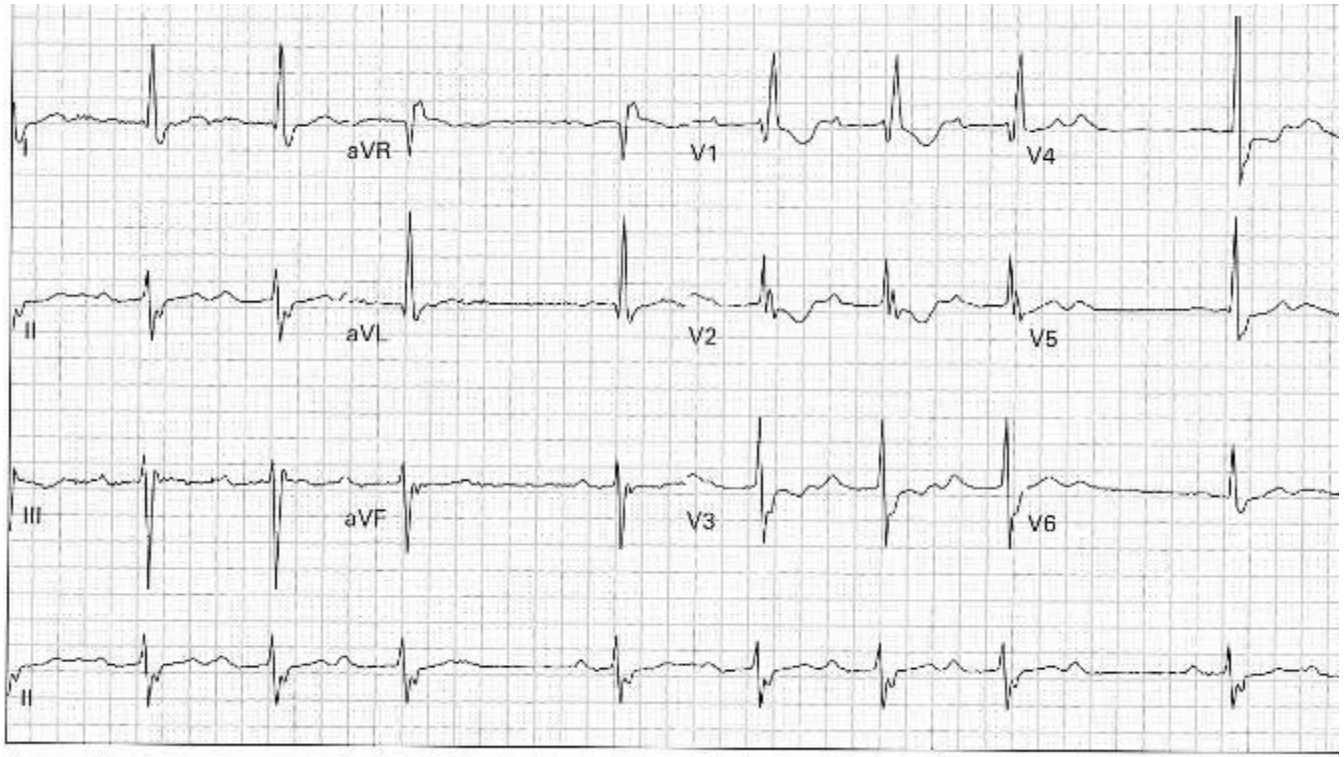
Right Bundle Branch Block



7. 43 year old man, asymptomatic

V1: RSR prime pattern with inverted T wave
V6: Wide deep slurred S wave

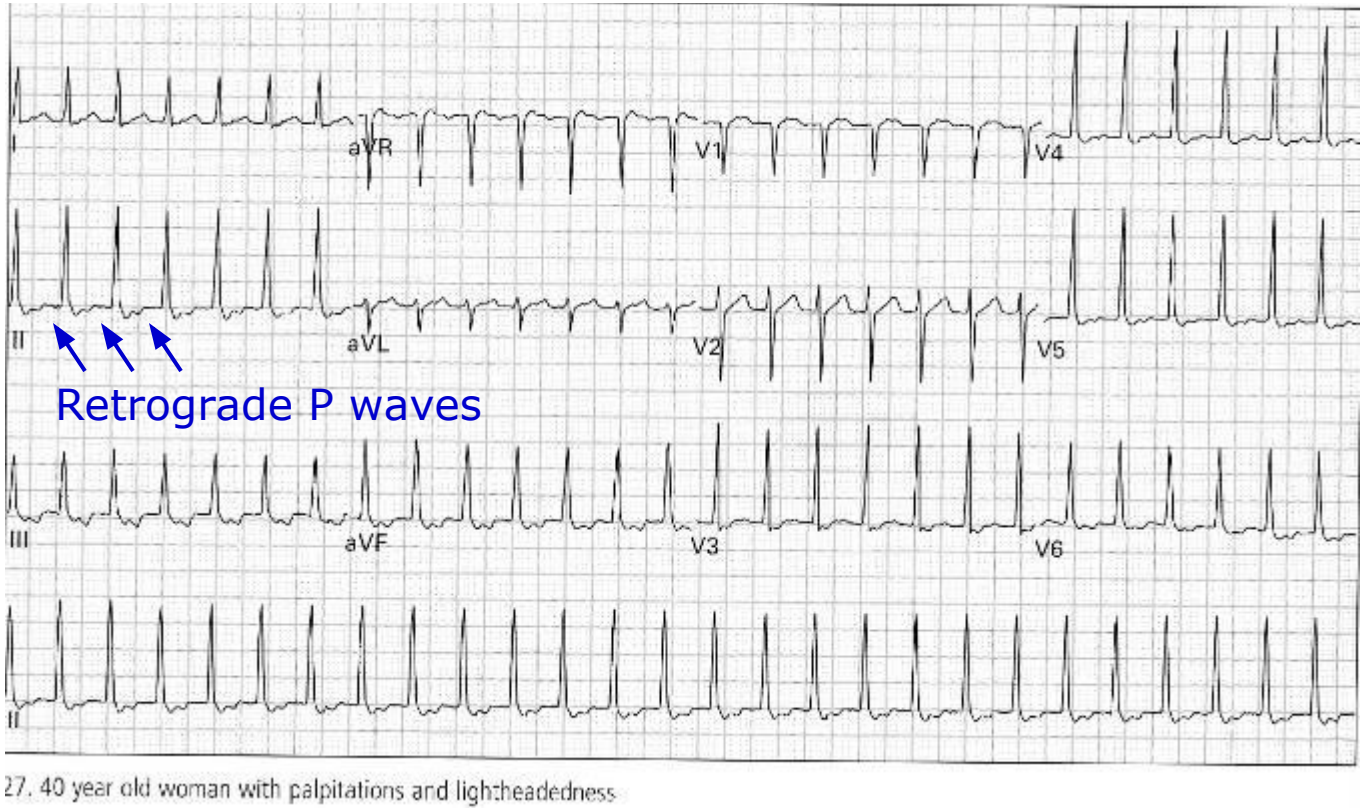
First Degree Heart Block, Mobitz Type I (Wenckebach)



12. 86 year old woman complains of generalized weakness

PR progressively lengthens until QRS drops

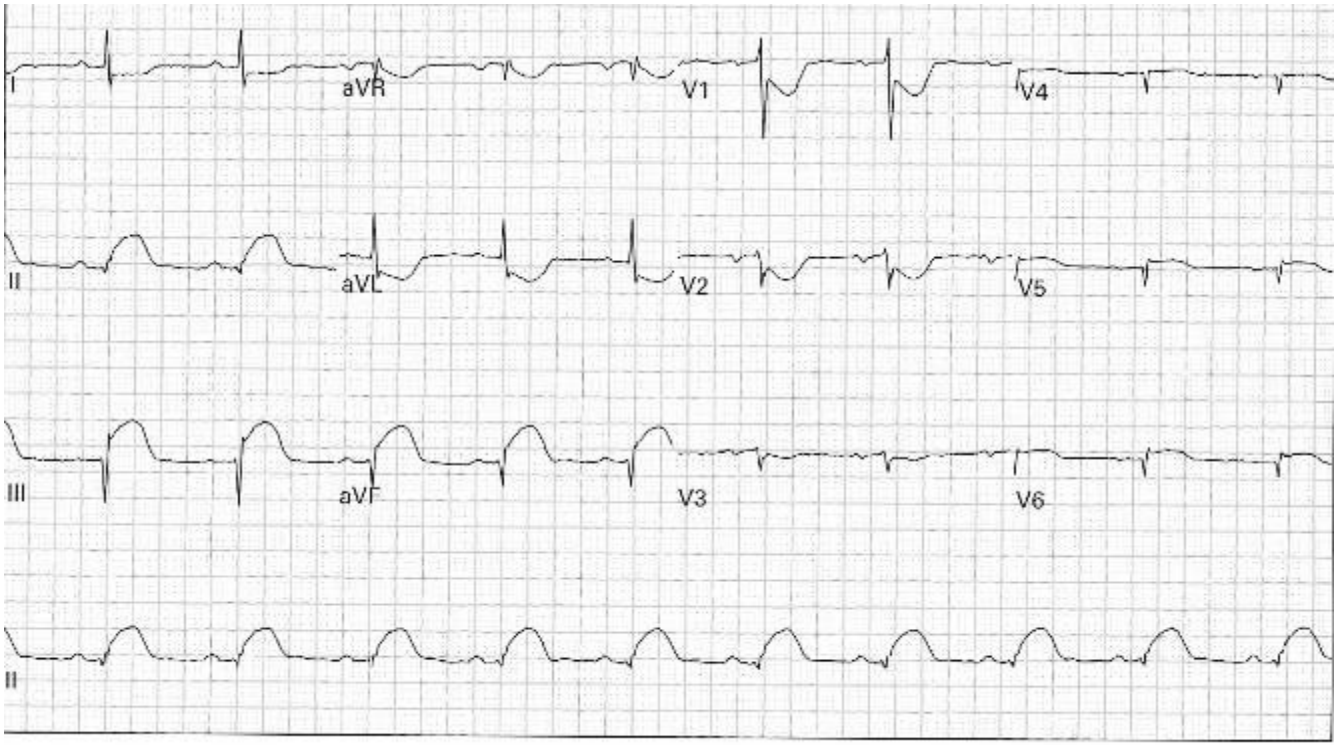
Supraventricular Tachycardia



27. 40 year old woman with palpitations and lightheadedness

Narrow complex, regular; retrograde P waves, rate <220

Right Ventricular Myocardial Infarction



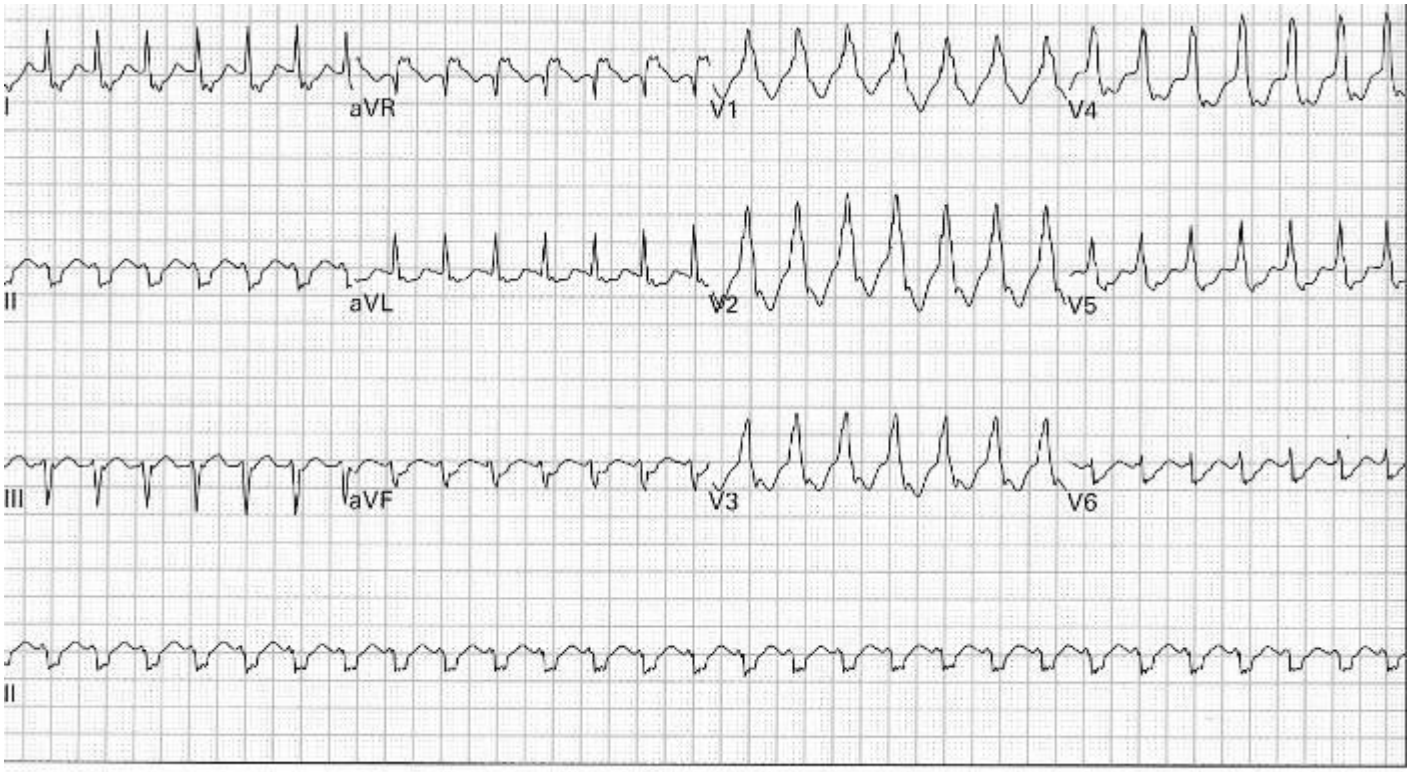
31. 57 year old man with chest pressure and diaphoresis (right-sided precordial leads)

Found in 1/3 of patients with inferior MI

Increased morbidity and mortality

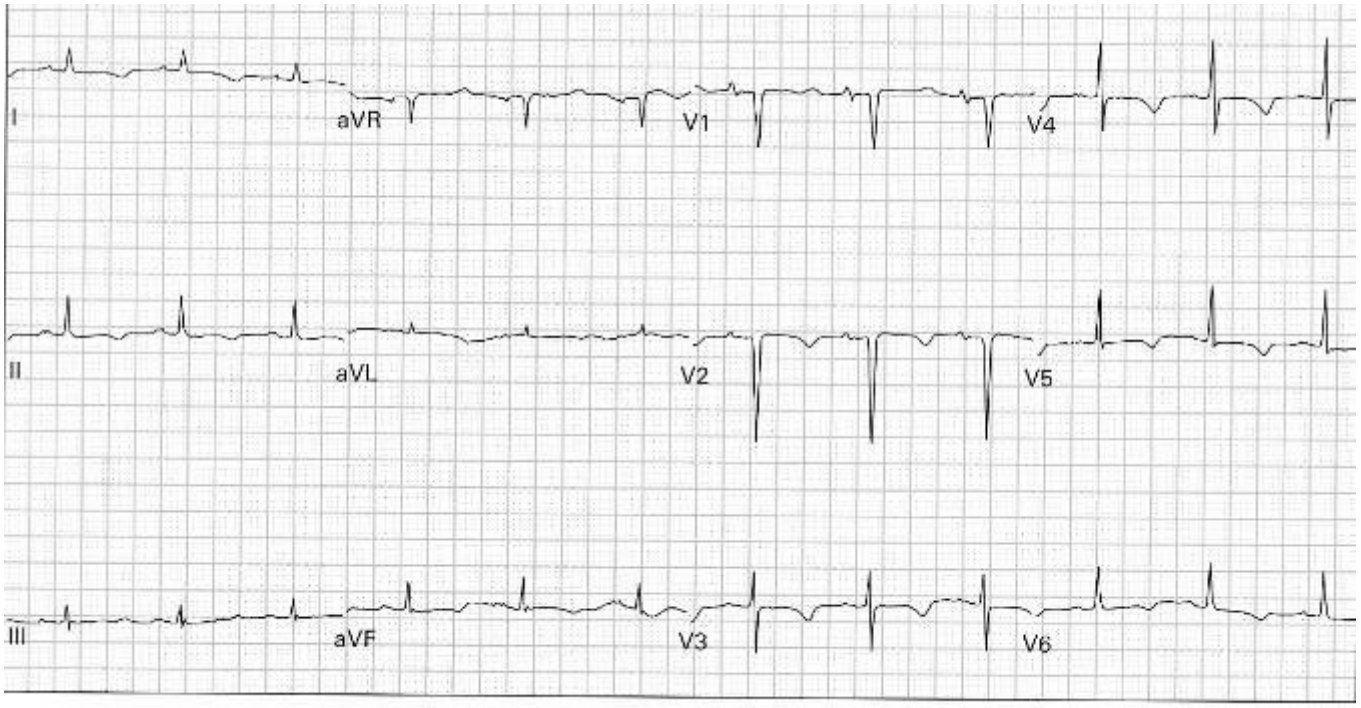
ST elevation in V4-V6 of Right-sided EKG

Ventricular Tachycardia



9. 74 year old man with chest pain and palpitations

Prolonged QT

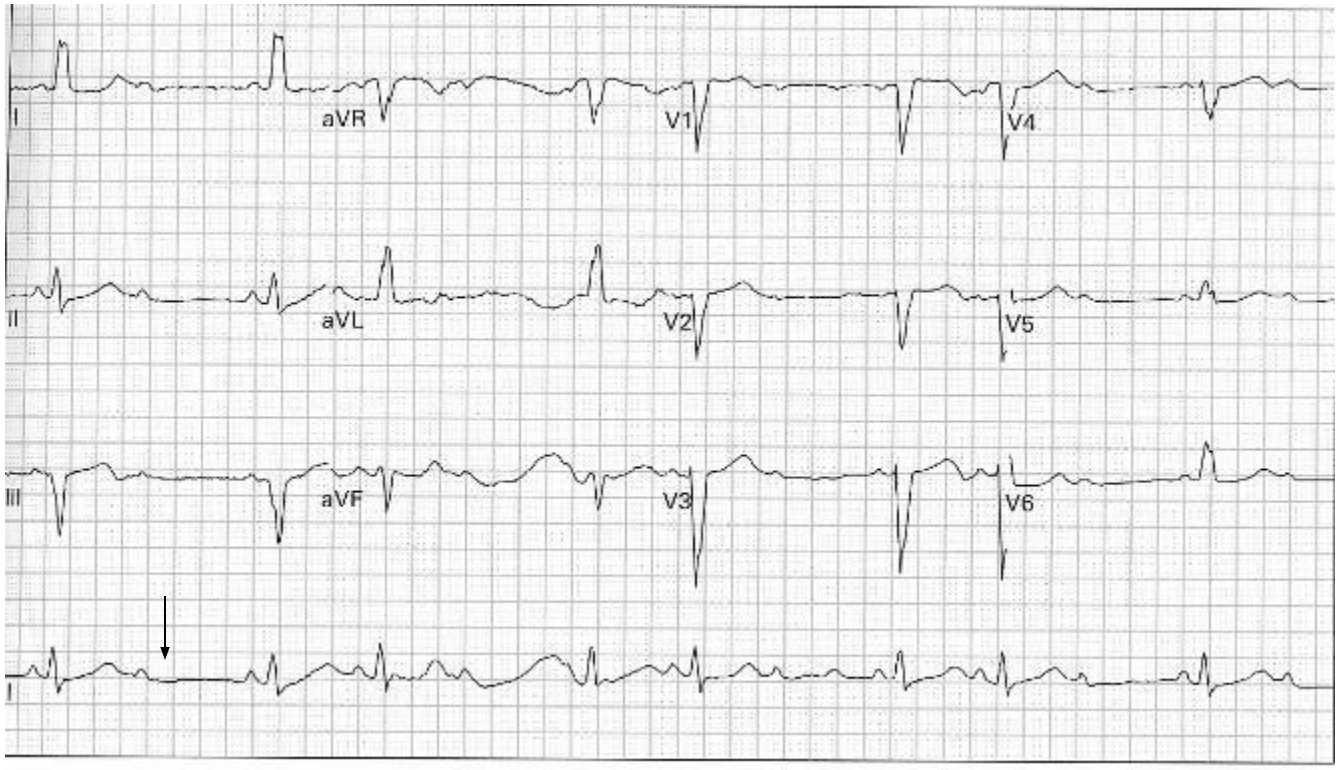


44. 71 year old woman with chronic renal insufficiency presents with carpopedal spasm

QT > 450 ms

Inferior and anterolateral ischemia

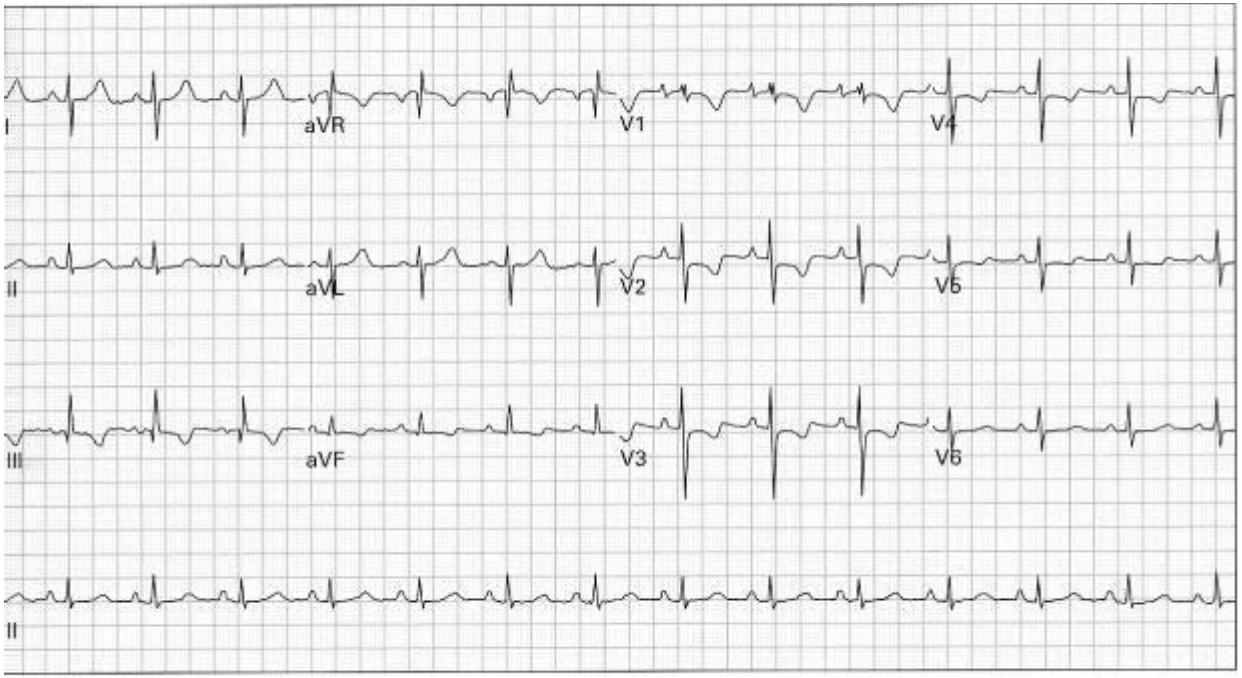
Second Degree Heart Block, Mobitz Type II



2. 85 year old woman presents after a syncopal episode, still reports lightheadedness

PR interval fixed, QRS dropped intermittently

Acute Pulmonary Embolism



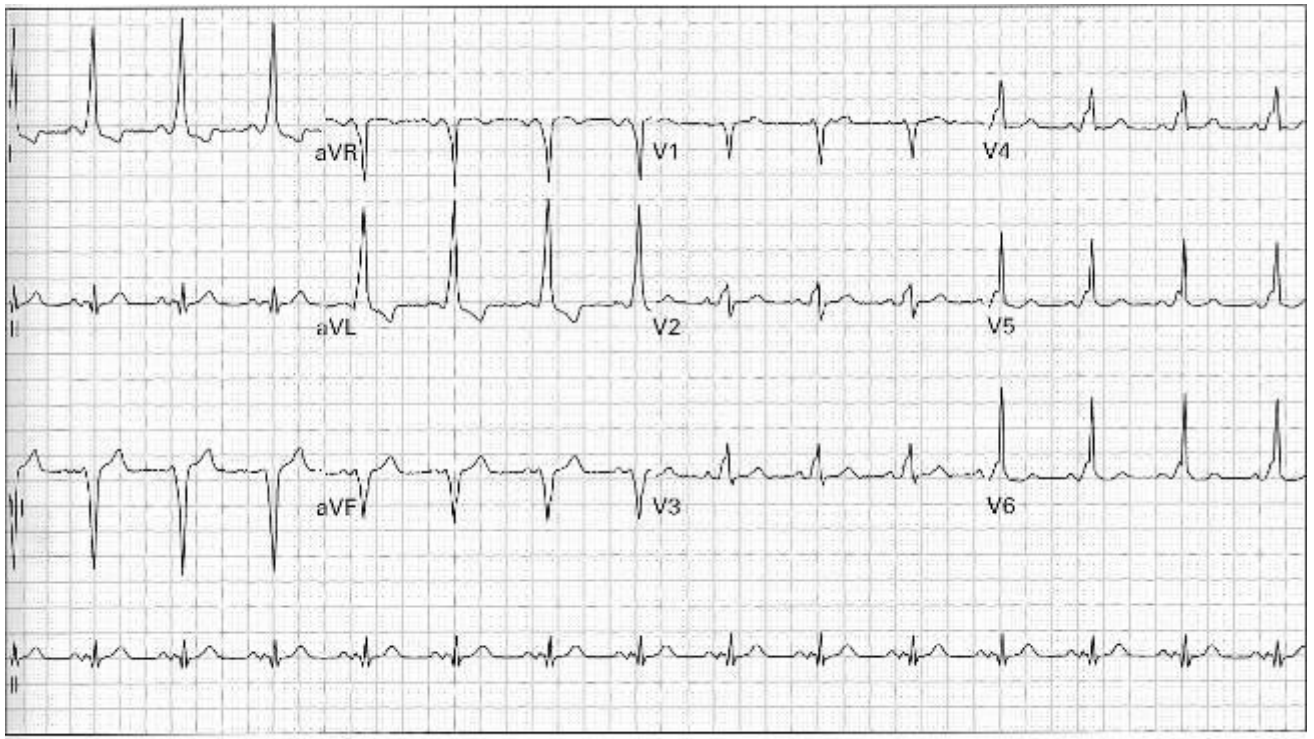
18. 33 year old obese man with sharp chest pain and dyspnea

$S_IQ_{III}T_{III}$ in 10-15%

T-wave inversions, especially occurring in inferior and anteroseptal simultaneously

RAD

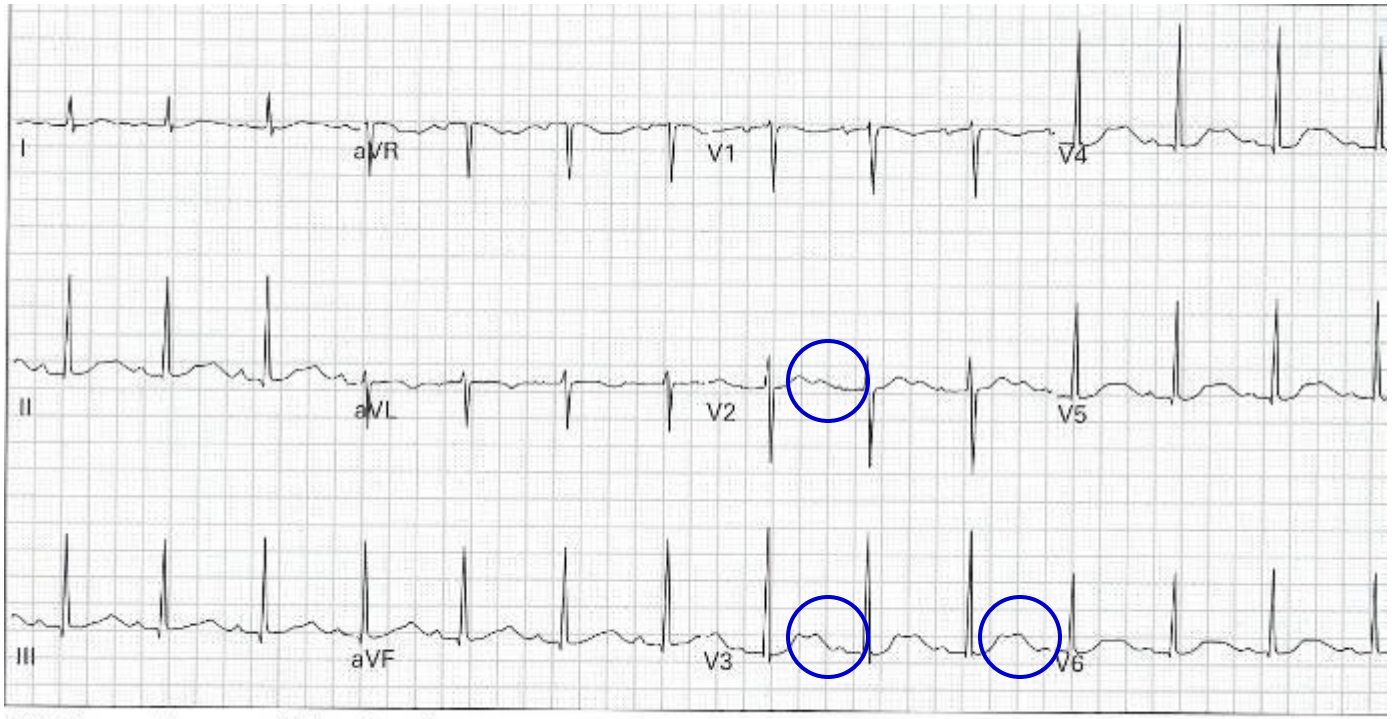
Wolff-Parkinson-White Syndrome



14. 44 year old woman with intermittent episodes of palpitations

Short PR interval <0.12 sec
Prolonged QRS >0.10 sec
Delta wave
Can simulate ventricular hypertrophy, BBB and previous MI

Hypokalemia



103. 46 year old woman with four days of vomiting and diarrhea

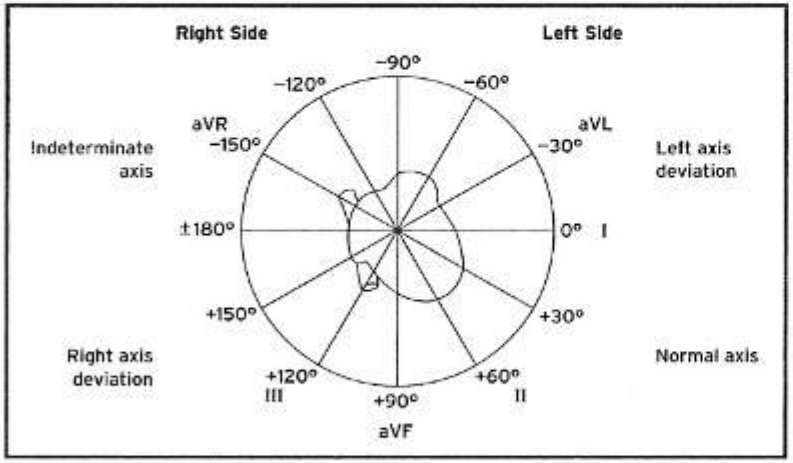
U waves
Can also see PVCs, ST depression, small T waves

12-Lead EKG Interpretation Checklist

Use this checklist to document your findings on 12-lead EKGs.

The Basics

- Rhythm _____
- Rate _____
- Intervals PR _____ QRS _____ QT _____



Axis

- Degree marking _____

Intraventricular Conduction Defects (IVCDs)

Check if present:

❑ RBBB ❑ LBBB ❑ LAHB ❑ LPHB

12-Lead EKG Interpretation Checklist (con't)

Hypertrophy

Check if present:

❑ RAE ❑ LAE ❑ RVH ❑ LVH

Infarction

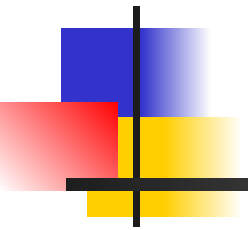
Check if present:

❑ Anterior MI
❑ Inferior MI
❑ Lateral MI
❑ Posterior MI
❑ Anteroseptal MI
❑ Extensive anterior (anterior-lateral) MI
❑ Subendocardial MI
❑ Ischemia

Miscellaneous Effects

Check if present:

❑ Hyperkalemia
❑ Severe hyperkalemia
❑ Hypokalemia
❑ Hypercalcemia
❑ Hypocalcemia
❑ Digitalis effect
❑ Quinidine effect



Thank You

Any Questions?