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**Cardiovascular
Course**

**Conquer the
Deteriorating
Cardiac Patient
Day 1**



1

Statement of Accuracy and Utility/Scope of Practice:

- “Materials that are included in this course may include interventions and modalities that are beyond the authorized practice of mental health professionals.
- As a licensed professional, you are responsible for reviewing the scope of practice, including activities that are defined in law as beyond the boundaries of practice in accordance with and in compliance with your professions standards.”

2

Limitations of the Research and Potential Risks

- Cardiology Guidelines were reviewed for this seminar. In each topic, the level of evidence and risks for the interventions will be listed.
- Culture, race, and other variables which are often not adequately represented in the literature will be listed.

3

Cardiovascular Course

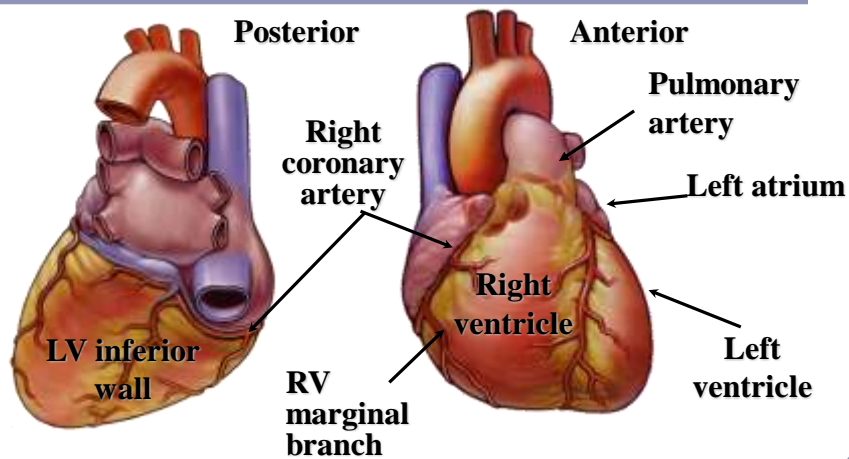
12 Lead EKG Pearls

Cheryl Herrmann
CARDIO CLINICAL NURSE SPECIALIST
APRN, CCRN, CCMSC, CMC



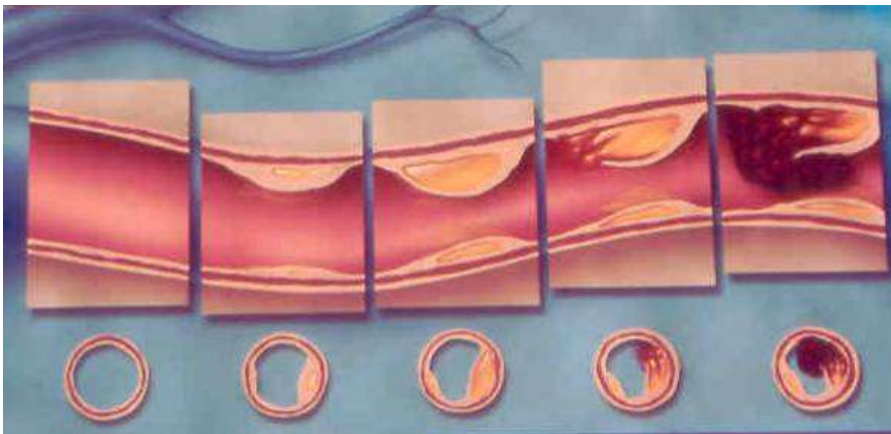
4

Cardiac Anatomy



5

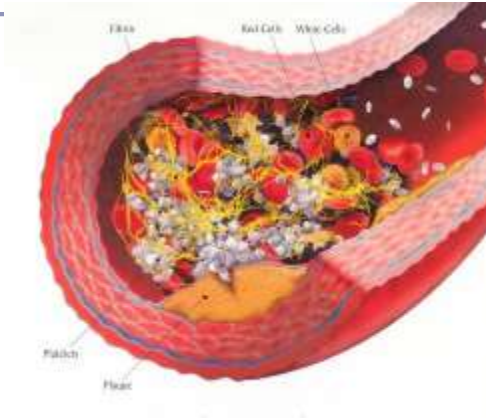
Atherosclerosis



6

Cascade effects of atherosclerotic plaque rupture

- Platelet aggregation
- Fibrin accumulation
- Thrombus formation
- Bleeding into the plaque
- Vasospasm



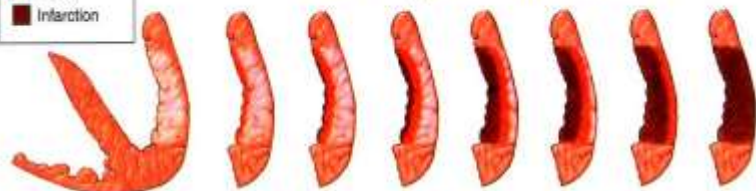
ARTERY OCCULSION

7

A. Changes in Anatomy



Evolutional Changes of an Acute Myocardial Infarction



Time after onset	Onset	<20-40 min	30 min	1 hour	2 hours	4 hours	6 hours	24 hours
Extent of infarction		0%	10%	30%	50%	70%	90%	100%

B. When Serum Markers Are First Detectable (Hours)

- Myoglobin
- Troponins
- CK-MB
- CK-MB isoenzymes



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Time Is Muscle

Muscle is Ejection Fraction

**Ejection Fraction is
Quality of Life**

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Target

Door to Balloon < 90 minutes

(Class 1, Level A)

or

Door to Needle < 30 minutes

(Class 1, Level B)

ACC/AHA 2013 Guidelines for Management of STEMI

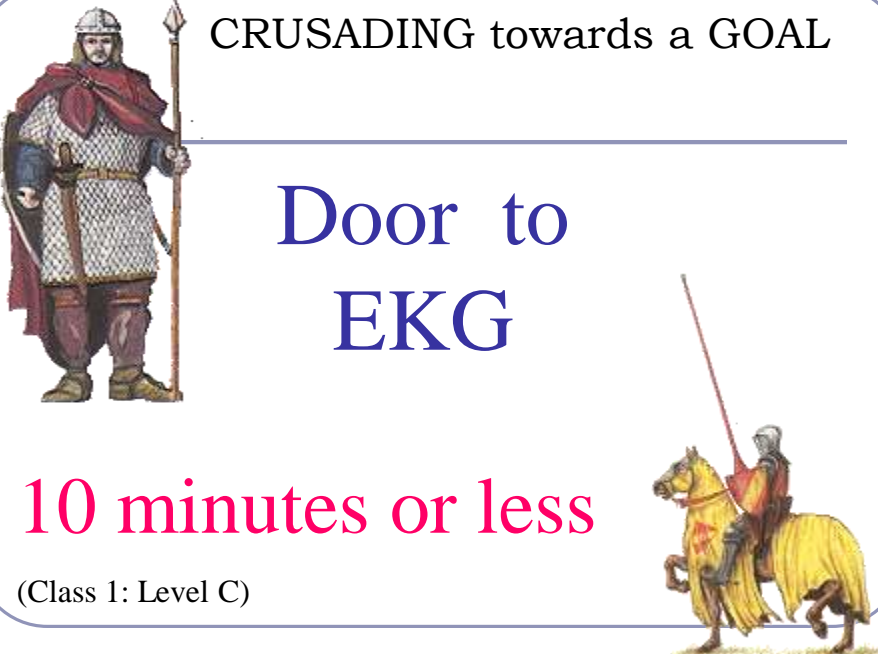
10

CRUSADING towards a GOAL

Door to
EKG

10 minutes or less

(Class 1: Level C)




11

EKG Changes with MI: Ischemia

Ischemia < 20 Minutes

Lack of oxygen to the myocardial muscle

- ♥ Peaked T Waves
- ♥ Inverted T Waves
- ♥ ST Segment Depression



Ischemia = screaming for oxygen

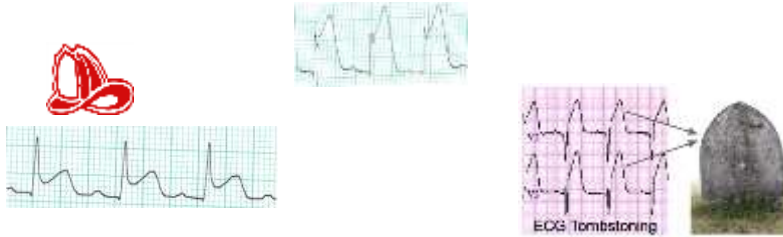
12

EKG Changes with MI: Injury

Injury 20 - 40 minutes

When the period of ischemia is prolonged more than a few minutes, ischemic areas of the heart become damaged (injured)

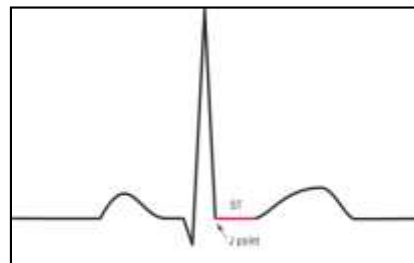
♥ ST segment elevation



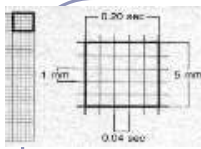
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The ST Segment

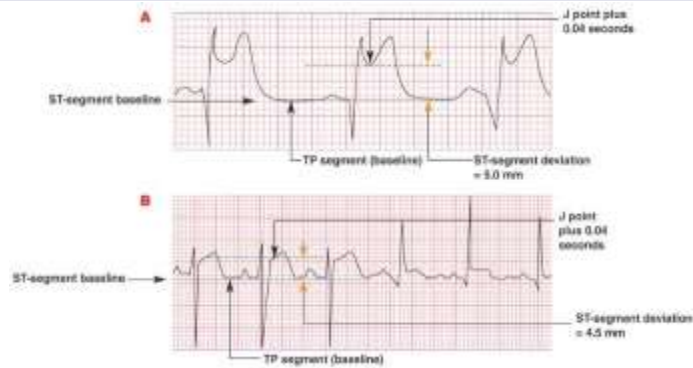
- From the end of the QRS complex to the beginning of the T wave
- Should be at the baseline



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Measurement of ST-Segment Deviation



STEMI: ≥ 1 mm ST-segment elevation in 2 leads.*

NSTEMI/UA: ≥ 0.5 mm ST-segment ischemic depression in 2 leads.*

*Anatomically (regionally) contiguous leads.

Source: AHA ACLS EP

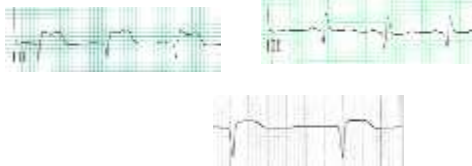
15

EKG Changes with MI: **Infarction**

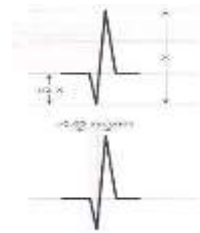
Infarction > 1 - 2 hours

♥ Abnormal Q waves

- > 1/3 the height of R wave in that lead
- or
- > 0.03 ms wide



Abnormal (significant Q waves)

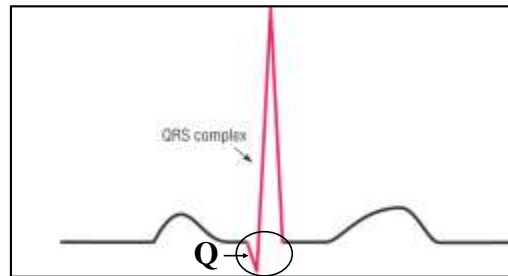


Normal Q wave 1st downward deflection of QRS



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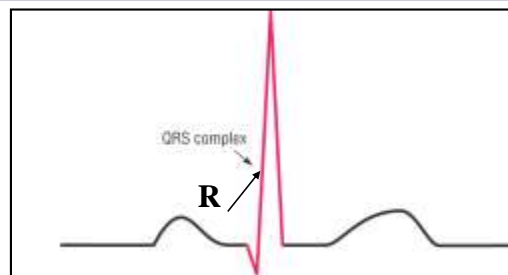
Normal QRS complex – The Q wave



- Q wave is the first negative deflection after the p wave
- Always first may or may not be there.
- Comes first in the alphabet
- There are normal and abnormal Q waves

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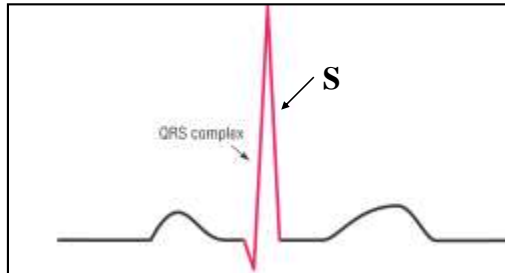
Normal QRS complex – The R wave



- R wave is the first positive deflection after the p wave
- Always Rising above

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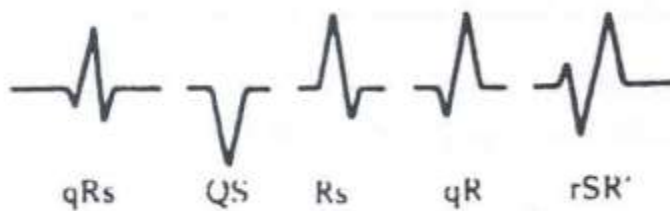
Normal QRS complex – The S wave



- S wave is the second negative deflection after the R wave
- Slipping down
- Always after R wave like in the alphabet

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Review of Normal QRS complex



- Q wave is the first negative deflection after the p wave
- R wave is the first positive deflection after the p wave
- S wave is the second negative deflection after the R wave

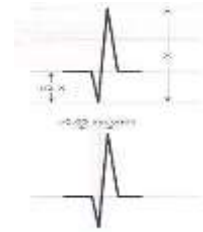
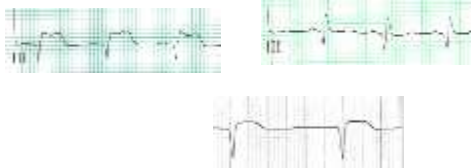
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EKG Changes with MI: Infarction

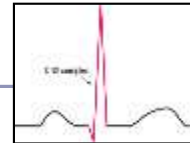
Infarction > 1 - 2 hours

Abnormal (significant Q waves)

- ♥ Abnormal Q waves
 - > 1/3 the height of R wave in that lead
 - or
 - > 0.03 ms wide

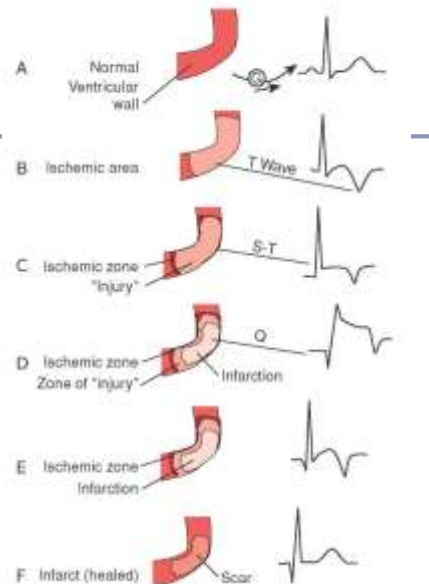


Normal Q wave
1st downward deflection of QRS



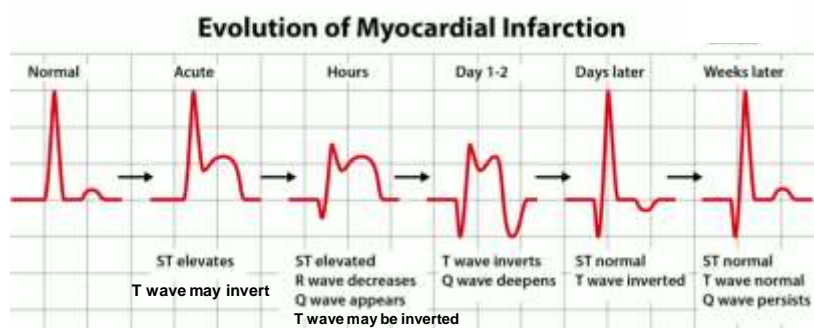
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Evolution of STEMI



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STEMI EKG Timeframe



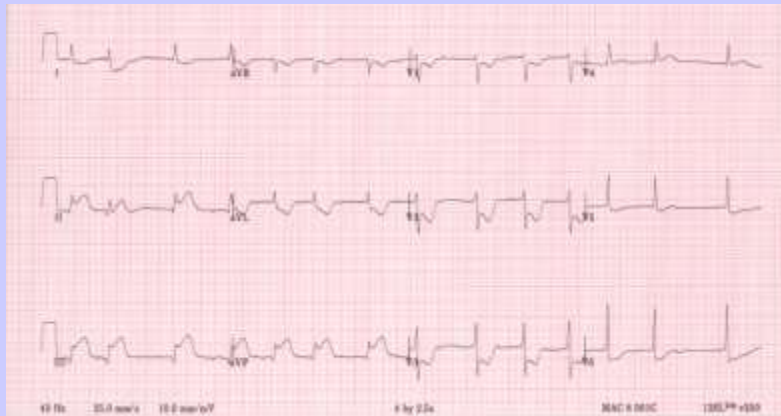
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Evolving AMI: EM #1 December 13 at 1701



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EM # 2 December 13 at 1823



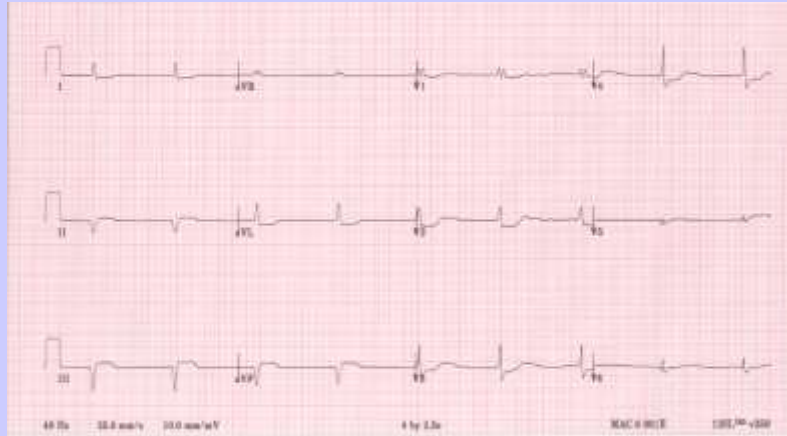
25

EM #3 December 14 at 0630



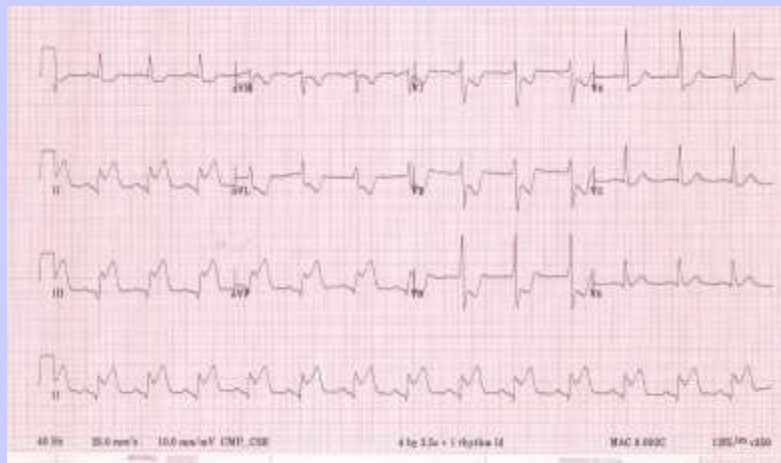
26

EM # 4 December 15 0600



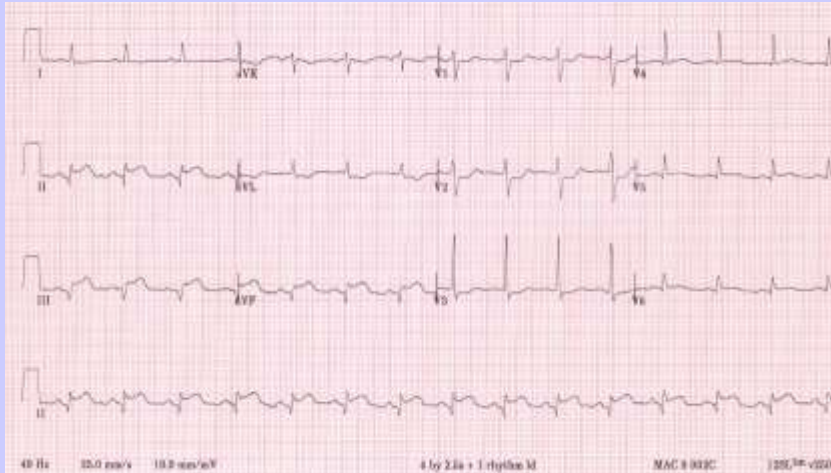
27

CC: Admission EKG 1445



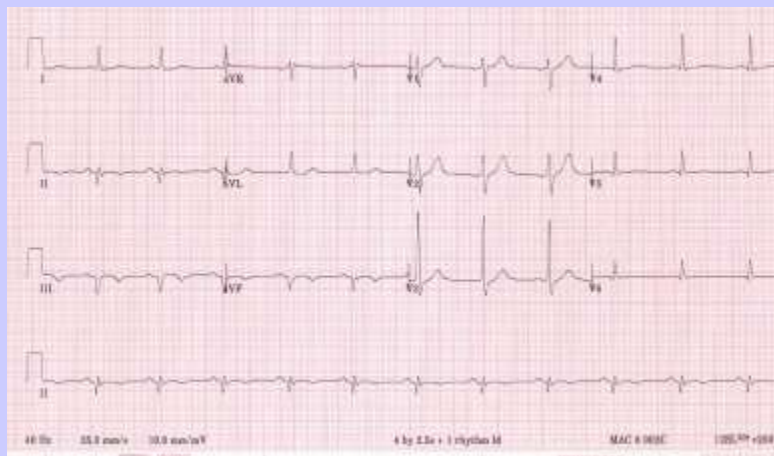
28

CC: 3 hours later



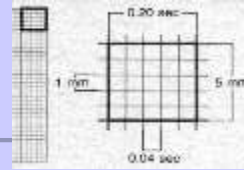
29

CC: 28 hours later



30

Positive EKG



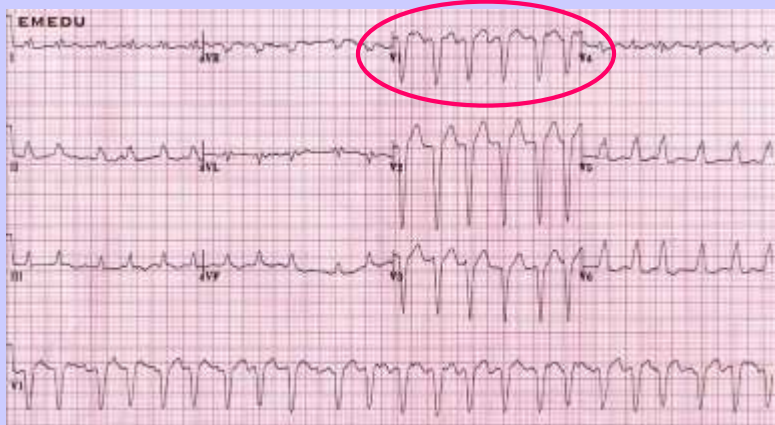
- ST elevation $> 0.1\text{mV}$ (1 mm) in at least 2 contiguous precordial leads or at least 2 adjacent limb leads (STEMI) (Class 1, Level A)

I lateral	aVL lateral	V ₁ septal	V ₄ anterior
II inferior	aVF lateral	V ₂ septal	V ₅ lateral
III inferior	aVF inferior	V ₃ anterior	V ₆ lateral

- Transient ST Elevation $> 0.5\text{ mm}$
- ST depression $> 0.5\text{ mm}$ (NSTEMI)
- T wave inversion $> 0.2\text{ mV}$ (2 mm)
- New LBBB (Class 1, Level A)

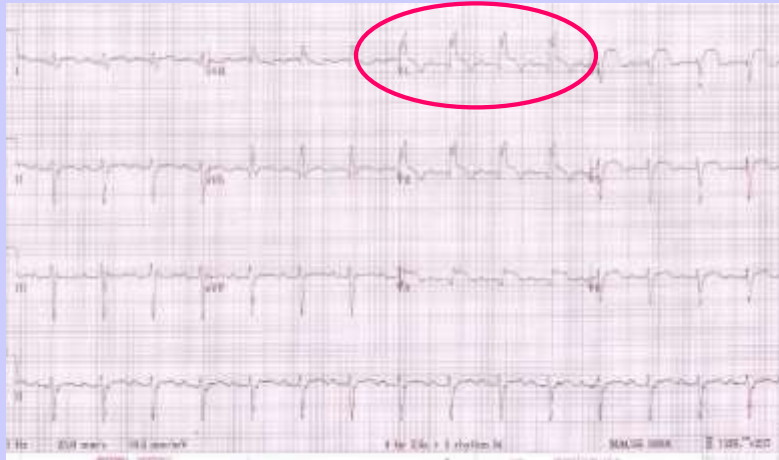
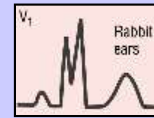
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LBBB = QRS $> 0.12\text{ sec}$ (120 msec)
Negative QRS in V1 (carrot)



32

RBBB = QRS > 0.12 sec (120 msec)
Positive QRS in V1 (rabbit ears)



33

BBB = QRS > 0.12 sec (120msec)

- LBBB = QRS > 0.12 sec
 Negative QRS in V1
 (carrot)



- RBBB = QRS > 0.12 sec
 Positive QRS in V1
 (rabbit ears)



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LBBB with AMI

Sgarbossa, N Engl J Med 1996

- Q waves in at least two of leads I, AVL, V5, V6
- R wave regression from lead V1 – V4
- Late notching of S wave in at least two of leads V3 – V5
- Primary ST & T wave changes in two or more adjacent leads
- ST elevation of 8 mm or half the height of T wave

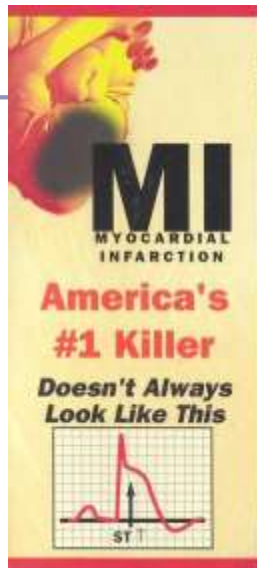
Fesmire Ann Emerg Med 1995

- ST elevation of ≥ 1 mm concordant with QRS
- ST depression ≥ 1 mm in leads V1, V2, or V3
- ST elevation > 5 mm discordant with QRS
- QRS > 0.12
- Q waves

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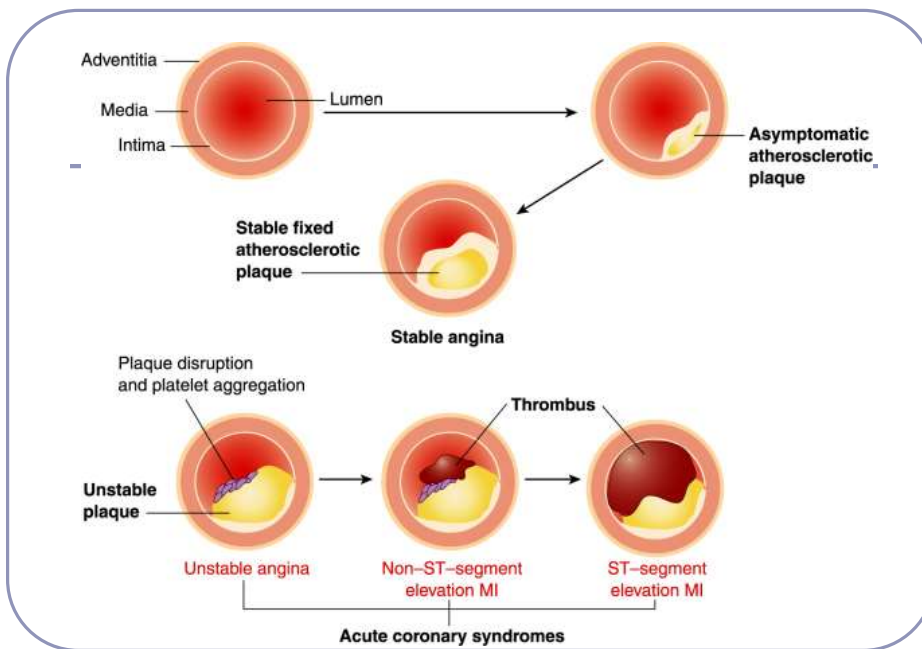
NSTEMI

Non ST Segment Elevation MI

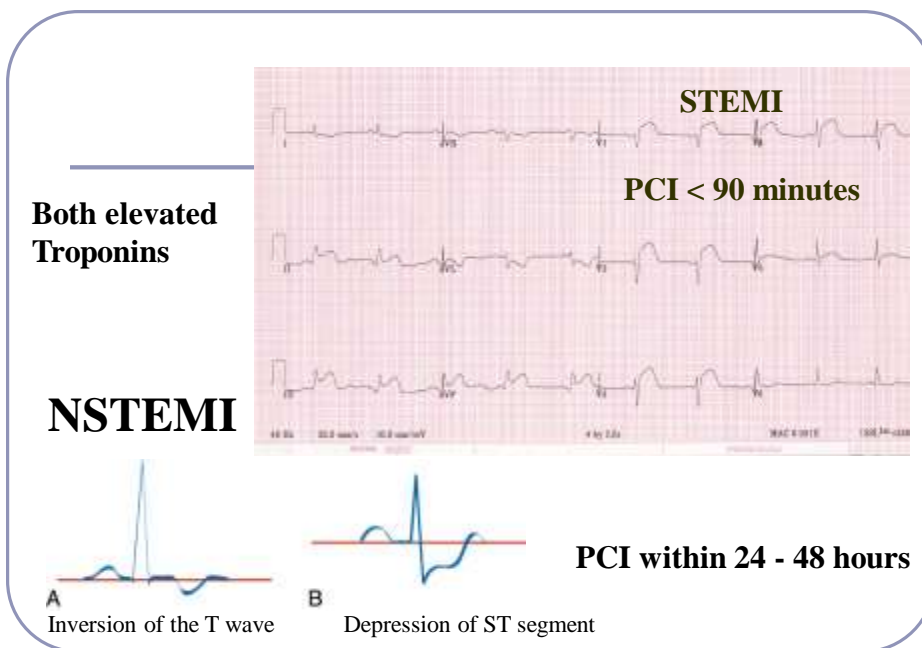


- ♥ No ST segment Elevation
- ♥ ST segment depression

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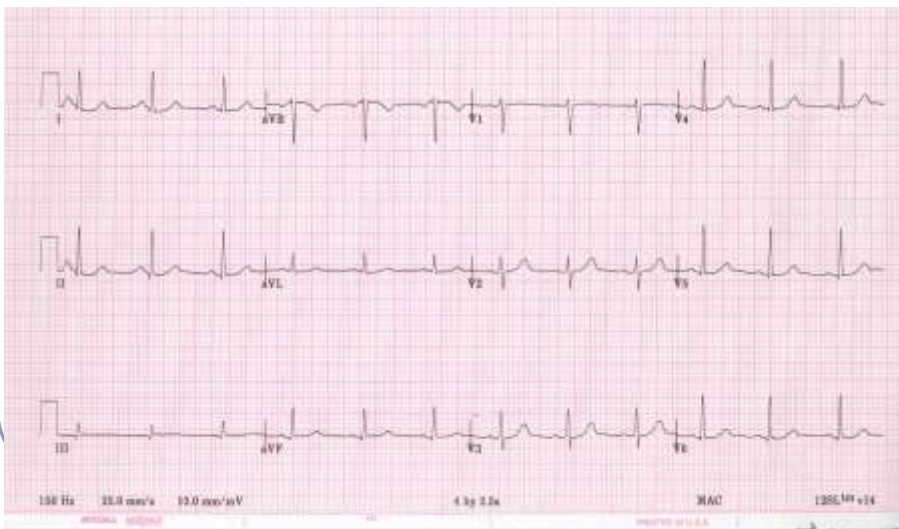
12 Lead EKG

Understanding Lead Placement

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12 Lead EKG 101

Learn the **Normal** so you can detect the abnormal



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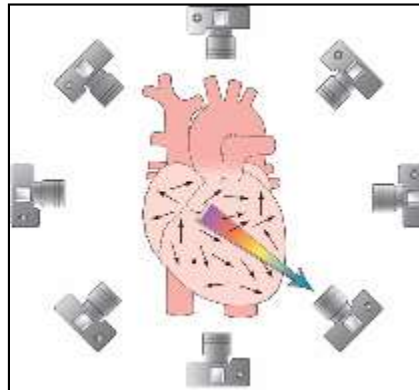
To Learn 12 Lead EKG

You **MUST** pick them up
and **LOOK** at them!



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Leads Are Like Pictures Camera is on the positive lead



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The 12 Leads

Bipolar Leads

Each lead has two poles:
One positive & one negative

I, II, III

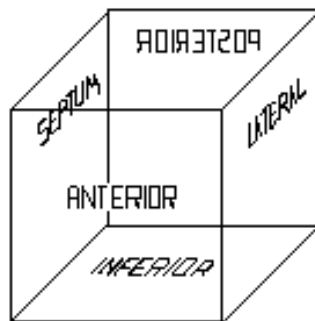
Unipolar Leads

Only one lead is physically positive.
Negative lead is not a specific site on the body

AVR, AVL, AVF, V1-V6

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Cube Concept of Left Ventricle



Each face of the cube represents
a different part of the left ventricle

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LIMB LEADS

I, II, III

- Also referred to as extremity leads due to placement on the body
- Record electrical forces two points equidistant from the heart.
- Each lead has two poles: one positive & one negative
- Two leads to give the picture
- Current travels Negative to Positive to create the electrical complex
- 12 Lead EKG Reads or takes the picture from the positive electrode to the heart

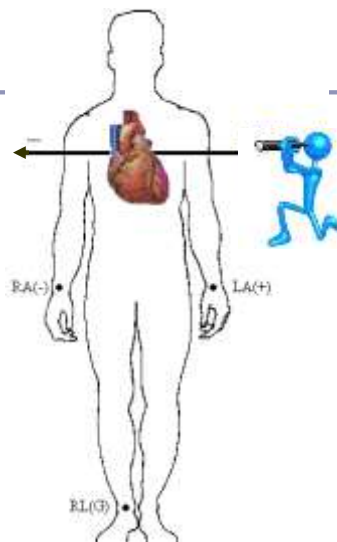
45

Lead I

Views the heart from
left arm to right arm

Area: *Lateral*

Artery: *Circumflex*



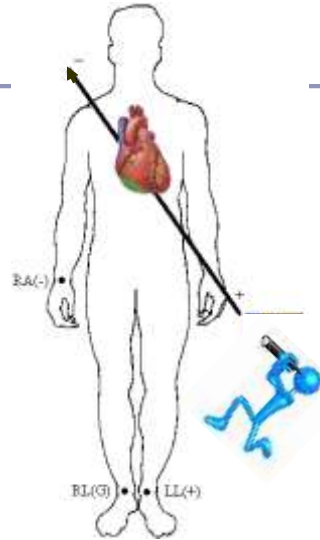
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Lead II

Views the heart from
left leg to right arm

Area: *Inferior*

Artery: RCA



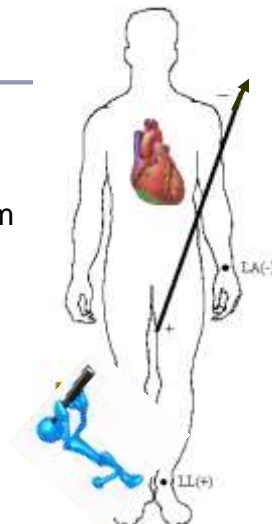
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Lead III

Views the heart from
left leg to left arm

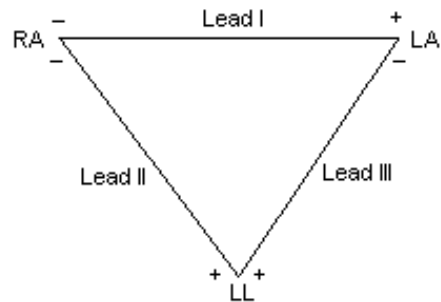
Area: *Inferior*

Artery: RCA



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Einthoven's Triangle



By connecting the electrodes of the limb leads, the Einthoven's Triangle is formed.

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Augmented Limb Leads

AVR, AVL, AVF

- ♥ Records electrical activity between the center of the heart and an extremity
- ♥ Since these leads are low voltage they are artificially augmented
- ♥ Unipolar leads: Negative pole is the heart

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AVR

Augmented Voltage Right

- Views electrical activity directed rightward.
- Very minimal rightward electrical activity occurs.
- Looks at great vessels not myocardium
- Configuration should be negative

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AVL

Augmented Voltage Left

Views the heart from the left arm to the mid-point between right arm & right leg

Area: *Lateral*

Artery: *Circumflex*

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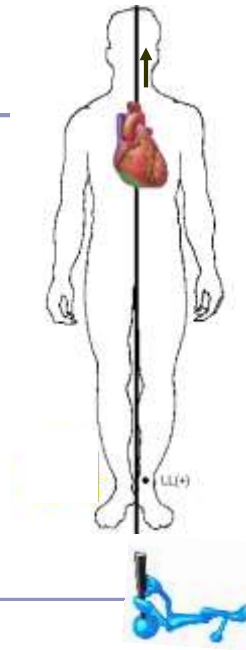
AVF

Augmented Voltage Foot

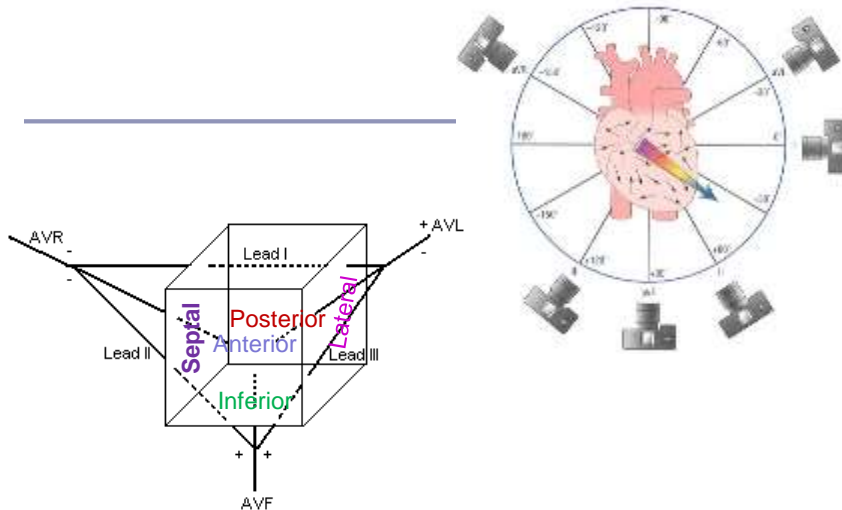
Views the heart from the feet to the chin

Area: *Inferior*

Artery: *RCA*



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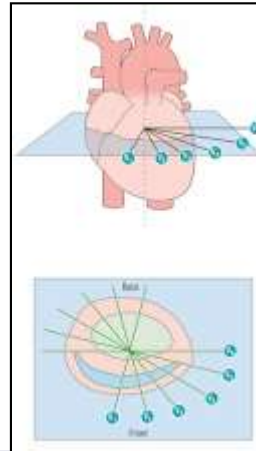
Correlation of the leads to the areas of left ventricle by superimposing Einthoven's Triangle over the cube.

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The Precordial System

Chest Leads V1 – V6

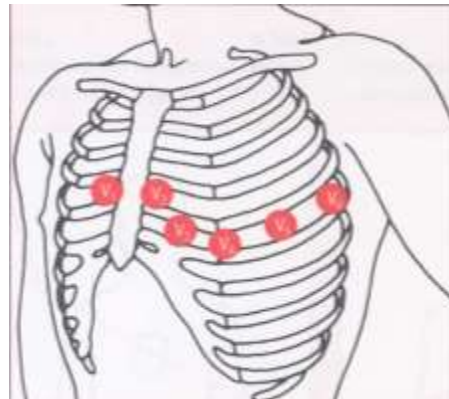
- ♥ Records electrical activity of the heart by placing electrodes on the anterior chest wall
- ♥ Heart is the negative pole
- ♥ Positive pole is where the electrode is placed
- ♥ Unipolar leads



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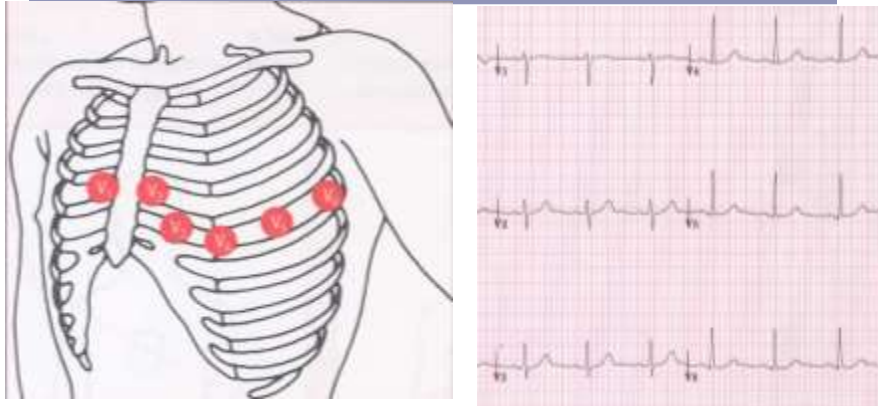
Precordial Leads Placement

- **V1** 4th intercostal space (ICS) right sternal border (septum)
- **V2** 4th ICS, left sternal border (septum)
- **V3** Midway between V2 and V4 (anterior)
- **V4** 5th ICS, left midclavicular line (anterior)
- **V5** 5th ICS, left anterior axillary line (lateral)
- **V6** 5th ICS, left midaxillary line (lateral)



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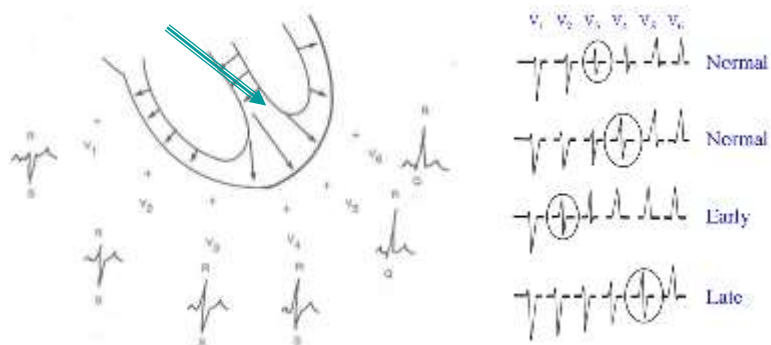
Precordial Leads



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R Wave Transition

R: Rises above baseline



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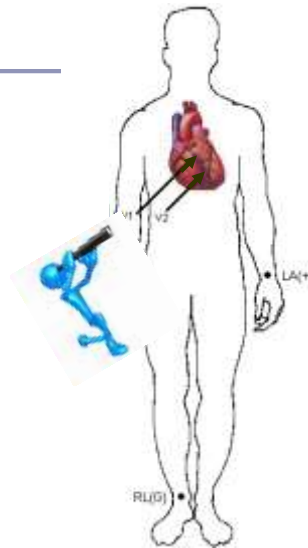
V1 & V2

Views the septum

of the heart

Area: *Septal*

Artery: *LAD*



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V3 & V4

Views the anterior area

of the left ventricle

Area: *Anterior*

Artery: *LAD*



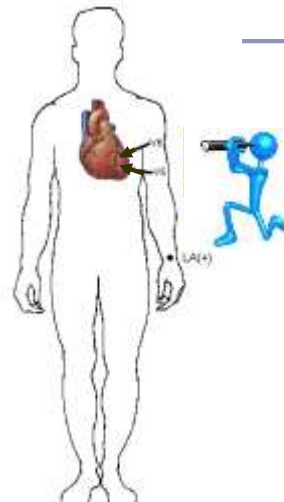
60

V5 & V6

Views the lateral area
of the left ventricle

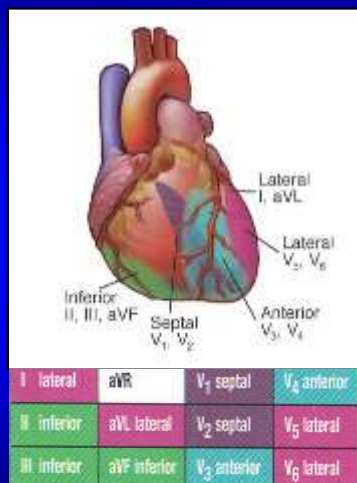
Area: *Lateral*

Artery: *Circumflex*



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Cardiac Anatomy in Relation to Coronary Artery



www.aha.channing-bete.com 1-800-611-6083
ACLS pocket cards or poster

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Reciprocal Changes

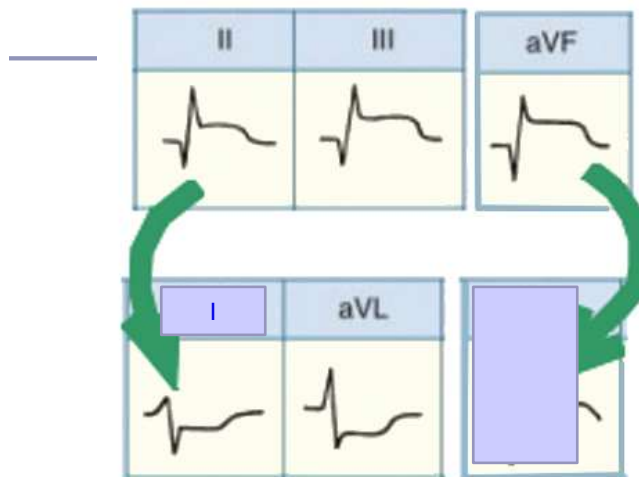
Reciprocal Leads that are opposite the damaged area will show opposite EKG Changes

- Mirror Image
- Two different electrodes viewing AMI from opposite angles
- Example: Take photo of male from front and from back – still a male but different view



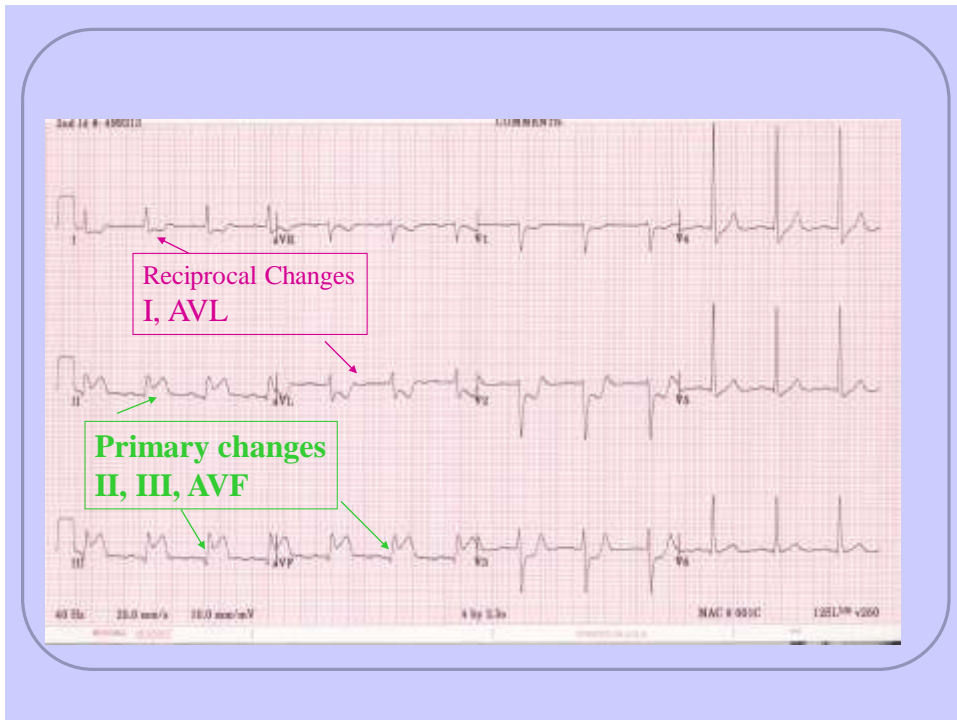
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Inferior STEMI



Reciprocal leads

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Reciprocal Changes Secondary Changes

- Ischemia , Injury , and infarction are primary changes
- Reciprocal changes are secondary changes
- Reciprocal Leads that are opposite the damaged area will show opposite EKG Changes
- Reciprocal changes = confirm primary changes

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A

- Inferior ↔ Lateral
 - II, III, aVF ↔ I, aVL, V5, V6
- Anterior ↔ Posterior
 - V1 – V4

I lateral	aVR	V1 septal	V4 anterior
II inferior	aVL lateral	V2 septal	V5 lateral
III inferior	aVF inferior	V3 anterior	V6 lateral

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Reciprocal Changes

Reciprocal Leads that are opposite the damaged area will show opposite EKG Changes

- If you see ST segment depression, look in opposite leads for primary changes
- If you see tall R waves in the V leads, question if this is an old posterior AMI and look for Q waves in the inferior leads

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- To learn you need to hear something

- 6 times

SIX

6

- 6 different ways

VI

seis

|||||

six

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Correlate the Coronary Arteries

Inferior – RCA – II, III, AVF

Septal – LAD – V1, V2

Anterior – LAD – V3, V4

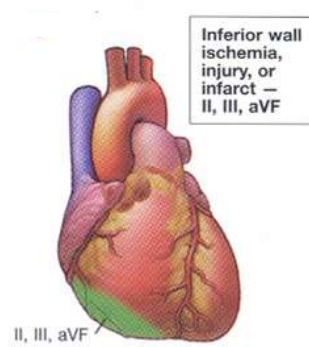
Lateral – Circumflex – I, AVL, V5, V6

Cheryl Herrmann
CARDIO CLINICAL NURSE SPECIALIST
APRN, CCRN, CCONSC, CMC



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Right Coronary Artery RCA Inferior Wall II, III, aVF

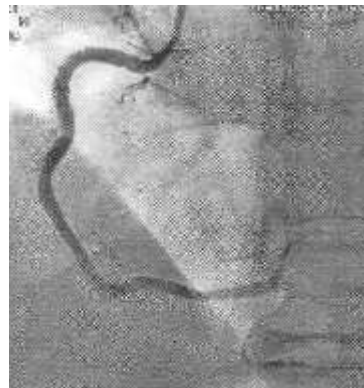


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Occluded RCA

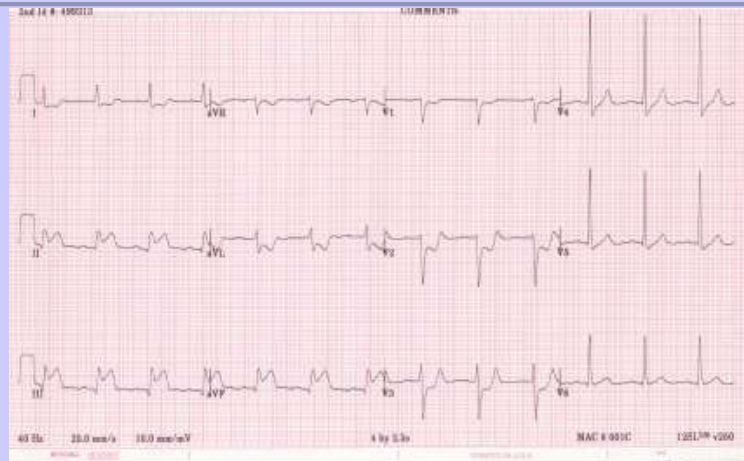


RCA post stent



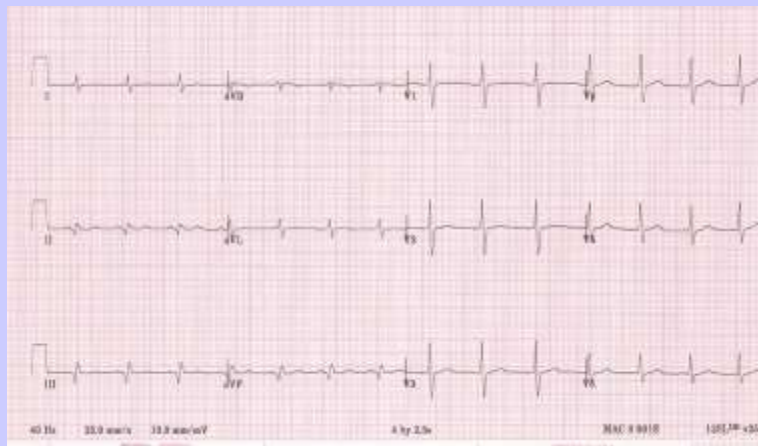
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Inferior Injury



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Old Inferior Infarction



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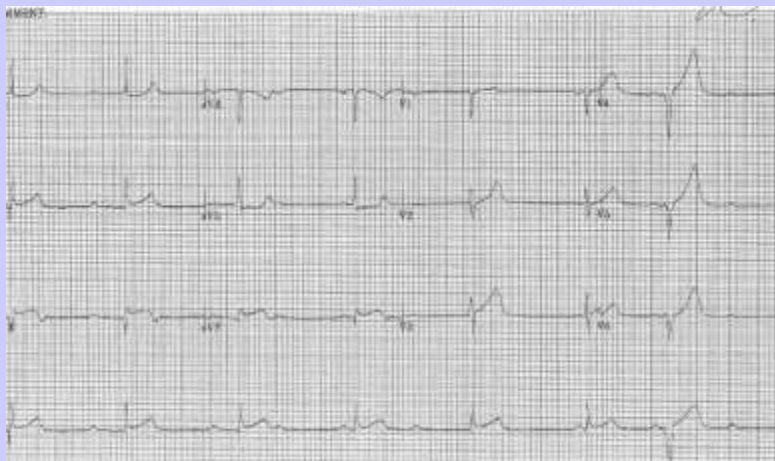
Inferior AMI

- Involves right ventricle – may also get right ventricular infarct
- Need lots of fluids to increase preload since RV is involved
- Arrhythmias= Blocks
- RCA wraps around the back of the heart and changes to PDA. Typically have inferior –posterior AMI.
- Inferior- Posterior AMI:
 - ST Elevation: II, III, AVF and
 - ST depression V1, V2, V3

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Inferior AMI

What's the rhythm?

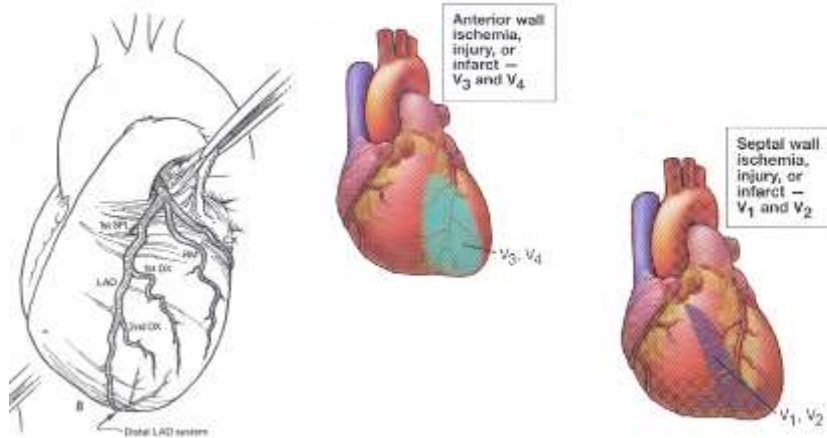


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Left Anterior Descending Artery LAD

Anterior Wall V3 & V4

Septal Wall V1 & V2



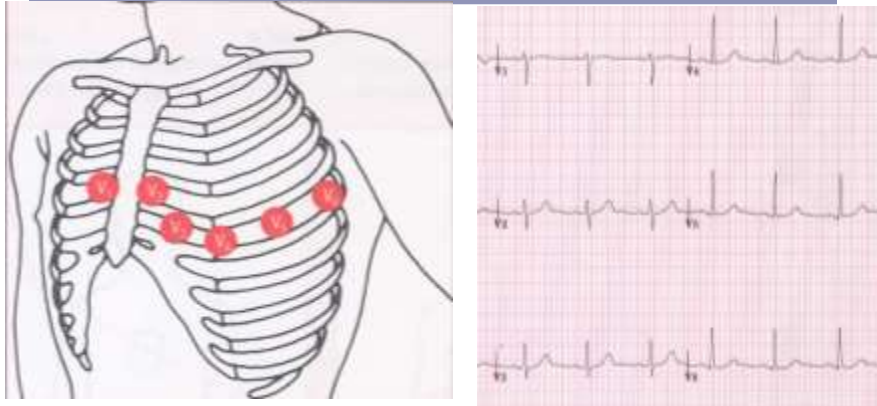
77

Anterior-septal Injury



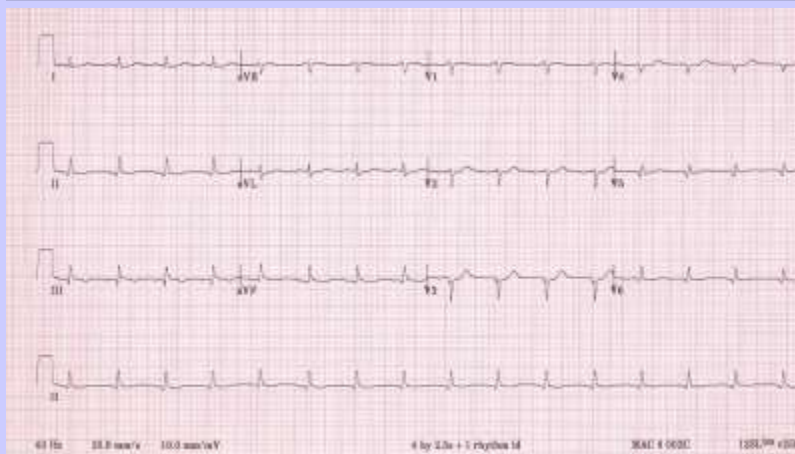
78

Precordial Leads – Know normal



79

Old Anterior Infarction



80

Occluded High LAD



LAD post stent



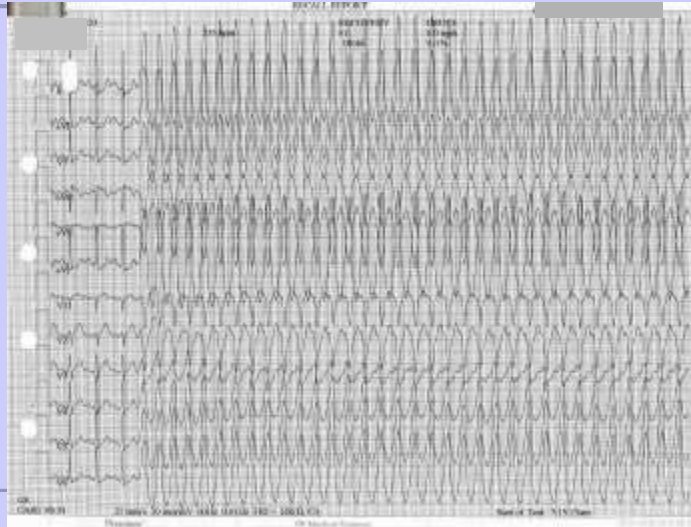
81

Anterior AMI

- Lose the most muscle mass
- Usually have the lowest EF
- Arrhythmias = VT or VF

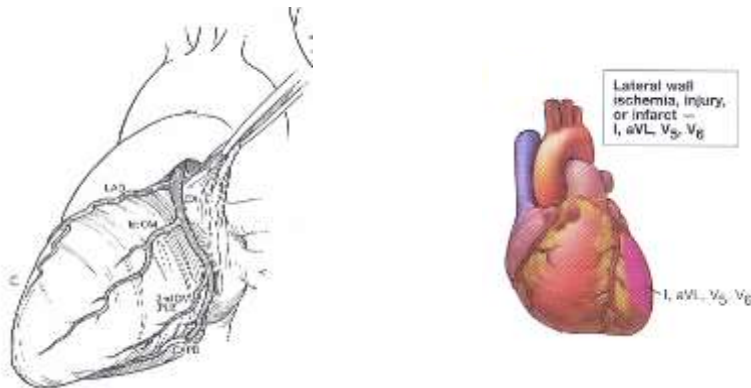
82

Stress Test – Angio found 3 occlusions in the LAD



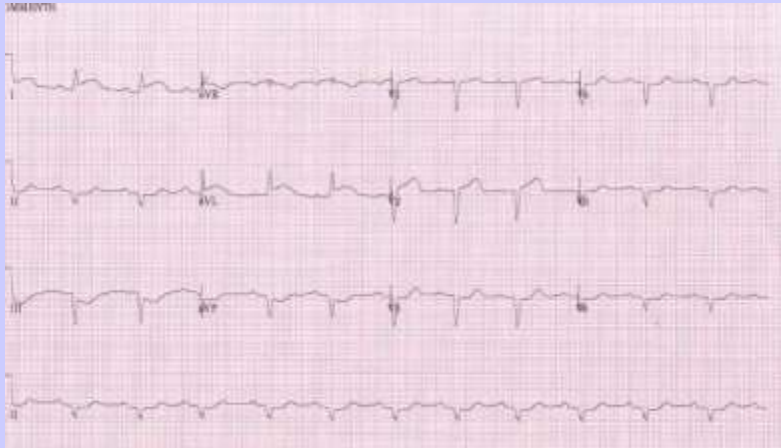
83

Circumflex Artery Cx Lateral Wall I, aVL, V5 & V6



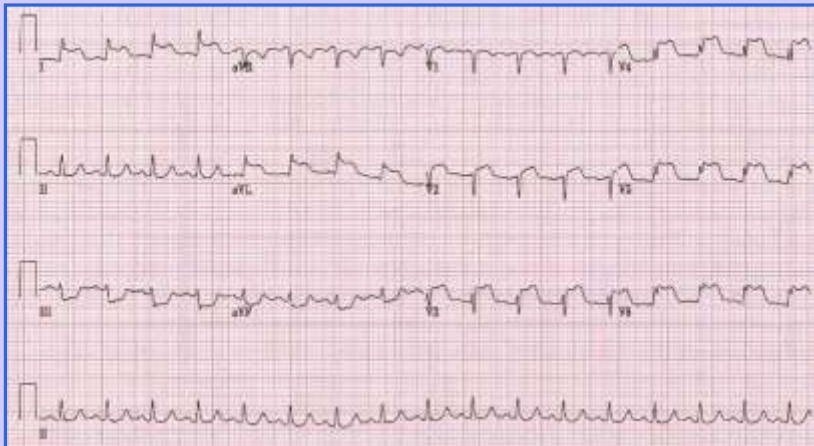
84

High Lateral Injury



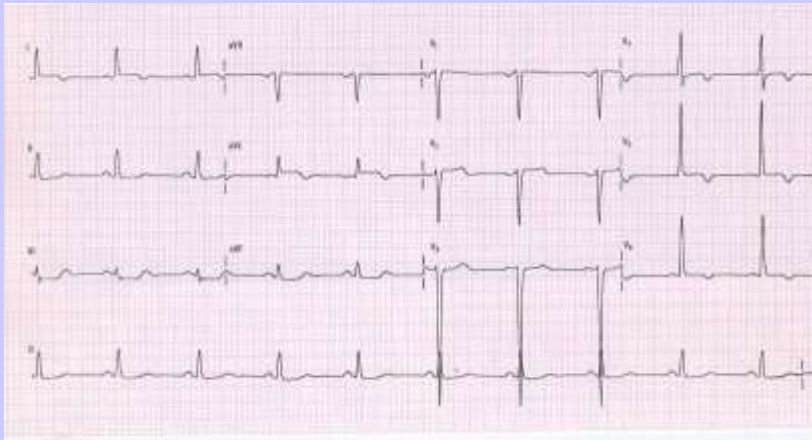
85

Anterior Lateral Injury



86

Lateral Ischemia



87

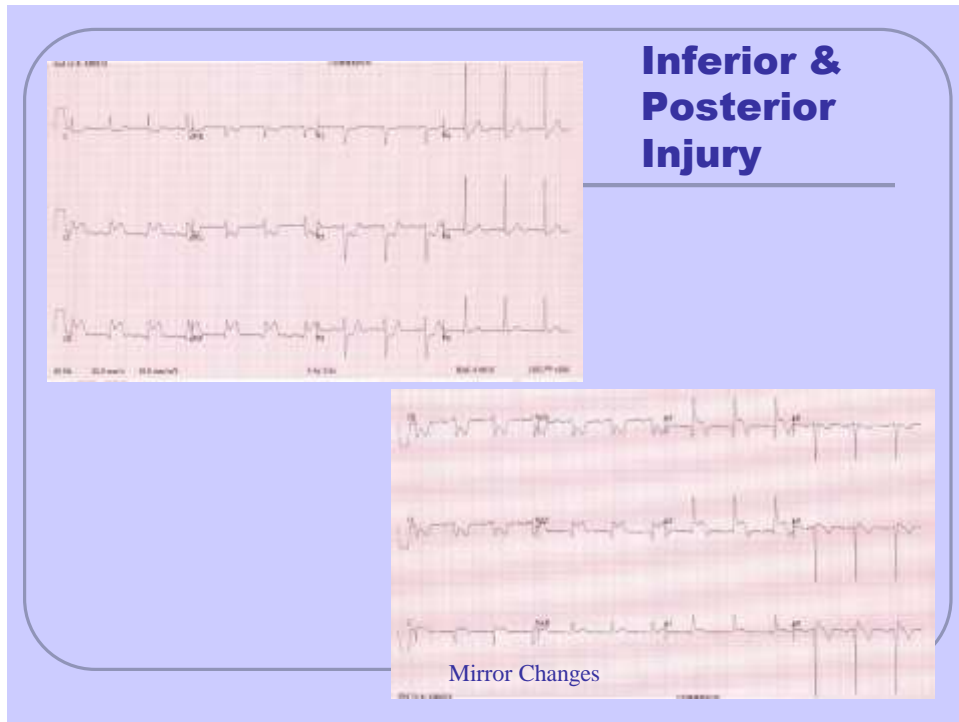
Posterior Descending Artery PDA Posterior Wall Reciprocal Changes



- Usually see with Inferior AMI as RCA wraps around the back of the heart and changes to PDA
- Reciprocal Changes V1 , V2, V3
(ST segment depression or Tall R Waves)
- 18 Lead EKG



88

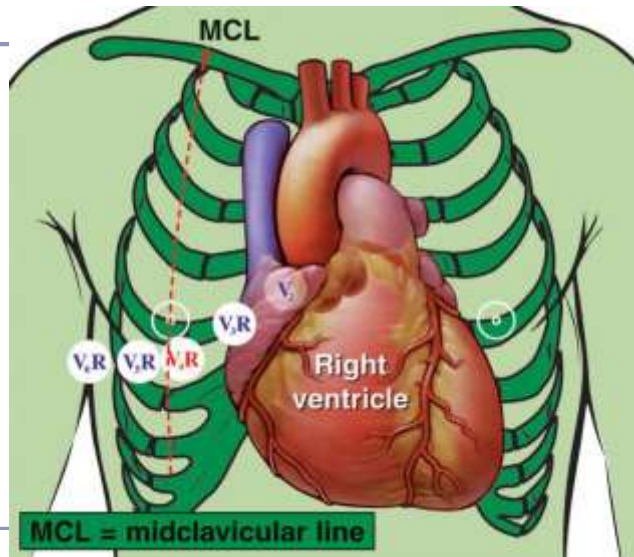


89



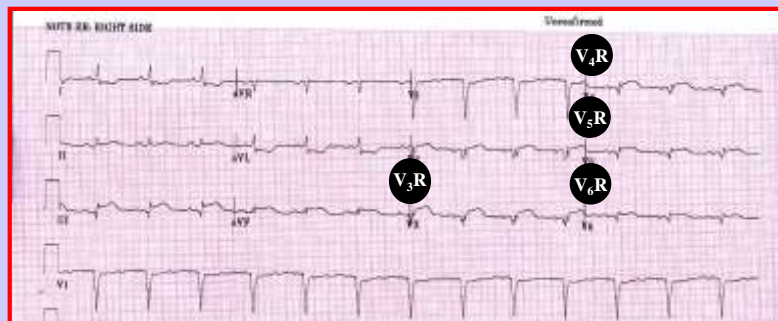
90

Lead Placement: Right-Sided ECG



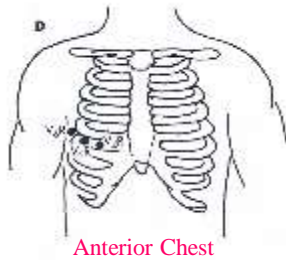
91

Right-Sided 12-Lead ECG: Patient With Inferior ST-Segment Changes

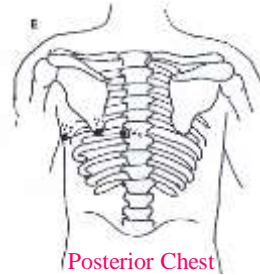


92

18 Lead EKG



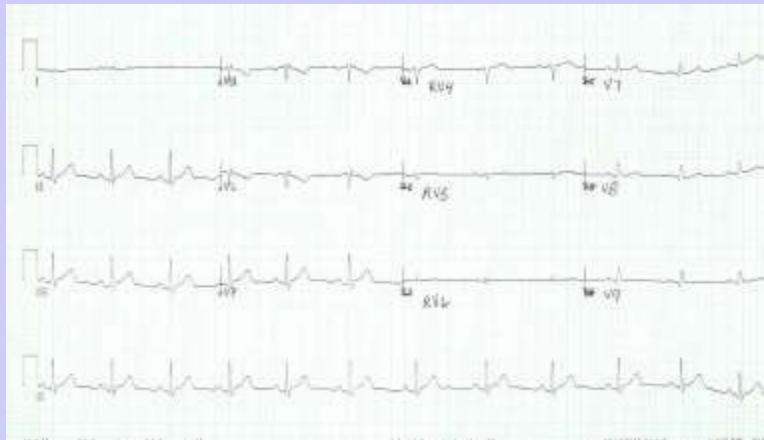
V4R = 5th ICS at RMCL
 V5R = 5th ICS at RAAL
 V6R = 5th ICS at RMAL



V7 = 5th ICS at Left Posterior axillary line
 V8 = Halfway between V7 & V9
 V9 = 5th ICS next to vertebral column

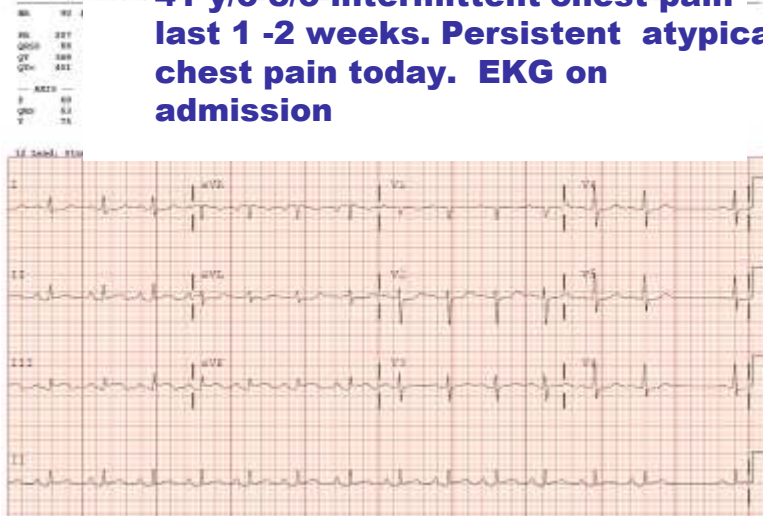
93

Right Chest and Posterior EKG



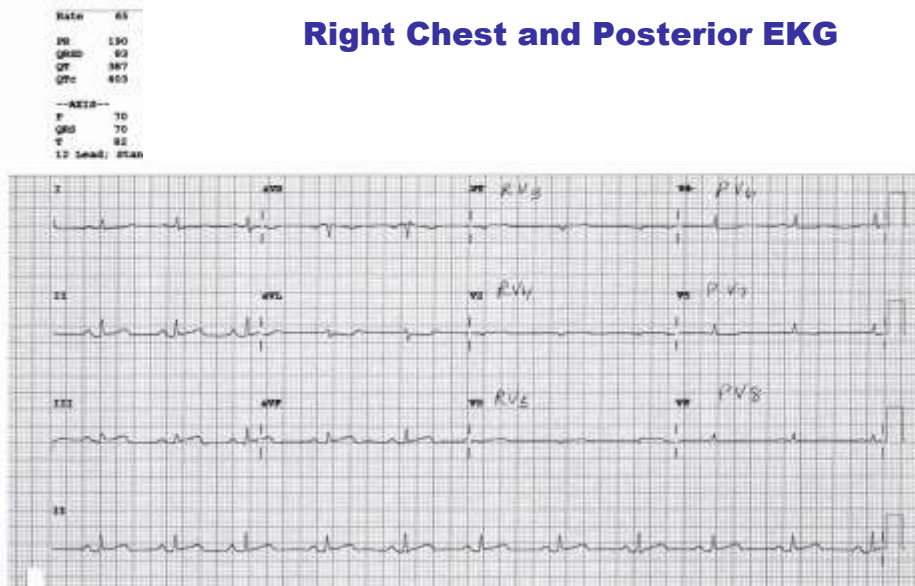
94

**41 y/o c/o intermittent chest pain
last 1 -2 weeks. Persistent atypical
chest pain today. EKG on
admission**



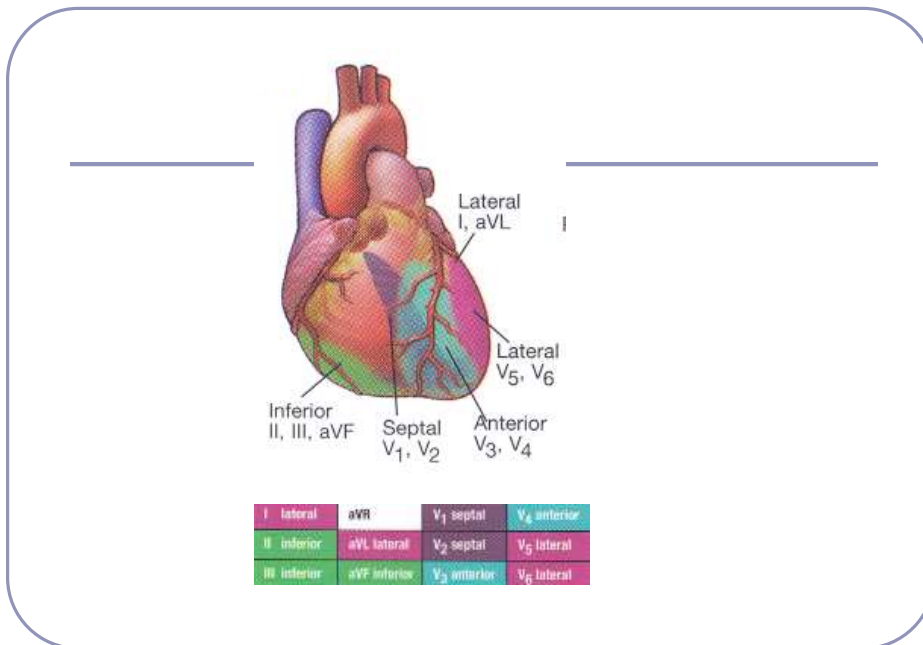
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Right Chest and Posterior EKG



Stent to RCA & PDA

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Pattern to Read EKG

Be consistent

- Rate & Rhythm
- QRS Interval V1 – for RBBB or LBBB
- QT interval
- Normal Depolarization – If not, why not
- ST & T waves
- What lead is abnormal and what other lead goes with it
- Evaluate axis
- Evaluate for hypertrophy

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