

**STAT 12 Lead ECG Workshop:
Basics & ACS**

Citrus County Fire Rescue

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THE ECG in PERSPECTIVE:

PROBLEMS with ECG:

- ↓ **SENSITIVITY**
(FALSE NEGATIVES)
- ↓ **SPECIFICITY**
(FALSE POSITIVES)

PROBLEMS WITH SENSITIVITY . . .

NORMAL ECG.

But

LETHAL TRIPLE VESSEL DISEASE

PROBLEMS WITH SPECIFICITY . . .

S-T SEGMENT ELEVATION - COMMON ETIOLOGIES:

CONDITION: _____

- **ACUTE INFARCTION (STEMI)**

J POINT < 1mm ABOVE P-Q JUNCTION

PROBLEMS WITH SPECIFICITY . . .

S-T SEGMENT ELEVATION - COMMON ETIOLOGIES:

CONDITION: _____

- **ACUTE INFARCTION**
- **HYPERKALEMIA**
- **BRUGADA SYNDROME**
- **PULMONARY EMBOLUS**
- **INTRACRANIAL BLEED**
- **MYOCARDITIS / PERICARDITIS**
- **L. VENT. HYPERTROPHY**
- **PRINZMETAL'S ANGINA**
- **L. BUNDLE BRANCH BLOCK**
- **PACED RHYTHM**
- **EARLY REPOLARIZATION & "MALE PATTERN" S-T ELEV.**

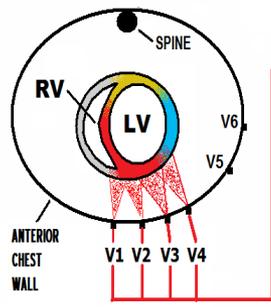
J POINT < 1mm ABOVE P-Q JUNCTION

The QUADRAD of ACS

- PRESENTING SYMPTOMS**
- EKG ABNORMALITIES**
- RISK FACTOR PROFILE**
- CARDIAC MARKERS**

A POSITIVE finding in TWO or MORE of the above categories indicates it is EXTREMELY LIKELY that ACS is present... steps must be **AGGRESSIVELY TAKEN** to definitively **RULE OUT** the **PRESENCE** of ACS!

V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL of the LEFT VENTRICLE



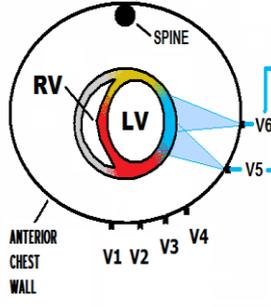
V1, V2 - ANTERIOR / SEPTAL
V3, V4 - ANTERIOR

RUPPERT, WAYNE		ID: 7445683659	05-OCT-2006	JOHNS-HOPKINS UNIV.
38 Yrs	MALE	Vent. Rate: 68	NORMAL SINUS RHYTHM	Normal EKG Very Healthy Athletic EKG!
		P-R Int.: 160 ms	Normal EKG	
		QRS: 100 ms	Normal EKG	
I	AVR	V1	V4	
II	AVL	V2	V5	
III	AVF	V3	V6	

Leads V1-V4:

- V1 – V4 view the _____ of the Left Ventricle.
- V1 and V2 also view the _____
- V1 – V3 view the _____ via Reciprocal Changes.

V5 - V6 VIEW THE LATERAL WALL of the LEFT VENTRICLE

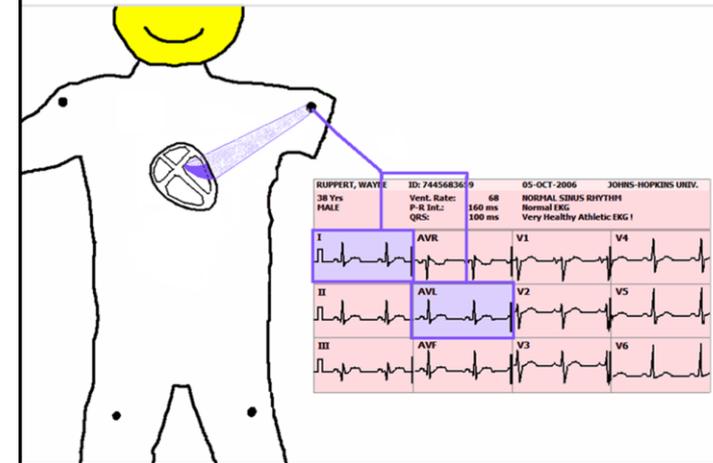


RUPPERT, WAYNE		ID: 7445683659	05-OCT-2006	JOHNS-HOPKINS UNIV.
38 Yrs	MALE	Vent. Rate: 68	NORMAL SINUS RHYTHM	Normal EKG Very Healthy Athletic EKG!
		P-R Int.: 160 ms	Normal EKG	
		QRS: 100 ms	Normal EKG	
I	AVR	V1	V4	
II	AVL	V2	V5	
III	AVF	V3	V6	

Leads V5 & V6:

- V5 & V6 view the _____ of the Left Ventricle.

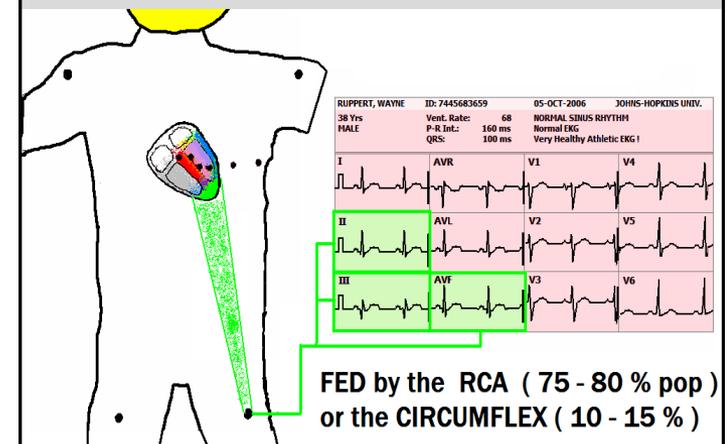
Leads I & AVL View: Proximal Lateral / Anterior Wall



Leads I and AVL:

- Leads I and AVL view the **PROXIMAL** aspect of the _____ and _____ **WALLS**
- I and AVL can be associated with EITHER the _____, the _____, or BOTH.

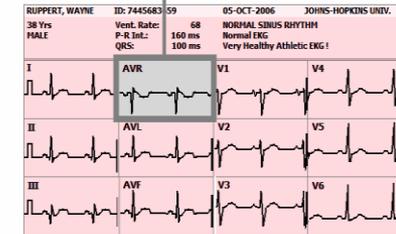
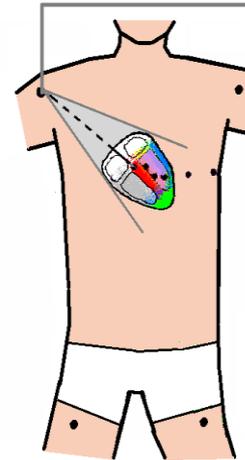
LEADS II, III, and aVF VIEW INFERIOR WALL of the LEFT VENTRICLE



Leads II, III, and AVF:

- Leads, II, III, and AVF view the _____ of the Left Ventricle.

Lead AVR Views the BASILAR SEPTUM (region of the Bundle of His).

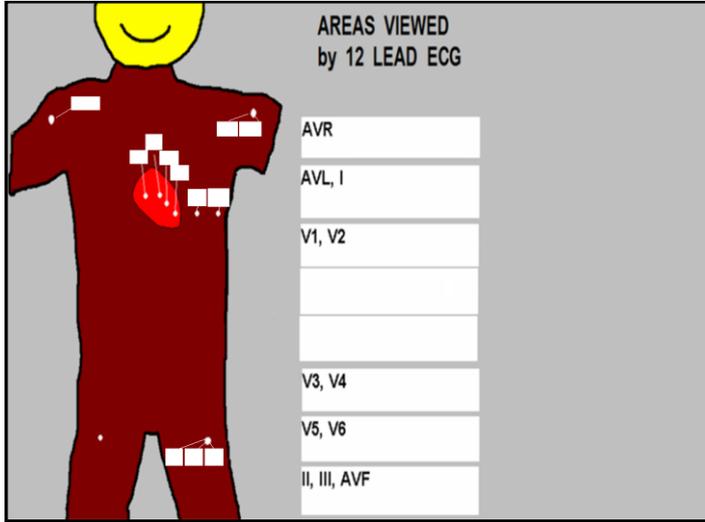
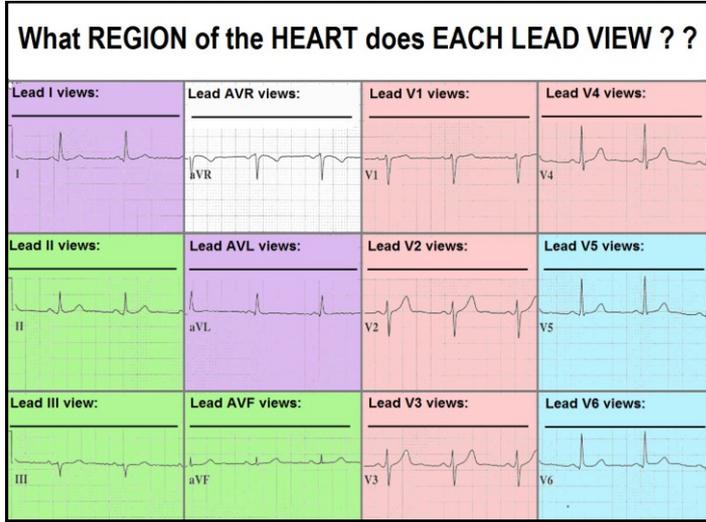


Lead AVR:

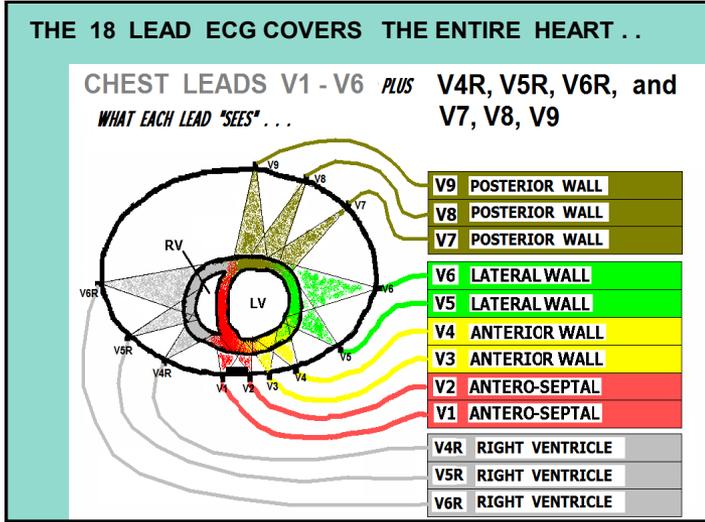
- Lead AVR views the _____.
- The _____ is the area where the _____ is typically located.

Lead AVR:

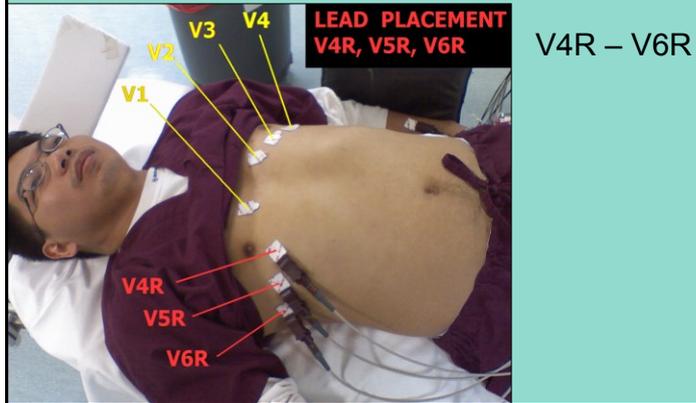
- ST Elevation in Lead AVR during Acute STEMI is associated with _____ obstruction, which has a ___% mortality Rate.**
- ST Elevation of Lead AVR when STEMI is NOT present is often associated with _____ disease, and/or CRITICAL OCCLUSION of the _____: both require Coronary Artery Bypass Graft (CABG) Surgery!!**



The TWO major BLIND SPOTS of the 12 Lead ECG are the _____ and the _____.



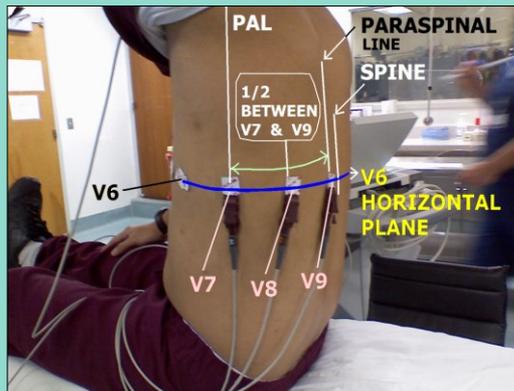
LEAD PLACEMENT for obtaining RIGHT VENTRICULAR ECG:



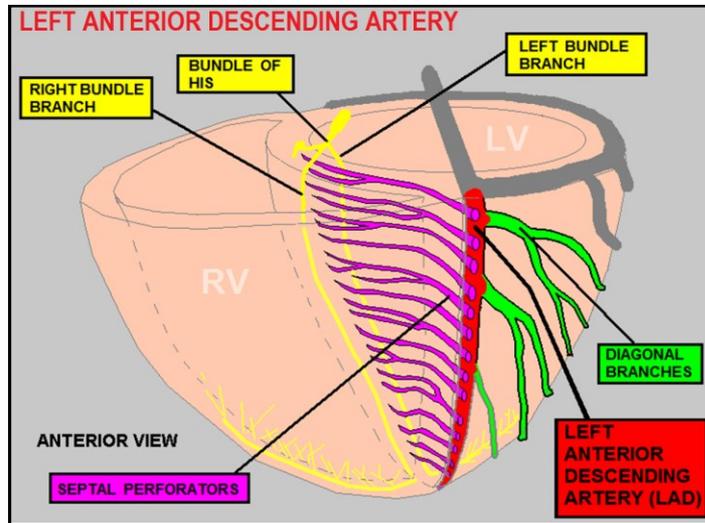
The INDICATION for obtaining a RIGHT VENTRICULAR ECG is

LEAD PLACEMENT for obtaining a POSTERIOR ECG.

Leads
V7 – V9



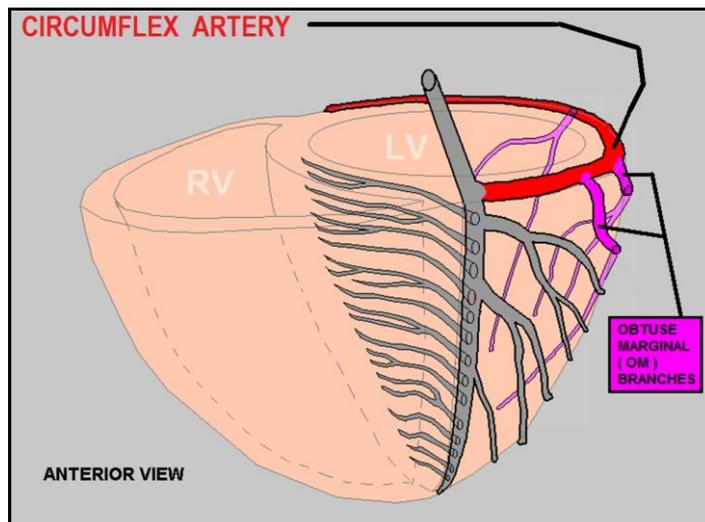
The INDICATION for obtaining a POSTERIOR LEAD ECG is



Left Anterior Descending Artery

The LAD supplies blood to the ANTERIOR and SEPTAL walls, and includes the following CRITICAL STRUCTURES:

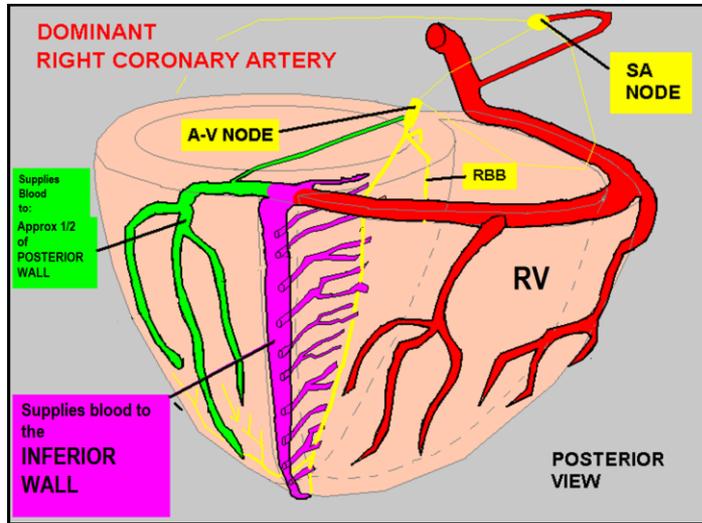
- Approximately ____ of the Left Ventricle
- _____
- _____



Circumflex (Cx) Artery

In patients with a Right Dominant coronary artery system, the Circumflex supplies blood to:

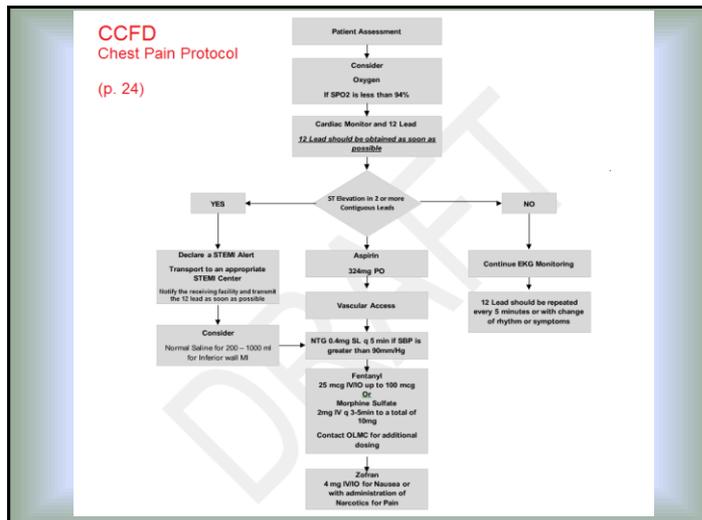
- Approximately 20-30% of the Left Ventricle, which includes:
 - _____ of Left Ventricle
 - _____
- On rare occasion, the _____



Right Coronary Artery (RCA)

In patients with a RIGHT DOMINANT system, the RCA supplies blood to the following cardiac structures:

- _____
- _____
- _____
- Approximately _____% of the Left Ventricle
 - INFERIOR Wall
 - ½ POSTERIOR WALL



“Classic” cardiac chest pain:

- Location: _____
- _____ or _____ in nature
- Does not change with _____

All patients with ACS symptoms . . .

STAT 12 Lead ECG; obtain and have read within _____!!!
ACC/AHA Guideline!

Unstable Angina Findings:

The 12 Lead ECG may exhibit:

- _____ in leads that view the ischemic region
 - ST Depression
 - T Wave Inversion
 - Other “non-specific” ST-T changes
- The ECG may be _____.
- Troponin is _____.

NSTEMI Findings:

The 12 Lead ECG may exhibit:

- _____ in leads that view the ischemic region
 - ST Depression
 - T Wave Inversion
 - Other “non-specific” ST-T changes
- The ECG may be _____.
- Troponin is _____.

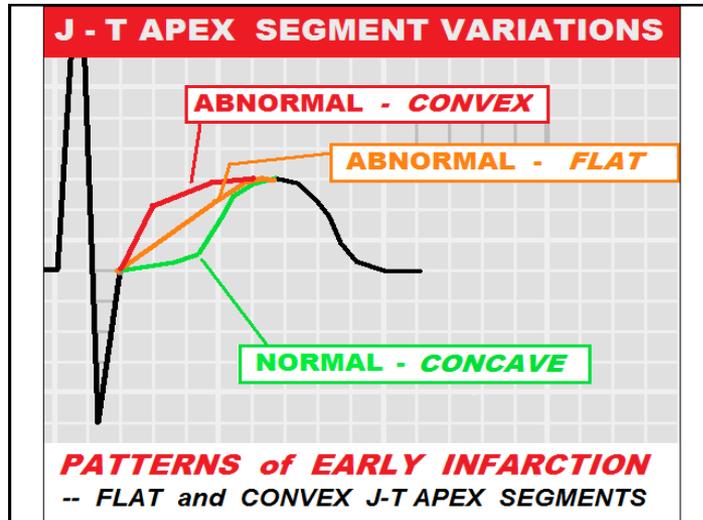
Q: To evaluate the patient for ischemia or infarction, what part of the ECG do we look at?

Q: Why is QRS width an issue when we look at J Points, ST Segments and T Waves??

PATTERNS of ACS & ISCHEMIA			
-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --			
! FLAT or CONVEX J-T APEX SEGMENT			ACUTE MI EARLY PHASE
! HYPER-ACUTE T WAVE			ACUTE MI EARLY PHASE
! S-T SEGMENT ELEVATION at J POINT			ACUTE MI
! DEPRESSED Jpt. DOWNSLOPING ST and INVERTED T			- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA

INVERTED T WAVE		- MYOCARDITIS - ELECTROLYTE IMBAL. - ISCHEMIA
SHARP S-T T ANGLE		- ACUTE MI (NOT COMMON) - ISCHEMIA
BI-PHASIC T WAVE (WELLEN'S)		- SUB-TOTAL LAD LESION - VASOSPASM - HYPERTROPHY
DEPRESSED J POINT with UPSLOPING ST		- ISCHEMIA
DOWNSLOPING S-T SEGMENT		- ISCHEMIA

Some less common, less reliable possible indicators of ACS:		
? FLAT S-T SEGMENT > 120 ms		- ISCHEMIA
? LOW VOLTAGE T WAVE WITH NORMAL QRS		- ISCHEMIA
? U WAVE POLARITY OPPOSITE THAT OF T WAVE		- ISCHEMIA



ECG Patterns associated with "EARLY PHASE MI:"

- *J-T Apex abnormalities*
- *Dynamic ST-T Wave Changes on Serial ECGs*

Dynamic ST-T Wave Changes:

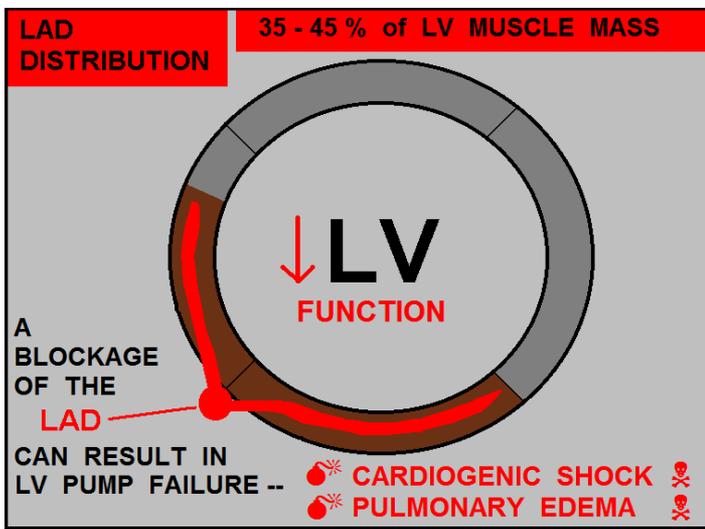
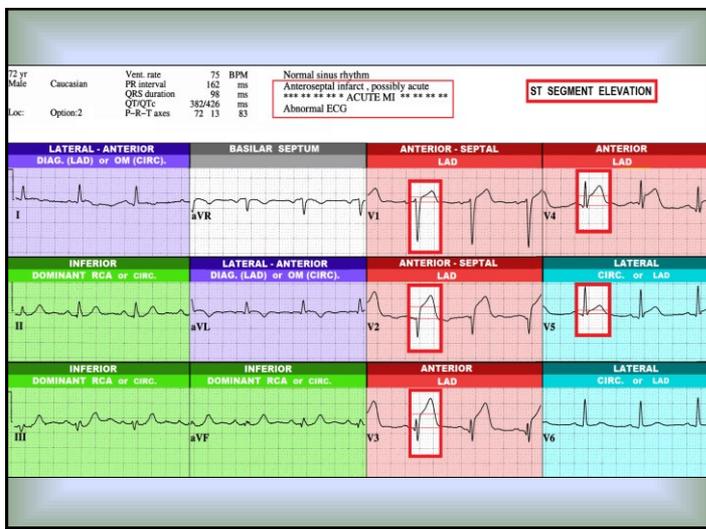
- Other than HEART RATE related variations (which affect intervals), *J Points, ST-Segments and T Waves SHOULD NOT CHANGE.*
- When changes to J Points, ST-Segments and/or T waves are NOTED, consider *EVOLVING MYOCARDIAL ISCHEMIA and/or EARLY PHASE MI, until proven otherwise.*

STEMI Criteria for 18 Lead ECGs:

Right-Sided Chest Leads (V3R – V6R): ___ mm

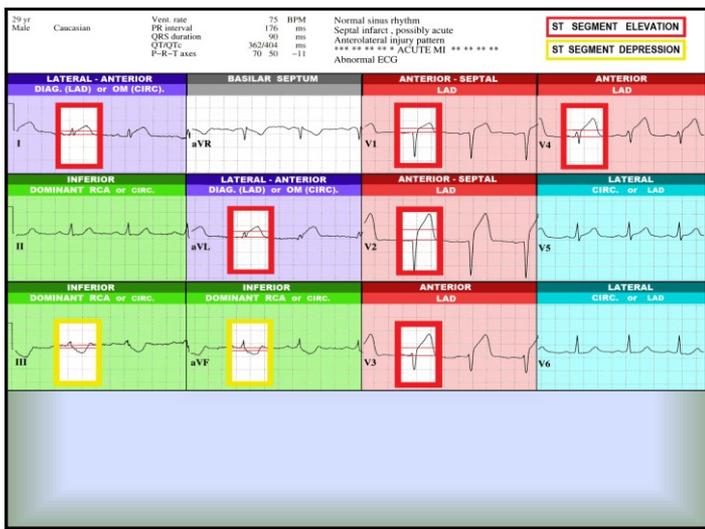
Posterior Chest Leads (V7 – V9): ___ mm

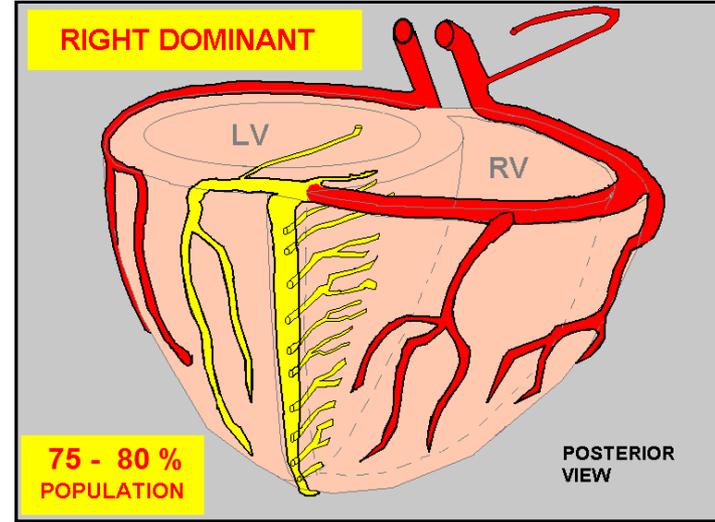
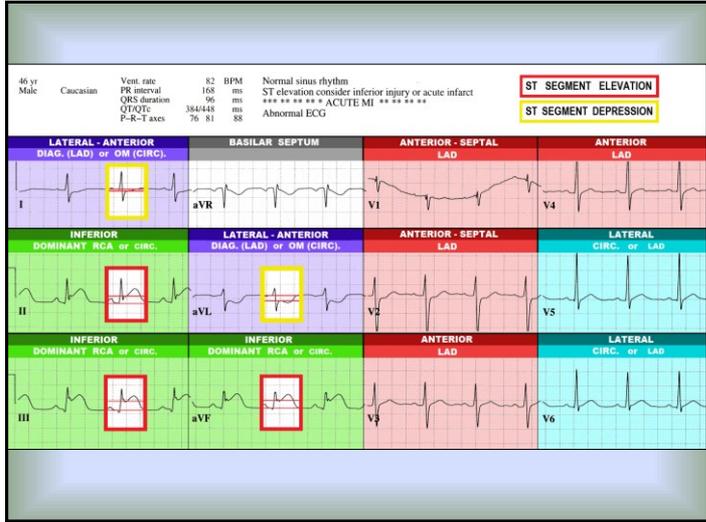
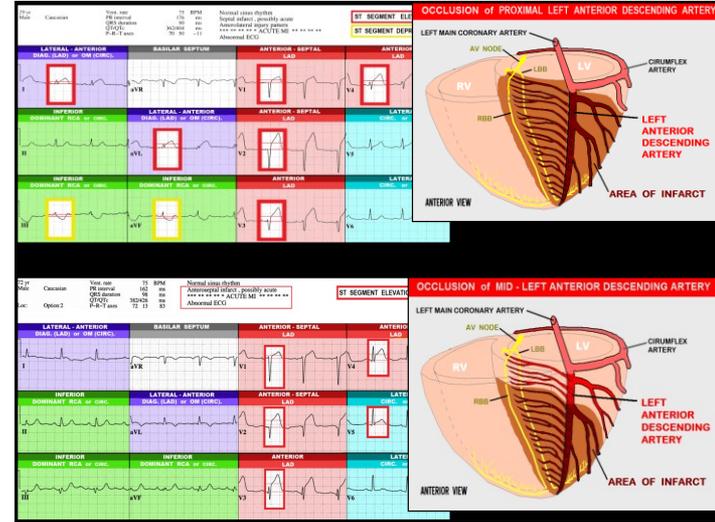
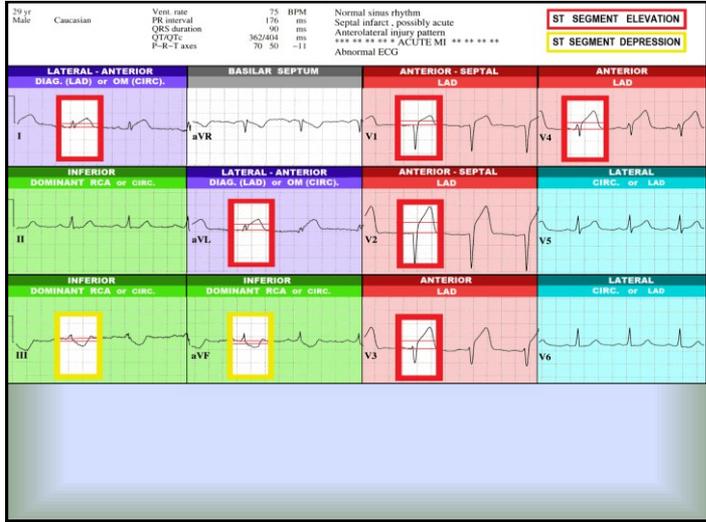
* P. Rautaharju et al, "Standardization and Interpretation of the ECG," JACC 2009;(53)No.11:982-991



ANTICIPATED COMPLICATIONS of ANTERIOR-SEPTAL WALL STEMI & POSSIBLE INDICATED INTERVENTIONS:

- CARDIAC ARREST	BCLS / ACLS
- CARDIAC DYSRHYTHMIAS (VT / VF)	ACLS (antiarrhythmics)
- PUMP FAILURE with CARDIOGENIC SHOCK	INOTROPE THERAPY: -DOPAMINE / DOBUTAMINE / LEVOPHED - INTRA-AORTIC BALLOON PUMP (use caution with fluid challenges due to PULMONARY EDEMA)
- PULMONARY EDEMA	- CPAP - ET INTUBATION (use caution with diuretics due to pump failure and hypotension)
- 3rd DEGREE HEART BLOCK - NOT RESPONSIVE TO ATROPINE	TRANSCUTANEOUS or TRANSVENOUS PACING





ANTICIPATED COMPLICATIONS of INFERIOR WALL STEMI secondary to RCA Occlusion & POSSIBLE INDICATED INTERVENTIONS:

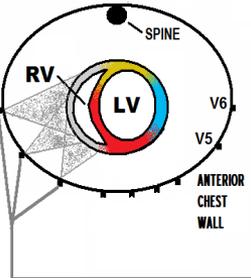
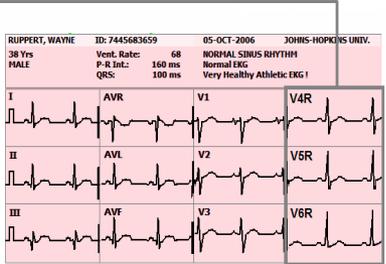
- CARDIAC ARREST	BCLS / ACLS
- CARDIAC DYSRHYTHMIAS (VT / VF)	ACLS (antiarrhythmics)
- SINUS BRADYCARDIA	ATROPINE 0.5mg, REPEAT as needed UP TO 3mg. (follow ACLS and/or UNIT protocols)
- HEART BLOCKS (1st, 2nd & 3rd Degree HB)	ATROPINE 0.5mg, REPEAT as needed UP TO 3mg, Transcutaneous Pacing, (follow ACLS and/or UNIT protocols)
- RIGHT VENTRICULAR MYOCARDIAL INFARCTION	- The standard 12 Lead ECG does NOT view the Right Ventricle. - You must do a RIGHT-SIDED ECG to see if RV MI is present. - Do NOT give any Inferior Wall STEMI patient NITRATES or DIURETICS until RV MI has been RULED OUT.
- POSTERIOR WALL INFARCTION	- POSTERIOR WALL MI presents on the 12 Lead ECG as ST DEPRESSION in Leads V1 - V3. - POSTERIOR WALL MI is NOT PRESENT ON THIS ECG

To see the
RIGHT VENTRICLE ...

... such as in cases of
INFERIOR WALL M.I.

 You must do a
RIGHT - SIDED EKG !!

V4R - V6R VIEW THE RIGHT VENTRICLE

RV MI STEMI Criteria:

- ST Elevation of ___mm (0.5mv) or more in Leads V3R, V4R, V5R or V6R

IN **EVERY** CASE of

INFERIOR WALL STEMI

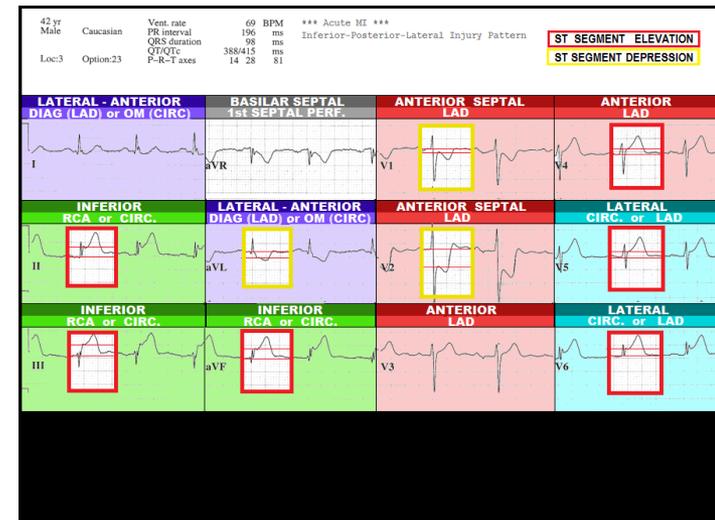
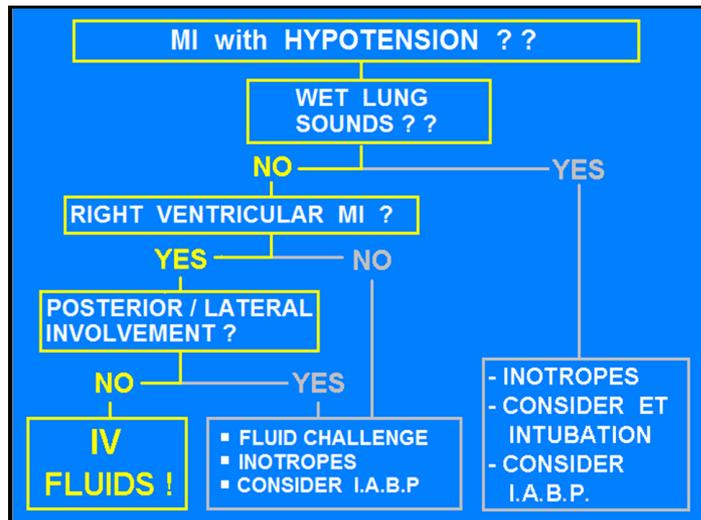
You must first **RULE OUT**
RIGHT VENTRICULAR MI
BEFORE giving any:

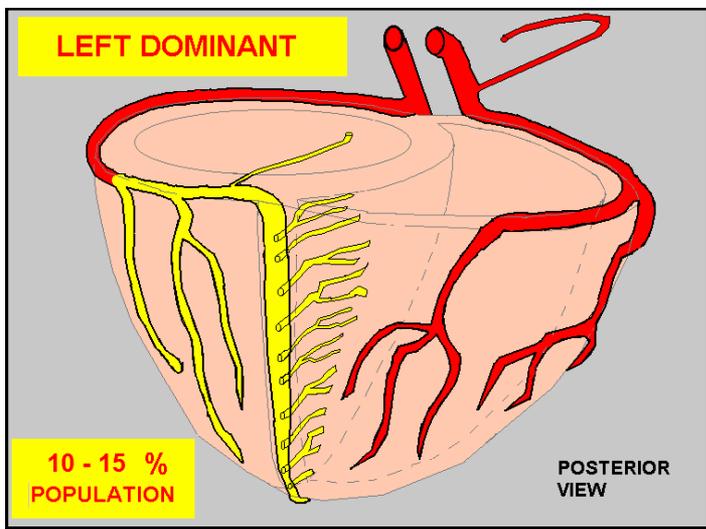
- NITROGLYCERIN
- Diuretics

Nitroglycerin & Diuretics
 are
CLASS III CONTRINDICATED
 in
RIGHT VENTRICULAR MI !!*

They precipitate SEVERE HYPOTENSION

* A.H.A. ACLS 2010 / 2015





Both patients will present with INFERIOR WALL STEMI (ST elevation leads II, III and aVF):

The DOMINANT CIRCUMFLEX ARTERY ...	The NON - DOMINANT CIRCUMFLEX ARTERY
SUPPLIES 35-55% OF THE LEFT VENTRICULAR MUSCLE MASS	SUPPLIES 25-30% OF THE LEFT VENTRICULAR MUSCLE MASS
<p>Occlusion of DOMINANT Circumflex typically presents with more:</p> <ul style="list-style-type: none"> - ST Depression Leads V1 – V3 (Posterior MI) - ST Elevation Leads V5, V6 (Lateral MI) <p>Usually has PROFOUND Cardiogenic Shock ALMOST NEVER has Right Ventricular MI</p>	<p>Occlusion of DOMINANT RCA typically presents with VERY LITTLE or NO:</p> <ul style="list-style-type: none"> - ST Depression Leads V1-V3 - ST Elevation Leads V5, V6 <p>Usually NO Cardiogenic Shock, good BP OFTEN has Right Ventricular MI</p>

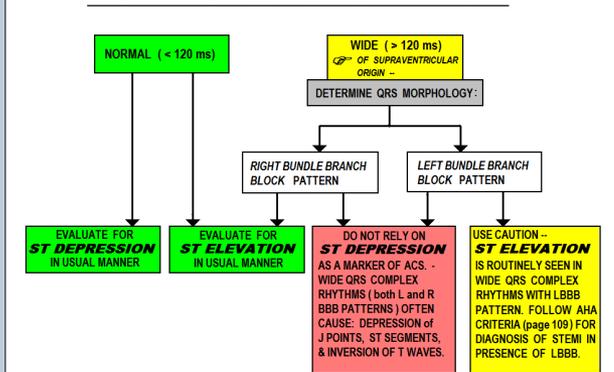
Posterior STEMI Criteria:

- ST Elevation of ___mm (0.5mv) or more in Leads V7, V8 and/or V9

Vent. rate 64 BPM Normal sinus rhythm PR interval 130 ms Normal ECG QRS duration 96 ms No previous ECGs available QT/QTc 396/408 ms P-R-T axes 40 11 61			
Referred by:			
LATERAL - ANTERIOR I	BASILAR SEPTUM aVR	ANTERIOR - SEPTAL V1	ANTERIOR V4
LAD - PROXIMAL CIRC. - PROXIMAL or RAMUS	LAD - PROXIMAL or LEFT MAIN COR. ART.	LEFT ANTERIOR DESCENDING (LAD)	LEFT ANTERIOR DESCENDING (LAD)
INFERIOR II	LATERAL - ANTERIOR aVL	ANTERIOR - SEPTAL V2	LATERAL V5
RCA (75 - 80 % pop.) CIRC. (10 - 15 % pop.)	LAD - PROXIMAL CIRC. - PROXIMAL or RAMUS	LEFT ANTERIOR DESCENDING (LAD)	CIRCUMFLEX
INFERIOR III	INFERIOR aVF	ANTERIOR V3	LATERAL V6
RCA (75 - 80 % pop.) CIRC. (10 - 15 % pop.)	RCA (75 - 80 % pop.) CIRC. (10 - 15 % pop.)	LEFT ANTERIOR DESCENDING (LAD)	CIRCUMFLEX

Evaluating the ECG for ACS:

STEP 1 - EVALUATE WIDTH OF QRS:



Simple “Turn Signal Method” . . .

THE “TURN SIGNAL METHOD” for identifying BUNDLE BRANCH BLOCK

V1

USE LEAD V1 for this technique

To make a **RIGHT TURN** you push the turn signal lever **UP**

THINK:
“QRS points UP = RIGHT BUNDLE BRANCH BLOCK”

V1

To make a **LEFT TURN** you push the turn signal lever **DOWN**

THINK:
“QRS points DOWN = LEFT BUNDLE BRANCH BLOCK”

Wide QRS present: (QRSd > 120ms)

- **When RIGHT Bundle Branch Block pattern is present:**
 - Precordial Leads typically demonstrate ST Depression and T wave Inversion
 - **DOES NOT MASK STEMI; when ST Elevation is noted, CONSIDER STEMI !!**

Wide QRS present: (QRSd > 120ms)

- **When LBBB QRS pattern is present:**
 - ST-Segment Elevation is typically noted in Precordial Leads
 - *Can cause up to 5mm of J Point Elevation in normally calibrated ECG (1mm=10mv)*
 - **Does NOT typically cause ST elevation in INFERIOR Leads (II, III and AVF).**

Diagnosis of STEMI with LBBB pattern:

2013 ACC/AHA Guideline for Management of STEMI

- *ST Elevation of 0.1mv (1mm) or more in leads with Positive Deflection QRS complexes*
- *ST Elevation of 0.5mv (5mm) or more in leads with Negative Deflection QRS complexes*
- *ST Segment Changes as compared with those of older ECGs with LBBB*
- *Convex ST Segment*
- *New Onset LBBB with ACS symptoms . . .*