12 LEAD ECG INTERPRETATION in

ACUTE CORONARY SYNDROME

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PROGRAM CONTENTS

SESSION TWO

THE ACUTE CORONARY SYNDROMES

- STEMI
- NSTEMI
- UNSTABLE ANGINA / OBSTRUCTIVE C.A.D.

\+ BRUGADA SYNDROME

IDENTIFY and MANAGE
ACUTE CORONARY SYNDROMES:

STEMI

NON-STEMI

UNSTABLE ANGINA

CP-LOW RISK

PROBLEM: Each year in the United States, it is estimated between 68,000 and 136,000 people with ACS are ***misdiagnosed*** and ***discharged*** from our nation's emergency departments,[1] resulting in needless ***morbidity*** and ***mortality.*** The emotional loss to grieving family members is incalculable. The negative financial impact to families who lose their primary income providers, as well as losses incurred by health care providers in legal expenses is also significant.

"The ACS Scorecard"

- ☐ PRESENTING SYMPTOMS
- ☐ RISK FACTOR PROFILE
- ☐ ECG ABNORMALITIES
- ☐ 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 !

PATIENT EVALUATION

- INITIAL APPROACH (SHOCK SURVEY)
- ABCs
- CHIEF COMPLAINT
- SECONDARY EVALUATION
  - RAPID, FOCUSED ASSESSMENT
  - PAIN / PRESSURE / BREATHING / SYMPTOMS ?

SHOCK ASSESSMENT

SHOCK =

INADEQUTE TISSUE PERFUSION

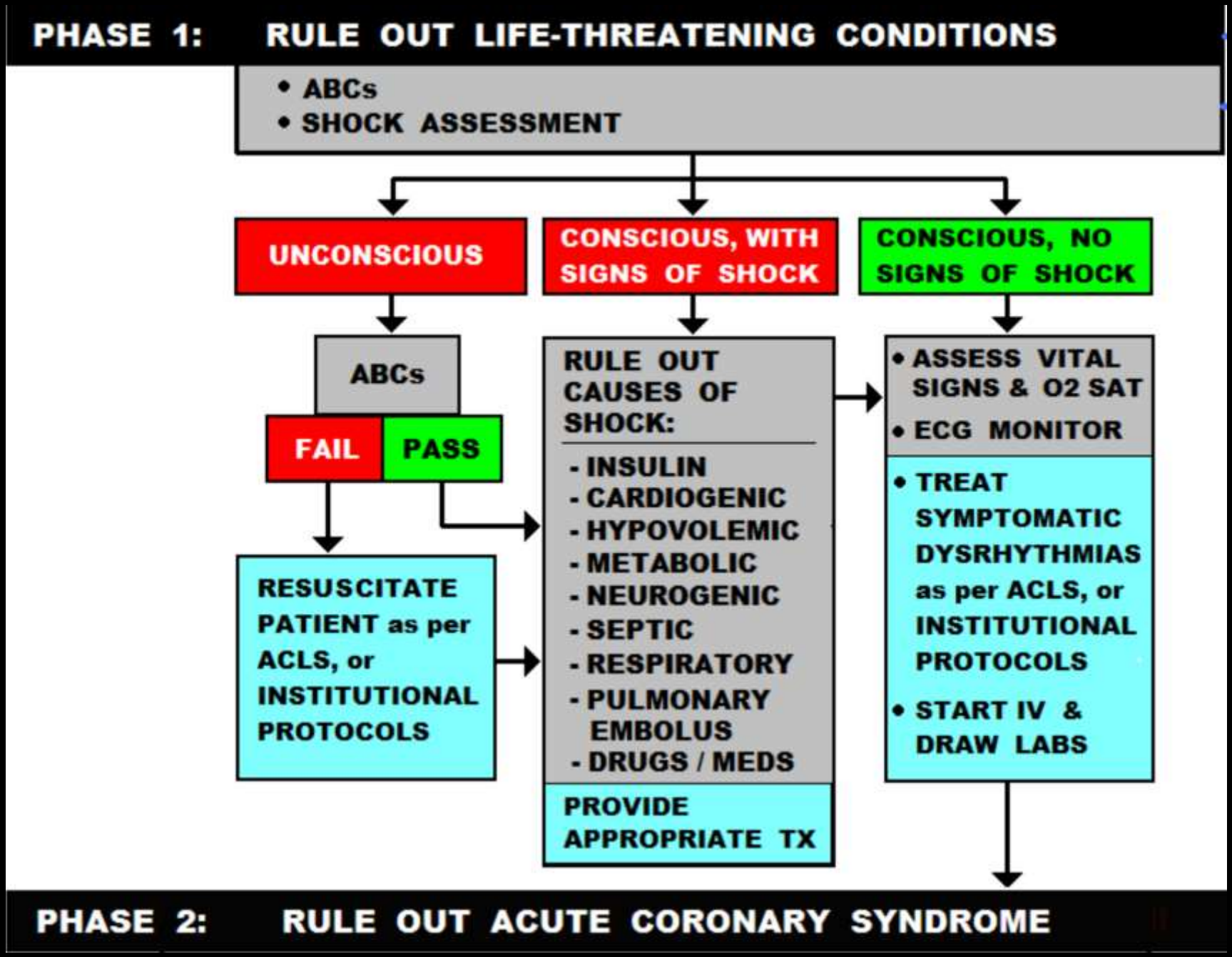
- STARTS THE INSTANT YOU SEE PATIENT
- ENDS WHEN YOU REACH THE PATIENT'S SIDE

SHOCK ASSESSMENT

LOC:	ANXIOUS RESTLESS LETHARGIC UNCONSCIOUS	AWAKE ALERT & ORIENTED
SKIN:	PALE / ASHEN CYANOTIC COOL DIAPHORETIC	NORMAL HUE WARM DRY
BREATHING:	TACHYPNEA	NORMAL
PULSE:	WEAK / THREADY TOO FAST or SLOW	STRONG
STATUS:	SHOCK	NORMAL

FAIL the SHOCK SURVEY ?

- **RAPIDLY FIND *AND TREAT***
  THE ROOT CAUSE . . .


PHASE 1: RULE OUT LIFE-THREATENING CONDITIONS
• ABCs
• SHOCK ASSESSMENT
UNCONSCIOUS
CONSCIOUS, WITH SIGNS OF SHOCK
CONSCIOUS, NO SIGNS OF SHOCK
ABCs
FAIL
PASS
RESUSCITATE PATIENT as per ACLS, or INSTITUTIONAL PROTOCOLS
RULE OUT CAUSES OF SHOCK:
- INSULIN
- CARDIOGENIC
- HYPOVOLEMIC
- METABOLIC
- NEUROGENIC
- SEPTIC
- RESPIRATORY
- PULMONARY EMBOLUS
- DRUGS / MEDS
PROVIDE APPROPRIATE TX
• ASSESS VITAL SIGNS & O2 SAT
• ECG MONITOR
• TREAT SYMPTOMATIC DYSRHYTHMIAS as per ACLS, or INSTITUTIONAL PROTOCOLS
• START IV & DRAW LABS
PHASE 2: RULE OUT ACUTE CORONARY SYNDROME

PASSED SHOCK SURVEY:

. . . . . Move on to
"RULING OUT ACS"
By conducting the . . .

INITIAL EVALUATION:

1. ASSESSMENT
2. RISK STRATIFICATION
3. ECG
4. CARDIAC MARKERS

ON-GOING E.D. EVALUATION

-REPEAT EKGs
-REPEAT CARDIAC MARKERS

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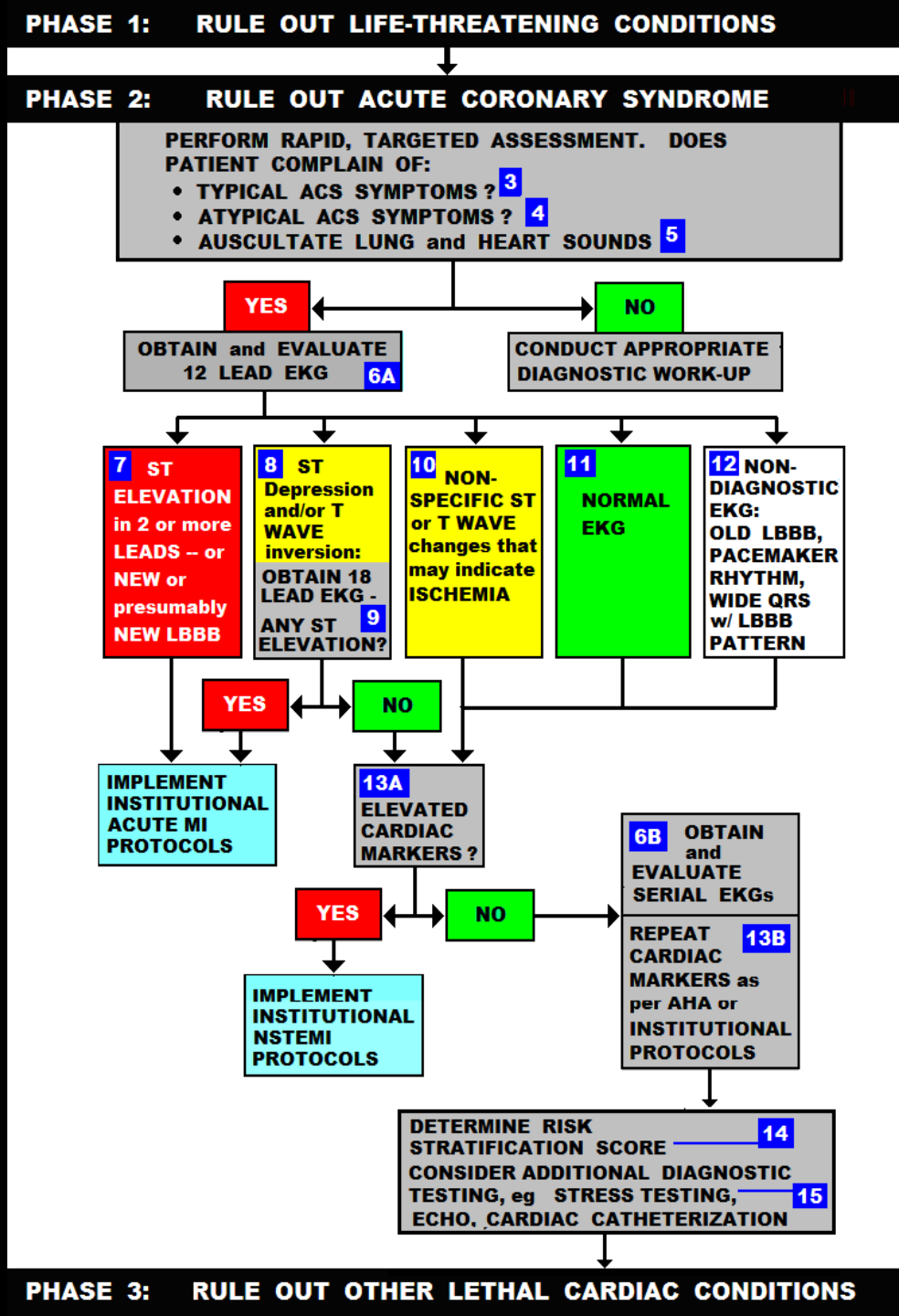

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CHIEF COMPLAINT

KEY WORDS:

“CHEST: PAIN / HEAVINESS / PRESSURE/ FUNNY FEELING IN,” etc.

SHORTNESS BREATH

DIZZINESS / LIGHTHEADEDNESS

ETC. ETC. ETC.

TYPICAL SYPTOMS of ACUTE CORNARY SYNDROME:

- ✓ **CHEST PAIN** - *DESCRIBED AS . . .*
  - "HEAVINESS, PRESSURE, DULL PAIN, TIGHTNESS"
  - CENTERED IN CHEST, SUBSTERNAL
  - MAY RADIATE TO SHOULDERS, JAW, NECK, LEFT or RIGHT ARM
  - NOT EFFECTED by:
    - MOVEMENT
    - POSITION
    - DEEP INSPIRATION
- ✓ **SHORTNESS OF BREATH**
  - MAY or MAY NOT BE PRESENT
- ✓ **NAUSEA / VOMITING**
  - MAY or MAY NOT BE PRESENT

INFARCTION

- - - "Classic Symptoms" - - -

QUICK ASSESSMENT "SHORT FORM"

- ☑ **SUBSTERNAL CHEST PAIN**
  (HAVE PATIENT POINT TO WORST PAIN)
- ☑ **DESCRIBED AS "DULL PAIN," "PRESSURE," or "HEAVINESS"**
- ☑ **DOES NOT CHANGE WITH DEEP BREATH**

stable angina

1. SYMPTOMS START DURING PHYSICAL EXERTION.
2. SYMPTOMS ARE "PREDICTABLE"

VS.

unstable angina

1. SYMPTOMS MAY START AT ANY TIME, EVEN DURING REST
2. SYMPTOMS ARE *NEW*, *DIFFERENT*, or *WORSE* THAN PREVIOUS EPISODES

BEWARE of the patient with "INTERMITTENT CHEST PAIN" . . . .

ATYPICAL SYMPTOMS of ACS

? ? ?

Acute MI patients who present without chest pain* are SHREWD:

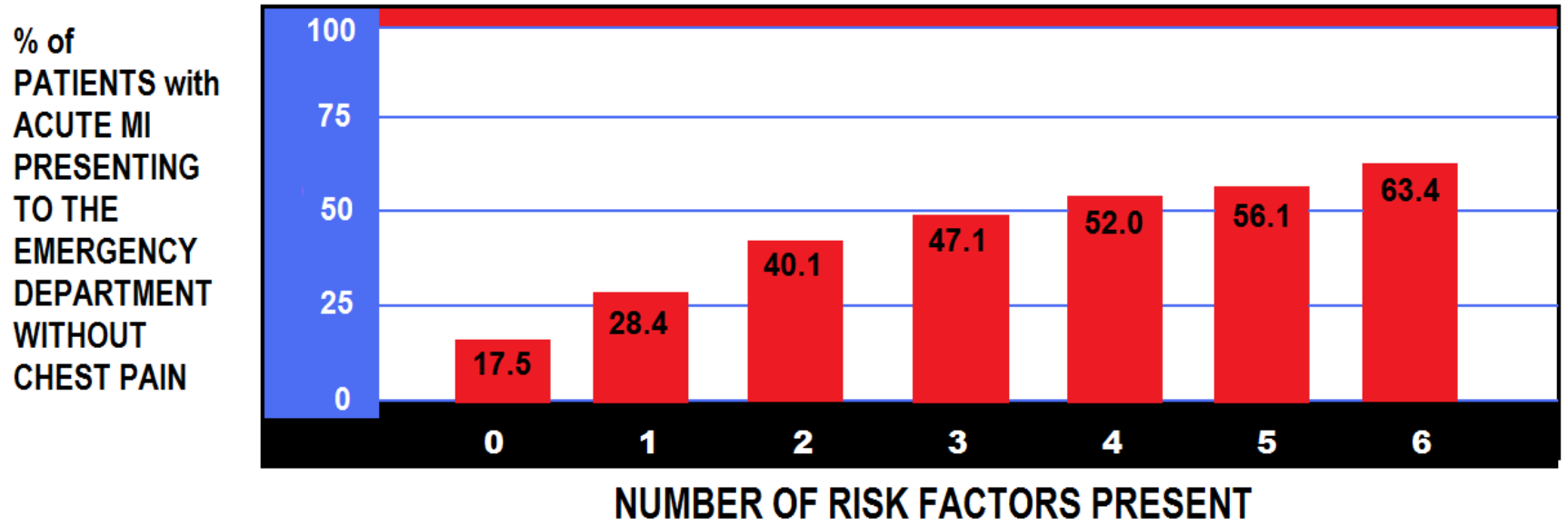
Stroke (previous history of)
Heart failure (previous history of)
Race (non-white)
Elderly (age 75+)
Women
Diabetes mellitus

* The information listed in the table to the immediate left resulted from a study conducted by John G. Canto, MD, MSPH, et. al., of the University of Alabama. The study consisted of 434,877 patients diagnosed with AMI between 1994 and 1998 in 1,674 US hospitals. Study results were published in the Journal of the American Medical Association (JAMA) on June 28, 2000, Vol. 283, No. 24, pages 3223-3229

Common atypical complaints associated with AMI without chest pain include:

Malaise (weakness)
Indigestion
Nausea
Dizziness
Syncope
Fatigue
Abdominal pain
Cold sweats
Elevated heart rate
Dsypnea

Effect of Having Multiple Risk Factors for AMI Without Chest Pain



RISK FACTORS INCLUDE: **S**troke (previous), **H**eart failure (previous), **R**ace (non-white), **E**lderly (age 75+), **W**omen, **D**iabtetes

DATA SOURCE: J. CANTO, MD, MSPH, et al, JAMA 2000 ; 283 : 3223 - 3229

WOMEN'S MAJOR SYMPTOMS *PRIOR* TO THEIR HEART ATTACK:

- UNUSUAL FATIGUE 71 %
- SLEEP DISTURBANCE 48 %
- SOB 42 %
- INDIGESTION 39 %
- ANXIETY 36 %

APPROXIMATELY 78 % OF WOMEN REPORTED EXPERIENCING AT LEAST ONE OF THESE SYMPTOMS FOR MORE THAN ONE MONTH EITHER DAILY OR SEVERAL TIMES PER WEEK PRIOR TO THEIR MI.

WOMEN'S MAJOR SYMPTOMS DURING THEIR HEART ATTACK:

SHORTNESS OF BREATH	58 %
WEAKNESS	55 %
UNUSUAL FATIGUE	43 %
COLD SWEAT	39 %
DIZZINESS	39 %

43 % HAD NO CHEST PAIN AT ANY TIME DURING THEIR MI !

Circulation, 2003:108;2619-2623

"The ACS Scorecard"

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RISK FACTORS

for the development of

CORONARY ARTERY DISEASE:

- HEREDITY
- ↑ LDL and ↓ HDL CHOLESTEROL PROFILES
- SMOKING
- DIABETES MELLITUS
- OBESITY
- PHYSICAL INACTIVITY
- HYPERTENSION
- AGE - OVER 65
- MALE
- HIGH STRESS

per the AMERICAN HEART ASSOCIATION

CASE STUDY: IMPORTANCE of RISK FACTORS

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

62 y/o MALE presents to cardiologist's office with intermittent ACS symptoms (chest heaviness, dyspnea). - Pt. DOES NOT correlate symptoms with exertion.

RISK FACTOR PROFILE:

- **FAMILY HISTORY -** both parents + CAD before age 65
- **PREVIOUS CIGARETTE SMOKER -** 20+ yrs., quit 15 years ago
- **HIGH CHOLESTEROL -** Dx 5 yrs ago, taking STATIN med since.
- **DIABETES -** Controlled with diet and oral meds.

PHYSICAL EXAM: Patient supine on exam table, skin warm, dry, color NL
Patient is asymptomatic, all systems WNL

VITAL SIGNS: BP 153/88, P 80, R 16, SAO2 99%

DIAGNOSTIC TESTING: EKG NORMAL, EXERCISE STRESS TEST PASSED.

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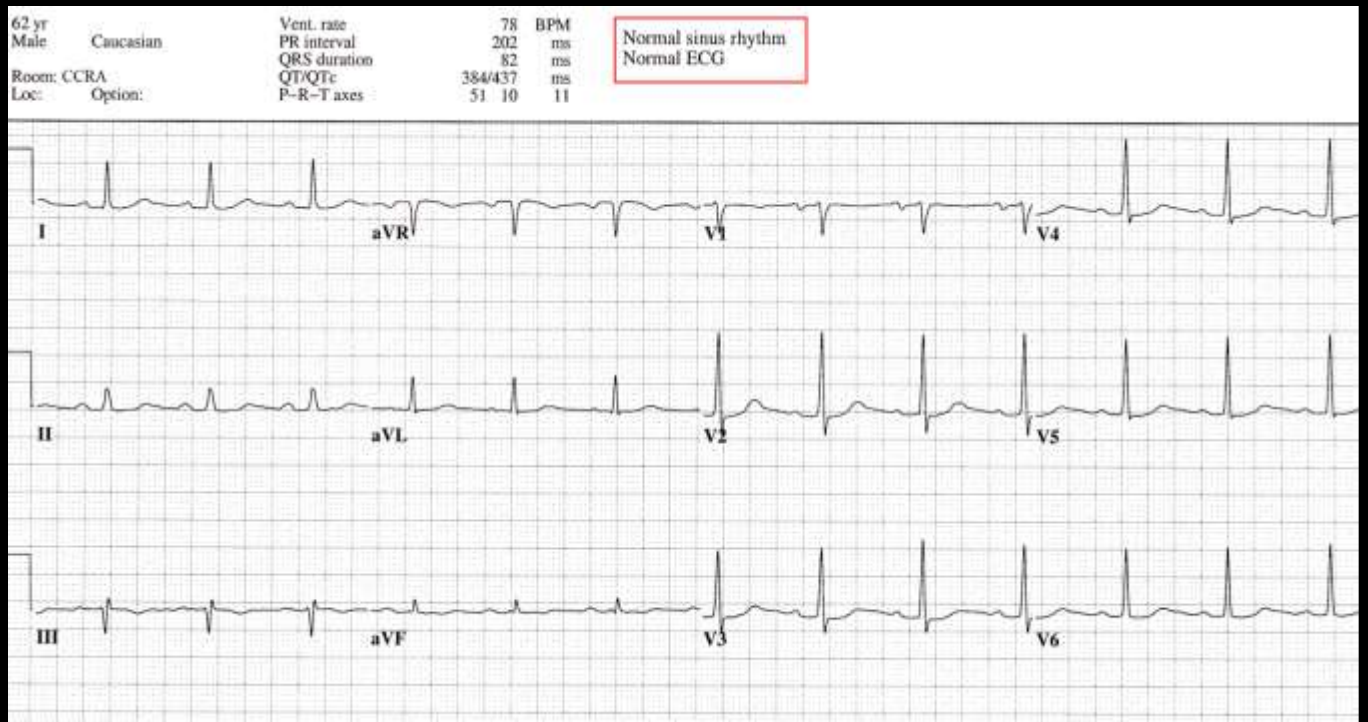
TROPONIN IS NEGATIVE.



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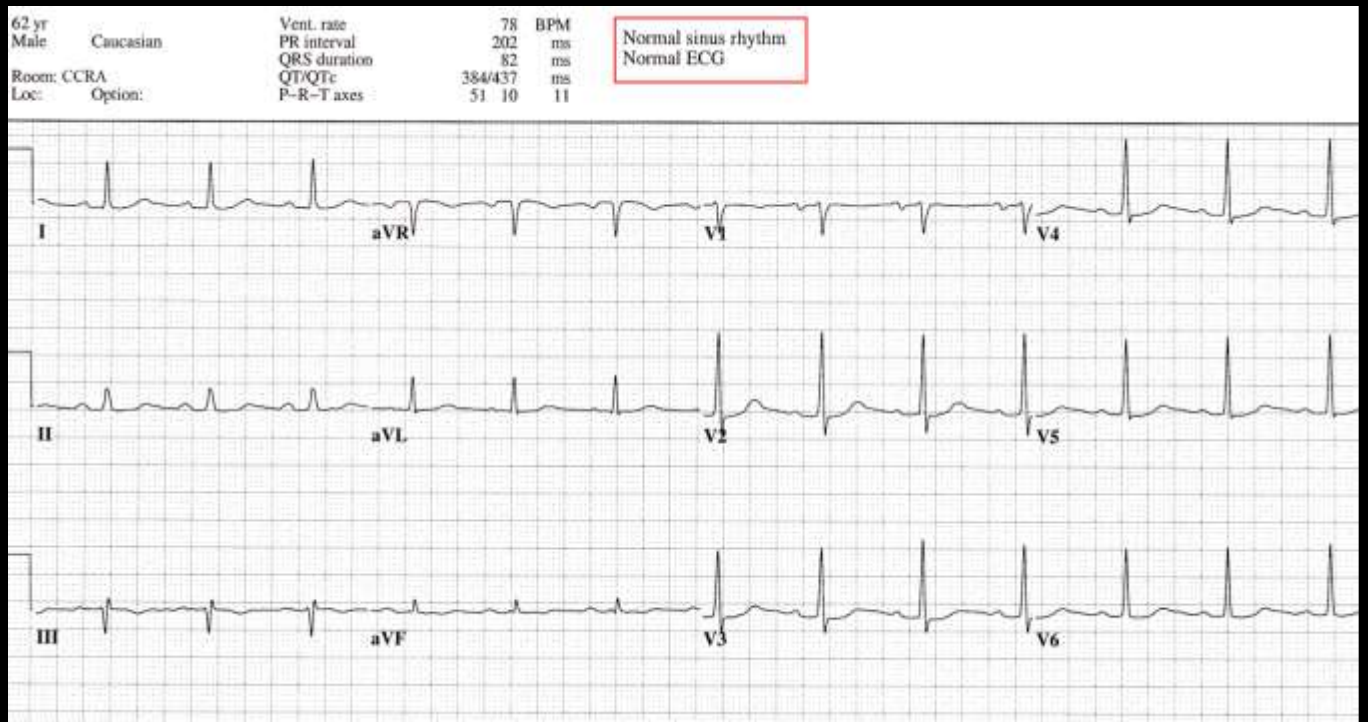
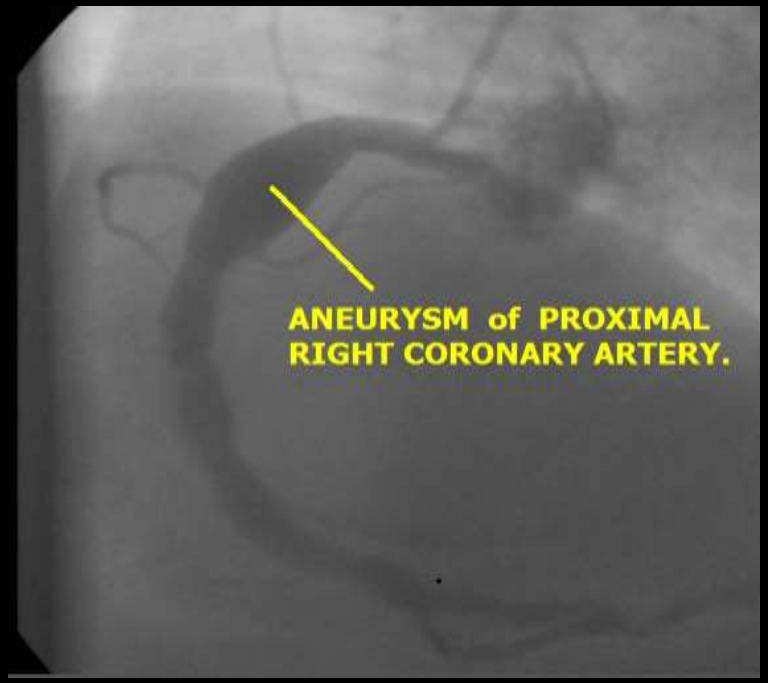
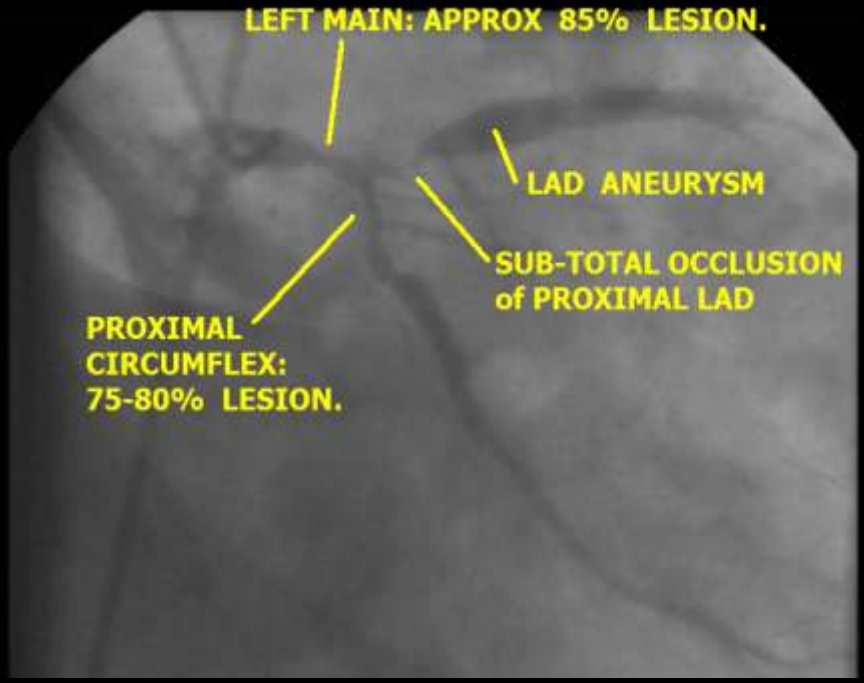



ANEURYSM of PROXIMAL
RIGHT CORONARY ARTERY.


LEFT MAIN: APPROX 85% LESION.
LAD ANEURYSM
SUB-TOTAL OCCLUSION
of PROXIMAL LAD
PROXIMAL
CIRCUMFLEX:
75-80% LESION.

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ECG EVALUATION for ACS:

STEP 1: EVALUATE *WIDTH of QRS*

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IF THE QRS IS TOO WIDE . . . . . .

(GREATER THAN 120 ms)

. . . . IS the QRS morphology:

LEFT BUNDLE BRANCH BLOCK

- OR -

RIGHT BUNDLE BRANCH BLOCK

?????

WIDE QRS COMPLEXES ALTER THE -J POINTS -ST SEGMENTS -T WAVES

Of the ECG . . .

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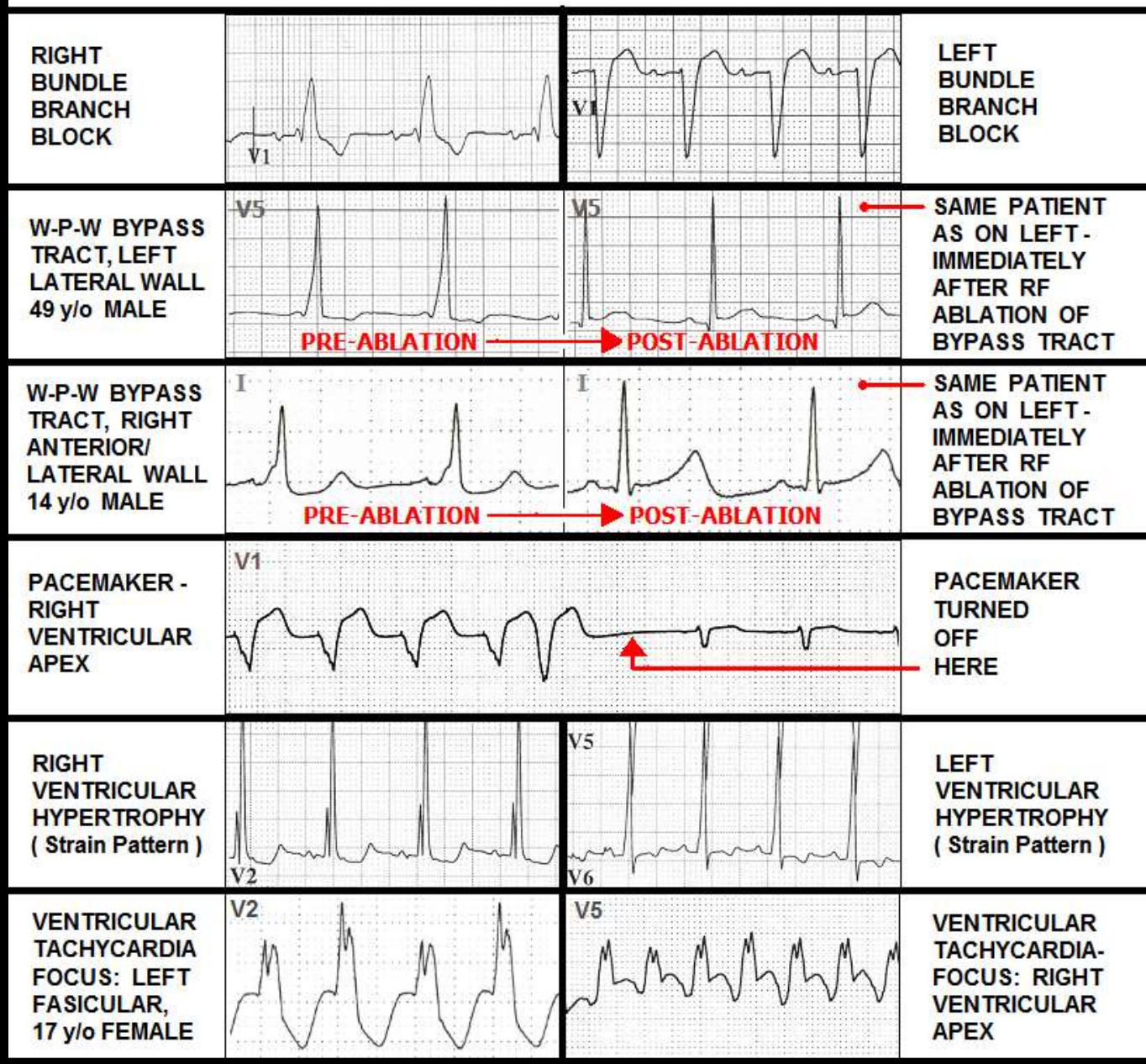
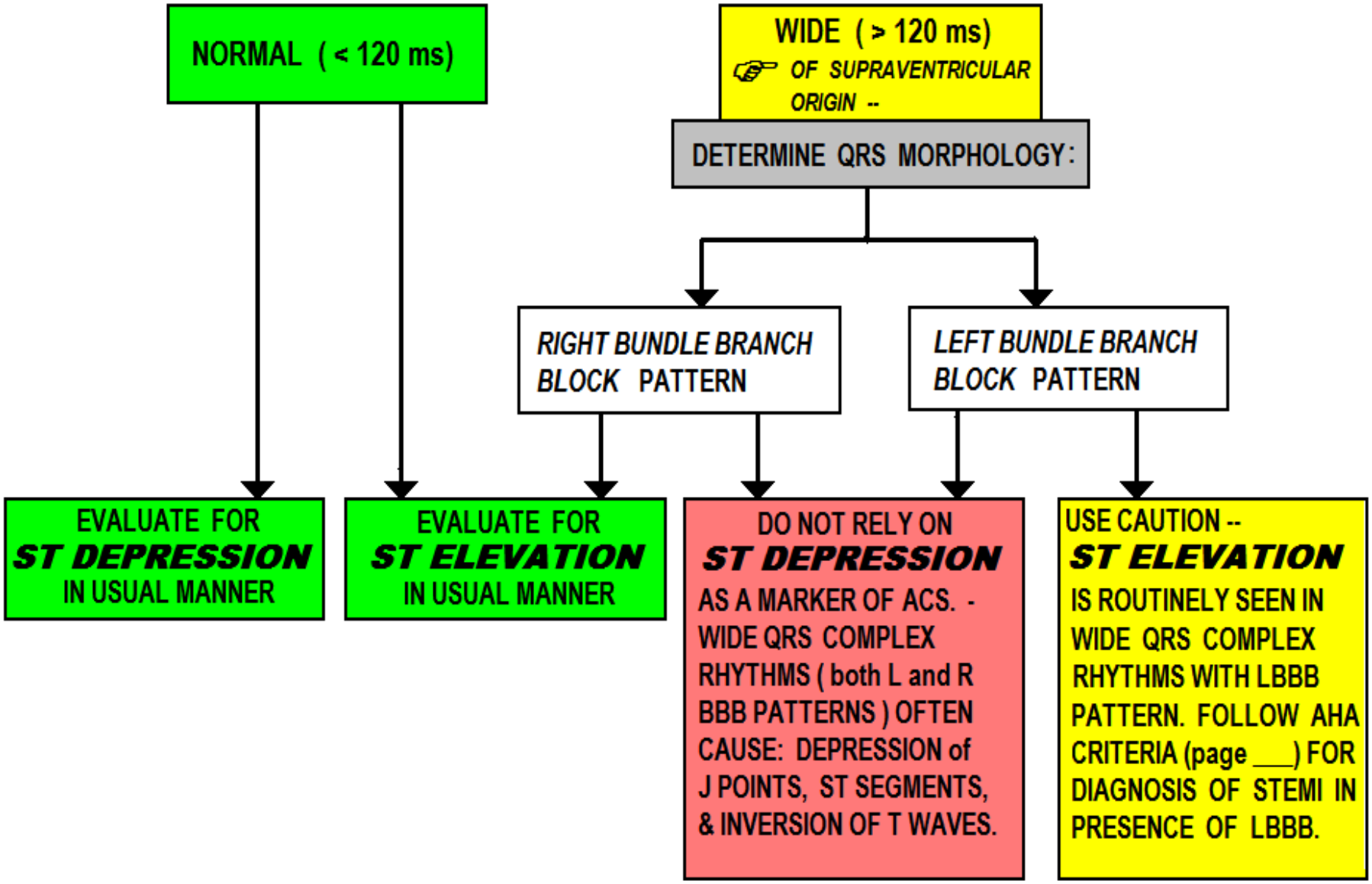
CONDITIONS WHICH ALTER THE ECG MARKERS of ACUTE CORONARY SYNDROME



STEP 1 - EVALUATE WIDTH OF QRS:



INFARCTION

A.H.A. ACLS GUIDELINES 2000 / 2006

PATIENTS with RIGHT BUNDLE BRANCH BLOCK --

use J-POINTS
and S-T SEGMENTS in the *usual manner* to screen for ACUTE MI

RBBB with CHEST PAIN - CASE 1: ST ELEVATION IN LEADS V1 - V4

48 yr
Male Caucasian

Room:ATL
Loc:3 Option:23

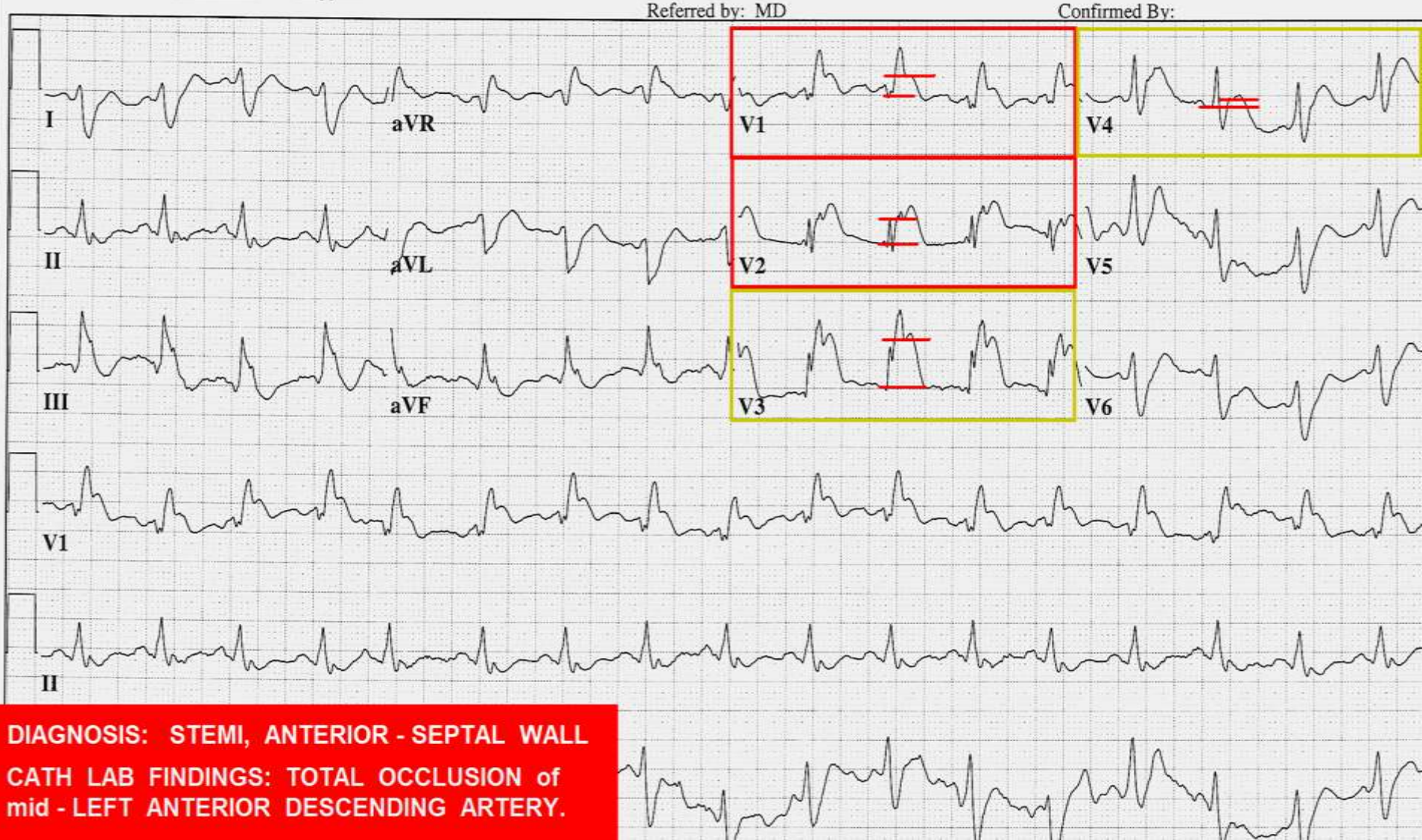
Vent. rate	102	BPM
PR interval	130	ms
QRS duration	168	ms
QT/QTc	400/521	ms
P–R–T axes	60 114	–19

Technician: W Ruppert

Sinus tachycardia with Premature supraventricular complexes and Fusion complexes
Right bundle branch block
ST elevation consider anterior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG ...

Referred by: MD

Confirmed By:



DIAGNOSIS: STEMI, ANTERIOR - SEPTAL WALL

CATH LAB FINDINGS: TOTAL OCCLUSION of mid - LEFT ANTERIOR DESCENDING ARTERY.

RBBB with CHEST PAIN - CASE 2: ST ELEVATION LEADS II, III, aVF - WITH RECIPROCAL ST DEPRESSION in LEADS V1 - V6

25 yr
Male Caucasian

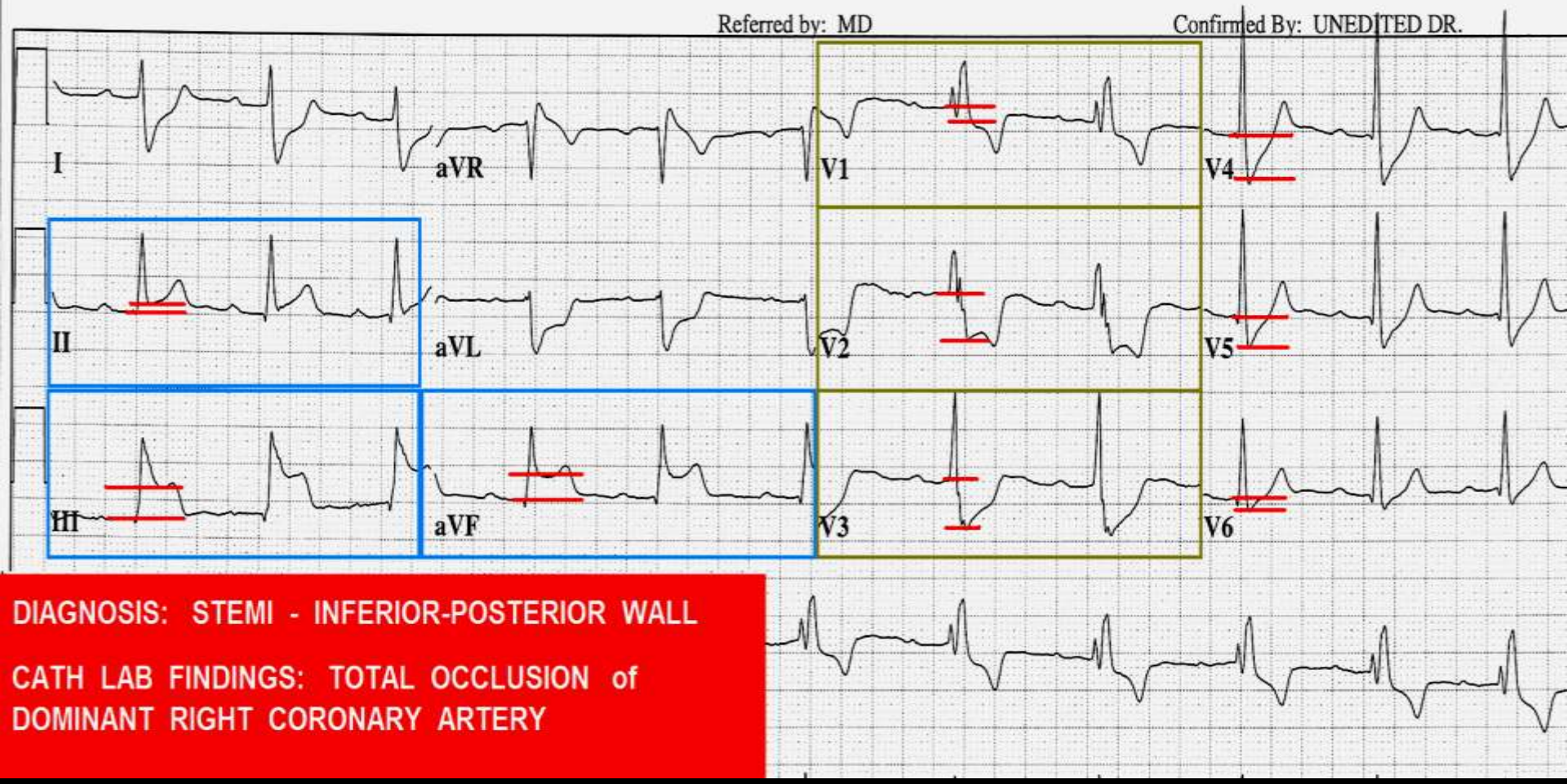
Loc:3 Option:23

Vent. rate	67	BPM
PR interval	258	ms
QRS duration	136	ms
QT/QTc	398/420	ms
P-R-T axes	44 94	82

Sinus rhythm with 1st degree A-V block
Right bundle branch block
ST elevation consider inferior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG

Referred by: MD

Confirmed By: UNEDITED DR.



DIAGNOSIS: STEMI - INFERIOR-POSTERIOR WALL

CATH LAB FINDINGS: TOTAL OCCLUSION of DOMINANT RIGHT CORONARY ARTERY

RBBB with CHEST PAIN - CASE 3: ST ELEVATION V3 - V6, II, III, aVF

75 yr
Male Caucasian

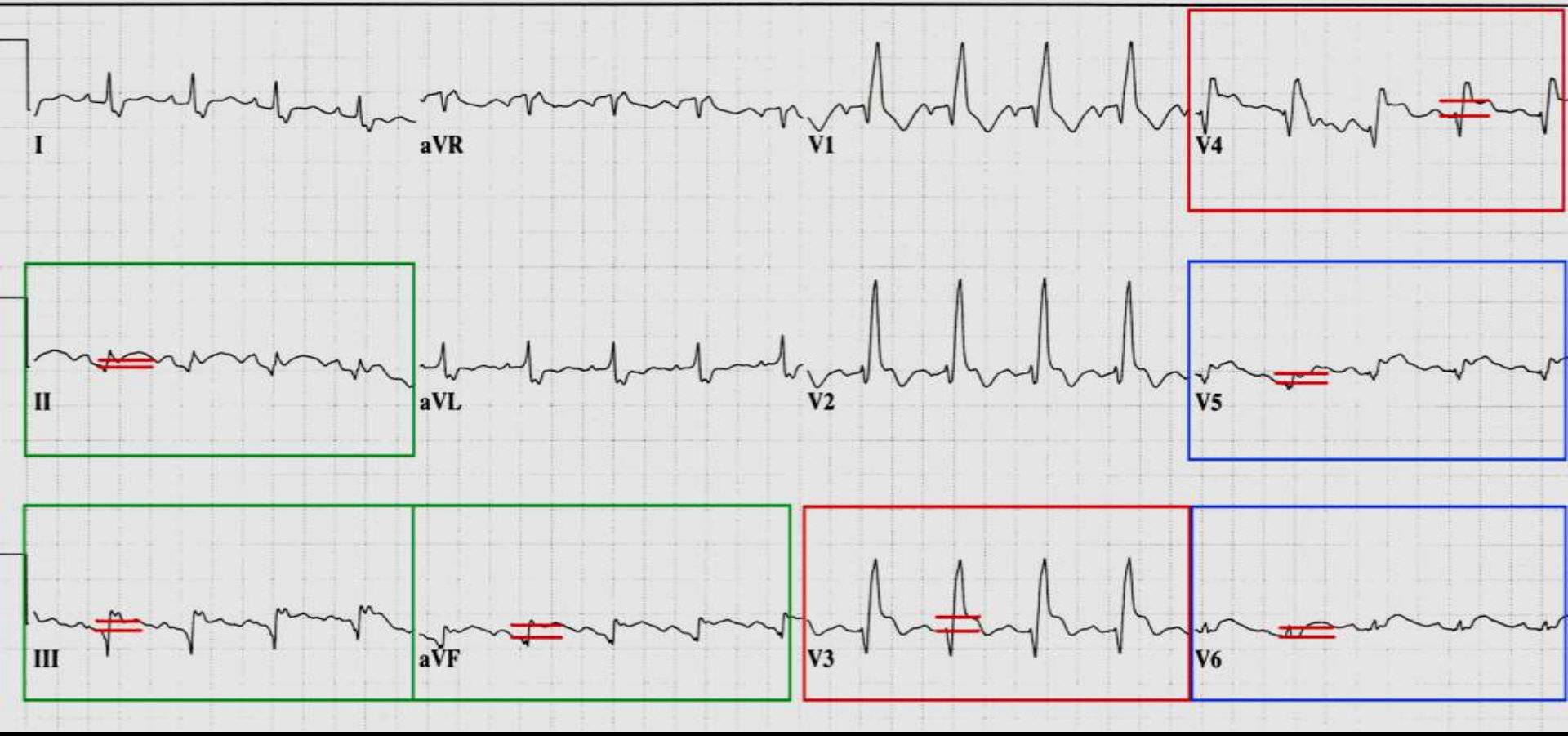
Room:CS–19
Loc:6 Option:41

Vent. rate	110	BPM
PR interval	170	ms
QRS duration	148	ms
QT/QTc	366/495	ms
P–R–T axes	57 19	69

Sinus tachycardia
Right bundle branch block
Lateral infarct , possibly acute
Inferior infarct , possibly acute
Anterior injury pattern
Abnormal ECG

ACUTE LATERAL - INFERIOR - ANTERIOR AMI

CATH LAB FINDINGS: OCCLUDED VEIN GRAFT TO THE CIRCUMFLEX DISTRIBUTION (DOMINANT CIRCUMFLEX)



A.H.A. ACLS GUIDELINES

1. If patient has a CONFIRMED HISTORY of LBBB, rely on:
   - CARDIAC MARKERS
   - SYMPTOMS
   - RISK FACTOR PROFILE
   - HIGH INDEX OF SUSPICION

   for diagnosis of STEMI

2. If patient has:

   a) previously NORMAL ECGs (no LBBB)

   -- or --

   b) no old ECGs available for comparison

   consider diagnosis as STEMI until proven otherwise.

78 yr
Female Black

Room:ICU5
Loc:6 Option:19

Vent. rate	94	BPM
PR interval	202	ms
QRS duration	160	ms
QT/QTc	388/485	ms
P-R-T axes	91 -23	87

Normal sinus rhythm with occasional Premature ventricular complexes
Left bundle branch block
Abnormal ECG

- Normal arteries
- Normal LV Function
- No hypertrophy

Technician: EKG CLASS #WR03602718

Referred by:

D.O.S.

25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 11

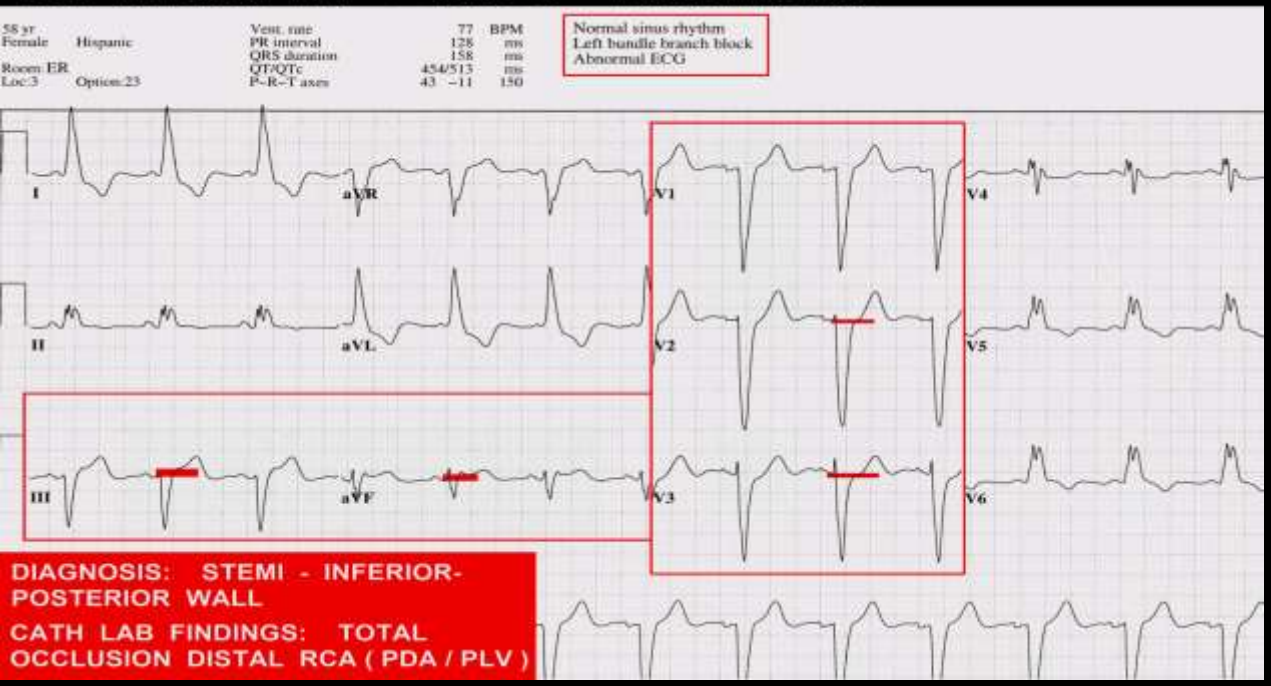
EID:18 EDT:

HELPFUL INDICATORS FOR ECG DIAGNOSIS OF STEMI in the presence of LBBB:

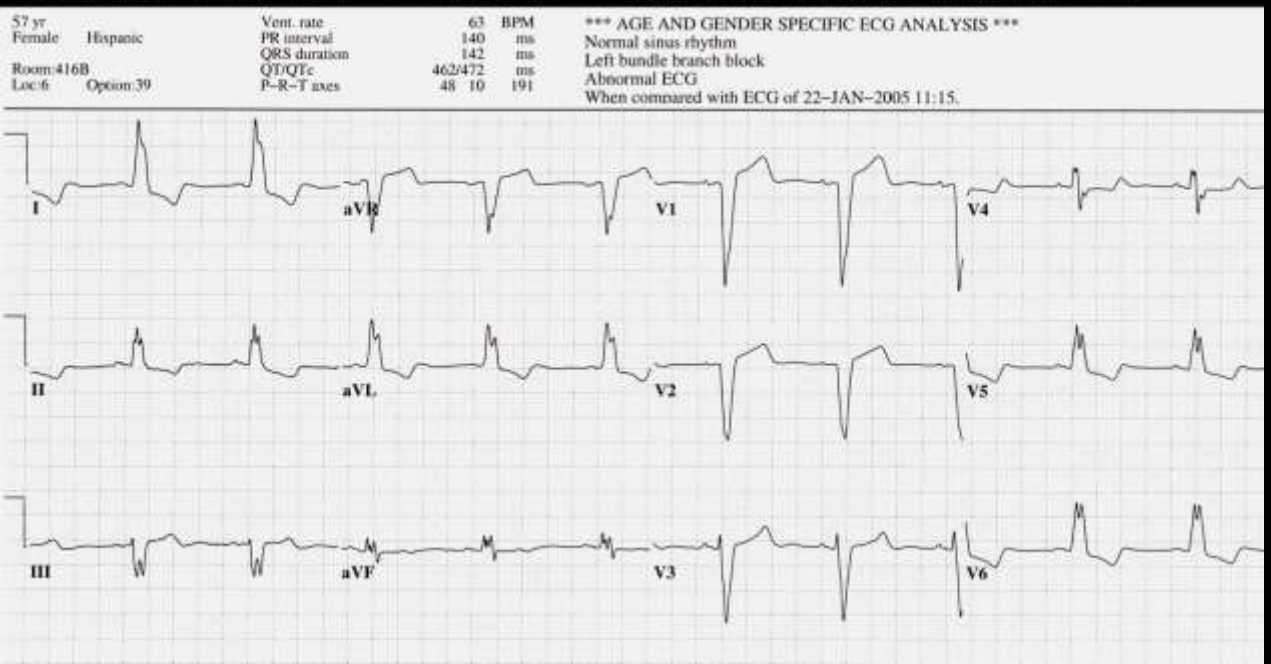
- ST ELEVATION > 5 mm
- COMPARE J POINT, ST SEGMENTS and T WAVES of previous ECG with LBBB to NEW ECG.
- CONVEX ST SEGMENT = poss. MI
  CONCAVE ST SEGMENT = normal
- CONCORDANT ST changes (1 mm or > ST DEPRESSION V1 - V3 or ST ELEVATION LEADS II, III, AVF)
- ST ELEVATION in LEADS II, III, and/or AVF

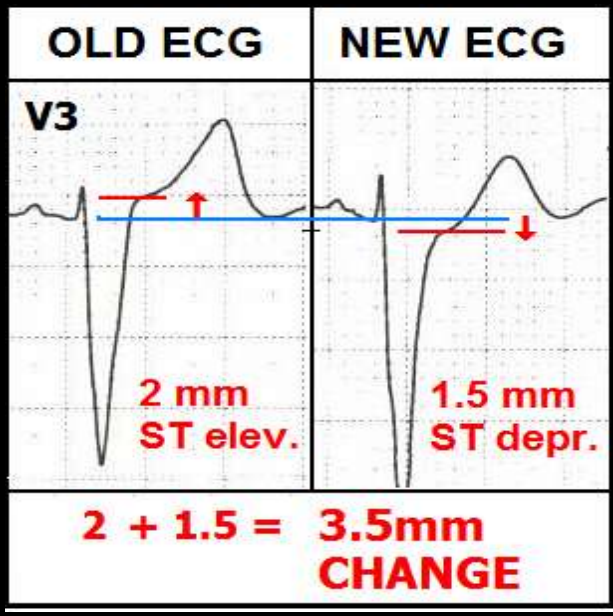
N. ENGL. J. MED v 348; p933 - 940 - Zimetbaum, et. al.

LBBB with CHEST PAIN - CASE 1: PRESENTING EKG



LBBB with CHEST PAIN - CASE 1: EKG RECORDED 7 MONTHS AGO





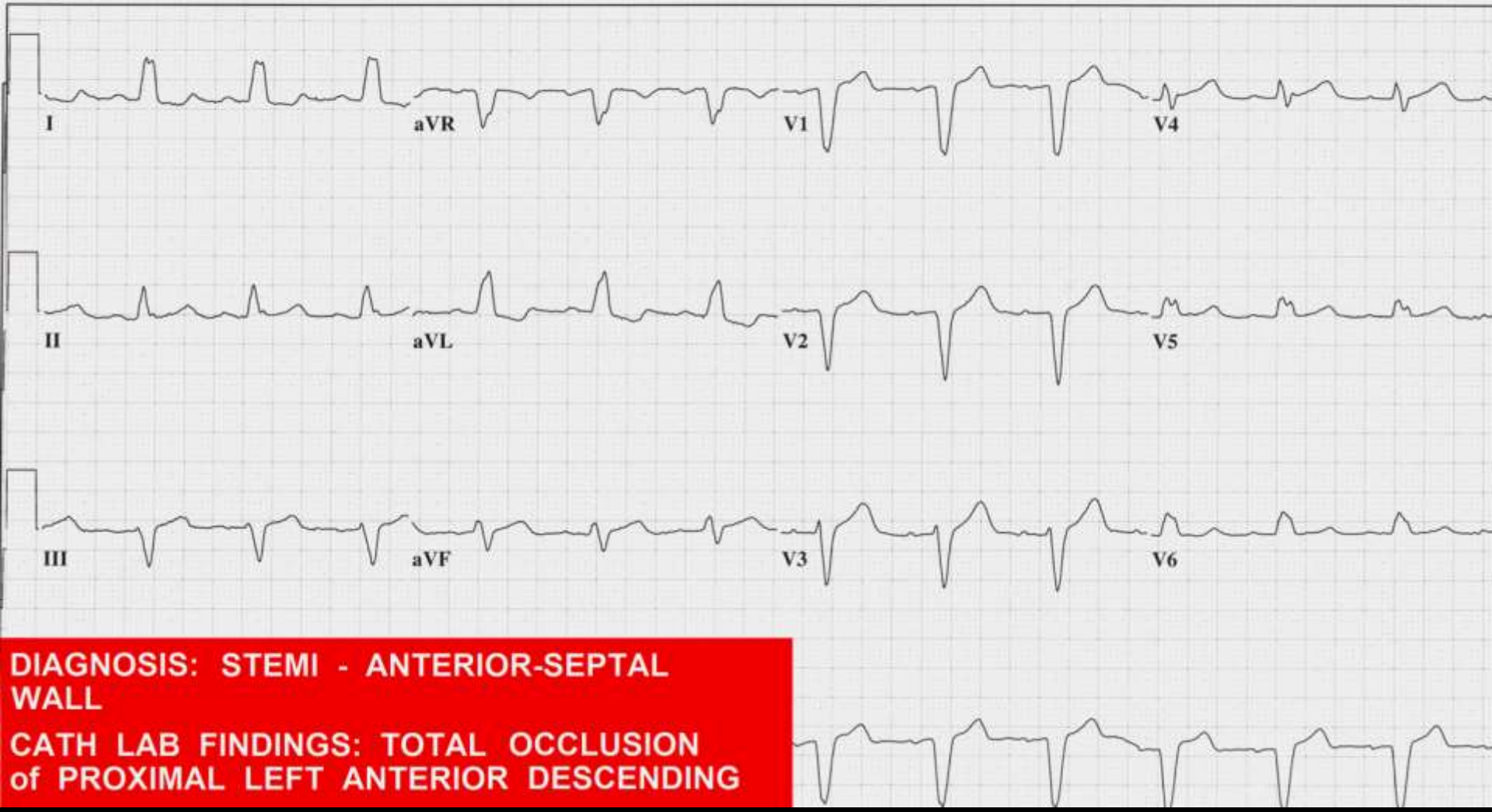
LBBB with CHEST PAIN - CASE 2: *NEW ONSET of LBBB*

46 yr
Male Caucasian

Room:ER
Loc:3 Option:23

Vent. rate	77	BPM
PR interval	172	ms
QRS duration	142	ms
QT/QTc	446/504	ms
P-R-T axes	38 0	92

Normal sinus rhythm
Left bundle branch block
Abnormal ECG



DIAGNOSIS: STEMI - ANTERIOR-SEPTAL WALL

CATH LAB FINDINGS: TOTAL OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING

IF THE QRS COMPLEXES ON THE EKG ARE OF NORMAL WIDTH (<120 ms) :

STEP 2 - EVALUATE the EKG for ACS

THE EKG MARKERS USED FOR DETERMINING THE PRESENCE OF ACUTE CORONARY SYNDROME INCLUDE:

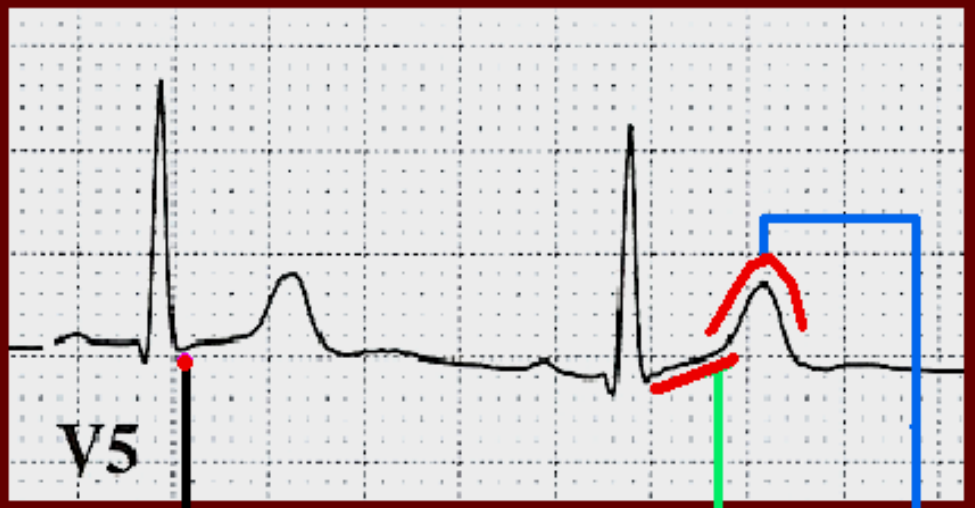
- J POINTS
- ST SEGMENTS
- T WAVES

CAREFULLY SCRUTINIZE THESE MARKERS IN EVERY LEAD OF THE 12 LEAD EKG, TO DETERMINE IF THEY ARE *NORMAL* or *ABNORMAL*.

BOOK PAGE: 80

NORMAL ST - T WAVES

- WHEN QRS WIDTH
  IS NORMAL (< 120 ms)



ASSESS:

- J POINT: ISOELECTRIC (or < 1 mm dev.)
- ST SEG: SLIGHT, POSITIVE INCLINATION
- T WAVE: UPRIGHT, POSITIVE

☞ *in EVERY LEAD EXCEPT aVR ! !*

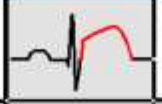
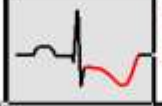
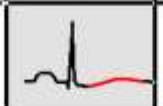
ALL KINDS of
WEIRD
ST SEGMENT and
T WAVE
VARIATIONS . . . .
ALL CAN SPELL
T-R-O-U-B-L-E.

"IF IT'S NOT
NORMAL, it's
ABNORMAL !

BOOK PAGE: 83

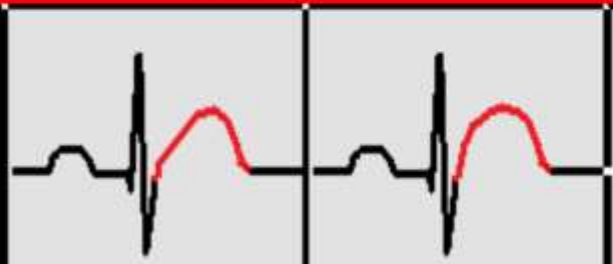
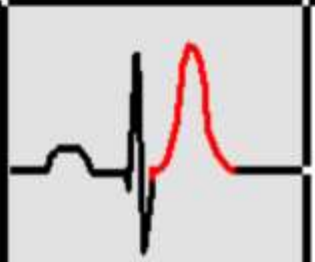
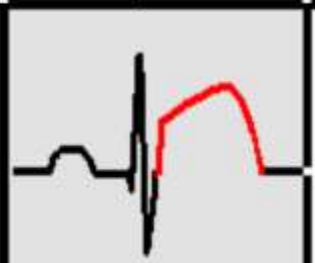
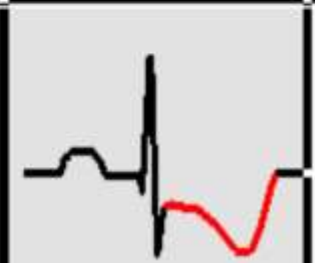
EKG PATTERNS of ACS & ISCHEMIA

– J POINT, ST SEGMENT, and T WAVE ABNORMALITIES –

!	S-T SEGMENT ELEVATION at J POINT		- ACUTE MI - ACUTE PERICARDITIS / MYOCARDITIS - EARLY REPOLARIZATION
!	FLAT or CONVEX J-T APEX SEGMENT		 - ACUTE MI - ISCHEMIA
!	HYPER-ACUTE T WAVE		- HYPERKALEMIA - TRANSMURAL ISCHEMIA - ACUTE MI - HYPERTROPHY
!	DEPRESSED J pt. 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
?	FLAT S-T SEGMENT > 120 ms		- ISCHEMIA
?	LOW VOLTAGE T WAVE WITH NORMAL QRS		- ISCHEMIA
?	U WAVE POLARITY OPPOSITE THAT OF T WAVE		- ISCHEMIA

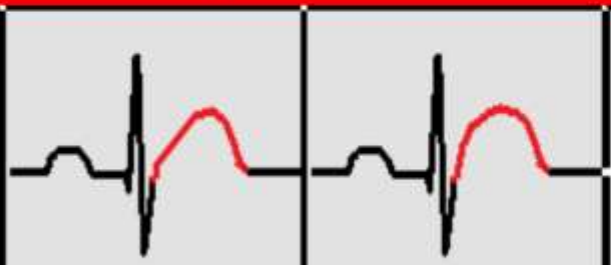
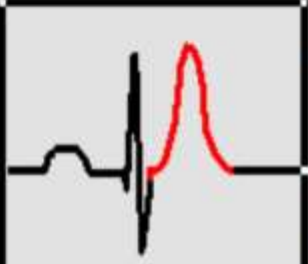
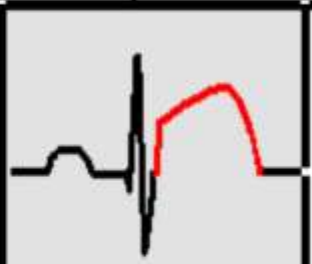
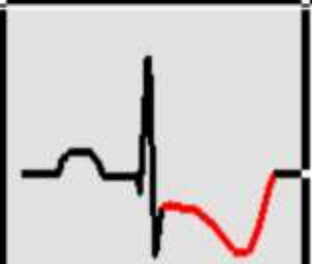
PATTERNS of ACS & ISCHEMIA

-- 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 J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

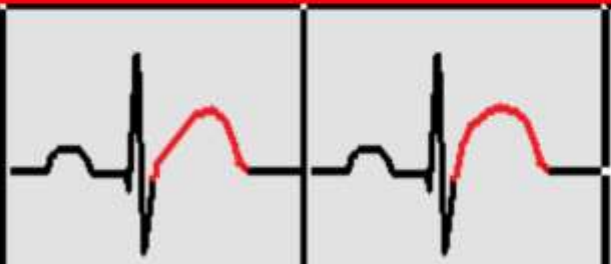
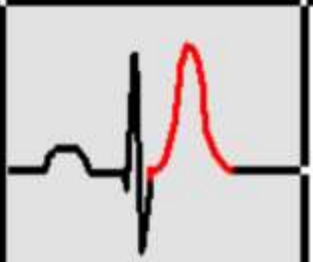
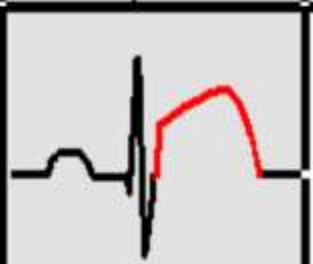
PATTERNS of ACS & ISCHEMIA

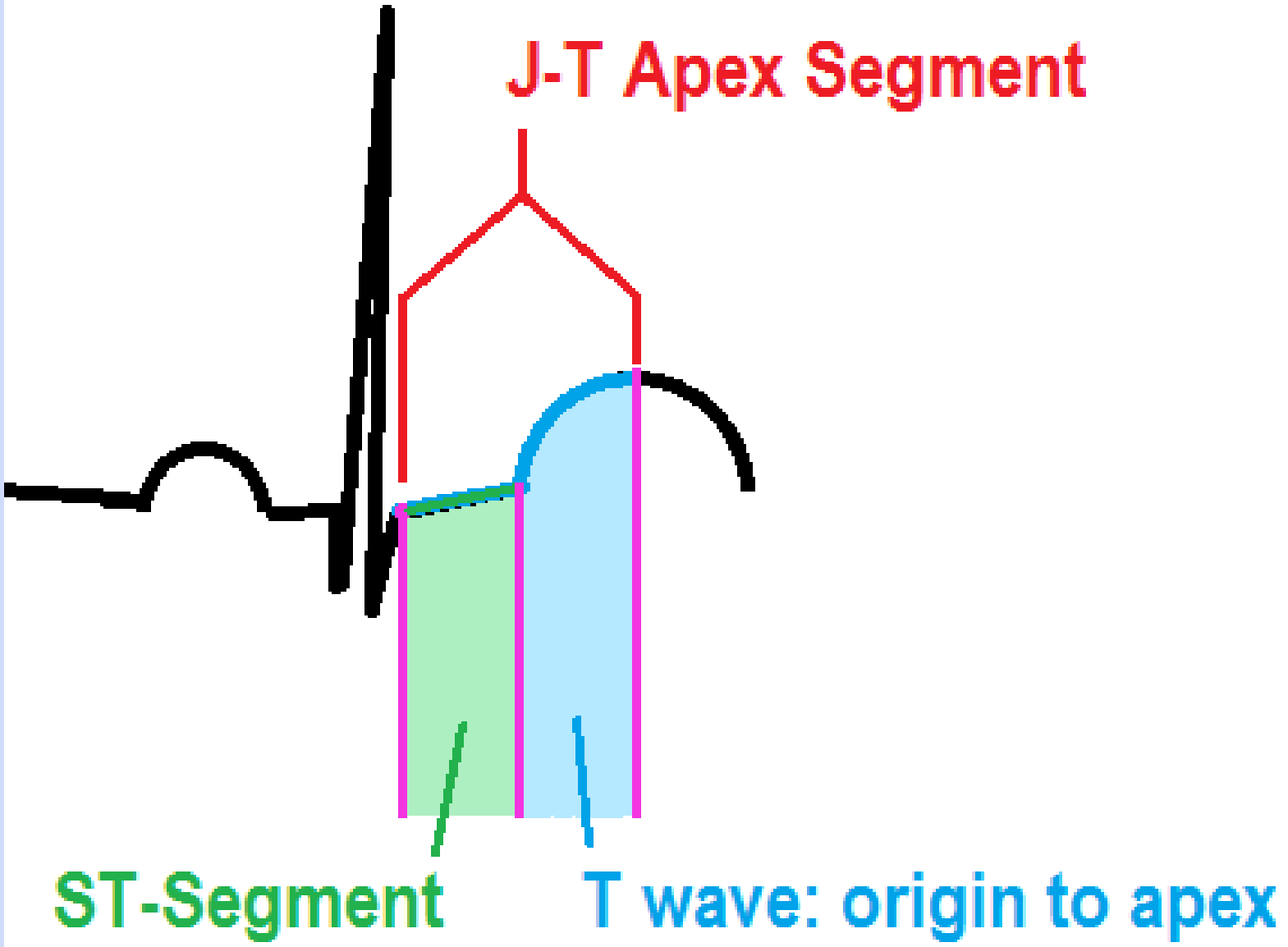
-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --

!	FLAT or CONVEX J-T APEX SEGMENT		- ACUTE MI - ISCHEMIA
!	HYPER-ACUTE T WAVE		- HYPERKALEMIA - TRANSMURAL ISCHEMIA - ACUTE MI - HYPERTROPHY
!	S-T SEGMENT ELEVATION at J POINT		- ACUTE MI - ACUTE PERICARDITIS / MYOCARDITIS - EARLY REPOLARIZATION
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA

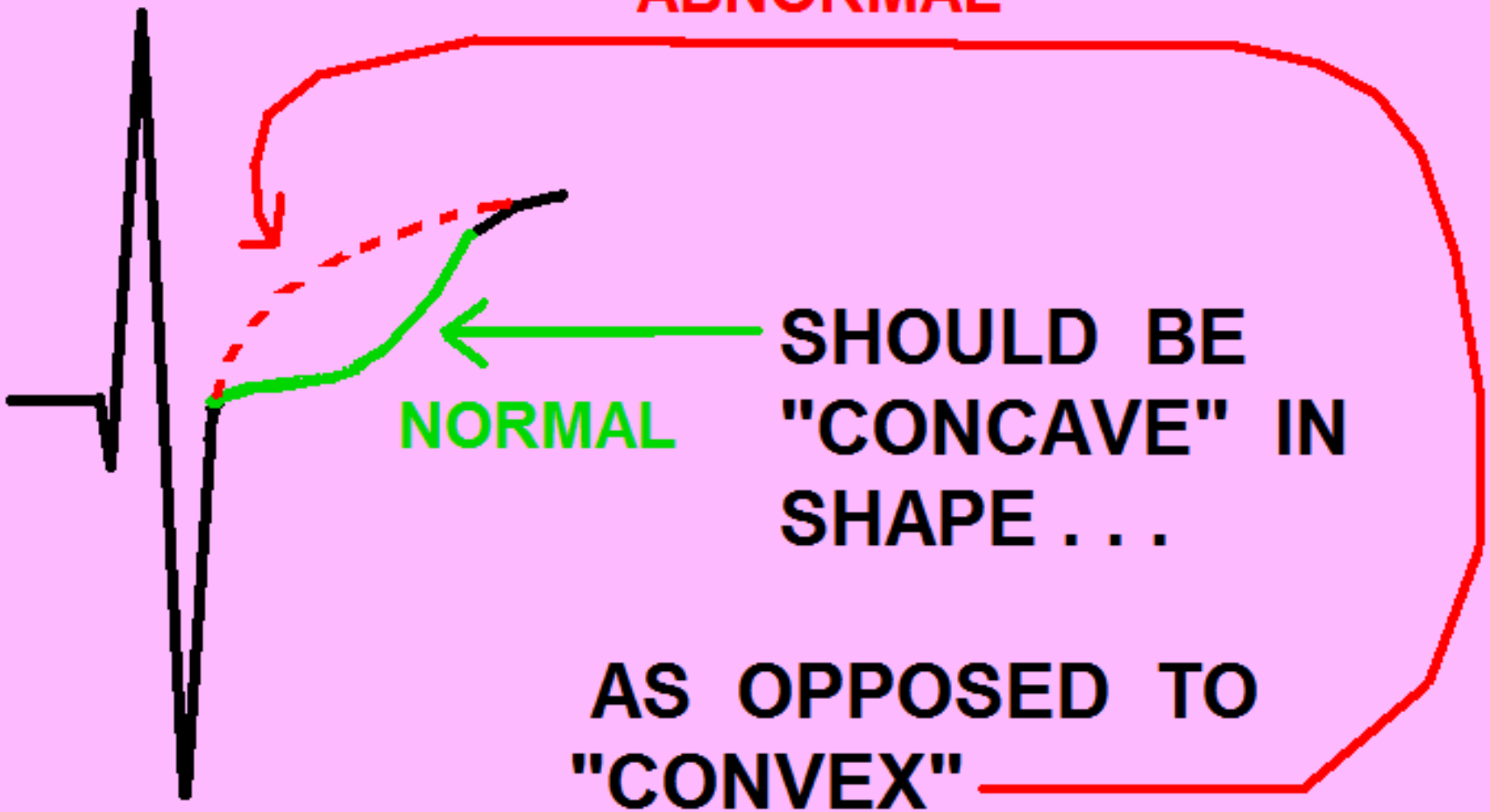
PATTERNS of ACS & ISCHEMIA

-- 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 J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

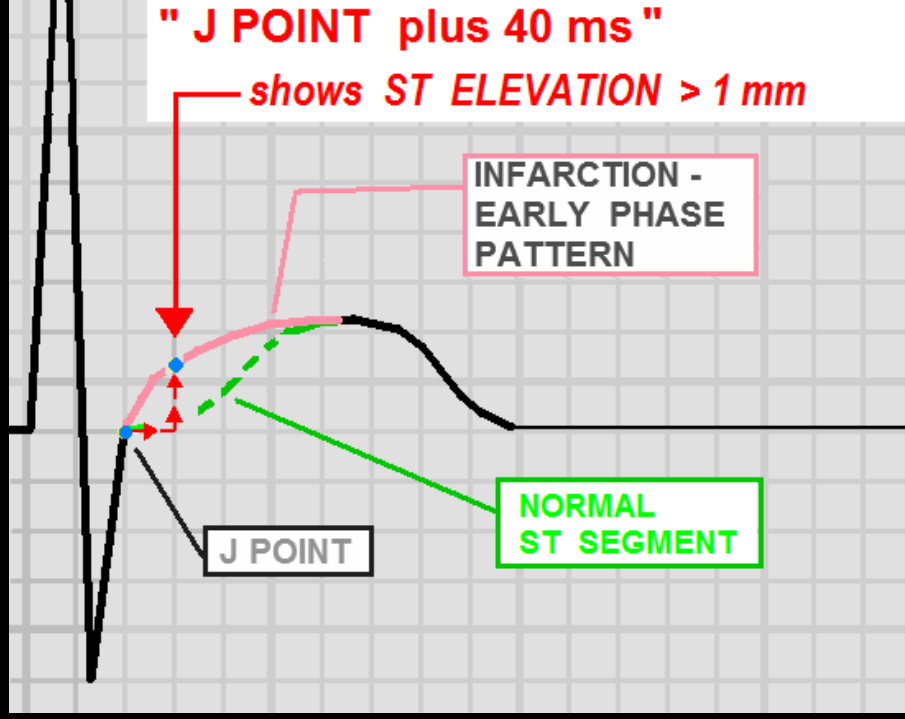

J-T Apex Segment
ST-Segment
T wave: origin to apex

THE S-T SEGMENT

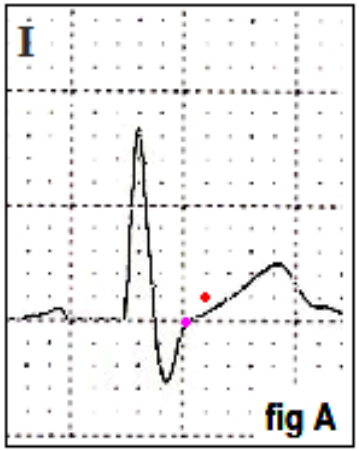


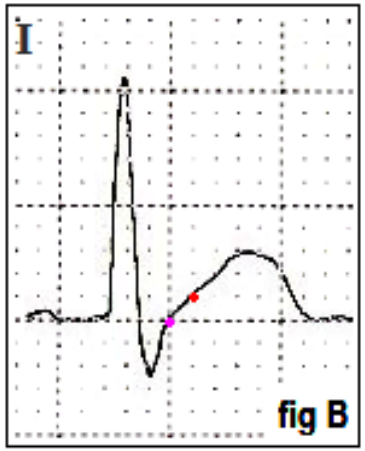
WHEN EVALUATING for ST SEGMENT ELEVATION . . . . . .

From:
AMERICAN HEART ASSOCIATION
ACLS 2005 REVISIONS



During NORMAL STATES of PERFUSION, the J POINT is ISOELECTRIC and the ST SEGMENT has a CONCAVE appearance. When measured 40 ms beyond the J POINT (noted by the RED DOT), the ST SEGMENT elevation is less than 1mm.

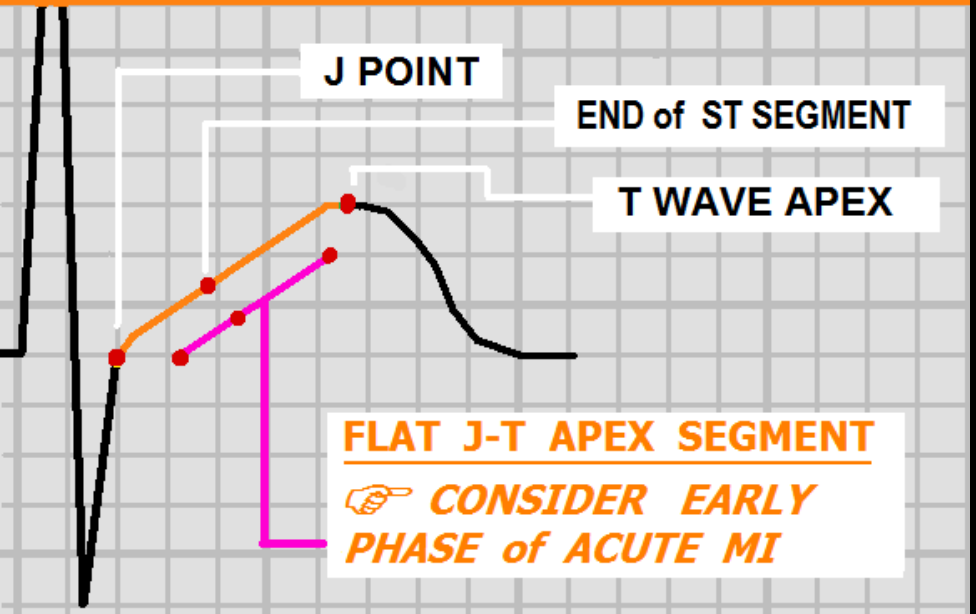




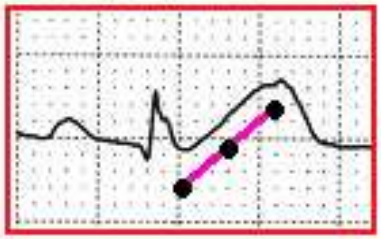
During a 20 second BALLOON OCCLUSION of the patient's LAD during routine PTCA, the ST segment assumes a CONVEX shape. When measured 40 ms beyond the J POINT, the ST segment is elevated > 1 mm. This phenonemon is seen routinely in the cath lab prior to the occurance of ST ELEVATION at the J POINT during PTCA and STENTING.

Both figures were recorded from a 54 year old male while resting (figure A), and during PTCA of the Left Anterior Descending artery (figure B).

ABNORMAL J-T APEX SEGMENT



LEAD II



1839 hrs

41 y/o FEMALE

In ER C/O CHEST PAIN x 30 minutes.

- *FLAT J-T APEX SEGMENT*
- *NO ST ELEVATION at J POINT !*

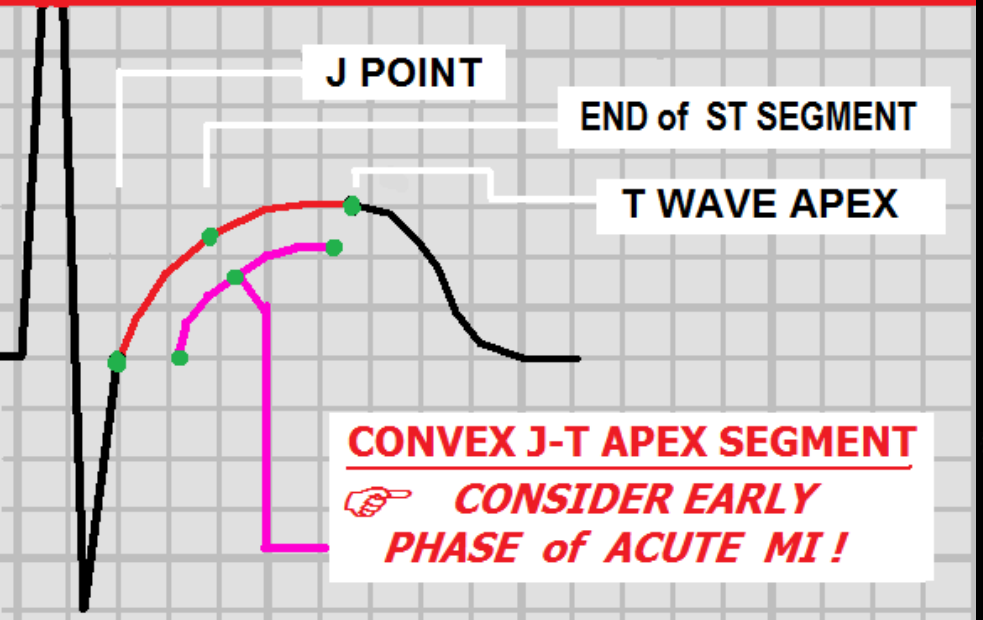
1850 hrs

STEMI - INFERIOR WALL

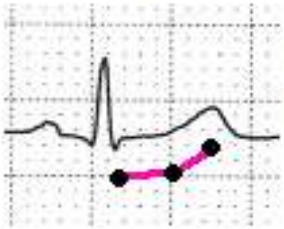
11 MINUTES LATER, S-T ELEVATION at the J POINT IS NOTED.

- CATH LAB FINDINGS: TOTAL OCCLUSION of the RIGHT CORONARY ARTERY

ABNORMAL J-T APEX SEGMENT

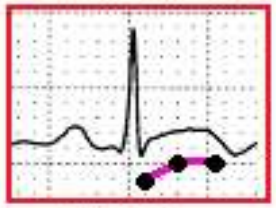


LEAD I



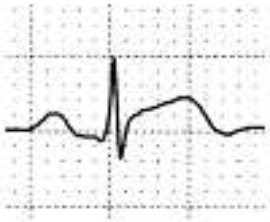
53 y/o MALE

1 yr. PRIOR TO MI
NORMAL EKG
CONCAVE J - T APEX SEGMENT



0732 hrs

STEMI LATERAL WALL
- *CONVEX J-T APEX SEGMENT*
- MINIMAL ST ELEVATION at J POINT



0747 hrs

15 MINUTES LATER, S-T ELEVATION at the J POINT IS NOTED.
- CATH LAB FINDINGS: TOTAL OCCLUSION OF CIRCUMFLEX ARTERY

CASE STUDY: ABNORMAL J-T APEX SEGMENTS

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

56 y/o MALE presents to ED with complaint of "INTERMITTENT SUBSTERNAL & SUB-EPIGASTRIC PRESSURE" x 3 HOURS. PMHx of ESOPHAGEAL REFLUX. NO other significant past medical history.

RISK FACTOR PROFILE:

- FAMILY HISTORY - father died of MI at age 62
- ☑ PREVIOUS CIGARETTE SMOKER - quit 15 years ago.
- ☑ CHOLESTEROL - DOES NOT KNOW; "never had it checked."
- ☑ OBESITY

PHYSICAL EXAM: Patient supine on exam table, mildly anxious, currently complaining of "mild indigestion," skin is warm, pale, dry; REST OF EXAM is UNREMARKABLE.

VITAL SIGNS: BP 142/94, P 80, R 20, SAO2 98%

LABS: JUST OBTAINED, RESULTS NOT AVAILABLE YET.

56 yr
Male Caucasian

Room:A9
Loc:3 Option:23

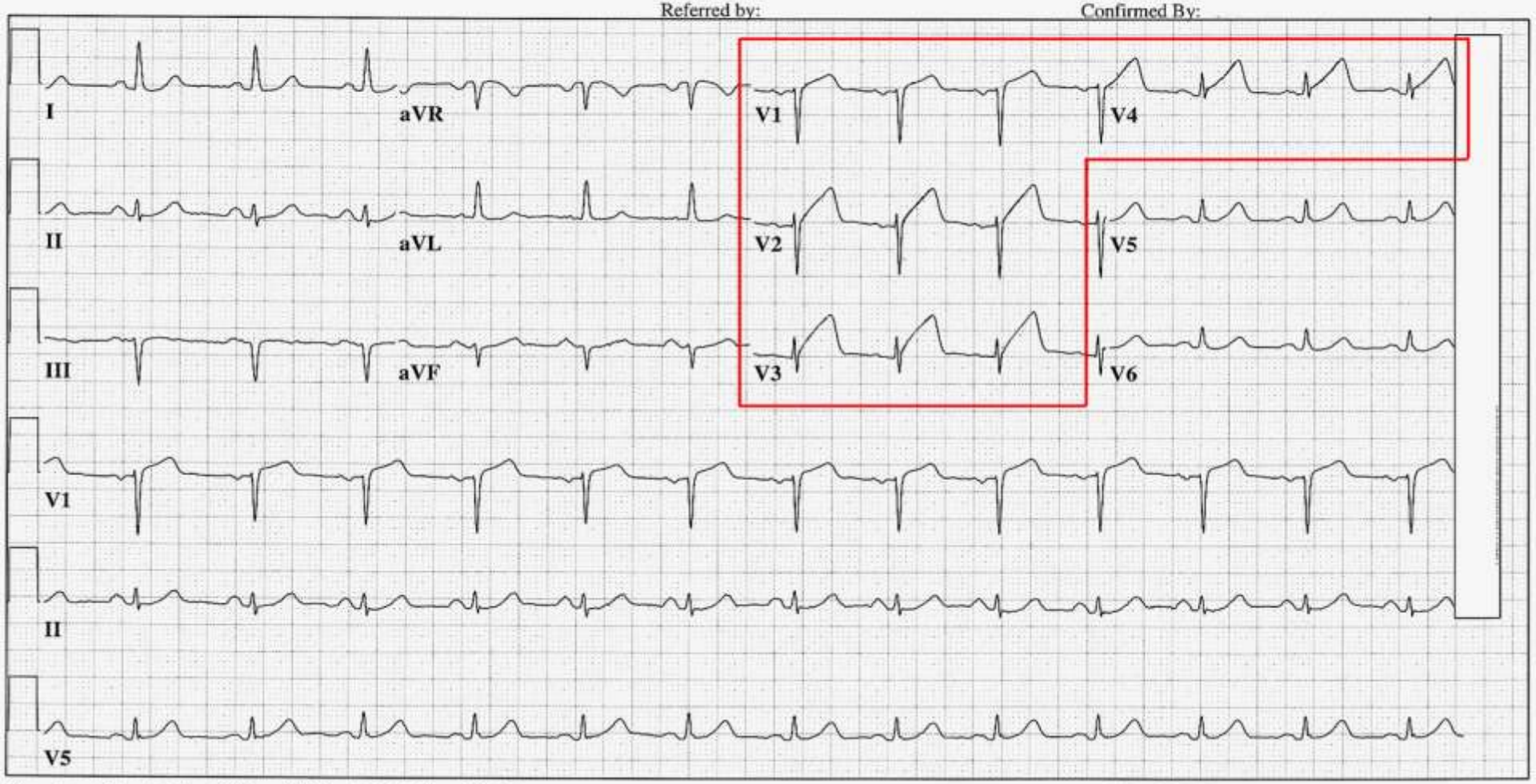
Vent. rate	80	BPM
PR interval	154	ms
QRS duration	78	ms
QT/QTc	380/438	ms
P–R–T axes	51 –24	38

**UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION

Normal sinus rhythm
Normal ECG
No previous ECGs available

Technician: W Ruppert

Referred by: Confirmed By:

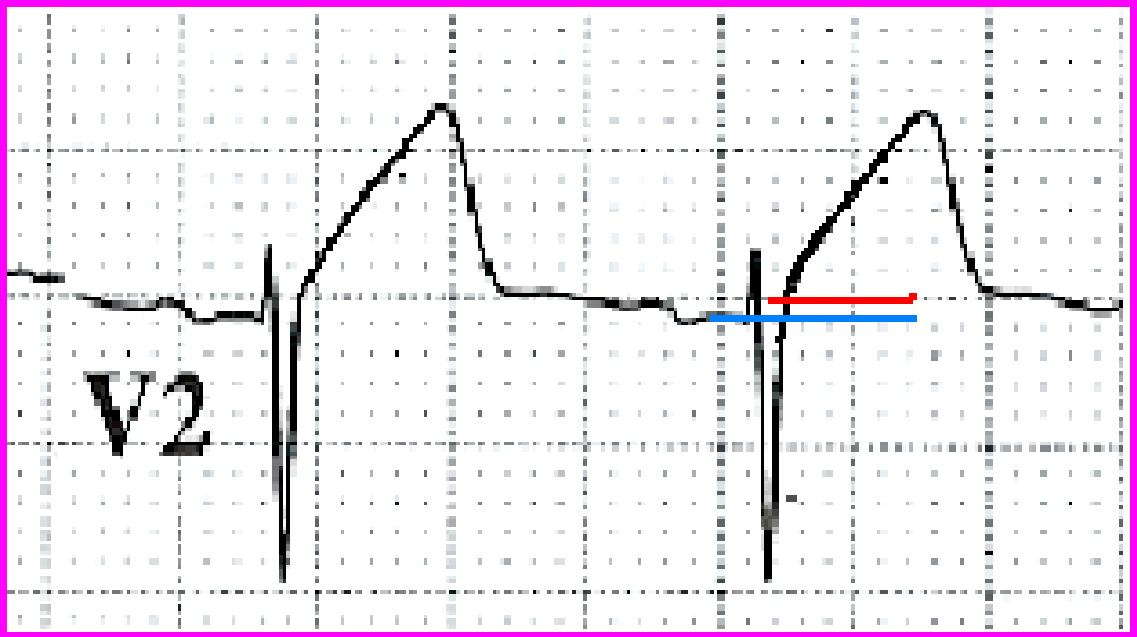


25mm/s 10mm/mV 40Hz 005C 12SL 235 CID: 3

EID:10 EDT:

ECG COMPUTER DOES NOT NOTICE THE CONVEX J-T APEX SEGMENTS !

measurement of S-T elevation



S-T elevation at J point = 0.5 mm

ACUTE MI = S-T elev. > 1.0 mm

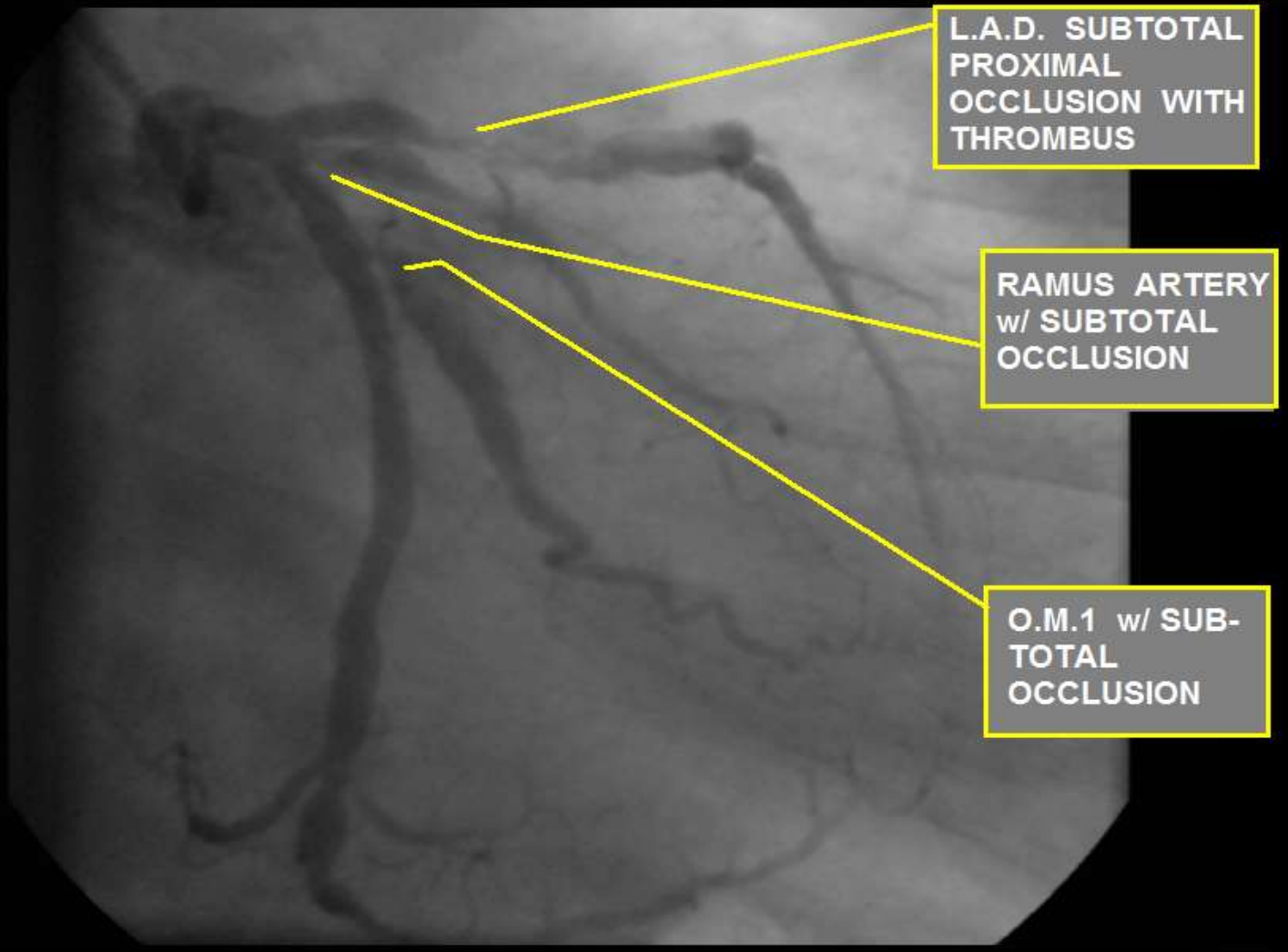
measurement of S-T elevation by "J point + .04" method

S-T elevation at J point = 0.5 mm

S-T elevation at J + .04 = 2.0 mm

ACUTE MI = S-T elev. > 1.0 mm

CASE STUDY: 56 y/o male with INTERMITTENT "CHEST HEAVINESS" . . . .



TREATMENT PLAN : EMERGENCY CORONARY ARTERY BYPASS SURGERY (4 VESSEL)

ECG Patterns associated with "EARLY PHASE MI:"

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

12:33:40

Seven R[illegible]rs Regiona
Dept: 2 so[illegible]
Room: er

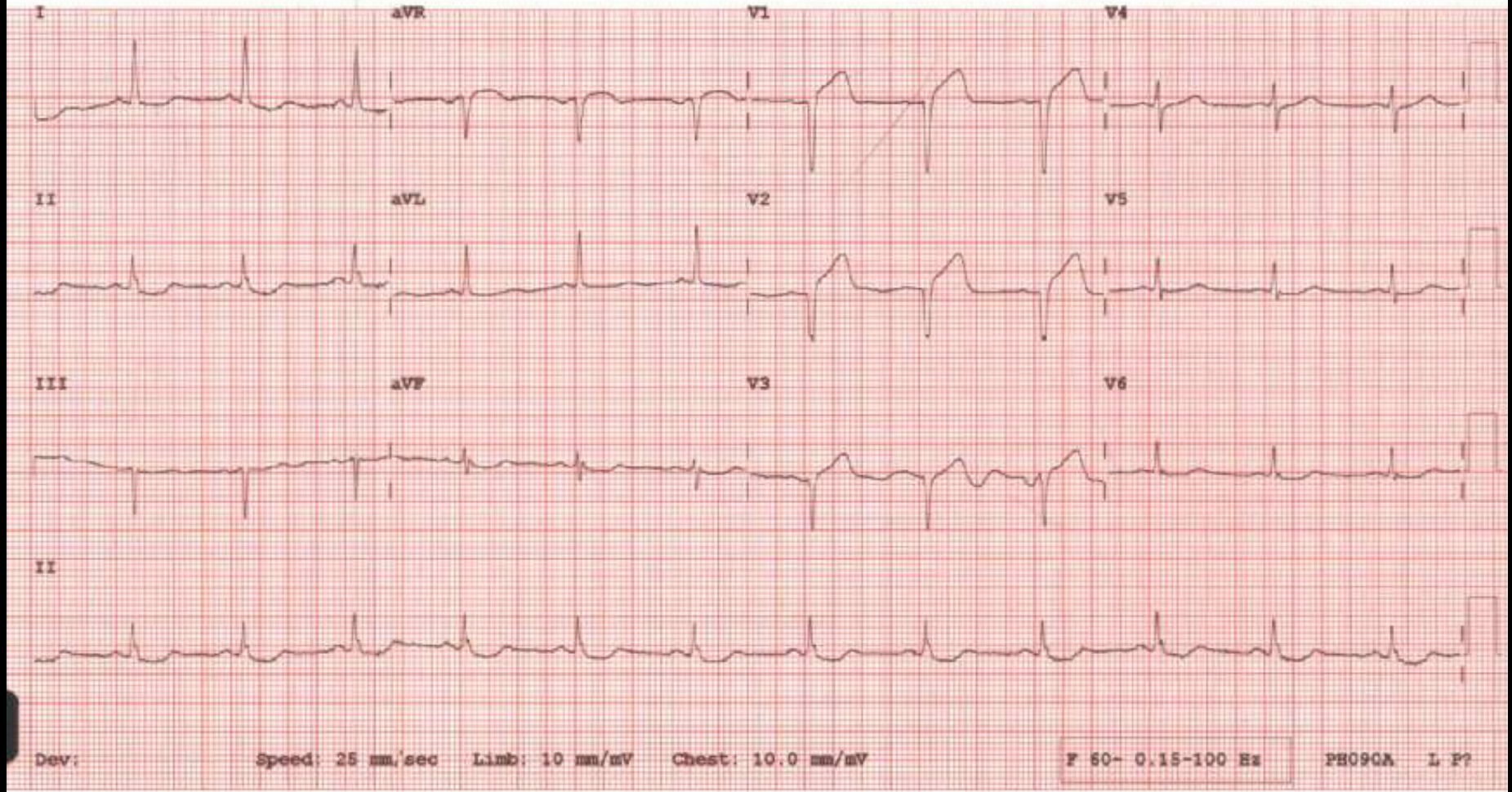
Rate	75	. SINUS RHYTHM.....normal P axis, V-rate 50- 99
		. CONSIDER ANTEROSEPTAL INFARCT.....Q >30mS, V1 V2
PR	140	. BORDERLINE REPOLARIZATION ABNORMALITY.....ST dep & abnormal T
QRSD	90	. BASELINE WANDER IN LEAD(S) V1,V2
QT	376	
QTc	420	

--AXIS--	
P	35
QRS	6
T	193

SEVEN RIVERS REGIONAL MED CTR

- ABNORMAL ECG -

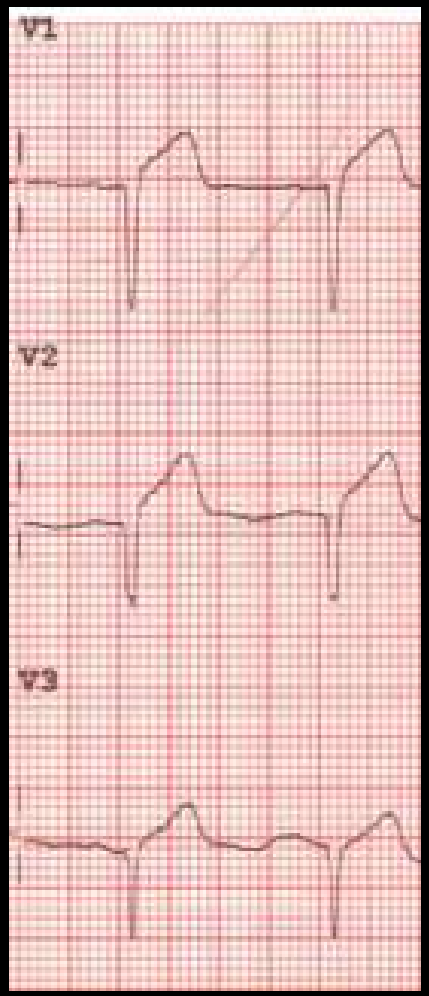
Unconfirmed Diagnosis



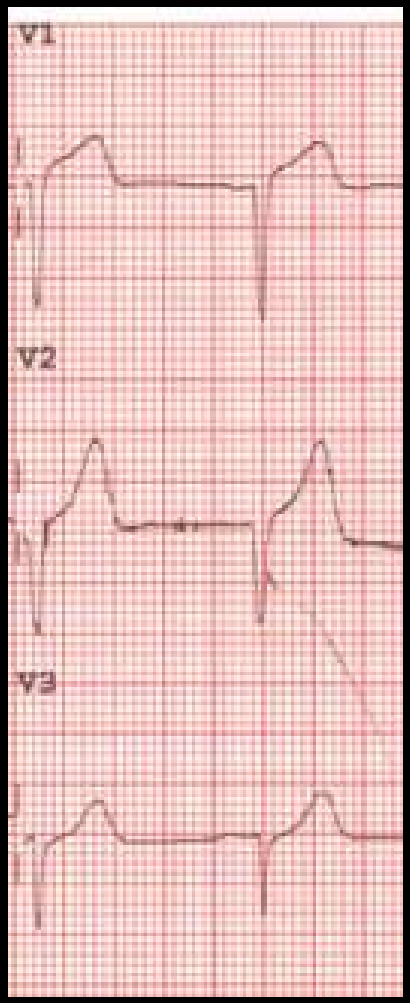
Dev: Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10.0 mm/mV F 60- 0.15-100 Hz PH090A L P?

3. Dynmamic ST-T Wave Changes in Serial ECGs. Recorded at SRRMC

1st ECG

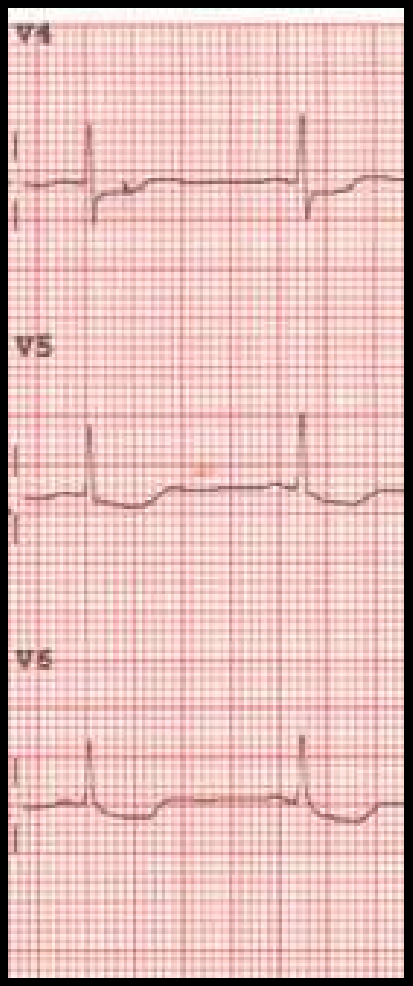


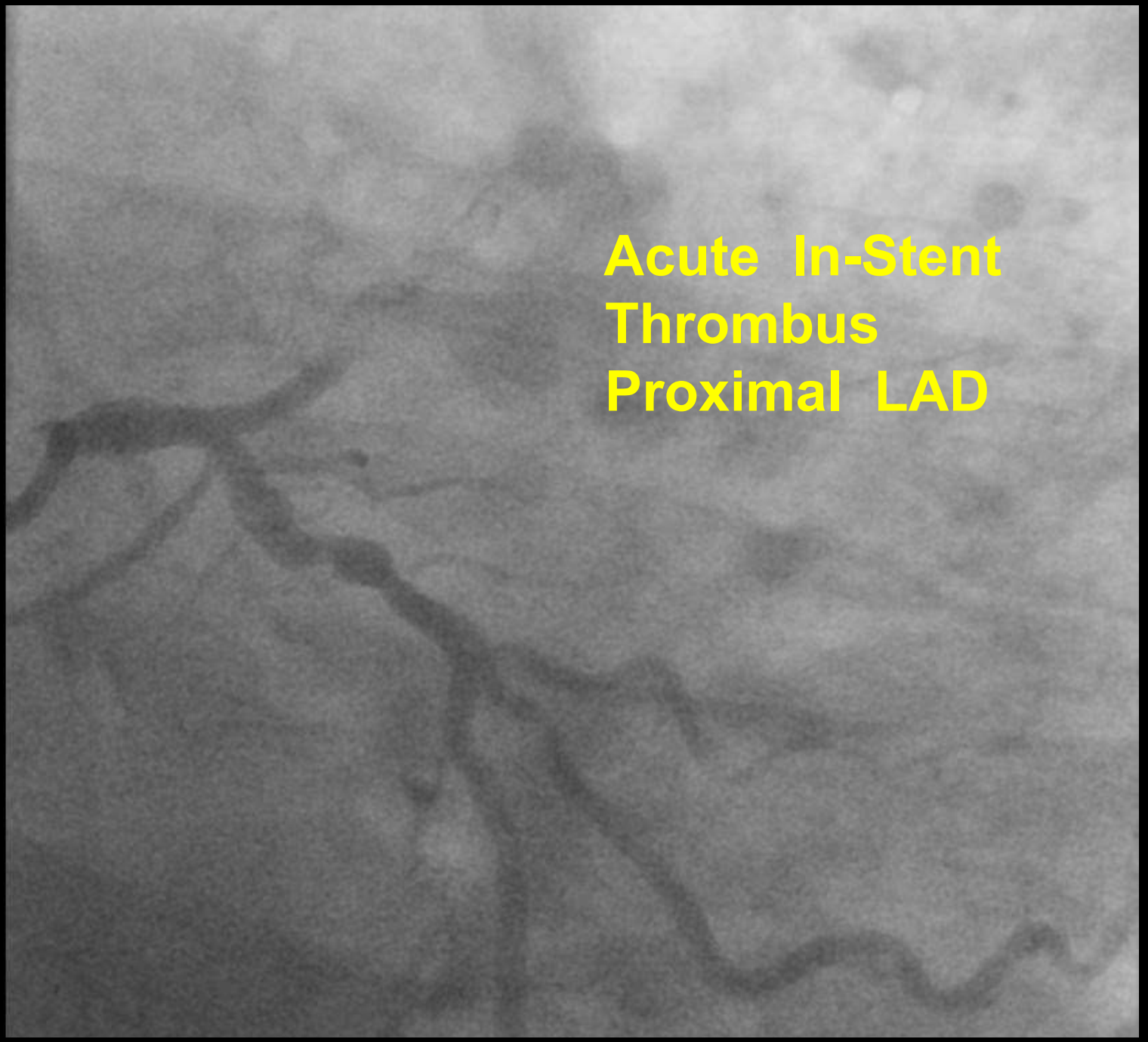
2nd ECG



1st ECG

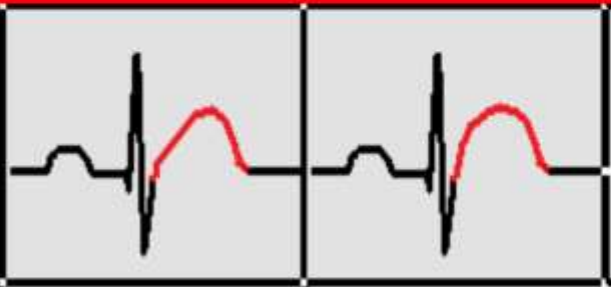
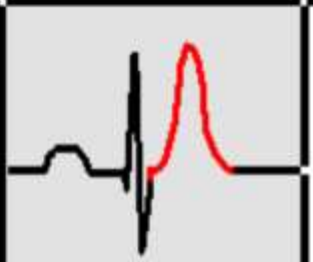
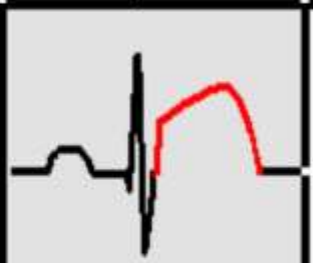
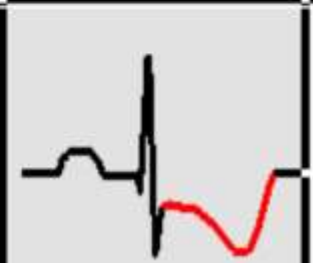
2nd ECG



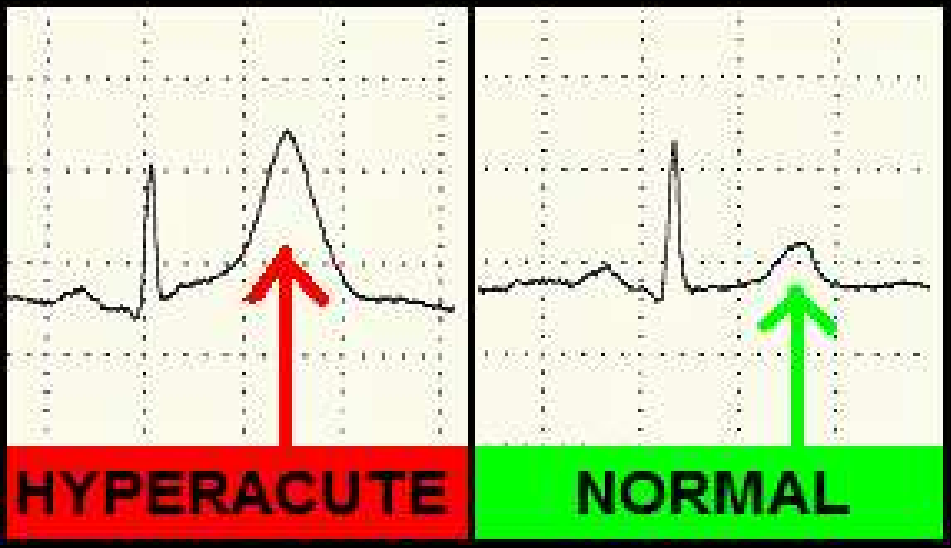

Acute In-Stent
Thrombus
Proximal LAD

PATTERNS of ACS & ISCHEMIA

-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --

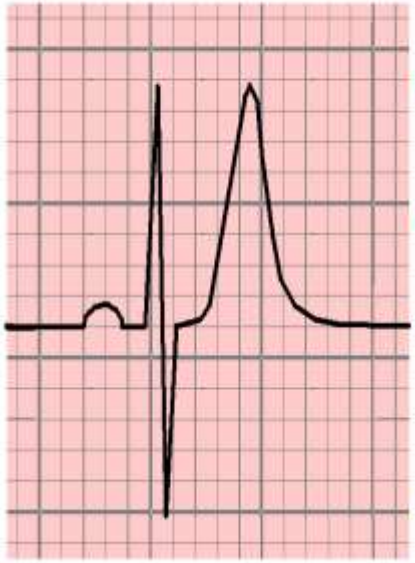
!	FLAT or CONVEX J-T APEX SEGMENT		**ACUTE MI** EARLY PHASE
!	HYPER-ACUTE T WAVE		**ACUTE MI** EARLY PHASE
!	S-T SEGMENT ELEVATION at J POINT		**ACUTE MI**
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

HYPERACUTE T WAVES

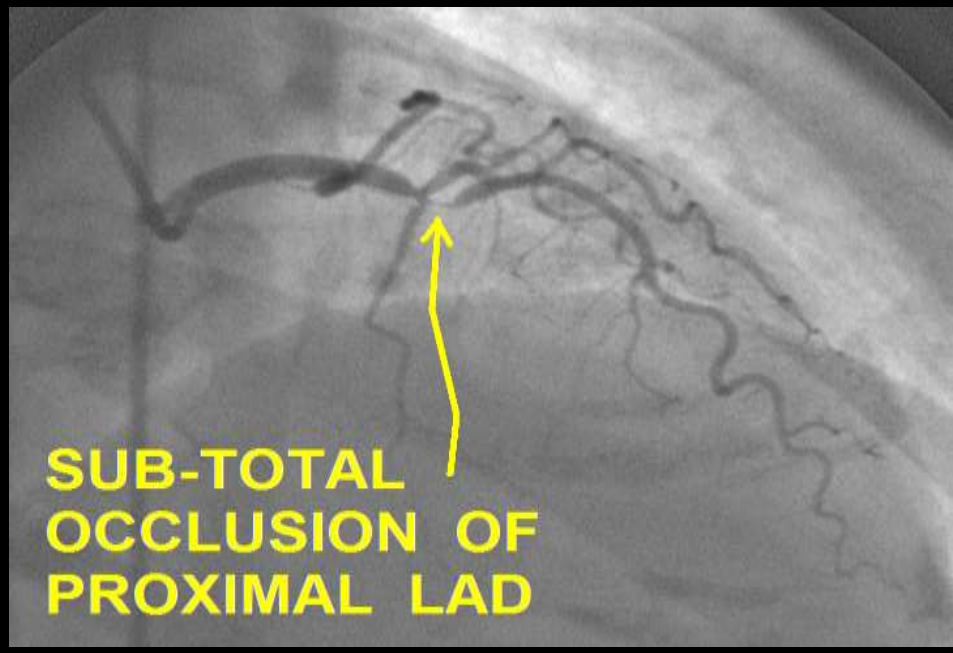


BOOK PAGE: 88

HYPER-ACUTE T WAVES - COMMON ETIOLOGIES:



CONDITION:	SEE PAGE(S):
HYPERKALEMIA	XX - XX
ACUTE MI	XX - XX
TRANS-MURAL ISCHEMIA	XX - XX
HYPERTROPHY	XX - XX



Helpful Clue: Hyper-Acute T Waves

- **GLOBAL Hyper-acute T Waves** (in leads viewing multiple myocardial regions / arterial distributions) **favors HYPERKALEMIA**

ID:

23-Nov-

REGIONAL MEDICAL CENTER

55years
Female Caucasian

Room:

Vent. rate	57 bpm
PR interval	150 ms
QRS duration	102 ms
QT/QTc	472/459 ms
P-R-T axes	76 70 58

Sinus bradyc a
Possible Left atrial enlargement
Borderline ECG

ER ATTENDING REVIEW
NO STEMI
TIME 1511

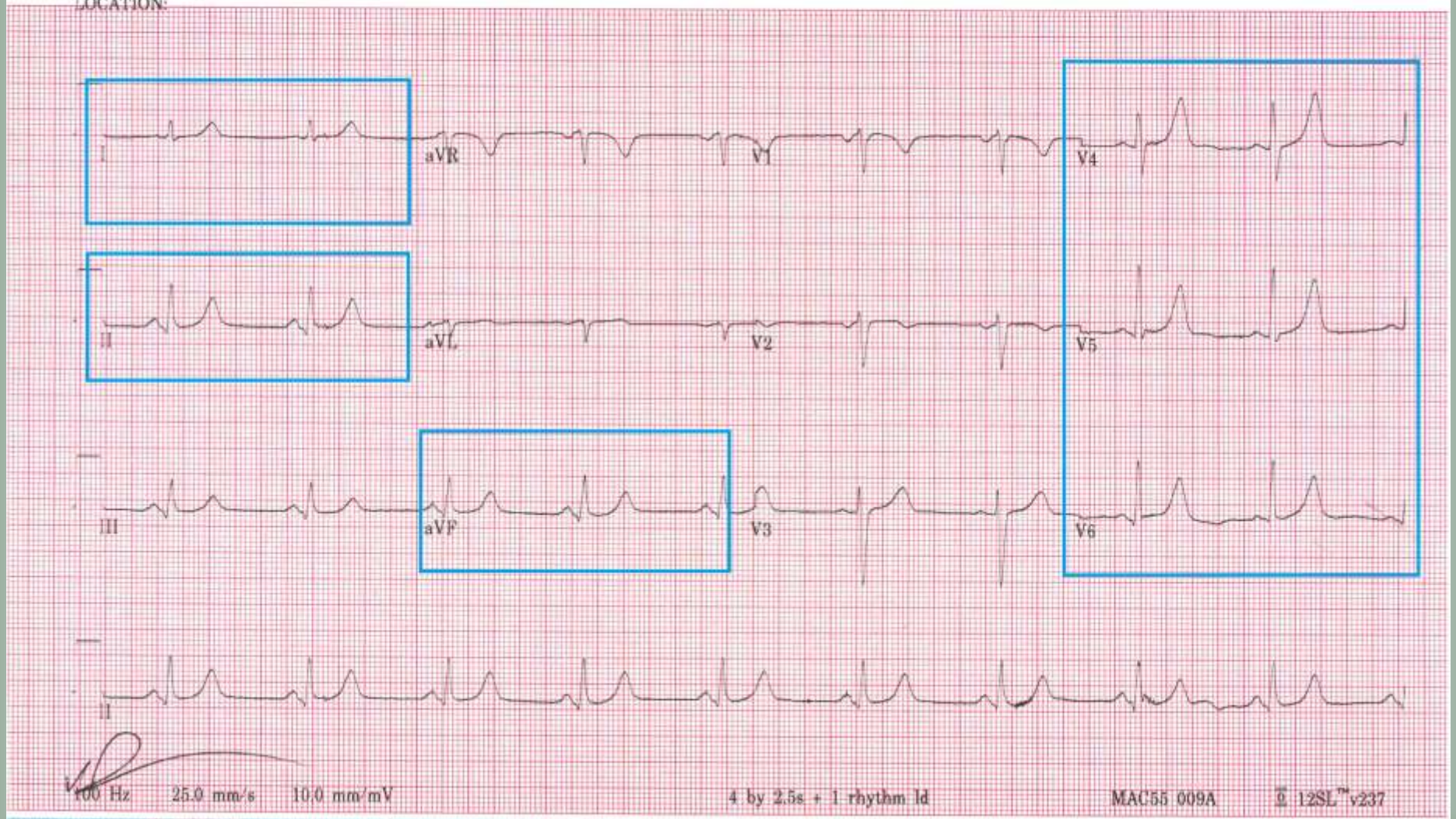
K+ = 6.7

Technician:
Test ind:

Referred by:

Unconfirmed

LOCATION:



Helpful Clue: Hyper-Acute T Waves

- **GLOBAL Hyper-acute T Waves** (in leads viewing multiple myocardial regions / arterial distributions) **favors HYPERKALEMIA**

- **Hyper-acute T Wave noted in ONE ARTERIAL DISTRIBUTION** (Anterior / Lateral / Inferior) favors TRANSMURAL ISCHEMIA / Early Phase Acute MI

CASE STUDY: HYPERACUTE T WAVES

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

30 y/o male presents to ER via EMS, c/o sudden onset of dull chest pain x 40 min. Pain level varies, not effected by position, movement or deep inspiration. No associated symptoms.

RISK FACTOR PROFILE: NONE. CHOLESTEROL UNKNOWN.

PHYSICAL EXAM: Patient is supine on exam table, CAO x 4, anxious, restless, skin pale, cool, dry. Patient c/o chest pressure, "7" on 1 - 10 scale, uneffected by position, movement, deep inspiration. Lungs clear. HS: NL S1, S2, no rubs, murmurs, gallops

VITAL SIGNS: BP 136/88 P 90 R 20 SAO2 98%

DIAGNOSTIC TESTING: 1st TROPONIN I - ultra: <0.07

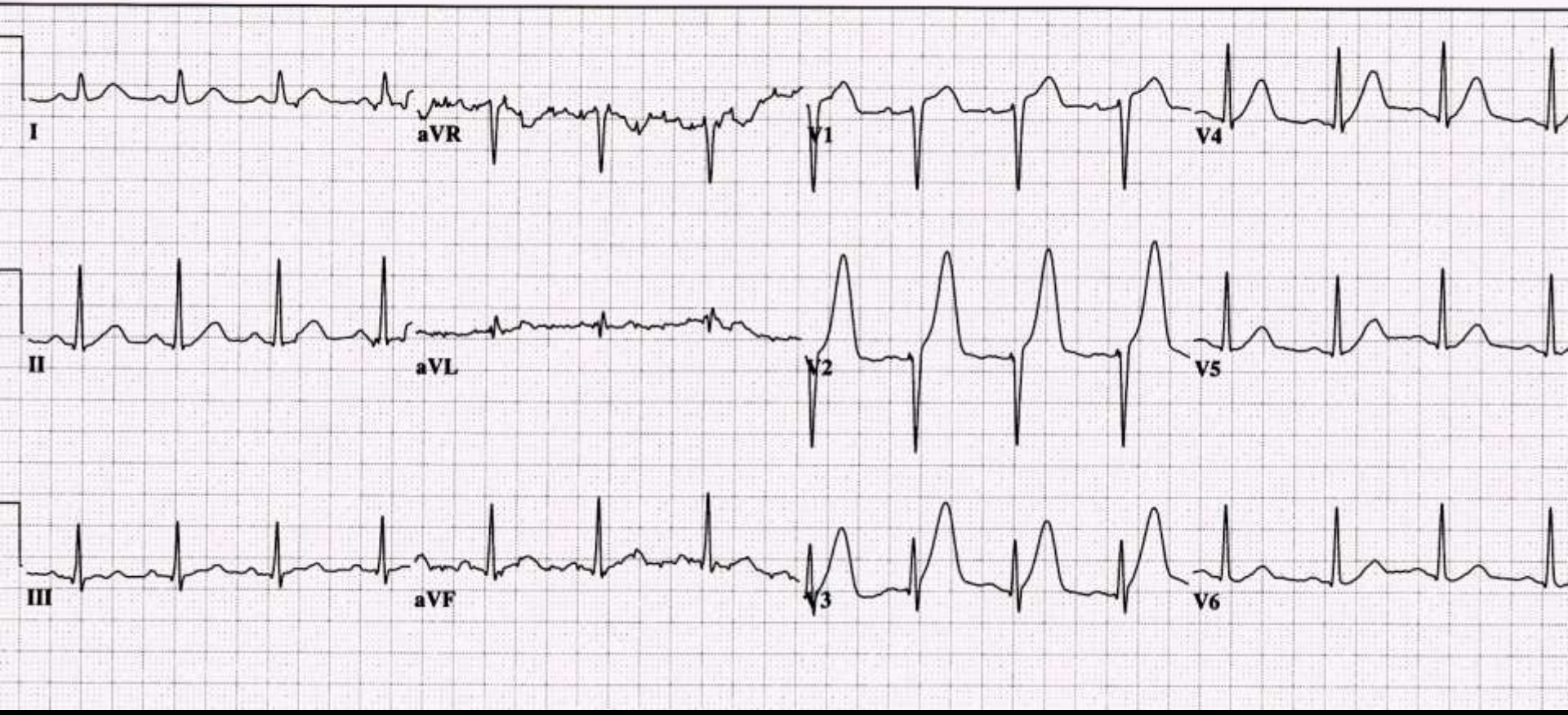
30 yr
Male Black

Room: ER
Loc: Option:

Vent. rate	88	BPM
PR interval	164	ms
QRS duration	90	ms
QT/QTc	370/447	ms
P-R-T axes	61 62	53

Normal sinus rhythm
Normal ECG
No previous ECGs available

← NOTE COMPUTER INTERPRETATION



30 yr
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Room: ER
Loc: Option:

Vent. rate	88	BPM
PR interval	164	ms
QRS duration	90	ms
QT/QTc	370/447	ms
P-R-T axes	61 62	53

Normal sinus rhythm
Normal ECG
No previous ECGs available

HIGHLIGHTED AREAS = HYPERACUTE T WAVES

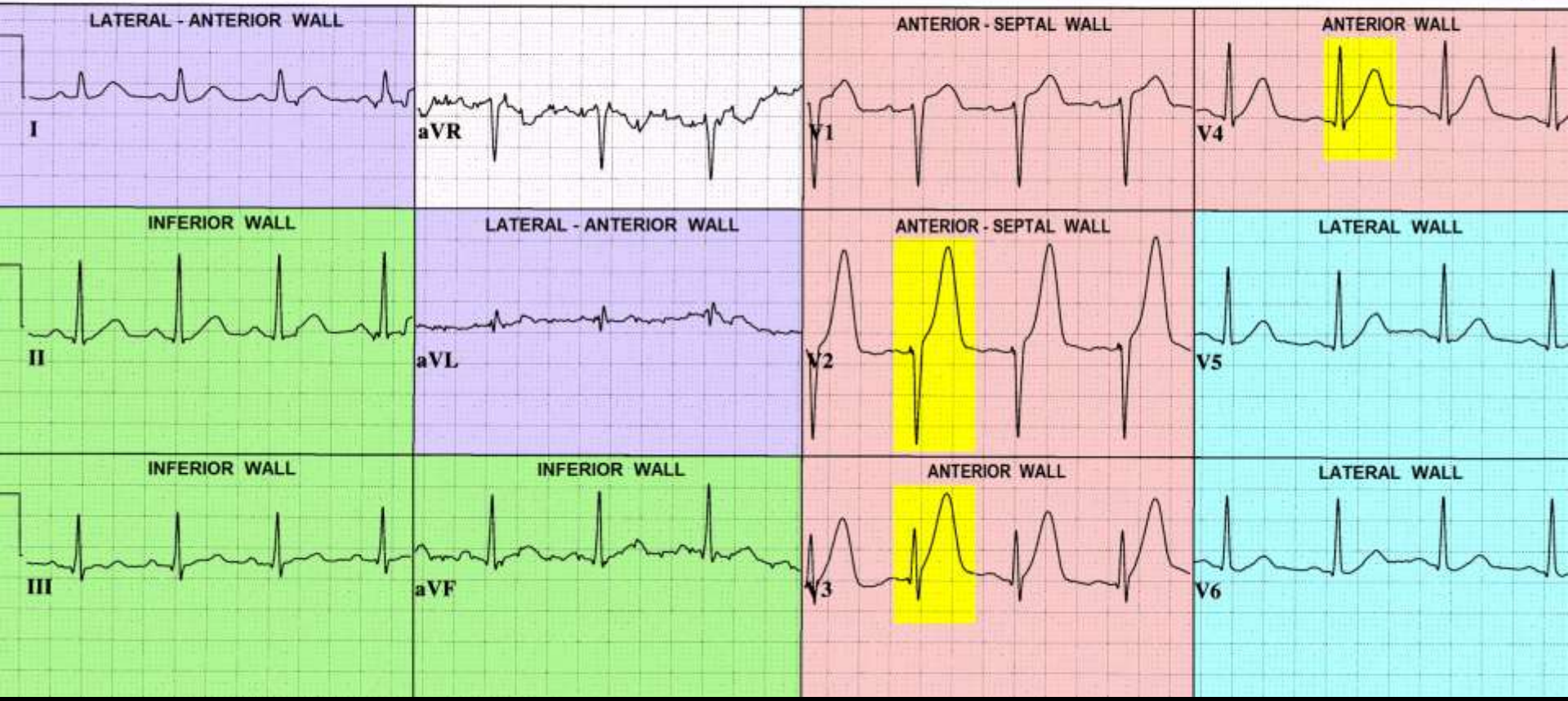
CORONARY ARTERIAL DISTRIBUTIONS:

V1 - V4 = LEFT ANTERIOR DESCENDING (LAD)

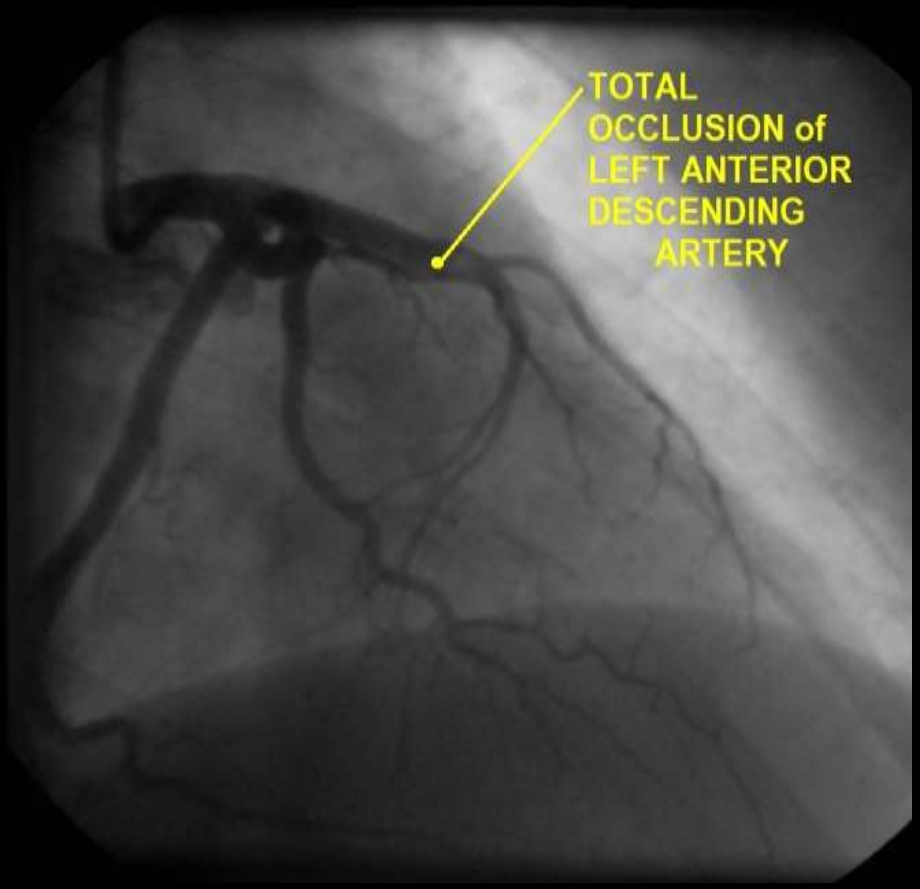
I, AVL = DIAGONAL (DIAG) off the LAD or OBTUSE MARGINAL (OM) off CIRCUMFLEX (CX)

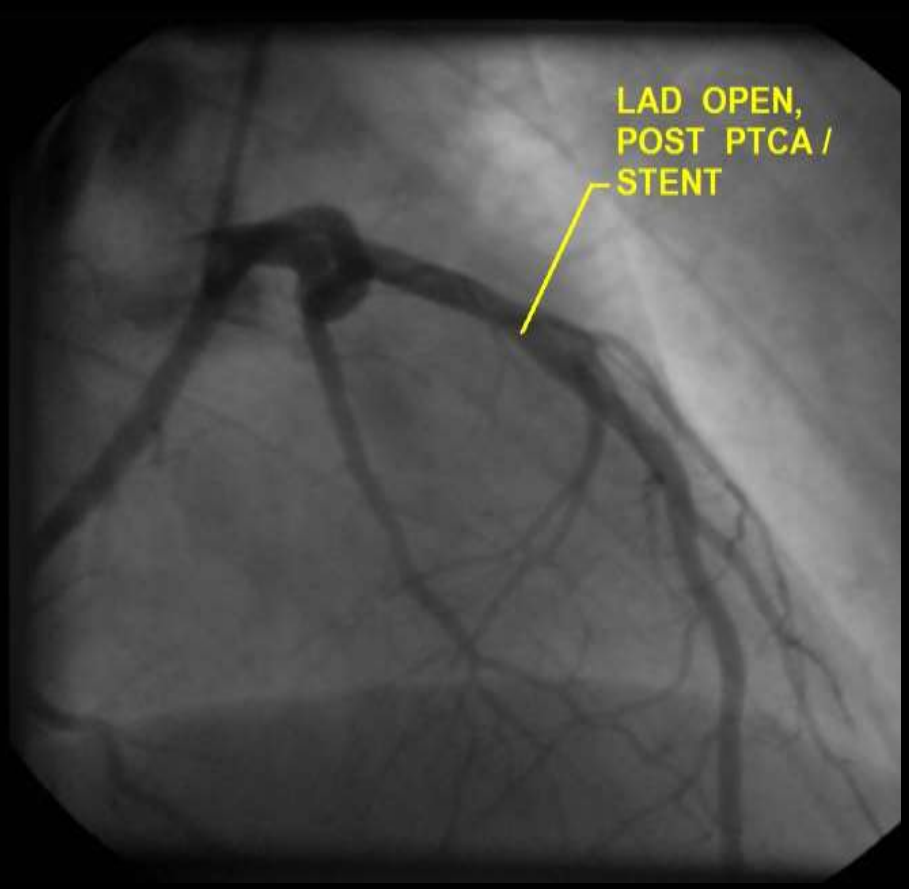
V5, V6 = CIRCUMFLEX

II, III, AVF = RIGHT CORONARY ARTERY or CX



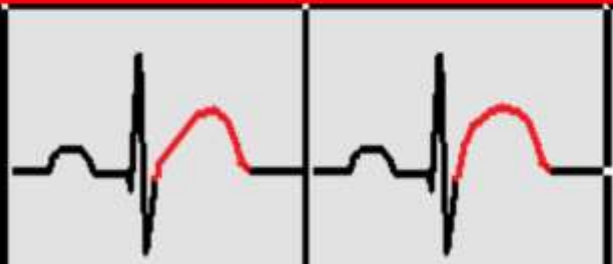
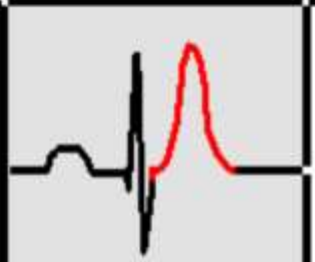
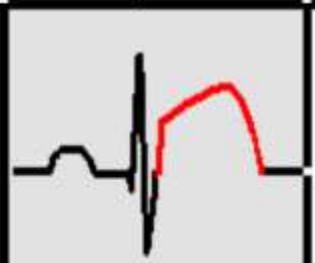
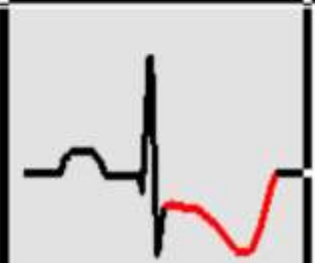
Cath Lab findings:





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 J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

ECG CRITERIA for DIAGNOSIS of STEMI:

(ST ELEVATION @ J POINT)

*LEADS V2 and V3:

MALES AGE 40 and up ------ 2.0 mm

(MALES LESS THAN 40------- 2.5 mm)

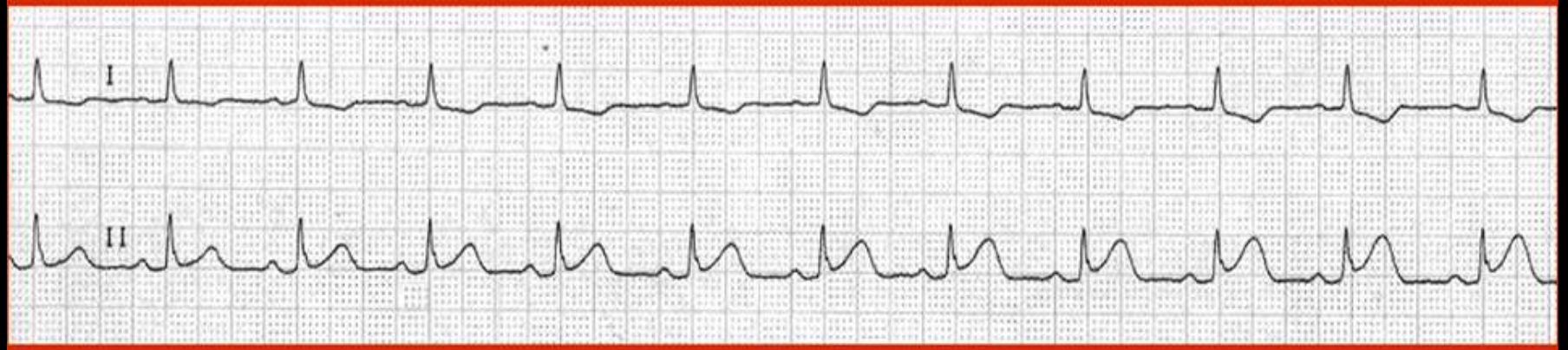
FEMALES ---------- 1.5 mm

ALL OTHER LEADS: 1.0 mm or more,
in TWO or more
CONTIGUOUS LEADS

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

ST SEGMENT ELEVATION:

S-T SEGMENTS ELEVATE WITHIN SECONDS OF CORONARY ARTERY OCCLUSION:



IN THIS CASE, a normal response to balloon occlusion of the RIGHT CORONARY ARTERY during PTCA in the CARDIAC CATH LAB

3 COMMON PATTERNS of ST SEGMENT ELEVATION From ACUTE MI:

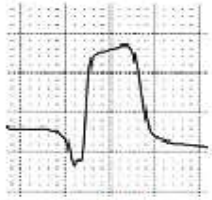
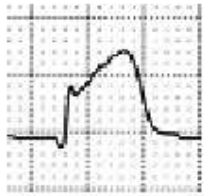
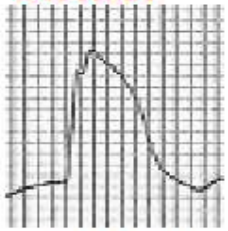
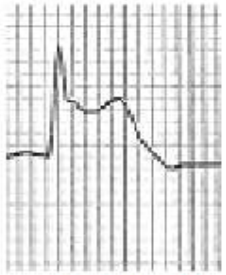
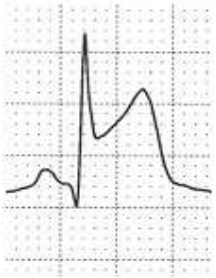
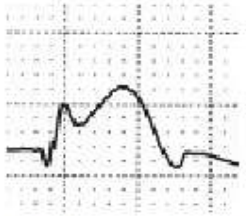
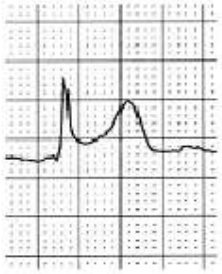
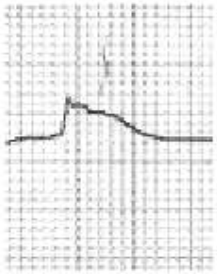
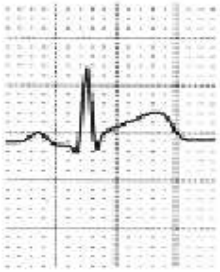
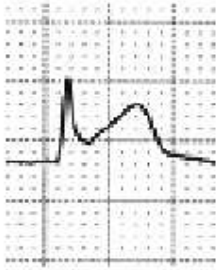
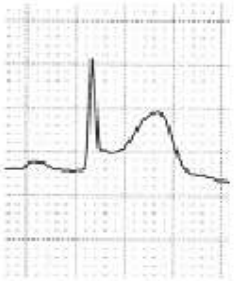
DOWNSLOPING S-T SEGMENT

FLAT S-T SEGMENT

UPSLOPING S-T SEGMENT

ST SEGMENT ELEVATION in ACUTE MI:

The following samples are from patients with ACUTE MI, as confirmed by discovery of total arterial occlusion in the Cardiac Cath Lab:

 V5 - ANTERIOR LATERAL MI	 V4 - ANTERIOR LATERAL MI	 aVL - ANTERIOR LATERAL MI	"TOOMBSTONE" PATTERN  V2 - ANTERIOR LATERAL MI	"FIREMAN'S HAT" PATTERN  V3- ANTERIOR LATERAL MI
"TOOMBSTONE" PATTERN  V4- ANTERIOR LATERAL MI	 V5- ANTERIOR LATERAL MI	 V5-ANTERIOR LATERAL MI	 II - INFERIOR POSTERIOR MI	"FIREMAN'S HAT" PATTERN  aVF- INFERIOR POSTERIOR MI
 III-INFERIOR MI	 III-INFERIOR POSTERIOR MI	 III-INFERIOR MI	 III-INFERIOR MI	 II- INFERIOR POSTERIOR MI

Reciprocal S-T Segment Depression ***may*** or ***may not*** be present during AMI.

The presence of S-T Depression on an EKG which exhibits significant S-T elevation is a fairly reliable indicator that AMI is the diagnosis.

However the ***lack of Reciprocal S-T Depression*** DOES NOT rule out AMI.

ACUTE MI

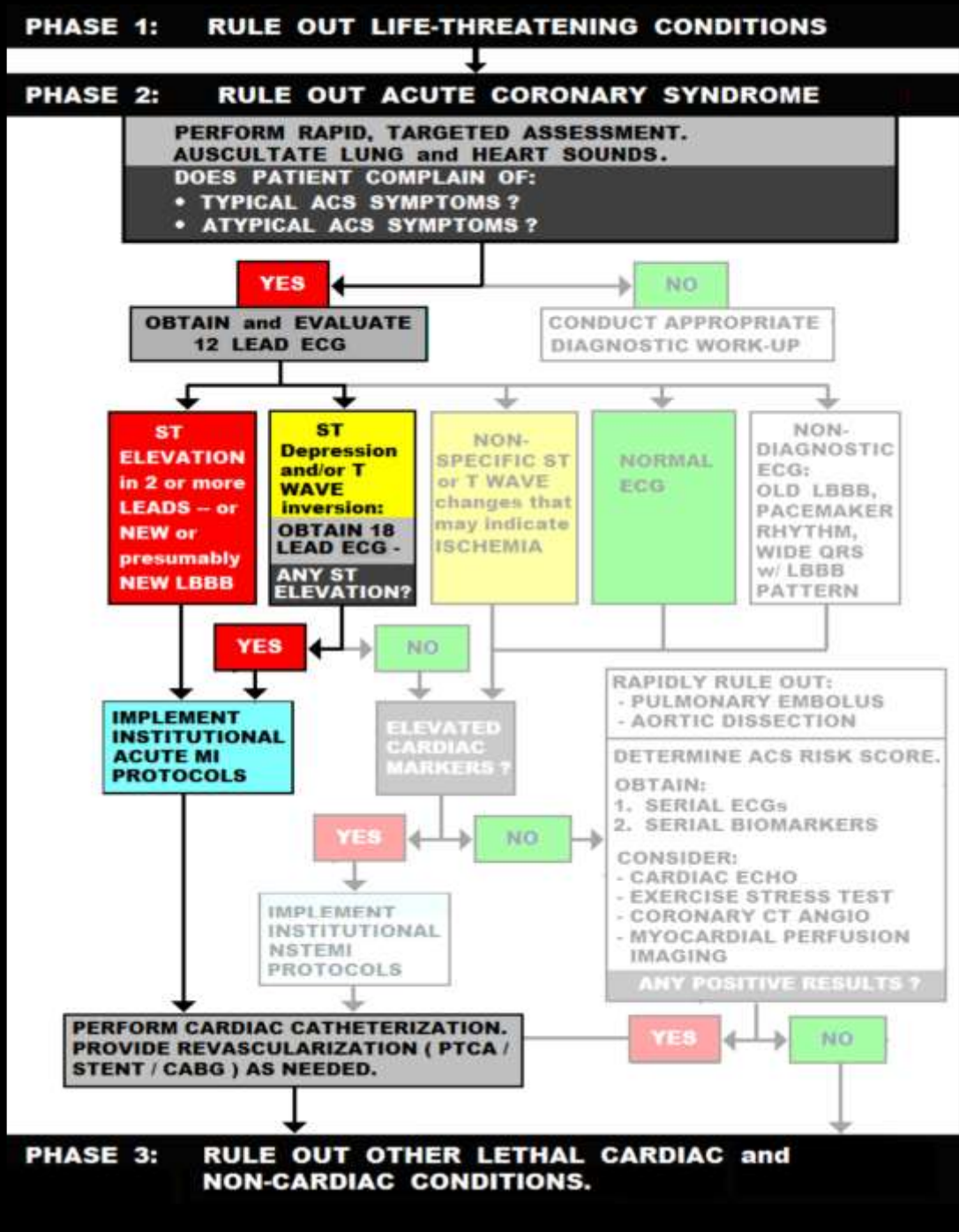
COMPLICATIONS TO ANTICIPATE FOR ALL MI PATIENTS :

LETHAL DYSRHYTHMIAS

CARDIAC ARREST

FAILURE OF STRUCTURE(S) SERVED BY THE BLOCKED ARTERY

STEMI CASE STUDIES



CASE STUDY 1 - STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

72 y/o male, c/o CHEST "HEAVINESS," started 20 minutes before calling 911. Pain is "8" on 1-10 scale, also c/o mild shortness of breath. Has had same pain "intermittently" x 2 weeks.

RISK FACTOR PROFILE:

- FAMILY HISTORY - father died of MI at age 77
- FORMER CIGARETTE SMOKER - smoked for 30 year - quit 27 years ago
- DIABETES - oral meds and diet controlled
- HIGH CHOLESTEROL - controlled with STATIN meds
- AGE: OVER 65

PHYSICAL EXAM: Patient calm, alert, oriented X 4, skin cool, dry, pale. No JVD, Lungs clear bilaterally. Heart sounds normal S1, S2. No peripheral edema.

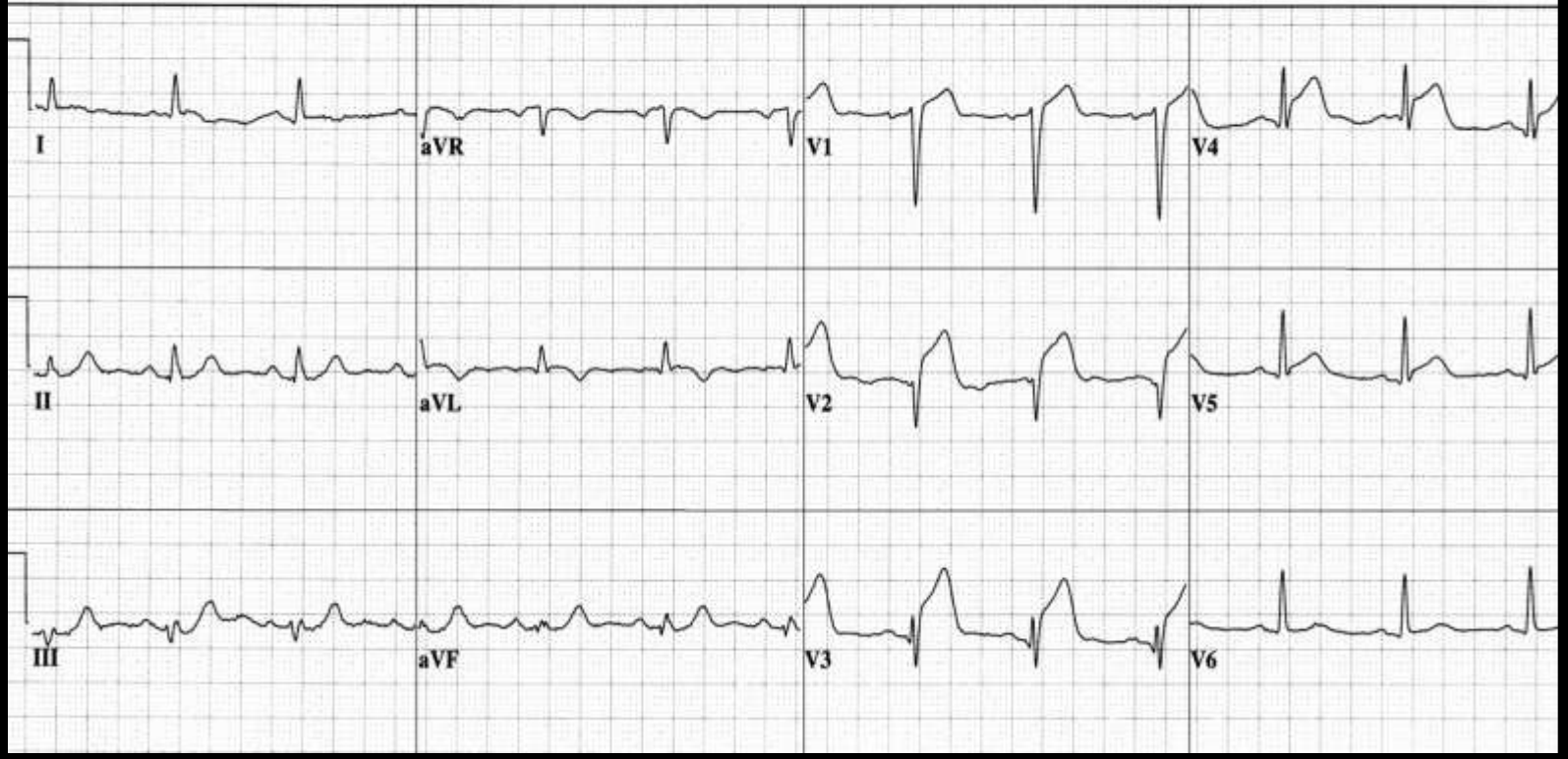
VITAL SIGNS: BP: 100/64, P: 75, R: 20, SAO2: 94%

LABS: FIRST TROPONIN: 6.4

72 yr		Vent. rate	75	BPM
Male	Caucasian	PR interval	162	ms
		QRS duration	98	ms
		QT/QTc	382/426	ms
Loc:3	Option:23	P-R-T axes	72 13	83

EVALUATE EKG for indicators of ACS:

- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- CONVEX ST SEGMENTS
- OTHER ST SEGMENT / T WAVE ABNORMALITIES



CASE STUDY QUESTIONS:

NOTE LEADS WITH ST ELEVATION:	NOTE LEADS WITH ST DEPRESSION:
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	LIST ANY POTENTIAL COMPLICATIONS:

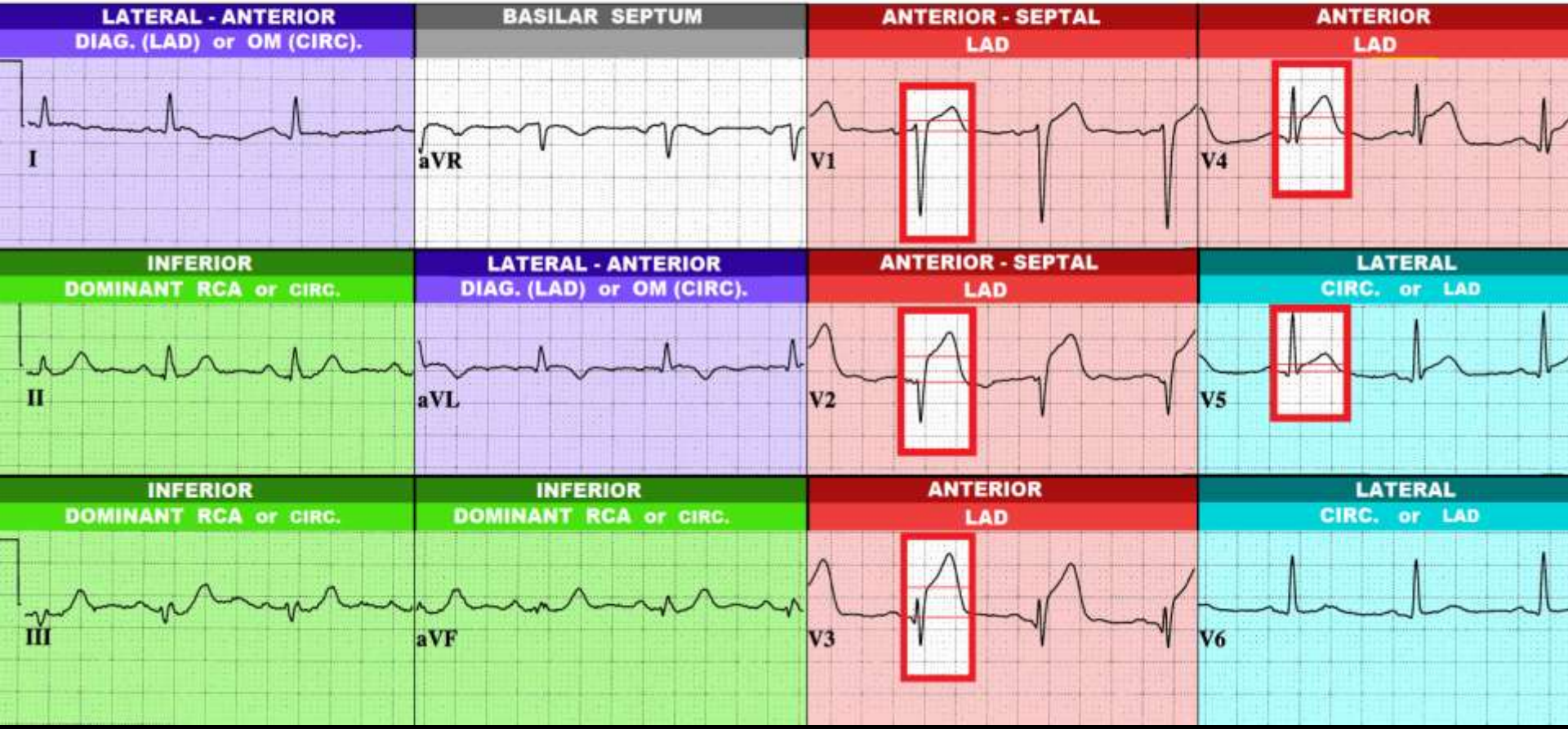
72 yr
Male Caucasian

Loc: Option:2

Vent. rate	75	BPM
PR interval	162	ms
QRS duration	98	ms
QT/QTc	382/426	ms
P-R-T axes	72 13	83

Normal sinus rhythm
Anteroseptal infarct , possibly acute
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG

ST SEGMENT ELEVATION



72 yr		Vent. rate	75	BPM
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		QT/QTc	382/426	ms
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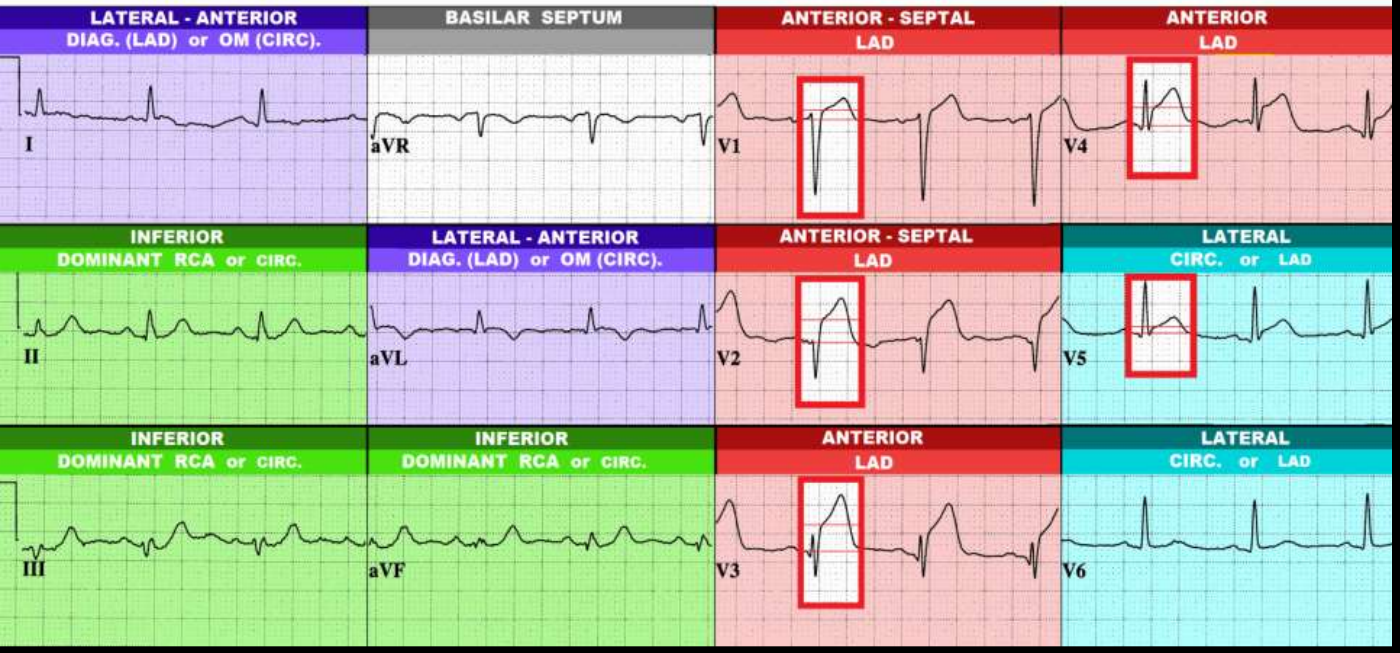
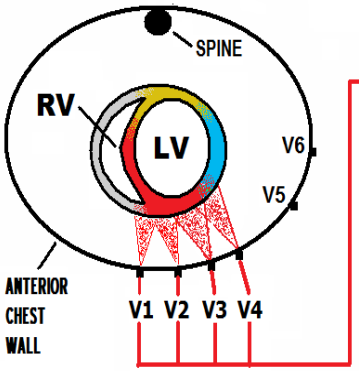
Abnormal ECG

ST SEGMENT ELEVATION

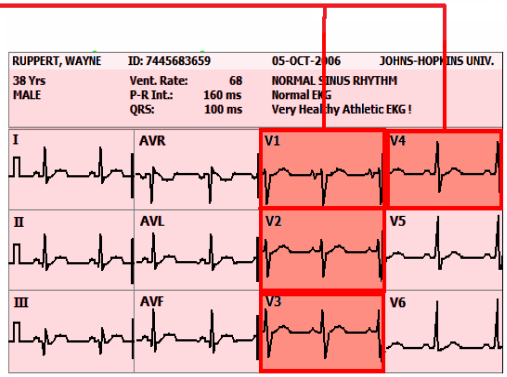


V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE



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



72 yr
Male Caucasian

Loc: Option:2

Vent. rate	75	BPM
PR interval	162	ms
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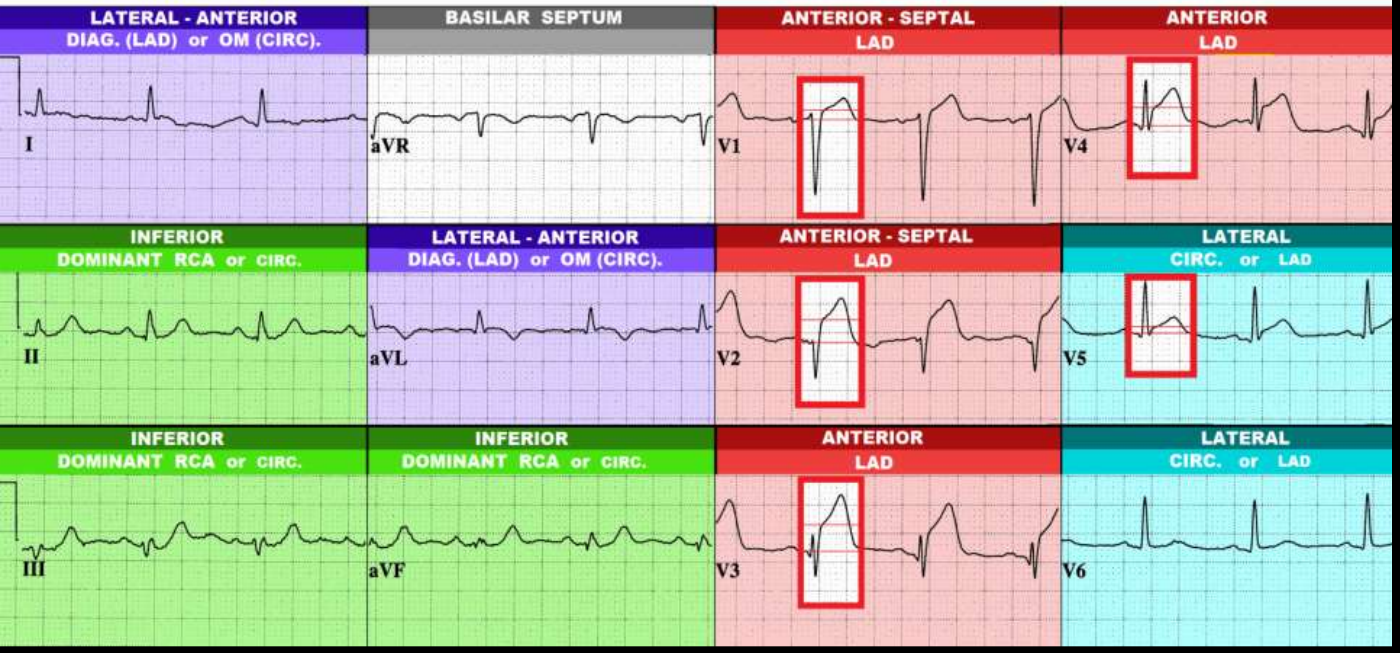
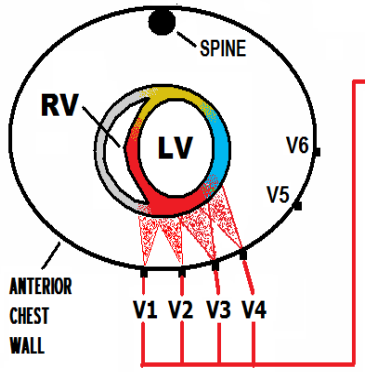
Normal sinus rhythm
Anteroseptal infarct , possibly acute
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG

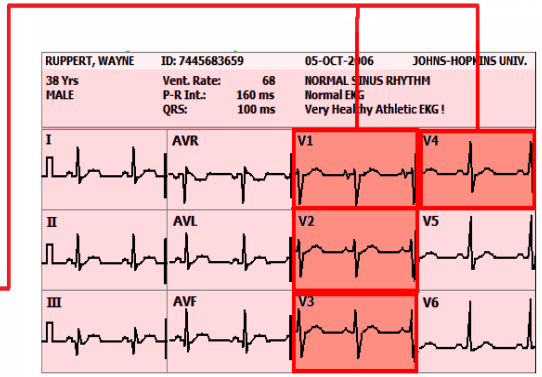
ST SEGMENT ELEVATION



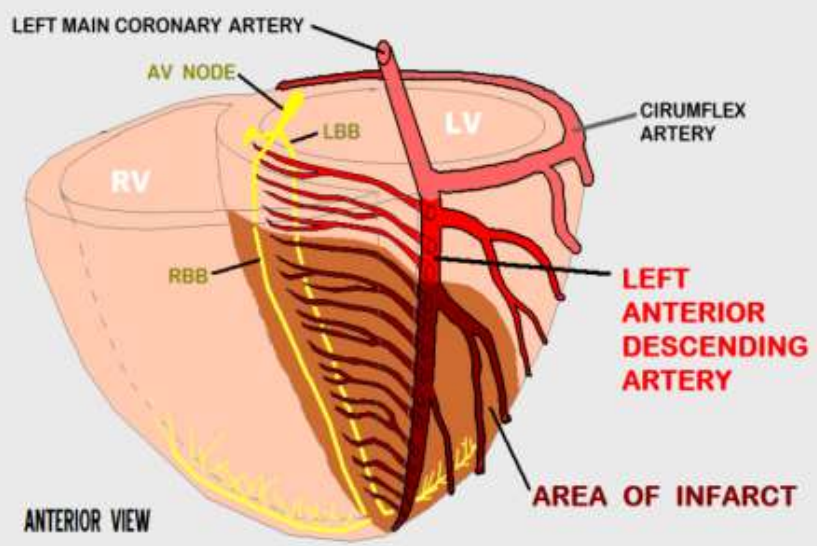
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL
of the LEFT VENTRICLE



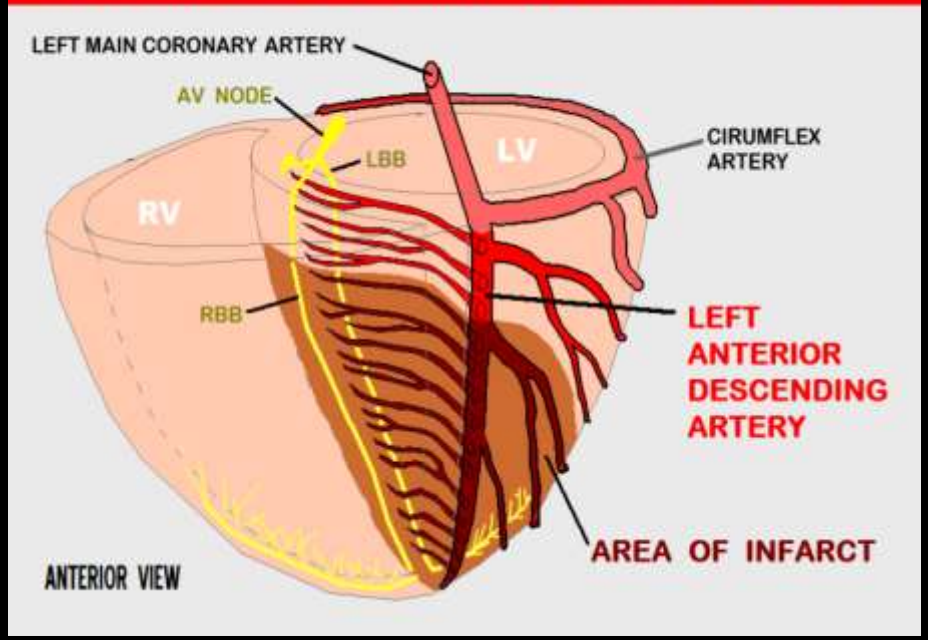
V1, V2 - ANTERIOR / SEPTAL
V3, V4 - ANTERIOR



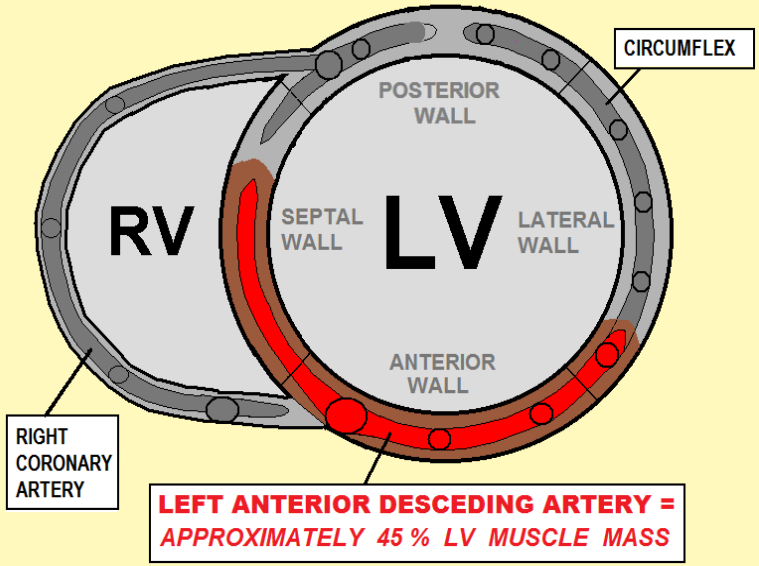
OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



BLOOD SUPPLY TO VENTRICLES:
COMMON ARTERIAL DISTRIBUTIONS



CASE STUDY SUMMARY

NOTE LEADS WITH ST ELEVATION: V1 - V5	NOTE LEADS WITH ST DEPRESSION: NONE
SUSPECTED DIAGNOSIS: ACUTE ANTERIOR - SEPTAL STEMI	
SUSPECTED "CULPRIT ARTERY" (if applicable): MID LEFT ANTERIOR DESCENDING ARTERY (LAD)	

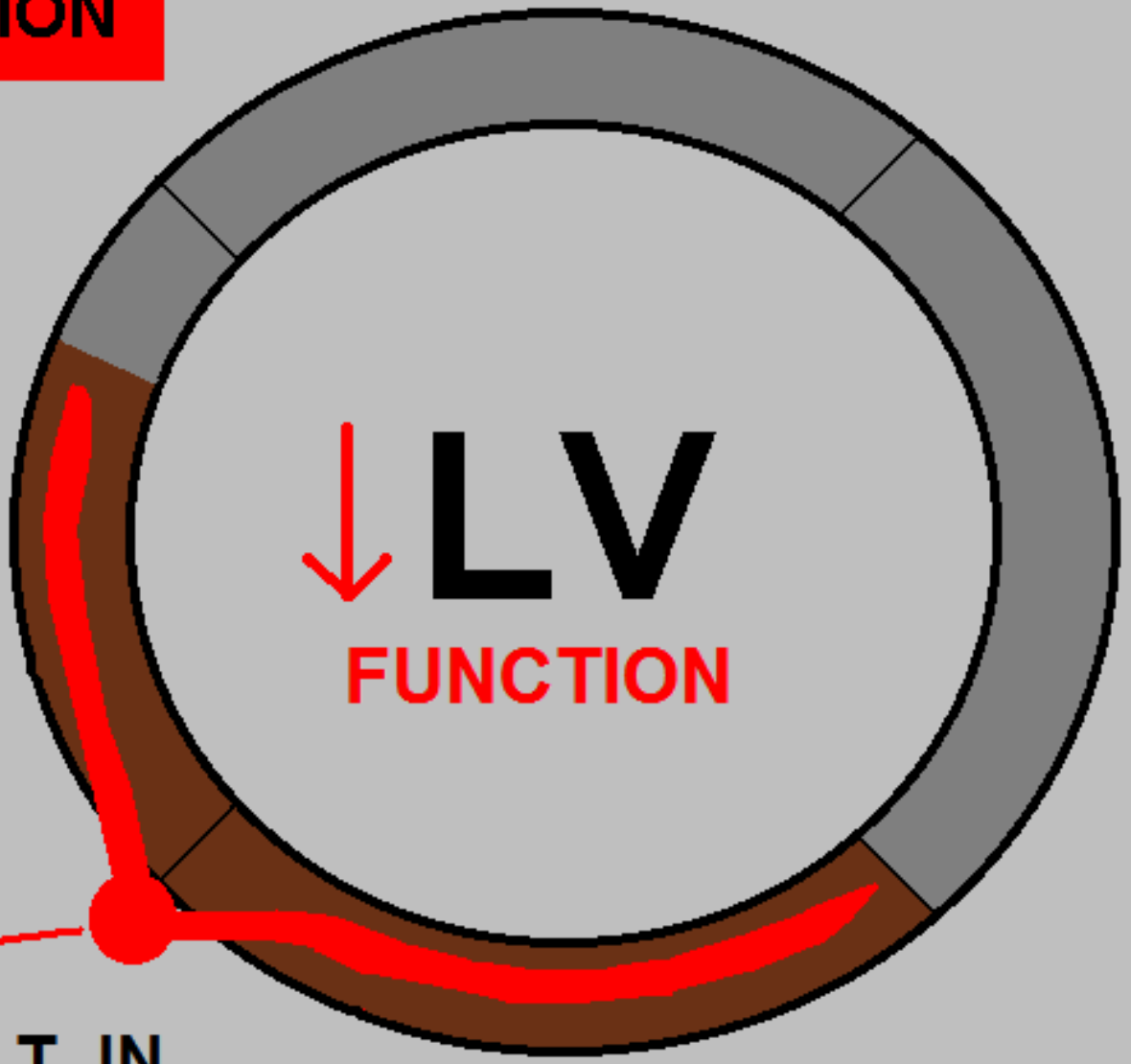
IMMEDIATE CONCERNS FOR ALL STEMI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
40-50% of the LV MUSCLE MASS	LV PUMP FAILURE leading to: - CARDIOGENIC SHOCK - PULMONARY EDEMA	INOTROPIC AGENTS ET INTUBATION I.A.B.P. INSERTION
	VENTRICULAR DYSRHYTHMIAS (VT / VF)	DEFIBRILLATION / ANTIARRHYTHMIC AGENTS
Potential compromise of BLOOD SUPPLY to: - Bundle of His - Proximal Bundle Branches	HIGH-GRADE HEART BLOCKS (2nd - 3rd degree)	TRANSCUTANEOUS or TRANSVENOUS PACING
	BUNDLE BRANCH BLOCKS	

LAD DISTRIBUTION

35 - 45 % of LV MUSCLE MASS



A BLOCKAGE OF THE LAD

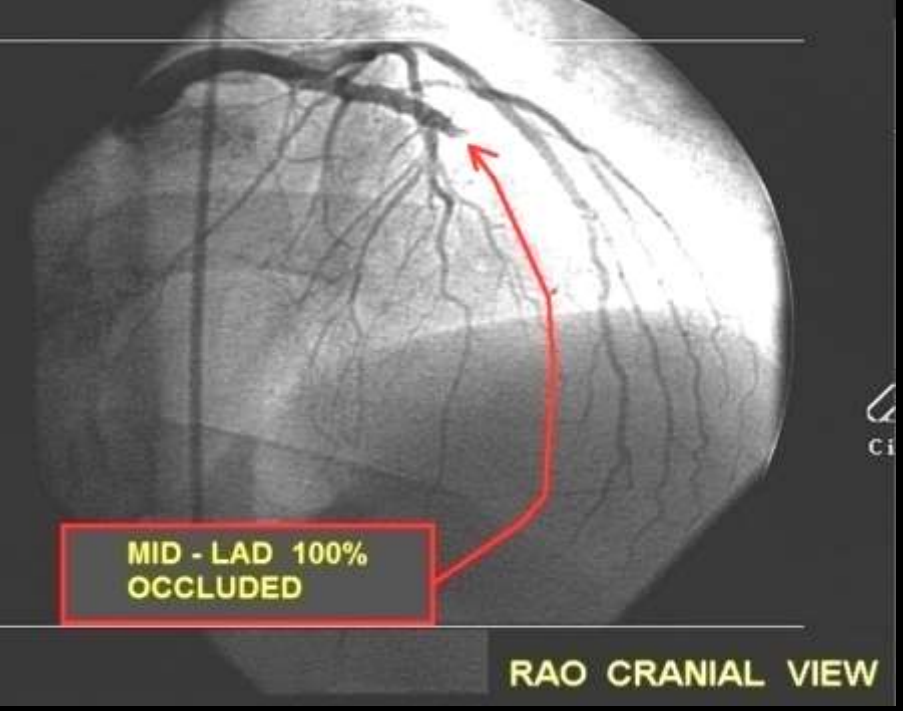
CAN RESULT IN LV PUMP FAILURE --

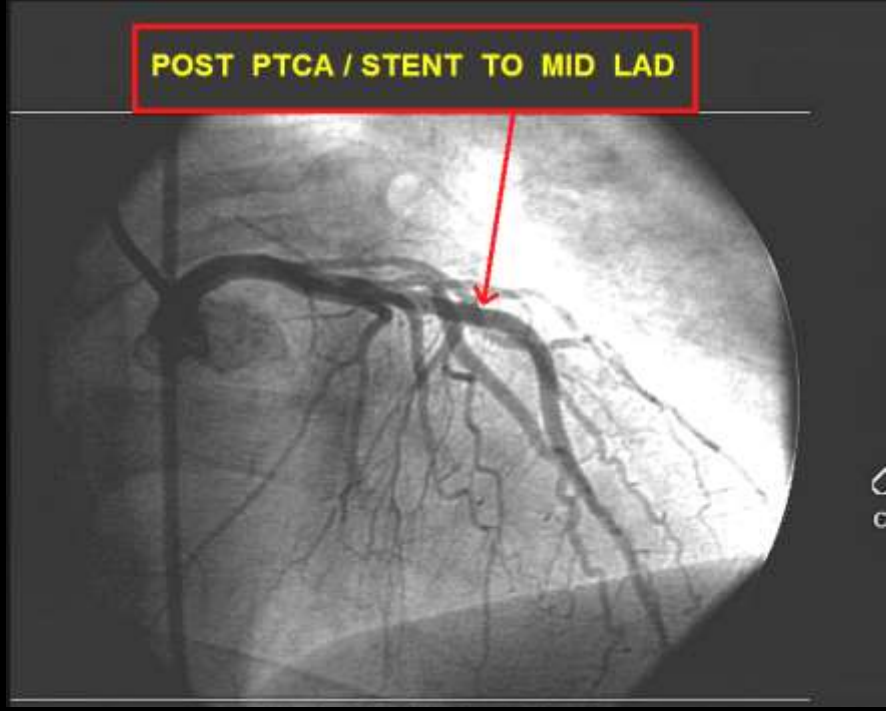
- CARDIOGENIC SHOCK
- PULMONARY EDEMA

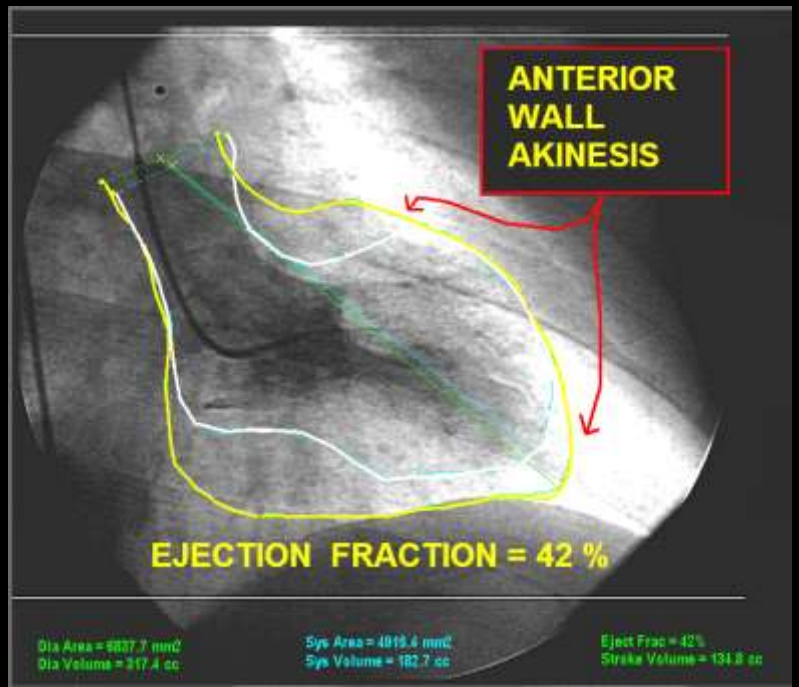

400 mg
Dopamine
(1600 mcg/mL)
Dopamine Hydrochloride
and 5% Dextrose Injection USP
250 mL
Baxter
500 mg Total
DOBUTamine
Hydrochloride in
5% Dextrose
250 mL
Baxter

LEFT ANTERIOR DESCENDING ARTERY (LAD)

- ANTERIOR WALL OF LEFT VENTRICLE
- 35 - 45 % OF LEFT VENTRICLE MUSCLE MASS
- SEPTUM, ANTERIOR 2/3
- BUNDLE BRANCHES
- ANTERIOR-MEDIAL PAPILLARY MUSCLE


MID - LAD 100%
OCCLUDED
RAO CRANIAL VIEW


POST PTCA / STENT TO MID LAD


ANTERIOR
WALL
AKINESIS
EJECTION FRACTION = 42 %
Dia Area = 6687.7 mm2
Dia Volume = 317.4 cc
Sys Area = 4819.4 mm2
Sys Volume = 182.7 cc
Eject Frac = 42%
Stroke Volume = 134.8 cc

CASE STUDY 2: STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

46 y/o Female walks into ED TRIAGE, with chief complaint of EPIGASTRIC PAIN, NAUSEA and WEAKNESS. Symptoms have been intermittent for last two days. She was awakened early this morning with the above symptoms, which are now PERSISTENT.

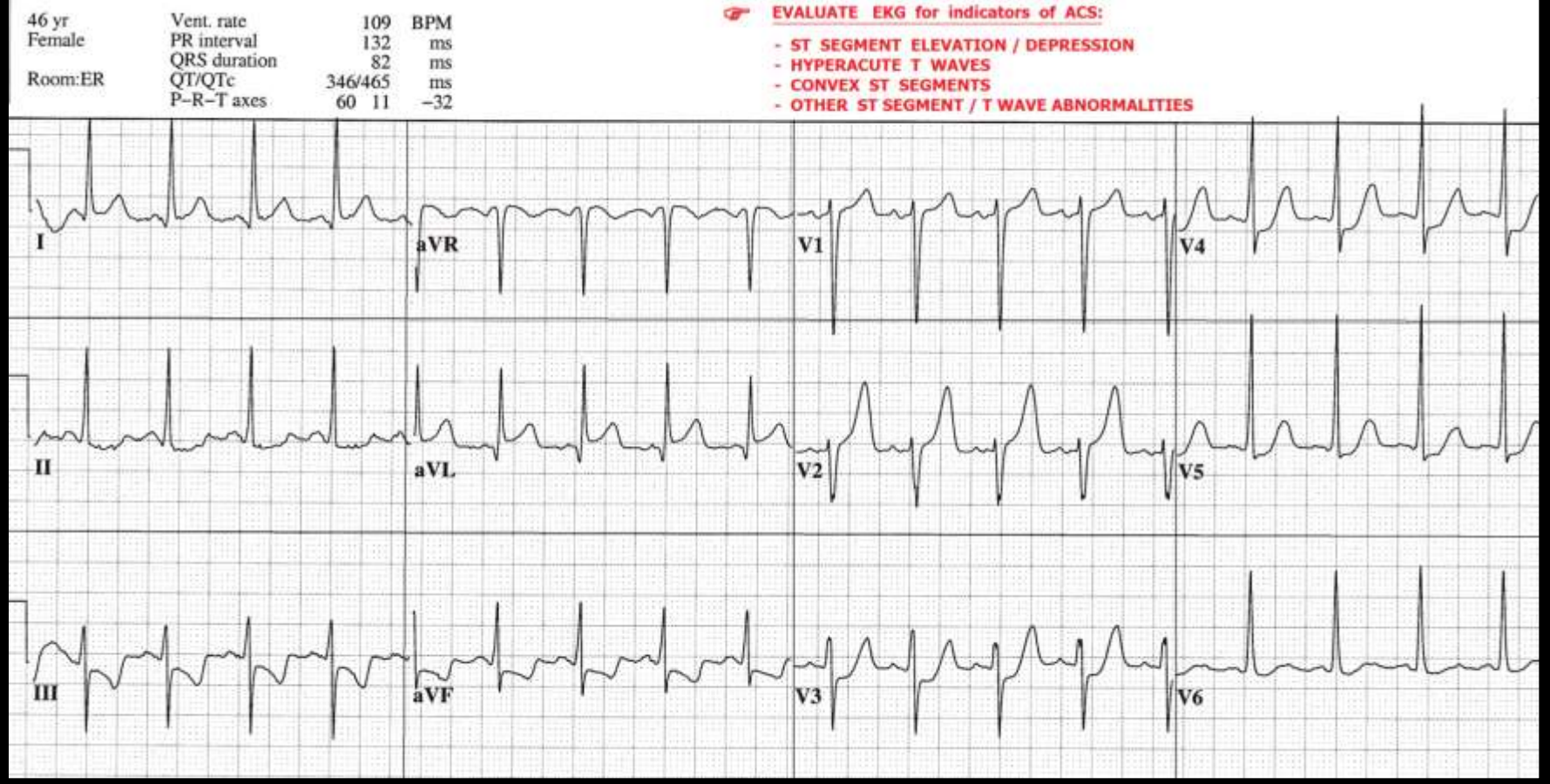
RISK FACTOR PROFILE:

- FAMILY HISTORY - father died of CAD, older brother had CABG, age 39
- DIABETES - diet controlled
- HYPERTENSION

PHYSICAL EXAM: Pt. CAOx4, anxious, SKIN cold, clammy, diaphoretic. No JVD. Lungs: clear, bilaterally. Heart Sounds: Normal S1, S2.

VITAL SIGNS: BP: 168/98, P: 110, R: 24, SAO2: 97% on O2 4 LPM via nasal canula

LABS: TROPONIN ultra = 2.8



CASE STUDY QUESTIONS:

NOTE LEADS WITH ST ELEVATION:	**NOTE LEADS WITH ST DEPRESSION:**
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	**LIST ANY POTENTIAL COMPLICATIONS:**

46 yr
Female

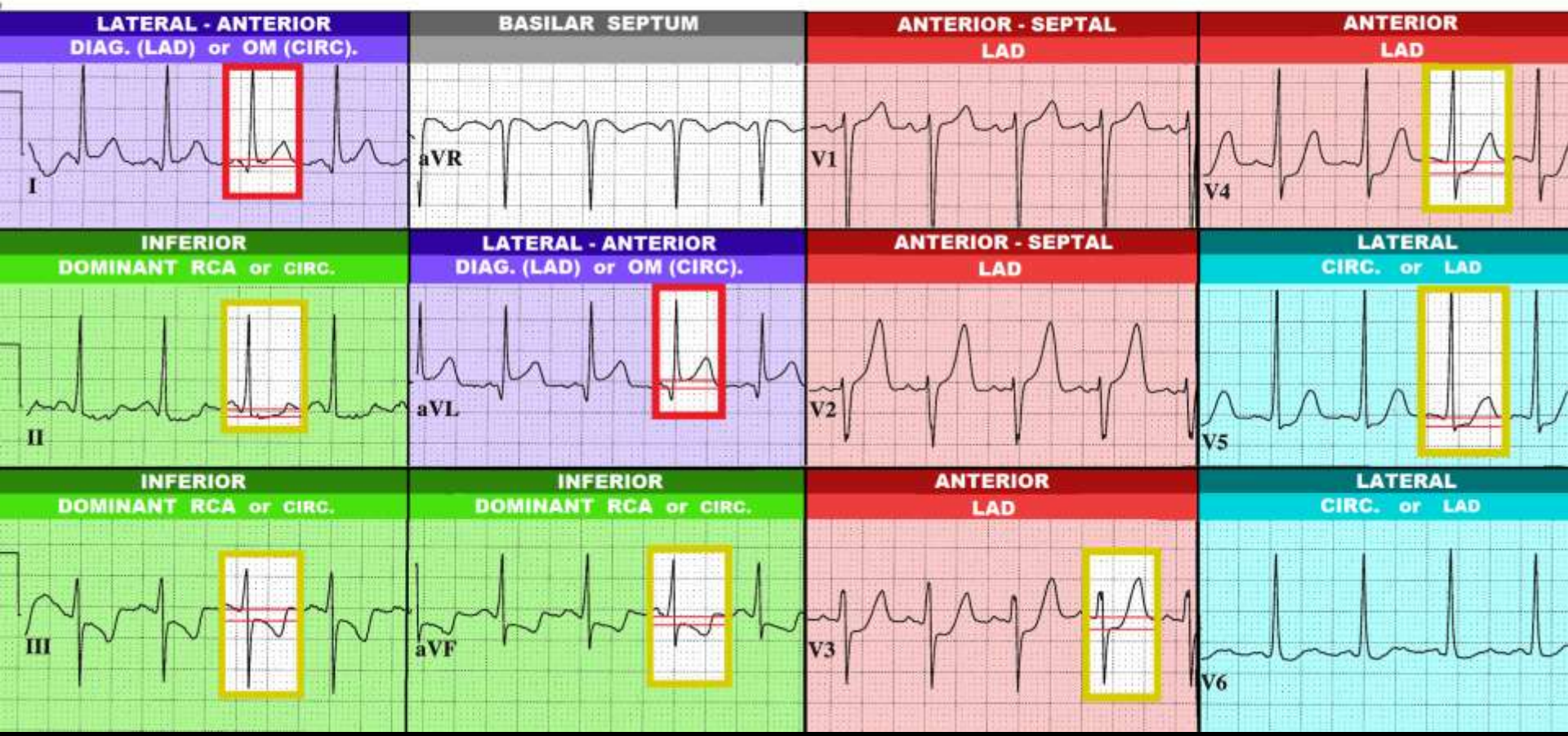
Room:ER

Vent. rate	109	BPM
PR interval	132	ms
QRS duration	82	ms
QT/QTc	346/465	ms
P–R–T axes	60 11	–32

Sinus tachycardia
Left ventricular hypertrophy with repolarization abnormality
ST elevation consider lateral injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION



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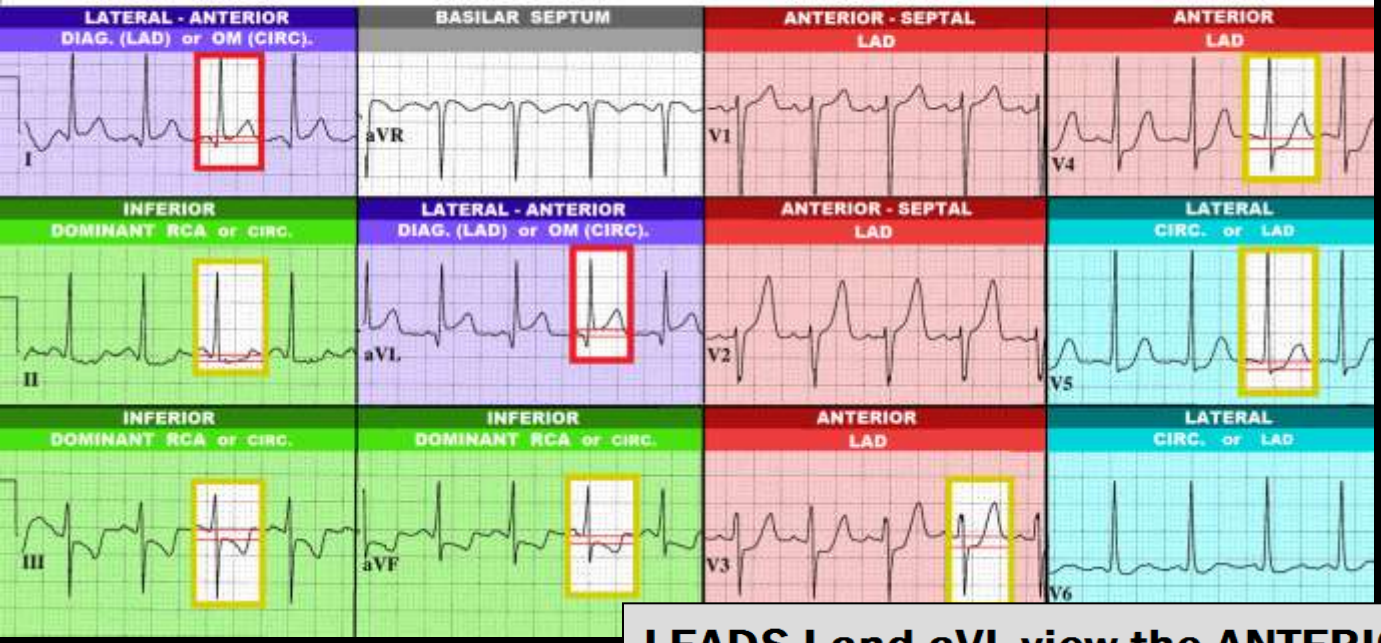
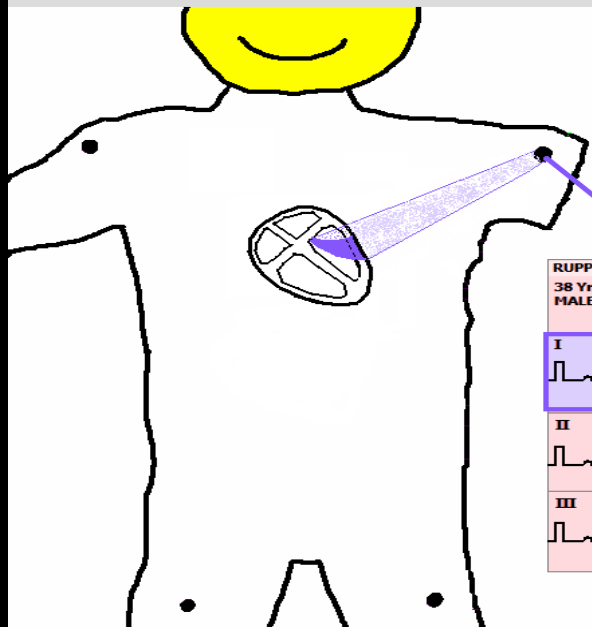
Left ventricular hypertrophy with repolarization abnormality
ST elevation consider lateral injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **

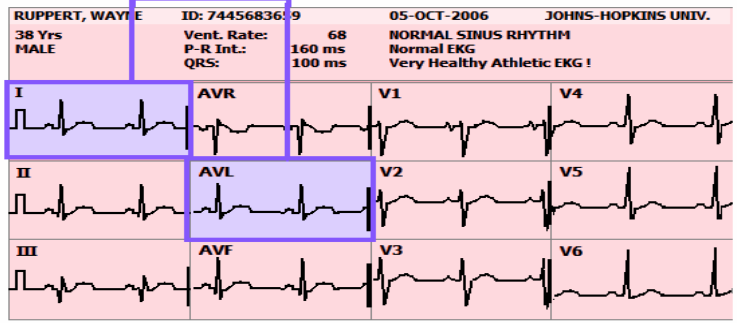
ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION

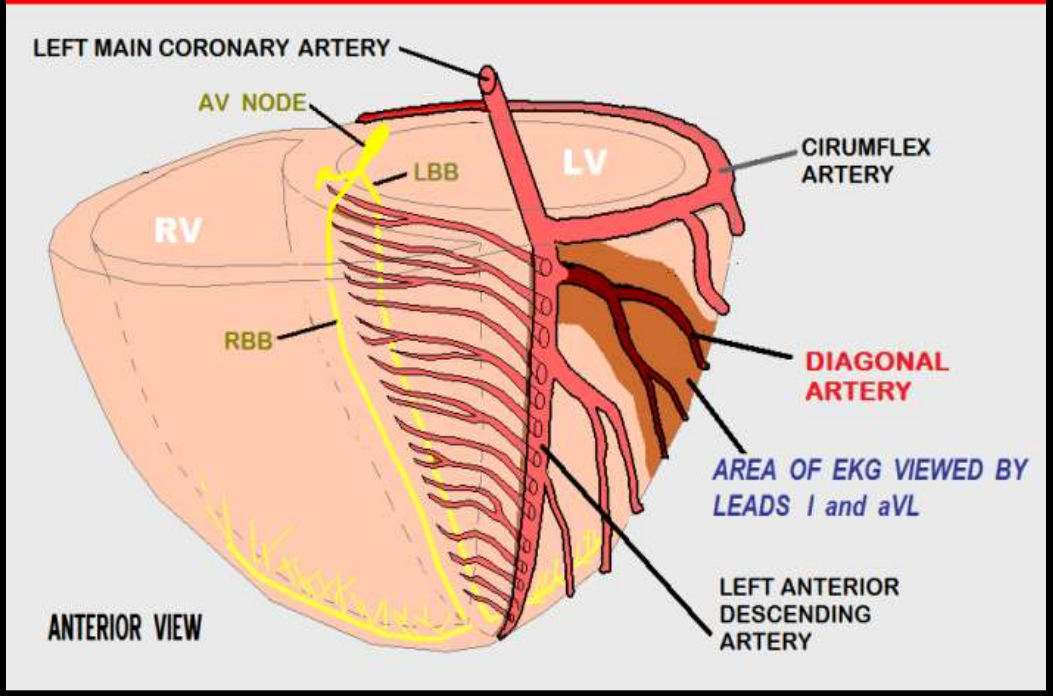


LEADS I and aVL view the ANTERIOR-LATERAL JUNCTION

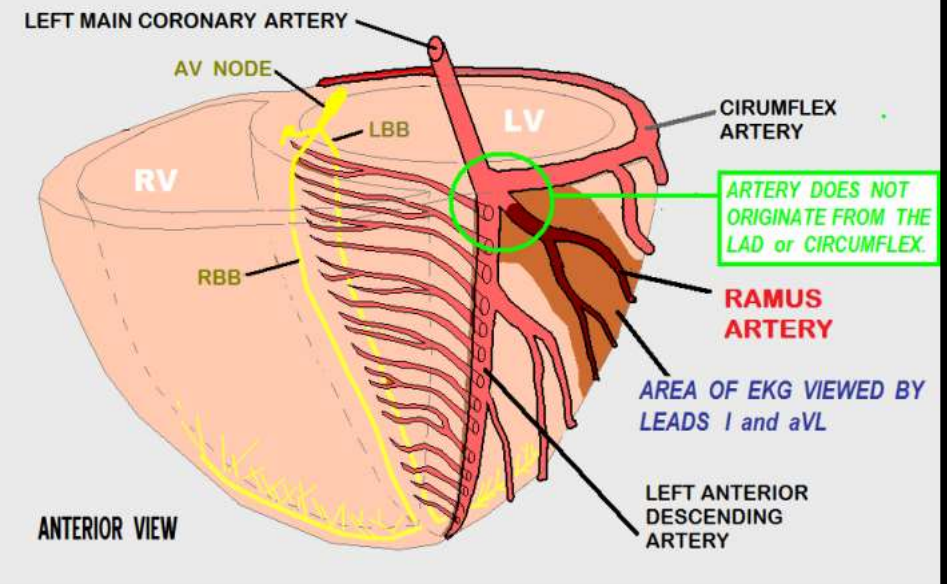




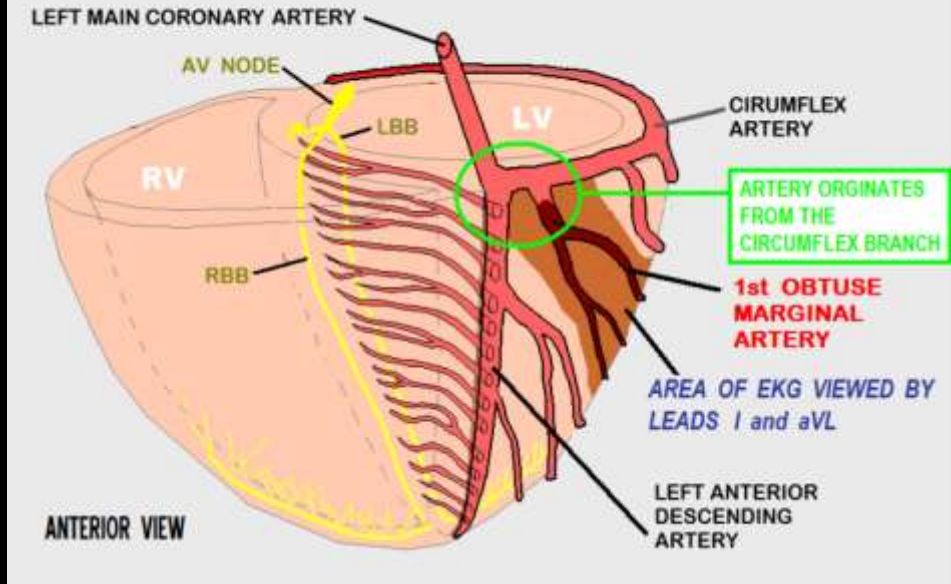
OCCLUSION of DIAGONAL ARTERY



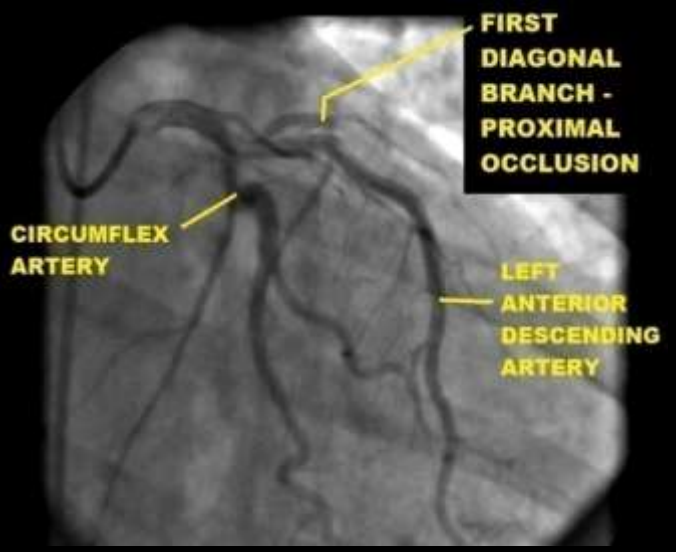
OCCLUSION of RAMUS ARTERY

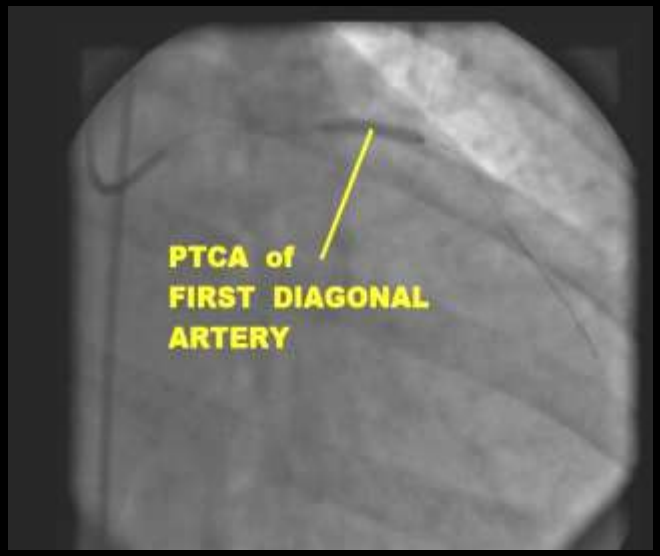


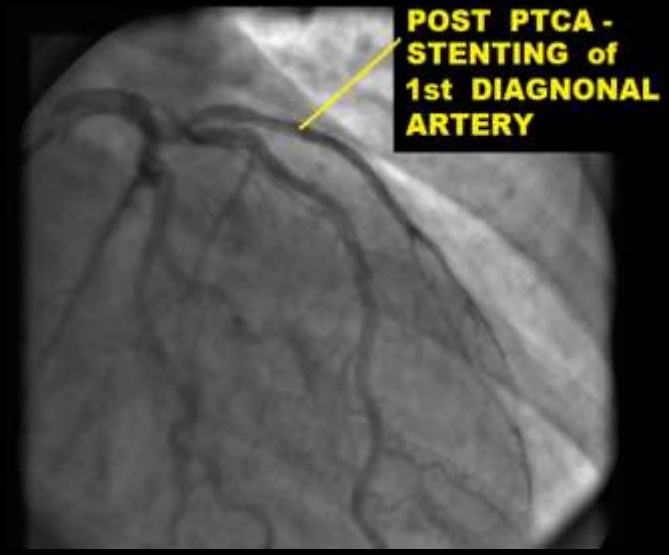
OCCLUSION of OBTUSE MARGINAL ARTERY

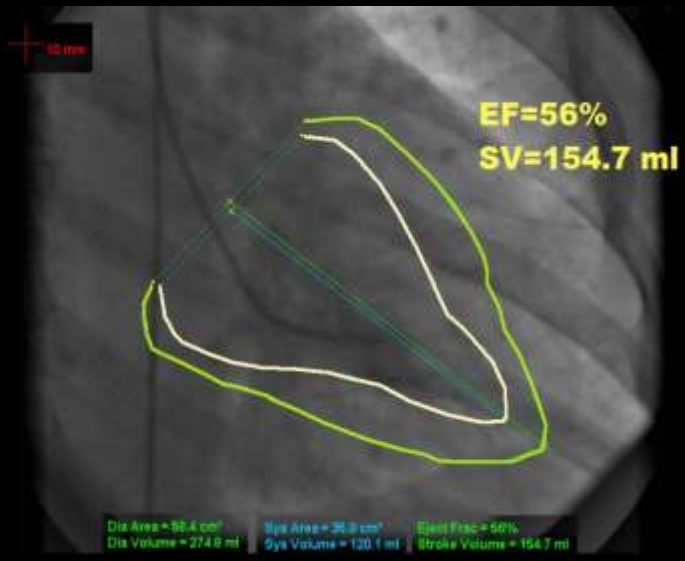


CASE PROGRESSION: As the patient was being prepared for transport to the Cardiac Cath Lab, she experienced an episode of Ventricular Fibrillation.









CASE STUDY SUMMARY

ST ELEVATION: I, aVL

ST DEPRESSION: II, III, aVF, V3 - V5

SUSPECTED DIAGNOSIS: ACUTE LATERAL WALL M.I.

SUSPECTED "CULPRIT ARTERY" (if applicable):

USUALLY ONE OF THE SMALLER SIDE-BRANCH ARTERIES:

1. DIAGONAL ARTERY. (This is a side-branch artery off of the LEFT ANTERIOR DESCENDING (LAD) artery.
2. OBTUSE MARGINAL ARTERY. (This is a side-branch artery off of the CIRCUMFLEX artery)
3. RAMUS ARTERY.

IMMEDIATE CONCERNS FOR ALL STEMI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
15-30% of the LV MUSCLE MASS →	POSSIBLE MODERATE LV PUMP FAILURE →	INOTROPIC AGENTS ET INTUBATION I.A.B.P. INSERTION

CASE STUDY 3: STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

29 y/o male presents to the ER c/o "HEAVY CHEST PRESSURE" x 30 minutes. The patient states he was playing football with friends after eating a large meal. Pt. also c/o nausea. Denies DIB.

RISK FACTOR PROFILE:

- FAMILY HISTORY - father died of MI age 46
- CURRENT CIGARETTE SMOKER
- "MILD" HYPERTENSION - untreated
- ☑ CHOLESTEROL - unknown - "never had it checked."

PHYSICAL EXAM: Patient alert, oriented X 4, skin cool, dry, pale. Patient restless. No JVD, Lungs clear bilaterally. Heart sounds normal S1, S2. No peripheral edema.

VITAL SIGNS: BP: 104/78, P: 76, R: 20, SAO2: 96%

LABS: INITIAL CARDIAC MARKERS - NEGATIVE

29 yr
Male Caucasian

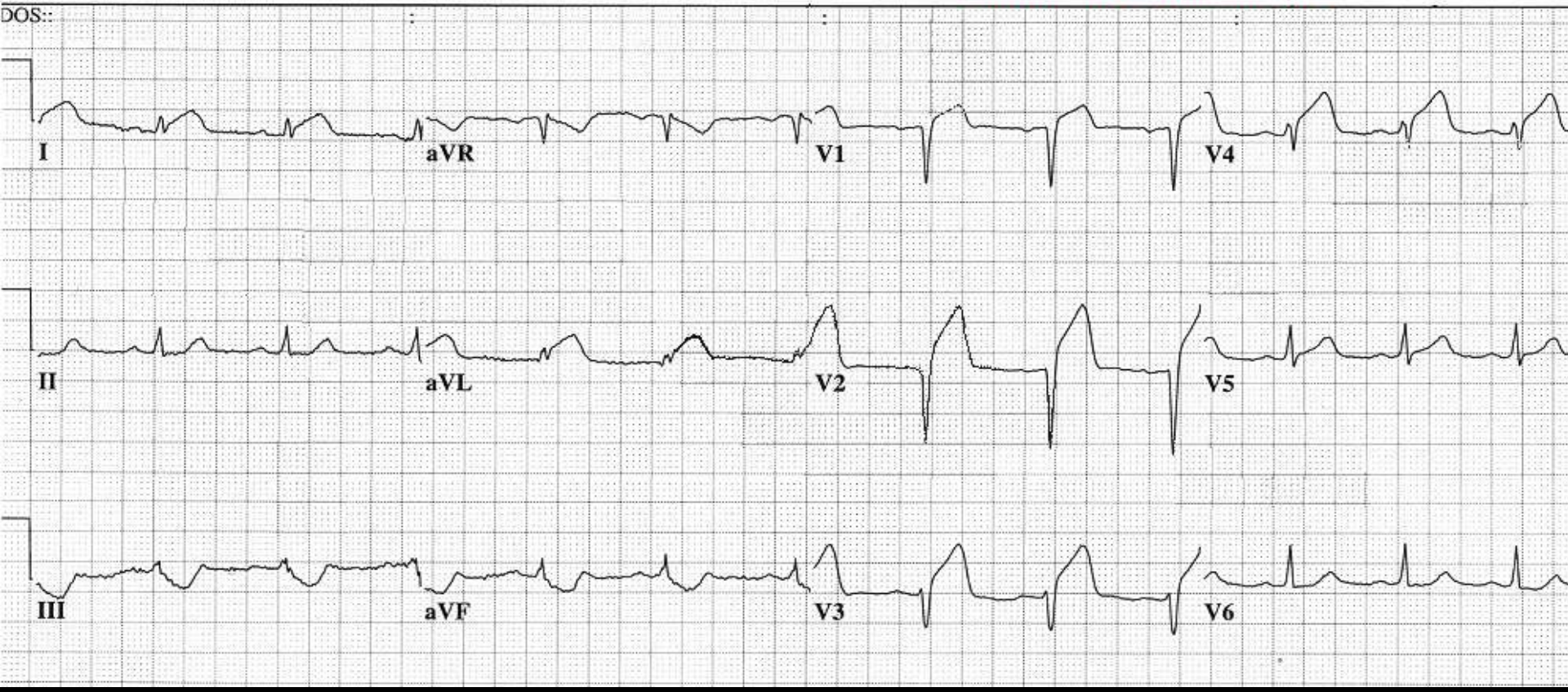
Loc:3 Option:20

Vent. rate	75	BPM
PR interval	176	ms
QRS duration	90	ms
QT/QTc	362/404	ms
P–R–T axes	70 50	–11

14:07 Hours

EVALUATE the EKG for signs of ACS:

- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- CONVEX / FLAT ST SEGMENTS
- OTHER ST - T WAVE ABNORMALITIES



29 yr
Male

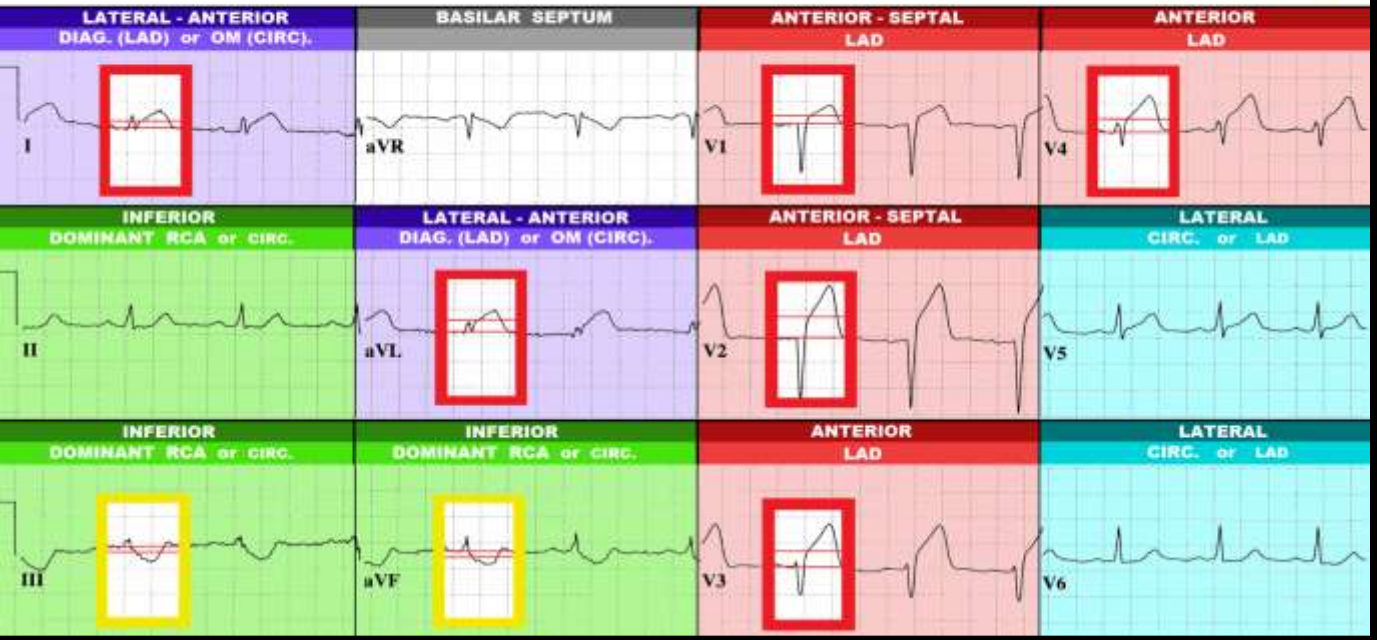
Caucasian

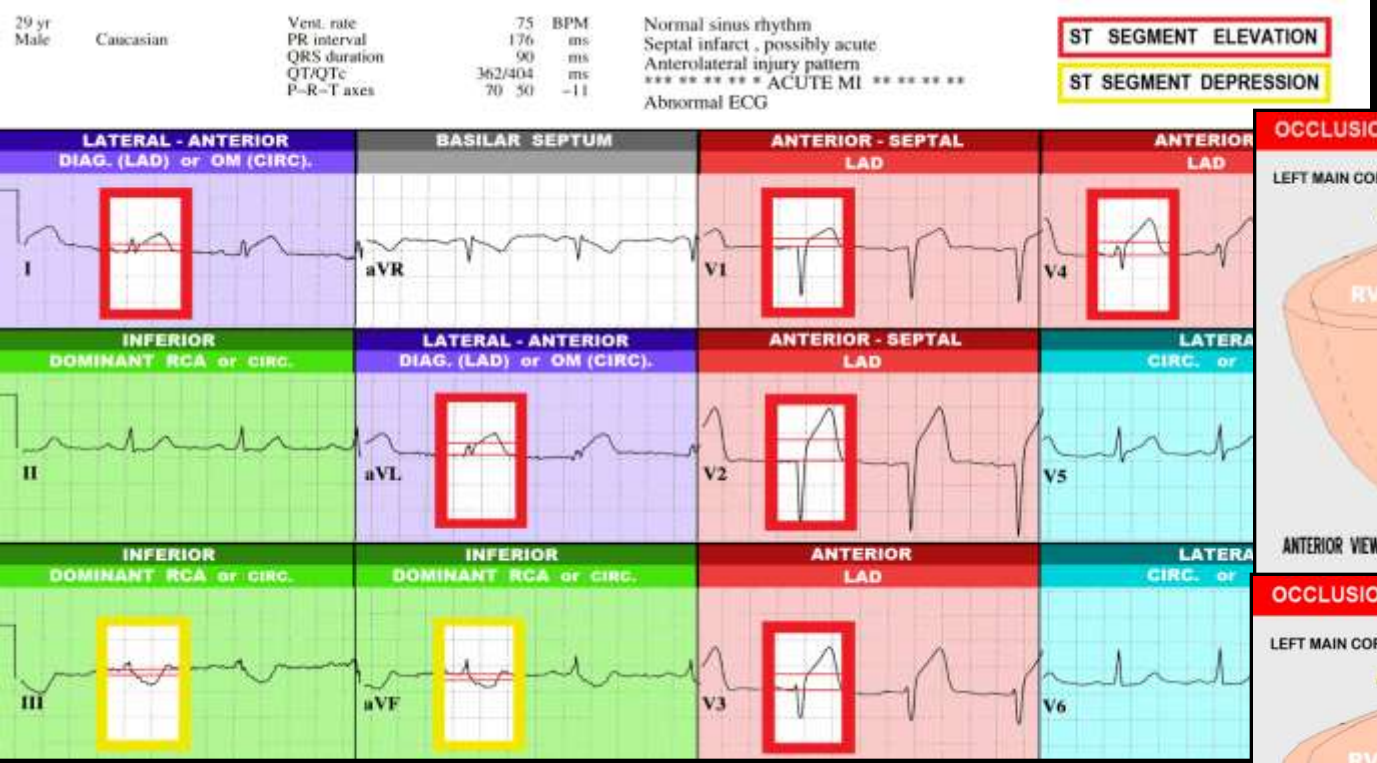
Vent. rate	75	BPM
PR interval	176	ms
QRS duration	90	ms
QT/QTc	362/404	ms
P-R-T axes	70 50	-11

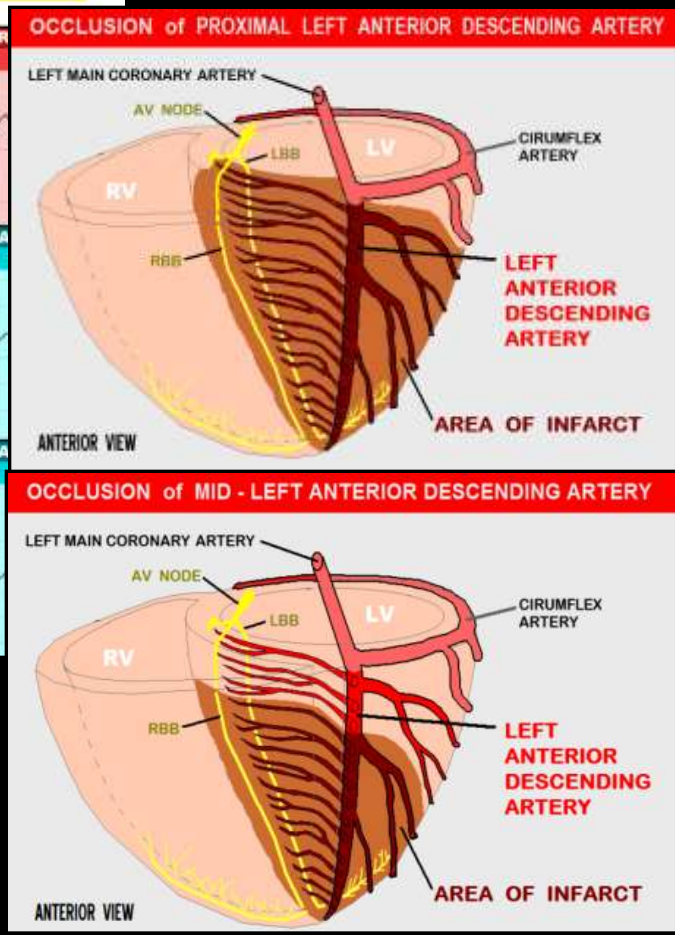
Normal sinus rhythm
Septal infarct , possibly acute
Anterolateral injury pattern
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION







☞ THERE ARE TWO IMPORTANT CLUES that the patient's BLOCKAGE is in the ***PROXIMAL*** LEFT ANTERIOR DESCENDING ARTERY:

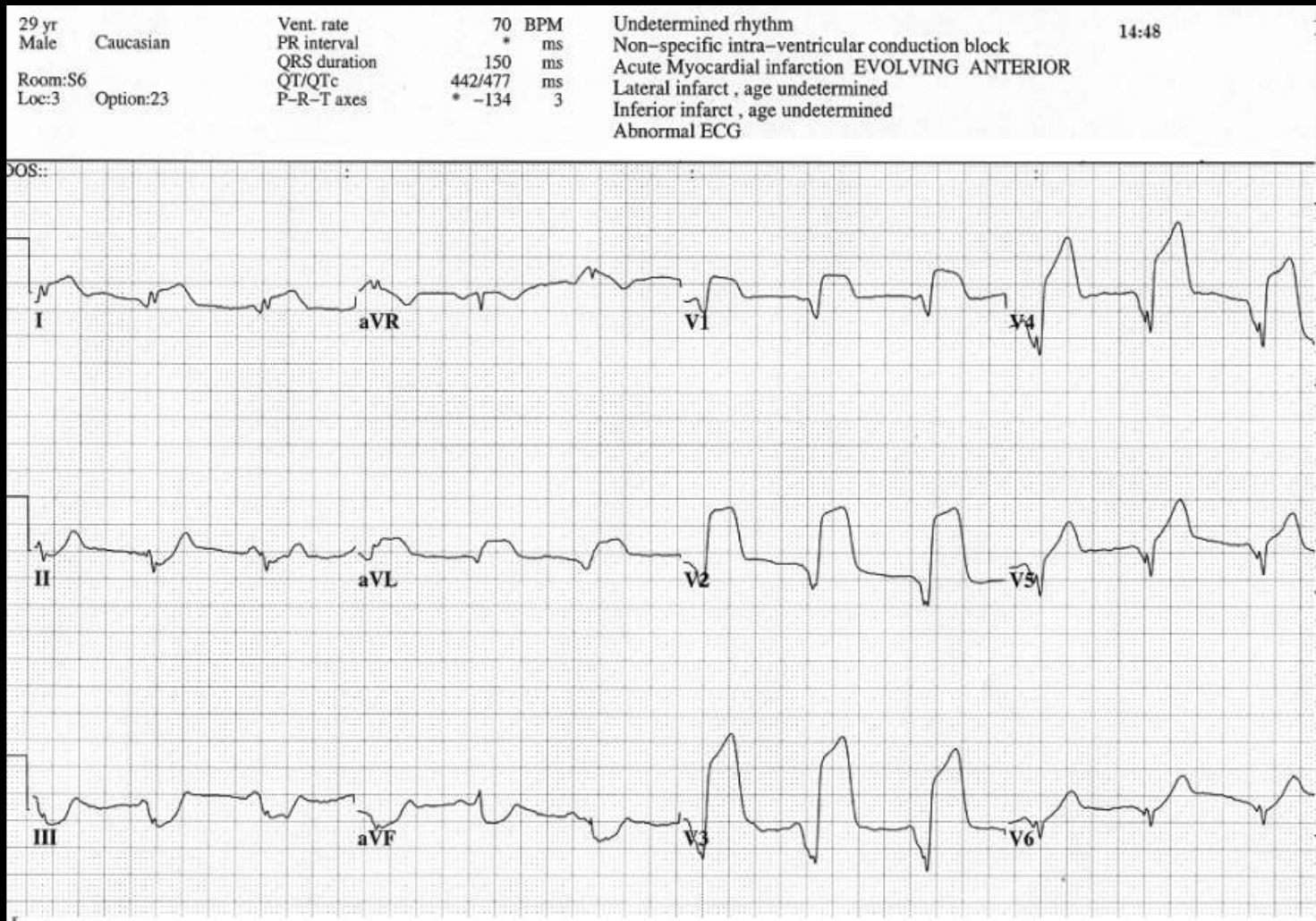
1. When ST elevation is noted in leads I and aVL in cases of ANTERIOR WALL STEMI, it is a good indicator that the FIRST DIAGONAL BRANCH is included in the zone of infarction.

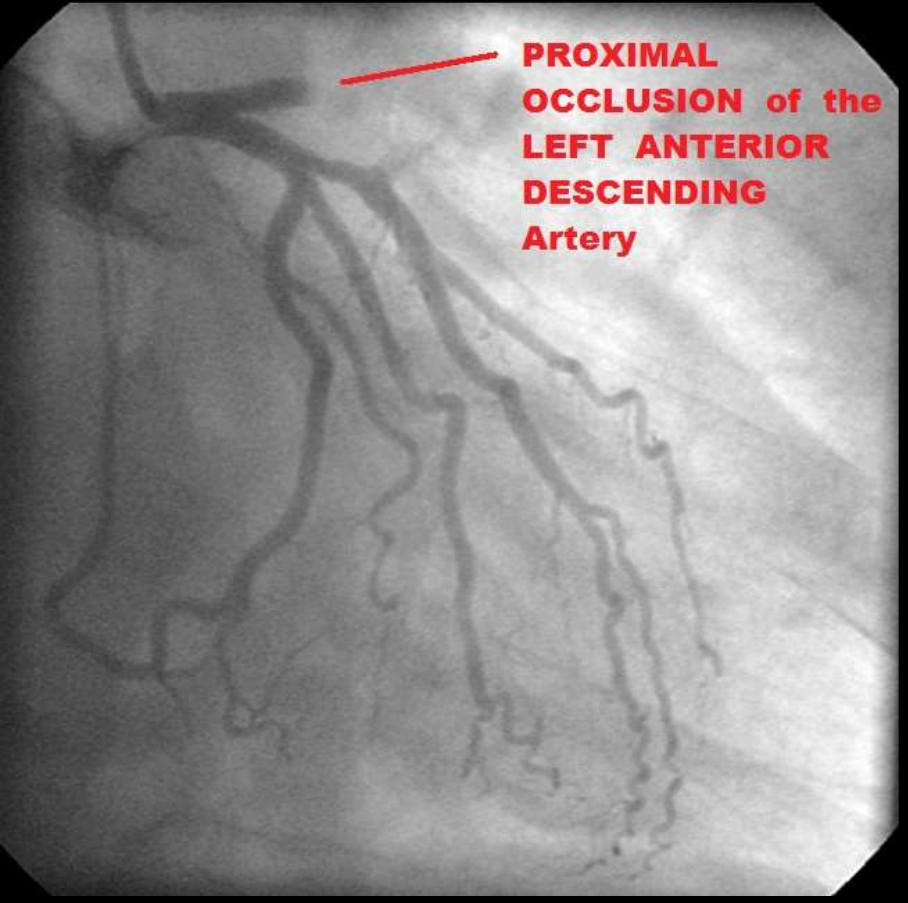
• RECIPROCAL ST DEPRESSION in the INFERIOR LEADS (II, III, and/or aVF) is an indication that the LAD is blocked proximal to the FIRST DIAGONAL BRANCH.[1]

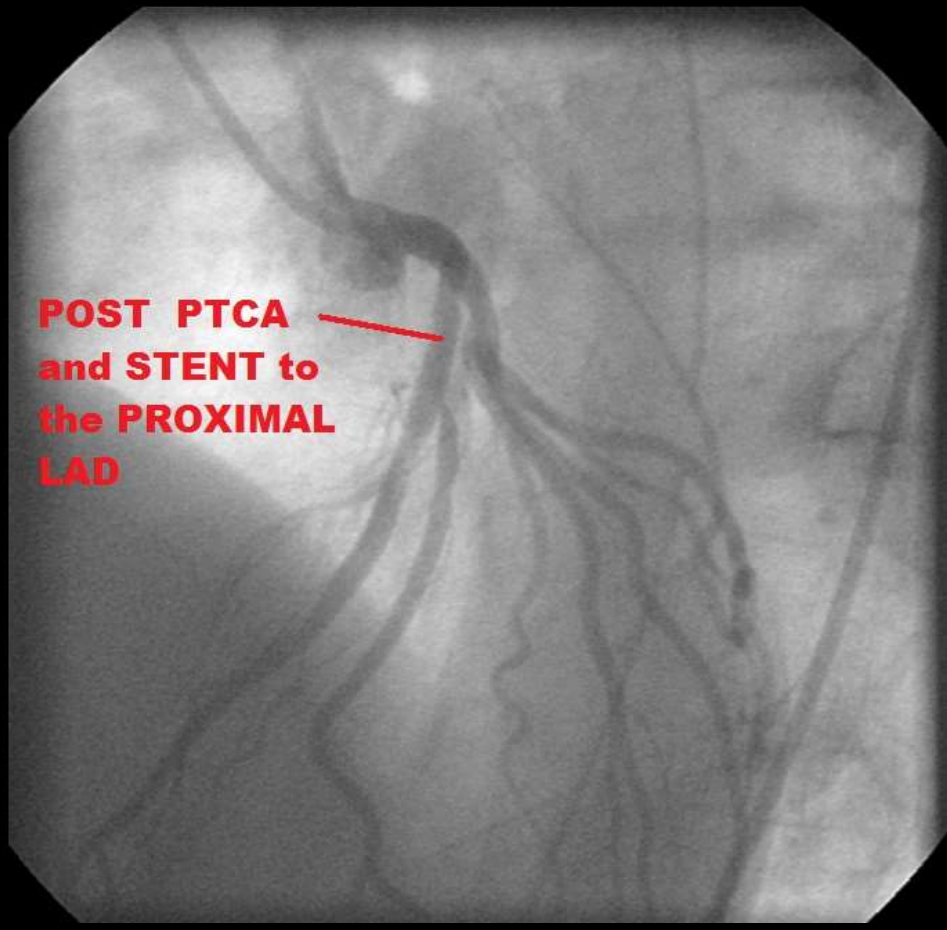
[1] "Use of the Electrocardiogram in Acute Myocardial Infarction," Zimetbaum, et al, NEJM 348:933-940

WHILE WAITING FOR THE RETEVASE TO WORK, THE PATIENT BEGAN VOMITING. SKIN BECAME ASHEN & DIAPHORETIC. REPEAT BP = 50/30.

-WHAT THERAPEUTIC INTERVENTIONS SHOULD BE IMPLMENTED AT THIS POINT ?




PROXIMAL
OCCLUSION of the
LEFT ANTERIOR
DESCENDING
Artery


POST PTCA
and STENT to
the PROXIMAL
LAD

CASE STUDY SUMMARY

ST ELEVATION: V1 - V5, I, aVL

ST DEPRESSION: III, aVF

SUSPECTED DIAGNOSIS: ACUTE ANTERIOR - SEPTAL STEMI

SUSPECTED "CULPRIT ARTERY" (if applicable): PROXIMAL LEFT ANTERIOR DESCENDING ARTERY (LAD)

IMMEDIATE CONCERNS FOR ALL STEMI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
40-50% of the LV MUSCLE MASS	LV PUMP FAILURE leading to: - CARDIOGENIC SHOCK - PULMONARY EDEMA	INOTROPIC AGENTS ET INTUBATION I.A.B.P. INSERTION
	VENTRICULAR DYSRHYTHMIAS (VT / VF)	DEFIBRILLATION / ANTIARRHYTHMIC AGENTS
Potential compromise of BLOOD SUPPLY to: - Bundle of His - Proximal Bundle Branches	HIGH-GRADE HEART BLOCKS (2nd - 3rd degree)	TRANSCUTANEOUS or TRANSVENOUS PACING
	BUNDLE BRANCH BLOCKS	

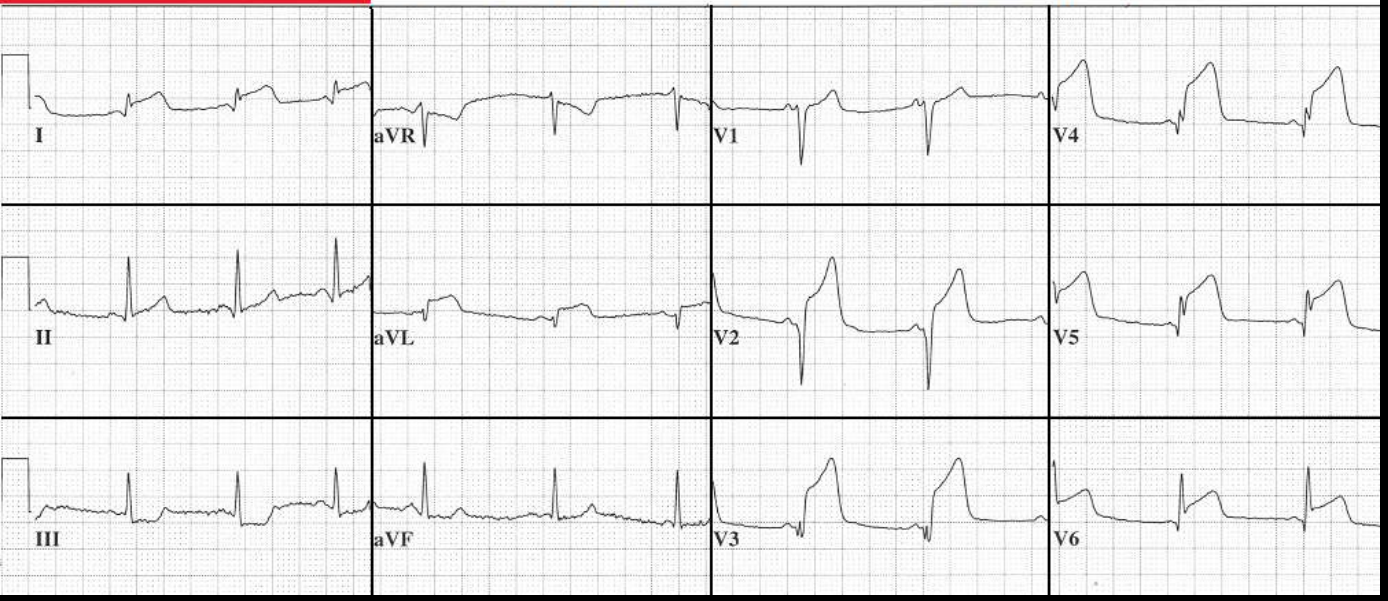
PLUS: EXTENSION OF THROMBUS LOAD INTO THE LEFT MAIN CORONARY ARTERY . . . .

CASE STUDY 4: CRITICAL DECISIONS SCENARIO

As per current AHA recommendations, your hospital's policy is to send every STEMI patient to the Cardiac Catheterization Lab for emergency PCI.

You are the ranking medical officer on duty in the ED when two acute STEMI patients arrive, ten minutes apart. The Cath Lab has one lab open, and can take ONE patient immediately.
Both patients duration of symptoms and state of hemodynamic stability are similar.

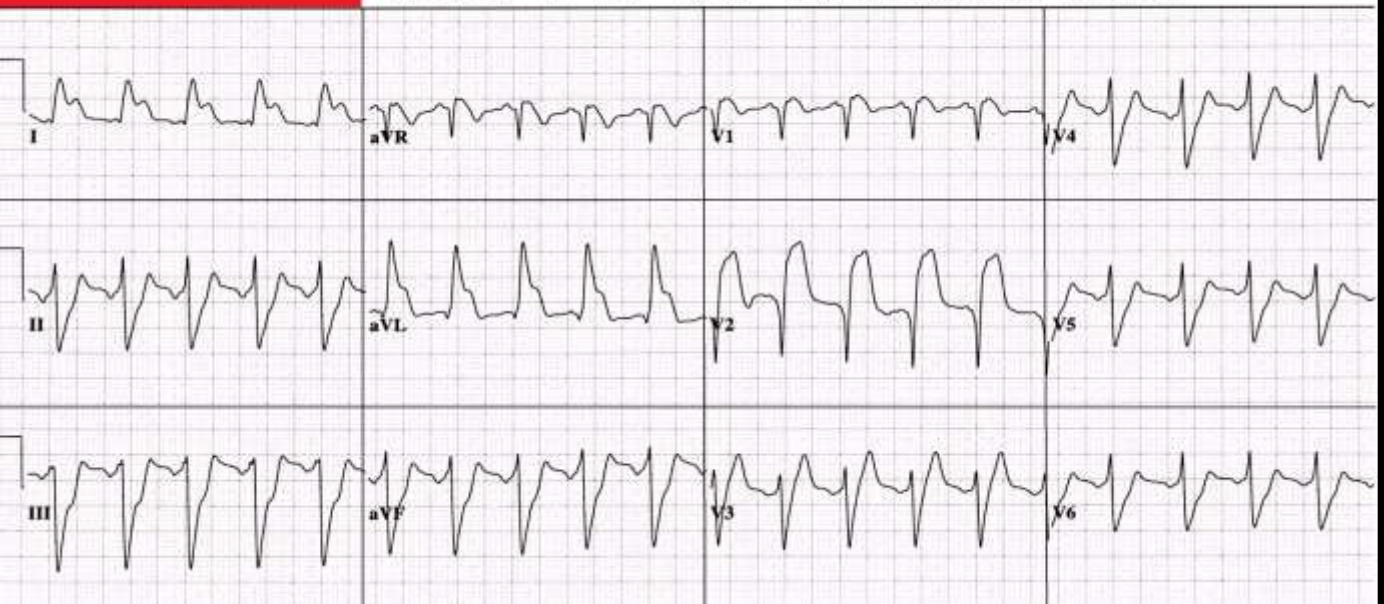
PATIENT A: 44 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 78/46, P: 70, R: 28. CARDIAC MARKERS: NEGATIVE



WHO SHOULD GO TO THE CATH LAB FIRST ?

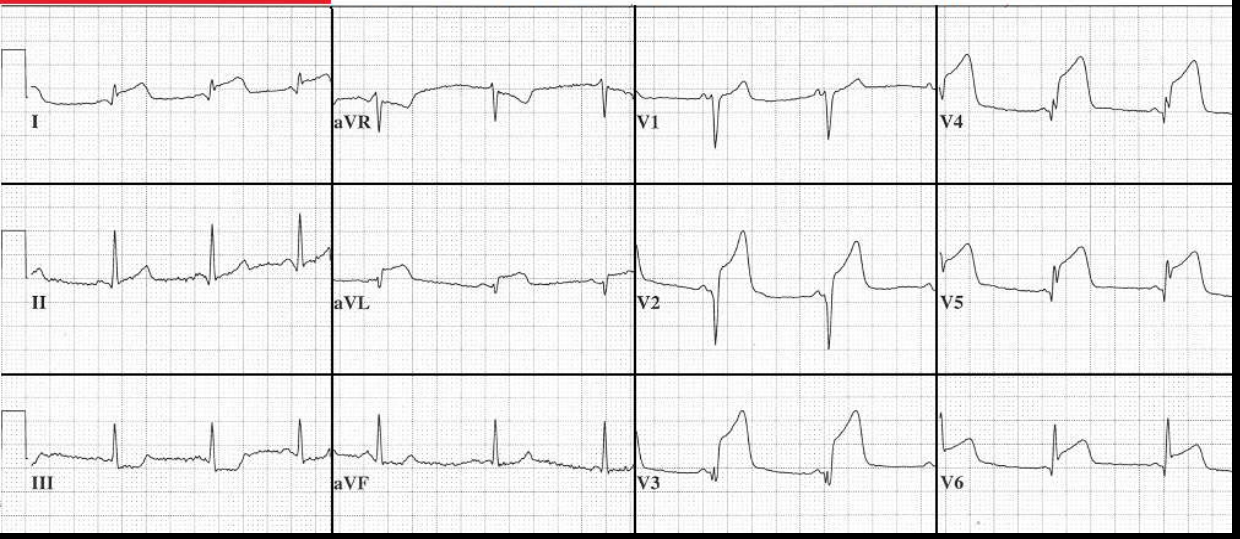
And . . . .

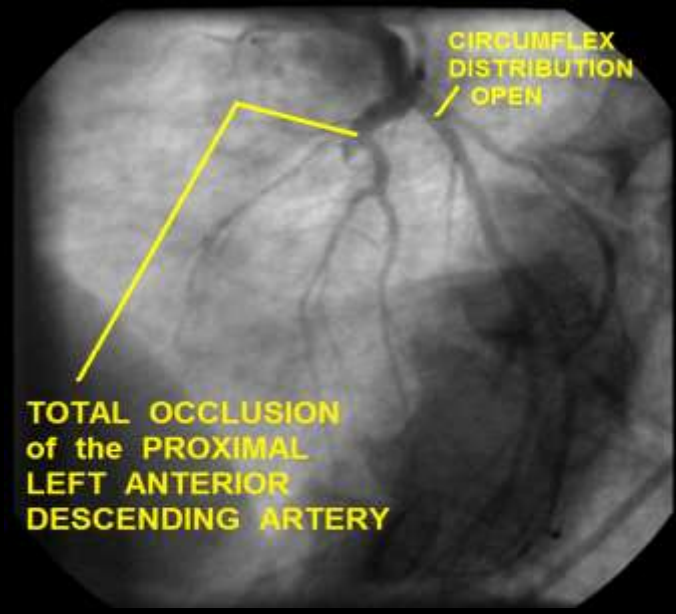
PATIENT B: 36 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 80/48, P: 120, R: 28 CARDIAC MARKERS: NEGATIVE



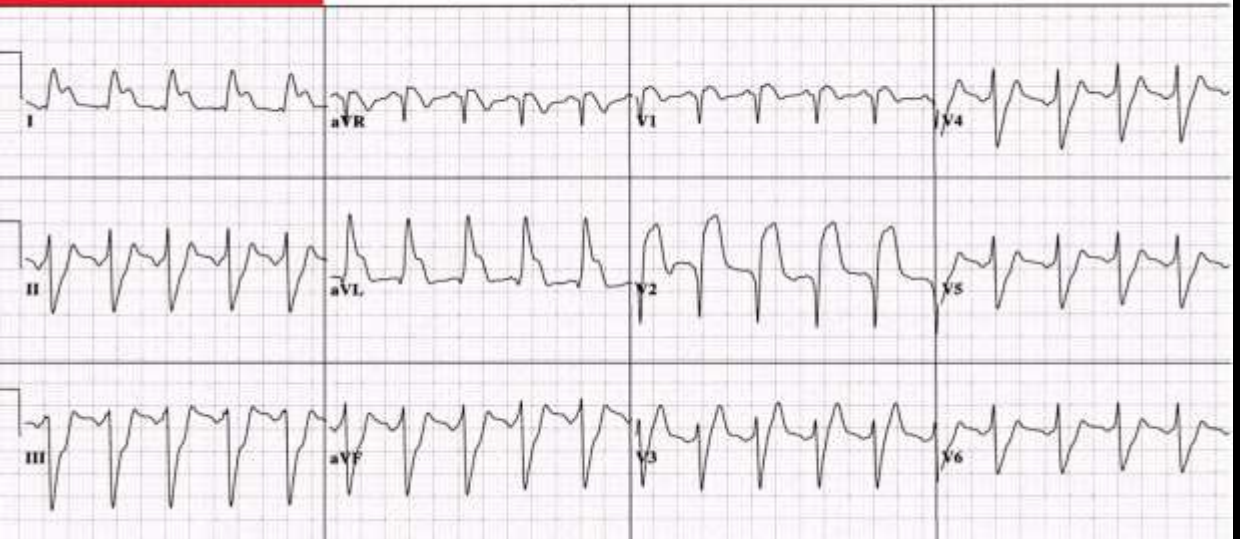
WHAT WOULD YOU DO WITH THE PATIENT WHO DID NOT GO TO THE CATH LAB ?

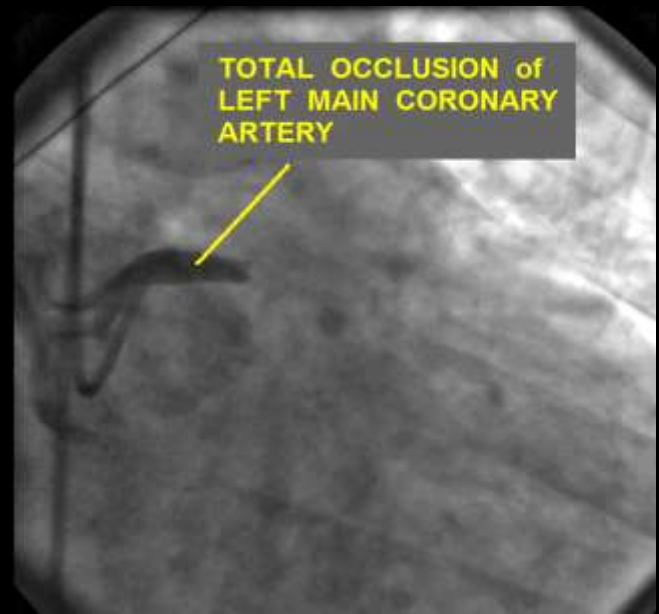
PATIENT A: 44 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 78/46, P: 70, R: 28. CARDIAC MARKERS: NEGATIVE



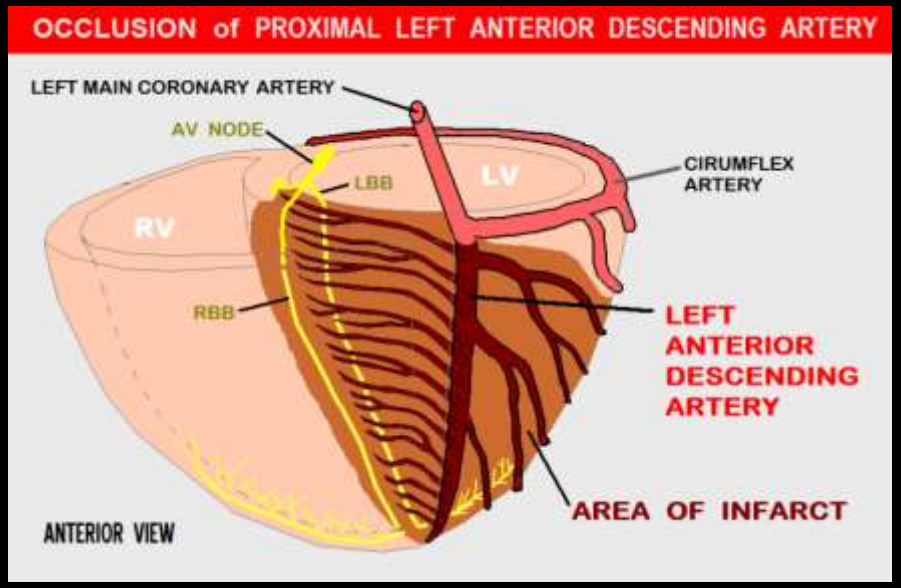


PATIENT B: 36 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 80/48, P: 120, R: 28 CARDIAC MARKERS: NEGATIVE

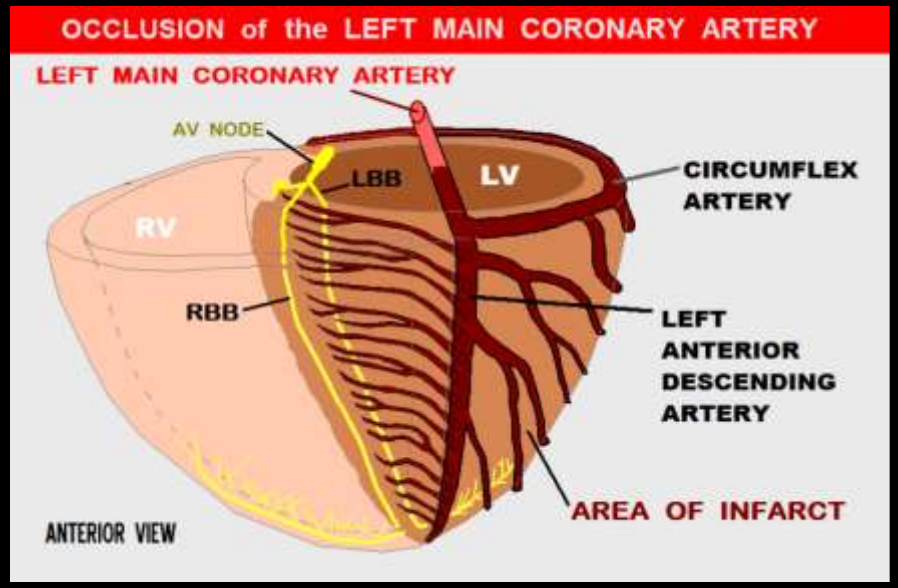


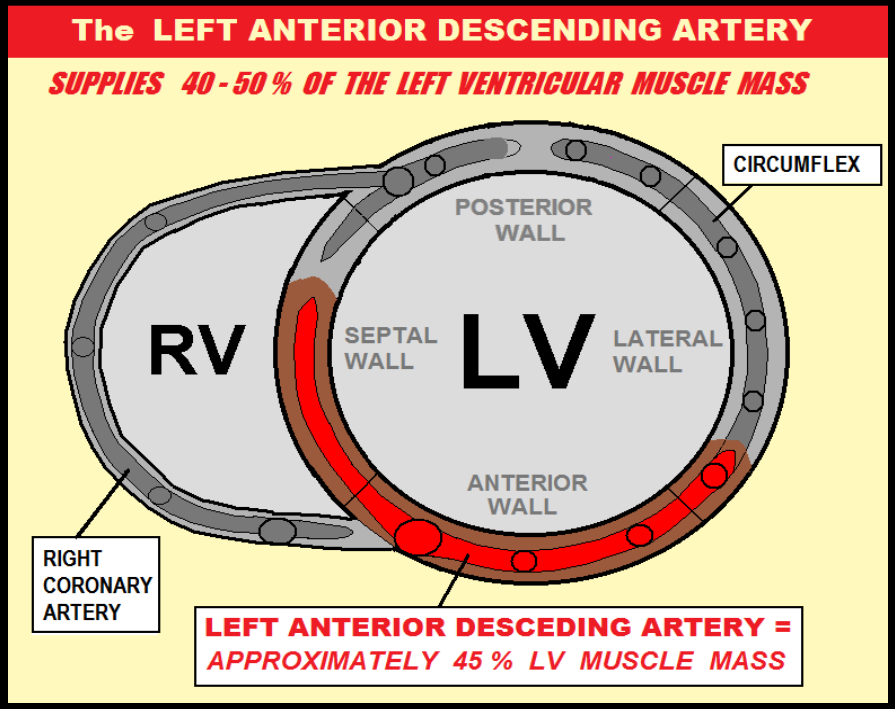


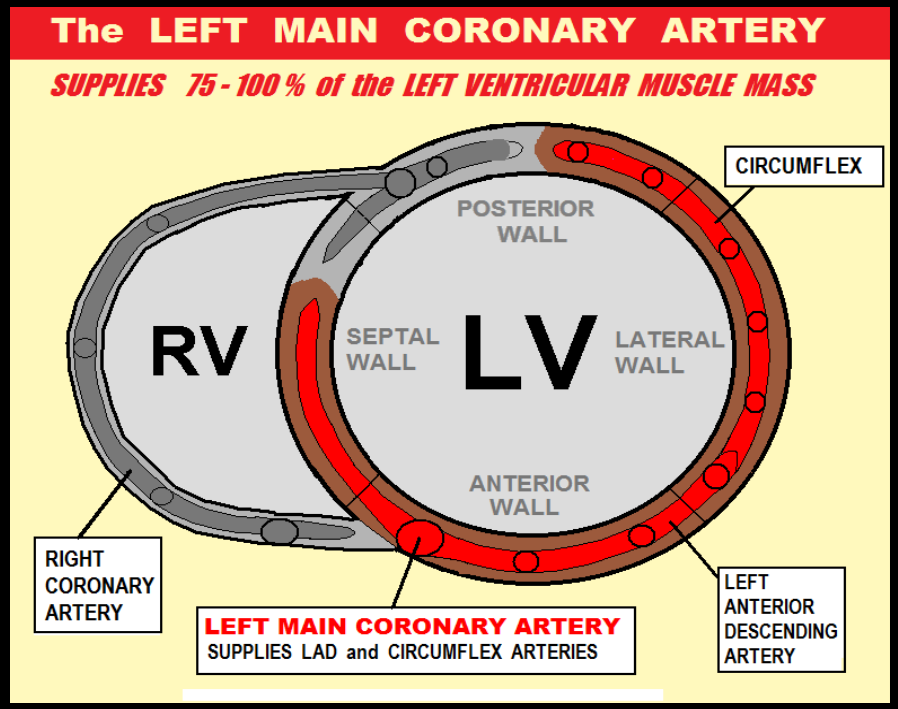
PATIENT A:



PATIENT B:



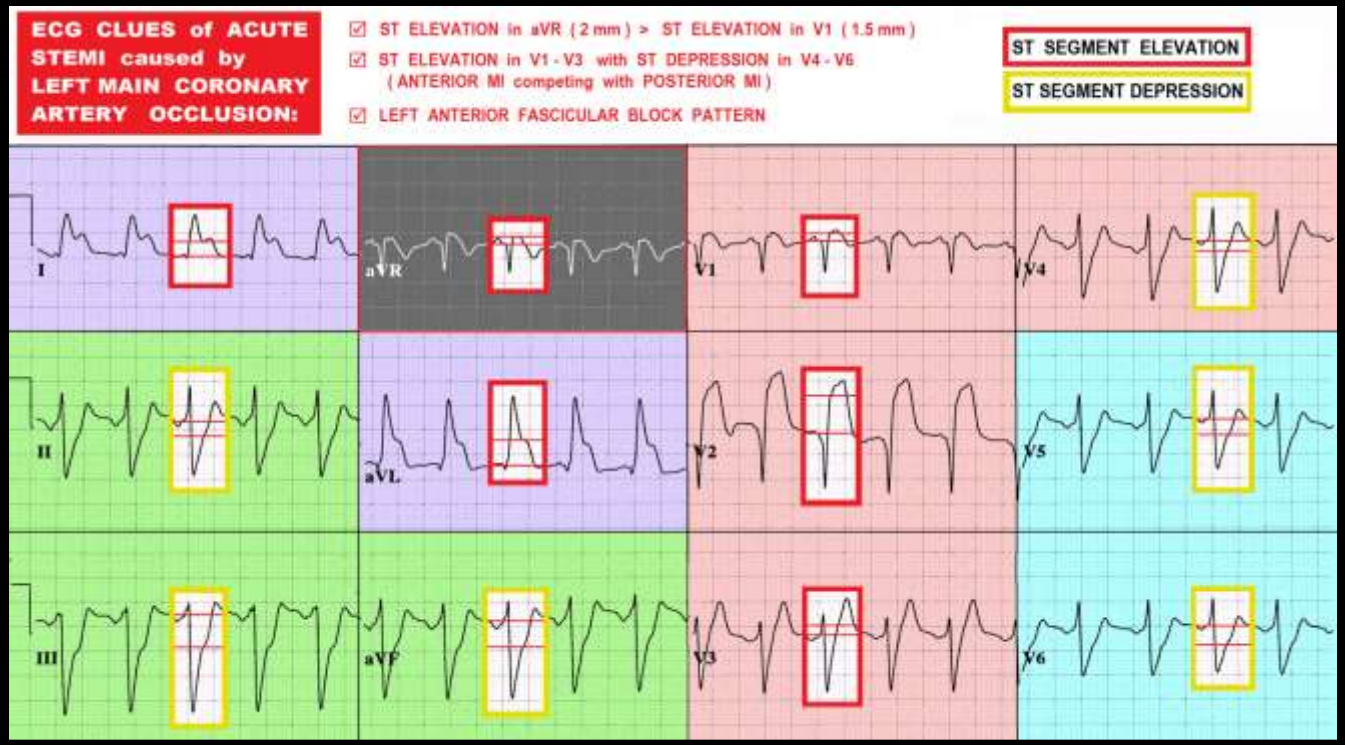




ECG Clues . . . for IDENTIFYING STEMI CAUSED BY LEFT MAIN CORONARY ARTERY occlusion:

- ☑ ST ELEVATION in ANTERIOR LEADS (V1 - V4) and LATERAL LEADS (V5 & V6)
- ☑ ST DEPRESSION or ISOELCTRIC J POINTS may be seen in V LEADS . . . . mainly V2 and/or V3 *caused by COMPETING FORCES of ANTERIOR vs. POSTERIOR WALL MI.* *+
  - → NOTE: it is very unusual to see ST DEPRESSION in V LEADS with isolated ANTERIOR WALL MI when caused by occluded LAD.
- ☑ ST ELEVATION in AVR is GREATER THAN ST ELEVATION in V1 *+
- ☑ ST ELEVATION in AVR GREATER THAN 0.5 mm
- ☑ ST ELEVATION in LEAD I and AVL (caused by NO FLOW to DIAGONAL / OBTUSE MARGINAL BRANCHES) *
- ☑ ST DEPRESSION in LEADS II, III, and AVF. (in cases of LMCA occlusion of DOMINANT CIRCUMFLEX, leads II, III, and AVF may show ST ELEVATION or ISOELECTRIC J POINTS) *+
- ☑ NEW / PRESUMABLY NEW RBBB, and/or LEFT ANTERIOR FASICULAR BLOCK *+

* Kurisu et al, HEART 2004, SEPTEMBER: 90 (9): 1059-1060
+ Yamaji et al, JACC vol. 38, No. 5, 2001, November 1, 2001:1348-54



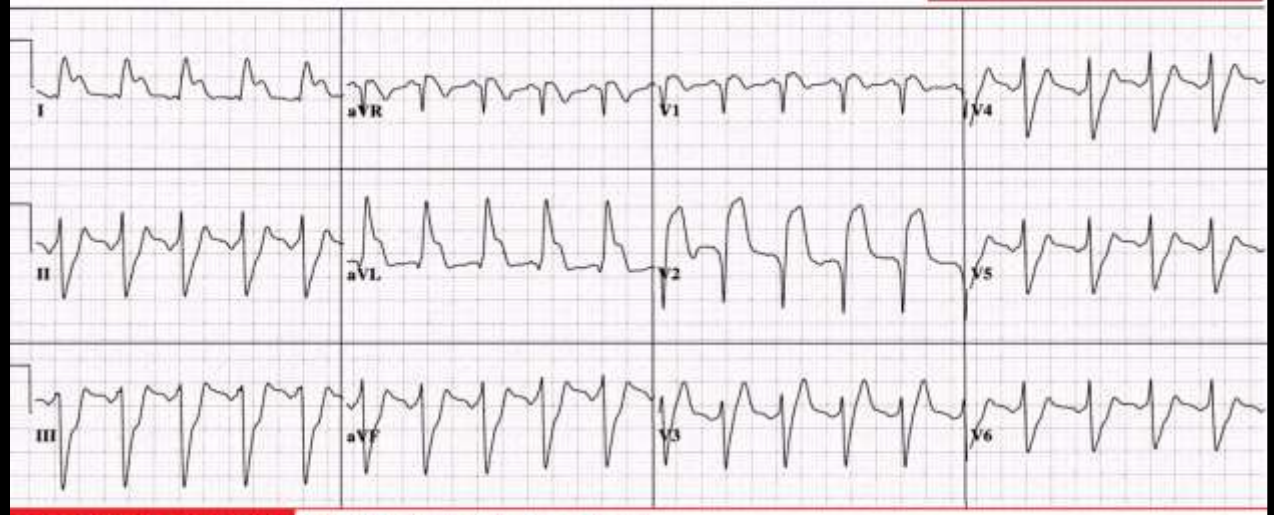
36 yr
Male
Caucasian

Room:C-
Loc:3

Vent. rate	123	BPM
PR interval	96	ms
QRS duration	130	ms
QT/QTc	310/443	ms
P-R-T axes	* -53	43

Sinus tachycardia with short PR
Left ventricular hypertrophy with QRS widening
Cannot rule out Septal infarct , age undetermined
Lateral injury pattern
*** ** ** ** * ACUTE MI ** ** ** **

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



ECG CLUES of ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION:

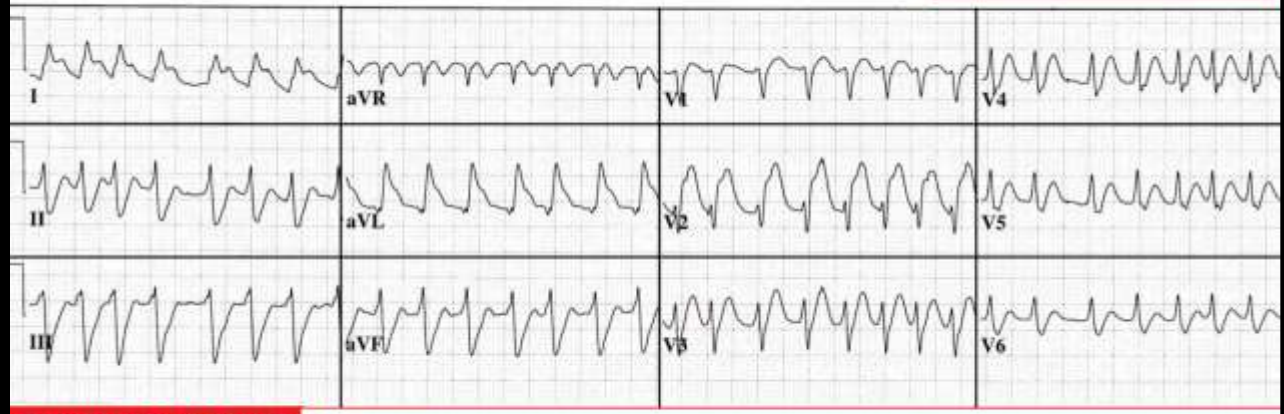
- ☑ ST ELEVATION in leads I and aVL
- ☑ INCONSISTENCY of ST SEGEMENT in leads V1 - V6 : V1 - V3 ST ELEVATION, V4 - V6 ST DEPRESSION (COMPETING FORCES of ANTERIOR vs. POSTERIOR M.I.)
- ☑ PATTERN of LEFT ANTERIOR FASCICULAR BLOCK (POS. QRS lead I; NEG rS leads II, III)
- ☑ ST ELEVATION in lead aVR > 0.5 mm

43 yr
Male

Vent. rate	183	BPM
PR interval	*	ms
QRS duration	106	ms
QT/QTc	240/418	ms
P-R-T axes	* -34	-18

Atrial fibrillation with rapid ventricular response
with premature ventricular or aberrantly conducted complexes
Left axis deviation
ST elevation consider anterolateral injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



ECG CLUES of ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION:

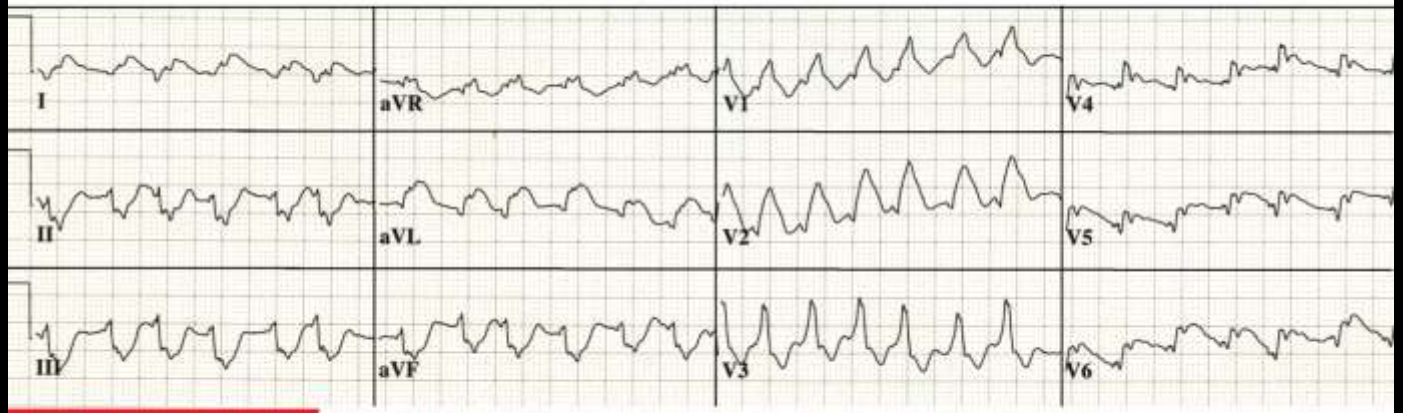
- ☑ ST ELEVATION in leads I and aVL
- ☑ INCONSISTENCY of ST SEGEMENT in leads V1 - V6 : V1 - V2 ST ELEVATION, V3 - V6 ST DEPRESSION (COMPETING FORCES of ANTERIOR vs. POSTERIOR M.I.)
- ☑ PATTERN of LEFT ANTERIOR FASCICULAR BLOCK (POS. QRS lead I; NEG rS leads II, III)

48 yr
Male Caucasian

Loc: Option:

Vent. rate	155	BPM
PR interval	*	ms
QRS duration	110	ms
QT/QTc	300/482	ms
P-R-T axes	* -83	-34

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



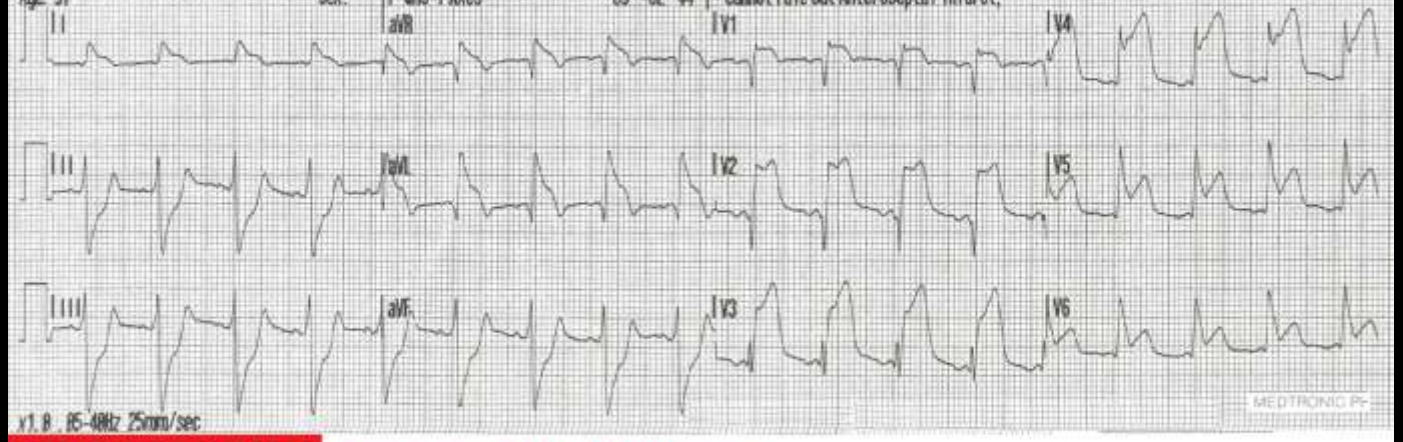
ECG CLUES of ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION:

- ☑ ST ELEVATION in LEADS I, aVL, V1 - V2, V4 - V6 with ST DEPRESSION in V3: (COMPETING FORCES of ANTERIOR vs. POSTERIOR M.I.)
- ☑ RIGHT BUNDLE BRANCH BLOCK PATTERN, with
- ☑ LEFT ANTERIOR FASCICULAR BLOCK PATTERN

Name:
ID:
Patient ID:
Incident:
Age: 37 Sex:

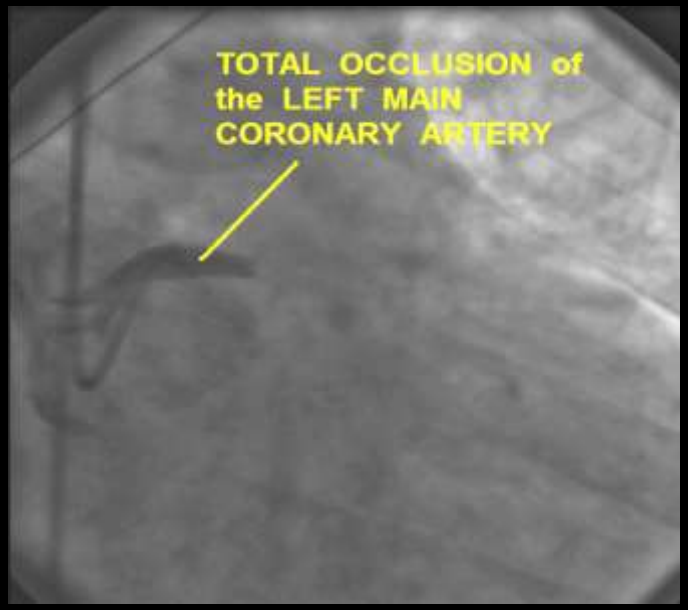
12-Lead 4	HR 107 bpm	*** ACUTE MI SUSPECTED ***
06 Oct 87	12:44:13	* Abnormal ECG **Unconfirmed**
PR 0.154s	QRS 0.102s	* Sinus tachycardia
QT/QTc	0.332s/0.443s	* Left anterior fascicular block
P-QRS-T Axes	89° -62° 44°	* Cannot rule out Anteroseptal infarct,

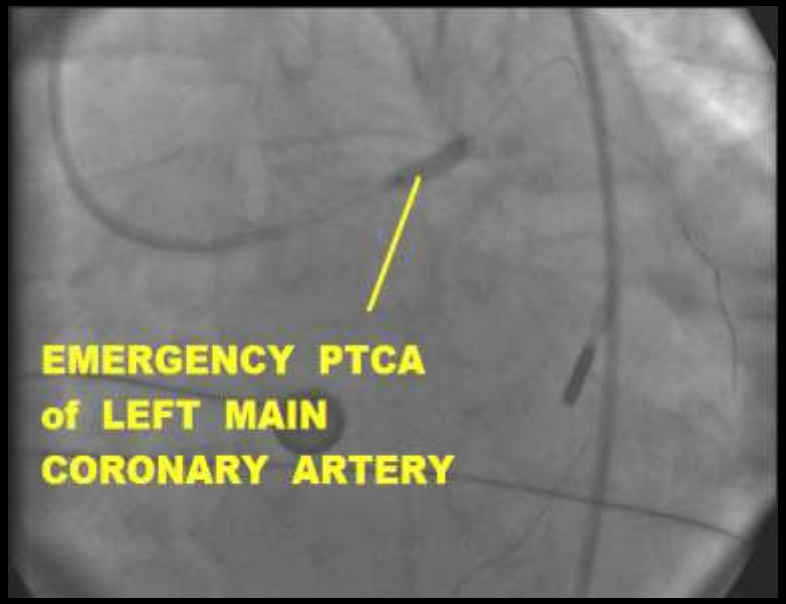
ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



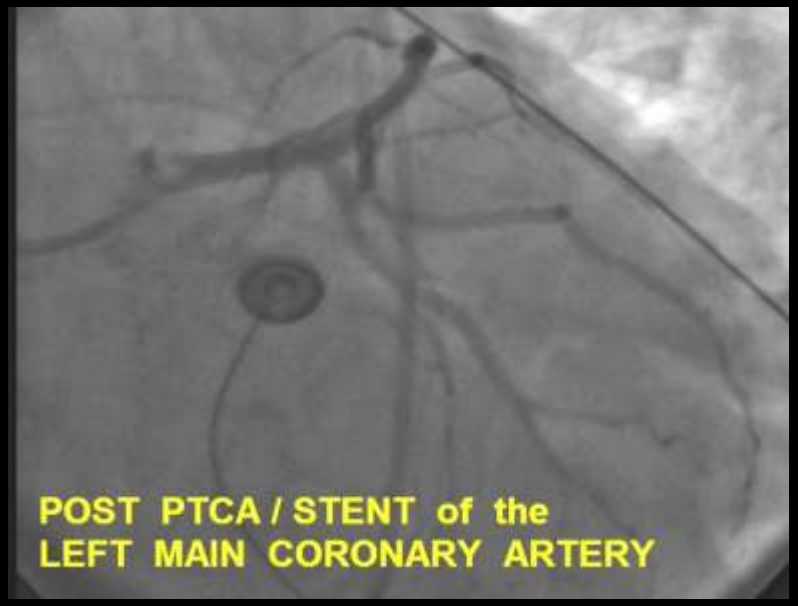
ECG CLUES of ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION:

- ☑ ST ELEVATION in LEADS I, aVL, V1 - V6
- ☑ ST ELEVATION in aVR GREATER THAN 0.5 mm
- ☑ ST ELEVATION in aVR GREATER THAN LEAD V1
- ☑ LEFT ANTERIOR FASCICULAR BLOCK PATTERN





Despite the dismal mortality rate associated with STEMI from total LMCA occlusion, this patient survived and was later discharged. His EF is estimated at approximately 30%. He received an ICD, and is currently stable.



CASE STUDY 4: CRITICAL DECISIONS SCENARIO

CONCLUSIONS:

QUESTION 1: WHICH PATIENT SHOULD BE TAKEN FIRST FOR IMMEDIATE CARDIAC CATHETERIZATION for EMERGENCY PCI ?

ANSWER: PATIENT B was taken emergently to the Cardiac Cath Lab - both the ED physician and the Interventional Cardiologist correctly identified the EKG patterns of LMCA occlusion.

QUESTION 2: WHAT COURSE OF ACTION SHOULD BE TAKEN WITH THE PATIENT NOT CHOSEN TO BE SENT TO THE CATH LAB FIRST?

ANSWER: PATIENT A received thrombolytic therapy in the ED. It was determined that THROMBOLYTIC THERAPY would achieve the FASTEST ROUTE to REPERFUSION -- -- *by at least 60 minutes.*

CASE STUDY 7 - STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

46 yr. old MALE arrives in ER, C/O SUDDEN ONSET OF CHEST PRESSURE 45 MINUTES AGO. PAIN IS CONSTANT, PRESSURE-LIKE, AND NOT EFFECTED BY POSITION, MOVEMENT or DEEP INSPIRATION. ALSO C/O D.I.B.

RISK FACTOR PROFILE:

- CURRENT CIGARTTE SMOKER x 18 YEARS
- HYPERTENSION
- HIGH LDL CHOLESTEROL

PHYSICAL EXAM: Patient is alert & oriented x 4, skin warm, dry, color normal. Non-anxious Lungs clear, normal S1, S2. No JVD, No ankle edema.

VITAL SIGNS: BP: 136/88 P: 88 R: 20 SAO2: 100% on 4 LPM O2

LABS: TROPONIN: < .04

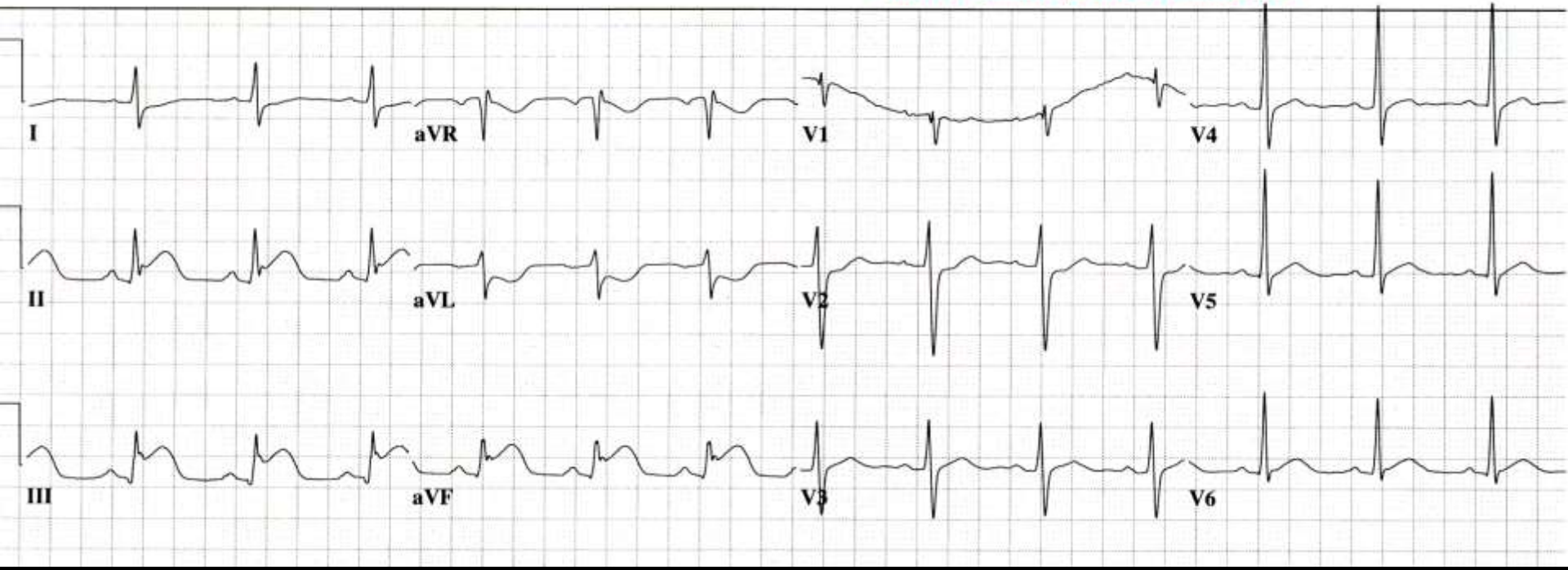
46 yr
Male Caucasian

Loc:3 Option:23

Vent. rate	82	BPM
PR interval	168	ms
QRS duration	96	ms
QT/QTc	384/448	ms
P-R-T axes	76 81	88

EVALUATE EKG for indicators of ACS:

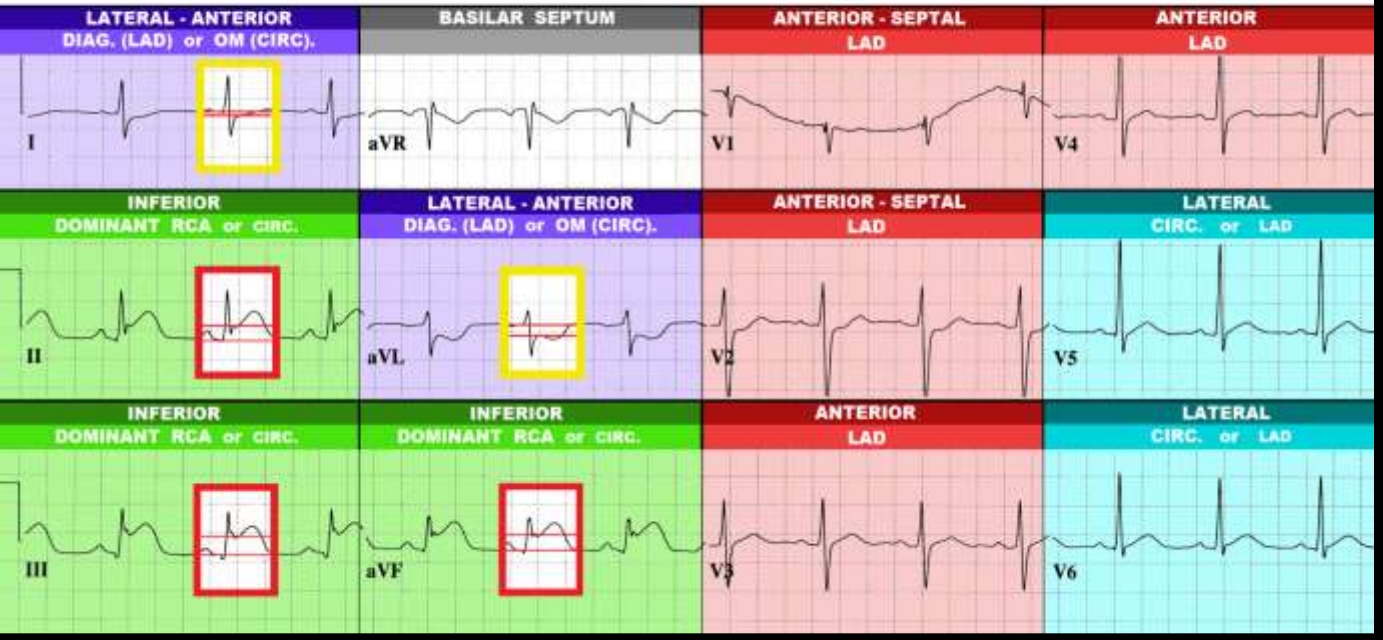
- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- CONVEX ST SEGMENTS
- OTHER ST SEGMENT / T WAVE ABNORMALITIES



46 yr		Vent. rate	82	BPM	Normal sinus rhythm
Male	Caucasian	PR interval	168	ms	ST elevation consider inferior injury or acute infarct
		QRS duration	96	ms	*** ** ** ** * ACUTE MI ** ** ** **
		QT/QTc	384/448	ms	Abnormal ECG
		P–R–T axes	76 81	88	

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION



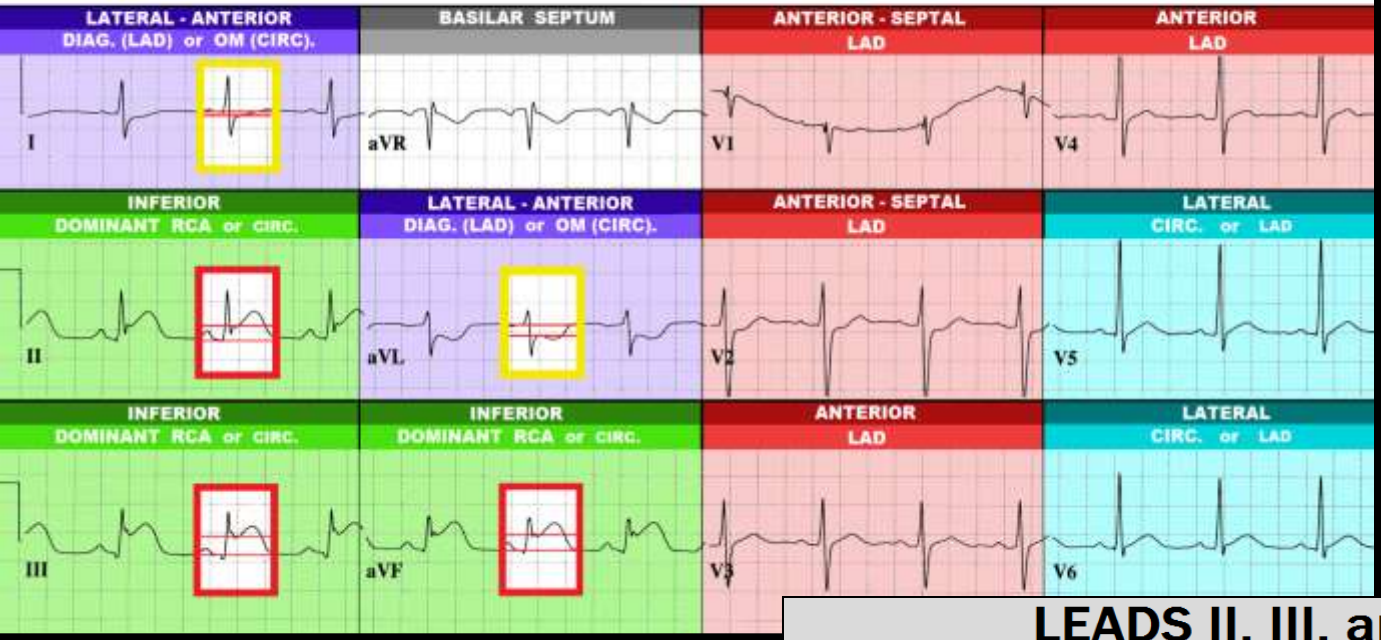
46 yr
Male
Caucasian

Vent. rate	82	BPM
PR interval	168	ms
QRS duration	96	ms
QT/QTc	384/448	ms
P-R-T axes	76 81	88

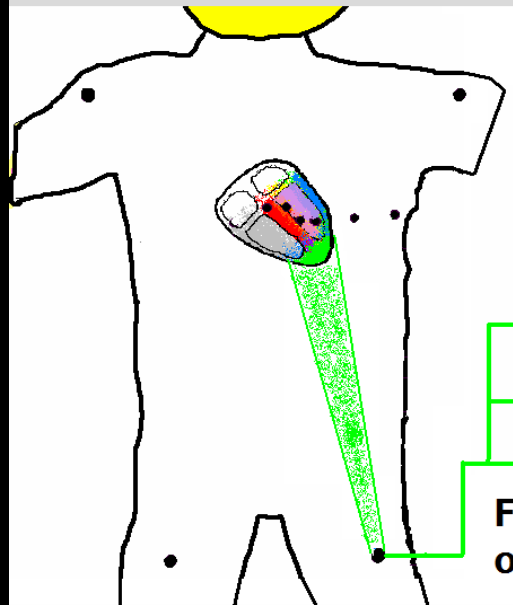
Normal sinus rhythm
ST elevation consider inferior injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG

ST SEGMENT ELEVATION

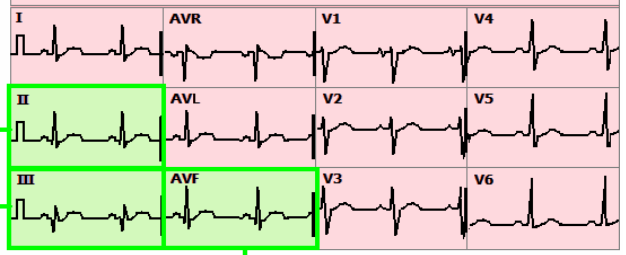
ST SEGMENT DEPRESSION



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

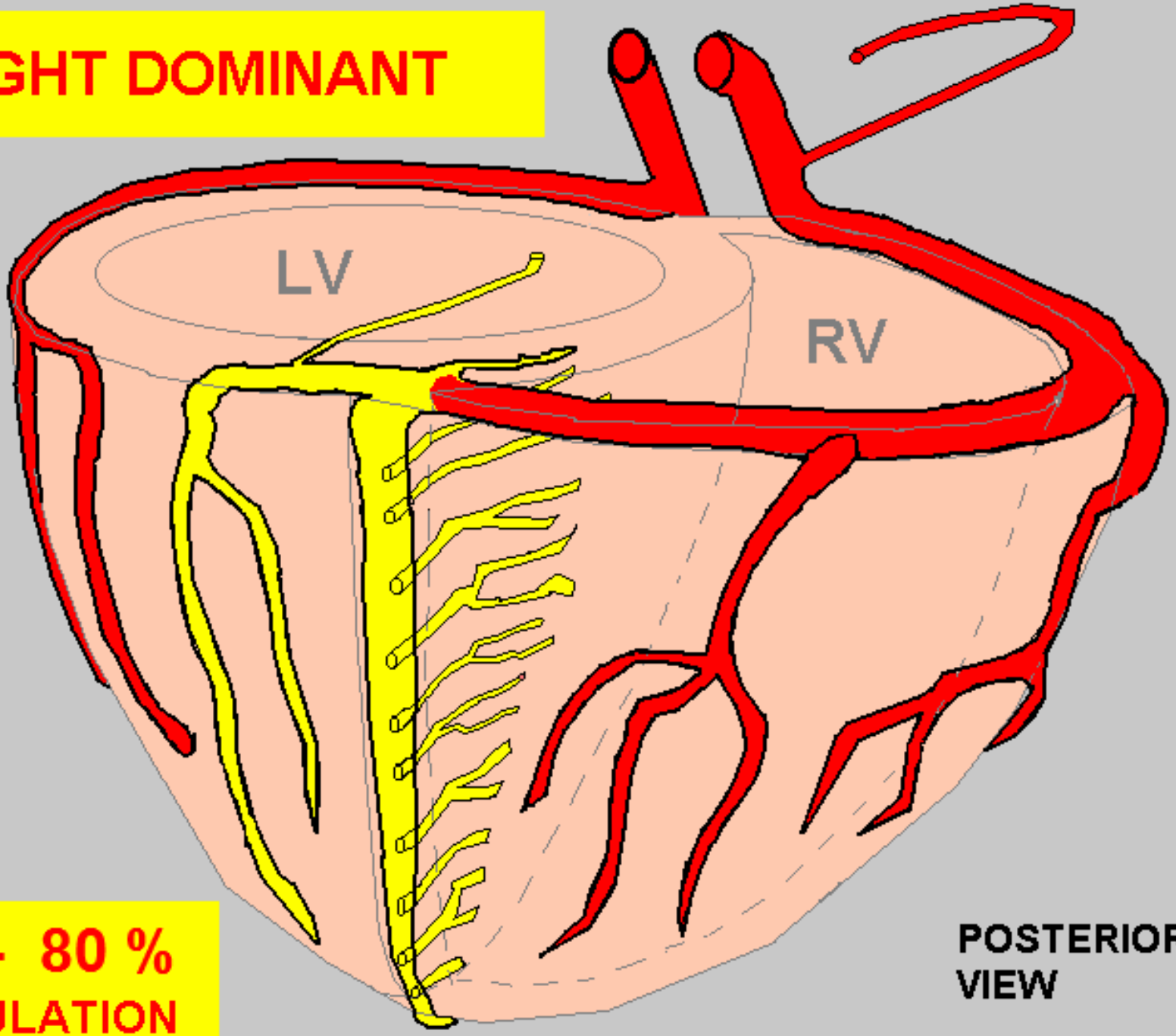


RUPPERT, WAYNE ID: 7445683659 05-OCT-2006 JOHNS-HOPKINS UNIV.
38 Yrs MALE
Vent. Rate: 68
P-R Int.: 160 ms
QRS: 100 ms
NORMAL SINUS RHYTHM
Normal EKG
Very Healthy Athletic EKG !



FED by the RCA (75 - 80 % pop)
or the CIRCUMFLEX (10 - 15 %)

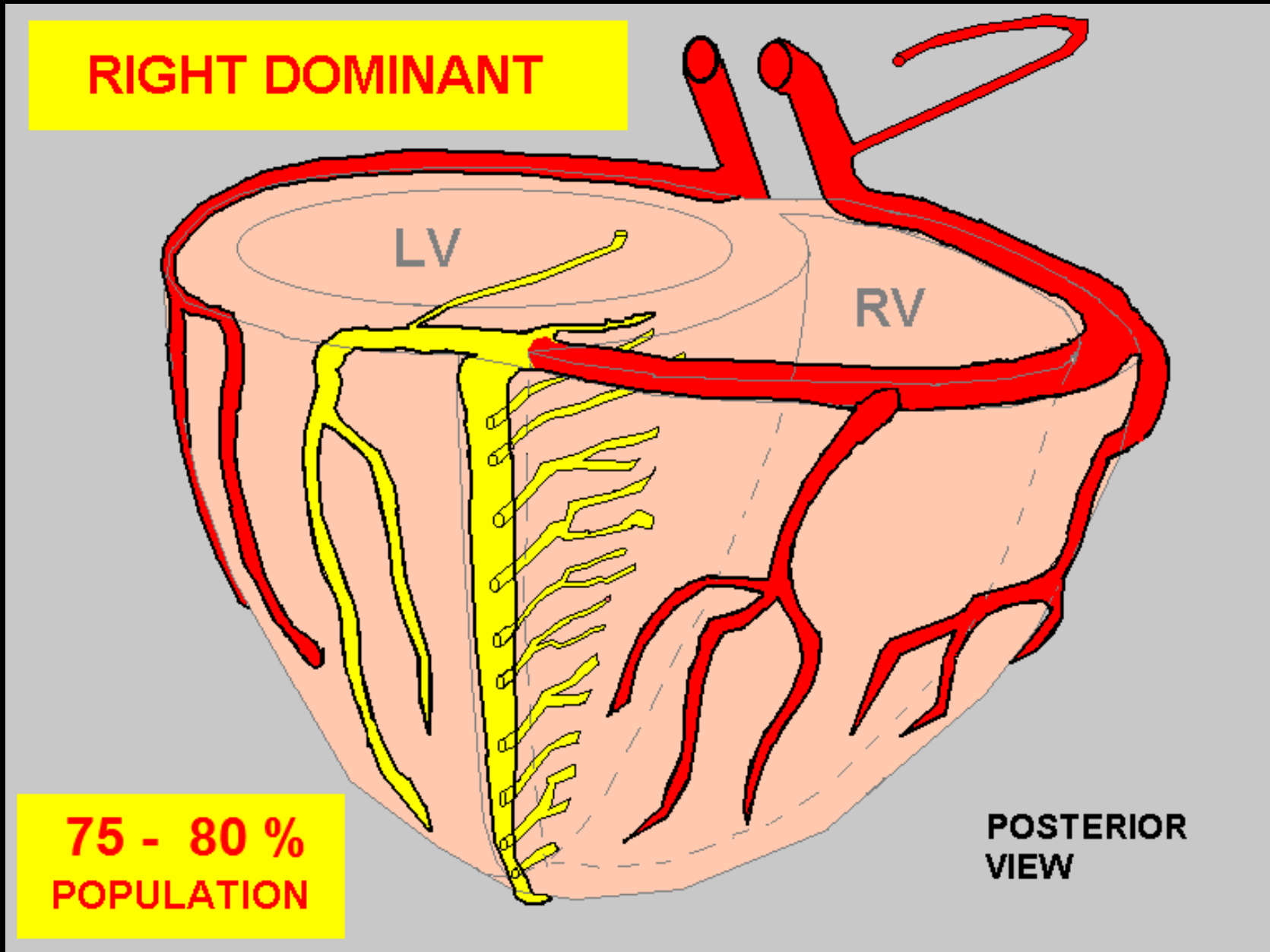
RIGHT DOMINANT



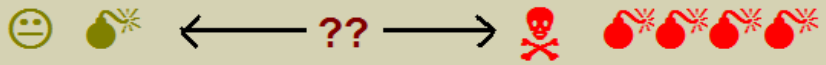
75 - 80 %
POPULATION

POSTERIOR VIEW

TEST QUESTION # 27



The MANY FACES of INFERIOR MI ...



INFERIOR WALL MIs can range from being "MILD" (many are) to being *MORE DEADLY* than a "typical" ANTERIOR WALL MI . . .

The MANY FACES of INFERIOR MI ...

. . . . THIS IS BECAUSE THE UNDERLYING VASCULATURE THAT SERVES THE INFERIOR WALL CAN VARY GREATLY . . . . .

The MANY FACES of INFERIOR MI ...

INFERIOR

INFERIOR-RV

INFERIOR-POSTERIOR

INFERIOR-RV -POSTERIOR

INFERIOR - LATERAL - POSTERIOR

INFERIOR - LATERAL - POSTERIOR - RV

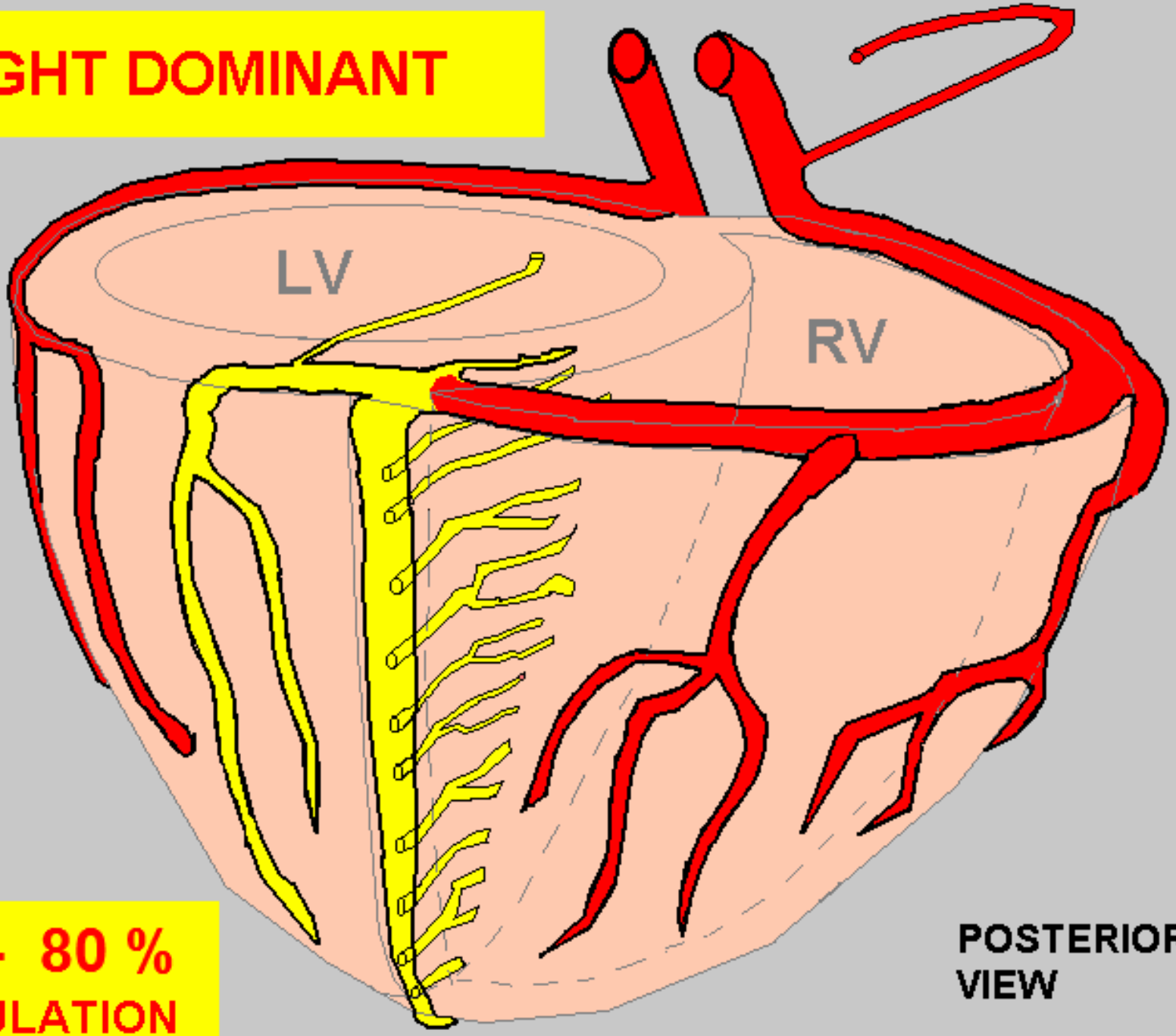
. . . . and more !!

*FREQUENCY OF OCCURRENCE

COMMON	INFERIOR
COMMON	INFERIOR-RV
LESS COMMON	INFERIOR-POSTERIOR
LESS COMMON	INFERIOR-RV -POSTERIOR
RARE	INFERIOR - LATERAL - POSTERIOR
RARE	INFERIOR - LATERAL - POSTERIOR - RV

* BASED ON AUTHOR'S PERSONAL OBSERVATIONS

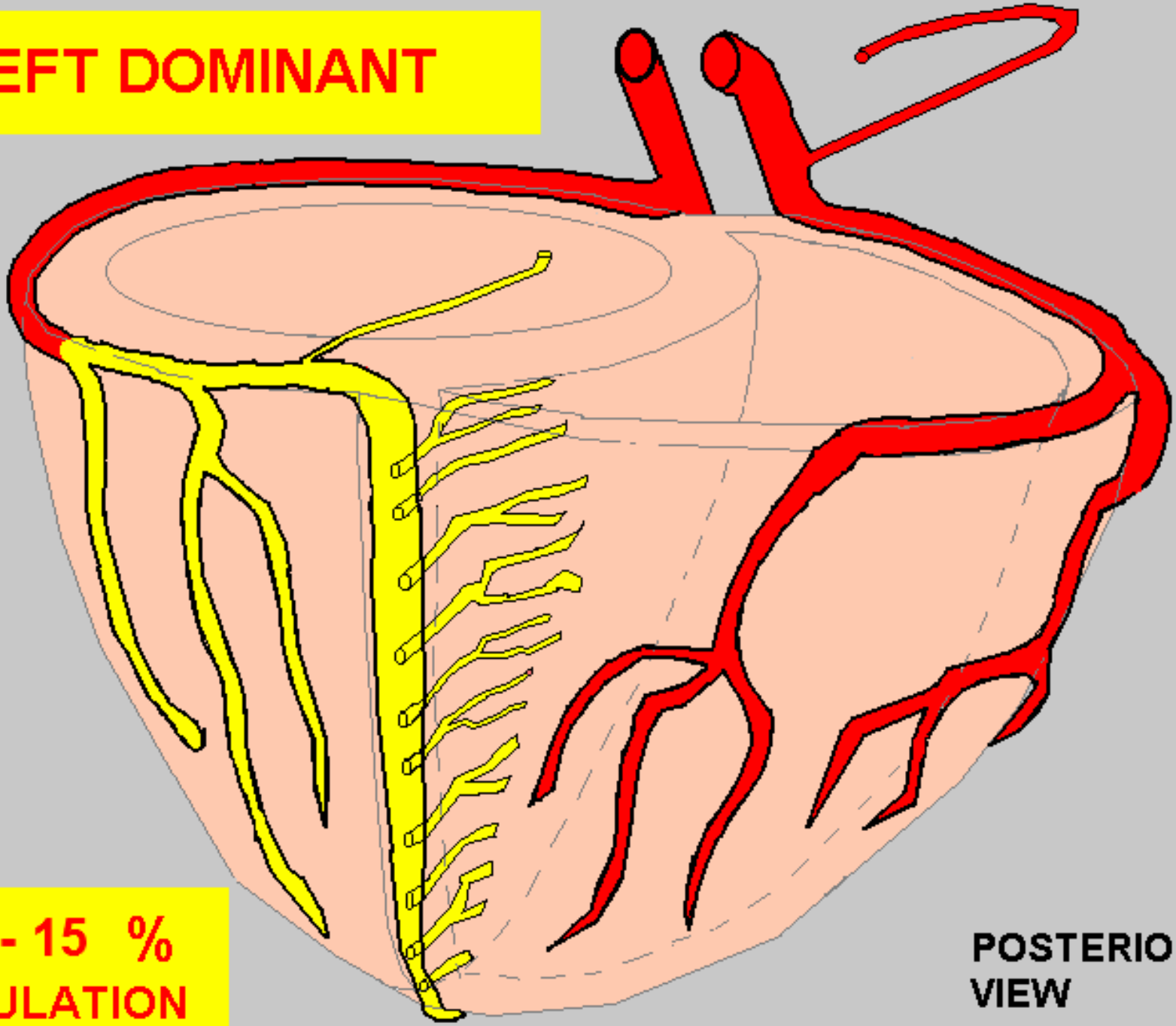
RIGHT DOMINANT



75 - 80 %
POPULATION

POSTERIOR VIEW

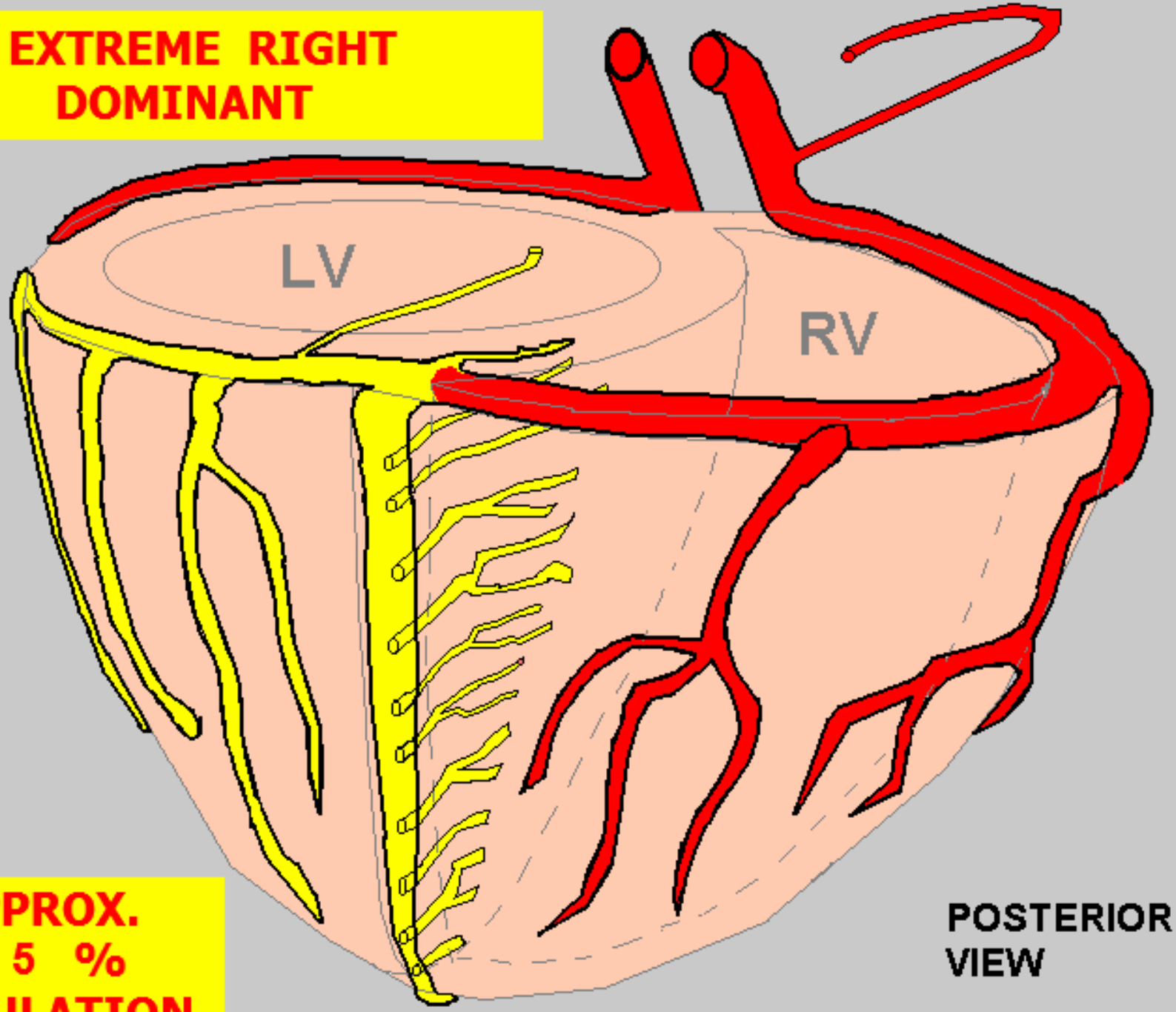
LEFT DOMINANT



10 - 15 %
POPULATION

POSTERIOR
VIEW

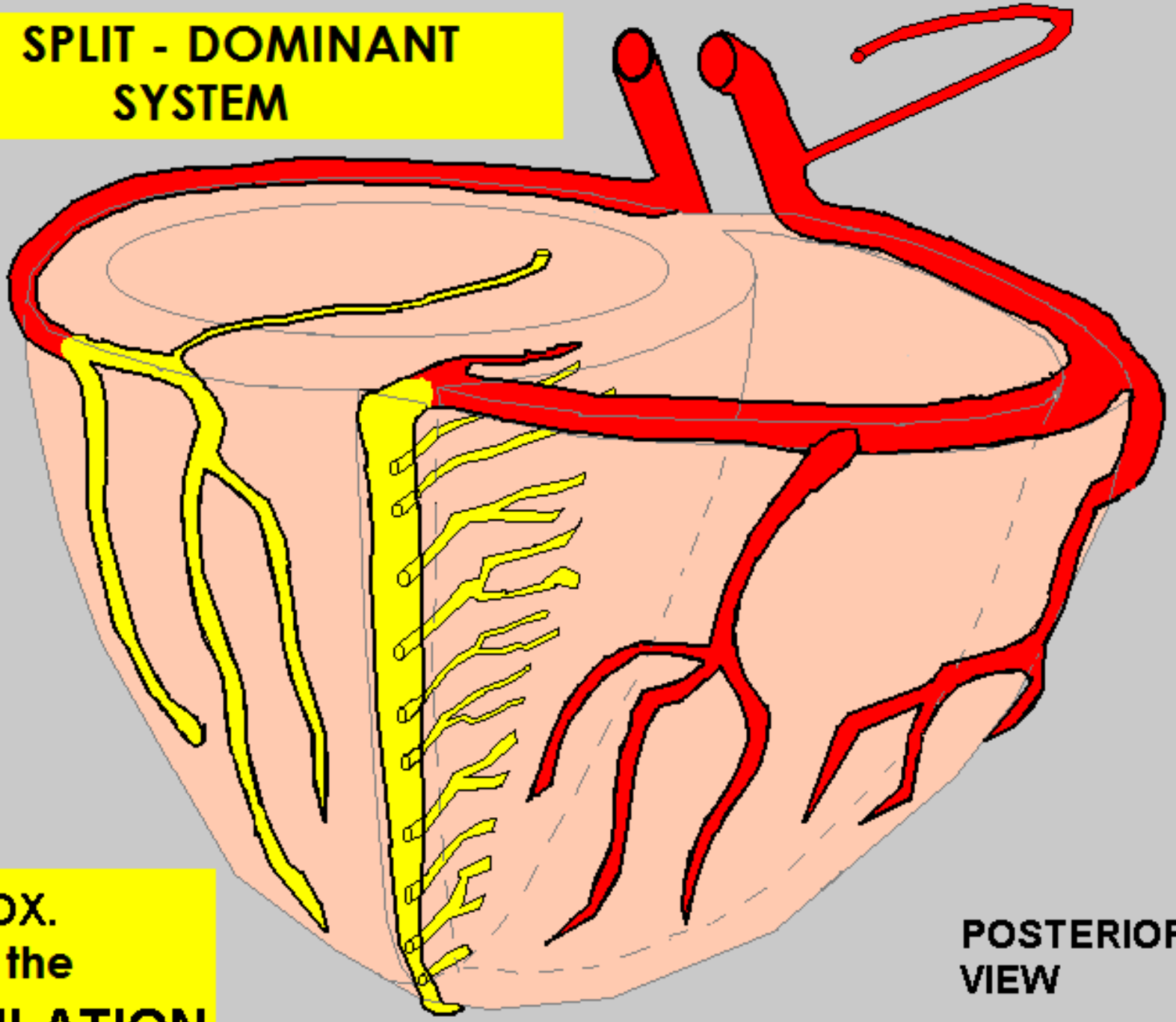
EXTREME RIGHT DOMINANT



APPROX.
3 - 5 %
POPULATION

POSTERIOR
VIEW

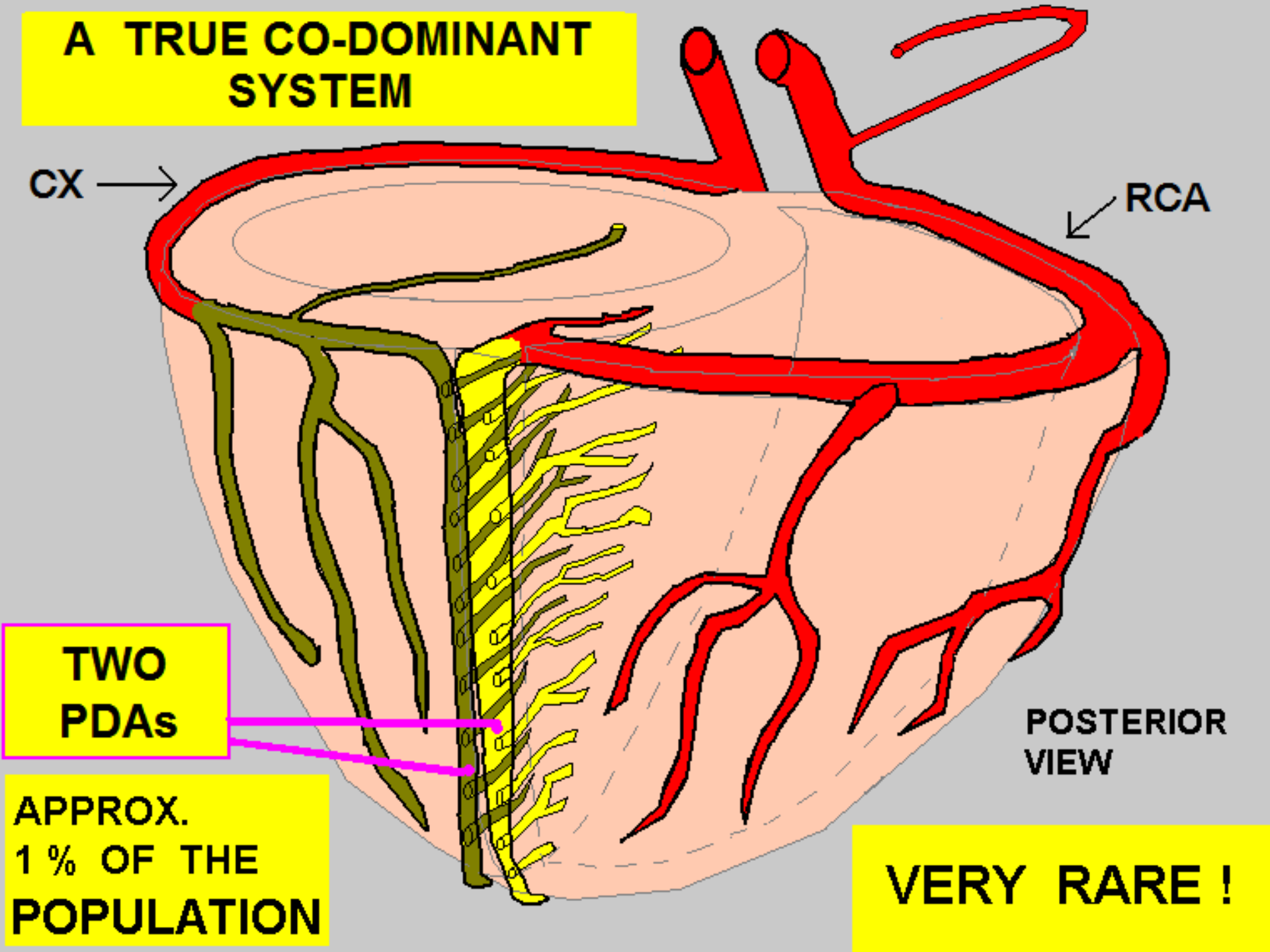
A SPLIT - DOMINANT SYSTEM



APPROX.
5% of the
POPULATION

POSTERIOR
VIEW

A TRUE CO-DOMINANT SYSTEM



APPROX. 1 % OF THE POPULATION

VERY RARE !

The MANY FACES of INFERIOR MI ...

INSTEAD OF PERFORMING THE

3 STEPS METHOD

YOU CAN OBTAIN AN

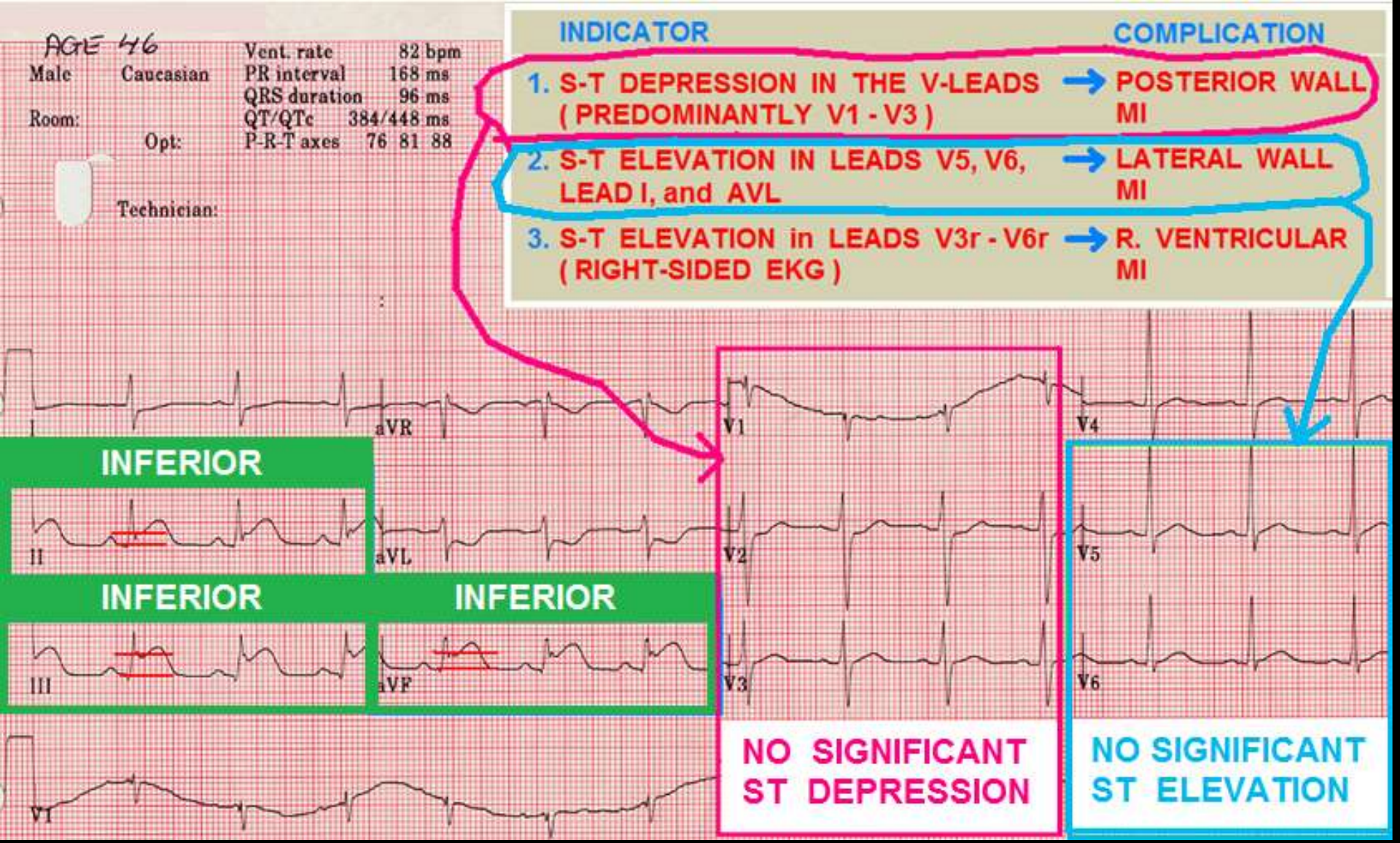
18 LEAD EKG.

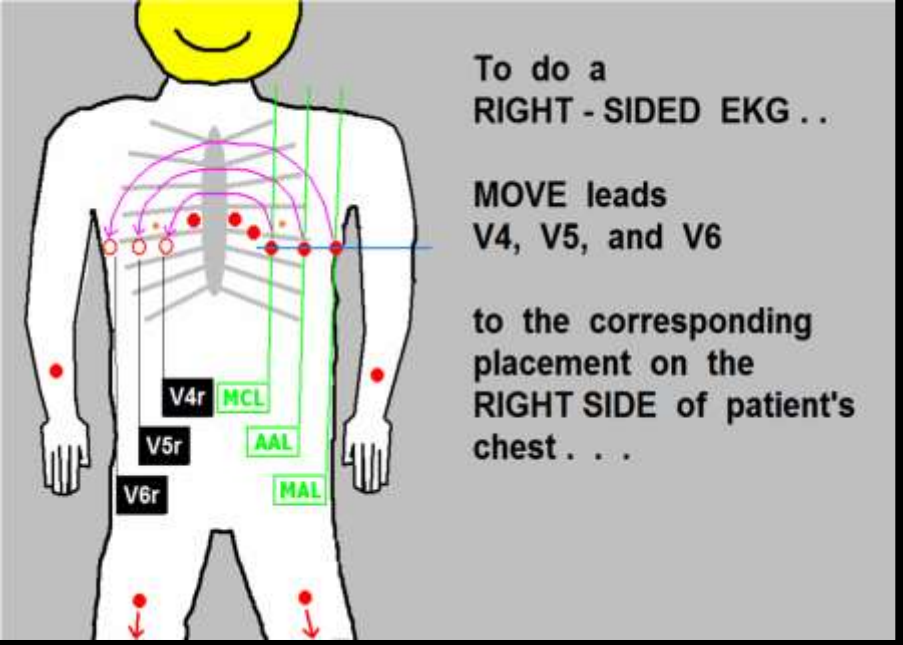
IT WILL PROVIDE YOU WITH MORE DATA, AND HAS BETTER SPECIFICITY . . . .

The MANY FACES of INFERIOR MI ...

☞ **WHEN YOU OBSERVE AN INFERIOR WALL MI (S-T ELVATION LEADS II, III, and AVF) . . . ALWAYS LOOK FOR THE FOLLOWING INDICATORS TO ASSESS THE EXTENT OF THE MI:**

INDICATOR		COMPLICATION
1. S-T DEPRESSION IN THE V-LEADS (PREDOMINANTLY V1 - V3)	→	POSTERIOR WALL MI
2. S-T ELEVATION IN LEADS V5, V6, LEAD I, and AVL	→	LATERAL WALL MI
3. S-T ELEVATION in LEADS V3r - V6r (RIGHT-SIDED EKG)	→	R. VENTRICULAR MI


AGE 46
Male Caucasian
Room:
Opt:
Technician:
Vent. rate 82 bpm
PR interval 168 ms
QRS duration 96 ms
QT/QTc 384/448 ms
P-R-T axes 76 81 88
INDICATOR
COMPLICATION
1. S-T DEPRESSION IN THE V-LEADS (PREDOMINANTLY V1 - V3) → POSTERIOR WALL MI
2. S-T ELEVATION IN LEADS V5, V6, LEAD I, and AVL → LATERAL WALL MI
3. S-T ELEVATION in LEADS V3r - V6r (RIGHT-SIDED EKG) → R. VENTRICULAR MI
I
aVR
V1
V4
INFERIOR
II
aVL
V2
V5
INFERIOR
INFERIOR
III
aVF
V3
V6
V1
NO SIGNIFICANT ST DEPRESSION
NO SIGNIFICANT ST ELEVATION

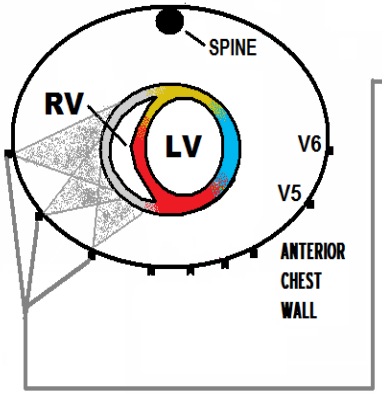


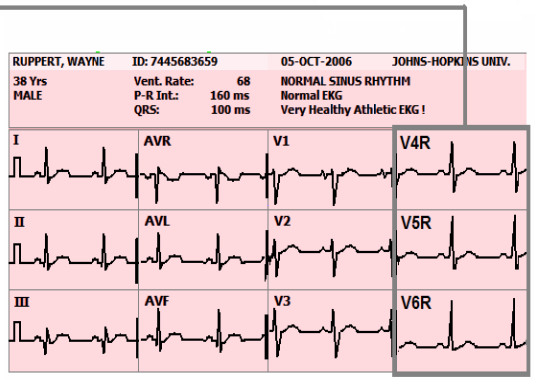
To do a
RIGHT - SIDED EKG . .

MOVE leads
V4, V5, and V6

to the corresponding placement on the RIGHT SIDE of patient's chest . . .

V4R - V6R VIEW THE RIGHT VENTRICLE





ID:

46 y°
Male Caucasian
Room:
Opt:
Technician:

Vent. rate 87 bpm
PR interval 176 ms
QRS duration 94 ms
QT/QTc 330/397 ms
P-R-T axes 79 81 102

Normal sinus rhythm
~~Anterolateral infarct, possibly acute~~
Inferior injury pattern
** ** ** ** * Acute MI * ** ** ** **
Abnormal ECG

Right Ventricular Infarct

Referred by:

Unconfirmed

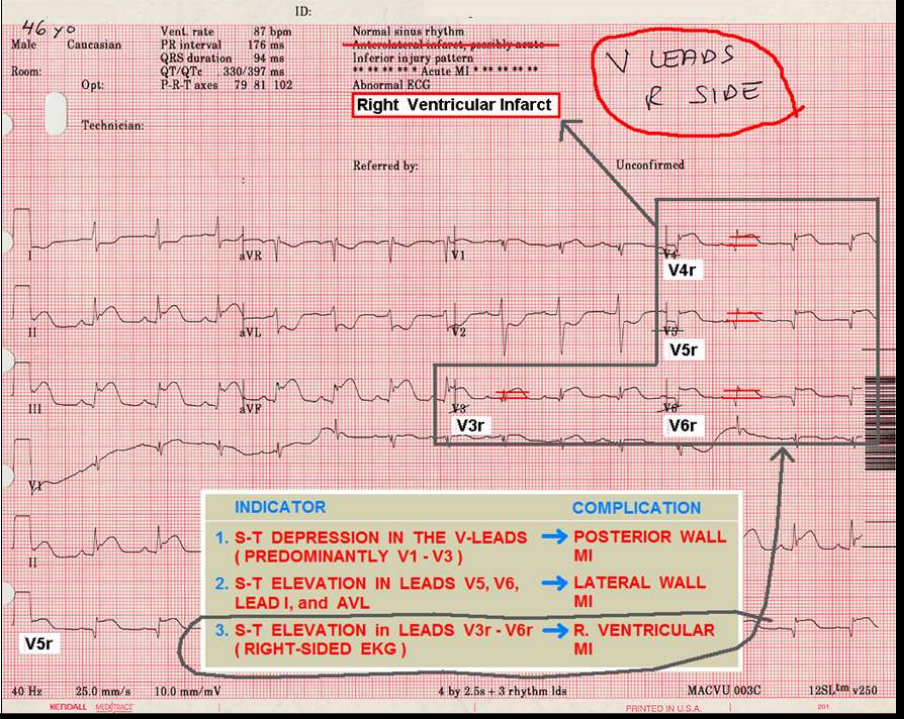
V LEADS
R SIDE

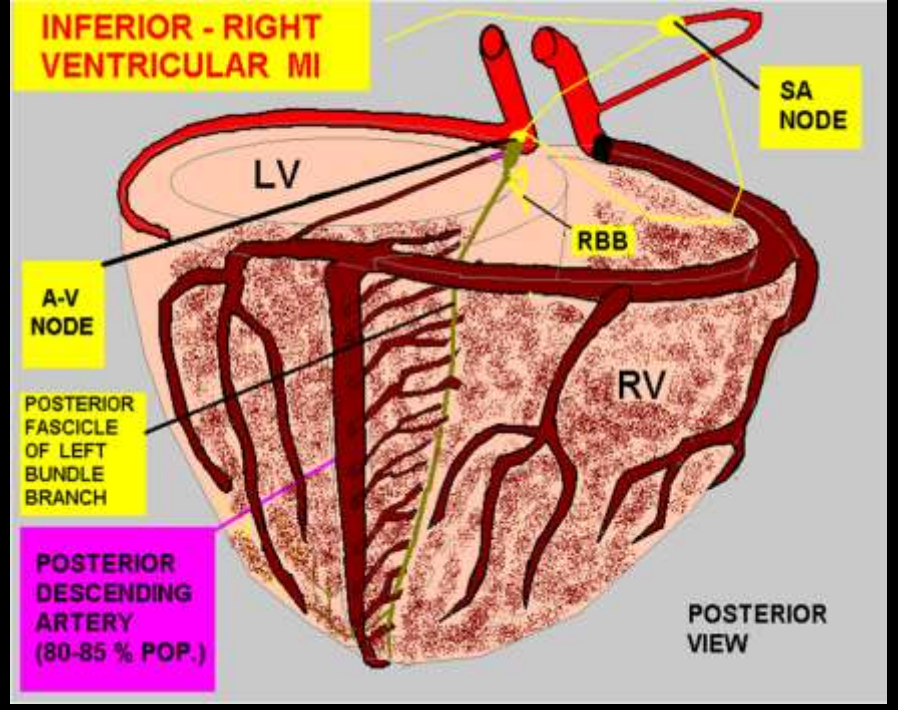
I aVR V1 V4 → V4r
II aVL V2 V5 → V5r
III aVF V3 → V3r V6 → V6r
V1
II
V5r

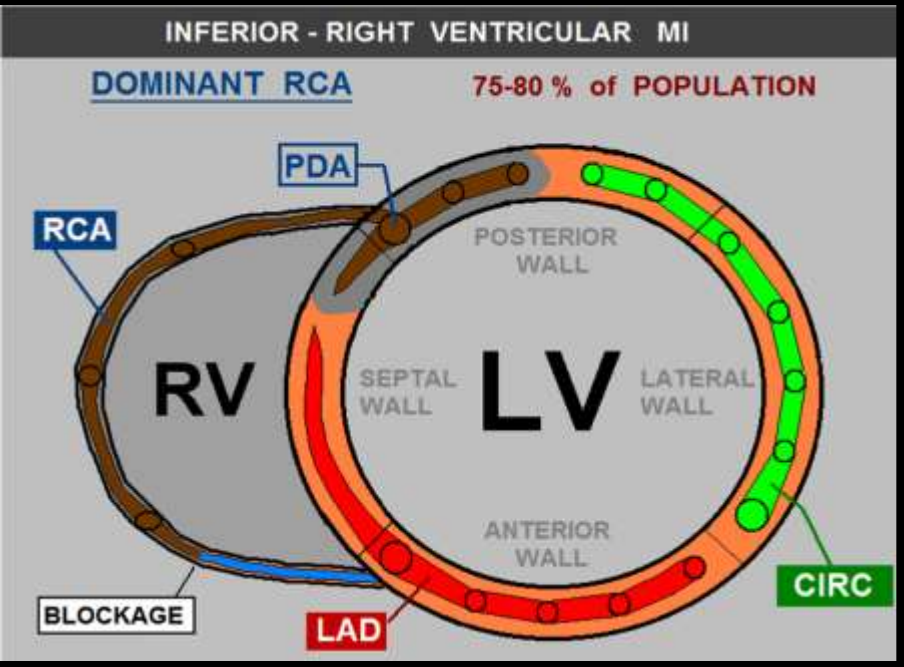
INDICATOR		COMPLICATION
1. S-T DEPRESSION IN THE V-LEADS (PREDOMINANTLY V1 - V3)	→	POSTERIOR WALL MI
2. S-T ELEVATION IN LEADS V5, V6, LEAD I, and AVL	→	LATERAL WALL MI
3. S-T ELEVATION in LEADS V3r - V6r (RIGHT-SIDED EKG)	→	R. VENTRICULAR MI

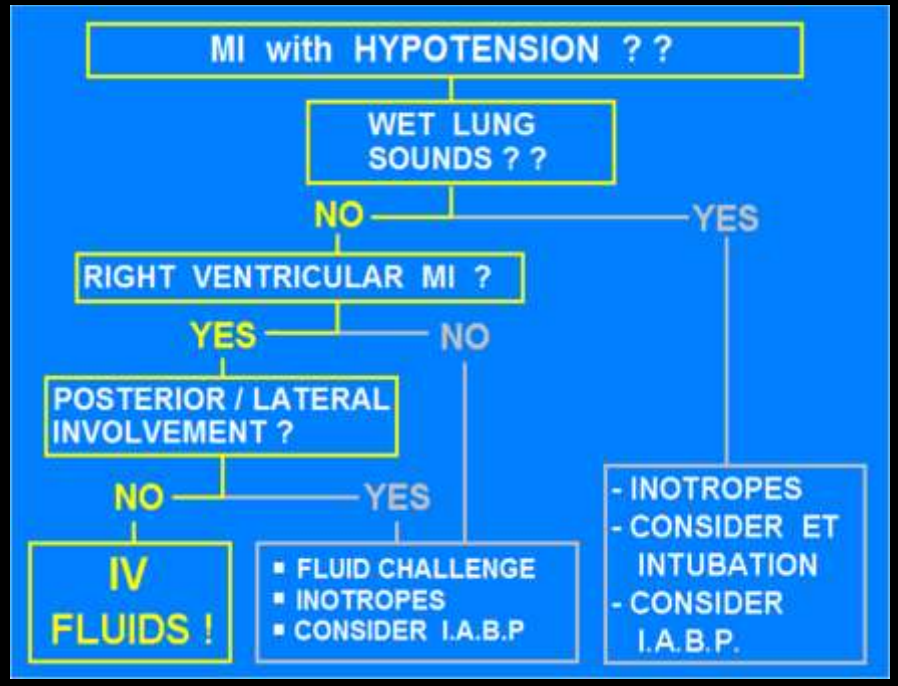
40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MACVU 003C 12SL[tm] v250

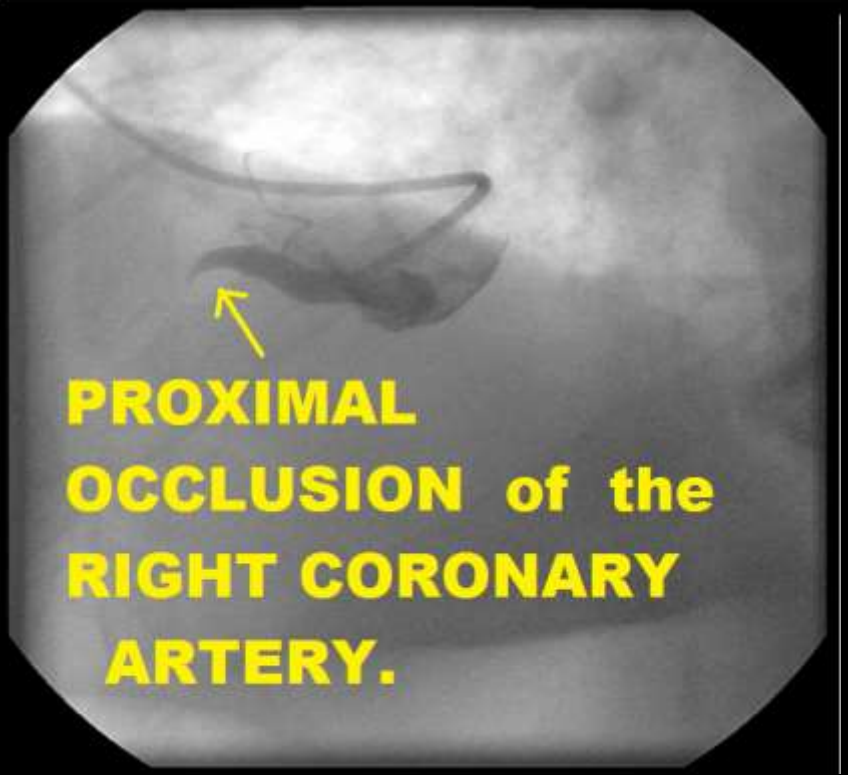
KENDALL MEDITRACE PRINTED IN U.S.A. 201

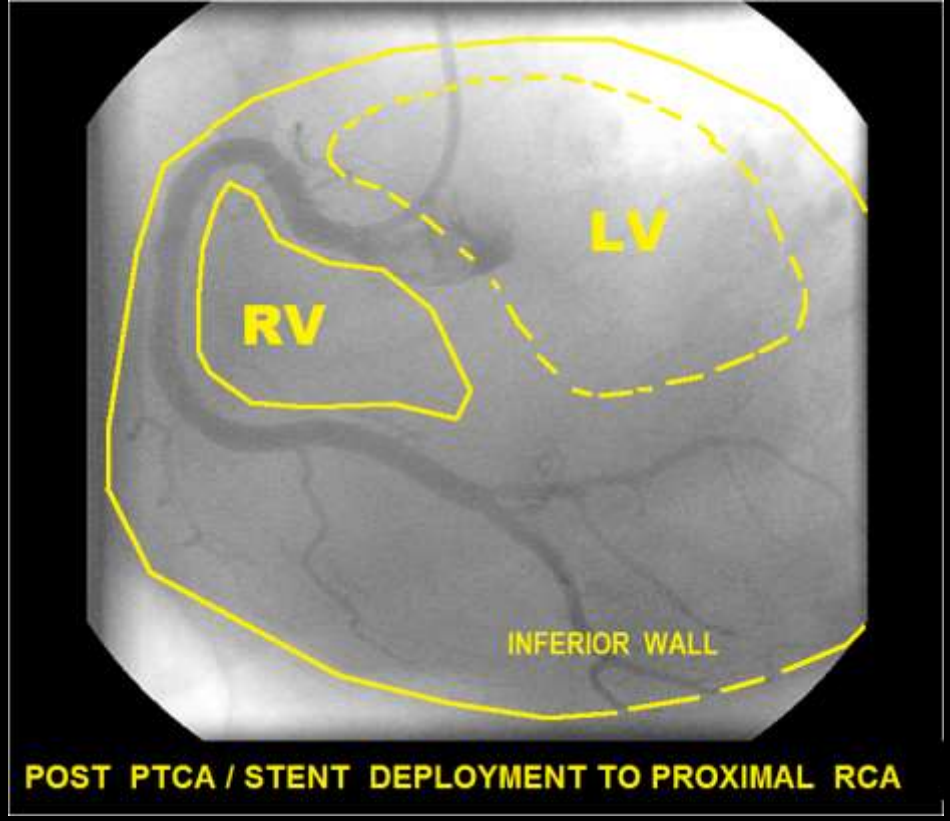

ID:
46 yo
Male Caucasian
Room:
Opt:
Technician:
Vent. rate 87 bpm
PR interval 176 ms
QRS duration 94 ms
QT/QTc 330/397 ms
P-R-T axes 79 81 102
Normal sinus rhythm
Inferior injury pattern
** ** ** ** * Acute MI * ** ** ** **
Abnormal ECG
Right Ventricular Infarct
V LEADS
R SIDE
Referred by:
Unconfirmed
I
aVR
V1
V4r
II
aVL
V2
V5r
III
aVF
V3r
V6r
V1
II
V5r
INDICATOR
COMPLICATION
1. S-T DEPRESSION IN THE V-LEADS (PREDOMINANTLY V1 - V3) → POSTERIOR WALL MI
2. S-T ELEVATION IN LEADS V5, V6, LEAD I, and AVL → LATERAL WALL MI
3. S-T ELEVATION in LEADS V3r - V6r (RIGHT-SIDED EKG) → R. VENTRICULAR MI
40 Hz 25.0 mm/s 10.0 mm/mV
4 by 2.5s + 3 rhythm lds
MACVU 003C
12SL tm v250
KENDALL MEDITRACE
PRINTED IN U.S.A.


INFERIOR - RIGHT VENTRICULAR MI
SA NODE
LV
RBB
A-V NODE
RV
POSTERIOR FASCICLE OF LEFT BUNDLE BRANCH
POSTERIOR DESCENDING ARTERY (80-85 % POP.)
POSTERIOR VIEW


INFERIOR - RIGHT VENTRICULAR MI
DOMINANT RCA
75-80 % of POPULATION
PDA
RCA
POSTERIOR WALL
RV
SEPTAL WALL
LV
LATERAL WALL
ANTERIOR WALL
CIRC
BLOCKAGE
LAD


MI with HYPOTENSION ? ?
WET LUNG SOUNDS ? ?
NO
YES
RIGHT VENTRICULAR MI ?
YES
NO
POSTERIOR / LATERAL INVOLVEMENT ?
NO
YES
IV FLUIDS !
▪ FLUID CHALLENGE
▪ INOTROPES
▪ CONSIDER I.A.B.P
- INOTROPES
- CONSIDER ET INTUBATION
- CONSIDER I.A.B.P.





POST PTCA / STENT DEPLOYMENT TO PROXIMAL RCA

CASE STUDY SUMMARY

ST ELEVATION: II, III, aVF , V4R - V6R

ST DEPRESSION: I, aVL

SUSPECTED DIAGNOSIS: ACUTE INFERIOR - RIGHT VENTRICULAR WALL MI

SUSPECTED "CULPRIT ARTERY" (if applicable):

RIGHT CORONARY ARTERY - DOMINANT

IMMEDIATE CONCERNS FOR ALL STEMI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
15-25% OF THE LV MUSCLE MASS	SLIGHT POSSIBILITY OF MILD LV FAILURE.	FLUID CHALLENGE INOTROPIC AGENTS
100% OF THE RIGHT VENTRICLE	EXTREME SENSITIVITY TO NITRATES AND OPIATES	FLUID BOLUSES
SINUS NODE ARTERY SUPPLIED BY RCA 55% of Pop.	BRADYCARDIA ASYSTOLE	ATROPINE TRANSCUTANEOUS PACING
AV NODAL ARTERY SUPPLIED BY DOMINANT ARTERY (RCA or Circ) IN MOST PATIENTS	AV NODAL BLOCKS: - 1 DEGREE - 2nd DEGREE type I, II - 3rd DEGREE	ATROPINE TRANSCUTANEOUS PACING

64 yr
Male Caucasian

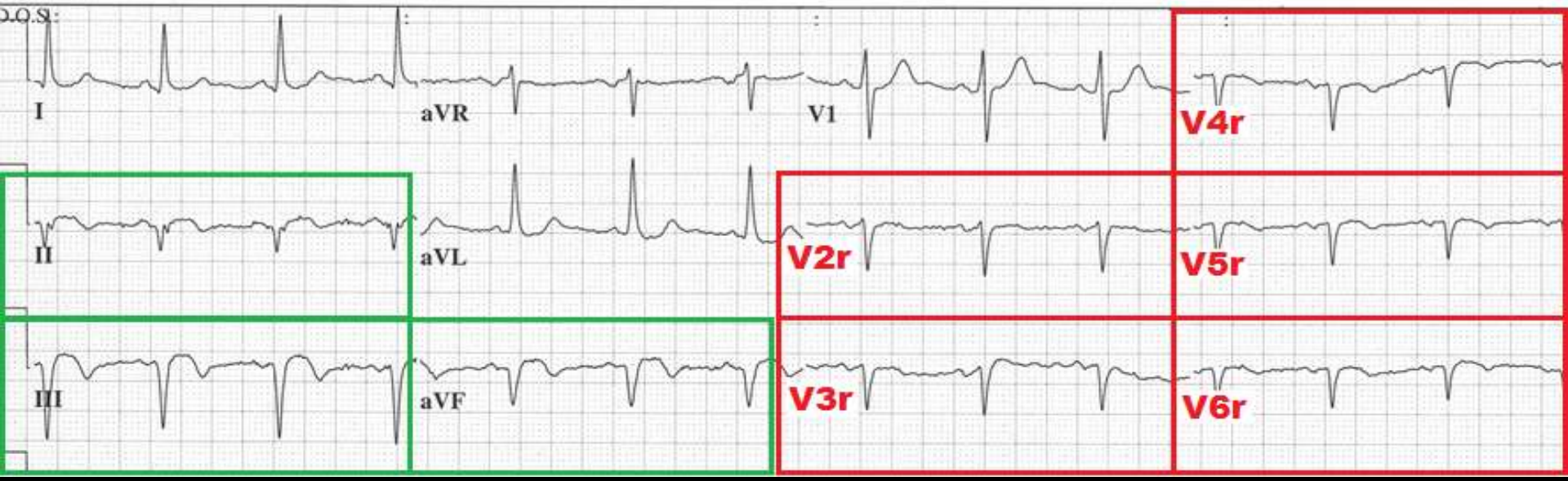
Loc:3 Option:23

Vent. rate	79	BPM
PR interval	136	ms
QRS duration	92	ms
QT/QTc	350/401	ms
P–R–T axes	42 –41	–3

ECG LEADS PLACED ON RIGHT CHEST WALL.

ECG INDICATORS of EVOLVING INFERIOR - RIGHT VENTRICULAR MYOCARDIAL INFARCTION:

- QS COMPLEXES LEADS II, III, aVF
- QS COMPLEXES LEADS V2r - V6r



CASE STUDY 9 - STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

42 y/o MALE arrived via EMS, c/o "HEAVY CHEST PRESSURE," SHORTNESS of BREATH X 40 min. He has experienced V-FIB and been DEFIBRILLATED multiple times

RISK FACTOR PROFILE:

- CIGARETTE SMOKER
- HYPERTENSION
- HIGH LDL CHOLESTEROL

PHYSICAL EXAM: Patient is alert & oriented x 4, ANXIOUS, with COOL, PALE, DIAPHORETIC SKIN. C/O NAUSEA, and is VOMITING. LUNG SOUNDS: COARSE CRACKLES, BASES, bilaterally

VITAL SIGNS: BP: 80/40 P: 70 R: 32 SAO2: 92 % on 15 LPM O2

LABS: TROPONIN: < .04

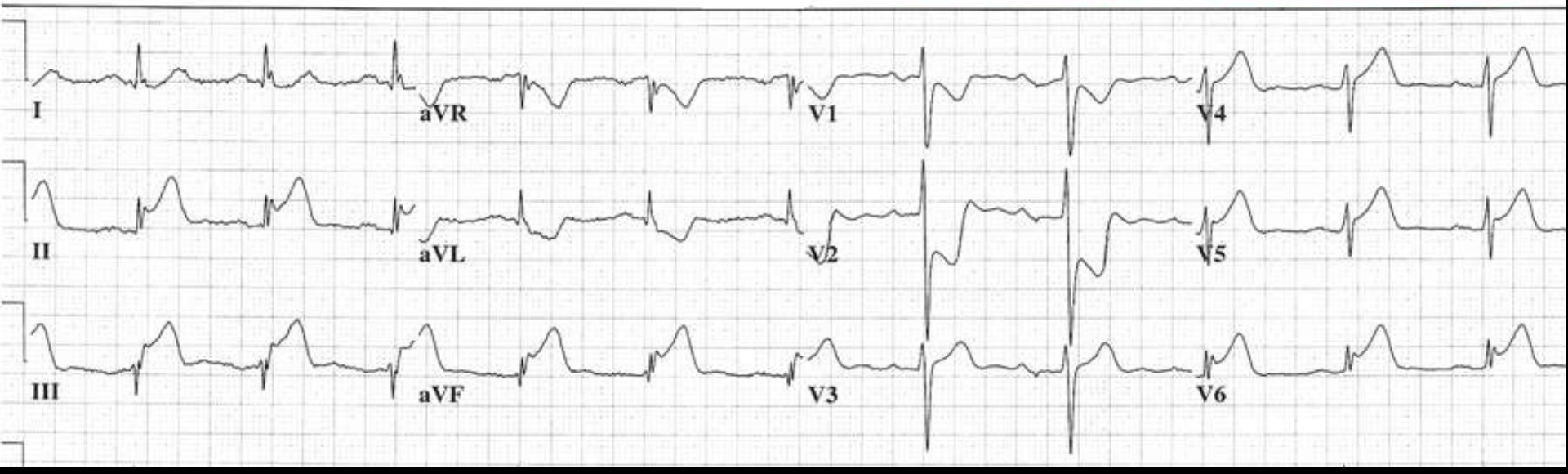
SHOCK ASSESSMENT

LOC:	ANXIOUS RESTLESS LETHARGIC UNCONSCIOUS	AWAKE ALERT & ORIENTED
SKIN:	PALE / ASHEN CYANOTIC COOL DIAPHORETIC	NORMAL HUE WARM DRY
BREATHING:	TACHYPNEA	NORMAL
PULSE:	WEAK / THREADY TOO FAST or SLOW	STRONG
STATUS:	SHOCK	NORMAL

42 yr		Vent. rate	69	BPM
Male	Caucasian	PR interval	196	ms
		QRS duration	98	ms
		QT/QTc	388/415	ms
Loc:3	Option:23	P–R–T axes	14 28	81

EVALUATE EKG for indicators of ACS:

- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- CONVEX ST SEGMENTS
- OTHER ST SEGMENT / T WAVE ABNORMALITIES



CASE STUDY QUESTIONS:

NOTE LEADS WITH ST ELEVATION:	**NOTE LEADS WITH ST DEPRESSION:**
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	**LIST ANY POTENTIAL COMPLICATIONS:**

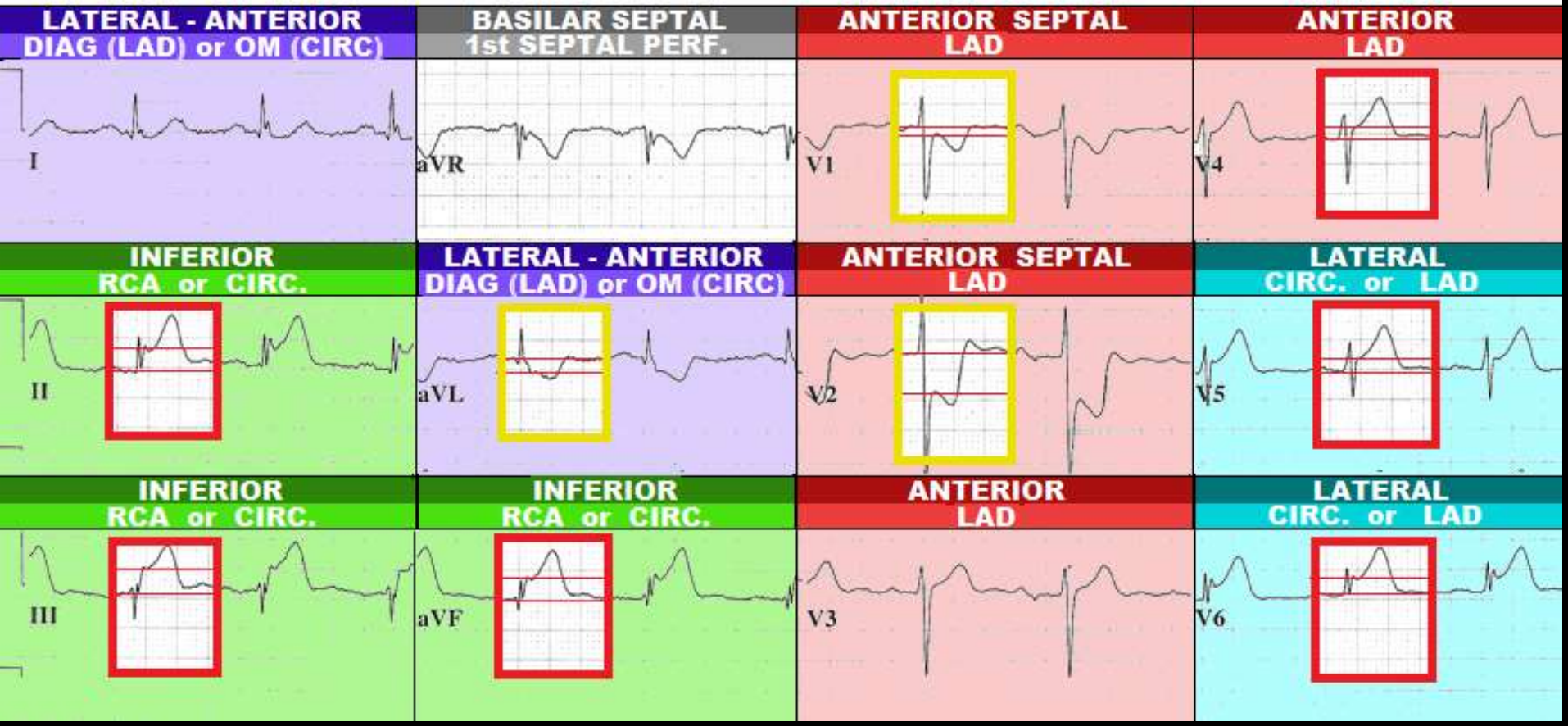
42 yr
Male
Caucasian

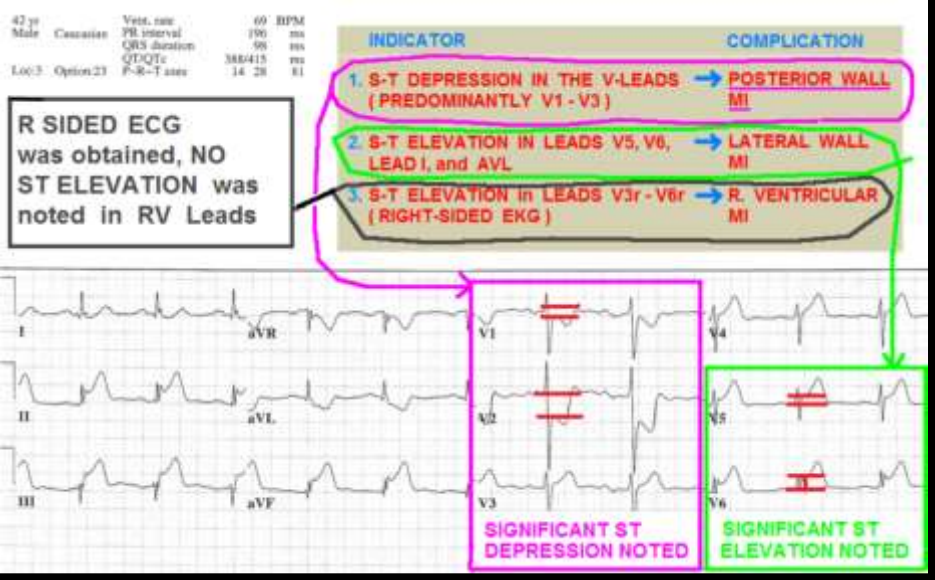
Loc:3
Option:23

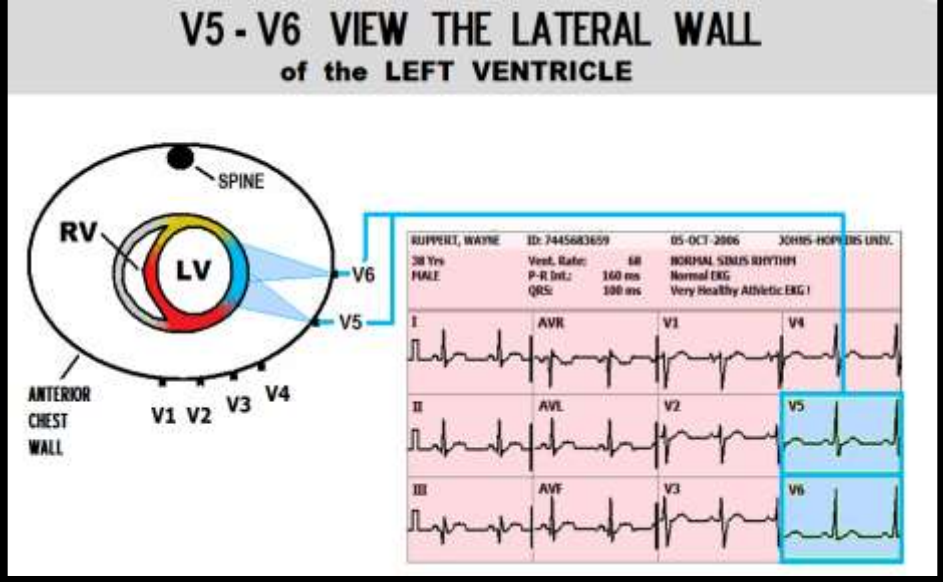
Vent. rate	69	BPM
PR interval	196	ms
QRS duration	98	ms
QT/QTc	388/415	ms
P-R-T axes	14 28	81

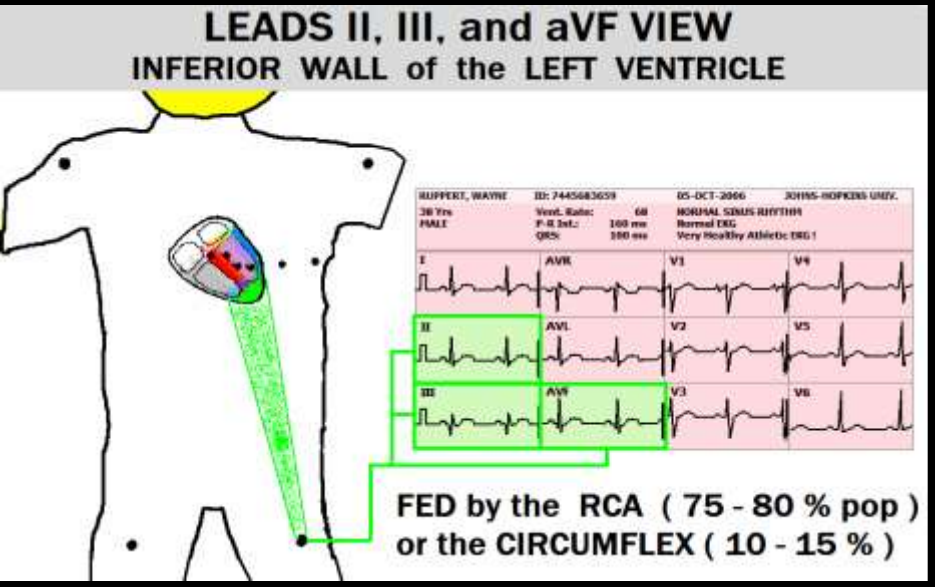
*** Acute MI ***
Inferior-Posterior-Lateral Injury Pattern

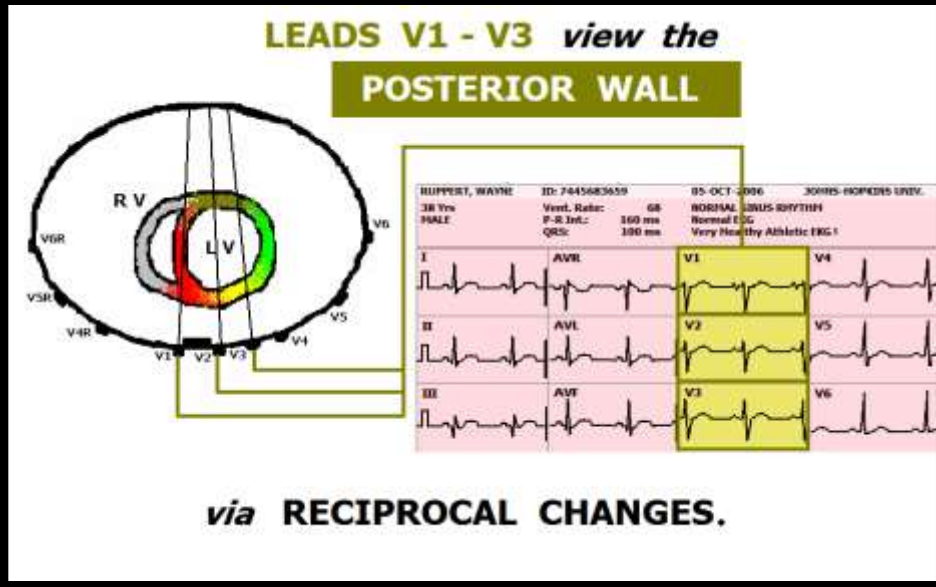
ST SEGMENT ELEVATION
ST SEGMENT DEPRESSION

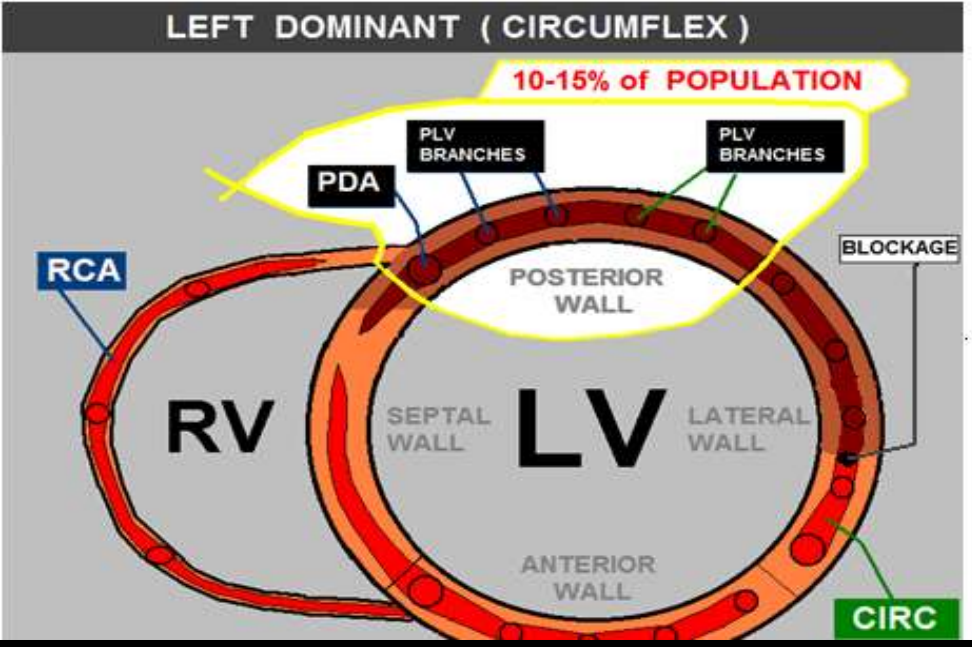


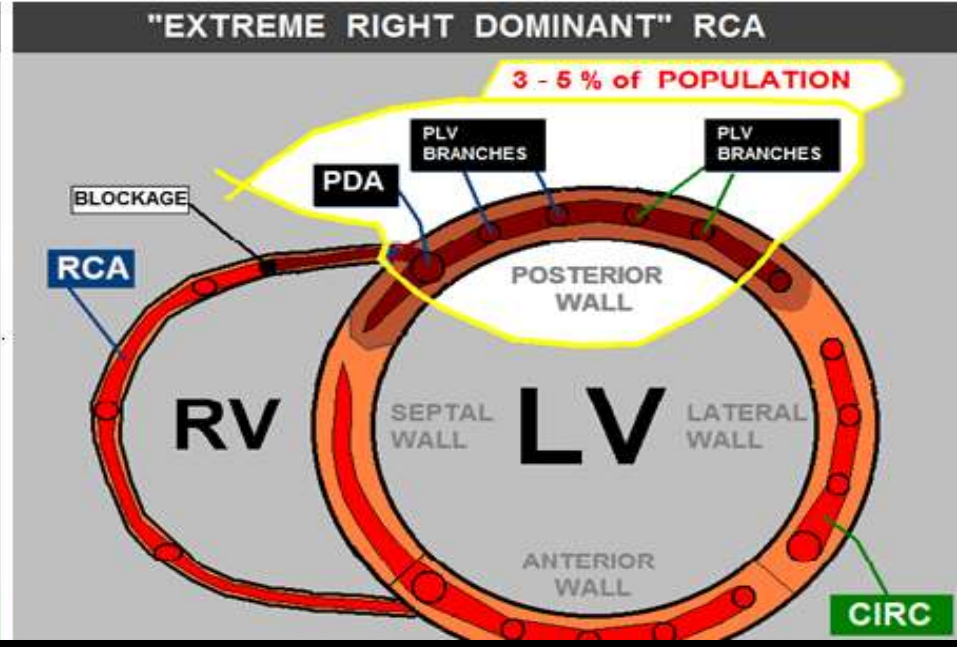

INDICATOR
COMPLICATION
1. S-T DEPRESSION IN THE V-LEADS (PREDOMINANTLY V1 - V3) → POSTERIOR WALL MI
2. S-T ELEVATION IN LEADS V5, V6, LEAD I, and AVL → LATERAL WALL MI
3. S-T ELEVATION in LEADS V3r - V6r (RIGHT-SIDED EKG) → R. VENTRICULAR MI
R SIDED ECG was obtained, NO ST ELEVATION was noted in RV Leads
SIGNIFICANT ST DEPRESSION NOTED
SIGNIFICANT ST ELEVATION NOTED


V5 - V6 VIEW THE LATERAL WALL
of the LEFT VENTRICLE
SPINE
RV
LV
V6
V5
ANTERIOR CHEST WALL
V1 V2 V3 V4


LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE
FED by the RCA (75 - 80 % pop)
or the CIRCUMFLEX (10 - 15 %)

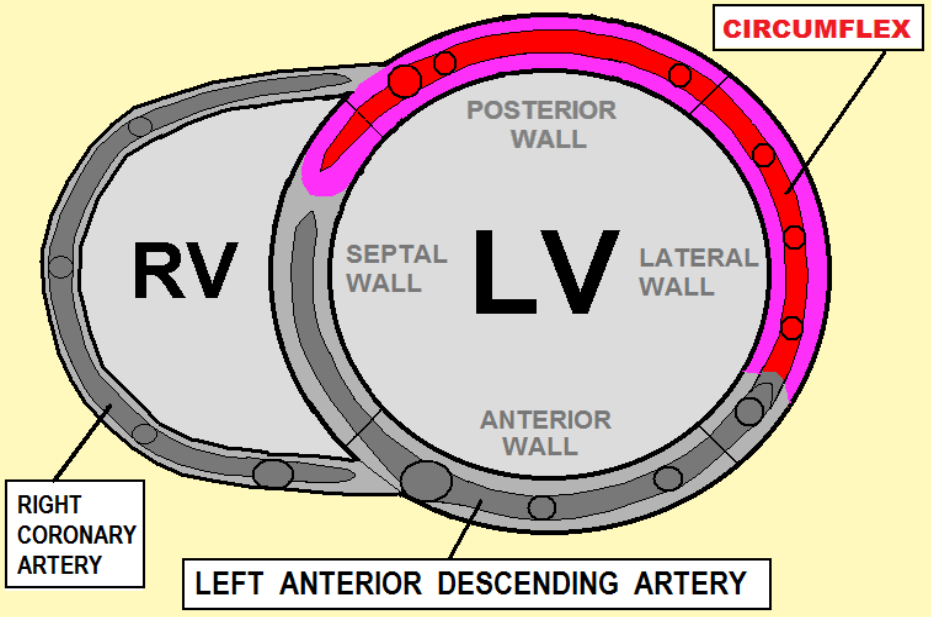

LEADS V1 - V3 view the
POSTERIOR WALL
RV
LV
via RECIPROCAL CHANGES.





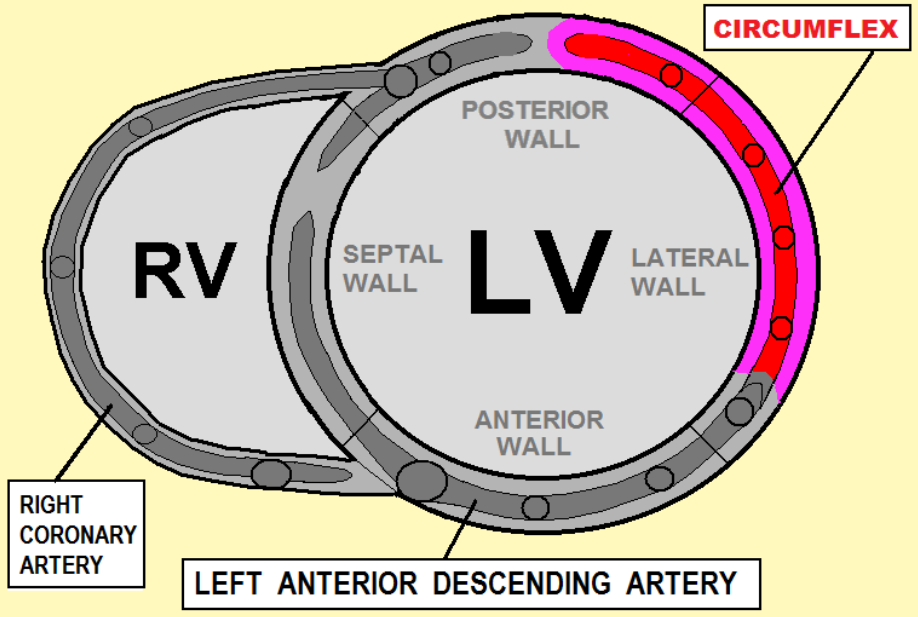
The DOMINANT CIRCUMFLEX ARTERY . . .

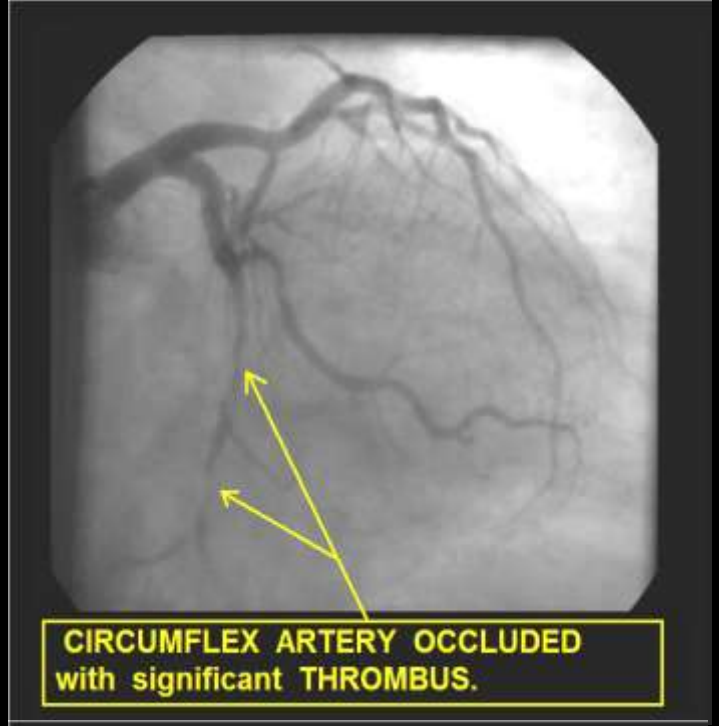
SUPPLIES 35 - 55% OF THE LEFT VENTRICULAR MUSCLE MASS

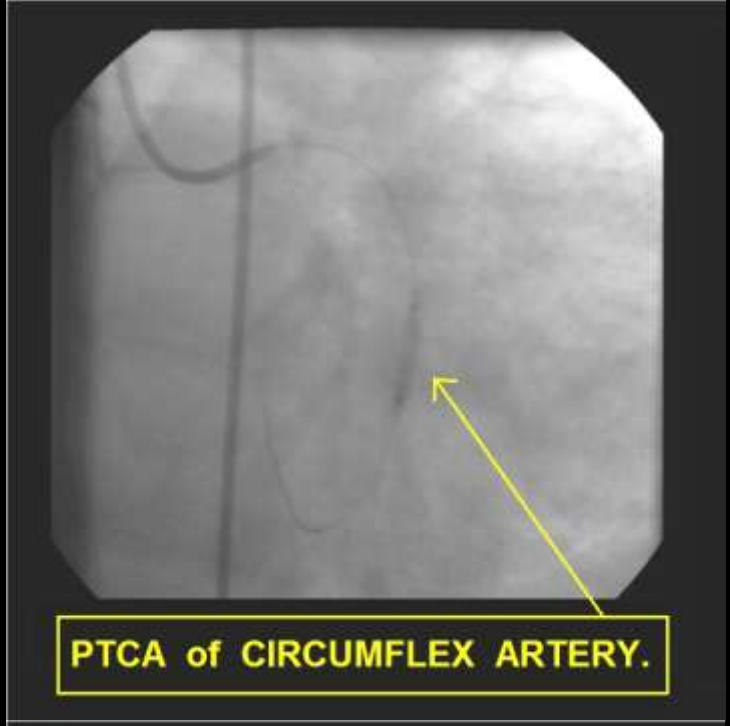


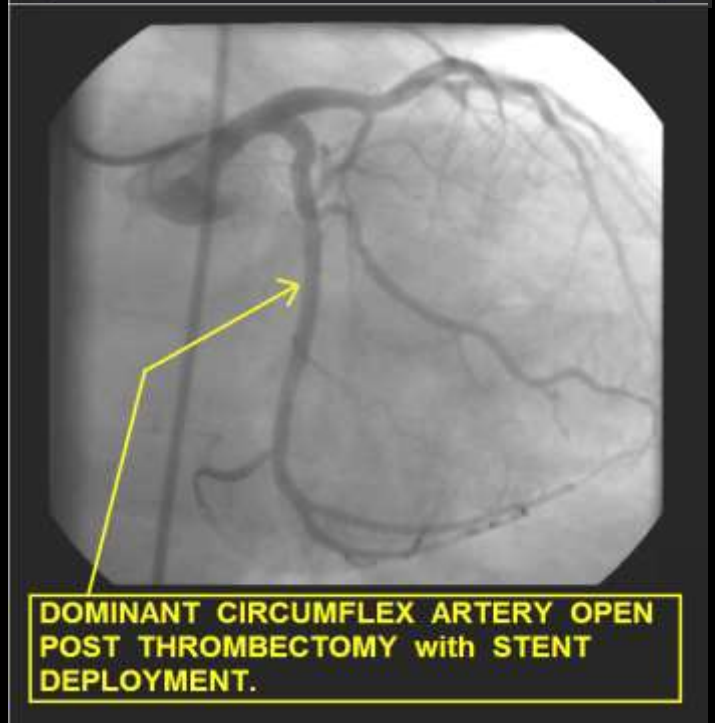
The NON - DOMINANT CIRCUMFLEX ARTERY

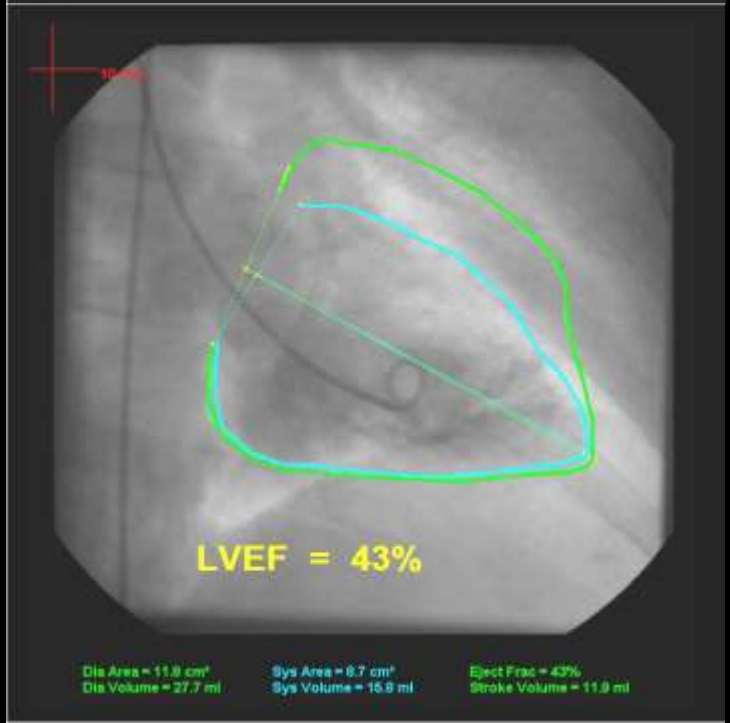
SUPPLIES 25-30 % OF THE LEFT VENTRICULAR MUSCLE MASS




CIRCUMFLEX ARTERY OCCLUDED
with significant THROMBUS.


PTCA of CIRCUMFLEX ARTERY.


DOMINANT CIRCUMFLEX ARTERY OPEN
POST THROMBECTOMY with STENT
DEPLOYMENT.


LVEF = 43%
Dia Area = 11.8 cm²
Dia Volume = 27.7 ml
Sys Area = 8.7 cm²
Sys Volume = 15.8 ml
Eject Frac = 43%
Stroke Volume = 11.9 ml

CASE STUDY SUMMARY

ST ELEVATION: II, III, aVF, V5, V6

ST DEPRESSION: V1 - V3, POSSIBLY I and aVL

SUSPECTED DIAGNOSIS: ACUTE INFERIOR - POSTERIOR - LATERAL MI

SUSPECTED "CULPRIT ARTERY" (if applicable):

OCCLUSION of DOMINANT CIRCUMFLEX ARTERY

IMMEDIATE CONCERNS FOR ALL STEMI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
30 - 55% of LV MUSCLE MASS	POSSIBLE SEVERE LV PUMP FAILURE	INOTROPIC AGENTS ET INTUBATION I.A.B.P. INSERTION
SA NODE	SINUS BRADYCARDIA / SINUS ARREST	ATROPINE TRANSCUTANEOUS PACING
AV NODE	HEART BLOCKS	ATROPINE TRANSCUTANEOUS PACING
SIGNIFICANT AMOUNT of PAPILLARY MUSCLE INSERTION to BASE of LV	ACUTE PAPILLARY MUSCLE TEAR and MITRAL VALVE REGURGITATION (7 - 10 DAYS)	INOTROPIC AGENTS DIEURETICS EMERGENCY SURGERY

CASE STUDY 10 - STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

48 y/o FEMALE arrives via EMS, c/o "EXCRUCIATING HEAVINESS" in center of chest, X 1 hour. She also c/o nausea (vomited several times). Per EMS, she experienced 4 episodes of V-Fib, was defibrillated successfully each time. Amiodarone drip is running @ 1mg/min.

RISK FACTOR PROFILE:

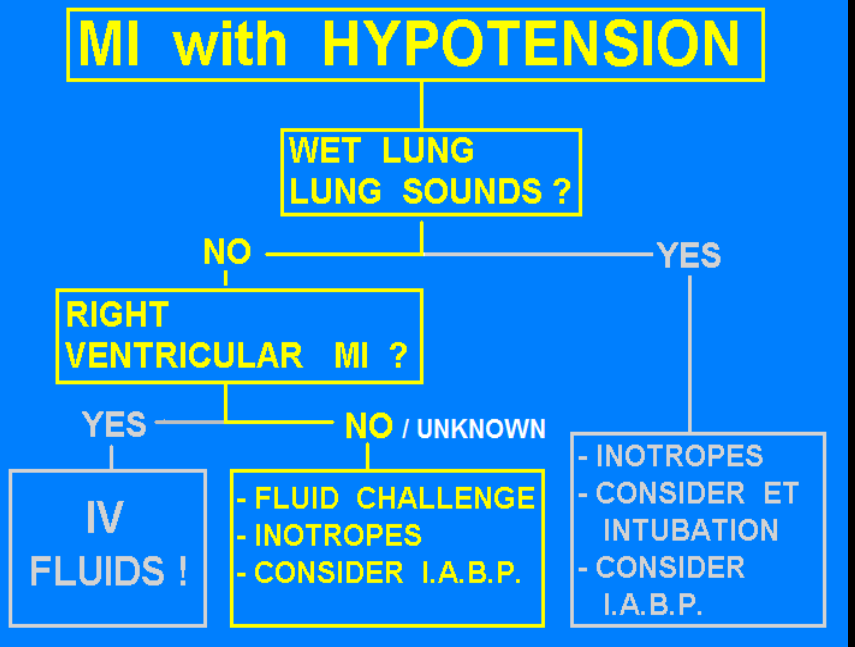
- CIGARETTE SMOKER
- HYPERTENSION
- BROTHER HAD AMI AT AGE 44

PHYSICAL EXAM: CAO x 4, anxious, SKIN cool, pale, diaphoretic. Lung sounds: clear Heart Sounds normal S1, S2,

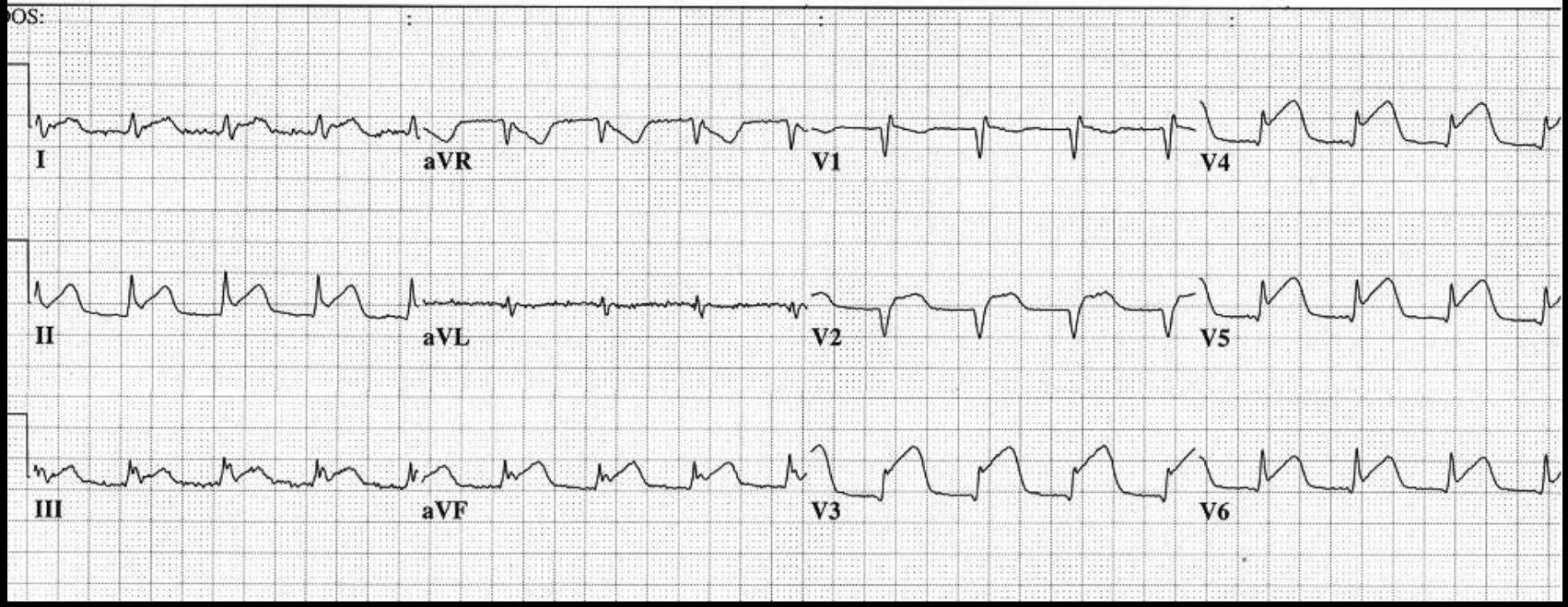
VITAL SIGNS: BP: 78/56 P: 100 R: 28 SAO2: 94% on 4 LPM O2

LABS: TROPONIN: < .04

MI with HYPOTENSION



48 yr		Vent. rate	98	BPM
Female	Caucasian	PR interval	*	ms
		QRS duration	112	ms
		QT/QTc	354/451	ms
Loc:3	Option:23	P–R–T axes	* 74	64



CASE STUDY QUESTIONS:

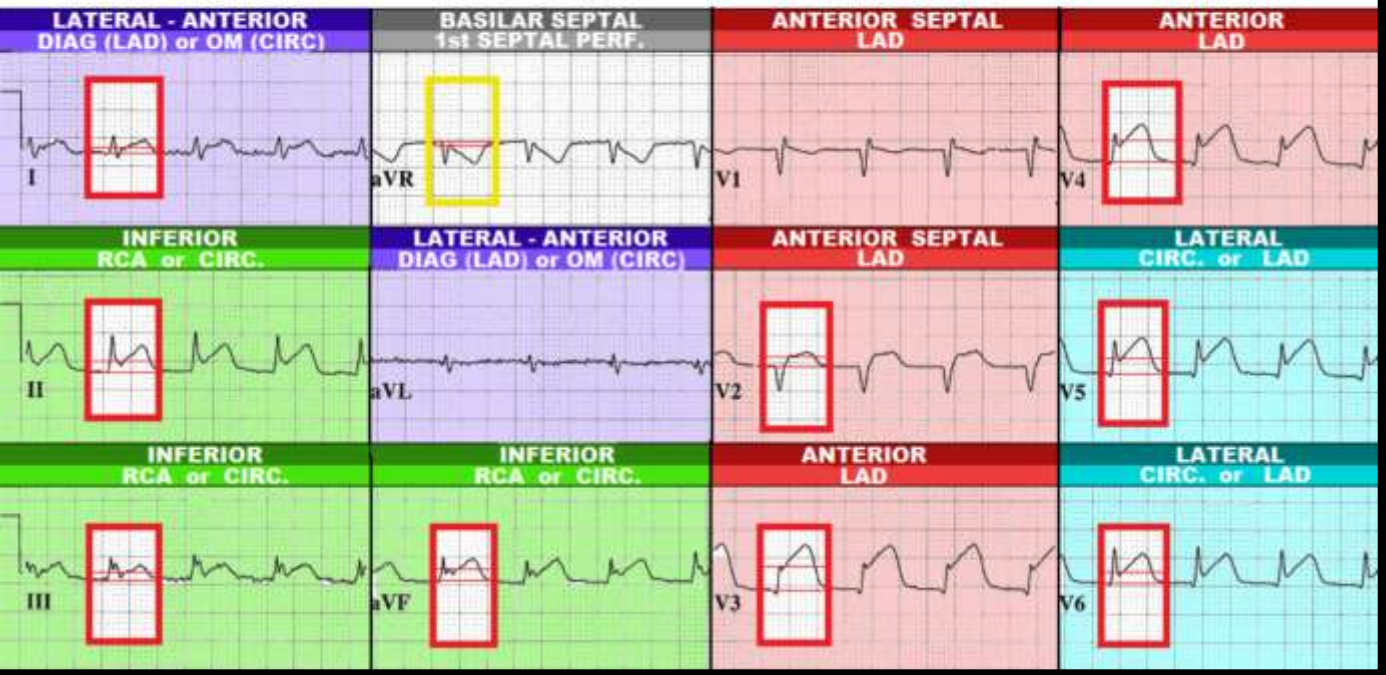
NOTE LEADS WITH ST ELEVATION:	**NOTE LEADS WITH ST DEPRESSION:**
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	**LIST ANY POTENTIAL COMPLICATIONS:**

48 yr		Vent. rate	98	BPM	Undetermined rhythm
Female	Caucasian	PR interval	*	ms	Low voltage QRS
		QRS duration	112	ms	Cannot rule out Anteroseptal infarct
		QT/QTc	354/451	ms	Inferolateral injury pattern
Loc:3	Option:23	P-R-T axes	* 74	64	** ** ** ** * ACUTE MI * ** ** ** **

ACUTE APRICAL MI
Abnormal ECG

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION



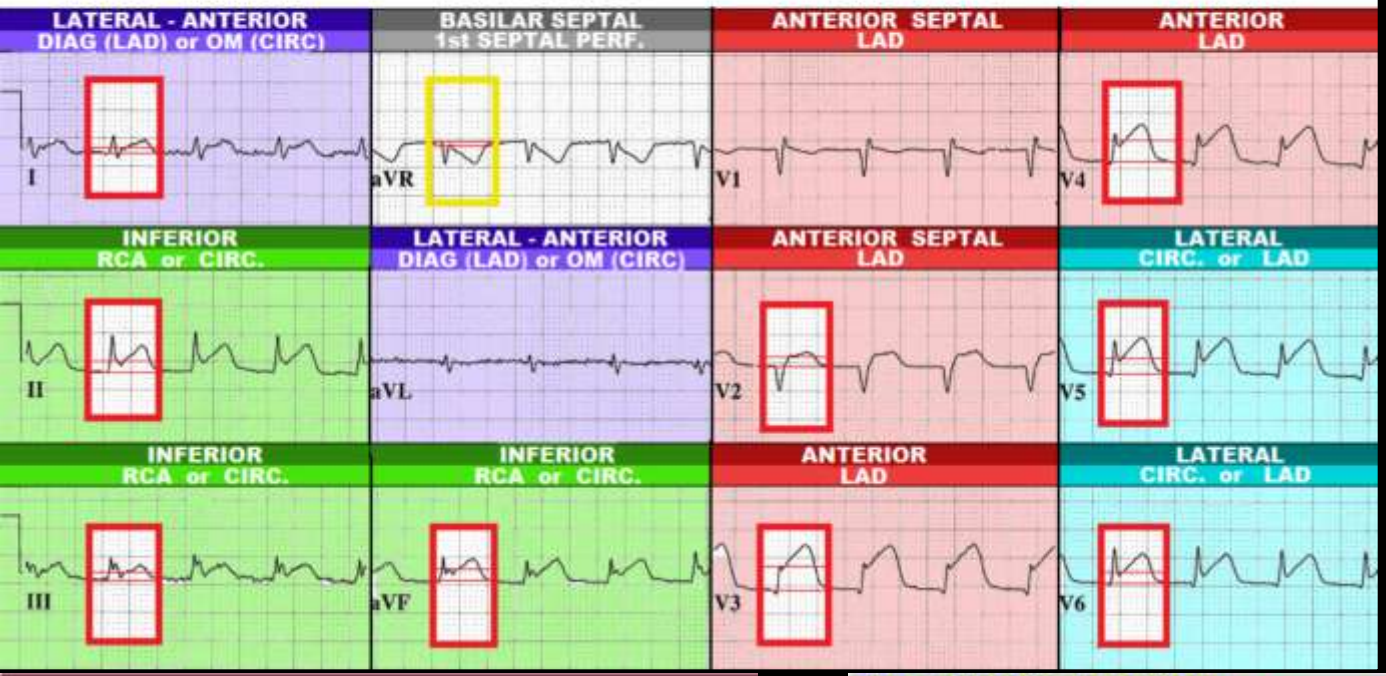
48 yr Female | Caucasian | Loc:3 | Option:23

Vent. rate	98 BPM	Undetermined rhythm
PR interval	* ms	Low voltage QRS
QRS duration	112 ms	Cannot rule out Anteroseptal infarct
QT/QTc	354/451 ms	Inferolateral injury pattern
P-R-T axes	* 74 64	** ** ** ** * ACUTE MI * ** ** ** **

ACUTE APRICAL MI
Abnormal ECG

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION



SO . . . . WHICH ARTERY IS IT ?

LAD ?

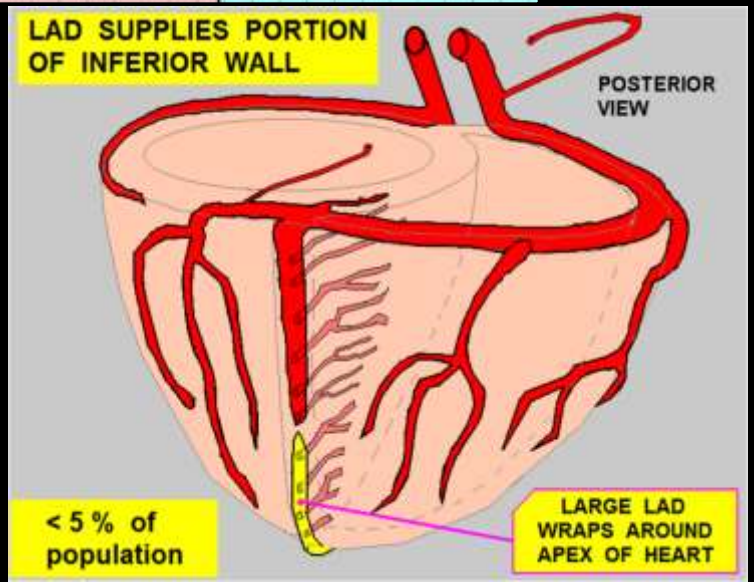
CIRC ?

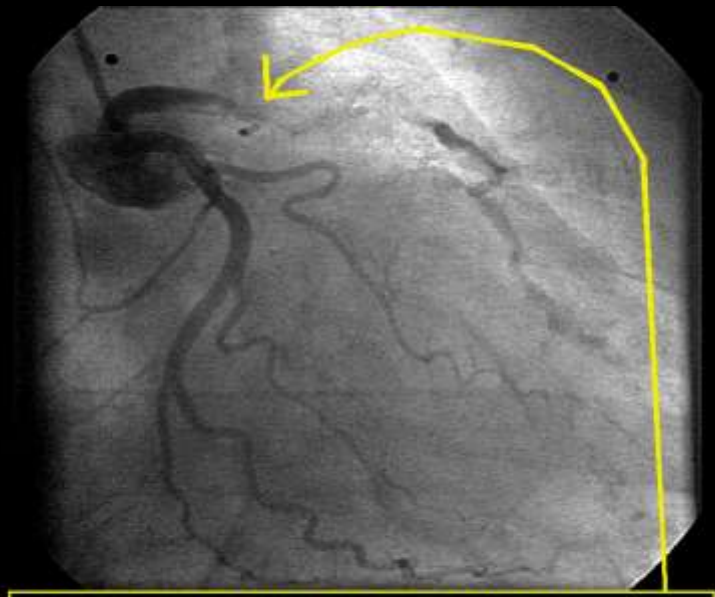
BOTH LAD and DOMINANT CIRC ?

RCA ?

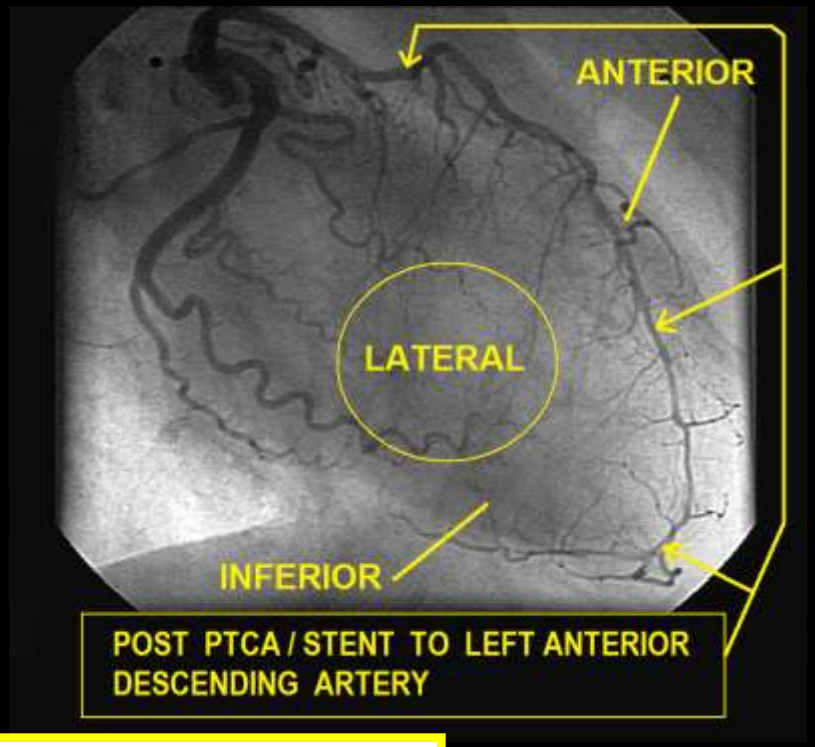
LEFT MAIN ?

ANOMOLOUS ?





PRE-INTERVENTION IMAGE. PROXIMAL OCCLUSION of the LEFT ANTERIOR DESCENDING ARTERY.



POST PTCA / STENT TO LEFT ANTERIOR DESCENDING ARTERY

CASE STUDY SUMMARY

ST ELEVATION: I, II, III, aVF, V2, V3, V4, V5, V6

ST DEPRESSION: aVR

SUSPECTED DIAGNOSIS: ACUTE ANTERIOR - INFERIOR - LATERAL MI

SUSPECTED "CULPRIT ARTERY" (if applicable):

OCCLUSION of TRANS-APICAL LEFT ANTERIOR DESCENDING ARTERY

IMMEDIATE CONCERNS FOR ALL STEMI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
50-70% of the LEFT VENTRICULAR MUSCLE MASS	POSSIBLE SEVERE LV PUMP FAILURE	INOTROPIC AGENTS ET INTUBATION I.A.B.P. INSERTION
BUNDLE of HIS and BUNDLE BRANCHES	HIGH GRADE (2nd, 3rd DEGREE) HEART BLOCKS BUNDLE BRANCH BLOCKS	TRANSCUTANEOUS PACING

EVOLVING STEMI:

-ST SEGMENTS DROP

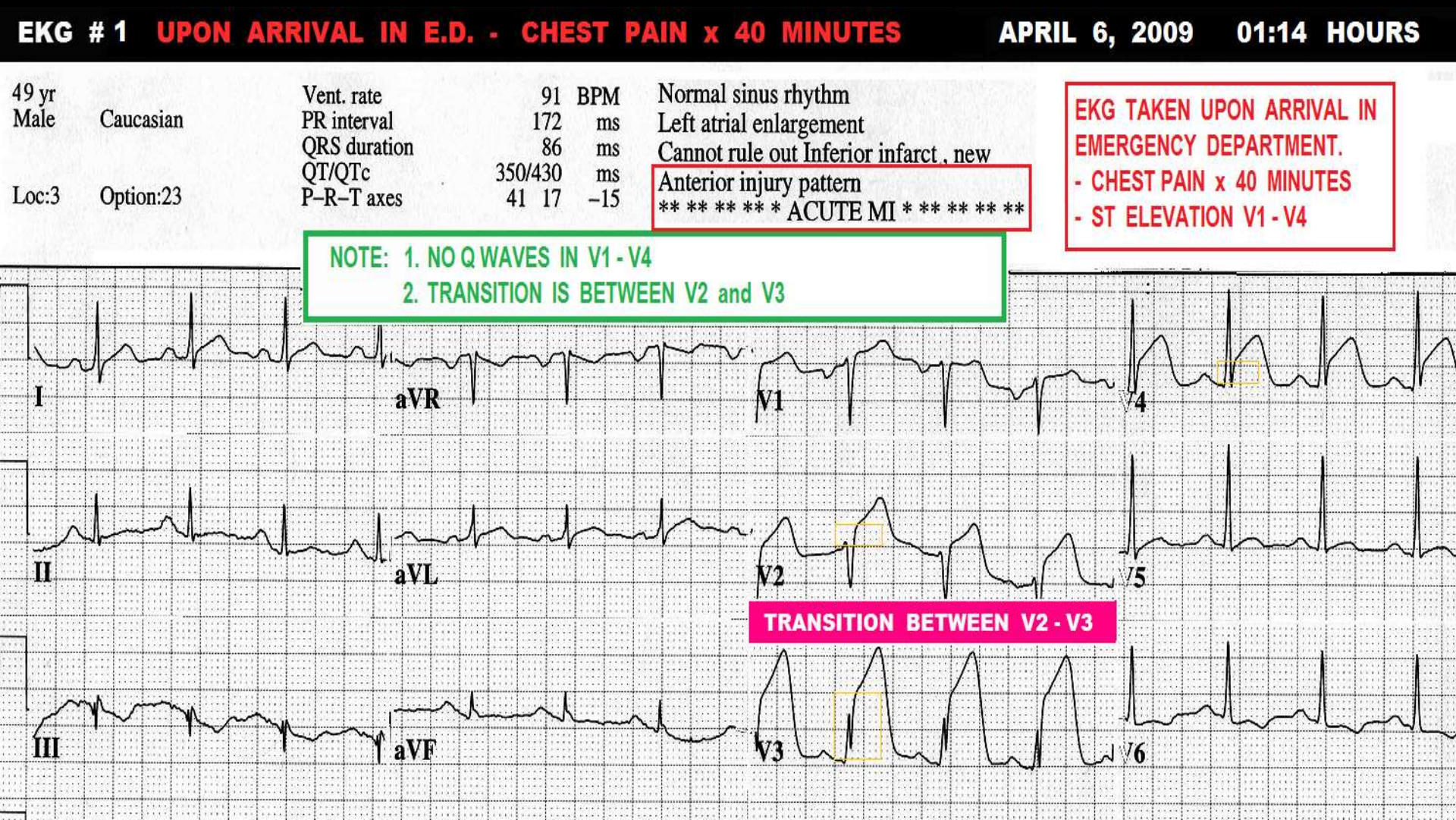
-Q WAVES FORM

-R WAVE PROGRESSION CHANGES IN PRECORDIAL LEADS.

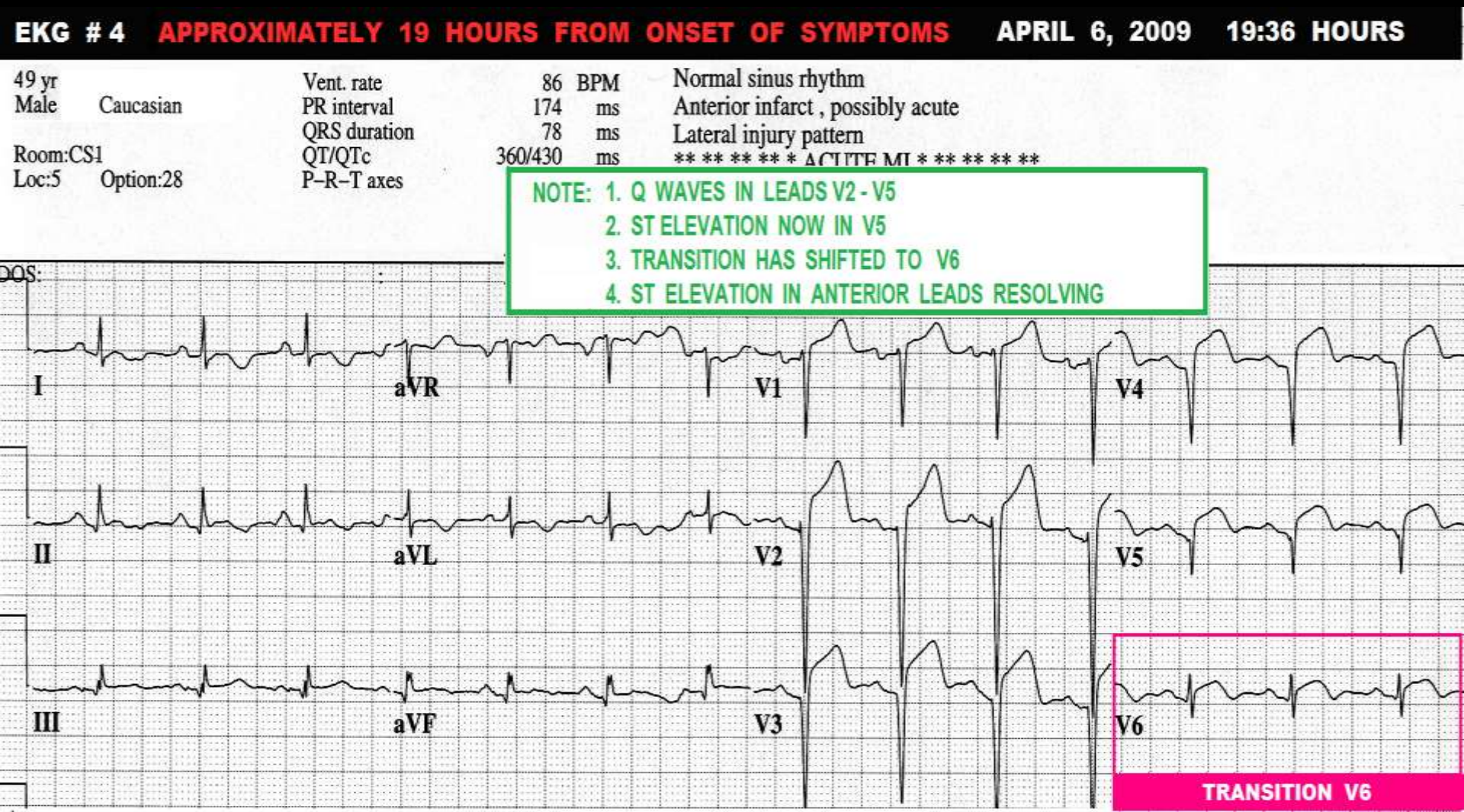
Q WAVE RULES - SUMMARY:

- Q WAVES SHOULD BE LESS THAN .40 WIDE (1 mm)
- Q WAVES SHOULD BE LESS THAN 1/3 THE HEIGHT OF THE R WAVE
- Q WAVES CAN BE ANY SIZE IN LEADS III and AVR
- THERE SHOULD BE NO Q WAVES IN LEADS V1, V2, or V3

ACUTE ANTERIOR WALL STEMI

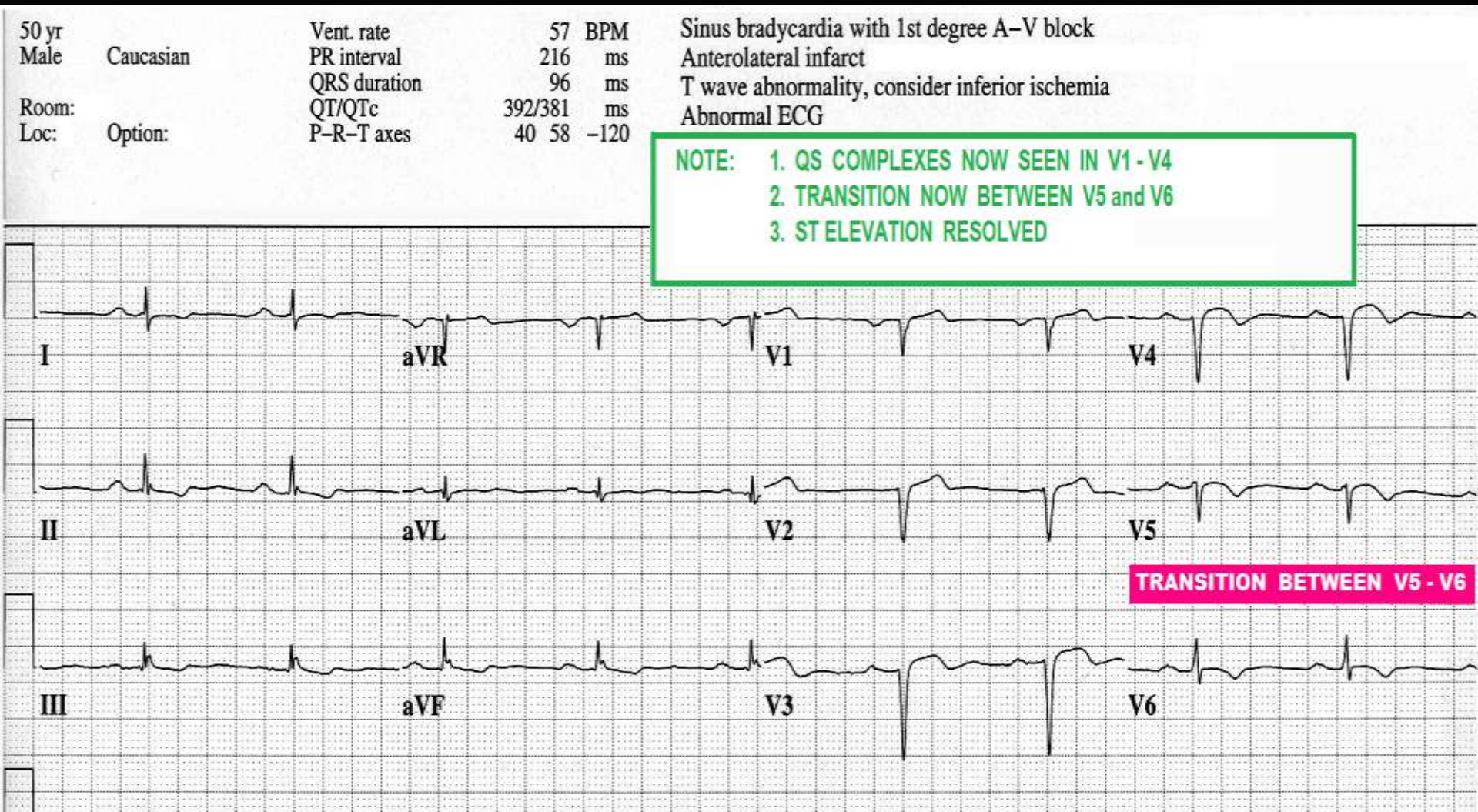


EVOLVING ANTERIOR WALL STEMI



FULLY EVOLVED ANTERIOR WALL MI

POST - INFARCTION EKG TAKEN 1 YEAR AFTER ANTERIOR WALL MI



“NOWHERE”, NEW MEXICO, 1994

BRUGADA SYNDROME and Other Infarction Mimics

CASE STUDY 18 -- BRUGADA SYNDROME

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

37 y/o FEMALE patient arrives via EMS after being involved in a low speed motor vehicle accident. Per EMS crew, patient was the driver and sole occupant of a car that struck a tree. Patient does not recall accident. Upon further questioning, patient admits to other episodes of syncope and near-syncope. Patient denies feeling any chest pain / pressure or shortness of breath. She states she "felt great" today, until just before the the accident, when she "suddenly felt lightheaded and must have blacked-out."

RISK FACTOR PROFILE:

- FAMILY HISTORY: MATERNAL AUNT DIED AT AGE 31, UNEXPECTEDLY. WAS RULED AS A "HEART ATTACK." THERE WAS NO PRIOR KNOWN HISTORY OF CAD.

PHYSICAL EXAM: Pt. CAO x 3, skin warm, dry, color normal. Abrasions /contusions on face (airbag deployment). Patient appears to be in excellent physical condition, states she exercises several times per week (aerobics, weight training, swimming).

VITAL SIGNS: BP: 112/66, P: , R: 20, SAO2: 100% on room air.

LABS: TROPONIN: < .04 BMP and CBC: all values within normal limits.

IS THERE ANYTHING ABNORMAL WITH THIS EKG ?

37 yr
Female Caucasian

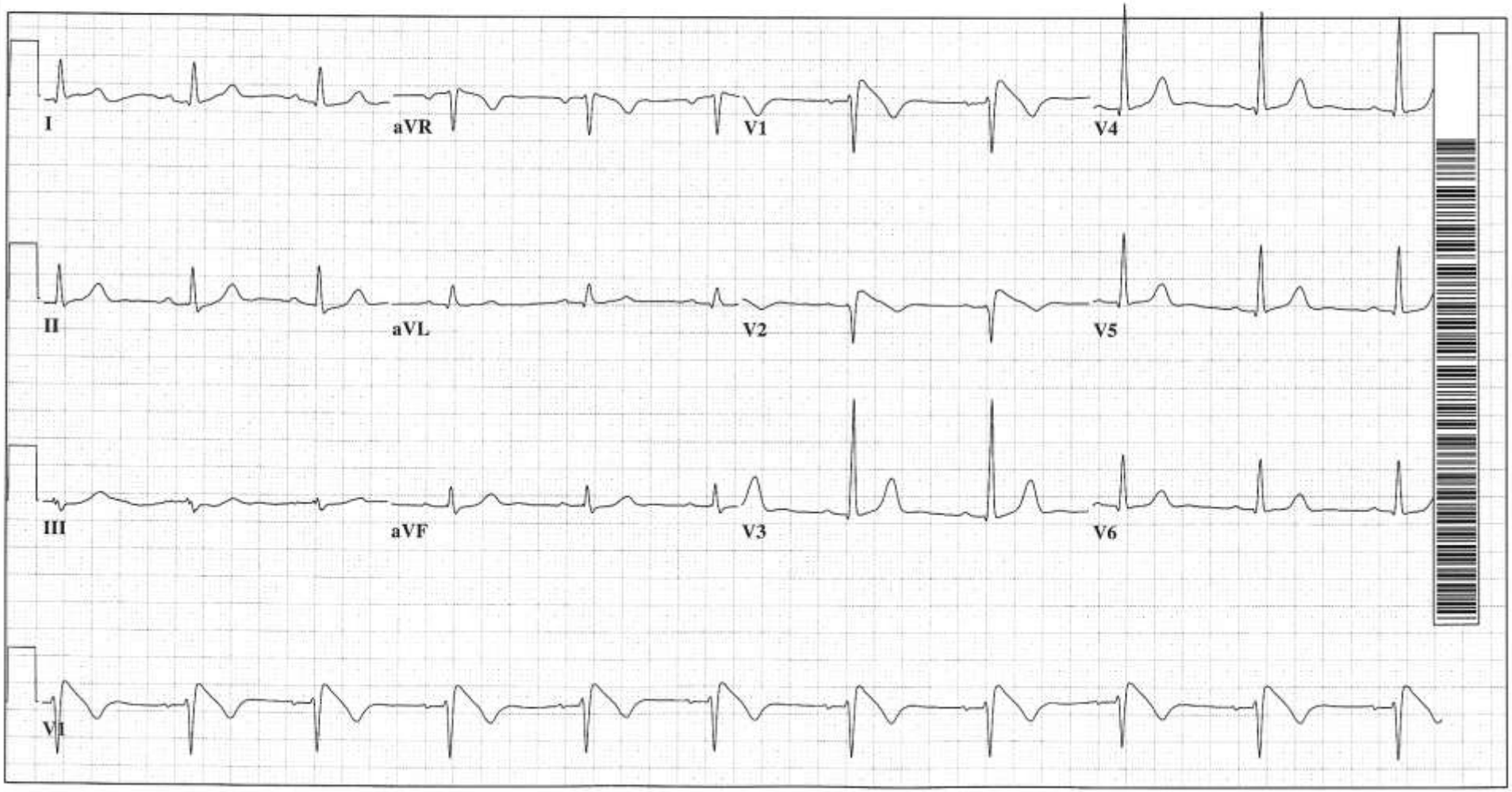
Room:C4A
Loc:3 Option:23

Vent. rate	62	BPM
PR interval	180	ms
QRS duration	88	ms
QT/QTc	418/424	ms
P-R-T axes	37 22	47

Normal sinus rhythm
Normal ECG
No previous ECGs available

Technician:

Referred by:



25mm/s 10mm/mV 40Hz 005D 12SL 235 CID: 3

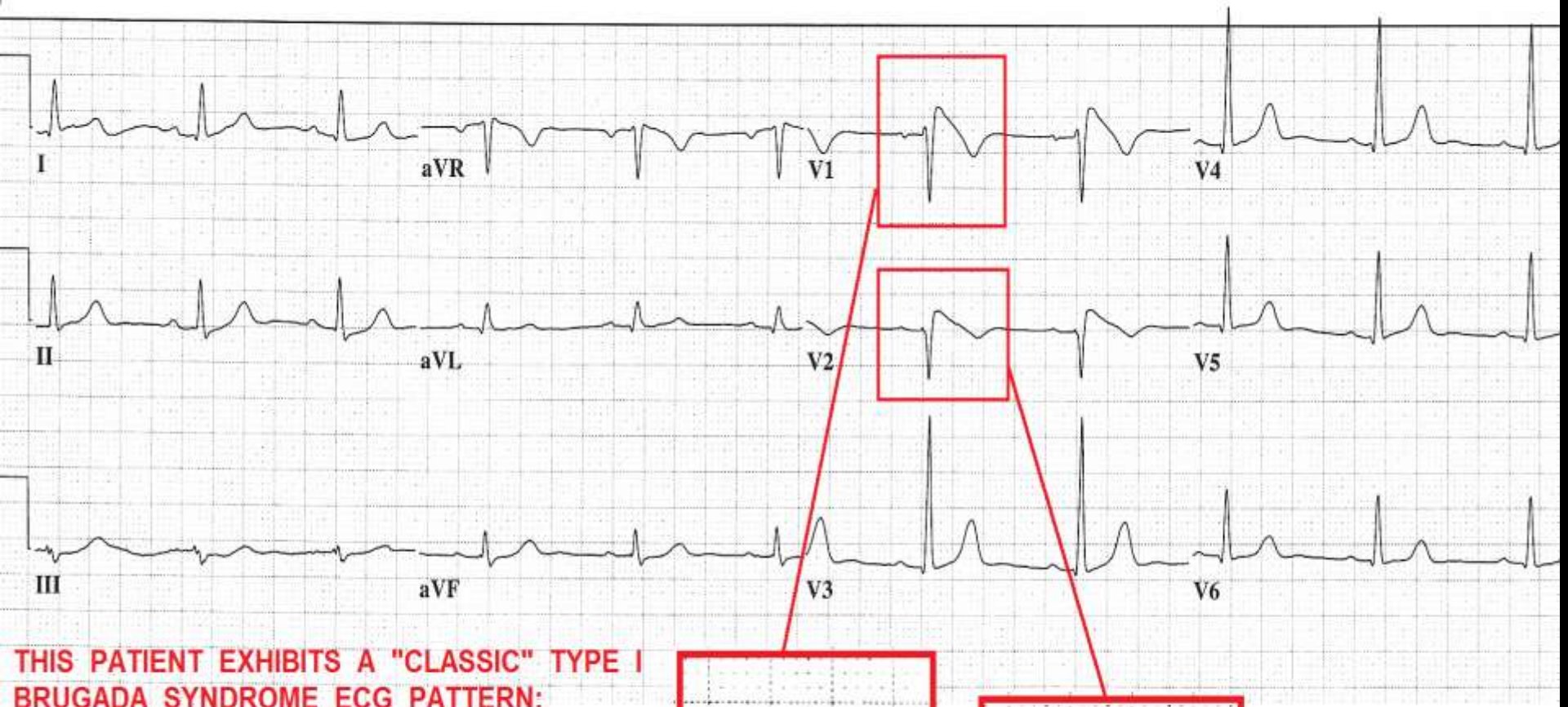
EID:46 EDT:

37 yr
Female Caucasian

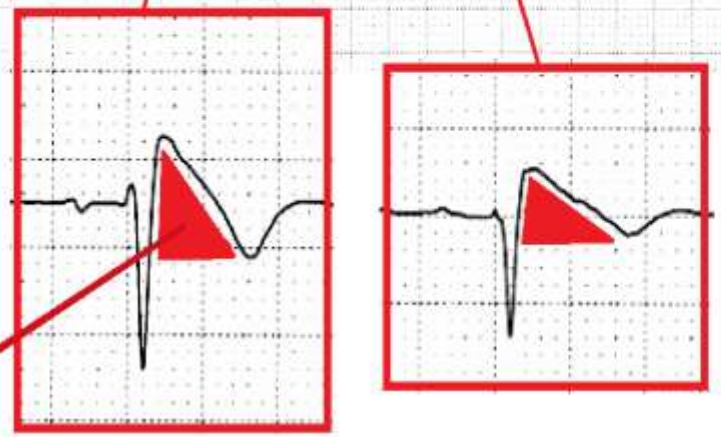
Vent. rate	62	BPM
PR interval	180	ms
QRS duration	88	ms
QT/QTc	418/424	ms
P–R–T axes	37 22	47

Normal sinus rhythm
Normal ECG
No previous ECGs available

NOTE COMPUTER INTERPRETATION !



THIS PATIENT EXHIBITS A "CLASSIC" TYPE I BRUGADA SYNDROME ECG PATTERN:
- ELEVATED J POINTS IN V1, V2
- DOWNSLOPING "COVED" ST SEGMENT
- INVERTED T WAVE.



NEVER FORGET THE "TRIANGULAR" SHAPE !

PATTERNS of S-T ELEVATION :

BEWARE of the

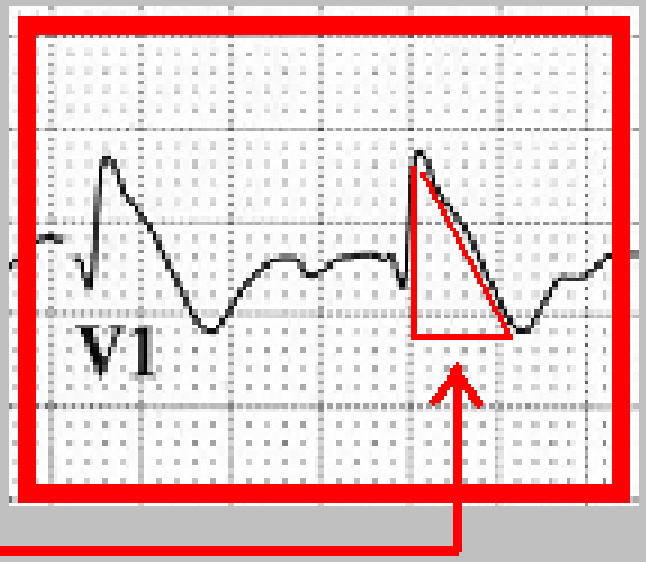
" TRIANGULAR "
SHAPED S-T SEGMENT
IN V1, V2, and some-
times also in V3 . . .

THINK - -

BRUGADA SYNDROME

BRUGADA SYNDROME

1. RBBB PATTERN
2. S-T ELEVATION
   V1, V2, possibly V3
3. ATYPICAL "TRIANGLE" SHAPED S-T SEGMENT



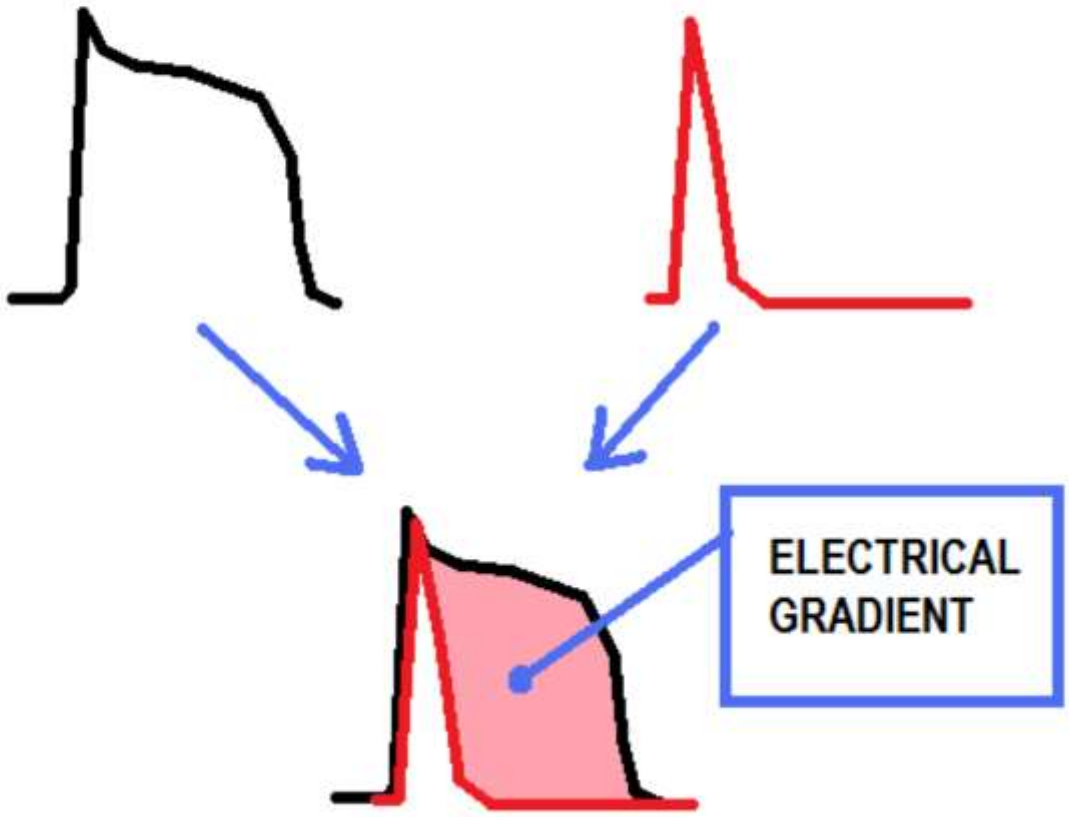
4. USUALLY EFFECTS YOUNG, HEALTHY PEOPLE
5. CAUSES SUDDEN DEATH by TORSADES

TEST QUESTION # 32

MECHANISM OF PHASE 2 RE-ENTRY IN BRUGADA SYNDROME

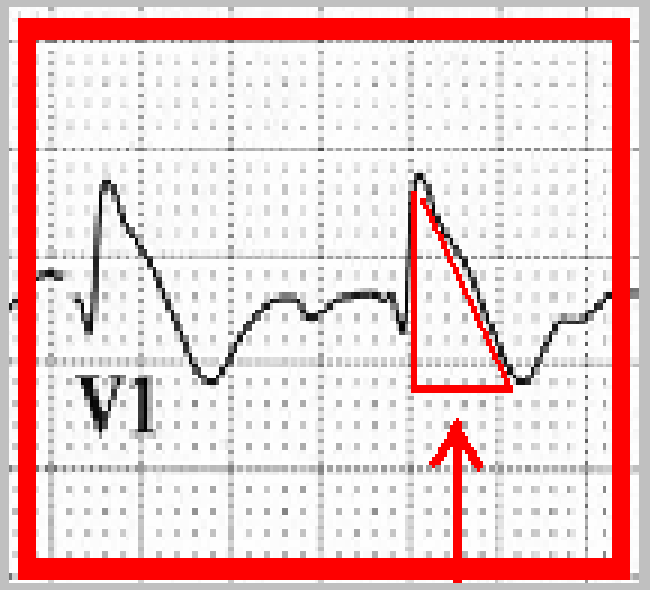
NORMAL ENDOCARDIAL ACTION POTENTIAL

ALTERED (SHORTENED) ACTION POTENTIAL OF EPICARDIAL CELLS



BRUGADA SYNDROME

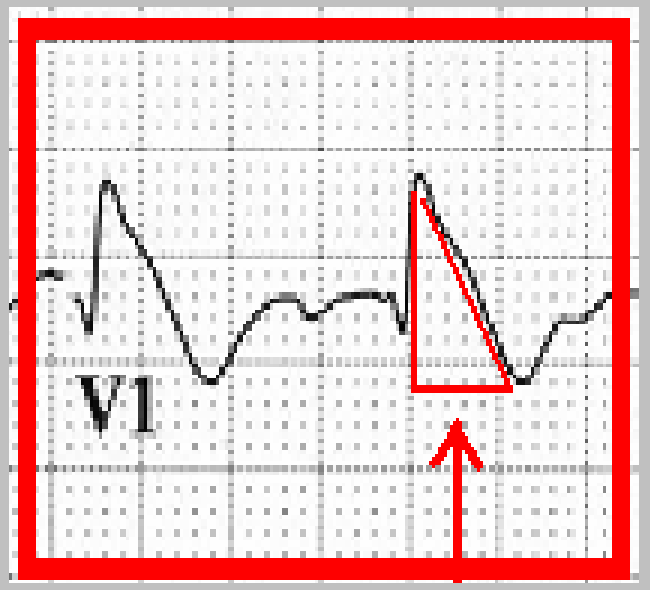
- GENETIC DISORDER - GENE SCN5A, which encodes CARDIAC SODIUM CHANNELS.
- CAUSES EARLY RIGHT VENTRICULAR SUB-EPICARDIAL REPOLARIZATION



- CAUSES RUNS OF TORSADES de POINTES, and SUDDEN DEATH from TORSADES and V-FIB.
- IS BELIEVED TO CAUSE 4 - 12 % of ALL SUDDEN DEATHS, and 50 % of ALL CARDIAC DEATHS where pt. has a STRUCTUALLY NORMAL HEART.

BRUGADA SYNDROME

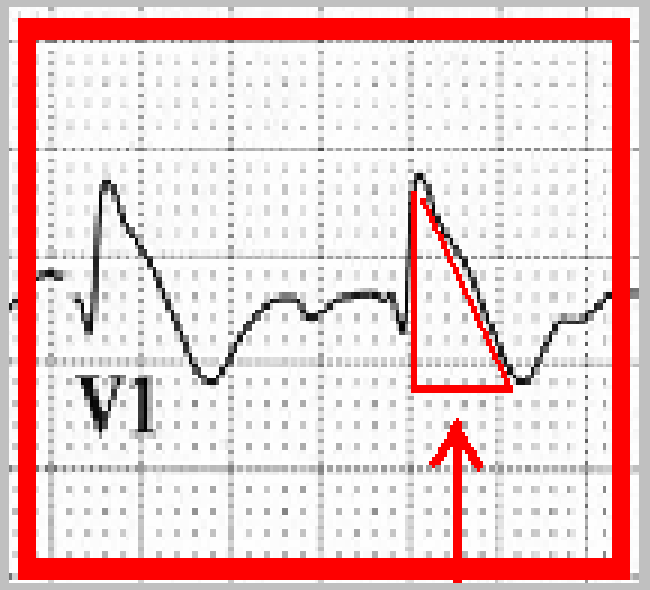
- SEVERAL VARIATIONS of this disorder are known to exist.
- CONCEALED and NON-CONCEALED.
- The NON-CONCEALED version HAS THE V1-V3 abnormality VISIBLE at all times.



- The CONCEALED version - pt. has a NORMAL EKG at most times - a DRUG STUDY, an EP STUDY, and / or GENETIC TESTING must be done to rule out or confirm diagnosis.

BRUGADA SYNDROME

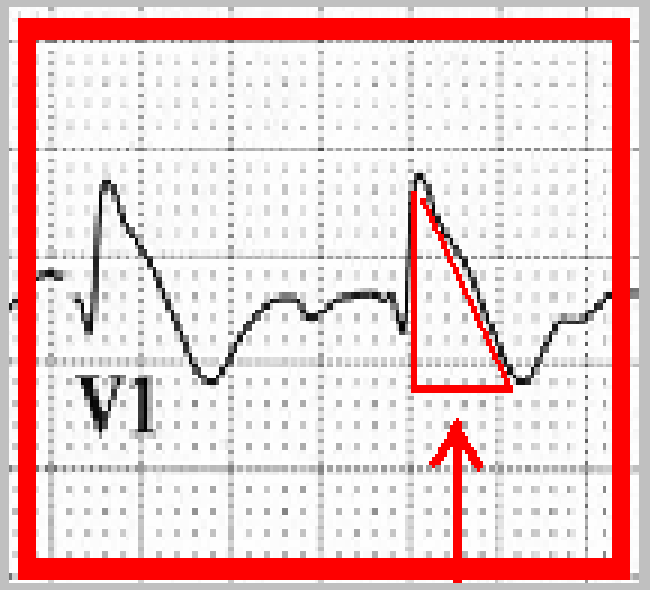
- YOUNG MALES of SOUTHEAST ASIAN DESCENT are in HIGH RISK GROUP, however this disorder affects ANY RACE or GENDER.



- BRUGADA SYNDROME is HEREDITARY.
- SUSPECT BRUGADA SYNDROME in patients with FAMILY HISTORY of BRUGADA / SUDDEN DEATH, and/or TORSADES.

BRUGADA SYNDROME - TESTING

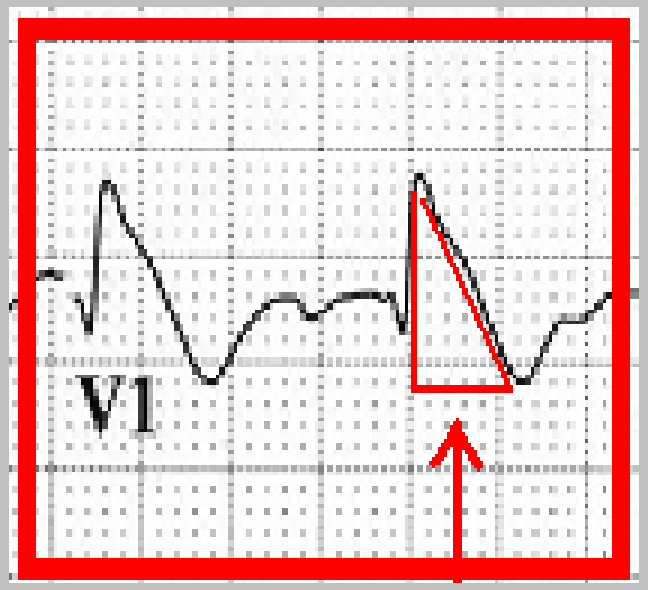
- For CONCEALED cases, a drug study of AJMALINE, FLECAINIDE, or PROCAINAMIDE can UNMASK the "tell-tale" TRIANGULAR COMPLEXES of V1 and V2.



- IN EP STUDIES, a PROLONGED H-V INTERVAL may be observed.
- GENETIC TESTING is performed by THE RAMON A. BRUGADA FOUNDATION.

BRUGADA SYNDROME - TREATMENT

ICD implantation is the only known effective treatment to date.

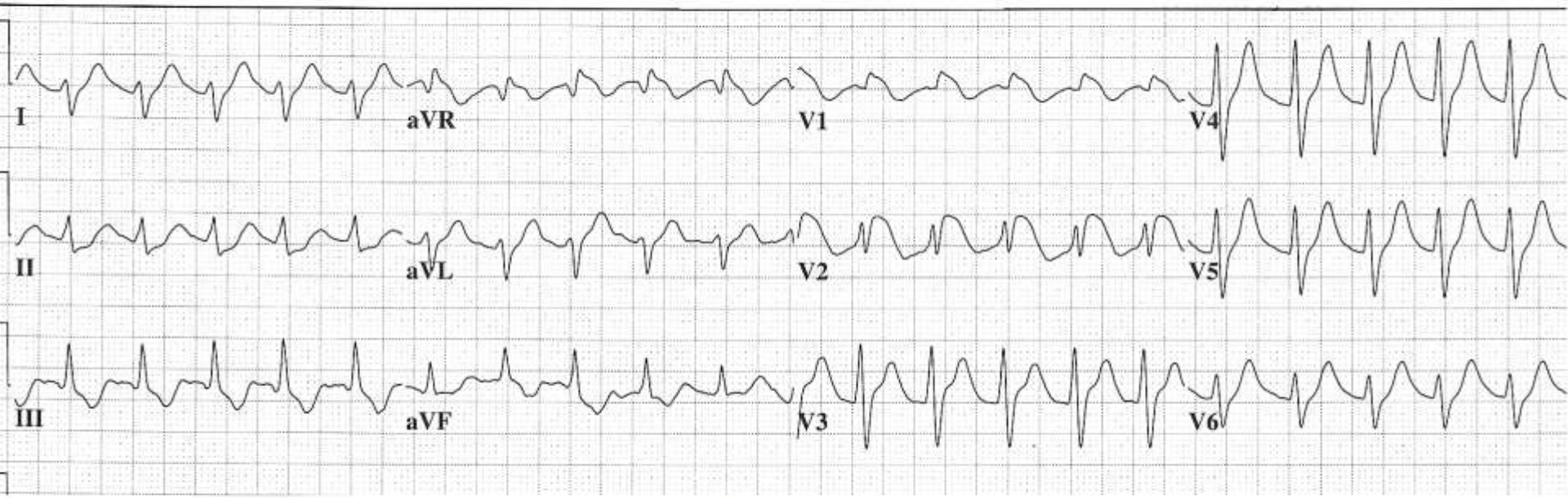


www.BRUGADA.org

33 y/o FEMALE

Vent. rate	129	BPM
PR interval	*	ms
QRS duration	112	ms
QT/QTc	398/583	ms
P–R–T axes	* 121	–2

Undetermined rhythm
Incomplete right bundle branch block
Right ventricular hypertrophy
ST elevation consider anterior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
No previous ECGs available



PT. BROUGHT TO EMERGENCY DEPARTMENT BY EMS AFTER SUFFERING SPONTANEOUS CARDIAC ARREST. PATIENT DID NOT EXPERIENCE ANY SYMPTOMS PRIOR TO COLLAPSE. HAD SEVERAL EPISODES OF NEAR-SYNCOPE IN THE PAST 10 YEARS. CARDIAC CATHETERIZATION REVEALED NO EVIDENCE OF CARDIOVASCULAR DISEASE. NORMAL LV FUNCTION.
DIAGNOSIS: BRUGADA SYNDROME. PT. RECEIVED ICD PRIOR TO HOSPITAL DISCHARGE.
VISIT: www.BRUGADA.org FOR MORE INFORMATION.

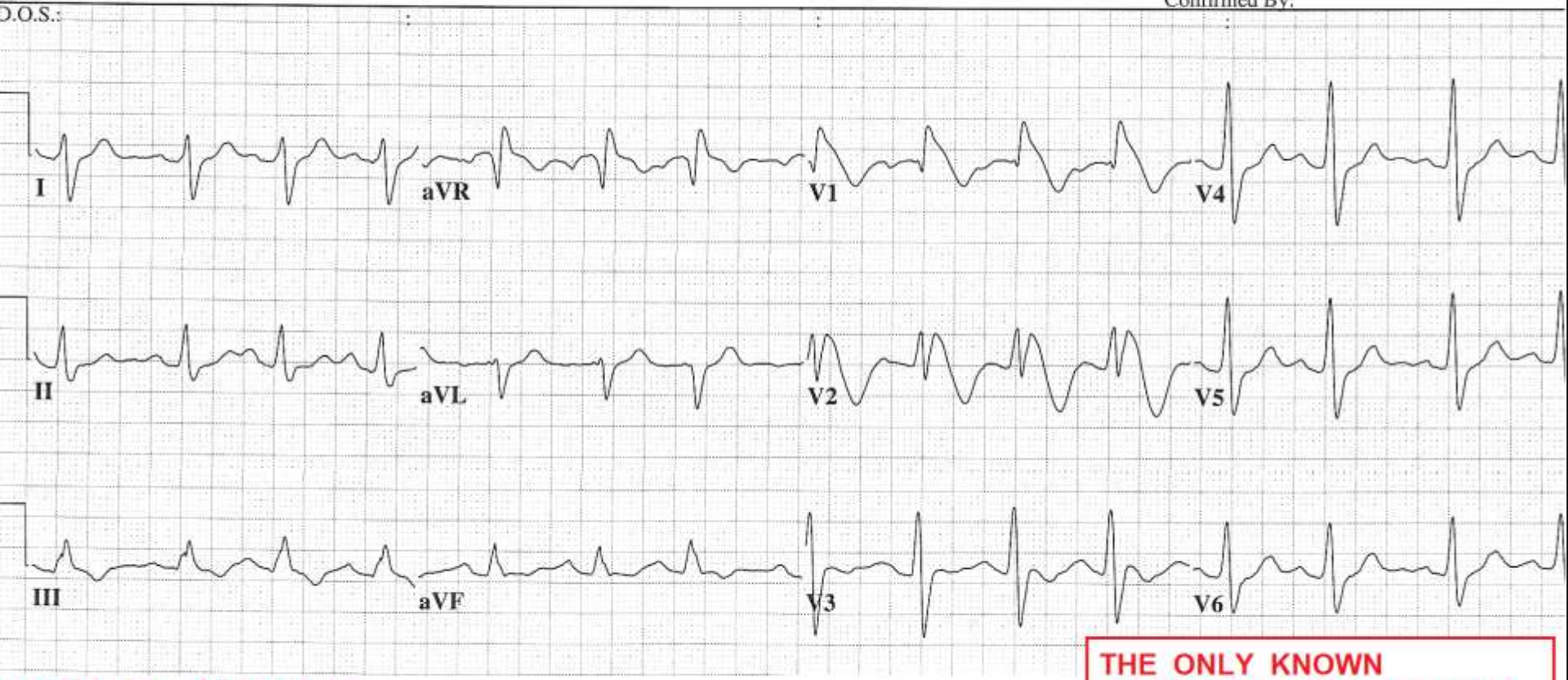
42 y/o FEMALE

Vent. rate	86	BPM
PR interval	200	ms
QRS duration	148	ms
QT/QTc	414/495	ms
P–R–T axes	64 114	17

Normal sinus rhythm with sinus arrhythmia
Right bundle branch block
ST elevation consider anterior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
No previous ECGs available

Confirmed By:

D.O.S.:



BRUGADA SYNDROME.

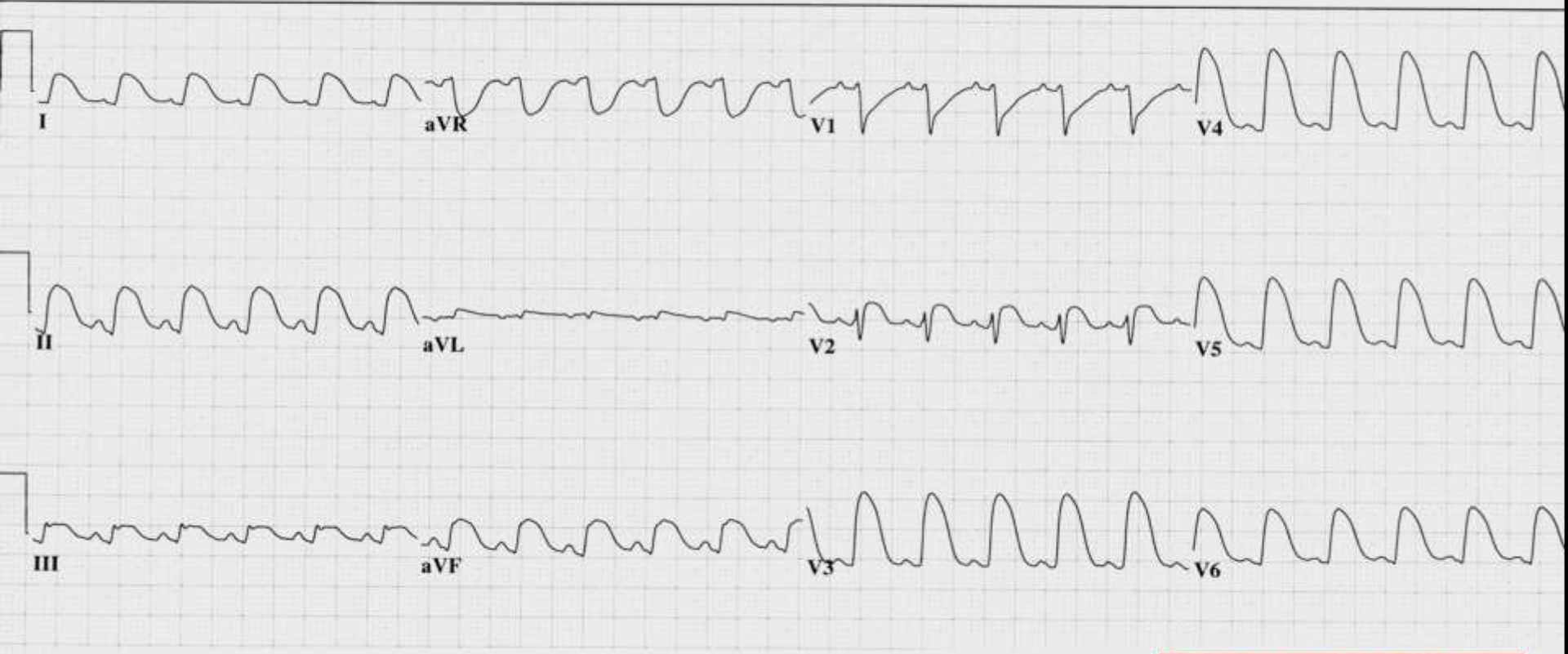
PATIENT HAD HISTORY of SYNCOPE of UNKNOWN ETIOLOGY.
FAMILY HISTORY of SUDDEN DEATH of YOUNG, HEALTHY ADULTS.
VISIT: www.BRUGADA.org FOR MORE INFORMATION!

THE ONLY KNOWN TREATMENT FOR BRUGADA SYNDROME is IMPLANTATION of an ICD. THIS PATIENT HAD ICD IMPLANTED PRIOR TO HOSPITAL DISCHARGE.

41 y/o FEMALE

Vent. rate	137	BPM
PR interval	116	ms
QRS duration	162	ms
QT/QTc	308/465	ms
P-R-T axes	69 50	58

Sinus tachycardia
Non-specific intra-ventricular conduction block
Abnormal ECG
When compared with ECG of 05-MAR-2008 13:35,
QRS duration has increased
ST elevation now present in Inferior leads
ST elevation now present in Anterior leads



ACUTE BACTERIAL MYOCARDITIS.
INTENSE FLU-LIKE SYMPTOMS x 4 - 5 DAYS.
SUDDEN ONSET OF SUBSTERNAL CHEST PRESSURE with SHORTNESS OF BREATH

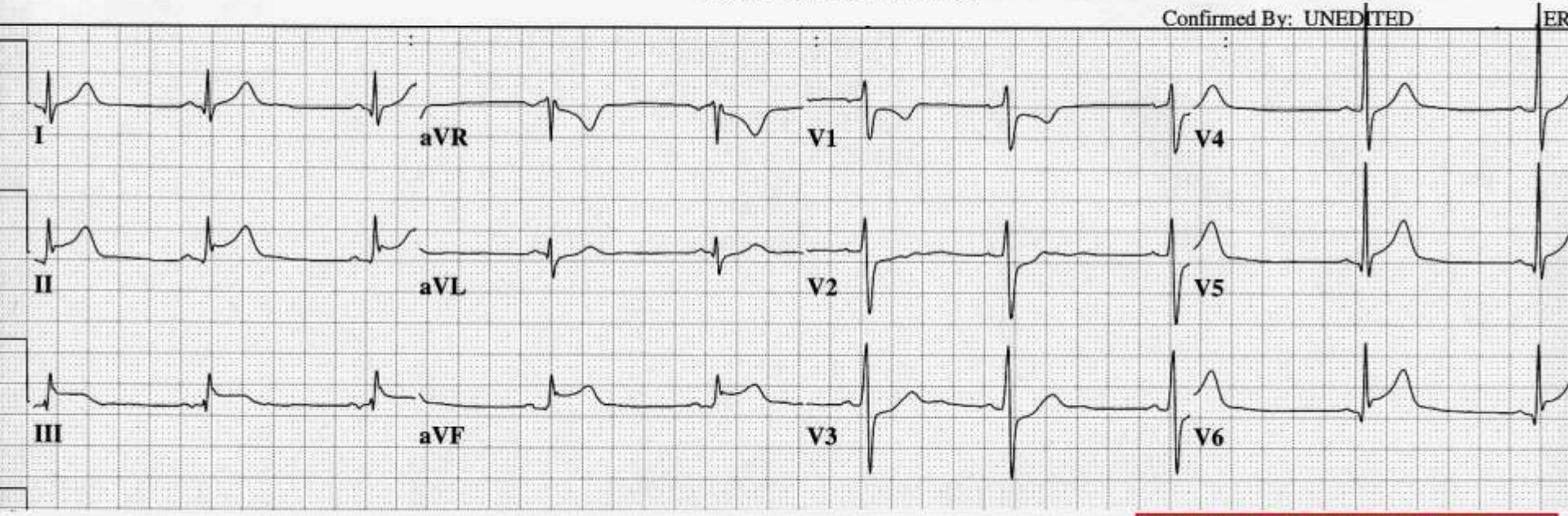
EJECTION FRACTION BY ECHOCARDIOGRAM = 10%

23 y/o MALE:

Vent. rate	56	BPM
PR interval	128	ms
QRS duration	96	ms
QT/QTc	410/395	ms
P–R–T axes	23 66	47

**UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION
Sinus bradycardia with sinus arrhythmia
ST elevation consider inferolateral injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
No previous ECGs available

Confirmed By: UNEDITED ER



ACUTE PERICARDITIS.

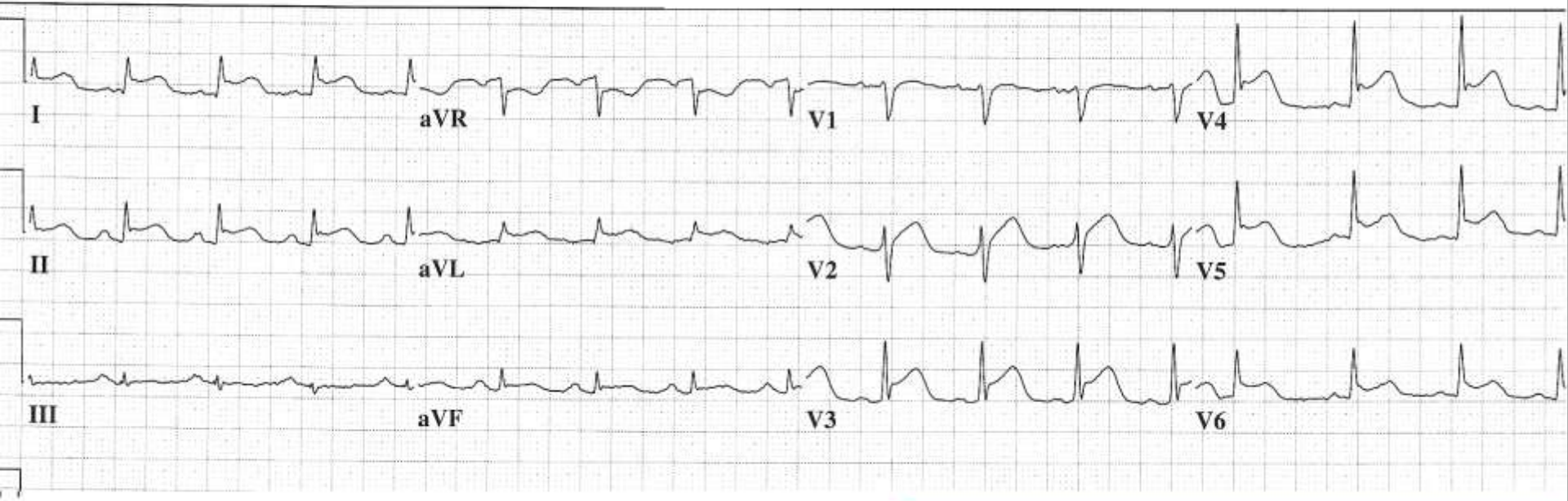
SHARP SUBSTERNAL CHEST PAIN x 1 DAY, HAD VIRAL SYMPTOMS with MOUTH ULCERS x 3 DAYS. CHEST PAIN INCREASES WITH DEEP INSPIRATION.

TESTED POSITIVE FOR COXSACKIE A and B VIRUS

37 y/o MALE:

Vent. rate	97	BPM
PR interval	152	ms
QRS duration	92	ms
QT/QTc	364/462	ms
P–R–T axes	66 34	30

**UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION
Sinus rhythm with Premature supraventricular complexes
ST elevation consider anterolateral injury or acute infarct
ST elevation consider inferior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG



ACUTE PERICARDITIS.

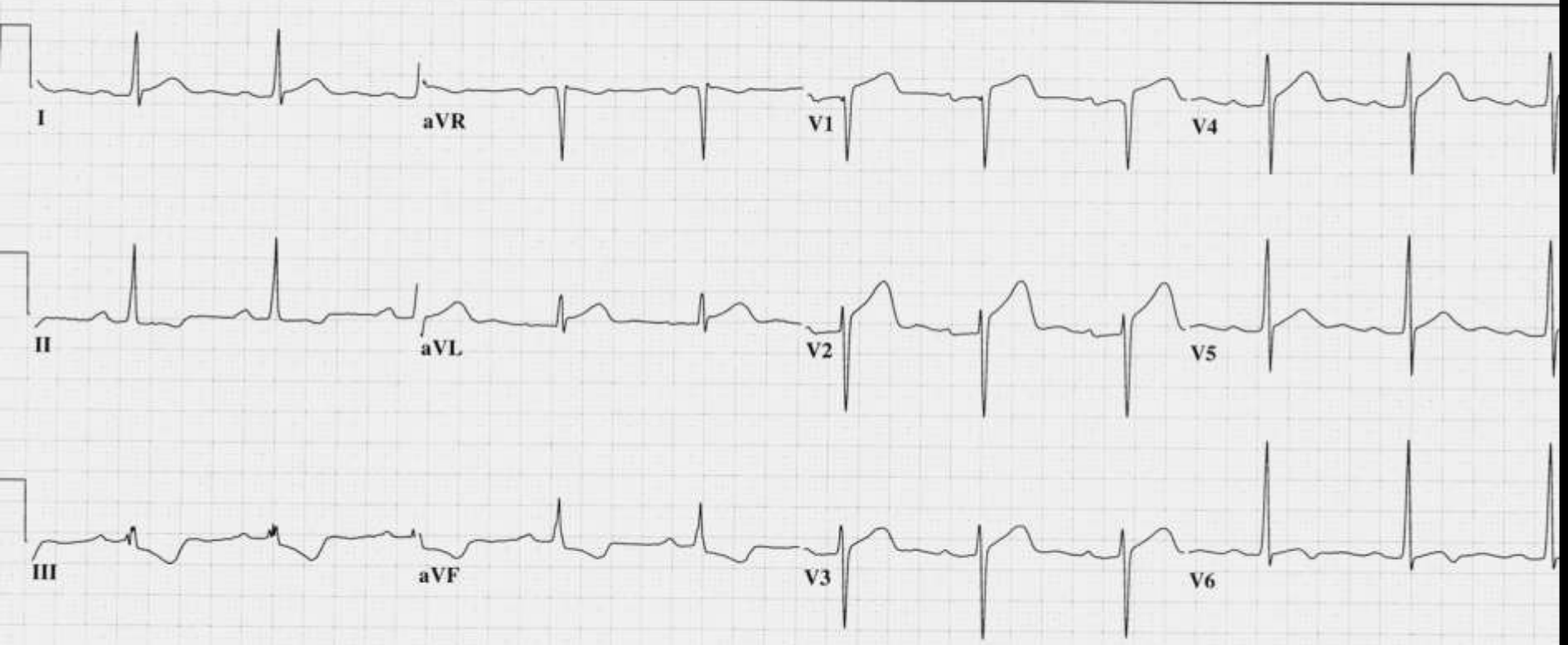
SHARP CHEST PAIN x 1 DAY, PROGRESSIVELY INCREASED PAIN, INCREASES WITH DEEP INSPIRATION. RECENT HISTORY OF VIRAL SYMPTOMS.

NOTE: THIS PATIENT EXPERIENCED SUDDEN VENTRICULAR FIBRILLATION in the EMERGENCY DEPARTMENT, WAS DEFIBRILLATED x 1 WITH RETURN OF SINUS RHYTHM. RECOVERED FULLY.

64 y/o MALE

Vent. rate	65	BPM
PR interval	232	ms
QRS duration	86	ms
QT/QTc	400/416	ms
P–R–T axes	53 43	–46

Sinus rhythm with 1st degree A–V block
ST elevation consider anterolateral injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG

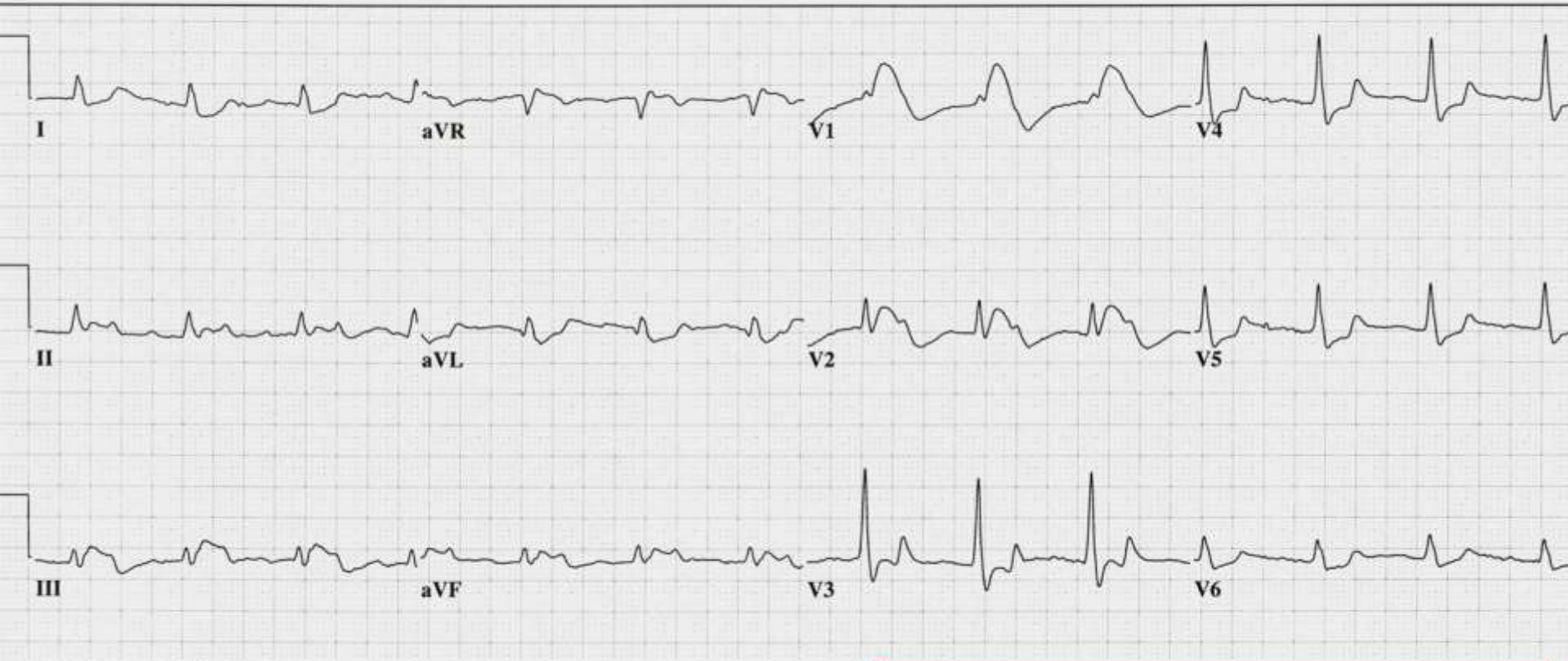


Dx: EARLY REPOLARIZATION. PT. ASYMPTOMATIC HAD 7 EKGs SPANNING 11 YEARS WITH IDENTICAL FINDINGS. NOTE U WAVES V3 - V5.

54 y/o FEMALE

Vent. rate	82	BPM
PR interval	*	ms
QRS duration	132	ms
QT/QTc	360/420	ms
P-R-T axes	159 31	21

*** AGE AND GENDER SPECIFIC ECG ANALYSIS ***
Unusual P axis, possible ectopic atrial rhythm with complete heart block and
Wide QRS rhythm
Non-specific intra-ventricular conduction block
ST elevation consider inferior injury or acute infarct
ST elevation consider anterior injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** ** ...

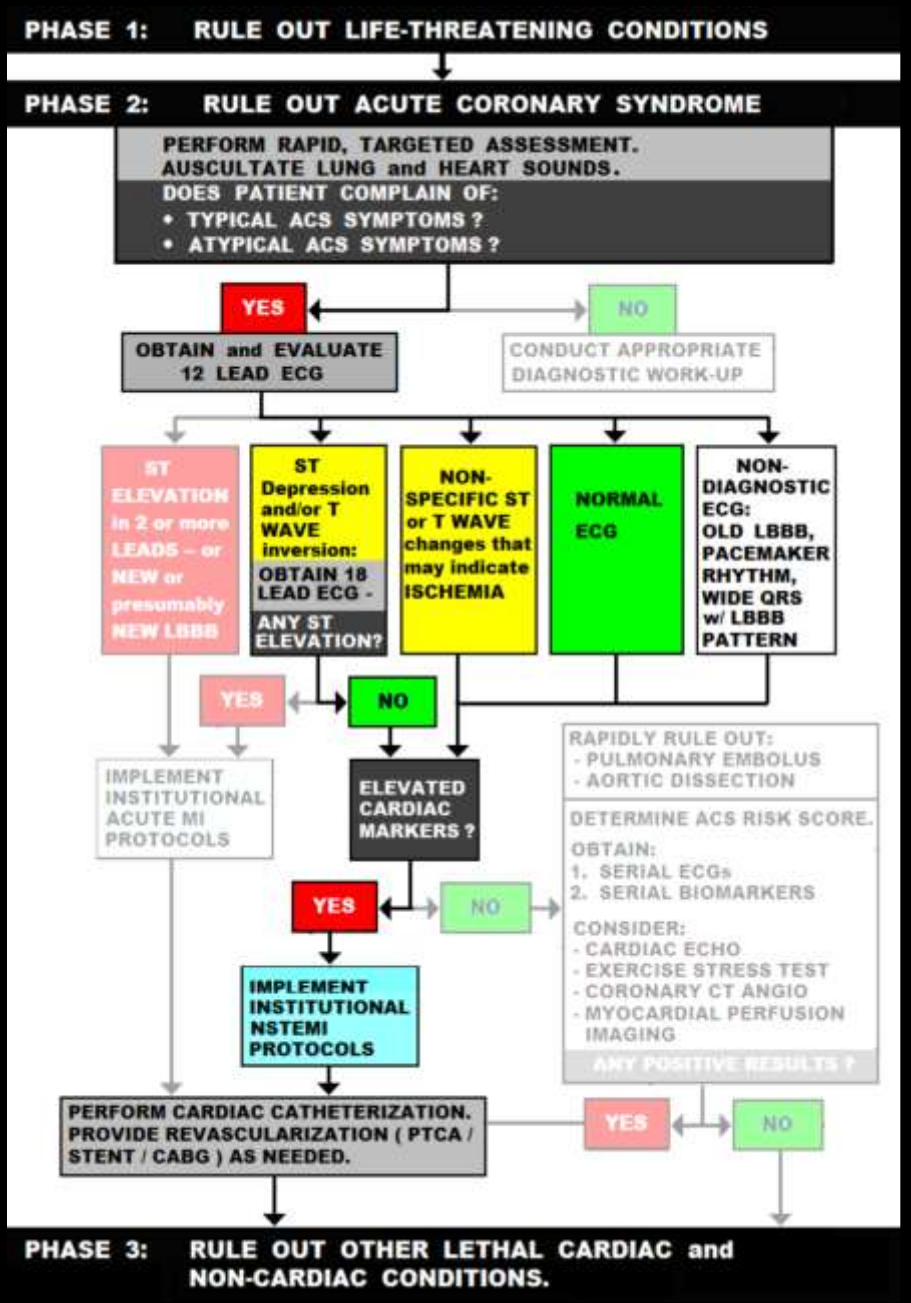


HYPERKALEMIA - K+ 8.6

Pt. FOUND UNRESPONSIVE BY FRIENDS. NO PRECIPITATING COMPLAINTS. Dx: ACUTE RENAL FAILURE.

Pt. EXPERIENCED CARDIAC ARREST, SUCCESSFUL RESUSCITATION with NaHCO3 100 mEq, CALCIUM CHLORIDE 1.0 gram, INSULIN 10 units, and DEXTROSE 25 gm. IV. DISCHARGED 11 DAYS LATER.

NSTEMI CASE STUDIES



Book Page: 186

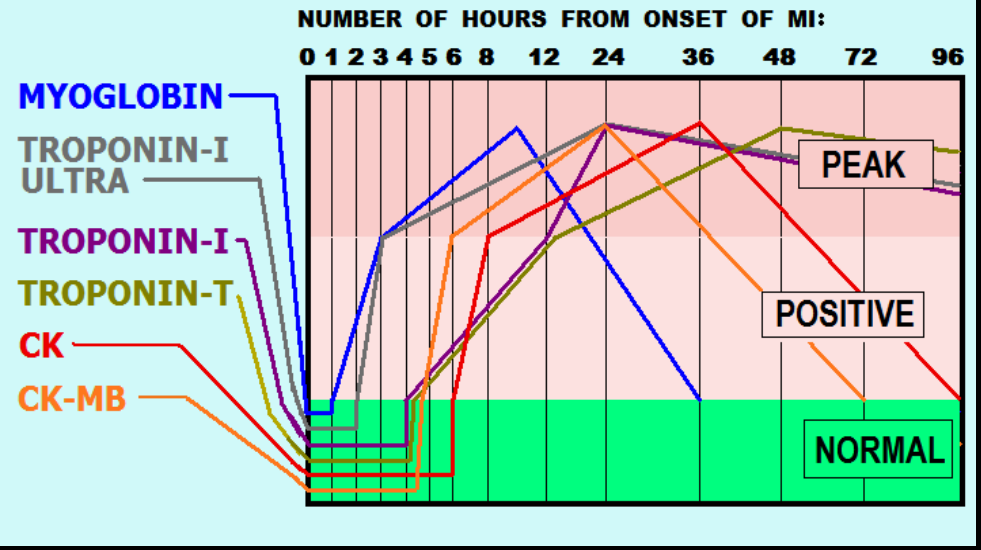
"The ACS Scorecard"

- ☑ PRESENTING SYMPTOMS
- ☑ RISK FACTOR PROFILE
- ☑ ECG ABNORMALITIES
- ☑ 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 !

CARDIAC MARKERS

RISE - PEAK - NORMALIZE TIME APPROXIMATIONS



BOOK PAGE: 108

CARDIAC MARKERS

RISE - PEAK - NORMALIZE TIME APPROXIMATIONS

NUMBER OF HOURS FROM ONSET OF MI:

	RISES (POSITIVE)	- PEAKS	- RETURNS TO NORMAL	
MYOGLOBIN	1 - 3	8 - 10	24 - 36	
TROPONIN-I ULTRA	2 - 3	10 - 24	5 - 10	days
TROPONIN-I	4 - 12	10 - 24	5 - 10	days
TROPONIN-T	4 - 12	12 - 48	5 - 15	days
CK	6 - 8	24 - 36	3 - 4	days
CK-MB	4 - 6	10 - 24	3	days

HEART

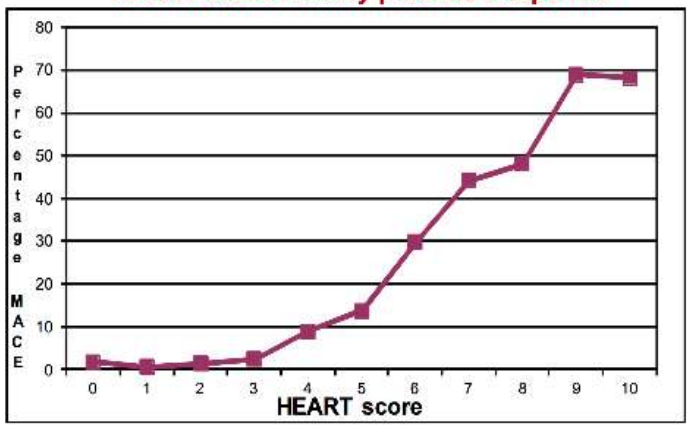
HEART score for chest pain patients

History (Anamnesis)	Highly suspicious	2	
	Moderately suspicious	1	
	Slightly suspicious	0	
ECG	Significant ST-deviation	2	
	Non-specific repolarisation disturbance / LBBB / PM	1	
	Normal	0	
Age	≥ 65 years	2	
	45 – 65 years	1	
	≤ 45 years	0	
Risk factors	≥ 3 risk factors *or* history of atherosclerotic disease	2	
	1 or 2 risk factors	1	
	No risk factors known	0	
Troponin	≥ 3x normal limit	2	
	1-3x normal limit	1	
	≤ normal limit	0	
		Total	

Risk factors for atherosclerotic disease:

Hypercholesterolemia	Cigarette smoking
Hypertension	Positive family history
Diabetes Mellitus	Obesity (BMI>30)

HEART score reliably predicts endpoints



HEART	~ % pts	MACE/n	MACE	Death	Proposed Policy
0-3	32%	38/1993	1.9%	0.05%	Discharge
4-6	51%	413/3136	13%	1.3%	Observation, risk management
7-10	17%	518/1045	50%	2.8%	Observation, treatment, CAG

*MACE = Major Adverse Cardiac Event = Myocardial Infarction, PCI/CABG, all-cause death. Based on N=6174

Literature:

1. Chest pain in the emergency room: value of the HEART score.
Six AJ, Backus BE, Kelder JC. Neth Heart J. 2008;16:191-6.
2. Chest pain in the emergency room: a multicenter validation of the HEART Score.
Backus BE, Six AJ, Kelder JC, et al. Crit Pathways in Cardiol. 2010;9:164-9.
3. A prospective validation of the HEART score for chest pain patients at the emergency department.
Backus BE, Six AJ, Kelder JC, et al. Int J Cardiol. 2013;168:2153-8.
4. The HEART score for the assessment of patients with chest pain in the emergency department
Six AJ, Cullen L, Backus BE, et al. Crit Pathways in Cardiol 2013;12:121–126.
5. Impact of using the HEART score in chest pain patients at the emergency department: a stepped wedge, cluster randomized trial. Poldervaart JM, et al. Annals of Internal Medicine. 2017. Epub ahead of print

Questions and comments:

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Jacob Six six@heartscore.nl
Judith Poldervaart poldervaart@heartscore.nl

www.heartscore.nl

HEART Score

-vs-

TIMI Score

63 y/o male patient's TMI Score is a TWO, which means He's only a LOW RISK patient. . . . .

Thrombolysis In Myocardial Infarction (TIMI) ACS Risk Stratification Tool:

One point is assigned for each positive value in the seven criteria listed below:

- ☐ Age 65 or older
- ☒ Chest pain / pressure within the last 24 hours
- ☒ 3 or more major risk factors:
  - Family history of CAD
  - Diabetes Mellitus
  - Hypercholesterolemia
  - Smoking
  - Hypertension
- ☐ Previously diagnosed coronary artery disease
- ☐ Aspirin taken in last 24 hours
- ☐ ST segment deviation (elevation or depression) equal to or greater than 0.5 mm
- ☐ Elevated Troponin level (any above your institution's normal ranges).

2 TOTAL SCORE (0 - 7)

	Risk of Death, MI, or Urgent Need for Revascularization Within Next 14 Days:	Risk Status:
0 - 2	5 - 8 %	LOW
3 - 4	13 - 20 %	INTERMEDIATE
5 - 7	26 - 41 %	HIGH

INFORMATION IN ABOVE TABLE FROM: "HANDBOOK OF EMERGENCY CARDIOVASCULAR CARE," AMERICAN HEART ASSOCIATION, 2006; p 38

CASE STUDY: IMPORTANCE of RISK FACTORS

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

62 y/o MALE presents to cardiologist's office with intermittent ACS symptoms (chest heaviness, dyspnea). - Pt. DOES NOT correlate symptoms with exertion.

RISK FACTOR PROFILE:

- **FAMILY HISTORY** - both parents + CAD before age 65
- **PREVIOUS CIGARETTE SMOKER** - 20+ yrs., quit 15 years ago
- **HIGH CHOLESTEROL** - Dx 5 yrs ago, taking STATIN med since.
- **DIABETES** - Controlled with diet and oral meds.

PHYSICAL EXAM: Patient supine on exam table, skin warm, dry, color NL
Patient is asymptomatic, all systems WNL

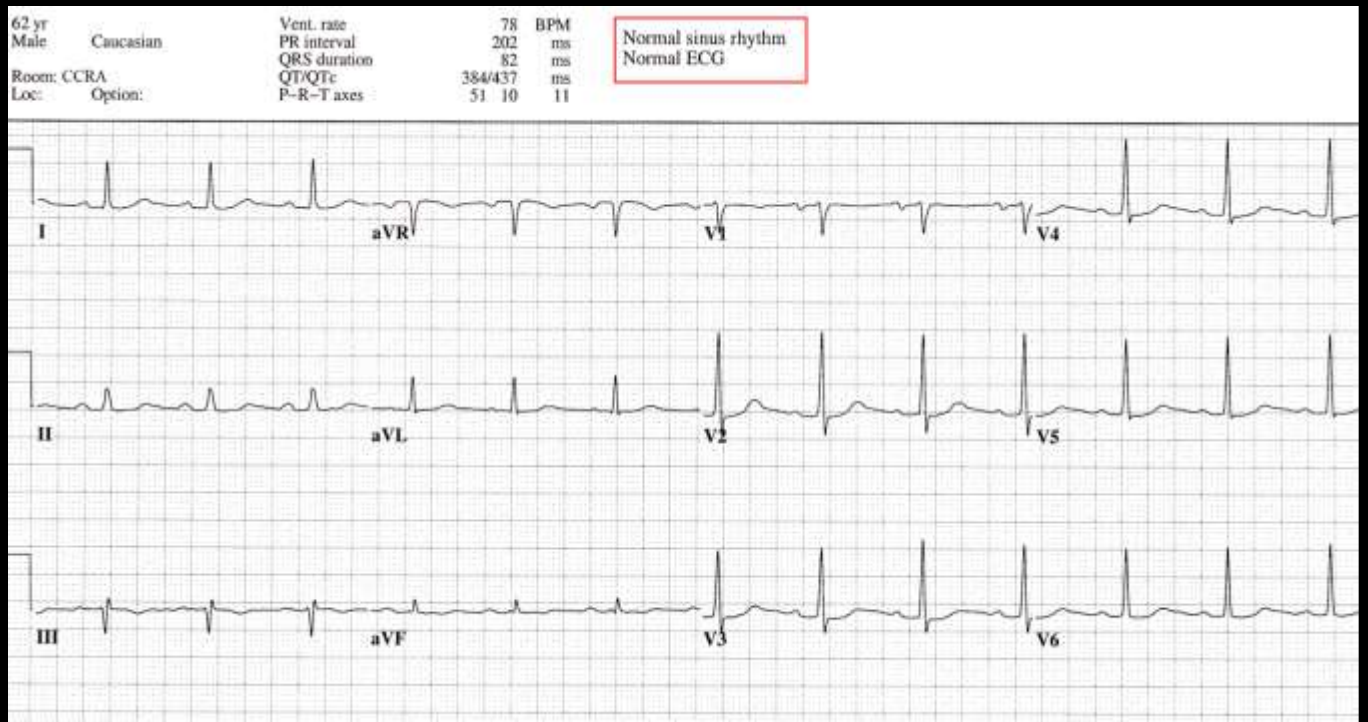
VITAL SIGNS: BP 153/88, P 80, R 16, SAO2 99%

DIAGNOSTIC TESTING: EKG NORMAL, EXERCISE STRESS TEST PASSED.

"The ACS Scorecard"

- ☑ PRESENTING SYMPTOMS
- ☑ RISK FACTOR PROFILE
- ☐ ECG ABNORMALITIES
- ☐ 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 !



62 y/o male patient's TMI Score is a TWO, which means He's only a LOW RISK patient. . . . .

62 y/o male patient's TMI Score is a TWO, which means He's only a LOW RISK patient. . . . .

The Interventional Cardiologist was very suspicious of the man's Risk Factors and Symptoms, and convinced the man to consent to a Cardiac Catheterization……..

62 y/o male patient's TMI Score is a TWO, which means He's only a LOW RISK patient. . . . .

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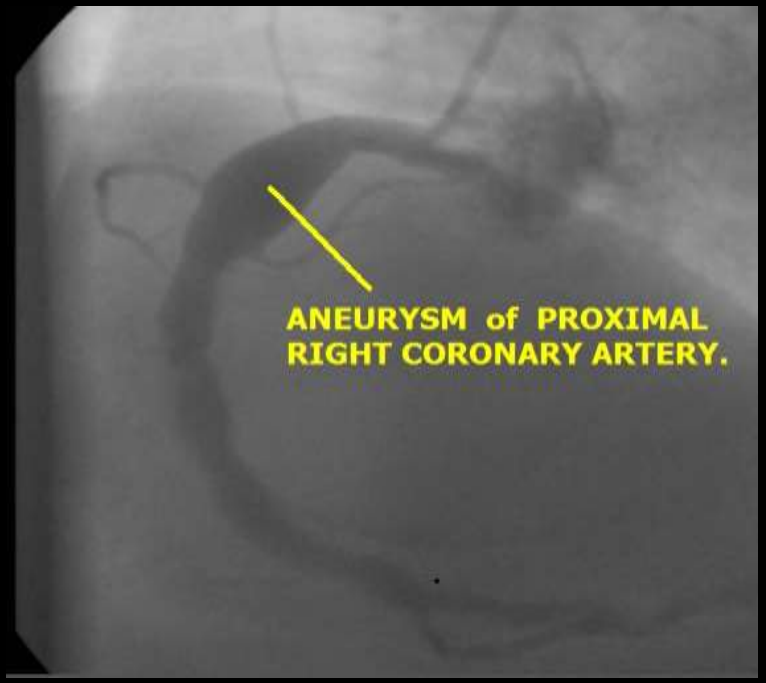

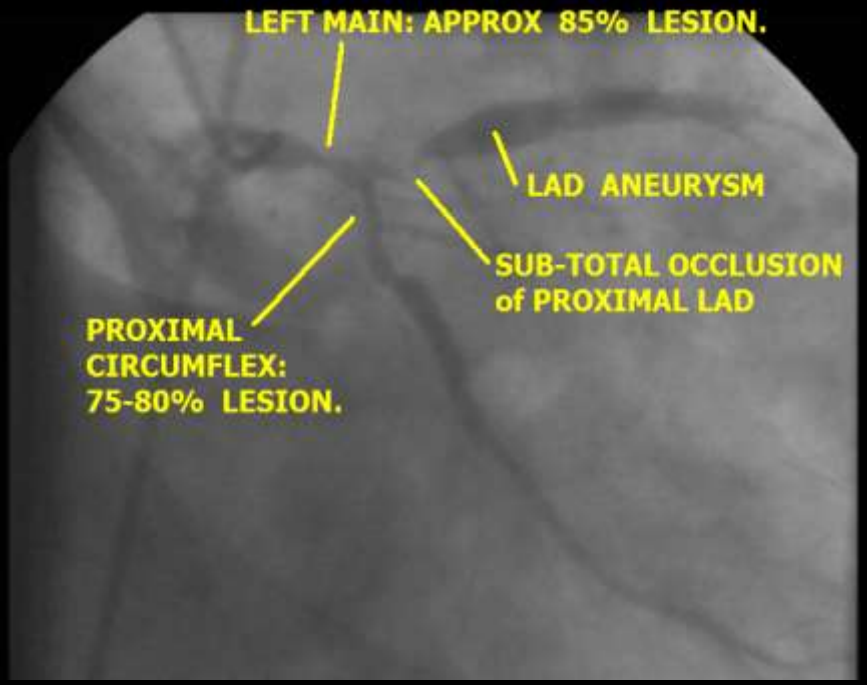

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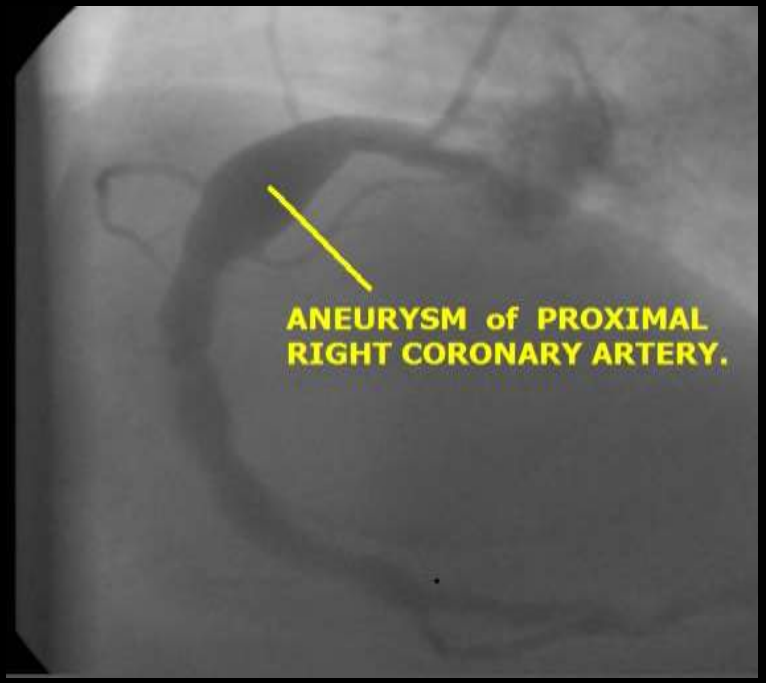
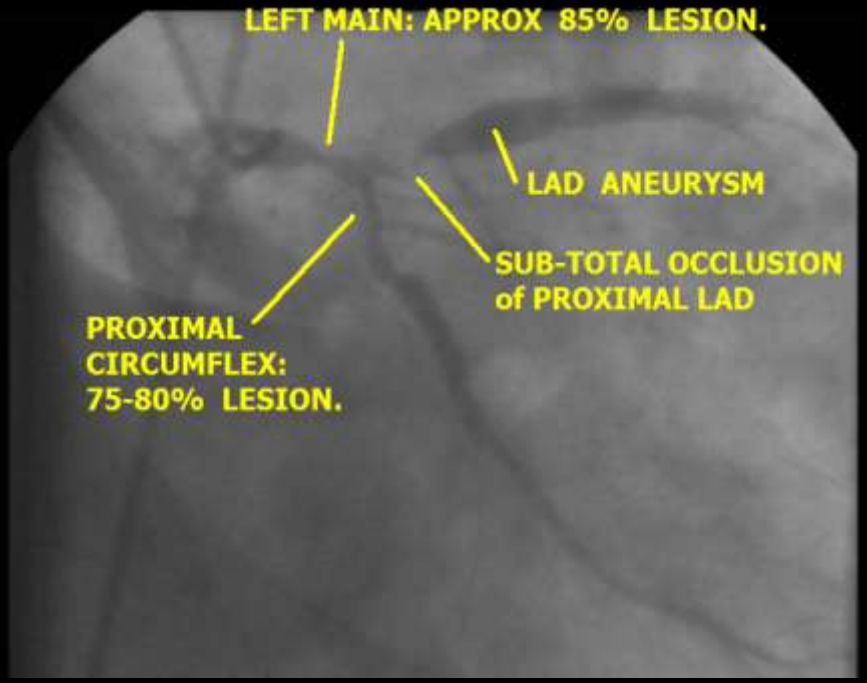




It's a good thing the Doctor didn't include the TIMI Score in his clinical decision-making. The patient was directly for emergency bypass surgery.

CASE STUDY 11 - NSTEMI *ATYPICAL EKG*

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

42 y/o MALE in ED c/o INTERMITTENT SUBSTERNAL CHEST PAIN x 9 HOURS, "8" on 1-10 scale, pain does not radiate, not effected by position/deep inspiration. Denies DIB.
Pt. given NTG 0.4mg SL without releif of CHEST PAIN.

RISK FACTOR PROFILE:

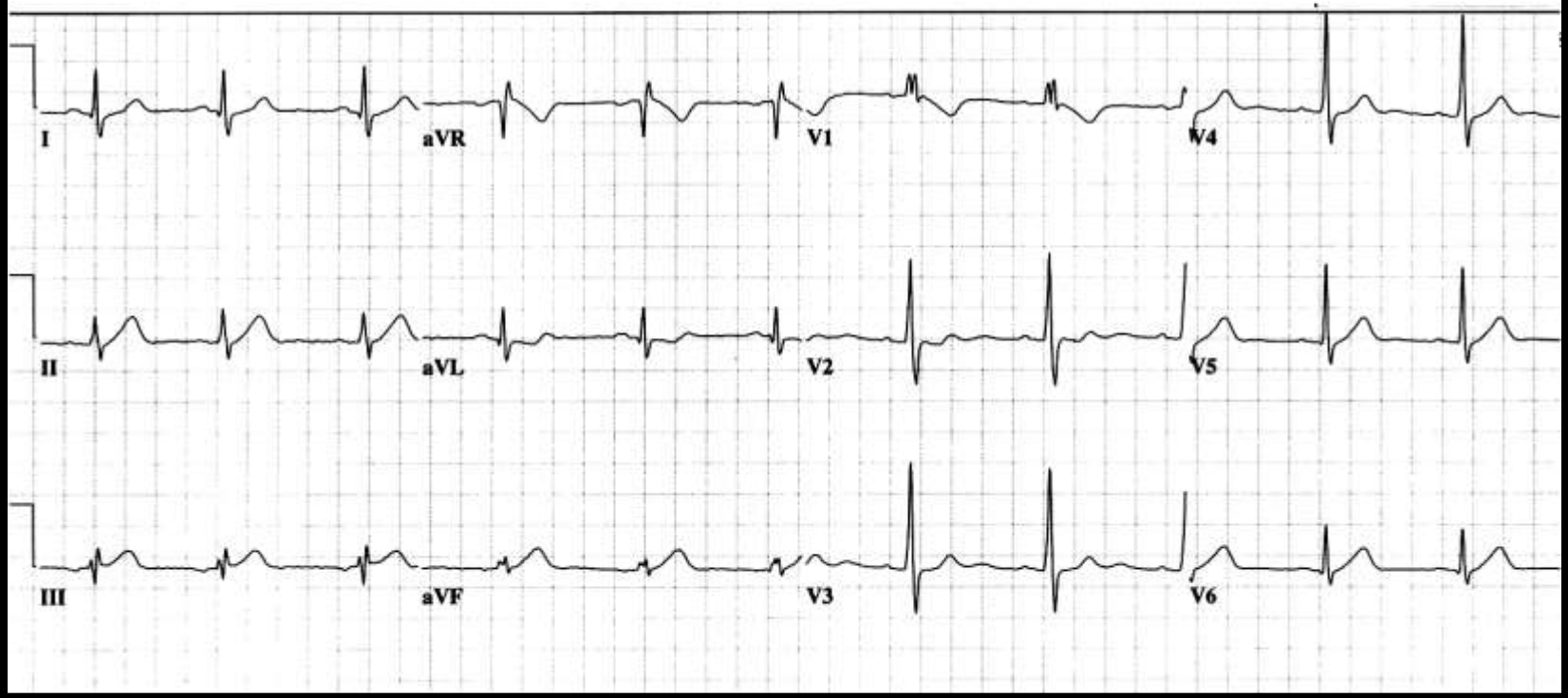
- ELEVATED LDL CHOLESTEROL, LOW HDL CHOLESTEROL
- ✔ PATIENT DENIES SMOKING, FAMILY HISTORY, HYPERTENSION

PHYSICAL EXAM: CAOx4, SKIN WARM, DRY, COLOR NORMAL, NON-ANXIOUS, LUNGS CLEAR, HEART SOUNDS NORMAL S1, S2, NO JVD, NO ANKLE EDEMA

VITAL SIGNS: BP: 122/76 P: 86 R: 16 SAO2: 98% on 2 LPM O2

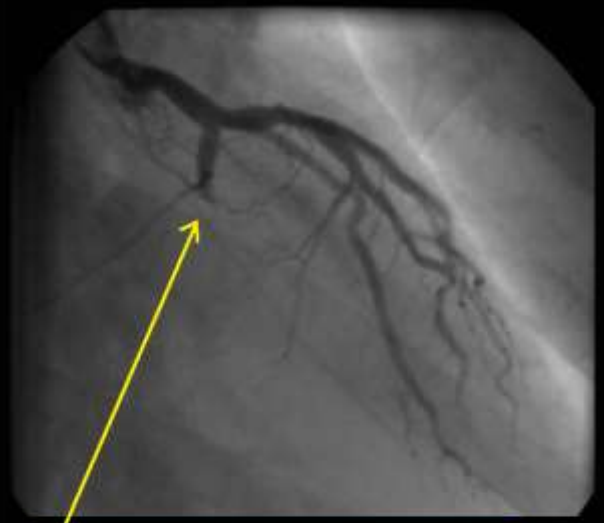
LABS: TROPONIN: >500 CK: 4,410 CK MB: 224.1 CK INDEX: 5.1

42 yr		Vent. rate	67	BPM	"**unedited copy: report is computer generated only, without physician interpretation".
Male	Hispanic	PR interval	148	ms	Normal sinus rhythm
		QRS duration	94	ms	Nonspecific ST abnormality
Room:ED		QT/QTc	400/422	ms	Abnormal ECG
Loc:3	Option:23	P-R-T axes	-5 34	59	No previous ECGs available



CASE STUDY QUESTIONS:

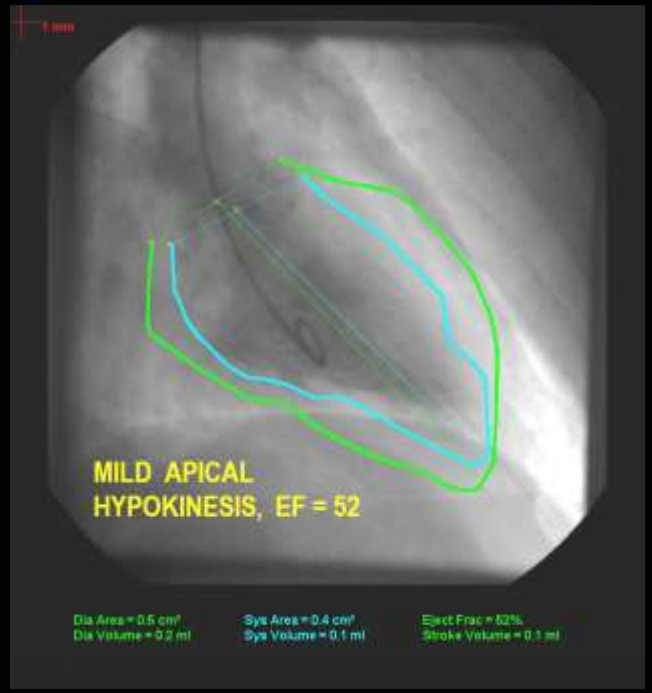
NOTE LEADS WITH ST ELEVATION:	**NOTE LEADS WITH ST DEPRESSION:**
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	**LIST ANY POTENTIAL COMPLICATIONS:**



TOTAL OBSTRUCTION - PROXIMAL CIRCUMFLEX ARTERY

DOMINANT RIGHT CORONARY ARTERY OPEN

POST PTCA / STENT TO CIRCUMFLEX ARTERY



CASE STUDY SUMMARY

ST ELEVATION: III

ST DEPRESSION: NONE.

SUSPECTED DIAGNOSIS: ACUTE NSTEMI - BASED ON SYMPTOMS & ELEVATED MARKERS

SUSPECTED "CULPRIT ARTERY" (if applicable):

UNABLE TO DETERMINE BASED ON 12 LEAD EKG PRESENTATION.

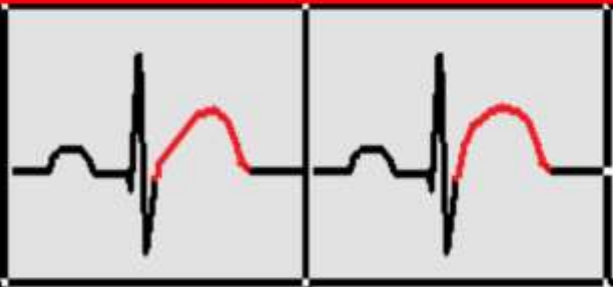
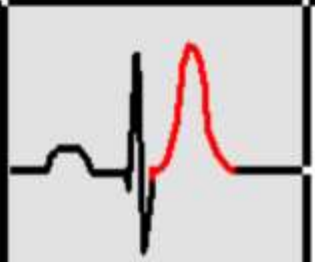
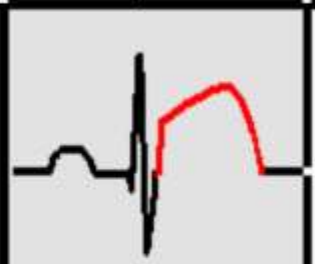
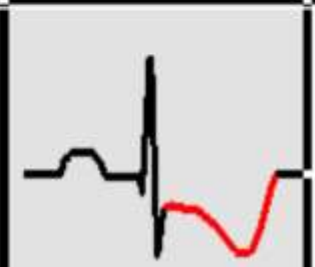
IMMEDIATE CONCERNS FOR ALL ACUTE MI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
20 - 30% of LV MUSCLE MASS	→ POSSIBLE MINOR - MODERATE LV FAILURE.	→ SMALL FLUID CHALLENGE INOTROPIC AGENTS
45% of POPULATION HAS SINUS NODE SUPPLIED BY CIRCUMFLEX ARTERY	→ SINUS BRADYCARDIA SINUS ARREST	→ ATROPINE TRANSCUTANEOUS PACING

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 J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

CASE STUDY 12 - NSTEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

63 y/o MALE in ED complaining of continuous PRESSURE in both SHOULDERS, with radiation down the RIGHT ARM to the elbow x approx. 6 hours. He took Motrin 800mg. without relief. Also c/o intermittent NAUSEA. He DENIES CHEST PRESSURE / DISCOMFORT and DIB.

RISK FACTOR PROFILE:

- ELEVATED TRIGLYCERIDES and LOW HDL
- ✔ SMOKER FOR 30+ YEARS, QUIT 6 YEARS AGO

PHYSICAL EXAM: CAOx4, SKIN WARM, DRY, COLOR PALE. PUPILS PERLA, NO JVD, LUNGS CLEAR, HEART SOUNDS NORMAL S1, S2. NO ANKLE EDEMA

VITAL SIGNS: BP: 106/50 P: 90 R: 20 SAO2: 96% on 4 LPM O2

LABS: TROPONIN: 66.3 CK: 187 CK MB: 4.2

Acute MI patients who present without chest pain* are SHREWD:

Stroke (previous history of)
Heart failure (previous history of)
Race (non-white)
Elderly (age 75+)
Women
Diabetes mellitus

* The information listed in the table to the immediate left resulted from a study conducted by John G. Canto, MD, MSPH, et. al., of the University of Alabama. The study consisted of 434,877 patients diagnosed with AMI between 1994 and 1998 in 1,674 US hospitals. Study results were published in the Journal of the American Medical Association (JAMA) on June 28, 2000, Vol. 283, No. 24, pages 3223-3229

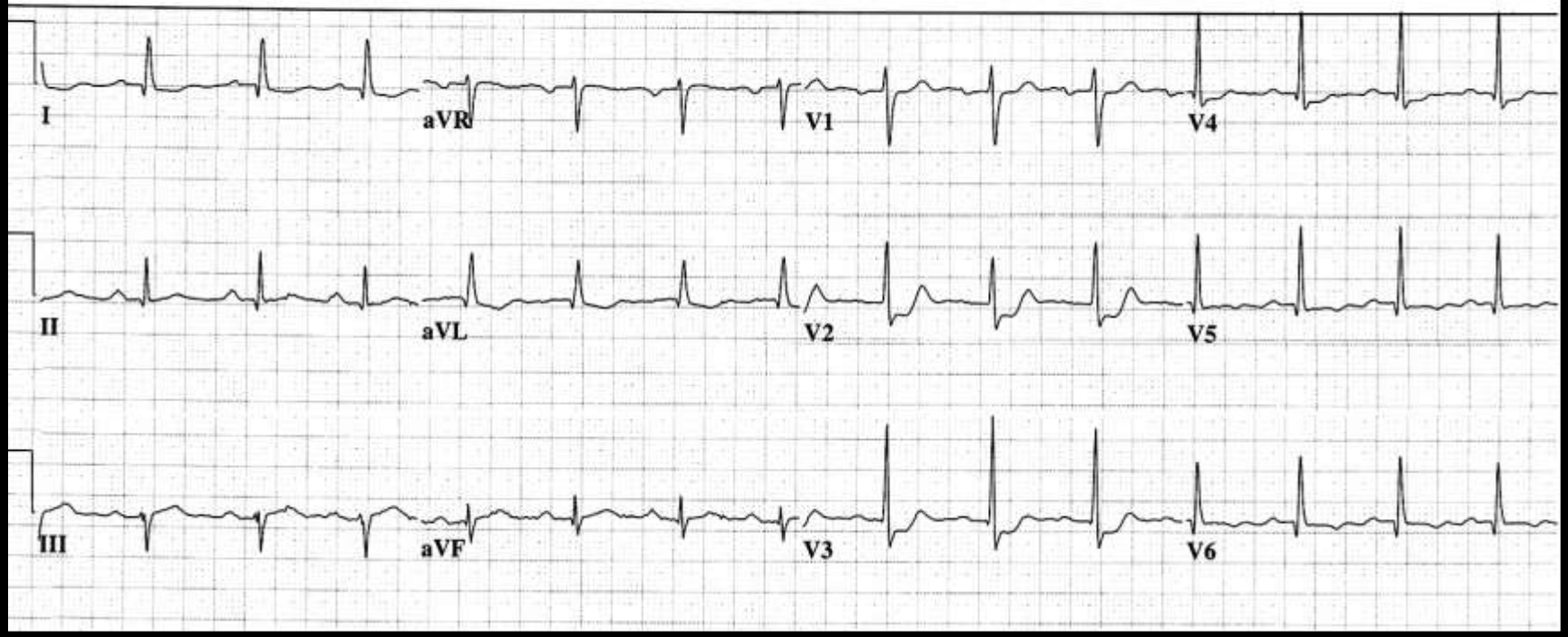
Common atypical complaints associated with AMI without chest pain include:

Malaise (weakness)
Indigestion
Nausea
Dizziness
Syncope
Fatigue
Abdominal pain
Cold sweats
Elevated heart rate
Dsypnea

63 yr
Male Hispanic

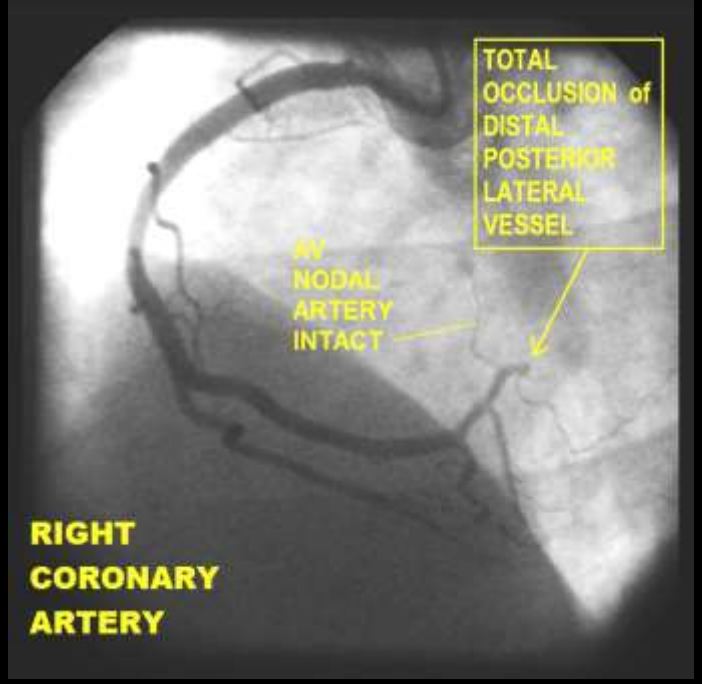
Room:VAM
Loc:3 Option:23

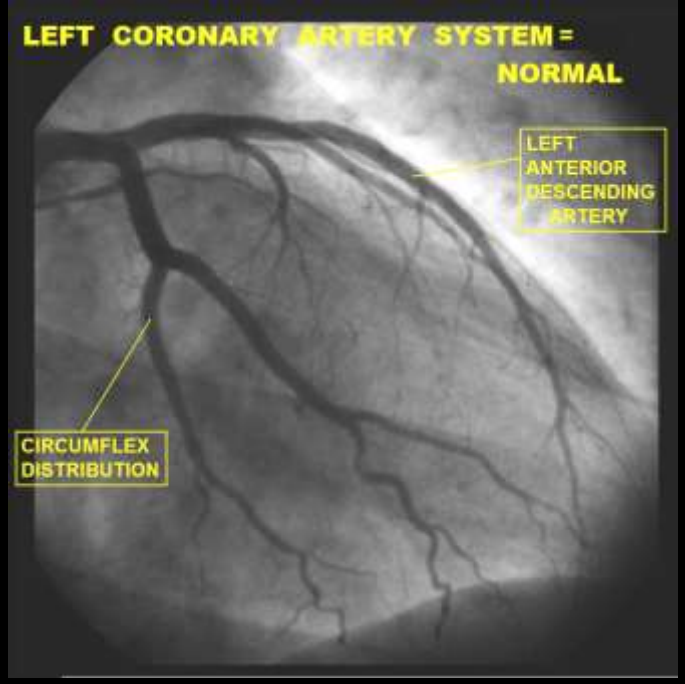
Vent. rate	88	BPM
PR interval	200	ms
QRS duration	94	ms
QT/QTc	352/425	ms
P–R–T axes	63 2	118

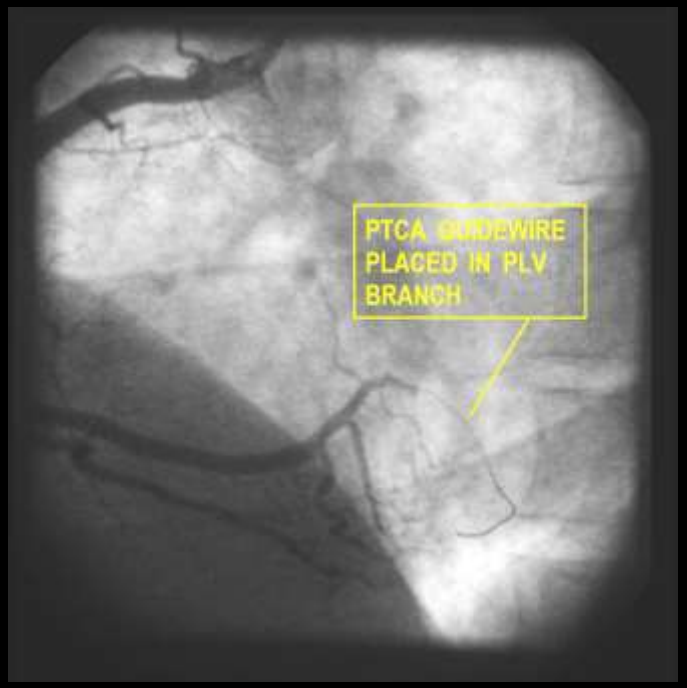


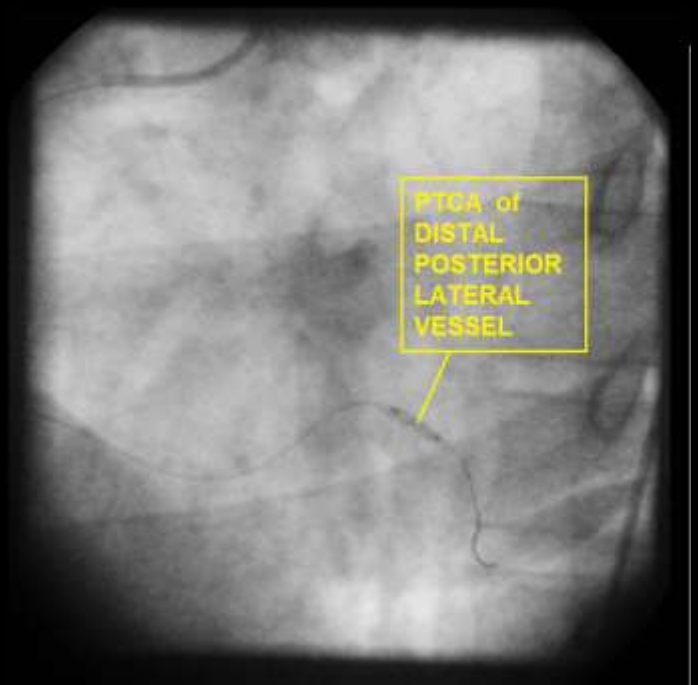
CASE STUDY QUESTIONS:

NOTE LEADS WITH ST ELEVATION:	**NOTE LEADS WITH ST DEPRESSION:**
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	**LIST ANY POTENTIAL COMPLICATIONS:**

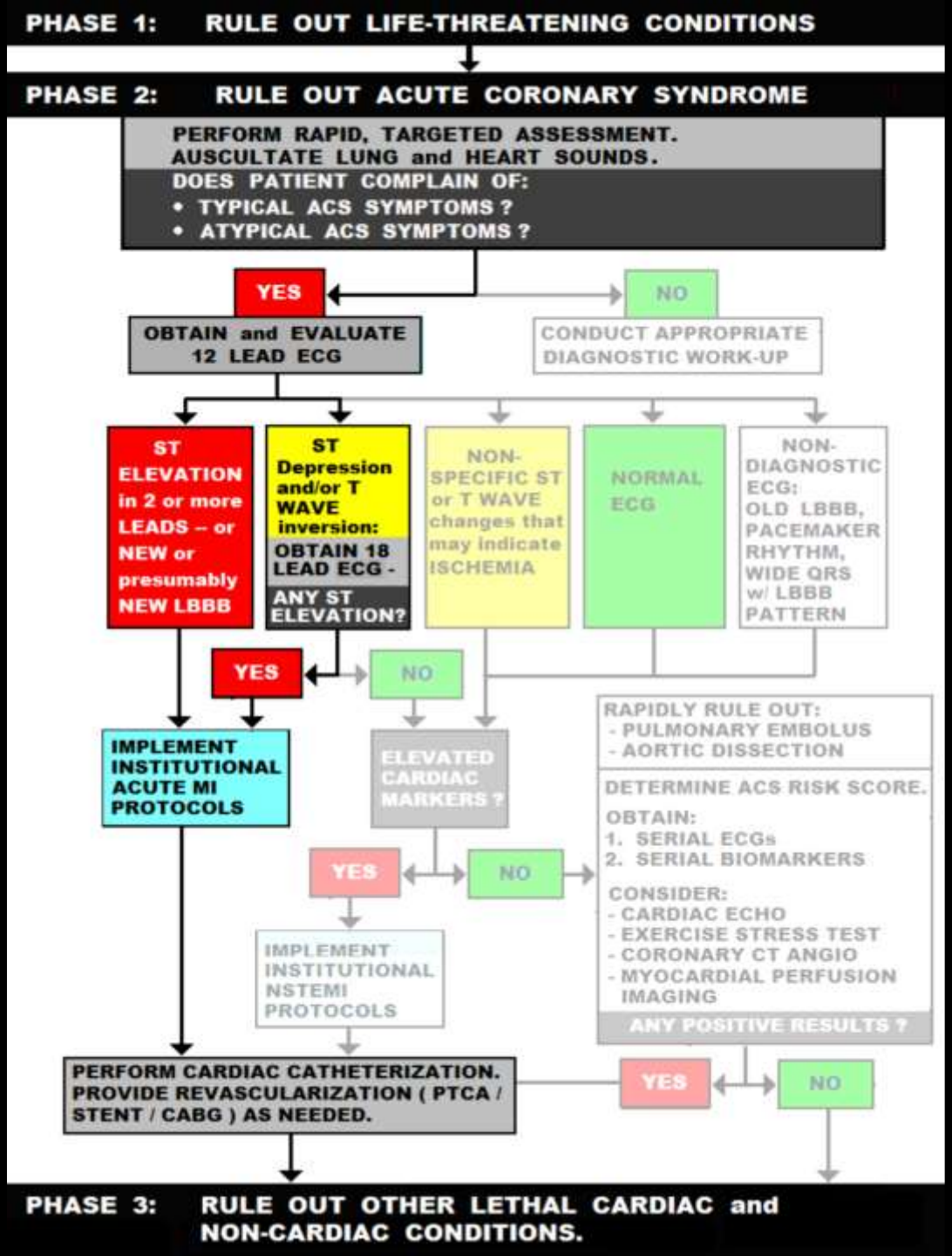

TOTAL
OCCLUSION of
DISTAL
POSTERIOR
LATERAL
VESSEL
AV
NODAL
ARTERY
INTACT
RIGHT
CORONARY
ARTERY


LEFT CORONARY ARTERY SYSTEM =
NORMAL
LEFT
ANTERIOR
DESCENDING
ARTERY
CIRCUMFLEX
DISTRIBUTION

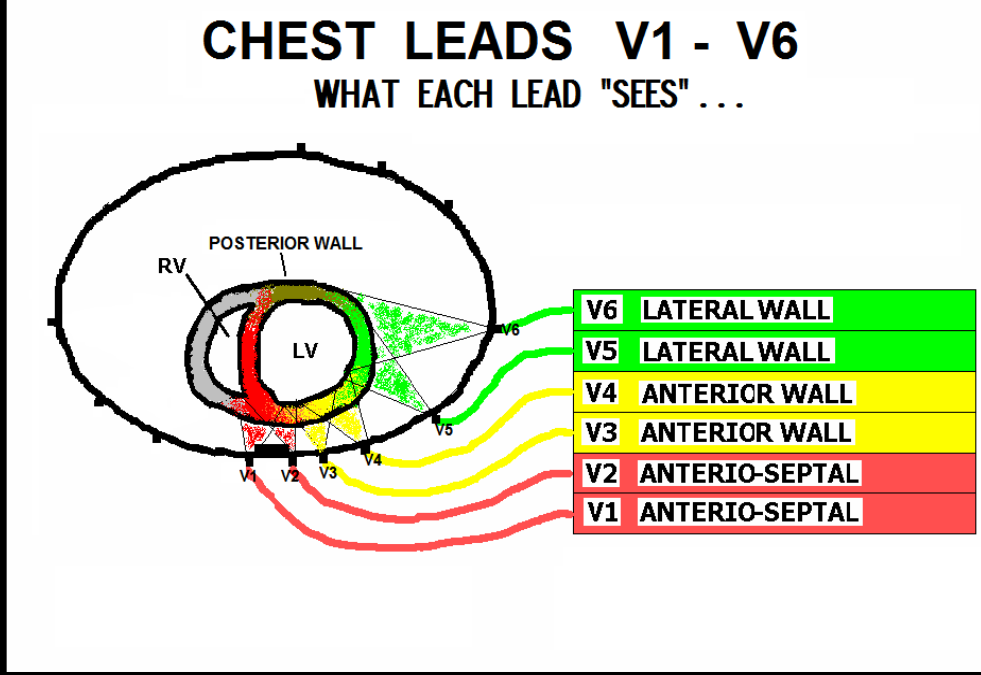

PTCA GUIDEWIRE
PLACED IN PLV
BRANCH

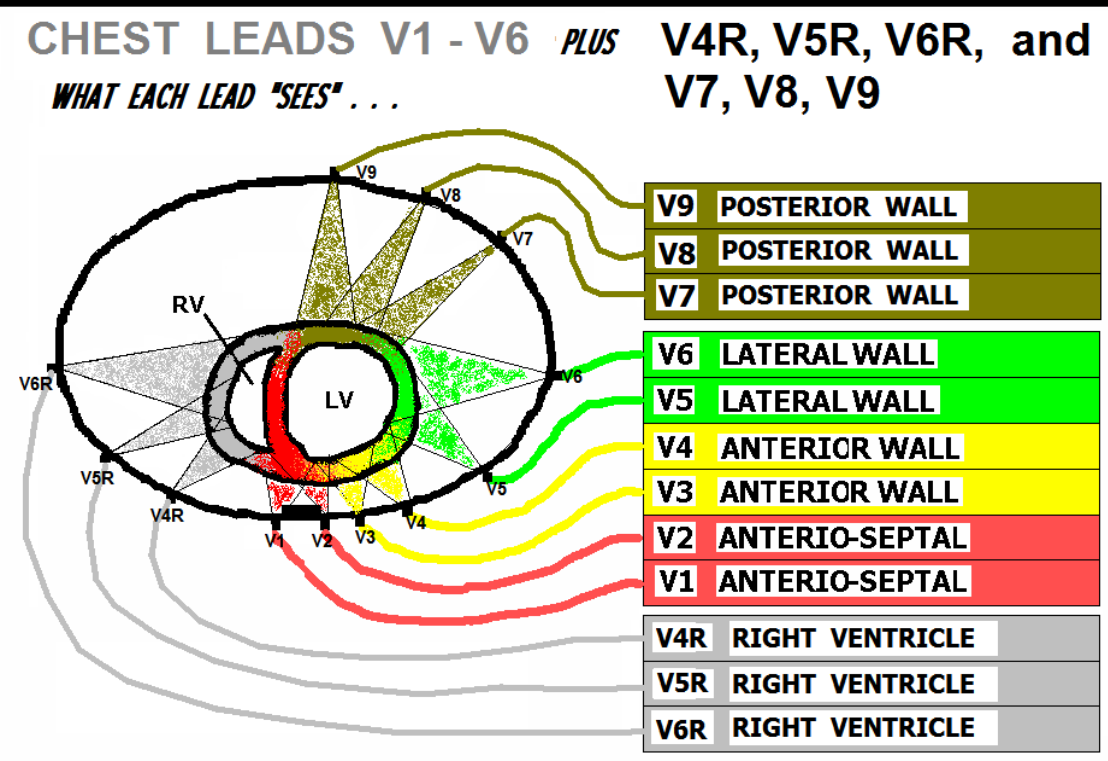

PTCA of
DISTAL
POSTERIOR
LATERAL
VESSEL

REMEMBER . . . . . IT'S POSSIBLE TO HAVE A STEMI . . . *WHEN THERE'S NO ST ELEV. ON THE 12 LEAD ! !*



THE 12 LEAD EKG HAS TWO MAJOR "BLIND SPOTS:"
- POSTERIOR WALL
- R VENTRICLE



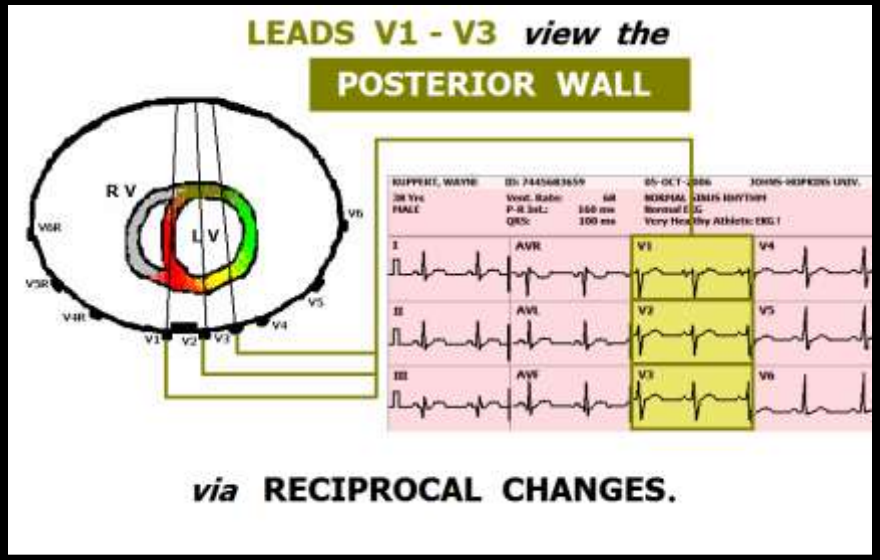


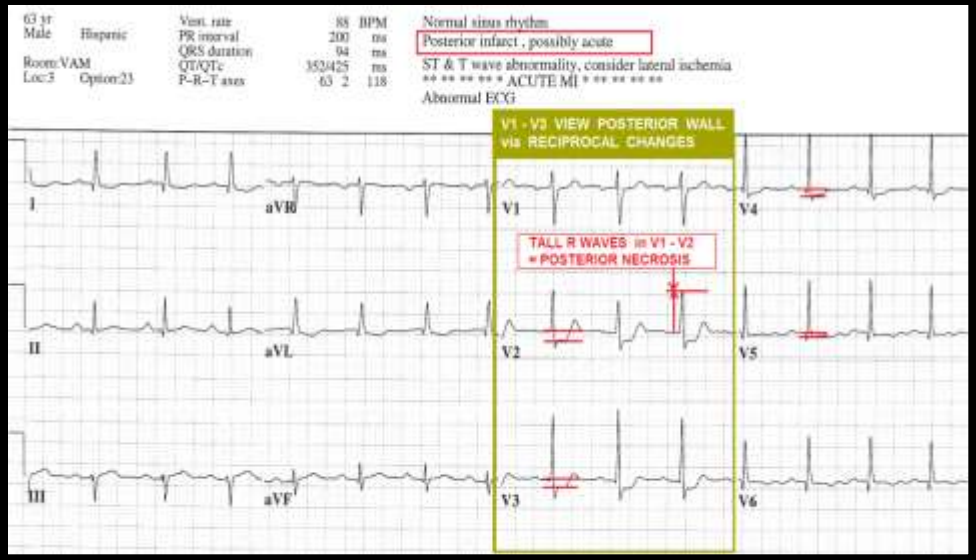
THE 18 LEAD EKG ADDS COVERAGE OF THE
-POSTERIOR WALL
-R VENTRICLE

INDICATIONS FOR OBTAINING AN 18 LEAD EKG:

1. INFERIOR WALL MIs
   (ST ELEV II, III, aVF)

2. SUSPECTED POSTERIOR WALL MI
   (ST DEPR V1, V2, and/or V3, V4)





CASE STUDY SUMMARY

ST ELEVATION: NONE.

ST DEPRESSION: V1 - V3

SUSPECTED DIAGNOSIS: ACUTE NSTEMI - BASED ON SYMPTOMS & ELEVATED MARKERS

SUSPECTED "CULPRIT ARTERY" (if applicable):

POSTERIOR LATERAL VESSEL(S) - originate off of RCA or CIRCUMFLEX

IMMEDIATE CONCERNS FOR ALL ACUTE MI PATIENTS:

- BE PREPARED TO MANAGE SUDDEN CARDIAC ARREST (PRIMARY V - FIB / V- TACH, BRADYCARDIAS / HEART BLOCKS)
- STAT REPERFUSION THERAPY: THROMBOLYTICS vs. CARDIAC CATHETERIZATION and PCI
- CONSIDER NEEDS FOR ANTI-PLATELET and ANTI-COAGULATION THERAPY

CRITICAL STRUCTURES COMPROMISED:	POTENTIAL COMPLICATIONS:	POSSIBLE CRITICAL INTERVENTIONS:
20 - 30% of LV MUSCLE MASS	→ POSSIBLE MINOR - MODERATE LV FAILURE.	→ SMALL FLUID CHALLENGE INOTROPIC AGENTS

CASE STUDY 13 - NSTEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

67 y/o FEMALE presents to ED with intermittent exertional CHEST PRESSURE x 1 day. Pt. DENIES shortness of breath, nausea. CHEST PRESSURE does not radiate.

RISK FACTOR PROFILE:

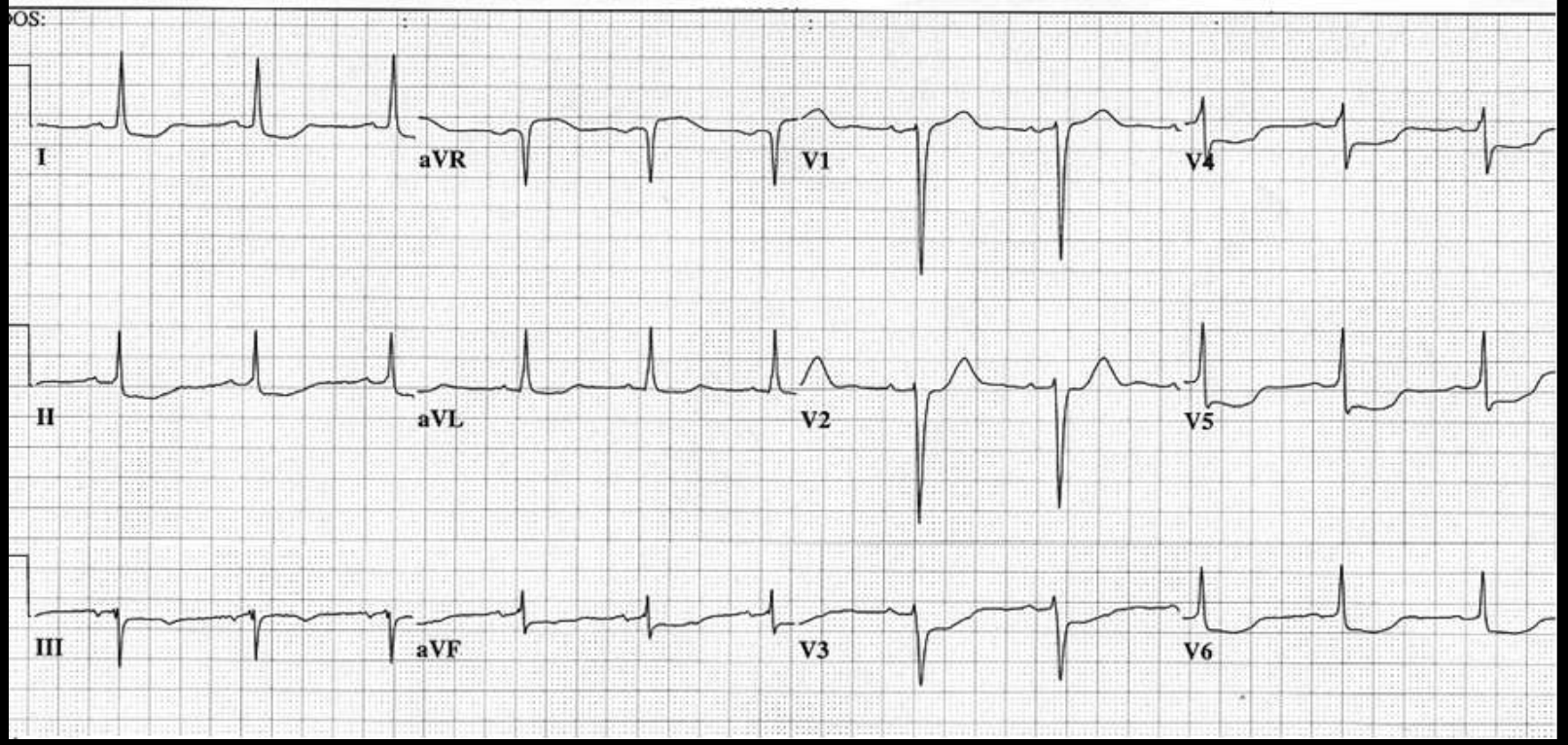
- CIGARETTE SMOKER x 40 YEARS
- HYPERTENSION
- AGE >65

PHYSICAL EXAM: Pt. CAO x 4 in NAD, SKIN WARM, DRY, COLOR NORMAL. PUPILS PERLA, NO JVD LUNGS = DECREASED, CRACKLES IN BASES. HEART SOUNDS NORMAL S1, S2, NO ANKLE EDEMA,

VITAL SIGNS: BP: 133/88 P: 68 R: 20 SAO2: 95% on 2 LPM O2

LABS: TROPONIN: 4.8 CK: 525 CK MB: 29

67 yr		Vent. rate	67	BPM
Female	Hispanic	PR interval	188	ms
		QRS duration	106	ms
Room:S7		QT/QTc	458/483	ms
Loc:3	Option:23	P-R-T axes	27 -3	-111



CASE STUDY QUESTIONS:

NOTE LEADS WITH ST ELEVATION:	NOTE LEADS WITH ST DEPRESSION:
WHAT IS THE SUSPECTED DIAGNOSIS ?	
WHAT IS THE "CULPRIT ARTERY" -- if applicable ?	
LIST ANY CRITICAL STRUCTURES COMPROMISED:	LIST ANY POTENTIAL COMPLICATIONS:

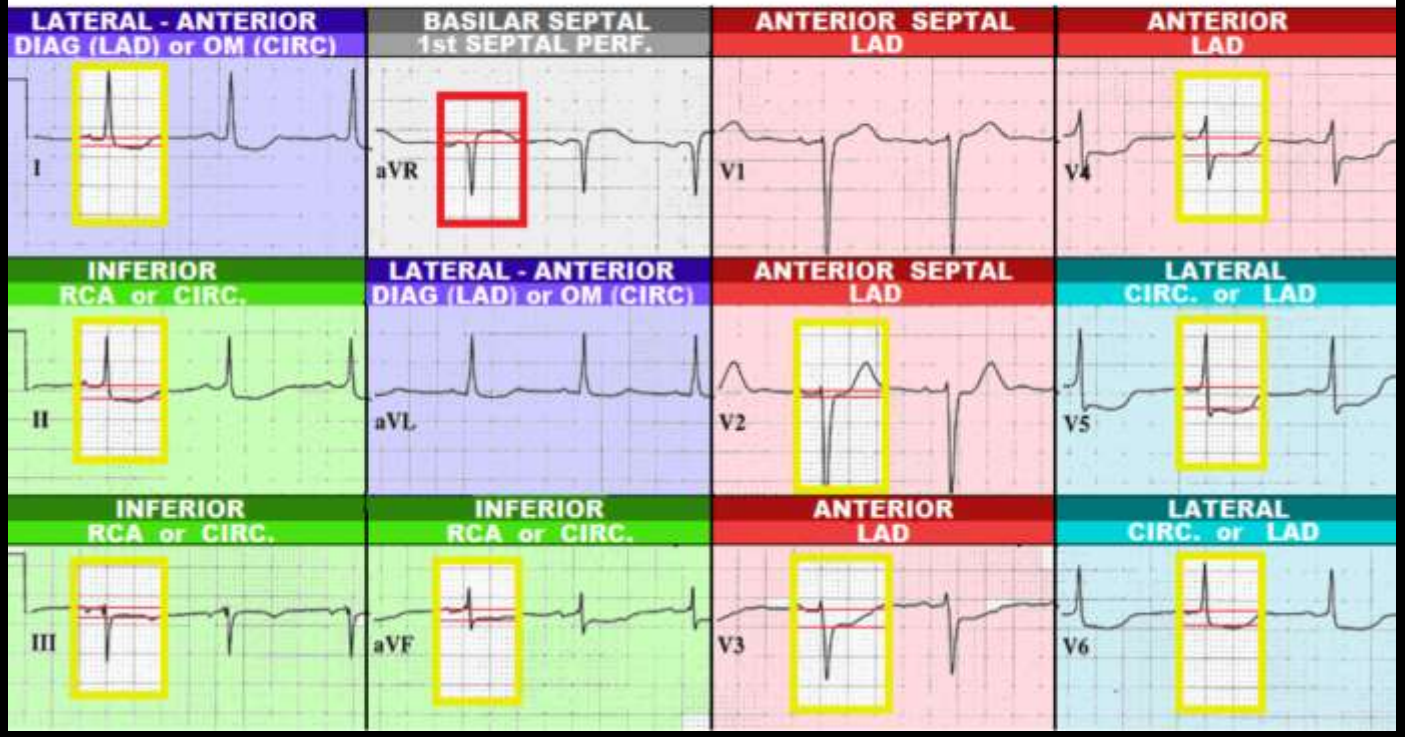
67 yr
Female Hispanic

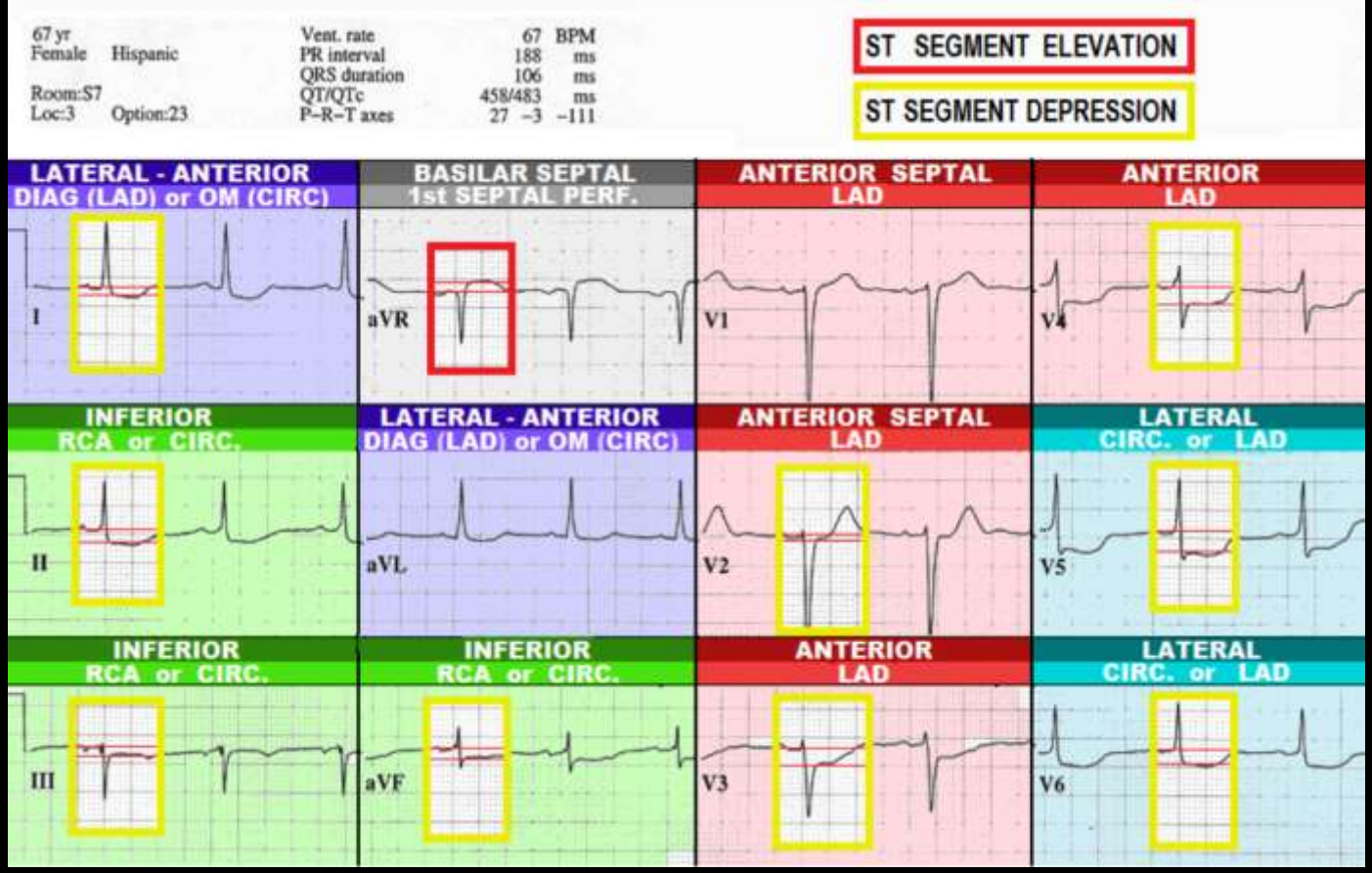
Room:S7
Loc:3 Option:23

Vent. rate	67	BPM
PR interval	188	ms
QRS duration	106	ms
QT/QTc	458/483	ms
P-R-T axes	27 -3	-111

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION

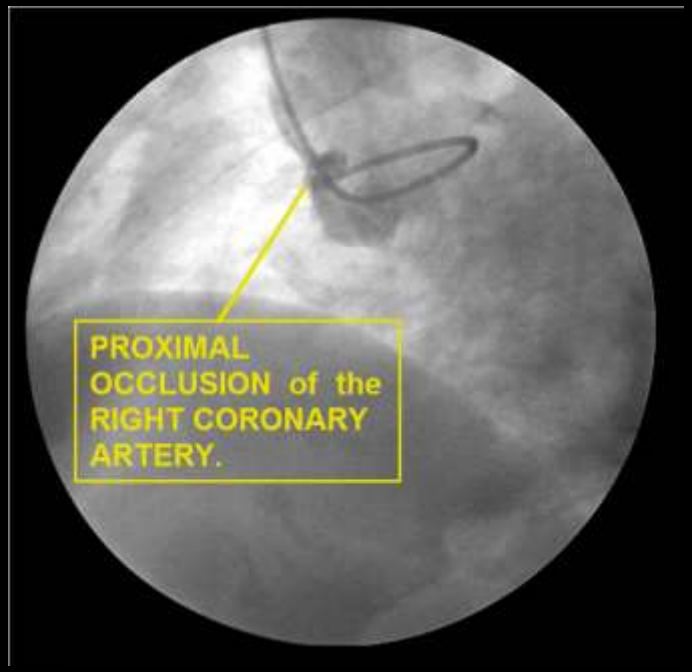


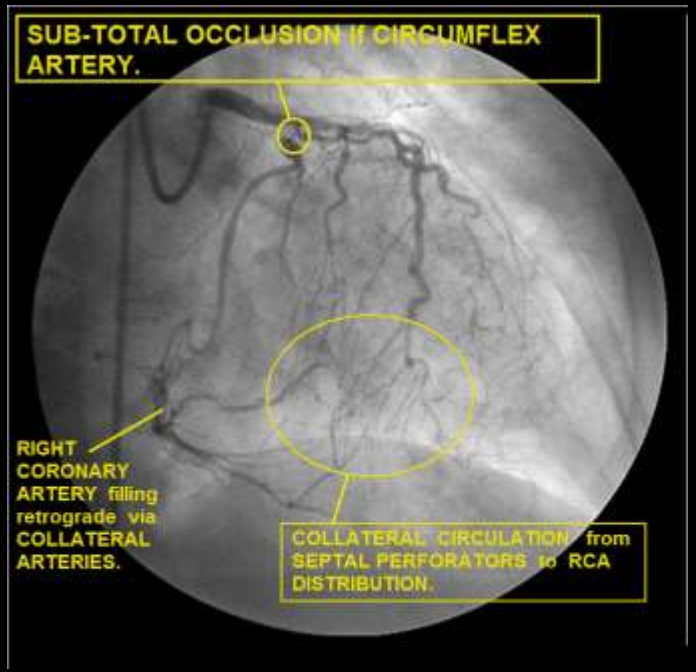


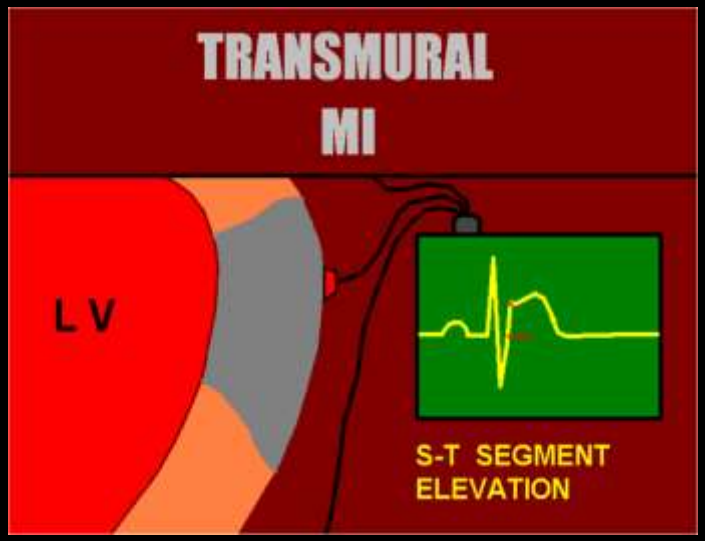
☞ **LEAD aVR – sometimes referred to as *"the forgotten 12th lead"* – can be a source of valuable information.** In this case study, lead aVR is the only lead with ST elevation.

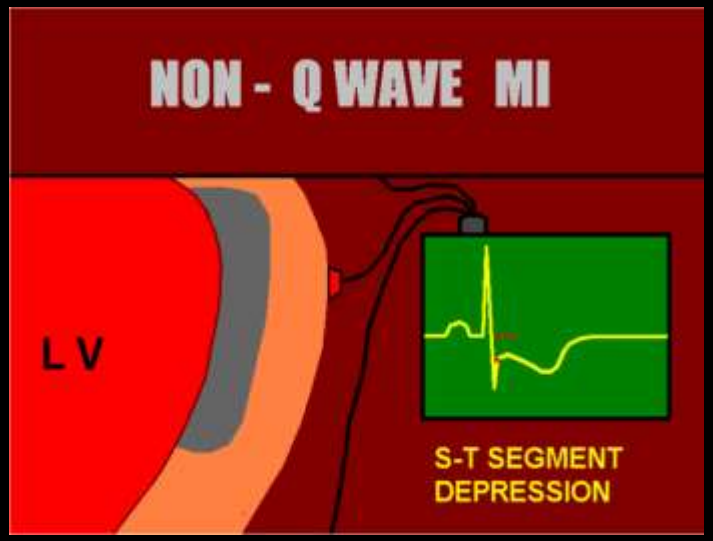
- In cases of myocardial ischemia and NSTEMI, ST segment elevation of lead aVR has been associated with a high incidence of triple vessel disease,[1] ***which is true in this case study***.
- In cases of anterior wall STEMI, elevation of lead aVR indicates the patient's lesion is proximal to the origin of the first septal perforator.[2]
- When the ST elevation of lead aVR is higher than that of V1, it is considered an indicator that the left main coronary artery is obstructed.[3] Please review Case Study 4 (p 183), STEMI, and involving occlusion of Left Main Coronary Artery.

While reviewing ECGs for inclusion in this curriculum, we noticed the correlation between J point elevation in lead aVR and the incidence of severe multi-vessel disease.


PROXIMAL OCCLUSION of the RIGHT CORONARY ARTERY.


SUB-TOTAL OCCLUSION if CIRCUMFLEX ARTERY.
RIGHT CORONARY ARTERY filling retrograde via COLLATERAL ARTERIES.
COLLATERAL CIRCULATION from SEPTAL PERFORATORS to RCA DISTRIBUTION.


TRANSMURAL MI
LV
S-T SEGMENT ELEVATION


NON - Q WAVE MI
LV
S-T SEGMENT DEPRESSION

CASE STUDY 14 - NSTEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

45 y/o FEMALE c/o CHEST PAIN, SHORTNESS of BREATH and WEAKNESS x "SEVERAL DAYS." She states she has been under "a great amount of stress" in the past month, and recently started taking diet pills containing EPHEDRA.

RISK FACTOR PROFILE:

- FAMILY HISTORY

PHYSICAL EXAM: Pt. CAO X 4, skin warm, dry, color normal. Lung sounds clear, HS Normal S1, S2. No JVD, No ankle edema.

VITAL SIGNS: BP: 106/66 P: 80 R: 24 SAO2: 95 % on 2 LPM O2

LABS: TROPONIN: 135

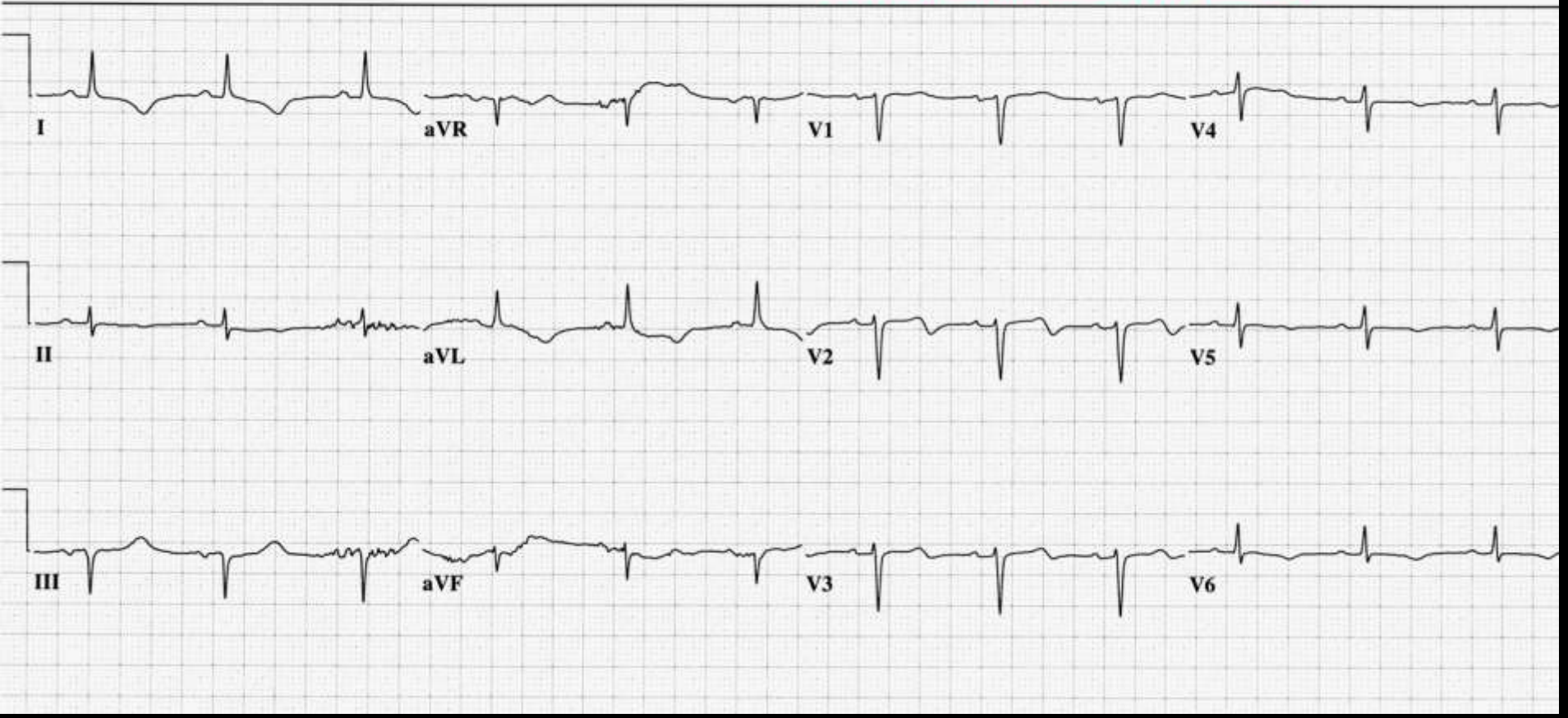
45 yr
Female Caucasian

Loc:1 Option:1

Vent. rate	72	BPM
PR interval	146	ms
QRS duration	80	ms
QT/QTc	480/525	ms
P-R-T axes	27 -28	153

EVALUATE EKG FOR:

- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- FLAT / CONVEX J-T APEX SEGMENTS
- OTHER ST - T WAVE ABNORMALITIES
- *ABNORMAL R WAVE PROGRESSION / TRANSITION*



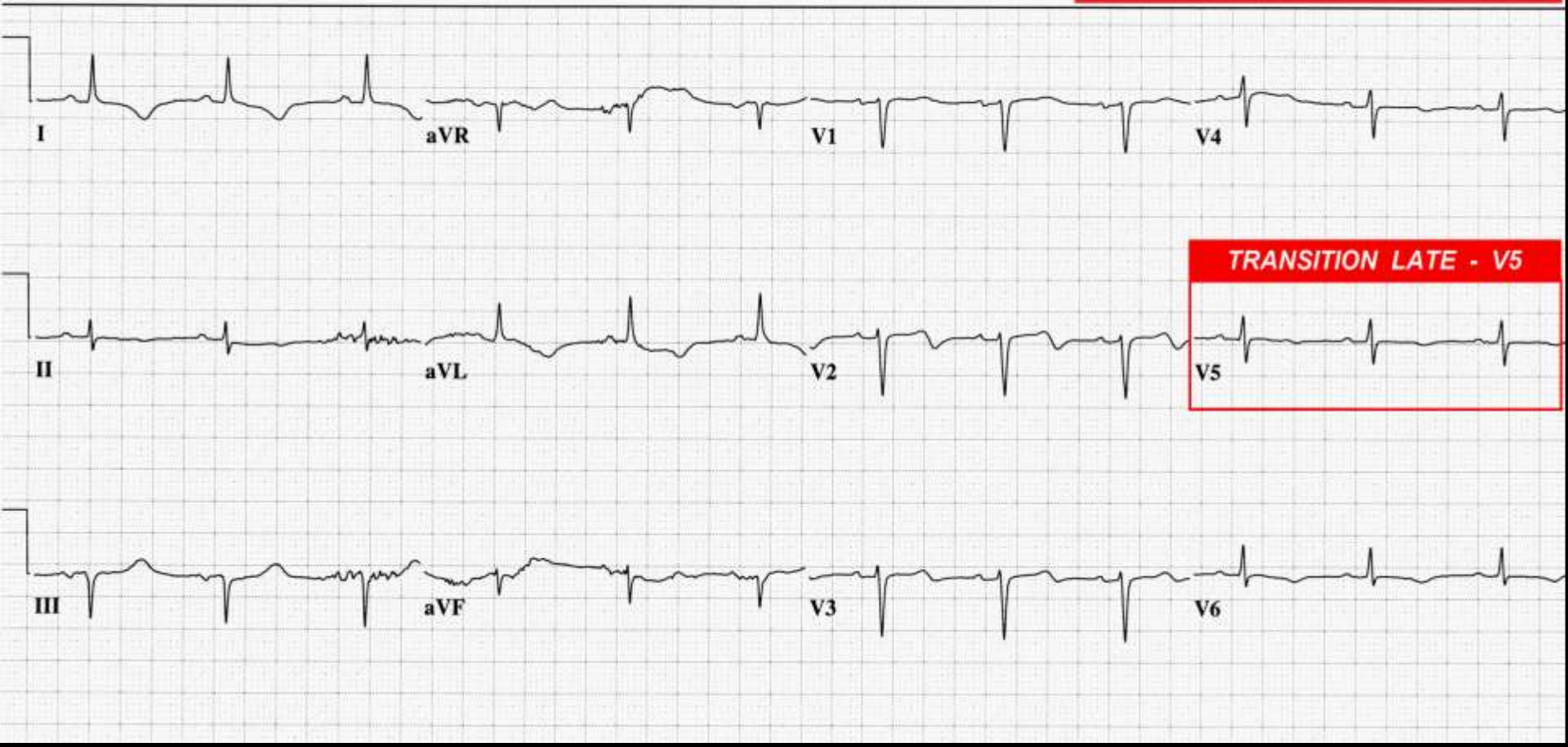
45 yr
Female Caucasian

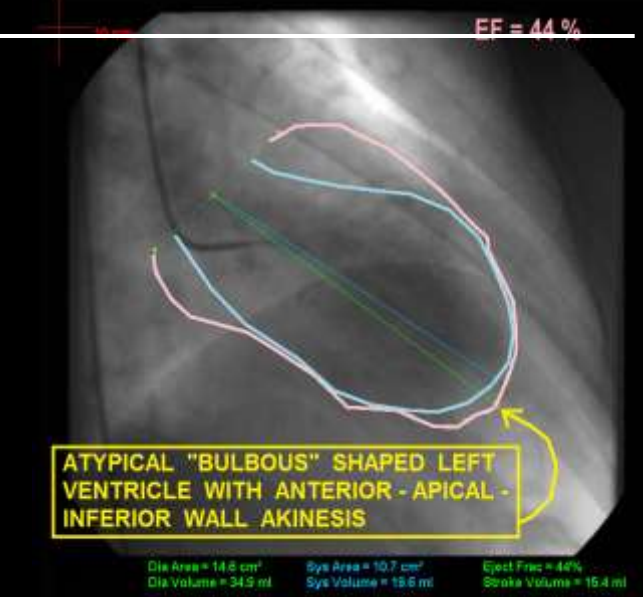
Loc:1 Option:1

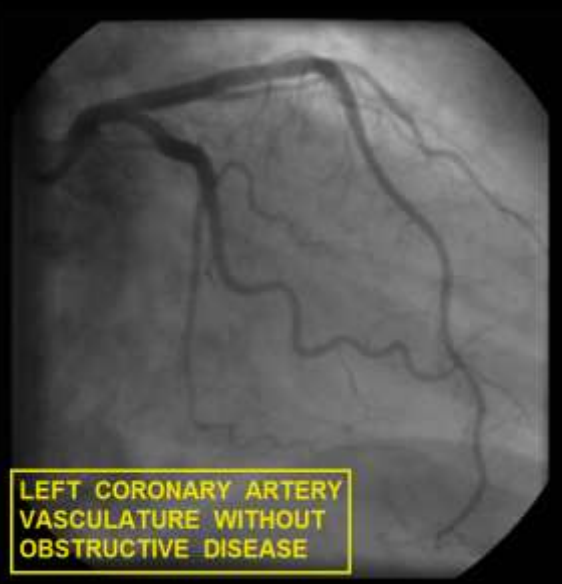
Vent. rate	72	BPM
PR interval	146	ms
QRS duration	80	ms
QT/QTc	480/525	ms
P–R–T axes	27 –28	153

Normal sinus rhythm
T wave abnormality, consider lateral ischemia
Prolonged QT
Abnormal ECG

ALSO NOTE:
- POOR R WAVE PROGRESSION V1 - V4
- LATE TRANSITION: V5
- BIPHASIC T WAVES: V2 - V5





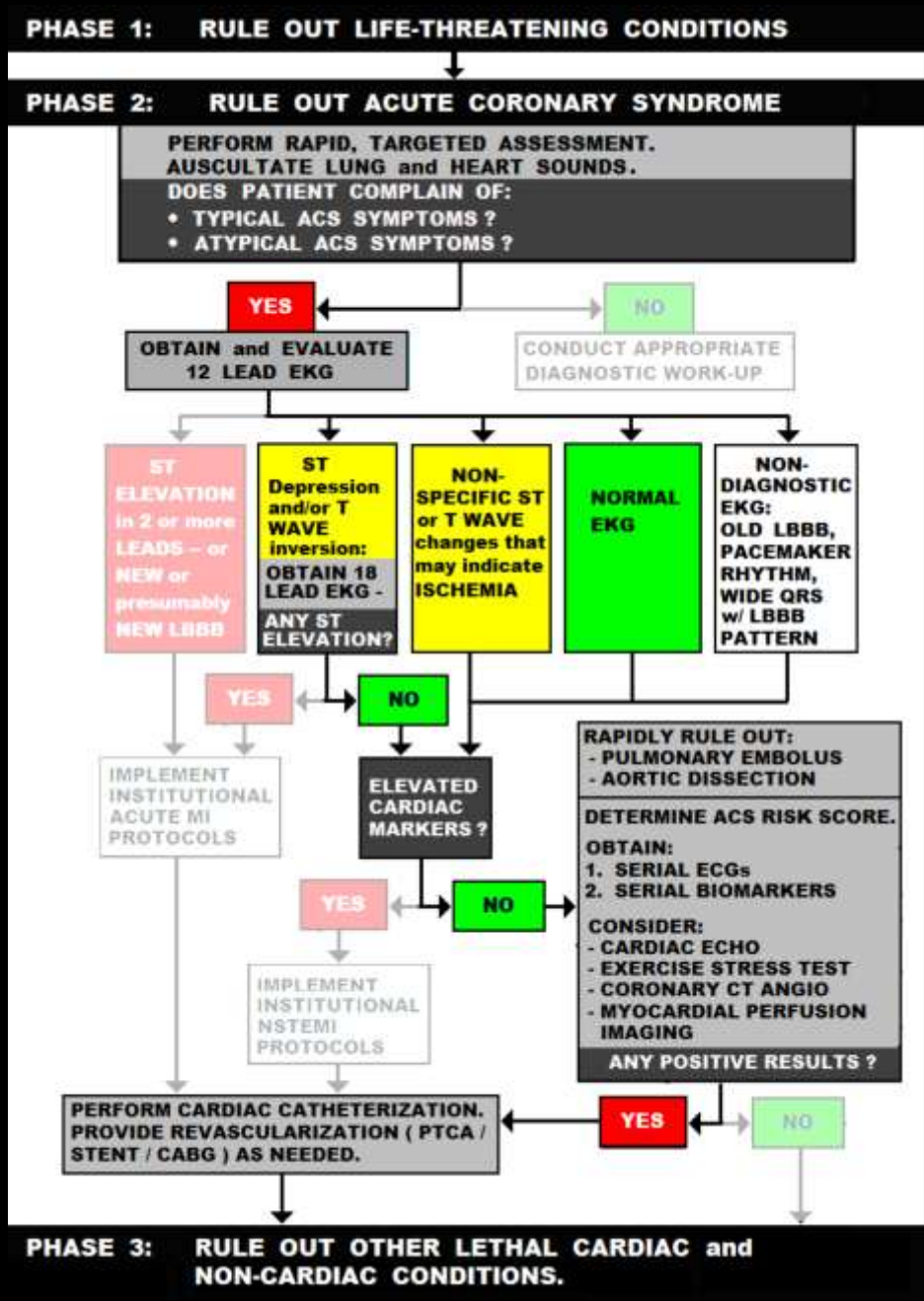


Apical ballooning syndrome, also known as “broken heart syndrome” and “acute stress induced cardiomyopathy,” may account for up to 2% of all incidents of acute myocardial infarction.[1] This condition is uncommon but often life-threatening. ABS can be provoked by extreme emotional distress and a-adrenergic substances (including ephedrine alkaloids).

[1] A. Prasad MD, Circulation 2007;115;e56-e59

UNSTABLE ANGINA CASE STUDIES

stable angina		unstable angina
1. SYMPTOMS START DURING PHYSICAL EXERTION.	VS.	1. SYMPTOMS MAY START AT ANY TIME, EVEN DURING REST
2. SYMPTOMS ARE "PREDICTABLE"		2. SYMPTOMS ARE *NEW*, *DIFFERENT*, or *WORSE* THAN PREVIOUS EPISODES



ACUTE CHEST PAIN PROTOCOL

DATE:

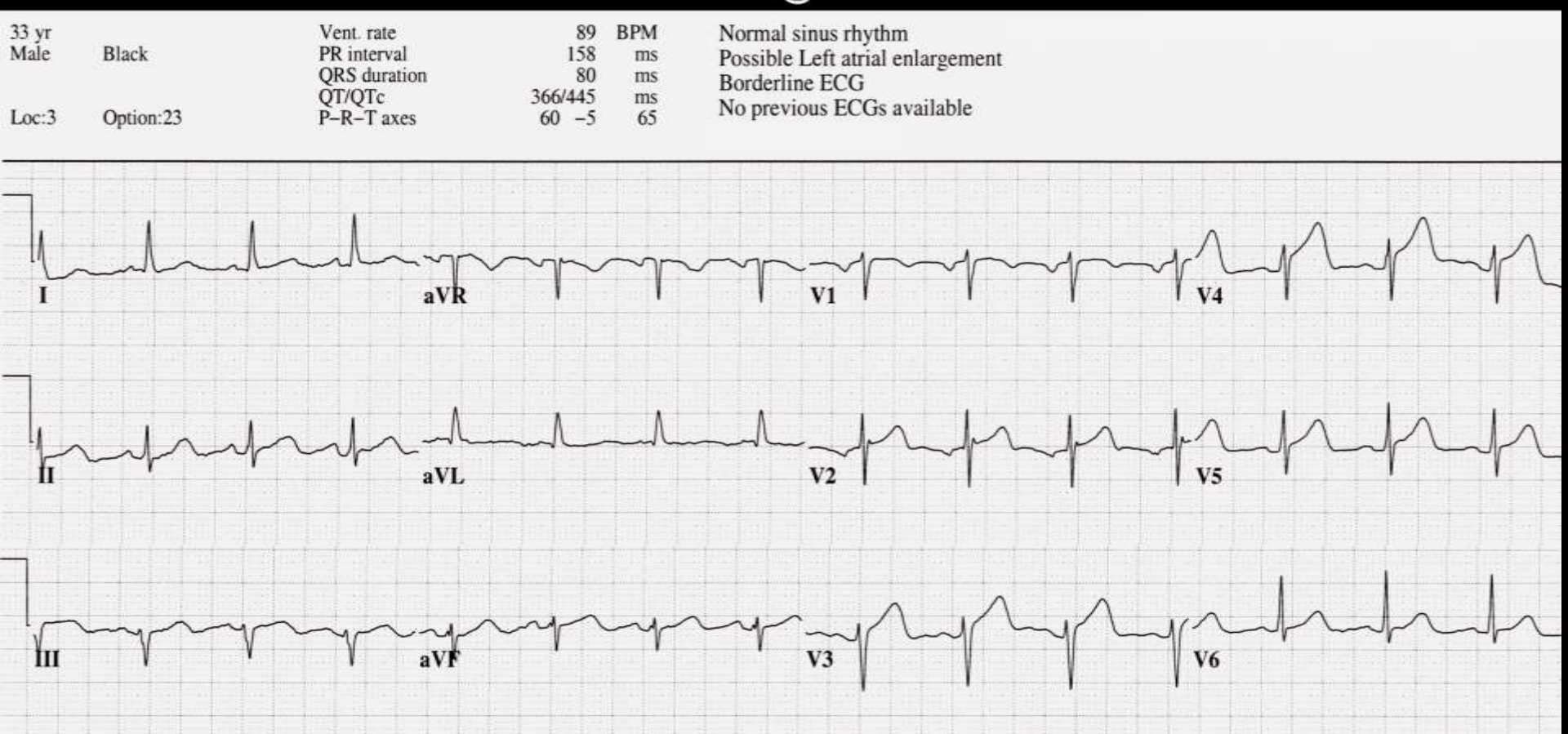
- ❑ Position Crash Cart close to patient.
- ❑ Implement Continuous Cardiac Montioring
- ❑ Obtain STAT 12 Lead ECG; Repeat every 30 minutes for persistent or worsening pain.
  - IF ST segment elevation is noted on ECG, immediately notify the House Nursing Supervisor of possible Code STEMI patient.
  - Notify *physician that STAT 12 Lead ECG is available online in PACS system for STAT interpretation -- if PACS is not available, FAX a copy of each ECG to physician
- ❑ Obtain STAT Vital signs, including patient's level of pain. Repeat every 15 minutes X 4
- ❑ If SAO2 <94%, administer Oxygen, 2 - 4 Litres/minute via nasal canula, titrate to keep SAO2 >94%
- ❑ Follow ACLS Protocols
- ❑ Initiate IV NS @KVO rate, preferably with 20g catheter or larger.
- ❑ Administer Aspirin - chew four 81mg baby aspirin (or one 325 mg adult tablet, if baby ASA not avail)
- ❑ Administer one NTG 0.4mg SL tablet or spray if Systolic BP is >90mmhg. Reassess pain in 5 minutes.
- ❑ If pain unrelieved after 5 minutes, may repeat Nitroglycerin dose, as above, X 2.
  - ☑ HOLD if sildenafil citrate (Viagra) or vardenafil (Levitra) has been taken within 24 hours
  - ☑ HOLD if tadalafil (Cialis) has been taken within 48 hours
  - ☑ HOLD and notify MD if SBP less than 90 mmHg
- ❑ Morphine Sulfate 2mg IV PRN for chest pain, may repeat every 5 minutes up to Max of 10 doses (20mg total) in 4 hours
- ❑ Obtain STAT Troponin. Repeat at 3 and 6 hours. Notify physician of results

- ❑ Notify physician of any abnormal ECG findings, ECG changes or abnormal Troponin values.

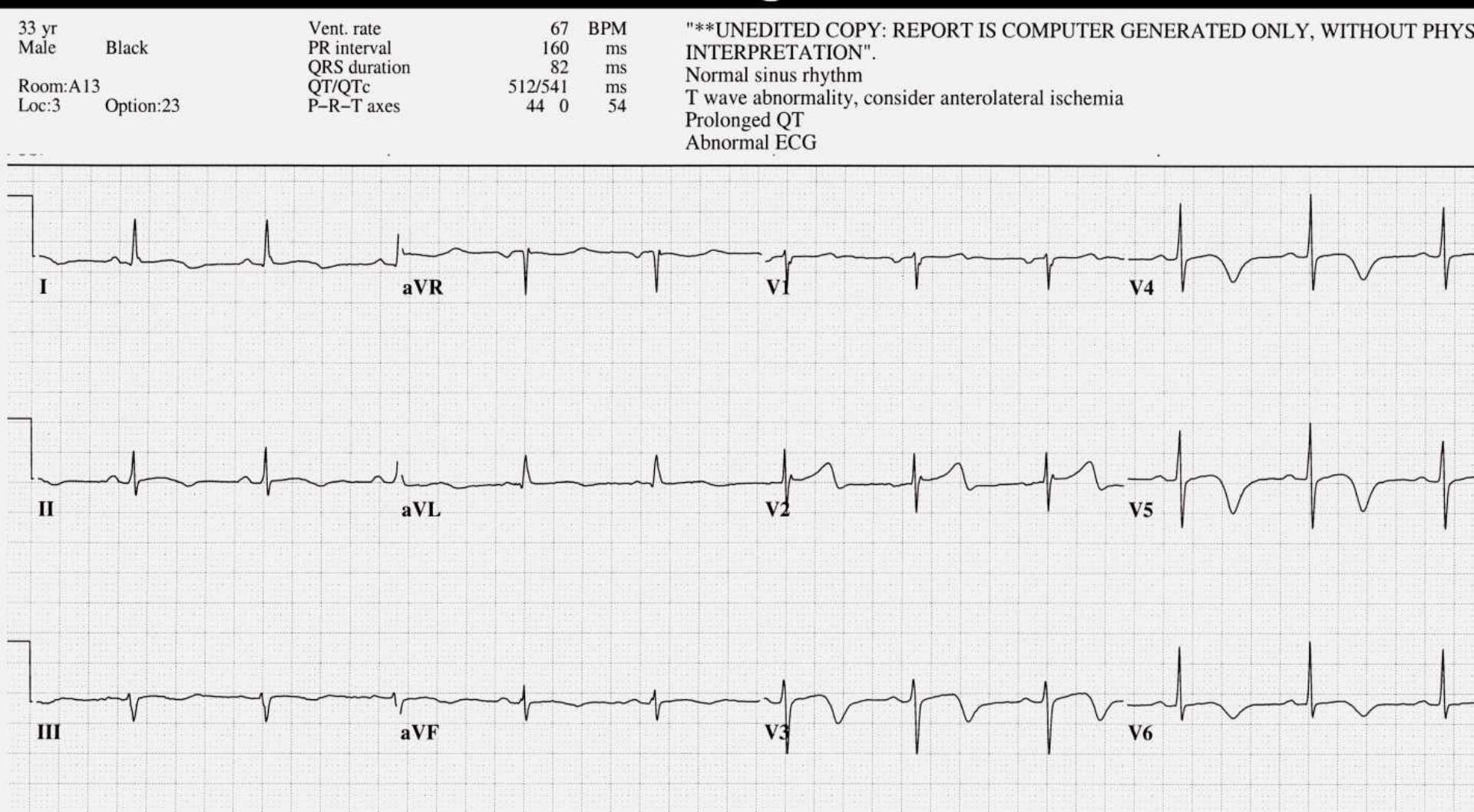
* If patient is currently under the services of Cardiology, the "physician" is the Cardiologist.
If patient is not being followed by Cardiology, then "physician" refers to Attending Physician.

CASE STUDY: SERIAL ECGs.

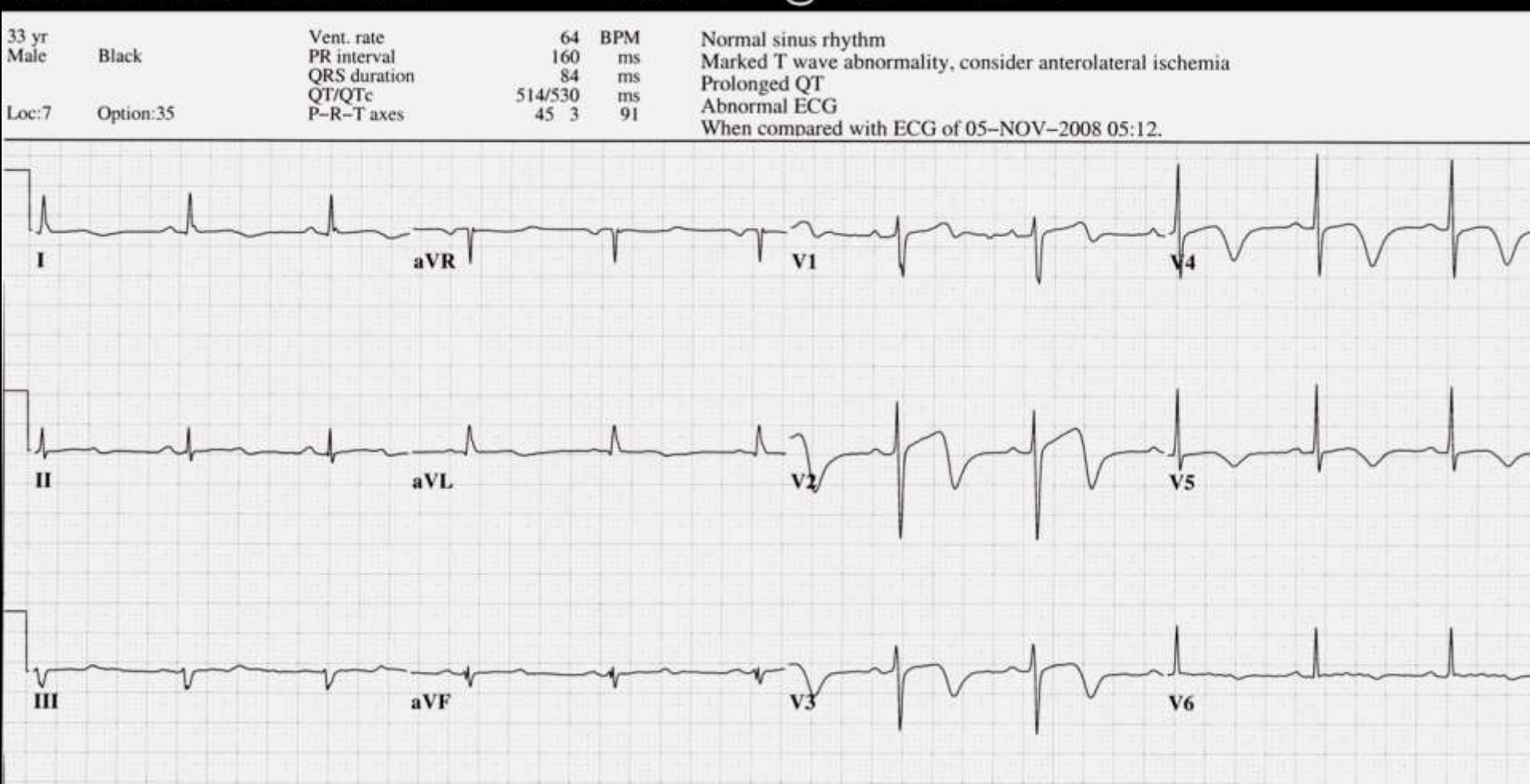
33 y/o MALE, C/O "COUGHING WITH CHEST PAIN." ST ELEVATION BELIEVED TO BE "EARLY REPOLARIZATION." A VETERAN ED PHYSICIAN DISCERNED THAT THE PATIENT'S CHEST PAIN STARTED BEFORE THE COUGHING, AND ORDERED SERIAL ECGs.



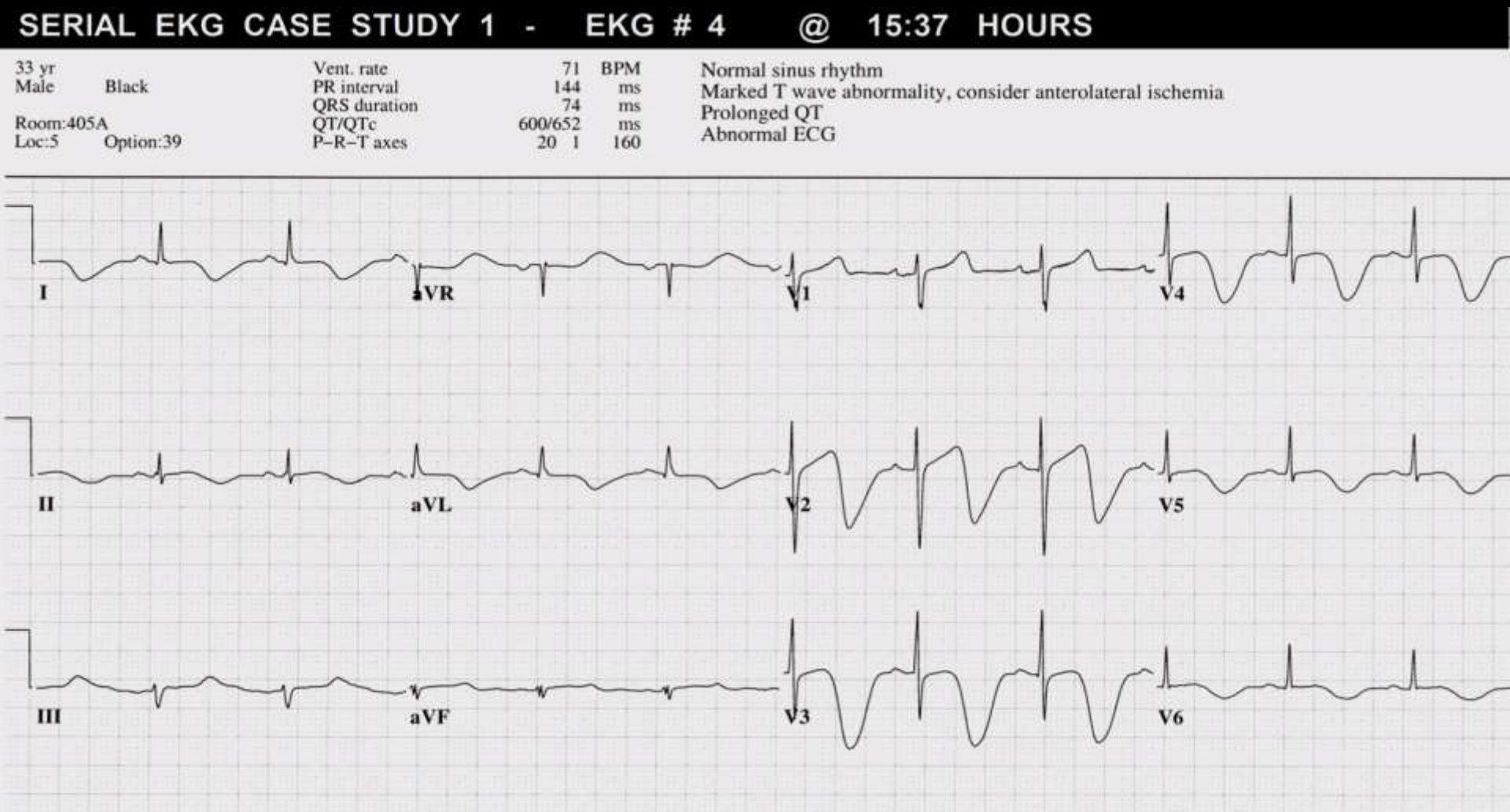
APPROX. 3 hrs LATER: BI-PHASIC T WAVES V2, V3; INVERTED Ts V4 – V6



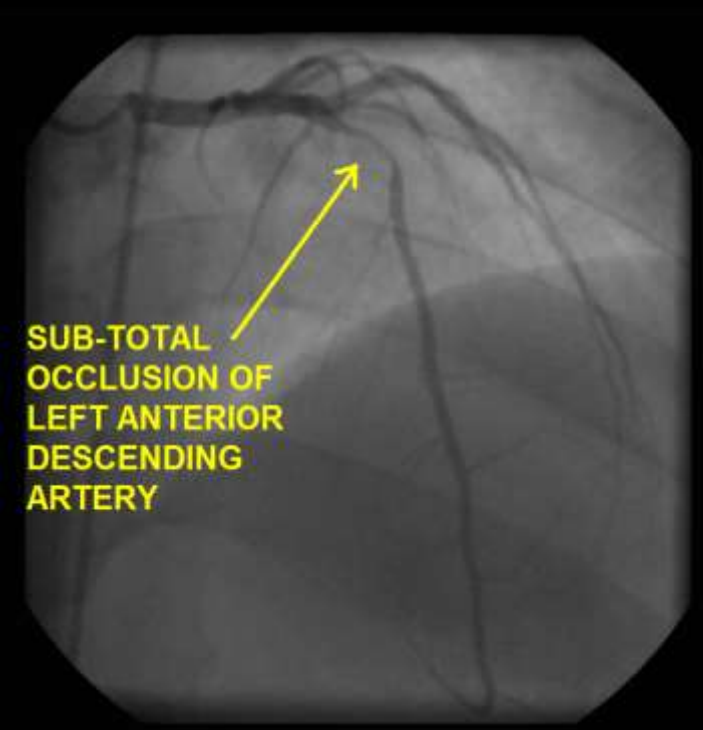
APPROX 6 hrs AFTER 1ST ECG: BIPHASIC Ts V1, V2; INVERTED T WAVES V3 - V6

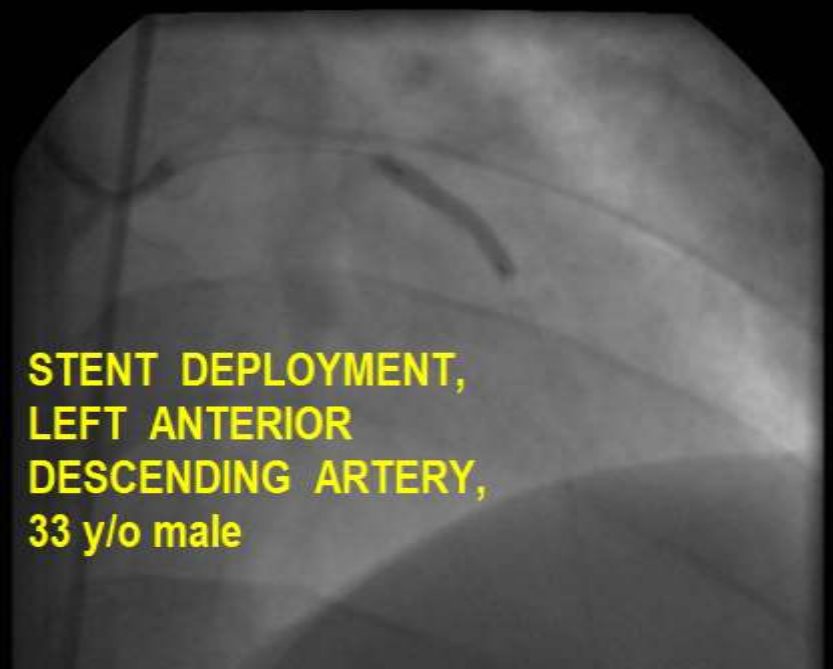


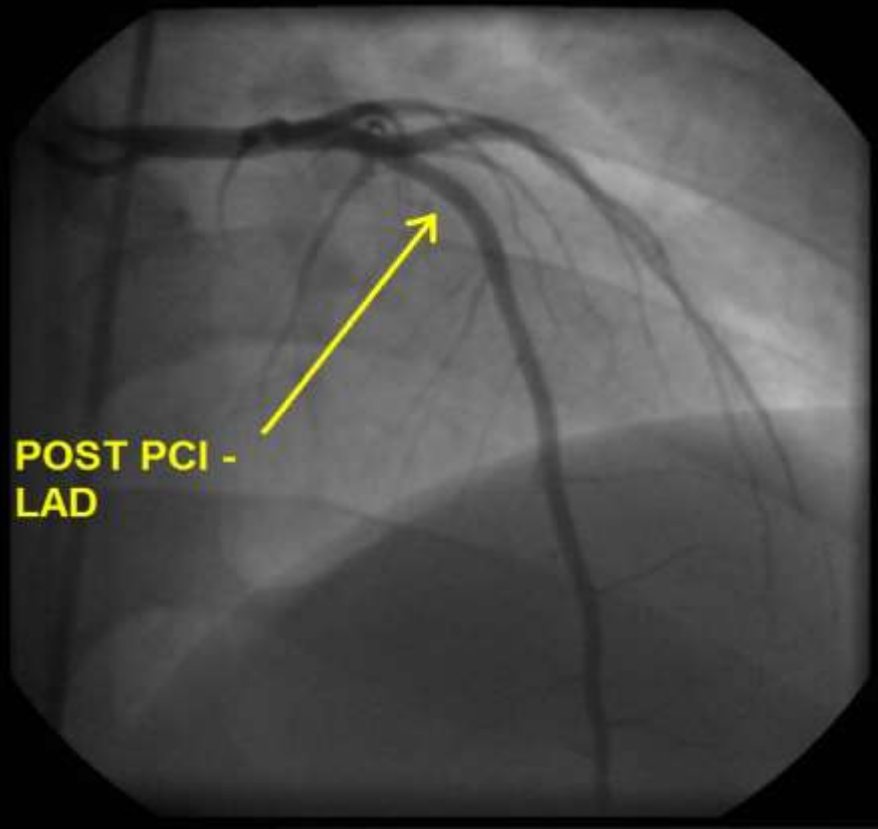
APPROX 9 hrs AFTER 1ST ECG: BIPHASIC Ts V1, V2; INVERTED T WAVES V3 - V6



PATIENT TAKEN TO THE CARDIAC CATH LAB, WHERE A SUB-TOTALLY OCCLUDED PROXIMAL L.A.D. WAS DISCOVERED (left). BOTTOM LEFT: PTCA/STENT TO L.A.D. BOTTOM RIGHT: POST STENT TO L.A.D.

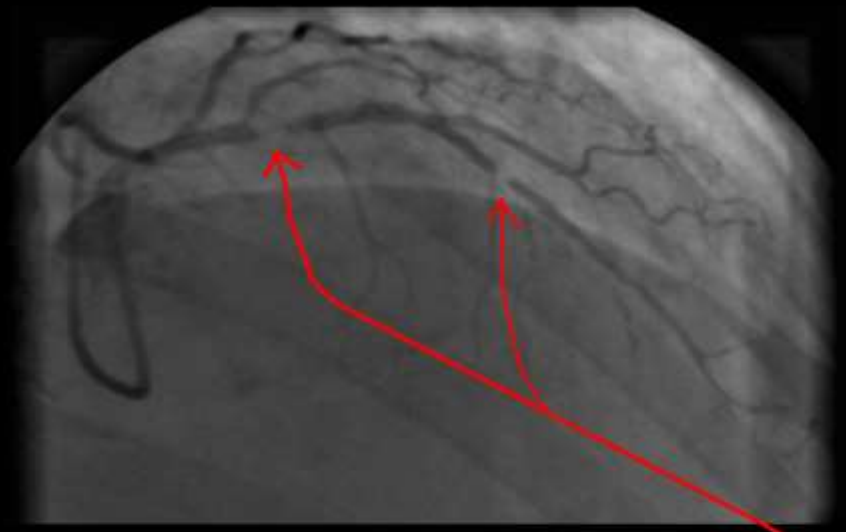






BI-PHASIC T WAVES

58 y/o MALE WITH SUB-TOTAL OCCLUSIONS OF THE LEFT ANTERIOR DESCENDING ARTERY



58 y/o MALE WITH "WELLEN'S WARNING." PT HAS SUB-TOTALLY OCCLUDED LAD X 2

Classic "Wellen's Syndrome:"

- Characteristic T wave changes
  - Biphasic T waves
  - Inverted T waves
- History of anginal chest pain
- Normal or minimally elevated cardiac markers
- ECG without Q waves, without significant ST-segment elevation, and with normal precordial R-wave progression

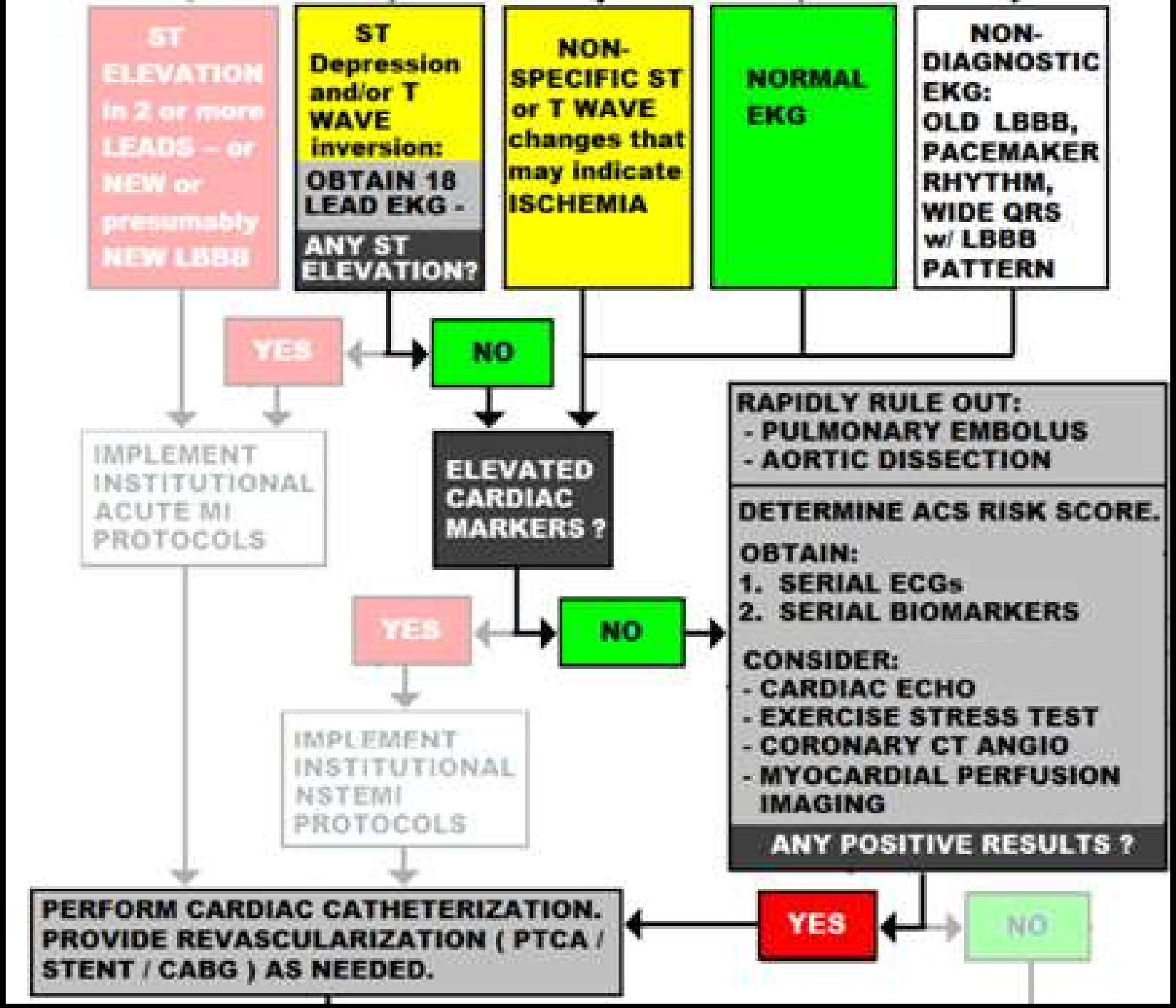
Wellen's Syndrome ETIOLOGY:

- Critical Lesion, Proximal LAD
- Coronary Artery Vasospasm
- Cocaine use (vasospasm)
- Increased myocardial oxygen demand
- Generalized Hypoxia / anemia / low H&H

Wellen's Syndrome EPIDEMIOLOGY & PROGNOSIS:

- **Present in 14-18% of patients admitted with unstable angina**
- **75% patients not treated developed extensive Anterior MI within 3 weeks.**
- ***Median Average time from presentation to Acute Myocardial Infarction – 8 days***

Sources: **H Wellens et. Al, Am Heart J 1982; v103(4) 730-736**


ST ELEVATION in 2 or more LEADS – or NEW or presumably NEW LBBB
ST Depression and/or T WAVE inversion:
OBTAIN 18 LEAD EKG -
ANY ST ELEVATION?
NON-SPECIFIC ST or T WAVE changes that may indicate ISCHEMIA
NORMAL EKG
NON-DIAGNOSTIC EKG: OLD LBBB, PACEMAKER RHYTHM, WIDE QRS w/ LBBB PATTERN
YES
NO
IMPLEMENT INSTITUTIONAL ACUTE MI PROTOCOLS
ELEVATED CARDIAC MARKERS ?
RAPIDLY RULE OUT:
- PULMONARY EMBOLUS
- AORTIC DISSECTION
DETERMINE ACS RISK SCORE.
OBTAIN:
1. SERIAL ECGs
2. SERIAL BIOMARKERS
CONSIDER:
- CARDIAC ECHO
- EXERCISE STRESS TEST
- CORONARY CT ANGIO
- MYOCARDIAL PERFUSION IMAGING
ANY POSITIVE RESULTS ?
YES
NO
IMPLEMENT INSTITUTIONAL NSTEMI PROTOCOLS
PERFORM CARDIAC CATHETERIZATION. PROVIDE REVASCULARIZATION (PTCA / STENT / CABG) AS NEEDED.

CASE STUDY: RELEVANCE OF STRESS TESTING

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

71 y/o male presents to the cardiologist's office, c/o EXERTIONAL SUBSTERNAL CHEST PRESSURE and DIZZINESS. PMHx of Hypertension, AV Nodal Reentrant Tachycardia and vertigo.

RISK FACTOR PROFILE:

- FAMILY HISTORY - both parents.
- ☑ PREVIOUS CIGARETTE SMOKER
- ☑ CHOLESTEROL - unknown.
- ☑ AGE - OVER 65
- ☑ HYPERTENSION

PHYSICAL EXAM: Patient alert, oriented x 3, skin warm, dry, color normal, carotids 2+ bilaterally, no bruits, Lungs clear, HS S1, S2 normal, no murmurs/gallops/rubs. Extremities: good distal pulses, no edema.

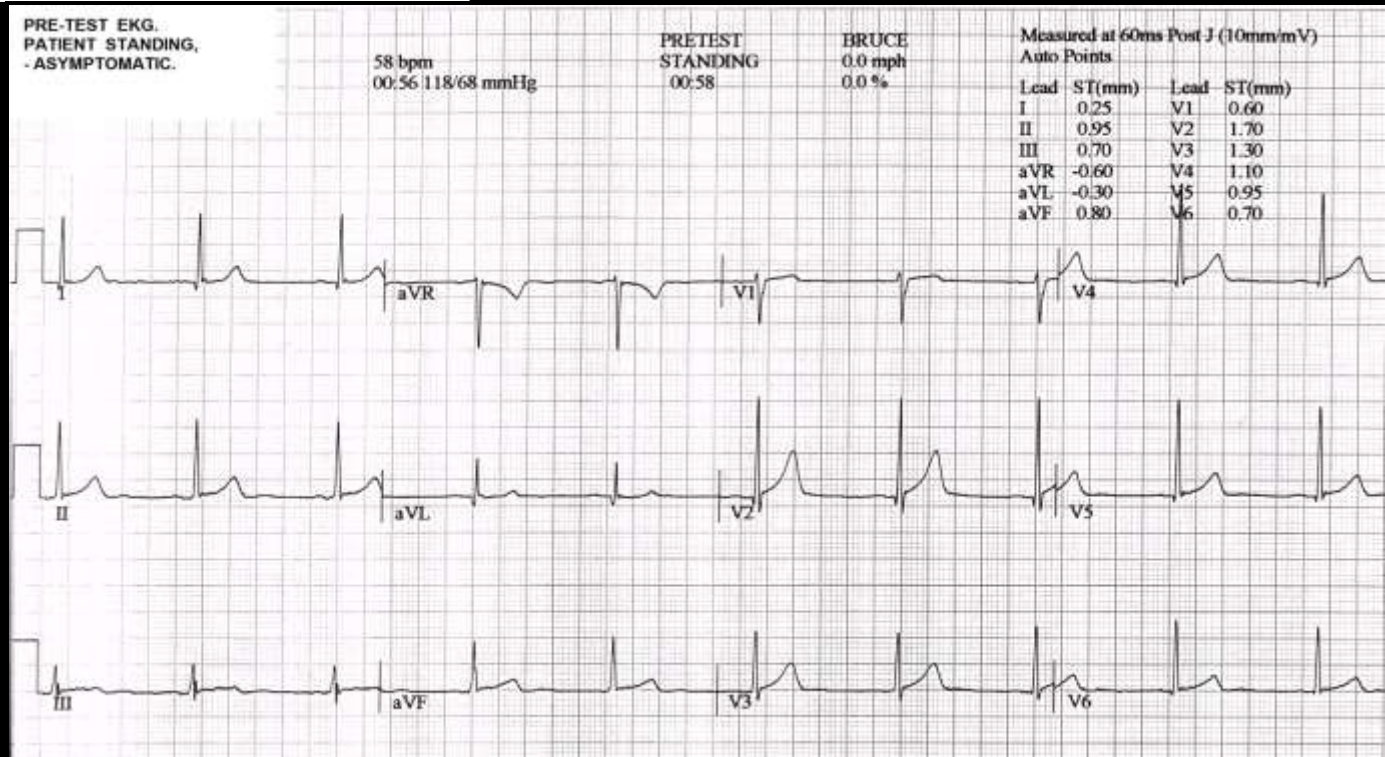
VITAL SIGNS: BP: 118/60, P: 74, R: 16, SAO2: 98%

LABS: CARDIAC MARKERS NEGATIVE. BMP, CBC: WNL.

DIANOSTIC EVALUATIONS:

- 2-D/M-MODE DOPPLER ECHOCARDIOGRAM: NORMAL
  (LV size, Normal LV function, trace of mitral and tricuspid regurgitation).
- MYOCARDIAL PERFUSION STUDY: NORMAL.
  (LVEF = 60%, STRESS and REST TOMOGRAPHIC PERFUSION IMAGES = NORMAL).

VALUE OF STRESS TESTING . .



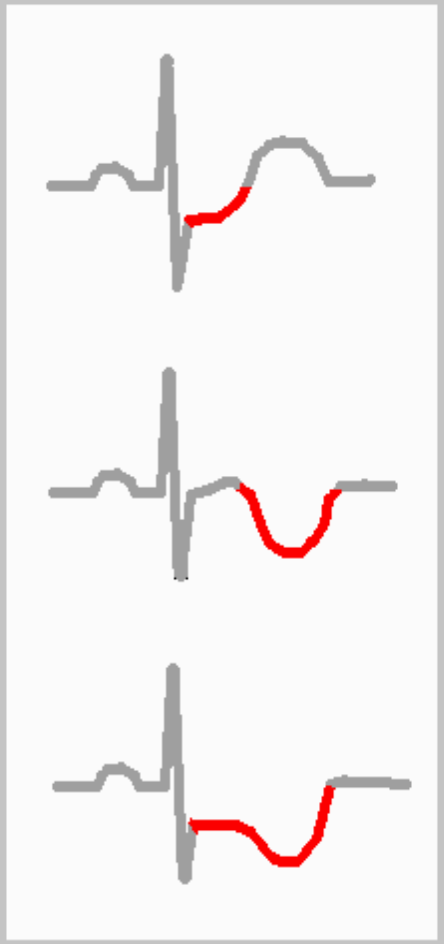
ISCHEMIA

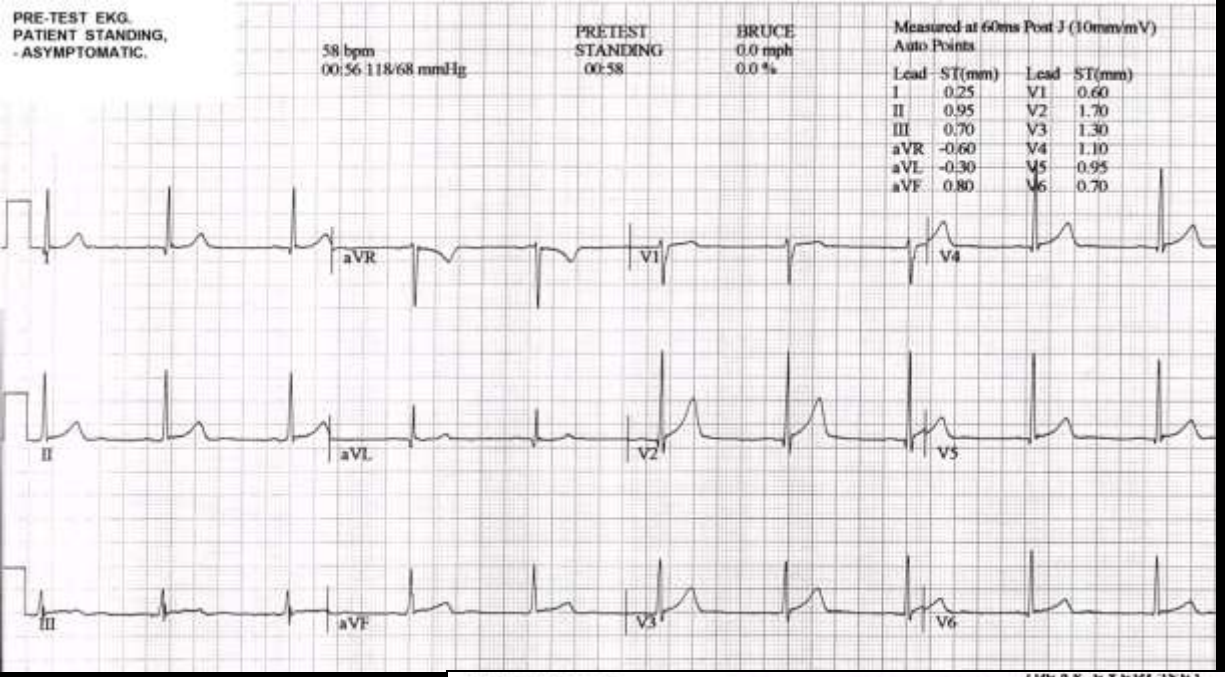
HELPFUL PATTERNS . . .

J POINT DEPRESSION
(> 1 mm)

INVERTED T WAVES

J POINT DEPRESSION
+ INVERTED T WAVES

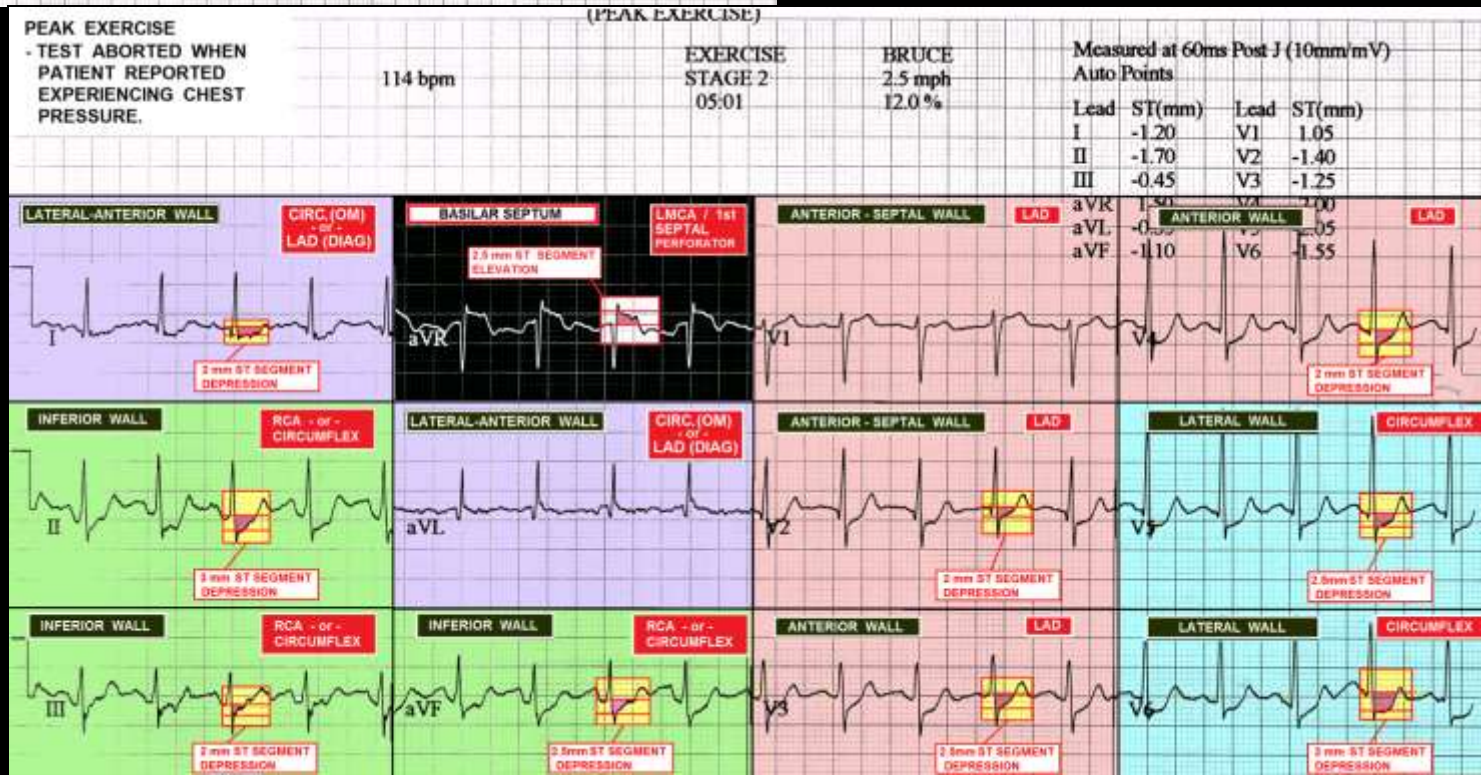


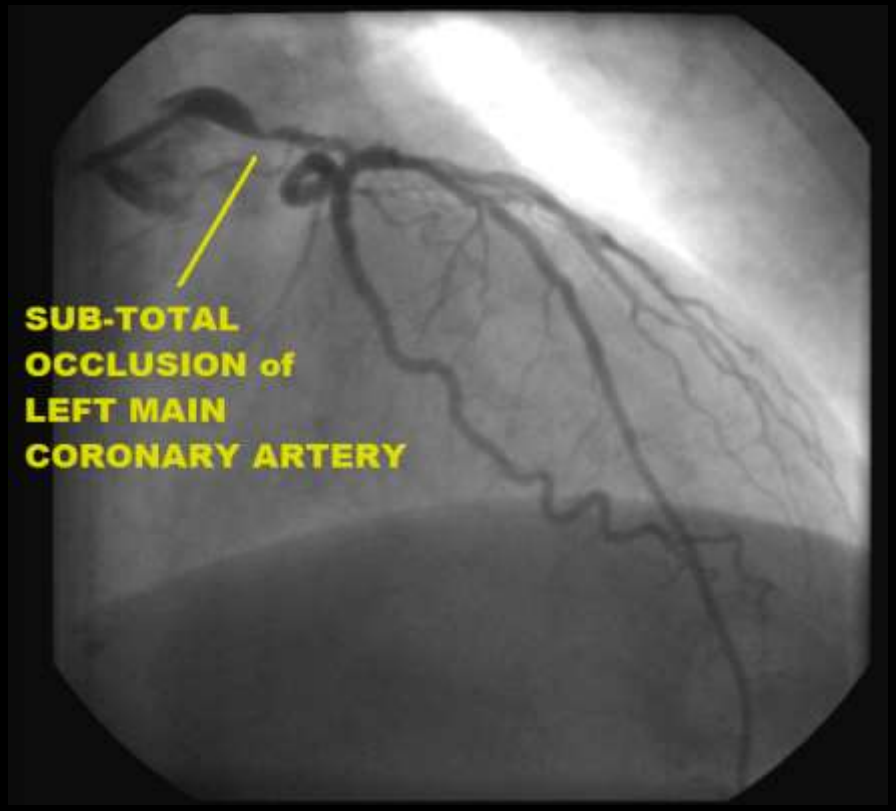


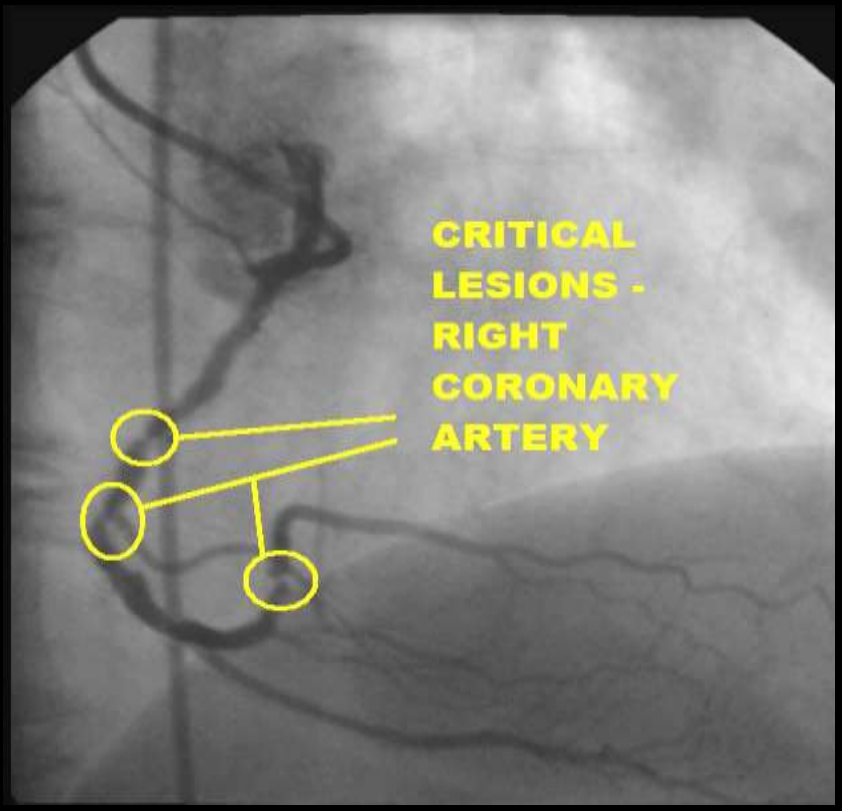
NON SPECIFIC ST-T WAVE ABNORMALITY:
- III

ST ELEVATION:
- -AVR

ST DEPRESSION:
- -I
- -II
- -III
- -AVF
- -V2
- -V3
- -V4
- -V5
- -V6




SUB-TOTAL
OCCLUSION of
LEFT MAIN
CORONARY ARTERY


CRITICAL
LESIONS -
RIGHT
CORONARY
ARTERY

CASE STUDY 15 - UNSTABLE ANGINA

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

42 y/o FEMALE c/o INTERMITTENT CHEST PRESSURE which has been WORSENING during the past week. Also c/o mild DIB. Symptoms previously provoked by exertion, now comes on at rest.

RISK FACTOR PROFILE:

- HYPERTENSION
- CIGARETTE SMOKER x 15 YEARS
- FAMILY HISTORY - FATHER Dx WITH CAD, HAD CABG AT 52

PHYSICAL EXAM: Pt. ASYMPTOMATIC at time of exam. SKIN WARM, DRY, COLOR NORMAL, PERLA, LUNGS= CLEAR, HS NORMAL S1, S2, NO ANKLE EDEMA.

VITAL SIGNS: BP: 148/92 P: 64 R: 20 SAO2: 97 % on 2 LPM O2

LABS: TROPONIN: < .04

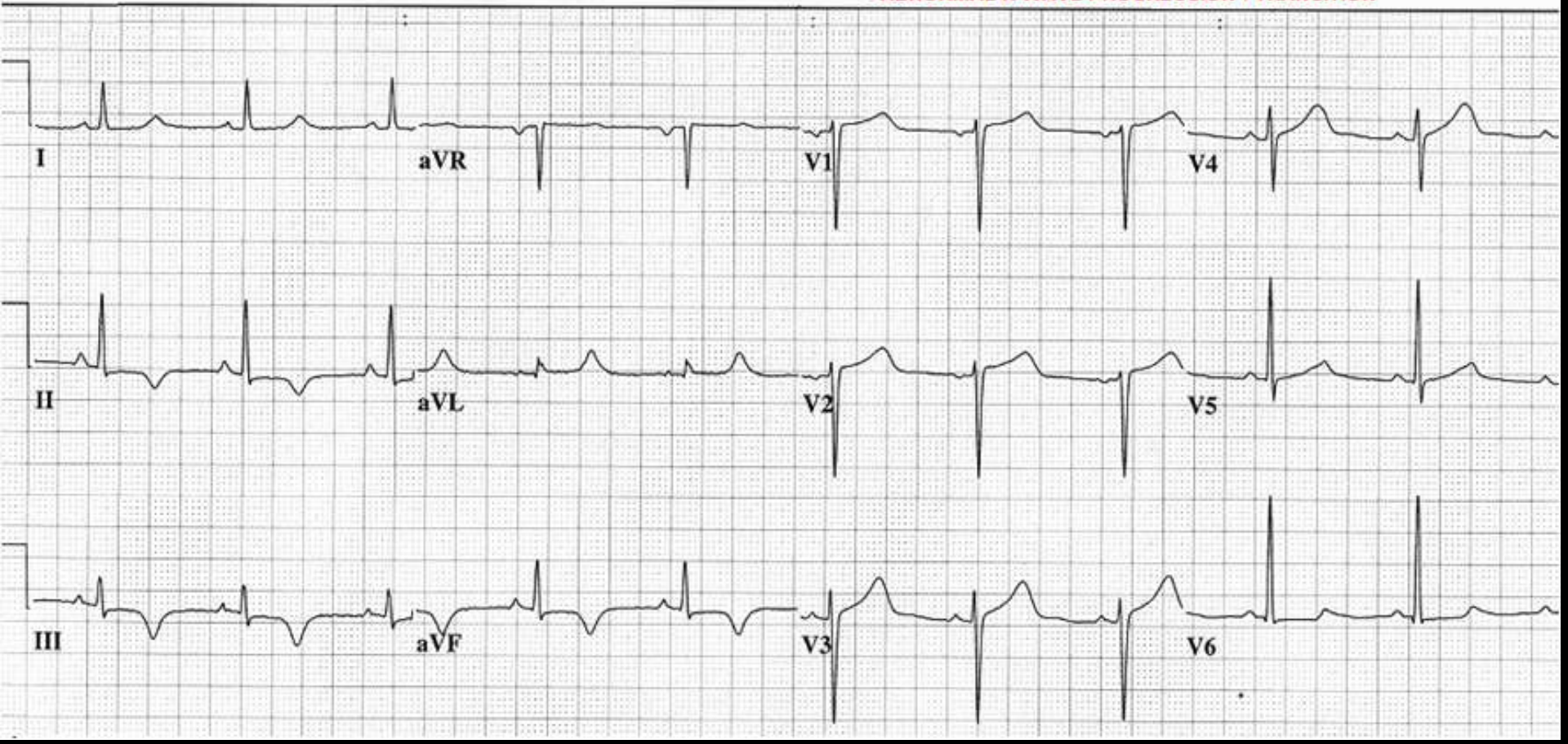
42 yr
Female Caucasian

Room:S5
Loc:3 Option:23

Vent. rate	63	BPM
PR interval	142	ms
QRS duration	74	ms
QT/QTc	462/472	ms
P–R–T axes	65 42	–72

☞ EVALUATE THE EKG FOR:

- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- FLAT / CONVEX J-T APEX SEGMENTS
- OTHER ST-T WAVE ABNORMALITIES
- ABNORMAL R WAVE PROGRESSION / TRANSITION



42 yr
Female Caucasian

Room:S5
Loc:3 Option:23

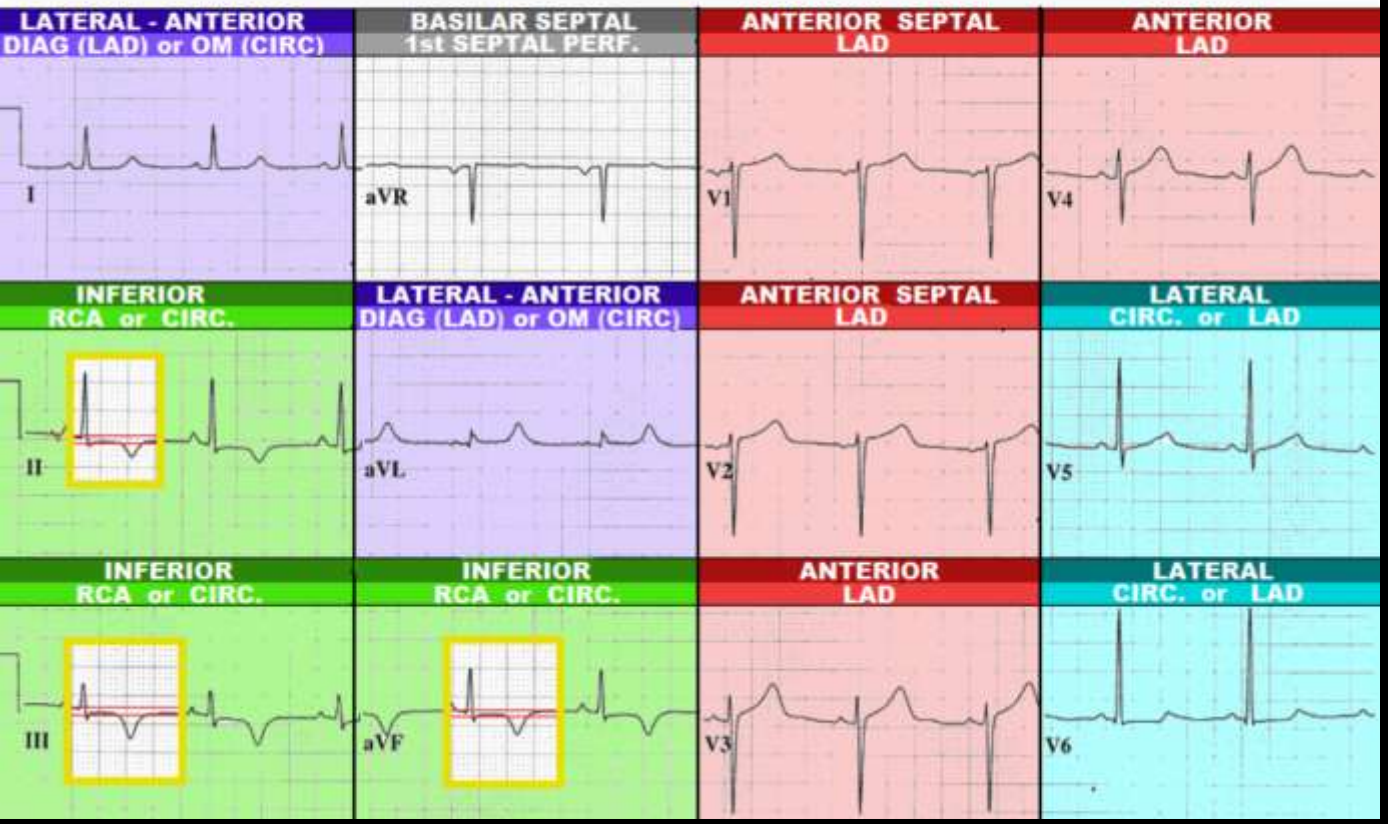
Vent. rate	63	BPM
PR interval	142	ms
QRS duration	74	ms
QT/QTc	462/472	ms
P–R–T axes	65 42	–72

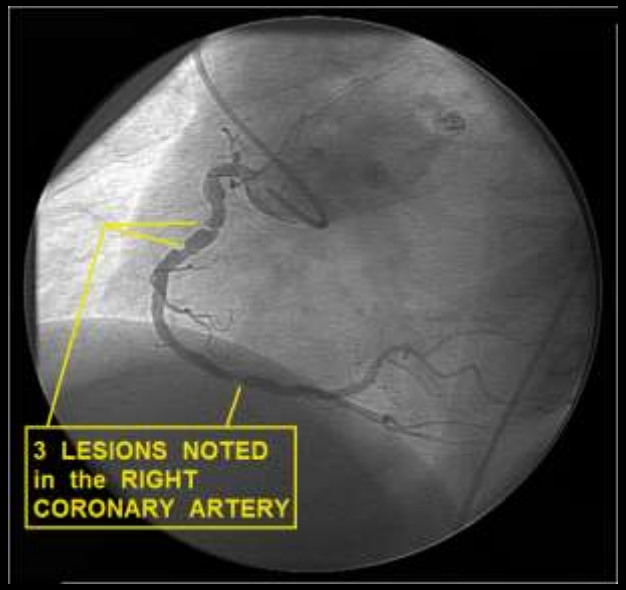
Normal sinus rhythm

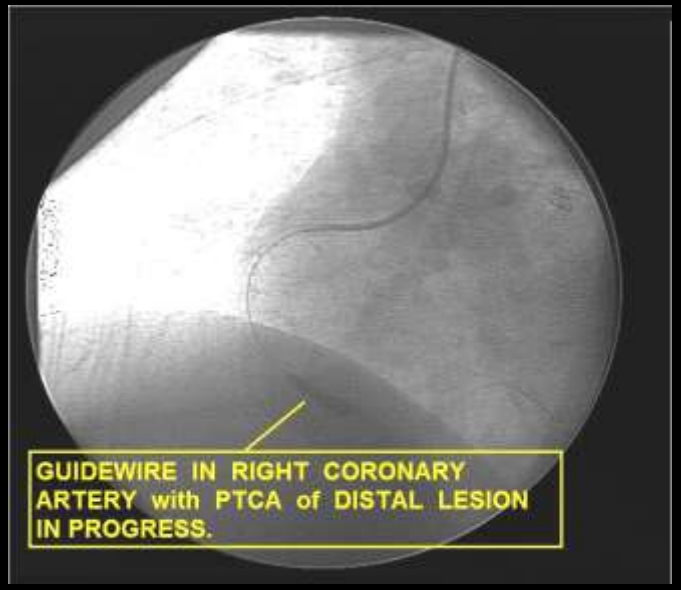
ST & T wave abnormality, consider inferior ischemia

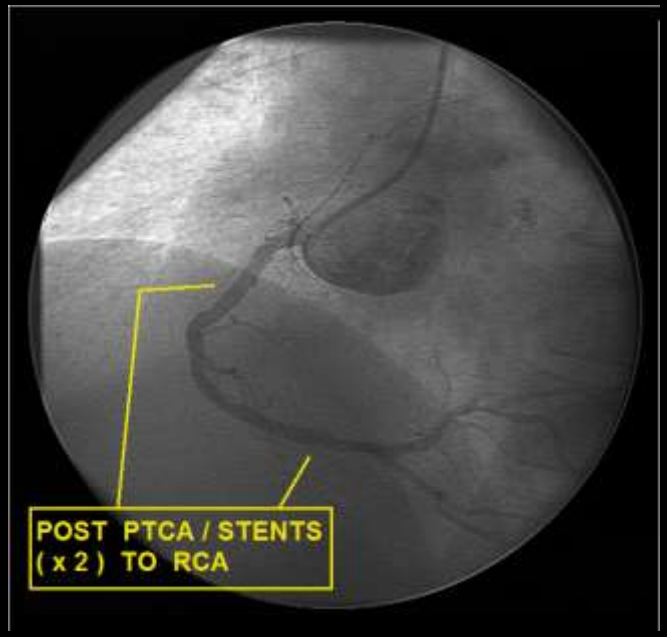
Abnormal ECG

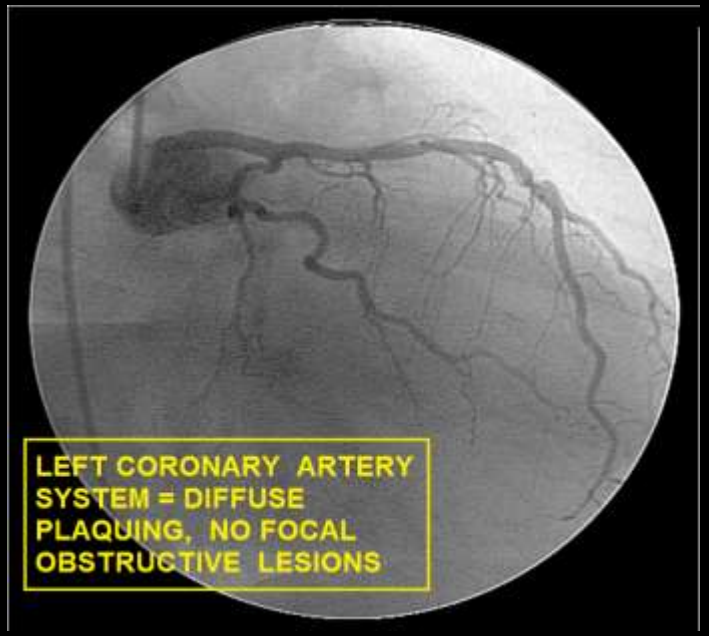
ST SEGMENT DEPRESSION




3 LESIONS NOTED
in the RIGHT
CORONARY ARTERY


GUIDEWIRE IN RIGHT CORONARY
ARTERY with PTCA of DISTAL LESION
IN PROGRESS.


POST PTCA / STENTS
(x 2) TO RCA


LEFT CORONARY ARTERY
SYSTEM = DIFFUSE
PLAQUING, NO FOCAL
OBSTRUCTIVE LESIONS

CASE STUDY 16 - UNSTABLE ANGINA

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

38 y/o MALE presents with sensation of exertional CHEST and NECK PAIN, described as "burning." Patient states symptoms also occur when he is under emotional duress. Symptoms have been occurring intermittently for approx. 2-3 weeks.

RISK FACTOR PROFILE:

- HYPERTENSION
- DIABETES x 5 YEARS

PHYSICAL EXAM: Pt. ASYMPTOMATIC at time of exam. SKIN WARM, DRY, COLOR NORMAL, PERLA, LUNGS= CLEAR, HS NORMAL S1, S2, NO ANKLE EDEMA.

VITAL SIGNS: BP: 144/92 P: 78 R: 16 SAO2: 100% on room air

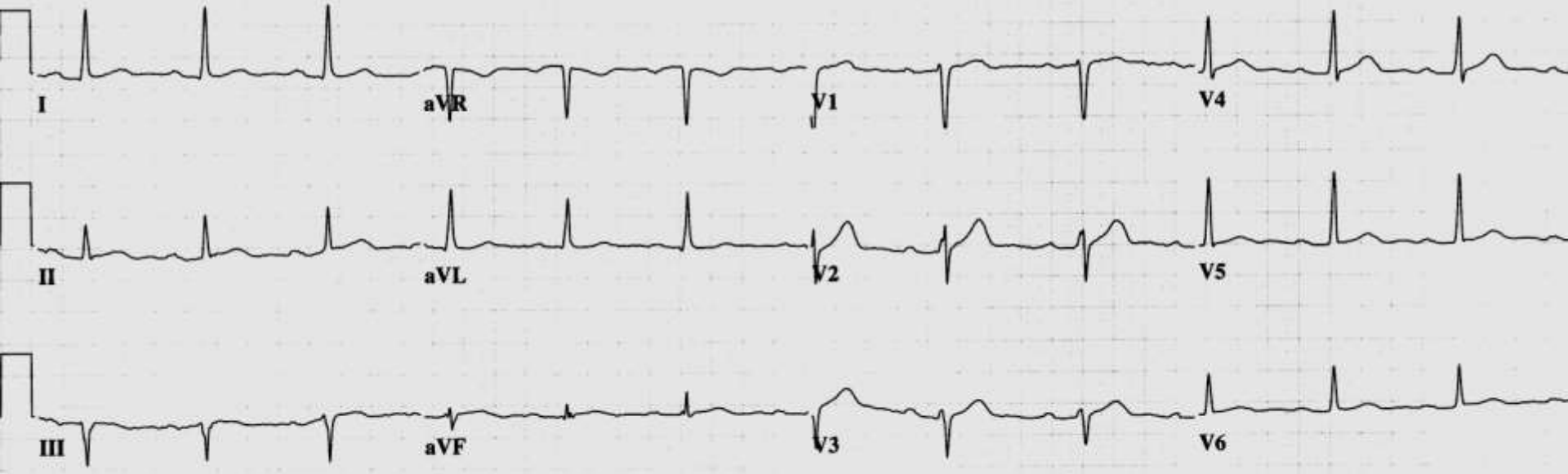
LABS: TROPONIN: < .04

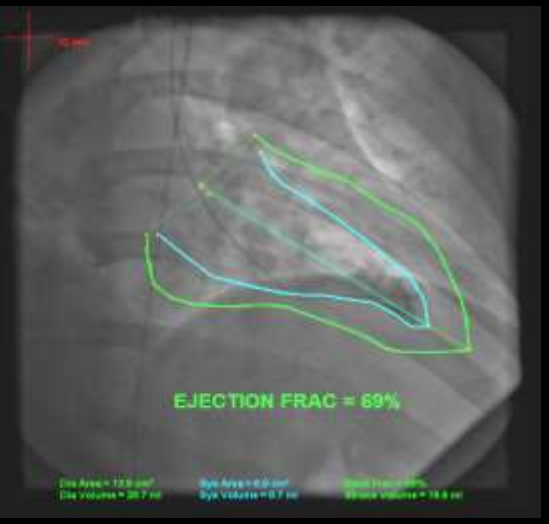
38 yr
Male Hispanic

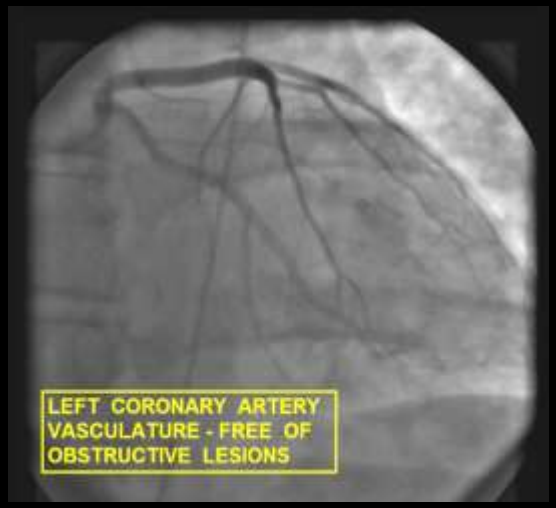
Vent. rate	74	BPM
PR interval	212	ms
QRS duration	86	ms
QT/QTc	364/404	ms
P-R-T axes	28 2	27

EVALUATE EKG FOR:

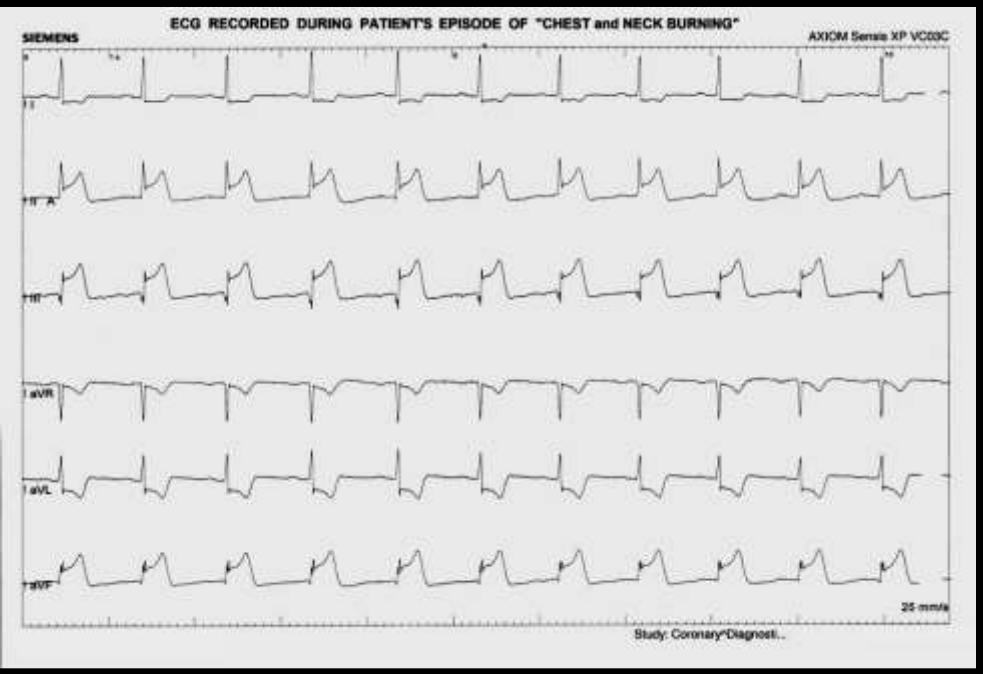
- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- FLAT / CONVEX J-T APEX SEGMENTS
- OTHER ST - T WAVE ABNORMALITIES
- *ABNORMAL R WAVE PROGRESSION / TRANSITION*

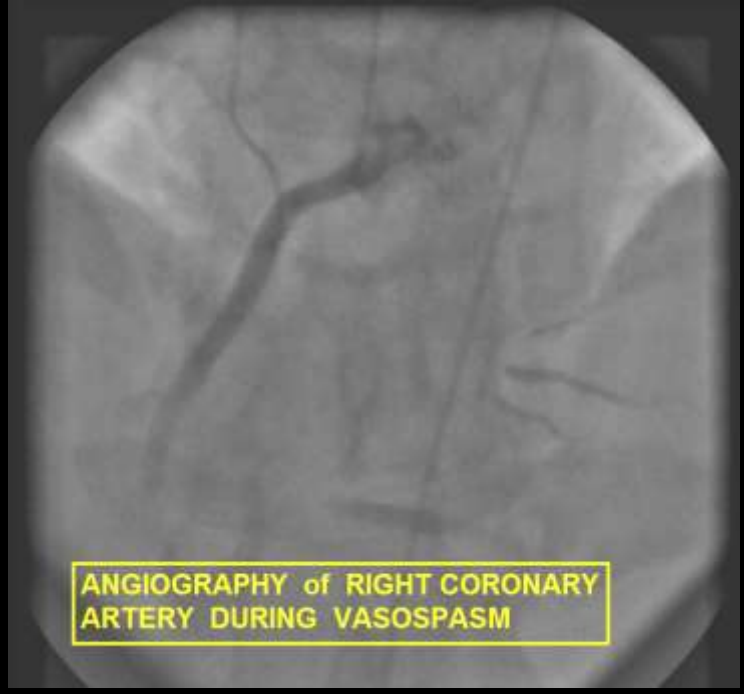


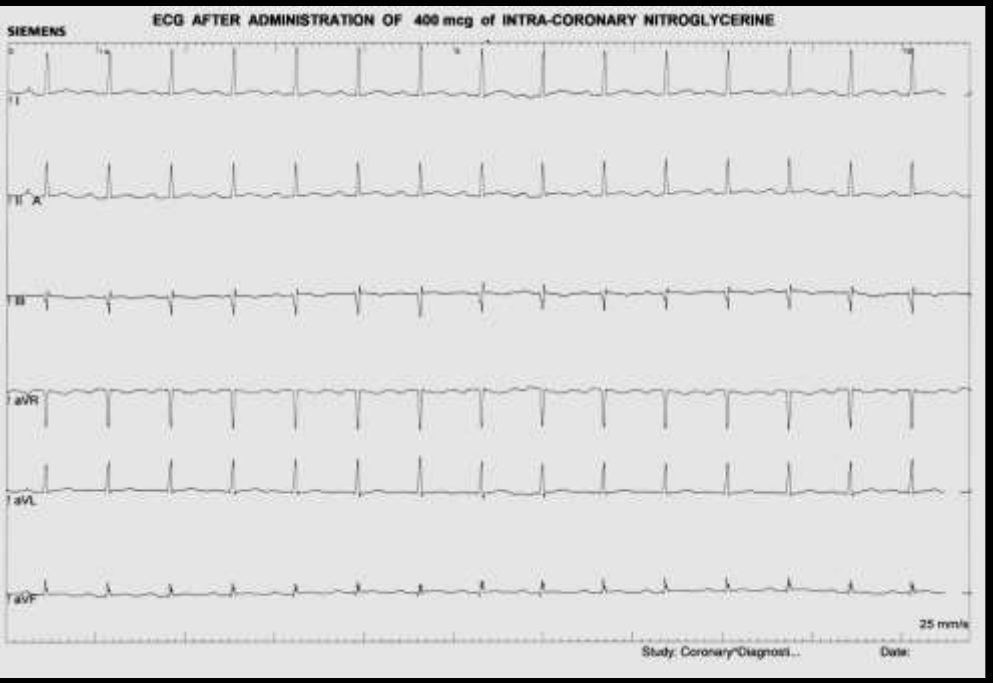

EJECTION FRAC = 69%

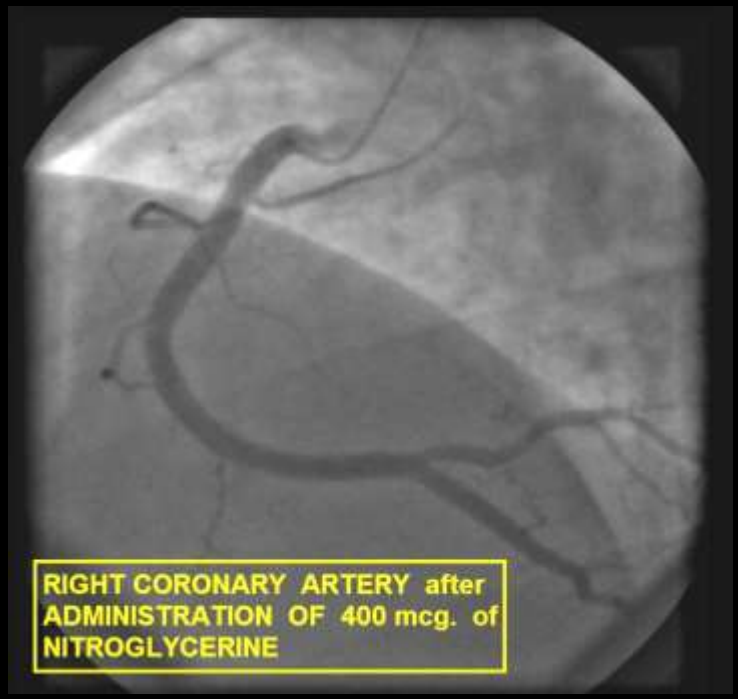

LEFT CORONARY ARTERY
VASCULATURE - FREE OF
OBSTRUCTIVE LESIONS


RIGHT CORONARY ARTERY
VASCULATURE - NO
OBSTRUCTIVE LESIONS


ECG RECORDED DURING PATIENT'S EPISODE OF "CHEST and NECK BURNING"
SIEMENS
AXIOM Sensis XP VC03C
I
II A
III
aVR
aVL
aVF
25 mm/s
Study: Coronary^Diagnosti...


ANGIOGRAPHY of RIGHT CORONARY ARTERY DURING VASOSPASM


ECG AFTER ADMINISTRATION OF 400 mcg of INTRA-CORONARY NITROGLYCERINE
SIEMENS
I
II A
III
aVR
aVL
aVF
25 mm/s
Study: Coronary^Diagnosti...
Date:


RIGHT CORONARY ARTERY after ADMINISTRATION OF 400 mcg. of NITROGLYCERINE

Prinzmetal or variant angina is caused by focal coronary artery vasospasm, and was first described by Myron Prinzmetal in 1959 as a syndrome of episodic chest pain that comes on at rest with ST segment elevation.[1] Prinzmetal angina is classified as unstable angina due to its unpredictability[2], and has been associated with myocardial infarction, ventricular dysrhythmias and cardiac arrest. The primary mechanism of vasospasm is hypercontraction of vascular smooth muscle cells. Variant angina is not an indicator of CAD; many patients are free of atherosclerotic plaque. Some factors known to provoke coronary artery vasospasm include: vasoconstrictor medications, stimulants such as cocaine, ephedrine and amphetamines, emotional duress, exposure to cold and alcohol withdraw.

Typical Prinzmetal's variant angina occurs at rest, in the early hours of the morning. The pain is often described as severe chest tightness or pressure. Variant angina is usually treated with and responds well to calcium channel blockers and nitrates.[3]

[1] Prinzmetal et al, *Am J Med*. 1959;27:375-388.
[2] National Institutes of Health, Library of Medicine, www.NIH.gov
[3] National Institutes of Health, Library of Medicine, www.NIH.gov

CASE STUDY 17 - UNSTABLE ANGINA

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

45 y/o MALE c/o EXERTIONAL CHEST PRESSURE x past 2 months, getting worse. In last week, CHEST PRESSURE has come on at rest. DYSPNEA sometimes present. Pain is relieved when patient rests, however now takes longer than 20 minutes to subside.

RISK FACTOR PROFILE:

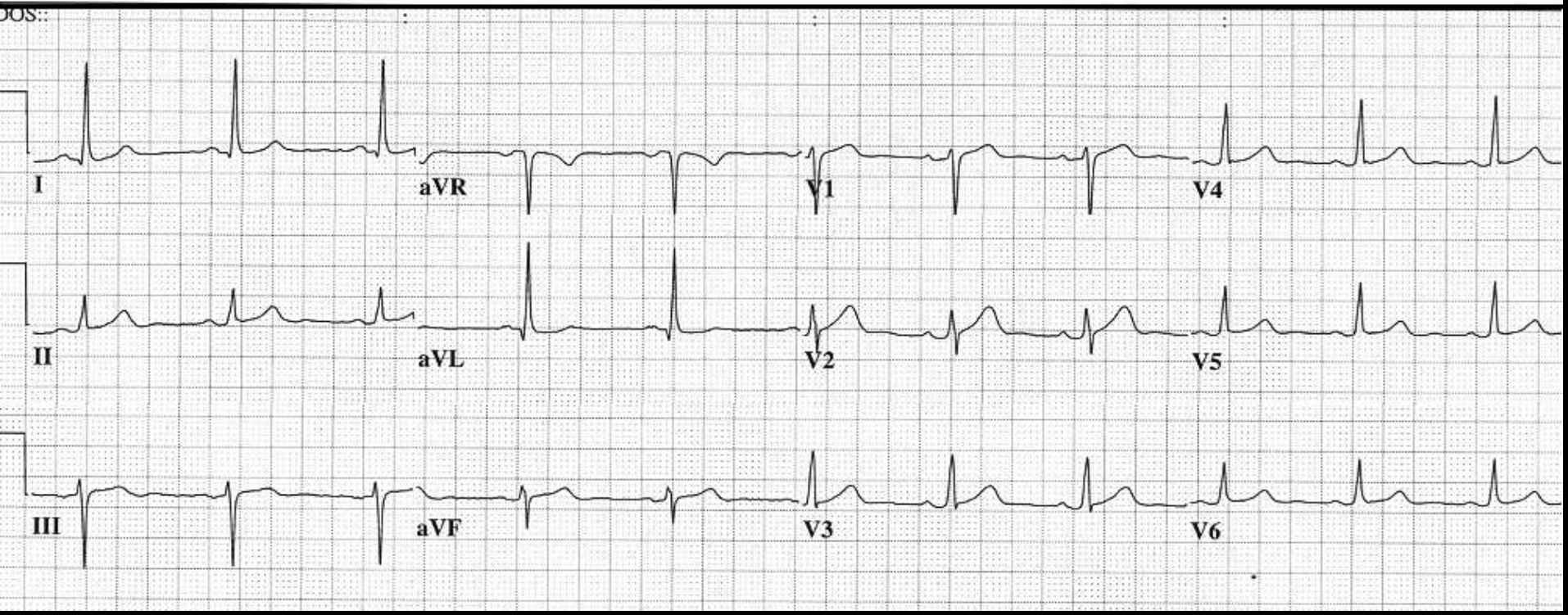
- FAMILY HISTORY: father died of AMI age 50, brother had CABG age 44
- CIGARETTE SMOKER x 20 YEARS
- HYPERTENSION
- ELEVATED LDL, TRIGLYCERIDES, LOW HDL CHOLESTEROL

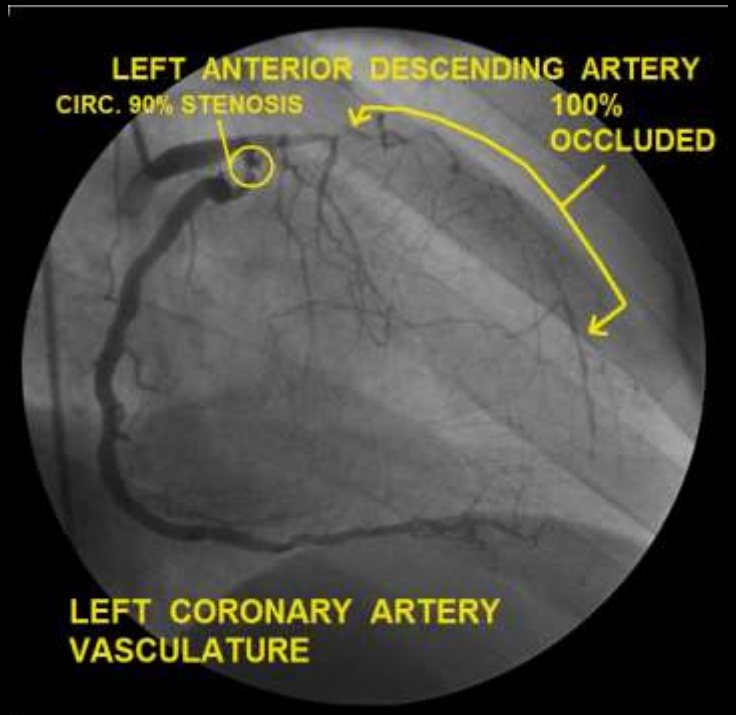
PHYSICAL EXAM: Pt. asymptomatic at time of exam, skin warm, dry, color normal, pupils PERLA, no JVD, lungs = clear, heart sounds normal S1, S2. Abd. soft, non-tender, No ankle edema

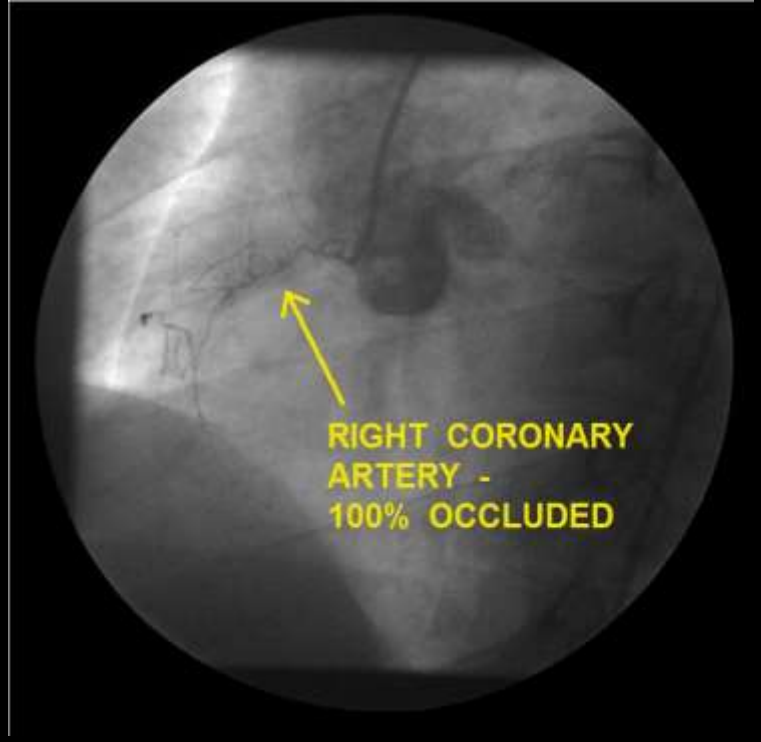
VITAL SIGNS: BP: 177/96 P: 64 R: 16 SAO2: 99 % on room air

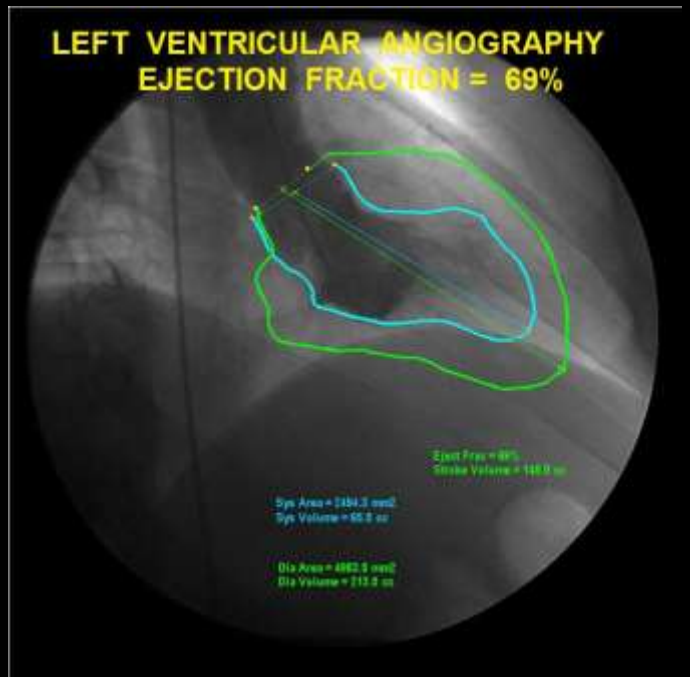
LABS: TROPONIN: < .04

45 yr		Vent. rate	65	BPM
Male	Caucasian	PR interval	160	ms
		QRS duration	86	ms
		QT/QTc	384/399	ms
Loc:7	Option:35	P–R–T axes	11 –8	55




LEFT ANTERIOR DESCENDING ARTERY
CIRC. 90% STENOSIS
100%
OCCLUDED
LEFT CORONARY ARTERY
VASCULATURE


RIGHT CORONARY
ARTERY -
100% OCCLUDED


LEFT VENTRICULAR ANGIOGRAPHY
EJECTION FRACTION = 69%

QUESTIONS ? ? ?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