American College of Cardiology
20th Congress 2017

Observation Medicine ECG Instructor Workshop, Session 3

Serial 12 Lead ECG Interpretation

Part 2

By: Wayne W Ruppert, CVT, CCCC, NREMT-P

About this Curriculum:

This curriculum is designed to provide nurses with evidence-based education and recommended practices for identifying changes in serial ECGs, and identifying ECG changes consistent with Acute Coronary Syndrome.

Observation Medicine ECG Course

BASIS:

- **Current ACC/AHA Guidelines and Recommendations**
- **Multiple additional recent Evidence-Based Publications**
- **ECGs from case files of the author, Wayne Ruppert**
- **Graphic art / images from published textbooks authored by Wayne Ruppert**

Observation Medicine ECG Workshop Version 1 - Today

- Acute Coronary Syndrome

Observation Medicine ECG Workshop Version 2 - Future

- Acute Coronary Syndrome
- Atrial Fibrillation
- Heart Failure
- QT syndrome abnormalities

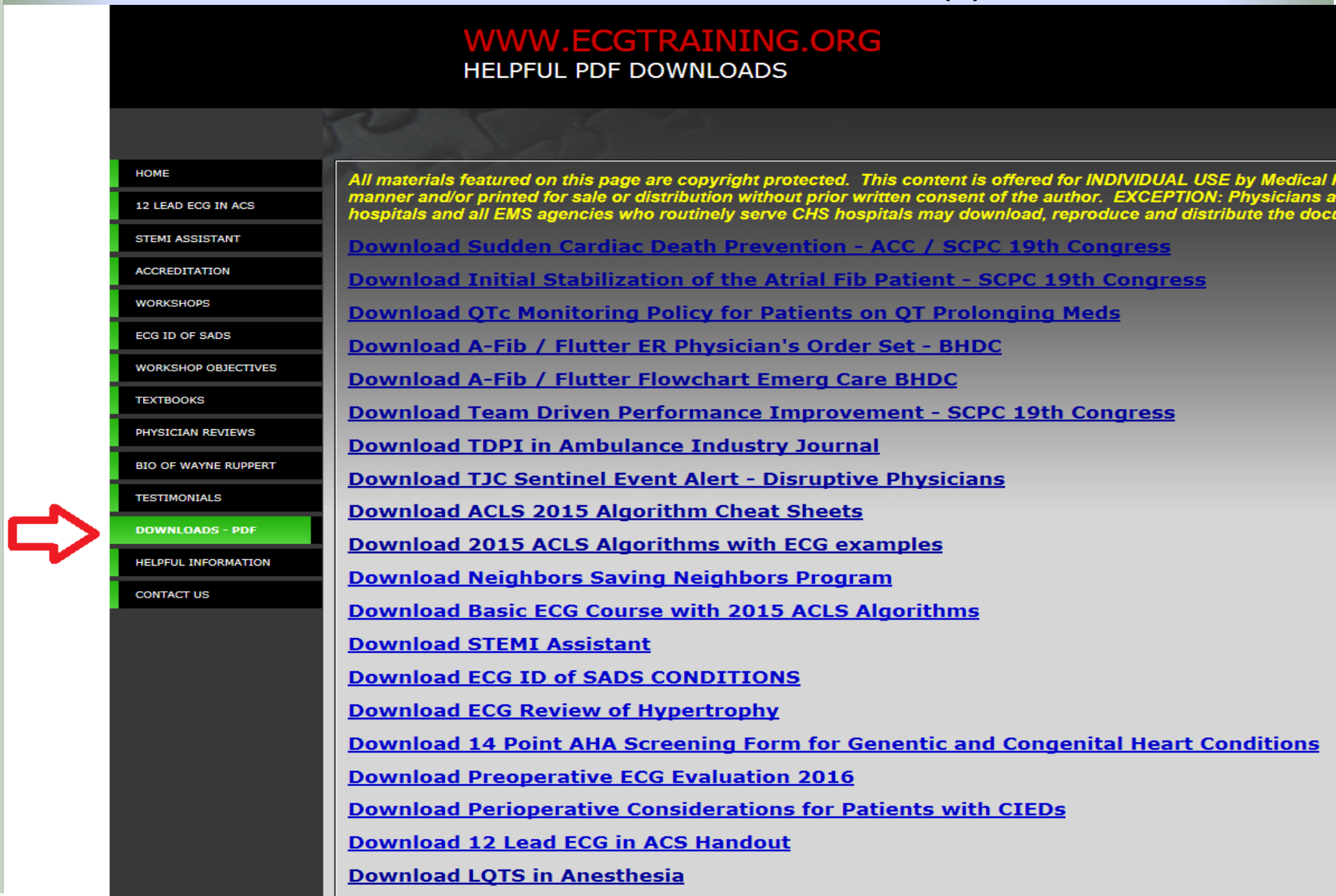
Bayfront Health
Dade City

- **Wayne Ruppert, Cardiovascular Coordinator Bayfront Health Dade City, Dade City, Florida Community Health Systems**

Wayne Ruppert bio:

- Cardiovascular Coordinator 2012-present (coordinated 4 successful accreditations)
- Interventional Cardiovascular / Electrophysiology Technologist, 1995-Present.
- Author of: "**12 Lead ECG Interpretation in Acute Coronary Syndrome with Case Studies from the Cardiac Cath Lab**," 2010, TriGen publishing / Ingram Books
- Author of: "**STEMI Assistant**," 2014, TriGen publishing / Ingram Books
- Florida Nursing CE Provider # 50-12998
- 12 Lead ECG Instructor, 1994-present (multiple hospitals, USF College of Medicine 1994)
- Website: www.ECGtraining.org

To download this course, go to www.ECGtraining.org, select "Downloads PDF" then select download(s) desired:



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Wayneruppert@aol.com

Suggested **Prerequisite Knowledge**:

Basic ECG Rhythm Interpretation Skills.

This course does not teach how to interpret basic ECG rhythms. Although it is not necessary to know Basic ECG Rhythms to understand the material in this course, it is strongly suggested that this course be used as "the next level" of education for health care providers who are already proficient in basic single-lead ECG rhythm strip interpretation.

Objectives (Part 2):

- Evaluation of the ECG for ACS
  - Wide QRS Complexes (R & LBBB patterns)
  - Normal Duration QRS Complexes
- Serial ECG Timing Strategies
- Indicators of Evolving Ischemia / STEMI
  - With Case Studies
- Review practice ECGs
- Discuss future “Observation Medicine ECG Proficiency Exam”

Evaluating the ECG for ACS:

A TWO-STEP process:

Evaluating the ECG for ACS:

A TWO-STEP process:

STEP 1: Evaluate QRS Width

Evaluating the ECG for ACS:

A TWO-STEP process:

STEP 1: Evaluate QRS Width

STEP 2: Evaluate J Points, ST-Segment and T waves in EVERY Lead

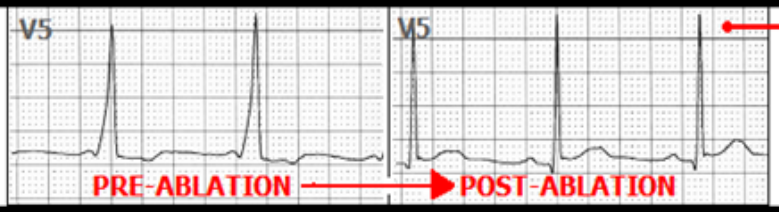
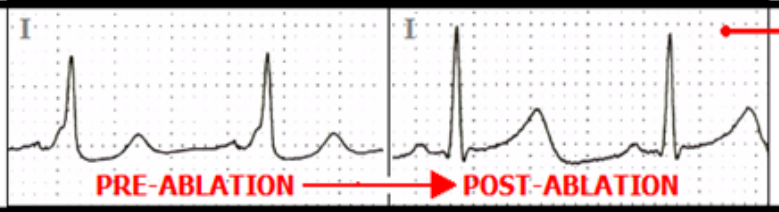
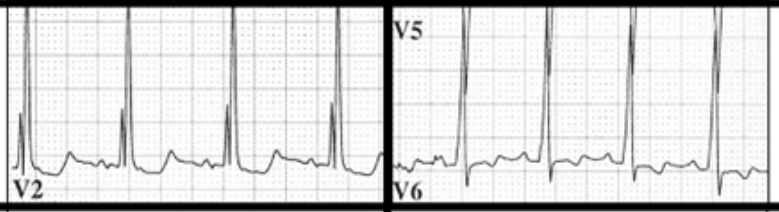
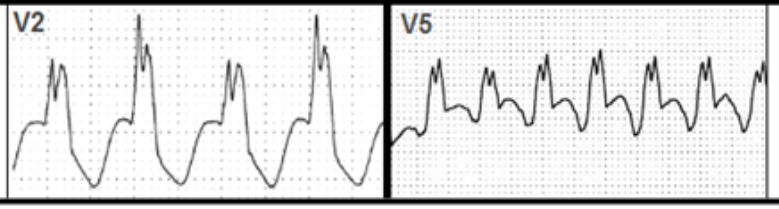
STEP 1 – evaluate QRS width:

- **QRS is ABNORMALLY WIDE (>120 ms),**
  - **indicates DEPOLARIZATION ABNORMALITY (e.g. "bundle branch block, Wolff-Parkinson-White Syndrome, etc).**

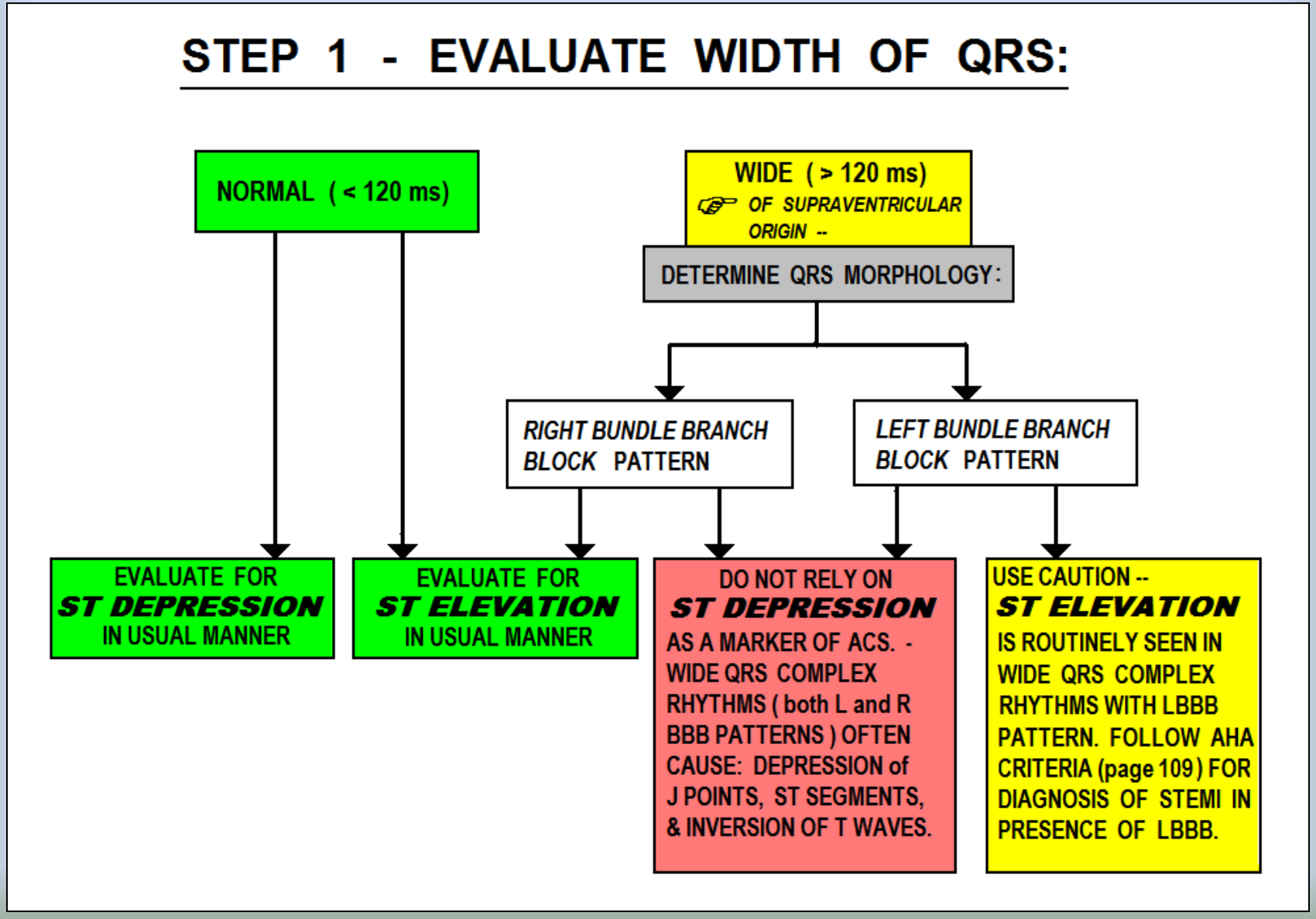
STEP 1 – evaluate QRS width:

- **QRS is ABNORMALLY WIDE (>120 ms),**
  - **indicates DEPOLARIZATION ABNORMALITY (e.g. "bundle branch block, Wolff-Parkinson-White Syndrome, etc).**
  - **DEPOLARIZATION ABNORMALITIES in turn cause REPOLARIZATION ABNORMALITIES, which alters the: *J Points, ST-Segments and/or T Waves.***

CONDITIONS THAT INCREASE QRS DURATION RESULT IN SECONDARY REPOLARIZATION ABNORMALITIES:

RIGHT BUNDLE BRANCH BLOCK		LEFT BUNDLE BRANCH BLOCK
W-P-W BYPASS TRACT, LEFT LATERAL WALL 49 y/o MALE		SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT
W-P-W BYPASS TRACT, RIGHT ANTERIOR/ LATERAL WALL 14 y/o MALE		SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT
PACEMAKER - RIGHT VENTRICULAR APEX		PACEMAKER TURNED OFF HERE
RIGHT VENTRICULAR HYPERTROPHY (Strain Pattern)		LEFT VENTRICULAR HYPERTROPHY (Strain Pattern)
VENTRICULAR TACHYCARDIA FOCUS: LEFT FASICULAR, 17 y/o FEMALE		VENTRICULAR TACHYCARDIA- FOCUS: RIGHT VENTRICULAR APEX

Evaluating the ECG for ACS:



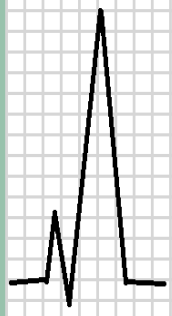
Wide QRS present:
QRSd > 120ms

- **Determine RIGHT vs. LEFT Bundle Branch Block Pattern**

Simple “Turn Signal Method” . . .

THE "TURN SIGNAL METHOD" for identifying BUNDLE BRANCH BLOCK

V1



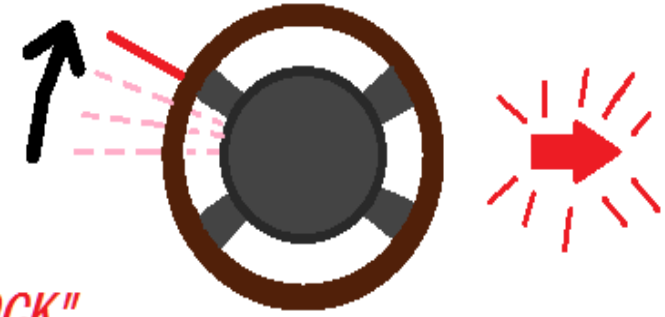
USE LEAD V1 for this technique

To make a **RIGHT TURN**

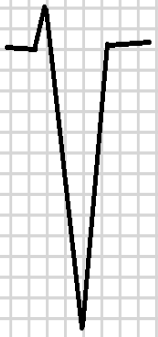
you push the turn signal lever **UP**. . . . .

THINK:

"QRS points UP = RIGHT BUNDLE BRANCH BLOCK"



V1

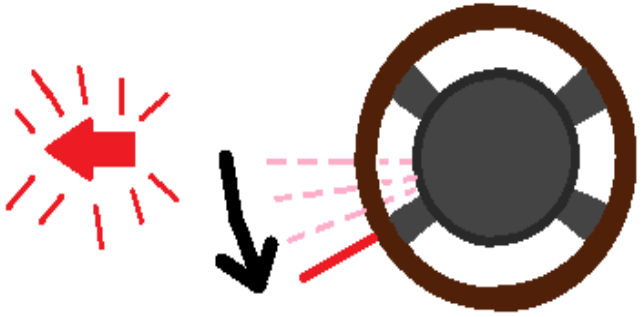


To make a **LEFT TURN**

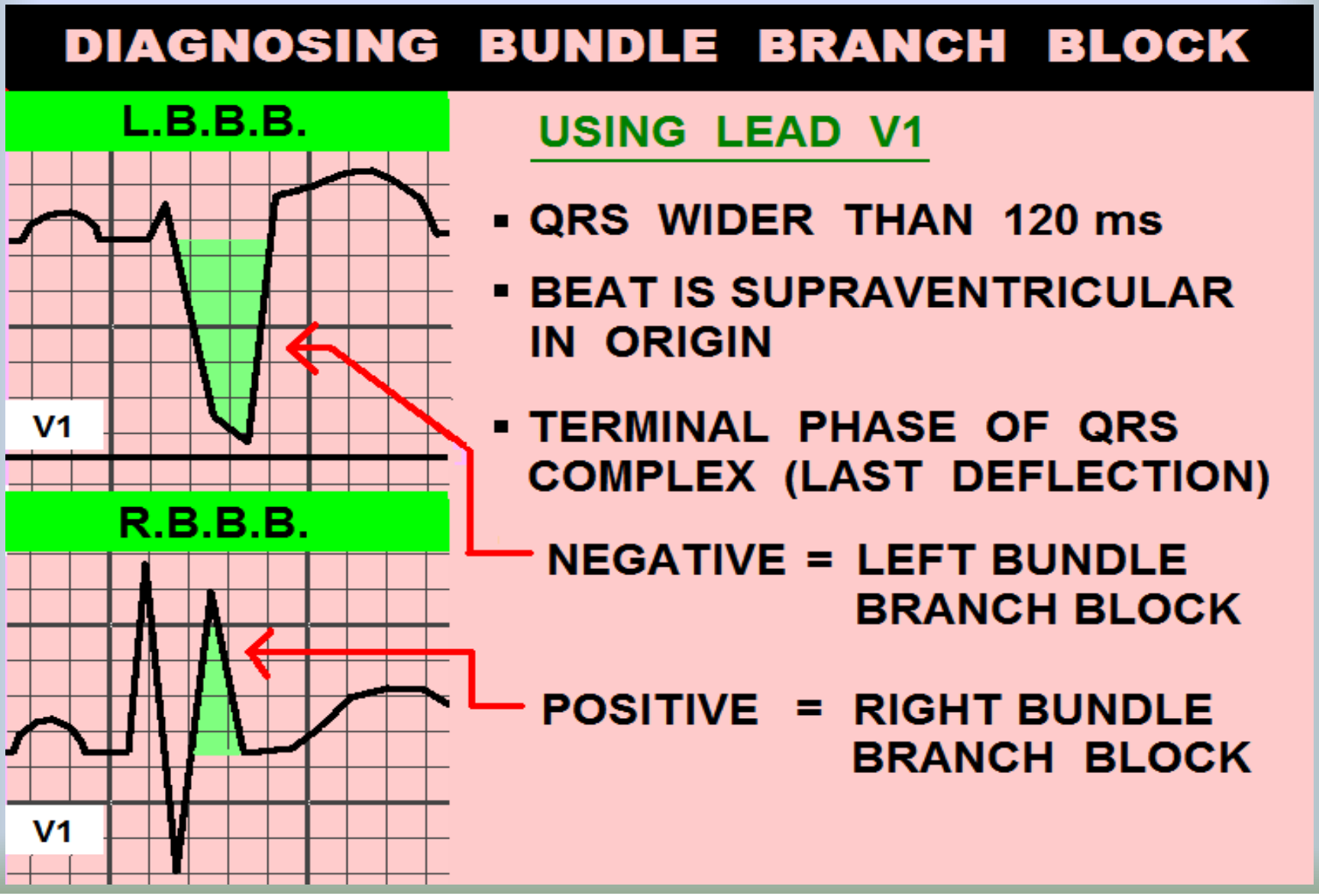
you push the turn signal lever **DOWN** . . . .

THINK:

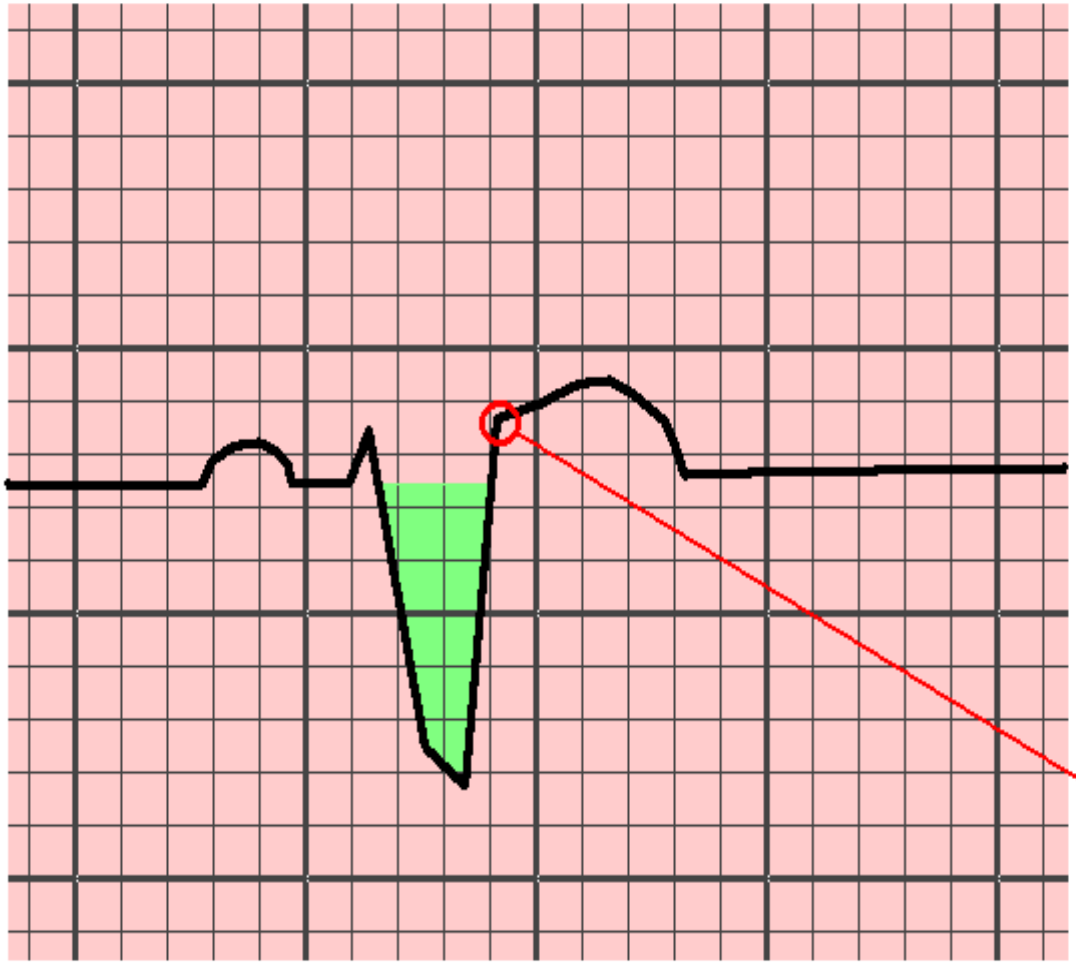
"QRS points DOWN = LEFT BUNDLE BRANCH BLOCK"



“Terminal Phase of QRS Method”. . .

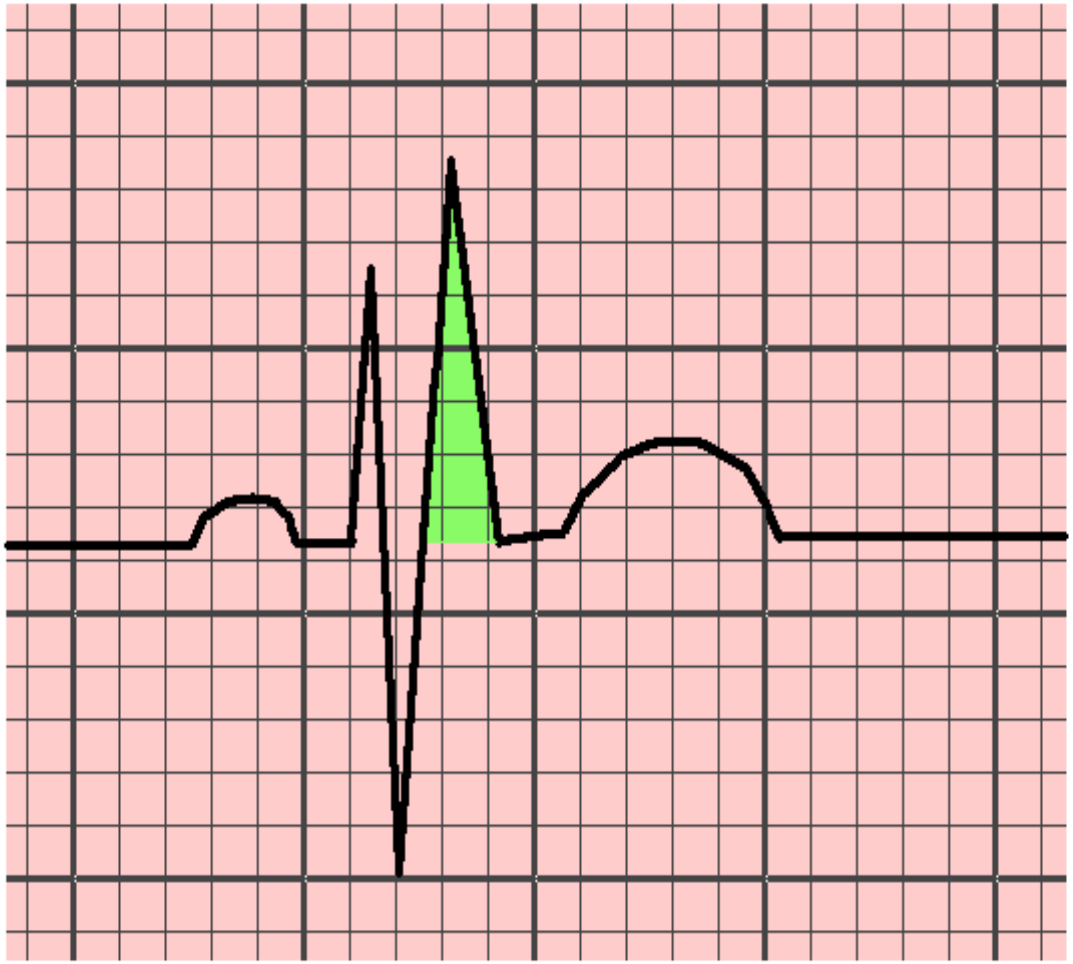


DIAGNOSING LBBB IN LEAD V1:



- QRS GREATER THAN 120 ms (.12)
- EVIDENCE THAT THIS IS NOT VENTRICULAR BEAT
- TERMINAL PHASE (LAST PART) OF QRS COMPLEX IS NEGATIVE DEFLECTION
- S-T SEGMENTS ARE NORMALLY ALWAYS ELEVATED !

DIAGNOSING RBBB IN LEAD V1:



- **WIDER THAN 120 ms (.12)**

(or 3 little boxes)

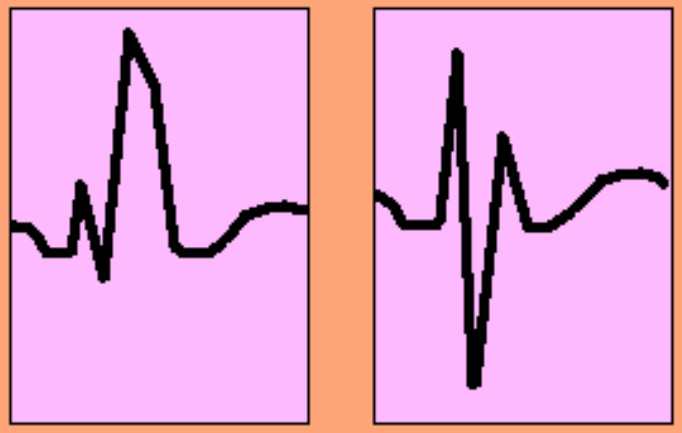
- **TERMINAL PHASE (LAST PART) OF QRS COMPLEX IS POSITIVE DEFLECTION**

DIAGNOSING BUNDLE BRANCH BLOCK

USING LEADS V1, V2, and V5, V6:

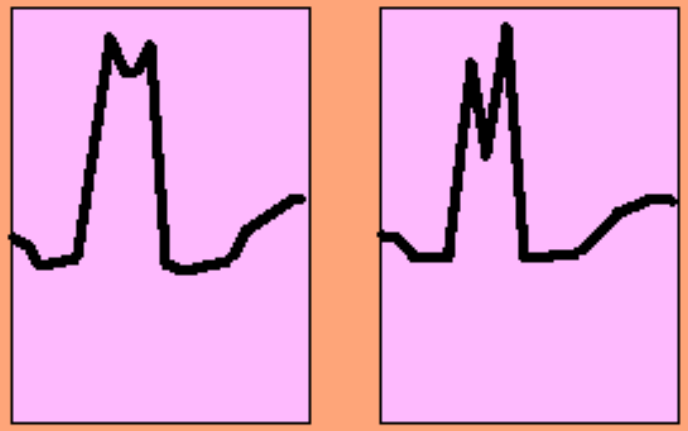
LOCATING RsR' or RR' COMPLEXES:

V1 V2



RIGHT BUNDLE BRANCH BLOCK

V5 V6



LEFT BUNDLE BRANCH BLOCK

RUPPERT, WAYNE ID: 099999999 4-Mar-2001

74years
Male Caucasian

Room:
Loc: 0 Opt:

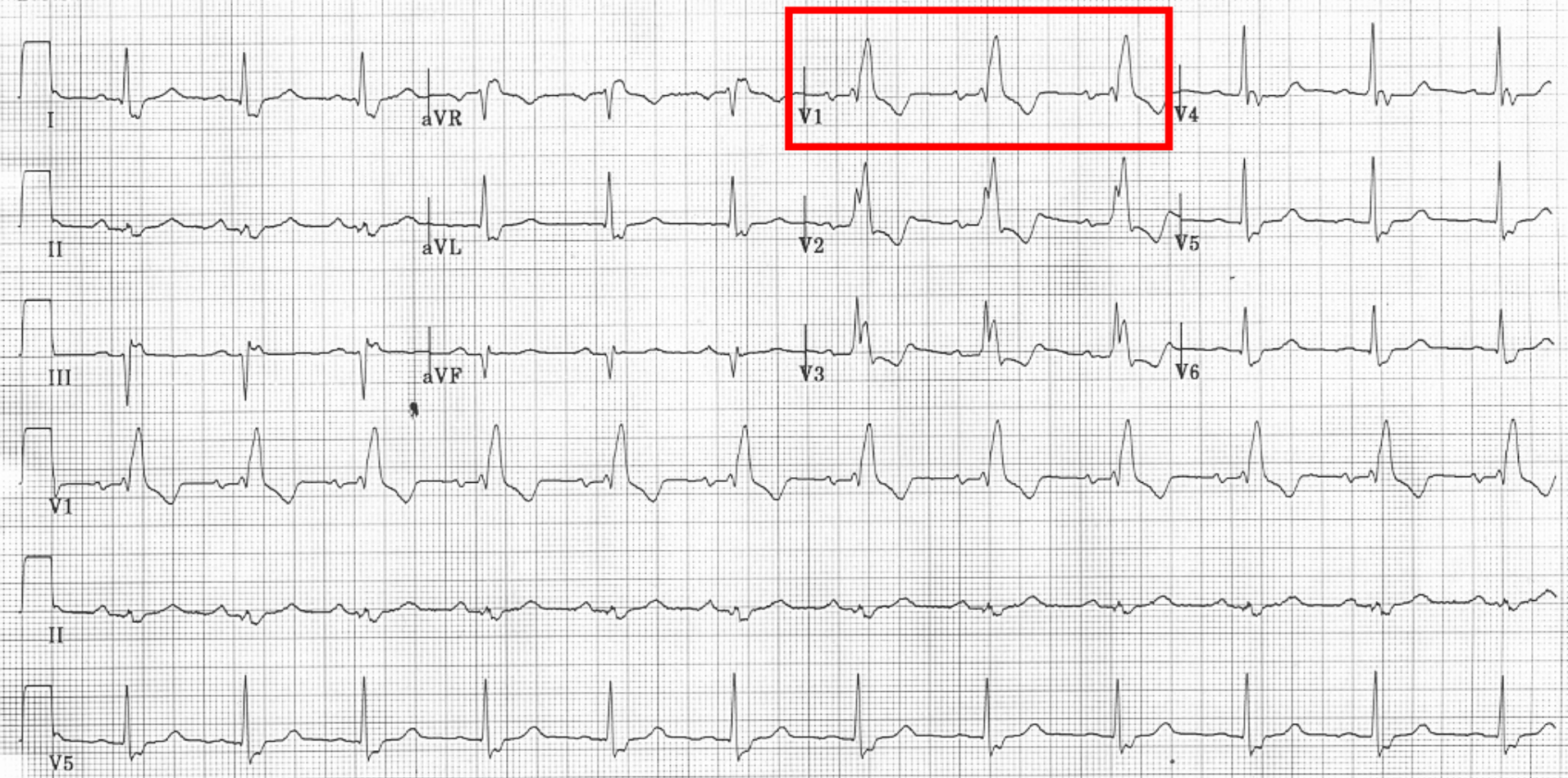
Vent. rate	72	bpm
PR interval	186	ms
QRS duration	166	ms
QT/QTc	436/477	ms
P-R-T axes	57 -32 32	

Normal sinus rhythm
Left axis deviation
Right bundle branch block
Inferior infarct, age undetermined
Abnormal ECG

Technician: WR

Referred by: Unconfirmed

D.O.S.:



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

TERMINAL PHASE OF QRS IS

POSITIVE

= RIGHT BUNDLE BRANCH BLOCK

09:16:40

74 yr
Female Caucasian

Loc:7 Option:35

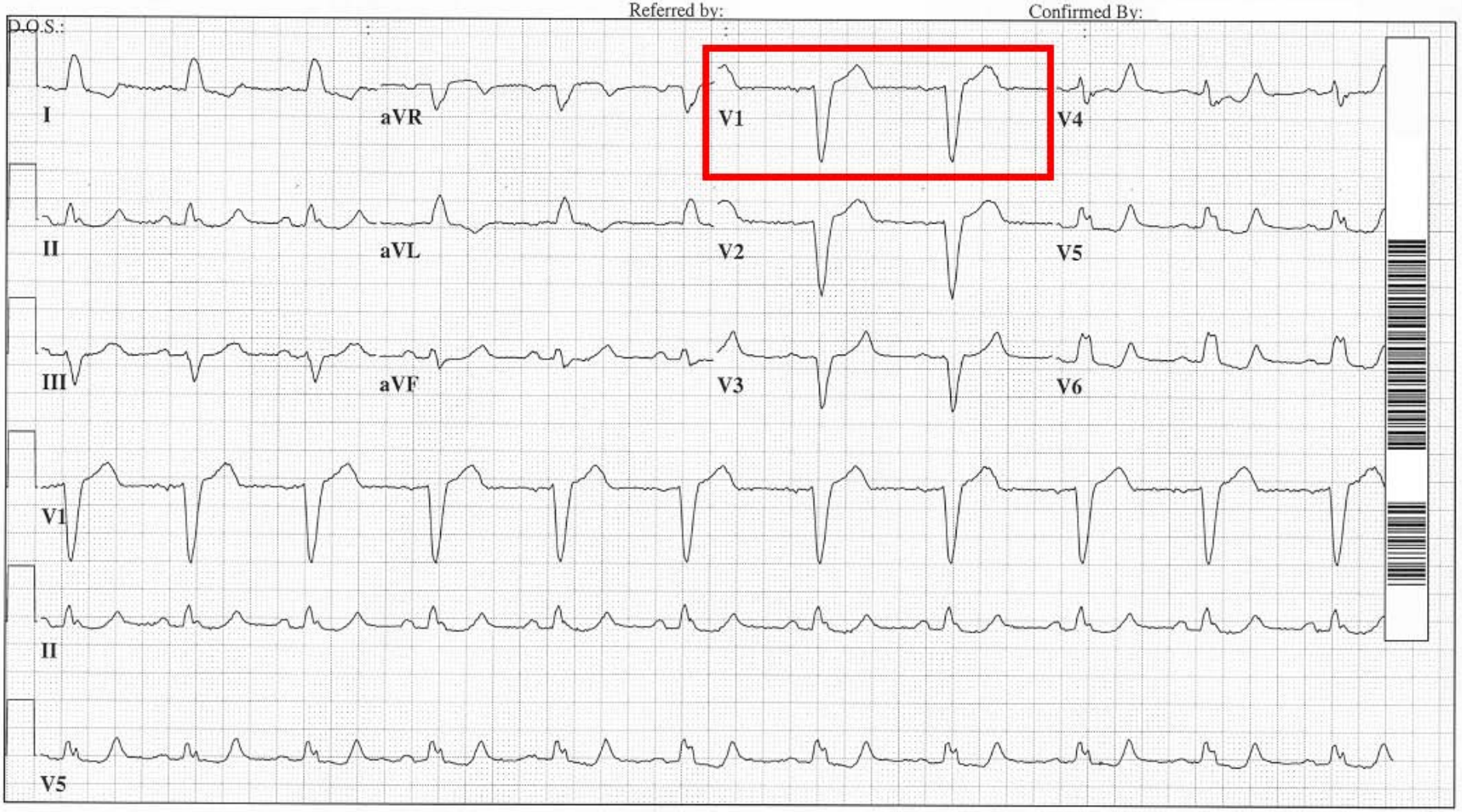
Vent. rate	64	BPM
PR interval	188	ms
QRS duration	152	ms
QT/QTc	472/486	ms
P–R–T axes	78 3	106

Normal sinus rhythm
Left bundle branch block
Abnormal ECG
When compared with ECG of 28–MAY–2003 06:36,

EKG #WR03029959

Technician: WW

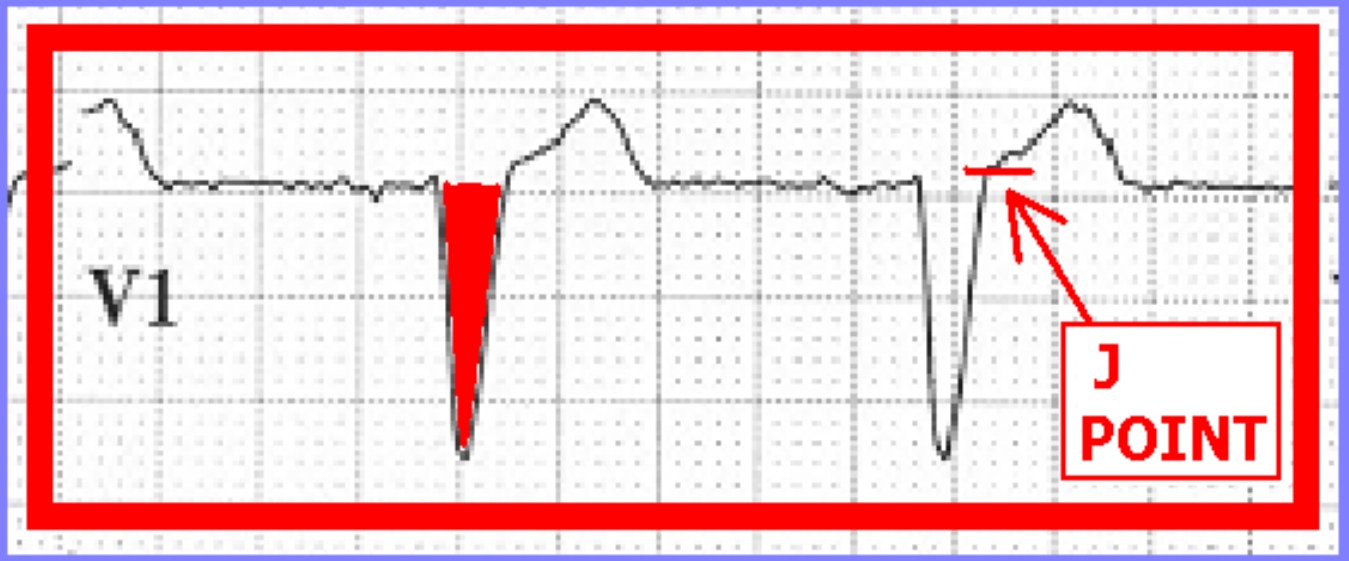
Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 229 CID: 0

EID:5 EDT:

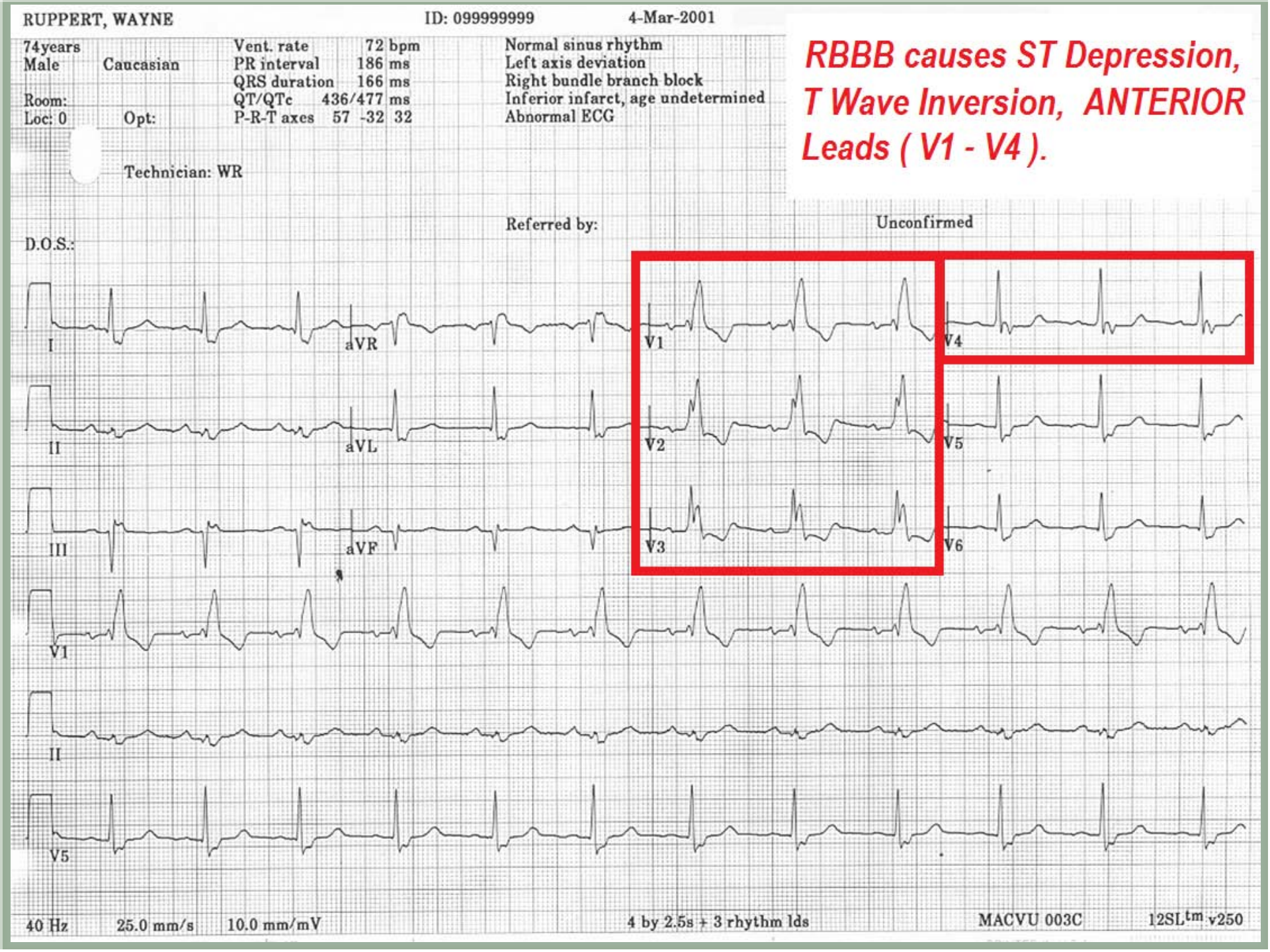
TERMINAL PHASE OF QRS IS NEGATIVE



= LEFT BUNDLE BRANCH BLOCK

Wide QRS present:
(QRSd > 120ms)

- **When RIGHT Bundle Branch Block pattern is present:**
  - **Precordial Leads typically demonstrate ST Depression and T wave Inversion**



RBBB causes ST Depression, T Wave Inversion, ANTERIOR Leads (V1 - V4).

Wide QRS present:
(QRSd > 120ms)

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

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

48 yr
Male Caucasian

Room:ATL
Loc:3 Option:23

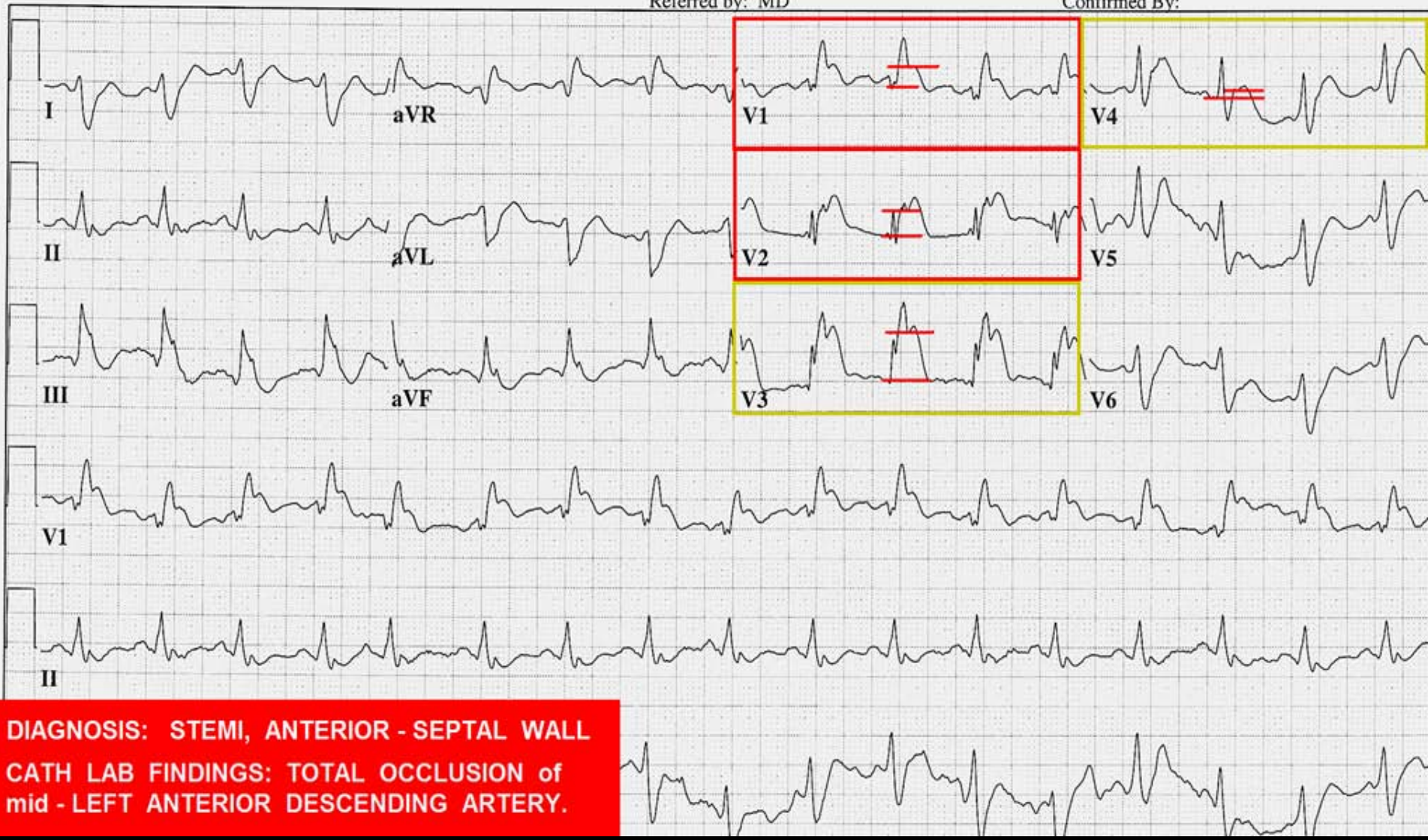
Vent. rate	102	BPM
PR interval	130	ms
QRS duration	168	ms
QT/QTc	400/521	ms
P-R-T axes	60 114	-19

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 ...

Technician: W Ruppert

Referred by: MD

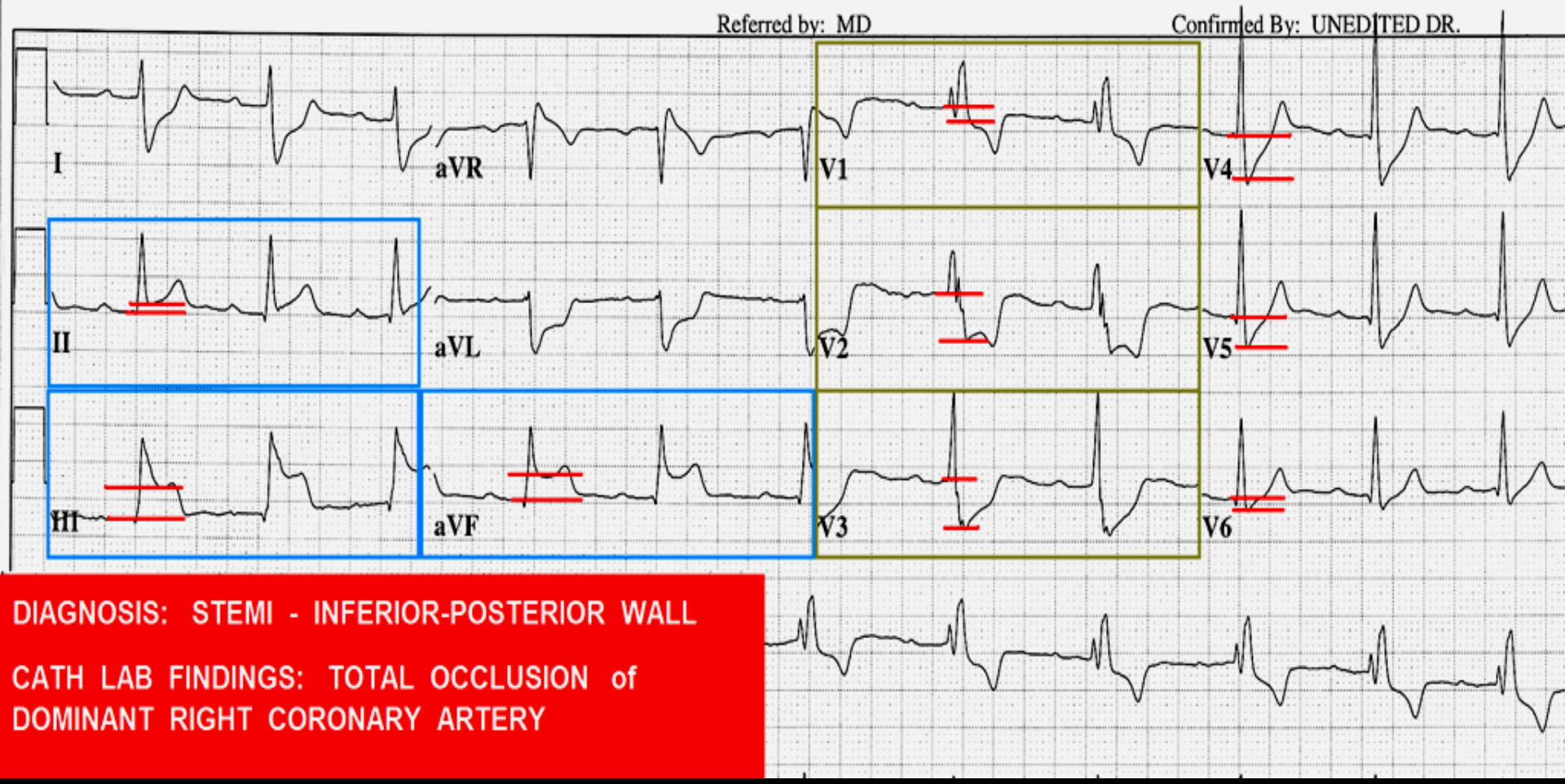
Confirmed By:



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



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

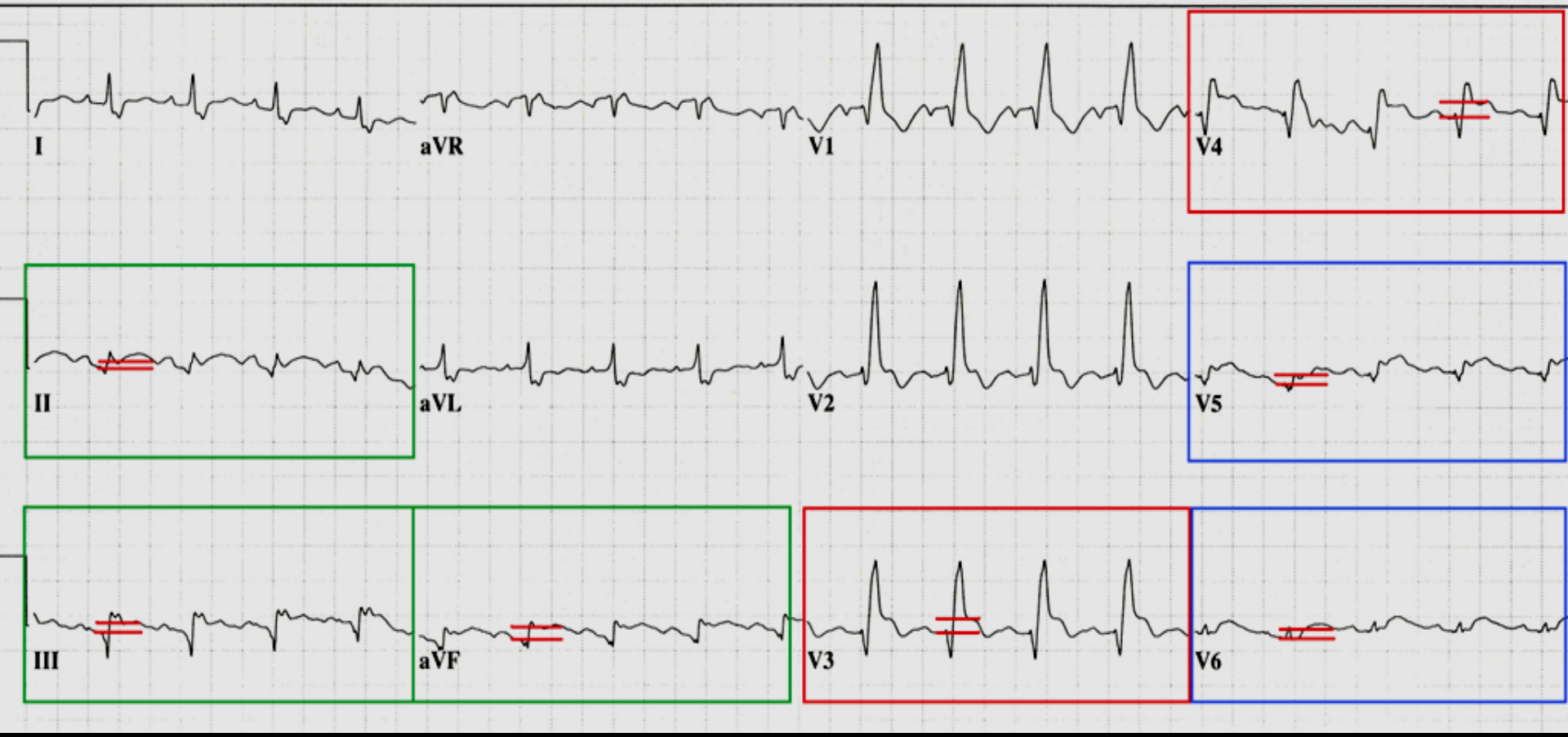
Room:CS-19
Loc:6 Option:41

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)



Wide QRS present:

(QRSd > 120ms)

- **When LBBB QRS pattern is present:**

Wide QRS present:

(QRSd > 120ms)

- **When LBBB QRS pattern is present:**
  - **ST-Segment Elevation is typically noted in Precordial Leads**

Wide QRS present:

(QRSd > 120ms)

- **When LBBB QRS pattern is present:**
  - **ST-Segment Elevation is typically noted in Precordial Leads**
  - ***Can cause up to 5mm of J Point Elevation in normally calibrated ECG (1mm=10mv)***

Wide QRS present:

(QRSd > 120ms)

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

Diagnosis of STEMI with LBBB pattern:

2013 ACC/AHA Guideline for Management of STEMI

- ***ST Elevation of 0.1mv (1mm) or more in leads with Positive Deflection QRS complexes***

Diagnosis of STEMI with LBBB pattern:

2013 ACC/AHA Guideline for Management of STEMI

- ***ST Elevation of 0.1mv (1mm) or more in leads with Positive Deflection QRS complexes***
- ***ST Elevation of 0.5mv (5mm) or more in leads with Negative Deflection QRS complexes***

Diagnosis of STEMI with LBBB pattern:

2013 ACC/AHA Guideline for Management of STEMI

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

Diagnosis of STEMI with LBBB pattern:

2013 ACC/AHA Guideline for Management of STEMI

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

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.

“Electrocardiographic Diagnosis of Evolving Acute Myocardial Infarction in the Presence of Left Bundle-Branch Block” Birnbaum et al, N Engl J Med 1996; 334:481-487

Be advised that in patients with

Left Bundle Branch Block

Combined with

Ventricular Hypertrophy,

The J Point elevation can exceed 0.5 mv (5mm) above the iso-electric line in patients without ACS.

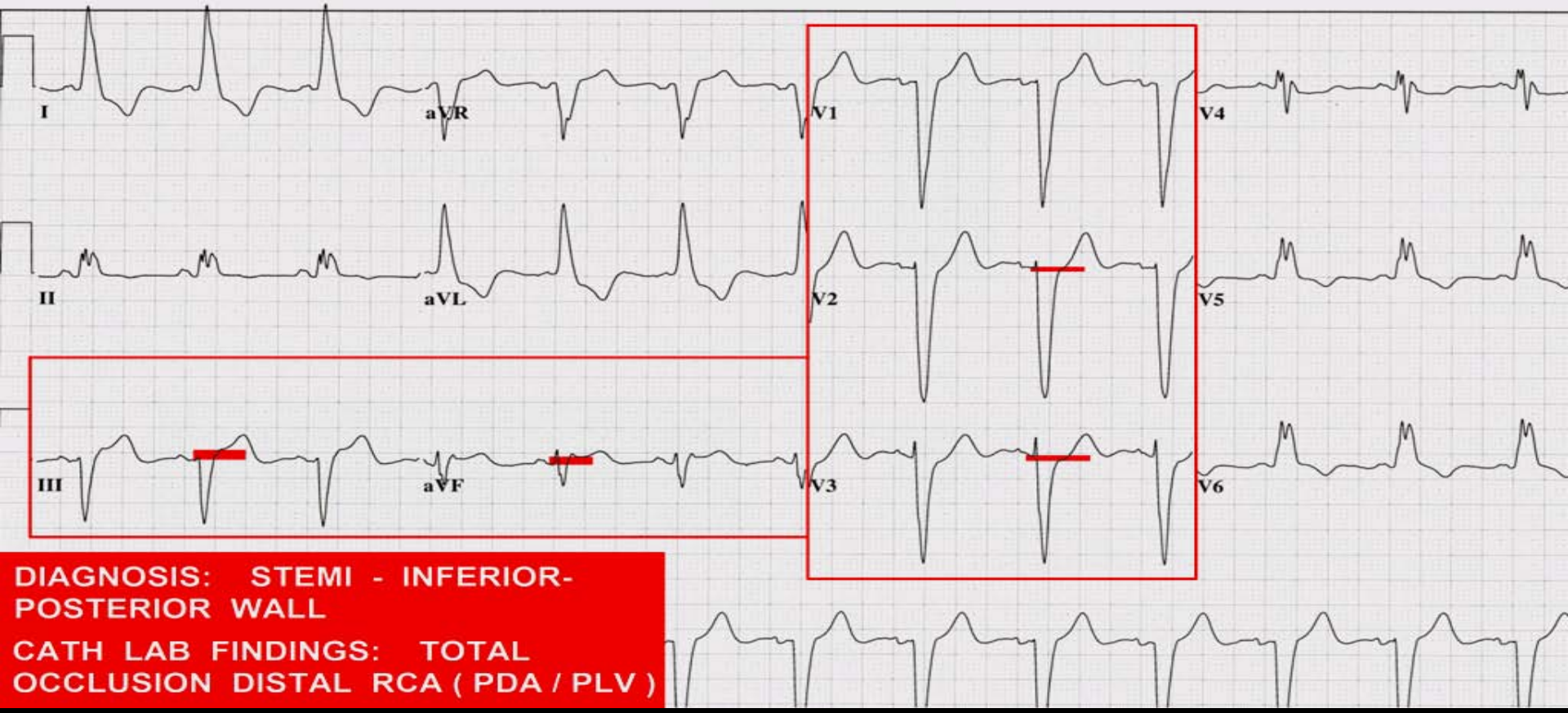
LBBB with CHEST PAIN - CASE 1 : PRESENTING EKG

58 yr
Female Hispanic

Room: ER
Loc:3 Option:23

Vent. rate	77	BPM
PR interval	128	ms
QRS duration	158	ms
QT/QTc	454/513	ms
P–R–T axes	43 –11	150

Normal sinus rhythm
Left bundle branch block
Abnormal ECG



DIAGNOSIS: STEMI - INFERIOR-POSTERIOR WALL

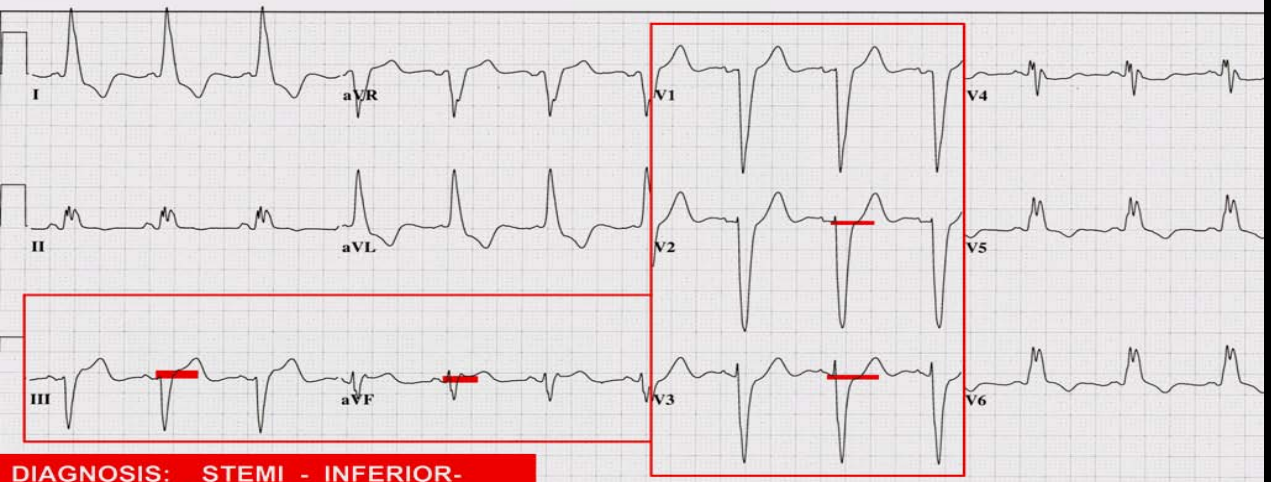
CATH LAB FINDINGS: TOTAL OCCLUSION DISTAL RCA (PDA / PLV)

LBBB with CHEST PAIN - CASE 1 : PRESENTING EKG

58 yr
Female Hispanic
Room: ER
Loc:3 Option:23

Vent. rate	77	BPM
PR interval	128	ms
QRS duration	158	ms
QT/QTc	454/513	ms
P-R-T axes	43 -11	150

Normal sinus rhythm
Left bundle branch block
Abnormal ECG



DIAGNOSIS: STEMI - INFERIOR-POSTERIOR WALL

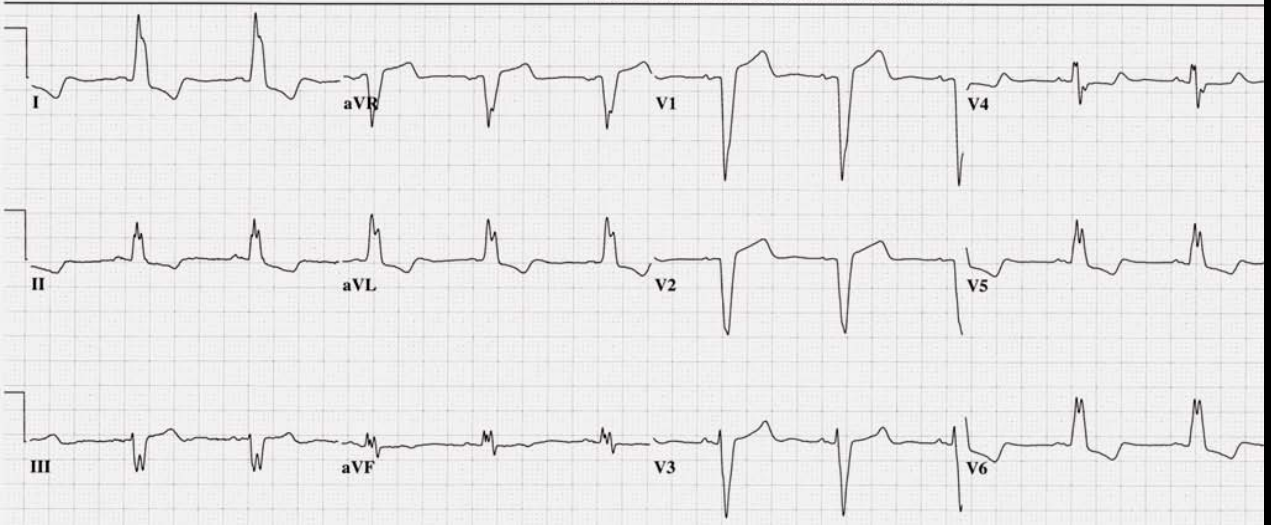
CATH LAB FINDINGS: TOTAL OCCLUSION DISTAL RCA (PDA / PLV)

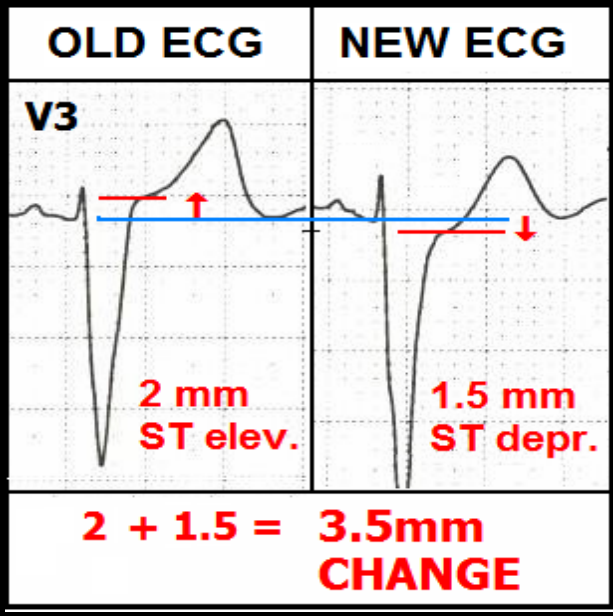
LBBB with CHEST PAIN - CASE 1 : EKG RECORDED 7 MONTHS AGO

57 yr
Female Hispanic
Room:416B
Loc:6 Option:39

Vent. rate	63	BPM
PR interval	140	ms
QRS duration	142	ms
QT/QTc	462/472	ms
P-R-T axes	48 10	191

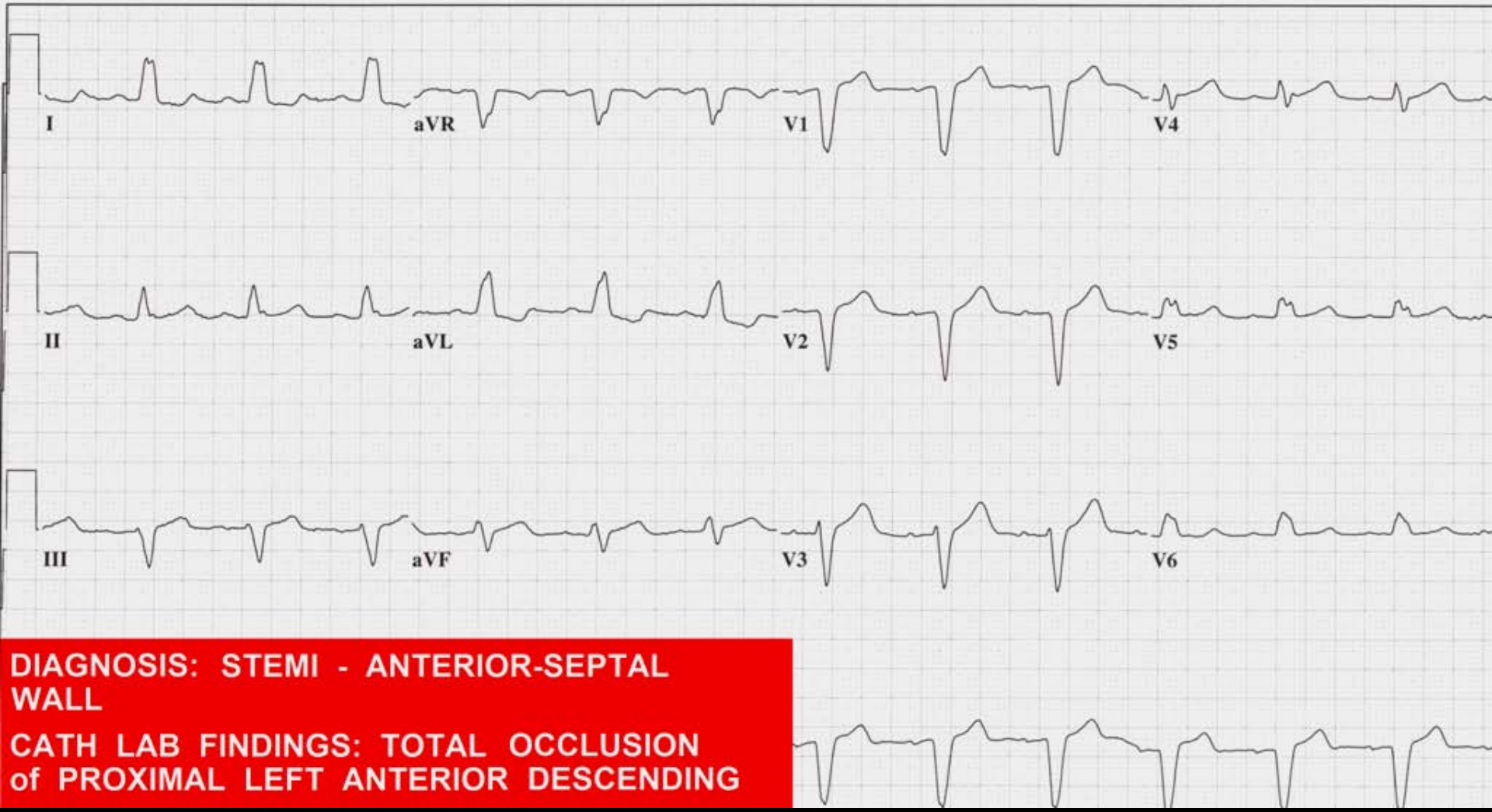
*** AGE AND GENDER SPECIFIC ECG ANALYSIS ***
Normal sinus rhythm
Left bundle branch block
Abnormal ECG
When compared with ECG of 22-JAN-2005 11:15.





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

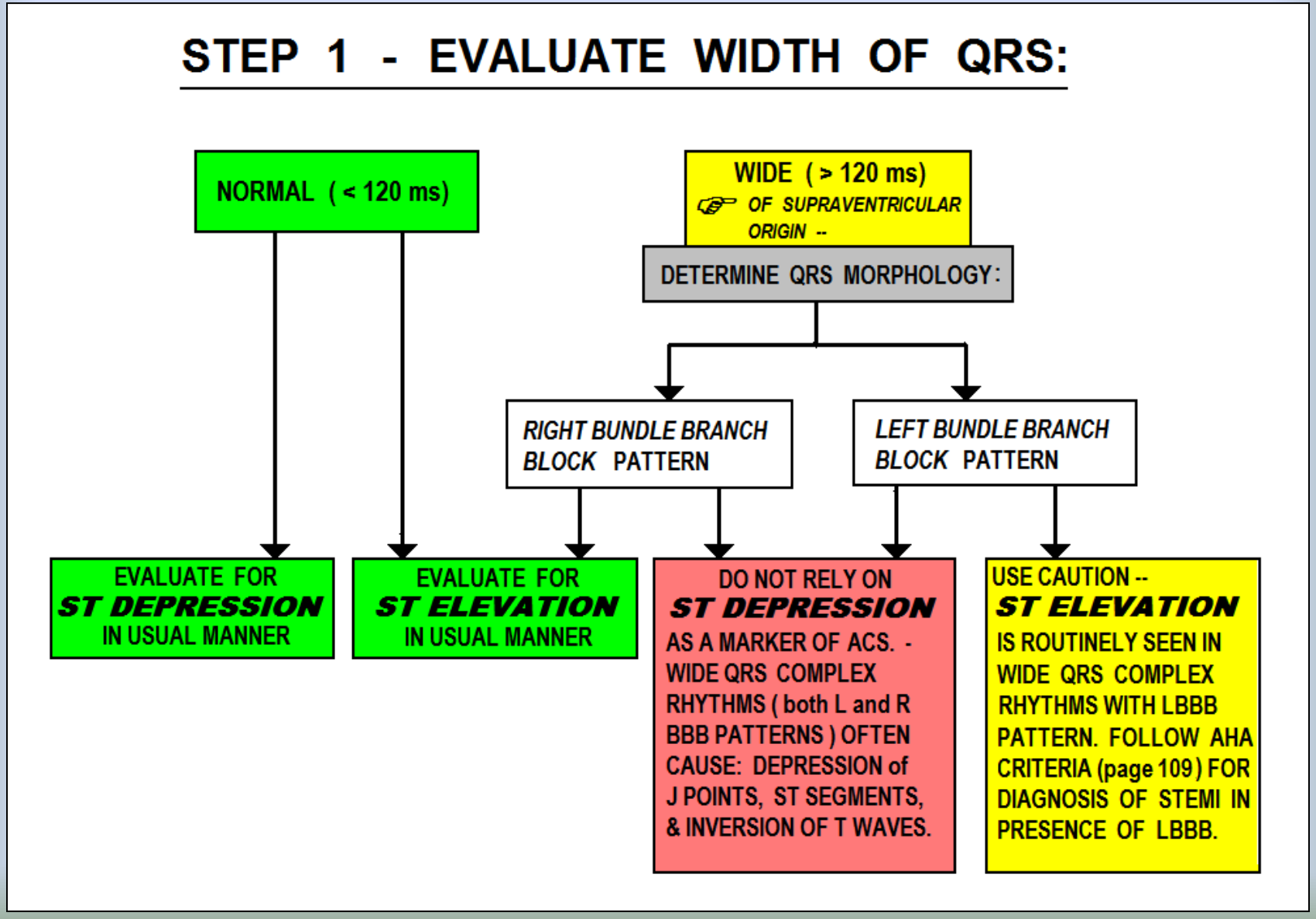
46 yr		Vent. rate	77	BPM	Normal sinus rhythm
Male	Caucasian	PR interval	172	ms	Left bundle branch block
		QRS duration	142	ms	Abnormal ECG
Room:ER		QT/QTc	446/504	ms	
Loc:3	Option:23	P-R-T axes	38 0	92	



DIAGNOSIS: STEMI - ANTERIOR-SEPTAL WALL

CATH LAB FINDINGS: TOTAL OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING

Evaluating the ECG for ACS:



Evaluating the ECG for ACS:

Patients with Normal Width QRS (QRSd < 120ms)

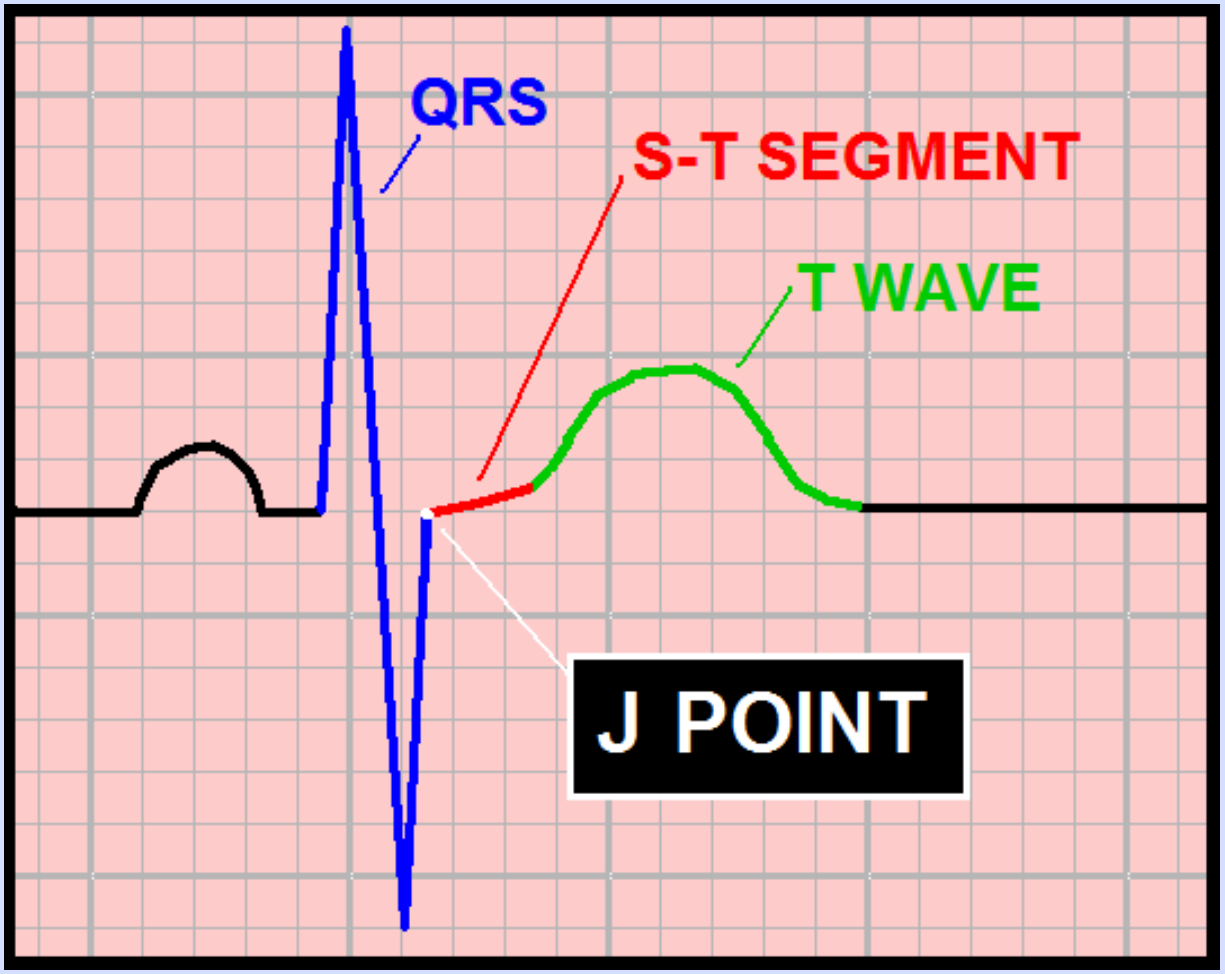
STEP 2 - EVALUATE the EKG for ACS

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*.

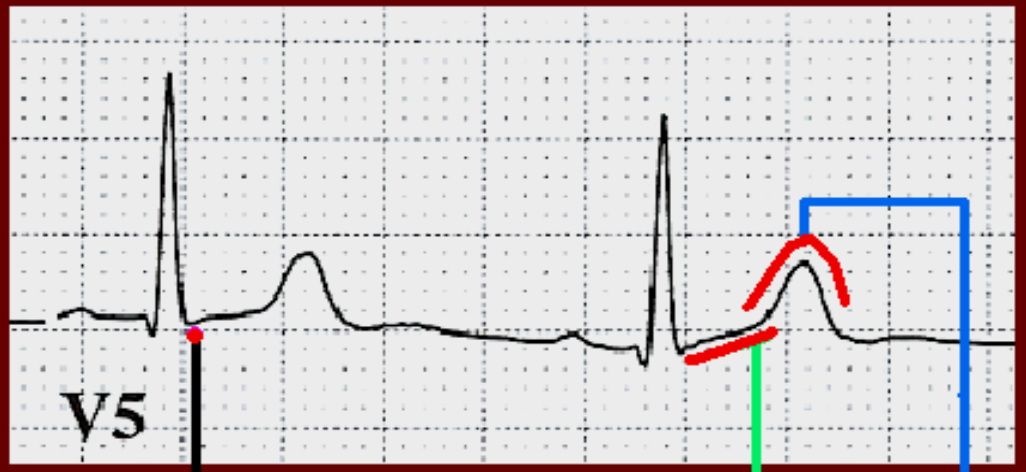
Defining NORMAL – QRS <120ms:



When QRS duration is NORMAL (< 120 ms):

NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL (< 120 ms)

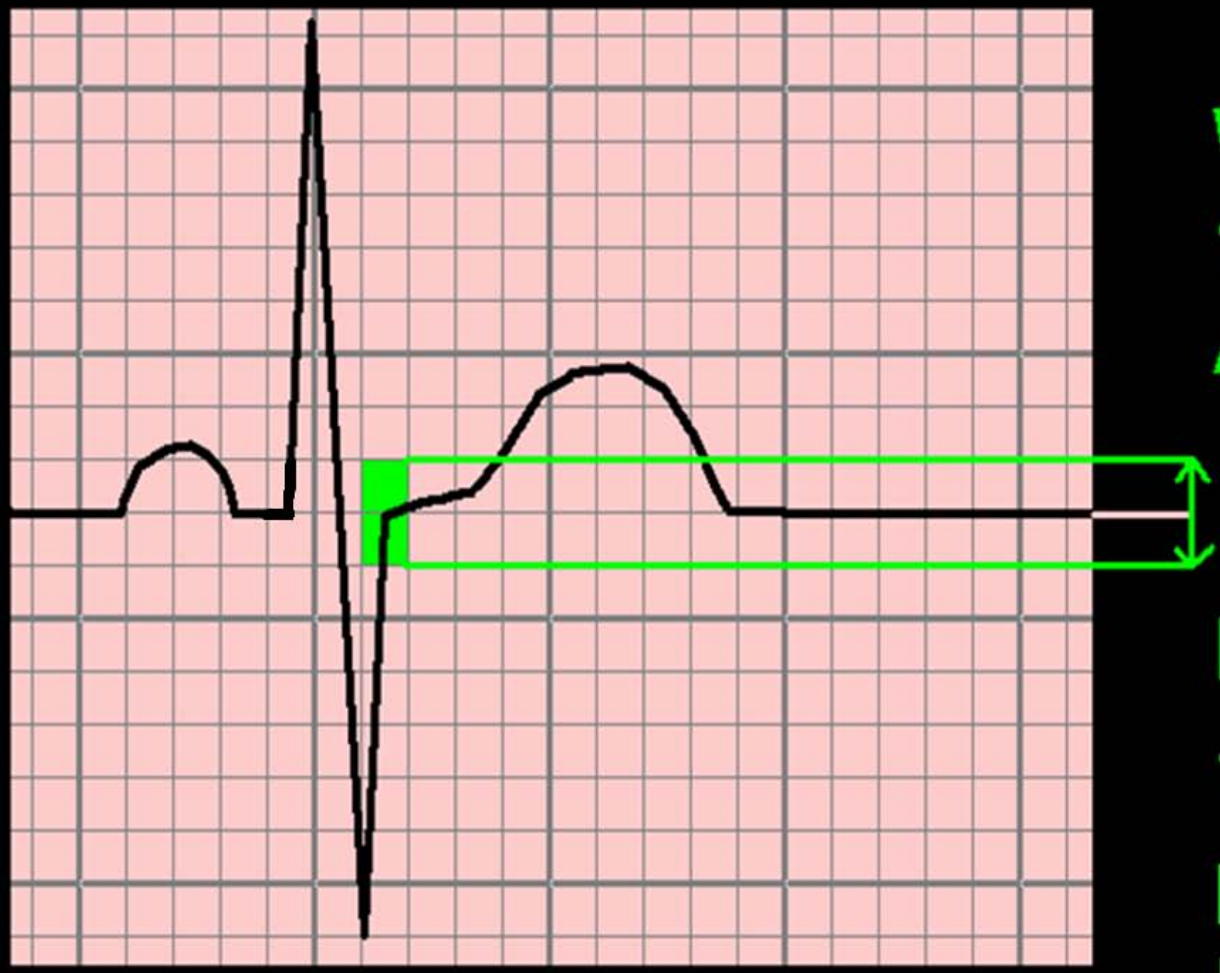


ASSESS:

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

☞ *in EVERY LEAD EXCEPT aVR ! !*

THE J POINT SHOULD BE . .

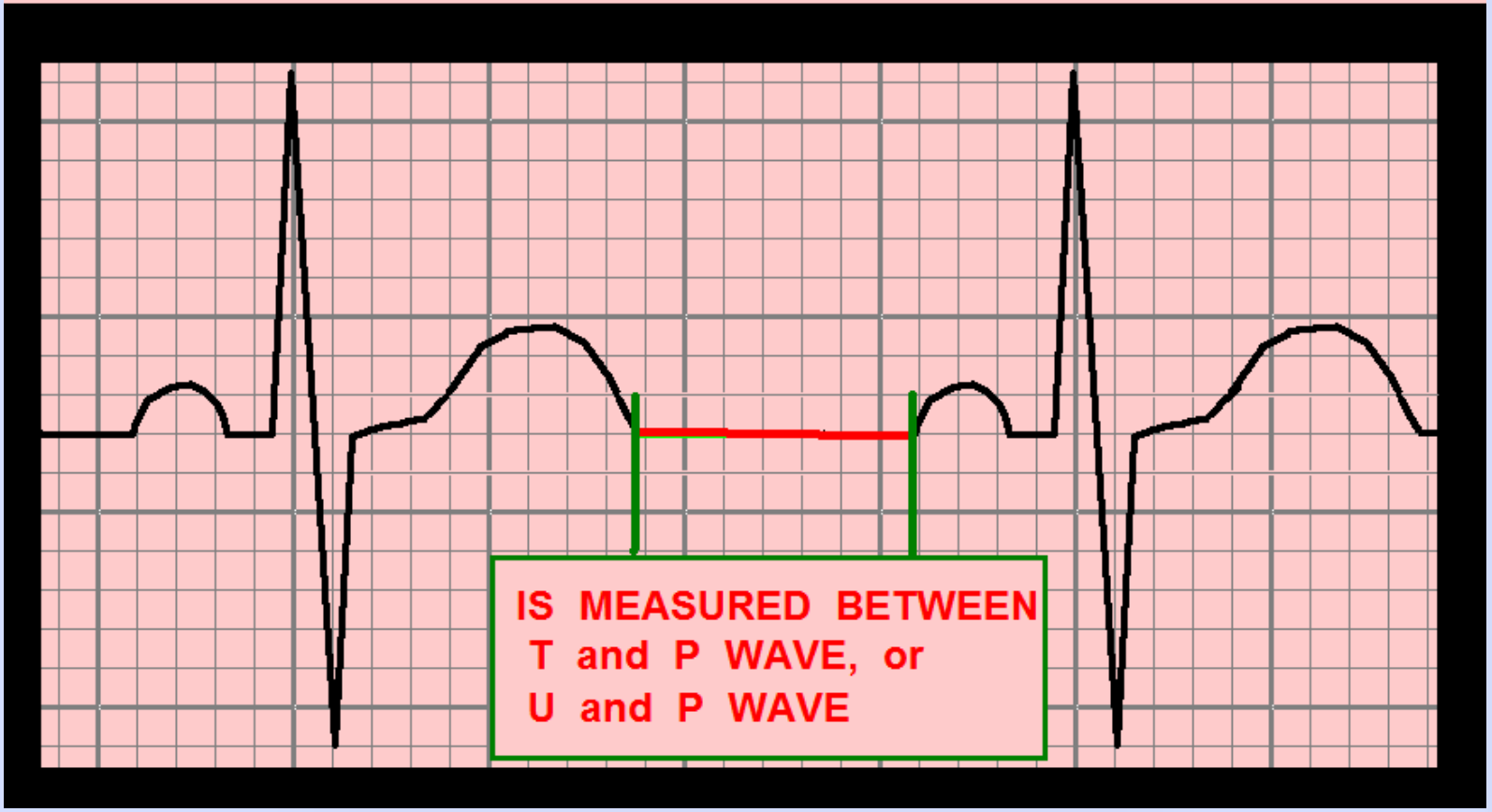


WITHIN
1 mm
ABOVE

OR

BELOW
the
ISOELECTRIC
LINE

THE ISOELECTRIC LINE



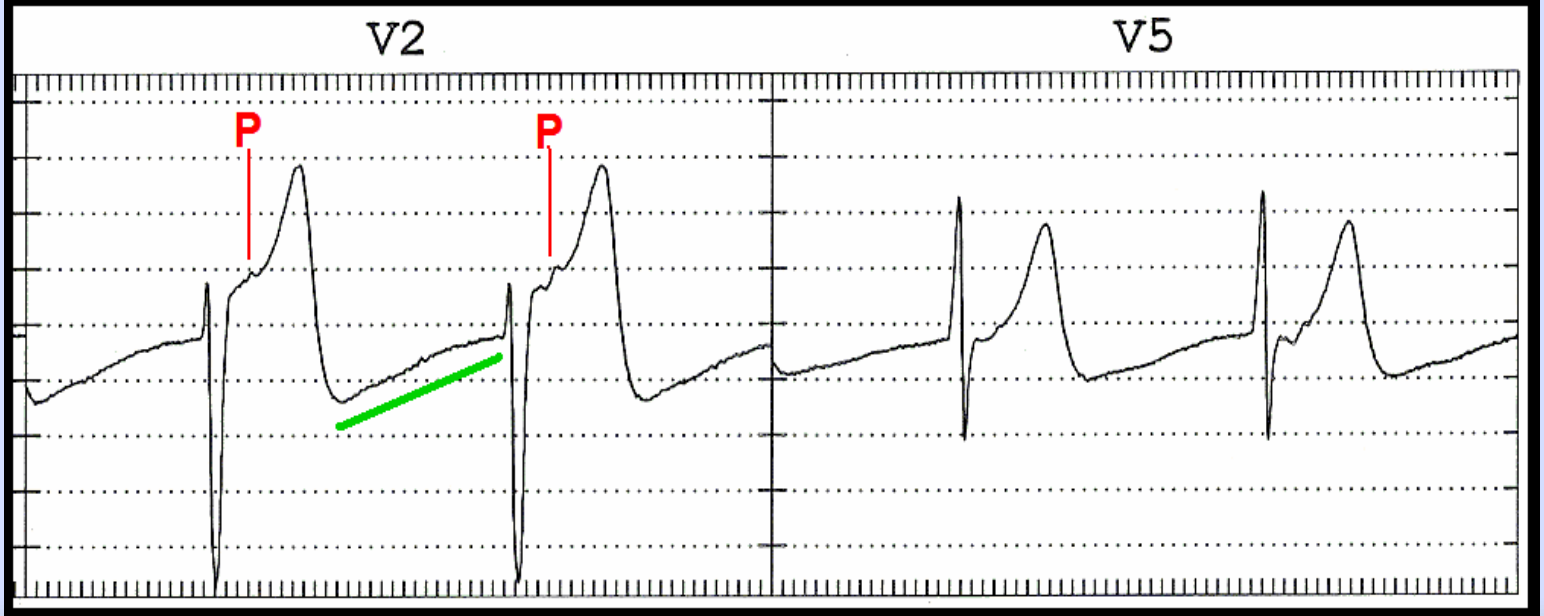
. . .the “flat line” between ECG complexes, when there is no detectable electrical activity . . .

The Isoelectric Line -

it's not always isoelectric !

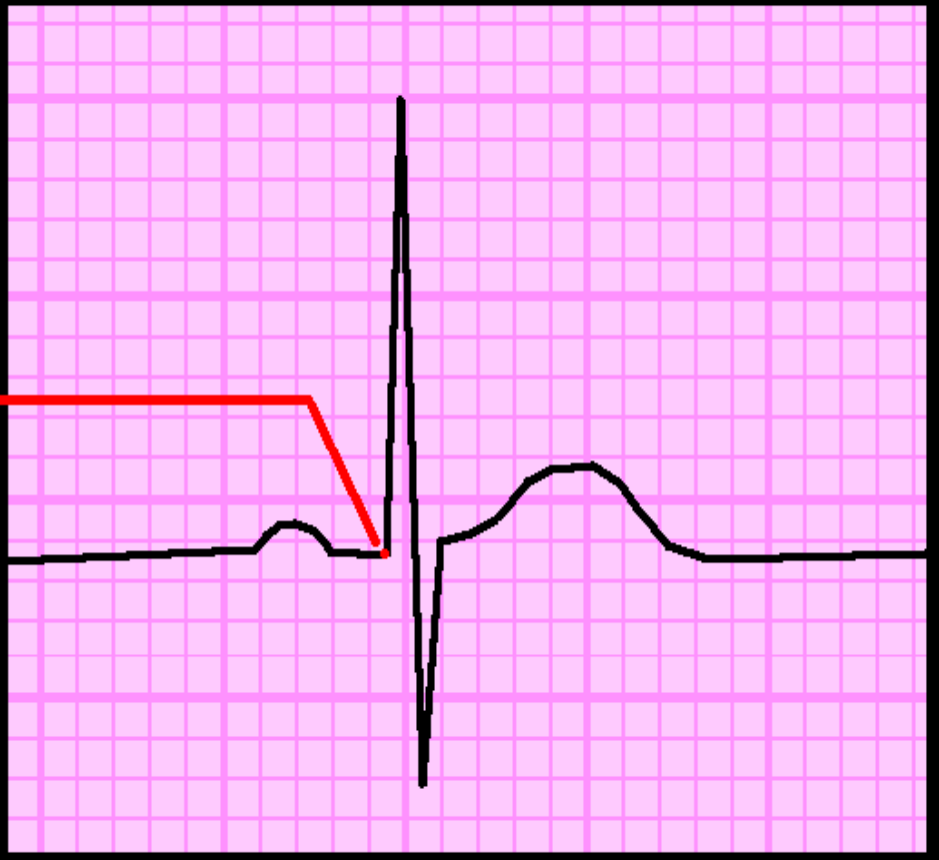
THE ISOELECTRIC LINE

EKG from 13 y/o girl in ACCELERATED JUNCTIONAL RHYTHM.
note: upsloping T-P interval, and P buried in T waves.



THE P-Q JUNCTION

. . . is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS.



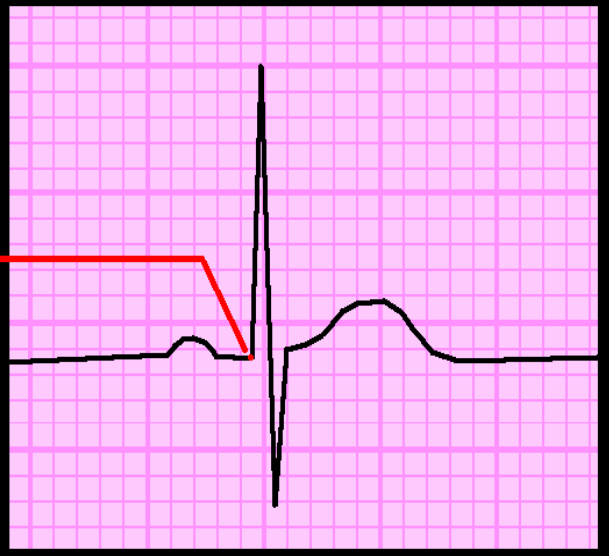
Used for POINT OF REFERENCE for measurement of the J-POINT and the S-T SEGMENT –

— as per the A.H.A., A.C.C., and WANG, ASINGER, and MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

Use the P-Q junction as a reference point for measuring the J Point and ST-Segment when “iso-electric line is not iso-electric !

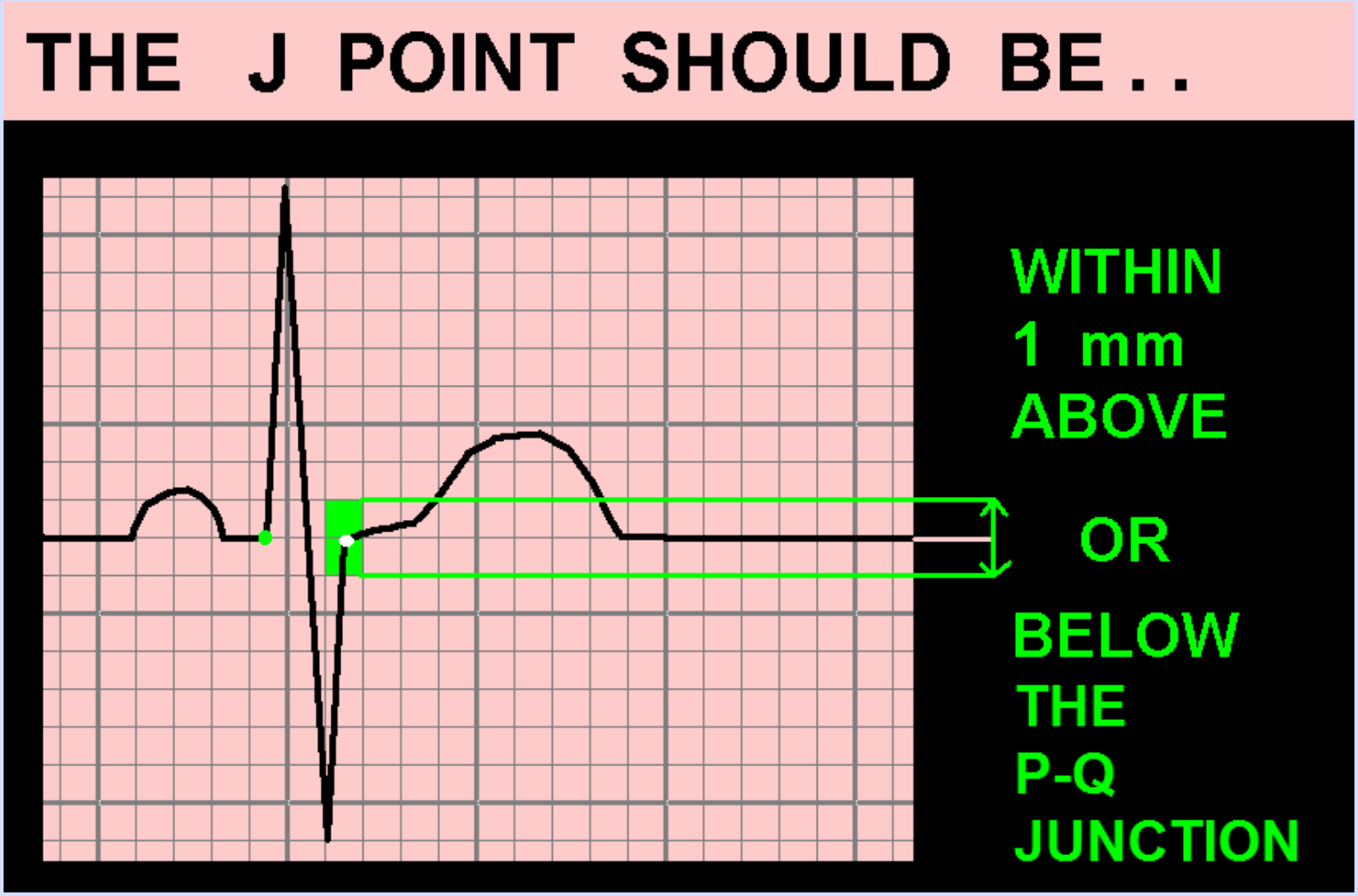
THE P-Q JUNCTION

. . . is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS. Used for POINT OF REFERENCE for measurement of the J-POINT and the S-T SEGMENT –

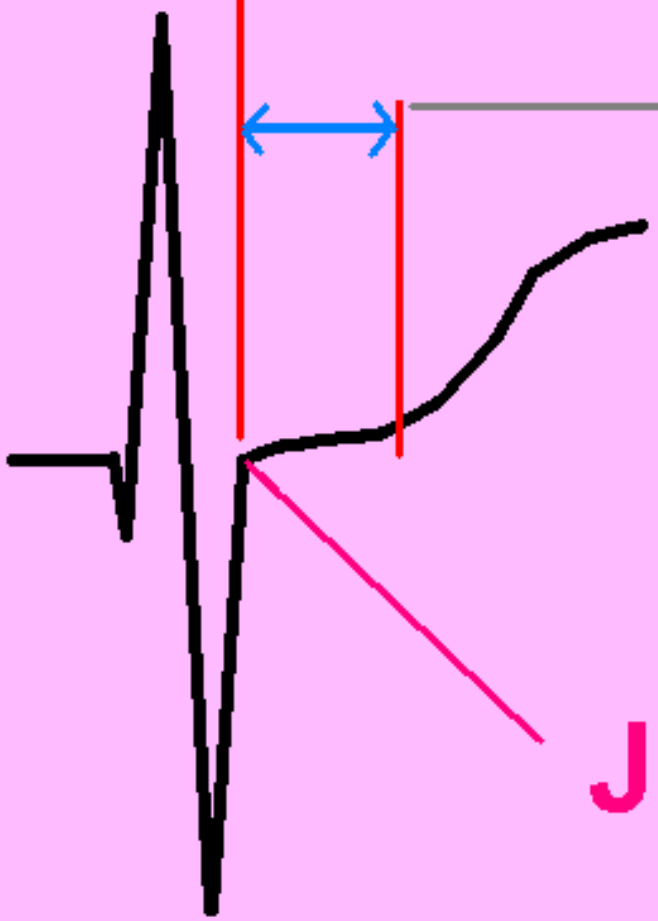


— as per the A.H.A., A.C.C., and WANG, ASINGER, and MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

Defining NORMAL:



THE S-T SEGMENT

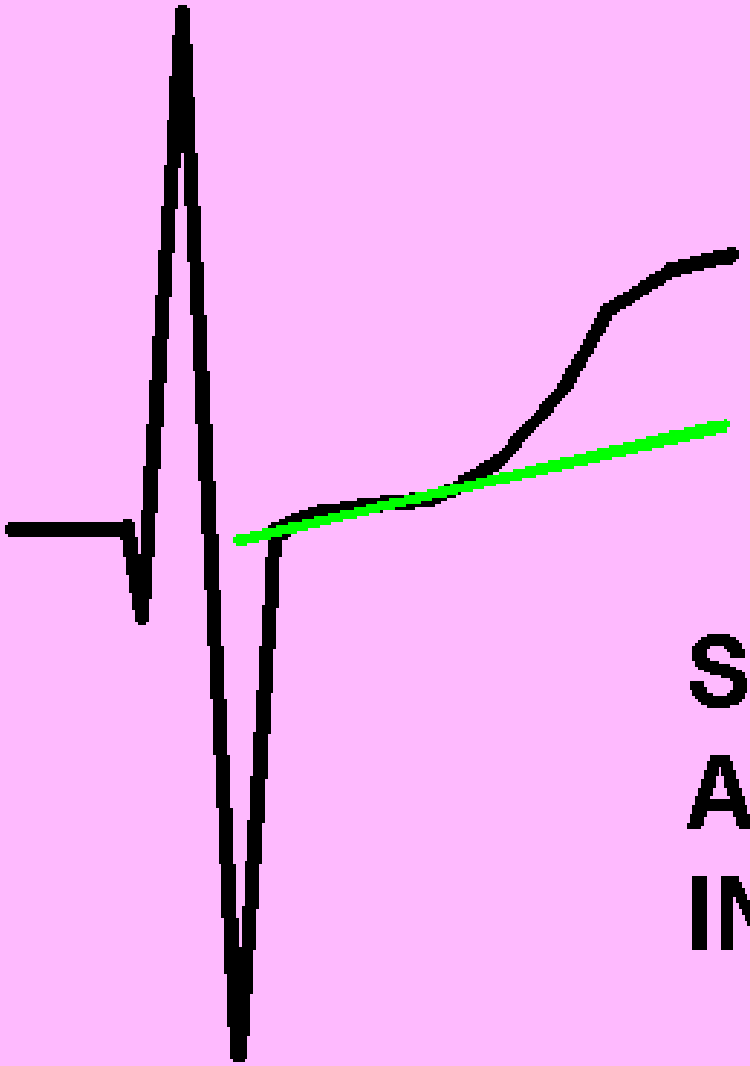


BEGINS AT J POINT

ENDS AT BEGINNING OF T WAVE

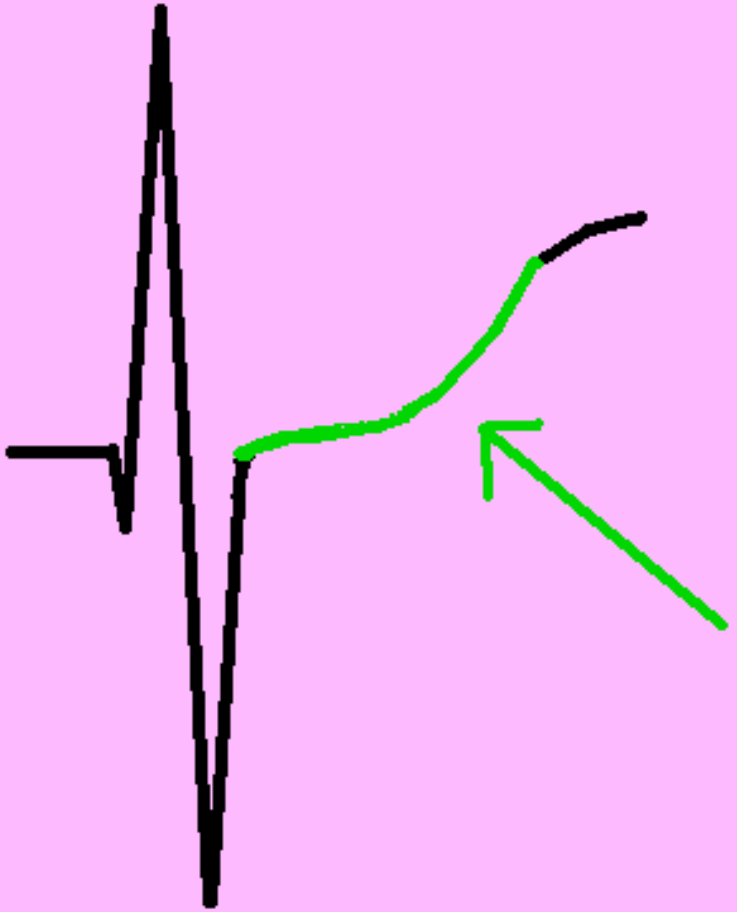
J POINT

THE S-T SEGMENT



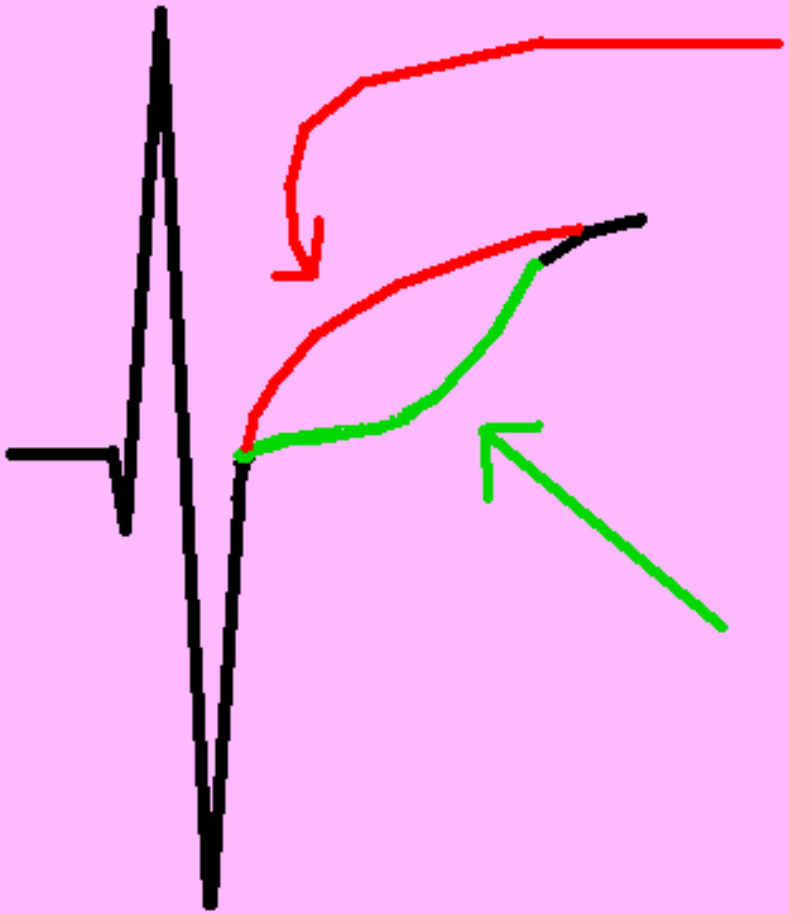
SHOULD HAVE
A "SLIGHT POSITIVE"
INCLINATION

THE S-T SEGMENT



SHOULD BE "CONCAVE" IN SHAPE . . .

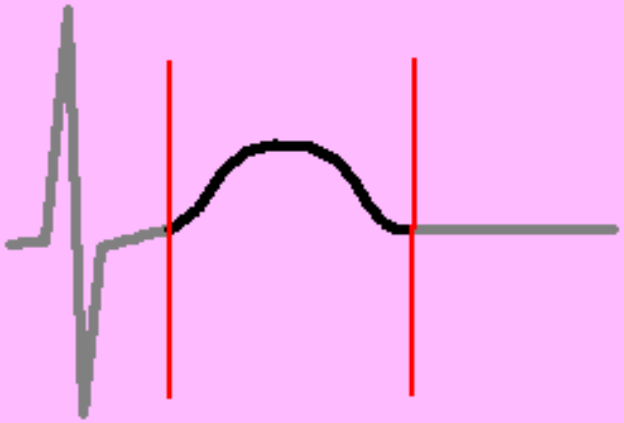
THE S-T SEGMENT



AS OPPOSED TO "CONVEX" IN SHAPE

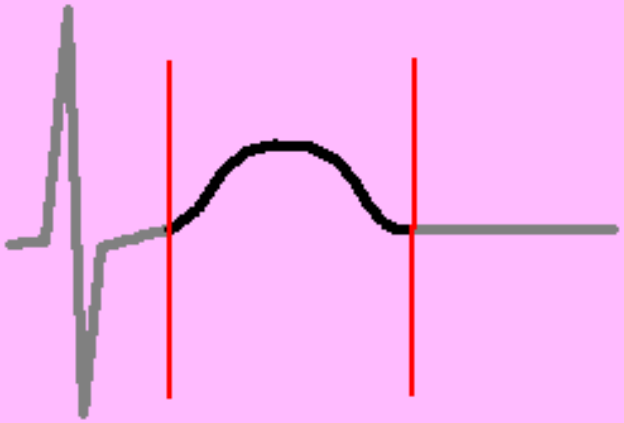
SHOULD BE "CONCAVE" IN SHAPE . . .

THE T WAVE



- SHOULD BE A "NICE," ROUNDED, CONVEX SHAPE
- SHOULD BE SYMMETRICAL

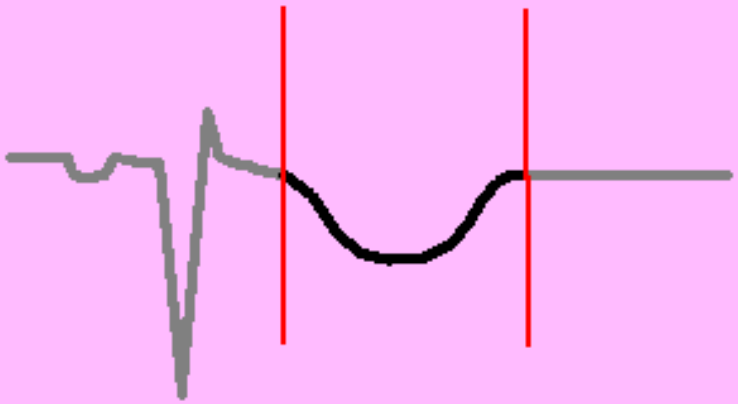
THE T WAVE



- SHOULD BE A "NICE," ROUNDED, CONVEX SHAPE

- SHOULD BE SYMMETRICAL
- SHOULD BE UPRIGHT IN ALL LEADS, EXCEPT AVR

THE T WAVE

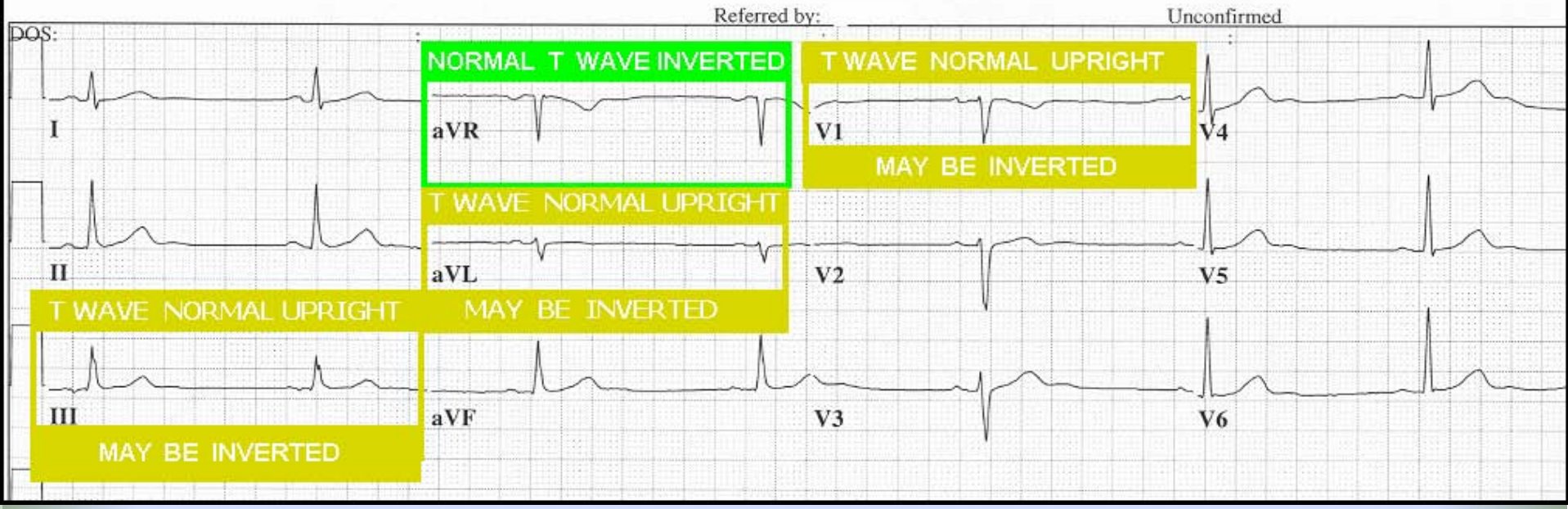


LEAD AVR

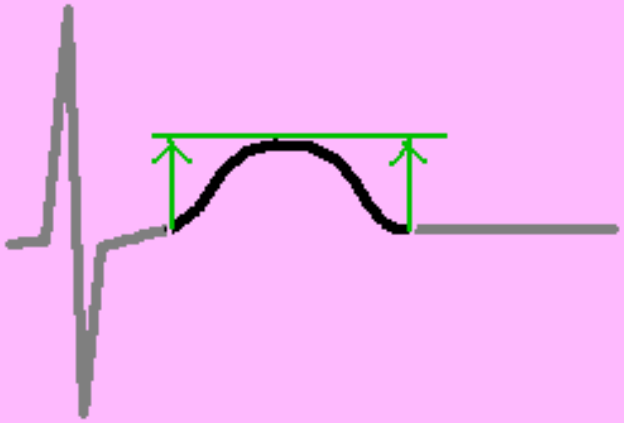
- REMEMBER, IN LEAD AVR *EVERYTHING* IS "UPSIDE-DOWN"

Normal Variants:
T Wave Inversion

Leads where the T WAVE may be INVERTED:



THE T WAVE



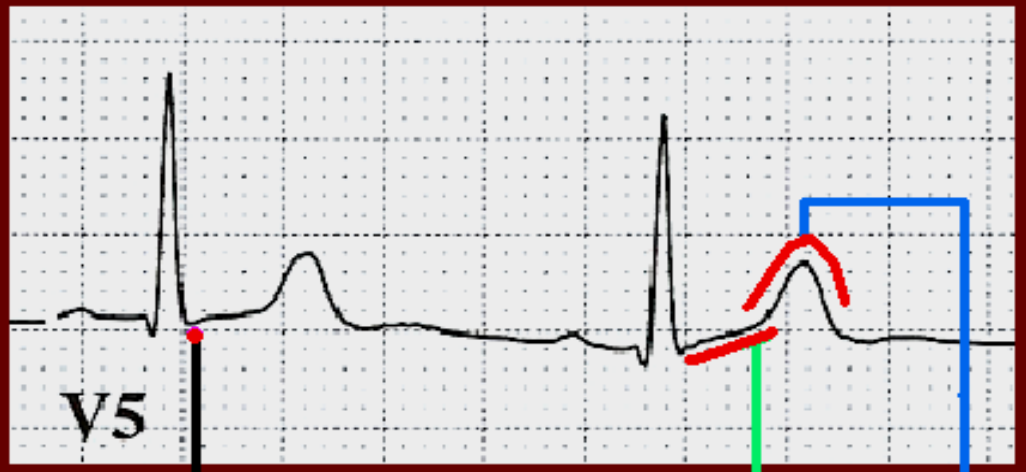
AMPLITUDE GUIDELINES:

- IN THE LIMB LEADS, SHOULD BE LESS THAN 1.0 mv (10 mm)
- IN THE PRECORDIAL LEADS, SHOULD BE LESS THAN 0.5 mv (5 mm)
- SHOULD NOT BE TALLER THAN R WAVE IN 2 OR MORE LEADS.

When QRS duration is NORMAL (< 120 ms):

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 ! !*

ECG Indicators of ACS in Patients with *Normal Width* QRS Complexes (QRS duration < 120 ms)

Multiple patterns of **ABNORMAL:**

- **J Point**
- **ST-Segment**
- **T Wave**

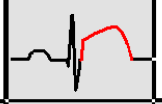
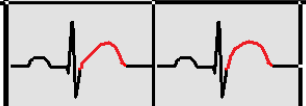
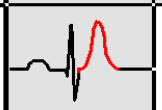
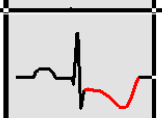
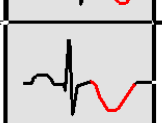
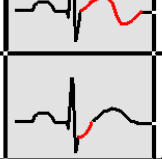
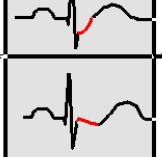
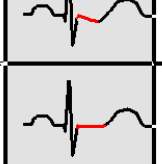
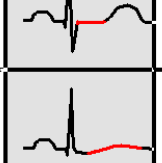
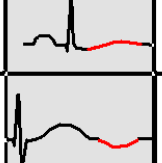
configurations **may indicate ACS.**

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

BOOK PAGE: 83

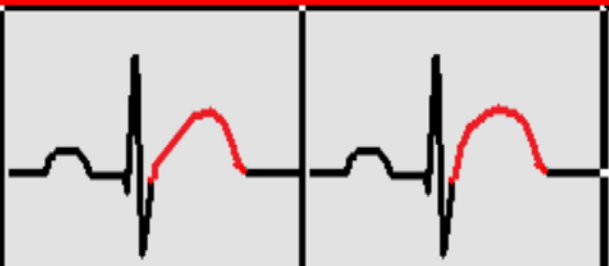
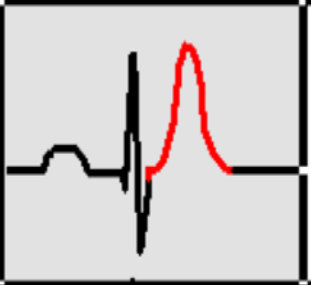
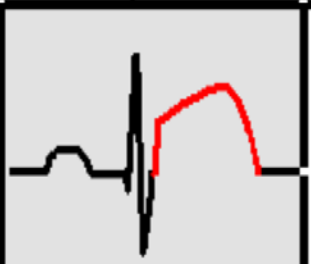
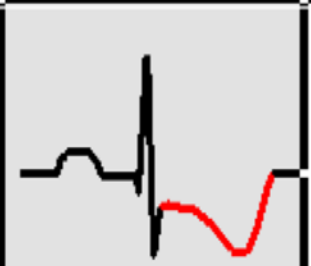
EKG PATTERNS of ACS & ISCHEMIA

-- 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

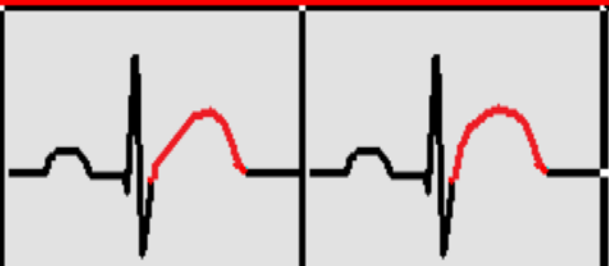
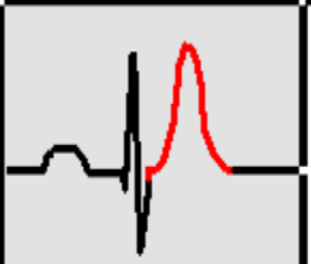
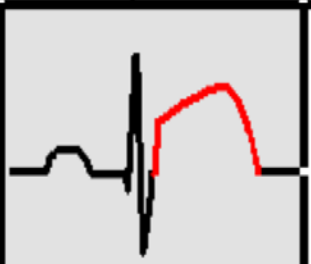
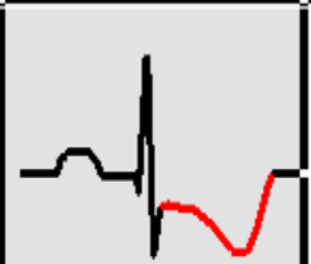
PATTERNS of ACS & ISCHEMIA

-- 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**

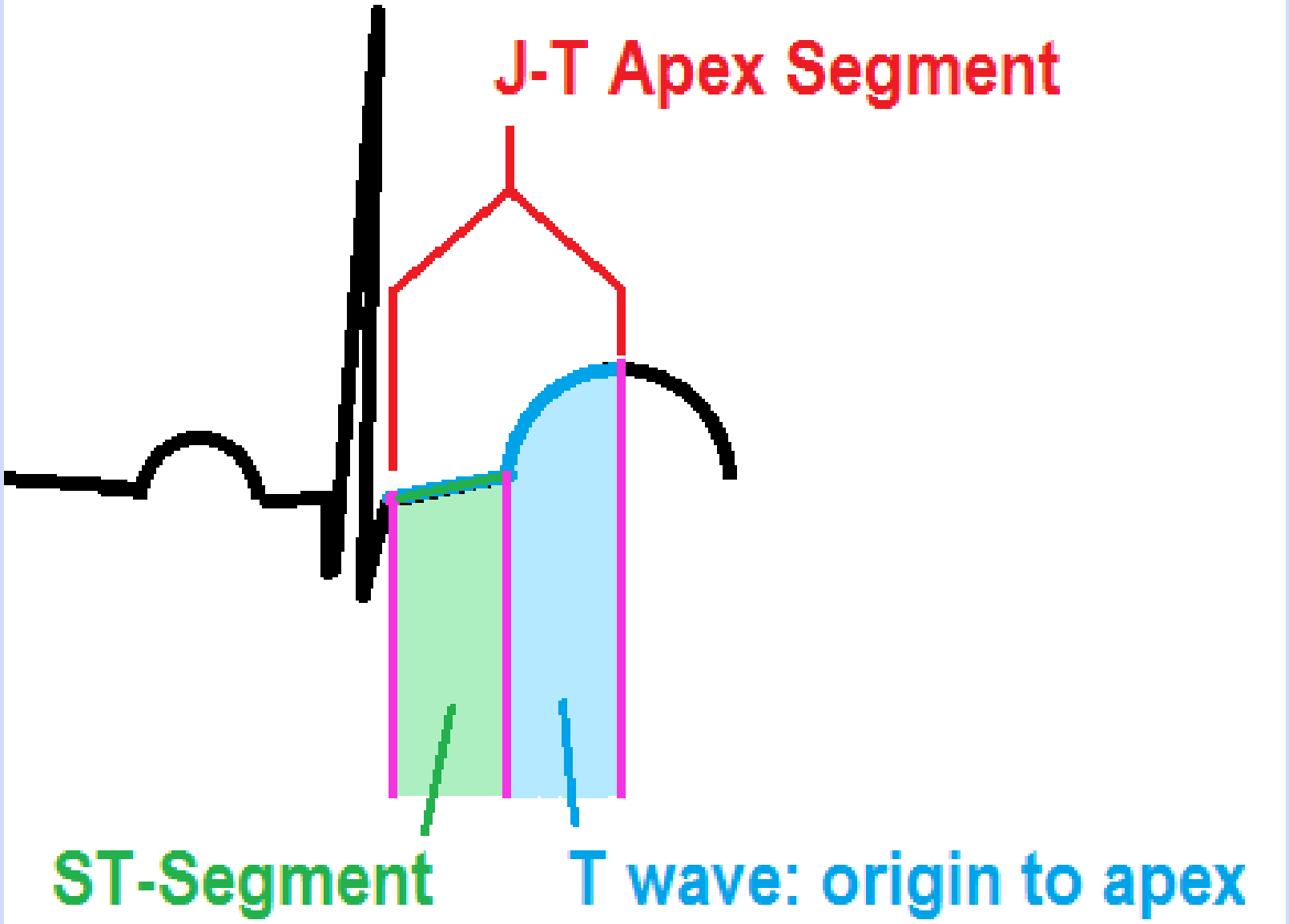
PATTERNS of ACS & ISCHEMIA

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

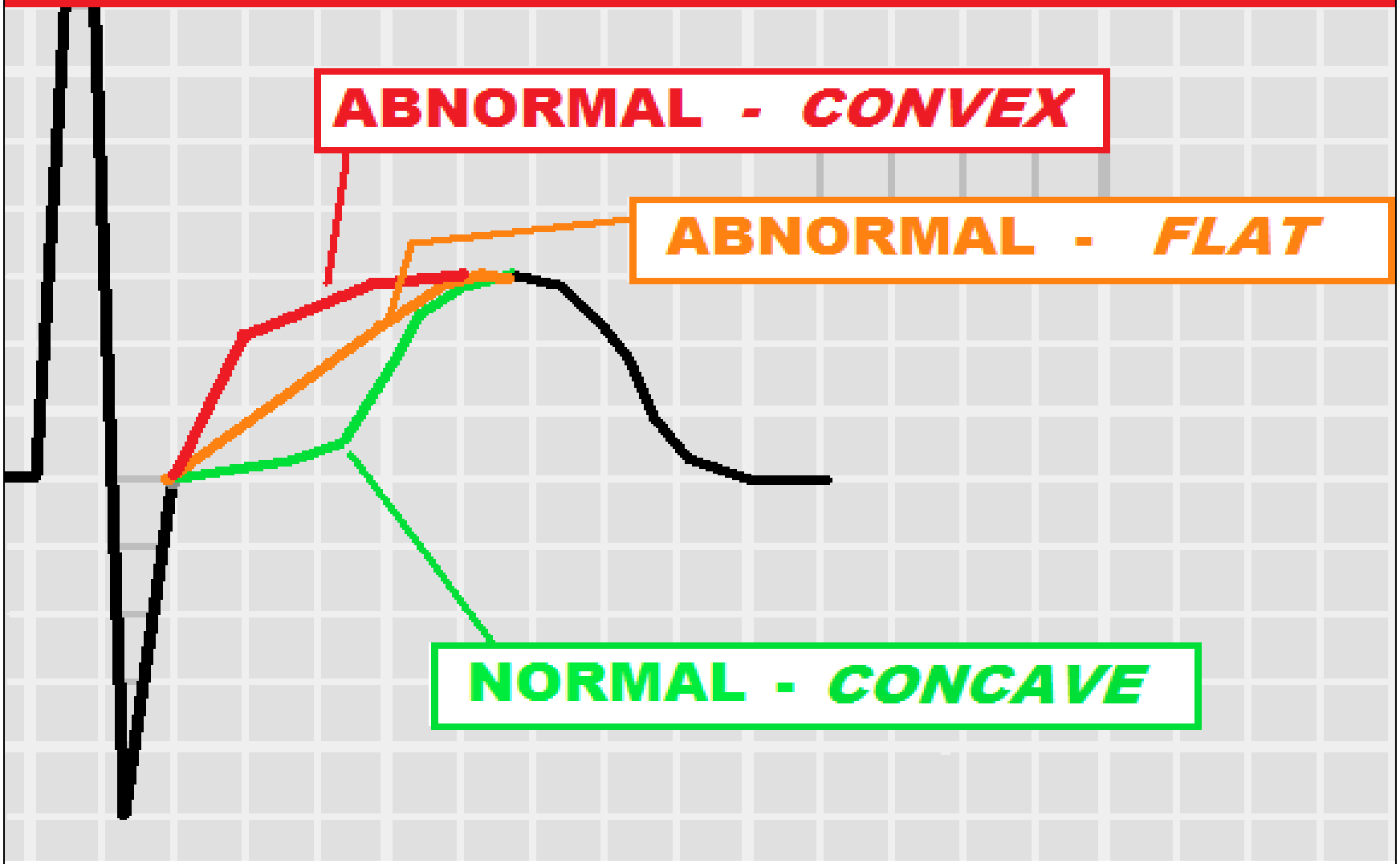
!	FLAT or CONVEX J-T APEX SEGMENT		**ACUTE MI** *EARLY PHASE*
!	HYPER-ACUTE T WAVE		**ACUTE MI** *EARLY PHASE*
!	S-T SEGMENT ELEVATION at J POINT		**ACUTE MI**
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

ECG Patterns associated with "EARLY PHASE MI:"

- *J-T Apex abnormalities*
- *Hyper-Acute T Waves*
- *ST-T Wave Changes*


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

J - T APEX SEGMENT VARIATIONS

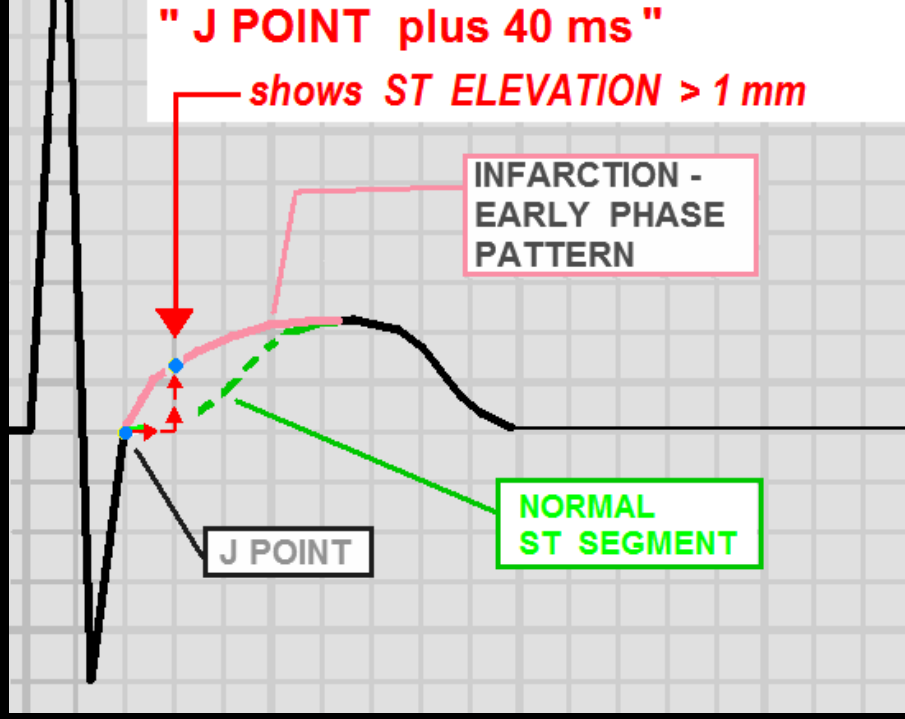


PATTERNS of EARLY INFARCTION

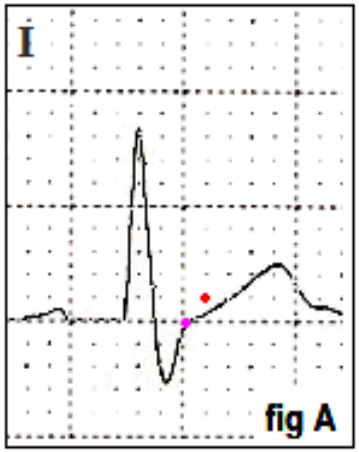
-- FLAT and CONVEX J-T APEX SEGMENTS

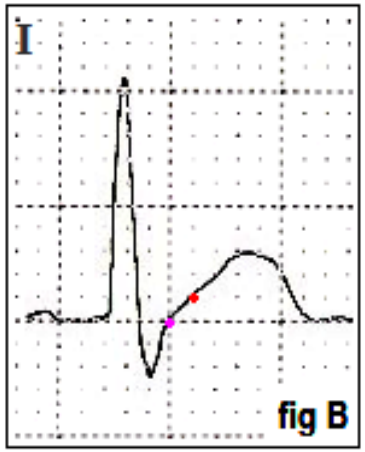
WHEN EVALUATING for ST SEGMENT ELEVATION . . . . . .

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.

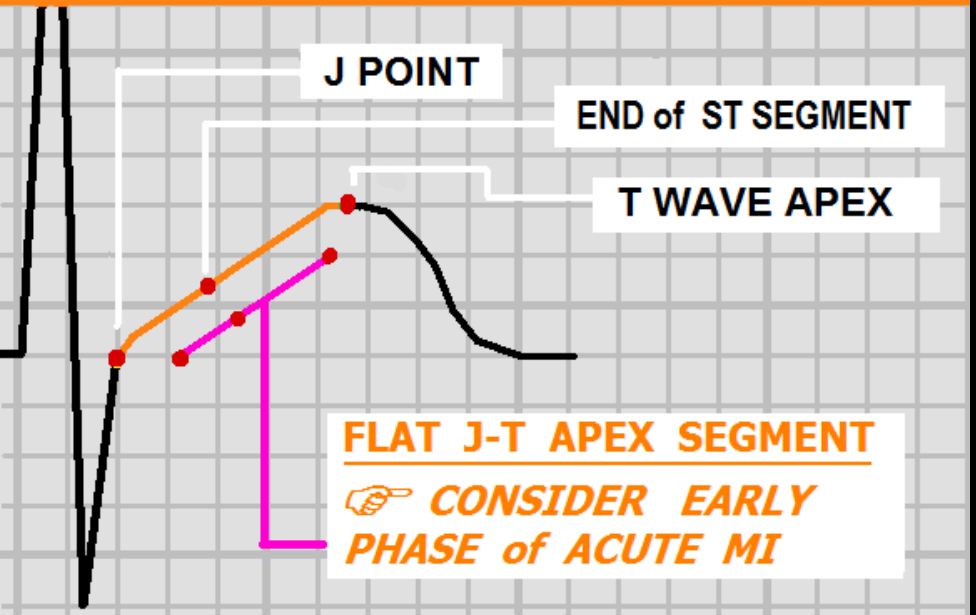




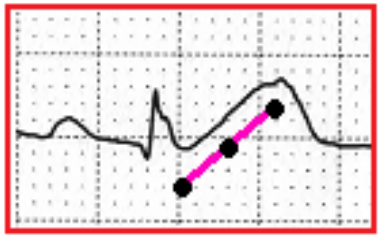
During a 20 second BALLOON OCCLUSION of the patient's LAD during routine PTCA, the ST segment assumes a CONVEX shape. When measured 40 ms beyond the J POINT, the ST segment is elevated > 1 mm. This phenonemon is seen routinely in the cath lab prior to the occurance of ST ELEVATION at the J POINT during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

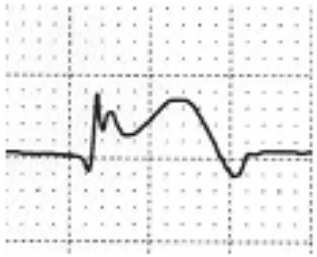


1839 hrs

41 y/o FEMALE

In ER C/O CHEST PAIN x 30 minutes.

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



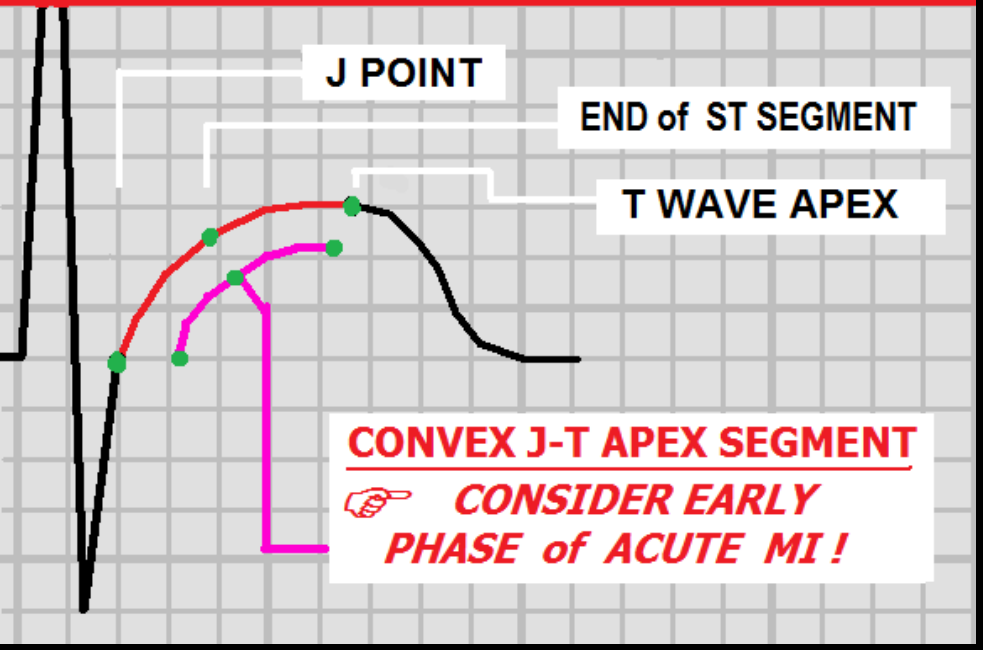
1850 hrs

STEMI - INFERIOR WALL

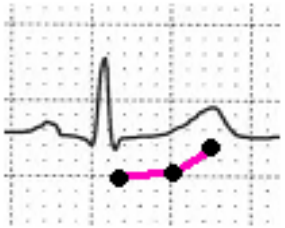
11 MINUTES LATER, S-T ELEVATION at the J POINT IS NOTED.

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

ABNORMAL J-T APEX SEGMENT

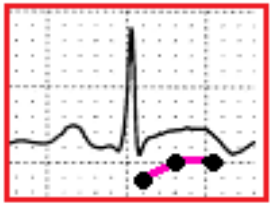


LEAD I



53 y/o MALE

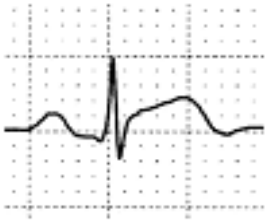
1 yr. PRIOR TO MI
NORMAL EKG
CONCAVE J - T APEX SEGMENT



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

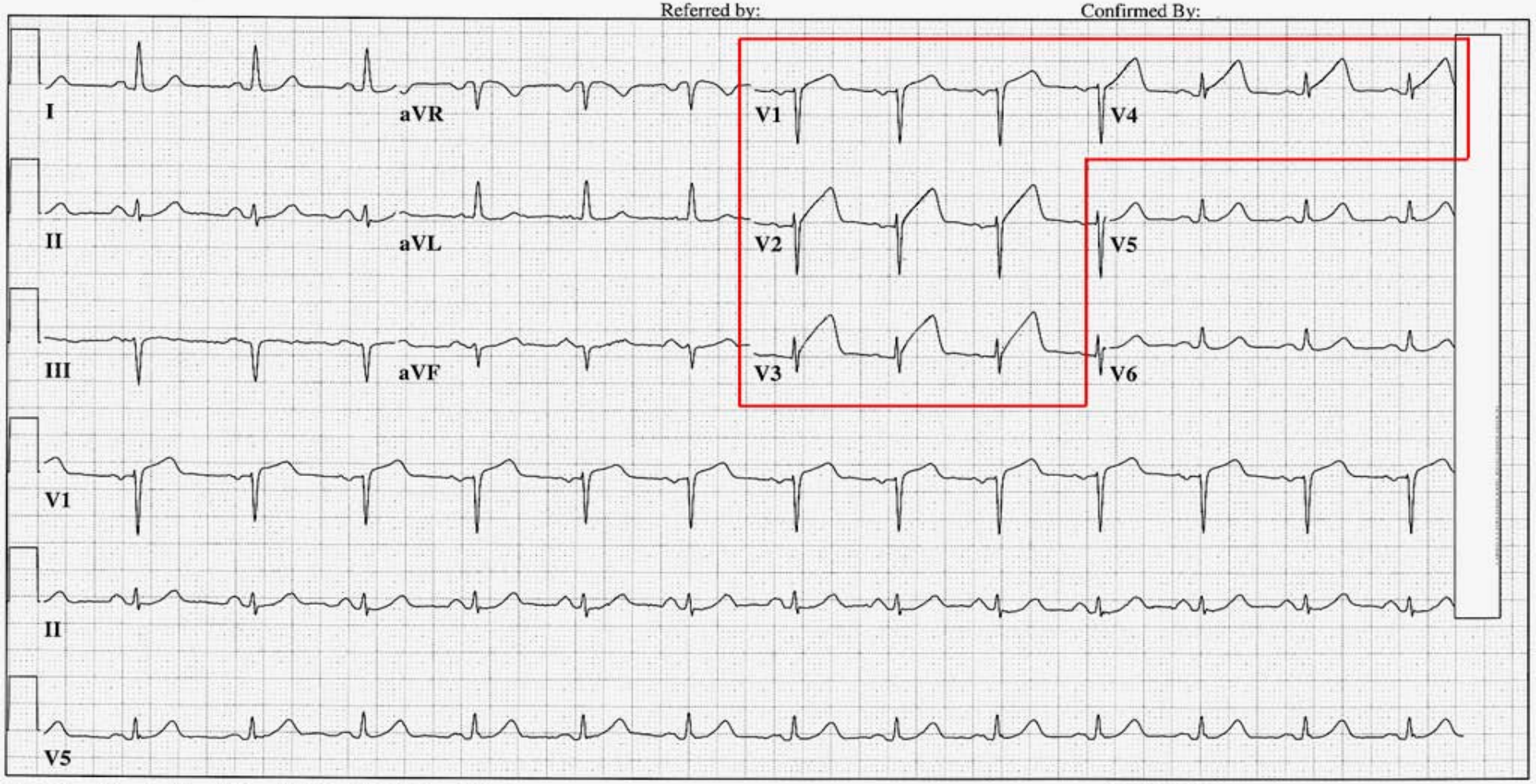
Vent. rate	80	BPM
PR interval	154	ms
QRS duration	78	ms
QT/QTc	380/438	ms
P–R–T axes	51 –24	38

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

Normal sinus rhythm
Normal ECG
No previous ECGs available

Technician: W Ruppert

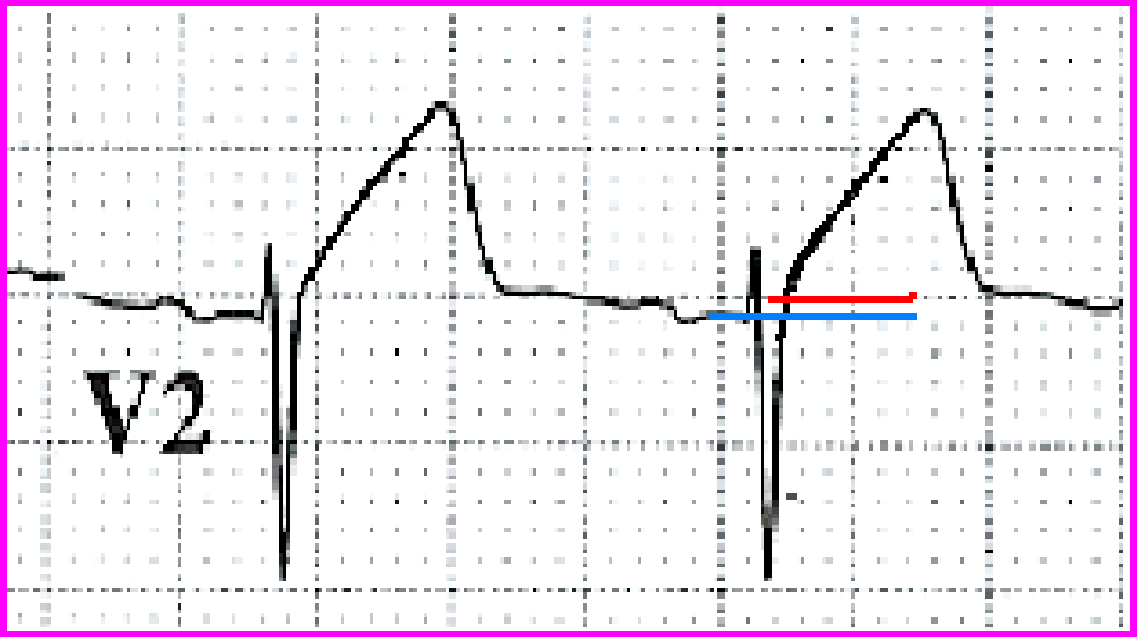
Referred by: Confirmed By:



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

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

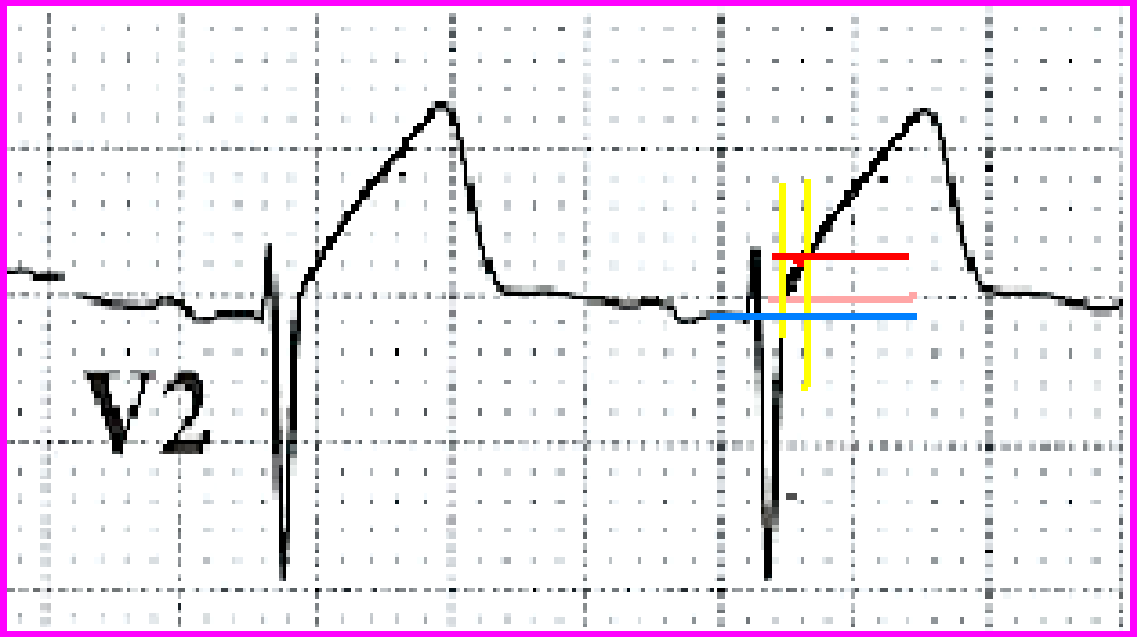
measurement of S-T elevation



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

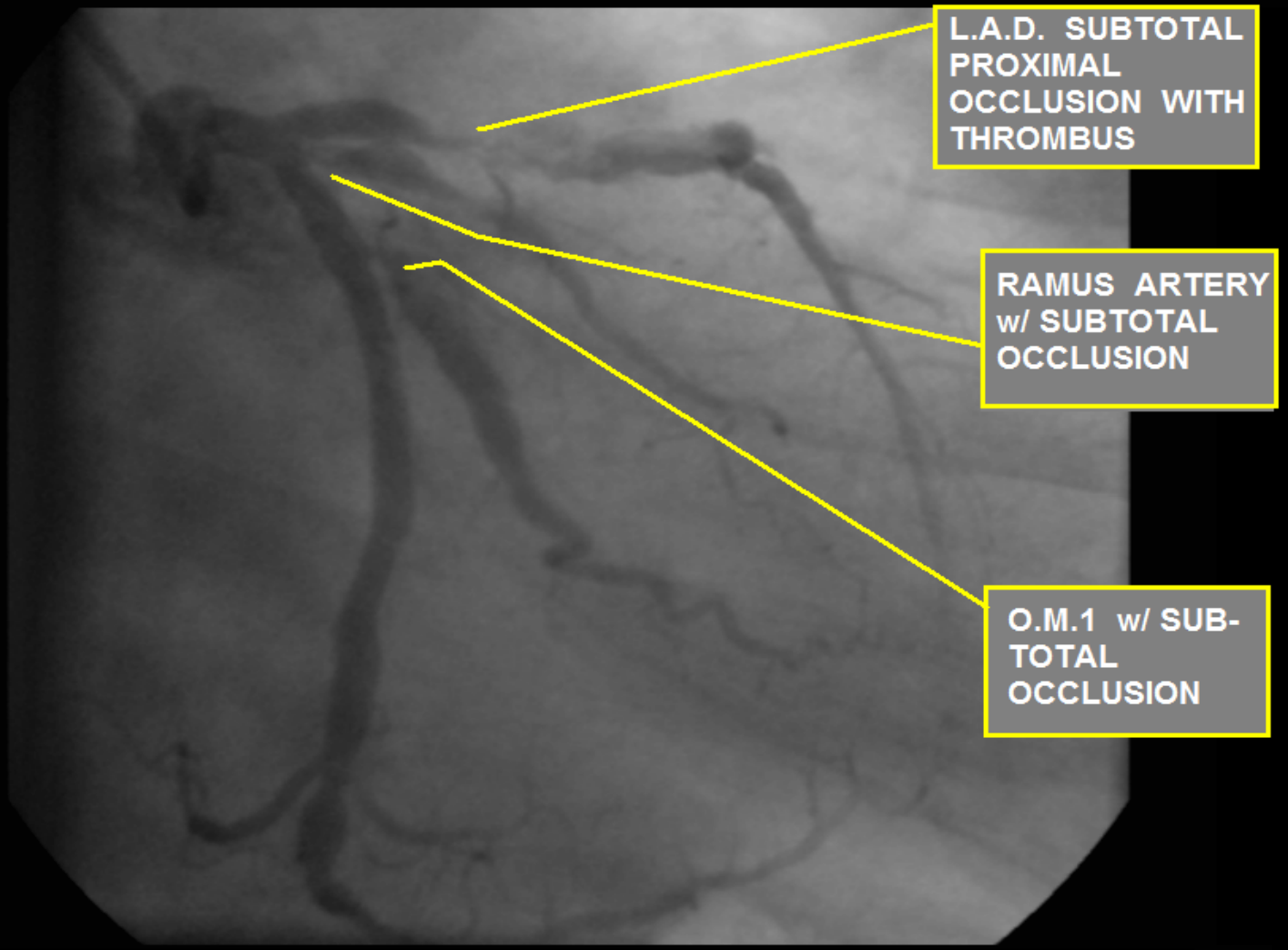


S-T elevation at J point = 0.5 mm

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

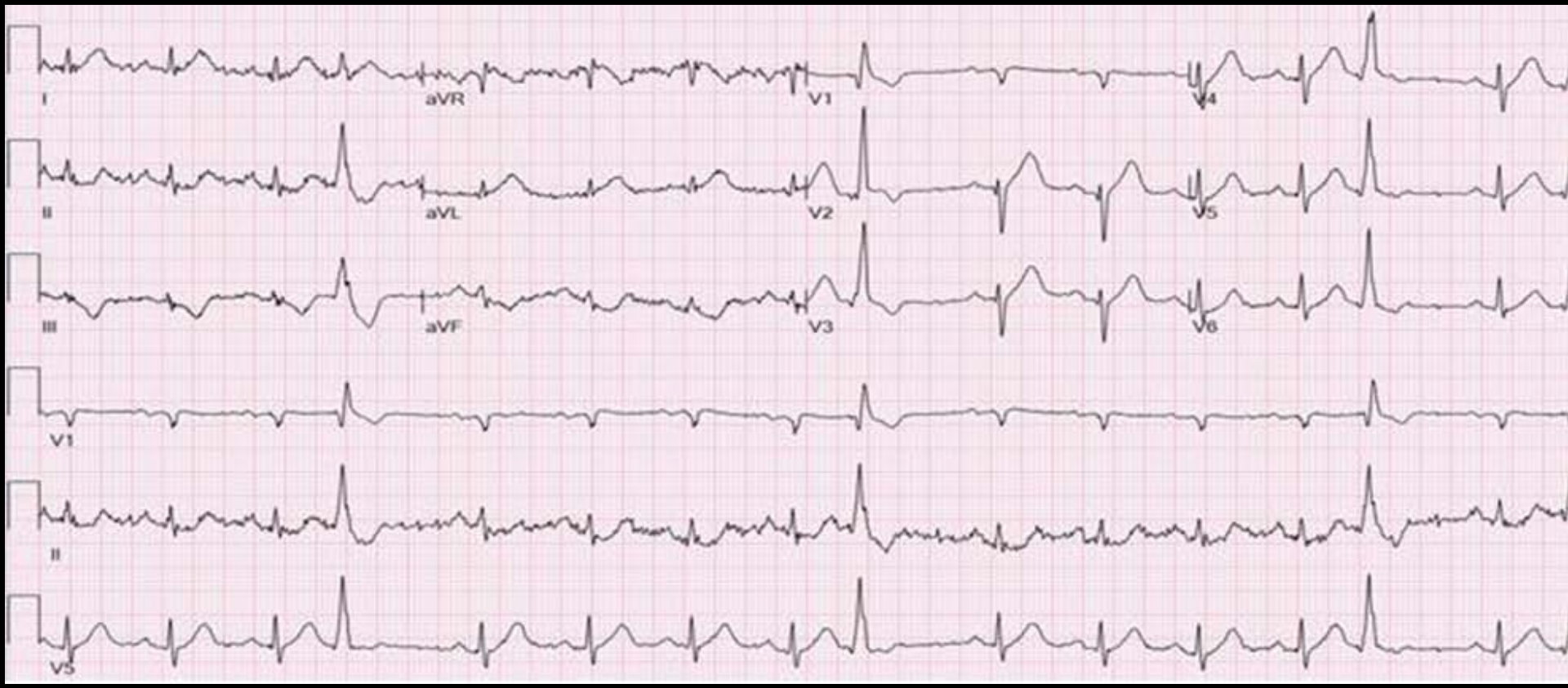
ACUTE MI = S-T elev. > 1.0 mm

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



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

J-T Apex Abnormality – Case 2:
44 y/o male with substernal CP x 30 min . . .



A special "thanks!" to Chelsie Carter, RN, BSN, Cardiovascular Coordinator Mountainview Regional Medical Center, Las Cruces, New Mexico

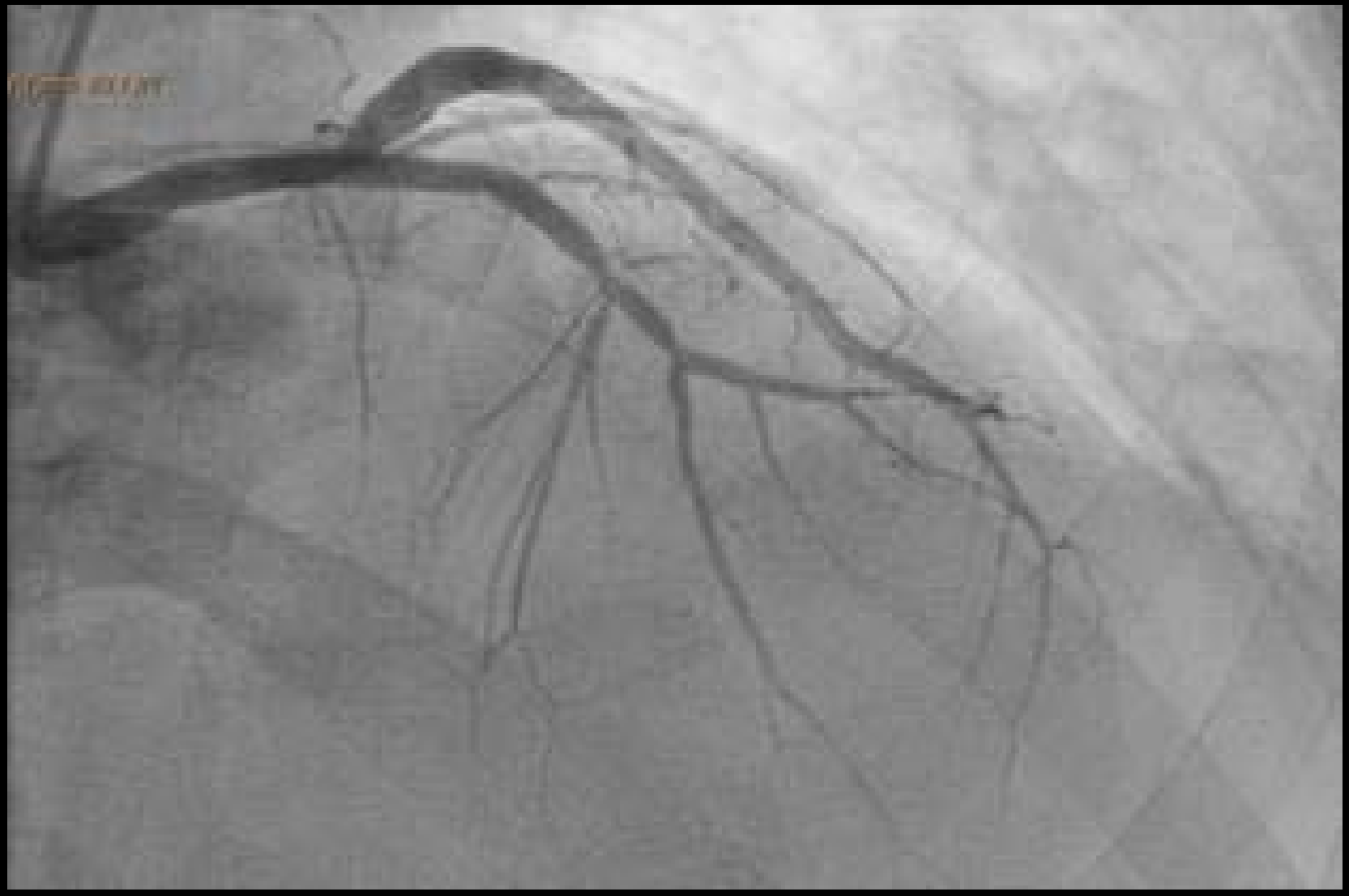
Flattening of J-T Apex segment . . . .

ST-Segment Depression, Inferior Leads
II, III and AVF.

Consistent with “Reciprocal ST Depression”
from STEMI (on opposite side of myocardium)

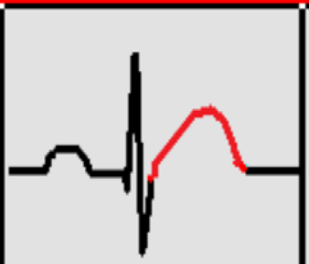
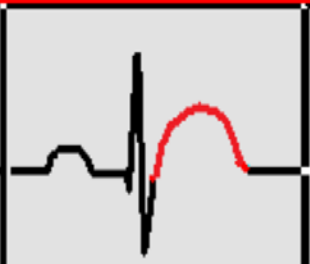
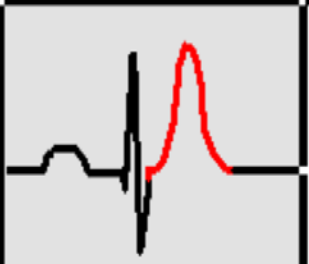
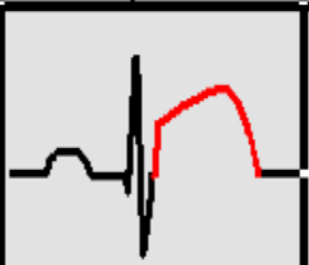
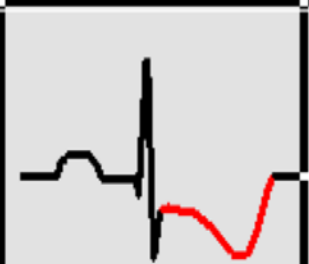
Proximal Total Occlusion of LAD Artery

Post-PCI / Stent, Proximal LAD lesion, 44 y/o male:

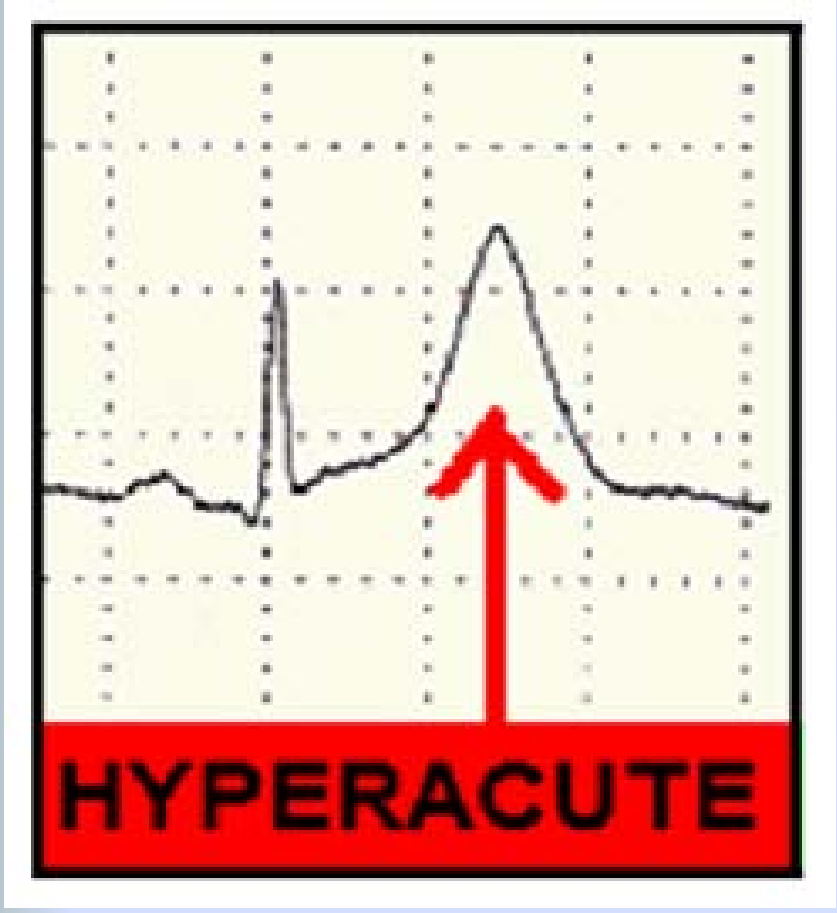


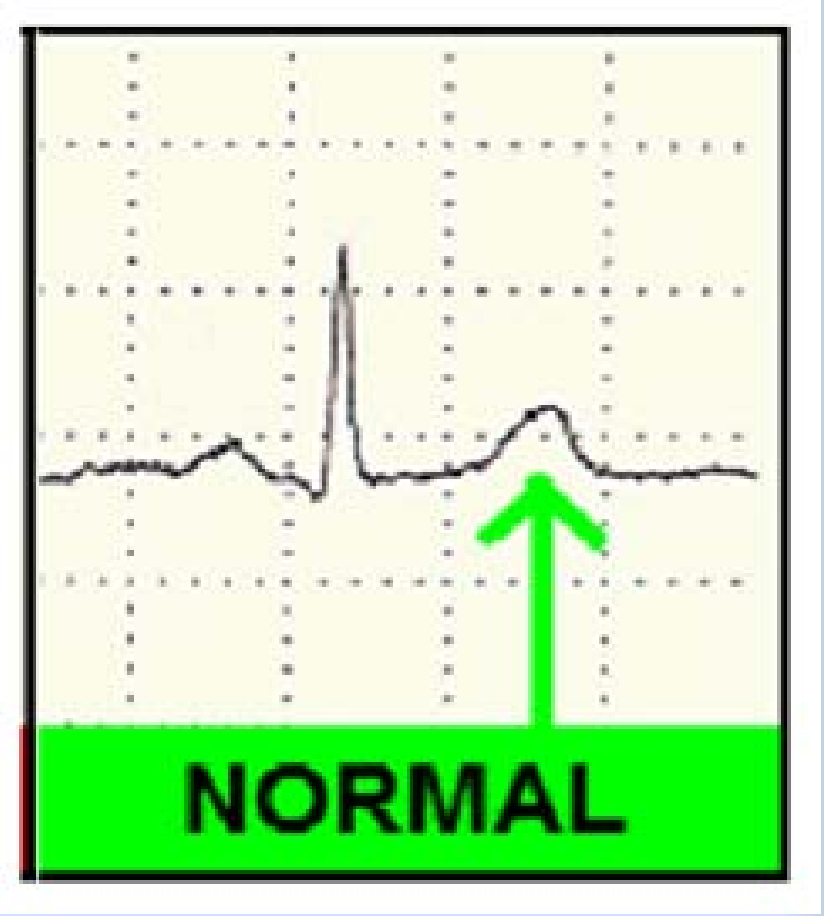
PATTERNS of ACS & ISCHEMIA

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

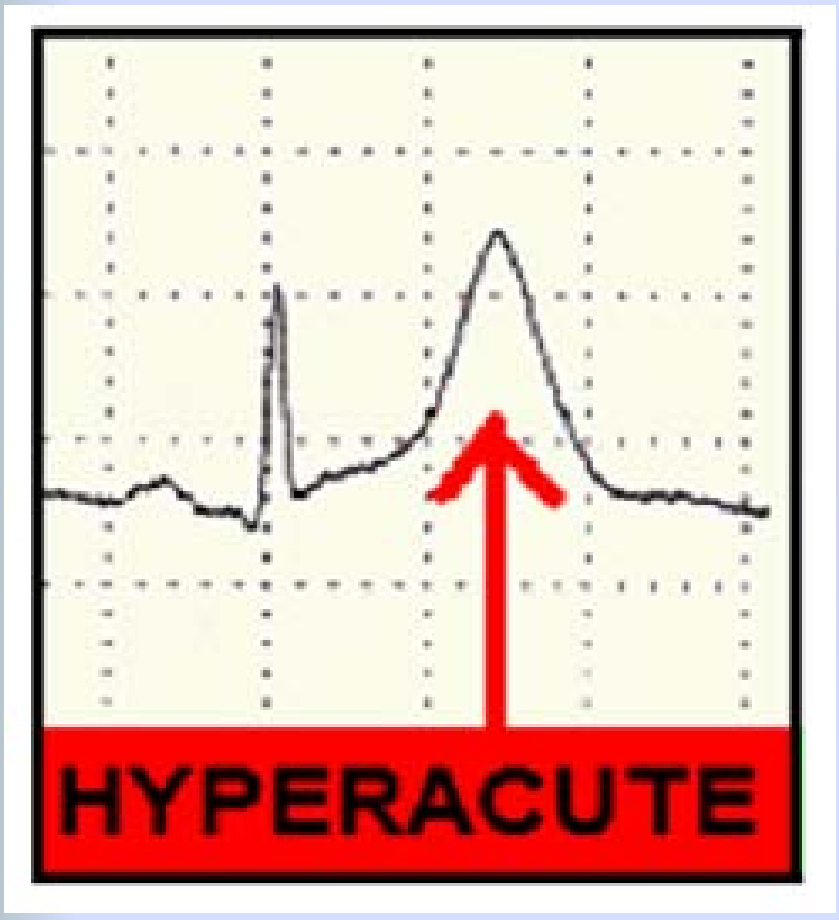
!	FLAT or CONVEX J-T APEX SEGMENT			**ACUTE MI** *EARLY PHASE*
!	HYPER-ACUTE T WAVE			**ACUTE MI** *EARLY PHASE*
!	S-T SEGMENT ELEVATION at J POINT			**ACUTE MI**
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T			- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

T waves should not be HYPERACUTE



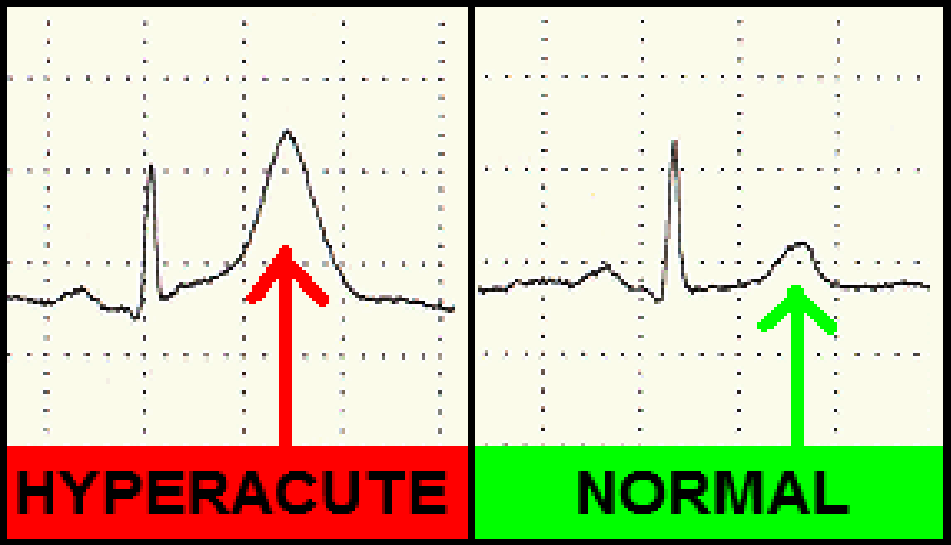


HYPERACUTE T Waves may indicate:



- **Early phase Acute MI**
- **Transmural ischemia** (usually seen in one region of the ECG)
- **Hyperkalemia** (seen globally across ECG)
- **Hypertrophy**

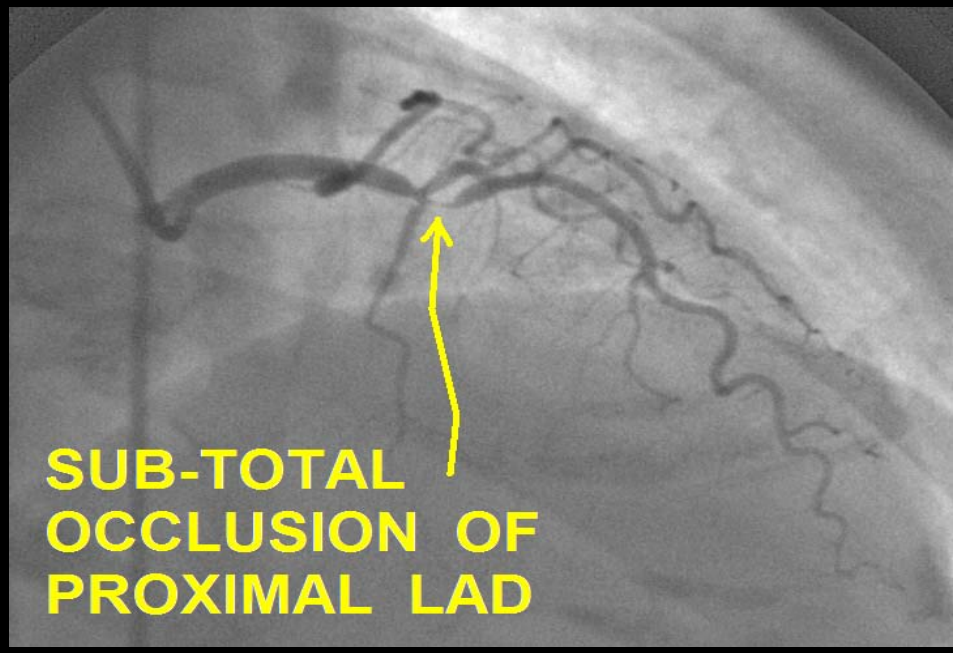
HYPERACUTE T WAVES



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

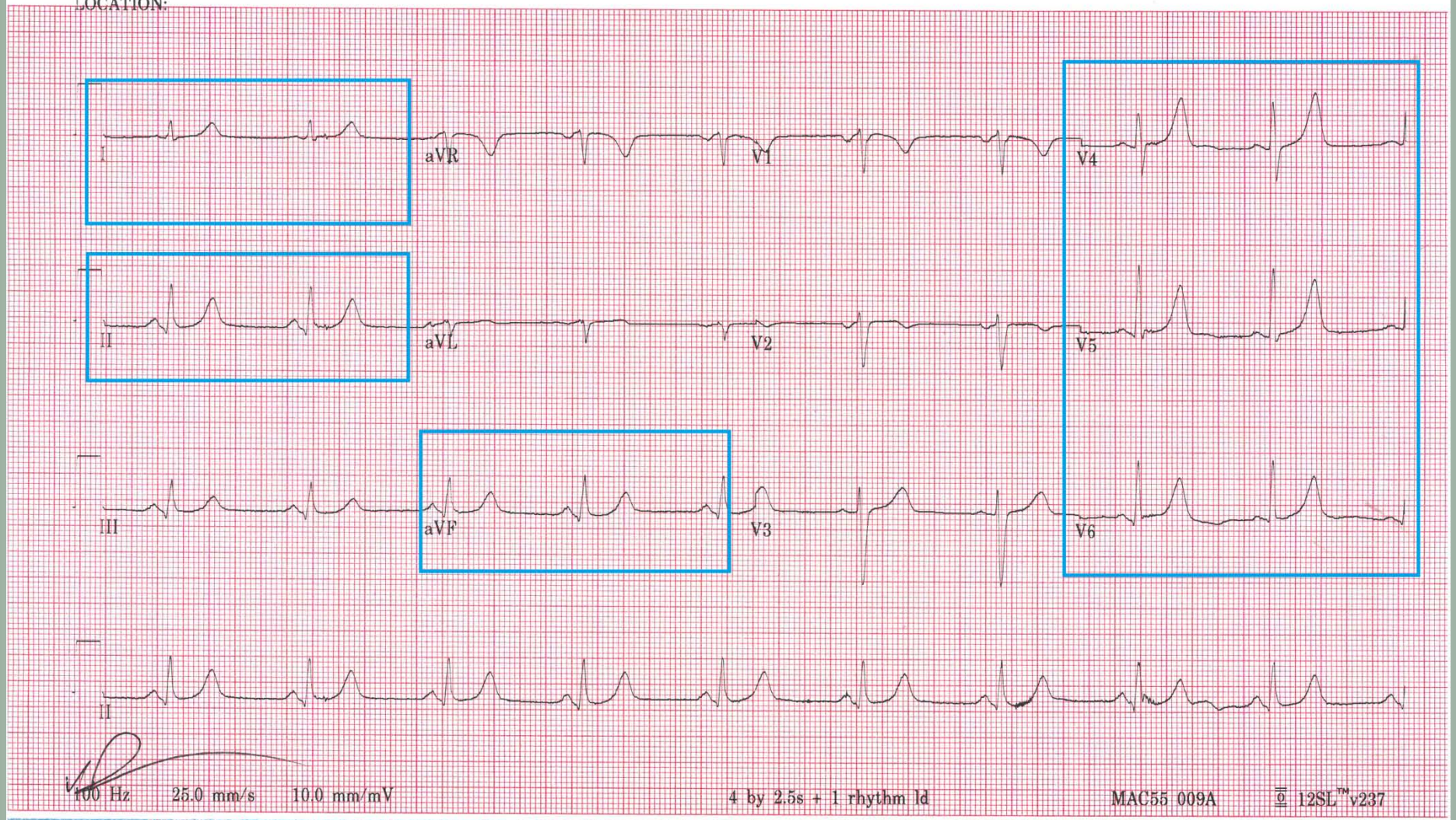
K+ = 6.7

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

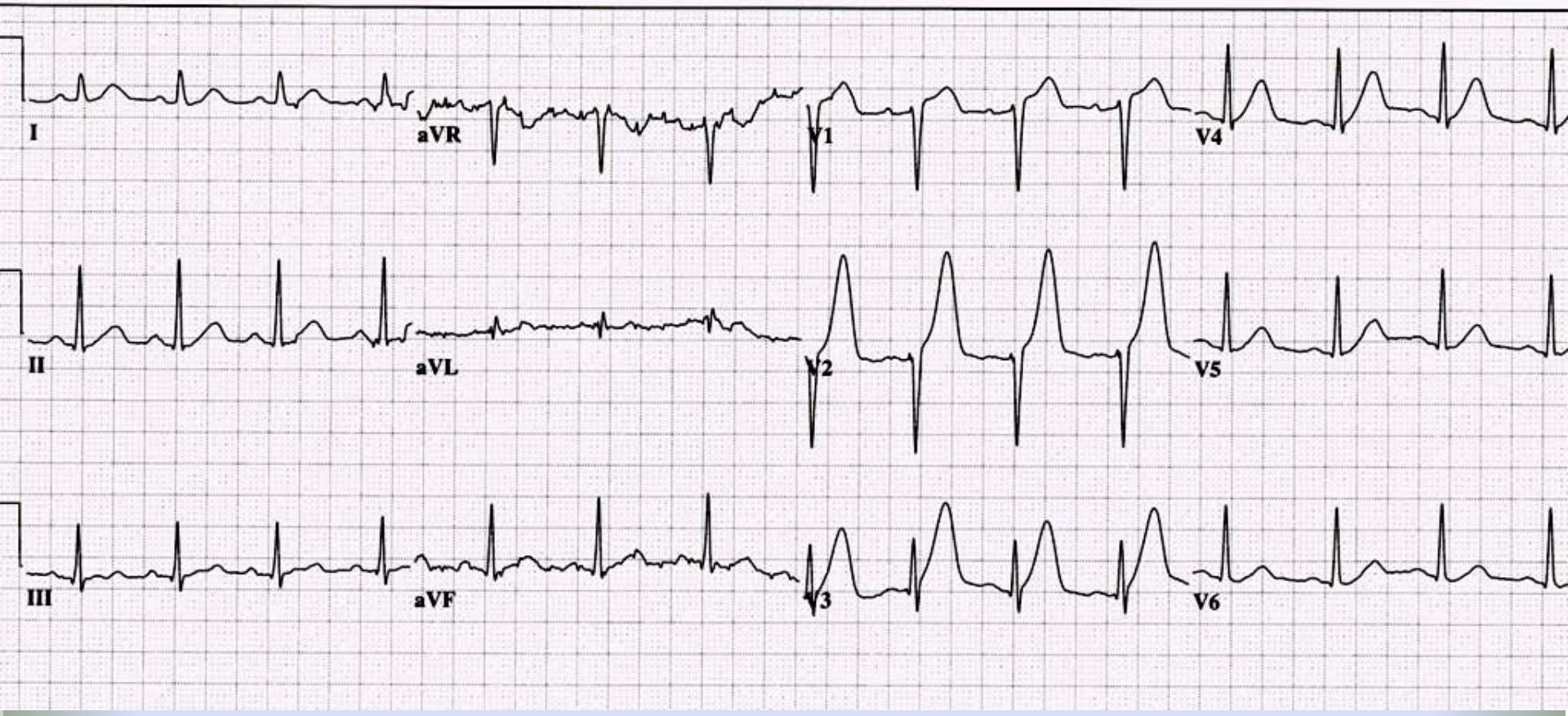
30 yr
Male Black

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
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

HIGHLIGHTED AREAS = HYPERACUTE T WAVES

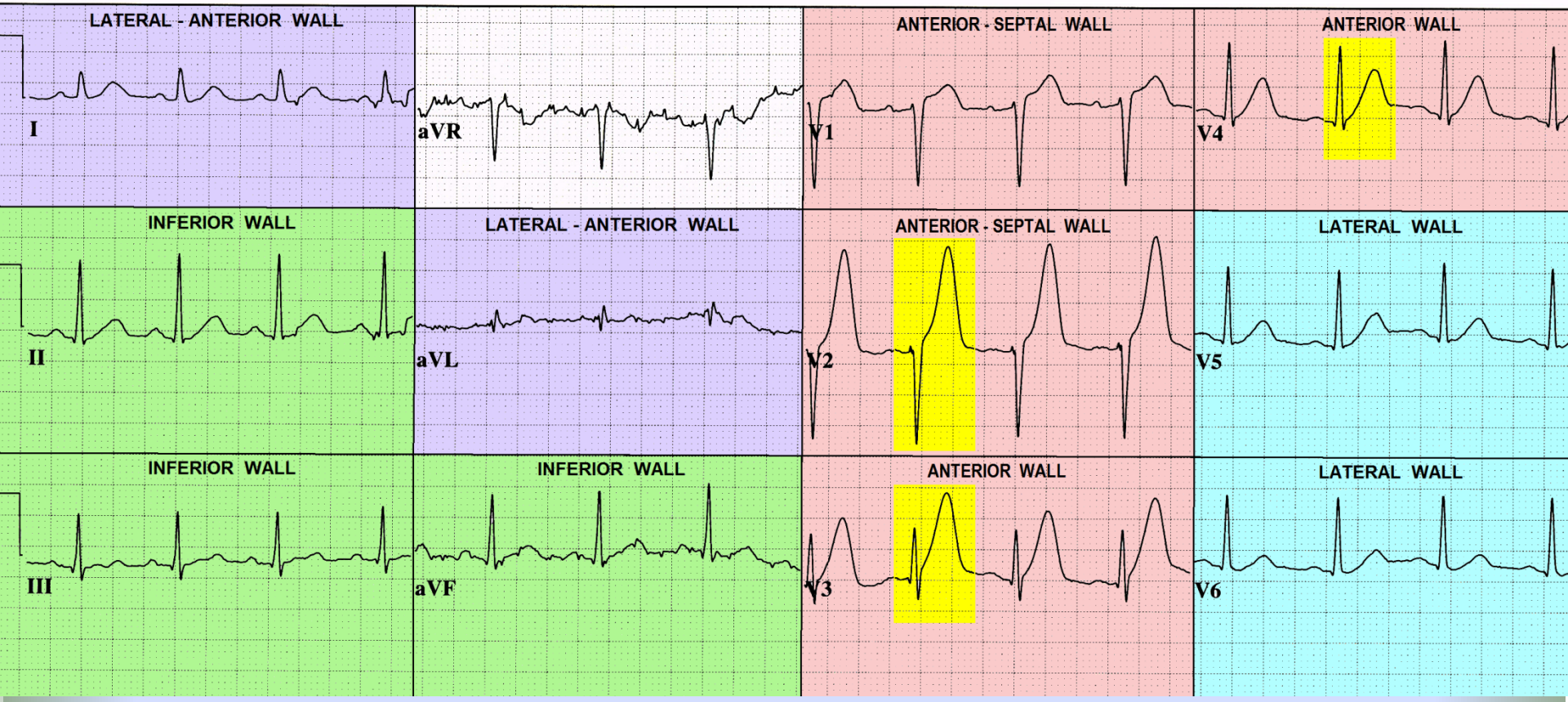
CORONARY ARTERIAL DISTRIBUTIONS:

V1 - V4 = LEFT ANTERIOR DESCENDING (LAD)

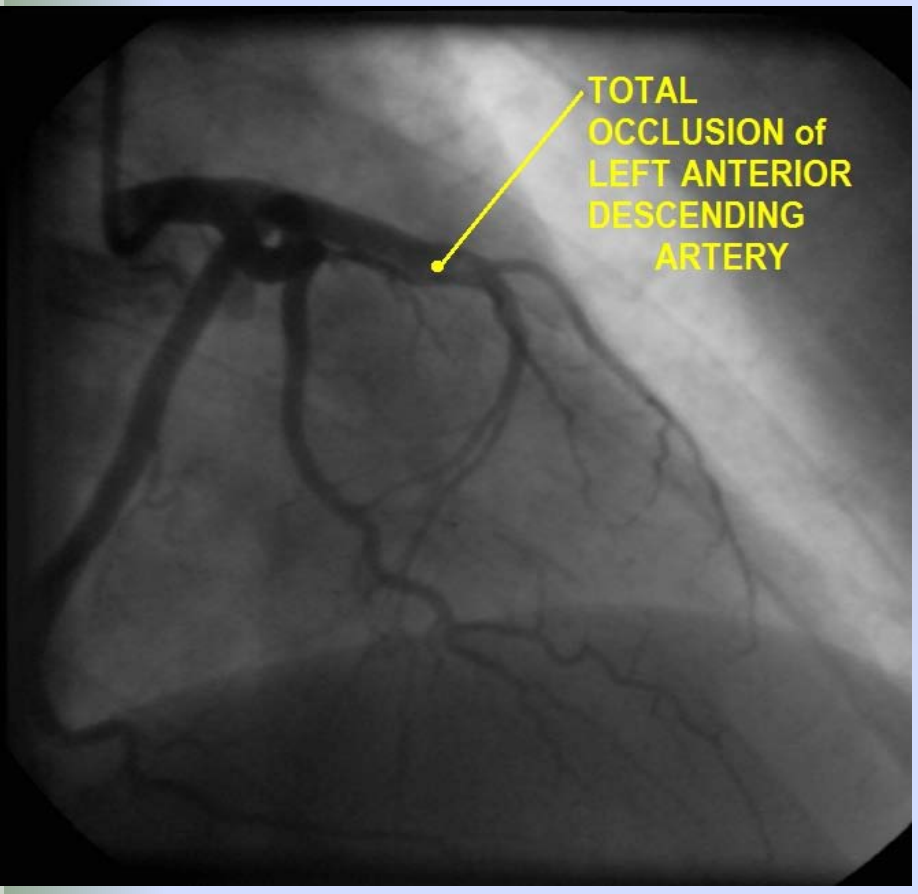
I, AVL = DIAGONAL (DIAG) off the LAD or OBTUSE MARGINAL (OM) off CIRCUMFLEX (CX)

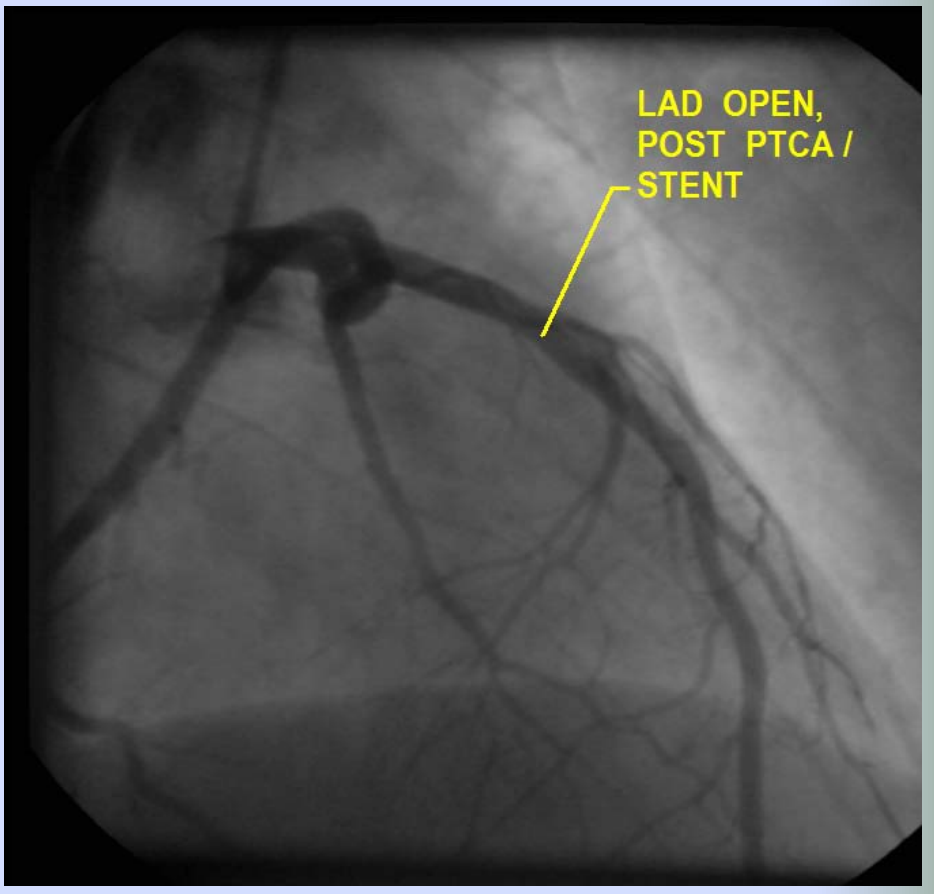
V5, V6 = CIRCUMFLEX

II, III, AVF = RIGHT CORONARY ARTERY or CX



Cath Lab findings:





Dynamic ST-T Wave Changes:

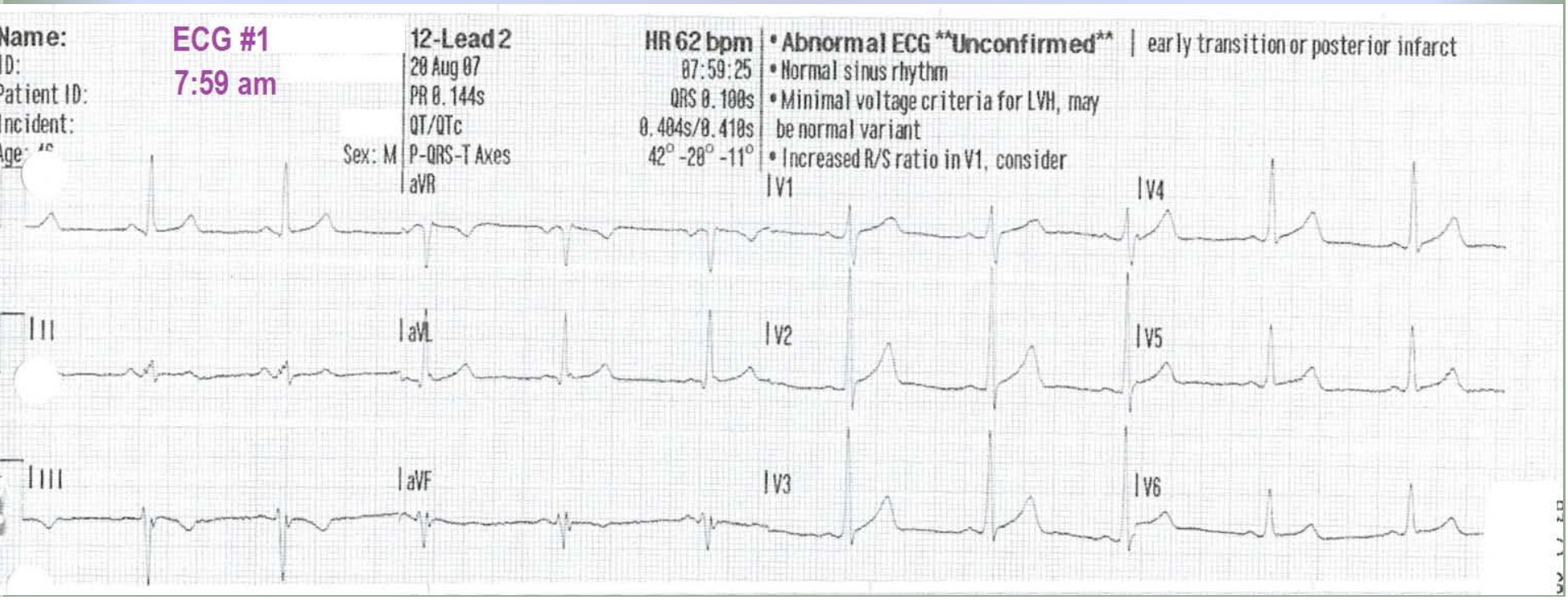
- Other than HEART RATE related variations (which affect intervals), ***J Points, ST-Segments and T Waves SHOULD NOT CHANGE.***

Dynamic ST-T Wave Changes:

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

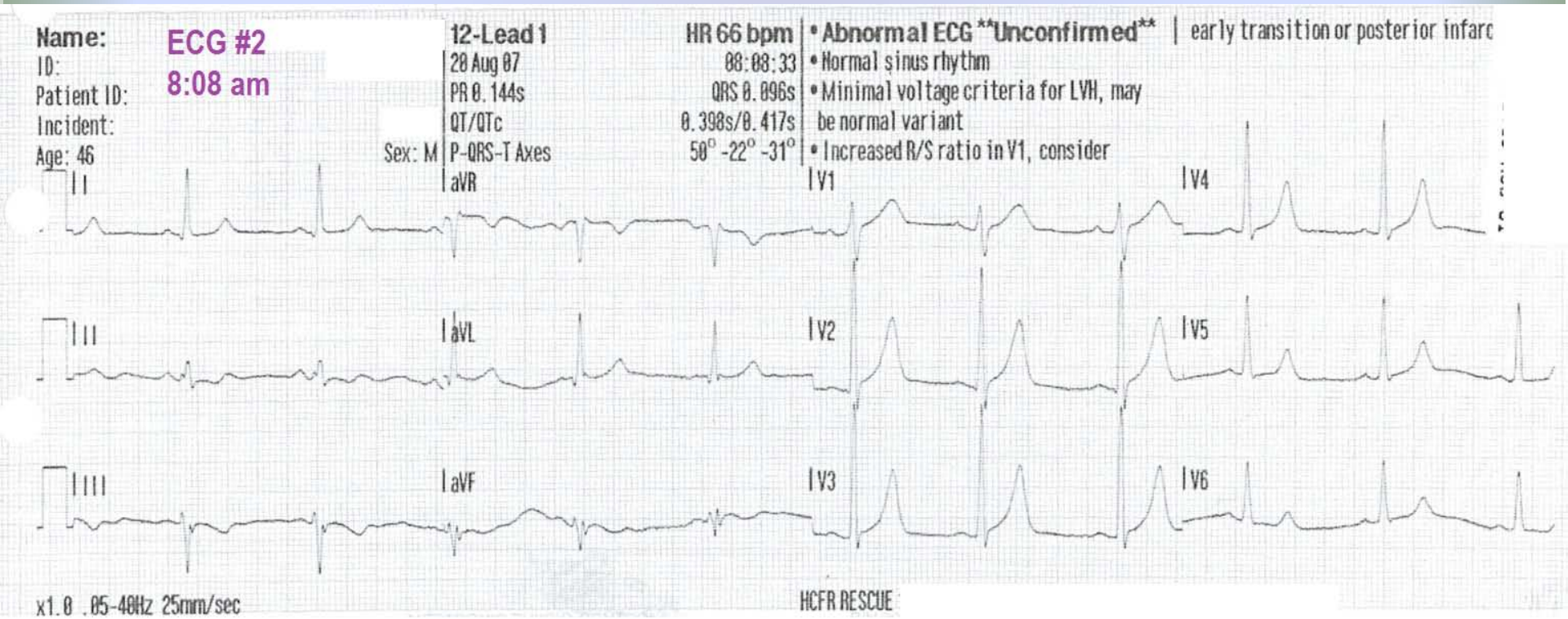
46 year old male

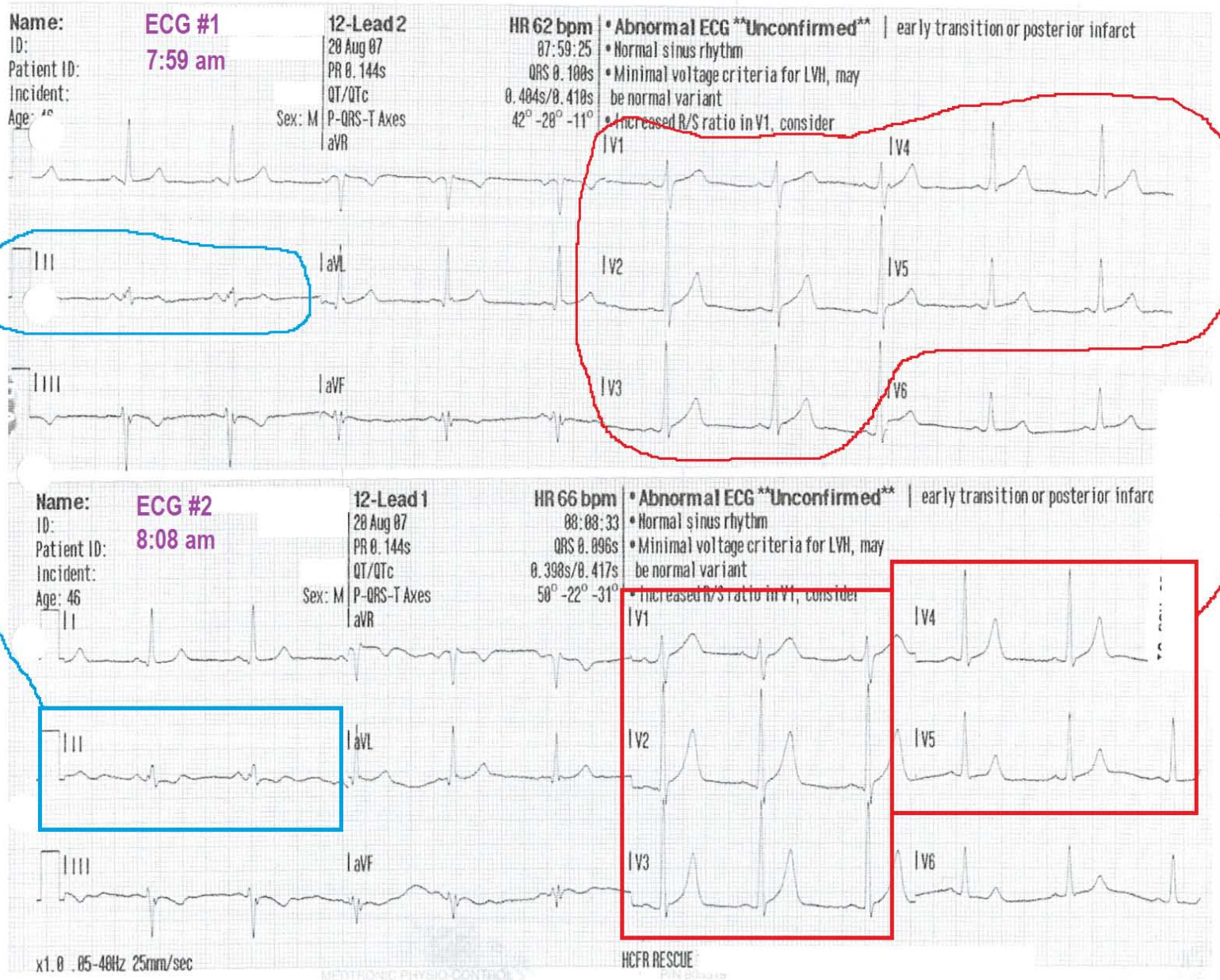
- Exertional dyspnea X “several weeks”
- Intermittent chest pressure X last 3 hours. Currently pain free.

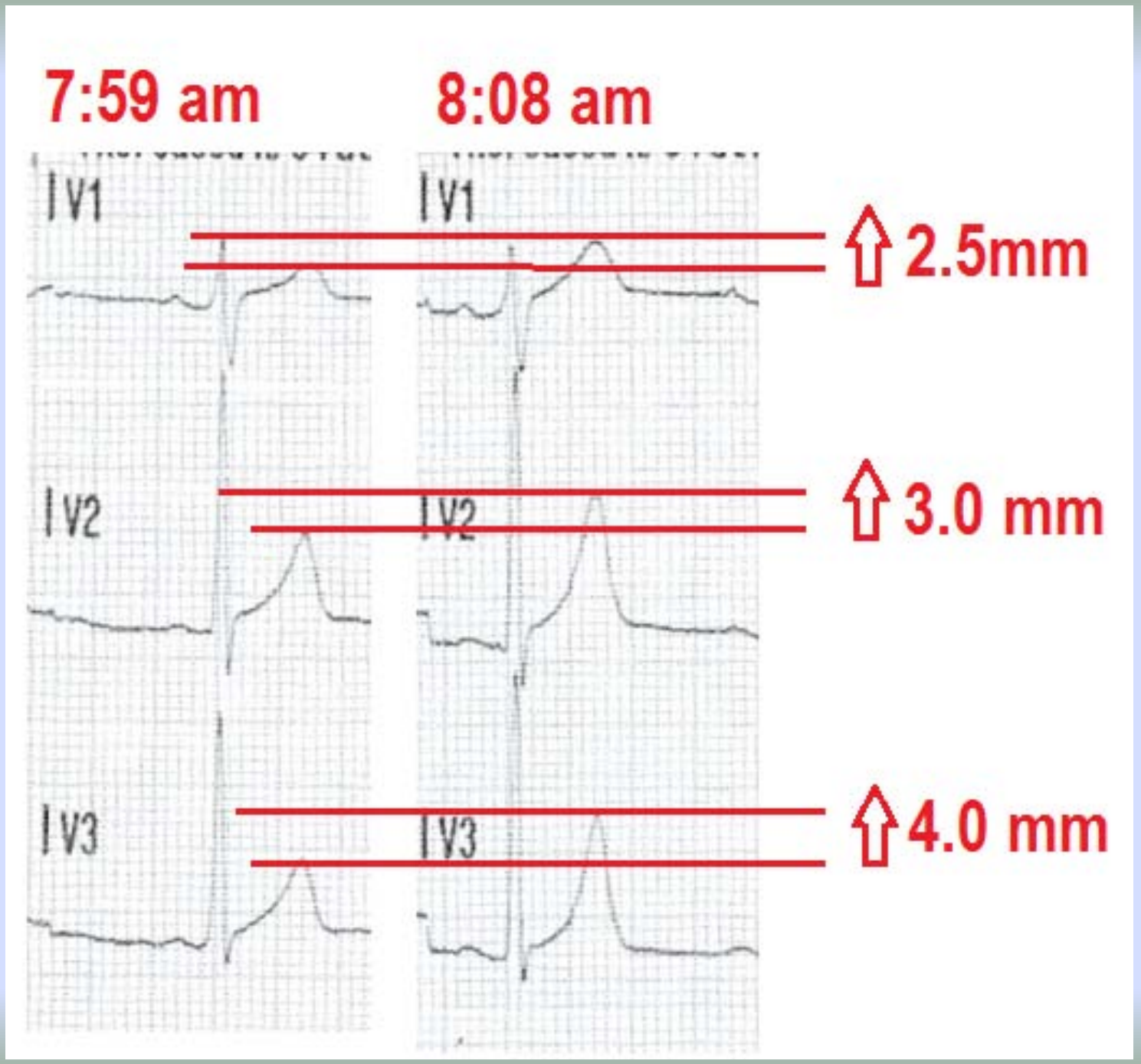


46 year old male: ECG 1

- Chest pressure has returned, "5" on 1-10 scale. 2nd ECG obtained due to "change in symptoms":




Name:
ID:
Patient ID:
Incident:
Age:
ECG #1
7:59 am
12-Lead 2
20 Aug 07
PR 0.144s
QT/QTc
Sex: M
P-QRS-T Axes
aVR
HR 62 bpm
07:59:25
QRS 0.100s
0.404s/0.410s
42° -28° -11°
• Abnormal ECG **Unconfirmed**
• Normal sinus rhythm
• Minimal voltage criteria for LVH, may be normal variant
• Increased R/S ratio in V1, consider
early transition or posterior infarct
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
ST-sements have dropped in Lead II
T waves have gained amplitude in Leads V1-V5
Name:
ID:
Patient ID:
Incident:
Age: 46
ECG #2
8:08 am
12-Lead 1
20 Aug 07
PR 0.144s
QT/QTc
Sex: M
P-QRS-T Axes
aVR
HR 66 bpm
08:08:33
QRS 0.096s
0.398s/0.417s
50° -22° -31°
• Abnormal ECG **Unconfirmed**
• Normal sinus rhythm
• Minimal voltage criteria for LVH, may be normal variant
• Increased R/S ratio in V1, consider
early transition or posterior infarc
x1.0 .05-40Hz 25mm/sec
HCFR RESCUE

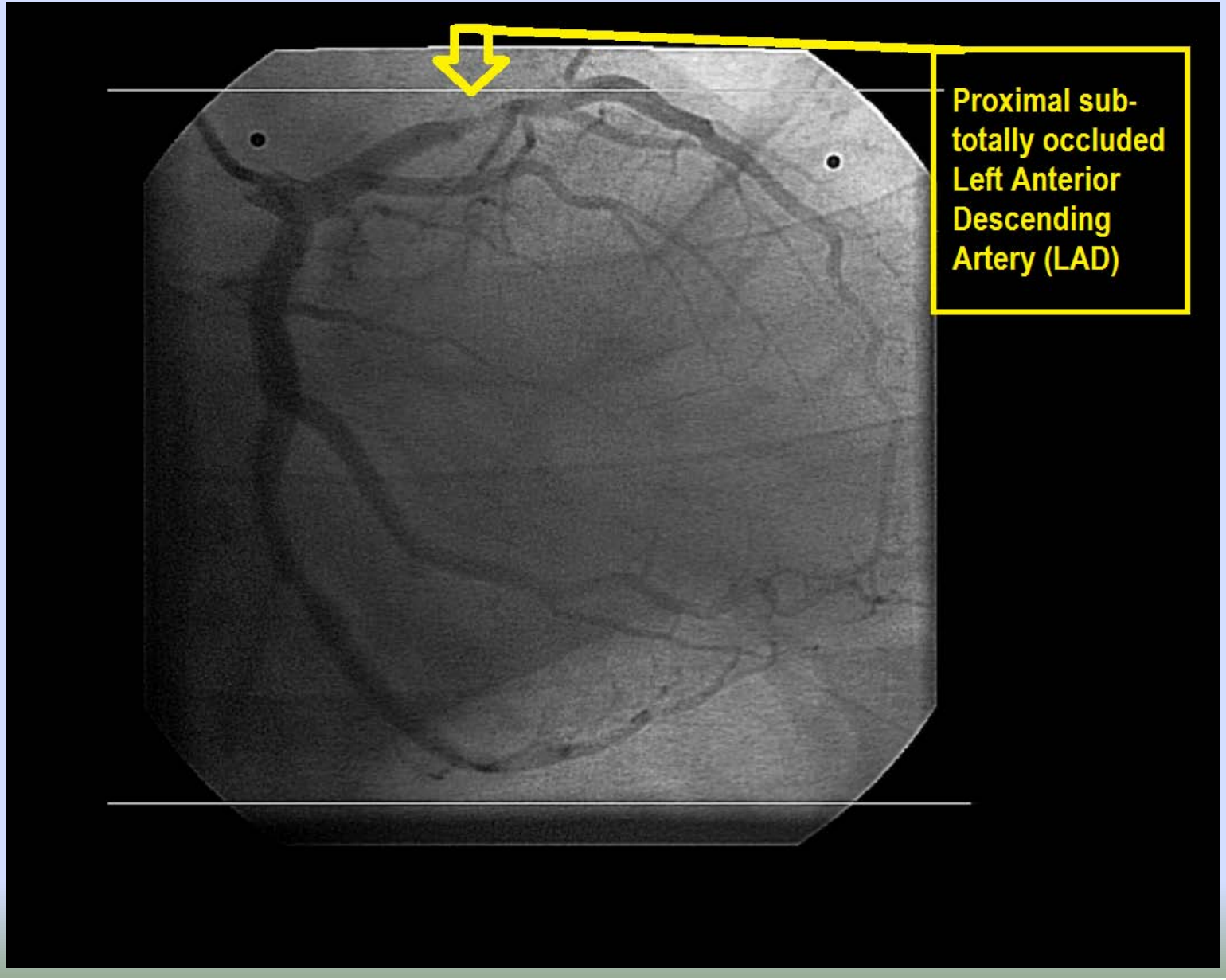

7:59 am
8:08 am
V1
V1
2.5mm
V2
V2
3.0 mm
V3
V3
4.0 mm

ST-Segment Depression

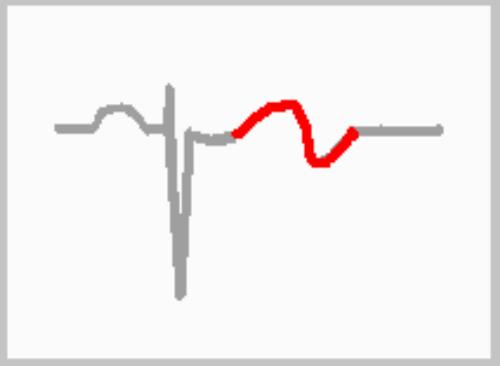
7:59 am

8:08 am

Cath Lab Angiography:



ISCHEMIA

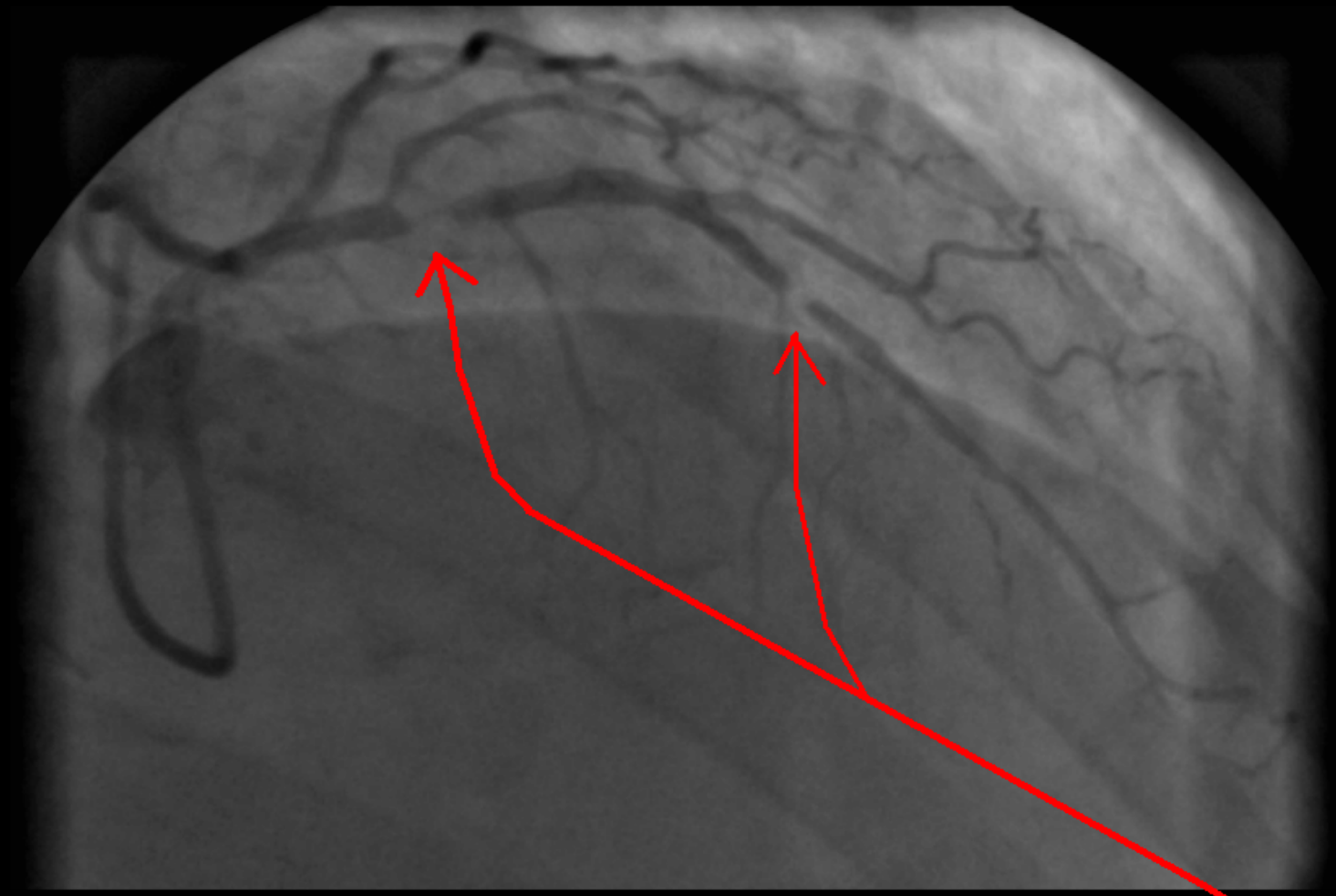


BI-PHASIC T WAVE

- SUB-TOTAL OCCLUSION of LEFT ANTERIOR DESCENDING ARTERY (when noted in V1-V4)
- LEFT VENTRICULAR HYPERTROPHY
- COCAINE INDUCED VASOSPASM

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:

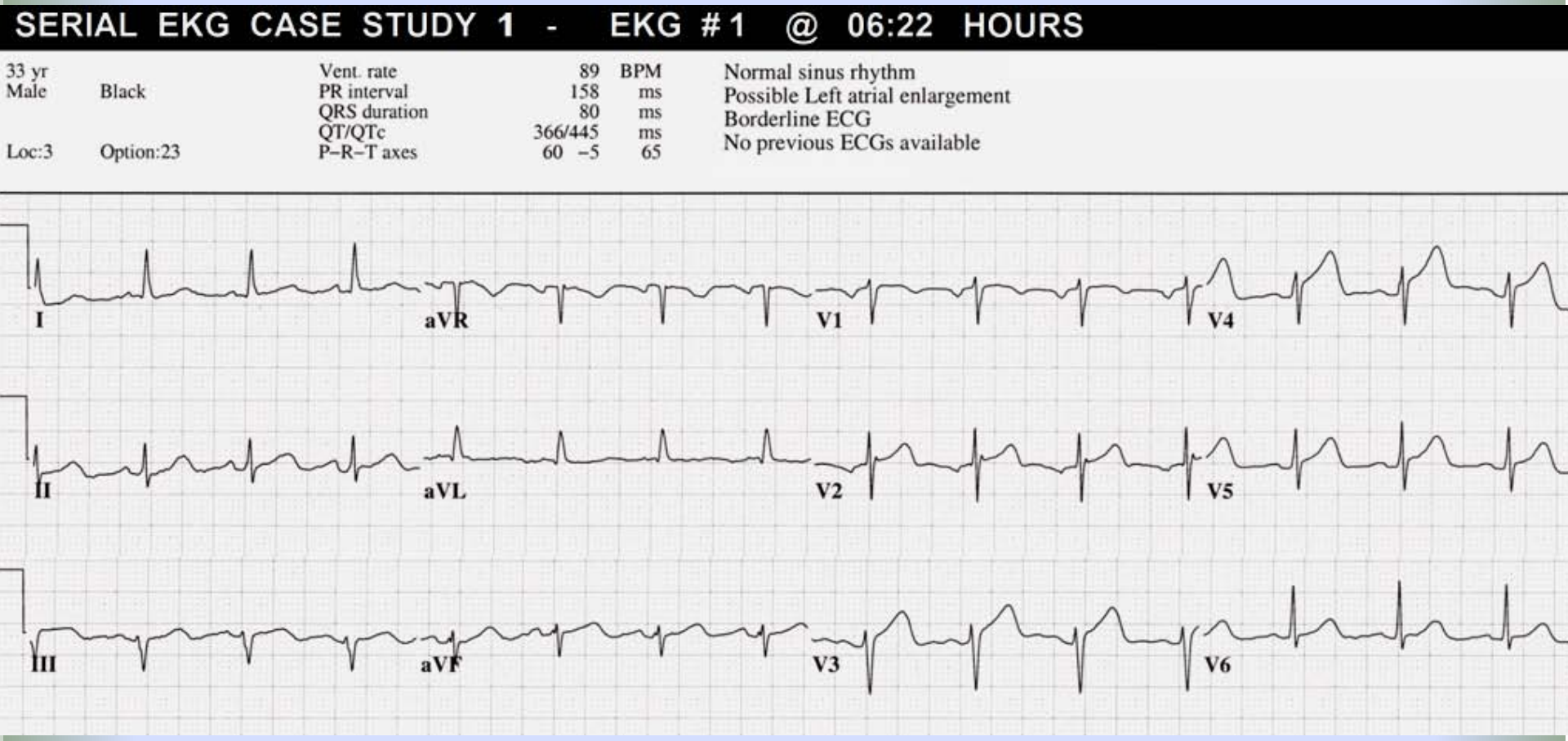
- **Present in 14-18% of patients admitted with unstable angina**
- **75% patients not treated developed extensive Anterior MI within 3 weeks.**
- ***Median Average time from presentation to Acute Myocardial Infarction – 8 days***

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

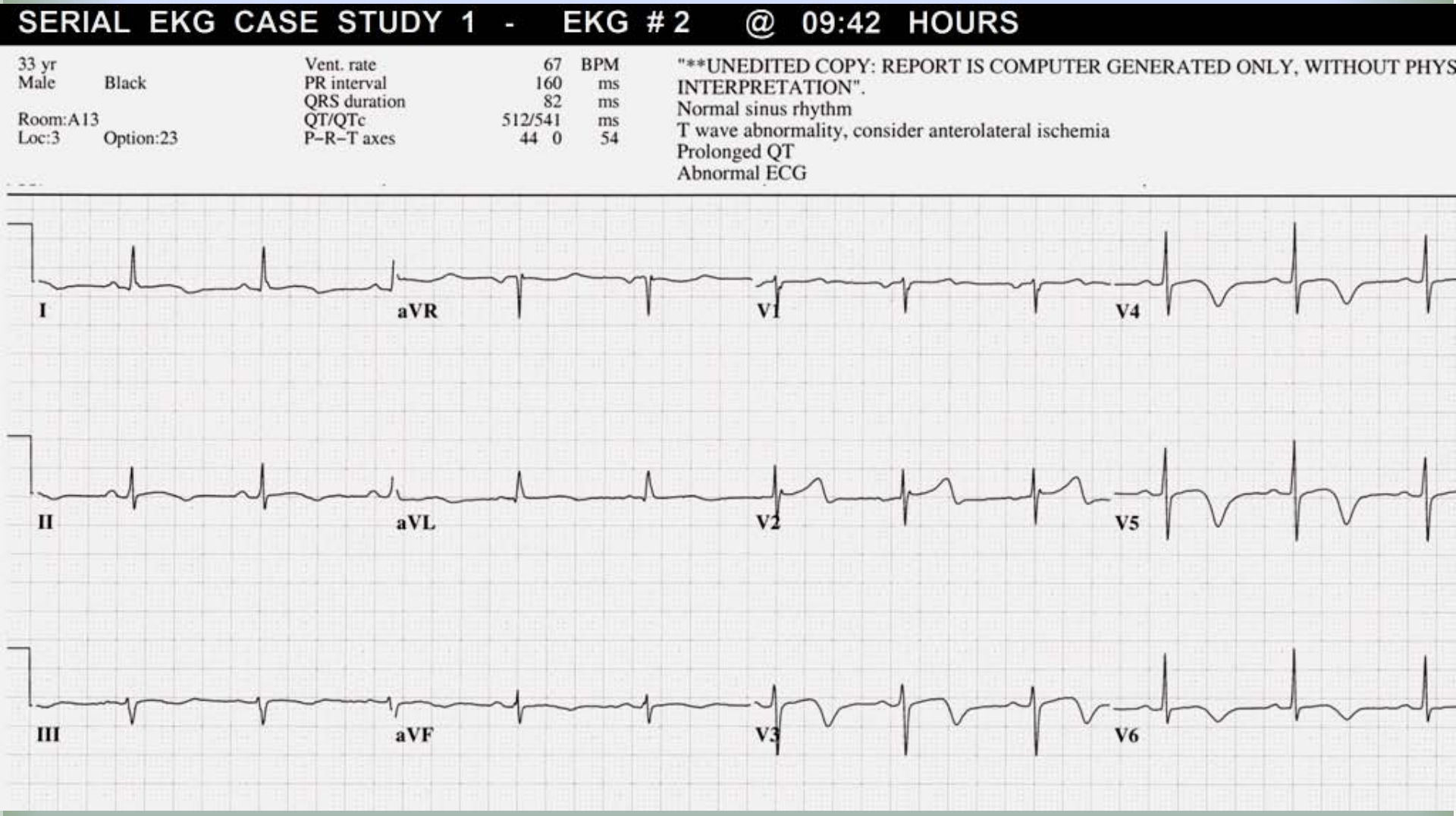
Wellen's Syndrome Case Study

- 33 y/o male
- Chief complaint "sharp, pleuritic quality chest pain, intermittent, recent history lower respiratory infection with productive cough."
- ED physician attributed the ST elevation in precordial leads to "early repolarization," due to patient age, gender, race (African American) and concave nature of ST-segments.

Wellen's Syndrome Case Study



Wellen's Syndrome Case Study

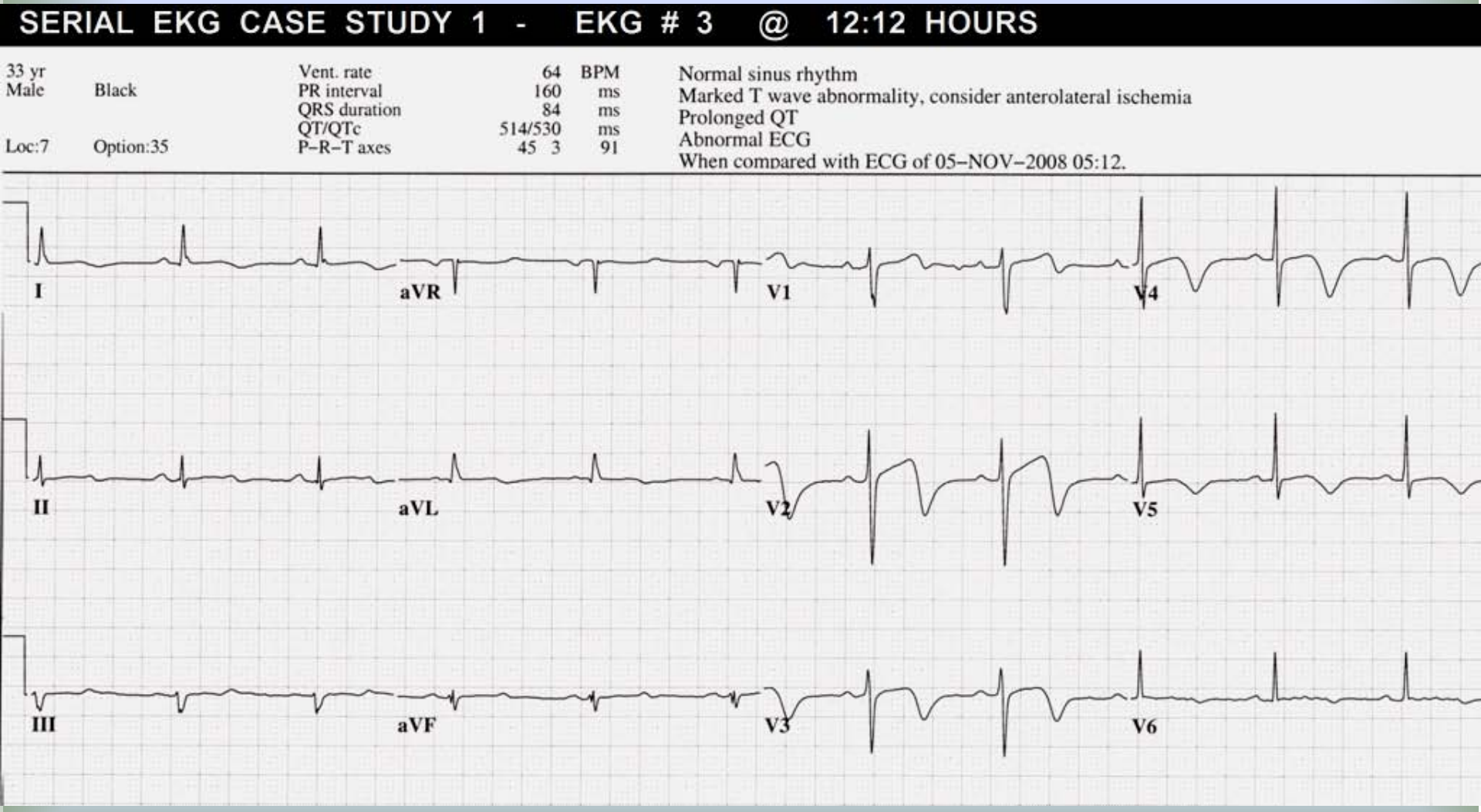


DYNAMIC ST-T Wave Changes ARE PRESENT !!

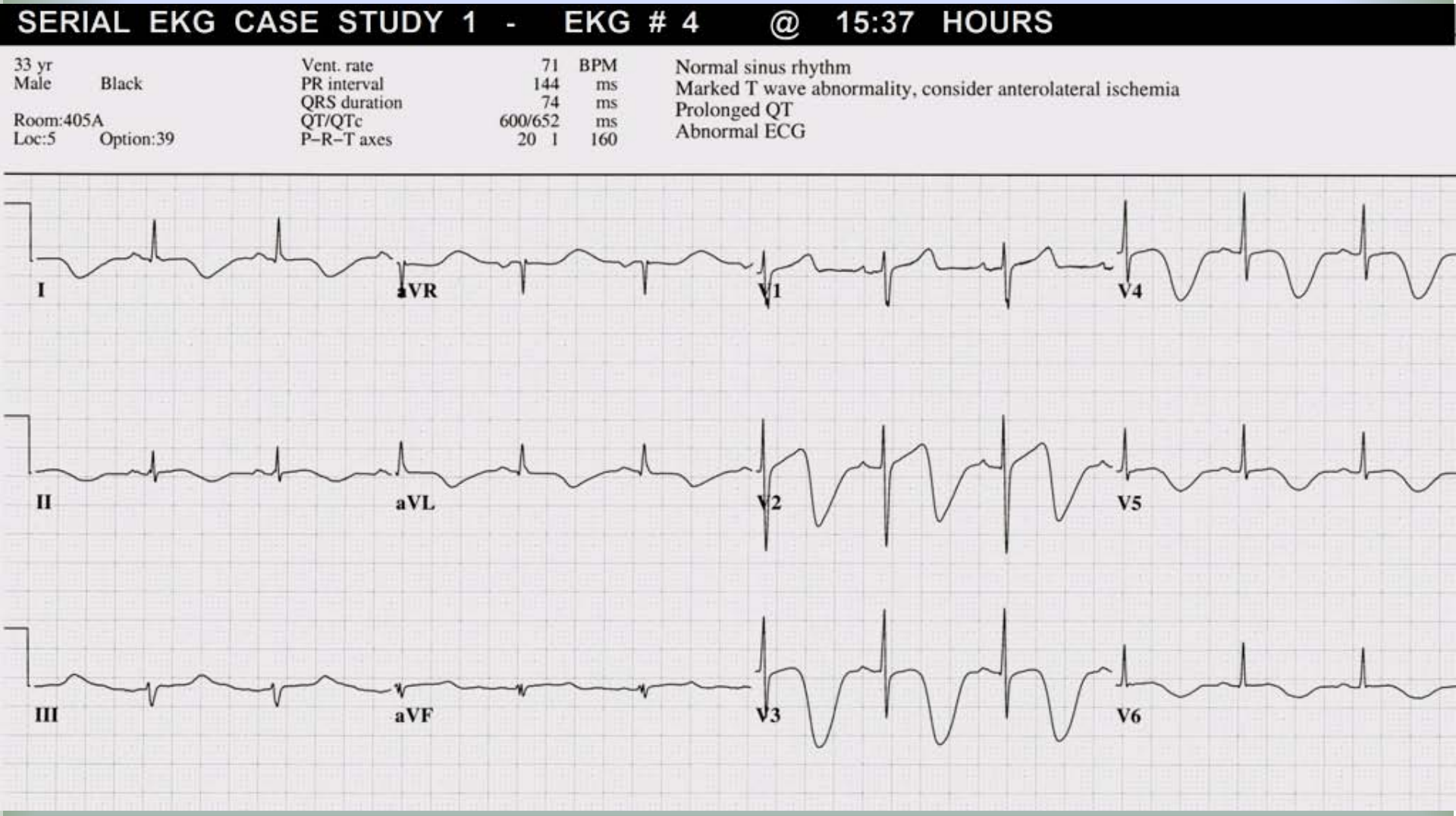
NOW

is the time for the STAT CALL to the CARDIOLOGIST !!!!

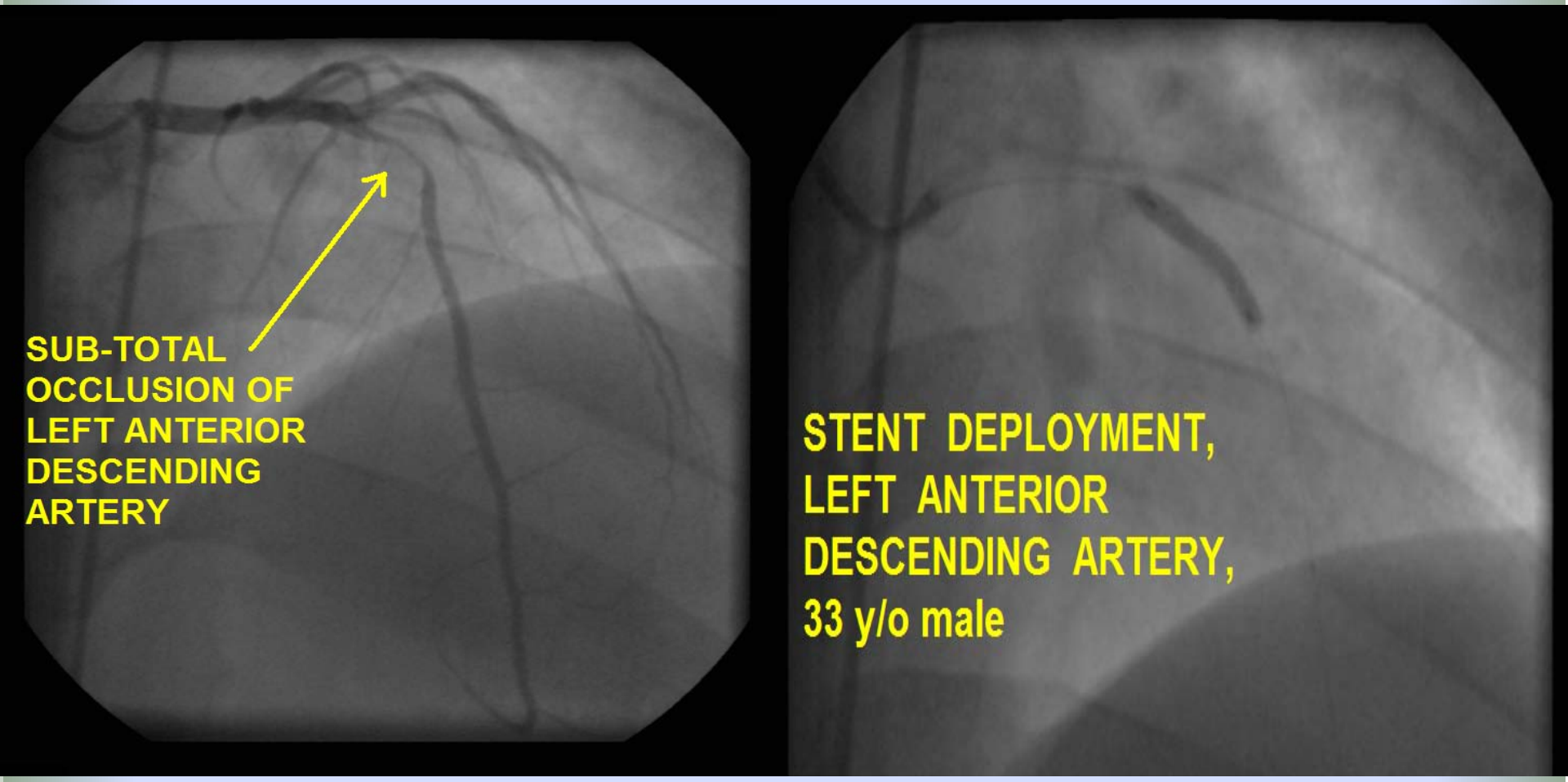
Wellen's Syndrome Case Study



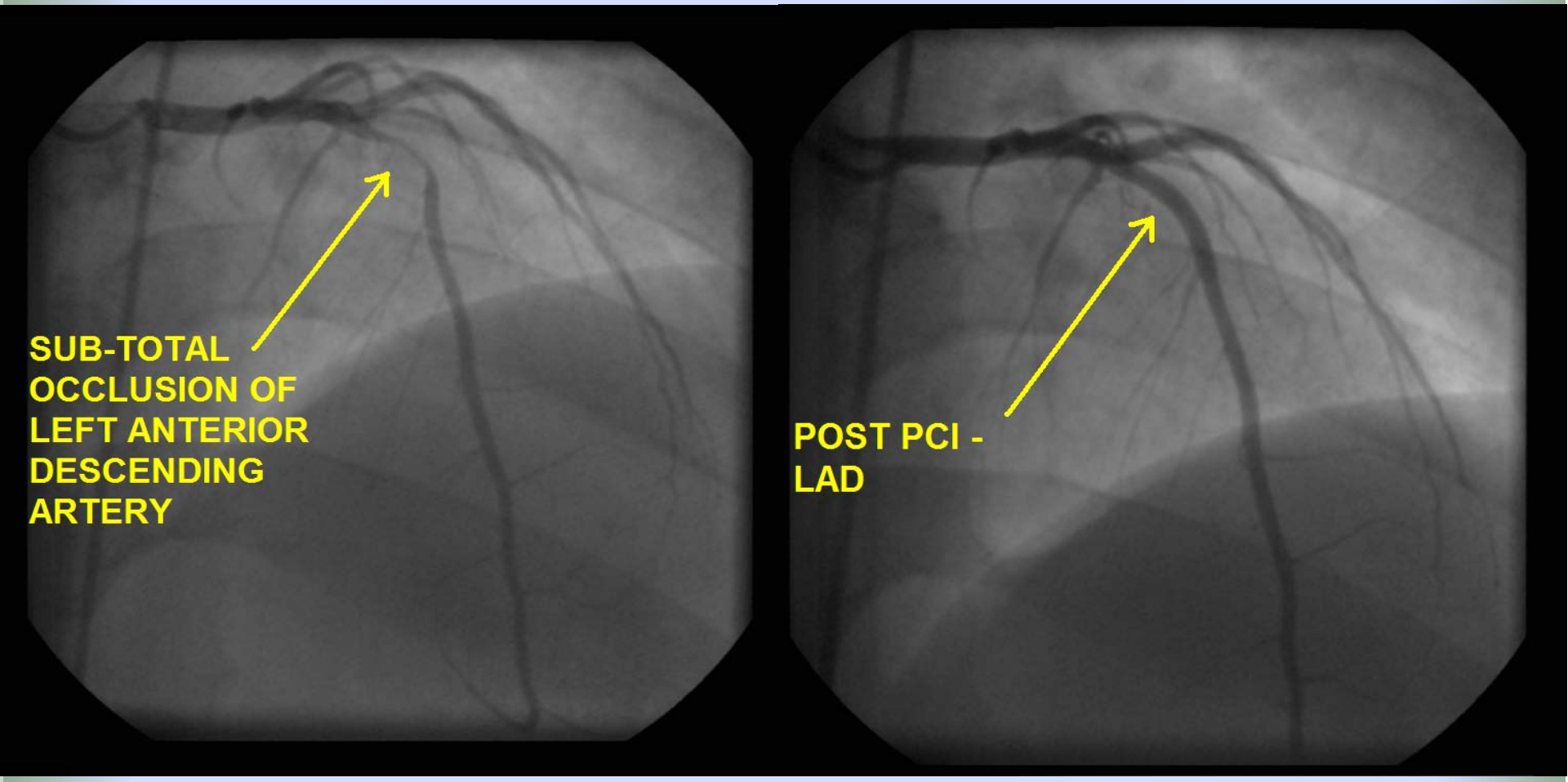
Wellen's Syndrome Case Study



Wellen's Syndrome Case Study



Wellen's Syndrome Case Study

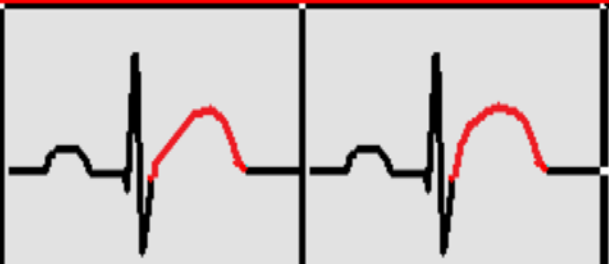
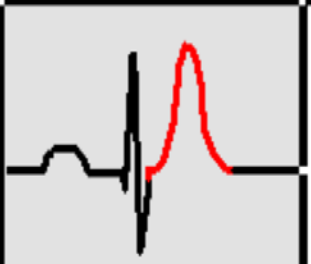
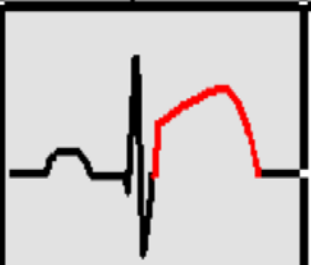
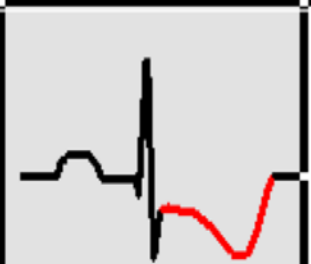


Additional Resources:

- Wellen's Syndrome, NEJM case study

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**

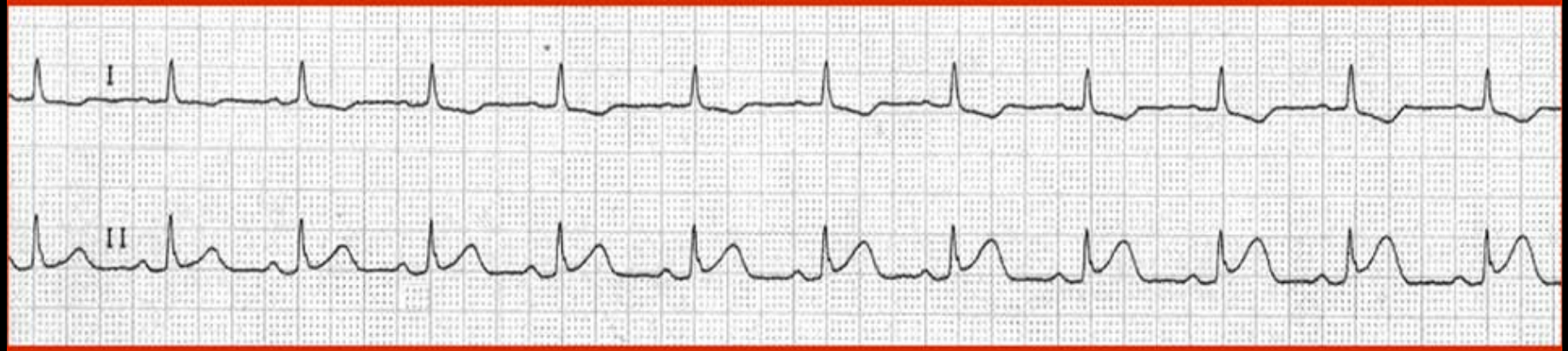
Abnormal ST Elevation Criteria: ACC/AHA 2009 "Standardization and Interpretation of the ECG, Part VI Acute Ischemia and Infarction," Galen Wagner, et al

Recommendations

1. For men 40 years of age and older, the threshold value for abnormal J-point elevation should be 0.2 mV (2 mm) in leads V_2 and V_3 and 0.1 mV (1 mm) in all other leads.
2. For men less than 40 years of age, the threshold values for abnormal J-point elevation in leads V_2 and V_3 should be 0.25 mV (2.5 mm).
3. For women, the threshold value for abnormal J-point elevation should be 0.15 mV (1.5 mm) in leads V_2 and V_3 and greater than 0.1 mV (1 mm) in all other leads.
4. For men and women, the threshold for abnormal J-point elevation in V_3R and V_4R should be 0.05 mV (0.5 mm), except for males less than 30 years of age, for whom 0.1 mV (1 mm) is more appropriate.
5. For men and women, the threshold value for abnormal J-point elevation in V_7 through V_9 should be 0.05 mV (0.5 mm).
6. For men and women of all ages, the threshold value for abnormal J-point depression should be −0.05 mV (−0.5 mm) in leads V_2 and V_3 and −0.1 mV (−1 mm) in all other leads.

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:

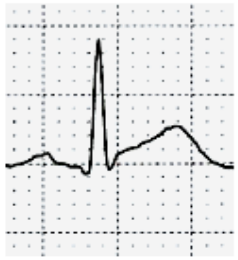
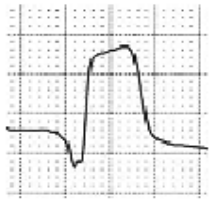
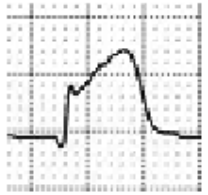
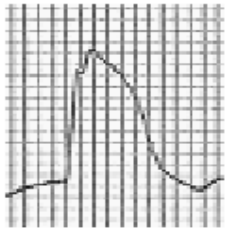
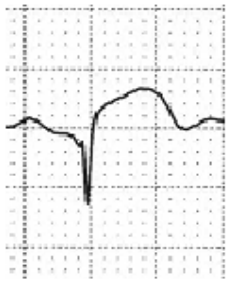
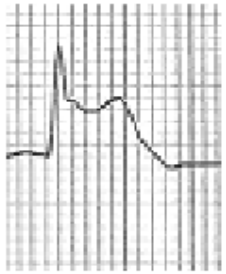
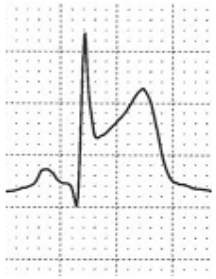
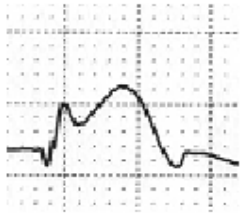
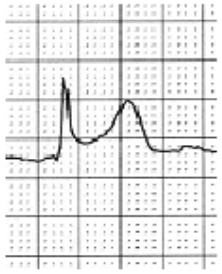
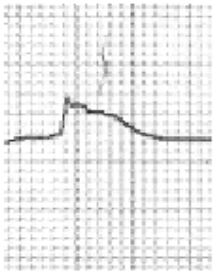
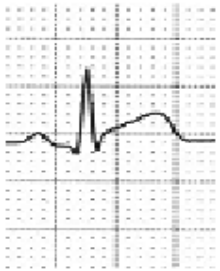
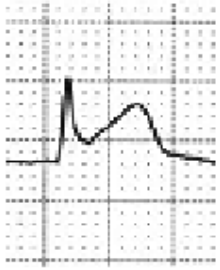
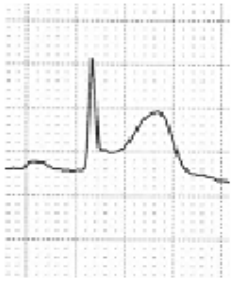
DOWNSLOPING S-T SEGMENT

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 STEMI.

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

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

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

ACUTE MI

COMPLICATIONS TO ANTICIPATE FOR ALL MI PATIENTS :

LETHAL DYSRHYTHMIAS

CARDIAC ARREST

FAILURE OF STRUCTURE(S) SERVED BY THE BLOCKED ARTERY

STEMI

- **Correlation of ECG Leads with Coronary Arterial Anatomy and the STRUCTURES SERVED by the OCCLUDED ARTERY . . . .**

STEMI

- **Correlation of ECG Leads with Coronary Arterial Anatomy and the STRUCTURES SERVED by the OCCLUDED ARTERY . . . .**

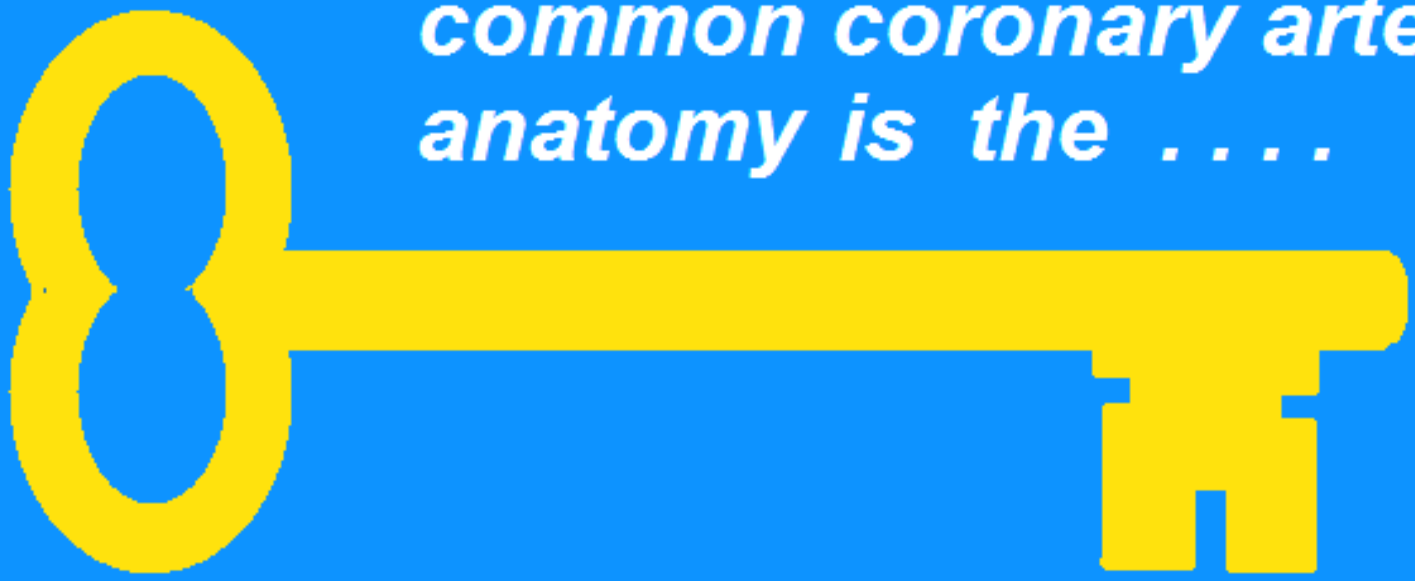
. . . . . Will serve as a "crystal ball," allowing you to ANTICIPATE complications of STEMI . . . .

STEMI

- **Correlation of ECG Leads with Coronary Arterial Anatomy and the STRUCTURES SERVED by the OCCLUDED ARTERY . . . .**

. . . . . Will serve as a "crystal ball," allowing you to ANTICIPATE complications of STEMI . . . . . BEFORE they occur !!

"Having knowledge of common coronary artery anatomy is the . . . .



to understanding the PHYSIOLOGICAL CHANGES that occur during ACUTE MI."

"an INVALUABLE ASSET for ALL MEDICAL PROFESSIONALS who provide direct care to STEMI patients !"

INTERPRET THE EKG, THEN:

- IDENTIFY THE AREA OF THE HEART WITH A PROBLEM . . .
- RECALL THE ARTERY WHICH SERVES THAT REGION . . .
- RECALL OTHER STRUCTURES SERVED BY THAT ARTERY . . .
- ANTICIPATE FAILURE OF THOSE STRUCTURES . . .
- ***INTERVENE APPROPRIATELY !***

3 STEMI Case Studies, excerpts from “12 Lead ECG Interpretation in ACS with Case Studies from the Cardiac Cath Lab.”

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.

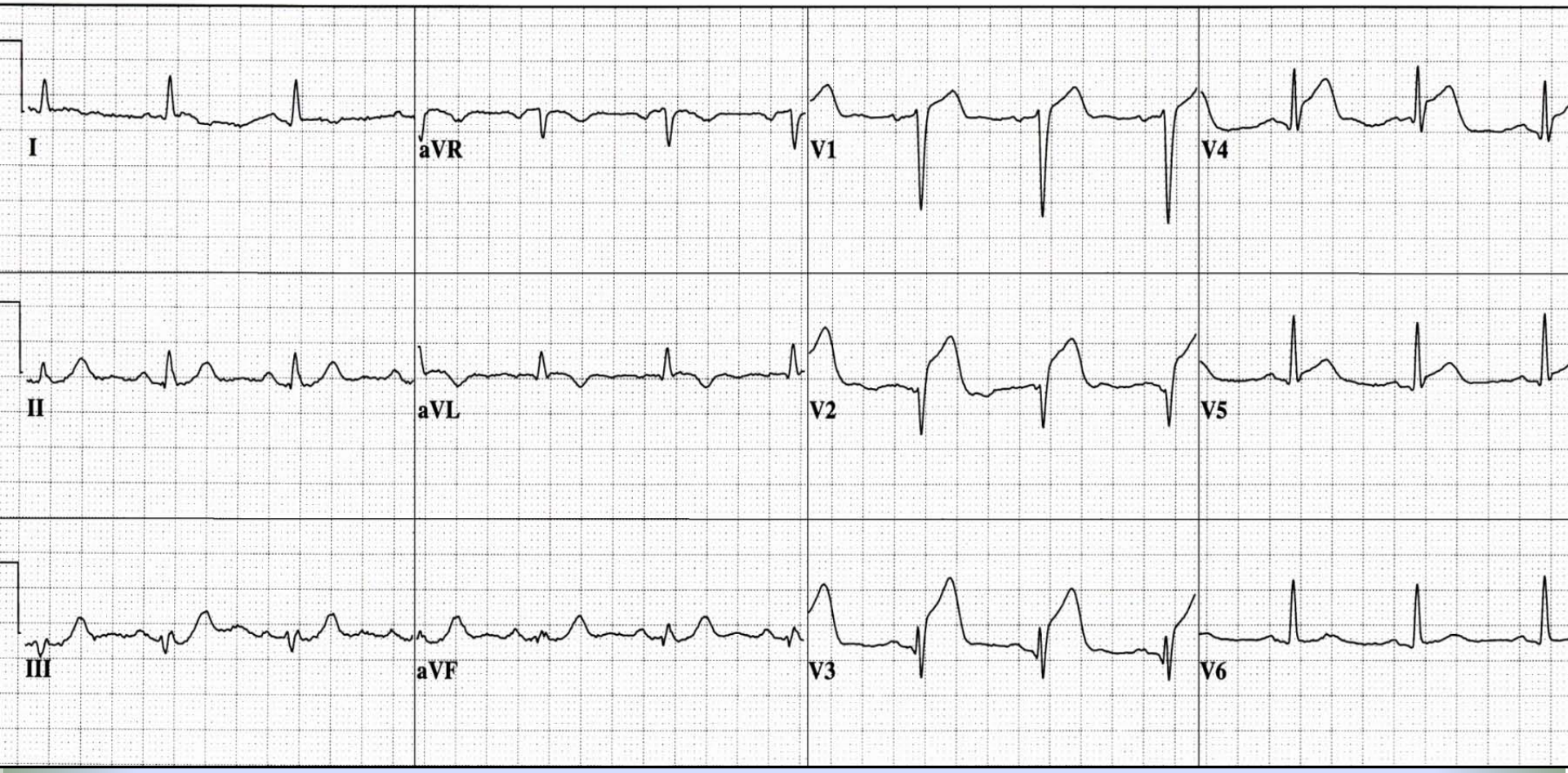
VITAL SIGNS: BP: 100/64, P: 75, R: 20, SAO2: 94%

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**



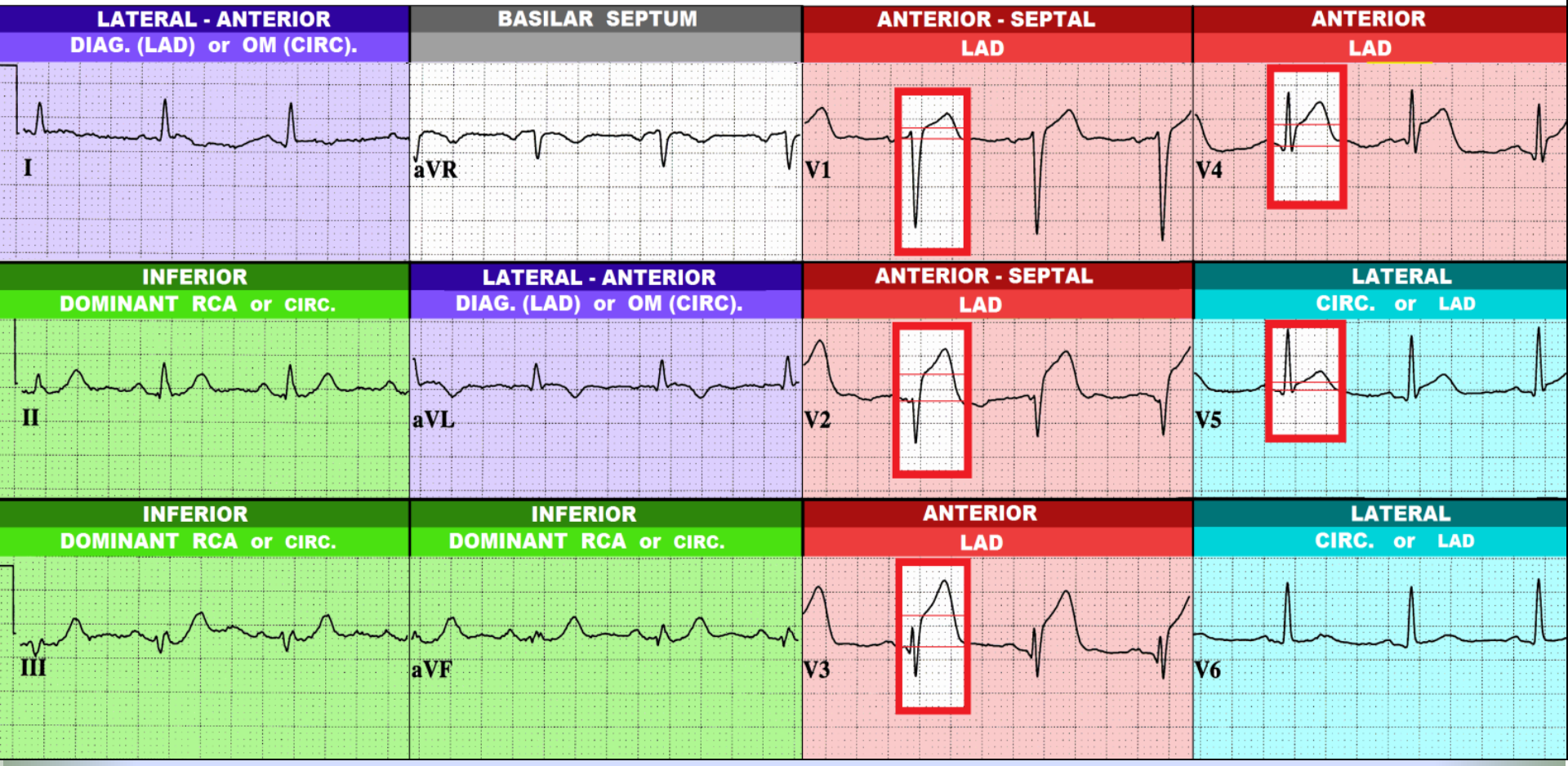
72 yr
Male Caucasian

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



Note: There is NO Reciprocal ST Depression on this STEMI ECG !

72 yr		Vent. rate	75	BPM
Male	Caucasian	PR interval	162	ms
		QRS duration	98	ms
		QT/QTc	382/426	ms
Loc:	Option:2	P-R-T axes	72 13	83

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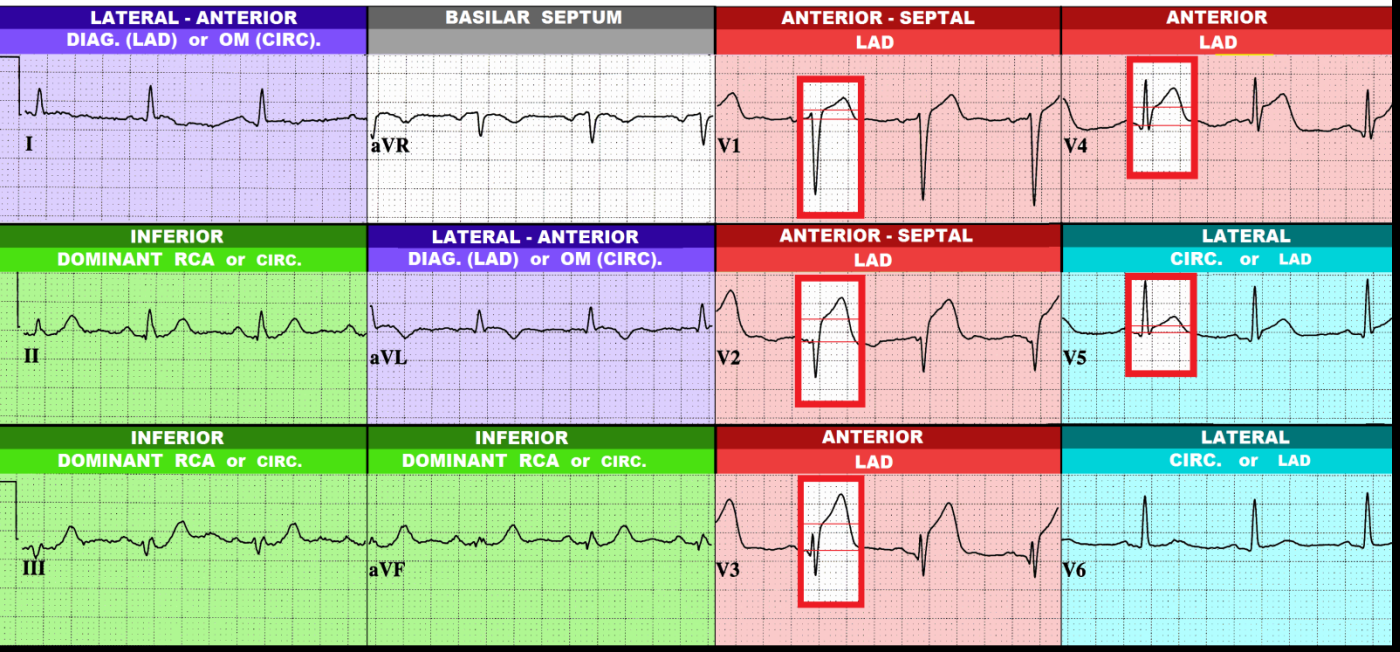
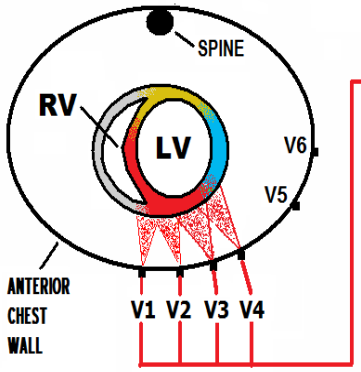
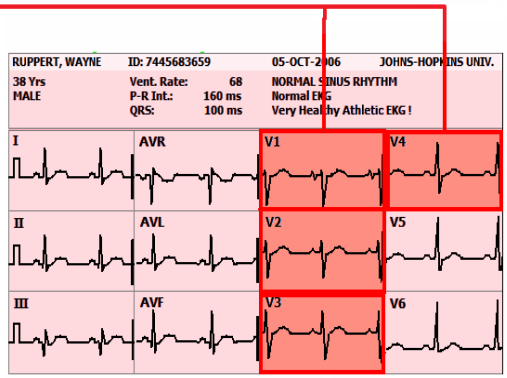


V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE



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



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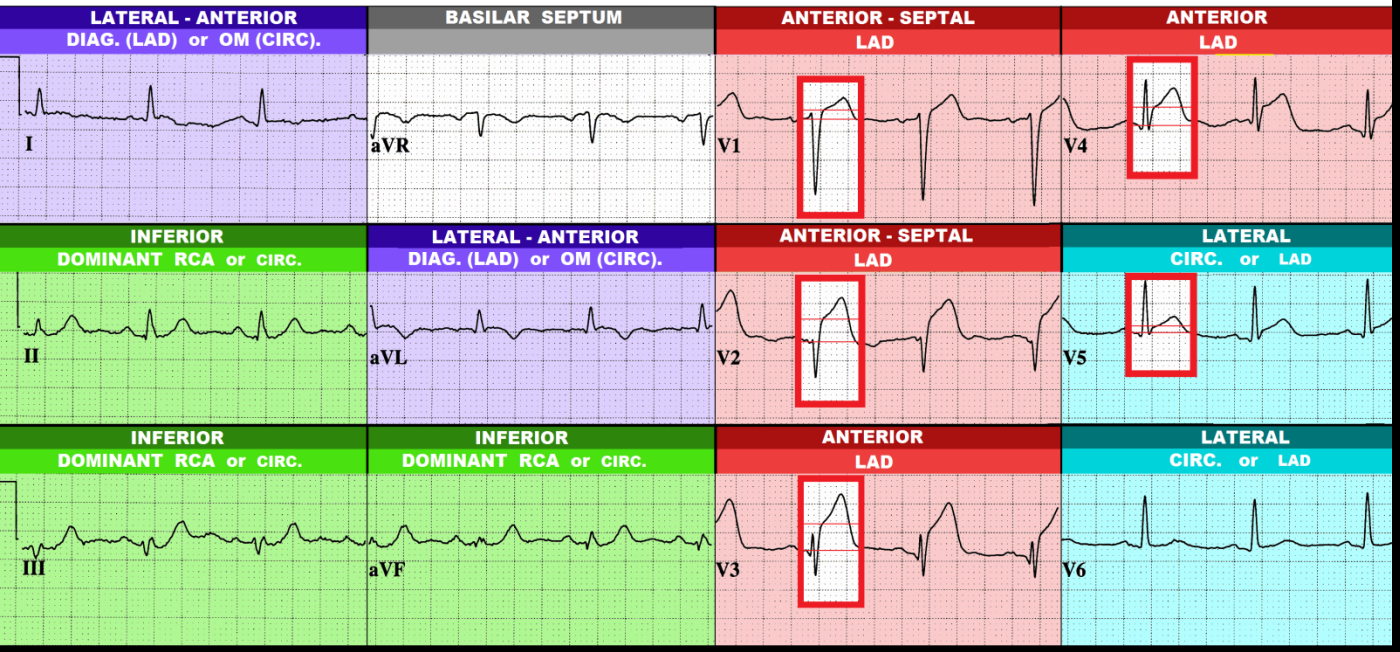
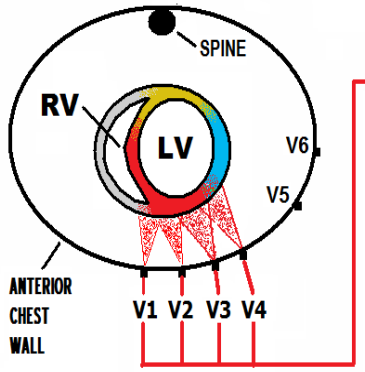
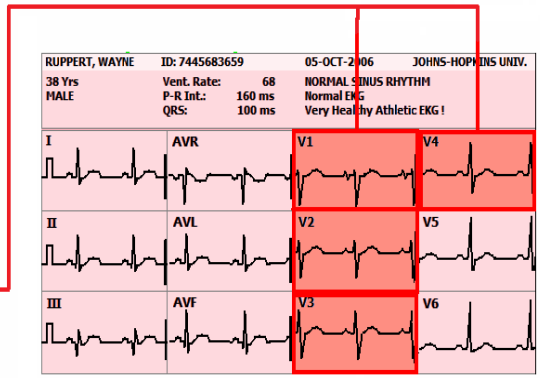


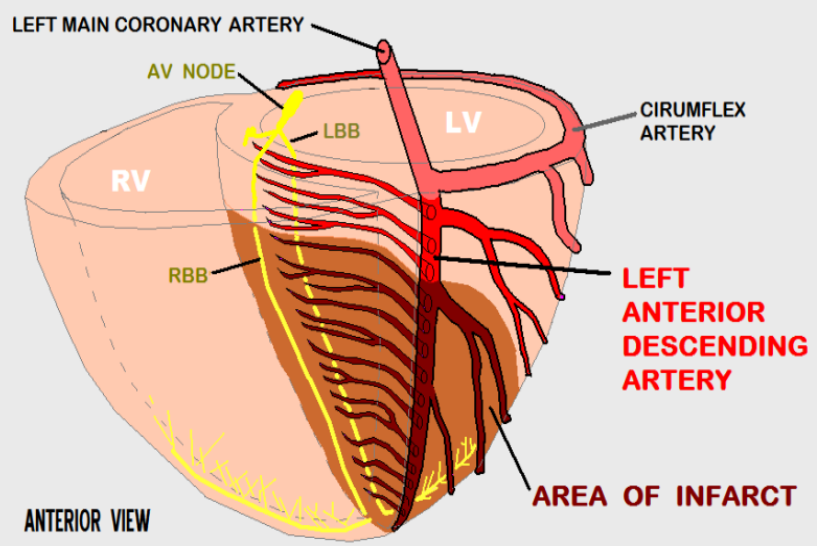
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL
of the LEFT VENTRICLE



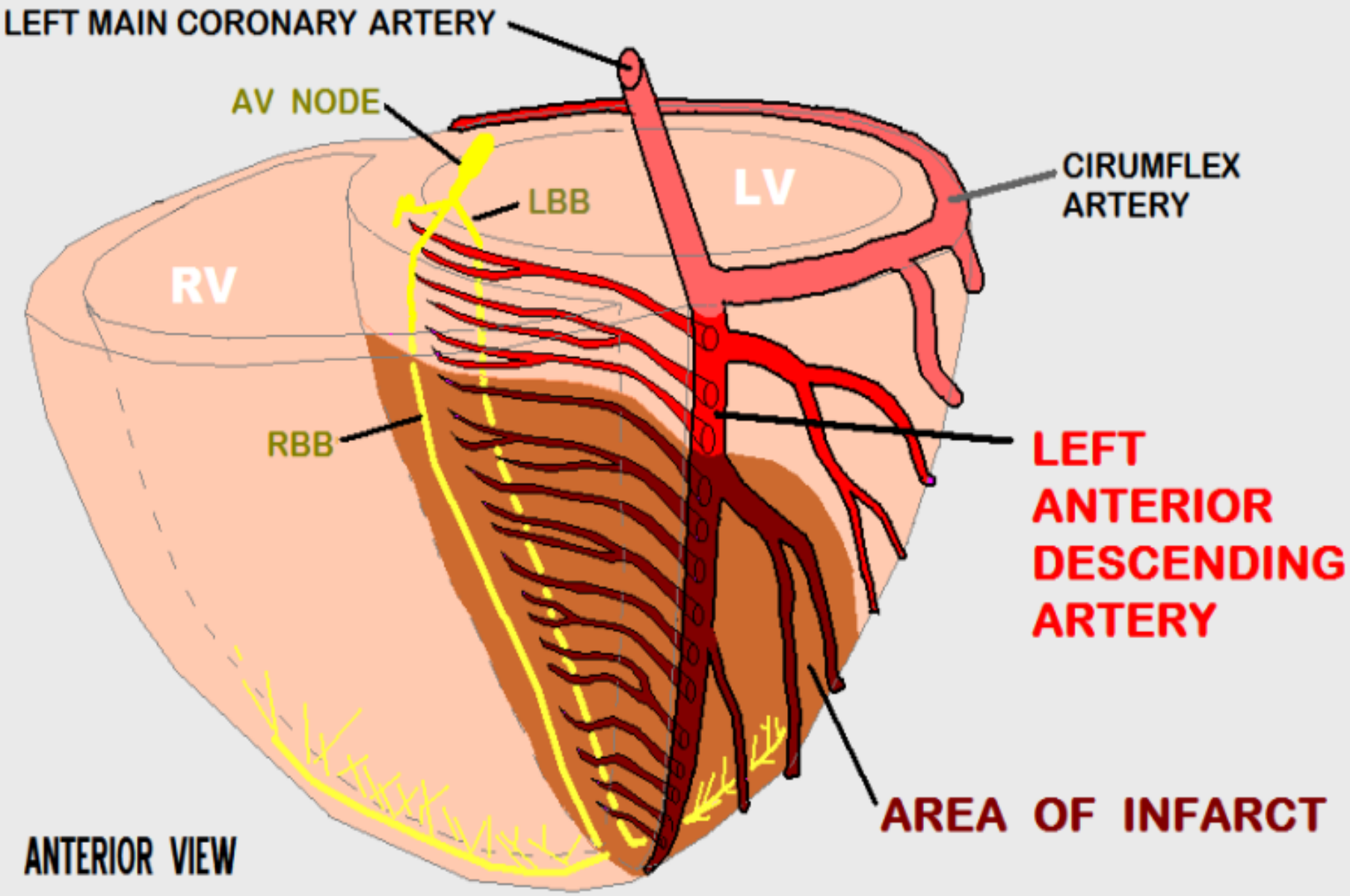
V1, V2 - ANTERIOR / SEPTAL
V3, V4 - ANTERIOR



OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY

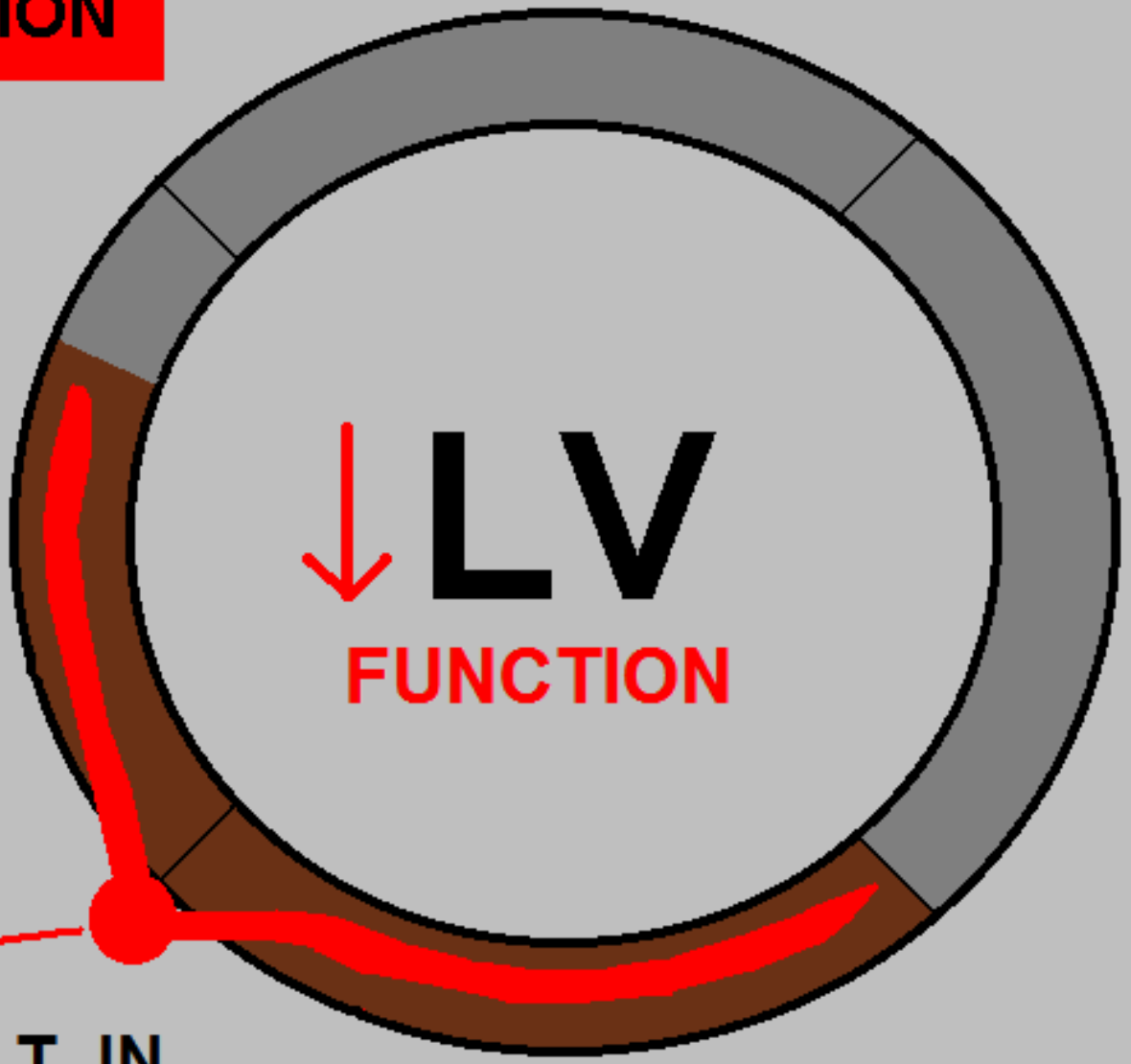


OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



LAD DISTRIBUTION

35 - 45 % of LV MUSCLE MASS



A BLOCKAGE OF THE LAD

CAN RESULT IN LV PUMP FAILURE --

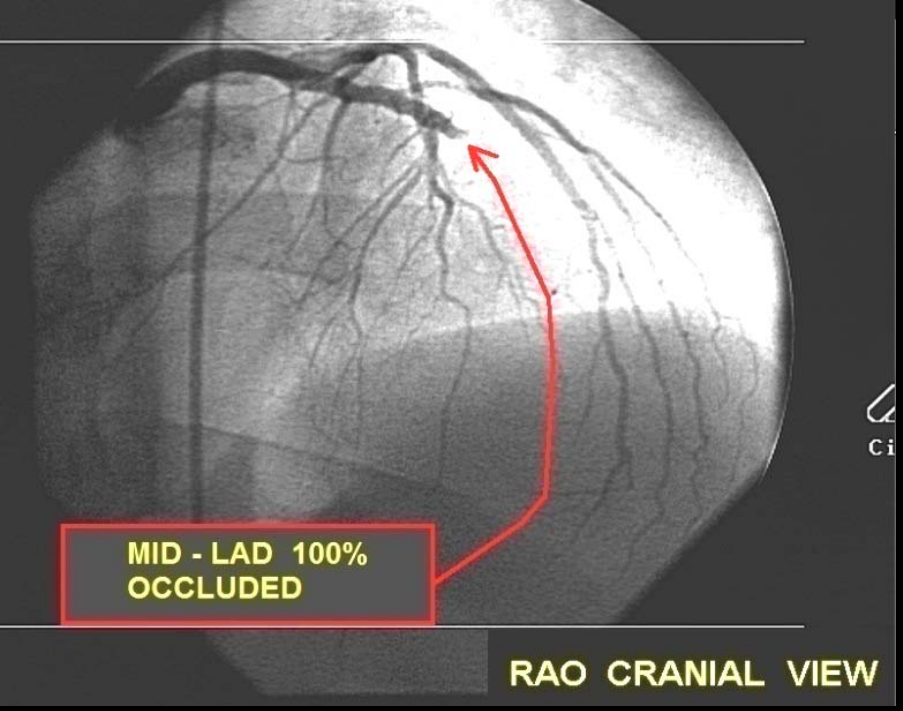
- CARDIOGENIC SHOCK
- PULMONARY EDEMA

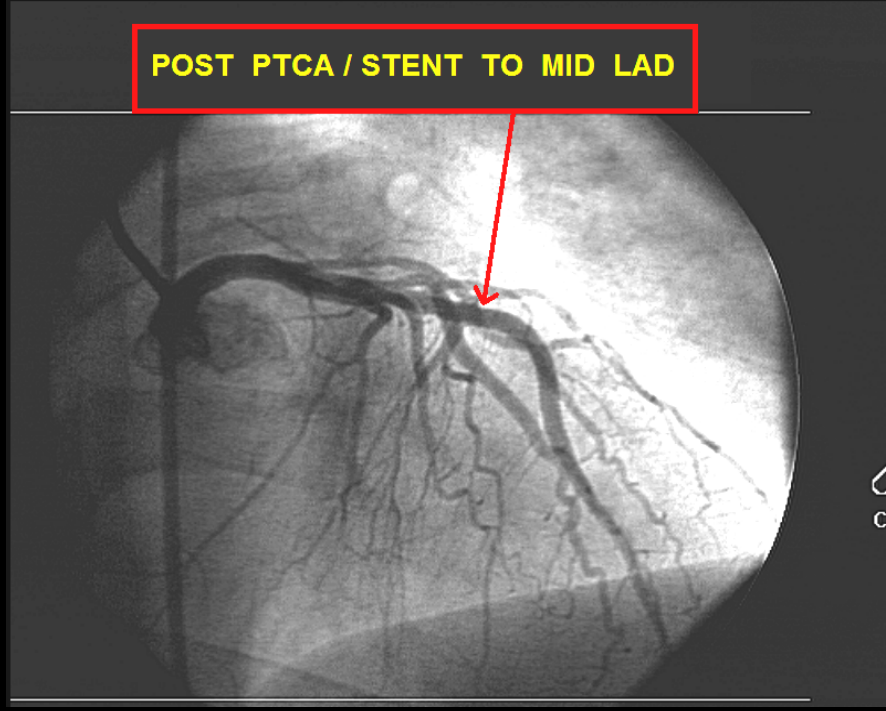

400 mg
Dopamine
(1600 mcg/mL)
Dopamine Hydrochloride
and 5% Dextrose Injection USP
250 mL
Baxter
500 mg Total
DOBUTamine
250 mL
Baxter

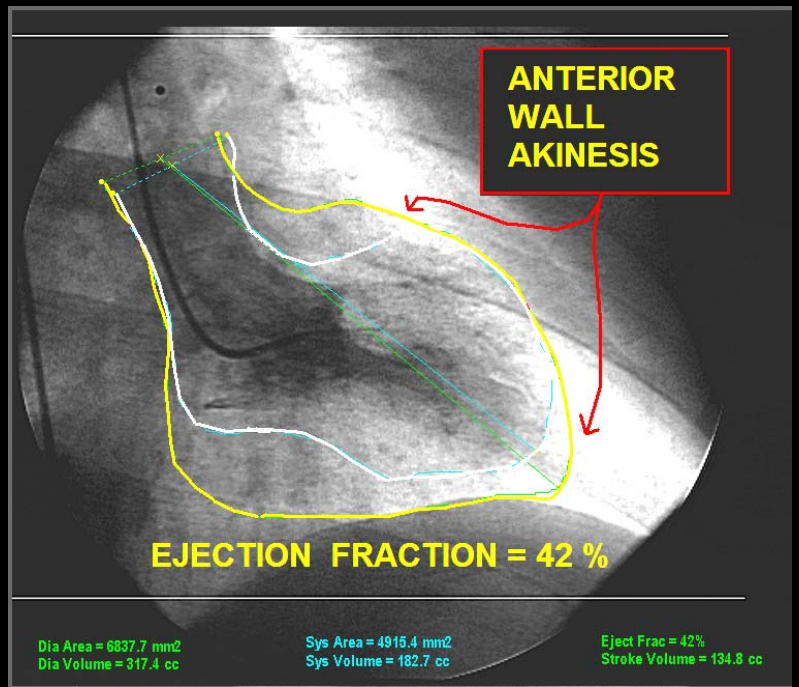
LEFT ANTERIOR DESCENDING ARTERY (LAD)

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

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


MID - LAD 100%
OCCLUDED
RAO CRANIAL VIEW


POST PTCA / STENT TO MID LAD


ANTERIOR
WALL
AKINESIS
EJECTION FRACTION = 42 %
Dia Area = 6837.7 mm2
Dia Volume = 317.4 cc
Sys Area = 4915.4 mm2
Sys Volume = 182.7 cc
Eject Frac = 42%
Stroke Volume = 134.8 cc

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.

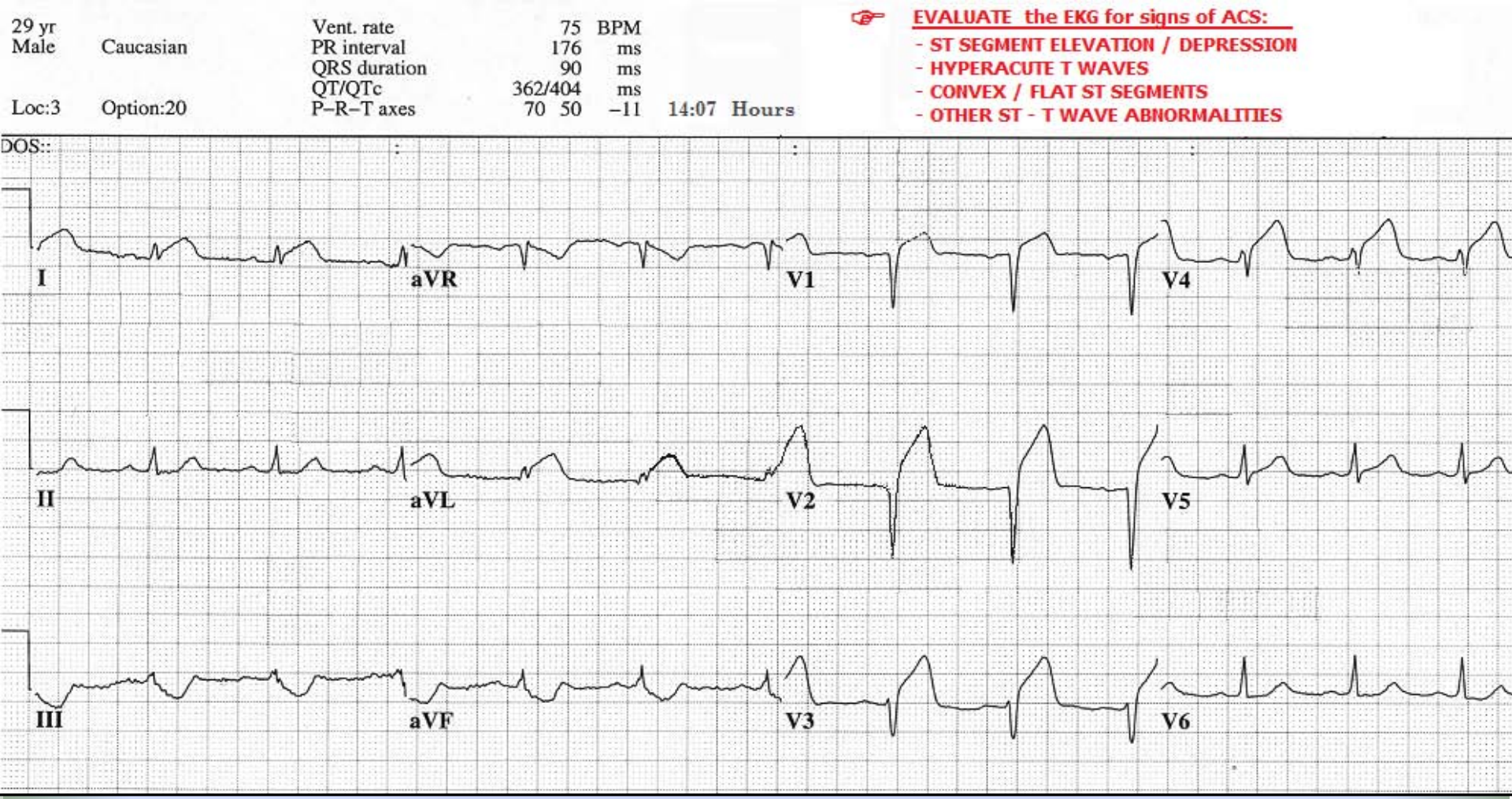
RISK FACTOR PROFILE:

- 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
DOS::
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

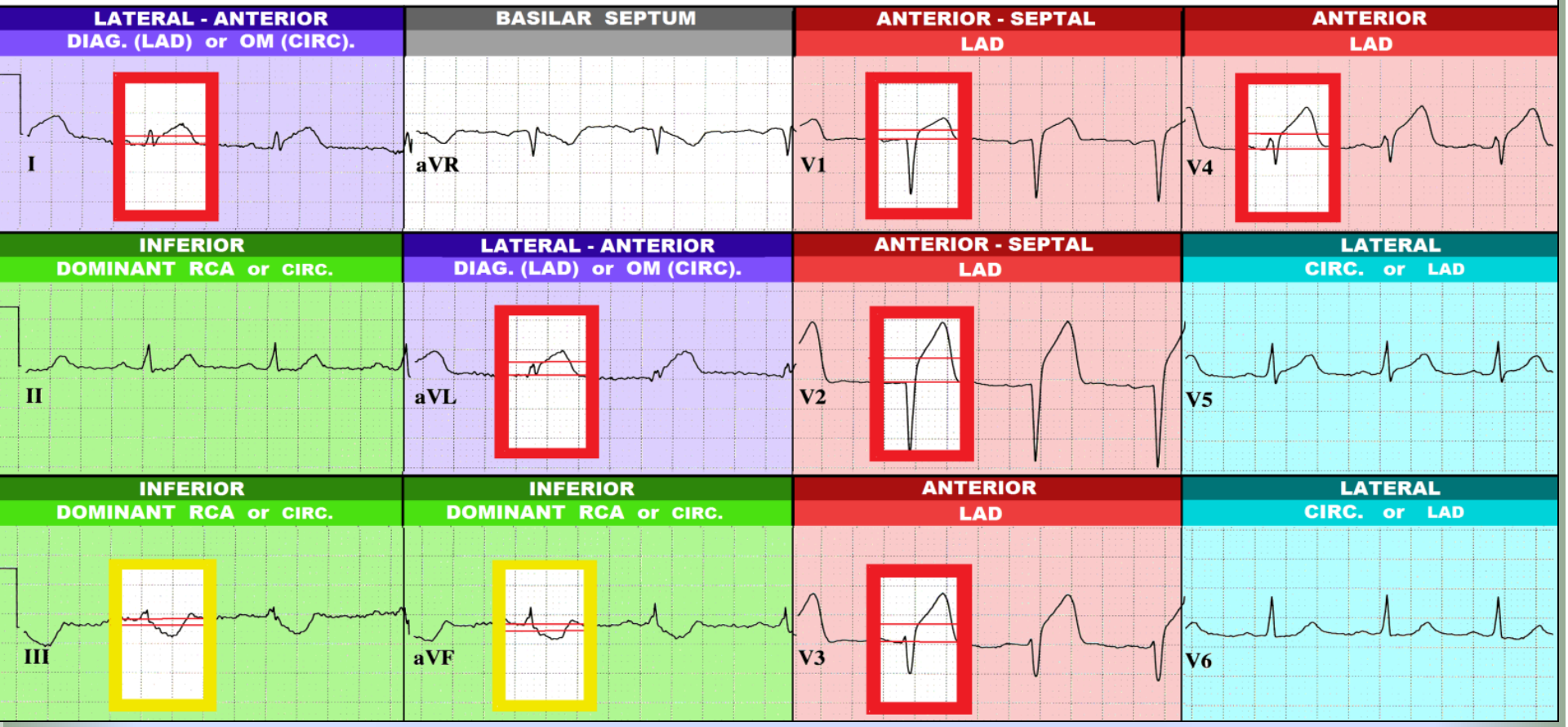
29 yr
Male
Caucasian

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



- **Reciprocal ST Depression is NOW PRESENT**
- **Additional ST Elevation is present in Leads I, AVL**

29 yr Male Caucasian

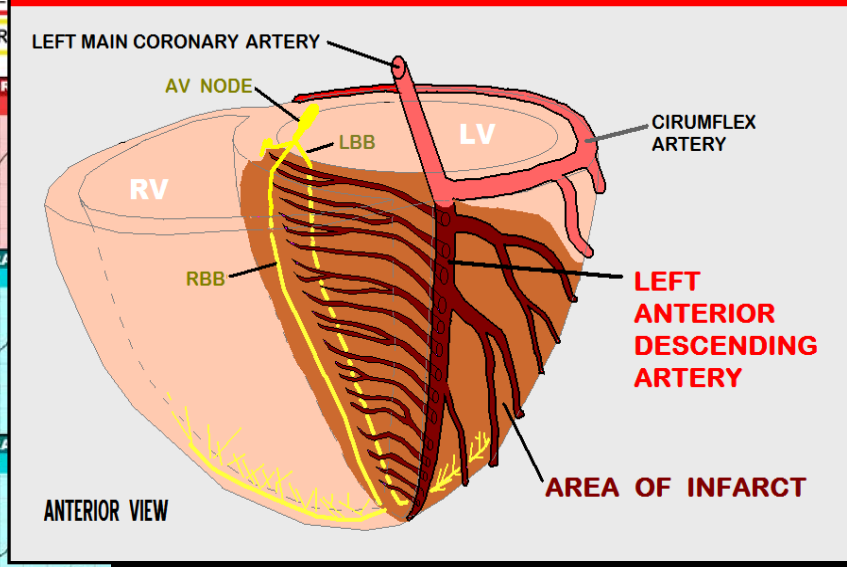
Vent. rate	75	BPM
PR interval	176	ms
QRS duration	90	ms
QT/QTc	362/404	ms
P–R–T axes	70 50	–11

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

ST SEGMENT ELE
ST SEGMENT DEPR

LATERAL - ANTERIOR DIAG. (LAD) or OM (CIRC).	BASILAR SEPTUM	ANTERIOR - SEPTAL LAD	ANTERIOR LAD
I	aVR	V1	V4
INFERIOR DOMINANT RCA or CIRC.	LATERAL - ANTERIOR DIAG. (LAD) or OM (CIRC).	ANTERIOR - SEPTAL LAD	LATERA CIRC. or
II	aVL	V2	V5
INFERIOR DOMINANT RCA or CIRC.	INFERIOR DOMINANT RCA or CIRC.	ANTERIOR LAD	LATERA CIRC. or
III	aVF	V3	V6

OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING ARTERY



72 yr Male Caucasian
Loc: Option:2

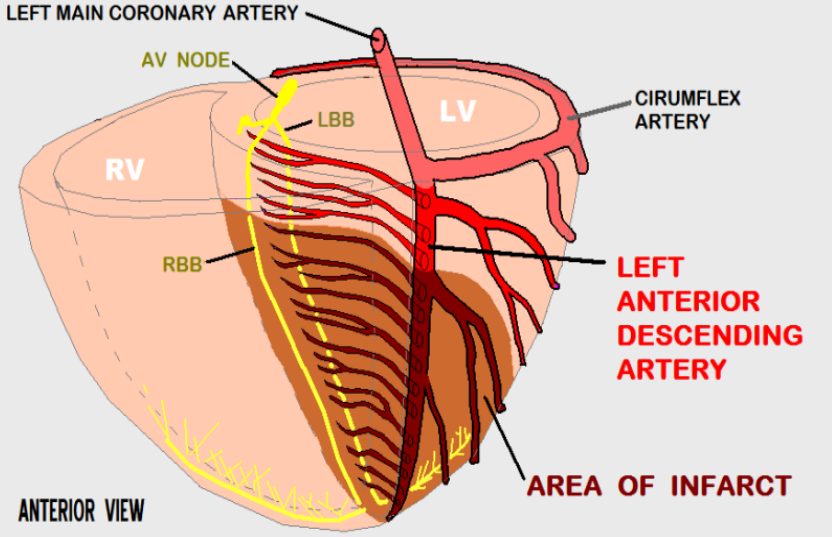
Vent. rate	75	BPM
PR interval	162	ms
QRS duration	98	ms
QT/QTc	382/426	ms
P–R–T axes	72 13	83

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

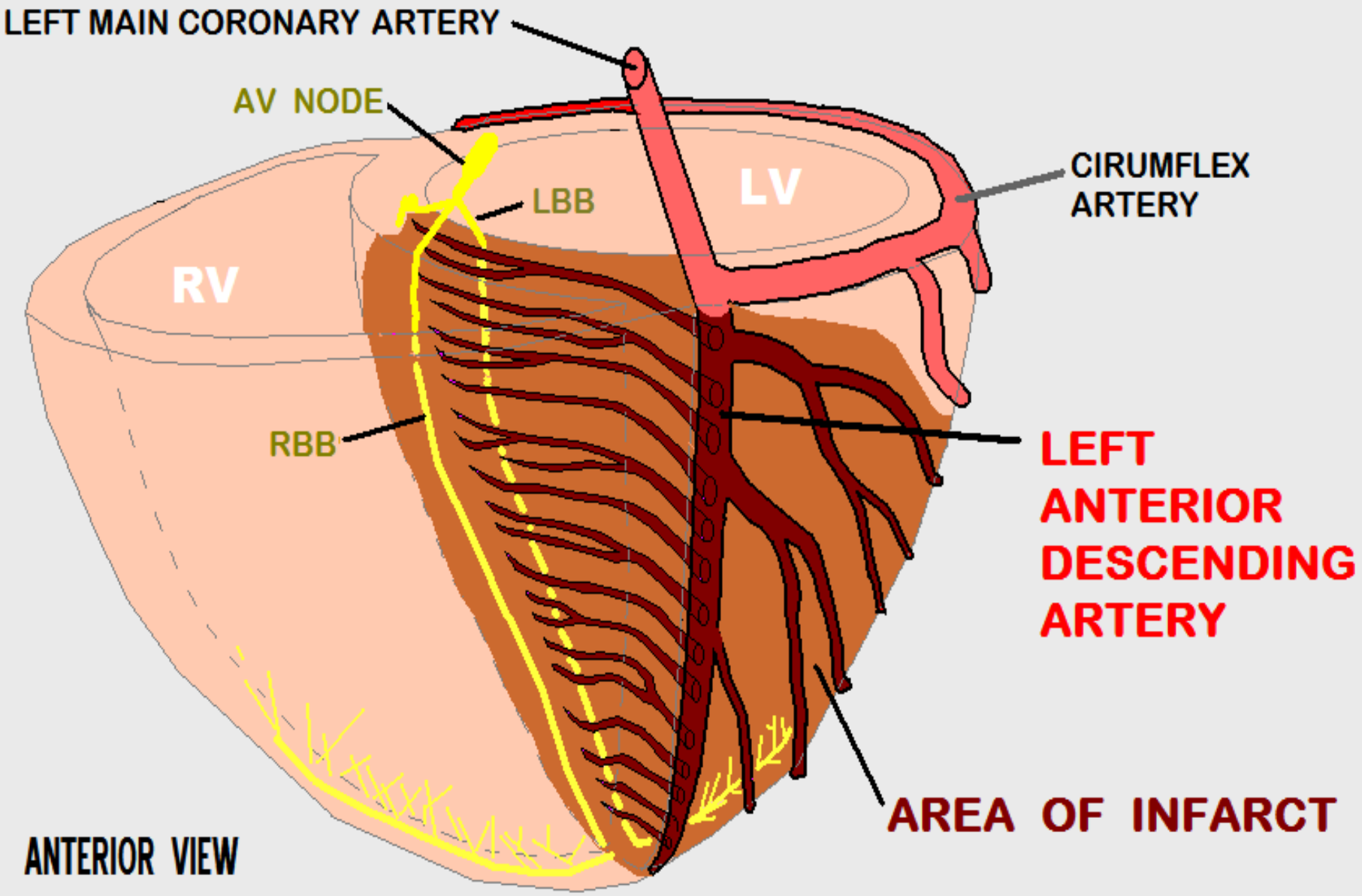
ST SEGMENT ELEVATIO

LATERAL - ANTERIOR DIAG. (LAD) or OM (CIRC).	BASILAR SEPTUM	ANTERIOR - SEPTAL LAD	ANTERIO LAD
I	aVR	V1	V4
INFERIOR DOMINANT RCA or CIRC.	LATERAL - ANTERIOR DIAG. (LAD) or OM (CIRC).	ANTERIOR - SEPTAL LAD	LATE CIRC. o
II	aVL	V2	V5
INFERIOR DOMINANT RCA or CIRC.	INFERIOR DOMINANT RCA or CIRC.	ANTERIOR LAD	LATE CIRC. o
III	aVF	V3	V6

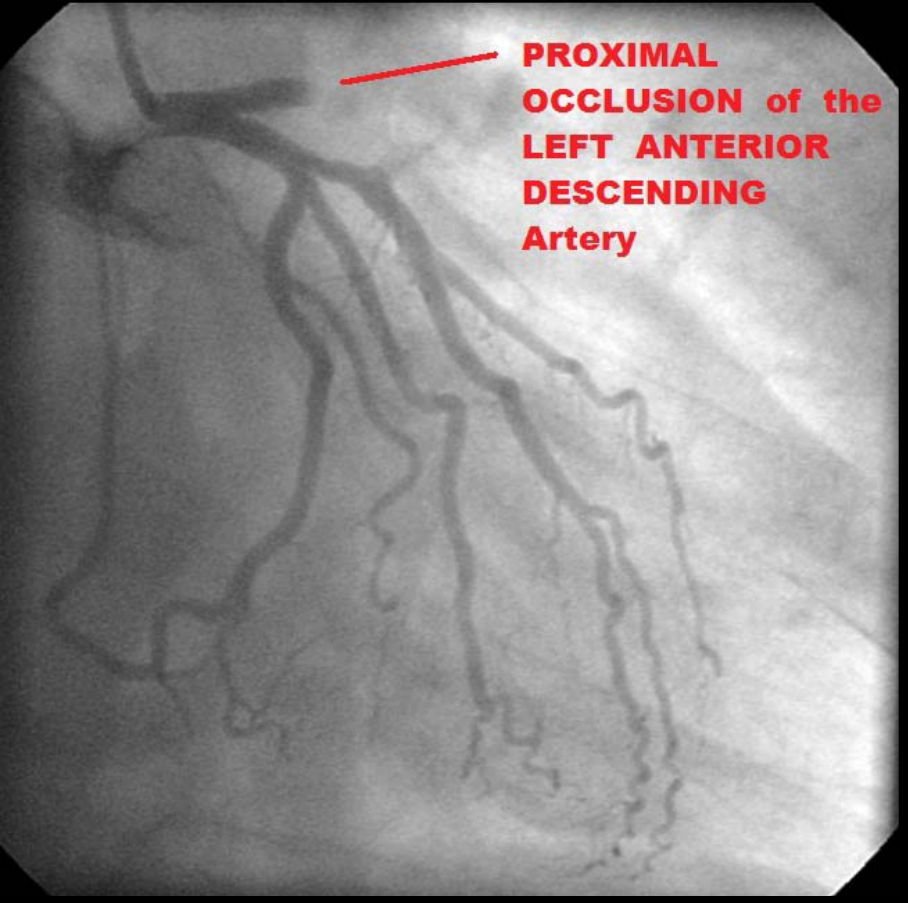
OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY

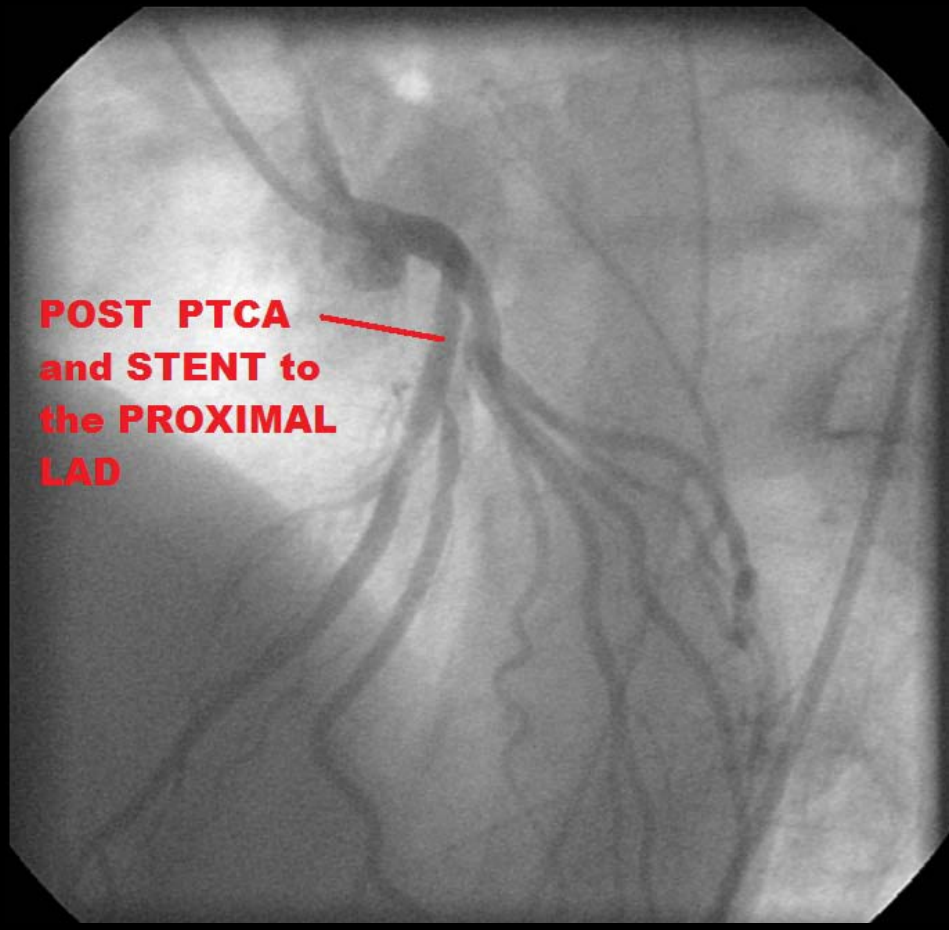


OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING ARTERY



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


PROXIMAL
OCCLUSION of the
LEFT ANTERIOR
DESCENDING
Artery


POST PTCA
and STENT to
the PROXIMAL
LAD

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.

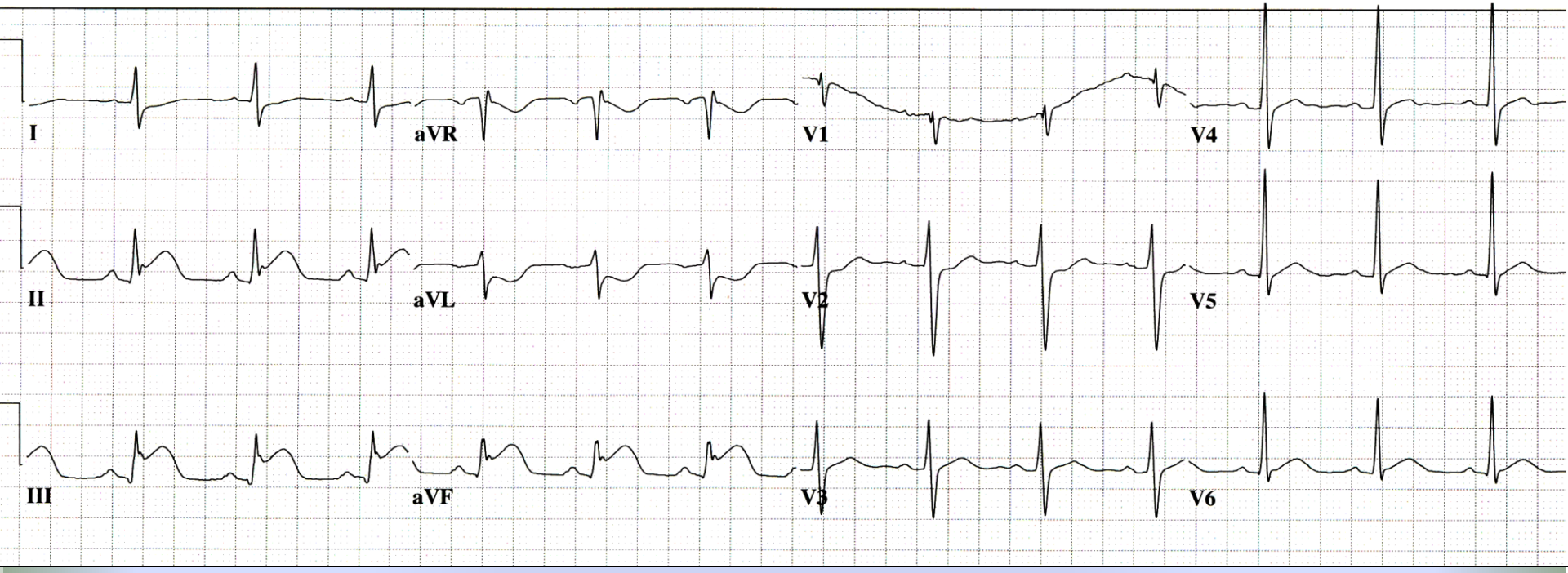
VITAL SIGNS: BP: 136/88 P: 88 R: 20 SAO2: 100% on 4 LPM O2

LABS: TROPONIN: < .04

46 yr		Vent. rate	82	BPM
Male	Caucasian	PR interval	168	ms
		QRS duration	96	ms
		QT/QTc	384/448	ms
Loc:3	Option:23	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
Male

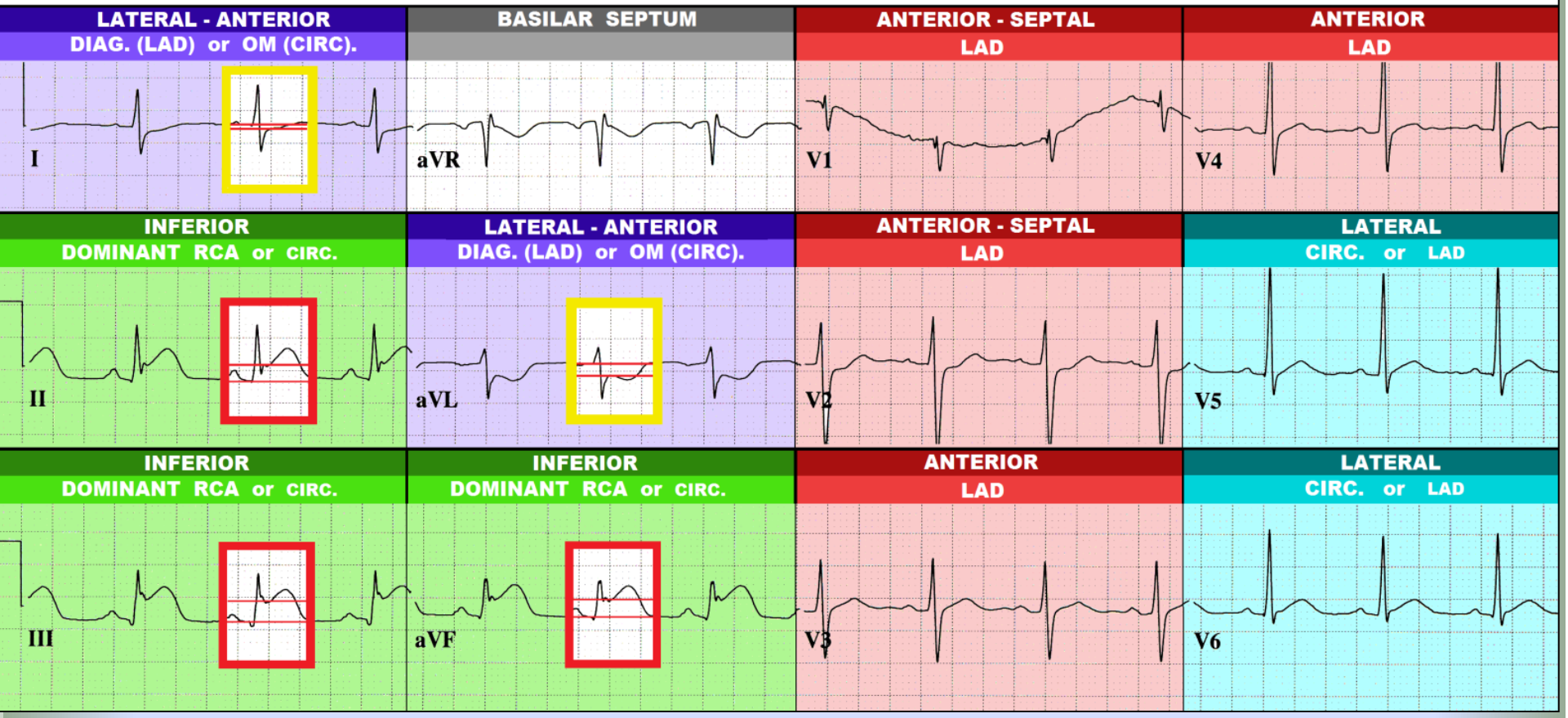
Caucasian

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



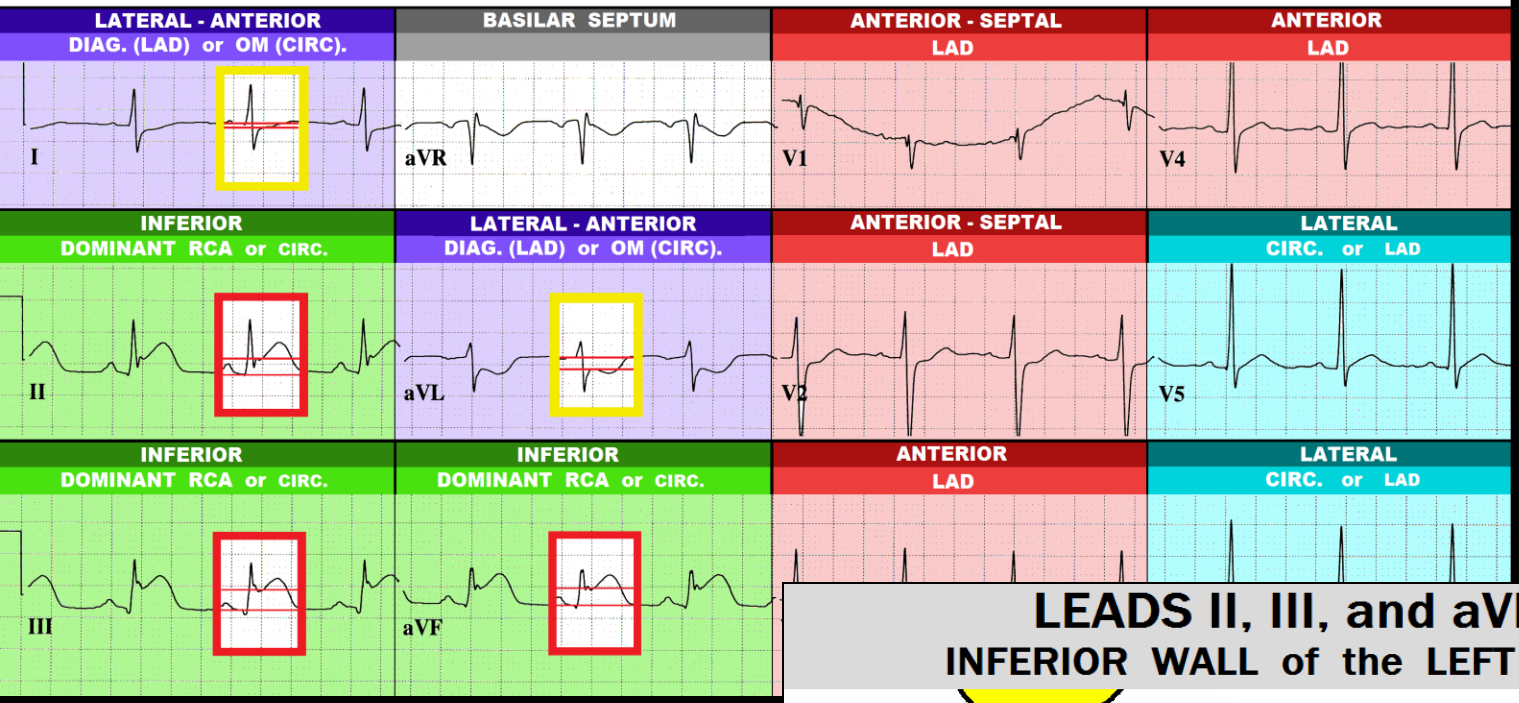
46 yr
Male
Caucasian

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

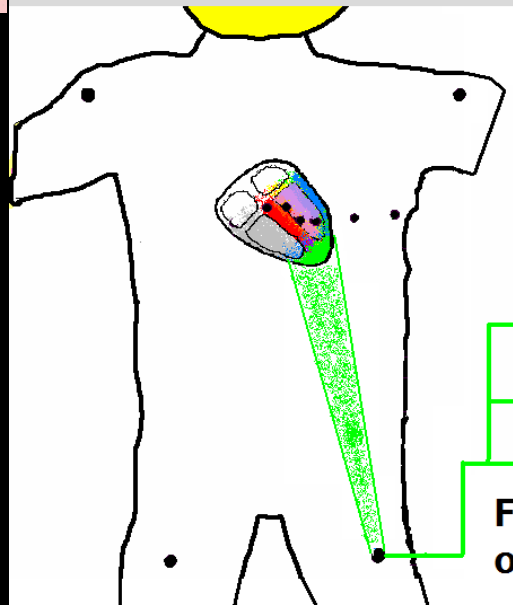
Normal sinus rhythm
ST elevation consider inferior injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG

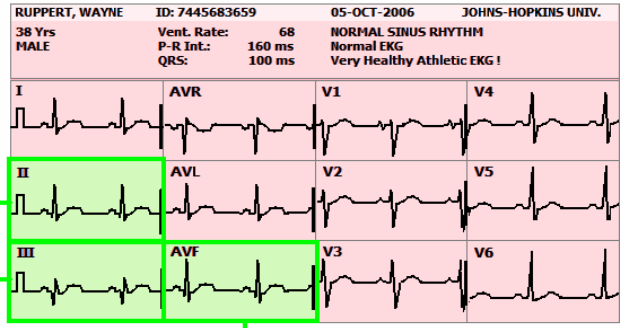
ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION



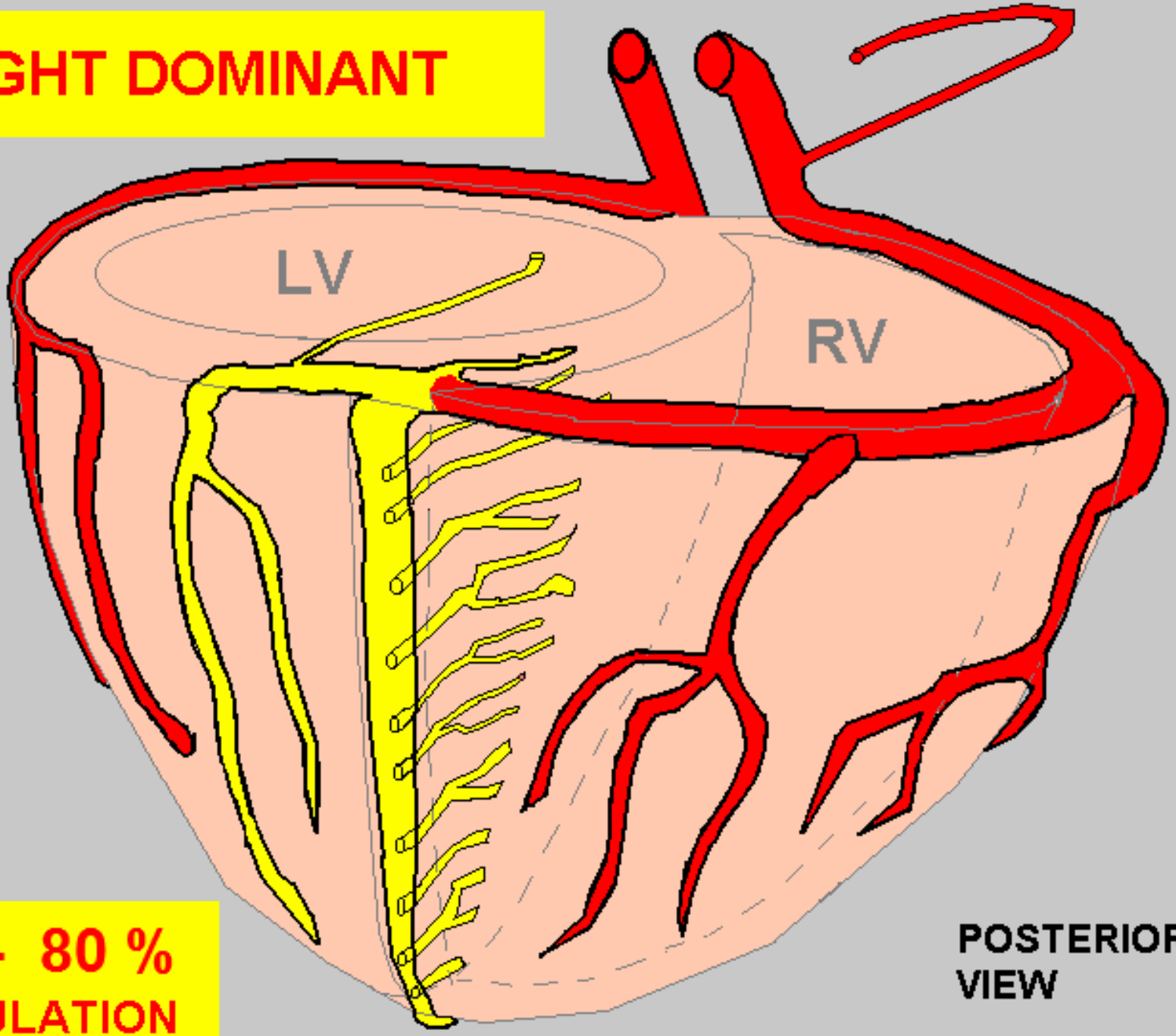
LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE





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

RIGHT DOMINANT



75 - 80 %
POPULATION

POSTERIOR VIEW

HELPFUL HINT . . . MEMORIZE THIS !

RIGHT CORONARY ARTERY (RCA)

RIGHT DOMINANT SYSTEMS

- RIGHT ATRIUM
- SINUS NODE (55% of the population)
- RIGHT VENTRICLE - 100 % of muscle mass
- LEFT VENTRICLE: 15 - 25 % of muscle mass
  - INFERIOR WALL
  - approx. 1/2 of POSTERIOR WALL
- AV NODE

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

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

A standard

12 LEAD EKG

Does NOT show the

RIGHT VENTRICLE

To see the

RIGHT VENTRICLE . . .

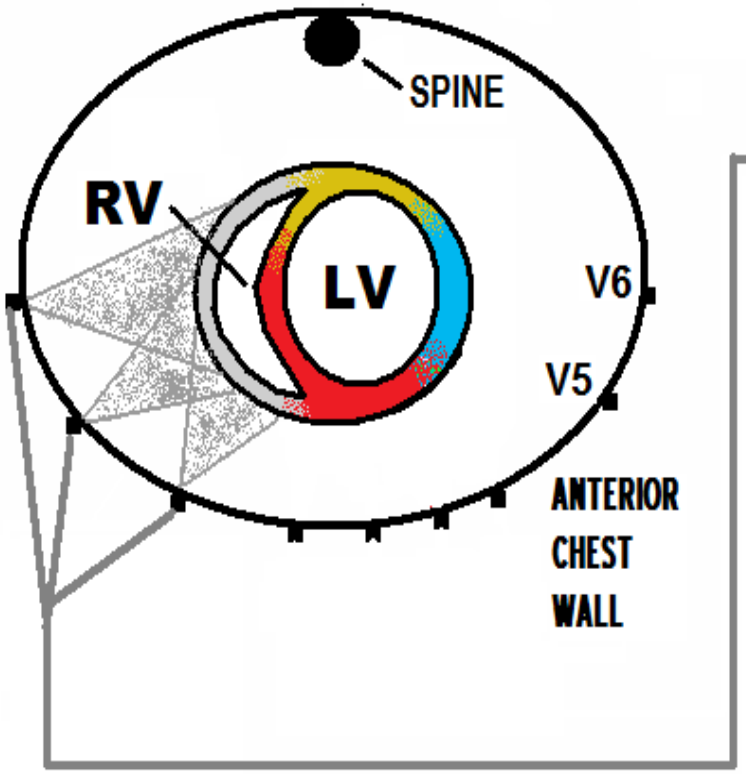
. . . such as in cases of

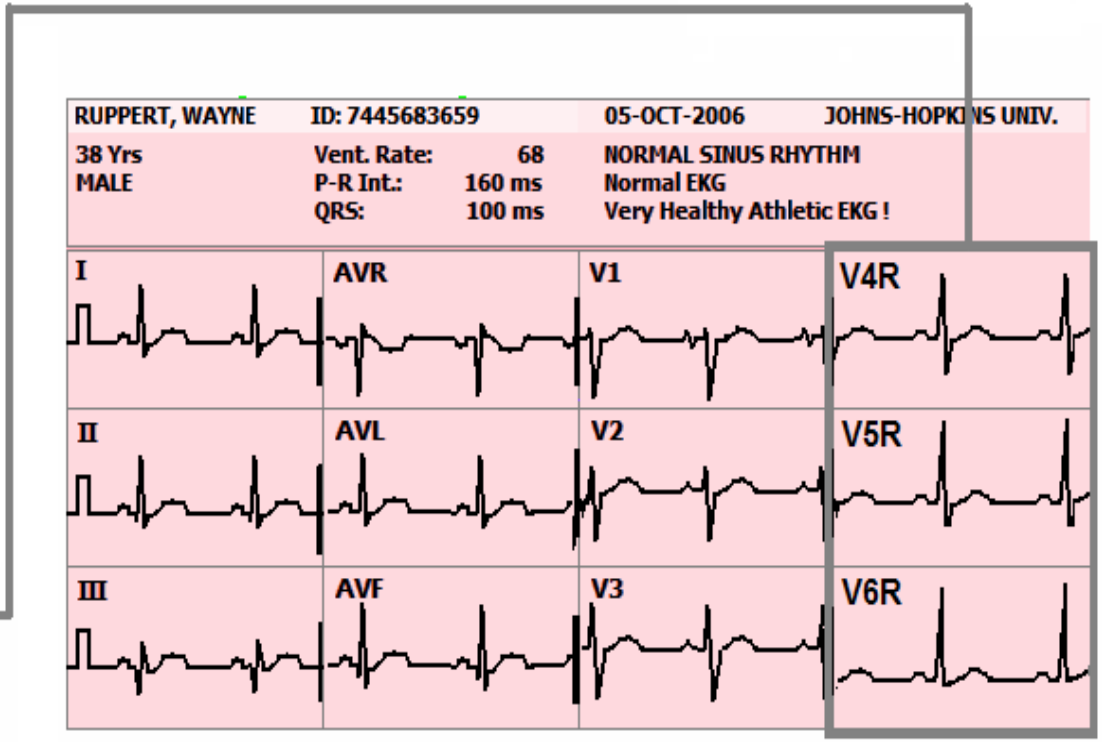
INFERIOR WALL M.I.

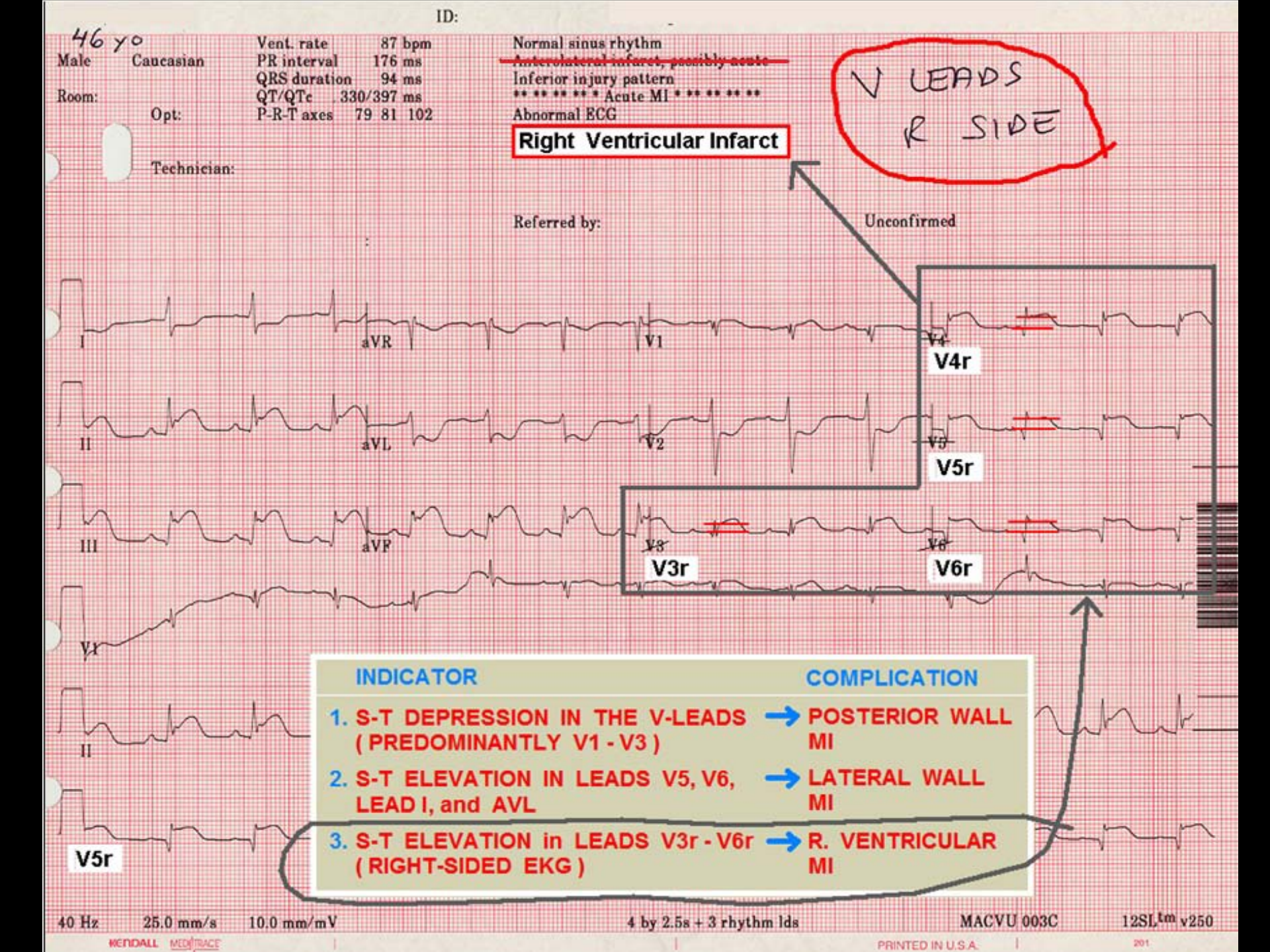
☞ You must do a

RIGHT - SIDED EKG ! !

V4R - V6R VIEW THE RIGHT VENTRICLE



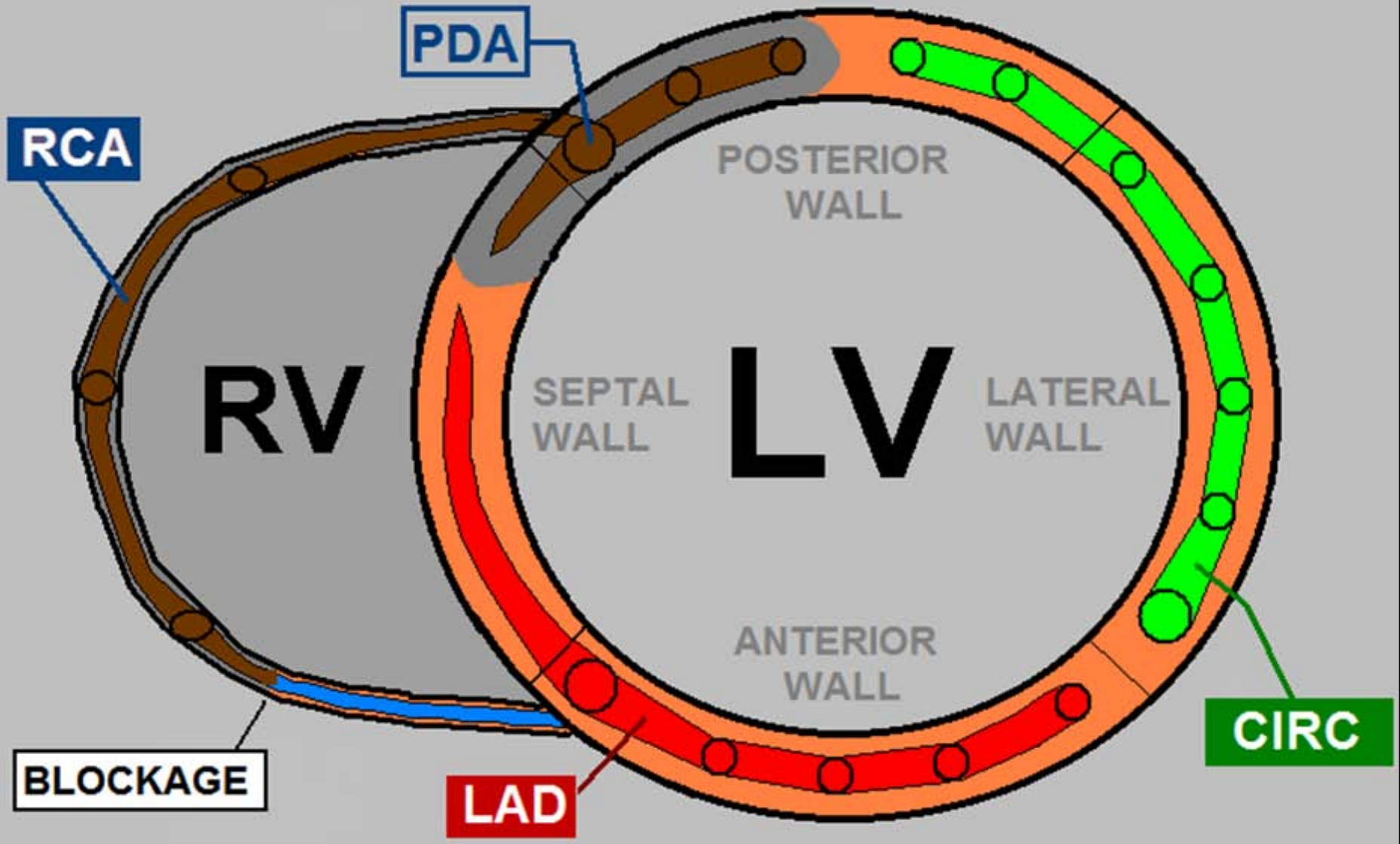



ID:
46 yo
Male Caucasian
Room:
Opt:
Technician:
Vent. rate 87 bpm
PR interval 176 ms
QRS duration 94 ms
QT/QTc 330/397 ms
P-R-T axes 79 81 102
Normal sinus rhythm
Inferior injury pattern
** ** ** ** * Acute MI * ** ** ** **
Abnormal ECG
Right Ventricular Infarct
V LEADS
R SIDE
Referred by:
Unconfirmed
I
aVR
V1
V4
V4r
II
aVL
V2
V5
V5r
III
aVF
V3
V3r
V6
V6r
VI
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

INFERIOR - RIGHT VENTRICULAR MI

DOMINANT RCA

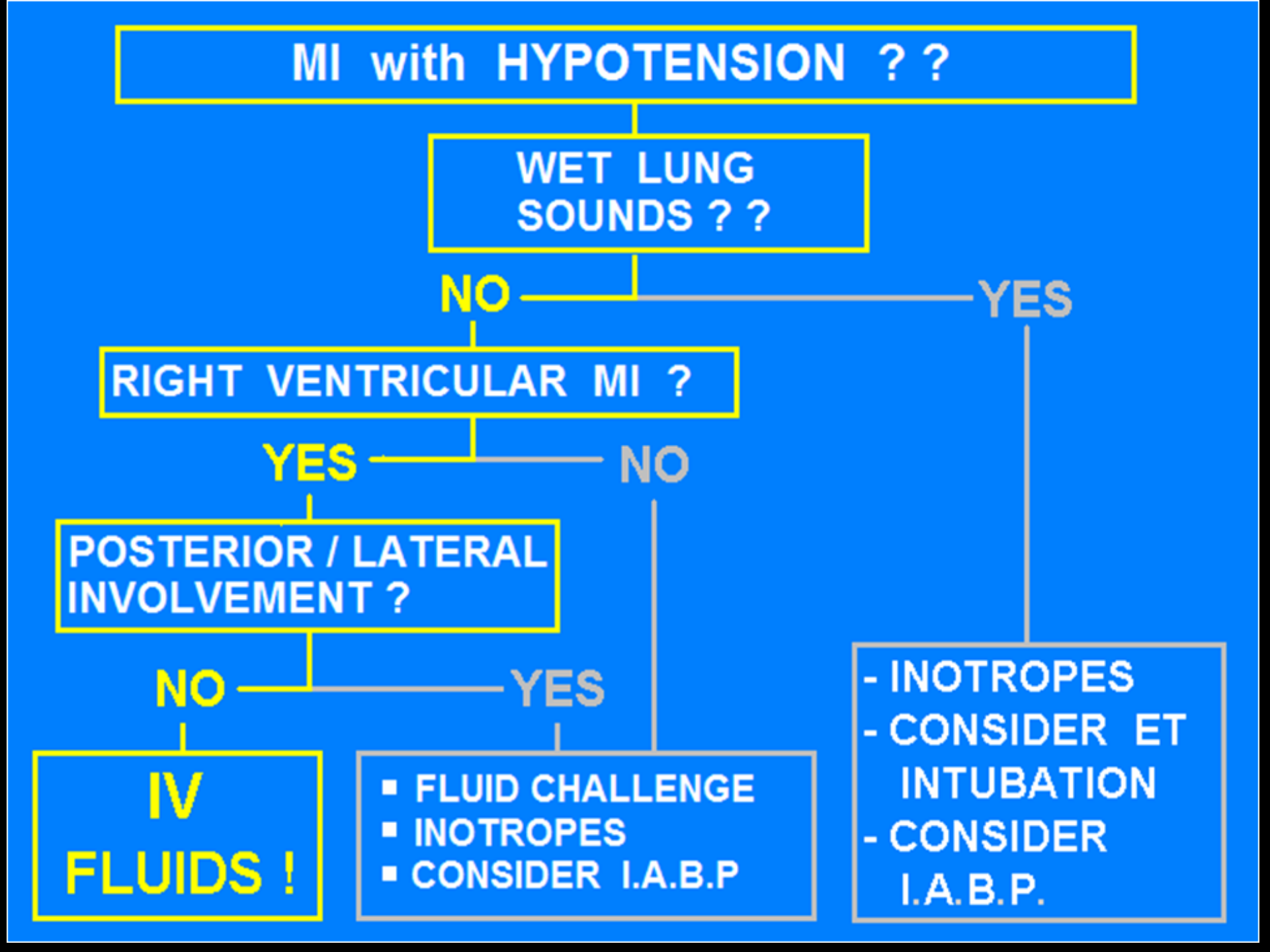
75-80 % of POPULATION

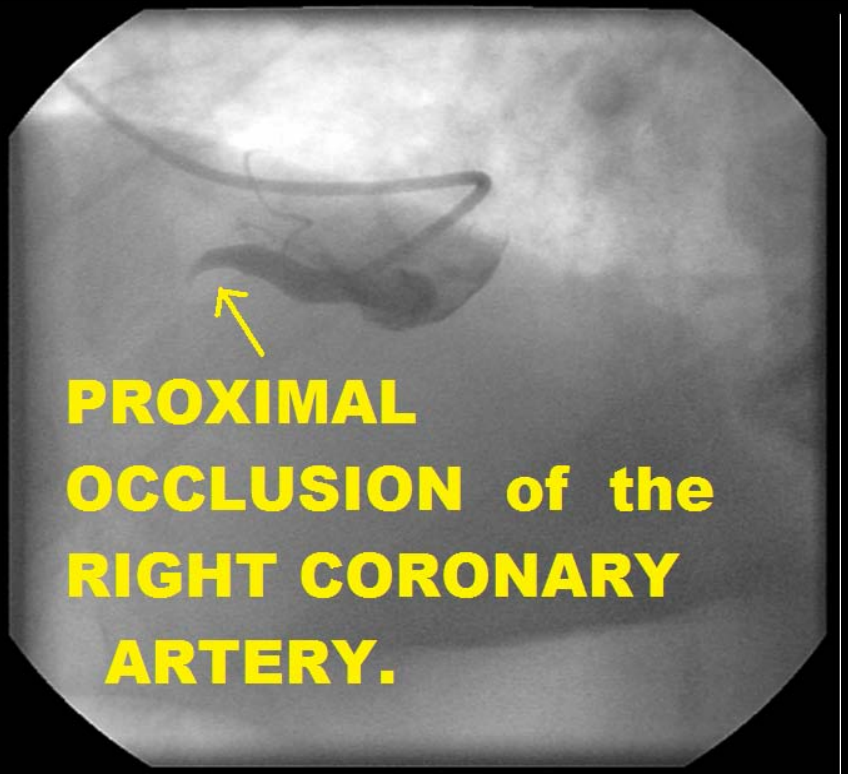


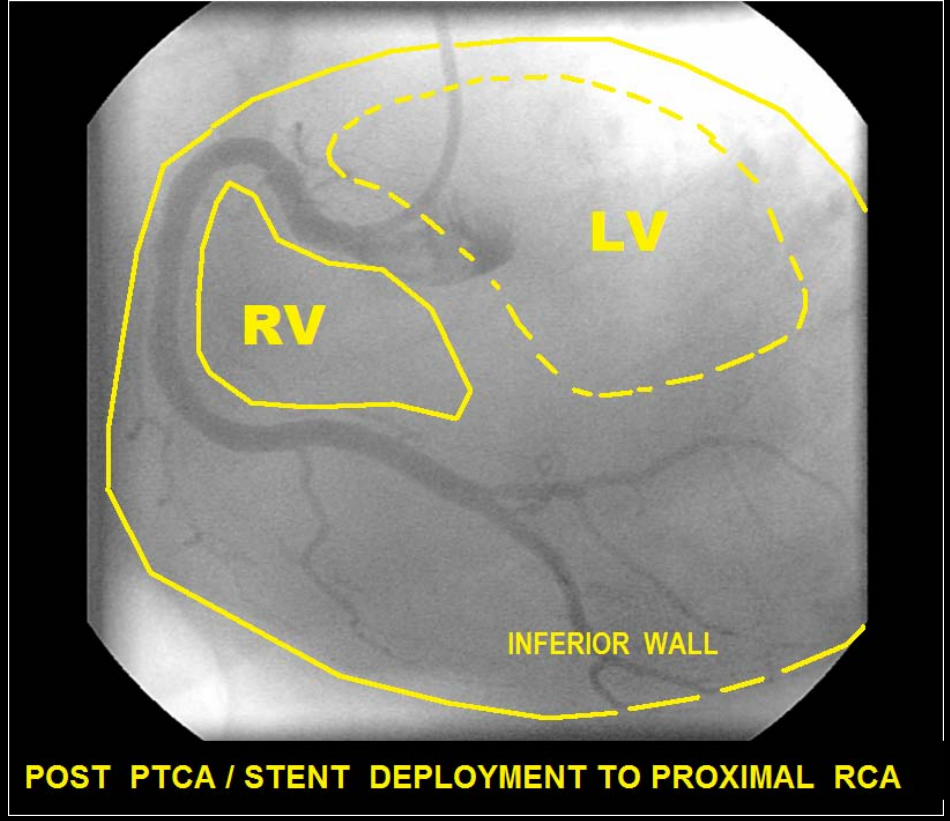
ANTICIPATED COMPLICATIONS of INFERIOR - RIGHT VENRICULAR WALL STEMI secondary to PROXIMAL RCA Occlusion & POSSIBLE INDICATED INTERVENTIONS:

- CARDIAC ARREST	BCLS / ACLS
- CARDIAC DYSRHYTHMIAS (VT / VF)	ACLS (antiarrhythmics)
- SINUS BRADYCARDIA	ATROPINE 0.5mg, REPEAT as needed UP TO 3mg. (follow ACLS and/or UNIT protocols)
- HEART BLOCKS (1st, 2nd & 3rd Degree HB)	ATROPINE 0.5mg, REPEAT as needed UP TO 3mg, Transcutaneous Pacing, (follow ACLS and/or UNIT protocols)
- RIGHT VENTRICULAR MYOCARDIAL INFARCTION	- NITRATES and DIURETICS are CONTRA-INDICATED. - TREAT HYPOTENSION WITH FLUIDS. (It is Not uncommon to give 500-2000ml of NORMAL SALINE to stabilize BP.
- POSTERIOR WALL INFARCTION	- POSTERIOR WALL MI presents on the 12 Lead ECG as ST DEPRESSION in Leads V1 - V3. - POSTERIOR WALL MI is NOT PRESENT ON THIS ECG.

If this patient becomes HYPOTENSIVE . . . . .

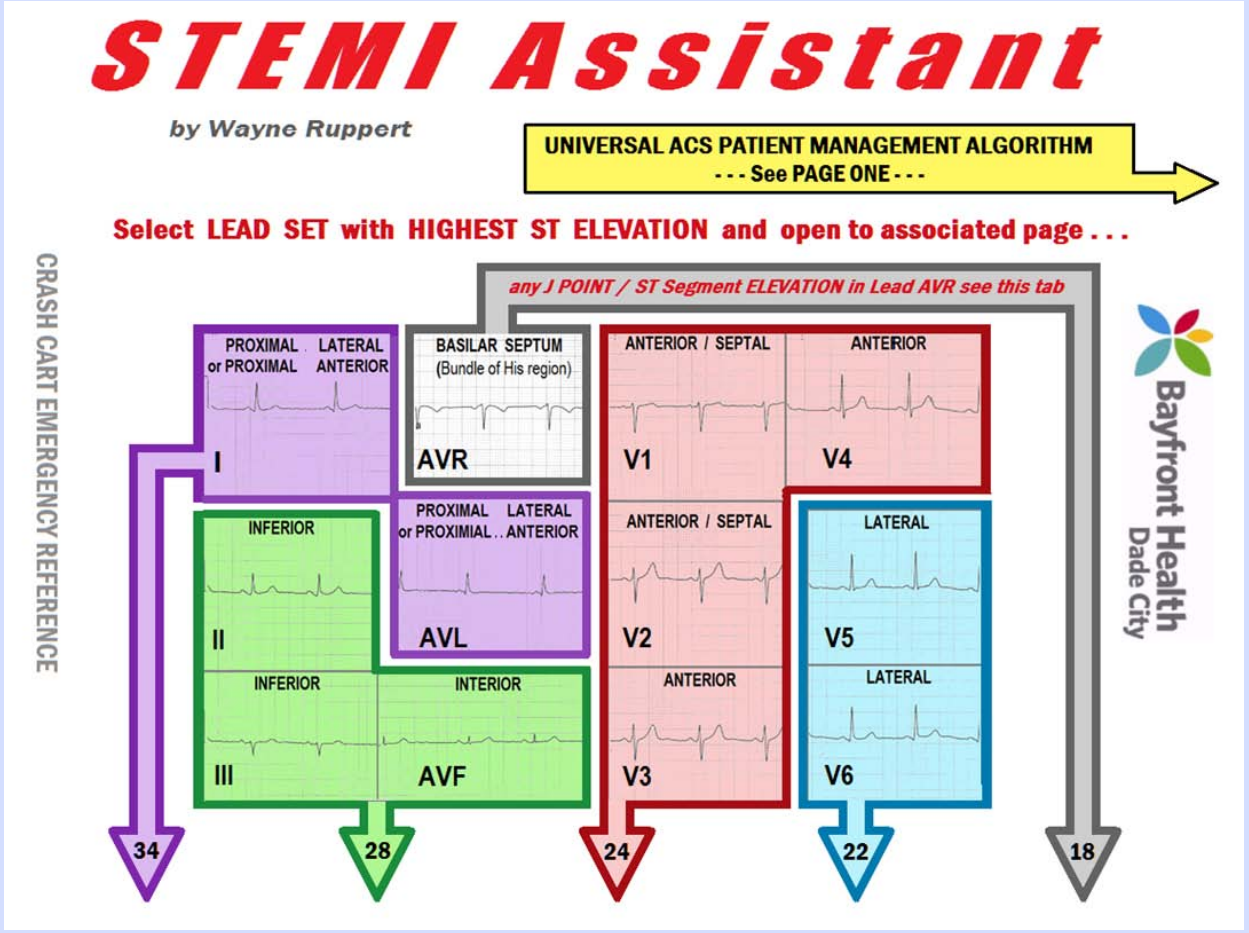

MI with HYPOTENSION ? ?
WET LUNG SOUNDS ? ?
NO
YES
RIGHT VENTRICULAR MI ?
YES
NO
POSTERIOR / LATERAL INVOLVEMENT ?
NO
YES
IV FLUIDS !
FLUID CHALLENGE
INOTROPES
CONSIDER I.A.B.P
- INOTROPES
- CONSIDER ET INTUBATION
- CONSIDER I.A.B.P.





POST PTCA / STENT DEPLOYMENT TO PROXIMAL RCA

STEMI Assistant: an Emergency Crash Cart Interactive Reference Manual - free Download



STEMI Assistant – Information Video

Helpful STEMI ECG Resources

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

Abnormal ST Elevation Criteria: ACC/AHA 2009 "Standardization and Interpretation of the ECG, Part VI Acute Ischemia and Infarction," Galen Wagner, et al

ECG in STEMI – excellent powerpoint – quick reference, in-depth material

Helpful STEMI ECG Resources

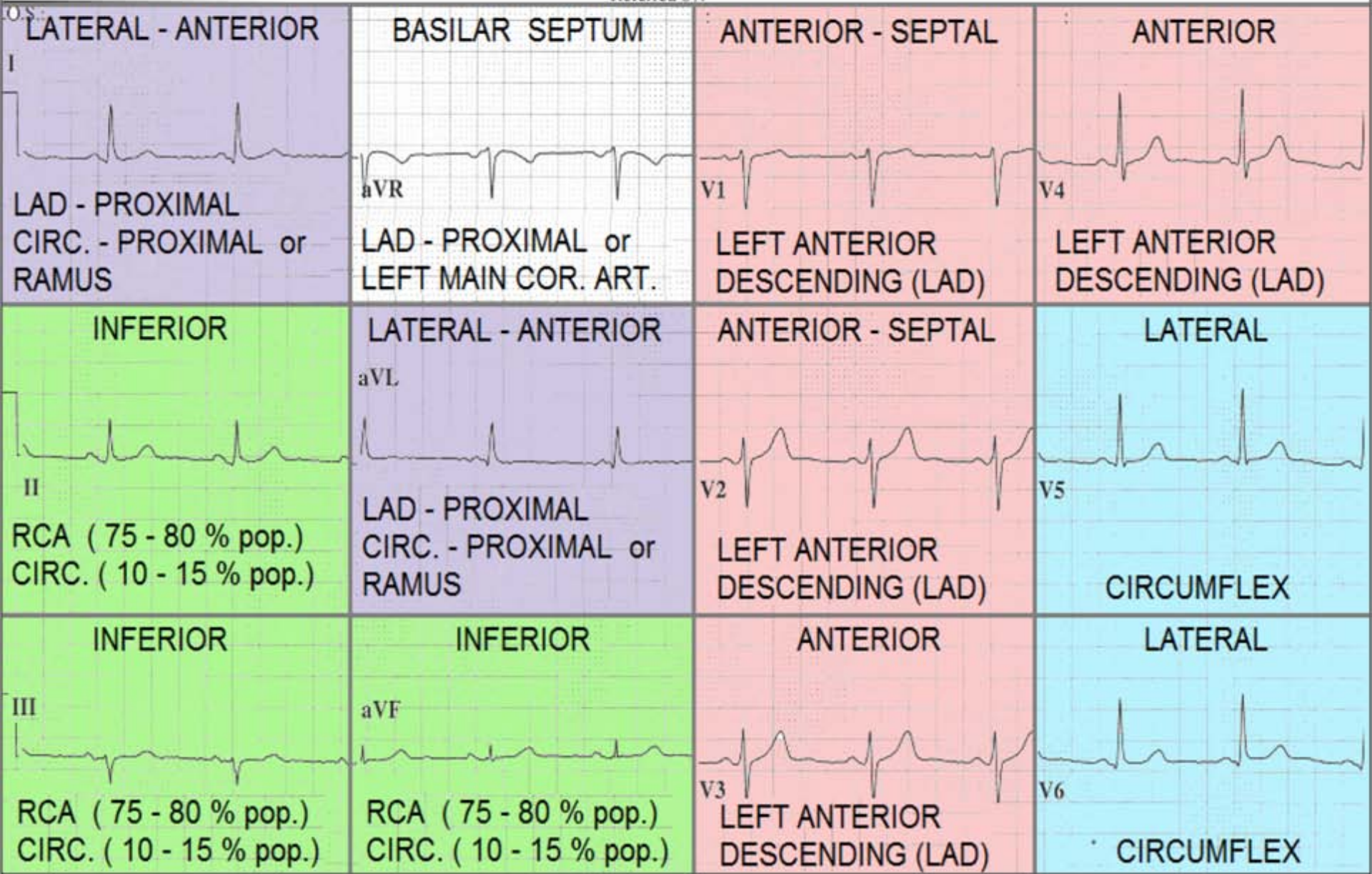
Download Non-ED STEMI Protocol - example

Download STEMI Alert ED Physicians Order Set

Vent. rate	64	BPM
PR interval	130	ms
QRS duration	96	ms
QT/QTc	396/408	ms
P–R–T axes	40 11	61

Normal sinus rhythm
Normal ECG
No previous ECGs available

Referred by:



Correlation of Leads with ST Elevation and Cardiac Structures at Risk, based on STEMI in patients with Common Coronary Arterial Anatomy

	ECG Leads:	Associated Region:	Coronary Artery:	Structures at Risk:
All Patients	V1 - V4	Anterior and Septal walls of LV	Left Anterior Descending (LAD) Atery	- 35 - 45% of LV muscle mass - Bundle of HIS - Bundle Branches
RCA Dominant	V5 - V6	Lateral wall LV, approx. 50% Posterior wall	Circumflex (Cx) (non - dominant)	- 20 - 30% LV muscle mass - Sinus Node (rare)
	II, III, AVF	Inferior Wall , approx. 50% Posterior wall	Right Coronary Artery (RCA)	- SA Node - Right Ventricle - AV Node
Cx Dominant	V5 - V6 + II, III, AVF	Lateral wall of LV Posterior Wall (all) Inferior Wall	Circumflex (Dominant)	- 45-55% LV muscle mass - SA Node (rare) - AV Node

EVOLVING STEMI:

-ST SEGMENTS DROP

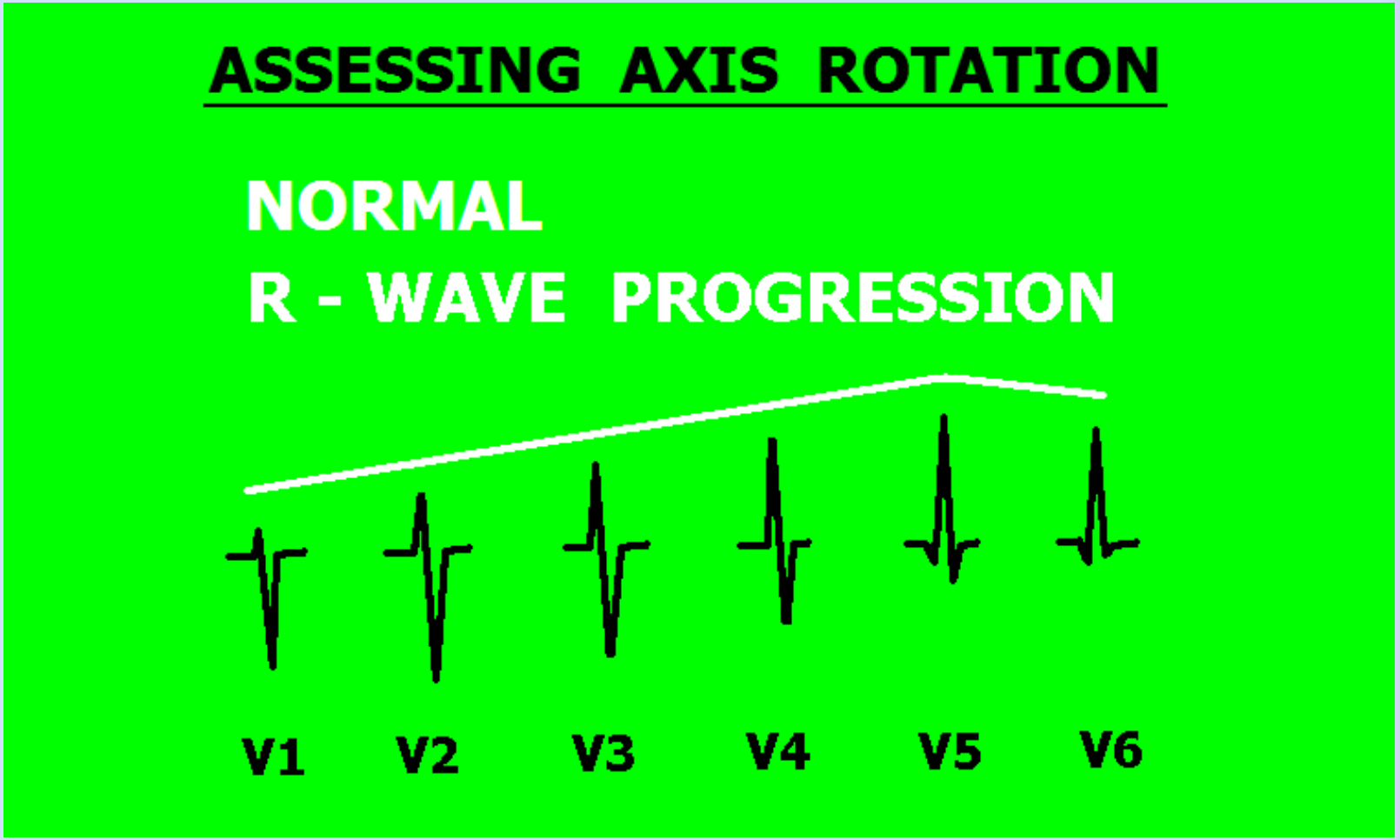
-Q WAVES FORM

-R WAVE PROGRESSION CHANGES IN PRECORDIAL LEADS.

Q WAVE RULES - SUMMARY:

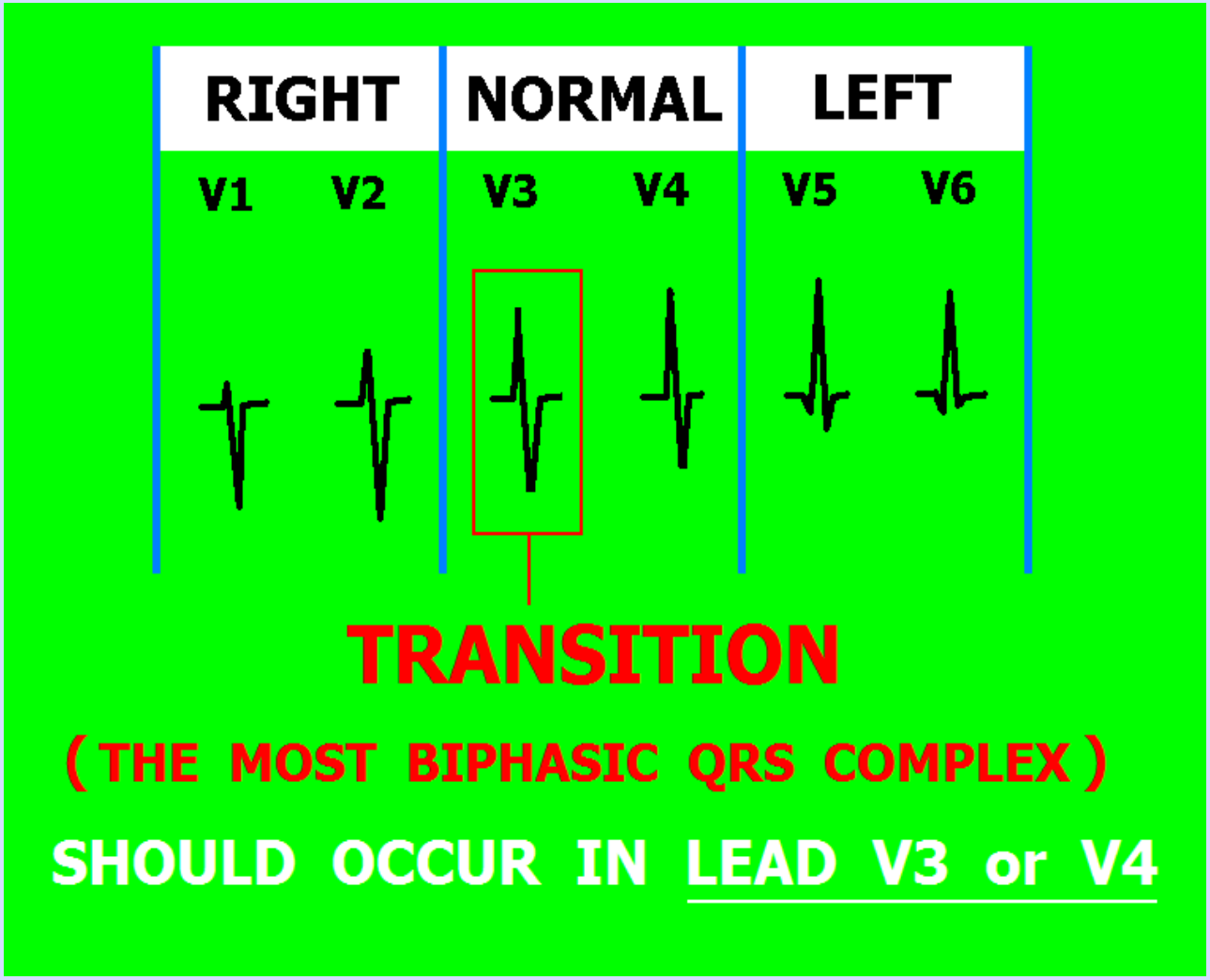
- Q WAVES SHOULD BE LESS THAN .40 WIDE (1 mm)
- Q WAVES SHOULD BE LESS THAN 1/3 THE HEIGHT OF THE R WAVE
- Q WAVES CAN BE ANY SIZE IN LEADS III and AVR
- THERE SHOULD BE NO Q WAVES IN LEADS V1, V2, or V3

The NORMAL ECG



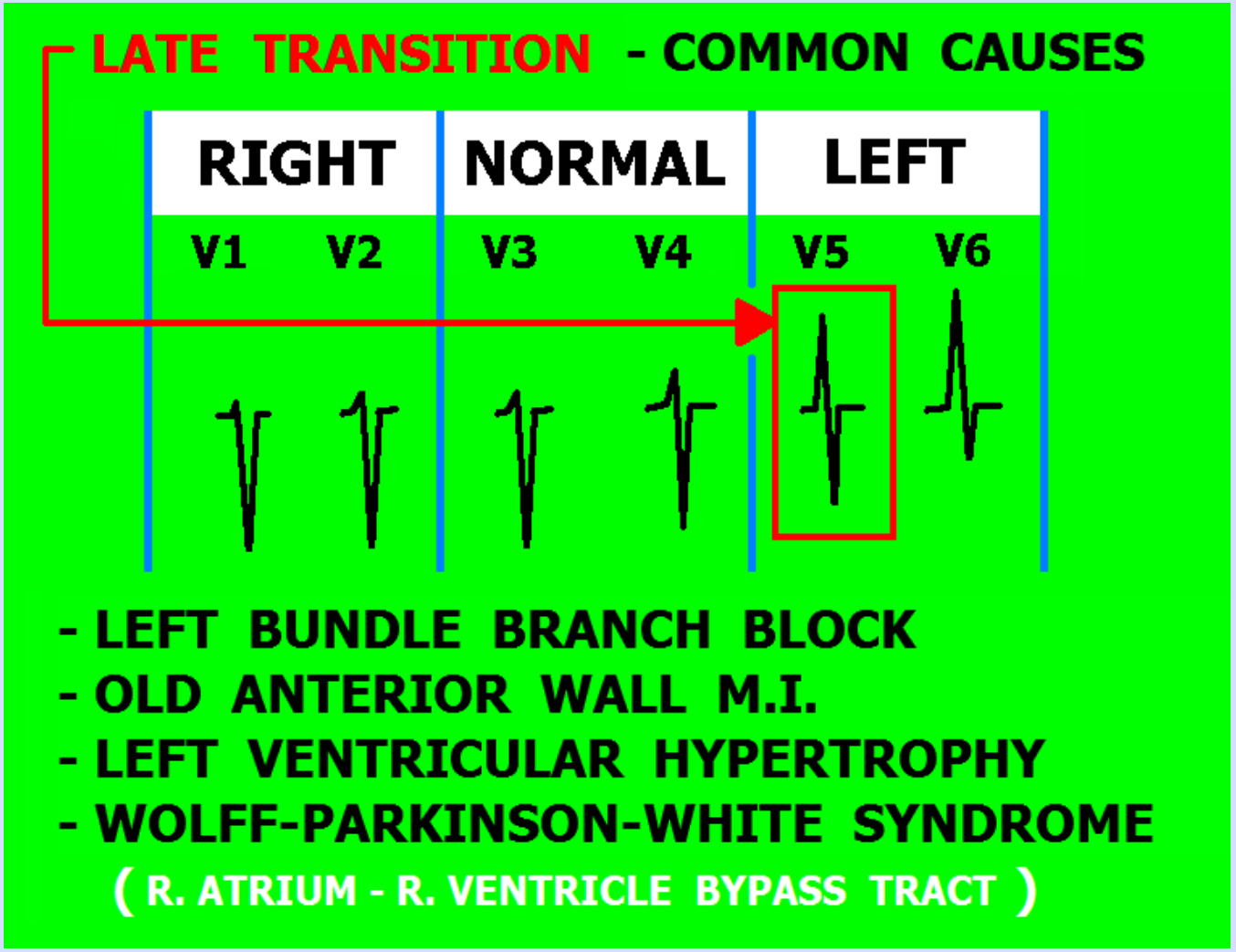
R wave amplitude (size) gradually increases from V1 through V6 . . . .

The NORMAL ECG

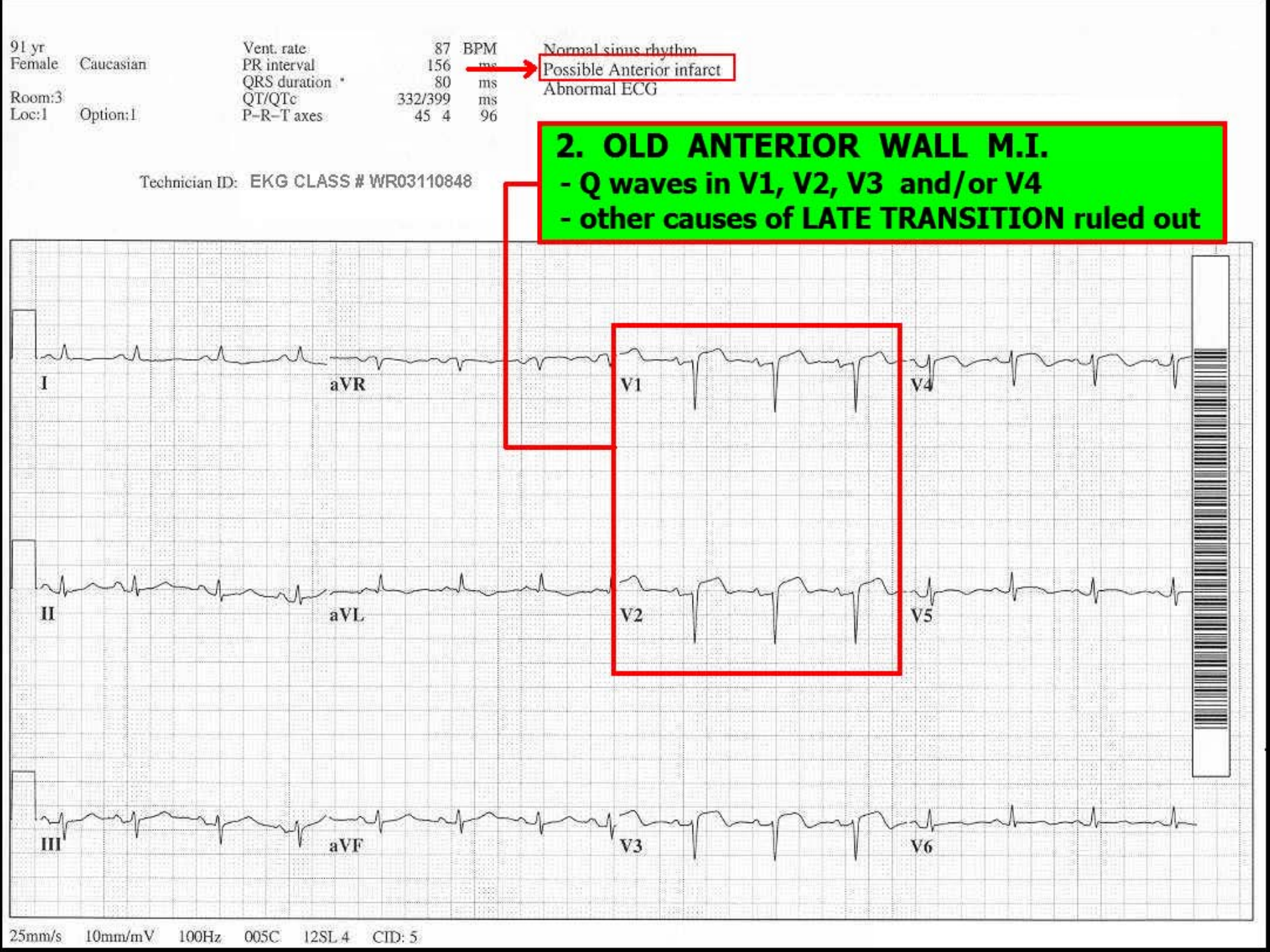


In V3 or V4, the QRS complex becomes Biphasic.

“Poor R Wave Progression” . . . .

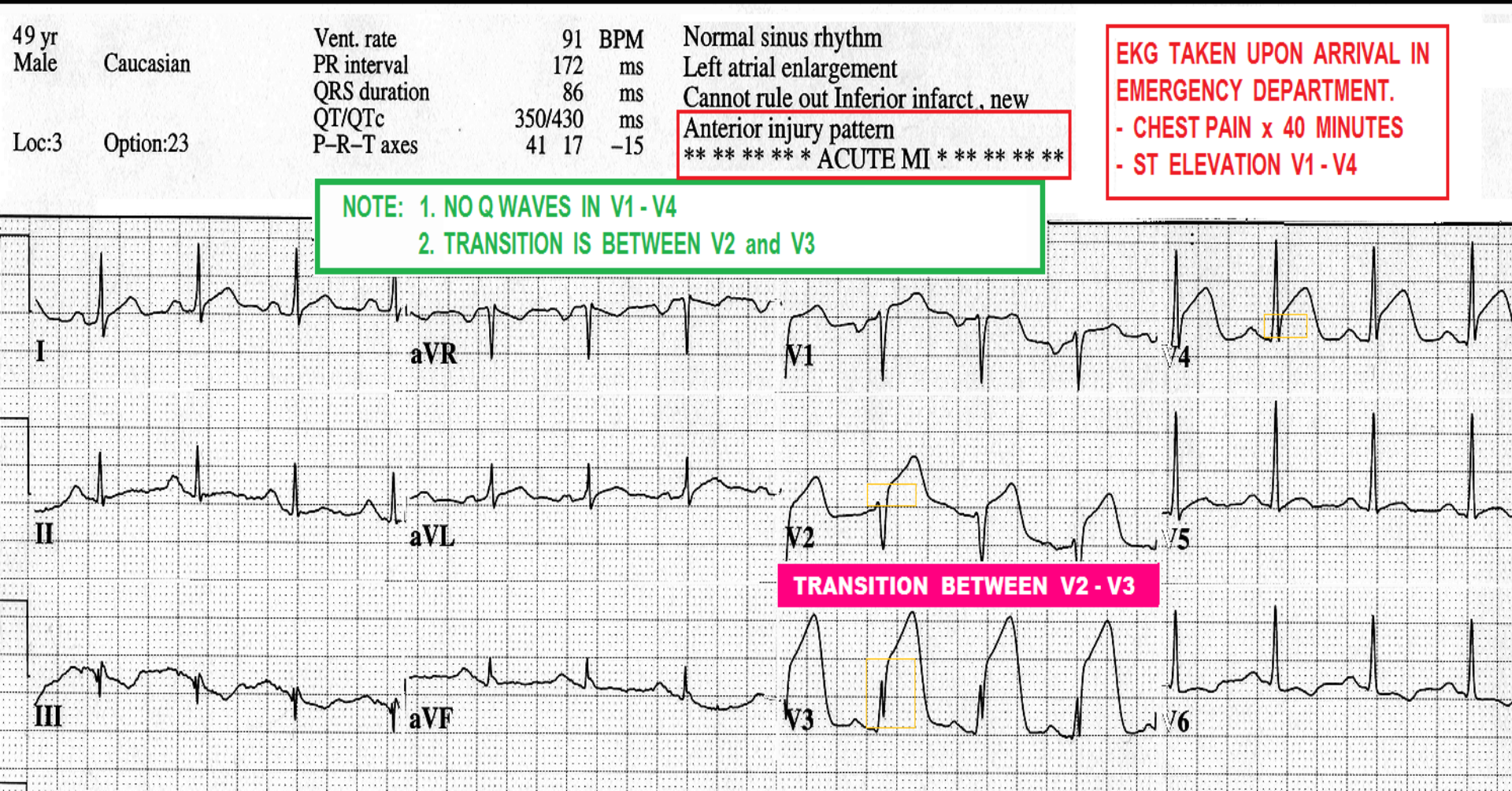


Anterior Wall necrosis (“old MI”) is a common cause of “Poor R Wave Progression”.


91 yr
Female Caucasian
Room:3
Loc:1 Option:1
Vent. rate 87 BPM
PR interval 156 ms
QRS duration 80 ms
QT/QTc 332/399 ms
P-R-T axes 45 4 96
Normal sinus rhythm
Possible Anterior infarct
Abnormal ECG
Technician ID: EKG CLASS # WR03110848
2. OLD ANTERIOR WALL M.I.
- Q waves in V1, V2, V3 and/or V4
- other causes of LATE TRANSITION ruled out
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5

ACUTE ANTERIOR WALL STEMI

EKG # 1 UPON ARRIVAL IN E.D. - CHEST PAIN x 40 MINUTES **APRIL 6, 2009 01:14 HOURS**



EVOLVING ANTERIOR WALL STEMI

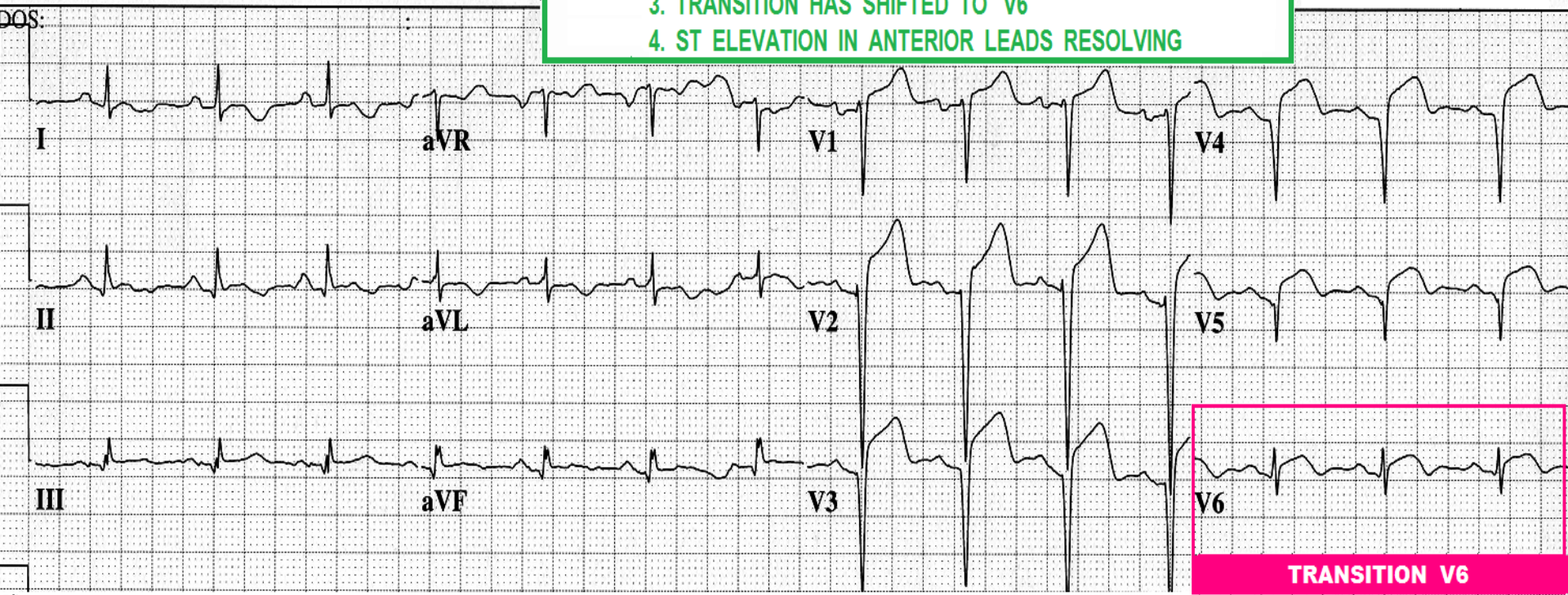
EKG # 4 APPROXIMATELY 19 HOURS FROM ONSET OF SYMPTOMS APRIL 6, 2009 19:36 HOURS

49 yr
Male Caucasian

Room:CS1
Loc:5 Option:28

Vent. rate	86 BPM	Normal sinus rhythm
PR interval	174 ms	Anterior infarct , possibly acute
QRS duration	78 ms	Lateral injury pattern
QT/QTc	360/430 ms	** ** ** ** * ACUTE MI * ** ** ** **
P–R–T axes		

NOTE: 1. Q WAVES IN LEADS V2 - V5
2. ST ELEVATION NOW IN V5
3. TRANSITION HAS SHIFTED TO V6
4. ST ELEVATION IN ANTERIOR LEADS RESOLVING



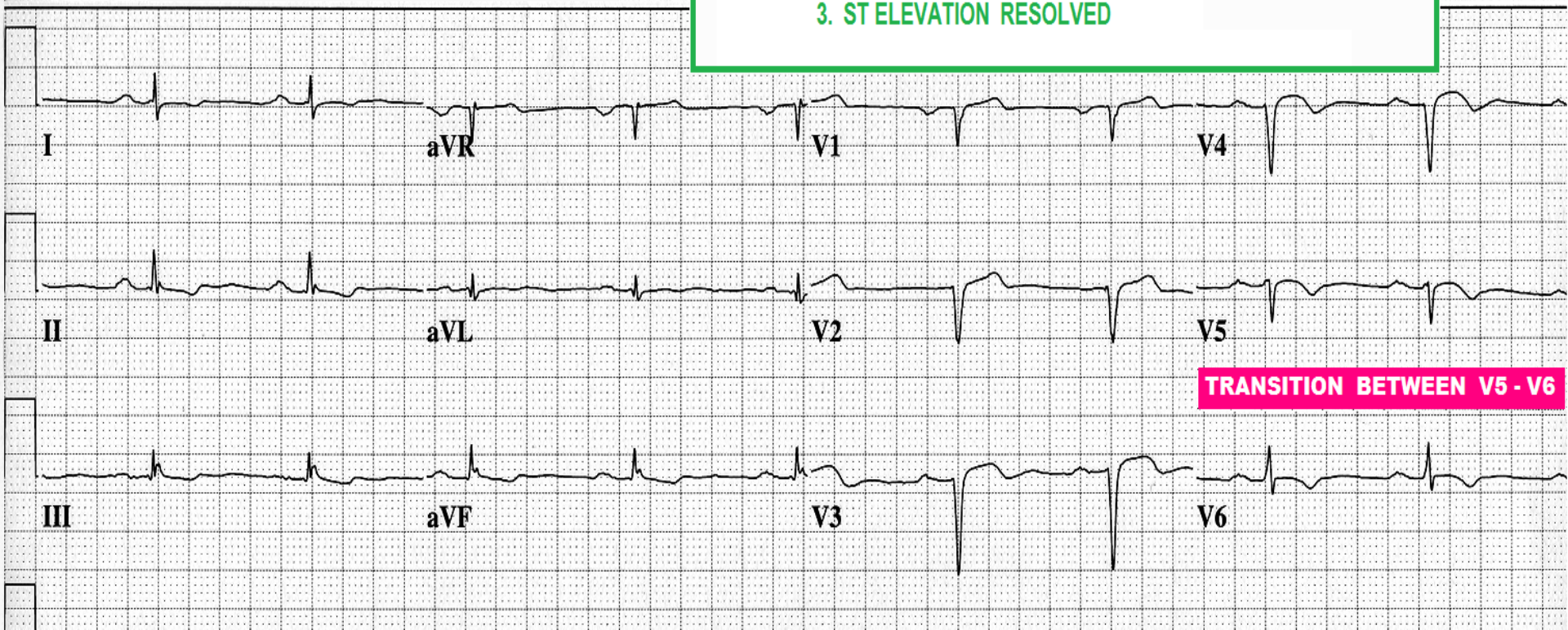
FULLY EVOLVED ANTERIOR WALL MI

POST - INFARCTION EKG TAKEN 1 YEAR AFTER ANTERIOR WALL MI

50 yr		Vent. rate	57	BPM
Male	Caucasian	PR interval	216	ms
		QRS duration	96	ms
Room:		QT/QTc	392/381	ms
Loc:	Option:	P–R–T axes	40 58	–120

Sinus bradycardia with 1st degree A–V block
Anterolateral infarct
T wave abnormality, consider inferior ischemia
Abnormal ECG

NOTE:
1. QS COMPLEXES NOW SEEN IN V1 - V4
2. TRANSITION NOW BETWEEN V5 and V6
3. ST ELEVATION RESOLVED



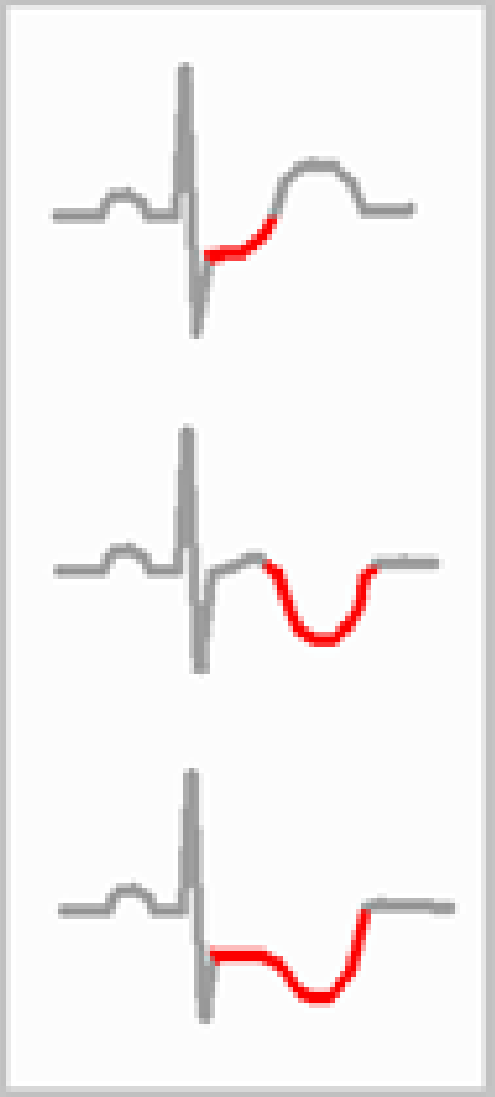
ISCHEMIA

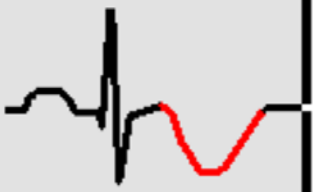
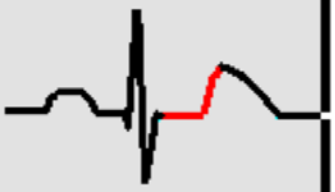
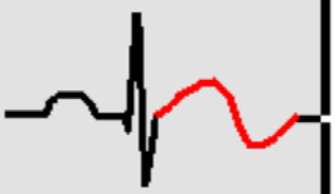
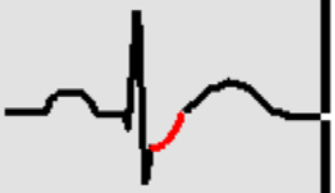
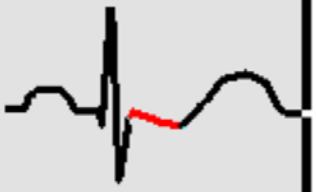
HELPFUL PATTERNS . . .

J POINT DEPRESSION
(> 1 mm)

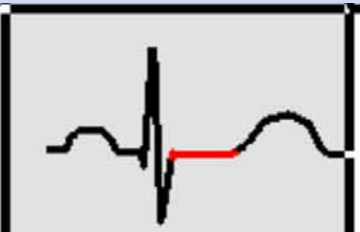
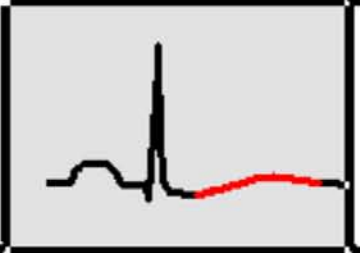
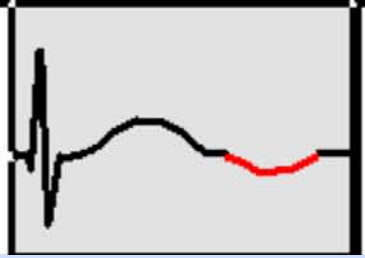
INVERTED T WAVES

J POINT DEPRESSION
+ INVERTED T WAVES

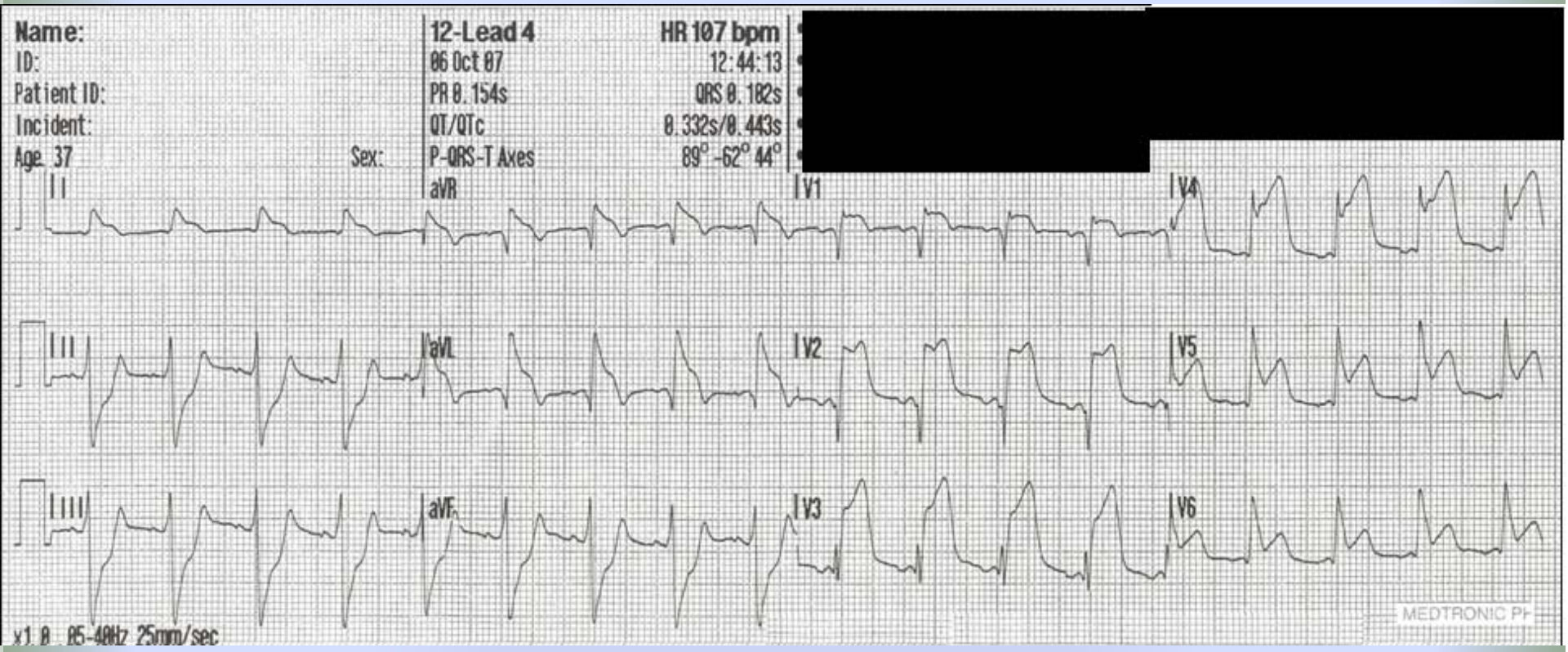


INVERTED T WAVE		- MYOCARDITIS - ELECTROLYTE IMBAL. - ISCHEMIA
SHARP S-T T ANGLE		- ACUTE MI (NOT COMMON) - ISCHEMIA
BI-PHASIC T WAVE (WELLEN'S)		- SUB-TOTAL LAD LESION - VASOSPASM - HYPERTROPHY
DEPRESSED J POINT with UPSLOPING ST		- ISCHEMIA
DOWNSLOPING S-T SEGMENT		- ISCHEMIA

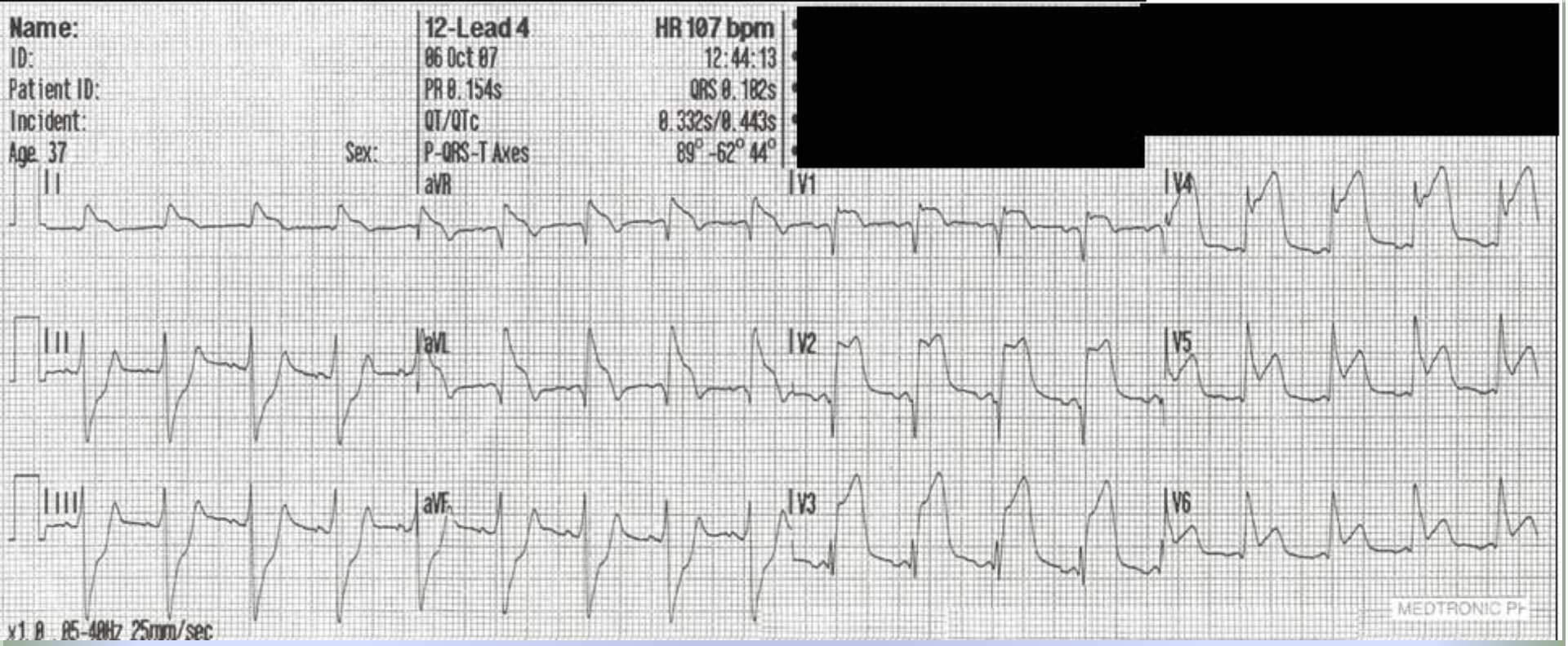
Some less common, less reliable possible indicators of ACS:

?	FLAT S-T SEGMENT > 120 ms		- ISCHEMIA
?	LOW VOLTAGE T WAVE WITH NORMAL QRS		- ISCHEMIA
?	U WAVE POLARITY OPPOSITE THAT OF T WAVE		- ISCHEMIA

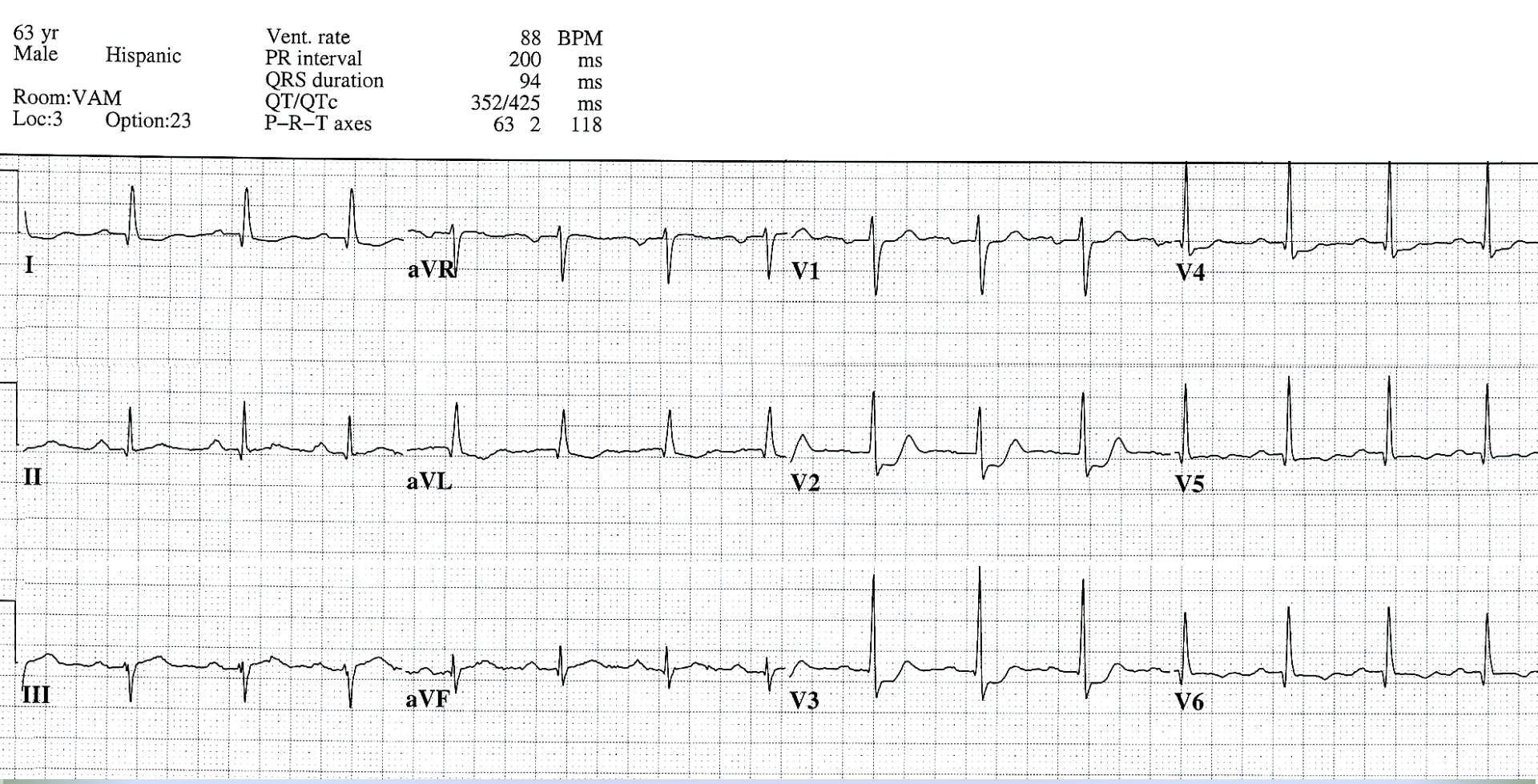
Let's review . . . .



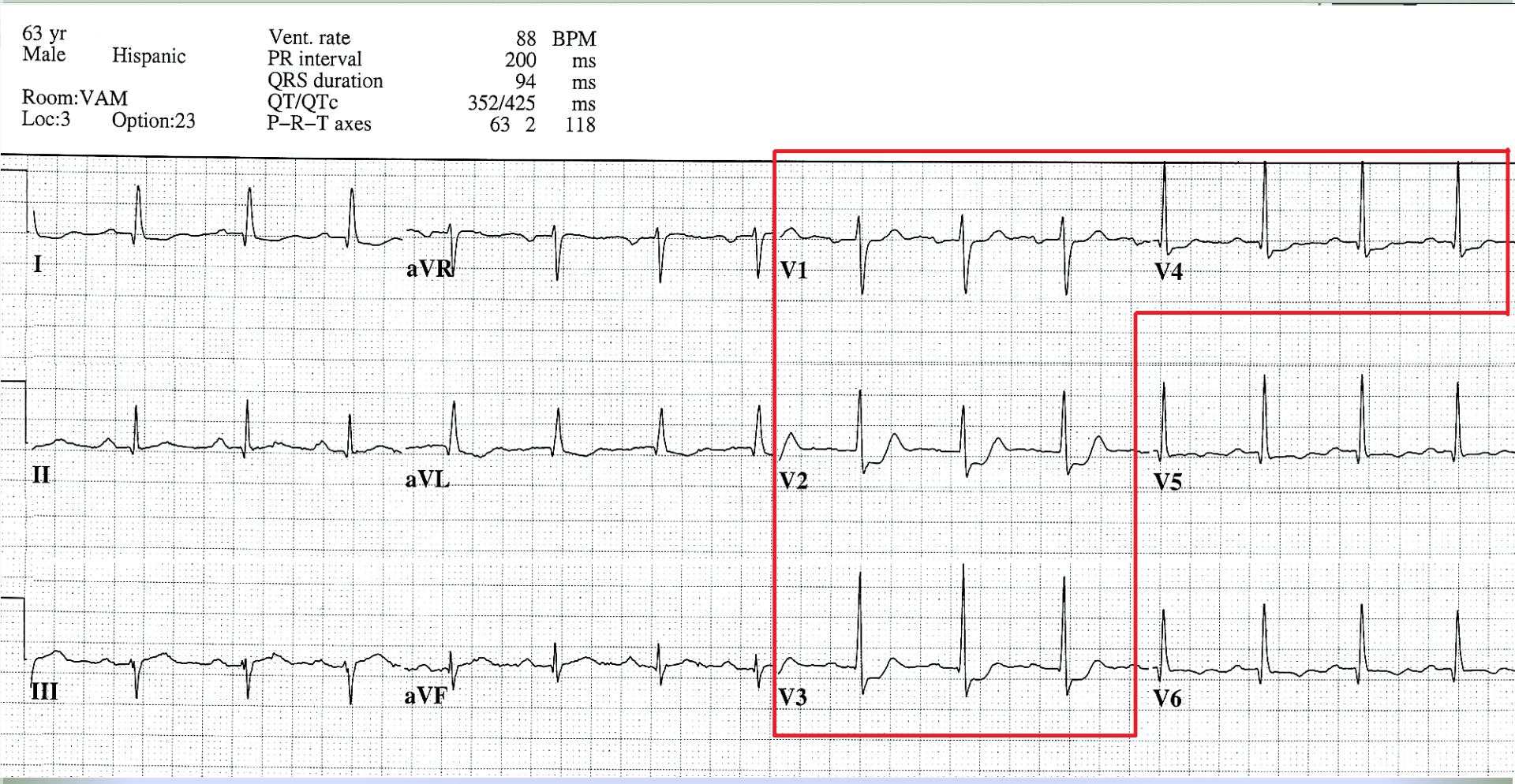
1. ECG abnormality(ies)?
2. Possible diagnosis?
3. Action / Intervention?



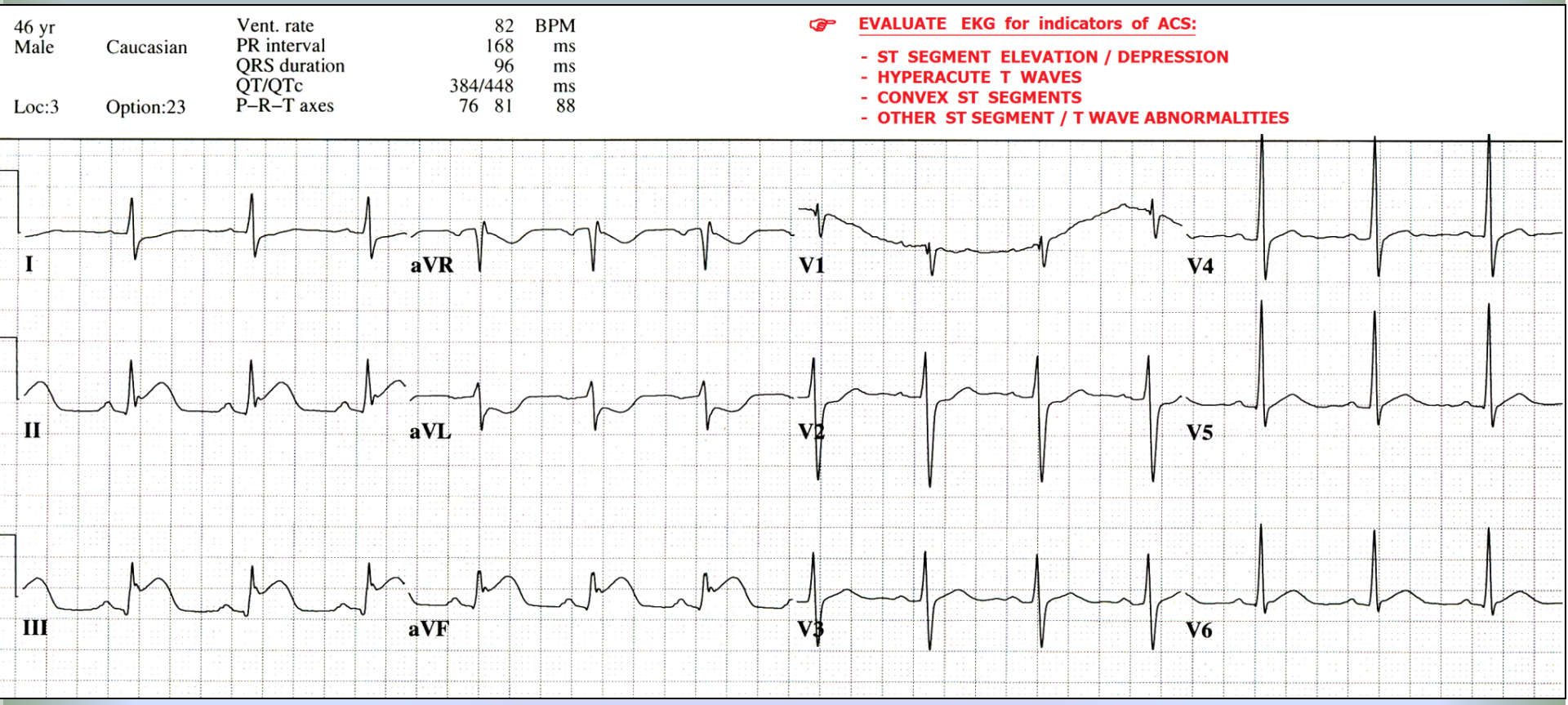
1. ECG abnormality(ies)? ST Elevation Leads I, AVR AVL, V1, V2, V3, V4, V5 & V6. ST Depression II, III and AVF
2. Possible diagnosis? Acute Anterolateral Wall STEMI secondary to Left Main Coronary Artery occlusion (widow-maker MI).
3. Action / Intervention? STAT CATH LAB vs STAT Thrombolytics. Prepare for Cardiac Arrest



1. ECG abnormality(ies)?
2. Possible diagnosis?
3. Action / Intervention?



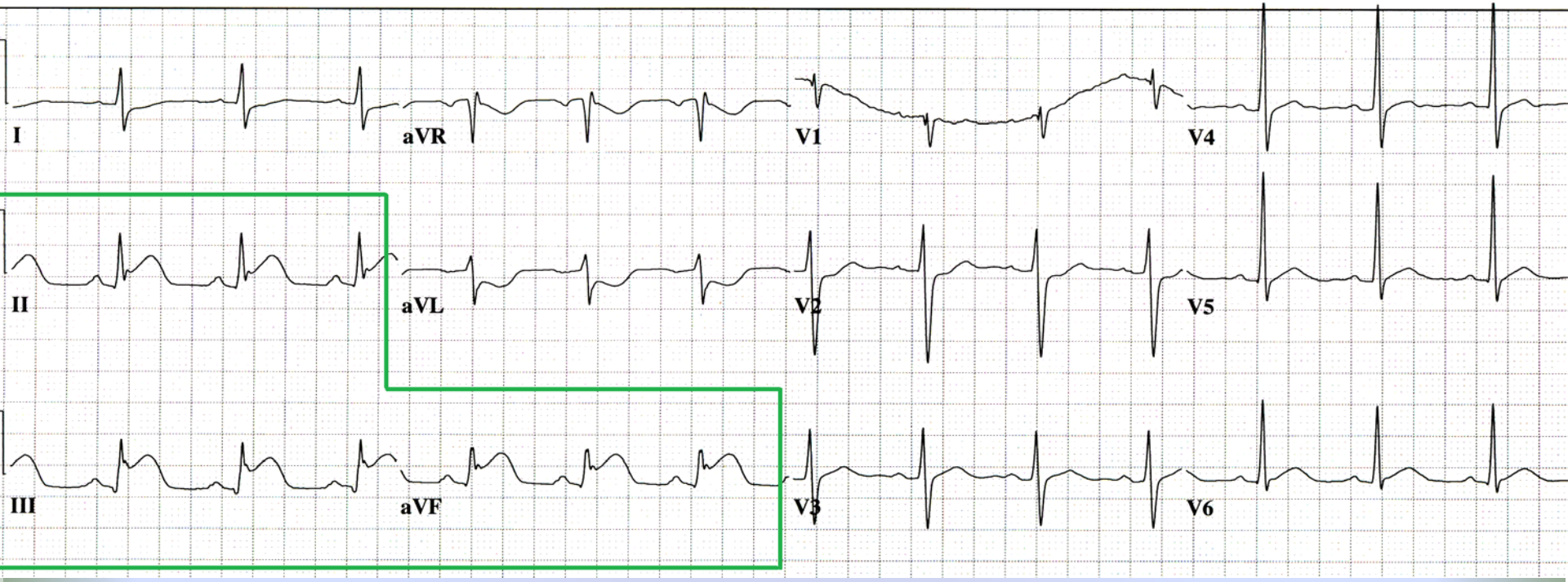
1. ECG abnormality(ies)? ST Depression V1-V4
2. Possible diagnosis? Anterior ischemia vs. Posterior wall STEMI
3. Action / Intervention? Posterior ECG (V7-V9)



1. ECG abnormality(ies)?
2. Possible diagnosis?
3. Action / Intervention?

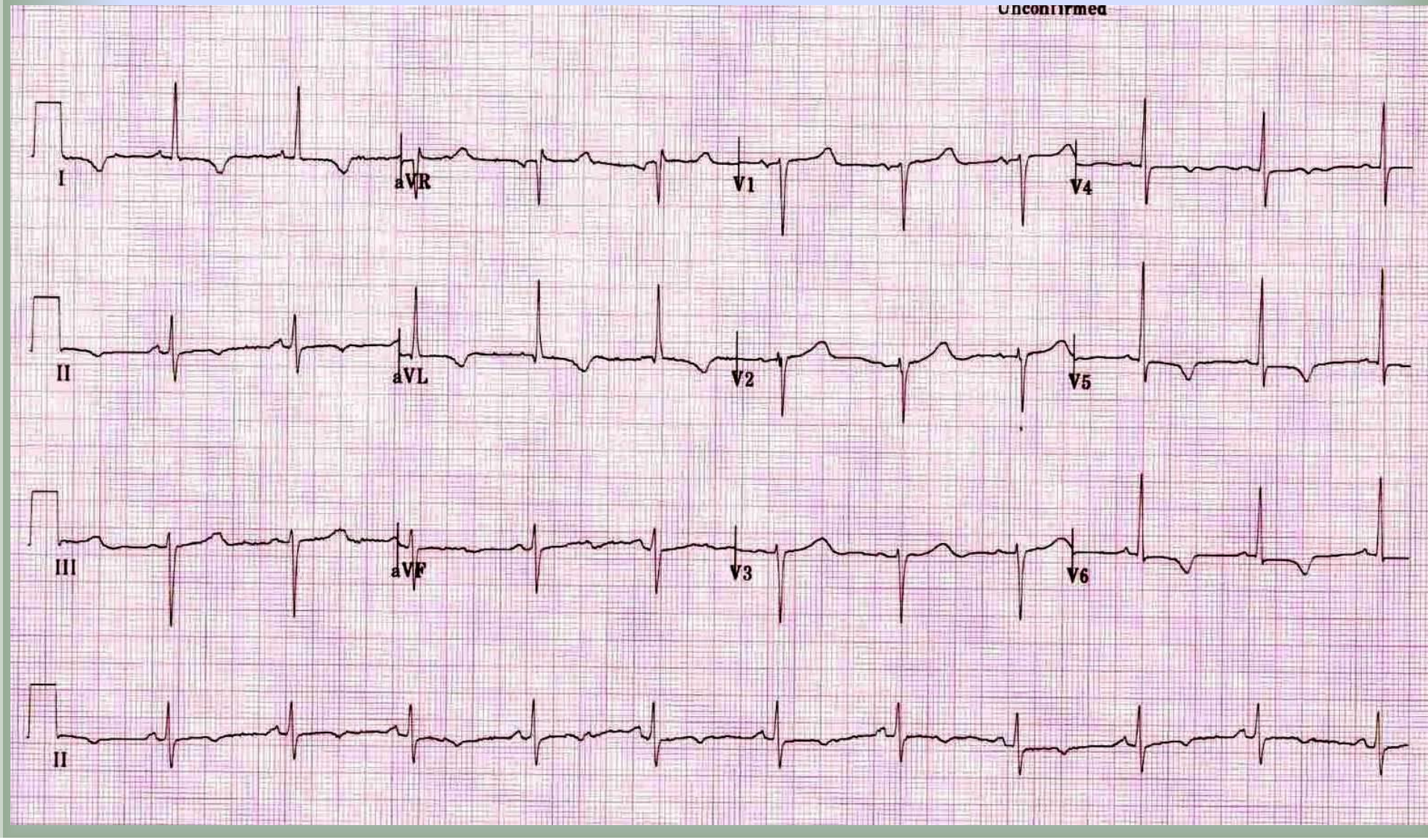
46 yr		Vent. rate	82	BPM
Male	Caucasian	PR interval	168	ms
		QRS duration	96	ms
		QT/QTc	384/448	ms
Loc:3	Option:23	P–R–T axes	76 81	88

ST-Segment Elevation in Leads II, III and AVF
Consistent with: INFERIOR STEMI

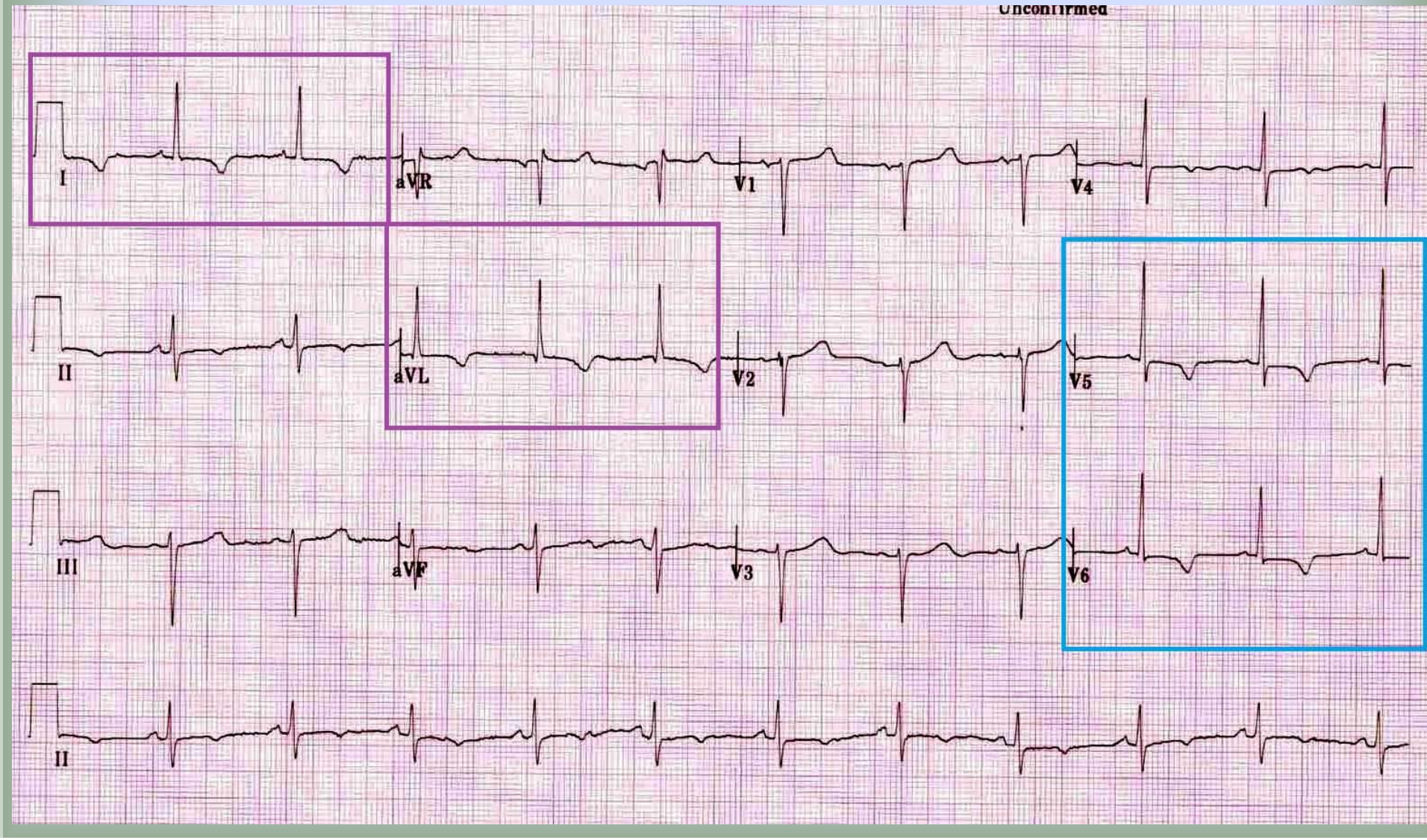


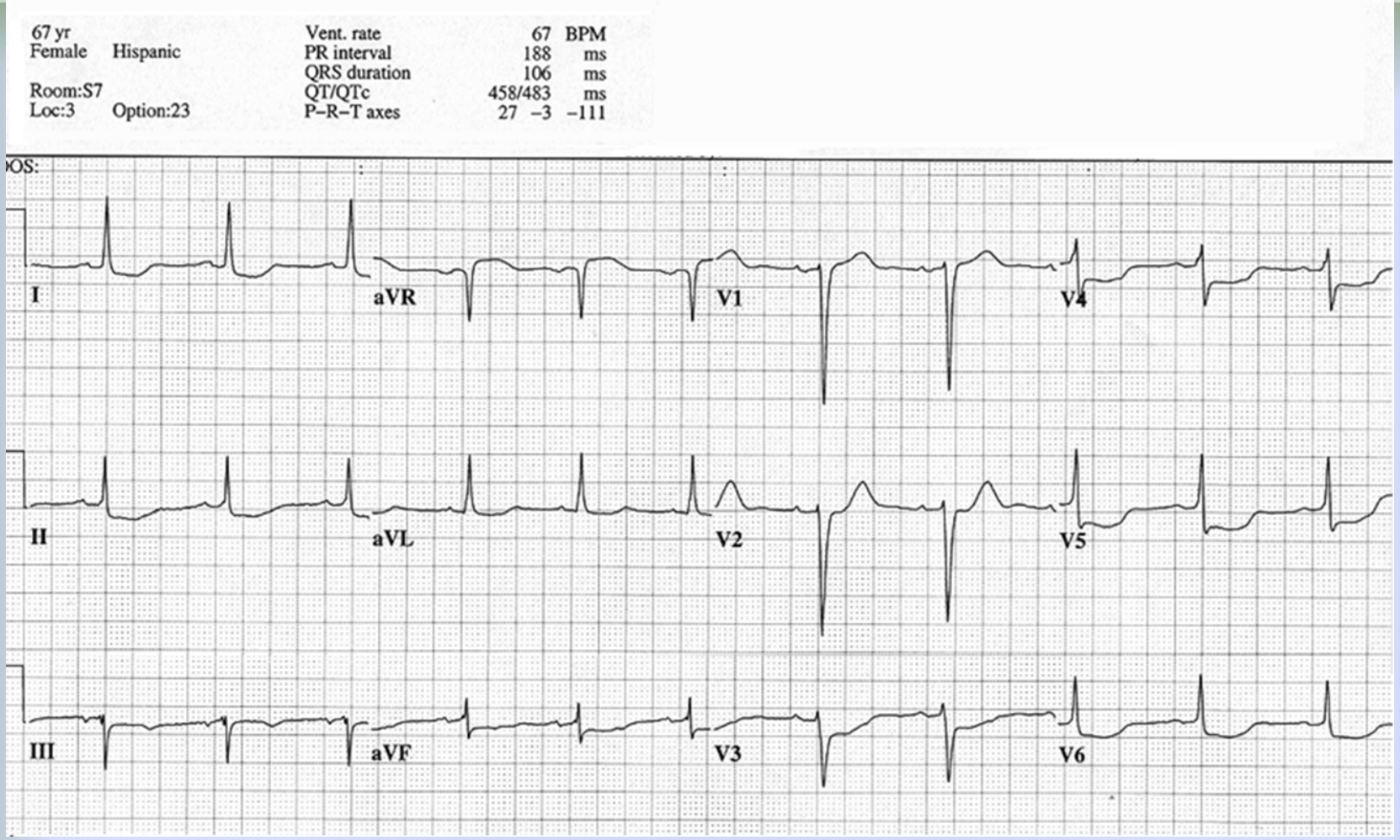
1. ECG abnormality(ies)? **ST Elevation, Leads II,III & AVF**
2. Possible diagnosis? **Inferior Wall STEMI**
3. Action / Intervention? **1. Do R-sided ECG, *prepare for* Atropine administration, external pacing, cardiac arrest, STAT cath lab visit !**

What leads show signs of possible ACS?

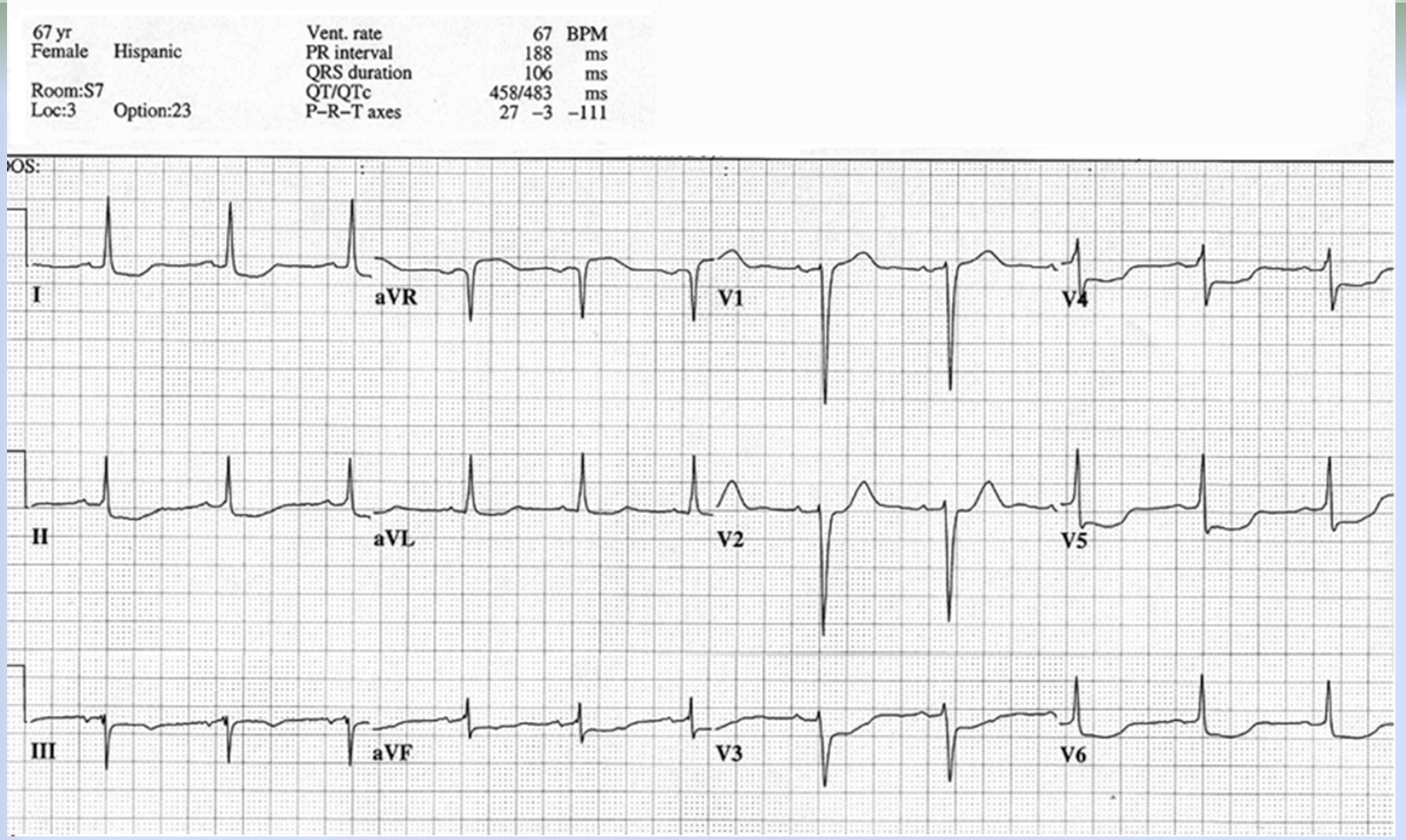


12 Lead ECG
shows ISCHEMIC CHANGES Lateral Wall:

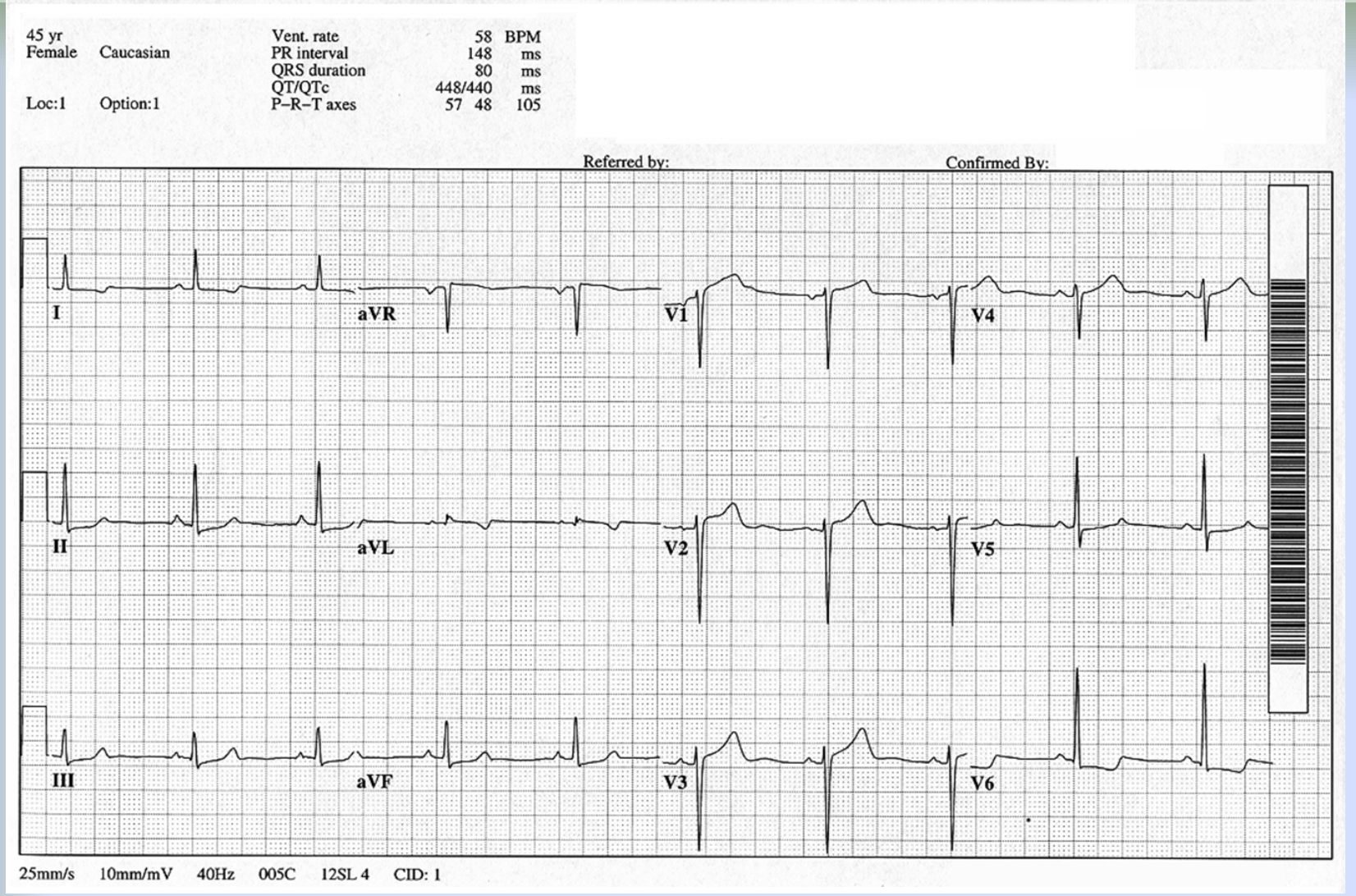




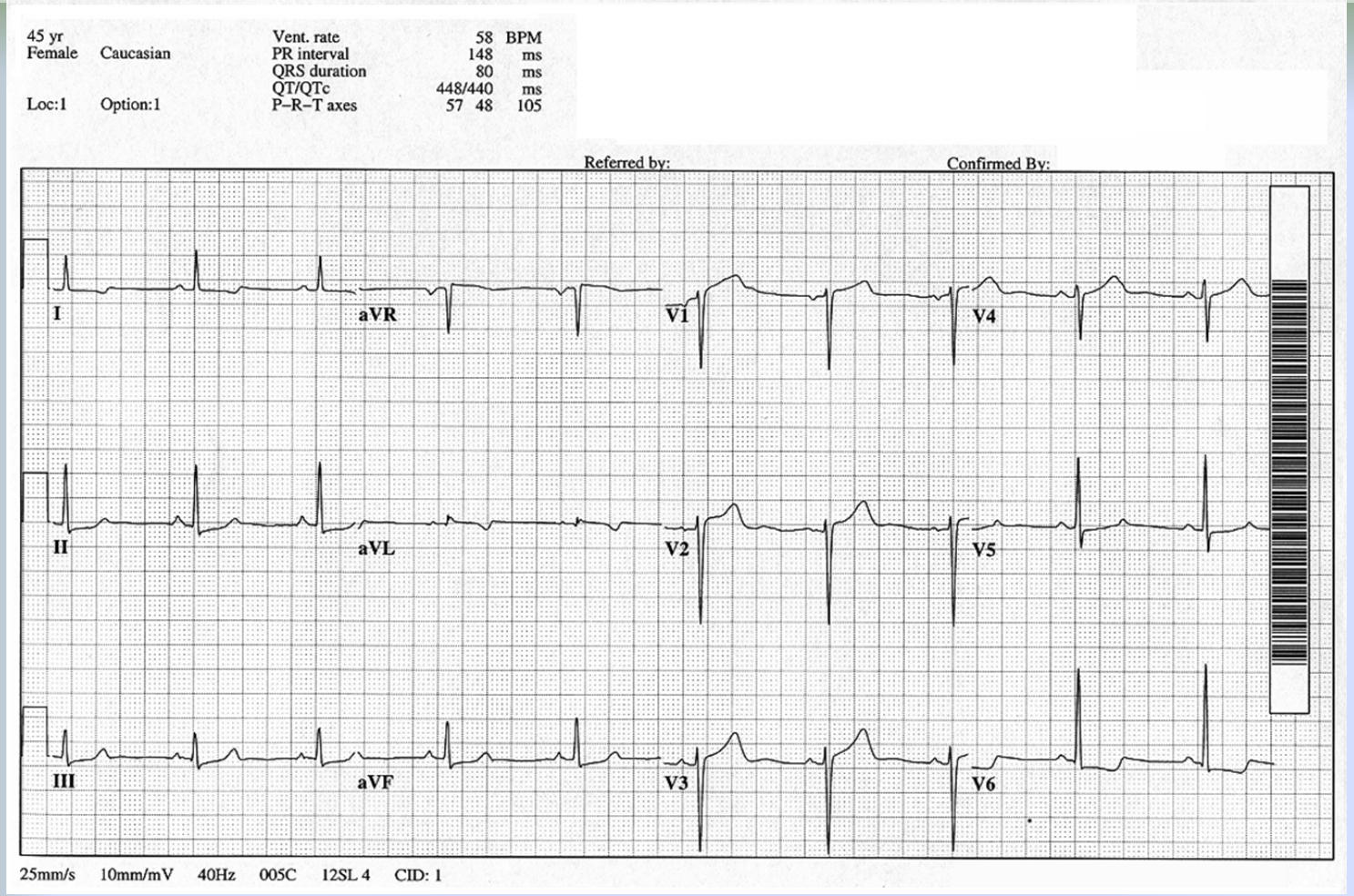
1. ECG abnormality(ies)?
2. Possible diagnosis?
3. Action / Intervention?



1. ECG abnormality(ies)? ST Elevation Lead AVR, Global ST Depression (I, II, III, AVL, AVF, V2, V3, V4, V5, V6)
2. Possible diagnosis? possible LMCA or 3x vessel disease.
3. Action / Intervention? Troponins, Continuous ST monitoring, cath lab visit STAT or ASAP (based on sympt.)



1. ECG abnormality(ies)?
2. Possible diagnosis?
3. Action / Intervention?



1. ECG abnormality(ies)? Inferior (II, III, AVF) ST Depr (ischemia?), I & AVL T wave inversion, V5 ST Depr
2. Possible diagnosis? Inferior / Lateral ischemia
3. Action / Intervention? Serial ECGs / Troponins, additional diagnostic testing, cath lab

Once an appropriate testing method is developed to validate ECG interpretation competency, it may be possible that this course, or others that are similar, can be a route to credential nurses to "interpret" Serial ECGs.

End of Current Program
Version 1

Version 2
under construction

Your thoughts, ideas, comments and feedback are welcome . . .

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“NOWHERE”, NEW MEXICO, 1994