BRAVERA HEALTH

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ACCREDITED AMERICAN COLLEGE OF CARDIOLOGY CHEST PAIN CENTER PRIMARY PCI WITH RESUSCITATION

ACCREDITED AMERICAN COLLEGE OF CARDIOLOGY HEART FAILURE

The INTEGRATED ECG

Wayne W Ruppert, CVT, CCCC, NREMT-P
Regional Director Cardiovascular Accreditations

CERTIFIED CARDIOVASCULAR C4 CARE COORDINATOR

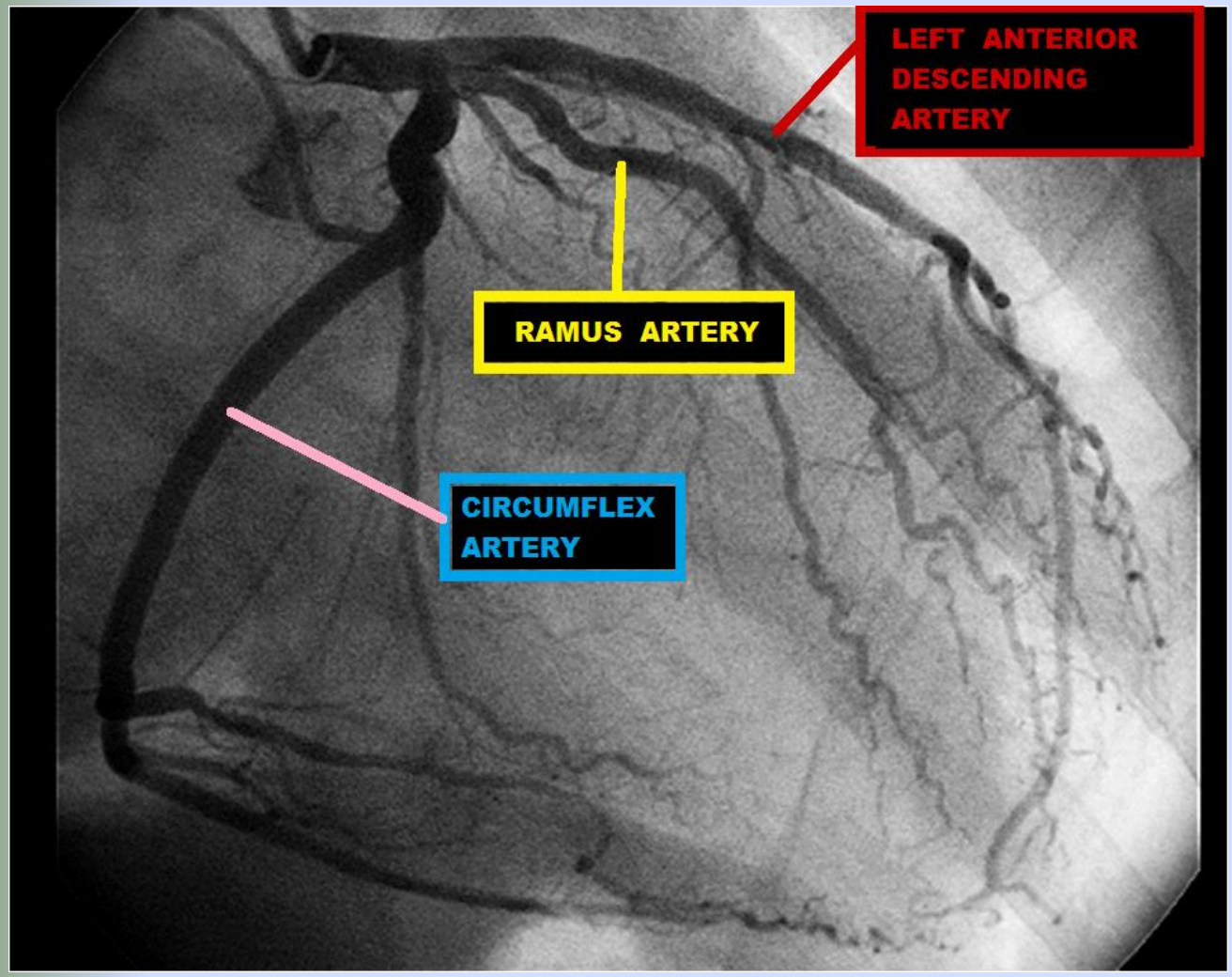
Welcome !

Paramedics Christ Megoulas and Wayne Ruppert, Hershey, PA Fire Department, 1982

13,000 – 15,000 EP and Cath Lab cases between 1996 - Today

Wayne Ruppert and Dr. James Irwin, St Joseph's Hospital, Tampa, 7/29/2004

Cardiac Cath Lab Advantage:



Correlation of ECG leads with SPECIFIC cardiac anatomic structures.

Electrophysiology Lab Case Studies

EP Catheters within the heart used for obtaining the Electrogram (the "internal ECG") Tracing and for Pace-mapping, an integral component of an EP study

Author Wayne Ruppert conducting Pace-mapping during EP study at the St Joseph's Hospital Heart Institute, Pediatric Electrophysiology Program, Tampa, FL in 2004

EP Lab Advantage:

Correlation of ECG derived diagnosis with true intra-cardiac electrogram acquired diagnosis.

Wayne Ruppert – Bio:

- 1978 – 1996 EMT-Paramedic
- 1996 – 2012 Interventional Cardiovascular Technologist Cardiac Cath Lab and Electrophysiology Labs
- 2012 – Present Cardiovascular Programs Director / Coordinator

Wayne Ruppert - Bio:

- Cardiovascular Coordinator 2012-present (coordinated 7 successful accreditations)
- Interventional Cardiovascular / Electrophysiology Technologist, 1995-Present. (Approx 13,000 patients)
- 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)
- ACLS Instructor: 1982 - 2022
- Website: www.ECGtraining.org

Source of Curriculum:

- Case Studies from Cardiac Catheterization and Electrophysiology Labs, 1996 – Present

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- Current Evidence-based Research
  - Journal of the American College of Cardiology (JACC)
  - American Heart Association (AHA) Circulation
  - ACC/AHA Guidelines
  - New England Journal of Medicine

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  - American Heart Association (AHA) Circulation
  - ACC/AHA Guidelines
  - New England Journal of Medicine
- Two peer reviewed, published textbooks

In the CARDIAC CATHETERIZATION LAB, we read our patients' 12 Lead ECGs and then evaluate their coronary arteries and ventricular function during angiography. Stated in plain English, ***we rapidly learn how to correlate 12 lead ECG findings with what's really going on inside our patients' hearts.*** Seeing ECGs from this perspective adds a new dimension to understanding the complex pathophysiologies of cardiovascular disease.

This book prepares you to:

- INTERPRET 12 Lead ECGs.
- ASSIMILATE DATA derived from the 12 Lead ECG into a comprehensive patient evaluation process designed to maximize diagnostic accuracy, while taking into consideration the 12 Lead ECGs inherent LACK of SENSITIVITY and SPECIFICITY.
- IDENTIFY 13 PATTERNS associated with myocardial ischemia and infarction, including the most subtle ECG changes often missed by clinicians and the ECG machine's computerized interpretation software.
- CORRELATE each lead of the ECG with specific regions of the heart – and the CORONARY ARTERIAL DISTRIBUTION that commonly supplies it. In cases of STEMI, this knowledge prepares you to ANTICIPATE the FAILURE OF CRITICAL CARDIAC STRUCTURES – often *BEFORE THEY FAIL.*

For those who need to master essential material quickly, this book has been written with an expedited learning" feature, *designed to make learning as easy as 1 2 3:*

1. **READ the YELLOW HIGHLIGHTED TEXT**
2. **STUDY the GRAPHIC IMAGES, PICTURES and ECGs**
3. **CORRECTLY ANSWER the REVIEW QUESTIONS at the end of each section.**

This is an invaluable resource for every medical professional who evaluates patients and reads their 12 lead ECGs:

- *Fellows in Emergency, Cardiology, and Family Medicine*
- *Medical Residents*
- *Veteran Physicians wanting a good review in ACS patient evaluation*
- *Physician Assistants and Nurse Practitioners*
- *Emergency Department Nurses*
- *Coronary Care Unit and Cardiac Telemetry Nurses*
- *Walk-in Clinic Physicians and Nurses*
- *Paramedics*

"I think this book will be a wonderful addition to the textbooks that are already available, with a fresh perspective'"

Joseph P. Ornato, MD, FACP, FACC, FACEP
- Professor and Chairman, Department of Emergency Medicine
Medical College of Virginia/Virginia Commonwealth University
- Medical Director, Richmond Ambulance Authority,
Richmond, Virginia

"This book integrates academic ECG principles with real-world clinical practice by incorporation of well chosen cath lab case studies into its curriculum. This combination lets readers see patients and their ECGs through the eyes of an experienced cath lab interventionalist, and provides a balanced approach to patient evaluation that compensates for the ECGs inherent lack of sensitivity and specificity. I highly recommend this book for all Emergency Medicine and Cardiology Fellows. For experienced clinicians, it's a superb review."

Humberto Coto, MD, FACP, FACC
- Chief of Interventional Cardiology
St. Joseph's Hospital
Tampa, Florida

ISBN 978-0-9829172-1-3
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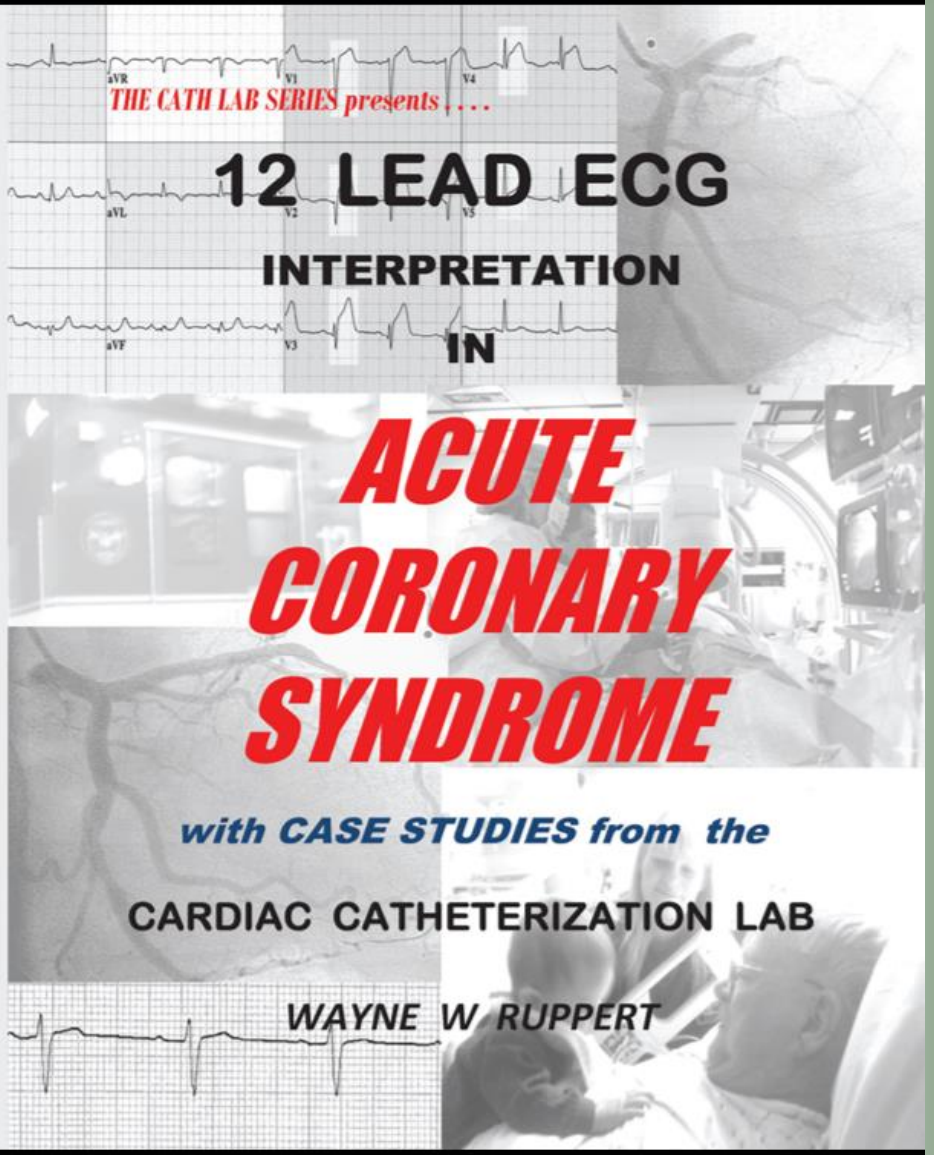
12 LEAD ECG INTERPRETATION in ACUTE CORONARY SYNDROME with CASE STUDIES from the CATH LAB -- WAYNE RUPPERT



www.TriGenPress.com
www.ECGtraining.org
BarnesandNoble.com
Amazon.com

TEXTBOOK REVIEWED BY:

Joseph P. Ornato, MD, FACP, FACEP, FACC, Professor and Chairman, Department of Emergency Medicine, Medical College of Virginia-Virginia Commonwealth University

Humberto Coto, MD, FACP, FACC, Chief of Cardiology, St. Joseph's Hospital

Matthew Glover, MD, FACP, FACC, Interventional Cardiologist, St. Joseph's Hospital

Xavier Prida, MD, FACP, FACC, Interventional Cardiologist, St. Joseph's Hospital

Charles Sand, MD, FACP, FACEP, Emergency Department Physician, St. Joseph's Hospital

Printed and Marketed Worldwide by The Ingram Book Company
2010 - Current

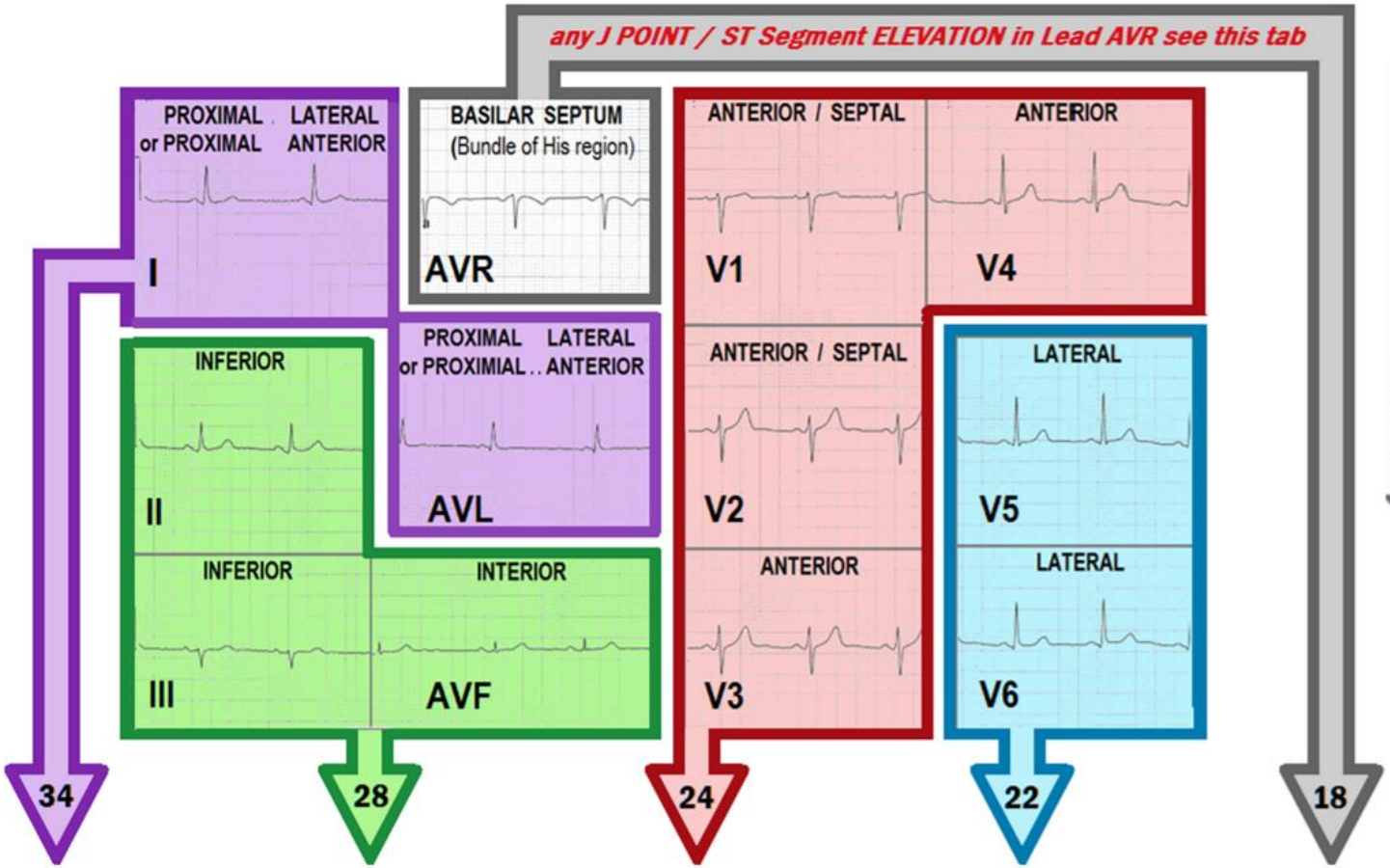
STEMI Assistant

by Wayne Ruppert

UNIVERSAL ACS PATIENT MANAGEMENT ALGORITHM
- - - See PAGE ONE - - -

Select LEAD SET with HIGHEST ST ELEVATION and open to associated page . . .

CRASH CART EMERGENCY REFERENCE



Bayfront Health Dade City

TEXTBOOK REVIEWED BY:

Barbra Backus, MD, PhD Inventor of "The HEART Score," University Medical Center, Utrech, Netherlands

Michael R. Gunderson, National Director, Clinical and Health IT, American Heart Association

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William Parker, PharmD, CGP, Director of Pharmacy, Bayfront Dade City

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2010 - Current

STEMI Assistant

Tutorial Video

Free download – electronic copy (PDF file)

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Wayne.ruppert@bayfronthealth.com

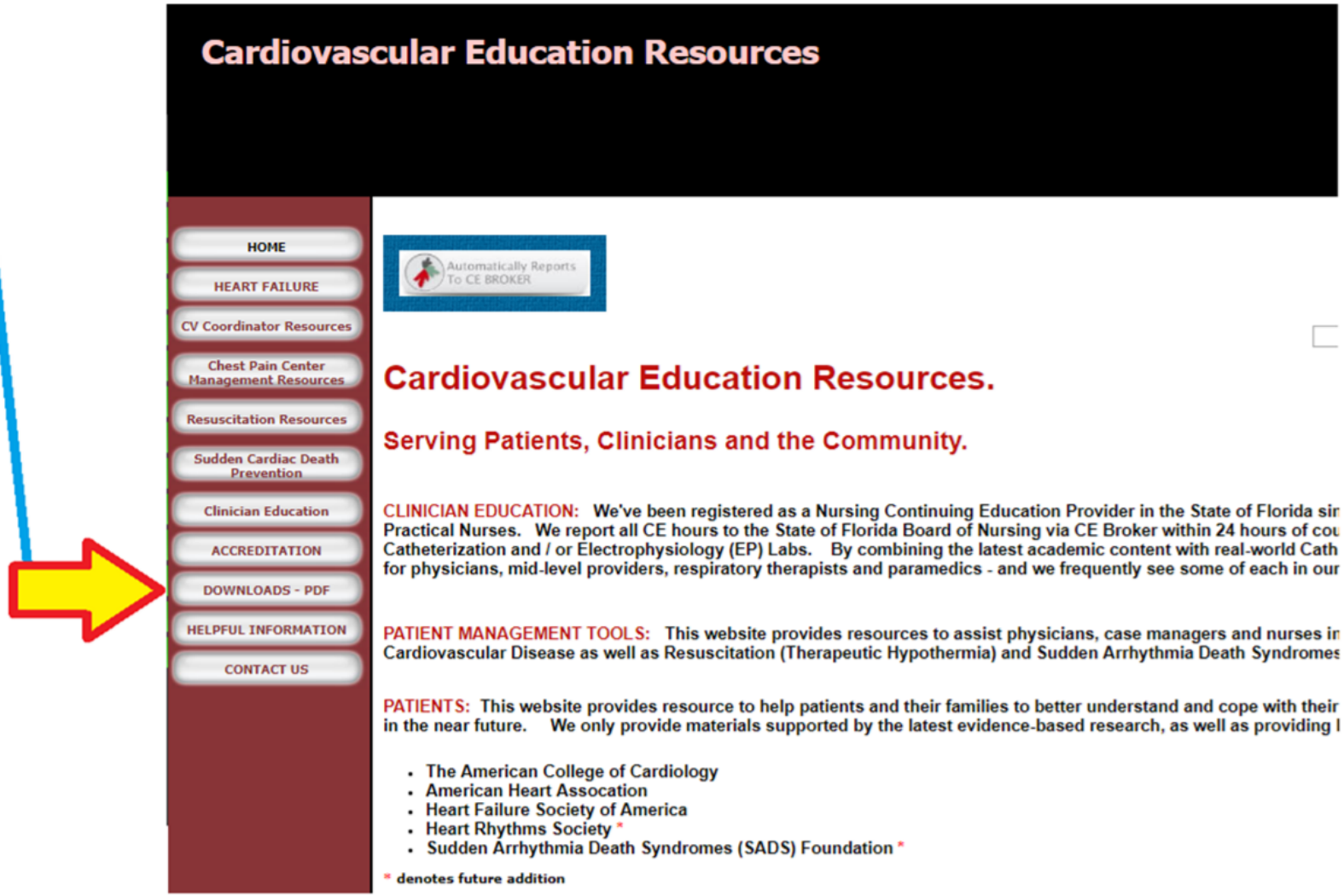
Helpful Web Resources:

www.practicalclinicalskills.com

www.skillstat.com/tools/ecg-simulator

www.ECGtraining.org

1. Go to: www.ECGtraining.org
2. Select "Downloads PDF" from menu bar



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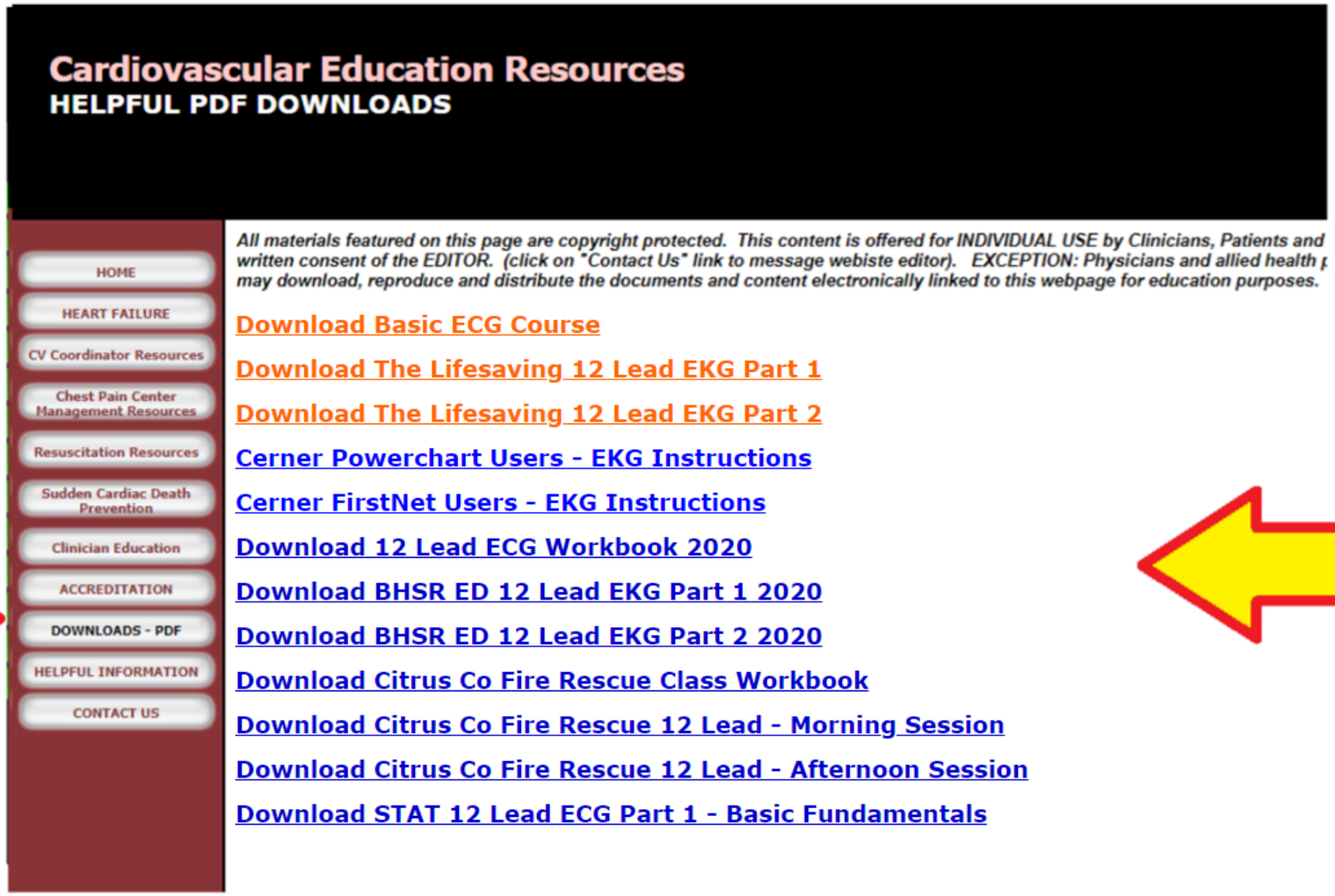
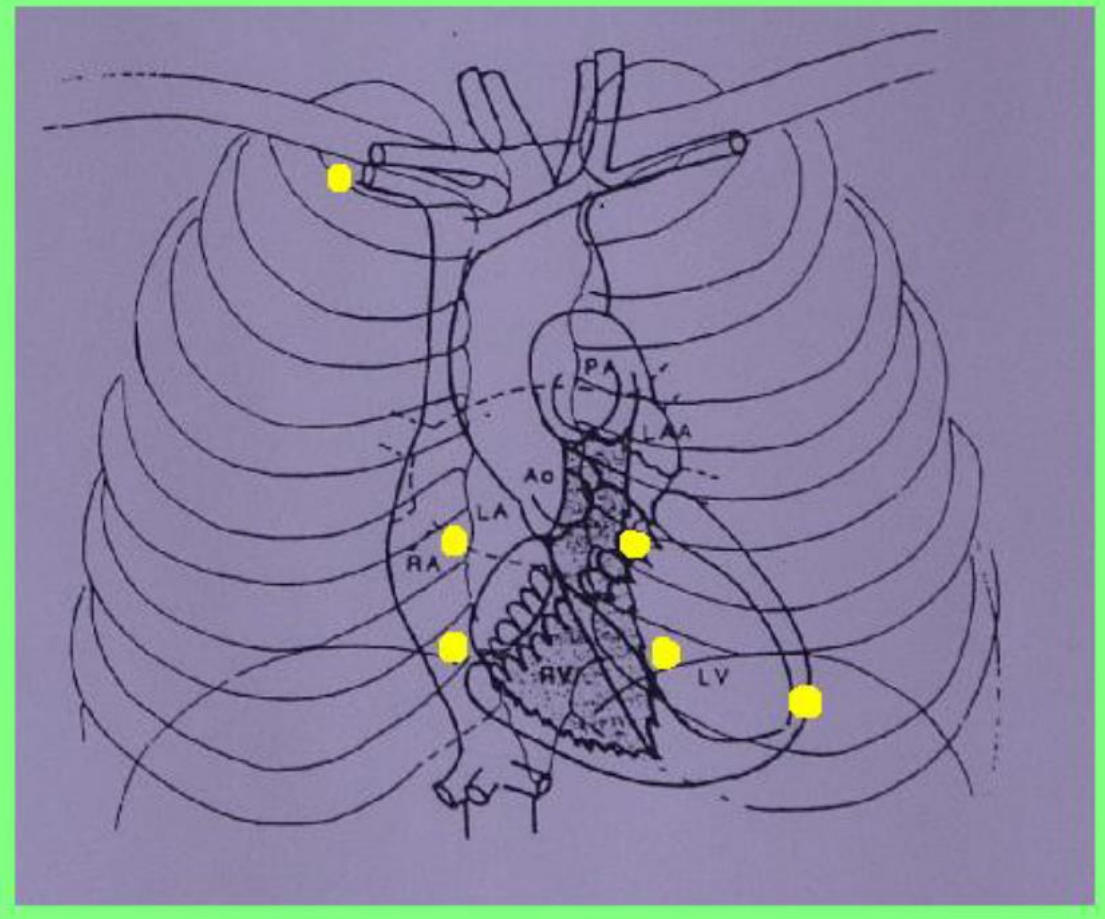


HEART SOUNDS ASSESSMENT

HEART SOUNDS ASSESSMENT



VERY BASIC HEART SOUNDS ASSESSMENT

- Normal Heart Sounds
- Murmurs
  - systolic
  - diastolic
- Friction Rubs

SCOTT DAVIDSON, RN auscultating heart sounds at St. Joseph's Hospital Heart Institute Tampa, FL

HEART SOUNDS ASSESSMENT

HEART SOUNDS ARE GENERATED BY THE SOUND OF THE HEART VALVES CLOSING.

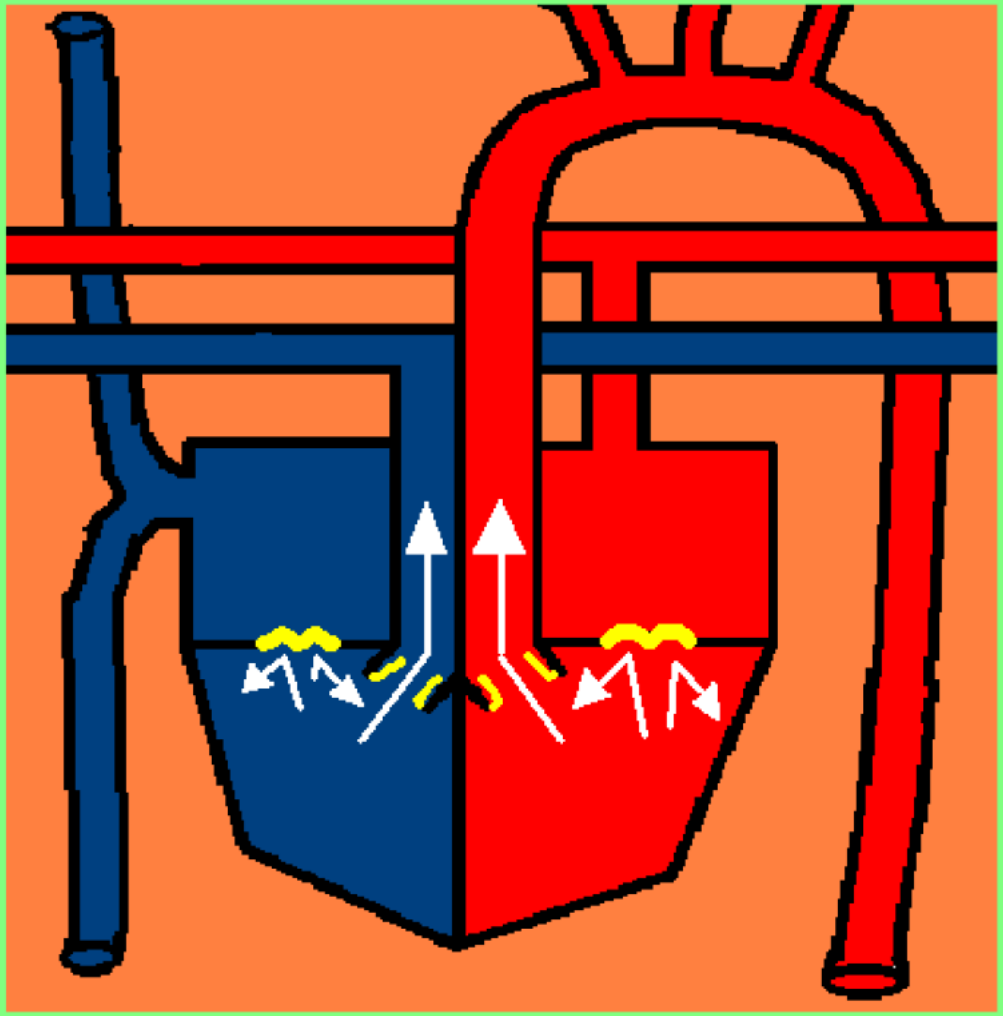
THERE ARE TWO NORMAL HEART SOUNDS, KNOWN AS: S-1 and S-2

WE OFTEN DESCRIBE THESE HEART SOUNDS AS "LUB - DUP"

HEART SOUNDS ASSESSMENT

S-1 BEGINNING OF SYSTOLE.

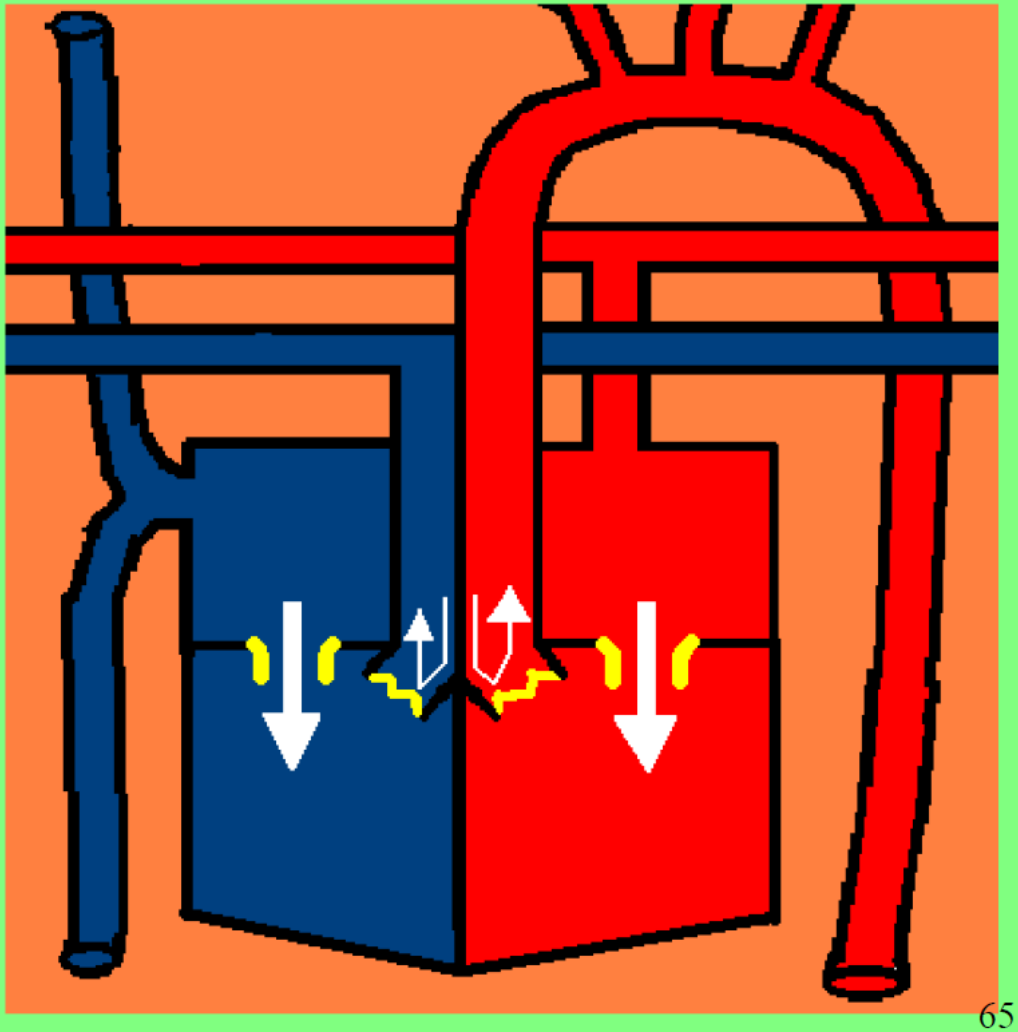
SOUND OF THE MITRAL AND TRICUSPID VALVES CLOSING.



HEART SOUNDS ASSESSMENT

S-2 OCCURS AT THE END OF SYSTOLE (THE BEGINNING OF DIASTOLE).

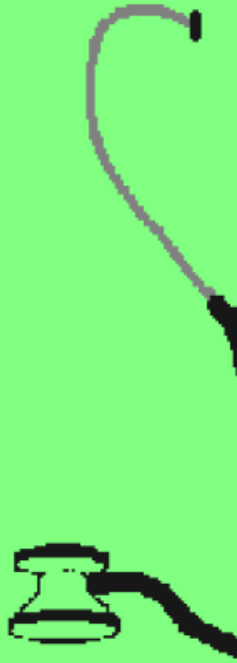
IT IS THE SOUND OF THE AORTIC AND PULMONARY VALVES CLOSING.



MURMUR = "SWOOSH"
SOUND CAUSED BY THE
SOUND OF TURBULENCE.

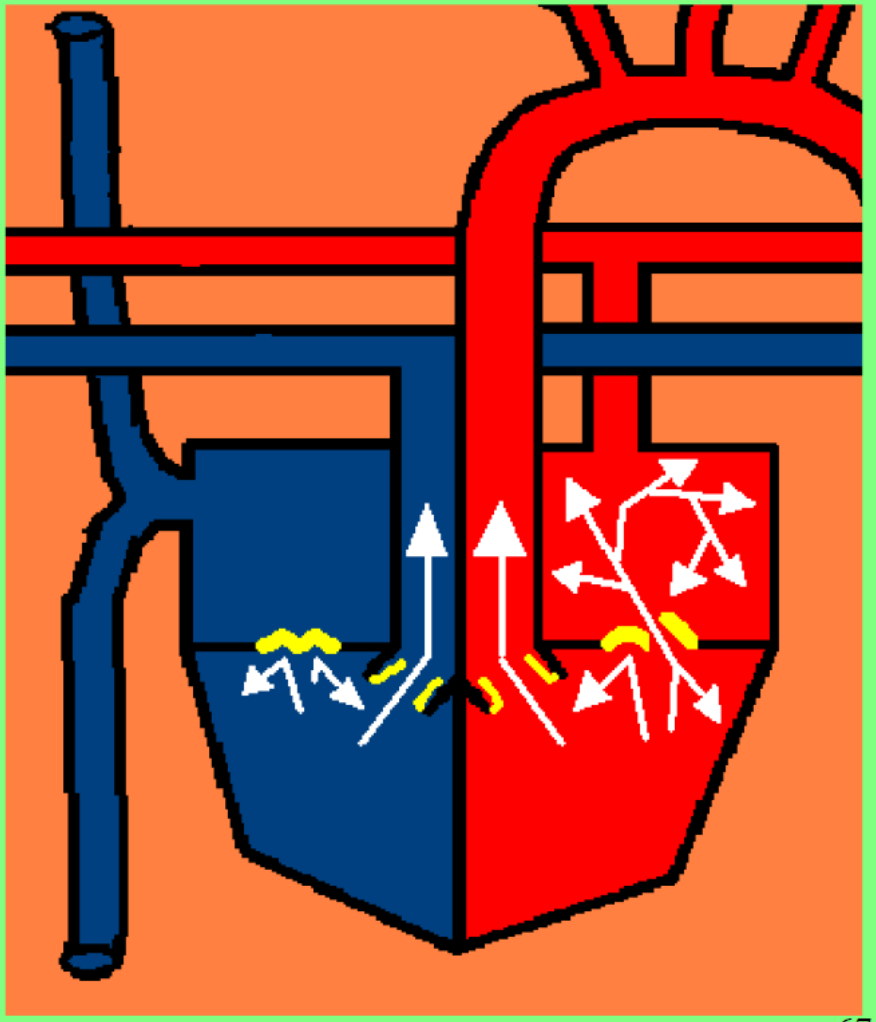
S-1 MURMUR SOUNDS LIKE:

"SWOOSH-DUB . . . . SWOOSH-
DUB . . . . SWOOSH-DUB . . . .
SWOOSH-DUB . . . "



CAUSE OF SYSTOLIC (S 1) MURMUR

- **DAMAGE TO MITRAL and/or TRICUSPID VALVE(s)**
- **CAUSES REGURGITATION**



- **MOST SYSTOLIC MURMURS CAUSED BY MITRAL VALVE FAILURE.**

- **ACUTE MITRAL VALVE REGURGITATION IS A POTENTIALLY LETHAL COMPLICATION OF ACUTE / RECENT EXTENSIVE TRANSMURAL MI**

ACUTE MITRAL VALVE RUPTURE USUALLY OCCURS 7-10 DAYS POST EXTENSIVE MI (e.g.: INFERIOR POSTERIOR LATERAL MI).

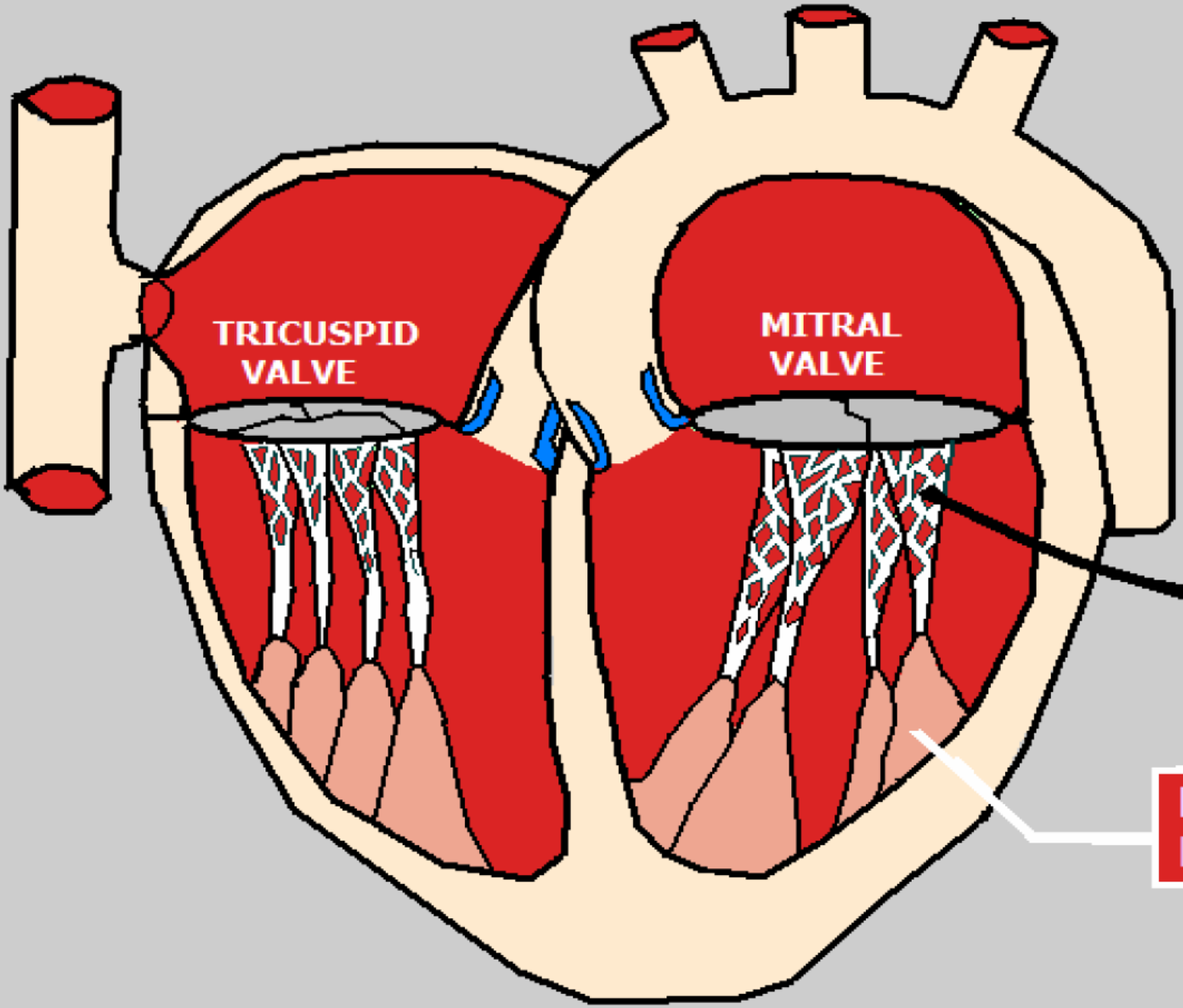
ACUTE Mitral Valve REGURGITATION can be caused by EXTENSIVE "Multi-Site" Myocardial Infarction and Necrosis – which results in PAPILLARY MUSCLE NECROSIS and PAPILLARY MUSCLE TEAR.

Papillary muscles are attached to "multiple surfaces" . . . . .

A Common Cause of ACUTE MITRAL REGURGITATION is:

"Patients who are 7-10 days POST-EXTENSIVE MI," in cases where the "zone of infarction" is large (e.g. "inferior-posterior-lateral") and there was a delay in PCI resulting in large zone of necrosis.

ATRIO-VENTRICULAR VALVES



ARE SECURED TO THE ENDO-CARDIAL SURFACE BY THE

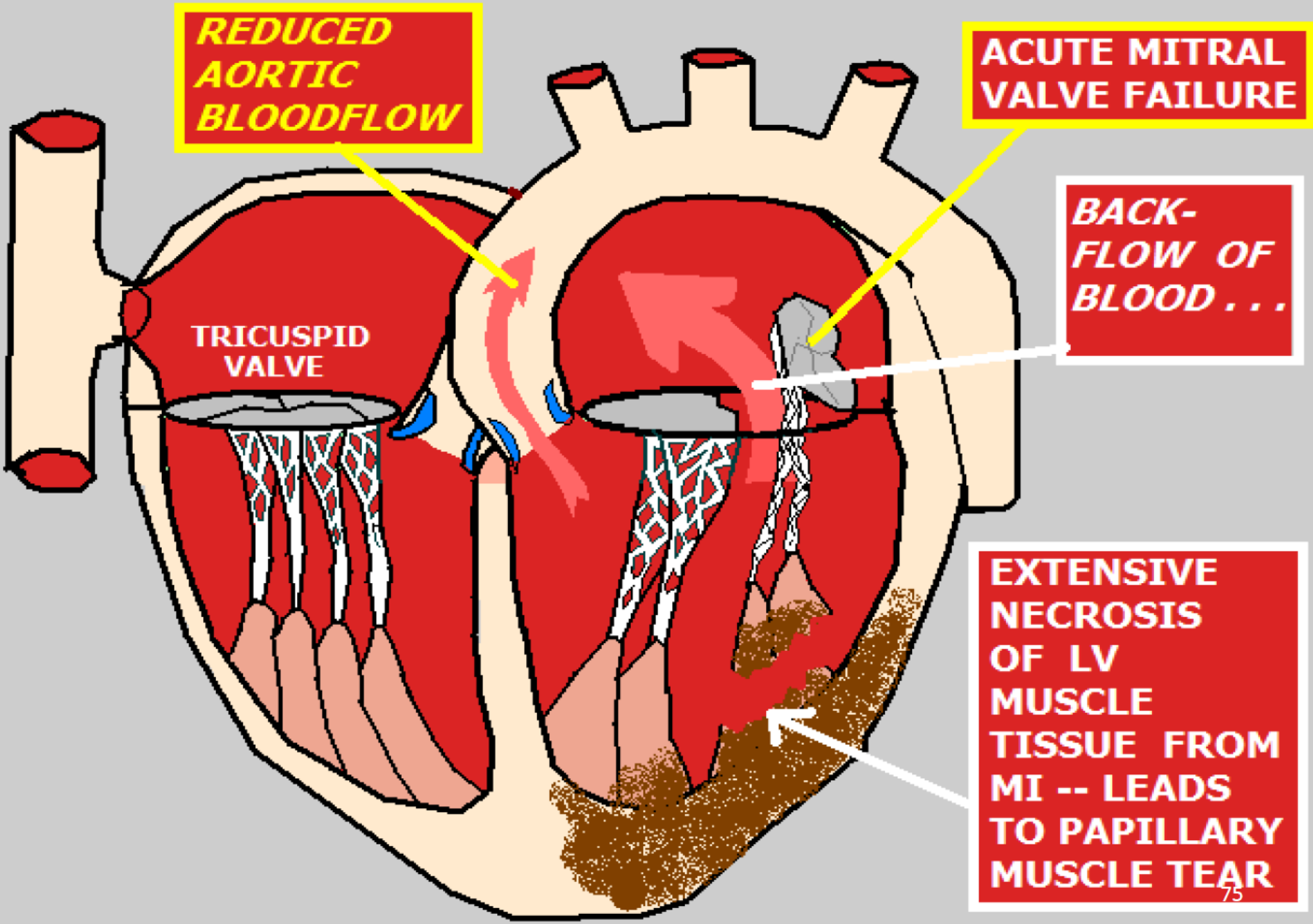
CHORDAE TENDINEAE

AND THE

PAPILLARY MUSCLES

ACUTE MITRAL REGURGITATION

DURING VENTRICULAR SYSTOLE



Symptoms of Acute Mitral Regurgitation

- SHOCK
- PROFOUND HYPOTENSION
- PINK, FROTHY SPUTUM
- PULMONARY EDEMA
- SYSTOLIC (S1) MURMUR

"SWOOSH – DUB……SWOOSH – DUB……SWOOSH – DUB…"

BASIC HEART SOUNDS ASSESSMENT

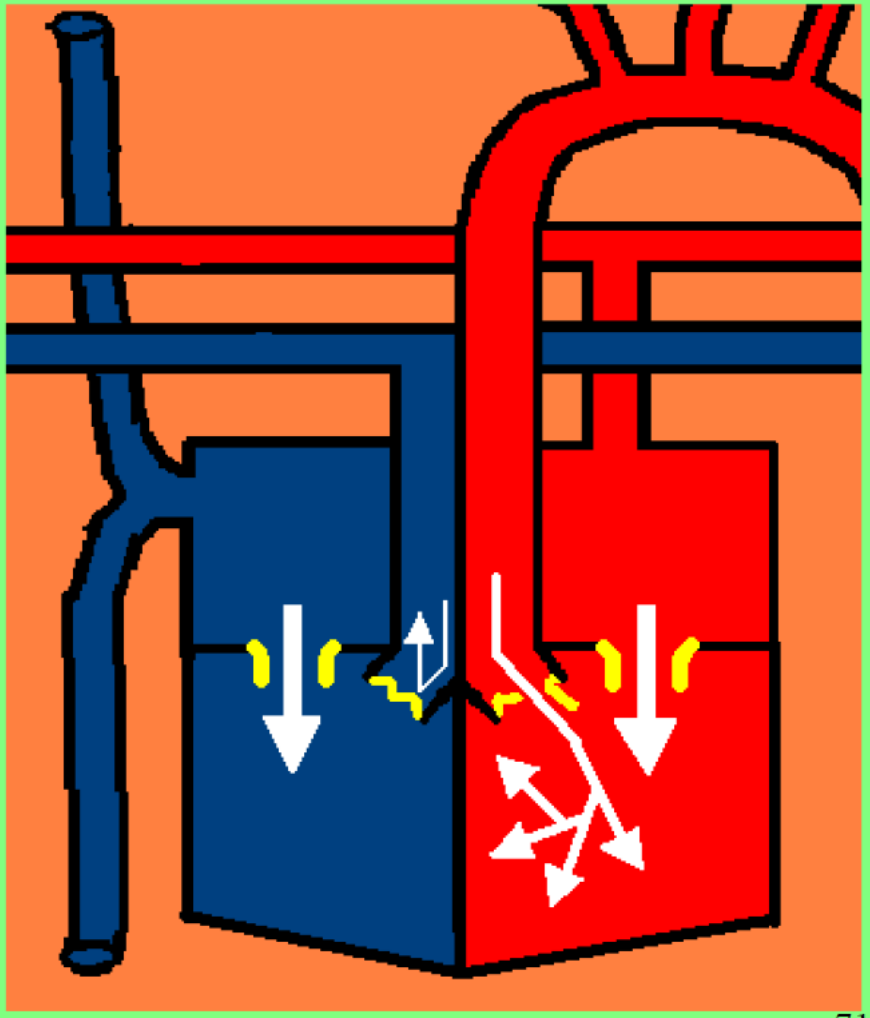
MURMUR = "SWOOSH"
SOUND CAUSED BY THE
SOUND OF TURBULENCE.

S-2 MURMUR SOUNDS LIKE:

"LUB-SWOOSH . . . . LUB-SWOOSH
. . . .LUB-SWOOSH . . . . LUB-
SWOOSH . . . "

CAUSE OF DIASTOLIC (S2) MURMUR

- **DAMAGE TO AORTIC and/or PULMONIC VALVE(s)**
- **CAUSES REGURGITATION**



Access
University of Washington
Department of Medicine

Heart Sound Simulator

Integrated ECG:

PATIENT'S HEMODYNAMIC STATUS

+

SYMPTOMS

+

ECG

Integrated ECG:

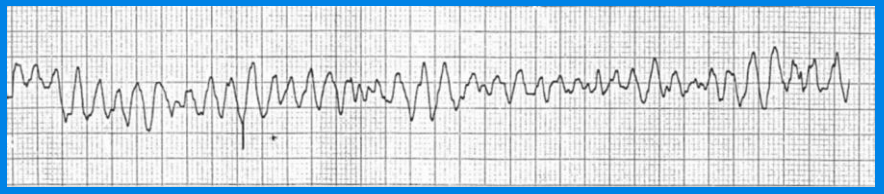
- HEMODYNAMIC STATUS
  - ABCs
  - Shock
- SYMPTOMS
  - Chest Pain / Pressure
  - Other ACS Symptoms
- ECG
  - 12 Lead
  - Single Lead “rhythm strip”

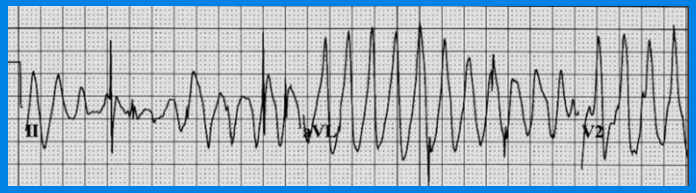
Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs (Airway open? + Breathing? + Pulse?)

If there is **NO PULSE** . . . .

- **Start CPR**
- **Apply ECG** – determine rhythm- shockable?
  - **SHOCKABLE:** V-fib / V-tach / Torsades





Defib 120-200 BiPhasic
- IV Access
- Advanced Airway

Defib 120-200 or HIGHER
- Epinephrine 1mg IV

Defib 120-200 or HIGHER
- Amiodarone 300mg - OR – Lidocaine 1.0 -1.5 mg/kg

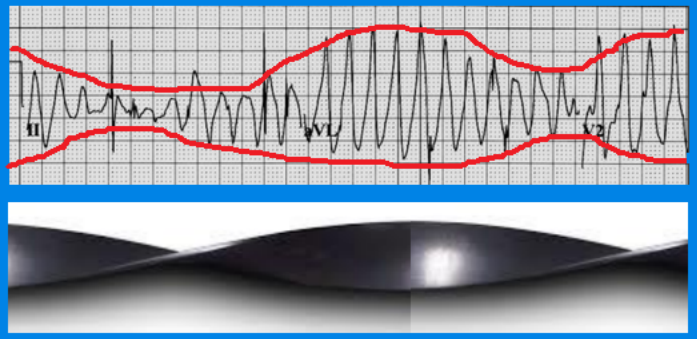
Defib 120-200 or HIGHER
- Epinephrine 1mg IV

Defib 120-200 or HIGHER
- CONTINUE as per ACLS….

If there is **NO PULSE** . . . .

- **Start CPR**
- **Apply ECG** – determine rhythm- shockable?
  - **SHOCKABLE:** V-fib / V-tach / Torsades

Torsades de Pointes . . . the QRS pattern resembles a "TWISTED RIBBON" . . . .



CONSIDER using Lidocaine in place of Amiodarone due to the increased possibility of QT PROLONGATION . . .

Defib 120-200 BiPhasic
- IV Access
- Advanced Airway

Defib 120-200 or HIGHER
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- ~~Amiodarone 300mg~~ – OR –
  Lidocaine 1.0-1.5 mg/kg

Defib 120-200 or HIGHER
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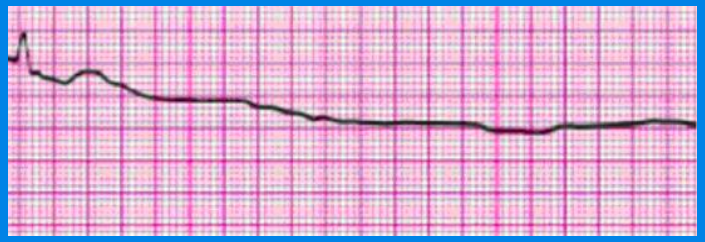
Defib 120-200 or HIGHER
- CONTINUE as per ACLS….

If there is **NO PULSE** . . . .

- **Start CPR**
- **Apply ECG** – determine rhythm- shockable?
  - **NOT SHOCKABLE:** Agonal Rhythm / Asystole / PEA



- Continue CPR
- IV/IO Access
- Advanced Airway
- Epinephrine 1mg IV
- Rule out reversible causes
- CONTINUE as per ACLS….

If there is **NO PULSE** . . . .

- **Start CPR**
- **Apply ECG** – determine rhythm- shockable?
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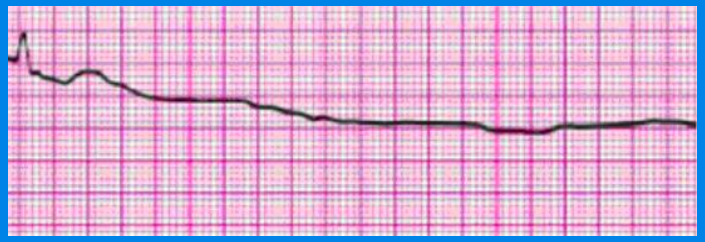


- Continue CPR
- IV/IO Access
- Advanced Airway
- Epinephrine 1mg IV
- Rule out reversible causes
- CONTINUE as per ACLS….

if the patient
HAS A PULSE with
AGONAL COMPLEXES . . . .
IMMEDIATELY BEGIN TRANSCUTANEOUS PACING -
you will probably save the patient's life !

Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs
  - Shock Assessment

SHOCK ASSESSMENT

SHOCK =

INADEQUTE TISSUE PERFUSION

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

SHOCK ASSESSMENT

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

SHOCK

is

THE CORRIDOR TO DEATH

SHOCK – FIND CAUSE . . .

- HYPOVOLEMIC (internal or external bleeding)
- OBSTRUCTIVE (PE / tamponade)
- PSYCHOGENIC (sudden fear – self-correcting)
- NEUROLOGICAL (spinal injury)
- INSULIN (hypoglycemia)
- SEPTIC (systemic infection)
- CARDIOGENIC (abnormal heart rate or contractility)

Actions at the Scene:

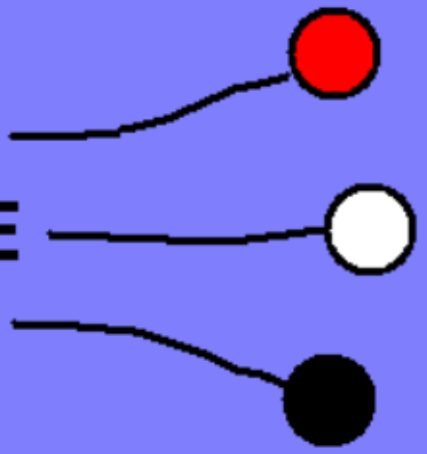
- Vital signs
- ECG
- Verbal history
- O2 (if indicated)
- IV (if indicated)

THE EKG MACHINE

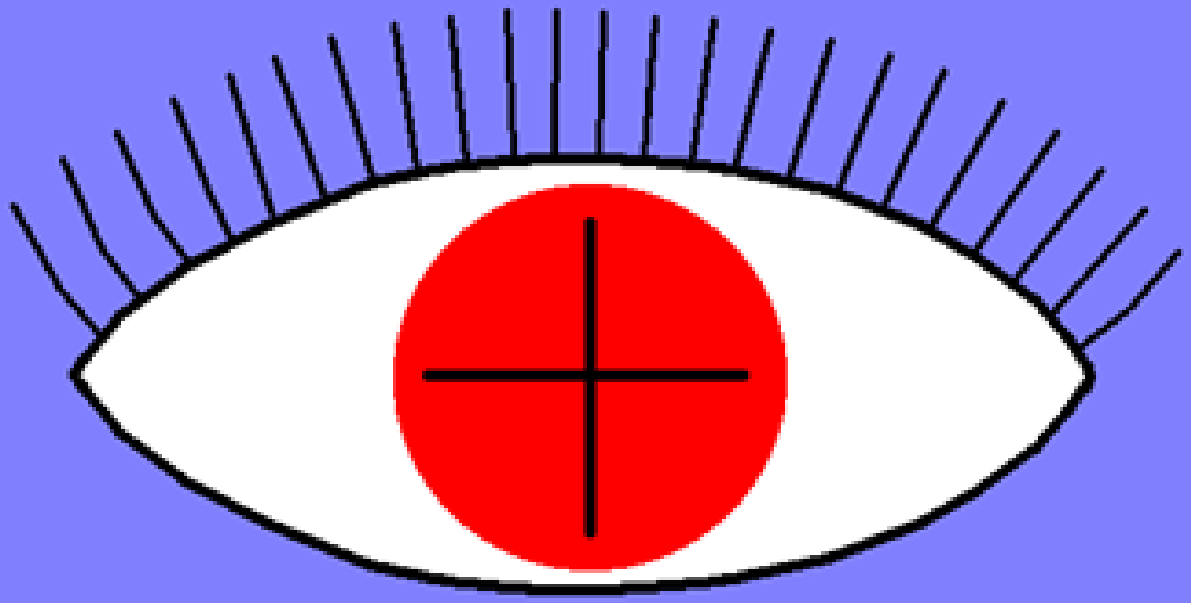
STANDARD 12 LEADS - USES 10 WIRES
(6 CHEST and 4 LIMB)

- I, II, III, and V1, V2, V3, V4, V5, V6
EACH CONSIST OF:

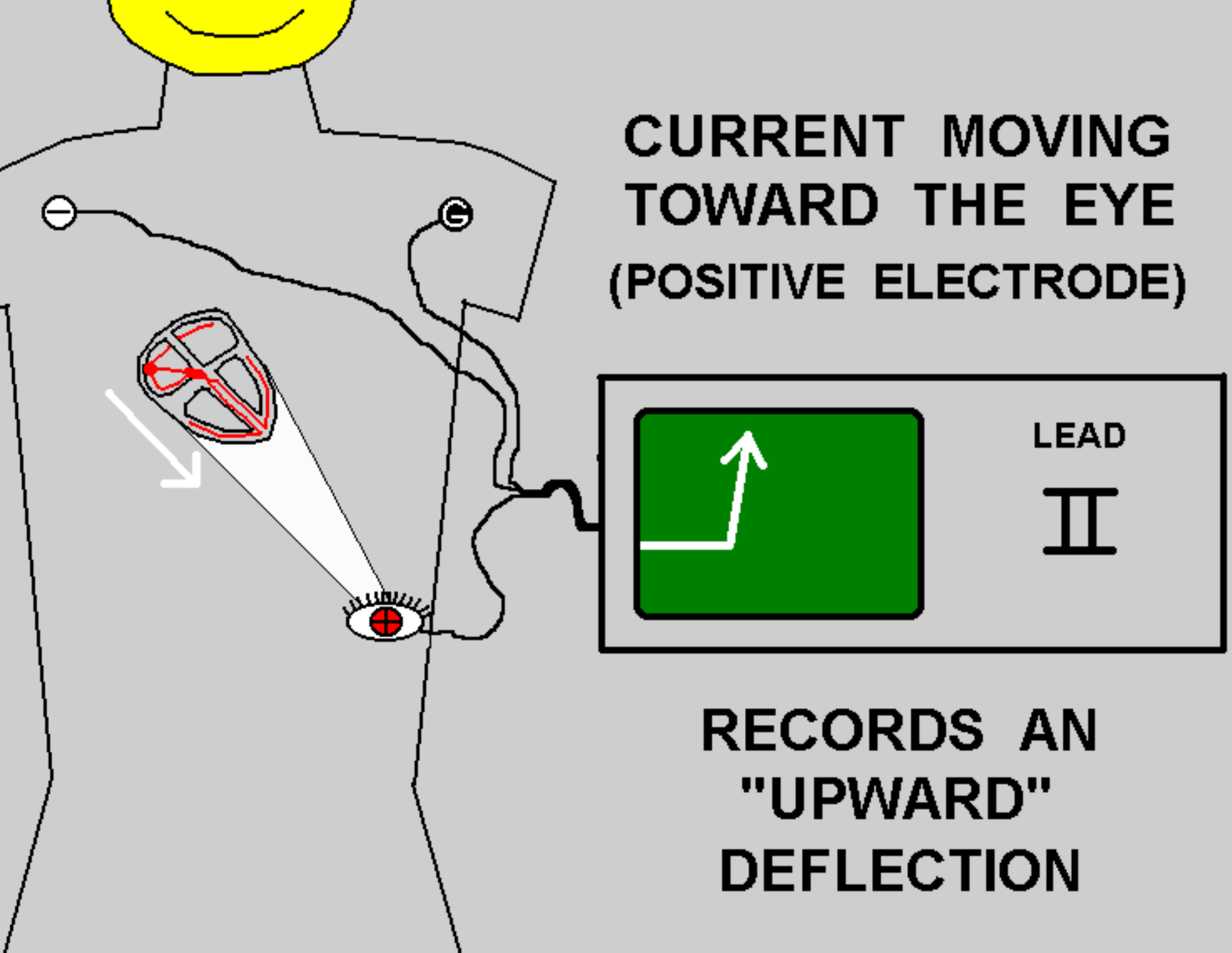
1 POSITIVE ELECTRODE
1 NEGATIVE ELECTRODE
1 GROUND ELECTRODE

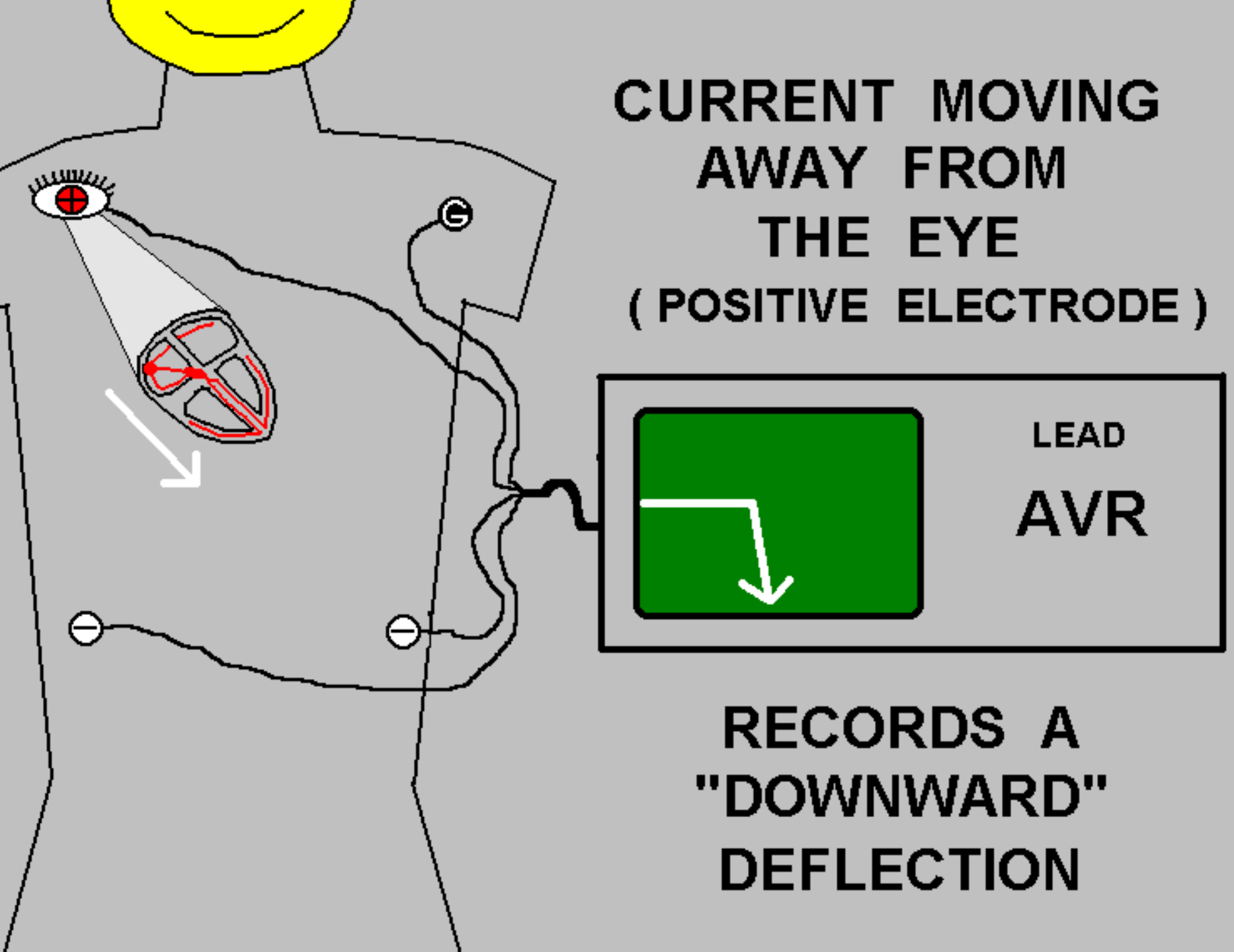


THE POSITIVE ELECTRODE



IS THE "EYE" . . .


CURRENT MOVING
TOWARD THE EYE
(POSITIVE ELECTRODE)
LEAD
II
RECORDS AN
"UPWARD"
DEFLECTION


CURRENT MOVING AWAY FROM THE EYE
(POSITIVE ELECTRODE)
LEAD
AVR
RECORDS A "DOWNWARD" DEFLECTION

CARDIOGENIC SHOCK

- **Heart Rate:**
  - **Should be between 50 – 150**

CARDIOGENIC SHOCK

- **Heart Rate:**
  - **Should be between 50 – 150**

DECREASED CARDIAC OUTPUT may be present when heart rate is:

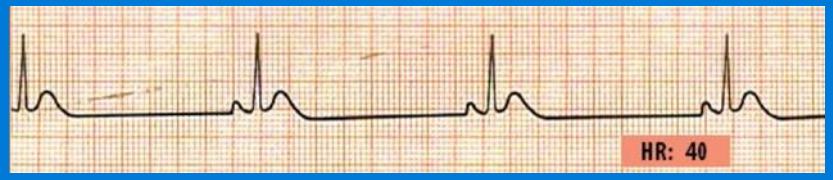
- **LESS THAN 50**
- **GREATER THAN 150**

CARDIOGENIC SHOCK

- **Heart Rate**
  - **TOO SLOW (less than 50) with signs of shock:**

☞ ***SPEED UP THE HEART RATE***

(follow ACLS and Protocols)

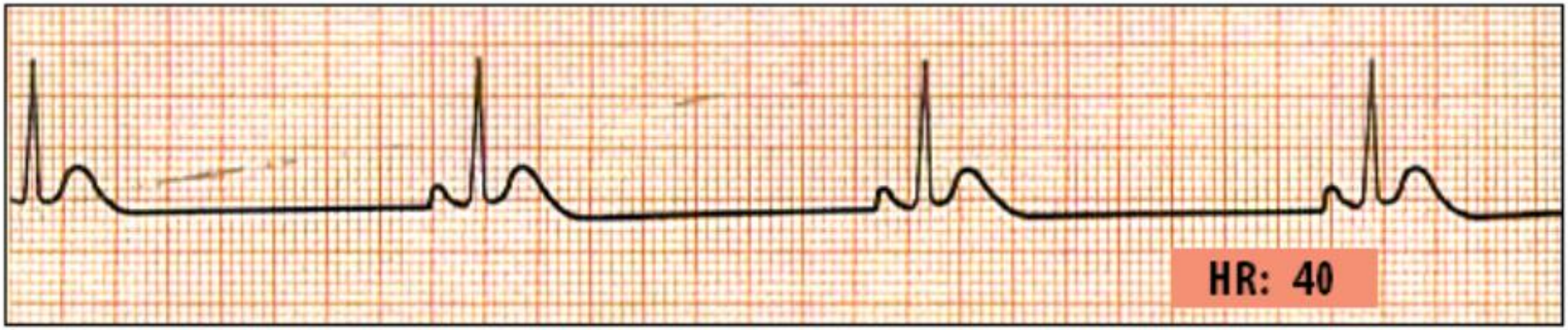


Usual treatment:
- Atropine
- Pacemaker

Bradycardias & Heart Block

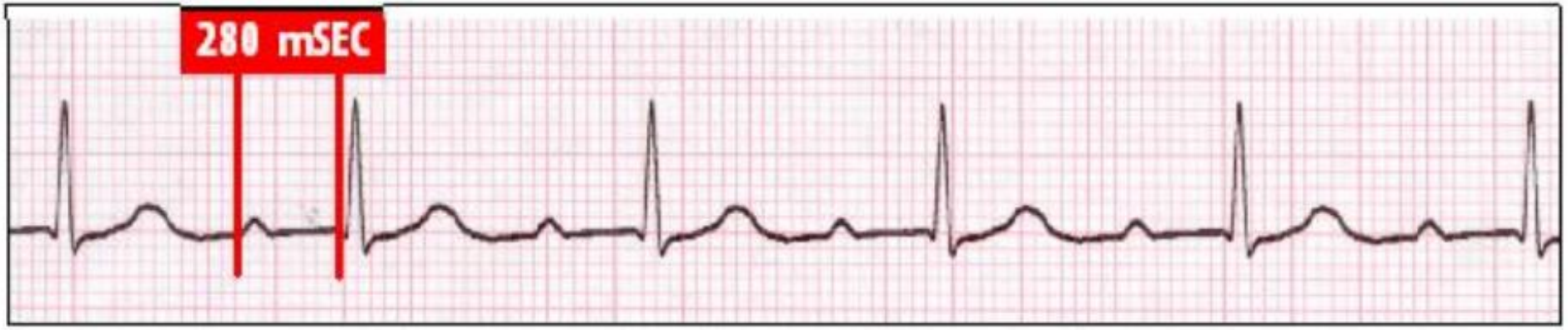
- There are several ECG Rhythms seen with “BRADYCARDIA”
- While you should be able to distinguish each rhythm, what is MORE IMPORTANT is that you simply “identify when the heart rate being TOO SLOW is causing the patient to be symptomatic (SHOCK) . . . .and that you. . .
- KNOW how to treat it.

THIS RHYTHM IS: SINUS BRADYCARDIA



WE MUST CONSIDER UNDERLYING CAUSES:		AND TREAT THEM:
INCREASED VAGAL TONE	→	ATROPINE
BLOCKED SA NODAL ARTERY (INFERIOR WALL MI)	→	CARDIAC CATH - PTCA / STENT THROMBOLYTICS
ELECTROLYTE IMBAL. (K+)	→	CORRECT ELECTROLYTES
HYPOTHERMIA	→	WARM PATIENT
ORGANOPHOSPHATE POISONING	→	ATROPINE
ATHLETIC METABOLISM (excellent health!)	→	COMPLIMENT PATIENT!

THIS RHYTHM IS: FIRST DEGREE HEART BLOCK



MAIN IDENTIFICATION CHARACTERISTIC(S): P-R INTERVAL TOO LONG - (GREATER THAN 200 mSEC.)

RATE	NORMAL
RHYTHM	REGULAR
P-R INTERVAL	> 200 mSEC.
P:QRS RATIO	1:1
QRS INTERVAL	NORMAL

P : QRS RATIO

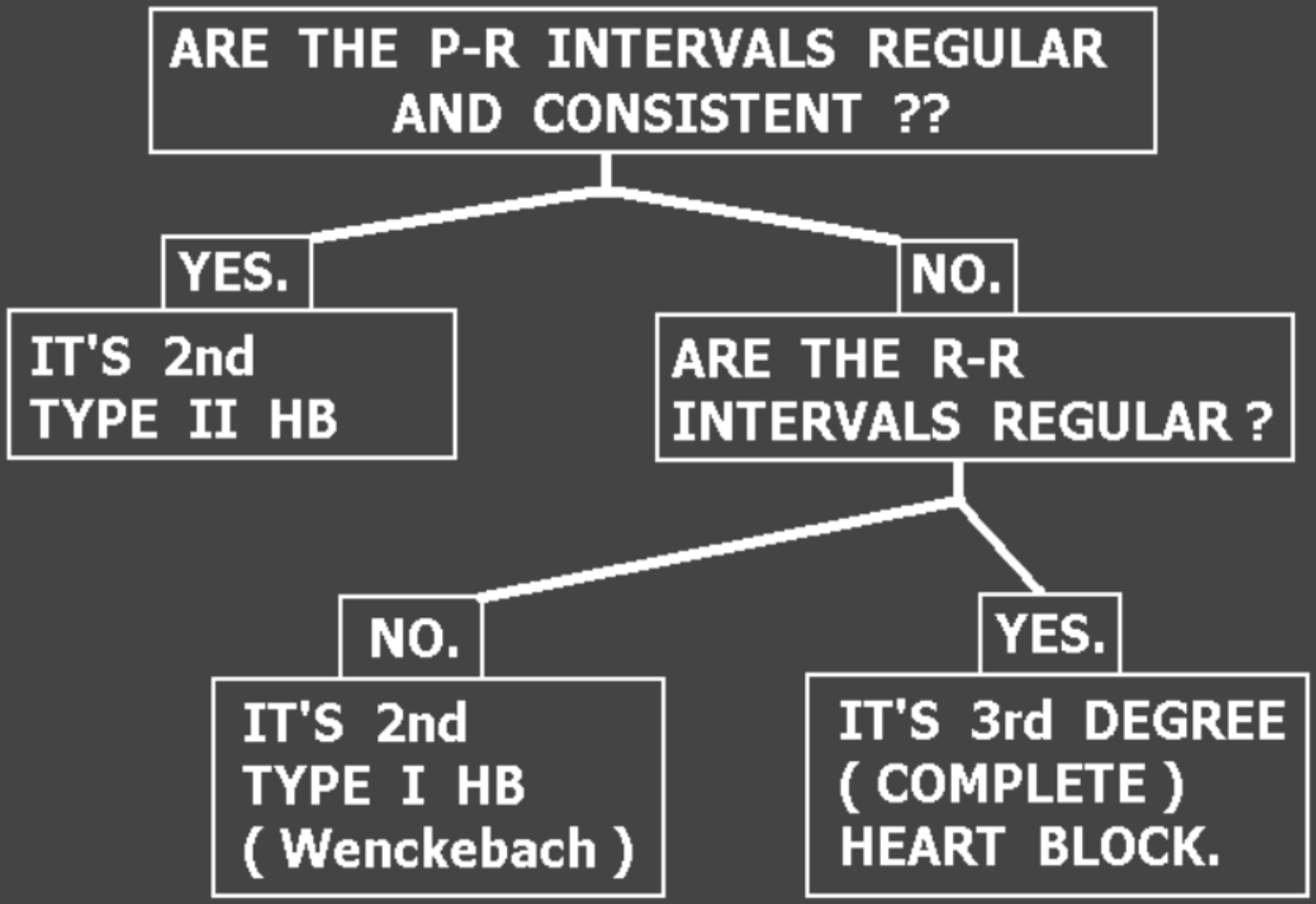
IF GREATER THAN 1 : 1

THINK:

- 2° HEART BLOCK
  (TYPE 1 or 2)
- 3° HEART BLOCK

DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

MORE P-WAVES THAN QRS COMPLEXES PRESENT.



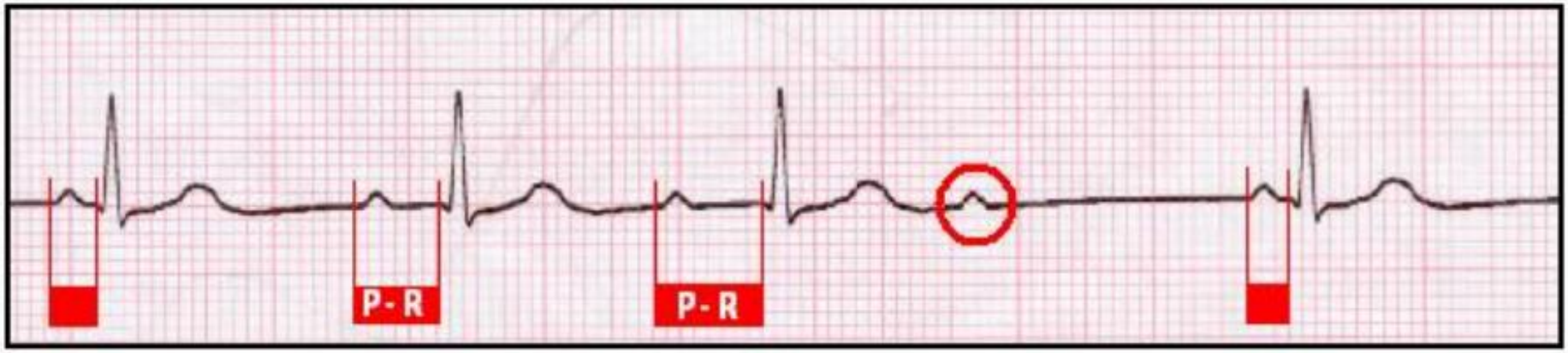
LET'S TEST THE PROCEDURE . . .

1

2

3

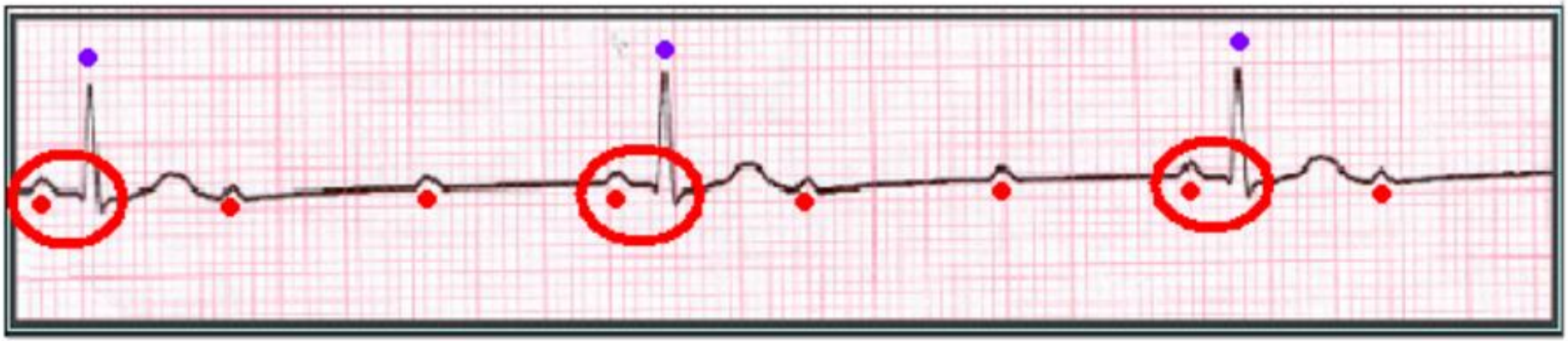
THIS RHYTHM IS: 2nd° TYPE I HB (Wenckebach)



MAIN IDENTIFICATION CHARACTERISTIC(S): P-R INTERVAL GETS PROGRESSIVELY LONGER UNTIL IT DROPS A QRS -- THEN CYCLE REPEATS

RATE	NORMAL or BRADYCARDIC
RHYTHM	REGULARLY IRREGULAR
P-R INTERVAL	VARIES (regularly irregular)
P:QRS RATIO	VAIRES (usually 1:1 and 2:1)
QRS INTERVAL	NORMAL

THIS RHYTHM IS: 2nd° TYPE II HEART BLOCK



MAIN IDENTIFICATION CHARACTERISTIC(S): MORE THAN ONE P WAVE FOR EACH QRS -- BUT EVERY QRS HAS A NORMAL, CONSISTENT P-R INTERVAL

RATE	USUALLY BRADYCARDIC
RHYTHM	USUALLY REGULAR (can be irregular)
P-R INTERVAL	NORMAL and CONSISTENT
P:QRS RATIO	≥ 2:1
QRS INTERVAL	NORMAL

THIS RHYTHM IS: 3rd° HB c̄ JUNCTIONAL ESCAPE

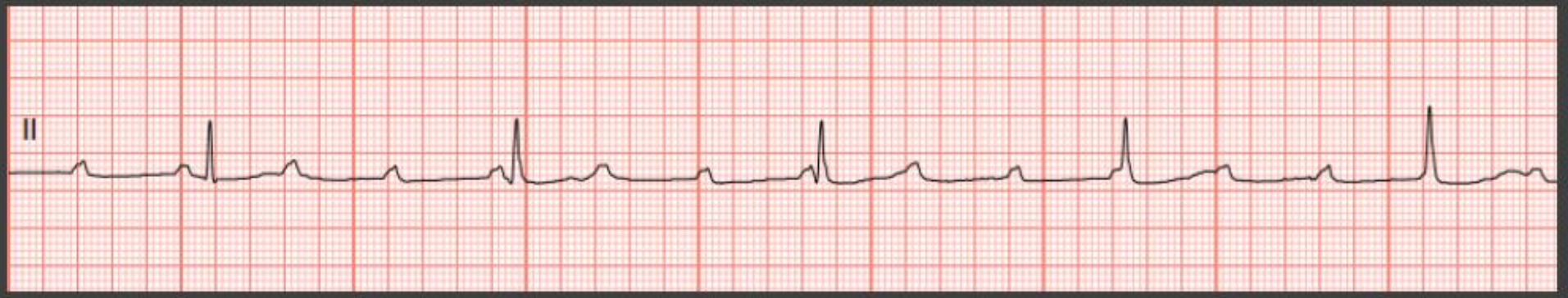
MAIN IDENTIFICATION CHARACTERISTIC(S): **P - R INTERVAL INCOSISTENT, P - P INTERVALS REGULAR, R - R INTERVALS REGULAR -- NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES.**

RATE ----------	USUALLY BRADYCARDIC (40 - 60 JUNCTIONAL RATE)
RHYTHM ----------	REGULAR
P-R INTERVAL -----	INCONSISTENT (irregularly irregular)
P: QRS RATIO ------	VARIES - USUALLY > 2 : 1
QRS INTERVAL ----	NORMAL (< 120 ms) UNLESS PT HAS BUNDLE BRANCH BLOCK

THIS RHYTHM IS: 3rd° HB c̄ IDIOVENTRICULAR ESCAPE

MAIN IDENTIFICATION CHARACTERISTIC(S): **P - R INTERVALS INCONSISTENT P - P INTERVALS REGULAR, R - R INTERVALS REGULAR. NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES. QRS COMPLEXES are WIDER THAN 120ms, AND OF SLOW VENTRICULAR RATE (usually < 40)**

RATE ----------	USUALLY BRADYCARDIC (< 40 VENTRICULAR RATE)
RHYTHM ----------	REGULAR
P-R INTERVAL ------	INCONSISTENT (irregularly irregular)
P: QRS RATIO -------	VARIES - USUALLY > 2 : 1
QRS INTERVAL -----	WIDER THAN 120 ms


II

???

THIS RHYTHM IS: JUNCTIONAL RHYTHM

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-T seg) or JUST BEFORE QRS (short P-R). WHEN P wave seen, it is INVERTED (upside-down).

RATE ---------- 40-60
RHYTHM ---------- REGULAR
P-R INTERVAL ---- ABSENT or SHORT
P:QRS RATIO ---- 1:1
QRS INTERVAL ---- NORMAL

- HR USUALLY 40-60

CARDIOGENIC SHOCK

- **Heart Rate**
  - **TOO FAST (greater than 150) with signs of shock:**

☞ ***SLOW the heart rate***

(follow ACLS and Protocols)

Usual treatment:
- Synchronized Cardioversion

Tachycardias

- Is the patient STABLE or UNSTABLE?
- QRS narrow or wide ???
  - Narrow = “not greater than 120 ms” (3 mm)
  - Wide = “greater than 120 ms (3 mm)

ALL UNSTABLE TACHYCARDIAS:

- SYNCHRONIZED CARDIOVERSION
  - As per agency PROTOCOL and/or ACLS
  - NARROW tachycardias = less initial energy
  - WIDE QRS tachycardias AND A-fib RVR = higher initial energy

ACLS TACHYCARDIA GUIDELINES

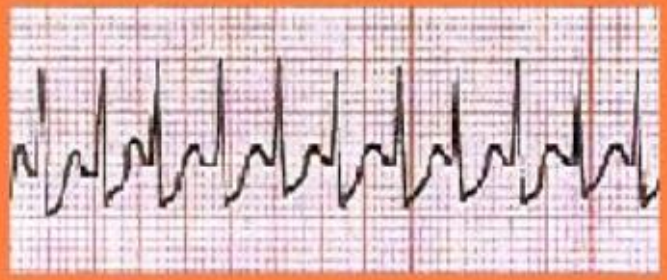
150

100

SVT

SINUS TACH

NSR



THIS RHYTHM IS: SINUS TACHYCARDIA

MAIN IDENTIFICATION CHARACTERISTIC(S): SINUS RHYTHM, RATE HIGHER THAN 100. (ACLS guidelines: heart rate 100 - 150)

RATE ---------- 100 - 150 (can be > 150)
RHYTHM ---------- REGULAR
P-R INTERVAL ------ NORMAL (120 - 200 ms)
P: QRS RATIO ------- 1 : 1
QRS INTERVAL ------ NORMAL (< 120 ms), (unless Bundle Branch Block present)

THIS RHYTHM IS: SINUS TACHYCARDIA

WE MUST CONSIDER UNDERLYING CAUSES:		AND TREAT THEM:
ANXIETY / FEAR	→	CALM PATIENT
HYPOVOLEMIA		
DEHYDRATION	→	FLUIDS
BLOOD LOSS	→	STOP BLEEDING
MEDICATION EFFECTS	→	CONSIDER MEDICAL Tx
OTHER ILLNESS	→	IDENTIFY & Tx DISORDER

RHTHYM CLUES . . . .

SUPRAVENTRICULAR TACHYCARDIA

SVT is usually PAROXSYMAL -- ie: has a SUDDEN ONSET.

SINUS TACHYCARDIA usually has a " ramp - up " and " ramp - down " period -- a gradual change in HEART RATE.

THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE TOO FAST, USUALLY > 150. P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."

RATE ----------	TACHYCARDIC (usually > 150)	
RHYTHM ----------	REGULAR	
P-R INTERVAL -----	NORMAL or ABNORMAL.	MAY BE IMPOSSIBLE TO SEE DUE TO P WAVE BURIED IN T WAVES
P:QRS RATIO ------	1:1	
QRS INTERVAL -----	NORMAL	

THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE TOO FAST, USUALLY > 150. P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."

TREATMENT / INTERVENTIONS:

BASED ON WHETHER PATIENT IS STABLE or UNSTABLE . . .

THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE ----------
RHYTHM ----------
P-R INTERVAL -----
P: QRS RATIO ------
QRS INTERVAL -----

THIS RHYTHM IS: MONOMORPHIC V-TACH

MAIN IDENTIFICATION CHARACTERISTIC(S): WIDE QRS COMPLEXES (> 120 ms)

HR USUALLY BETWEEN 150 - 200; ALL QRS COMPLEXES APPEAR SAME IN SHAPE and DEFELCTION; IF P WAVES SEEN, DISASSOTIATED w/ QRS

RATE	> 100 (usually 150 - 200)
RHYTHM	REGULAR
P-R INTERVAL	N/A
P: QRS RATIO	N/A
QRS INTERVAL	> 120 ms

V-Tach

- NO PULSE – Follow Protocols / ACLS for “V-Fib / V-Tach”
- PULSE – but UNSTABLE – Synchronized Cardioversion
- STABLE - Give MEDS as per Protocols / ACLS

THIS RHYTHM IS: POLYMORPHIC V - TACH

MAIN IDENTIFICATION CHARACTERISTIC(S): WIDE QRS COMPLEXES, MULTIPLE SHAPES AND FORMS, POSITVE AND NEGATIVE DEFLECTIONS, APPEARS TO ROTATE BETWEEN NEGATIVE AND POSITIVE (TWISTING OF POINTS)

RATE ---------- 200 - 300
RHYTHM ---------- VARIES
P-R INTERVAL ------ N/A
P: QRS RATIO ------- N/A
QRS INTERVAL ------ VARIES

ECG Characteristics of TdP: The QRS Pattern of *Torsades de Pointes*

resembles . . . . .

a piece of Twisted Ribbon !

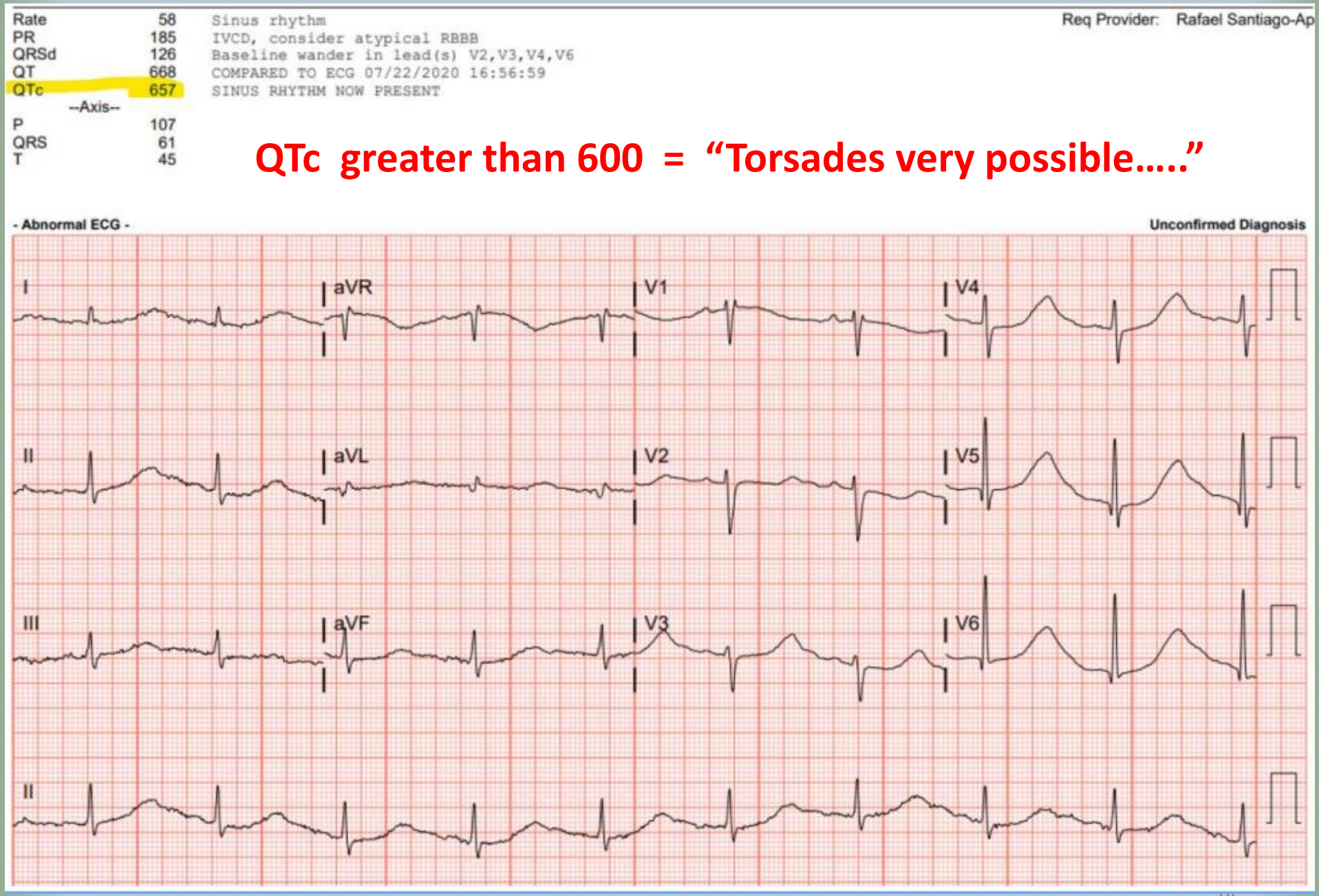
ABC s

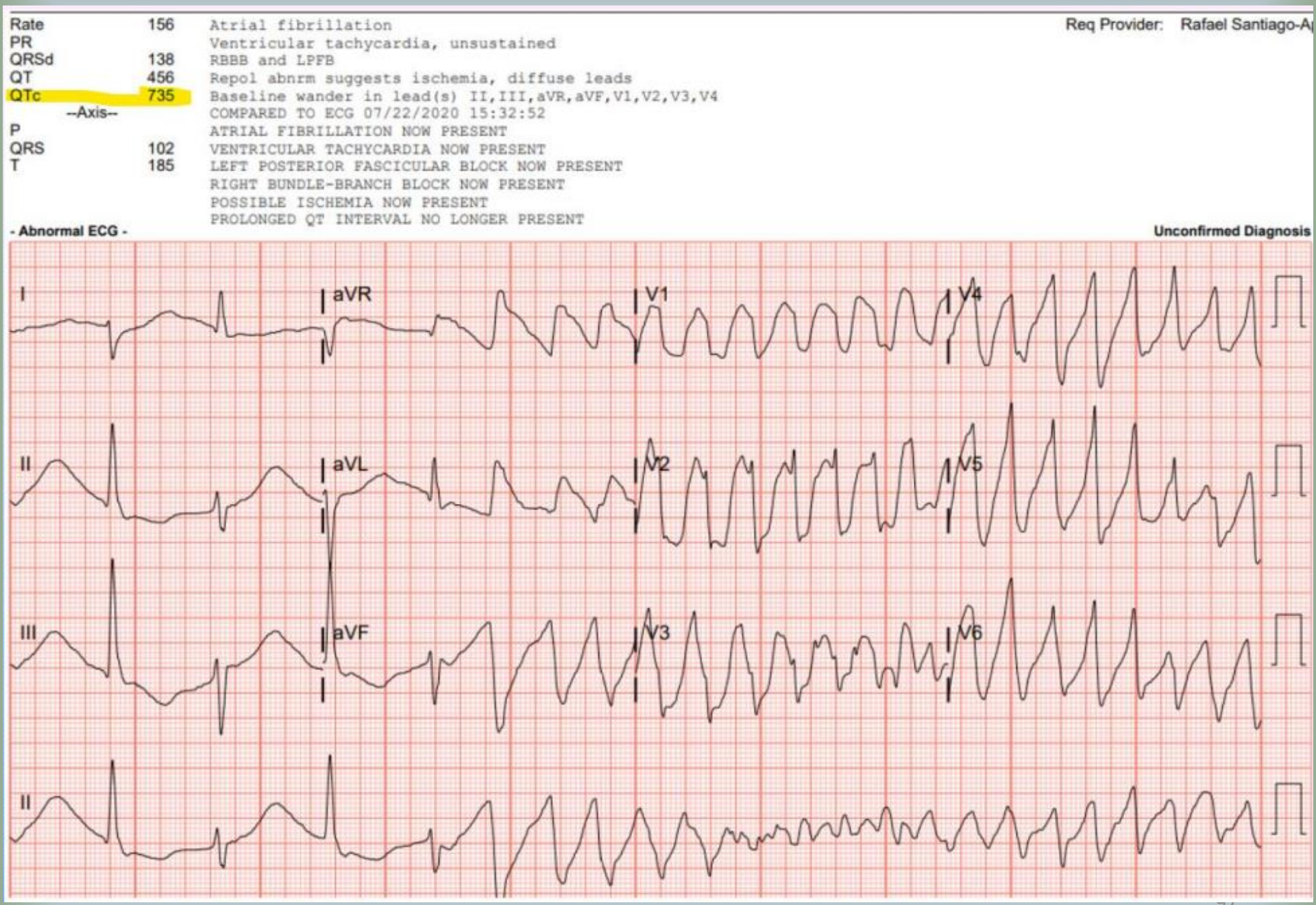
NO PULSE	PULSE - UNSTABLE	PULSE - STABLE
GO TO V - FIB ALGORITHM !	▪ IMMEDIATE DEFIBRILLATION START IV CONSIDER SEDATION	▪ O2 / IV / EKG ▪ MAGNESIUM INFUSION 1 - 2 gm OVER 5 - 60 min,

DO NOT give PROCAINAMIDE, AMIODARONE, or SOTALOL to patients with TORSADES or POLYMORPHIC VT !!!

QTc Values:

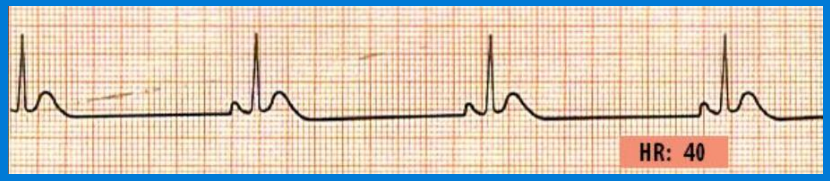
Too Short:	**< 390 ms**
Normal	
-Males:	**390 - 450 ms**
-Females:	**390 - 460 ms**
Borderline High	
-Males:	**450 - 500 ms**
-Females:	**460 - 500 ms**
High (All Genders):	**500 - 600 ms**
Critical High (associated with TdP):	**600 + ms**


Rate 58
PR 185
QRSd 126
QT 668
QTc 657
--Axis--
P 107
QRS 61
T 45
Sinus rhythm
IVCD, consider atypical RBBB
Baseline wander in lead(s) V2,V3,V4,V6
COMPARED TO ECG 07/22/2020 16:56:59
SINUS RHYTHM NOW PRESENT
Req Provider: Rafael Santiago-Ap
QTc greater than 600 = "Torsades very possible….."
- Abnormal ECG -
Unconfirmed Diagnosis
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


Rate 156
PR
QRSd 138
QT 456
QTc 735
--Axis--
P
QRS 102
T 185
Atrial fibrillation
Ventricular tachycardia, unsustained
RBBB and LPFB
Repol abnrm suggests ischemia, diffuse leads
Baseline wander in lead(s) II,III,aVR,aVF,V1,V2,V3,V4
COMPARED TO ECG 07/22/2020 15:32:52
ATRIAL FIBRILLATION NOW PRESENT
VENTRICULAR TACHYCARDIA NOW PRESENT
LEFT POSTERIOR FASCICULAR BLOCK NOW PRESENT
RIGHT BUNDLE-BRANCH BLOCK NOW PRESENT
POSSIBLE ISCHEMIA NOW PRESENT
PROLONGED QT INTERVAL NO LONGER PRESENT
Req Provider: Rafael Santiago-A
- Abnormal ECG -
Unconfirmed Diagnosis
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

CARDIOGENIC SHOCK

- Heart Rate – TOO SLOW or TOO FAST
  - Wide QRS
  - Narrow QRS



CARDIOGENIC SHOCK

- **Heart Rate:**
  - **Should be between 50 – 150**

CARDIOGENIC SHOCK

- **Heart Rate:**
  - **Should be between 50 – 150**
- **Decreased Contractility:**
  - **STEMI / Acute Coronary Syndrome (vascular)**

CARDIOGENIC SHOCK

- **Heart Rate:**
  - **Should be between 50 – 150**
- **Decreased Contractility:**
  - **STEMI / Acute Coronary Syndrome (vascular)**
  - **Myocarditis (muscle dysfunction)**

CARDIOGENIC SHOCK

- **Heart Rate:**
  - **Should be between 50 – 150**
- **Decreased Contractility:**
  - **STEMI / Acute Coronary Syndrome (vascular)**
  - **Myocarditis (muscle dysfunction)**

    Often mimics STEMI on the ECG. Often "challenging" for advanced practitioners to diagnose.

Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs
  - Shock
- SYMPTOMS
  - Chest Pain / Pressure

Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs
  - Shock
- SYMPTOMS
  - Chest Pain / Pressure = ***STAT 12 LEAD ECG !!!***

    (within 10 minutes) !!

CHIEF COMPLAINT

KEY WORDS:

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

SHORTNESS BREATH

DIZZINESS / LIGHTHEADEDNESS

ETC. ETC. ETC.

INFARCTION

SYMTOMS OF MYOCARDIAL INFARCTION:

1. CHEST PAIN:
   - Substernal - can radiate to neck, shoulders, jaw, L or R arm
   - Pain described as "Dull Pain" or "Pressure" or "Heaviness" - but can be sharp
   - Usually NOT effected by DEEP INSPIRATION, POSITION, or MOVEMENT

INFARCTION

SYMTOMS OF MYOCARDIAL INFARCTION:

1. CHEST PAIN
2. SHORTNESS OF BREATH
   May or may not be present.

INFARCTION

SYMTOMS OF MYOCARDIAL INFARCTION:

1. CHEST PAIN
2. SHORTNESS OF BREATH
3. NAUSEA
   May or may not be present

INFARCTION

SYMTOMS OF MYOCARDIAL INFARCTION:

1. CHEST PAIN
2. SHORTNESS OF BREATH
3. NAUSEA
4. COLD, CLAMMY, PALE SKIN
   and other signs of hypoperfusion
   may be present

INFARCTION

- - - "Classic Symptoms" - - -

QUICK ASSESSMENT "SHORT FORM"

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

Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs
  - Shock
- SYMPTOMS
  - Chest Pain / Pressure
  - Other ACS Symptoms

Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs
  - Shock
- SYMPTOMS
  - Chest Pain / Pressure
  - Other ACS Symptoms = ***STAT 12 LEAD ECG !!!***

    (within 10 minutes) !!

ATYPICAL SYMPTOMS of ACS

? ? ?

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

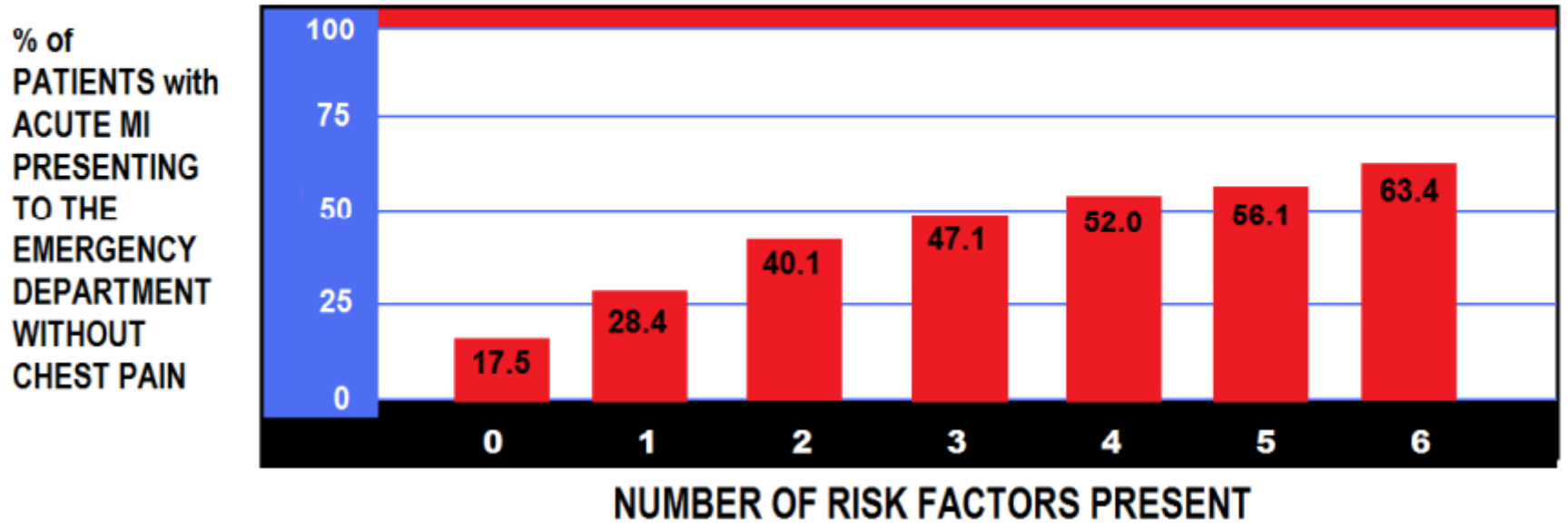
Stroke (previous history of)
Heart failure (previous history of)
Race (non-white)
Elderly (age 75+)
Women
Diabetes mellitus

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

Common atypical complaints associated with AMI without chest pain include:

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

Effect of Having Multiple Risk Factors for AMI Without Chest Pain



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

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

Integrated ECG:

- HEMODYNAMIC STATUS
  - ABCs
  - Shock
- SYMPTOMS
  - Chest Pain / Pressure
  - Other ACS Symptoms
- ECG
  - 12 Lead
  - Single Lead “rhythm strip”

Actions at the Scene

- If patient has ANY symptoms of ACS, get a

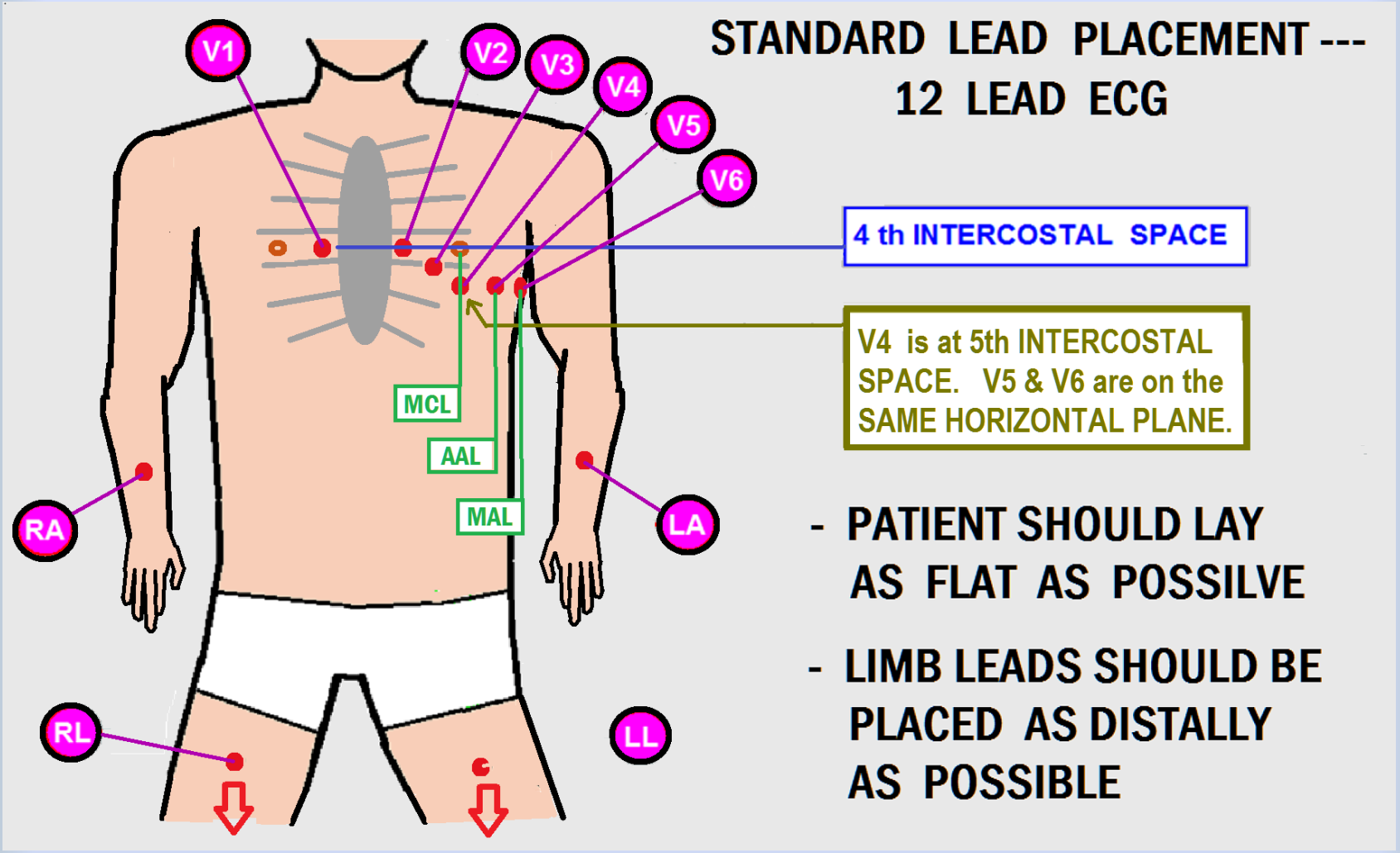
STAT 12 Lead ECG

EMS 12 Lead ECG

10 wires . . .

- 4 limb leads
- 6 chest (“V”) leads

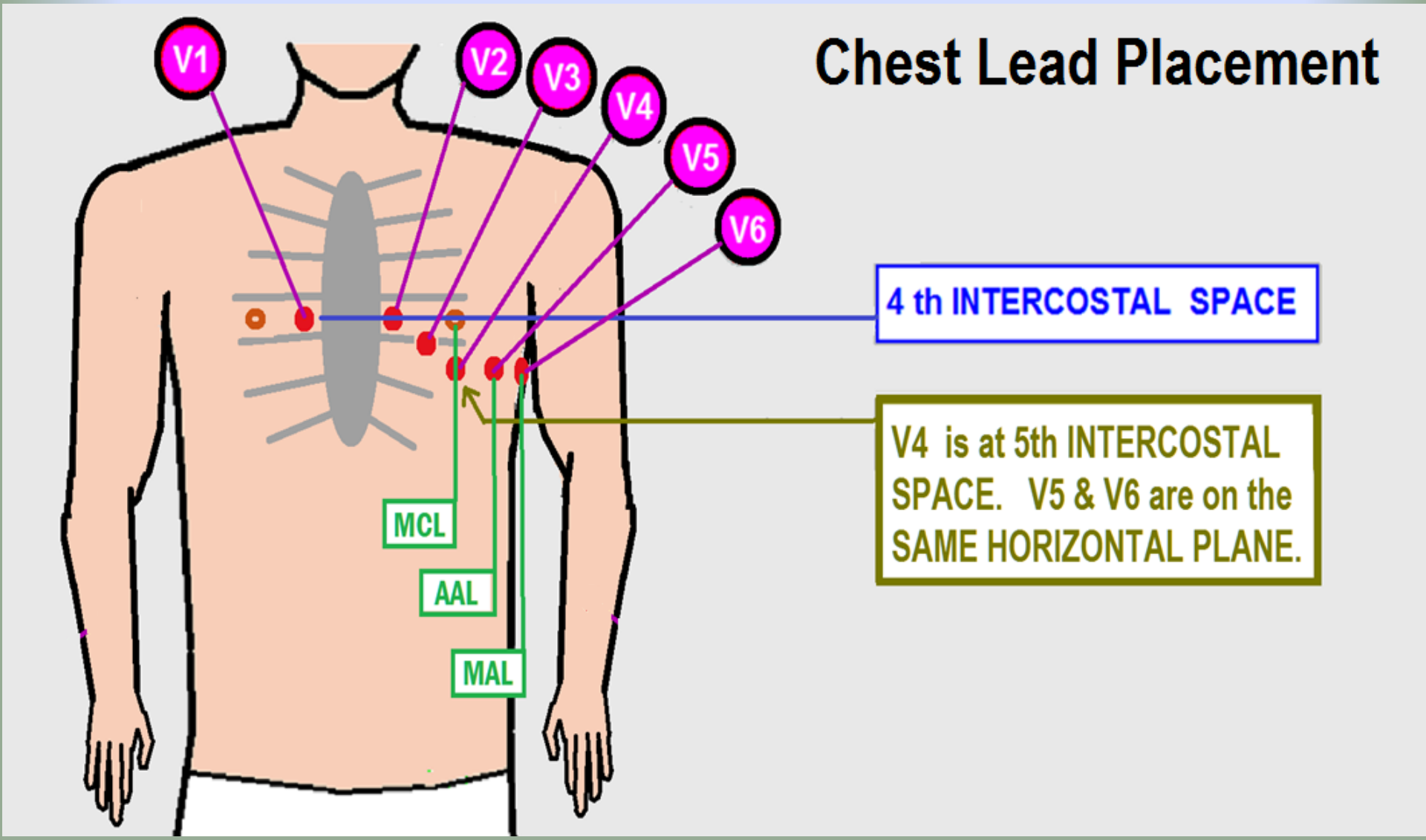
Obtaining the 12 Lead ECG



Leads V1 & V2 on 12 Lead ECG:

- **Proper lead placement of precordial Leads V1 and V2 are 4th intercostal space on opposite sides of the sternum.**
- **Incorrect placement of Leads V1 and V2 will result in: reduction of R wave amplitude (resulting in poor R wave progression) leading to misdiagnosis of previous anterior / septal infarction.**

CORRECT Lead placement:



[redacted] [redacted] [redacted]

DOB [redacted] 75 Years Female (2)

Rate 76 . Sinus rhythm.....normal P axis, V-rate 50- 99

PR 161
QRSD 90
QT 350
QTc 394

--AXIS--
P 50
QRS 51
T 44

12 Lead; Standard Placement

[redacted]

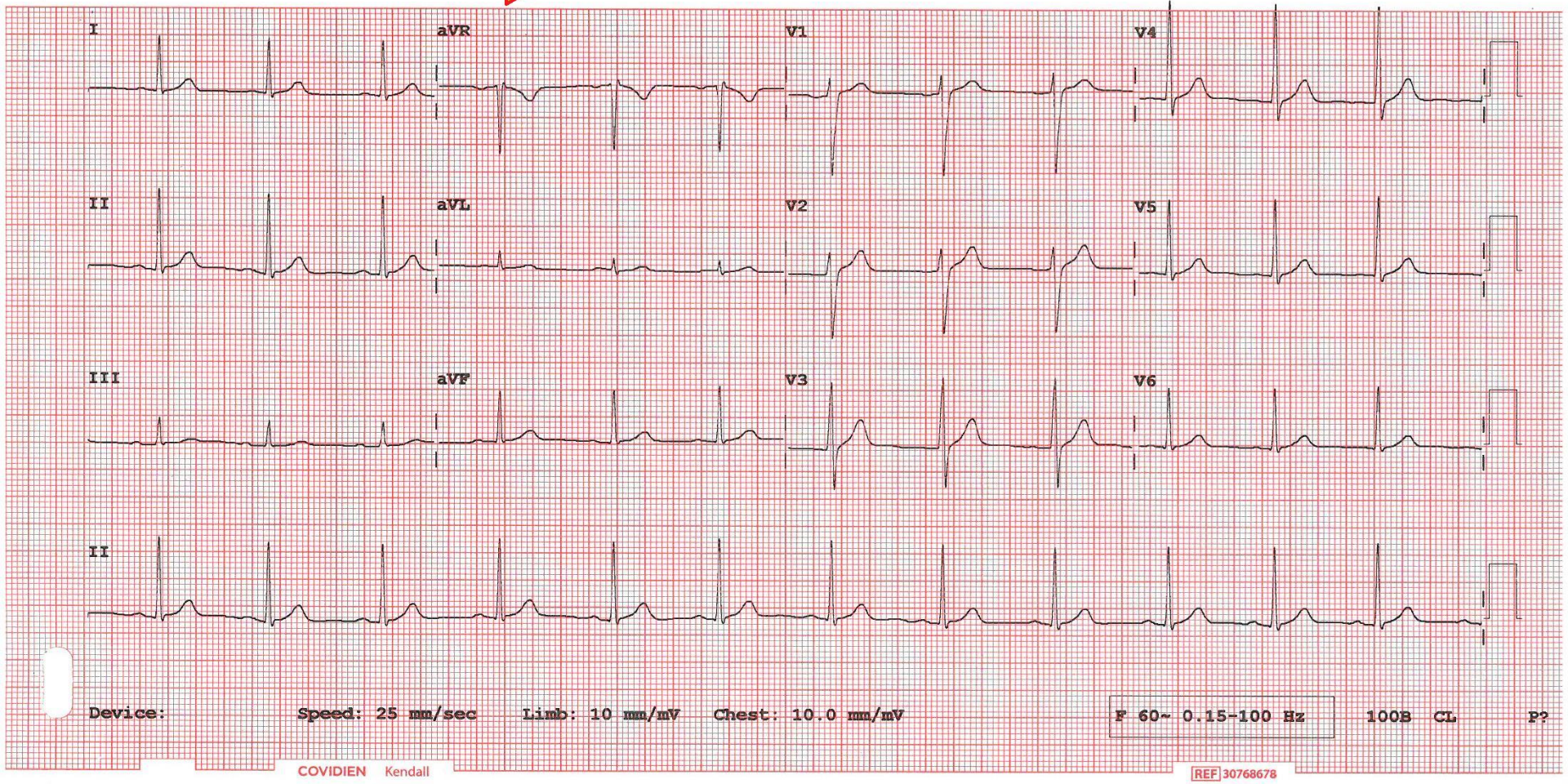
TECH SD

[redacted]

- NORMAL ECG -

Unconfirmed Diagnosi

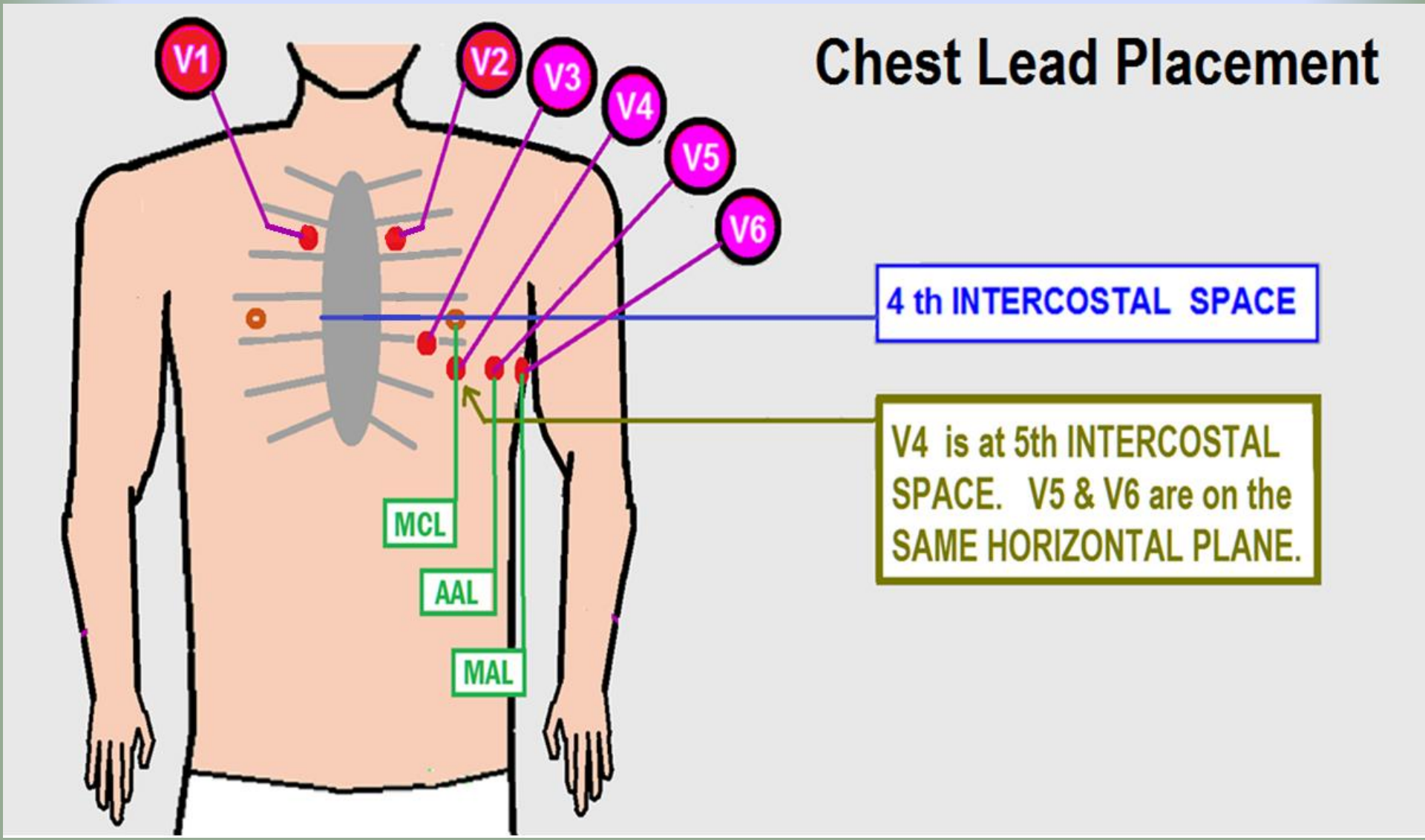
[redacted]



Device: Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10.0 mm/mV F 60~ 0.15-100 Hz 100B CL P?

COVIDIEN Kendall REF 30768678

INCORRECT Lead placement:



[redacted] [redacted] [redacted] 5:20:58 AM

DOB [redacted]1988 30 Years Female (1)

3NE

Rate 89 . Sinus rhythm.....normal P axis. V-rate 50- 99

. Anteroseptal infarct, age indeterminate.....Q >35mS

PR 157
QRSD 96
QT 365
QTc 445

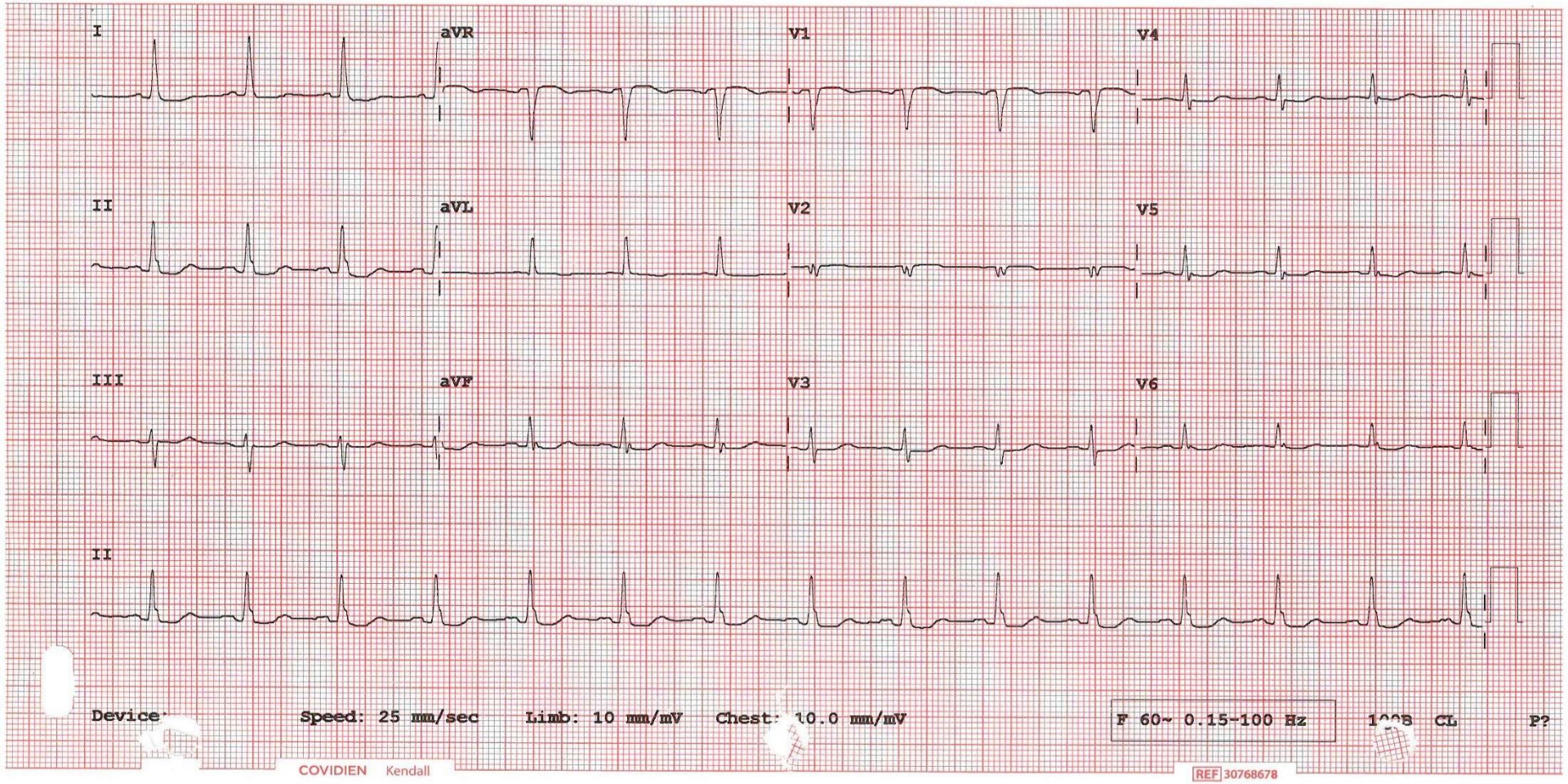
--AXIS--
P 46
QRS 24
T 86

12 Lead; Standard Placement

- ABNORMAL ECG -

Unconfirmed Diagnosis

[redacted]



COVIDIEN Kendall REF 30768678

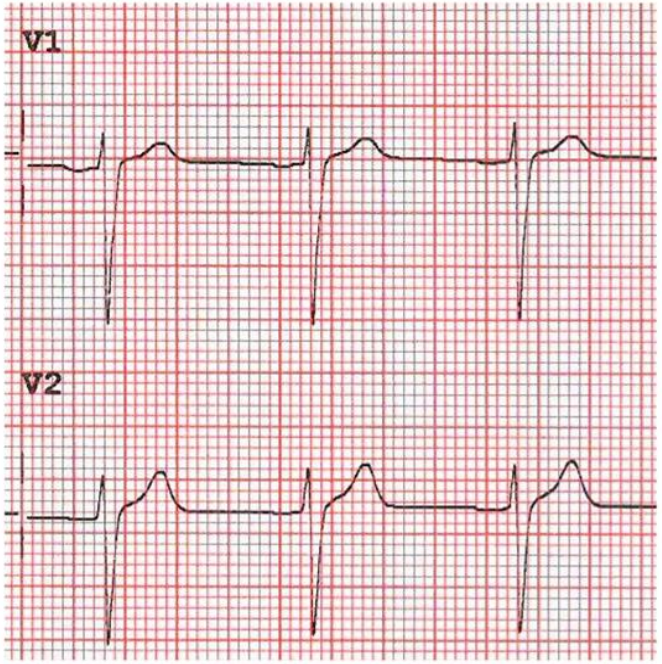
AHA/ACC/HRS Scientific Statement

Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part I: The Electrocardiogram and Its Technology

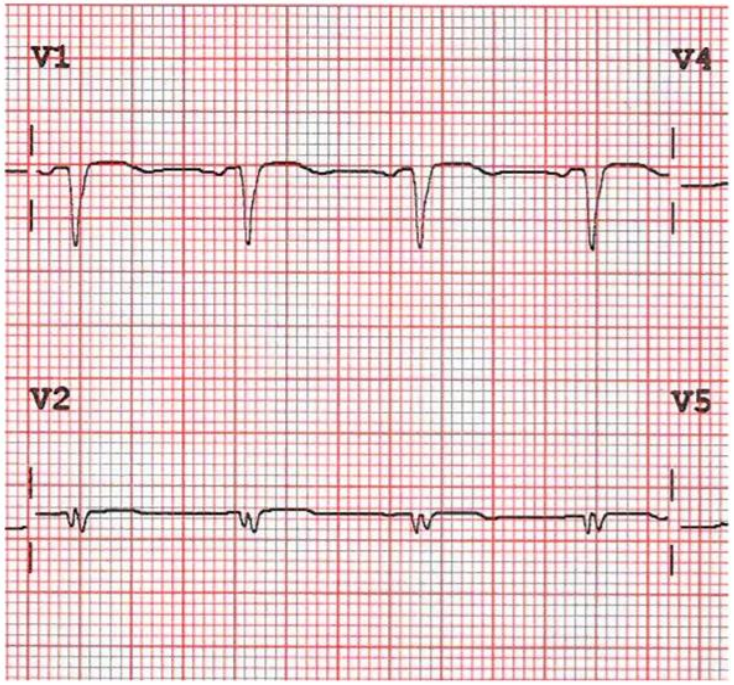
the often profound alterations in waveforms that can result from precordial electrode misplacement.[85,86] A common error is superior misplacement of V_1 and V_2 in the second or third intercostal space. This can result in reduction of initial R-wave amplitude in these leads, approximating 0.1 mV per interspace, which can cause poor R-wave progression or erroneous signs of anterior infarction.[87] Superior displacement of the V_1 and V_2 electrodes will often result in rSr′ complexes with T-wave inversion, resembling the complex in lead aVR. It also has been shown that in patients with low diaphragm position, as in obstructive pulmonary disease,[88,89]

Correct Lead Placement



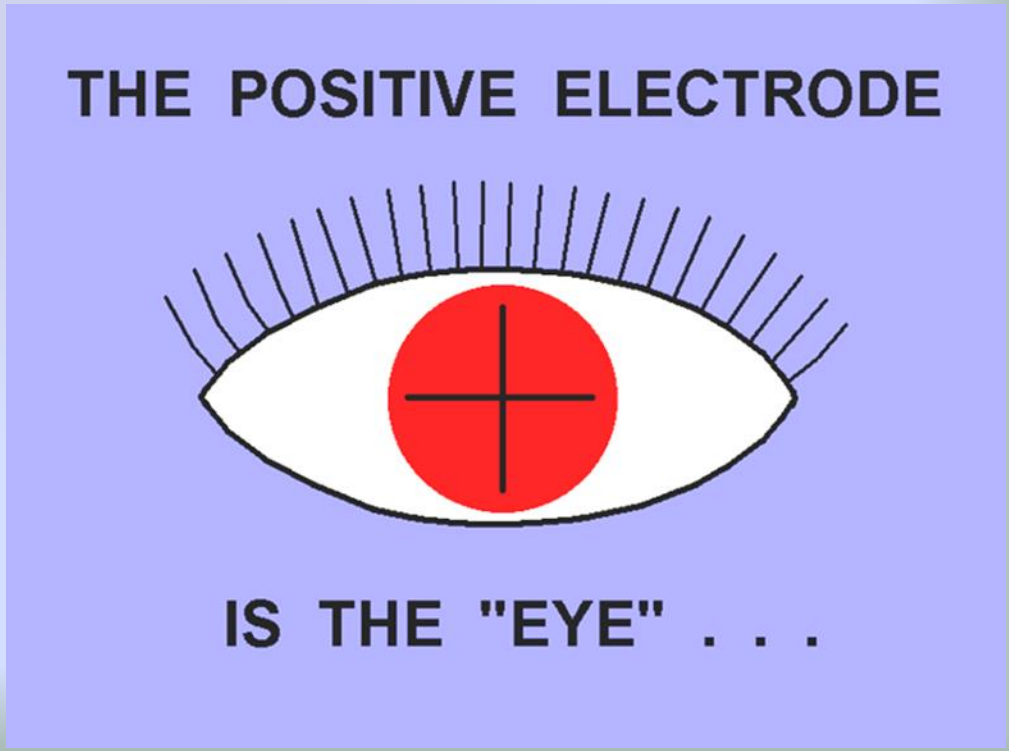
RS = NO old MI

Incorrect Lead Placement



QS = old MI

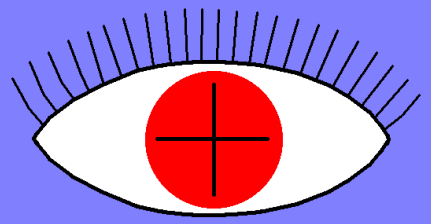
What part of the HEART does each lead SEE ?



AREAS VIEWED by 12 LEAD ECG

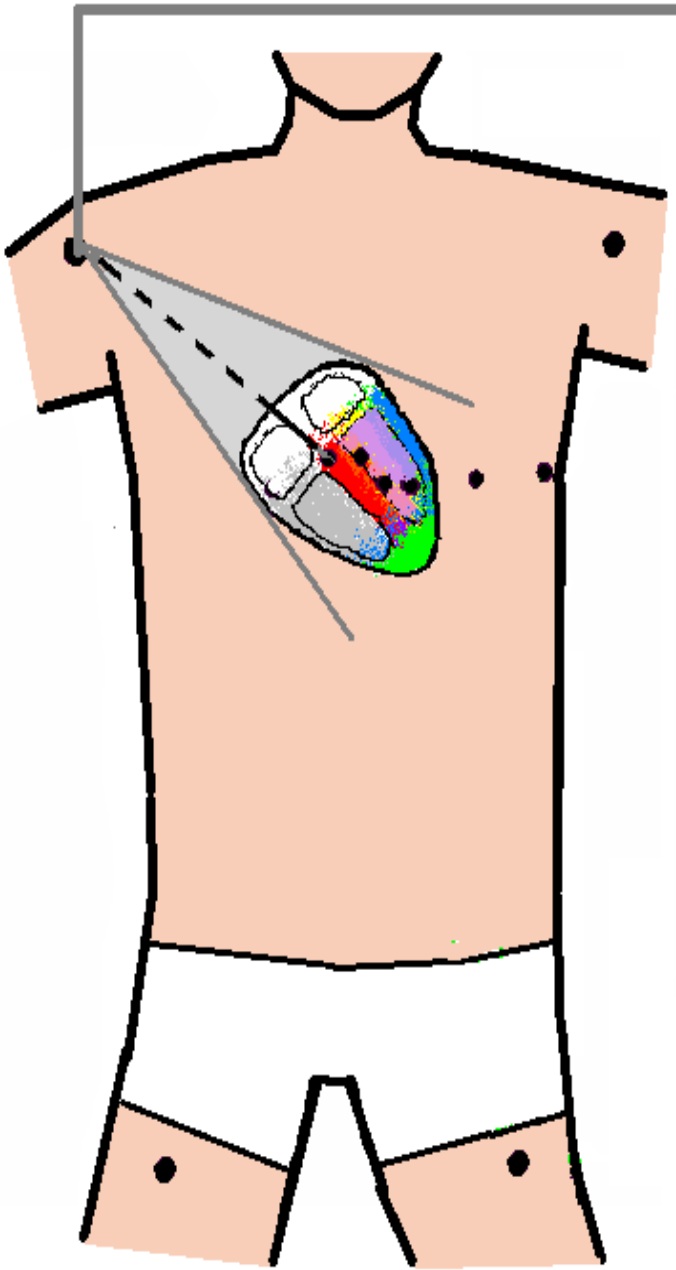
AVR
AVL, I
V1, V2
V3, V4
V5, V6
II, III, AVF

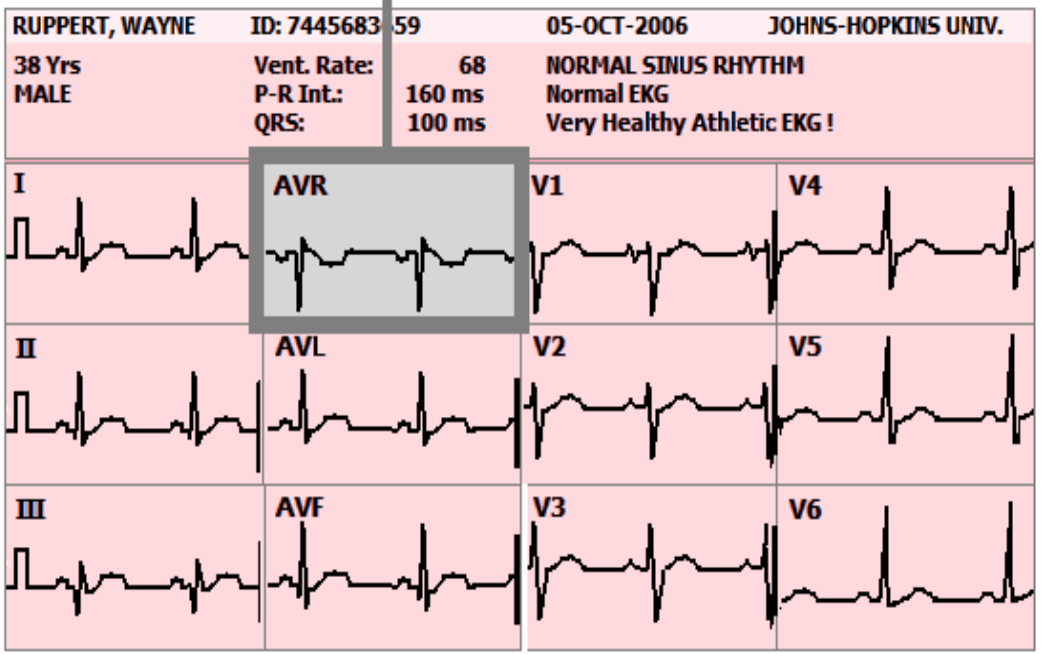
THE POSITIVE ELECTRODE



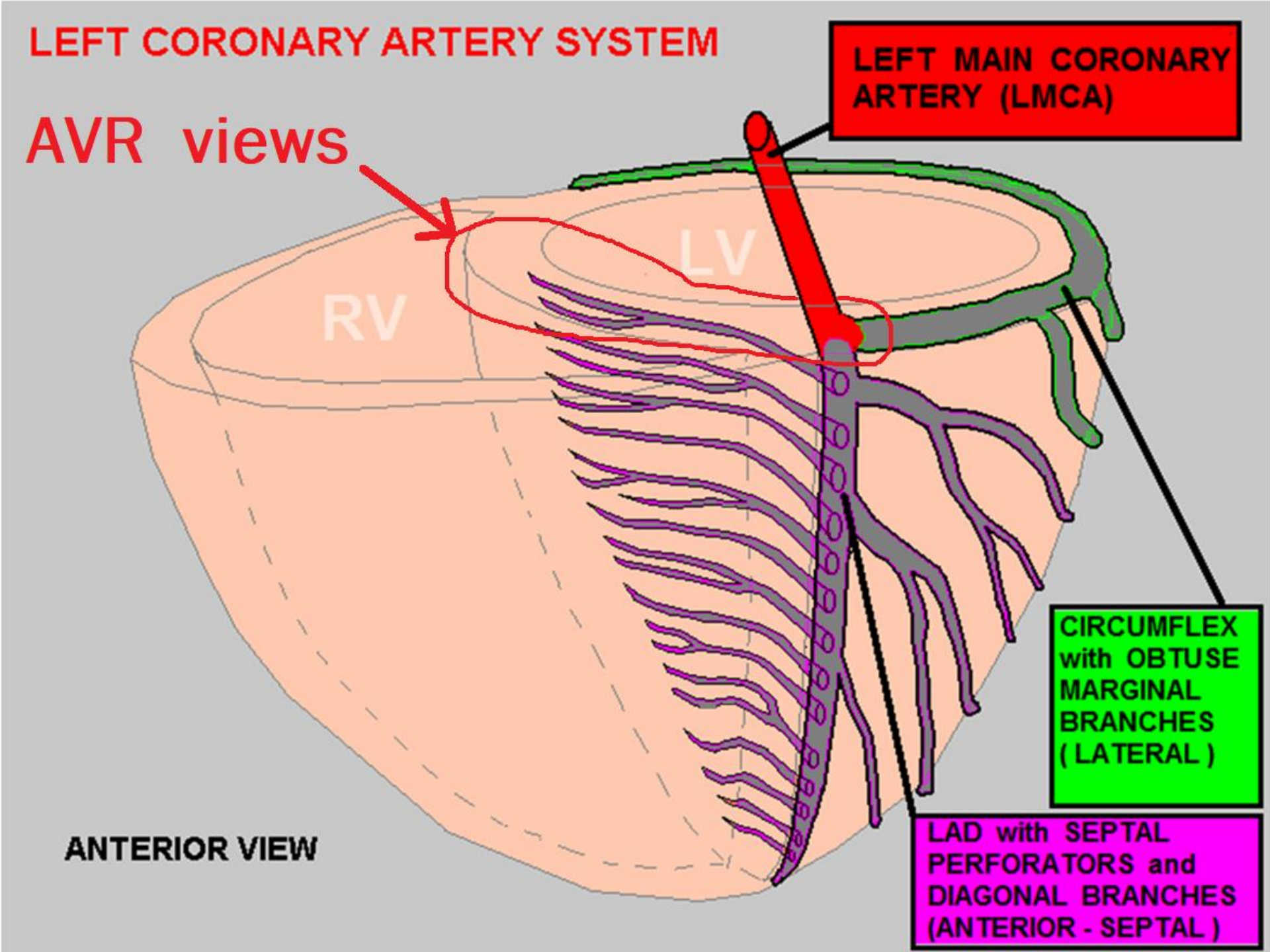
IS THE "EYE" . . .

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

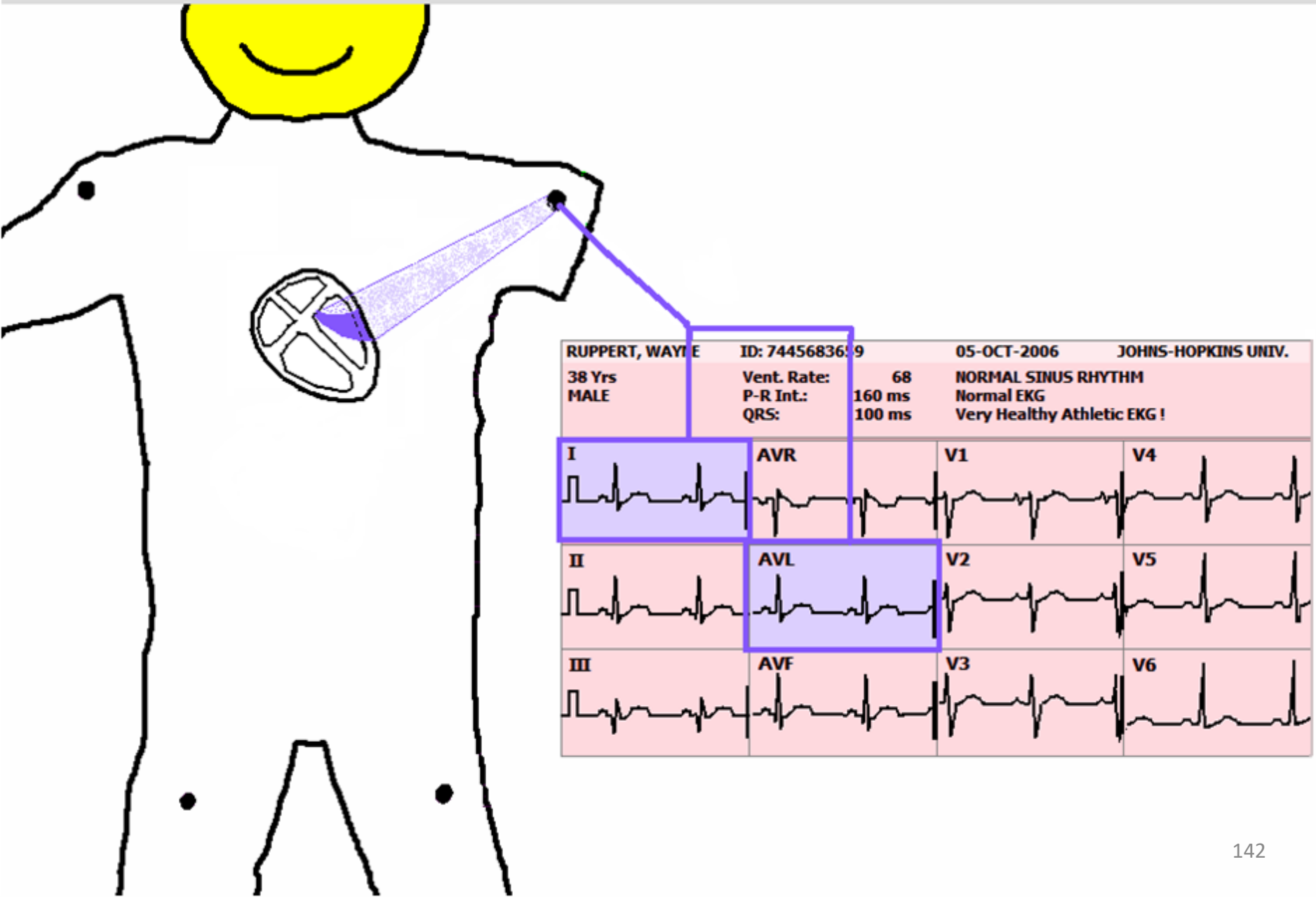




LEFT CORONARY ARTERY SYSTEM

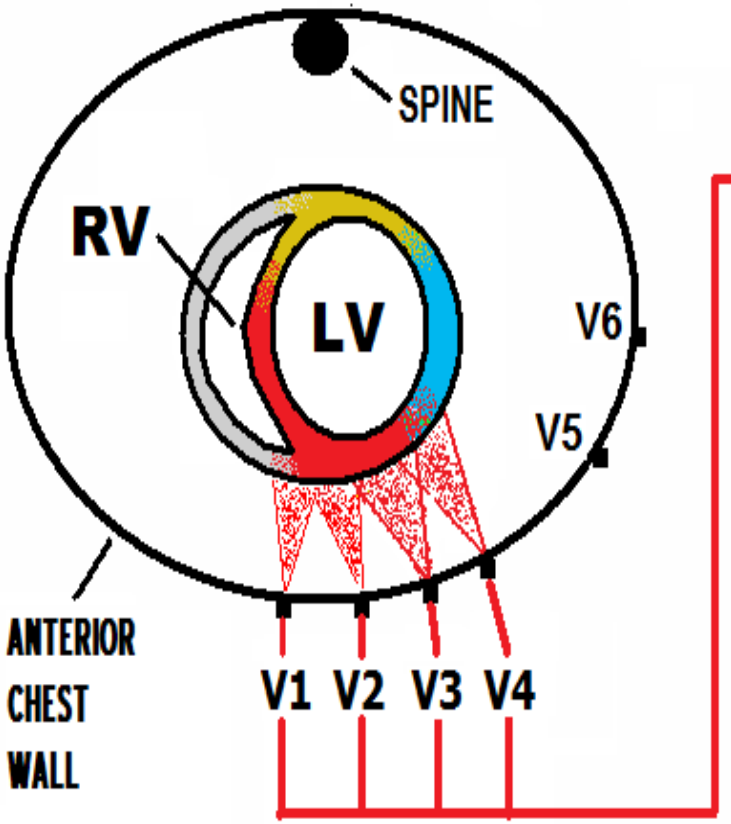


LEADS I and aVL VIEW the LATERAL - ANTERIOR WALL



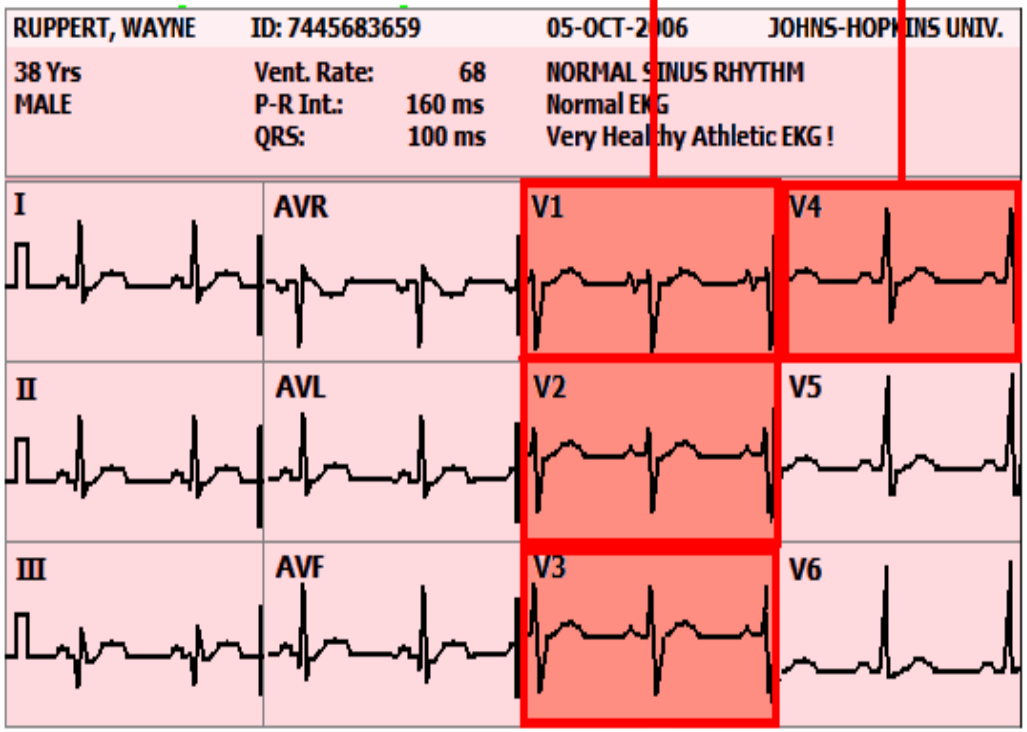
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE



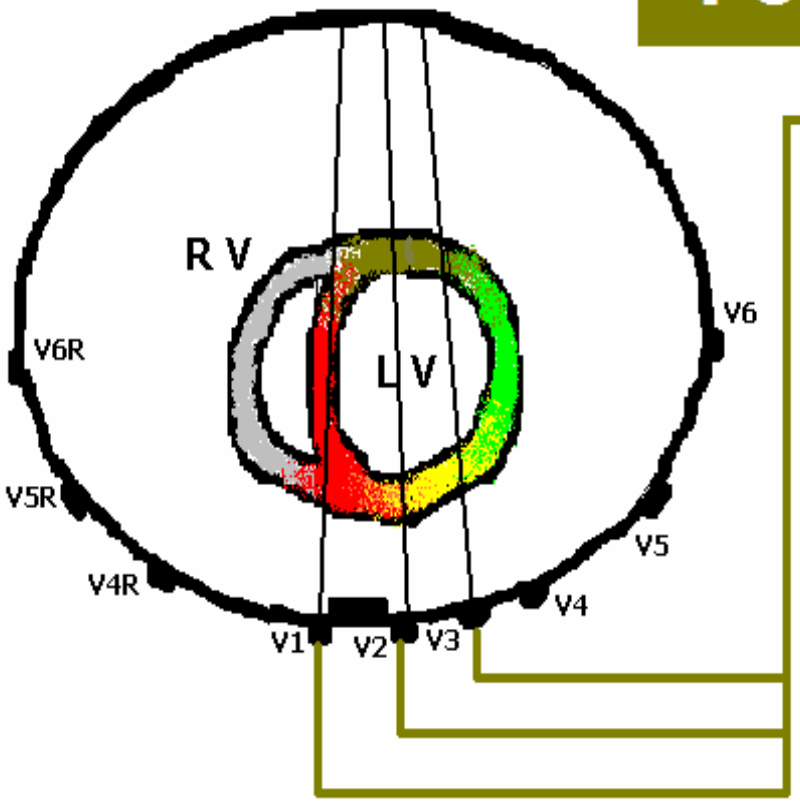
V1, V2 - ANTERIOR / SEPTAL

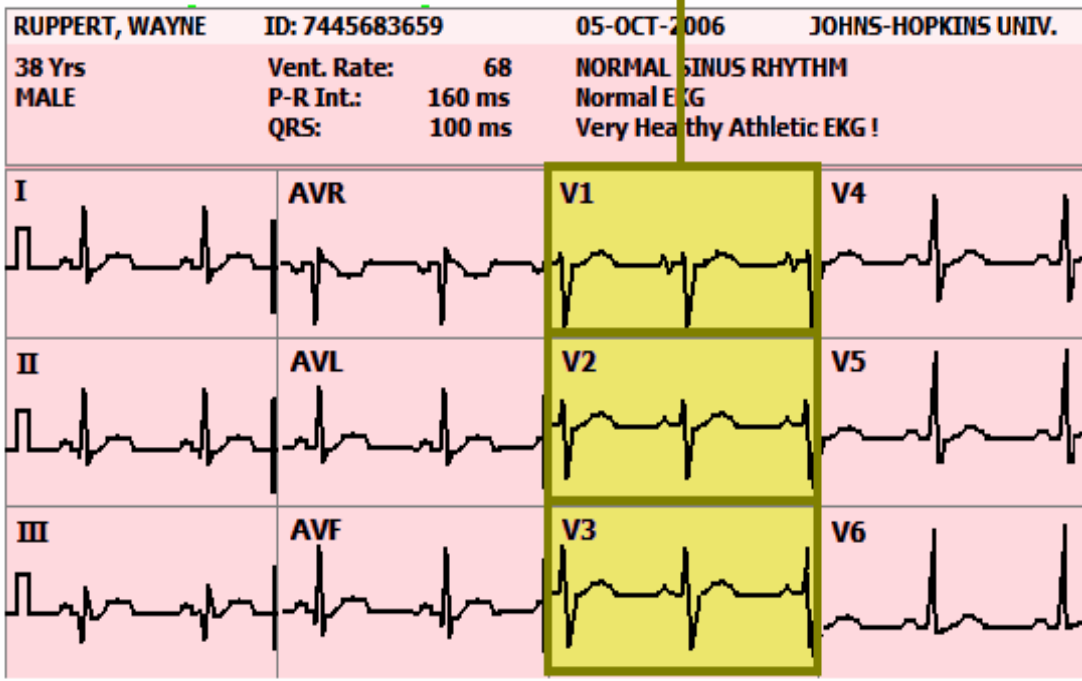
V3, V4 - ANTERIOR



LEADS V1 - V3 *view the*

POSTERIOR WALL

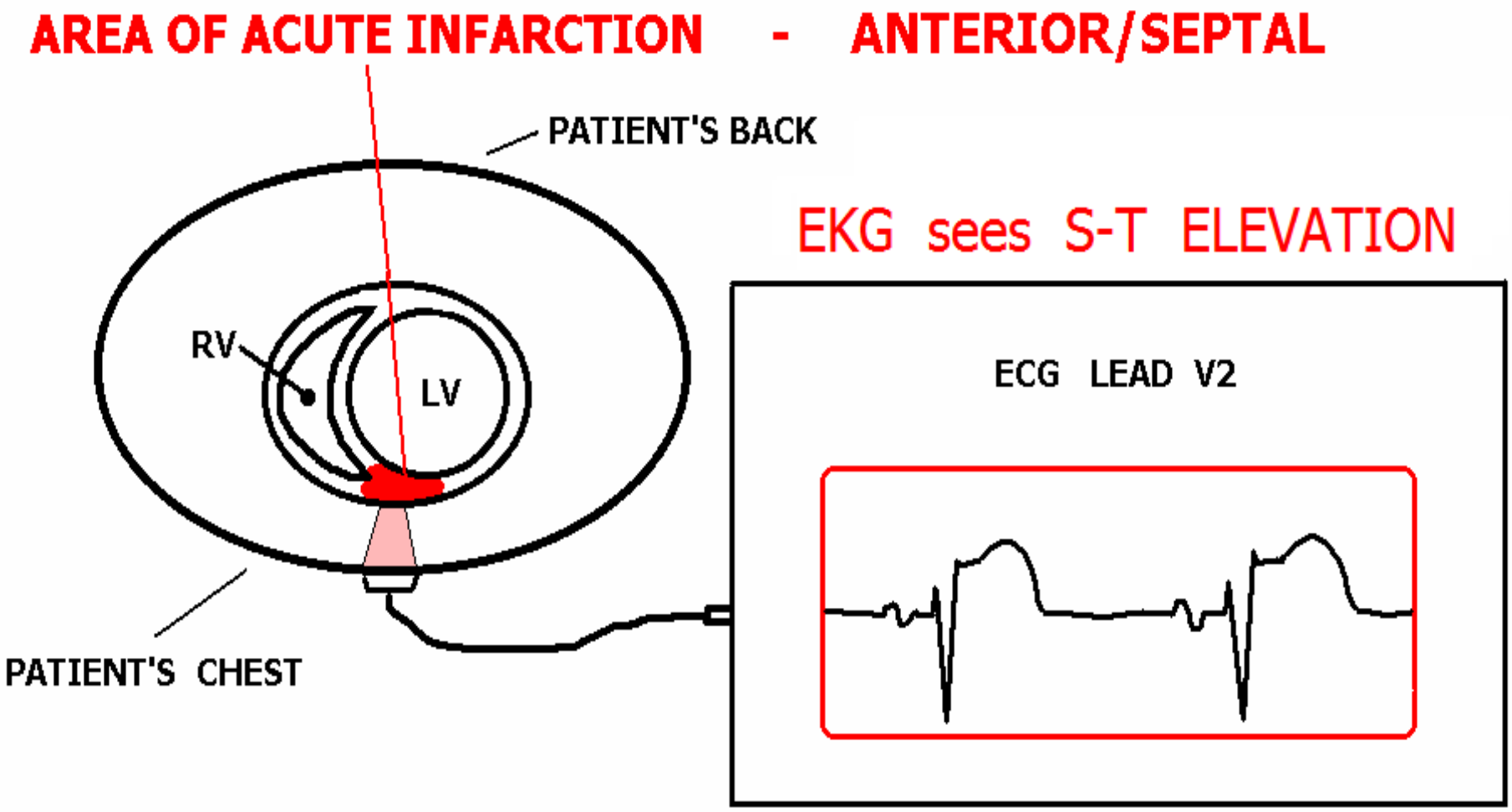




via RECIPROCAL CHANGES.

HOW EKG VIEWS INDICATIVE CHANGES

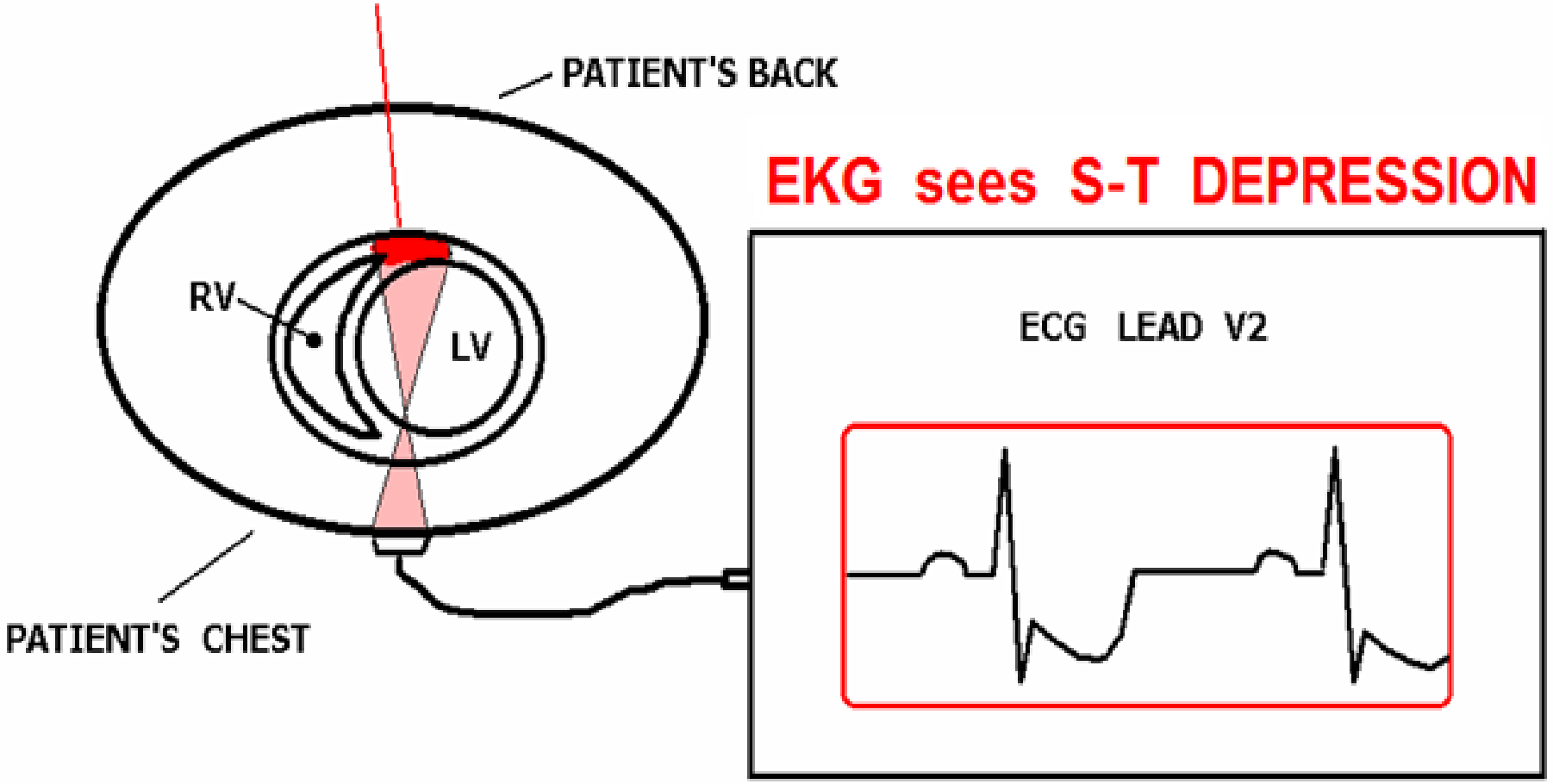
EXAMPLE:



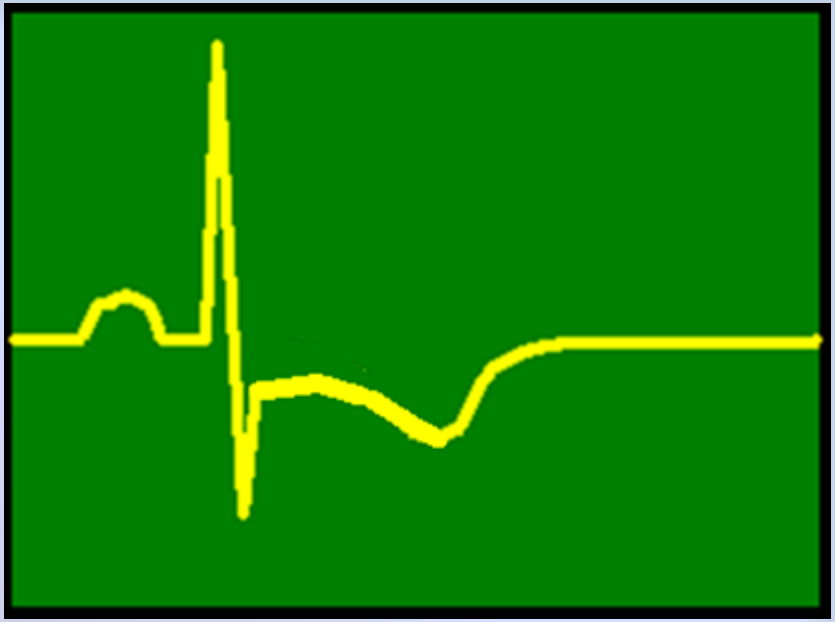
HOW EKG VIEWS RECIPROCAL CHANGES

EXAMPLE:

AREA OF ACUTE INFARCTION - POSTERIOR WALL



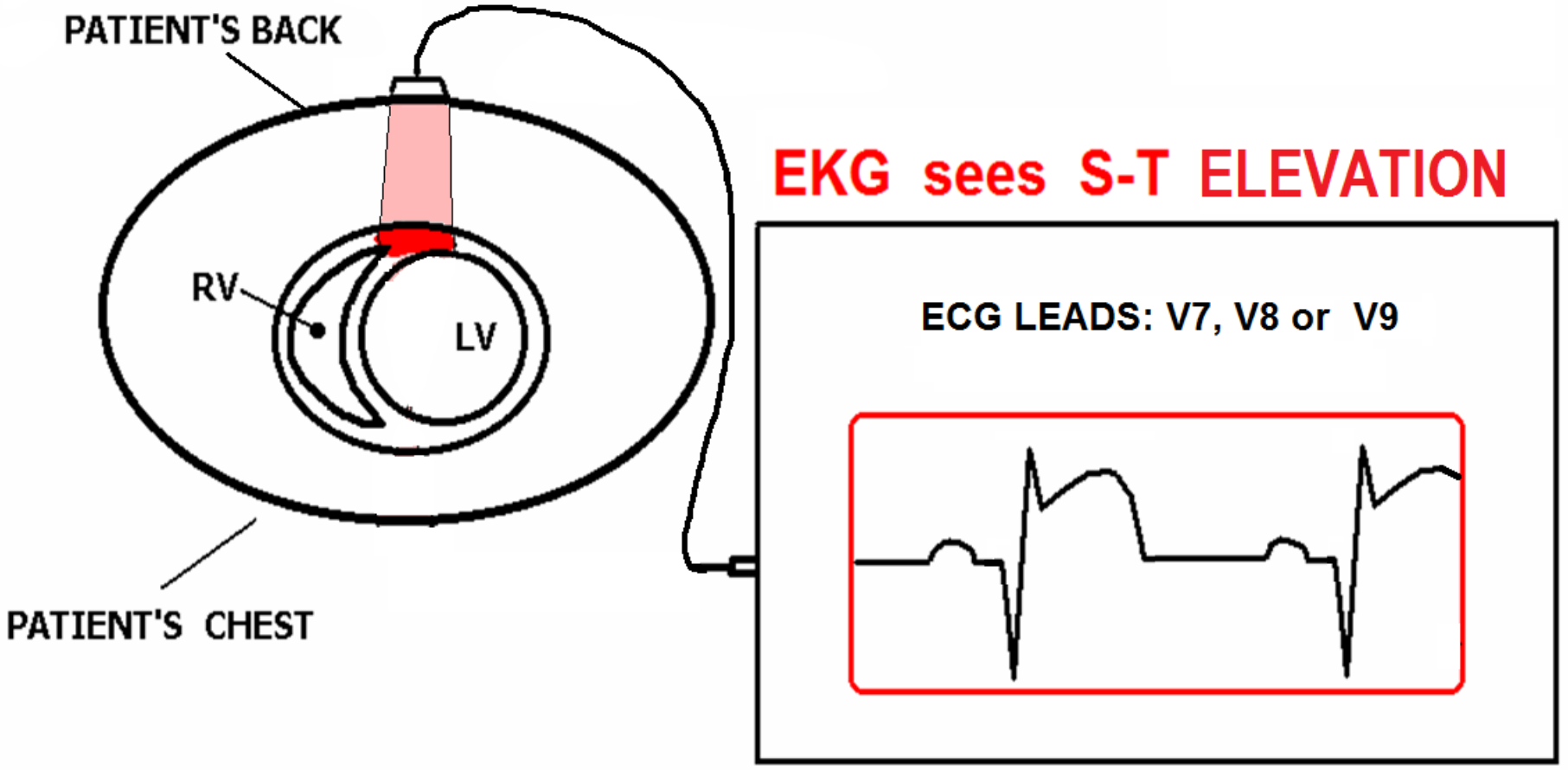
ST Depression can indicate:



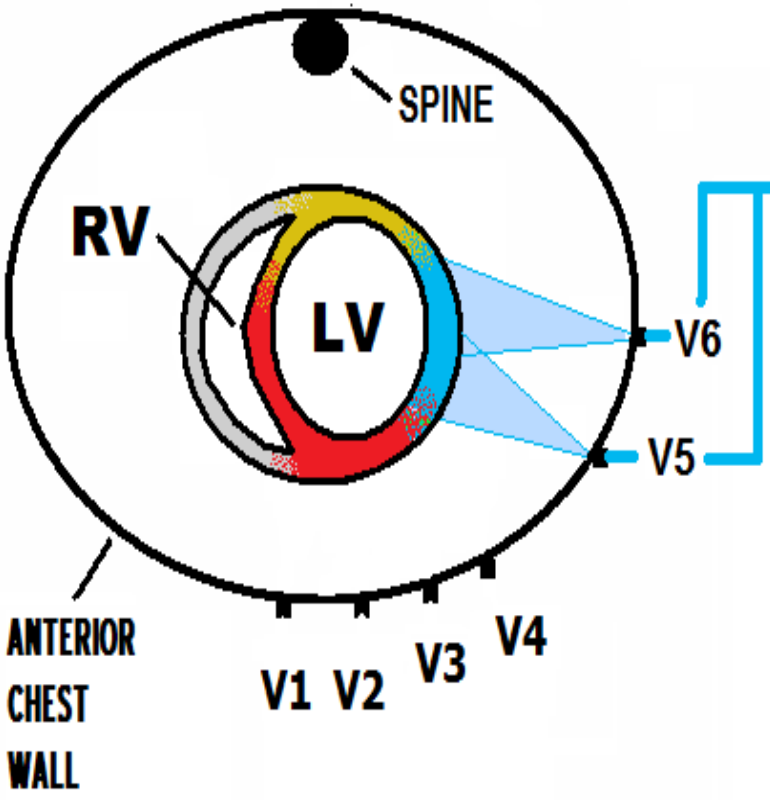
- ISCHEMIA
- “Partial-wall thickness” MI (NSTEMI)
- STEMI (in the opposite side of the heart)
- Other things (like RBBB, certain medications, etc).

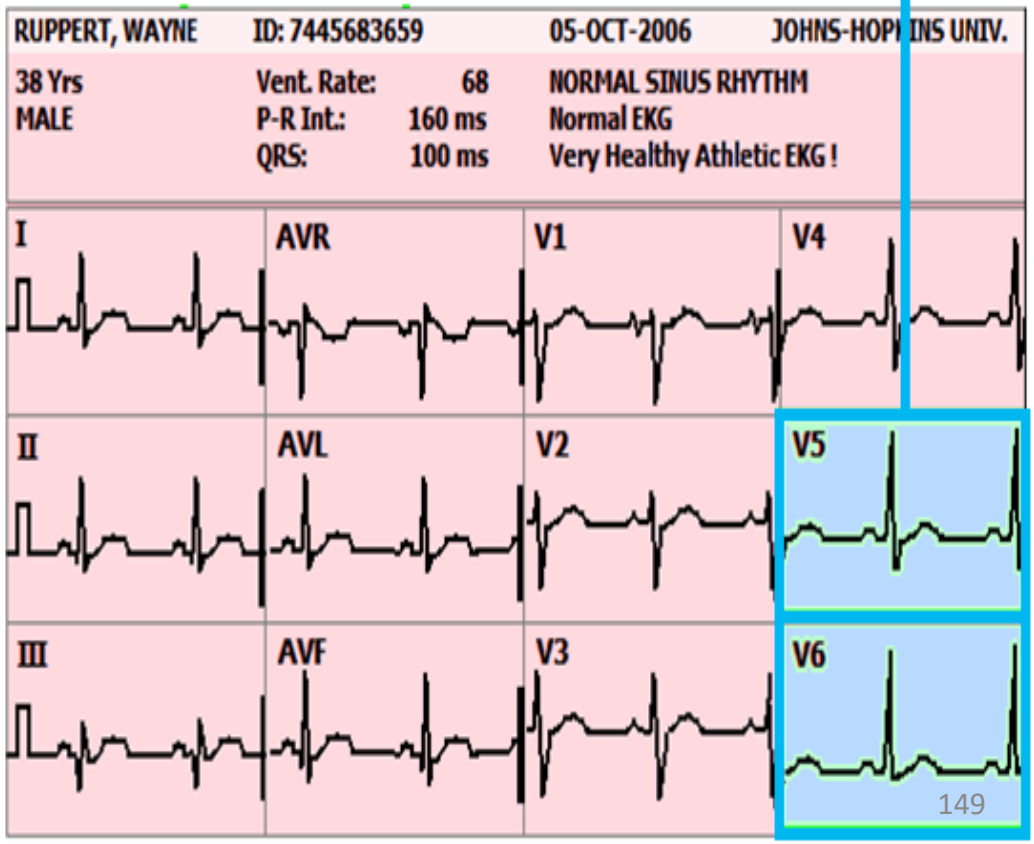
If we put ECG leads on the BACK of a PATIENT who is having an

ACUTE POSTERIOR WALL MI . . . . .

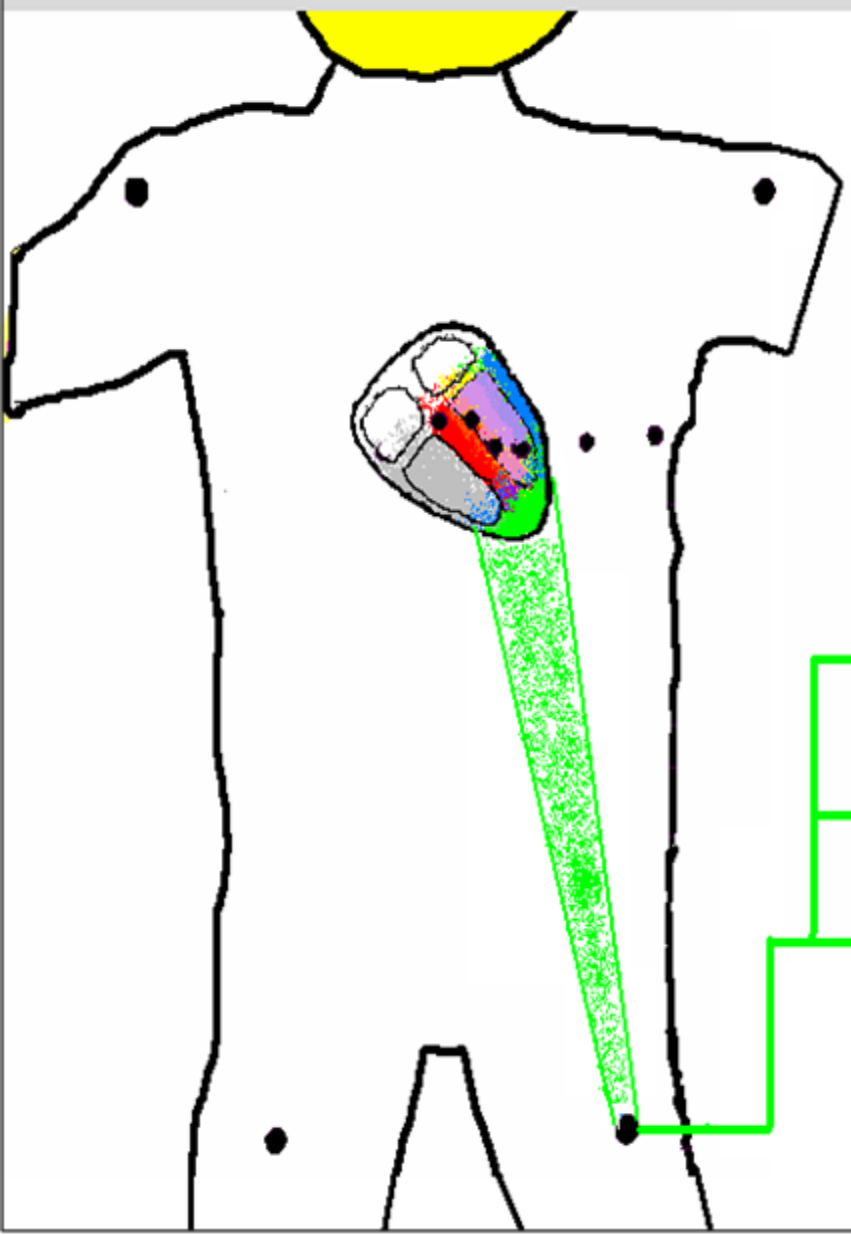


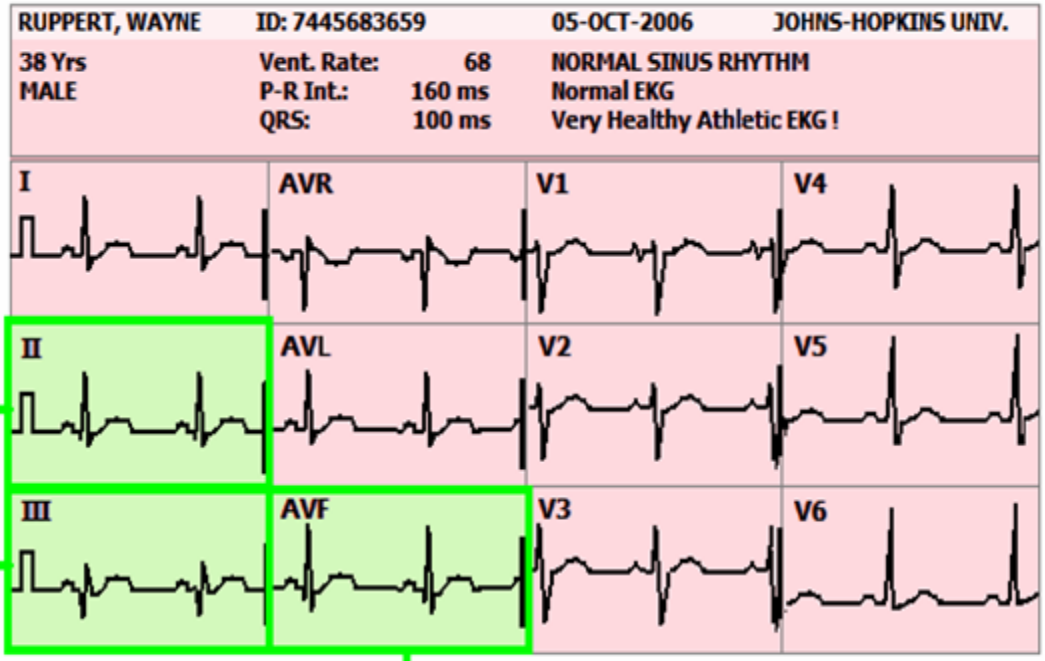
V5 - V6 VIEW THE LATERAL WALL
of the LEFT VENTRICLE



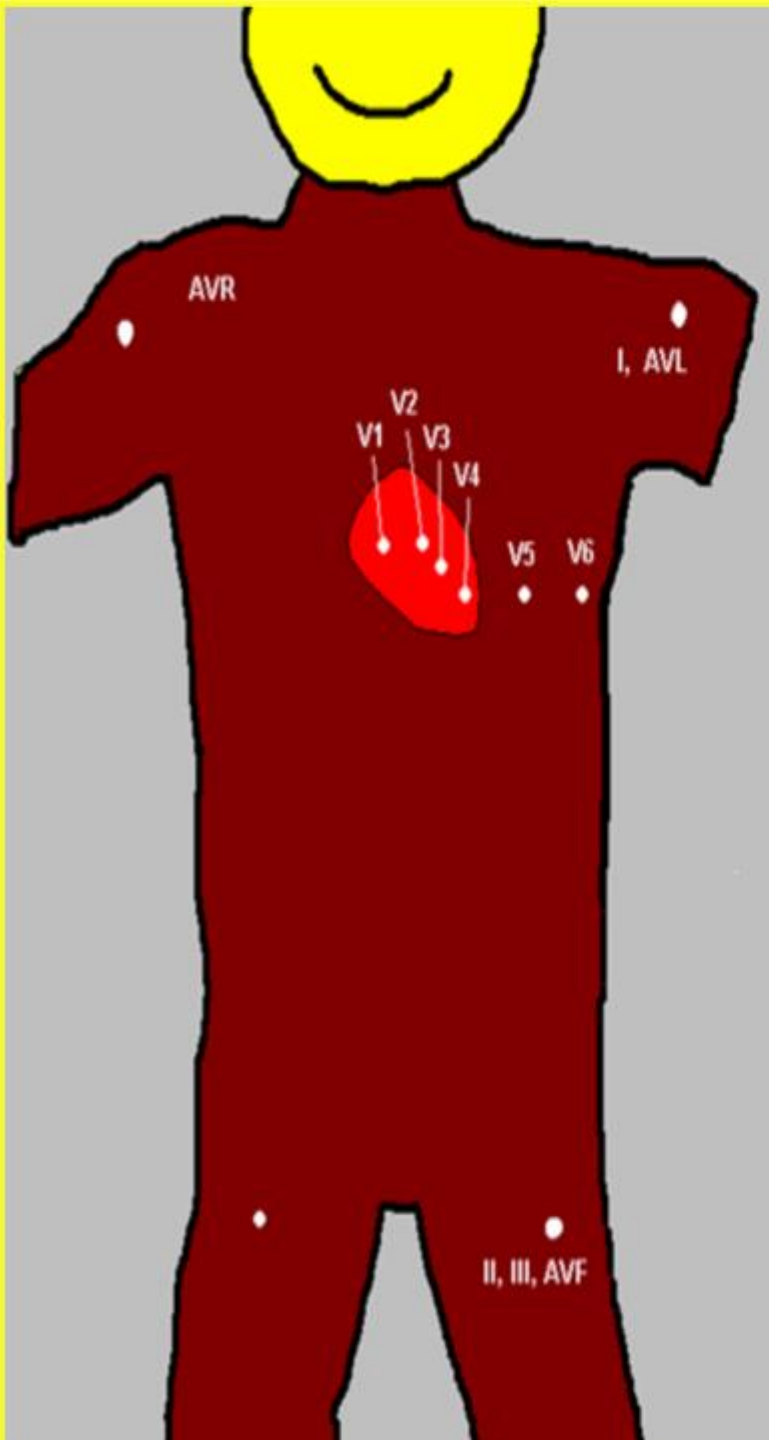


LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE





AREAS VIEWED by 12 LEAD ECG

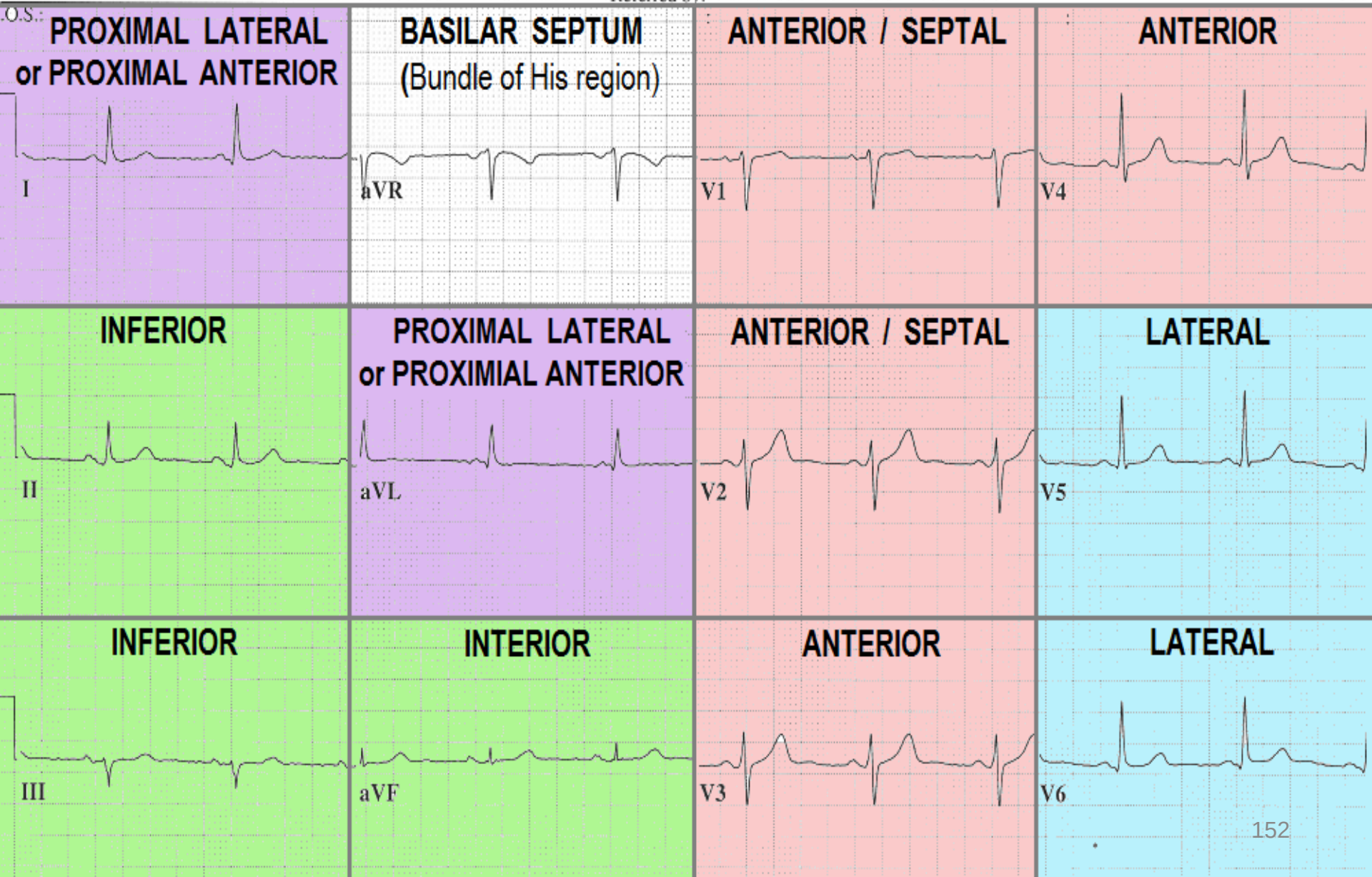


AVR	*BASILAR SEPTAL*
AVL, I	LATERAL ANTERIOR
V1, V2	ANTERIOR
	SEPTAL
	POSTERIOR (recip.)
V3, V4	ANTERIOR
V5, V6	LATERAL
II, III, AVF	INFERIOR

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

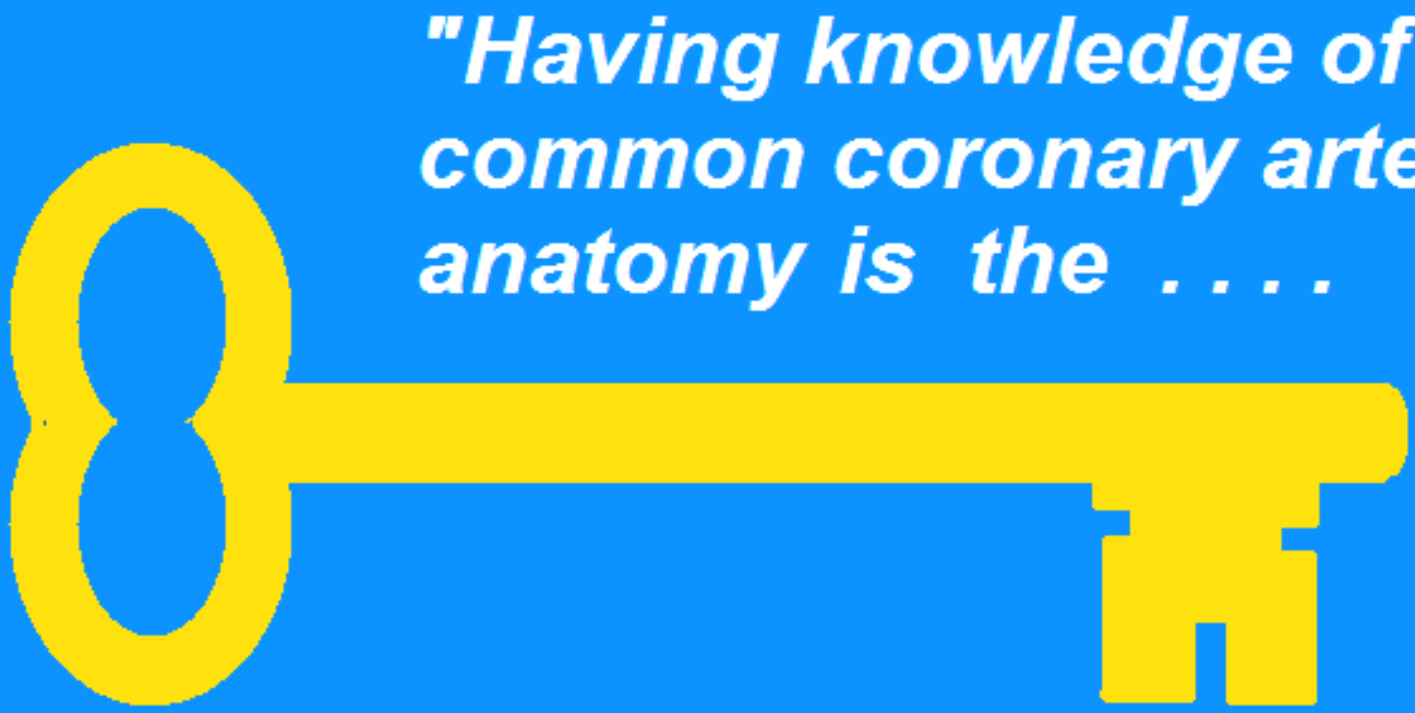
Referred by:



THE CORONARY

ARTERIES

STRUCTURES SERVED BY THE CORONARY ARTERIES



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

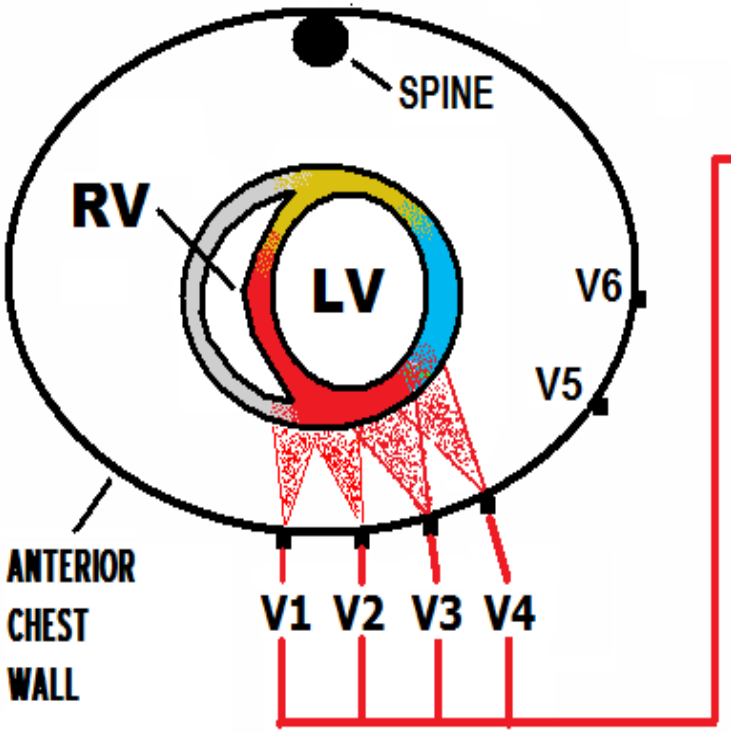
The 12 Lead ECG becomes your "crystal ball !!"

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 !***

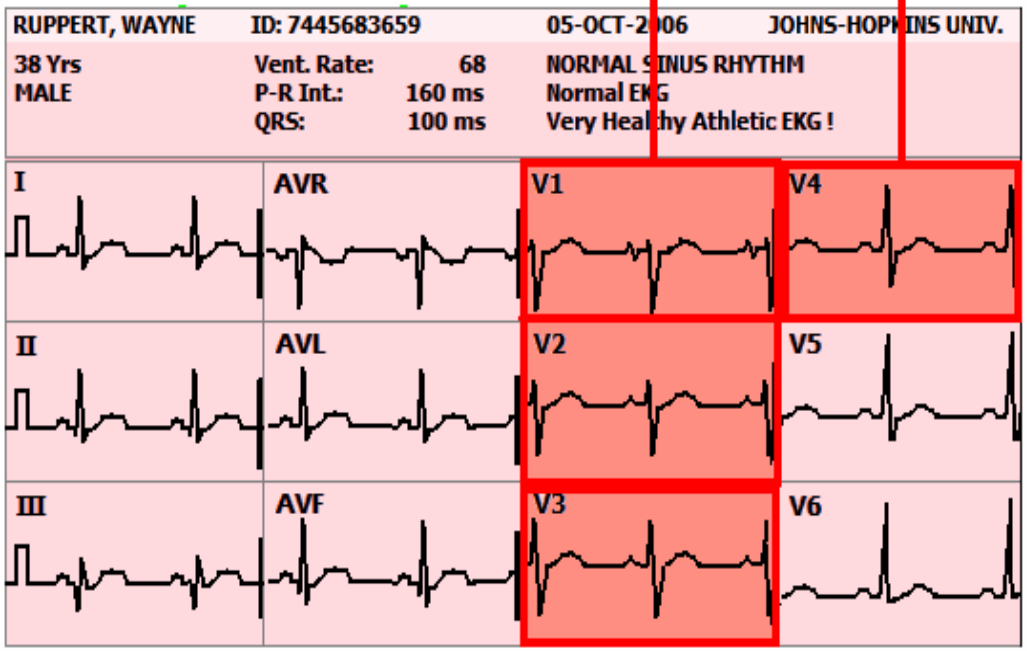
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE



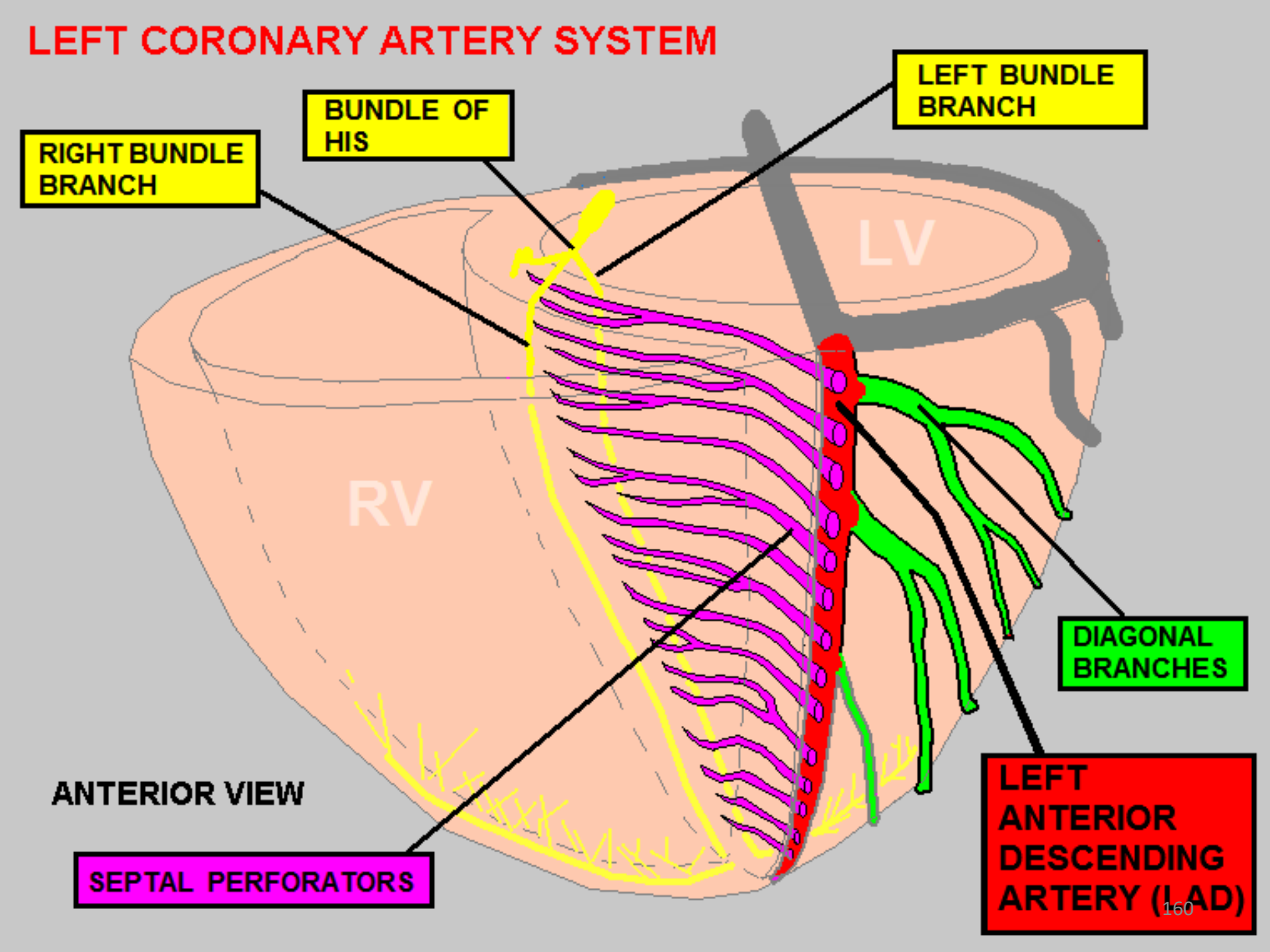
V1, V2 - ANTERIOR / SEPTAL

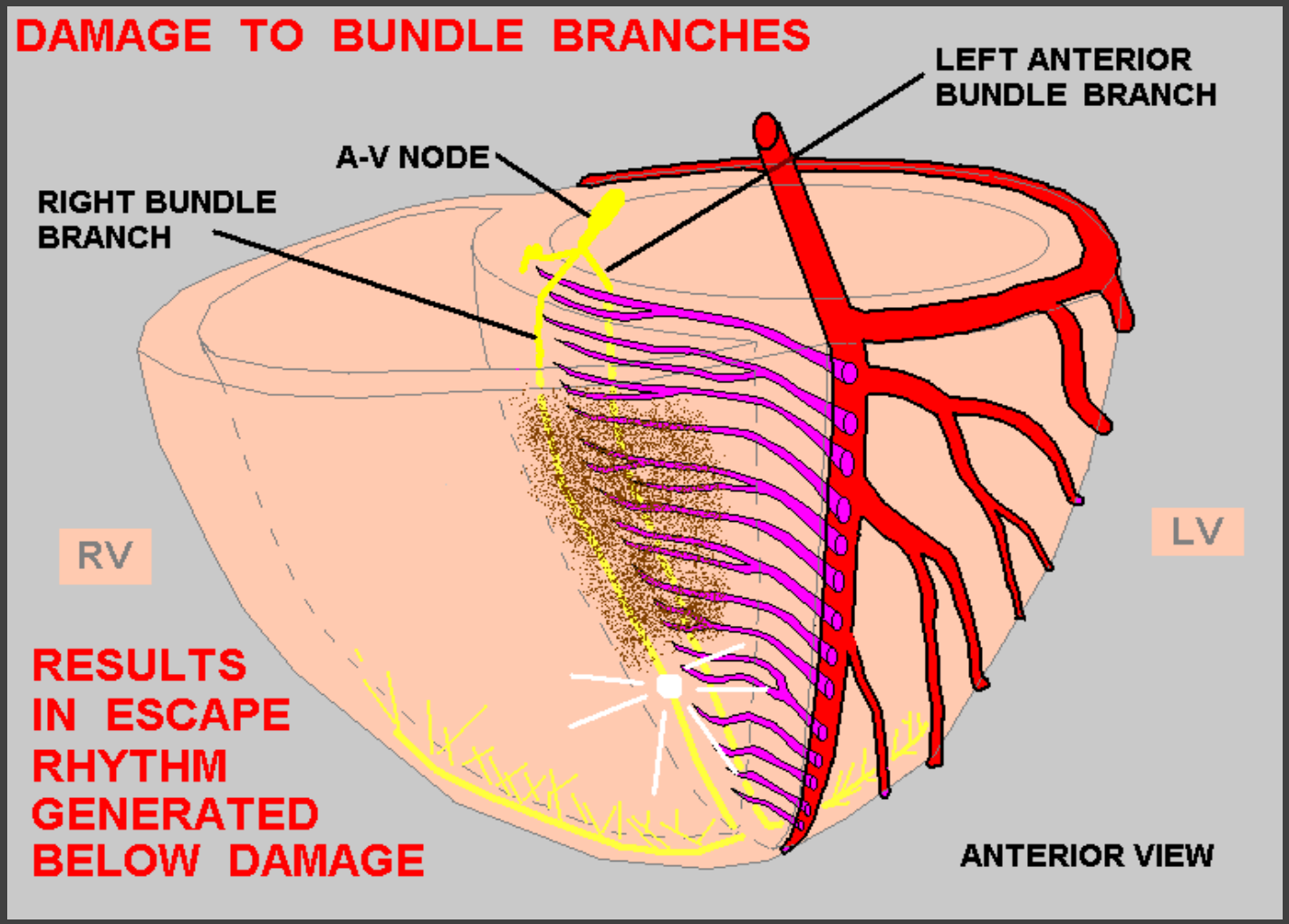
V3, V4 - ANTERIOR



Which Coronary Artery typically Supplies the ANTERIOR WALL ?

LEFT CORONARY ARTERY SYSTEM

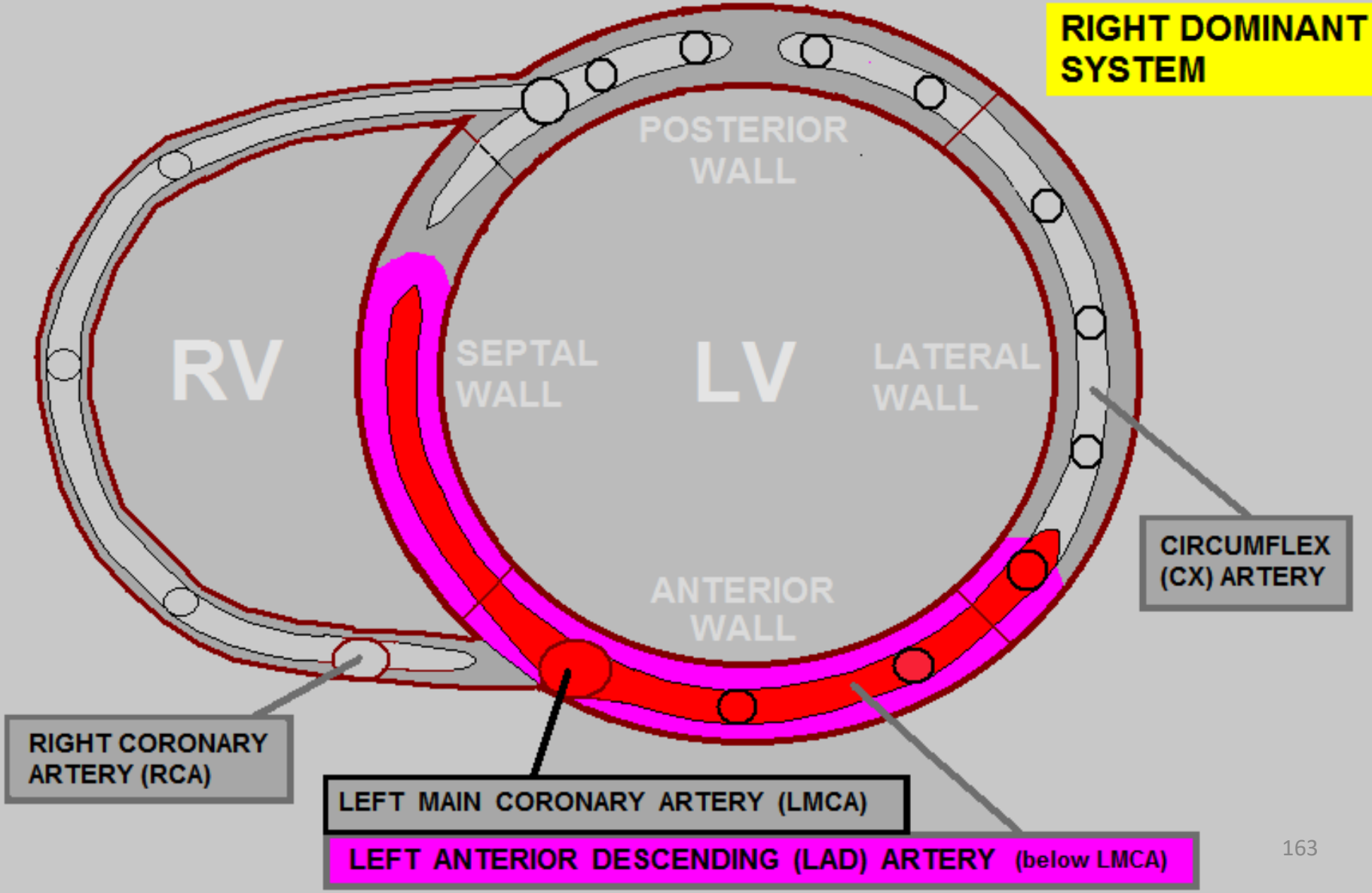



DAMAGE TO BUNDLE BRANCHES
LEFT ANTERIOR BUNDLE BRANCH
A-V NODE
RIGHT BUNDLE BRANCH
RV
LV
RESULTS IN ESCAPE RHYTHM GENERATED BELOW DAMAGE
ANTERIOR VIEW

cutaway view of the

LEFT ANTERIOR DESCENDING ARTERY (LAD)

SUPPLIES APPROX. 35 - 45% of the LV MUSCLE MASS



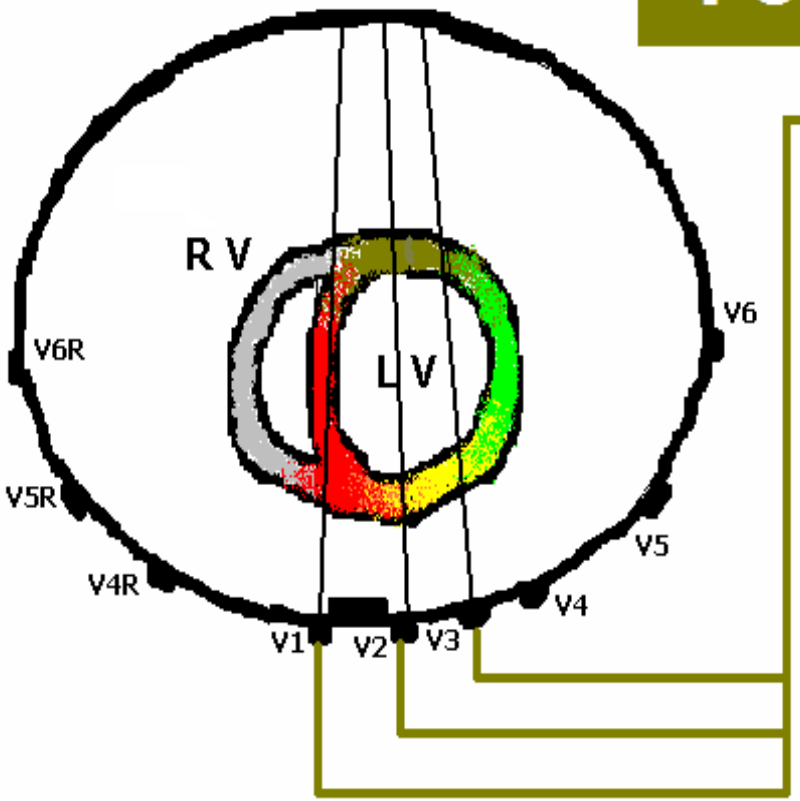
HELPFUL HINT . . . MEMORIZE THIS !

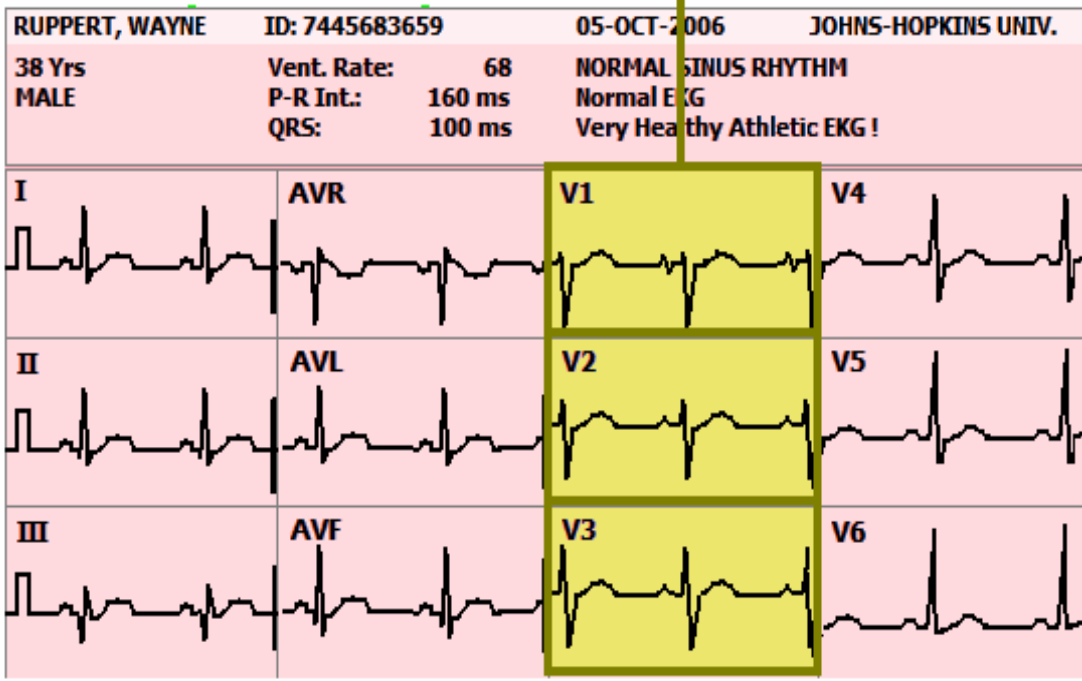
LEFT ANTERIOR DESCENDING ARTERY (LAD)

- BUNDLE OF HIS
- BUNDLE BRANCHES ( )
- 35 - 45 % OF LV MUSCLE MASS
  - ANTERIOR WALL
  - SEPTAL WALL (anterior 2/3)

LEADS V1 - V3 *view the*

POSTERIOR WALL

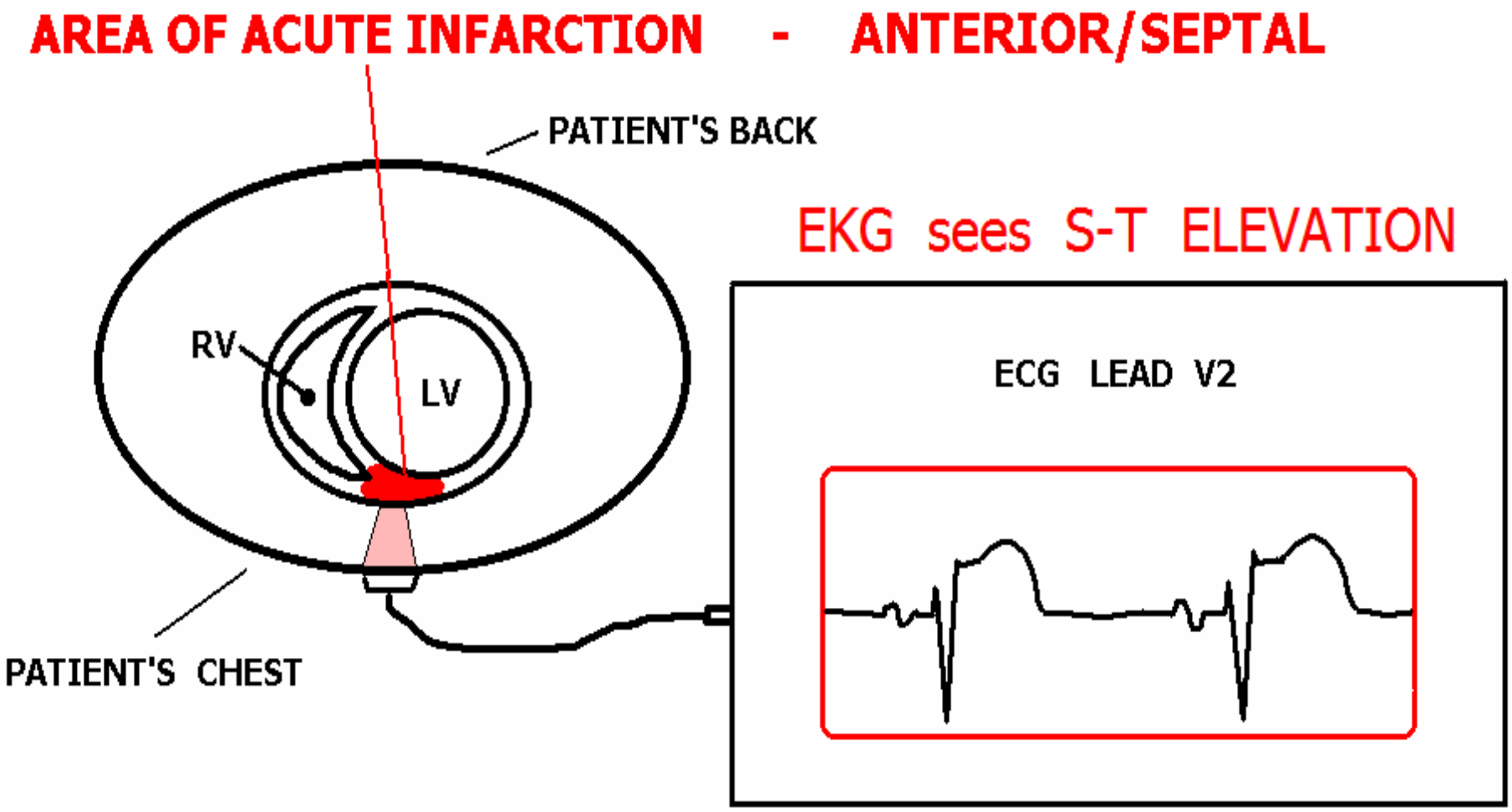




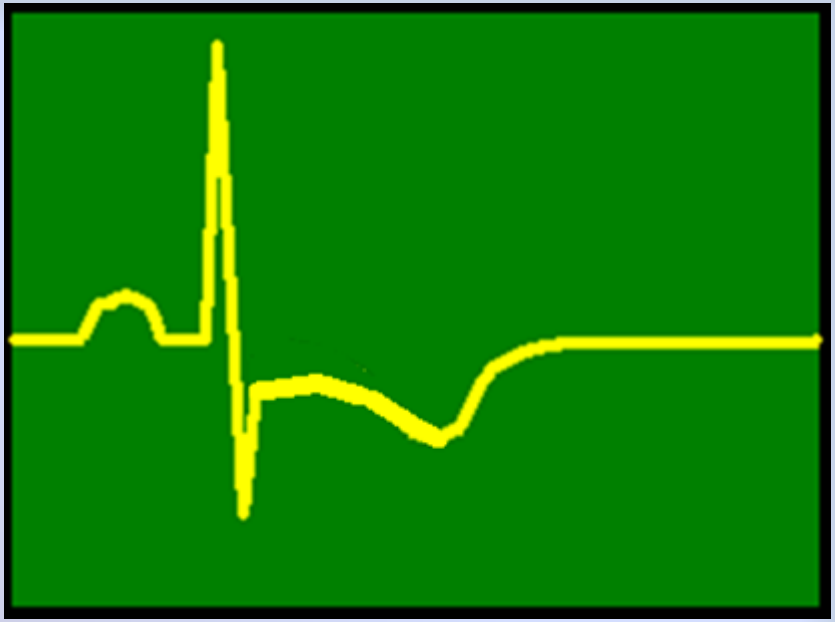
via RECIPROCAL CHANGES.

HOW EKG VIEWS INDICATIVE CHANGES

EXAMPLE:

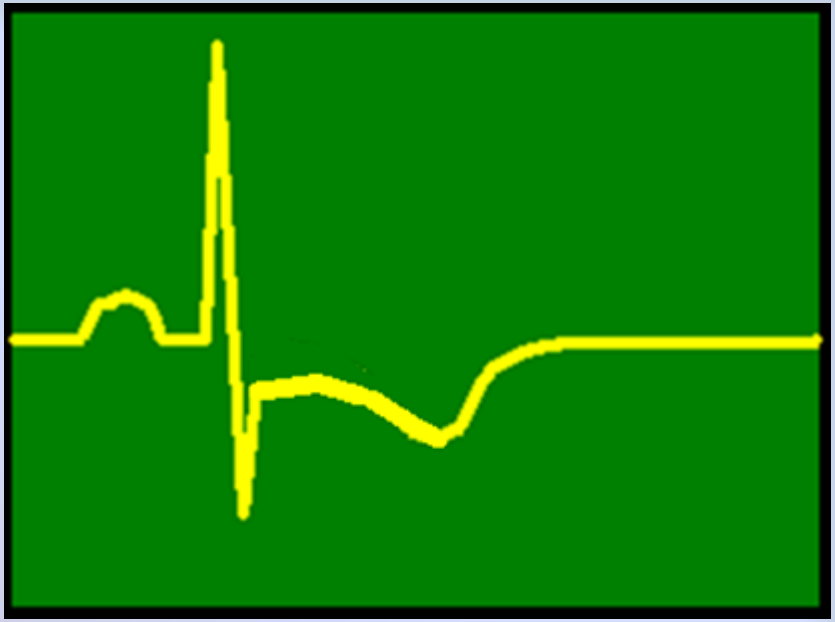


ST Depression in Leads V1 – V4:



- Direct view of ISCHEMIA (anterior wall)

ST Depression in Leads V1 – V4:

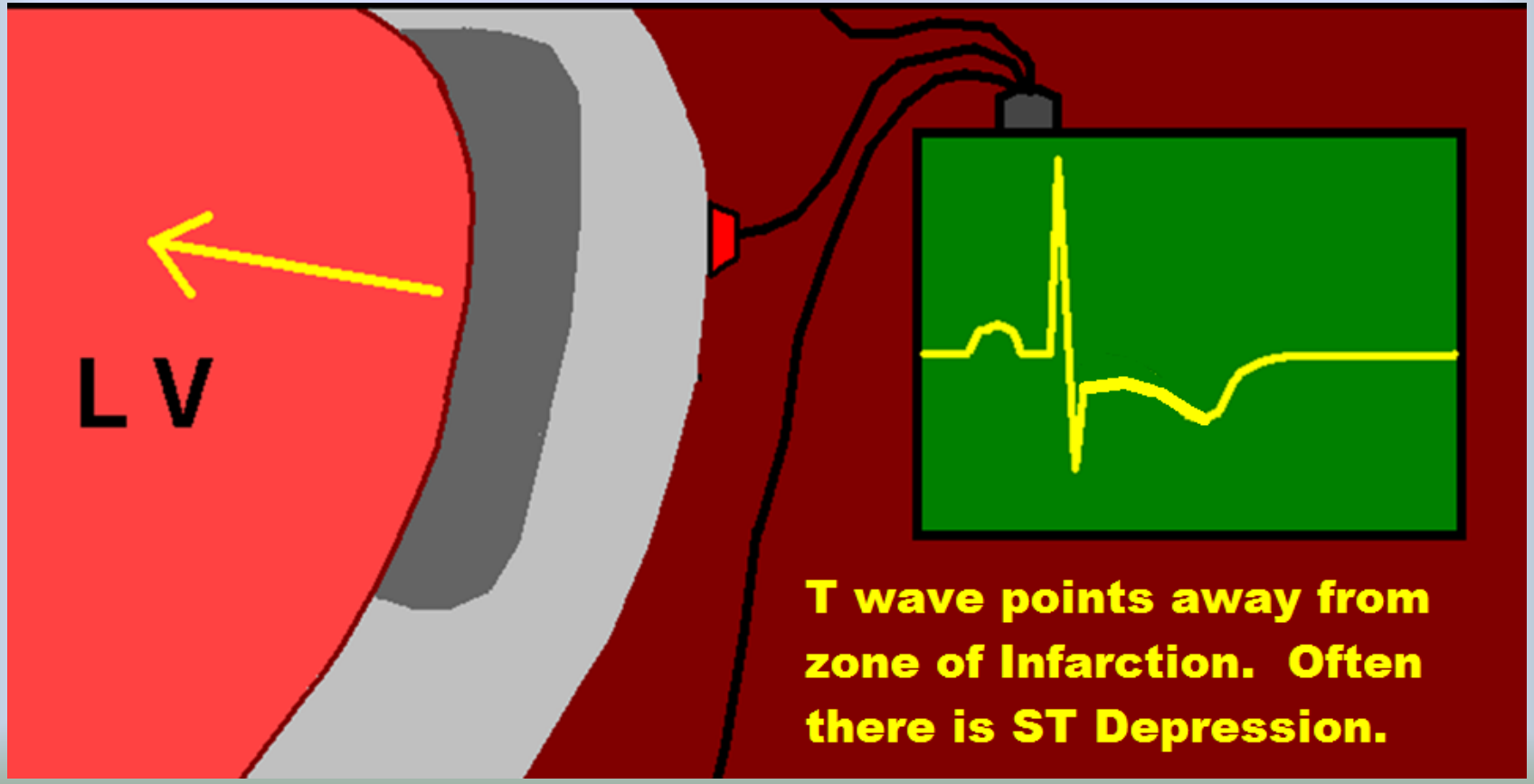


- Direct view of ISCHEMIA (anterior wall)
- Direct view of NSTEMI (anterior wall)

Non-STEMI (NSTEMI)

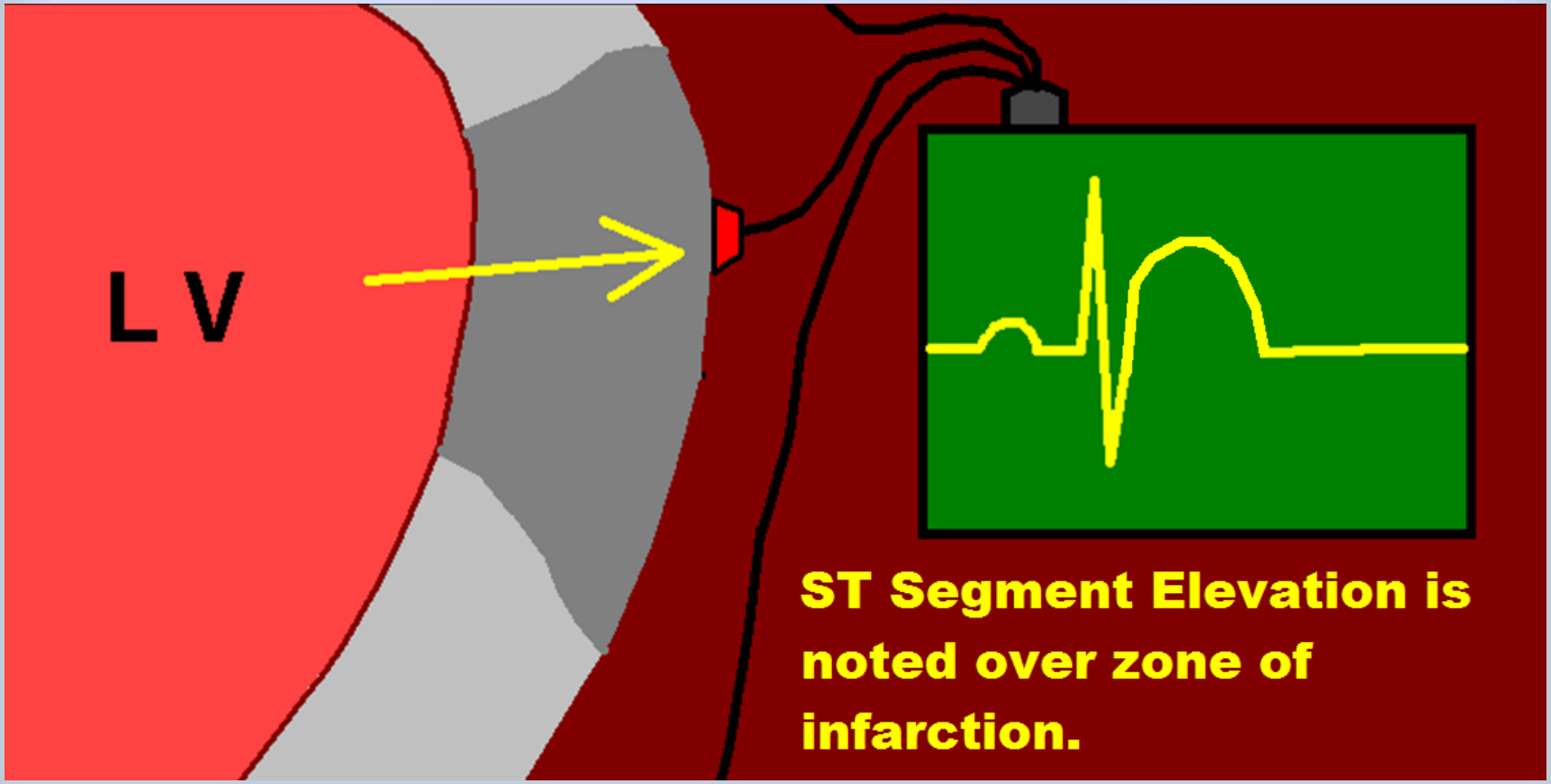
Non-ST Segment Elevation Myocardial Infarction.

"sub-endocardial MI" . . . "partial wall thickness"

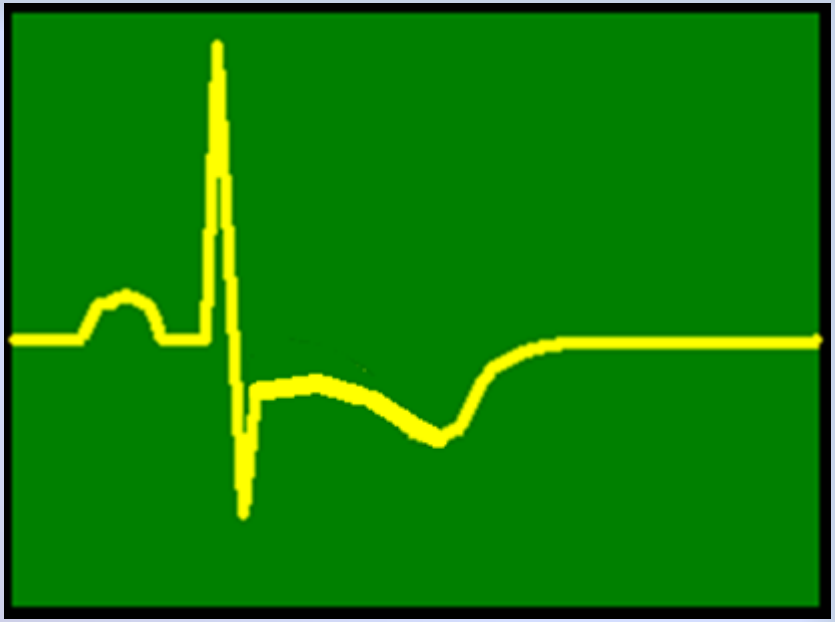


STEMI

- ST Segment Elevation Myocardial Infarction.



ST Depression in Leads V1 – V4:

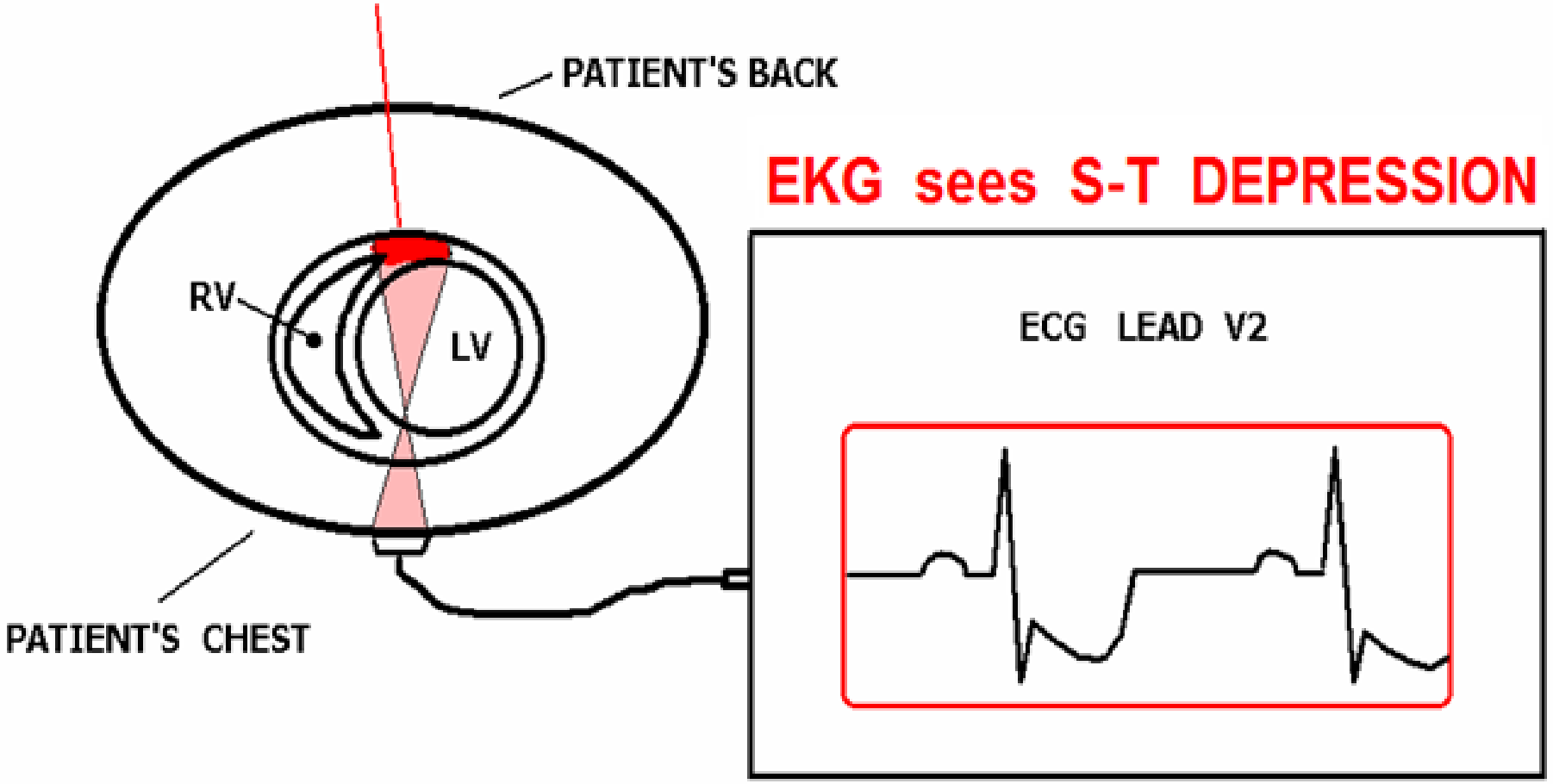


- Direct view of ISCHEMIA (anterior wall)
- Direct view of NSTEMI (anterior wall)
- Reciprocal view of STEMI (opposite side of heart - posterior wall)

HOW EKG VIEWS RECIPROCAL CHANGES

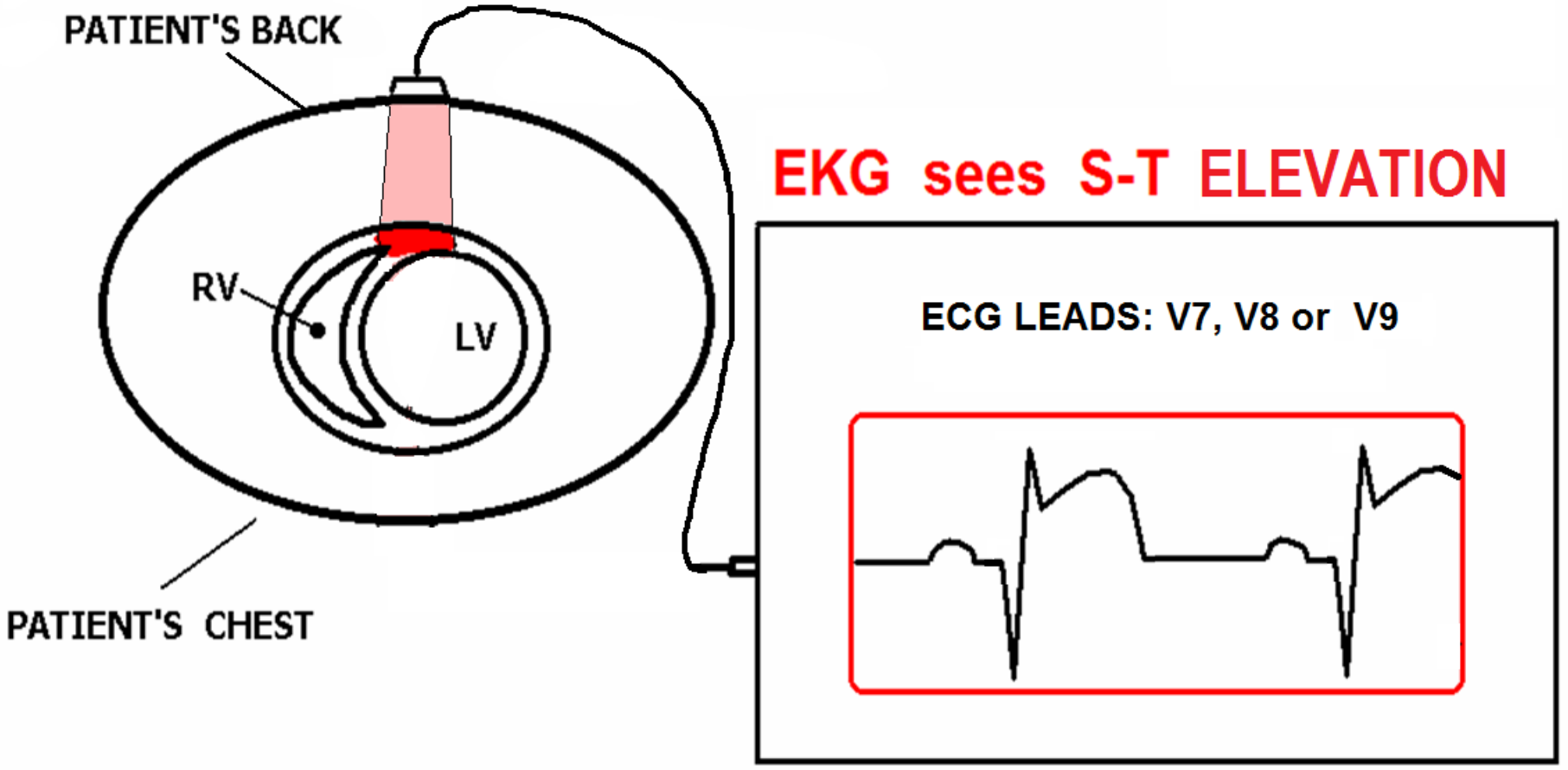
EXAMPLE:

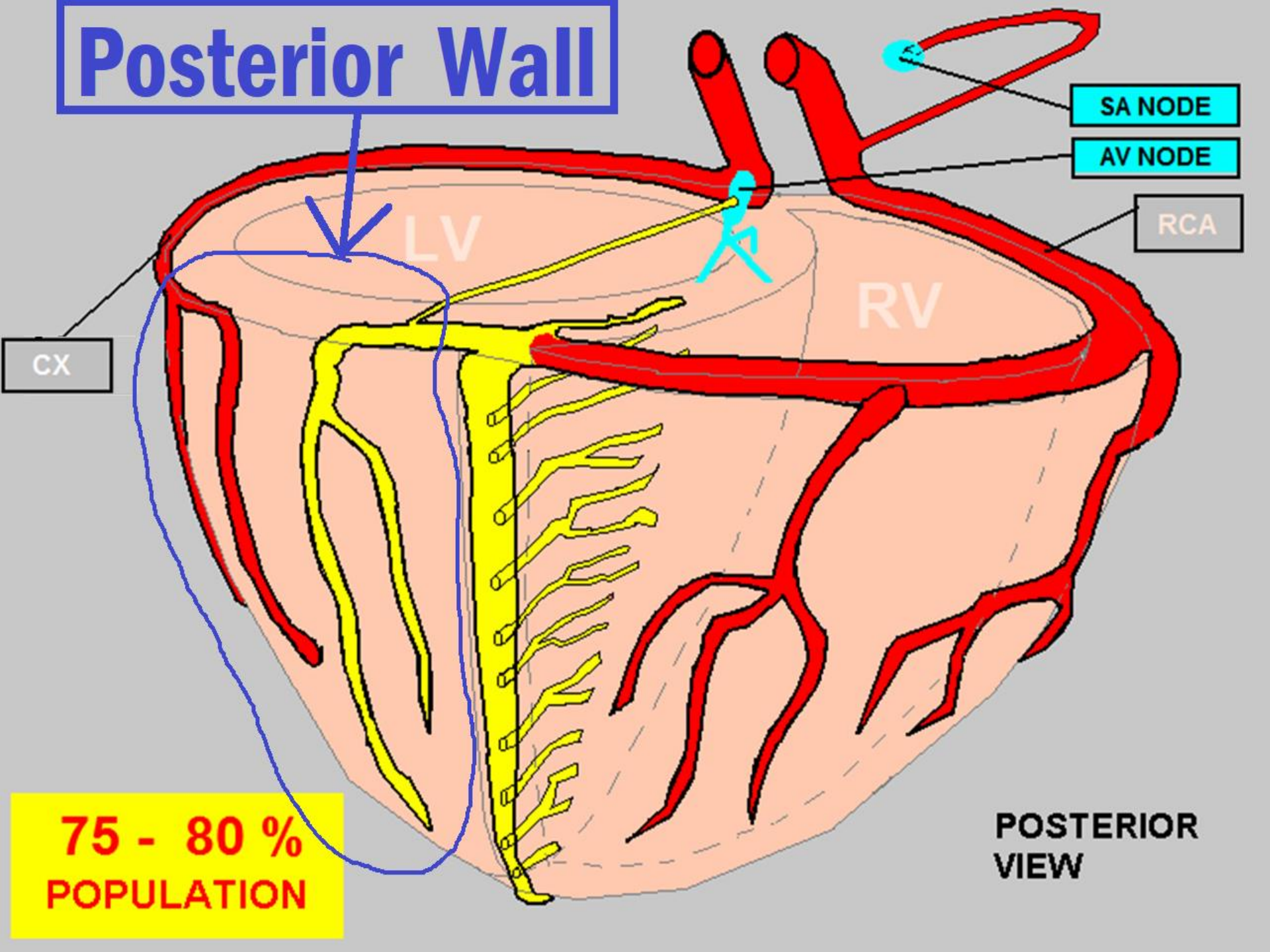
AREA OF ACUTE INFARCTION - POSTERIOR WALL



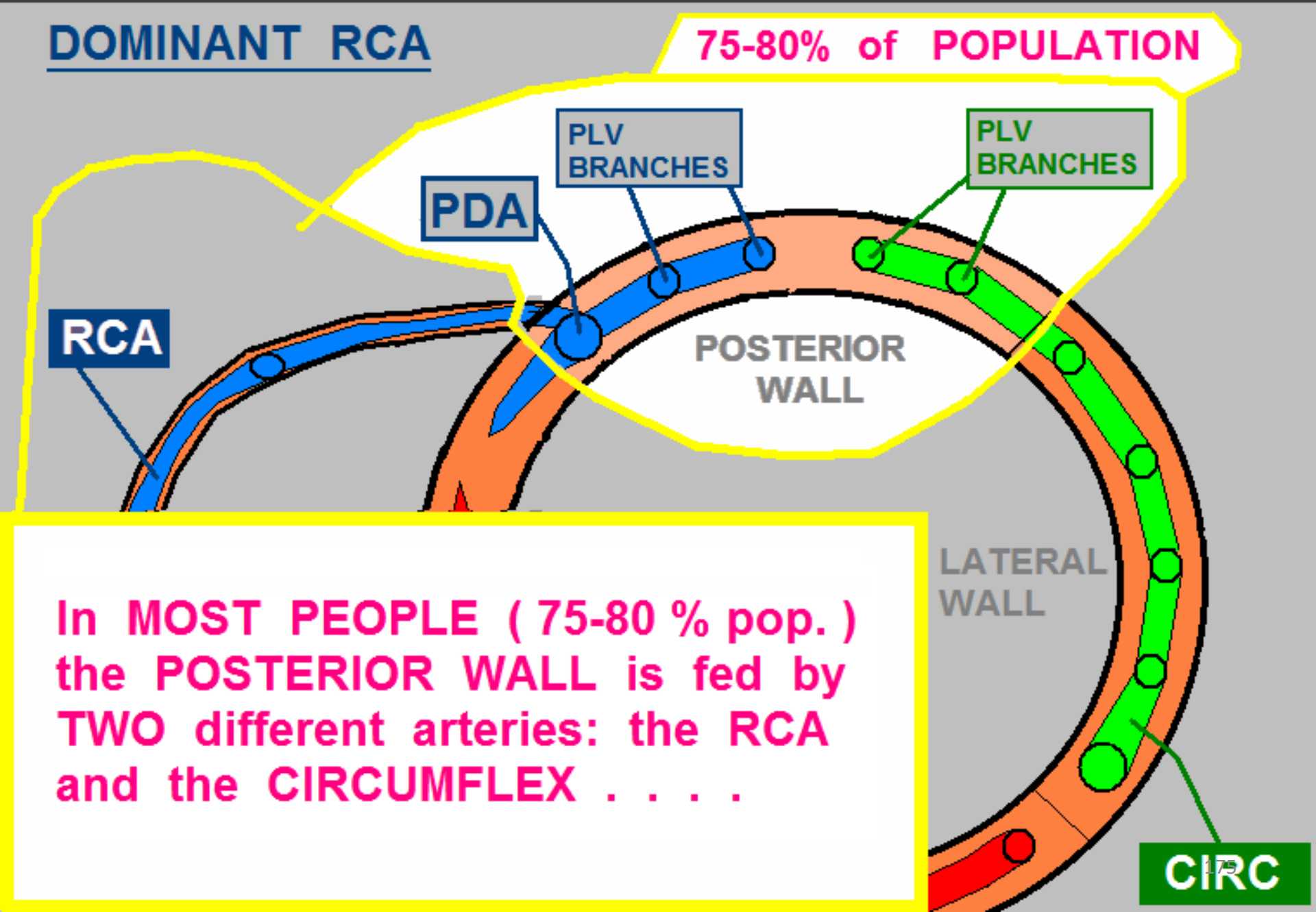
If we put ECG leads on the BACK of a PATIENT who is having an

ACUTE POSTERIOR WALL MI . . . . .



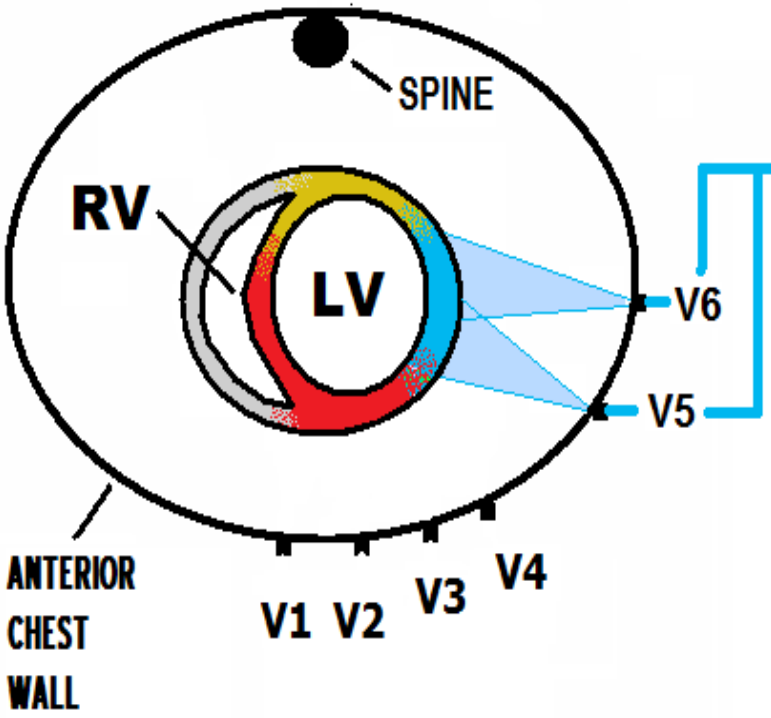

Posterior Wall
SA NODE
AV NODE
RCA
LV
RV
CX
75 - 80 %
POPULATION
POSTERIOR
VIEW

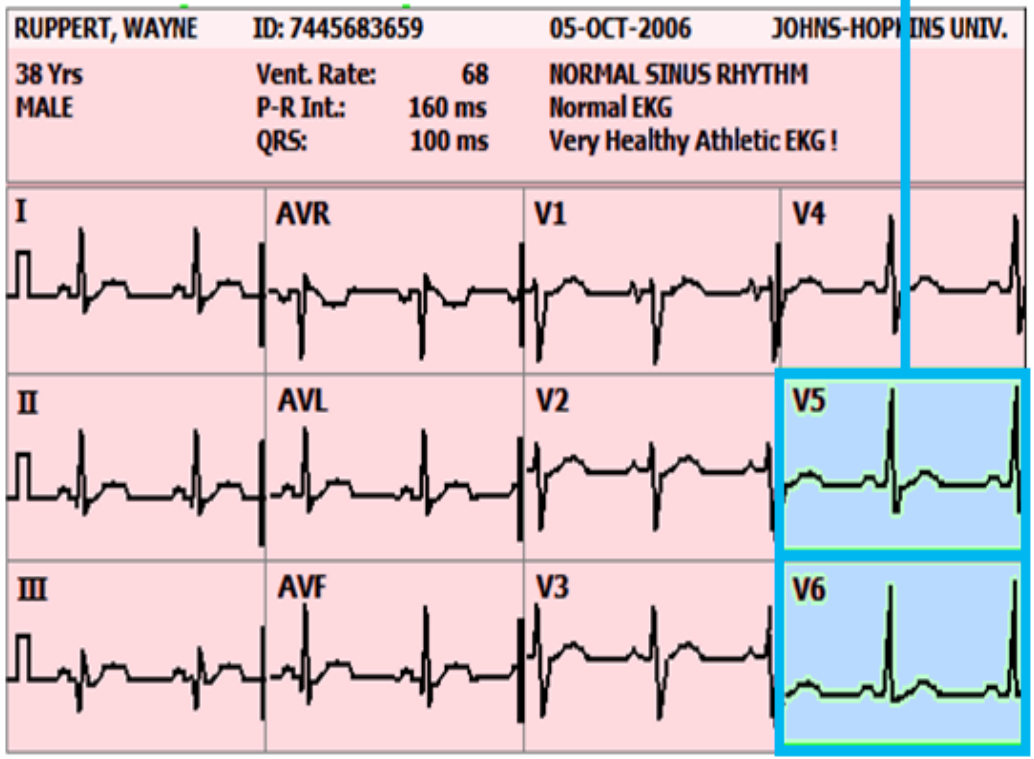
POSTERIOR WALL BLOOD SUPPLY



In MOST PEOPLE (75-80 % pop.) the POSTERIOR WALL is fed by TWO different arteries: the RCA and the CIRCUMFLEX . . . .

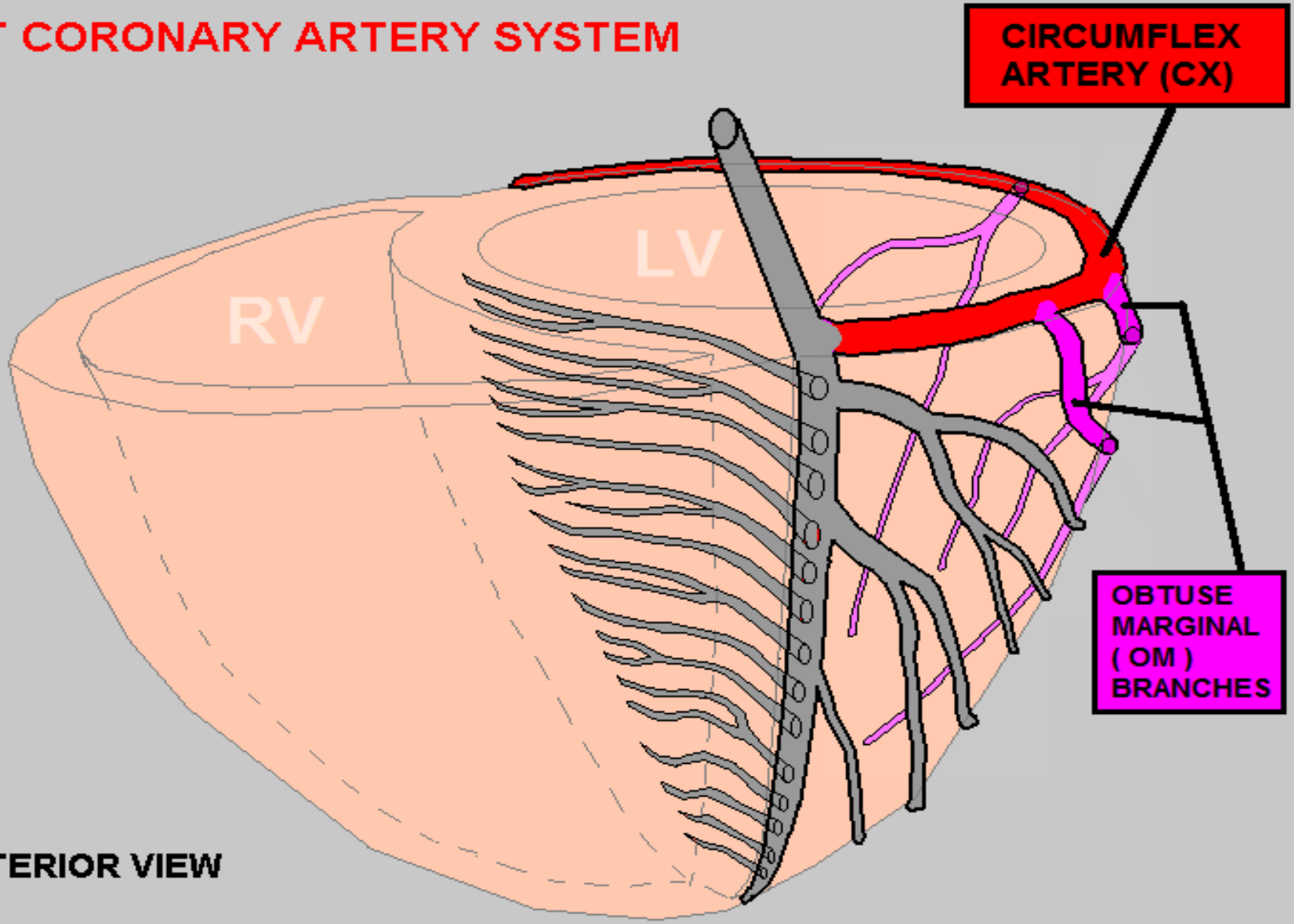
V5 - V6 VIEW THE LATERAL WALL
of the LEFT VENTRICLE





Which Coronary Artery typically Supplies the LATERAL WALL ?

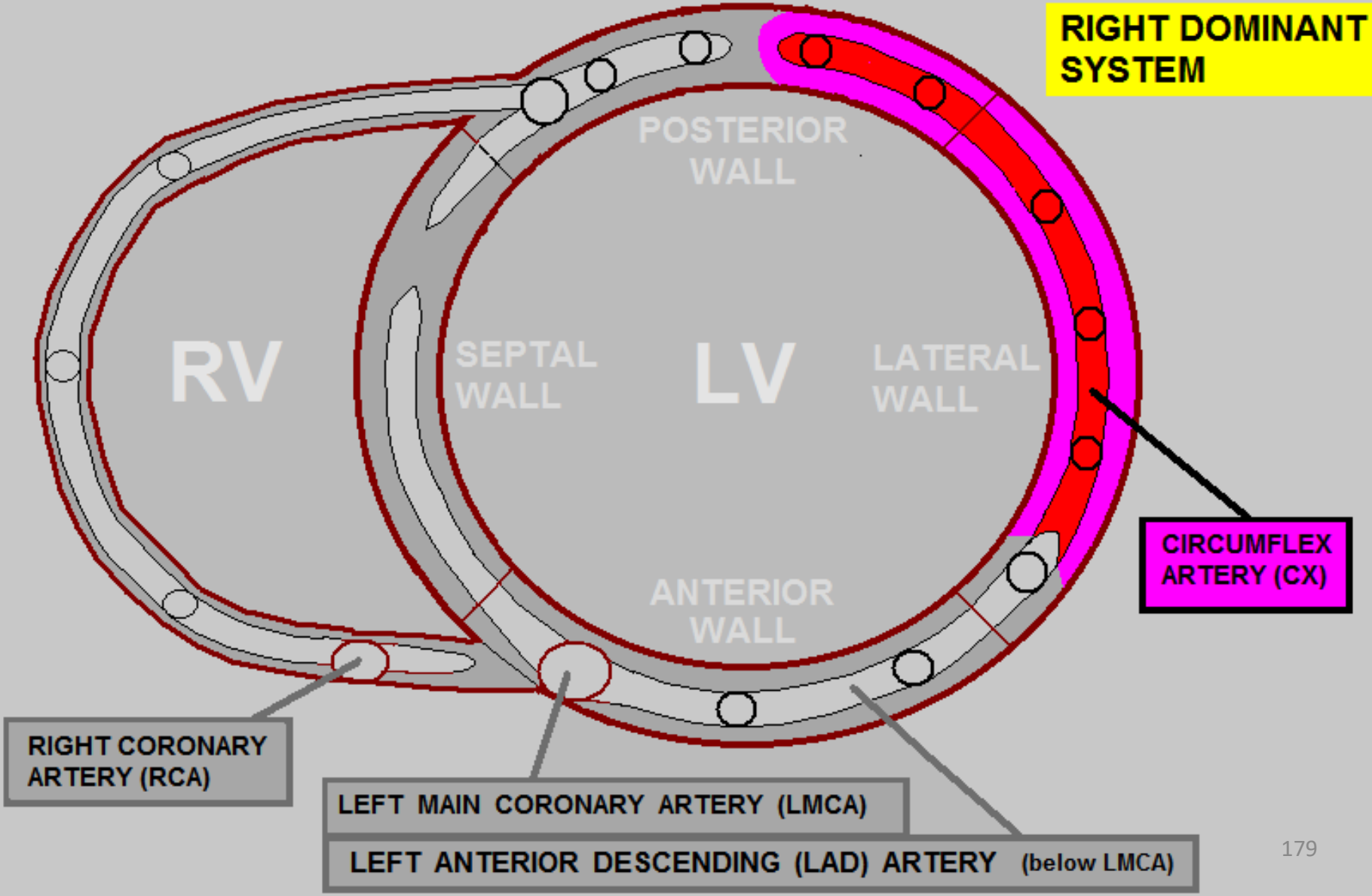
LEFT CORONARY ARTERY SYSTEM



cutaway view of the

CIRCUMFLEX ARTERY (CX) DISTRIBUTION

SUPPLIES 20 - 30 % of the LV MUSCLE MASS



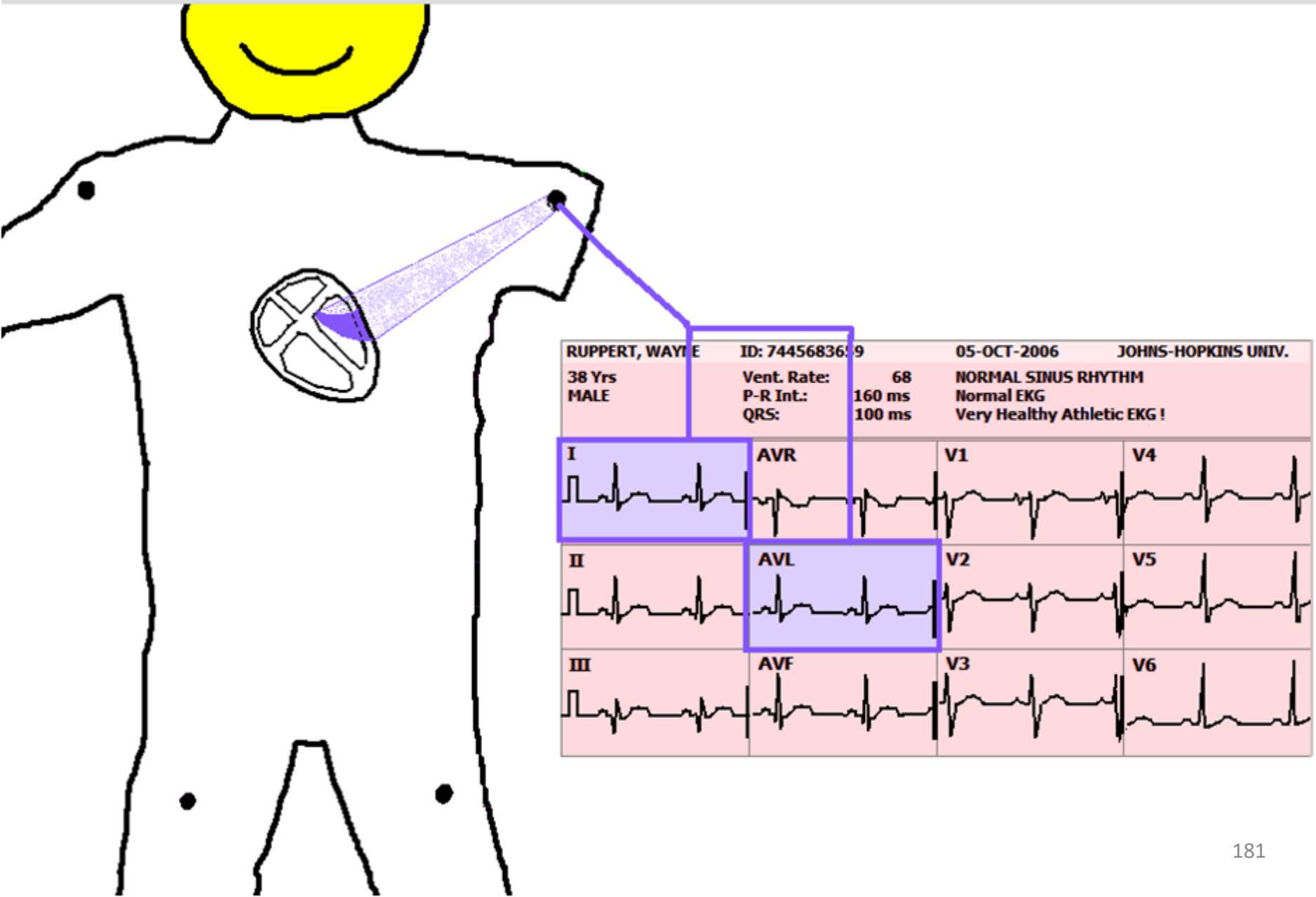
HELPFUL HINT . . . MEMORIZE THIS !

CIRCUMFLEX ARTERY (CX)

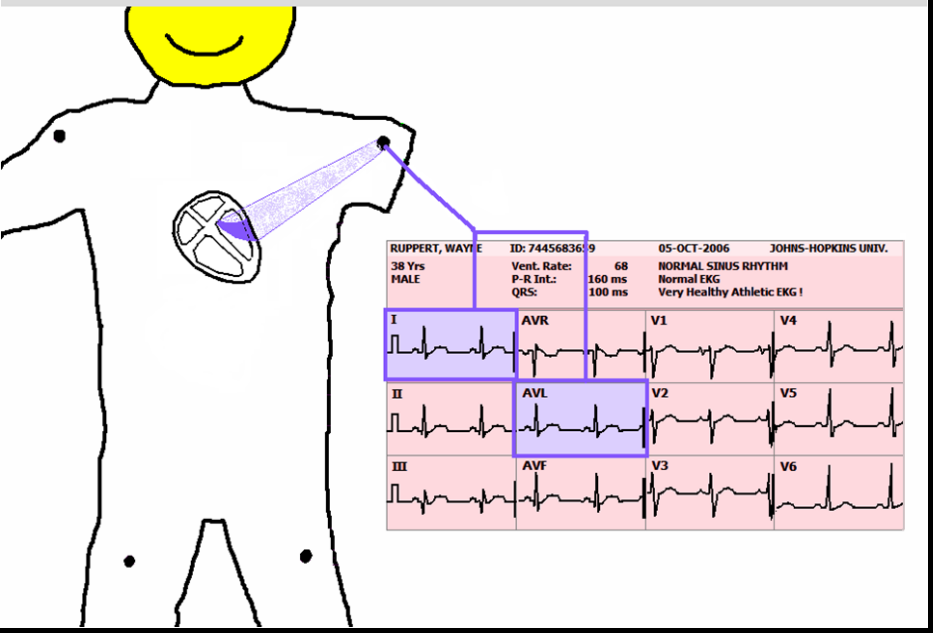
RIGHT DOMINANT SYSTEMS

- LEFT ATRIUM
- SINUS NODE (5% of the population)
- LEFT VENTRICLE: 20 - 30 % of muscle mass
  - LATERAL WALL
  - up to 1/2 of POSTERIOR WALL

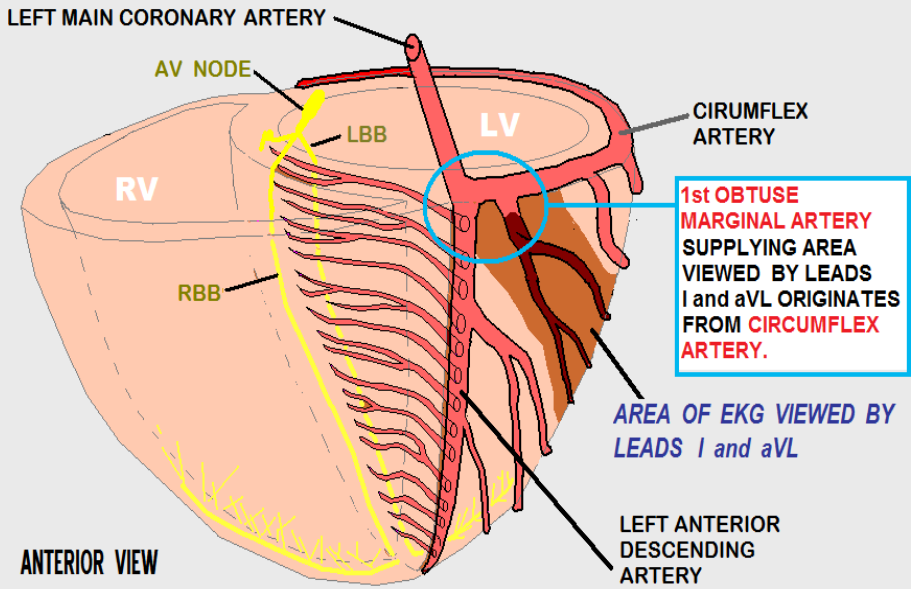
LEADS I and aVL VIEW the LATERAL - ANTERIOR WALL



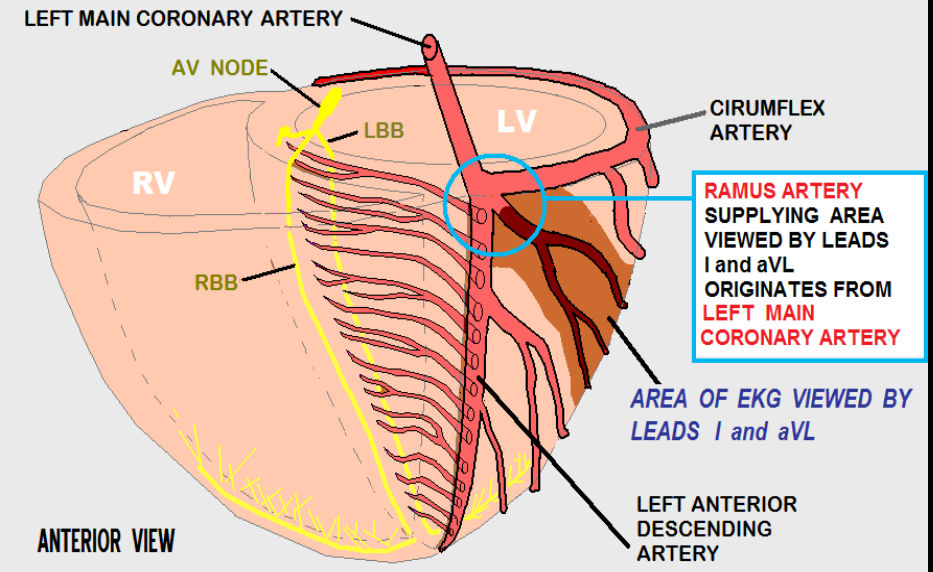
LEADS I and aVL VIEW the LATERAL - ANTERIOR WALL



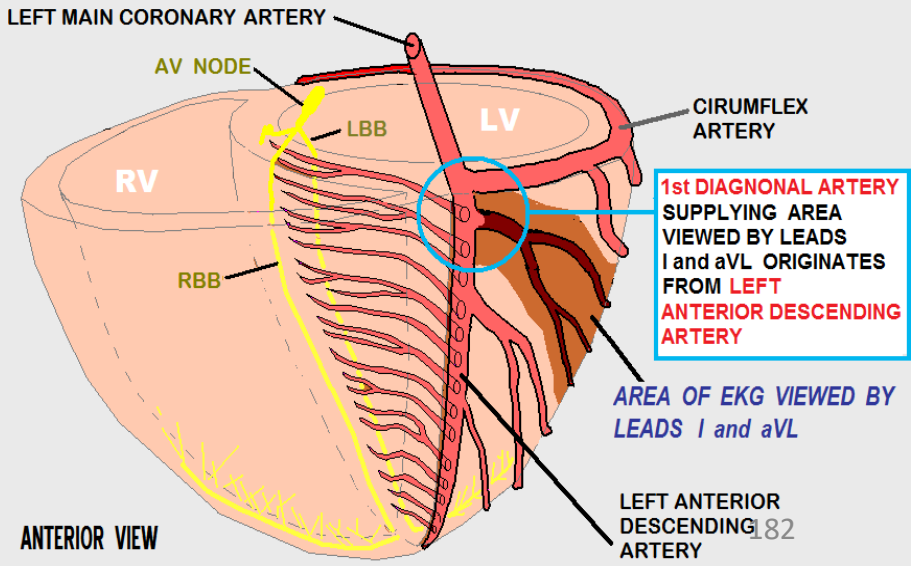
OCCLUSION of OBTUSE MARGINAL ARTERY

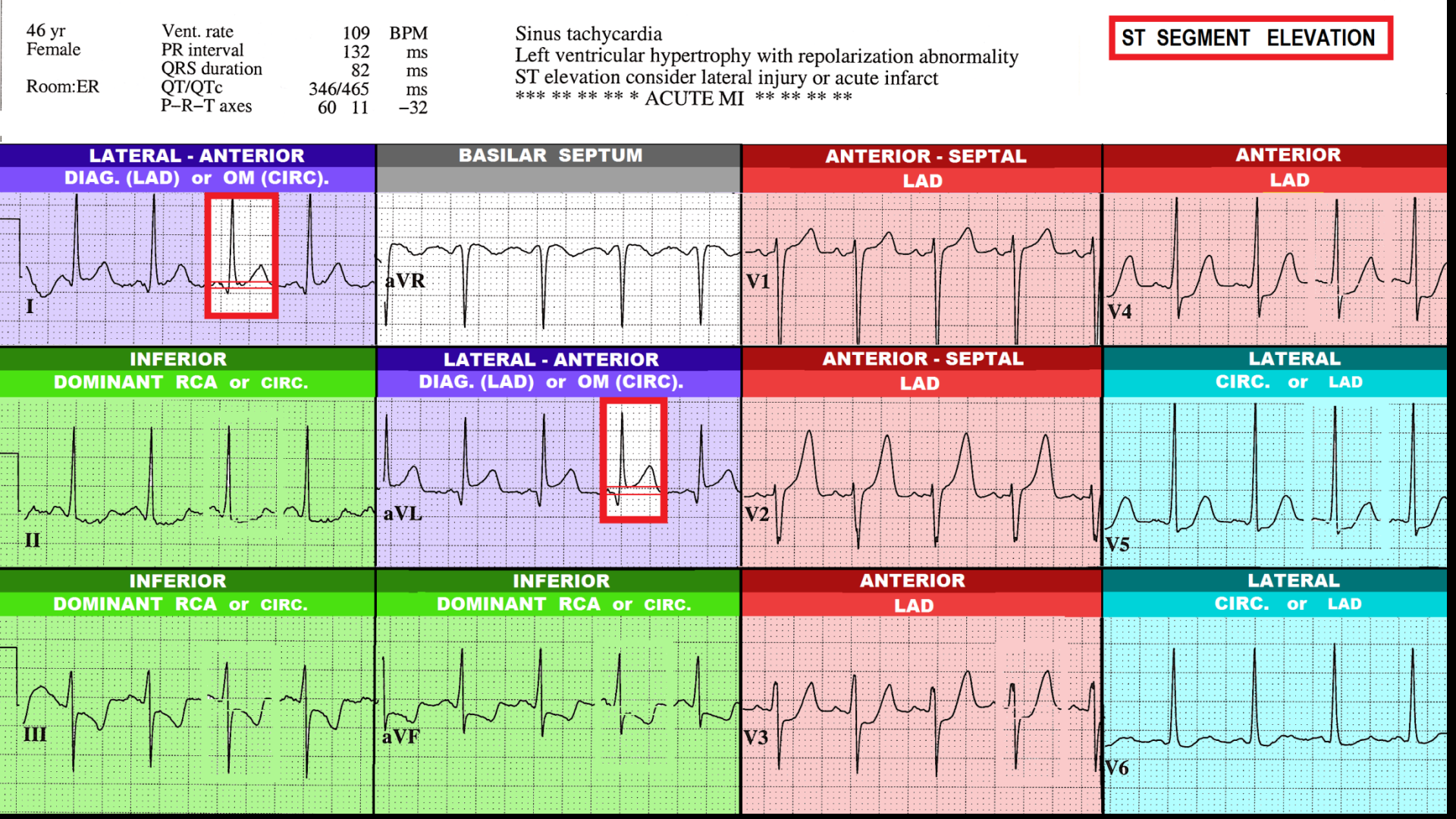


OCCLUSION of RAMUS ARTERY



OCCLUSION of DIAGONAL ARTERY

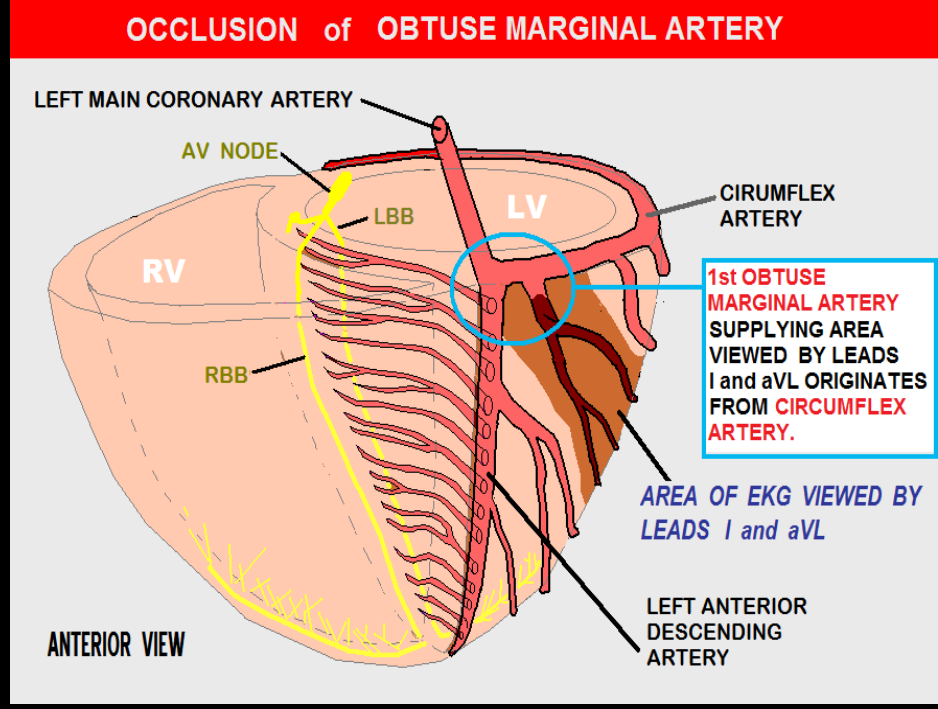


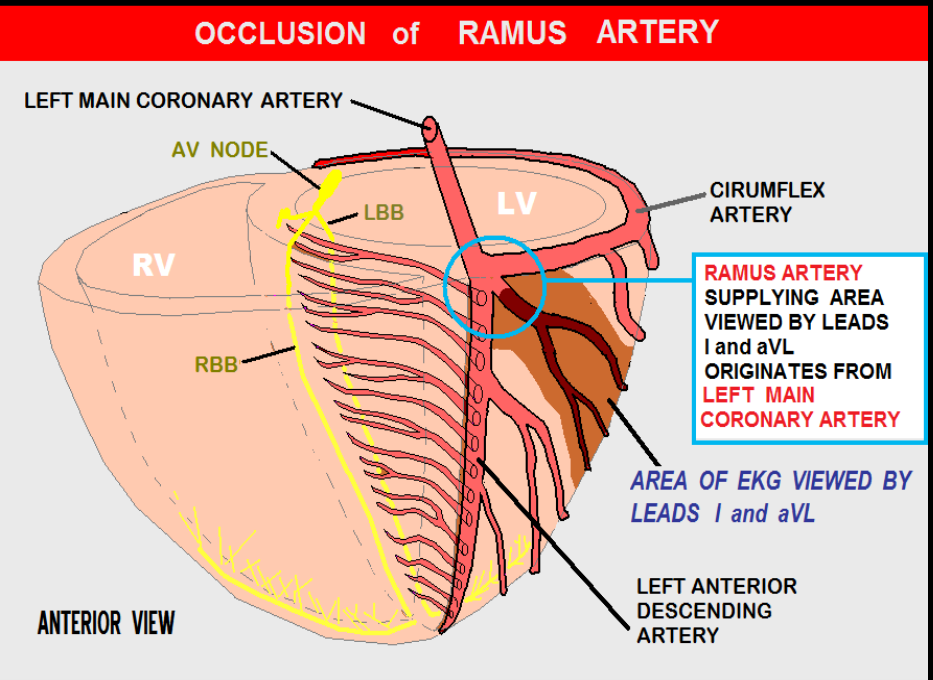


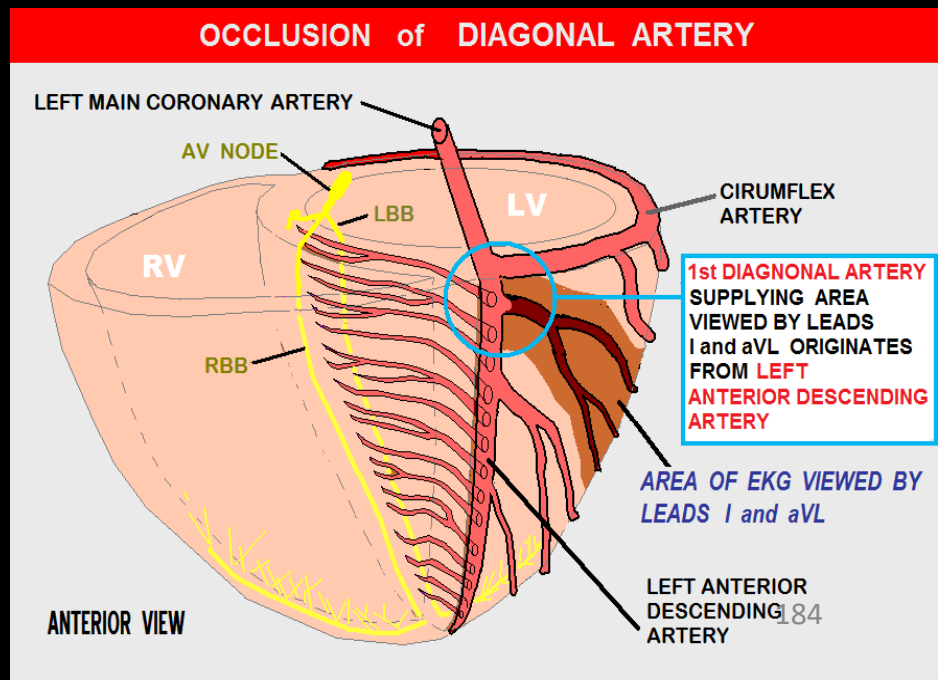
ST Segment elevation ONLY in Leads I and aVL

ST Elevation isolated to Leads I and aVL - usually indicates the "Culprit Artery" is most likely One of the following:

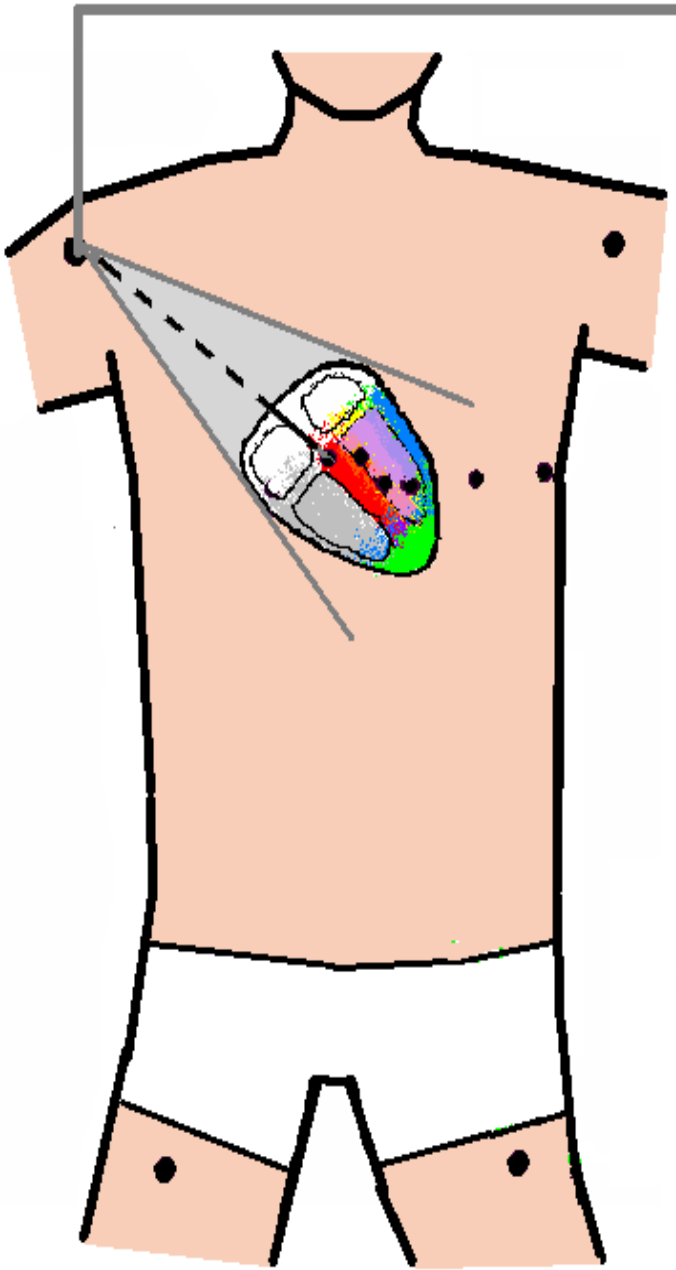
- **RAMUS BRANCH**
- **1st DIAGONAL off of LAD**
- **1st OBTUSE MARGINAL off of CIRCUMFLEX**

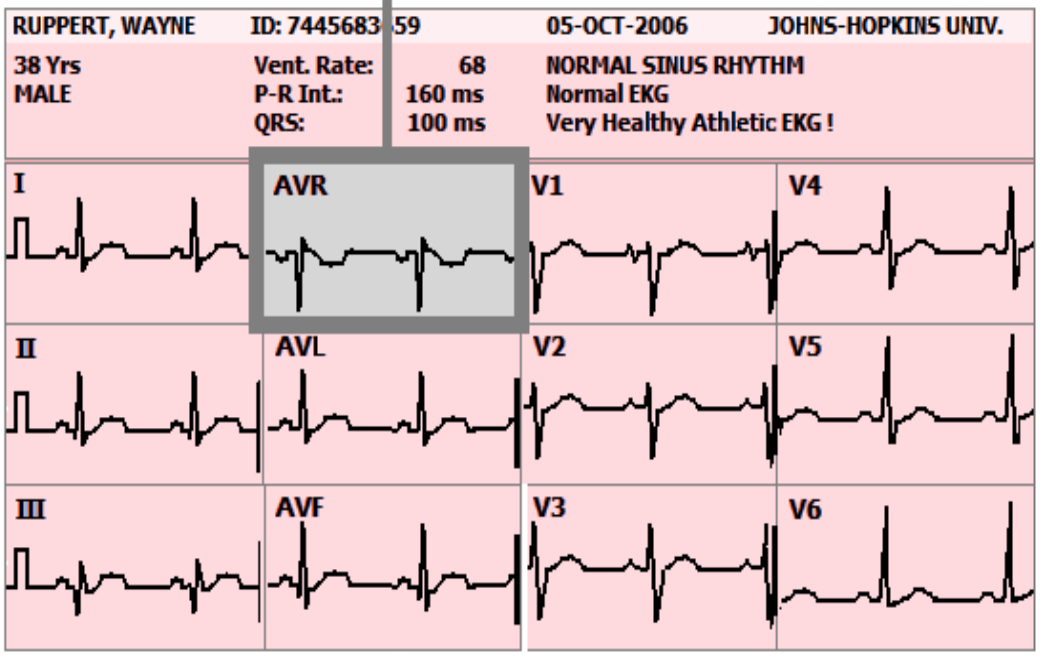




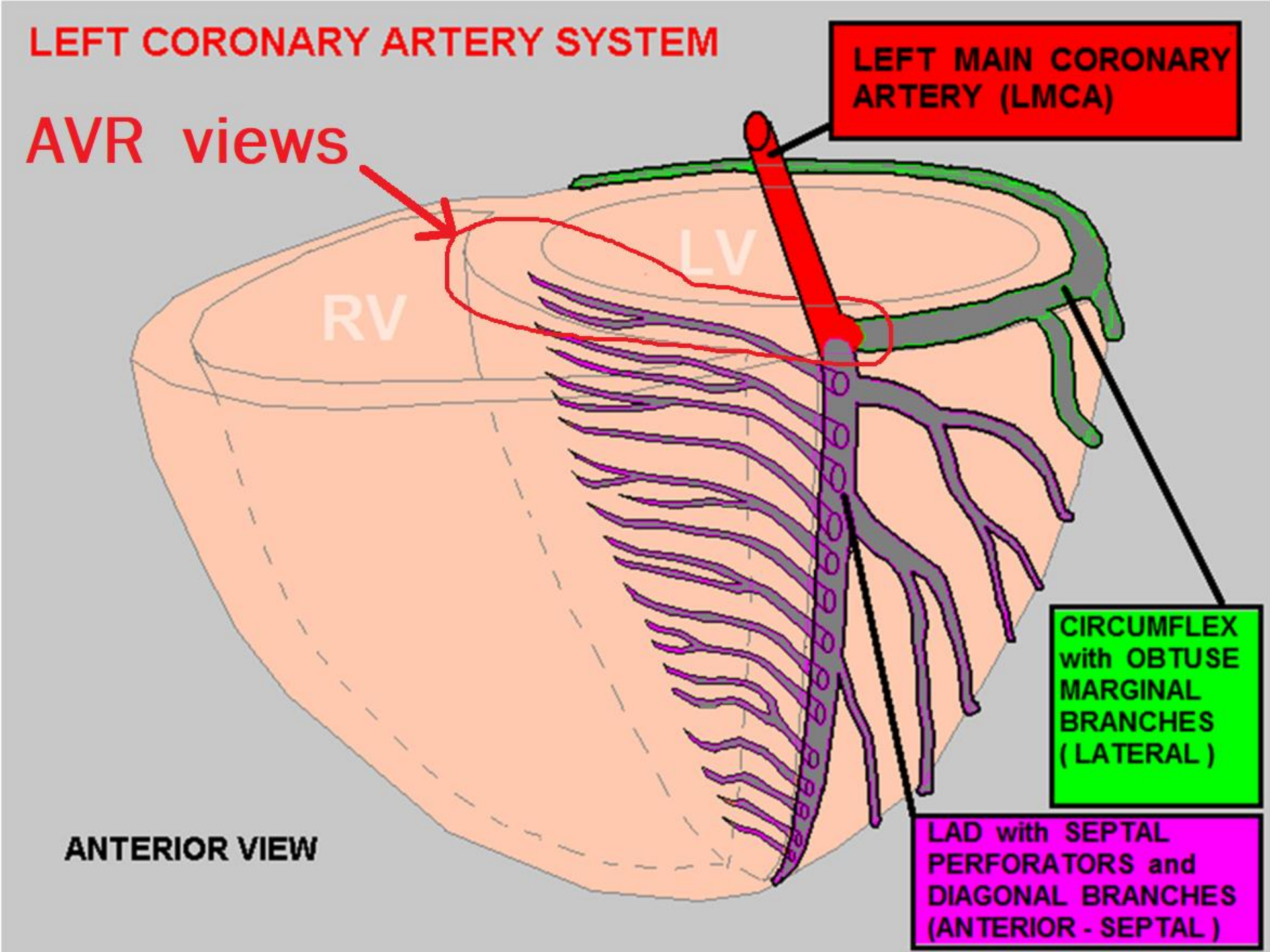


Lead AVR Views the BASILAR SEPTUM (region of the Bundle of His)





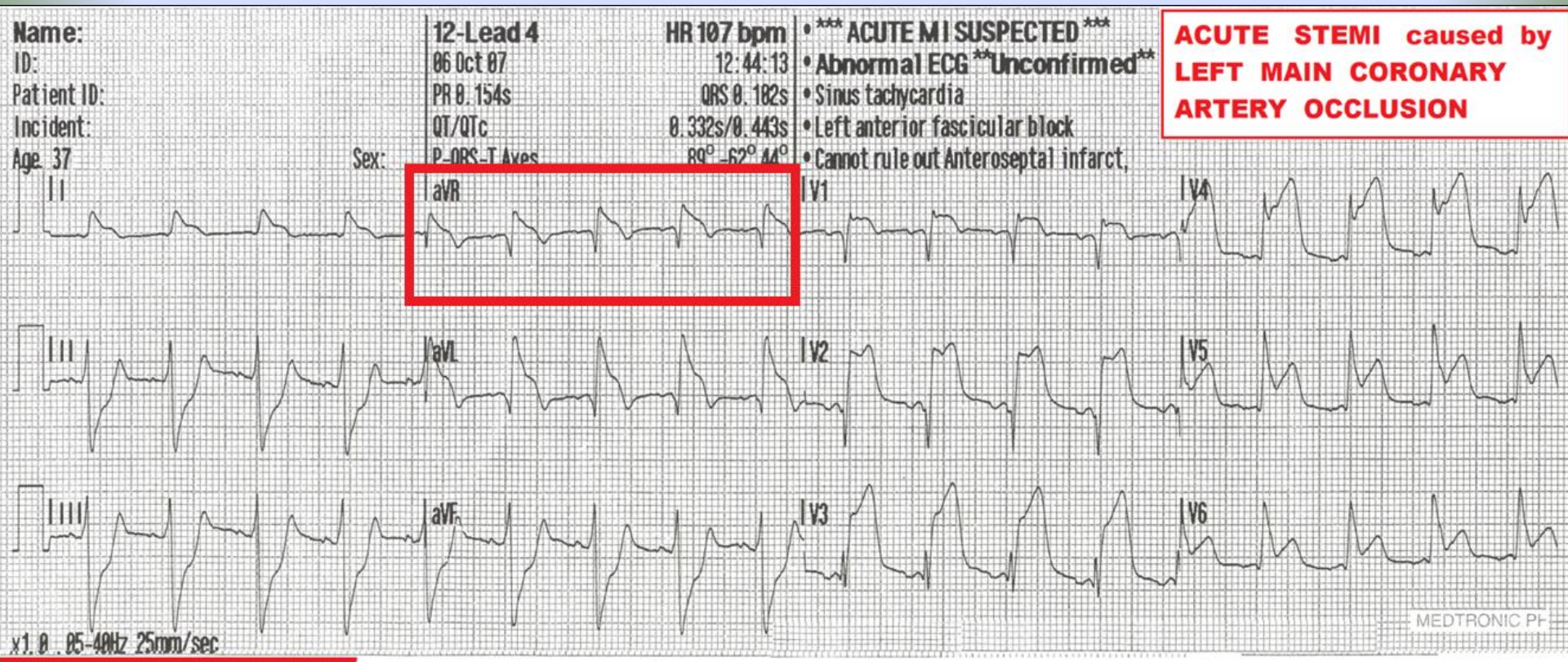
LEFT CORONARY ARTERY SYSTEM



When LEAD AVR shows ST Elevation:

- **STEMI:** consider occlusion of the Left Main Coronary Artery.

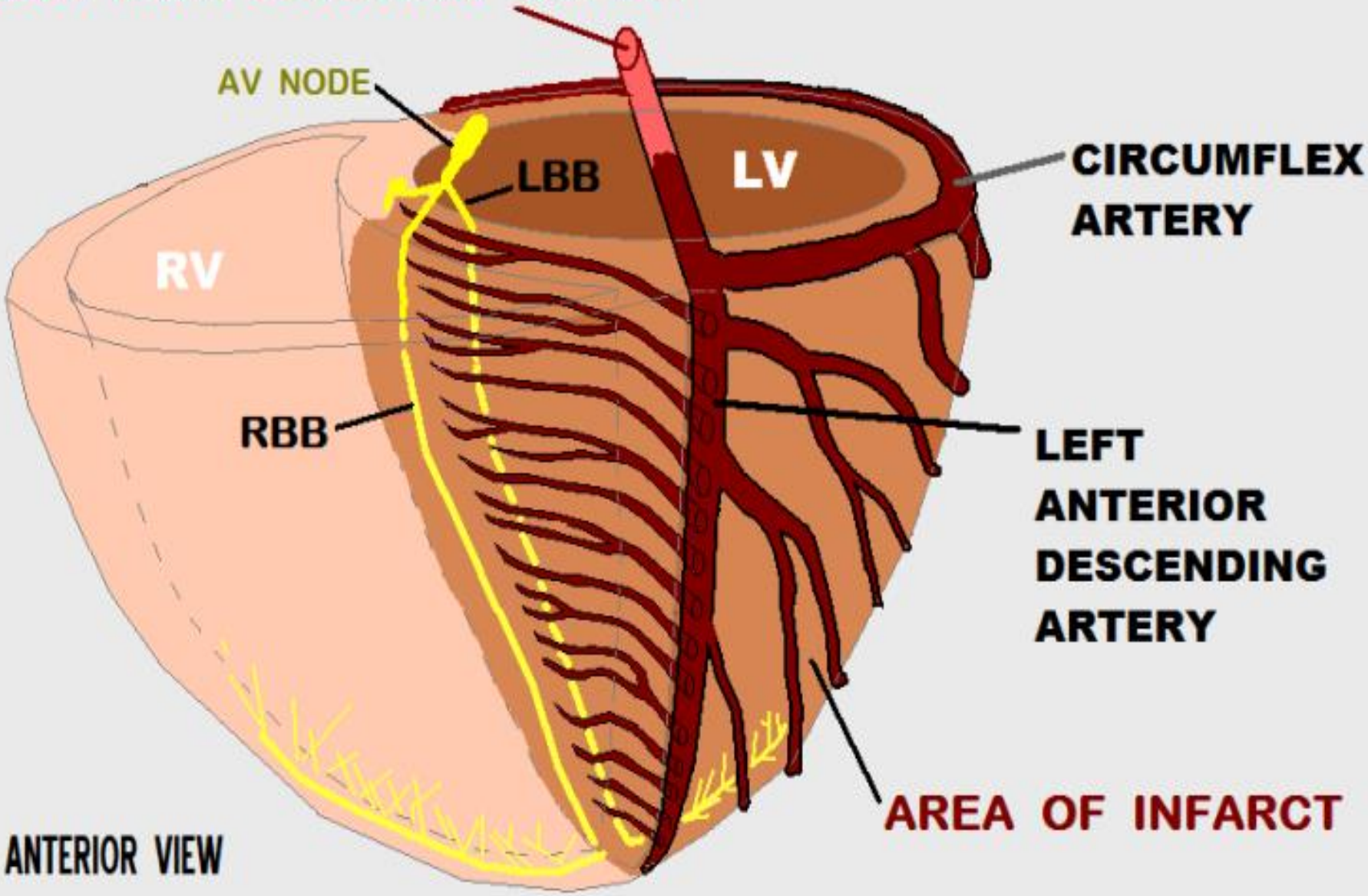
ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION

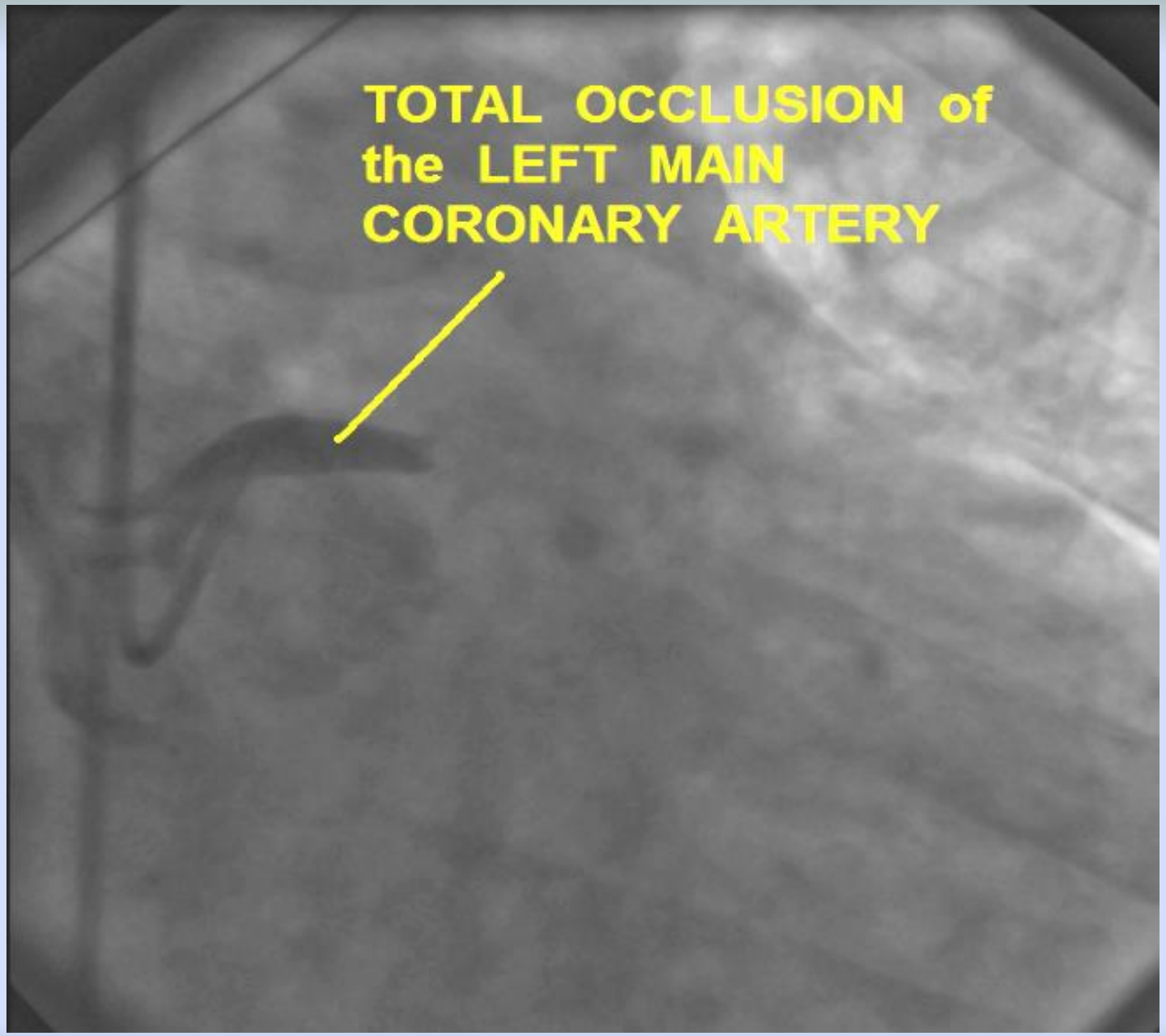


ECG CLUES of ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION:

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

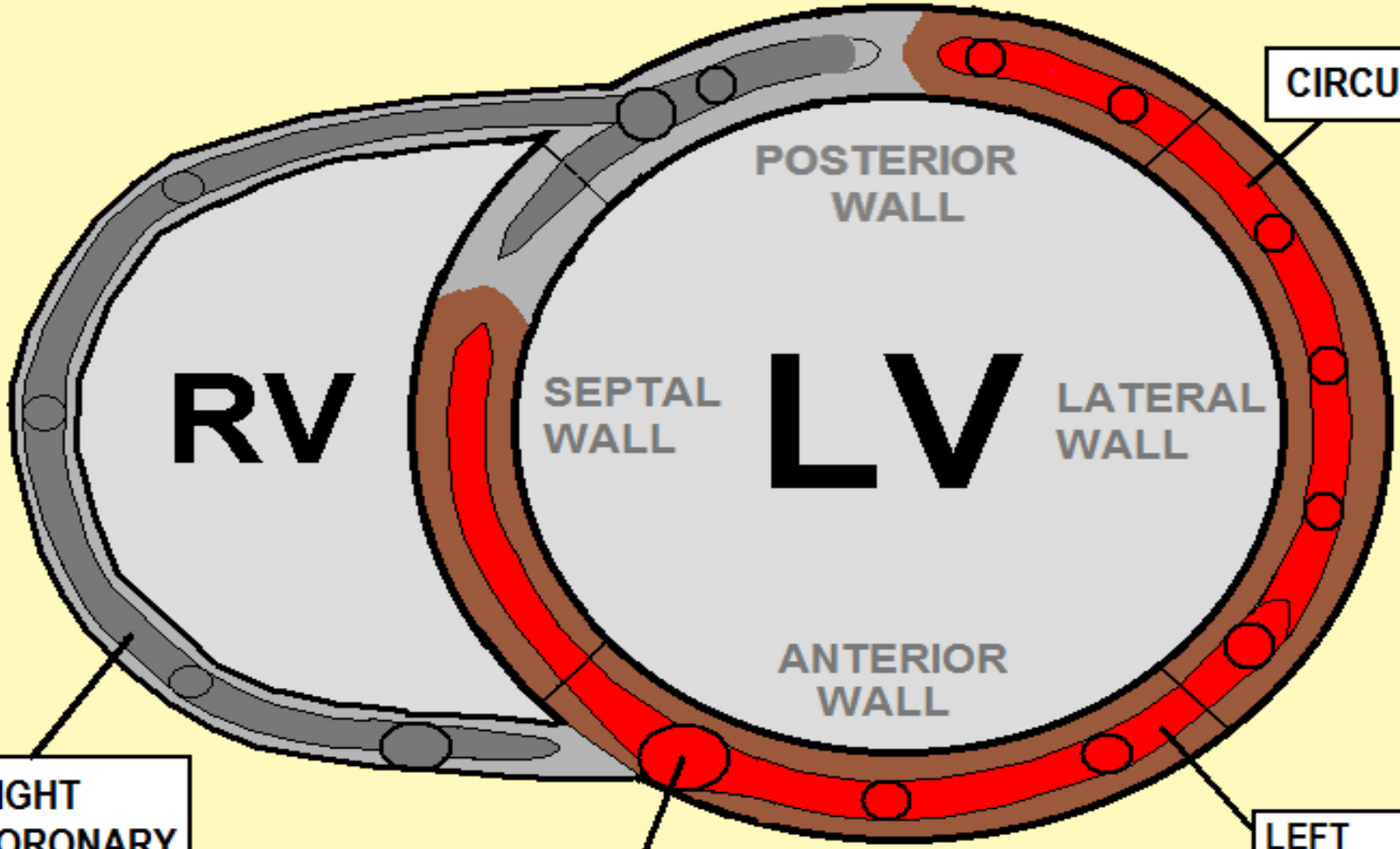
OCCLUSION of the LEFT MAIN CORONARY ARTERY




TOTAL OCCLUSION of
the LEFT MAIN
CORONARY ARTERY

The LEFT MAIN CORONARY ARTERY

SUPPLIES 75 - 100 % of the LEFT VENTRICULAR MUSCLE MASS



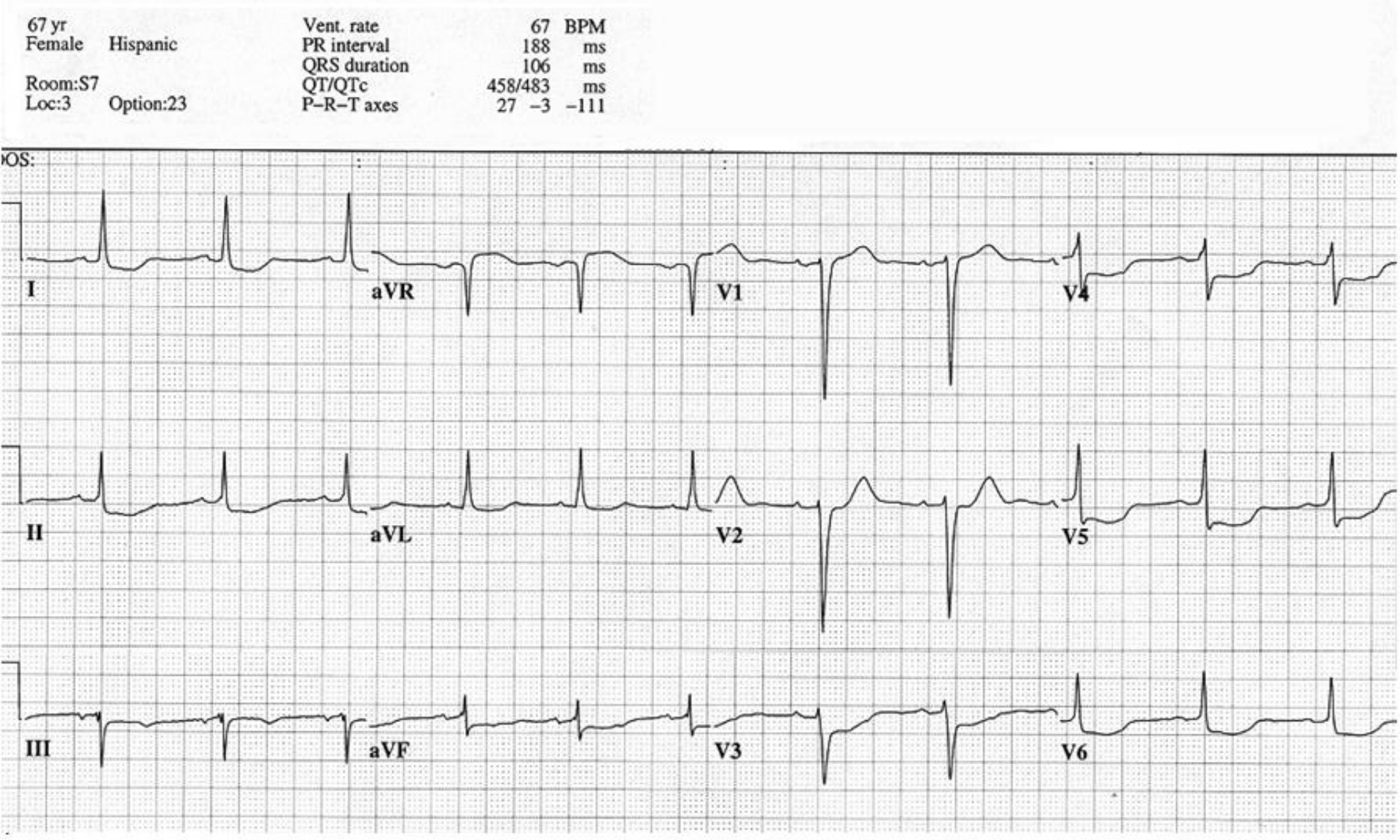
When LEAD AVR shows ST Elevation:

- **STEMI:** consider occlusion of the Left Main Coronary Artery.

When LEAD AVR shows ST Elevation:

- **STEMI:** consider occlusion of the Left Main Coronary Artery.
- **NSTEMI** and **Unstable Angina** consider LMCA Occlusion – or TRIPLE VESSEL DISEASE

In patients without STEMI, ST Elevation in AVR, when seen with global indications of ischemia (ST Depression in 8 leads or more), is indicative of advanced multi-vessel disease or significant Left Main Coronary Artery stenosis


67 yr
Female Hispanic
Room:S7
Loc:3 Option:23
Vent. rate 67 BPM
PR interval 188 ms
QRS duration 106 ms
QT/QTc 458/483 ms
P-R-T axes 27 -3 -111
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

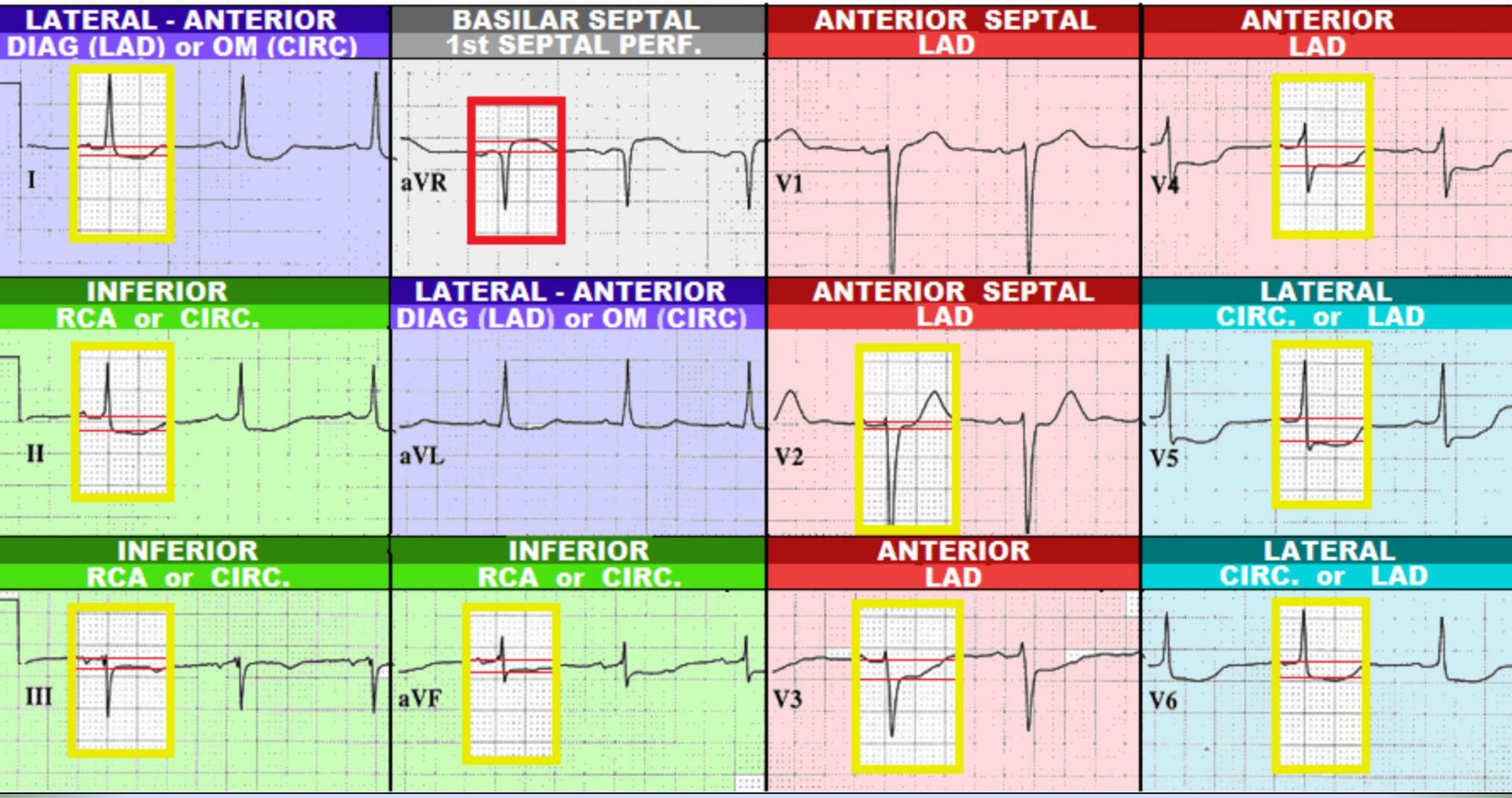
67 yr
Female Hispanic

Room:S7
Loc:3 Option:23

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

ST SEGMENT ELEVATION

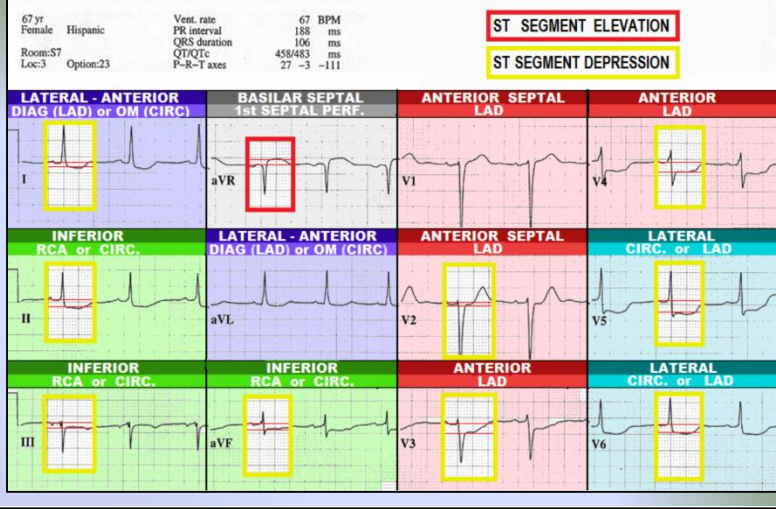
ST SEGMENT DEPRESSION

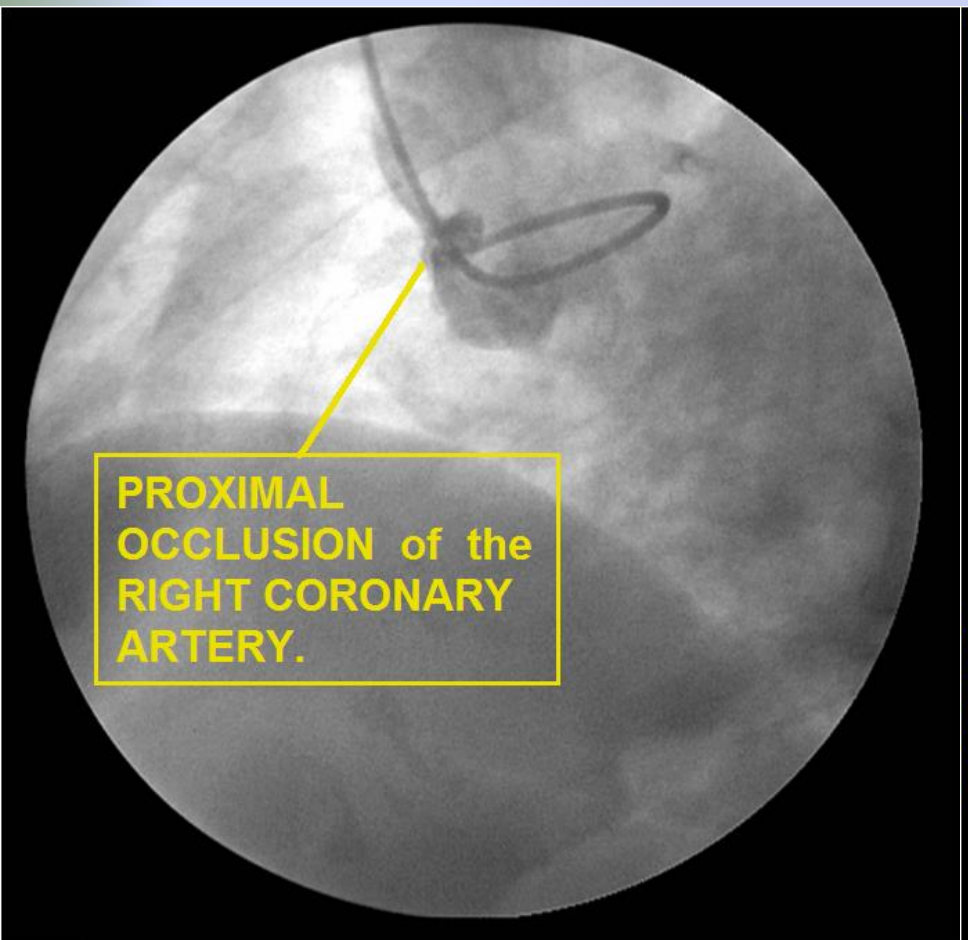


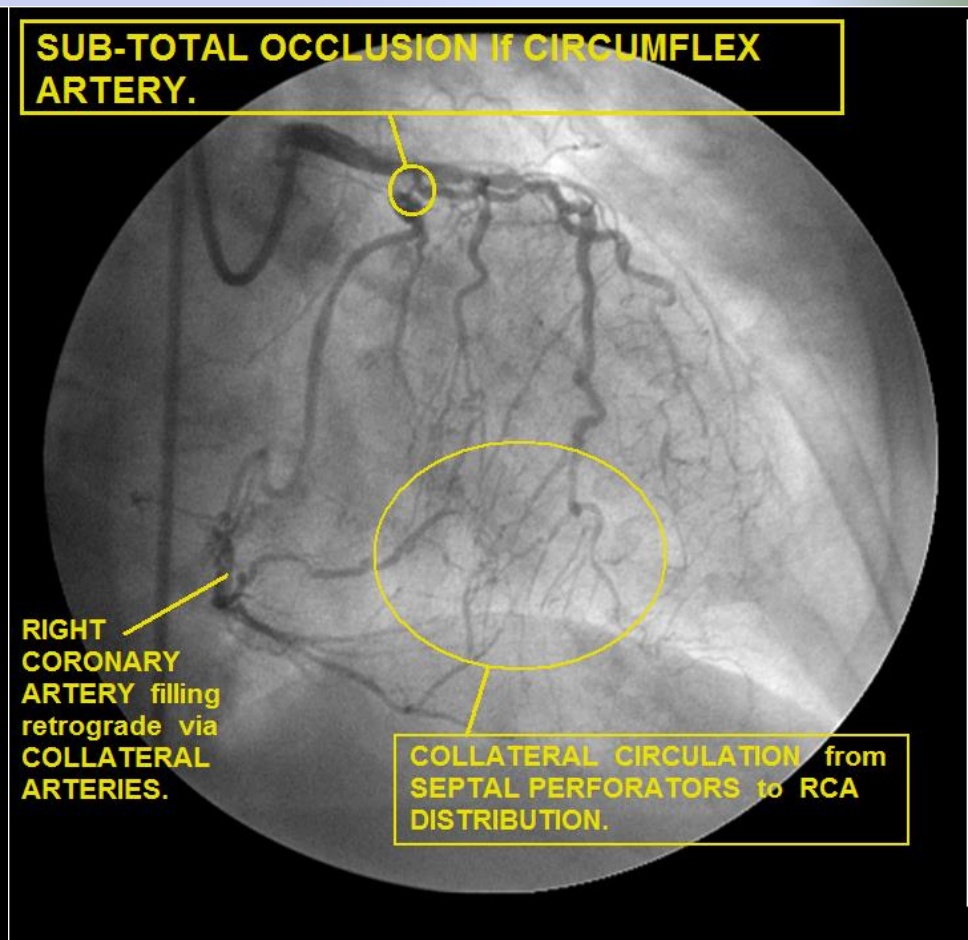
GLOBAL ISCHEMIA

- **ST Elevation Lead aVR**
- **ST Depression in 8 or more other Leads**
- **Indicates either SUB-TOTALLY OCCLUDED LEFT MAIN CORONARY ARTERY – or – TRIPLE VESSEL DISEASE.**
- ***MOST PATIENTS WITH THIS ECG PRESENTATION REQUIRE OPEN HEART SURGERY.***

Critical Triple Vessel Disease = *STAT Coronary Artery Bypass Surgery*



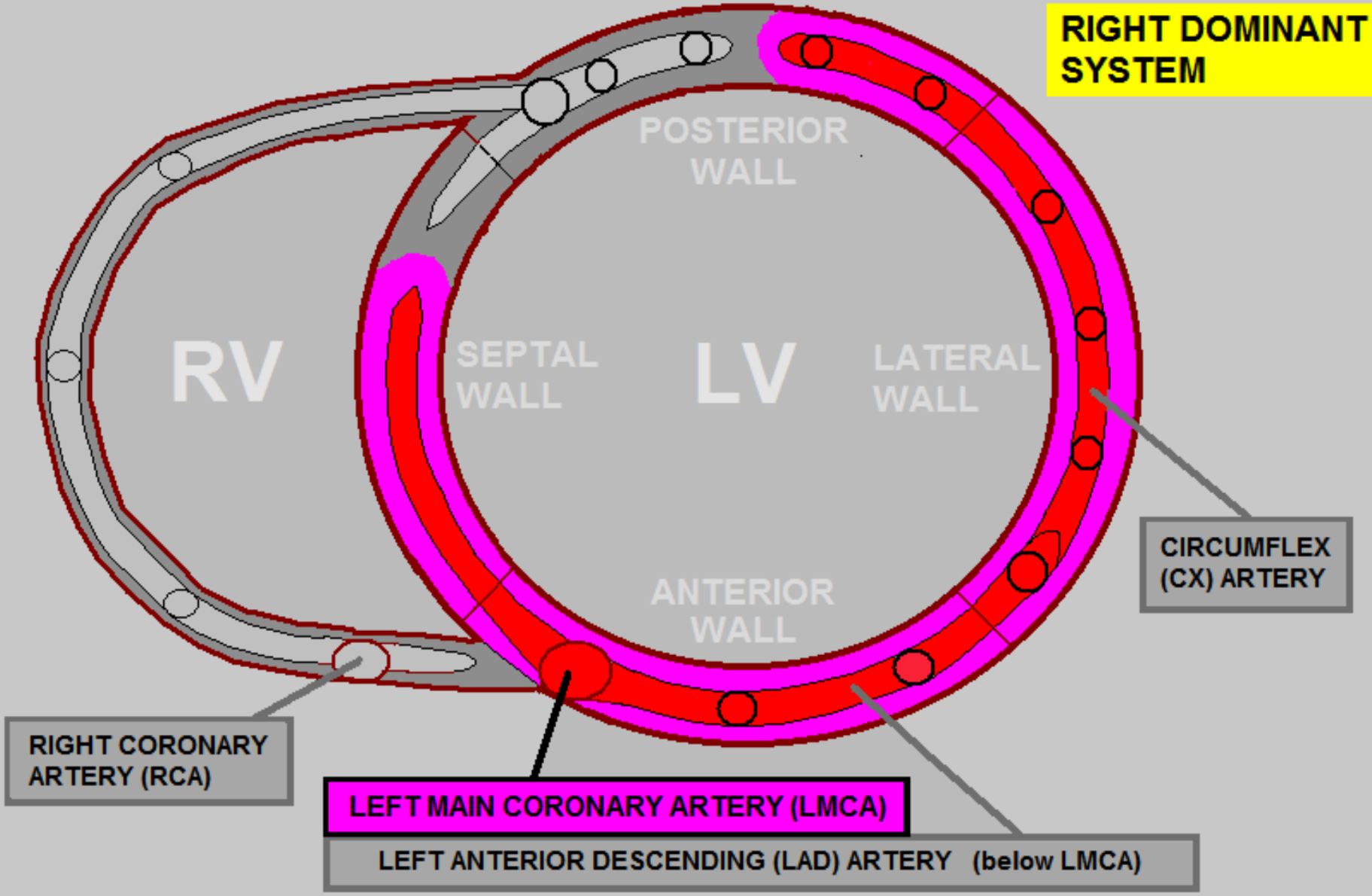




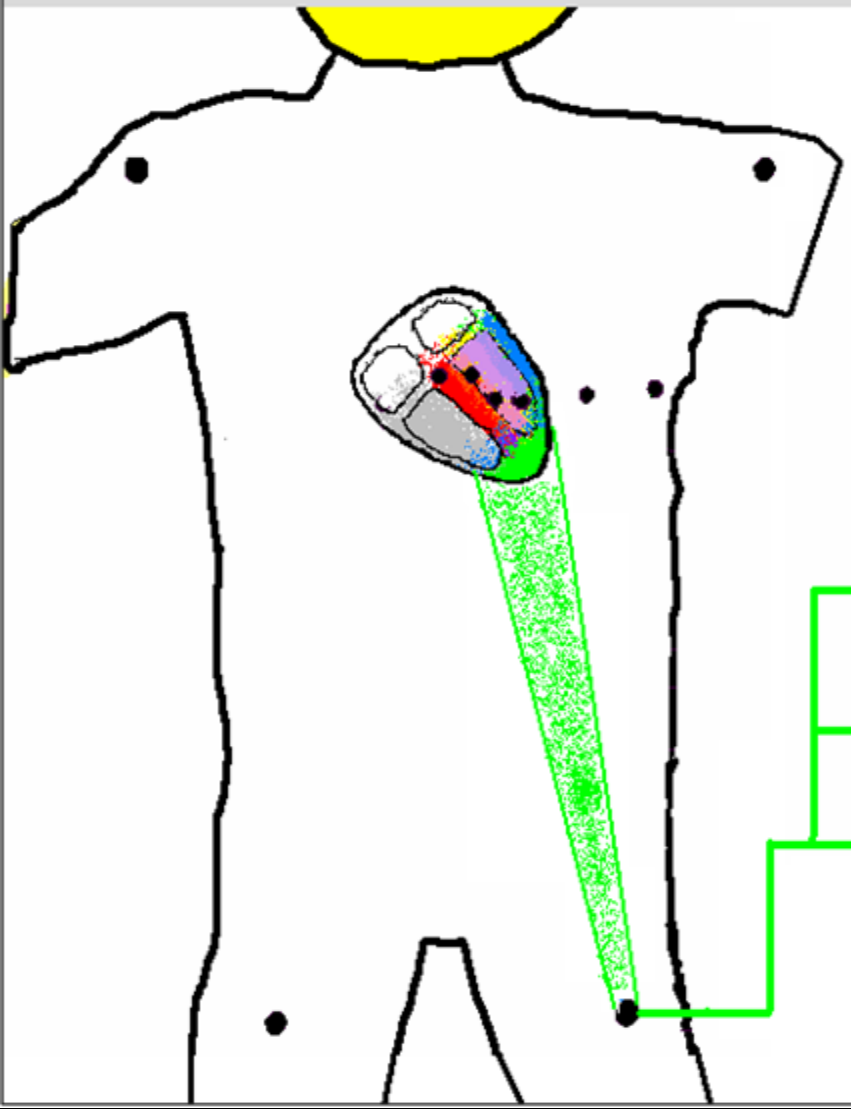
cutaway view of the

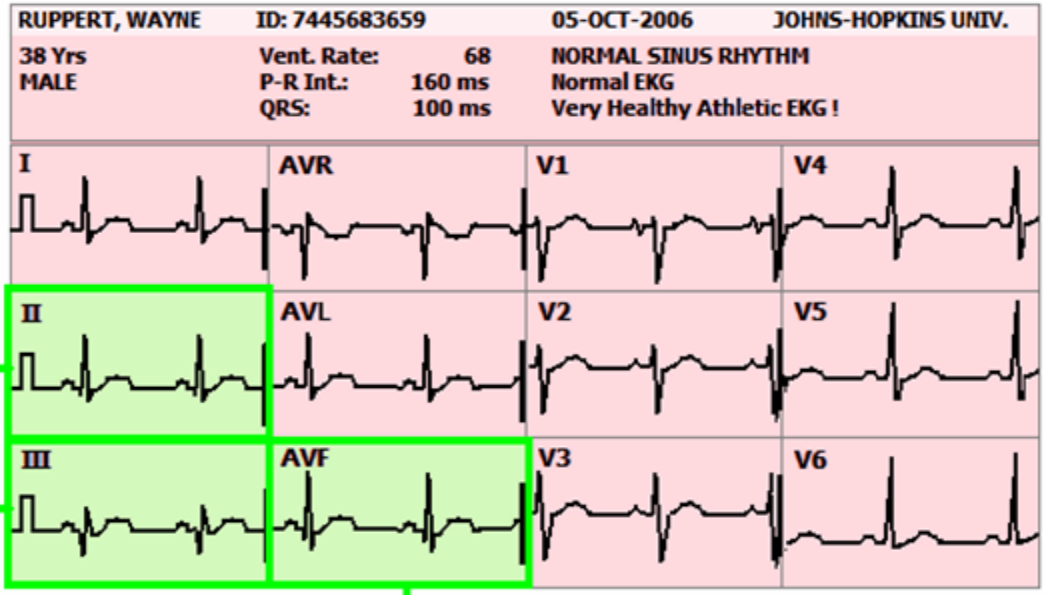
LEFT MAIN CORONARY ARTERY (LMCA)

SUPPLIES APPROXIMATELY 75% OF LV MUSCLE MASS

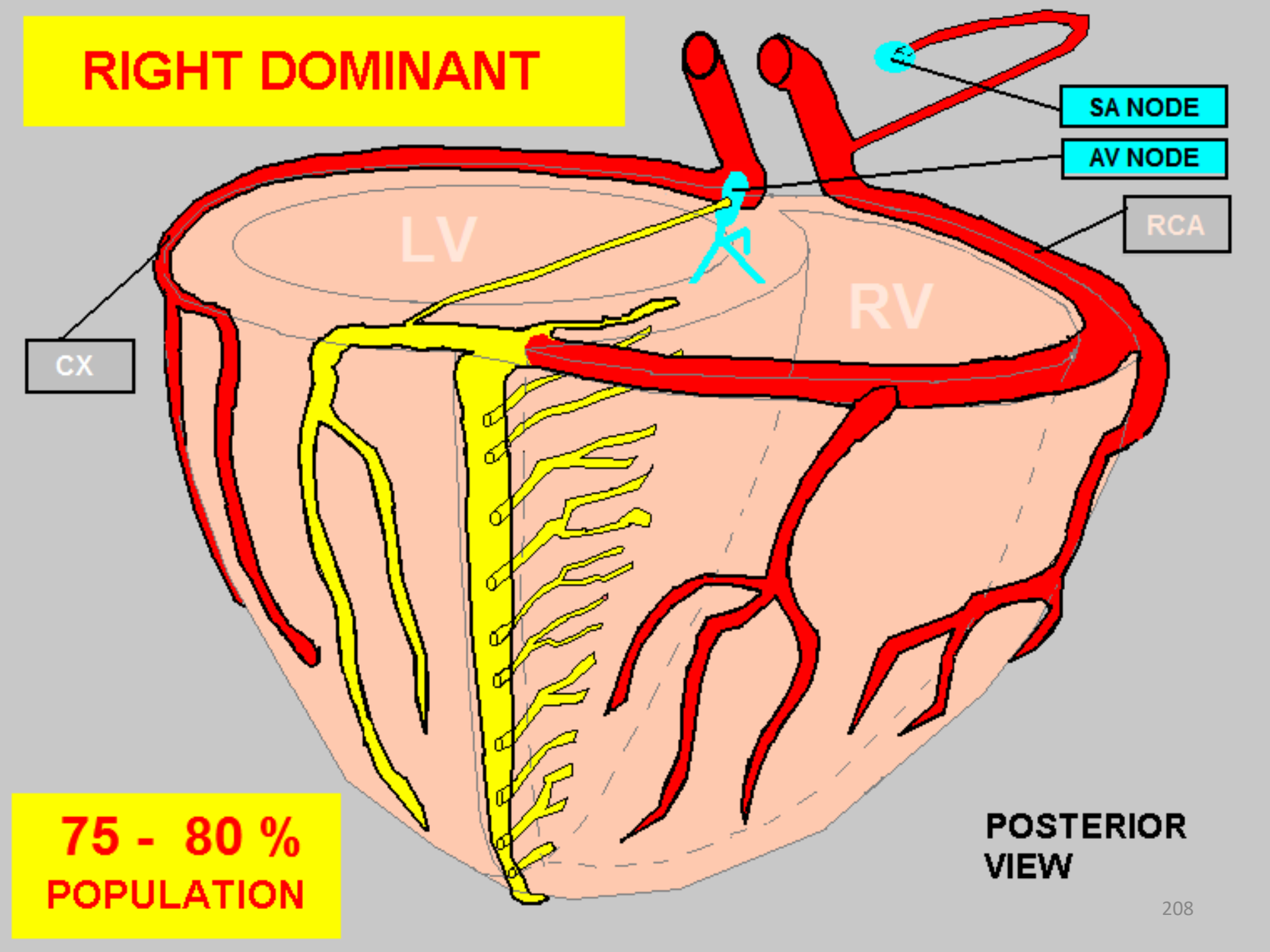


LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE





Which CORONARY ARTERY usually supplies the INFERIOR WALL?

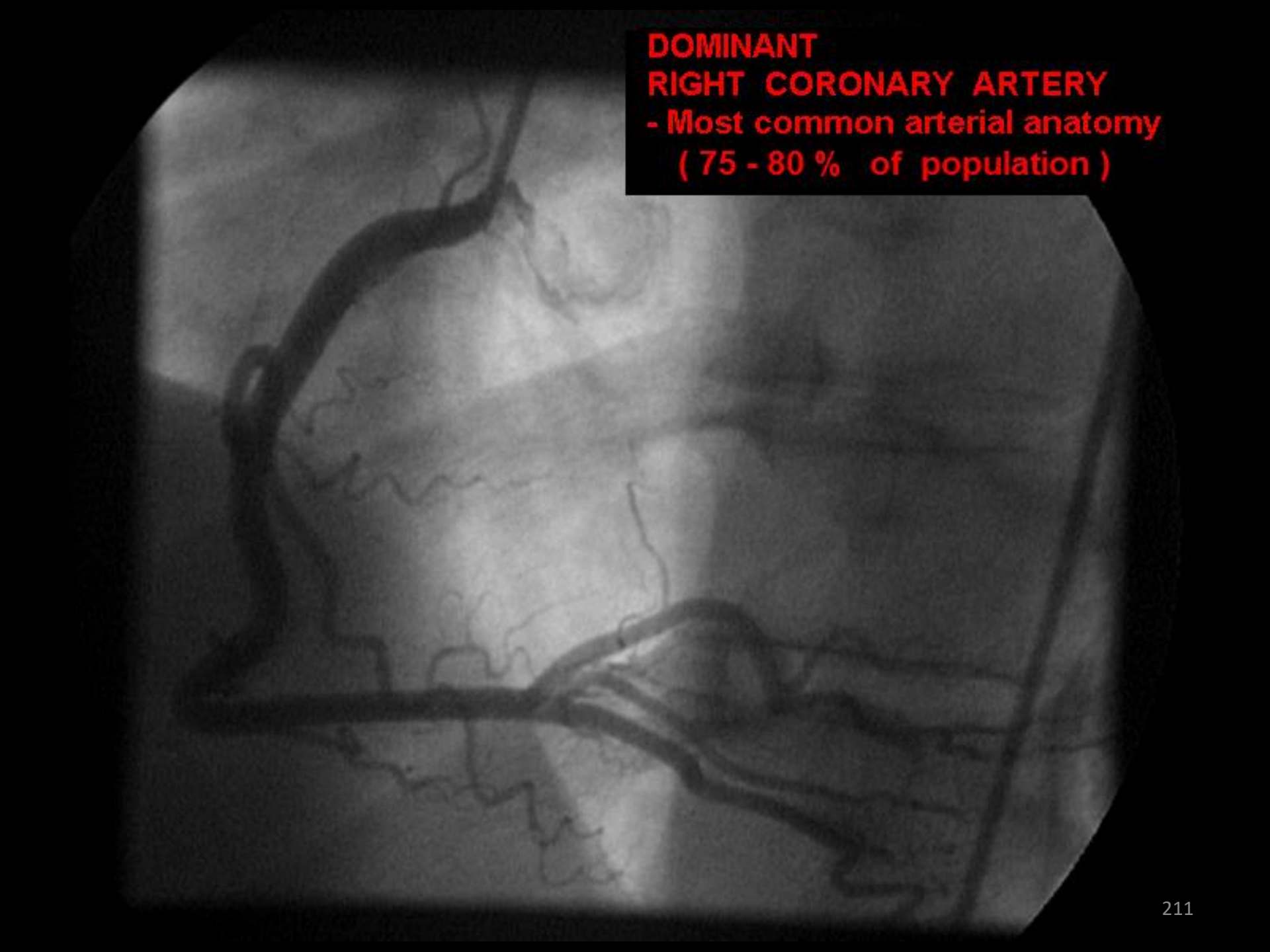

RIGHT DOMINANT
SA NODE
AV NODE
RCA
LV
RV
CX
75 - 80 %
POPULATION
POSTERIOR
VIEW

HELPFUL HINT . . . MEMORIZE THIS !

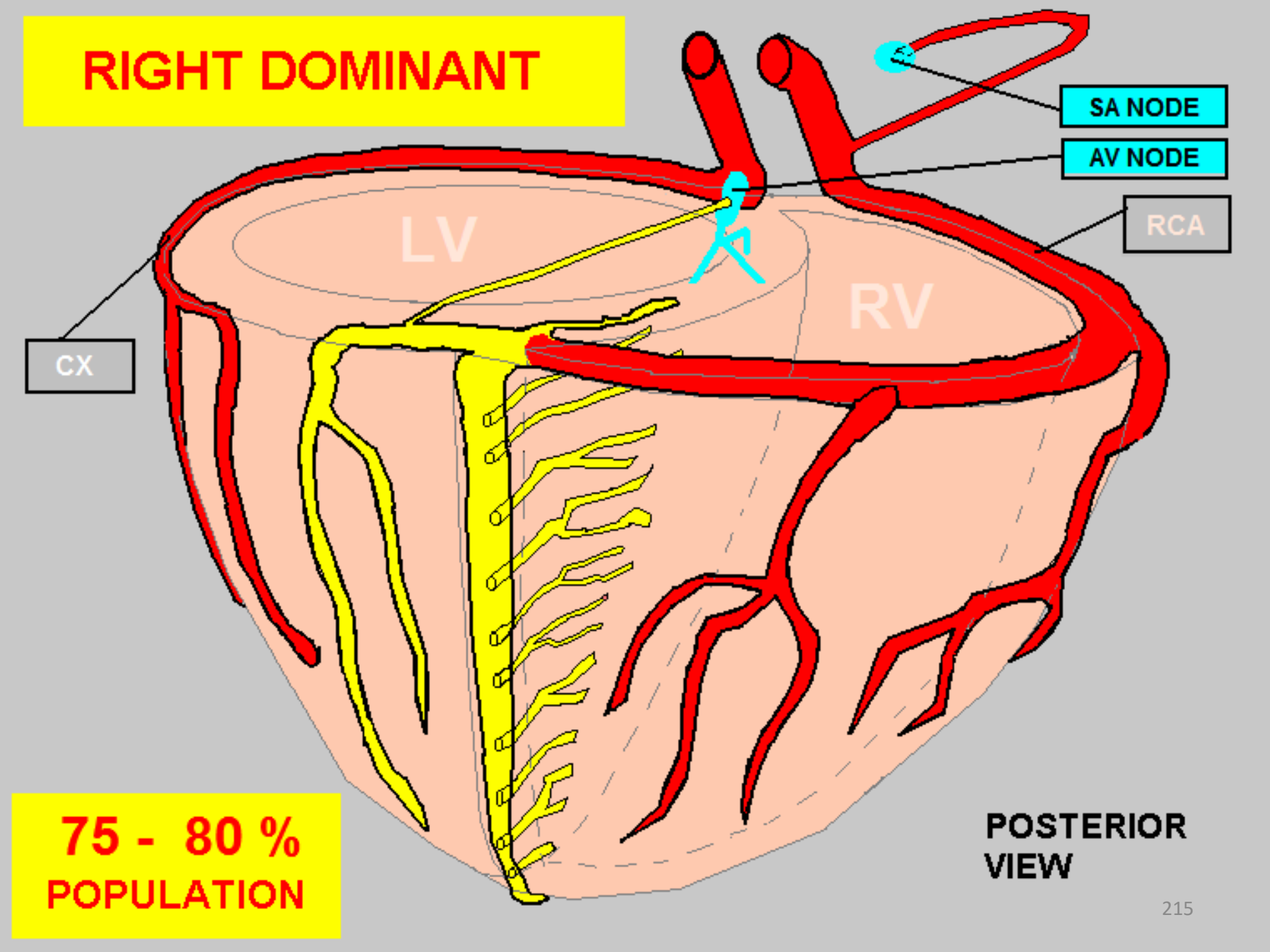
RIGHT CORONARY ARTERY (RCA)

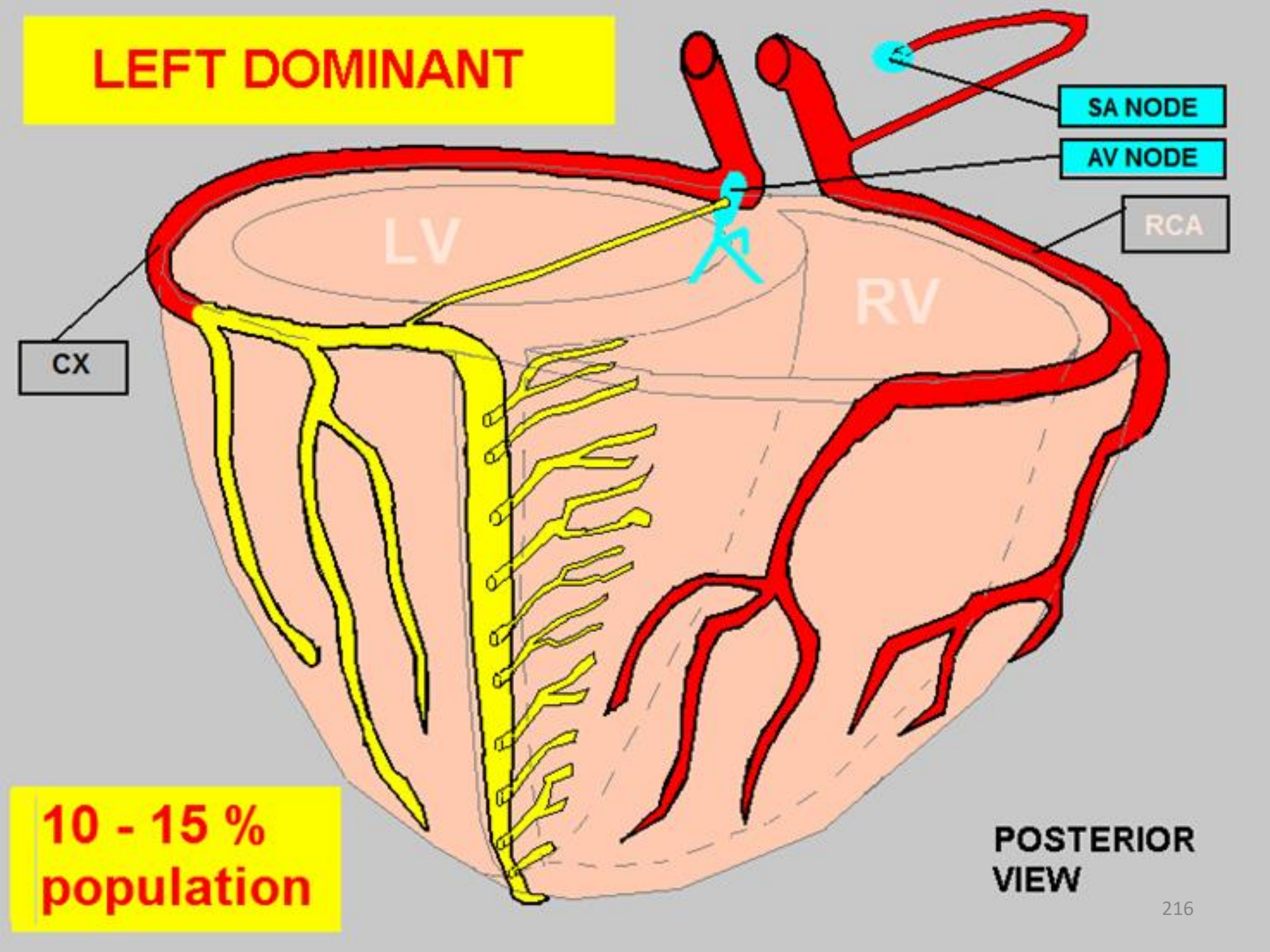
RIGHT DOMINANT SYSTEMS

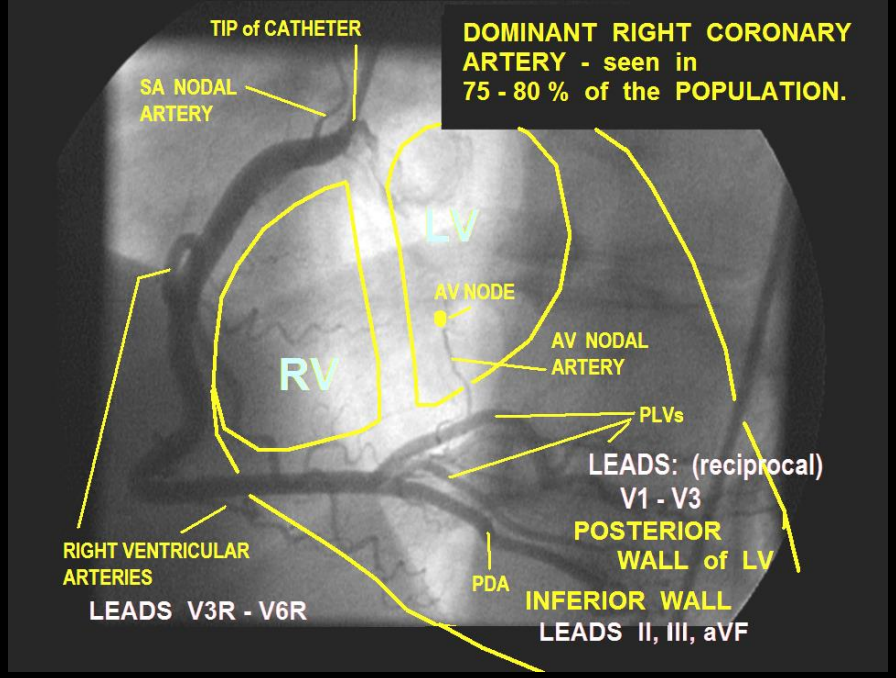
- RIGHT ATRIUM
- SINUS NODE (55% of the population)
- RIGHT VENTRICLE - 100 % of muscle mass
- LEFT VENTRICLE: 15 - 25 % of muscle mass
  - INFERIOR WALL
  - approx. 1/2 of POSTERIOR WALL
- AV NODE

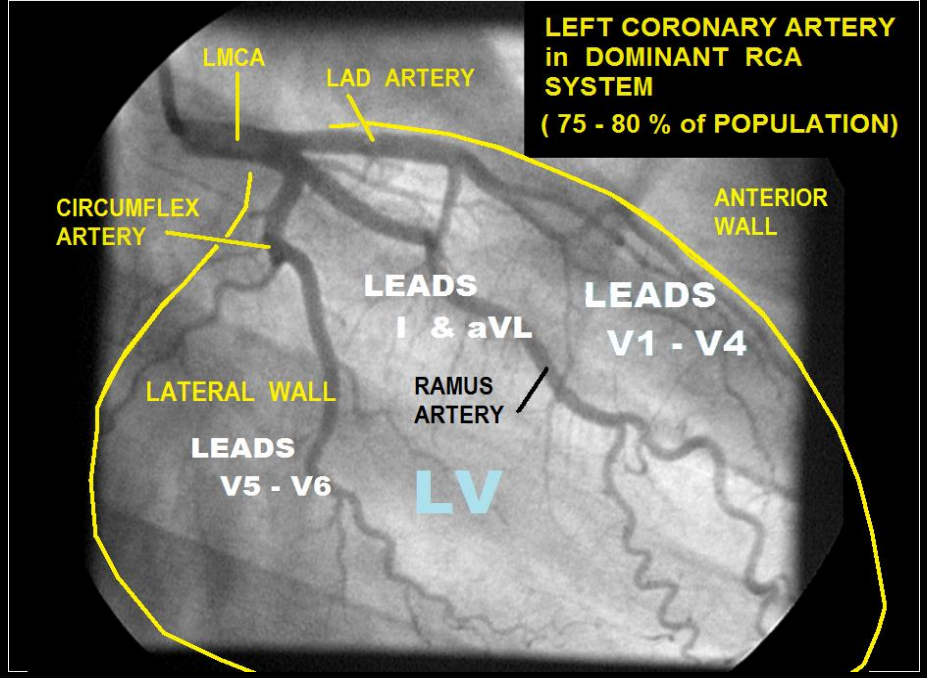

DOMINANT
RIGHT CORONARY ARTERY
- Most common arterial anatomy
(75 - 80 % of population)

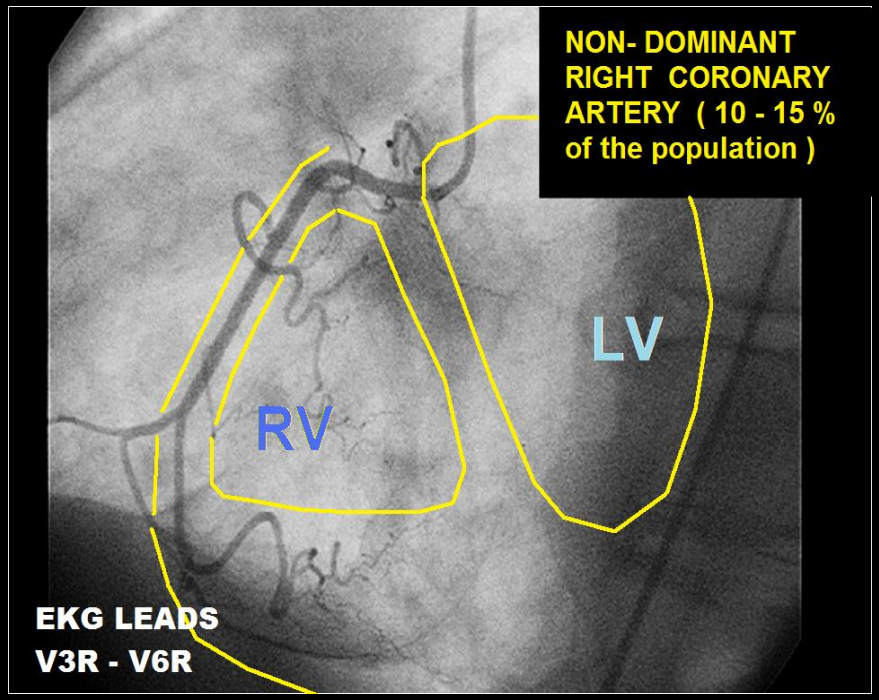
So if the Right Coronary Artery Is DOMINANT in 75 – 80% of the POPULATION, what accounts for the Other 20 – 25% ??

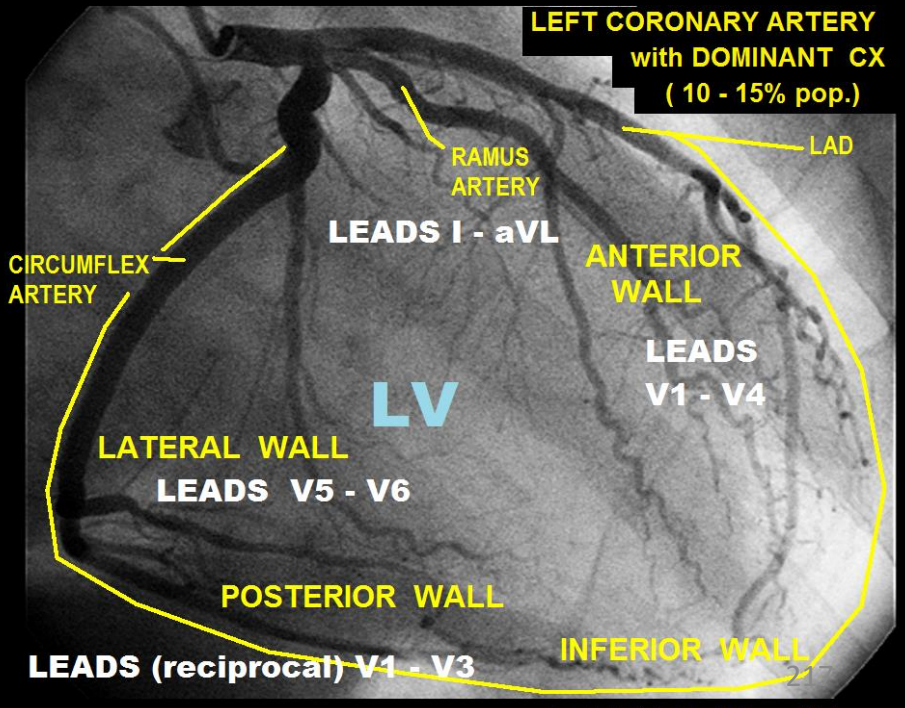

RIGHT DOMINANT
SA NODE
AV NODE
RCA
LV
RV
CX
75 - 80 %
POPULATION
POSTERIOR
VIEW

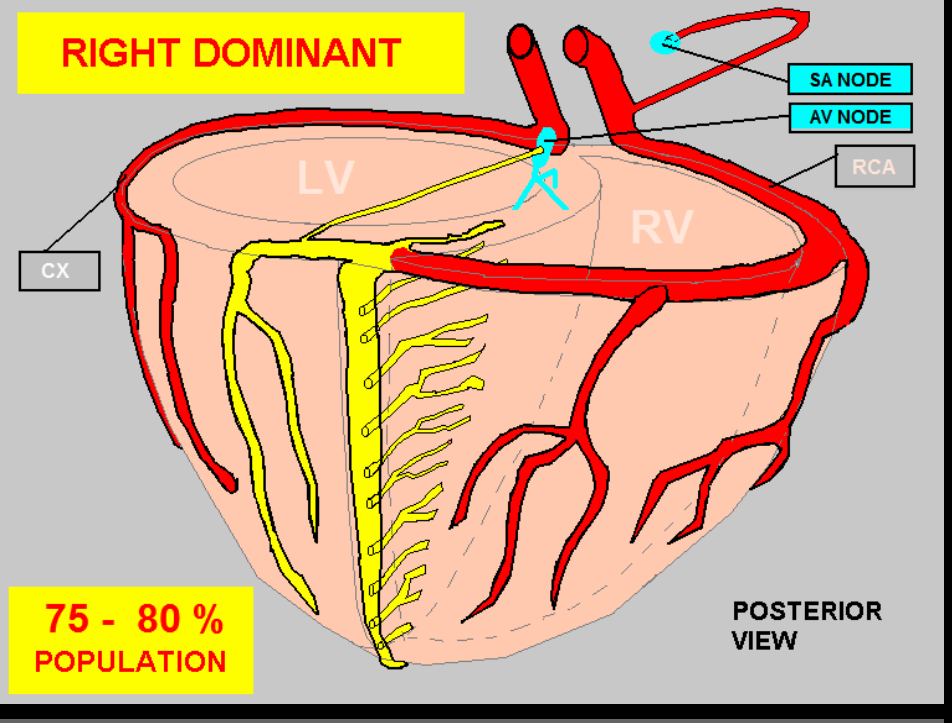

LEFT DOMINANT
SA NODE
AV NODE
RCA
LV
RV
CX
10 - 15 %
population
POSTERIOR
VIEW

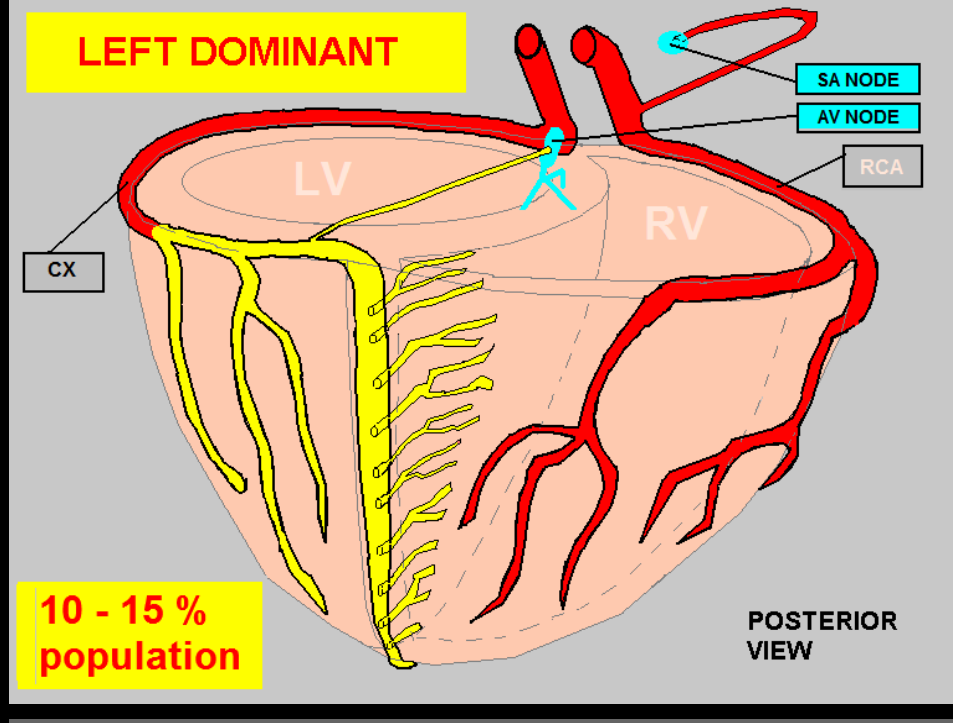

TIP of CATHETER
SA NODAL ARTERY
DOMINANT RIGHT CORONARY ARTERY - seen in 75 - 80 % of the POPULATION.
LV
AV NODE
AV NODAL ARTERY
RV
PLVs
LEADS: (reciprocal) V1 - V3
POSTERIOR WALL of LV
RIGHT VENTRICULAR ARTERIES
PDA
INFERIOR WALL
LEADS V3R - V6R
LEADS II, III, aVF

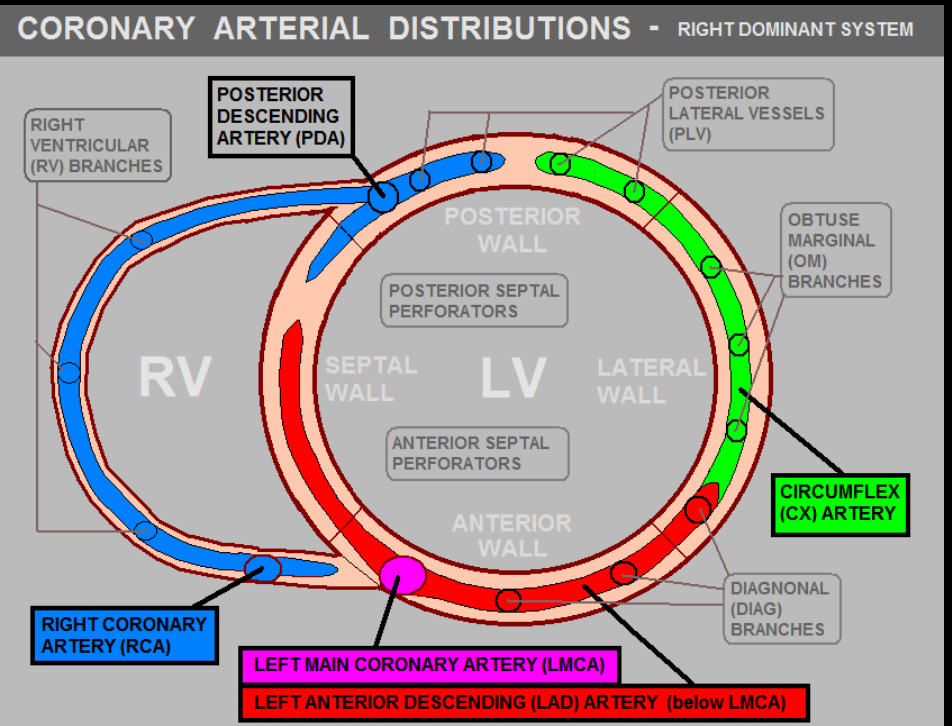

LMCA
LAD ARTERY
LEFT CORONARY ARTERY in DOMINANT RCA SYSTEM
(75 - 80 % of POPULATION)
CIRCUMFLEX ARTERY
ANTERIOR WALL
LEADS I & aVL
LEADS V1 - V4
LATERAL WALL
RAMUS ARTERY
LEADS V5 - V6
LV

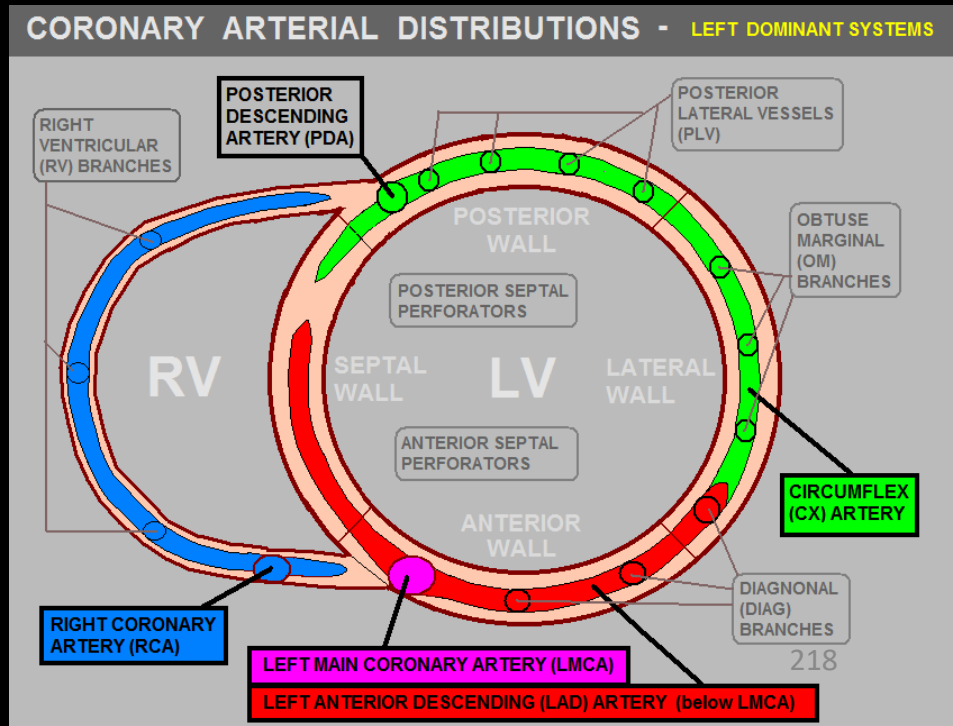

NON- DOMINANT RIGHT CORONARY ARTERY (10 - 15 % of the population)
LV
RV
EKG LEADS V3R - V6R


LEFT CORONARY ARTERY with DOMINANT CX (10 - 15% pop.)
RAMUS ARTERY
LAD
LEADS I - aVL
CIRCUMFLEX ARTERY
ANTERIOR WALL
LEADS V1 - V4
LV
LATERAL WALL
LEADS V5 - V6
POSTERIOR WALL
INFERIOR WALL
LEADS (reciprocal) V1 - V3
LEADS II, III, aVF


RIGHT DOMINANT
SA NODE
AV NODE
RCA
CX
LV
RV
75 - 80 %
POPULATION
POSTERIOR
VIEW


LEFT DOMINANT
SA NODE
AV NODE
RCA
CX
LV
RV
10 - 15 %
population
POSTERIOR
VIEW


CORONARY ARTERIAL DISTRIBUTIONS - RIGHT DOMINANT SYSTEM
POSTERIOR DESCENDING ARTERY (PDA)
POSTERIOR LATERAL VESSELS (PLV)
RIGHT VENTRICULAR (RV) BRANCHES
OBTUSE MARGINAL (OM) BRANCHES
POSTERIOR WALL
POSTERIOR SEPTAL PERFORATORS
RV
SEPTAL WALL
LV
LATERAL WALL
ANTERIOR SEPTAL PERFORATORS
ANTERIOR WALL
CIRCUMFLEX (CX) ARTERY
DIAGNONAL (DIAG) BRANCHES
RIGHT CORONARY ARTERY (RCA)
LEFT MAIN CORONARY ARTERY (LMCA)
LEFT ANTERIOR DESCENDING (LAD) ARTERY (below LMCA)


CORONARY ARTERIAL DISTRIBUTIONS - LEFT DOMINANT SYSTEMS
POSTERIOR DESCENDING ARTERY (PDA)
POSTERIOR LATERAL VESSELS (PLV)
RIGHT VENTRICULAR (RV) BRANCHES
OBTUSE MARGINAL (OM) BRANCHES
POSTERIOR WALL
POSTERIOR SEPTAL PERFORATORS
RV
SEPTAL WALL
LV
LATERAL WALL
ANTERIOR SEPTAL PERFORATORS
ANTERIOR WALL
CIRCUMFLEX (CX) ARTERY
DIAGNONAL (DIAG) BRANCHES
RIGHT CORONARY ARTERY (RCA)
LEFT MAIN CORONARY ARTERY (LMCA)
LEFT ANTERIOR DESCENDING (LAD) ARTERY (below LMCA)

Pat ID [redacted]
01/20/2021 07:46:46
08/17/1955 65 yrs
Account # [redacted]
RX
DX

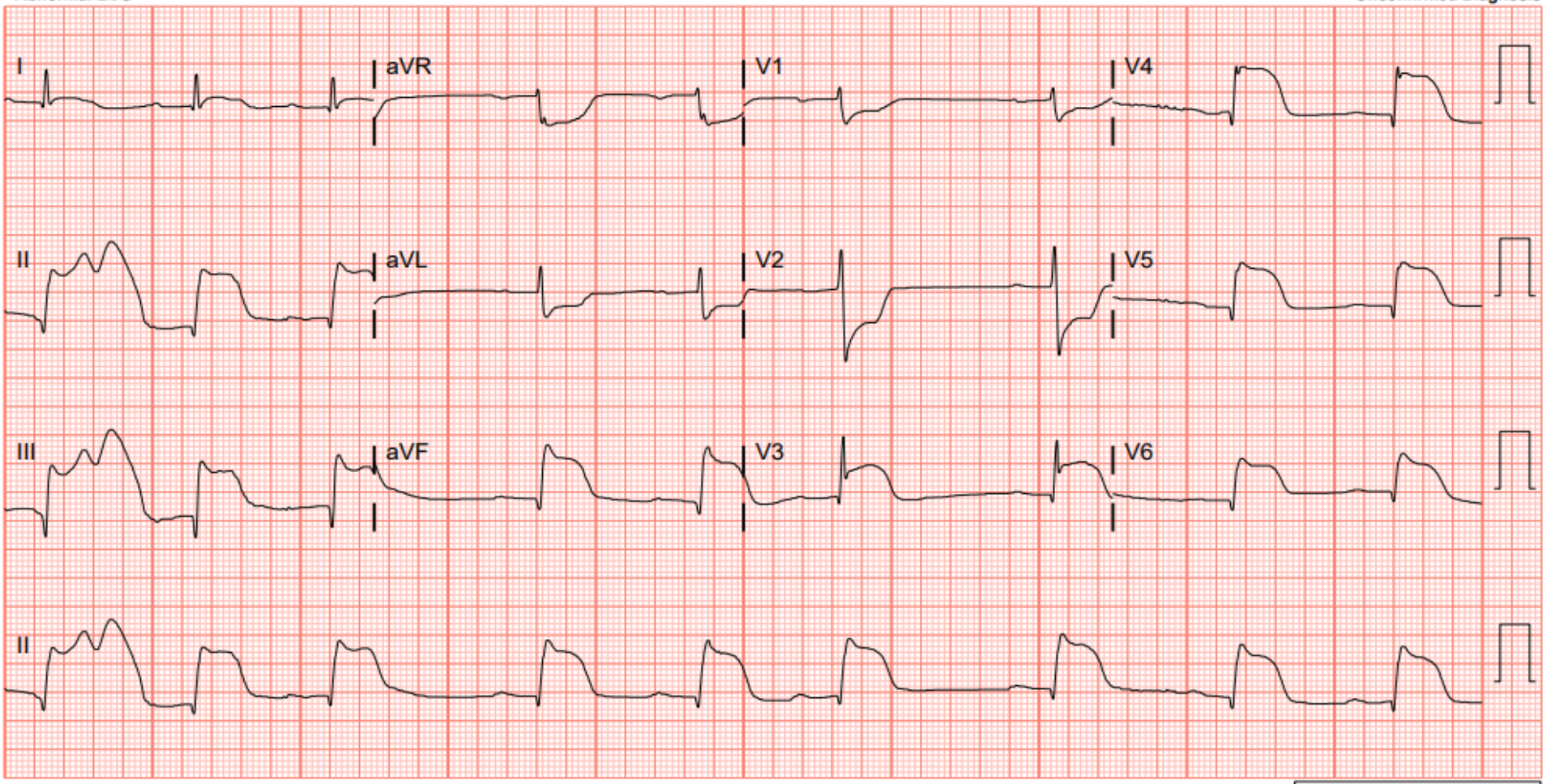
Bayfront Health Seven Rivers ED
Dept ED
Room EDWR
Tech mg

Rate	54	Sinus or ectopic atrial rhythm
PR	329	Atrial premature complex
QRSd	139	Prolonged PR interval
QT	437	Nonspecific intraventricular conduction delay
QTc	415	Inferoposterior infarct, acute (LCx)
--Axis--		Anterolateral infarct, acute
P	-83	Baseline wander in lead(s) V3,V4
QRS	80	NO PREVIOUS ECG AVAILABLE FOR COMPARISON
T	77	

Req Provider: Xandus Chen

- Abnormal ECG -

Unconfirmed Diagnosis



Philips PageWriter TC 25 mm/sec 10.00 mm/mV F 60~ 0.15 - 100 Hz

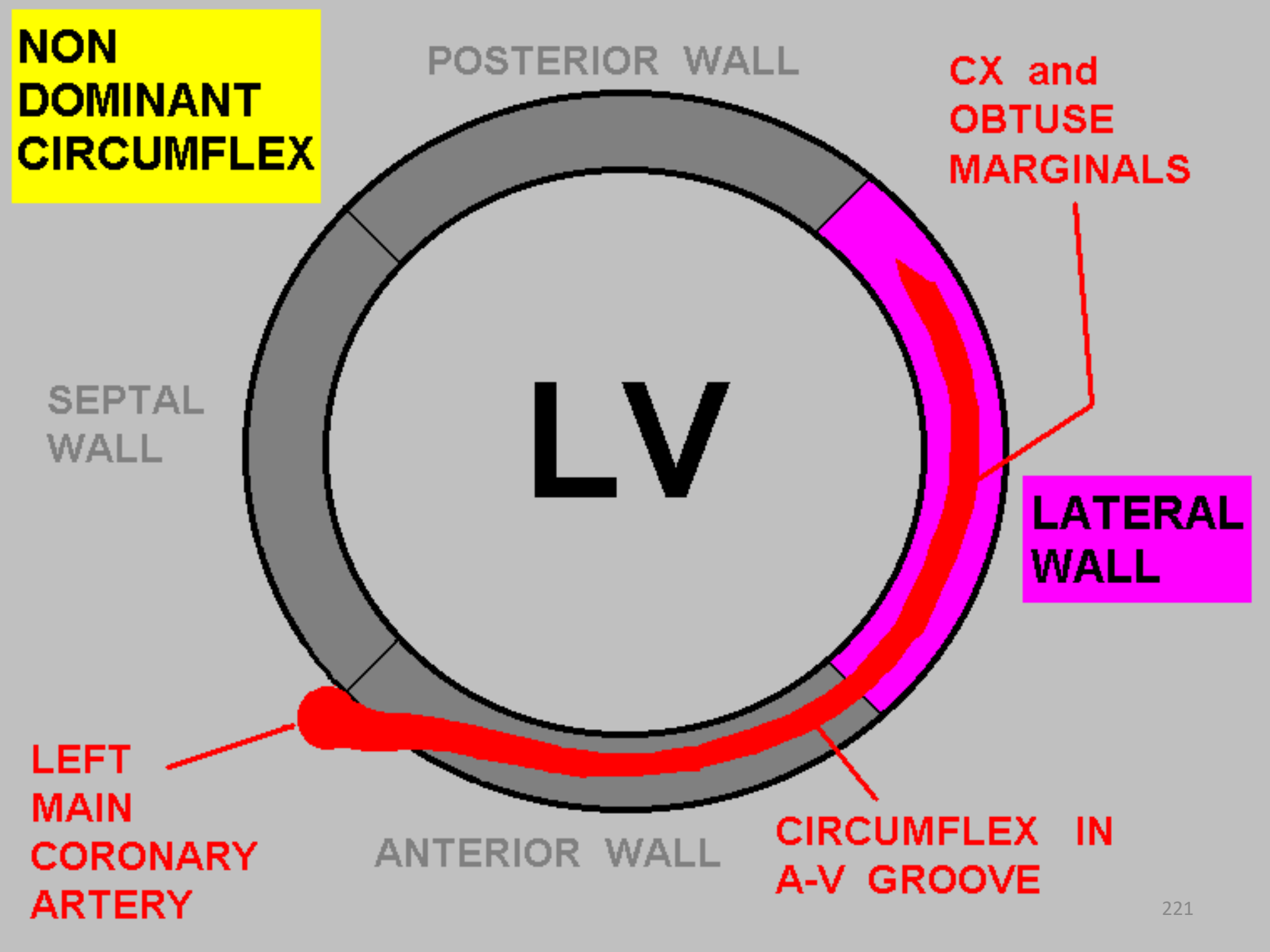
CIRCUMFLEX ARTERY (CX)

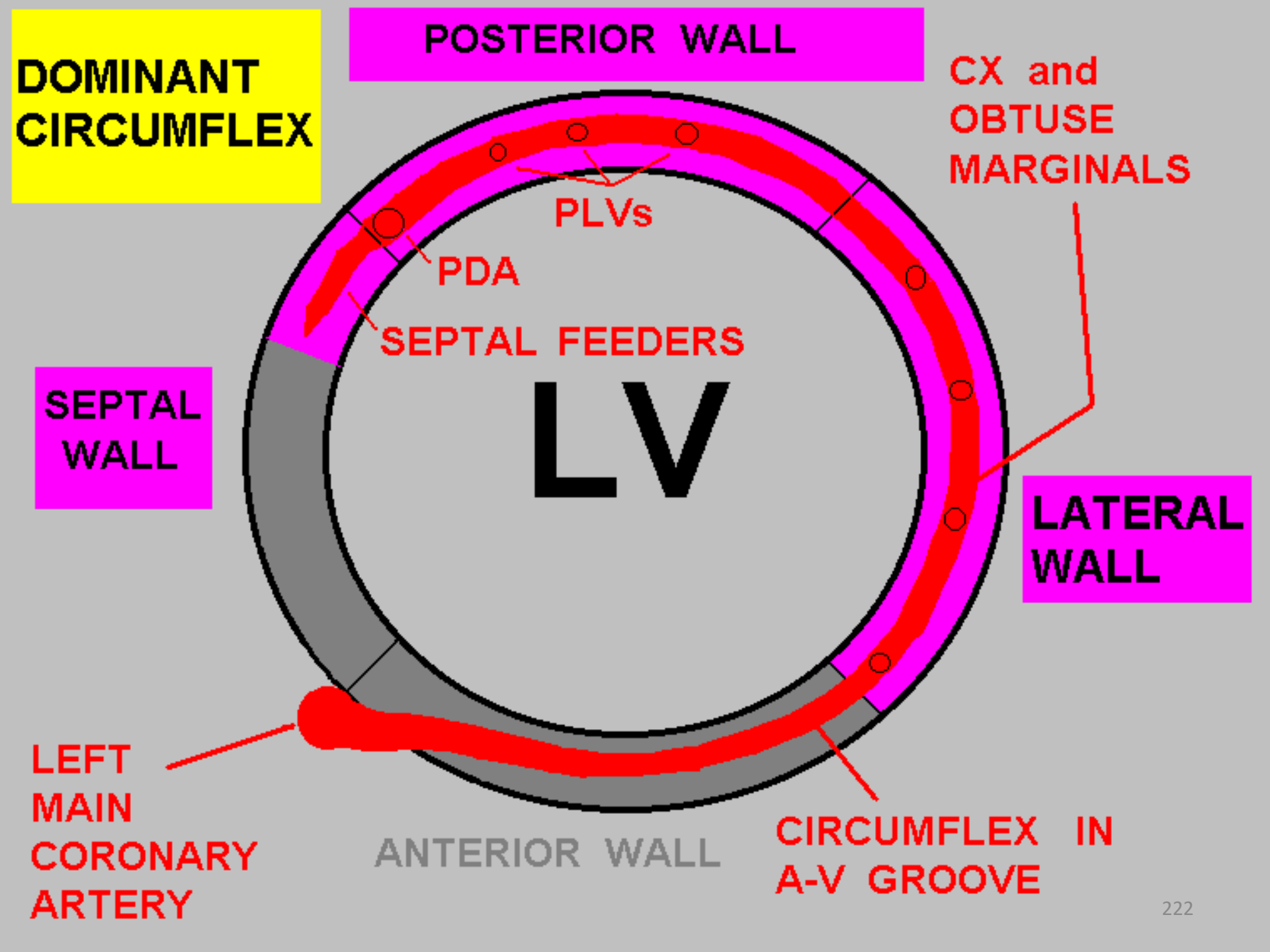
- NON-DOMINANT CX:

CX = 15 - 30% OF LV MASS

- DOMINANT CX:

CX	=	15 - 30% OF LV MASS
+ PDA	=	15 - 25% OF LV MASS
TOTAL		30 - 55% OF LV MASS

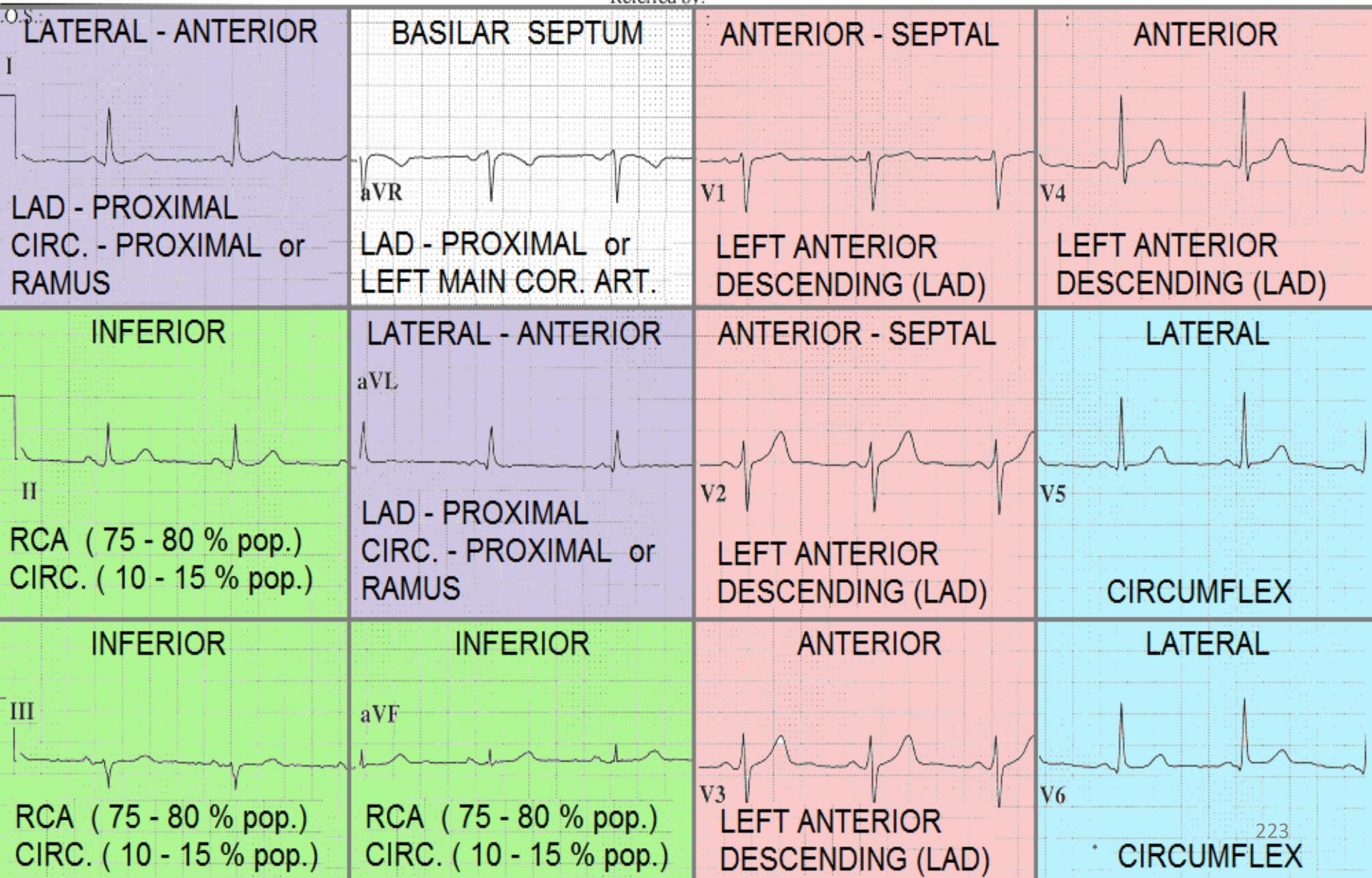

NON DOMINANT CIRCUMFLEX
POSTERIOR WALL
CX and OBTUSE MARGINALS
SEPTAL WALL
LV
LATERAL WALL
LEFT MAIN CORONARY ARTERY
ANTERIOR WALL
CIRCUMFLEX IN A-V GROOVE


DOMINANT CIRCUMFLEX
POSTERIOR WALL
CX and OBTUSE MARGINALS
PLVs
PDA
SEPTAL FEEDERS
LV
SEPTAL WALL
LATERAL WALL
LEFT MAIN CORONARY ARTERY
ANTERIOR WALL
CIRCUMFLEX IN A-V GROOVE

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:

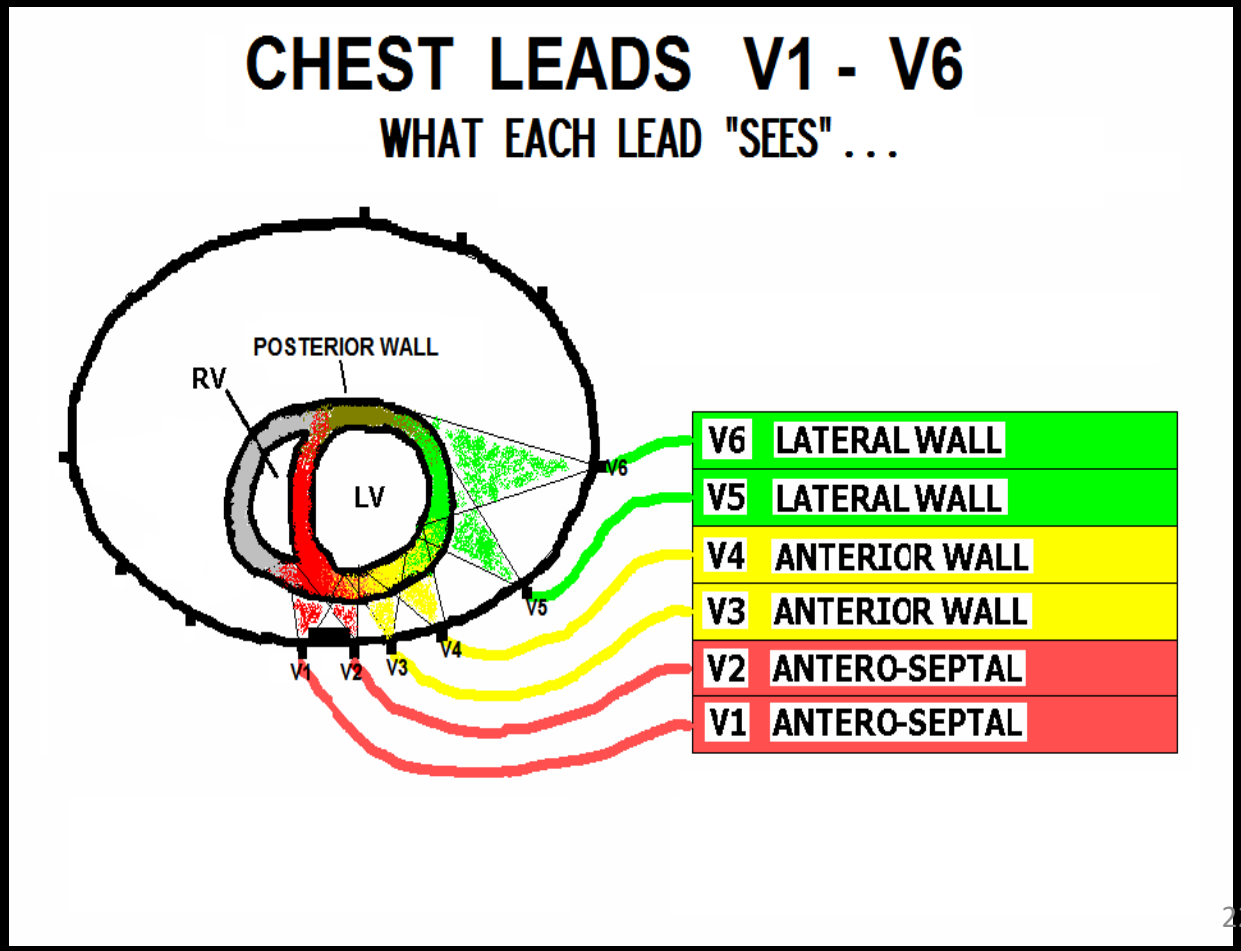


The 12 Lead ECG
Has TWO major BLIND SPOTS . . . . .

The POSTERIOR WALL

&

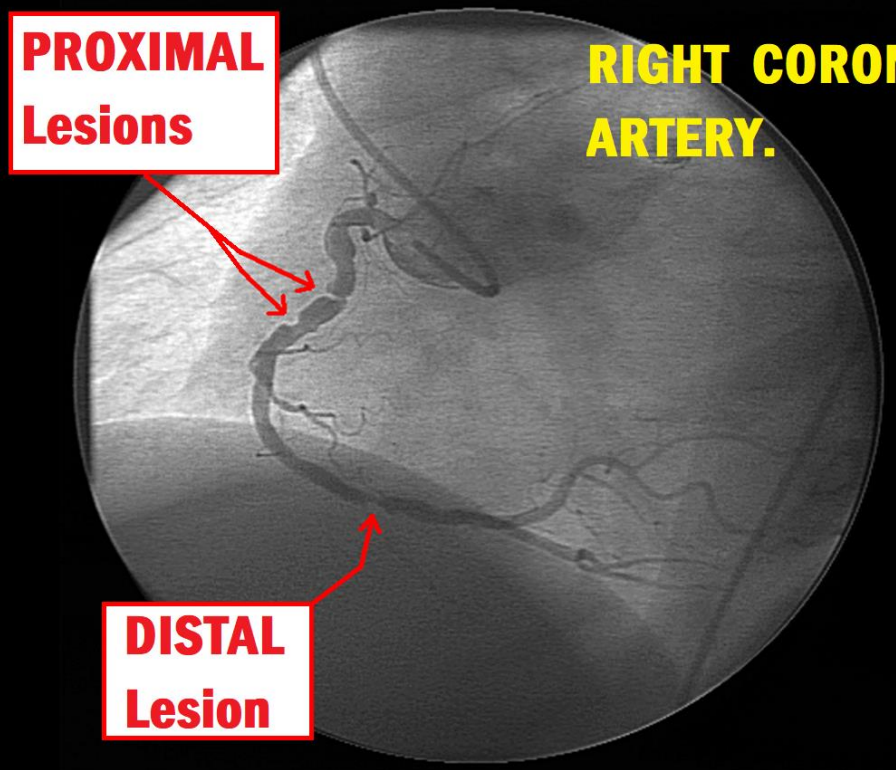
RIGHT VENTRICLE

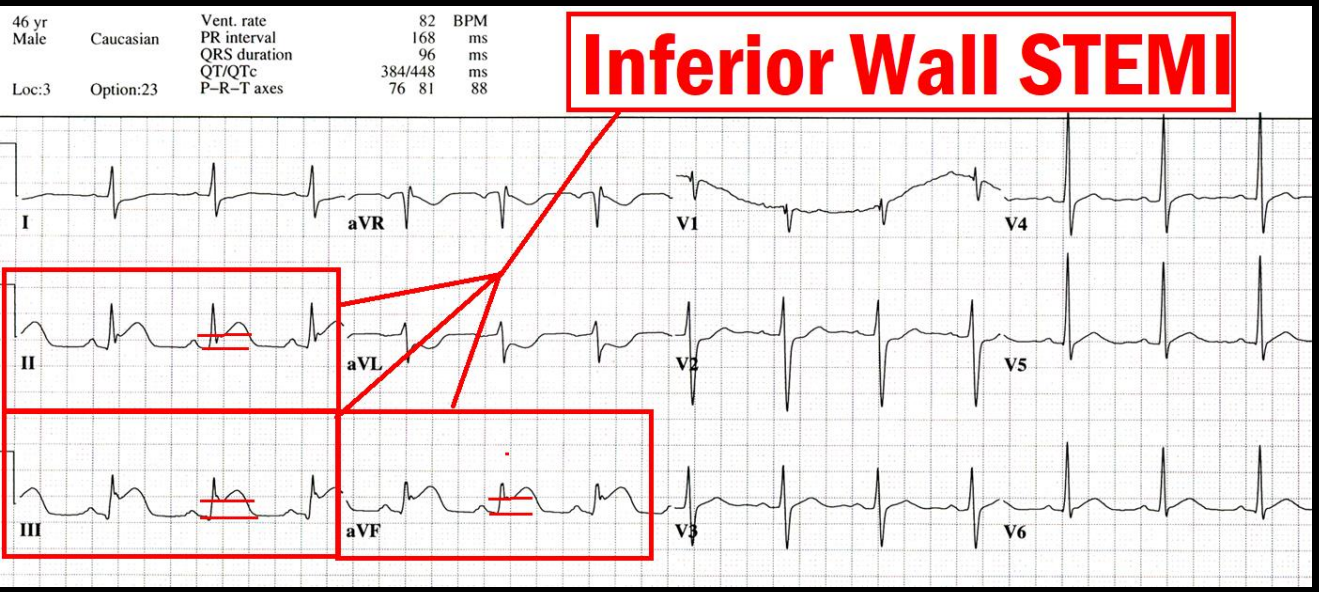


When do we need to see the Right Ventricle?

- All Patient with INFERIOR WALL STEMI (ST Elevation in Leads II, III, aVF).

When you see an EKG with **ST Elevation in Leads II, III and AVF** (Inferior Wall STEMI) – you cannot tell if the blockage is in the PROXIMAL RCA – or the DISTAL RCA.





To see the

RIGHT VENTRICLE . . .

. . . such as in cases of

INFERIOR WALL M.I.

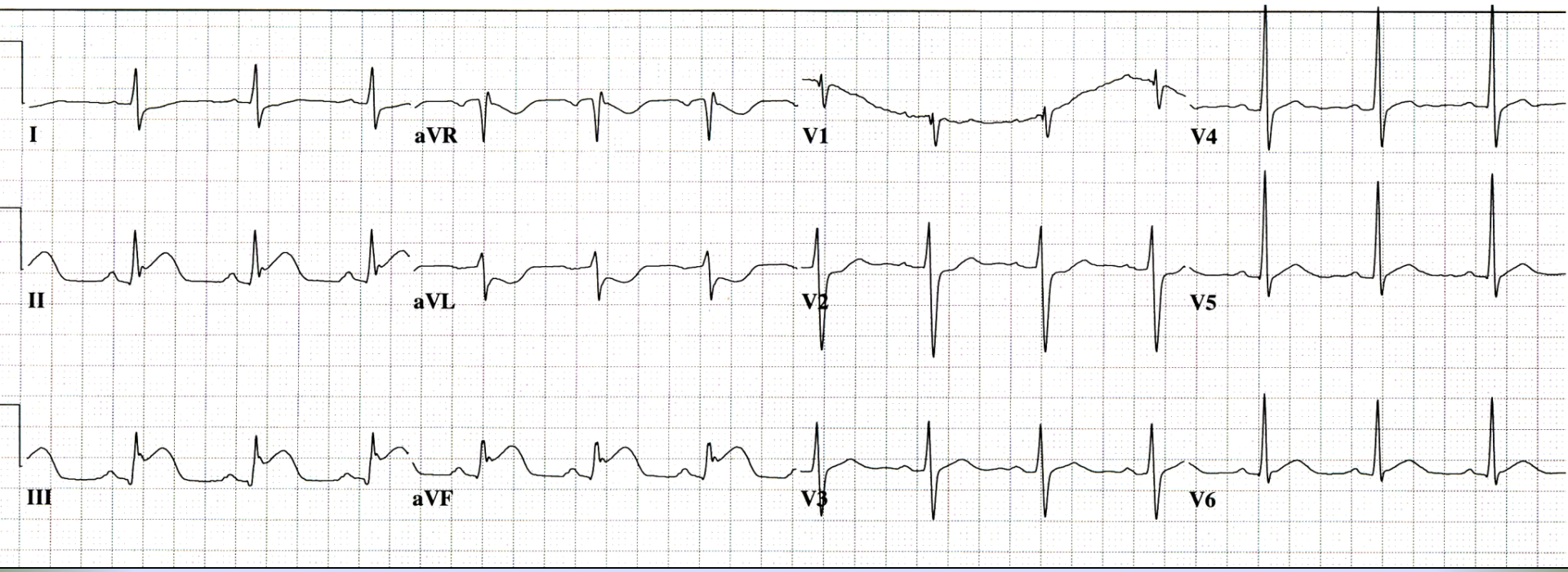
☞ You must do a

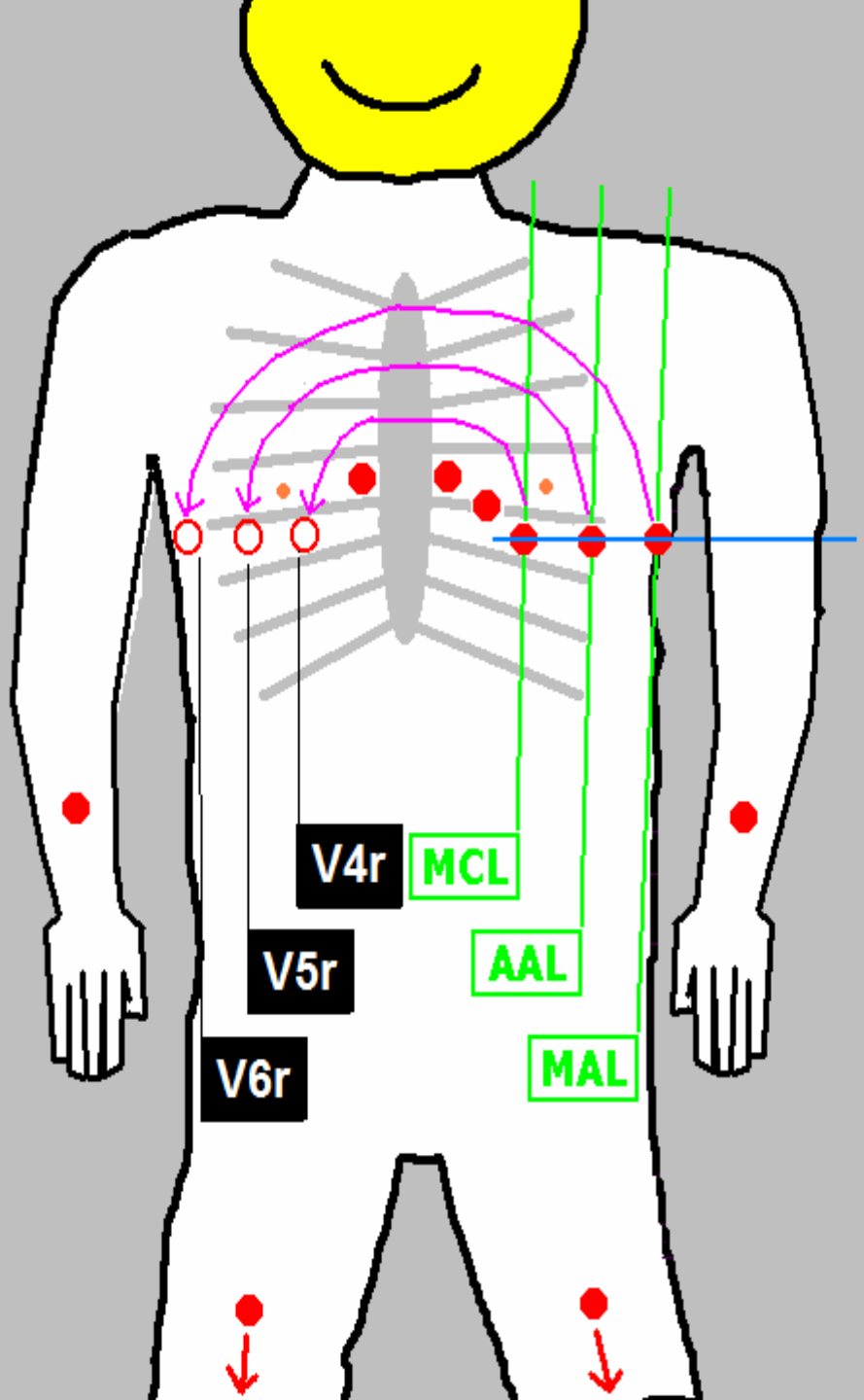
RIGHT - SIDED EKG ! !

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**



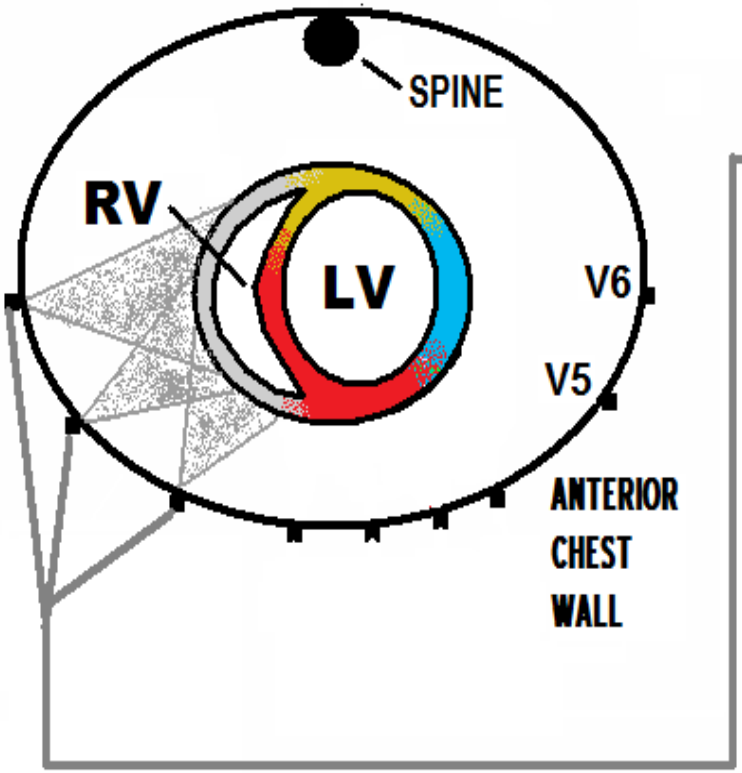


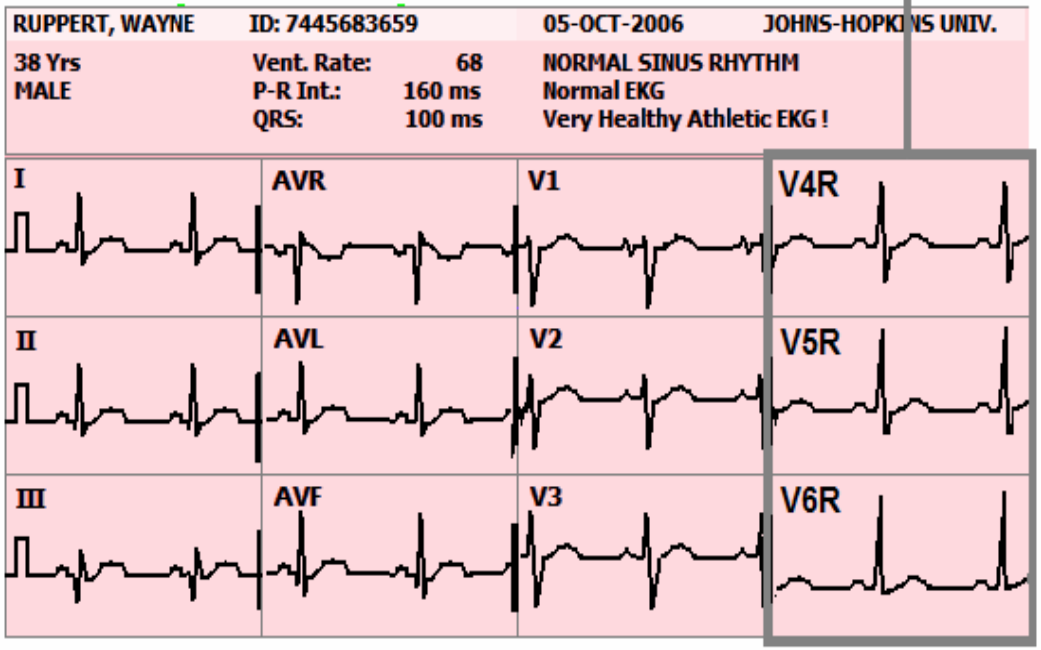
To do a
RIGHT - SIDED EKG . .

MOVE leads
V4, V5, and V6

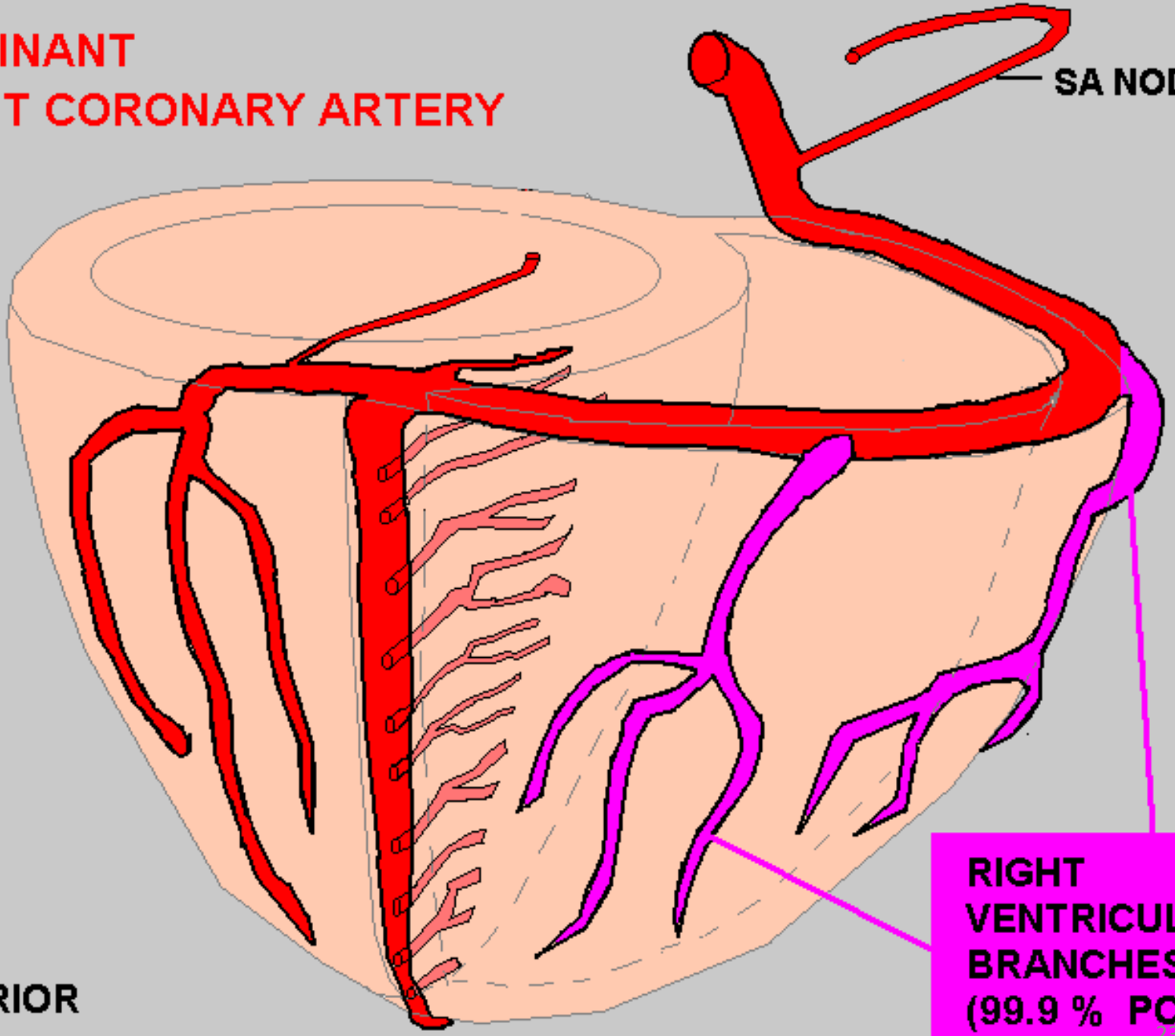
to the corresponding placement on the RIGHT SIDE of patient's chest . . .

V4R - V6R VIEW THE RIGHT VENTRICLE





DOMINANT RIGHT CORONARY ARTERY



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

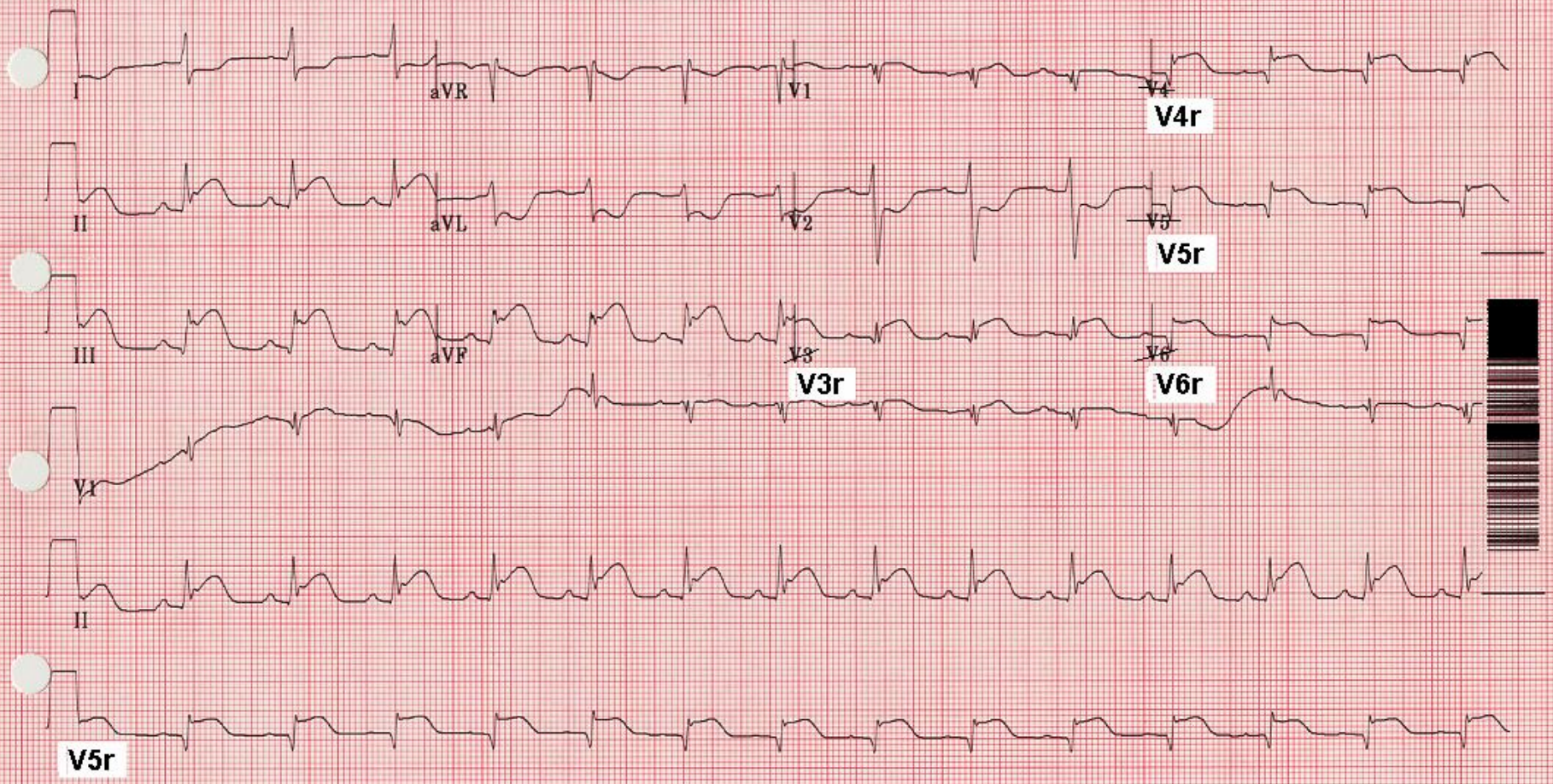
Normal sinus rhythm
~~Anterolateral infarct, possibly acute~~
Inferior injury pattern
** ** ** ** * Acute MI * ** ** ** **
Abnormal ECG

Right Ventricular Infarct

V LEADS
R SIDE

Referred by:

Unconfirmed



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

When do we need to see the Posterior Wall?

- Any time a patient presents with symptoms of ACS and the 12 Lead ECG shows ST Depression in Leads V1, V2, V3 and/or V4.

Whenever you see

ST DEPRESSION in Leads V1 - V4

you must do a

POSTERIOR LEAD ECG

(V7 - V9)

to see if you Patient is having a

POSTERIOR WALL STEMI

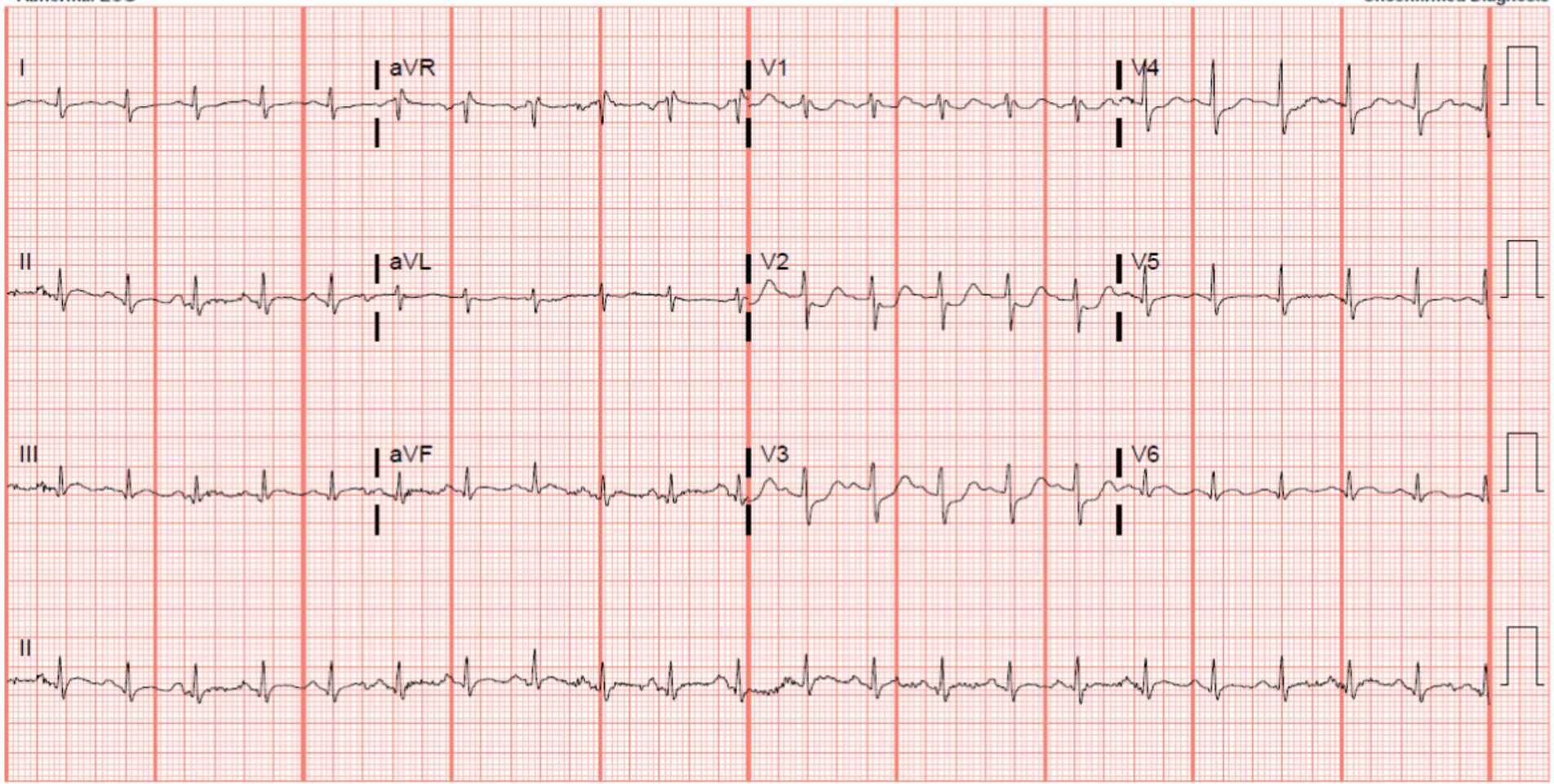
Pat ID [redacted]
[redacted]2019 22:07:54
[redacted] 46 yrs
[redacted]
Caucasian Female
Account # [redacted]
Bayfront Health Seven Rivers ED
Dept ED
Room [redacted]
Tech LDC
RX
DX

Rate	131	Sinus tachycardia
PR	128	Probable inferior infarct, old
QRSd	92	Posterior infarct, acute (LCx)
QT	317	ST depression V1-V3, suggest recording posterior leads
QTc	468	NO PREVIOUS ECG AVAILABLE FOR COMPARISON
--Axis--		
P	65	
QRS	83	
T	132	

Req Provider: CHARLES NOLES

- Abnormal ECG -

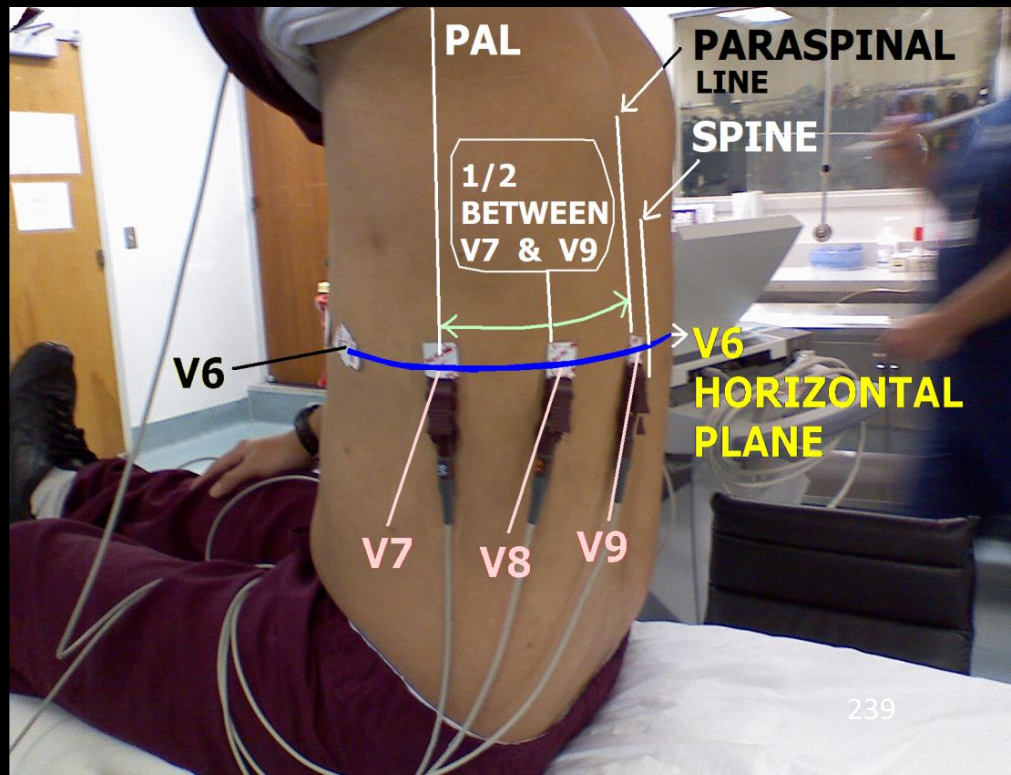
Unconfirmed Diagnosis

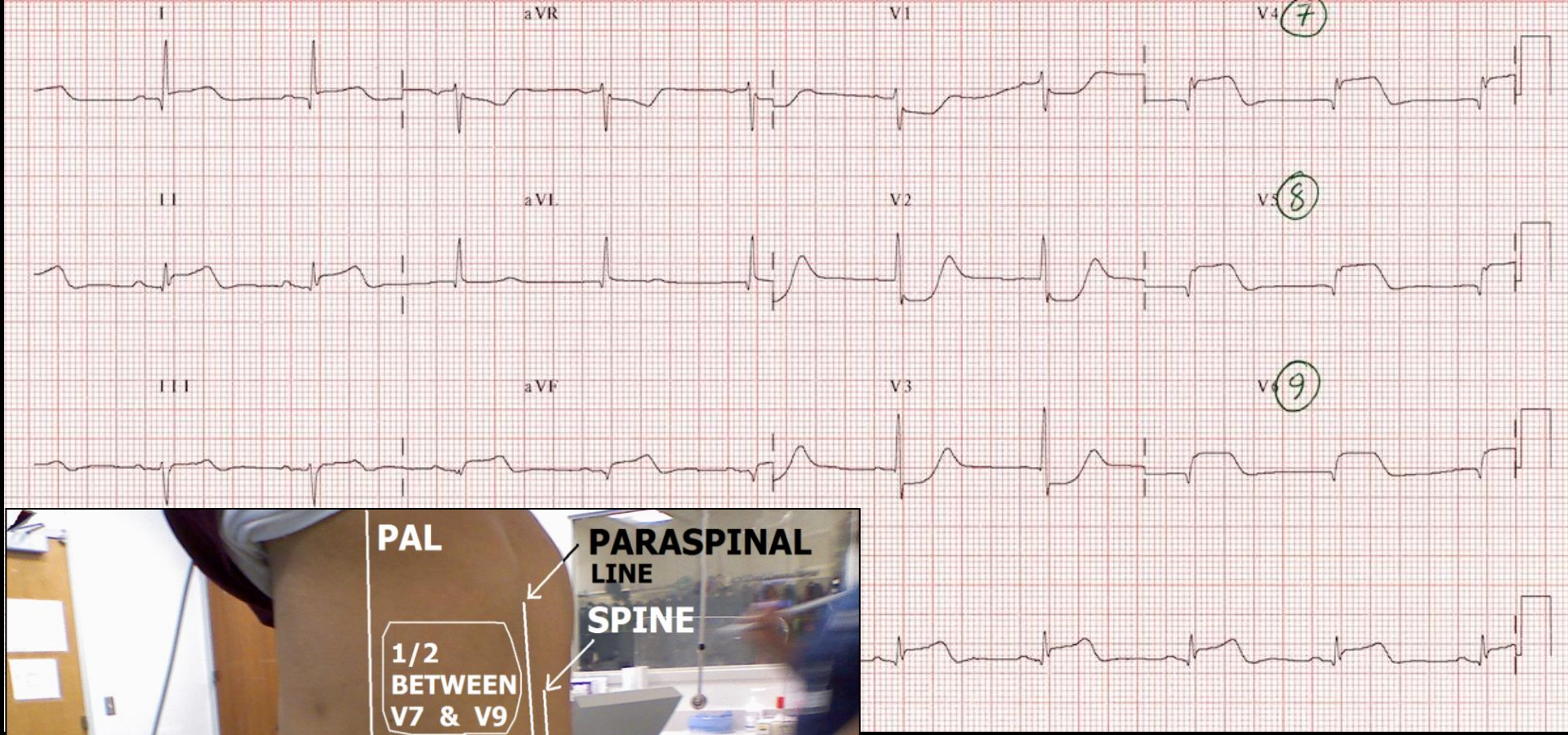


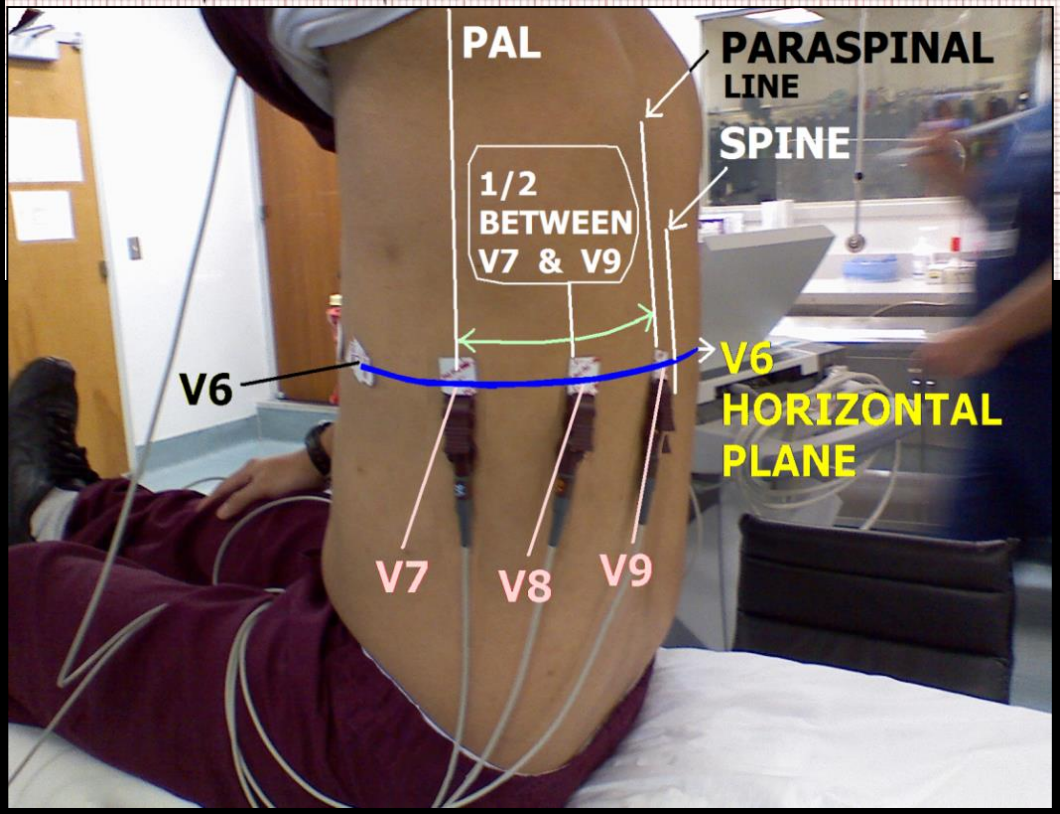
Philips PageWriter TC 25 mm/sec 10.00 mm/mV F 60~ 0.15 - 100 Hz

Whenever your patient's ECG exhibits ST DEPRESSION in any of the ANTERIOR LEADS (V1-V4), CONSIDER the possibility of POSTERIOR WALL STEMI ! !

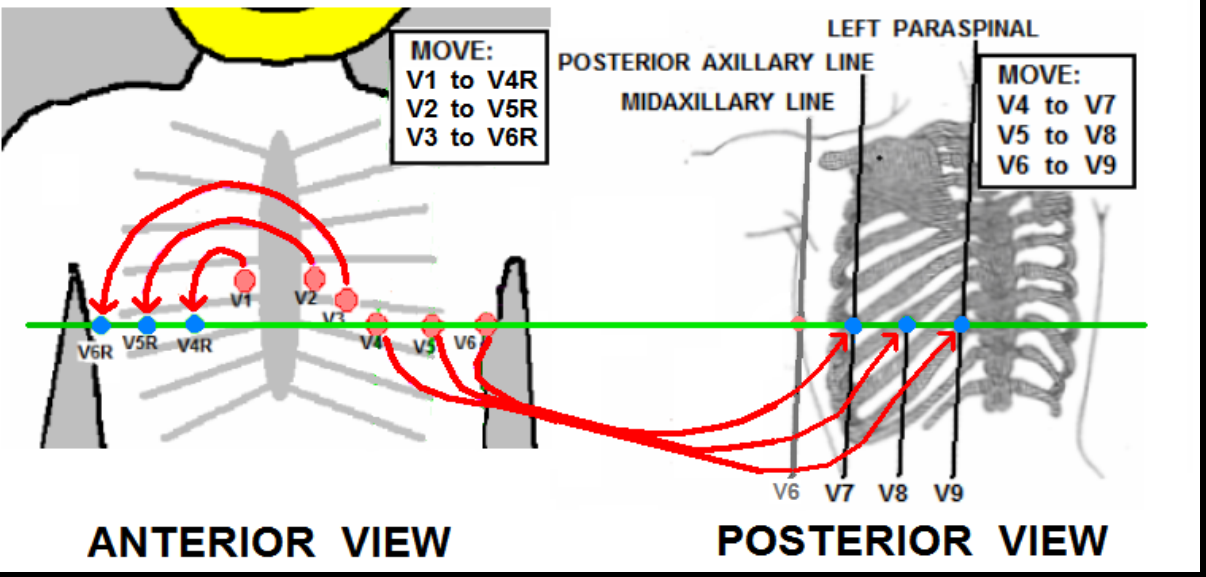
. . . To DIGANOSE Posterior Wall STEMI, we should see LEADS V7 – V9 !!




I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
7
8
9

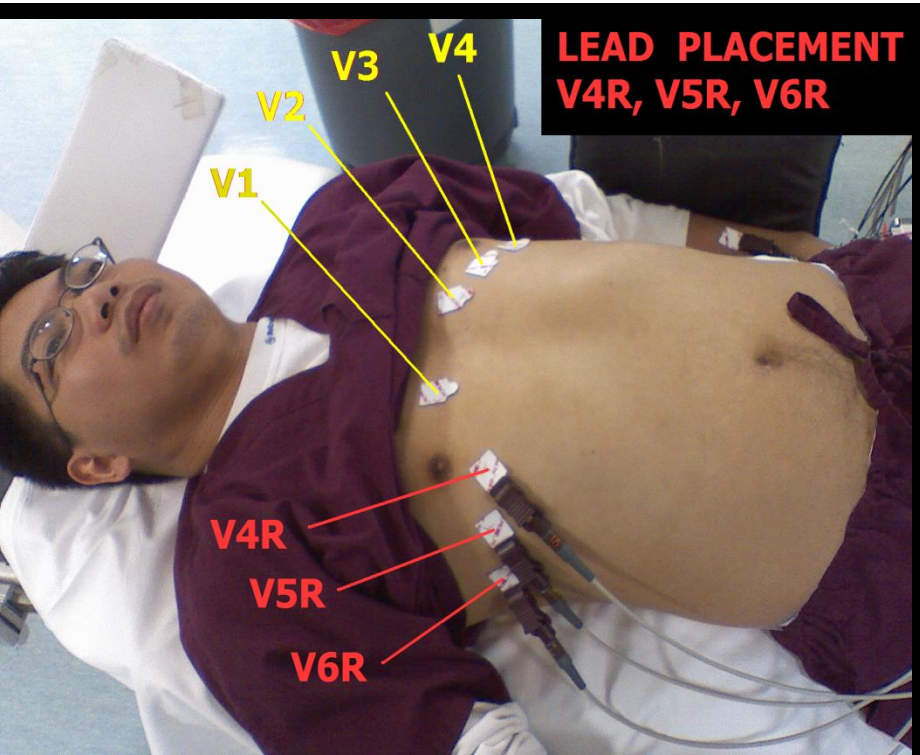

PAL
PARASPINAL LINE
SPINE
1/2 BETWEEN V7 & V9
V6
V6 HORIZONTAL PLANE
V7
V8
V9

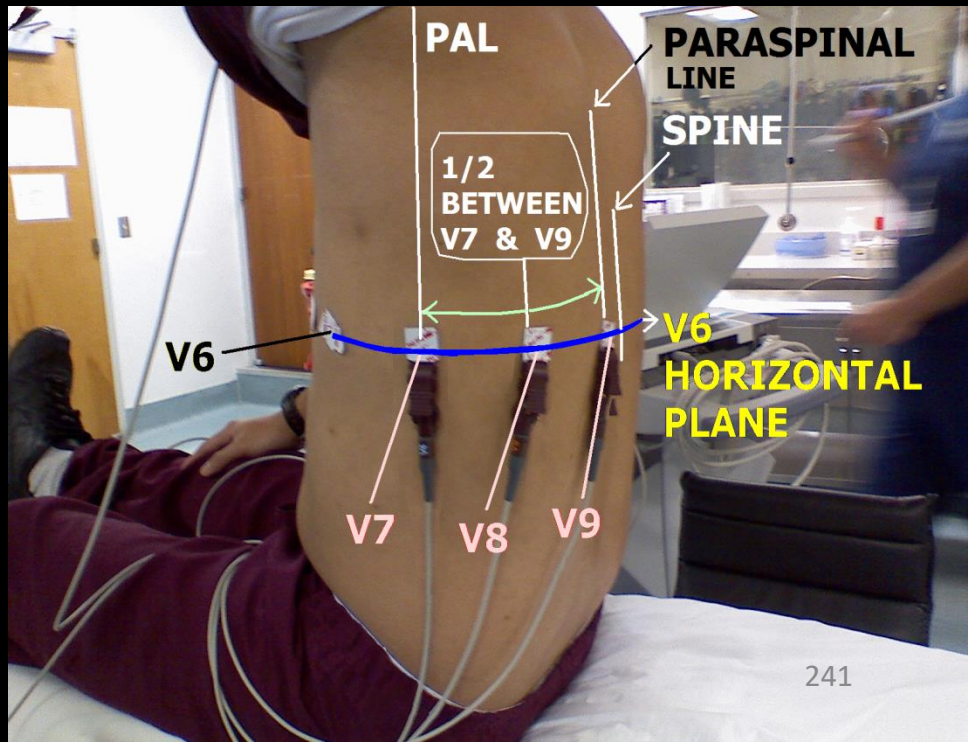
HOW TO REPOSITION 6 CHEST LEADS to OBTAIN 3 R VENTRICLE and 3 POSTERIOR LEADS

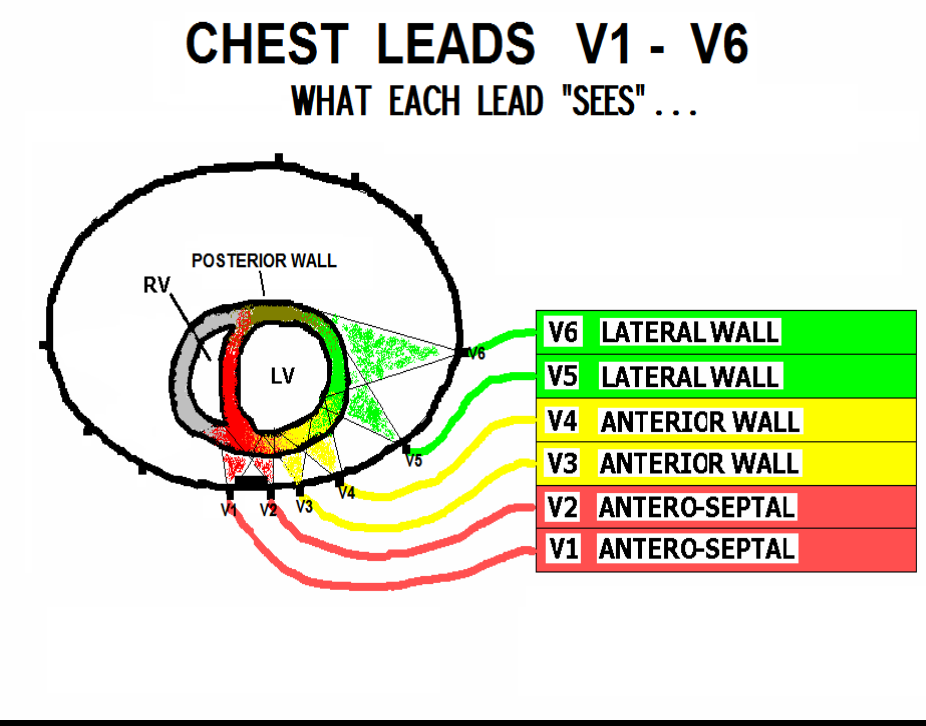


ANTERIOR VIEW

POSTERIOR VIEW

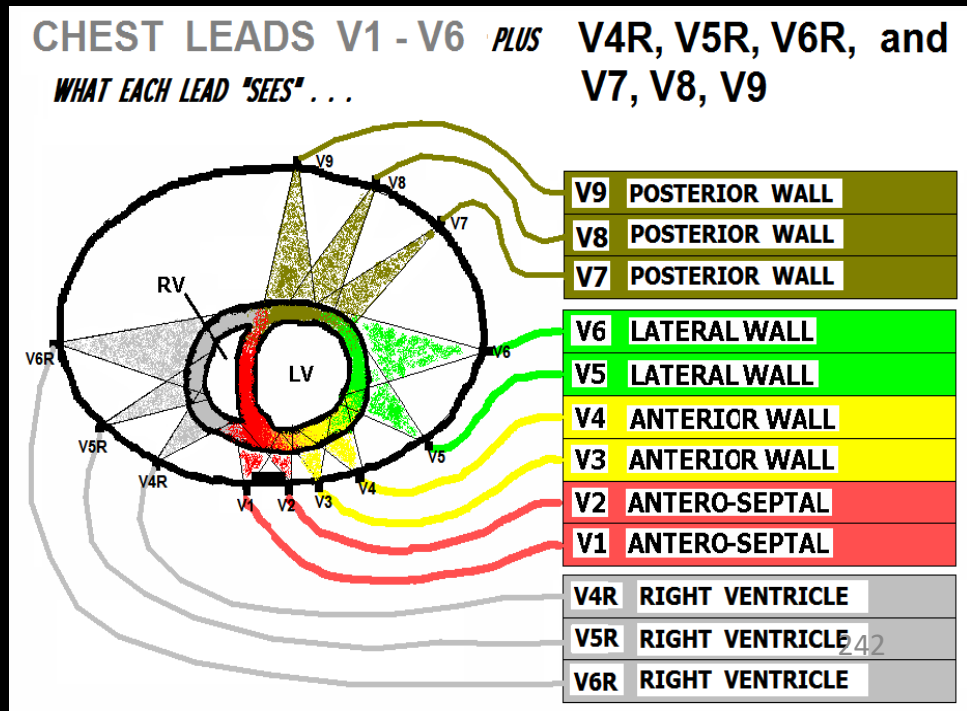






⇦ The 12 Lead ECG

The 18 Lead ECG ⇨



34years
Male Asian

Room:

Opt:

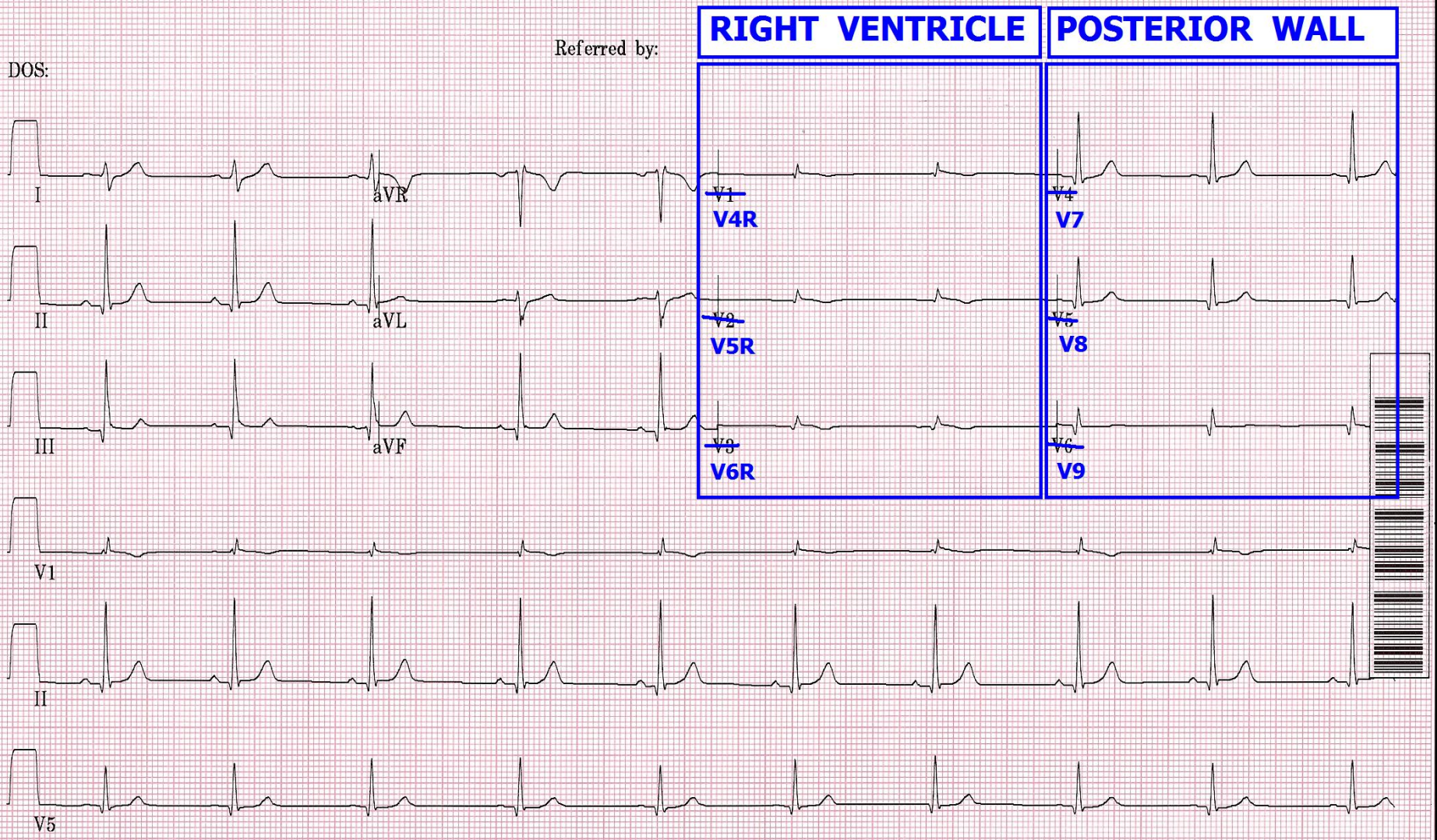
Technician: WR

Vent. rate 58 bpm
PR interval 146 ms
QRS duration 82 ms
QT/QTc 372/365 ms
P-R-T axes 29 82 50

Sinus bradycardia
~~RSR' or QR pattern in V1 suggests right ventricular conduction delay~~
~~Cannot rule out Anteroseptal infarct, age undetermined~~
~~Abnormal ECG~~

Referred by:

DOS:



40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MAC5K 007A.2 12SL™v235

POSTERIOR WALL MI usually accompanies INFERIOR and/or LATERAL WALL MI !!!

POSTERIOR WALL MI usually accompanies INFERIOR and/or LATERAL WALL MI !!!

. . . . On rare occasions, we see isolated cases of POSTERIOR WALL MI

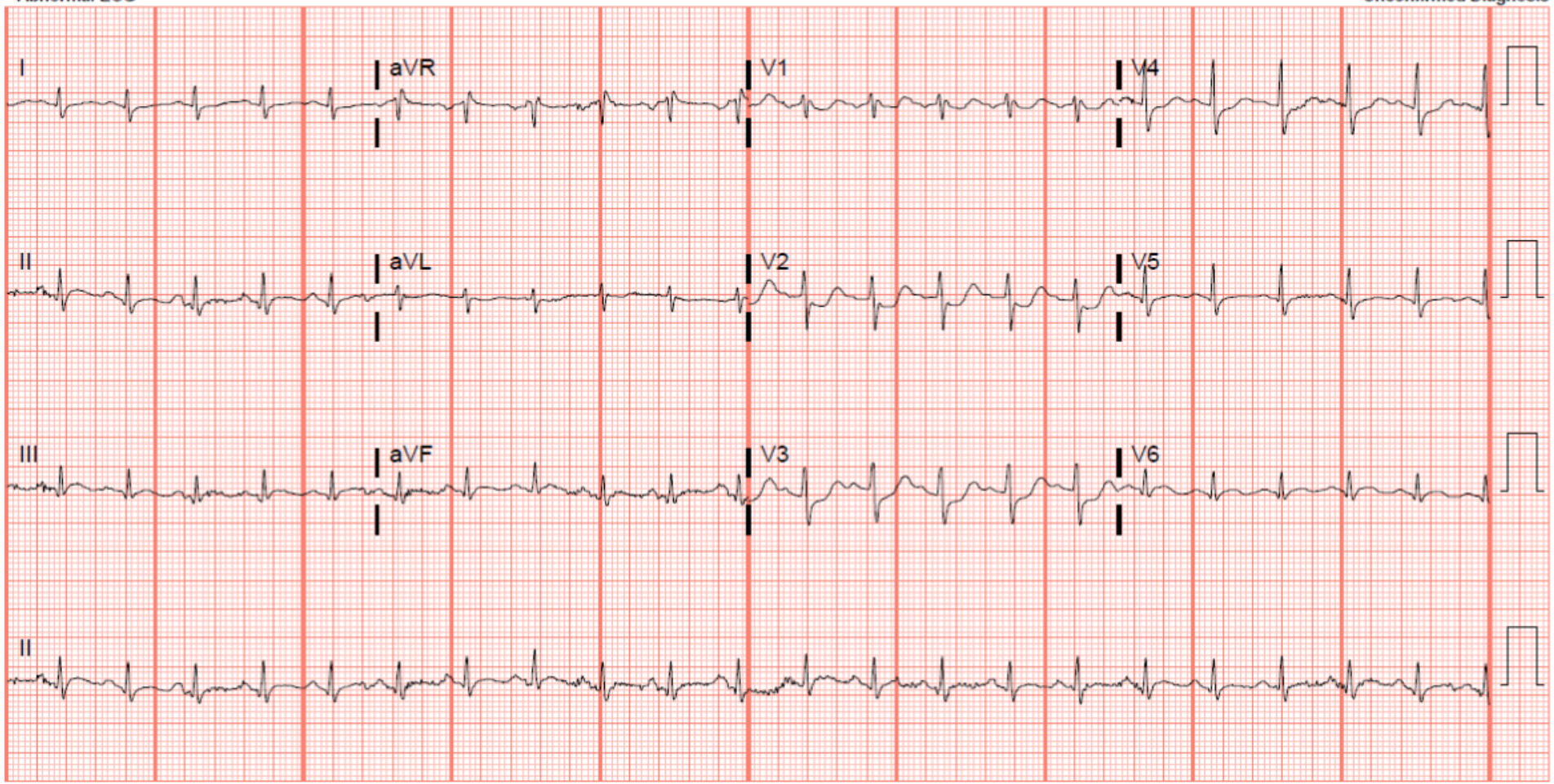
Pat ID [redacted]
[redacted]2019 22:07:54
[redacted] 46 yrs
[redacted]
Caucasian Female
Account # [redacted]
Bayfront Health Seven Rivers ED
Dept ED
Room [redacted]
Tech LDC
RX
DX

Rate	131	Sinus tachycardia
PR	128	Probable inferior infarct, old
QRSd	92	Posterior infarct, acute (LCx)
QT	317	ST depression V1-V3, suggest recording posterior leads
QTc	468	NO PREVIOUS ECG AVAILABLE FOR COMPARISON
--Axis--		
P	65	
QRS	83	
T	132	

Req Provider: CHARLES NOLES

- Abnormal ECG -

Unconfirmed Diagnosis



Philips PageWriter TC 25 mm/sec 10.00 mm/mV F 60~ 0.15 - 100 Hz

“ROAD TO FOREVER,” Rt 385, Oklahoma panhandle, 1994

Your patient has chest pain……

Your patient has chest pain……

You obtain a STAT 12 Lead ECG……

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

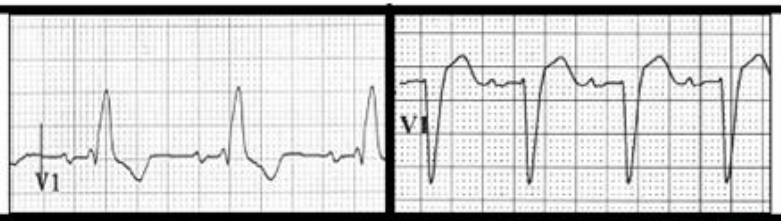
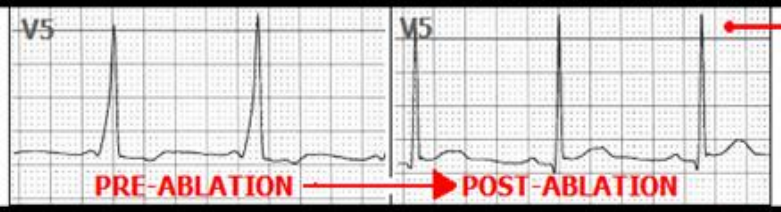
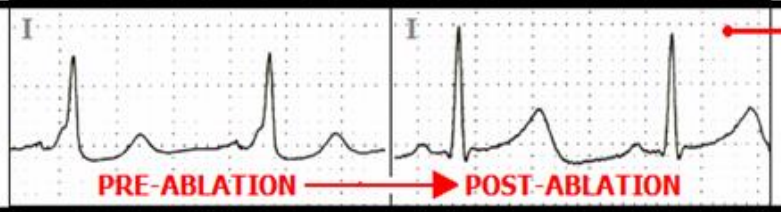
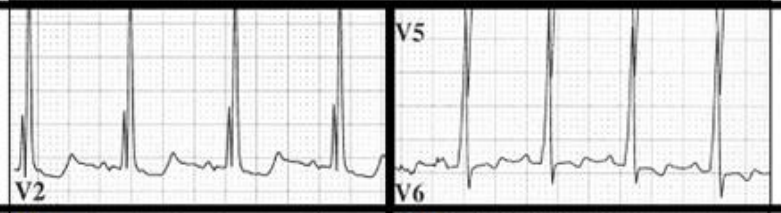
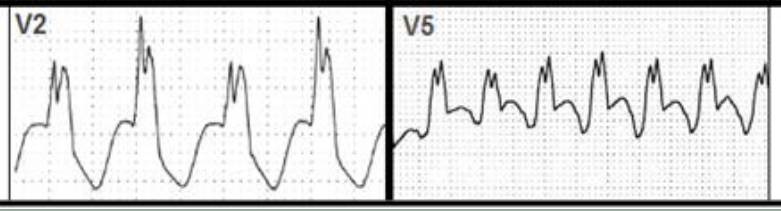
STEP 1 – evaluate QRS width:

- **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:

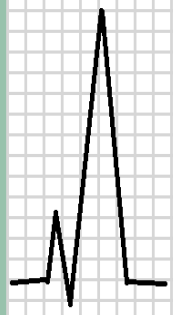
RIGHT BUNDLE BRANCH BLOCK		LEFT BUNDLE BRANCH BLOCK
W-P-W BYPASS TRACT, LEFT LATERAL WALL 49 y/o MALE		SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT
W-P-W BYPASS TRACT, RIGHT ANTERIOR/ LATERAL WALL 14 y/o MALE		SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS 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

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



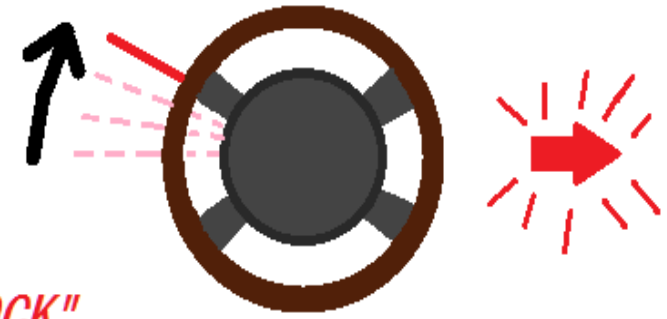
USE LEAD V1 for this technique

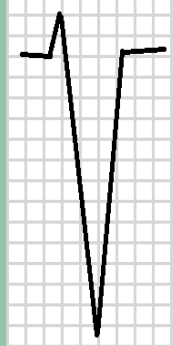
To make a **RIGHT TURN**

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

THINK:

"QRS points UP = RIGHT BUNDLE BRANCH BLOCK"



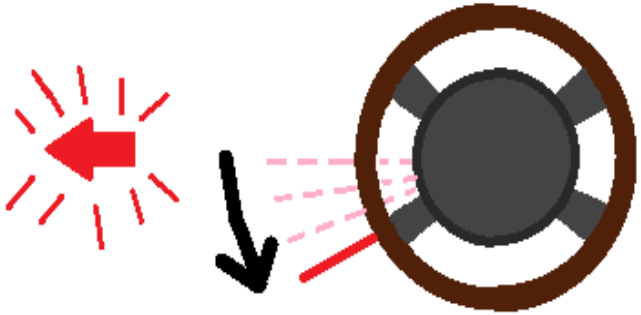


To make a **LEFT TURN**

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

THINK:

"QRS points DOWN = LEFT BUNDLE BRANCH BLOCK"

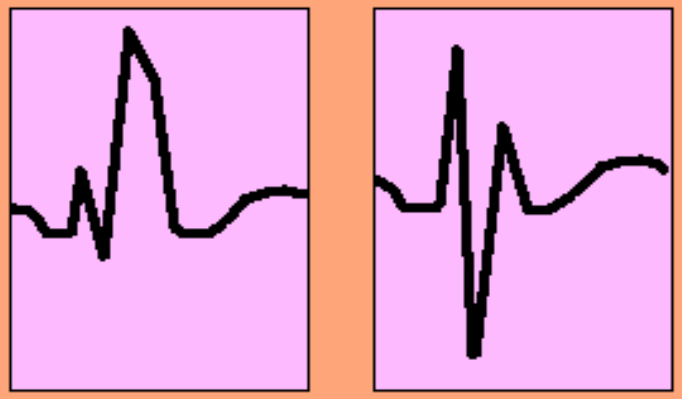


DIAGNOSING BUNDLE BRANCH BLOCK

USING LEADS V1, V2, and V5, V6:

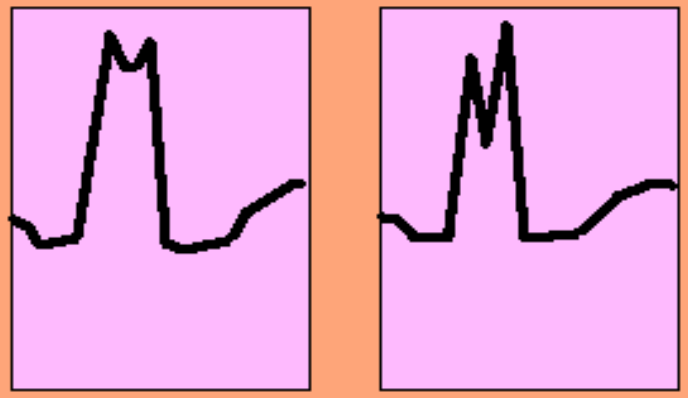
LOCATING RsR' or RR' COMPLEXES:

V1 V2



RIGHT BUNDLE BRANCH BLOCK

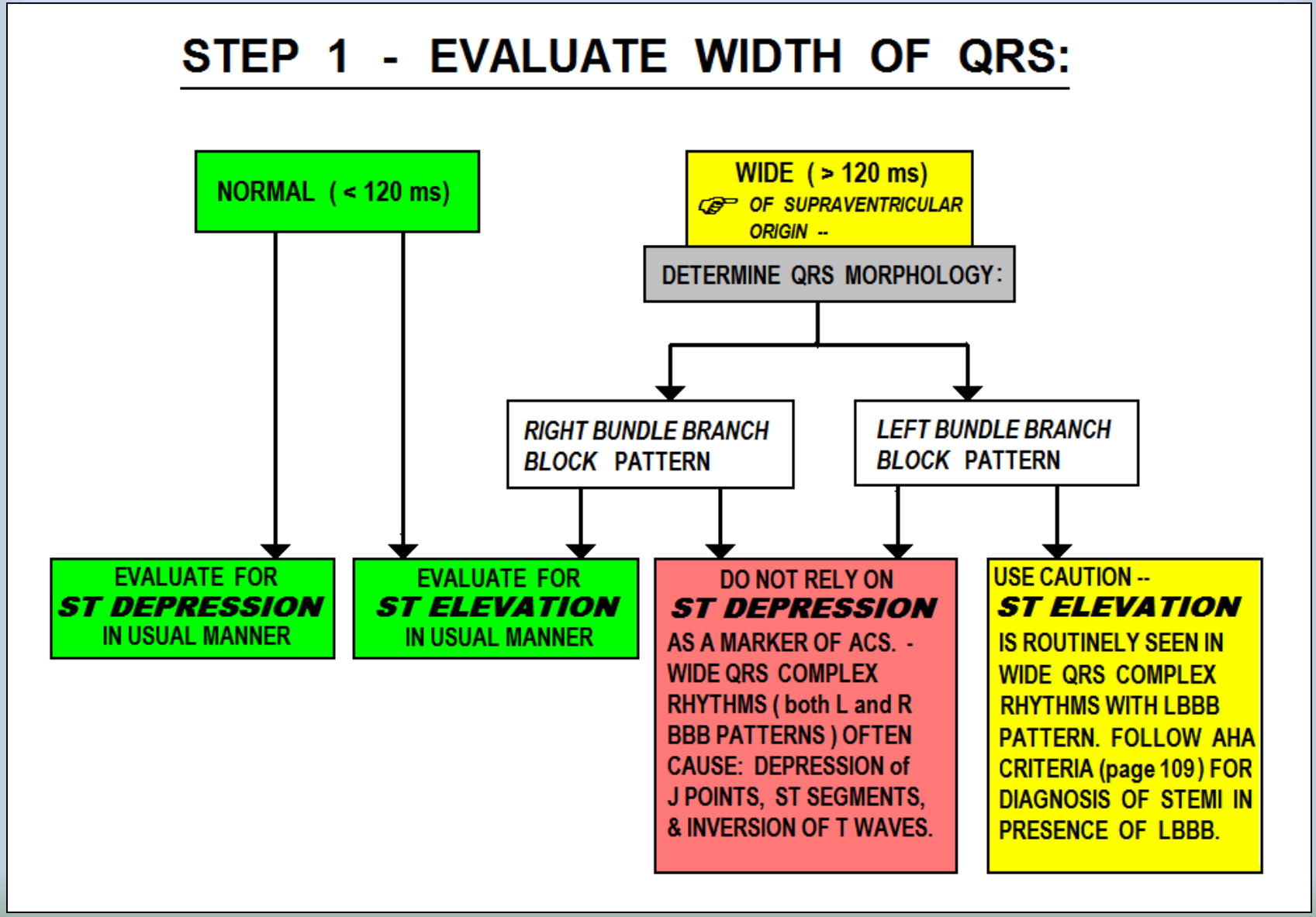
V5 V6



LEFT BUNDLE BRANCH BLOCK

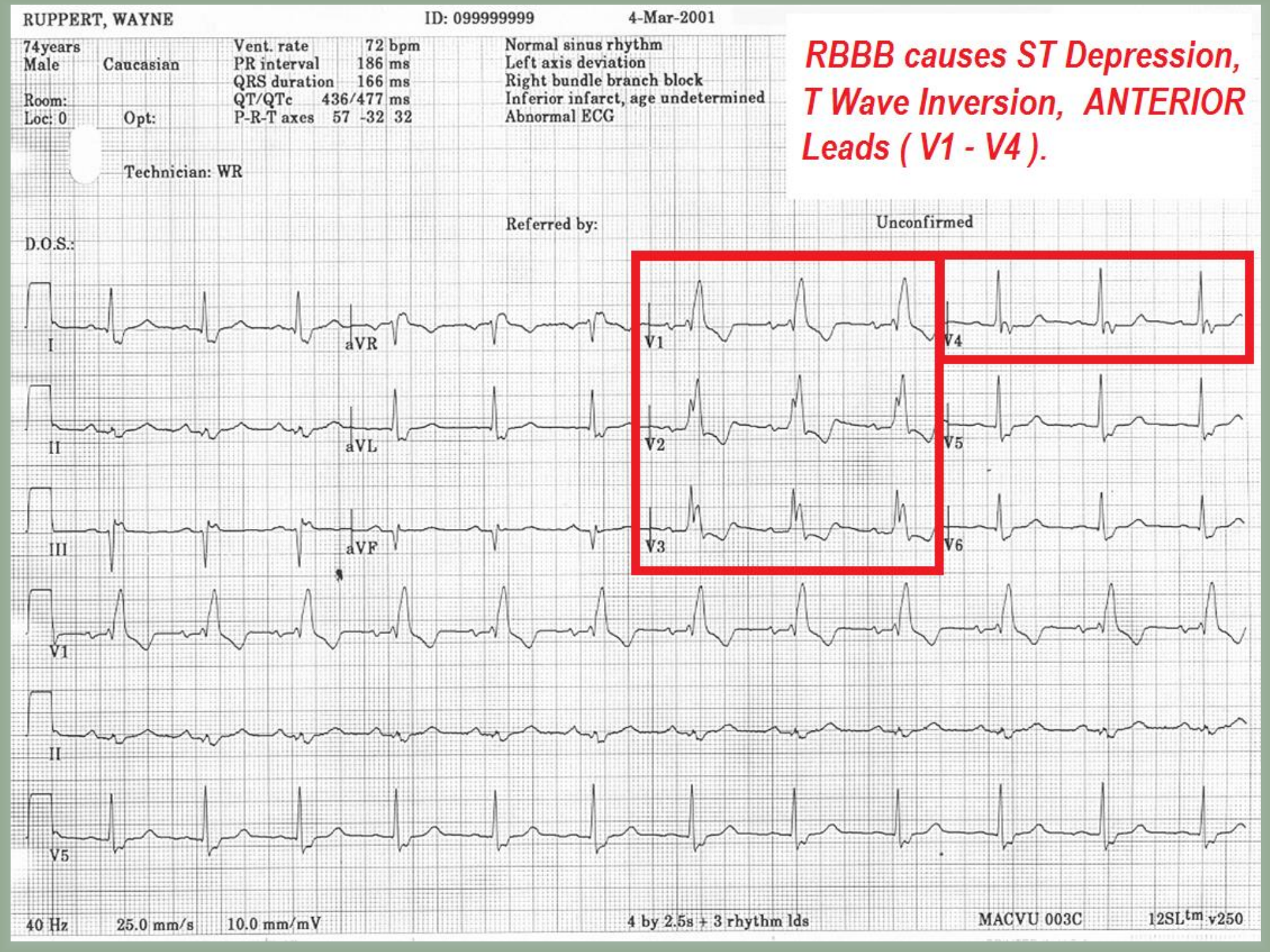
From: “Rapid Interpretation of ECGs” by Dale Dubin, MD

Evaluating the ECG for ACS:



Wide QRS present:
(QRSd > 120ms)

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


RUPPERT, WAYNE
ID: 099999999
4-Mar-2001
74years
Male
Caucasian
Room:
Loc: 0
Opt:
Technician: WR
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
RBBB causes ST Depression, T Wave Inversion, ANTERIOR Leads (V1 - V4).
Referred by:
Unconfirmed
D.O.S.:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
40 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 3 rhythm lds
MACVU 003C
12SL tm v250

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

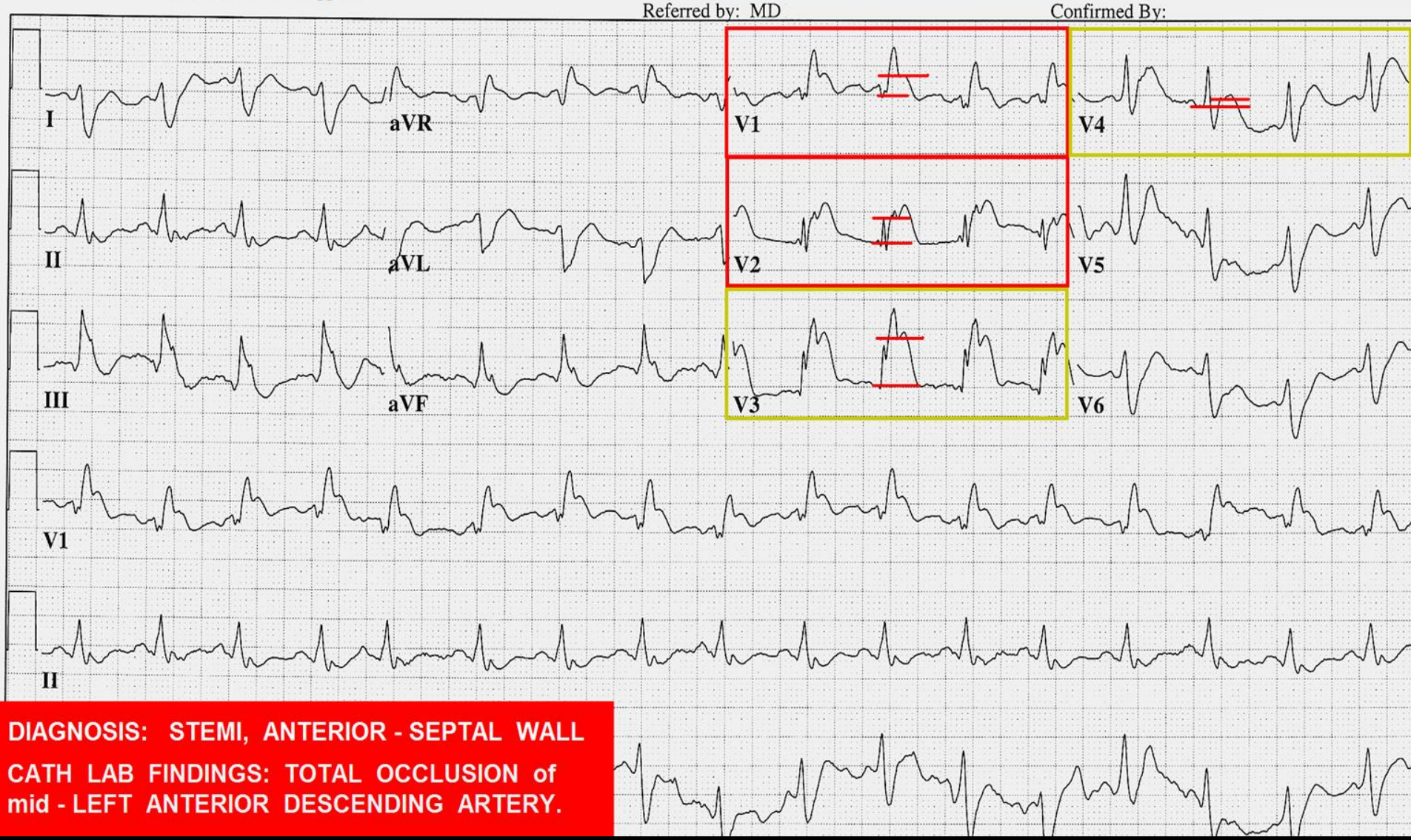
Vent. rate	102	BPM
PR interval	130	ms
QRS duration	168	ms
QT/QTc	400/521	ms
P–R–T axes	60 114	–19

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

25 yr Male Caucasian

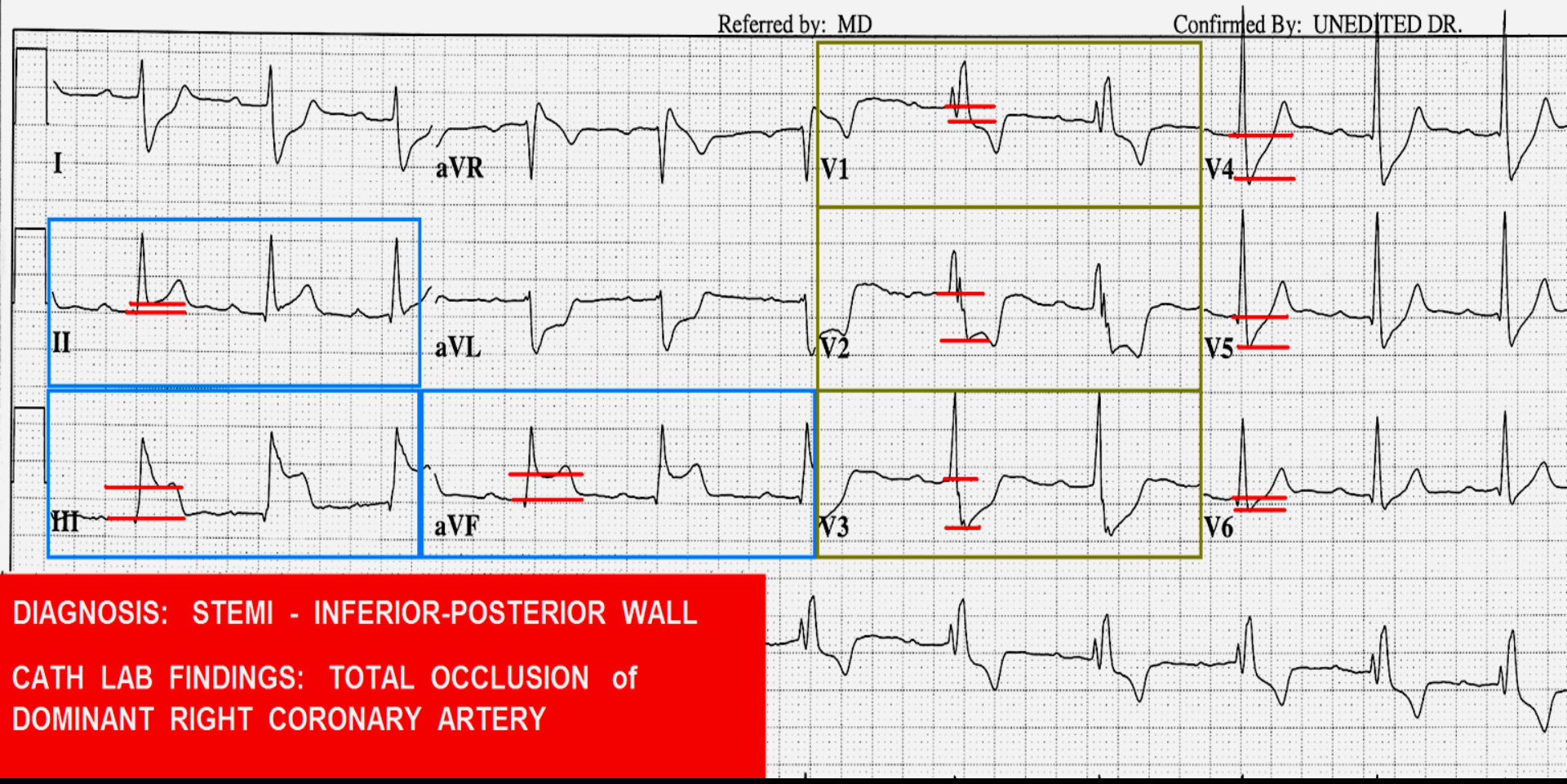
Loc:3 Option:23

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

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

Referred by: MD

Confirmed By: UNEDITED DR.



DIAGNOSIS: STEMI - INFERIOR-POSTERIOR WALL

CATH LAB FINDINGS: TOTAL OCCLUSION of DOMINANT RIGHT CORONARY ARTERY

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

75 yr
Male Caucasian

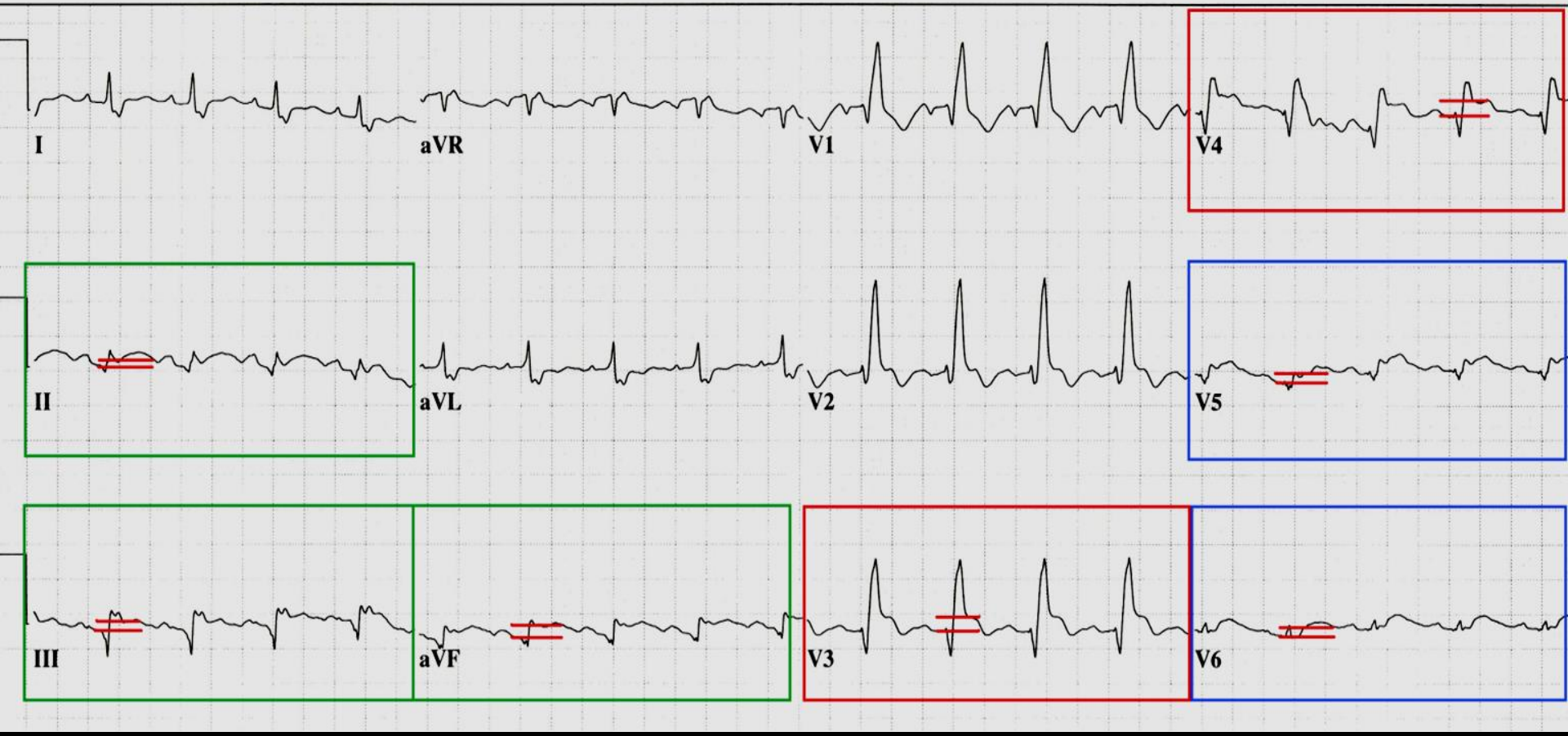
Room:CS-19
Loc:6 Option:41

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

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

ACUTE LATERAL - INFERIOR - ANTERIOR AMI

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



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***

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.

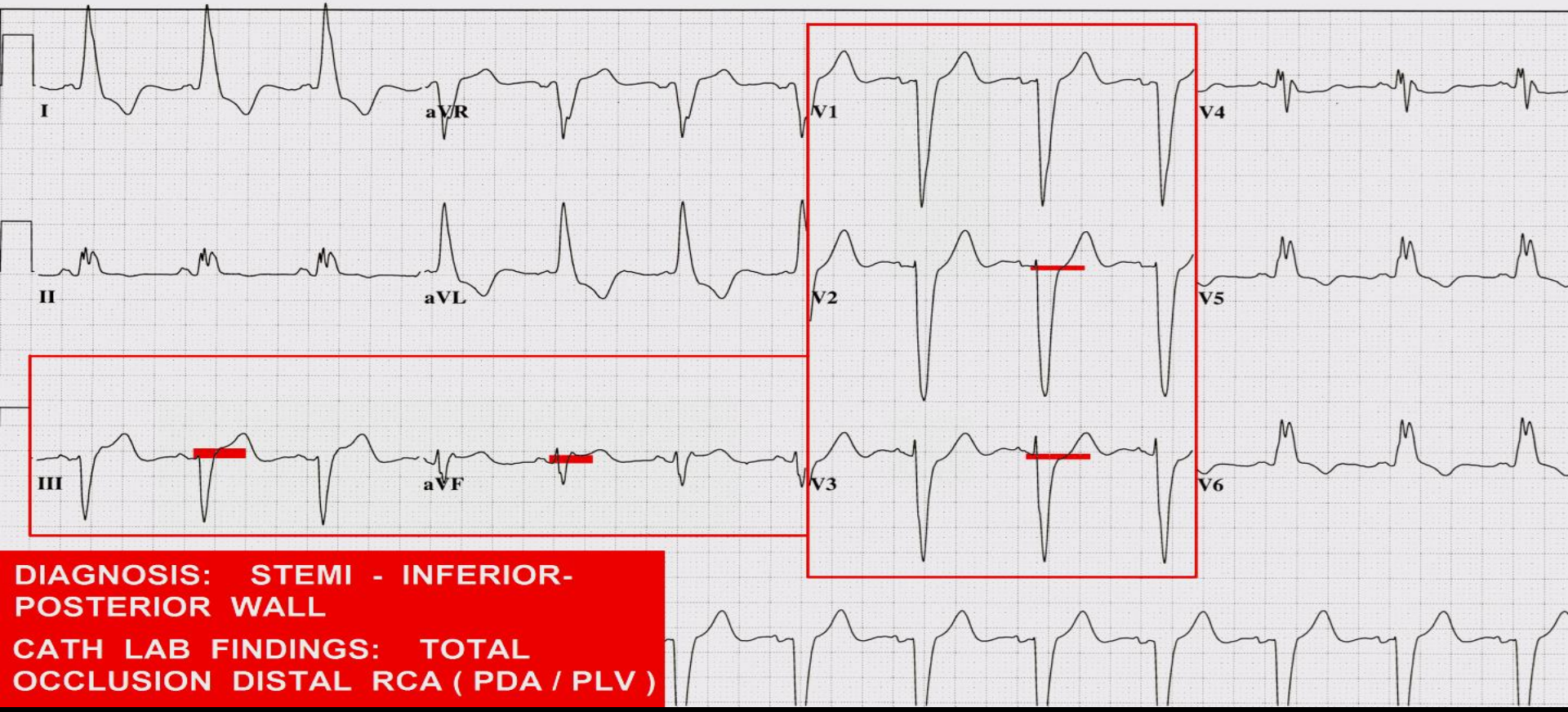
LBBB with CHEST PAIN - CASE 1 : PRESENTING EKG

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

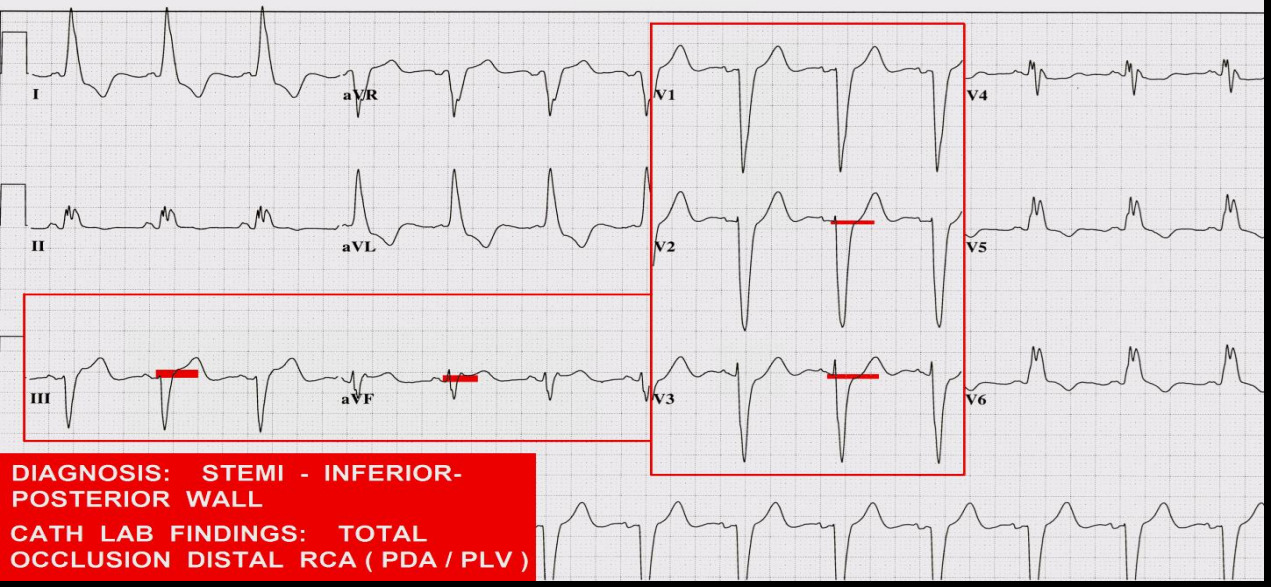
CATH LAB FINDINGS: TOTAL OCCLUSION DISTAL RCA (PDA / PLV)

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

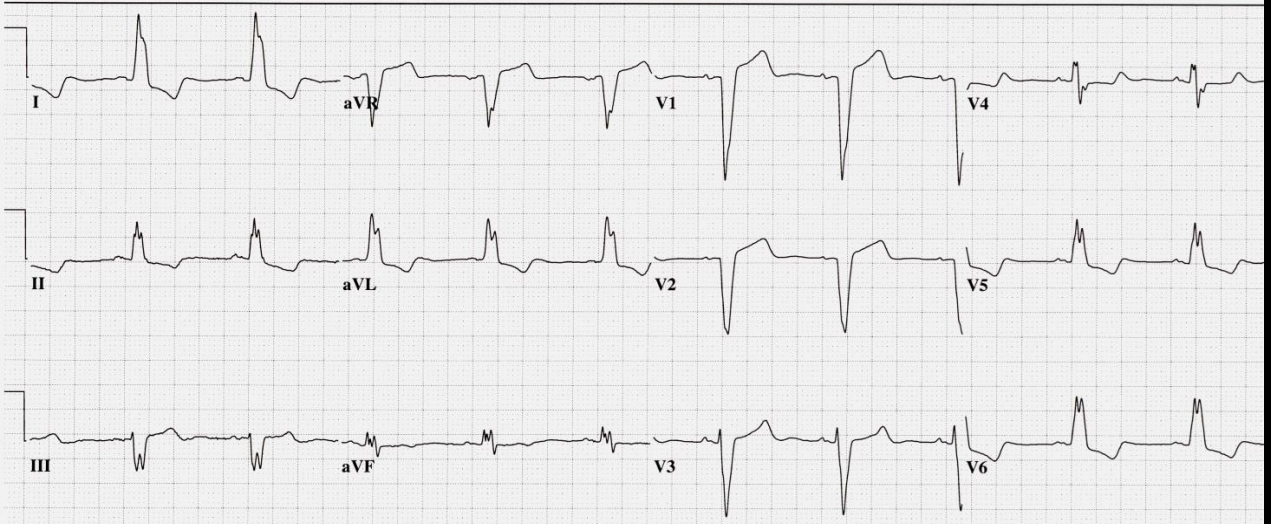
CATH LAB FINDINGS: TOTAL OCCLUSION DISTAL RCA (PDA / PLV)

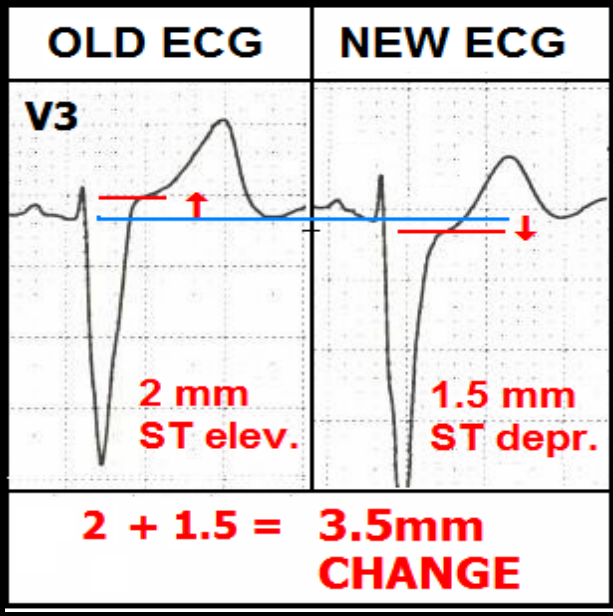
LBBB with CHEST PAIN - CASE 1 : EKG RECORDED 7 MONTHS AGO

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

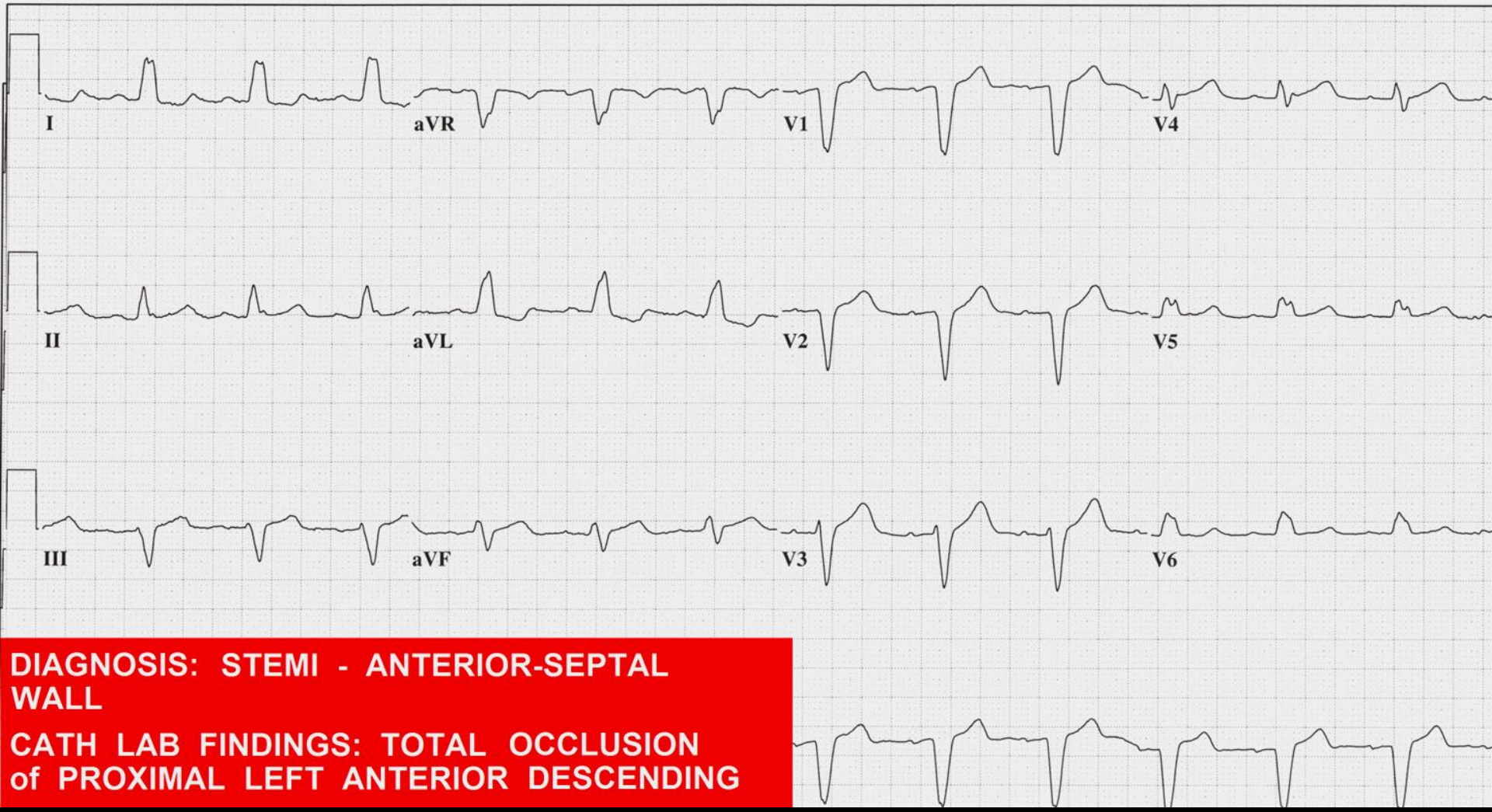
*** AGE AND GENDER SPECIFIC ECG ANALYSIS ***
Normal sinus rhythm
Left bundle branch block
Abnormal ECG
When compared with ECG of 22–JAN–2005 11:15.





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

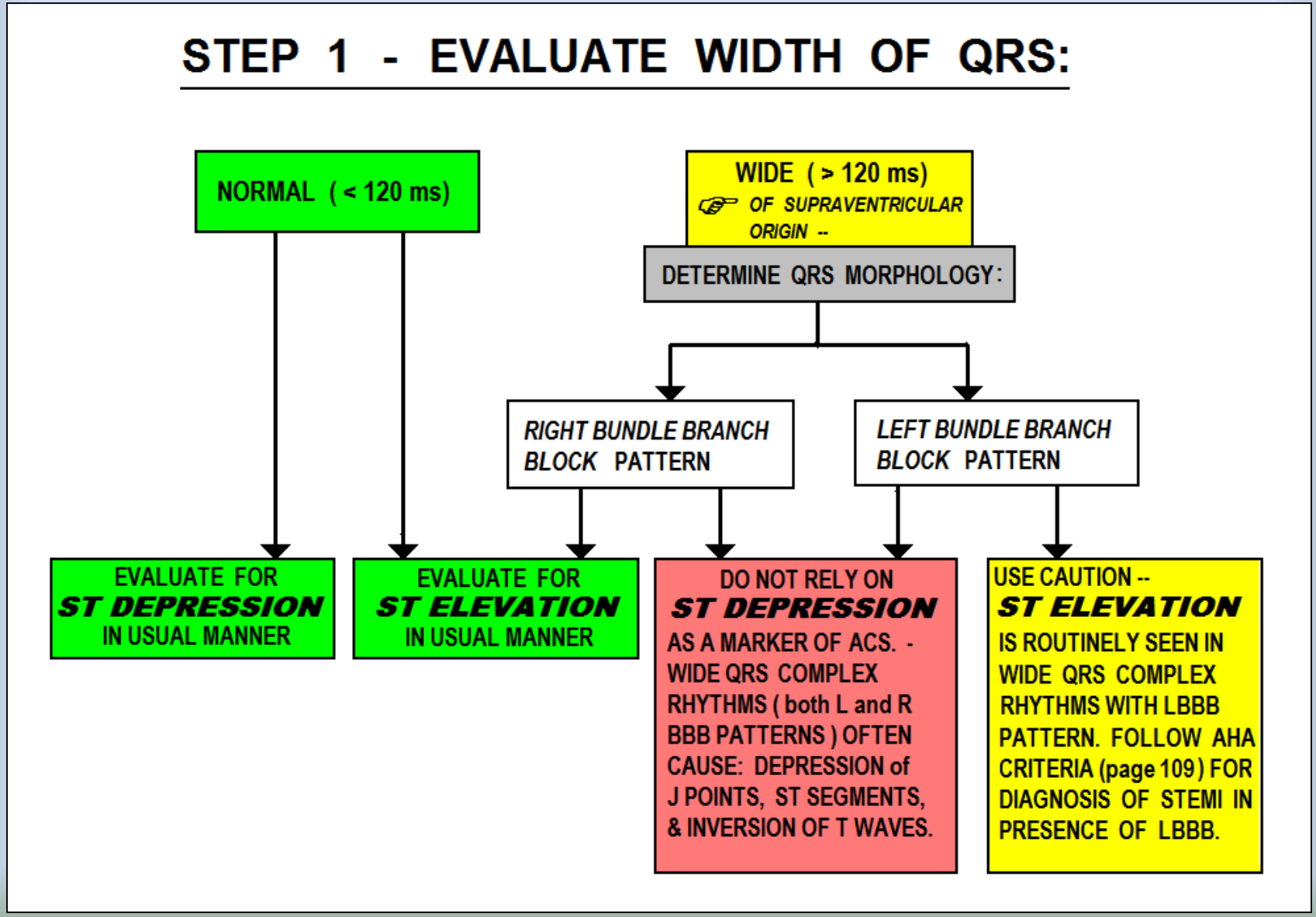
46 yr		Vent. rate	77	BPM	Normal sinus rhythm
Male	Caucasian	PR interval	172	ms	Left bundle branch block
		QRS duration	142	ms	Abnormal ECG
Room:ER		QT/QTc	446/504	ms	
Loc:3	Option:23	P–R–T axes	38 0	92	



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)

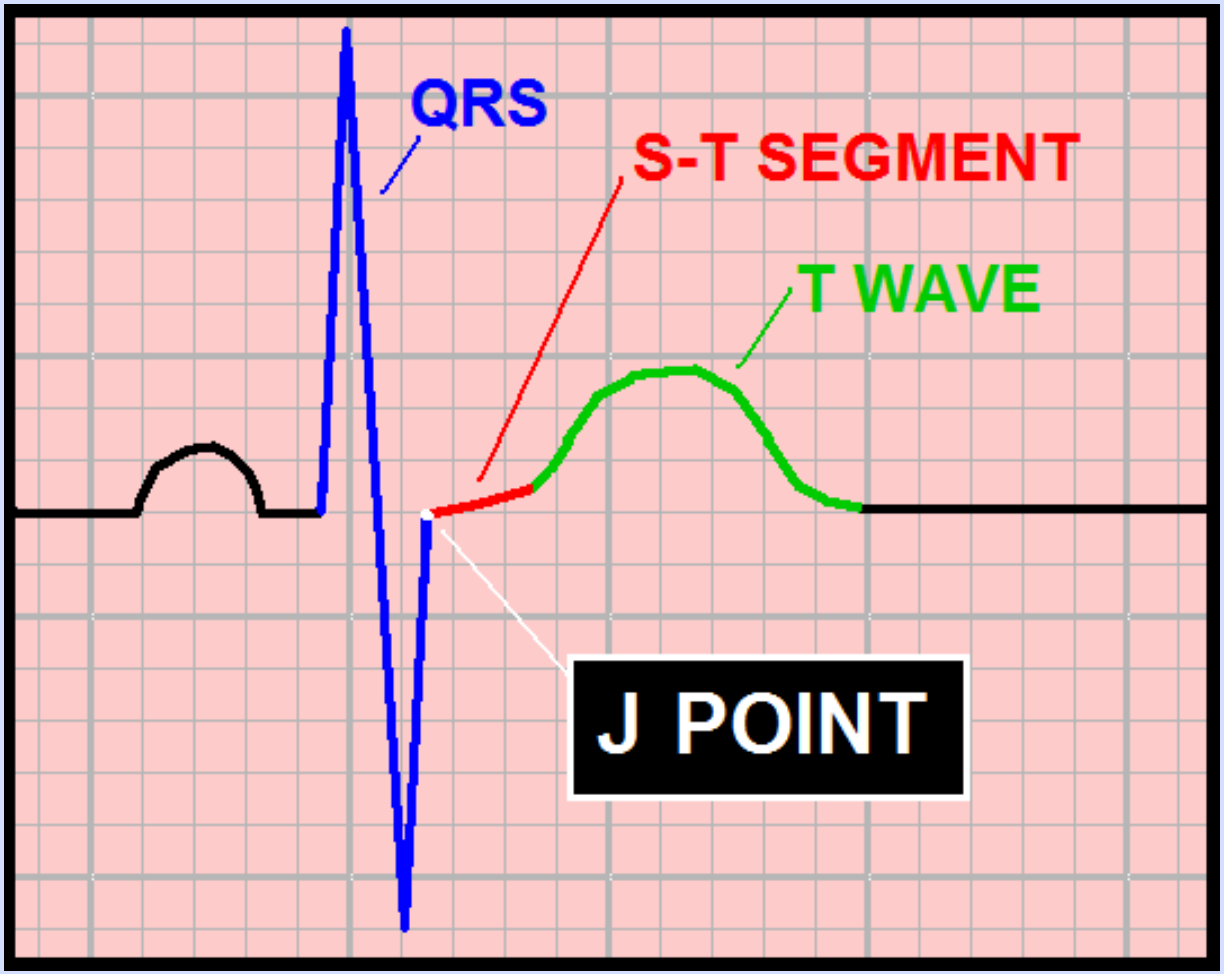
STEP 2 - EVALUATE the EKG for ACS

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*.

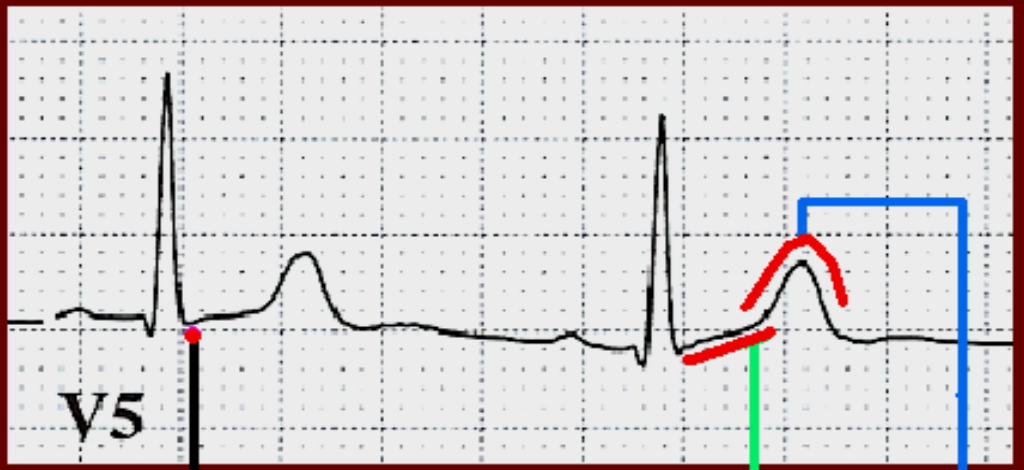
Defining NORMAL – QRS <120ms:



When QRS duration is NORMAL (< 120 ms):

NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL (< 120 ms)

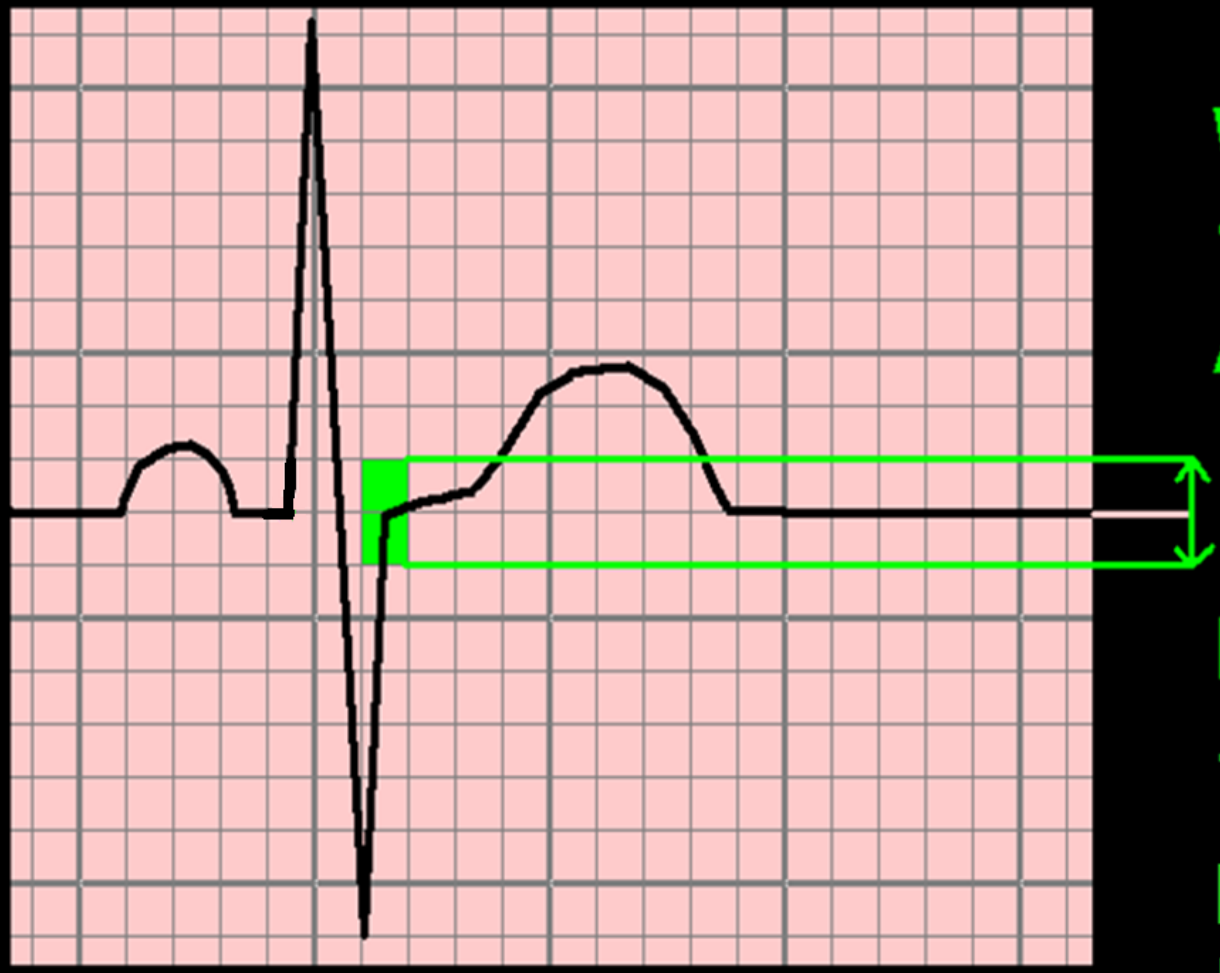


ASSESS:

- 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 . .

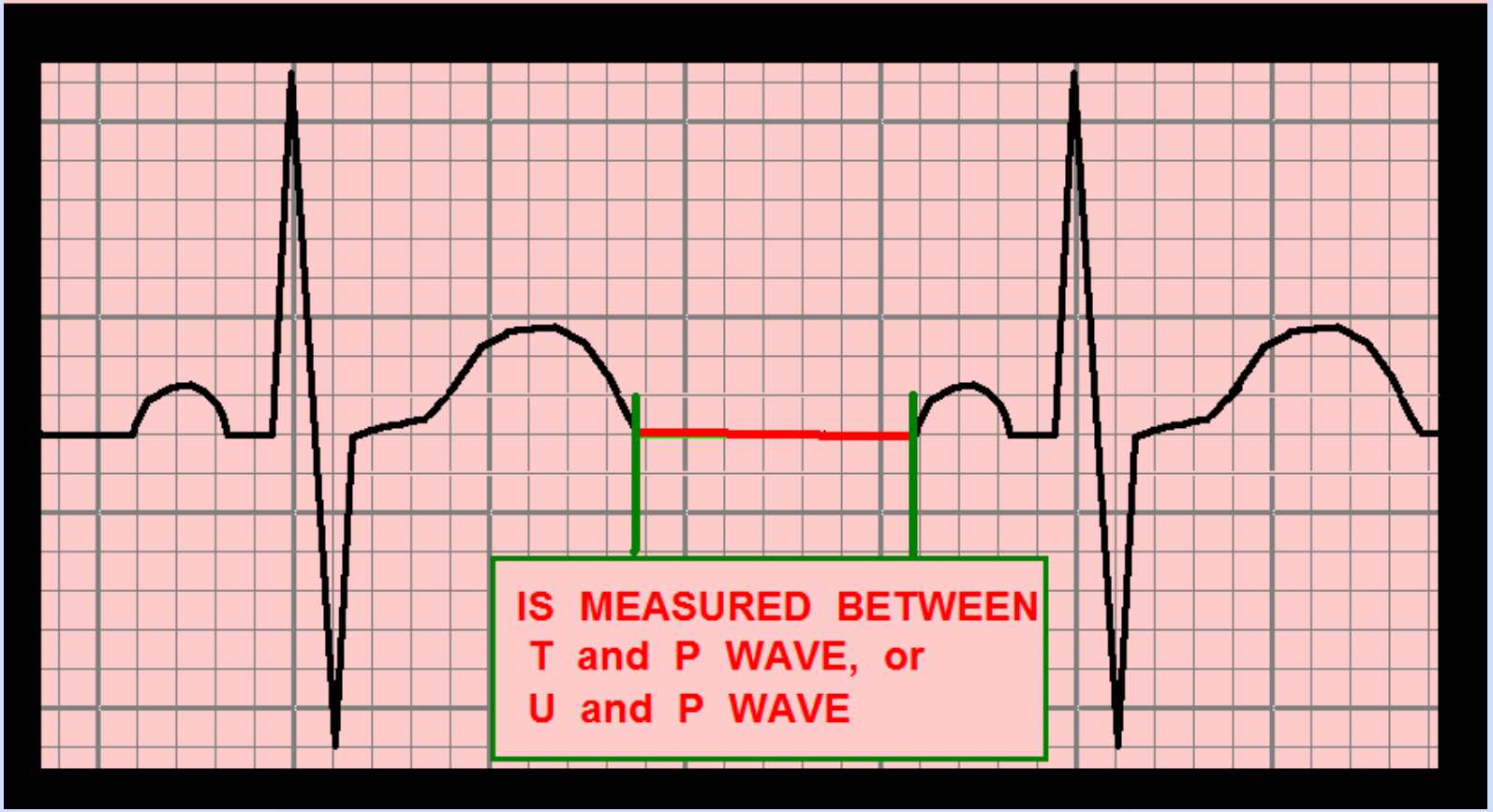


WITHIN
1 mm
ABOVE

OR

BELOW
the
ISOELECTRIC
LINE

THE ISOELECTRIC LINE



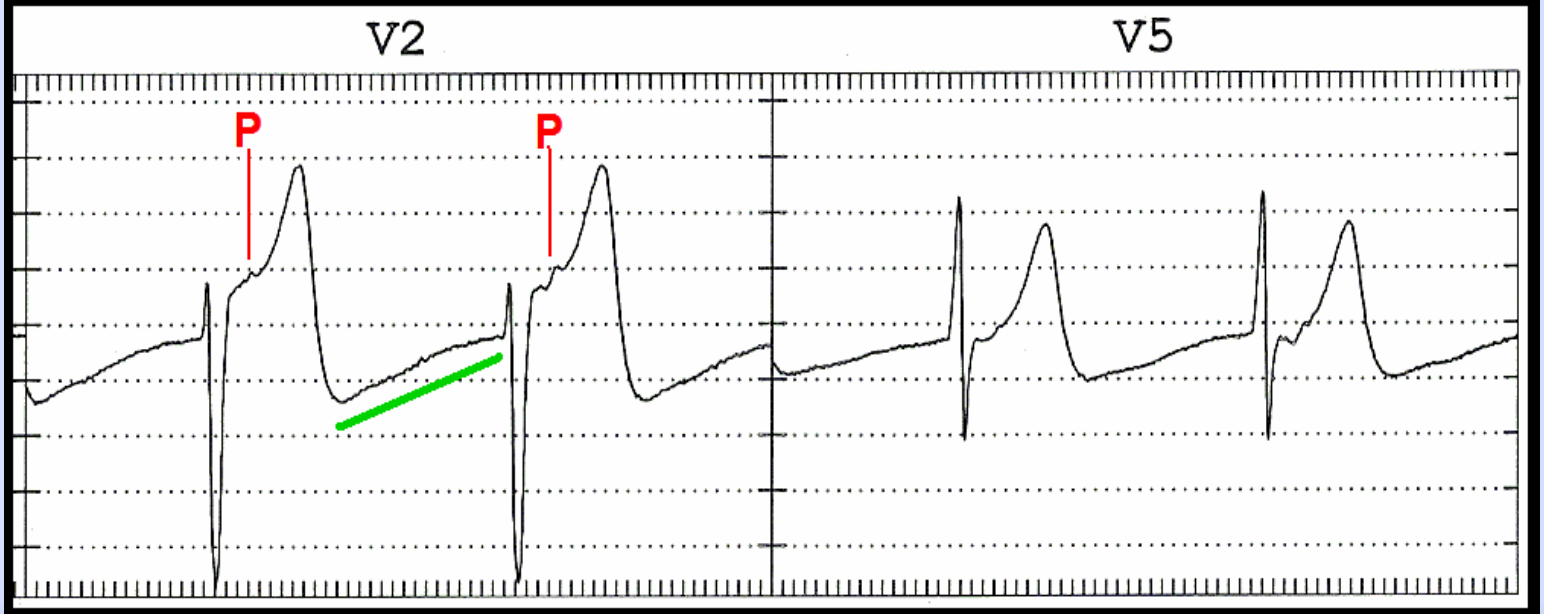
. . .the “flat line” between ECG complexes, when there is no detectable electrical activity . . .

The Isoelectric Line -

it's not always isoelectric !

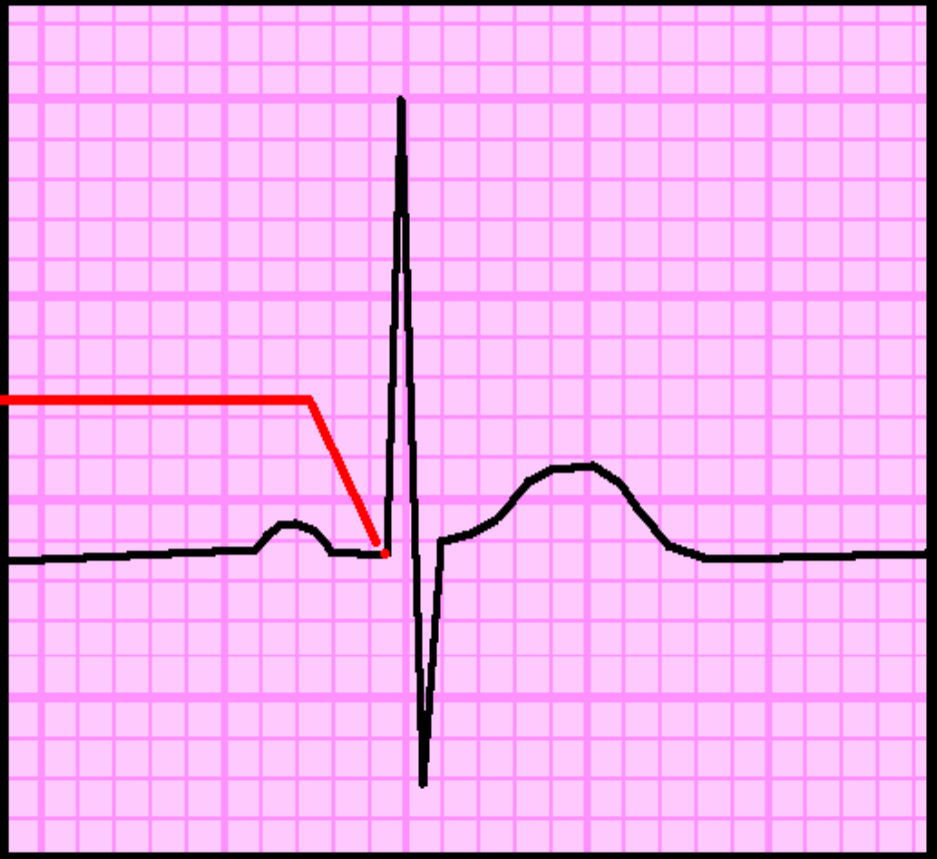
THE ISOELECTRIC LINE

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.



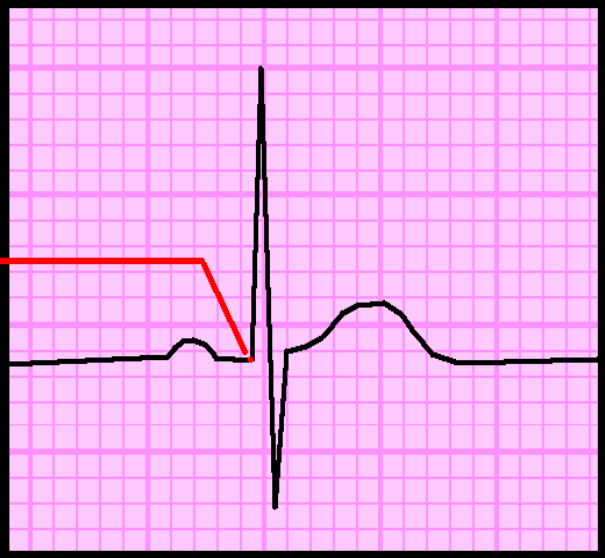
Used for POINT OF REFERENCE for measurement of the J-POINT and the S-T SEGMENT –

— 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 !

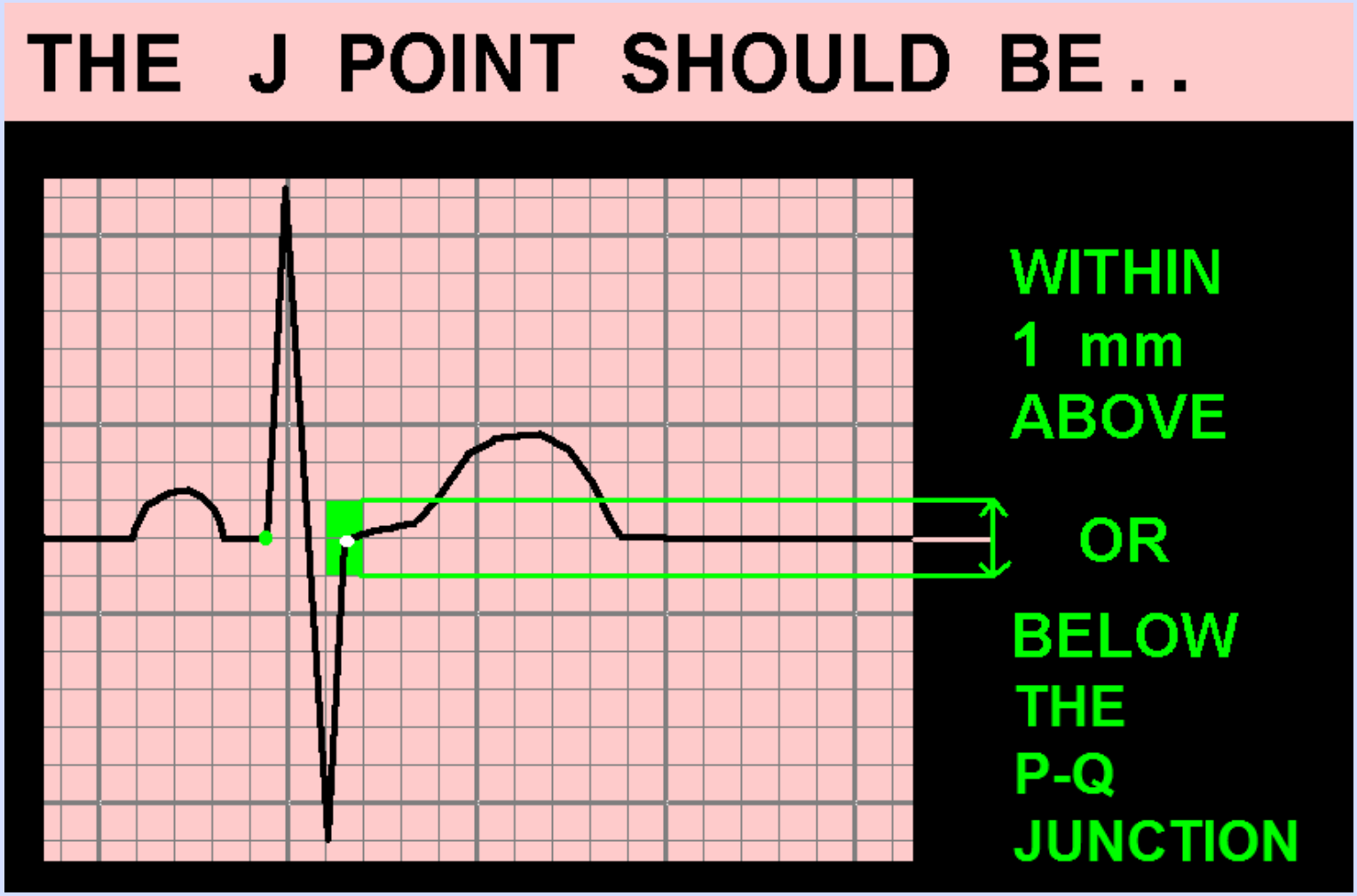
THE P-Q JUNCTION

. . . 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 –

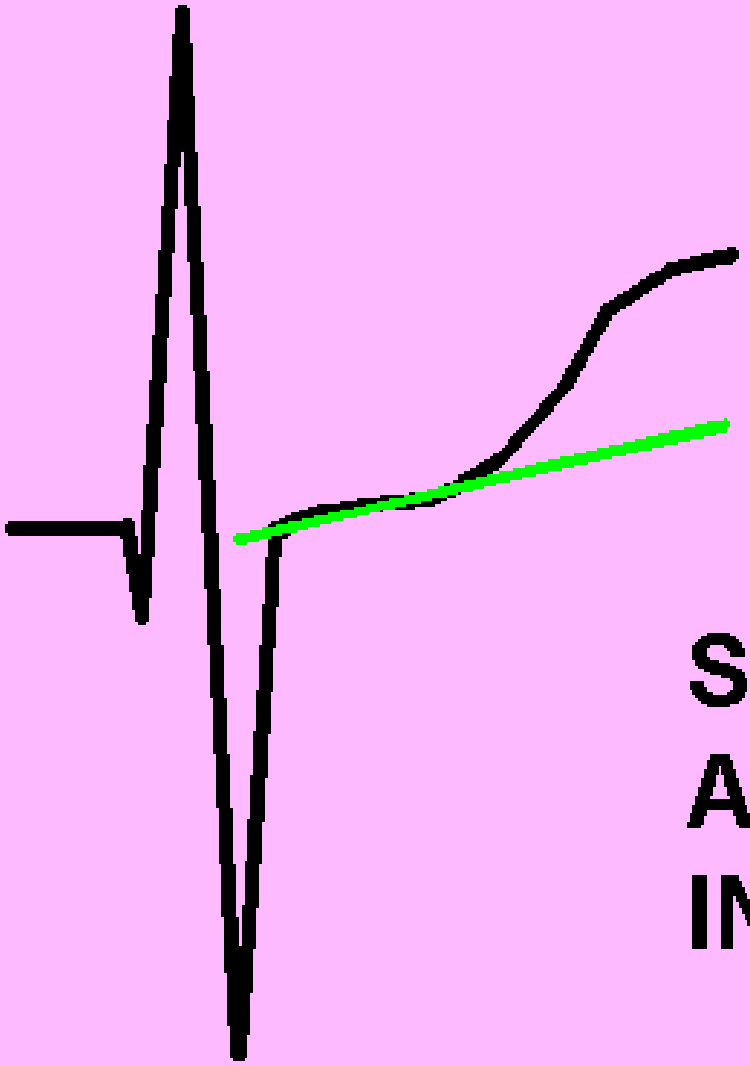


— as per the A.H.A., A.C.C., and WANG, ASINGER, and MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

Defining NORMAL:

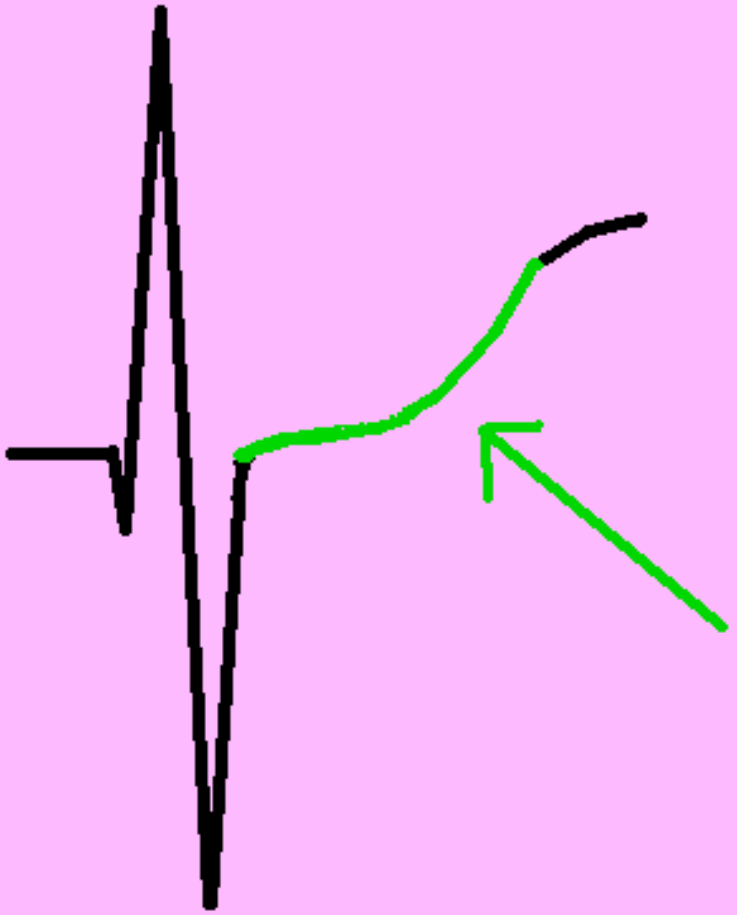


THE S-T SEGMENT



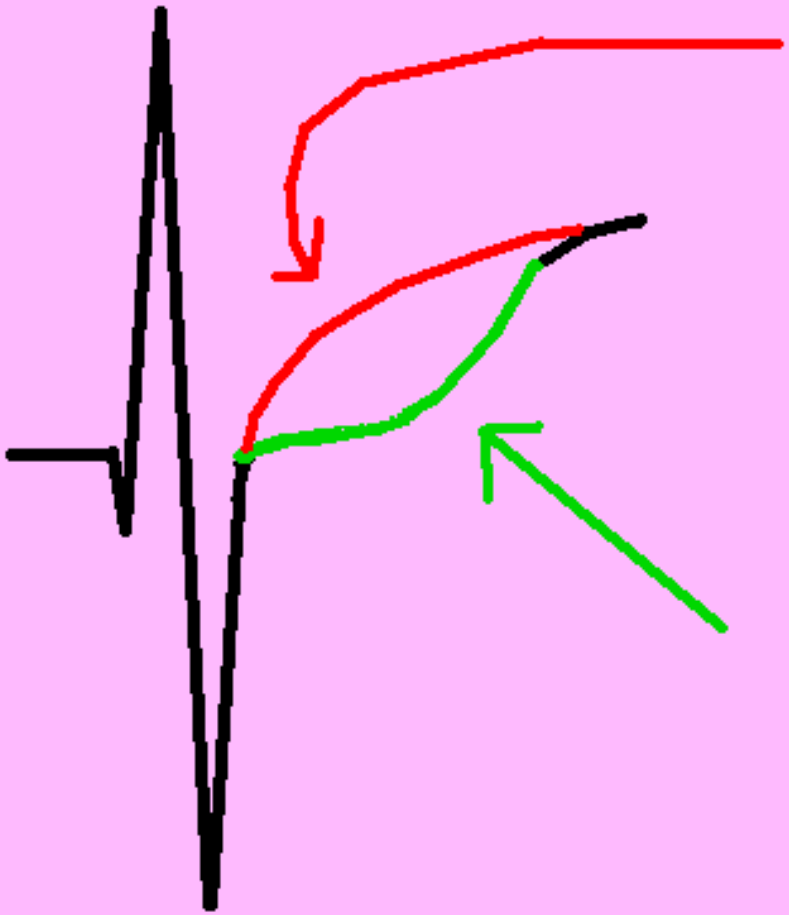
SHOULD HAVE
A "SLIGHT POSITIVE"
INCLINATION

THE S-T SEGMENT



SHOULD BE "CONCAVE" IN SHAPE . . .

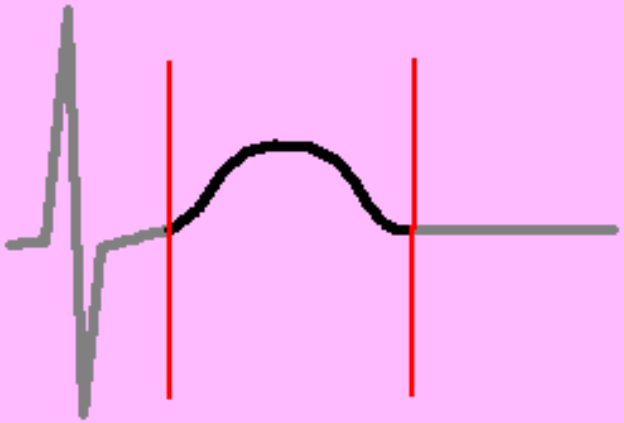
THE S-T SEGMENT



AS OPPOSED TO "CONVEX" IN SHAPE

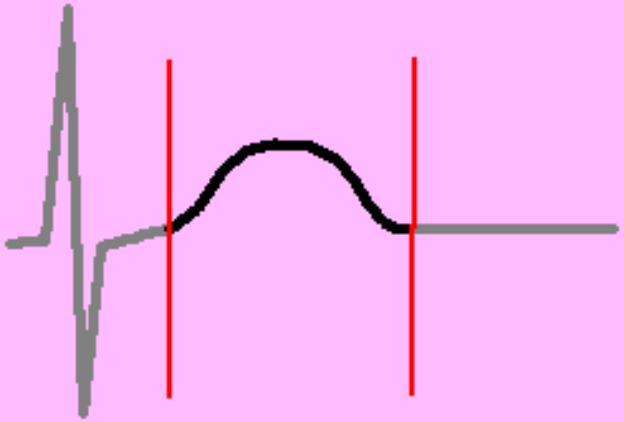
SHOULD BE "CONCAVE" IN SHAPE . . .

THE T WAVE



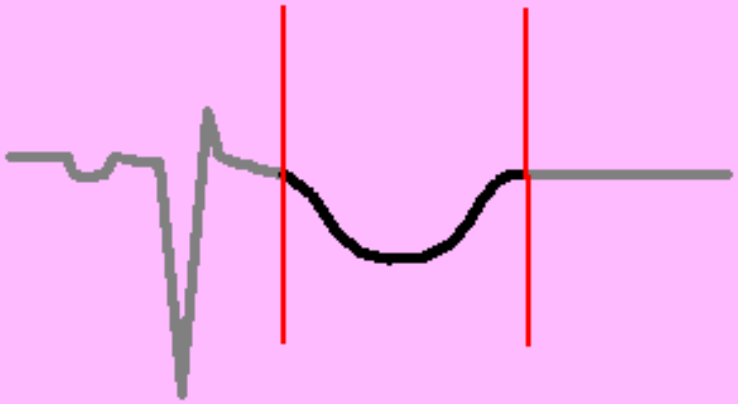
- SHOULD BE A "NICE," ROUNDED, CONVEX SHAPE
- SHOULD BE SYMMETRICAL

THE T WAVE



- SHOULD BE A "NICE," ROUNDED, CONVEX SHAPE
- SHOULD BE SYMMETRICAL
- SHOULD BE UPRIGHT IN ALL LEADS, EXCEPT AVR

THE T WAVE

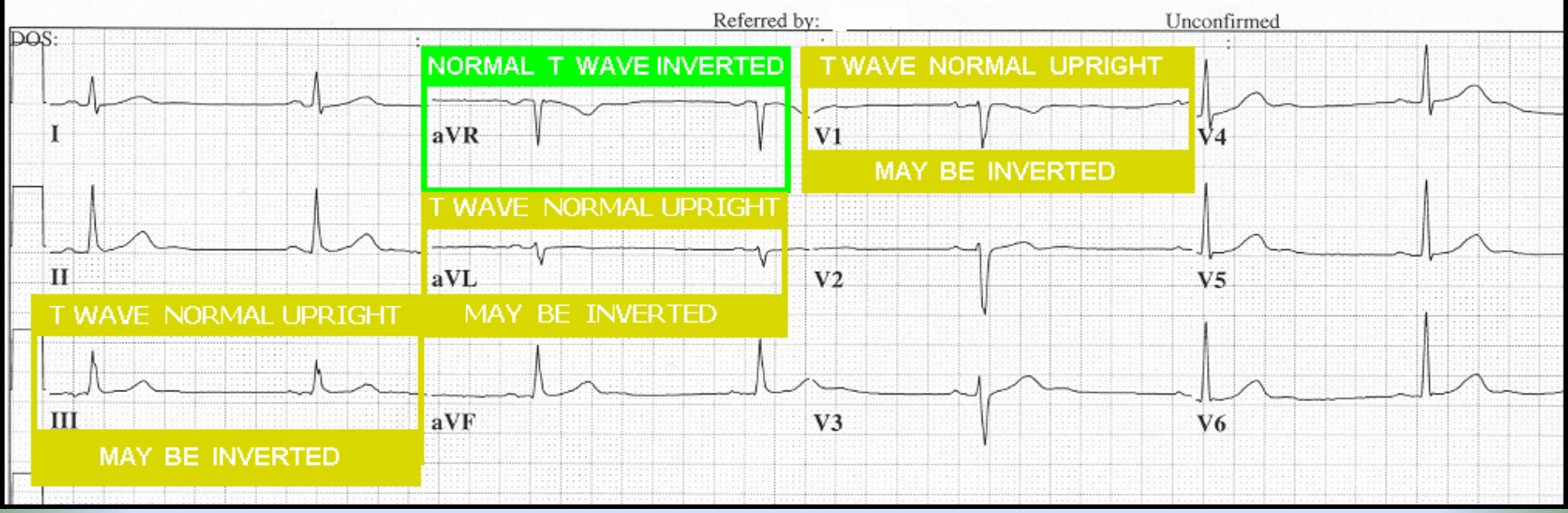


LEAD AVR

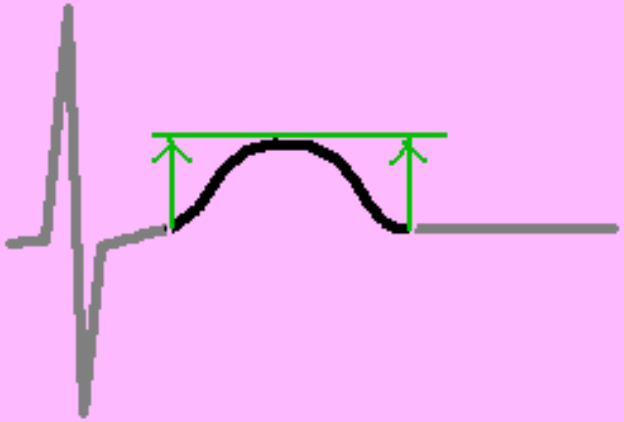
- REMEMBER, IN LEAD AVR *EVERYTHING* IS "UPSIDE-DOWN"

Normal Variants:
T Wave Inversion

Leads where the T WAVE may be INVERTED:



THE T WAVE



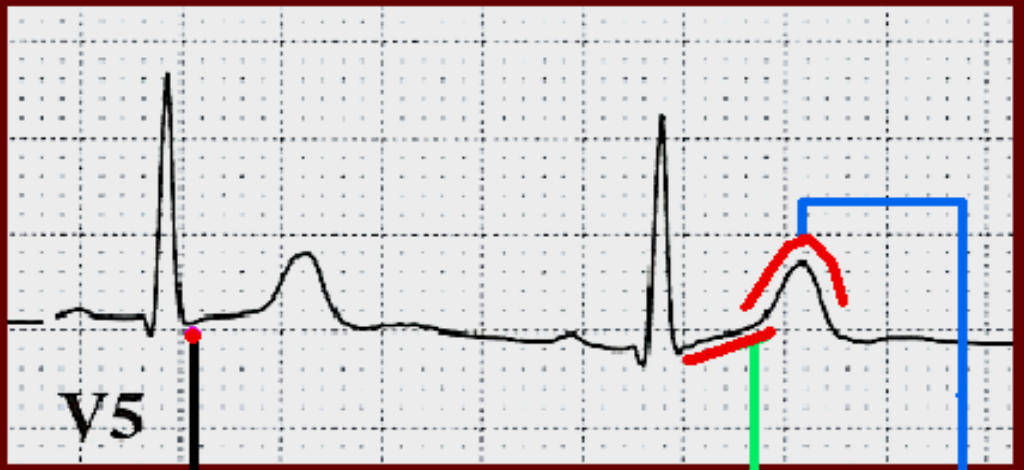
AMPLITUDE GUIDELINES:

- 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**

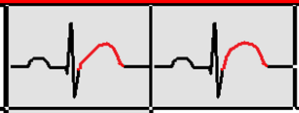
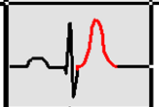
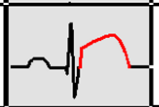
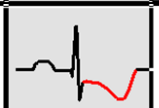
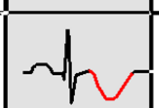
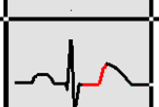
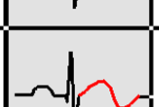
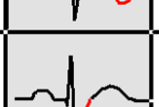
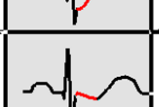
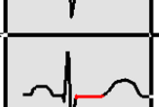
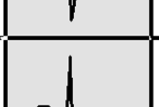
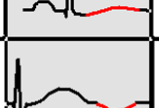
configurations **may indicate ACS.**

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

BOOK PAGE: 83

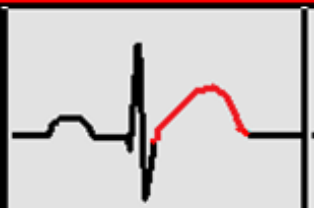
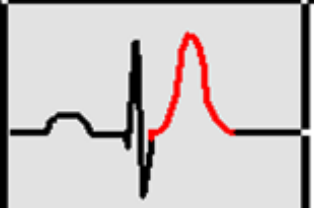
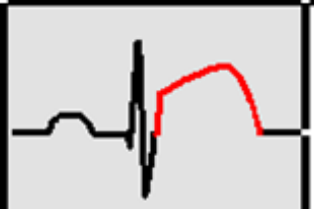
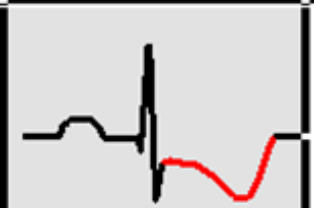
EKG PATTERNS of ACS & ISCHEMIA

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

!	FLAT or CONVEX J-T APEX SEGMENT		- Typical Cath Lab Finding: Coronary Artery Thrombus (TIMI Grade 1-2 blood flow)
!	HYPER-ACUTE T WAVE		- HYPERKALEMIA - TRANSMURAL ISCHEMIA - ACUTE MI - HYPERTROPHY
!	S-T SEGMENT ELEVATION at J POINT		- ACUTE MI - ACUTE PERICARDITIS / MYOCARDITIS - EARLY REPOLARIZATION
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA
	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

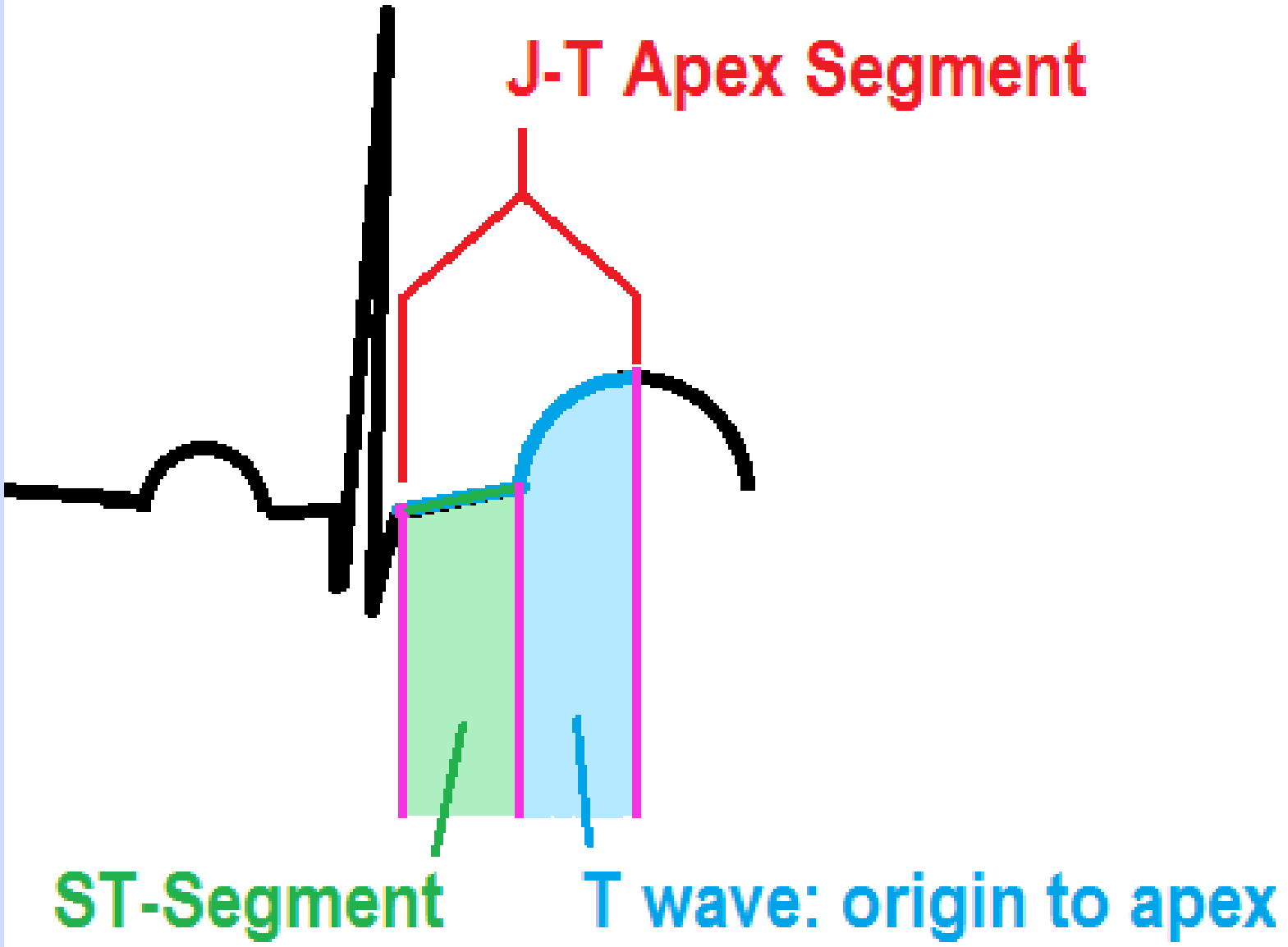
EKG PATTERNS of ACS & ISCHEMIA

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

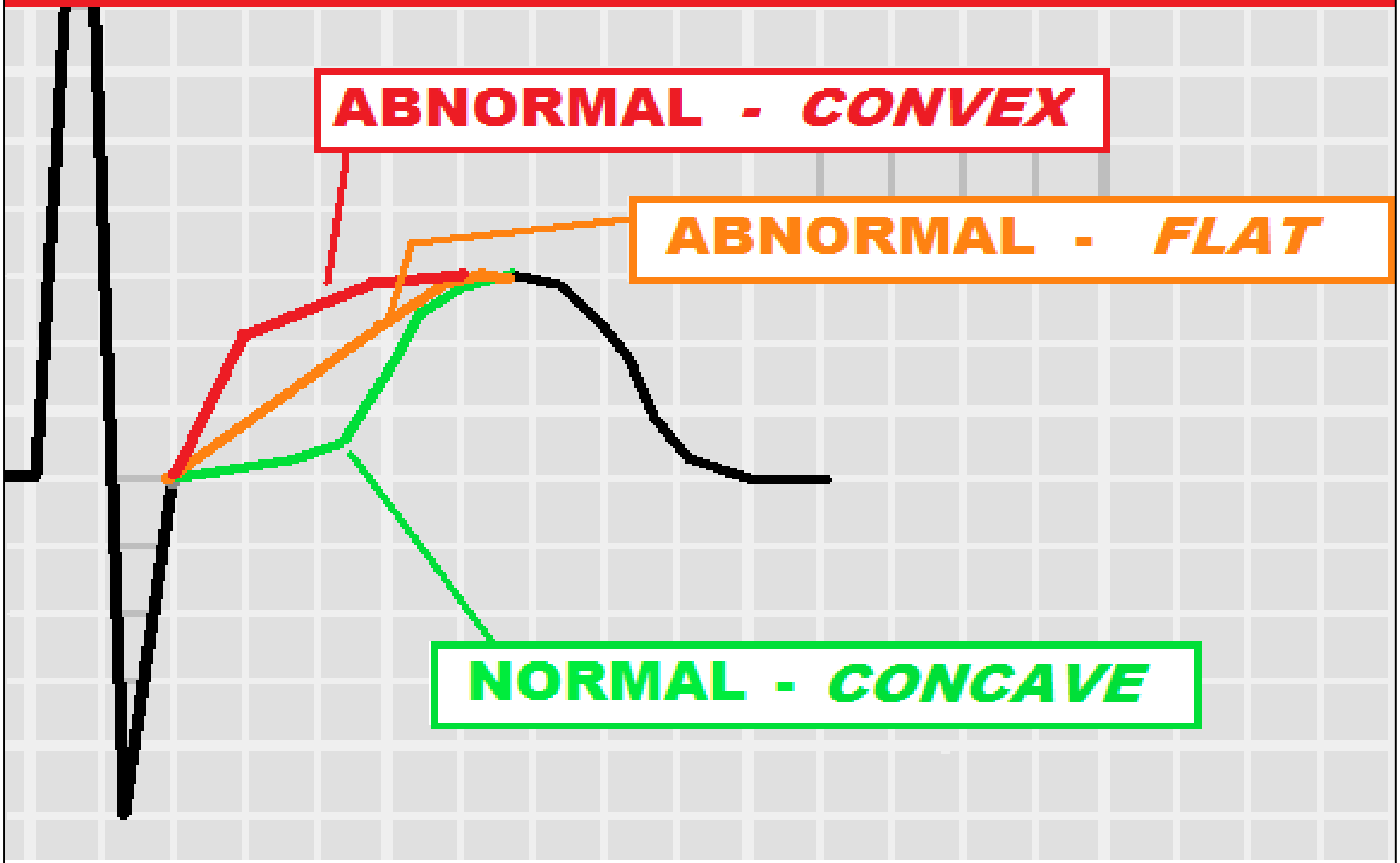
!	FLAT or CONVEX J-T APEX SEGMENT		- Typical Cath Lab Finding: Coronary Artery Thrombus (TIMI Grade 1-2 blood flow)
!	HYPER-ACUTE T WAVE		- HYPERKALEMIA - TRANSMURAL ISCHEMIA - ACUTE MI - HYPERTROPHY
!	S-T SEGMENT ELEVATION at J POINT		- ACUTE MI - ACUTE PERICARDITIS / MYOCARDITIS - EARLY REPOLARIZATION
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA

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

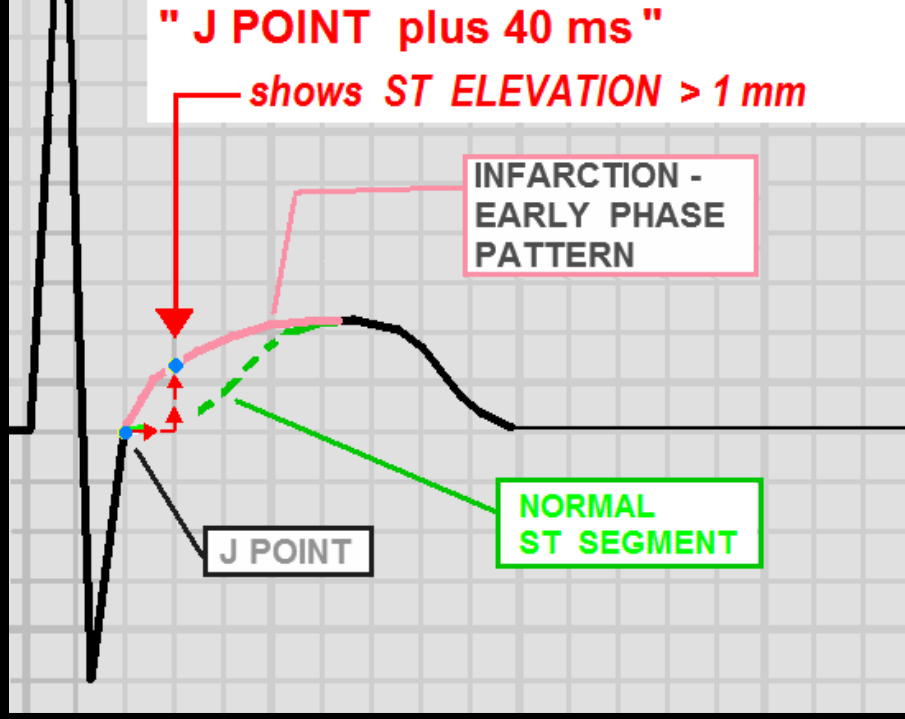


PATTERNS of EARLY INFARCTION

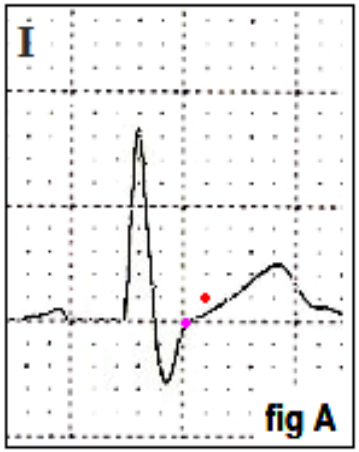
-- FLAT and CONVEX J-T APEX SEGMENTS

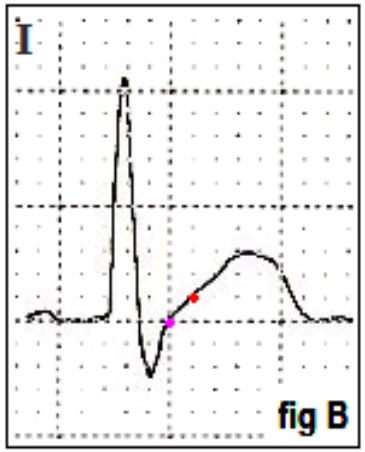
WHEN EVALUATING for ST SEGMENT ELEVATION . . . . . .

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.

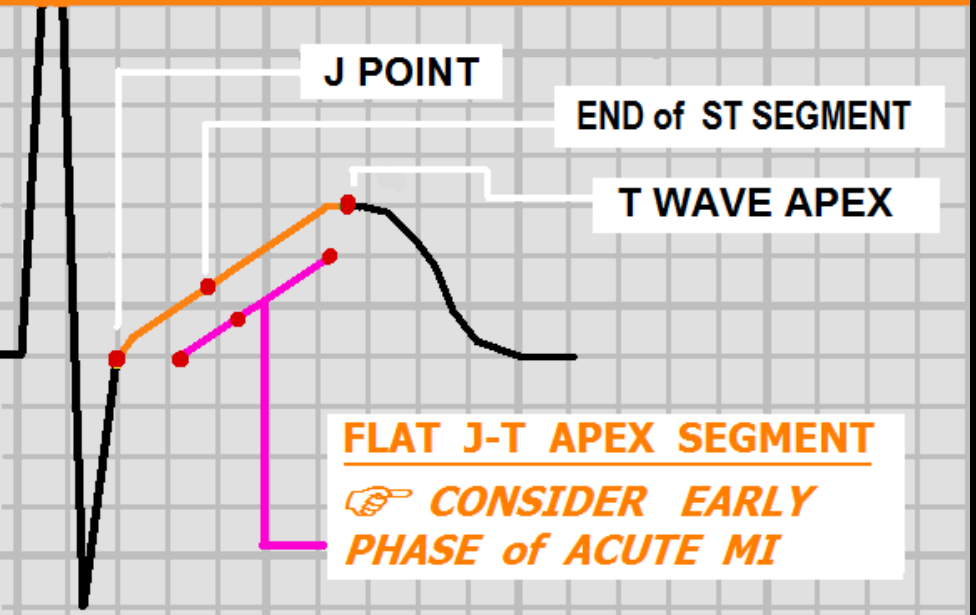




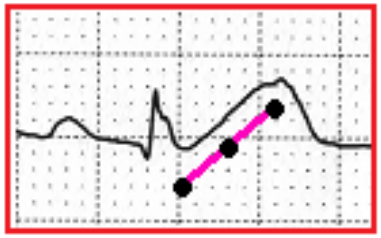
During a 20 second BALLOON OCCLUSION of the patient's LAD during routine PTCA, the ST segment assumes a CONVEX shape. When measured 40 ms beyond the J POINT, the ST segment is elevated > 1 mm. This phenonemon is seen routinely in the cath lab prior to the occurance of ST ELEVATION at the J POINT during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

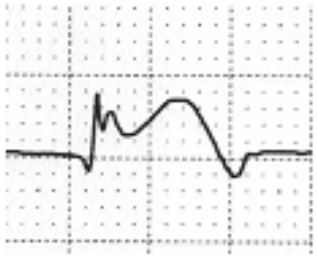


1839 hrs

41 y/o FEMALE

In ER C/O CHEST PAIN x 30 minutes.

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



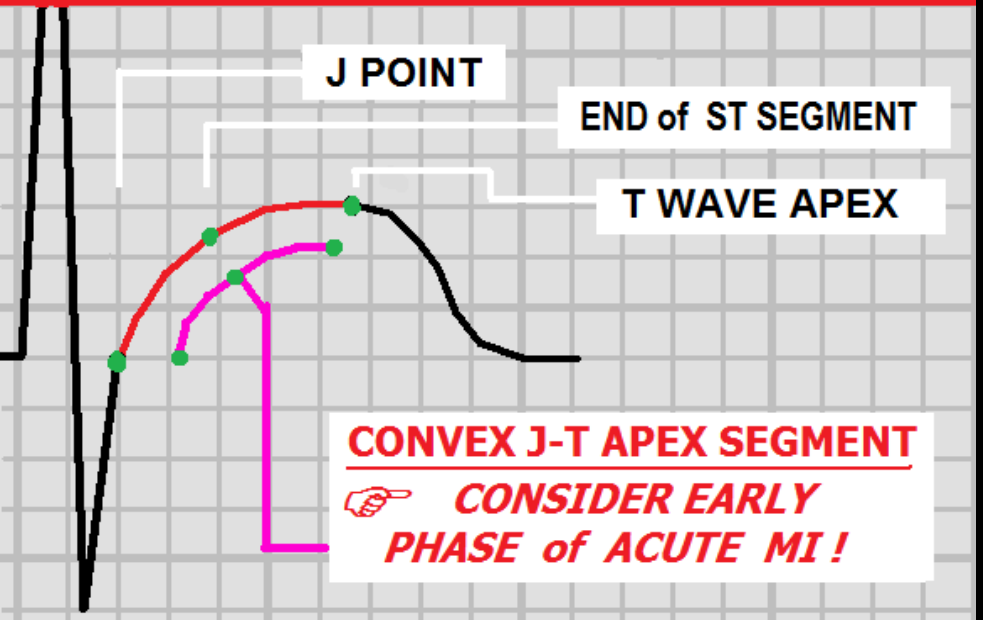
1850 hrs

STEMI - INFERIOR WALL

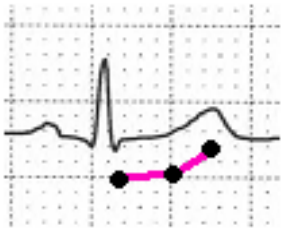
11 MINUTES LATER, S-T ELEVATION at the J POINT IS NOTED.

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

ABNORMAL J-T APEX SEGMENT

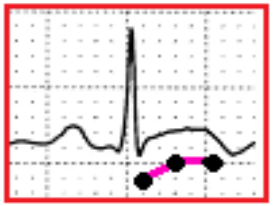


LEAD I



53 y/o MALE

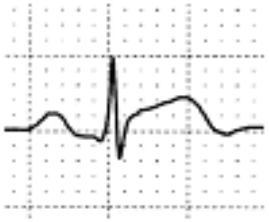
1 yr. PRIOR TO MI
NORMAL EKG
CONCAVE J - T APEX SEGMENT



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

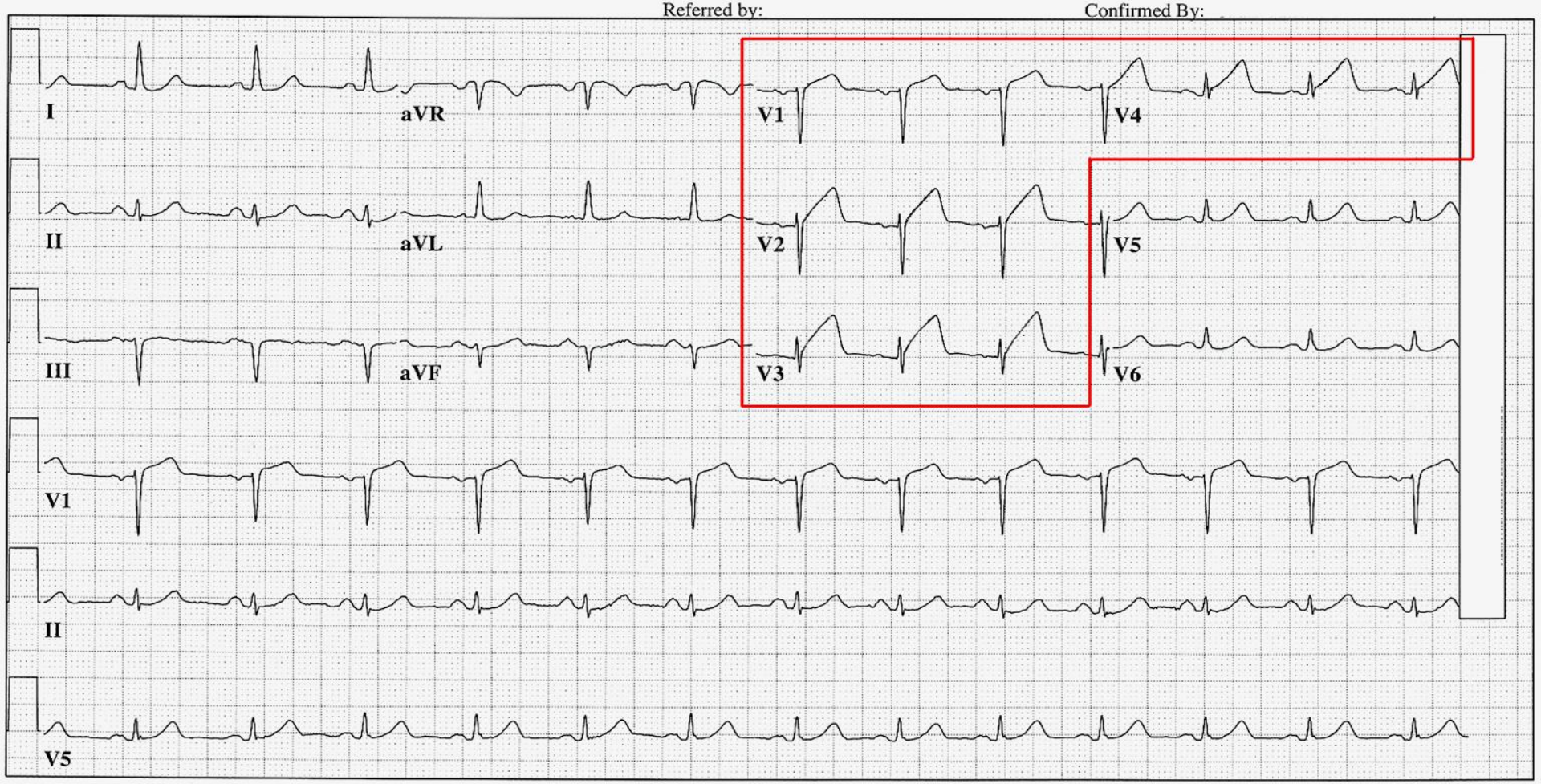
Vent. rate	80	BPM
PR interval	154	ms
QRS duration	78	ms
QT/QTc	380/438	ms
P–R–T axes	51 –24	38

**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:

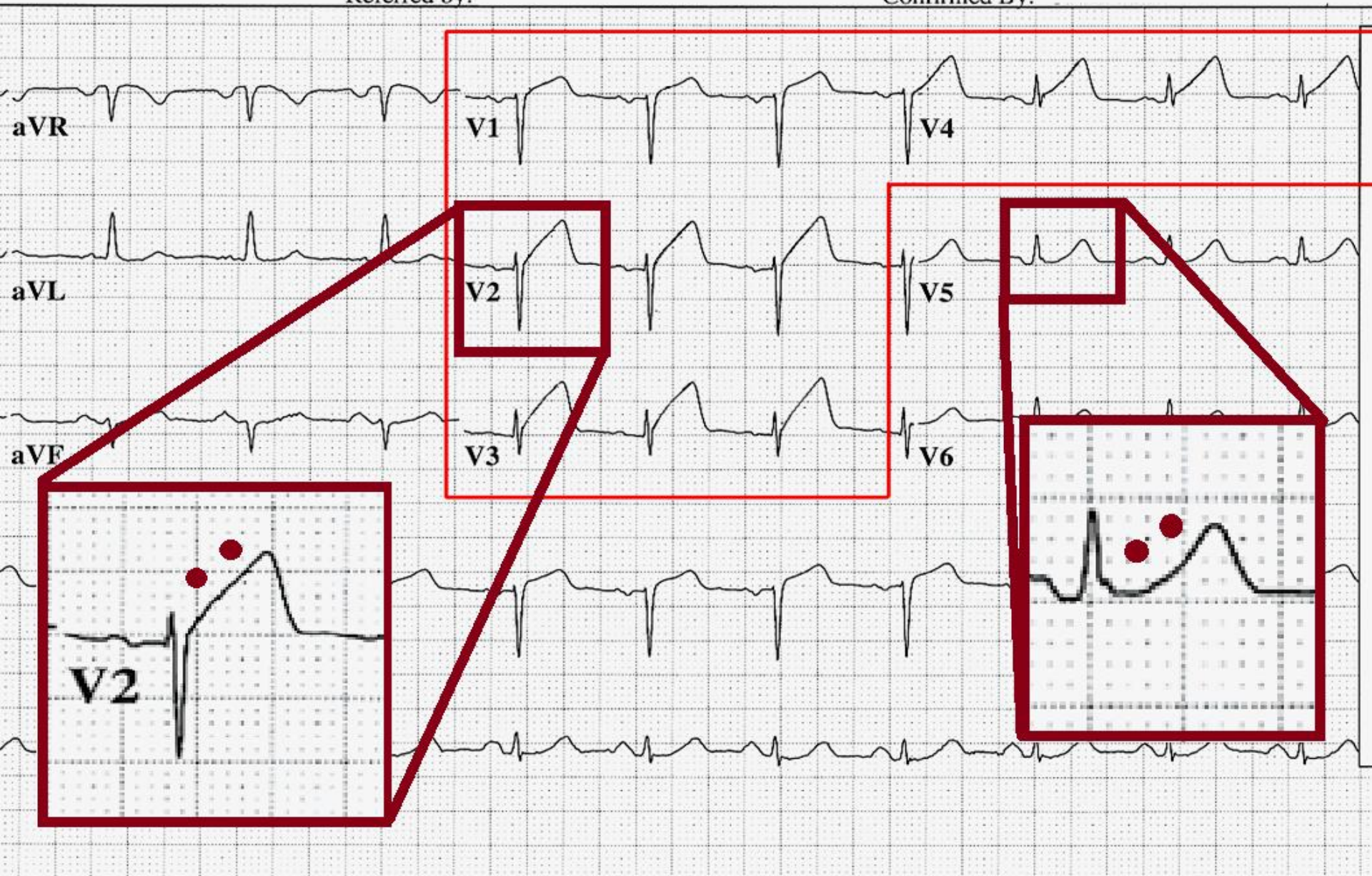
ECG COMPUTER DOES NOT NOTICE THE CONVEX J-T APEX SEGMENTS !

380/438 ms
51 –24 38

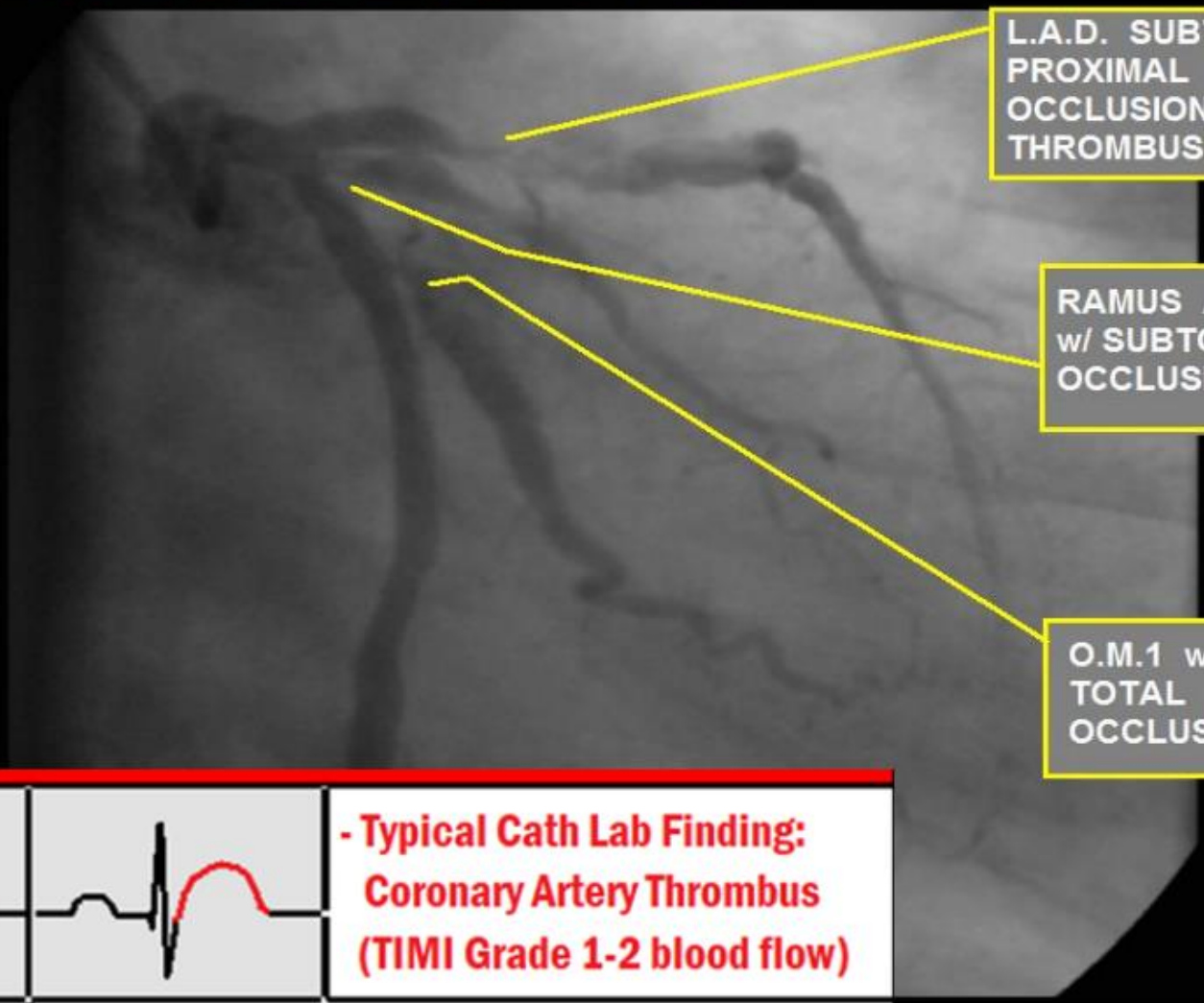
Normal sinus rhythm
Normal ECG
No previous ECGs available

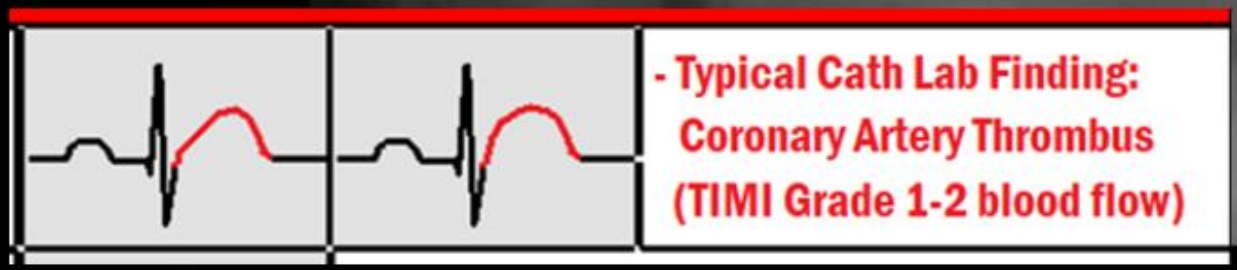
Referred by:

Confirmed By:



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



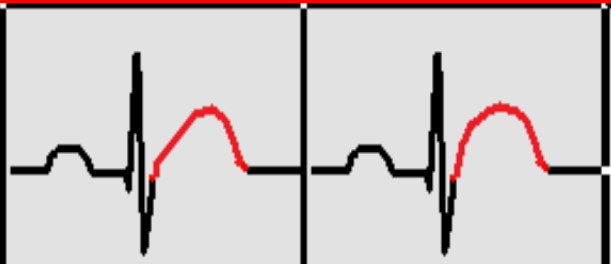
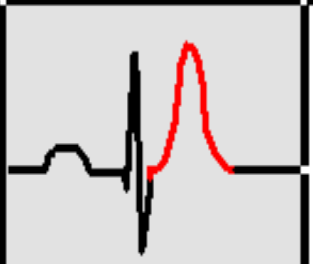
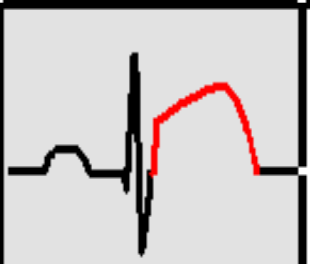
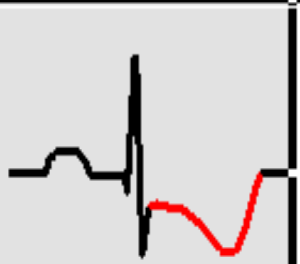


- Typical Cath Lab Finding:
  Coronary Artery Thrombus
  (TIMI Grade 1-2 blood flow)

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

PATTERNS of ACS & ISCHEMIA

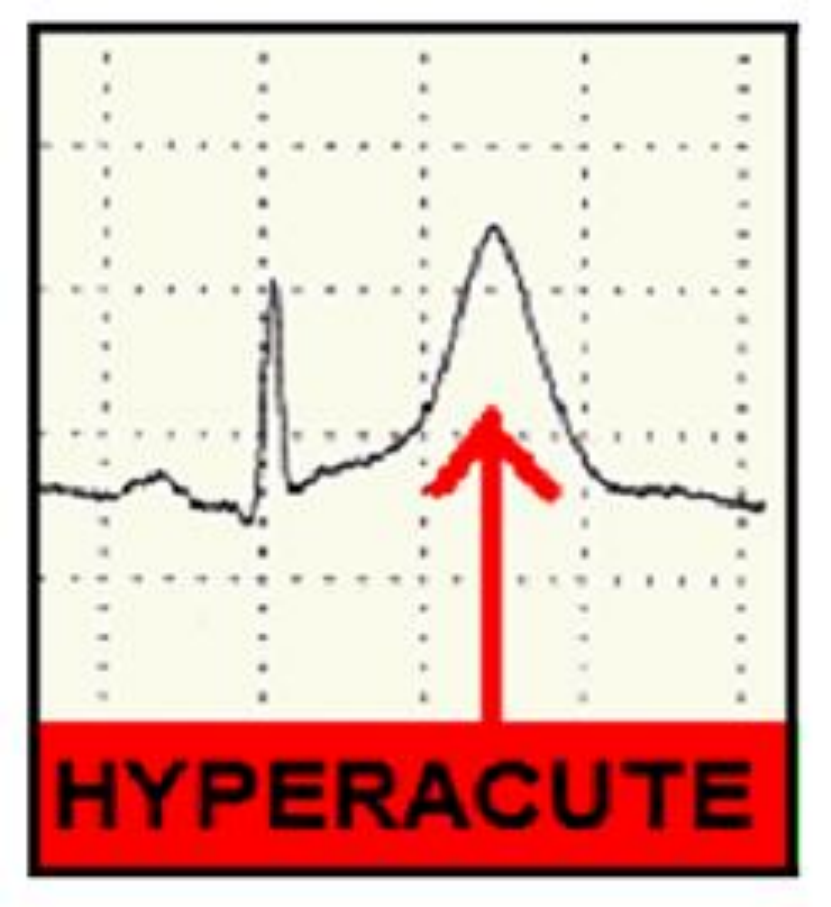
-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --

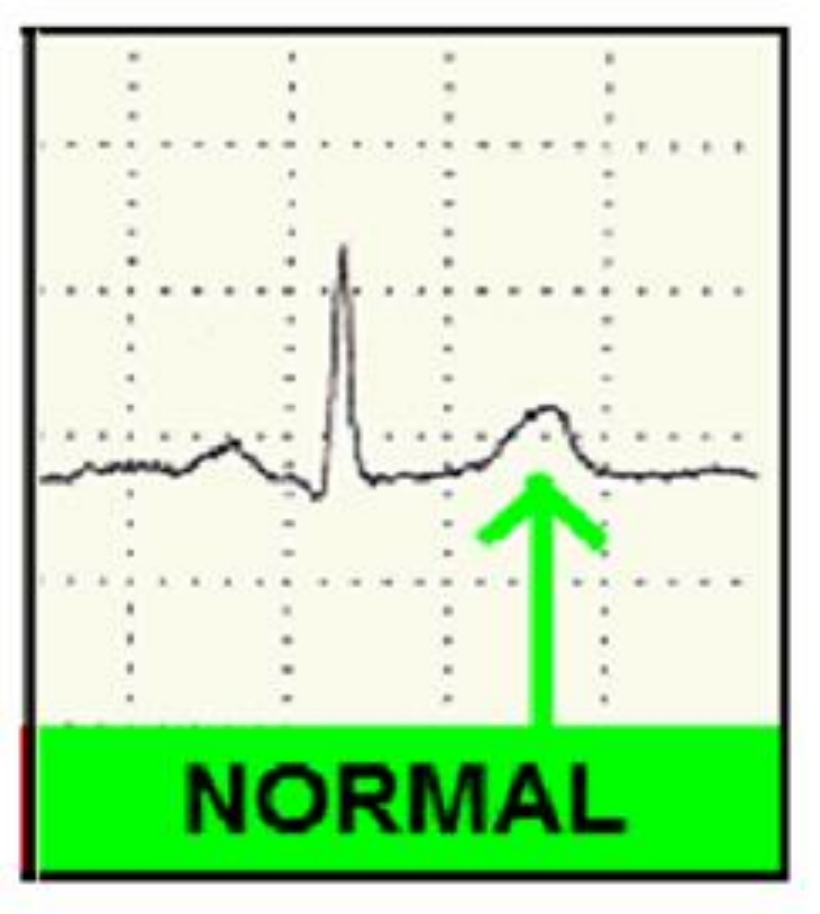
!	FLAT or CONVEX J-T APEX SEGMENT		**ACUTE MI** EARLY PHASE
!	HYPER-ACUTE T WAVE		**ACUTE MI** EARLY PHASE
!	S-T SEGMENT ELEVATION at J POINT		**ACUTE MI**
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- **ACUTE (NON-Q WAVE) MI** - **ACUTE MI** - (RECIPROCAL CHANGES) - **ISCHEMIA**

HYPER-ACUTE T WAVES - COMMON ETIOLOGIES:

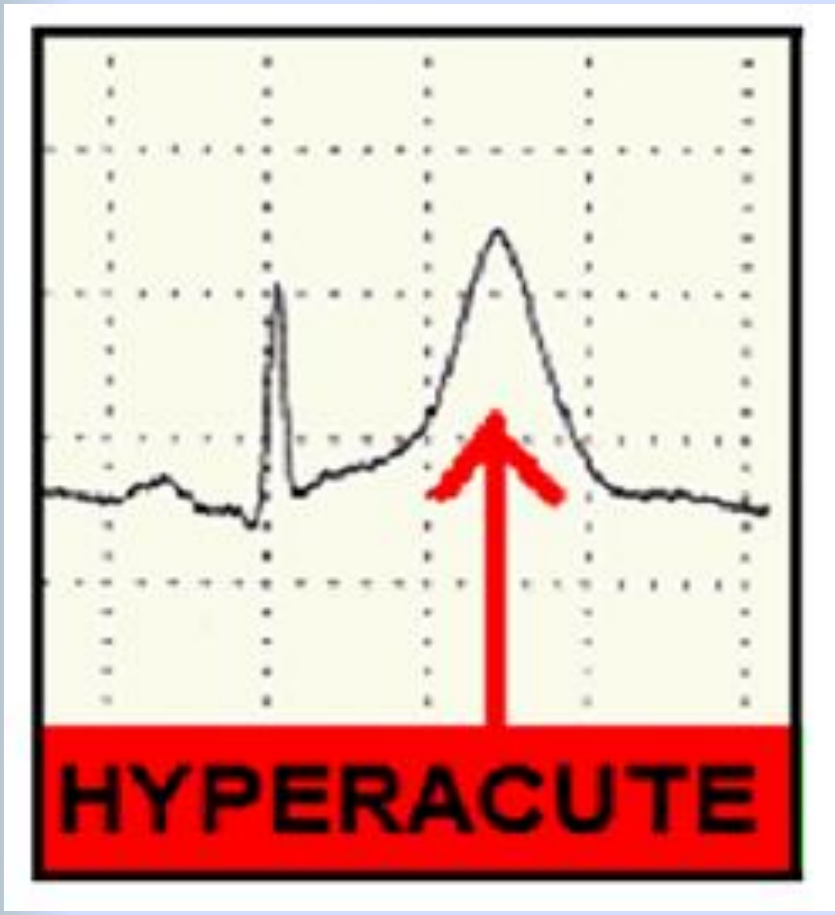
CONDITION:	SEE PAGE(S):
HYPERKALEMIA	XX - XX
ACUTE MI	XX - XX
TRANS-MURAL ISCHEMIA	XX - XX
HYPERTROPHY	XX - XX

T waves should not be HYPERACUTE



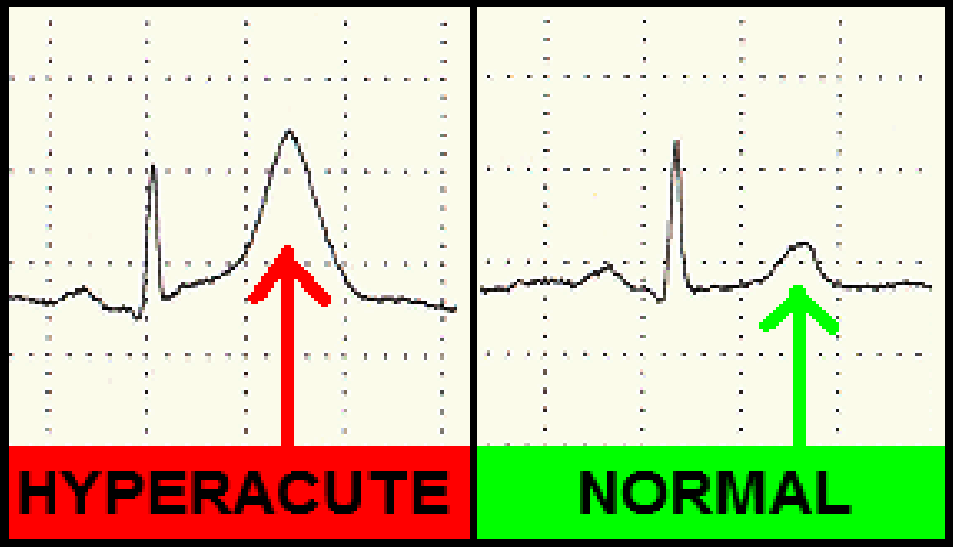


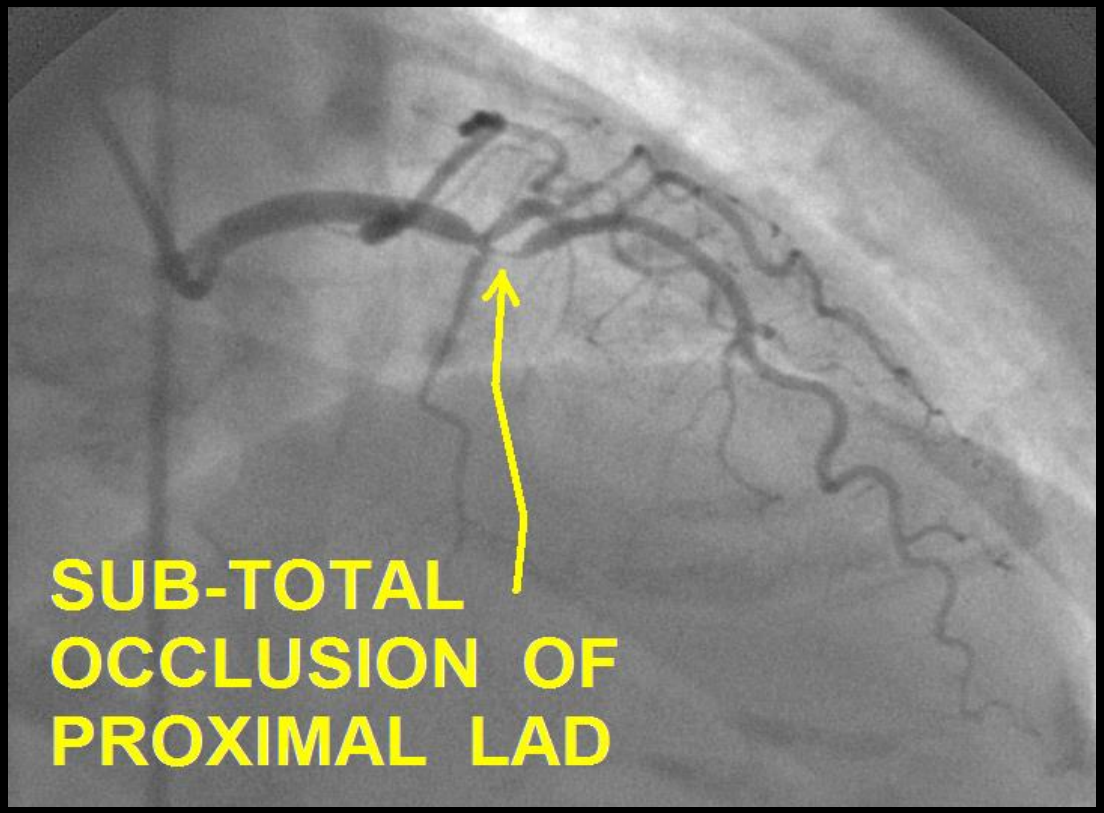
HYPERACUTE T Waves may indicate:



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

HYPERACUTE T WAVES





Helpful Clue: Hyper-Acute T Waves

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

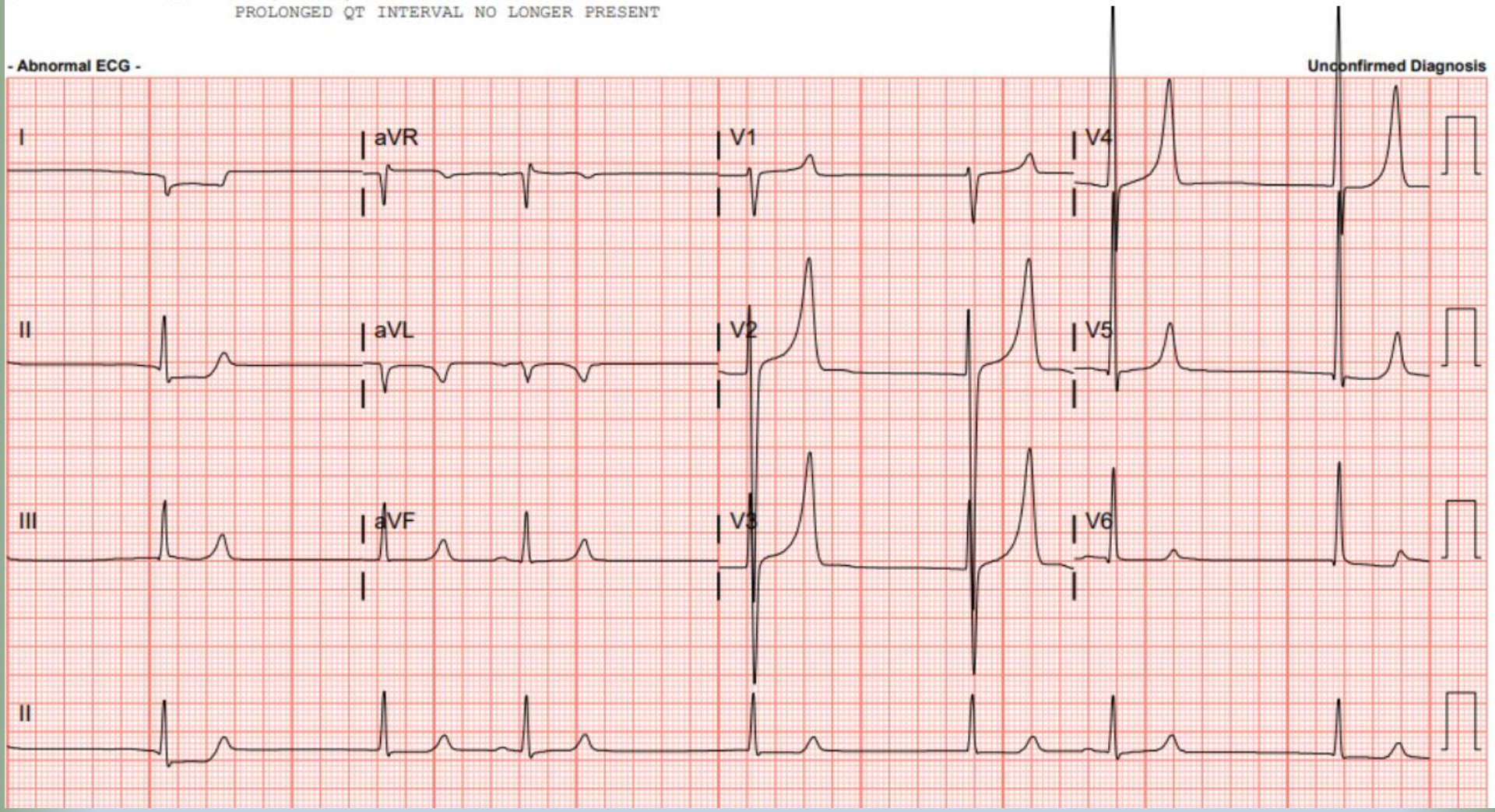
Rate	39	Right and left arm electrode reversal, interpretation assumes no reversal
PR	500	Sinus bradycardia
QRSd	117	Atrial premature complexes
QT	549	LVH with IVCD and secondary repol abnrm
QTc	443	Anterior ST elevation, probably due to LVH
--Axis--		COMPARED TO ECG 02/24/2020 21:46:48
P	0	SINUS BRADYCARDIA NOW PRESENT
QRS	96	INTRAVENTRICULAR CONDUCTION DELAY NOW PRESENT
T	117	ST (T WAVE) DEVIATION NOW PRESENT
		PROLONGED QT INTERVAL NO LONGER PRESENT

Req Provider: ONIER VILLARREA

K+ = 7.9

- Abnormal ECG -

Unconfirmed Diagnosis



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

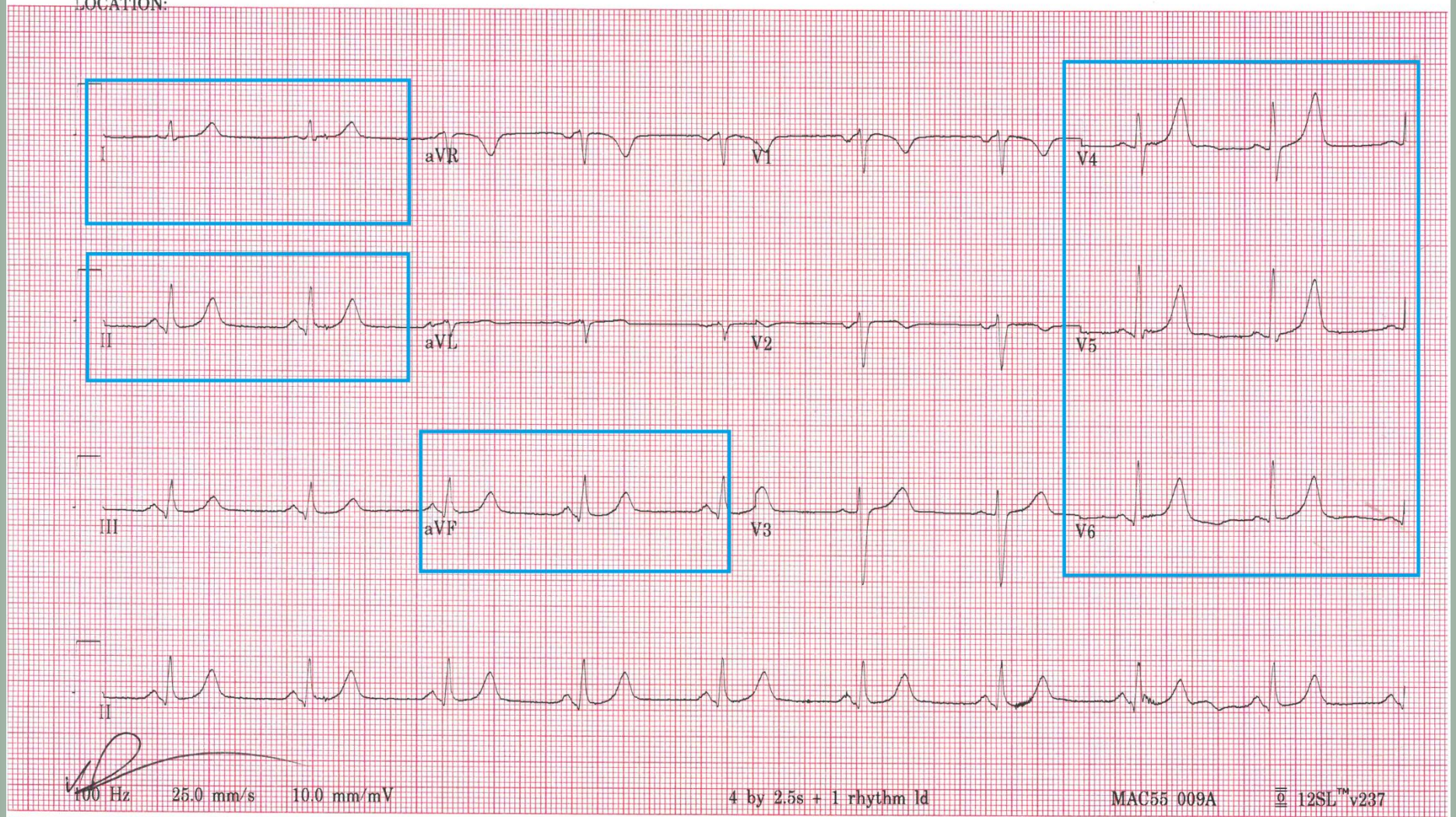
K+ = 6.7

Technician:
Test ind:

Referred by:

Unconfirmed

LOCATION:



100 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 1 rhythm ld MAC55 009A 12SL™v237

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

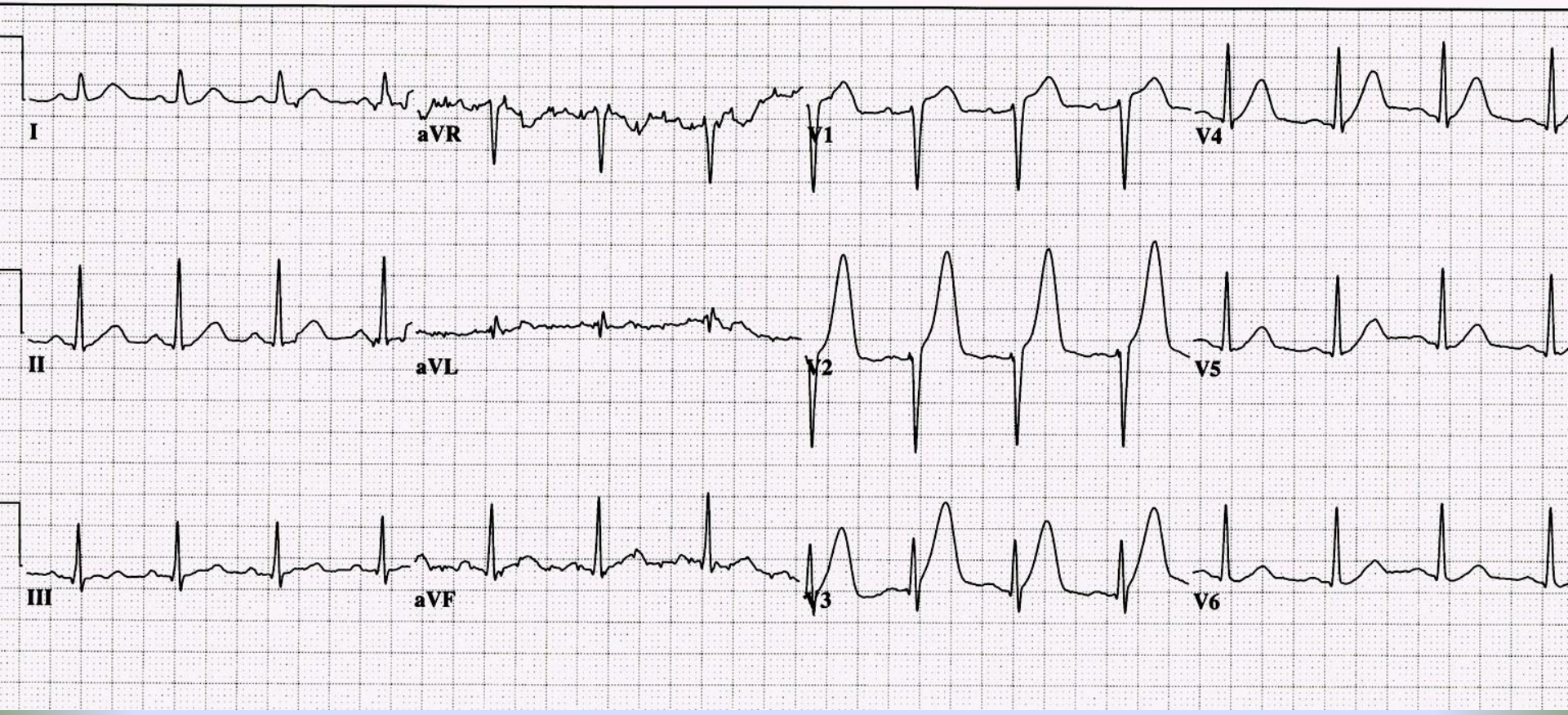
30 yr
Male Black

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:

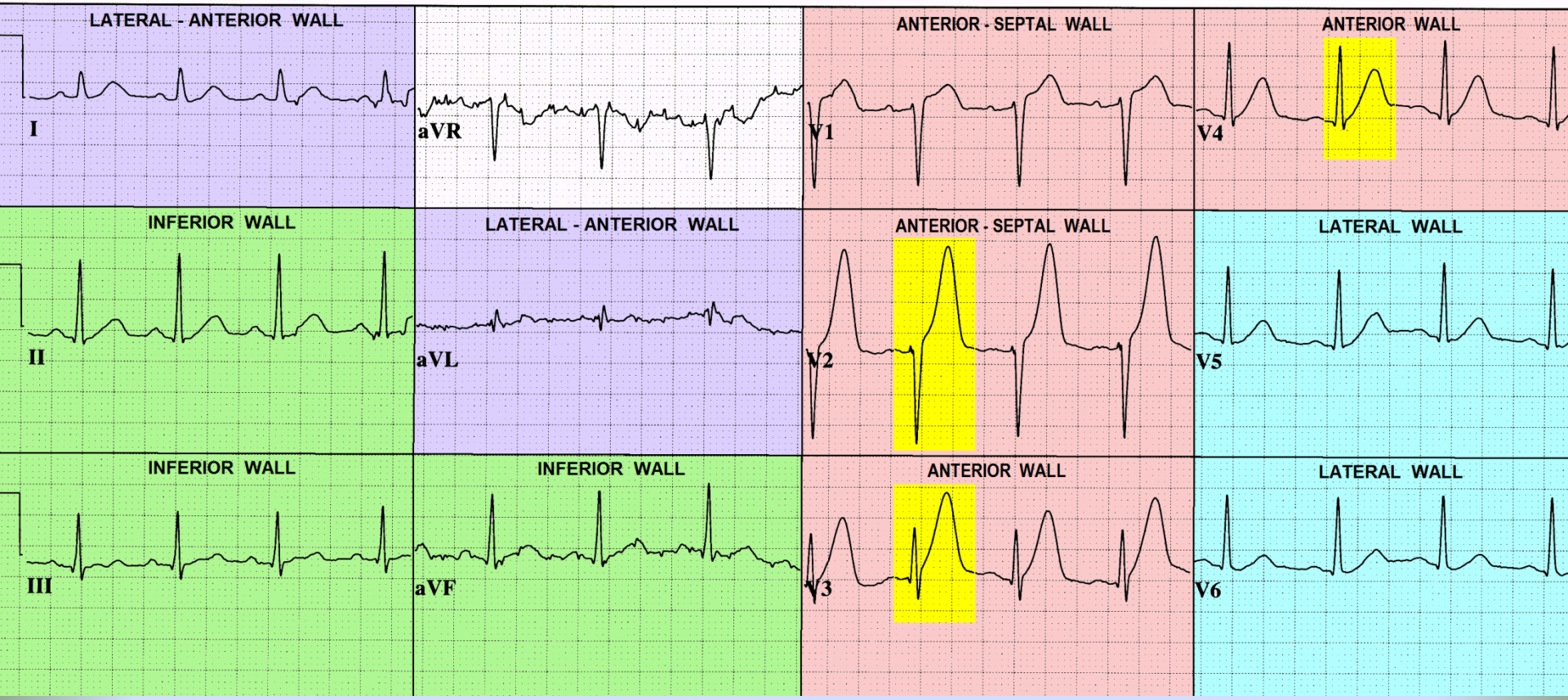
Vent. rate	88	BPM
PR interval	164	ms
QRS duration	90	ms
QT/QTc	370/447	ms
P–R–T axes	61 62	53

Normal sinus rhythm
Normal ECG
No previous ECGs available

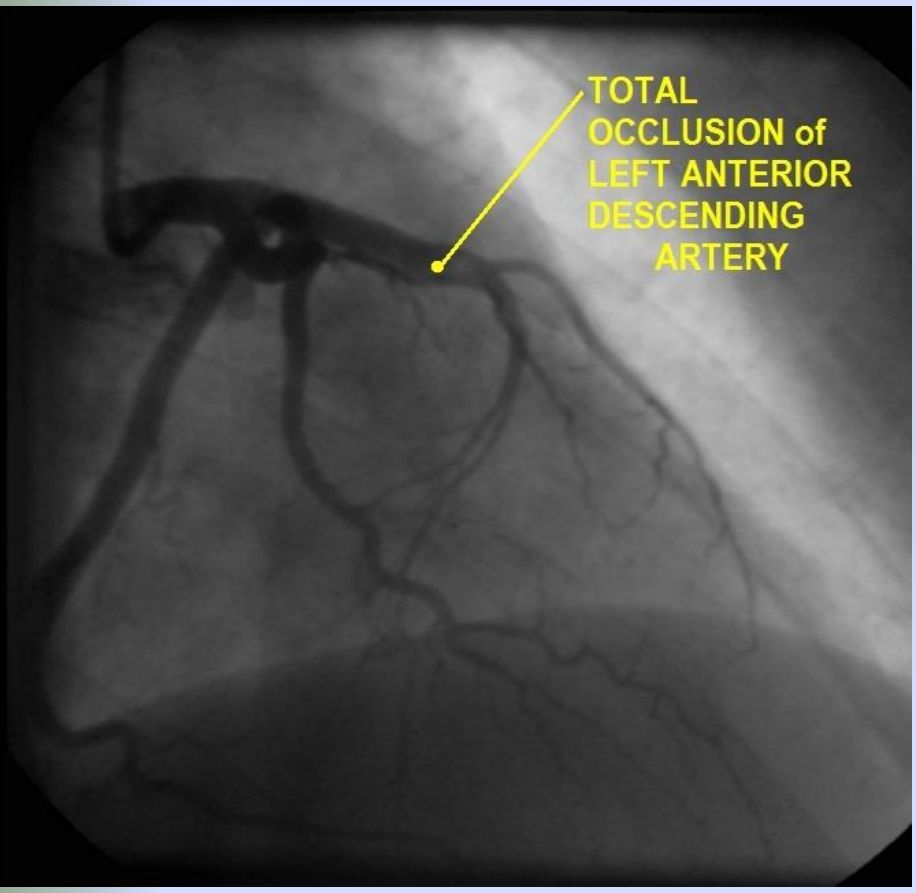
HIGHLIGHTED AREAS = HYPERACUTE T WAVES

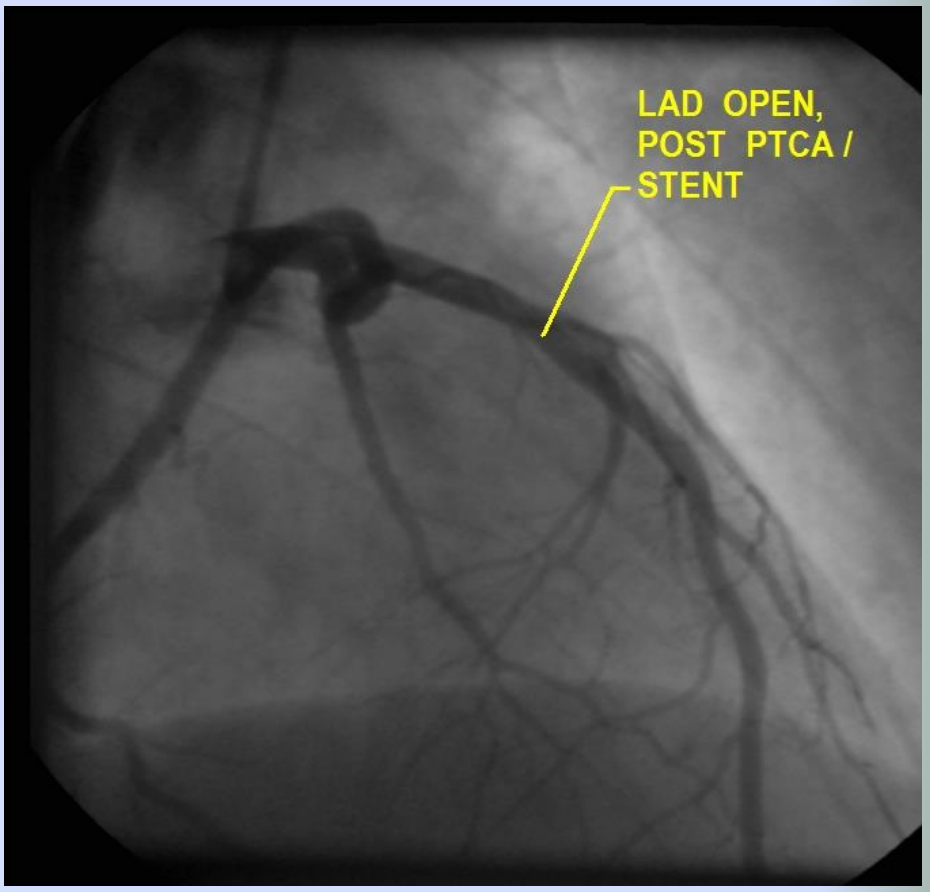
CORONARY ARTERIAL DISTRIBUTIONS:

- *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:

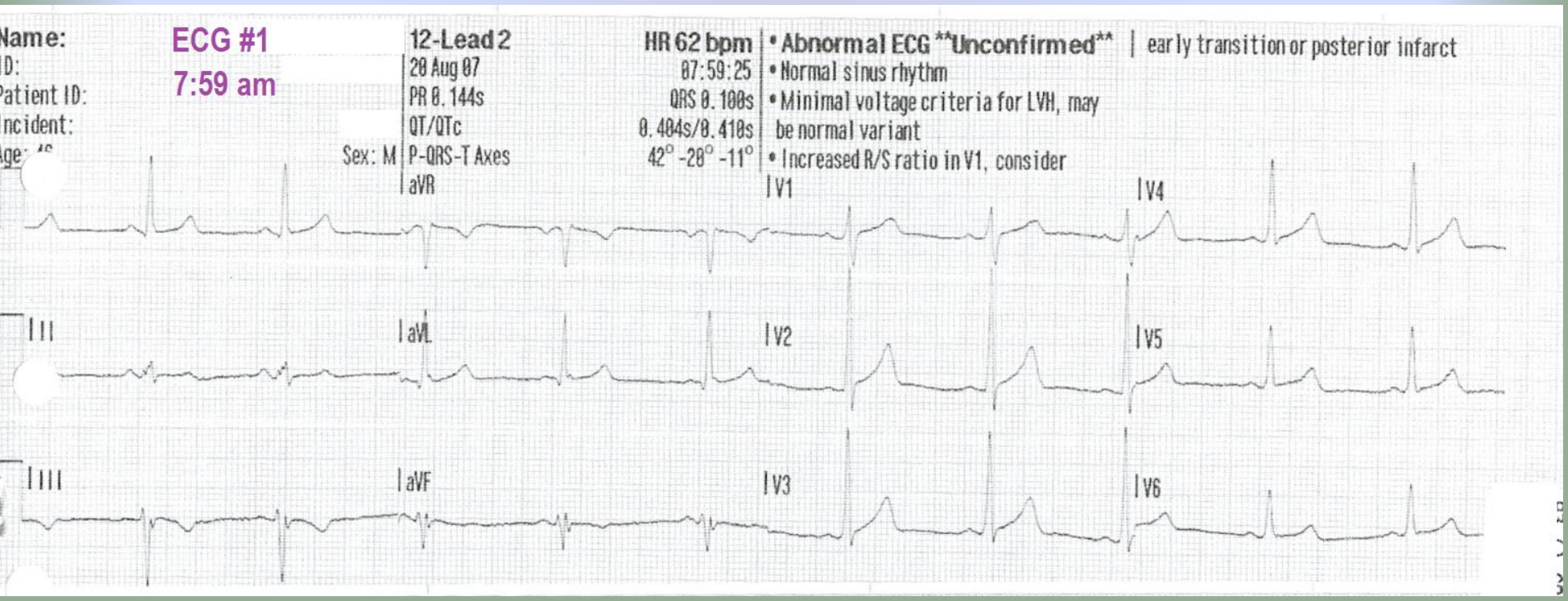
- Other than HEART RATE related variations (which affect intervals), ***J Points, ST-Segments and T Waves SHOULD NOT CHANGE.***

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.**

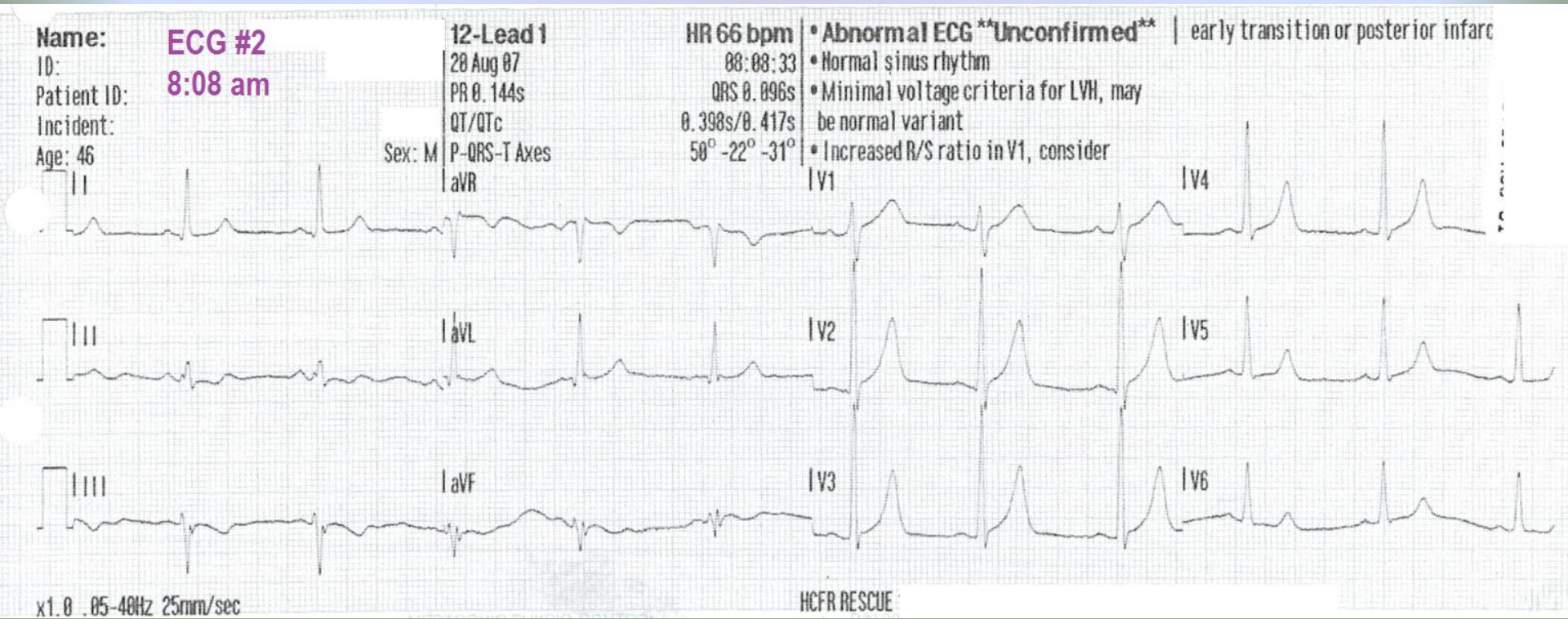
46 year old male

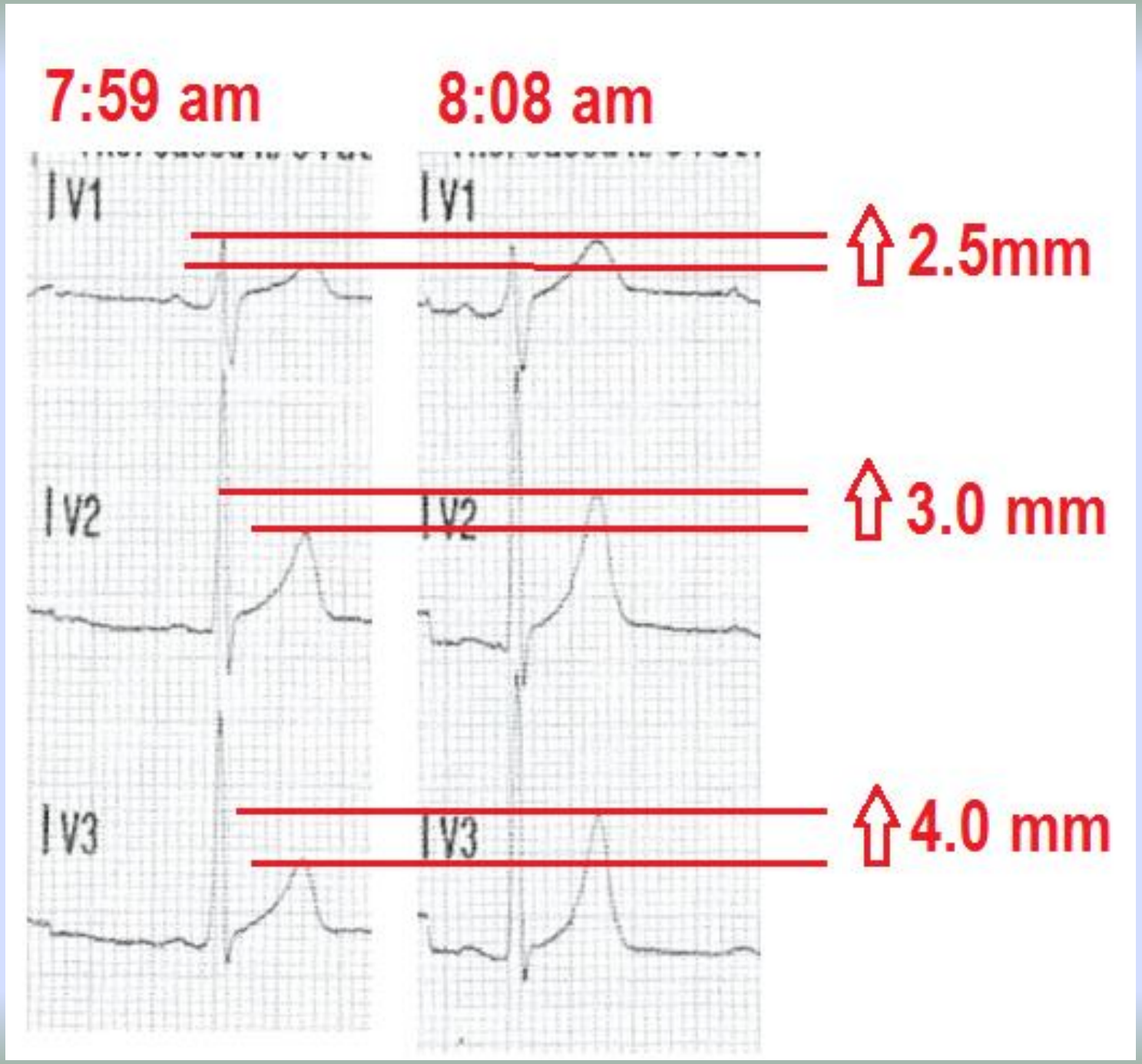
- Exertional dyspnea X “several weeks”
- Intermittent chest pressure X last 3 hours. Currently pain free.



46 year old male: ECG 1

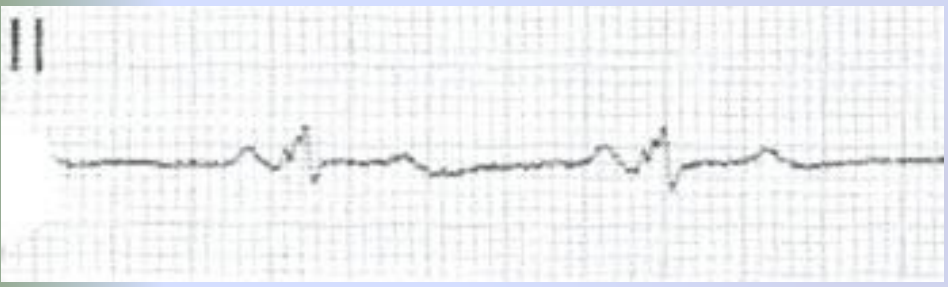
- Chest pressure has returned, "5" on 1-10 scale. 2nd ECG obtained due to "change in symptoms":



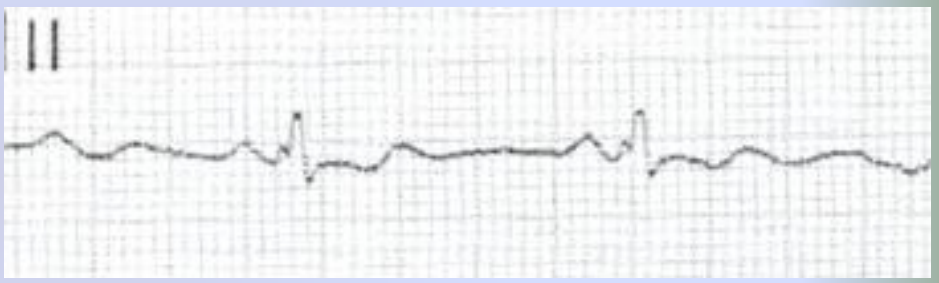

7:59 am
8:08 am
V1
V1
2.5mm
V2
V2
3.0 mm
V3
V3
4.0 mm

ST-Segment Depression

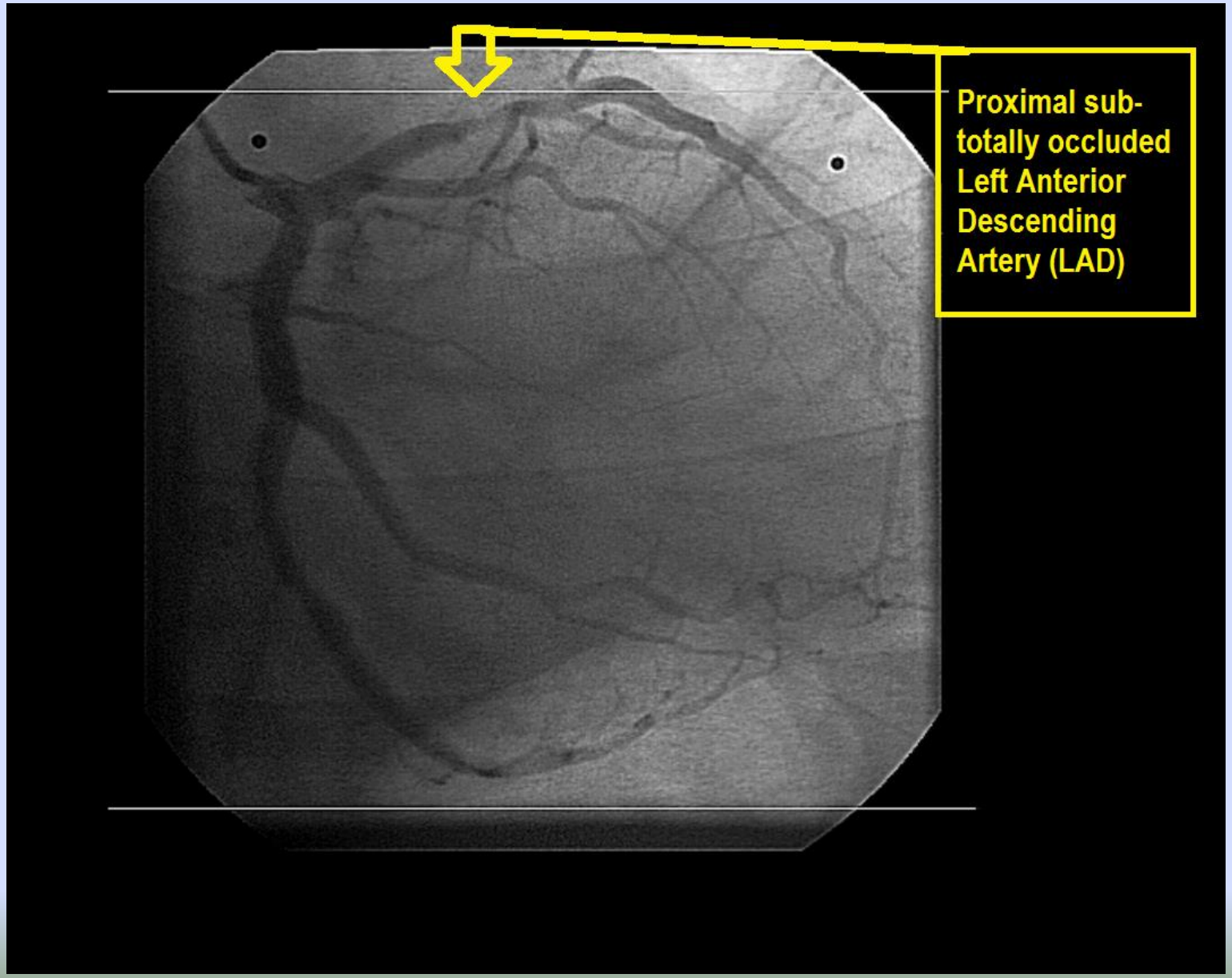
7:59 am



8:08 am

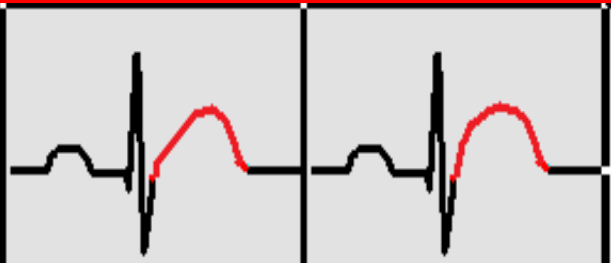
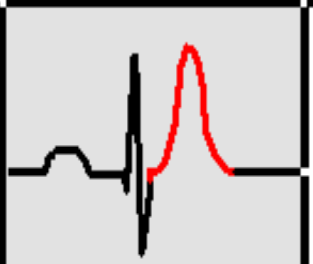
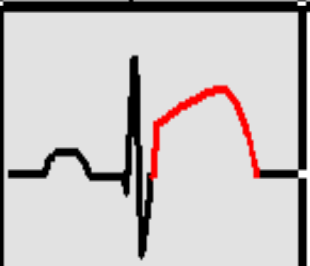
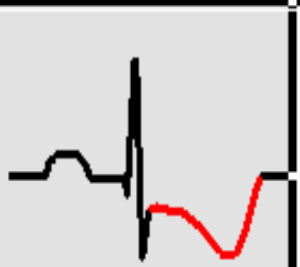


Cath Lab Angiography:



PATTERNS of ACS & ISCHEMIA

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

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

ECG CRITERIA for DIAGNOSIS of STEMI:

(ST ELEVATION @ J POINT)

*LEADS V2 and V3:

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

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

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

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

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

STEMI Criteria for 18 Lead ECGs:

Right-Sided Chest Leads

(V3R – V6R): 0.5 mm

Posterior Chest Leads

(V7 – V9): 0.5 mm

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

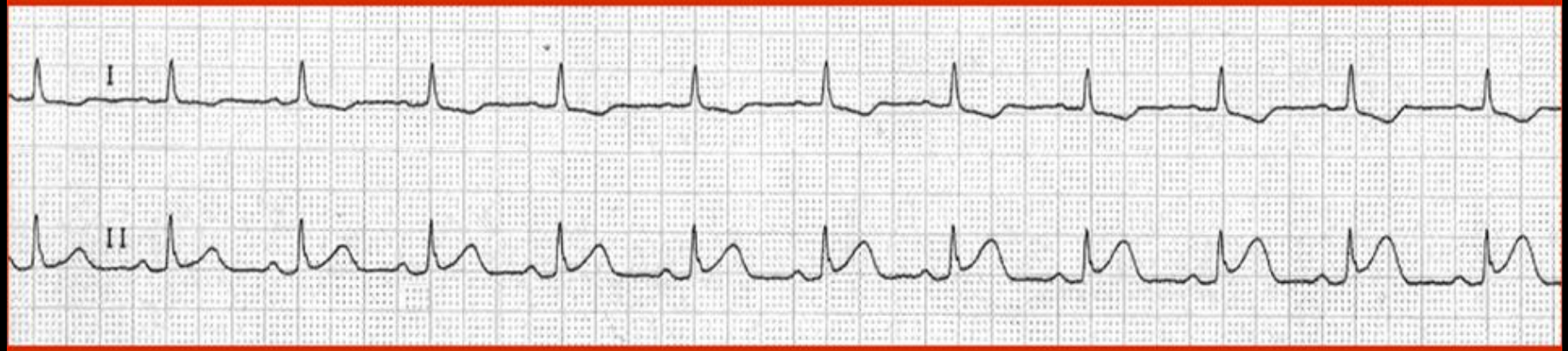
Abnormal ST Elevation Criteria: ACC/AHA 2009 "Standardization and Interpretation of the ECG, Part VI Acute Ischemia and Infarction," Galen Wagner, et al

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:

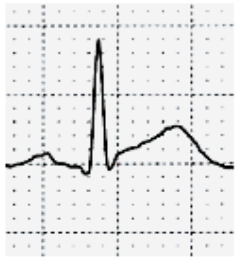
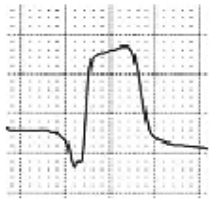
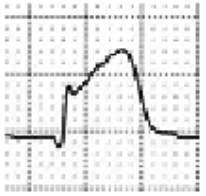
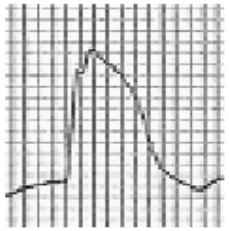
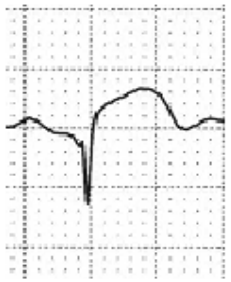
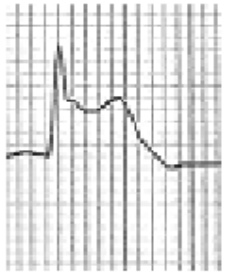
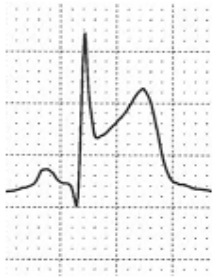
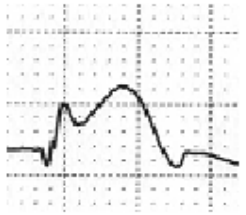
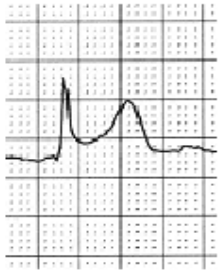
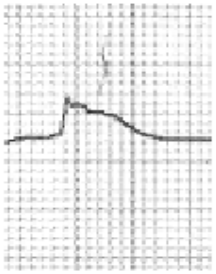
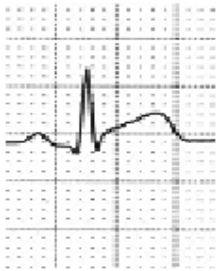
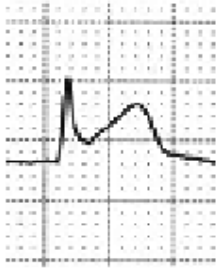
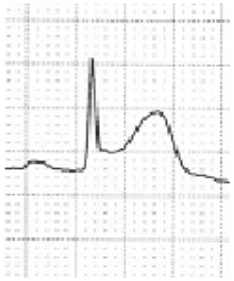
DOWNSLOPING S-T SEGMENT

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.

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

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


Lancaster County, Pennsylvania
Winter, 2002

“NOWHERE”, NEW MEXICO, 1994

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.

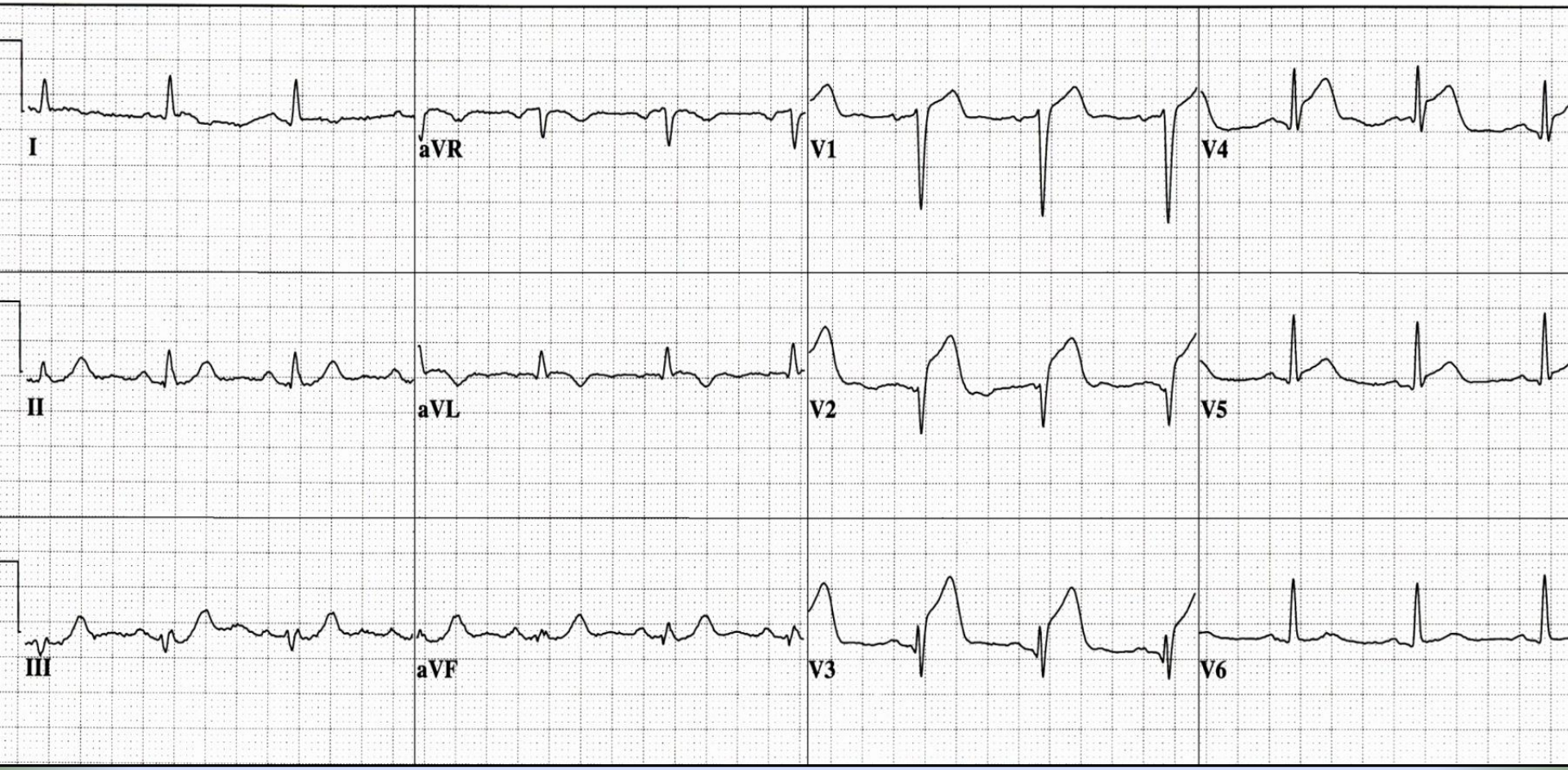
VITAL SIGNS: BP: 100/64, P: 75, R: 20, SAO2: 94%

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

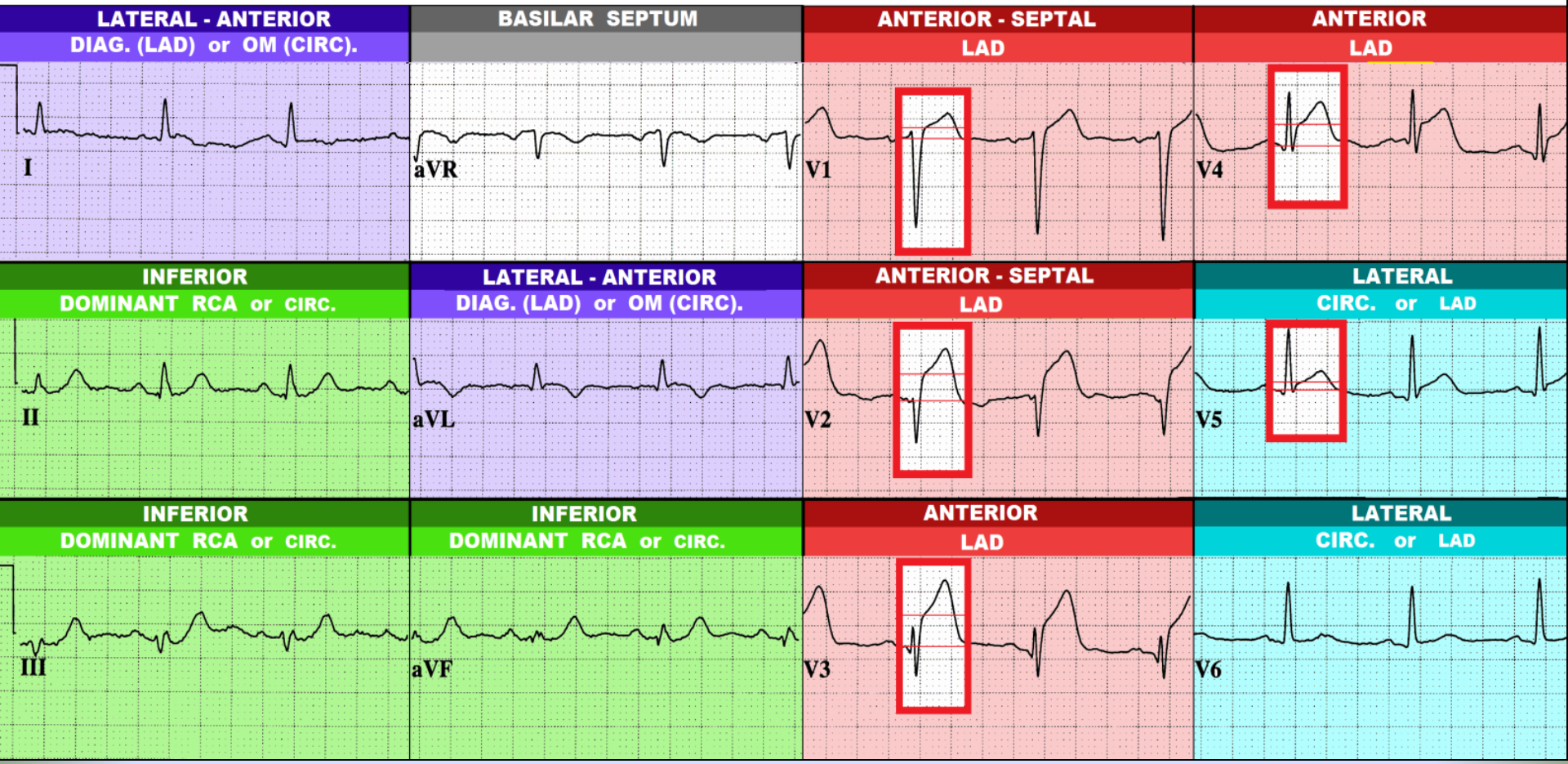
☞ **EVALUATE EKG for indicators of ACS:**

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



72 yr		Vent. rate	75	BPM	Normal sinus rhythm
Male	Caucasian	PR interval	162	ms	Anteroseptal infarct , possibly acute
		QRS duration	98	ms	*** ** ** ** * ACUTE MI ** ** ** **
		QT/QTc	382/426	ms	Abnormal ECG
Loc:	Option:2	P–R–T axes	72 13	83	

ST SEGMENT ELEVATION



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

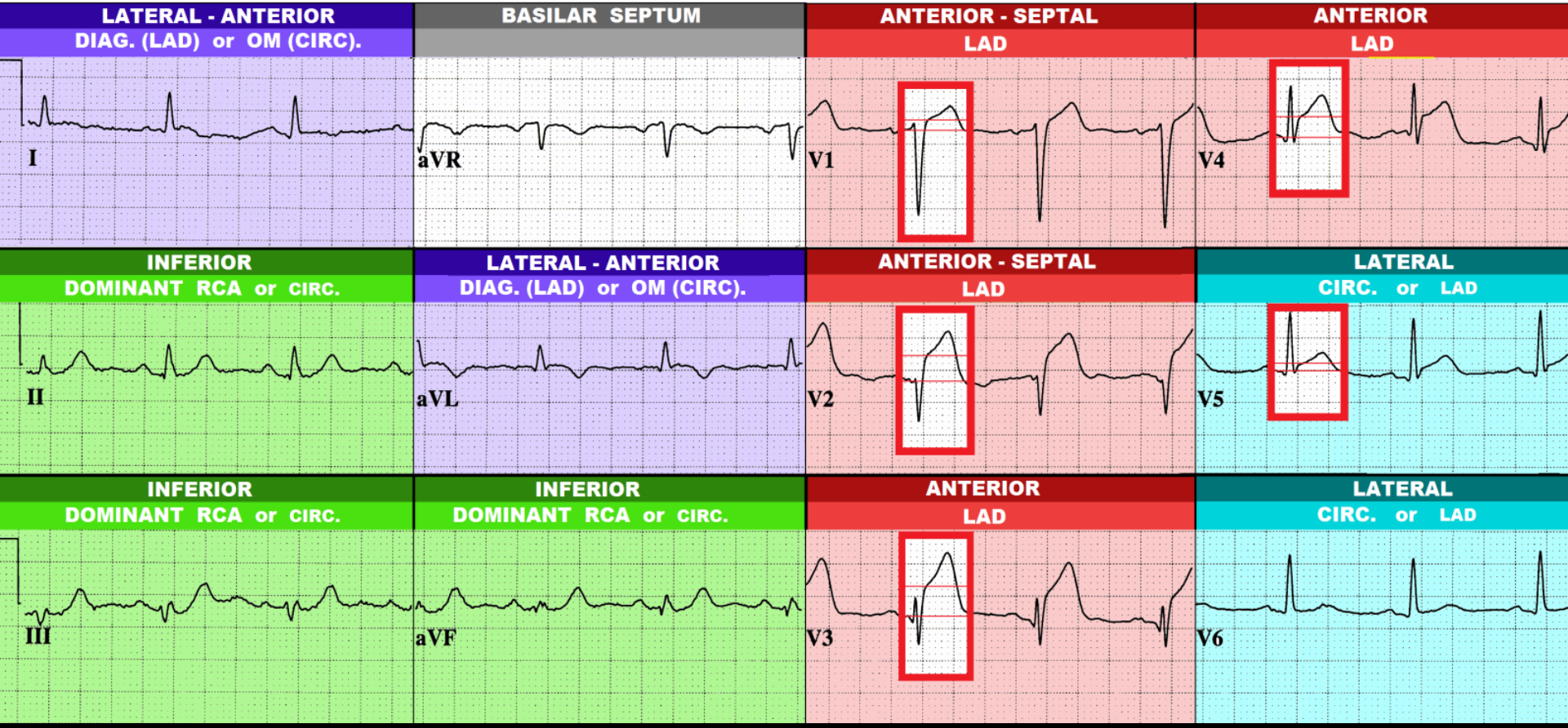
72 yr
Male Caucasian

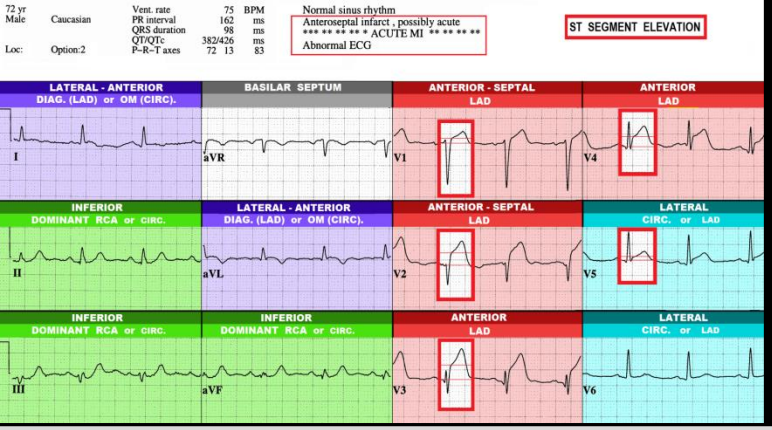
Loc: Option:2

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

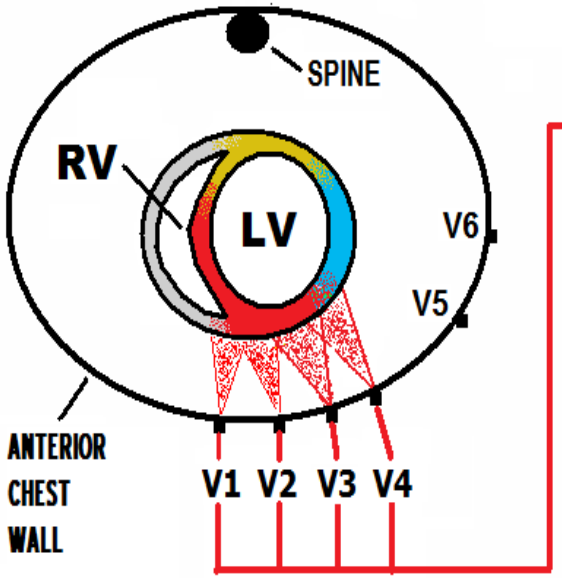
ST SEGMENT ELEVATION





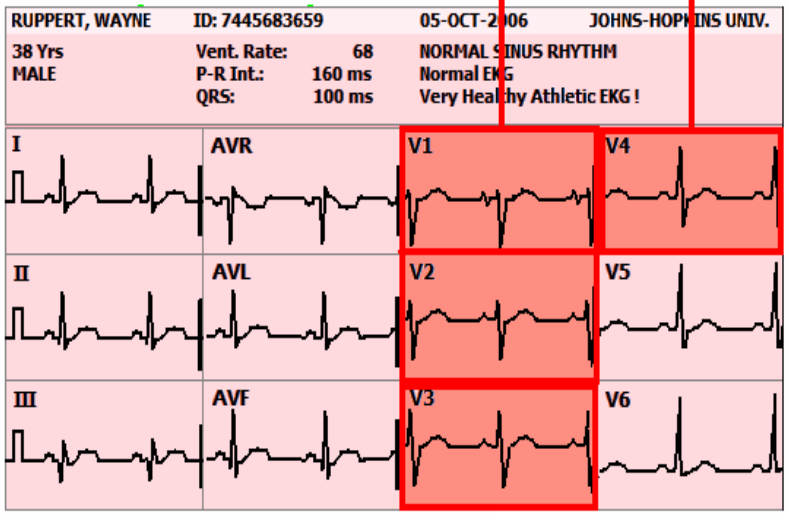
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE

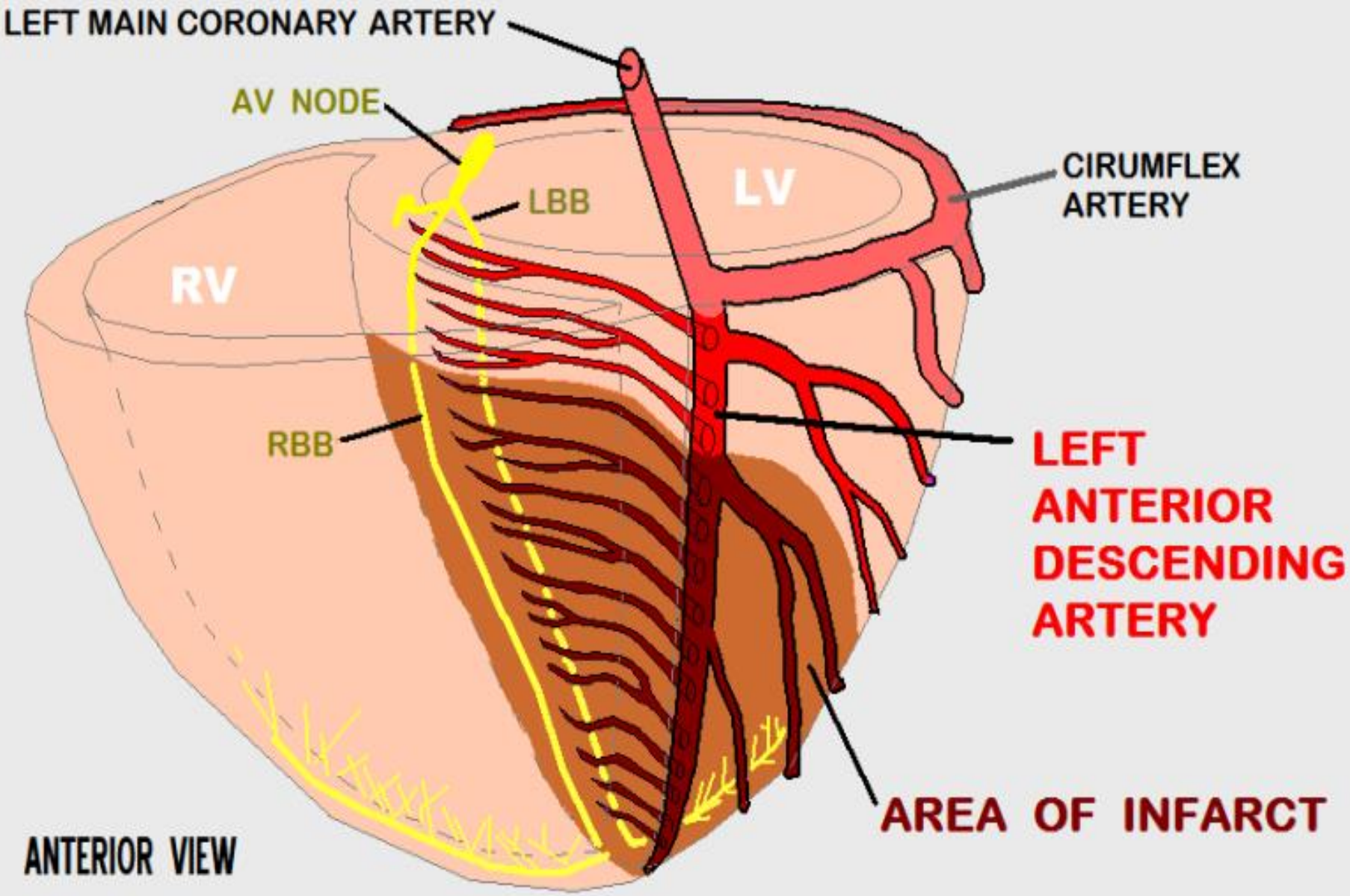


V1, V2 - ANTERIOR / SEPTAL

V3, V4 - ANTERIOR

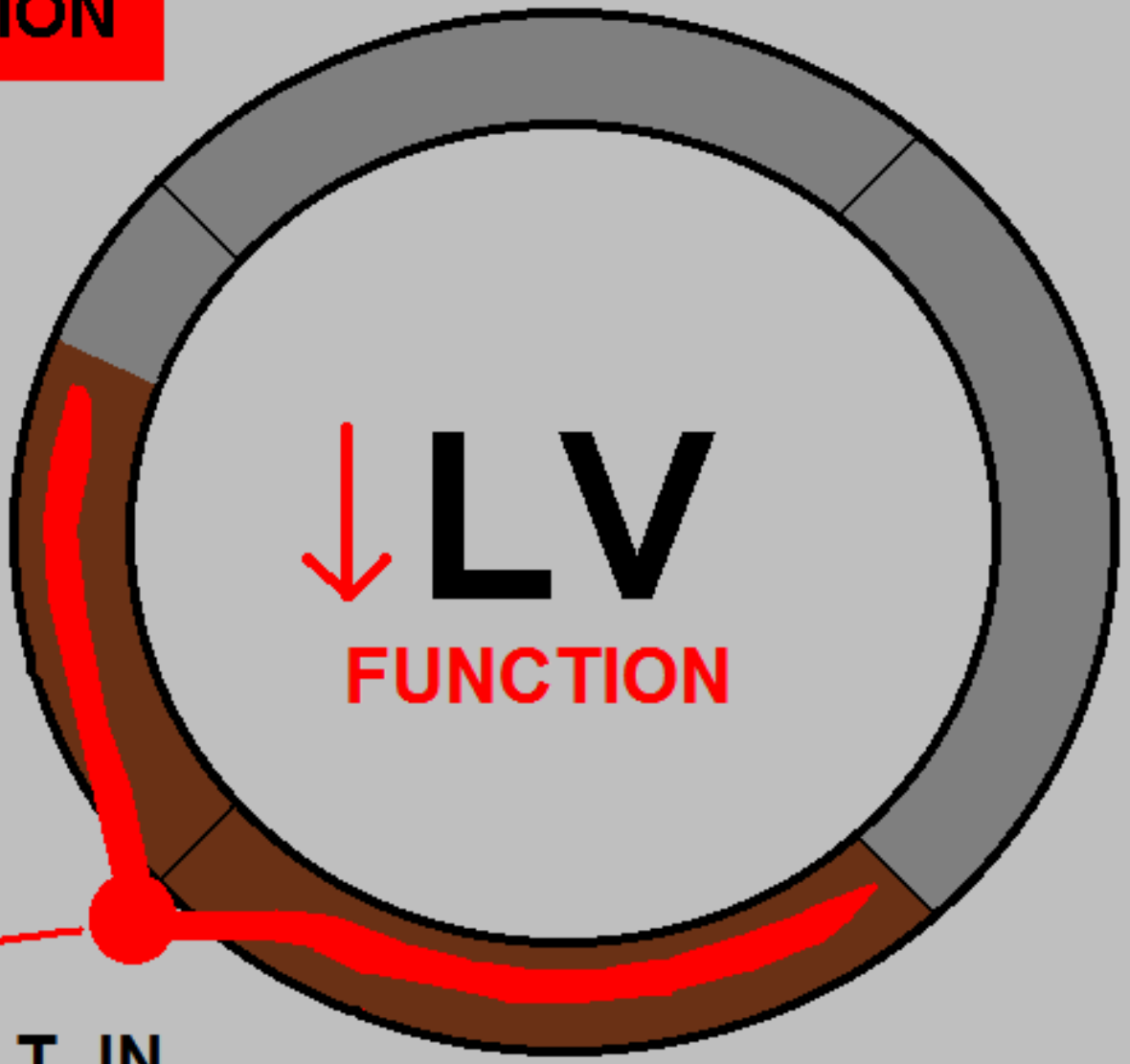


OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



LAD DISTRIBUTION

35 - 45 % of LV MUSCLE MASS



A BLOCKAGE OF THE LAD

CAN RESULT IN LV PUMP FAILURE --

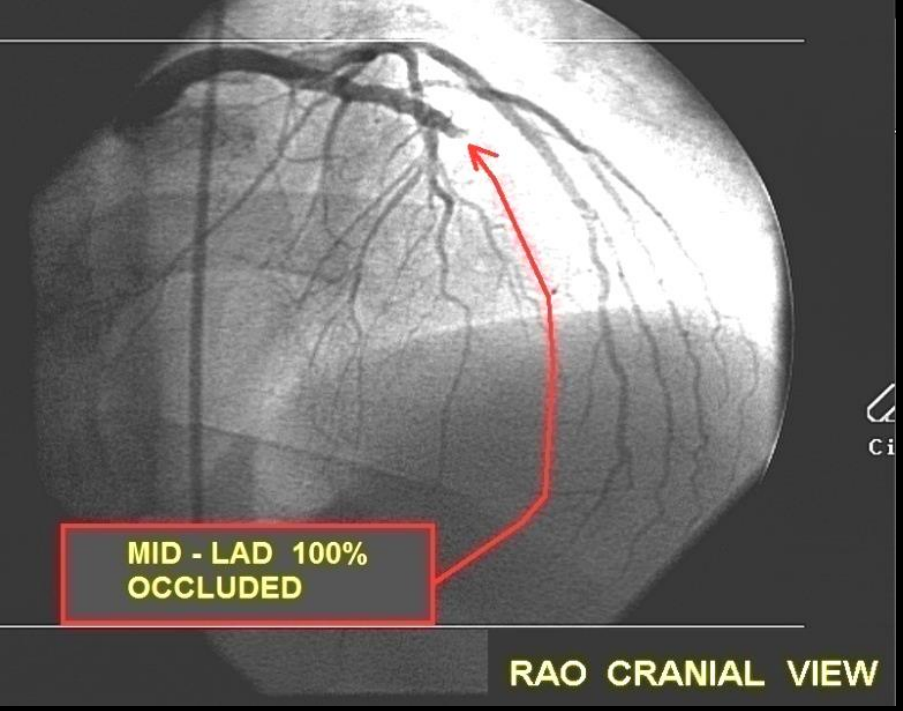
- CARDIOGENIC SHOCK
- PULMONARY EDEMA

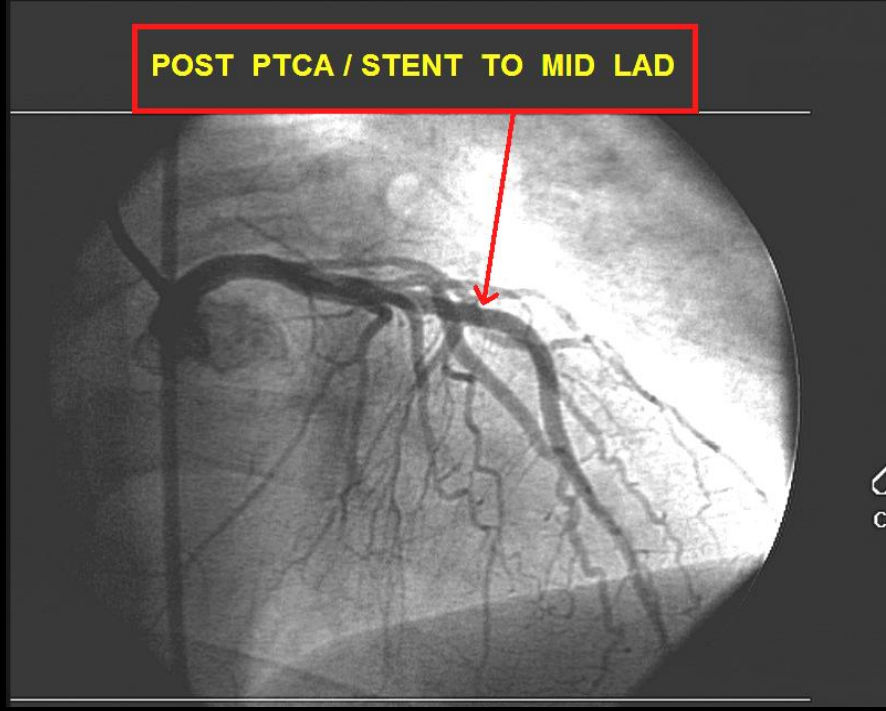

400 mg
Dopamine
(1600 mcg/mL)
Dopamine Hydrochloride
and 5% Dextrose Injection USP
250 mL
Baxter
500 mg Total
DOBUTamine
250 mL
Baxter

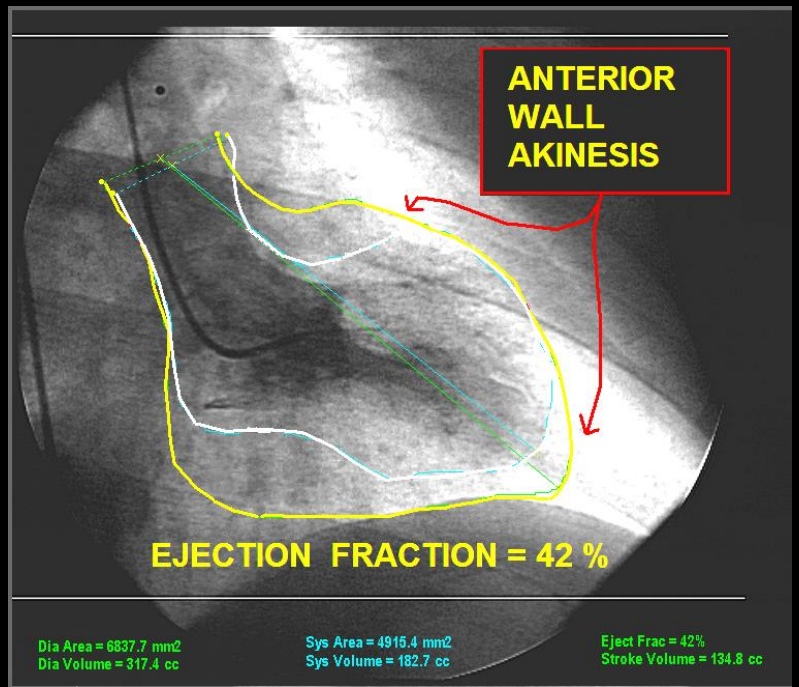
LEFT ANTERIOR DESCENDING ARTERY (LAD)

- 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)


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 2: STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

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

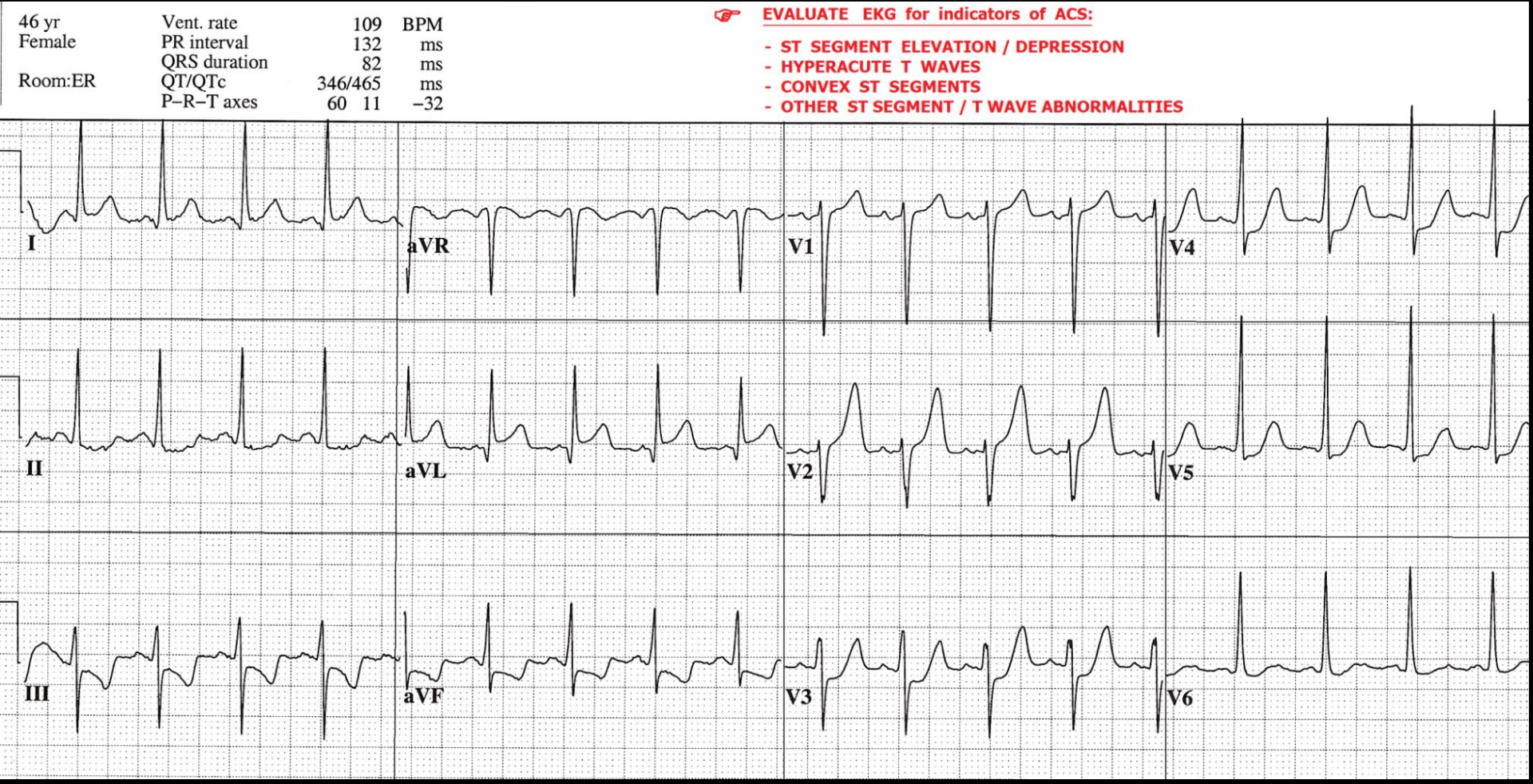
RISK FACTOR PROFILE:

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

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

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

LABS: TROPONIN ultra = 2.8


46 yr
Female
Room:ER
Vent. rate 109 BPM
PR interval 132 ms
QRS duration 82 ms
QT/QTc 346/465 ms
P–R–T axes 60 11 –32
EVALUATE EKG for indicators of ACS:
- ST SEGMENT ELEVATION / DEPRESSION
- HYPERACUTE T WAVES
- CONVEX ST SEGMENTS
- OTHER ST SEGMENT / T WAVE ABNORMALITIES
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

46 yr
Female

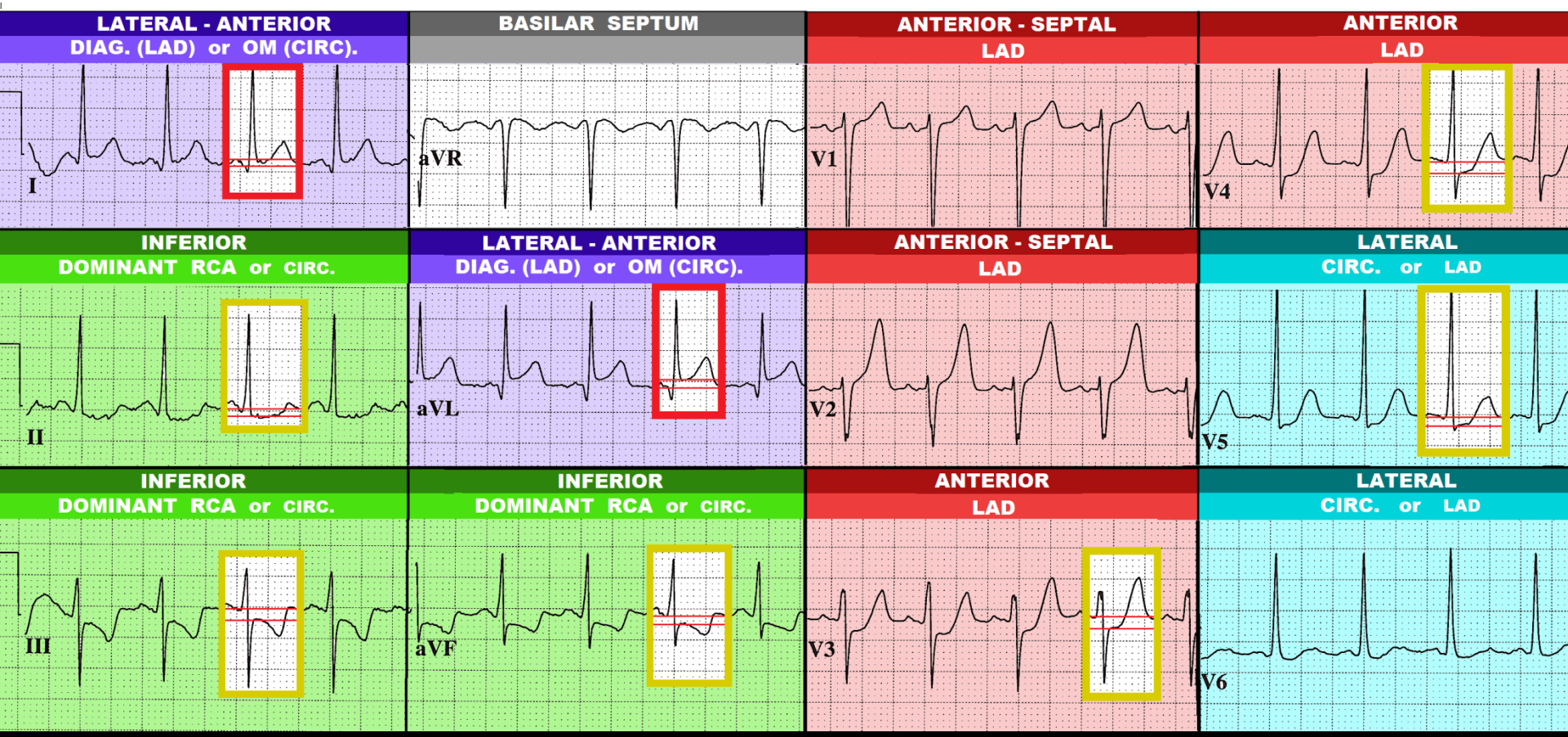
Room:ER

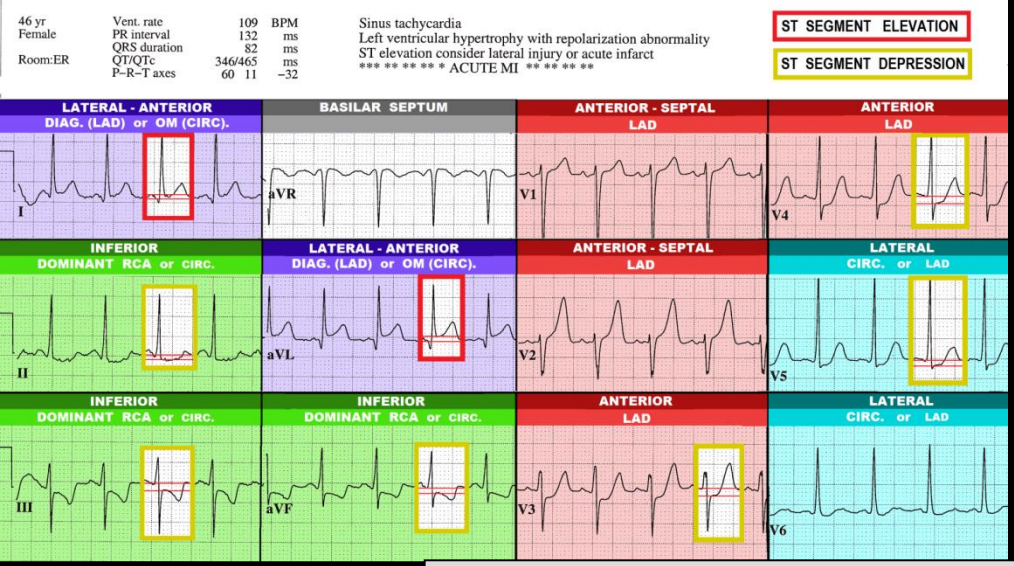
Vent. rate	109	BPM
PR interval	132	ms
QRS duration	82	ms
QT/QTc	346/465	ms
P–R–T axes	60 11	–32

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

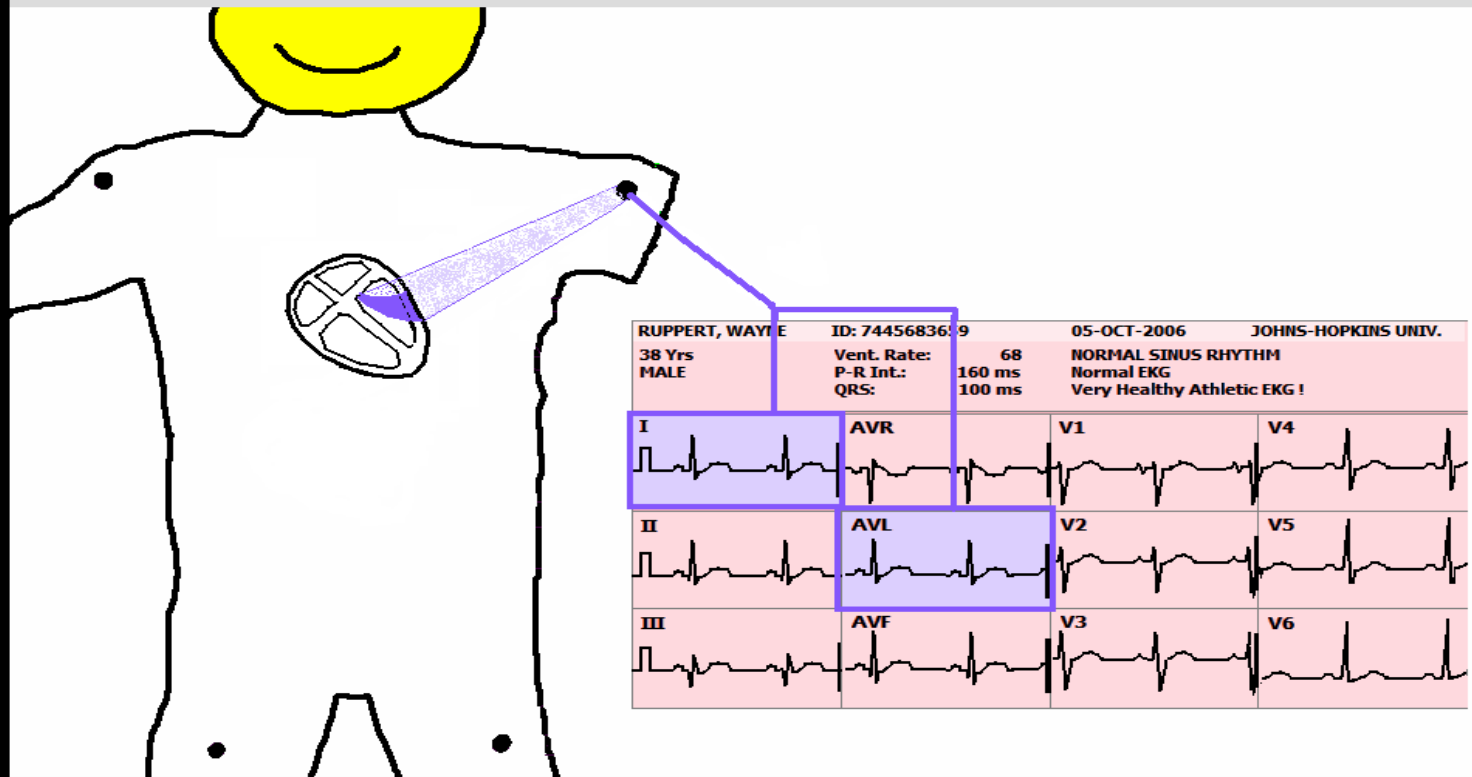
ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION

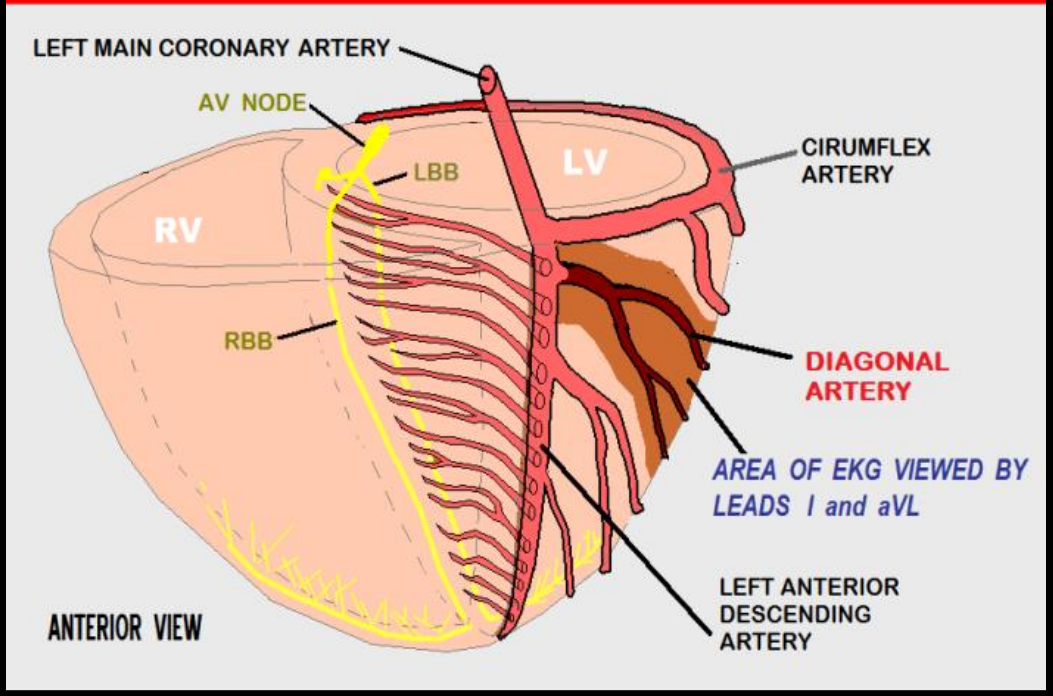




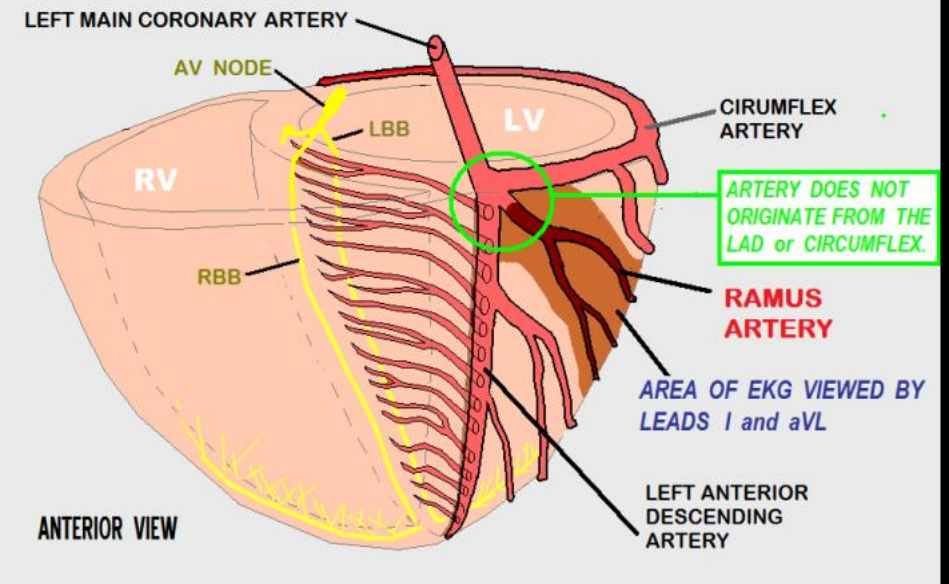
LEADS I and aVL view the ANTERIOR-LATERAL JUNCTION



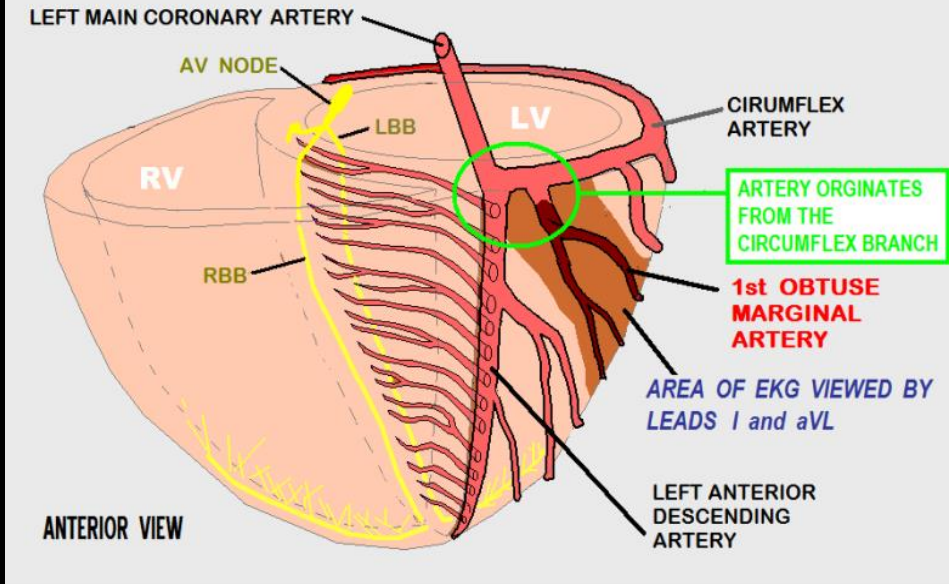
OCCLUSION of DIAGONAL ARTERY



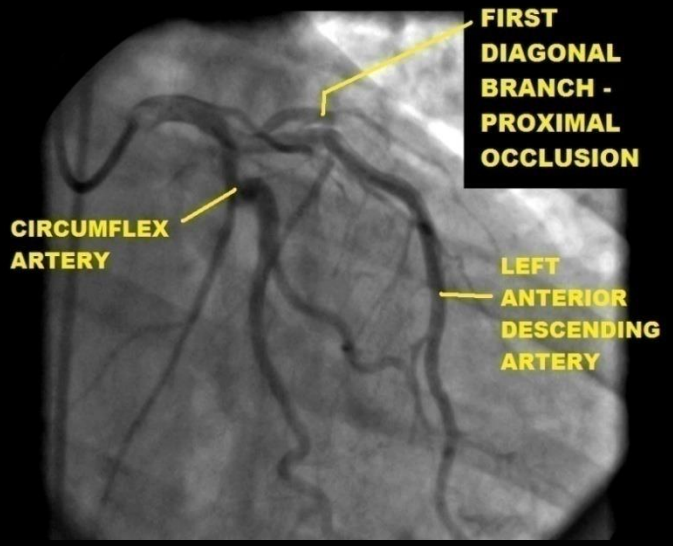
OCCLUSION of RAMUS ARTERY

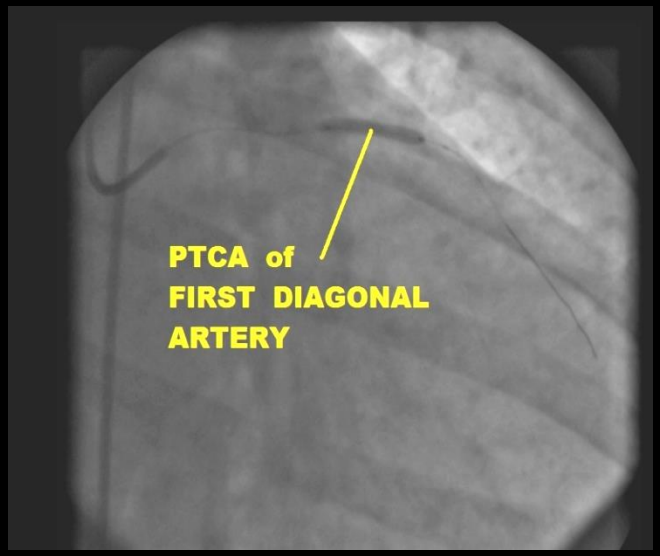


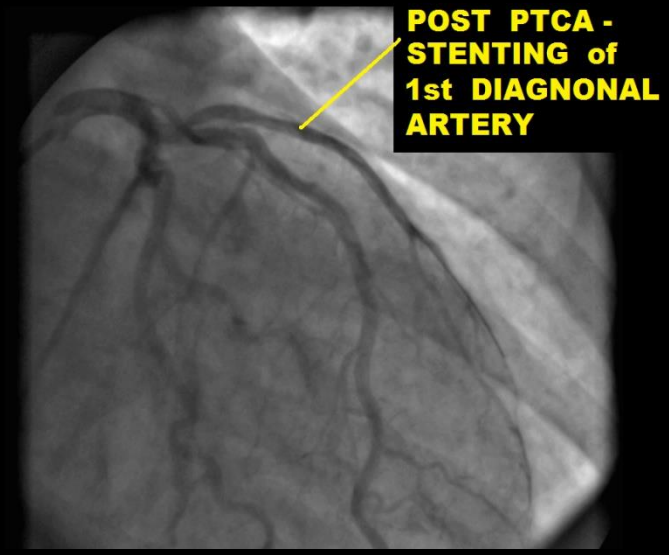
OCCLUSION of OBTUSE MARGINAL ARTERY

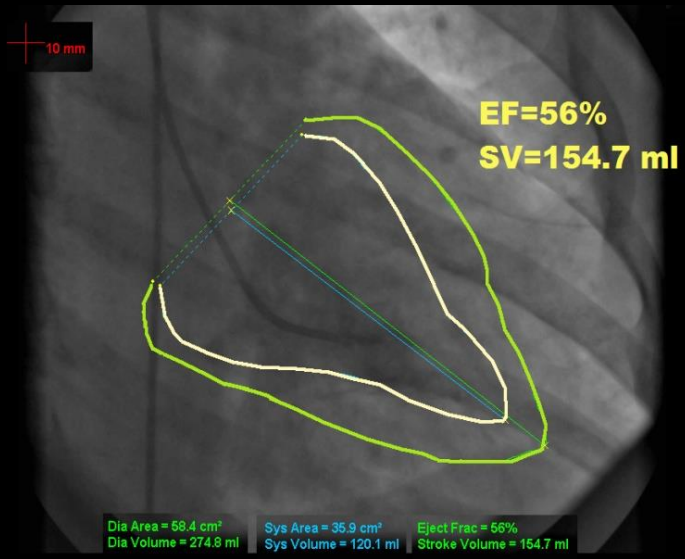


CASE PROGRESSION: As the patient was being prepared for transport to the Cardiac Cath Lab, she experienced an episode of Ventricular Fibrillation.









[redacted]

Acct# [redacted] MR# [redacted]
ONIER VILLARREAL
Adm: [redacted]2018 DOB: [redacted]
SEVEN RIVERS RMC
[redacted]

11111[redacted]11
Born 1/ 1941 77 Years

3/16/2018 1:31:57 PM
Seven Rivers Reg al

Rate 69 . SINUS RHYT[redacted].....normal P axis, V-rate 50- 99
. LEFT ATRIAL ABNORMALITY.....P,P'>60mS, <-0.15mV V1
PR 180 . LEFT ANTERIOR FASCICULAR BLOCK.....axis(240,-40), init forces inf
QRSD 94 .[redacted]
QT 436
QTc 467

--AXIS--
P 56
QRS -51
T -7

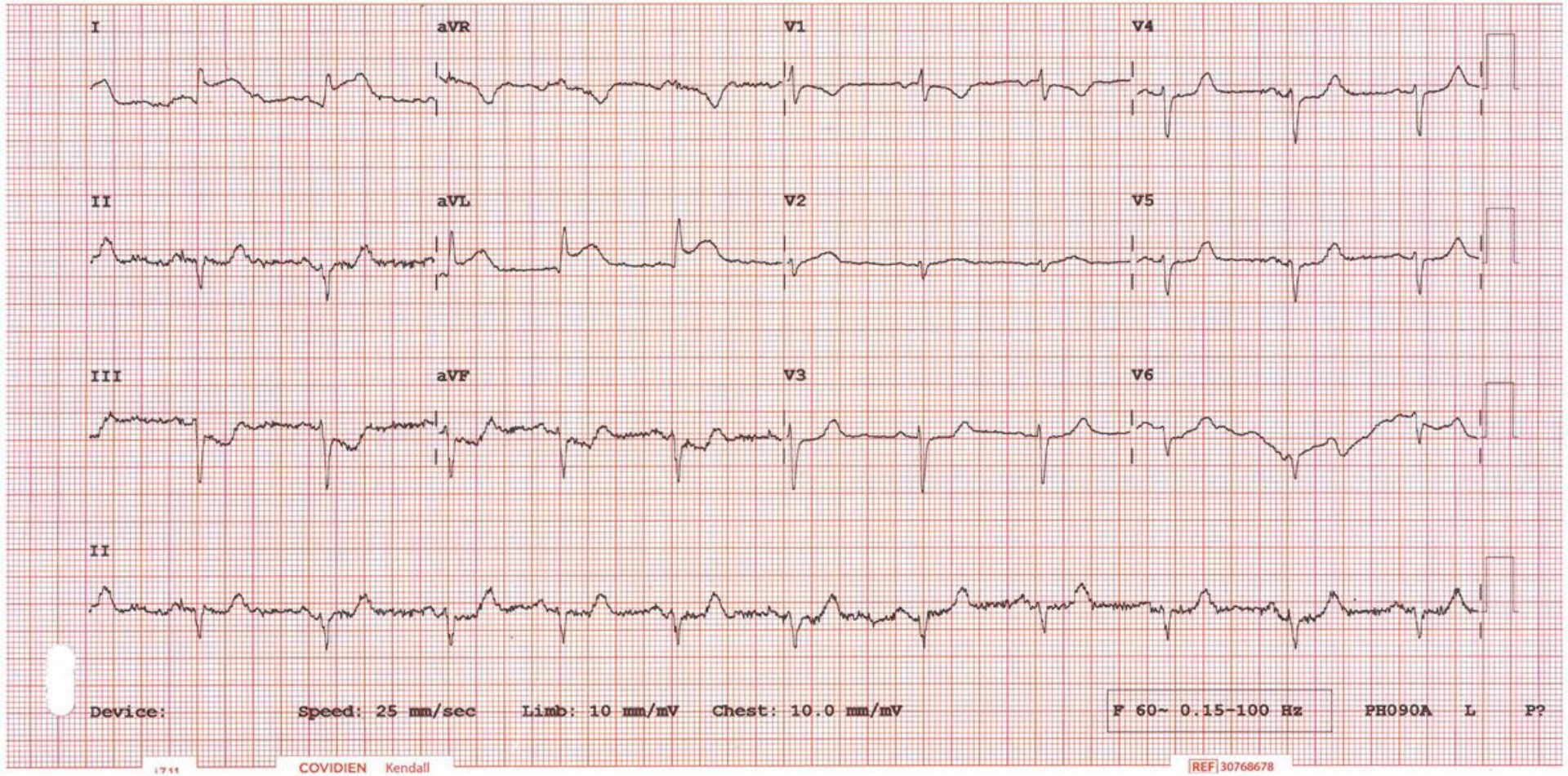
Room: er11

Physician [redacted]
Date
Time 1331
STEMI YES NO

- ABNORMAL ECG -

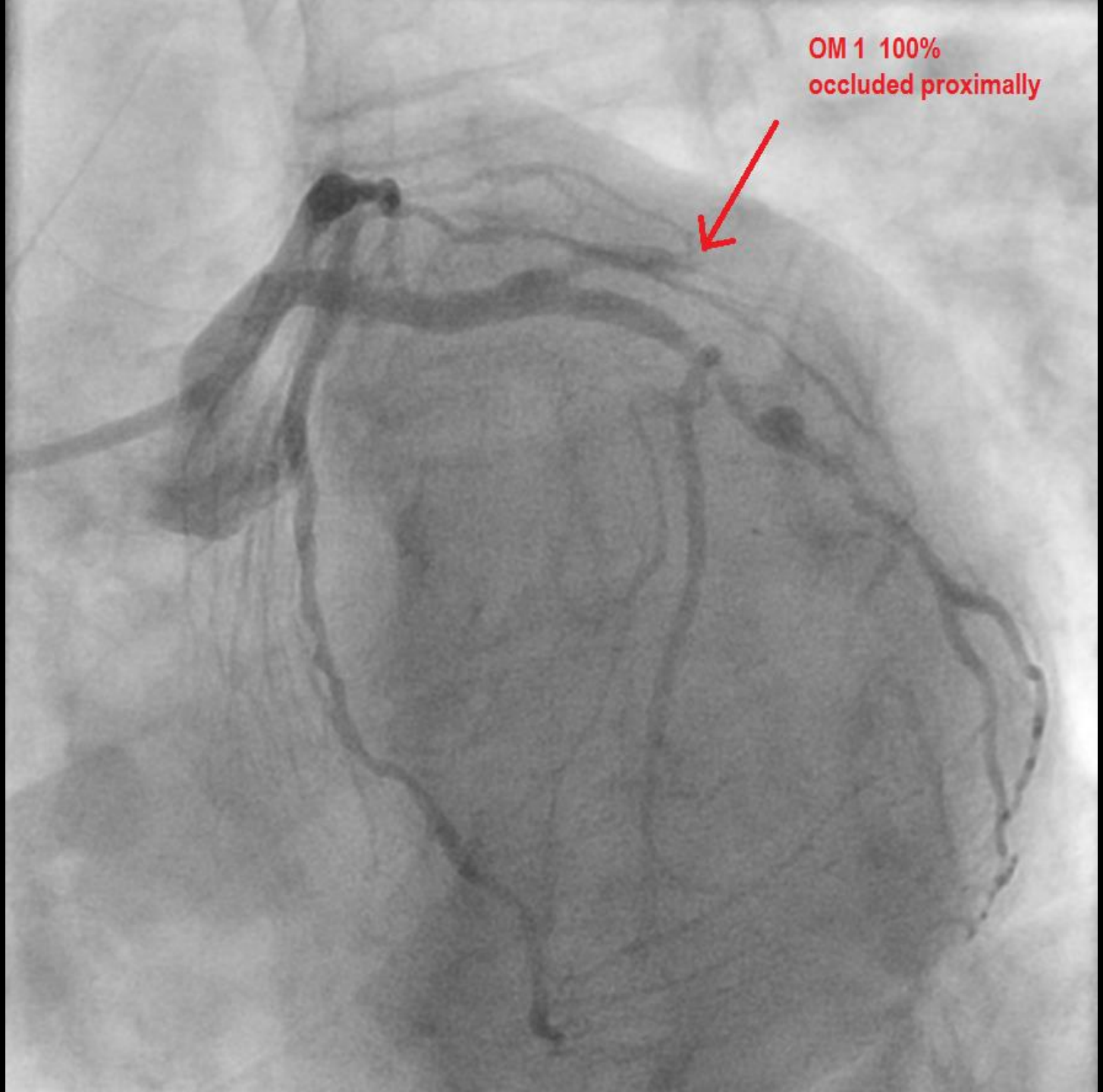
12 Lead; Standard Placement

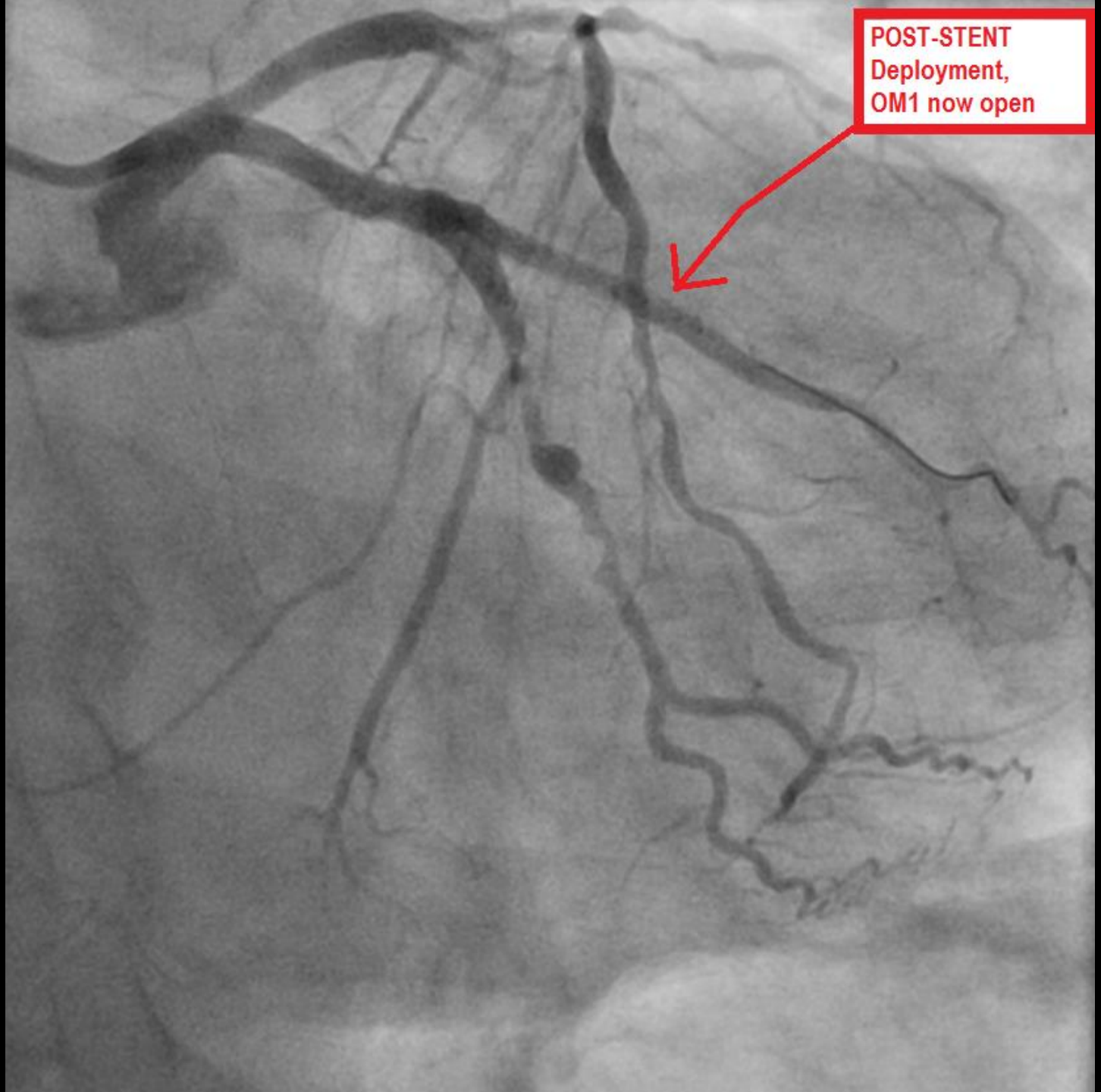
Unconfirmed Diagnosis



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

COVIDIEN Kendall REF 30768678


OM 1 100%
occluded proximally


POST-STENT
Deployment,
OM1 now open

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.

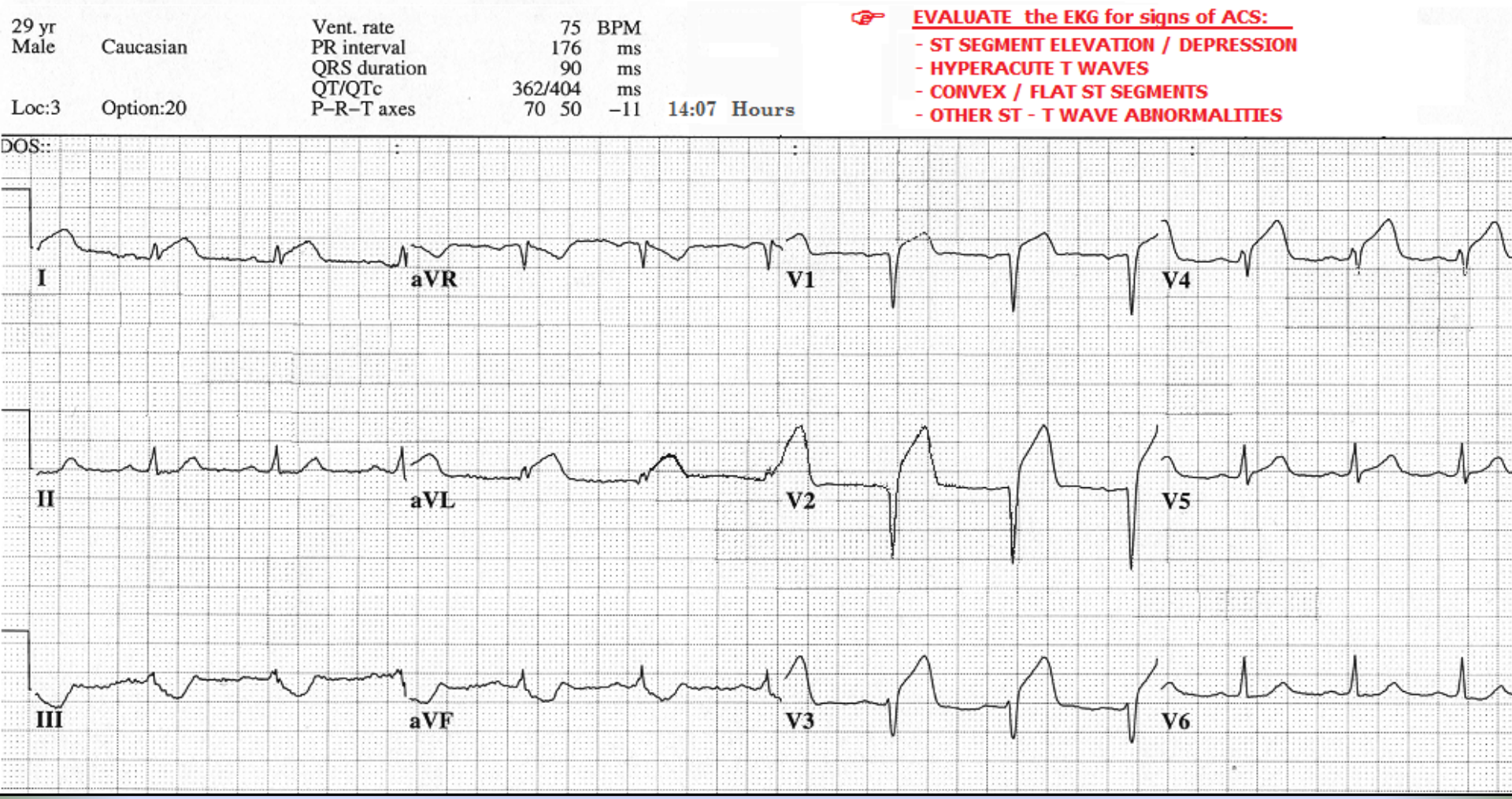
RISK FACTOR PROFILE:

- 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

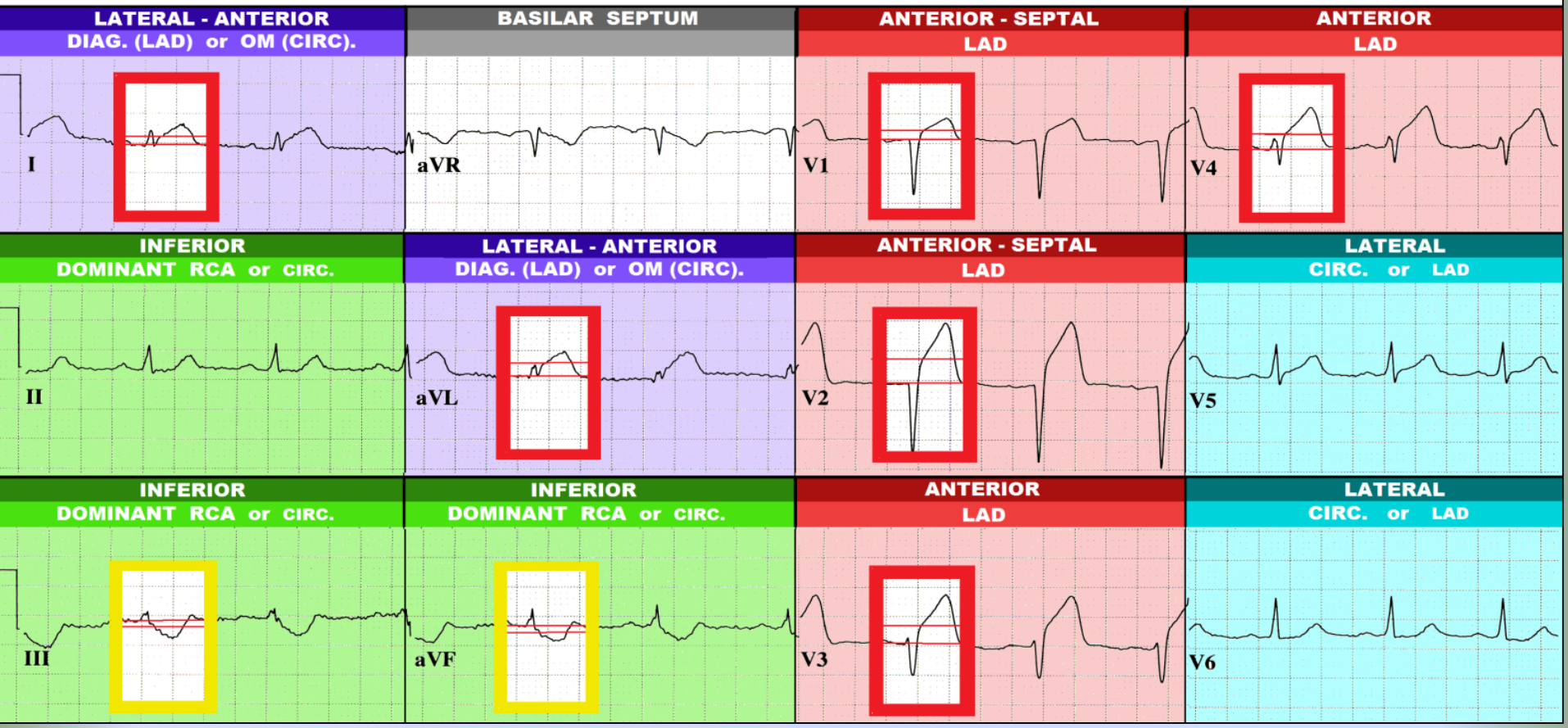
Caucasian

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

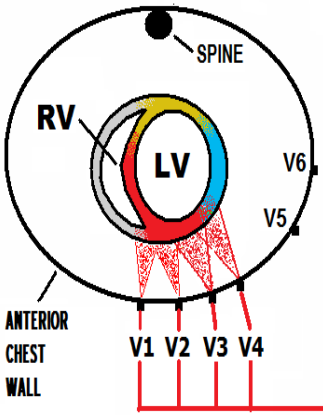
ST SEGMENT DEPRESSION



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

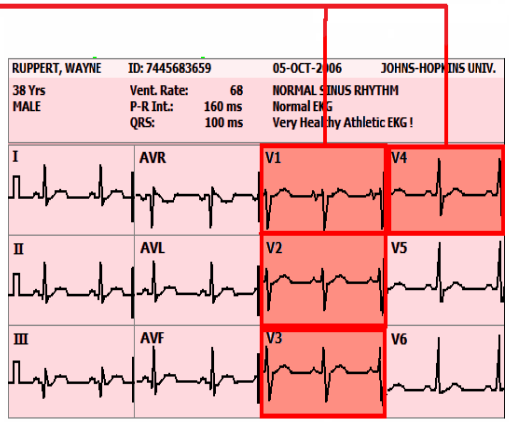
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE

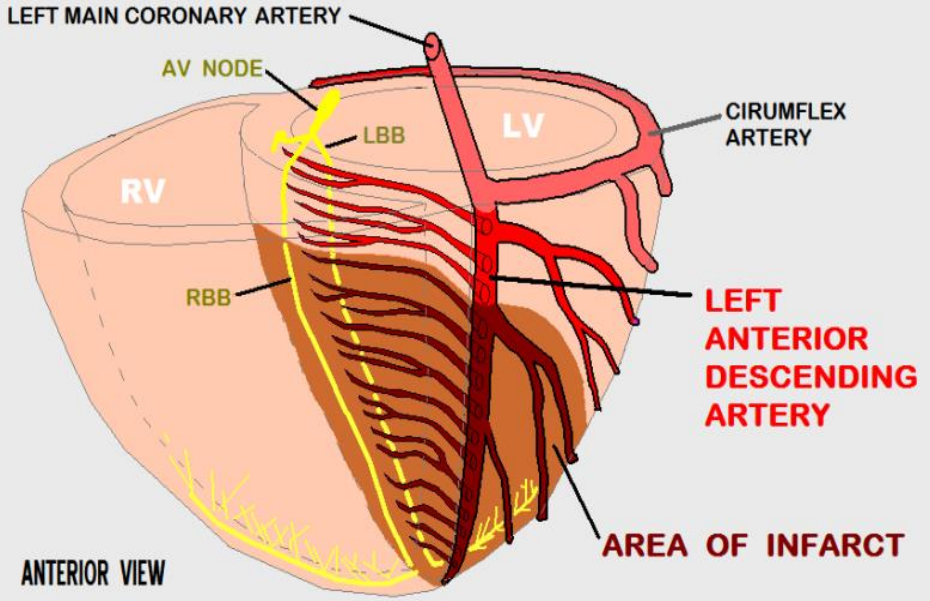


V1, V2 - ANTERIOR / SEPTAL

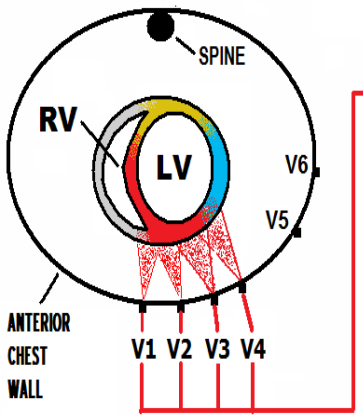
V3, V4 - ANTERIOR



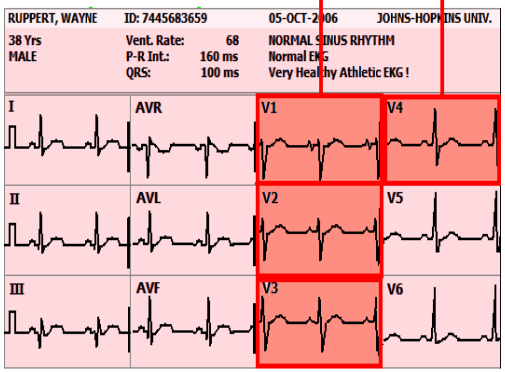
OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



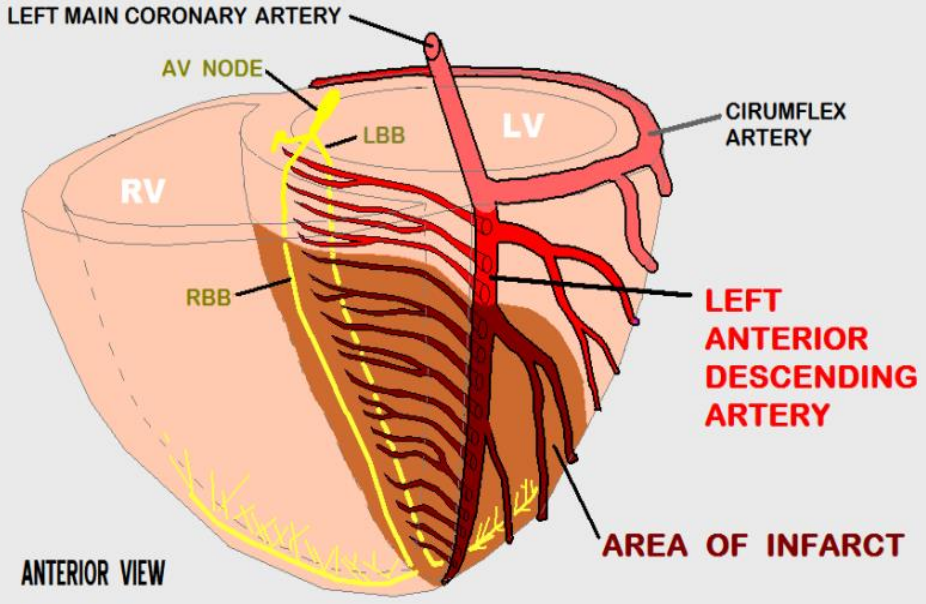
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL
of the LEFT VENTRICLE



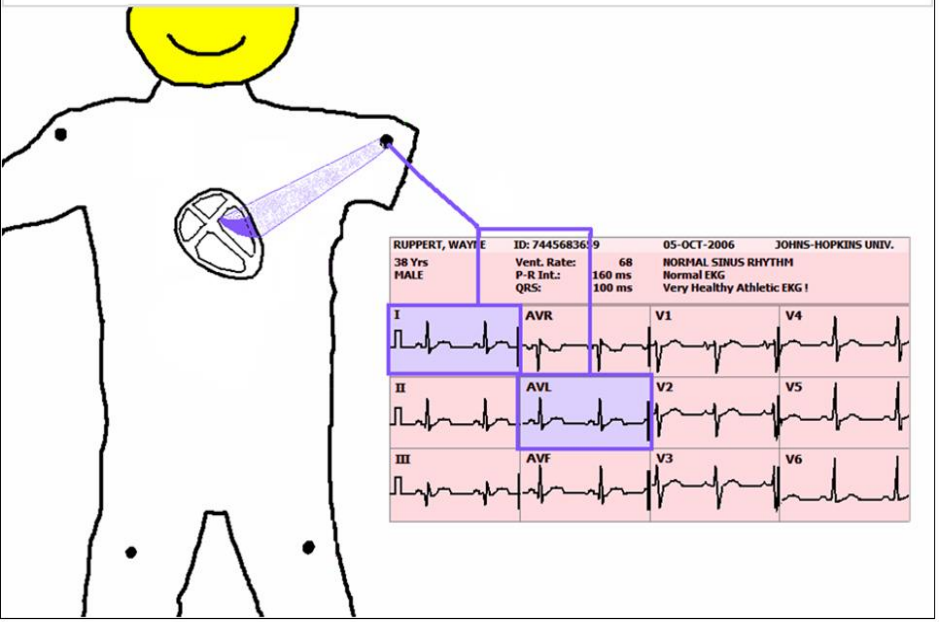
V1, V2 - ANTERIOR / SEPTAL
V3, V4 - ANTERIOR



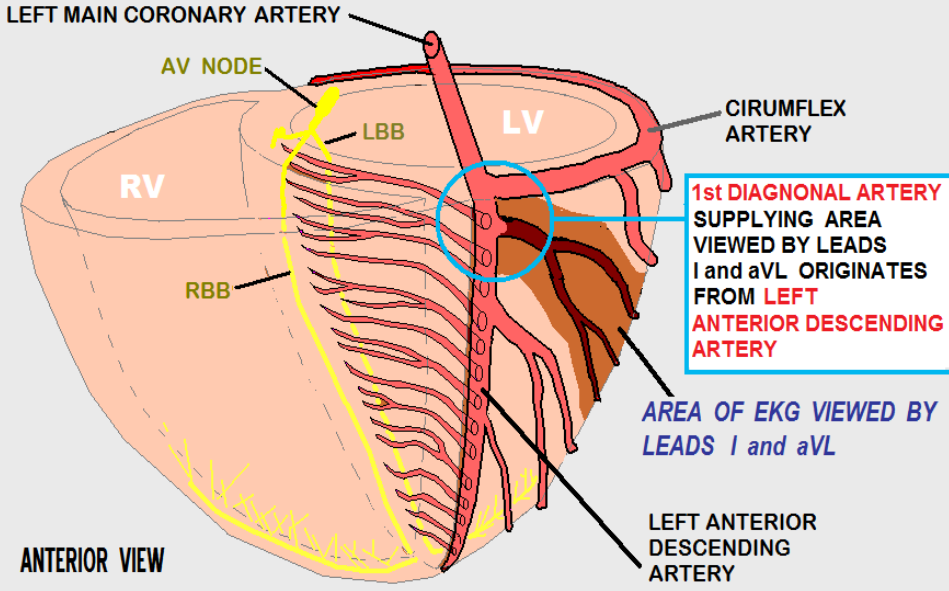
OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



Leads I & AVL view the ANTERIOR-LATERAL JUNCTION



OCCLUSION of DIAGONAL ARTERY

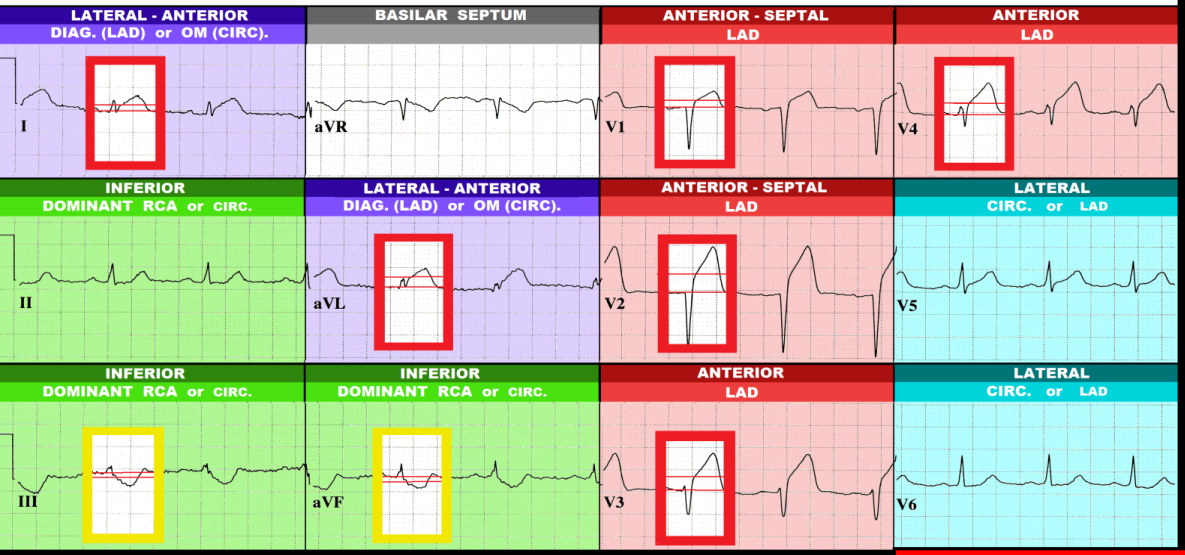


29 yr
Male
Caucasian

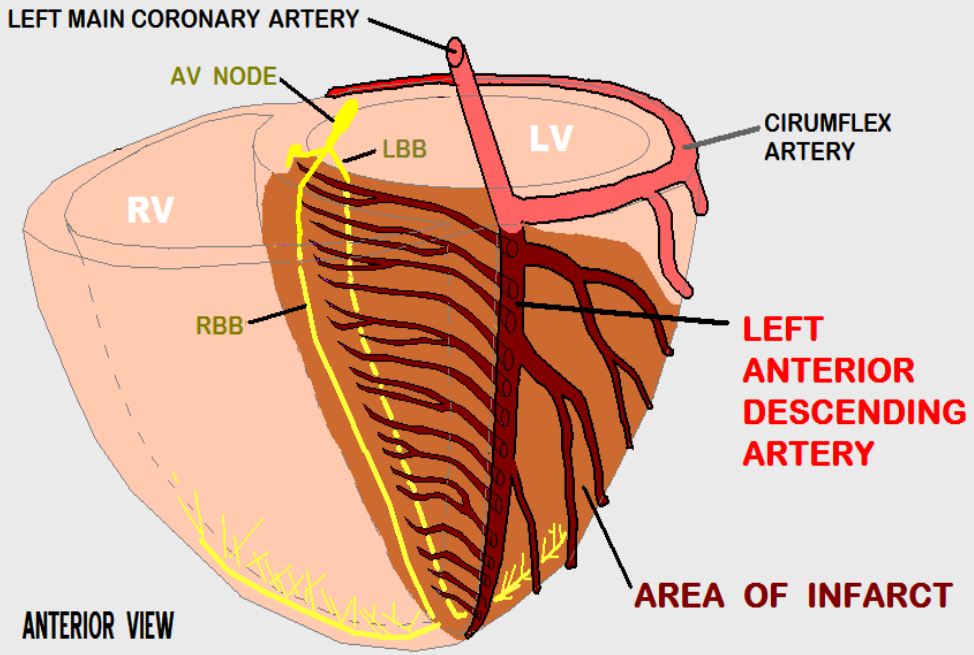
Vent. rate	75	BPM
PR interval	176	ms
QRS duration	90	ms
QT/QTc	362/404	ms
P–R–T axes	70 50	–11

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

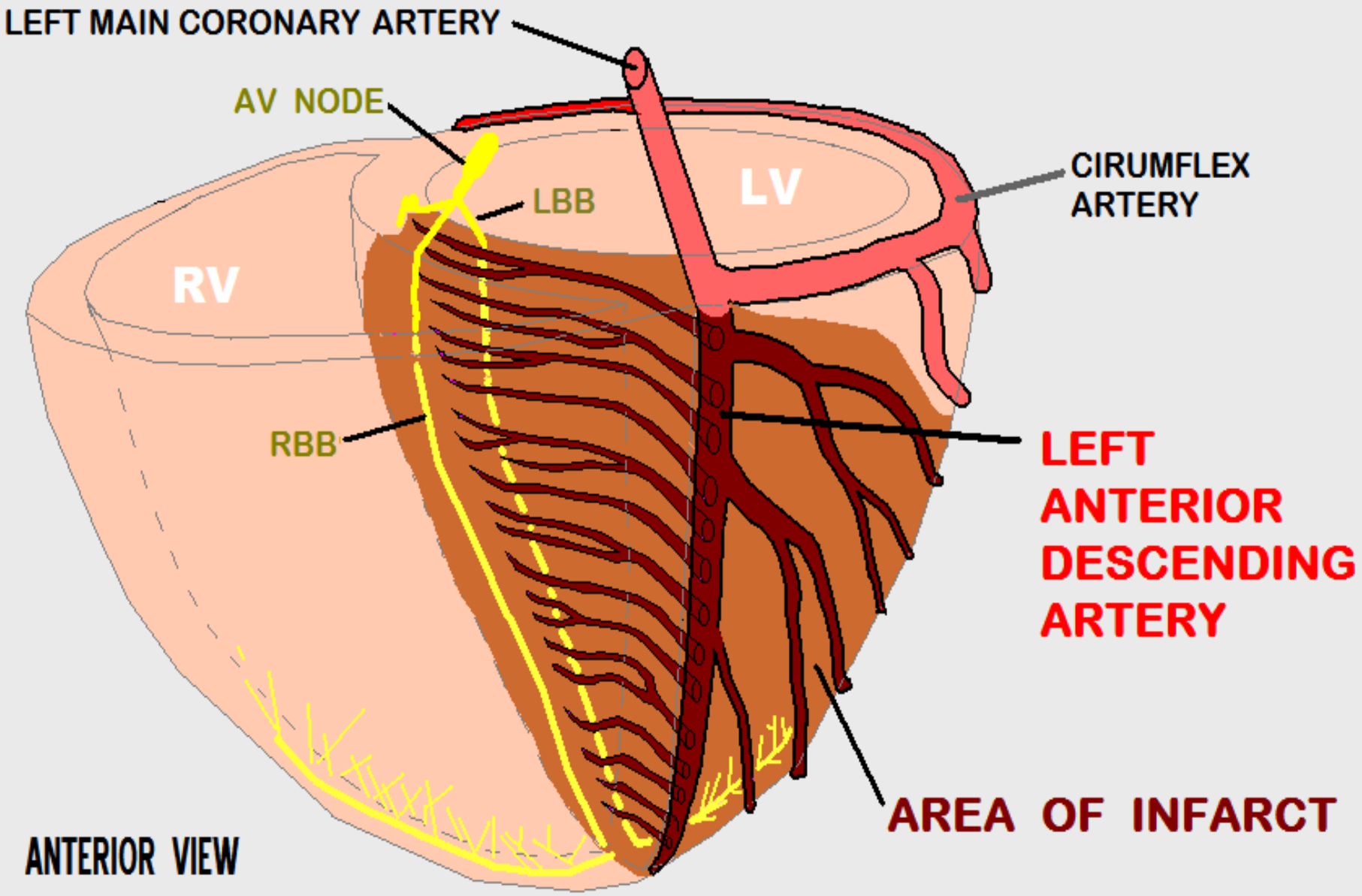
ST SEGMENT ELEVATION
ST SEGMENT DEPRESSION



OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING ARTERY



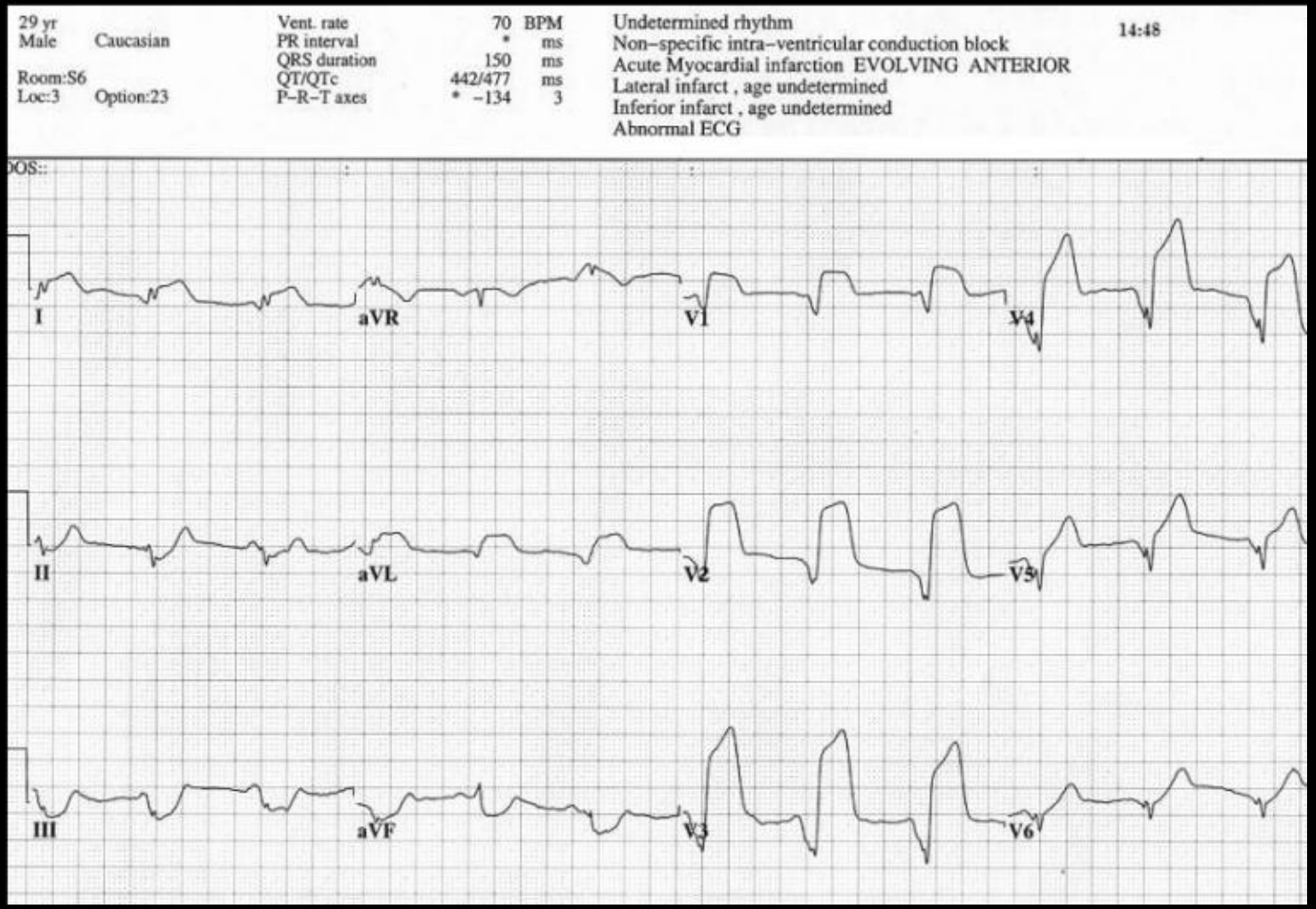
OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING ARTERY

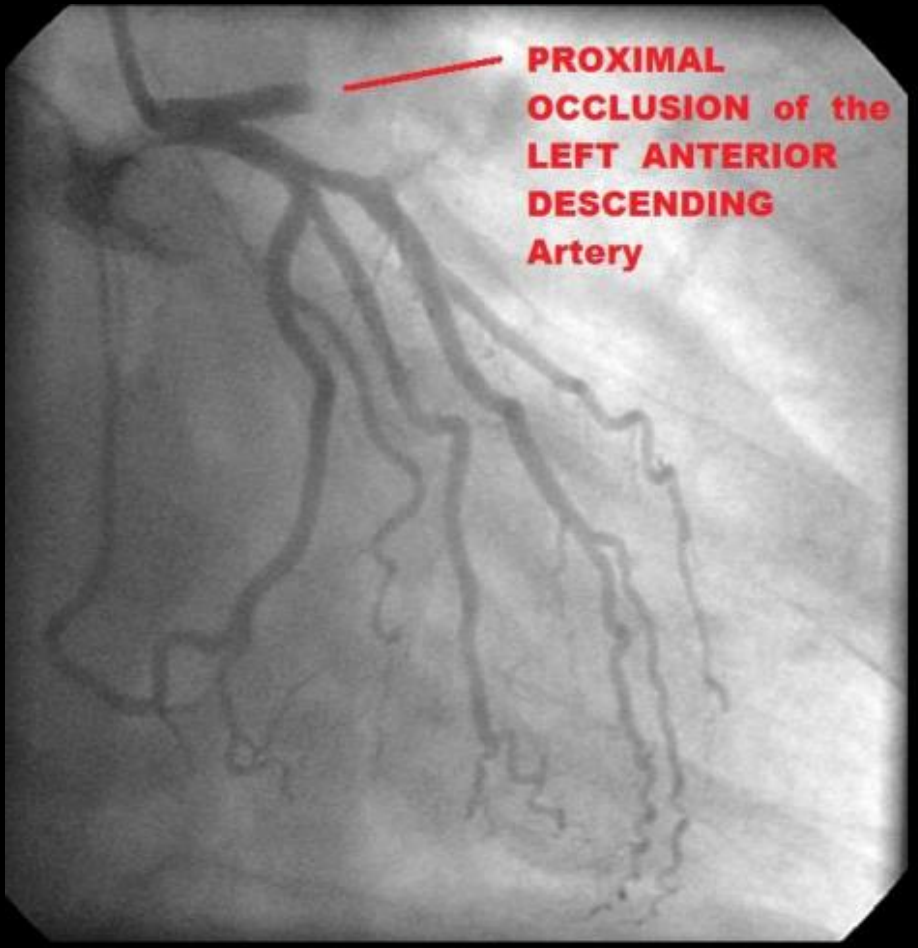


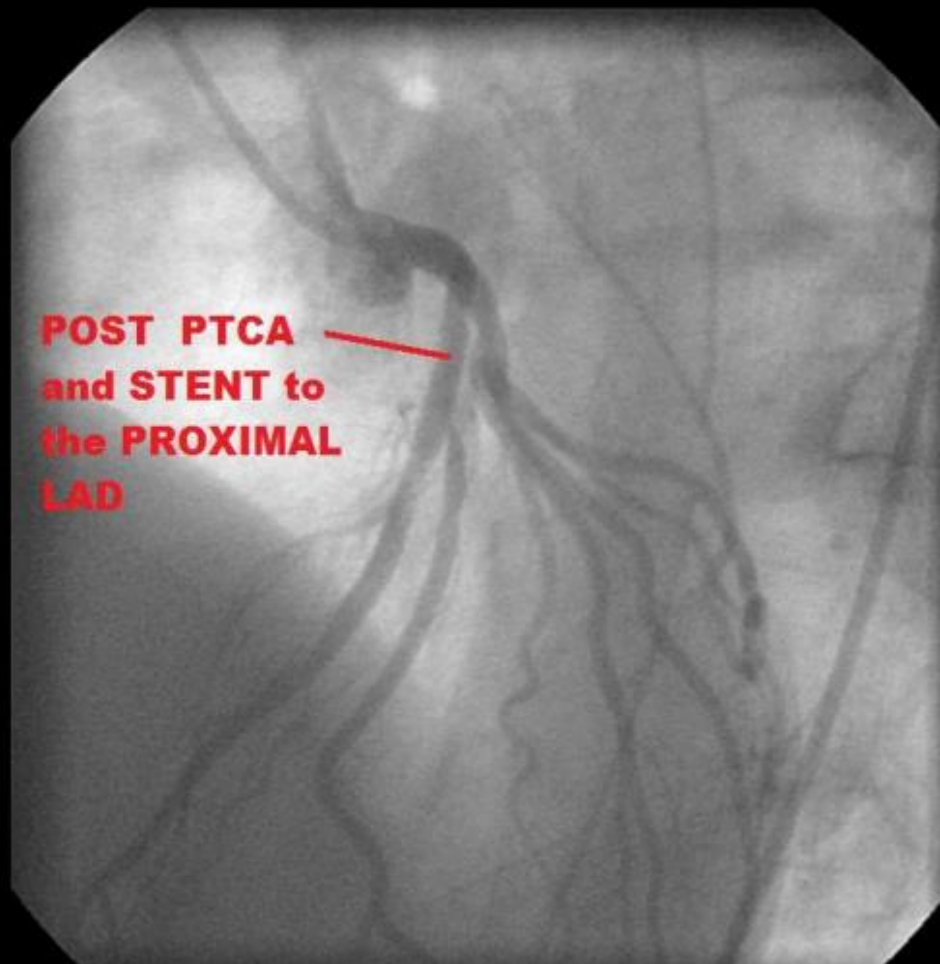
ANTICIPATED COMPLICATIONS of ANTERIOR-SEPTAL WALL STEMI & POSSIBLE INDICATED INTERVENTIONS:	
- CARDIAC ARREST	BCLS / ACLS
- CARDIAC DYSRHYTHMIAS (VT / VF)	ACLS (antiarrhythmics)
- PUMP FAILURE with CARDIOGENIC SHOCK	INOTROPE THERAPY: -DOPAMINE / DOBUTAMINE / LEVOPHED - INTRA-AORTIC BALLOON PUMP (use caution with fluid challenges due to PULMONARY EDEMA)
- PULMONARY EDEMA	- CPAP - ET INTUBATION (use caution with dieuretics due to pump failure and hypotension)

WHILE AWAITING THE CATH TEAM, THE PATIENT BEGAN VOMITING. SKIN BECAME ASHEN & DIAPHORETIC. REPEAT BP = 50/30.

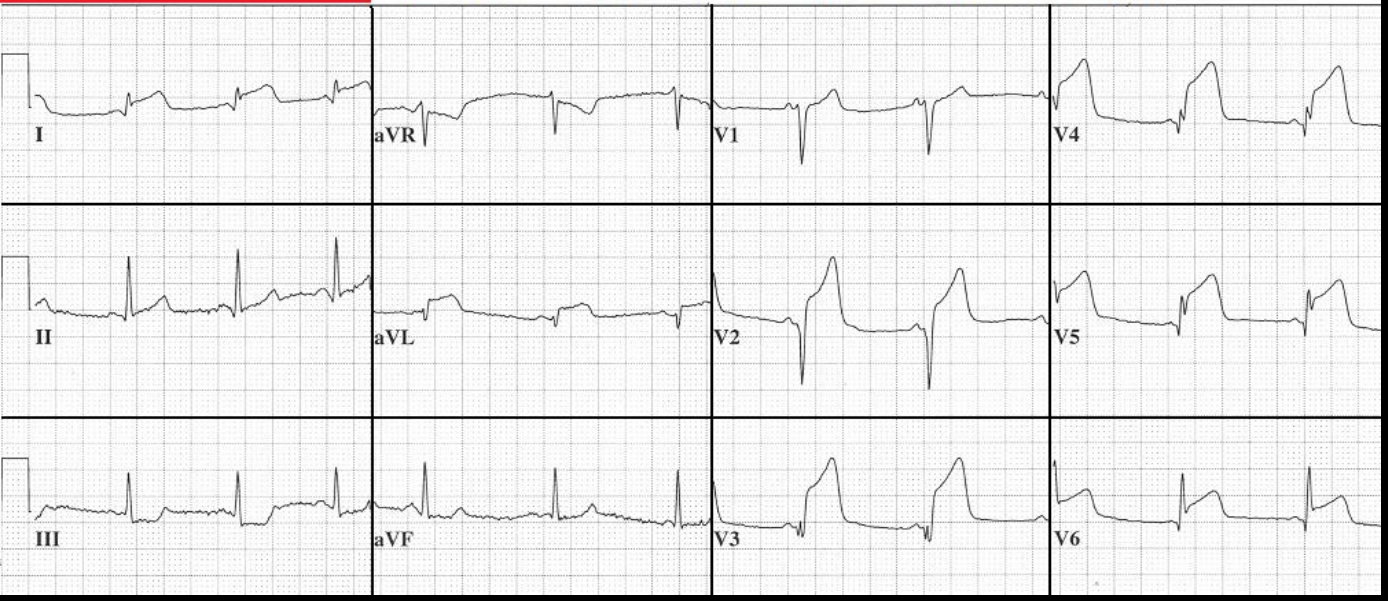
-WHAT THERAPEUTIC INTERVENTIONS SHOULD BE IMPLMENTED AT THIS POINT ?




PROXIMAL
OCCLUSION of the
LEFT ANTERIOR
DESCENDING
Artery


POST PTCA
and STENT to
the PROXIMAL
LAD

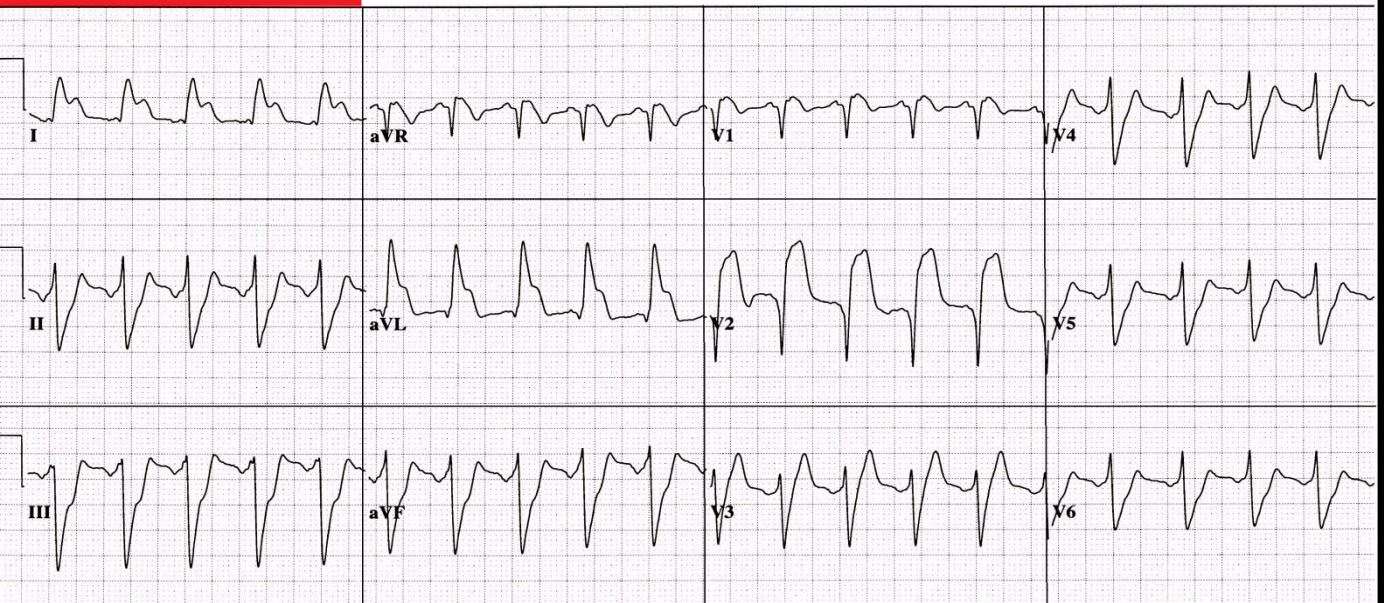
PATIENT A: 44 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 78/46, P: 70, R: 28. CARDIAC MARKERS: NEGATIVE



WHO SHOULD GO TO THE CATH LAB FIRST ?

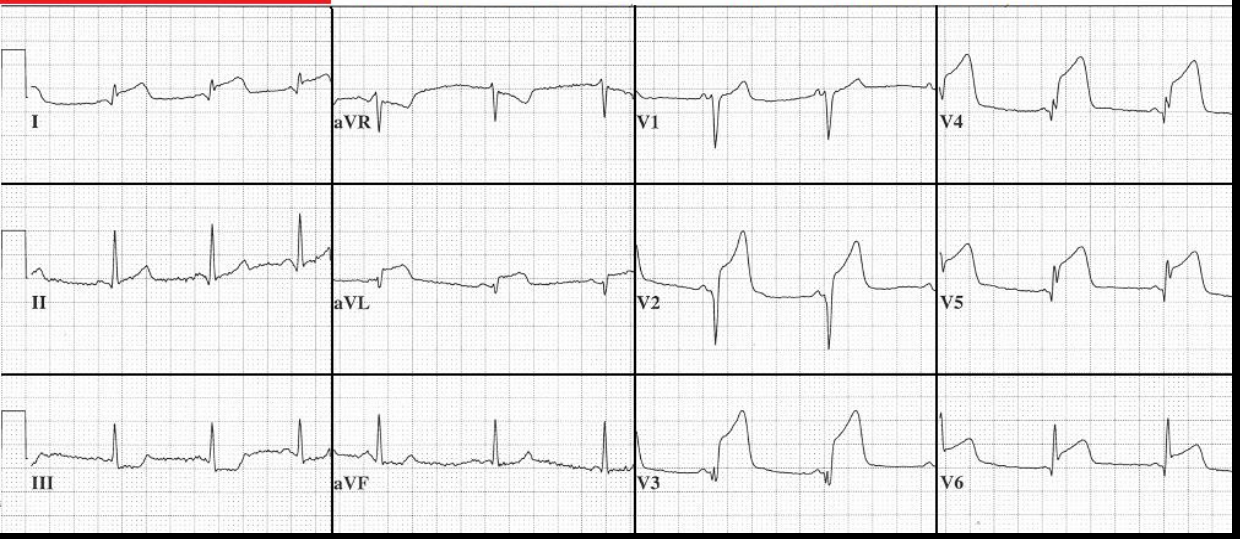
And . . . .

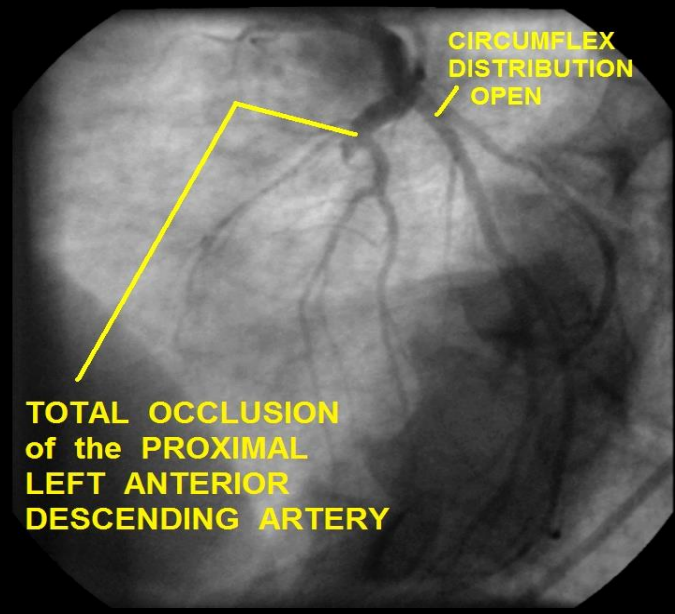
PATIENT B: 36 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 80/48, P: 120, R: 28 CARDIAC MARKERS: NEGATIVE



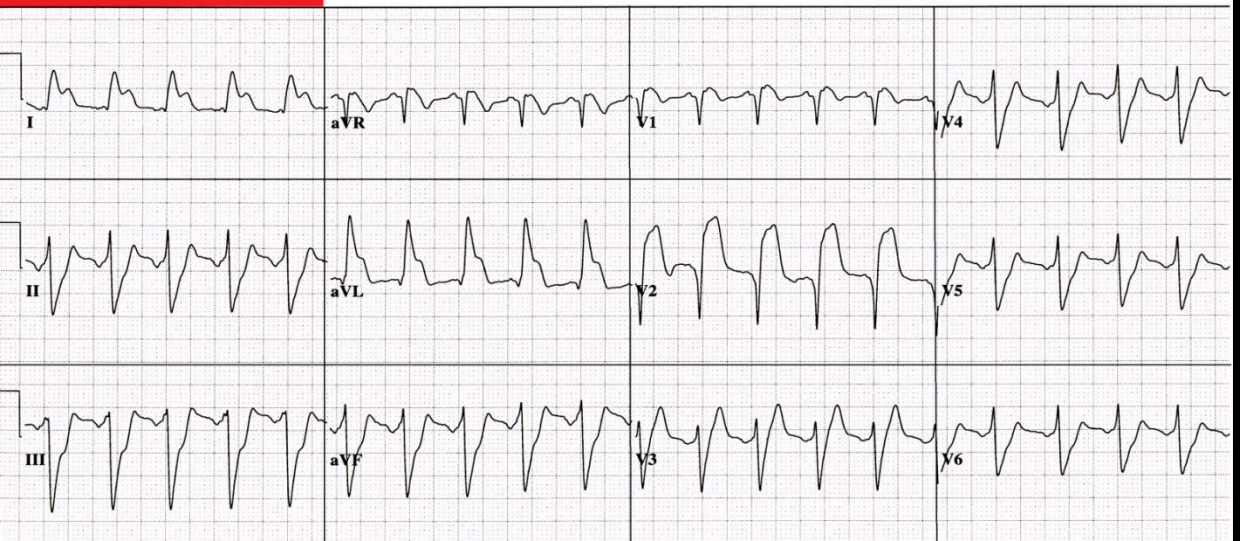
WHAT WOULD YOU DO WITH THE PATIENT WHO DID NOT GO TO THE CATH LAB ?

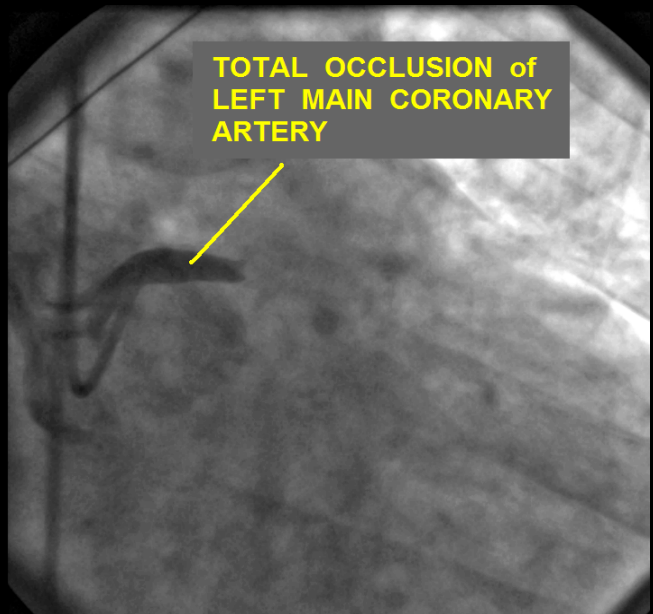
PATIENT A: 44 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 78/46, P: 70, R: 28. CARDIAC MARKERS: NEGATIVE



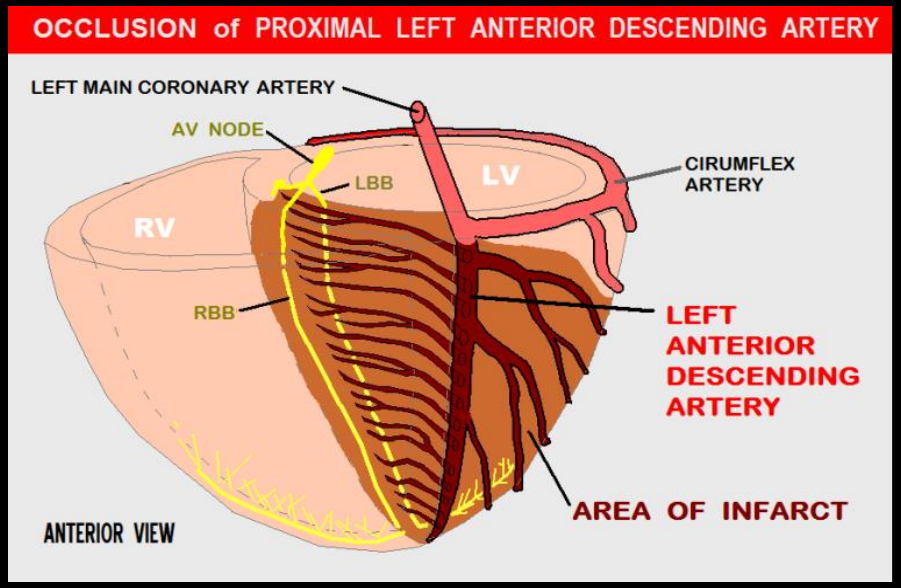


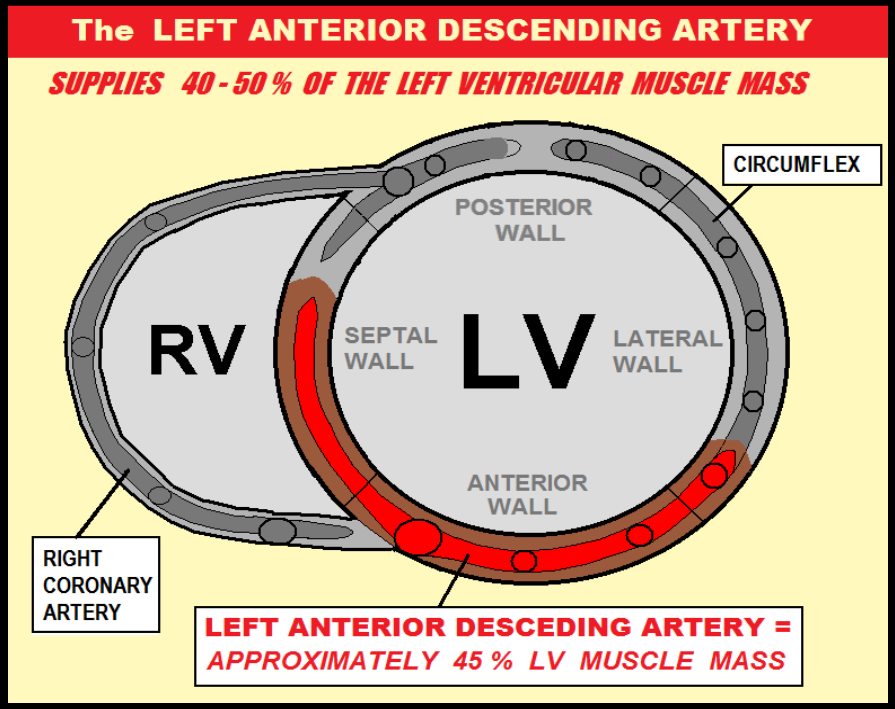
PATIENT B: 36 y/o MALE, CHEST PAIN x 1 HOUR,
BP: 80/48, P: 120, R: 28 CARDIAC MARKERS: NEGATIVE



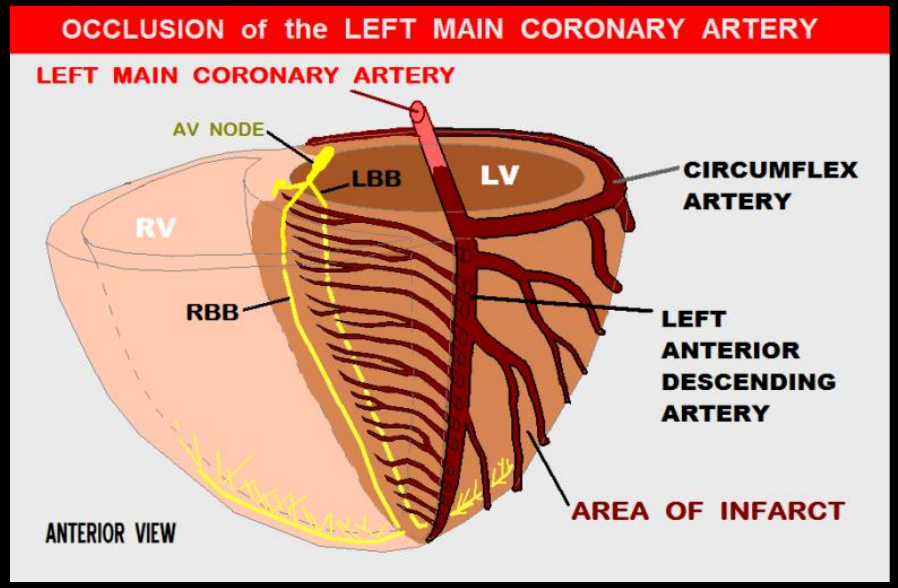


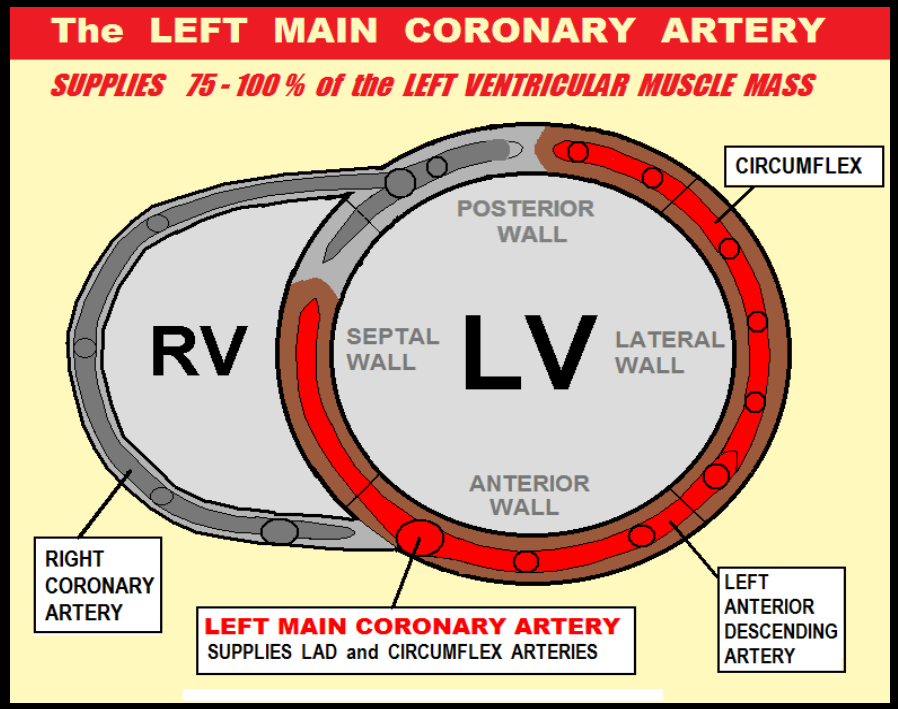
PATIENT A:





PATIENT B:



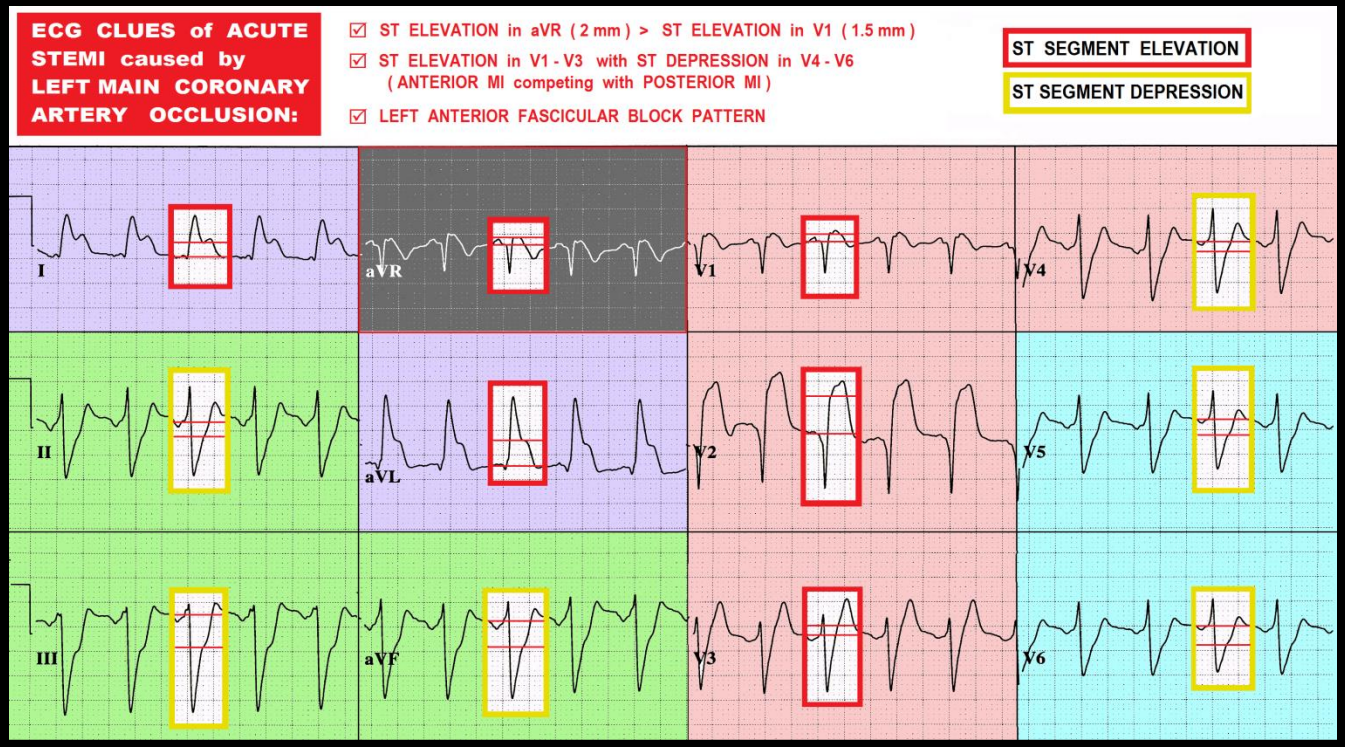


ECG Clues . . . for IDENTIFYING STEMI CAUSED BY LEFT MAIN CORONARY ARTERY occlusion:

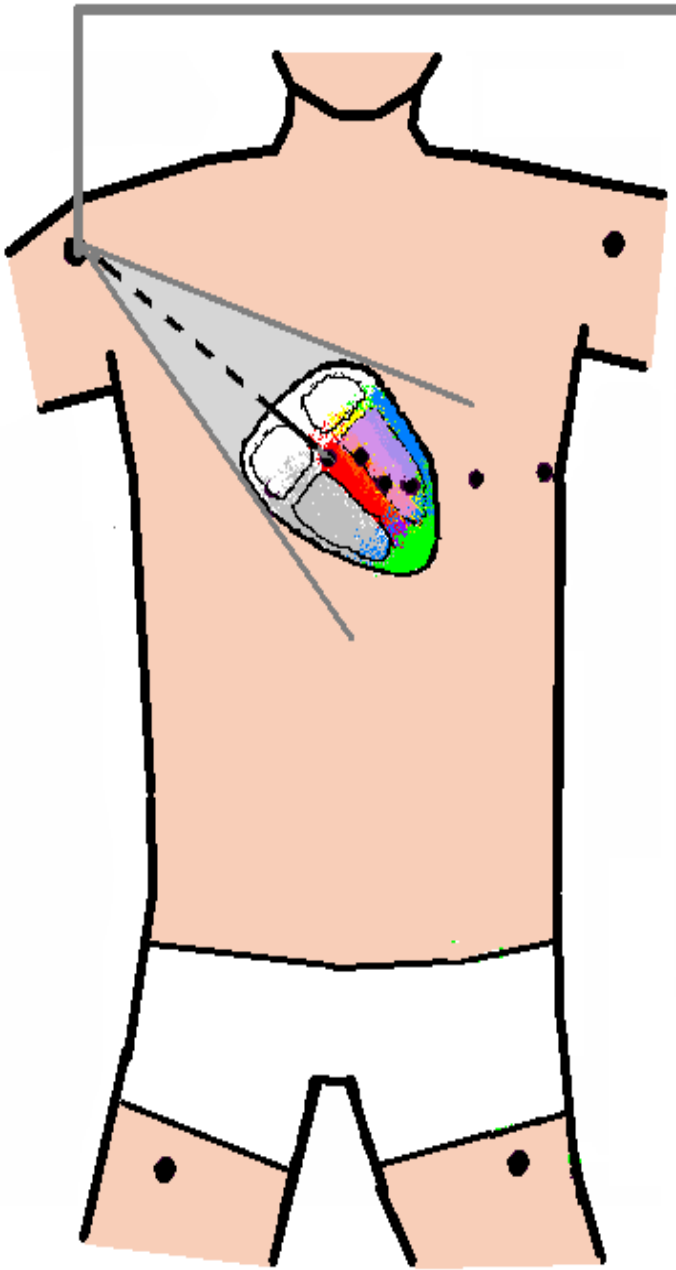
- ☑ ST ELEVATION in ANTERIOR LEADS (V1 - V4) and LATERAL LEADS (V5 & V6)
- ☑ ST DEPRESSION or ISOELCTRIC J POINTS may be seen in V LEADS . . . . mainly V2 and/or V3 *caused by COMPETING FORCES of ANTERIOR vs. POSTERIOR WALL MI.* *+
  - → NOTE: it is very unusual to see ST DEPRESSION in V LEADS with isolated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

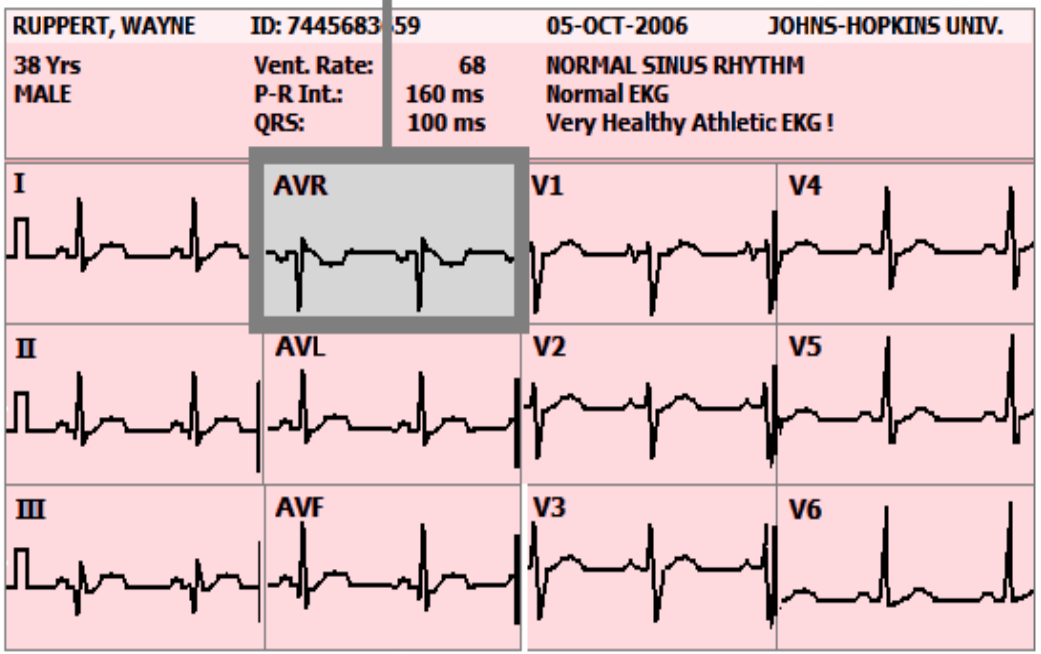
* Kurisu et al, HEART 2004, SEPTEMBER: 90 (9): 1059-1060

+ Yamaji et al, JACC vol. 38, No. 5, 2001, November 1, 2001:1348-54



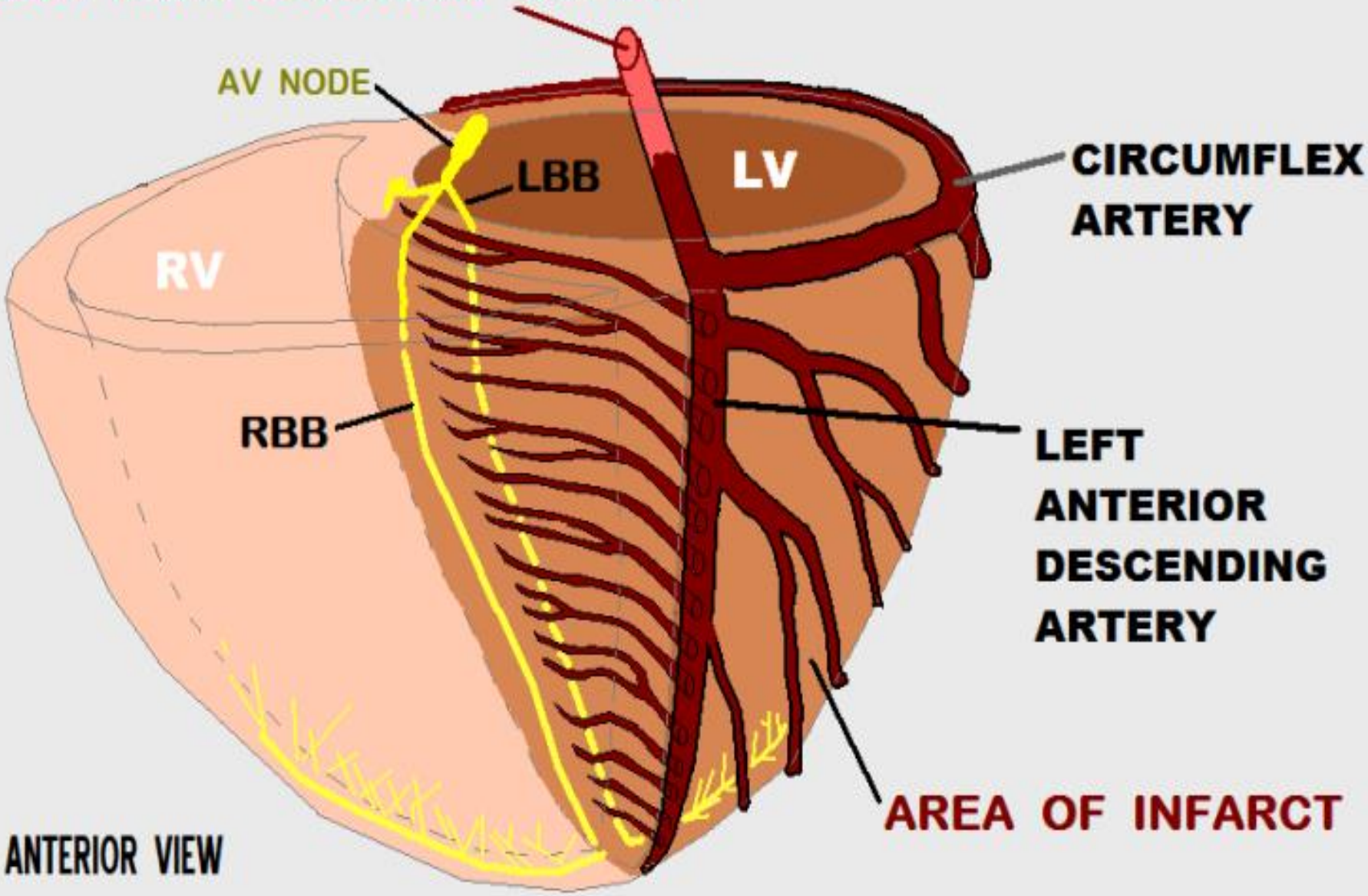
Lead AVR Views the BASILAR SEPTUM (region of the Bundle of His)

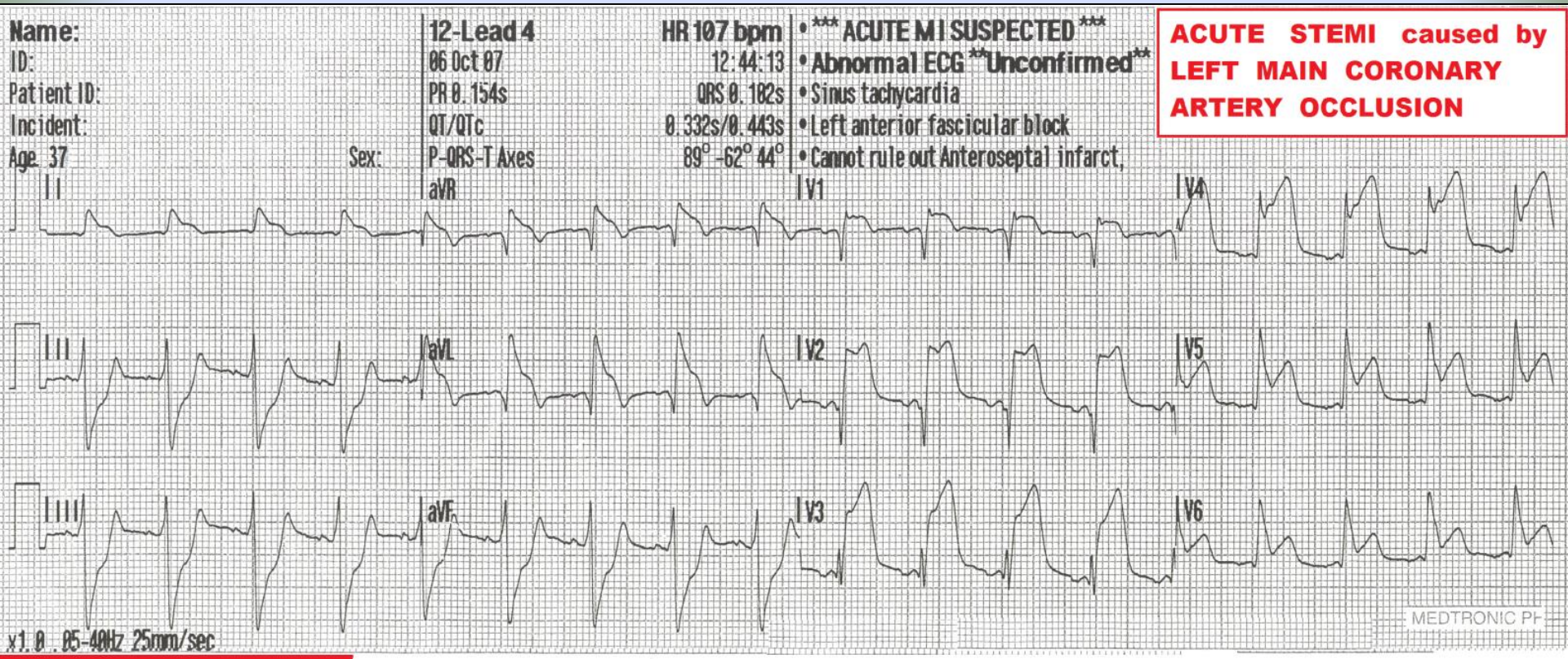




In STEMI with ST-Segment Elevation in Lead AVR,
This is indicative of
Left Main Coronary Artery Occlusion . . .

OCCLUSION of the LEFT MAIN CORONARY ARTERY



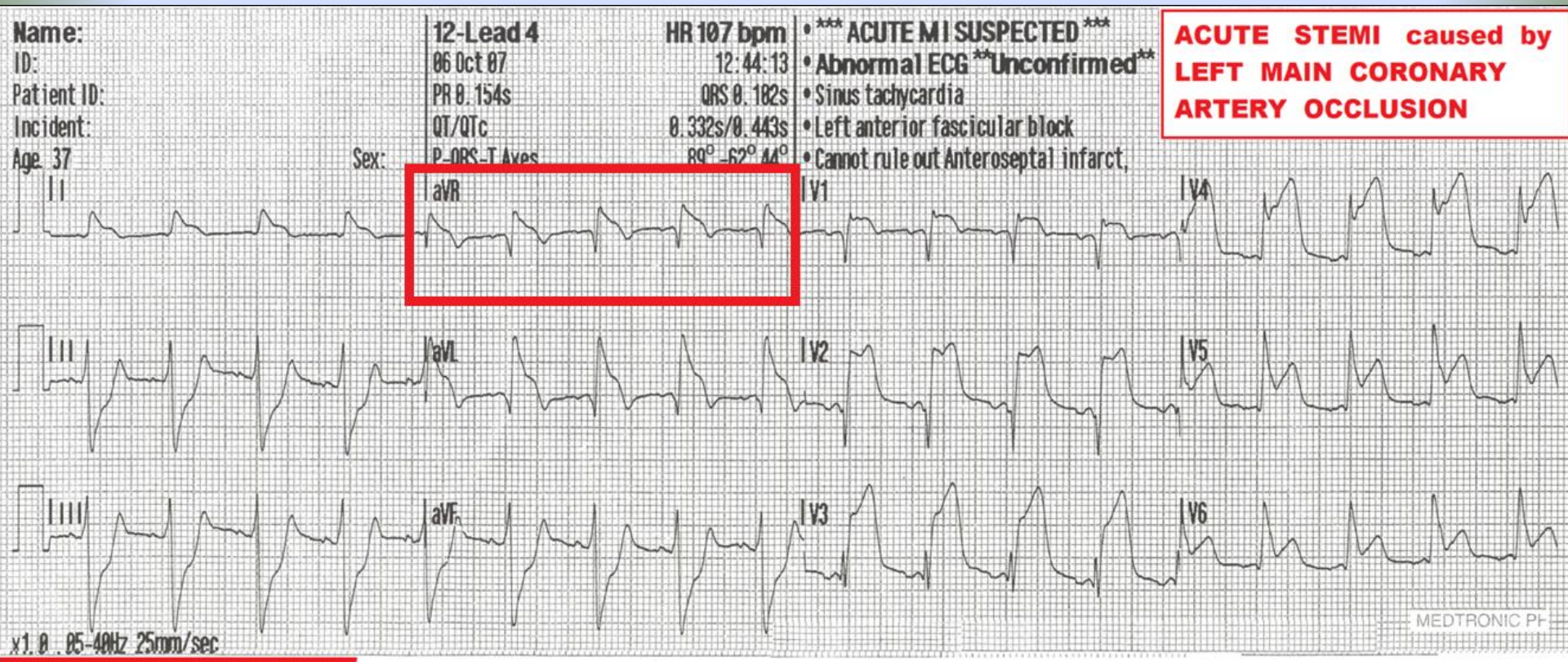


ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION

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

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

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



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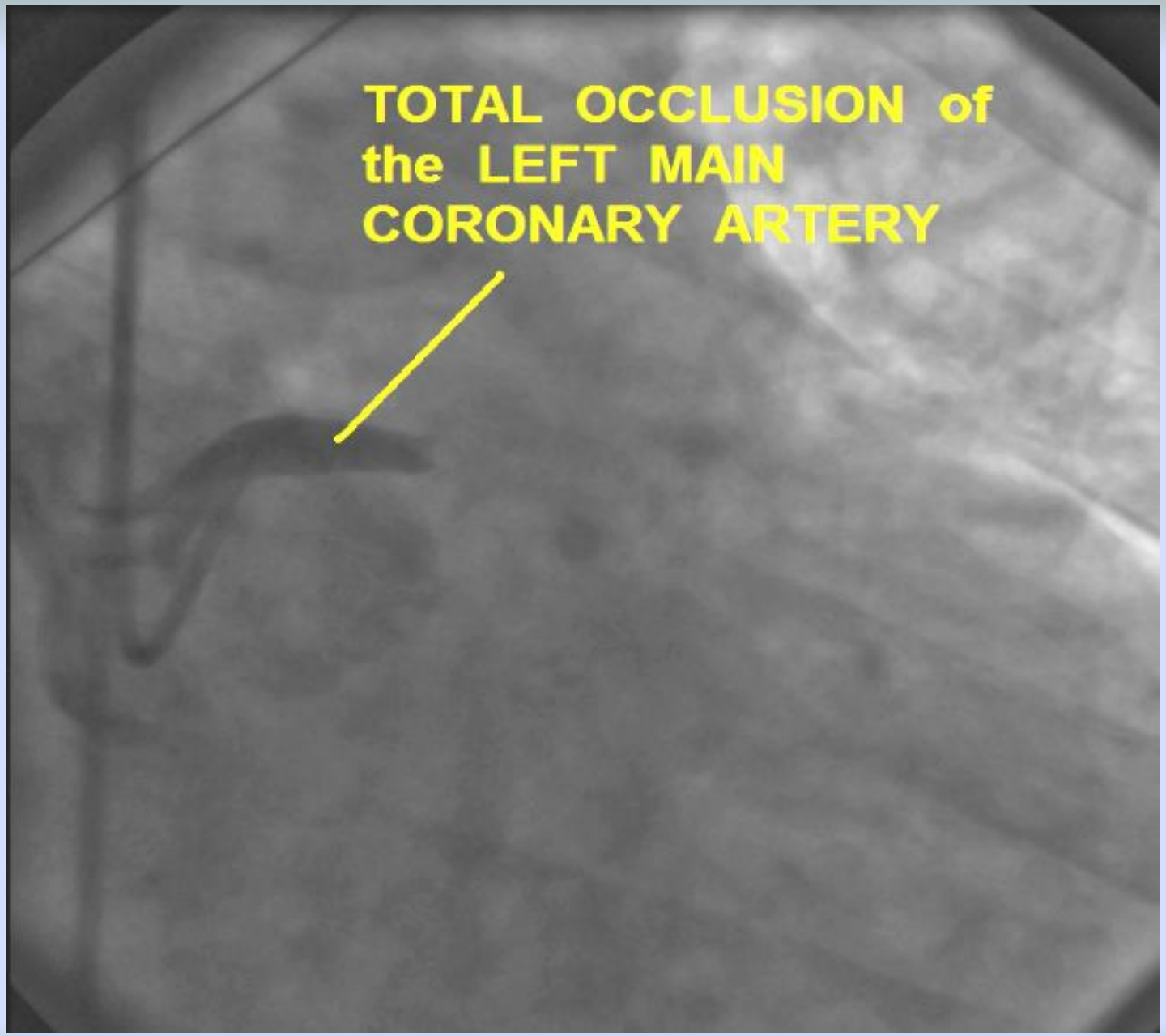
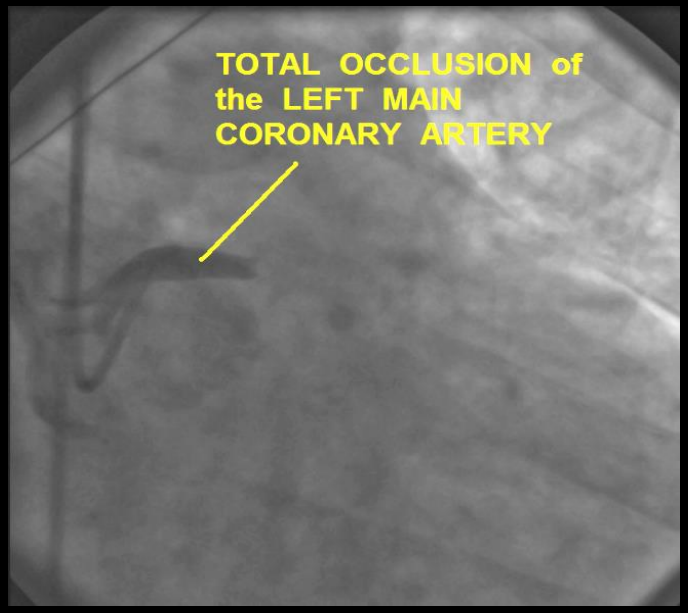
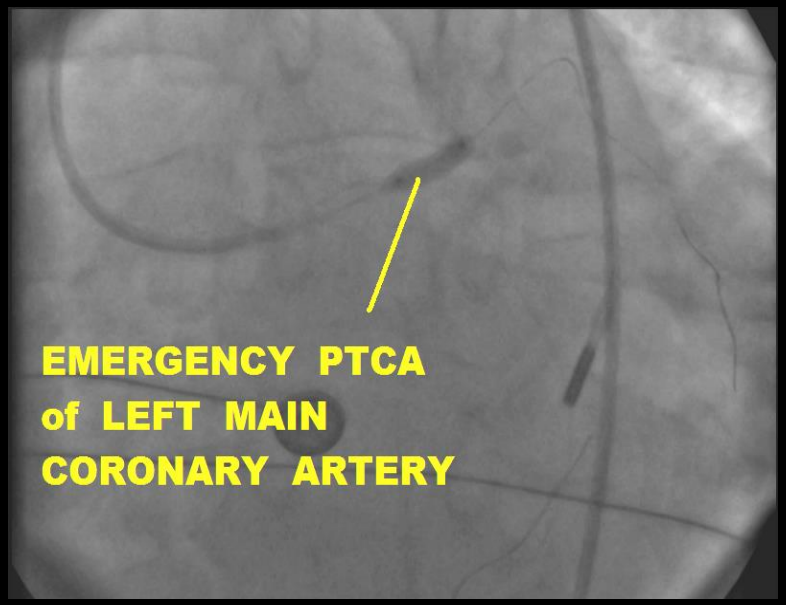
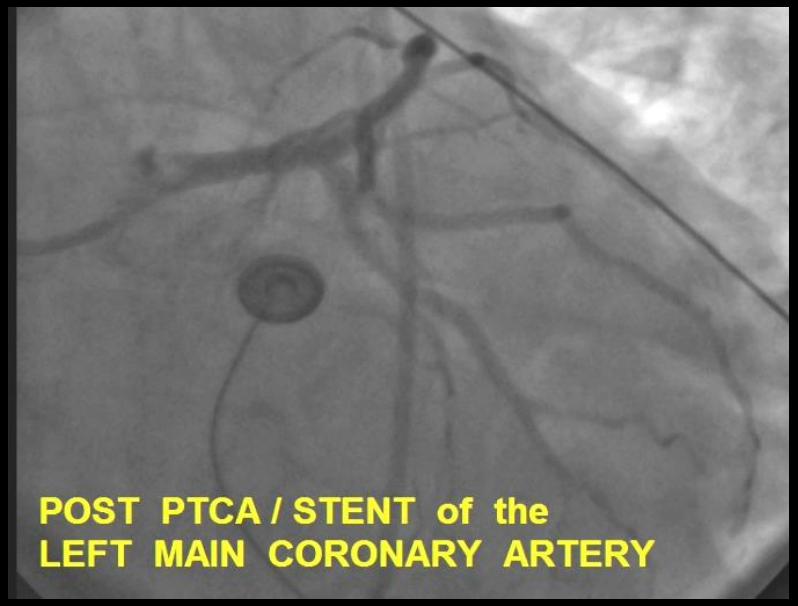

TOTAL OCCLUSION of
the LEFT MAIN
CORONARY ARTERY





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



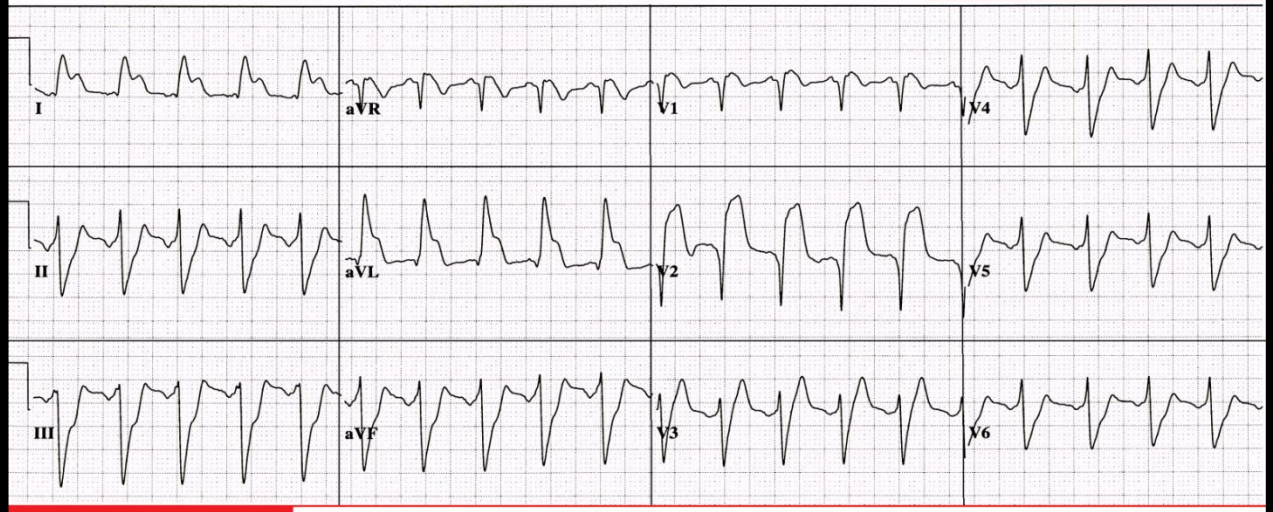
36 yr Male Caucasian

Room:C-
Loc:3

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

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

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



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

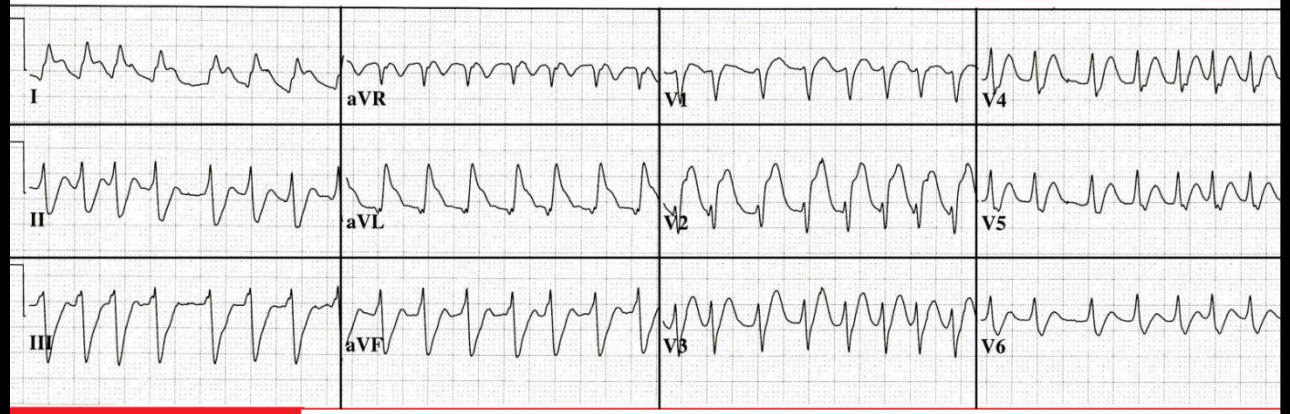
- ☑ ST ELEVATION in leads I and aVL
- ☑ INCONSISTENCY of ST SEGEMENT in leads V1 - V6 : V1 - V3 ST ELEVATION, V4 - V6 ST DEPRESSION (COMPETING FORCES of ANTERIOR vs. POSTERIOR M.I.)
- ☑ PATTERN of LEFT ANTERIOR FASCICULAR BLOCK (POS. QRS lead I; NEG rS leads II, III)
- ☑ ST ELEVATION in lead aVR > 0.5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

43 yr Male

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

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

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



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

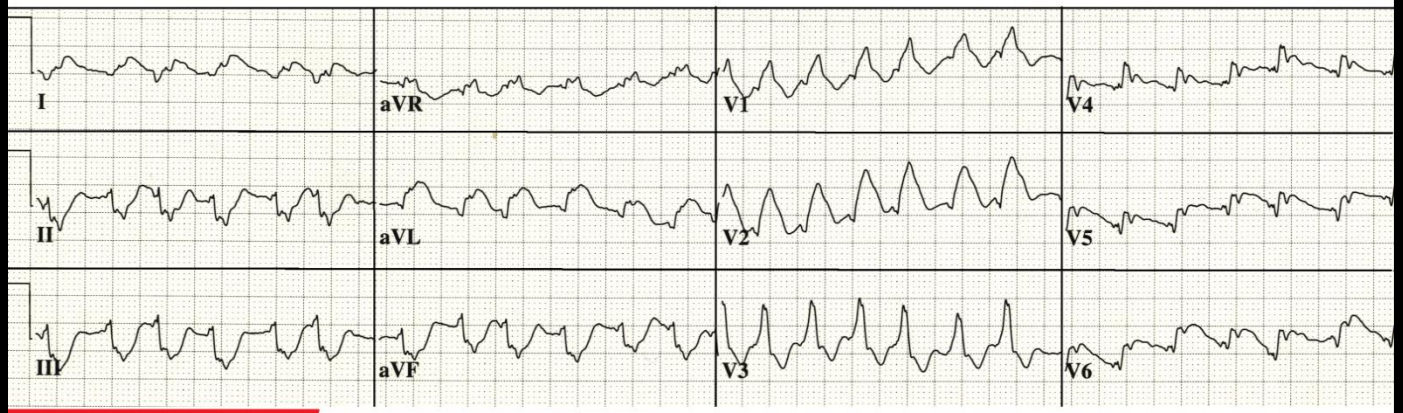
- ☑ ST ELEVATION in leads I and aVL
- ☑ INCONSISTENCY of ST SEGEMENT in leads V1 - V6 : V1 - V2 ST ELEVATION, V3 - V6 ST DEPRESSION (COMPETING FORCES of ANTERIOR vs. POSTERIOR M.I.)
- ☑ PATTERN of LEFT ANTERIOR FASCICULAR BLOCK (POS. QRS lead I; NEG rS leads II, III)

48 yr
Male Caucasian

Loc: Option:

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

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



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

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

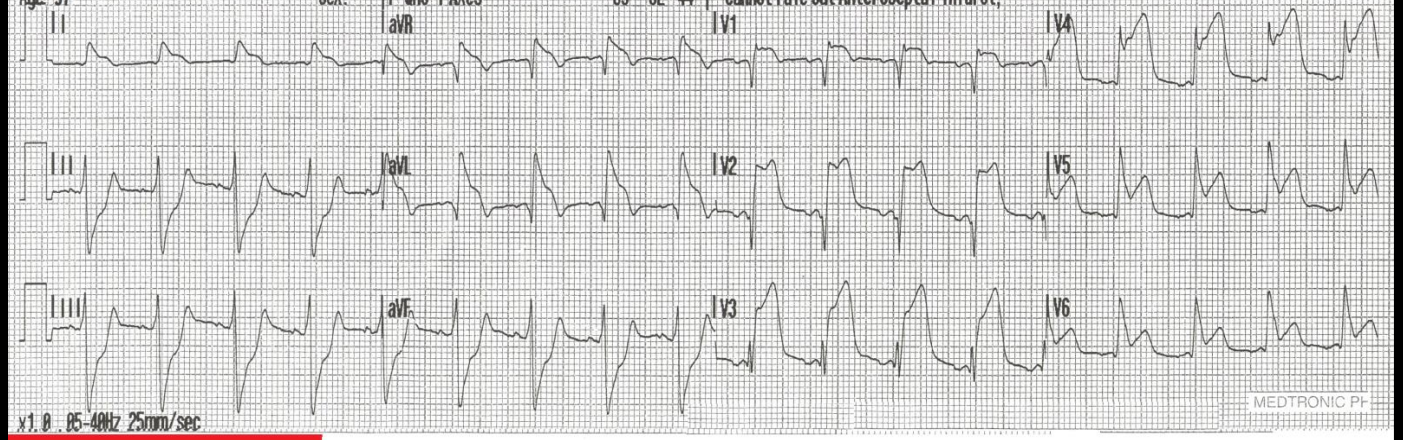
Name:
ID:
Patient ID:
Incident:
Age: 37 Sex:

12-Lead 4
06 Oct 07
PR 0.154s
QT/QTc
P-QRS-T Axes
aVR

HR 107 bpm
12:44:13
QRS 0.102s
0.332s/0.443s
89° -62° 44°

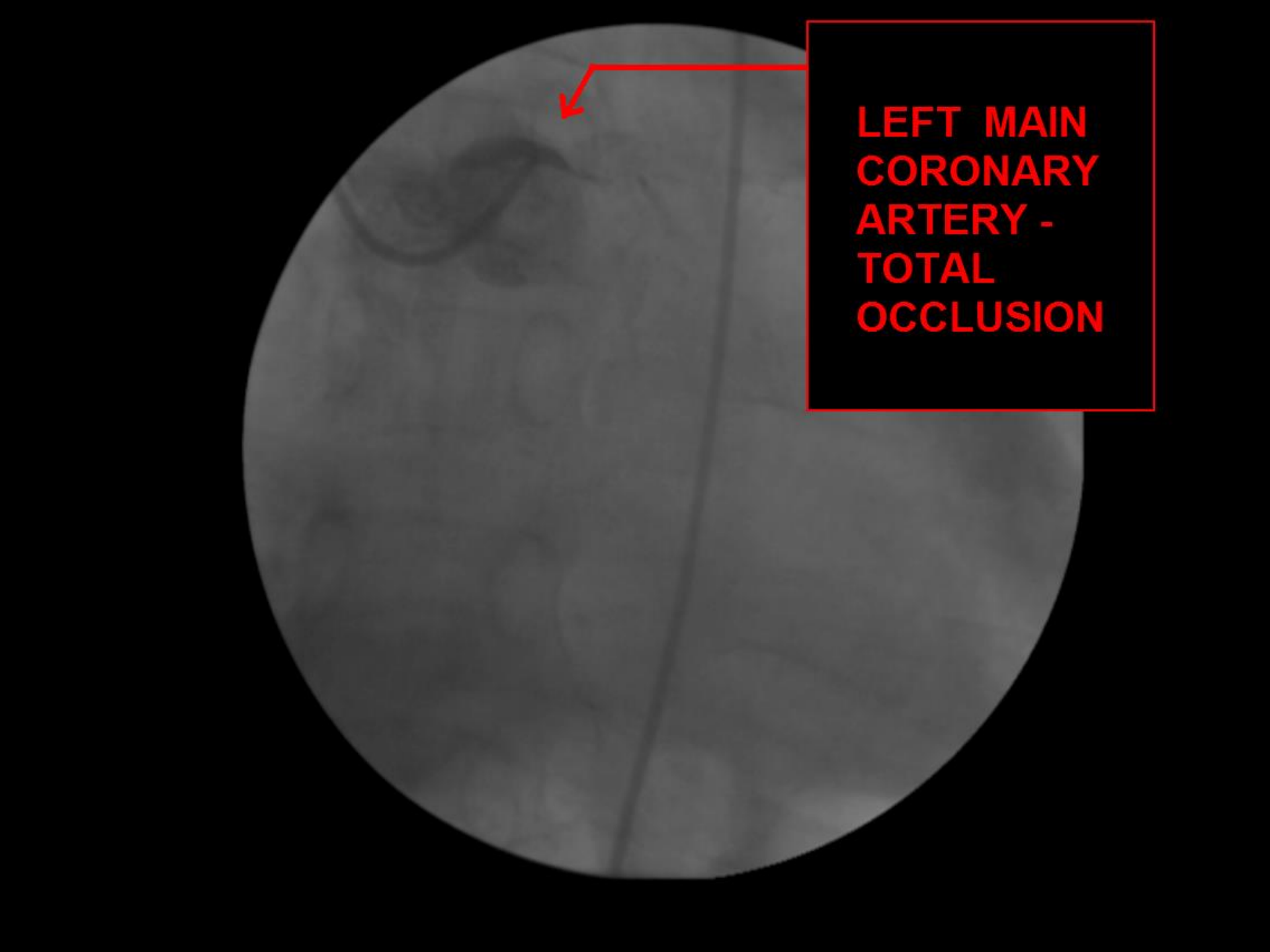
- *** ACUTE MI SUSPECTED ***
- Abnormal ECG **Unconfirmed**
- Sinus tachycardia
- Left anterior fascicular block
- Cannot rule out Anteroseptal infarct,

ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION



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

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


LEFT MAIN
CORONARY
ARTERY -
TOTAL
OCCLUSION

CASE STUDY 4: CRITICAL DECISIONS SCENARIO

CONCLUSIONS:

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

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

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

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

CASE STUDY 7 - STEMI

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

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

RISK FACTOR PROFILE:

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

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

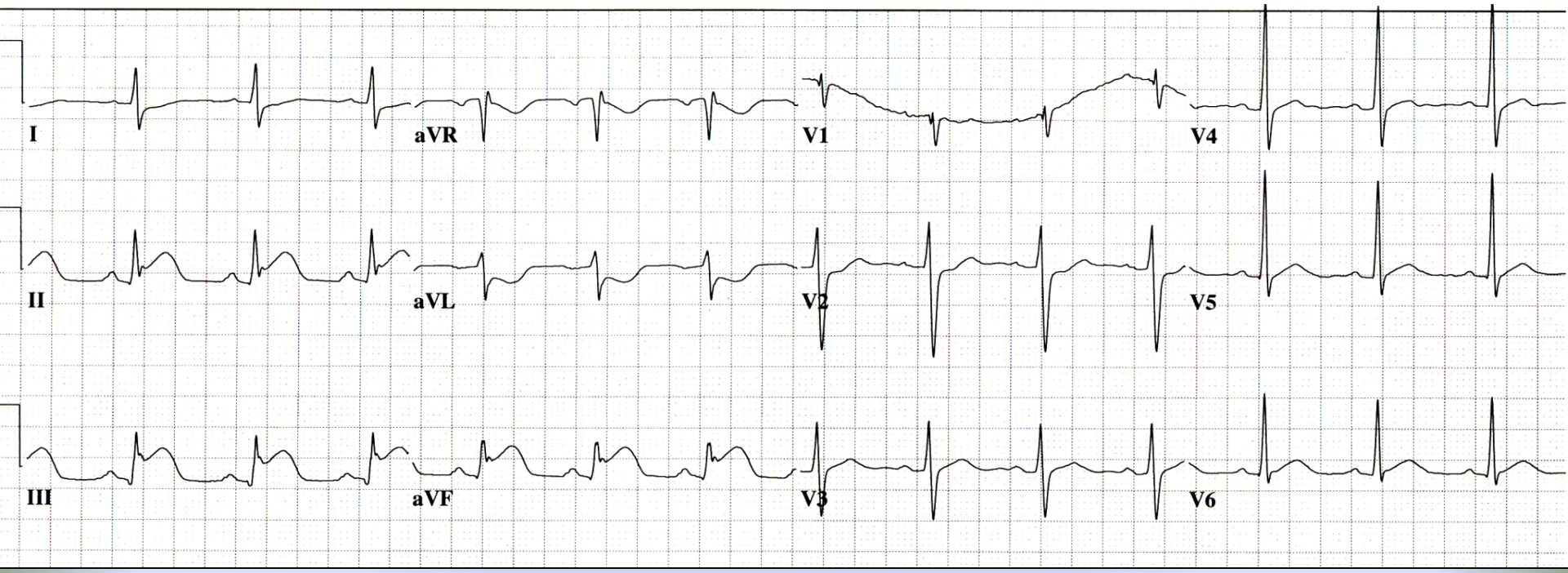
VITAL SIGNS: BP: 136/88 P: 88 R: 20 SAO2: 100% on 4 LPM O2

LABS: TROPONIN: < .04

46 yr		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

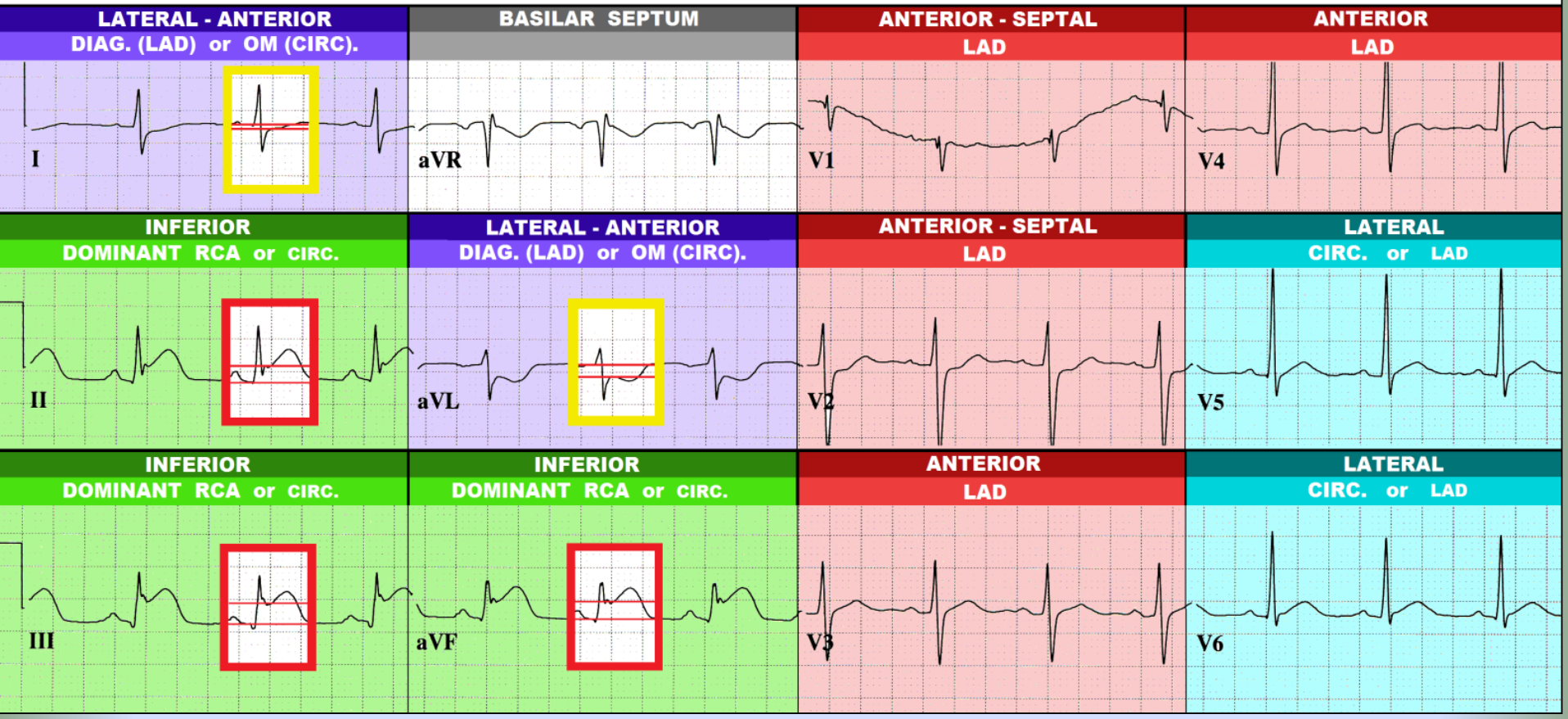
Caucasian

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



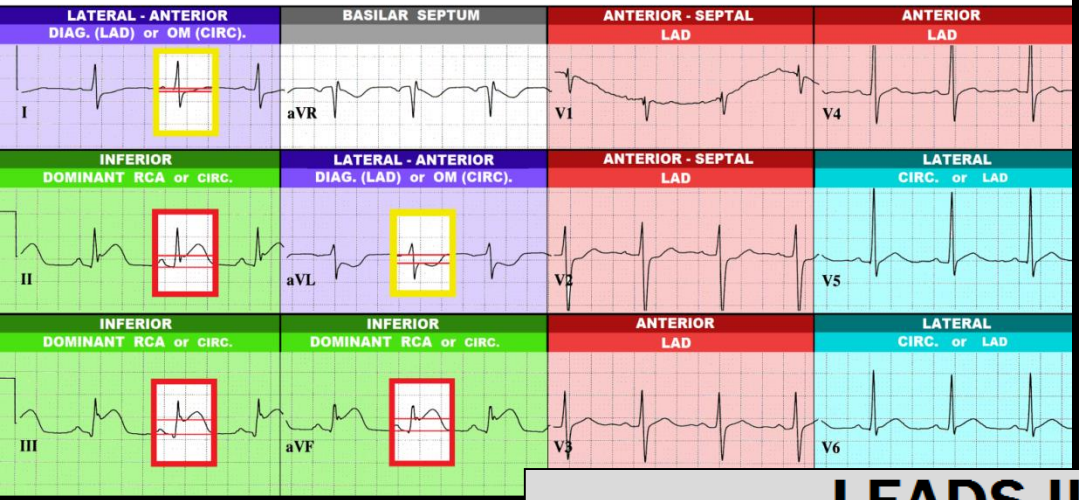
46 yr Male Caucasian

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

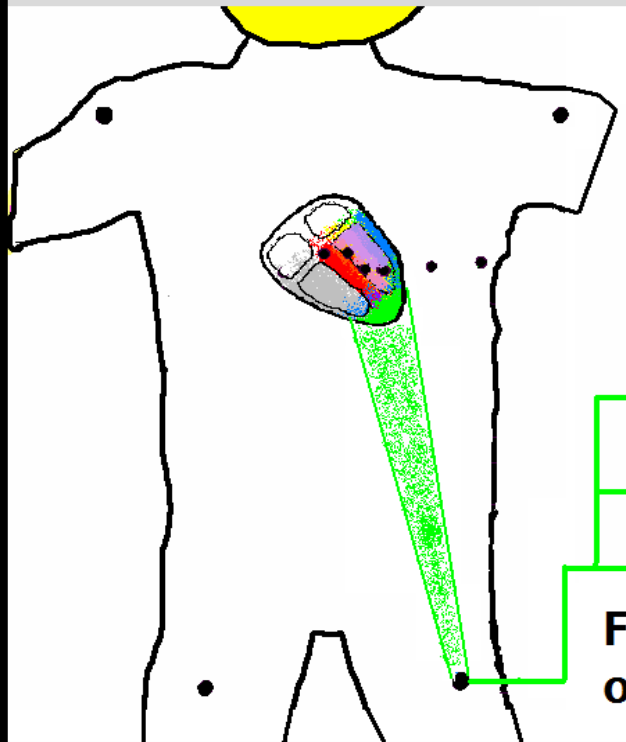
ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION



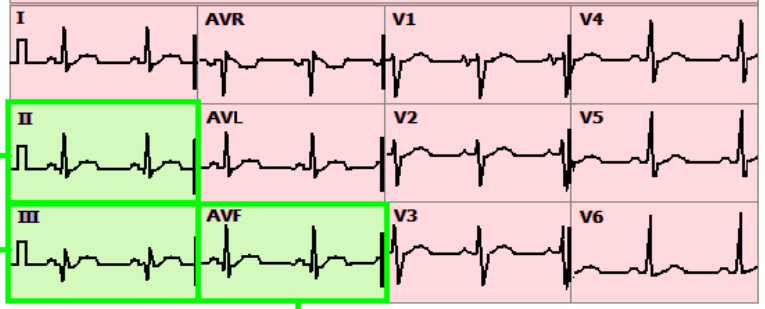
LEADS II, III, and aVF VIEW

INFERIOR WALL of the LEFT VENTRICLE



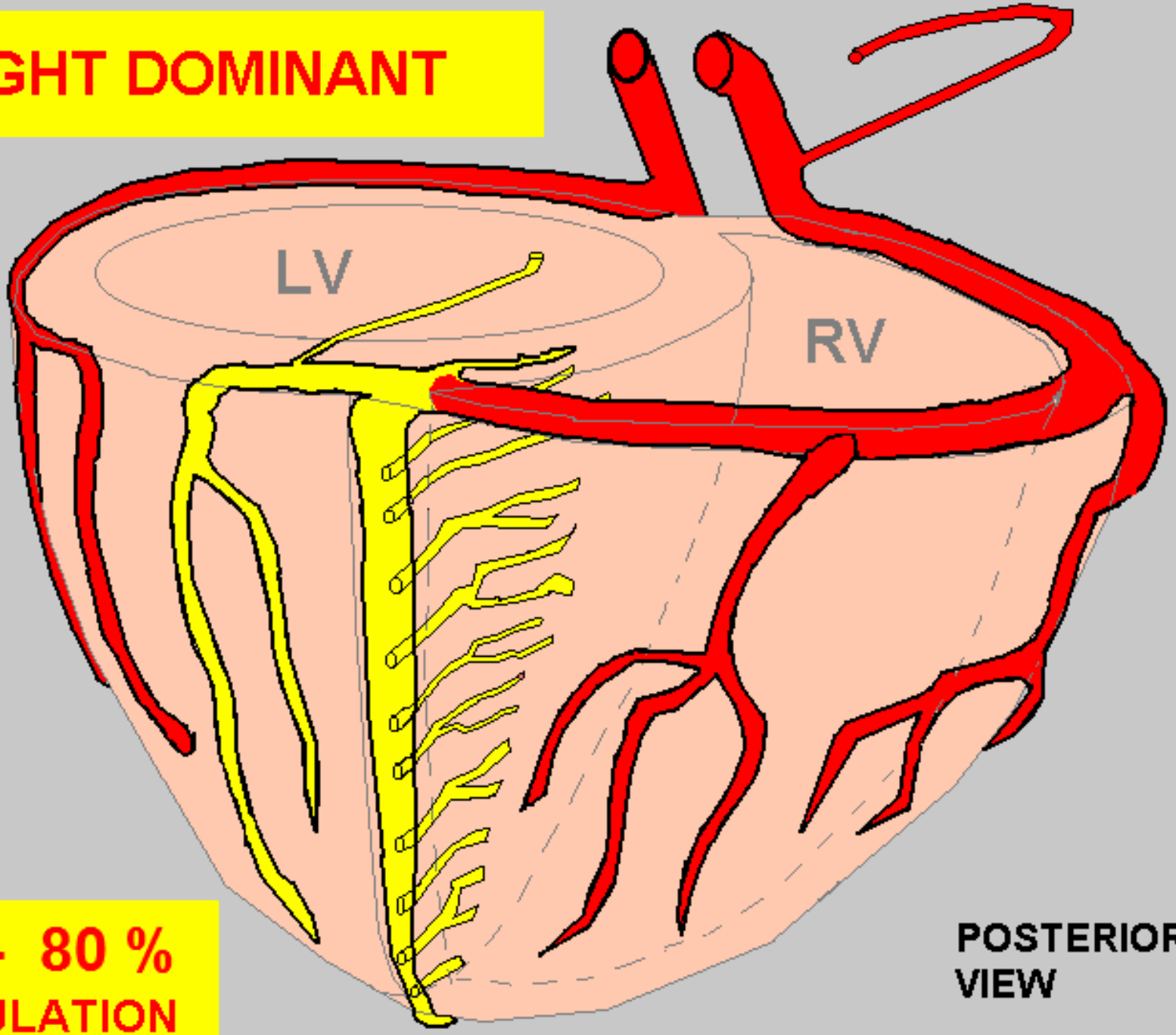
RUPPERT, WAYNE ID: 7445683659 05-OCT-2006 JOHNS-HOPKINS UNIV.

38 Yrs MALE
Vent. Rate: 68
P-R Int.: 160 ms
QRS: 100 ms
NORMAL SINUS RHYTHM
Normal EKG
Very Healthy Athletic EKG !



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

RIGHT DOMINANT



75 - 80 %
POPULATION

POSTERIOR VIEW

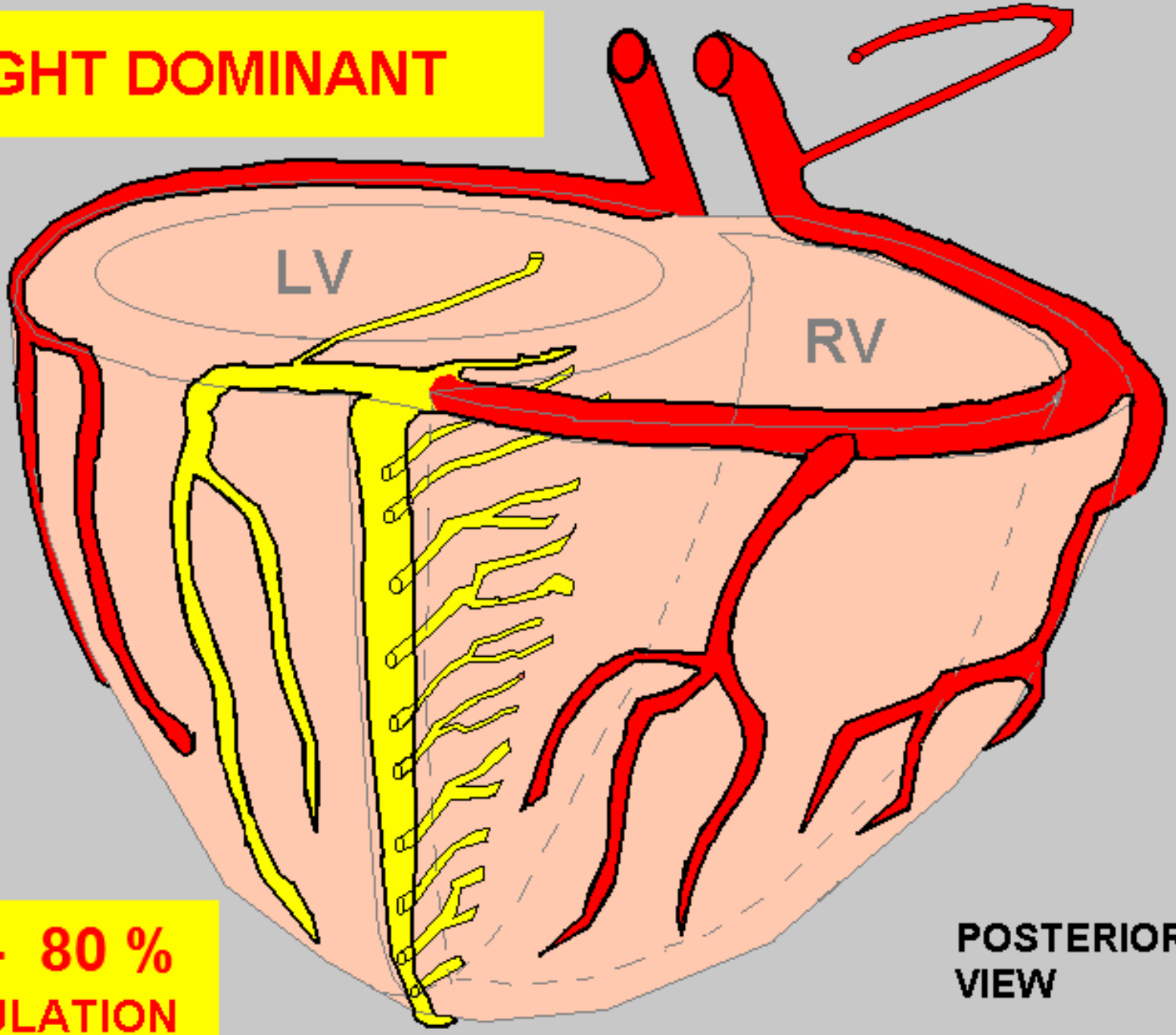
HELPFUL HINT . . . MEMORIZE THIS !

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

RIGHT DOMINANT



75 - 80 %
POPULATION

POSTERIOR VIEW

A standard

12 LEAD EKG

Does NOT show the

RIGHT VENTRICLE

To see the

RIGHT VENTRICLE . . .

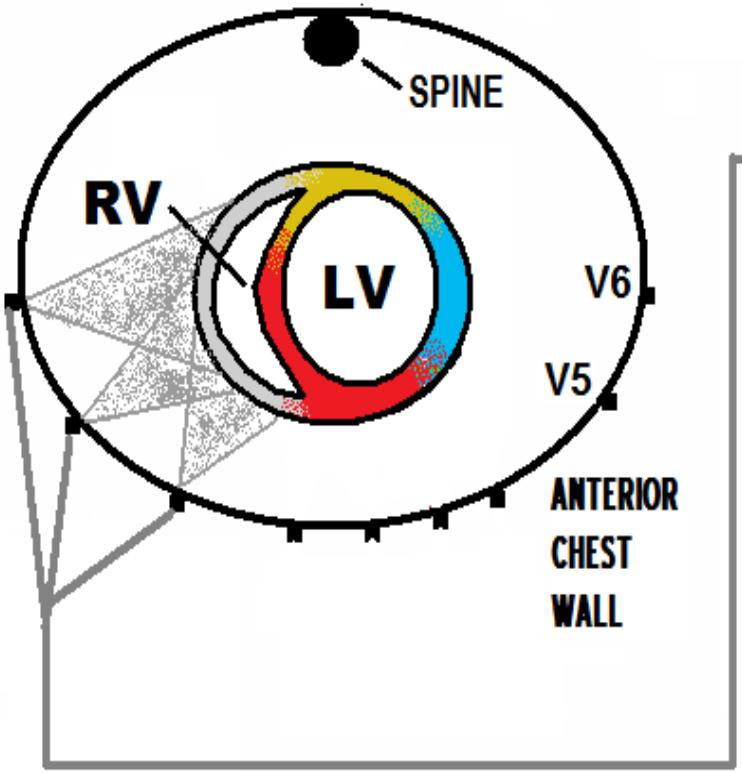
. . . such as in cases of

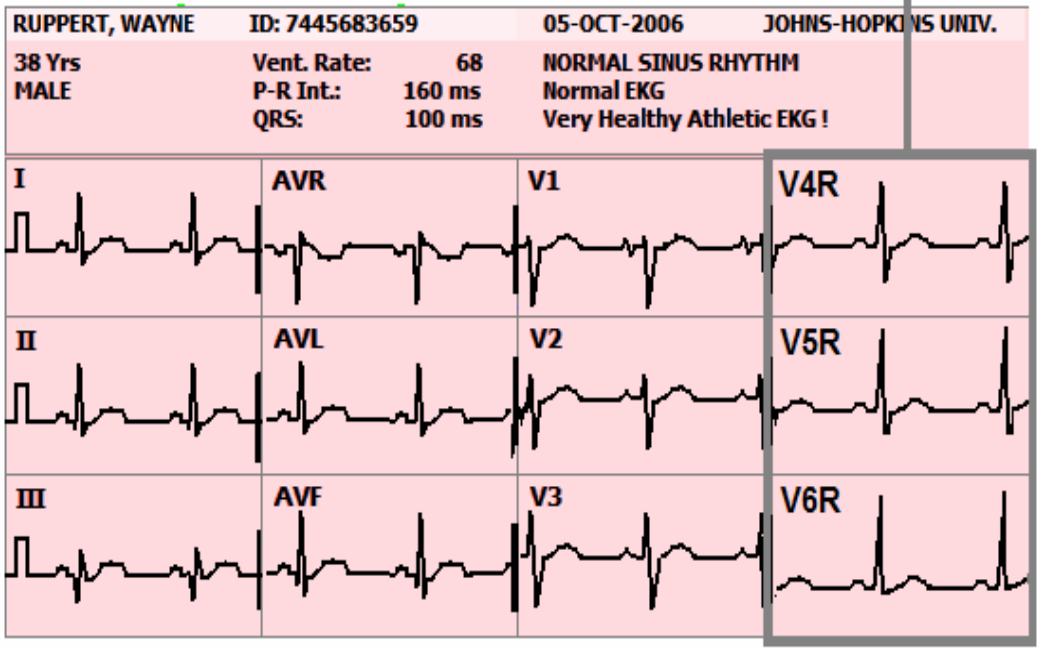
INFERIOR WALL M.I.

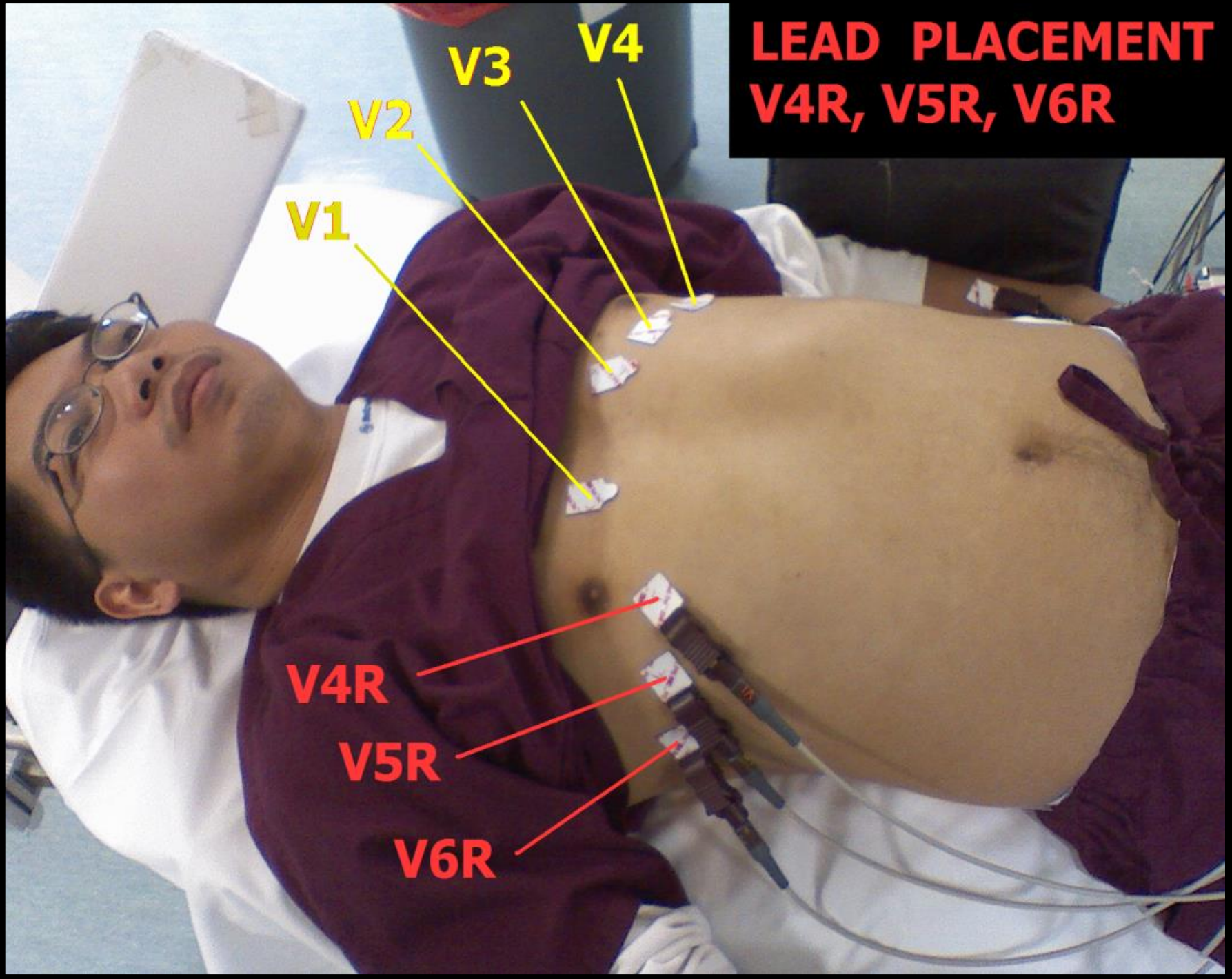
☞ You must do a

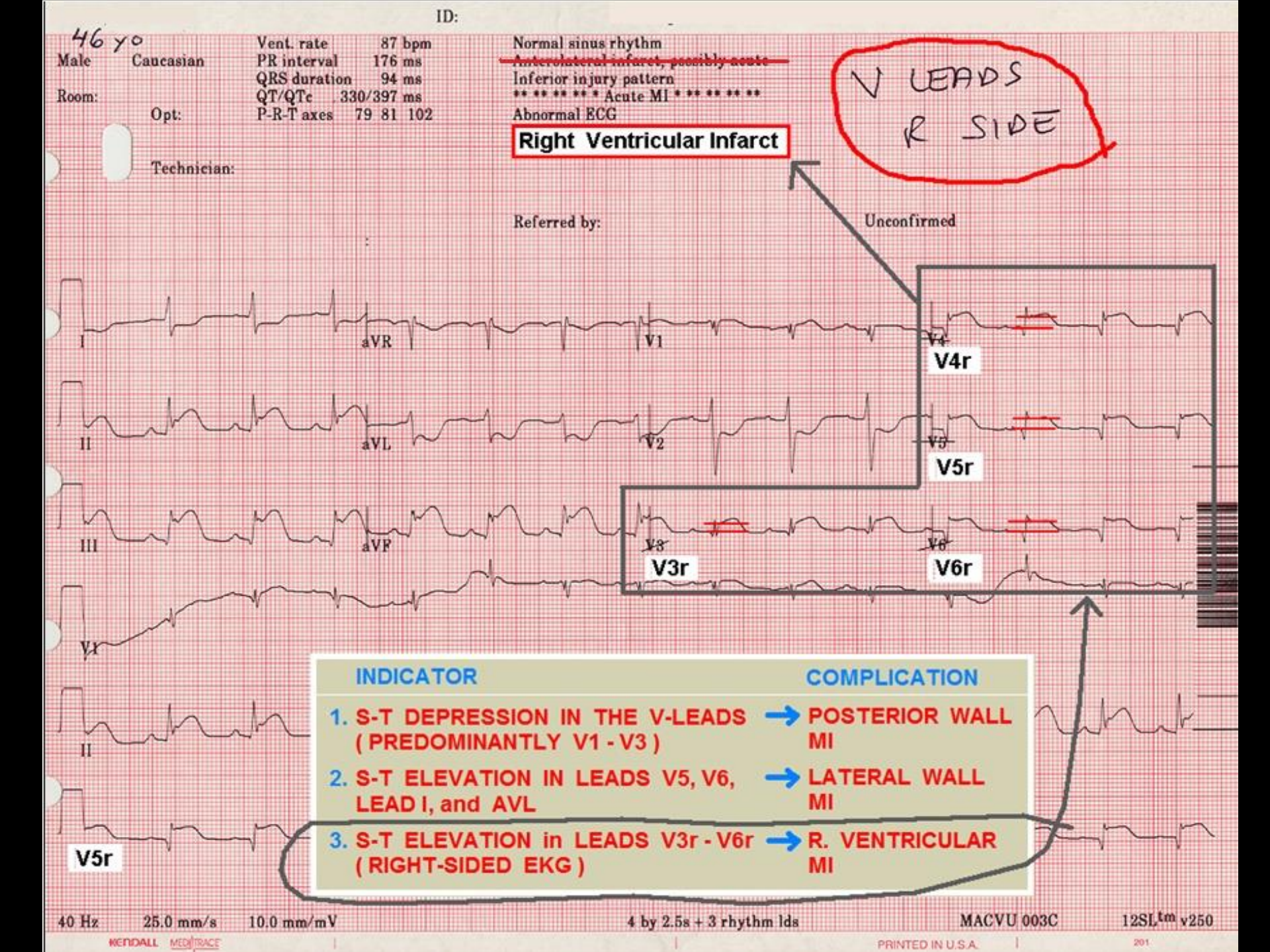
RIGHT - SIDED EKG ! !

V4R - V6R VIEW THE RIGHT VENTRICLE





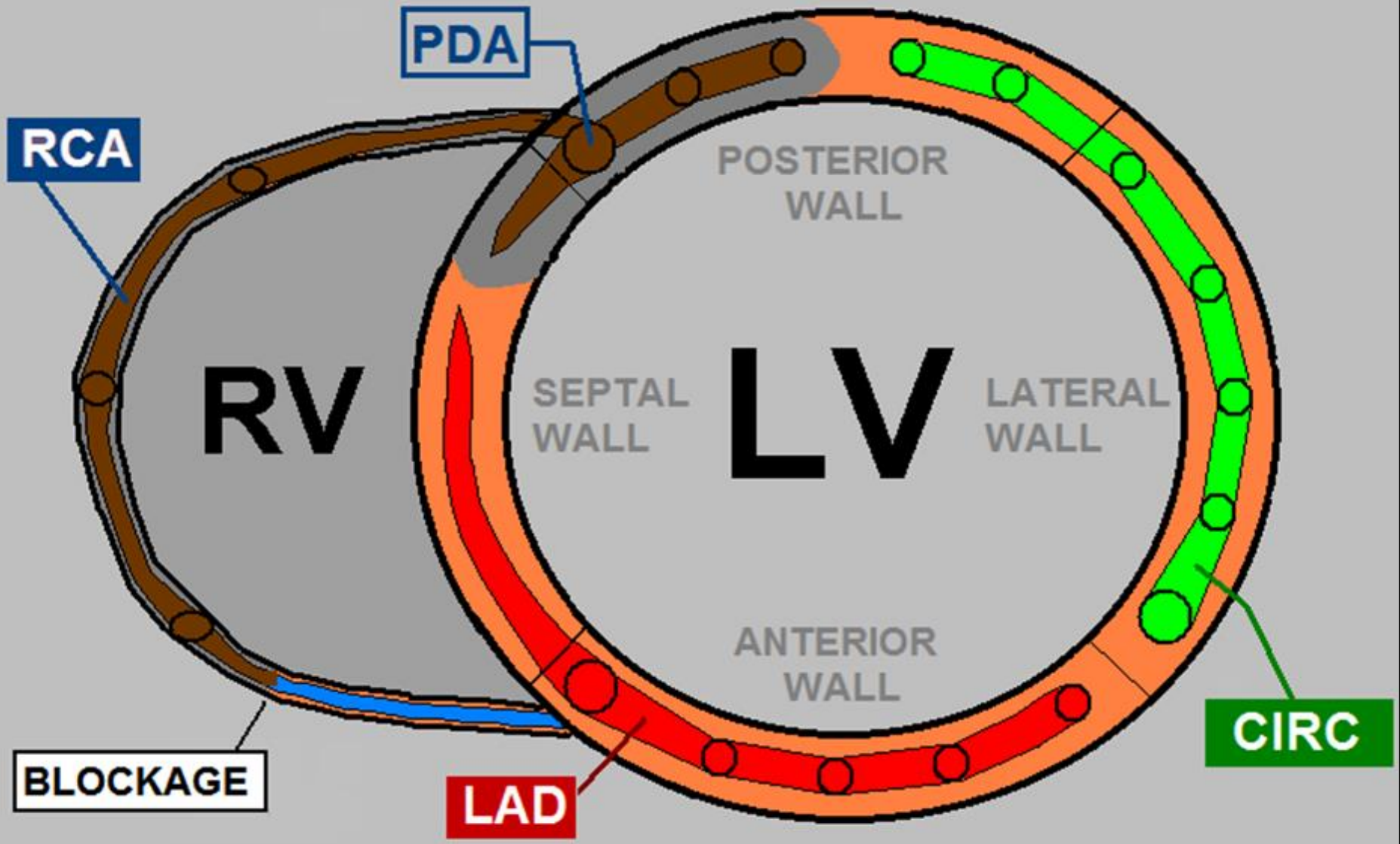

LEAD PLACEMENT
V4R, V5R, V6R
V1
V2
V3
V4
V4R
V5R
V6R


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

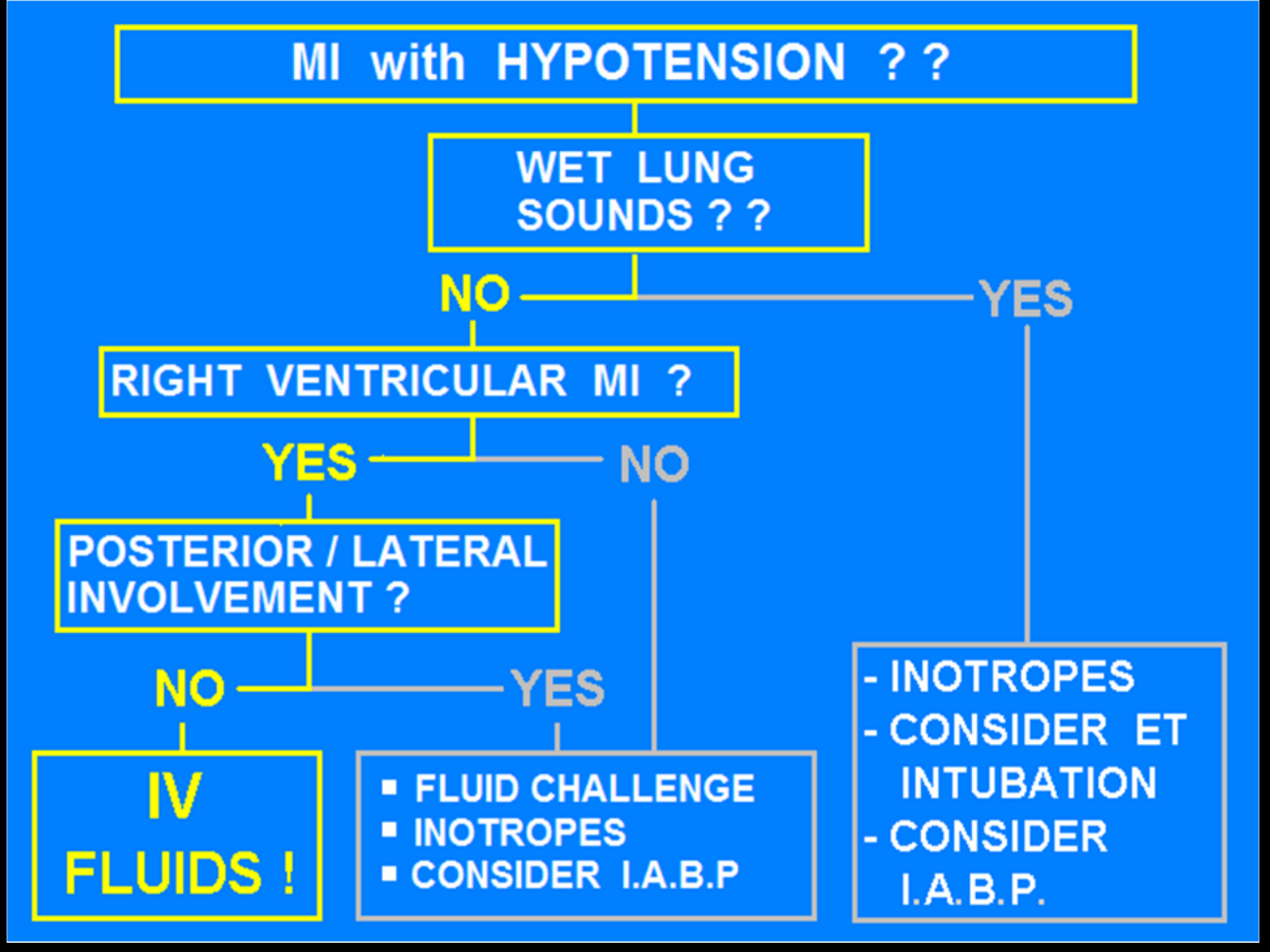
75-80 % of POPULATION

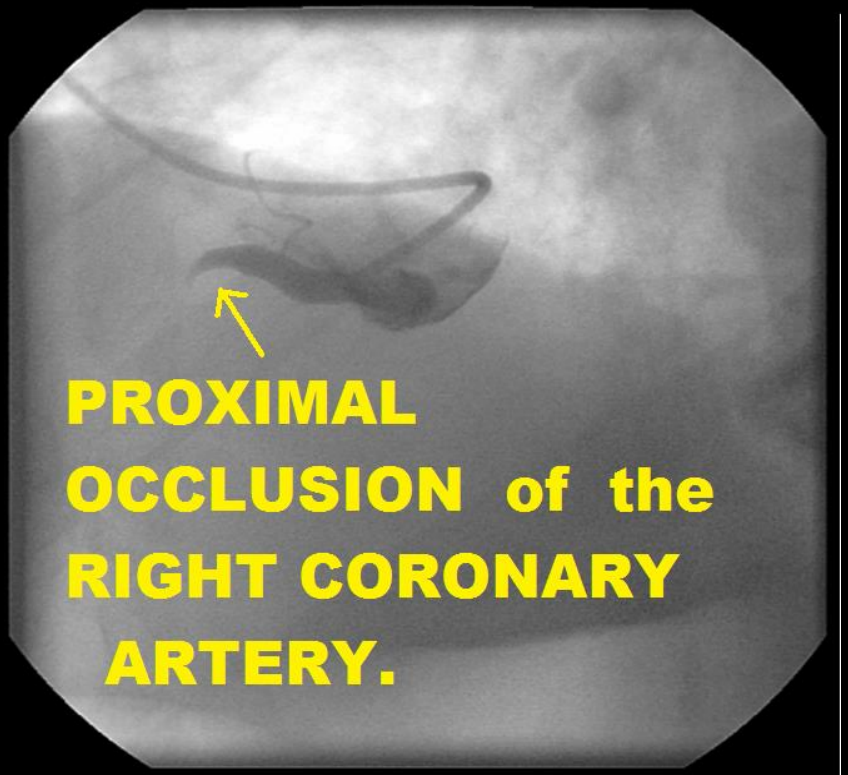


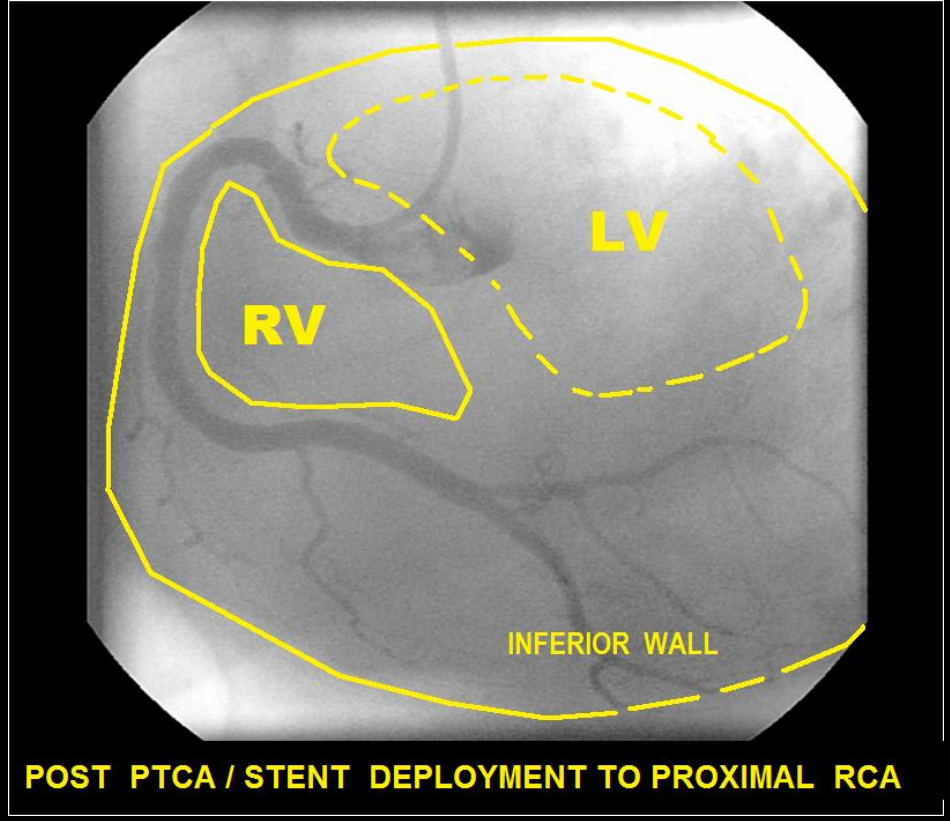
ANTICIPATED COMPLICATIONS of INFERIOR WALL STEMI secondary to RCA Occlusion & POSSIBLE INDICATED INTERVENTIONS:

- 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.

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

IN ***EVERY*** CASE of

INFERIOR WALL STEMI

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

- NITROGLYCERIN
- Diuretics

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

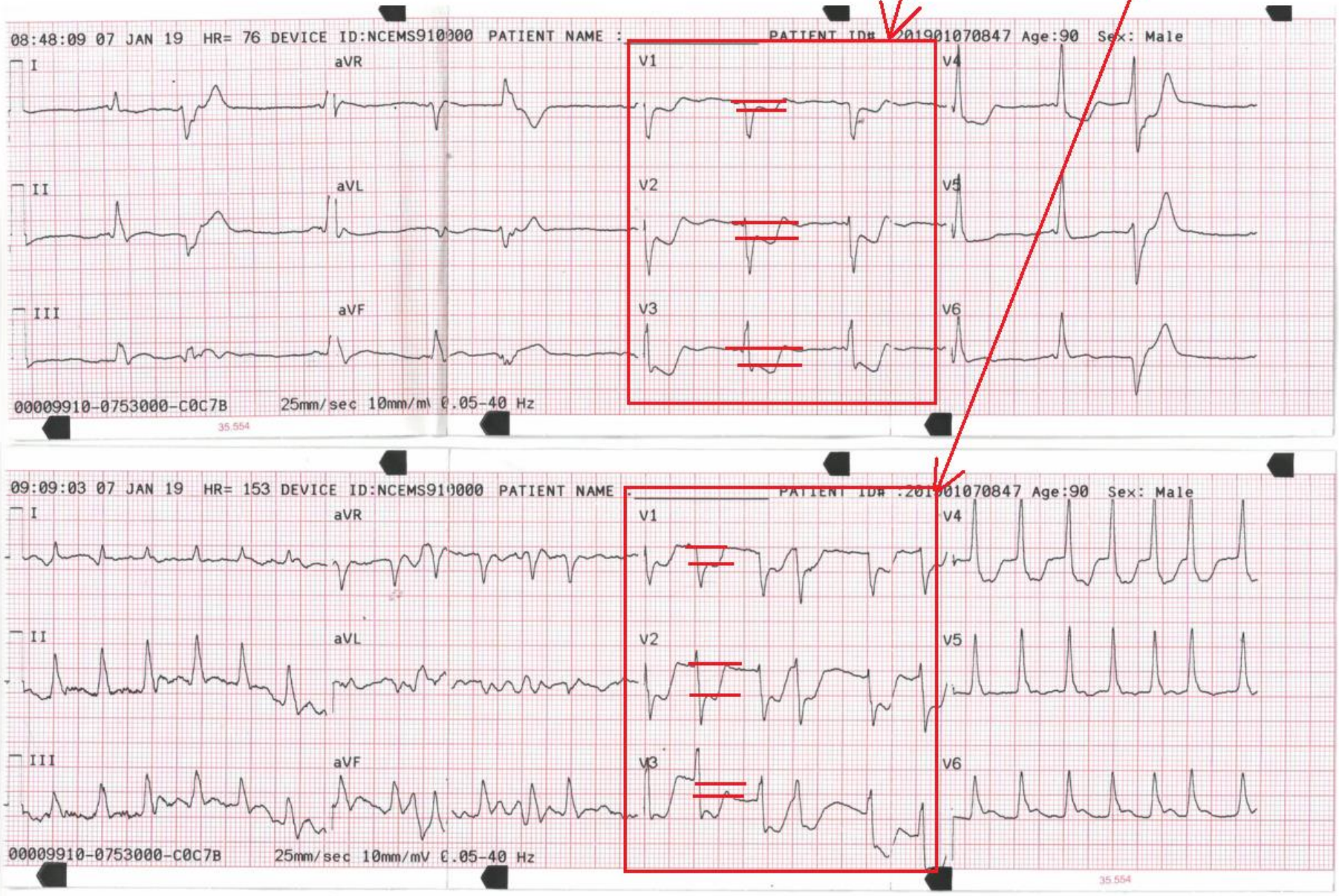
They precipitate SEVERE HYPOTENSION

* **A.H.A. ACLS 2010 / 2015**

Case Study- January 2019

- 79 y/o female complaining of “L arm pain, and minimal chest pain”
- EMS 12 Lead ECGs show ST Depression in Anterior Leads V1-V4. There is NO ST Elevation……

Two EMS 12 Lead ECGs: none show ST Elevation, but both show significant ST depression in Anterior Leads V1-V3.



Initial Exam in ED

- Upon arrival in ED, 12 Lead ECG confirmed EMS findings: ST Depression in Leads V1-V4.

Pat ID [redacted]

01/07/2019 09:19:35
[redacted] 79 yrs

[redacted]
Caucasian Female
Account # [redacted]

Bayfront Health Seven Rivers ED
Dept ED
Room ED01
Tech gp

RX
DX

Rate	153
PR	
QRSd	117
QT	260
QTc	415
--Axis--	
P	
QRS	73
T	78

Atrial fibrillation with rapid V-rate
Nonspecific intraventricular conduction delay
NO PREVIOUS ECG AVAILABLE FOR COMPARISON

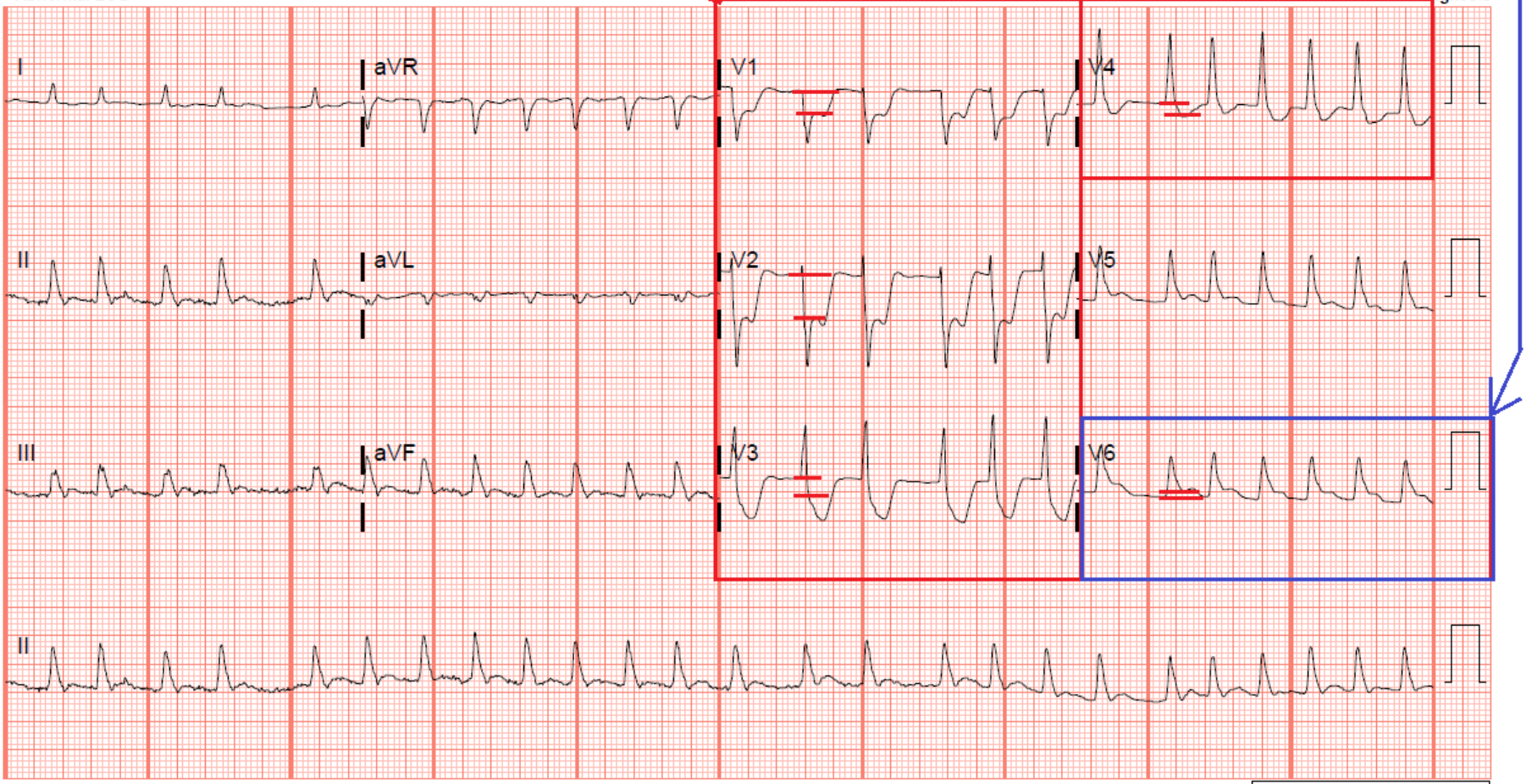
Req Provider:

ST Depression Leads V1 - V4

Minimal ST Elevation in Lead V6.
(Does not meet STEMI Criteria)

- Abnormal ECG -

Unconfirmed Diagnosis



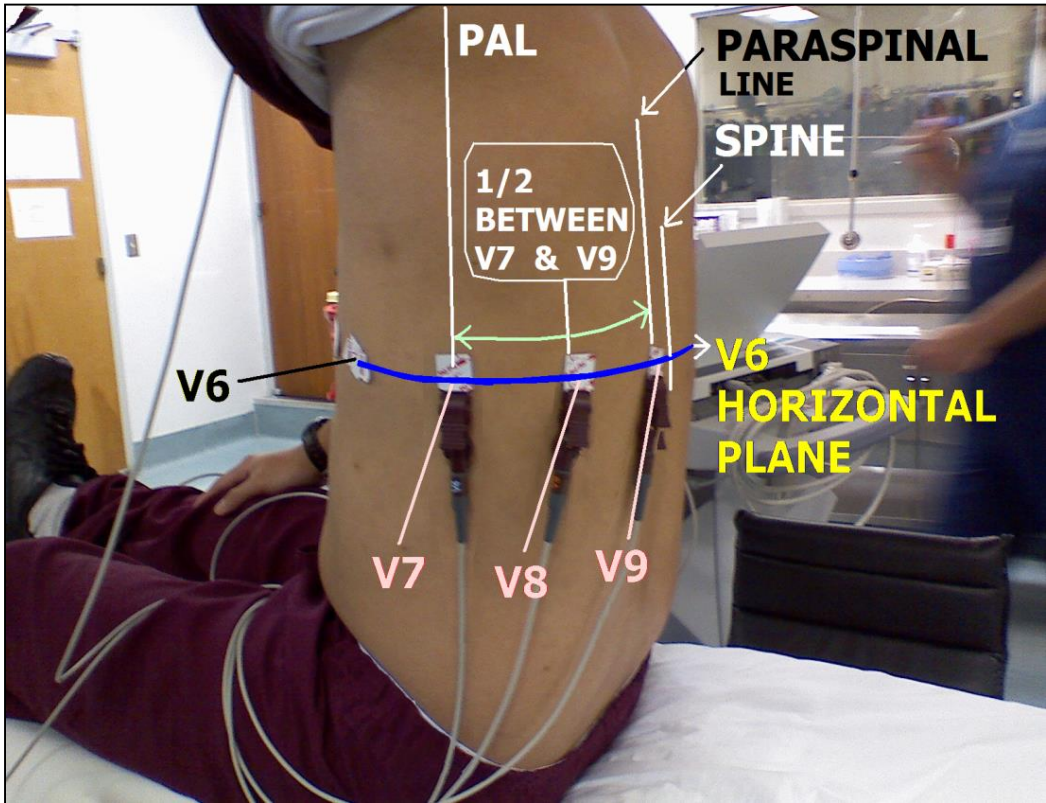
Philips PageWriter TC | 25 mm/sec | 10.00 mm/mV | F 60~ 0.15 - 100 Hz

Causes of ST Depression V1-V4

- Anterior Wall ischemia
- Anterior Wall NSTEMI (partial wall thickness myocardial infarction)
- Posterior Wall STEMI

Continued Exam in the ED….

- Upon noting ST Depression in Anterior Leads, 3 leads were placed on the patient's back. The lead wires for V4, V5 and V6, were repositioned, as shown here:
- The "Posterior Lead ECG" is seen on the next slide……



Pat ID [redacted]

01/07/2019 09:23:29
[redacted] 79 yrs

[redacted]
Caucasian Female
Account [redacted]

Bayfront Health Seven Rivers ED
Dept EDHD
Room EDH
Tech gp

RX
DX

Req Provider: ONIER VILLARREAL

Rate	133	Atrial fibrillation
PR		~~Anterolateral infarct, acute~~
QRSd	114	Prolonged QT interval
QT	337	COMPARED TO ECG 01/07/2019 09:21:04
QTc	502	PROLONGED QT INTERVAL NOW PRESENT
--Axis--		
P		
QRS	77	
T	121	

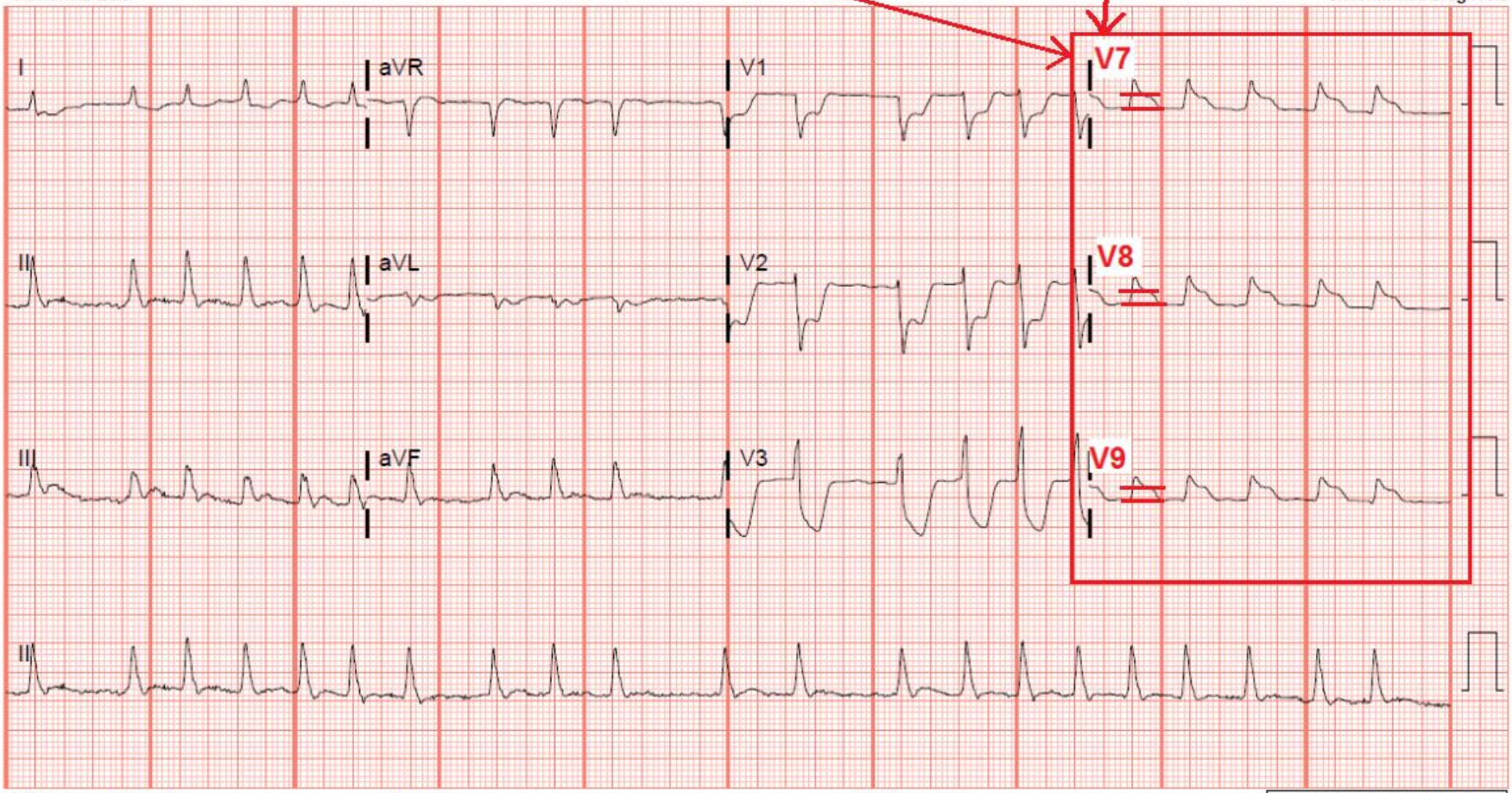
**** Posterior Infarct - Acute ****

ACUTE POSTERIOR WALL STEMI

Chest leads V4-V6 repositioned to patient's back (Posterior Leads V7, V8 and V9) reveal ST Segement Elevation. Patient diagnosis changes from "possible NSTEMI" to "Acute STEMI."

- Abnormal ECG -

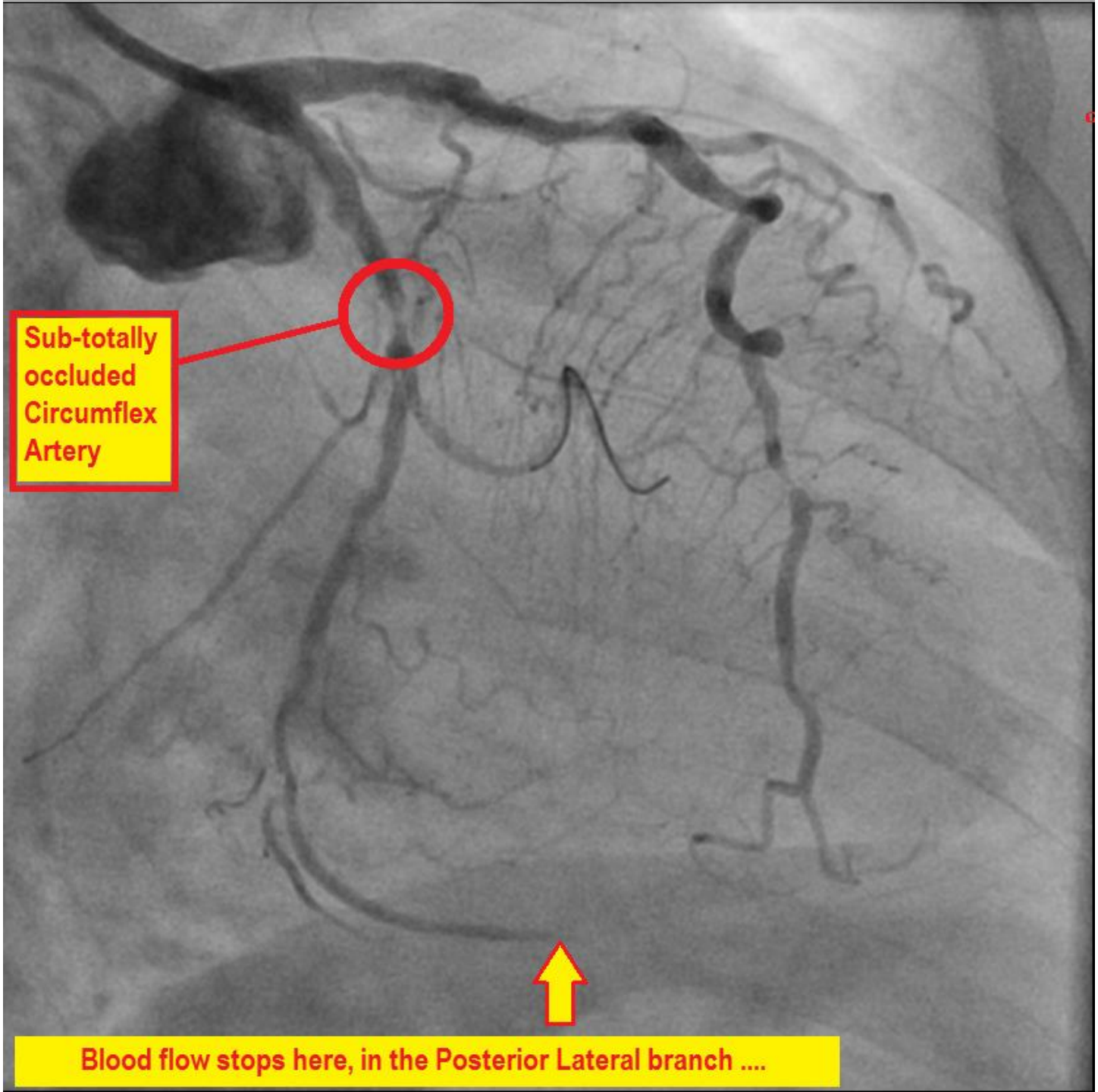
Unconfirmed Diagnosis

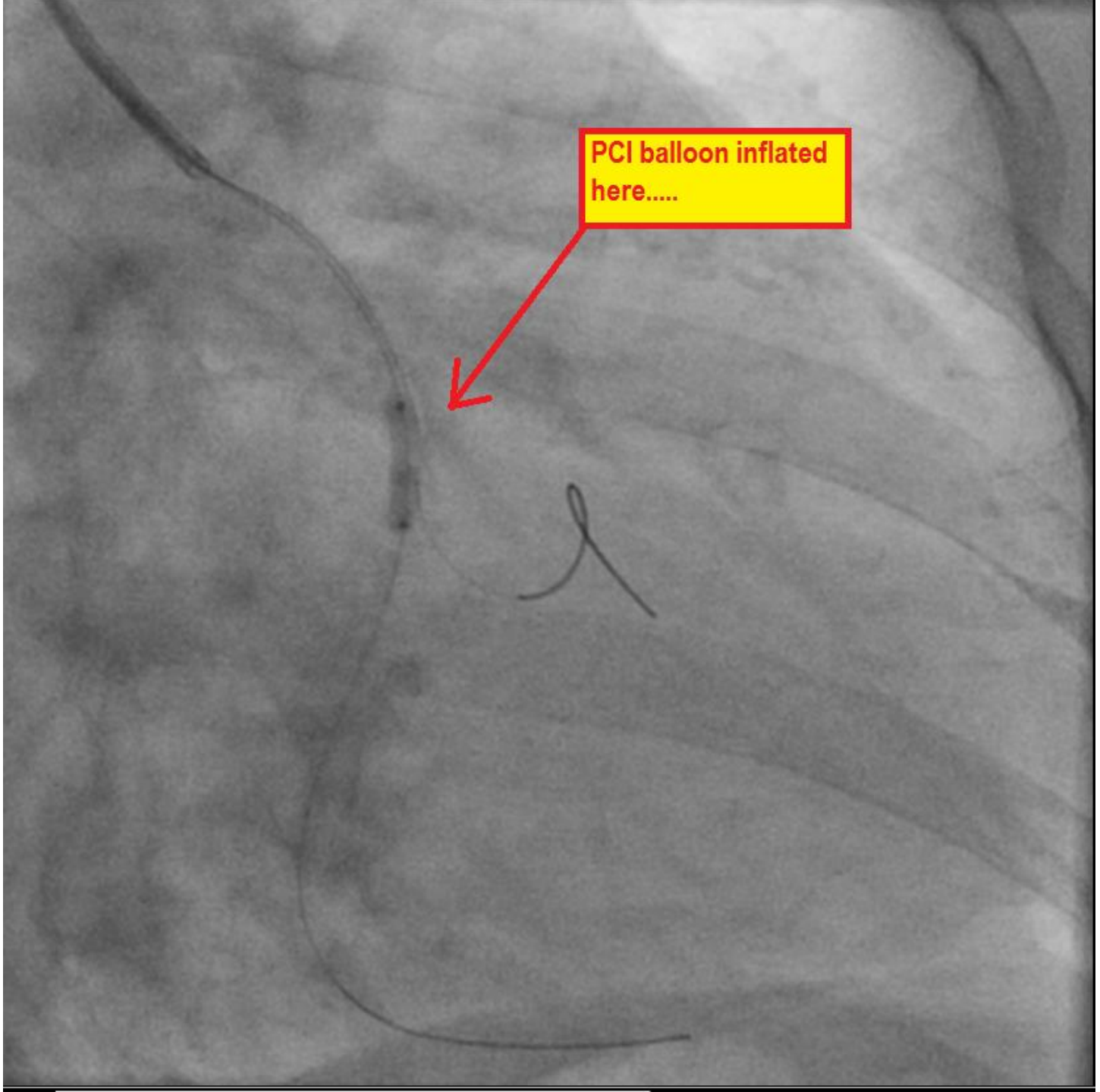


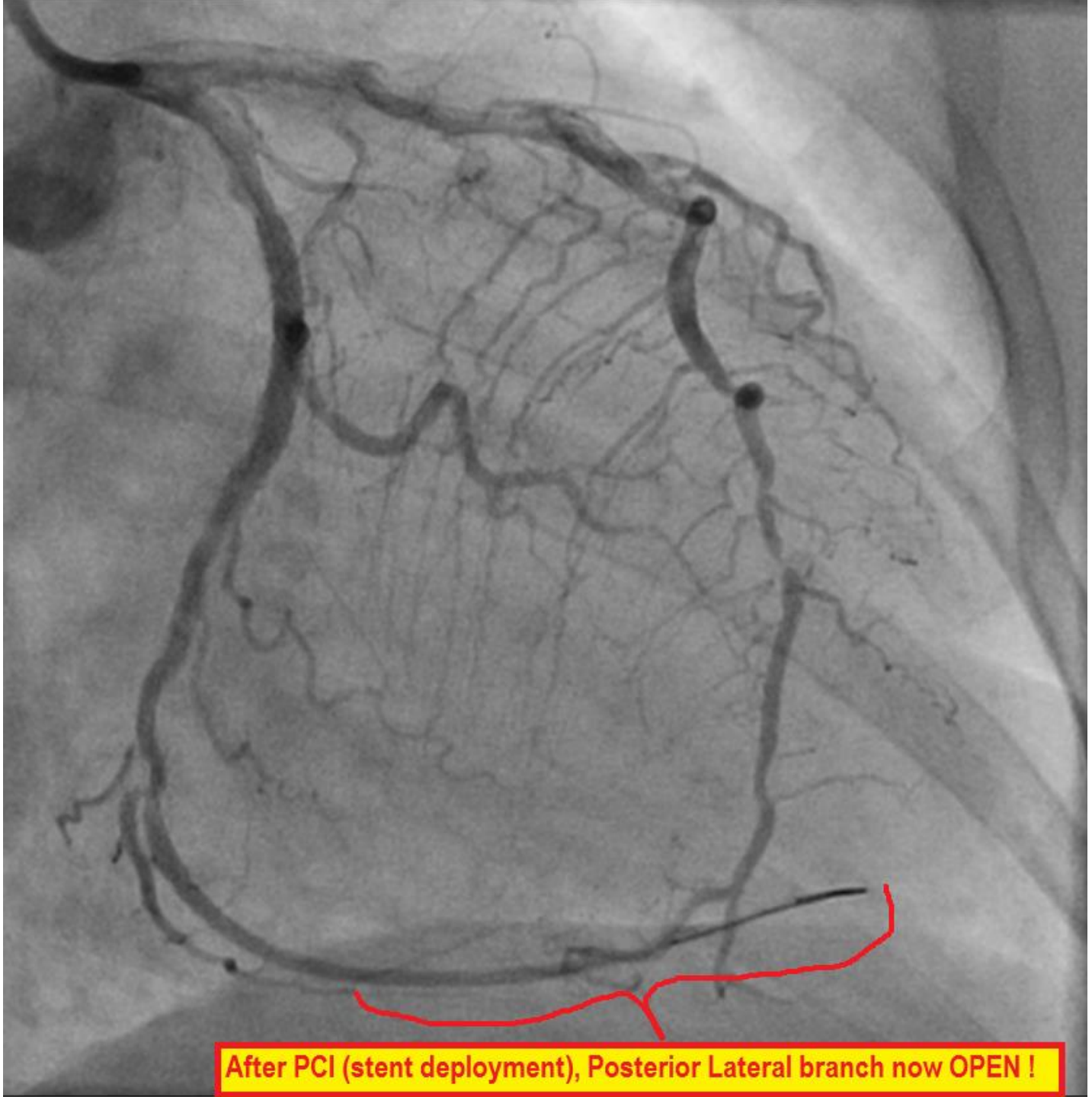
Philips PageWriter TC | 25 mm/sec | 10.00 mm/mV | F 60~ 0.15 - 100 Hz

STEMI Alert !

Upon seeing “Significant ST Elevation in TWO or more CONTIGUOUS LEADS, the ED physician diagnosed “Posterior Wall STEMI,” a STEMI Alert was issued, and the patient was taken immediately to the cardiac cath lab, where the following images were obtained…….


Sub-totally occluded Circumflex Artery
Blood flow stops here, in the Posterior Lateral branch ....


PCI balloon inflated here.....


After PCI (stent deployment), Posterior Lateral branch now OPEN !

SUMMARY

- Whenever ST Depression is noted in Anterior Leads (V1-V4), it could indicate that Acute Posterior Wall STEMI is present.
- To rule-out Posterior Wall STEMI, a “posterior lead ECG” (V7 – V9) must be obtained.
- In THIS CASE, Posterior Wall STEMI was diagnosed via Posterior Lead ECG.
- **STEMI Alert was issued, with a Door-to-PCI time of 53 minutes.**