American College of Cardiology
20th Congress 2017

Observation Medicine ECG Instructor Workshop, Version 1 Part 1

Principles and Practices of Continuous ST-Segment Monitoring

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

Observation Medicine ECG Course

BASIS:

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

Observation Medicine ECG Workshop Version 1 - Today

- **Acute Coronary Syndrome**

Observation Medicine ECG Workshop Version 2 - Future

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

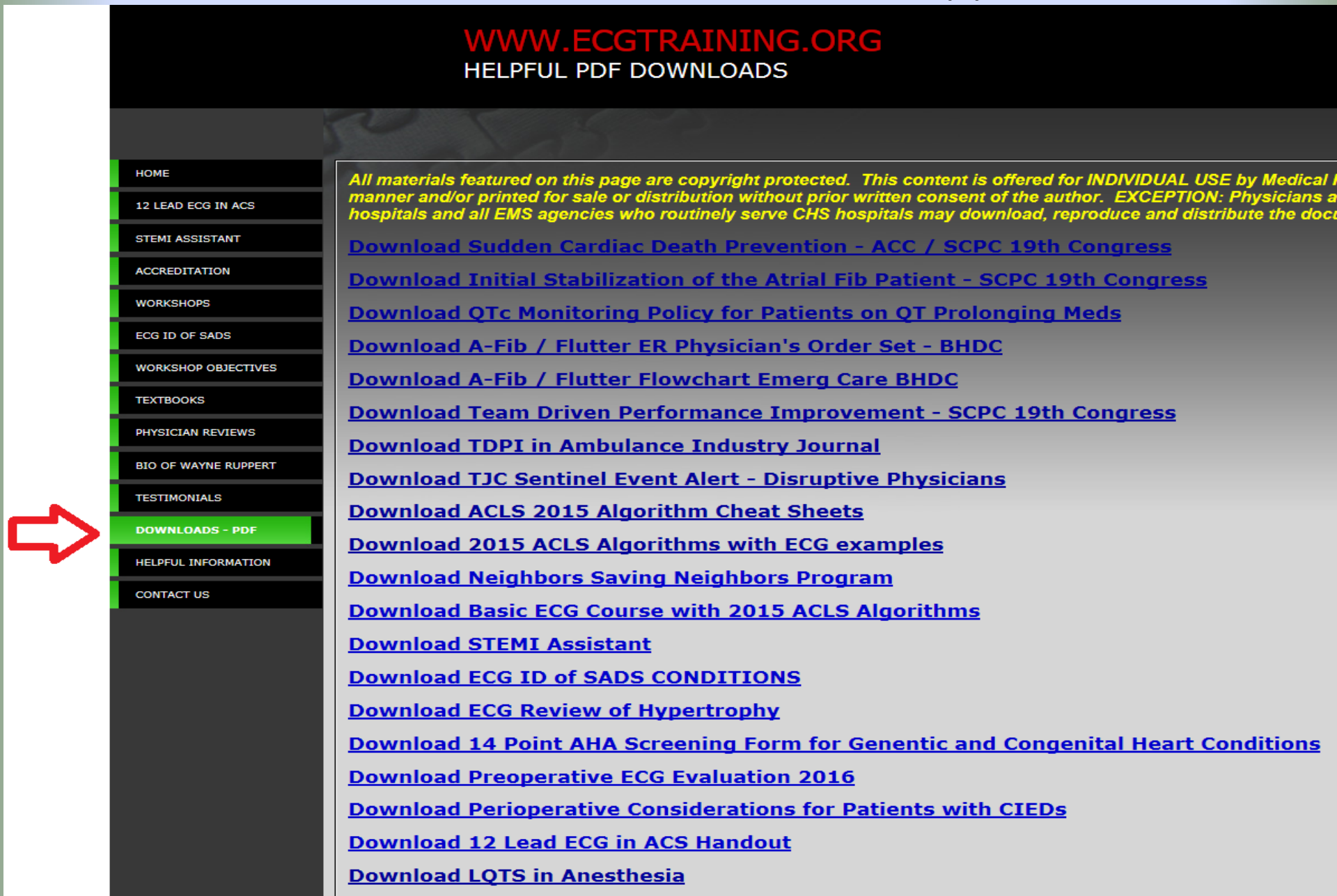
Bayfront Health
Dade City

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

Wayne Ruppert bio:

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

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



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Suggested **Prerequisite Knowledge**:

Basic ECG Rhythm Interpretation Skills.

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

Objectives (Part 1):

- Review The Joint Commission (TJC) National Patient Safety Goal #6: "Clinical Alarms"
- Review ACC/AHA ECG Monitoring Guidelines for Hospitals
- Learn correlation of ECG leads with specific coronary anatomy
- Learn the ECG Markers of ACS
- Learn which leads to select for "Continuous ST-Segment Monitoring

Reference Sources:

- **ACC / AHA / HRS Guidelines for the Standardization and Interpretation of the ECG, Parts I, II, III, IV, V, VI (2007 – 2010)**
- **ACC / AHA Practice Guidelines for Electrocardiographic Monitoring in Hospitals (2004)**
- **TJC National Patient Safety Goals 2013-2017**
- **American Journal of Critical Care**

See last section of this handout for downloads of all reference source materials.

The Joint Commission (TJC) National Patient Safety Goals (NPSG)

- 2013 TJC Sentinel Event identified “Alarm Fatigue” as a cause of mortality and established need for Clinical Alarms Management.”
- 2014 added “Clinical Alarms Management” to its list of NPSGs
- 2017 NPSG requires hospitals to have developed and implemented policies and procedures for clinical alarms management.

The Joint Commission (TJC) National Patient Safety Goals (NPSG)

- Hospital units with continuous automated ST Segment monitoring capabilities should establish and follow a policy and procedure for monitoring ST segment changes in patients suspected of ACS, or who have the potential to develop ACS.

ST Segment monitor alarm setting:

- **Example for patients with suspected ACS:**
  - **Set baseline ST segment measurement to patient's admission ECG (J point + 60ms)**
  - **Set to alarm if there is a deviation (elevation or depression) of 0.10mv (1mm) from baseline ECG (J point + 60ms)**

Critical Baseline Settings:

- **Heart Rate** (upper / lower)
  - Keeps you informed of patient condition changes
  - Aids you in medication rate management (IV infusions, e.g.: Cardizem)
- **ST-Segment** (ACS)
- **QT Interval** (all patients, patients receiving QT prolonging medications)

If the ST-Segment alarm activates, what should you do ??

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- **Go assess the patient!**
  - **Are there any symptoms now present?**
  - **Changes in prior symptoms?**
- **Get a STAT 12 Lead ECG ! . . . *And***

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- **Get a STAT 12 Lead ECG ! . . . *And***
- ***Compare it to the last ECG(s)!***

Clinical Alarm Management Resources

- American Journal of Critical Care – Monitoring Clinical Alarms.

- To download a sample CLINICAL ALARMS MONITORING POLICY and a CLINCIAL ALARMS PARAMETERS example, CLICK HERE. This will take you to my "PDF Downloads" page on my website.

Continuous ST-Segment Monitoring

"The practice of continuously monitoring of the ST-Segment of ECG Lead(s) viewing the region of the myocardium where potential or actual ischemia exists."

Objectives of Continuous ST-Segment Monitoring:

- **Detection of SILENT ISCHEMIA.**

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- **Detection of SILENT ISCHEMIA.**
- **Detection of developing / worsening ischemia, early detection of infarction / STEMI**

Hold on there!

Does this mean *we're no longer just monitoring every patient in limb lead II ???*

What's wrong with TRADITIONAL ECG Monitoring using Lead II ? ?

Lead II: sees good P waves

vs.

Lead II: sees good P waves

vs.

The ECG Lead viewing region of suspected myocardial ischemia: detection of worsening ischemia and early infarction.

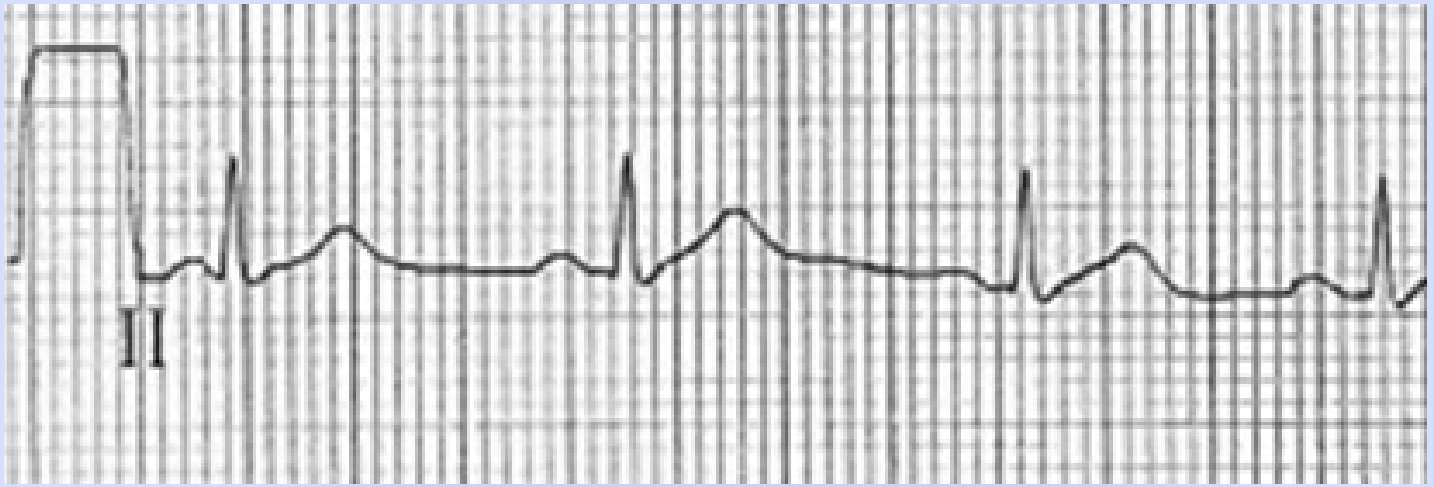
What's the rationale behind monitoring the ECG lead viewing the region of known/suspected ischemia?

The “common sense” rationale:

If your friend says, “pick me up in front of my house in 15 minutes.”

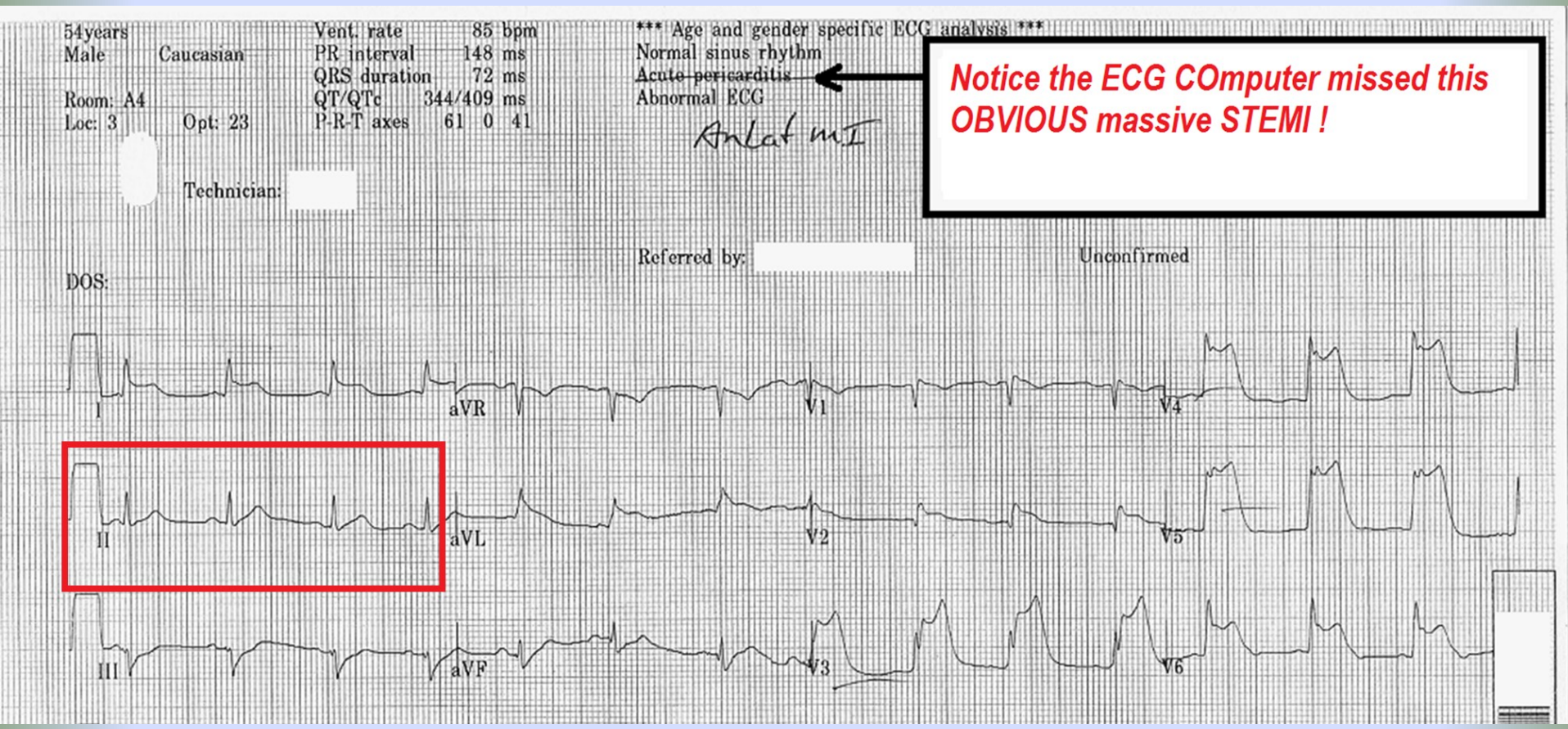
. . . You wouldn’t drive around to the back of the house and watch for your friend at the back door.

If you were only monitoring Lead II on this patient with *suspected Anterior Wall ischemia . . . . .*



.

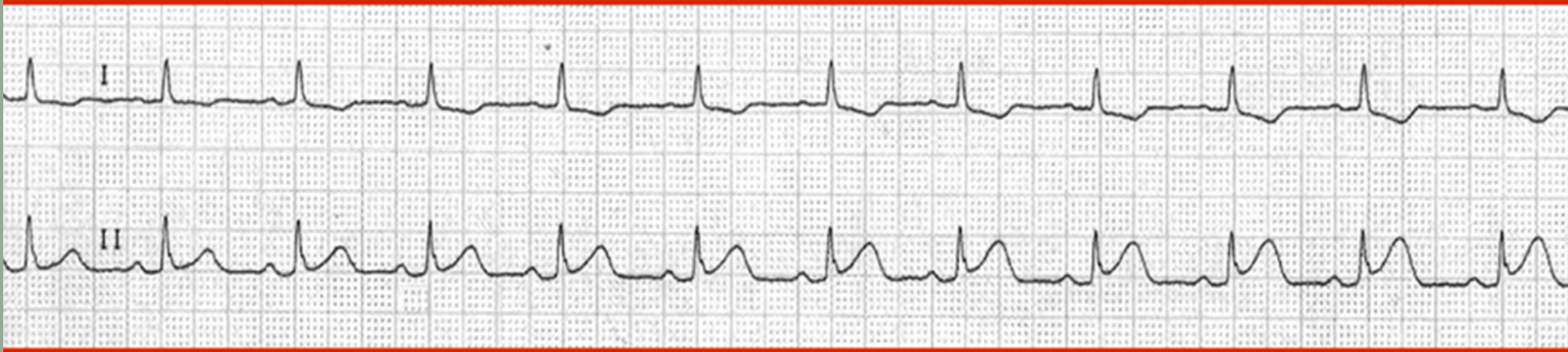
YOU WOULD MISS THIS:



AND you may have noted the subtle ECG changes LONG BEFORE the patient's MI evolved into this massive ANTERIOR LATERAL STEMI.

ST Segments often elevate *within seconds* of acute obstruction

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



We don't want to miss this ! !

This patient – in Cath Lab, ST segments immediately elevated in response to inflation of PTCA balloon in RCA

Continuous ST-Segment Monitoring;

Scientific Support:

- 1999 – JACC paper establishes Continuous 12 Lead ECG ST Segment Monitoring is beneficial for ACS / suspected ACS patients

Continuous ST-Segment Monitoring;
Scientific Support:

- Between 60-70% of episodes of transient myocardial ischemia are unreported by patients. (Drew et. Al, Am J Crit Care)
- Prevalence of **transient myocardial ischemia** in:
  - Telemetry Units: 15%
  - Coronary Care Units: 19%

Continuous ST-Segment Monitoring;
Scientific Support:

- AJCC: National Survey of Cardiologists' Standard of Practice for Continuous ST-Segment Monitoring

- Critical Care Nurse J 2009: vol 29: Continuous ST-Segment Monitoring: Protocol for Practice

What's the benefit of continuous ST-Segment Monitoring ?

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- ***IT ALLOWS YOU TO CONTINUOUSLY EVALUATE THE REGION OF THE HEART WITH SUSPECTED or KNOWN ISCHEMIA.***

What's the benefit of continuous ST-Segment Monitoring ?

- ***IT ALLOWS YOU TO CONTINUOUSLY EVALUATE THE REGION OF THE HEART WITH SUSPECTED or KNOWN ISCHEMIA."***
- ***IF THE ISCHEMIA WORSENS – or STEMI DEVELOPS – you may detect it on the ECG BEFORE the patient complains of any symptoms***

“Silent Ischemia”

- **First described in the 1970s**

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“Silent Ischemia”

- First described in the 1970s
- Patients may be asymptomatic during episodes of ischemia.
- ECG changes may be visible before the patient experiences symptoms
- Patients who are diabetic, female, over age 65, past history of CVA or heart failure frequently do not have chest pain with ischemia (Canto et al)

.

Detecting ACS on the ECG – what are we looking for?

Detecting ACS on the ECG – what are we looking for?

Changes in the ECG markers of Acute Coronary Syndrome

The ECG markers of Acute Coronary Syndrome = abnormal changes to:

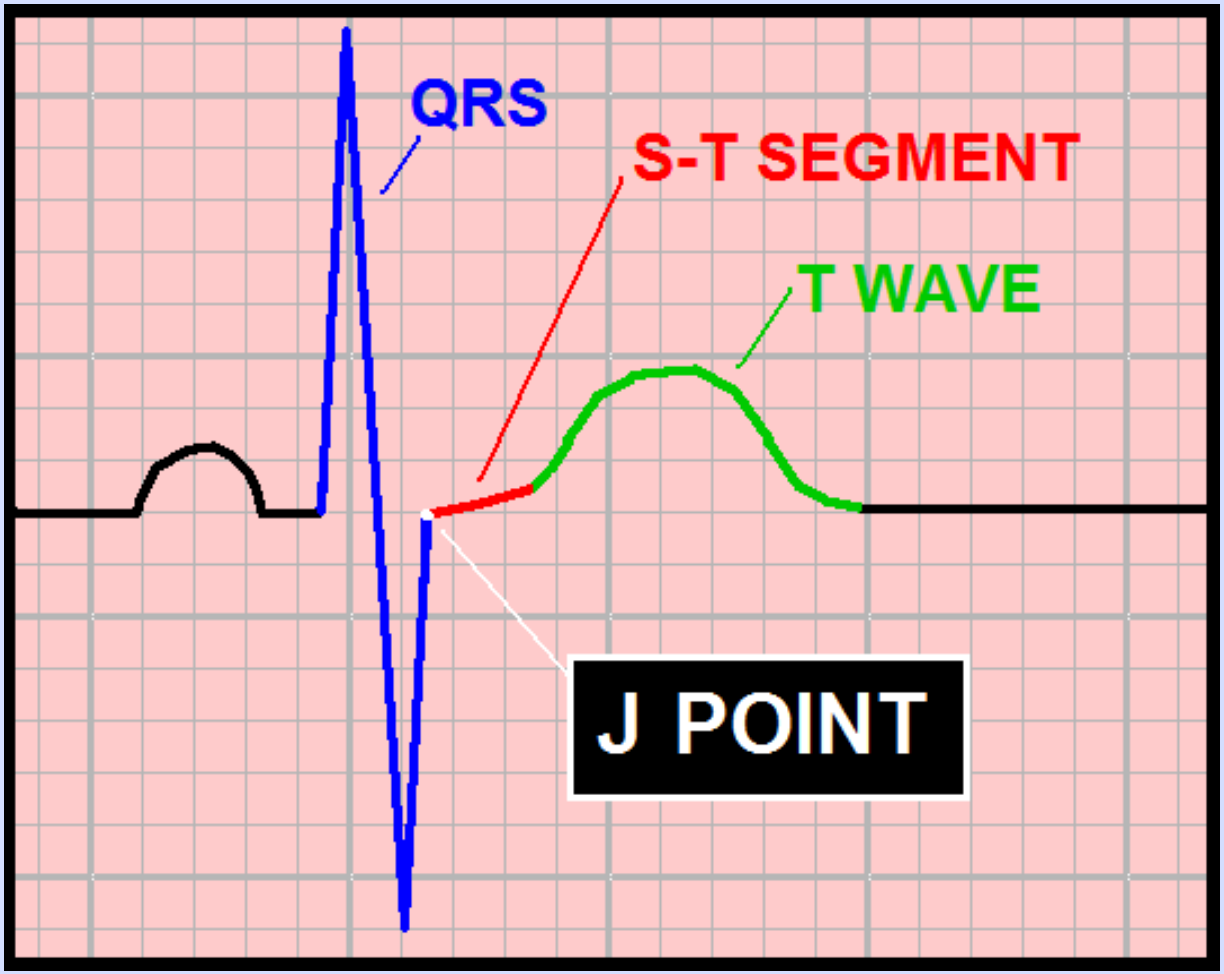
- ***J Points***
- ***ST-Segments***
- ***T Waves***

Detecting ACS on the ECG:

Detecting ACS on the ECG:

Before we can determine what is "ABNORMAL," we must first define what is NORMAL.

Defining NORMAL:



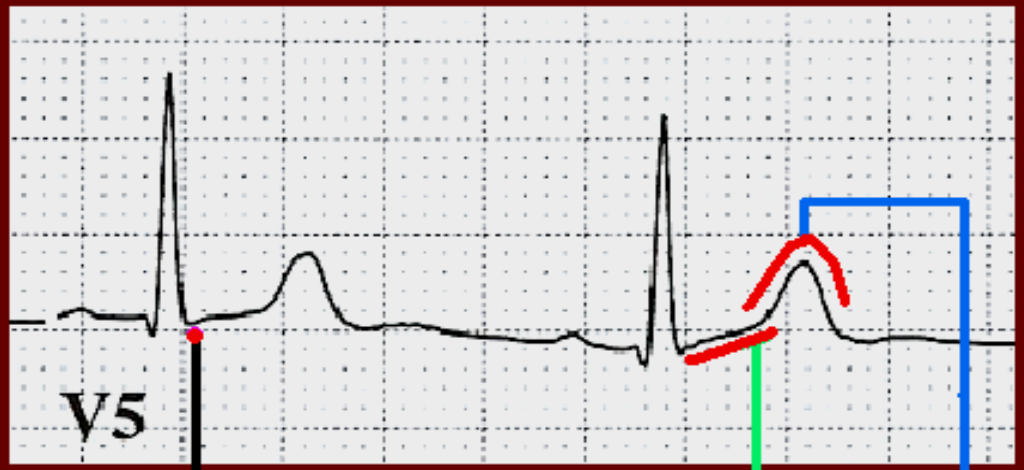
Note: The criteria presented here for evaluating the markers of ACS is for patients with narrow QRS complexes (QRSd <120ms)

Criteria for evaluating the markers of ACS for patients with WIDE QRS complexes (QRS duration 120ms or more) is covered in the Session 3.

When QRS duration is NORMAL (< 120 ms):

NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL (< 120 ms)

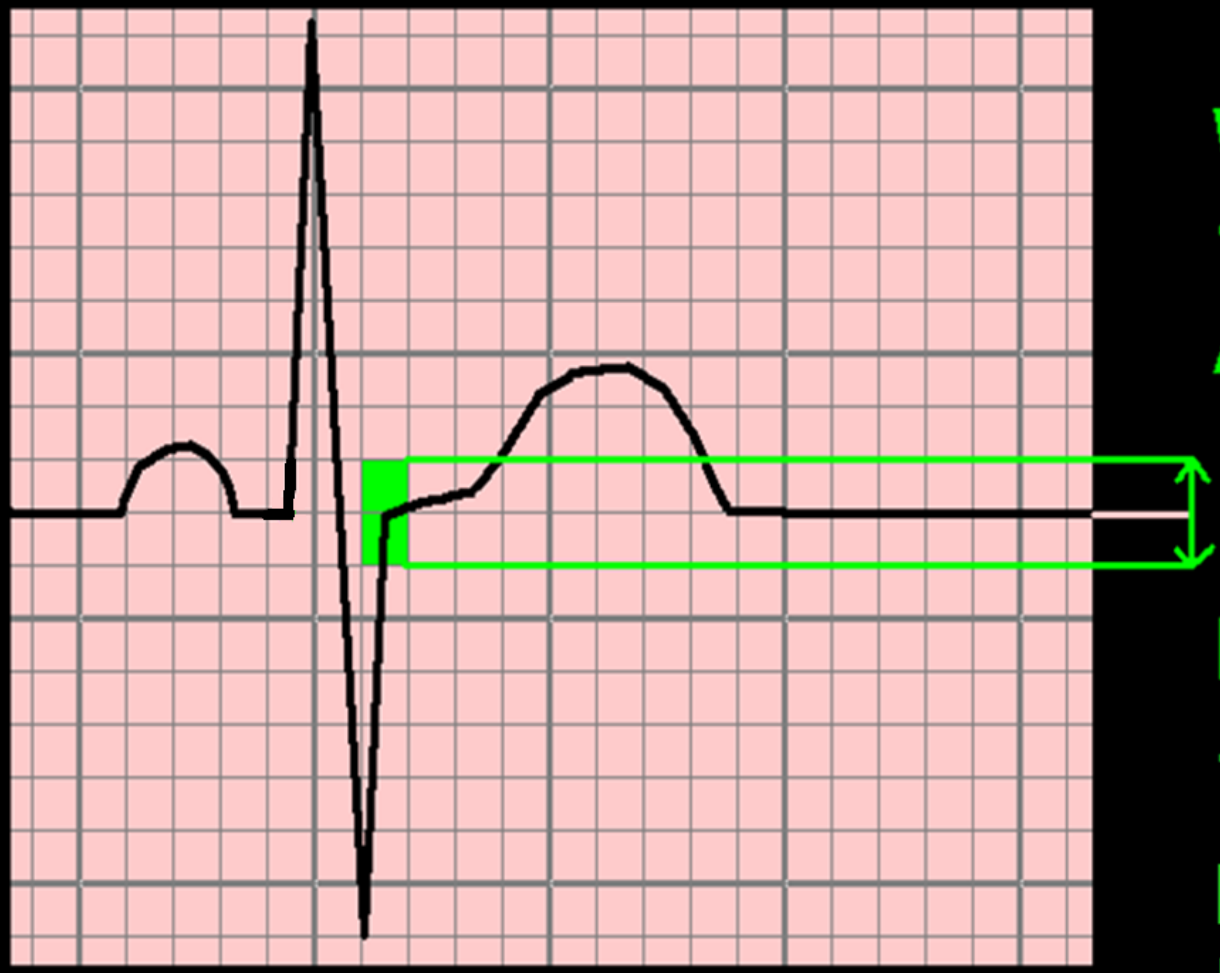


ASSESS:

- 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 . .

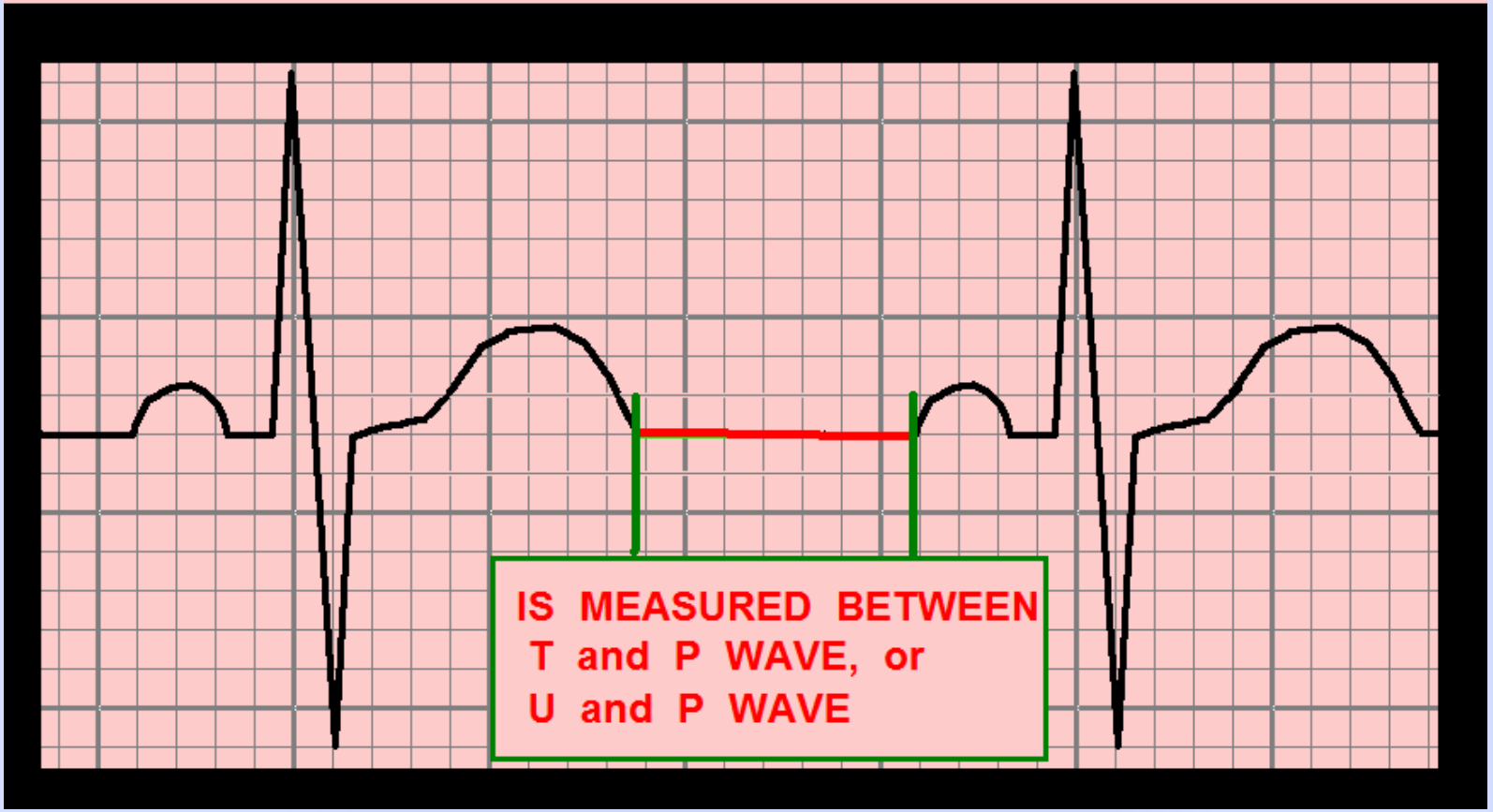


WITHIN
1 mm
ABOVE

OR

BELOW
the
ISOELECTRIC
LINE

THE ISOELECTRIC LINE



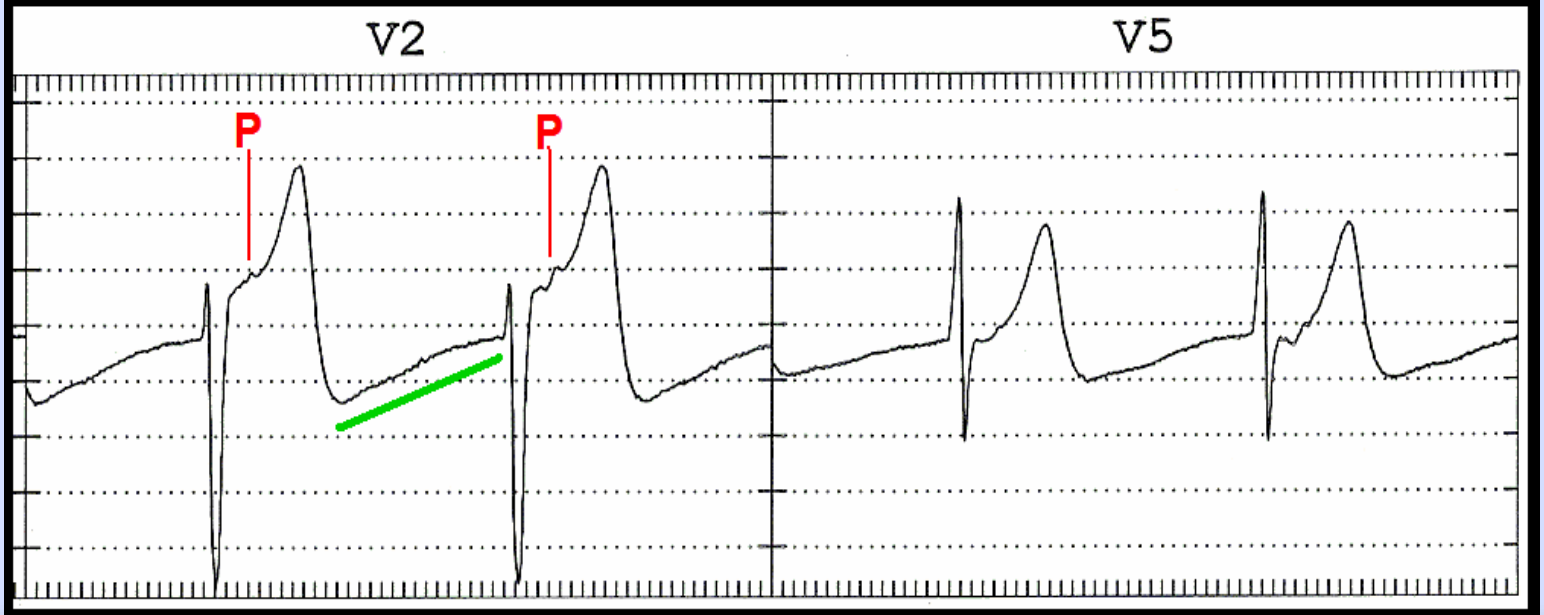
. . .the “flat line” between ECG complexes, when there is no detectable electrical activity . . .

The Isoelectric Line -

it's not always isoelectric !

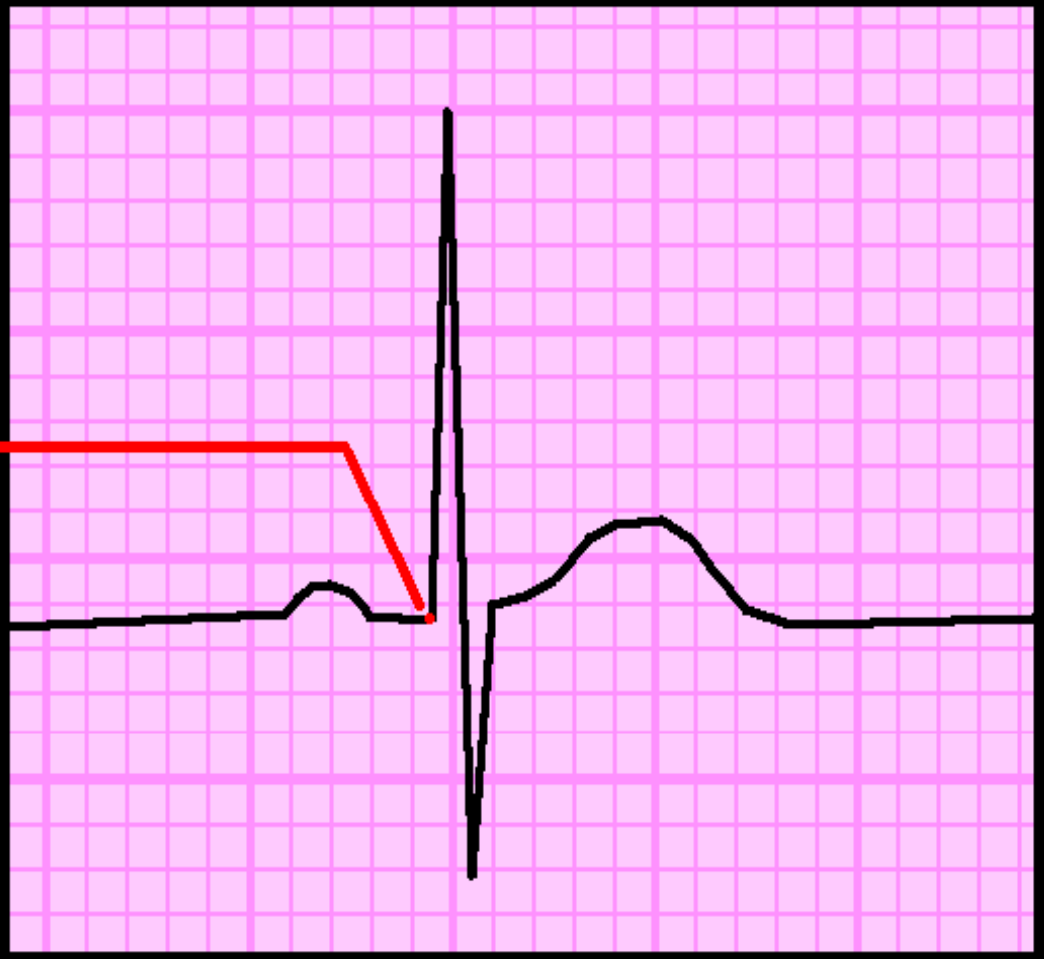
THE ISOELECTRIC LINE

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

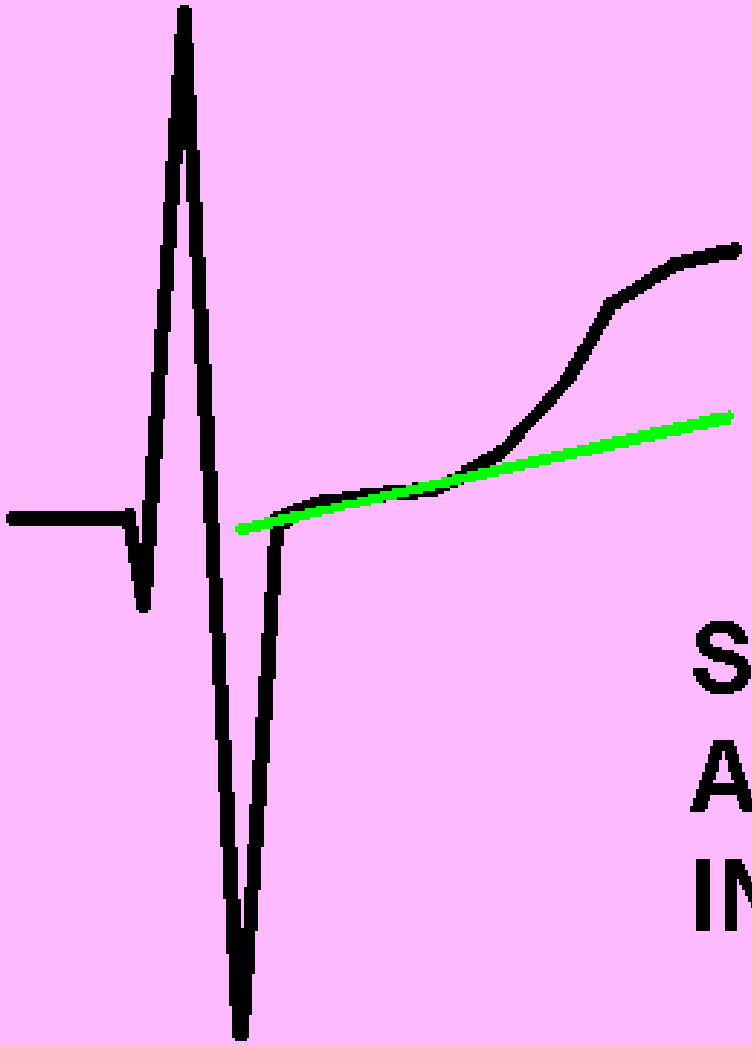
. . . is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS.



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

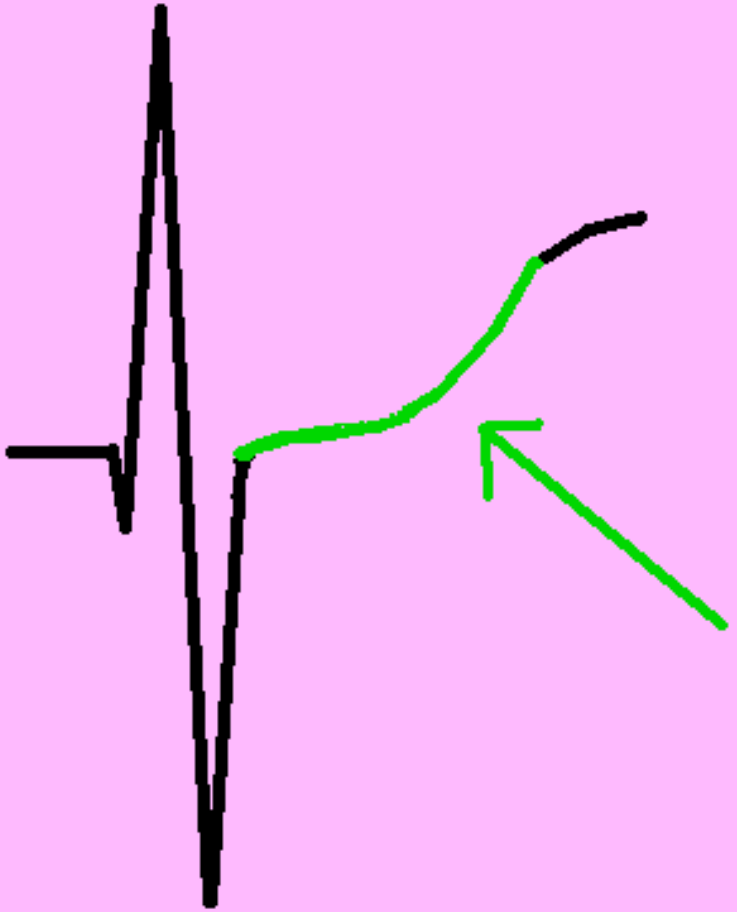
— as per the A.H.A., A.C.C., and WANG, ASINGER, and MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

THE S-T SEGMENT



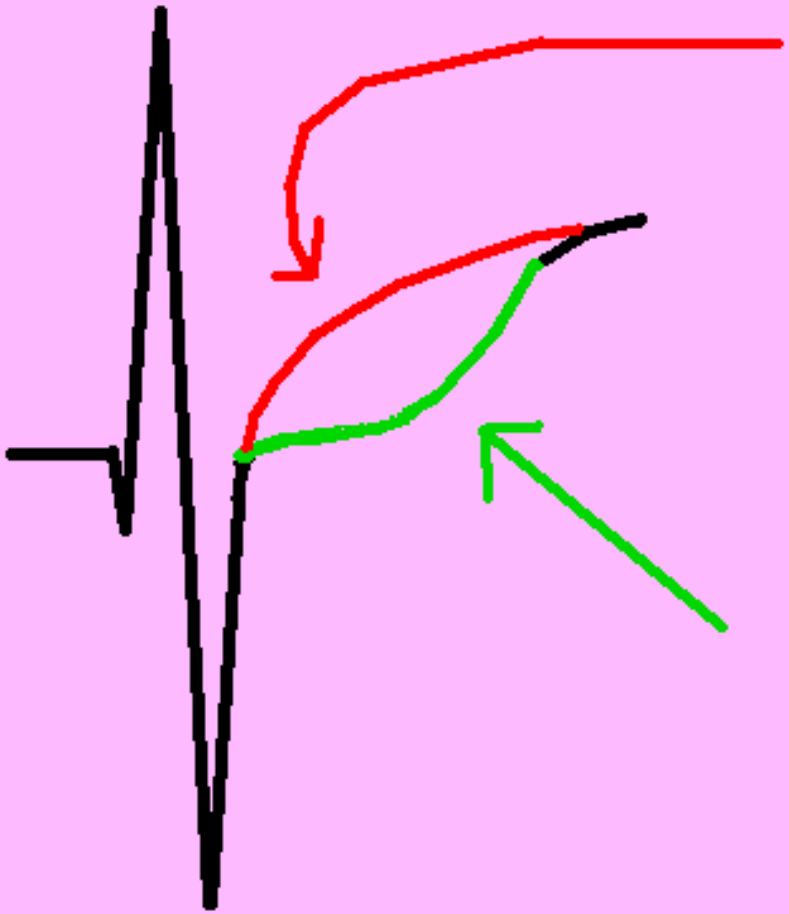
SHOULD HAVE
A "SLIGHT POSITIVE"
INCLINATION

THE S-T SEGMENT



SHOULD BE "CONCAVE" IN SHAPE . . .

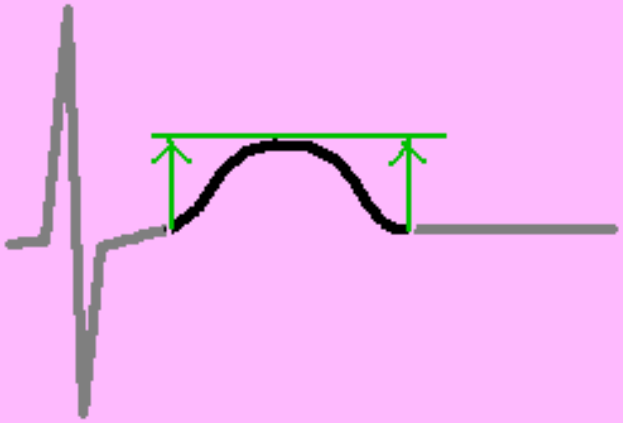
THE S-T SEGMENT



AS OPPOSED TO "CONVEX" IN SHAPE

SHOULD BE "CONCAVE" IN SHAPE . . .

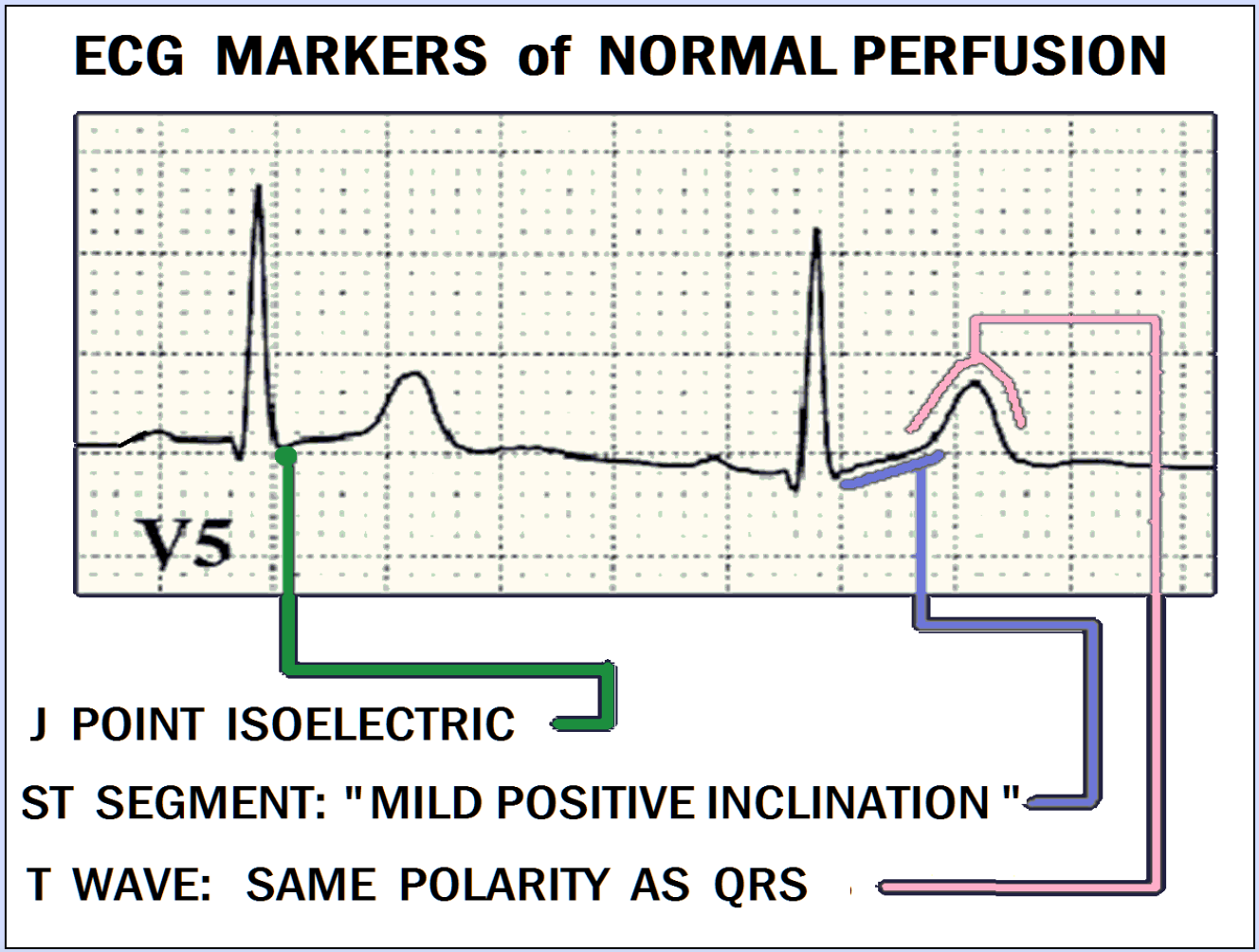
THE T WAVE



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.

Patients with normal QRS duration (QRS < 120 ms) :



QUESTION:

If we just defined *NORMAL,* what is *ABNORMAL* ? ?

ANSWER:

EVERYTHING ELSE.

If it isn't NORMAL

is

ABNORMAL !!

Simply stated, if the

- J Points
- ST-Segments
- T Waves

are *NOT NORMAL*,
they are ***ABNORMAL.*** . . .

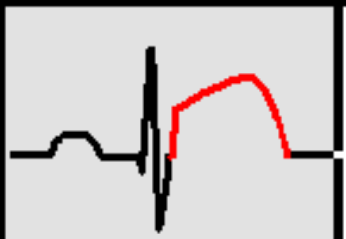
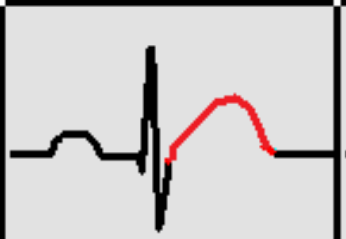
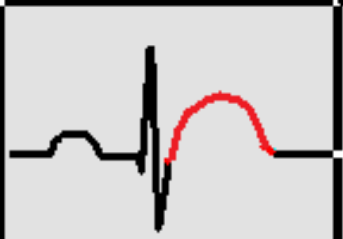
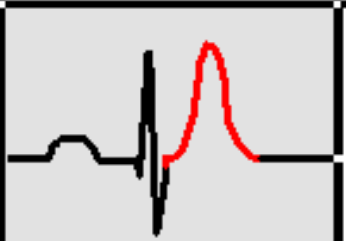
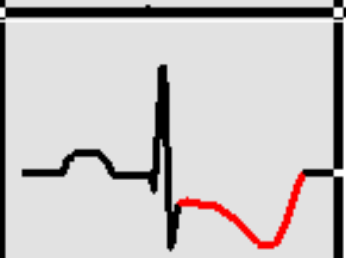
. . . And whenever the

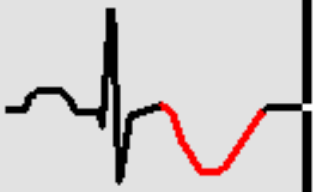
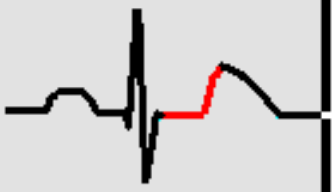
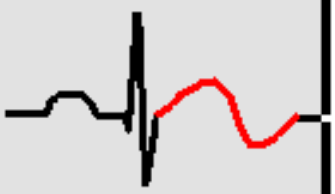
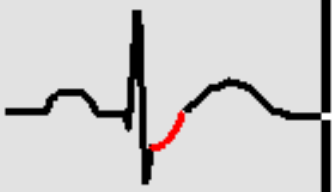
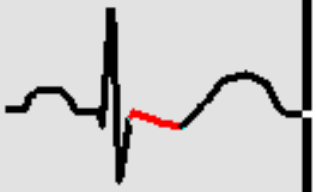
- J Points
- ST-Segments
- T Waves

are ***ABNORMAL,*** *it can be an INDICATION of* ***ACUTE CORONARY SYNDROME !***

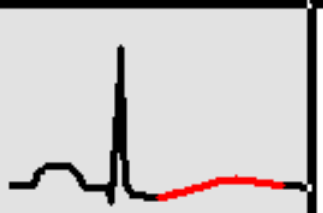
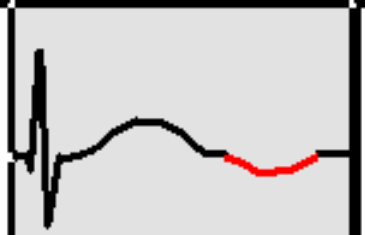
13 ECG PATTERNS of ACS & ISCHEMIA

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

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

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

Some less common, less reliable possible indicators of ACS:

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

A ***CRITICAL INDICATOR***

of

worsening ischemia

and/or

EARLY INFARCTION

is

DYNAMIC CHANGES

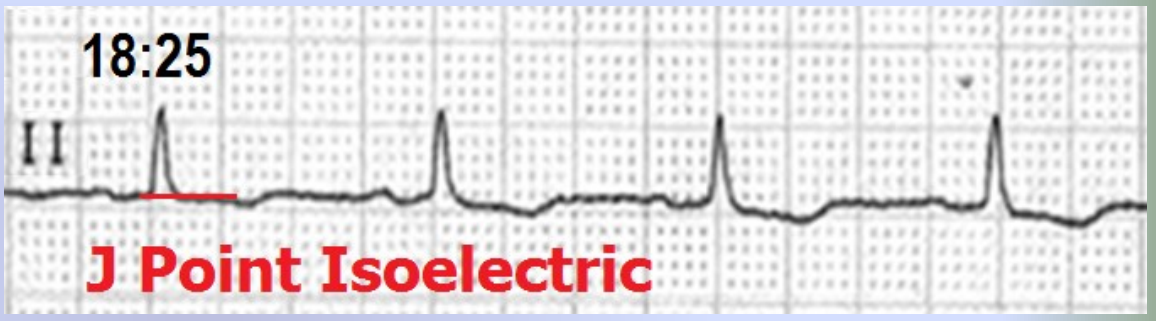
to the patient's

J Points, ST-Segments and T Waves.

Dynamic ST-T wave changes . . .

Potential Issues ?

1. Progressive Inferior ischemia



2. NSTEMI

3. Reciprocal ST Changes from Anterior STEMI

What should you do ??

- **STAT patient evaluation !**
  - **Are there any symptoms now present?**
  - **Changes in prior symptoms?**
- **Get a STAT 12 Lead ECG !**

What should you do ??

- **STAT patient evaluation !**
  - **Are there any symptoms now present?**
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- **Get a STAT 12 Lead ECG !**
- ***And compare it to previous 12 Lead ECG(s) !!***

Indications for Continuous ST-Segment Monitoring:

- **Patients with known or suspected ACS / ischemia**

Indications for Continuous ST-Segment Monitoring:

- Patients with known or suspected ACS / ischemia
- Patients who have just undergone Percutaneous Coronary Intervention (PCI)

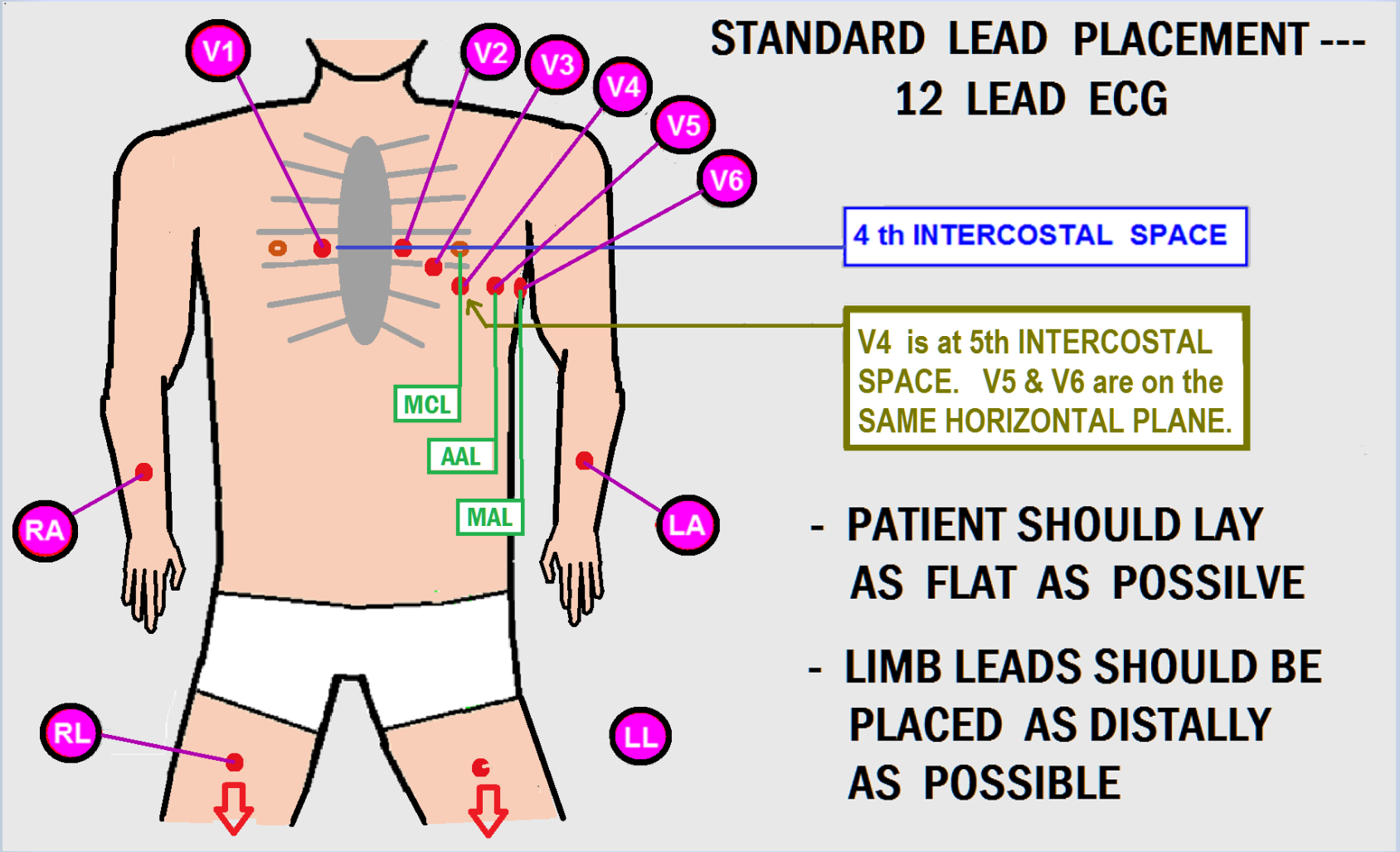
Indications for Continuous ST-Segment Monitoring:

- Patients with known or suspected ACS / ischemia
- Patients who have just undergone Percutaneous Coronary Intervention (PCI)
  - IN STENT THROMBUS
  - CORONARY ARTERY DISSECTION (“Edge Dissection”)

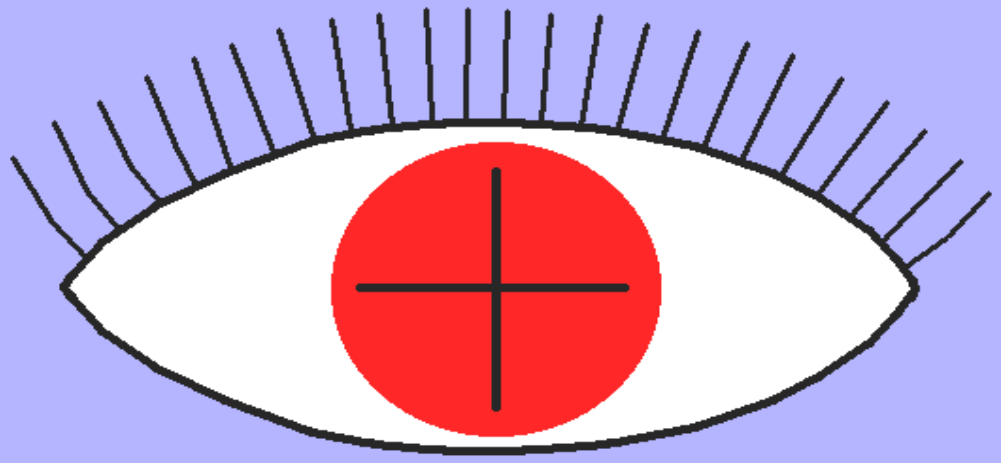
Determining the appropriate ECG Lead(s) for Continuous ST-Segment Monitoring:

- Obtain and interpret the 12 Lead ECG:

Locations of Positive Electrodes



THE POSITIVE ELECTRODE



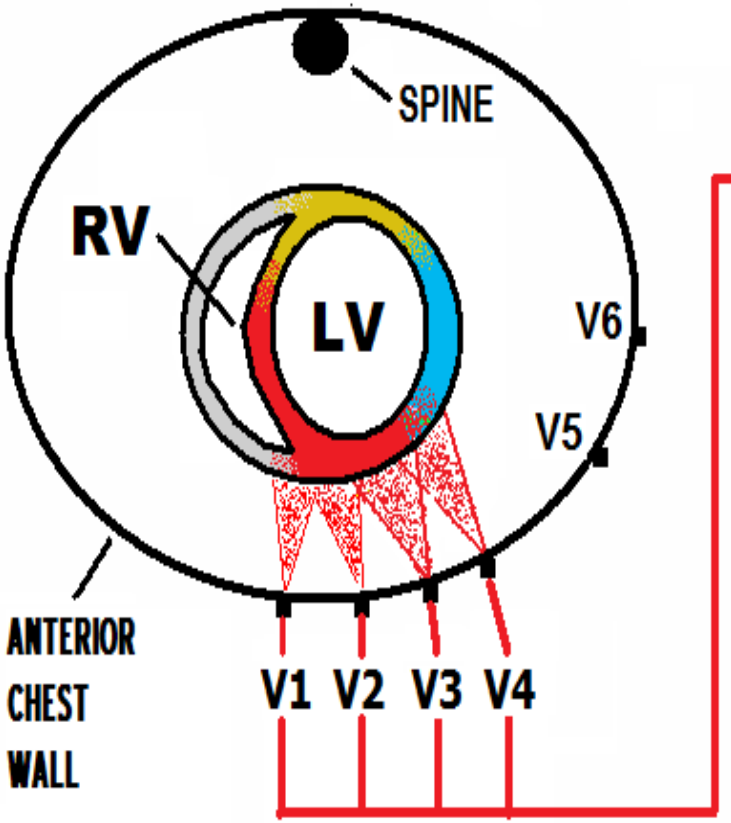
IS THE "EYE" . . .

Wherever it's positioned on the body, that's the perspective of the heart it's seeing . . . .

Which Lead(s)
on the
12 Lead ECG
shows *the most profound*
ABNORMAL
- J Points
- ST-Segments
- T Waves
???

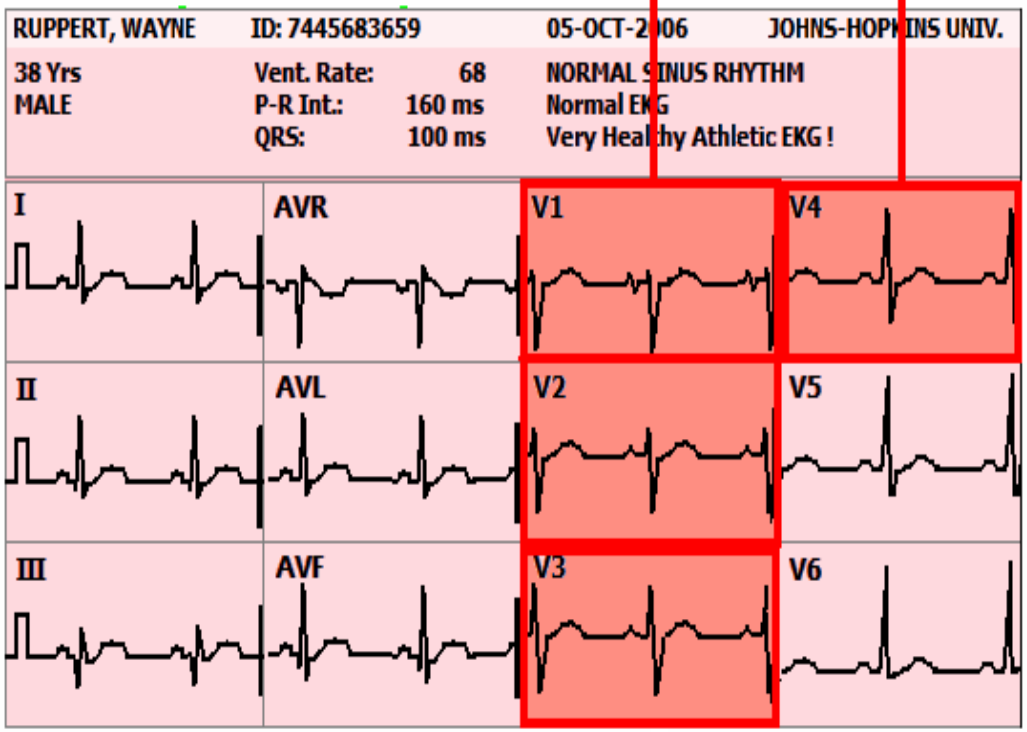
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE

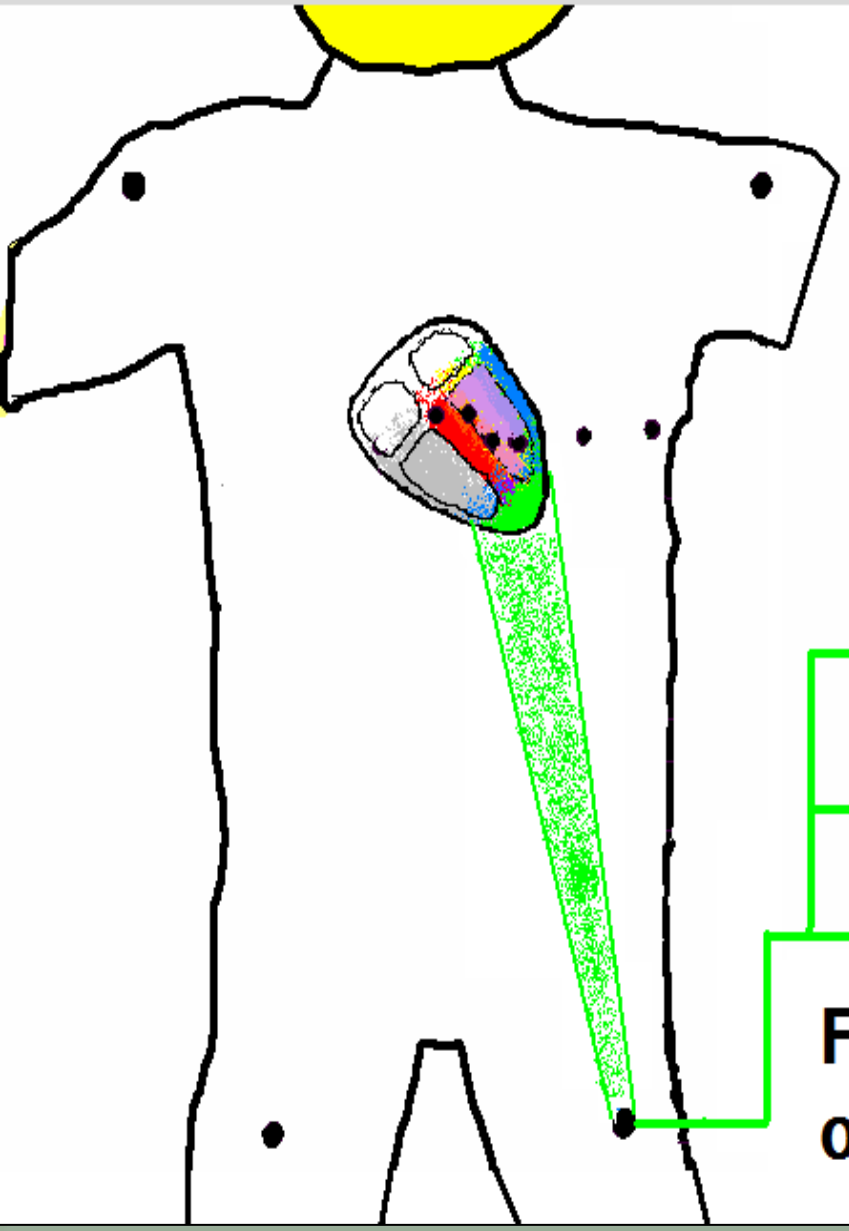


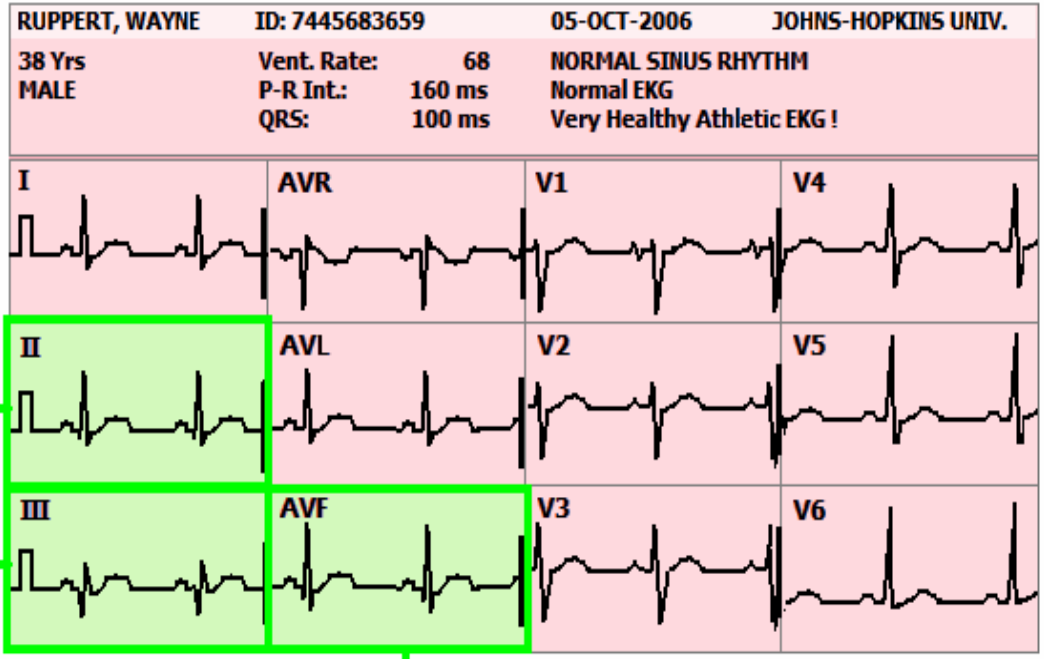
V1, V2 - ANTERIOR / SEPTAL

V3, V4 - ANTERIOR



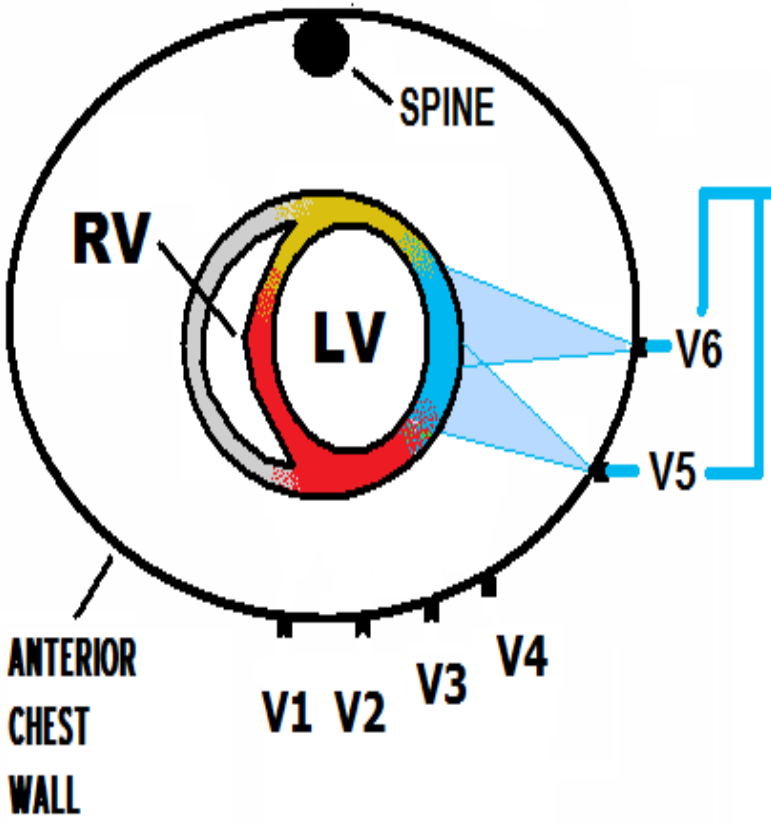
LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE

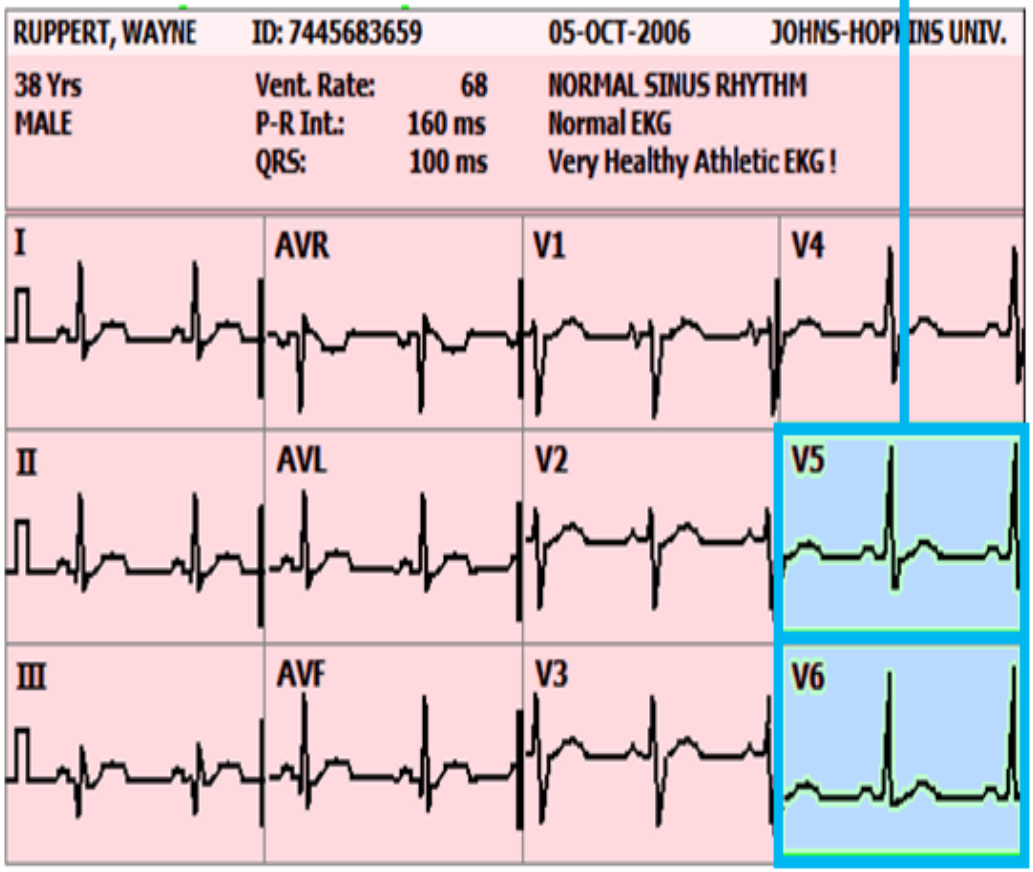




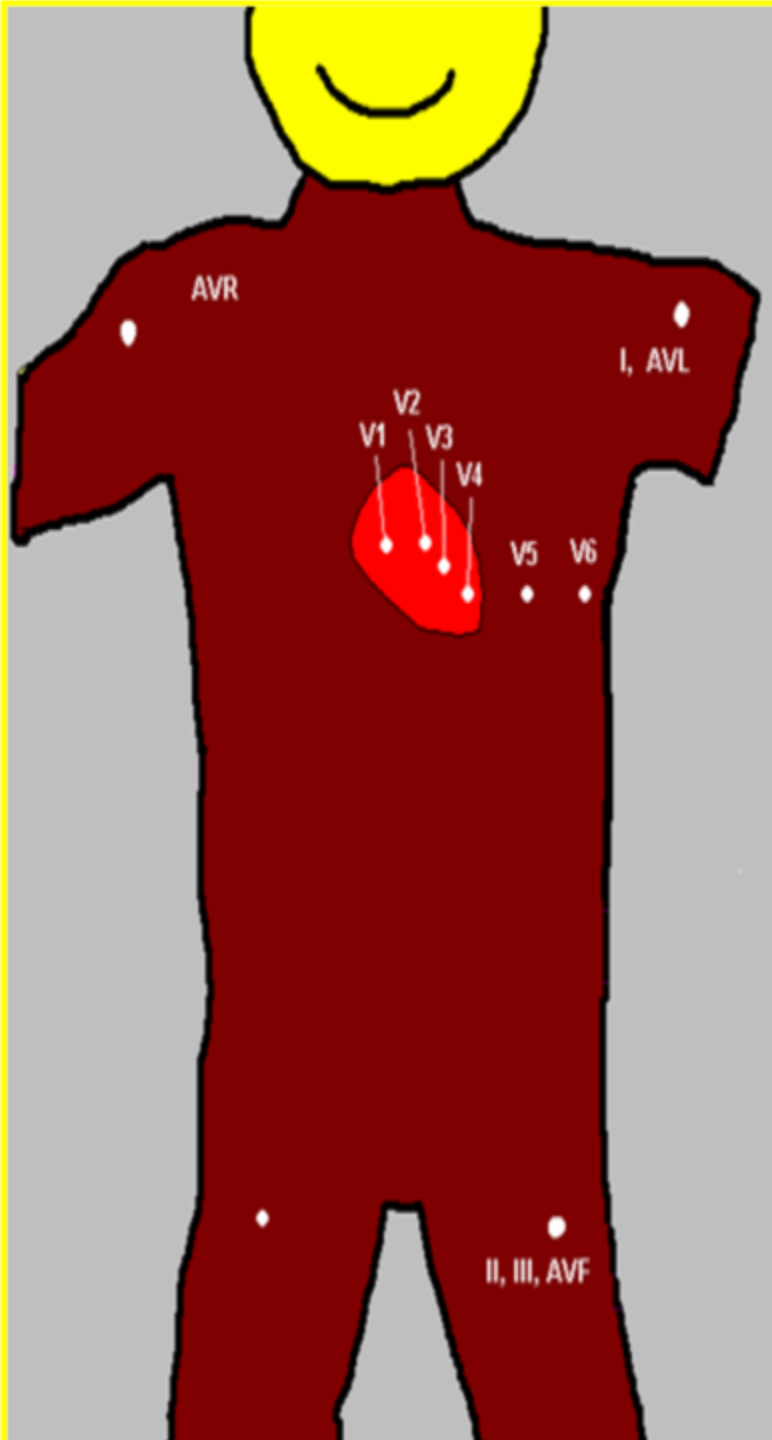
FED by the RCA (75 - 80 % pop)
or the CIRCUMFLEX (10 - 15 %)

V5 - V6 VIEW THE LATERAL WALL
of the LEFT VENTRICLE

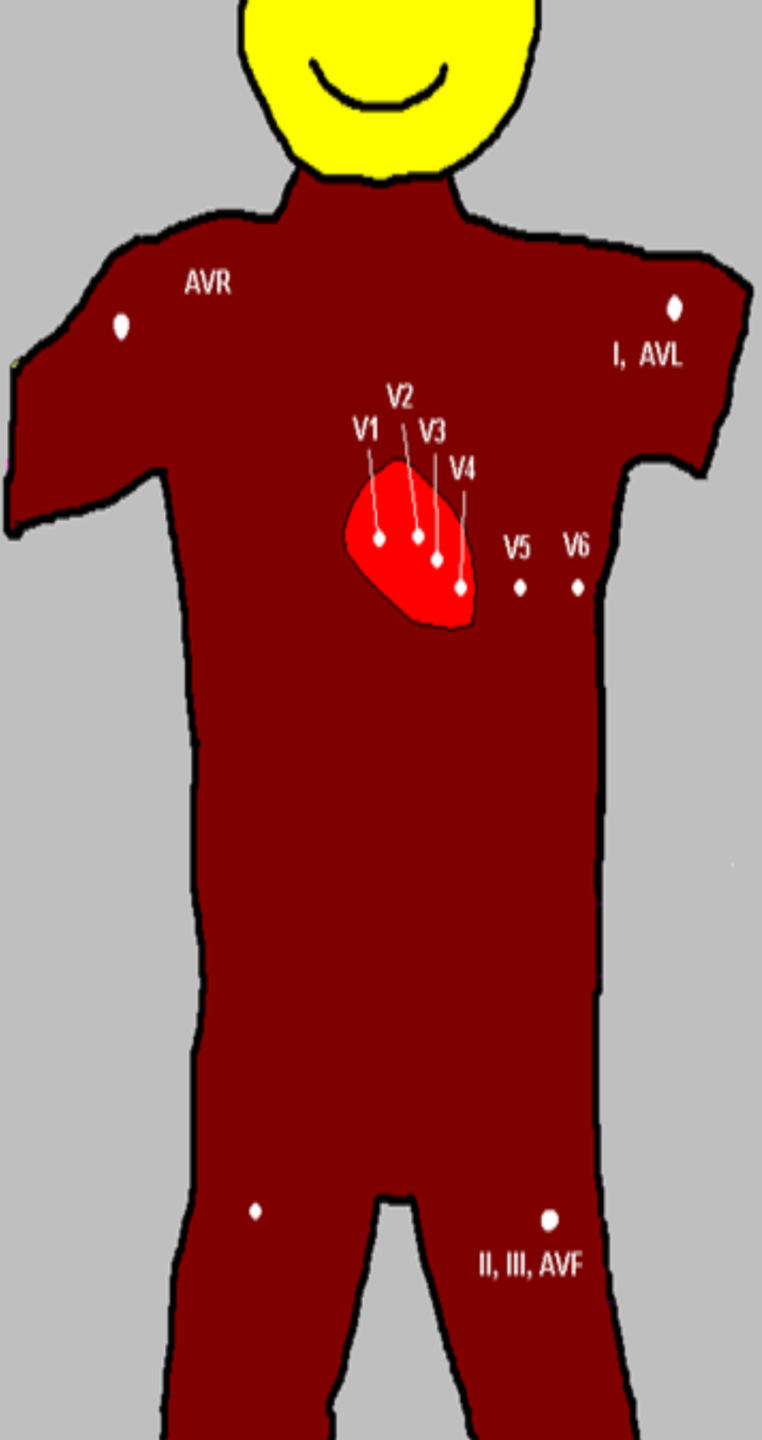




AREAS VIEWED by 12 LEAD ECG



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



AREAS VIEWED by 12 LEAD ECG + TYPICAL CORONARY ARTERIAL DISTRIBUTION

AVR	*BASILAR SEPTAL*	→	1st SEPTAL PERFORATOR
AVL, I	LATERAL ANTERIOR	→	1st DIAGONAL or RAMUS or 1st OBTUSE MARGINAL
V1, V2	ANTERIOR	→	LEFT ANTERIOR DESCENDING
	SEPTAL	→	LEFT ANTERIOR DESCENDING
	POSTERIOR (recip.)	→	POSTERIOR LATERAL VESSELS
V3, V4	ANTERIOR	→	LEFT ANTERIOR DESCENDING
V5, V6	LATERAL	→	CIRCUMFLEX
II, III, AVF	INFERIOR	→	RIGHT CORONARY ARTERY or CIRCUMFLEX

Continuous ST monitoring

- **Ideal condition: your unit has the capability for continuous monitoring of all 12 leads.**

Continuous ST monitoring

- **Ideal condition: your unit has the capability for continuous monitoring of all 12 leads.**
- **If your unit does not have continuous 12 lead monitoring capabilities, monitor the lead that demonstrates the highest degree of ischemic changes.**

Units WITH continuous 12 Lead monitoring capabilities:

- **Obtain baseline ECG**

Units WITH continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
- Continuously monitor all 12 Leads for signs of progressing ischemia / early infarction.

Units WITHOUT continuous 12 Lead monitoring capabilities:

- **Obtain baseline ECG**

Units WITHOUT continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
- Identify ECG lead(s) showing most profound J Point, ST-Segment and T Wave abnormalities.

Units WITHOUT continuous 12 Lead monitoring capabilities:

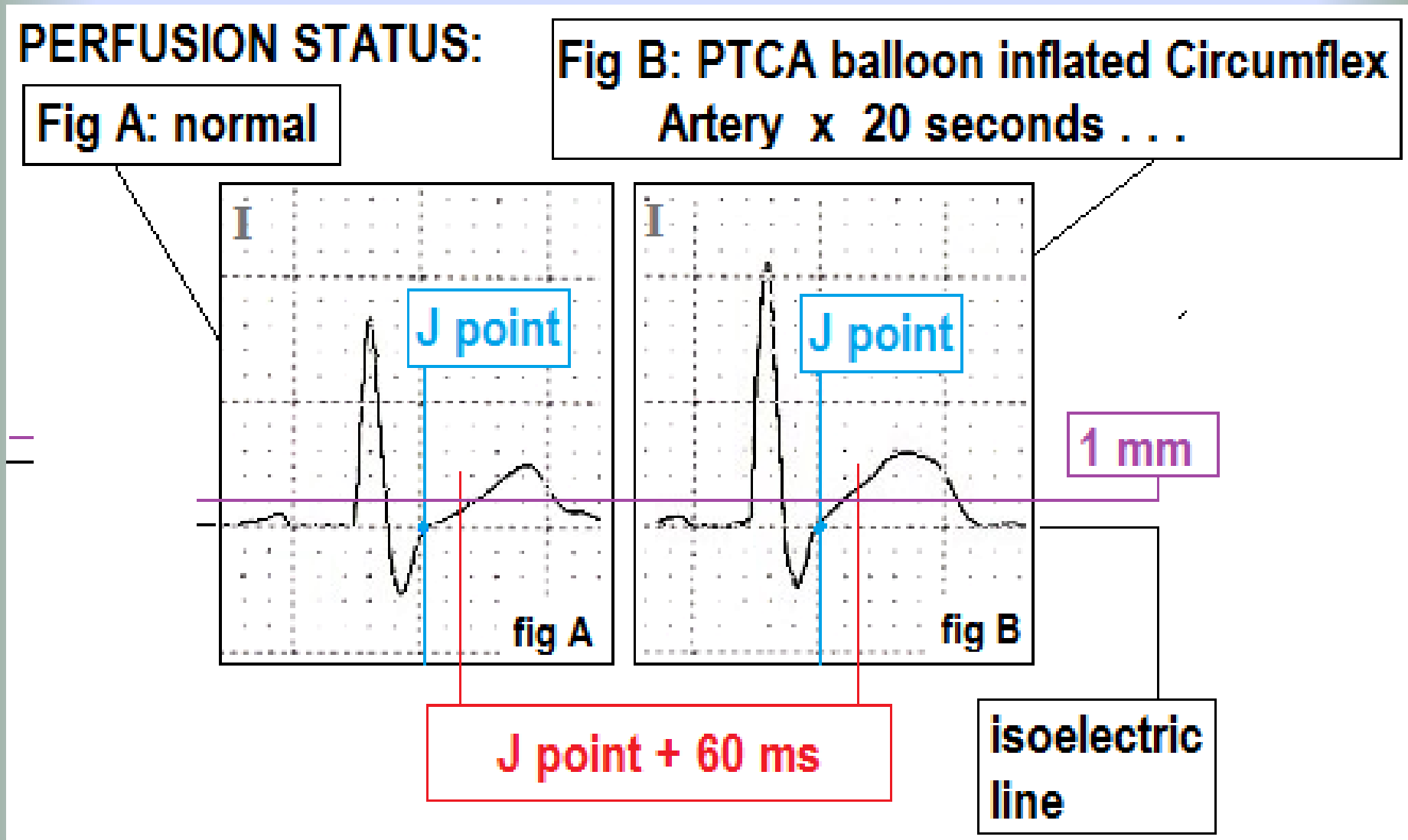
- Obtain baseline ECG
- Identify ECG lead(s) showing most profound J Point, ST-Segment and T Wave abnormalities.
- Select the leads identified in the above step as the lead(s) for continuous monitoring.

Automated ST-Segment Monitoring Systems – MEASUREMENT:

Vary based on manufacturer. Multiple recent evidence-based papers recommend:

- **J Point + 60ms** (1.5mm on ECG recorded at standard 25mm/sec speed).

J point + 60ms detects ST-segment shift when J Point remains isoelectric



Automated ST-Segment Monitoring Systems – MEASUREMENT:

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- More accurate method, compensates for heart rate variation: **J Point + 1/16 R-R Interval**

Automated ST-Segment Monitoring Systems – MEASUREMENT:

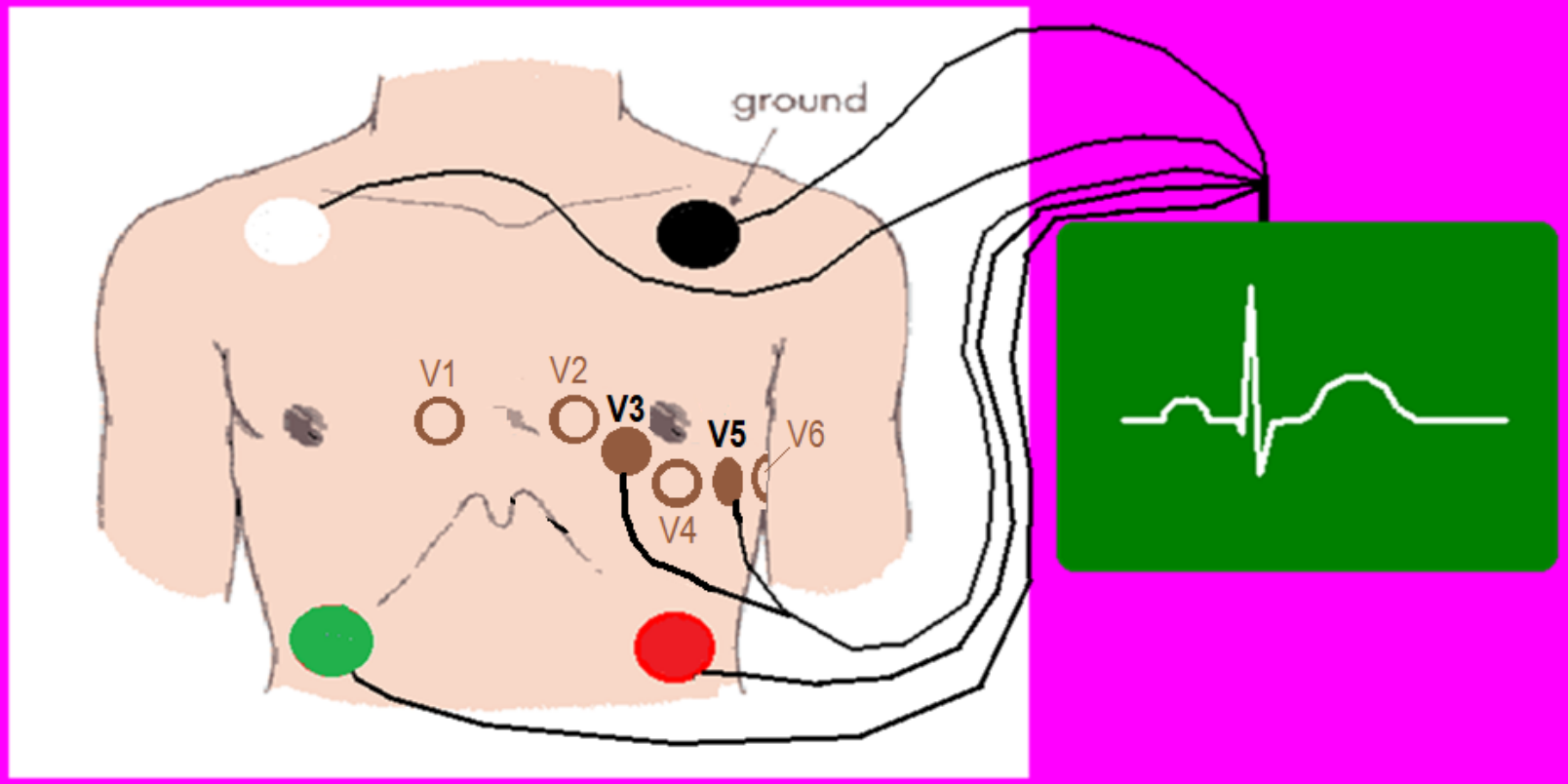
Vary based on manufacturer. Multiple recent evidence-based papers recommend:

- **J Point + 60ms** (1.5mm on ECG recorded at standard 25mm/sec speed).
- More accurate method, compensates for heart rate variation: **J Point + 1/16 R-R Interval**
- **Set to alarm 1 mm (0.1mv) above patient's baseline ST-segment measurement.**

5 Lead Tele System

- White lead – Right Shoulder
- Black lead – Left Shoulder
- Red lead – Left Lower Chest / Abdomen
- Green lead – Right Lower Chest / Abdomen
- Brown (chest) lead: V3 or V5 position (to be determined by 12 Lead ECG findings).

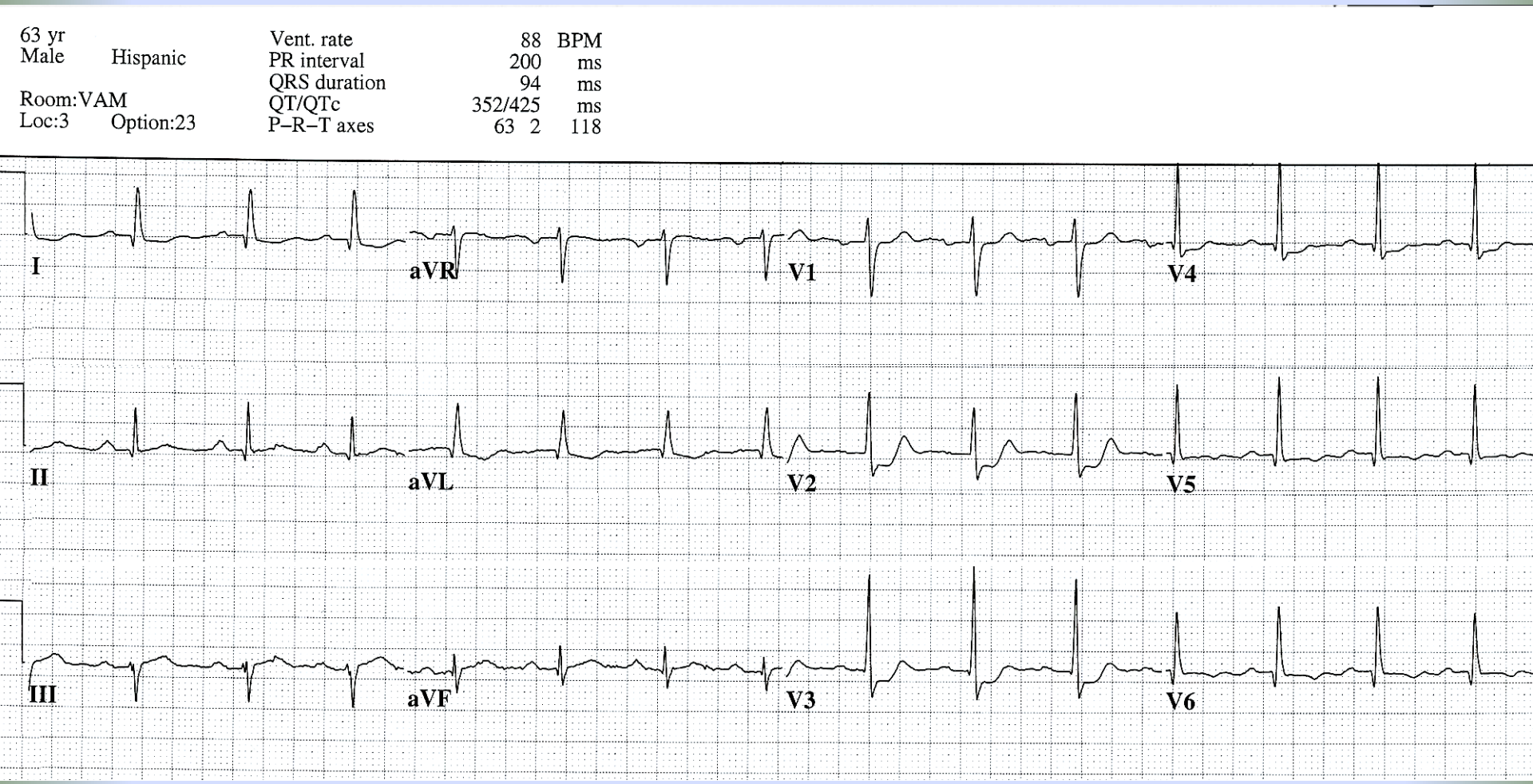
LEAD PLACEMENT



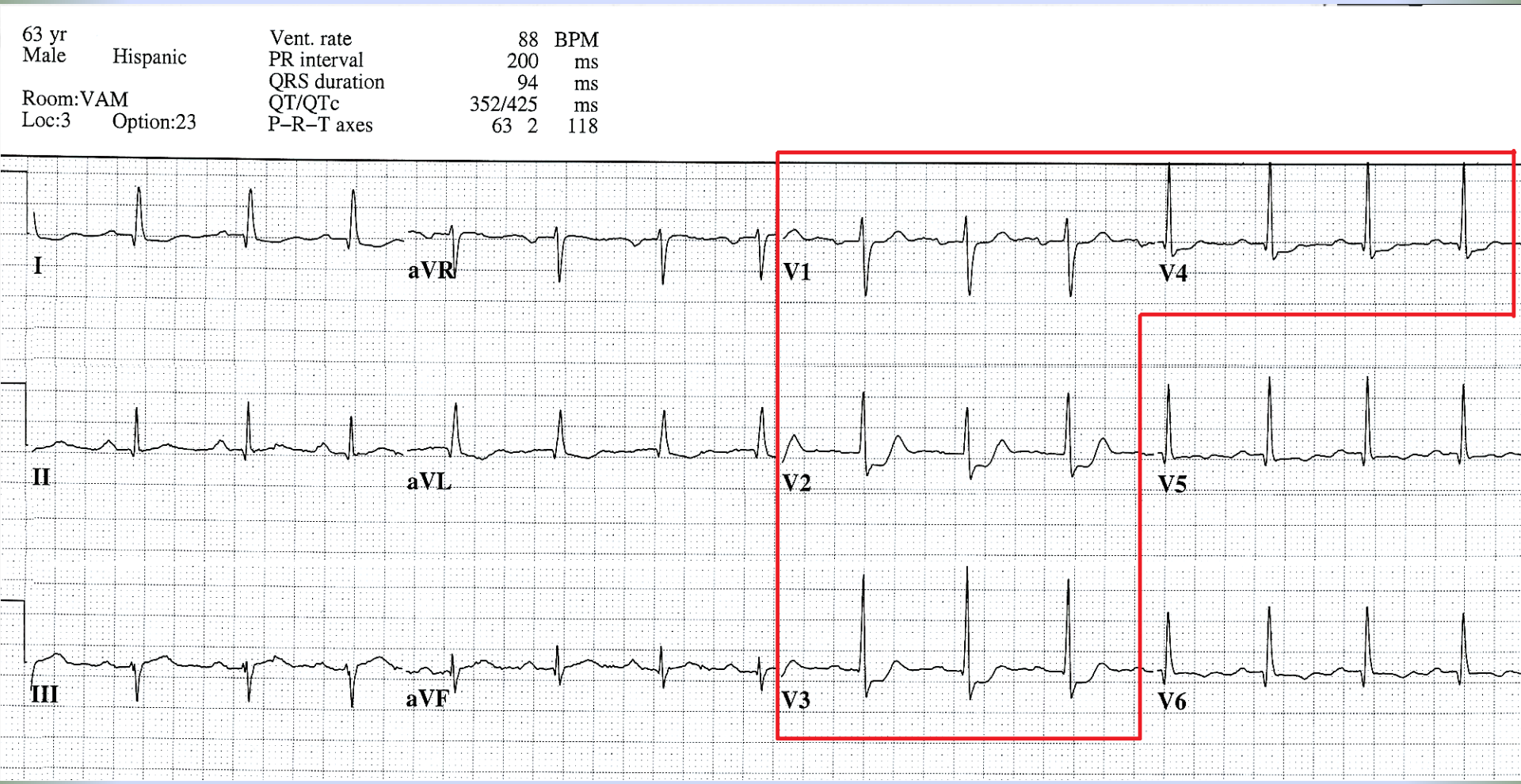
5 WIRE TELEMETRY UNIT

Let’s Practice . . . .

What leads show signs of possible ACS?

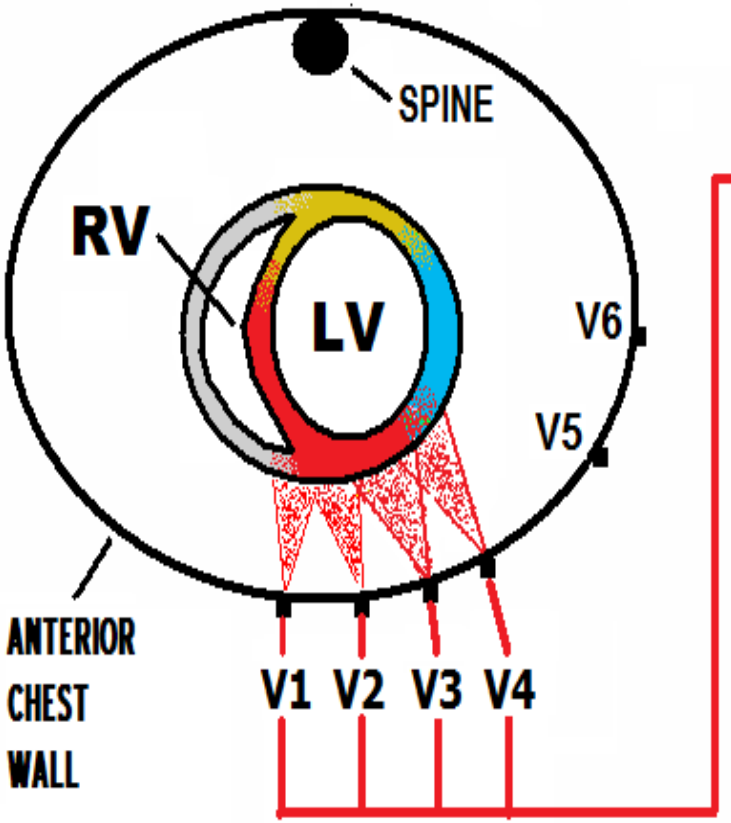


12 Lead ECG
shows ISCHEMIC CHANGES Anterior Wall:



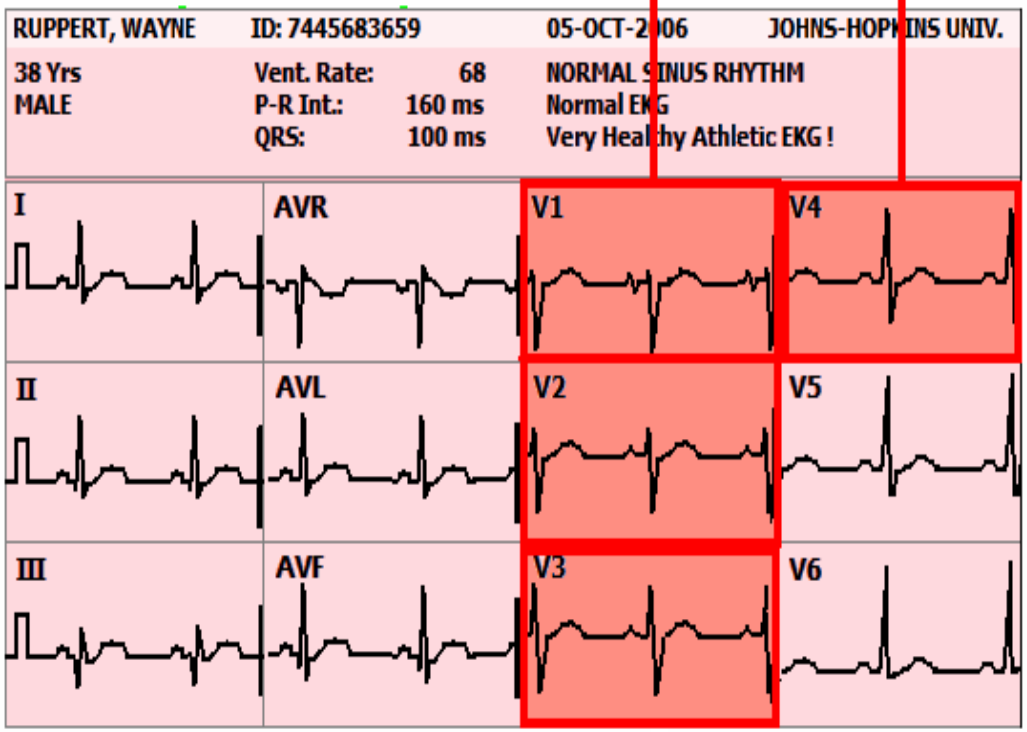
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE

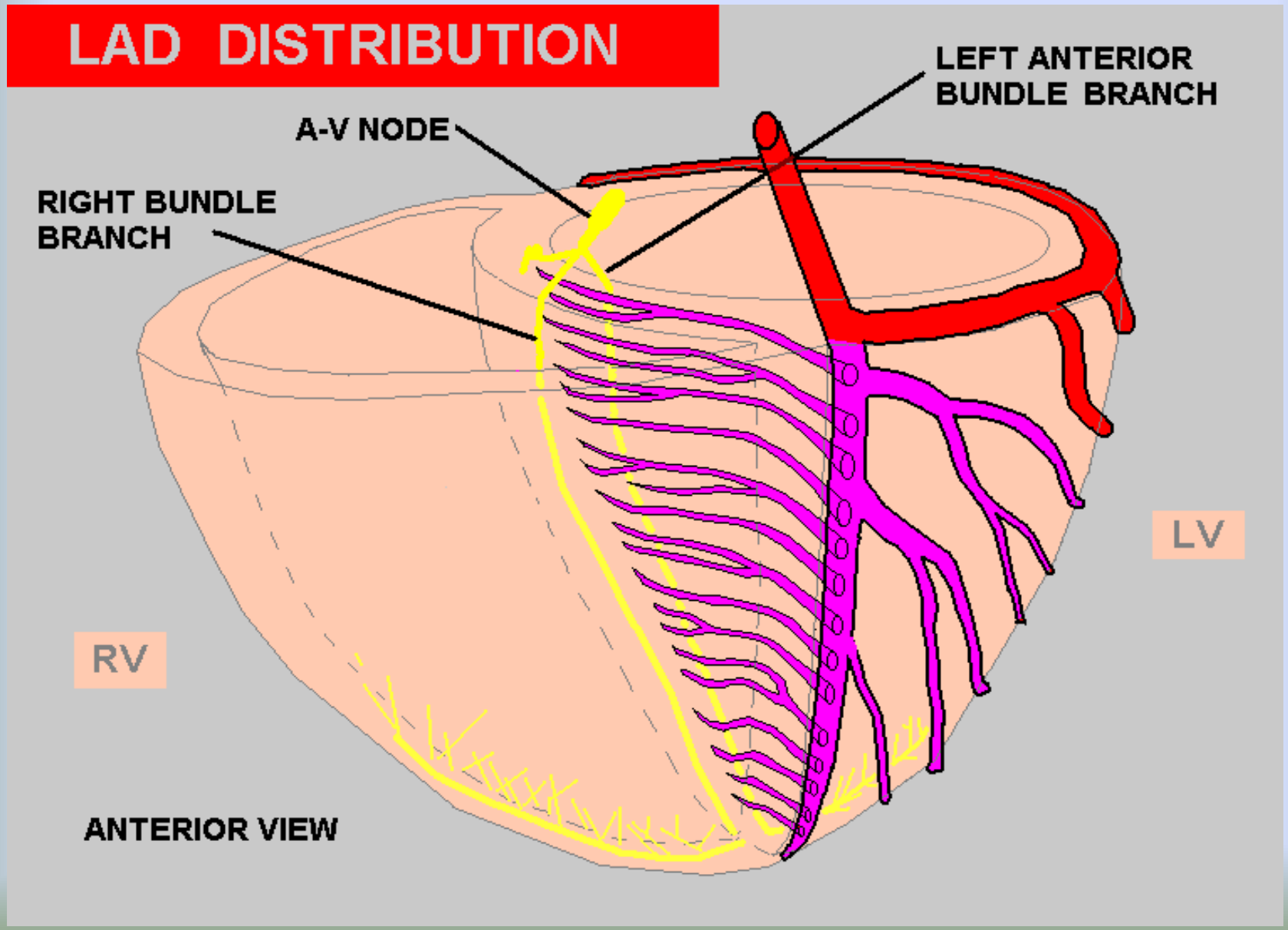


V1, V2 - ANTERIOR / SEPTAL

V3, V4 - ANTERIOR



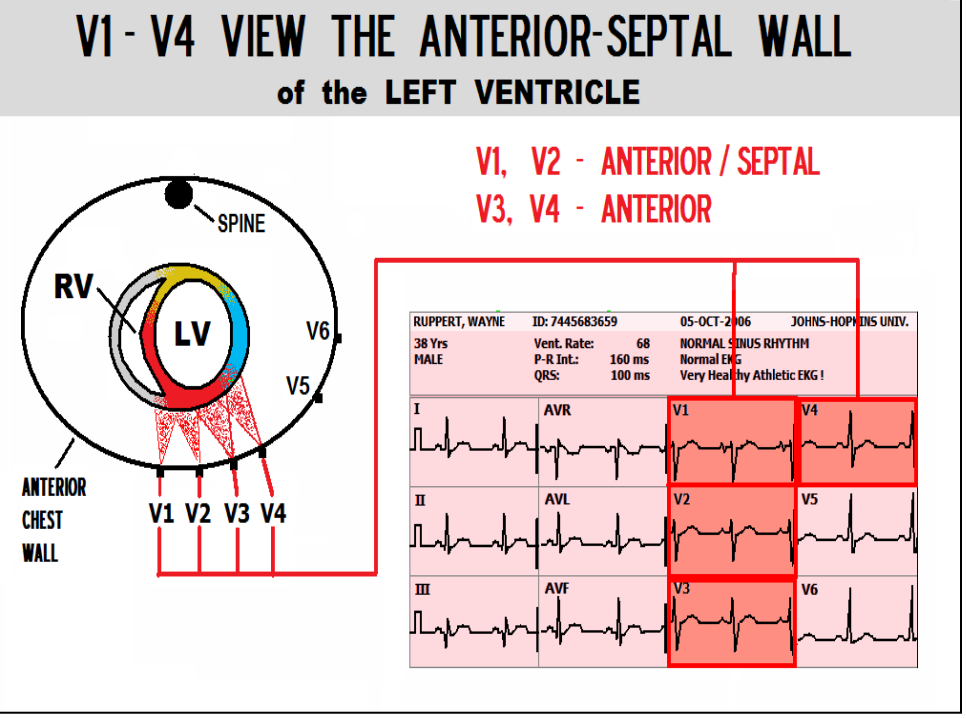
Left Anterior Descending Artery (LAD) provides ANTERIOR WALL blood supply

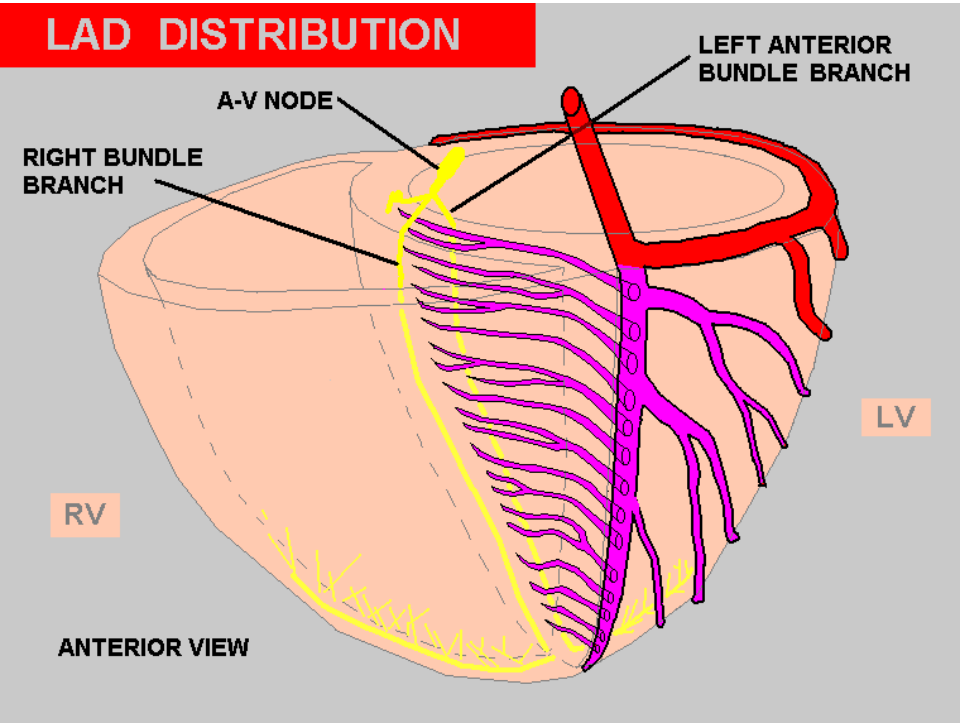


POST – PCI of the LAD or DIAGONAL BRANCHES:

Monitor Lead V3 for ST changes resulting from compromised blood flow due to:

- Acute STENT Thrombus
- STENT induced CORONARY ARTERY DISSECTION.





Anterior Wall Ischemia / Post-PCI of Left Anterior Descending or Diagonal Artery:

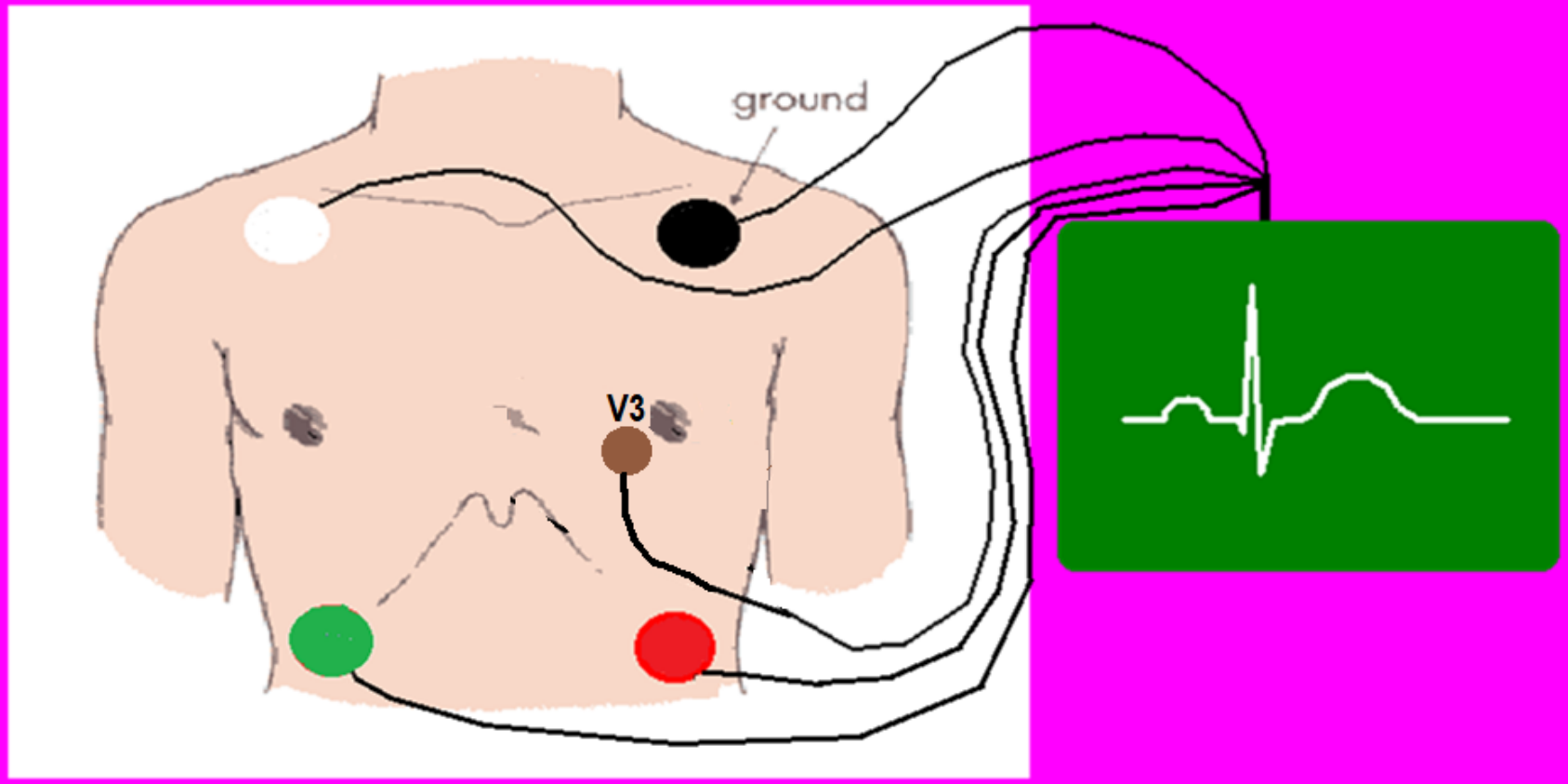
Monitor chest lead with most profound ST changes.

If there is no single lead with clearly the most degree of ST changes, MONITOR LEAD V3.

-12 LEAD ECG INDICATES:
ANTERIOR WALL ISCHEMIA / INFARCTION

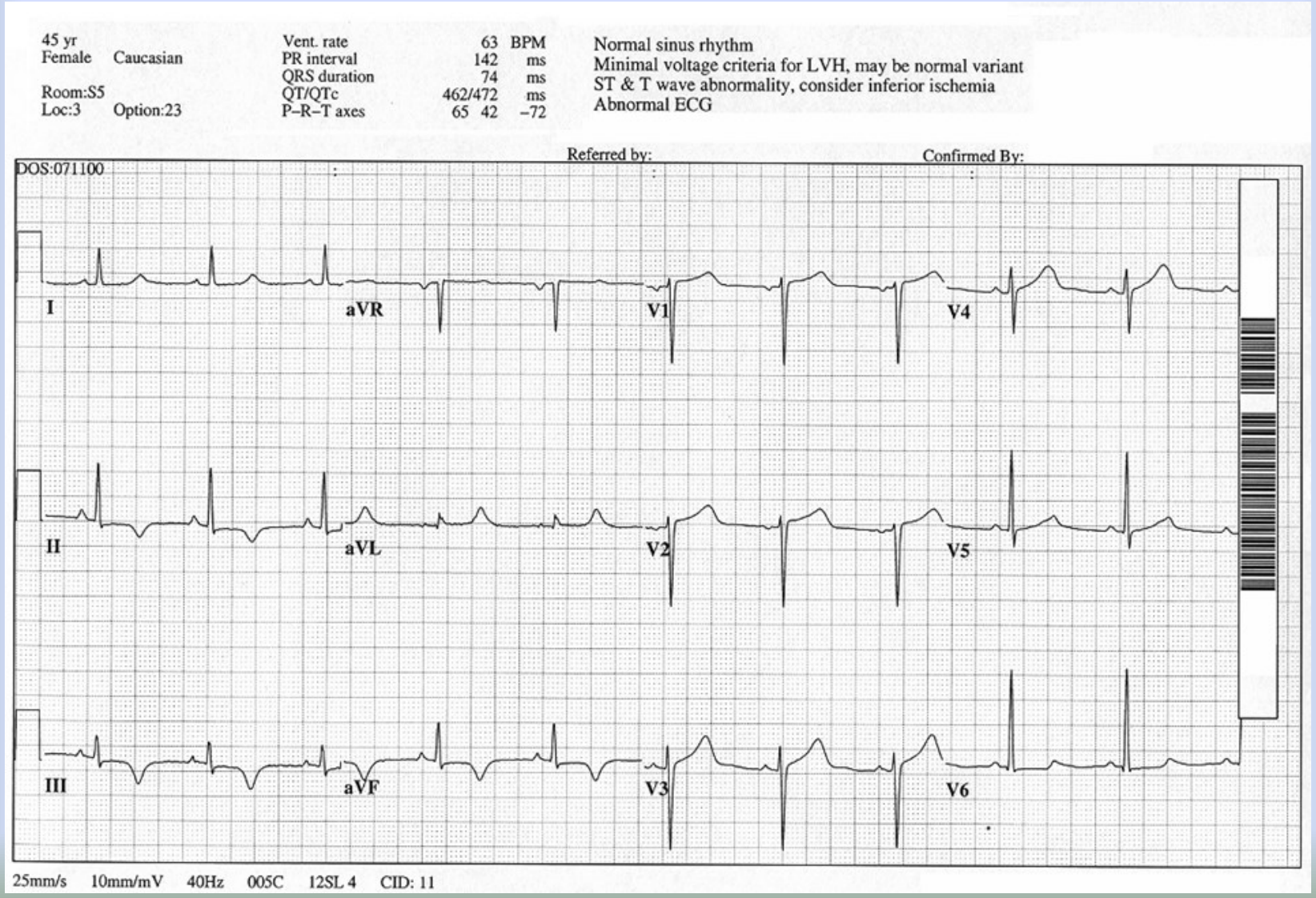
-PCI / STENT TO LEFT ANTERIOR DESCENDING ARTERY (LAD)

LEAD PLACEMENT

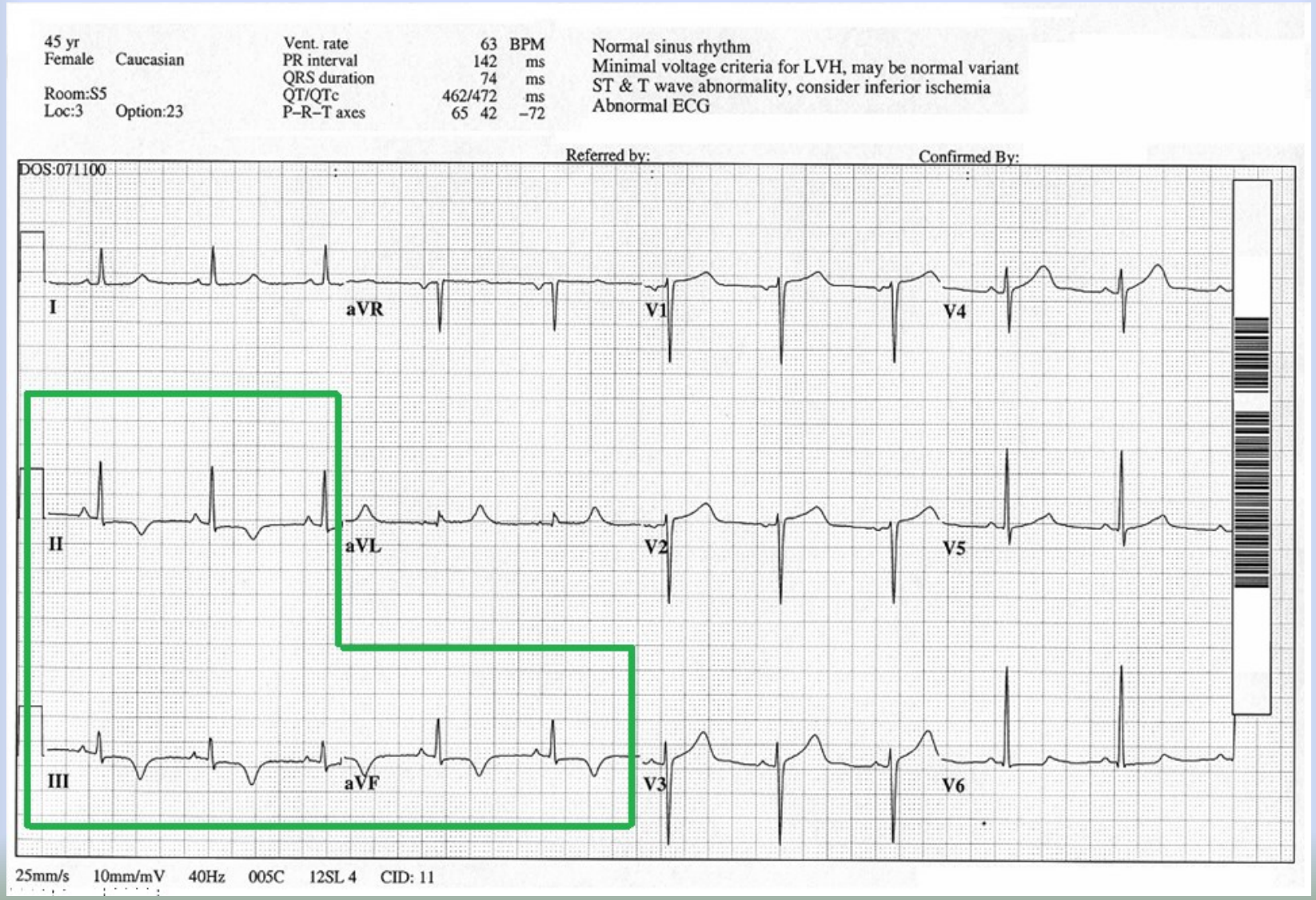


5 WIRE TELEMETRY UNIT

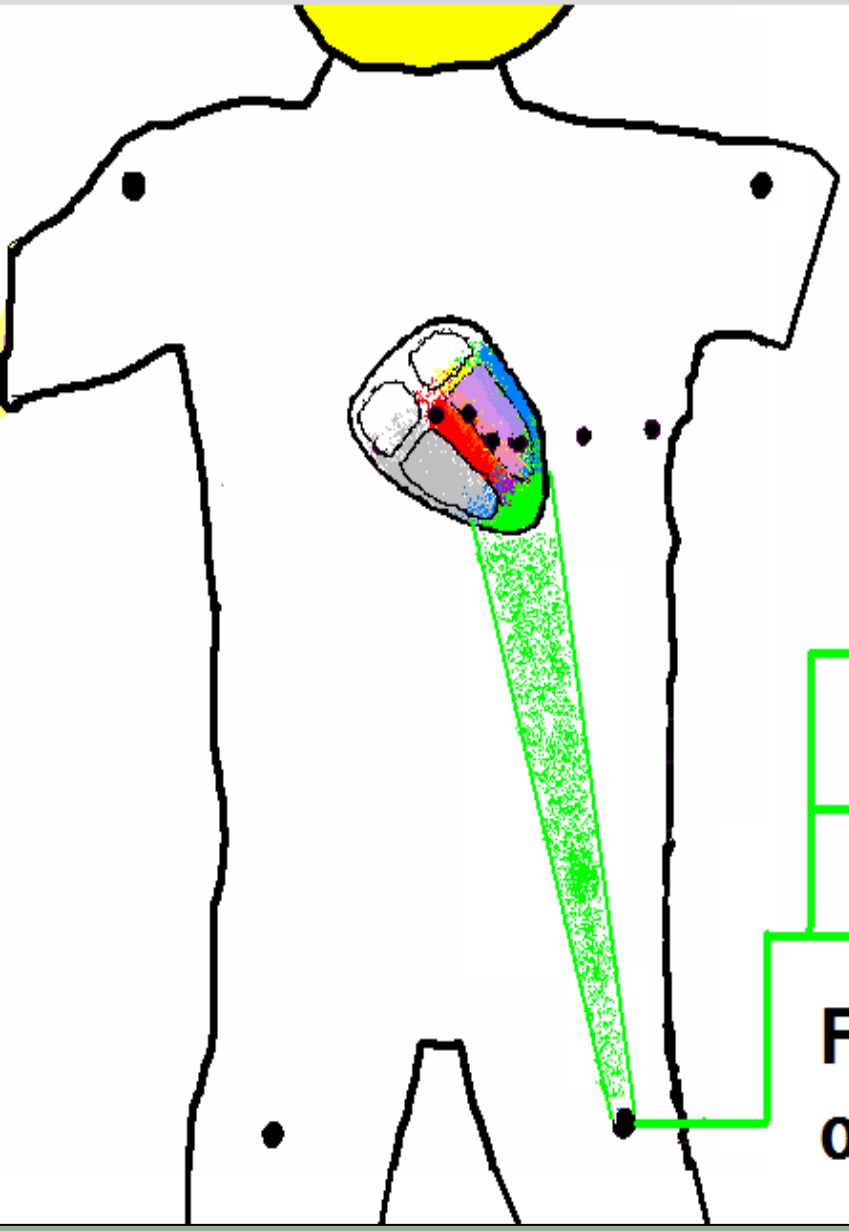
What leads show signs of possible ACS?

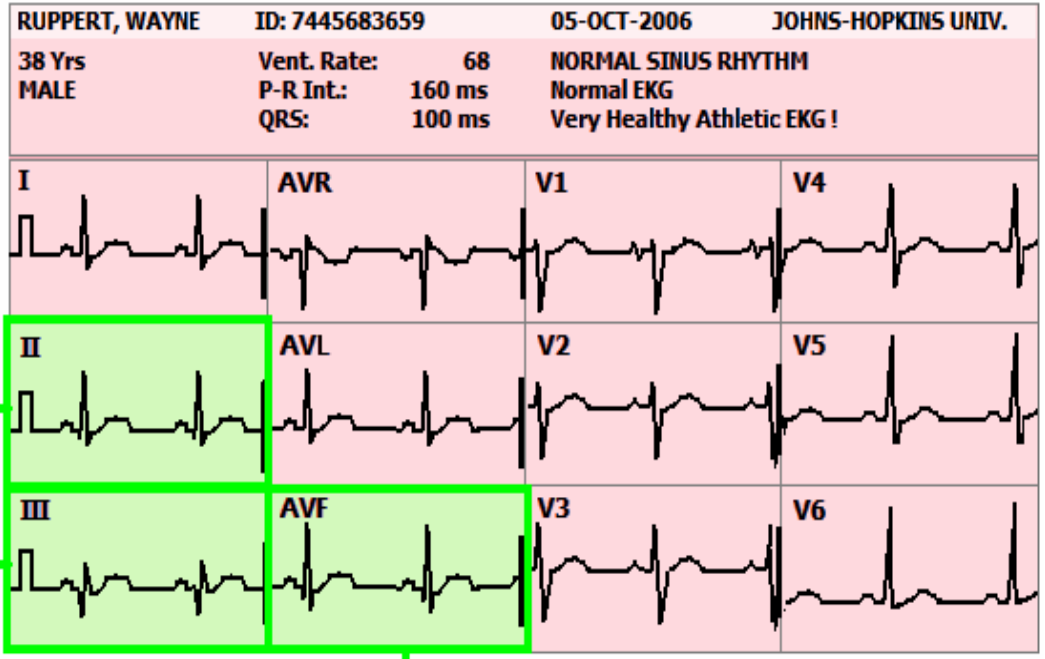


12 Lead ECG
shows ISCHEMIC CHANGES Inferior Wall:



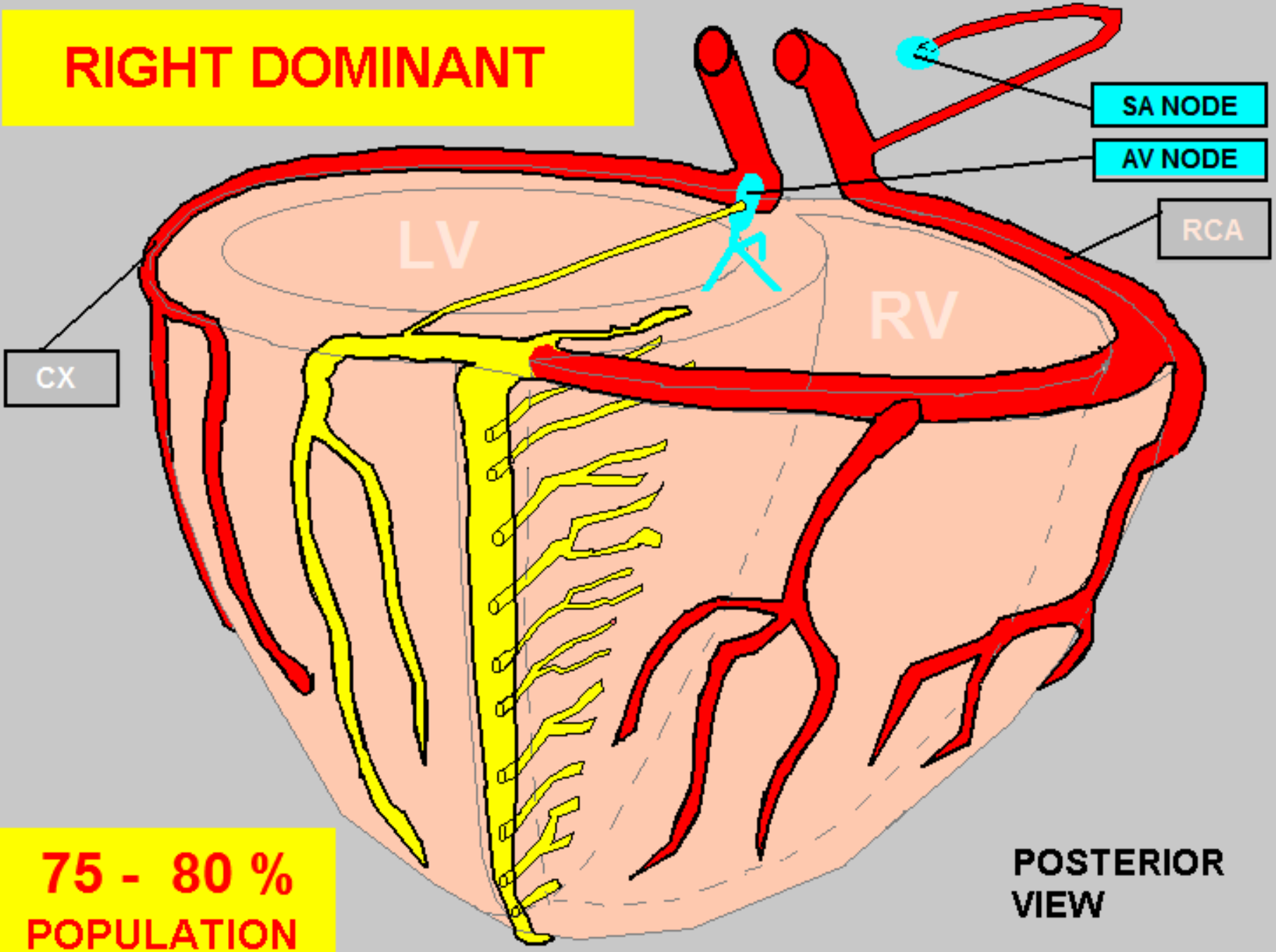
LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE





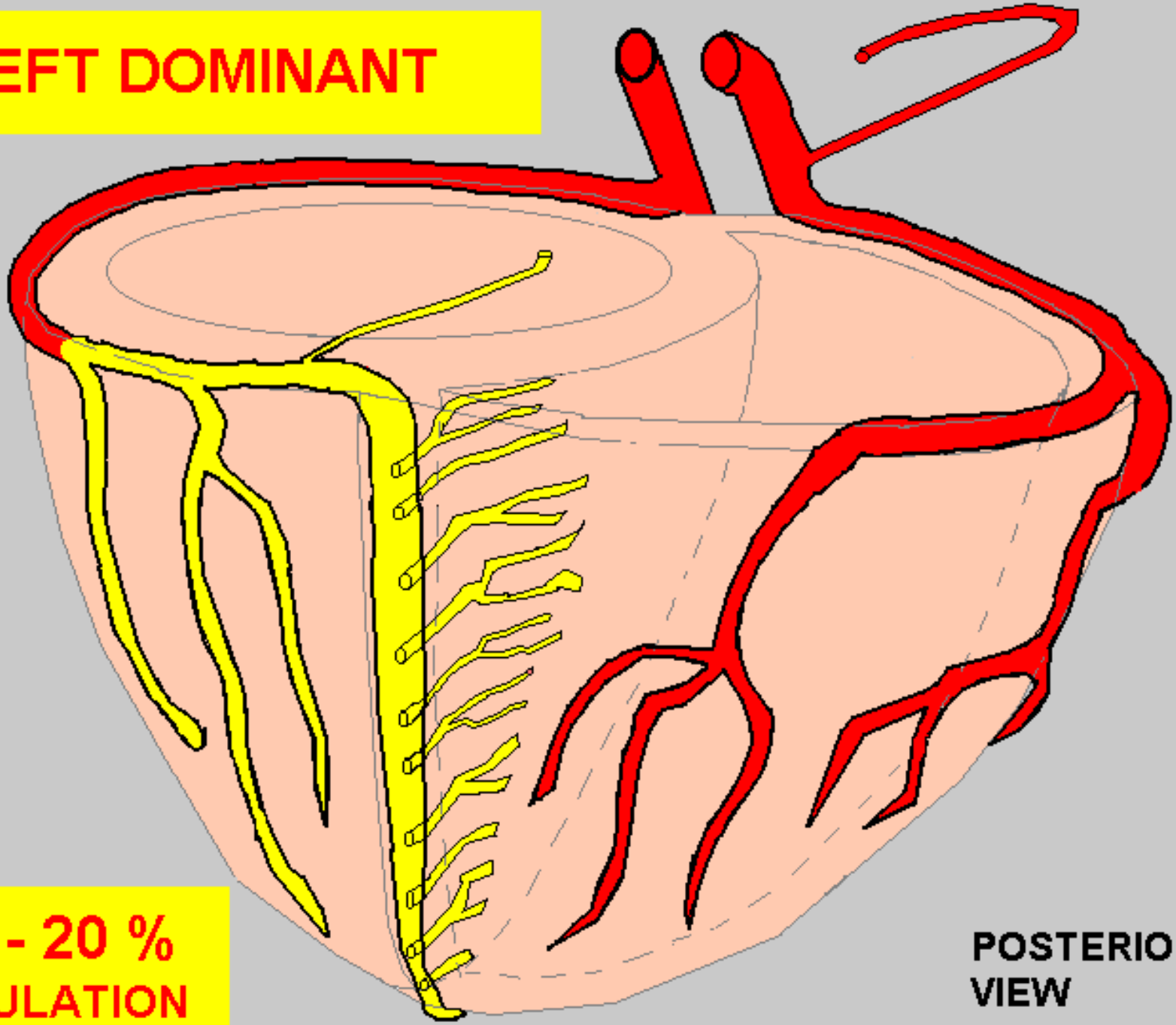
FED by the RCA (75 - 80 % pop)
or the CIRCUMFLEX (10 - 15 %)

RIGHT DOMINANT



75 - 80 %
POPULATION

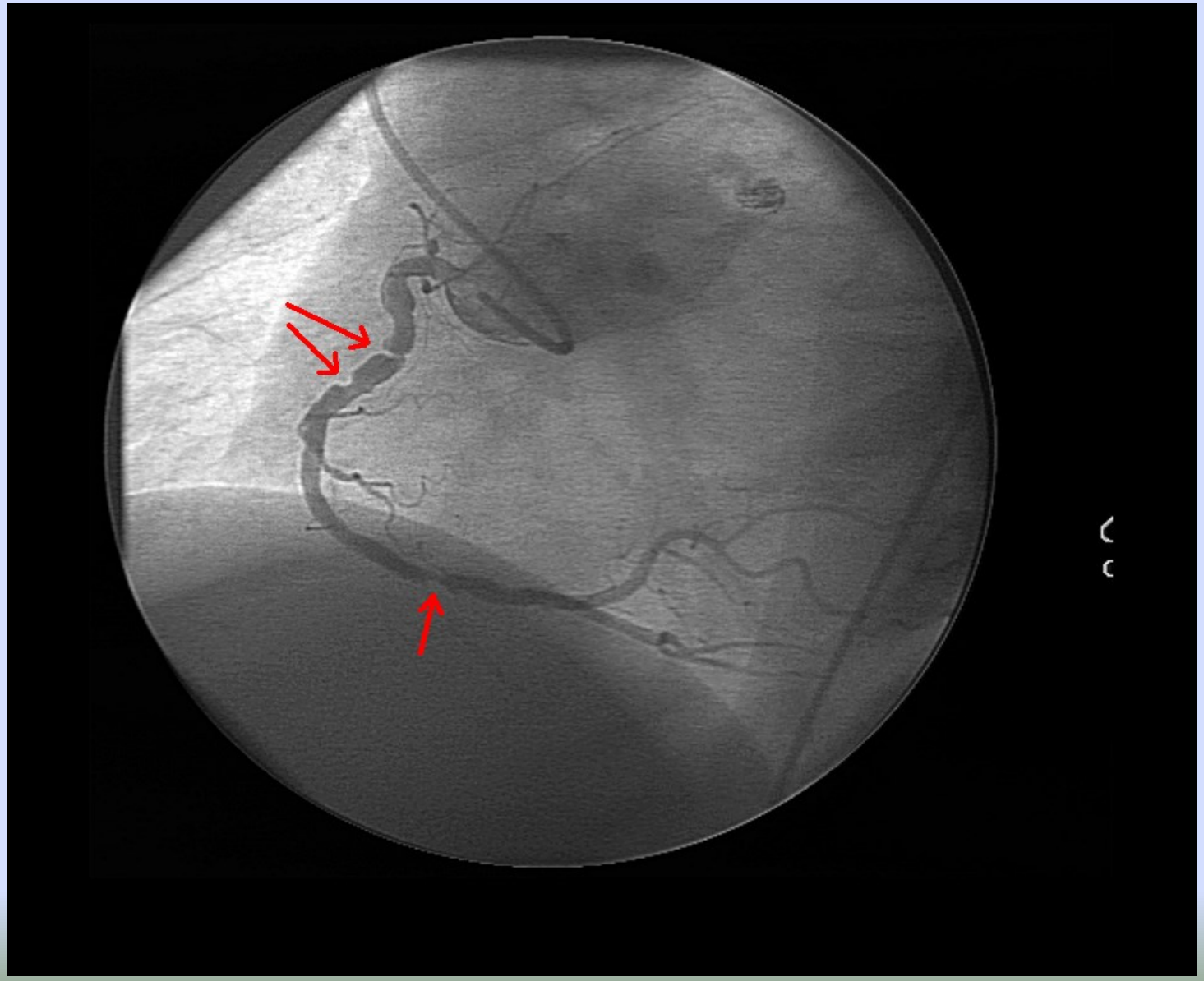
LEFT DOMINANT



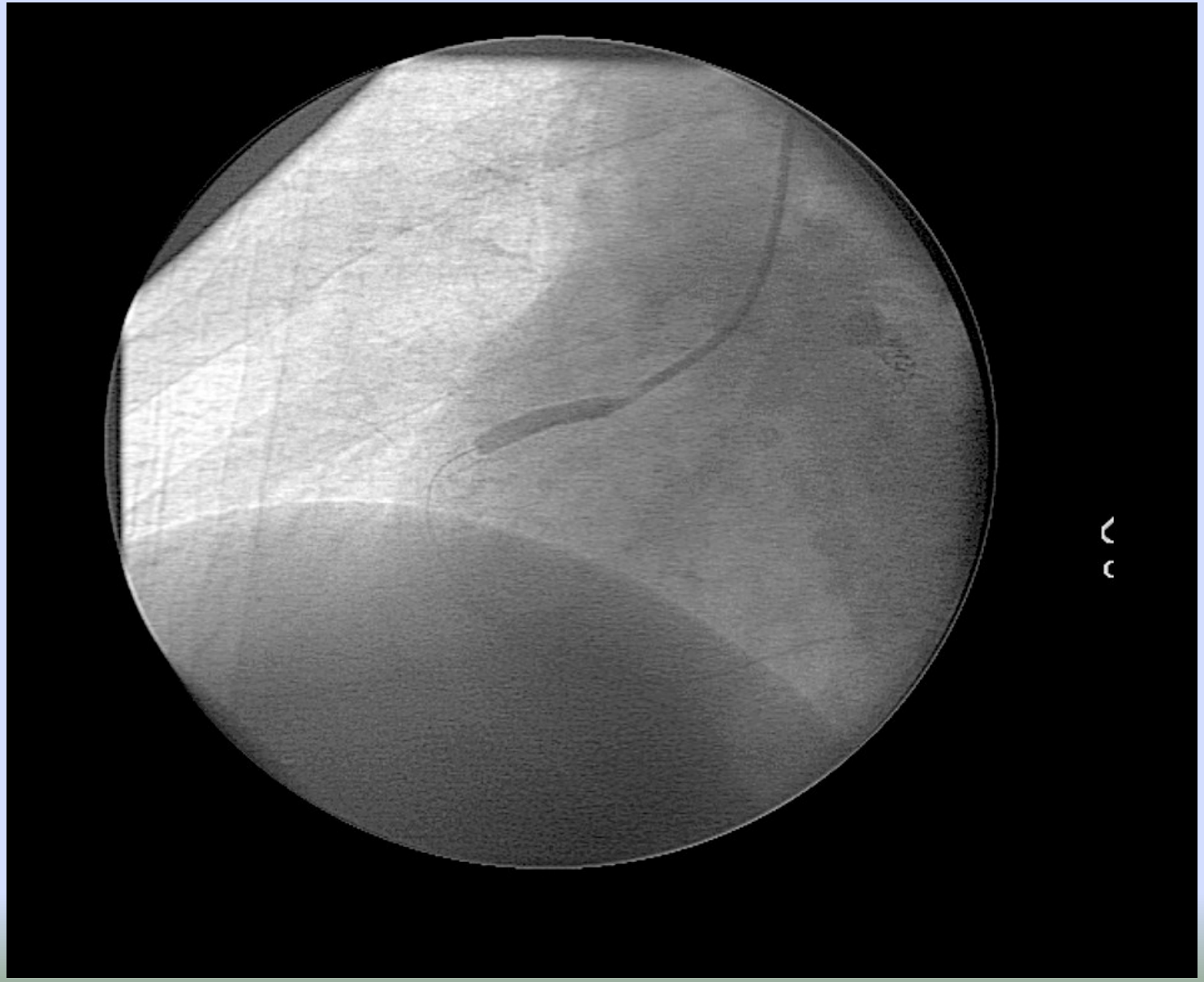
15 - 20 %
POPULATION

POSTERIOR
VIEW

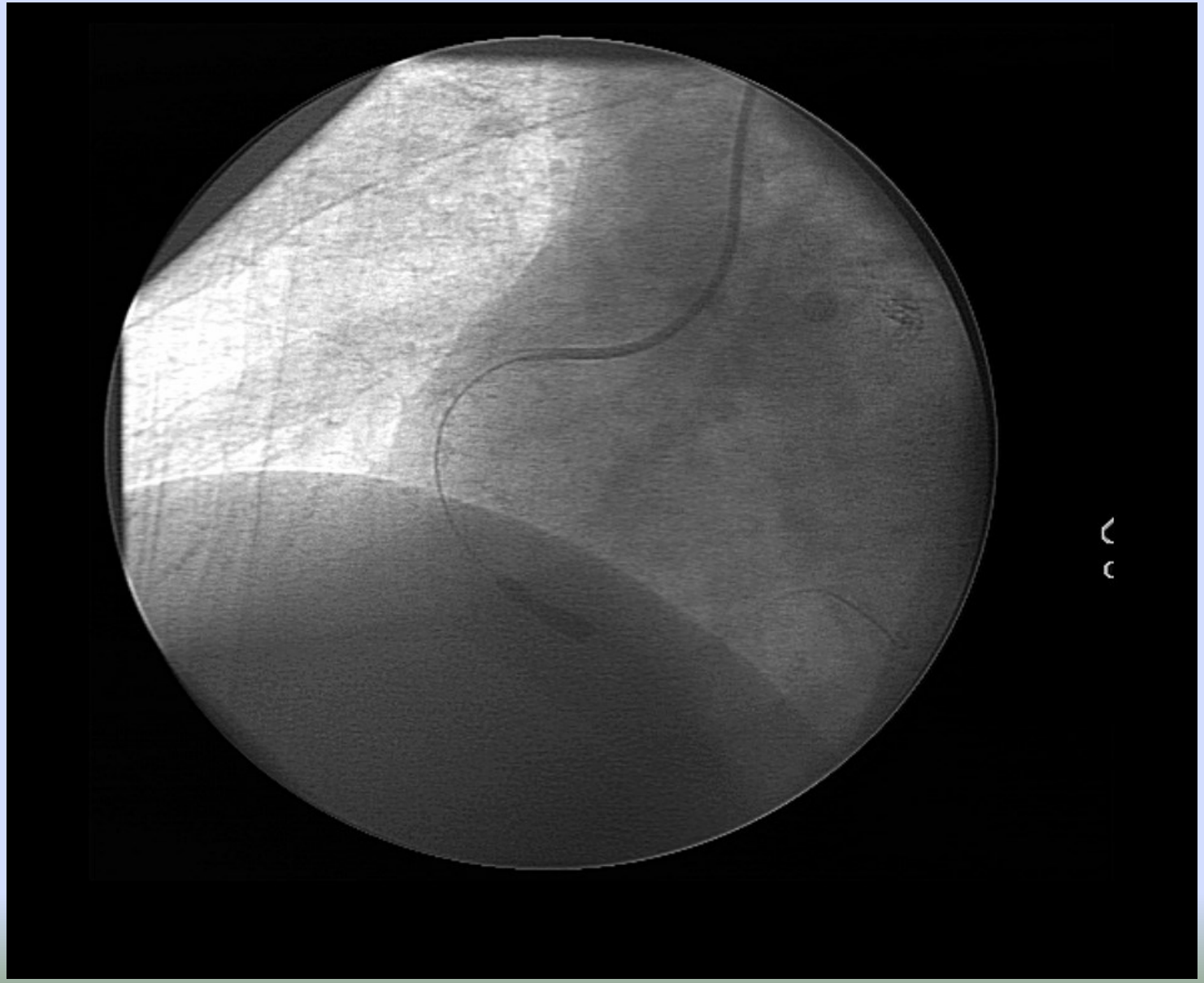
In THIS case . . . .



PTCA to the RCA



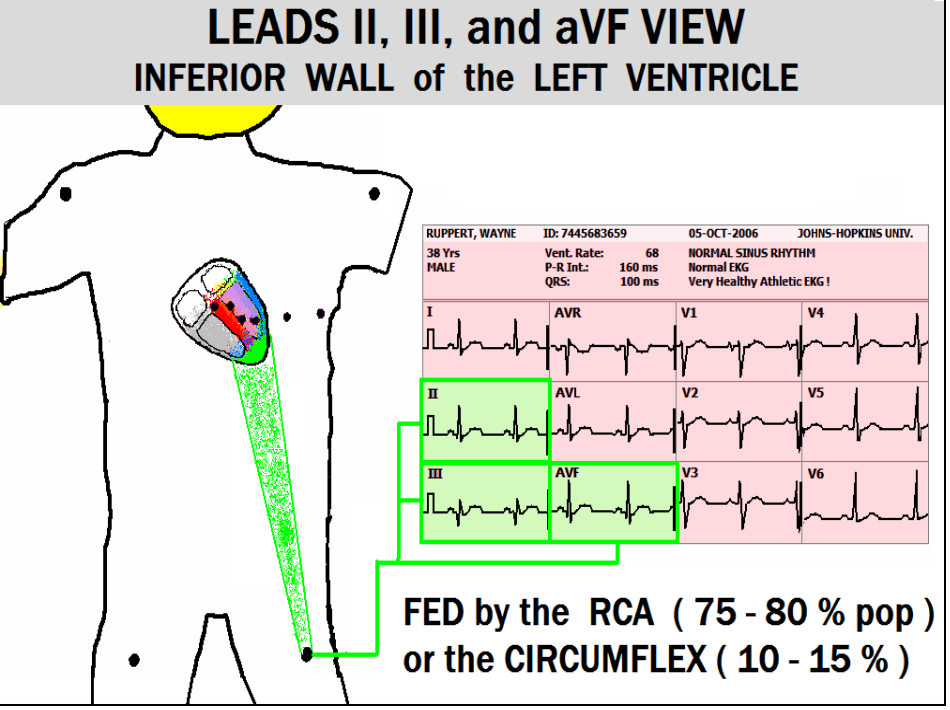
PTCA to the RCA x2 !

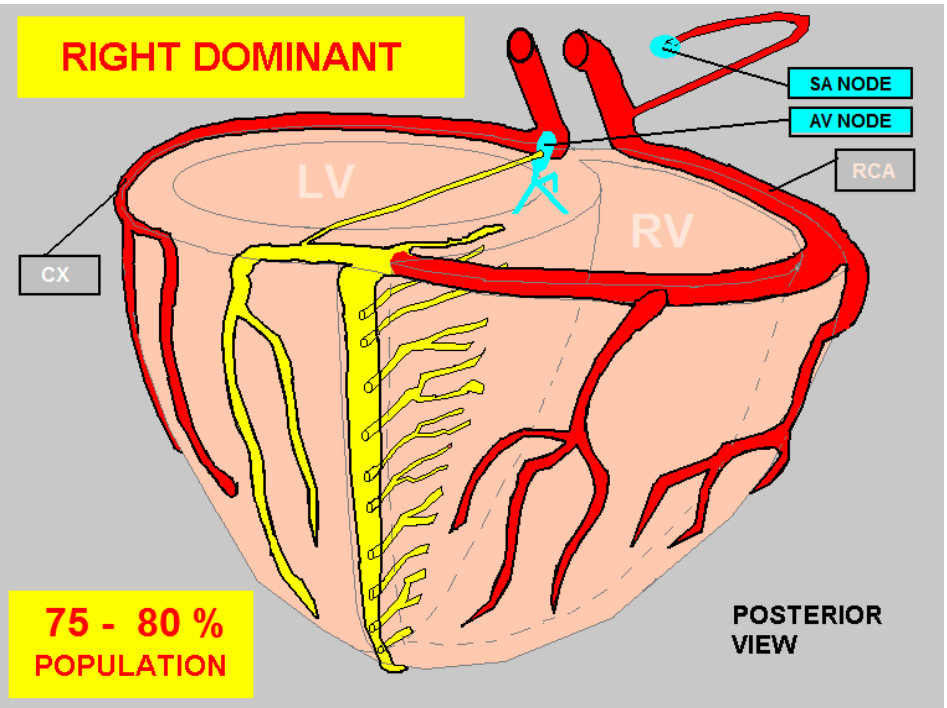


POST – PCI of the RCA or DOMINANT Circumflex Artery:

Monitor Lead III for ST changes resulting from compromised blood flow due to:

- Acute STENT Thrombus
- STENT induced CORONARY ARTERY DISSECTION.





Inferior Wall Ischemia / Post-PCI of Right Coronary Artery:

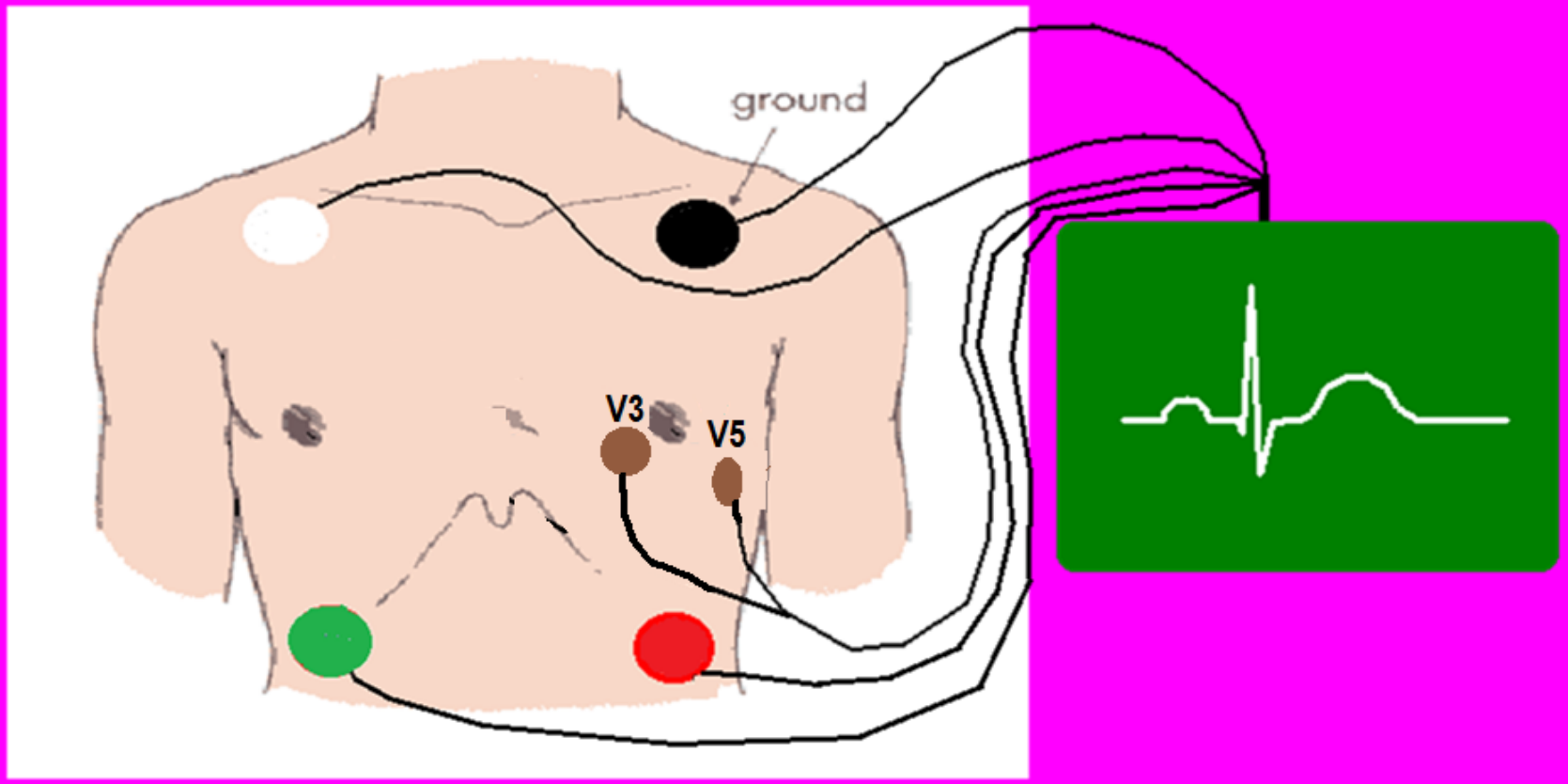
Monitor Inferior Lead (II, III or AVF) with most pronounced ST abnormalities.

If there is no single lead with clearly the most degree of ST changes, MONITOR LEAD III.

-12 lead ECG indicates "INFERIOR WALL ISCHEMIA / INFARCTION

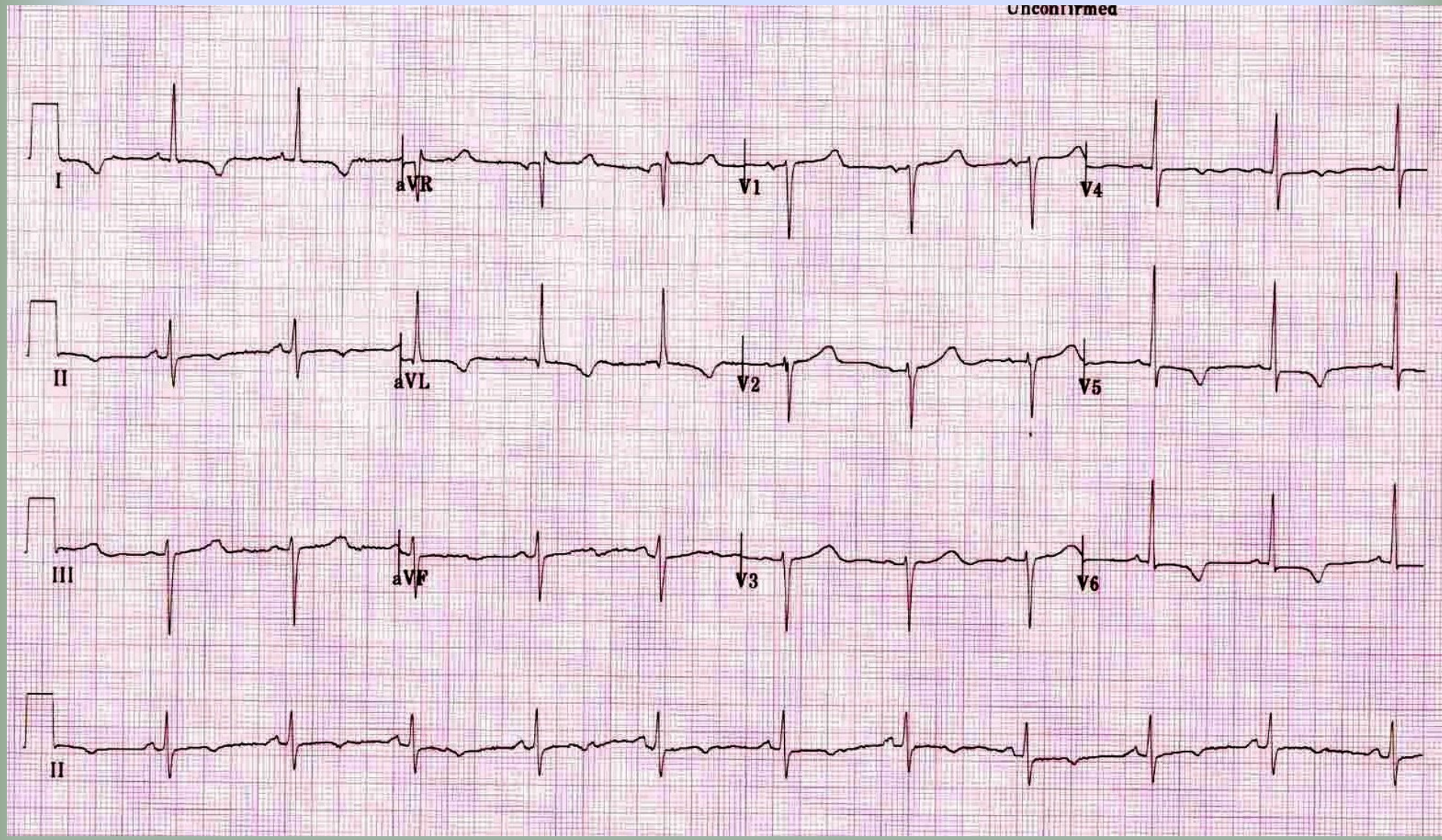
-PATIENT HAD BALLOON / STENT WORK TO RIGHT CORONARY ARTERY (RCA) or Dominant Circumflex Artery

LEAD PLACEMENT

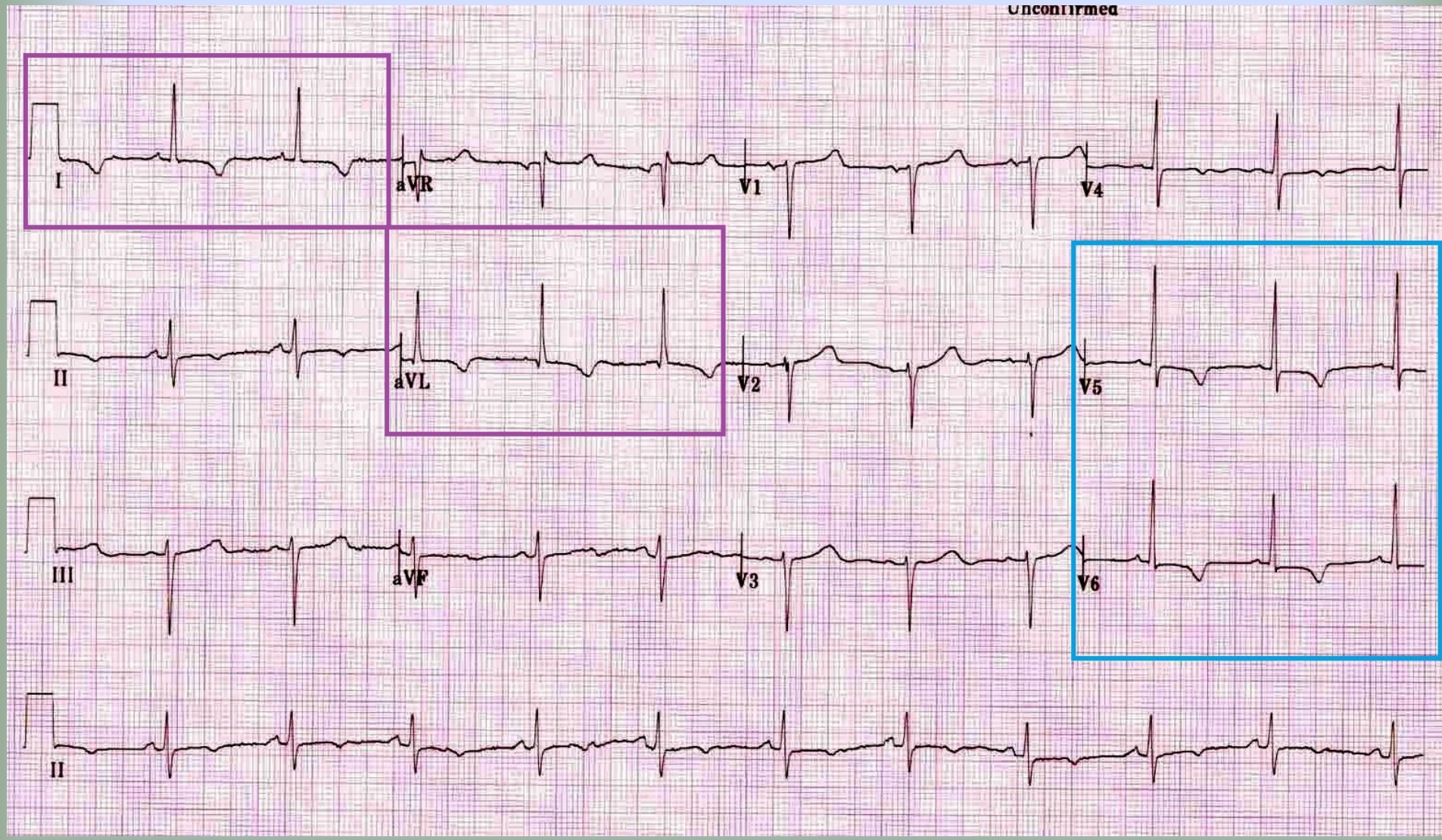


5 WIRE TELEMETRY UNIT

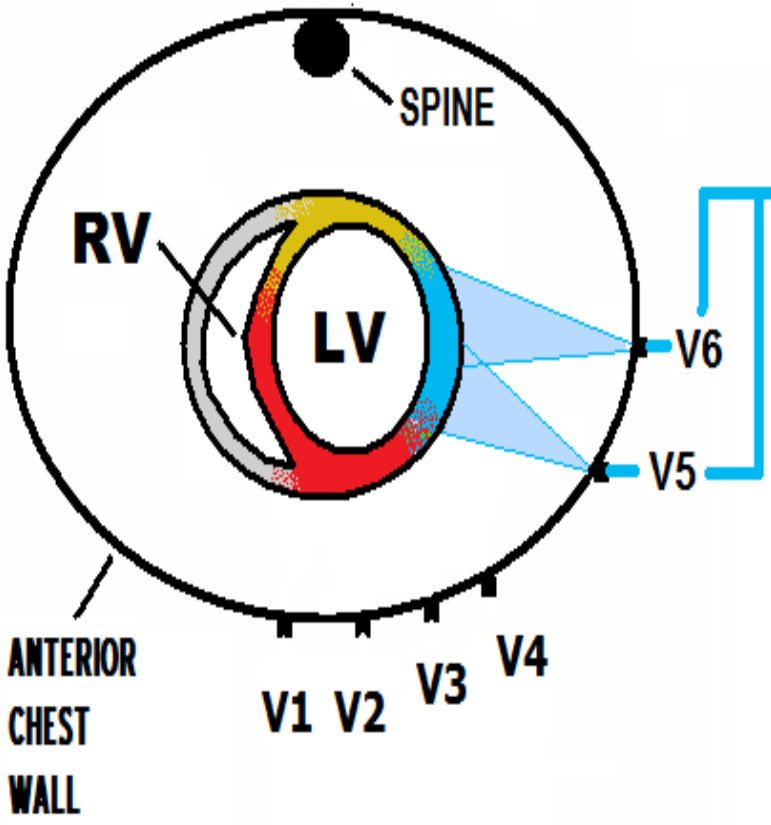
What leads show signs of possible ACS?

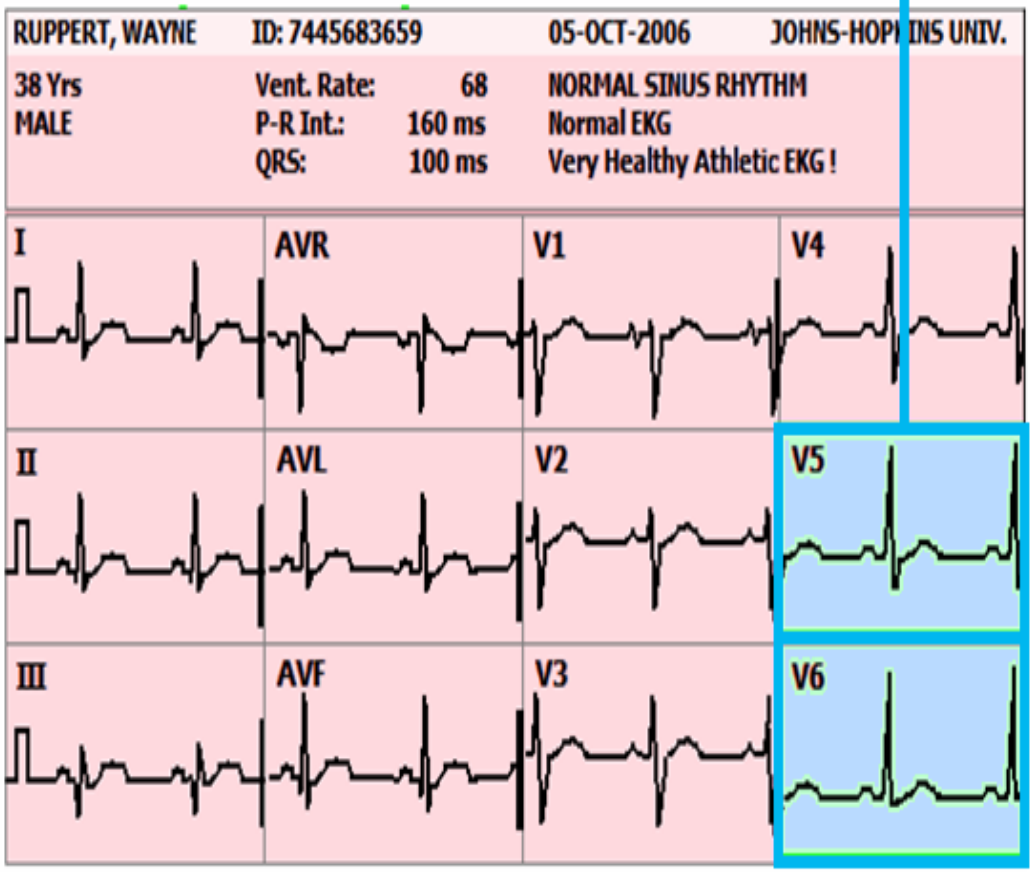


12 Lead ECG
shows ISCHEMIC CHANGES Lateral Wall:

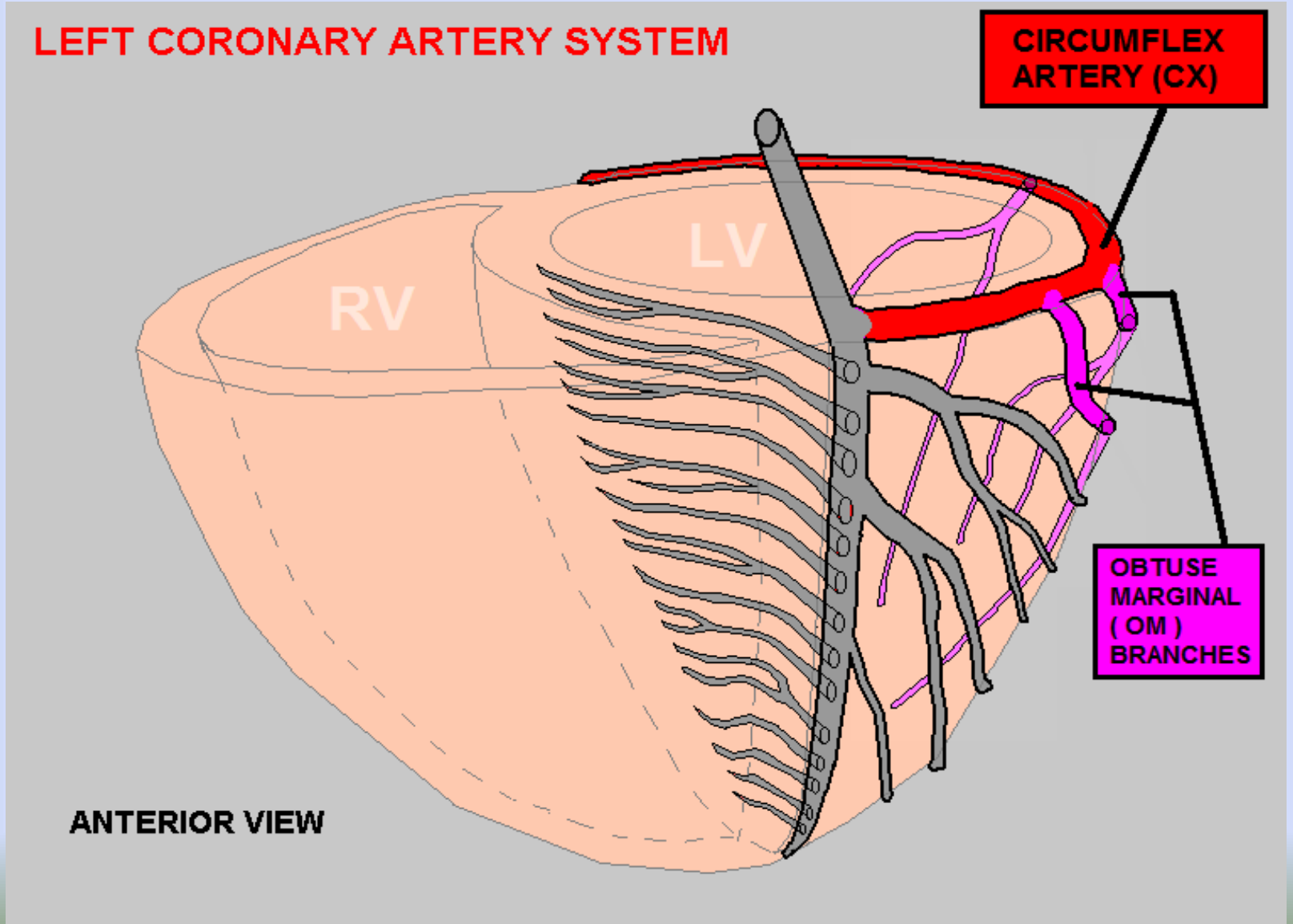


V5 - V6 VIEW THE LATERAL WALL
of the LEFT VENTRICLE





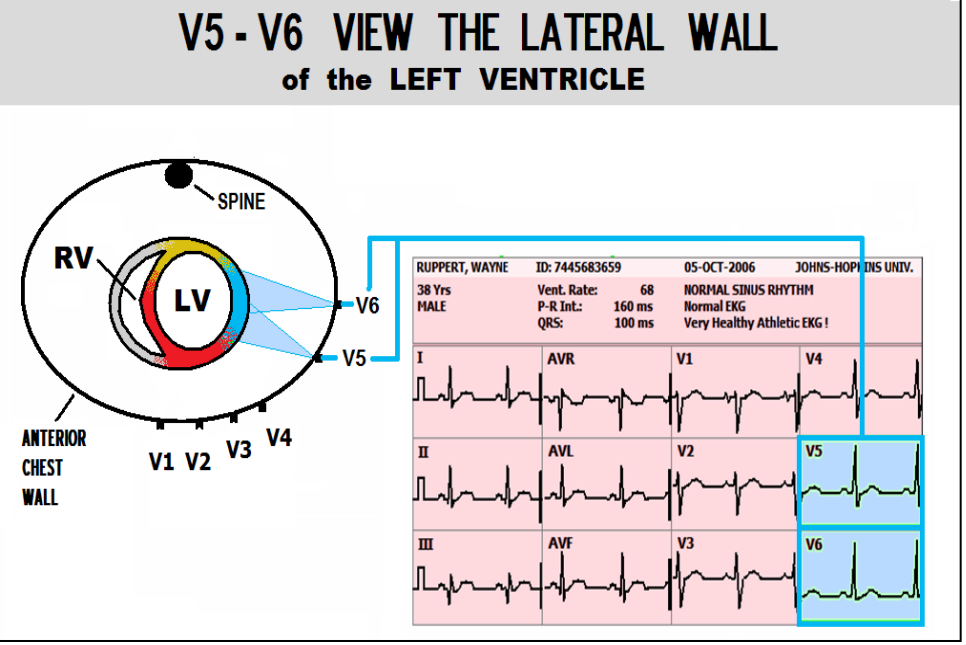
The Circumflex (CX) Artery provides Lateral Wall blood supply

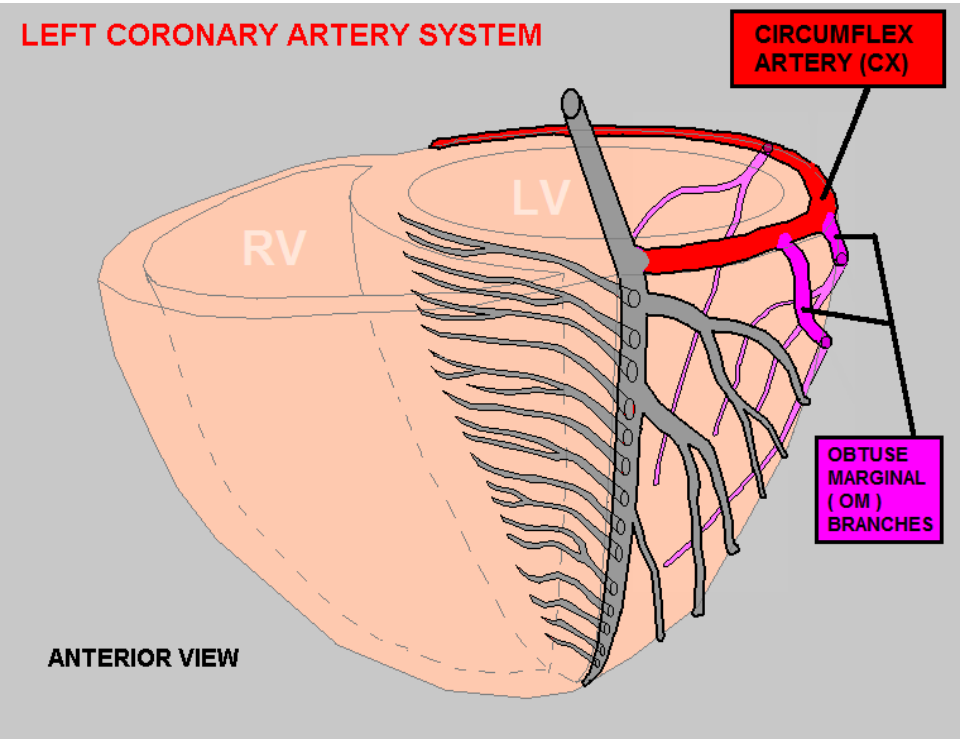


POST – PCI of the (non-dominant) Circumflex Artery:

Monitor V5 for ST changes resulting from compromised blood flow due to:

- Acute STENT Thrombus
- STENT induced CORONARY ARTERY DISSECTION.





Lateral Wall Ischemia / Post-PCI of Circumflex Artery:

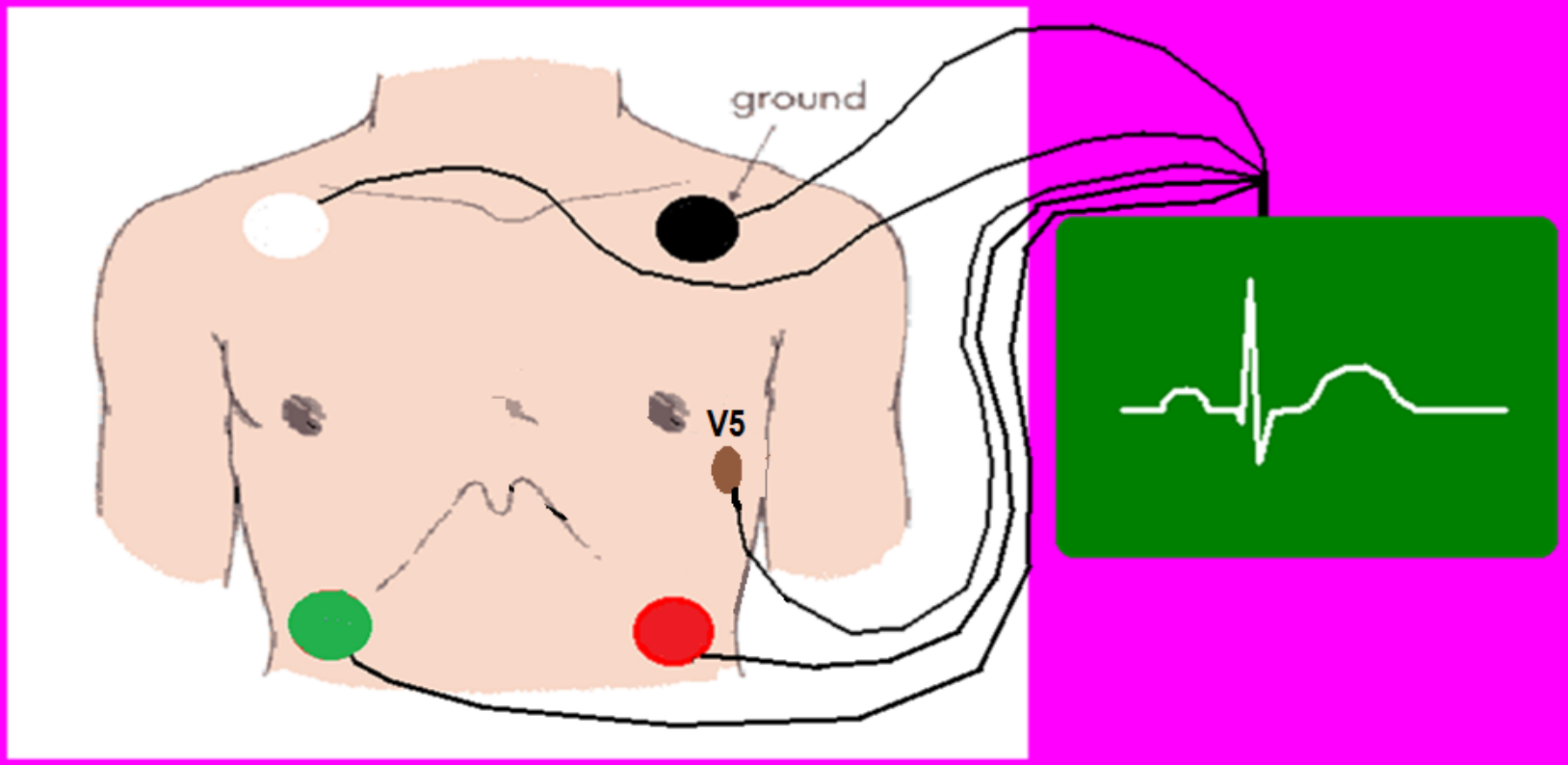
Monitor chest lead with most profound ST changes.

If there is no single lead with clearly the most degree of ST changes, MONITOR LEAD V5

-12 LEAD ECG INDICATES: LATERAL WALL ISCHEMIA / INFARCTION

-PCI / STENT TO CIRCUMFLEX ARTERY (Cx)

LEAD PLACEMENT



5 WIRE TELEMETRY UNIT

Monitor Lead V5

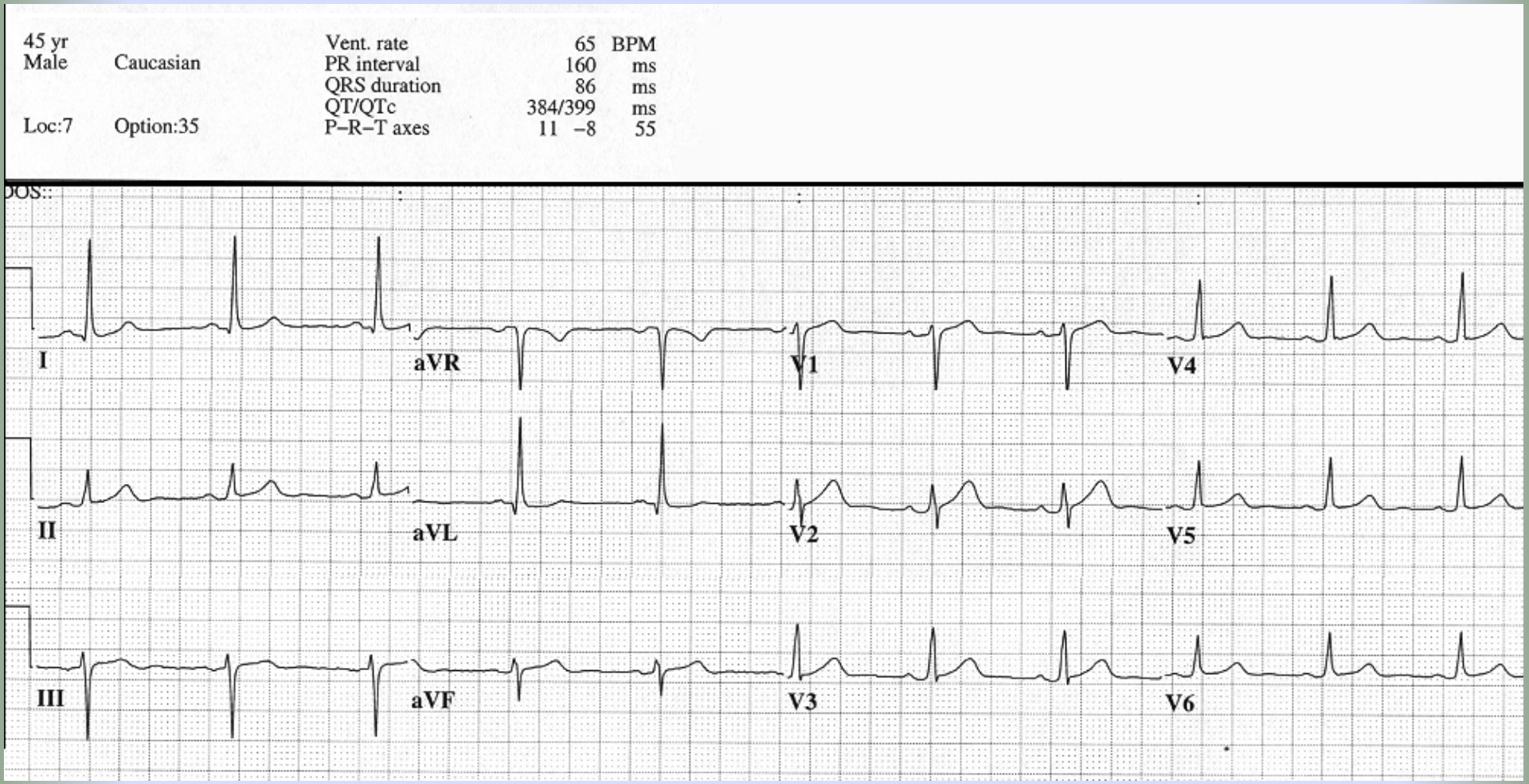
Vent. rate	64	BPM
PR interval	130	ms
QRS duration	96	ms
QT/QTc	396/408	ms
P–R–T axes	40 11	61

Normal sinus rhythm
Normal ECG
No previous ECGs available

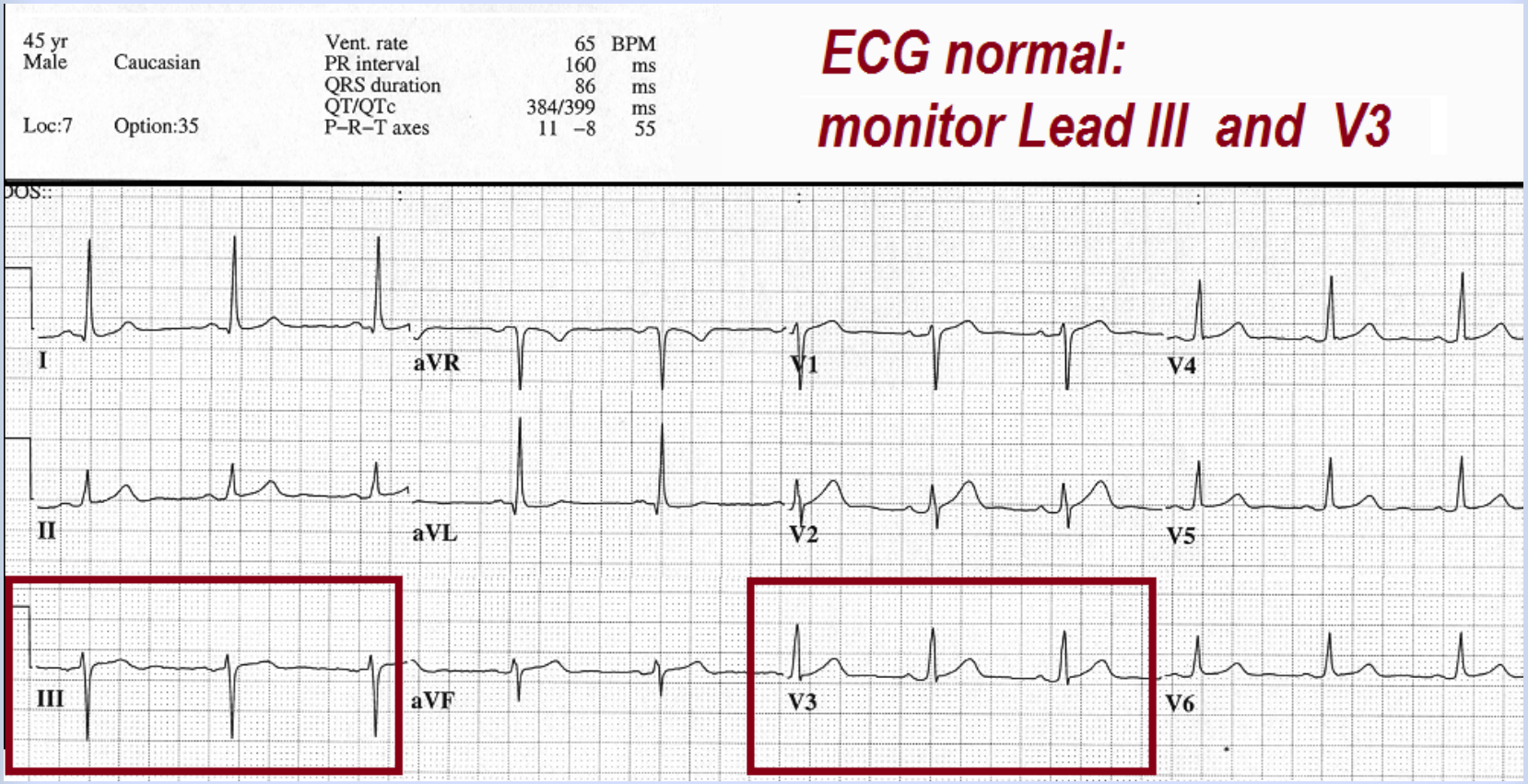
Referred by:

LATERAL - ANTERIOR I LAD - PROXIMAL CIRC. - PROXIMAL or RAMUS	BASILAR SEPTUM aVR LAD - PROXIMAL or LEFT MAIN COR. ART.	ANTERIOR - SEPTAL V1 LEFT ANTERIOR DESCENDING (LAD)	ANTERIOR V4 LEFT ANTERIOR DESCENDING (LAD)
INFERIOR II RCA (75 - 80 % pop.) CIRC. (10 - 15 % pop.)	LATERAL - ANTERIOR aVL LAD - PROXIMAL CIRC. - PROXIMAL or RAMUS	ANTERIOR - SEPTAL V2 LEFT ANTERIOR DESCENDING (LAD)	LATERAL V5 CIRCUMFLEX
INFERIOR III RCA (75 - 80 % pop.) CIRC. (10 - 15 % pop.)	INFERIOR aVF RCA (75 - 80 % pop.) CIRC. (10 - 15 % pop.)	ANTERIOR V3 LEFT ANTERIOR DESCENDING (LAD)	LATERAL V6 CIRCUMFLEX

Patients with suspected ACS (LRCP) or NSTEMI with normal 12 Lead ECGs:



Patients with suspected ACS (LRCP) or NSTEMI with normal 12 Lead ECGs:

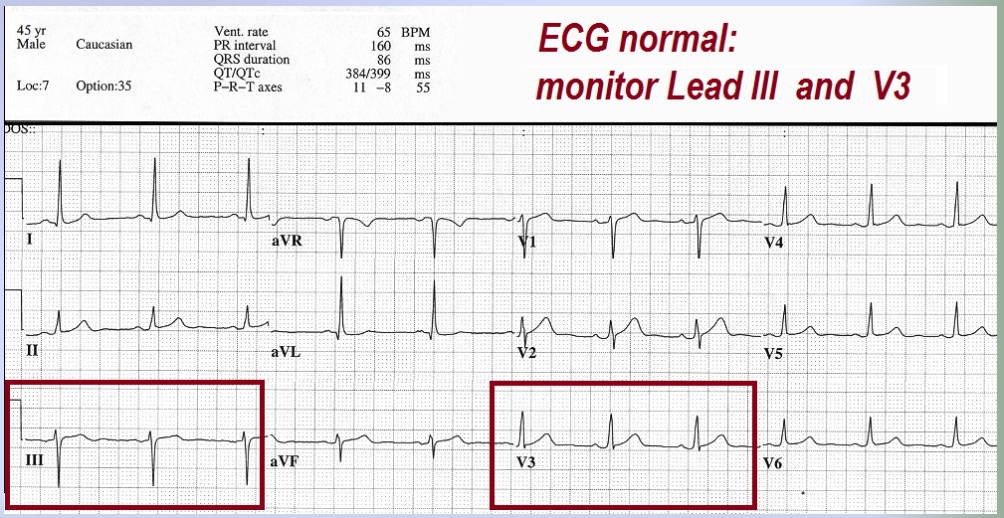


☞ **MONITOR LEADS III and V3**

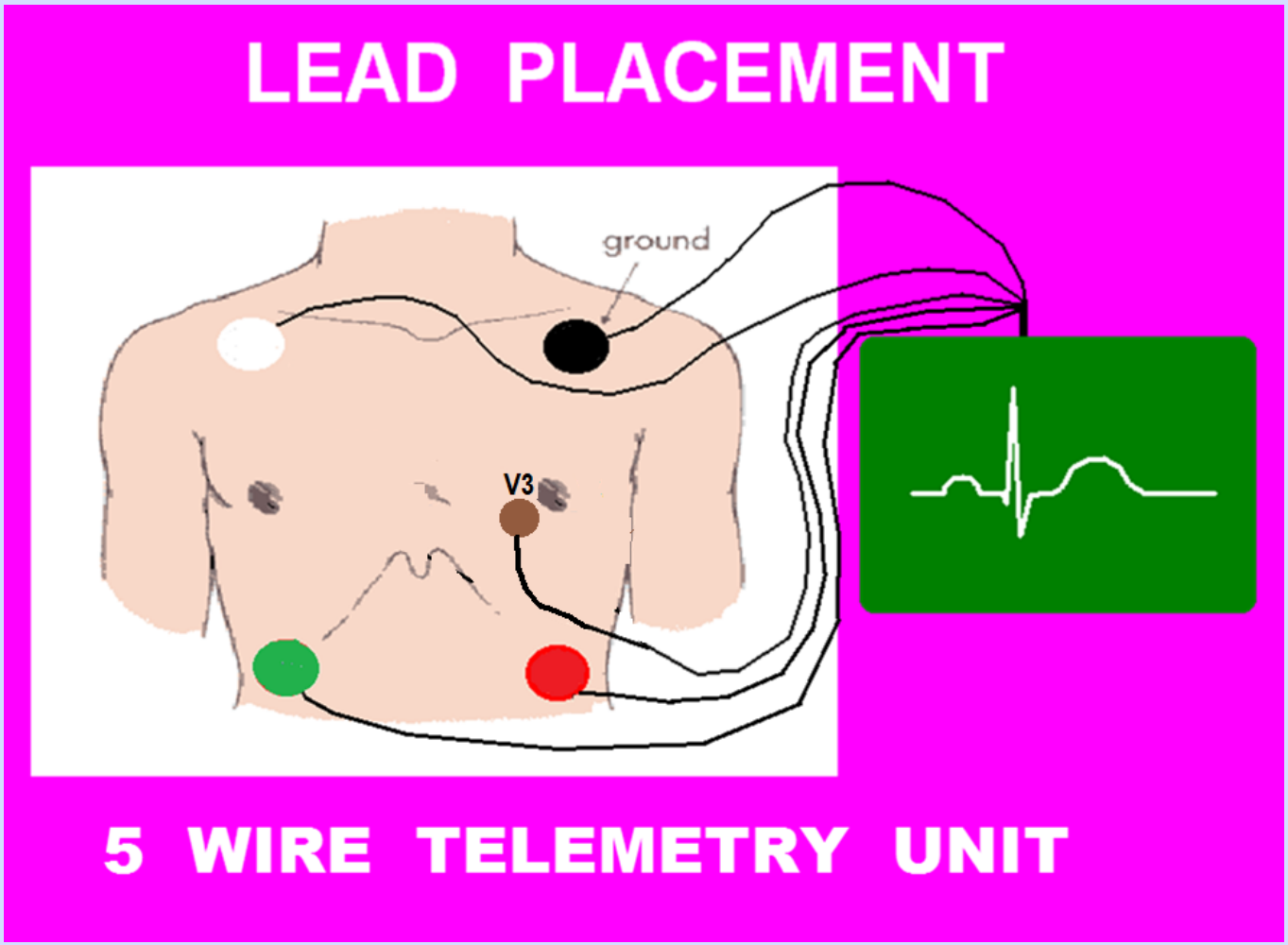
Patients with suspected ACS (LRCP) or NSTEMI with NORMAL 12 Lead ECGs:

Why Lead III and V3 are good choices:

- Lead III should indicate ischemia / early infarction of INFERIOR wall (blocked RCA)
- Lead V3 should indicate ischemia / early infarction of either ANTERIOR and/or LATERAL region(s) (blocked LAD/Cx)



ECG Lead Placement - patients with LRCP, UA or NSTEMI – with NORMAL ECGs:



- Monitor Leads III and V3

Indications of ACS:

- Changes to J Point
- Changes to ST-Segment
- Changes to T wave

Post-workshop Questions:

1. What are the BEST ECG leads to use for continuous monitoring of a patient with suspected Acute Coronary Syndrome (ACS) ?
   a. Lead II – it shows good P Waves
   b. Lead MCL1 (V1) – shows good P waves and R vs. L bundle branch blocks and R vs. L ventricular ectopy
   c. Depends- use the lead that views the region of the myocardium with suspected ischemia.
   d. Same as above (c.) but add: “obtain baseline 12 Lead ECG – use whatever lead shows the most profound ST – T wave (ischemic) abnormalities.

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1. What are the BEST ECG leads to use for continuous monitoring of a patient with suspected Acute Coronary Syndrome (ACS) ?
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   d. Same as above (c.) but add: "obtain baseline 12 Lead ECG – use whatever lead shows the most profound ST – T wave (ischemic) abnormalities.

Post-workshop Questions:

2. Important objective(s) of continuous ECG monitoring in patients with SUSPECTED ACS is (are):
   a. monitor for dynamic J point, ST segment and T wave changes.
   b. Determine left vs. right ventricular ectopy
   c. Monitor ventricular heart rate for dangerous bradycardias and tachycardias
   d. Both a and c

Post-workshop Questions:

2. Important objective(s) of continuous ECG monitoring in patients with SUSPECTED ACS is (are):

   a. monitor for dynamic J point, ST segment and T wave changes.

   b. Determine left vs. right ventricular ectopy

   c. Monitor ventricular heart rate for dangerous bradycardias and tachycardias

   d. Both a and c

Post-workshop Questions:

3. Which patient described below potentially warrants a STAT call to *Interventional Cardiology?* Both patients are hemodynamically stable.

   a. 68 y/o male, ECG changes from normal sinus rhythm (NSR) to accelerated junctional rhythm, rate 56. Patient is asymptomatic.

   b. 44 y/o female, asleep, NSR, rate 70, T waves increase approx. 7mm in amplitude, J point raises 1mm.

Post-workshop Questions:

3. Which patient described below potentially warrants a STAT call to *Interventional Cardiology?* Both patients are hemodynamically stable.

a. 68 y/o male, ECG changes from normal sinus rhythm (NSR) to accelerated junctional rhythm, rate 56. Patient is asymptomatic.

b. 44 y/o female, asleep, NSR, rate 70, T waves increase approx. 7mm in amplitude, J point raises 1mm.

Post-workshop Questions:

4. A low risk chest pain (LRCP) patient is being held in observation. His 12 Lead ECG does not show any abnormalities. Which statement is true?
   a. If your Obs. Unit does not have continuous 12 Lead ECG monitoring capabilities, monitor Leads III and Chest Lead 3 (V3) for J Point, S-T and T wave changes.
   b. If his 12 Lead ECG is normal, he cannot be suffering from ACS.

Post-workshop Questions:

4. A low risk chest pain (LRCP) patient is being held in observation. His 12 Lead ECG does not show any abnormalities. Which statement is true?
   a. **If your Obs. Unit does not have continuous 12 Lead ECG monitoring capabilities, monitor Leads III and Chest Lead 3 (V3) for J Point, S-T and T wave changes.**
   b. If his 12 Lead ECG is normal, he cannot be suffering from ACS.

NEXT SLIDES:
Hyperlinks to the evidence-based publications that were used to develop this curriculum:

Key Reference – download this paper

AHA Scientific Statement

Practice Standards for Electrocardiographic Monitoring in Hospital Settings

An American Heart Association Scientific Statement From the Councils on Cardiovascular Nursing, Clinical Cardiology, and Cardiovascular Disease in the Young

Endorsed by the International Society of Computerized Electrocardiology and the American Association of Critical-Care Nurses

Barbara J. Drew, RN, PhD, Chair; Robert M. Califf, MD; Marjorie Funk, RN, PhD; Elizabeth S. Kaufman, MD; Mitchell W. Krucoff, MD; Michael M. Laks, MD; Peter W. Macfarlane, DSc, FRCP; Claire Sommargren, RN, PhD; Steven Swiryn, MD; George F. Van Hare, MD

Abstract—The goals of electrocardiographic (ECG) monitoring in hospital settings have expanded from simple heart rate and basic rhythm determination to the diagnosis of complex arrhythmias, myocardial ischemia, and prolonged QT interval. Whereas computerized arrhythmia analysis is automatic in cardiac monitoring systems, computerized ST-segment ischemia analysis is available only in newer-generation monitors, and computerized QT-interval monitoring is currently unavailable. Even in hospitals with ST-monitoring capability, ischemia monitoring is vastly underutilized

Key Reference – download this paper

AHA/ACC/HRS Scientific Statement

Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part I: The Electrocardiogram and Its Technology

A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Paul Kligfield, MD, FAHA, FACC; Leonard S. Gettes, MD, FAHA, FACC; James J. Bailey, MD; Rory Childers, MD; Barbara J. Deal, MD, FACC; E. William Hancock, MD, FACC; Gerard van Herpen, MD, PhD; Jan A. Kors, PhD; Peter Macfarlane, DSc; David M. Mirvis, MD, FAHA; Olle Pahlm, MD, PhD; Pentti Rautaharju, MD, PhD; Galen S. Wagner, MD

Key Reference – download this paper

AHA/ACC/HRS SCIENTIFIC STATEMENT

Recommendations for the standardization and interpretation of the electrocardiogram

Part II: Electrocardiography diagnostic statement list

A Scientific Statement from the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Jay W. Mason, MD, FAHA, FACC, FHRS; E. William Hancock, MD, FACC;
Leonard S. Gettes, MD, FAHA, FACC

Abstract— This statement provides a concise list of diagnostic terms for ECG interpretation that can be shared by students, teachers, and readers of electrocardiography. This effort was motivated by the existence of multiple automated diagnostic code sets containing imprecise and overlapping terms. An intended outcome of this statement list is greater uniformity of ECG diagnosis and a resultant improvement in patient care. The lexicon includes primary diagnostic statements, secondary diagnostic statements, modifiers, and statements for the comparison of ECGs. This diagnostic lexicon should be reviewed and updated periodically.

KEYWORDS AHA Scientific Statements; electrocardiography; computers; diagnosis

(Heart Rhythm 2007;4:413–419)

This is the second of 6 articles designed to upgrade the guidelines for the standardization and interpretation of the ECG. The project was initiated by the American Heart Asso-

present a limited set of ECG diagnostic statements that are clinically useful and that do not create unnecessary overlap or contain vague terminology. Some statements that are com-

Key Reference – download this paper

AHA/ACCF/HRS SCIENTIFIC STATEMENT

AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part III: Intraventricular Conduction Disturbances: A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society: *Endorsed by the International Society for Computerized Electrocardiology*

Borys Surawicz, Rory Childers, Barbara J. Deal, Leonard S. Gettes

DOI https://doi.org/10.1161/CIRCULATIONAHA.108.191095
Circulation. 2009;119:e235-e240
Originally published March 16, 2009

Key Reference – download this paper

Circulation

AHA/ACCF/HRS SCIENTIFIC STATEMENT

AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part IV: The ST Segment, T and U Waves, and the QT Interval: A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society: *Endorsed by the International Society for Computerized Electrocardiology*

Pentti M. Rautaharju, Borys Surawicz, Leonard S. Gettes

DOI https://doi.org/10.1161/CIRCULATIONAHA.108.191096
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AHA/ACCF/HRS SCIENTIFIC STATEMENT

AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part V: Electrocardiogram Changes Associated With Cardiac Chamber Hypertrophy: A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society: *Endorsed by the International Society for Computerized Electrocardiology*

E. William Hancock, Barbara J. Deal, David M. Mirvis, Peter Okin, Paul Kligfield, Leonard S. Gettes

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Circulation. 2009;119:e251-e261
Originally published March 16, 2009

Key Reference – download this paper

AHA/ACCF/HRS Scientific Statement

AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part VI: Acute Ischemia/Infarction

A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Galen S. Wagner, MD; Peter Macfarlane, DSc; Hein Wellens, MD, FAHA, FACC; Mark Josephson, MD, FACC, FHRS; Anton Gorgels, MD; David M. Mirvis, MD; Olle Pahlm, MD, PhD; Borys Surawicz, MD, FAHA, FACC; Paul Kligfield, MD, FAHA, FACC; Rory Childers, MD; Leonard S. Gettes, MD, FAHA, FACC

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