12 LEAD ECG INTERPRETATION in

ACUTE CORONARY SYNDROME

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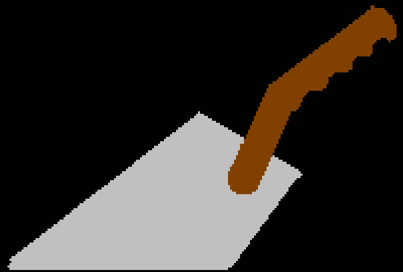
Tampa, FL

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

PROGRAM CONTENTS

SESSION ONE:

"Laying the FOUNDATION of your EKG ASSESSMENT SKILLS". . . .

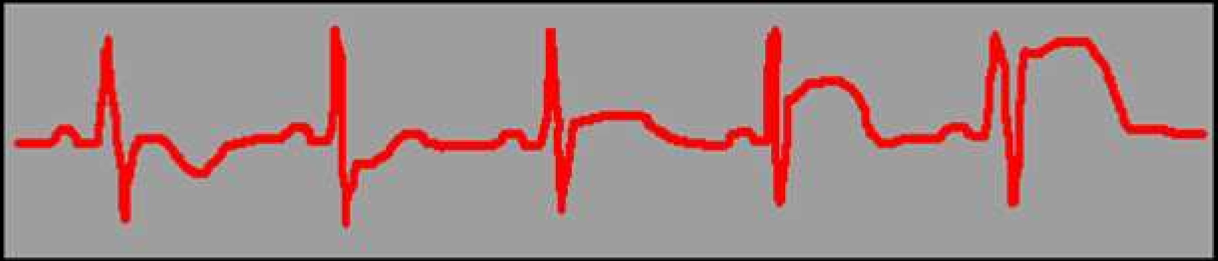


1. THE EKG IN PERSPECTIVE
2. ESSENTIAL ANATOMY and PHYSIOLOGY
3. BASIC EKG PRINCIPLES
4. WAVEFORMS and INTERVALS
5. QRS PATTERNS
6. BUNDLE BRANCH BLOCKS
7. FACTORS EFFECTING THE EKG
8. STRUCTURED APPROACH TO EKG EVALUATION
9. EVALUATING RATE and RHYTHM
10. AXIS DEVIATION
11. AXIS ROTATION and R-WAVE PROGRESSION

PROGRAM CONTENTS

SESSION TWO

THE ACUTE CORONARY SYNDROMES



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

+ BRUGADA SYNDROME

PROGRAM CONTENTS

SESSION THREE (4 HOURS)

~ Paced Rhythms
~ Early Repolarization
~ Pericarditis / Myocarditis
~ EKG features of Old MI
~ Hemiblocks, BiFasicular Blocks, Heart Blocks
~ Chamber Hypertrophy
~ Electrolyte Imbalance effects on EKG
~ Medication Effects on EKG
~ Wolff-Parkinson-White
~ Ventricular Tachycardia vs.
Supraventricular Tachycardia with BBB

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~ Wolff-Parkinson-White
~ Ventricular Tachycardia vs.
Supraventricular Tachycardia with BBB

. . . . But NOT Today !

Curriculum Development:
- Didactic Materials:

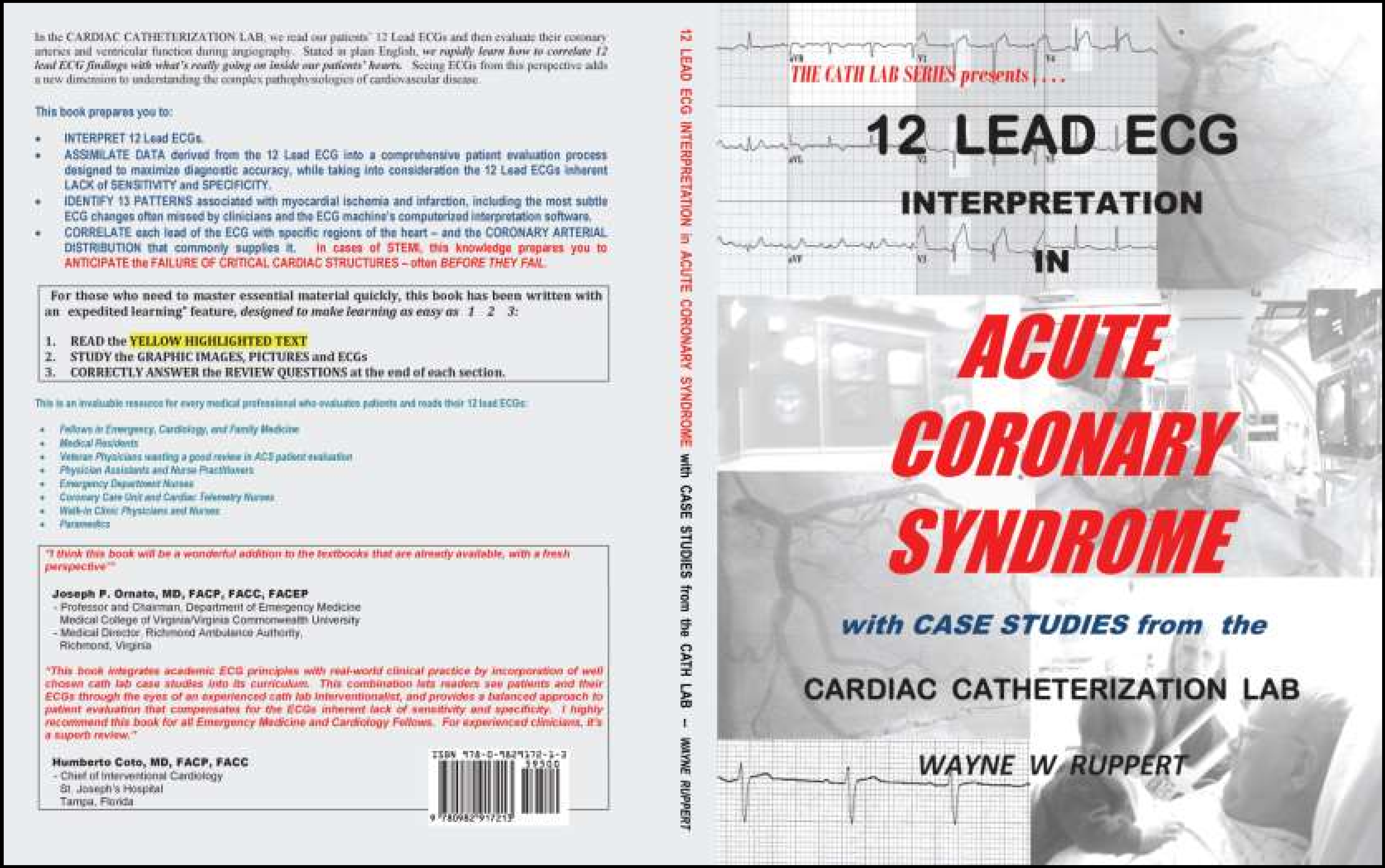
"<u>Practical Electrocardiography</u>" by Galen Wagner, MD and Henry J. L. Marriott, MD

"<u>Practical Electrophysiology</u>" by Richard Fogoros, MD

70+ current Medical Journal article citations: primary sources NEJM, JACC, JAMA, AHA Circulation, + others

<u>CASE STUDIES</u> from St. Joseph's Hospital CARDIAC CATH LAB 1997 – TODAY

PowerPoint presentation converted to TEXTBOOK in 2010.



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

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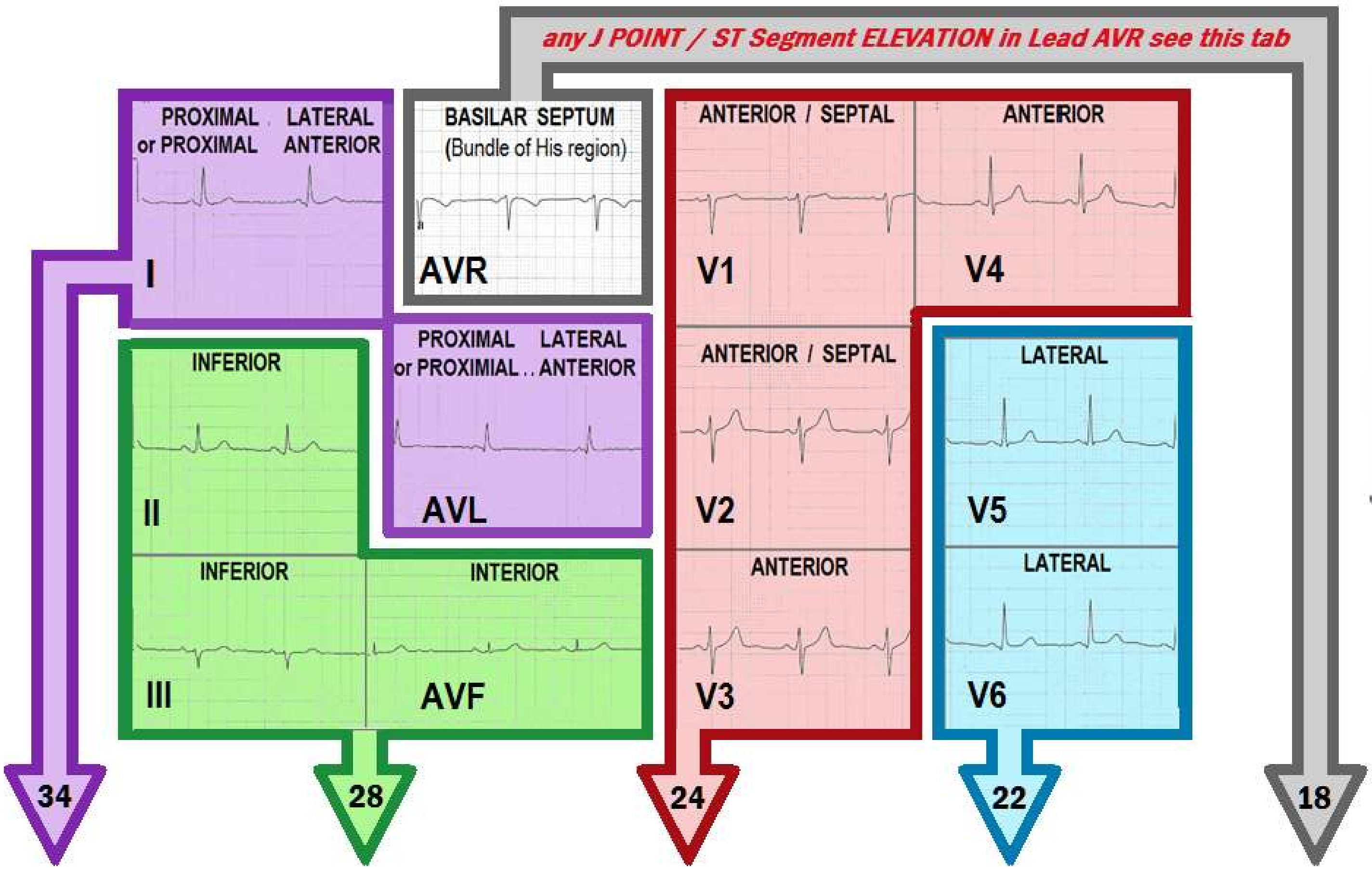
STEMI Assistant

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



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Download Sudden Cardiac Death Prevention - ACC / SCPC 19th Congress

Download Initial Stabilization of the Atrial Fib Patient - SCPC 19th Congress

Download Continuous ST-Segment Monitoring Policy

Download QTc Monitoring Policy for Patients on QT Prolonging Meds

Download QT Monitoring Protocol - Patients on QT Prolonging Meds - 2018

Download A-Fib / Flutter ER Physician's Order Set - BHDC

Download A-Fib / Flutter Flowchart Emerg Care BHDC

Download Team Driven Performance Improvement - SCPC 19th Congress

Download TDPI in Ambulance Industry Journal

Download TJC Sentinel Event Alert - Disruptive Physicians

Download ACLS 2015 Algorithm Cheat Sheets

Download 2015 ACLS Algorithms with ECG examples

Download Basic ECG Course Handout - 4 slides per page

The EKG in PERSPECTIVE

1. Much development in the 1950s and 60s, and at that time, EKGs were the primary diagnostic tool.

2. Today we have better diagnostic tools (e.g. ECHO, CARDIAC CATH, EP STUDIES) that sometimes conflict with traditional EKG-made diagnoses.

3. Some EKG findings are more accurate and reliable than others .

AND . . .

The EKG in PERSPECTIVE

PROBLEMS WITH EKGs . . .

↓ SENSITIVITY

(FALSE NEGATIVES)

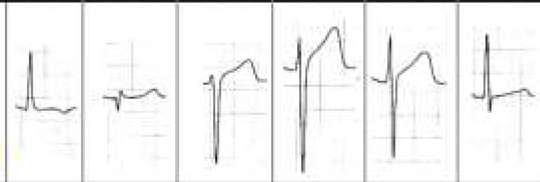
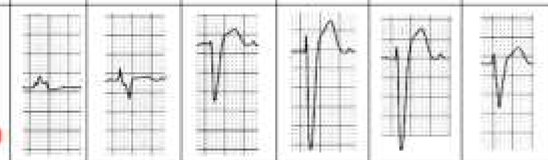
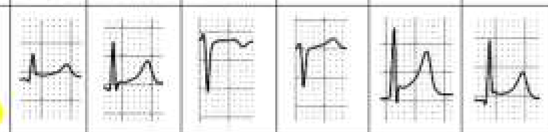
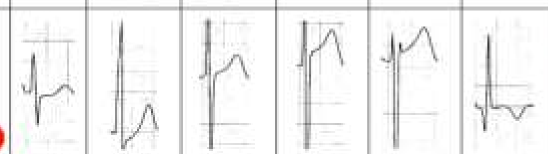
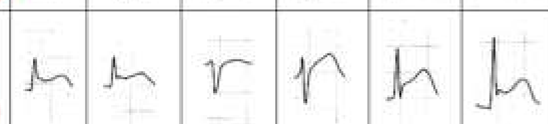
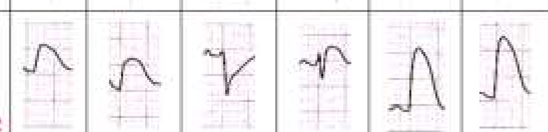
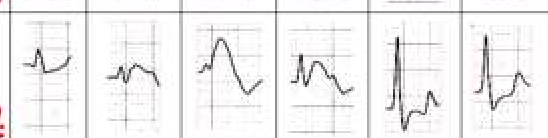
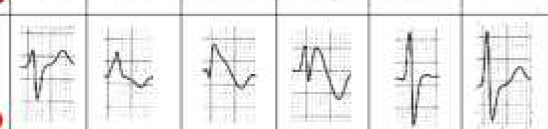
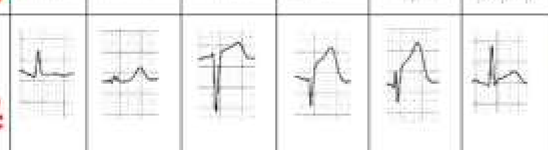
↓ SPECIFICITY

(FALSE POSITIVES)

AND . . .

ST SEGMENT ELEVATION

DIFFERENTIAL DIAGNOSIS

CASE INFORMATION:	I	III	V1	V2	V3	V5	REFERENCE NOTES:
NORMAL "MALE PATTERN" ST ELEVATION - 38 y/o MALE, no CAD							In a study of 529 men ages 16-24, 93% had ST ELEVATION of >1mm in LEADS V1 - V4. 20% of women had the same finding. - J SURAWICZ, el al, J AM COLL CARDIOL 2002;40:1870-76
LEFT BUNDLE BRANCH BLOCK, 46 y/o FEMALE no CAD							A common finding in patients with QRS > 120 ms with LBBB pattern is ST ELEVATION > 1mm. This includes most PACED RHYTHMS (RV Lead)
EARLY REPOLARIZATION 36 y/o MALE no CAD							In many healthy young men (mostly black men) this ST pattern is often noted. - KAMBARA, et al, J AM COLL CARDIOL 1976;38:157-61
LEFT VENTRICULAR HYPERTROPHY 61 y/o FEMALE no CAD							In LVH, the deeper the S WAVE, the GREATER the ST ELEVATION. May present with QS in precordial leads. ST segments CONCAVE - WANG, et al, N ENGL J MED 2003;349:1128-35
PERICARDITIS 41 y/o MALE no CAD							ST ELEVATION diffusely elevated in throughout 12 lead EKG. Often PR segment ↑ aVR and ↓ Lead II. - WANG, et al, N ENGL J MED 2003;349:1128-35
MYOCARDITIS 30 y/o FEMALE no CAD							ST ELEVATION in ACUTE MYOCARDITIS can mimick that of ACUTE MI. - SPODICK et al, CIRCULATION 1995;91:1886-87
HYPERKALEMIA (K+ 8.6) 53 y/o MALE no CAD							HYPERKALEMIA can mimic EKG findings of AMI. Other findings include TALL, PEAKED T WAVES - LEVINE, et al, CIRCULATION 1956;13:29-36
BRUGADA SYNDROME 36 y/o FEMALE no CAD							Genetic disorder responsible for 40-60% of all idiopathic V-FIB. Recognizable V1-V3 pattern. - BRUGADA & BRUGADA et al, J AM COLL CARDIOL 1992;20:1391-96
ACUTE ANTERIOR WALL MI 52 y/o MALE - MID LAD OCCLUSION							ACUTE ST SEGMENT ELEVATION MI (STEMI) characterized by: - ST ELEVATION of >1mm in 2 or more contiguous leads. - ST segments usually CONVEX

EKGs in PERSPECTIVE, con't:

In my personal experience, the reliability of the following EKG findings are:

Heart Rates	- Extremely accurate
Heart Blocks	- Extremely accurate
Bundle Branch Blocks	- Extremely accurate
Acute MI	- Usually accurate
Old MI (necrosis)	- Usually accurate
Pericarditis	- Usually accurate
Ischemia	- Somewhat accurate
V-tach vs. SVT abberancy	- Not very accurate
Fascicular Blocks	- Not very accurate
Chamber Hypertrophy	- Not very accurate

EKGs in PERSPECTIVE, con't:

One of the MOST MISLEADING scenarios of all is when the EKG APPEARS PERFECTLY NORMAL . . .

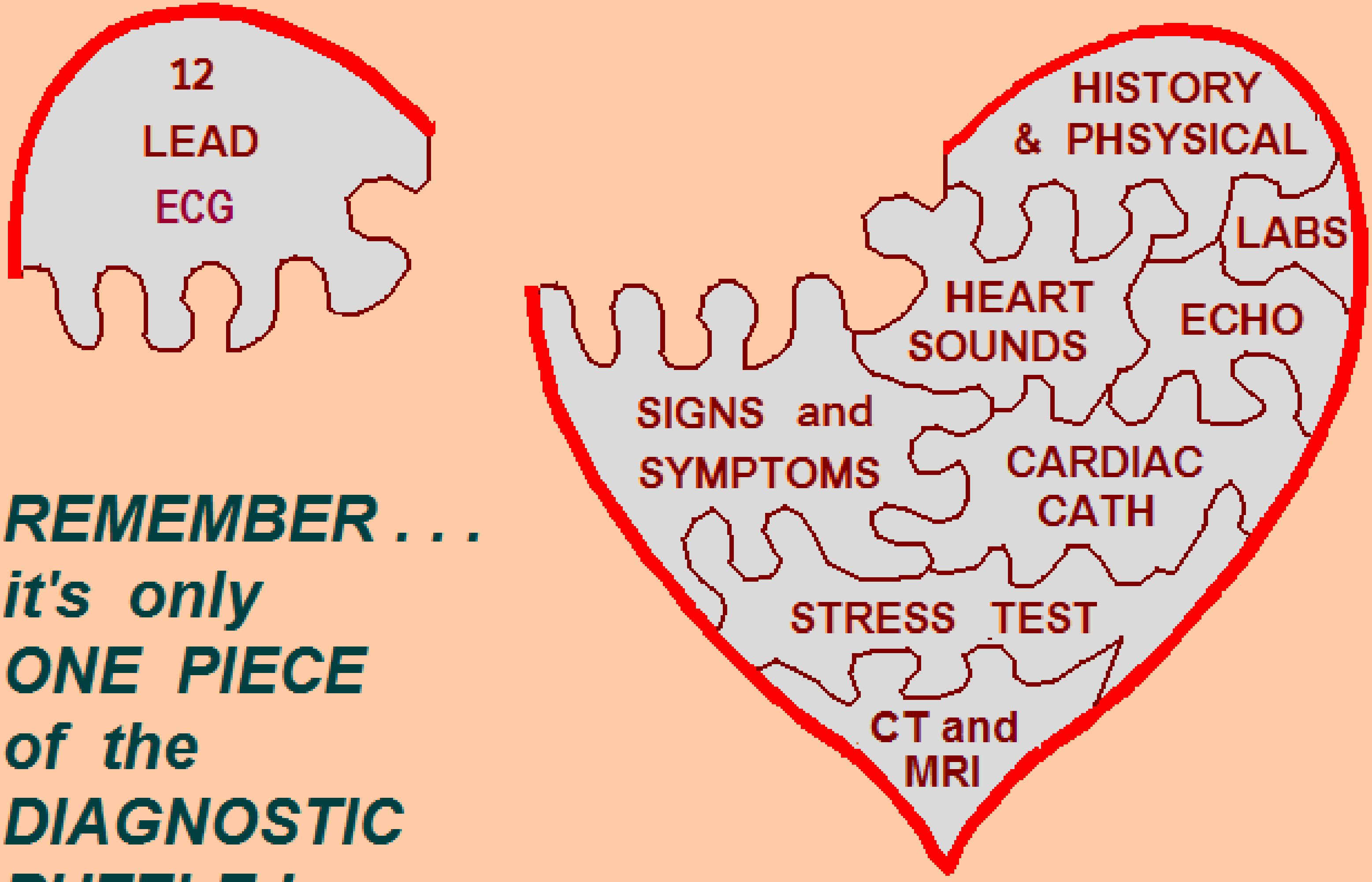
. . . but MASKS serious, LIFE - THREATENING CONDITIONS.

that is why YOU must do a THOROUGH PATIENT EVALUATION . . . and have a HIGH INDEX OF SUSPICION ! ! !

DESPITE ALL OF OUR TECHNOLOGICAL ADVANCES IN DIAGNOSTIC CARDIOLOGY.....

THE 12 LEAD EKG IS THE QUICKEST AND MOST COST-EFFICIENT FRONT-LINE TRIAGE TOOL THAT WE HAVE TODAY.

REMEMBER . . . . Keep the ECG Results in PROPER PERSPECTIVE . . . .



REMEMBER . . .
it's only
ONE PIECE
of the
DIAGNOSTIC
PUZZLE !

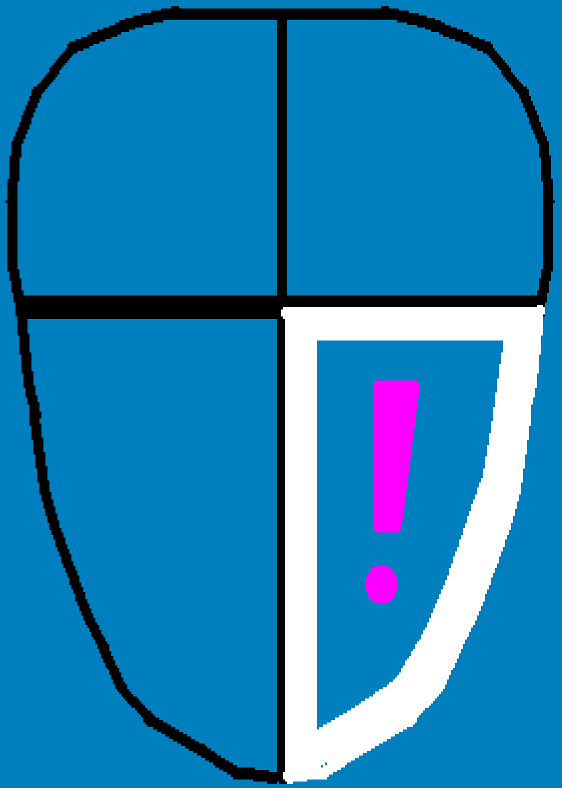
THE CHAMBER MOST IMPORTANT TO KEEPING THE PATIENT ALIVE

(and the ONLY one you can't live without)

IS THE

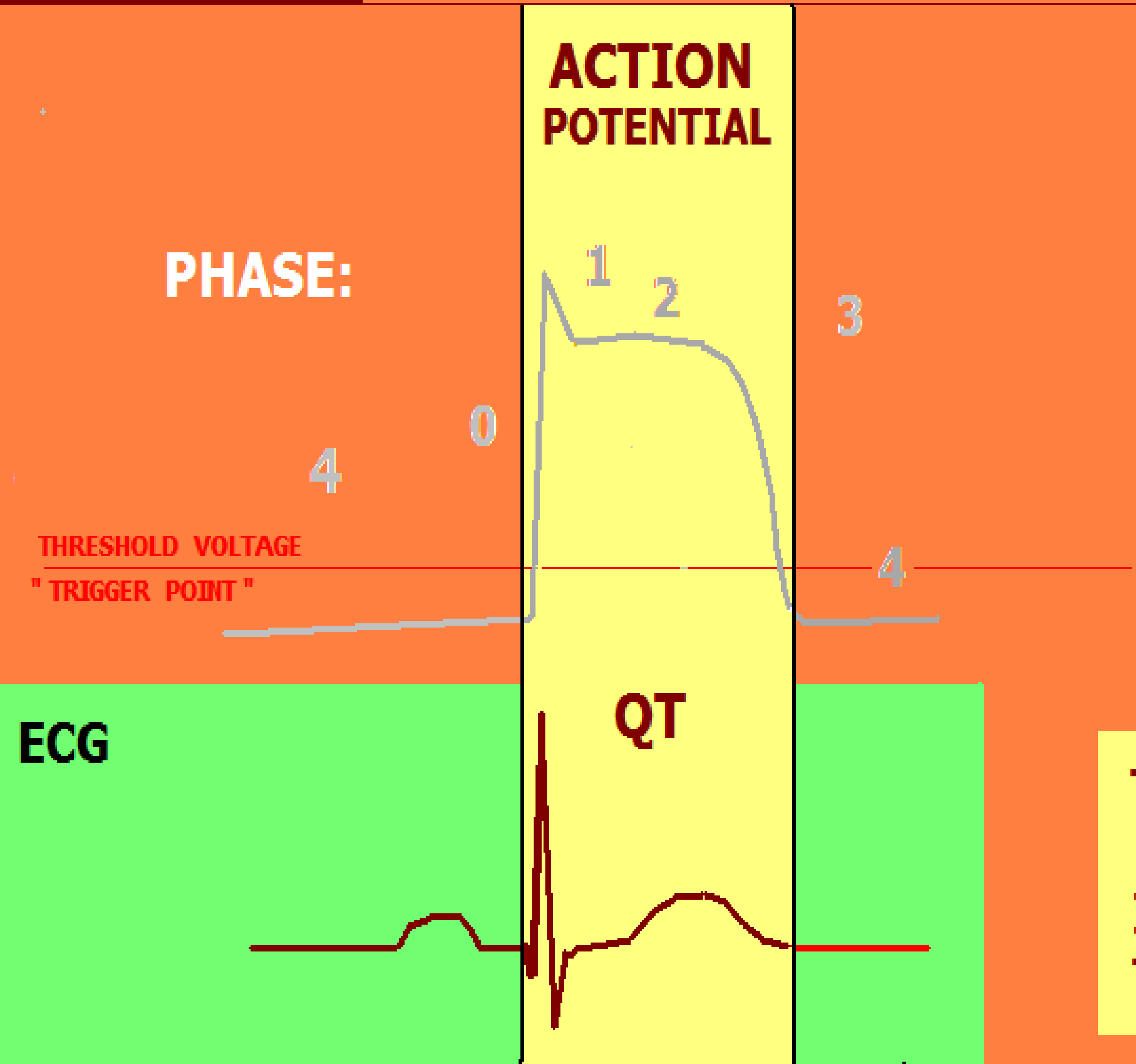
LEFT VENTRICLE

WHICH WE WILL REFER TO AS <u>THE PUMP</u>



CARDIAC ANATOMY and PHYSIOLOGY "101"

VENTRICULAR MUSCLE CELL ACTION POTENTIAL



CELL " STATUS: "

4
- CELL REPOLARIZED
- -80 to -90 mV CHARGE
- SLIGHT " LEAKAGE " OF IONS

0
- RAPID INFLUX OF + CHARGED SODIUM IONS
- CELL DEPOLARIZATION

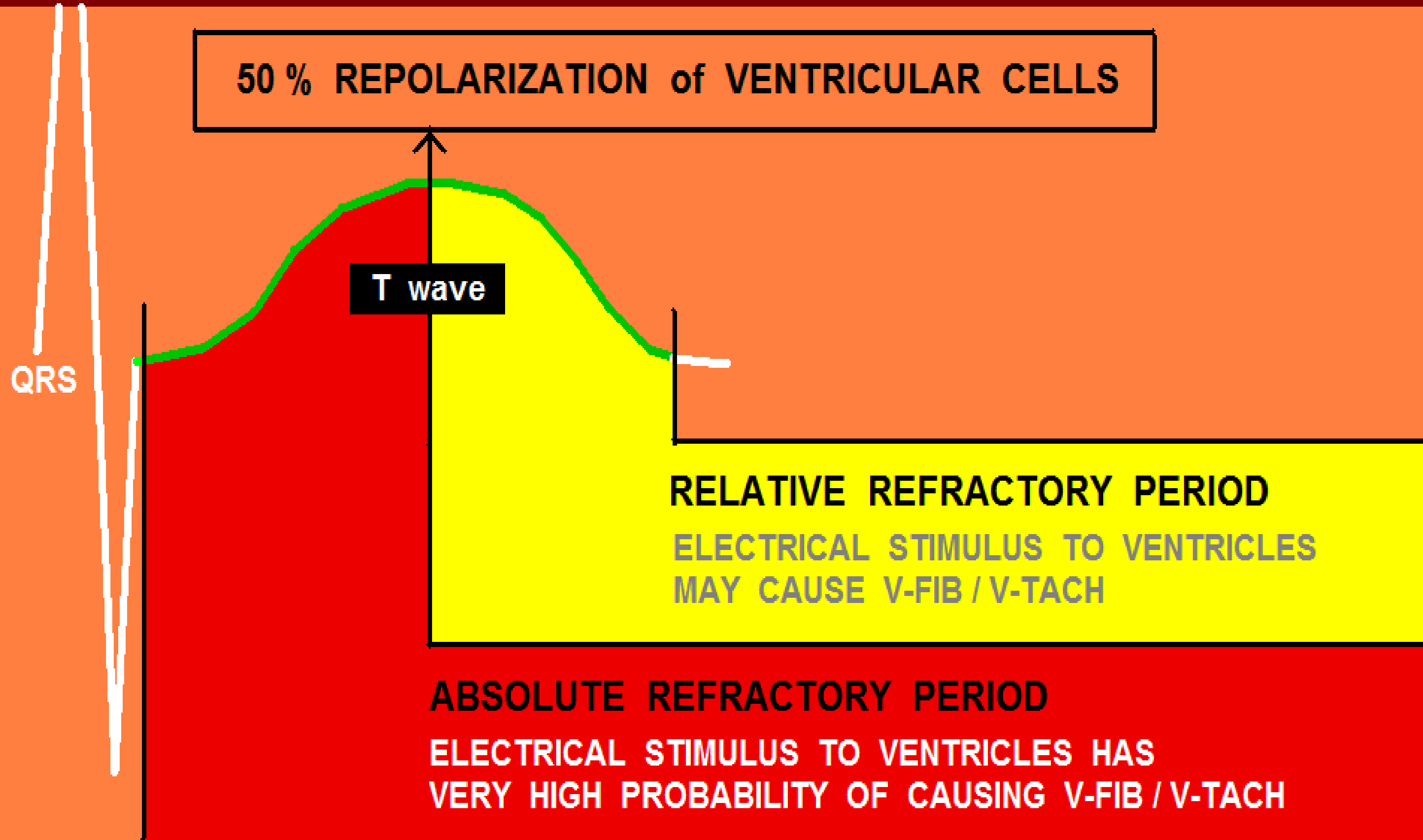
1
- SODIUM EXITS CELL
- REPOLARIZATION BEGINS

2
- CALCIUM IONS CONTINUE TO ENTER CELL

3
- CALCIUM CHANNELS CLOSE

THE ACTION POTENTIAL
(OF VENTRICULAR MUSCLE CELLS)
IS ROUGHLY EQUAL TO THE Q - T INTERVAL

CARDIAC ANATOMY and PHYSIOLOGY "101"



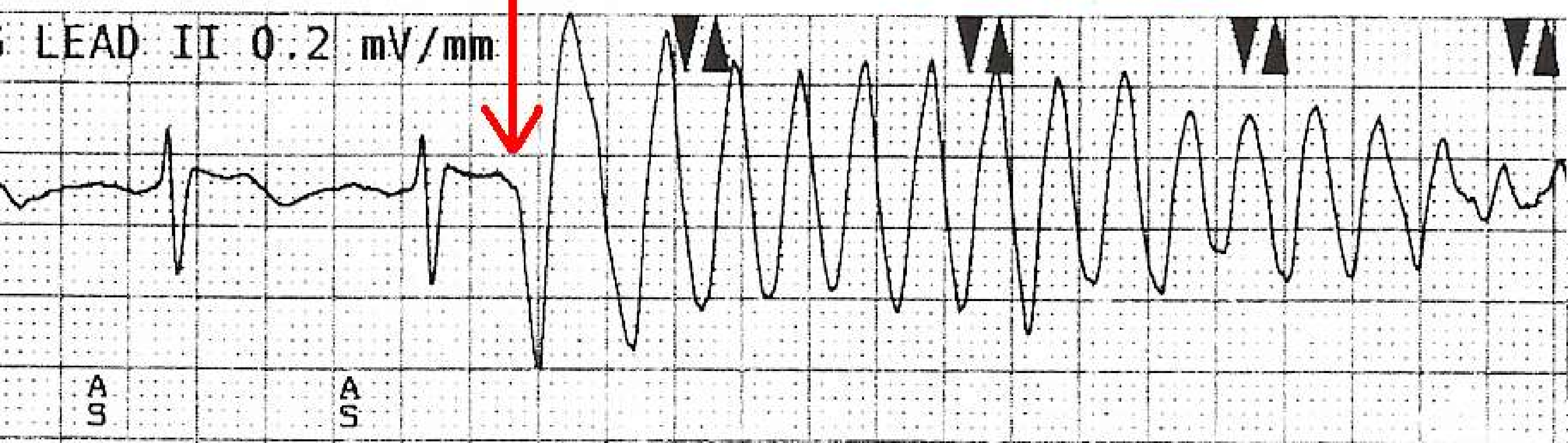
ROUTINE TEST OF ICD

ELECTRICAL IMPULSE ADMINISTERED DURING ABSOLUTE REFRACTORY PERIOD -- INDUCES VENTRICULAR FIBRILLATION

08-Sep-2006 18:01:47

Test Started

SPECIAL THANKS TO:
Ray Heinley
Medtronic Corporation
for this contribution



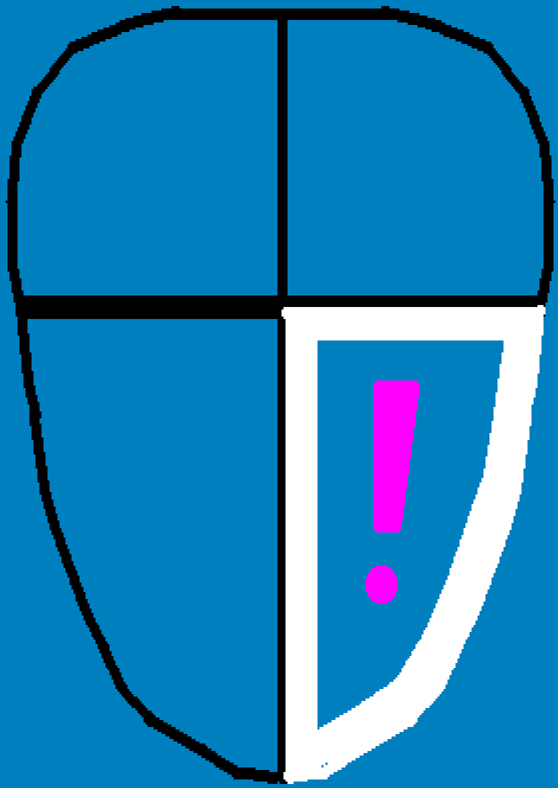
THE CHAMBER MOST IMPORTANT TO KEEPING THE PATIENT ALIVE

(and the ONLY one you can't live without)

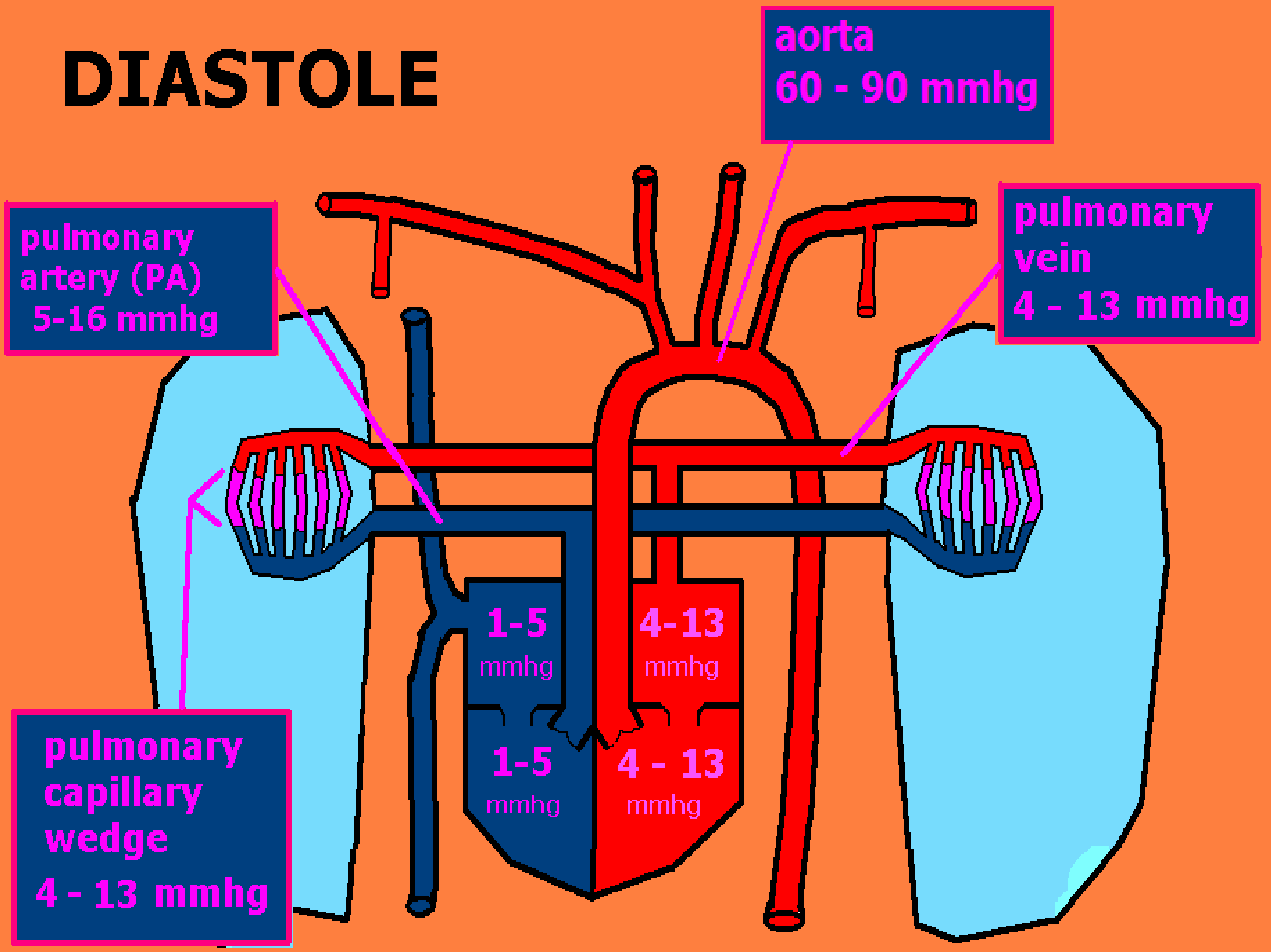
IS THE

LEFT VENTRICLE

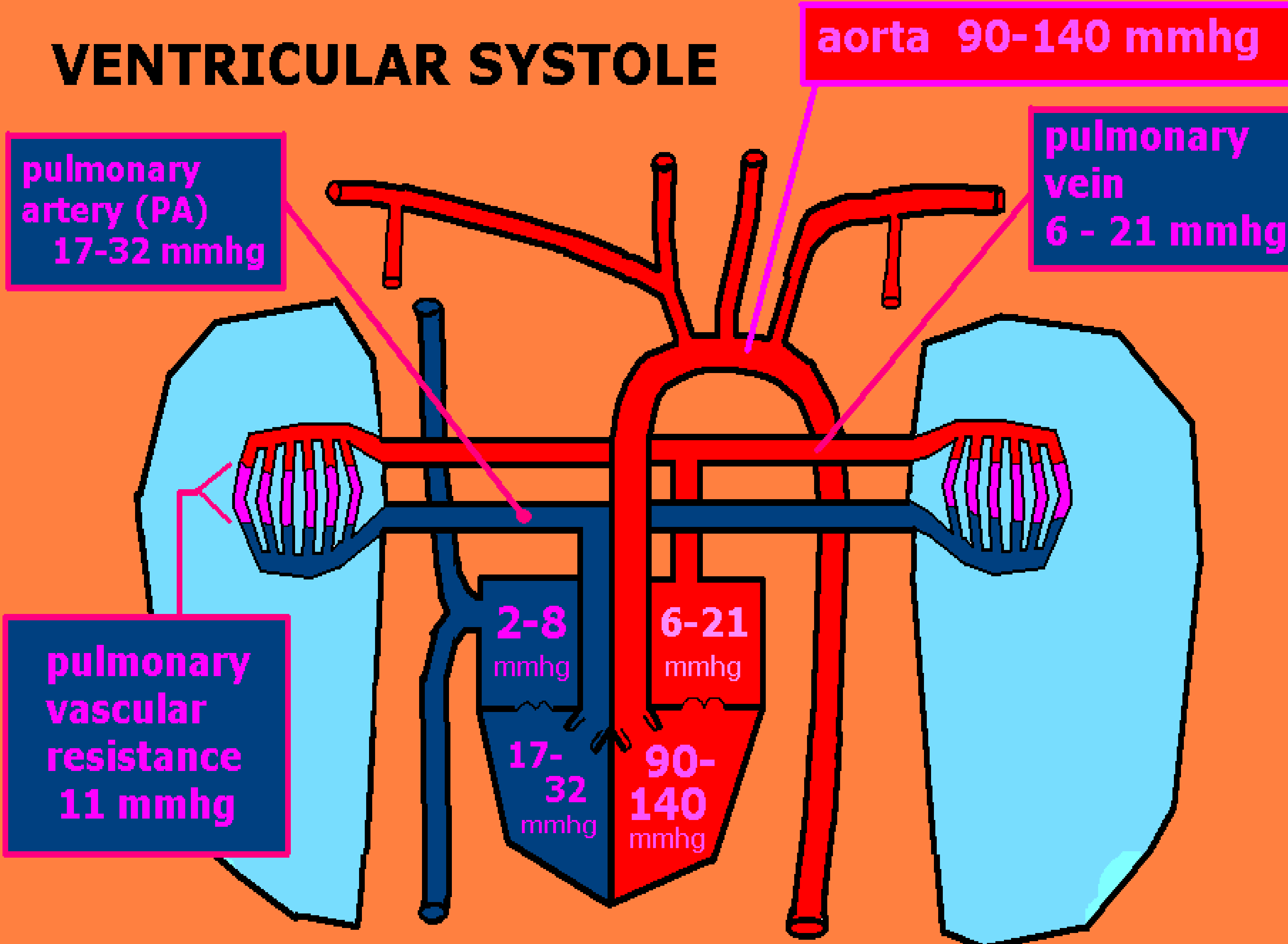
WHICH WE WILL REFER TO AS THE PUMP



DIASTOLE


aorta
60 - 90 mmhg
pulmonary
artery (PA)
5-16 mmhg
pulmonary
vein
4 - 13 mmhg
1-5
mmhg
4-13
mmhg
1-5
mmhg
4 - 13
mmhg
pulmonary
capillary
wedge
4 - 13 mmhg

VENTRICULAR SYSTOLE



HEMODYNAMIC DATA from:
"The Cardiac Catheterization Handbook," Morton J. Kearn, MD

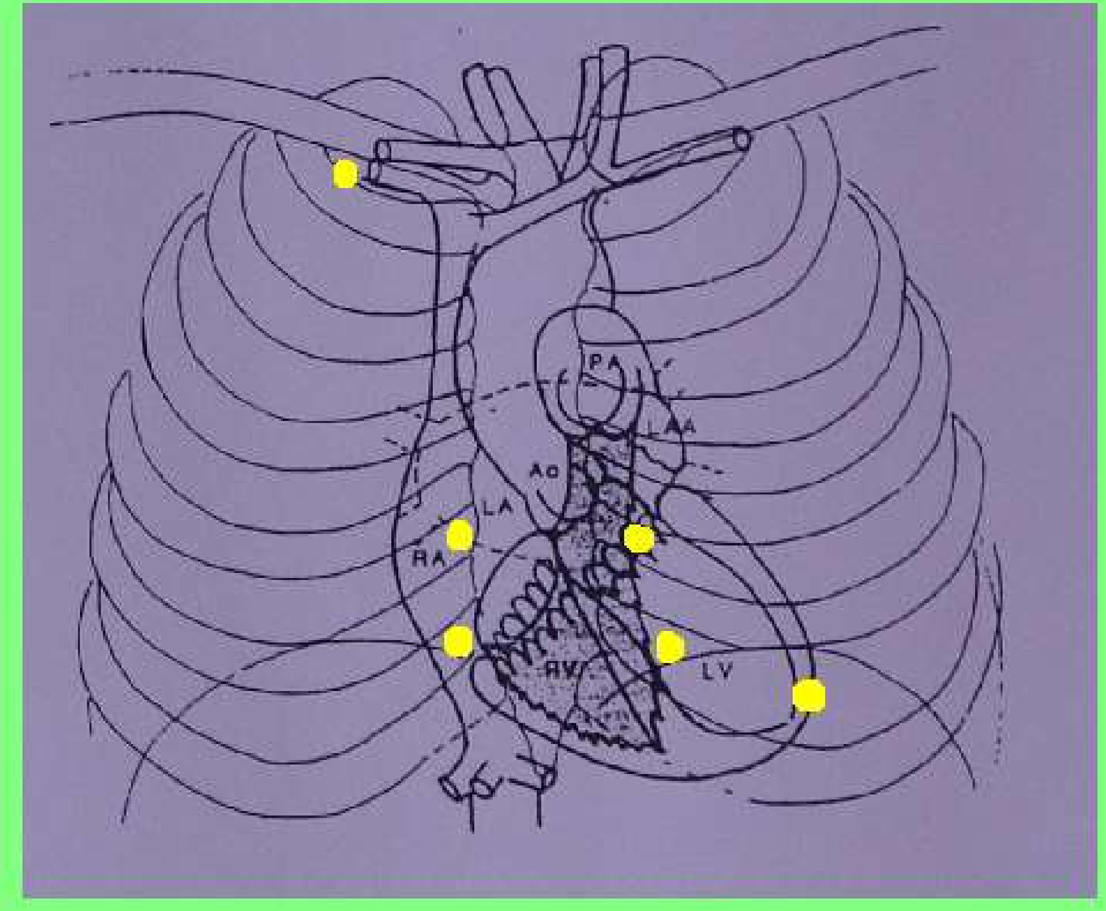
VERY BASIC HEART SOUNDS ASSESSMENT

ABNORMAL EKG CHANGES THAT MAY PRESENT WITH ABNORMAL HEART SOUNDS :

- ACUTE MI
- CHAMBER HYPERTROPHY
- RECENT MI (NECROSIS)
- PERICARDITIS

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 ASSSESSMENT

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

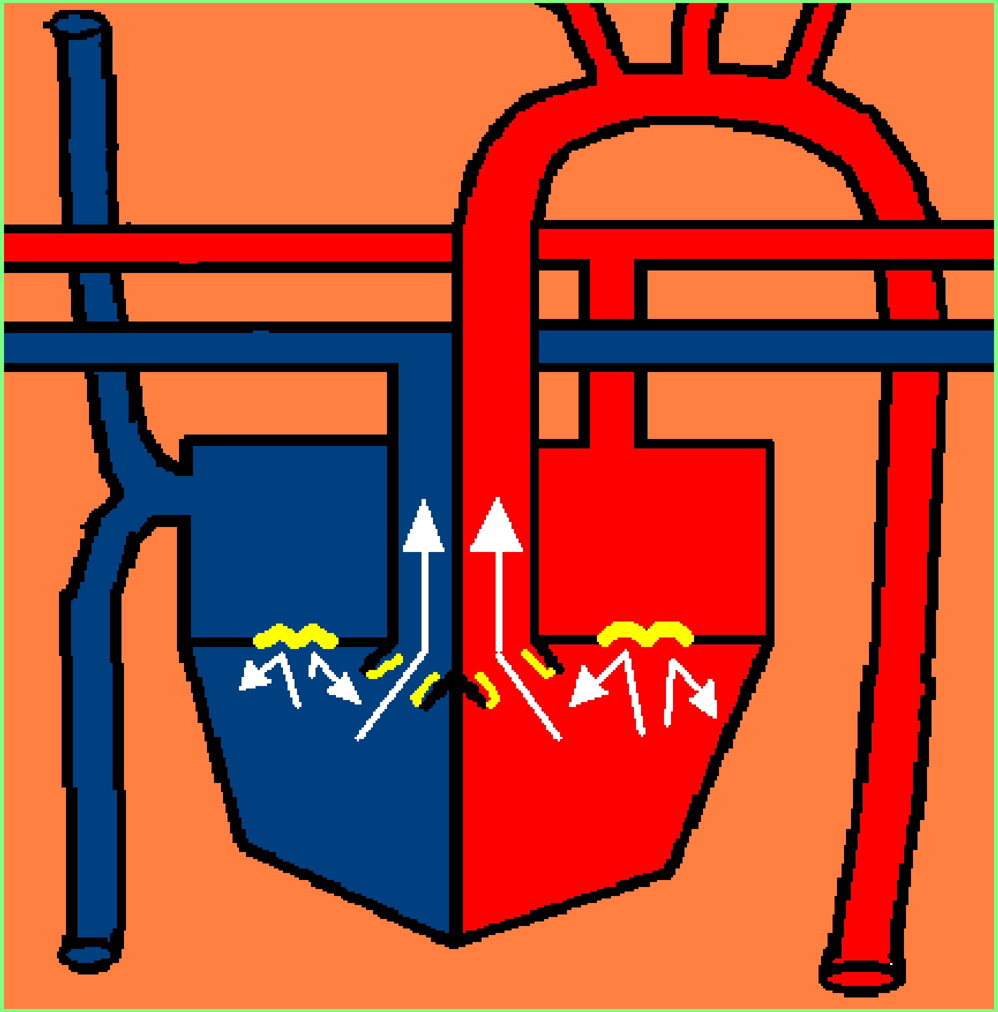
THERE ARE TWO NORMAL HEART SOUNDS, KNOWN AS: **S-1** and **S-2**

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

HEART SOUNDS ASSESSSMENT

S-1
BEGINNING
OF
SYSTOLE.

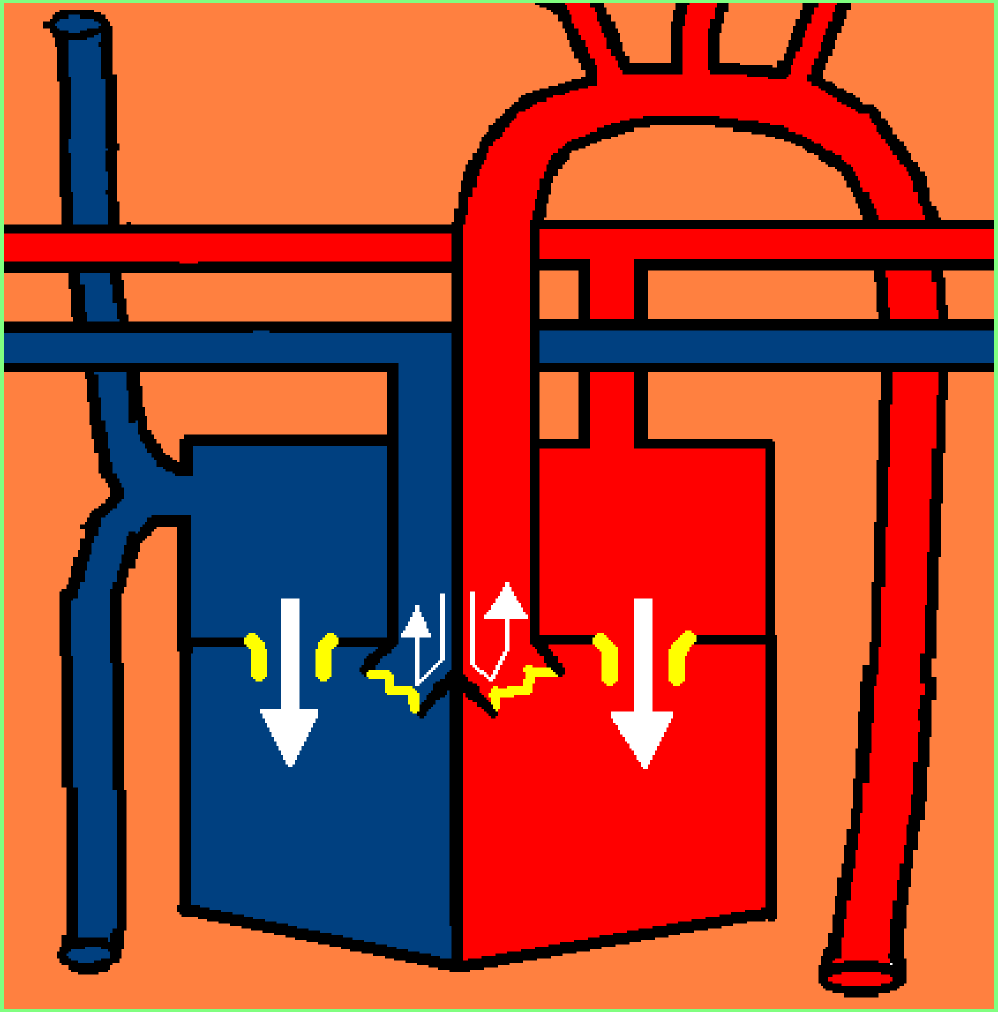
SOUND OF
THE
MITRAL
AND
TRICUSPID
VALVES
CLOSING.



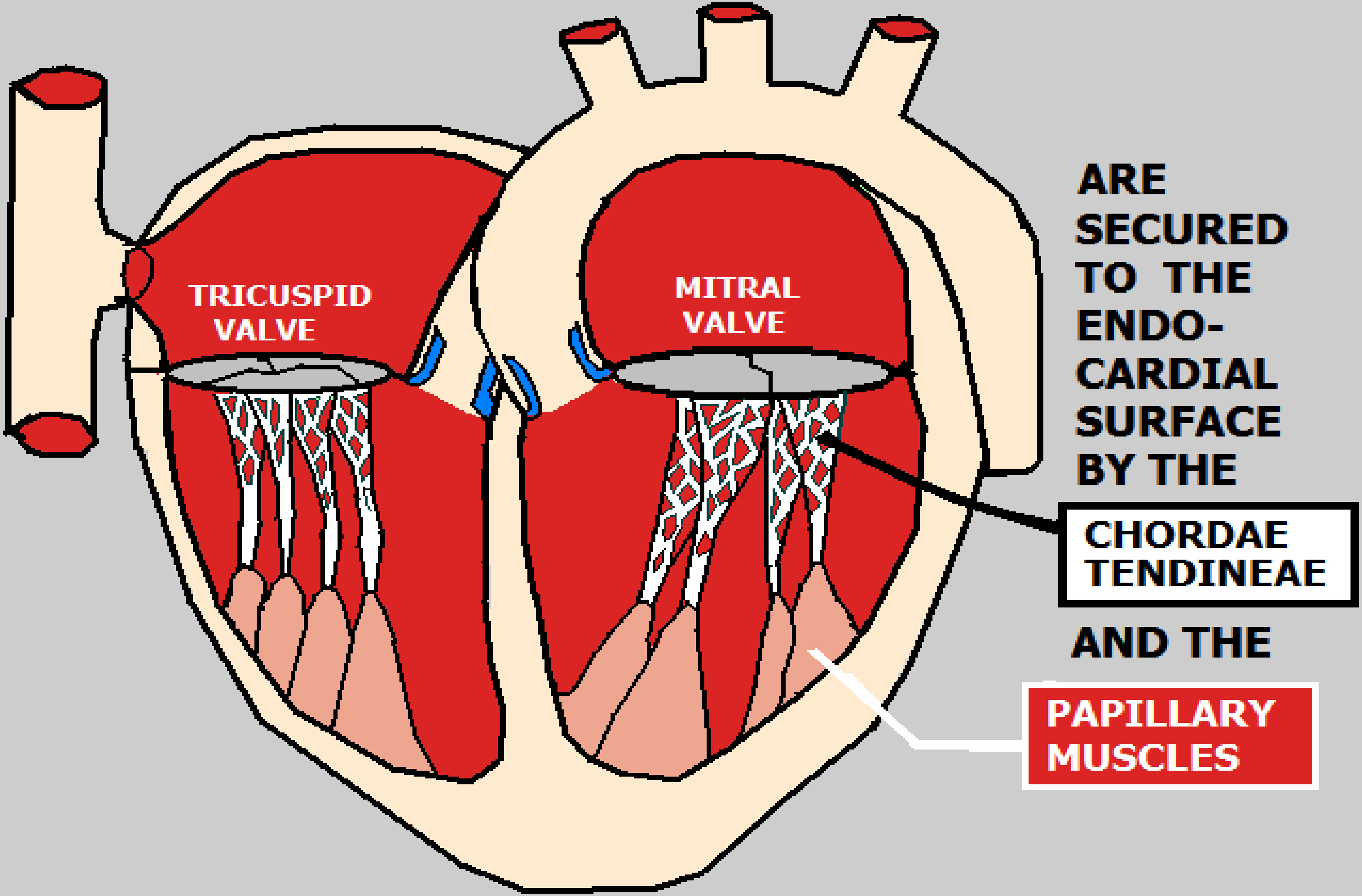
HEART SOUNDS ASSSESSMENT

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

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



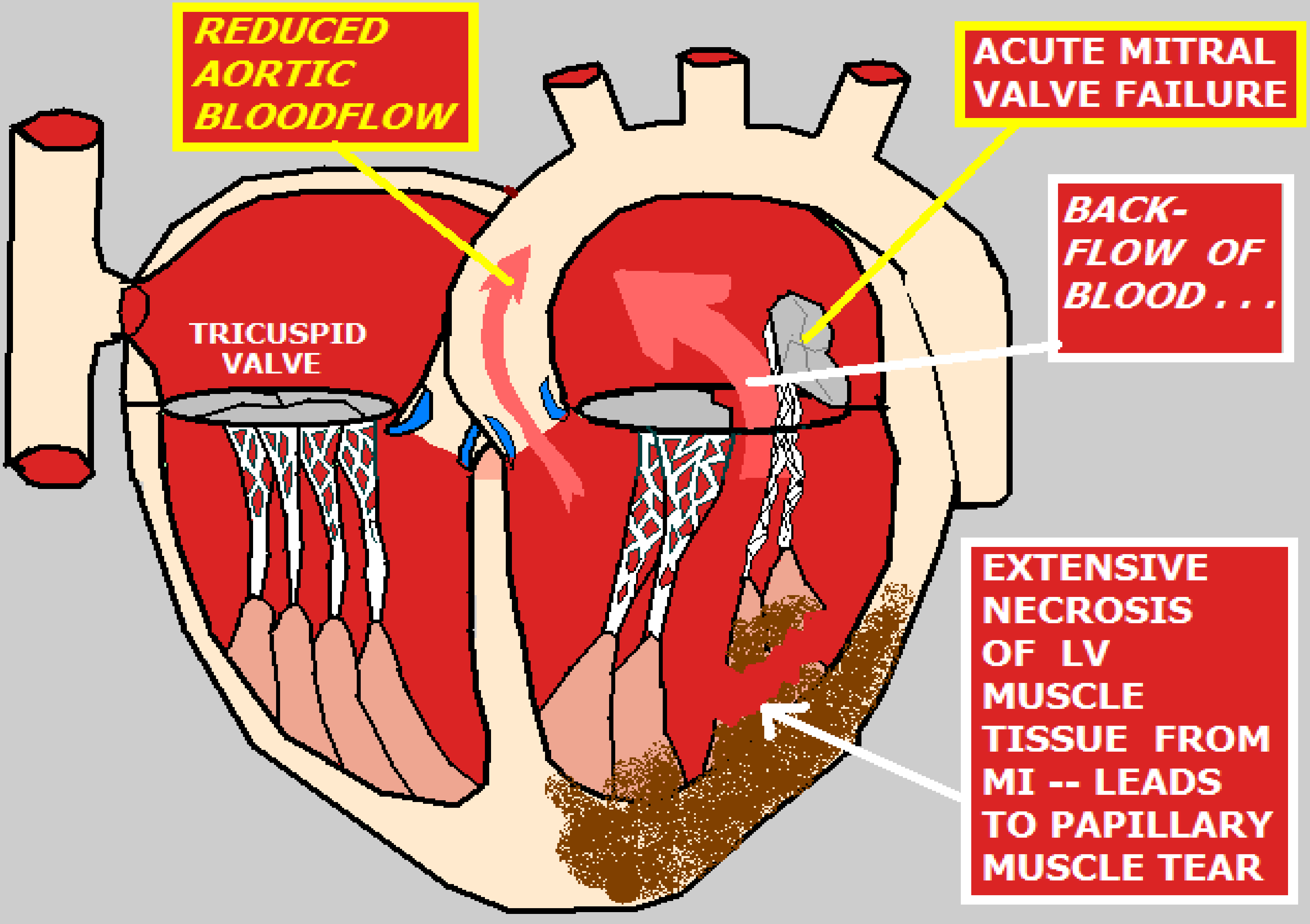
ATRIO-VENTRICULAR VALVES



ARE SECURED TO THE ENDO-CARDIAL SURFACE BY THE CHORDAE TENDINEAE AND THE PAPILLARY MUSCLES

ACUTE MITRAL REGURGITATION

DURING VENTRICULAR SYSTOLE



BASIC HEART SOUNDS ASSESSMENT

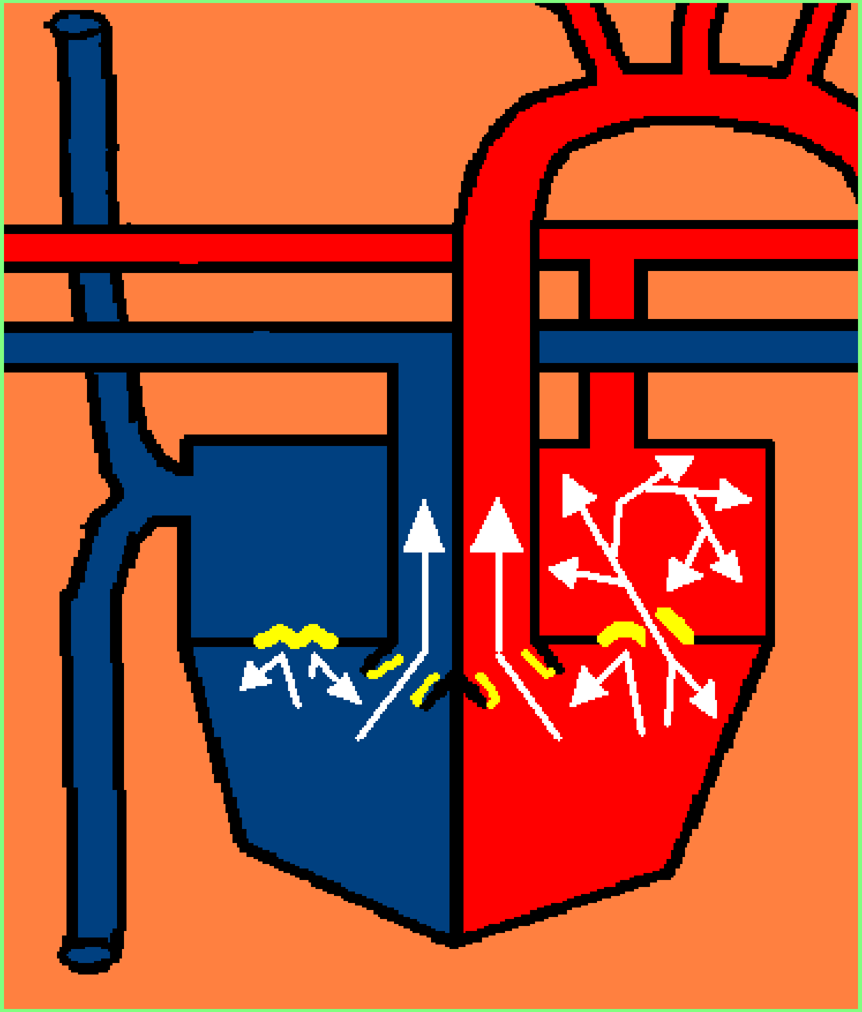
MURMUR = "SWOOSH" SOUND CAUSED BY THE SOUND OF TURBULENCE.

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



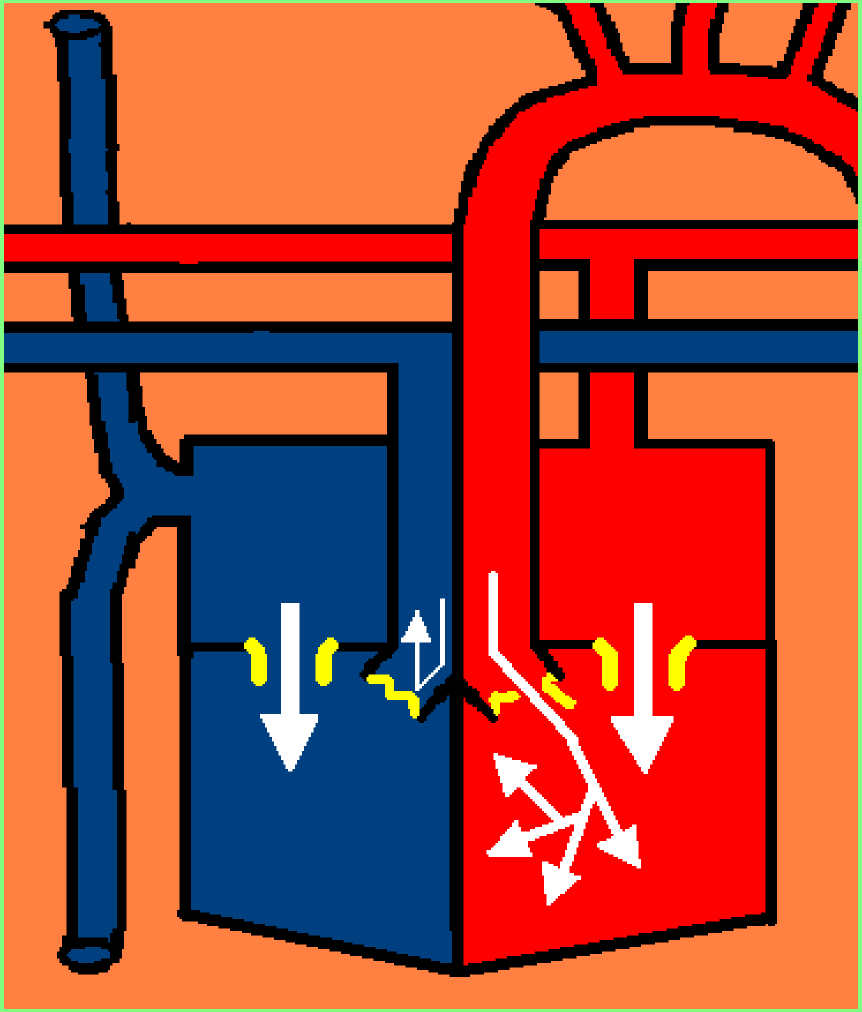
- MOST SYSTOLIC MURMURS CAUSED BY MITRAL VALVE FAILURE.

- 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).

CAUSE OF DIASTOLIC (S2) MURMUR

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



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 . . . "

- AORTIC VALVE FAILURE MOST COMMON CAUSE OF S-2 MURMUR

- DUE TO THE HIGHER PRESSURES OF THE LEFT SIDE OF THE HEART

BASIC HEART SOUNDS ASSESSMENT

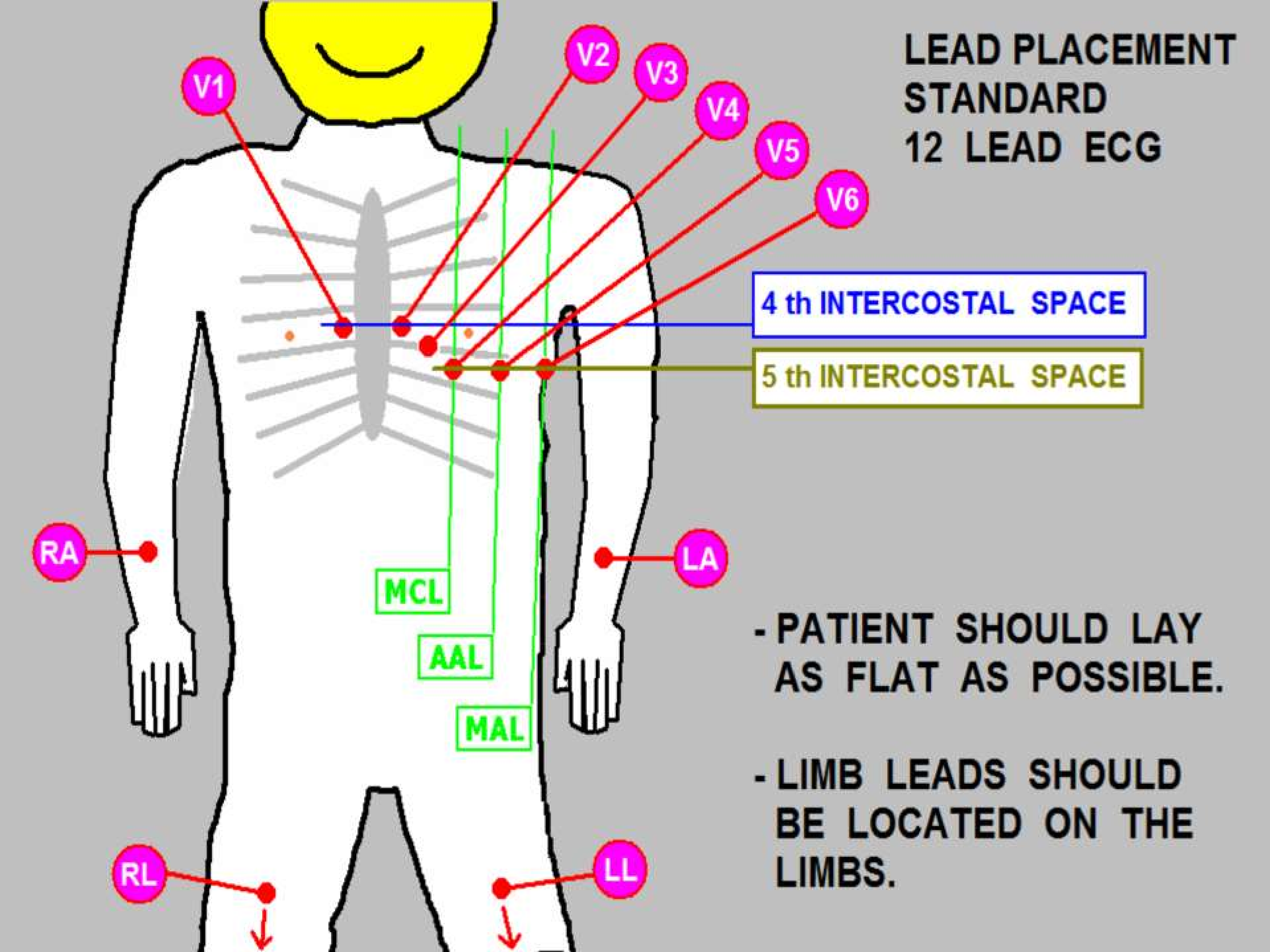
FRICTION RUB

- ASSOCIATED WITH PERICARDITIS
- SOUNDS LIKE THE GENTLE RUBBING OF SANDPAPER
- HAS 3 COMPONENTS: SYSTOLIC, EARLY, and LATE DIASTOLIC

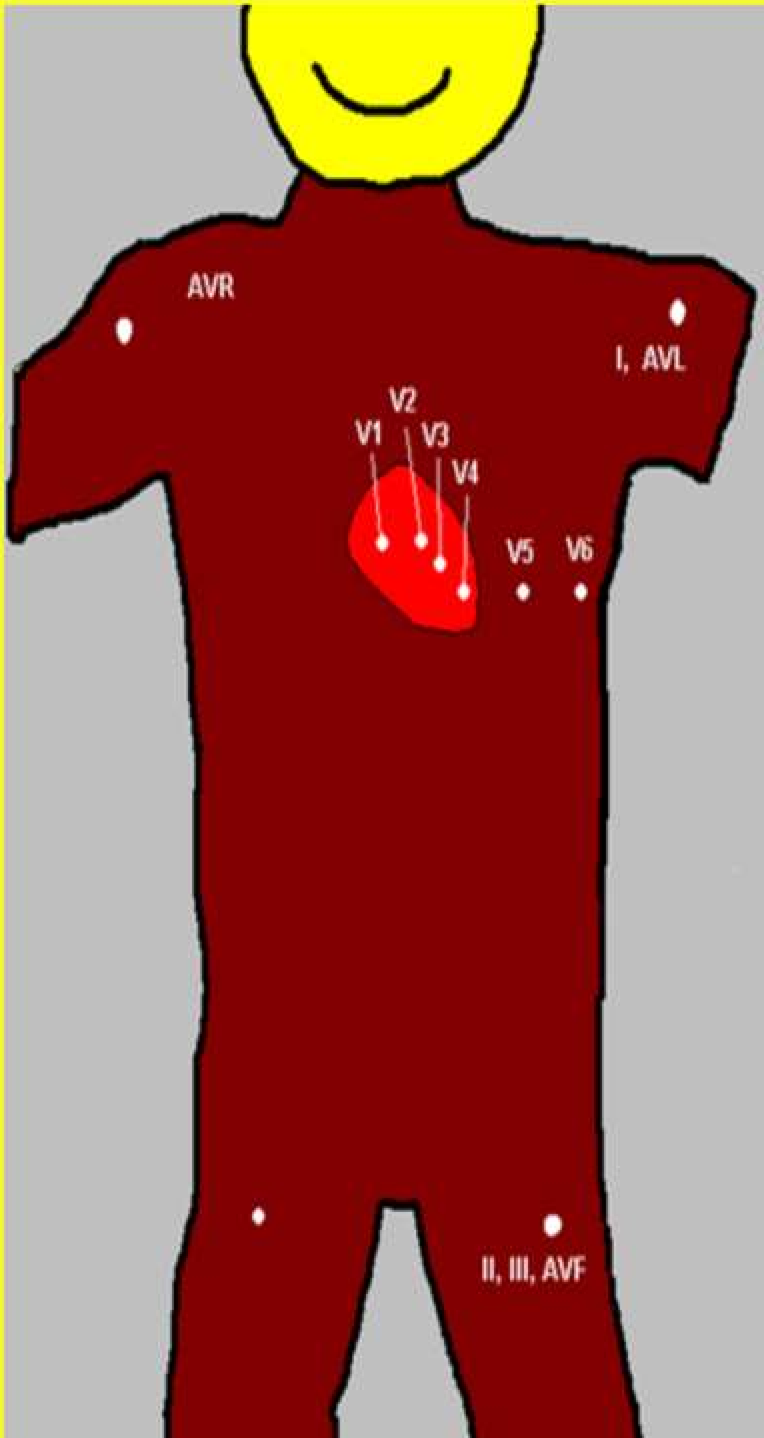
BASIC HEART SOUNDS ASSESSMENT

FRICTION RUB

- ❑ IS PRESENT IN MOST ACUTE TRANSMURAL MI PATIENTS
- ❑ MAY BE PRESENT WITHIN HOURS AFTER ONSET
- ❑ IS TRANSIENT -- MAY LAST FOR A FEW DAYS


LEAD PLACEMENT
STANDARD
12 LEAD ECG
V1
V2
V3
V4
V5
V6
4 th INTERCOSTAL SPACE
5 th INTERCOSTAL SPACE
RA
LA
MCL
AAL
MAL
RL
LL
- PATIENT SHOULD LAY AS FLAT AS POSSIBLE.
- LIMB LEADS SHOULD BE LOCATED ON THE LIMBS.

AREAS VIEWED by 12 LEAD ECG



AVR

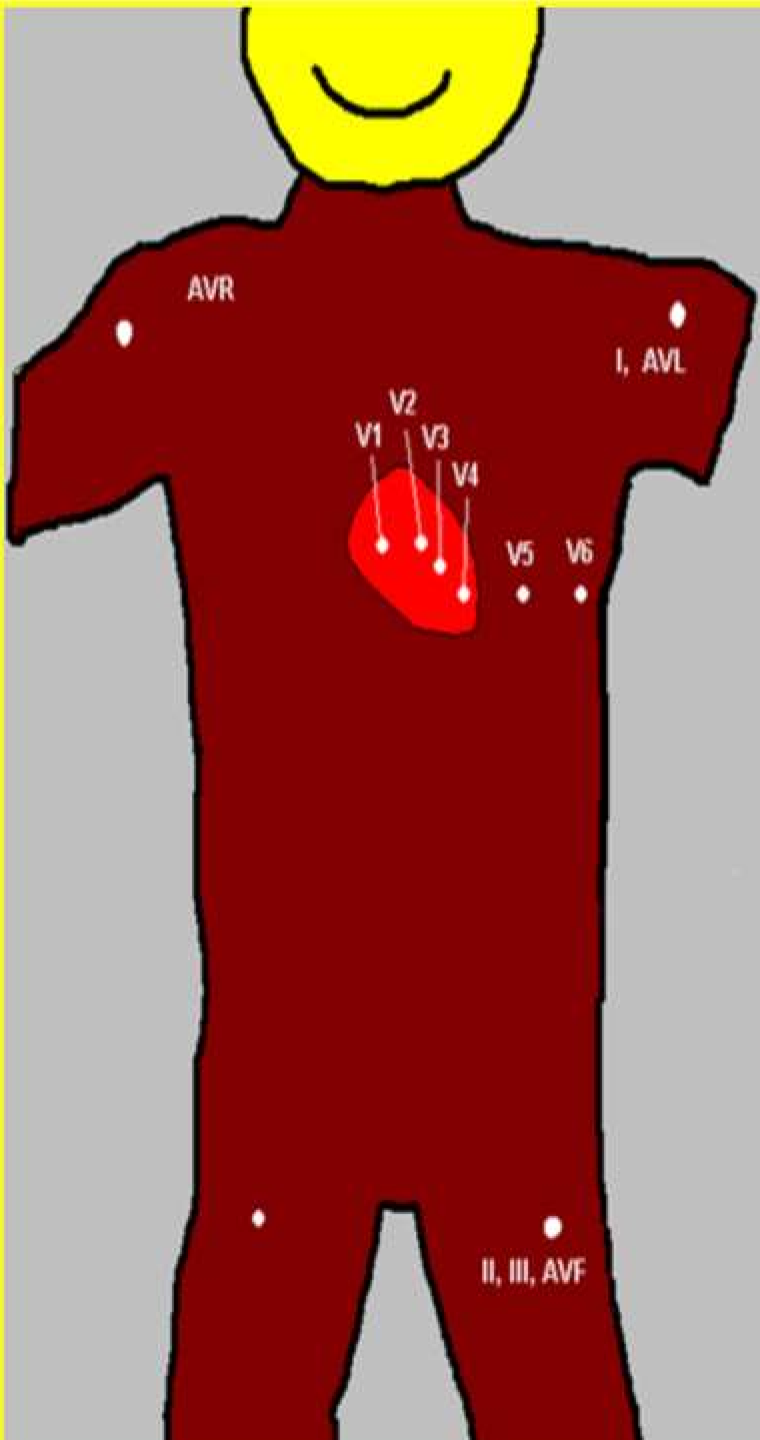
AVL, I

V1, V2

V3, V4

V5, V6

II, III, AVF

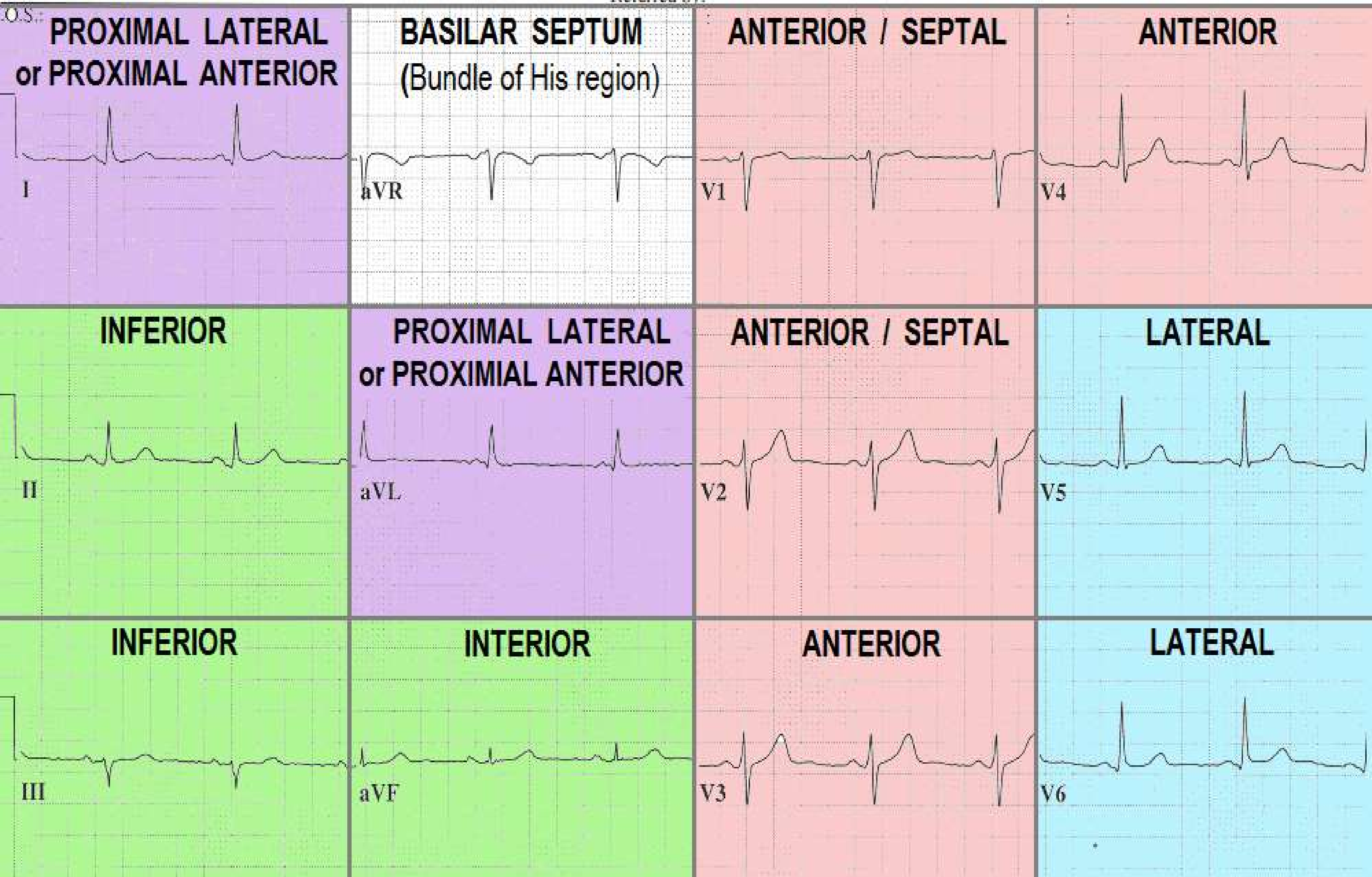


AREAS VIEWED by 12 LEAD ECG

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	Normal sinus rhythm
PR interval	130	ms	Normal ECG
QRS duration	96	ms	No previous ECGs available
QT/QTc	396/408	ms	
P–R–T axes	40 11	61	

Referred by:

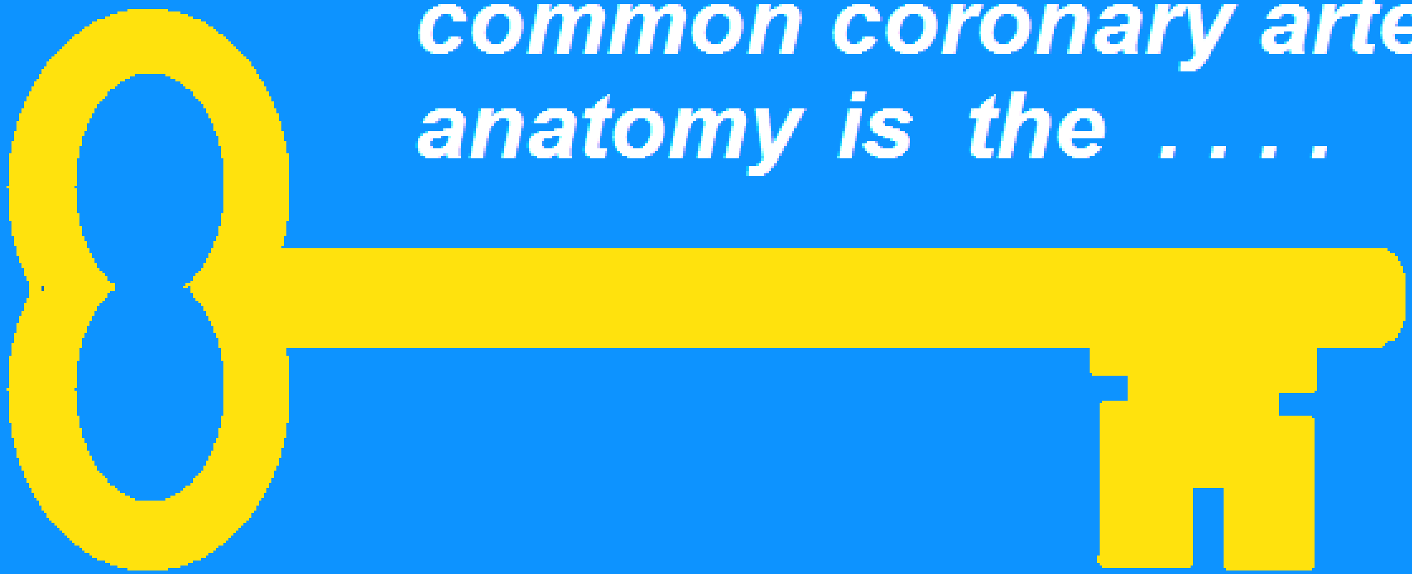


THE CORONARY

ARTERIES

STRUCTURES SERVED BY THE CORONARY ARTERIES

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



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

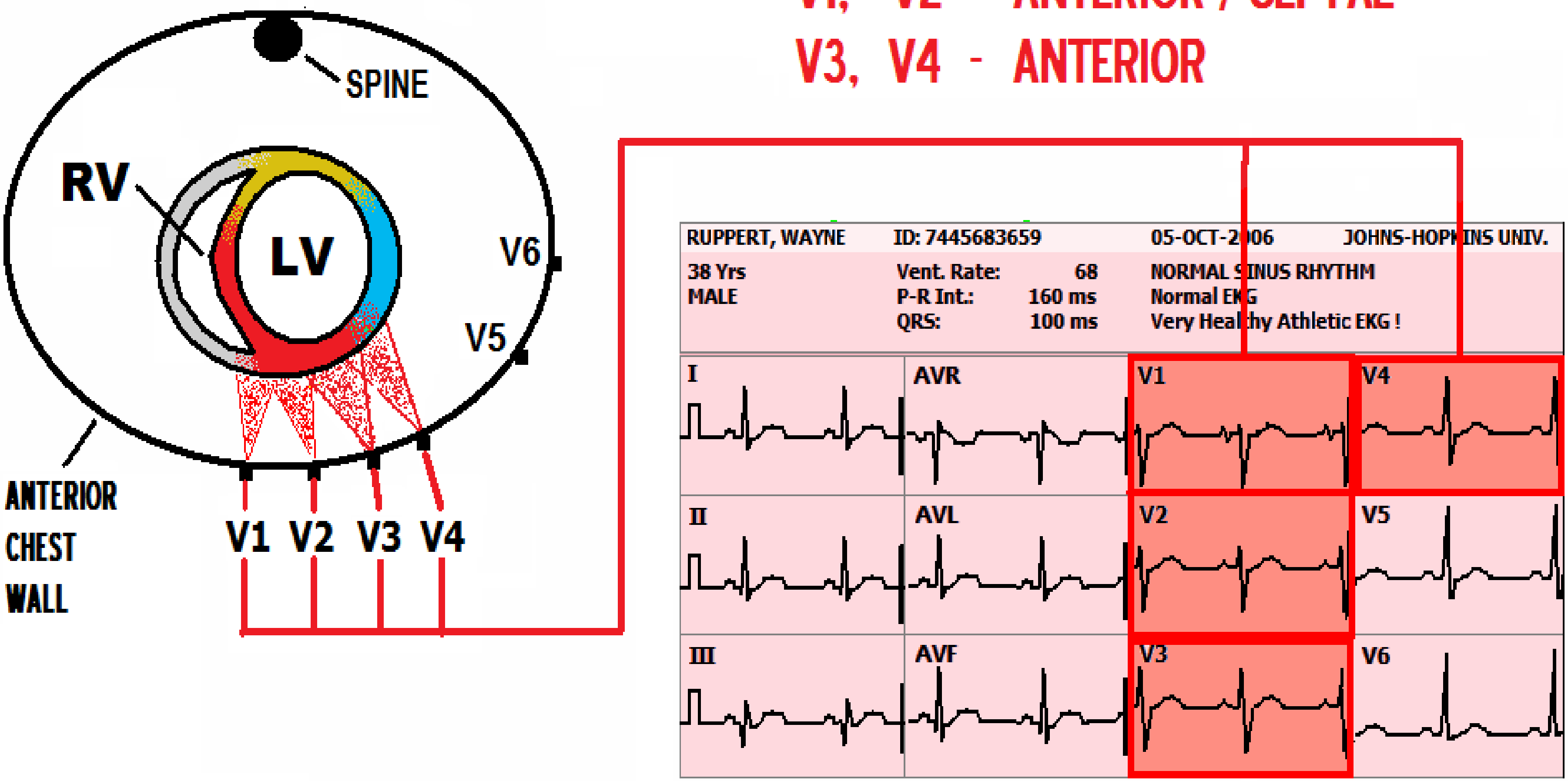
"INVALUABLE ASSET for ALL MEDICAL PROFESSIONALS who provide direct care to STEMI patients !"

INTERPRET THE EKG, THEN:

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

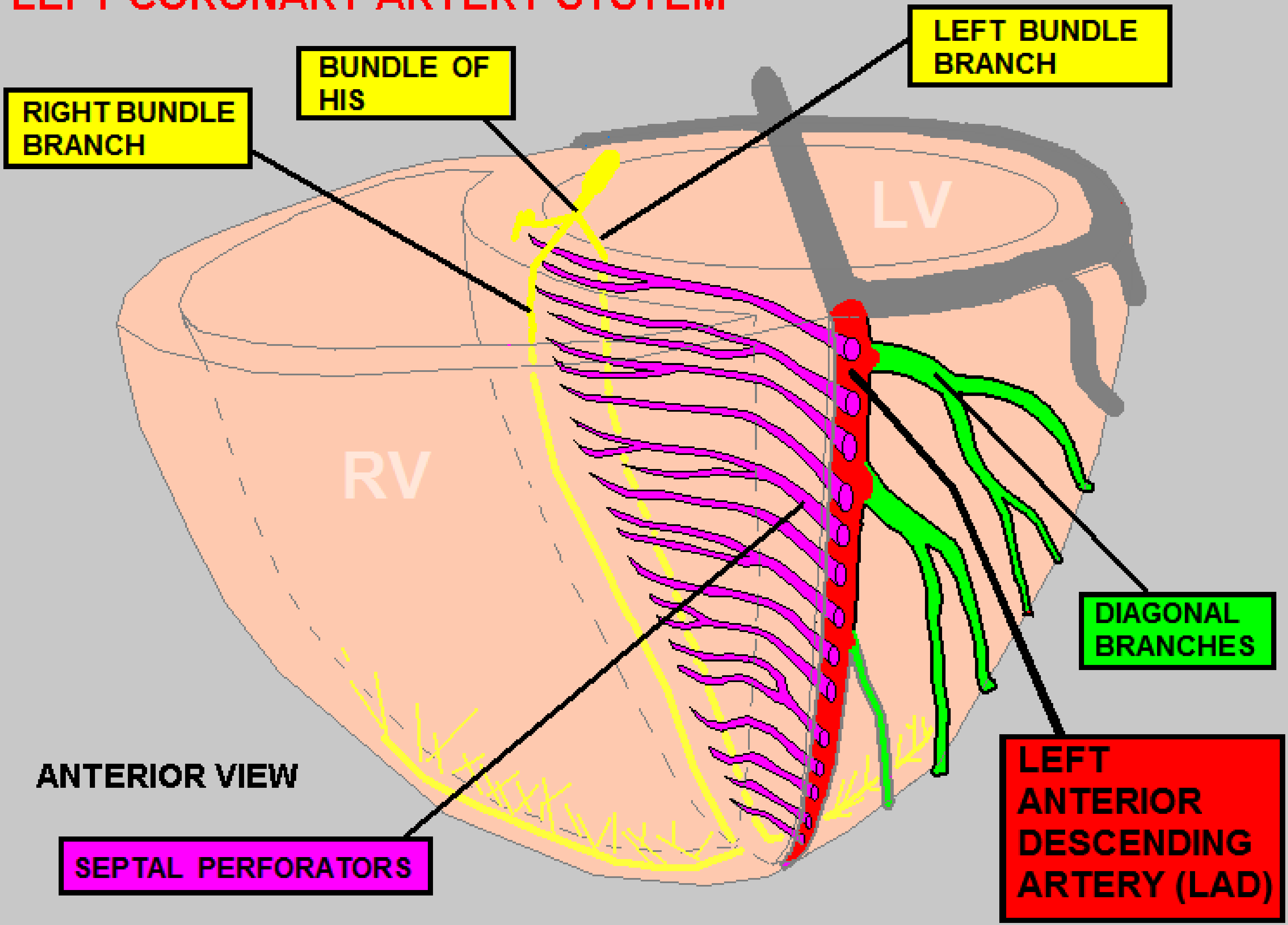
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL of the LEFT VENTRICLE

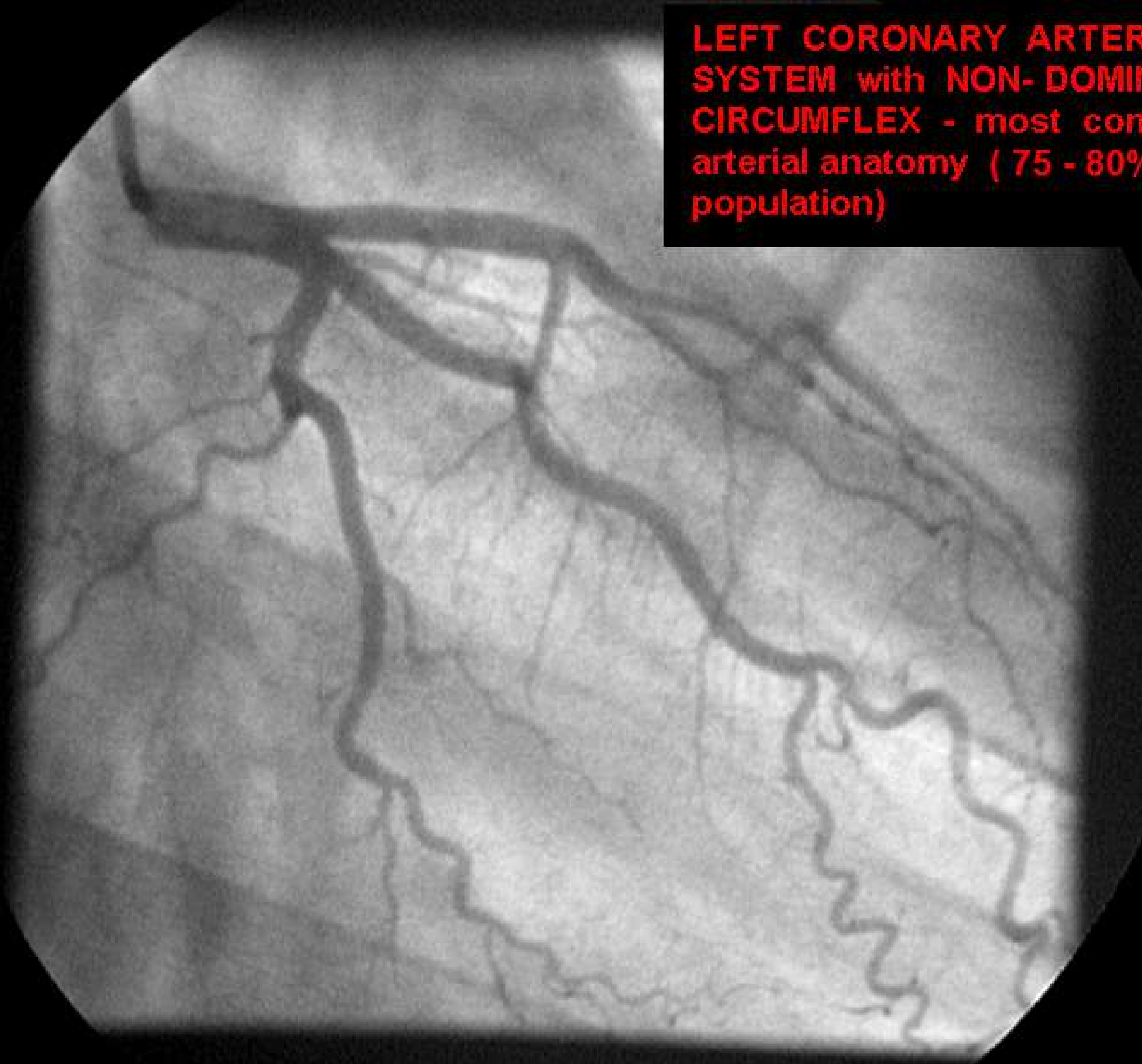
V1, V2 - ANTERIOR / SEPTAL
V3, V4 - ANTERIOR



Which Coronary Artery typically Supplies the ANTERIOR WALL ?

LEFT CORONARY ARTERY SYSTEM




LEFT CORONARY ARTERY SYSTEM with NON- DOMINANT CIRCUMFLEX - most common arterial anatomy (75 - 80% of population)

HELPFUL HINT . . . MEMORIZE THIS !

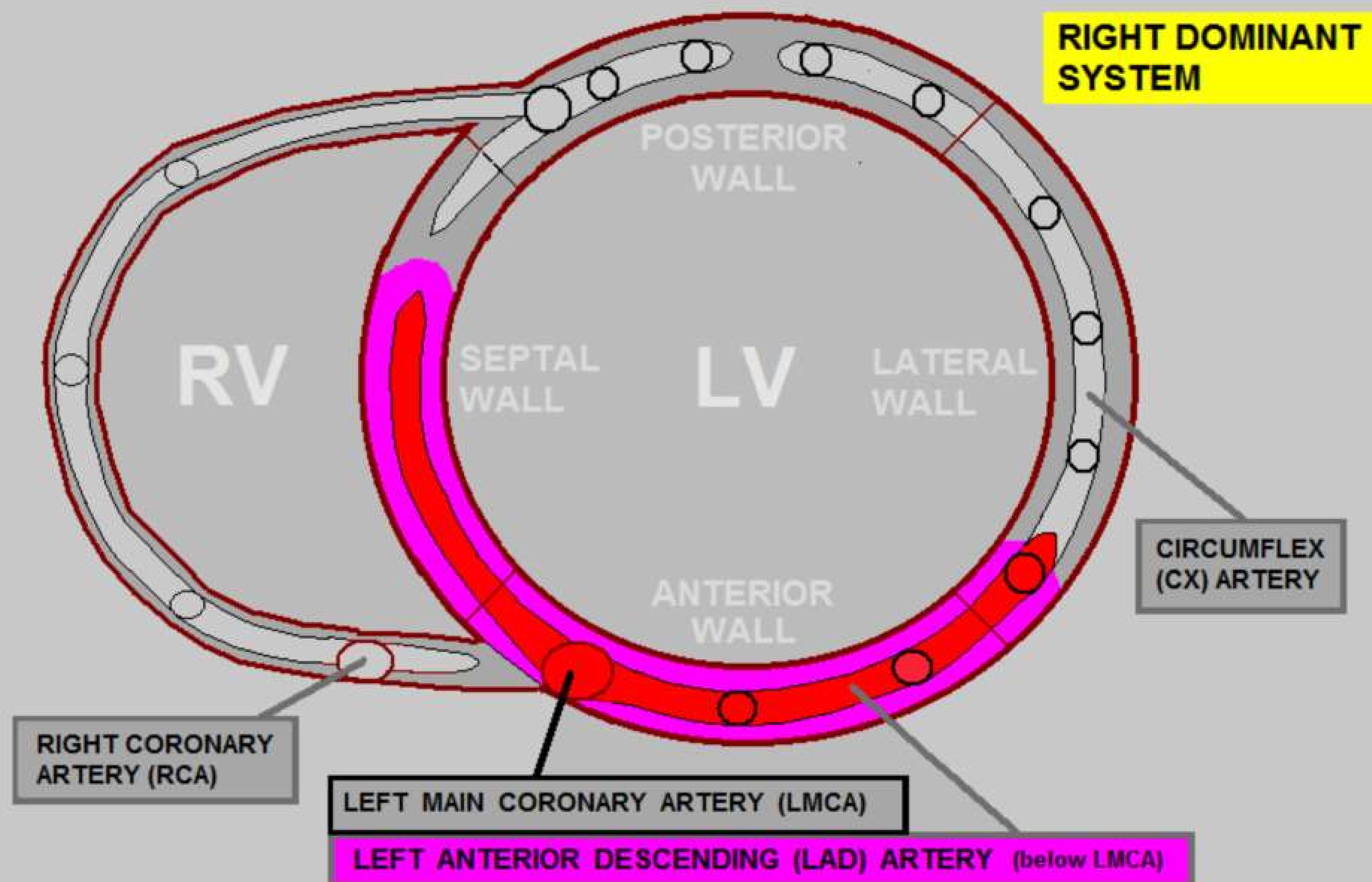
LEFT ANTERIOR DESCENDING ARTERY (LAD)

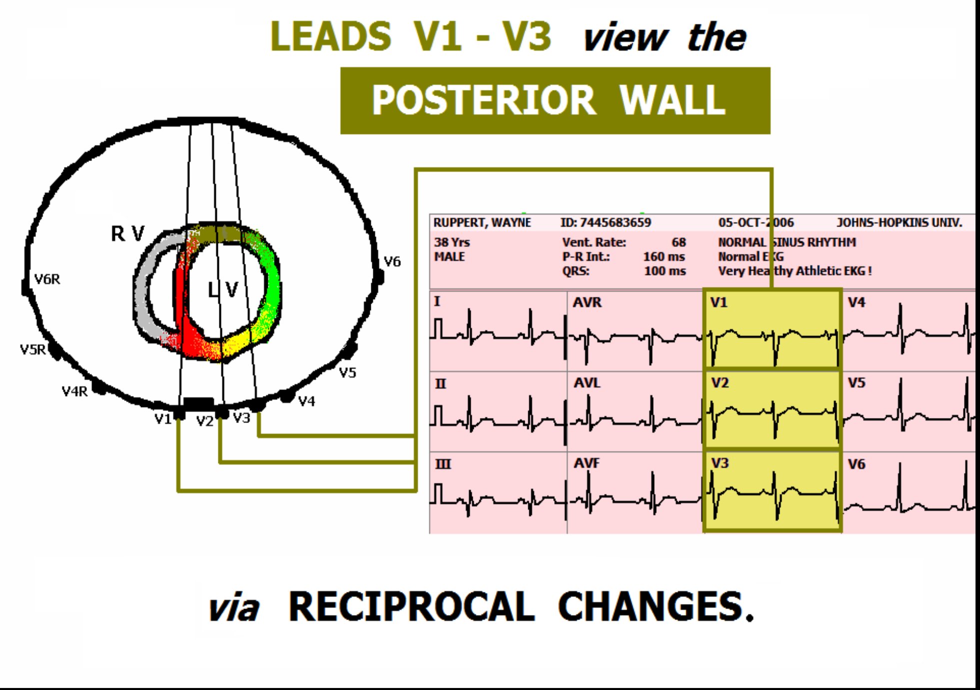
- BUNDLE OF HIS
- BUNDLE BRANCHES ( )
- 35 - 45 % OF LV MUSCLE MASS
  - ANTERIOR WALL
  - SEPTAL WALL (anterior 2/3)

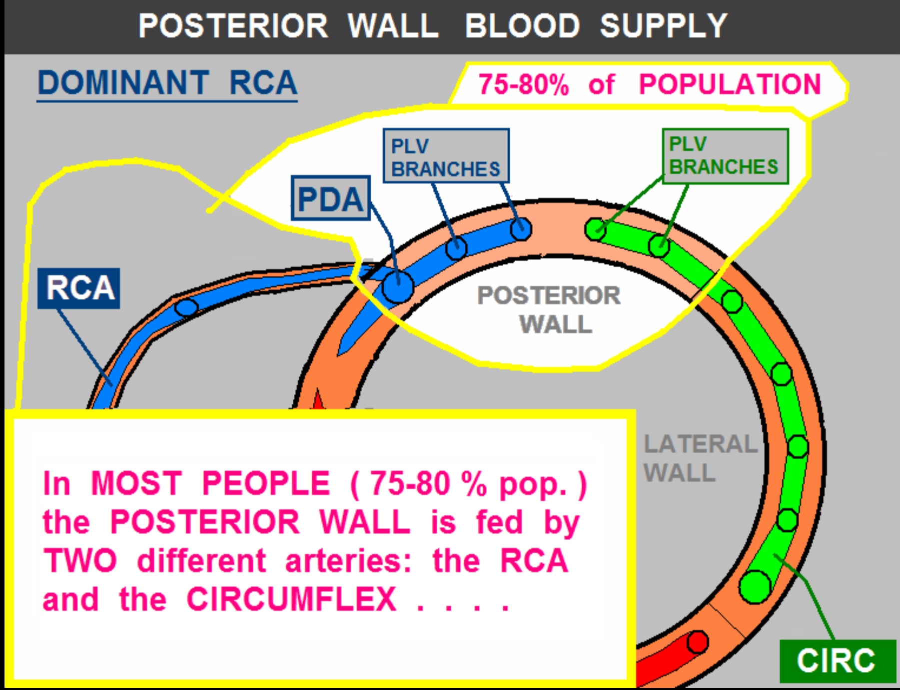
cutaway view of the

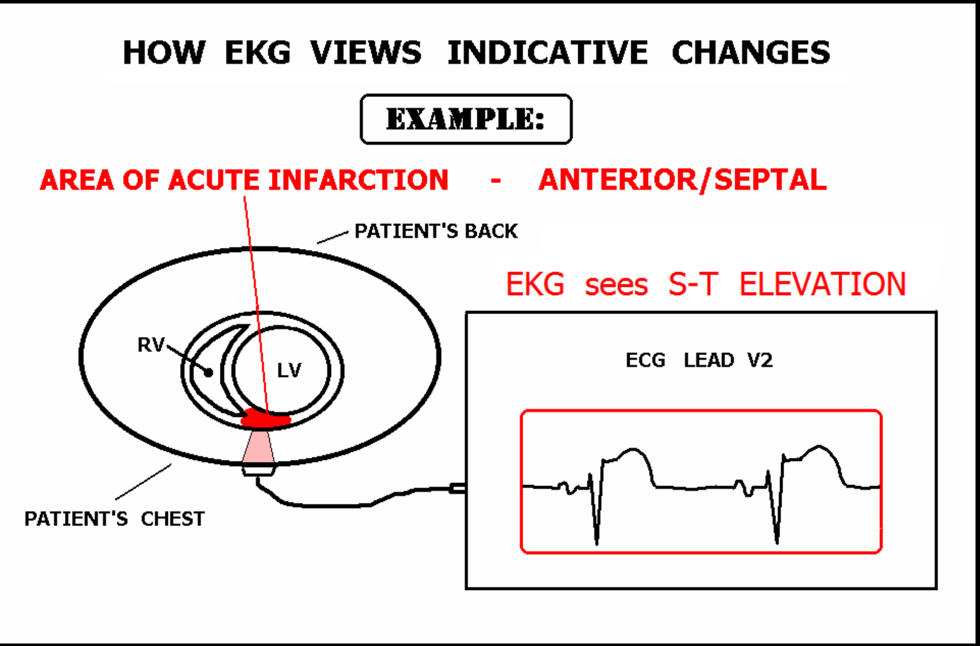
LEFT ANTERIOR DESCENDING ARTERY (LAD)

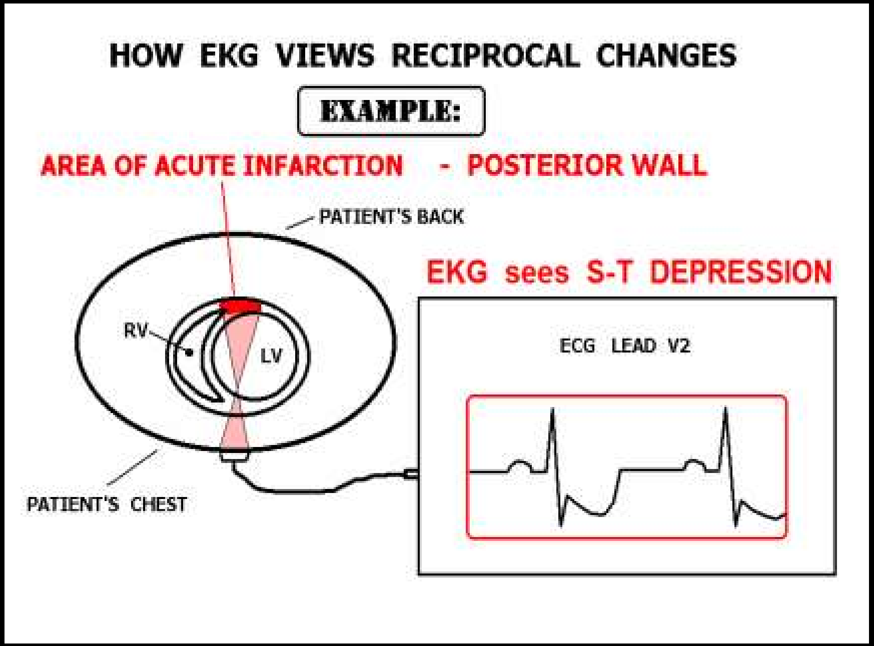
☛ **SUPPLIES APPROX. 35 - 45% of the LV MUSCLE MASS**




LEADS V1 - V3 view the
POSTERIOR WALL
R V
L V
V6R
V5R
V4R
V1
V2
V3
V4
V5
V6
RUPPERT, WAYNE
38 Yrs
MALE
ID: 7445683659
Vent. Rate: 68
P-R Int.: 160 ms
QRS: 100 ms
05-OCT-2006
NORMAL SINUS RHYTHM
Normal EKG
Very Healthy Athletic EKG !
JOHNS-HOPKINS UNIV.
I
II
III
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
via RECIPROCAL CHANGES.

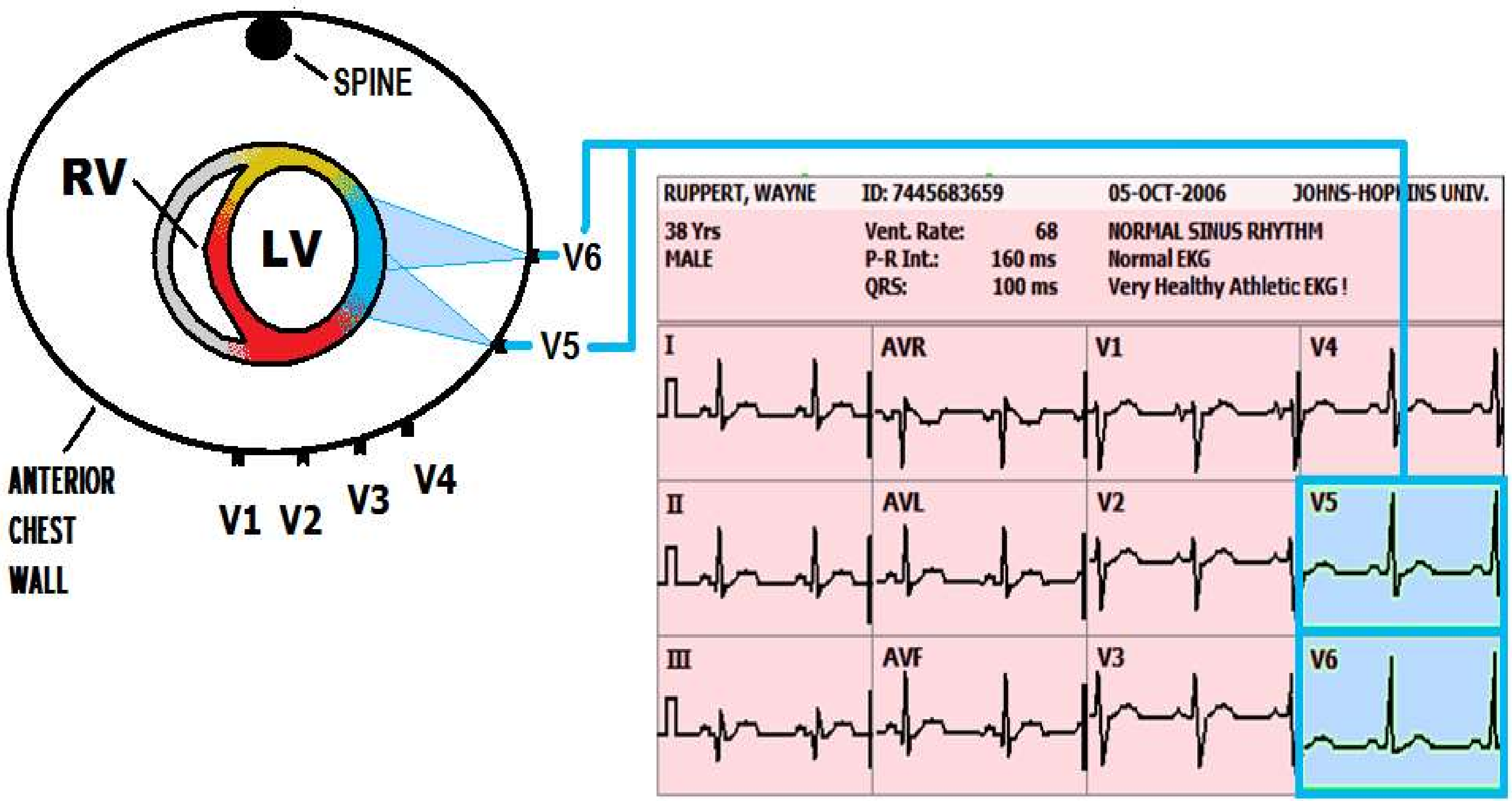

POSTERIOR WALL BLOOD SUPPLY
DOMINANT RCA
75-80% of POPULATION
PLV BRANCHES
PLV BRANCHES
PDA
RCA
POSTERIOR WALL
LATERAL WALL
In MOST PEOPLE (75-80 % pop.) the POSTERIOR WALL is fed by TWO different arteries: the RCA and the CIRCUMFLEX . . . .
CIRC


HOW EKG VIEWS INDICATIVE CHANGES
EXAMPLE:
AREA OF ACUTE INFARCTION - ANTERIOR/SEPTAL
PATIENT'S BACK
EKG sees S-T ELEVATION
RV
LV
ECG LEAD V2
PATIENT'S CHEST

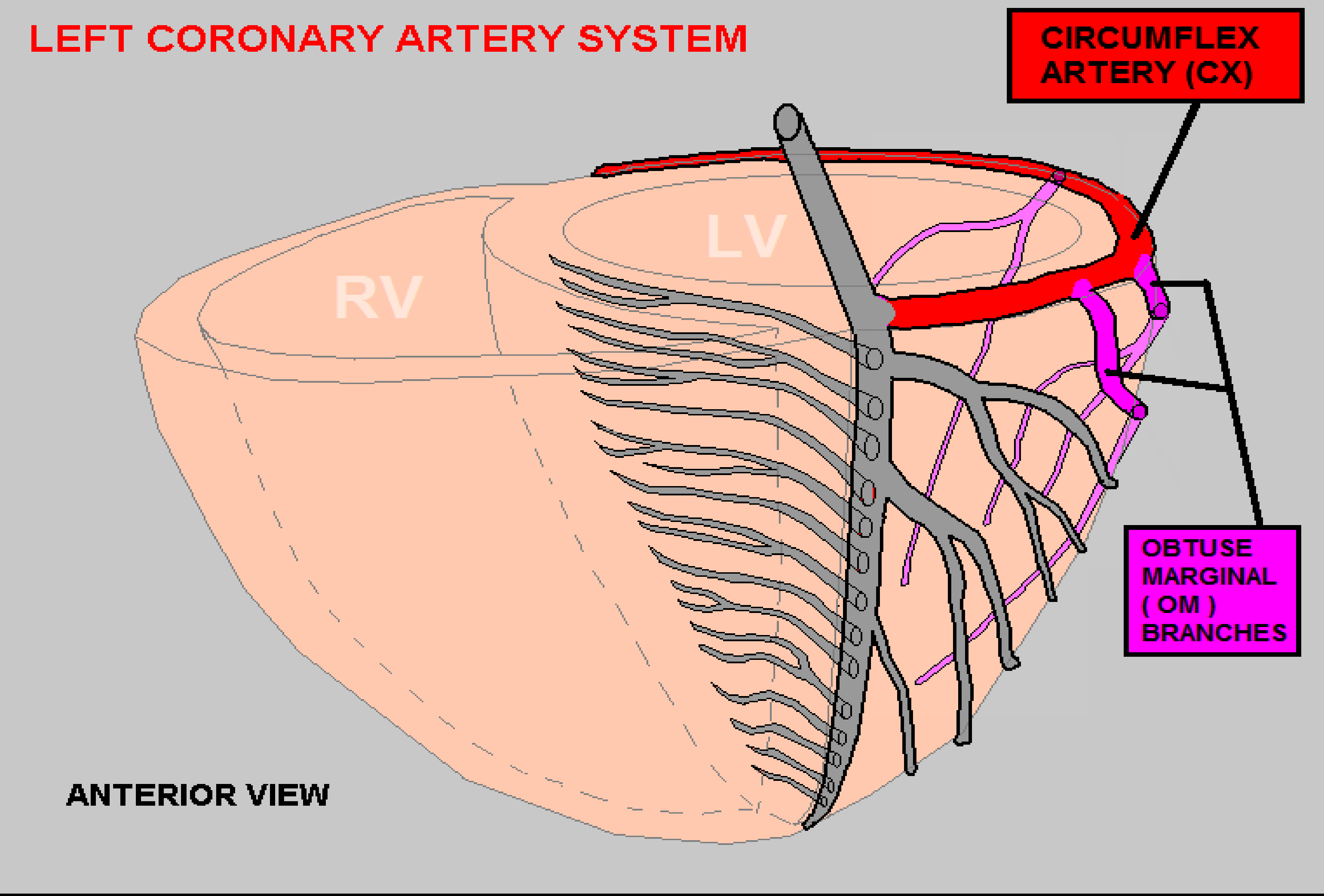

HOW EKG VIEWS RECIPROCAL CHANGES
EXAMPLE:
AREA OF ACUTE INFARCTION - POSTERIOR WALL
PATIENT'S BACK
EKG sees S-T DEPRESSION
RV
LV
ECG LEAD V2
PATIENT'S CHEST

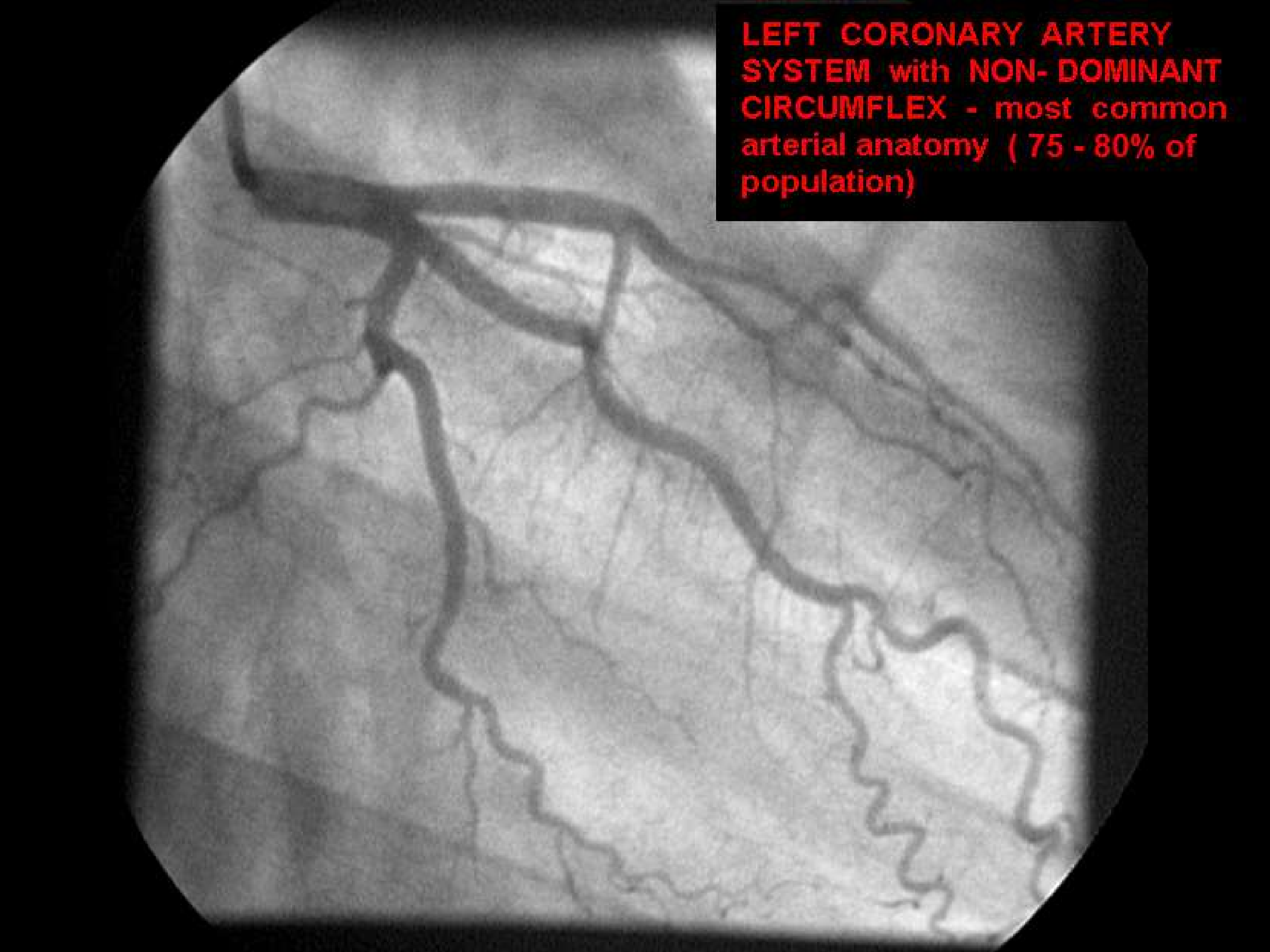
V5 - V6 VIEW THE LATERAL WALL

of the LEFT VENTRICLE



Which Coronary Artery typically Supplies the LATERAL WALL ?

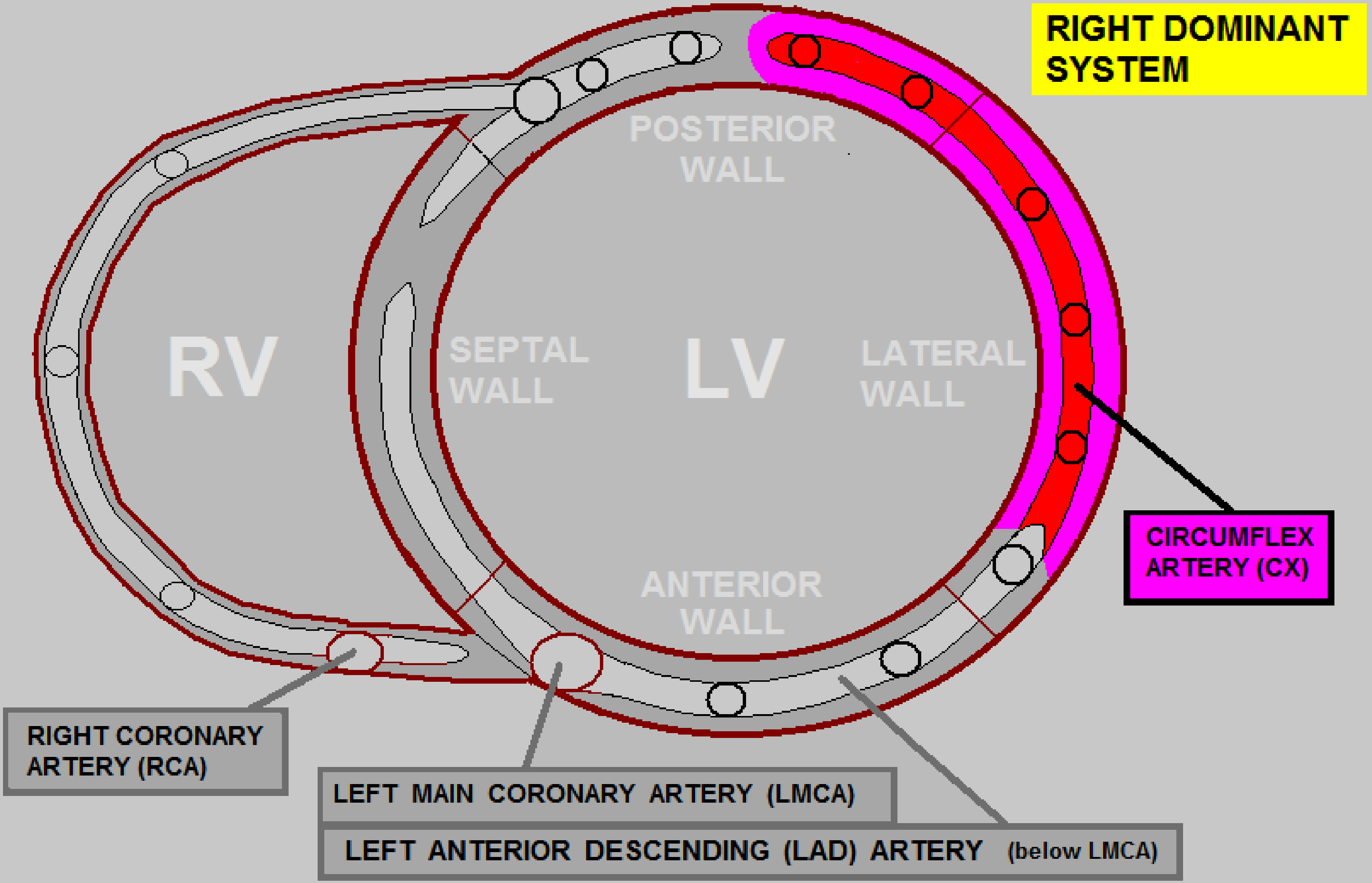

LEFT CORONARY ARTERY SYSTEM
CIRCUMFLEX ARTERY (CX)
LV
RV
OBTUSE MARGINAL (OM) BRANCHES
ANTERIOR VIEW


LEFT CORONARY ARTERY SYSTEM with NON- DOMINANT CIRCUMFLEX - most common arterial anatomy (75 - 80% of population)

cutaway view of the

CIRCUMFLEX ARTERY (CX) DISTRIBUTION

SUPPLIES 20 - 30 % of the LV MUSCLE MASS



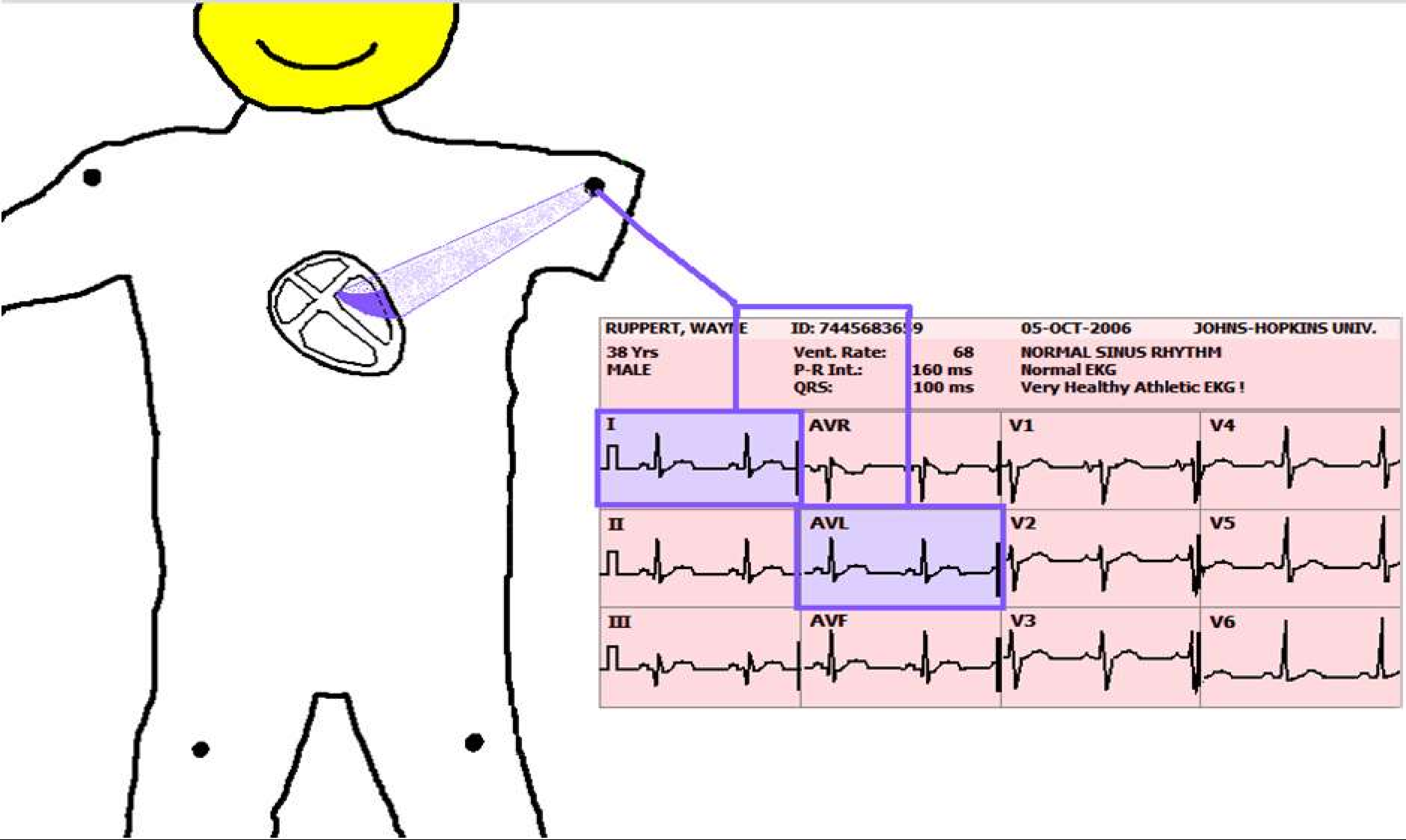
HELPFUL HINT . . . MEMORIZE THIS !

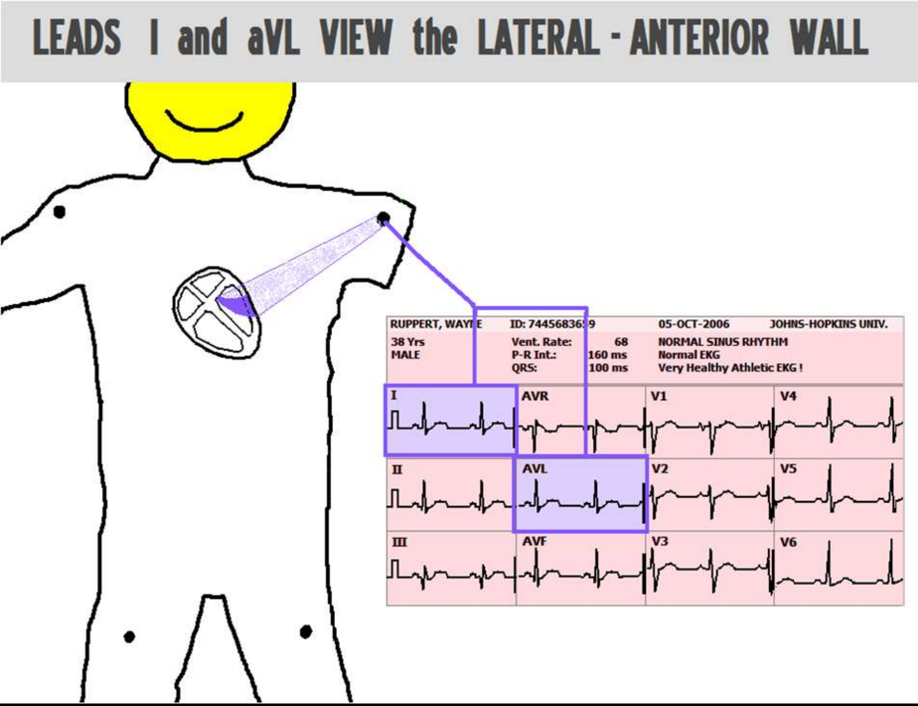
CIRCUMFLEX ARTERY (CX)

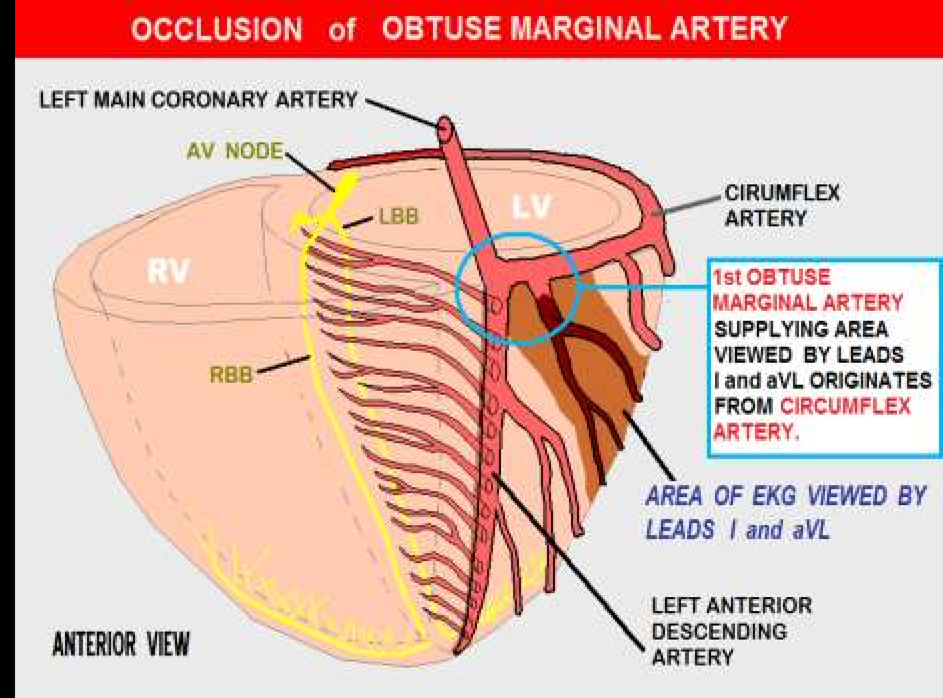
RIGHT DOMINANT SYSTEMS

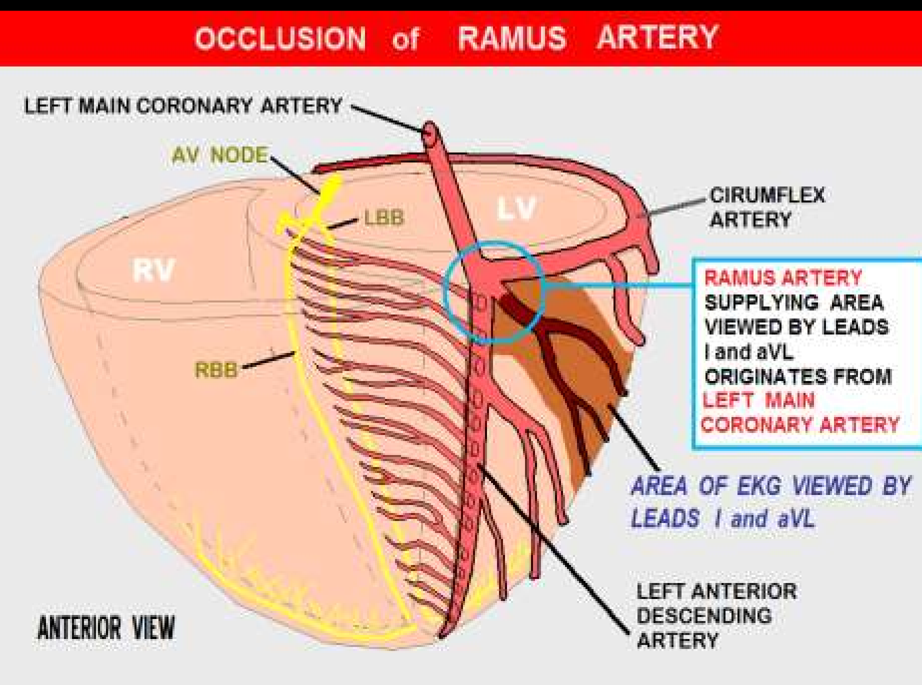
- LEFT ATRIUM
- SINUS NODE (45% of the population)
- LEFT VENTRICLE: 20 - 30 % of muscle mass
  - LATERAL WALL
  - up to 1/2 of POSTERIOR WALL

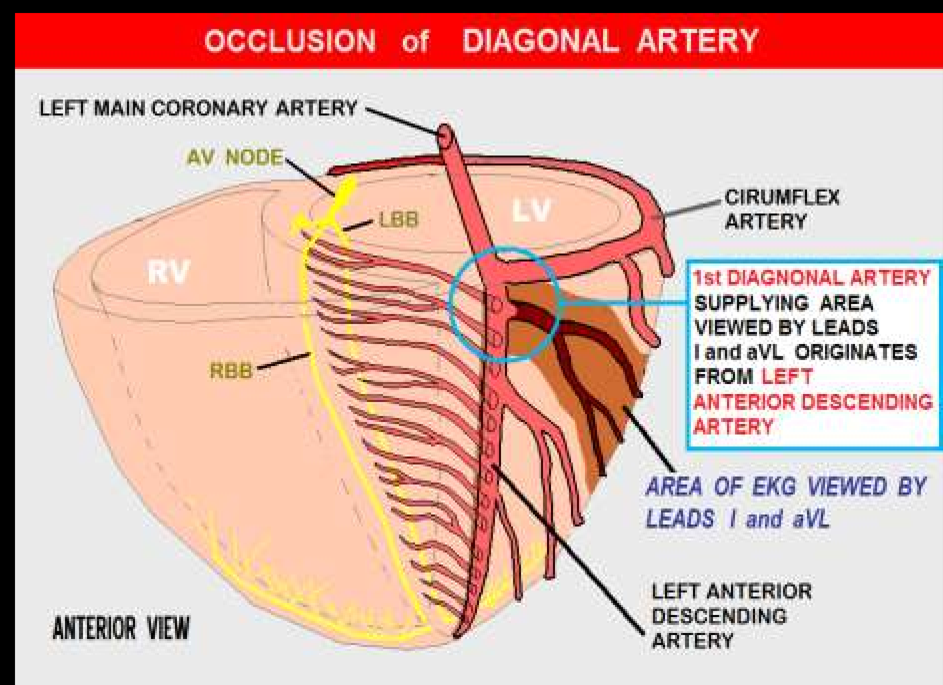
LEADS I and aVL VIEW the LATERAL - ANTERIOR WALL

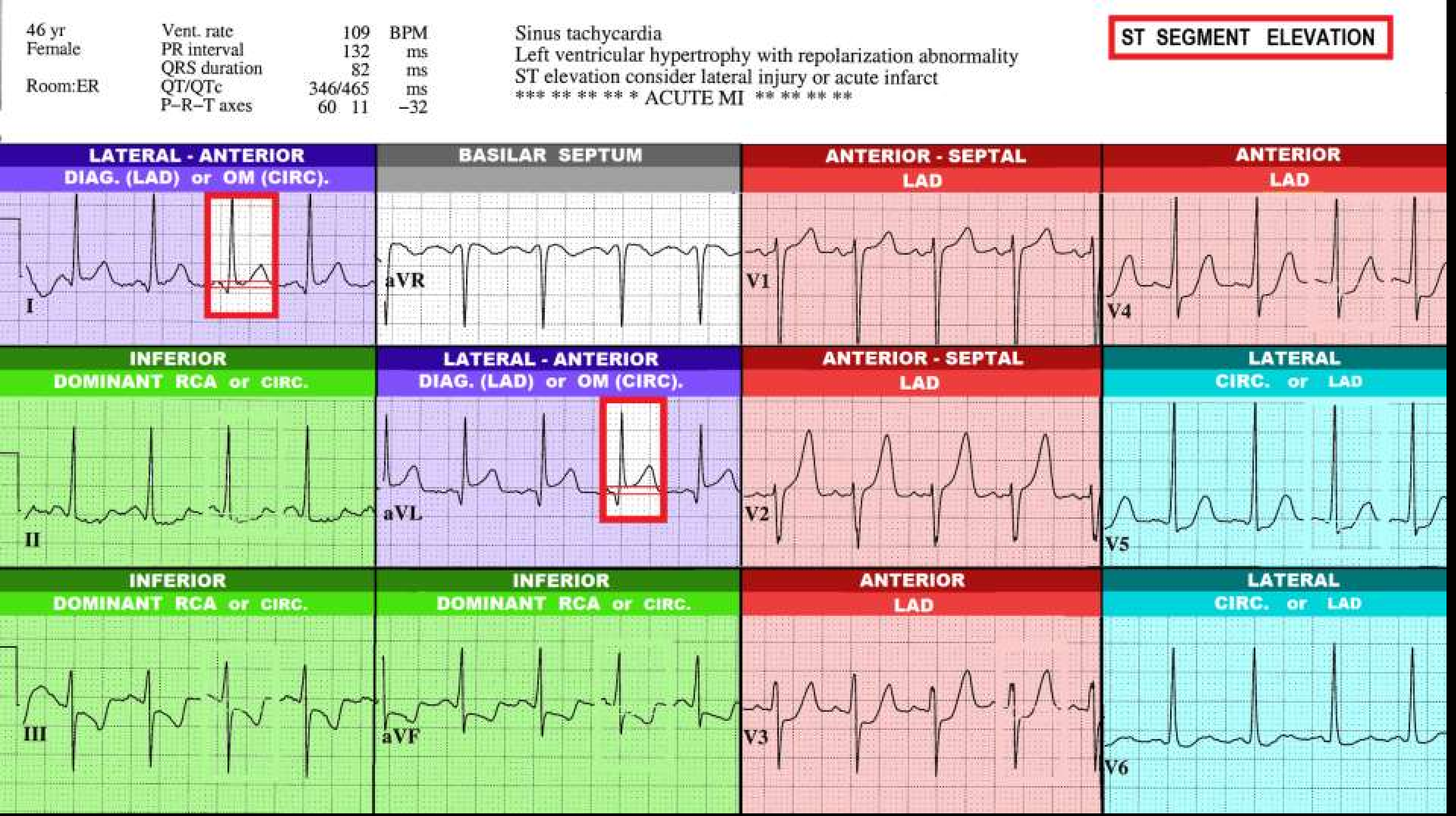



LEADS I and aVL VIEW the LATERAL - ANTERIOR WALL
05-OCT-2006
JOHNS-HOPKINS UNIV.
38 Yrs
MALE
Vent. Rate: 68
P-R Int.: 160 ms
QRS: 100 ms
NORMAL SINUS RHYTHM
Normal EKG
Very Healthy Athletic EKG !
I
AVR
V1
V4
II
AVL
V2
V5
III
AVF
V3
V6


OCCLUSION of OBTUSE MARGINAL ARTERY
LEFT MAIN CORONARY ARTERY
AV NODE
LBB
LV
CIRUMFLEX ARTERY
RV
RBB
1st OBTUSE MARGINAL ARTERY SUPPLYING AREA VIEWED BY LEADS I and aVL ORIGINATES FROM CIRCUMFLEX ARTERY.
AREA OF EKG VIEWED BY LEADS I and aVL
LEFT ANTERIOR DESCENDING ARTERY
ANTERIOR VIEW


OCCLUSION of RAMUS ARTERY
LEFT MAIN CORONARY ARTERY
AV NODE
LBB
LV
CIRUMFLEX ARTERY
RV
RBB
RAMUS ARTERY SUPPLYING AREA VIEWED BY LEADS I and aVL ORIGINATES FROM LEFT MAIN CORONARY ARTERY
AREA OF EKG VIEWED BY LEADS I and aVL
LEFT ANTERIOR DESCENDING ARTERY
ANTERIOR VIEW

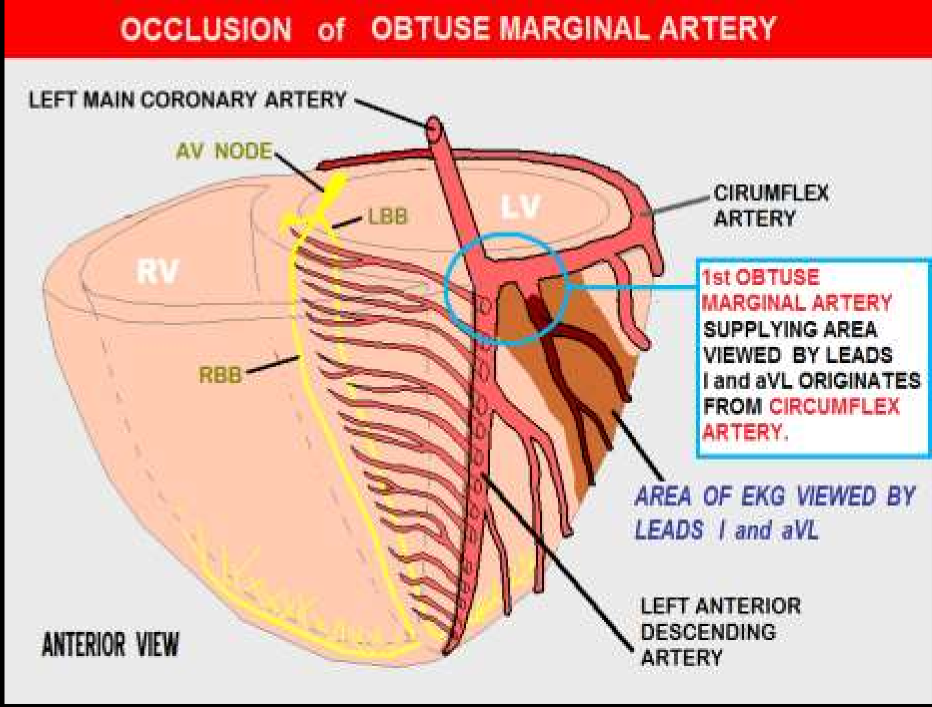

OCCLUSION of DIAGONAL ARTERY
LEFT MAIN CORONARY ARTERY
AV NODE
LBB
LV
CIRUMFLEX ARTERY
RV
RBB
1st DIAGNONAL ARTERY SUPPLYING AREA VIEWED BY LEADS I and aVL ORIGINATES FROM LEFT ANTERIOR DESCENDING ARTERY
AREA OF EKG VIEWED BY LEADS I and aVL
LEFT ANTERIOR DESCENDING ARTERY
ANTERIOR VIEW

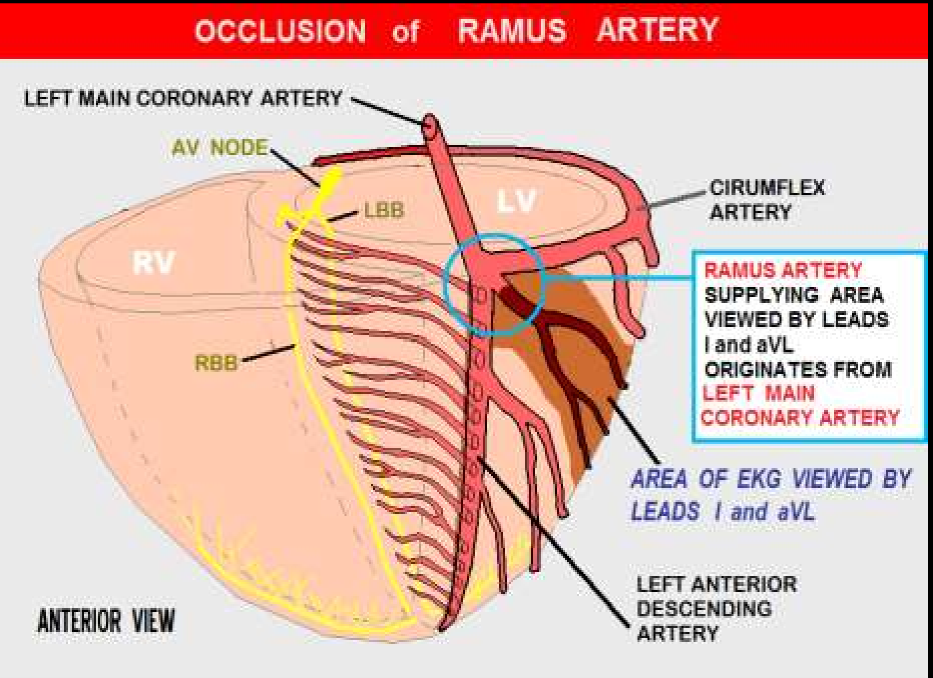


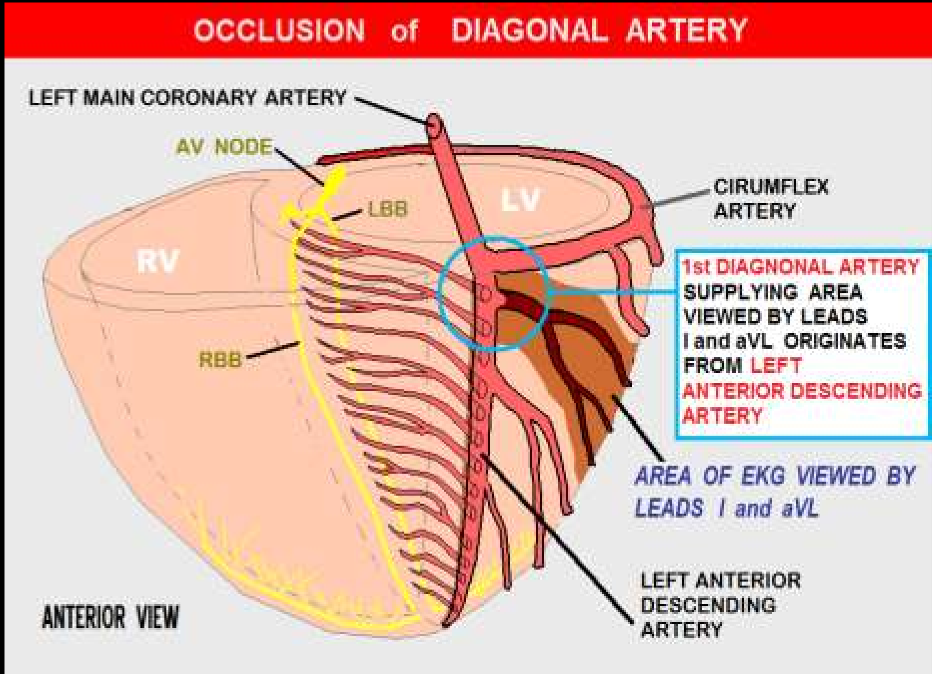
ST Segment elevation ONLY in Leads I and aVL

Usually indicates the "Culprit Artery" is most likely One of the following:

- RAMUS BRANCH
- 1^{st} DIAGONAL off of LAD
- 1^{st} OBTUSE MARGINAL off of CIRCUMFLEX

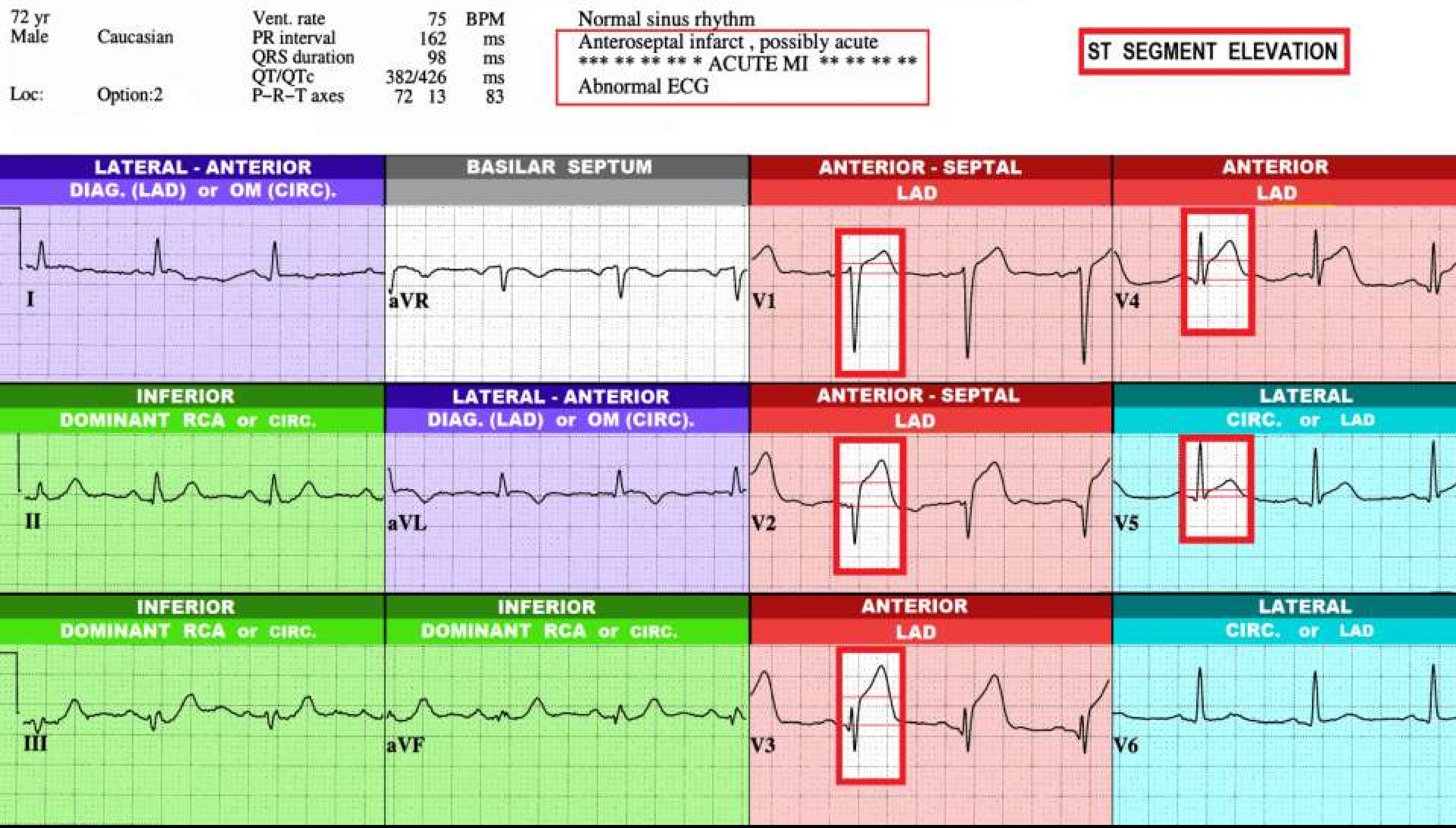




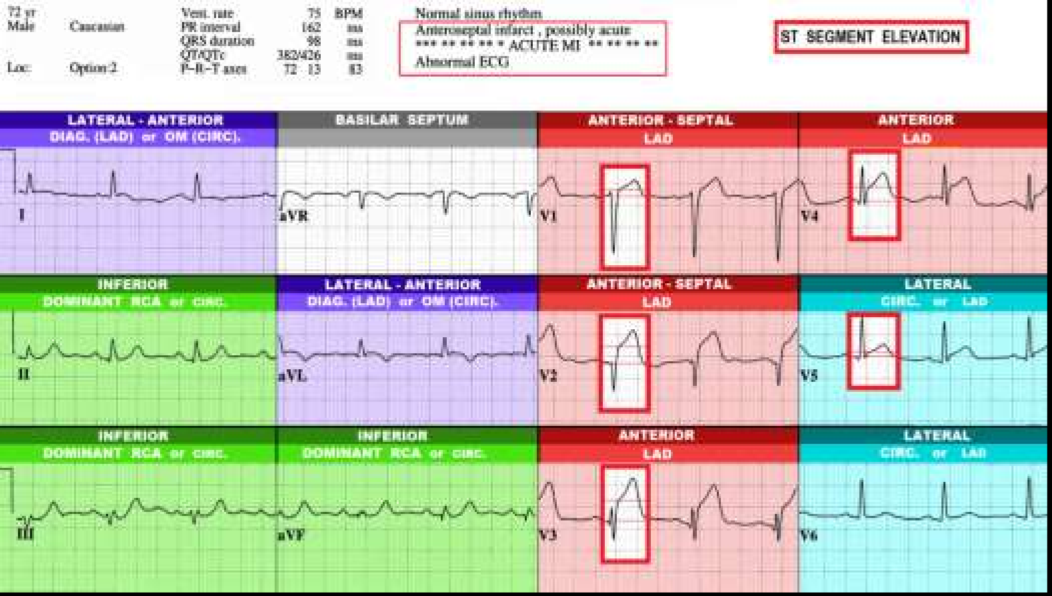


Here's why we care:
Think of Leads I and aVL as

"THE POWERBALL " . . . . .

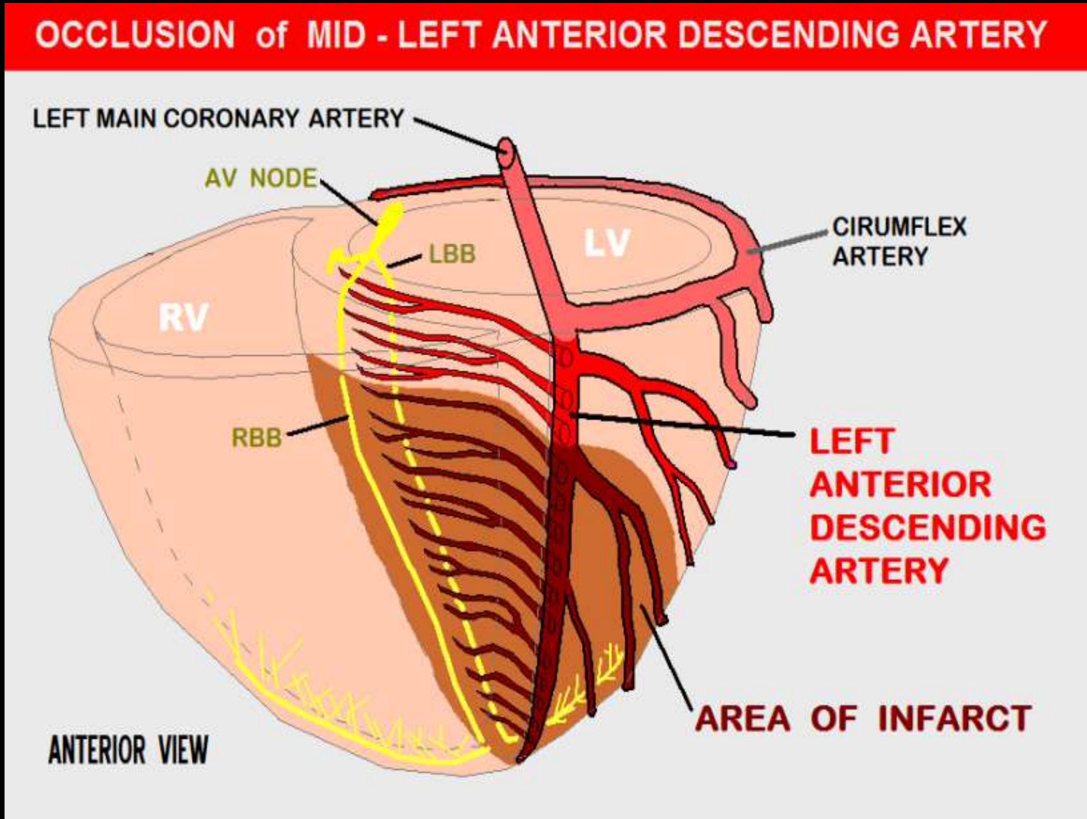


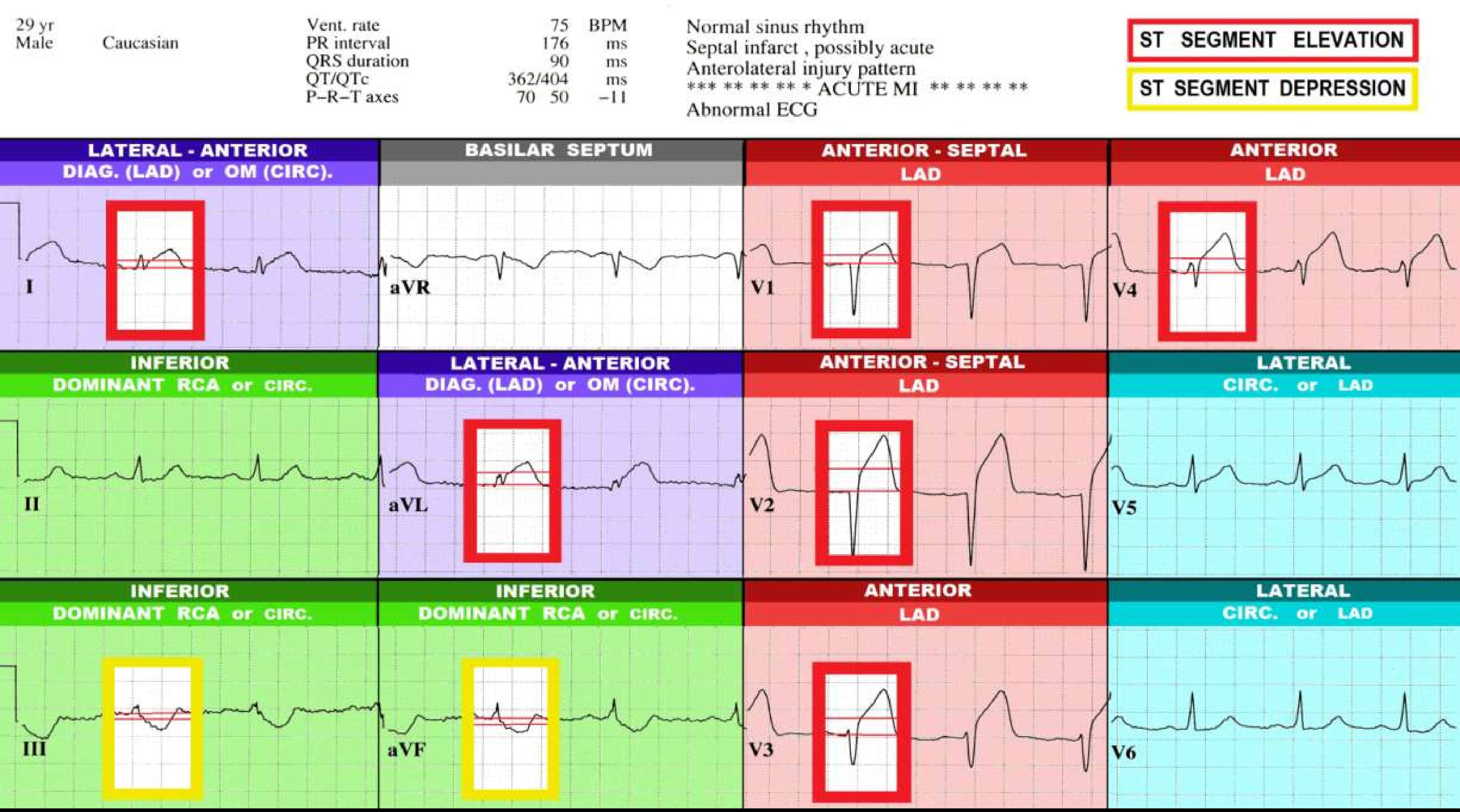
If you patient's ECG shows
ST Elevation in **Leads V1 – V4 . . . .**



If your patient's ECG shows ST Elevation in Leads V1 – V4 . . .

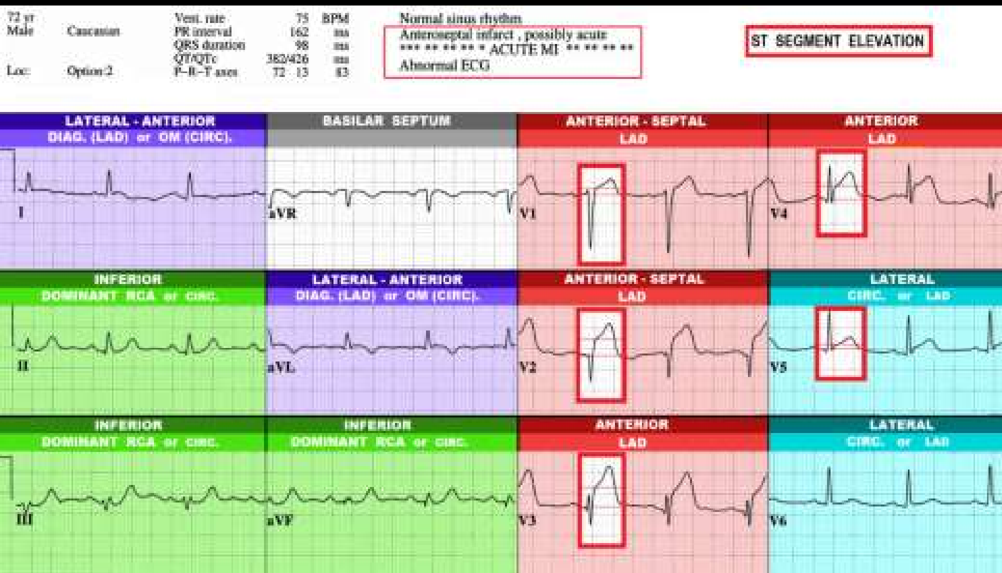
The obstruction is usually located at The MID – LAD level.

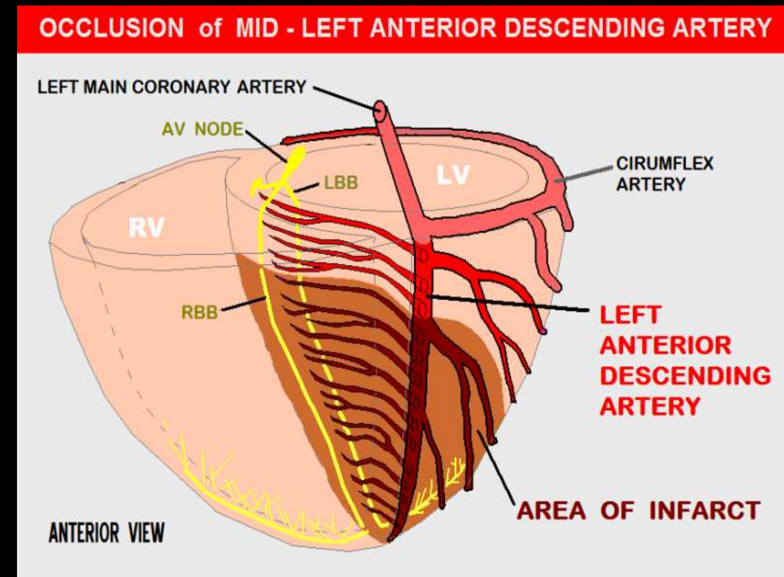




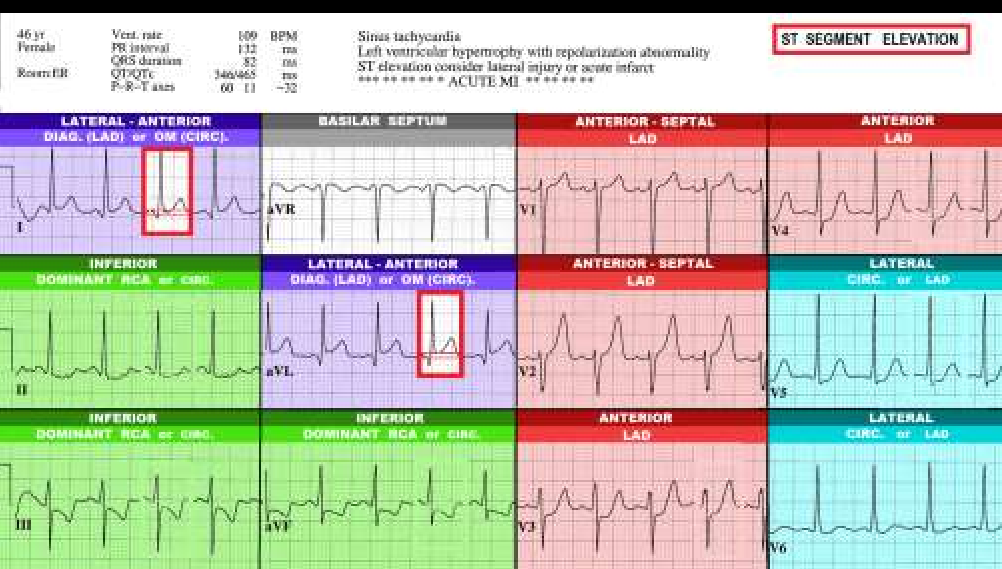
This patient's ECG shows ST ↑ in V1 – V4 ***AND***
Leads I and aVL . . .

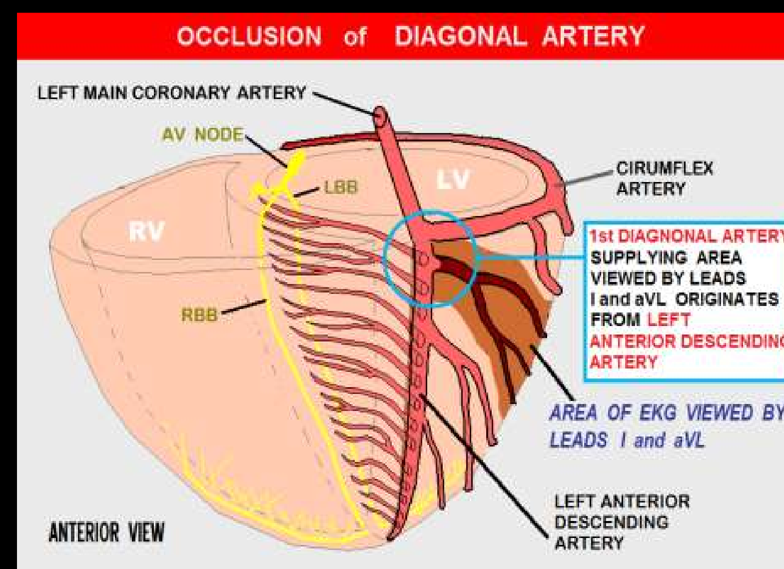
That means WE ADD THIS :



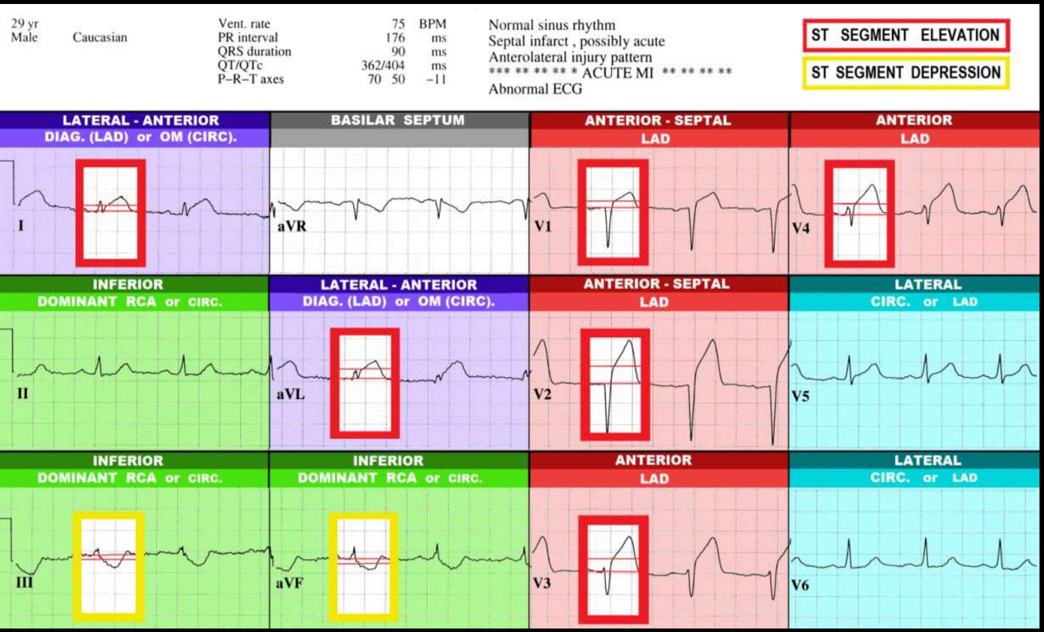


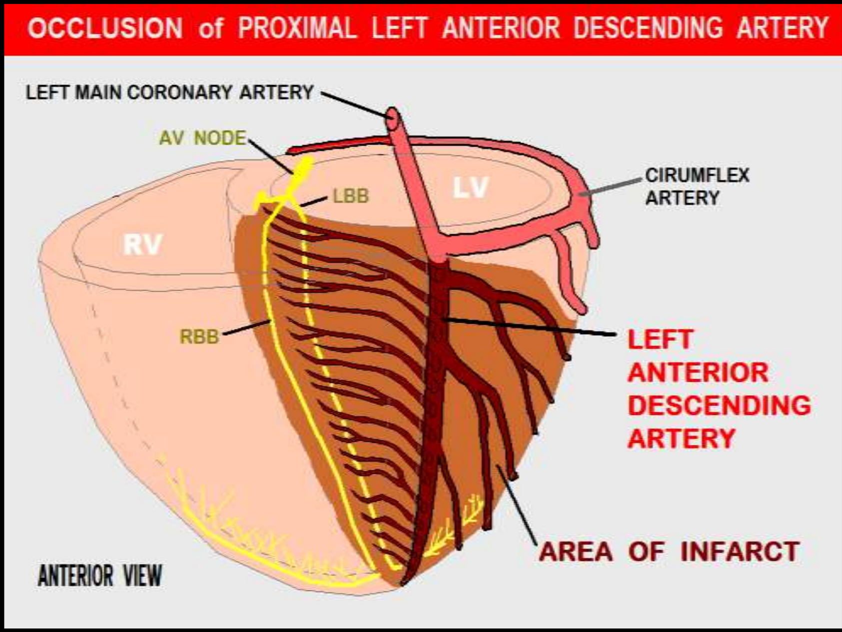
TO THIS :





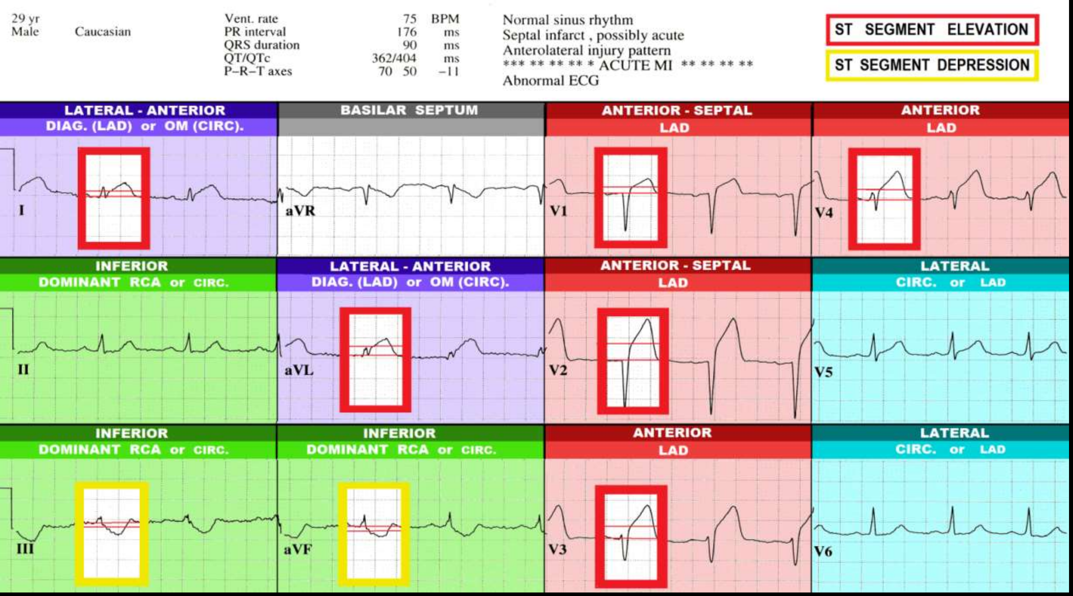
AND WE GET THIS . . . .





Our patient just hit the ***POWERBALL !***

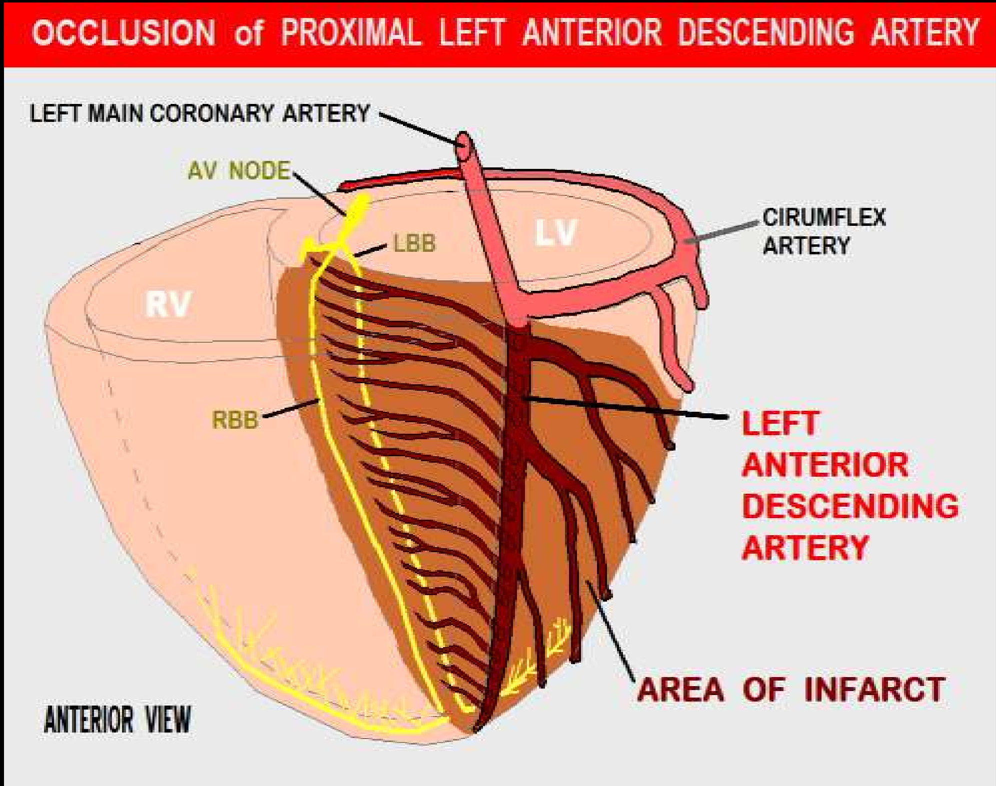
[1] Use of the Electrocardiogram in Acute Myocardial Infarction," Zimetbaum, et al, NEJM 348:933-940



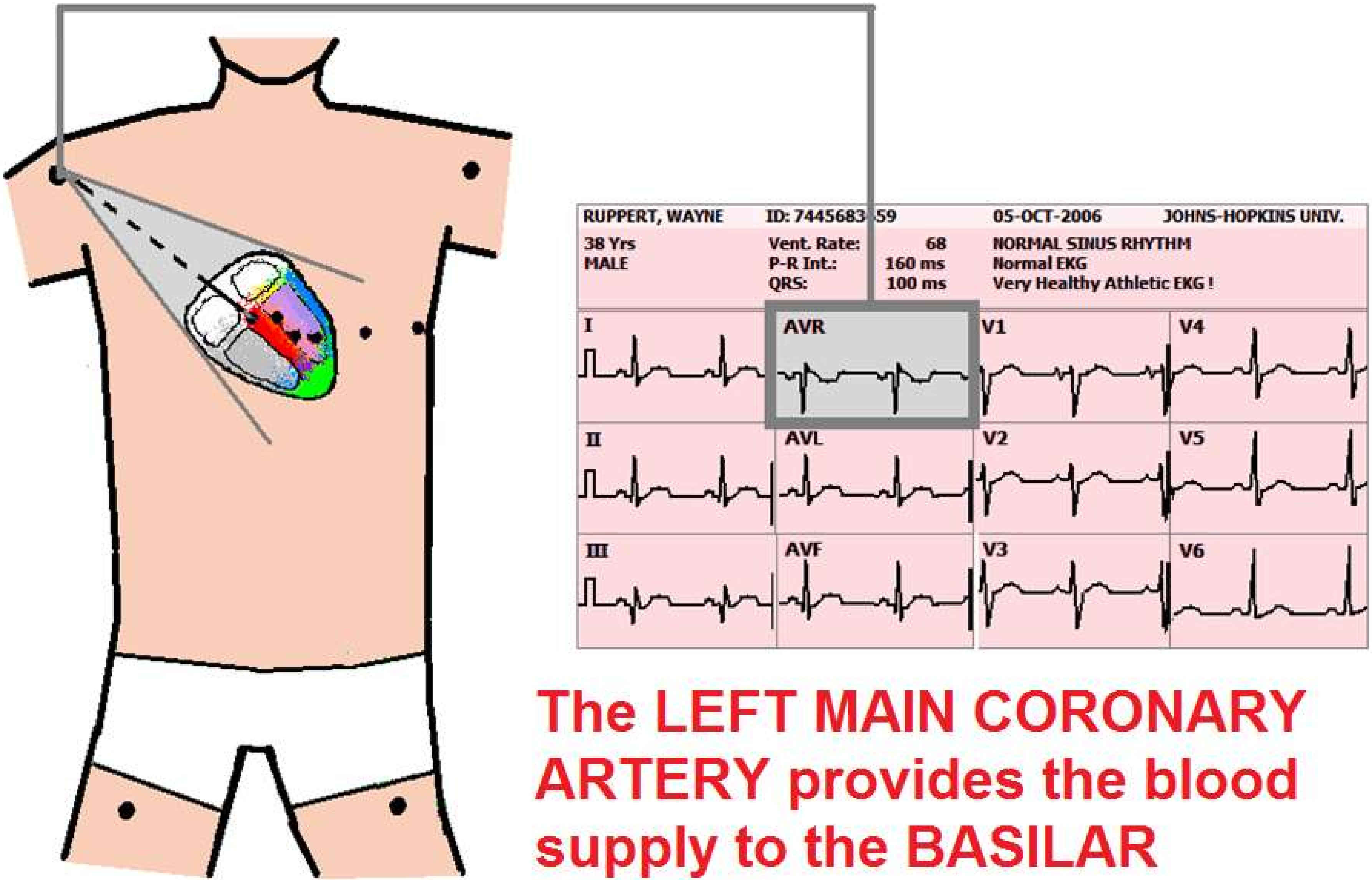
If you patient's ECG shows ST Elevation in Leads V1 – V4 & I and aVL . . .

The obstruction is usually located at in the PROXIMAL LAD, above the level of the 1st Diagonal Branch ! !

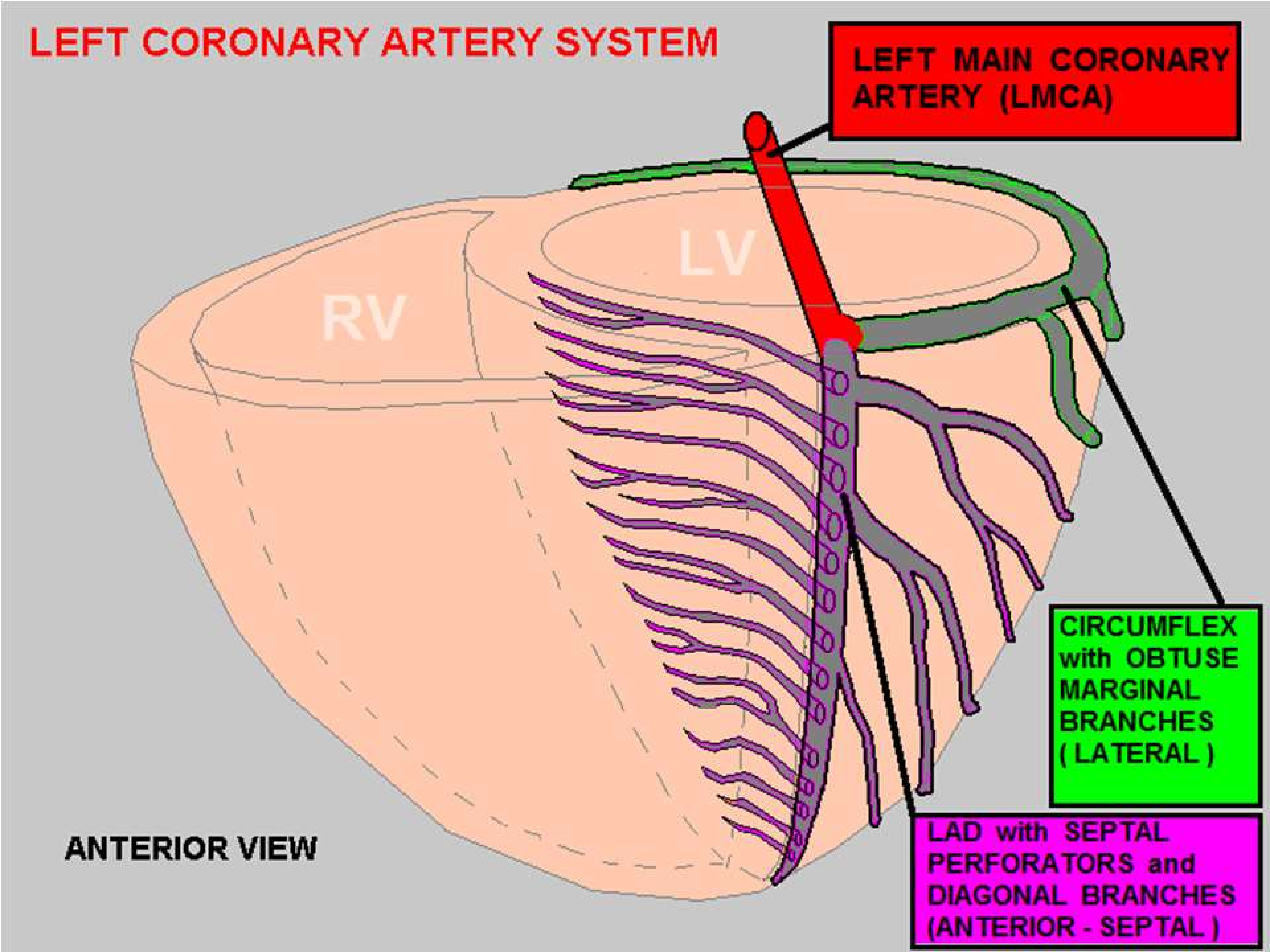
[1] Use of the Electrocardiogram in Acute Myocardial Infarction," Zimetbaum, et al, NEJM 348:933-940



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



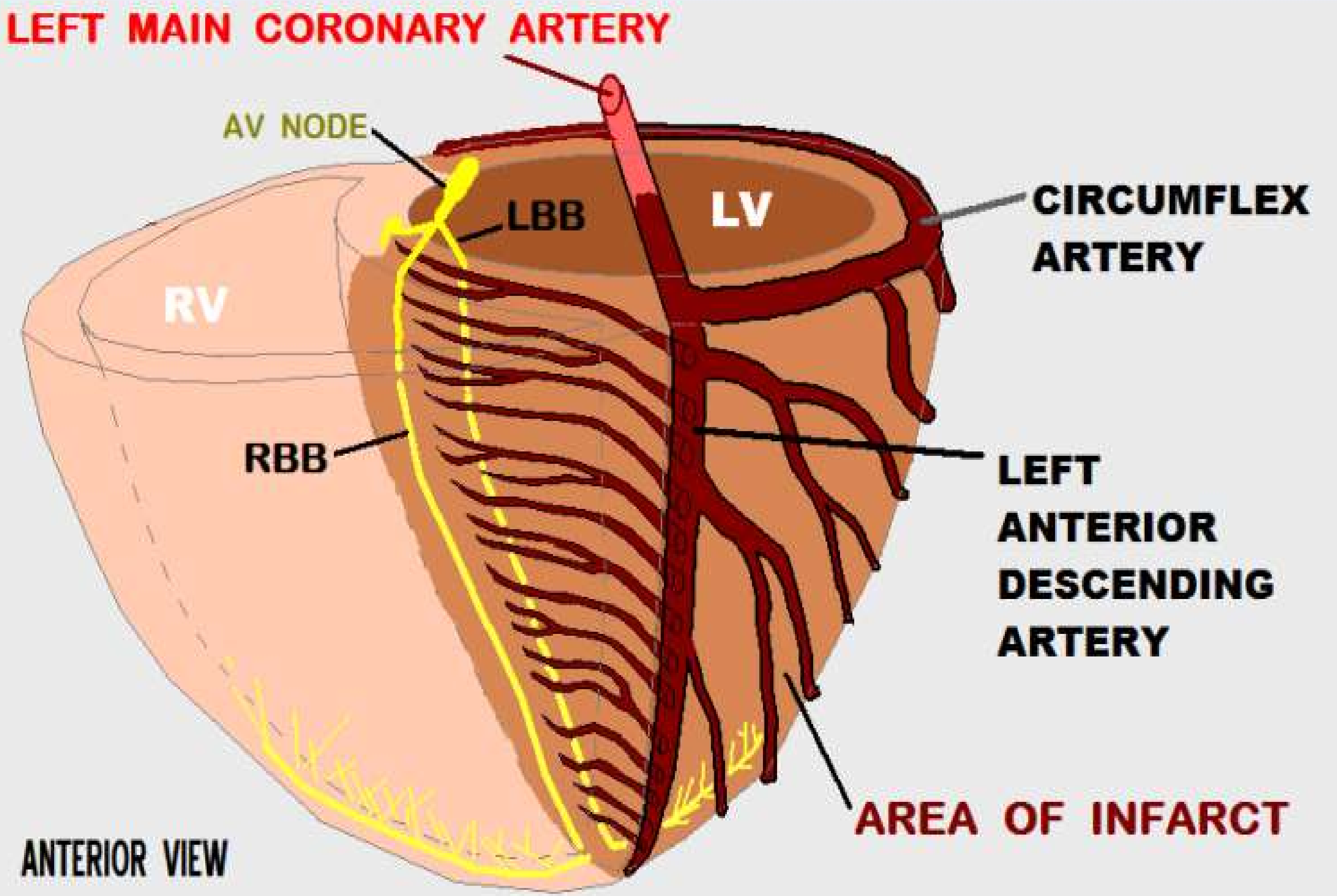
The LEFT MAIN CORONARY ARTERY provides the blood supply to the BASILAR SEPTUM.


LEFT CORONARY ARTERY SYSTEM
LEFT MAIN CORONARY ARTERY (LMCA)
LV
RV
CIRCUMFLEX with OBTUSE MARGINAL BRANCHES (LATERAL)
LAD with SEPTAL PERFORATORS and DIAGONAL BRANCHES (ANTERIOR - SEPTAL)
ANTERIOR VIEW

When LEAD AVR shows ST Elevation:

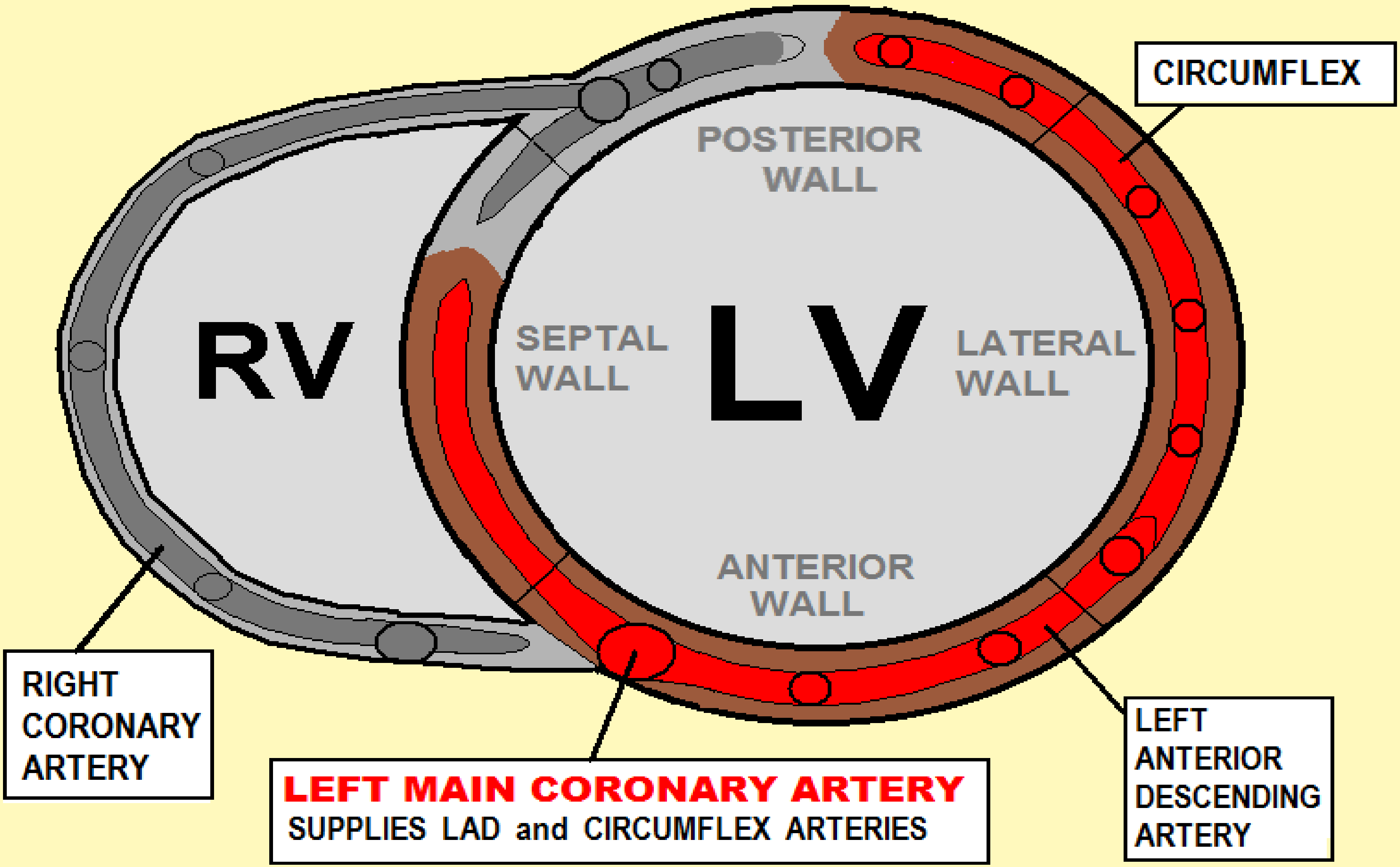
- **STEMI:** consider occlusion of the Left Main Coronary Artery.

OCCLUSION of the LEFT MAIN CORONARY ARTERY



The LEFT MAIN CORONARY ARTERY

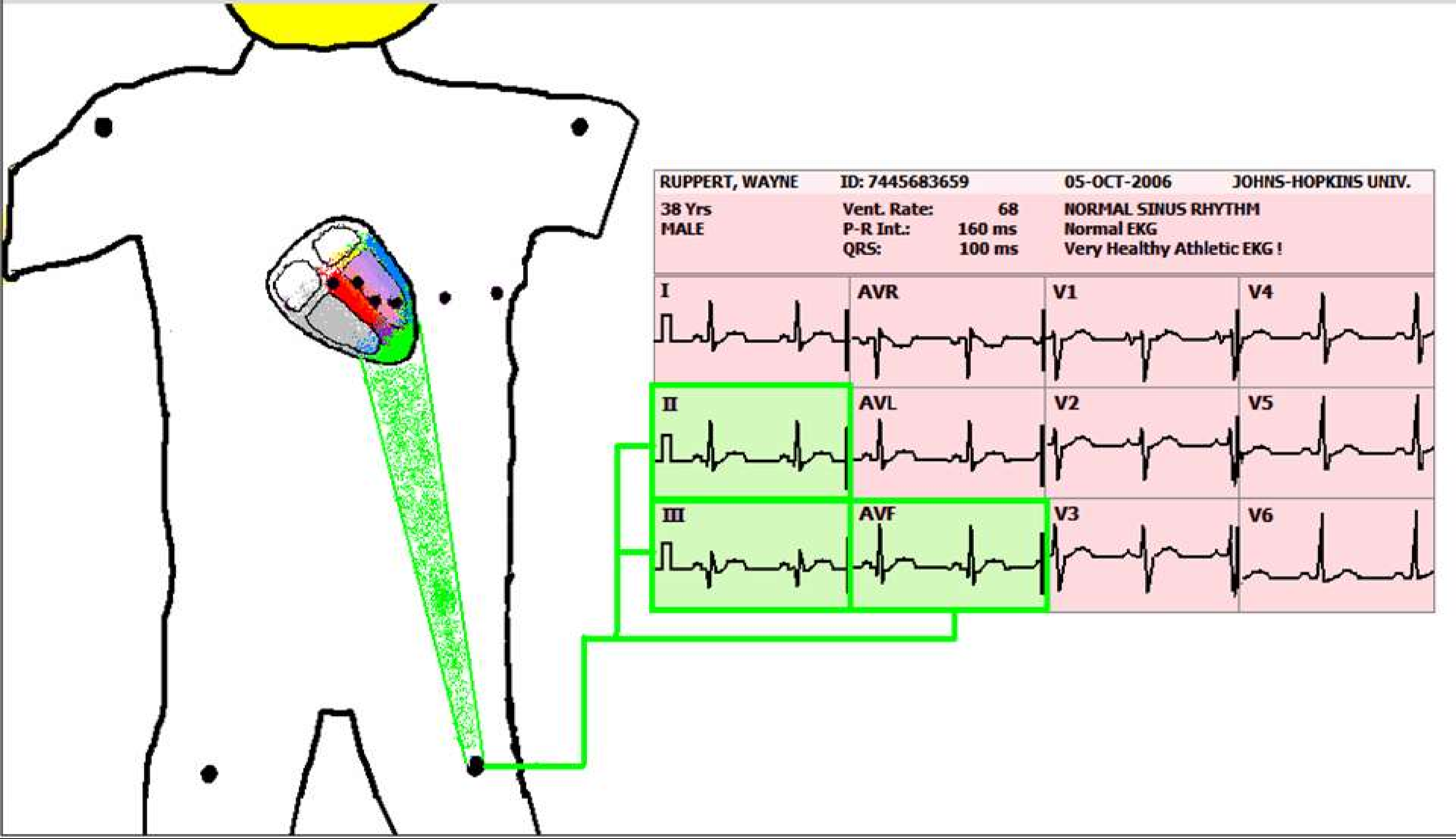
SUPPLIES 75 - 100 % of the LEFT VENTRICULAR MUSCLE MASS



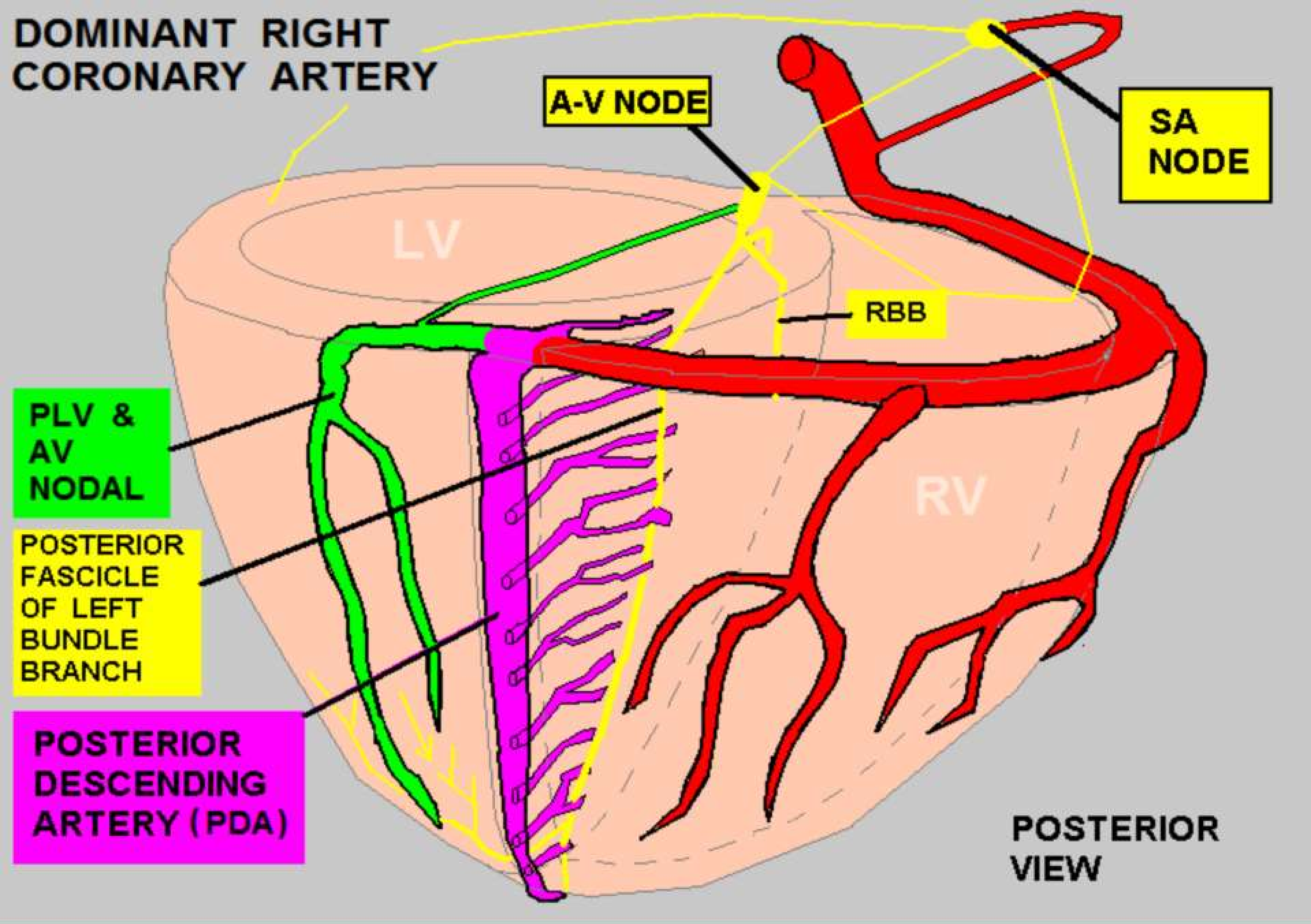
When LEAD AVR shows ST Elevation:

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

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



Which CORONARY ARTERY usually supplies the INFERIOR WALL ?



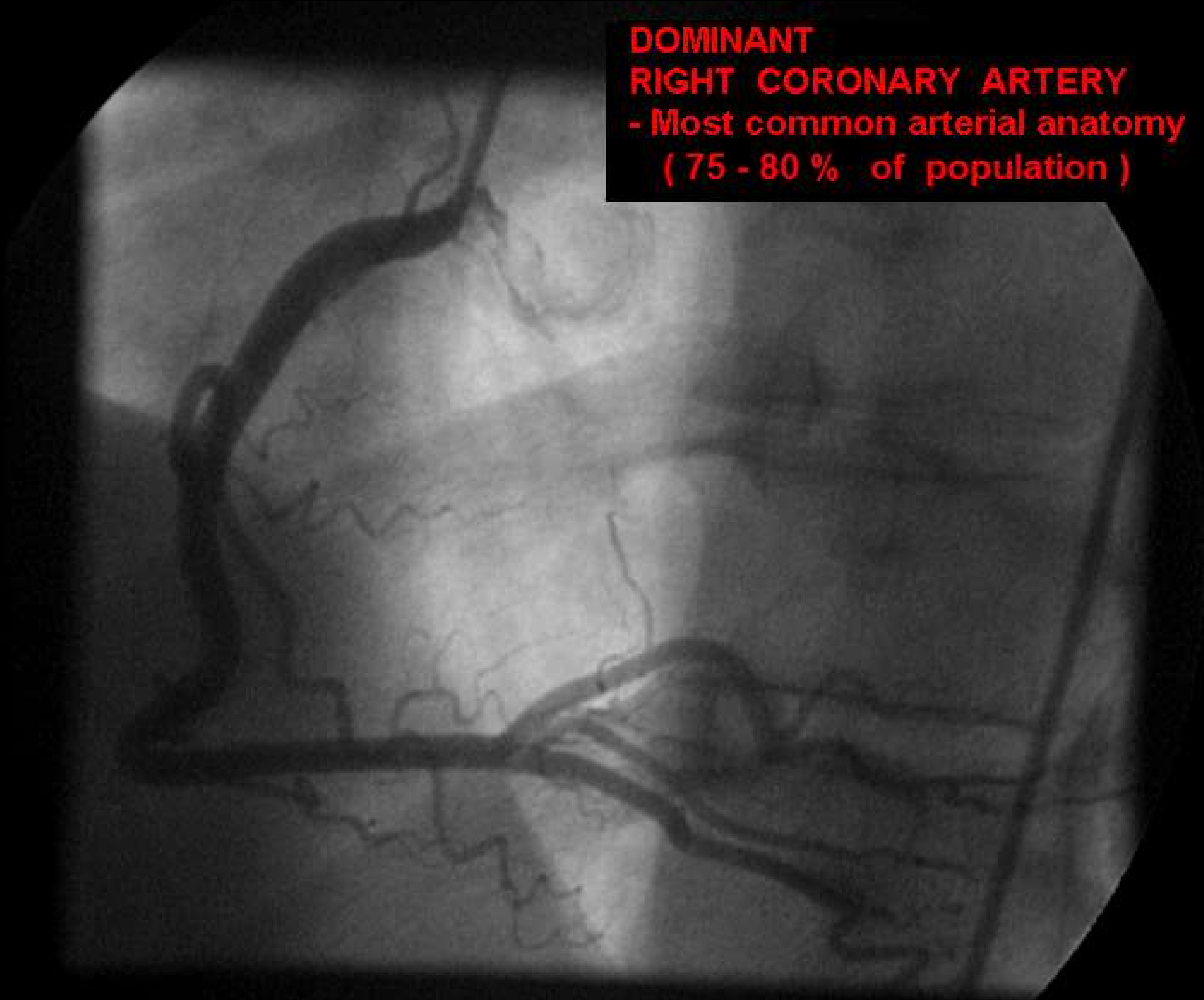
75 - 80% of the POPULATION HAVE THIS CORONARY ARTERY ANATOMY

HELPFUL HINT . . . MEMORIZE THIS !

RIGHT CORONARY ARTERY (RCA)

RIGHT DOMINANT SYSTEMS

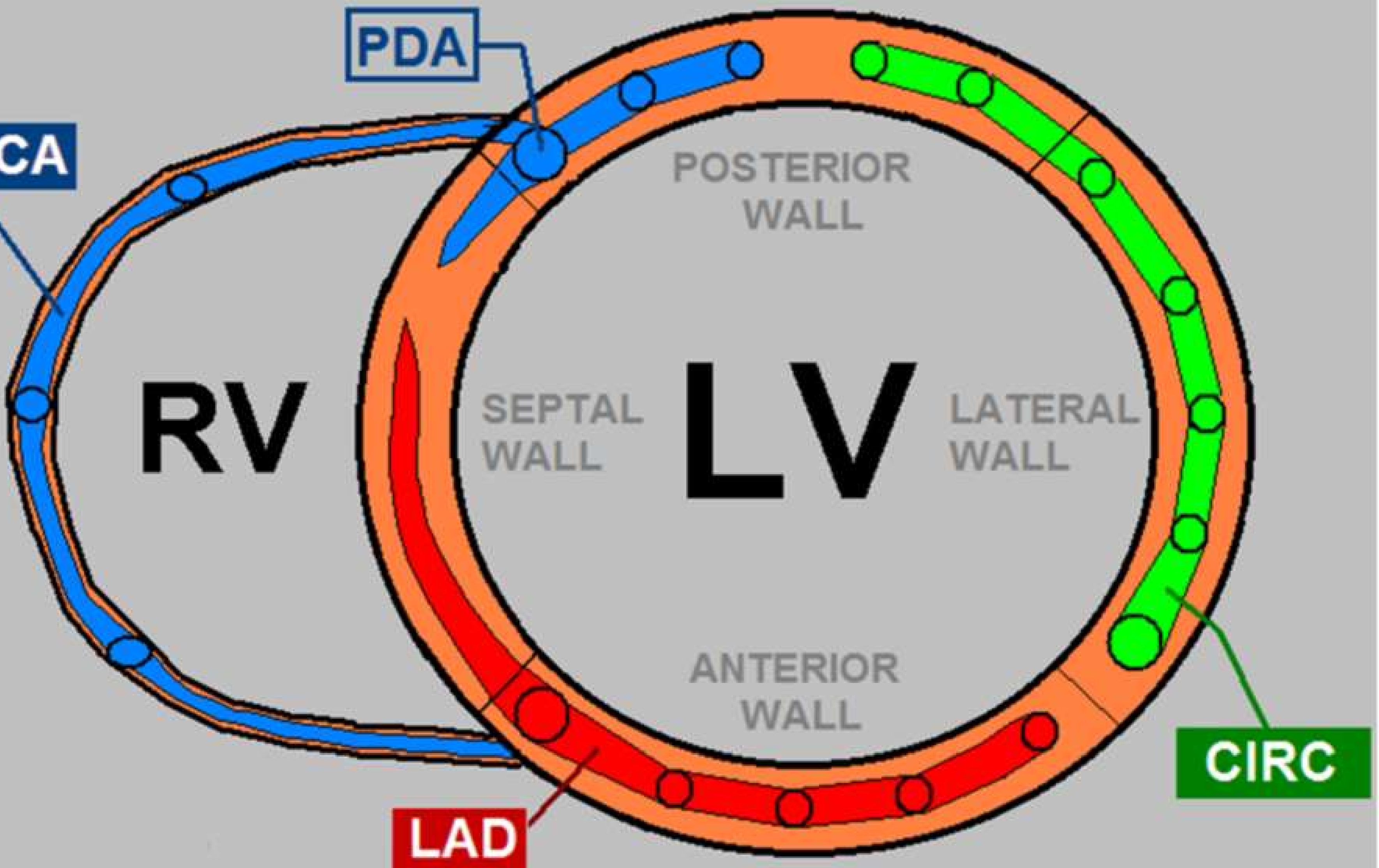
- RIGHT ATRIUM
- SINUS NODE (55% of the population)
- RIGHT VENTRICLE - 100 % of muscle mass
- LEFT VENTRICLE: 15 - 25 % of muscle mass
  - INFERIOR WALL
  - approx. 1/2 of POSTERIOR WALL
- AV NODE


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

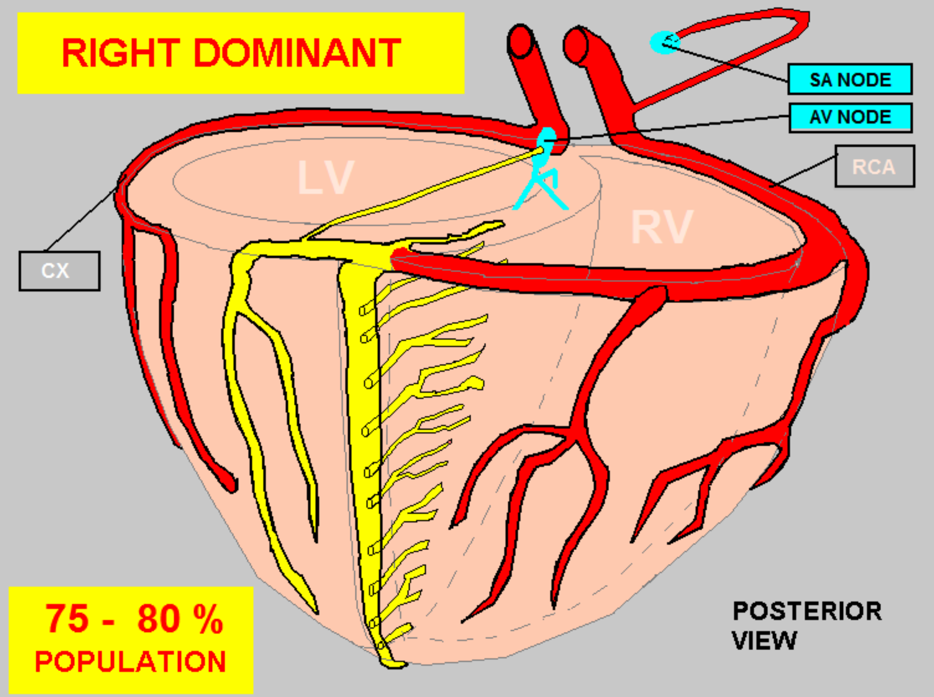
ARTERIAL DISTRIBUTION - MYOCARDIUM

DOMINANT RCA

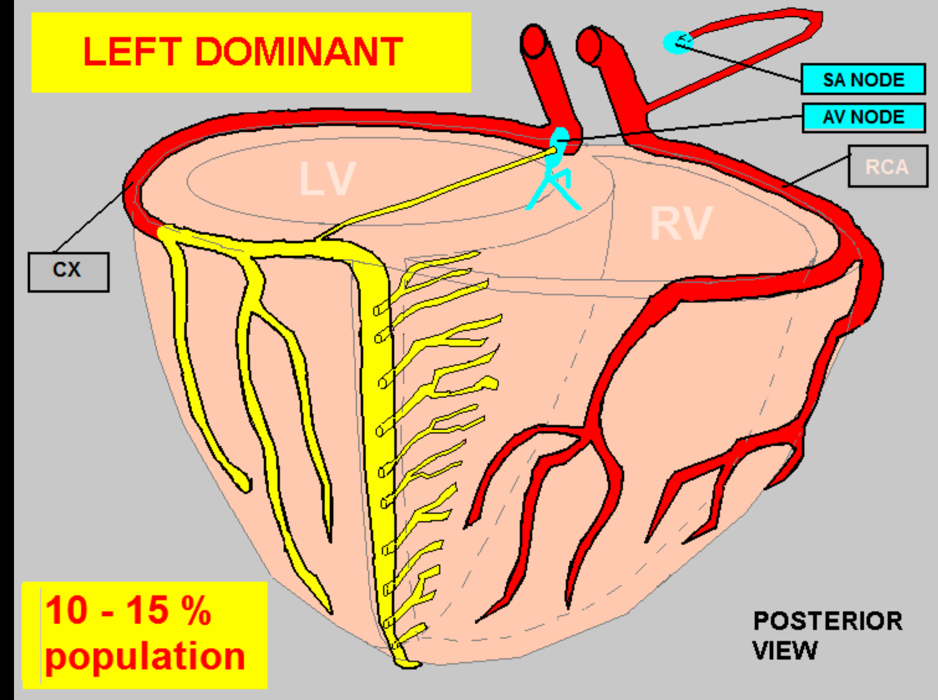
75-80 % of POPULATION



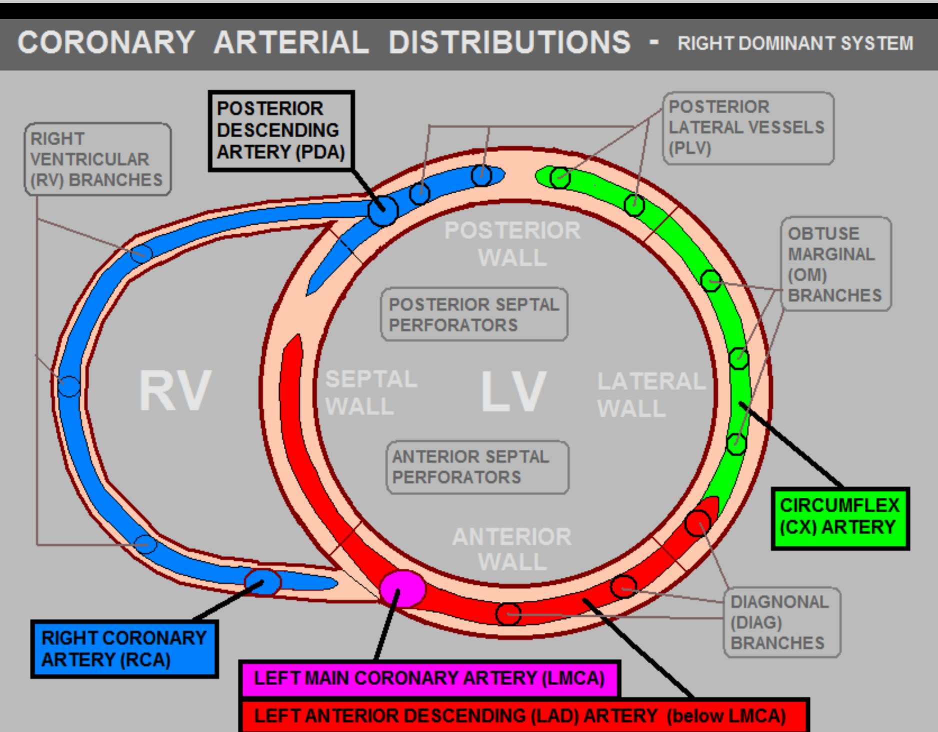
So if the Right Coronary Artery Is DOMINANT in 75 – 80% of the POPULATION, what accounts for the Other 20 – 25% ??



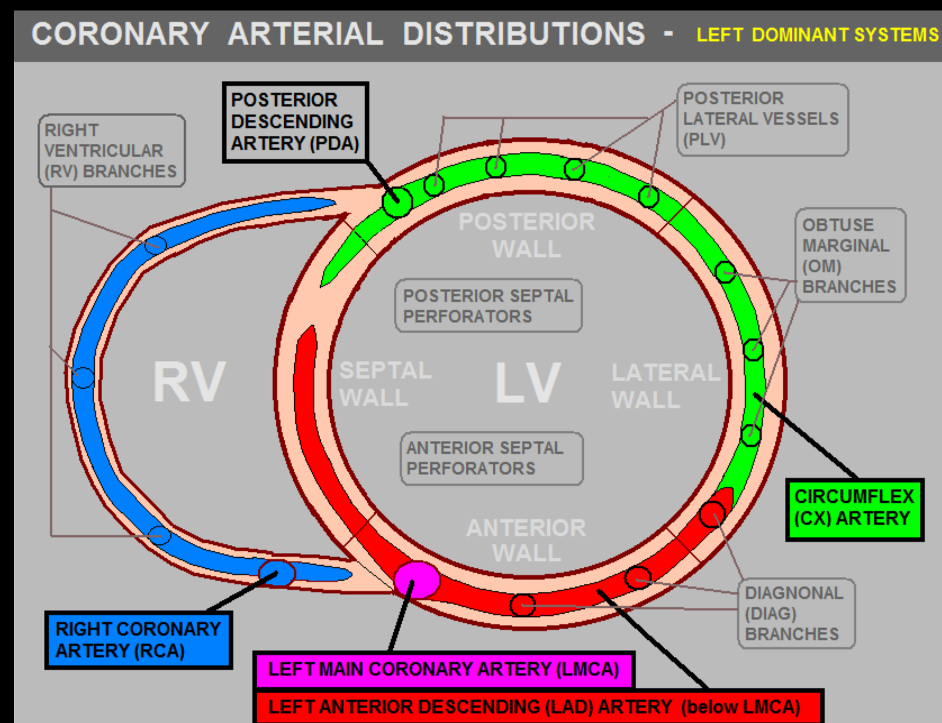
RIGHT DOMINANT
SA NODE
AV NODE
RCA
LV
RV
CX
75 - 80 %
POPULATION
POSTERIOR
VIEW



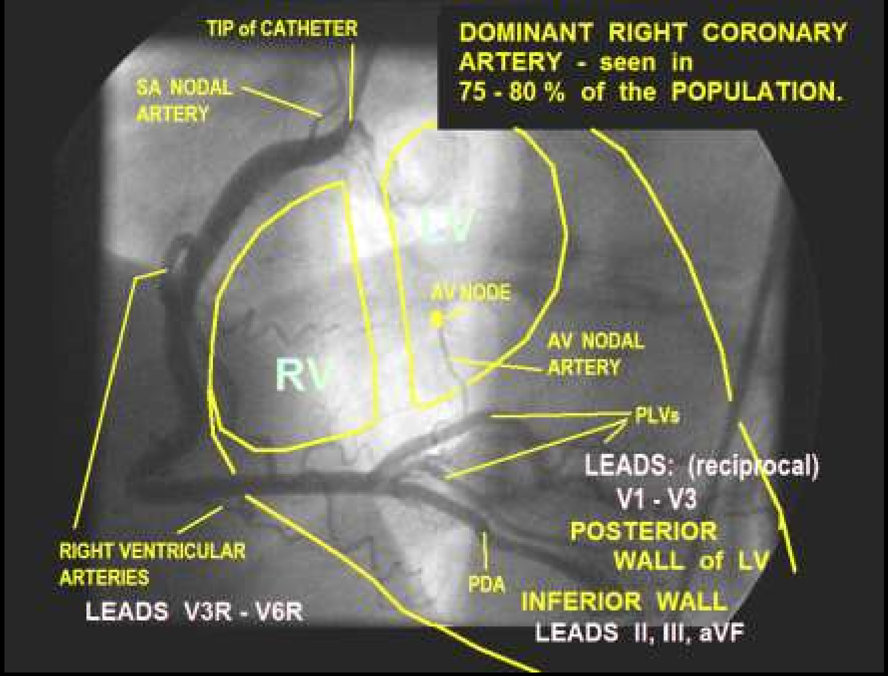
LEFT DOMINANT
SA NODE
AV NODE
RCA
LV
RV
CX
10 - 15 %
population
POSTERIOR
VIEW

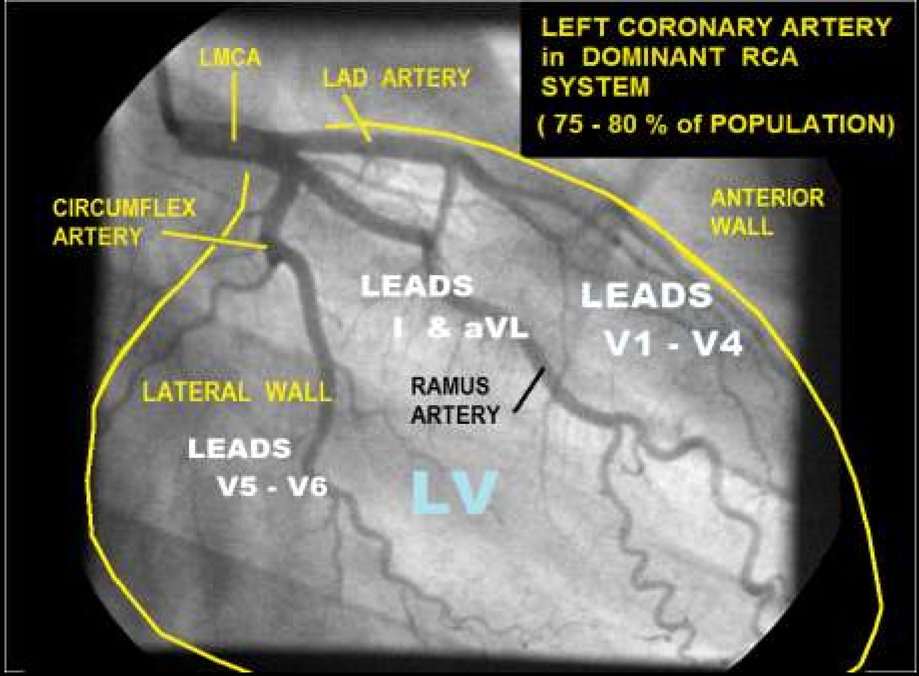


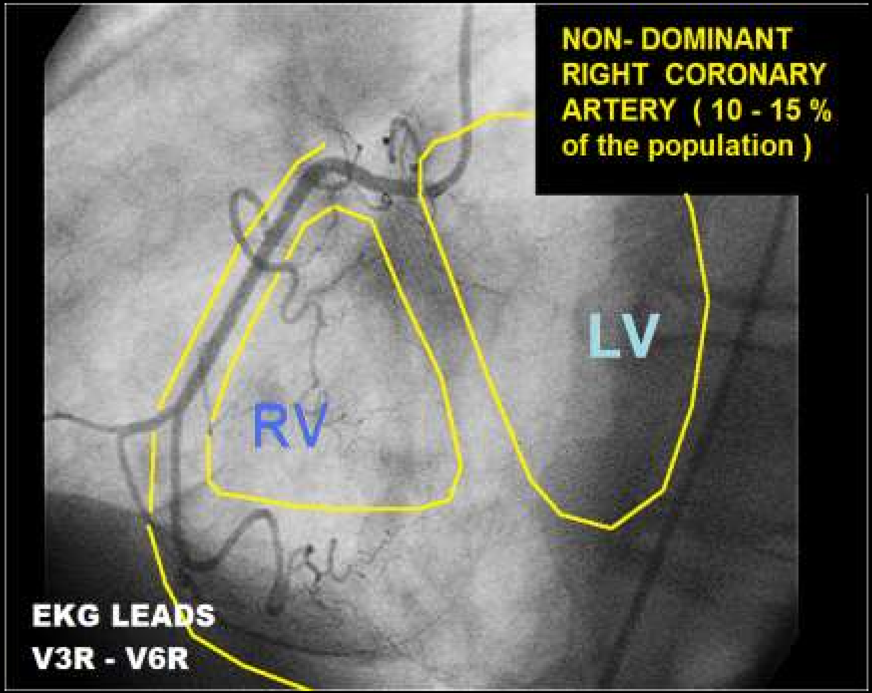
CORONARY ARTERIAL DISTRIBUTIONS - RIGHT DOMINANT SYSTEM
RIGHT VENTRICULAR (RV) BRANCHES
POSTERIOR DESCENDING ARTERY (PDA)
POSTERIOR LATERAL VESSELS (PLV)
POSTERIOR WALL
OBTUSE MARGINAL (OM) BRANCHES
POSTERIOR SEPTAL PERFORATORS
RV
SEPTAL WALL
LV
LATERAL WALL
ANTERIOR SEPTAL PERFORATORS
CIRCUMFLEX (CX)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

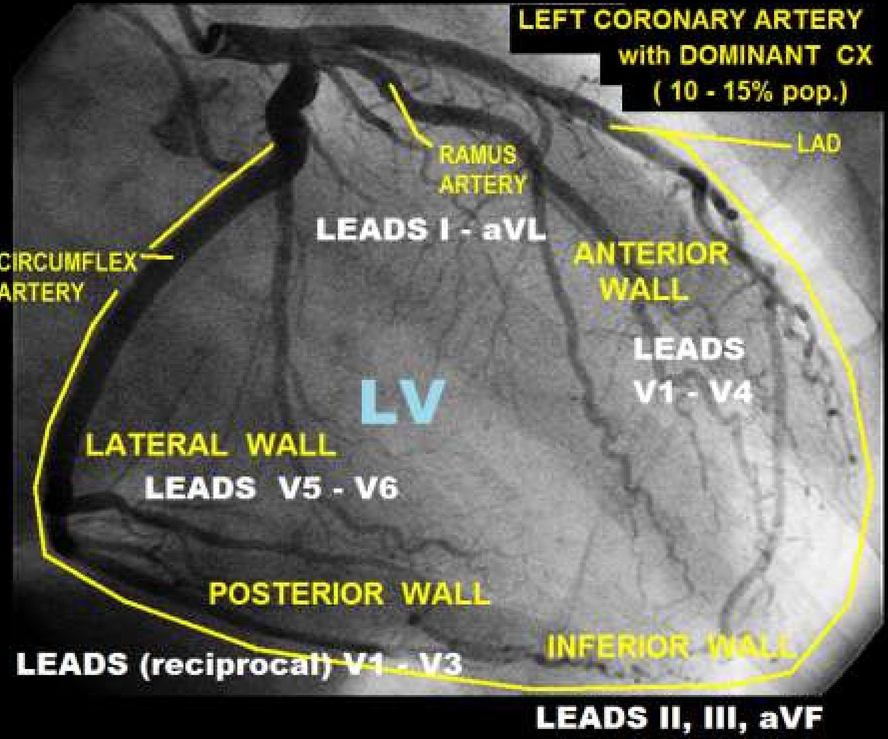


CORONARY ARTERIAL DISTRIBUTIONS - LEFT DOMINANT SYSTEMS
RIGHT VENTRICULAR (RV) BRANCHES
POSTERIOR DESCENDING ARTERY (PDA)
POSTERIOR LATERAL VESSELS (PLV)
POSTERIOR WALL
OBTUSE MARGINAL (OM) BRANCHES
POSTERIOR SEPTAL PERFORATORS
RV
SEPTAL WALL
LV
LATERAL WALL
ANTERIOR SEPTAL PERFORATORS
CIRCUMFLEX (CX)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


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


LEFT CORONARY ARTERY in DOMINANT RCA SYSTEM
(75 - 80 % of POPULATION)
LMCA
LAD ARTERY
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.)
LAD
RAMUS ARTERY
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

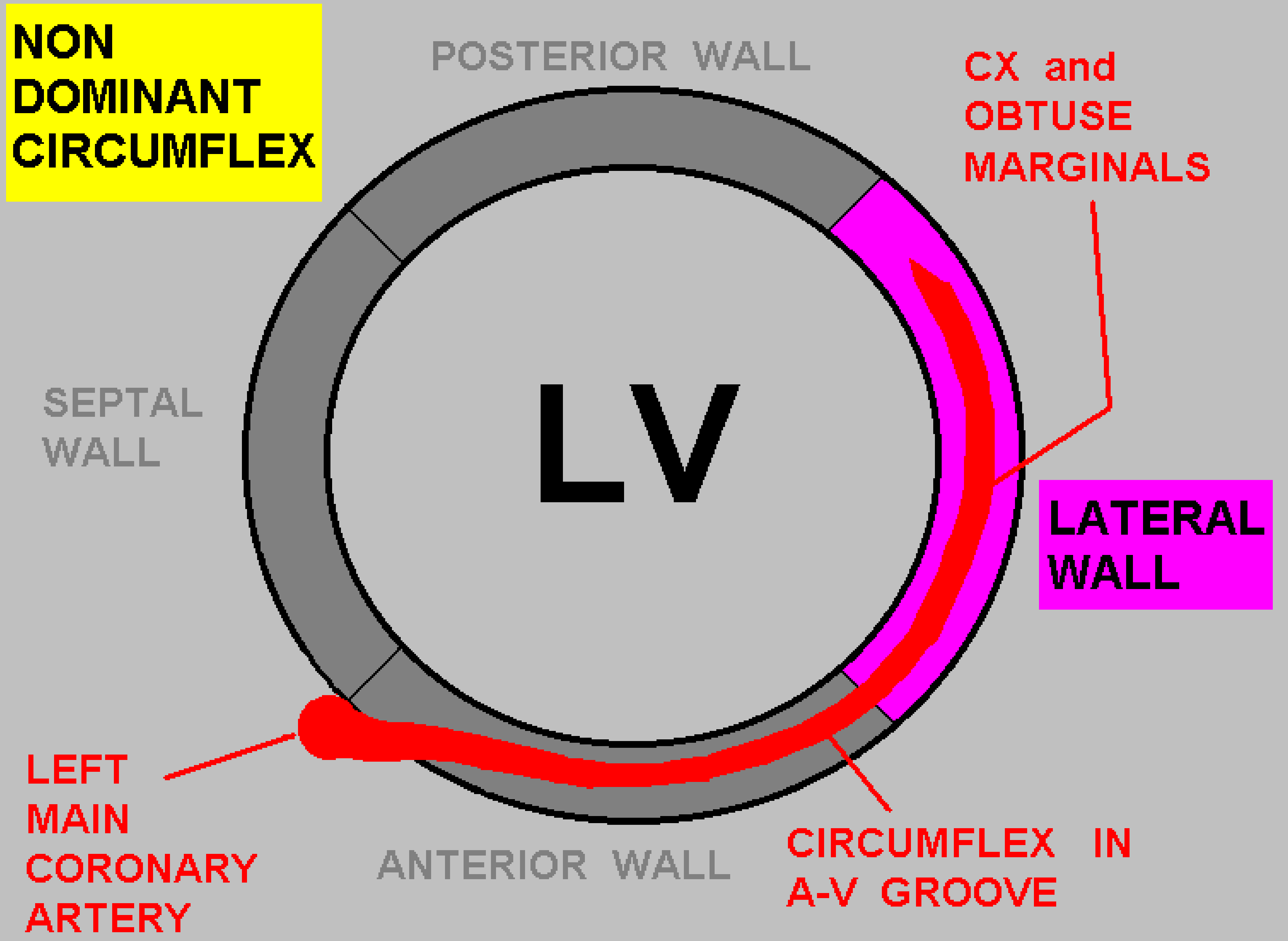
CIRCUMFLEX ARTERY (CX)

- NON-DOMINANT CX:

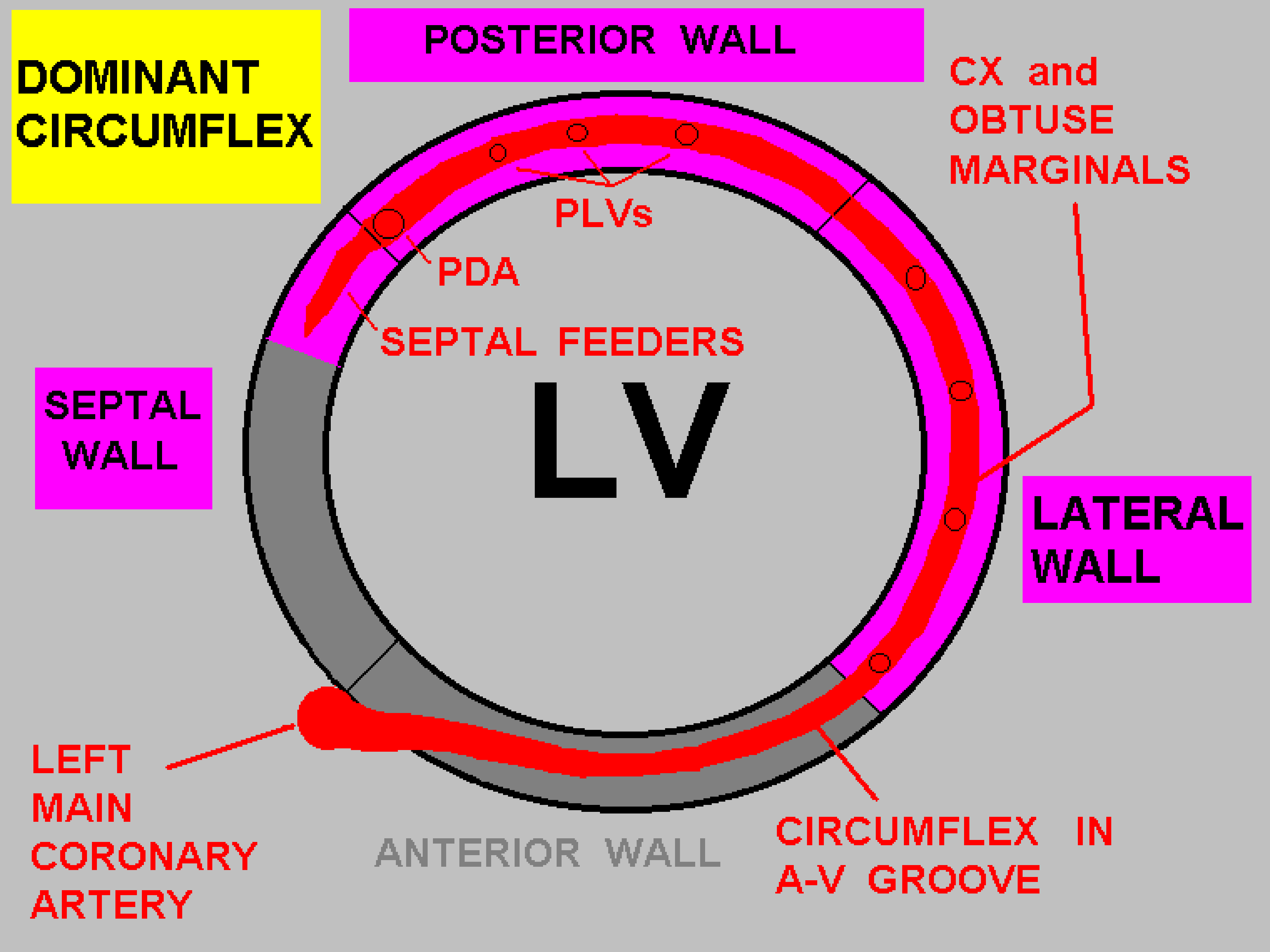
CX = 15 - 30% OF LV MASS

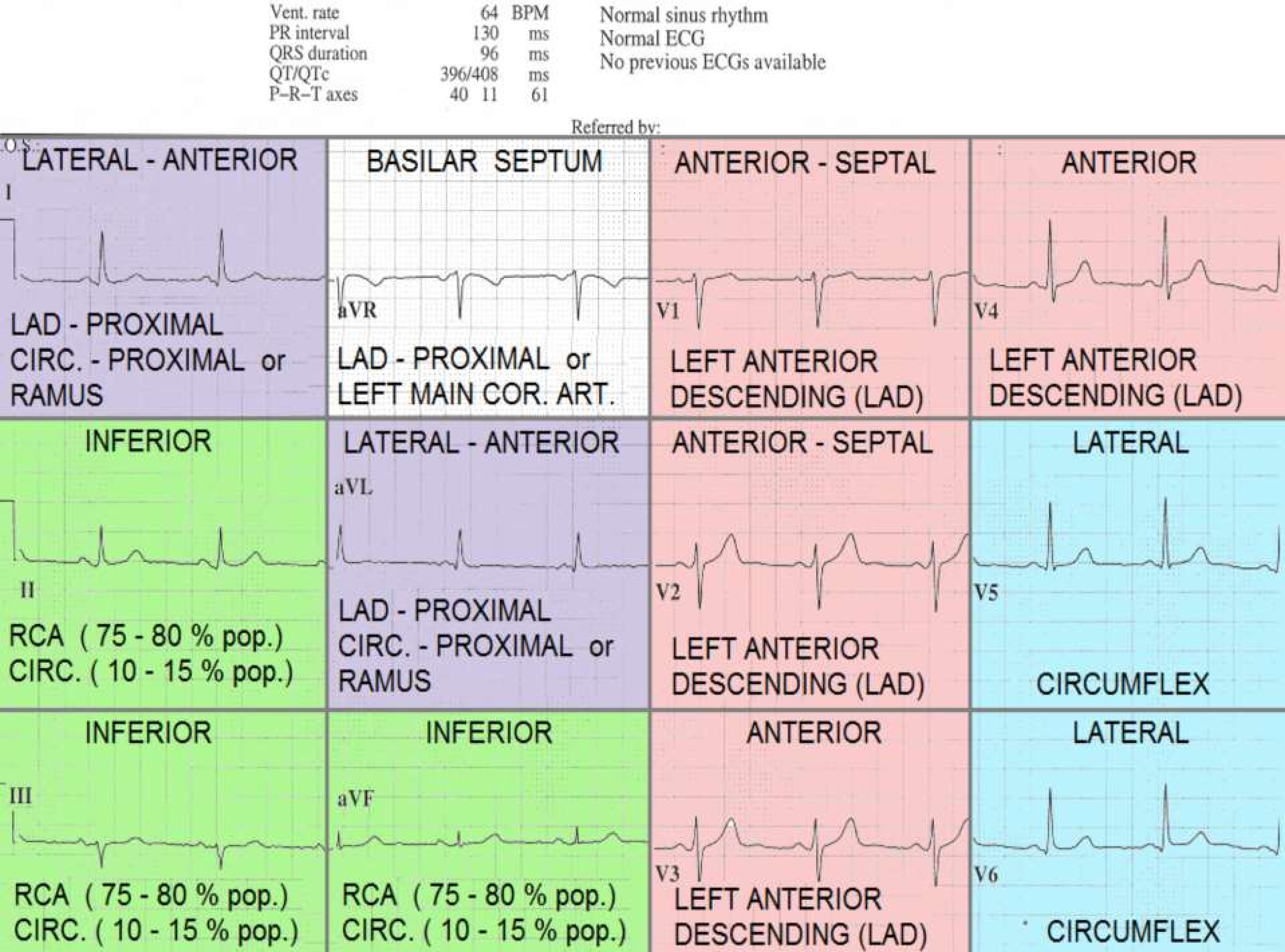
- DOMINANT CX:

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:
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

A standard

12 LEAD EKG

Does NOT show the

RIGHT VENTRICLE

To see the

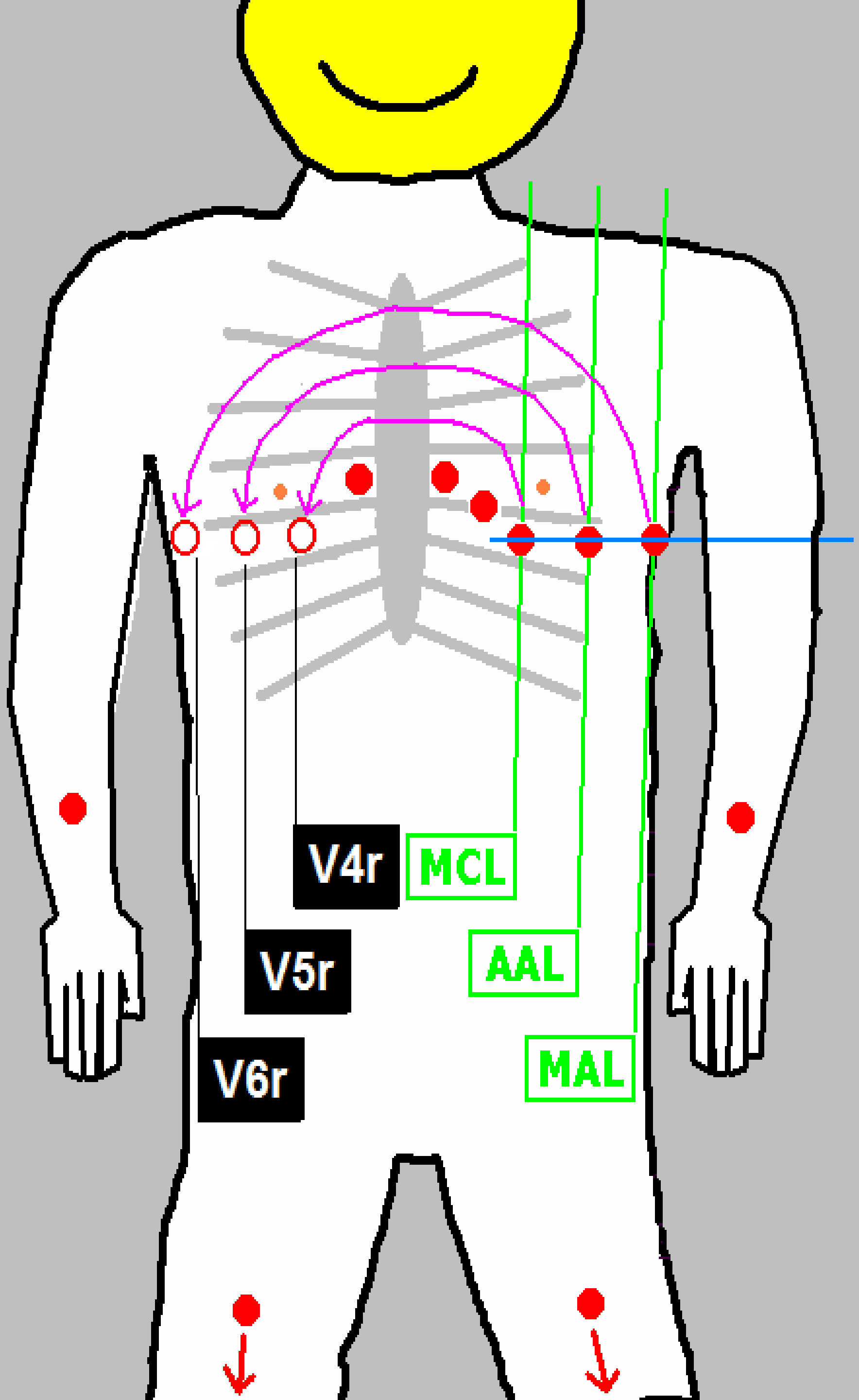
RIGHT VENTRICLE . . .

. . . such as in cases of

INFERIOR WALL M.I.

☞ You must do a

RIGHT - SIDED EKG ! !

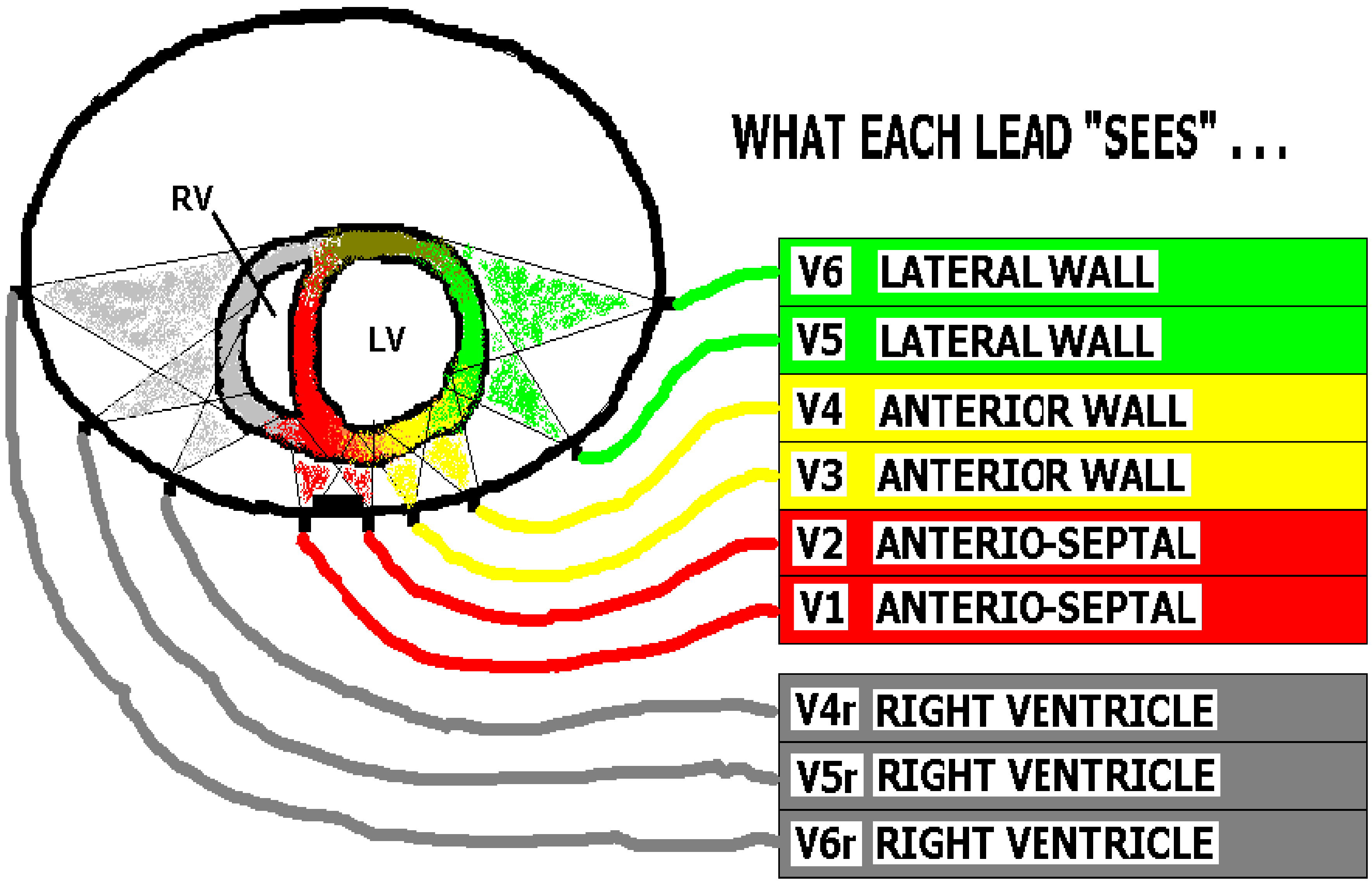


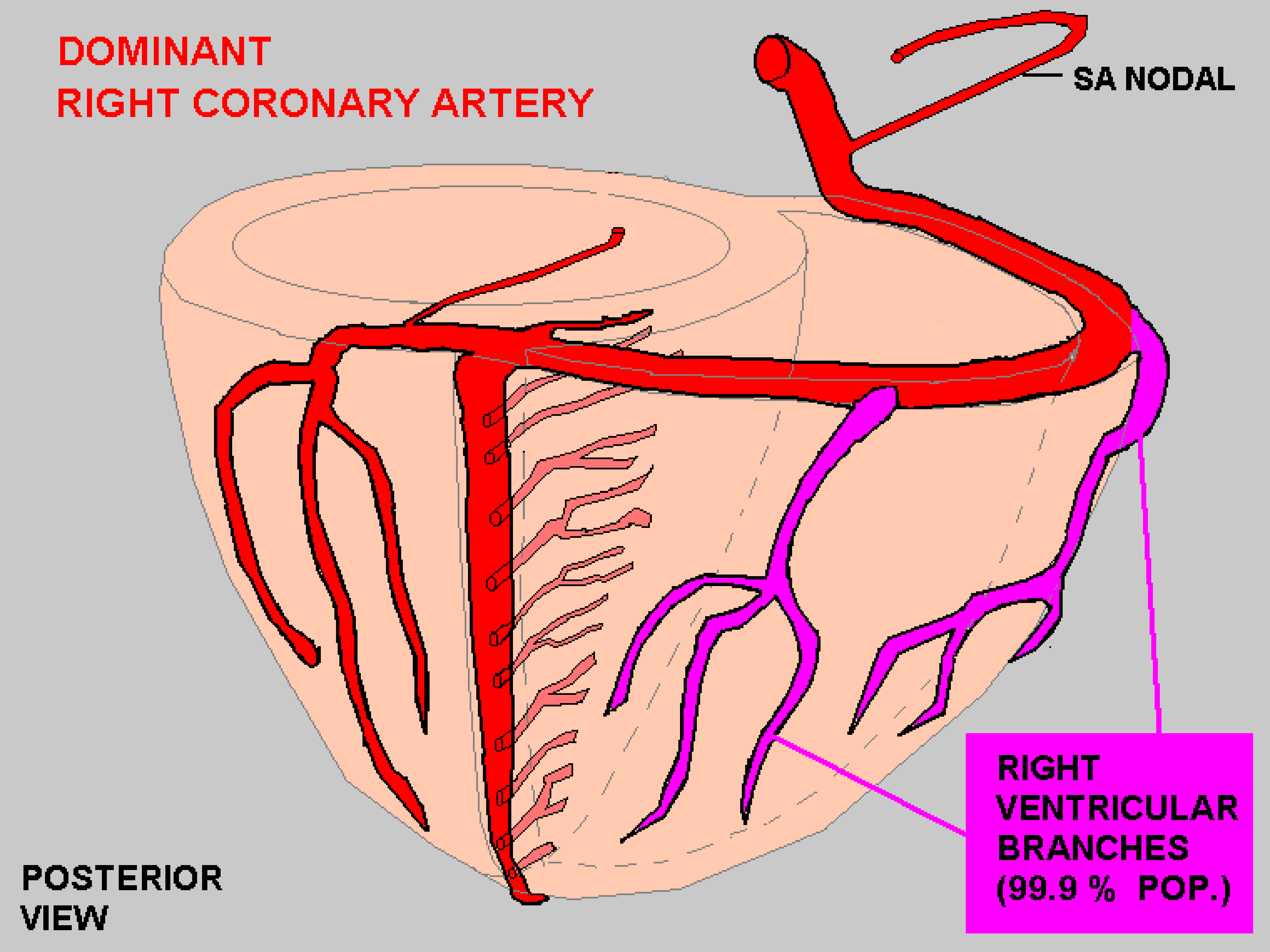
To do a
RIGHT - SIDED EKG . .

MOVE leads
V4, V5, and V6

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

THE V - LEADS


RV
LV
WHAT EACH LEAD "SEES" . . .
V6 LATERAL WALL
V5 LATERAL WALL
V4 ANTERIOR WALL
V3 ANTERIOR WALL
V2 ANTERIO-SEPTAL
V1 ANTERIO-SEPTAL
V4r RIGHT VENTRICLE
V5r RIGHT VENTRICLE
V6r RIGHT VENTRICLE


DOMINANT
RIGHT CORONARY ARTERY
SA NODAL
RIGHT
VENTRICULAR
BRANCHES
(99.9 % POP.)
POSTERIOR
VIEW

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

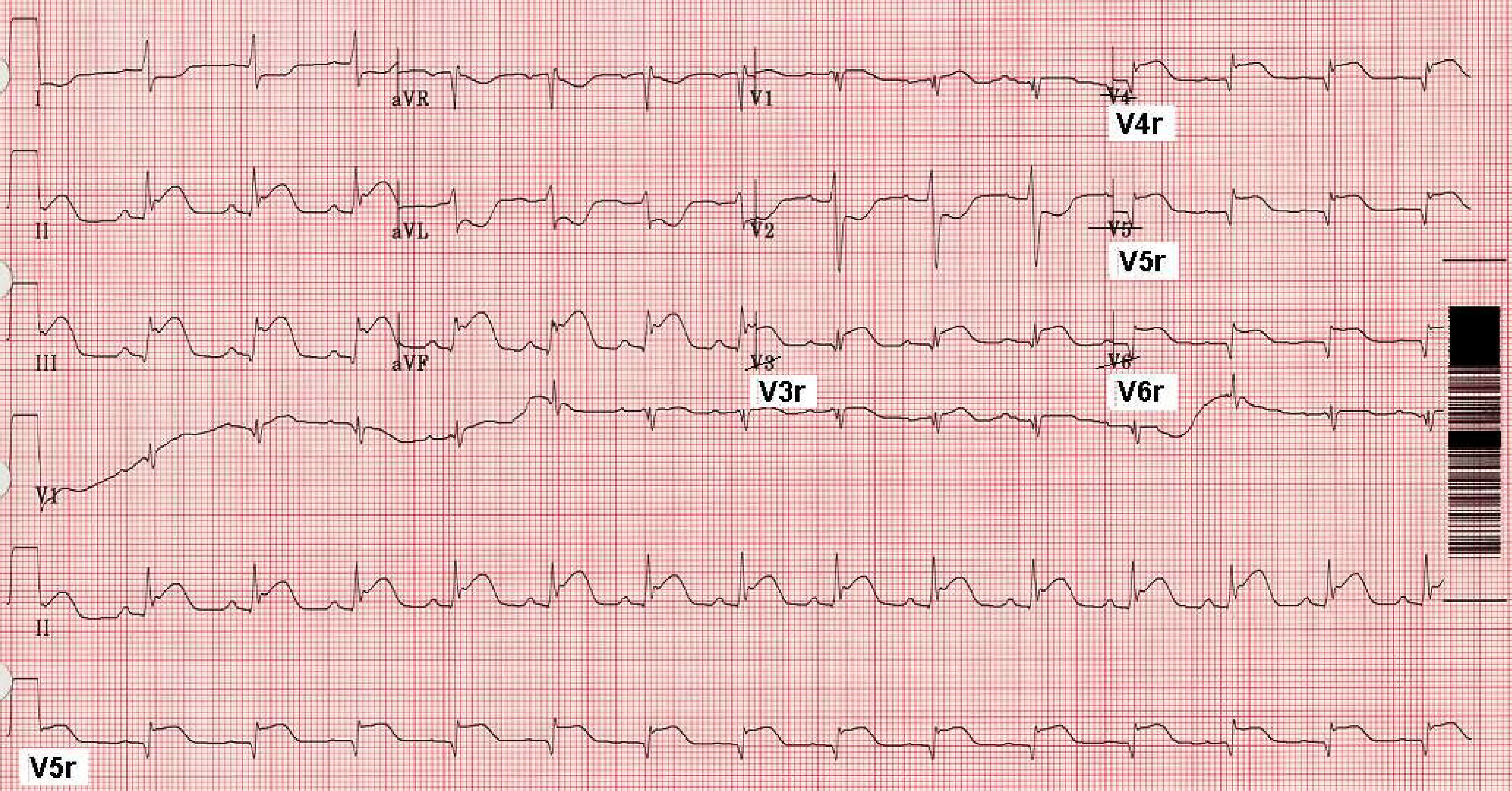
Normal sinus rhythm
~~Anterolateral infarct, possibly acute~~
Inferior injury pattern
** ** ** ** * Acute MI * ** ** ** **
Abnormal ECG

Right Ventricular Infarct

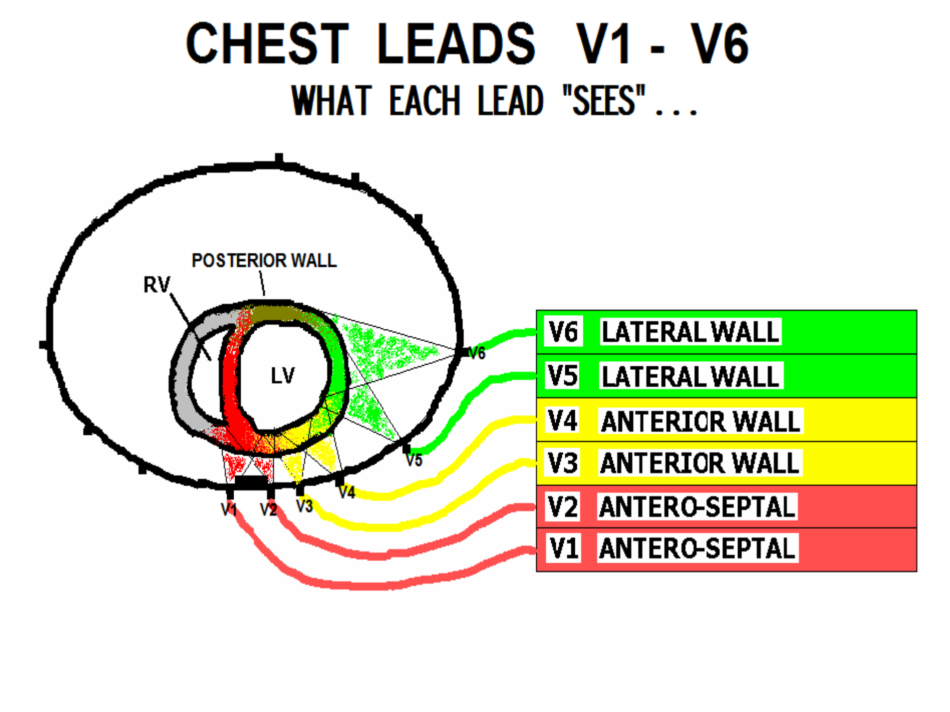
V LEADS
R SIDE

Referred by:

Unconfirmed

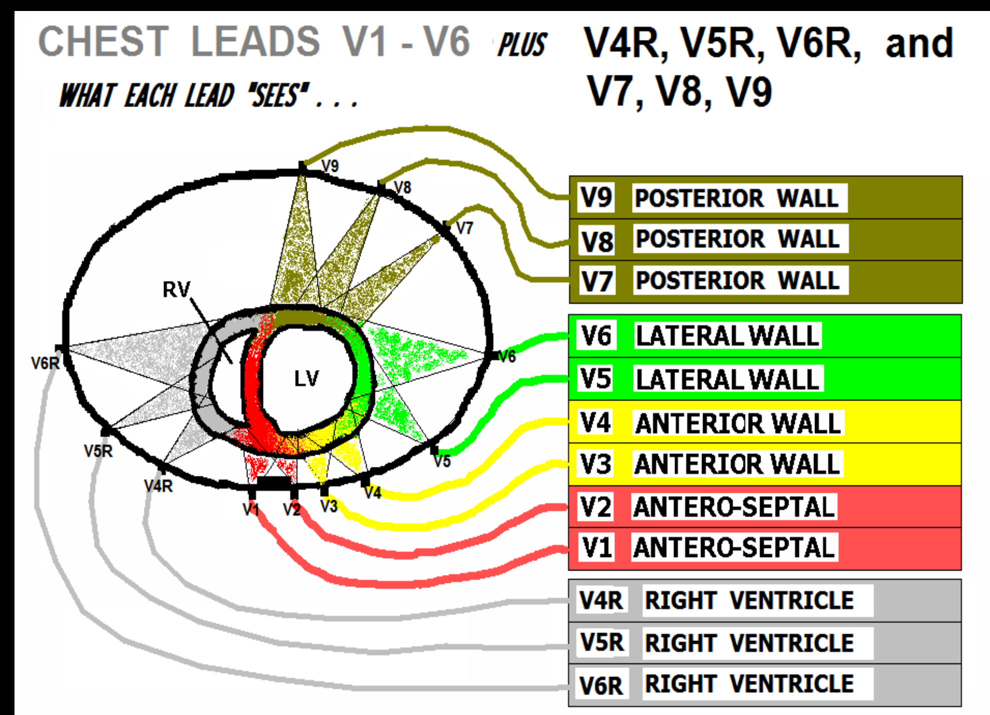


40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MACVU 003C 12SL tm v250

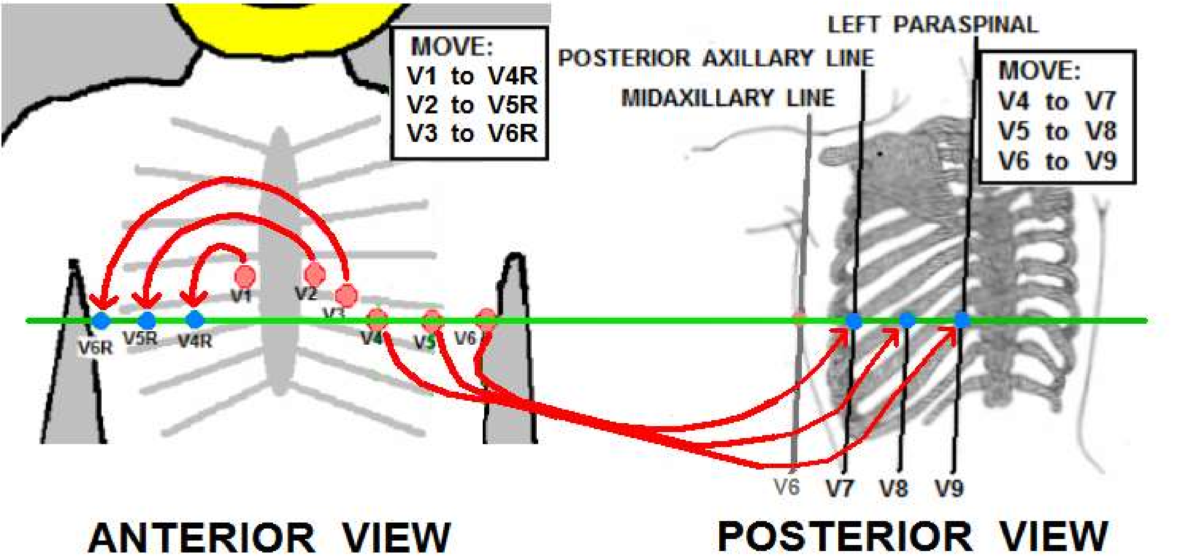


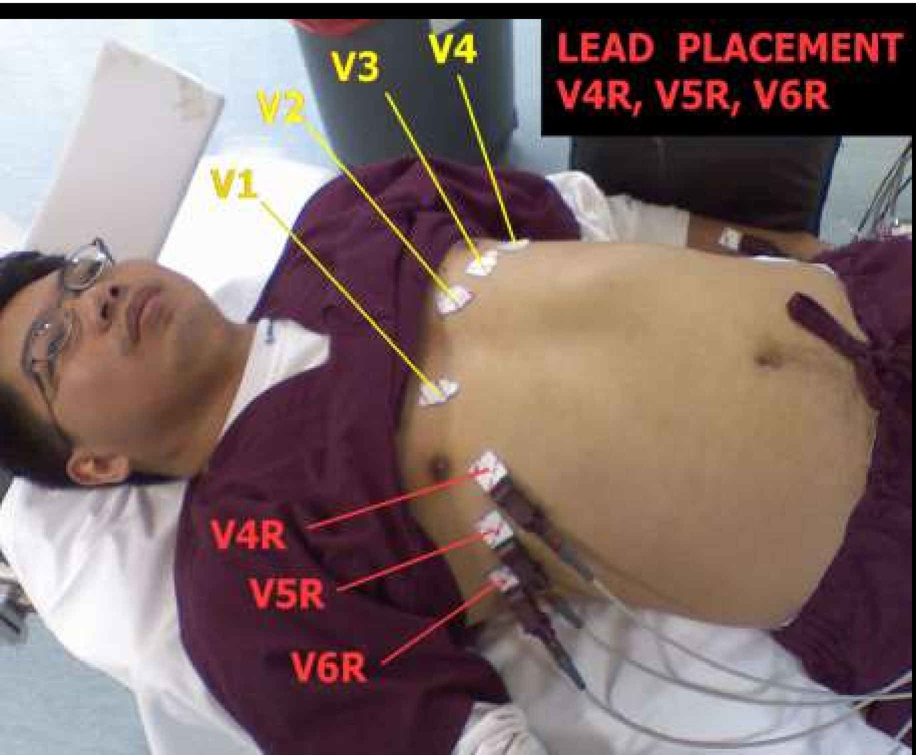
⇦ The 12 Lead ECG

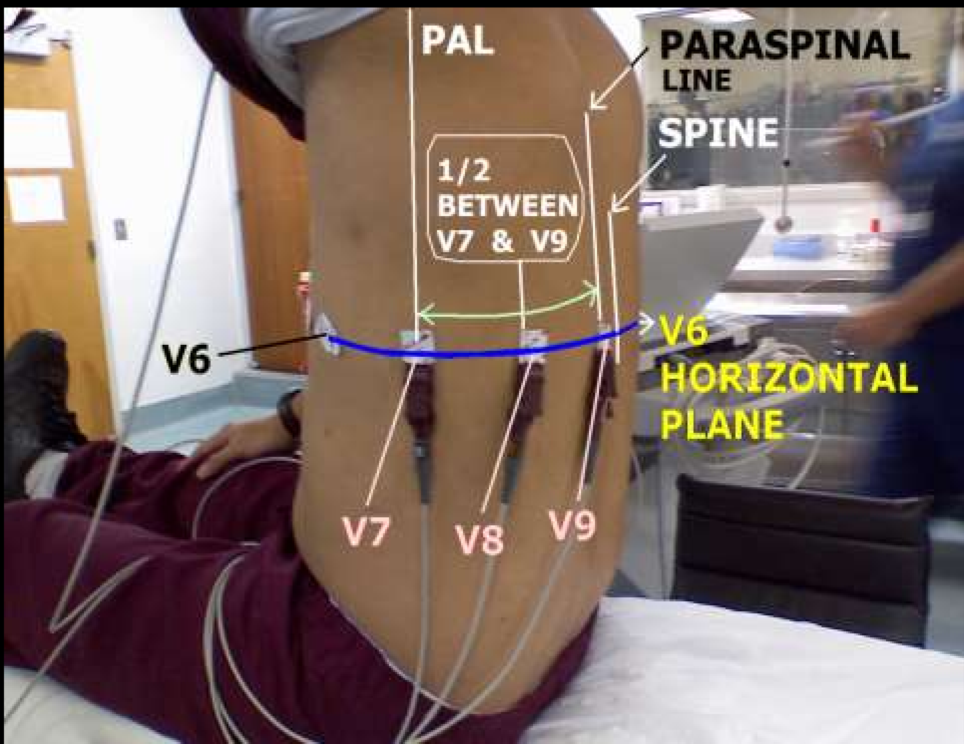
The 18 Lead ECG ⇨



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





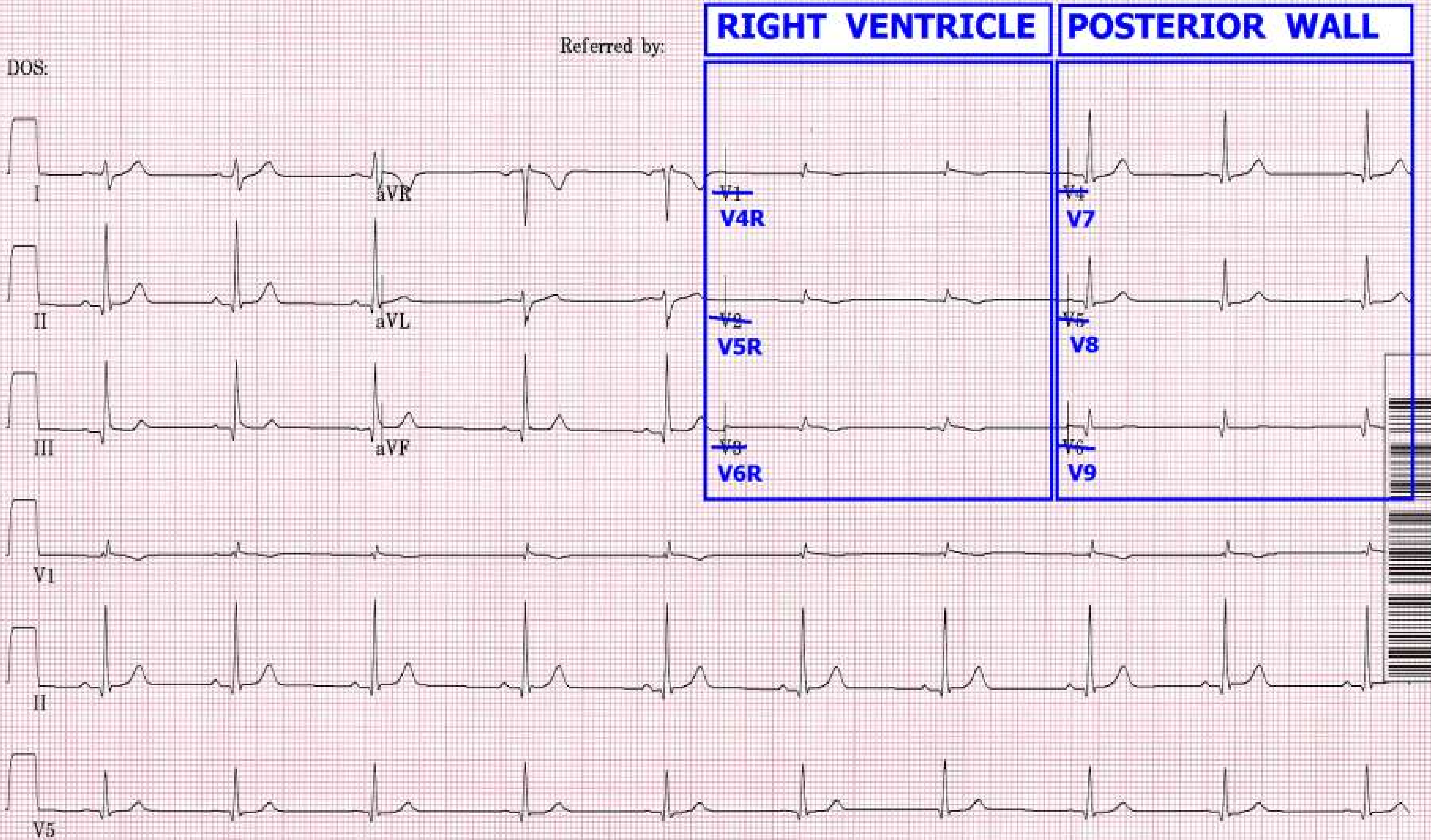


34years | Vent. rate 58 bpm | Sinus bradycardia
Male Asian | PR interval 146 ms | ~~RSR' or QR pattern in V1 suggests right ventricular conduction delay~~
| QRS duration 82 ms | ~~Cannot rule out Anteroseptal infarct, age undetermined~~
Room: | QT/QTc 372/365 ms | ~~Abnormal ECG~~
Opt: | P-R-T axes 29 82 50

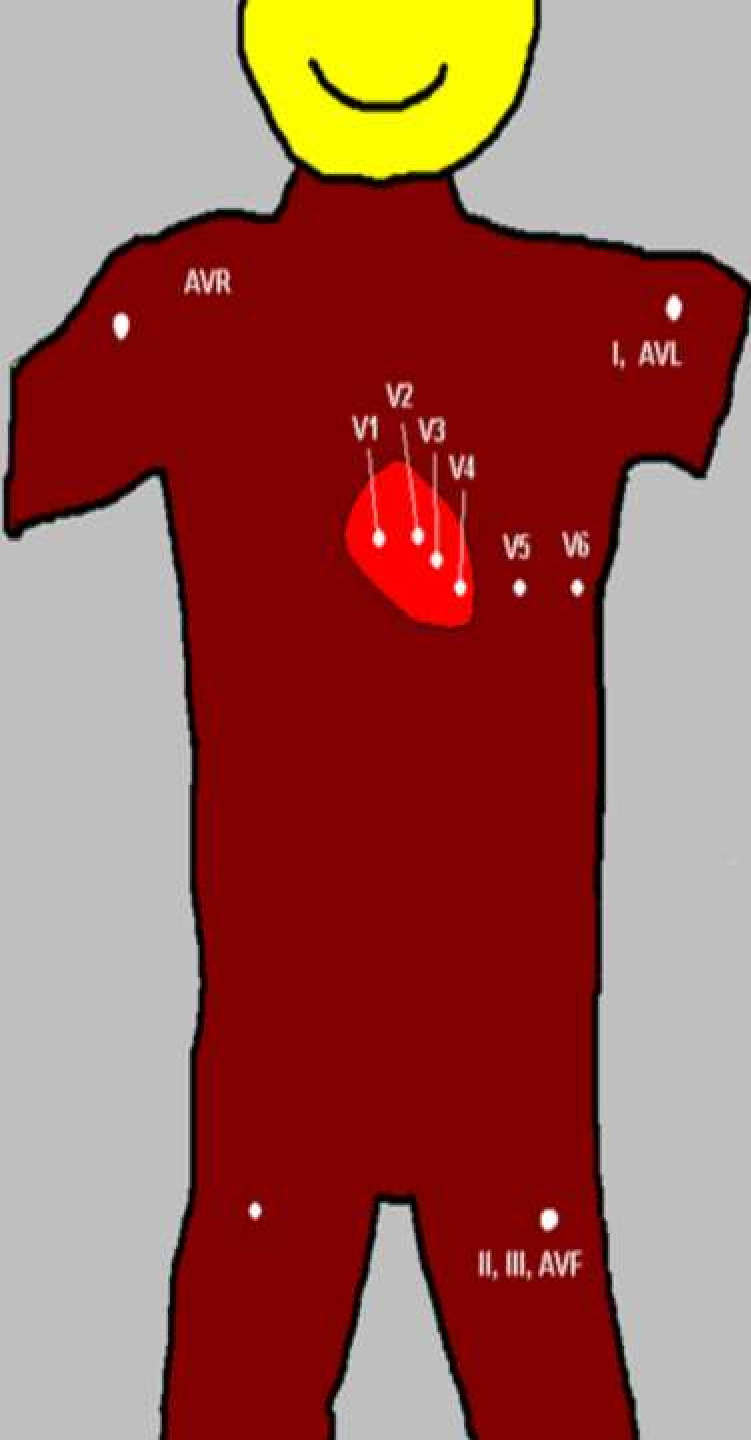
Technician: WR

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



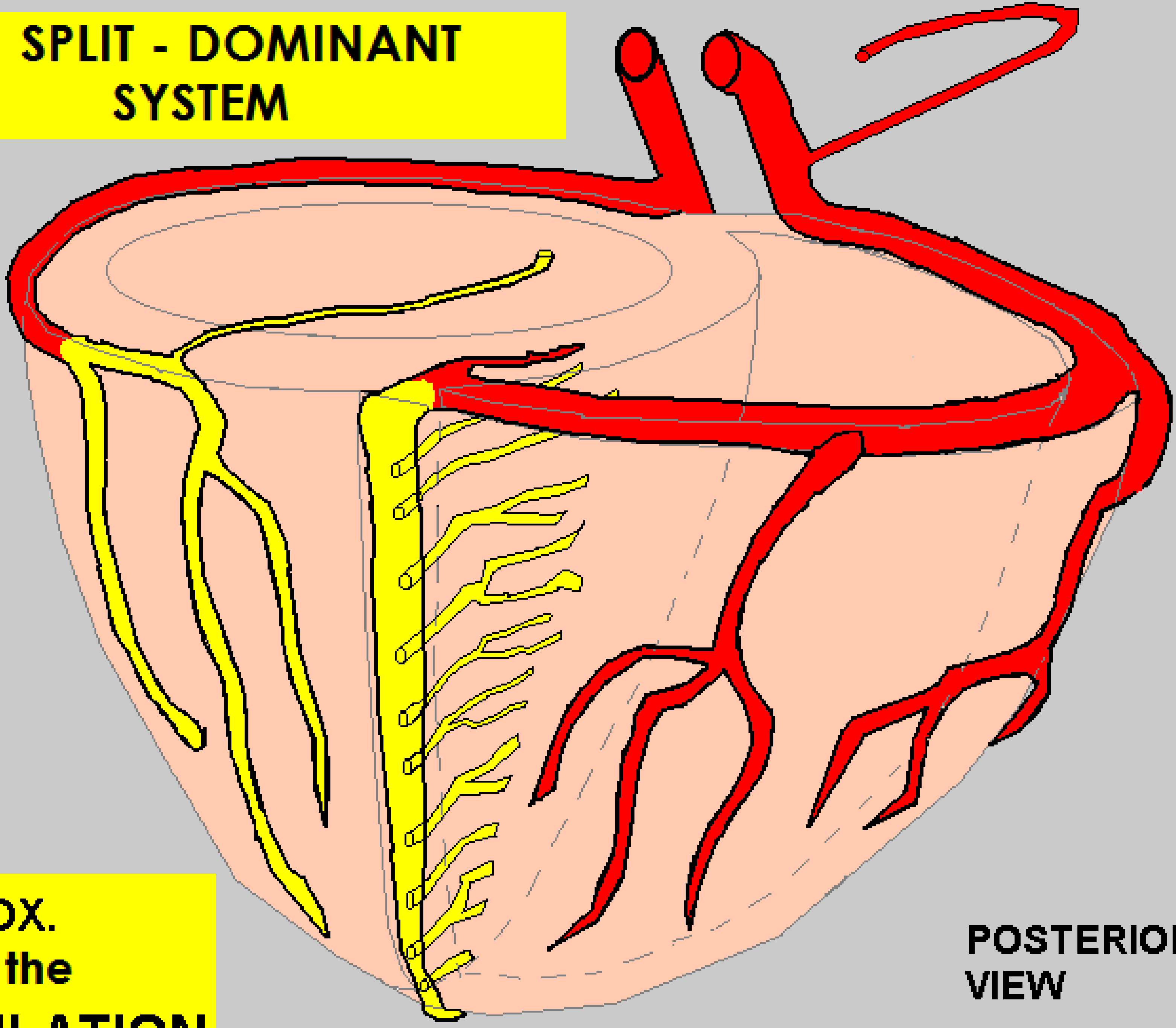
AREAS VIEWED by 12 LEAD ECG + TYPICAL CORONARY ARTERIAL DISTRIBUTION

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

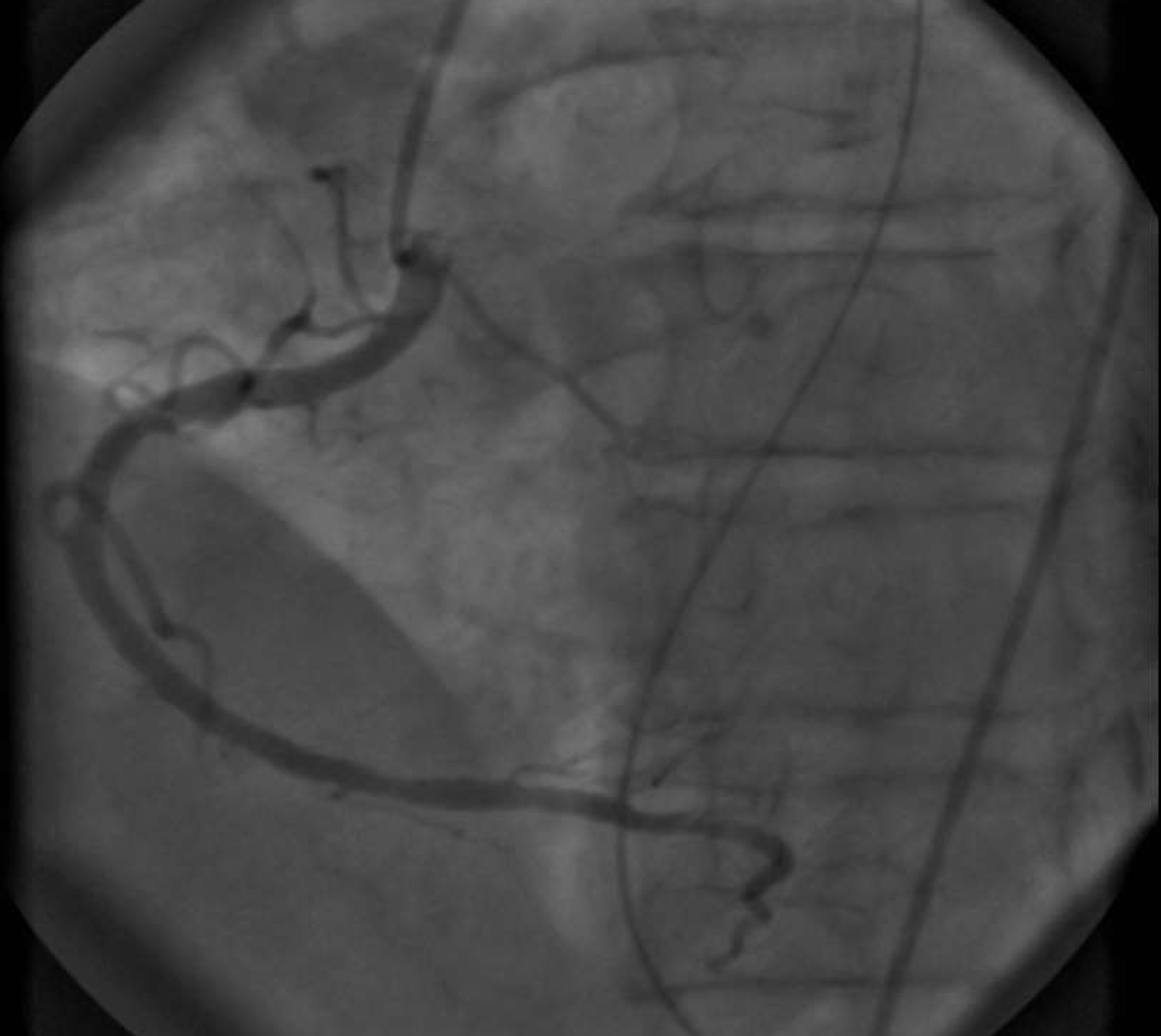
RIGHT DOMINANT and LEFT DOMINANT systems account for approximately 90 % of the population. . . . .

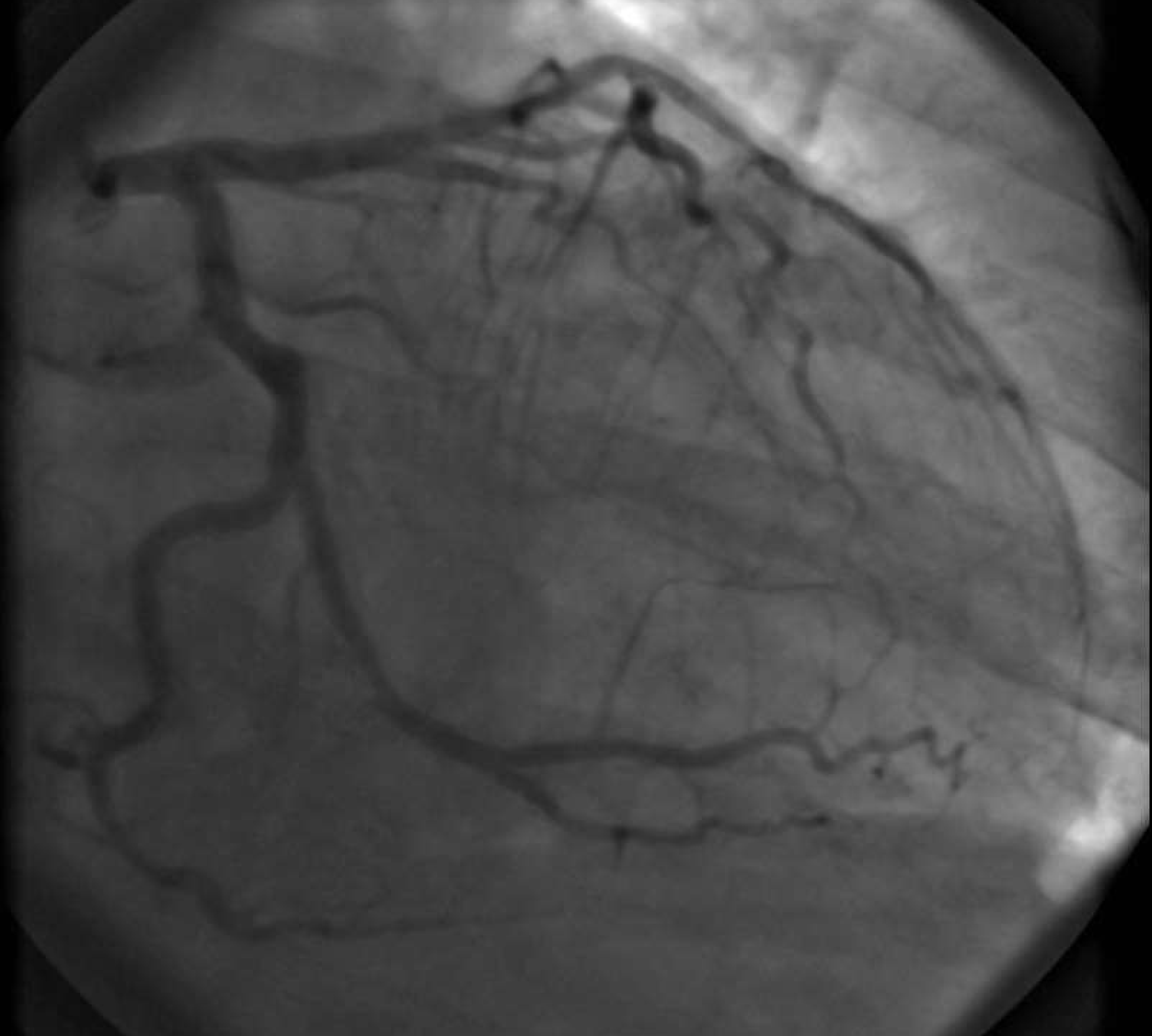
COMING UP ... some LESS COMMON variations that comprise the remaining 10%. . .

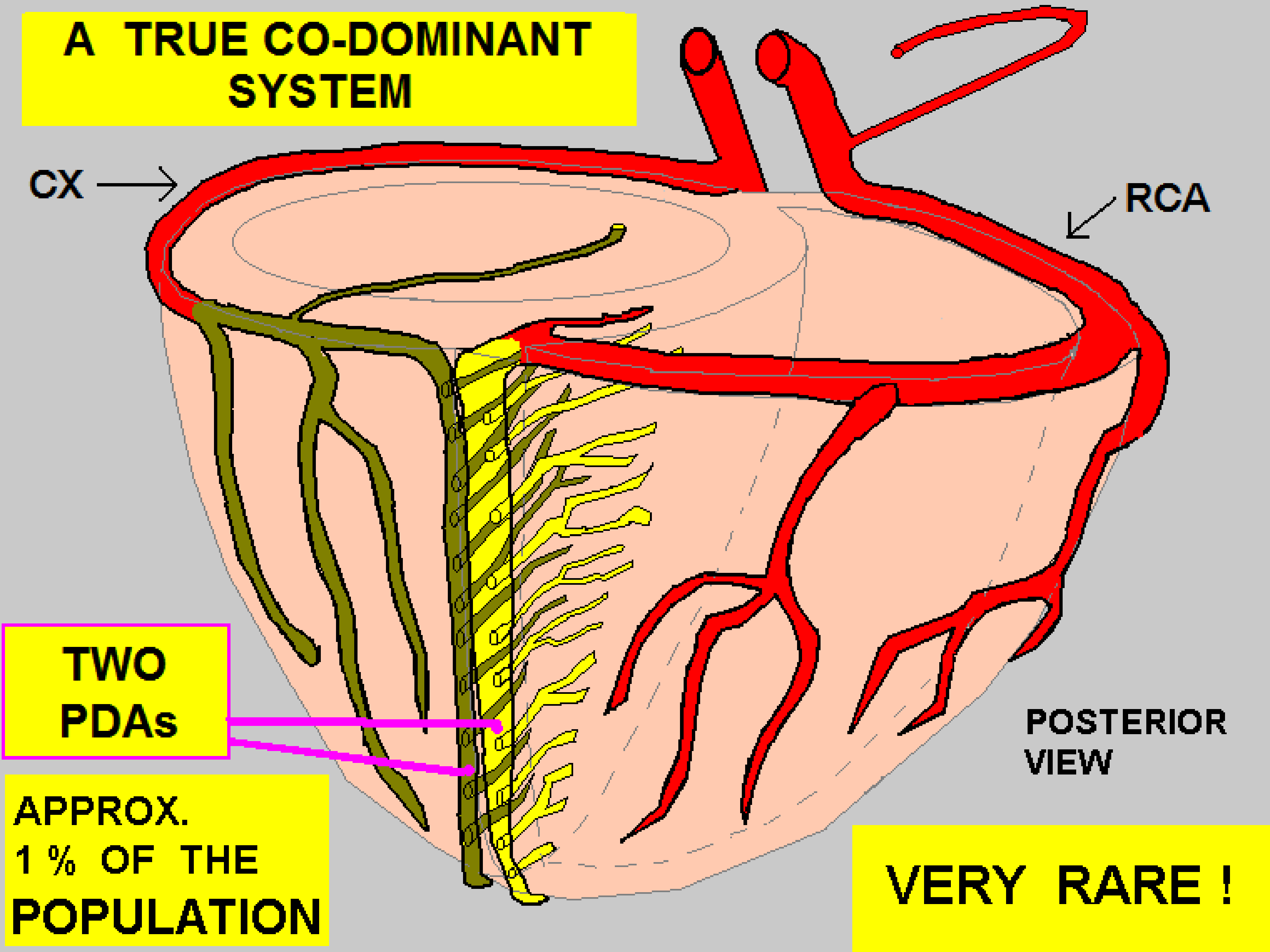
A SPLIT - DOMINANT SYSTEM

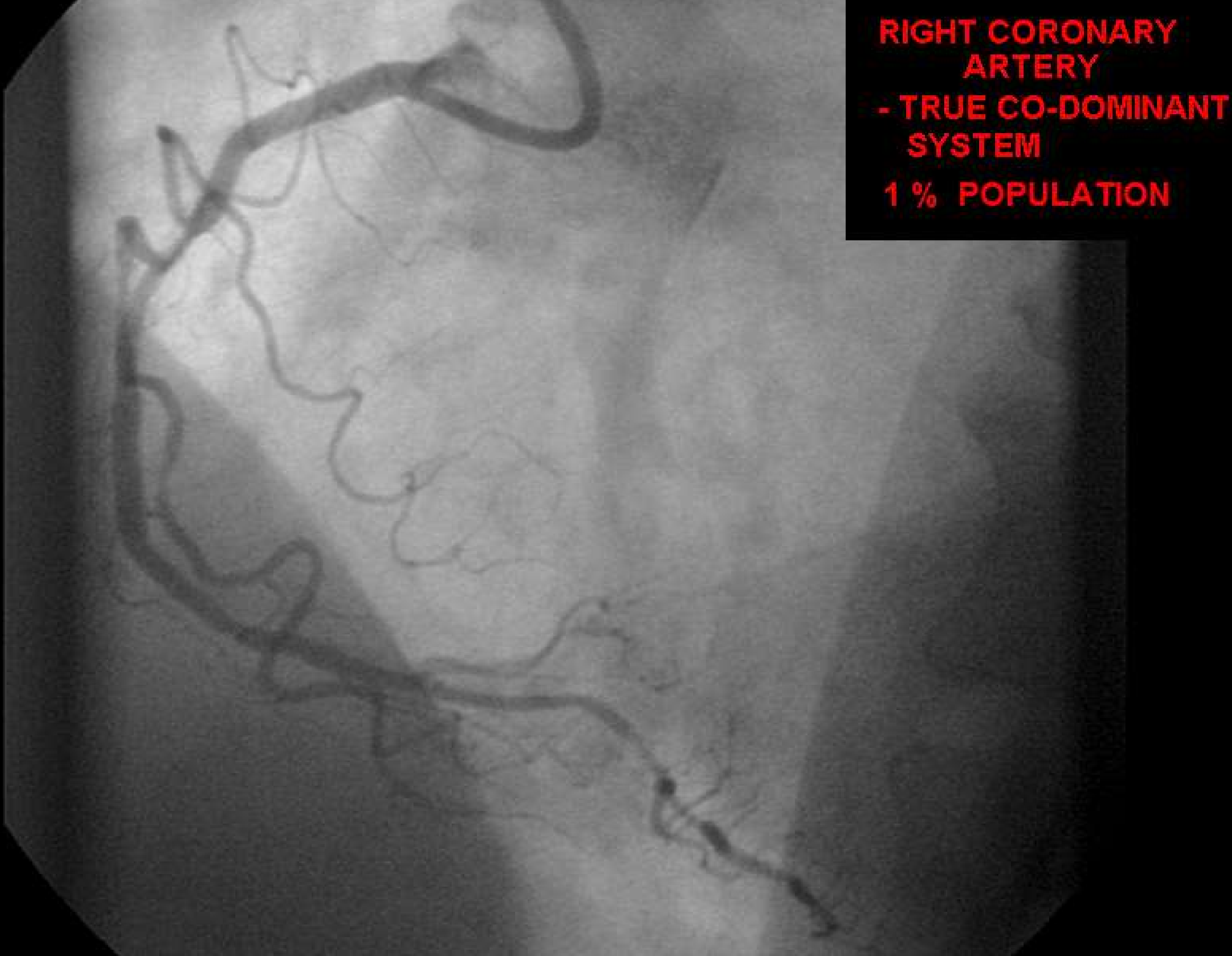


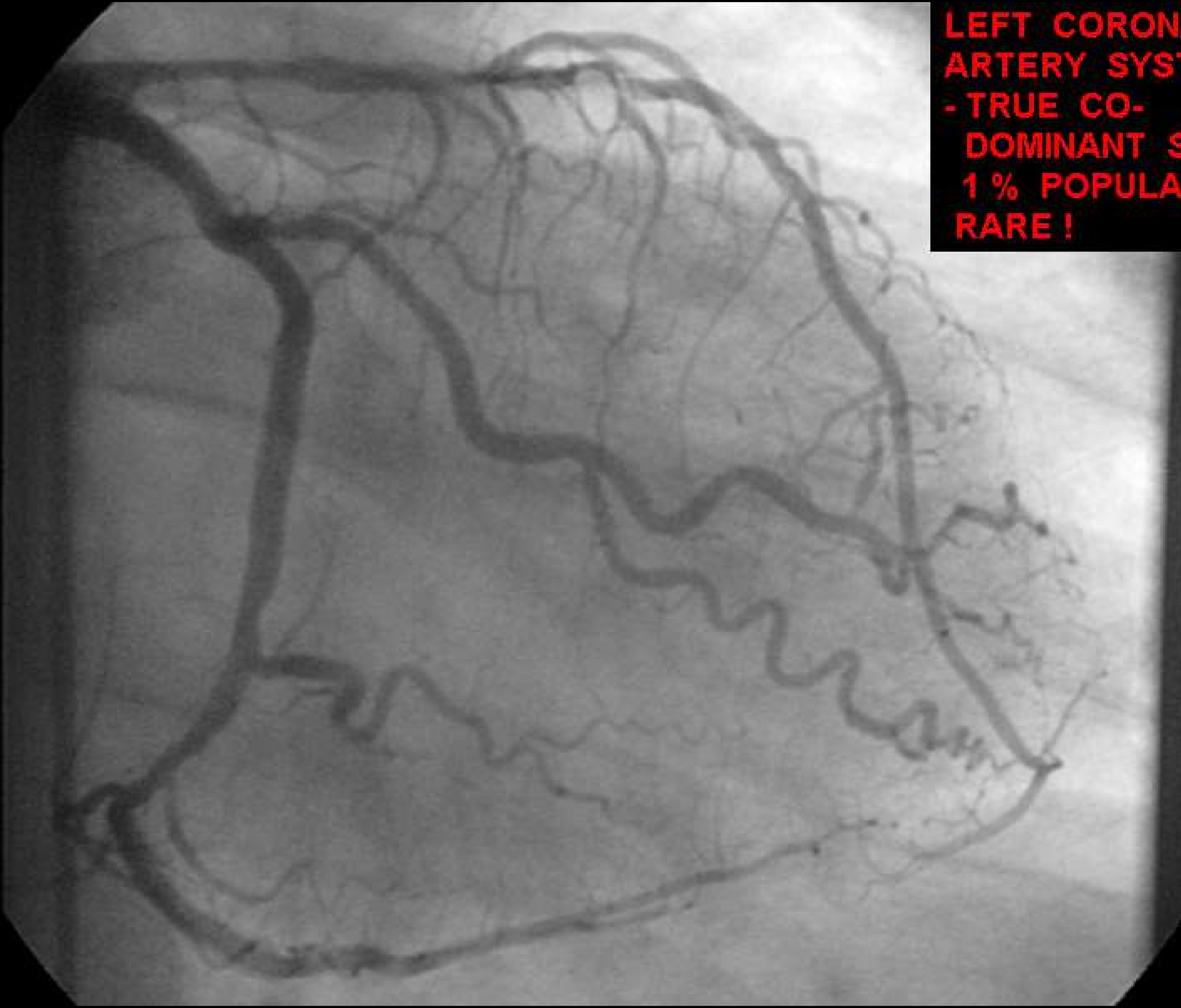
APPROX.
5% of the
POPULATION



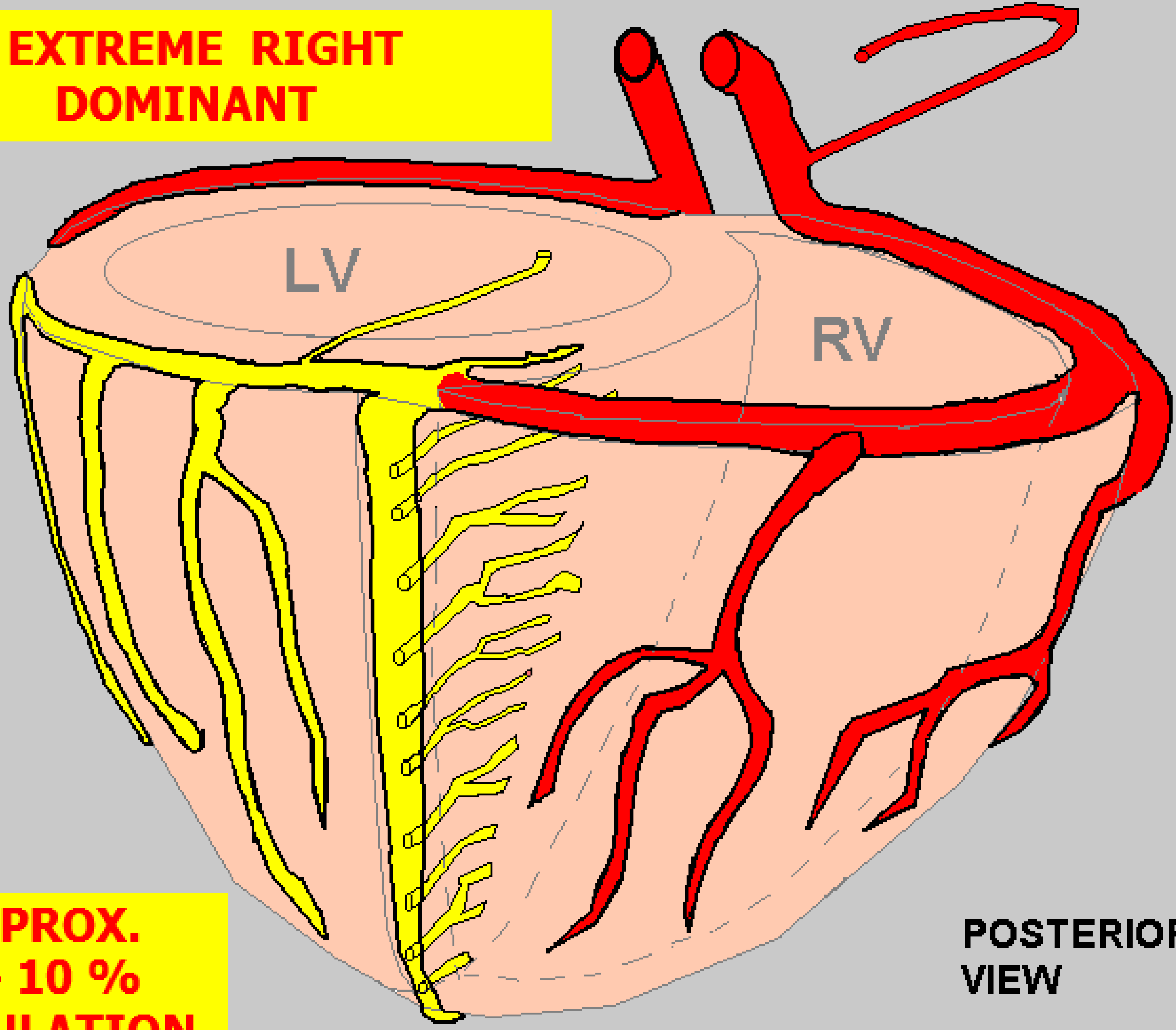



A TRUE CO-DOMINANT SYSTEM
CX
RCA
TWO PDAs
APPROX. 1 % OF THE POPULATION
POSTERIOR VIEW
VERY RARE !

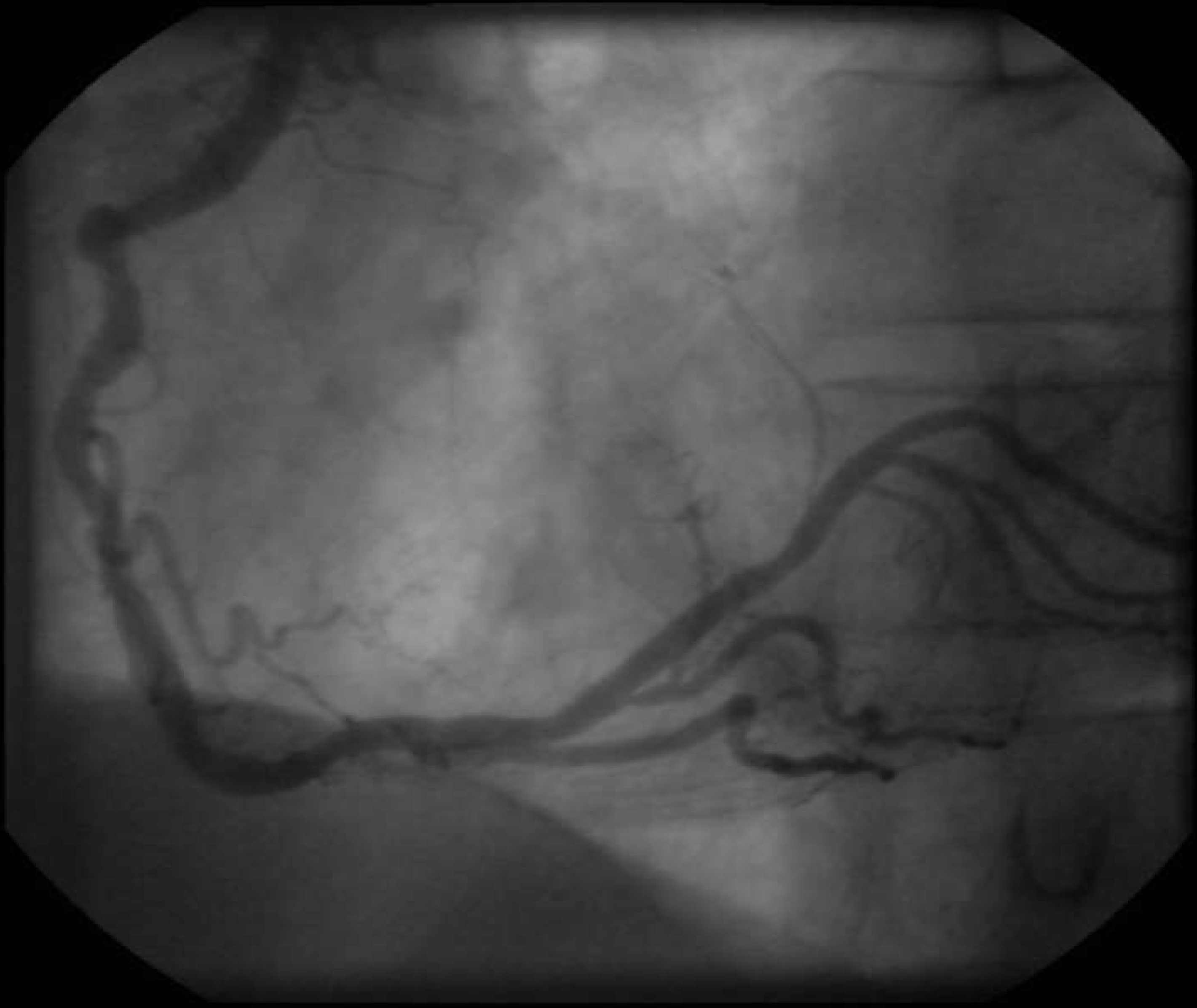

RIGHT CORONARY
ARTERY
- TRUE CO-DOMINANT
SYSTEM
1 % POPULATION


LEFT CORONARY
ARTERY SYSTEM
- TRUE CO-
DOMINANT SYSTEM
1 % POPULATION
RARE !

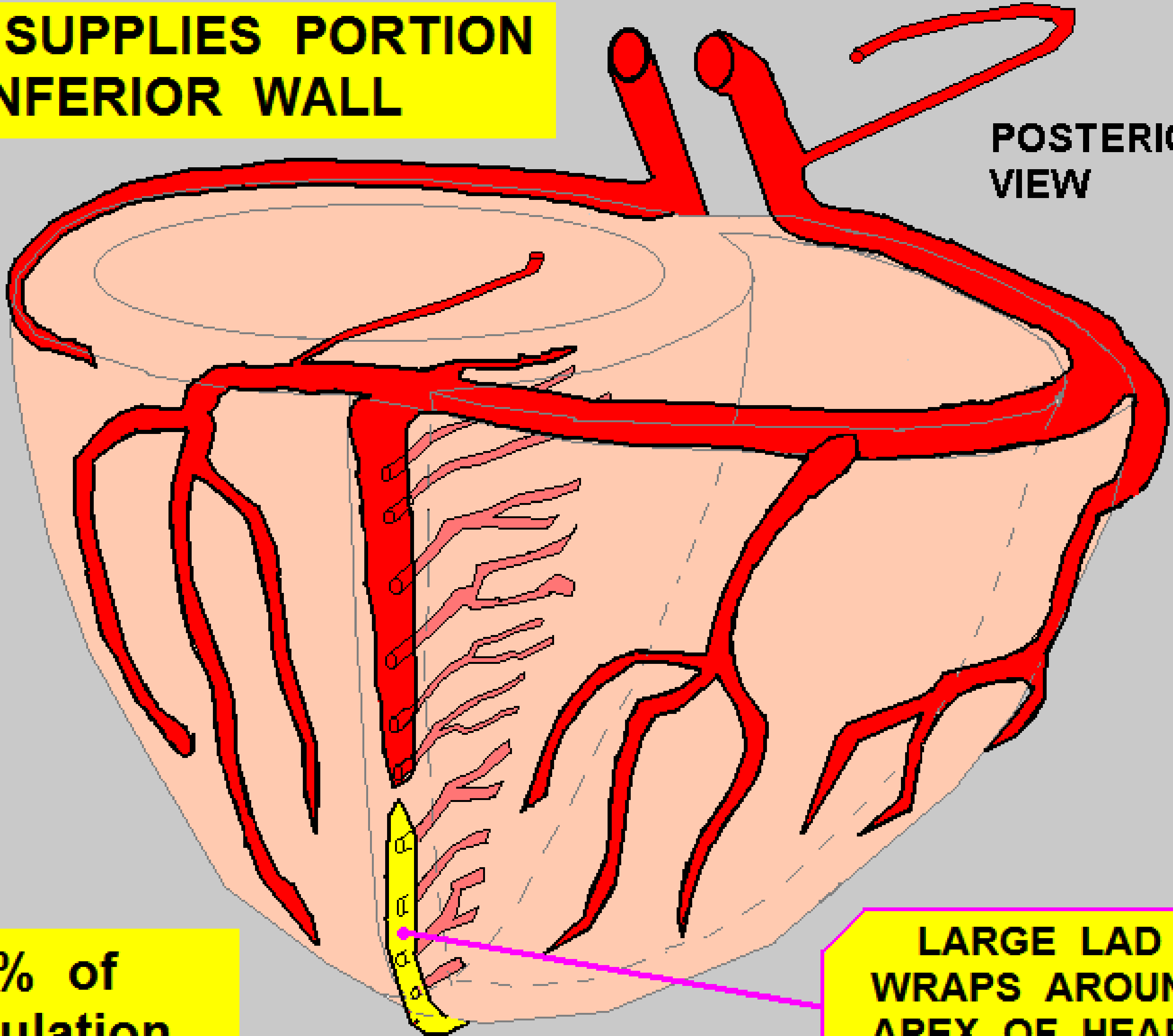
EXTREME RIGHT DOMINANT



APPROX.
5 - 10 %
POPULATION



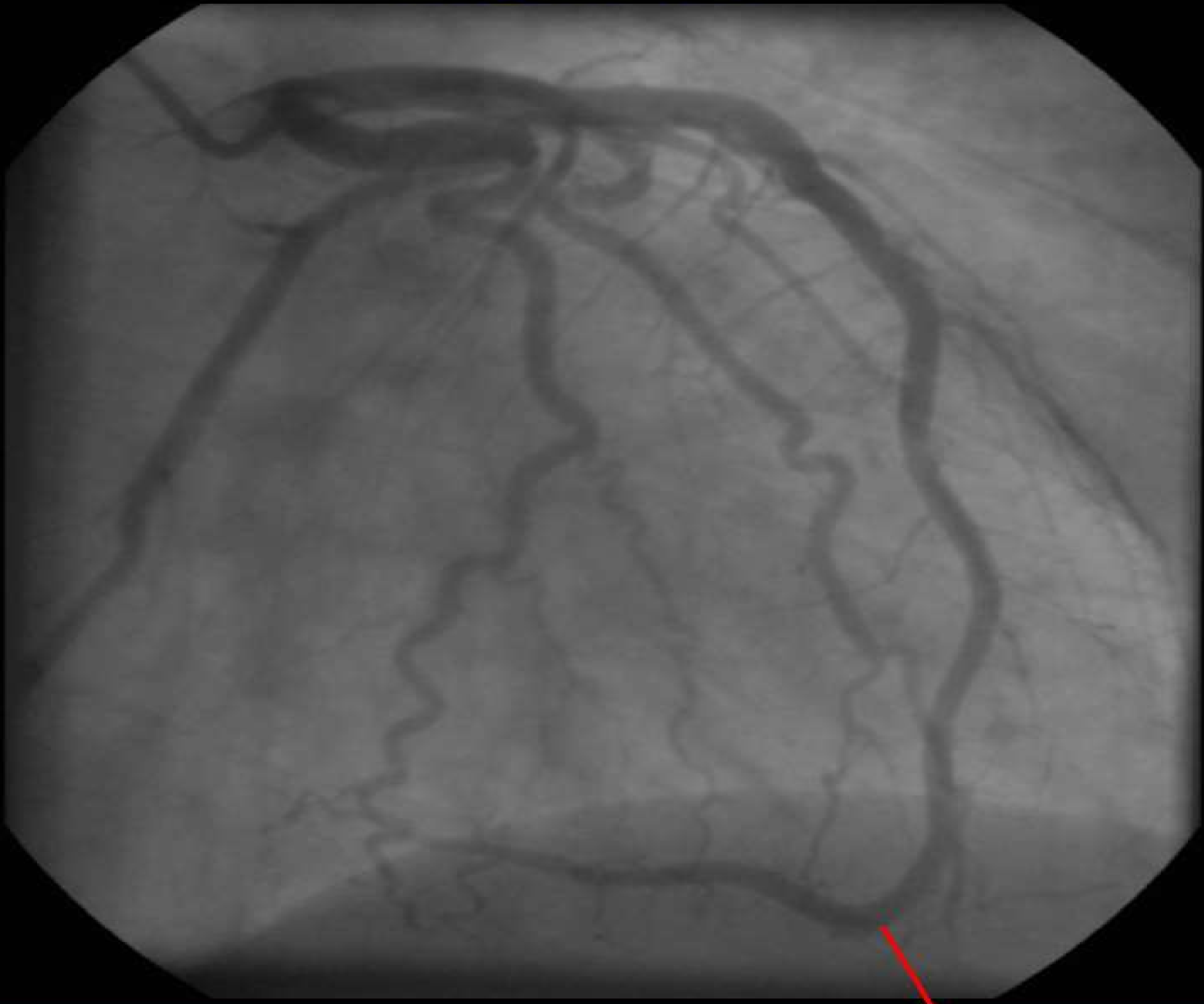
LAD SUPPLIES PORTION OF INFERIOR WALL



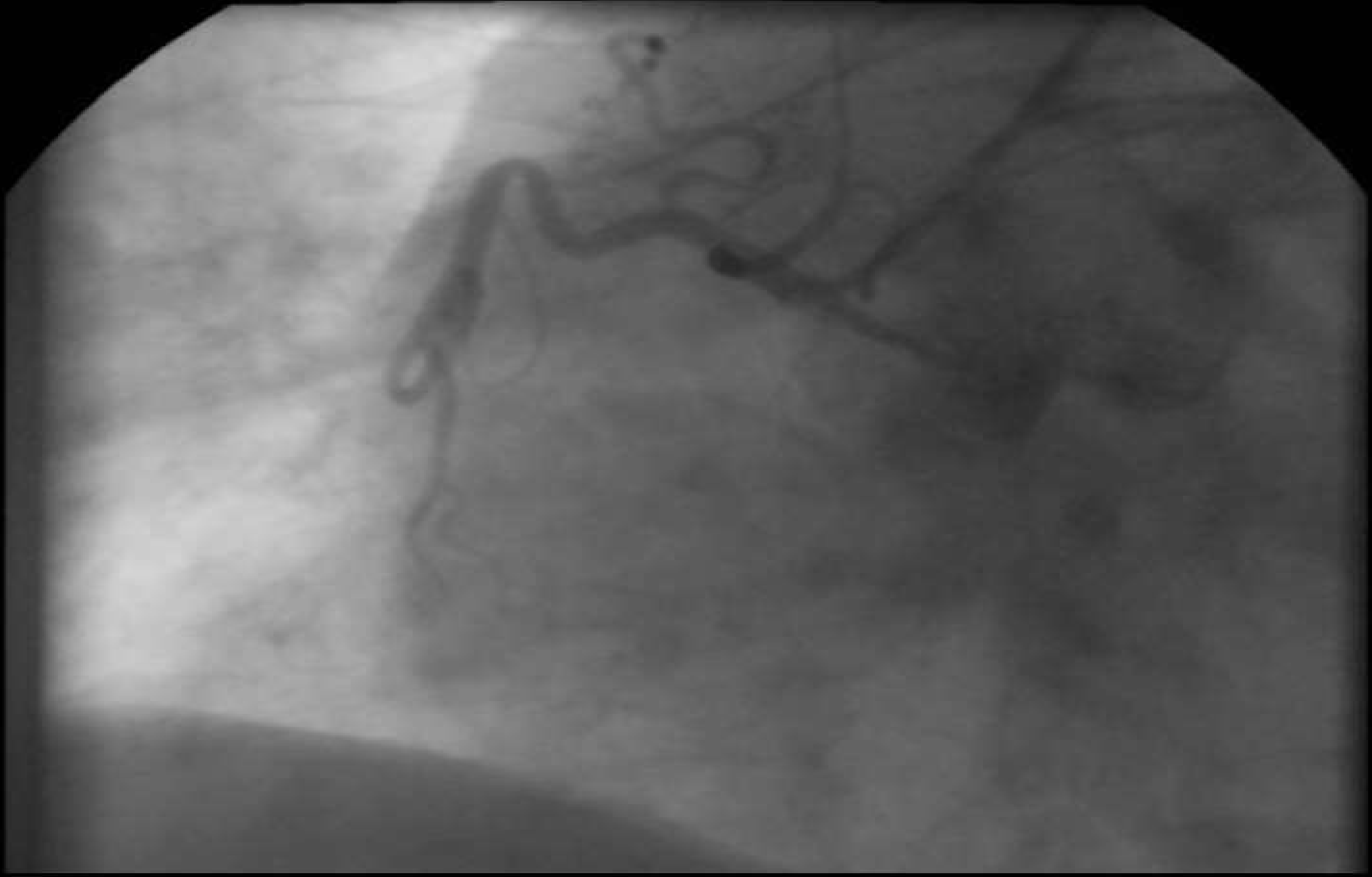
< 5 % of population

LARGE LAD WRAPS AROUND APEX OF HEART

ANTERIOR VIEW



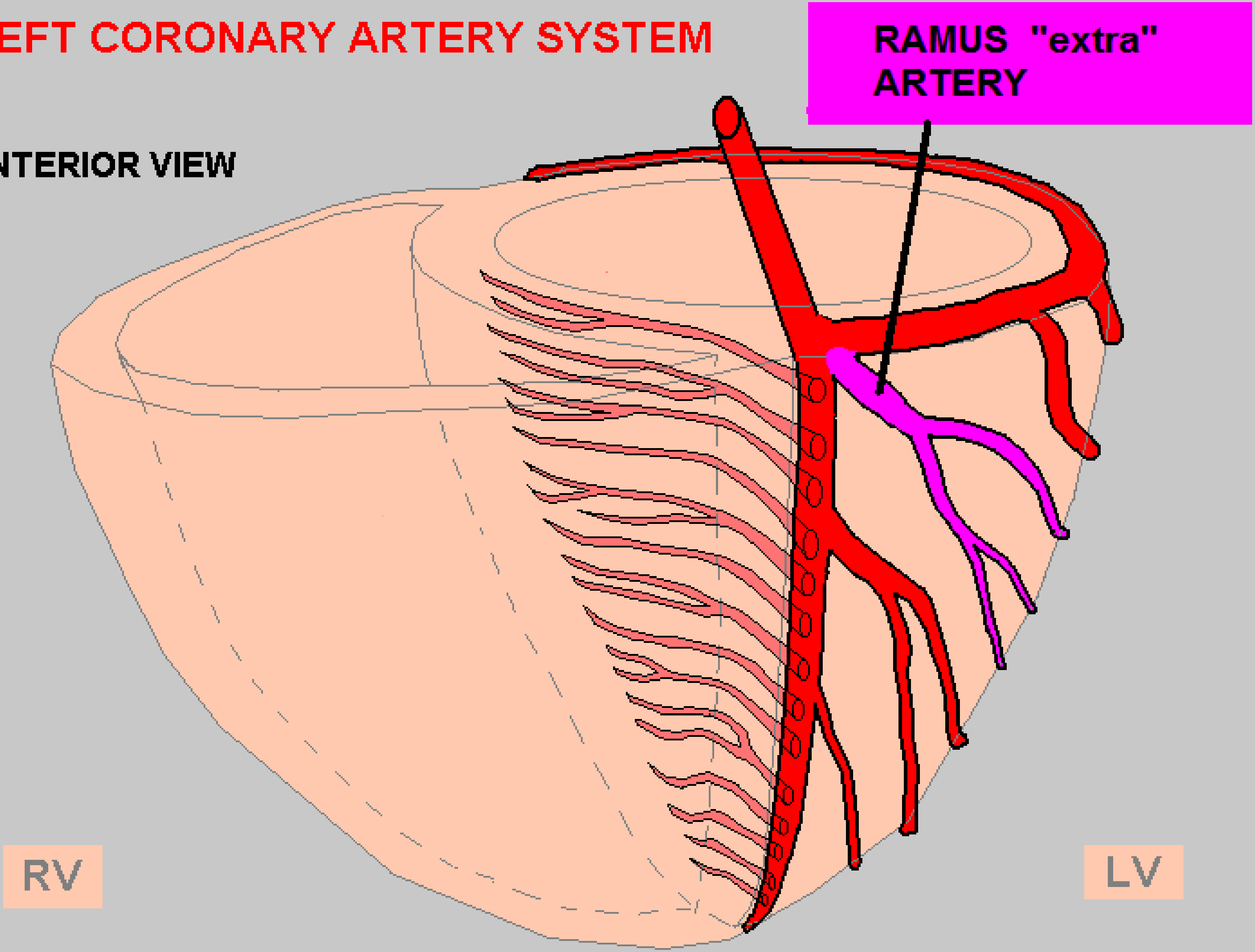
LEFT ANTERIOR DESCENDING artery wraps around apex of heart and supplies INFERIOR WALL

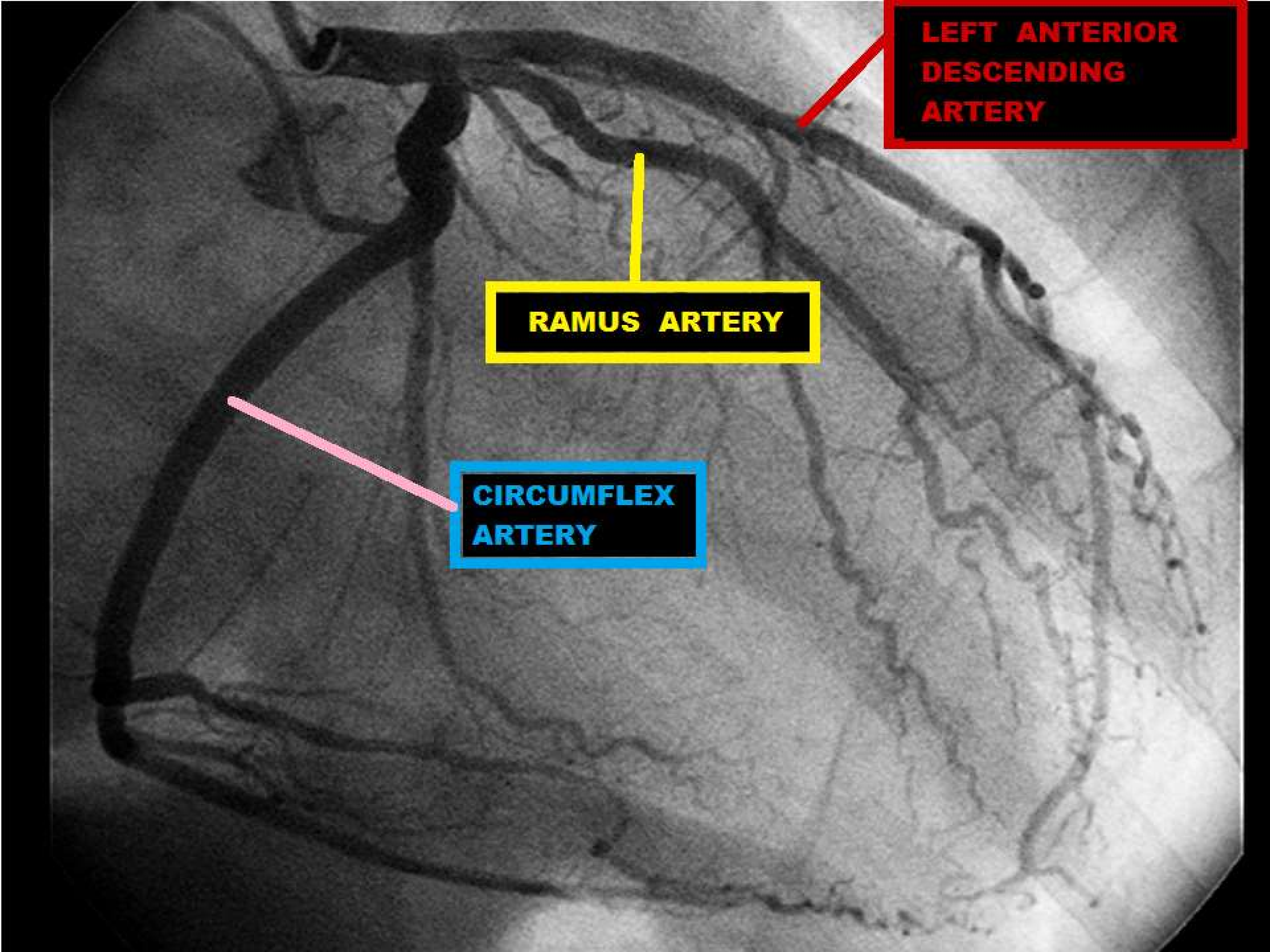


SMALL, NON-DOMINANT RCA

LEFT CORONARY ARTERY SYSTEM

ANTERIOR VIEW




LEFT ANTERIOR DESCENDING ARTERY
RAMUS ARTERY
CIRCUMFLEX ARTERY

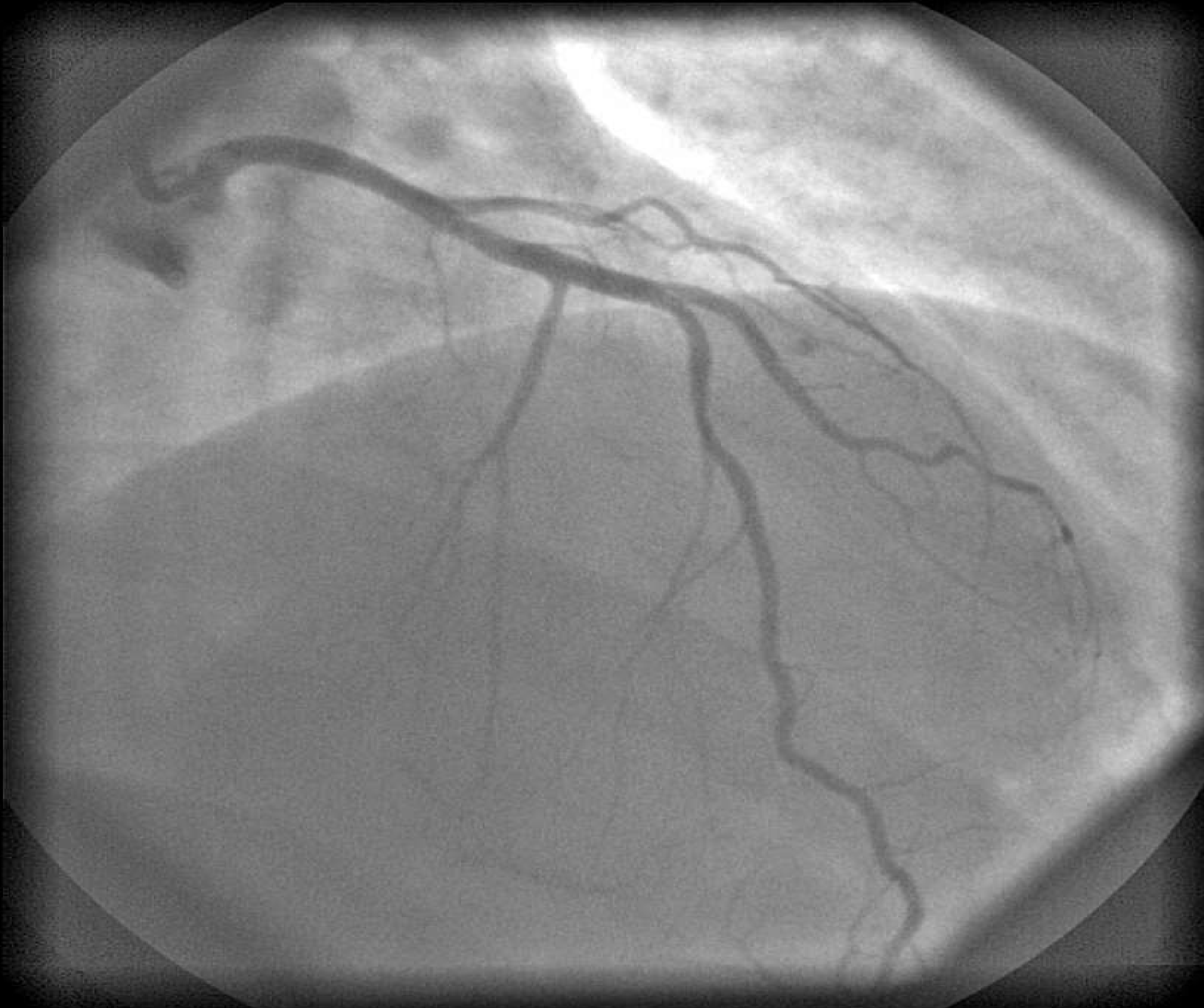
The New England Medical Journal

CORONARY ARTERY ANOMALITIES

CIRCUMFLEX

Originates From the

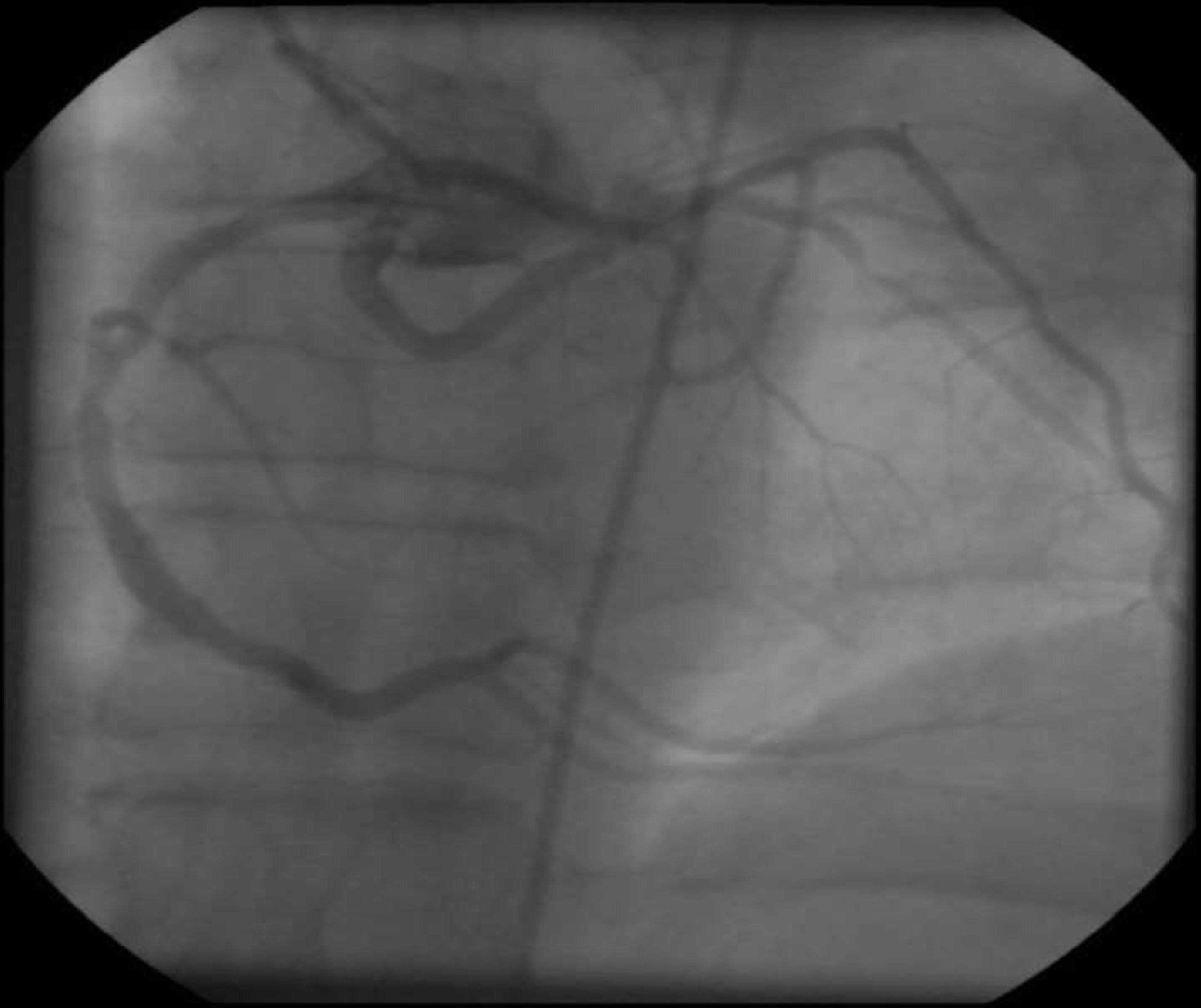
RCA

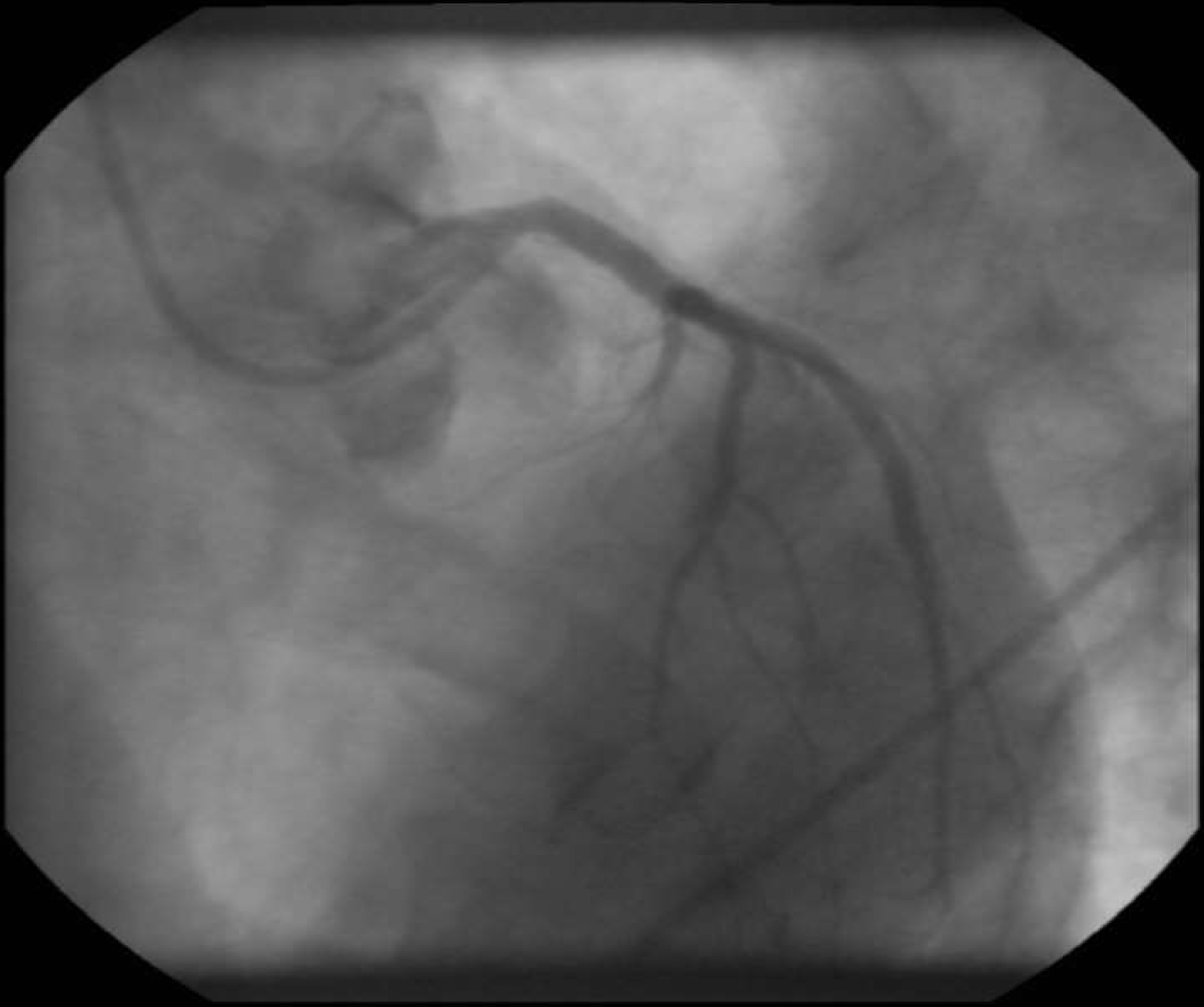


LAD

originates from

RCA





SINGLE
ARTERY
SUPPLIES
ENTIRE
HEART


ANOMALOUS
CORONARY ARTERY
RAO Caudal View
ONE ARTERY SUPPLIES ENTIRE MYOCARDIUM

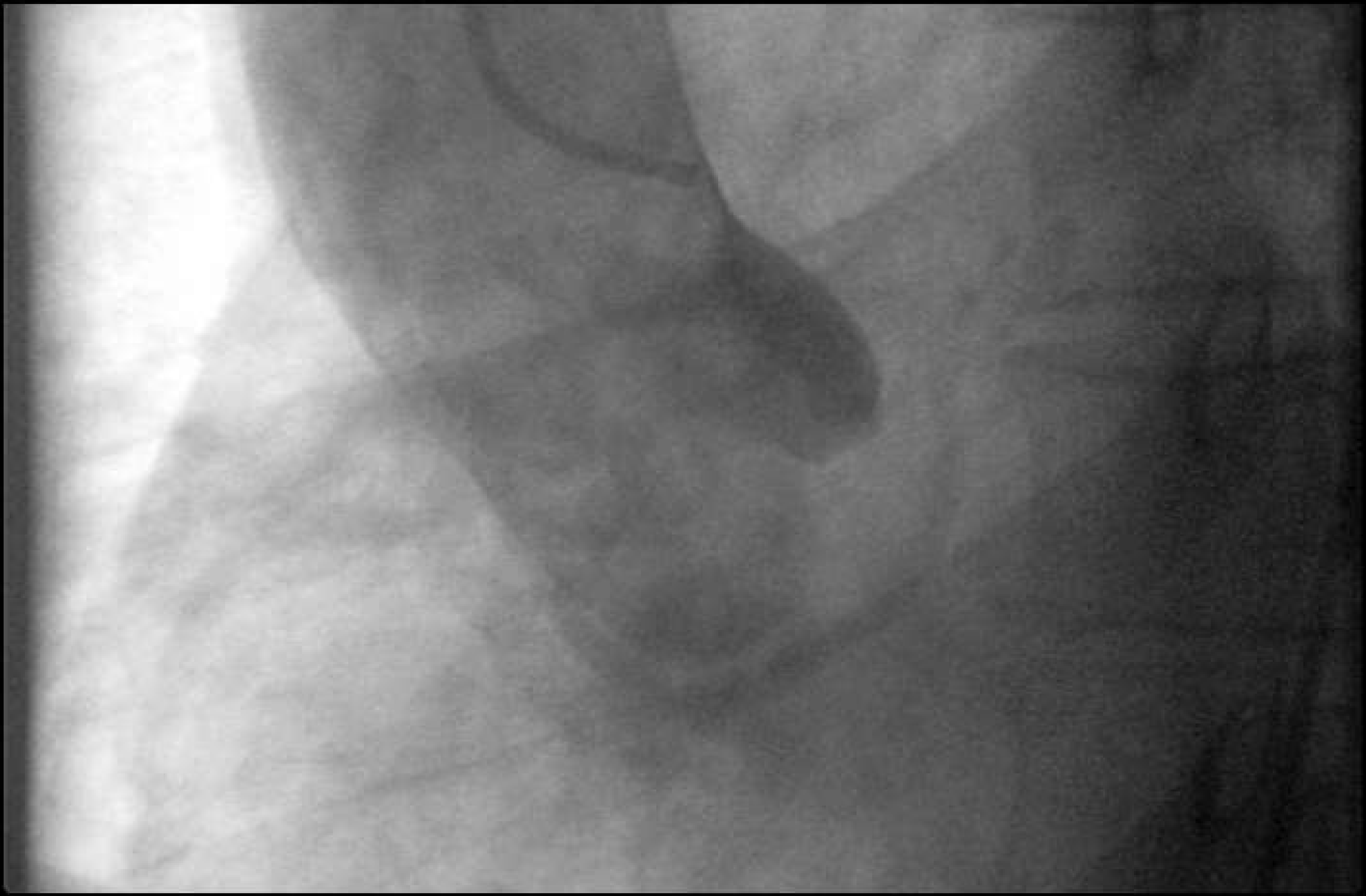

ANOMALOUS CORONARY ARTERY

SIGNIFICANT INCREASE OF SUDDEN DEATH

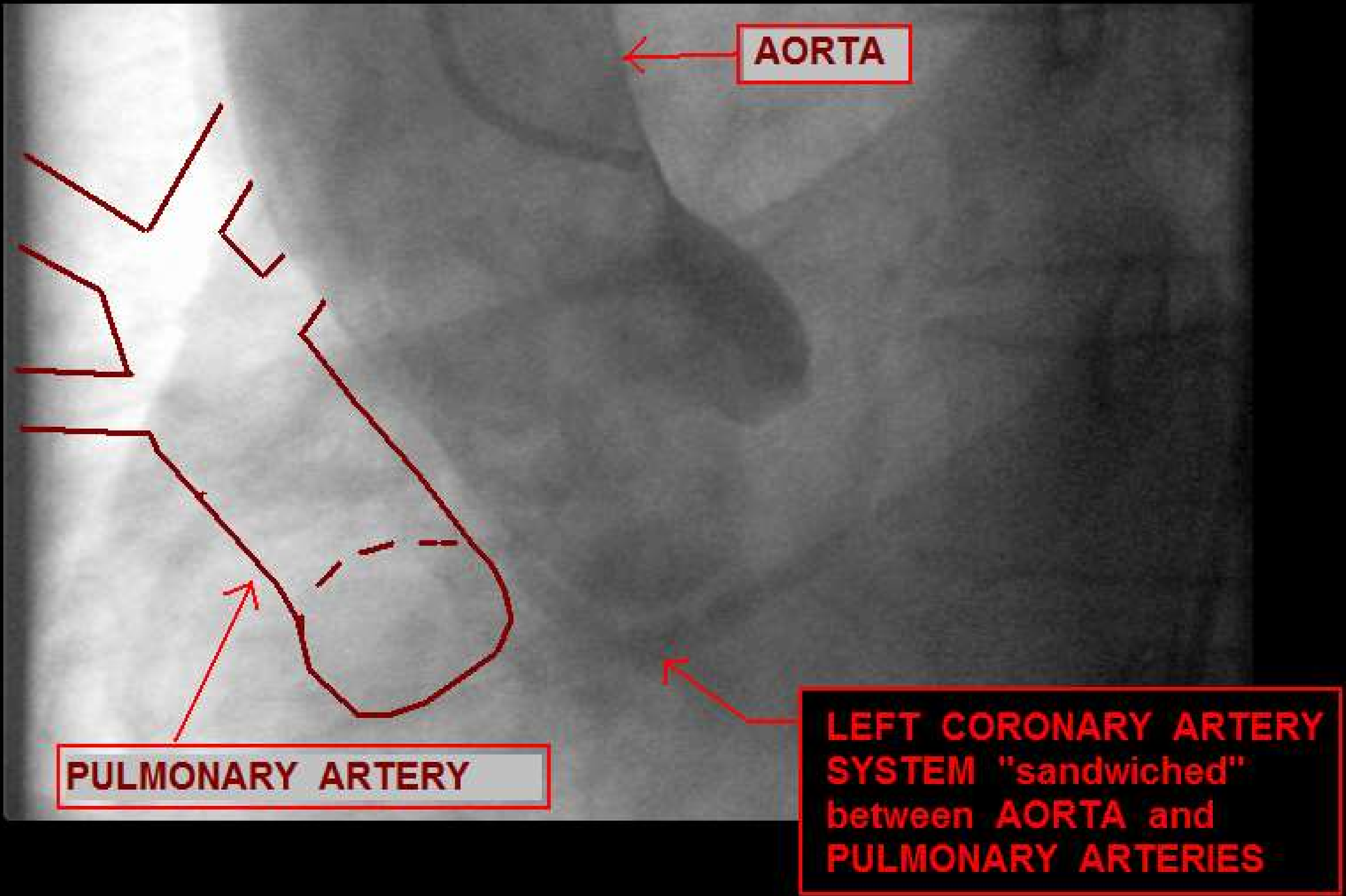
for people with
anomalous coronary artery

- due to constriction of the circumflex branch as it wraps around AORTA
- this condition can be corrected surgically.

Aortic Root Injection of Patient With Anomalous Coronary Artery

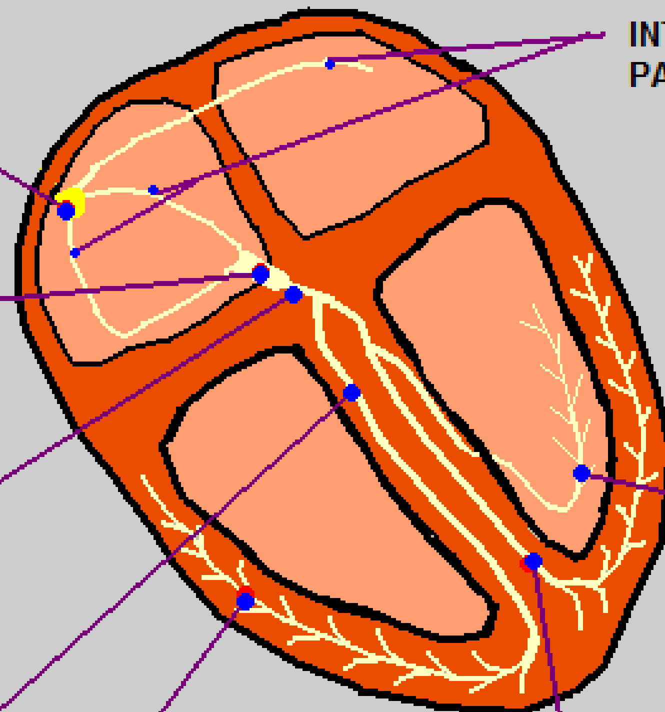


Aortic Root Injection of Patient With Anomalous Coronary Artery



OLD BARN, SHREWSBURY, PA -- 2001

The Cardiac Electrical System



SINUS NODE
- INHERENT RATE 60 - 100
- BLOOD SUPPLY:
  - INFERIOR WALL (RCA) or
  - LATERAL WALL (CIRC.)

AV NODE
- INHERENT RATE 40 - 60
- BLOOD SUPPLY:
  - INFERIOR WALL (RCA or CIRC.)

BUNDLE OF HIS
- INHERENT RATE 40 - 60
- BLOOD SUPPLY:
  - ANTERIOR WALL (LAD)

RIGHT BUNDLE BRANCH
- BLOOD SUPPLY:
  - ANTERIOR WALL (LAD)

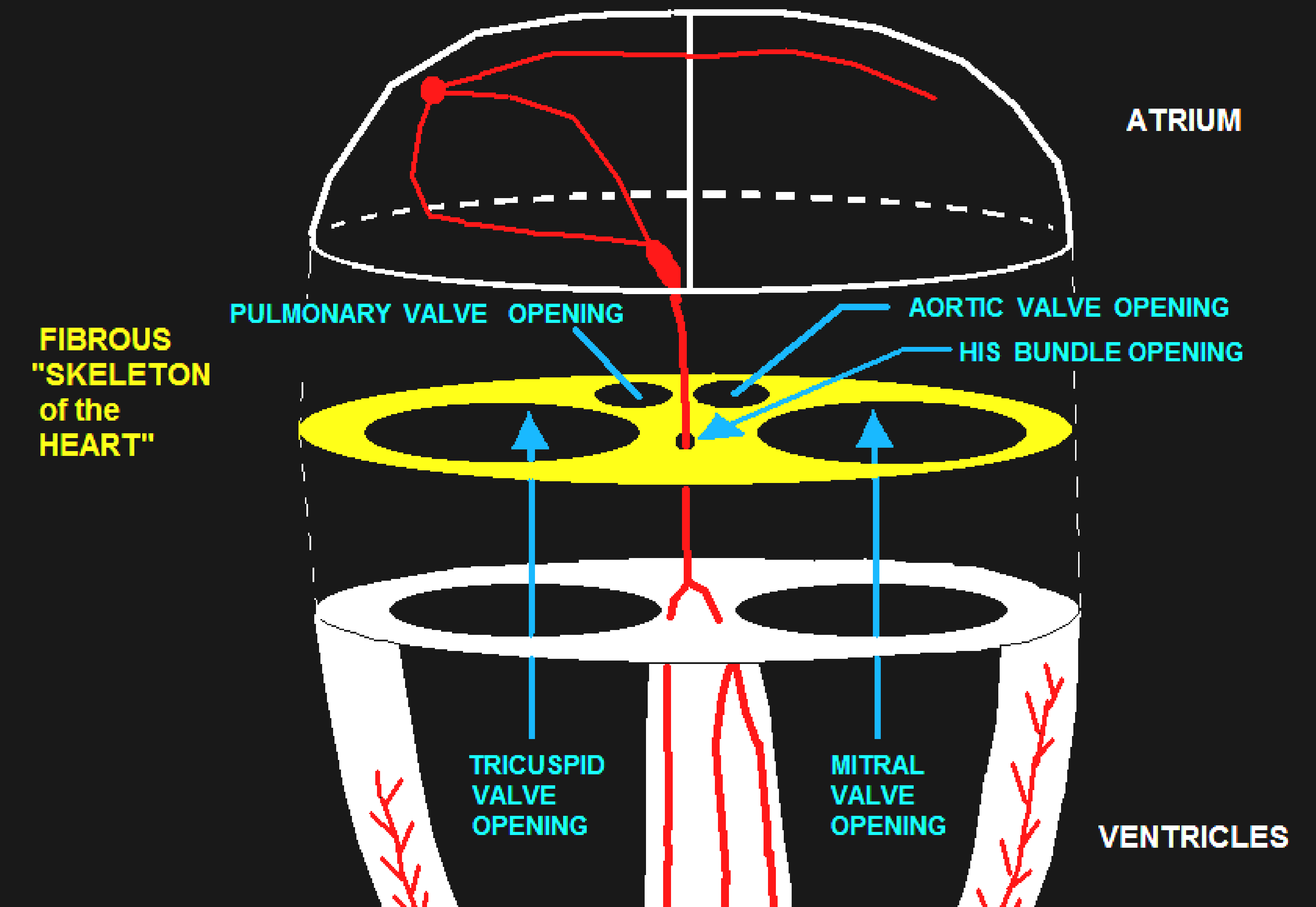
PURKINJE FIBERS
- INHERENT RATE 1 - 40

LEFT BUNDLE BRANCH

ANTERIOR FASCICLE
- BLOOD SUPPLY:
  - ANTERIOR WALL (LAD)

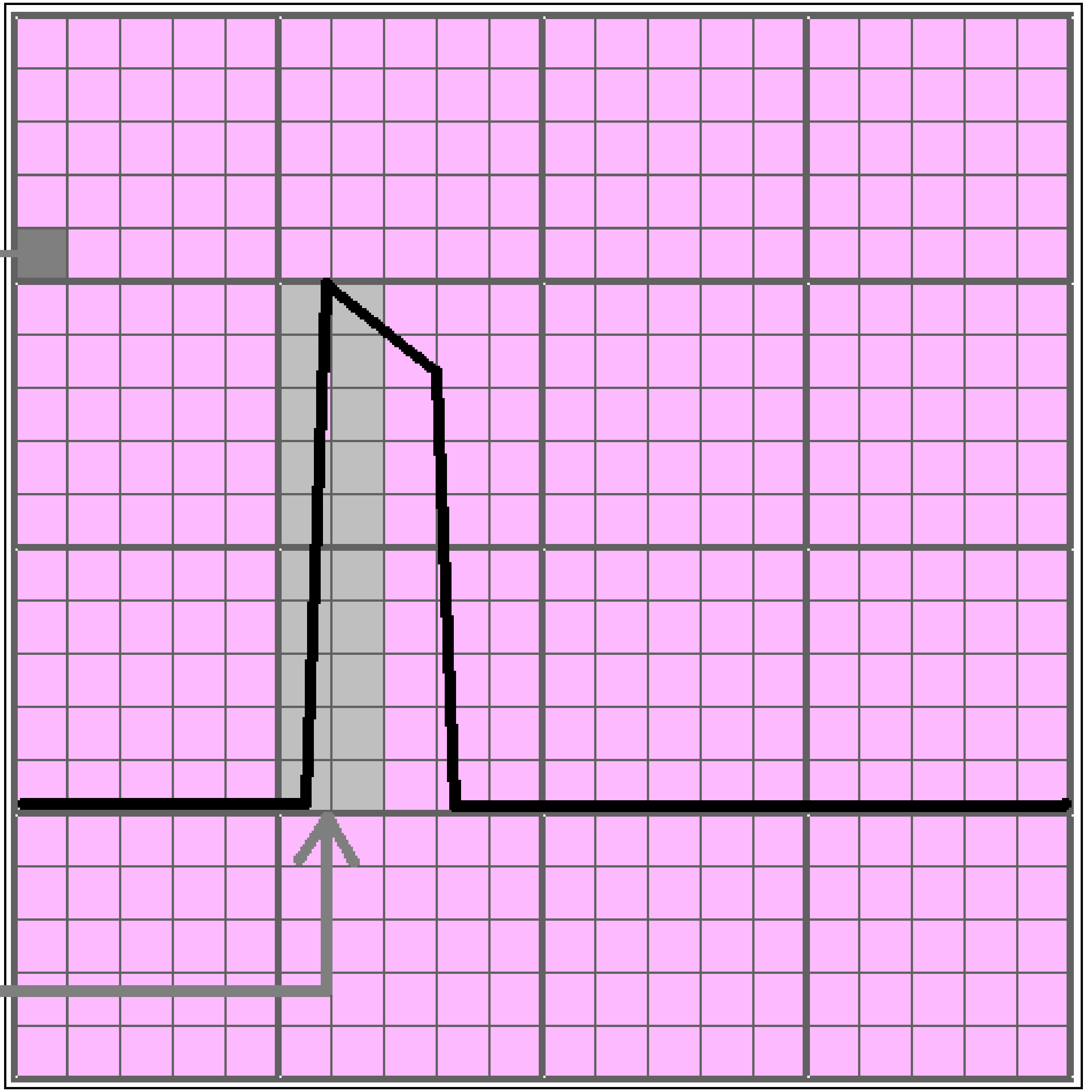
POSTERIOR FASCICLE
- BLOOD SUPPLY:
  - INFERIOR WALL (RCA or CIRC)

THE "SKELETON OF THE HEART"



ECG PAPER - THE VERTICAL AXIS:

- SMALL BOXES = 1mm SQUARES
- THE VERTICAL AXIS REPRESENTS AMPLITIUDE (VOLTAGE)
- IN VERTICAL DIRECTION, THERE ARE 5 SMALL BOXES IN EACH LARGE (5mm) BOX
- 1 mv CALIBRATION SPIKE = 10 mm



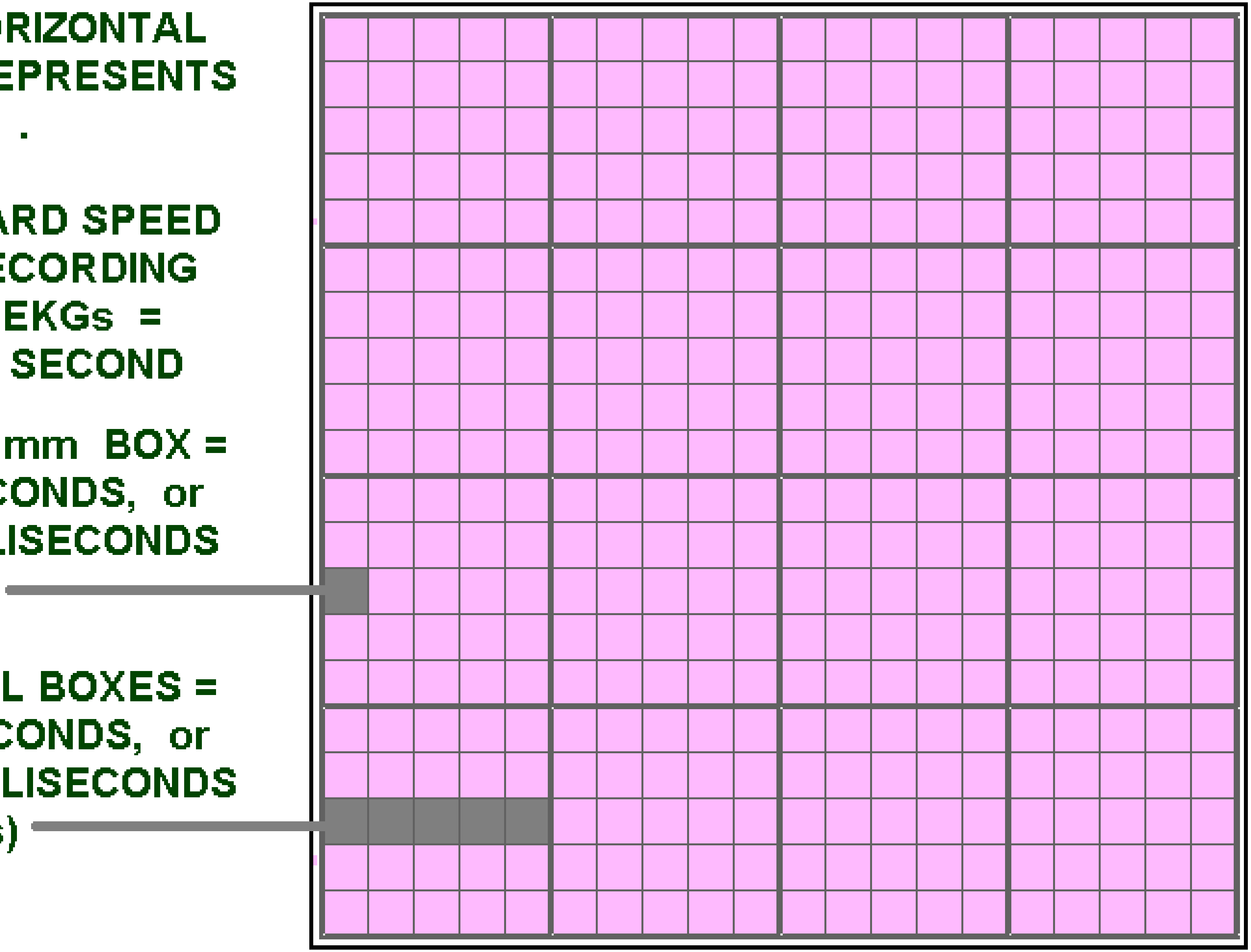
ECG PAPER - THE HORIZONTAL AXIS:

THE HORIZONTAL AXIS REPRESENTS TIME . . .

STANDARD SPEED FOR RECORDING ADULT EKGs = 25 mm / SECOND

EACH 1mm BOX = .04 SECONDS, or 40 MILLISECONDS (40 ms)

5 SMALL BOXES = .20 SECONDS, or 200 MILLISECONDS (200 ms)



THE ECG MACHINE

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

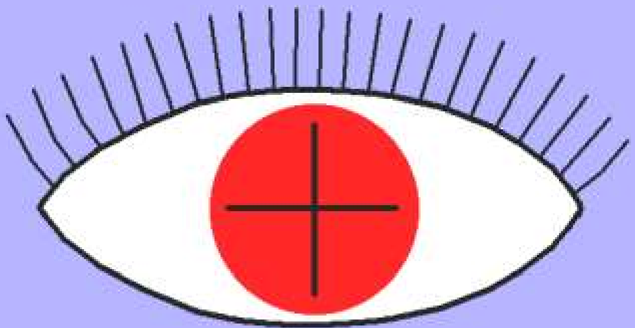
- LEADS I, II, III, and V1, V2, V3, V4, V5, V6

  1 POSITIVE ELECTRODE
  1 NEGATIVE ELECTRODE
  1 GROUND ELECTRODE

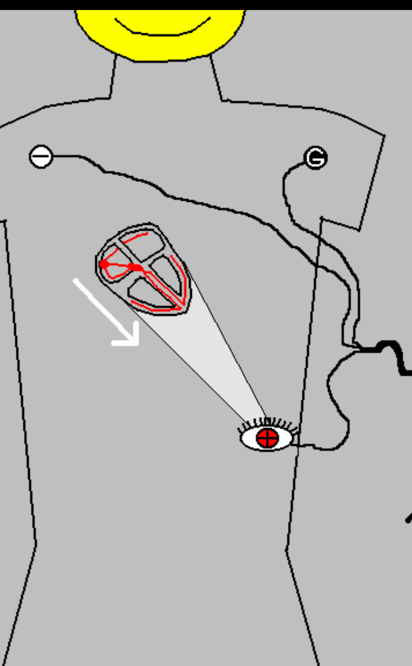
- LEADS AVR, AVL, and AVF

  1 POSITIVE ELECTRODE
  2 NEGATIVE ELECTRODES
  1 GROUND ELECTRODE

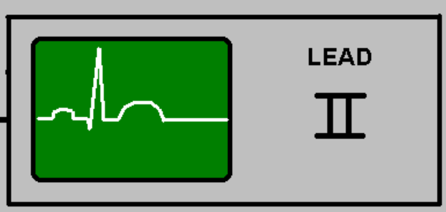
THE POSITIVE ELECTRODE



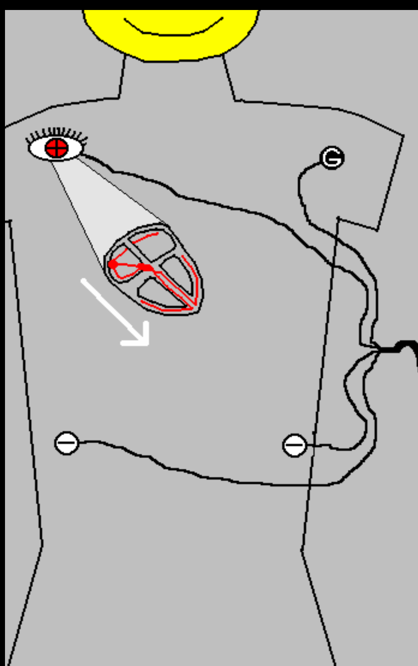
IS THE "EYE" . . .



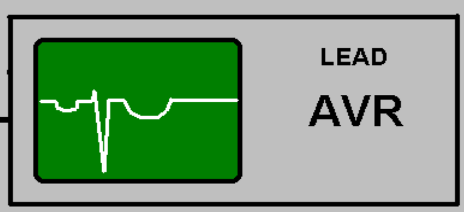
CURRENT MOVING TOWARD THE EYE
(POSITIVE ELECTRODE)



RECORDS AN "UPWARD" DEFLECTION



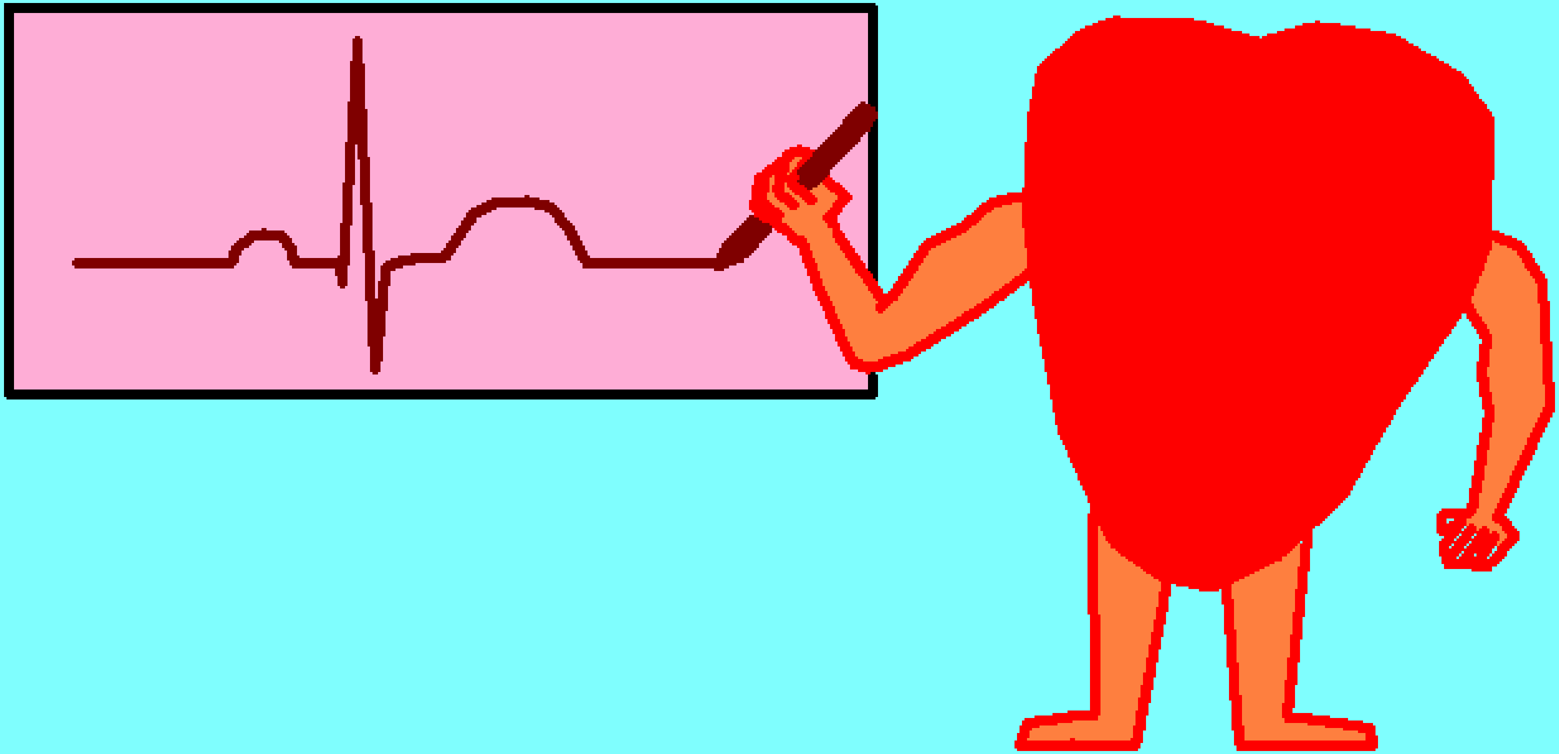
CURRENT MOVING AWAY FROM THE EYE
(POSITIVE ELECTRODE)



RECORDS A "DOWNWARD" DEFLECTION

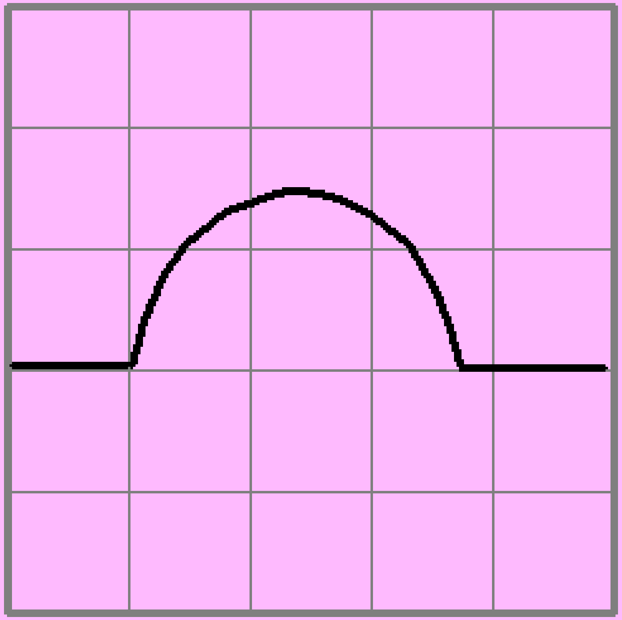
PUTTING IT ALL ON PAPER . . .

WAVEFORMS and INTERVALS . . .



THE P WAVE

- SHOULD BE UPRIGHT, CONVEX-SHAPED DOME IN ALL LEADS EXCEPT AVR and V1



- SHOULD BE LESS THAN .2 mv (2 mm) HIGH
- SHOULD BE LESS THAN 100 ms (2.5mm) LONG

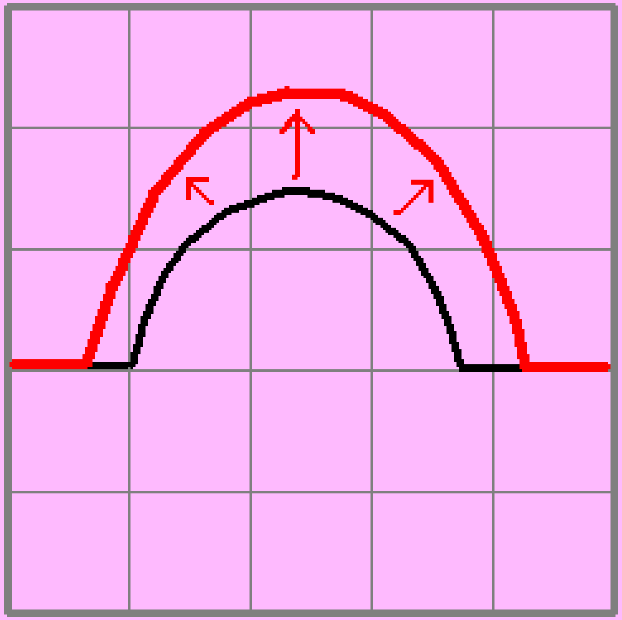
THE P WAVE

When the P WAVE

is

TOO LARGE

We think of

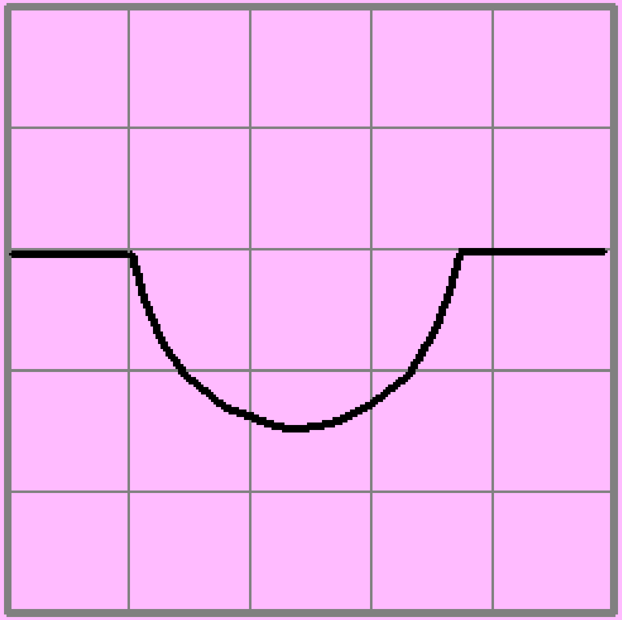


ATRIAL HYPERTROPHY

(SPECIFIC CRITERIA FOR ATRIAL HYPERTROPHY IS DISCUSSED IN MORE DETAIL IN THE "CHAMBER HYPERTROPHY" SECTION)

THE P WAVE

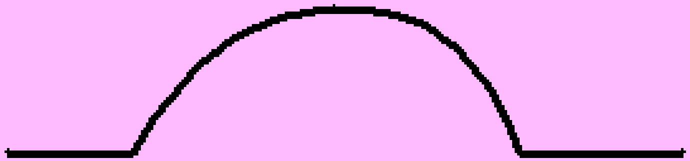
- SHOULD BE INVERTED IN LEAD AVR



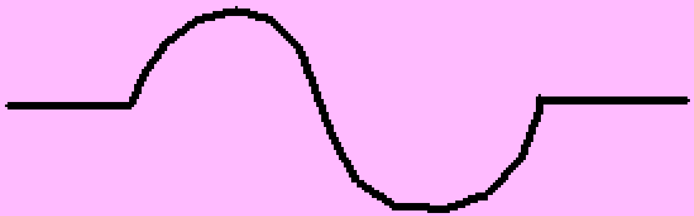
THE P WAVE

IN LEAD V1 MAY BE:

- POSITIVE

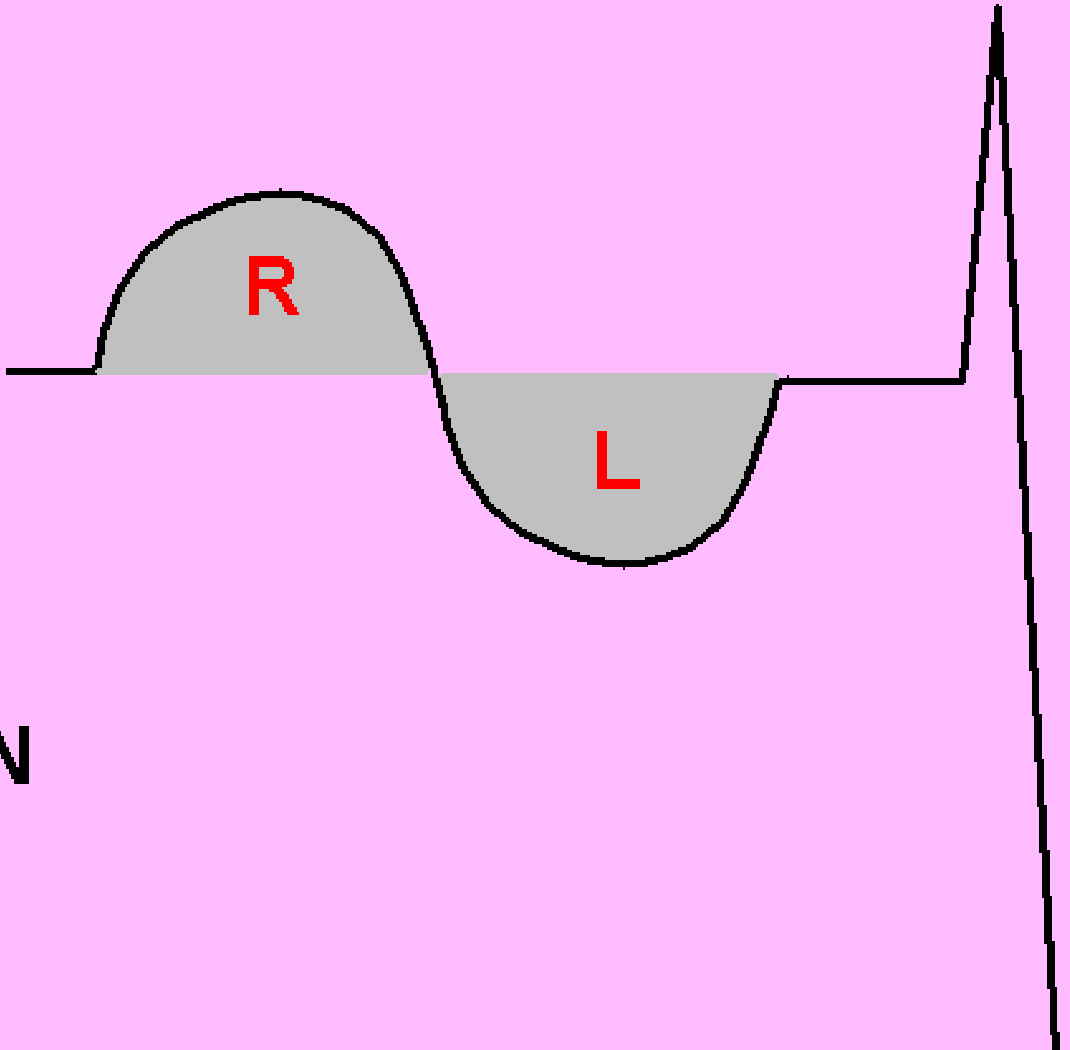


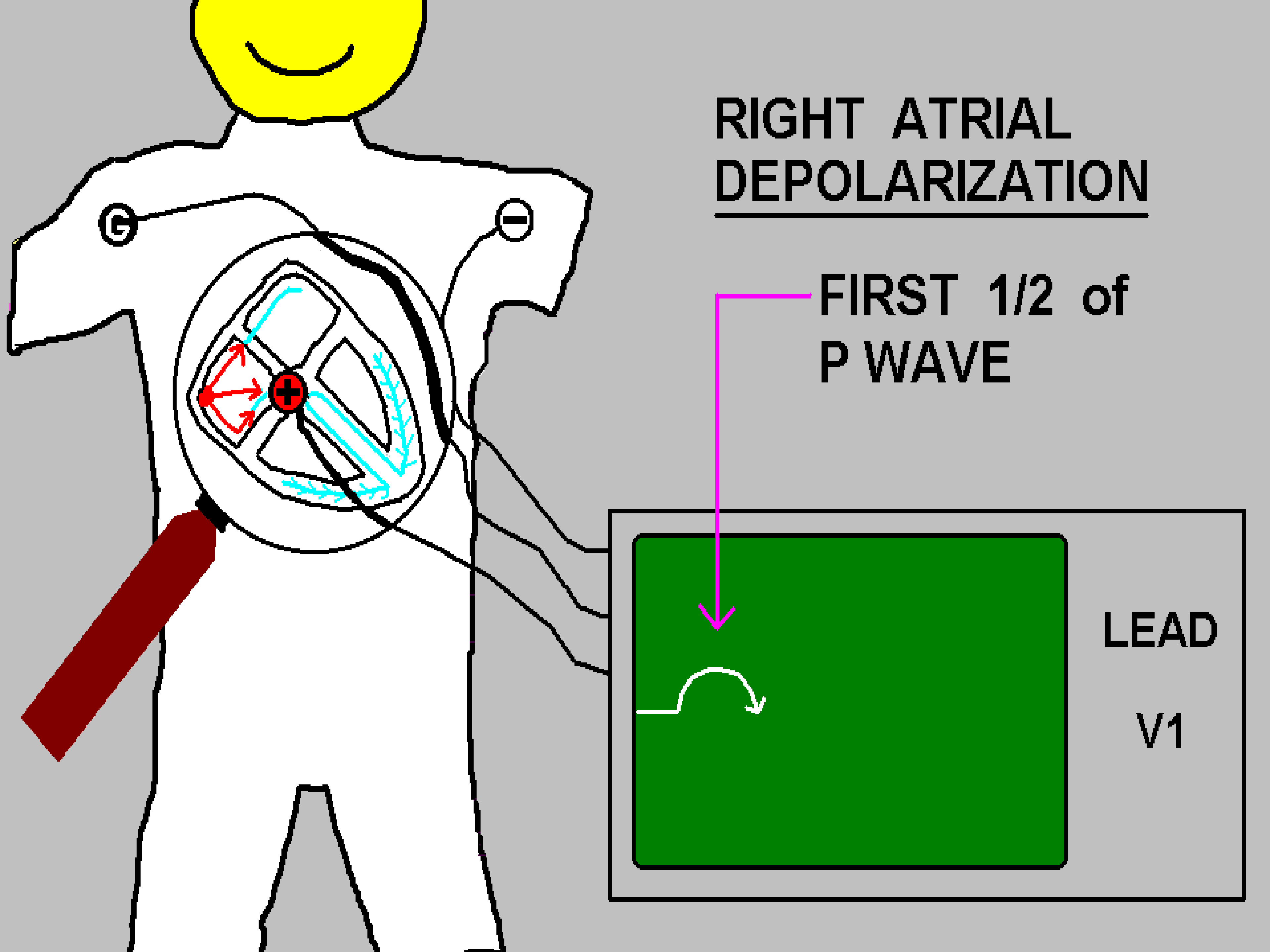
- OR BI-PHASIC

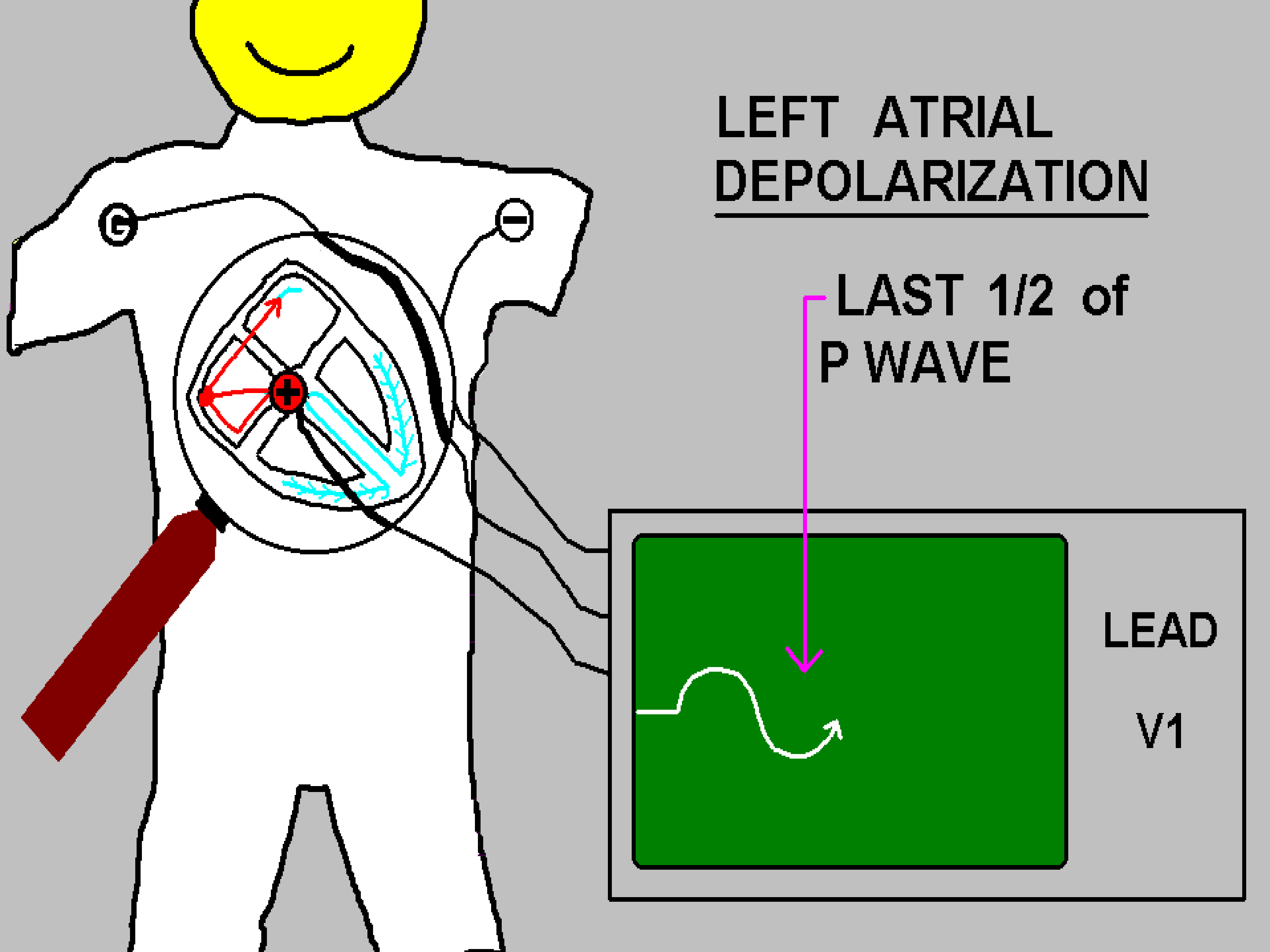


THE P WAVE

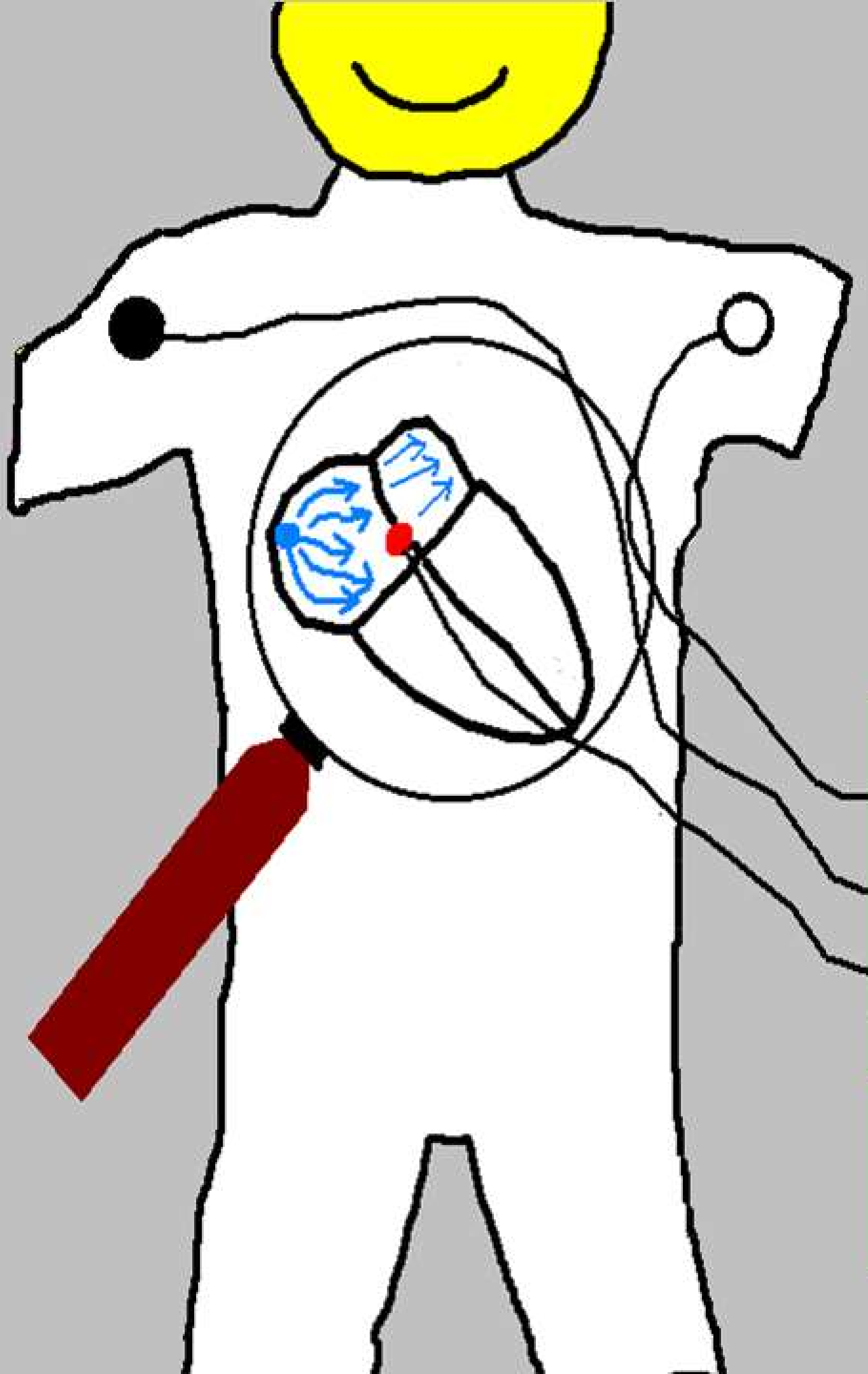
- WHEN THE P WAVE IS BI-PHASIC IN V1, IT DISPLAYS BOTH R and L ATRIAL DEPOLARIZATION




RIGHT ATRIAL DEPOLARIZATION
FIRST 1/2 of P WAVE
G
LEAD
V1

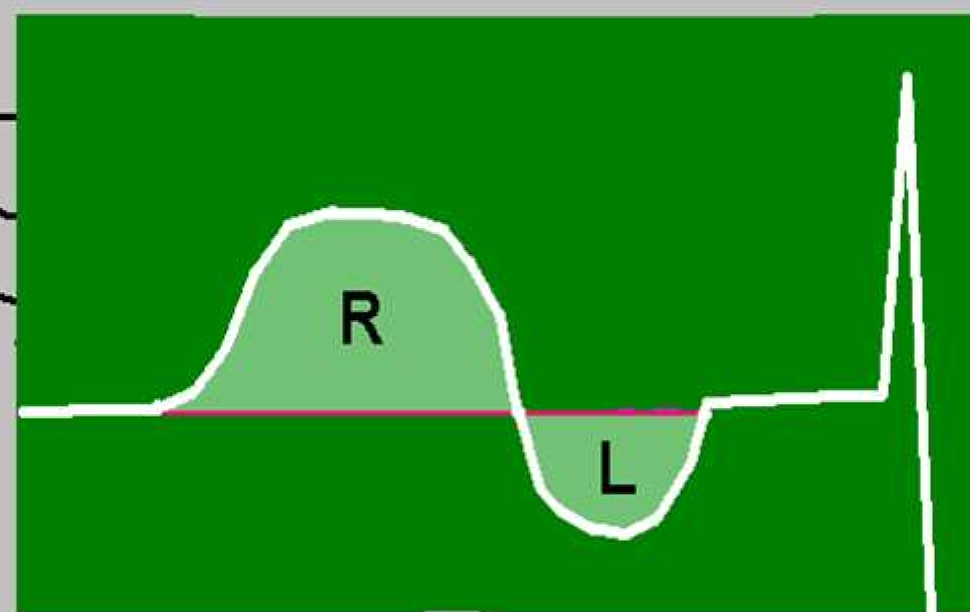


LEFT ATRIAL DEPOLARIZATION
LAST 1/2 of P WAVE
G
LEAD
V1



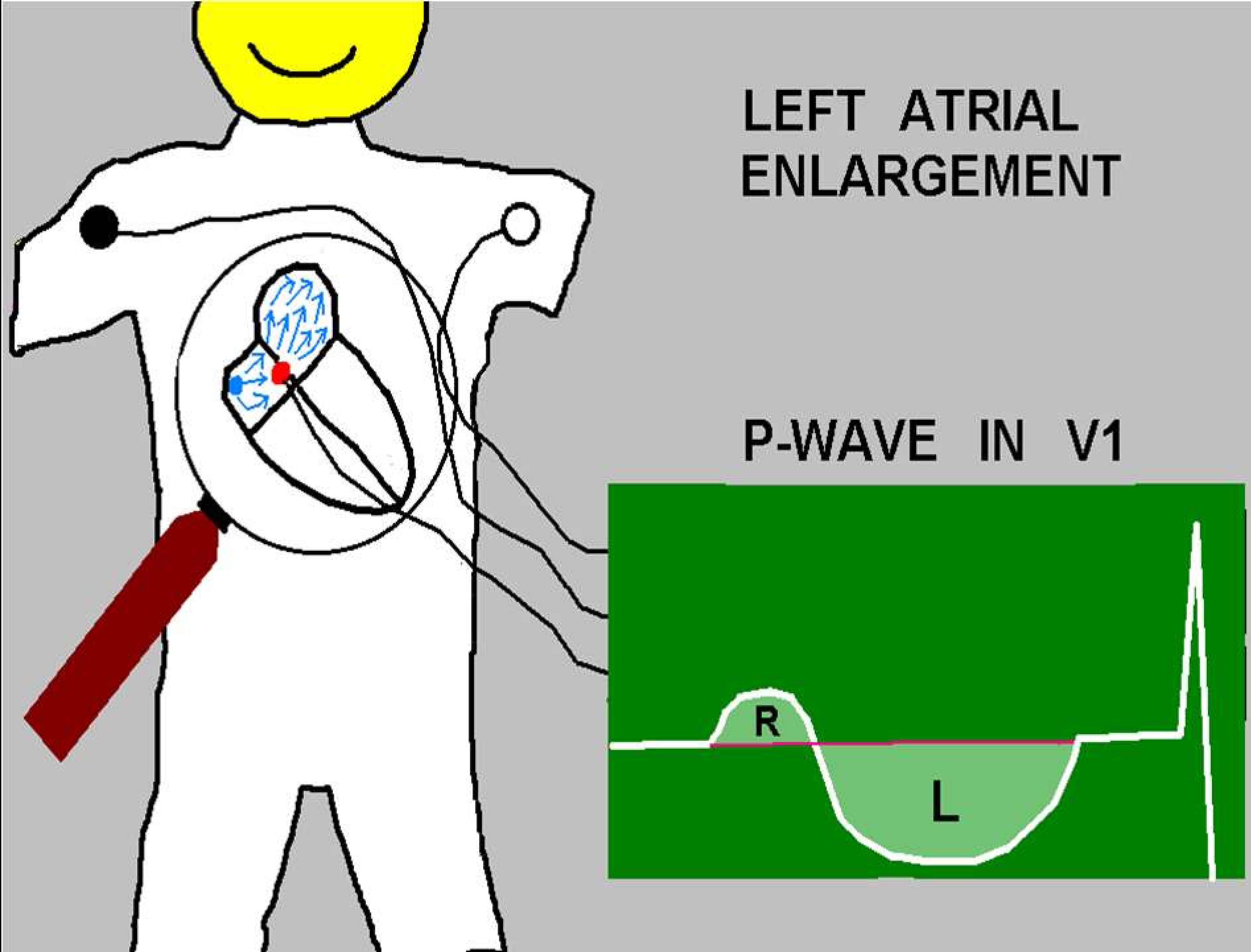
RIGHT ATRIAL ENLARGEMENT

P-WAVE IN V1



LEFT ATRIAL ENLARGEMENT

P-WAVE IN V1



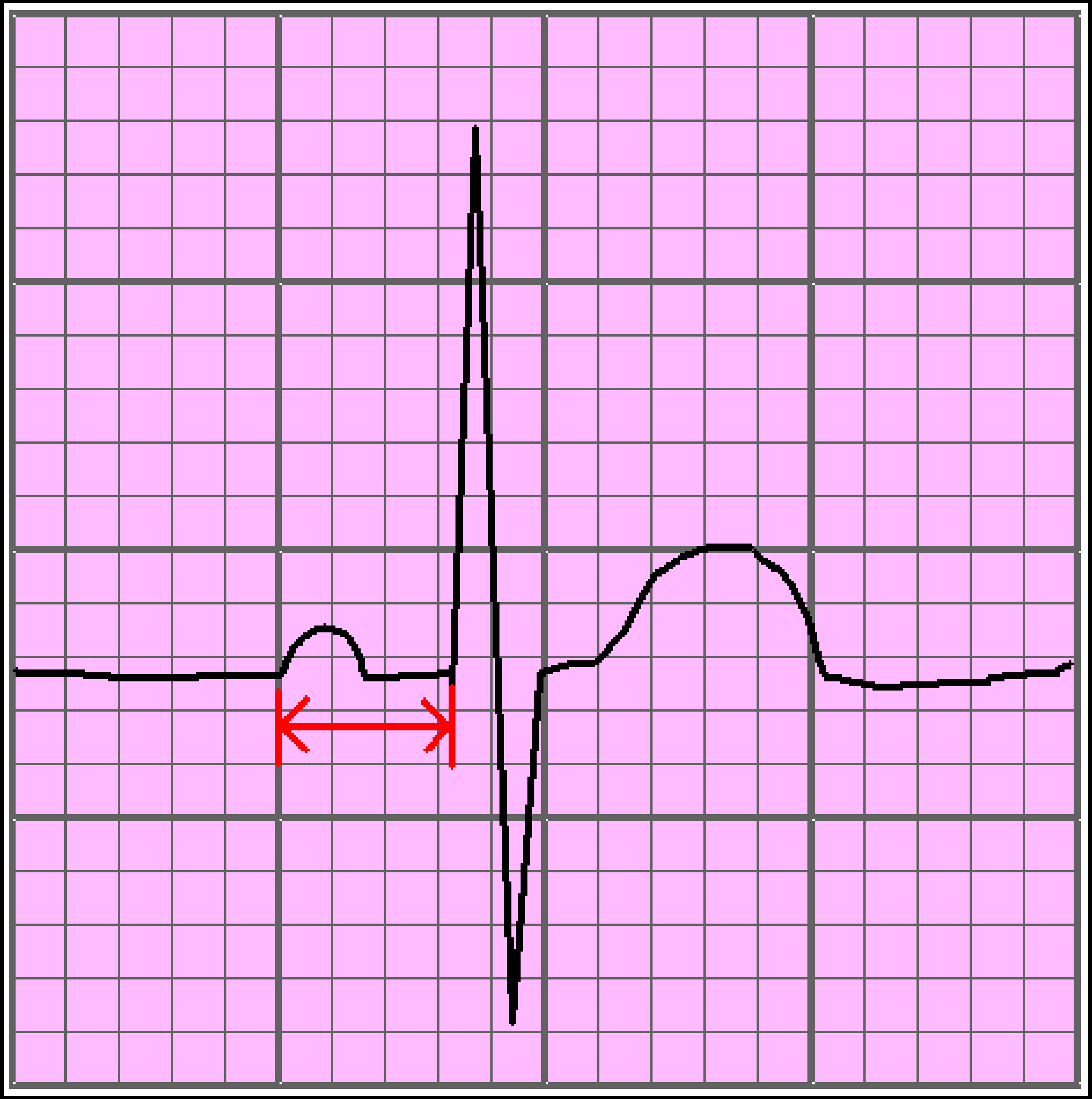
NORMAL P-R INTERVAL

.12 - .20 SEC

or

120 - 200

mSEC



P - R INTERVAL TOO SHORT . . .

LESS THAN 120 mSEC

THINK:

- ECTOPIC ATRIAL ACTIVITY
- PRE-EXCITATION (WPW)
- JUNCTIONAL (nearly on top of QRS, possibly inverted)

P - R INTERVAL TOO LONG

GREATER THAN 200 mSEC

THINK:

- HEART BLOCK

THE P-R SEGMENT

SHOULD

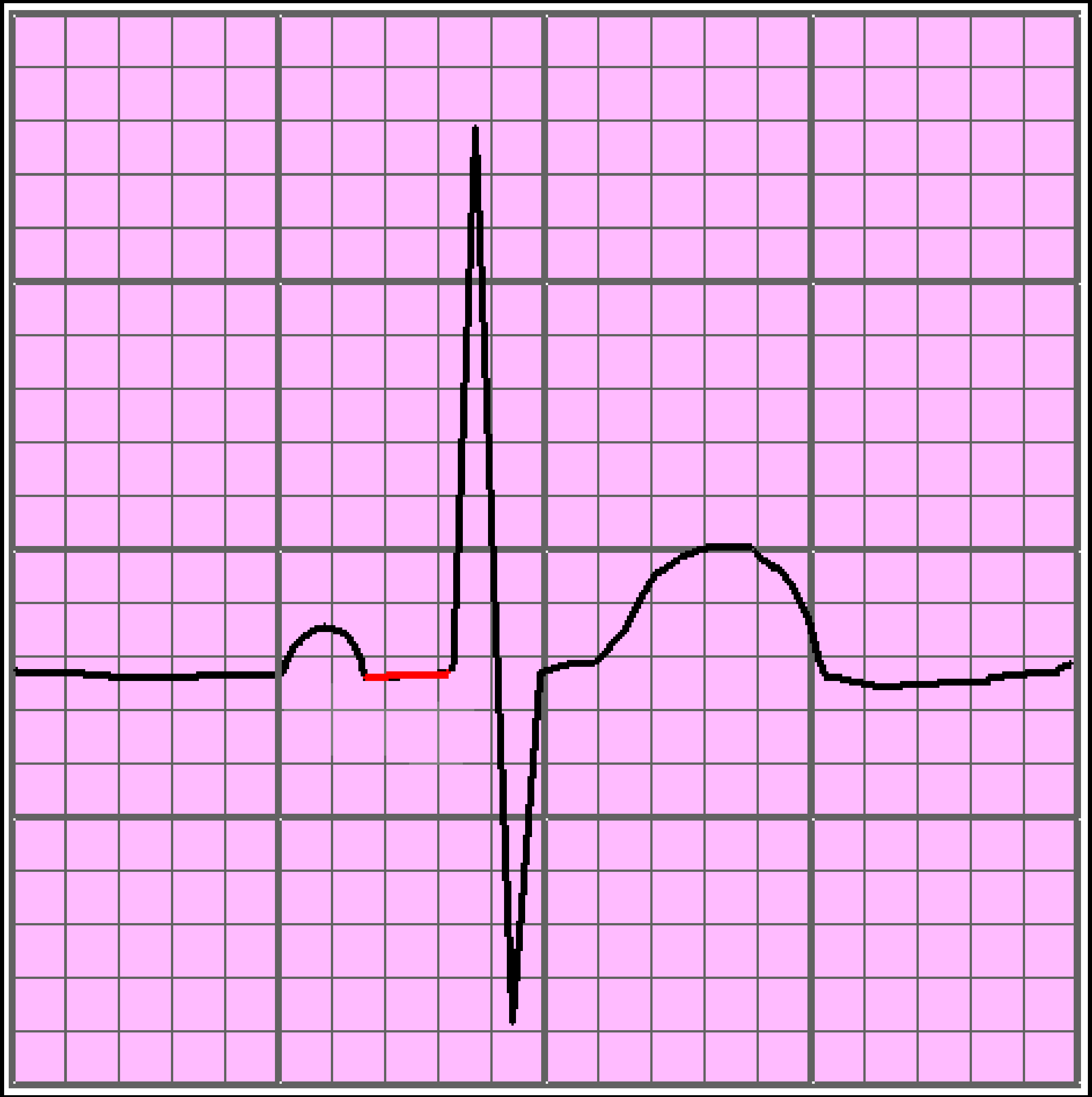
RETURN TO

THE

ISO-

ELECTRIC

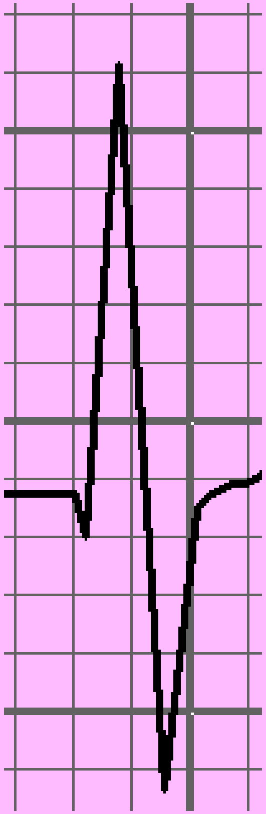
LINE.



THE QRS COMPLEX

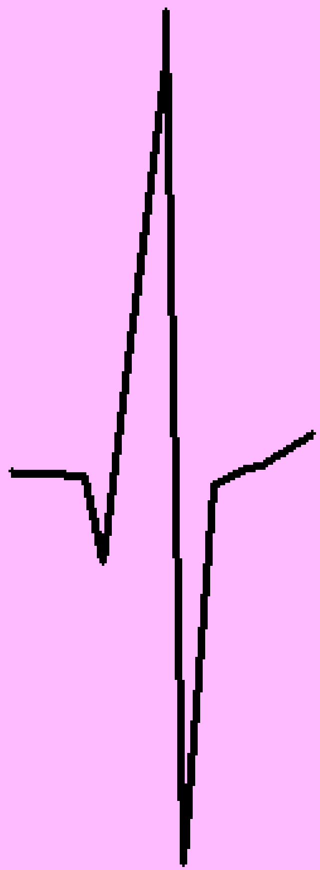
- MAY BE POSITIVE, NEGATIVE, OR BI- PHASIC, BASED ON THE LEAD VIEWED

- TOTAL WIDTH SHOULD BE LESS THAN 120 ms / or .12



THE QRS COMPLEX

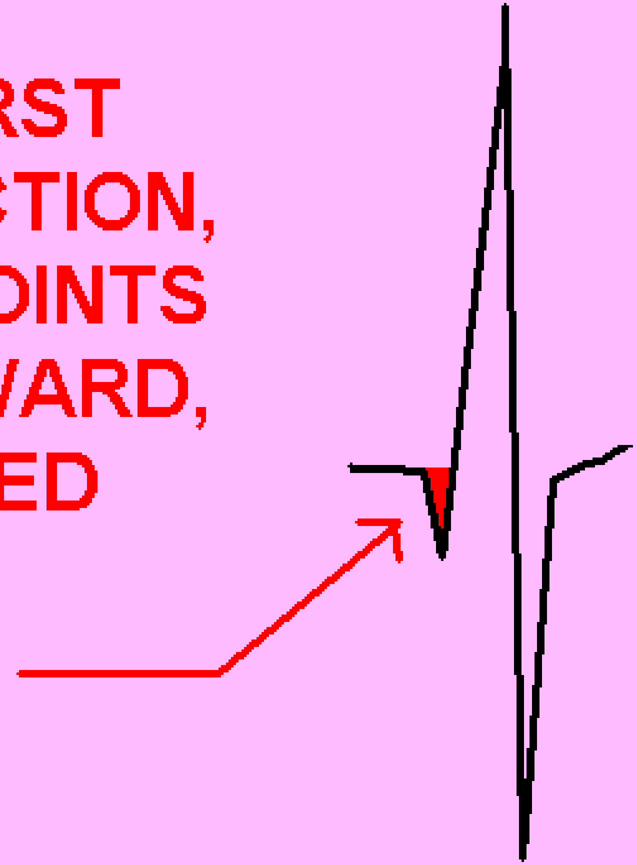
THIS QRS COMPLEX CONSISTS OF 3 DEFLECTIONS . . . .



THE QRS COMPLEX

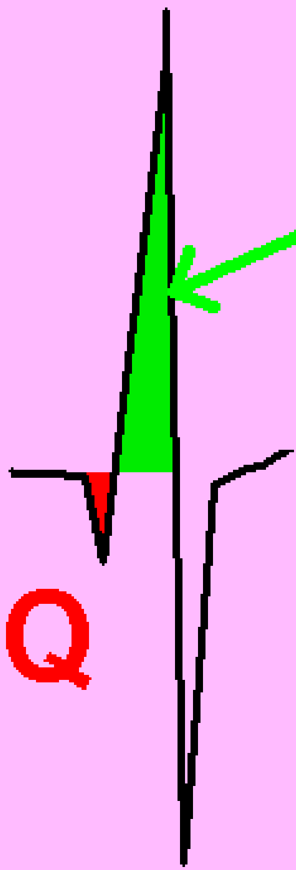
THIS QRS COMPLEX CONSISTS OF 3 DEFLECTIONS . . . .

THE FIRST DEFLECTION, IF IT POINTS DOWNWARD, IS NAMED THE "Q WAVE"



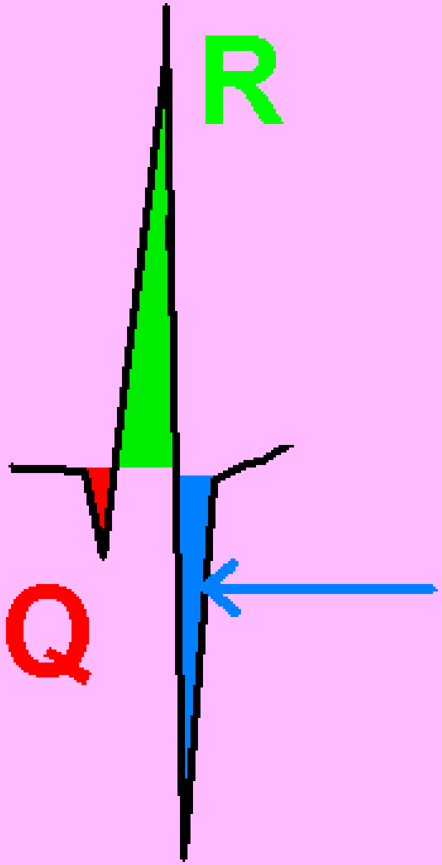
THE QRS COMPLEX

THIS QRS COMPLEX CONSISTS OF 3 DEFLECTIONS . . . .



THE QRS COMPLEX

THIS QRS COMPLEX CONSISTS OF 3 DEFLECTIONS . . . .

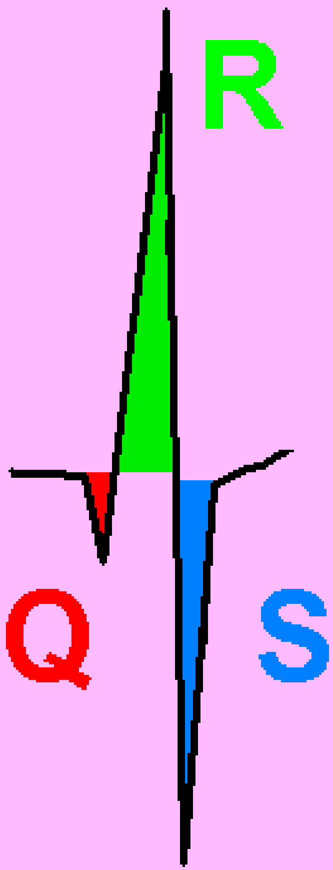


A NEGATIVE DEFLECTION AFTER THE R WAVE IS CALLED THE " S " WAVE

THE QRS COMPLEX

THIS QRS COMPLEX CONSISTS OF
3 DEFLECTIONS . . . .

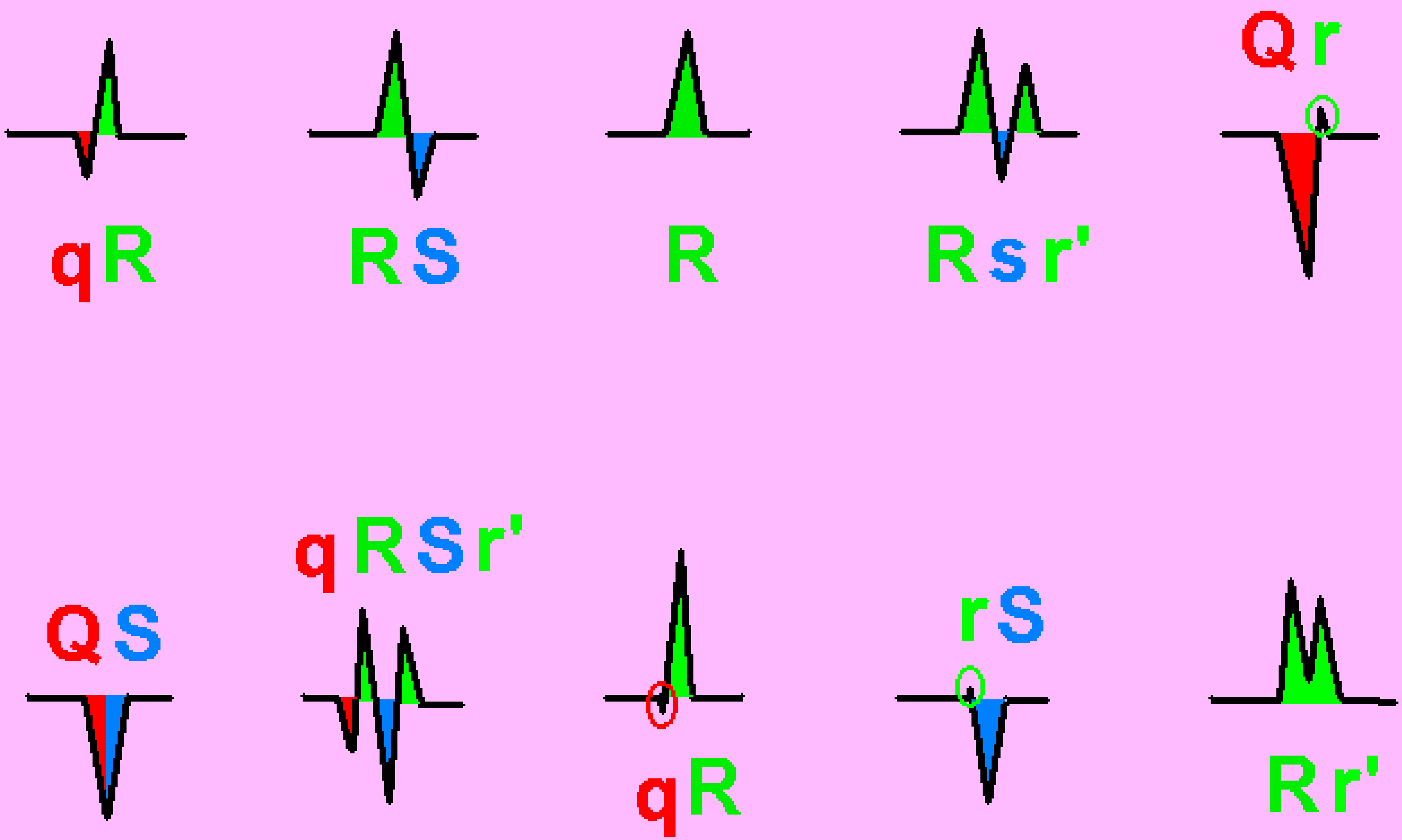
AND IS
THE <u>ONLY</u>
TRUE
"QRS"
COMPLEX



SOME OF
THE OTHER
VARIATIONS
INCLUDE . . . .

THE QRS COMPLEX

WHAT ARE THESE COMPLEXES ??



QRS INTERVAL

LESS THAN

.12

OR

120 mSEC

QRS COMPLEX TOO WIDE

WIDER THAN 120 mSEC

THINK:

- BUNDLE BRANCH BLOCK
- VENTRICULAR COMPEX (ES)
- PACED RHYTHM
- L VENTRICULAR HYPERTROPHY
- ELECTROLYTE IMBAL. ($\uparrow K^+$ $\downarrow Ca^{++}$)
- DELTA WAVE (PRE-EXCITATION)

THE QRS COMPLEX

QRS HEIGHT

is a reflection of the QRS AMPLITUDE.

The NORMAL QRS AMPLITUDE varies from one lead to another . . .

THE QRS COMPLEX

QRS AMPLITUDE

is influenced by:

- age
- physical fitness
- body size
- conduction system disorders
- chamber hypertrophy

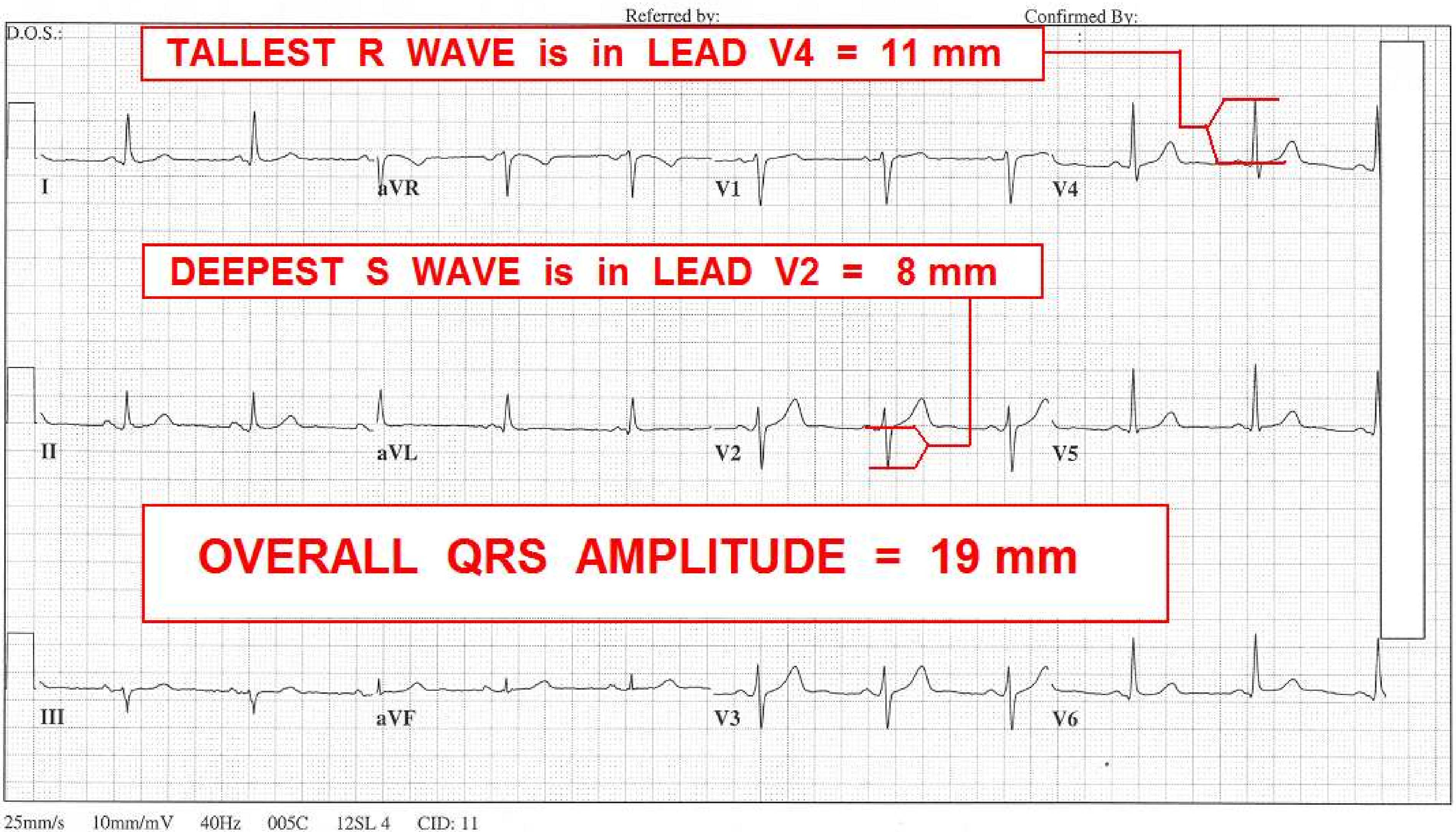
THE QRS COMPLEX

QRS AMPLITUDE

is measured by finding the TALLEST POSITIVE DEFLECTION (R WAVE) and the DEEPEST NEGATIVE DEFLECTION (S WAVE) on the 12 LEAD EKG and ADDING THE VALUES TOGETHER

MEASURING THE "OVERALL QRS AMPLITUDE"

Add the SIZE of the TALLEST R WAVE to the SIZE of the DEEPEST S WAVE . . . .



THE QRS COMPLEX

QRS AMPLITUDE

MAXIMUM NORMAL VALUES are difficult to define due to differences in PATIENT AGE, BODY SIZE, and FITNESS.

HOWEVER A GENERAL VALUE GUIDELINE IS: 3.0 mV (30 mm on normally calibrated EKG)

OVERALL QRS AMPLITUDE TOO HIGH:

(GREATER THAN 3.0 mV / 30 mm)

THINK:

☛ VENTRICULAR HYPERTROPHY

THE QRS COMPLEX

QRS AMPLITUDE

CRITERIA FOR MINIMUM AMPLITUDE:

Abnormally LOW QRS VOLTAGE occurs when the OVERALL QRS is:

$\leq$ 0.5 mV IN ANY LIMB LEAD

— *and* —

$\leq$ 1.0 mV IN ANY PRECORDIAL LEAD

OVERALL QRS AMPLITUDE TOO LOW:

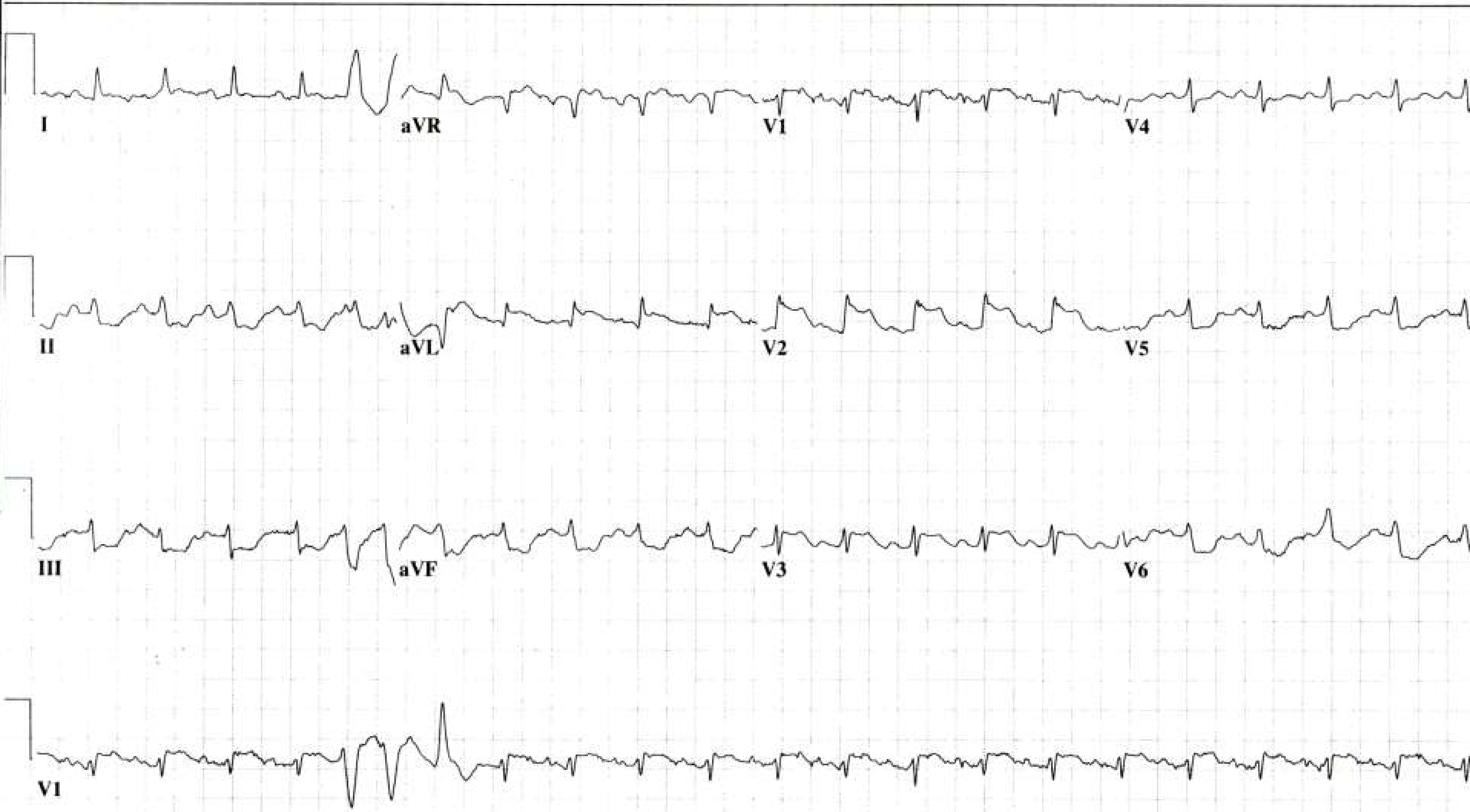
(VERTICAL QRS SIZE)

THINK (in absence of obvious OBESITY):

- MYOCARDITIS / CONSTRICTIVE PERICARDITIS
- EFFUSIONS / TAMPONADE
- COPD c HYPERINFLATION
- AMYLOIDOSIS (abnormal protein accumulation in organs)
- SCLERODERMA (abnormal hardening of skin)
- HEMACHROMOTOSIS (excessive iron buildup in blood / organs)
- MYXEDEMA (thyroid disorder)

33 yr		Vent. rate	132	BPM	"**unedited copy: report is computer generated only, without physician interpretation".
Female	Black	PR interval	154	ms	*** Age and gender specific ECG analysis ***
		QRS duration	76	ms	Sinus tachycardia with occasional , and consecutive
Room:ATL		QT/QTc	282/417	ms	Premature ventricular complexes
Loc:3	Option:23	P-R-T axes	51 17	-80	Low voltage QRS

ST elevation consider anterolateral injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG
No previous ECGs available



33 yr
Female Black

Room:ATL
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PR interval	154	ms
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QT/QTc	282/417	ms
P–R–T axes	51 17	–80

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*** Age and gender specific ECG analysis ***
Sinus tachycardia with occasional , and consecutive
Premature ventricular complexes
Low voltage QRS
ST elevation consider anterolateral injury or acute infarct
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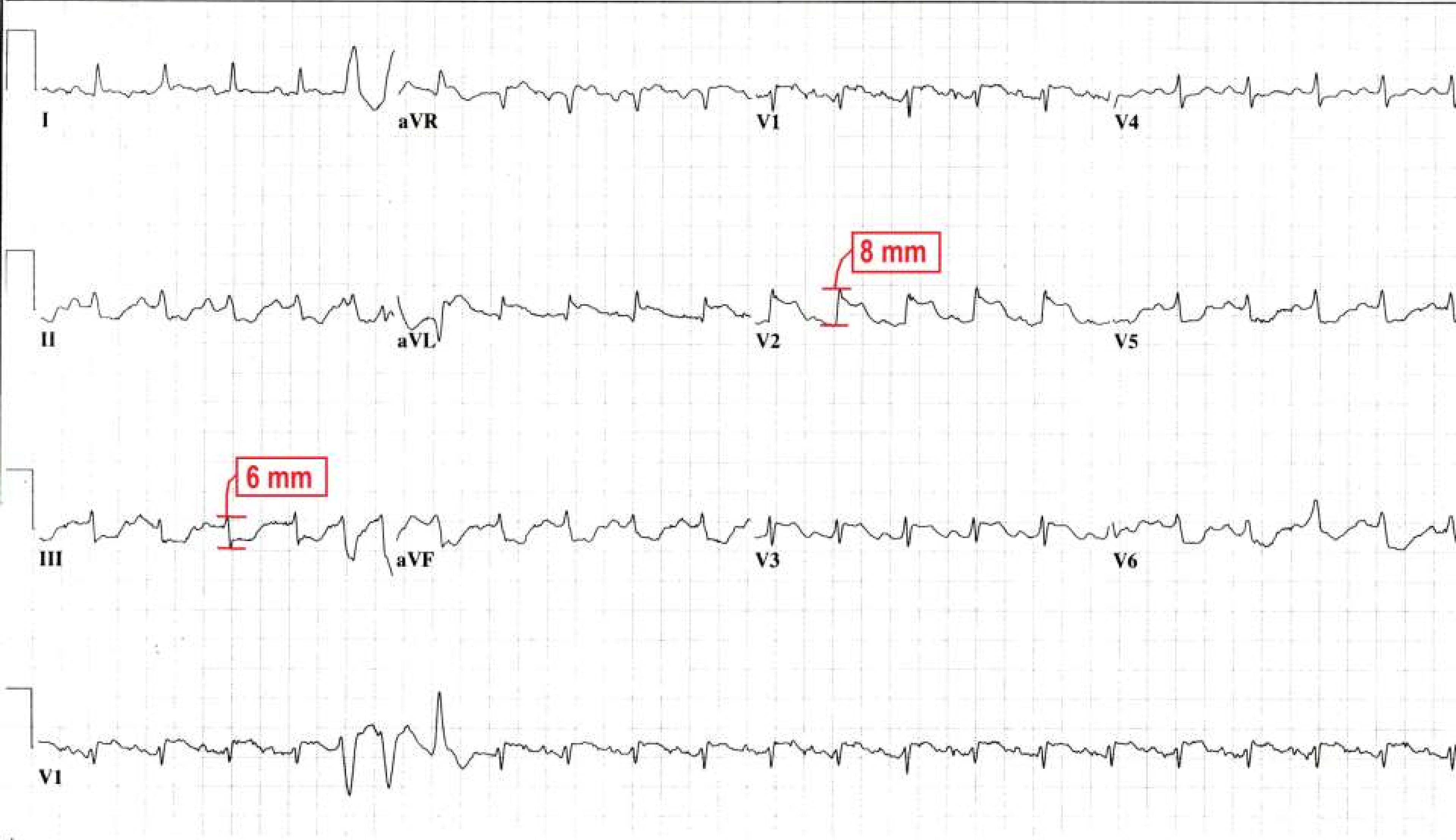
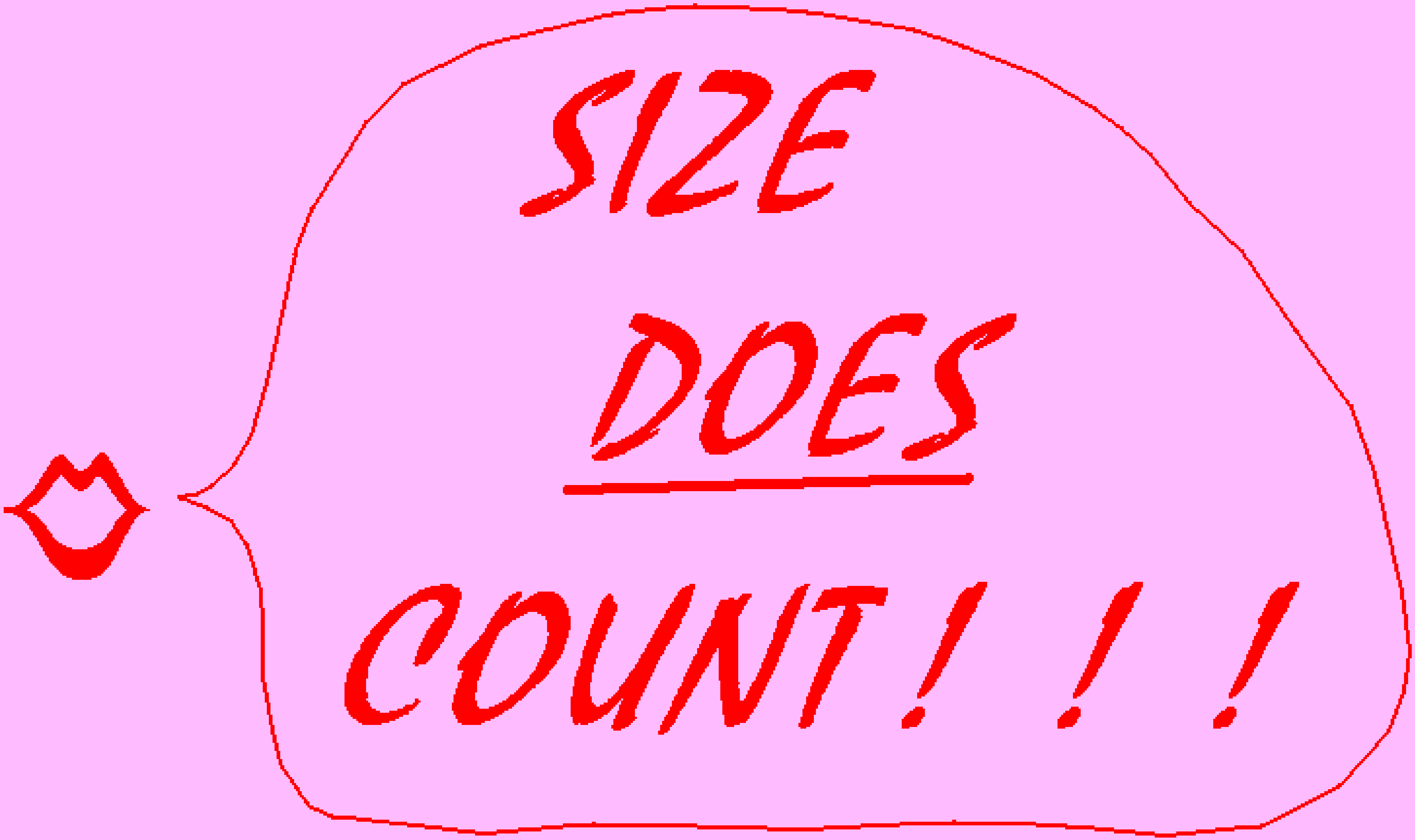
Abnormal ECG
No previous ECGs available



• Q WAVES •

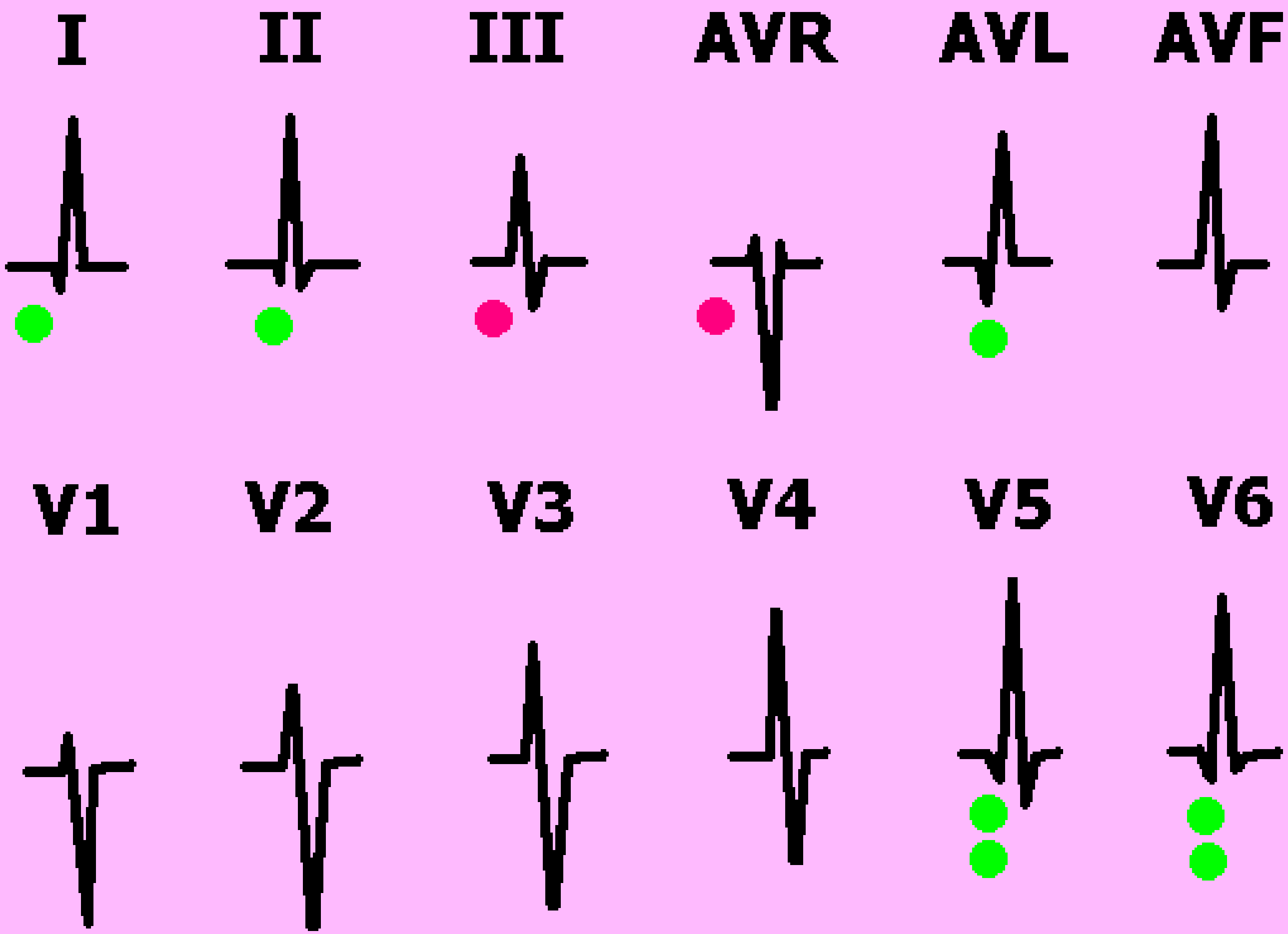
Normal Q Waves	caused by depolarization of the intraventricular septum
Abnormal Q Waves -	caused by: • necrosis (old infarction) • hypertrophy

Q WAVES



LEADS WHERE Q WAVES ARE NORMAL

- Normal Q WAVES caused by SEPTAL DEPOLARIZATION



● Q WAVES NORMAL AND FREQUENTLY SEEN	●● Q WAVES EXPECTED	● Q WAVES, IF PRESENT, CAN NORMALLY BE ANY SIZE

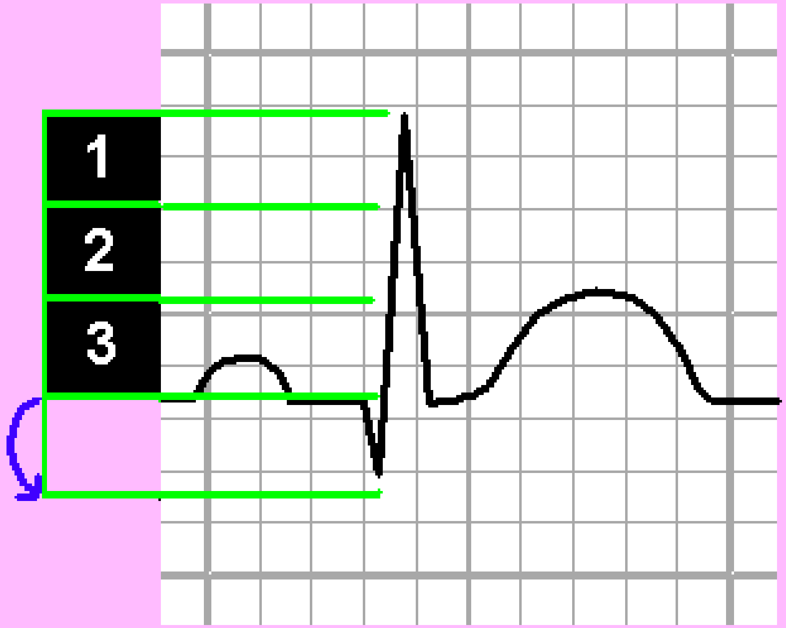
THE QRS COMPLEX

GENERAL RULES FOR NORMAL Q WAVES - WIDTH

LESS THAN .40
(1 mm) WIDE

THE QRS COMPLEX

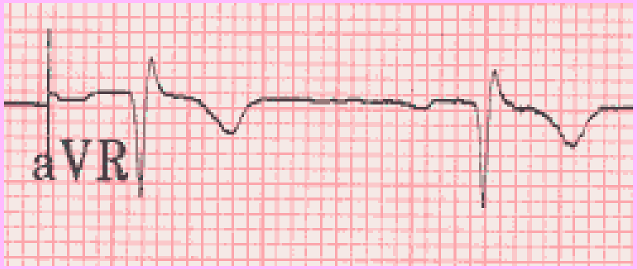
GENERAL RULES FOR NORMAL Q WAVES - HEIGHT



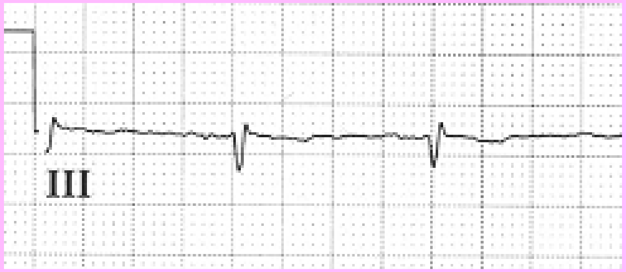
LESS THAN 1/3 THE HEIGHT OF THE <u>R WAVE</u>

THE QRS COMPLEX

NORMAL Q WAVES
EXCEPTIONS TO THE RULES



LEAD AVR



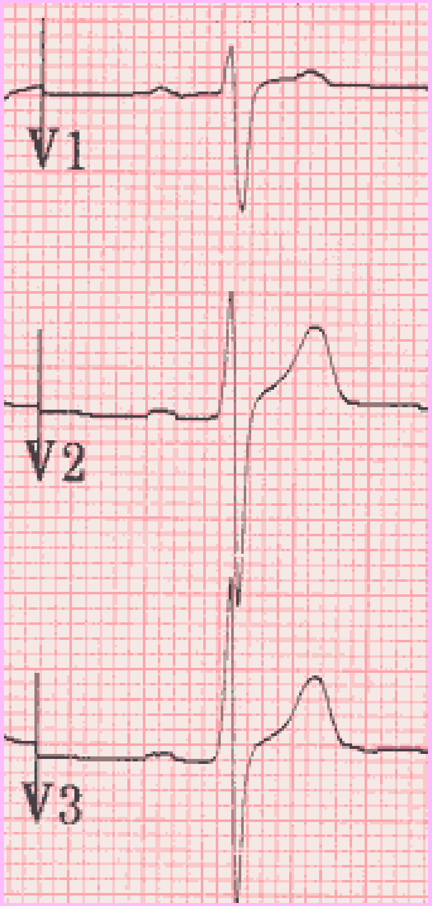
LEAD III

☞ THE Q WAVE CAN BE ANY SIZE

THE QRS COMPLEX

NORMAL Q WAVES
EXCEPTIONS TO THE RULES

☞ THERE SHOULD BE NO Q WAVES PRESENT IN LEADS: V1
V2
V3



THE QRS COMPLEX

Q WAVE RULES - SUMMARY:

- Q WAVES SHOULD BE LESS THAN .40 WIDE (1 mm)

- Q WAVES SHOULD BE LESS THAN 1/3 THE HEIGHT OF THE R WAVE

- Q WAVES CAN BE ANY SIZE IN LEADS III and AVR

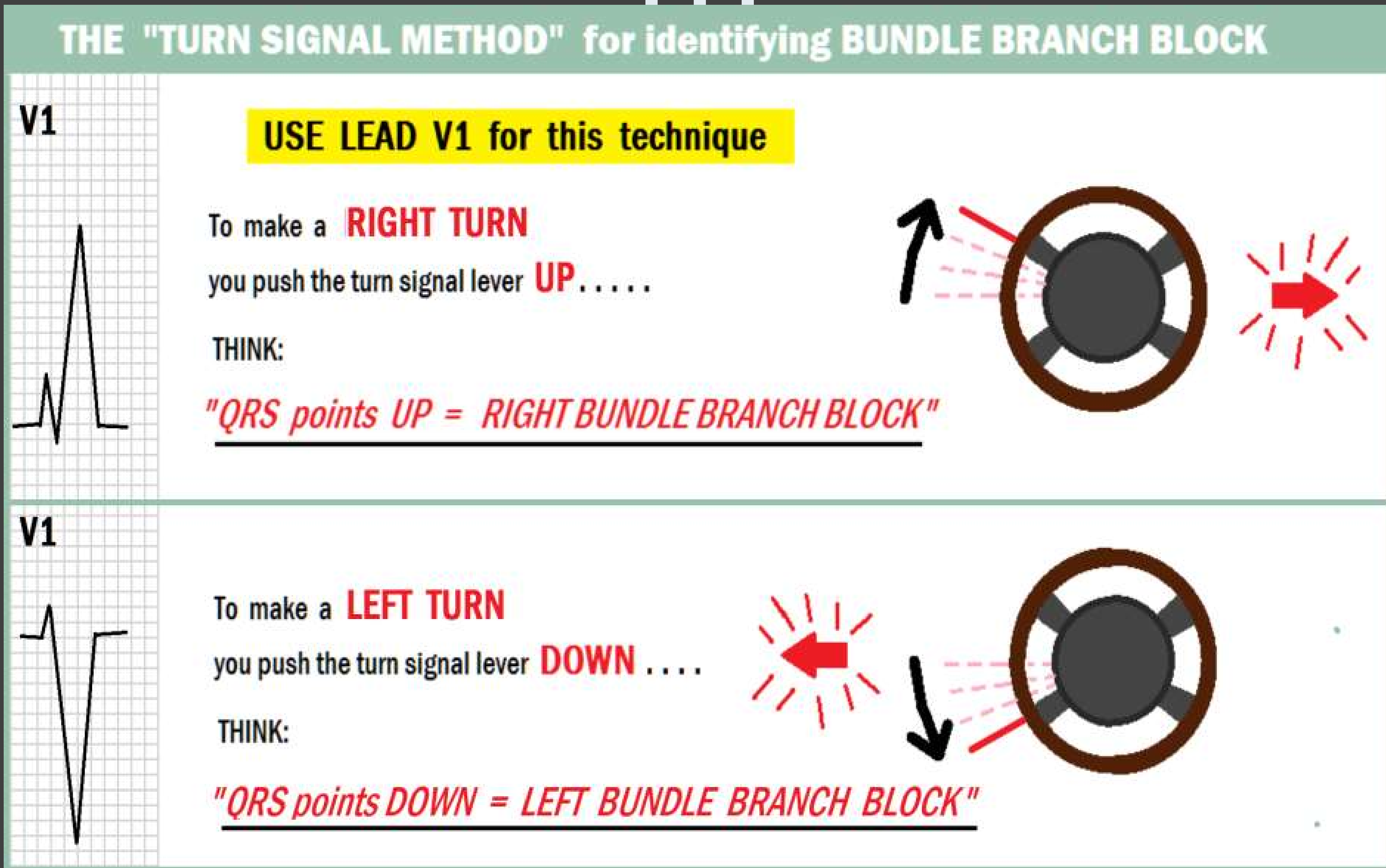
- THERE SHOULD BE NO Q WAVES IN LEADS V1, V2, or V3

THE QRS COMPLEX

DIAGNOSING
BUNDLE BRANCH BLOCK

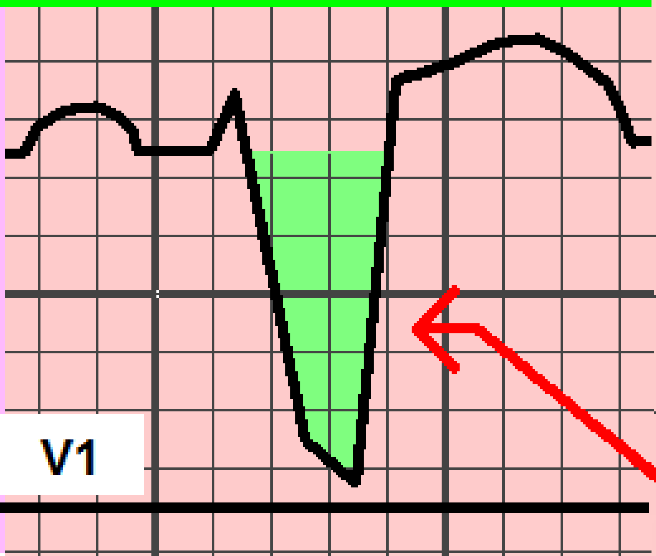
K.I.S.S.
THEORY

Simple “Turn Signal Method”

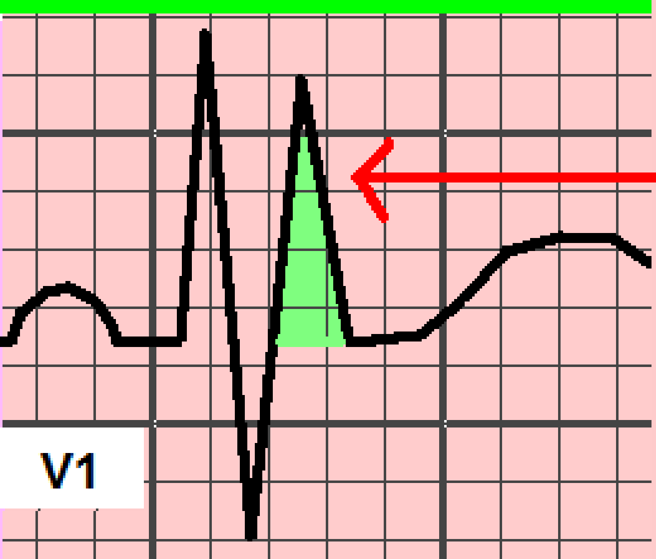


DIAGNOSING BUNDLE BRANCH BLOCK

L.B.B.B.



R.B.B.B.



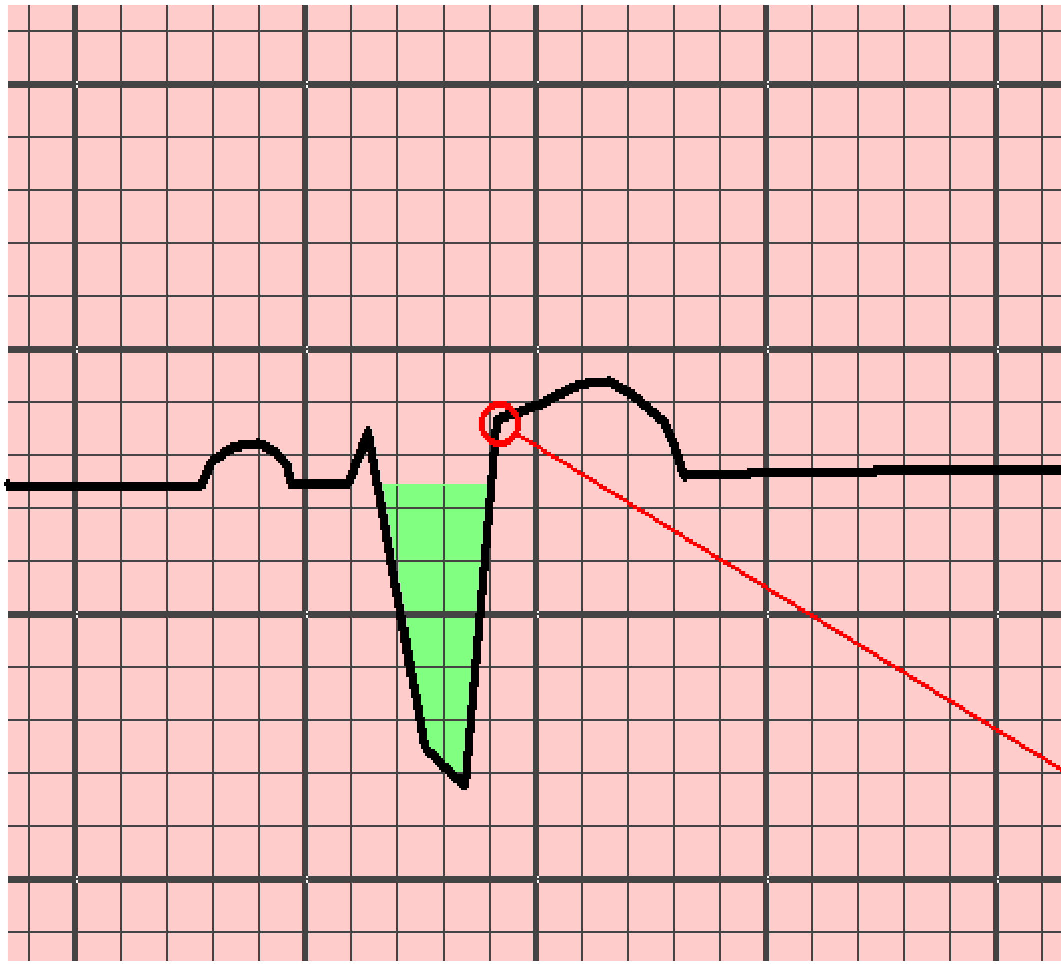
USING LEAD V1

- QRS WIDER THAN 120 ms
- BEAT IS SUPRAVENTRICULAR IN ORIGIN
- TERMINAL PHASE OF QRS COMPLEX (LAST DEFLECTION)

NEGATIVE = LEFT BUNDLE BRANCH BLOCK

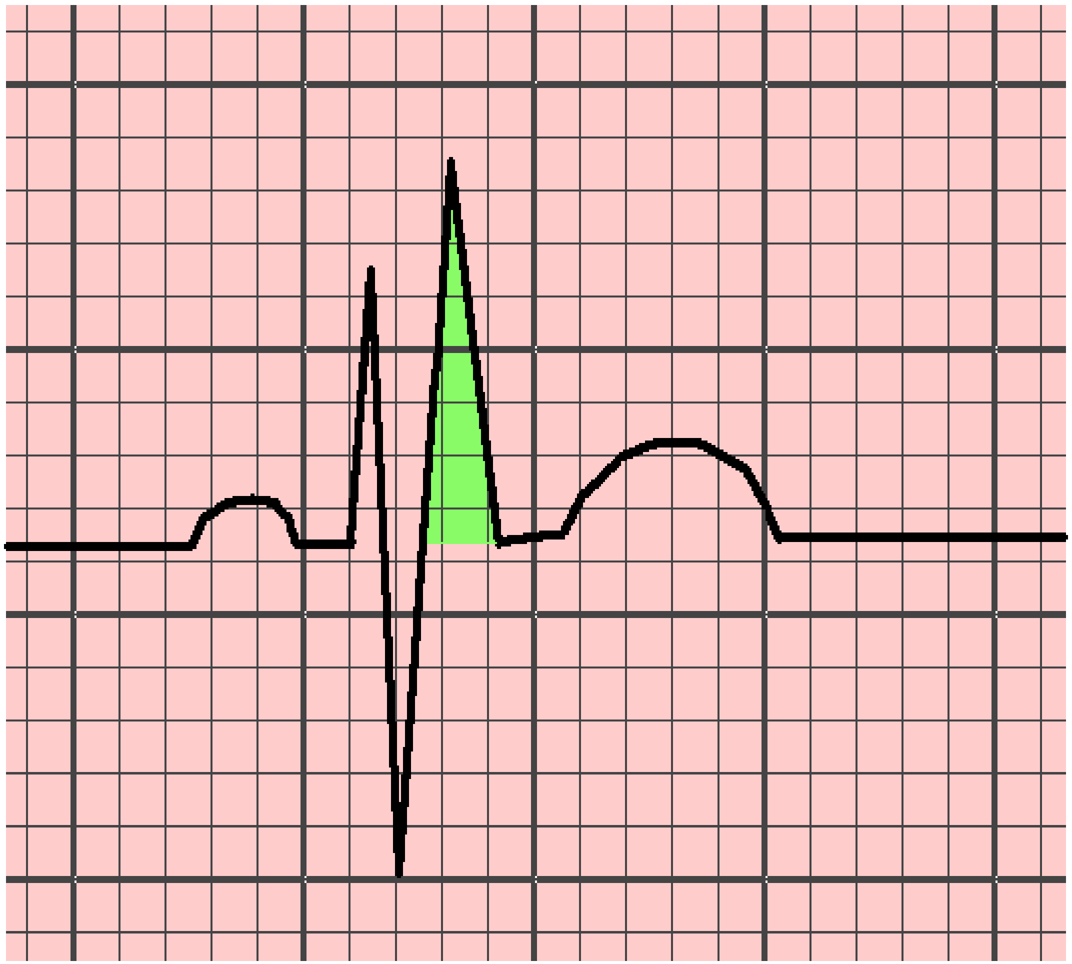
POSITIVE = RIGHT BUNDLE BRANCH BLOCK

DIAGNOSING LBBB IN LEAD V1:



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

DIAGNOSING RBBB IN LEAD V1:



- WIDER THAN 120 ms (.12)

(or 3 little boxes)

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

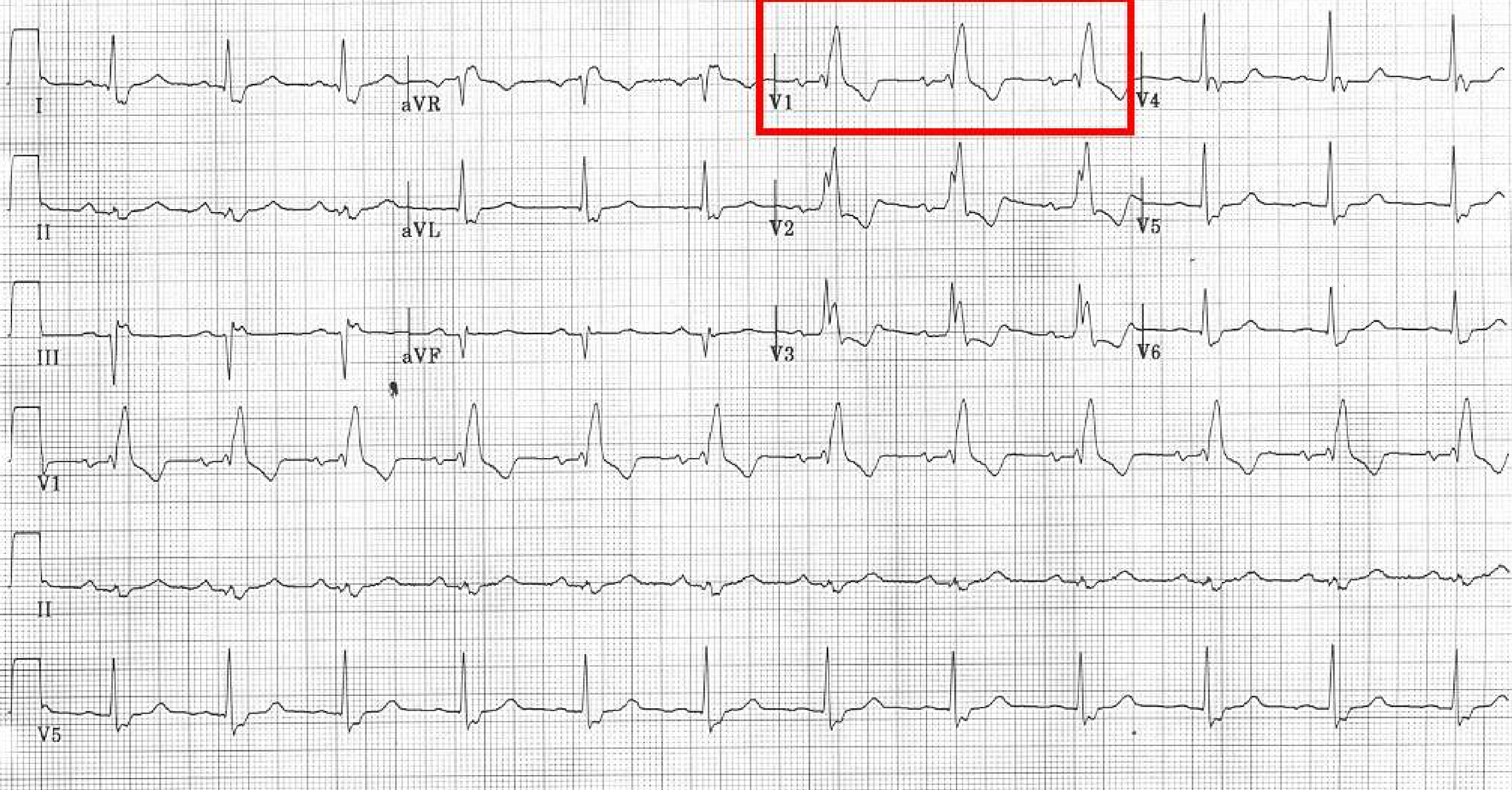
RUPPERT, WAYNE ID: 099999999 4-Mar-2001

74years	Vent. rate	72 bpm	Normal sinus rhythm
Male Caucasian	PR interval	186 ms	Left axis deviation
	QRS duration	166 ms	Right bundle branch block
Room:	QT/QTc	436/477 ms	Inferior infarct, age undetermined
Loc: 0 Opt:	P-R-T axes	57 -32 32	Abnormal ECG

Technician: WR

Referred by: Unconfirmed

D.O.S.:



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

TERMINAL PHASE OF QRS IS

POSITIVE

= RIGHT BUNDLE BRANCH BLOCK

09:16:40

74 yr
Female Caucasian

Loc:7 Option:35

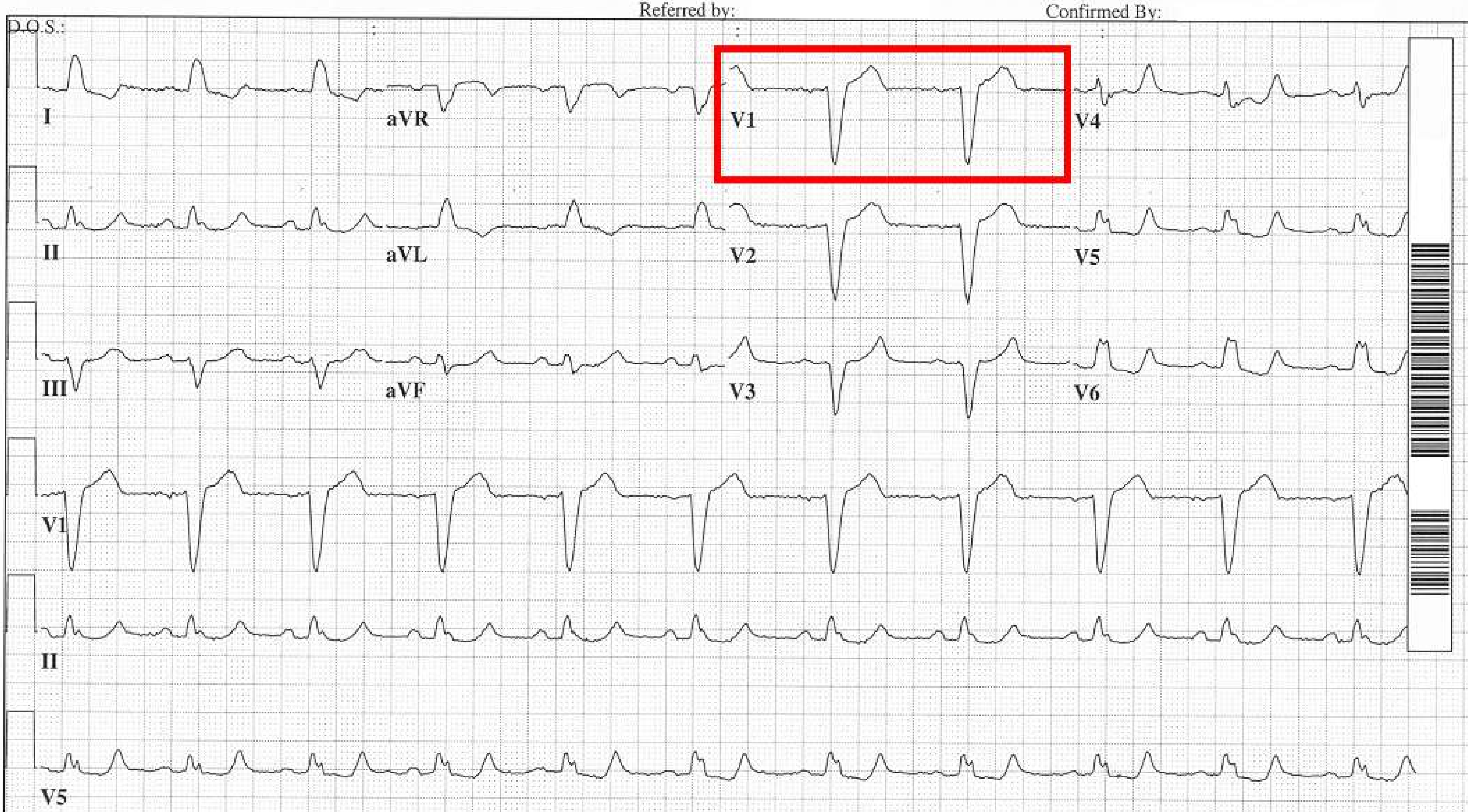
Vent. rate	64	BPM
PR interval	188	ms
QRS duration	152	ms
QT/QTc	472/486	ms
P-R-T axes	78 3	106

EKG #WR03029959

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

Technician: WW

Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 229 CID: 0 EID:5 EDT:

TERMINAL PHASE OF QRS IS **NEGATIVE**

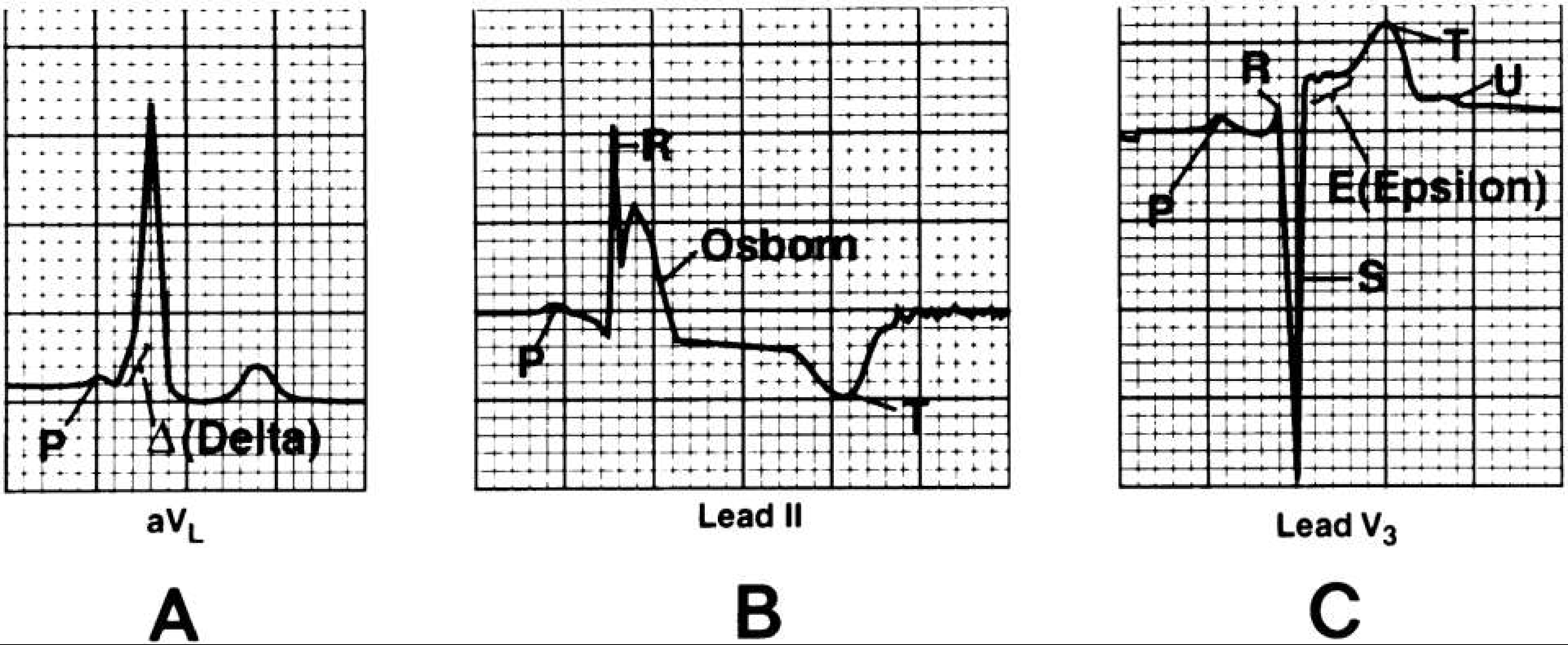
= LEFT BUNDLE BRANCH BLOCK

SOME CAUSES OF RIGHT BUNDLE BRANCH BLOCK (RBBB)

- CONGENITAL VARIATION (IN HEALTHY HEART)
- CONDUCTION SYSTEM DISEASE
- OLD ANT./SEPTAL MI (NECROSIS TO RBB)
- PREVIOUS C.A.B.G. (RBB CUT DURING SURGERY)
- SEVERE R.V.H.
- ACUTE PULMONARY EMBOLUS
- BRUGADA SYNDROME

SOME CAUSES OF LEFT BUNDLE BRANCH BLOCK (LBBB)

- CONDUCTION SYSTEM DISEASE
- OLD ANT./ SEPTAL MI (NECROSIS TO LBB)
- CARDIOMYOPATHY
- SEVERE L.V.H.
- ACUTE MYOCARDITIS



A. Delta wave, seen in Wolff-Parkinson-White Syndrome
B. Osborn's wave, seen in HYPOTHERMIA
C. Epsilon's wave, seen in Right Ventricular Dysplasia

NORMAL ST - T WAVES

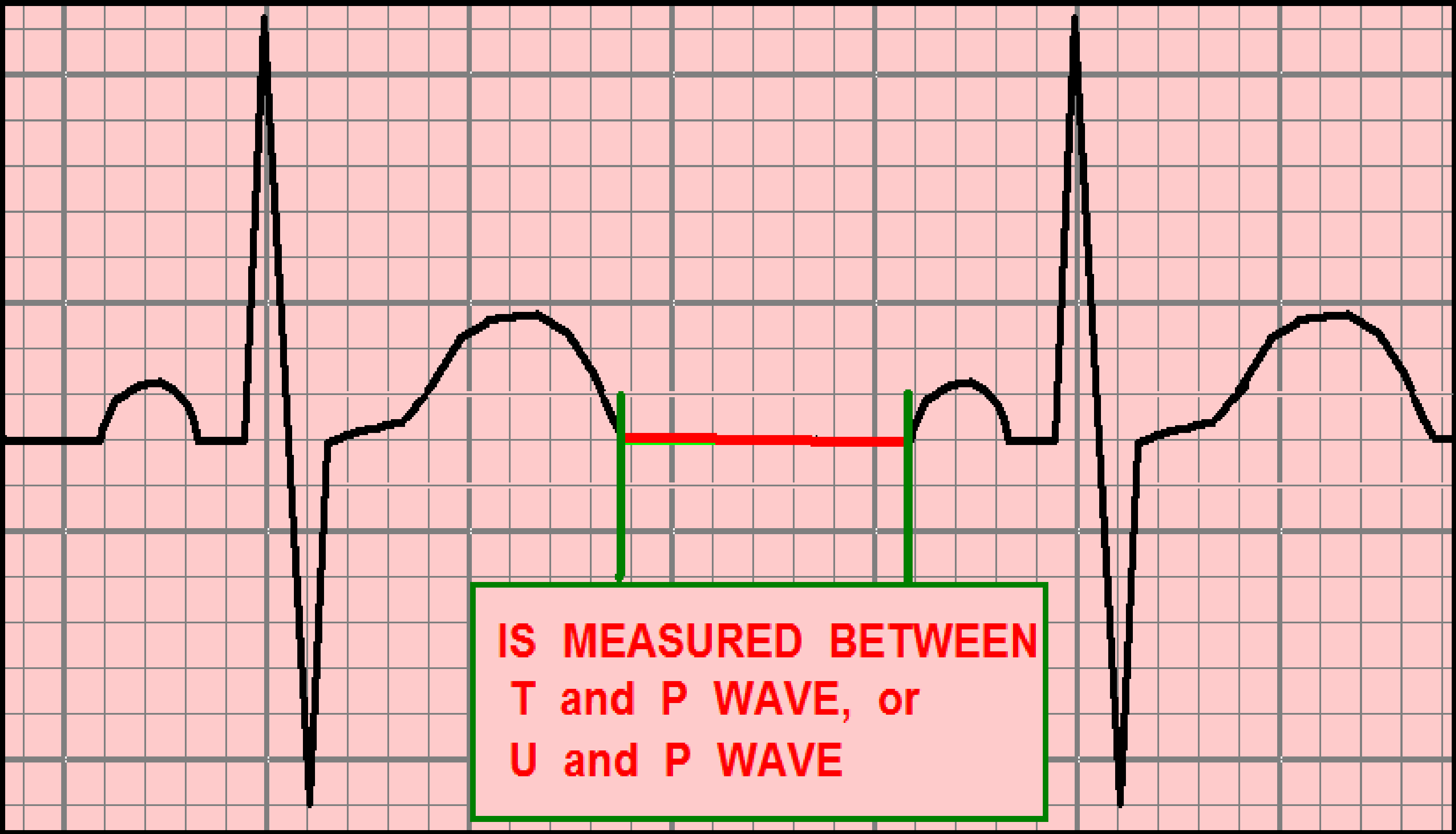
- WHEN QRS WIDTH IS NORMAL (< 120 ms)

ASSESS:

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

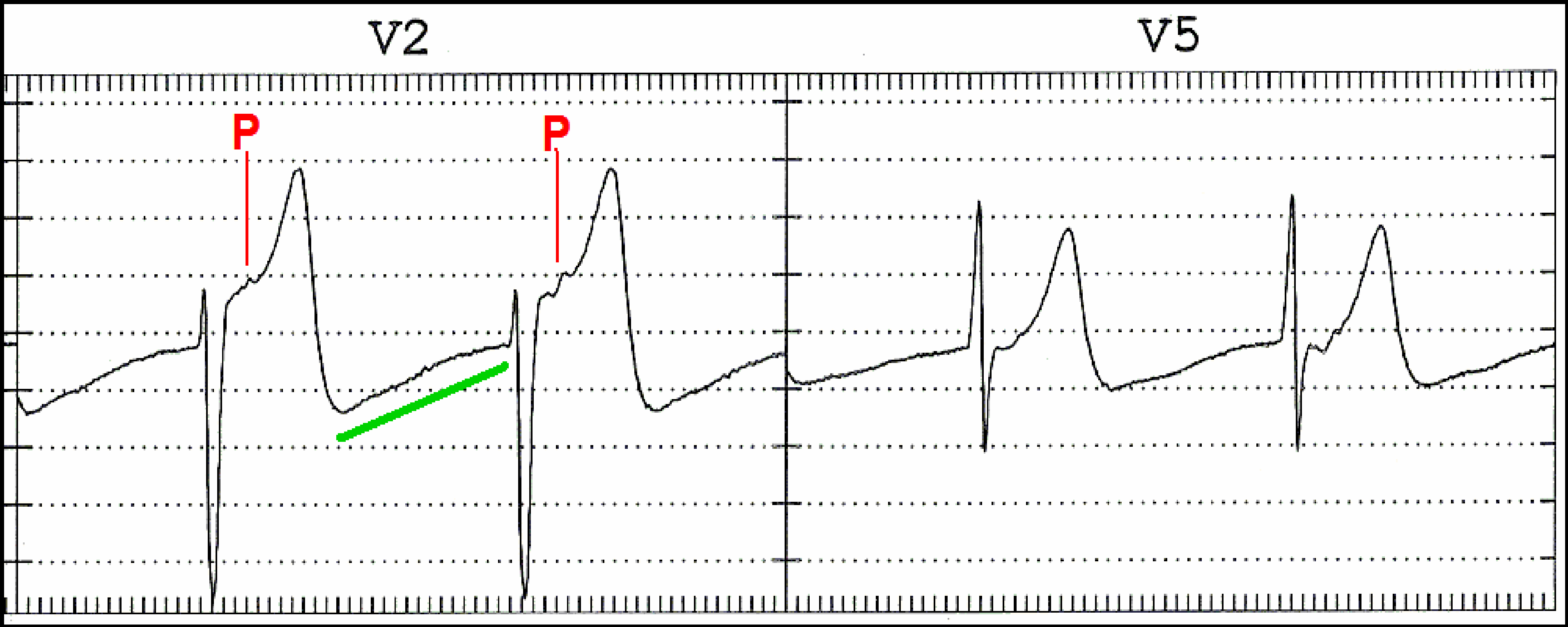
☞ ***in EVERY LEAD EXCEPT aVR ! !***

THE ISOELECTRIC LINE



THE ISOELECTRIC LINE

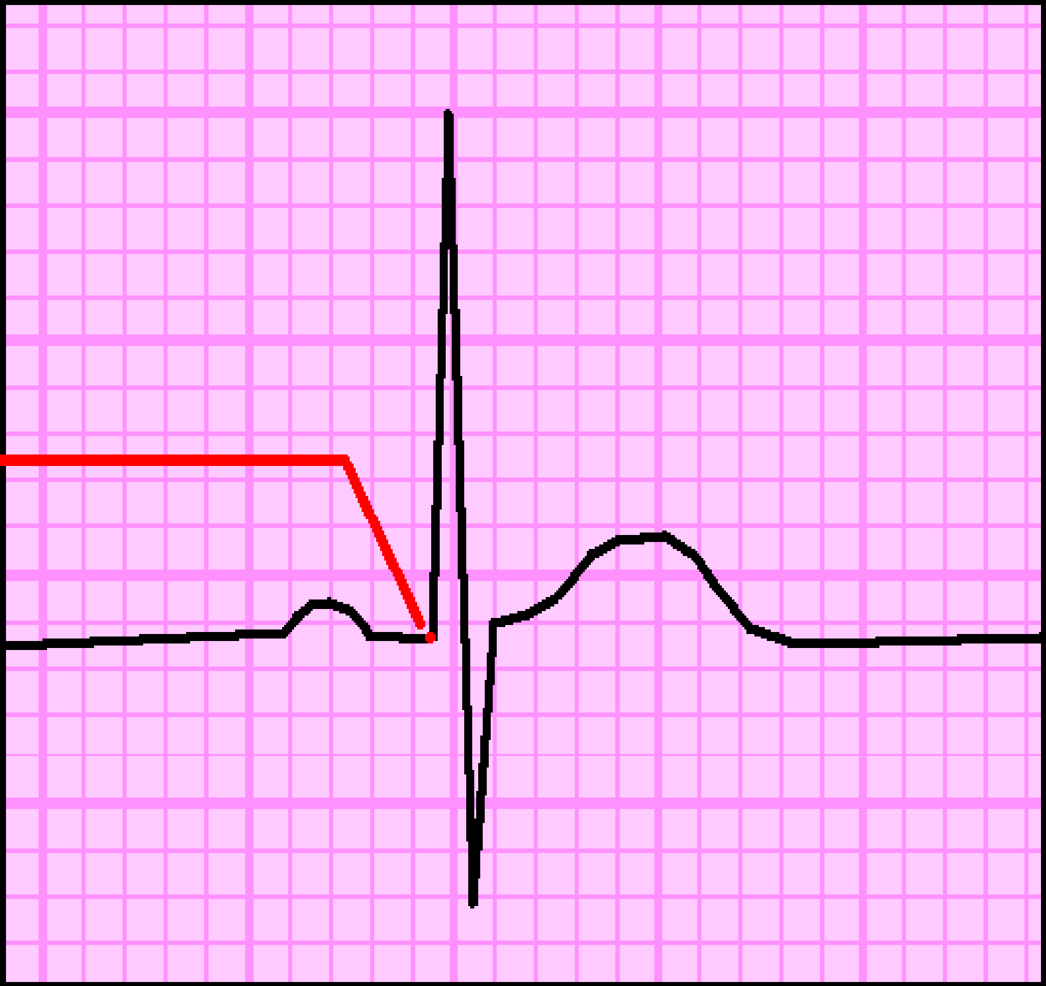
EKG from 13 y/o girl in ACCELERATED JUNCTIONAL RHYTHM.
note: upsloping T-P interval, and P buried in T waves.



THE P-Q JUNCTION

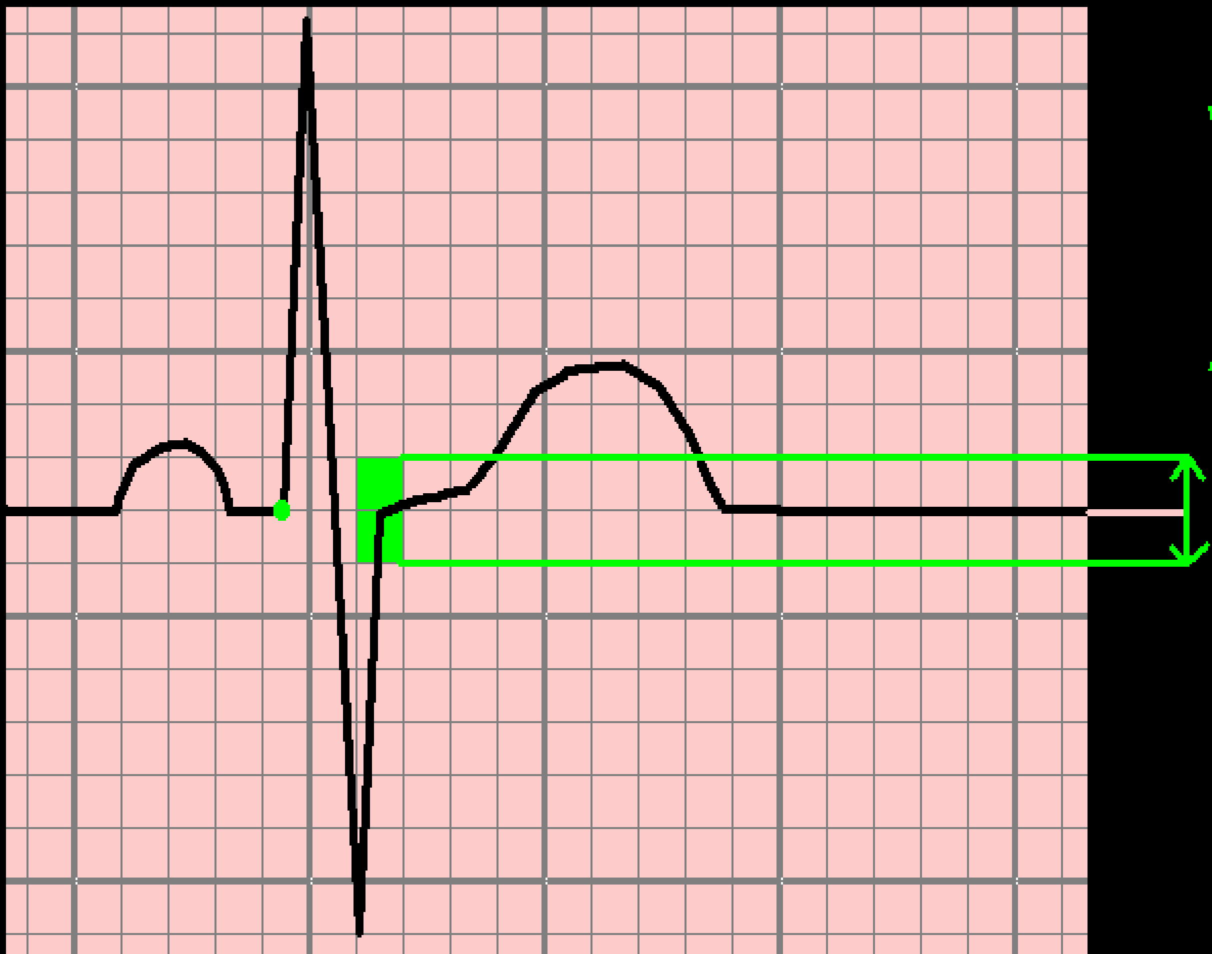
. . . . is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS.

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 J POINT SHOULD BE . .

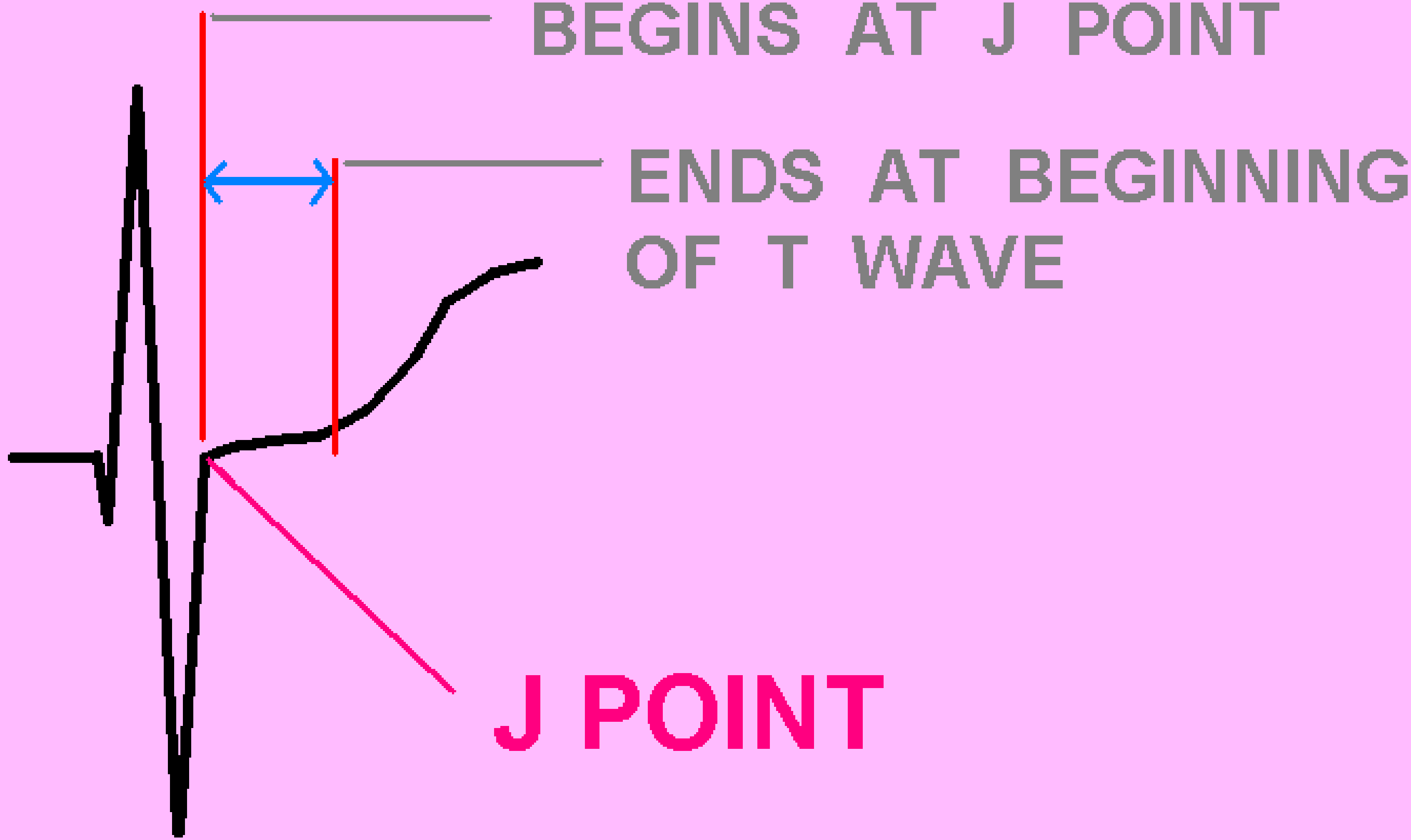


WITHIN
1 mm
ABOVE

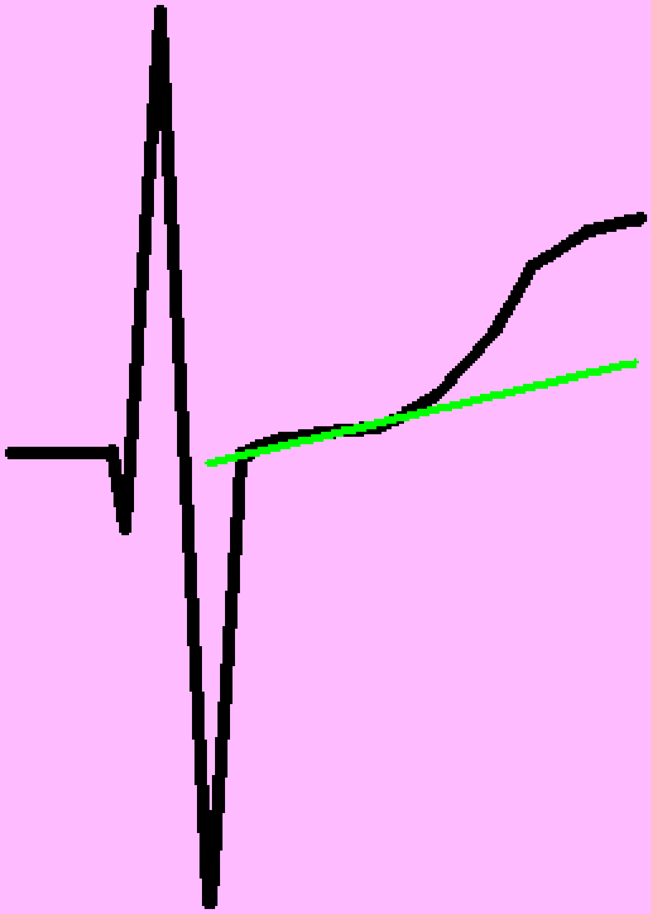
OR

BELOW
THE
P-Q
JUNCTION

THE S-T SEGMENT

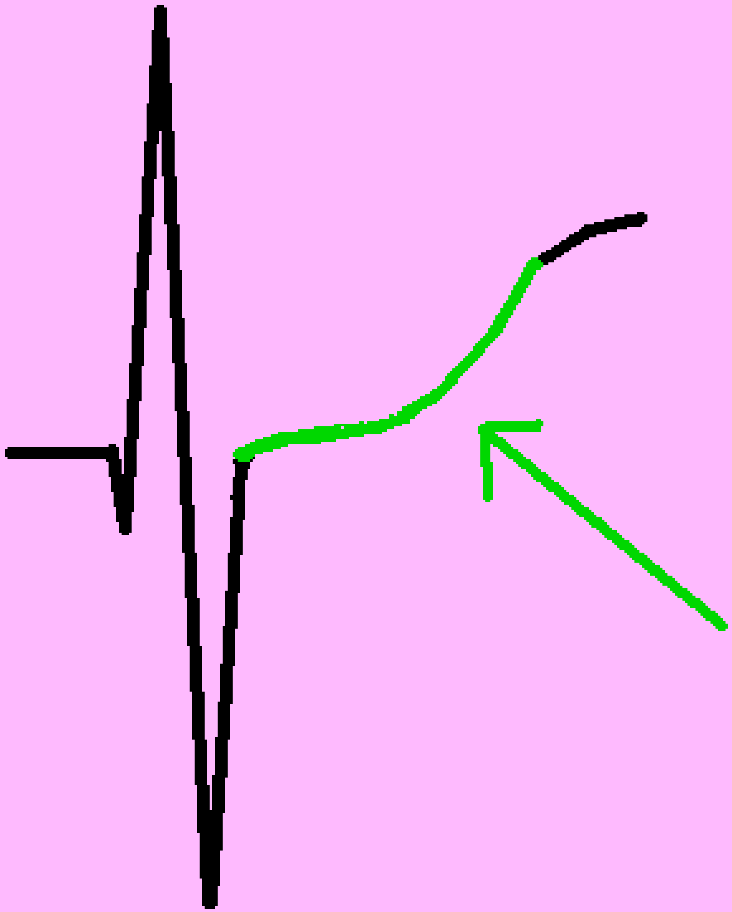


THE S-T SEGMENT



SHOULD HAVE
A "SLIGHT POSITIVE"
INCLINATION

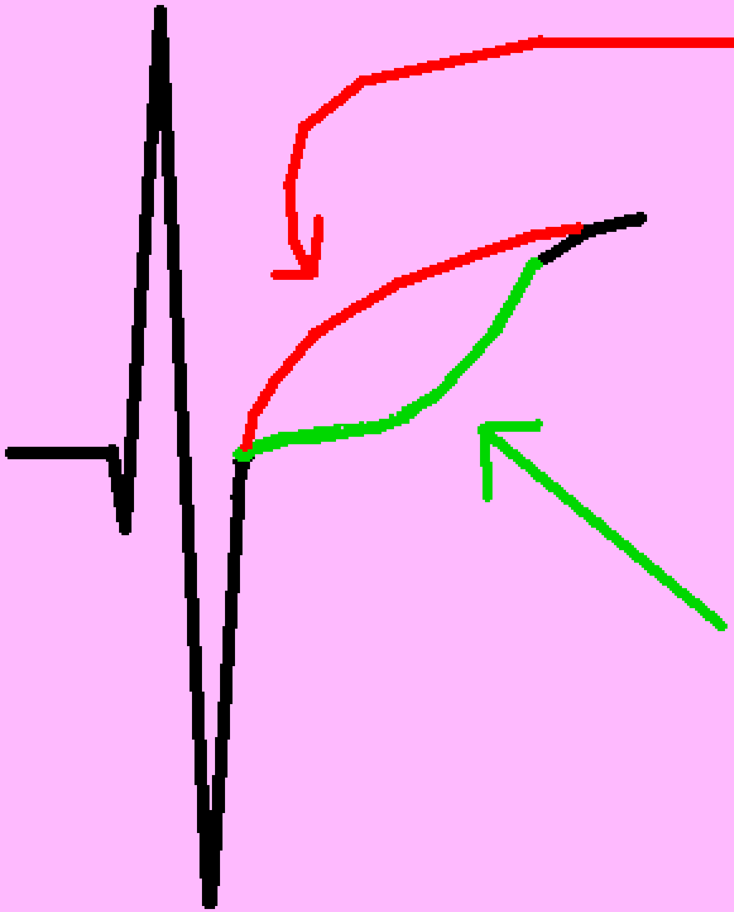
THE S-T SEGMENT



SHOULD BE "CONCAVE" IN SHAPE . . .

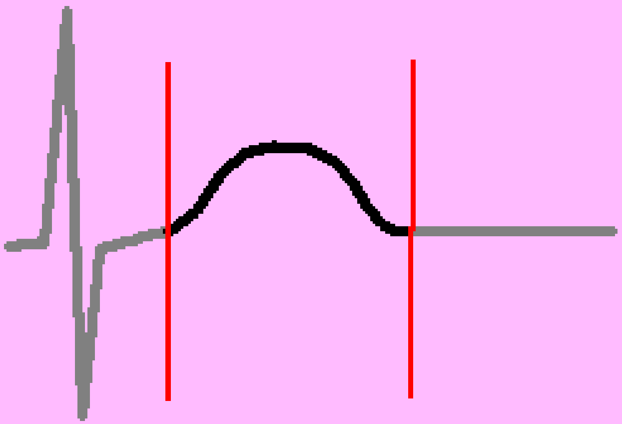
THE S-T SEGMENT

AS OPPOSED TO
"CONVEX" IN
SHAPE



SHOULD BE
"CONCAVE" IN
SHAPE . . .

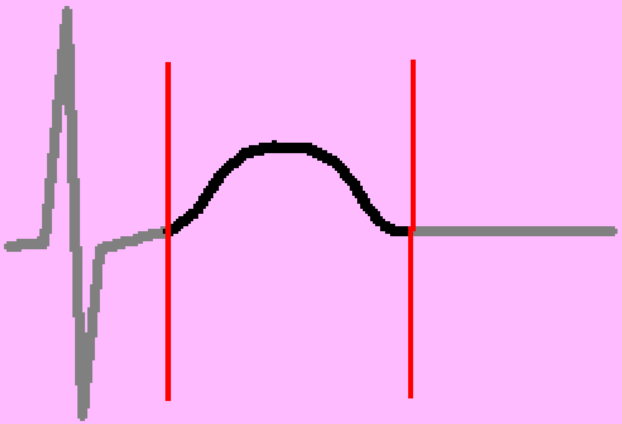
THE T WAVE



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

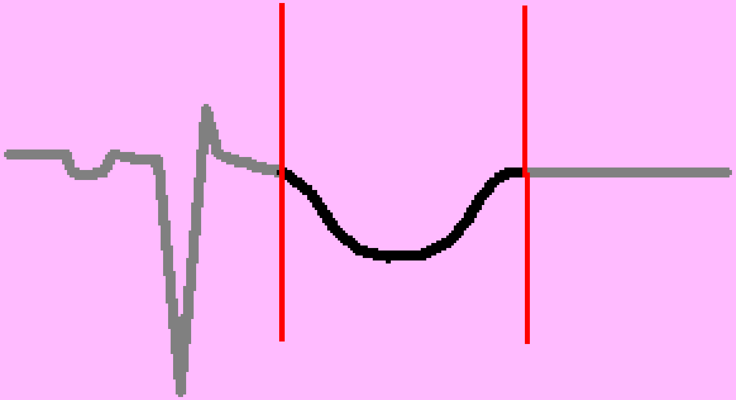
- SHOULD BE SYMMETRICAL

THE T WAVE



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

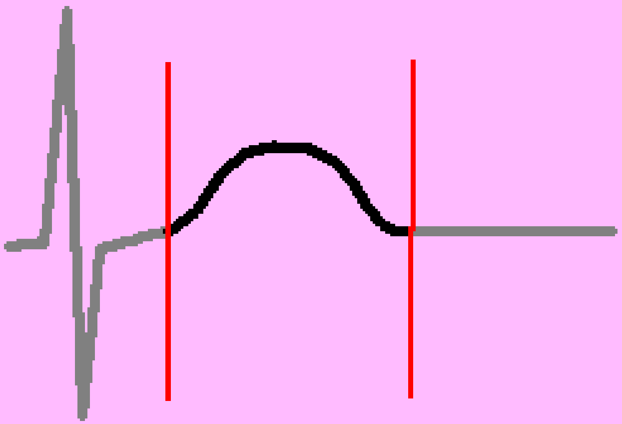
THE T WAVE



LEAD AVR

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

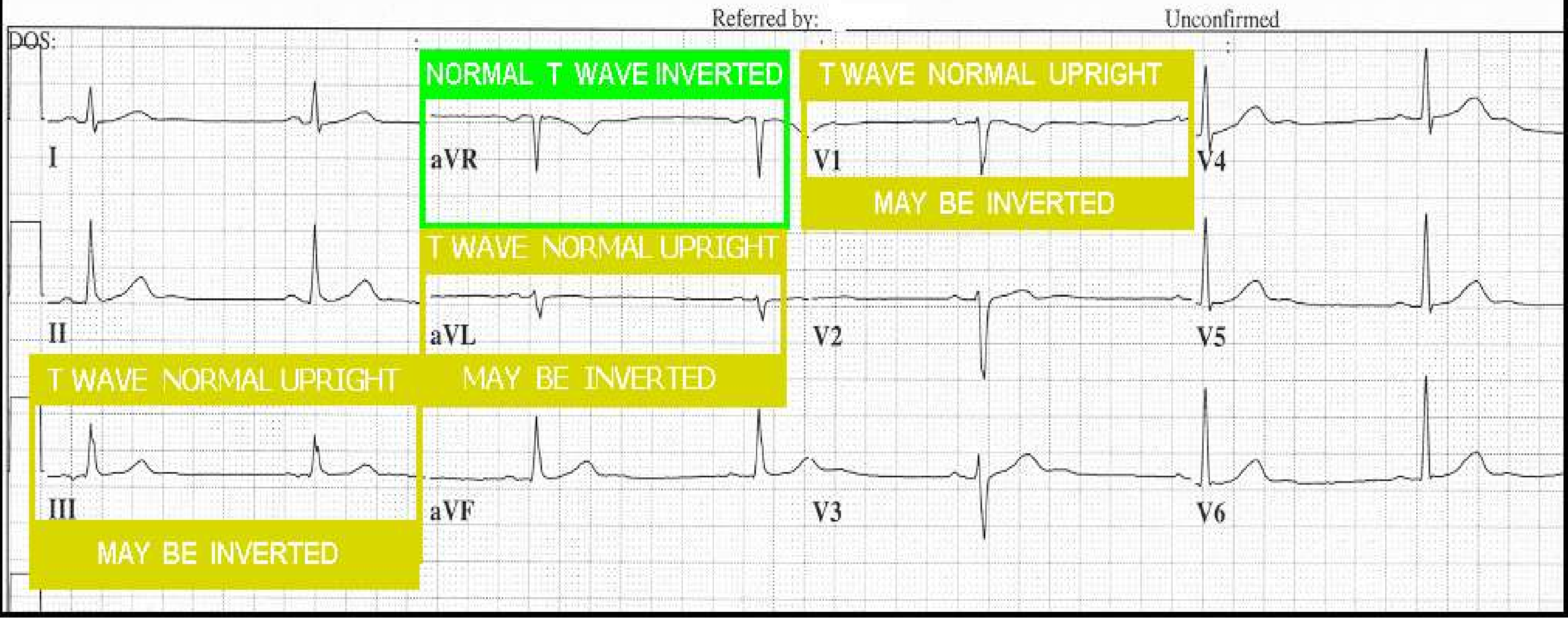
THE T WAVE



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

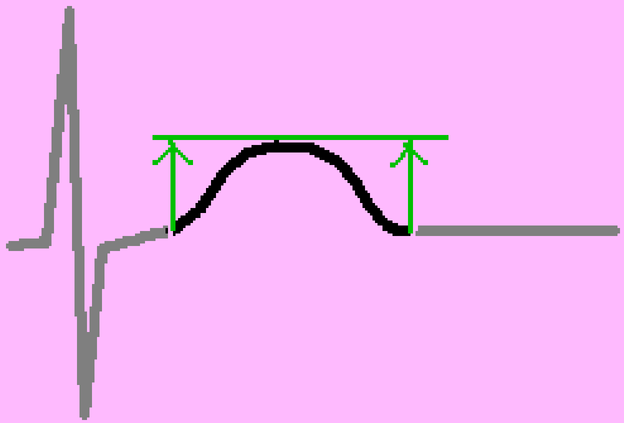
- SHOULD BE SYMMETRICAL
- SHOULD BE UPRIGHT IN ALL LEADS, EXCEPT AVR
- MAY BE INVERTED IN LEADS I, III, and V1

Leads where the T WAVE may be INVERTED:



An inverted T wave in TWO OR MORE CONTIGUOUS LEADS = potential problem (ischemia)

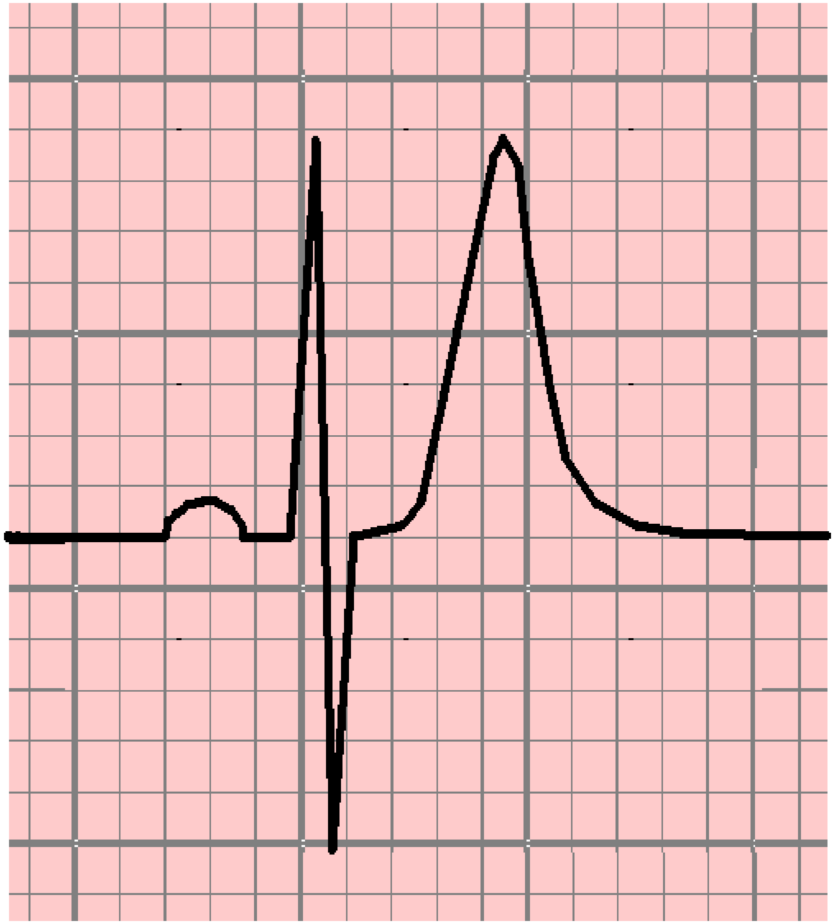
THE T WAVE



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.

HYPER-ACUTE T WAVES - COMMON ETIOLOGIES:

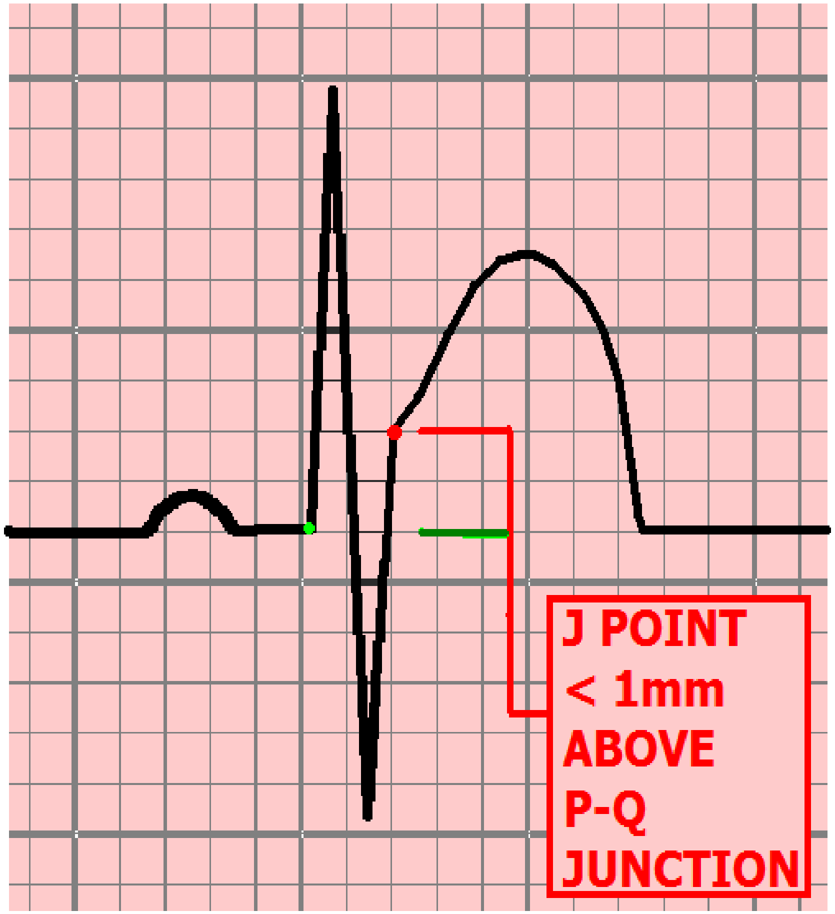


CONDITION:

- HYPERKALEMIA
- ACUTE MI
- TRANSMURAL ISCHEMIA
- HYPERTROPHY

MORE INFORMATION ON HYPERACUTE T WAVES COMING UP SOON . . .

S-T SEGMENT ELEVATION - COMMON ETIOLOGIES:



CONDITION:

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

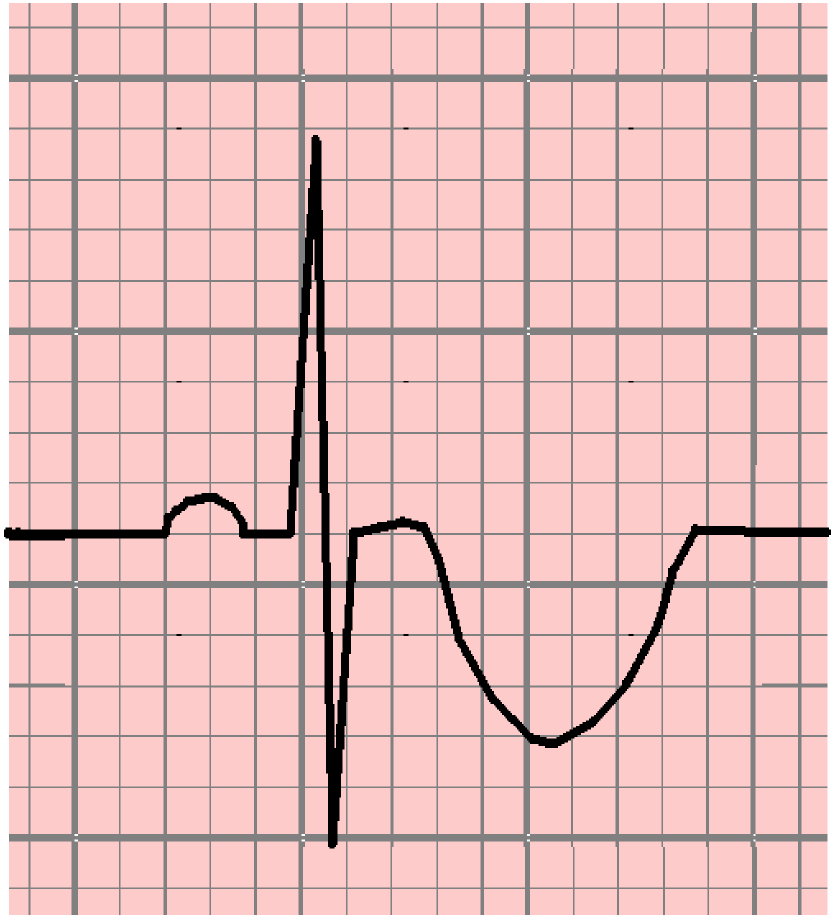
ON THE NEXT PAGE IN YOUR BOOK ARE SOME EXAMPLES OF THE ABOVE CONDITIONS

S-T SEGMENT DEPRESSION - COMMON ETIOLOGIES:

CONDITION:

- RECIPROCAL CHANGES of ACUTE MI
- NON-Q WAVE M.I. (NON-STEMI)
- ISCHEMIA
- POSITIVE STRESS TEST
- VENTRICULAR HYPERTROPHY (STRAIN PATTERN)
- WOLFF-PARKINSON-WHITE
- OLD MI (NECROSIS vs. ISCHEMIA)
- DIGITALIS
- R. BUNDLE BRANCH BLOCK

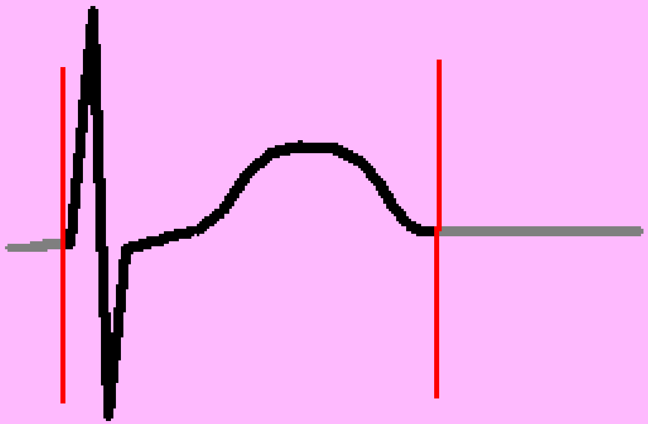
T WAVE INVERSION - COMMON ETIOLOGIES:



CONDITION:

- MYOCARDITIS
- ELECTROLYTE IMBALANCE
- ISCHEMIA
- POSITIVE STRESS TEST
- CEREBRAL DISORDER
- MITRAL VALVE PROLAPSE
- VENTRICULAR HYPERTROPHY
- WOLFF-PARKINSON-WHITE
- HYPERVENTILATION
- CARDIOACTIVE DRUGS
- OLD MI (NECROSIS vs. ISCHEMIA)
- DIGITALIS
- R. BUNDLE BRANCH BLOCK
- NO OBVIOUS CAUSE

THE Q - T INTERVAL



- BEGINNING OF QRS COMPLEX TO THE END OF THE T WAVE

- NORMAL VALUES VARY BASED ON HEART RATE

- SEVERAL WAYS TO DETERMINE NORMAL LIMITS

THE *QTc INTERVAL

* QTc = Q-T interval, *corrected* for heart rate

HEART RATE	MALE	FEMALE
150	0.25	0.28
125	0.26	0.29
100	0.31	0.34
93	0.32	0.35
83	0.34	0.37
71	0.37	0.40
60	0.40	0.44
50	0.44	0.48
43	0.47	0.51

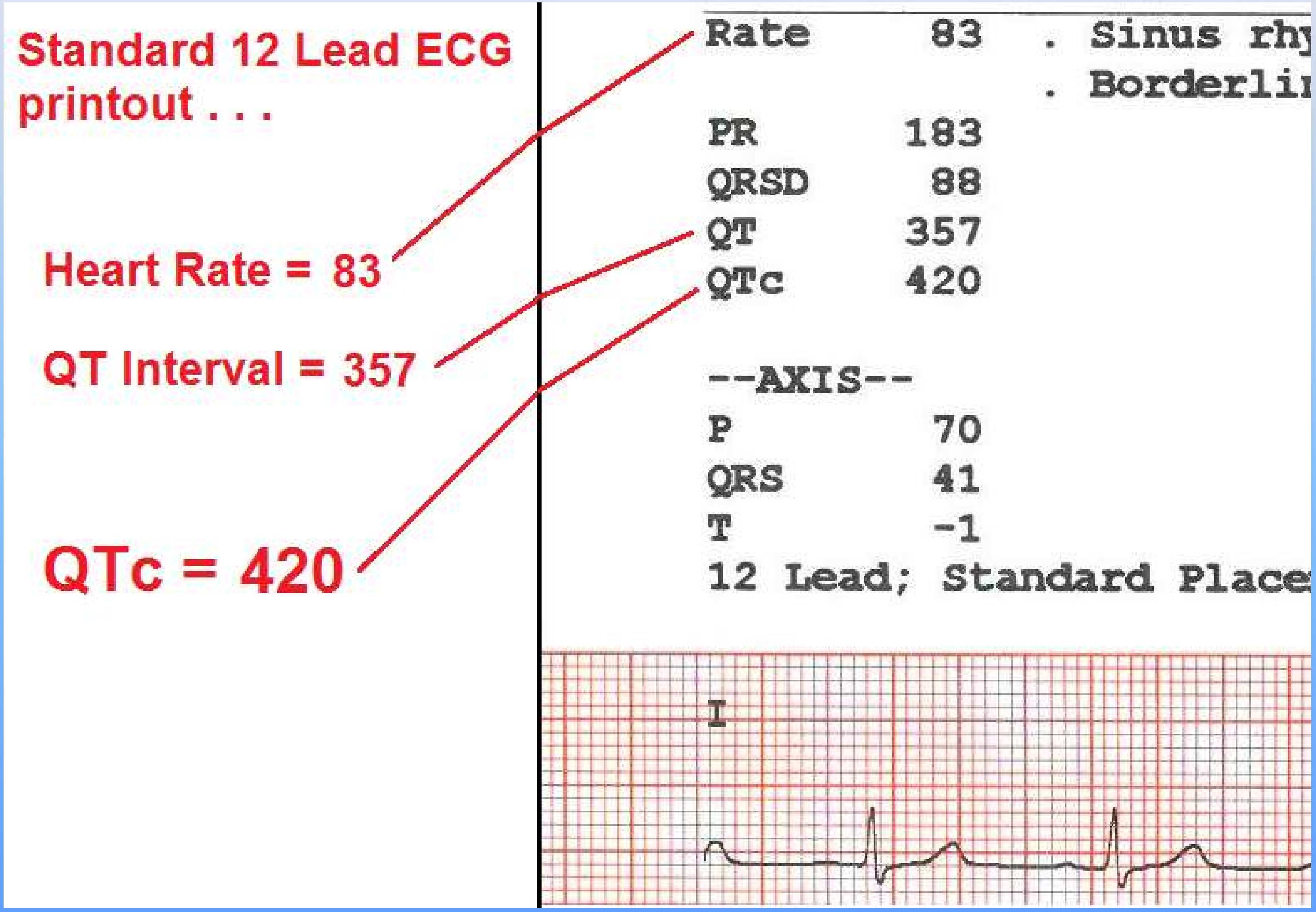
Annals of Internal Medicine, 1988 109:905.

QT CORRECTION FORMULAS:

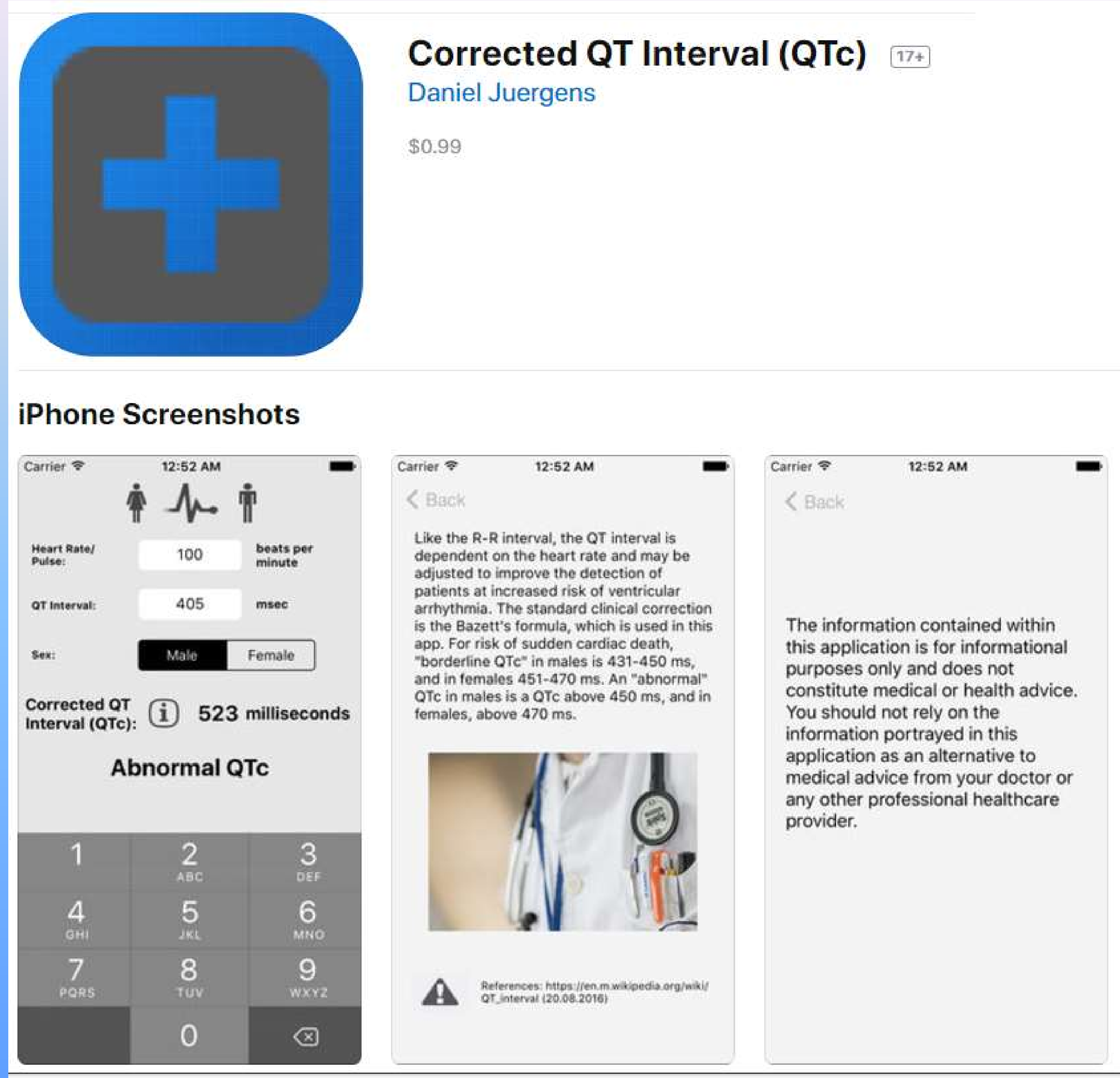
Bazett's	$QTc=QT/\sqrt{RR}$
Fredericia	QTc=QT/(RR)1/3
Framingham	QTc=QT+0.154(1-RR)
Rautaharju	QTc=656/(1+HR/100)

Determining the QT / QTc

Method 1 – 12 Lead ECG Report:



"There's an APP for that!"



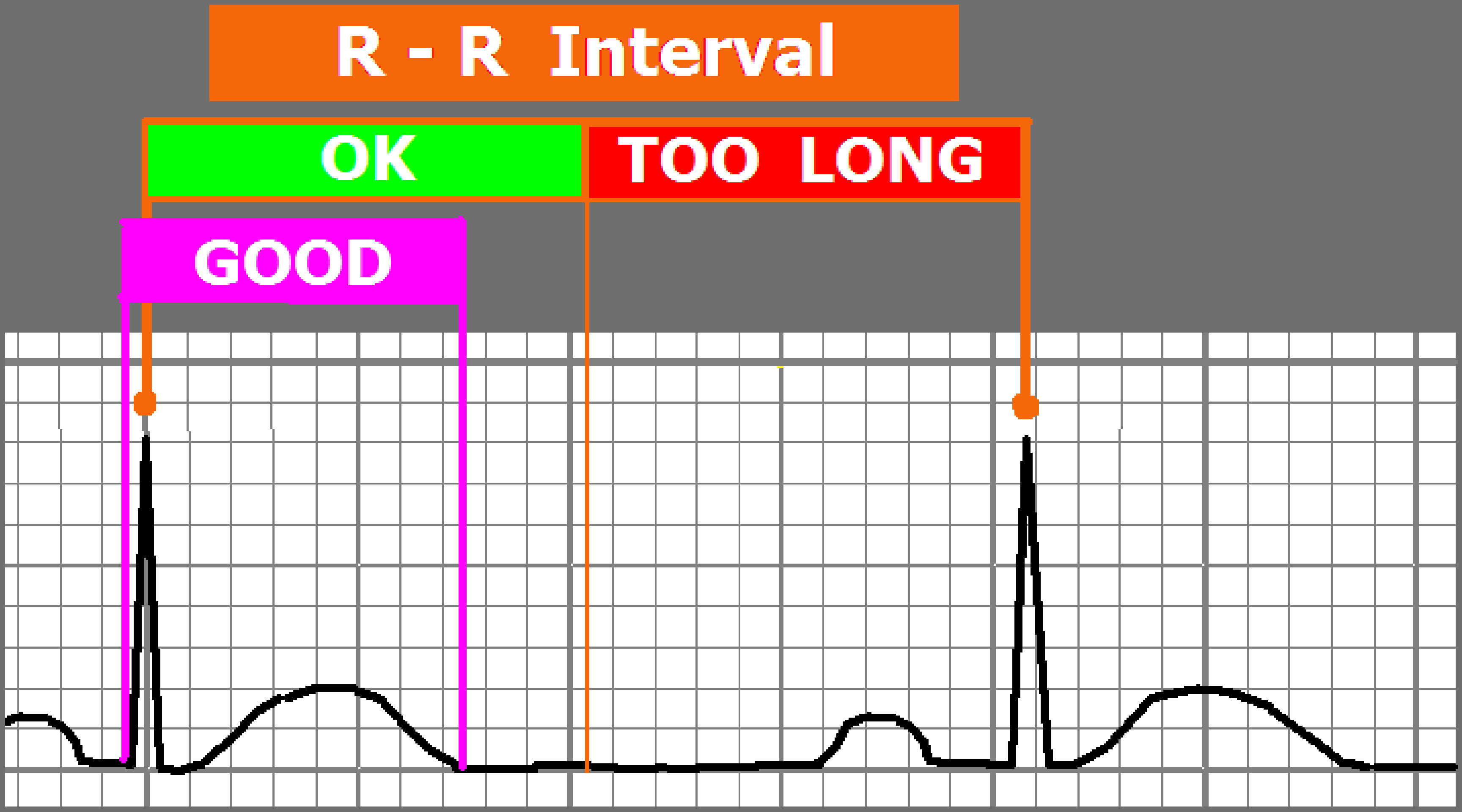
Determining the QTc

Smartphone Apps:

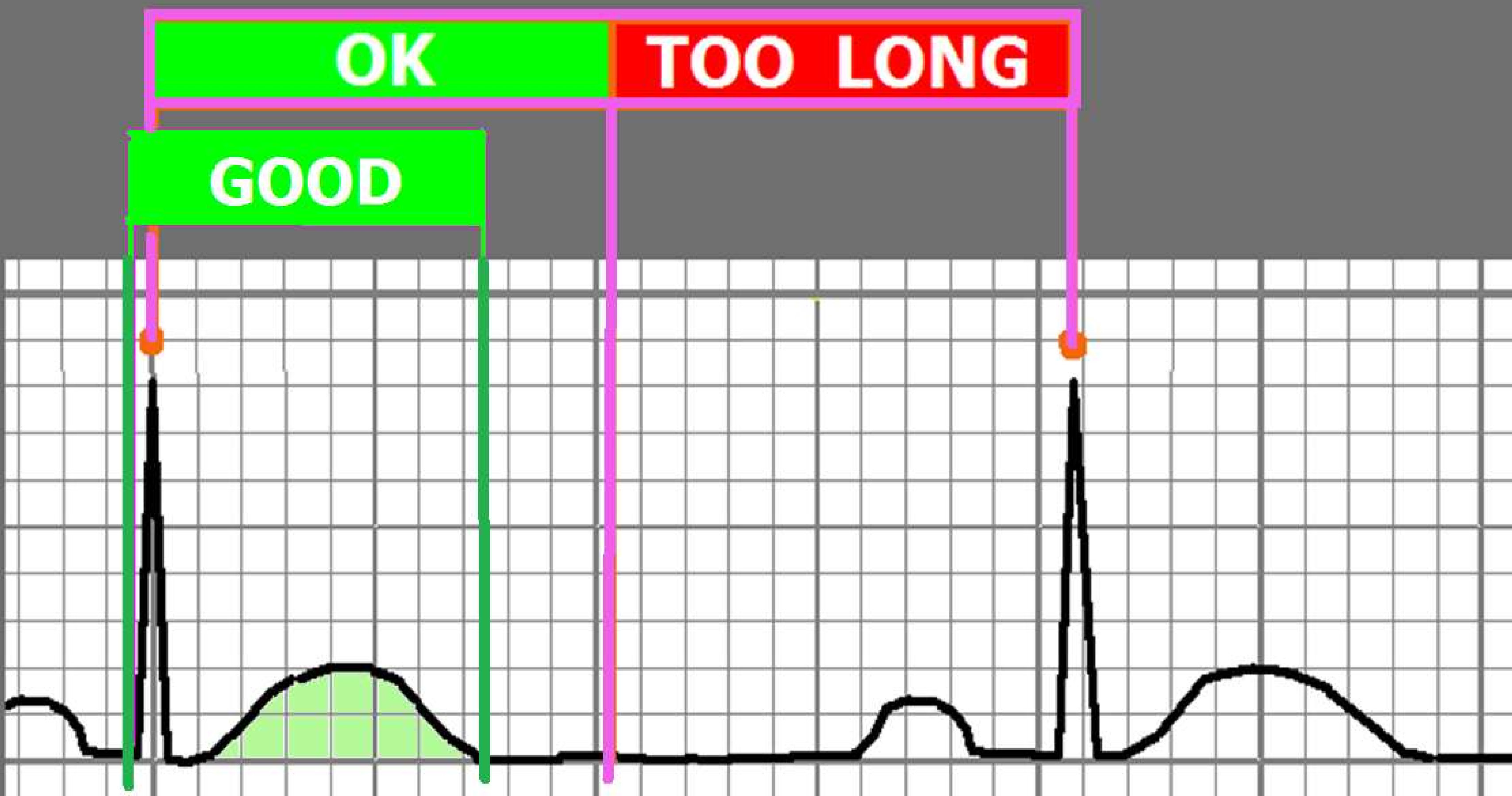
- **iPhone**
  - https://itunes.apple.com/us/app/corrected-qt-interval-qtc/id1146177765?mt=8
- **Android**
  - https://play.google.com/store/apps/details?id=com.medsam.qtccalculator&hl=en

FOR VENTRICULAR RATES BETWEEN 60 – 100 with QRSd <120ms:

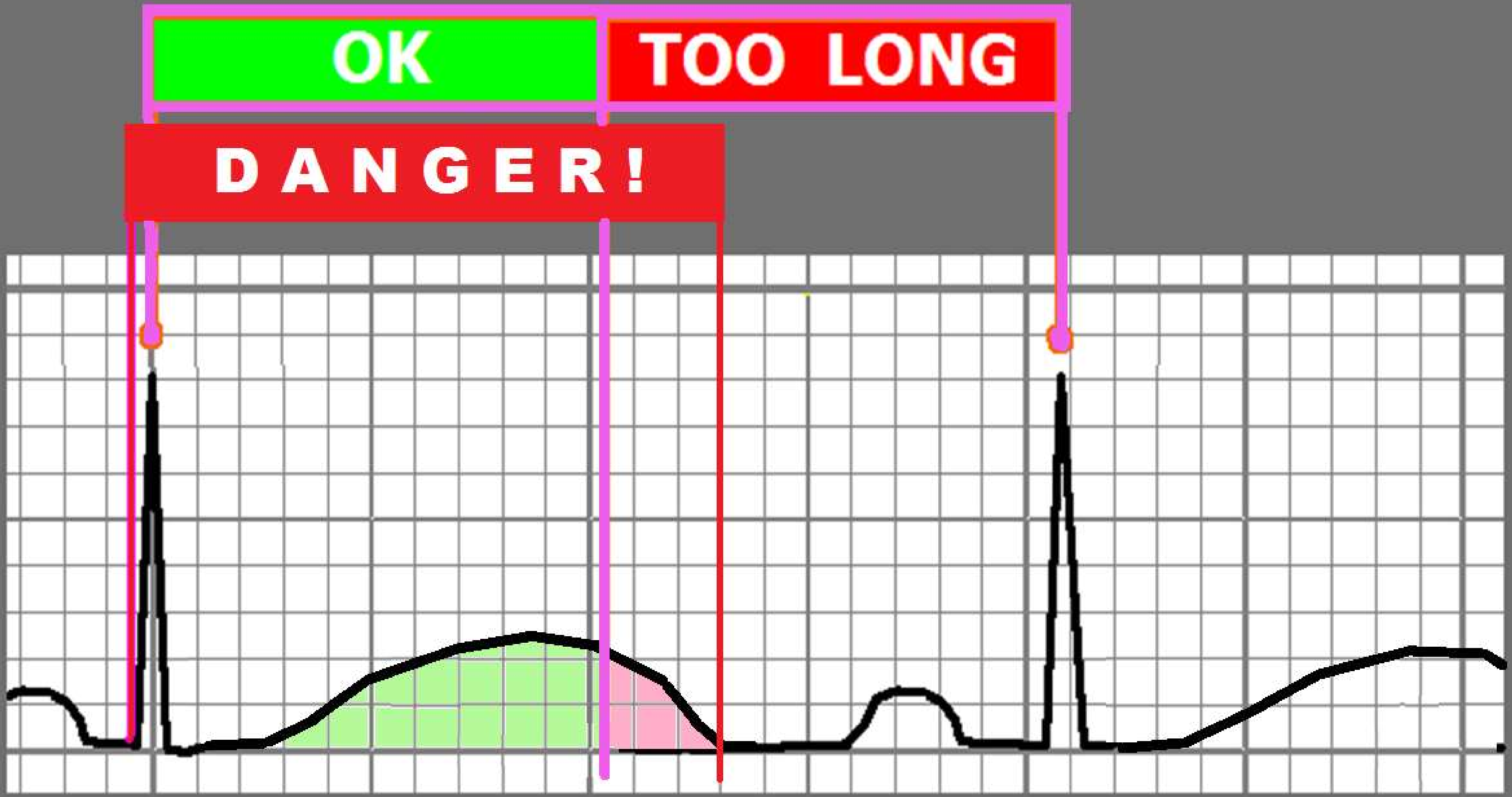
The Q - T Interval
should be LESS THAN 1/2 the



The Q - T Interval
should be LESS THAN 1/2 the
R - R Interval



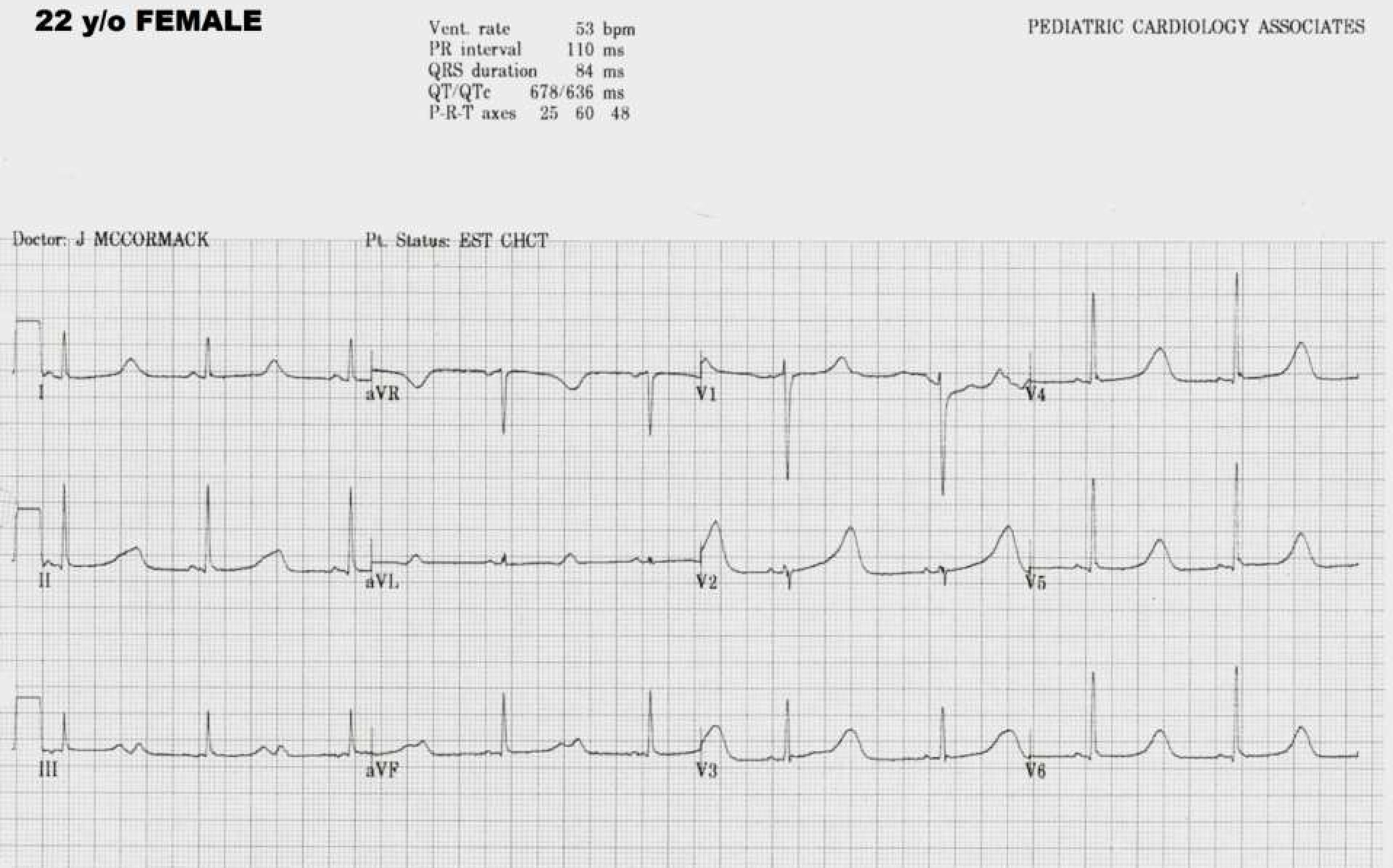
The Q - T Interval should be LESS THAN 1/2 the R - R Interval



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**

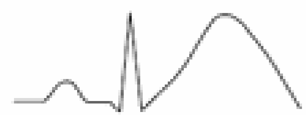
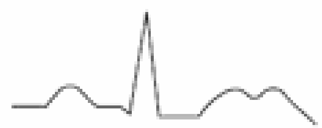
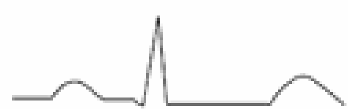
SOURCE: "ACC/AHA/HRS Recommendations for Standardization and Interpretation of the ECG, Part IV: The ST Segment, T and U Waves, and the QT Interval" Rautaharju et al 2009



WHEN THE "QUICK PEEK" METHOD for QT INTERAL EVALUATION IS APPLIED TO THE ABOVE ECG, WHAT IS THE RESULT?

GENETICALLY ACQUIRED LONG QT SYNDROMES:

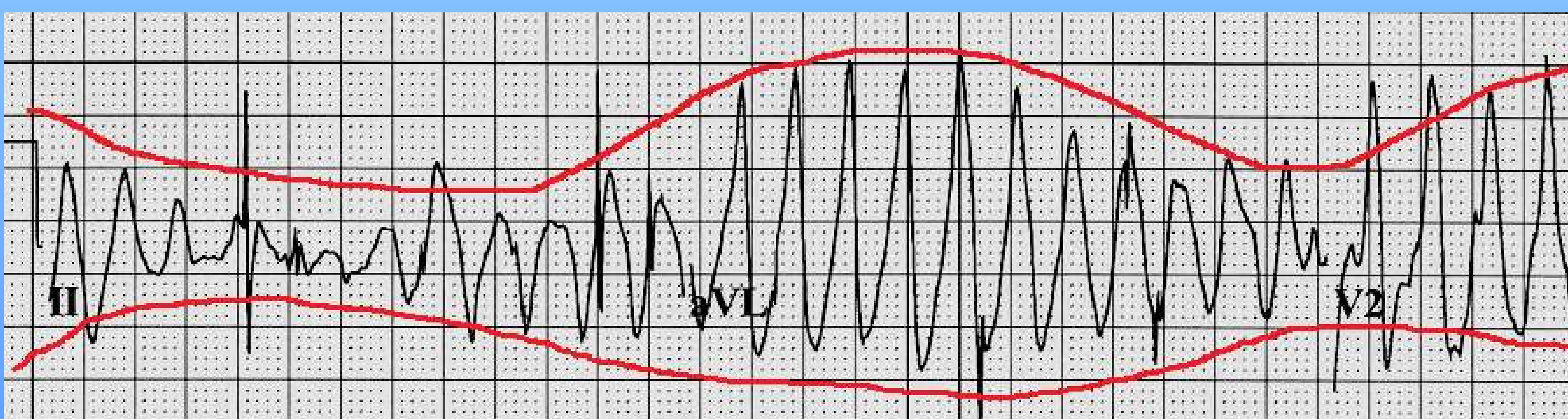
ECG PATTERNS of 3 MOST COMMON VARIATIONS:

Type	Current	Functional Effect	Frequency Among LQTS	ECG[12,13]	Triggers Lethal Cardiac Event[10]	Penetrance*
LQTS1	K	↓	30%-35%		Exercise (68%) Emotional Stress (14%) Sleep, Repose (9%) Others (19%)	62%
LQTS2	K	↓	25%-30%		Exercise (29%) Emotional Stress (49%) Sleep, Repose (22%)	75%
LQTS3	Na	↑	5%-10%		Exercise (4%) Emotional Stress (12%) Sleep, Repose (64%) Others (20%)	90%

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

resembles . . . . .

a piece of Twisted Ribbon !



Etiology of Long QT Syndromes:

Congenital (14 known subtypes)

Genetic mutation results in abnormalities of cellular ion channels

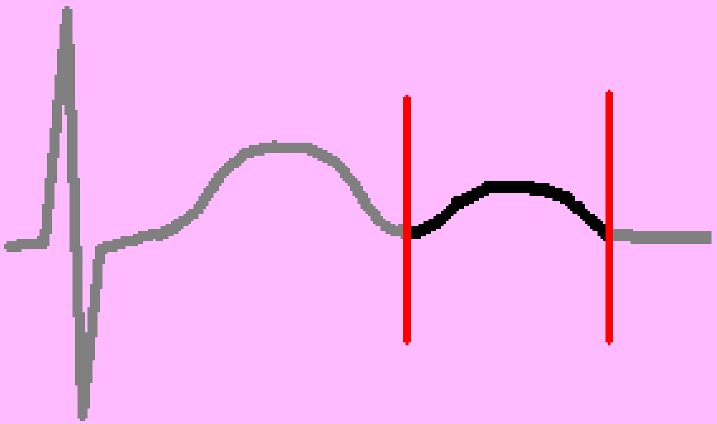
Acquired

- Drug Induced
- Metabolic/electrolyte induced
- Very low energy diets / anorexia
- CNS & Autonomic nervous system disorders

Miscellaneous

- Coronary Artery Disease
- Mitral Valve Prolapse

THE U WAVE



- SEEN INFREQUENTLY
- IF PRESENT, SHOULD BE THE SAME DEFLECTION AS T WAVE
- SHOULD BE NO MORE THAN 10% THE SIZE OF THE T WAVE
- MORE PROMINENT IN V2 OR V3

U WAVES

ROUTINE RETRIEVAL

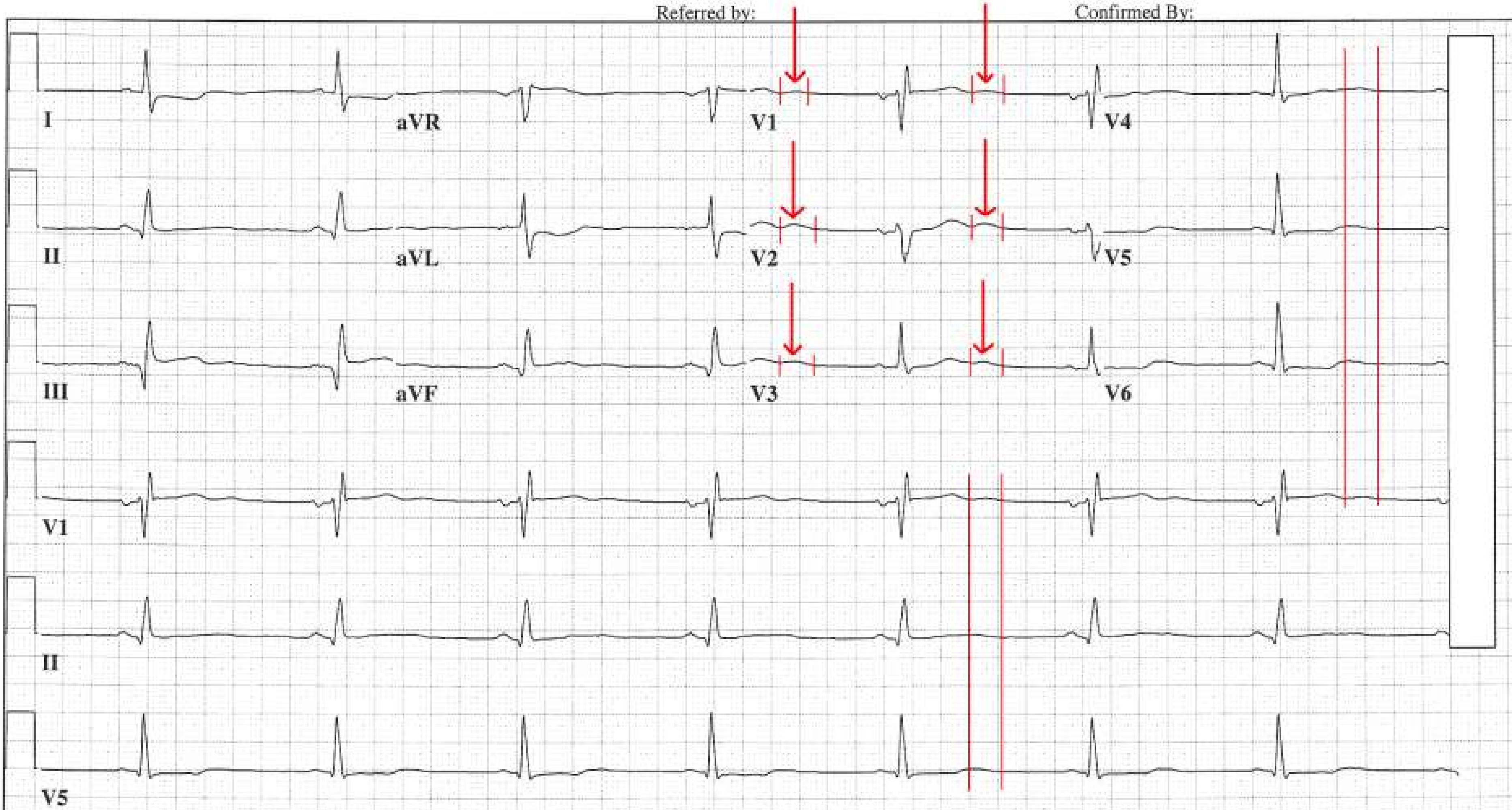
69 yr
Female Caucasian

Room:6
Loc:1 Option:1

Vent. rate	44	BPM
PR interval	144	ms
QRS duration	118	ms
QT/QTc	494/422	ms
P–R–T axes	63 63	123

Marked sinus bradycardia
Incomplete right bundle branch block
Possible Inferior infarct , age undetermined
ST & T wave abnormality, consider lateral ischemia
Abnormal ECG
When compared with ECG of 26–MAR–2006 20:32,
no significant change

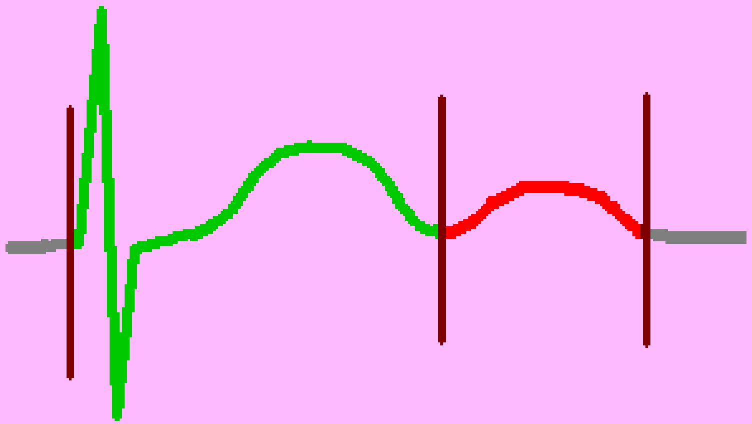
Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 231 CID: 1

EID:7 EDT: 14:59 30–MAR–2006 ORDER:

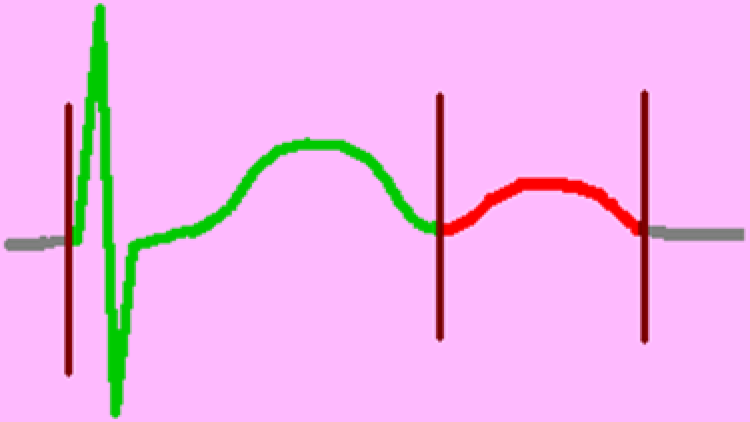
THE U WAVE



REPORTED CAUSES OF U WAVES:

- *OFTEN SEEN IN BRADYCARDIAS (RATES BELOW 60)*
- *HYPOKALEMIA, HYPOCALCEMIA, HYPOMAGNESEMIA*
- *AFTER-DEPOLARIZATIONS of VENTRICULAR*
- *HYPOTHERMIA*
- *DRUGS THAT PROLONG THE QT INTERVAL*
- *LONG QT SYNDROMES*
- *REPORTED IN APPROX 15% of ISCHEMIC STROKES*

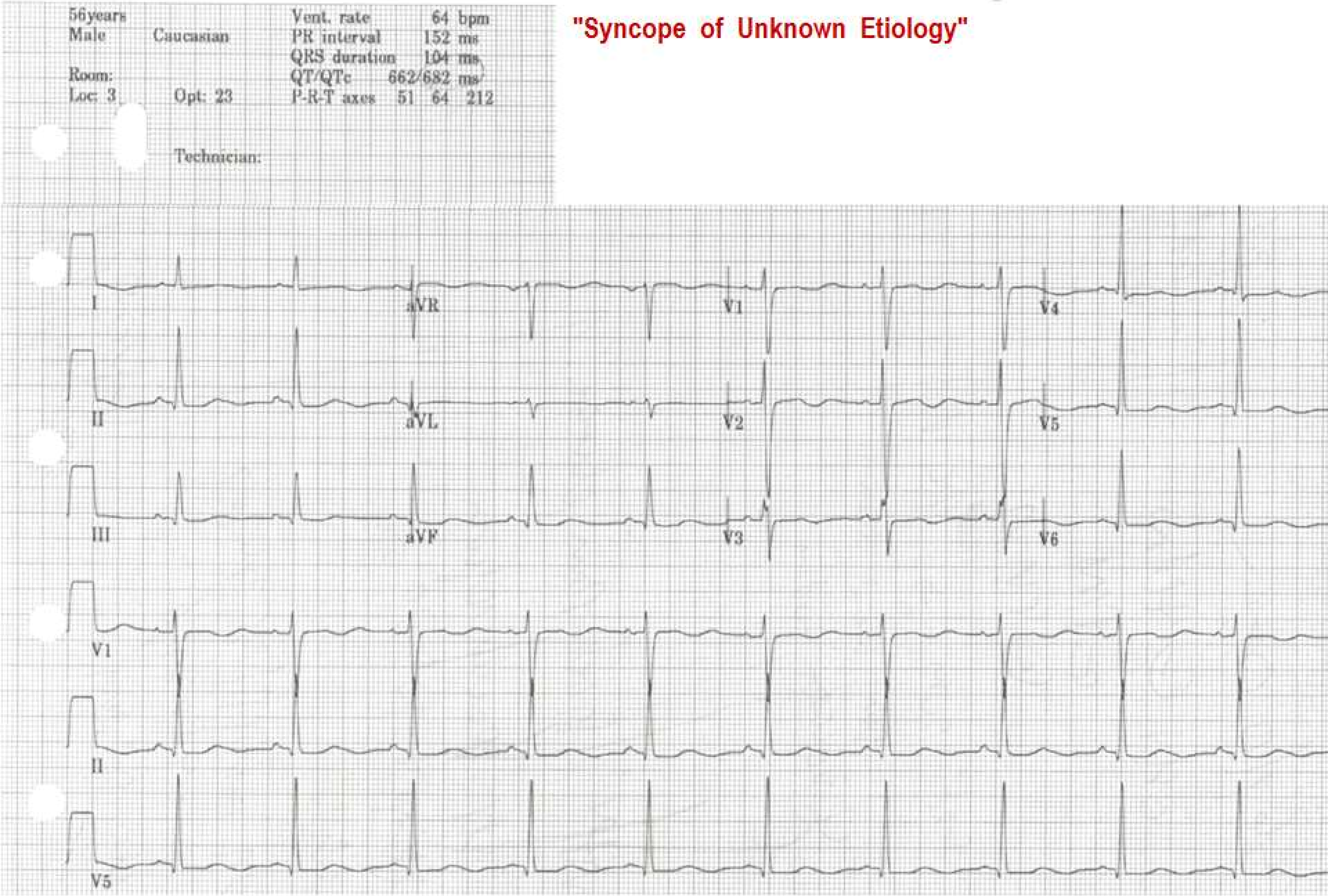
THE U WAVE



!! ALERT !!

ABNORMAL U WAVES ARE ASSOCIATED WITH A HIGH INCIDENCE OF TORSADES de POINTES,

"Syncope of Unknown Etiology"



If patient has a PROLONGED Q-T INTERVAL, AVOID DRUGS THAT LENGTHEN THE Q-T.

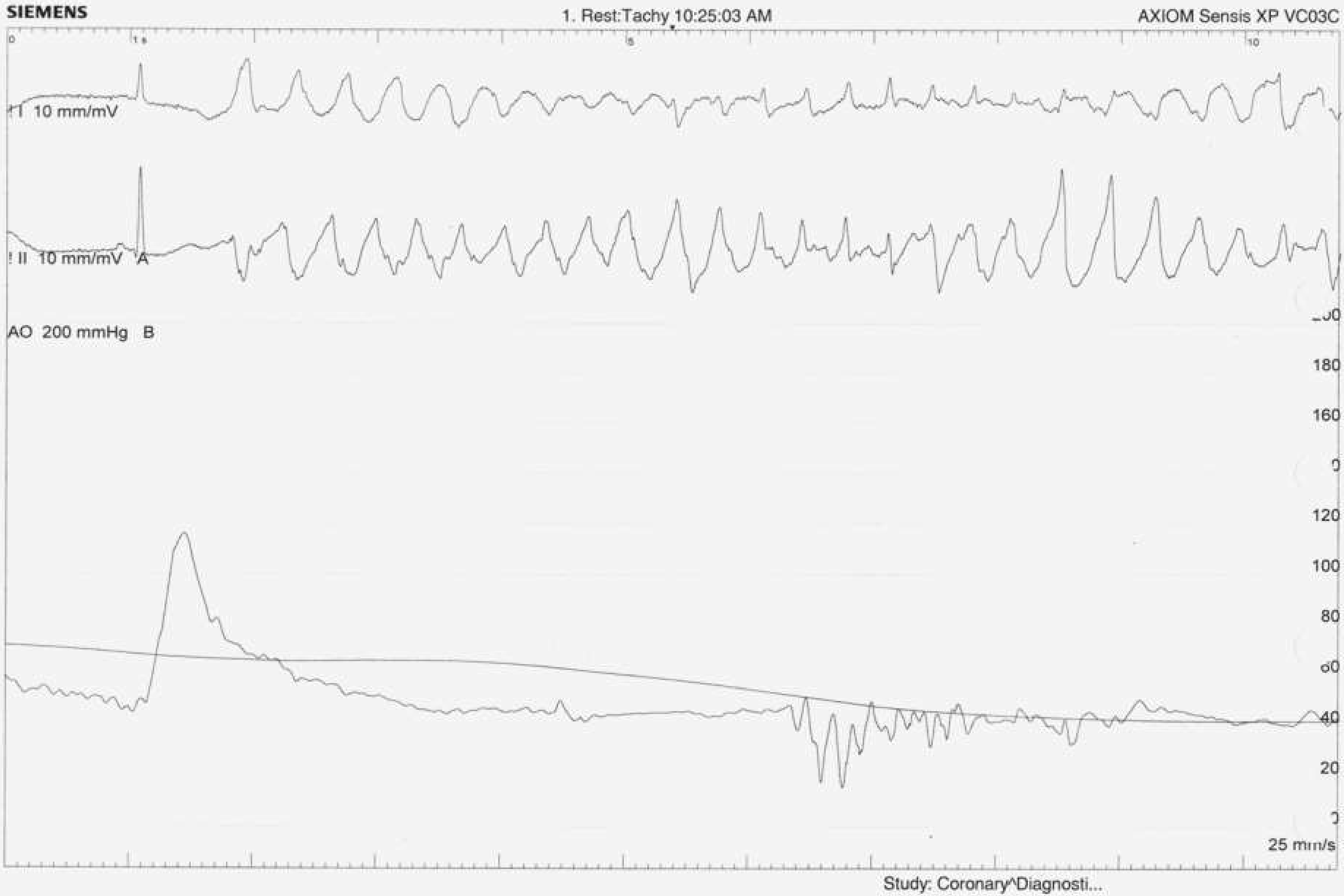
Such drugs include:

- -Amiodarone
- -Procainamide
- -Levaquin
- -Erythromycin
- -Norpace
- -Tequin
- -Ritalin
- -Pseudophedrine
- -Haloperidol
- -Thorazine
- -Propulcid

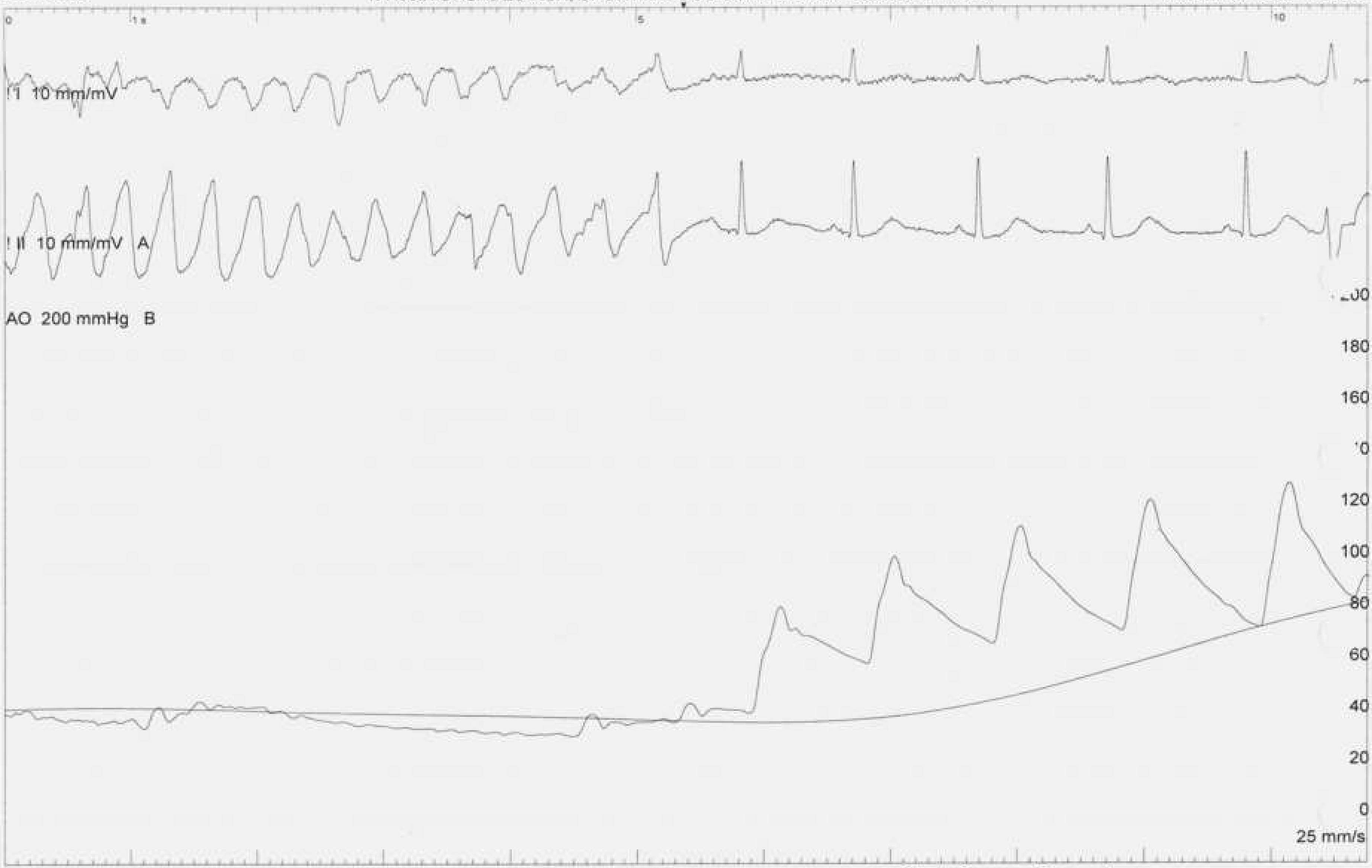
. . . . . AND MANY MORE . . . .

AND MANY MORE . . .

See: www.torsades.org / JAMA

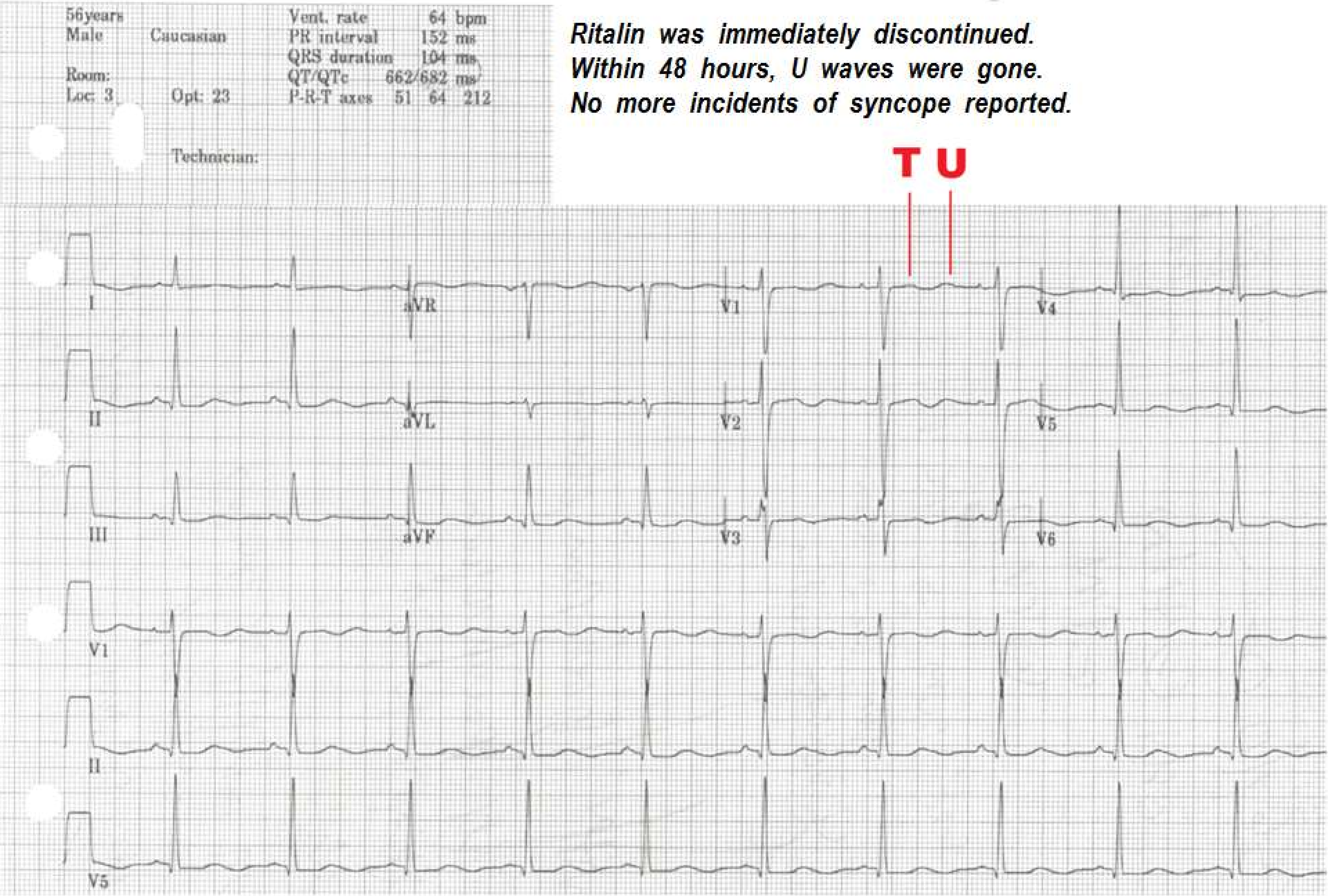

SIEMENS
1. Rest:Tachy 10:25:03 AM
AXIOM Sensis XP VC03C
I 10 mm/mV
II 10 mm/mV A
AO 200 mmHg B
180
160
120
100
80
40
20
25 mm/s
Study: Coronary^Diagnosti...

SIEMENS 1. Rest:TORSADES-NSR, SPONTANEOUS CONVERSION 10:25:03 AM+22 s AXIOM Sensis XP VC03C

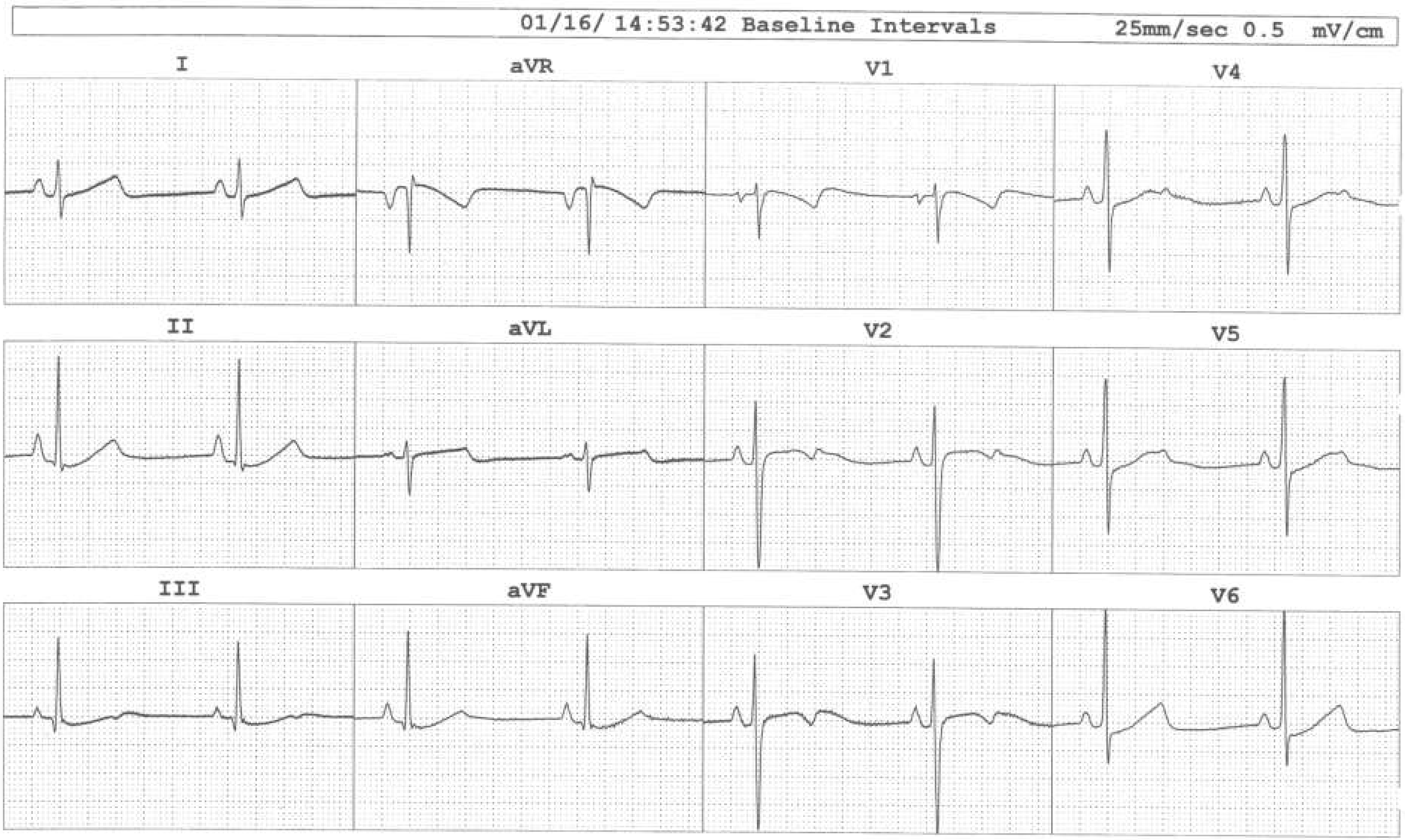


Study: Coronary^Diagnosti...

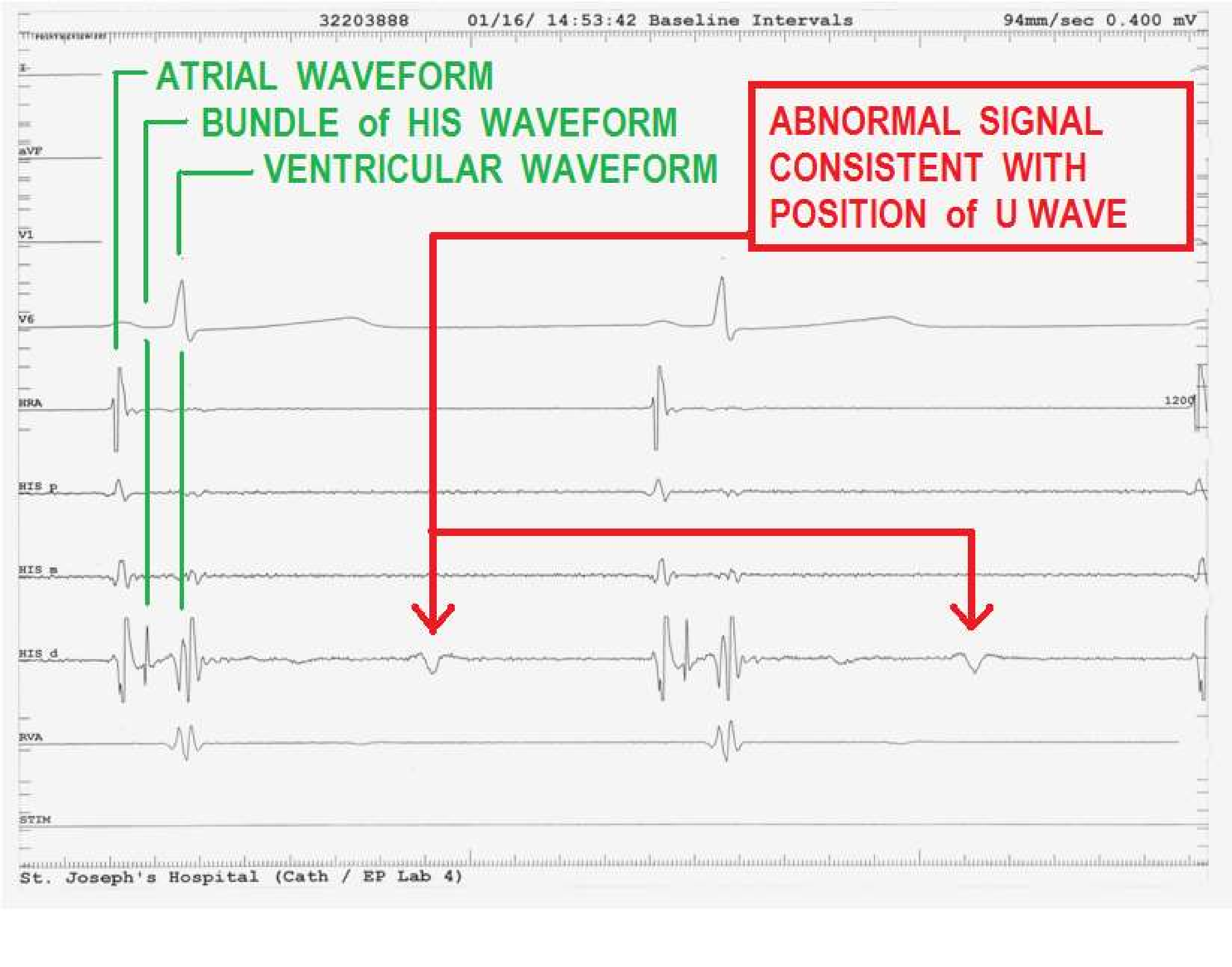
Ritalin was immediately discontinued.
Within 48 hours, U waves were gone.
No more incidents of syncope reported.



15 year old male , suffered sudden cardiac arrest. Successful out-of-hospital resuscitation with CPR / AED. His ECG is shown below:



EP STUDY REVEALS ABNORMAL AFTER-DEPOLARIZATION. PATIENT RECEIVED ICD.



ECG Indicators of Long QT Syndrome:

- QTc 460ms or longer in females*
- QTc 450ms or longer in males*
- T wave alterans
- U waves >100% of the T wave
- U waves merged with T waves
- U waves >0.1mv (1mm on standard calibrated ECG)

*P. Rautaharju, et al, "Standardization and Interpretation of the ECG, Part IV"

JACC2009;53, no. 11:982-991

☞ WHEN LQTS IS SUSPECTED, TAKE THE FOLLOWING PRECAUTIONS . . . .

<u>Suspected LQTS Considerations include:</u>

- ***Avoidance of Meds that are known to prolong the QT Interval.***

  (refer to LIST OF MEDS KNOWN TO PROLONG THE QT INTERVAL).

- **Immediate expert consultation, such as with cardiologist / electrophysiologist, in order to rule out LQTS**

- **Continuous ECG monitoring until LQTS ruled out, or until expert consultant deems it safe to discontinue continuous ECG monitoring**

QT Prolongation -- *D/C QT Prolonging Meds:*

☞ ***Avoidance of Meds that are known to prolong the QT Interval. Click here for current list from CREDIBLEMEDS.ORG***

Commonly used QT prolonging meds include:

- -Amiodarone
- -Procainamide
- -Levaquin
- -Erythromycin
- -Norpace
- -Tequin
- -Benadryl
- -Ritalin
- -Pseudophedrine
- -Haloperidol
- -Thorazine
- -Propulcid
- -Zofran
- -Ilbutilide

and MANY more!

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- Info: Congenital LQT and Drugs to Avoid
- My Medicines Online with MedSafety Scan®
- CredibleMedia™ Educational Papers »
- Guide for Safe Medication Use
- Virtual Medicine Cabinet
- More...

QUICK LINKS

- CredibleMedia™ Library
- Drug-Drug Interactions
- QT Drugs List
- FAQs about

See *News* below!

List of QT Clinical Factors Launched - QTFactors.org

Free Smartphone App for QTdrugs Lists (click here)

QUICK SCAN for drugs on the QTdrugs Lists:

Click Here — Quick Scan for one drug at a time (No registration required)

Click Here — Review all lists and download (Free, registration required)

Visitors to the CredibleMeds® website can use Quick Scan to search for drugs on the QTDrugs lists. Access to download the lists of QTdrugs requires registration so that users can be notified when the lists have been revised.

Commercial use or reproduction of the QTdrugs lists or other copyrighted content from this website is prohibited without prior authorization from AZCERT, Inc. See "Terms of Use" below.

News

The Rising Costs of Prescription Medicines

LINK to preview EP tools on iTunes website – click here

//itunes.apple.com/us/app/eptools/id430201878?mt=8

App Store Preview

epTools 17+

Resources for Cardiac EP

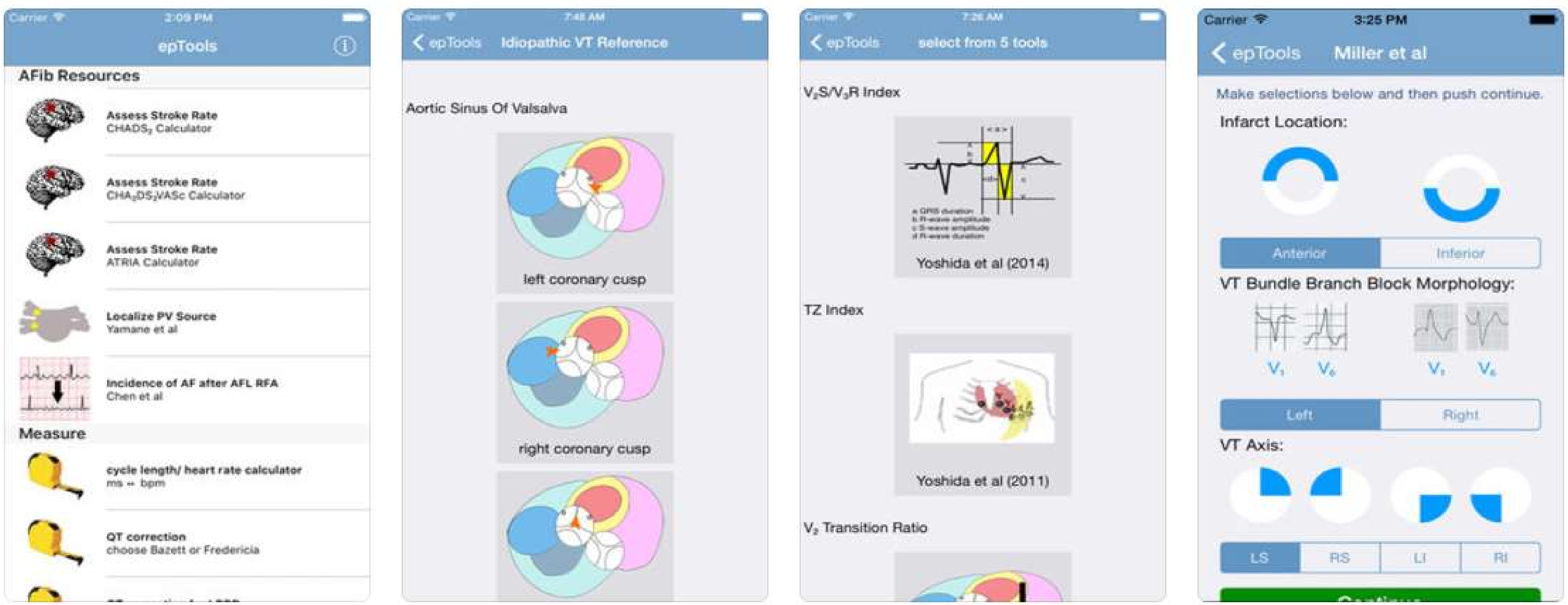
Busy Being Born Solutions, LLC

$5.99

My favorite ECG / Cardiology iPhone APP:
- **has updated list of QT prolonging meds from AZ University (AZCERT)**
- **QTc calculation tools (Bazett's & Fredericia)**

Screenshots

iPhone iPad



Also for patients with known QT prolongation or "at risk" patients:

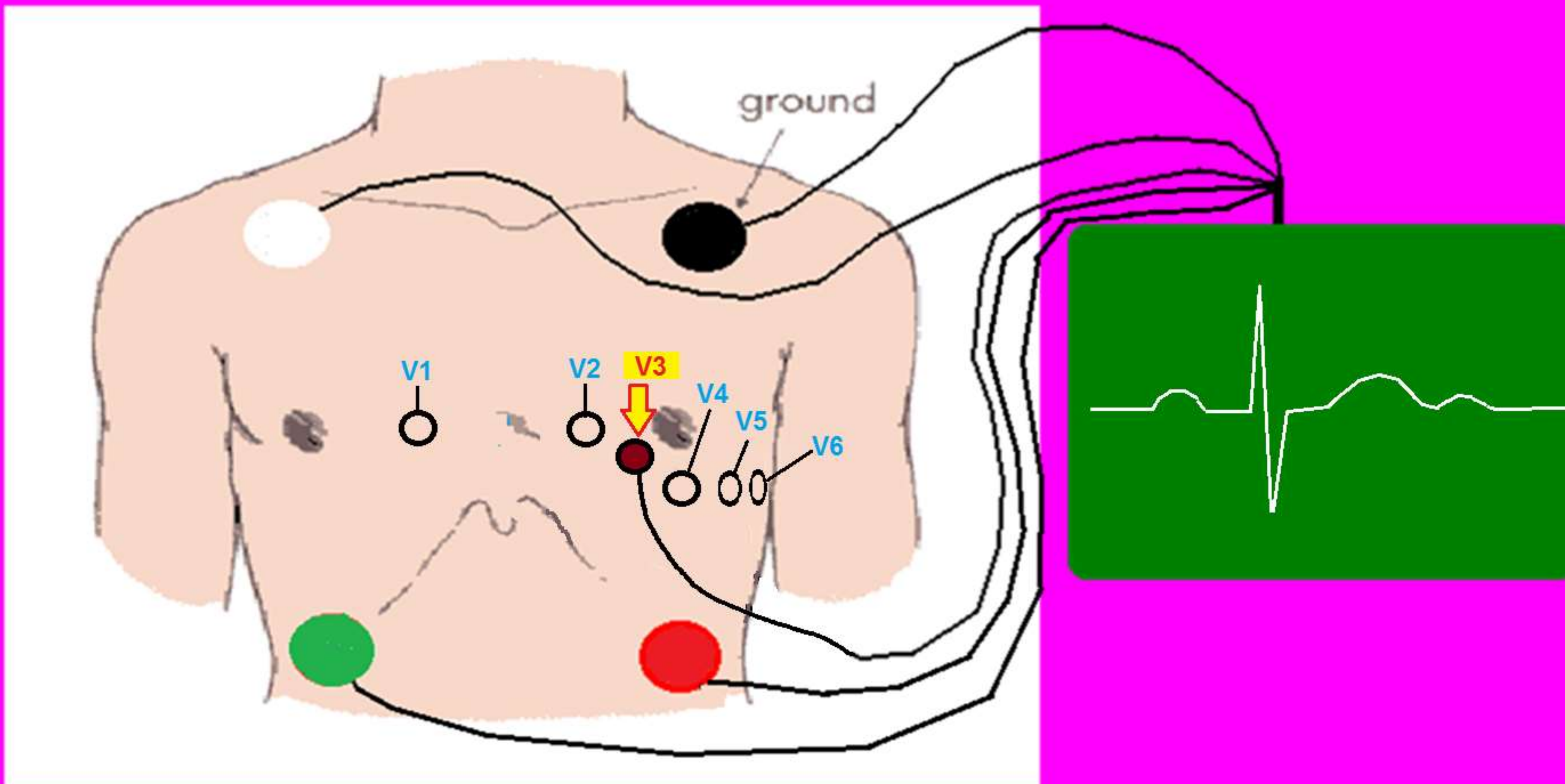
Consider ordering

CONTINUOUS QTc MONITORING

For CPC Accreditation, SRRMC is currently developing a "QTc Monitoring Protocol."

It will include . . . .

LEAD PLACEMENT - V3



5 WIRE TELEMETRY UNIT

At SRRMC: Automated CONTINUOUS QTc MONITORING Available for Tele:

At SRRMC: Automated CONTINUOUS QTc MONITORING Available for Tele:

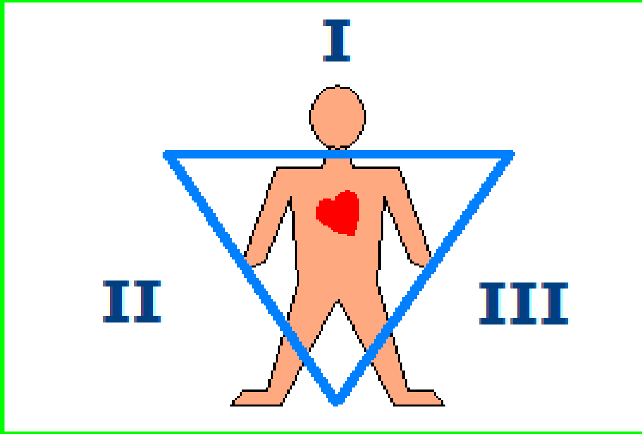
ABSOLUTELY NO DRUGS THAT PROLONG THE Q-T INTERVAL ! !

OPTIONAL CURRICULUM :

☞ EVALUATE THE AXIS IN BOTH PLANES

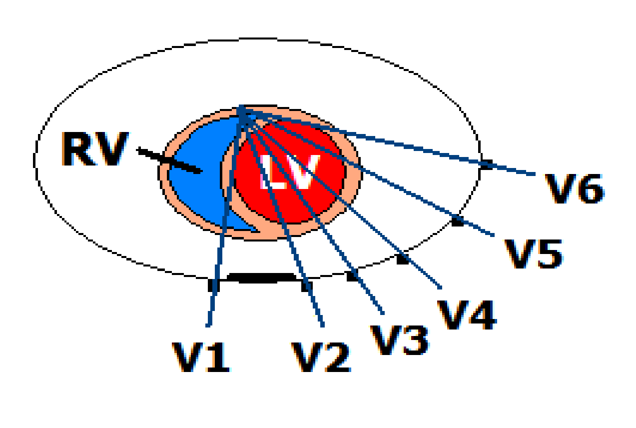
- VERTICAL

" AXIS DEVIATION "

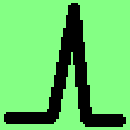
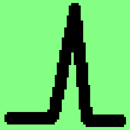
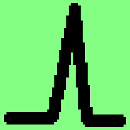
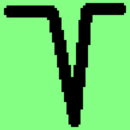
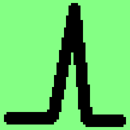


- HORIZONTAL

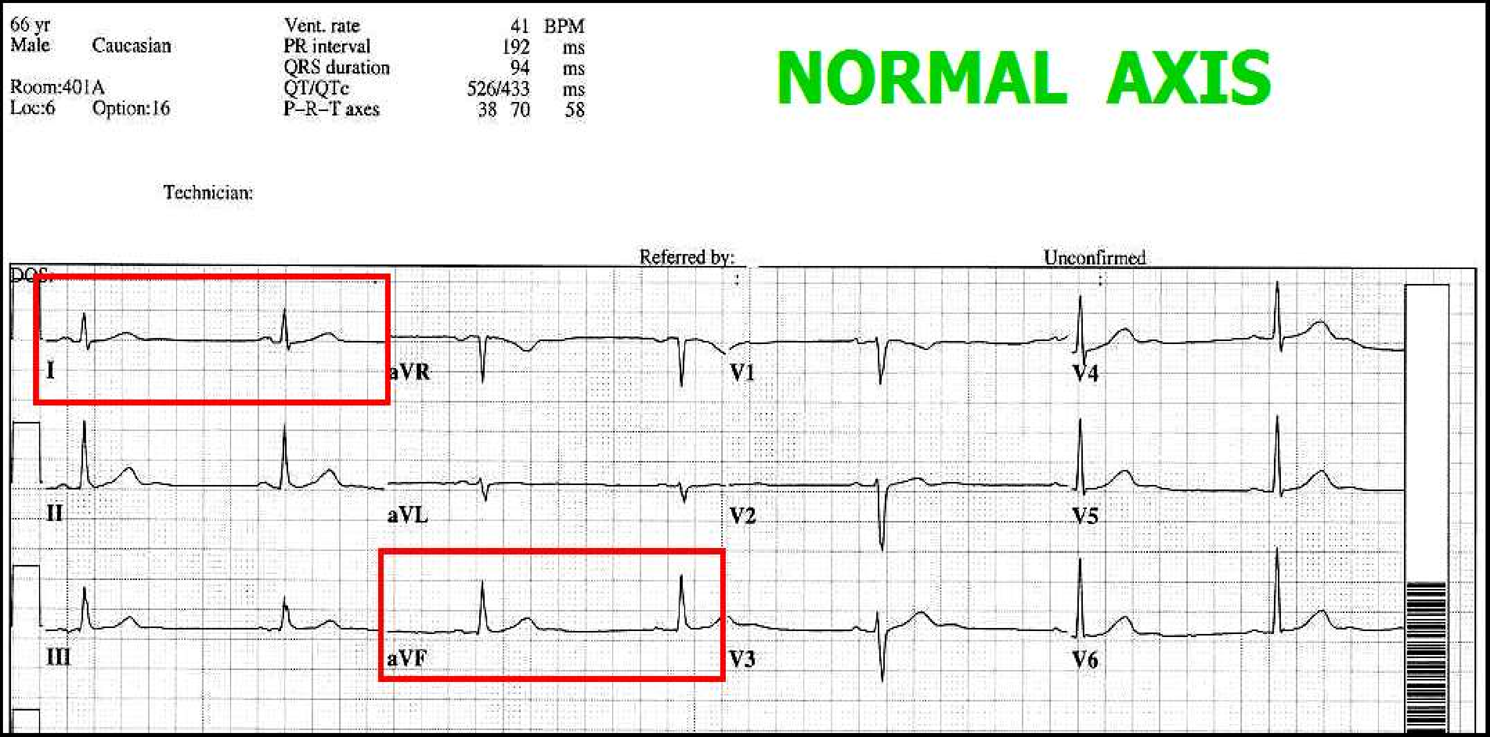
" AXIS ROTATION "



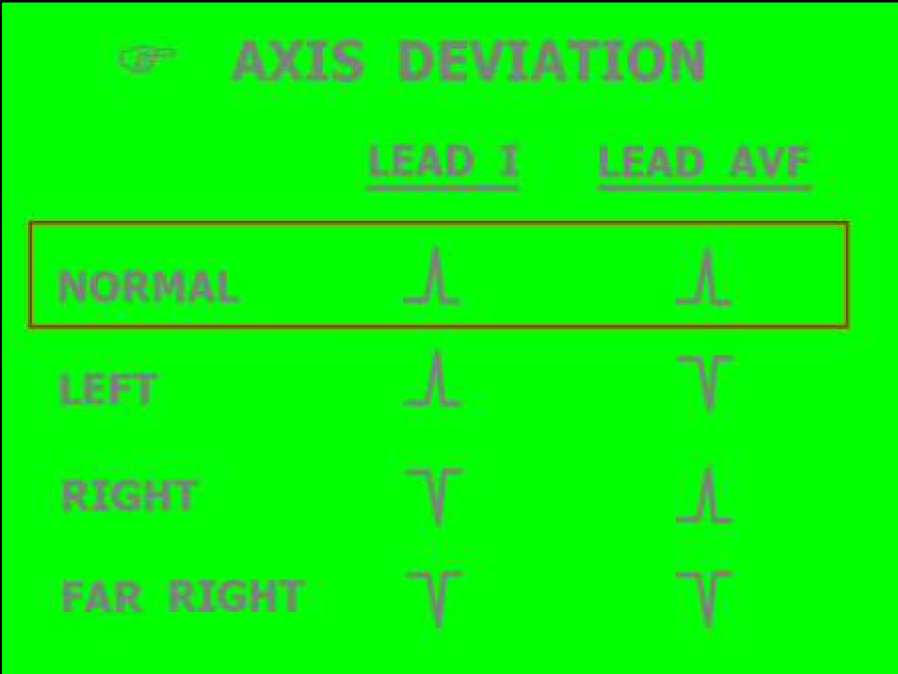
AXIS DEVIATION

	<u>LEAD I</u>	<u>LEAD AVF</u>
NORMAL		
LEFT		
RIGHT		
FAR RIGHT		

NORMAL AXIS



66 yr
Male Caucasian
Room:401A
Loc:6 Option:16
Vent. rate 41 BPM
PR interval 192 ms
QRS duration 94 ms
QT/QTc 526/433 ms
P–R–T axes 38 70 58
Technician:
Referred by:
Unconfirmed
DOS:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6



AXIS DEVIATION
LEAD I
LEAD AVF
NORMAL
LEFT
RIGHT
FAR RIGHT

RUPPERT, WAYNE ID: 099999999 4-Mar-2001 19:44:52

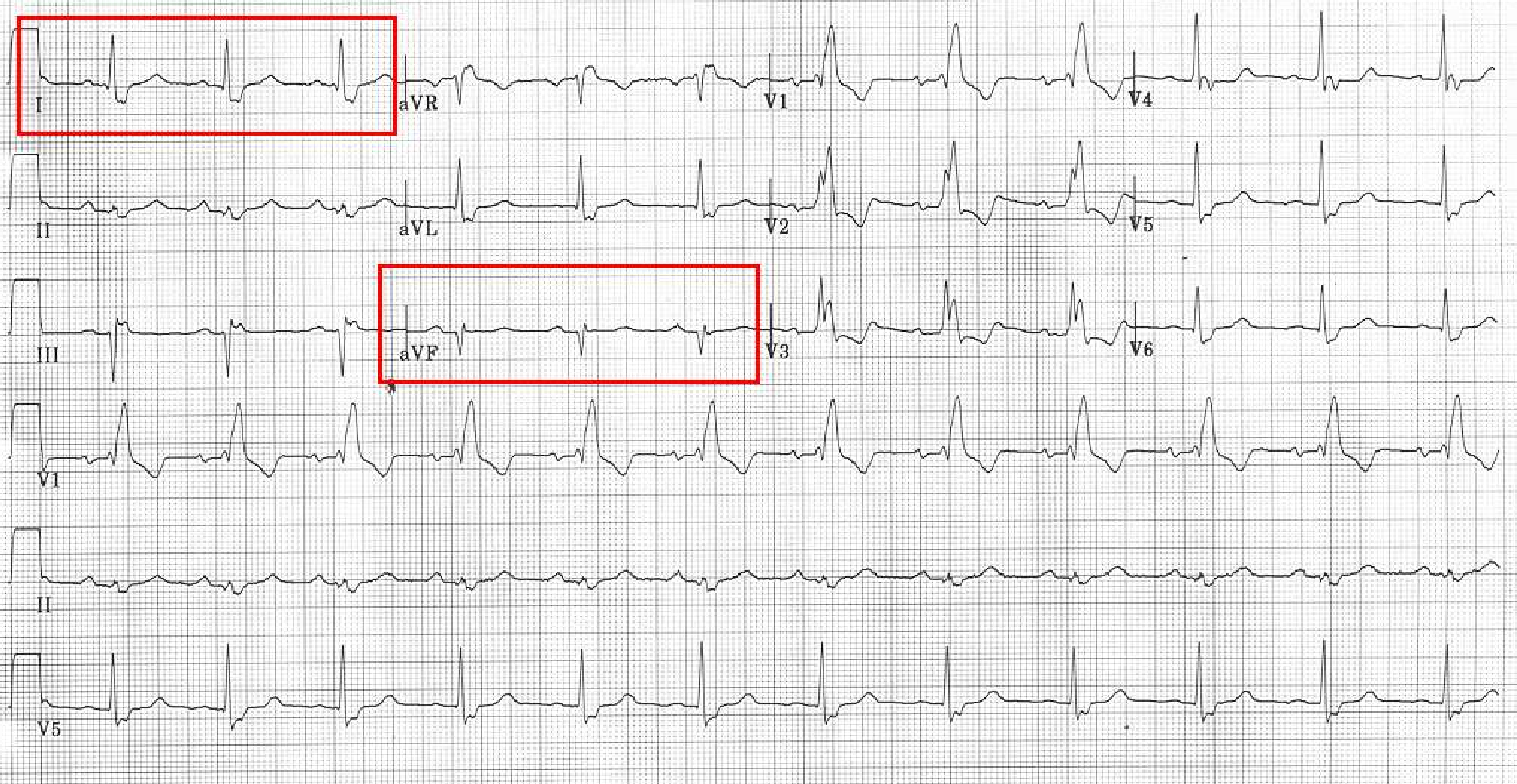
74years		Vent. rate	72 bpm
Male	Caucasian	PR interval	186 ms
		QRS duration	166 ms
Room:		QT/QTc	436/477 ms
Loc: 0	Opt:	P-R-T axes	57 -32 32

Technician: WR

What is the AXIS of this EKG ?

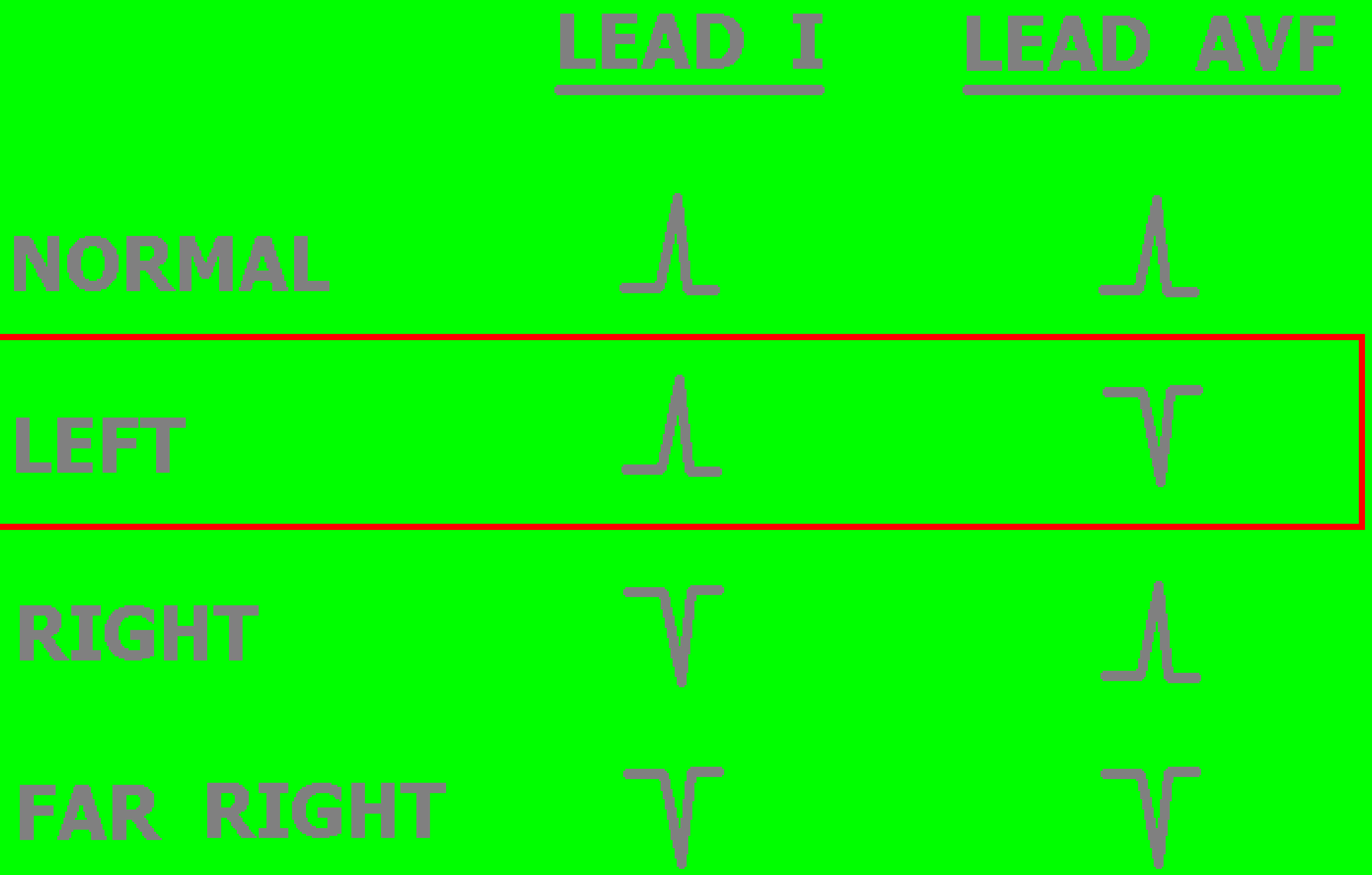
Referred by: Unconfirmed

D.O.S.:



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

☞ AXIS DEVIATION



COMMON CONDITIONS WHICH *MAY* CAUSE

LEFT AXIS DEVIATION:

- LEFT BUNDLE BRANCH BLOCK
- PACEMAKER
- C.O.P.D.
- LEFT VENTRICULAR HYPERTROPHY
- OLD INFERIOR WALL MI
- HYPERKALEMIA
- LEFT ANTERIOR FASCICULAR BLOCK
- WOLFF-PARKINSON-WHITE (types A & B)

11:18:02

81 yr
Female Hispanic

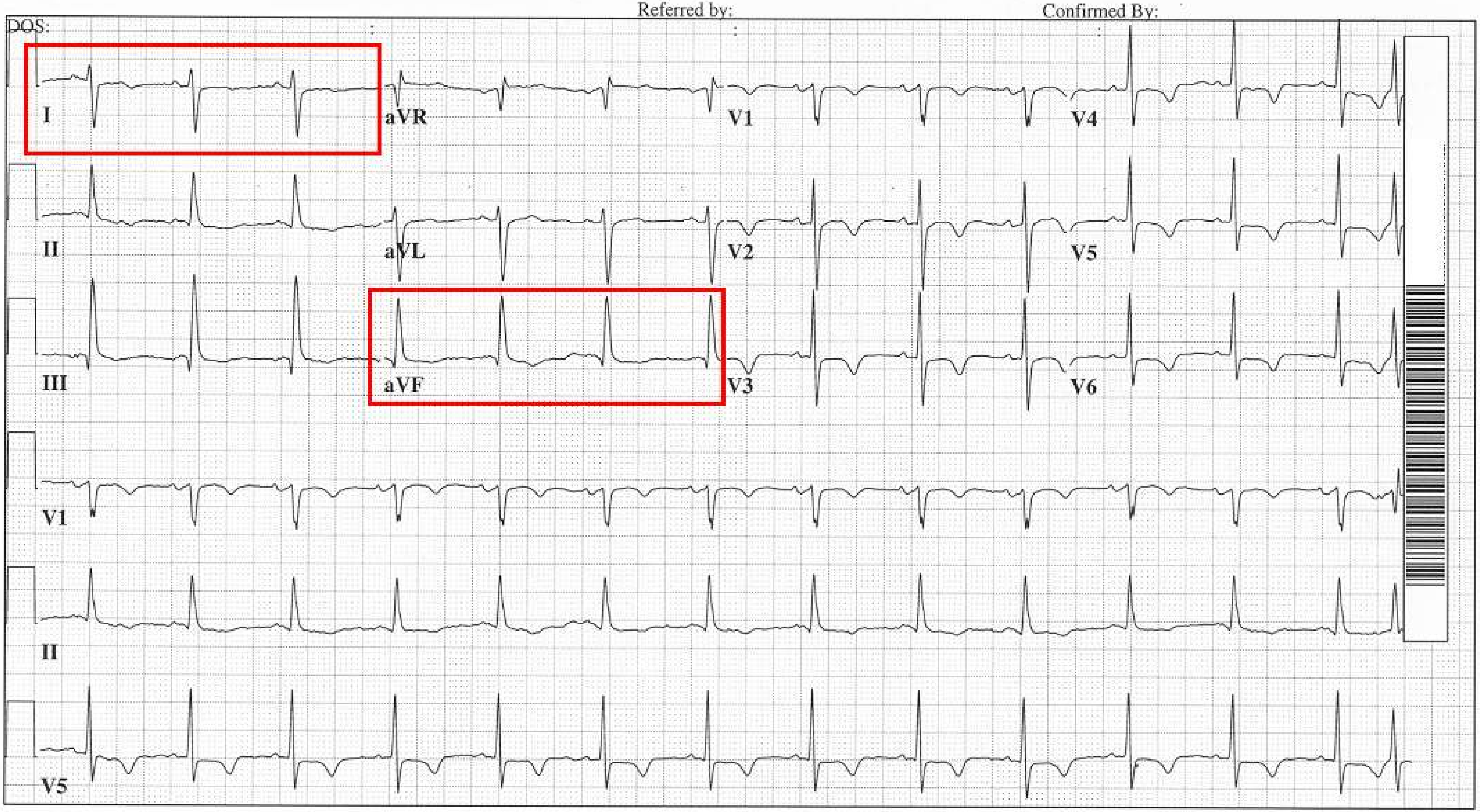
Room:303A
Loc:6 Option:11

Vent. rate	82	BPM
PR interval	128	ms
QRS duration	86	ms
QT/QTc	392/457	ms
P–R–T axes	38 112 –142	

What is the AXIS of this EKG ?

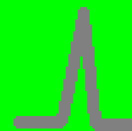
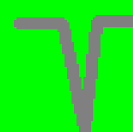
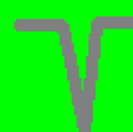
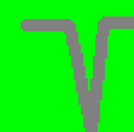
Technician: EKG CLASS CODE
WR03899892

Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 233 CID: 6 EID:13 EDT:

☞ AXIS DEVIATION

	LEAD I	LEAD AVF
NORMAL		
LEFT		
RIGHT		
FAR RIGHT		

COMMON CONDITIONS WHICH *MAY* CAUSE

RIGHT AXIS DEVIATION:

- NORMAL FOR PEDS & TALL, THIN ADULTS
- RIGHT VENTRICULAR HYPERTROPHY
- OLD LATERAL WALL MI
- LEFT POSTERIOR FASICULAR BLOCK
- PULMONARY EMBOLUS
- DEXTROCARDIA
- C.O.P.D.
- ATRIAL / VENTRICULAR SEPTAL DEFECTS

02:55:00

Male Caucasian

Room:5
Loc:1

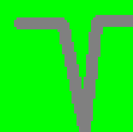
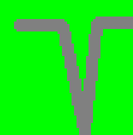
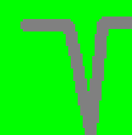
Vent. rate	92	BPM	ACCELERATED IDIOVENTRICULAR RHYTHM
PR interval	*		
QRS duration	172	ms	
QT/QTc	420/520	ms	
P–R–T axes	* –123	61	

EKG CLASS CODE #WR03611255

Referred by: Confirmed By:

25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5 EID:17 EDT:

☞ AXIS DEVIATION

	LEAD I	LEAD AVF
NORMAL		
LEFT		
RIGHT		
FAR RIGHT		

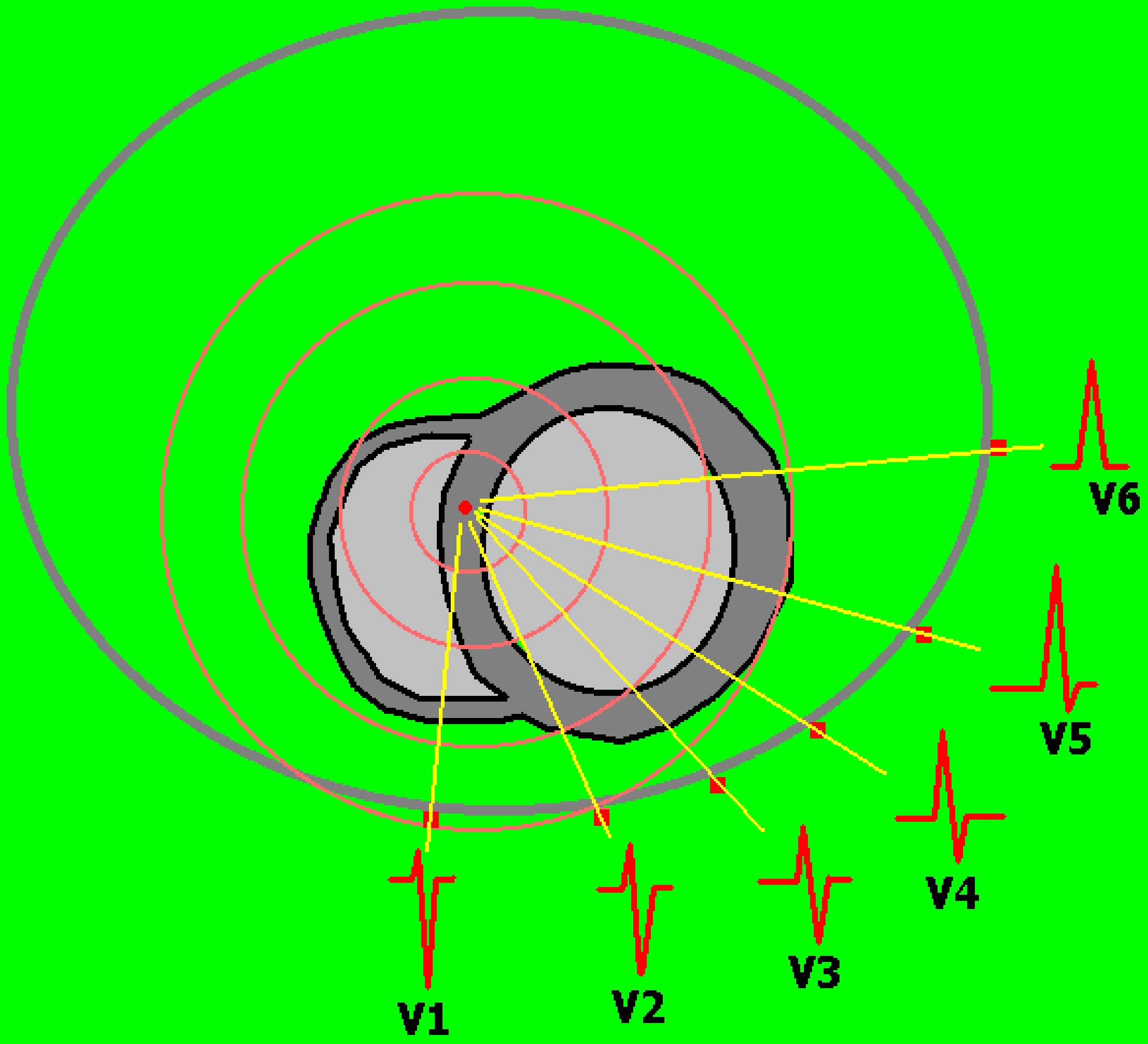
COMMON CONDITIONS WHICH *MAY* CAUSE

(NO-MAN'S LAND AXIS)

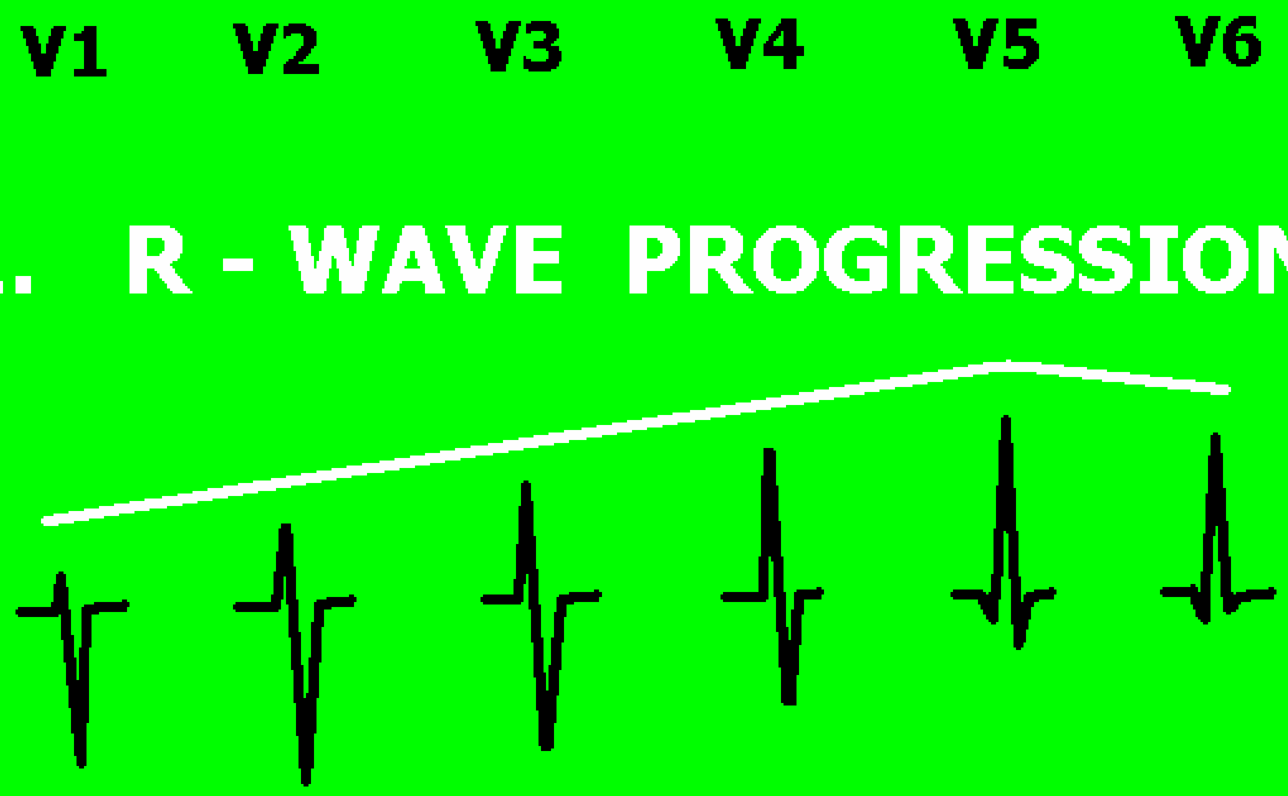
FAR RIGHT AXIS DEVIATION:

- LEAD TRANSPOSITION
- PACEMAKER RHYTHMS
- **VENTRICULAR RHYTHMS**
- C.O.P.D.
- **HYPERKALEMIA**

AXIS ROTATION

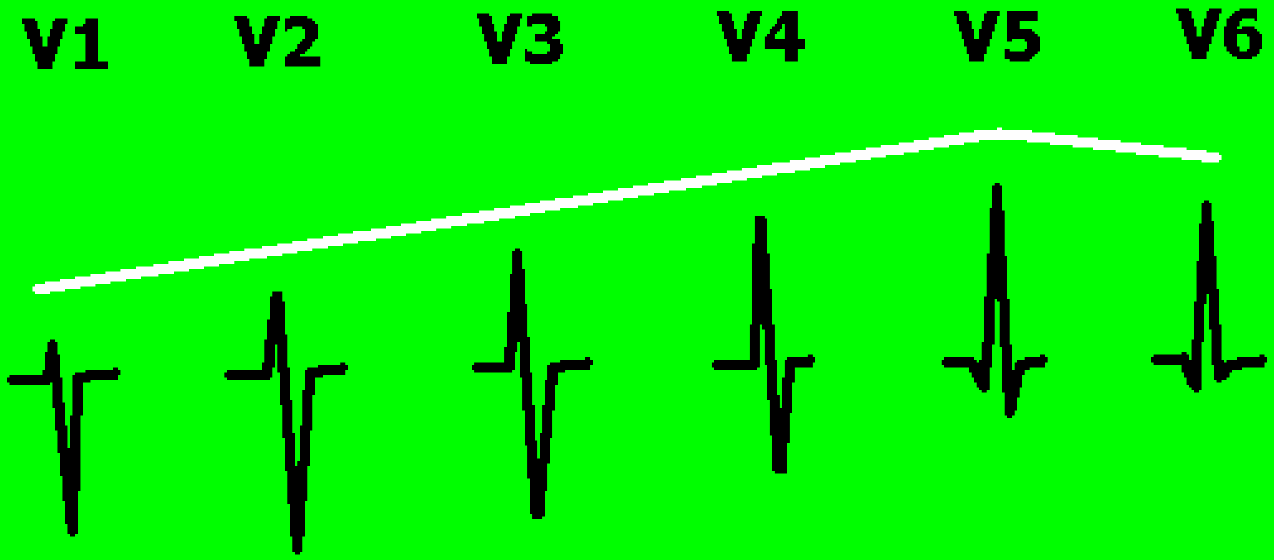


ASSESSING AXIS ROTATION:



1. R - WAVE PROGRESSION
2. IDENTIFICATION OF TRANSITION

ASSESSING AXIS ROTATION:



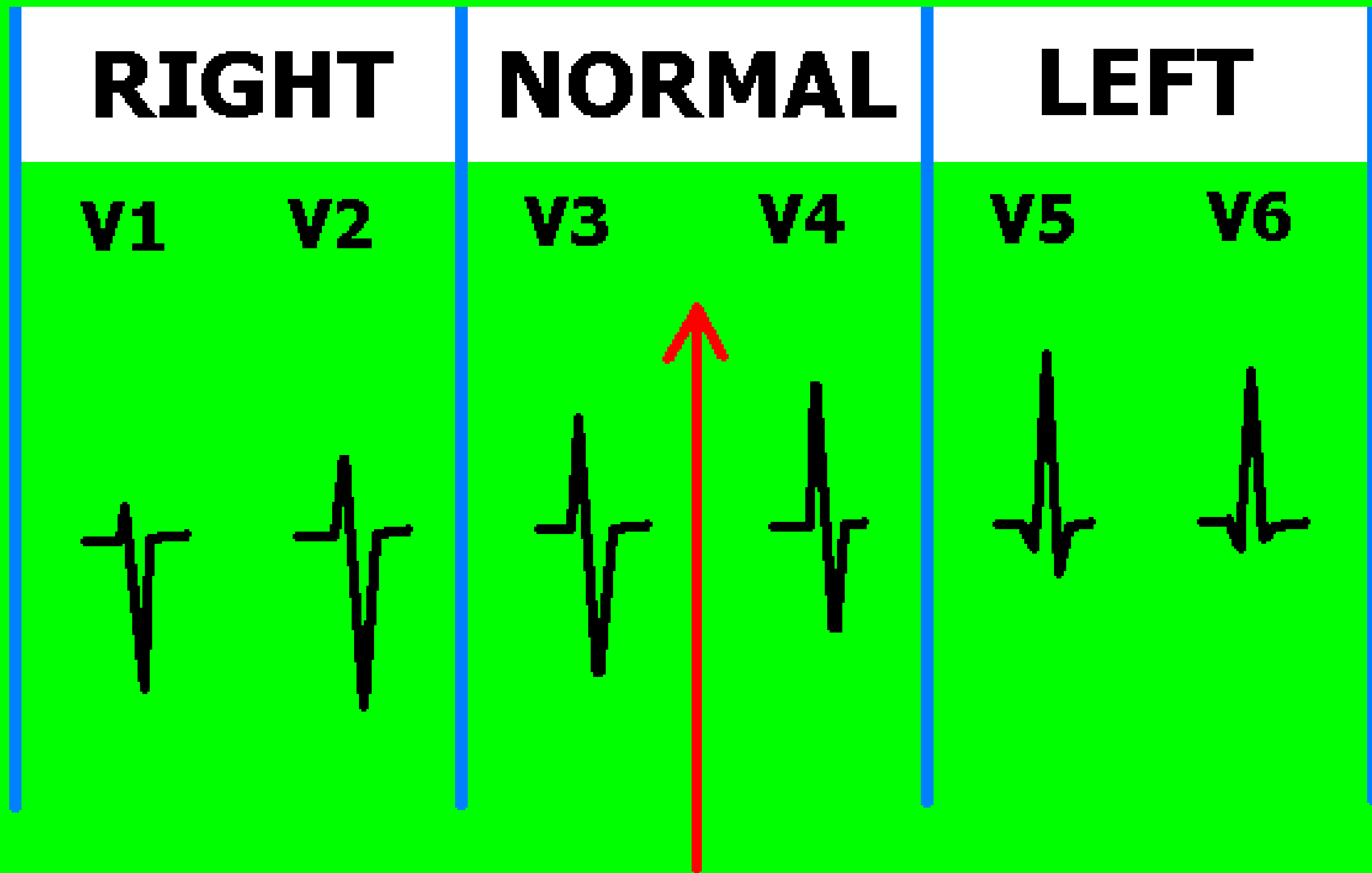
3. RECALL COMMON PATTERNS of ABNORMAL R-WAVE PROGRESSION to help you build your list of POSSIBLE DIAGNOSES.

AXIS ROTATION

TRANSITION

OCCURS IN THE LEAD WHERE THE QRS IS THE MOST BIPHASIC

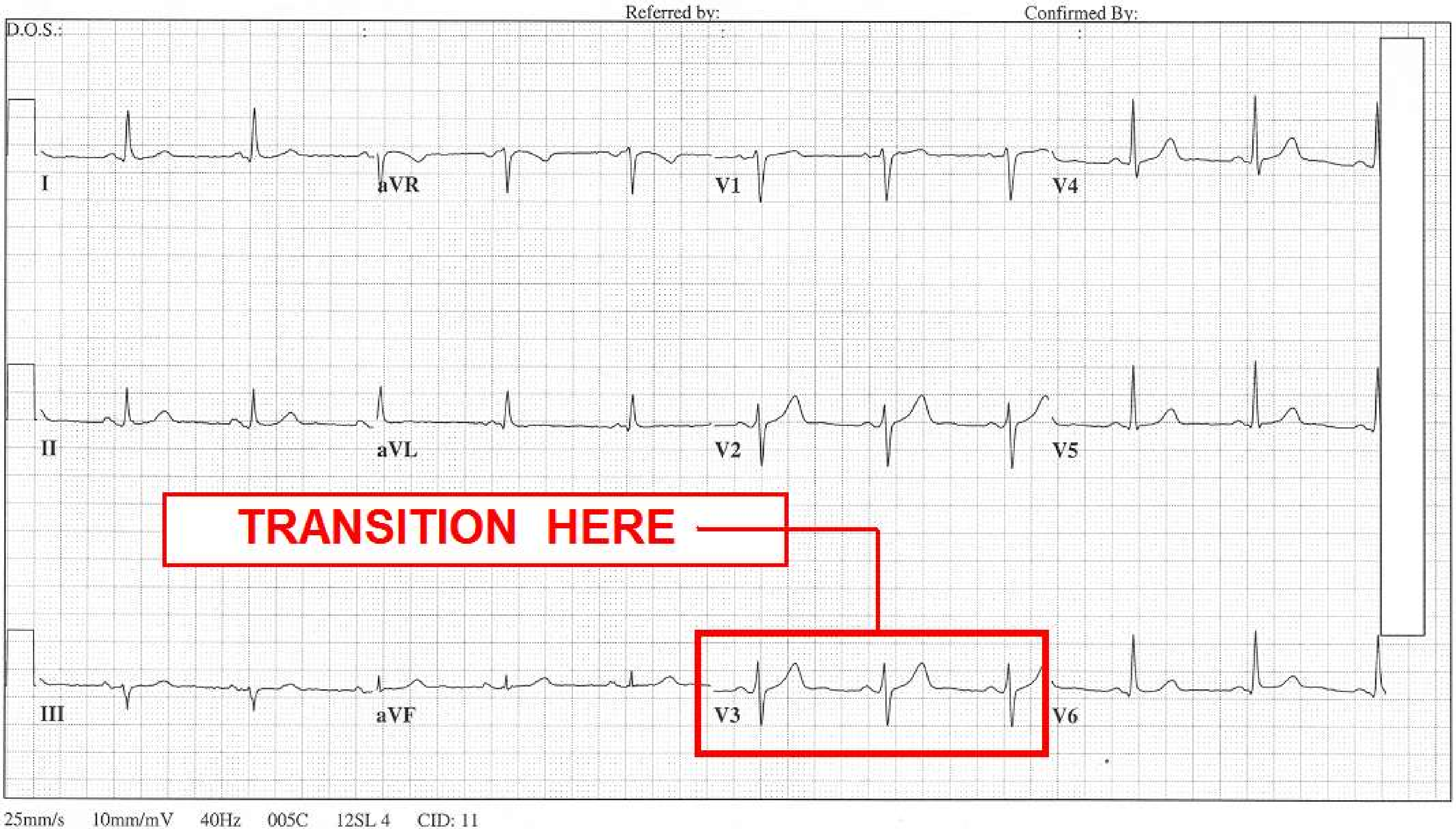
AXIS ROTATION



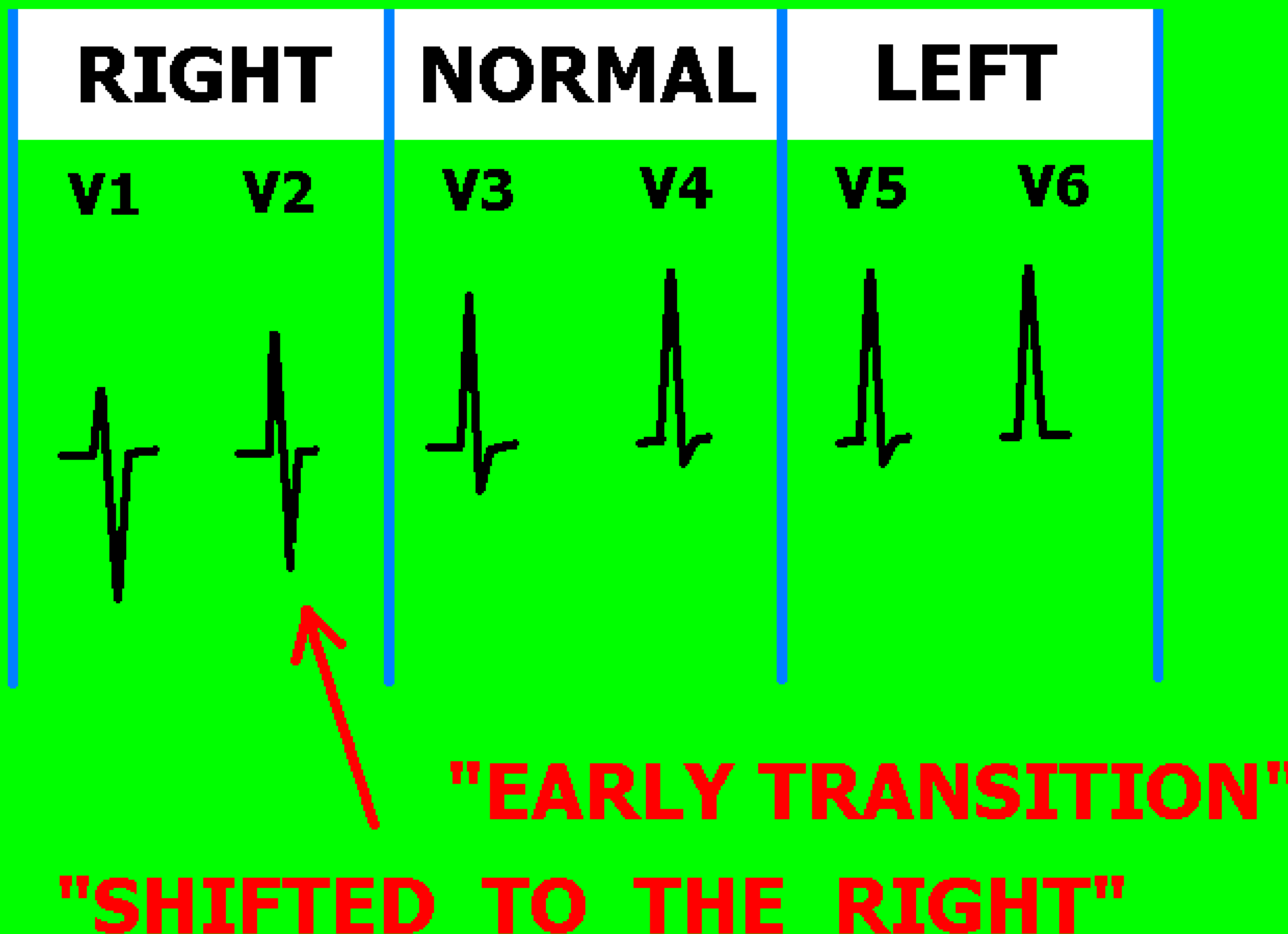
TRANSITION SHOULD
OCCUR IN LEADS V3 or V4

NORMAL TRANSITION

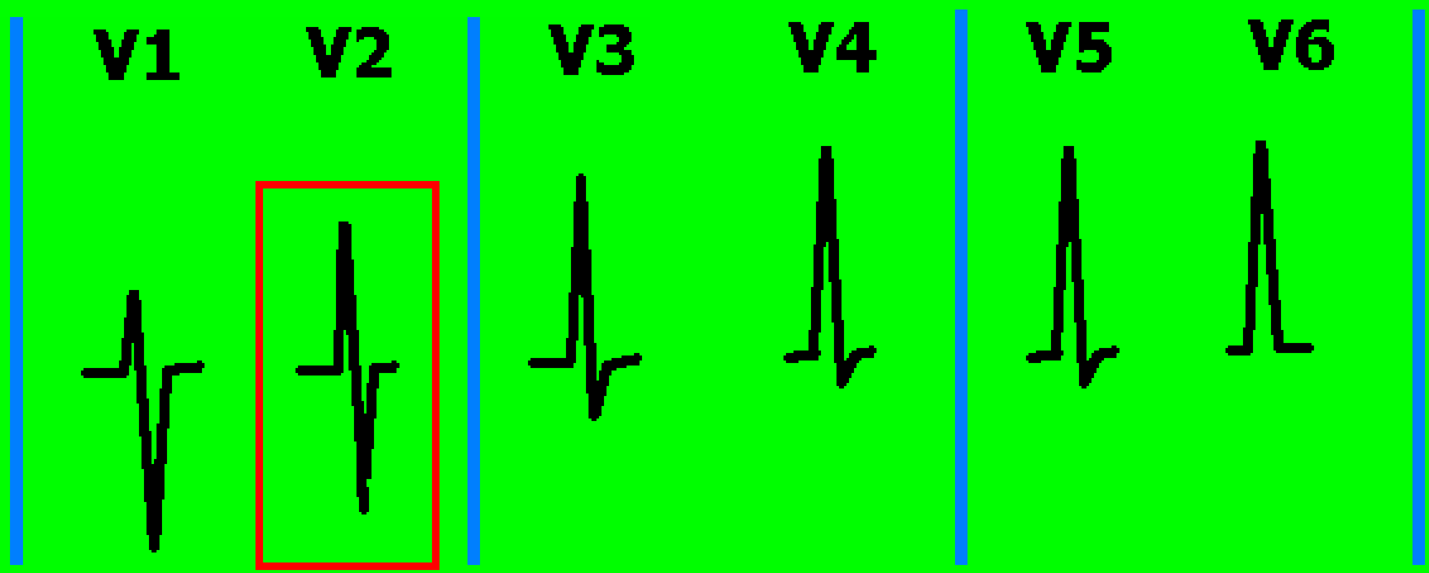
IS BETWEEN LEADS V3 and V4



AXIS ROTATION



* COMMON CAUSES of EARLY TRANSITION



1. Right Bundle Branch Block
2. Right Ventricular Hypertrophy
3. Old Posterior Wall MI
4. Wolff-Parkinson-White (type A)

LEFT - SIDED PATHWAY - FROM MARRIOTT'S
"<u>Practical Electrocardiography</u> - <u>10th Edition,</u>" 2000

COMMON CAUSES OF EARLY TRANSITION

....SOME HELPFUL CLUES:

1. **Right Bundle Branch Block (RBBB)**
   - QRS wider than 120ms
   - Supraventricular rhythm (normal P : QRS relationship)
   - RSR' or RR' ("notching") in V1, V2, and/or V3
2. **Right Ventricular Hypertrophy (RVH)**
   - Corresponding Right Atrial Hypertrophy (RAH)
   - Right Axis Deviation (RAD)
   - QRS in LEAD I more NEGATIVE than POSITIVE (R<S)
3. **Old Posterior Wall MI**
   - Usually accompanied by OLD INFERIOR WALL MI
   - Does NOT abnormally widen the QRS complex
4. **Wolff-Parkinson-White (WPW) type A**
   - Short P-R Interval
   - Presence of Delta Waves
   - Wide QRS complexes

RUPPERT, WAYNE   ID: 099999999   4-Mar-2001   19:44:52   ST JOSEPHS HOSPITAL

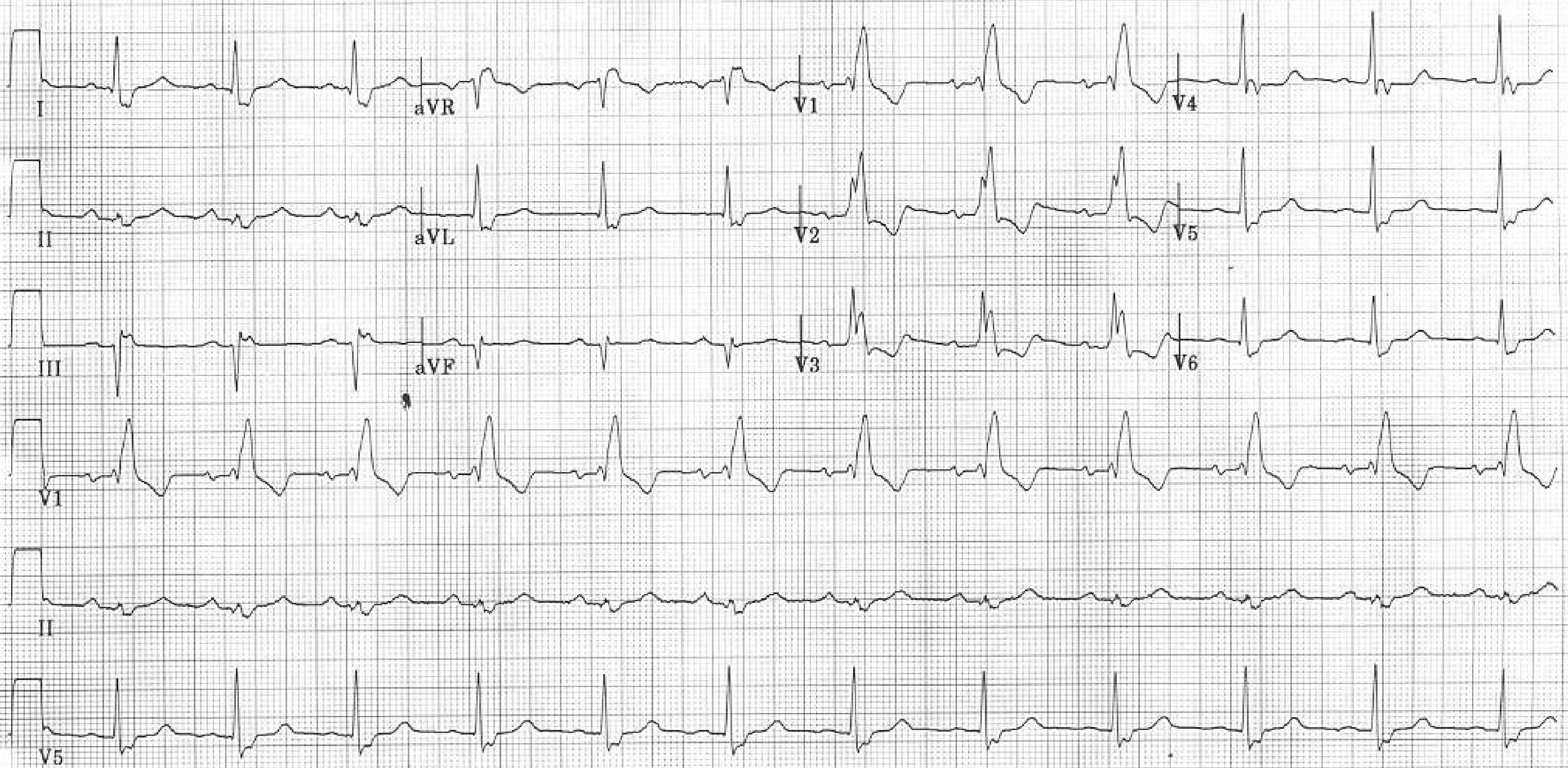
74years		Vent. rate	72 bpm
Male	Caucasian	PR interval	186 ms
		QRS duration	166 ms
Room:		QT/QTc	436/477 ms
Loc: 0	Opt:	P-R-T axes	57 -32 32

Technician: WR

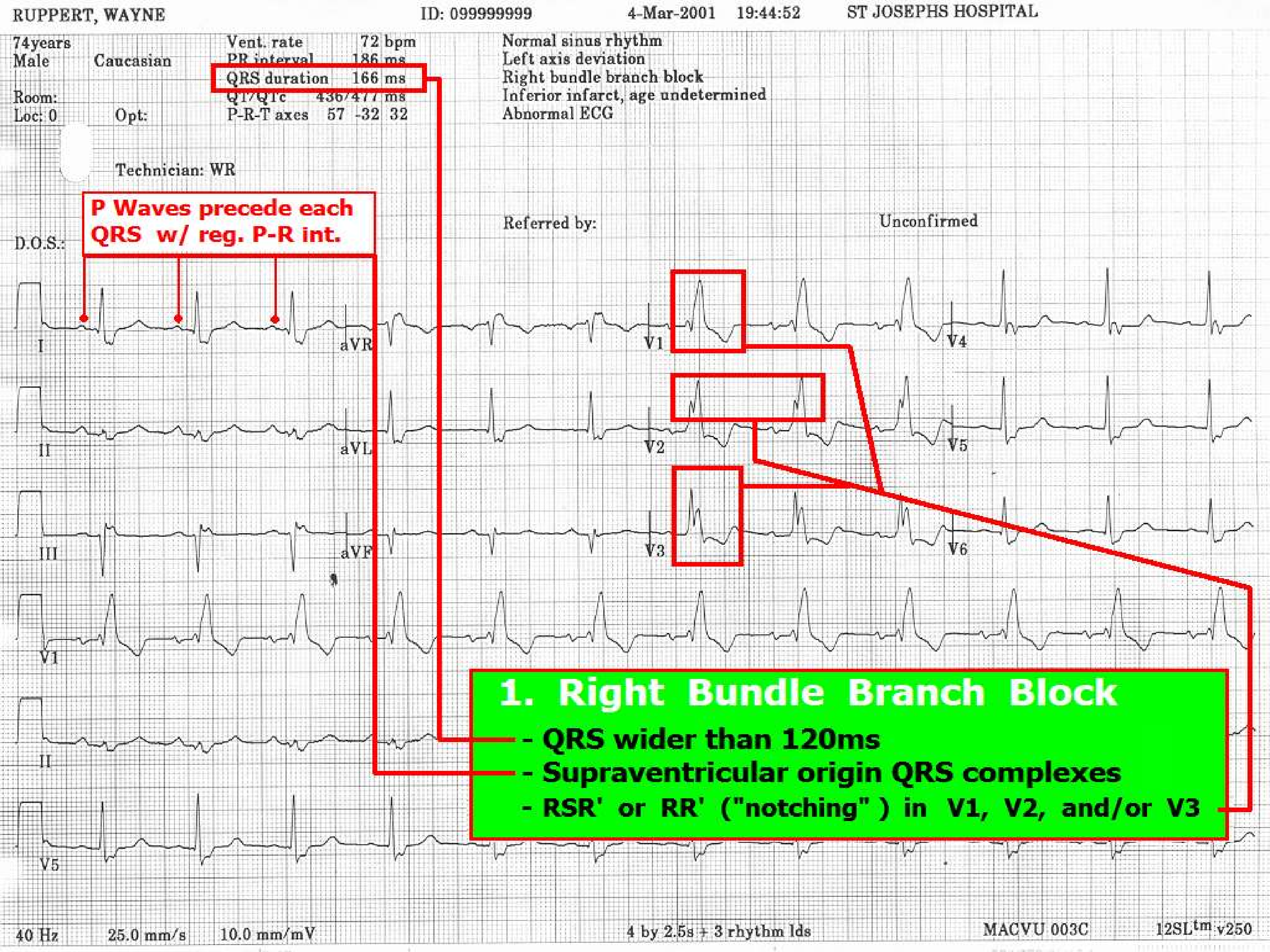
What is the cause of EARLY TRANSITION in this EKG? -- Use the list of COMMON CAUSES OF EARLY TRANSITION to rule out different causes . . .

Referred by: Unconfirmed

D.O.S.:



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


RUPPERT, WAYNE
ID: 099999999
4-Mar-2001 19:44:52
ST JOSEPHS HOSPITAL
74years
Male Caucasian
Room:
Loc: 0 Opt:
Vent. rate 72 bpm
PR interval 186 ms
QRS duration 166 ms
QT/QTc 436/477 ms
P-R-T axes 57 -32 32
Normal sinus rhythm
Left axis deviation
Right bundle branch block
Inferior infarct, age undetermined
Abnormal ECG
Technician: WR
P Waves precede each QRS w/ reg. P-R int.
Referred by:
Unconfirmed
D.O.S.:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
1. Right Bundle Branch Block
- QRS wider than 120ms
- Supraventricular origin QRS complexes
- RSR' or RR' ("notching") in V1, V2, and/or V3
40 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 3 rhythm lds
MACVU 003C
12SLtm v250

15–MAR–2000 10:29:05 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

31 yr
Male Black

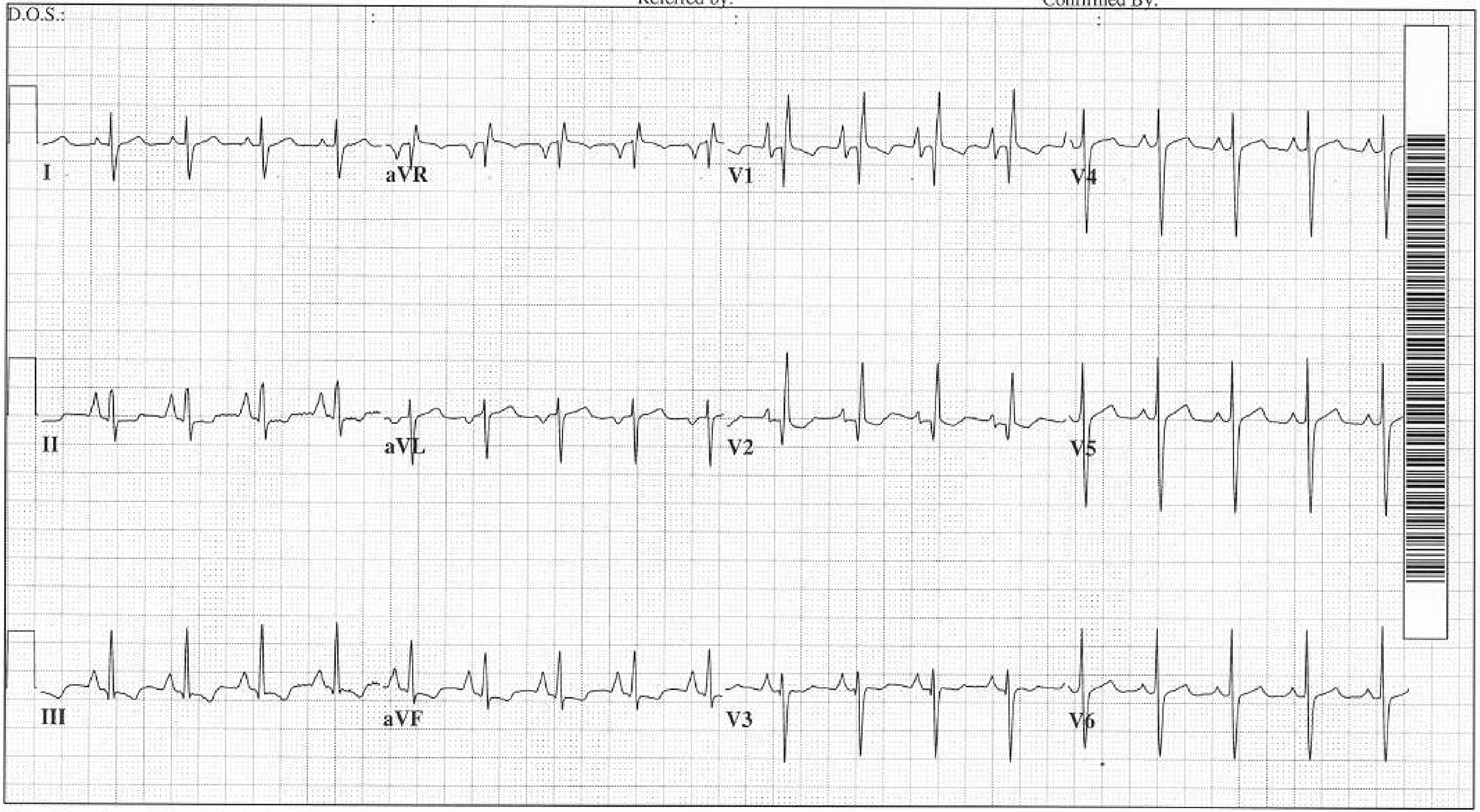
Room:ER
Loc:3 Option:16

Vent. rate	109	BPM
PR interval	122	ms
QRS duration	84	ms
QT/QTc	296/398	ms
P–R–T axes	79 117	–27

Technician: EKG CLASS #WR03446043

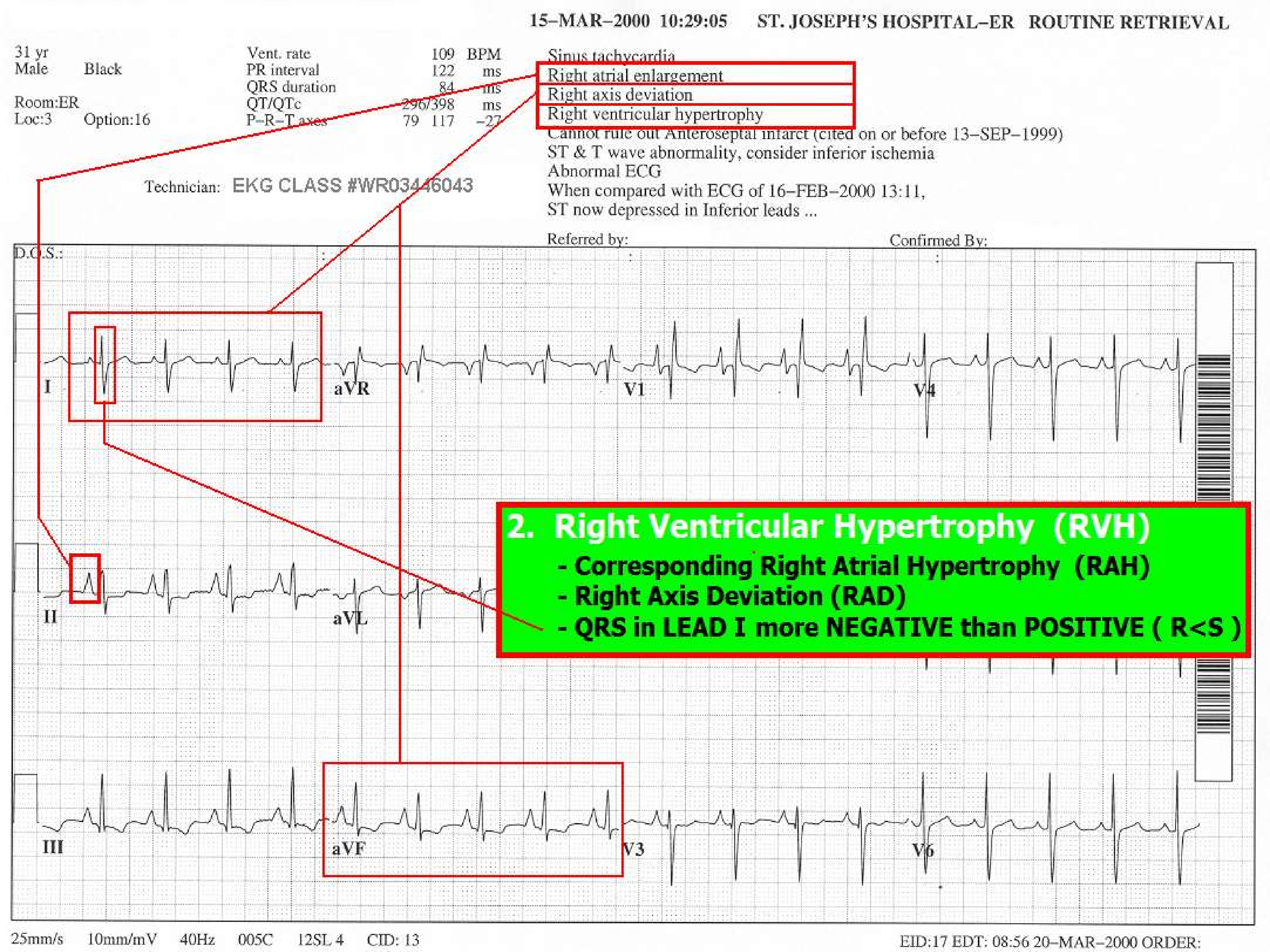
What is the cause of EARLY TRANSITION in this EKG ?

Referred by: Confirmed By:



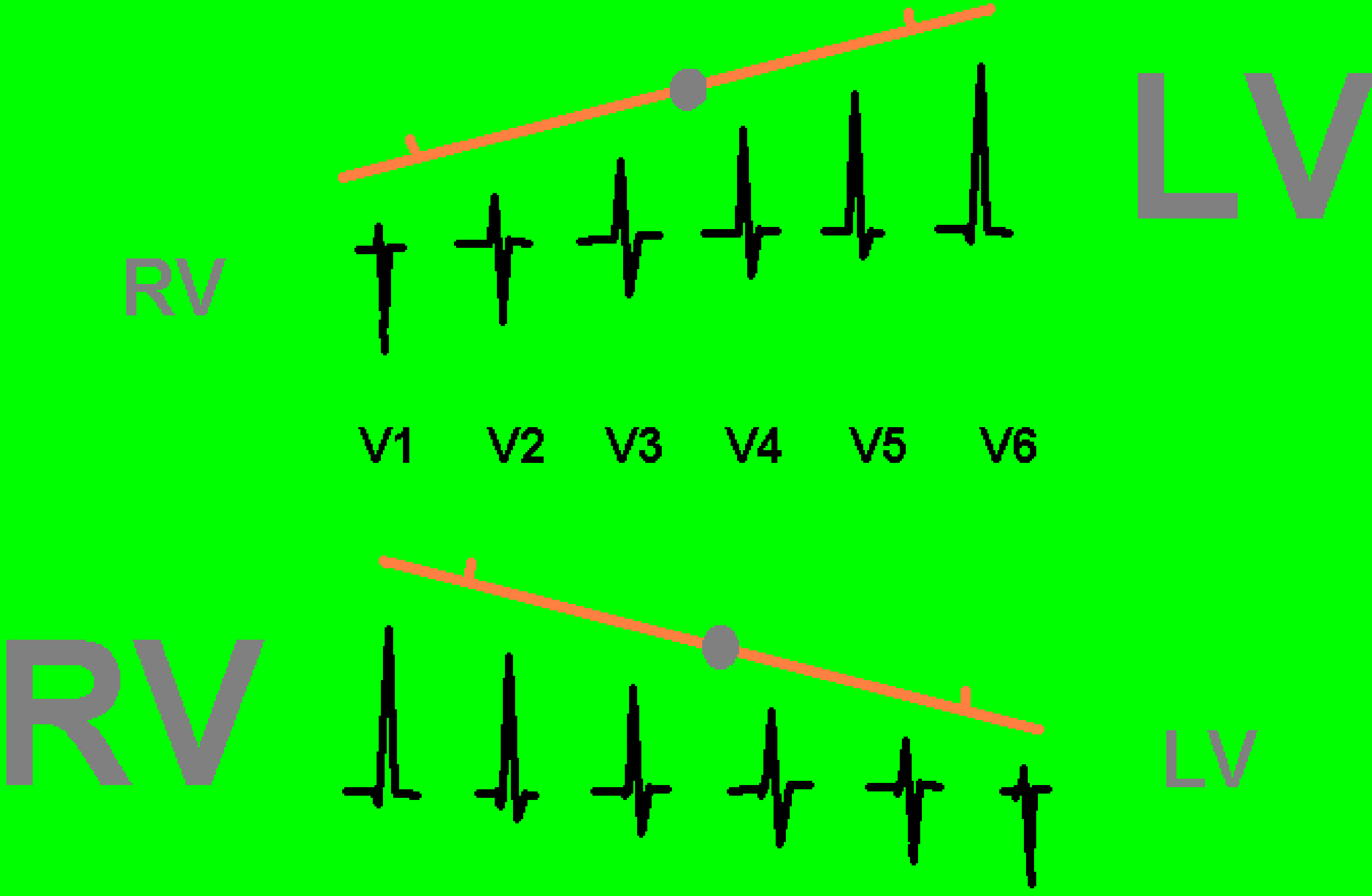
25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 13

EID:17 EDT: 08:56 20–MAR–2000 ORDER:



15–MAR–2000 10:29:05 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL
31 yr
Male Black
Room:ER
Loc:3 Option:16
Vent. rate 109 BPM
PR interval 122 ms
QRS duration 84 ms
QT/QTc 296/398 ms
P–R–T axes 79 117 –27
Sinus tachycardia
Right atrial enlargement
Right axis deviation
Right ventricular hypertrophy
Cannot rule out Anteroseptal infarct (cited on or before 13–SEP–1999)
ST & T wave abnormality, consider inferior ischemia
Abnormal ECG
When compared with ECG of 16–FEB–2000 13:11,
ST now depressed in Inferior leads ...
Technician: EKG CLASS #WR03446043
Referred by:
Confirmed By:
D.O.S.:
I
aVR
V1
V4
II
aVL
III
aVF
V3
V6
2. Right Ventricular Hypertrophy (RVH)
- Corresponding Right Atrial Hypertrophy (RAH)
- Right Axis Deviation (RAD)
- QRS in LEAD I more NEGATIVE than POSITIVE (R<S)
25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 13
EID:17 EDT: 08:56 20–MAR–2000 ORDER:

"SEE-SAW EFFECT" of RVH on R WAVE PROGRESSION



14–JUL–1997 14:30:58 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

17 yr
Male Black

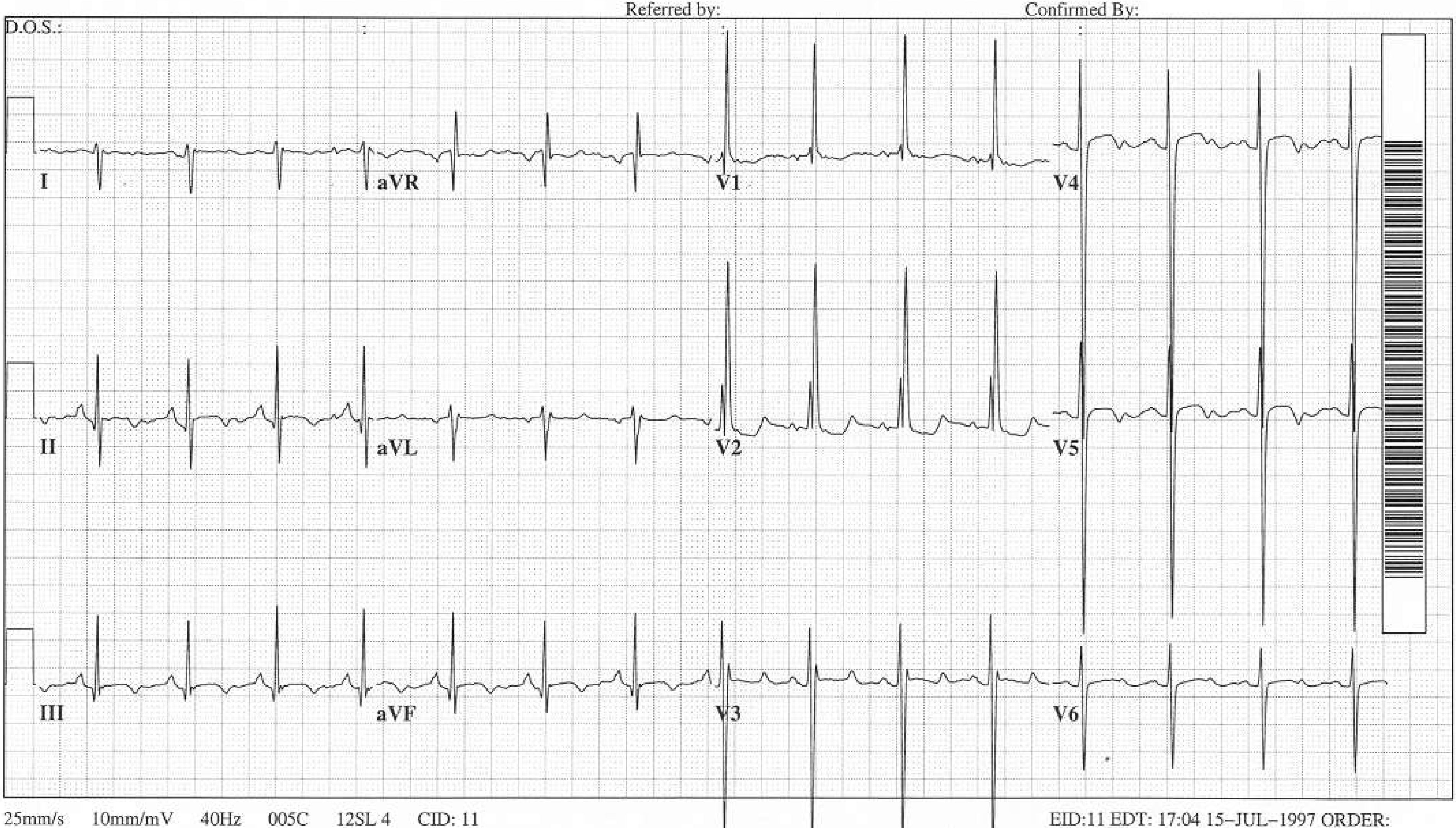
Room:ER
Loc:3 Option:16

Vent. rate	90	BPM
PR interval	136	ms
QRS duration	94	ms
QT/QTc	378/462	ms
P–R–T axes	77 123	58

Normal sinus rhythm
Right atrial enlargement
Right axis deviation
Incomplete right bundle branch block , plus right ventricular hypertrophy
NORMAL SINUS INFERIOR LATERAL CHANGES
Abnormal ECG

Technician: EKG CLASS #WR03616941

Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 11 EID:11 EDT: 17:04 15–JUL–1997 ORDER:

Male Caucasian

Room:CCU3

Loc:1 Option:1

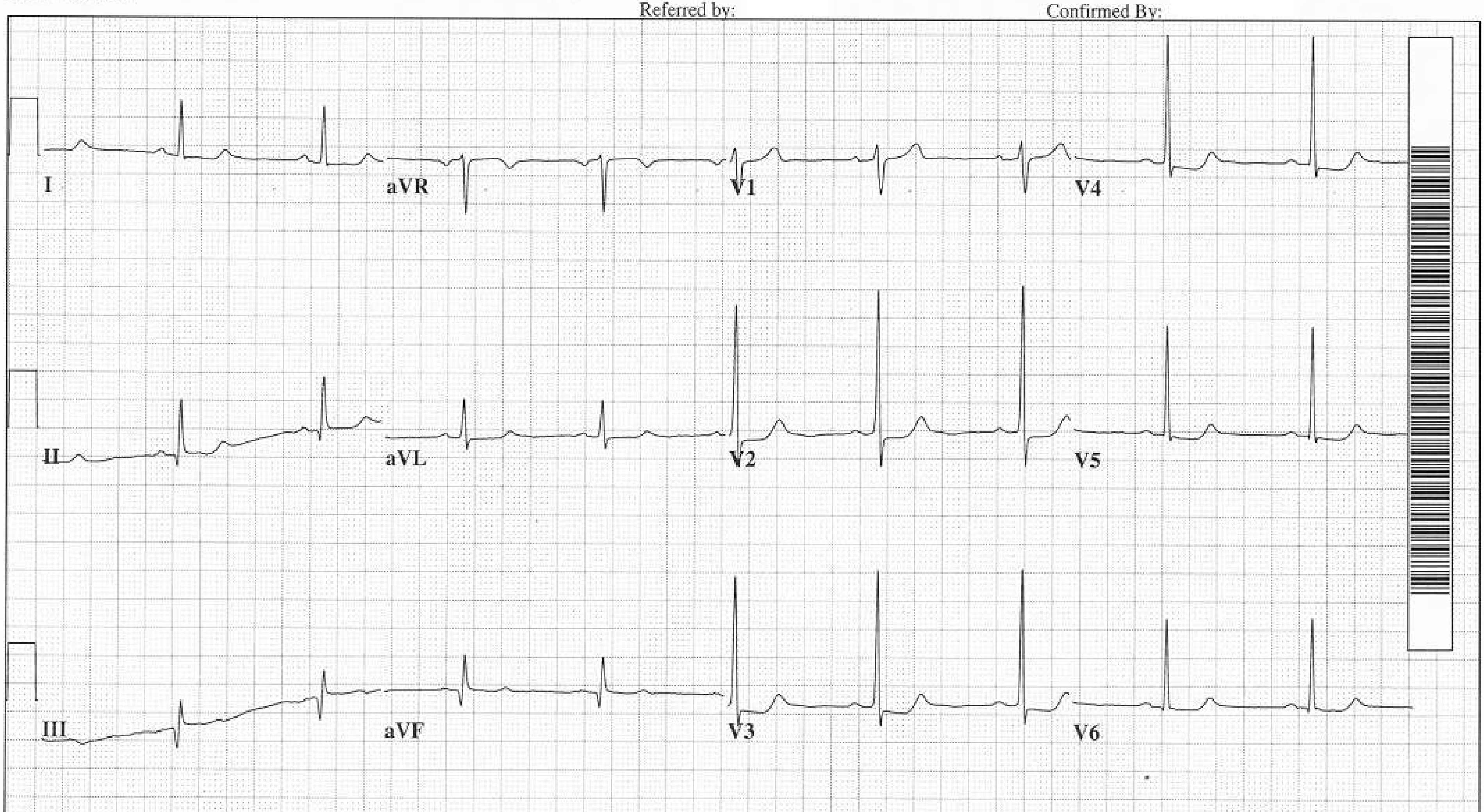
Vent. rate	58	BPM
PR interval	168	ms
QRS duration	84	ms
QT/QTc	424/416	ms
P–R–T axes	18 28	29

What is the cause of EARLY TRANSITION in this EKG ?

Technician ID: EKG CLASS #WR03602216

Med: Unknown

Referred by: Confirmed By:



25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5 EID:18 EDT: 21:53 06–MAY–1997 ORDER:

Male Caucasian

Room:CCU3

Loc:1 Option:1

Vent. rate	58	BPM
PR interval	168	ms
QRS duration	84	ms
QT/QTc	424/416	ms
P–R–T axes	18 28	29

Sinus bradycardia

Inferior–posterior infarct (cited on or before 27–APR–1997)

Abnormal ECG

When compared with ECG of 30–APR–1997 13:39,

No significant change was found

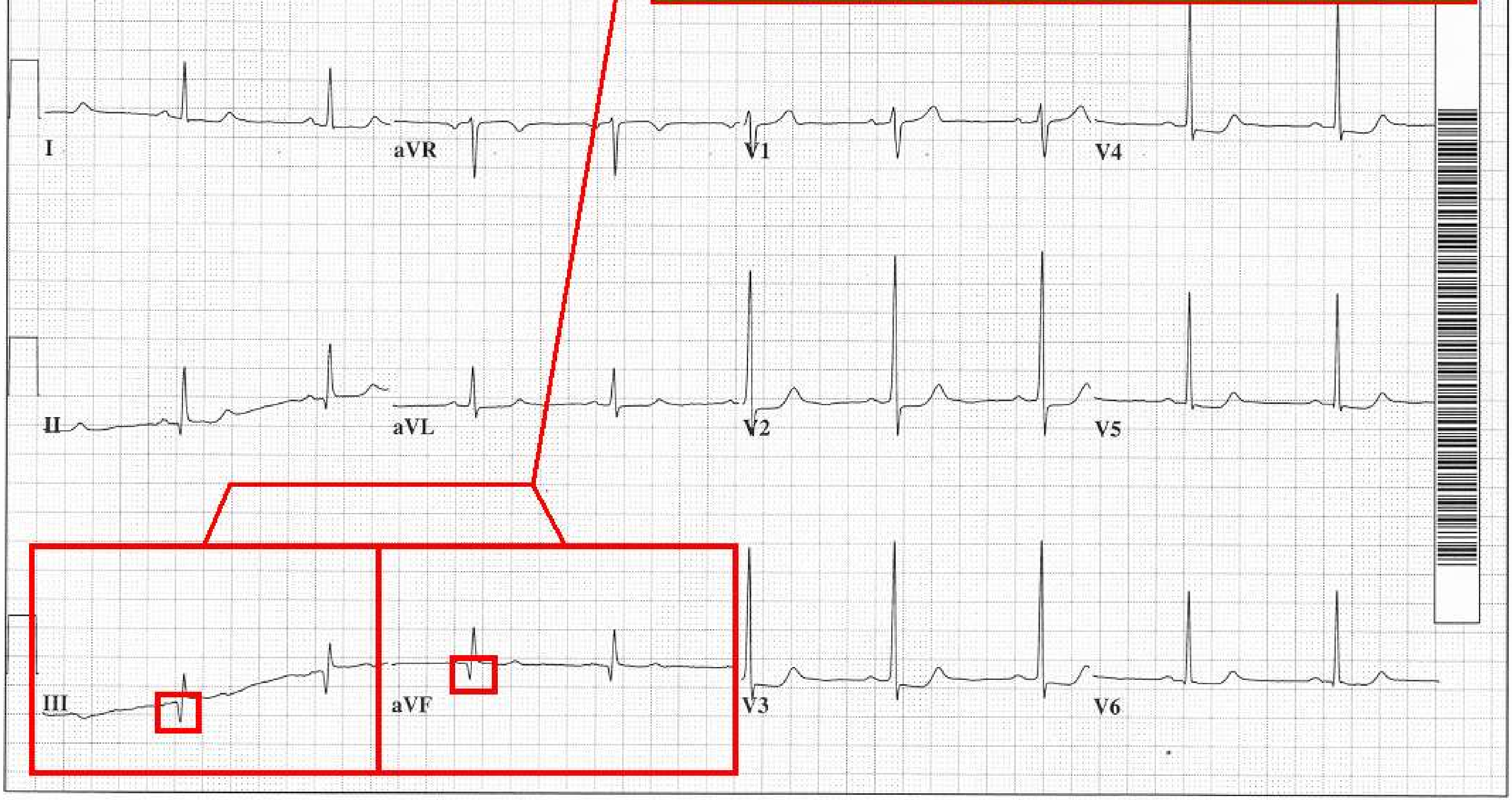
Technician ID: EKG CLASS #WR03602216

Med: Unknown

Old Posterior Wall MI

→ **Usually accompanied by OLD INFERIOR WALL MI**

- Does NOT abnormally widen the QRS complex



25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5

EID:18 EDT: 21:53 06–MAY–1997 ORDER:

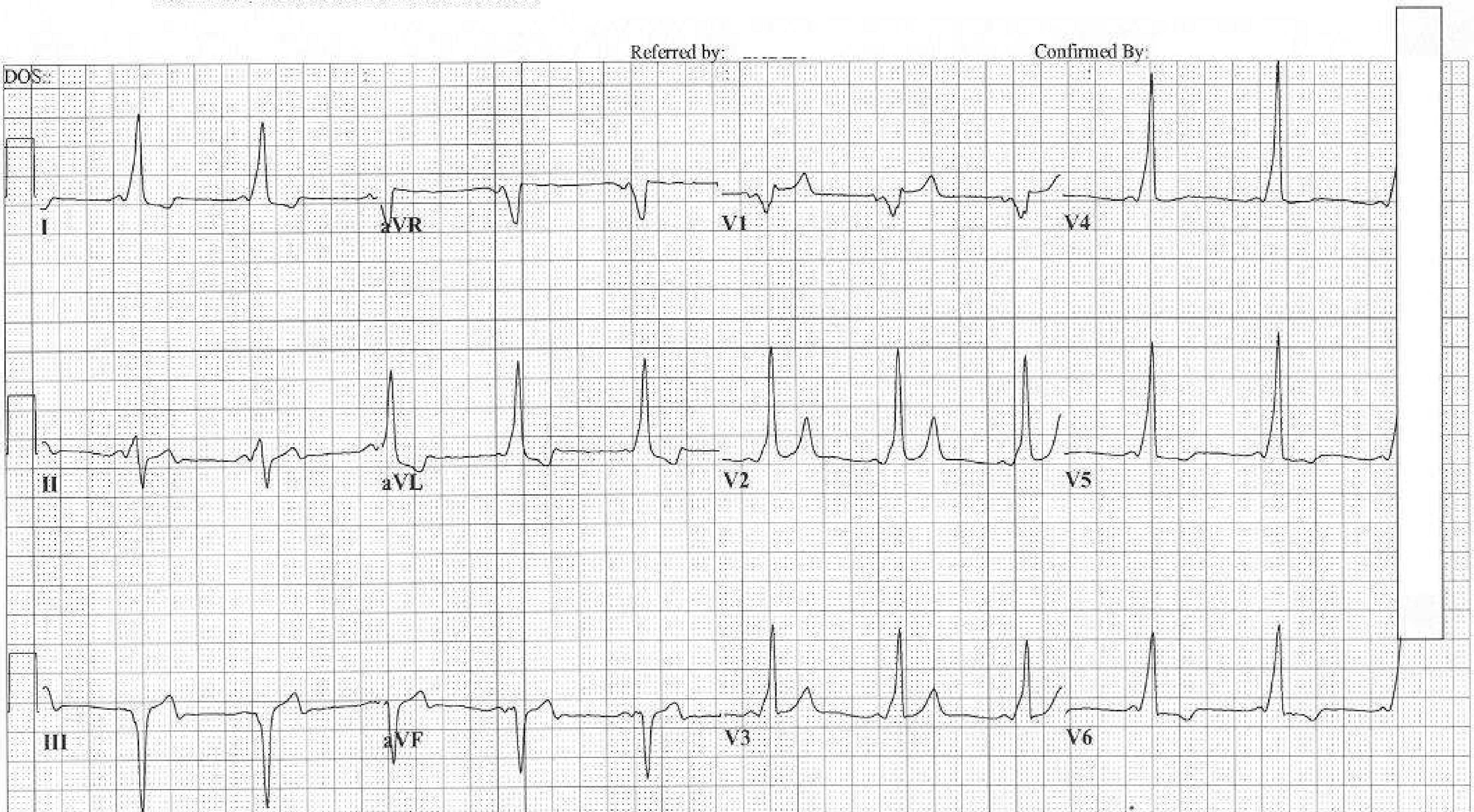
01-MAY- 04:14:17

51 yr		Vent. rate	64	BPM
Male	Caucasian	PR interval	110	ms
		QRS duration	146	ms
Room:540		QT/QTc	418/431	ms
Loc:5	Option:28	P-R-T axes	50 -36 119	

What is the cause of EARLY TRANSITION in this EKG ?

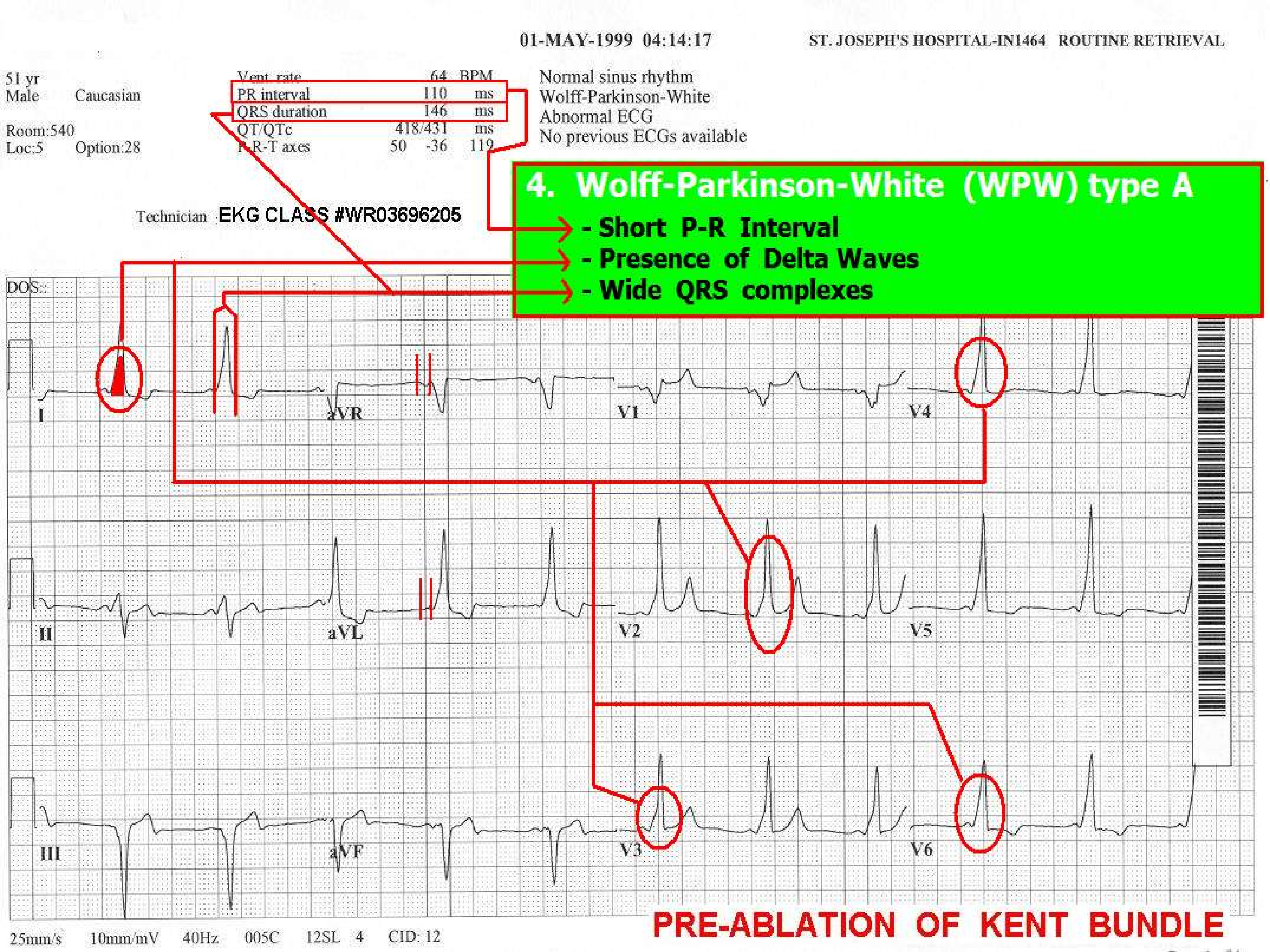
Technician EKG CLASS #WR03696205

Referred by: Confirmed By:



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

EID:17 EDT: 08:49 01-MAY-1999 ORDER:


01-MAY-1999 04:14:17
ST. JOSEPH'S HOSPITAL-IN1464 ROUTINE RETRIEVAL
51 yr
Male Caucasian
Room:540
Loc:5 Option:28
Vent. rate 64 BPM
PR interval 110 ms
QRS duration 146 ms
QT/QTc 418/431 ms
P-R-T axes 50 -36 119
Normal sinus rhythm
Wolff-Parkinson-White
Abnormal ECG
No previous ECGs available
Technician EKG CLASS #WR03696205
4. Wolff-Parkinson-White (WPW) type A
- Short P-R Interval
- Presence of Delta Waves
- Wide QRS complexes
DOS::
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
PRE-ABLATION OF KENT BUNDLE
25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 12

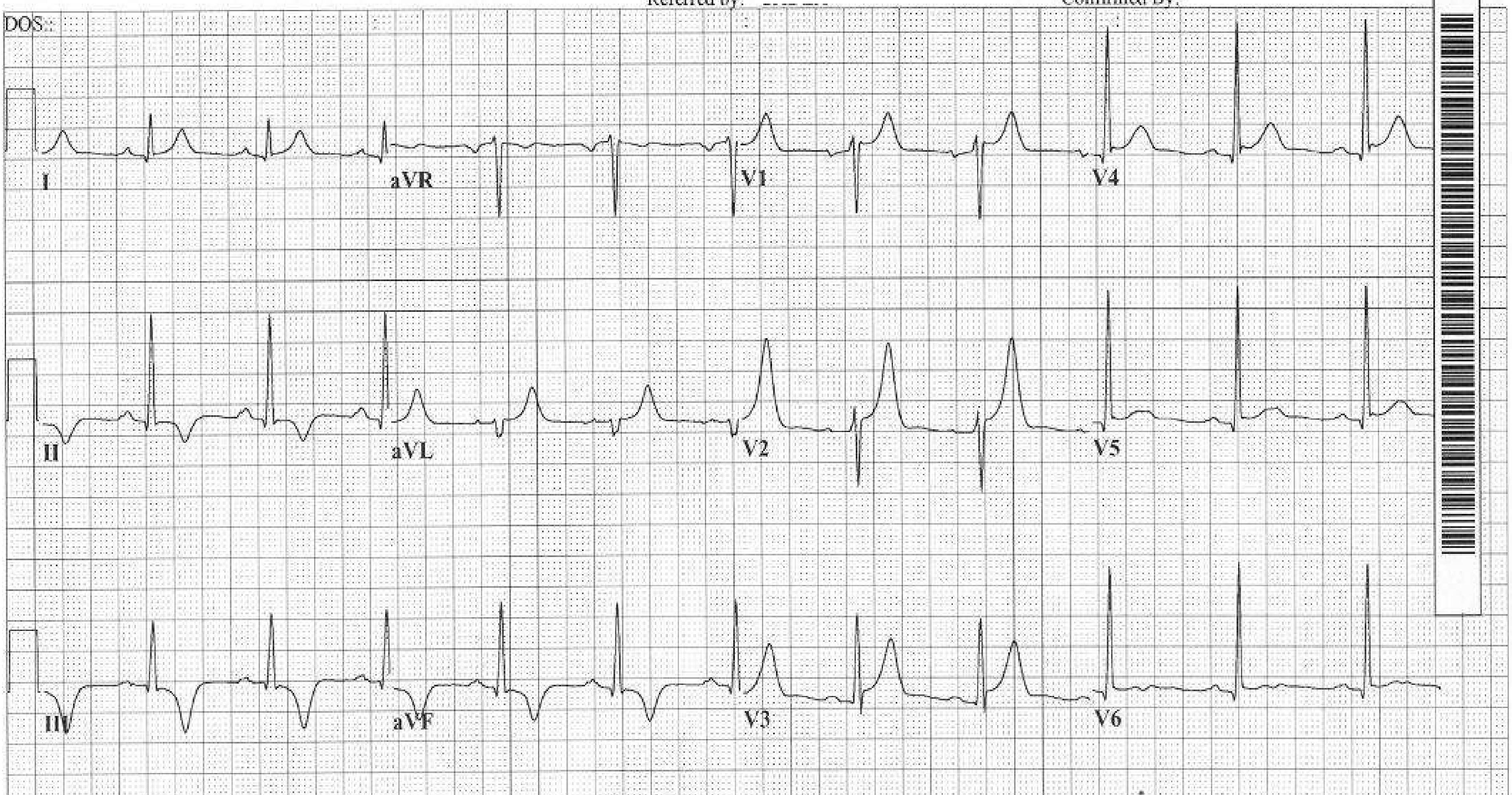
04-MAY-1999 04:47:41 ST. JOSEPH'S HOSPITAL-IN1464 ROUTINE RETRIEVAL

51 yr		Vent. rate	69	BPM		Normal sinus rhythm
Male	Caucasian	PR interval	184	ms		Marked T wave abnormality, consider inferior ischemia
		QRS duration	88	ms		Abnormal ECG
Room:426		QT/QTc	392/420	ms		When compared with ECG of 01-MAY-1999 21:36,
Loc:5	Option:28	P-R-T axes	60 69	-50		Wolff-Parkinson-White is no longer Present

POST-ABLATION OF KENT BUNDLE

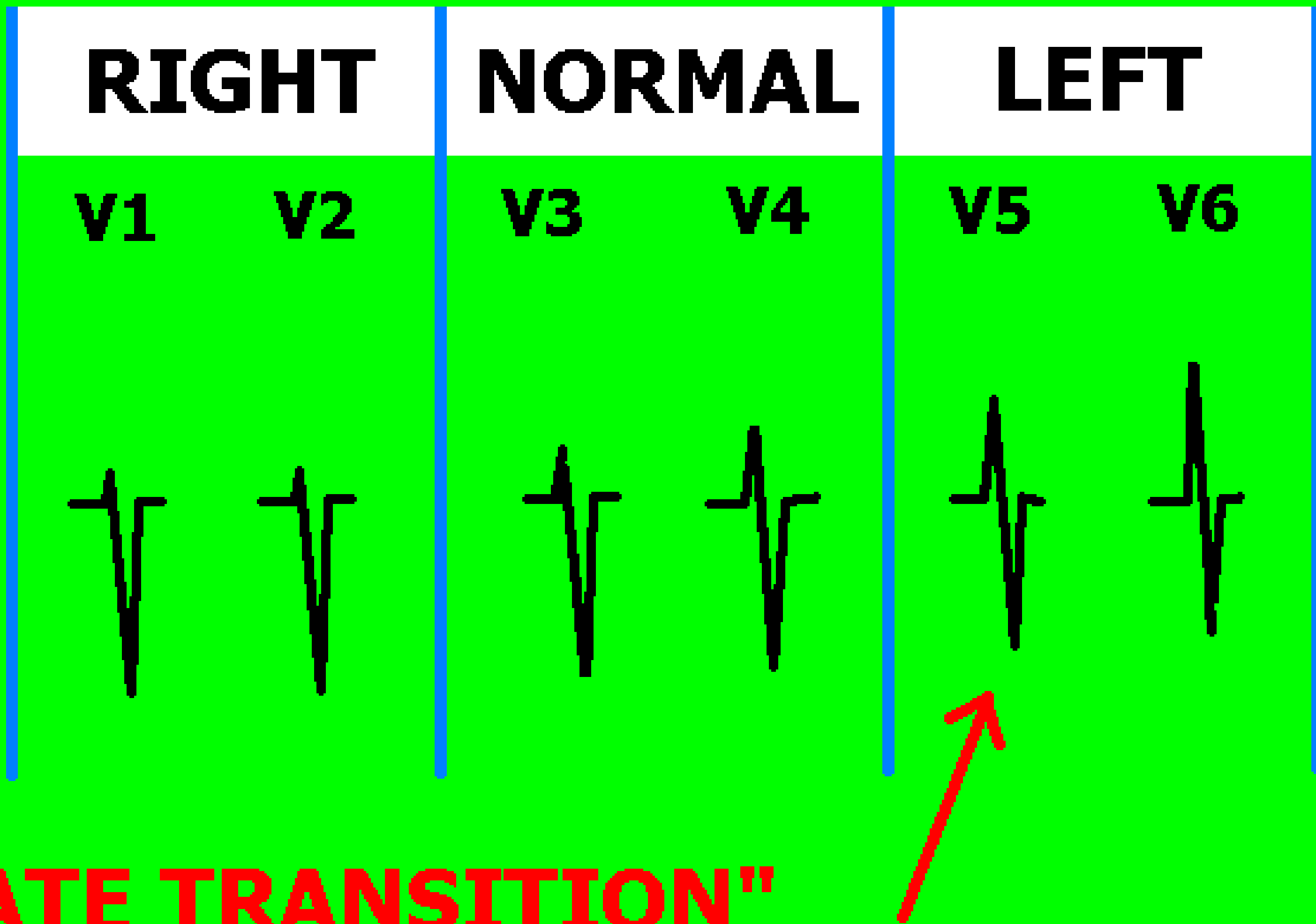
Technician: EKG CLASS #WR03696205

Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 12 EID:17 EDT: 09:08 04-MAY-1999 ORDER:

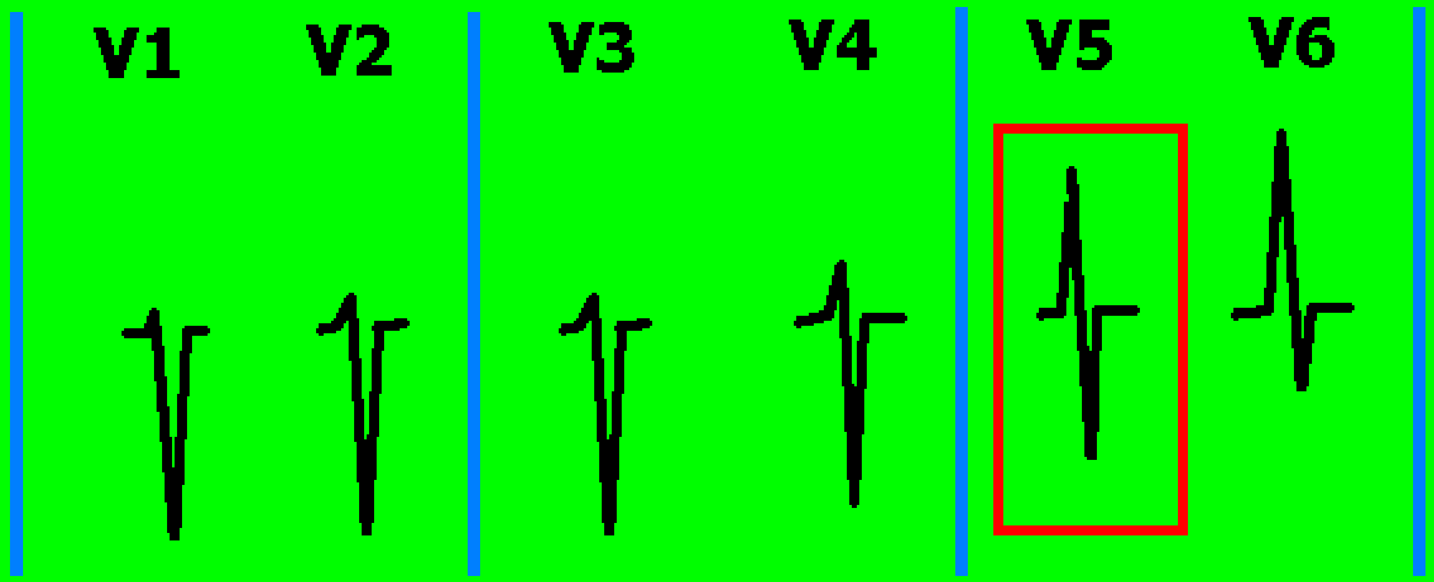
AXIS ROTATION



"LATE TRANSITION"

"SHIFTED TO THE LEFT"

COMMON CAUSES of LATE TRANSITION



1. Old Anterior Wall M.I.
2. Left Bundle Branch Block
3. Left Ventricular Hypertrophy
4. Wolff-Parkinson-White (type B)

RIGHT-SIDED PATHWAY - FROM MARRIOTT'S "Practical Electrocardiography - 10th Edition," 2000

COMMON CAUSES OF LATE TRANSITION

....WITH SOME *COMMON* HELPFUL CLUES:

1. **Old Anterior MI**
   - Q Waves in V1, V2, and /or V3
   - Other causes of LATE TRANSITION ruled out
2. **Left Bundle Branch Bock (LBBB)**
   - Supraventricular Rhythm
   - QRS wider than 120 ms (.12 sec)
   - RsR' or RR' ("notching") in V5 and/or V6
3. **Left Ventricular Hypertrophy (LVH)**
   - Corresponding Left Atrial Hypertrophy (LAH)
   - T wave Strain Pattern V5 / V6
   - Intrinsicoid Deflection in V5 / V6 > 45 ms
   - V1 S wave + V5 or V6 R wave > 35 mm
   - R or S wave in any LIMB LEAD > 2.0 mV (20 mm)
4. **Wolff-Parkinson-White (Type B)**
   - Presence of DELTA waves
   - Short P-R Interval (< 120 ms)
   - Wide QRS (> 120 ms)

28-MAR-1997 05:46:00

91 yr
Female Caucasian

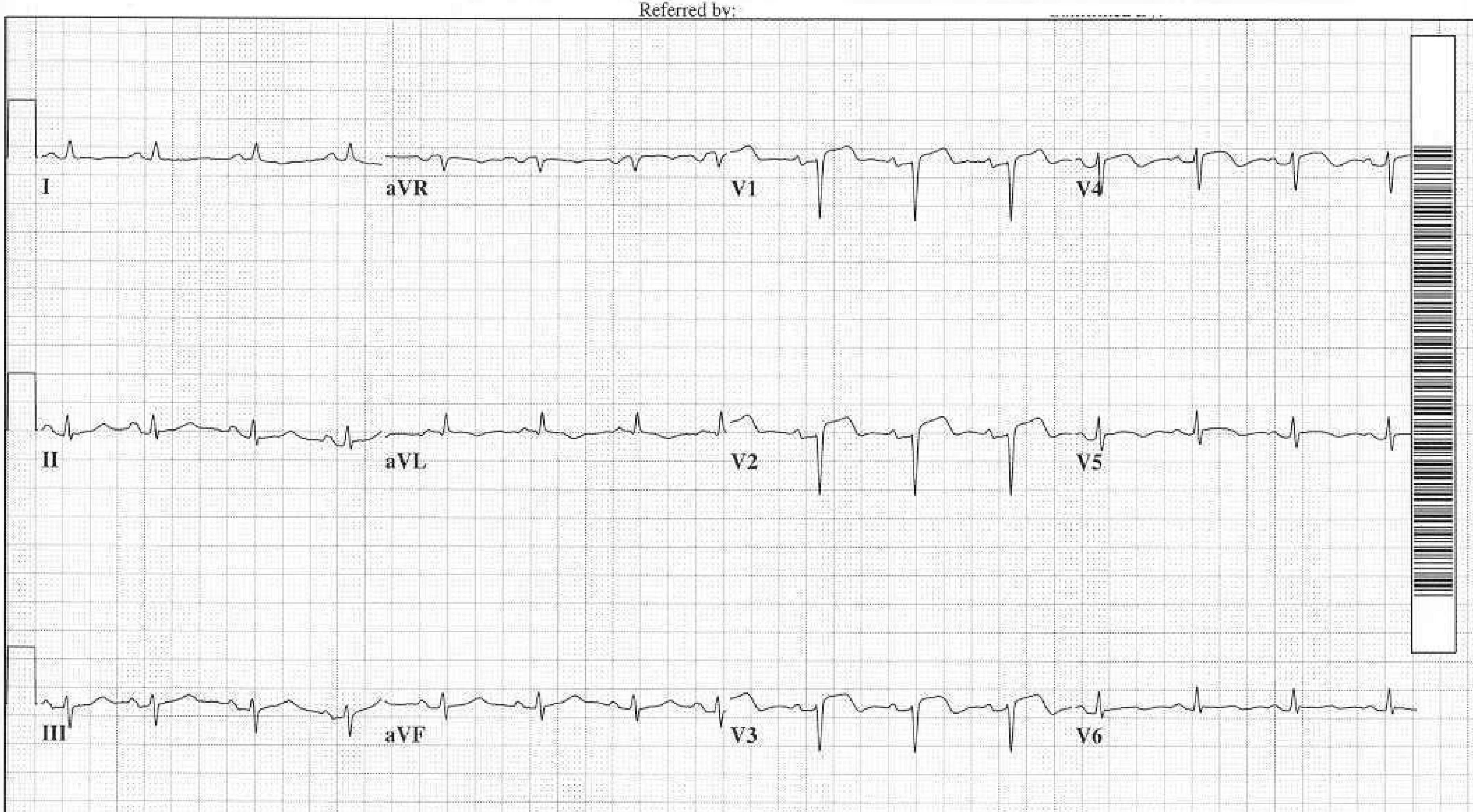
Room:3
Loc:1 Option:1

Vent. rate	87	BPM
PR interval	156	ms
QRS duration *	80	ms
QT/QTc	332/399	ms
P-R-T axes	45 4	96

What is the cause of LATE TRANSITION in this EKG ?

Technician ID: EKG CLASS # WR03110848

Referred by:



25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5

EID:16 EDT: 11:25 30-MAR-1997 ORDER:

91 yr		Vent. rate	87	BPM
Female	Caucasian	PR interval	156	ms
		QRS duration *	80	ms
Room:3		QT/QTc	332/399	ms
Loc:1	Option:1	P–R–T axes	45 4	96

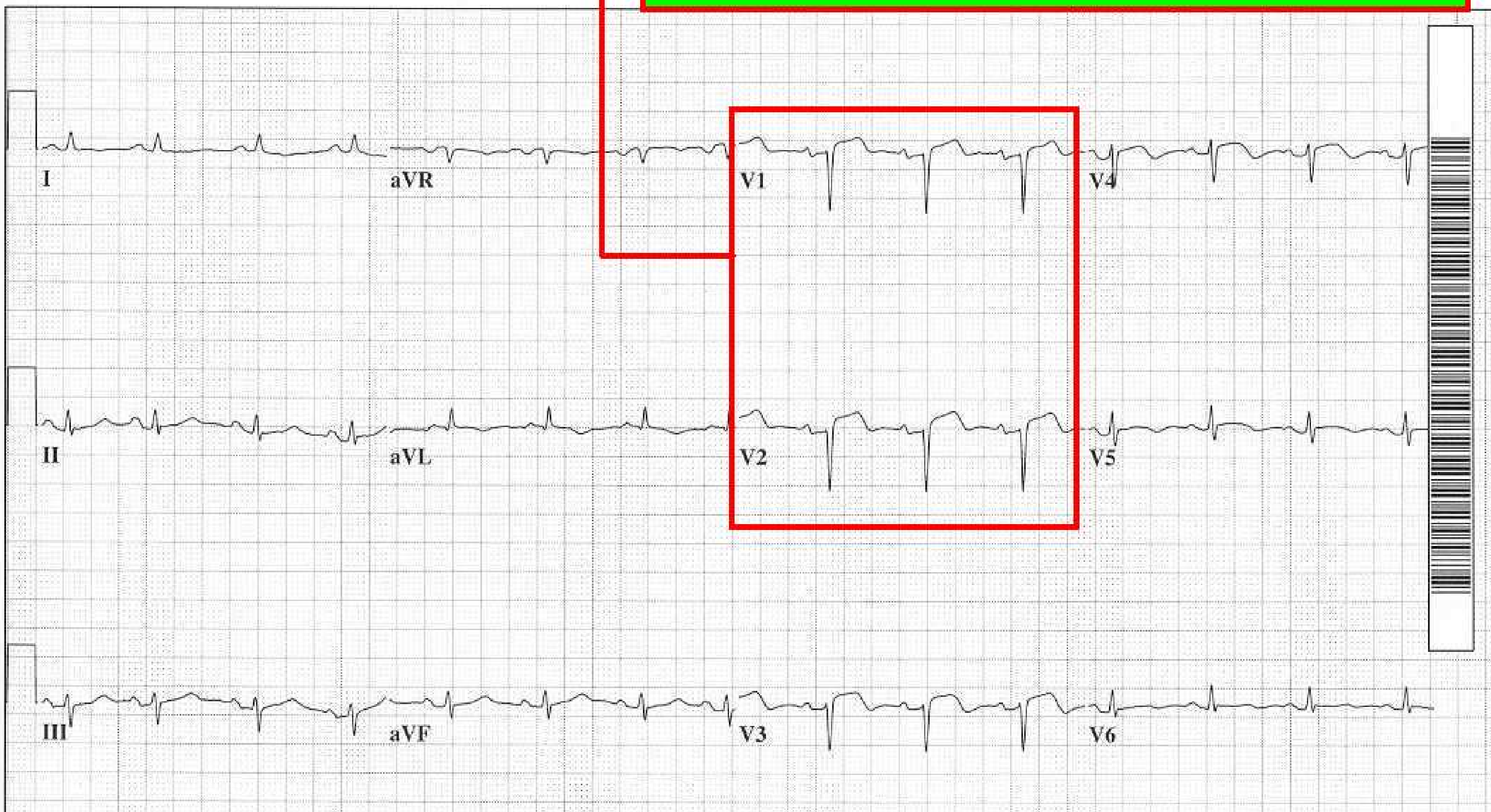
Normal sinus rhythm
Possible Anterior infarct (cited on or before 27–MAR–1997)
Abnormal ECG

Technician ID: EKG CLASS # WR03110848

Old Anterior MI

- Q waves in V1, V2, V3 and/or V4

- other causes of LATE TRANSITION ruled out



25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5

EID:16 EDT: 11:25 30–MAR–1997 ORDER:

27-MAR-1991 13:29:00 ST. JOSEPH'S HOSPITAL-IN 65+ ROUTINE RETRIEVAL

85 yr
Female Caucasian

Room:715A
Loc:6 Option:19

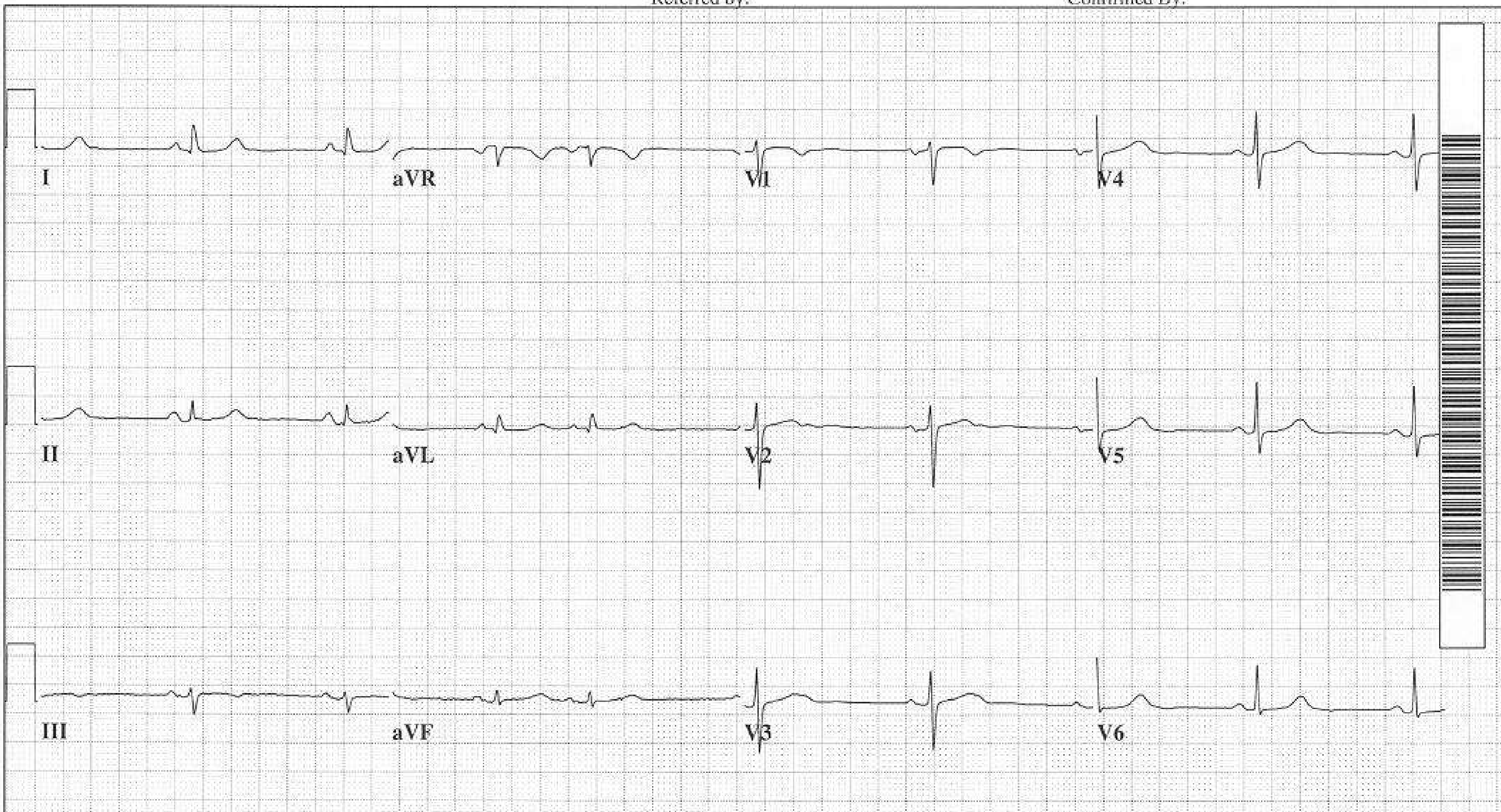
Vent. rate	55	BPM
PR interval	152	ms
QRS duration	76	ms
QT/QTc	432/413	ms
P-R-T axes	40 14	34

Sinus bradycardia with occasional Premature supraventricular complexes
Otherwise normal ECG

EKG CLASS # WR03110848

PRE-INFARCTION EKG

Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 68 CID: 0 EID:Cnvrtd EDT: ORDER:

27–MAR–1997 12:42:11 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

91 yr
Female Caucasian

Room:ER
Loc:3 Option:17

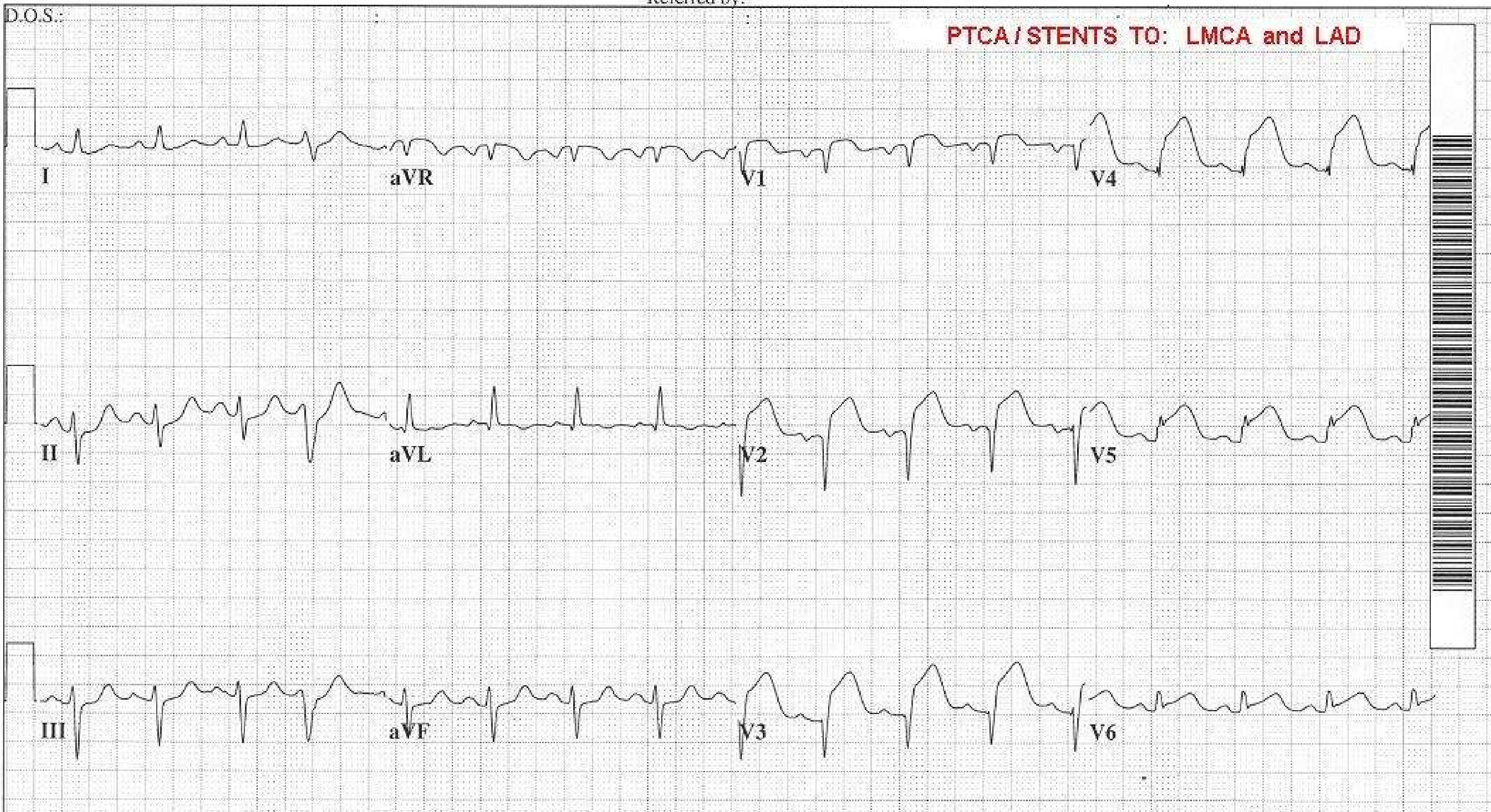
Vent. rate	100	BPM
PR interval	166	ms
QRS duration	80	ms
QT/QTc	360/464	ms
P–R–T axes	52 –38	70

Technician: EKG CLASS# WR03110848

Normal sinus rhythm with frequent , and consecutive Premature ventricular and fusion complexes
Left atrial enlargement
Left axis deviation
Septal infarct , possibly acute
Anterolateral injury pattern
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
When compared with ECG of 27–MAR–1991 13:29,

Referred by:

SUDDEN ONSET CHEST PAIN
-WAITED "SEVERAL HOURS" BEFORE SEEKING HELP
-ER - DIRECTLY TO CATH LAB
CPK: 2,471
CK/MB: 483
CK INDEX: 14



25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 1 EID:13 EDT: 18:31 28–MAR–1997 ORDER:

28–MAR–1997 05:46:00 ST. JOSEPH'S HOSPITAL–CCU ROUTINE RETRIEVAL

91 yr
Female Caucasian

Room:3
Loc:1 Option:1

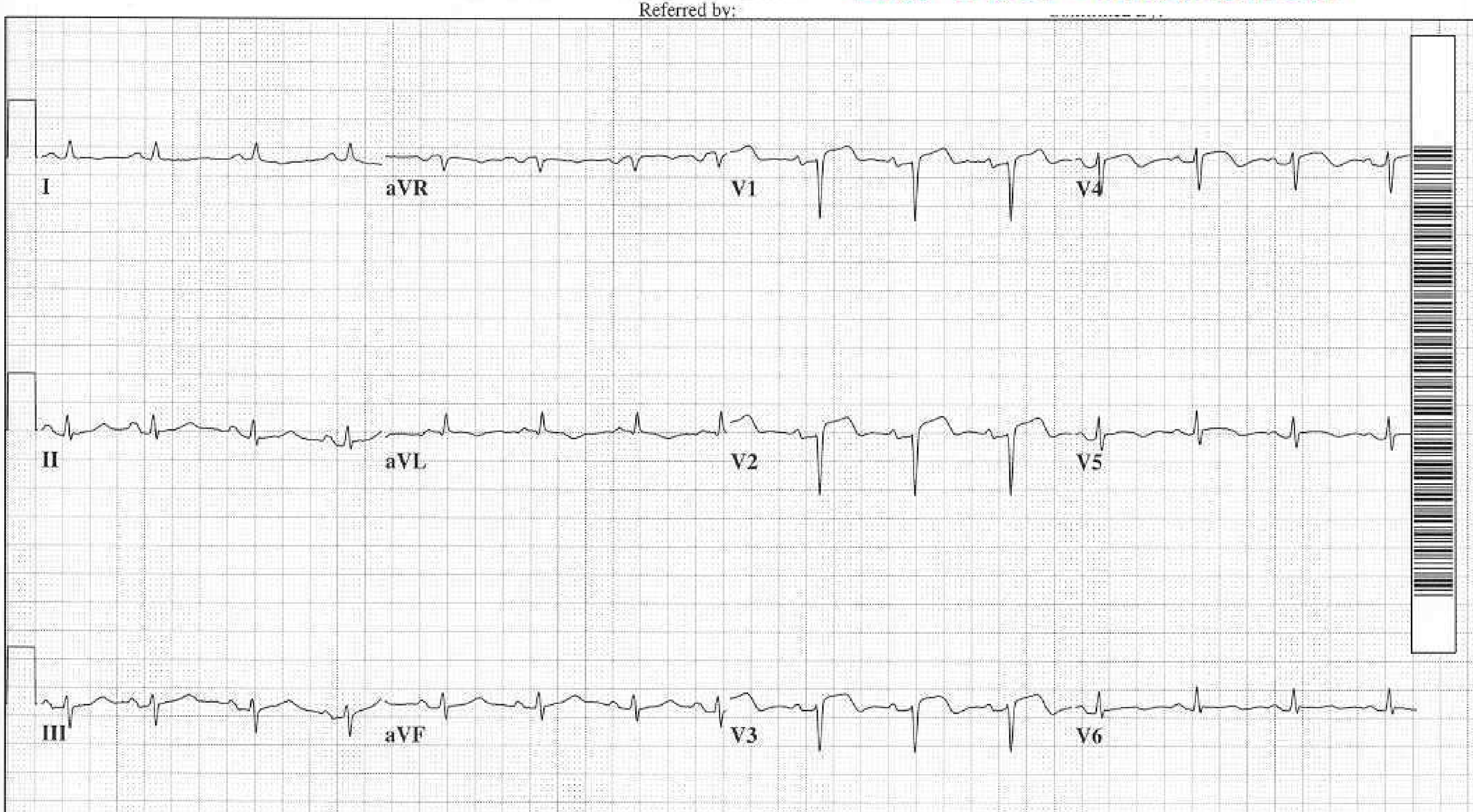
Vent. rate	87	BPM
PR interval	156	ms
QRS duration *	80	ms
QT/QTc	332/399	ms
P–R–T axes	45 4	96

Technician ID: EKG CLASS # WR03110848

Normal sinus rhythm
Possible Anterior infarct (cited on or before 27–MAR–1997)
Abnormal ECG
When compared with ECG of 27–MAR–1997 16:26 (UNCONFIRMED),
QRS duration has decreased
Questionable change in initial forces of Anteroseptal leads
Non–specific change in ST segment in Lateral leads
QT has shortened

EKG POST - INFARCTION

Referred by:



25mm/s 10mm/mV 100Hz 005C 12SL 4 CID: 5

EID:16 EDT: 11:25 30–MAR–1997 ORDER:

11:36:49

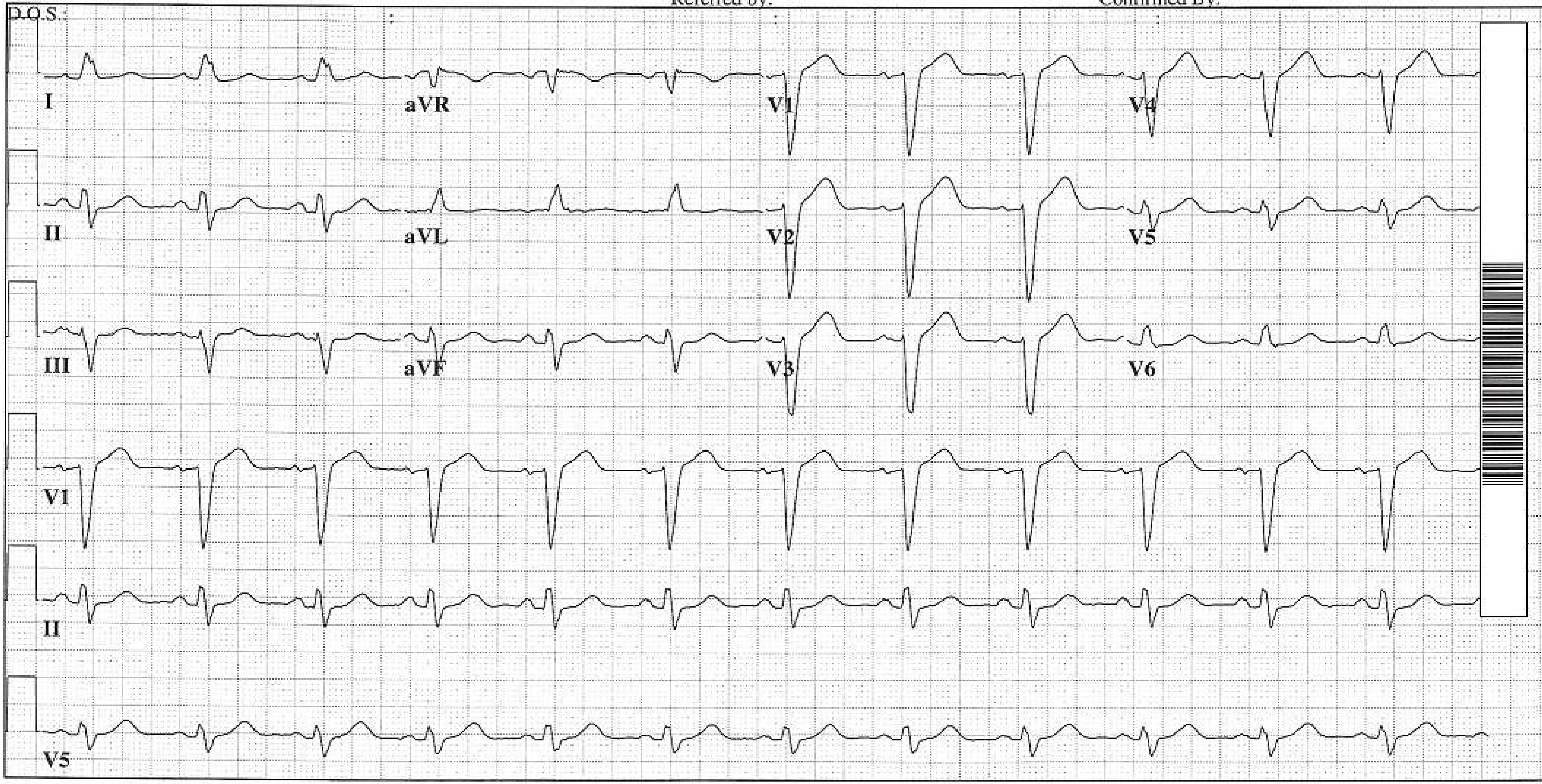
74 yr
Female Caucasian

Loc:7 Option:35

Vent. rate	73	BPM
PR interval	160	ms
QRS duration	134	ms
QT/QTc	450/495	ms
P–R–T axes	67 –33	62

What is the cause of LATE TRANSITION in this EKG ?

Referred by: Confirmed By:



11:36:49

74 yr
Female Caucasian

Loc:7 Option:35

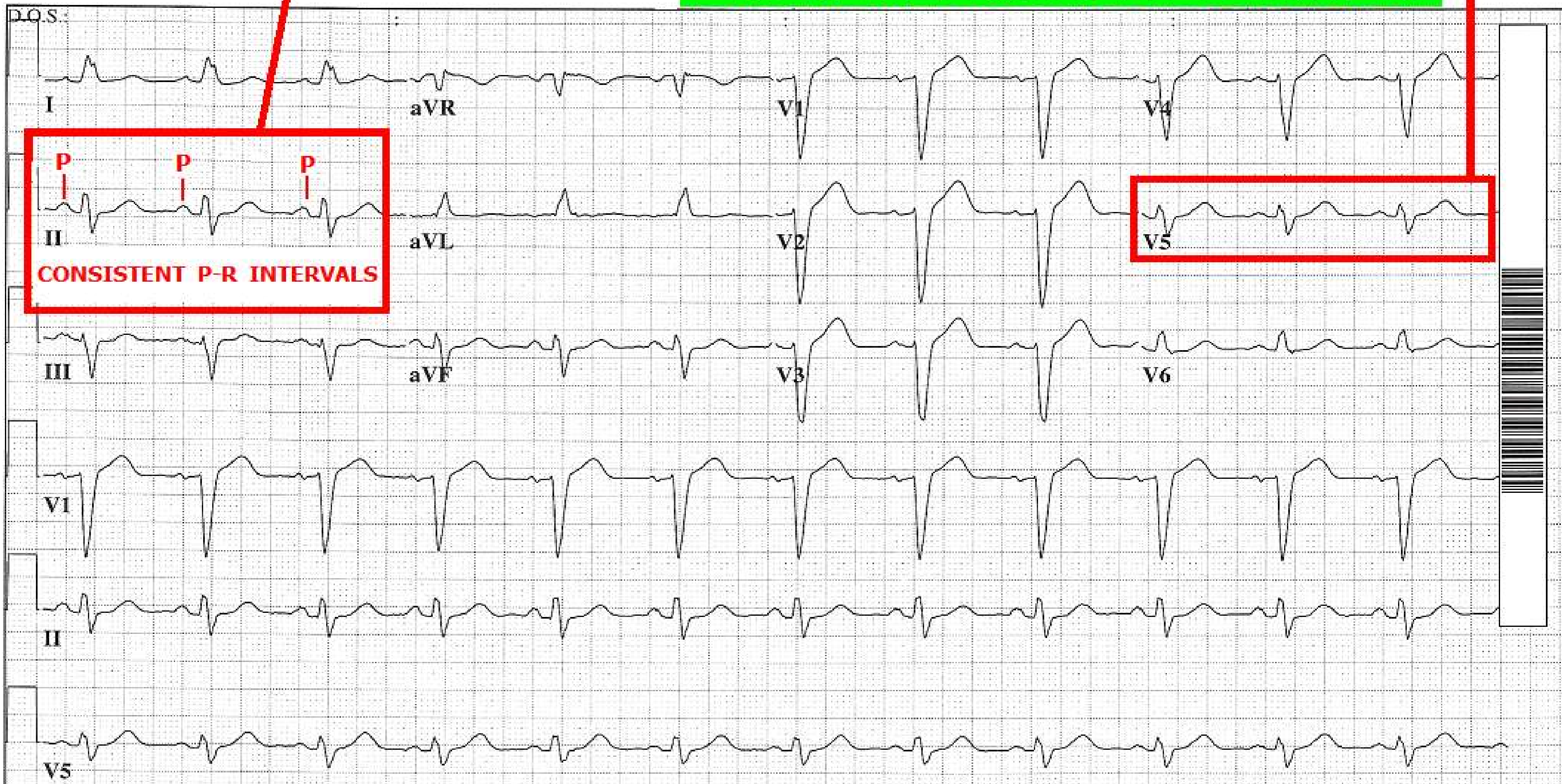
Vent. rate	73	BPM
PR interval	160	ms
QRS duration	134	ms
QT/QTc	458/495	ms
P–R–T axes	67 –33	62

Normal sinus rhythm
Left axis deviation
Left bundle branch block

Left Bundle Branch Bock (LBBB)

- **Supraventricular Rhythm**
- **QRS wider than 120 ms (.12 sec)**
- **RsR' or RR' ("notching") in V5 and/or V6**

P P



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

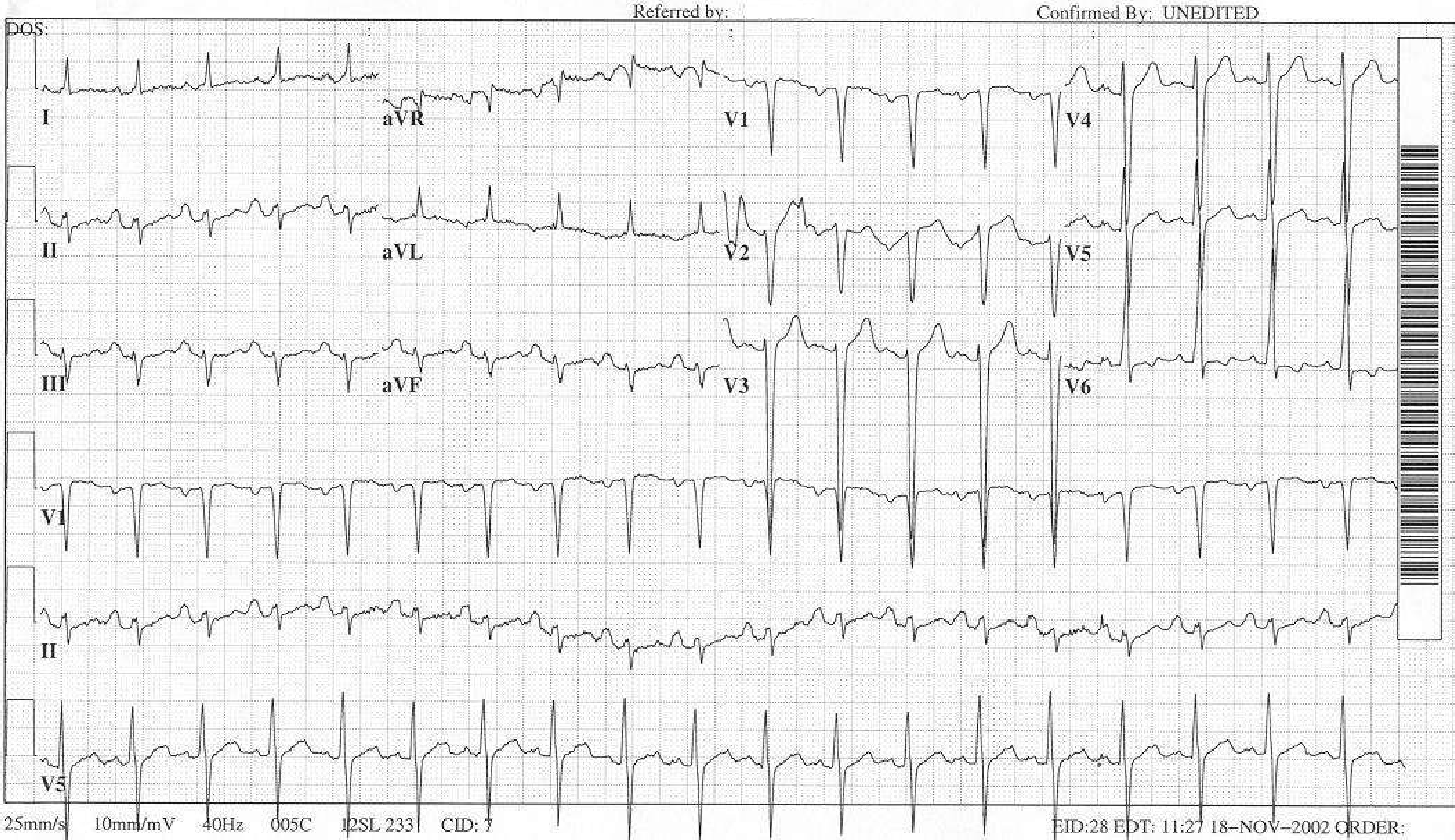
53 yr
Male Black

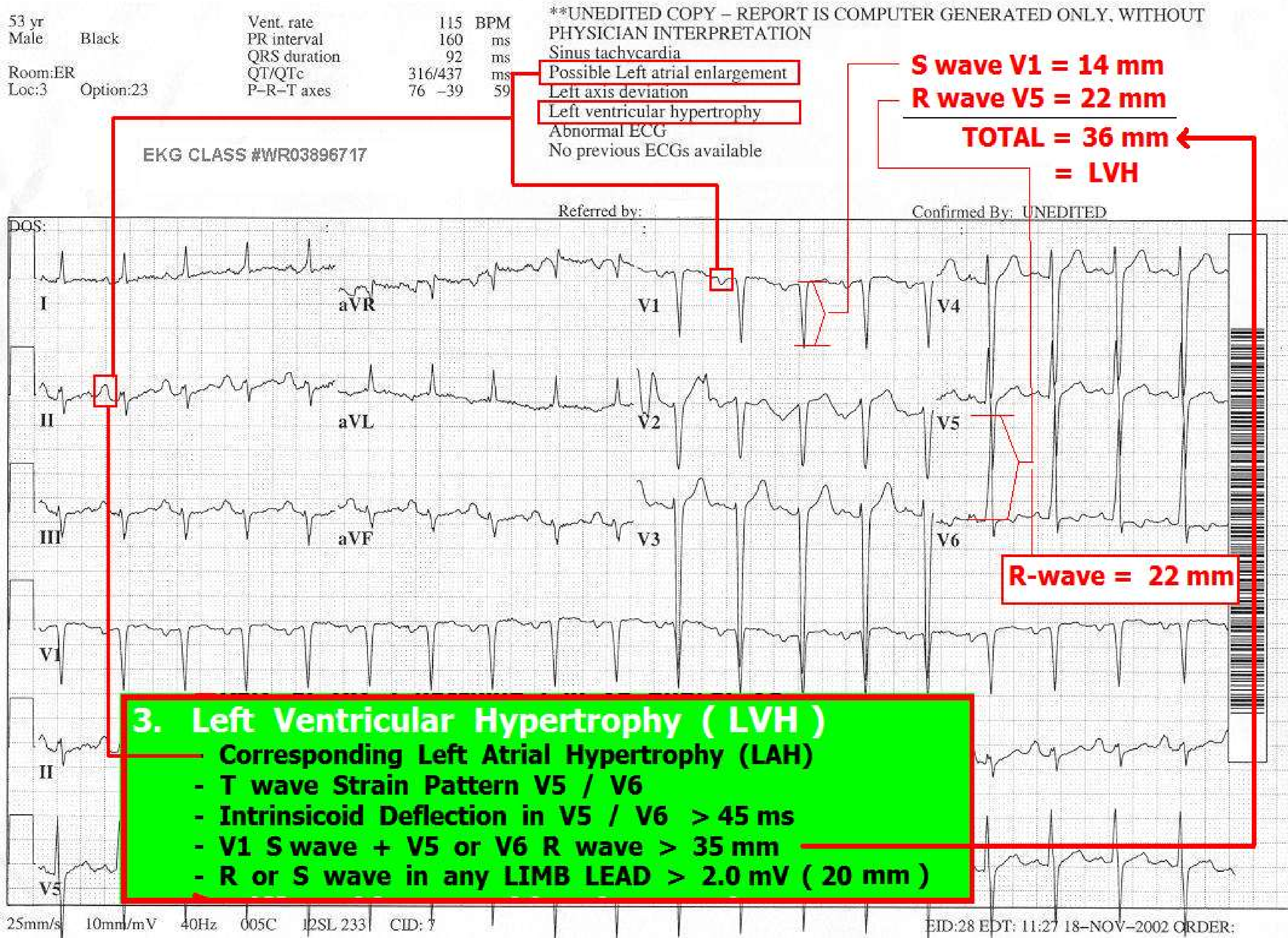
Room:ER
Loc:3 Option:23

Vent. rate	115	BPM
PR interval	160	ms
QRS duration	92	ms
QT/QTc	316/437	ms
P–R–T axes	76 –39	59

EKG CLASS #WR03896717

What is the cause of LATE TRANSITION in this EKG ?




53 yr
Male Black
Room:ER
Loc:3 Option:23
Vent. rate 115 BPM
PR interval 160 ms
QRS duration 92 ms
QT/QTc 316/437 ms
P–R–T axes 76 –39 59
**UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION
Sinus tachycardia
Possible Left atrial enlargement
Left axis deviation
Left ventricular hypertrophy
Abnormal ECG
No previous ECGs available
EKG CLASS #WR03896717
S wave V1 = 14 mm
R wave V5 = 22 mm
TOTAL = 36 mm
= LVH
Referred by:
Confirmed By: UNEDITED
DOS:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
R-wave = 22 mm
V1
II
V5
3. Left Ventricular Hypertrophy (LVH)
- Corresponding Left Atrial Hypertrophy (LAH)
- T wave Strain Pattern V5 / V6
- Intrinsicoid Deflection in V5 / V6 > 45 ms
- V1 S wave + V5 or V6 R wave > 35 mm
- R or S wave in any LIMB LEAD > 2.0 mV (20 mm)
25mm/s 10mm/mV 40Hz 005C 12SL 233 CID: 7
EID:28 EDT: 11:27 18–NOV–2002 ORDER:

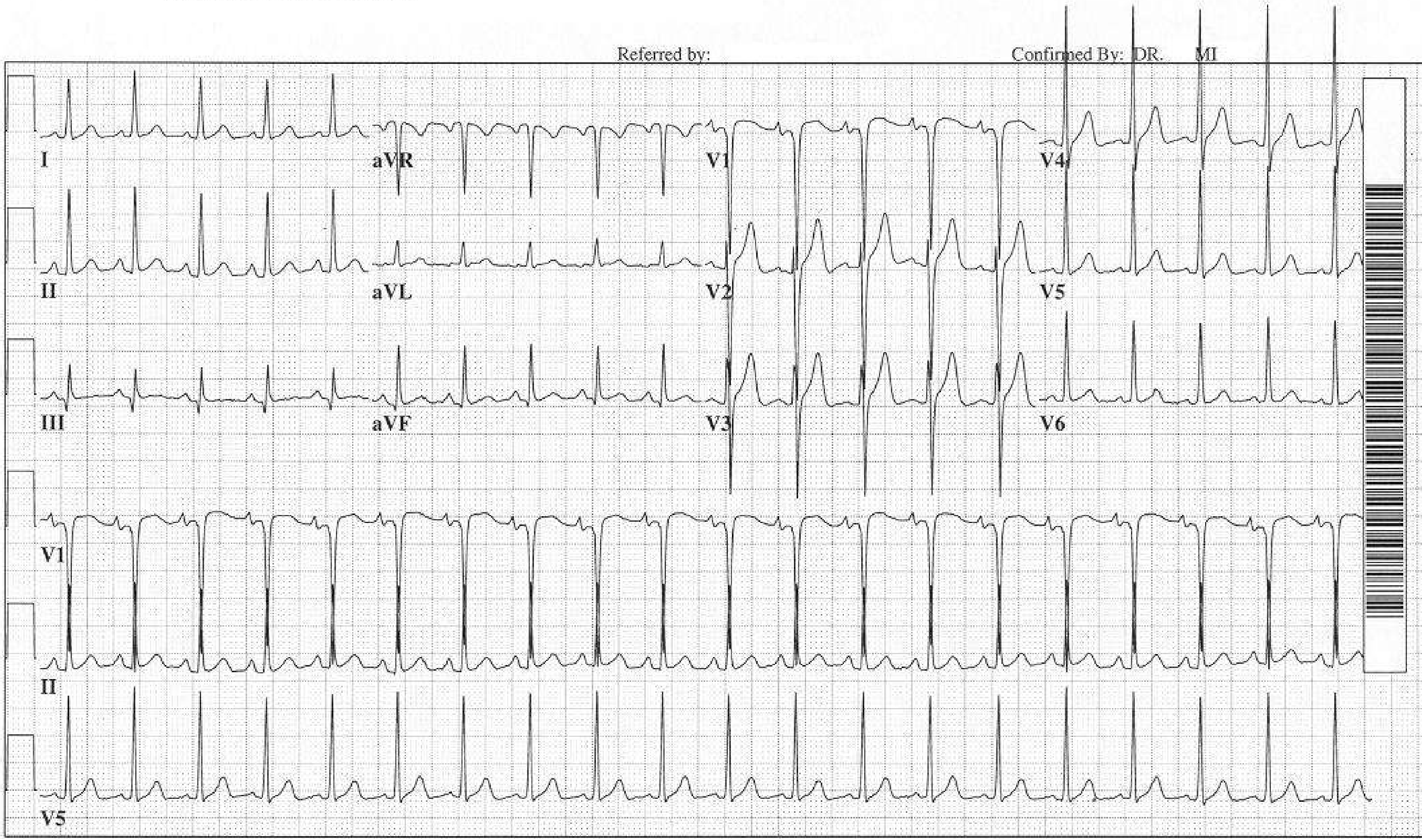
19–JUN–1995 22:39:00 ST. JOSEPH'S HOSPITAL–TCHD ROUTINE RETRIEVAL

26 yr		Vent. rate	119	BPM
Male	Black	PR interval	126	ms
		QRS duration	78	ms
Room:703A		QT/QTc	282/397	ms
Loc:8	Option:25	P–R–T axes	68 46	41

Sinus tachycardia
Minimal voltage criteria for LVH, may be normal variant
Borderline ECG

EKG CLASS #WR03446043

Referred by: Confirmed By: DR. MI



25mm/s 10mm/mV 40Hz 005C 12SL 250 CID: 0 EID:Cnvrtd EDT: ORDER:

16 yr
Female Caucasian

Room:REC
Loc:20 Option:50

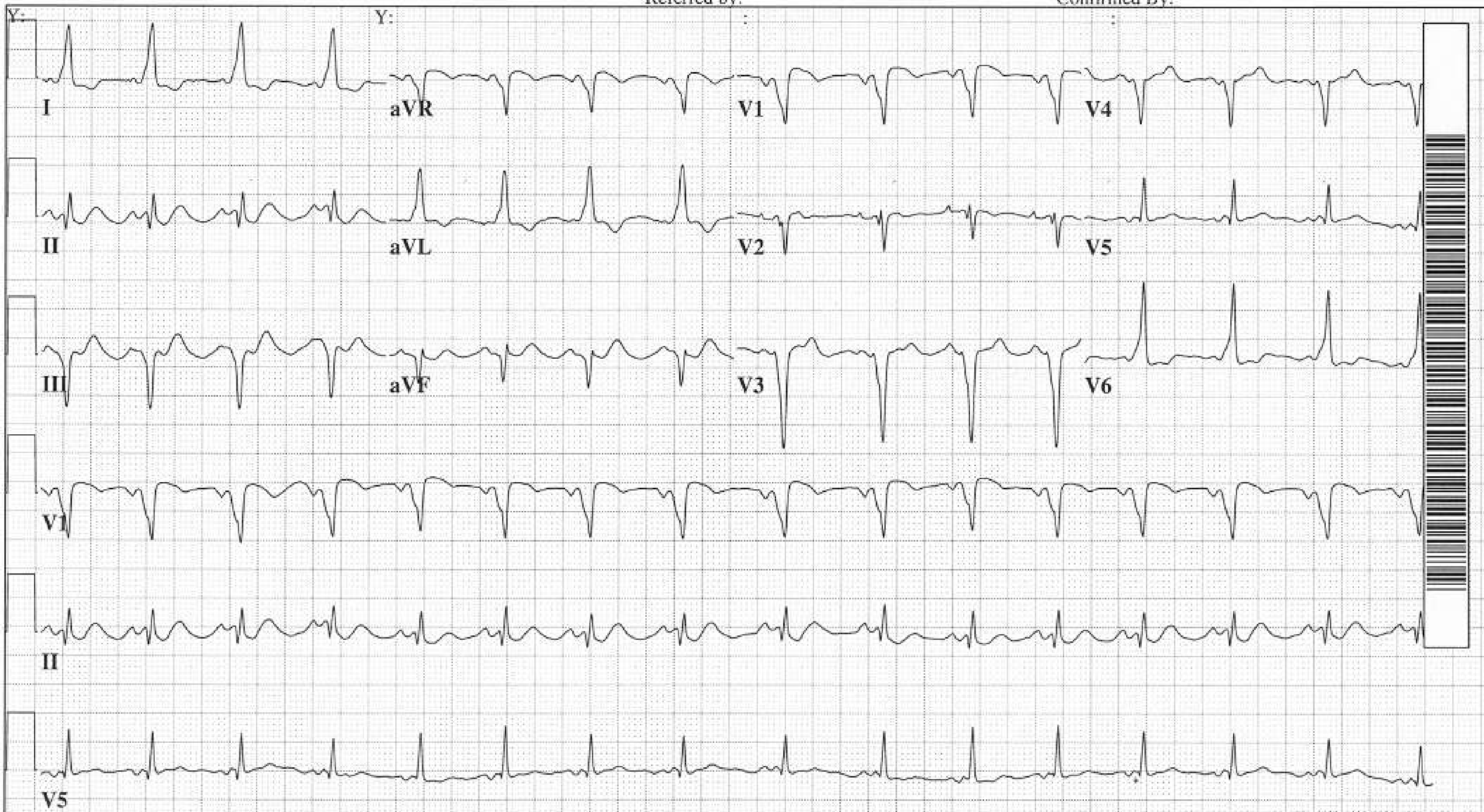
Vent. rate	92	BPM
PR interval	112	ms
QRS duration	118	ms
QT/QTc	356/440	ms
P–R–T axes	59 –22	107

History:Unknown
Technician: DP
Test ind:EKG

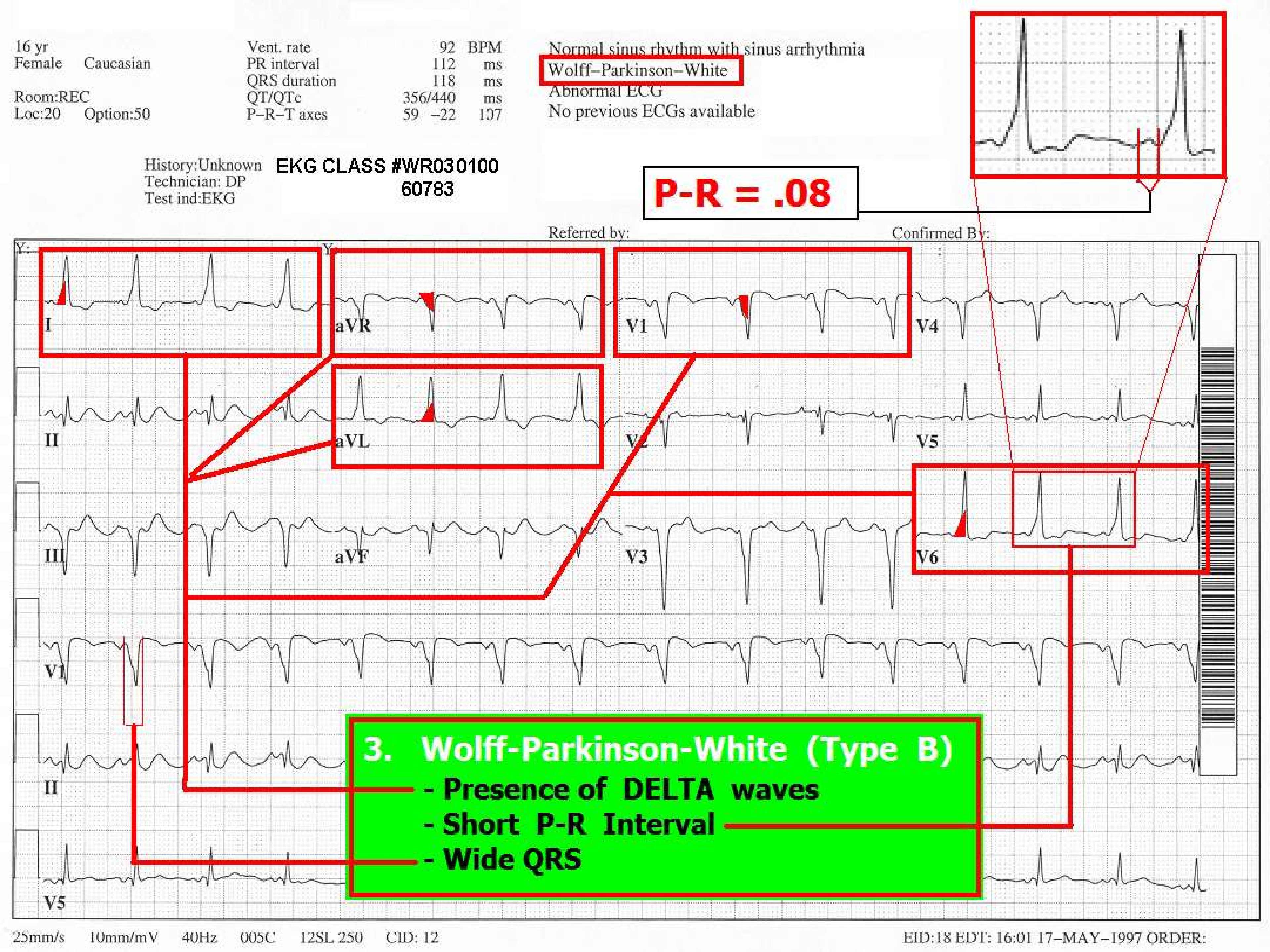
EKG CLASS #WR030100
60783

what is the cause of LATE TRANSITION on this EKG ?

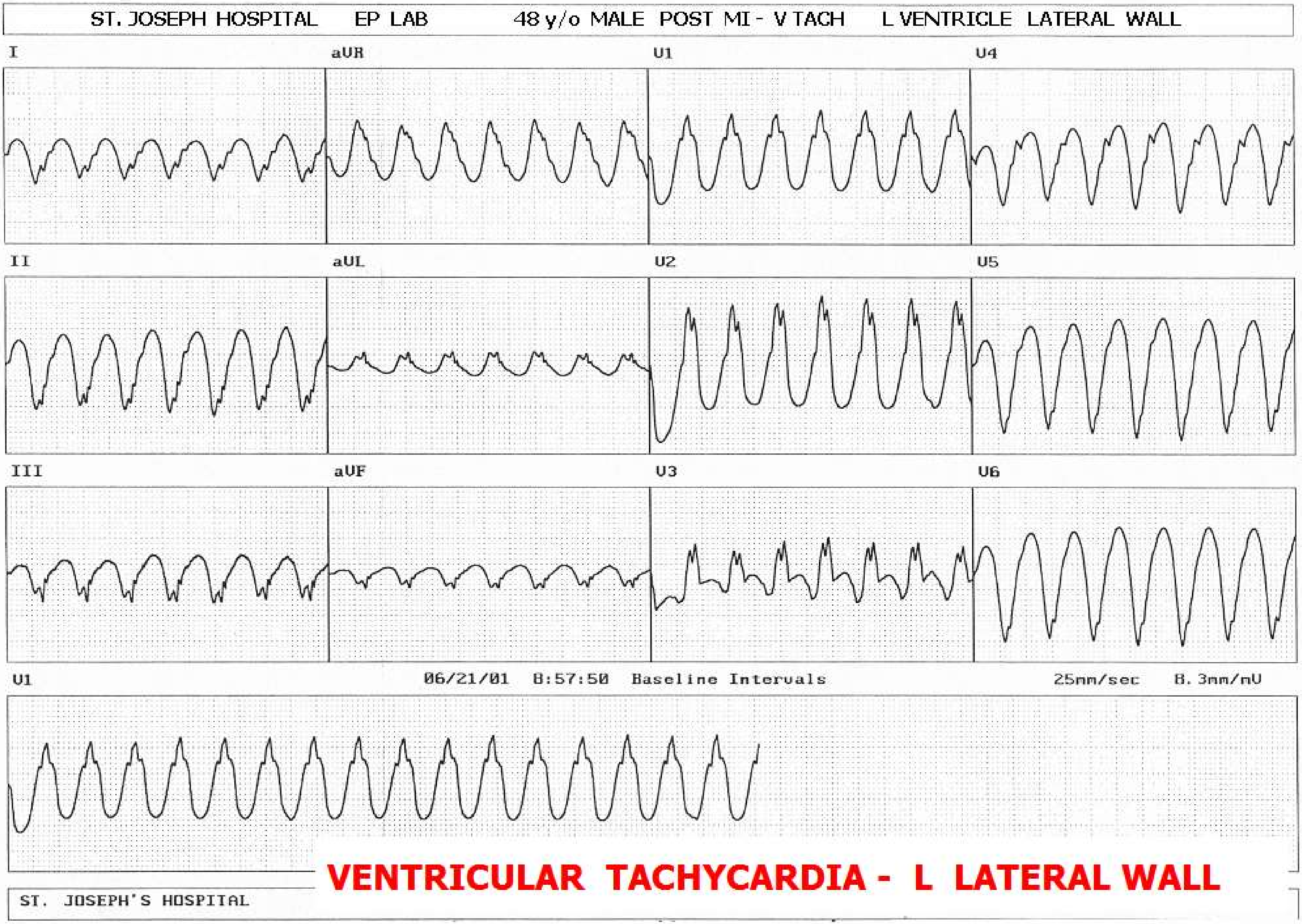
Referred by: Confirmed By:



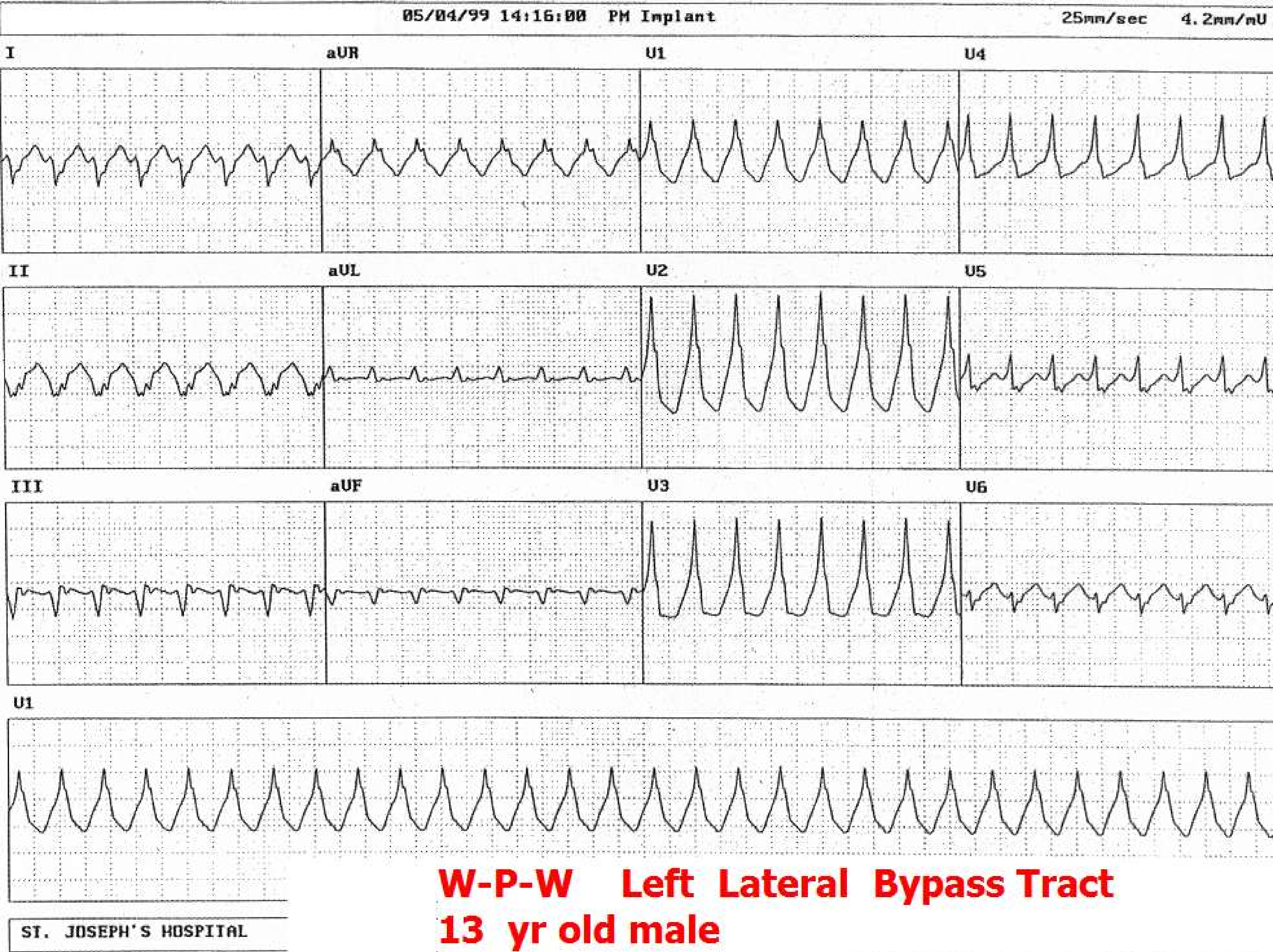
25mm/s 10mm/mV 40Hz 005C 12SL 250 CID: 12 EID:18 EDT: 16:01 17–MAY–1997 ORDER:



16 yr
Female Caucasian
Room:REC
Loc:20 Option:50
Vent. rate 92 BPM
PR interval 112 ms
QRS duration 118 ms
QT/QTc 356/440 ms
P–R–T axes 59 –22 107
Normal sinus rhythm with sinus arrhythmia
Wolff–Parkinson–White
Abnormal ECG
No previous ECGs available
History:Unknown
Technician: DP
Test ind:EKG
EKG CLASS #WR030100
60783
P-R = .08
Referred by:
Confirmed By:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
3. Wolff-Parkinson-White (Type B)
- Presence of DELTA waves
- Short P-R Interval
- Wide QRS
25mm/s 10mm/mV 40Hz 005C 12SL 250 CID: 12
EID:18 EDT: 16:01 17–MAY–1997 ORDER:



VENTRICULAR TACHYCARDIA - L LATERAL WALL



W-P-W Left Lateral Bypass Tract
13 yr old male

ECG EVALUATION

THE TRADITIONAL FORMAT

- RATE
  - BRADY, NORMAL, or TACHY
  - HOW WILL RATE EFFECT PT'S HEMODYNAMIC STATUS?
- RHYTHM
  - REGULAR, IRREGULAR, or IRREGULARLY IRREGULAR
  - IDENTIFY FOCUS: SINUS, JUNCTIONAL, or VENTRICULAR
  - IDENTIFY RHYTHM: (SR, A-FIB, FLUTTER, HEART BLOCK, etc.)
- AXIS
  - DEVIATION: NORMAL, LEFT, RIGHT, FAR RIGHT
  - ROTATION: SHIFT TO L or R
- HYPERTROPHY
  - ATRIAL: R and/or L
  - VENTRICULAR
  - CONSIDER CAUSE OF HYPERTROPHY (VAVLE DISORDERS, PULONARY DISEASE, HYPERTENSION, CONGENITAL DEFECTS)
- ISCHEMIA / INFARCTION / NECROSIS
  - INDENTIFY AREA OF HEART INVOLVED
  - CONSIDER COMMON ARTERIES THAT SERVE EFFECTED AREA
  - ANTICIPATE FAILURES OF ASSO. STRUCTURES / ACTION PLAN !

ECG EVALUATION

EMERGENT "CATH LAB" APPROACH

- RATE

- ☐ BRADY, NORMAL, or TACHY ? (PACE / CARDIOVERT)
- ☐ HOW WILL RATE EFFECT PT'S HEMODYNAMIC STATUS ?

- QRS WIDTH

- ☐ PACEMAKER RHYTHM (USELESS FOR STEMI / ISCHEMIA EVAL.)
- ☐ LBBB (NEW LBBB vs. PREVIOUSLY DIAGNOSED ? - LOW EF ?)
- ☐ VENTRICULAR RHYTHM ? (V-TACH: MONO or POLYMORPHIC)
- ☐ DELTA WAVES ?!? (W-P-W: NO AV NODAL BLOCKERS !!!!)
- ☐ ACUTE HYPERKALEMIA ? (TALL, PEAKED T WAVES)
- ☐ PROLONGED Q-T INTERVAL ?
- ☐ BRUGADA SYNDROME ? (RBBB, V1-V3 "TRIANGULAR" S-T ELEV.)

- ISCHEMIA / INFARCTION / NECROSIS (EVALUATION of J POINT, S-T SEGMENTS, T WAVES)

- ☐ IDENTIFY AREA OF HEART INVOLVED
- ☐ IDENTITY SUSPECTED "CULPRIT" ARTERY
- ☐ CONSIDER SIZE OF MI (CARDIOGENIC SHOCK ?)
- ☐ ANTICIPATE FAILURE OF ASSOCIATED STRUCTURES
- ☐ SIGNIFICANT Q WAVES ? - OLD MI vs. CURRENT EVOLVING MI

- AXIS

- ☐ ROTATION: LATE R WAVE PROGRESSION - OLD ANTERIOR MI ?
  EARLY R WAVE PROGR. - OLD POSTERIOR MI ?

- then CONTINUE WITH TRADITIONAL FORMAT . . .

THE COMPUTER IS VERY GOOD, BUT . . . .

ID:999999999 12:05:23

86 yr
Male Hispanic

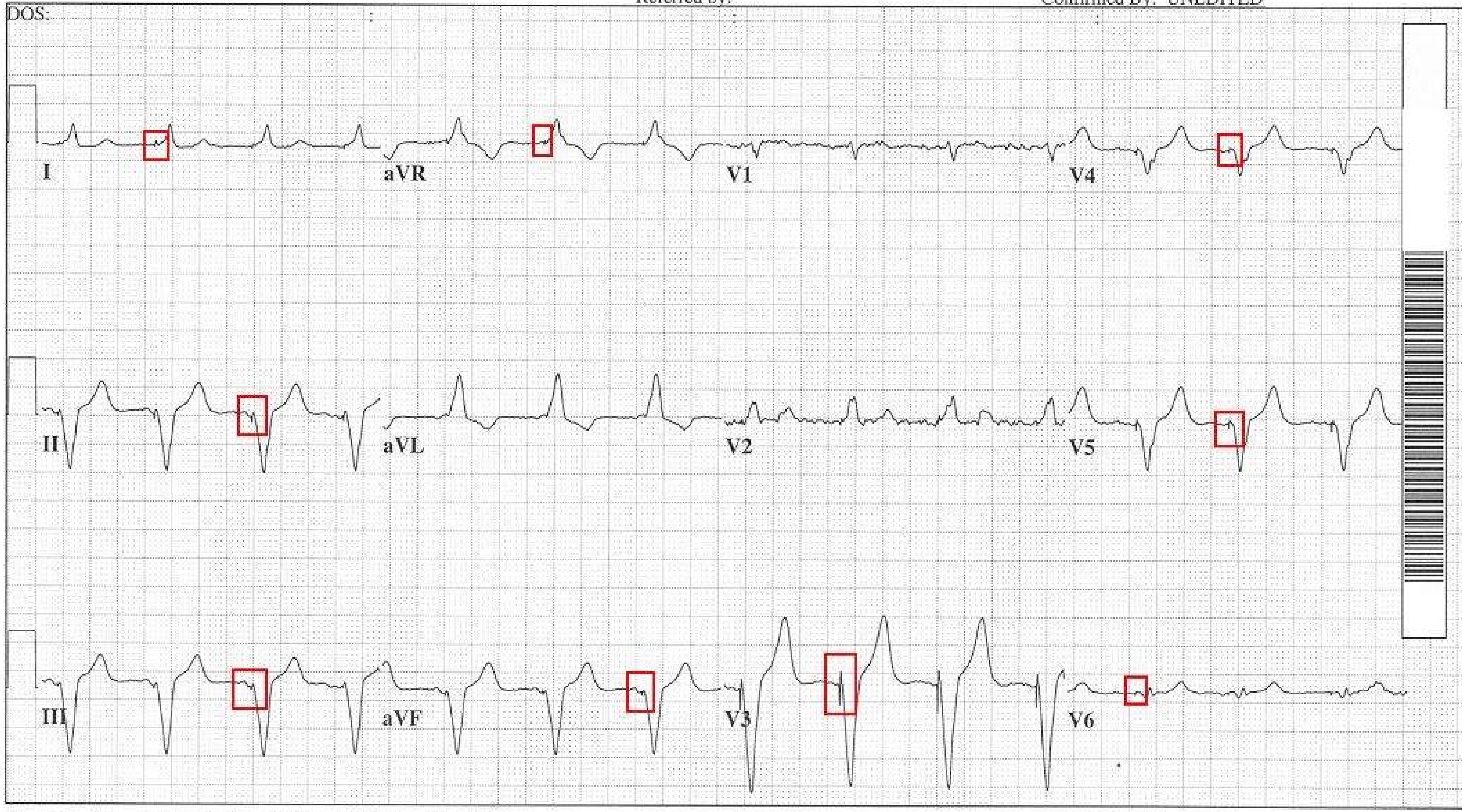
Room:ER
Loc:3 Option:23

Vent. rate	83	BPM
PR interval	*	ms
QRS duration	150	ms
QT/QTc	416/488	ms
P–R–T axes	* –76	89

**UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION
Undetermined rhythm
Non–specific intra–ventricular conduction block
Abnormal ECG
When compared with ECG of 09–JUN–2001 18:11,
Current undetermined rhythm precludes rhythm comparison, needs review
QRS duration has increased
Non–specific change in ST segment in Lateral leads ...

COMPUTER MISDIAGNOSIS DESPITE VISIBLE SPIKES IN 9 of 12 LEADS

Referred by: Confirmed By: UNEDITED



25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 12 EID:16 EDT:

EKG CLASS #WR03628072 16:43:31

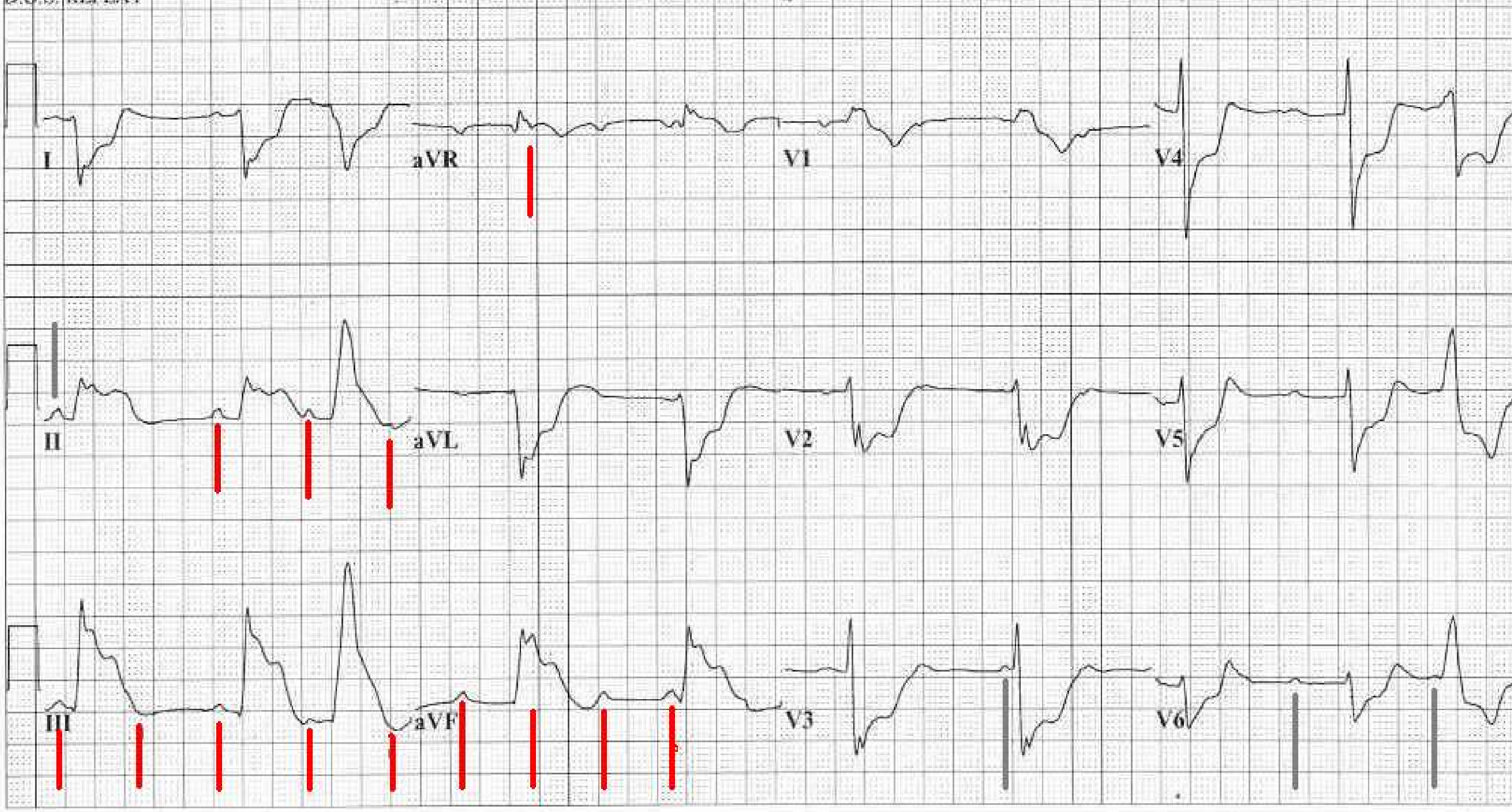
72 yr		Vent. rate		58	BPM	
Female	Caucasian	PR interval		*	ms	
		QRS duration		150	ms	
Room:S8		QT/QTc		538/528	ms	
Loc:3	Option:22	P-R-T axes	*	128	64	

Atrial fibrillation with slow ventricular response with premature ventricular or aberrantly conducted complexes
Right bundle branch block
Left posterior fascicular block
*** Bifascicular block ***
ST elevation consider inferior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
When compared with ECG of 16-OCT-1997 16:04 (UNCONFIRMED),

COMPUTER MISDIAGNOSES COMPLETE 3rd DEGREE HB as "atrial fibrillation w/ PVCs "

Referred by: Confirmed By:

D.O.S. REPEAT



25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 8 EID:16 EDT:

EKG CLASS #WR03416454

12:23:21

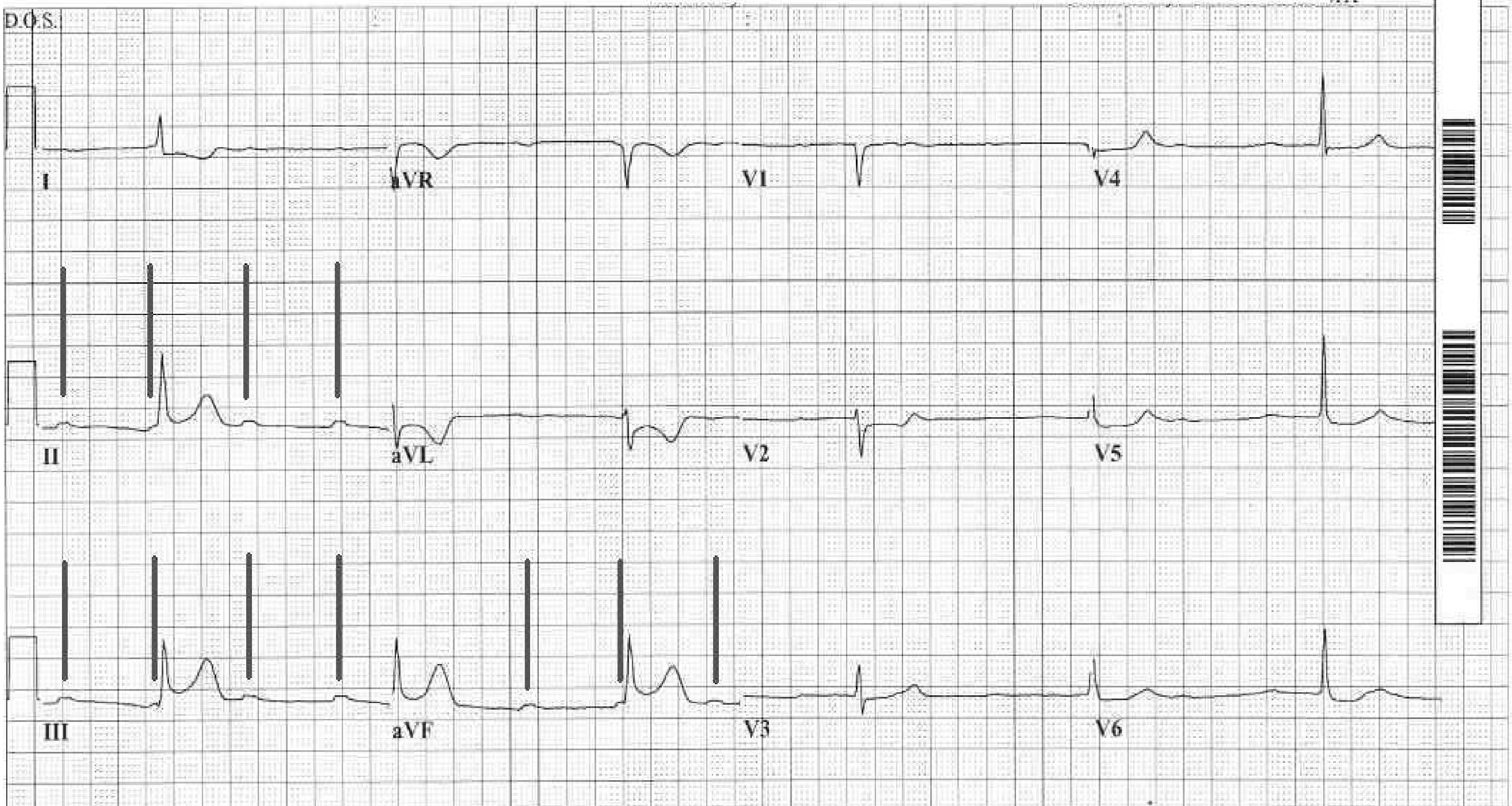
81 yr		Vent. rate	36	BPM
Female	Caucasian	PR interval	846	ms
		QRS duration	88	ms
Room:ER		QT/QTc	574/443	ms
Loc:3	Option:11	P-R-T axes	* 78	99

Marked sinus bradycardia with 1st degree A-V block
ST elevation consider inferior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
No previous ECGs available

?

COMPUTER MISDIAGNOSIS - Actual diagnosis - 3rd DEGREE HEART BLOCK !

TA



25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 1 EID:18 EDT:

ID: 4:26:07

54years
Male Caucasian

Room: A4
Loc: 3 Opt: 23

Technician:

DOS:

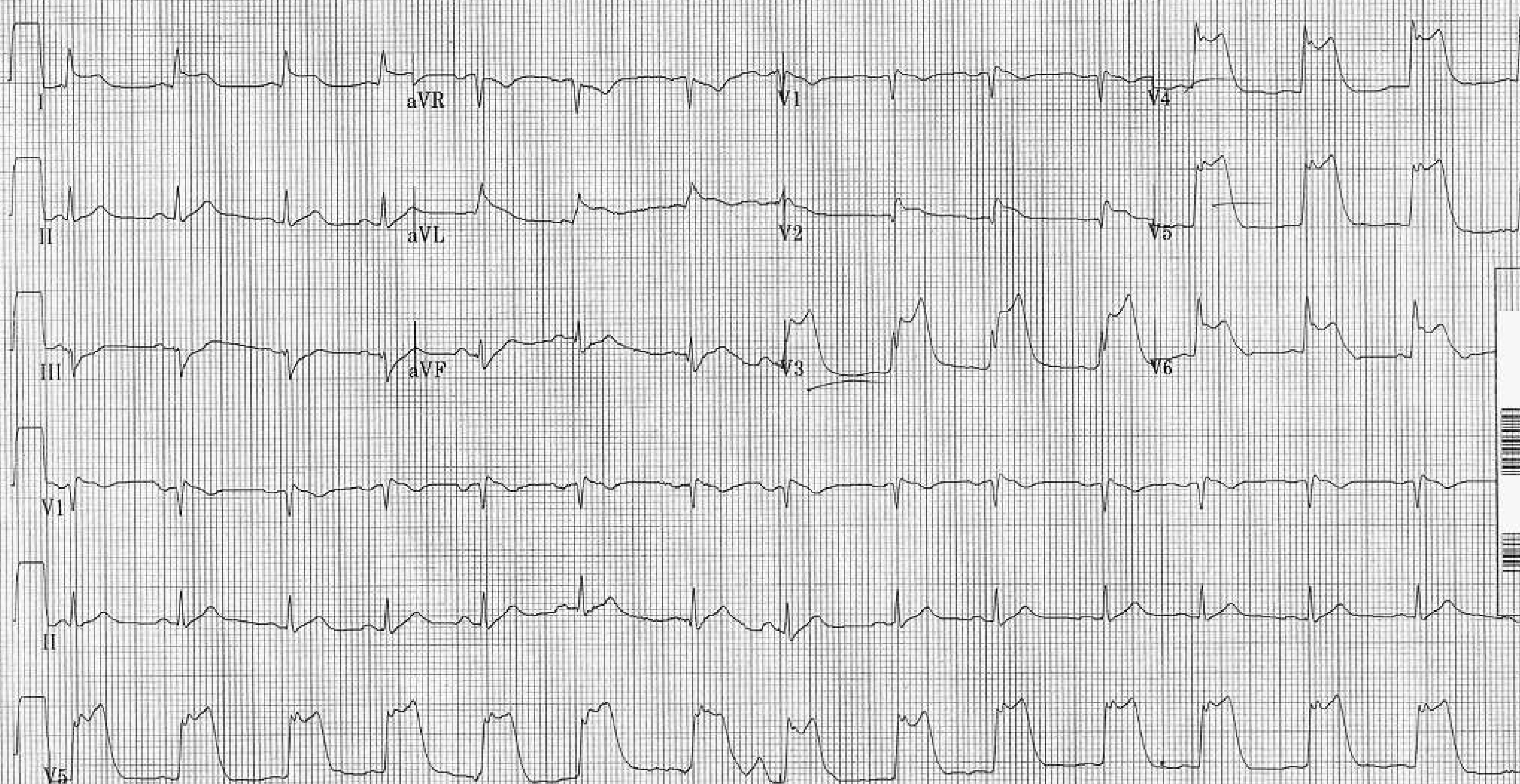
Vent. rate	85	bpm
PR interval	148	ms
QRS duration	72	ms
QT/QTc	344/409	ms
P-R-T axes	61 0 41	

*** Age and gender specific ECG analysis ***
Normal sinus rhythm
~~Acute pericarditis~~
Abnormal ECG

Antlat MI

? ACUTE PERICARDITIS ? ?
. . . . "YEAH, RIGHT !"

Referred by: Unconfirmed



40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MAC5K 006A 12SL™ v233

ID: 30-Sep-2002 4:04:35

54years
Male Caucasian
Room:
Opt:
Technician: **EKG CLASS #WR03999999B**

Vent. rate 107 bpm
PR interval * ms
QRS duration 162 ms
QT/QTc 342/456 ms
P-R-T axes * 35 131

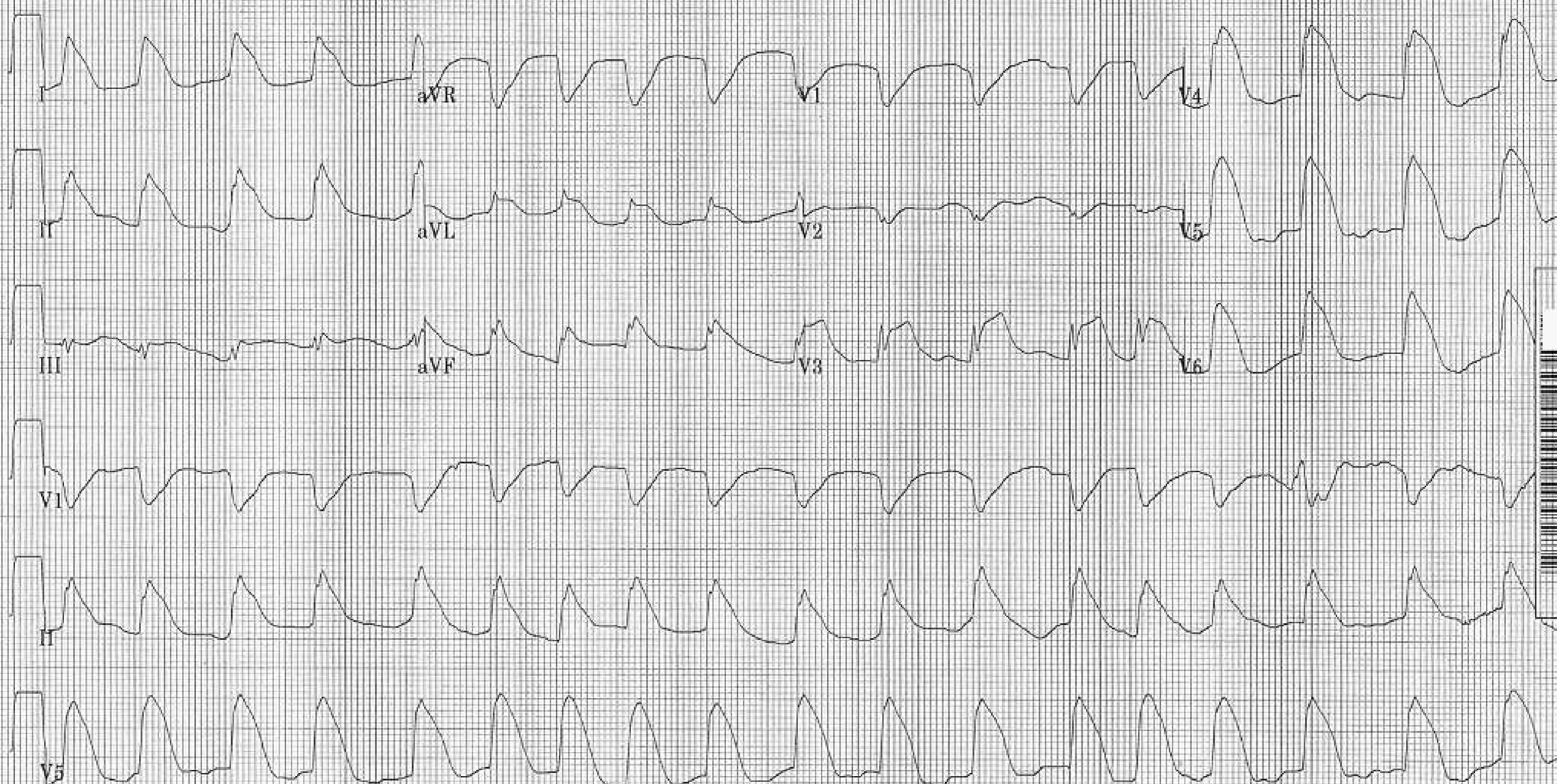
*** Age and gender specific ECG analysis ***
Atrial fibrillation with rapid ventricular response
Left bundle branch block
Abnormal ECG

#1

Oh Really?

Referred by: Unconfirmed

DOS:



40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MAC5K 006A 12SL™ v233

KENDALL MEDITRACE

ID: 30-Sep-2002 4:04:35

54years
Male Caucasian
Room:
Opt:

Vent. rate 107 bpm
PR interval * ms
QRS duration 162 ms
QT/QTc 342/456 ms
P-R-T axes * 35 131

*** Age and gender specific ECG analysis ***
Atrial fibrillation with rapid ventricular response
Left bundle branch block
Abnormal ECG

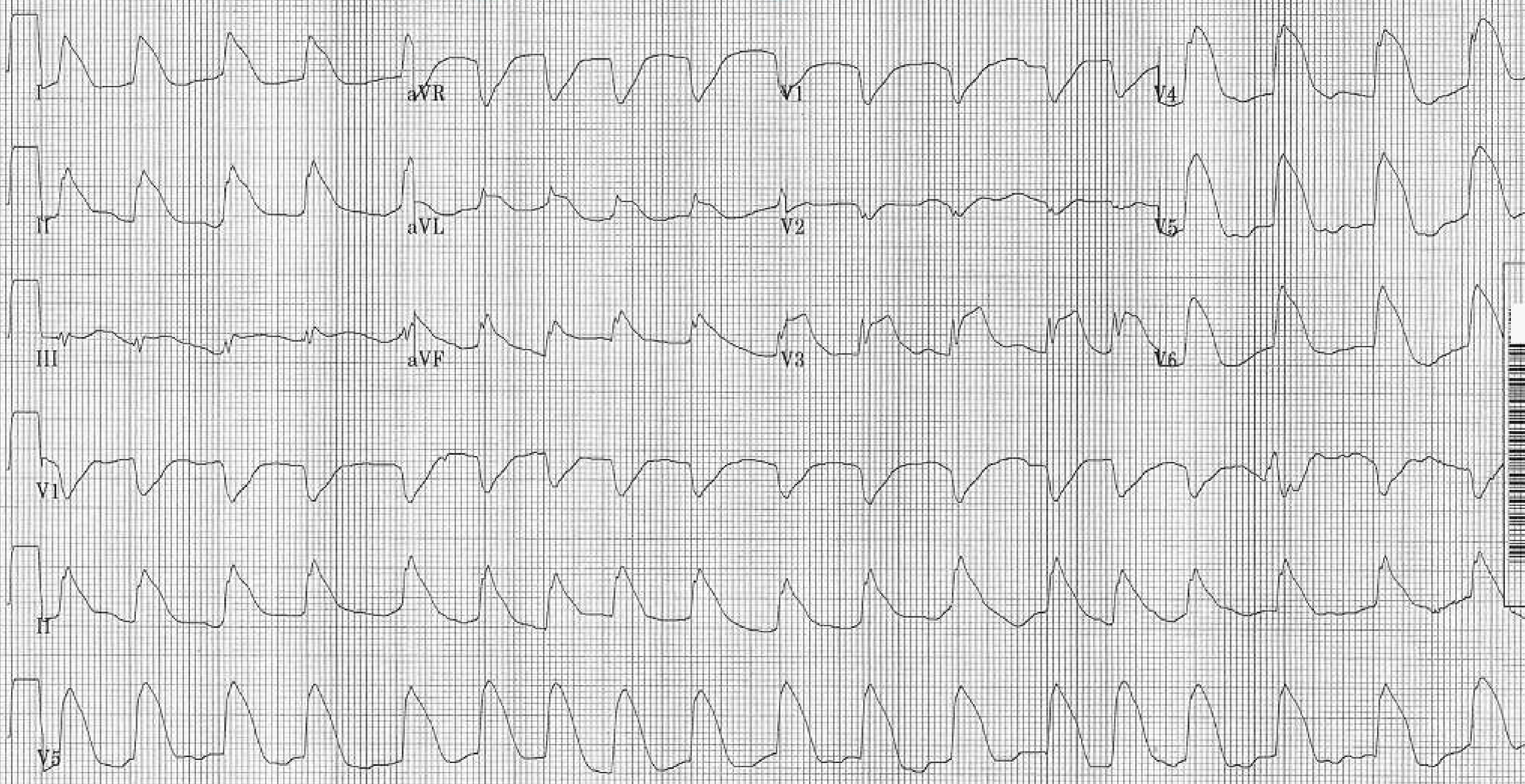
#1 0445

Oh Really?

ACUTE (MASSIVE) ANTERIOR -INFERIOR-LATERAL INFARCTION - Total Left Main Occlusion. Pt. expired minutes $\bar{p}$ EKG recorded.

firmed

DOS:



40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MAC5K 006A 12SL™ v233

KENDALL MEDITRACE

MOM and DAD at Lee's Diner, York, PA 2006