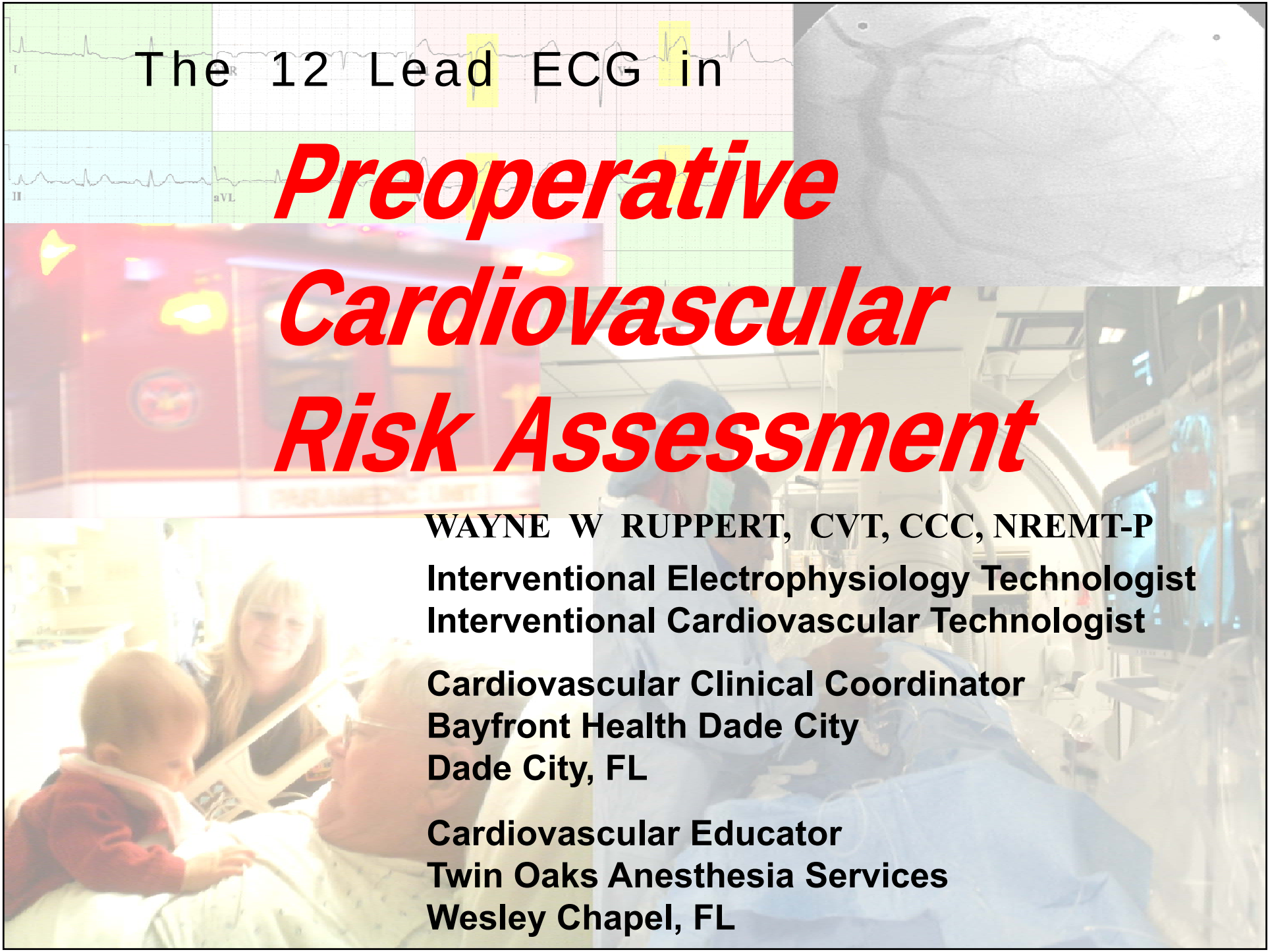


The 12 Lead ECG in

Preoperative Cardiovascular Risk Assessment

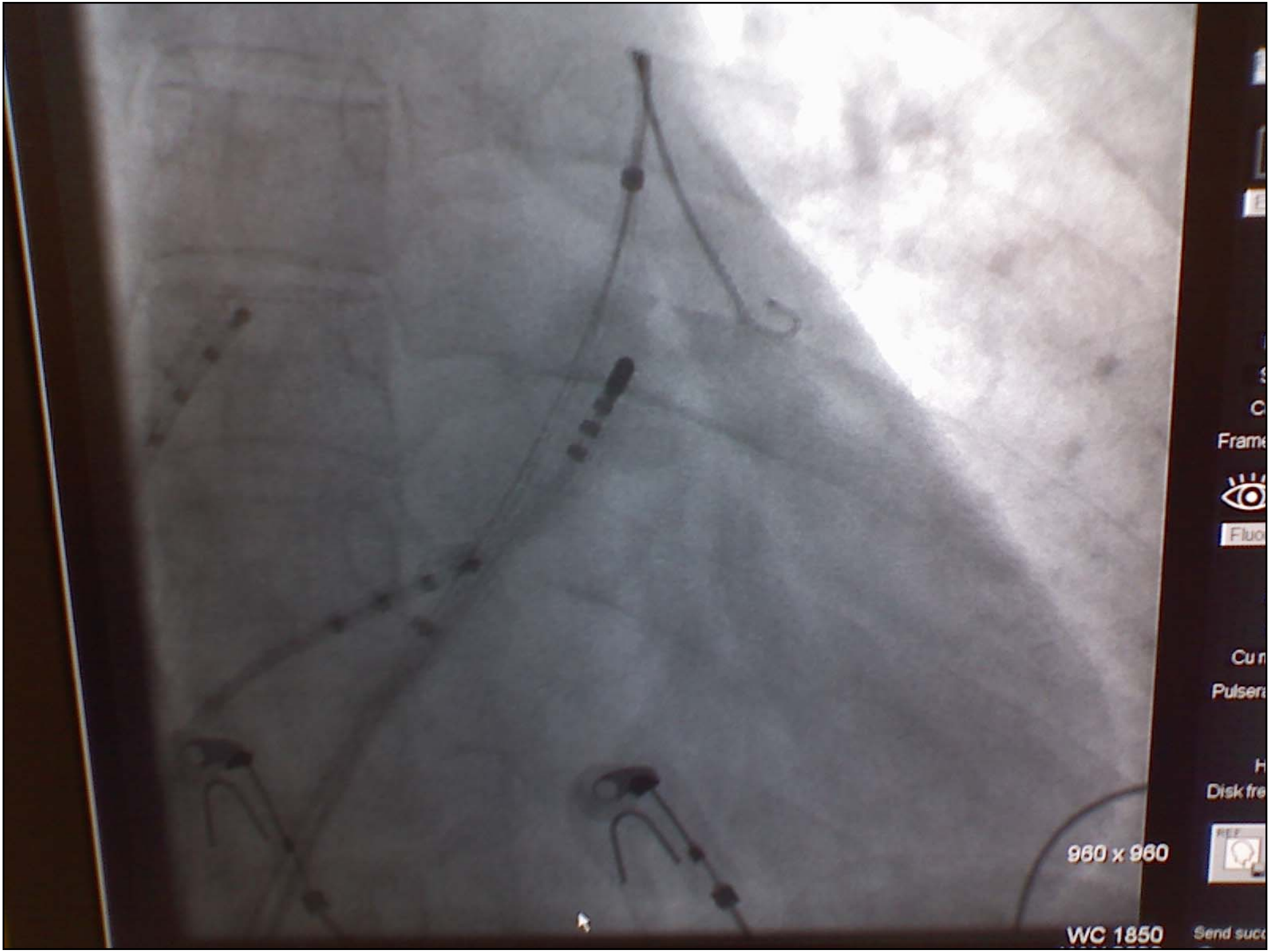
WAYNE W RUPPERT, CVT, CCC, NREMT-P

Interventional Electrophysiology Technologist
Interventional Cardiovascular Technologist

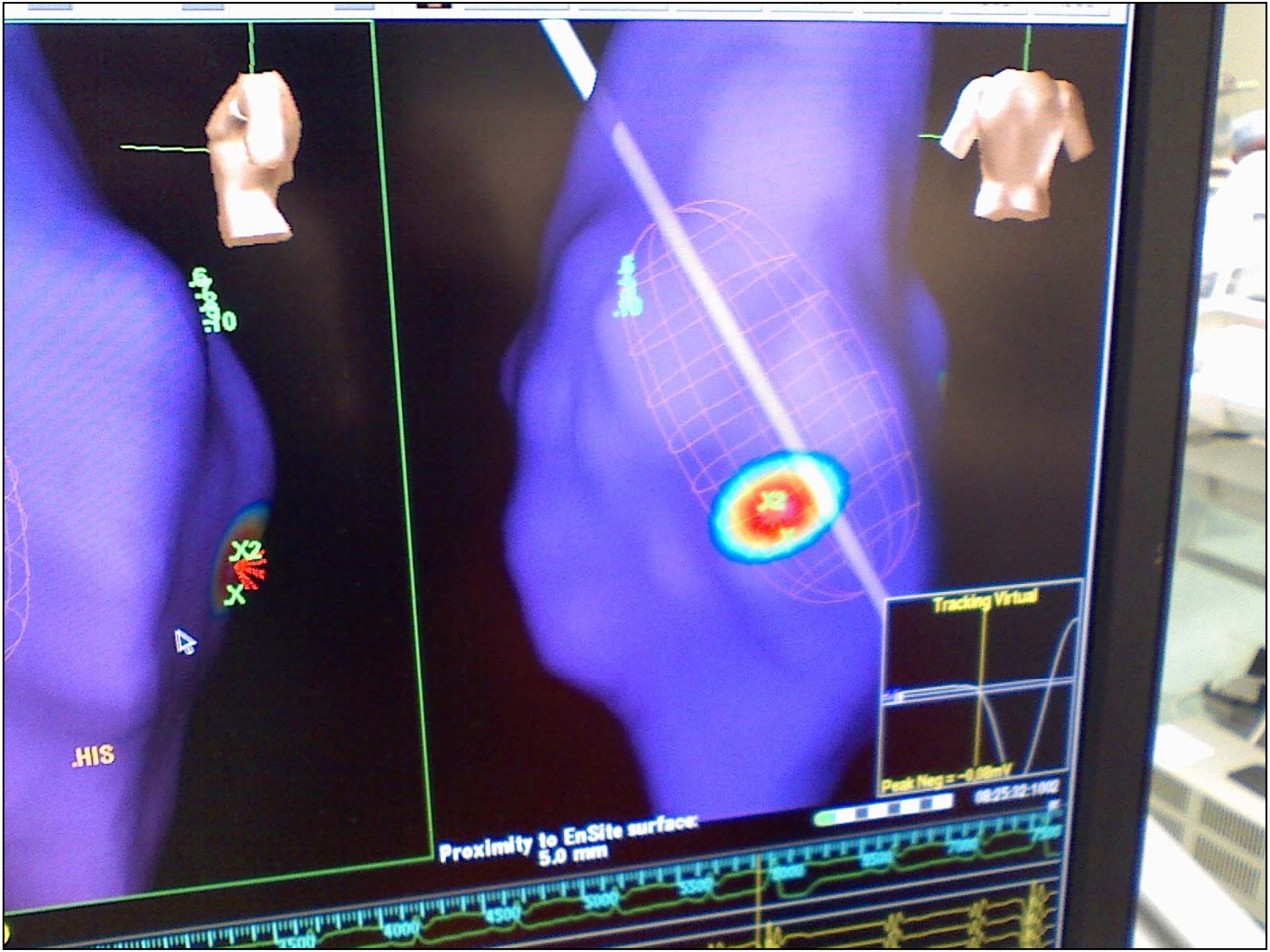
Cardiovascular Clinical Coordinator
Bayfront Health Dade City
Dade City, FL

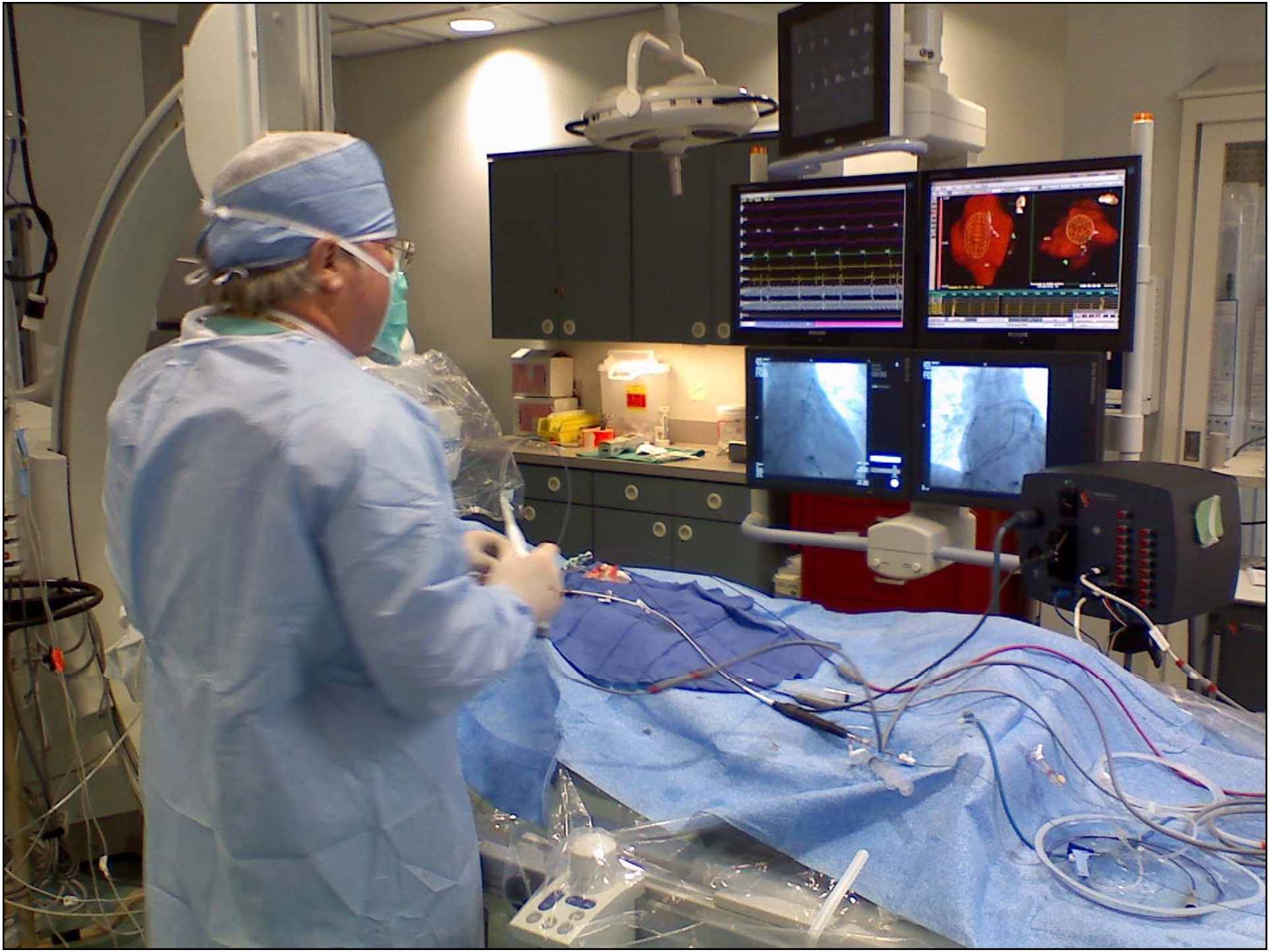
Cardiovascular Educator
Twin Oaks Anesthesia Services
Wesley Chapel, FL

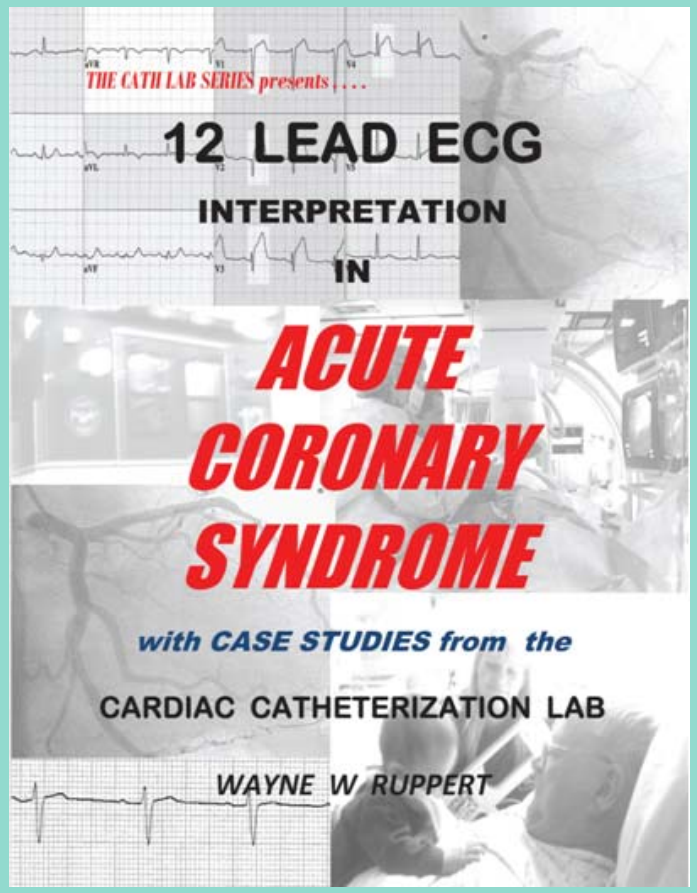
Paramedics Christ Megoulas and Wayne Ruppert, Hershey, PA Fire Department, 1982


960 x 960
WC 1850

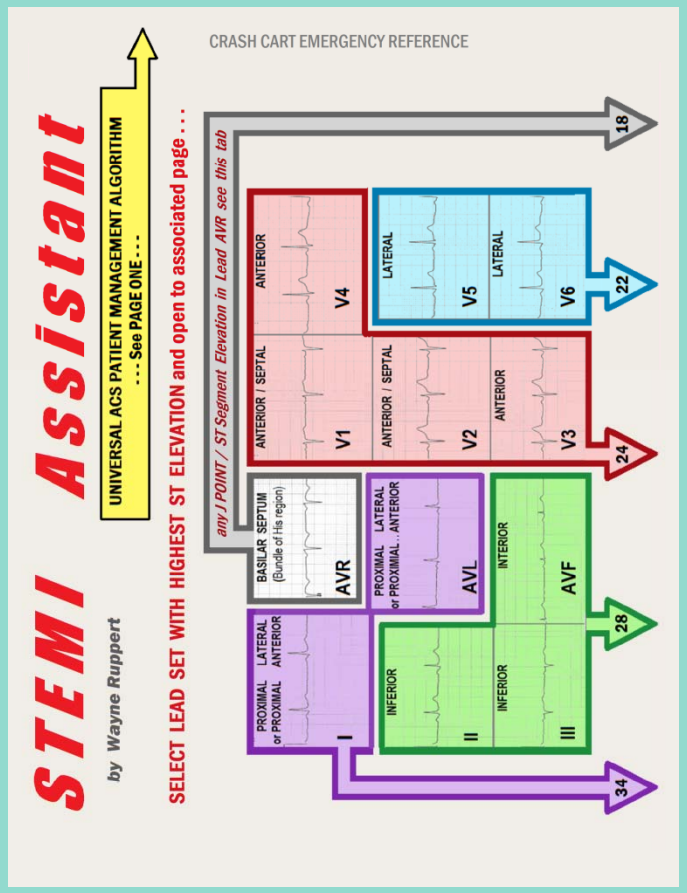

Arrhythmia Induction RVA_d S1=530 S2=370
PHILIPS
PHILIPS


Tracking Virtual
Proximity to EnSite surface:
5.0 mm





Published 2010



Published 2015

TriGen Publishing: Marketed and Distributed worldwide by The Ingram Book Company

www.ECGtraining.org

Wayne Ruppert bio:

2012 – Present: Bayfront Health Dade City
Cardiovascular Clinical Coordinator
Stroke Coordinator
Principal Investigator, "Simple Acute Coronary Syndrome (SACS Risk Stratification Score – Scientific Validation Study and Comparison to Modified TIMI and HEART ACS Risk Stratification Scores, NIH #NCT

1994 – 2012: St Joseph's Hospital, Tampa, FL
Interventional Cardiovascular Technologist
Cardiac Electrophysiology Technologist
12 Lead ECG Instructor, Education Department

2010: Author, Editor, "12 Lead ECG Interpretation in Acute Coronary Syndrome with Case Studies from the Cardiac Catheterization Lab," 310 page textbook marketed by Ingram Book Company.

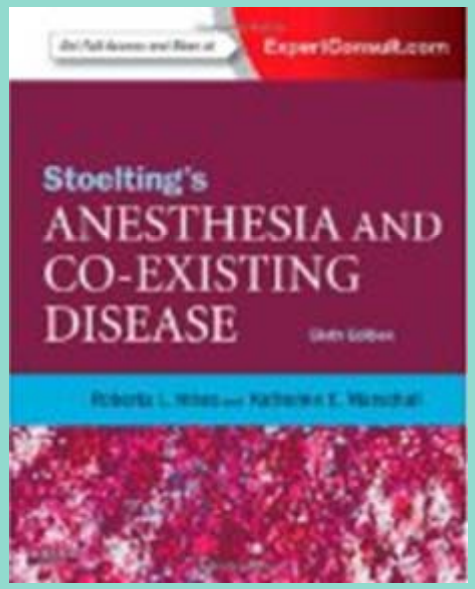
-1982 – present, Paramedic (National Registry, Pennsylvania, Florida)
-1982 - present, AHA ACLS Instructor
-1988 – present, AHA PALS Instructor

Course Reference Sources:

JACC Journals

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

J Am Coll Cardiol. 2014;64(22):e77-e137. doi:10.1016/j.jacc.2014.07.944



Stoelting's Anesthesia and Co-Existing Disease, 5th Edition

EXPERT CONSULT - ONLINE AND PRINT
By Roberta L. Hines, MD and Katherine E. Marschall, MD

Course Syllabus:

- Pre-operative Verbal History for Cardiovascular Disorders
- The Normal ECG
- Bundle Branch Blocks
- Myocardial Infarction
- Myocardial Ischemia
- Old MI
- Brugada Syndrome
- Long QT Syndrome (LQTS)
- Wolff-Parkinson-White Syndrome (WPW)
- Arrhythmogenic Right Ventricular Dysplasia (ARVD)
- Pericarditis / Myocarditis
- Hypertrophy
    - Hypertrophic Cardiomyopathy (HCM)
    - Valvular Disorders
    - Cor Pulmonale
- Atrial Fibrillation /Flutter

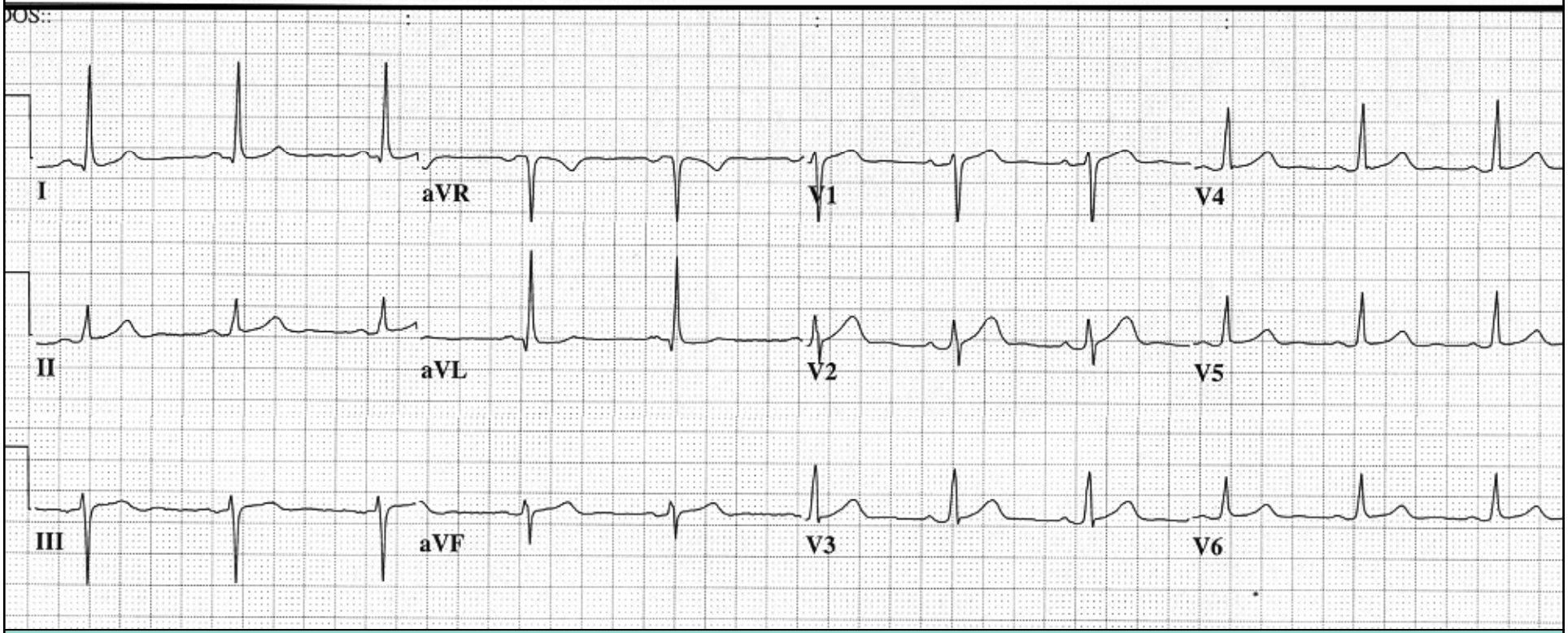
Preoperative CV Diagnostic Tests:

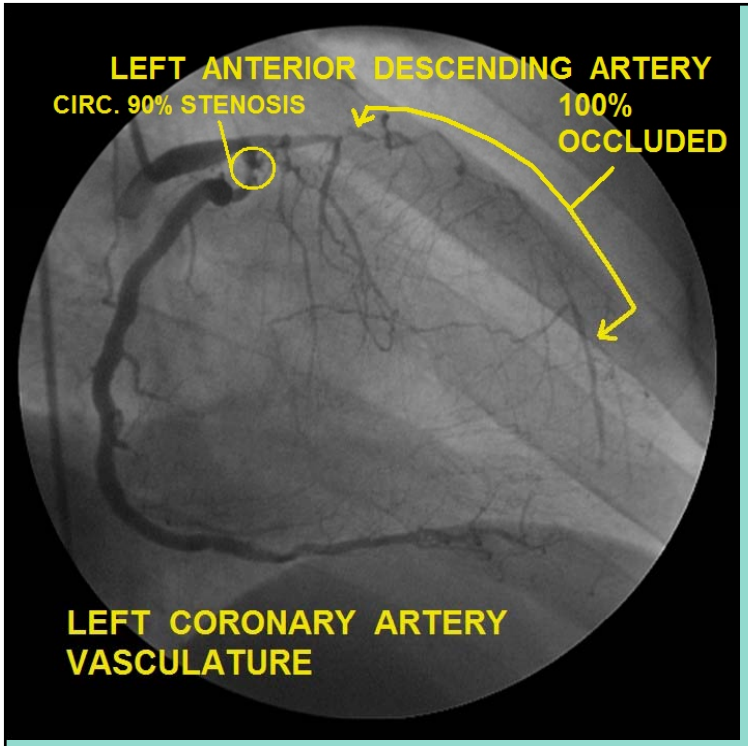
- 12 Lead ECG
- Echocardiogram
- Stress Test
- CT / MRI
- Cardiac Catheterization

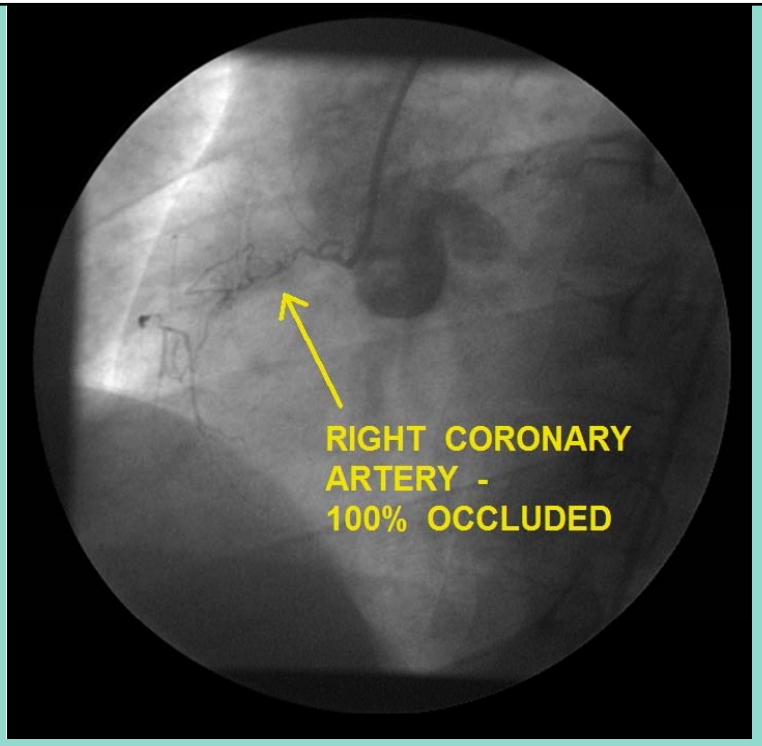
The need for PREOPERATIVE CAD Risk Factor Assessment . . . .

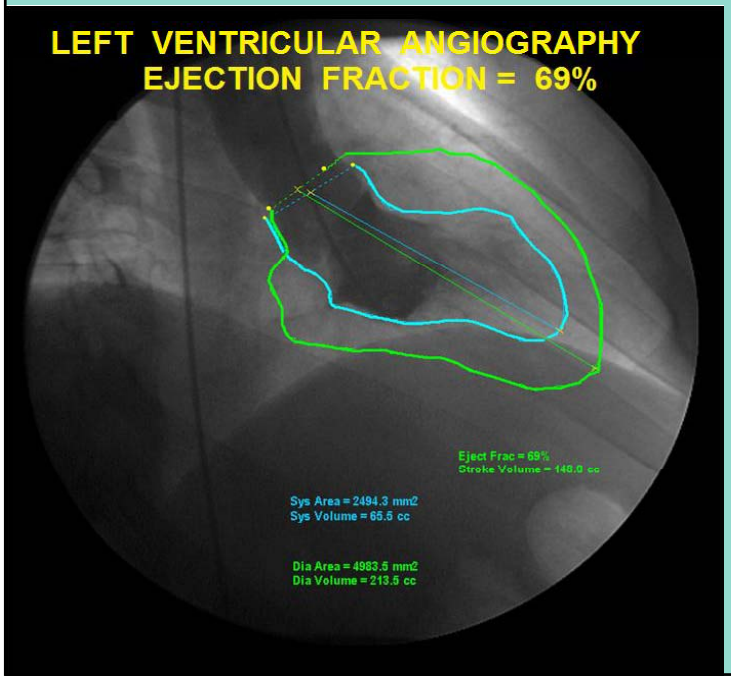
Does the NORMAL ECG rule out OBSTRUCTIVE Coronary Artery Disease ??

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





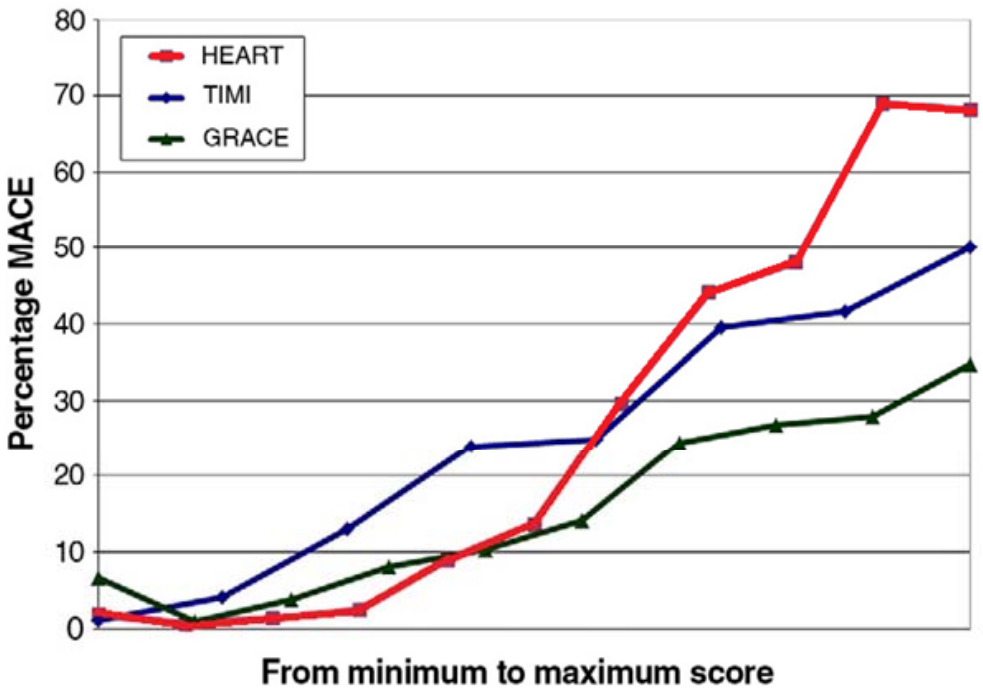




"The WORST coronary vasculature I have seen in nearly 20 years -- an estimated 12,000 cases -- in the CATH LAB . . . And this patient's 12 Lead ECG was essentially normal !!"

ACS Risk Stratification: HEART Score

History	Highly suspicious	2
	Moderately suspicious	1
	Slightly/not suspicious	0
ECG	ST Depression	2
	Non-specific repol. Abnormality.....	1
	Normal	0
Age	65 + ...	2
	45-65	1
	< 45	0
Risk Factors	3 + Risk Factors –or-- known CAD	2
	1 or 2 Risk Factors	1
	No known Risk Factors	0
Troponin	3X or more normal limit	2
	2 x normal limit	1
	Normal	0



C-Statistic scores achieved in this study:

HEART: 0.83
TIMI: 0.75
GRACE: 0.70

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

CLASS IIa

1. A validated risk-prediction tool can be useful in predicting the risk of perioperative MACE in patients undergoing noncardiac surgery (37,114,115). (Level of Evidence: B)

Regarding ACS Risk Stratification tools:

- Modified TIMI ACS Score has been "national standard" for several years
- "**Modified TIMI Risk Score CANNOT be used to identify low-risk chest pain in the ED**"
  Emerg Med J 2014 Apr; 31 (14):281-5
- "Prospective **Validation of HEART Score for Chest Pain patient in the ED**,"
  Int J Cardiol 2013 Oct 3;168(3):2153-8
- Study to validate Simple Acute Coronary Syndrome (SACS) Score + comparison to HEART and Modified TIMI: www.clinicaltrials.gov NIH Study ID # NCT02358148

The Simple Acute Coronary Syndrome (SACS) Score

Developed in 2009 from noting correlations between patients' SYMPTOMS, ECG RESULTS, RISK FACTOR PROFILE and CARDIAC MARKERS in approximately 12,000 patients.

A scientific study to VALIDATE this score, and to compare its accuracy and reliability to the Modified TIMI and HEART Scores for predicting the presence of OBSTRUCTIVE CORONARY ARTERY DISEASE is in progress at Bayfront Health St Petersburg and Bayfront Health Dade City.

NIH Study ID # NCT02358148
www.clinicaltrials.gov

Simple Acute Coronary Syndrome Score:

❑ SYMPTOMS		POINTS ASSIGNED	TOTAL POINTS
CHECK ONE:	◆ **TYPICAL ACS - eg:** - CHEST PAIN (pressure / heaviness / dull) (may radiate to neck/ shoulders/ jaw/ arm) - DYSPNEA (may or may not be present)	2	
	◆ **ATYPICAL ACS - eg:** EPIGASTRIC PAIN / UNUSUAL FATIGUE / WEAKNESS / DIZZINESS / DIB COLD SWEATS / NAUSEA / PALPITATIONS	1	
	◆ **NONE RELEVANT**	0	
❑ ECG			
CHECK ONE:	◆ **ST ELEVATION** (2010 AHA/ACC Criteria) ◆ **HYPERACUTE T WAVES** - and/or - ◆ **CONVEX ST SEGMENTS** ◆ **DYNAMIC ST SEGMENT** and/or **T WAVE CHANGES** IN SERIAL EKGs -- ANY of ABOVE in 2 or more contiguous leads ◆ **NEW or PRESUMABLY NEW LBBB**	2	
	◆ **ST DEPRESSION** (>0.5 mm @ J POINT) and/or ◆ **INVERTED or BIPHASIC T WAVES** and/or ◆ **PREVIOUSLY UNDIAGNOSED Q WAVES &/or ABNORMAL R WAVE PROGRESSION** (CONSISTENT WITH MYOCARDIAL INJURY /NECROSIS) (any of the above IN 2 or MORE CONTIGUOUS LEADS)	1	
	◆ **NORMAL or NON-DIAGNOSTIC EKG**	0	
❑ RISK FACTORS for CORONARY ARTERY DISEASE			
CHECK ALL THAT APPLY:	◆ **PREVIOUSLY DIAGNOSED CORONARY ARTERY DISEASE** (CAD) **and / or**	1	
	◆ **FAMILY HISTORY** — **3 or MORE RISK FACTORS:**		
	◆ **DIABETES**		
	◆ **↑ LDL and/or ↓ HDL**		
	◆ **SMOKING** — **NO Hx OF CAD & LESS THAN 3 RISK FACTORS:**	0	
	◆ **AGE: 65 or MORE**		
	◆ **HYPERTENSION**		
❑ CARDIAC MARKERS			
CHECK ONE:	◆ **TROPONIN** and/or **CK/MB** - ANY ELEVATION ABOVE YOUR INSTITUTION'S NORMAL RANGE:	1	
	◆ **NORMAL**	0	
TOTAL SCORE →			

American Heart Association.
SCIENTIFIC SESSIONS 2015
November 7-11 | Orlando, Florida
scientificsessions.org

Session Summary:

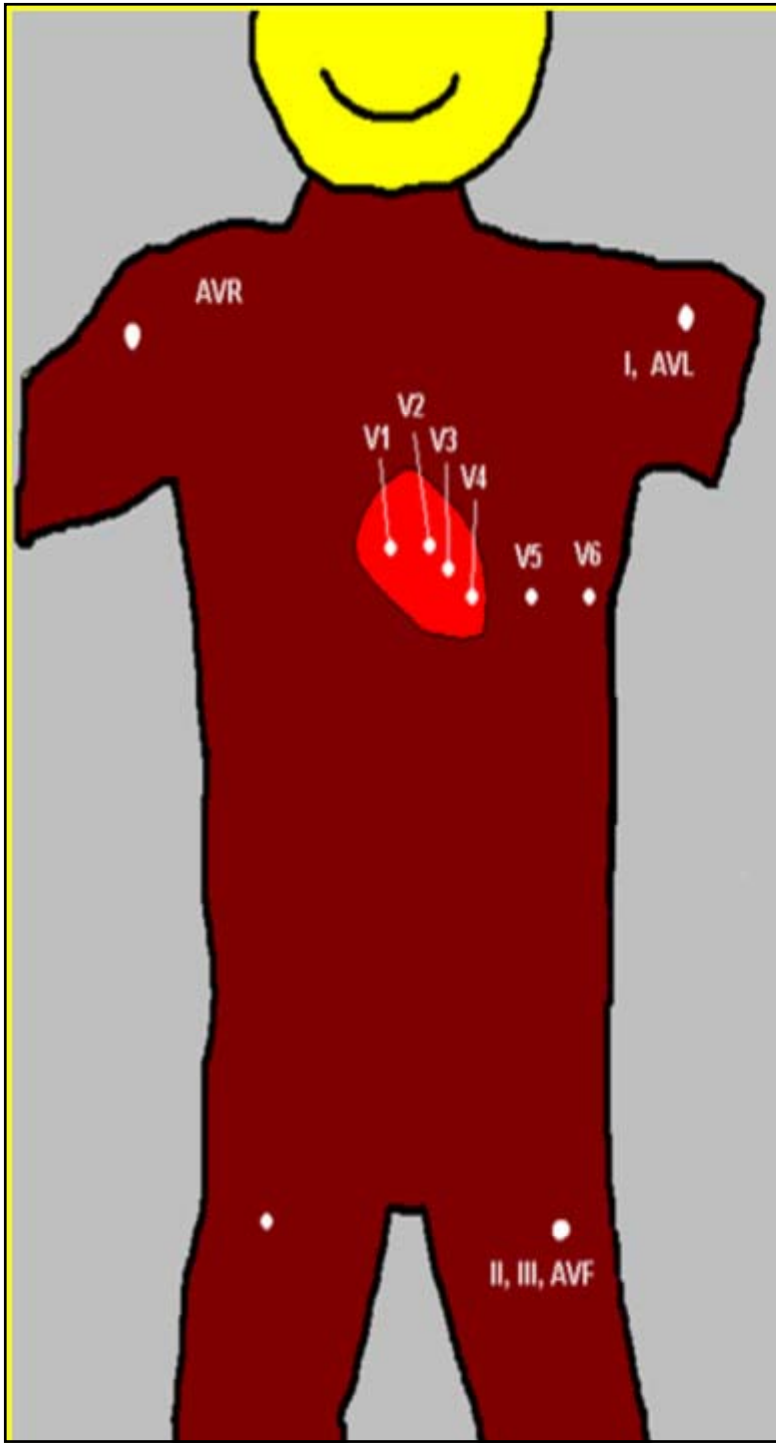
Session Type: Abstract Poster Session
Session Title: Clinical and Hospital-Based Observational Studies
Session Date and Time: Sunday Nov 8, 2015 9:00 AM - 6:45 PM
Abstract Title: Validation of the Simple Acute Coronary Syndrome (SACS) Score for Identifying Obstructive Coronary Artery Disease
Control Number: 20047
Presentation Number: S 3025
Board Number: 3025
Poster Presentation Time: 2:00pm - 3:15pm

HEART Score

+

SACS Score

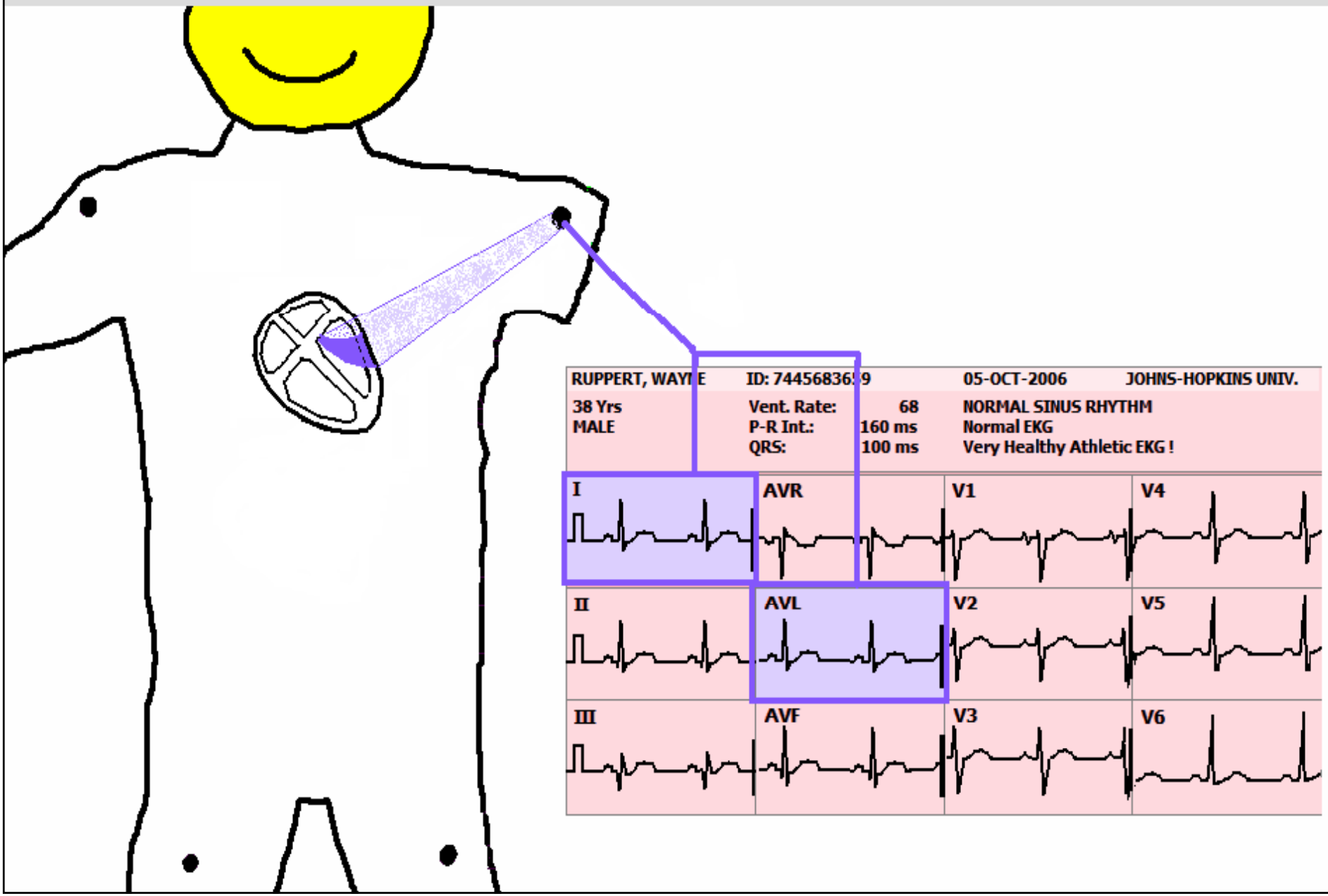
= **?**



AREAS VIEWED by 12 LEAD ECG

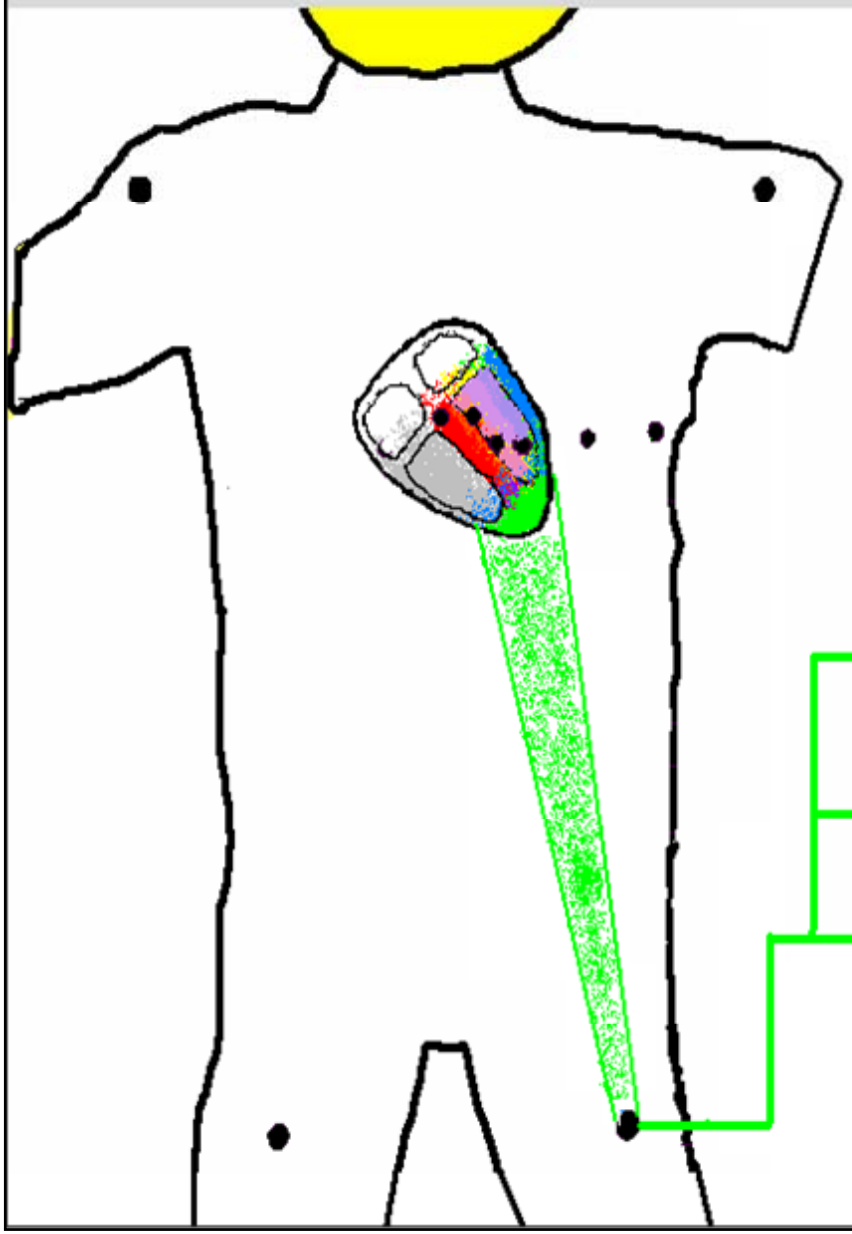
AVR	*BASILAR SEPTAL*
AVL, I	LATERAL ANTERIOR
V1, V2	ANTERIOR
	SEPTAL
	POSTERIOR (recip.)
V3, V4	ANTERIOR
V5, V6	LATERAL
II, III, AVF	INFERIOR

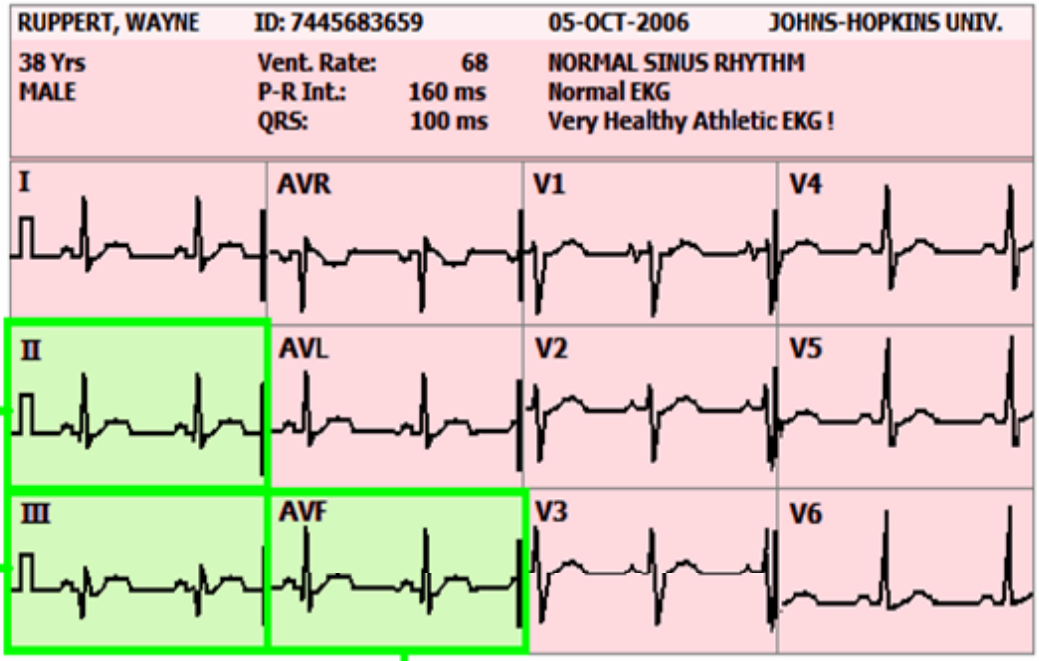
LEADS I and aVL view the ANTERIOR-LATERAL JUNCTION



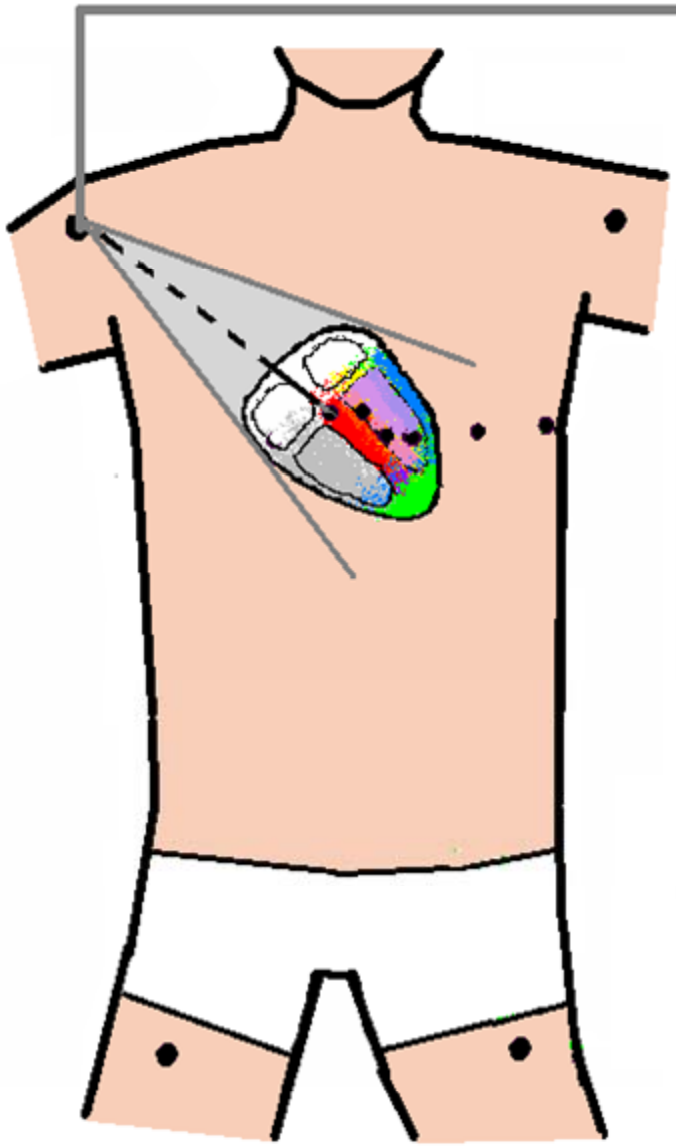
LEADS II, III, and aVF VIEW

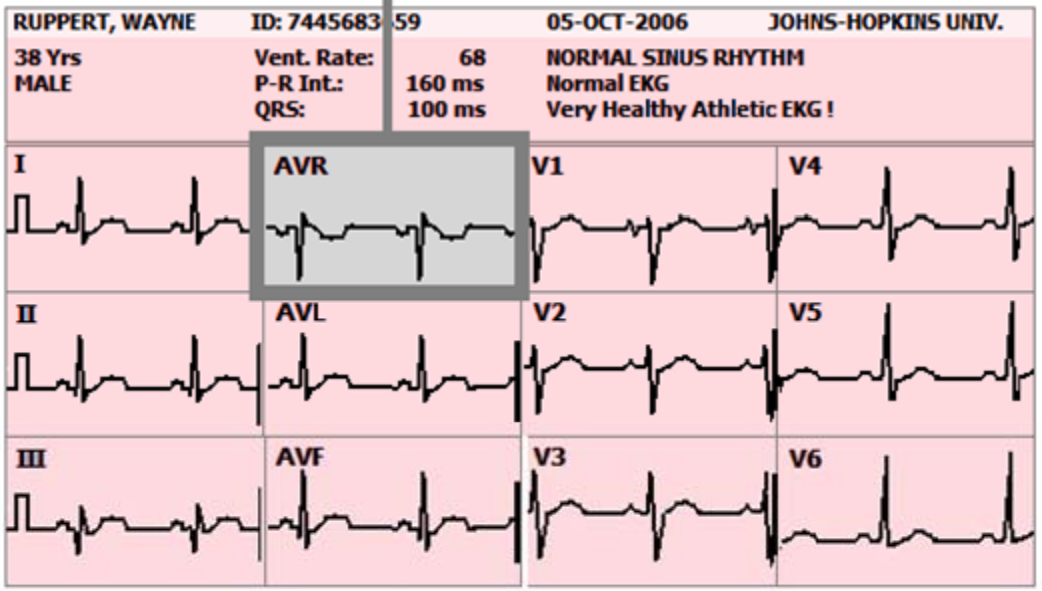
INFERIOR WALL of the LEFT VENTRICLE





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

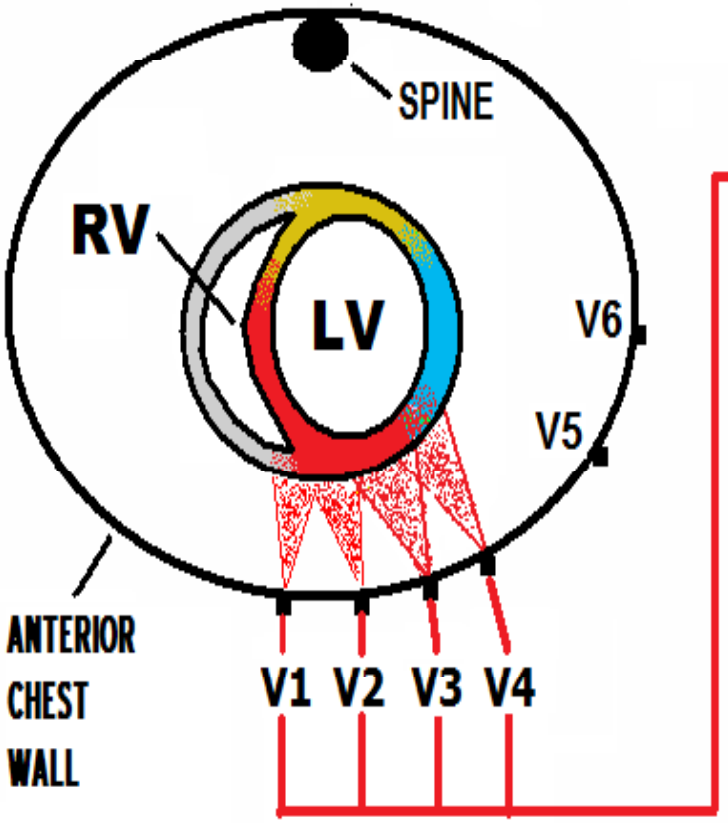




The LEFT MAIN CORONARY ARTERY provides the blood supply to the BASILAR SEPTUM.

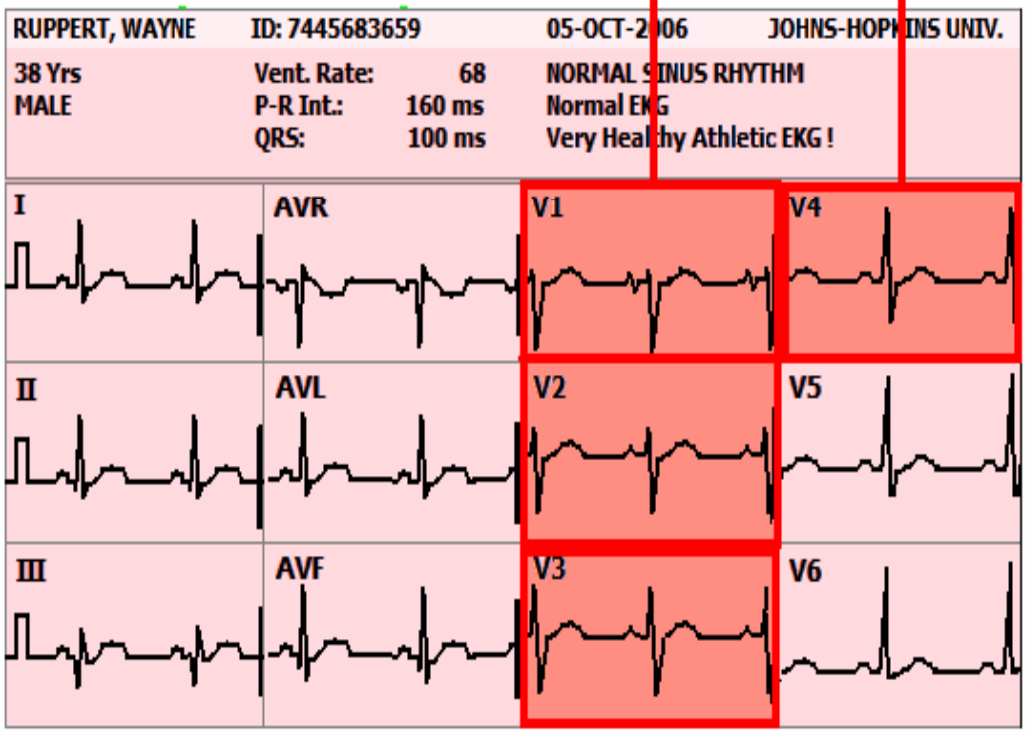
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL

of the LEFT VENTRICLE



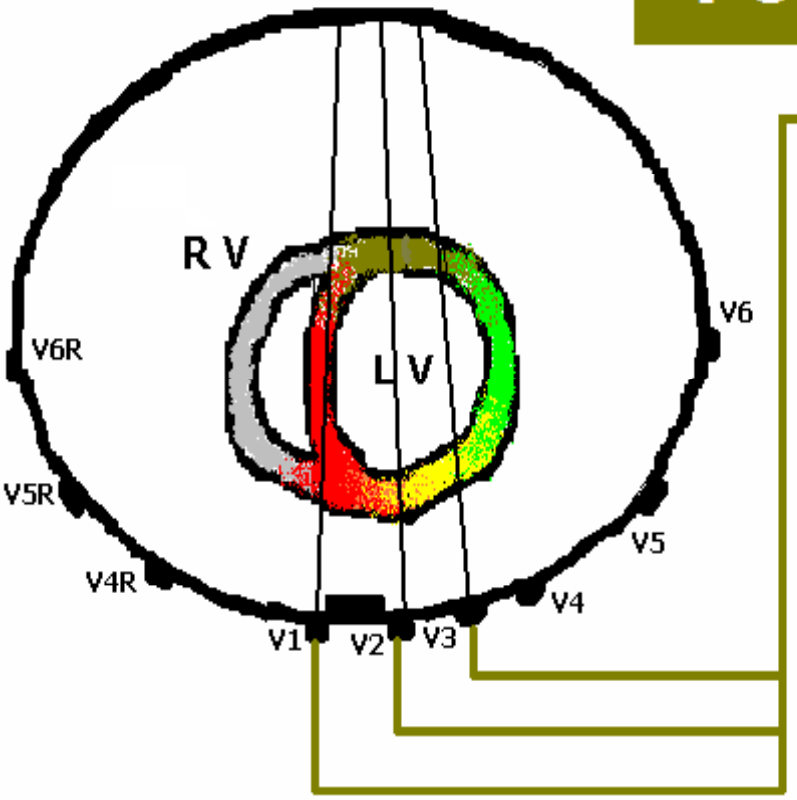
V1, V2 - ANTERIOR / SEPTAL

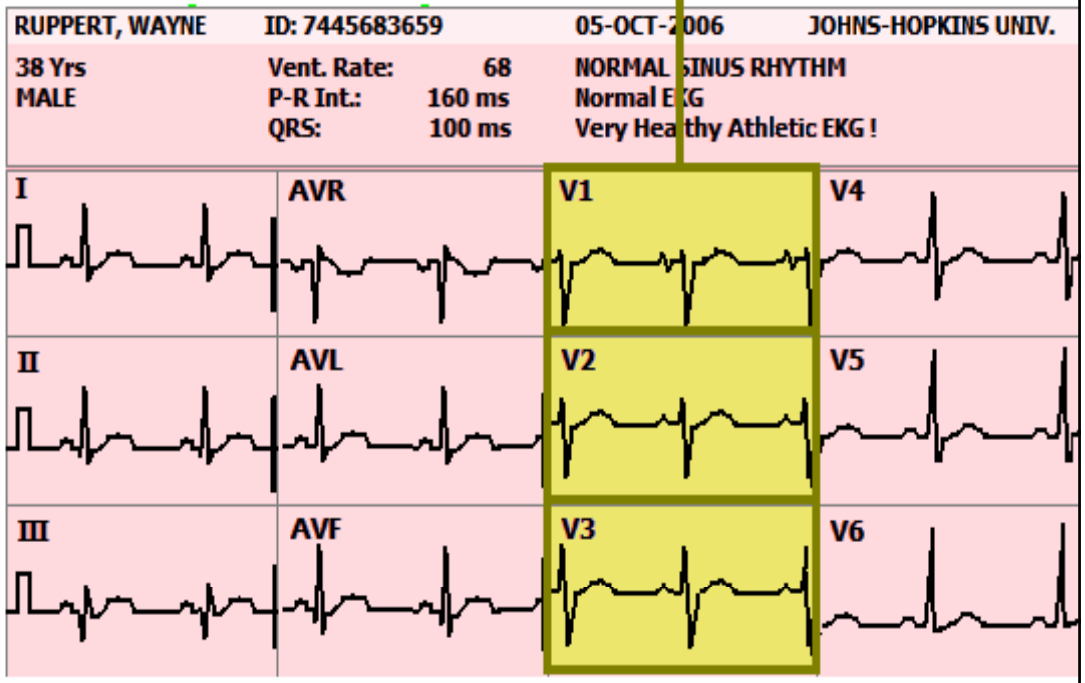
V3, V4 - ANTERIOR



LEADS V1 - V3 *view the*

POSTERIOR WALL



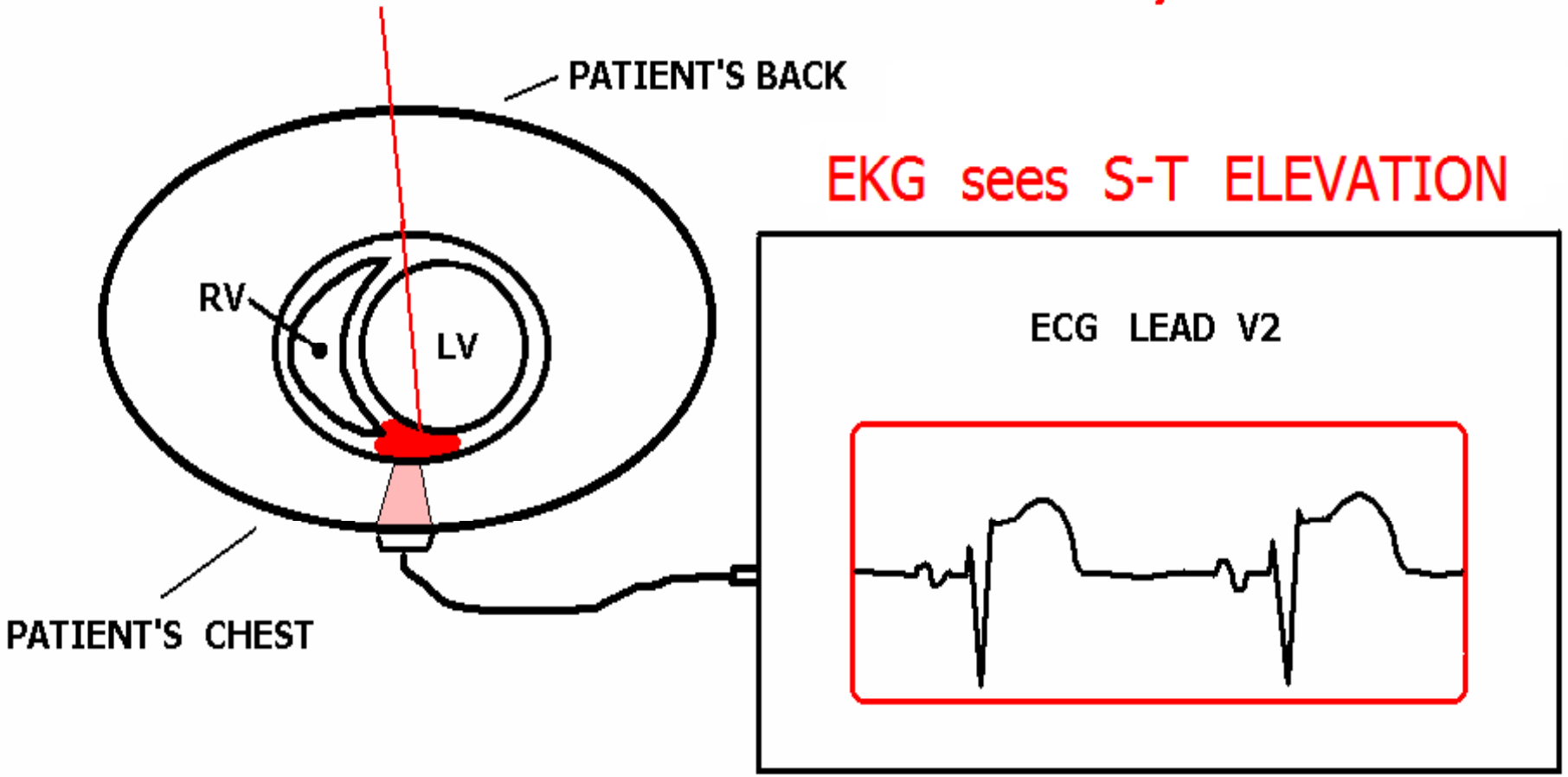


via RECIPROCAL CHANGES.

HOW EKG VIEWS INDICATIVE CHANGES

EXAMPLE:

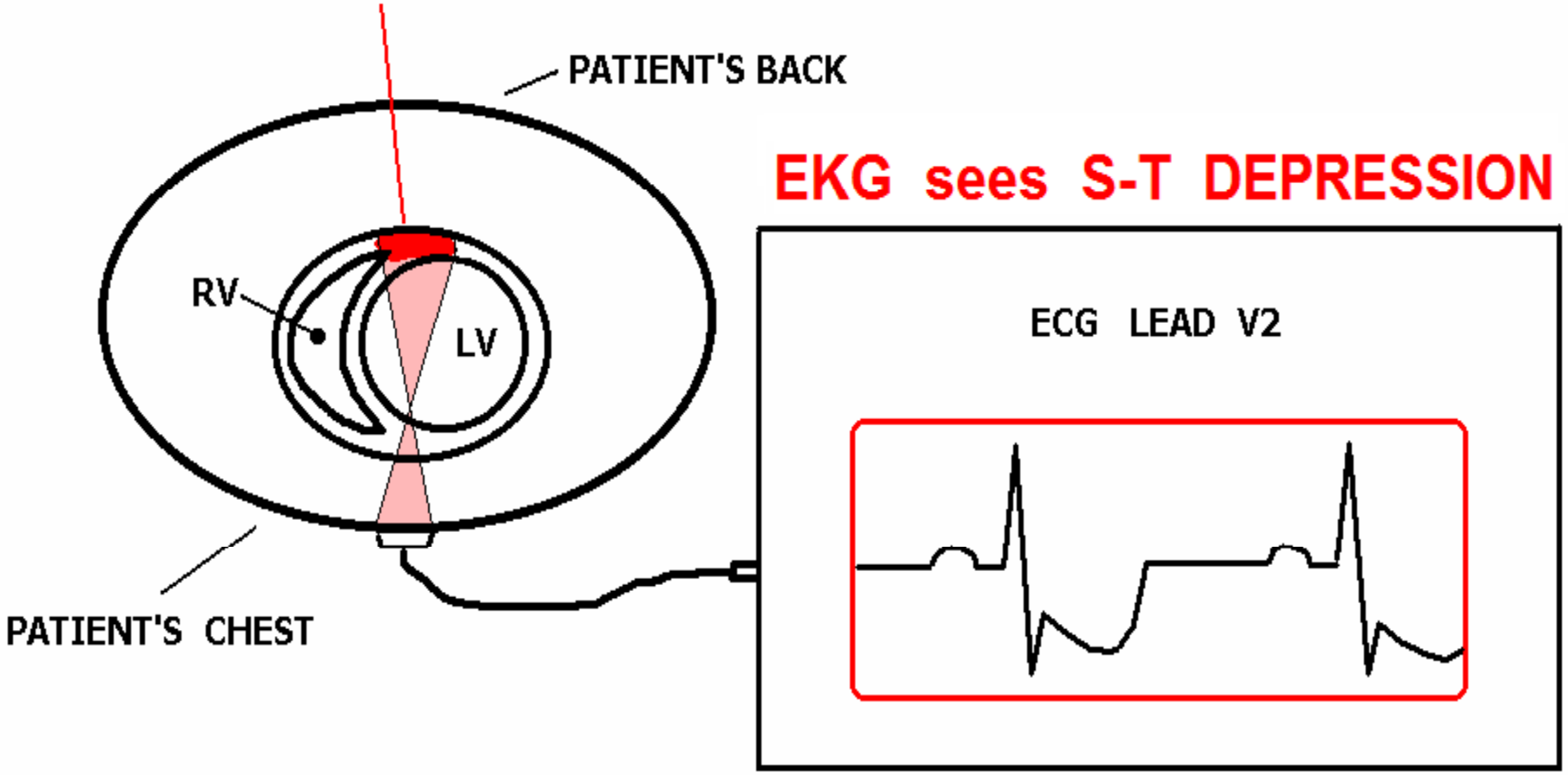
AREA OF ACUTE INFARCTION - ANTERIOR/SEPTAL



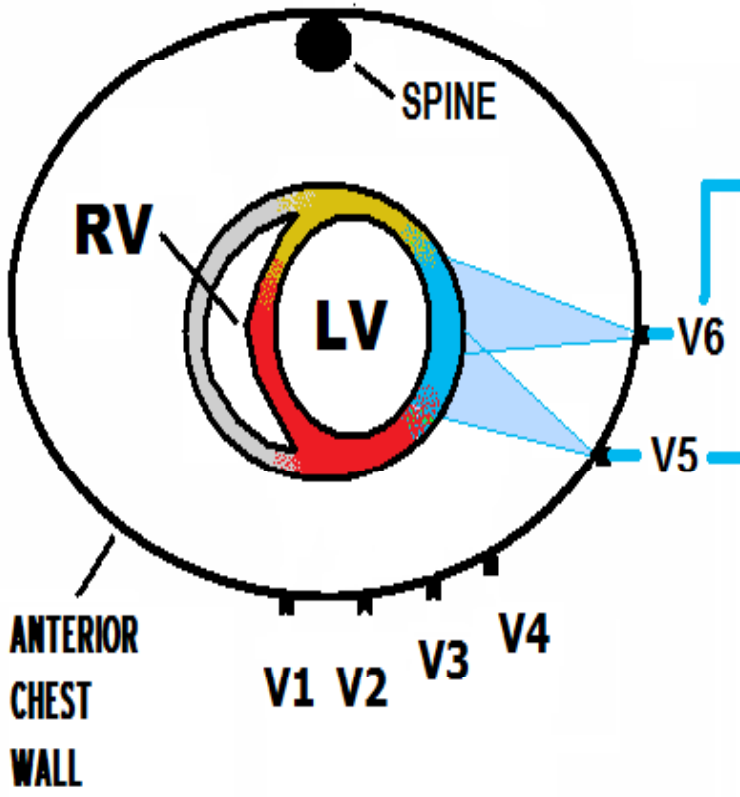
HOW EKG VIEWS RECIPROCAL CHANGES

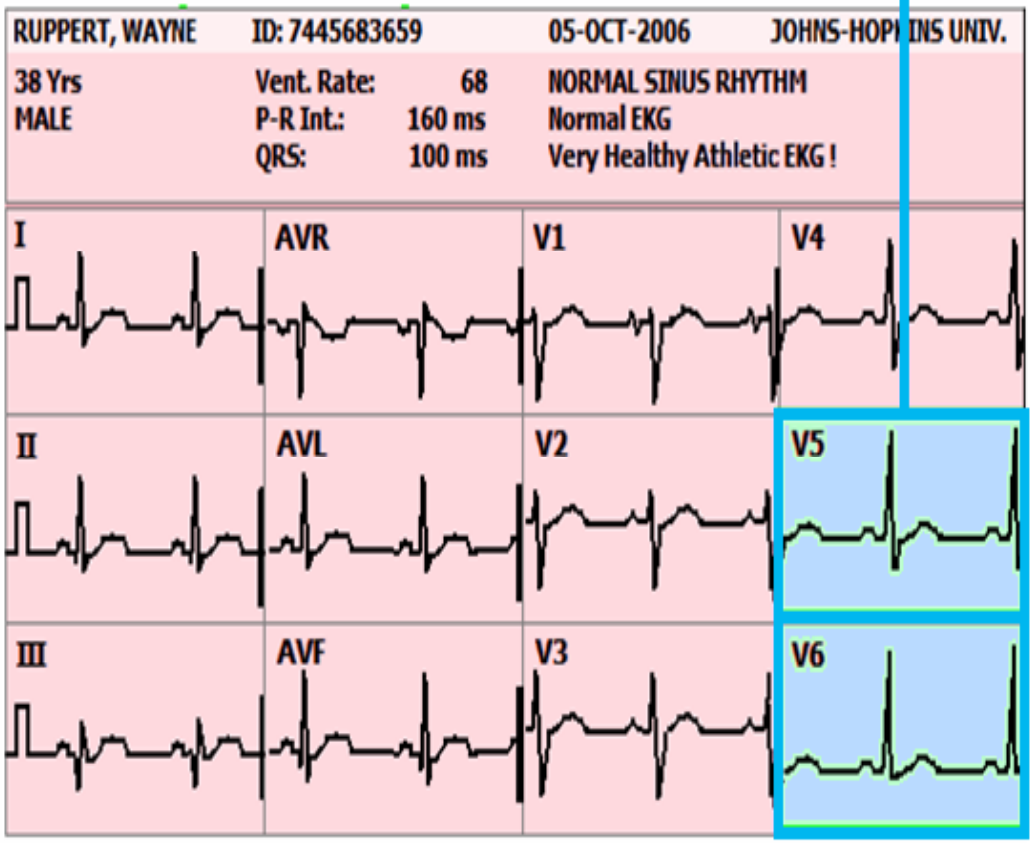
EXAMPLE:

AREA OF ACUTE INFARCTION - POSTERIOR WALL



V5 - V6 VIEW THE LATERAL WALL
of the LEFT VENTRICLE



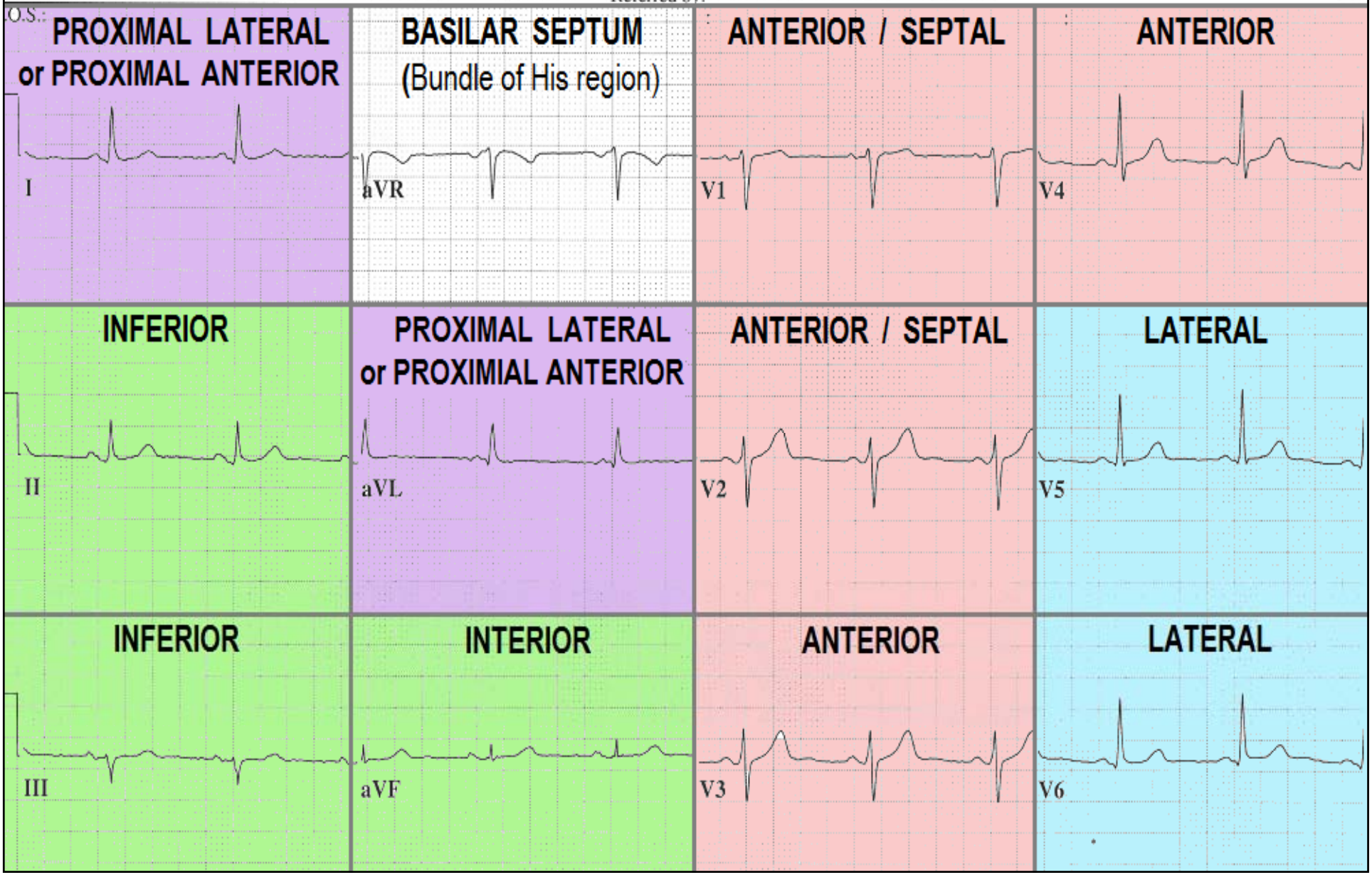


Vent. rate	64	BPM
PR interval	130	ms
QRS duration	96	ms
QT/QTc	396/408	ms
P–R–T axes	40 11	61

Normal sinus rhythm
Normal ECG
No previous ECGs available

Referred by:

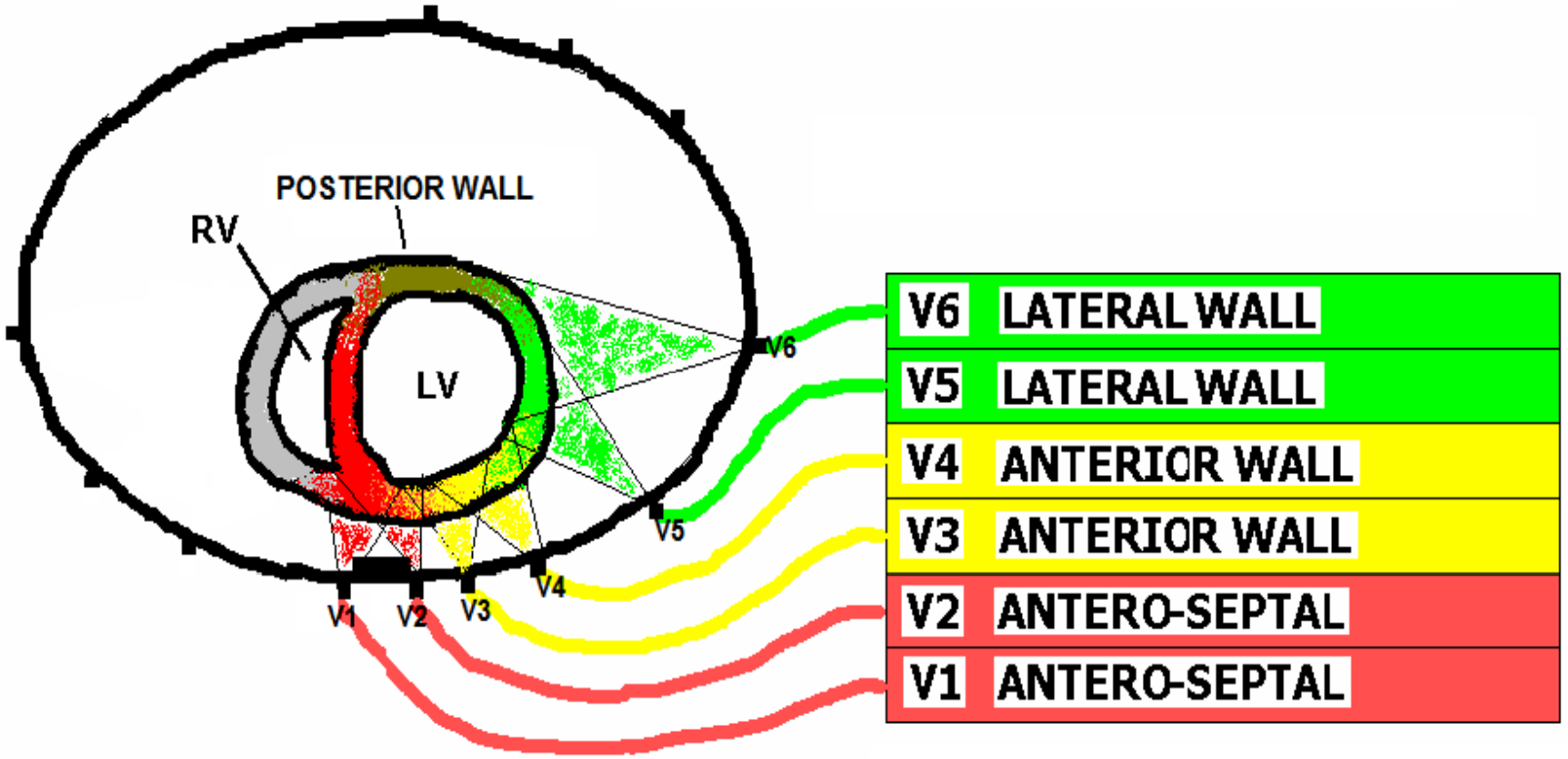
O.S.:



THE 12 LEAD ECG HAS TWO MAJOR BLIND SPOTS . .

CHEST LEADS V1 - V6

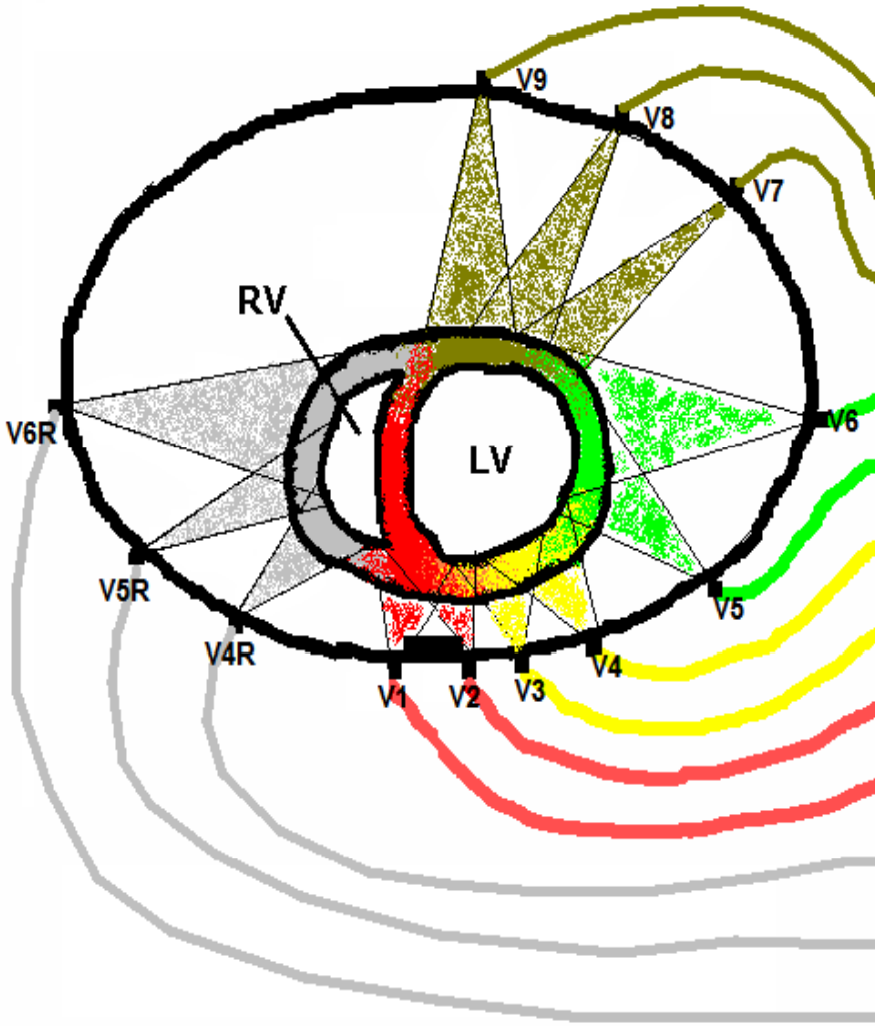
WHAT EACH LEAD "SEES" . . .



THE 18 LEAD ECG COVERS THE ENTIRE HEART . .

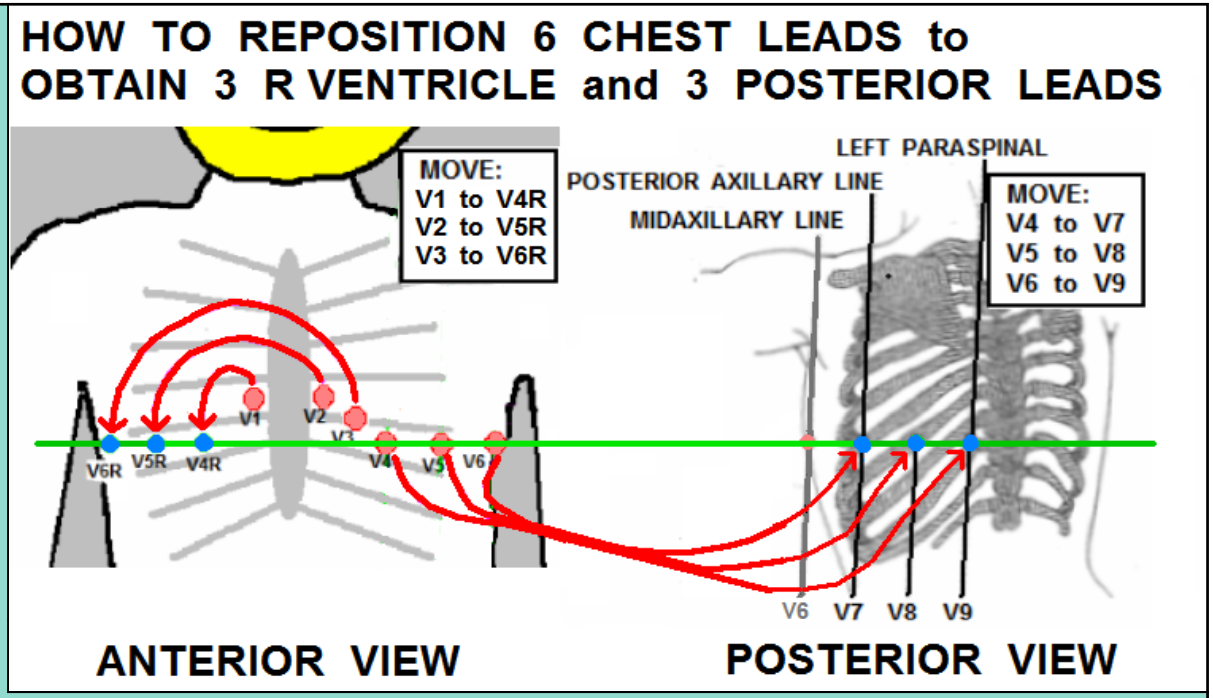
CHEST LEADS V1 - V6 *PLUS* V4R, V5R, V6R, and V7, V8, V9

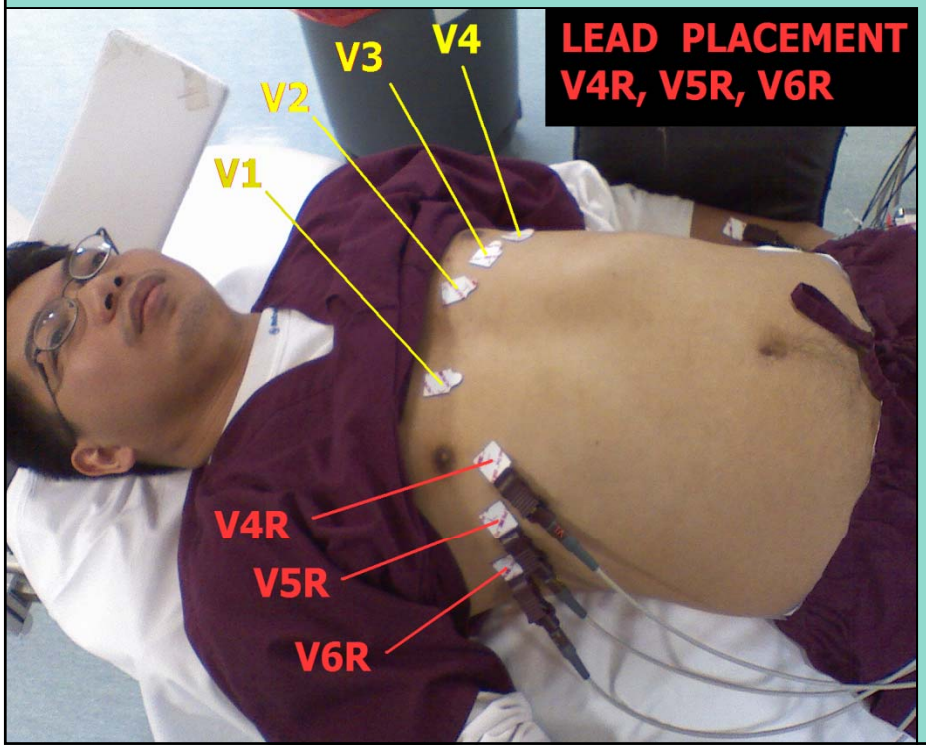
WHAT EACH LEAD "SEES" . . .

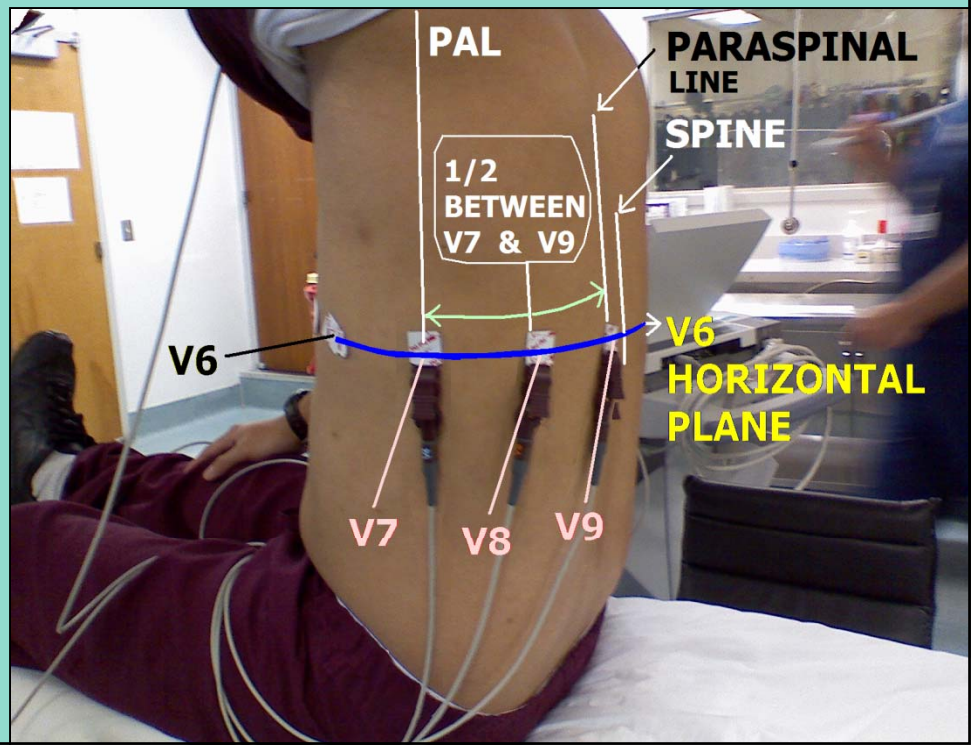


V9	POSTERIOR WALL
V8	POSTERIOR WALL
V7	POSTERIOR WALL
V6	LATERAL WALL
V5	LATERAL WALL
V4	ANTERIOR WALL
V3	ANTERIOR WALL
V2	ANTERO-SEPTAL
V1	ANTERO-SEPTAL
V4R	RIGHT VENTRICLE
V5R	RIGHT VENTRICLE
V6R	RIGHT VENTRICLE

To do 18 Lead ECG with 12 Lead machine – after you obtain 12 Lead, reposition CHEST LEADS to this configuration, then print !







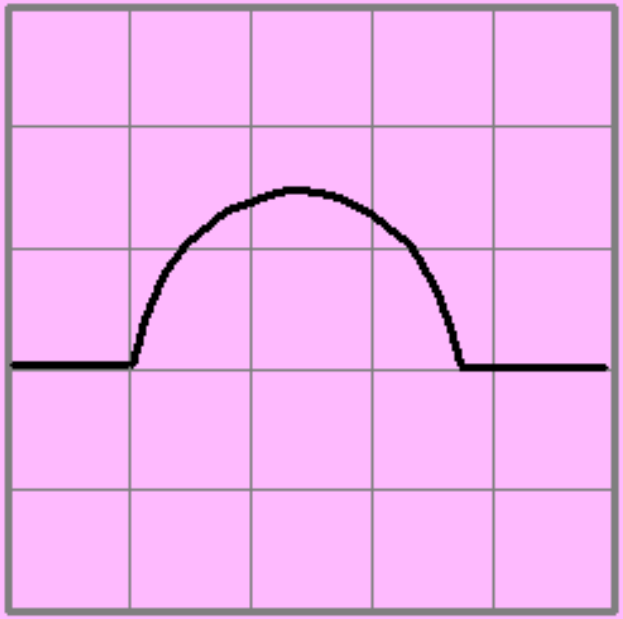
INDICATIONS for 18 Lead ECG include:

- INFERIOR WALL MI
- ST Depression in LEADS V1-V4

Quick Review Of Essential Waveforms

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



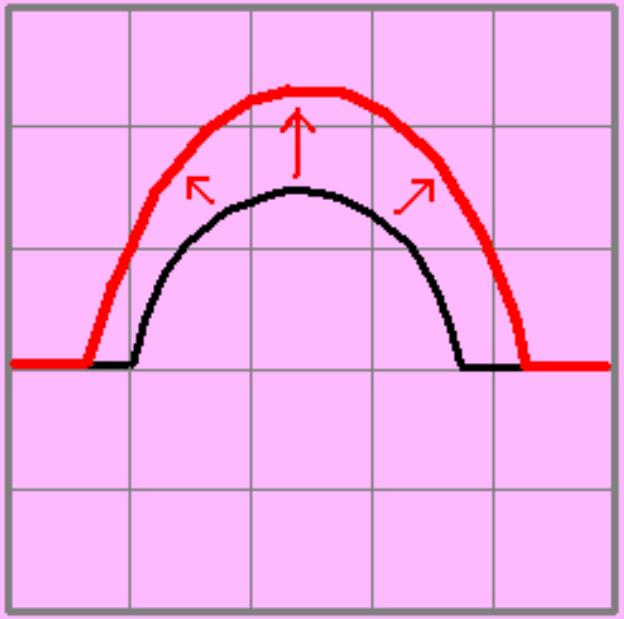
THE P WAVE

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)

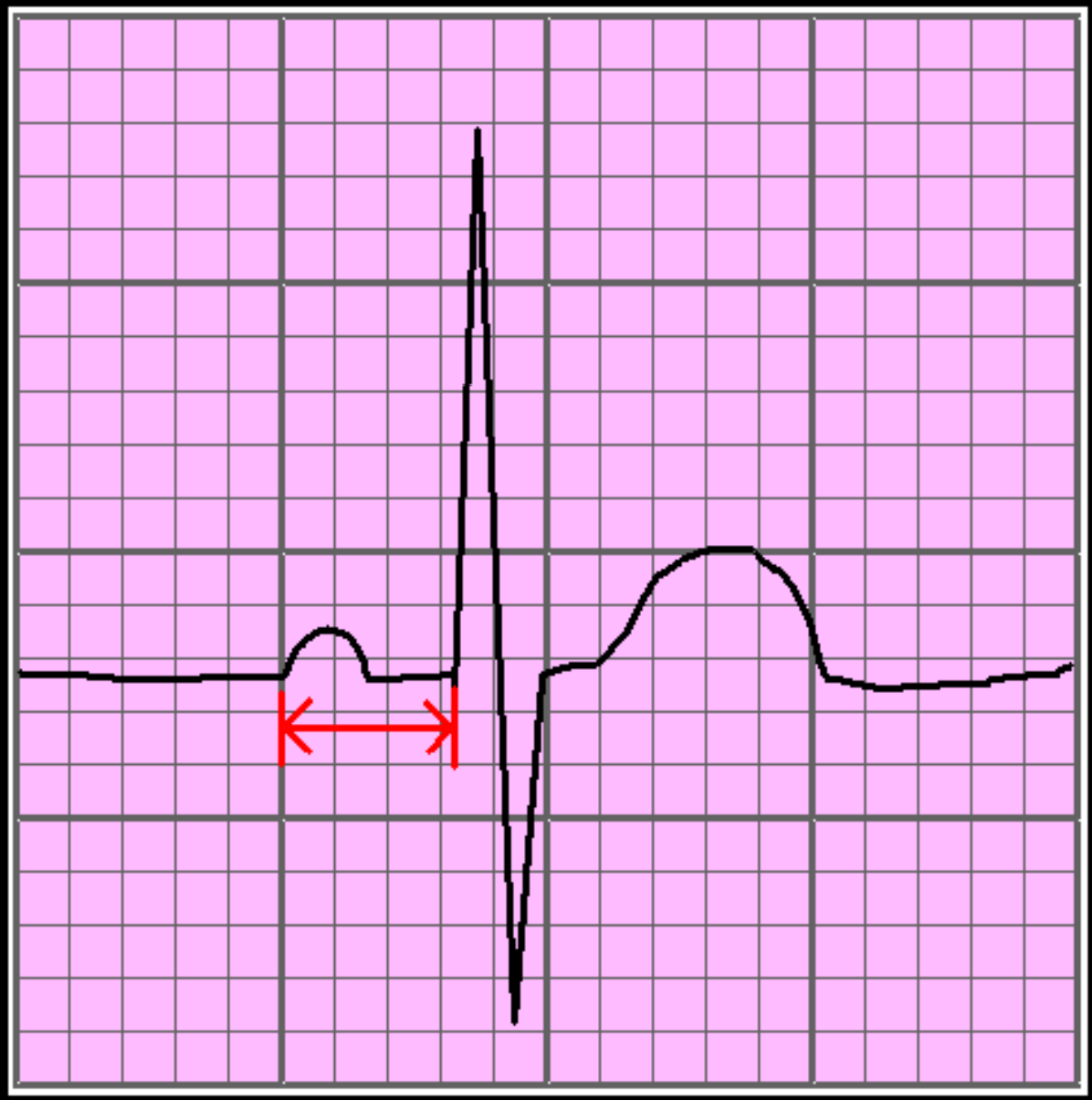
NORMAL P-R INTERVAL

.12 - .20 SEC

or

120 - 200

mSEC



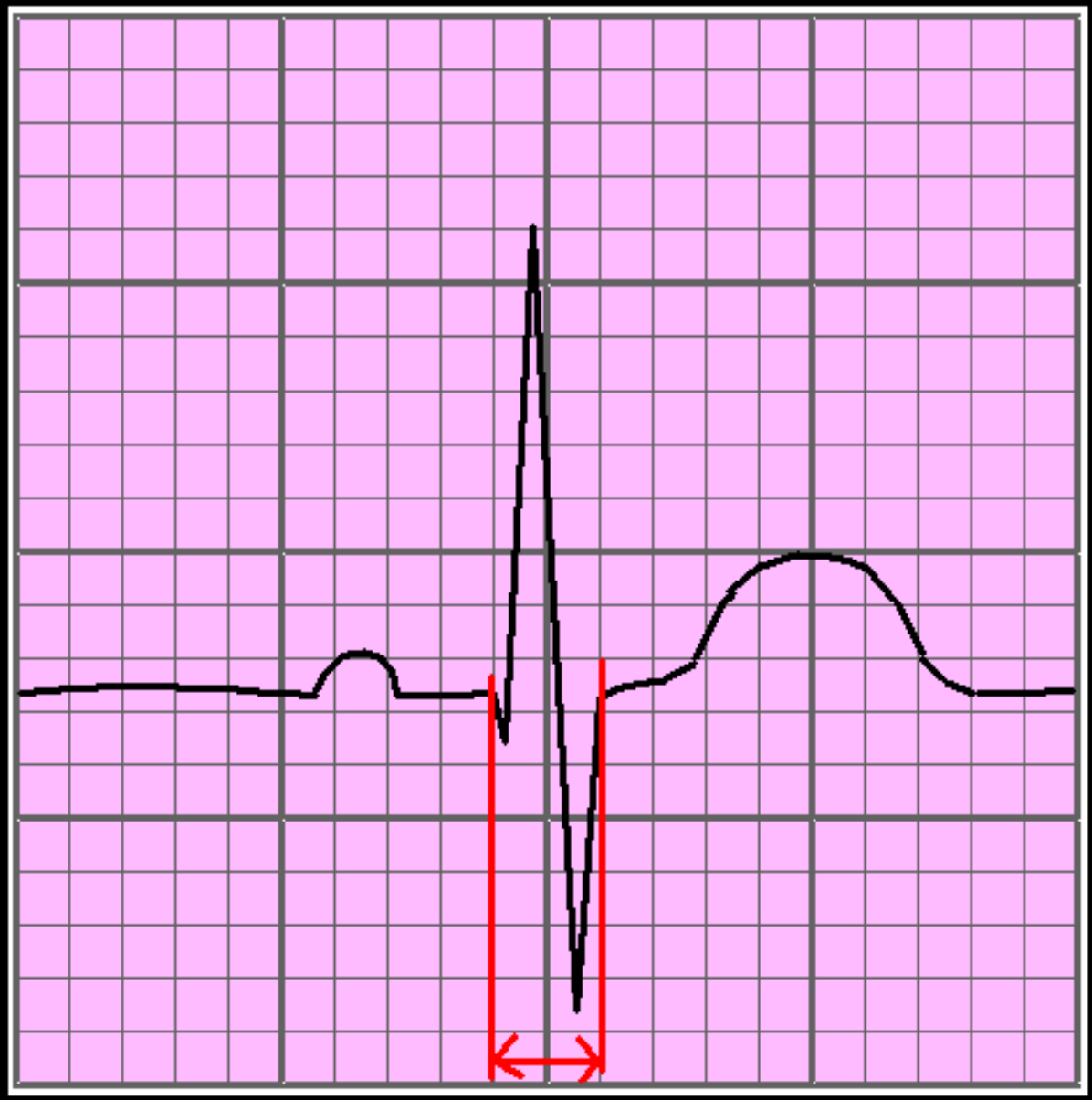
QRS INTERVAL

LESS THAN

.12

OR

120 mSEC



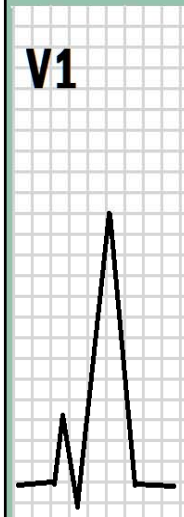
QRS COMPLEX TOO WIDE

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 "TURN SIGNAL METHOD" for identifying BUNDLE BRANCH BLOCK



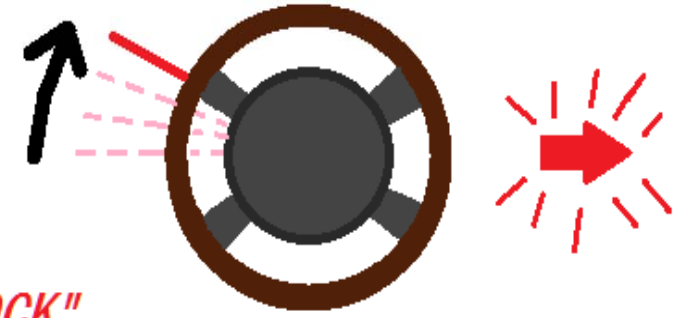
USE LEAD V1 for this technique

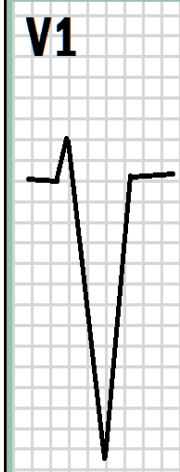
To make a **RIGHT TURN**

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

THINK:

"QRS points UP = RIGHT BUNDLE BRANCH BLOCK"



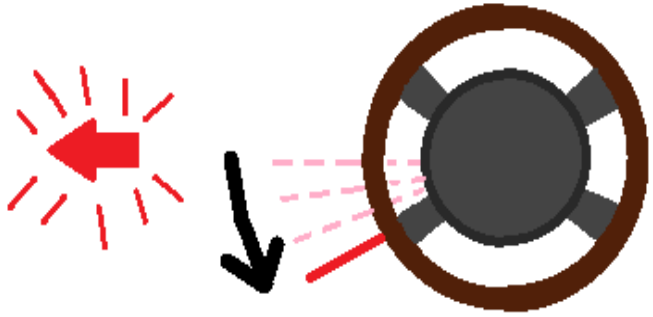


To make a **LEFT TURN**

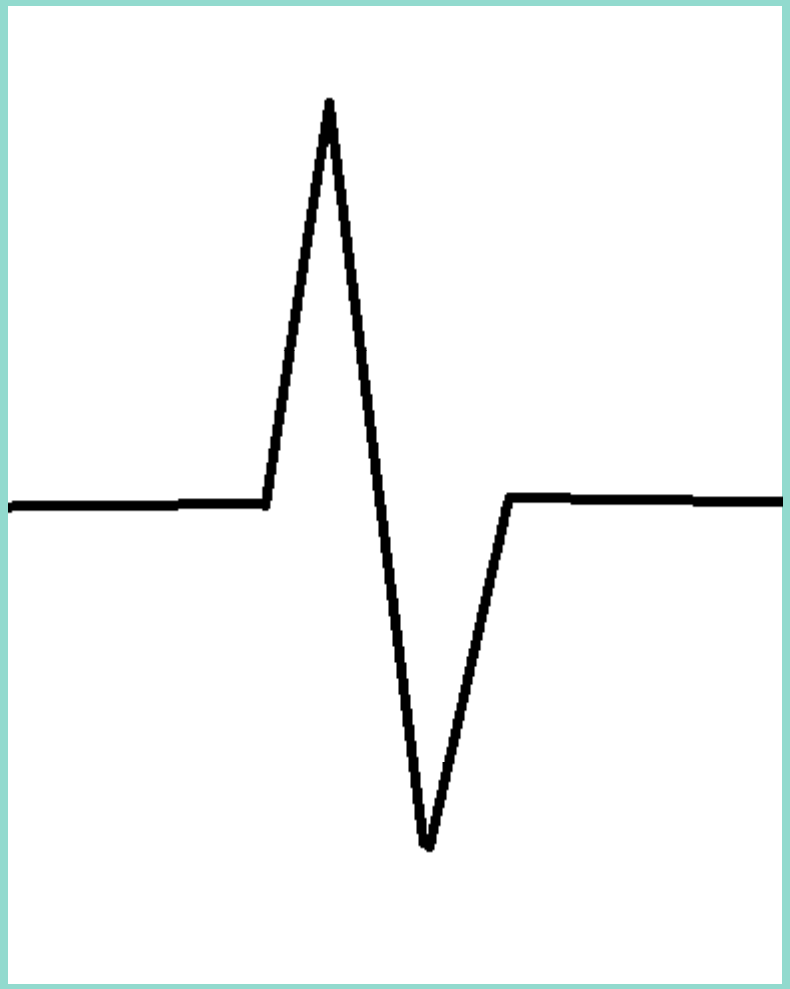
you push the turn signal lever **DOWN** . . . .

THINK:

"QRS points DOWN = LEFT BUNDLE BRANCH BLOCK"

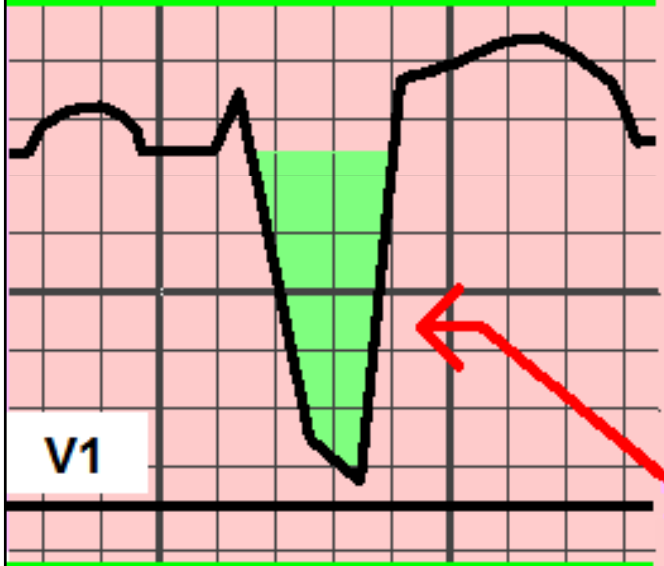


What about biphasic QRS ?

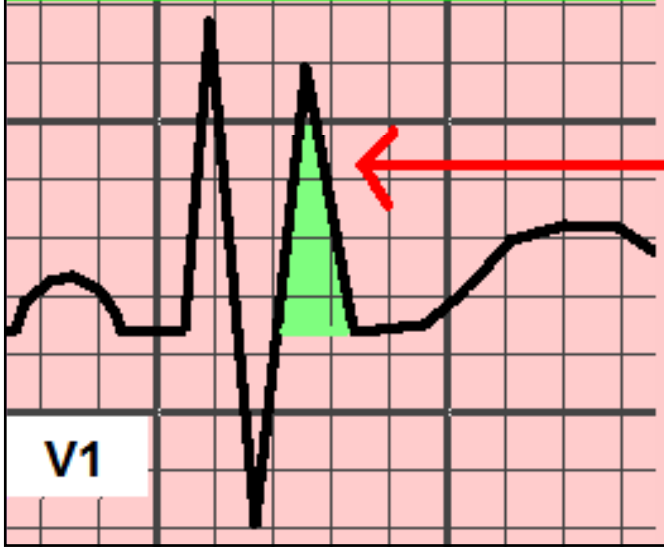


DIAGNOSING BUNDLE BRANCH BLOCK

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

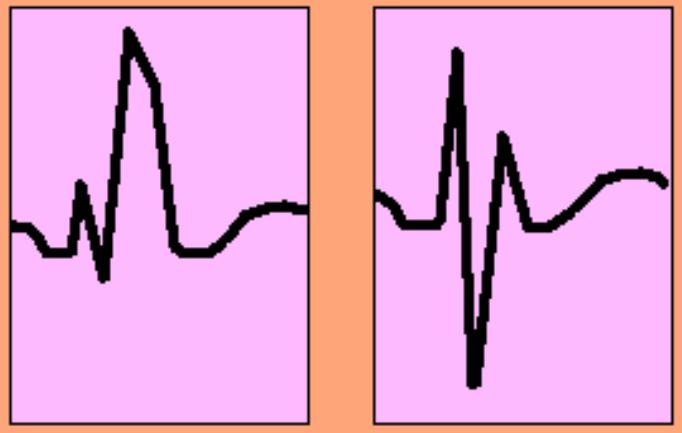
POSITIVE = RIGHT BUNDLE BRANCH BLOCK

DIAGNOSING BUNDLE BRANCH BLOCK

USING LEADS V1, V2, and V5, V6:

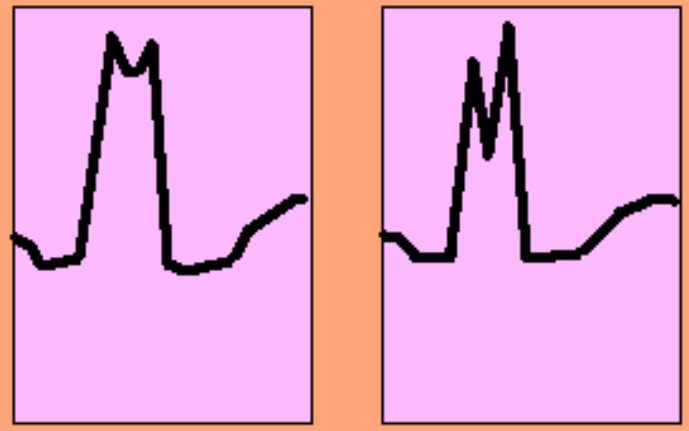
LOCATING RsR' or RR' COMPLEXES:

V1 V2



RIGHT BUNDLE BRANCH BLOCK

V5 V6



LEFT BUNDLE BRANCH BLOCK

or simply say, "it's a LEFT BUNDLE BRANCH BLOCK !"

09:16:40

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

Left bundle branch block

Abnormal ECG

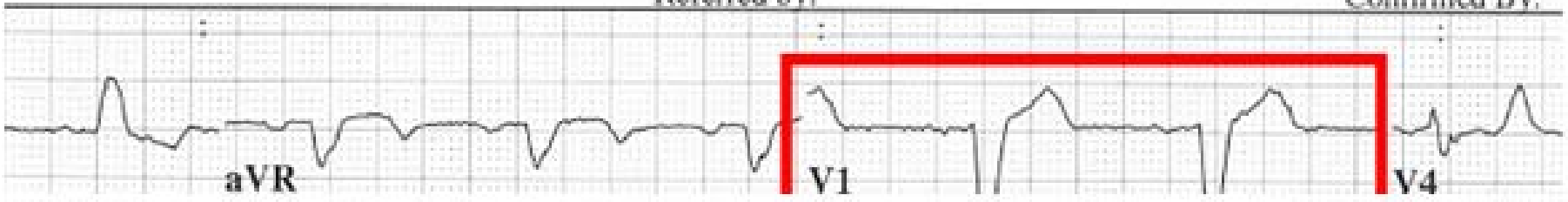
When compared with ECG of 28–MAY–2003 06:36,

EKG #WR03029959

WW

Referred by:

Confirmed By:



09:16:40

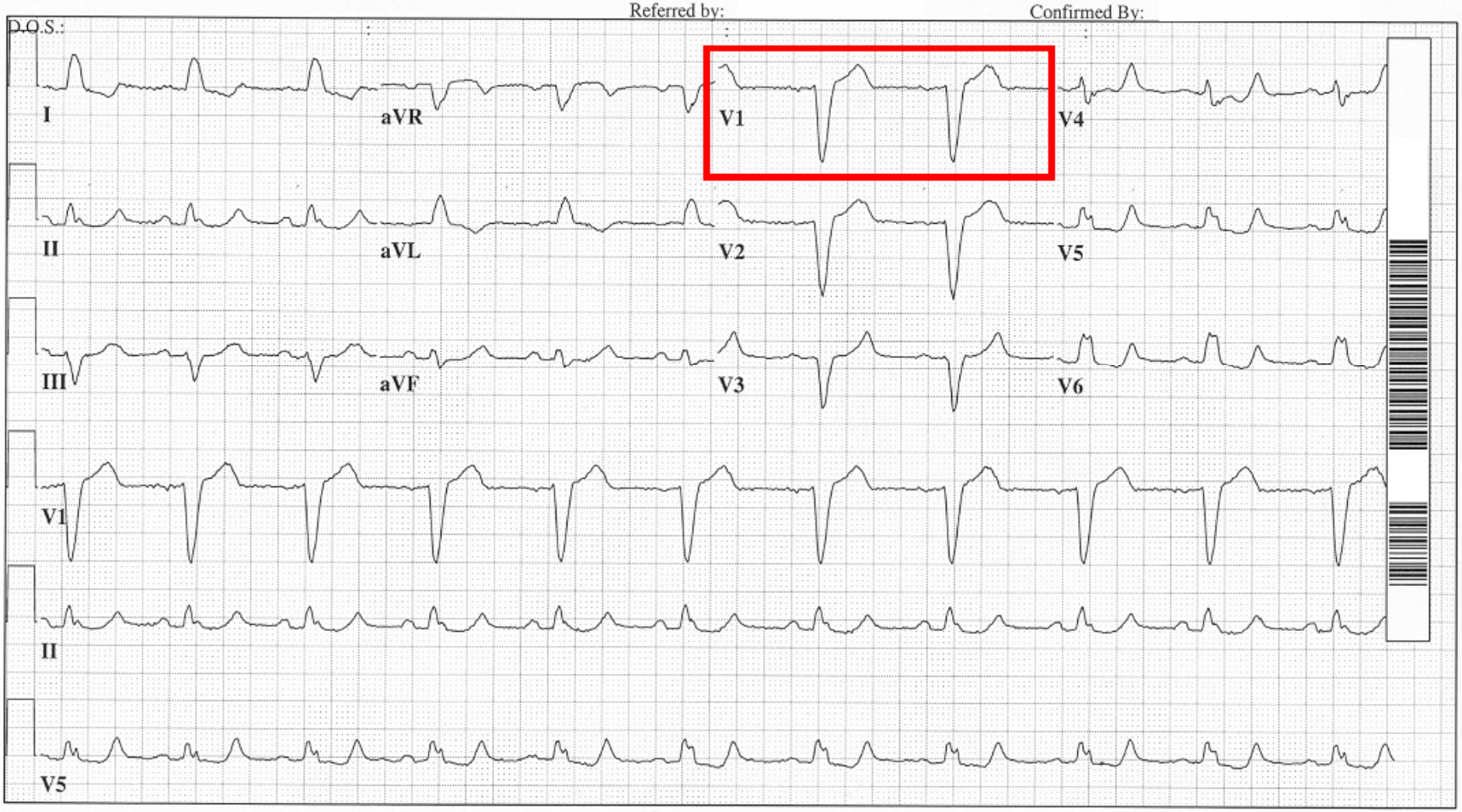
74 yr		Vent. rate	64	BPM
Female	Caucasian	PR interval	188	ms
		QRS duration	152	ms
		QT/QTc	472/486	ms
Loc:7	Option:35	P–R–T axes	78 3	106

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:

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

RUPPERT, WAYNE ID: 099999999 4-Mar-2001

74years
Male Caucasian

Room:
Loc: 0 Opt:

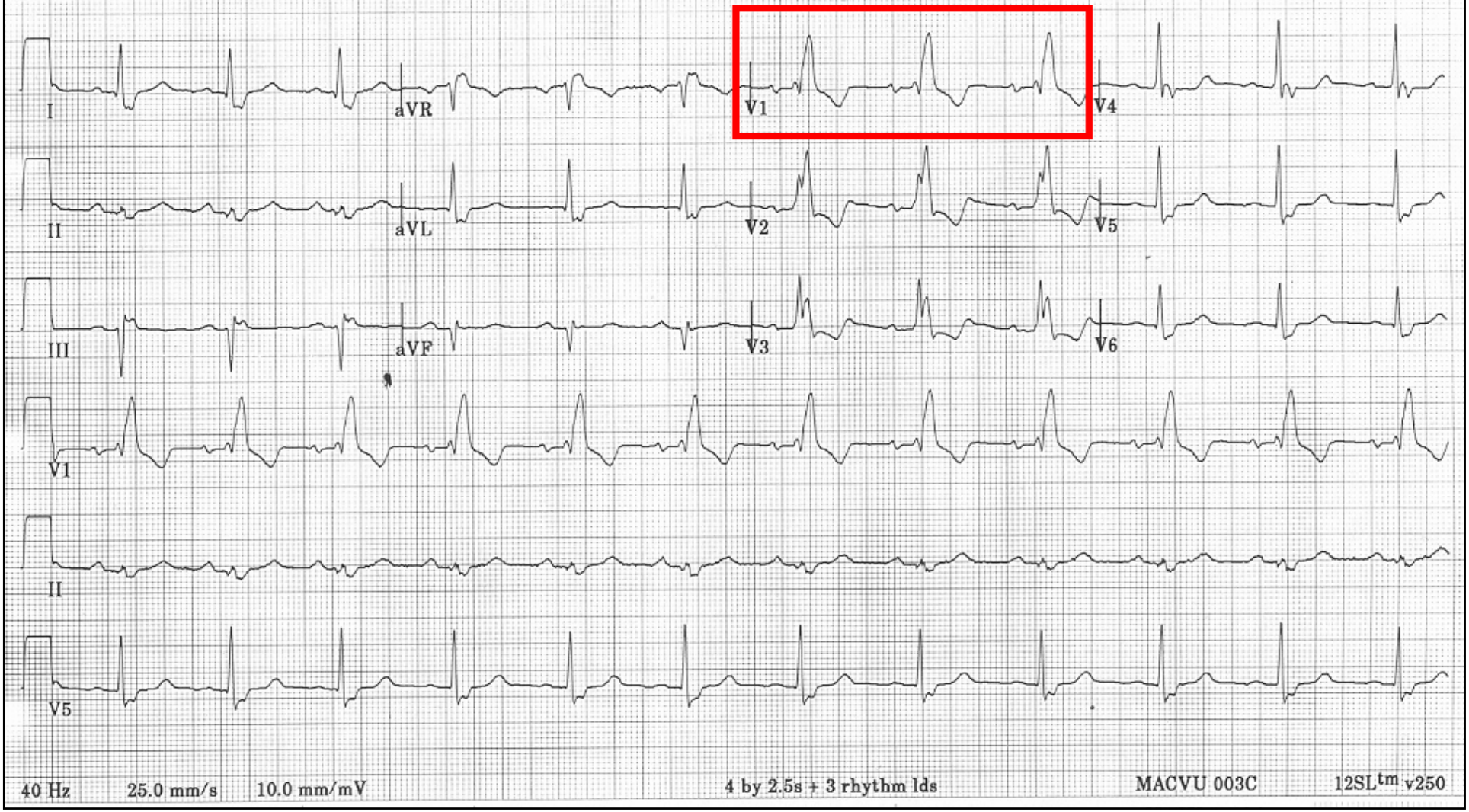
Technician: WR

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

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

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

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)

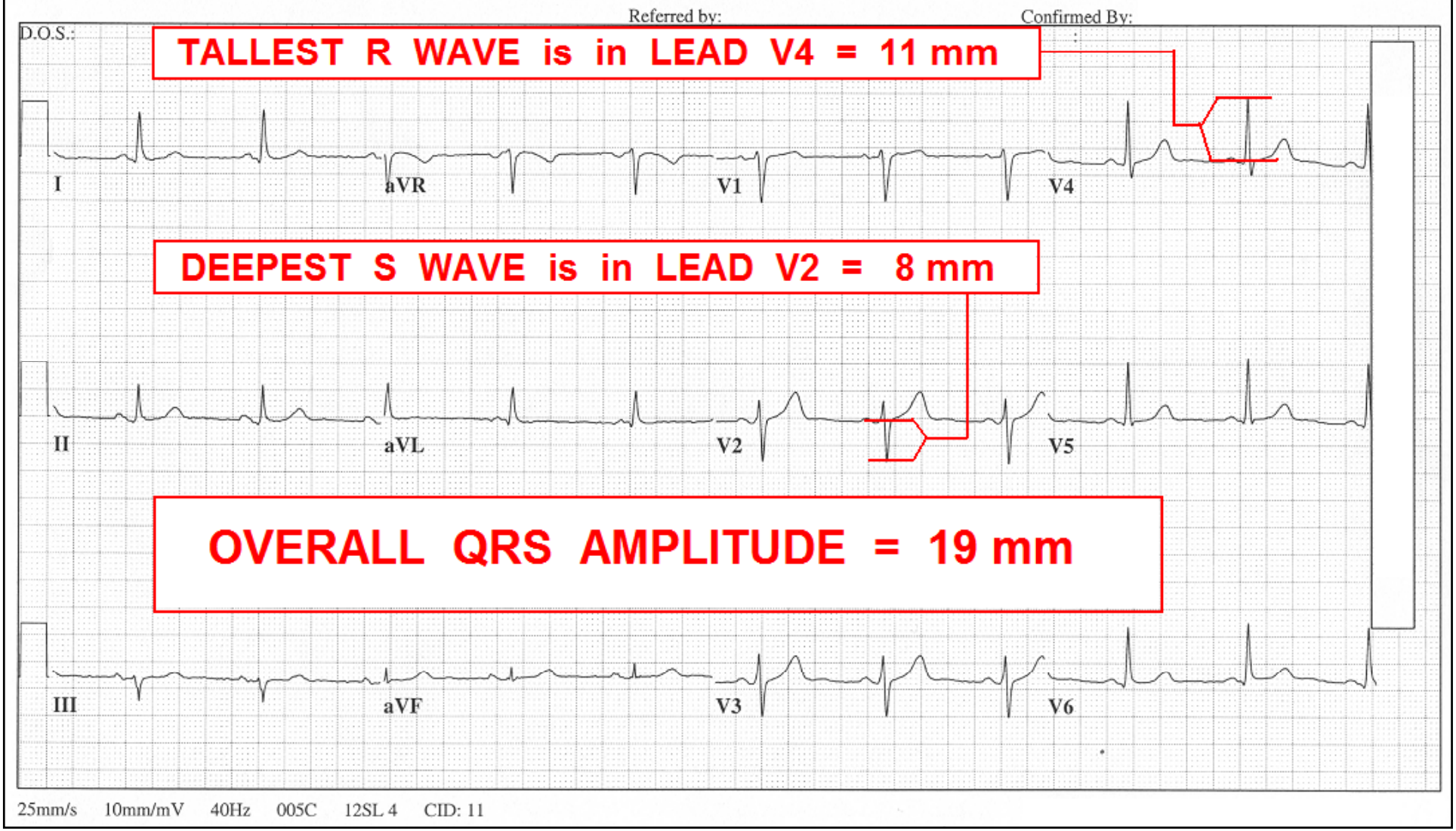

SEVERE R.V.H.


ACUTE PULMONARY EMBOLUS


BRUGADA SYNDROME

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:

≤ 0.5 mV IN ANY LIMB LEAD

— *and* —

≤ 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)

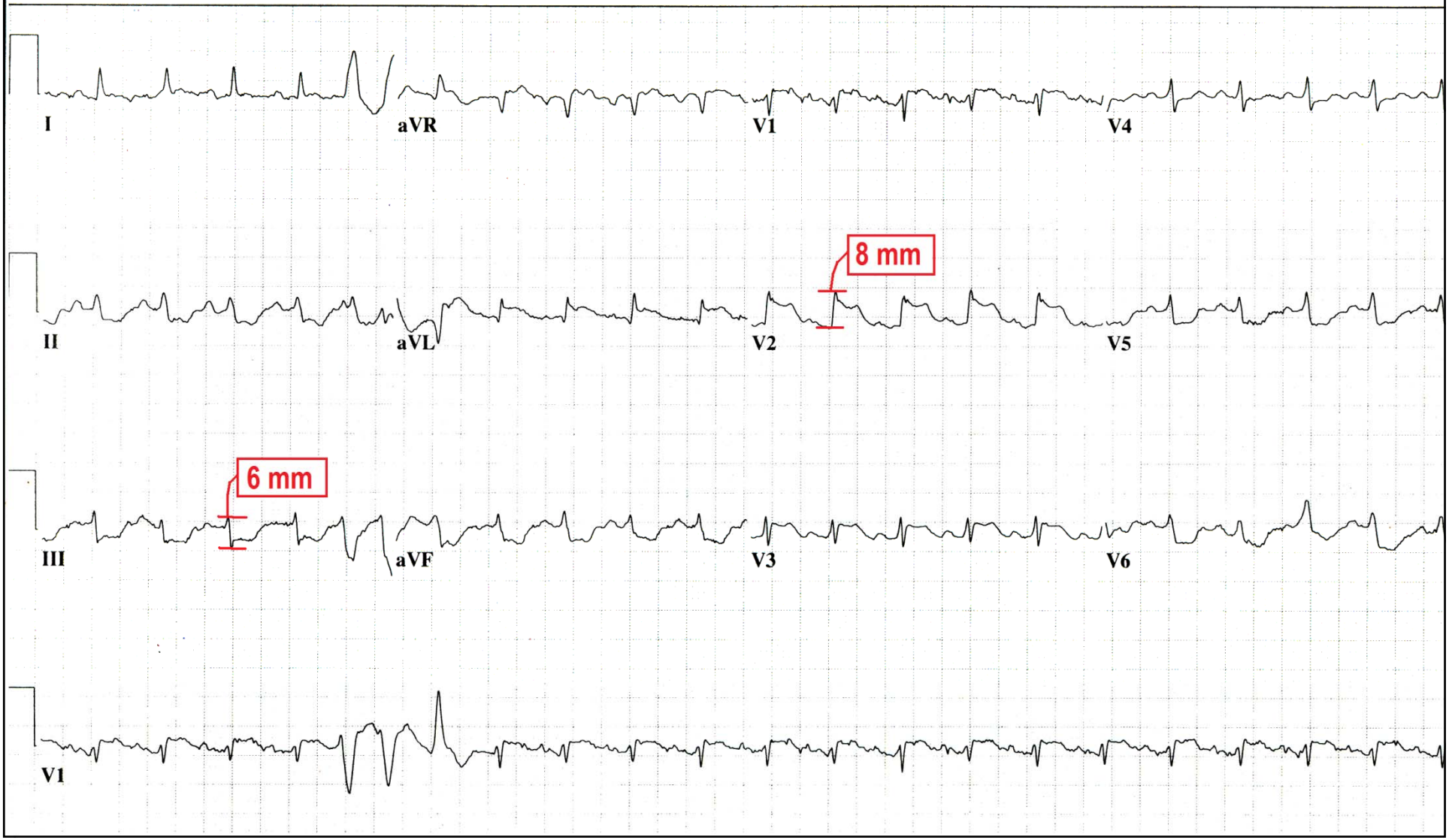
MYXEDEMA (thyroid disorder)

33 yr
Female Black

Room:ATL
Loc:3 Option:23

Vent. rate	132	BPM
PR interval	154	ms
QRS duration	76	ms
QT/QTc	282/417	ms
P–R–T axes	51 17	–80

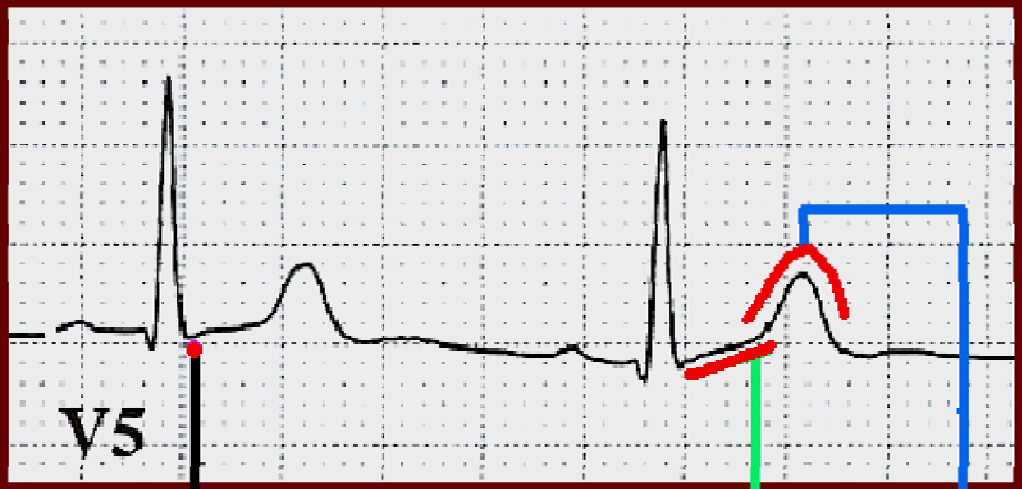
"**unedited copy: report is computer generated only, without physician interpretation".
*** Age and gender specific ECG analysis ***
Sinus tachycardia with occasional , and consecutive
Premature ventricular complexes
Low voltage QRS
ST elevation consider anterolateral injury or acute infarct
*** ** ** ** * ACUTE MI ** ** ** **
Abnormal ECG
No previous ECGs available



THE MARKERS of ACUTE CORONARY SYNDROME . . . .

NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL (< 120 ms)

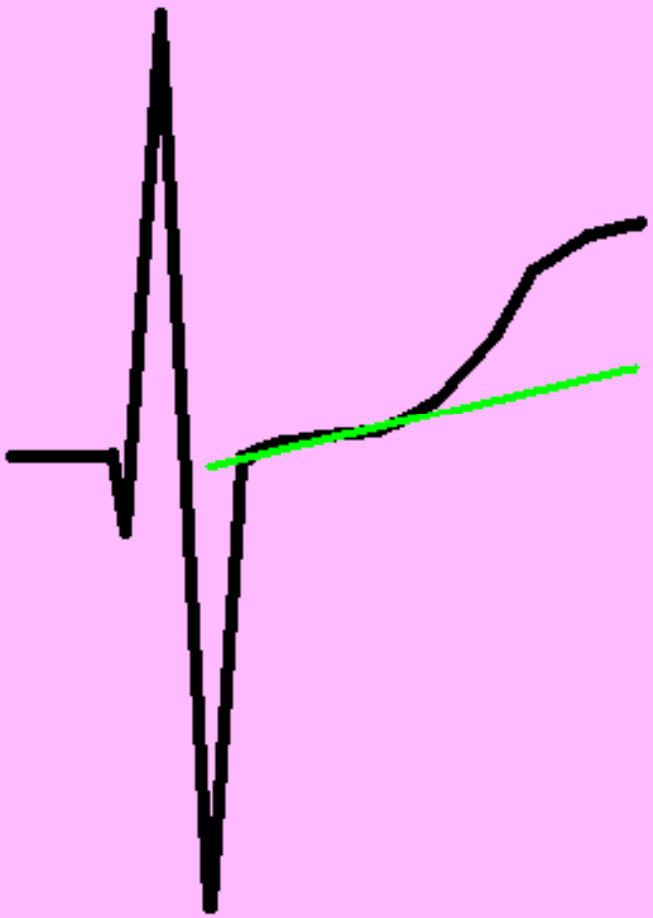


ASSESS:

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

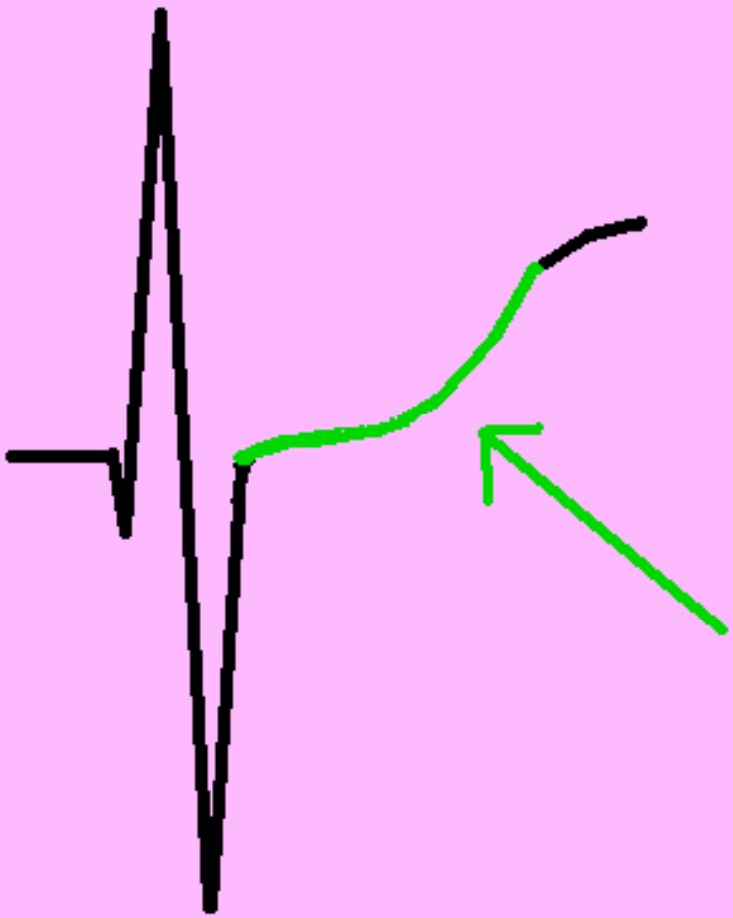
☞ *in EVERY LEAD EXCEPT aVR ! !*

THE S-T SEGMENT



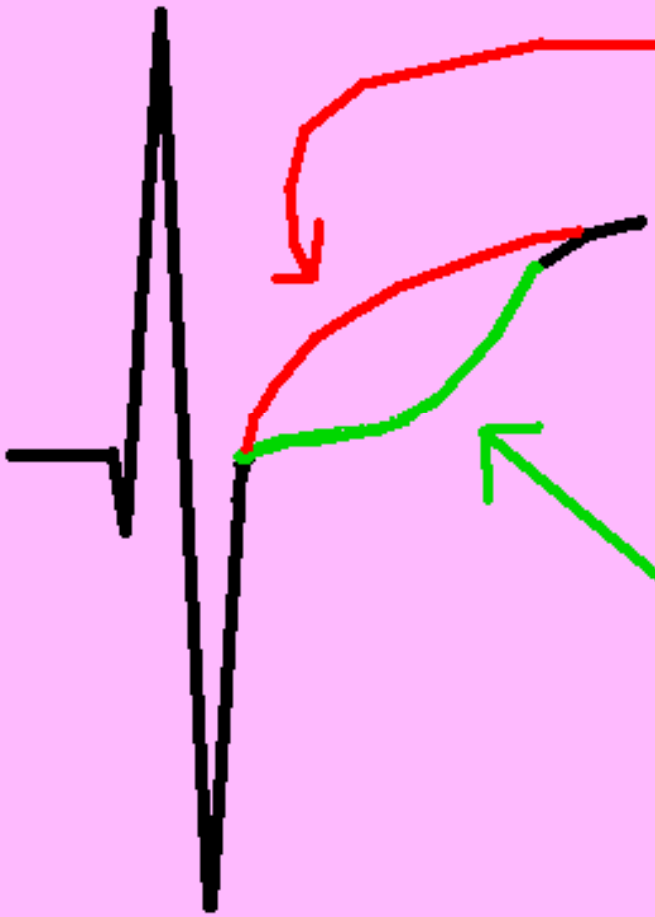
SHOULD HAVE
A "SLIGHT POSITIVE"
INCLINATION

THE S-T SEGMENT



SHOULD BE "CONCAVE" IN SHAPE . . .

THE S-T SEGMENT



AS OPPOSED TO "CONVEX" IN SHAPE

SHOULD BE "CONCAVE" IN SHAPE . . .

CHANGES ASSOCIATED WITH CELLULAR PERFUSION INVOLVING THE:

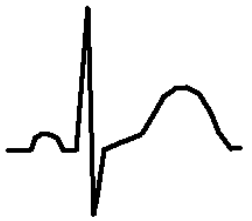
- QRS
- J POINT
- ST SEGMENT
- T WAVE

CARDIAC CELL PERFUSION STATES

NORMAL STATE OF PERFUSION

ARTERIAL BLOCKAGES → NONE SIGNIFICANT
CELLULAR OXYGENATION → NORMAL
CELLULAR METABOLISM → AEROBIC
CELLULAR FUNCTION → NORMAL CONTRACTION

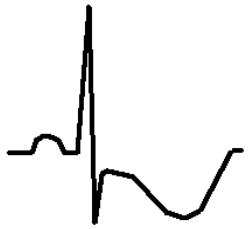
EKG: J POINT ISOELECTRIC, ST SEG "SLIGHT, POSTIVE INCLINATION, T WAVE POSITIVE, UPRIGHT.



ISCHEMIA

ARTERIAL BLOCKAGES → PARTIAL OBSTRUCTION
CELLULAR OXYGENATION → INSUFFICIENT
CELLULAR METABOLISM → AEROBIC
CELLULAR FUNCTION → REDUCED CONTRACTION
PATIENT SYMPTOMS → *POSSIBLE*, WITH EXERTION

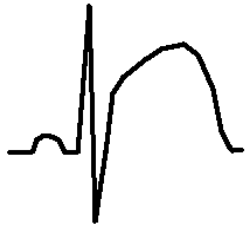
EKG: J POINT DEPRESSED, ST SEGMENT VARIES, T WAVE VARIES



INFARCTION

ARTERIAL BLOCKAGES → TOTAL OBSTRUCTION
CELLULAR OXYGENATION → NONE
CELLULAR METABOLISM → ANAEROBIC *CELL BEGINS TO BURN GLYCOGEN RESERVES*
CELLULAR FUNCTION → STOPS CONTRACTING
PATIENT SYMPTOMS → *TYPICAL or ATYPICAL ACS Sx*

EKG - INDICATIVE: J POINT ELEVATES, ST SEGMENT CONVEX, T WAVE POSITIVE, MAY ENLARGE
EKG - RECIPROCAL: J POINT DEPRESSES, ST SEGMENT DOWNSLOPING, T WAVE INVERTED



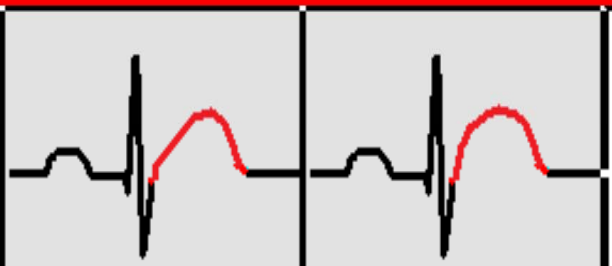
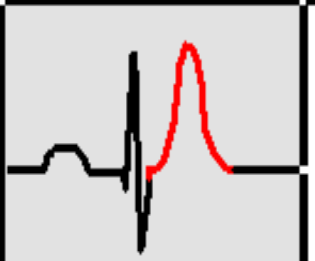
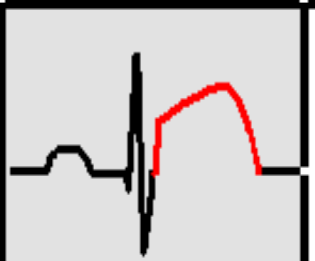
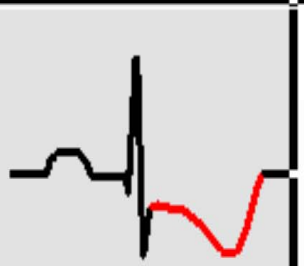
NECROSIS

ARTERIAL BLOCKAGES → TOTAL OBSTRUCTION
CELLULAR OXYGENATION → NONE
CELLULAR METABOLISM → *CELL DIES WHEN GLYCOGEN RESERVES DEPLETED.*
CELLULAR FUNCTION → NONE. CELL DEAD.
PATIENT SYMPTOMS → *POSS. HYPOTENSION, DEATH*

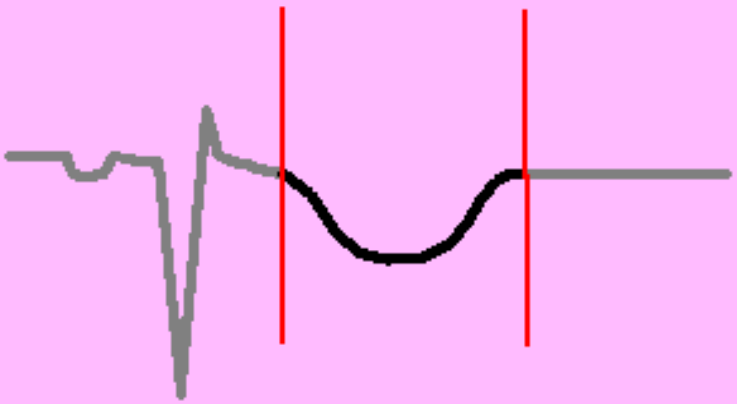
EKG - INDICATIVE: J POINTS, ST SEGMENTS NORMALIZE; ABNORMAL Q WAVES FORM
EKG - RECIPROCAL: J POINTS, ST SEGMENTS NORMALIZE; ABNORMAL TALL R WAVES FORM

PATTERNS of ACS & ISCHEMIA

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

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

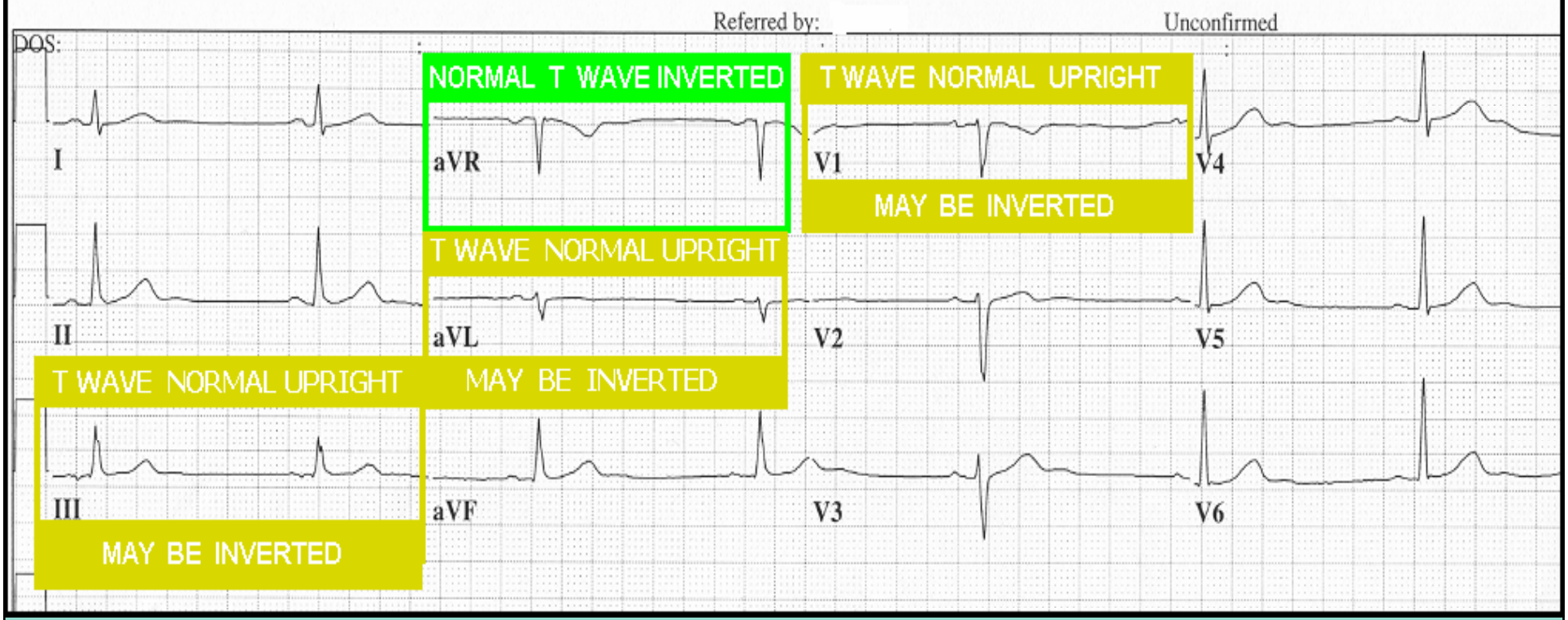
THE T WAVE



LEAD AVR

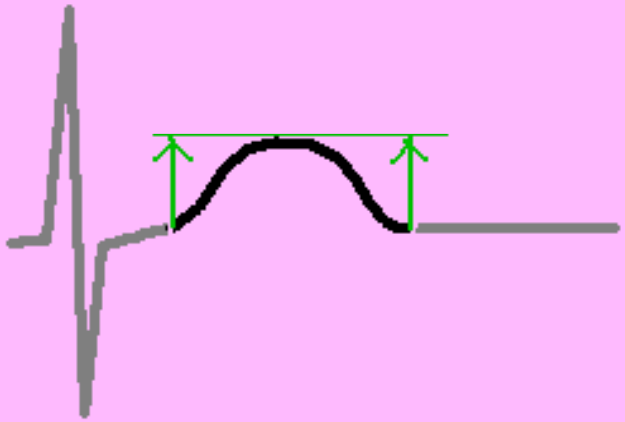
- REMEMBER, IN LEAD AVR
EVERYTHING
IS
"UPSIDE-DOWN"

Leads where the T WAVE may be INVERTED:



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

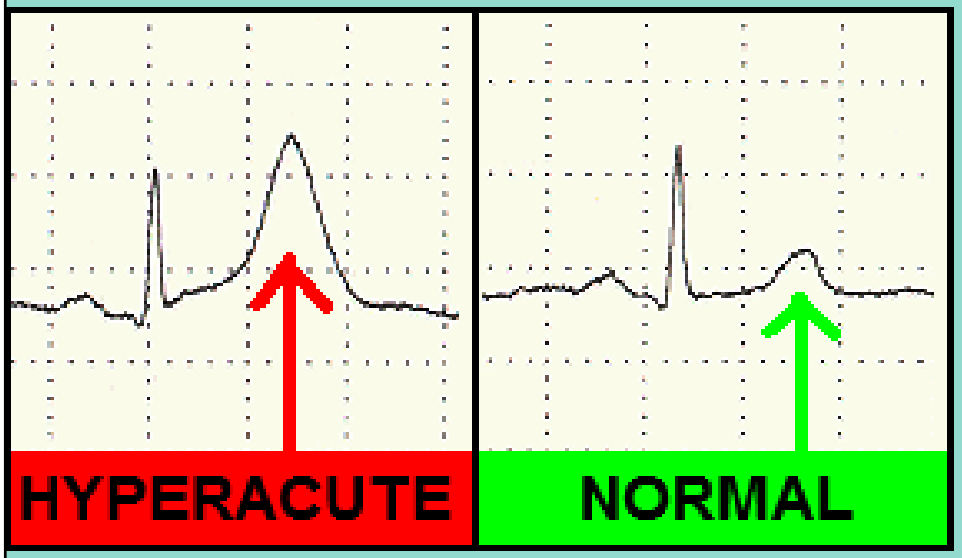
THE T WAVE



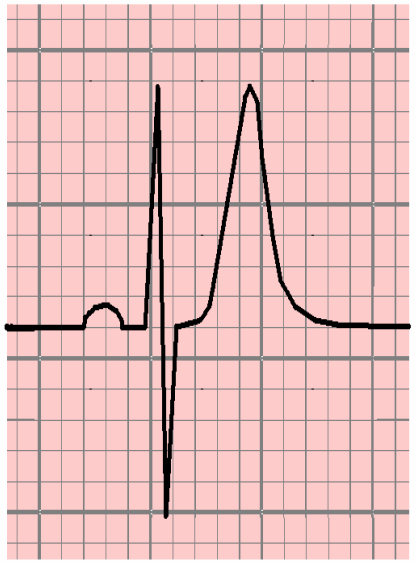
AMPLITUDE GUIDELINES:

- 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.

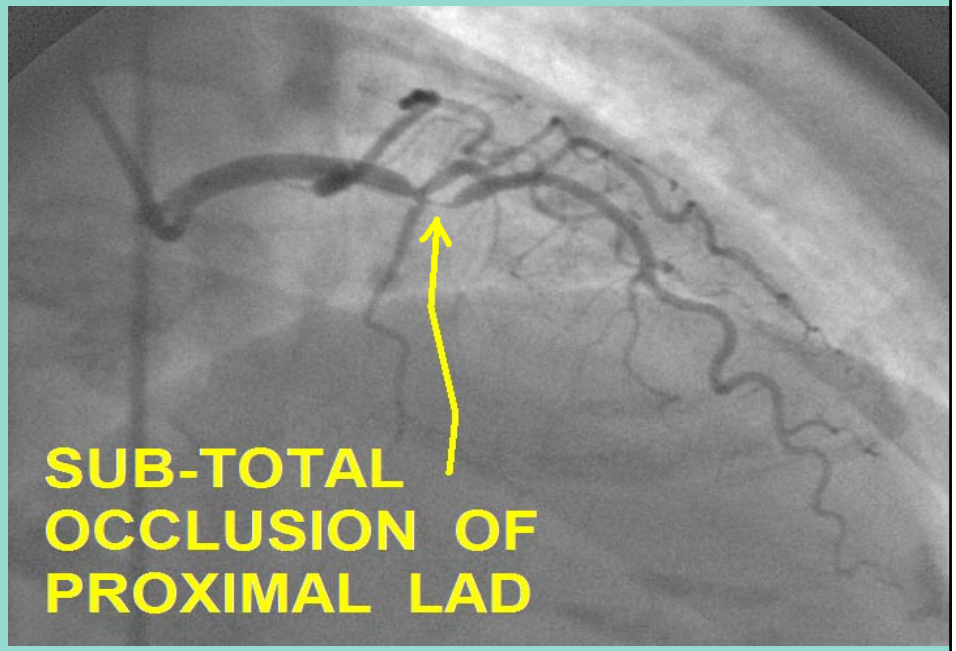
HYPERACUTE T WAVES



HYPER-ACUTE T WAVES - COMMON ETIOLOGIES:



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



ECG CRITERIA for DIAGNOSIS of STEMI:

(ST ELEVATION @ J POINT)

*LEADS V2 and V3:

MALES ---------- 2.0 mm

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

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

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

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

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

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

ACUTE MI

COMPLICATIONS TO ANTICIPATE FOR ALL MI PATIENTS :

LETHAL DYSRHYTHMIAS

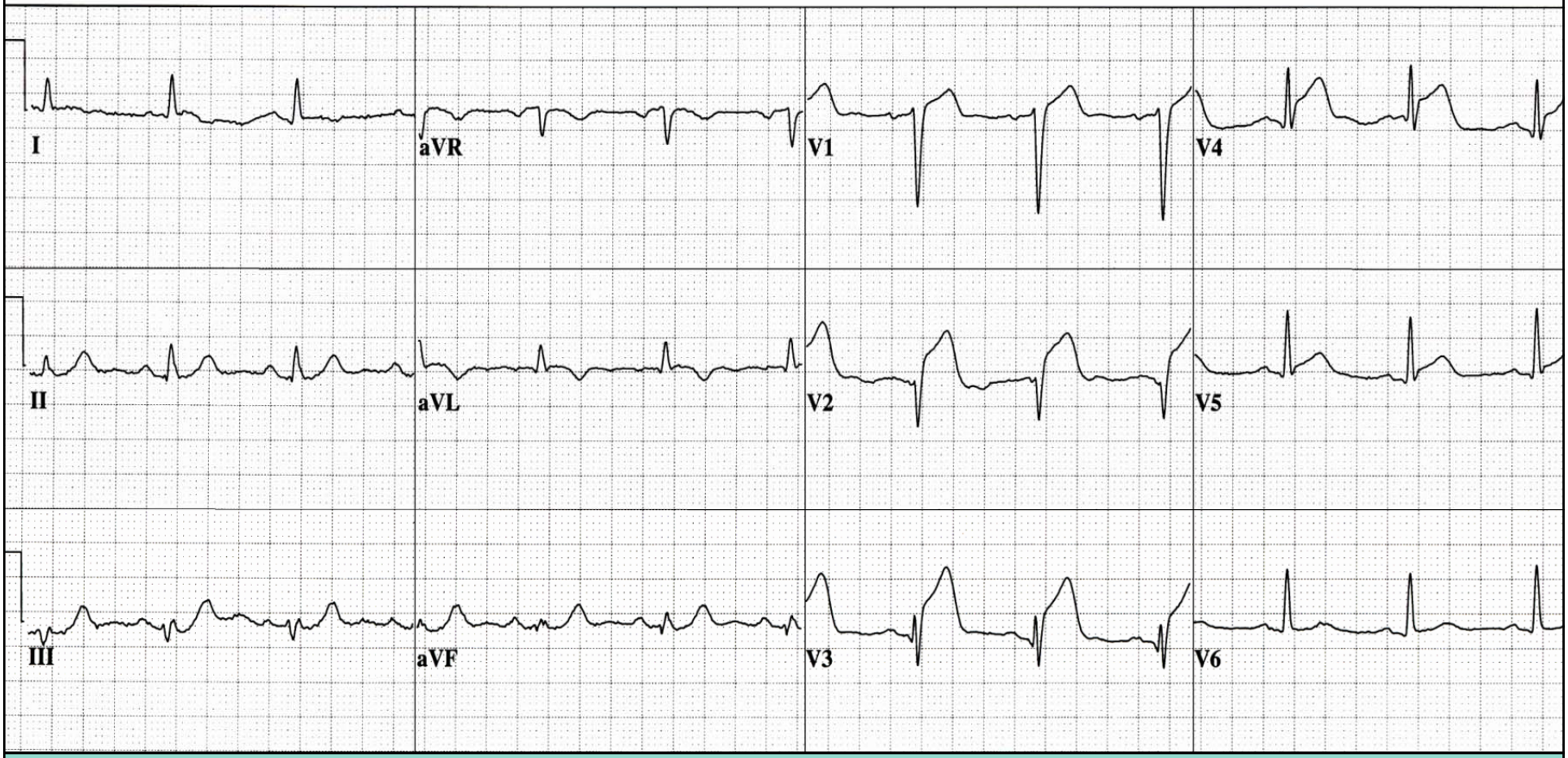
CARDIAC ARREST

FAILURE OF STRUCTURE(S) SERVED BY THE BLOCKED ARTERY

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

EVALUATE EKG for indicators of ACS:

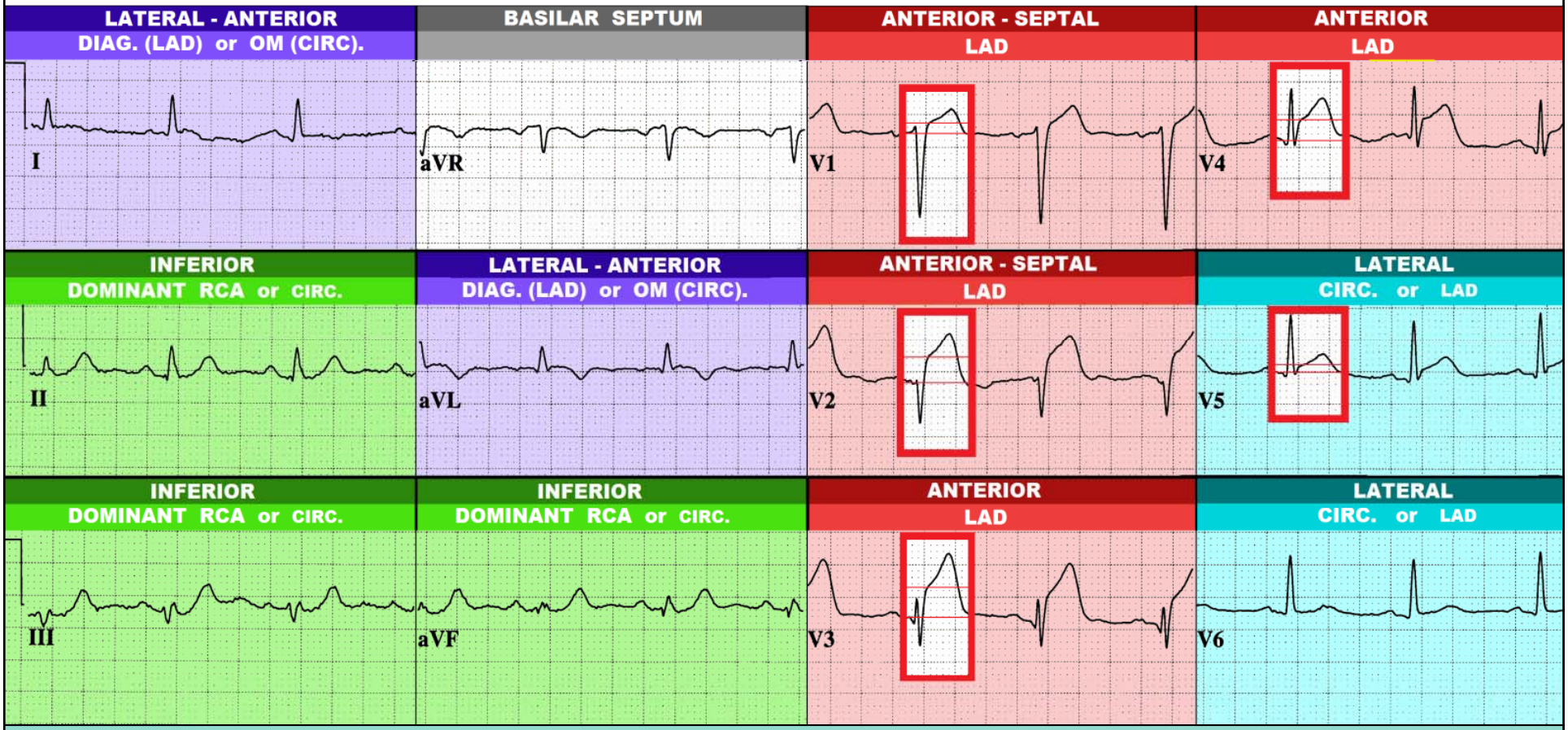
- **ST SEGMENT ELEVATION / DEPRESSION**
- **HYPERACUTE T WAVES**
- **CONVEX ST SEGMENTS**
- **OTHER ST SEGMENT / T WAVE ABNORMALITIES**



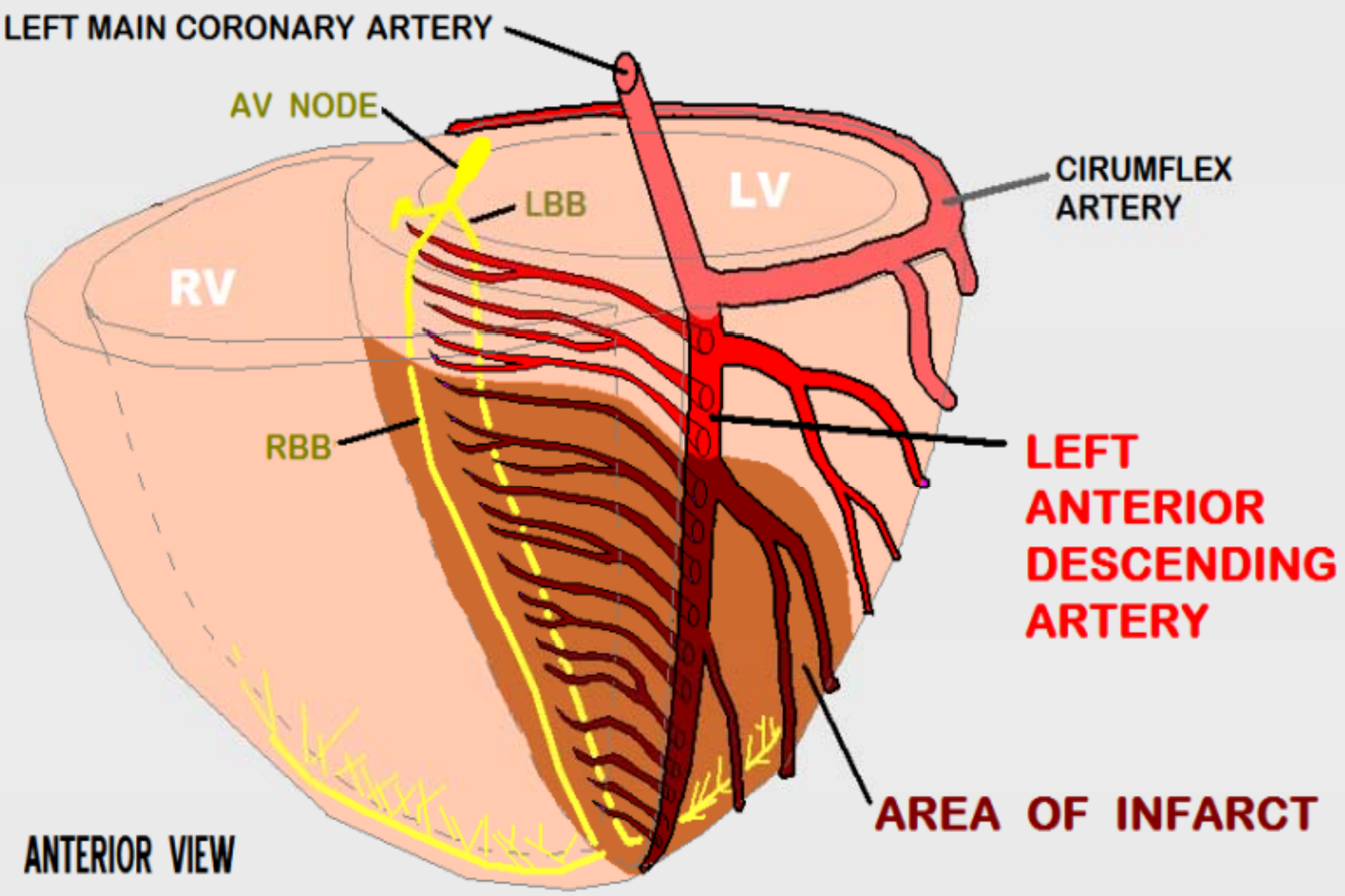
72 yr		Vent. rate	75	BPM
Male	Caucasian	PR interval	162	ms
		QRS duration	98	ms
		QT/QTc	382/426	ms
Loc:	Option:2	P-R-T axes	72 13	83

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

ST SEGMENT ELEVATION



OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



ANTERIOR WALL STEMI

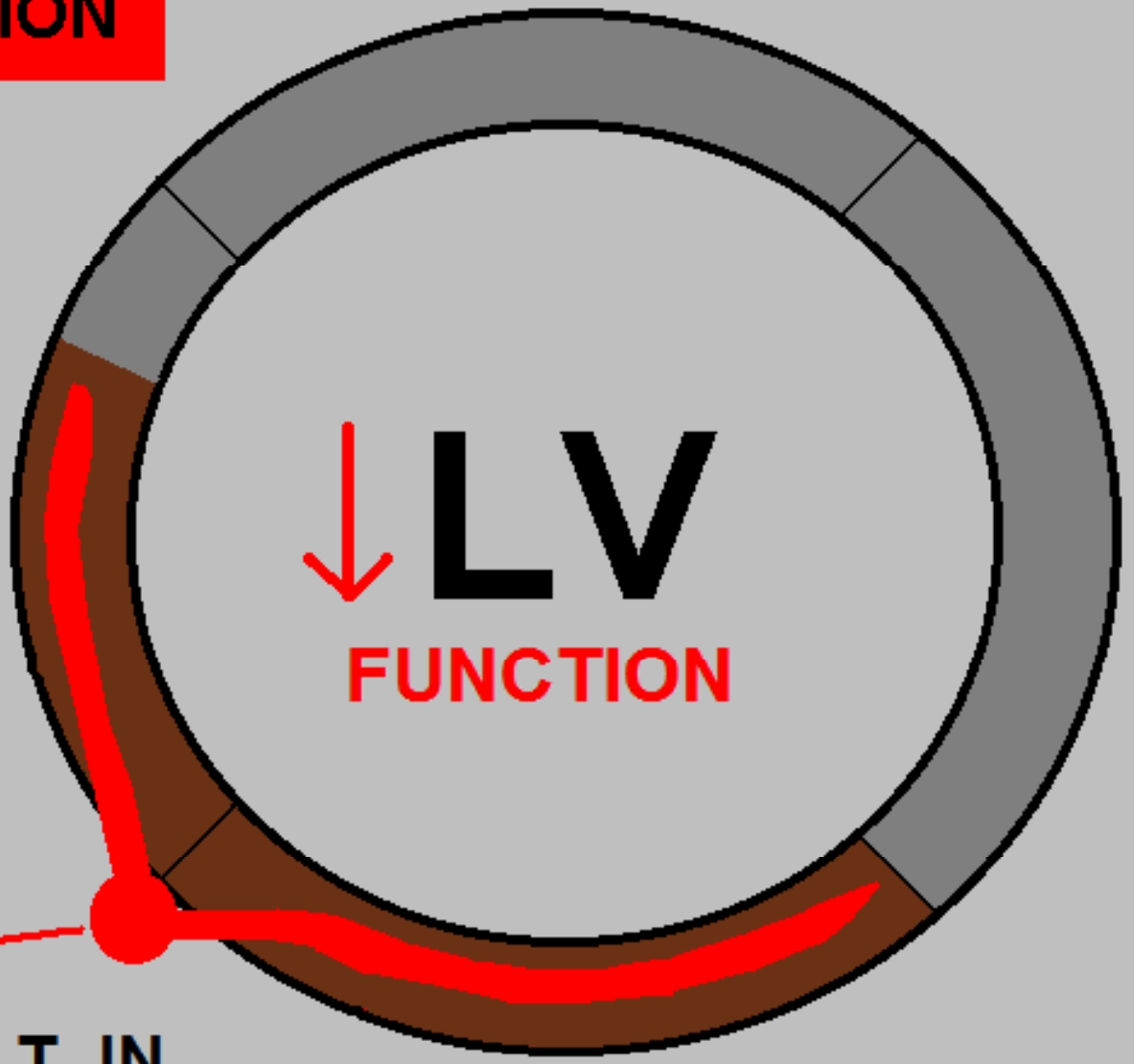
-LEFT ANTERIOR DESCENDING (LAD) ARTERY

ANTICIPATED COMPLICATIONS based on structures fed by the LAD:

- **LV PUMP FAILURE and CARDIOGENIC SHOCK**
  (LAD feeds approx 45% of LV muscle mass)
- **PULMONARY EDEMA**
  (resulting from depressed LV function)
- **COMPLETE HEART BLOCK with IDIO-VENTRICULAR ESCAPE Complexes** (resulting from failure of Bundle of HIS and Bundle Branches)

LAD DISTRIBUTION

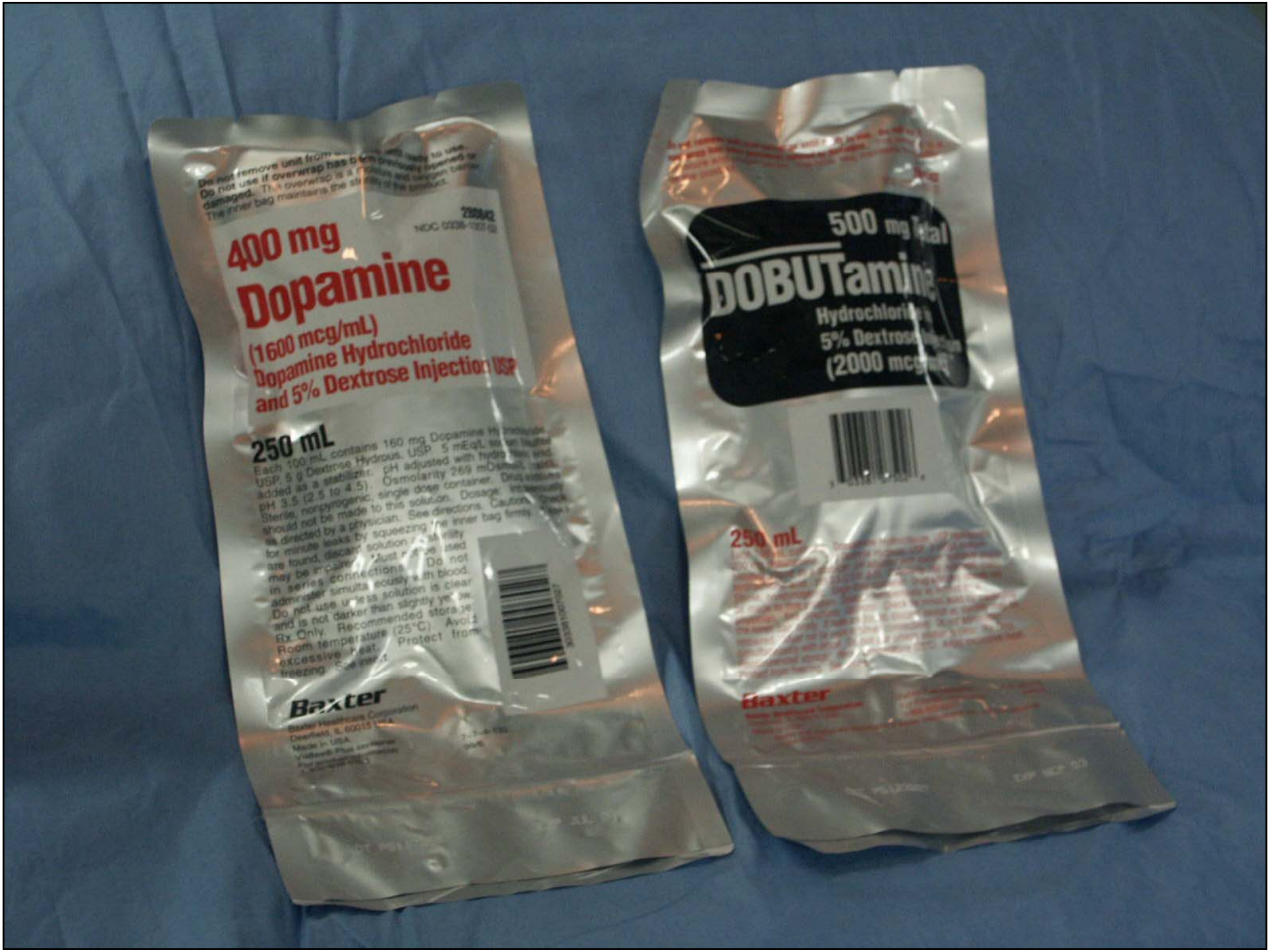
35 - 45 % of LV MUSCLE MASS

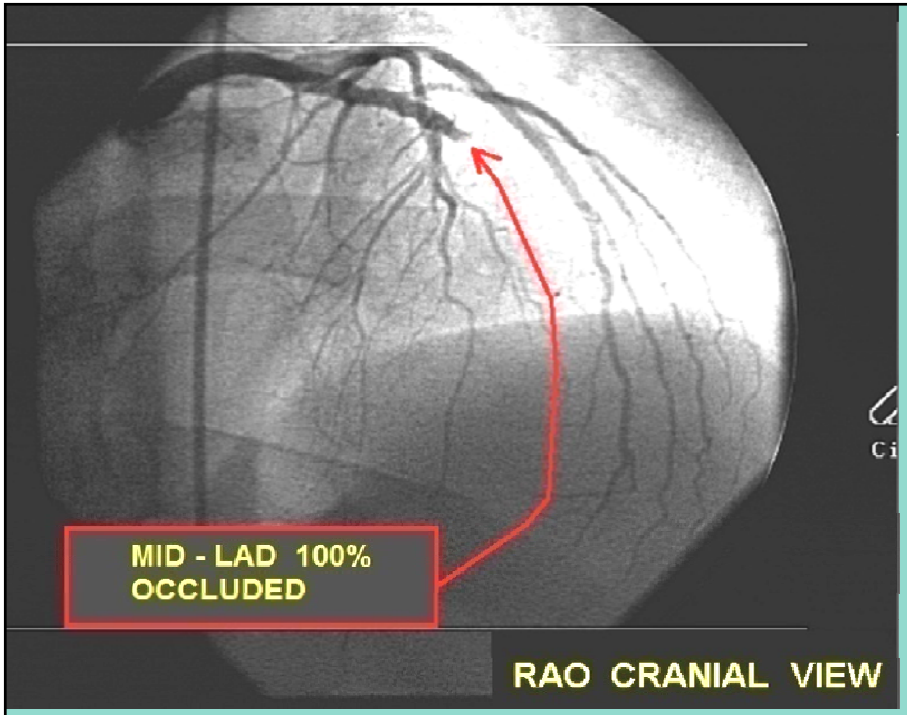


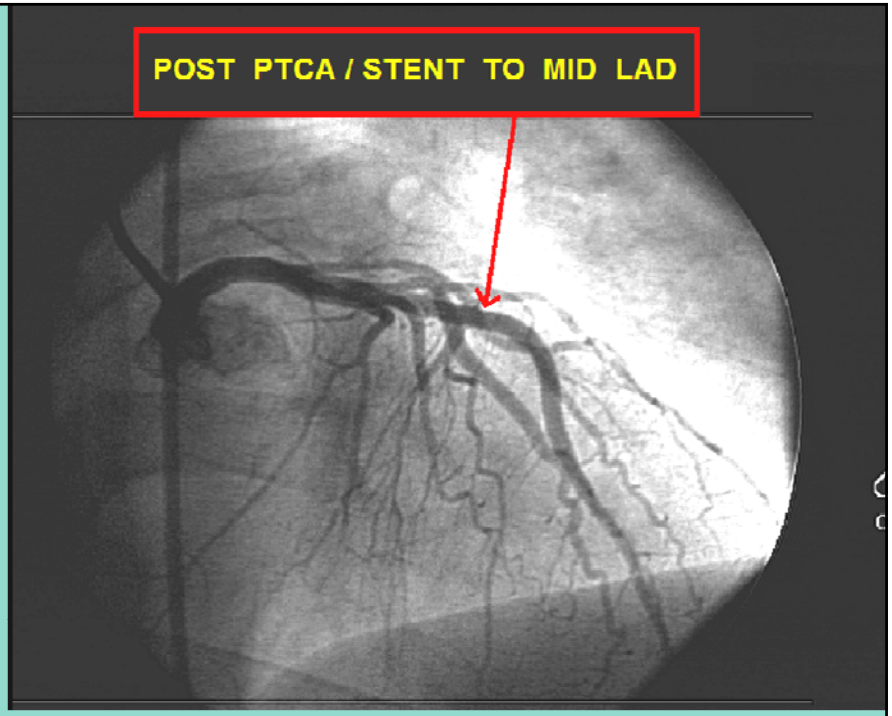
A BLOCKAGE OF THE LAD

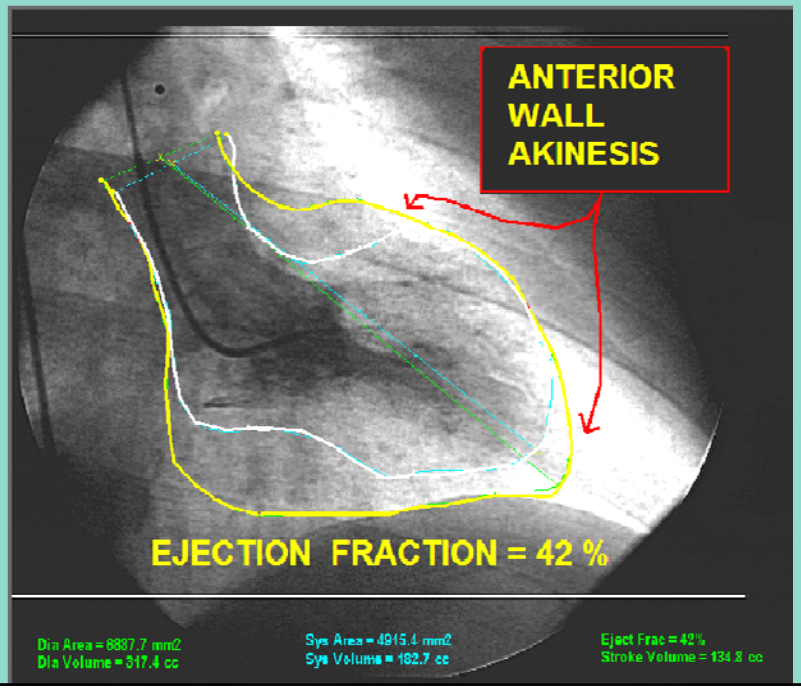
CAN RESULT IN LV PUMP FAILURE --

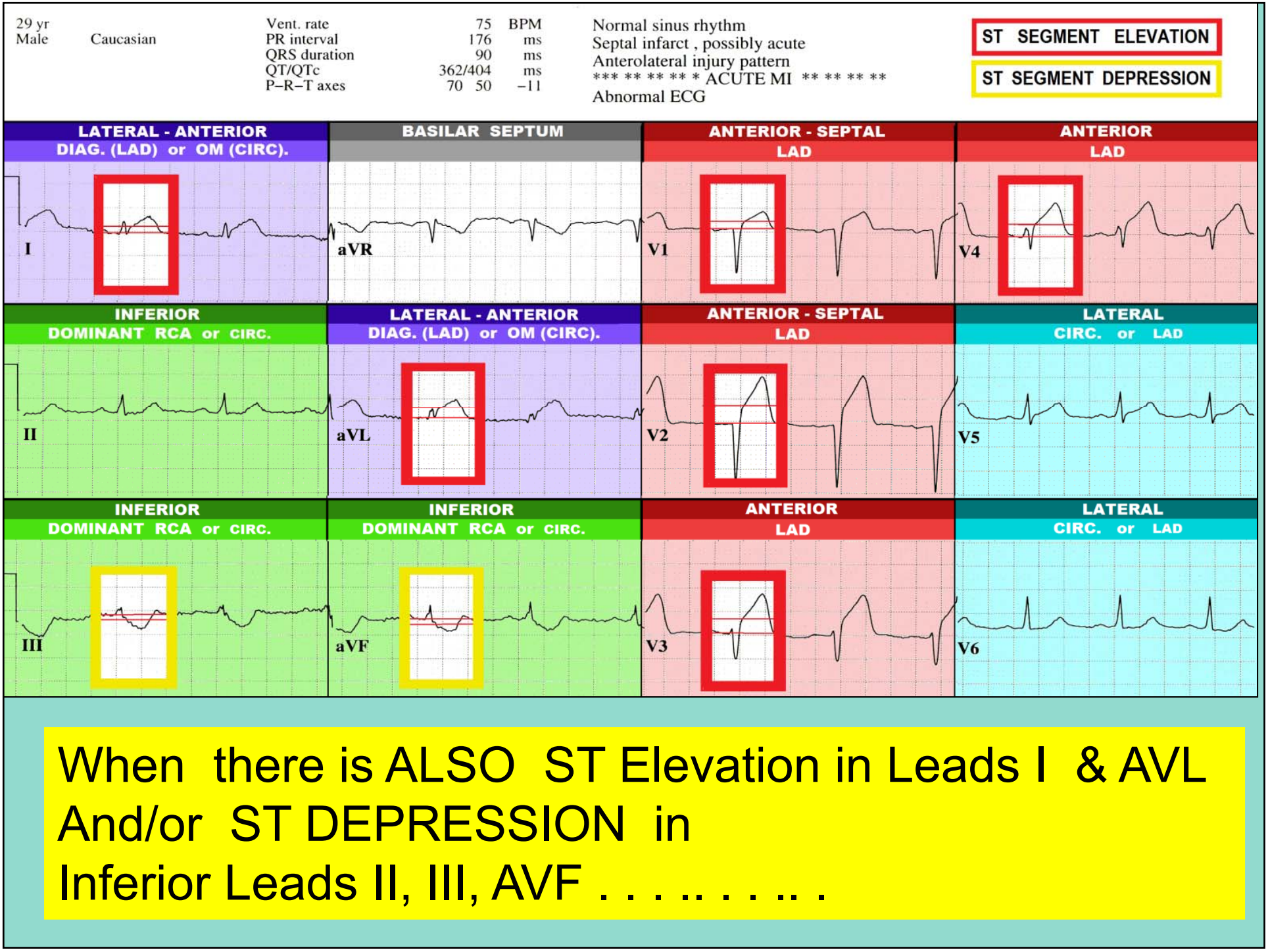
- CARDIOGENIC SHOCK
- PULMONARY EDEMA


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


MID - LAD 100%
OCCLUDED
RAO CRANIAL VIEW

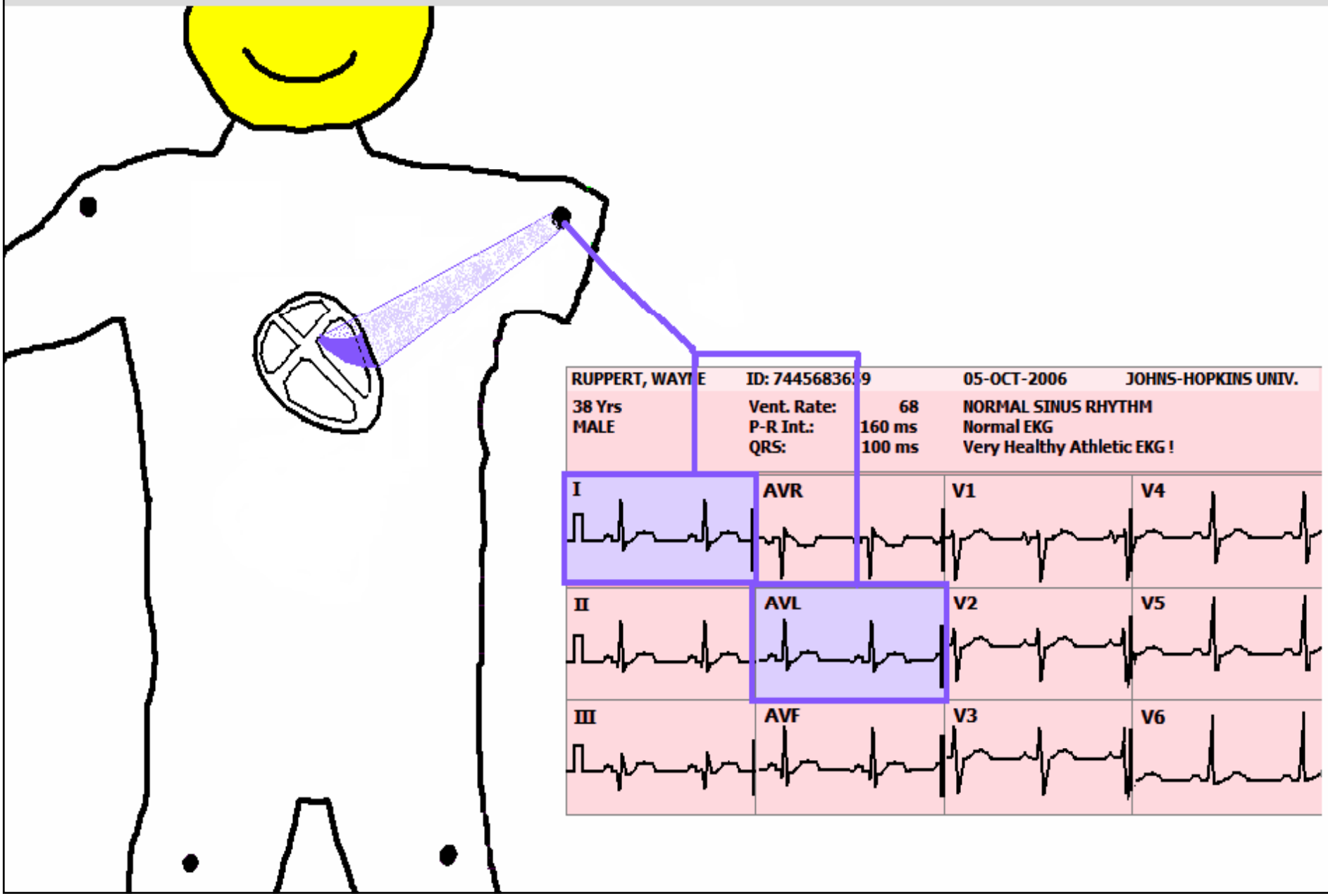

POST PTCA / STENT TO MID LAD


ANTERIOR
WALL
AKINESIS
EJECTION FRACTION = 42 %
Dia Area = 8887.7 mm2
Dia Volume = 317.4 cc
Sys Area = 4915.4 mm2
Sys Volume = 182.7 cc
Eject Frac = 42%
Stroke Volume = 134.8 cc

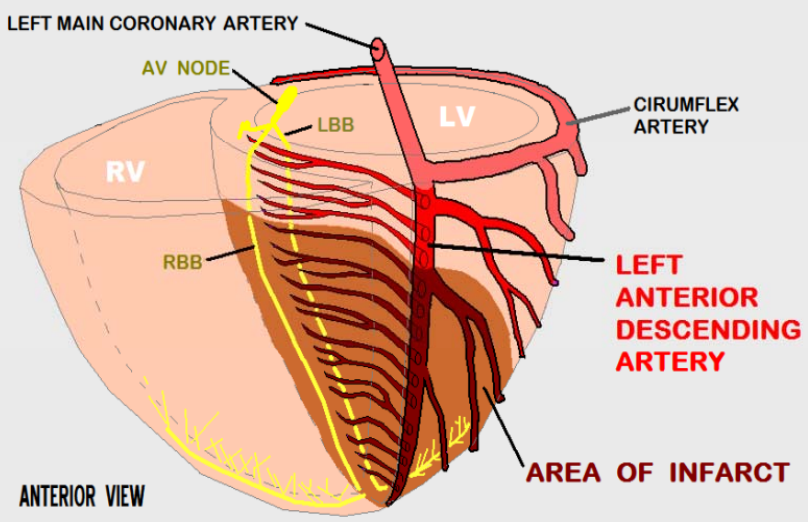


When there is ALSO ST Elevation in Leads I & AVL
And/or ST DEPRESSION in
Inferior Leads II, III, AVF . . . .

LEADS I and aVL view the ANTERIOR-LATERAL JUNCTION

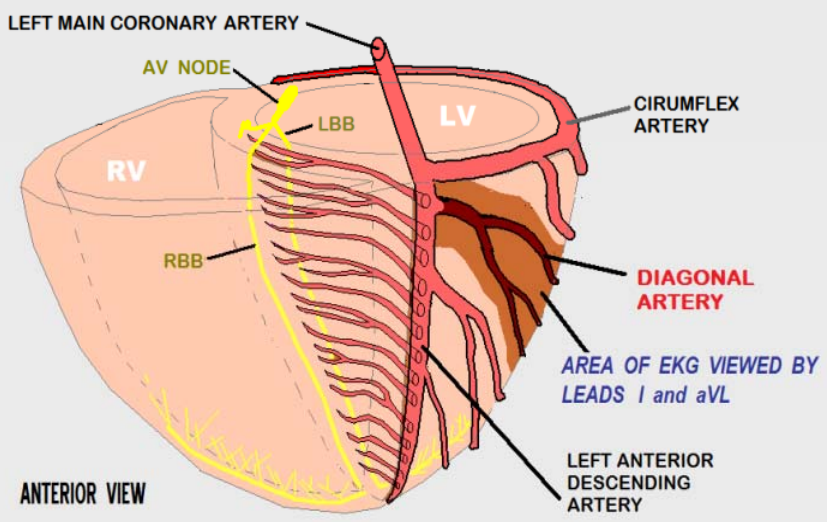


OCCLUSION of MID - LEFT ANTERIOR DESCENDING ARTERY



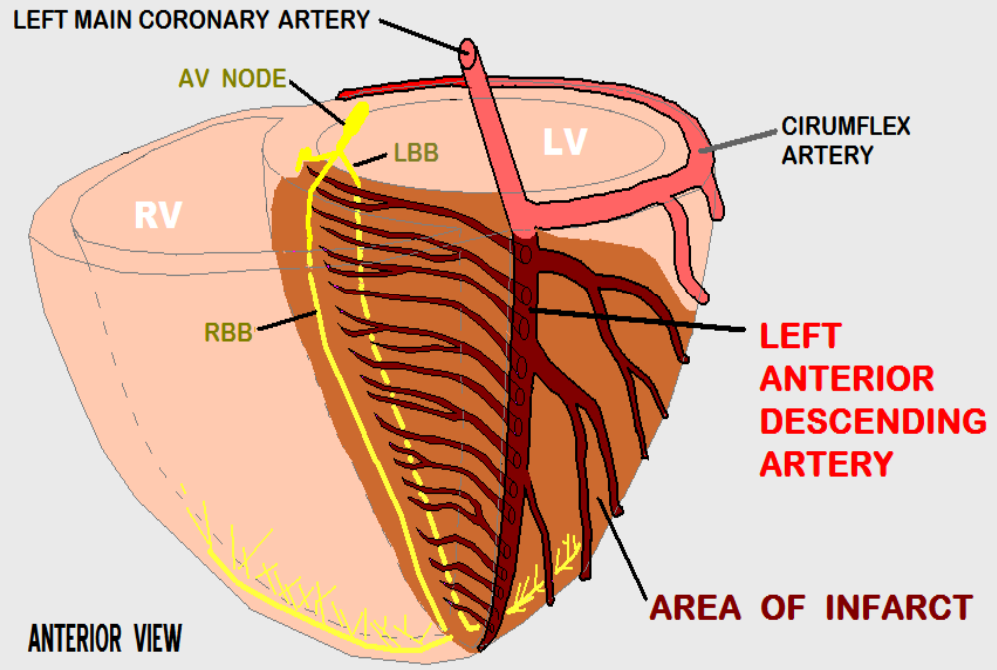
+

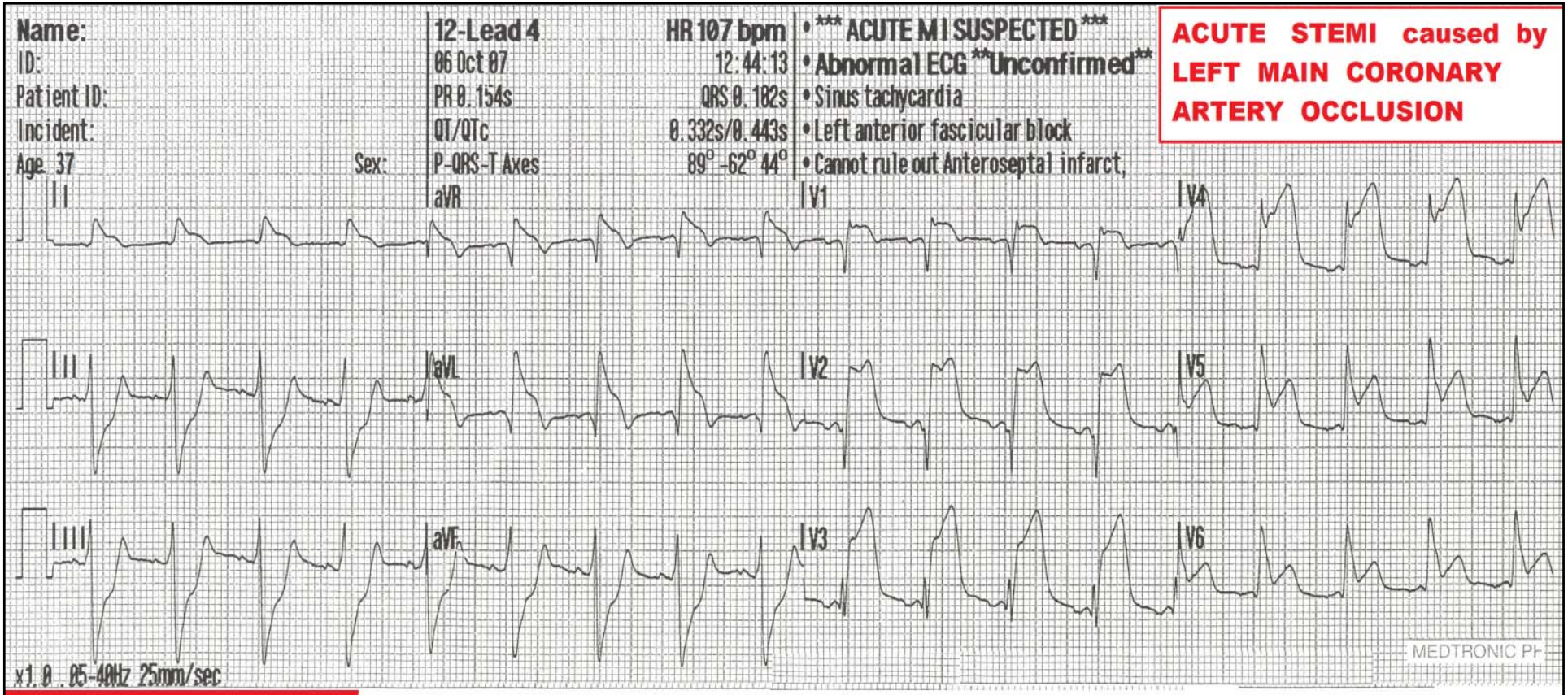
OCCLUSION of DIAGONAL ARTERY



=

OCCLUSION of PROXIMAL LEFT ANTERIOR DESCENDING ARTERY



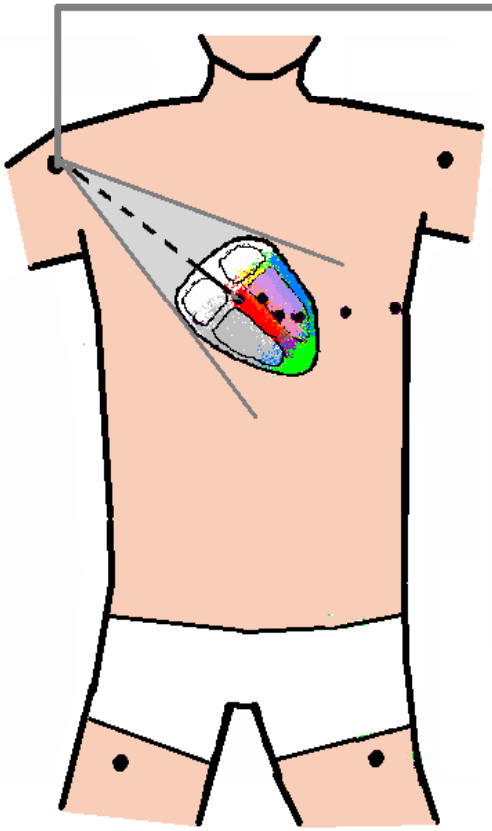


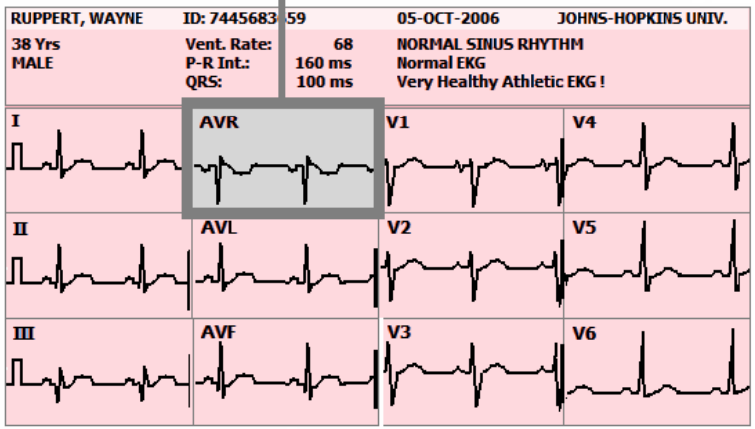
ECG CLUES of ACUTE STEMI caused by LEFT MAIN CORONARY ARTERY OCCLUSION:

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

ST Elevation in Lead AVR with STEMI ? ?

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





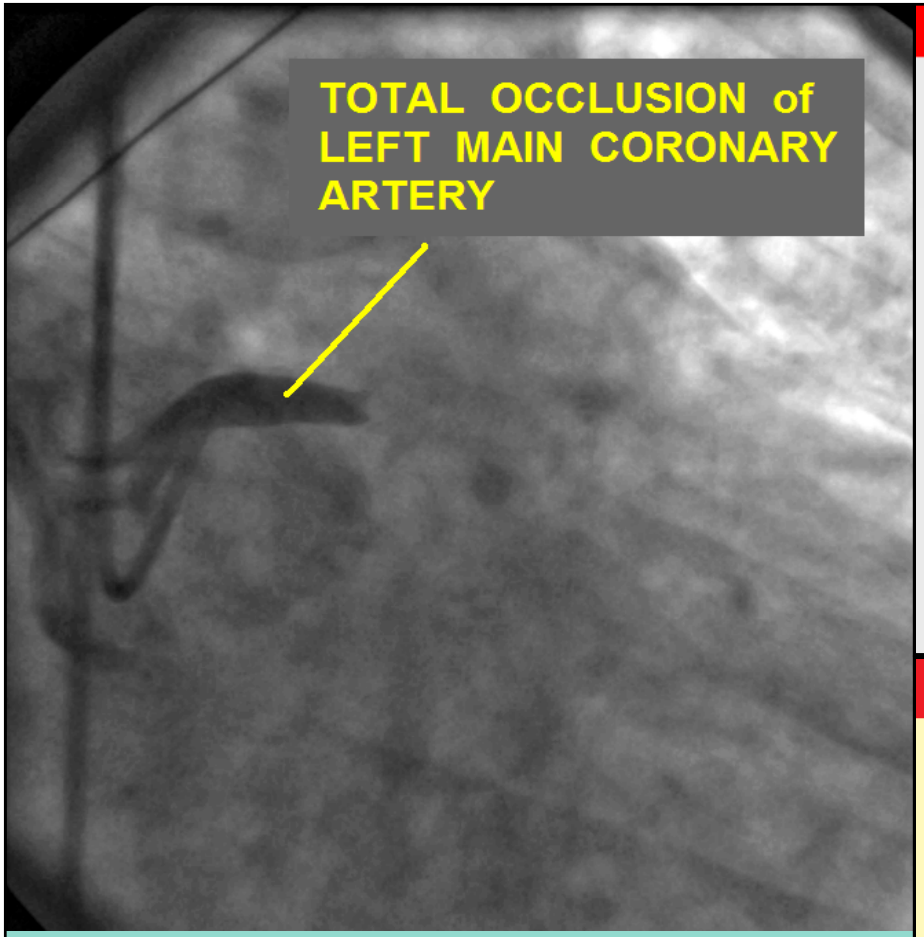
ST ELEVATION in Lead AVR

With STEMI . . . . .

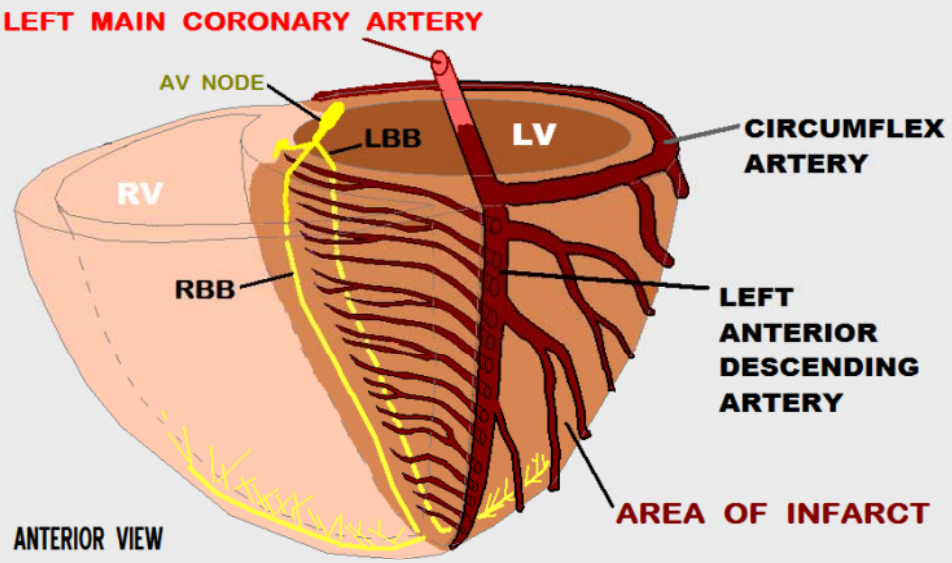
THINK *"LEFT MAIN CORONARY ARTERY OCCLUSION !"*

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

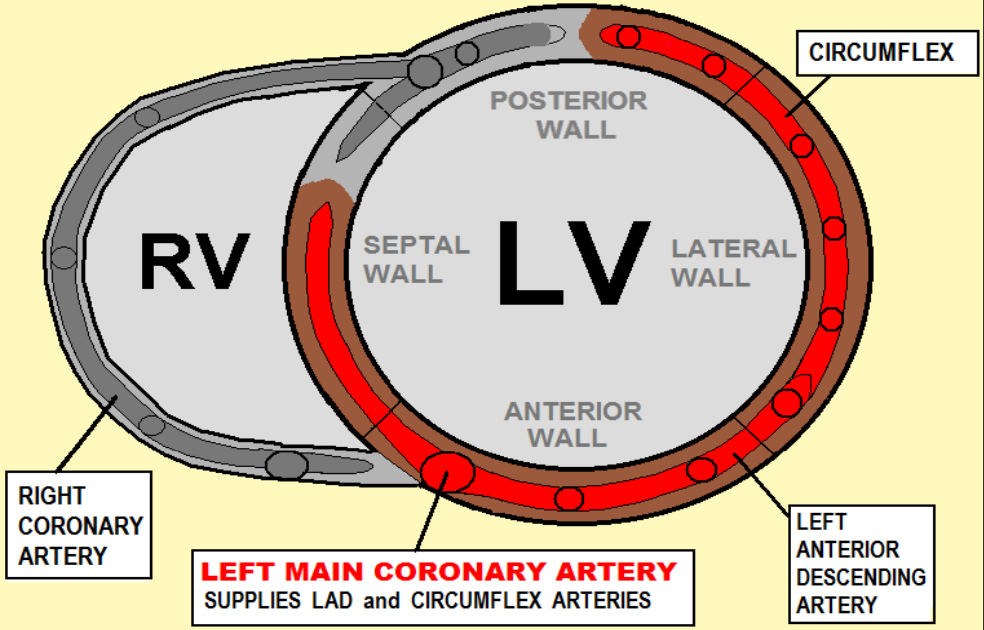


OCCLUSION of the LEFT MAIN CORONARY ARTERY



The LEFT MAIN CORONARY ARTERY

SUPPLIES 75 - 100 % of the LEFT VENTRICULAR MUSCLE MASS



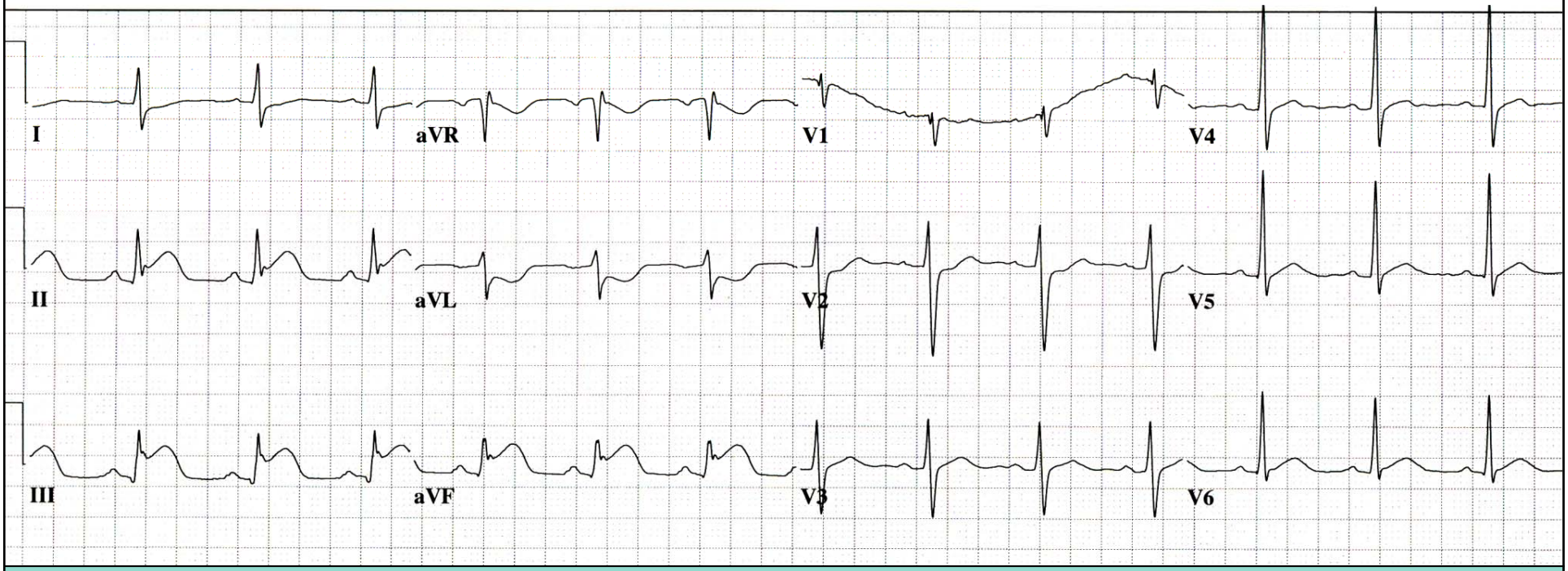
STEMI from Left Main Coronary Artery occlusion = GLOBAL WALL MI:

- **75% Mortality Rate**
- **Cardiogenic Shock**
- **Pulmonary Edema**
- **Imminent Cardiac Arrest**
- **Standard "90 min D2B"**
  TOO LONG !

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

EVALUATE EKG for indicators of ACS:

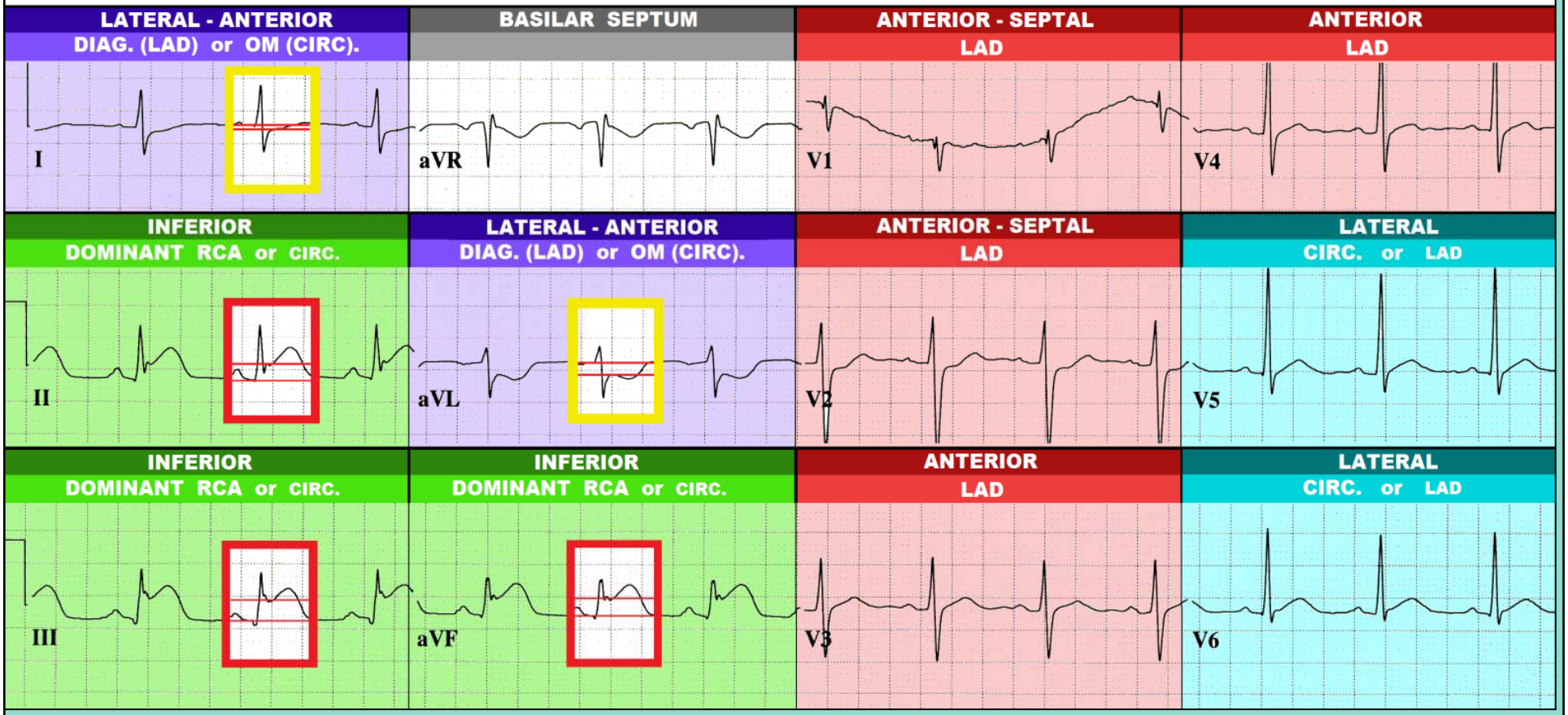
- **ST SEGMENT ELEVATION / DEPRESSION**
- **HYPERACUTE T WAVES**
- **CONVEX ST SEGMENTS**
- **OTHER ST SEGMENT / T WAVE ABNORMALITIES**

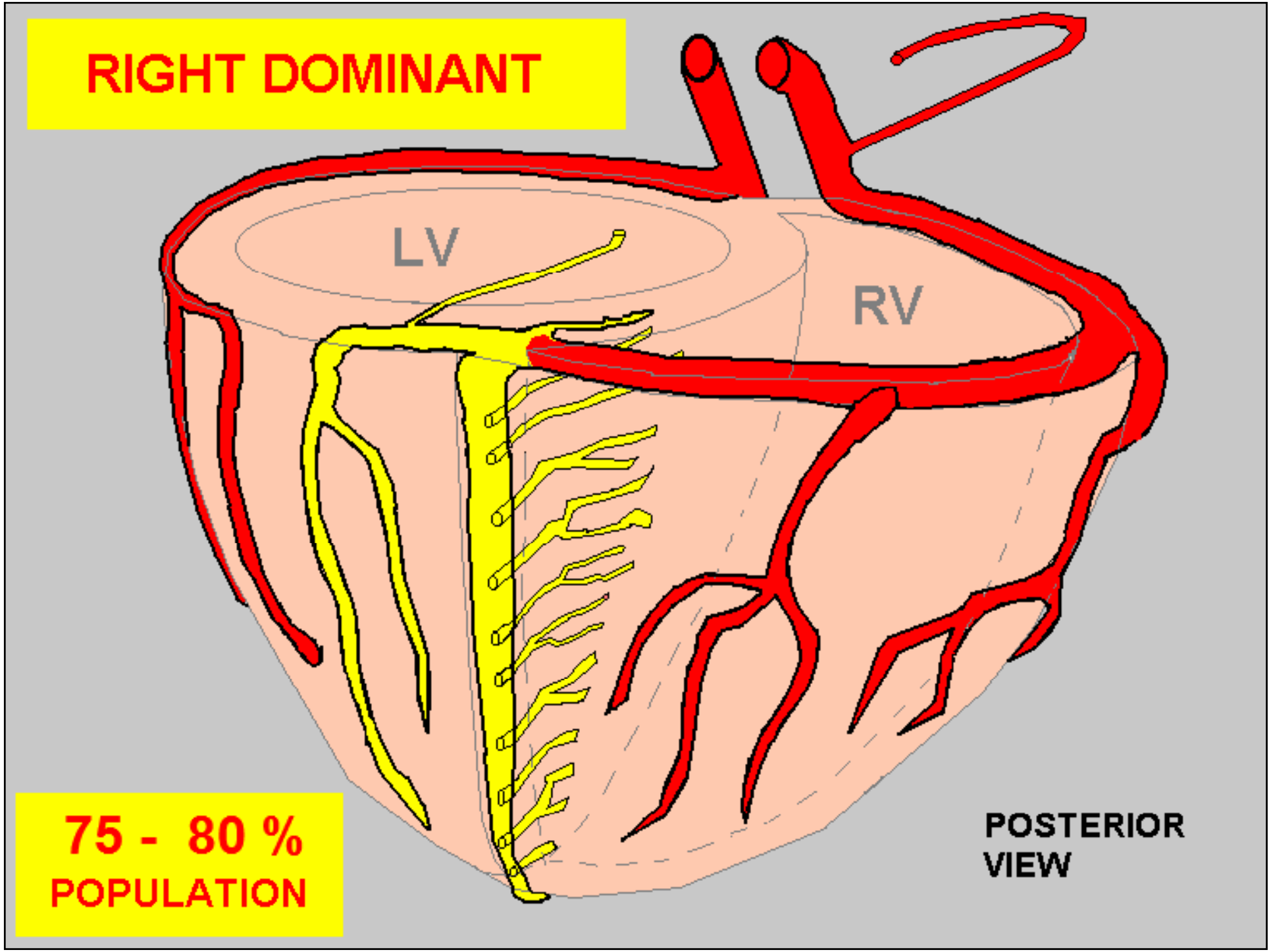


46 yr		Vent. rate	82	BPM	Normal sinus rhythm
Male	Caucasian	PR interval	168	ms	ST elevation consider inferior injury or acute infarct
		QRS duration	96	ms	*** ** ** ** * ACUTE MI ** ** ** **
		QT/QTc	384/448	ms	Abnormal ECG
		P–R–T axes	76 81	88	

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION




RIGHT DOMINANT
LV
RV
75 - 80 %
POPULATION
POSTERIOR
VIEW

INFERIOR WALL STEMI

-RIGHT CORONARY ARTERY (RCA) - 75-80%
- CIRCUMFLEX (CX) ARTERY – 10-15%

ANTICIPATED COMPLICATIONS based on structures fed by the **RCA:**

- **BRADYCARDIA**
  (RCA feeds SA Node 85-90% of patients)
- **RIGHT VENTRICULAR MI**
  (RCA feeds RIGHT VENTRICLE)
- **1st, 2nd AND 3rd DEGREE HEART BLOCKS**
  (Dominant artery feeds AV Node)
- ***If POSTERIOR and/or LATERAL WALL MI present, expect PUMP FAILURE / CARDIOGENIC SHOCK***

IN ***EVERY*** CASE of

INFERIOR WALL STEMI

You must first *RULE OUT*

RIGHT VENTRICULAR MI

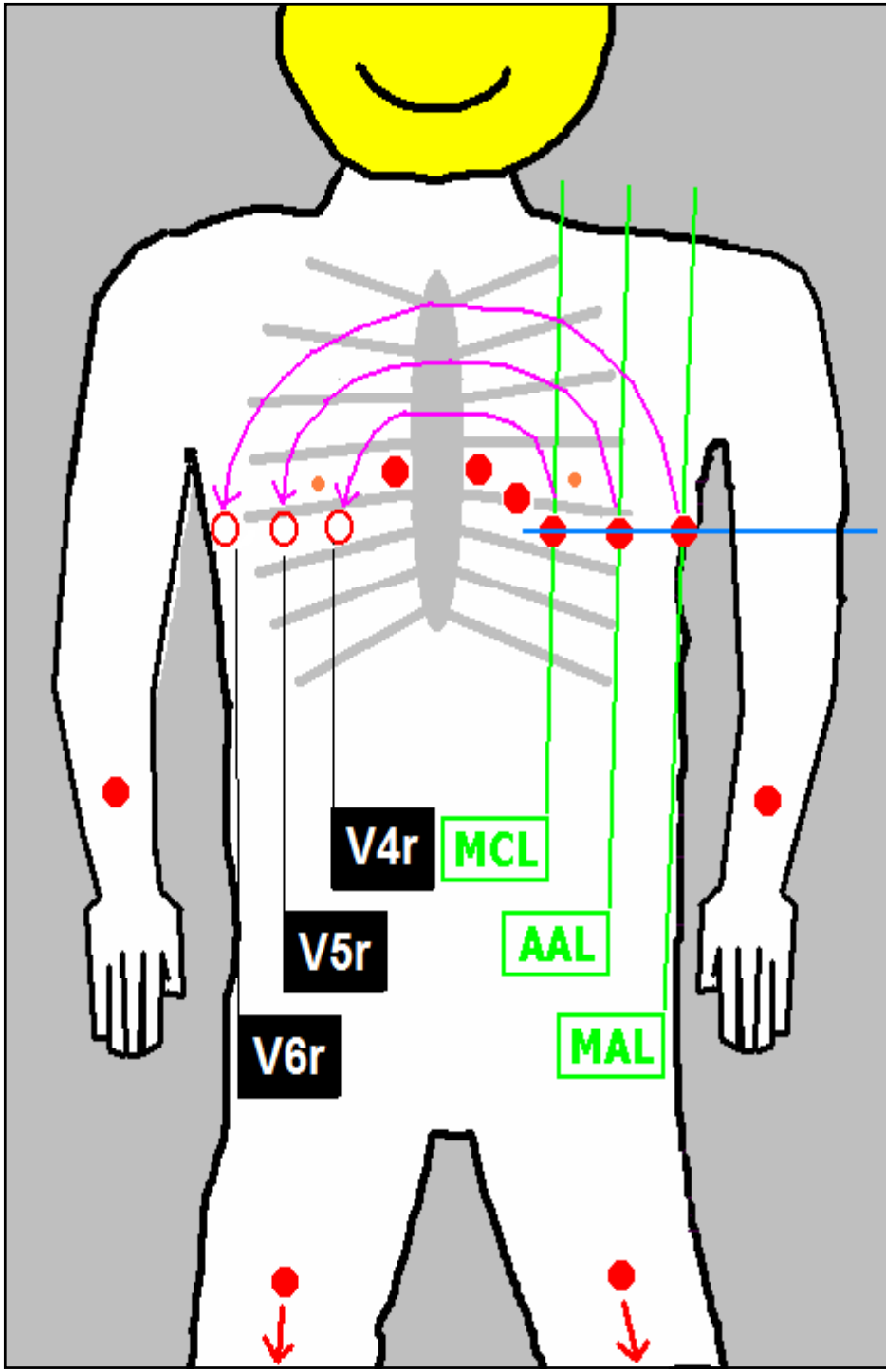
By obtaining a RIGHT SIDED ECG BEFORE giving any:

- NITROGLYCERIN
- Dieuretics

NITROGLYCERIN is a
CLASS III CONTRINDICATION
in
RIGHT VENTRICULAR MI ! !*

It *WILL* precipitate
PROFOUND HYPOTENSION !

*** AHA/ACC 2013 STEMI Guidelines**

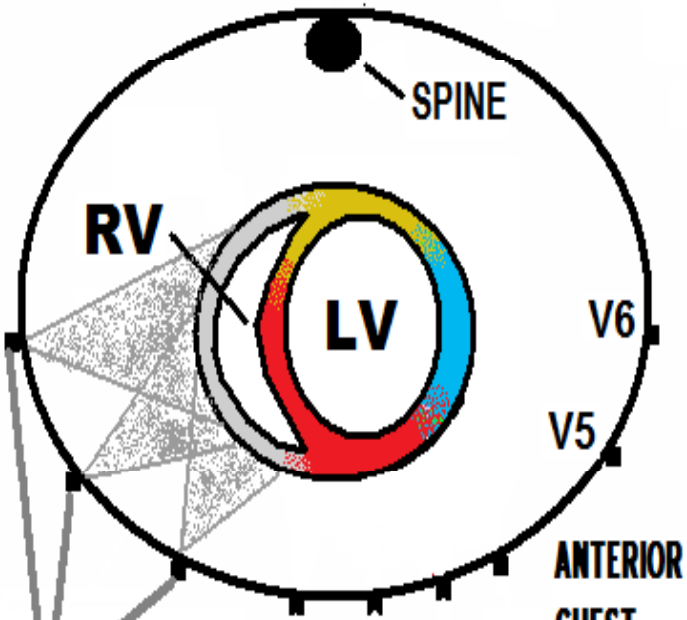


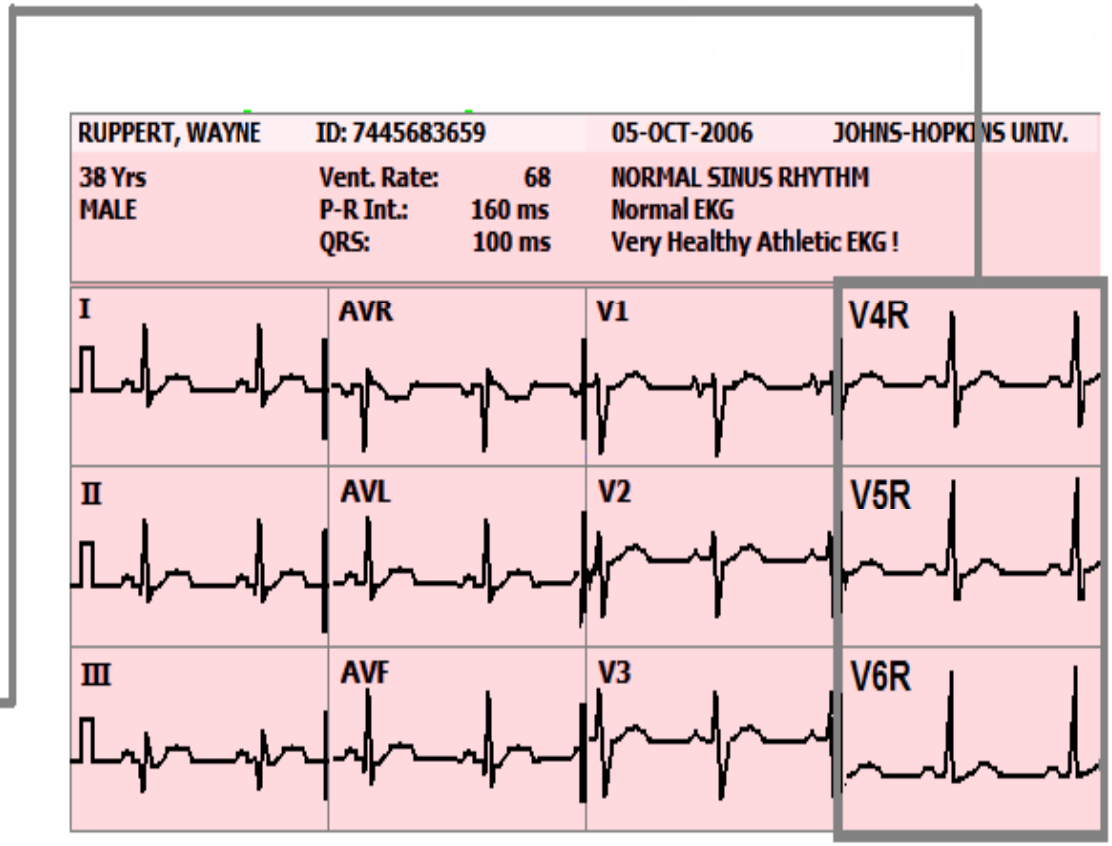
To do a
RIGHT - SIDED EKG . .

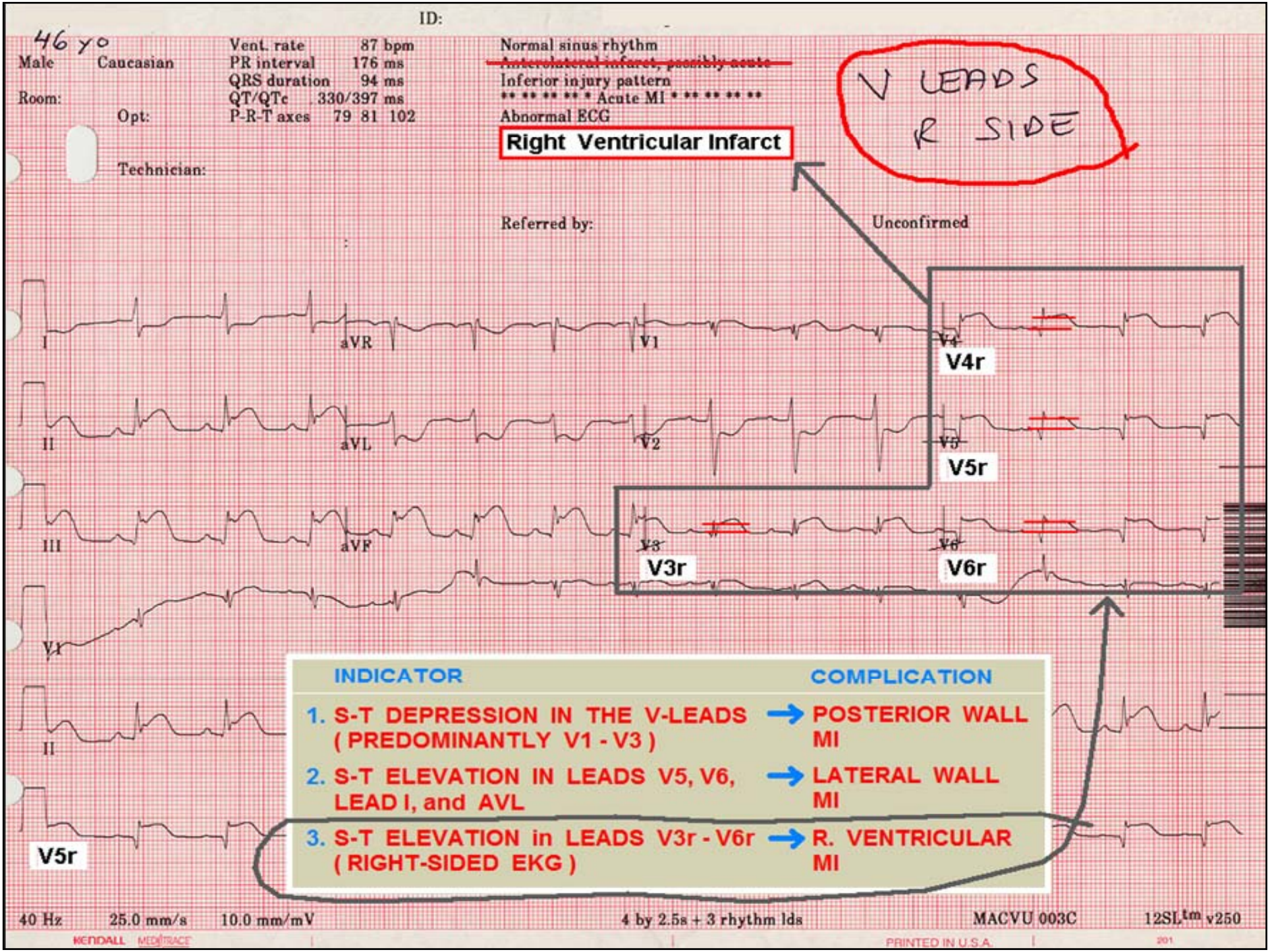
MOVE leads
V4, V5, and V6

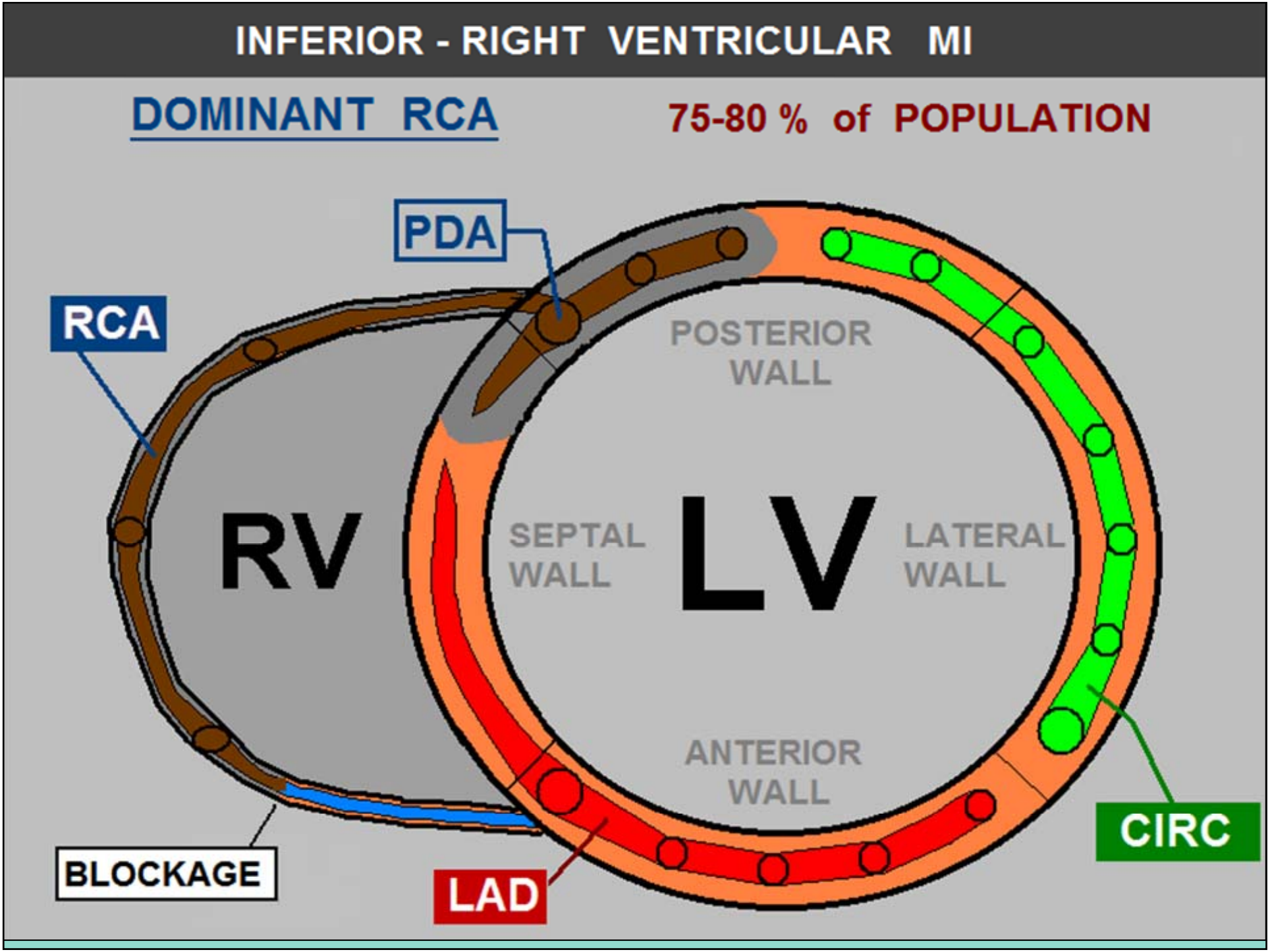
to the corresponding
placement on the
RIGHT SIDE of patient's
chest . . .

V4R - V6R VIEW THE RIGHT VENTRICLE

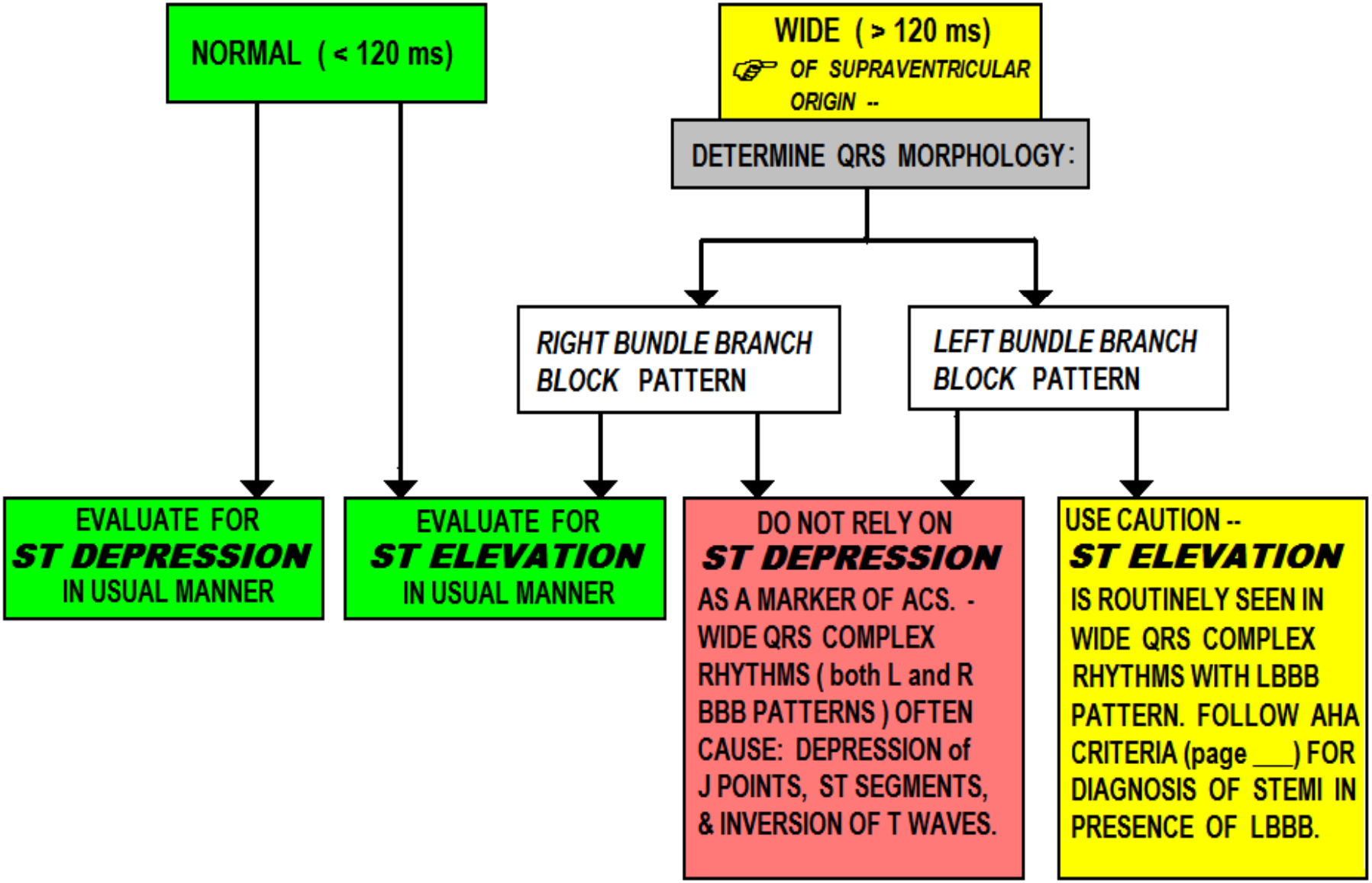





ID:
46 yo
Male Caucasian
Room:
Opt:
Technician:
Vent. rate 87 bpm
PR interval 176 ms
QRS duration 94 ms
QT/QTc 330/397 ms
P-R-T axes 79 81 102
Normal sinus rhythm
Anterolateral infarct, possibly acute
Inferior injury pattern
** ** ** ** * Acute MI * ** ** ** **
Abnormal ECG
Right Ventricular Infarct
V LEADS
R SIDE
Referred by:
Unconfirmed
I
aVR
V1
V4
V4r
II
aVL
V2
V5
V5r
III
aVF
V3
V3r
V6
V6r
V1
II
V5r
INDICATOR
COMPLICATION
1. S-T DEPRESSION IN THE V-LEADS (PREDOMINANTLY V1 - V3) → POSTERIOR WALL MI
2. S-T ELEVATION IN LEADS V5, V6, LEAD I, and AVL → LATERAL WALL MI
3. S-T ELEVATION in LEADS V3r - V6r (RIGHT-SIDED EKG) → R. VENTRICULAR MI
40 Hz 25.0 mm/s 10.0 mm/mV
4 by 2.5s + 3 rhythm lds
MACVU 003C
12SLtm v250
KENDALL MEDITRACE
PRINTED IN U.S.A.
201


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

STEP 1 - EVALUATE WIDTH OF QRS:



INFARCTION

A.H.A. ACLS GUIDELINES 2000 / 2006

PATIENTS with RIGHT BUNDLE BRANCH BLOCK --

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

A.H.A. ACLS GUIDELINES

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

   for diagnosis of STEMI

2. If patient has:

   a) previously NORMAL ECGs (no LBBB)

   -- or --

   b) no old ECGs available for comparison

   consider diagnosis as STEMI until proven otherwise.

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

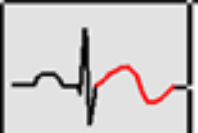
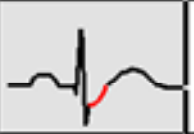
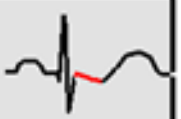
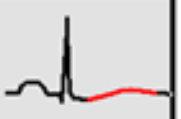
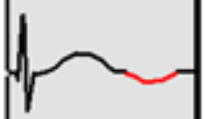
- ST ELEVATION > 5 mm
- COMPARE J POINT, ST SEGMENTS and T WAVES of previous ECG with LBBB to NEW ECG.
- CONVEX ST SEGMENT = poss. MI
  CONCAVE ST SEGMENT = normal
- CONCORDANT ST changes (1 mm or > ST DEPRESSION V1 - V3 or ST ELEVATION LEADS II, III, AVF)
- ST ELEVATION in LEADS II, III, and/or AVF

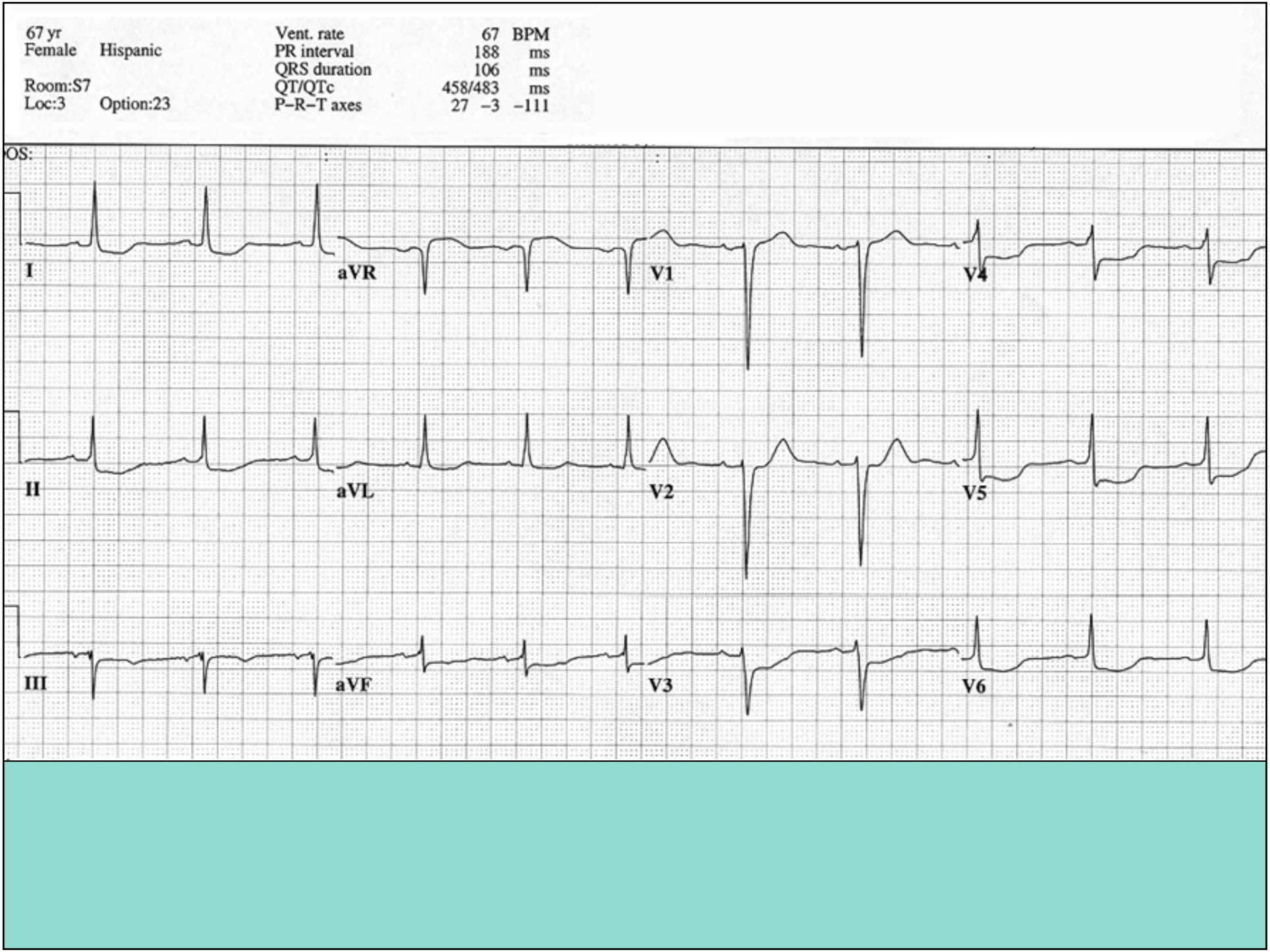
N. ENGL. J. MED v 348; p933 - 940 - Zimetbaum, et. al.

Patterns of ISCHEMIA:

EKG PATTERNS of ACS & ISCHEMIA

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

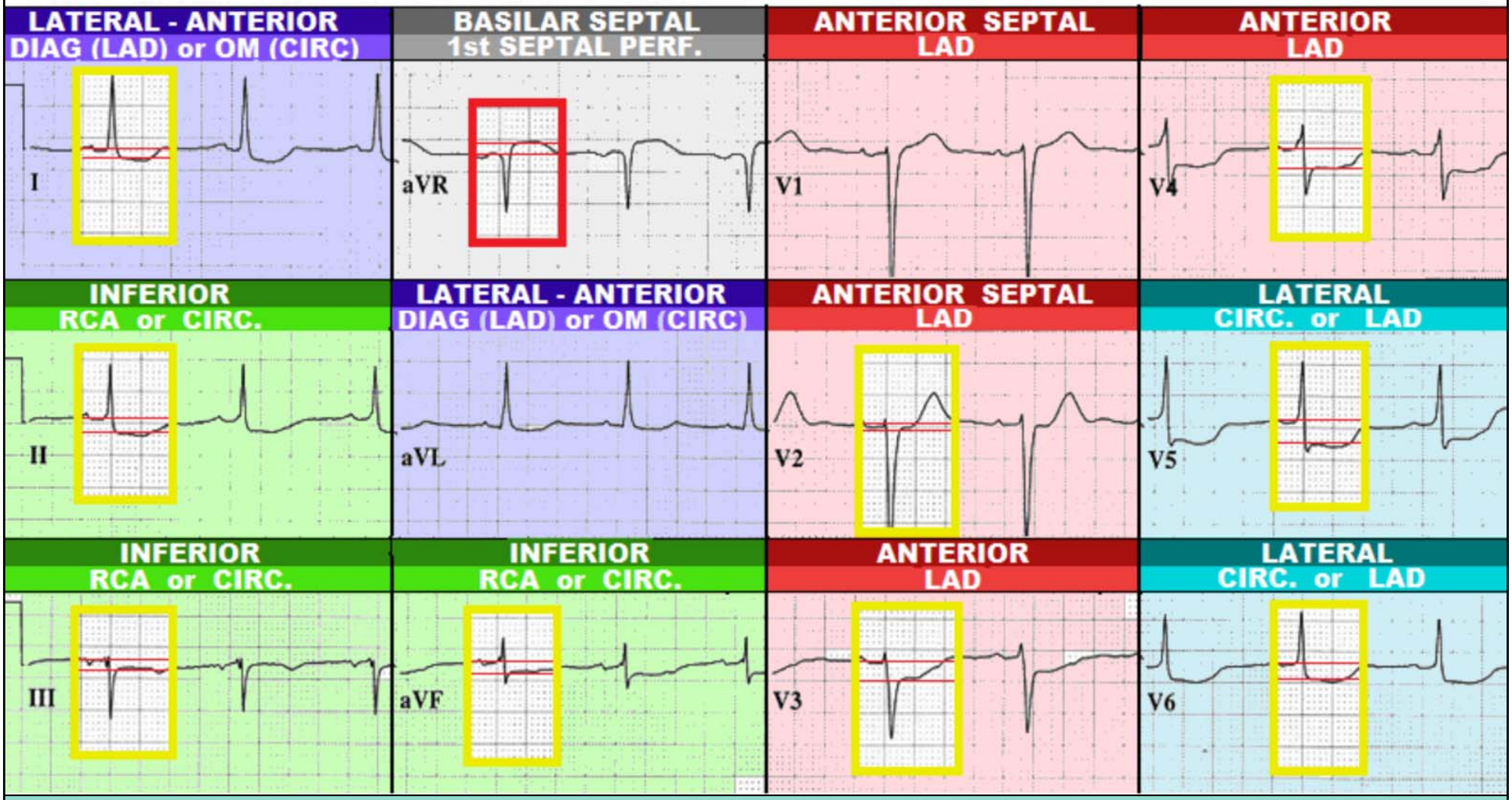
!	DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA
	INVERTED T WAVE		- MYOCARDITIS - ELECTROLYTE IMBAL. - ISCHEMIA
	SHARP S-T T ANGLE		- ACUTE MI (NOT COMMON) - ISCHEMIA
	BI-PHASIC T WAVE (WELLEN'S)		- SUB-TOTAL LAD LESION - VASOSPASM - HYPERTROPHY
	DEPRESSED J POINT with UPSLOPING ST		- ISCHEMIA
	DOWNSLOPING S-T SEGMENT		- ISCHEMIA
?	FLAT S-T SEGMENT > 120 ms		- ISCHEMIA
?	LOW VOLTAGE T WAVE WITH NORMAL QRS		- ISCHEMIA
?	U WAVE POLARITY OPPOSITE THAT OF T WAVE		- ISCHEMIA


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

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

ST SEGMENT ELEVATION

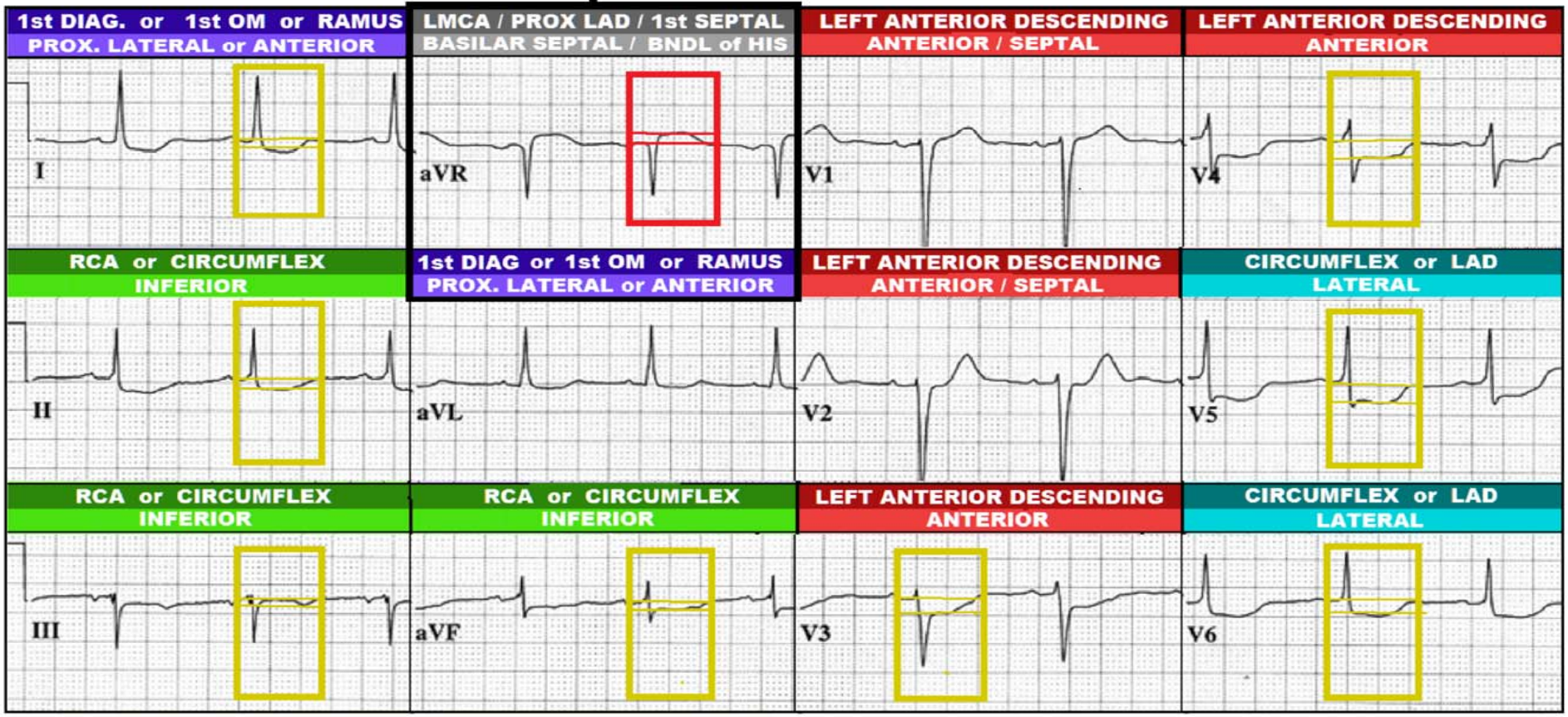
ST SEGMENT DEPRESSION

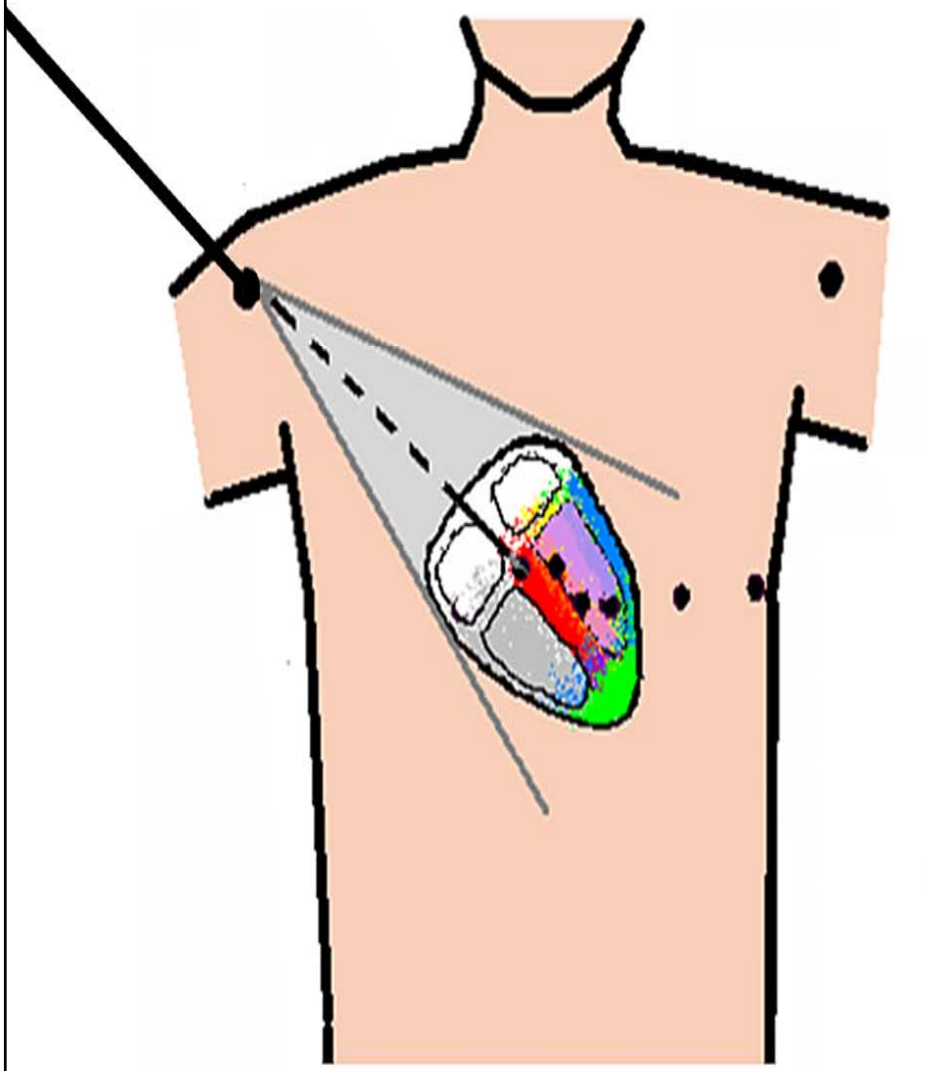


- ☑ ST ELEVATION in LEAD AVR
- ☑ ST DEPRESSION in 8 OR MORE LEADS
- ☑ NOT CLASSIFIED as "STEMI" DUE TO ST ELEVATION PRESENT IN LEAD AVR ONLY TROPONIN MAY BE ELEVATED (NSTEMI) or NORMAL.

ST SEGMENT ELEVATION

ST SEGMENT DEPRESSION

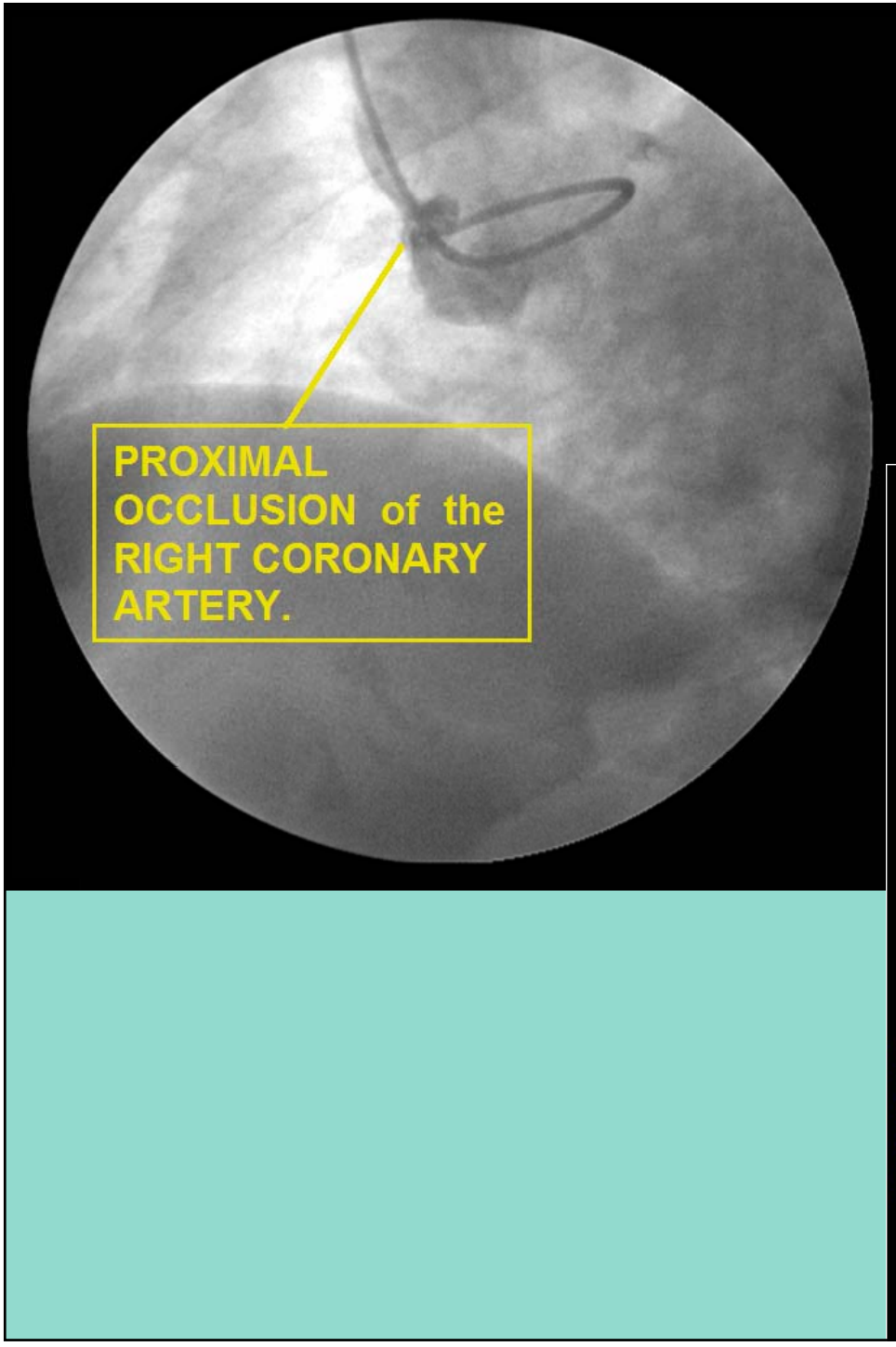


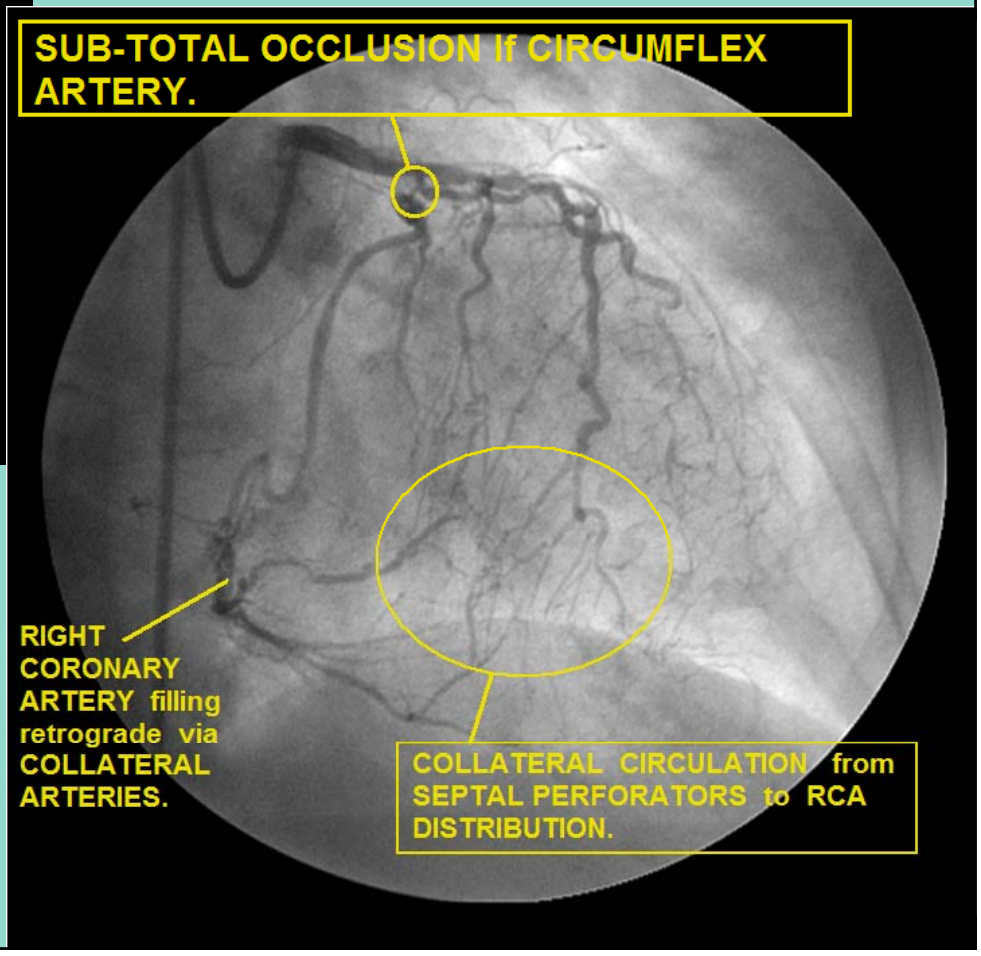


Lead AVR views the BASILAR SEPTUM, the region perfused by the FIRST SEPTAL PERFORATOR originating from the PROXIMAL LAD.

Patients with PRIMARY ST ELEVATION in Lead AVR and GLOBAL ISCHEMIA (ST - DEPRESSION in 8 or more ECG Leads) who experience ANGINA at REST have a 75% incidence of CRITICAL STENOSIS of the LEFT MAIN CORONARY ARTERY or SEVERE TRIPLE- VESSEL DISEASE *

* 1. Circulation 2009: AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the ECG: Part VI: Acute Ischemia / Infarction;
2. Circulation 2013: ACCF/AHA Guidelines for Management of STEMI


PROXIMAL OCCLUSION of the RIGHT CORONARY ARTERY.


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

OLD MI:

Within last 6 months ??

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

MACE after noncardiac surgery is often associated with prior CAD events. The stability and timing of a recent MI impact the incidence of perioperative morbidity and mortality.

Recent MI,
defined as having occurred within 6 months of non-cardiacsurgery, was also found to be an independent risk factor for perioperative stroke, which was associated with an 8-fold increase in the perioperative mortality rate

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

A study using discharge summaries demonstrated that the postoperative MI rate decreased substantially as the length of time from MI to operation Increased. This risk was modified by the presence and type of coronary revascularization (coronary artery bypass grafting [CABG] versus percutaneous coronary interventions [PCIs]) that occurred at the time of the MI.

Taken together, the data suggest that 60 days should elapse after a MI before noncardiac surgery in the absence of a coronary intervention.

• Q WAVES •

Normal Q Waves

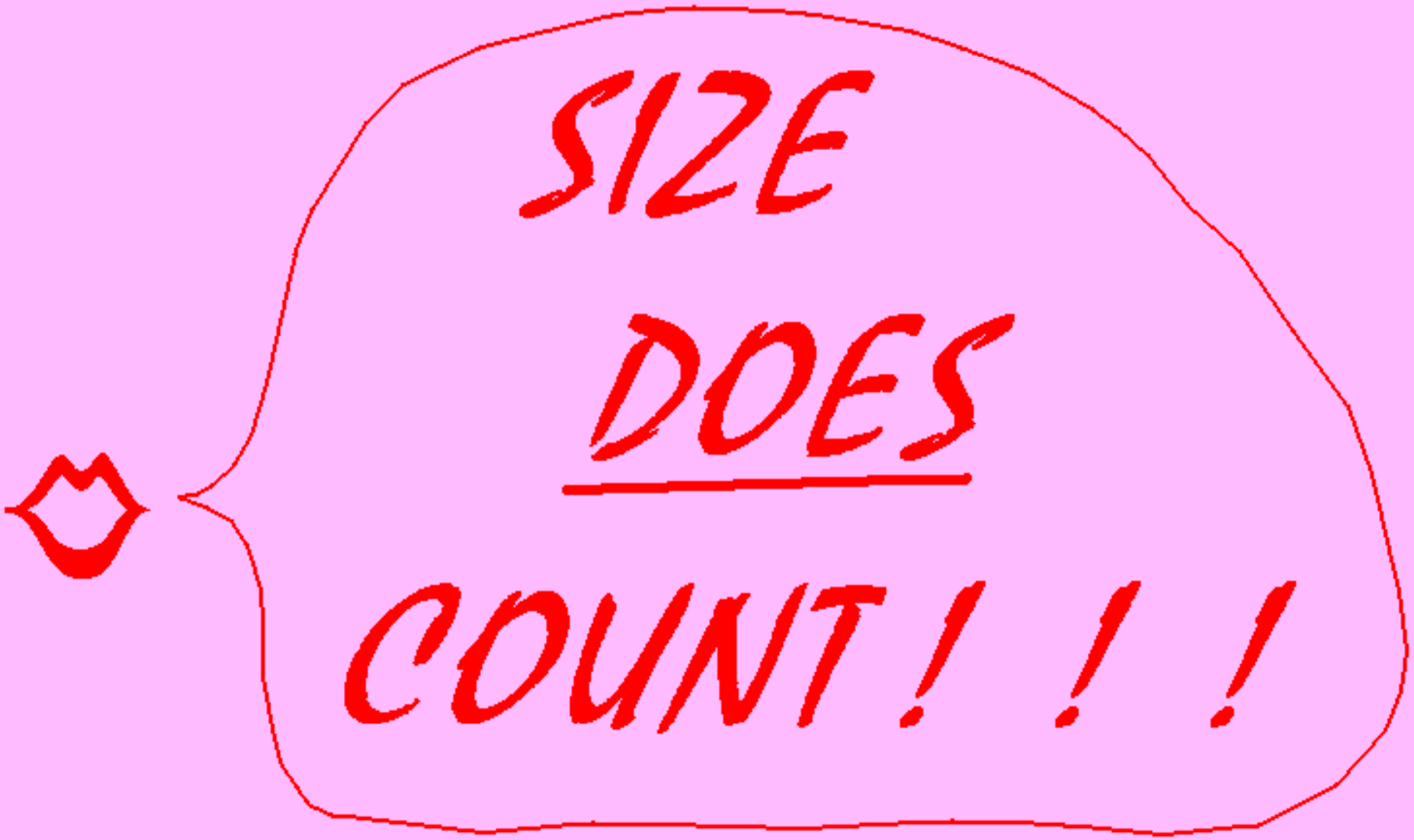
caused by depolarization of the intraventricular septum

Abnormal Q Waves -

caused by:

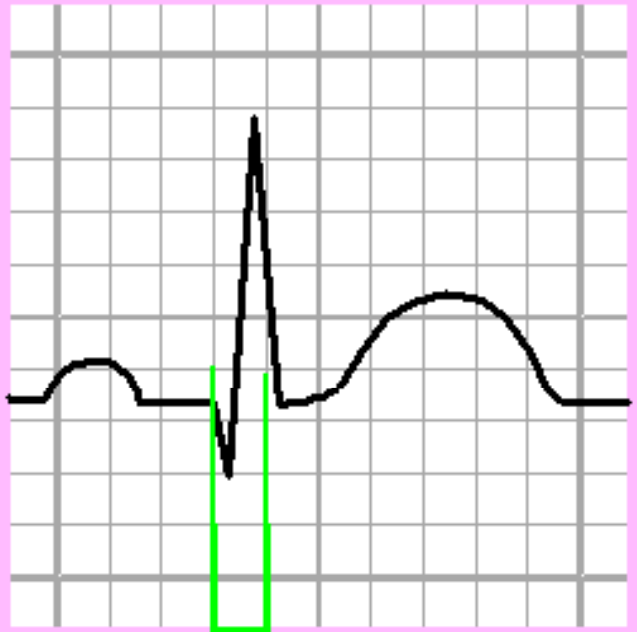
- necrosis (old infarction)
- hypertrophy

• Q WAVES •



THE QRS COMPLEX

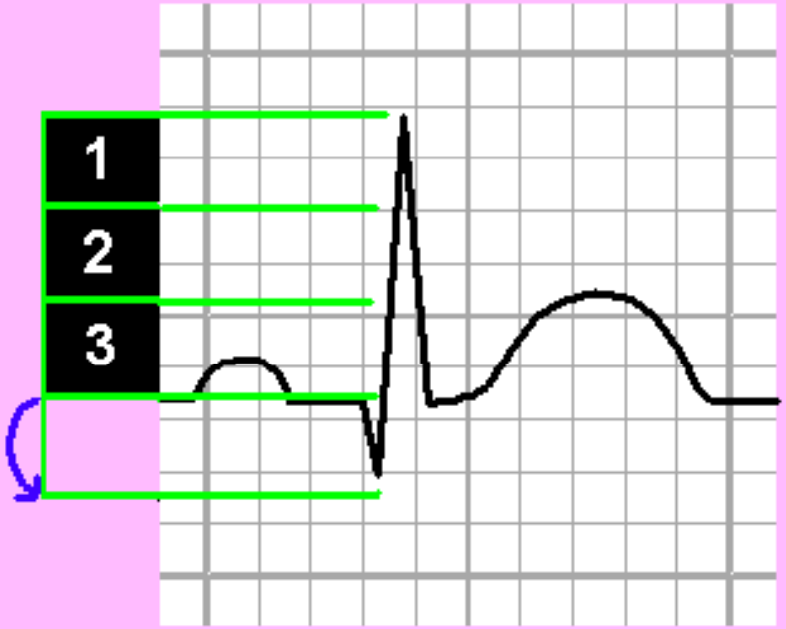
GENERAL RULES FOR NORMAL Q WAVES - WIDTH



LESS THAN .40 (1 mm) WIDE

THE QRS COMPLEX

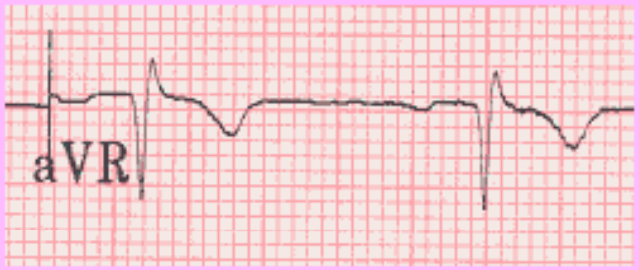
GENERAL RULES FOR NORMAL Q WAVES - HEIGHT



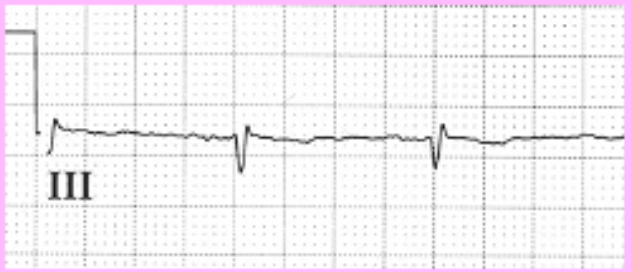
LESS THAN 1/3 THE HEIGHT OF THE R WAVE

THE QRS COMPLEX

NORMAL Q WAVES
EXCEPTIONS TO THE RULES



LEAD AVR



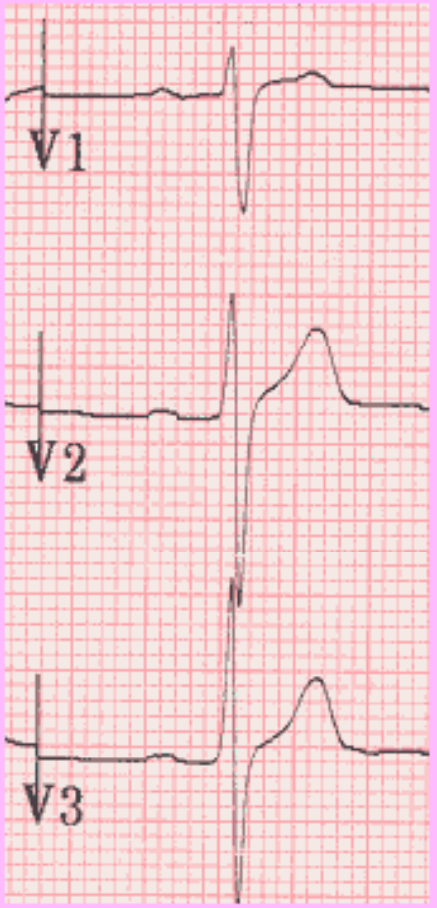
LEAD Ⅲ

☞ 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

21-MAR-1997 15:37:12 ST. JOSEPH'S HOSPITAL-PAT ROUTINE RETRIEVAL

56 yr
Male Caucasian

Room:SGC
Loc:2 Option:13

Vent. rate	64	BPM
PR interval	130	ms
QRS duration	84	ms
QT/QTc	398/410	ms
P-R-T axes	69 -17	-97

Normal sinus rhythm
Inferior-posterior infarct , age undetermined
Abnormal ECG
No previous ECGs available

EKG CLASS #WR03601840

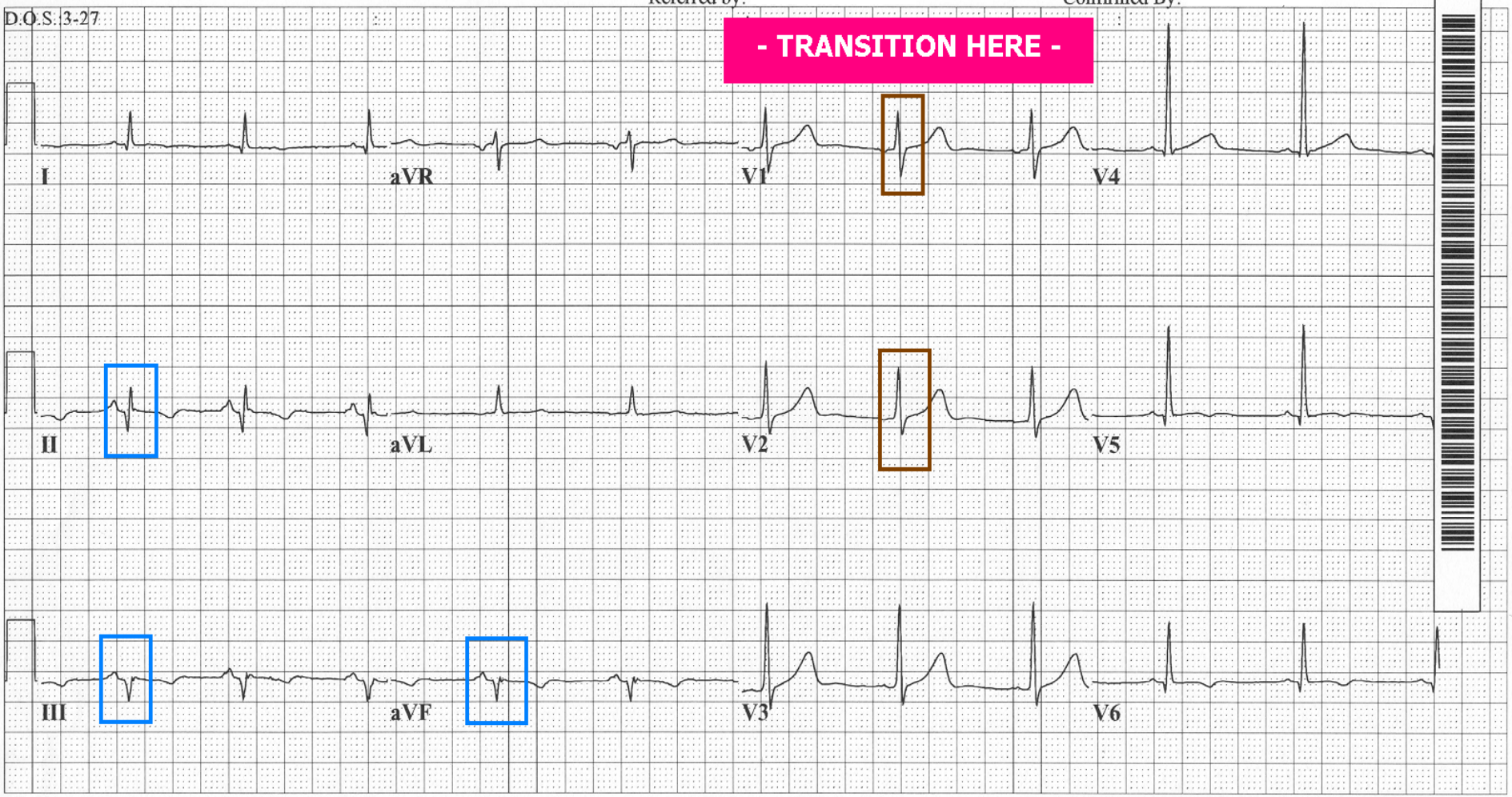
- SIGNIFICANT Q WAVES LEADS II, III, AVF

- TRANSITION V1 -- EARLY

Referred by: Confirmed By:

D.O.S.:3-27

- TRANSITION HERE -



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

EID:17 EDT: 08:45 22-MAR-1997 ORDER:

03–OCT–2000 08:40:42 ST. JOSEPH'S HOSPITAL–CCR ROUTINE RETRIEVAL

45 yr
Male Caucasian

Room:CCR
Loc:7 Option:35

Vent. rate	59	BPM
PR interval	144	ms
QRS duration	88	ms
QT/QTc	416/411	ms
P–R–T axes	5 99	25

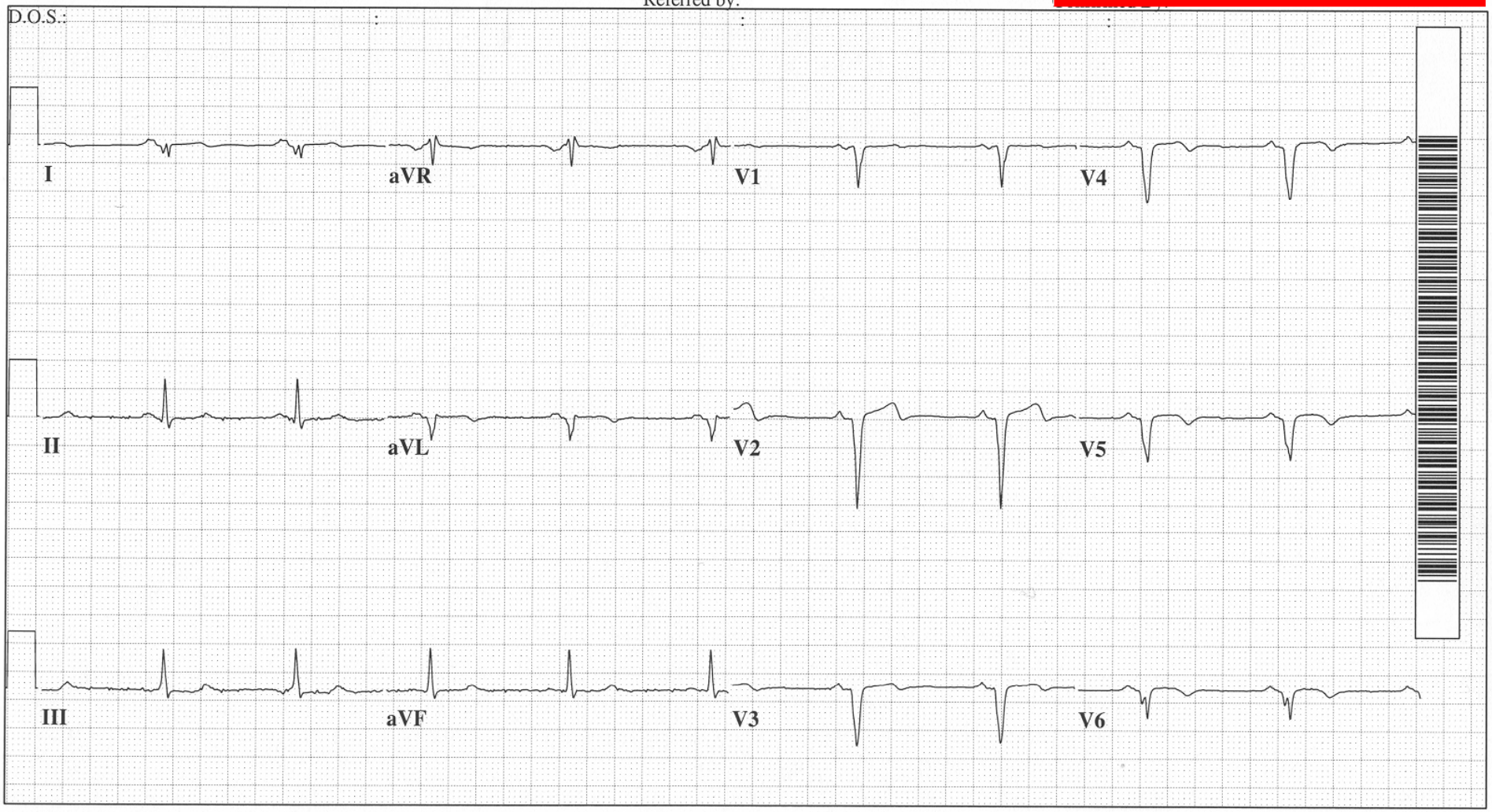
Sinus bradycardia
Anterolateral infarct
(cited on or before 13–NOV–1999)
Abnormal ECG
When compared with ECG of 13–NOV–1999
Significant changes have occurred

EKG CLASS #WR03578799

- NO R-WAVE PROGRESSION IN V-LEADS + Q-WAVES IN V1 - V4 = OLD ANTERIOR WALL MI
- Q WAVES IN I, AVL, V5, V6 = OLD LATERAL WALL MI

Referred by:

D.O.S.:



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

EID:16 EDT: 10:44 04–OCT–2000 ORDER:

For Slides that are not in your handout:

www.ECGtraining.org

Select tab:
ECG ID of SADS Conditions

Then choose:
"ECG ID of SADS Conditions – PDF"

BRUGADA SYNDROME
A DEADLY STEMI Mimic . . . . .

CASE STUDY 18 -- BRUGADA SYNDROME

CHIEF COMPLAINT and SIGNIFICANT HISTORY:

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

RISK FACTOR PROFILE:

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

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

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

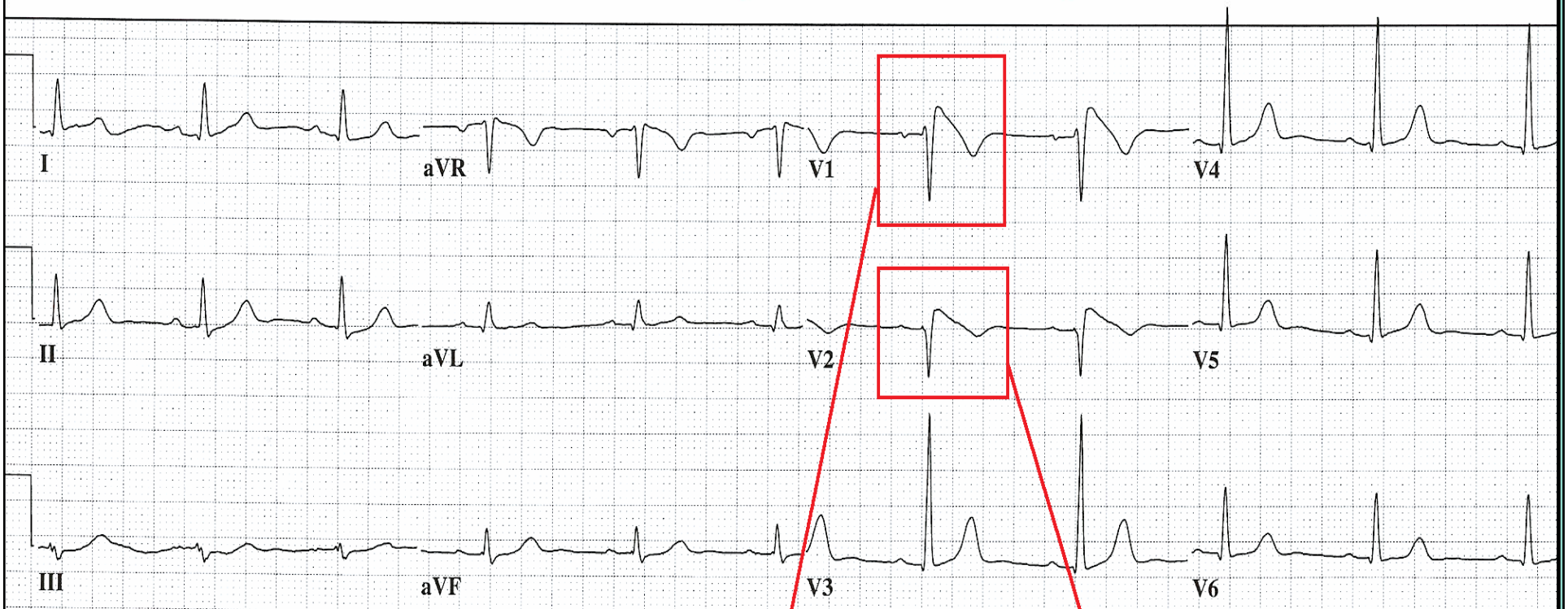
LABS: TROPONIN: < .04 BMP and CBC: all values within normal limits.

37 yr
Female Caucasian

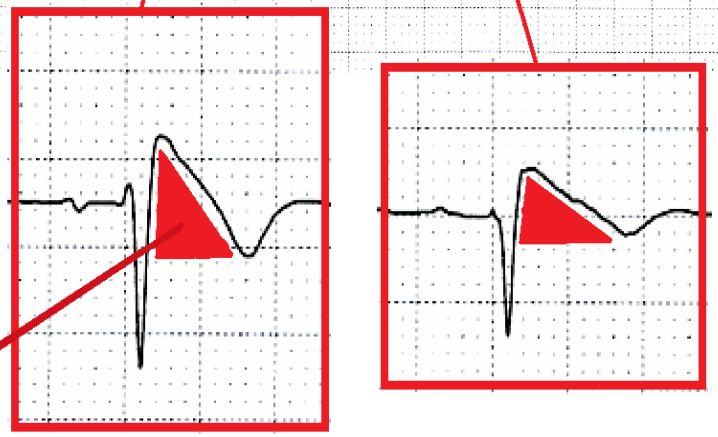
Vent. rate	62	BPM
PR interval	180	ms
QRS duration	88	ms
QT/QTc	418/424	ms
P–R–T axes	37 22	47

Normal sinus rhythm
Normal ECG
No previous ECGs available

NOTE COMPUTER INTERPRETATION !

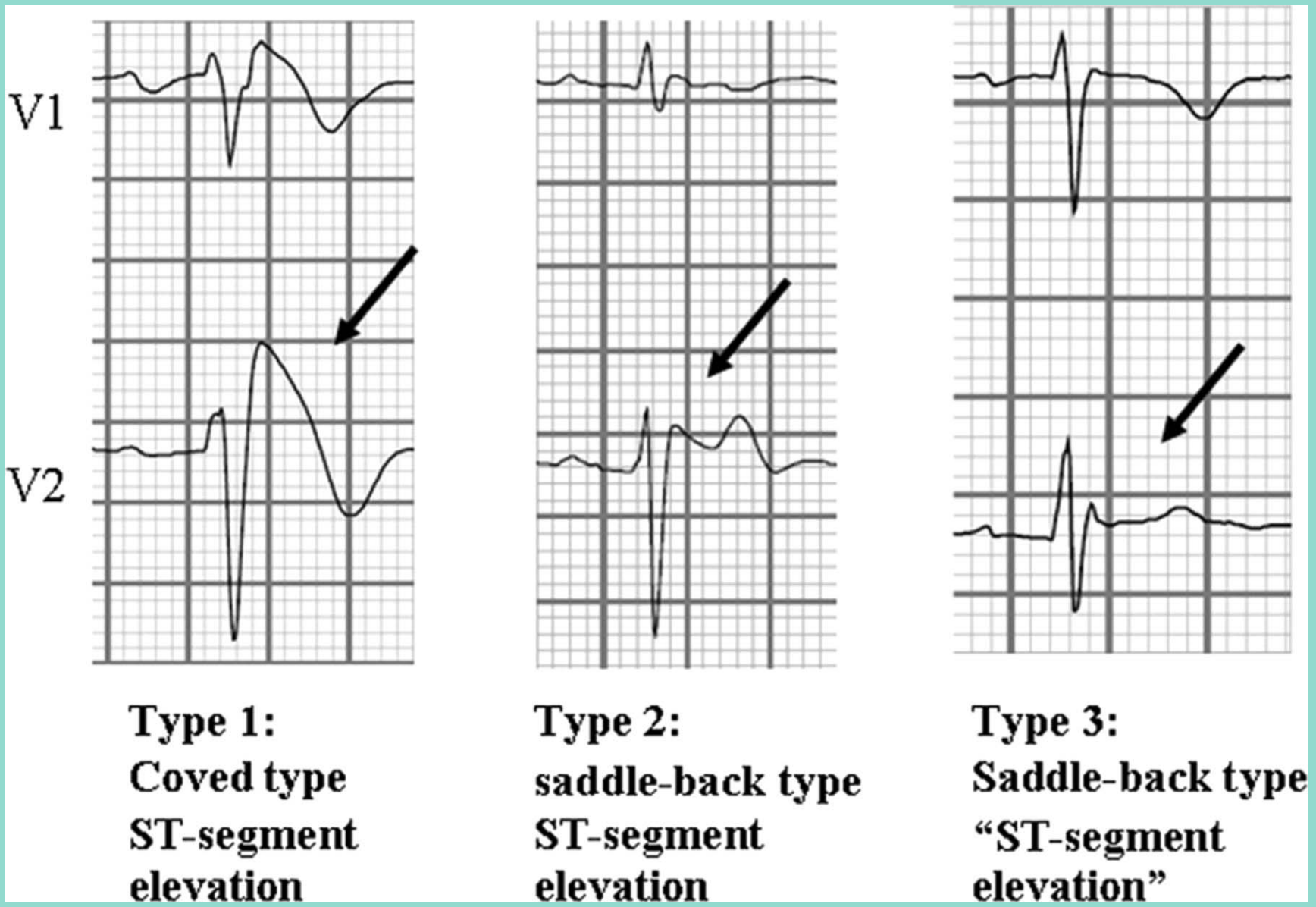


THIS PATIENT EXHIBITS A "CLASSIC" TYPE I BRUGADA SYNDROME ECG PATTERN:
- ELEVATED J POINTS IN V1, V2
- DOWNSLOPING "COVED" ST SEGMENT
- INVERTED T WAVE.



NEVER FORGET THE "TRIANGULAR" SHAPE !

Brugada Syndrome -- 3 ECG Patterns:

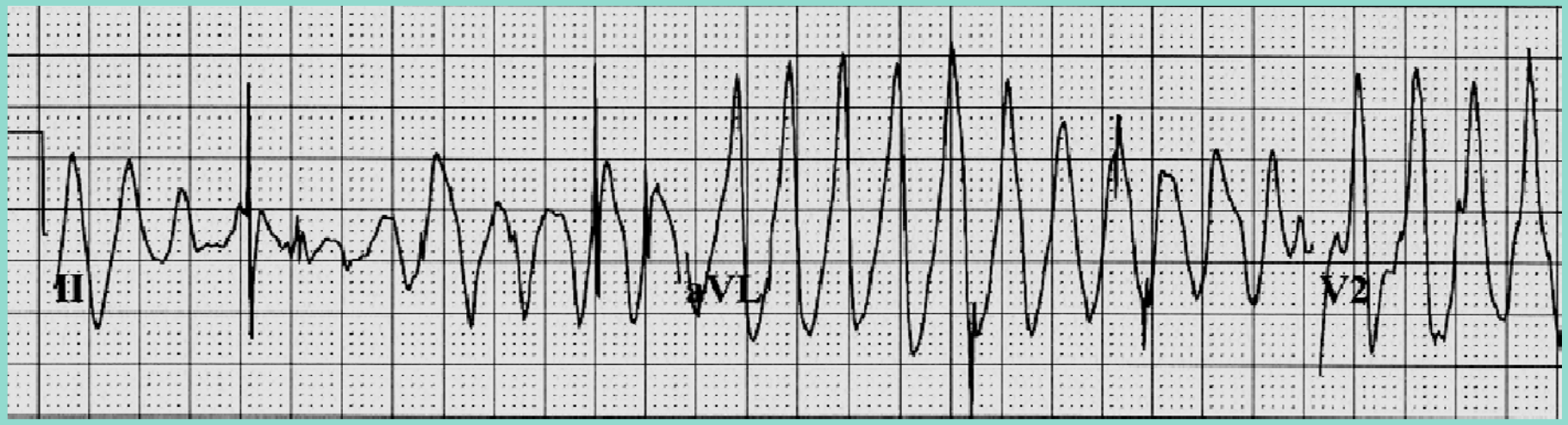


Type 1:
Coved type
ST-segment elevation

Type 2:
saddle-back type
ST-segment elevation

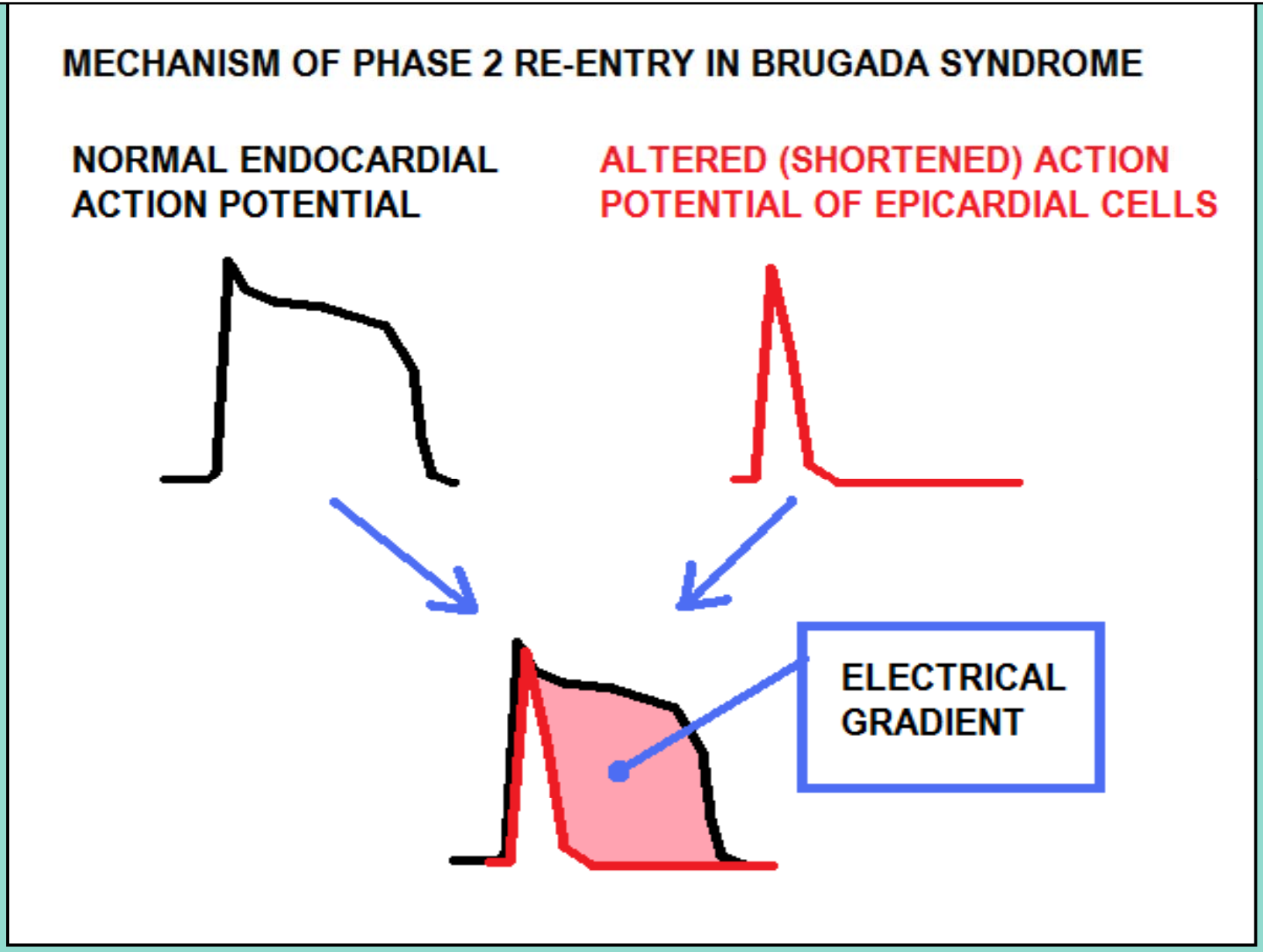
Type 3:
Saddle-back type
"ST-segment elevation"

Brugada / Long QT Syndromes cause:



Torsades de Pointes:

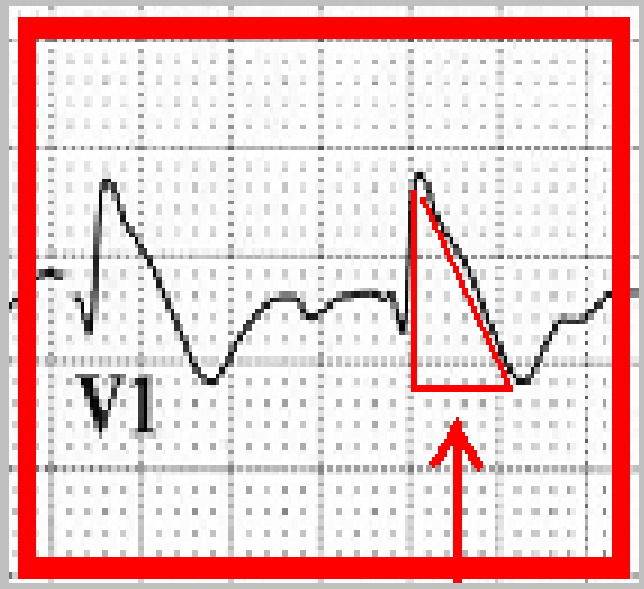
- **Decreased – to – NO Cardiac Output**
- **Often patient PULSELESS during episode**
- **Causes SYNCOPE**
- **Often DETERIORATES into VENTRICULAR FIBRILLATION and CARDIAC ARREST.**



Trigger for Torsades de Pointes – ECTOPIC BEAT during The "ELECTRICAL GRADIENT" phase shown above.

BRUGADA SYNDROME

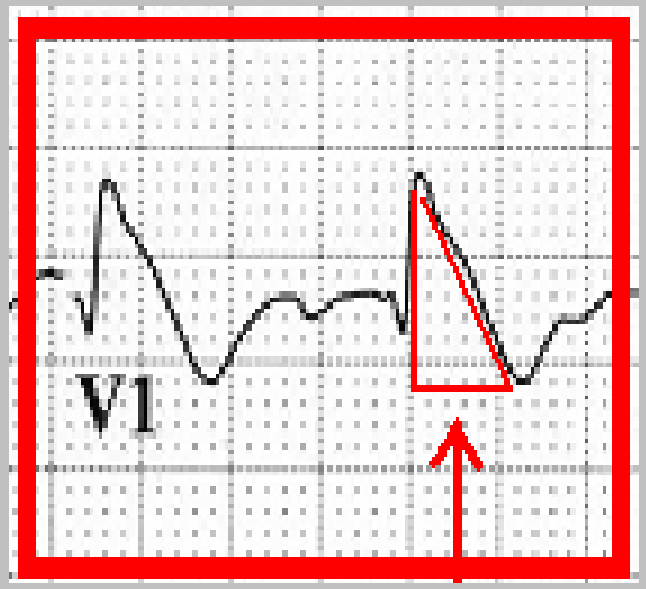
- GENETIC DISORDER - GENE SCN5A, which encodes CARDIAC SODIUM CHANNELS.
- CAUSES EARLY RIGHT VENTRICULAR SUB-EPICARDIAL REPOLARIZATION



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

BRUGADA SYNDROME

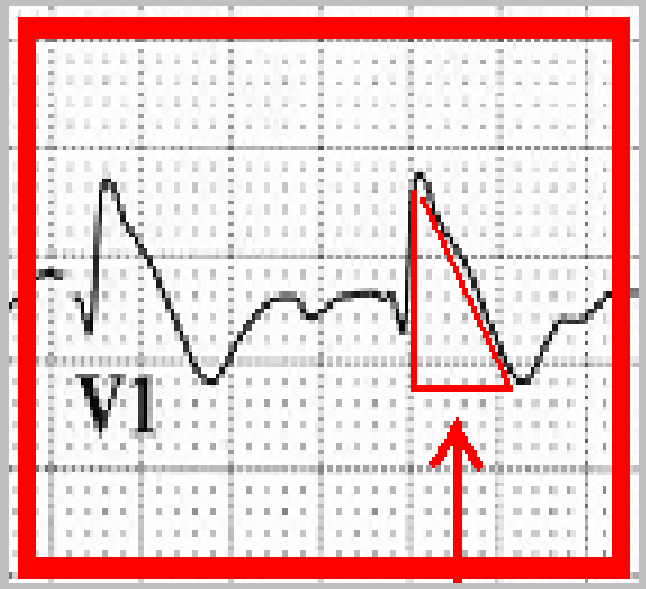
- SEVERAL VARIATIONS of this disorder are known to exist.
- CONCEALED and NON-CONCEALED.
- The NON-CONCEALED version HAS THE V1-V3 abnormality VISIBLE at all times.



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

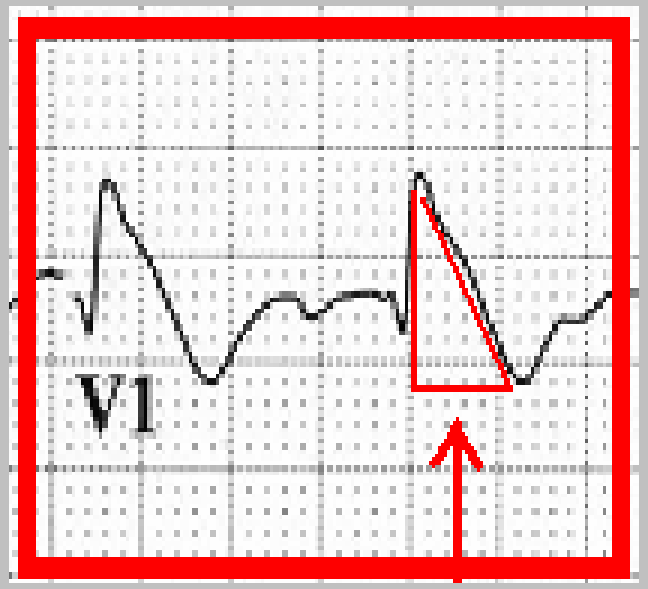
BRUGADA SYNDROME

- YOUNG MALES of SOUTHEAST ASIAN DESCENT are in HIGH RISK GROUP, however this disorder affects ANY RACE or GENDER.
- BRUGADA SYNDROME is HEREDITARY.
- SUSPECT BRUGADA SYNDROME in patients with FAMILY HISTORY of BRUGADA / SUDDEN DEATH, and/or TORSADES.



BRUGADA SYNDROME - TREATMENT

ICD implantation is the only known effective treatment to date.



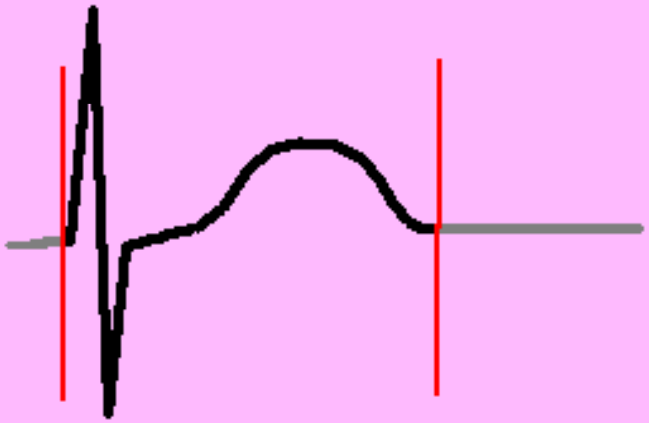
www.brugada.org

www.sads.org

www.QTsyndrome.ch

www.crediblemeds.org

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.

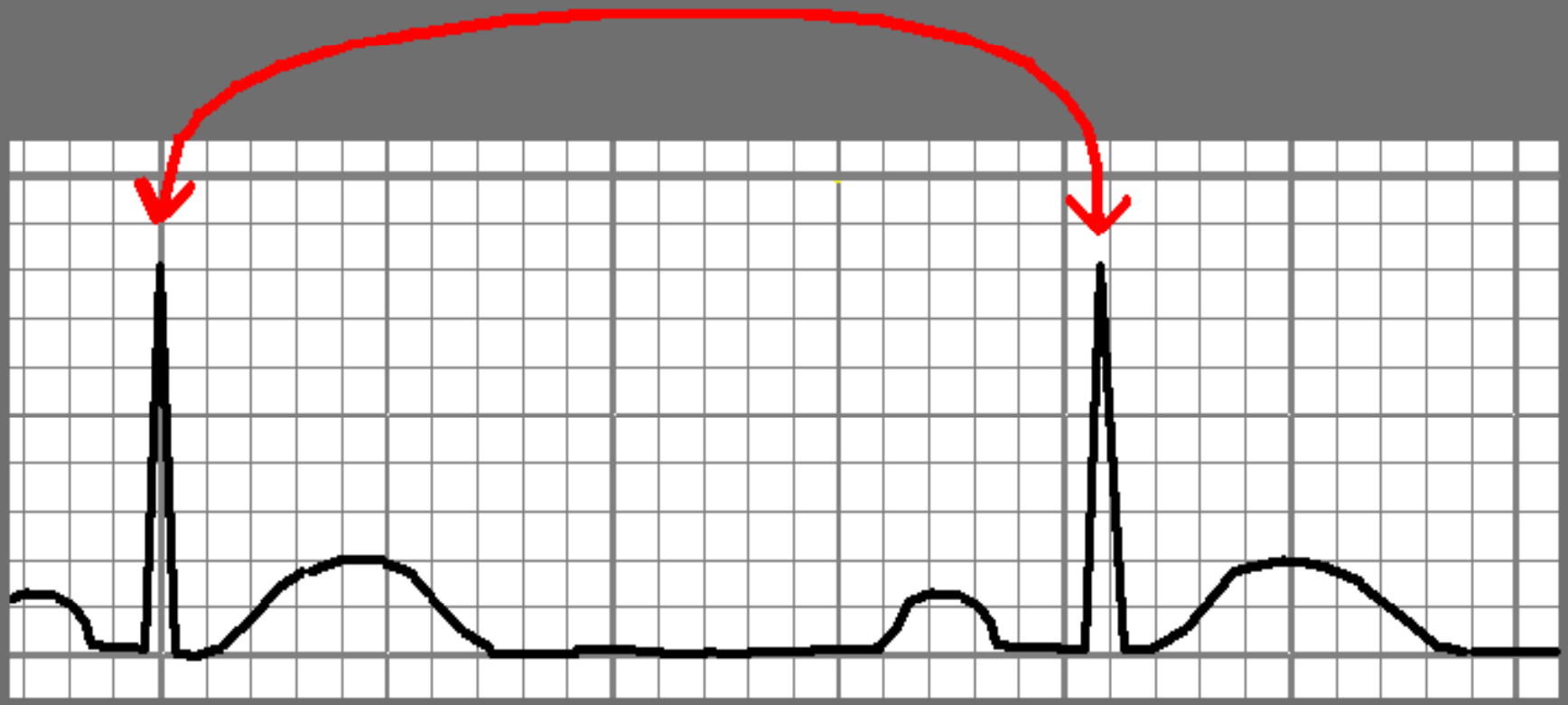
QT CORRECTION FORMULAS:

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

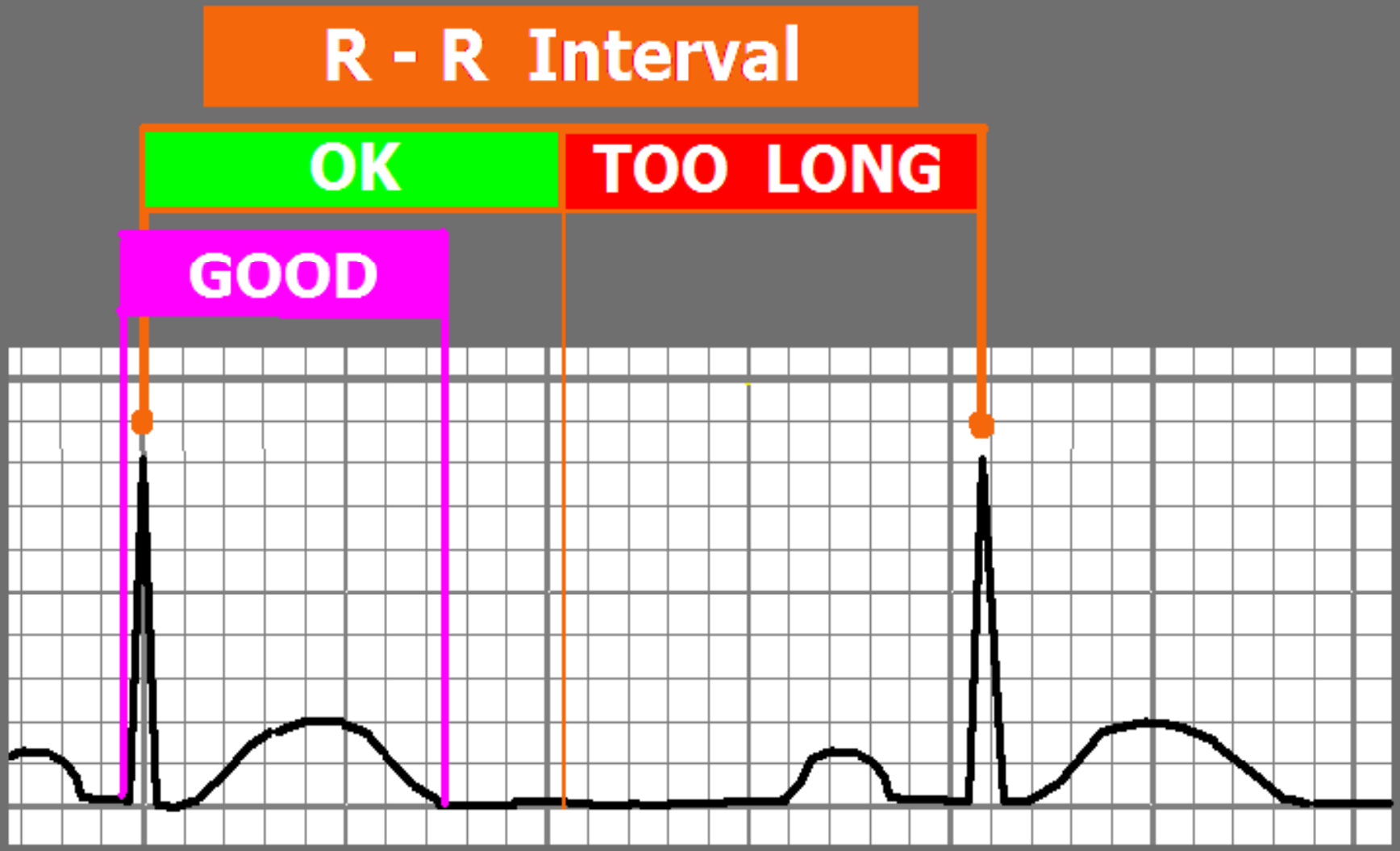
DETERMINING Q-T INTERVAL LIMITS

THE "QUICK PEEK" METHOD

(for Heart Rates 60 - 100)



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



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"

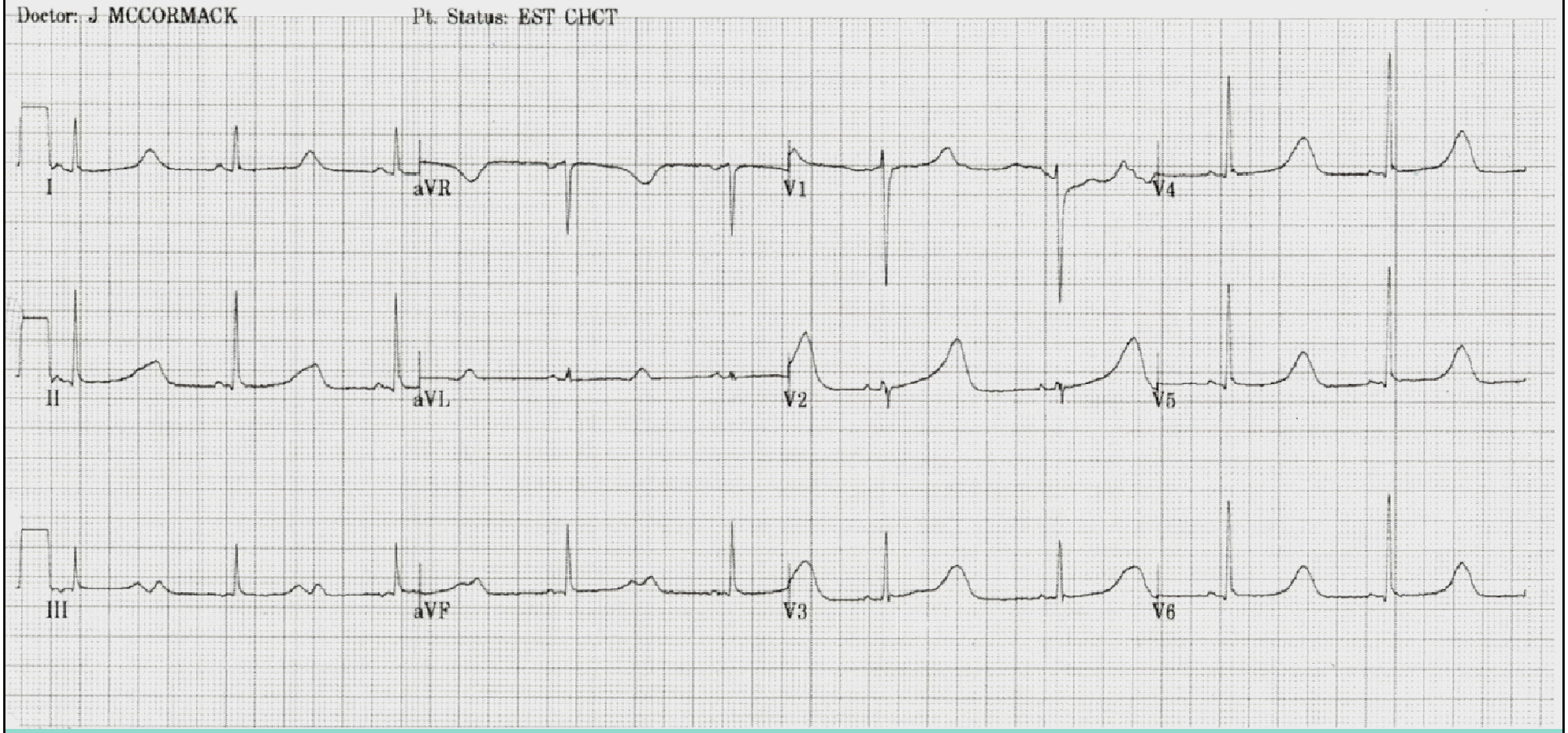
JACC2009;53, no. 11:982-991

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

22 y/o FEMALE

Vent. rate	53 bpm
PR interval	110 ms
QRS duration	84 ms
QT/QTc	678/636 ms
P-R-T axes	25 60 48

PEDIATRIC CARDIOLOGY ASSOCIATES



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

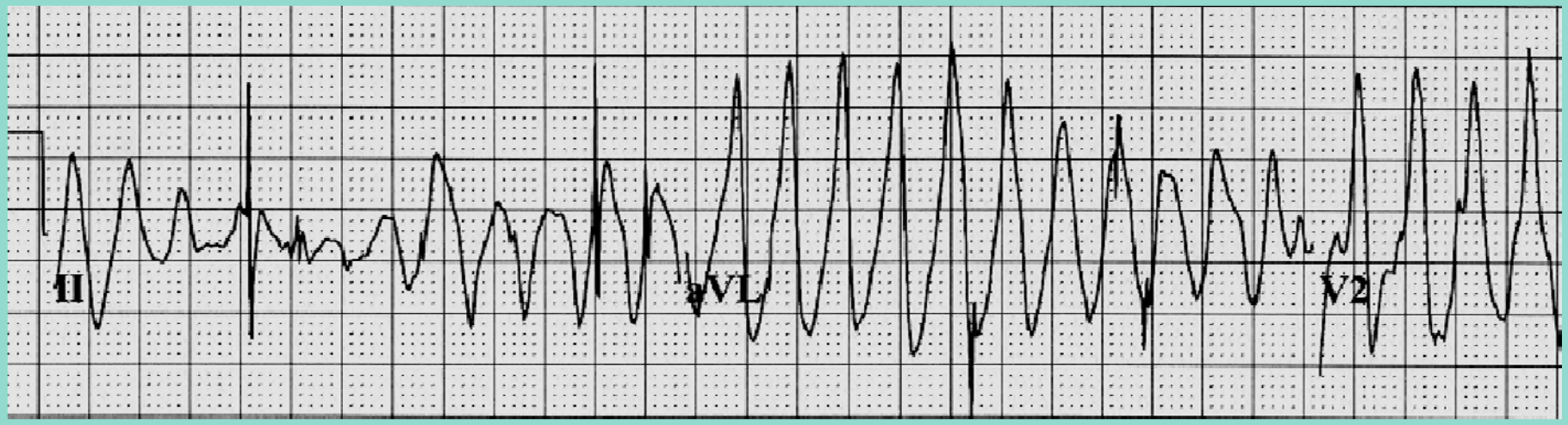
CASE PROGRESSION - 22 YEAR OLD FEMALE:

DIAGNOSED WITH "EPILEPSY." All anticonvulsant medications were INEFFECTIVE at Controling grand-mal seizure activity.

During visit with Electrophysiologist, patient exhibited Torsades de Pointes during EST, collapsed. DURING TDP EPISODE patient experienced "grand mal Seizure."

ICD Implanted. ECG finding also discovered in patient's infant son. Received ICD at age 5.

Brugada / Long QT Syndromes cause:



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Etiology of Long QT Syndromes:

Congenital (14 known subtypes)

Genetic mutation results in abnormalities of cellular ion channels

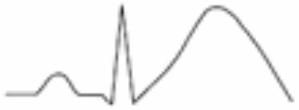
Acquired

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

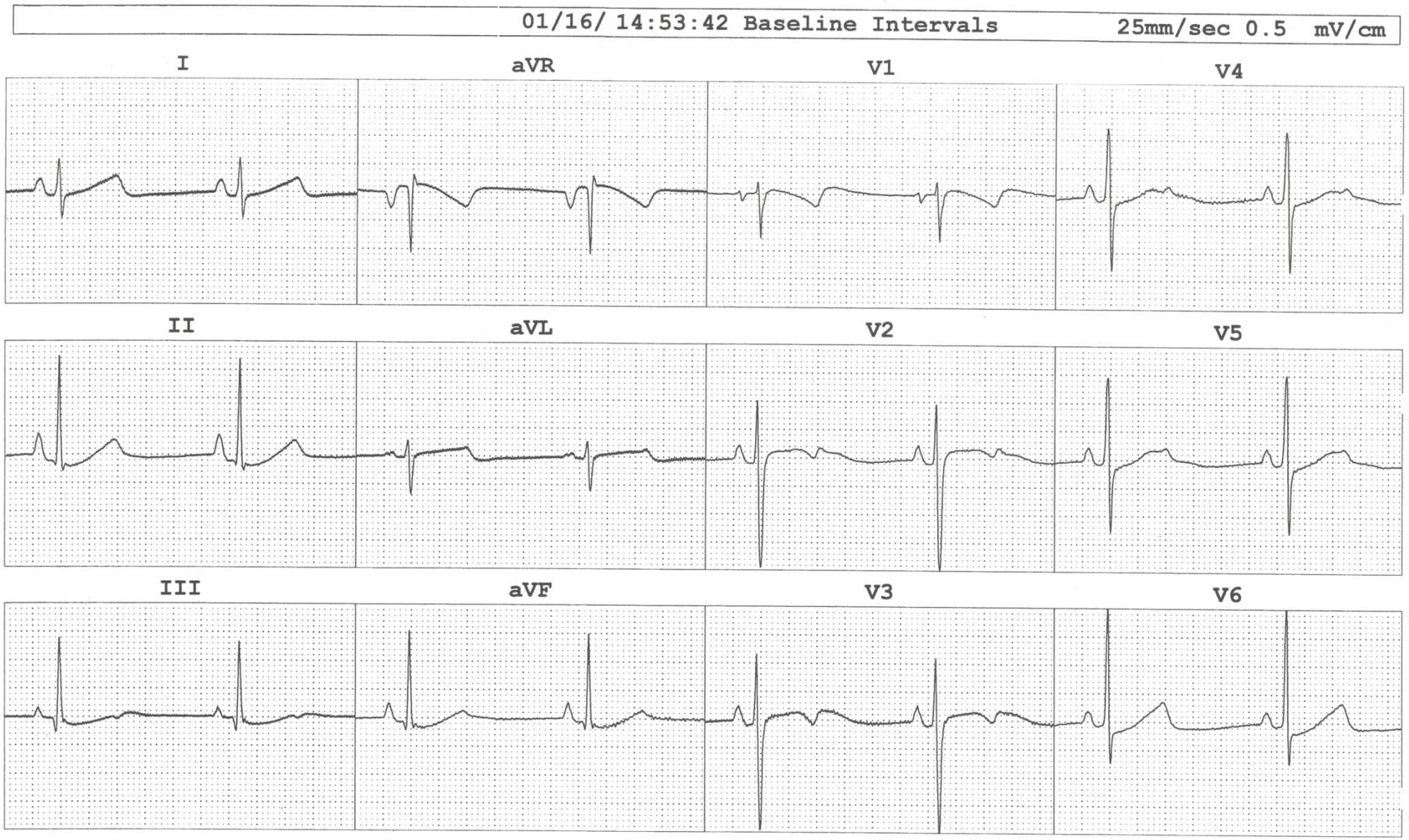
Miscellaneous

- Coronary Artery Disease
- Mitral Valve Prolapse

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%

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



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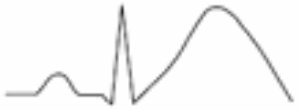
LQTS1	K	↓	30%-35%		Exercise (68%) Emotional Stress (14%) Sleep, Repose (9%) Others (19%)	62%
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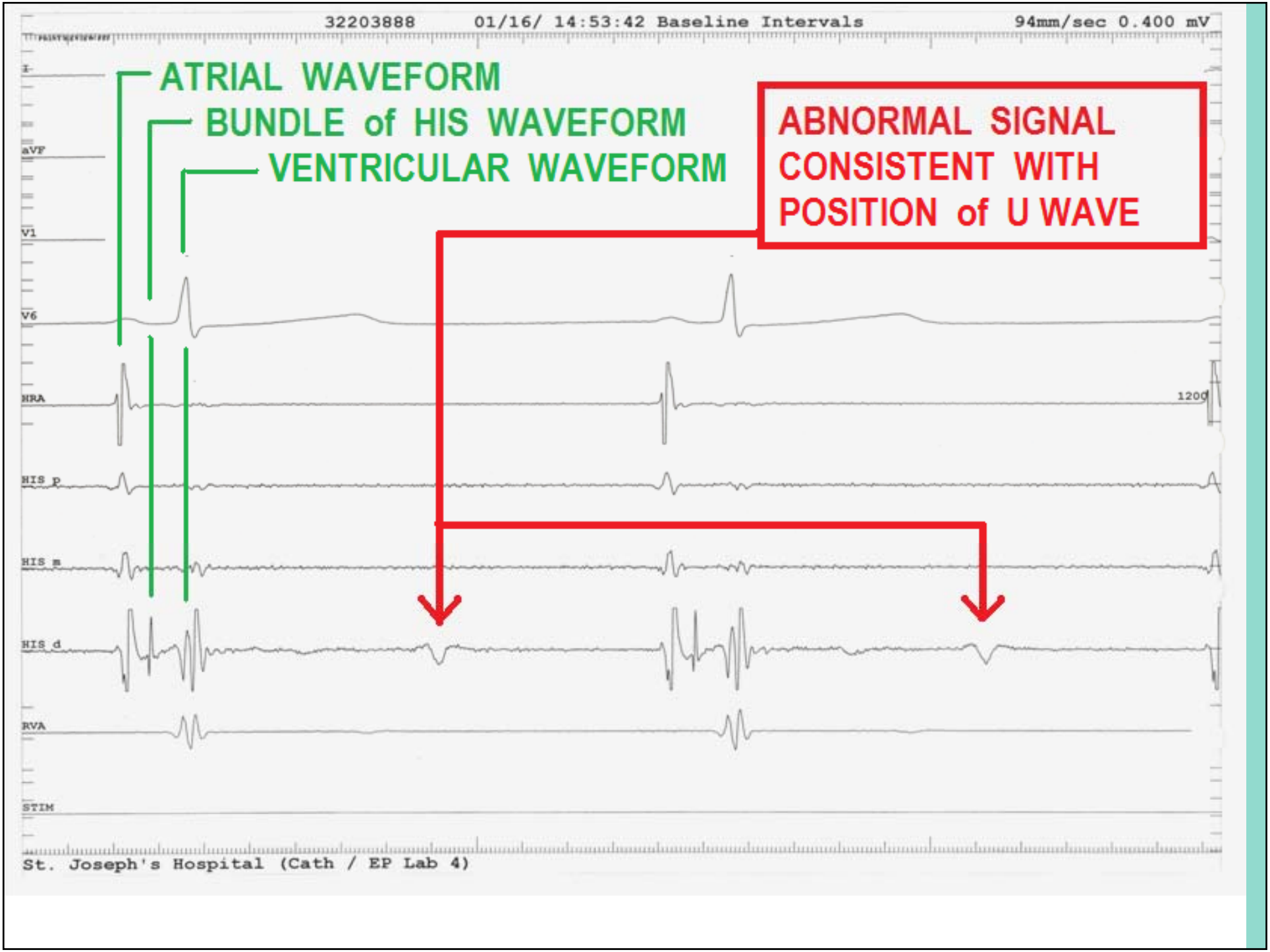
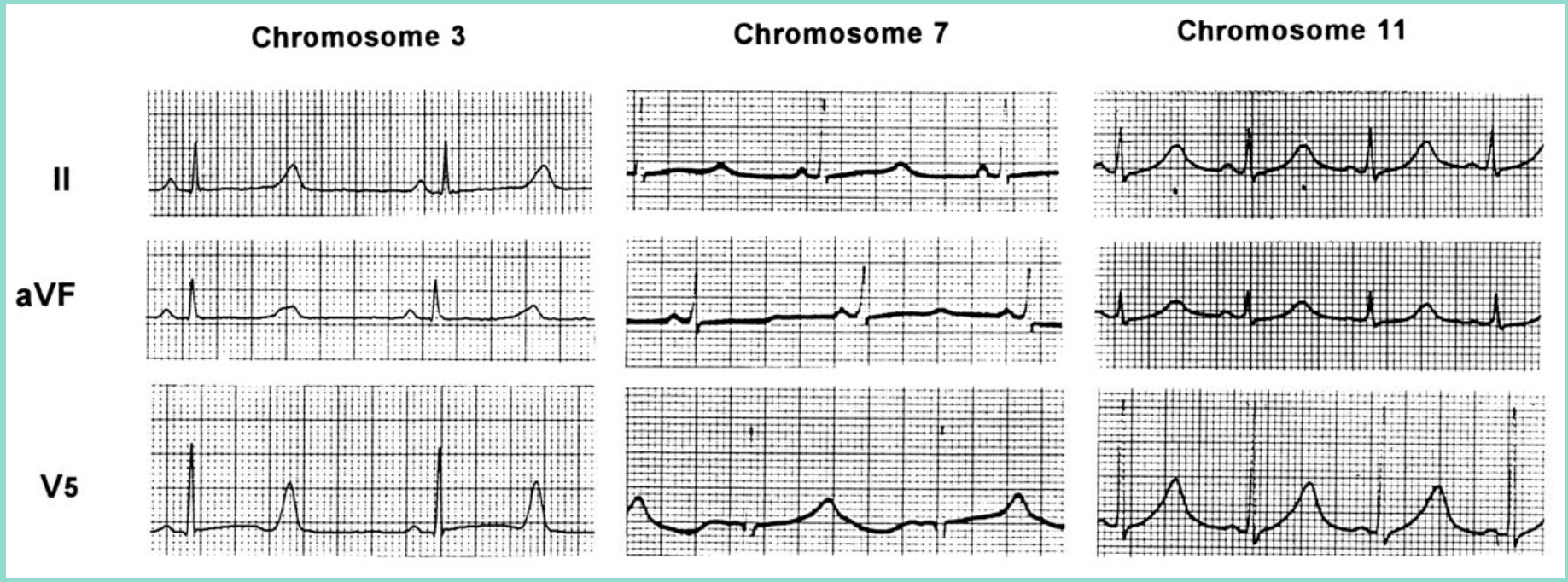
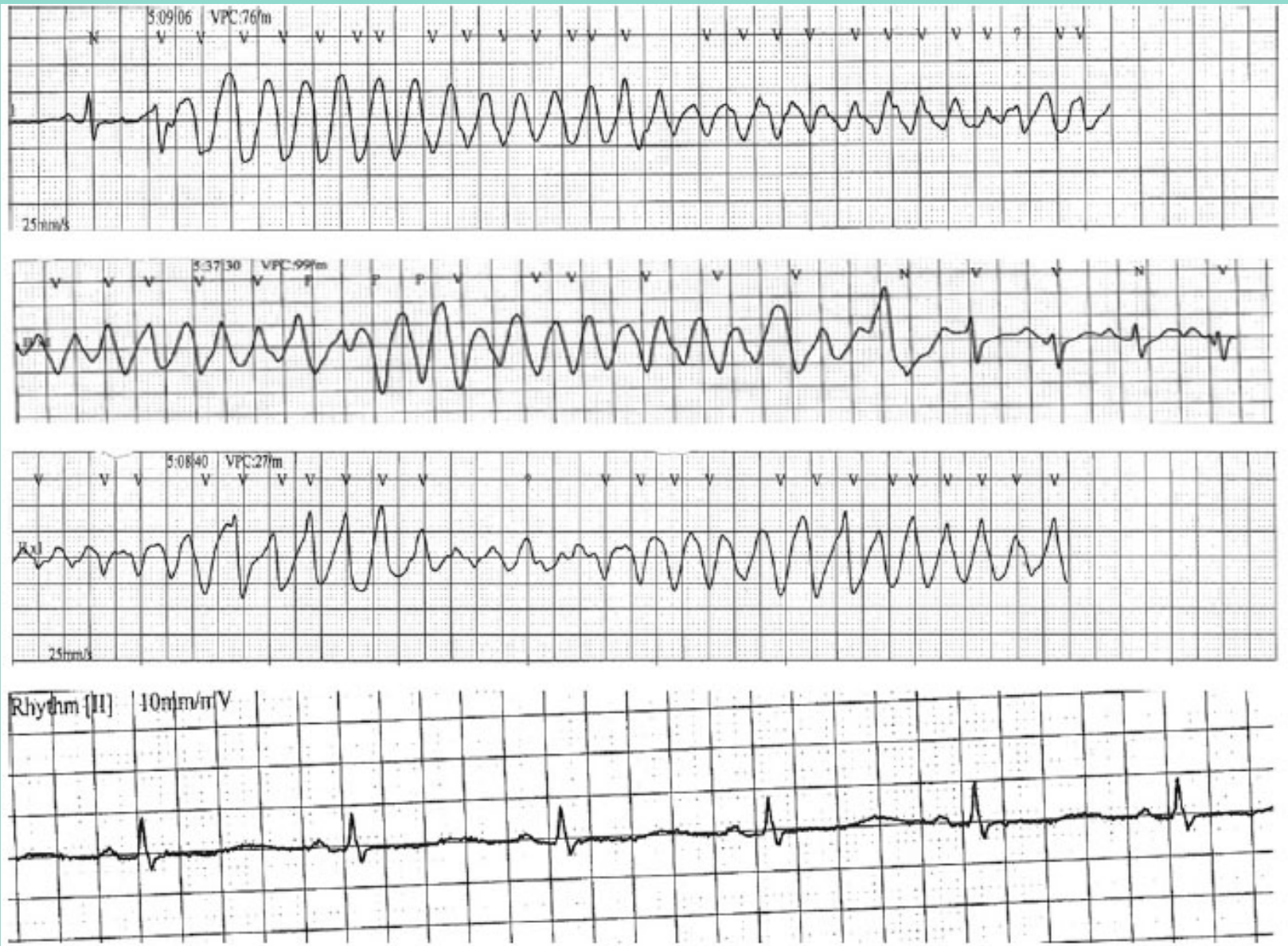

32203888 01/16/ 14:53:42 Baseline Intervals 94mm/sec 0.400 mV
ATRIAL WAVEFORM
BUNDLE of HIS WAVEFORM
VENTRICULAR WAVEFORM
ABNORMAL SIGNAL CONSISTENT WITH POSITION of U WAVE
I
aVF
V1
V6
HRA
HIS p
HIS m
HIS d
RVA
STIM
1200
St. Joseph's Hospital (Cath / EP Lab 4)

ECG recordings from leads II, aVF, and V5 in three patients from families with long QT syndrome linked to genetic markers on chromosomes 3, 7, and 11.



Moss A et al. Circulation 1995;92:2929-2934



Rhythm strip of II showing QTc of 720 msec at admission

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

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

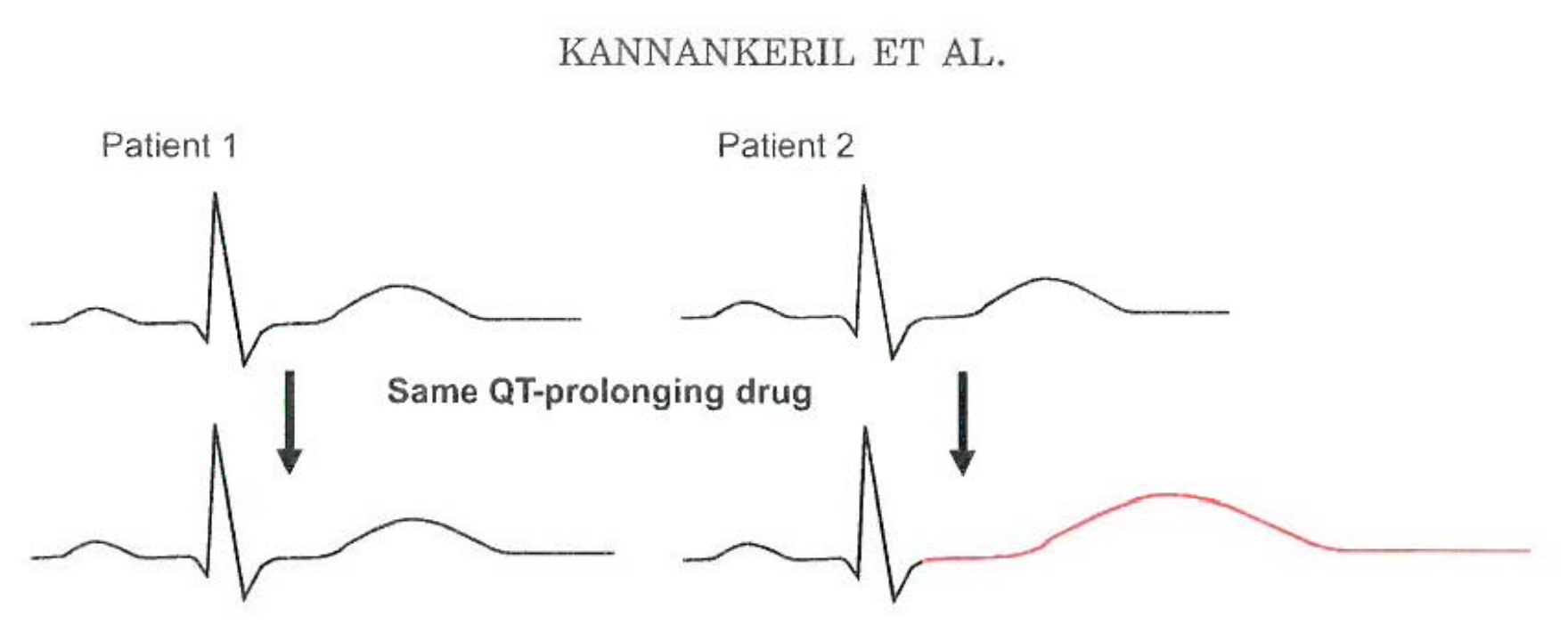
Such drugs include:

-Amiodarone	**-Ritalin**
-Procainamide	**-Benadryl**
-Levaquin	**-Haloperidol**
-Erythromycin	**-Thorazine**
-Norpace	**-Propulcid**
-Tequin	**. . . . . AND MANY MORE . . . . . .**

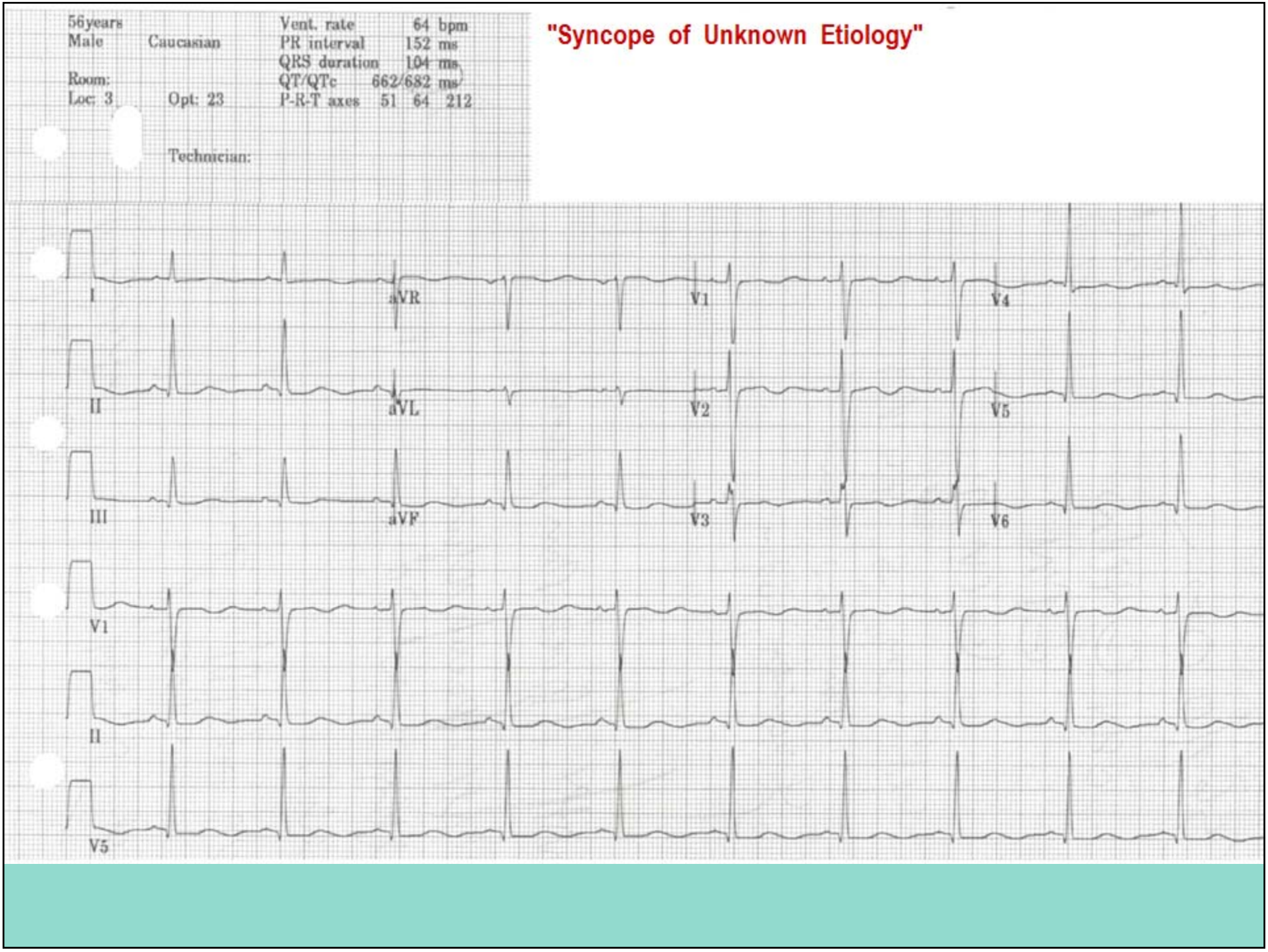
www.torsades.org , & www.azcert.org

PATIENT 1: NORMAL

PATIENT 2: GENETIC REPOLARIZATION ABNORMALITIES and/or HYPOKALEMIA is PRESENT.



"Syncope of Unknown Etiology"



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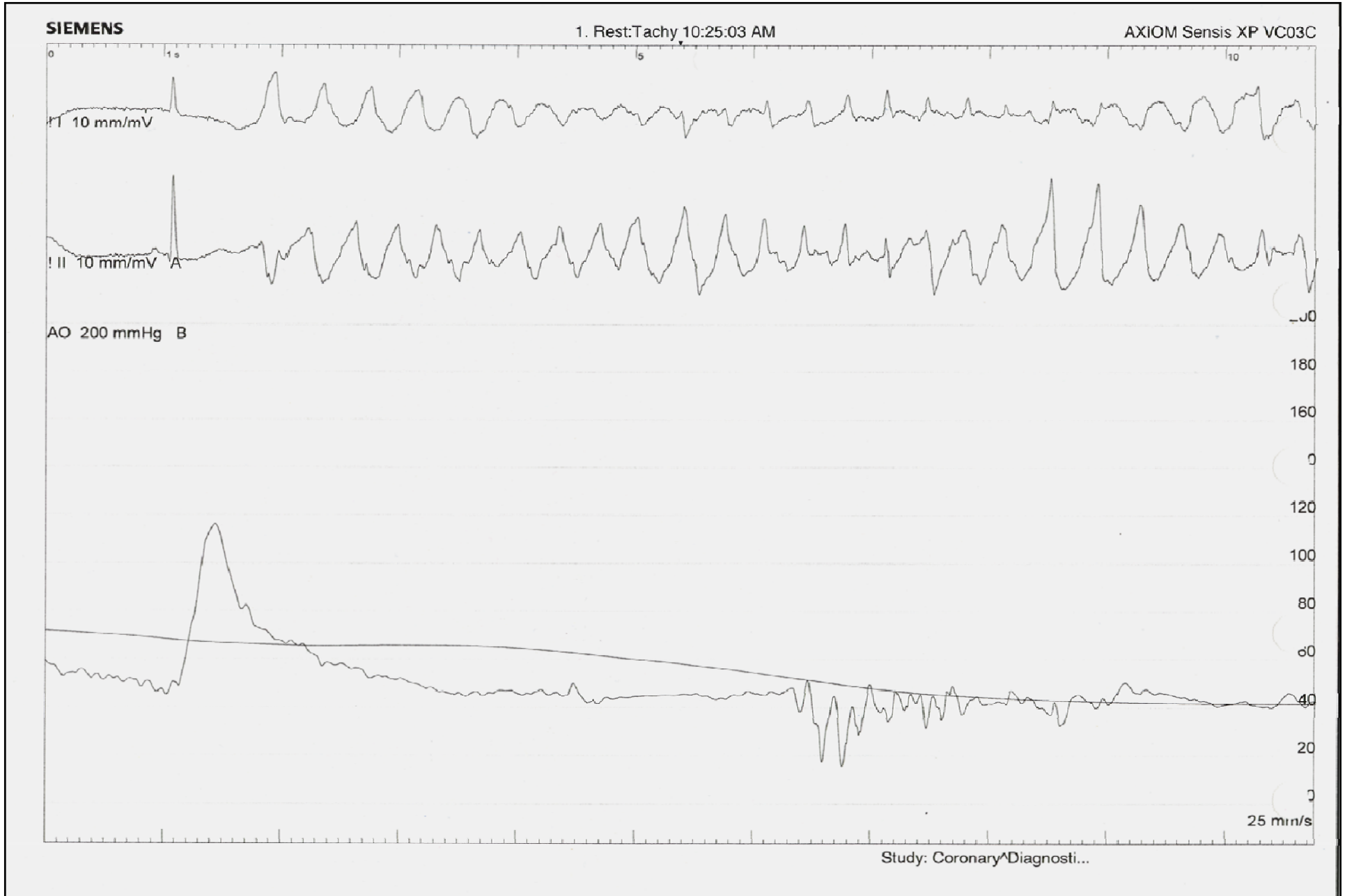
Such drugs include:

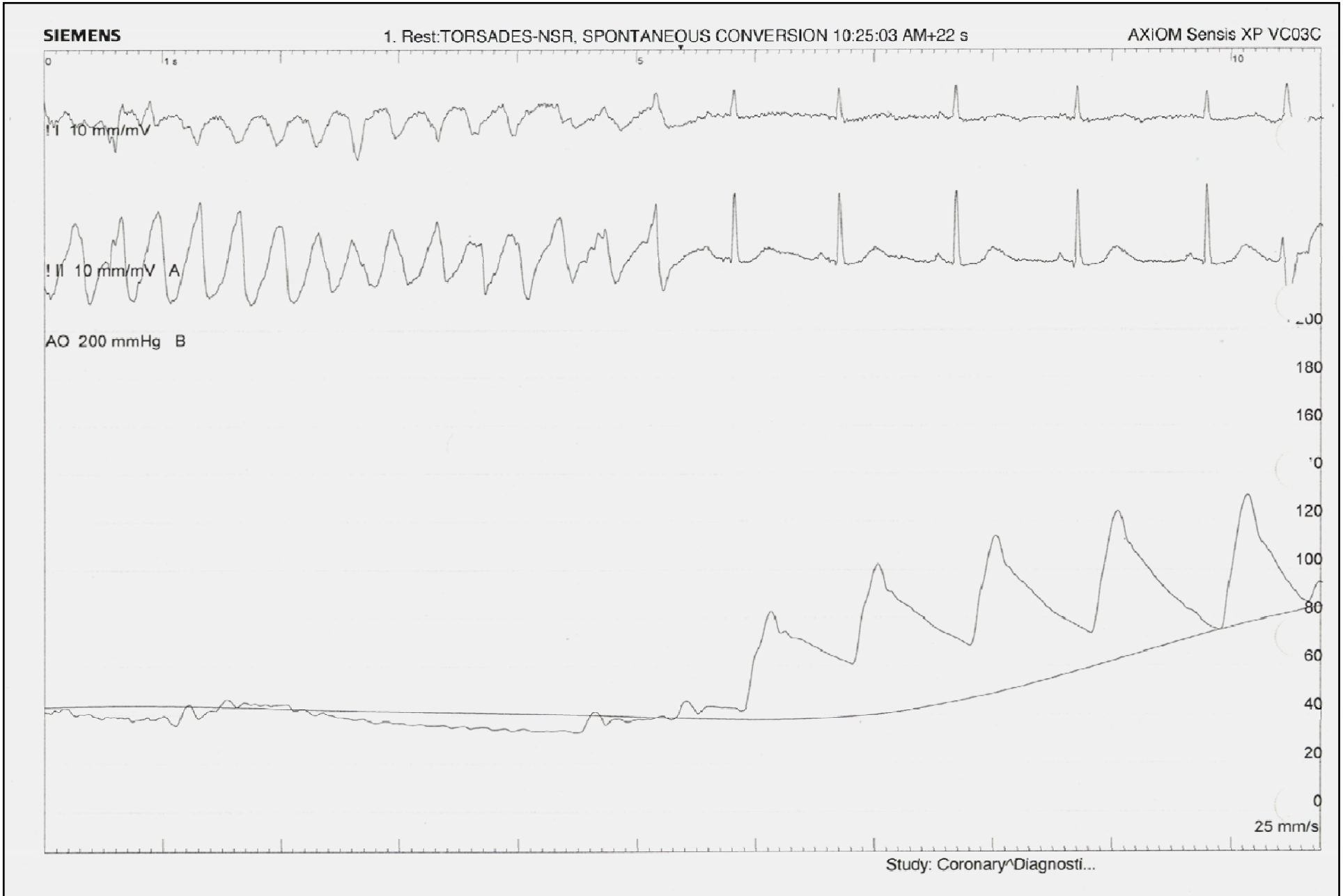
- -Amiodarone
- -Procainamide
- -Levaquin
- -Erythromycin
- -Norpace
- -Tequin
- -Ritalin
- -Pseudophedrine
- -Haloperidol
- -Thorazine
- -Propulcid

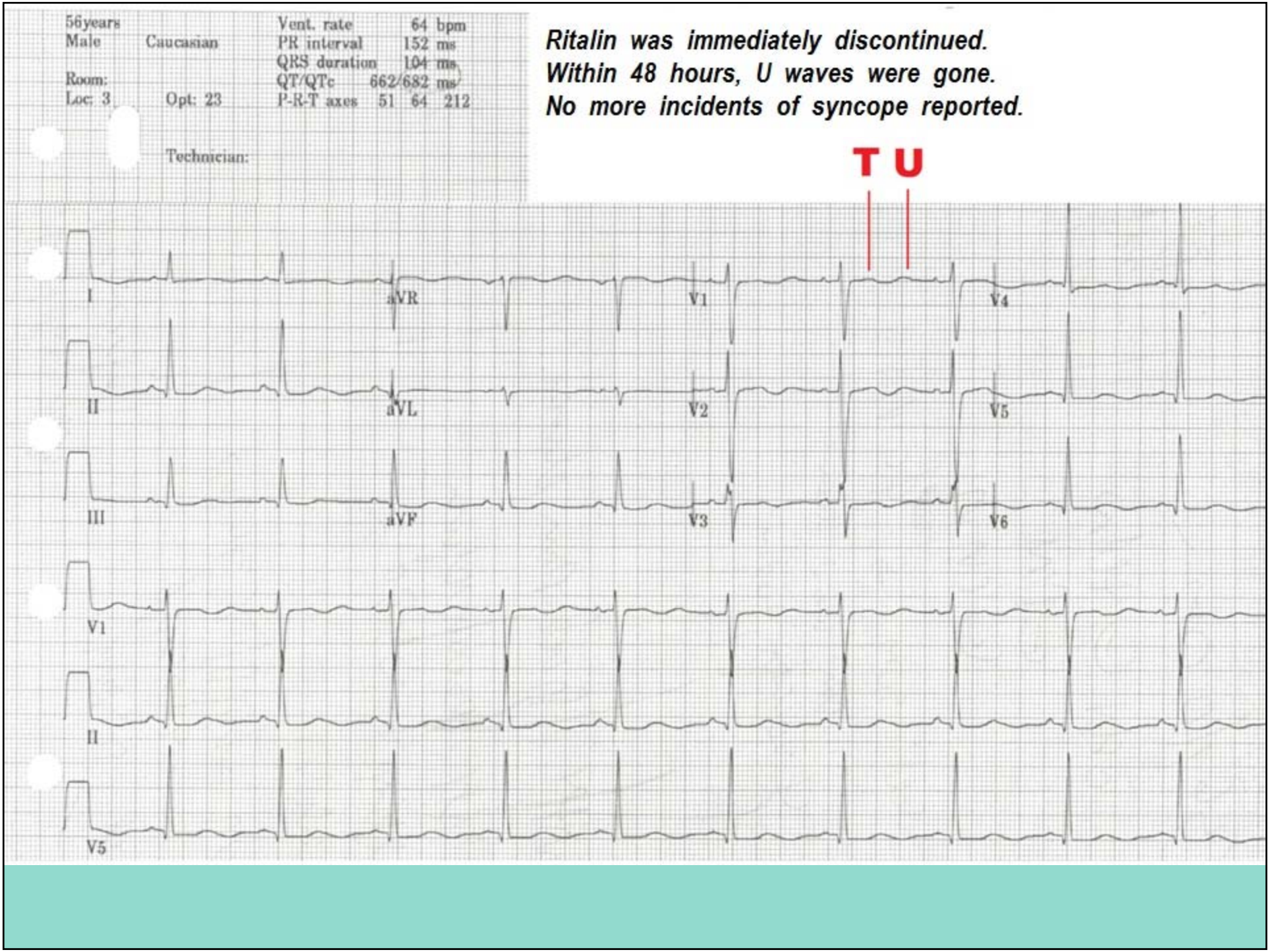
. . . . . AND MANY MORE . . . . . .

AND MANY MORE . . .

See: www.torsades.org / JAMA


SIEMENS
1. Rest:Tachy 10:25:03 AM
AXIOM Sensis XP VC03C
0
1 s
5
10
I 10 mm/mV
II 10 mm/mV A
AO 200 mmHg B
180
160
120
100
80
60
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
0
1 s
5
10
I 10 mm/mV
II 10 mm/mV A
AO 200 mmHg B
180
160
120
100
80
60
40
20
0
25 mm/s
Study: Coronary^Diagnosti...


56years
Male
Caucasian
Room:
Loc: 3
Opt: 23
Technician:
Vent. rate 64 bpm
PR interval 152 ms
QRS duration 104 ms
QT/QTc 662/682 ms
P-R-T axes 51 64 212
Ritalin was immediately discontinued.
Within 48 hours, U waves were gone.
No more incidents of syncope reported.
T U
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5

Q: What is the ideal medication to treat Torsades?

Q: What is the ideal medication to treat Torsades?

A: Magnesium Sulfate, 1 – 2 grams over 5 – 60 minutes (AHA ACLS)

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

ECG Indicators of Long QT Syndrome:

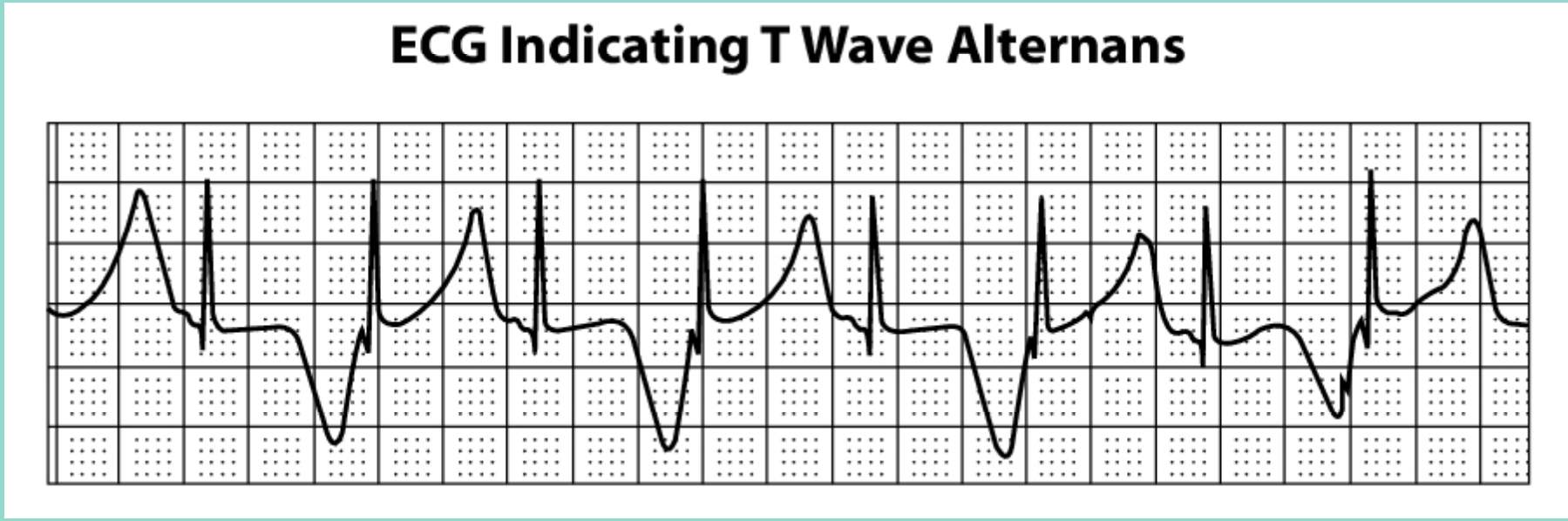
- QTc 460ms or longer in females*
- QTc 450ms or longer in males*
- T wave alterans
- U waves >100% of the T wave
- U waves merged with T waves
- U waves >0.1mv (1mm on standard calibrated ECG)

*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 . . . .

Long QT Syndrome: T wave Alterans:



ECG Indicators of Long QT Syndrome:

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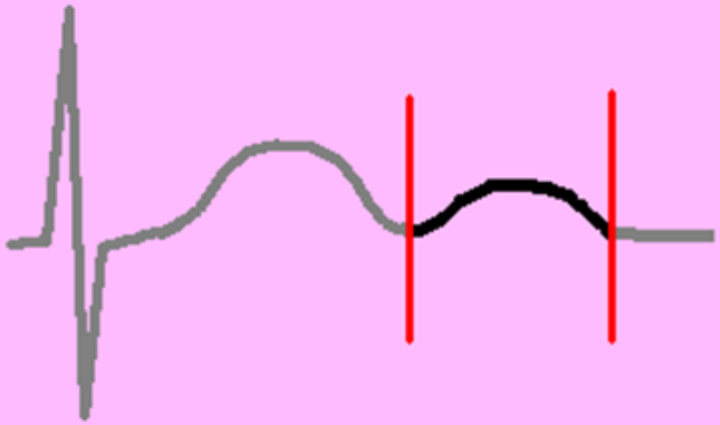
☞ WHEN LQTS IS SUSPECTED, TAKE THE FOLLOWING PRECAUTIONS . . . .

THE U WAVE

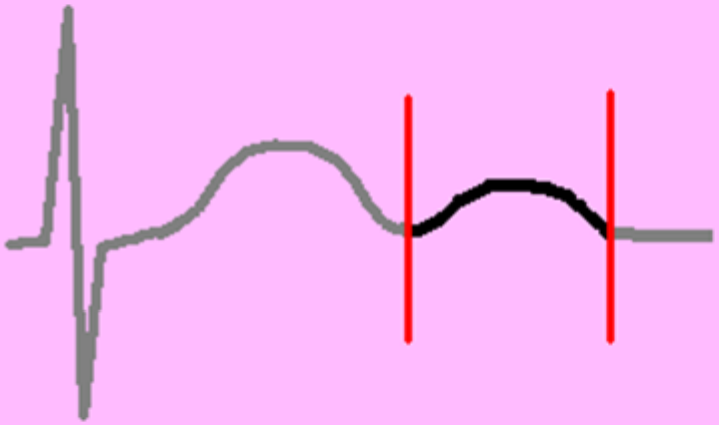


- SEEN INFREQUENTLY

U WAVES PANIC VALUES (CONSIDERED INDICATOR OF LONG QT SYNDROME) WHEN:

- 100% or more SIZE OF T WAVE
- MERGED WITH T WAVE
- MORE THAN 1mm IN HEIGHT

THE U WAVE



- SEEN INFREQUENTLY

- MOST VISIBLE IN LEADS V2 & V3

- OFTEN NOT PRESENT IN LEADS II, III, AVF

U WAVES

ROUTINE RETRIEVAL

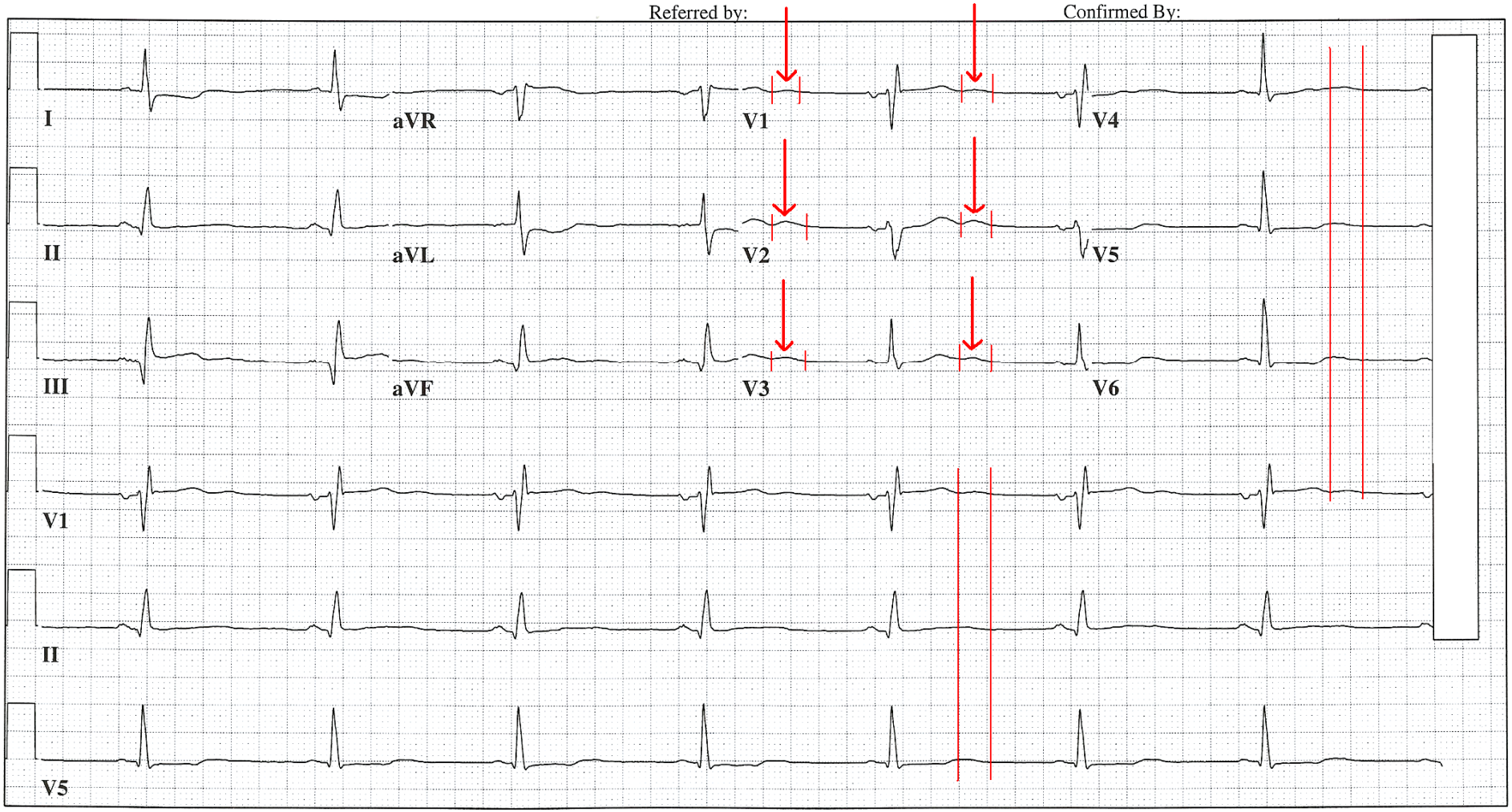
69 yr
Female Caucasian

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

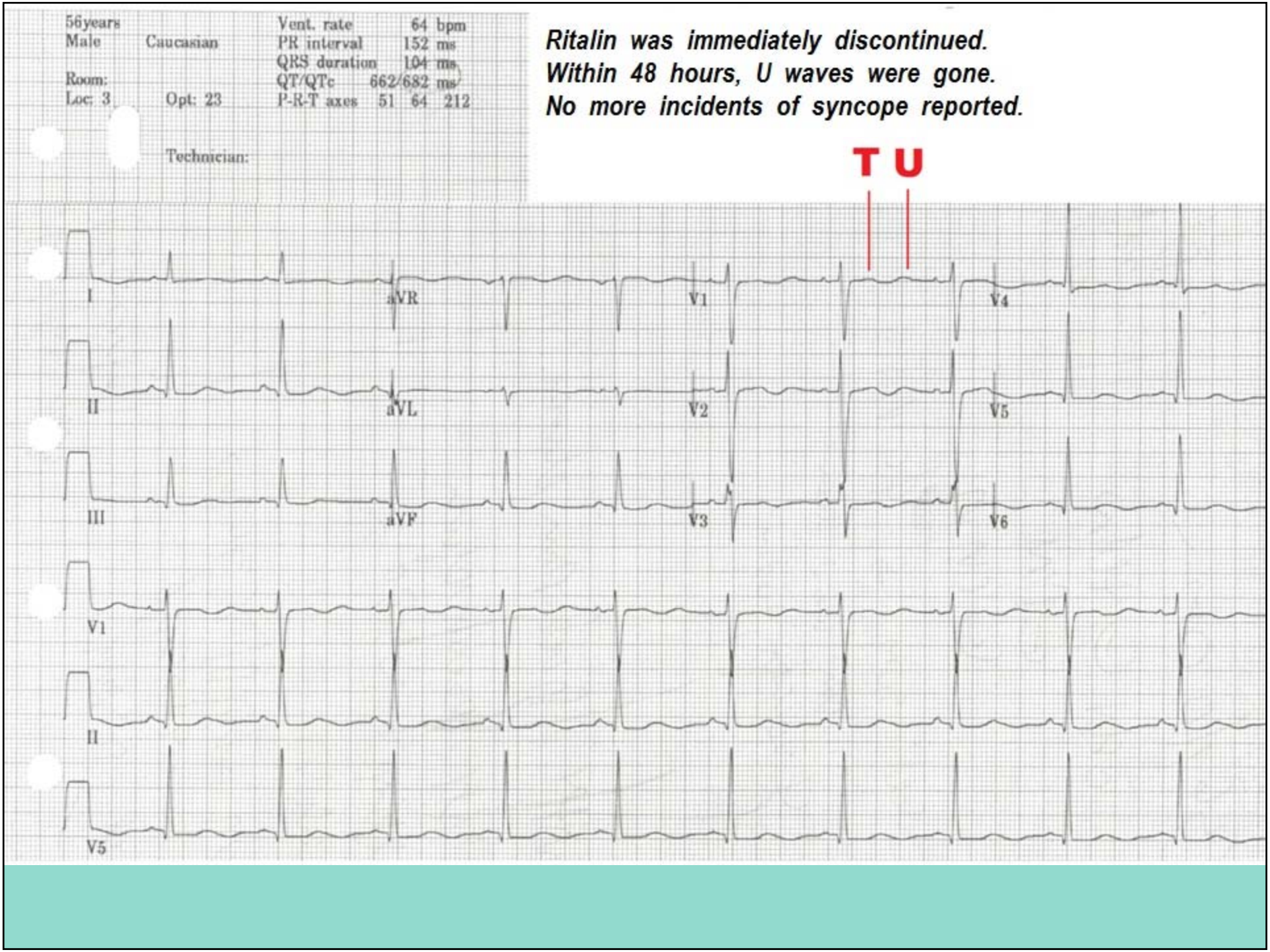
Marked sinus bradycardia
Incomplete right bundle branch block
Possible Inferior infarct , age undetermined
ST & T wave abnormality, consider lateral ischemia
Abnormal ECG
When compared with ECG of 26–MAR–2006 20:32,
no significant change

Referred by: Confirmed By:



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

EID:7 EDT: 14:59 30–MAR–2006 ORDER:


56years
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Room:
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Technician:
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T U
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5

When ECG Indicators of Long QT Synrome are present:

- Obtain a thorough patient history, to rule out incidence of syncope and family history of sudden death/ near sudden death.
- Evaluate patient's meds list for meds that prolong the QT Interval.
- Rule out hypothermia
- Rule out CVA
- Evaluate the patient's electrolyte levels, and
- MONITOR PATIENT'S ECG FOR RUNS OF TORSADES
- Consider "expert consult" (electrophysiologist) to rule out LQTS

When ECG Indicators of Long QT Synrome are present:

- Obtain a thorough patient history, to rule out incidence of syncope and family history of sudden death/ near sudden death.
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- Evaluate the patient's electrolyte levels, and
- MONITOR PATIENT'S ECG FOR RUNS OF TORSADES
- Consider "expert consult" (electrophysiologist) to rule out LQTS

☞ ***LQTS + ECTOPY = ⇧ Risk of Torsades de Pointes!***

Suspected LQTS Considerations include:

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

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

TREATMENT OF TORSADES de POINTES per AHA ACLS:

-TRANSIENT: MAGNESIUM SULFATE 1 – 2 gm IV infusion over 5 – 60 minutes.

-PERSISTENT, PATIENT UNSTABLE: DEFIBRILLATION (prior to 2010: Synchronized Cardioversion)

-CARDIAC ARREST: FOLLOW Ventricular Fibrillation Algorithm.

LQTS / Brugada – Anesthesia:

- Avoid Triggers of QT Prolongation and Torsades

- Maintain:
  - -Normothermia
  - - Normoxia
  - - Euglycemia
  - - Normocarbia

- Provide Peri-op:
  - - Anxiolysis
  - - Beta Blockade
  - - Analgesia

LQTS / Brugada – Anesthesia, con't:

- **Avoid Hemodynamic Extremes:**
  - Bradycardia / Tachycardia
  - Hypo / Hypertension
- **Correct Syrum Electrolytes, especially:**
  - Potassium (K+)
  - Magnesium (Mg++)
- **Prevent & Treat Dysrhythmias:**
  - Monitor ECG in 2+ leads (II, V1, V5)
  - Have Defibrillator / Pacer available
  - Consult Cardiology as needed

Anesthesia Related Drugs:

- Midazolam has not been shown to prolong QT interval
- Propofol produces an insignificant QT prolongation compared to Thiopental
  - Another study – shortens QT interval
  - Preferred agent for maintenance (TIVA)
- Vecuronium and Cisatracurium show no QT interval prolongation
- Succynlcholine consistently prolonged QT interval

Anesthesia Related Drugs, Con't:

- Reversals:
  - neostigmine-atropine,
  - edrophonioum-atropine,
  - neostigmine-glycopyrrolate

. . . . *All Prolong the QT interval*

- Droperidol 0.75mg IV and Zofran 4mg IV produced similar QT prolongation

- Droperidol 0.625mg did not produce a significant prolongation of the QT interval, compared to saline placebo (separate study)

Volatile Agents

- **Sevoflurane, Isoflurane and Desflurane at 1 MAC all prolong the QT interval**

- **Halothane significantly shortens QT interval**
  - **But Halothane also sensitizes cardiac myoctyes to catecholamines**
  - **Should be avoided in susceptible patients**

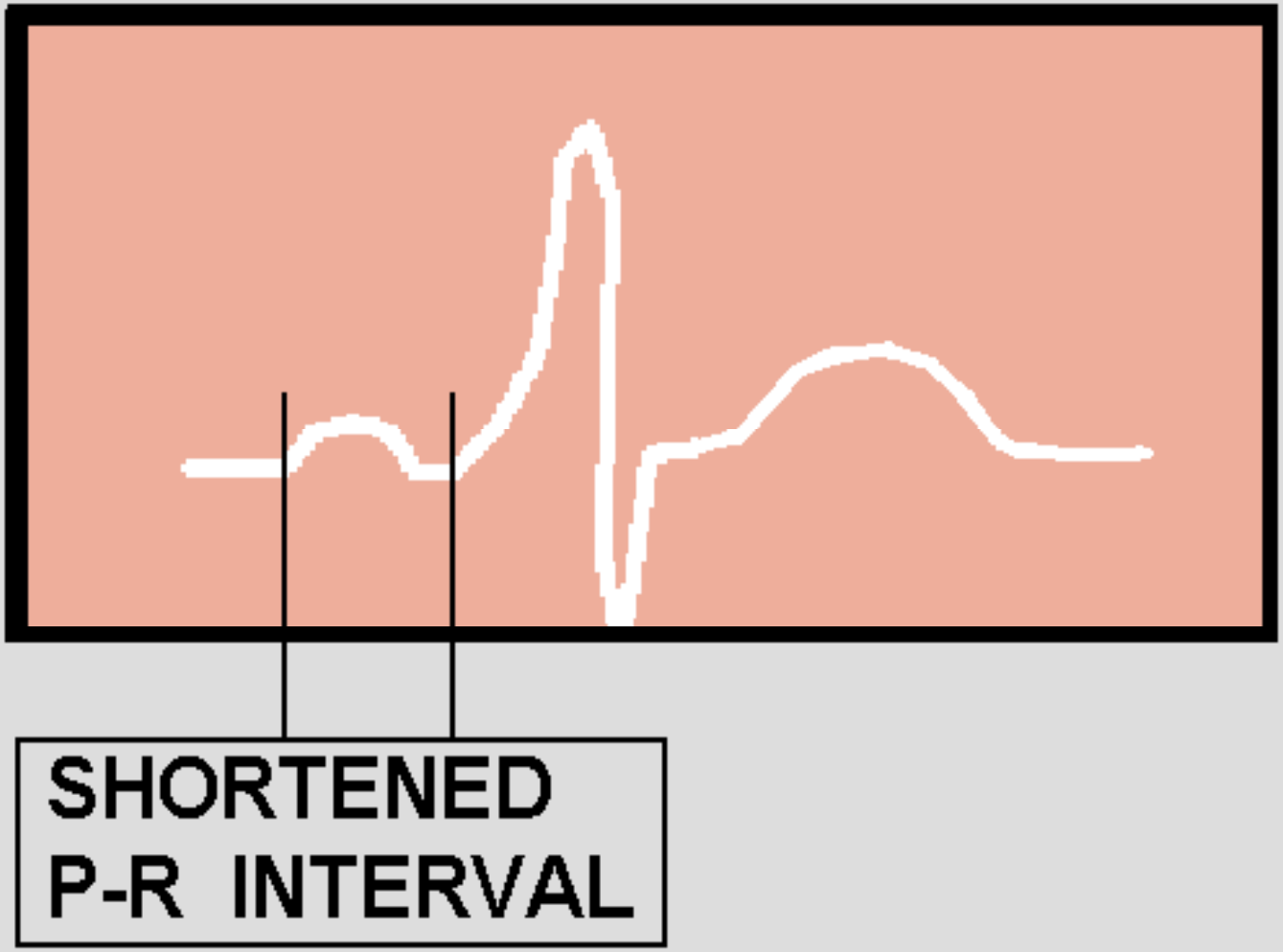
☞ ***Agents have all been administered safely with peri-operative beta blockade, in patients with known LQTS.***

Regional Anesthesia

☞ **Study in ASA I and II male patients undergoing elective surgery under spinal anesthesia showed significant QT prolongation after onset of blockade**

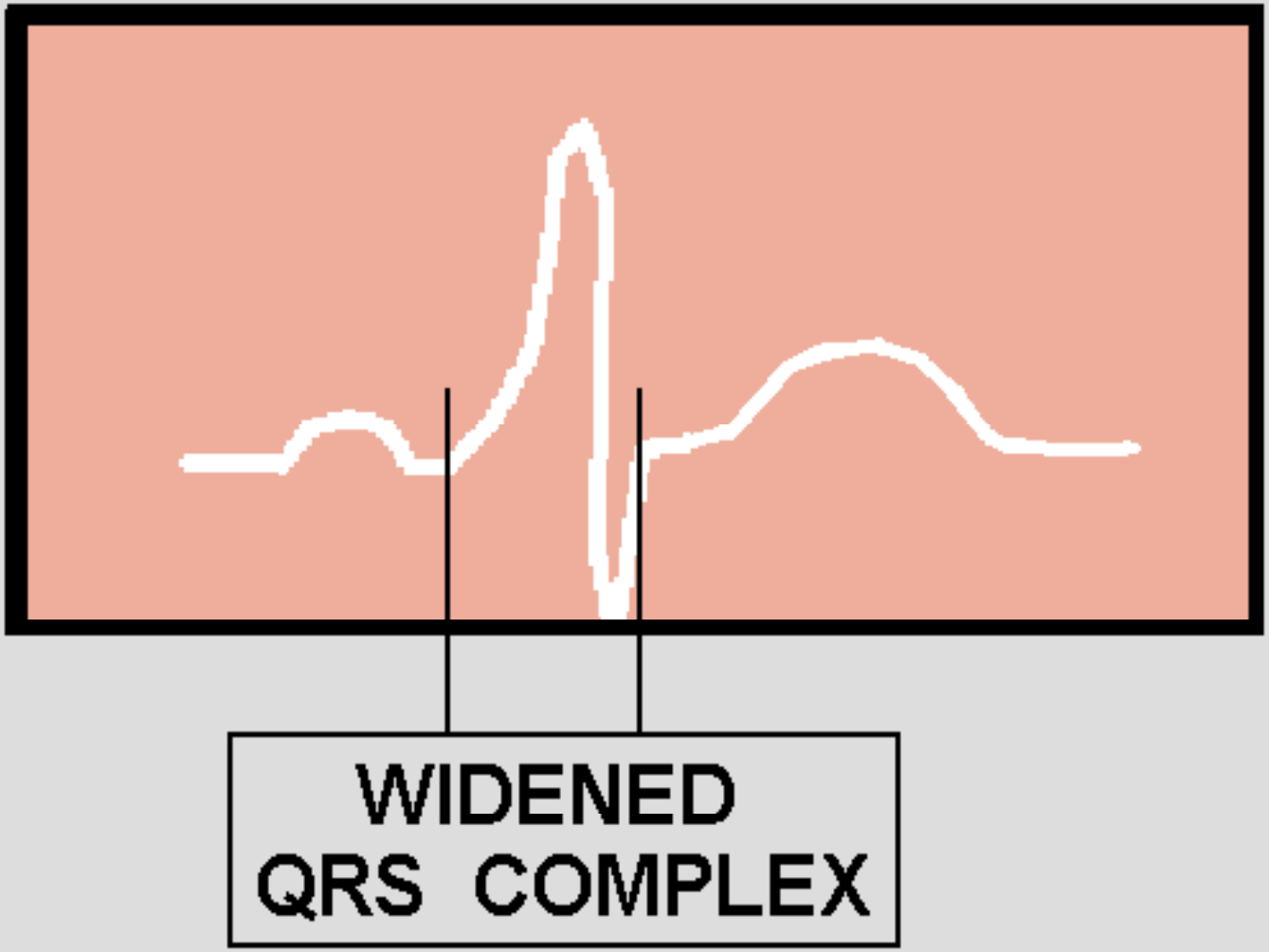
WOLFF-PARKINSON-WHITE

EKG CHARACTERISTICS



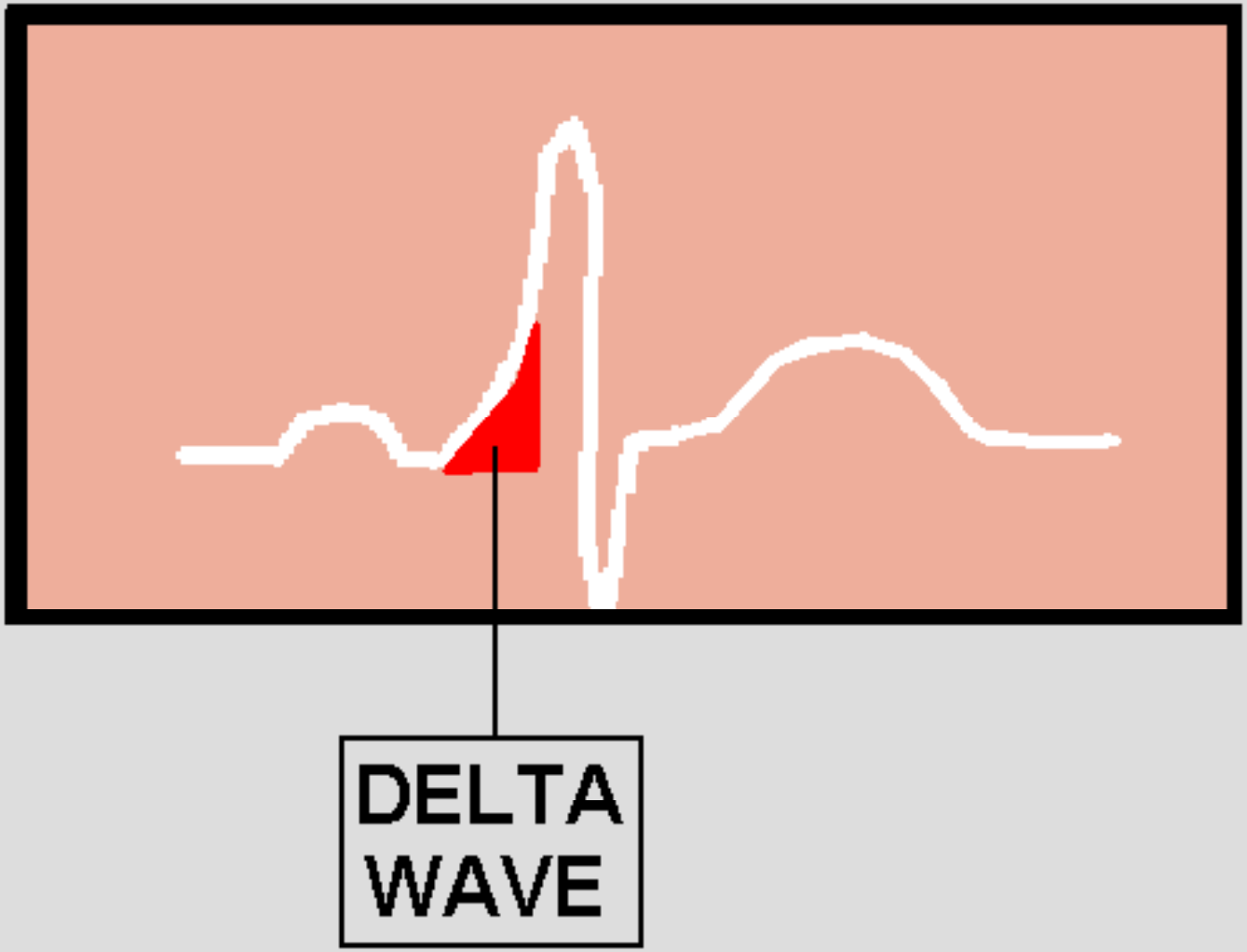
WOLFF-PARKINSON-WHITE

EKG CHARACTERISTICS



WOLFF-PARKINSON-WHITE

EKG CHARACTERISTICS



17–MAY–1997 15:32:09 ST. JOSEPH'S WOMEN'S–WOMEN' ROUTINE RETRIEVAL

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

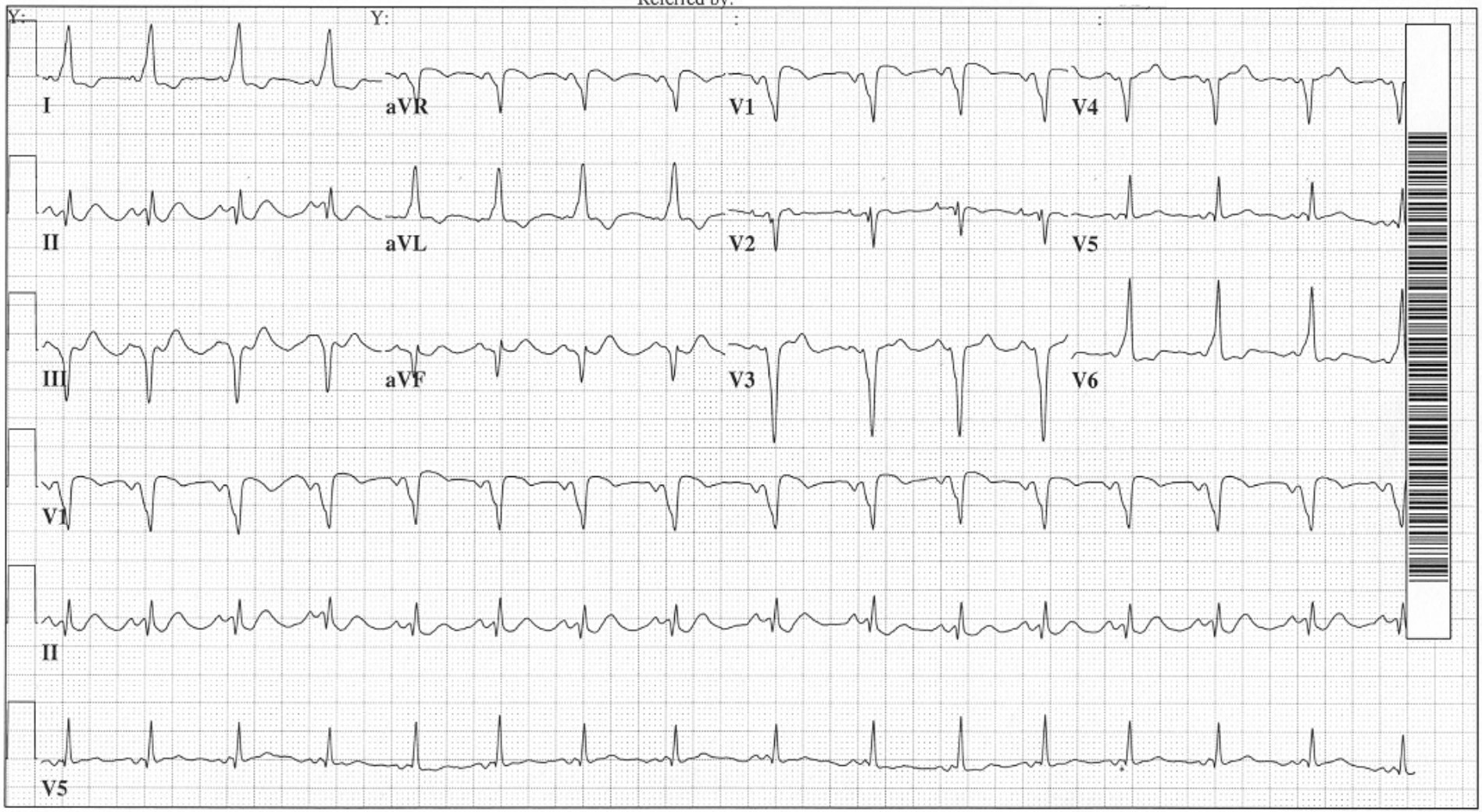
Normal sinus rhythm with sinus arrhythmia
Left atrial enlargement
Anterior infarct , age undetermined
Inferior infarct , age undetermined
ST & T wave abnormality, consider lateral ischemia
Wolff–Parkinson–White
Abnormal ECG
No previous ECGs available

History:Unknown
Technician: DP
Test ind:EKG

EKG CLASS #WR030100
60783

WOLFF-PARKINSON-WHITE
TYPE B

Referred by:



25mm/s 10mm/mV 40Hz 005C 12SL 250 CID: 12

EID:18 EDT: 16:01 17–MAY–1997 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

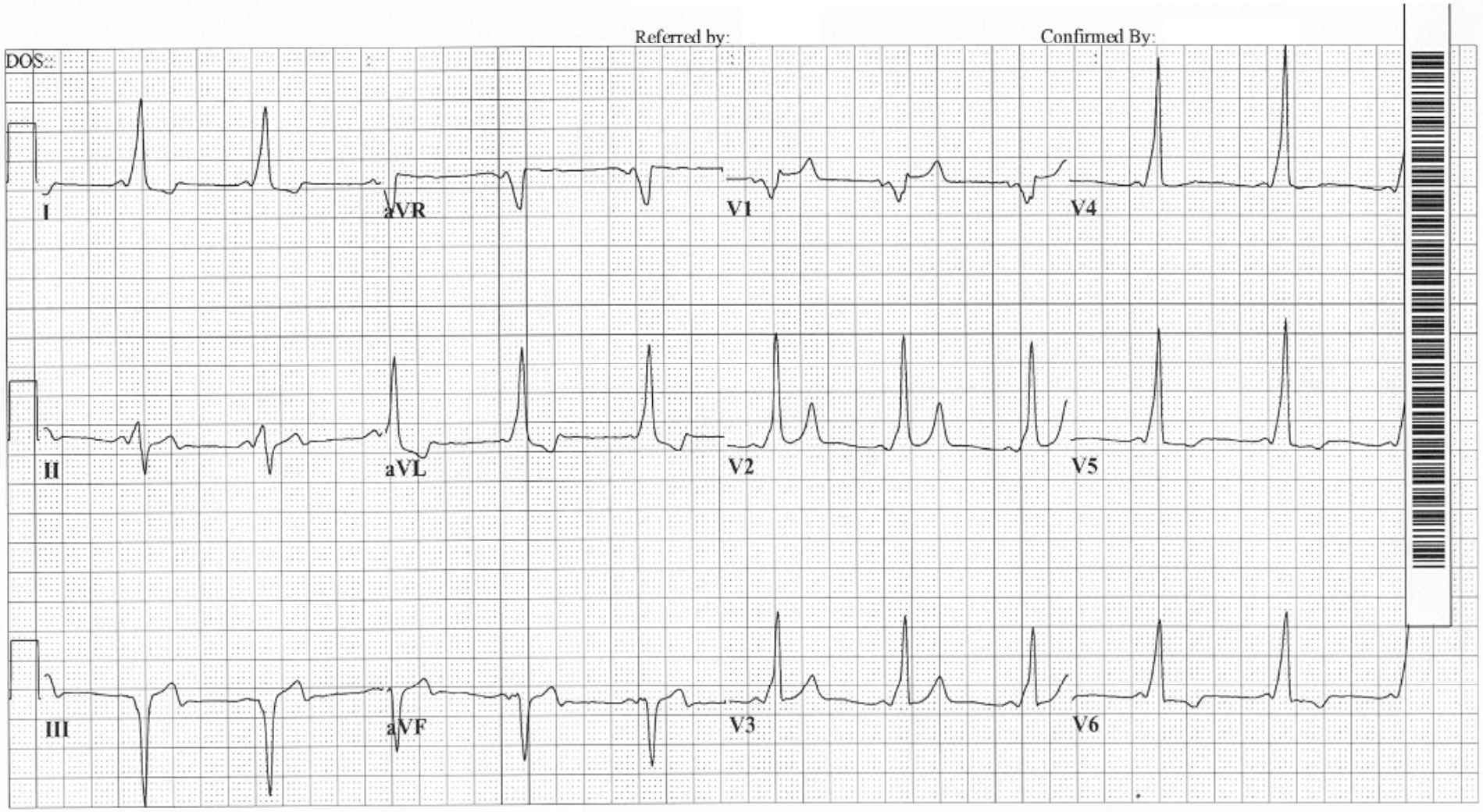
Normal sinus rhythm
Wolff-Parkinson-White
Abnormal ECG
No previous ECGs available

PRE-ABLATION

WOLFF-PARKINSON-WHITE
TYPE A

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:

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

51 yr
Male Caucasian

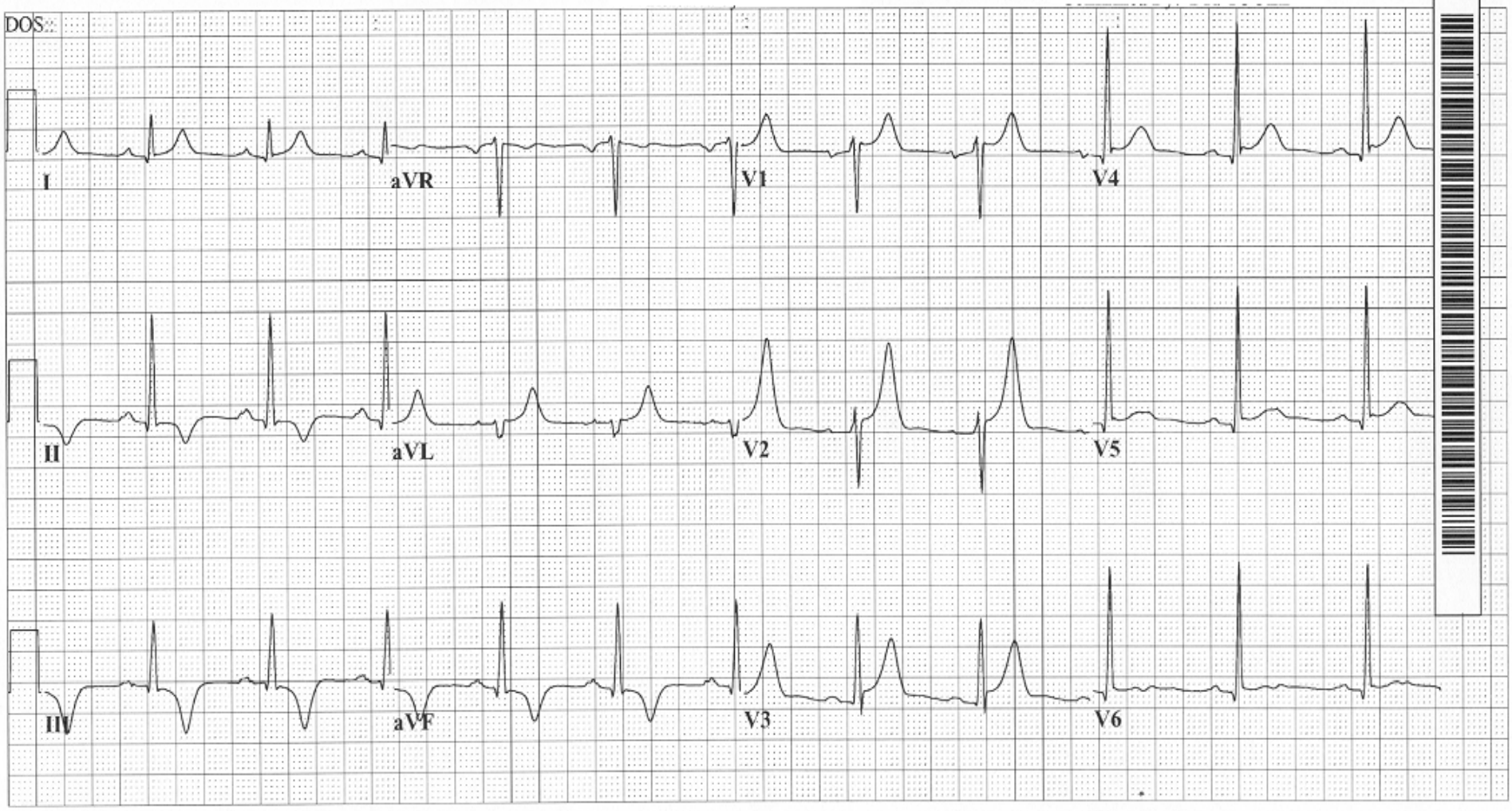
Room:426
Loc:5 Option:28

Vent. rate	69	BPM
PR interval	184	ms
QRS duration	88	ms
QT/QTc	392/420	ms
P-R-T axes	60 69	-50

Normal sinus rhythm
Marked T wave abnormality, consider inferior ischemia
Abnormal ECG
When compared with ECG of 01-MAY-1999 21:36,
Wolff-Parkinson-White is no longer Present

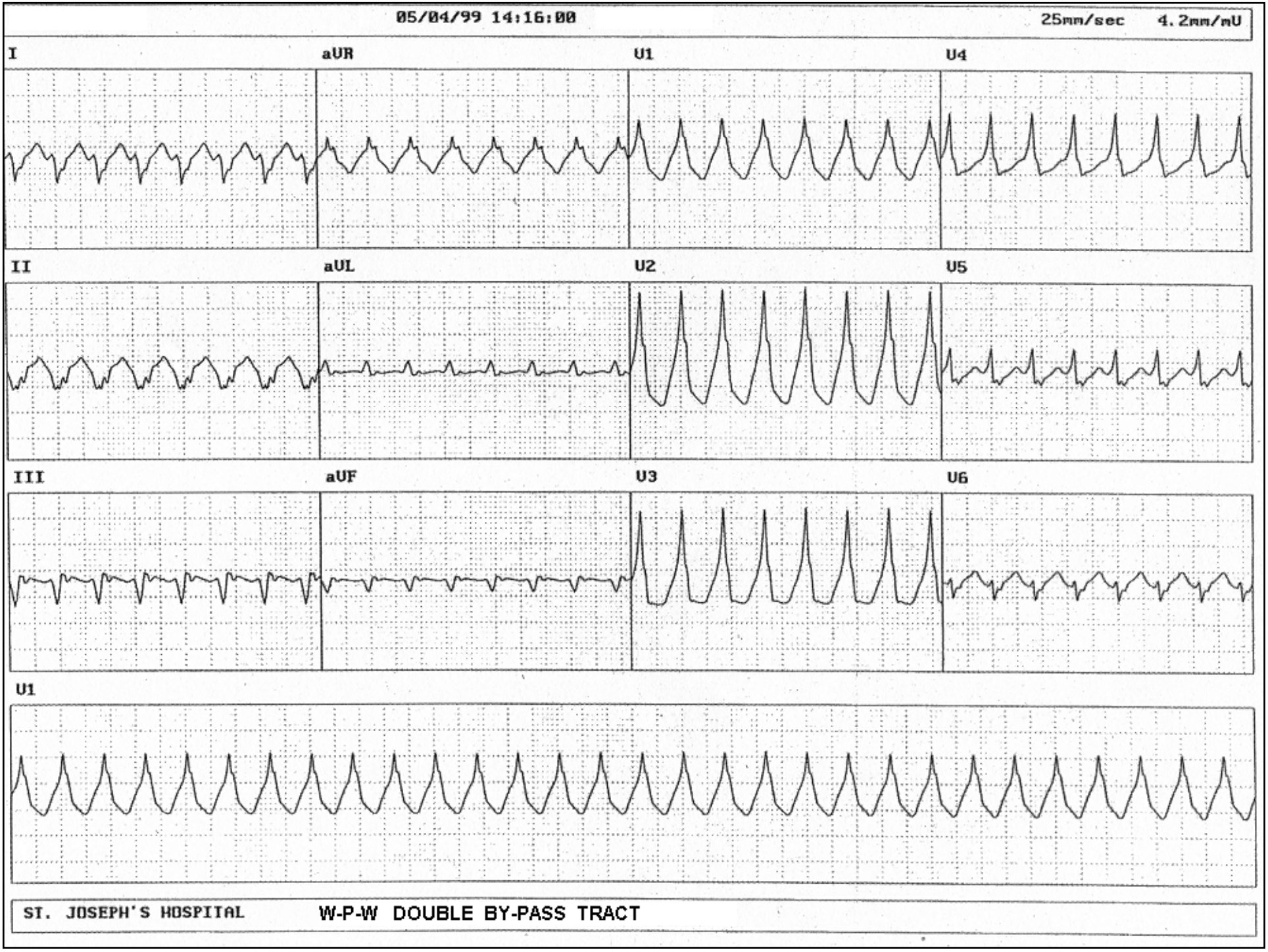
EKG CLASS #WR03696205

POST-ABLATION



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

EID:17 EDT: 09:08 04-MAY-1999 ORDER:


05/04/99 14:16:00
25mm/sec 4.2mm/mU
I
aVR
U1
U4
II
aVL
U2
U5
III
aVF
U3
U6
U1
ST. JOSEPH'S HOSPITAL
W-P-W DOUBLE BY-PASS TRACT

Wolff-Parkinson-White + A-fib = DISASTER

37 y/o male

Chief Complaint: Lightheadedness, Palpitations, Shortness of Breath

HPI: Sudden onset of above symptoms approx. 1 hour ago

PMH: HTN (non-compliant)

37 y/o male

PE: Alert, oriented, restless, cool, pale, dry skin. PERL, No JVD, Lungs clear. Abd soft non tender, Extremities: WNL, no edema

Meds: None, NKDA

VS: BP 106/50, P 180, R 26, SAO2 93%

ST. JOSEPH'S HOSPITAL-

37 yr
Male Caucasian

Room:OP
Loc:8 Option:16

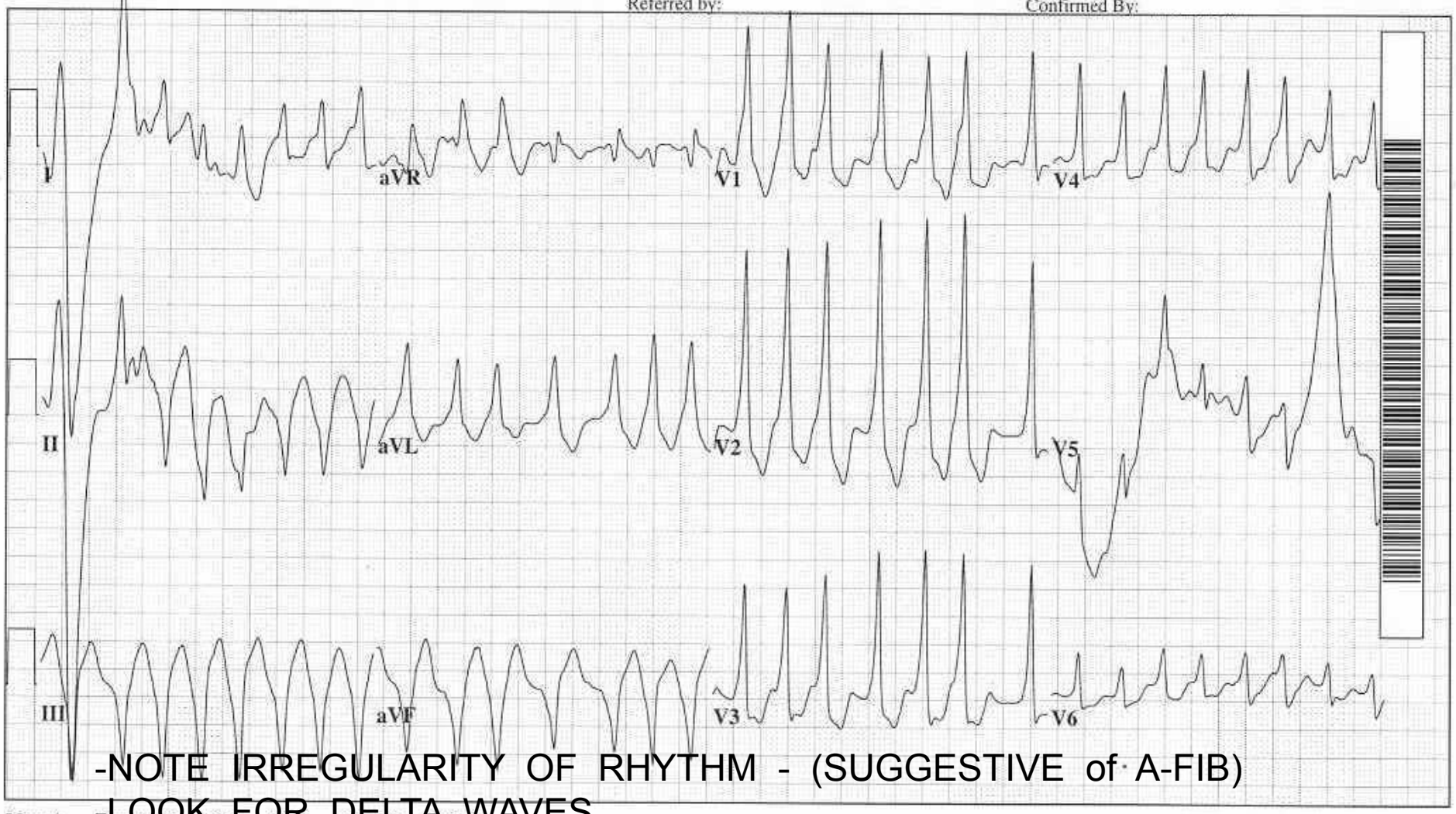
Vent. rate	180	BPM
PR interval	*	ms
QRS duration	148	ms
QT/QTc	284/491	ms
P-R-T axes	* -77	103

WIDE QRS TACHYCARDIA – POSSIBLE VT
Right bundle branch block PATTERN
Abnormal ECG

Med: Unknown

Referred by:

Confirmed By:



25mm/s

-NOTE IRREGULARITY OF RHYTHM - (SUGGESTIVE of A-FIB)
-LOOK FOR DELTA WAVES

ST. JOSEPH'S HOSPITAL- ROUTINE RETRIEVAL

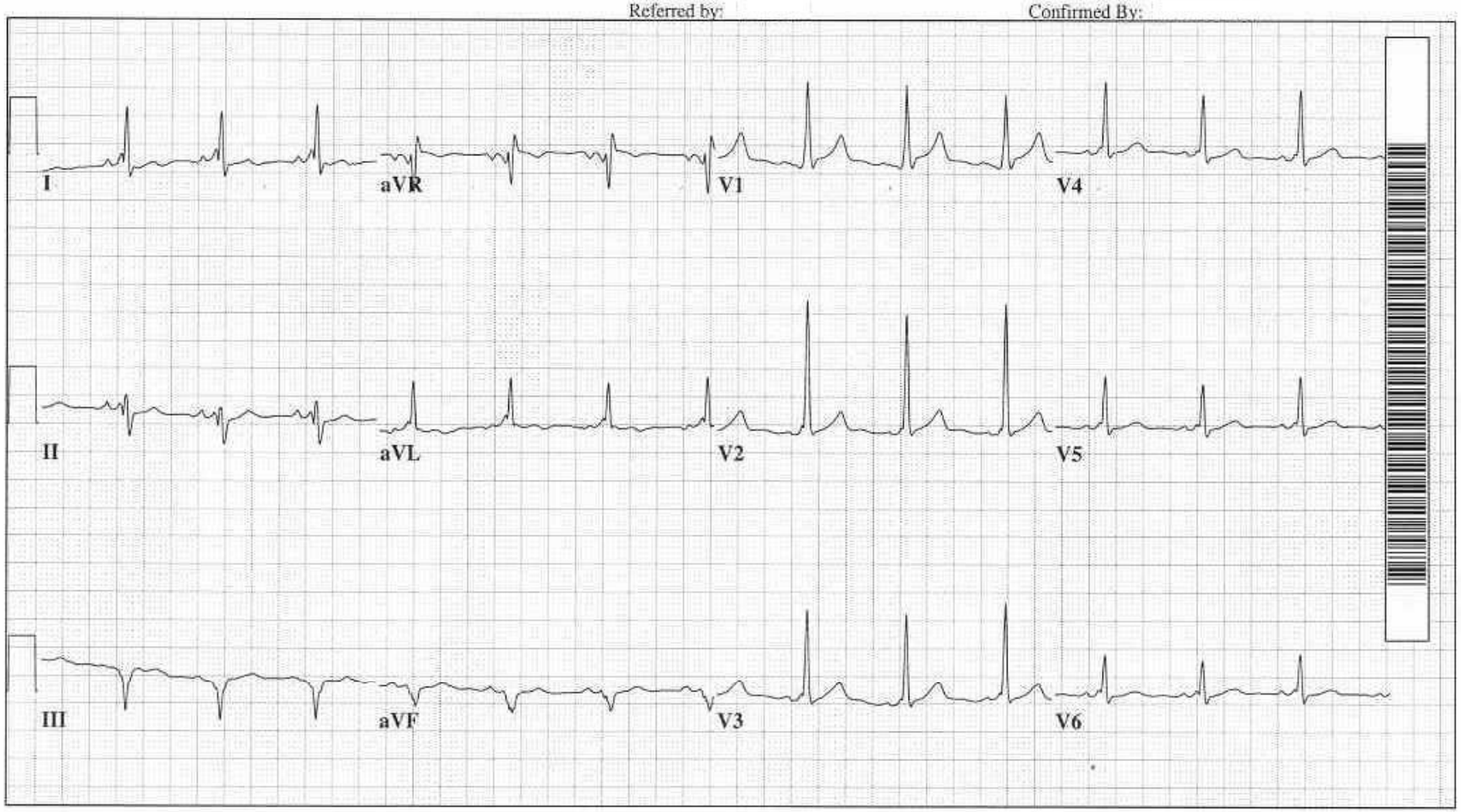
37 yr
Male Caucasian

Room:OP
Loc:8 Option:19

Vent. rate	82	BPM
PR interval	132	ms
QRS duration	128	ms
QT/QTc	392/458	ms
P-R-T axes	77 -44	154

Normal sinus rhythm
Ventricular pre-excitation, WPW pattern type A
Abnormal ECG

Referred by: Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 78 CID: 0

Physician correctly identified Atrial Fibrillation with Rapid Ventricular Response.

However did NOT identify the Wolff-Parkinson-White component.

Patient was given Diltiazem – promptly converted to - ***VENTRICULAR FIBRILLATION.***

WIDE COMPLEX TACHYCARDIA (QRS > 120 ms)

MONOPHASIC

ABC s

NO PULSE

GO TO
V - FIB
ALGORITHM !

PULSE - UNSTABLE

- IMMEDIATE SYNC. CARDIOVERSION:
  - 100 j biphasic
  - consider sedation
- INCREASE joules
- MEDS:
  - PROCAINAMIDE
  - AMIODARONE

PULSE - STABLE

- O2, IV-IO, EKG
- MEDS:
  - ADENOSINE 6-12 (only if REGULAR)
  - PROCAINAMIDE (20-50mg/min)
  - AMIODARONE (150 over 10min + 1mg/ min INFUSION

WIDE COMPLEX TACHYCARDIA (QRS > 120 ms)

MONOPHASIC

ABC s

NO PULSE

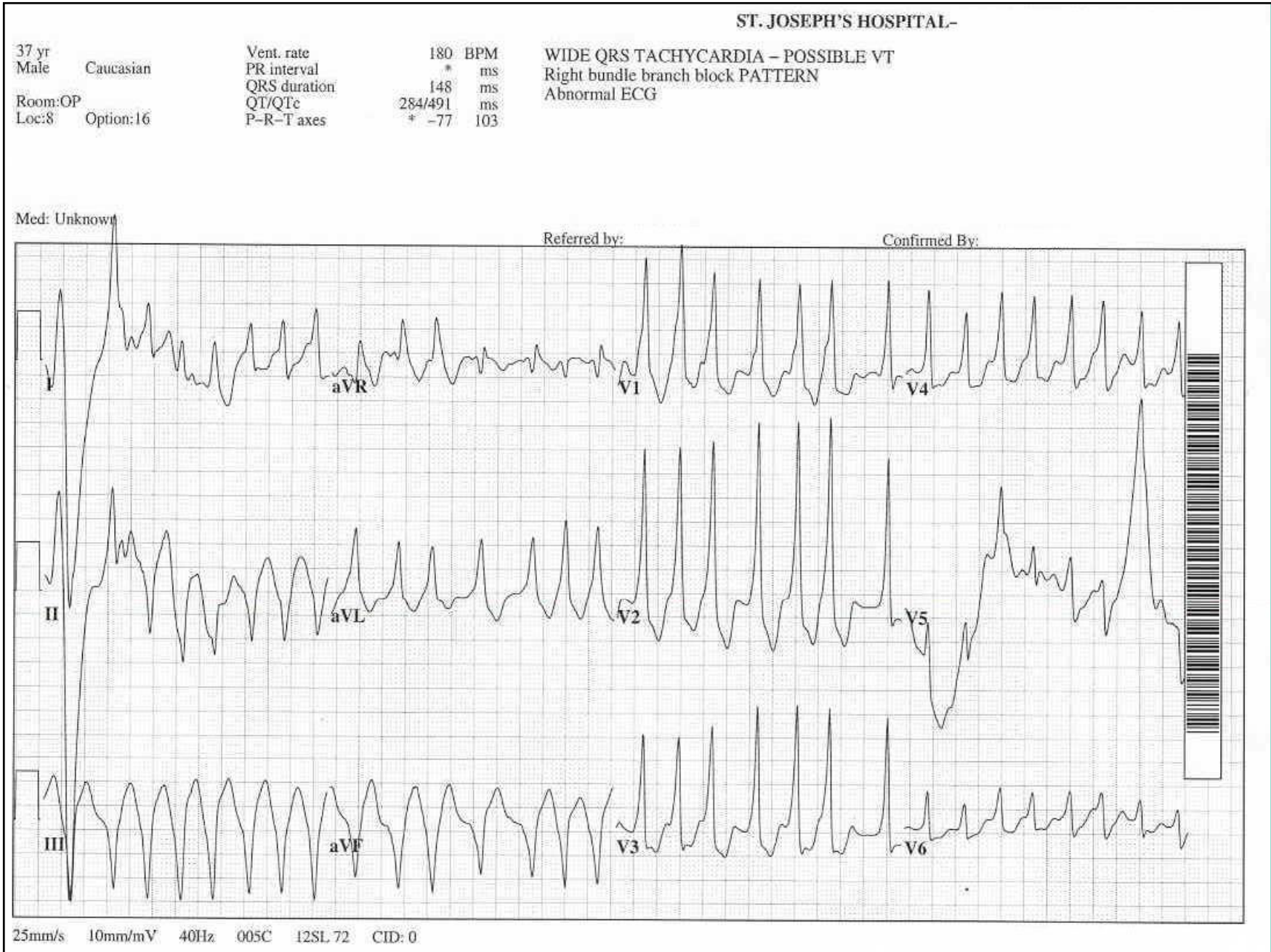
GO TO
V - FIB
ALGORITHM !

PULSE - UNSTABLE

- IMMEDIATE SYNC. CARDIOVERSION:
  - 100 j biphasic
  - consider sedation
- INCREASE joules
- MEDS:
  - -PROCAINAMIDE
  - -AMIODARONE

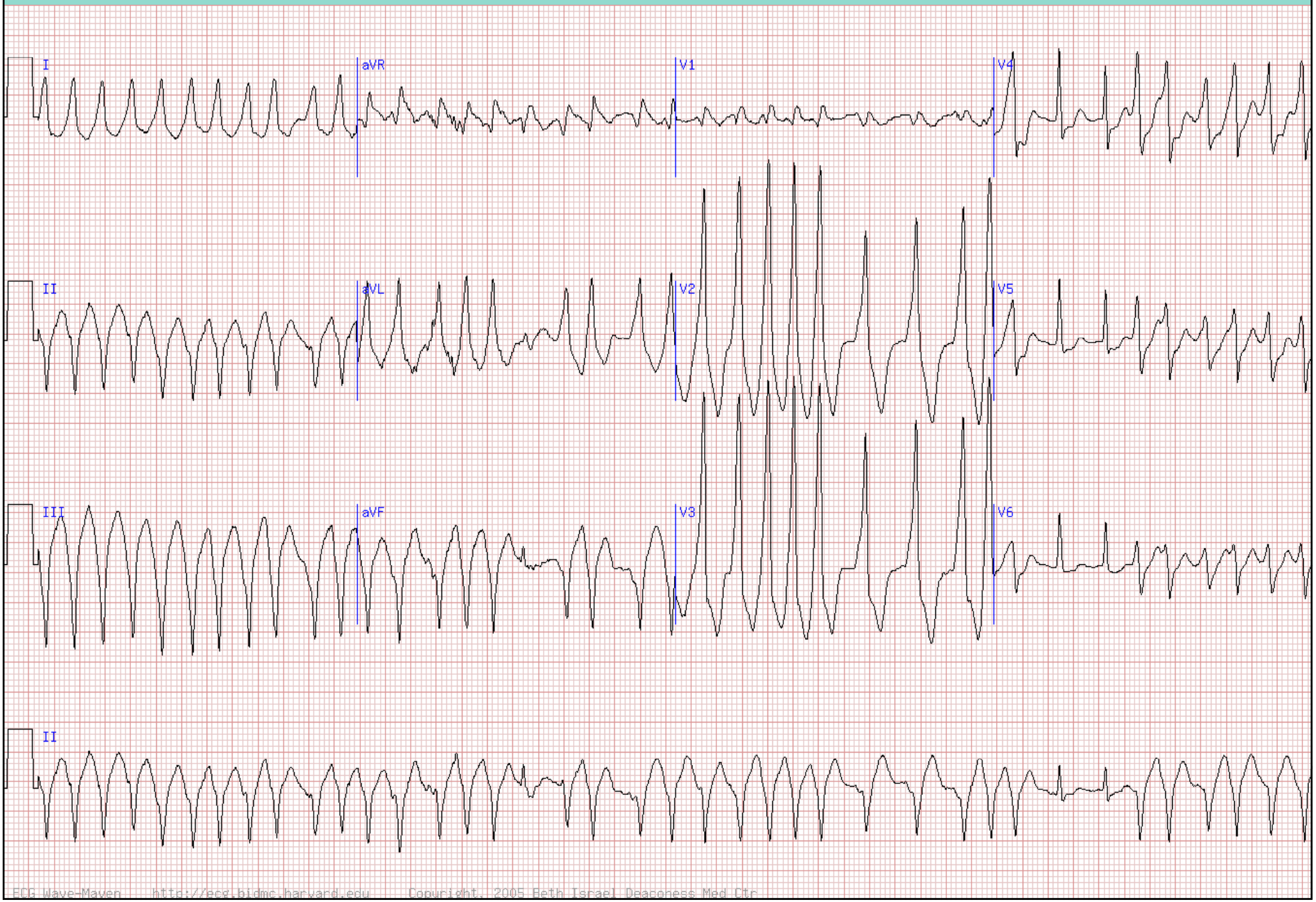
PULSE - STABLE

- O2, IV-IO, EKG
- MEDS:
  - ADENOSINE 6-12 (RAPID BOLUS)
  - PROCAINAMIDE (20-50mg/min)
  - AMIODARONE (150 over 10min + 1mg/ min INFUSION



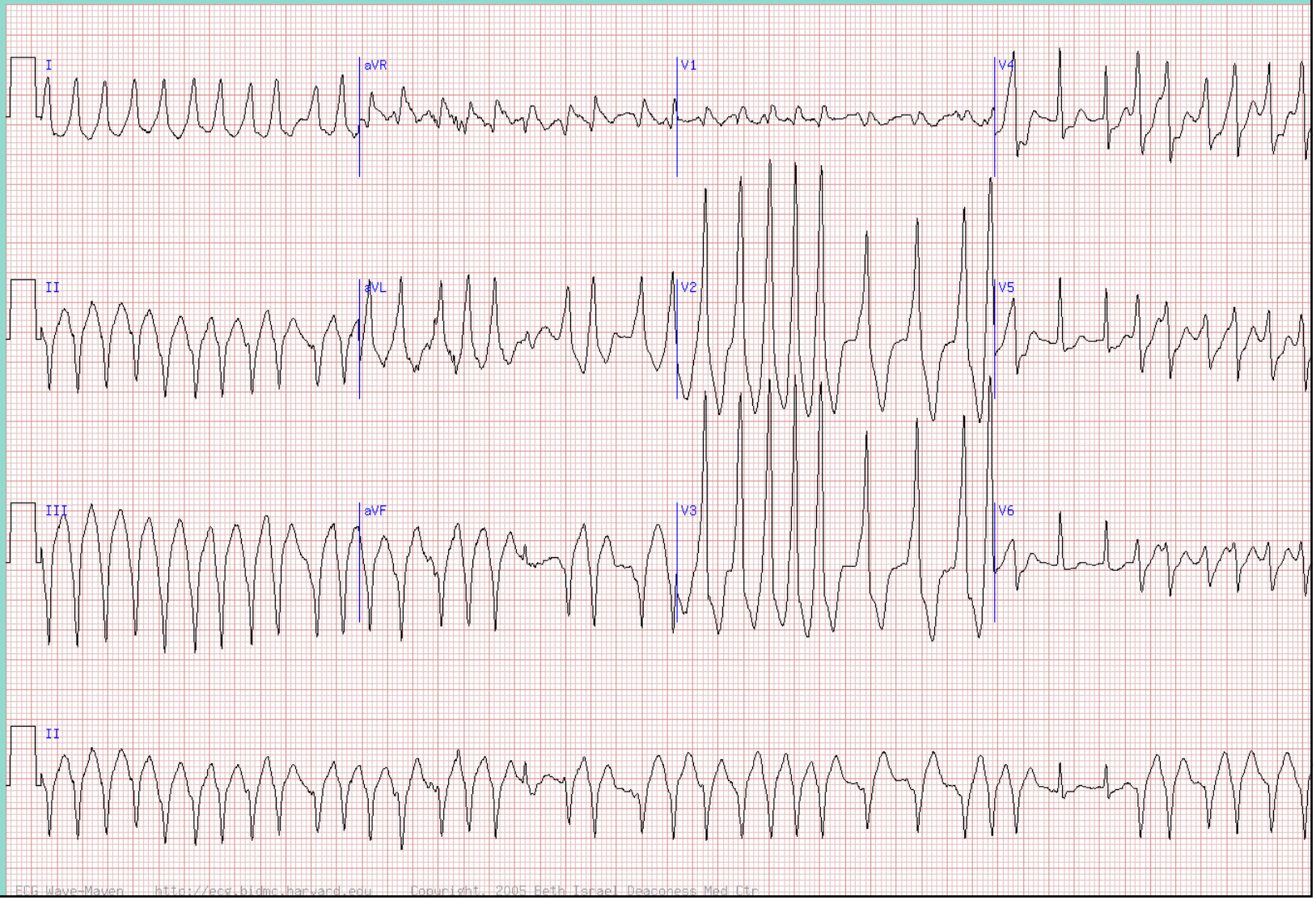
-NOTE IRREGULARITY OF RHYTHM - (SUGGESTIVE of A-FIB)
-LOOK FOR DELTA WAVES

17 year old male: W-P-W with Afib & RVR



CHARACTERISTICS of W-P-W with Afib & RVR:

- WIDE COMPLEX TACHYCARDIA
- IRREGULARLY IRREGULAR R – R INTERVALS !!



NO AV NODAL BLOCKERS
(e.g. ADENOSINE, CALCIUM CHANNEL BLOCKERS)
FOR WIDE COMPLEX TACHYCARDIAS THAT COULD BE ATRIAL FIBRILLATION with Pre-Excitation (W-P-W)

Arrhythmogenic Right Ventricular Dysplasia

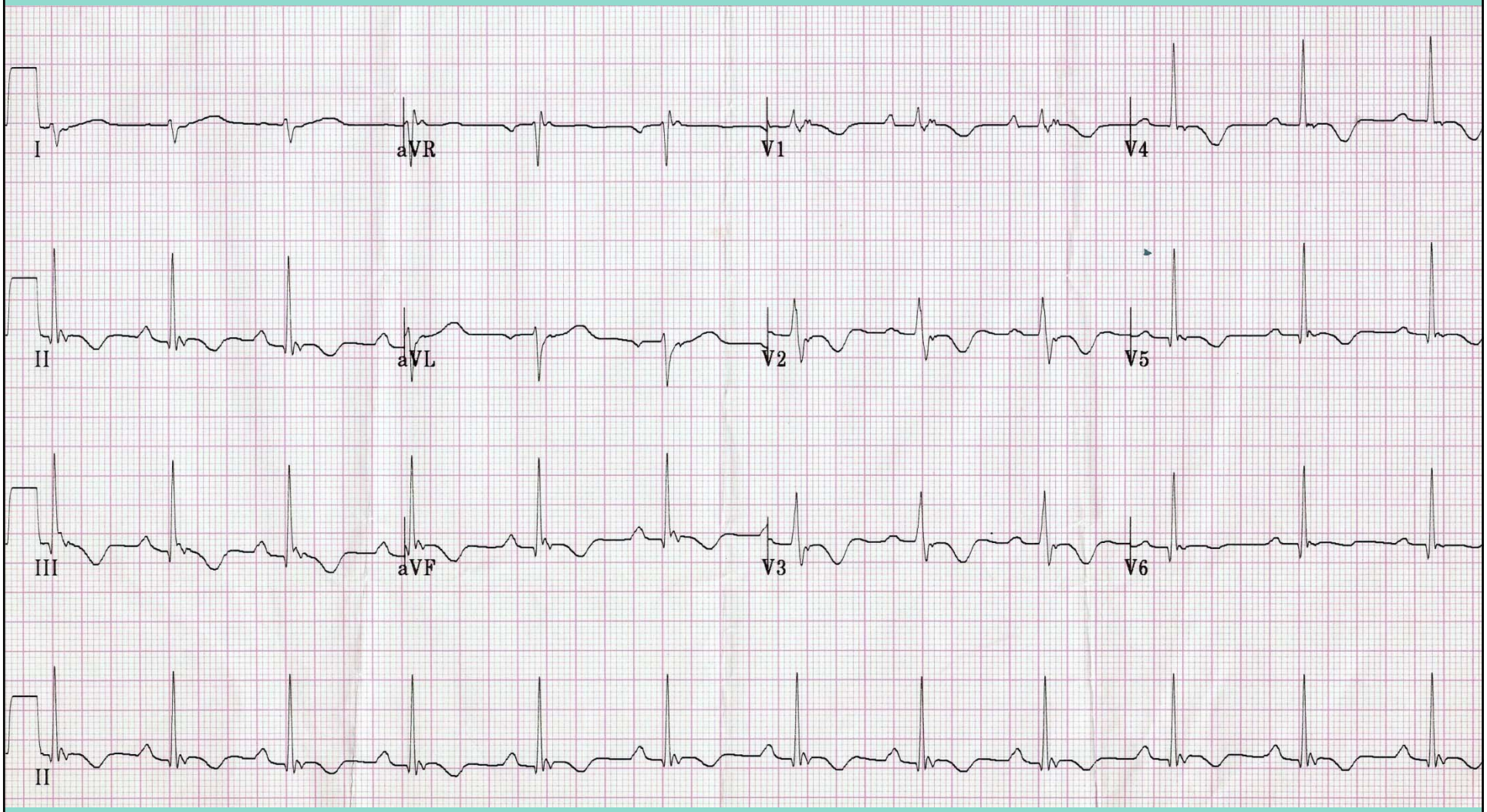
- A genetically acquired myocardial disease associated with paroxysmal ventricular arrhythmias and sudden cardiac death.
- Characterized pathologically by fibro-fatty replacement of the right ventricular myocardium.
- The second most common cause of sudden cardiac death in young people (after HOCM), causing *up to 20% of sudden cardiac deaths in patients < 35 yrs of age*.
- Typically inherited as an autosomal dominant trait, with variable penetrance and expression (there is an autosomal recessive form calledNaxos Disease, which is associated with woolly hair and skin changes).
- More common in men than women (3:1) and in people of Italian or Greek descent.
- Estimated to affect approximately 1 in 5,000 people overall.

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Arrhythmogenic Right Ventricular (RV) Cardiomyopathy and/or Dysplasia:

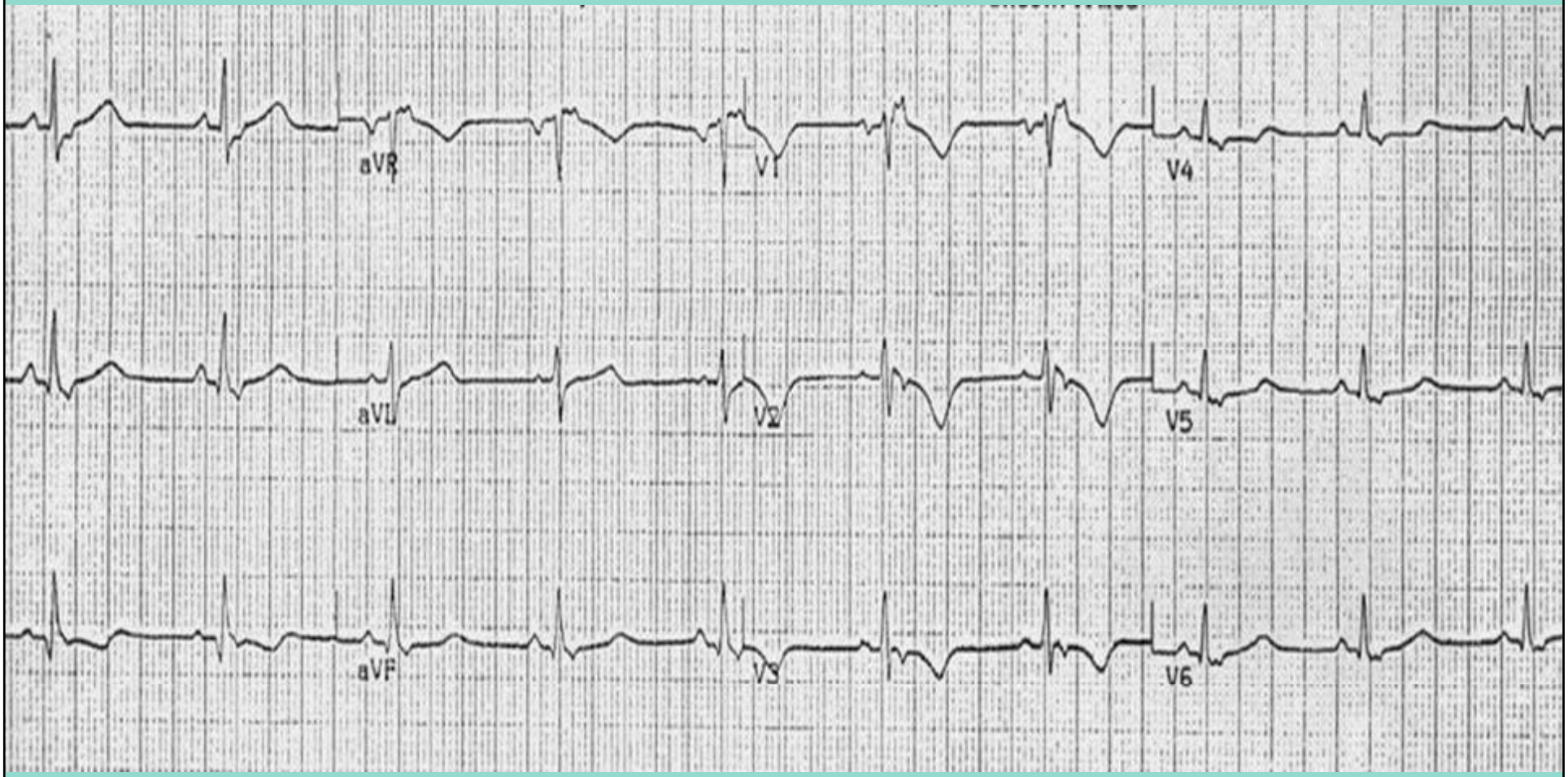
In 1 autopsy study examining a series of 200 cases of sudden death associated with arrhythmogenic RV cardiomyopathy and/or dysplasia, death occurred in 9.5% of cases during the perioperative period. This emphasizes the importance of close perioperative evaluation and monitoring of these patients for ventricular arrhythmia. Most of these patients require cardiac electrophysiologist involvement and consideration for an implantable cardioverter-defibrillator (ICD) for long-term management.

ARVD ECG 1



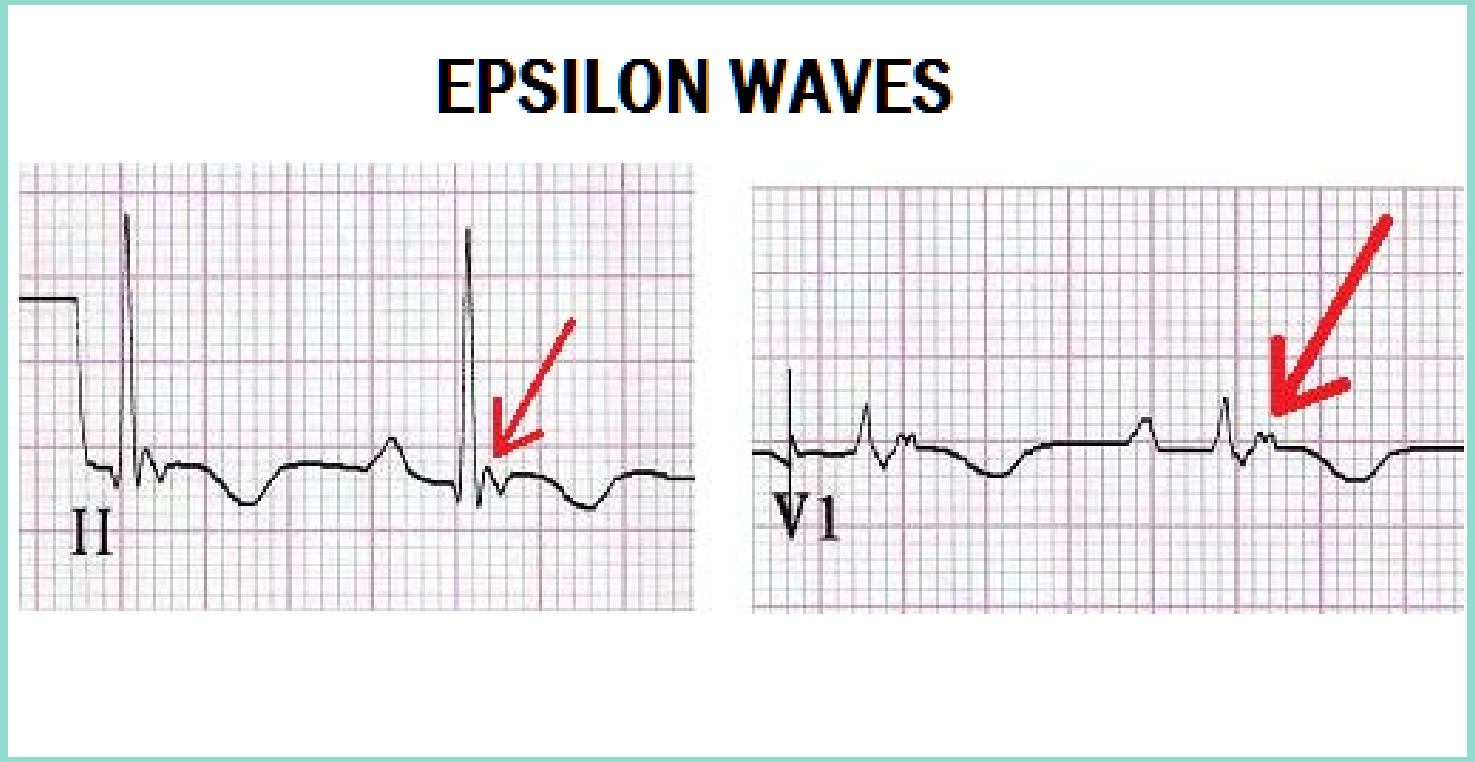
1. "Incomplete RBBB" Pattern
2. V1, V2 Rs pattern
3. Inverted T waves, symmetrical, - Global
4. Epsilon's waves

ARVD ECG 2



1. "Incomplete RBBB" Pattern
2. V1, V2 Rs pattern
3. Inverted T waves, symmetrical, - Global
4. Epsilon's waves

ARVD – 12 Lead ECG Indicators



EARLY REPOLARIZATION

- POSSIBLY CAUSED BY ACCELERATED SUBEPICARDIAL REPOLARIZATION
- MILD S-T ELEVATION, USUALLY LESS THAN 2mm HEIGHT
- S-T ELEVATION SEEN IN LIMB AND PRECORDIAL LEADS (NEARLY ALL !)
- S-T ELEVATION MOST PROMINENT IN V-4 thru V6

EARLY REPOLARIZATION

- MAY APPEAR IDENTICAL TO ACUTE PERICARDITIS EKG

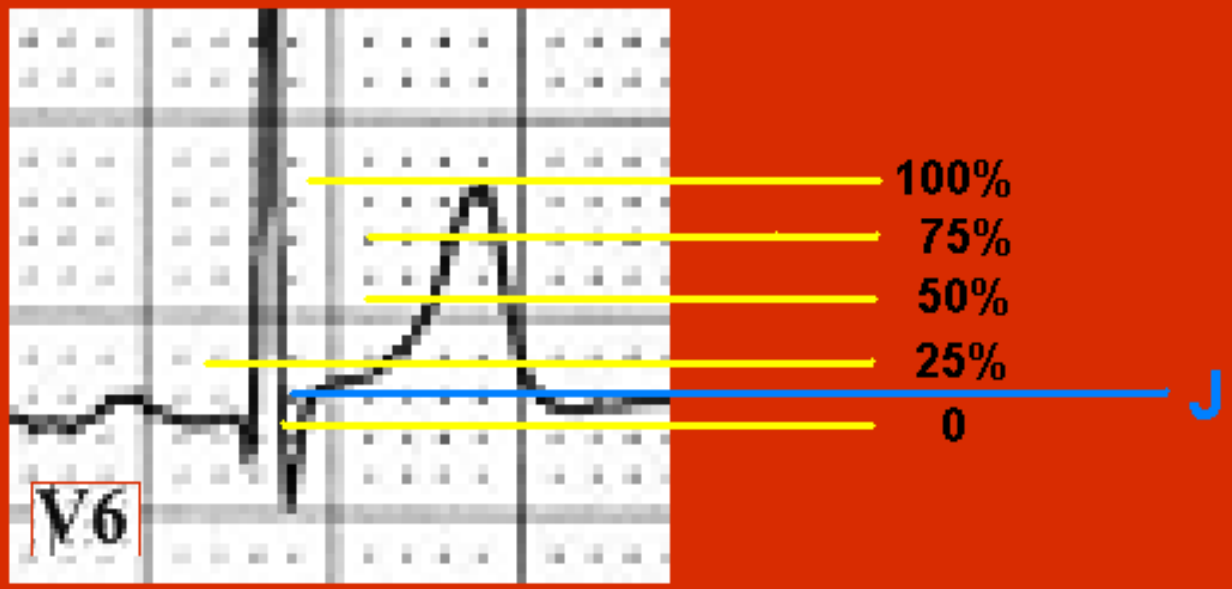
- ONE POSSIBLE DISTINGUISHING CHARACTERISTIC IS THE

  * S-T : T RATIO IS LESS THAN 0.25 in lead V6

* ACCORDING TO: "CARDIOLOGY" the HOUSE OFFICER SERIES, PUBLISHED BY WILLIAMS AND WILKENS,1998

EARLY REPOLARIZATION

* S-T : T RATIO in LEAD V6:



LESS THAN 0.25

FAVORS EARLY REPOLARIZATION

* ACCORDING TO: "CARDIOLOGY" the HOUSE OFFICER SERIES, PUBLISHED BY WILLIAMS AND WILKENS,1998

14-SEP-1997 08:09:43 ST. JOSEPH'S HOSPITAL-ER ROUTINE RETRIEVAL

21 yr
Male Black

Room:ER
Loc:3 Option:16

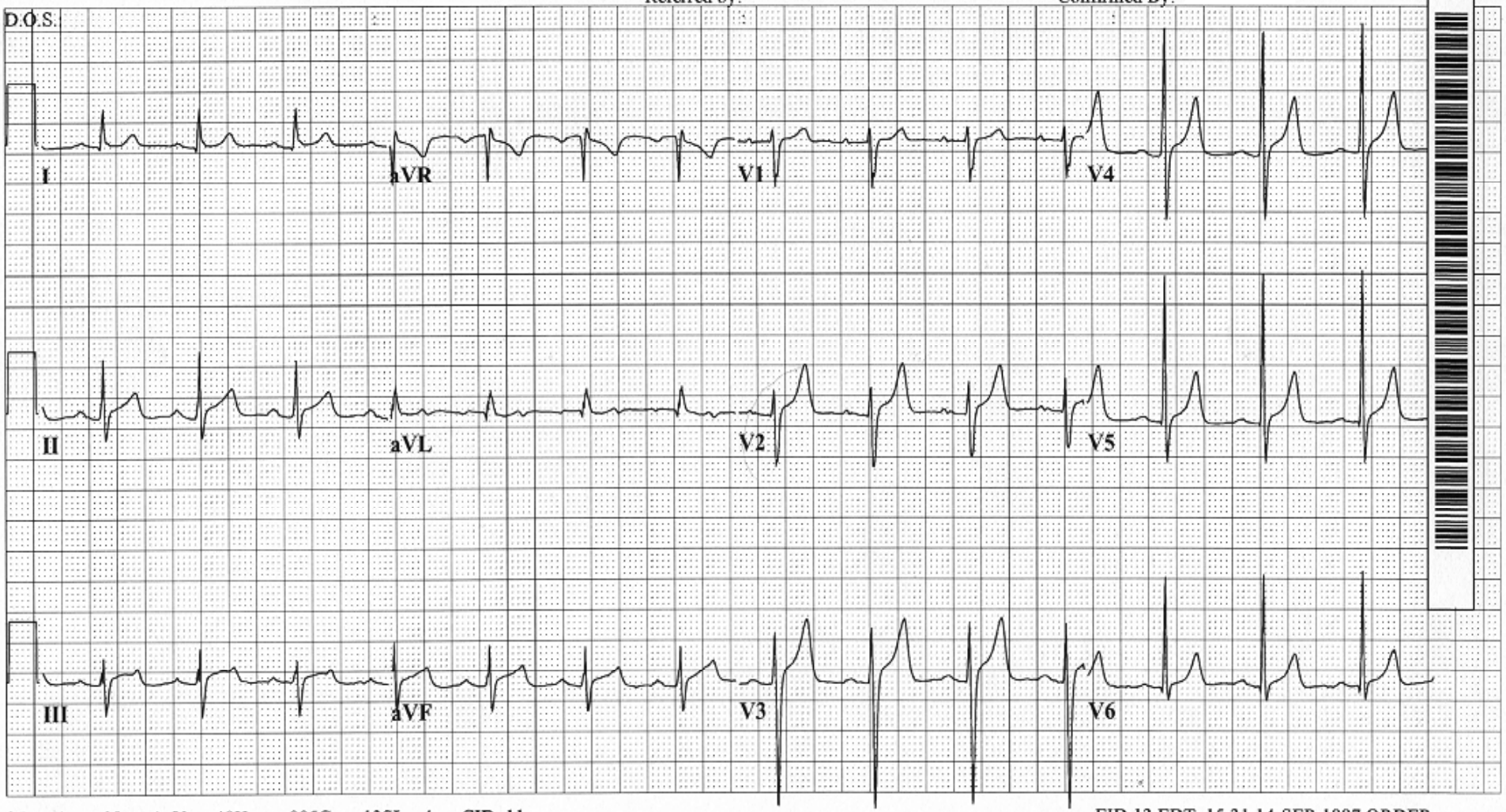
Vent. rate	86	BPM
PR interval	176	ms
QRS duration	90	ms
QT/QTc	330/394	ms
P-R-T axes	63 26	65

Normal sinus rhythm
Early repolarization
Normal ECG

Technician **EKG CLASS #WR03130614**

Referred by: Confirmed By:

D.O.S.



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

EID:13 EDT: 15:31 14-SEP-1997 ORDER:

14-SEP-1997 08:09:43 ST. JOSEPH'S HOSPITAL-ER ROUTINE RETRIEVAL

21 yr
Male Black

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PR interval	176	ms
QRS duration	90	ms
QT/QTc	330/394	ms
P-R-T axes	63 26	65

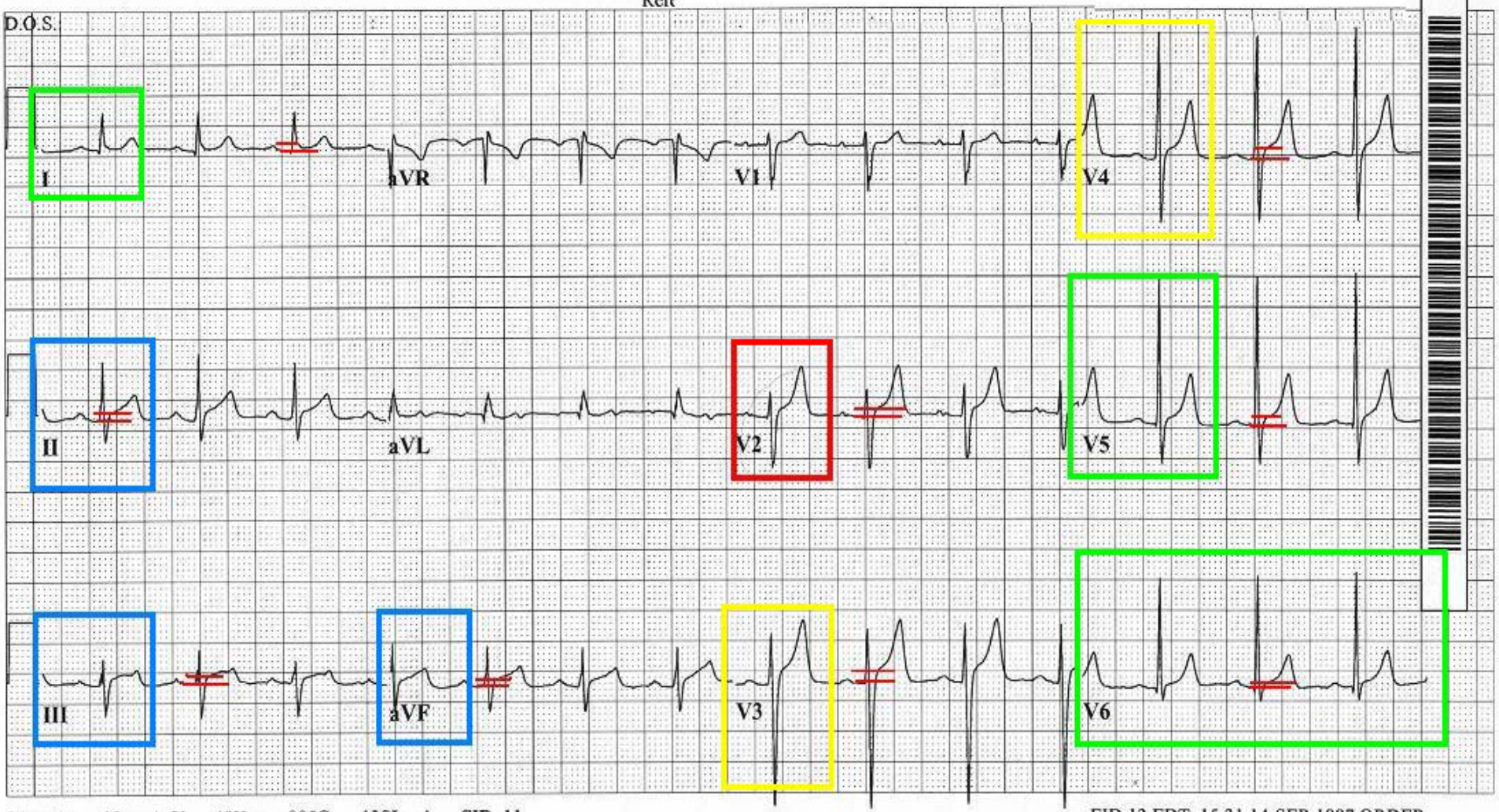
Normal sinus rhythm
Early repolarization
Normal ECG

- Pt IS YOUNG, HEATHY, MALE
- DIFFUSE S-T ELEV. IN MANY LEADS
- "V6 TEST" FAVORS EARLY REPOLARIZATION

Technician **EKG CLASS #WR03130614**

Refc

D.O.S.



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

EID:13 EDT: 15:31 14-SEP-1997 ORDER:

EARLY REPOLARIZATION

REMEMBER TO CONSIDER THE
BIG PICTURE . . .

- Pt. HAS "UNEXPLAINED" DIFFUSE S-T ELEVATION IN NEARLY ALL LEADS
- Pt. IS ASYMPTOMATIC
- Pt. HAS NO REPRODUCEABLE CHEST PAIN
- Pt. IS USUALLY A YOUNG, HEALTHY, ATHLETIC MALE ! !


-2 0 418 348
ROTATION CRANIOCAUD SID TABLE HEIGHT

PERICARDITIS

COMMON EKG FEATURES

- DIFFUSE S-T ELEVATION (1 - 2 mm) IN MANY OR ALL LEADS.
- USUALLY GREATEST S-T ELEVATION NOTED IN LEADS I, II, V5 and V6
- P-R SEGMENT ELEVATION IN LEAD AVR
  P-R SEGMENT DEPRESSION IN LEAD II
- S-T ELEVATION (J POINT) USUALLY GREATER THAN 25% OF HEIGHT OF T-WAVE IN V-6

17-Dec-1998 6:42:22 ST JOSEPH HOSPITAL

64years
Female Black

Room:

Opt:

Vent. rate 121 bpm
PR interval 116 ms
QRS duration 60 ms
QT/QTc 286/406 ms
P-R-T axes 64 0 44

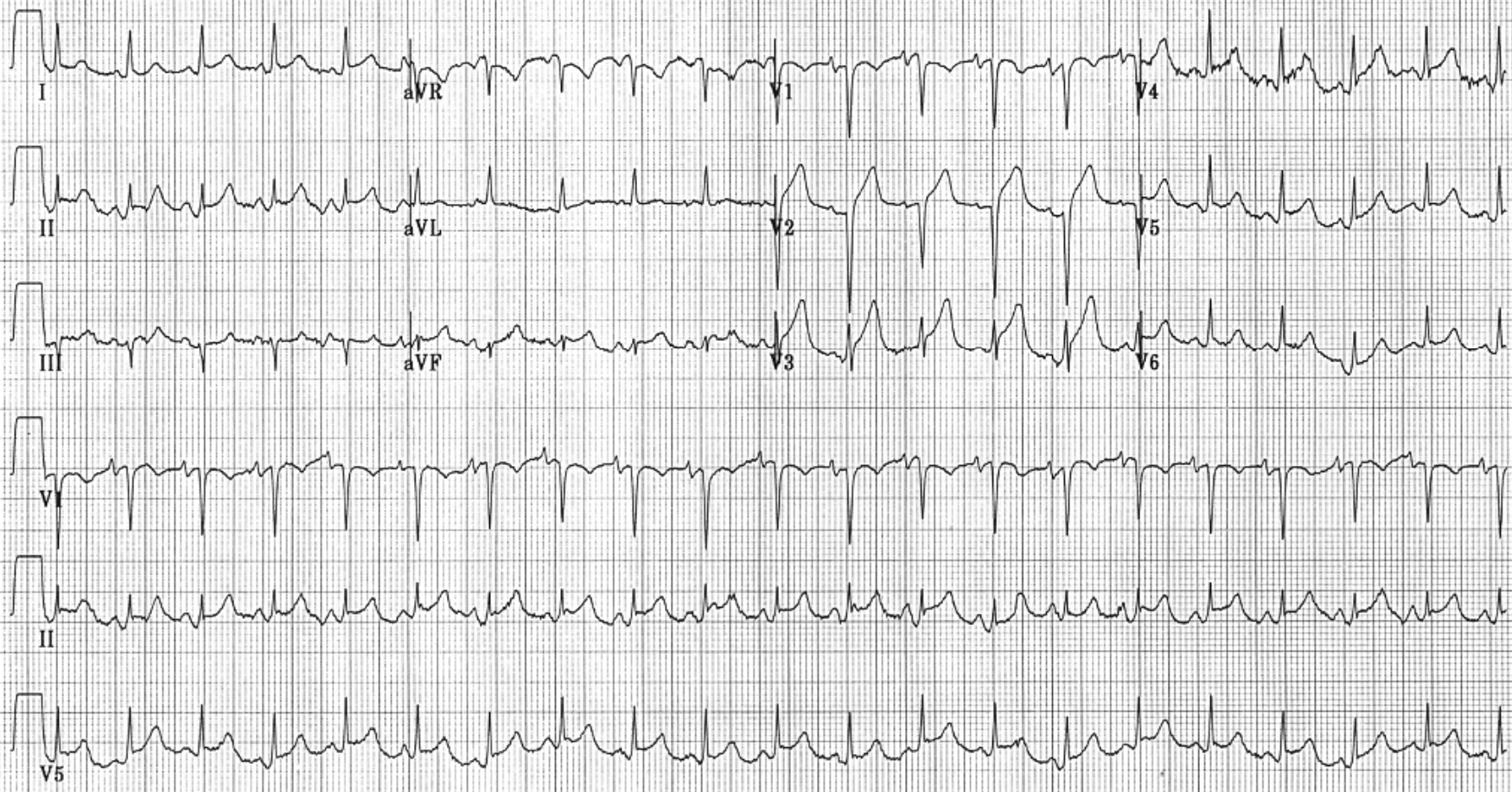
Sinus tachycardia
Acute pericarditis
Abnormal ECG

Technician: EKG CLASS #WR03999999

Referred by:

Reviewed by:

D.O.S.:

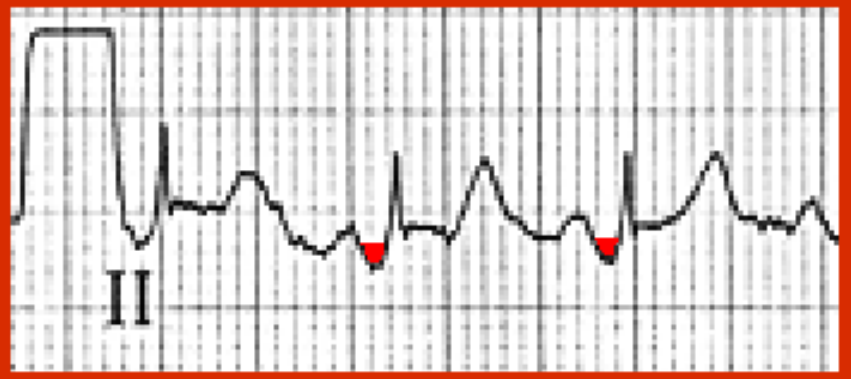


40 Hz .0 mm/s 10.0 mm/mV ELECTROTRACE 8671 2.5s + 3 rhythm lds MACVU 002C L[tm] v250

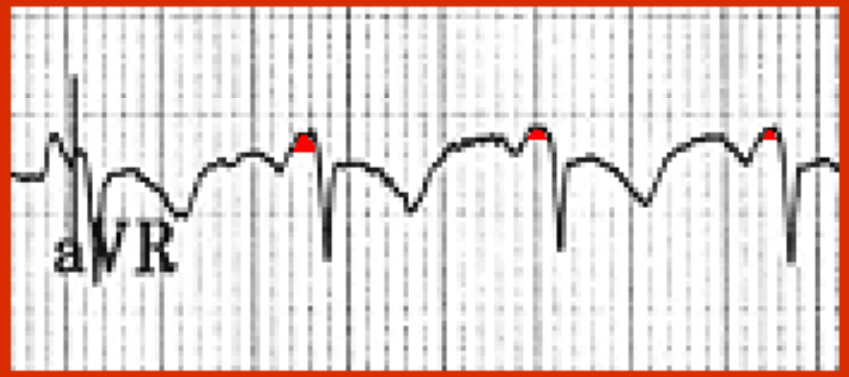
PERICARDITIS

EKG CLASS #WR03999999

DEPRESSED
P-R SEGMENT
LEAD II



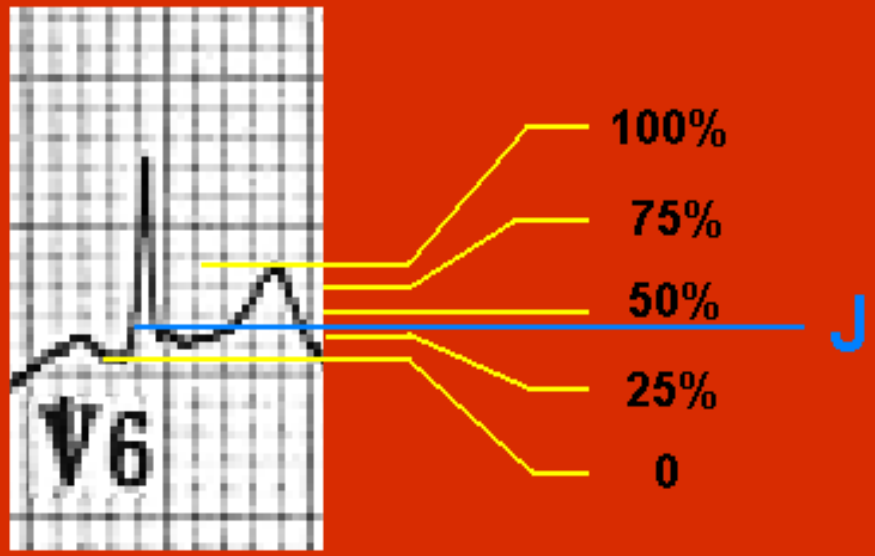
ELEVATED
P-R SEGMENT
LEAD AVR



PERICARDITIS

EKG CLASS #WR03999999

* S-T : T RATIO in LEAD V6:



MORE THAN 0.25

FAVORS PERICARDITIS

* ACCORDING TO: "CARDIOLOGY" the HOUSE OFFICER SERIES, PUBLISHED BY WILLIAMS AND WILKENS,1998

17-Dec-1998 6:42:22 ST JOSEPH HOSPITAL

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Room: Opt:

Vent. rate	121 bpm
PR interval	116 ms
QRS duration	60 ms
QT/QTc	286/406 ms
P-R-T axes	64 0 44

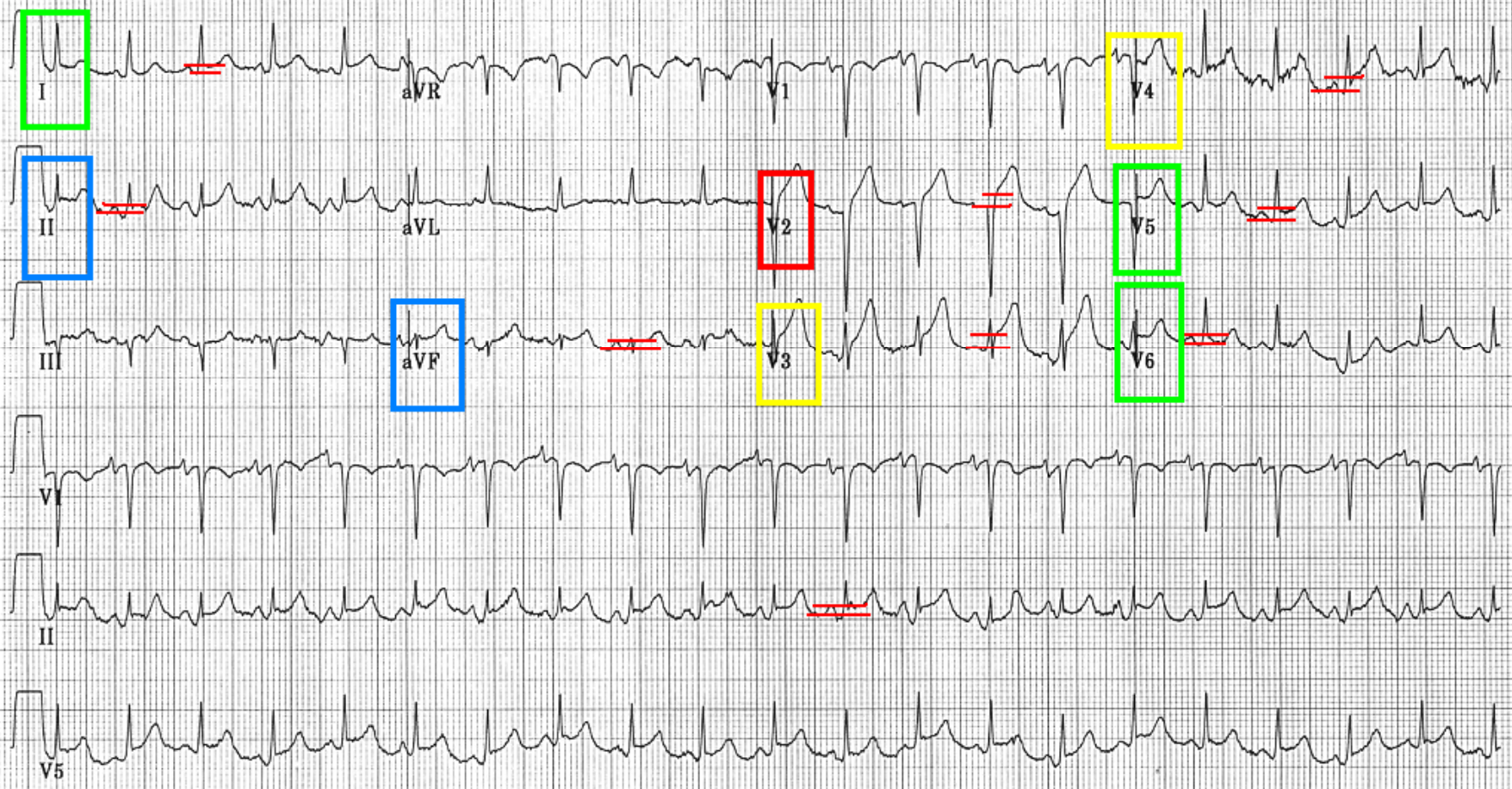
Sinus tachycardia
Acute pericarditis
Abnormal ECG

Technician: EKG CLASS #WR03999999

- DIFFUSE S-T ELEVATION MULTIPLE LEADS
- DEPRESSED P-R SEG. LD II
- ELEVATED P-R SEG. AVR

Referred by: Reviewed by:

D.O.S.:



40 Hz .0 mm/s 10.0 mm/mV 2.5s + 3 rhythm lds MACVU 002C v250

-- EKG ALERT --

- DIFFERENTIATION OF PERICARDITIS vs. EARLY REPOLARIZATION BASED ON EKG ALONE CAN BE DIFFICULT AND MISLEADING.

- THE NEXT TWO EKGs ARE FROM THE SAME ASYMPTOMATIC HEALTHY YOUNG MALE, TAKEN ON DIFFERENT DATES . . .

01–FEB–2001 05:55:51 ST. JOSEPH'S HOSPITAL–IN1464 ROUTINE RETRIEVAL

36 yr		Vent. rate	59	BPM
Male	Caucasian	PR interval	150	ms
		QRS duration	88	ms
Room:312		QT/QTc	362/358	ms
Loc:5	Option:28	P–R–T axes	75 58	66

Sinus bradycardia with marked sinus arrhythmia

Early repolarization

Otherwise normal ECG

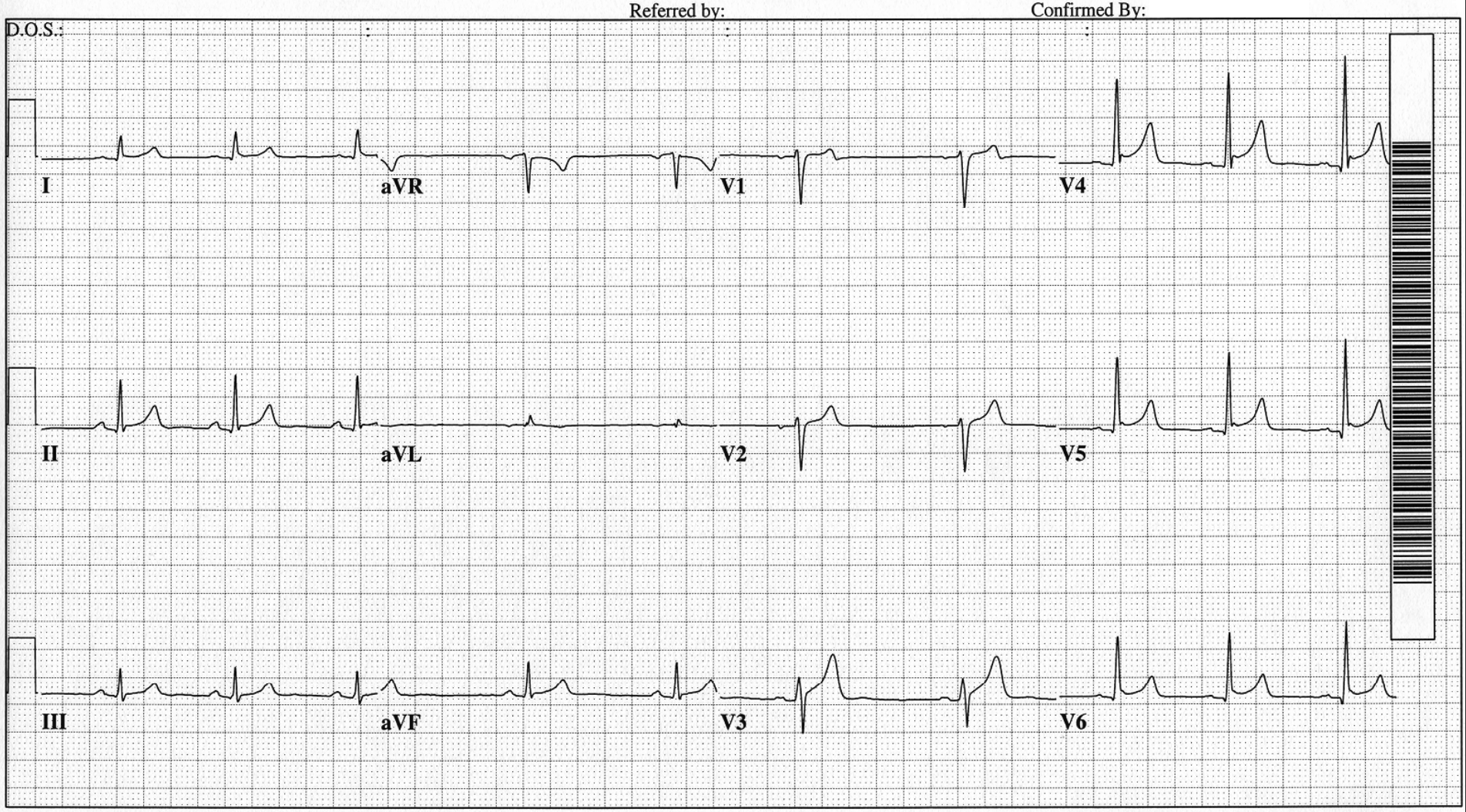
When compared with ECG of 31–JAN–2001 06:57 (UNCONFIRMED),

No significant change was found

EKG CLASS #WR03778819B

Referred by: Confirmed By:

D.O.S.:



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

EID:13 EDT: 21:17 01–FEB–2001 ORDER:

30–MAY–2000 06:42:02 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

36 yr		Vent. rate	64	BPM
Male	Caucasian	PR interval	144	ms
		QRS duration	86	ms
Room:ER		QT/QTc	348/359	ms
Loc:3	Option:23	P–R–T axes	75 49	62

Normal sinus rhythm with marked sinus arrhythmia

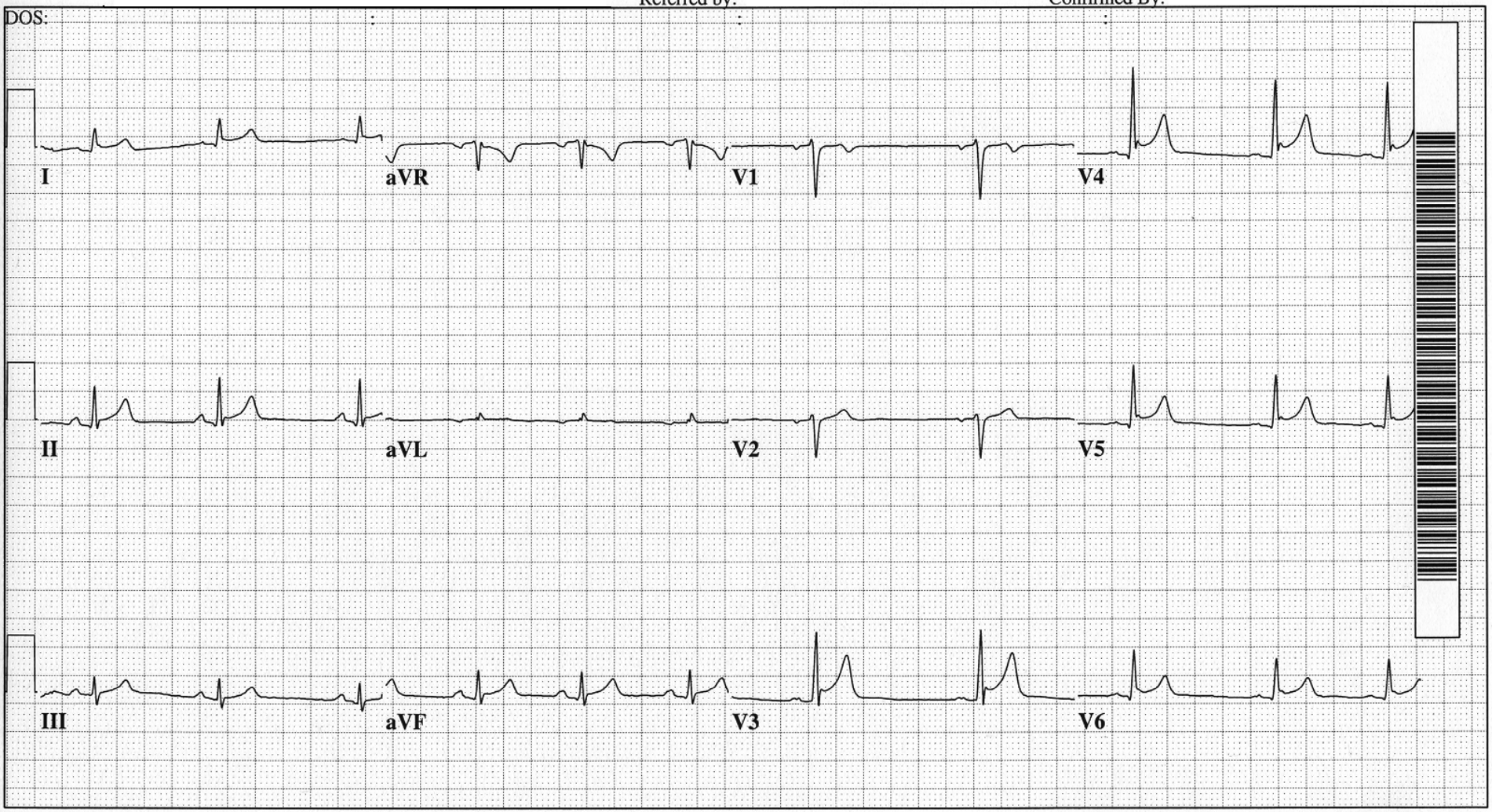
Possible Acute pericarditis

Abnormal ECG
When compared with ECG of 30–MAY–2000 04:48 (UNCONFIRMED),
No significant change was found

EKG CLASS WR#03778819A

Referred by: Confirmed By:

DOS:



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

EID:17 EDT: 08:39 31–MAY–2000 ORDER:

PERICARDITIS vs. EARLY REPOLARIZATION

DIFFERENTIAL DIAGNOSIS

PERICARDITIS

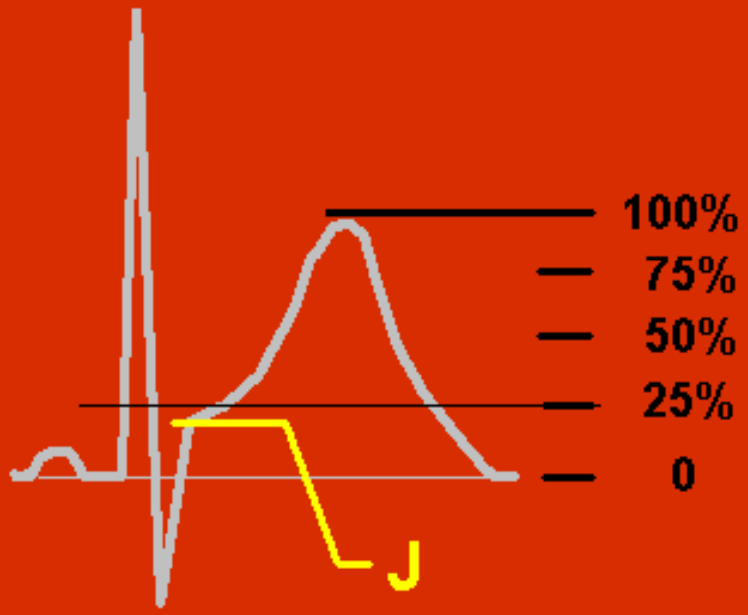
- Recent FLU or VIRAL infection
- Complaint of Chest Pain
- HS=Friction Rub

EARLY REPOLARIZATION

- No Hx of recent illness.
- No chest- related complaints
- Normal Heart Sounds

EARLY REPOLARIZATION vs. PERICARDITIS

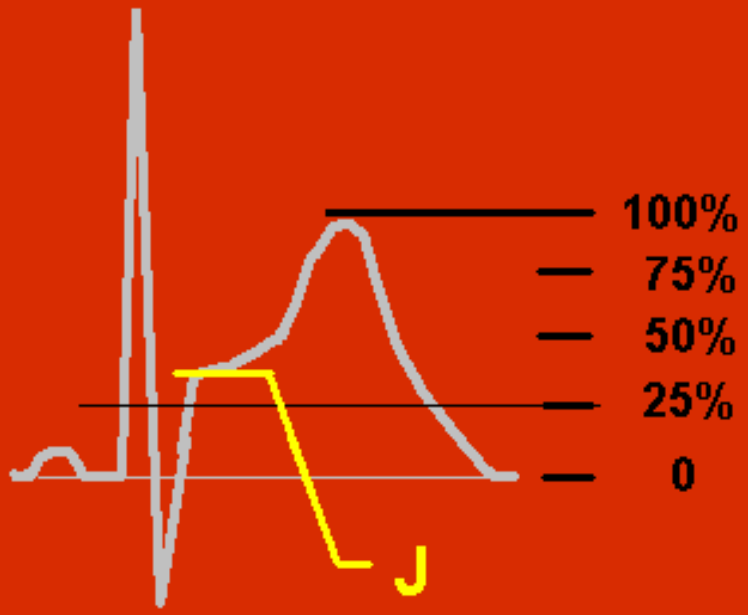
* S-T : T RATIO in LEAD V6:



LESS THAN 0.25

FAVORS

EARLY REPOLARIZATION



MORE THAN 0.25

FAVORS

PERICARDITIS

* ACCORDING TO: "CARDIOLOGY" the HOUSE OFFICER SERIES, PUBLISHED BY WILLIAMS AND WILKENS, 1998

THE CARDIOMYOPATHIES

CARDIOMYOPATHY -

DAMAGE or DEATH OF CARDIAC MUSCLE CELLS, USUALLY THE RESULT OF A PATHOLOGICAL PROCESS, RESULTING IN A GLOBAL DECREASE OF VENTRICULAR FUNCTION.

THE CARDIOMYOPATHIES

ETIOLOGY (NON-ISCHEMIC):

- IDIOPATHIC
- INFECTIOUS
- AUTOIMMUNE
- GENETIC
- ALCOHOLIC / TOXIC
- CARDIOVASCULAR DISEASE / CHRONIC HYPERTENSION

THE CARDIOMYOPATHIES

INFECTIOUS ETIOLOGIES:

VIRAL:

- COXSACKIE A & B
- ECHO
- INFLUENZA
- POLIO
- HERPES
- ADENOVIRUS
- MUMPS
- RUBELLA / RUBEOLA
- HEPATITIS B & C
- HIV

SPIROCHETAL:

- LYME'S DISEASE

BACTERIAL:

- SALMONELLA
- LEGIONELLA
- CLOSTRIDIUM

RICKETTSIAL

FUNGAL:

- CRYPTOCOCCUS

PROTOZOAN:

- TOXOPLASMOSIS GONDI
- TYPANOSOMIASIS CRUZI

THE CARDIOMYOPATHIES

SPECTRUM OF CLINICAL PRESENTATIONS:

- WEAKNESS
- DYSPNEA (often exertional)
- CONGESTIVE HEART FAILURE
- ANGINA / CHEST DISCOMFORT
- MIMIC ACUTE MI
- SYMPTOMS OF PERICARDITIS
- CONGESTIVE HEART FAILURE
- PALPITATIONS
- SUDDEN DEATH

THE CARDIOMYOPATHIES

EKG FINDINGS MAY INCLUDE:

- PERCARDITIS CHANGES
- CHAMBER HYPERTROPHY (A / V)
- Q / QS COMPLEXES
- POOR R WAVE PROGRESSION
- AV NODAL / BBB (LBBB common)
- ATRIAL FIBRILLATION
- VENTRICULAR COMPLEXES

THE CARDIOMYOPATHIES

EKG FINDINGS, con't:

- Normal EKG

- ACUTE MI (S-T ELEVATION > 1mm IN TWO or more consecutive leads)

THE CARDIOMYOPATHIES

CASE STUDY: 19 y/o Female presents to ER via EMS, C/O shortness of breath. Her skin is pale, clammy, and diaphoretic. EMS states they found her lethargic, with a BP of 66/38. Her O2 SAT was 79. They placed her on O2 15 LPM via NRB mask, and started IV NS KVO, then bolused her with a 250cc fluid challenge. Currently she is awake, C/O DIB, weakness and nausea. She's "had the flu" for the last 10 days.

THE CARDIOMYOPATHIES

CASE STUDY: PHYSICAL EXAM reveals JVD, BBS= Coarse Crackles in bases and mid fields, rales in the upper fields. Pt is becoming increasingly anxious by the minute, C/O increased DIB. Her family states she has been "too weak to get out of bed for the last few days." Repeat BP = 56 / 30, HR = 134, R = 36, SAO2 = 88% on 15 LPM O2 via NRB.

YOUR COURSE OF ACTION IS ?

ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

19 yr
Female

Room:CR
Loc:3 Option:23

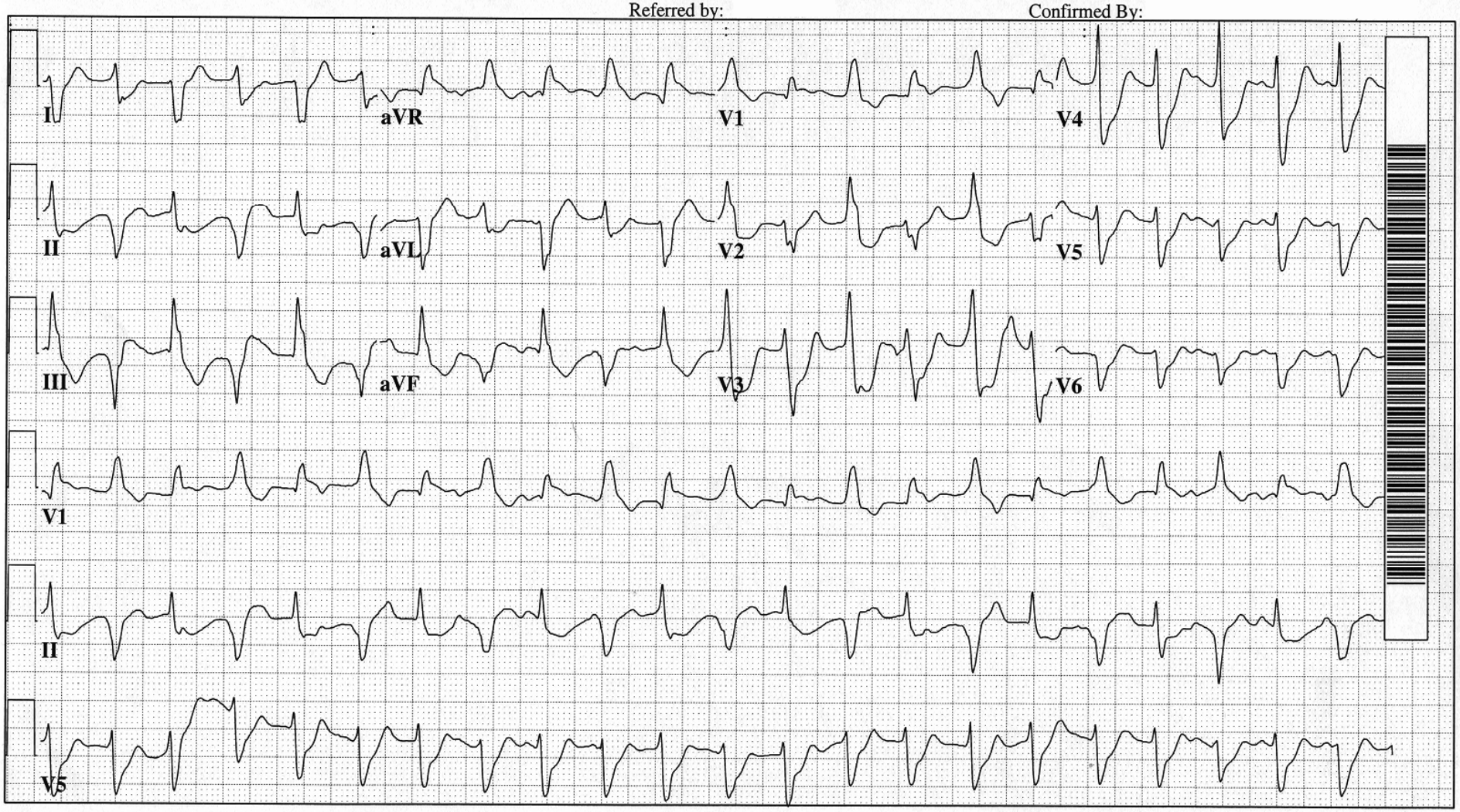
Vent. rate	131	BPM
PR interval	240	ms
QRS duration	130	ms
QT/QTc	304/448	ms
P–R–T axes	–31 –99	103

**UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION
Unusual P axis, possible ectopic atrial tachycardia with 1st degree A–V block
Right bundle branch block
Possible Lateral infarct , age undetermined
Inferior infarct , age undetermined
Abnormal ECG
No previous ECGs available

EKG CLASS #WR03883506

Referred by:

Confirmed By:



25mm/s 10mm/mV 40Hz 005C 12SL 250 CID: 11

THE CARDIOMYOPATHIES

EKG FINDINGS MAY INCLUDE:

- A NORMAL EKG
- PERCARDITIS CHANGES
- CHAMBER HYPERTROPHY (A / V)
- Q / QS COMPLEXES
- POOR R WAVE PROGRESSION
- AV NODAL / BBB (LBBB common)
- ATRIAL FIBRILLATION
- VENTRICULAR COMPLEXES

ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

19 yr
Female

Room:CR
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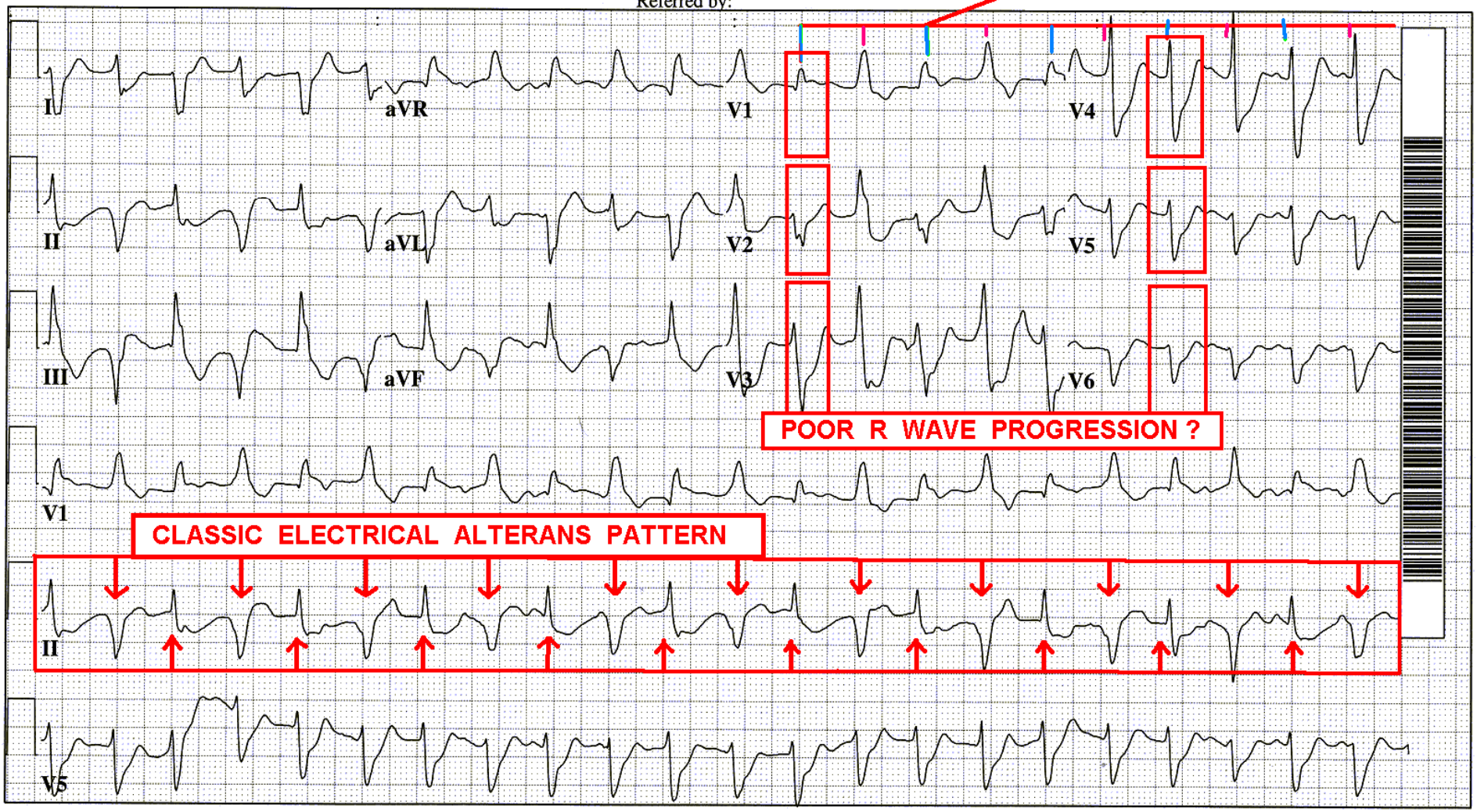
**UNEDITED COPY
PHYSICIAN INTERPRETATION
possible ectopic atrial tachycardia
1st degree A–V block
Right bundle branch block
Possible ~~Lateral infarct~~, age undetermined
~~Inferior infarct~~, age undetermined
Abnormal ECG
No previous ECGs available
Referred by:

EKG CLASS #WR03883506

CARDIOMYOPATHY FINDINGS:

- AV BLOCK (1rst DEGREE)
- WIDE QRS / BUNDLE BRANCH BLOCK
- Q and QS COMPLEXES
- ELECTRICAL ALTERANS



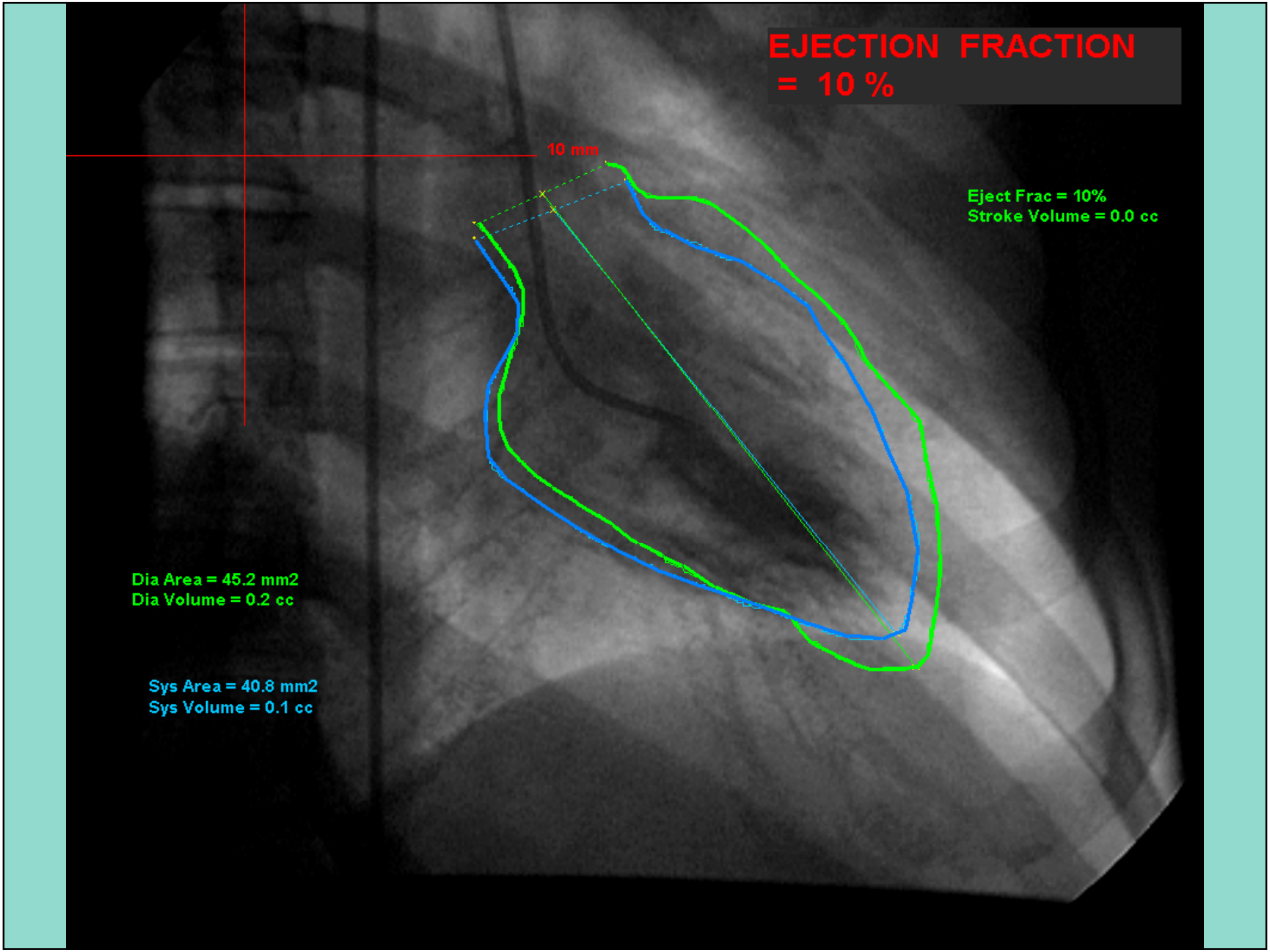
25mm/s 10mm/mV 40Hz 005C 12SL 250 CID: 11

THE CARDIOMYOPATHIES

CASE STUDY :

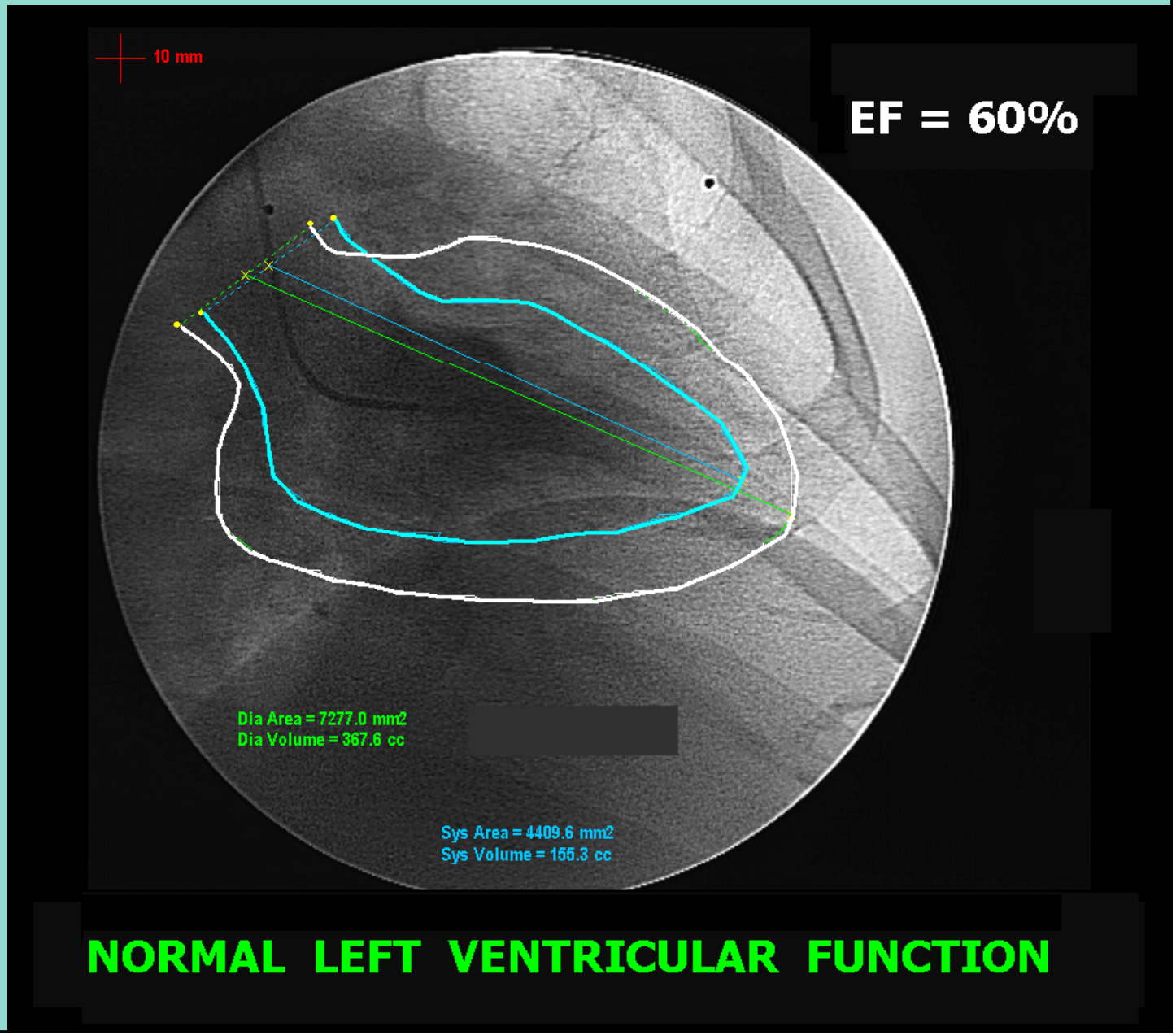
STAT ECHOCARDIOGRAM REVEALED
GLOBAL HYPOKINESIS, EF < 20%.
NO PERICARDIAL EFFUSION NOTED.
NO VALVULAR DYSFUNCTION NOTED.

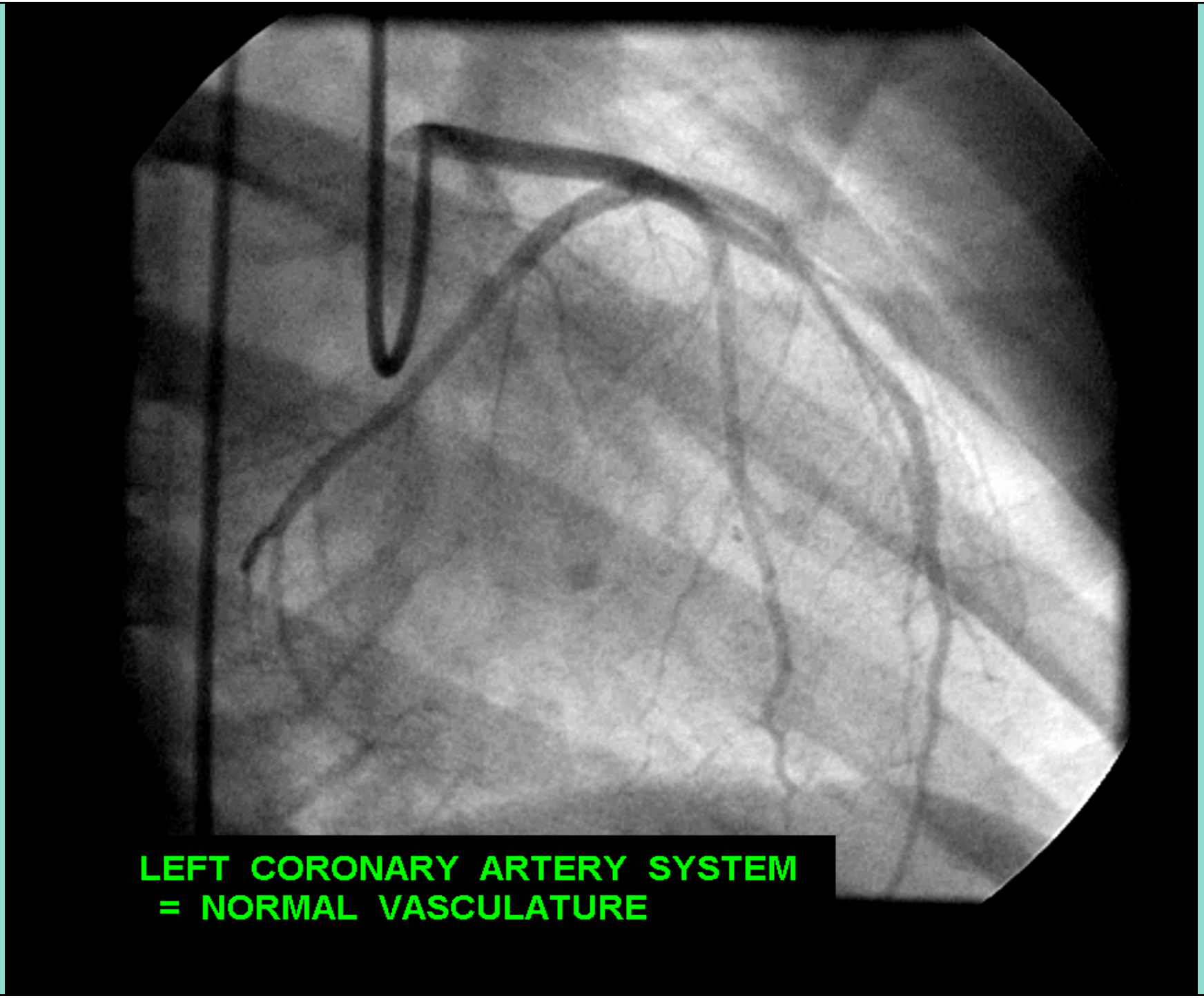
NEXT COURSE OF ACTION ?

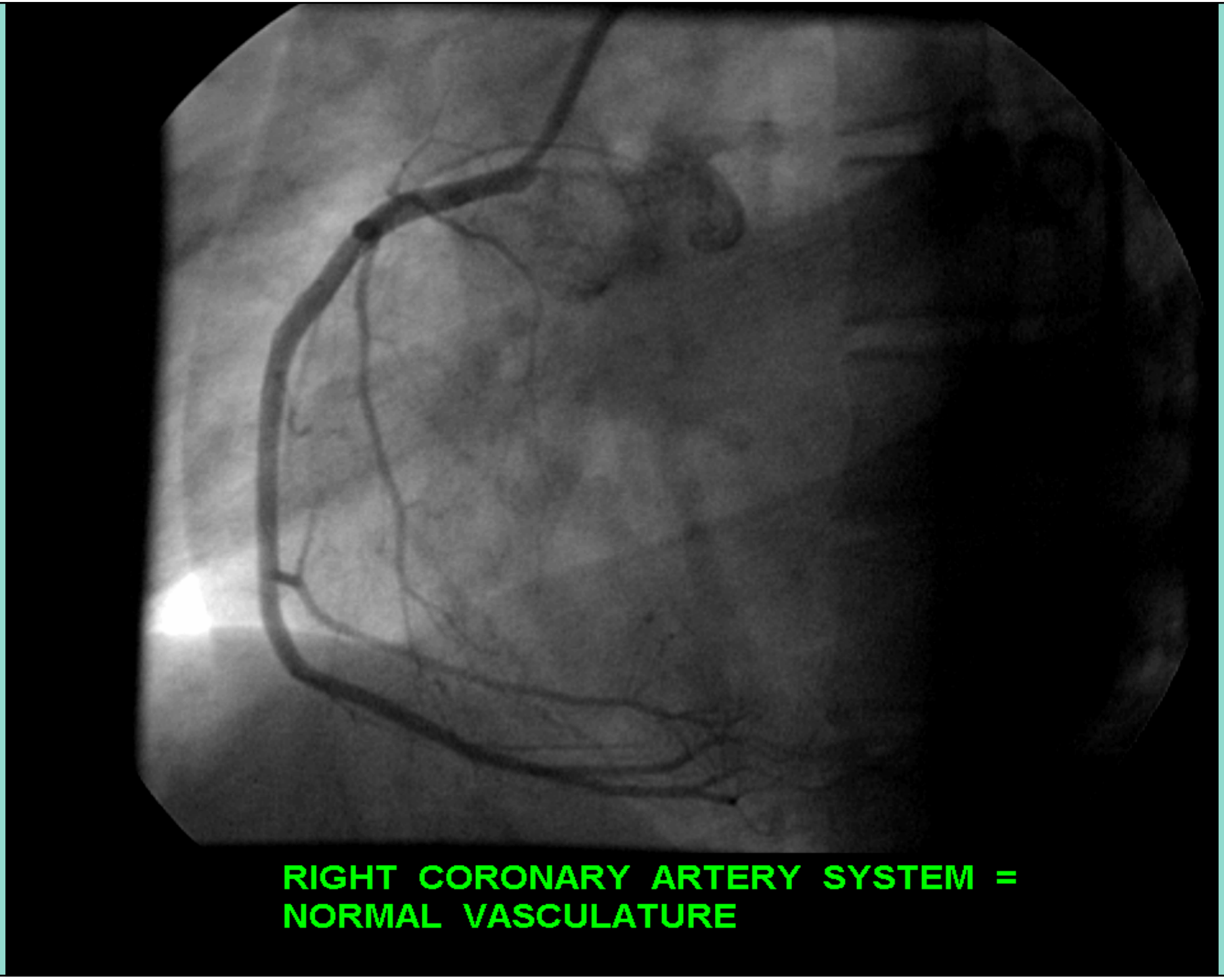

EJECTION FRACTION
= 10 %
10 mm
Eject Frac = 10%
Stroke Volume = 0.0 cc
Dia Area = 45.2 mm2
Dia Volume = 0.2 cc
Sys Area = 40.8 mm2
Sys Volume = 0.1 cc

NORMAL EJECTION FRACTION =

55 - 70%




LEFT CORONARY ARTERY SYSTEM
= NORMAL VASCULATURE


RIGHT CORONARY ARTERY SYSTEM =
NORMAL VASCULATURE

THE CARDIOMYOPATHIES

CASE STUDY :

IABP INSERTED DURING CARDIAC CATH.

STAT TRANSFER TO REGIONAL CARDIAC TRANSPLANT FACILITY ORDERED.

PATIENT EXPERIENCED VENTRICULAR TACHYCARDIA and IRREVERSIBLE V-FIB BEFORE HELICOPTER ARRIVAL.

CARDIAC VALVE DISORDERS
Such as:

- AORTIC STENOSIS
- MITRAL STENOSIS

- AORTIC REGURGITATION
- MITRAL REGURGITATION

result in CHAMBER HYPERTROPHY on the 12 lead ECG.

When ECG Indicators of CHAMBER HYPERTROPHY Are present on the 12 Lead ECG, An ECHOCARDIOGRAM should Be obtained and evaluated to:

- **CONFIRM HYPERTROPHY**
- **DETERMINE ETIOLOGY** (VALVULAR STENOSIS / VALVULAR REGURGITATION vs other etiology) **. . . .**

CHAMBER ENLARGEMENT

SYSTOLIC OVERLOAD

A CONDITION WHERE THE HEART MUST OVERCOME UNUSUAL RESISTANCE TO EJECT BLOOD. THIS RESULTS IN MUSCLE THICKENING, or HYPERTROPHY.

- VALVULAR STENOSIS
- SYSTEMIC HYPERTENSION
- PULMONARY HYPERTENSION
- CONGENITAL ABNORMALITIES

CHAMBER ENLARGEMENT

DIASTOLIC OVERLOAD

A CONDITION WHERE DURING DIASTOLE, THE CHAMBER IS OVER-ENGORGED BY EXCESSIVE BLOOD VOLUME. THIS RESULTS IN "STRETCHING" or DILATION OF THE CHAMBER.

- VALVULAR REGURGITATION
- FLUID VOLUME OVERLOAD

CHAMBER ENLARGEMENT

EKG CHANGES

INCREASE IN CHAMBER SIZE and/or MASS RESULTS IN AN INCREASE IN AMPLITUDE and/or TIME IN ORDER TO ACHIEVE DEPOLARIZATION.

SIMPLY PUT, THE EKG WAVEFORMS ARE BIGGER AND LONGER THAN NORMAL IN CHAMBER ENLARGEMENT.

CHAMBER ENLARGEMENT

ATRIAL ENLARGEMENT

- IF THE P-WAVE IS TOO HIGH IN LEAD II, WE SUSPECT RIGHT ATRIAL ENLARGEMENT.

- IF THE P-WAVE IS TOO LONG IN LEAD II, WE SUSPECT LEFT ATRIAL ENLARGEMENT.

CHAMBER ENLARGEMENT

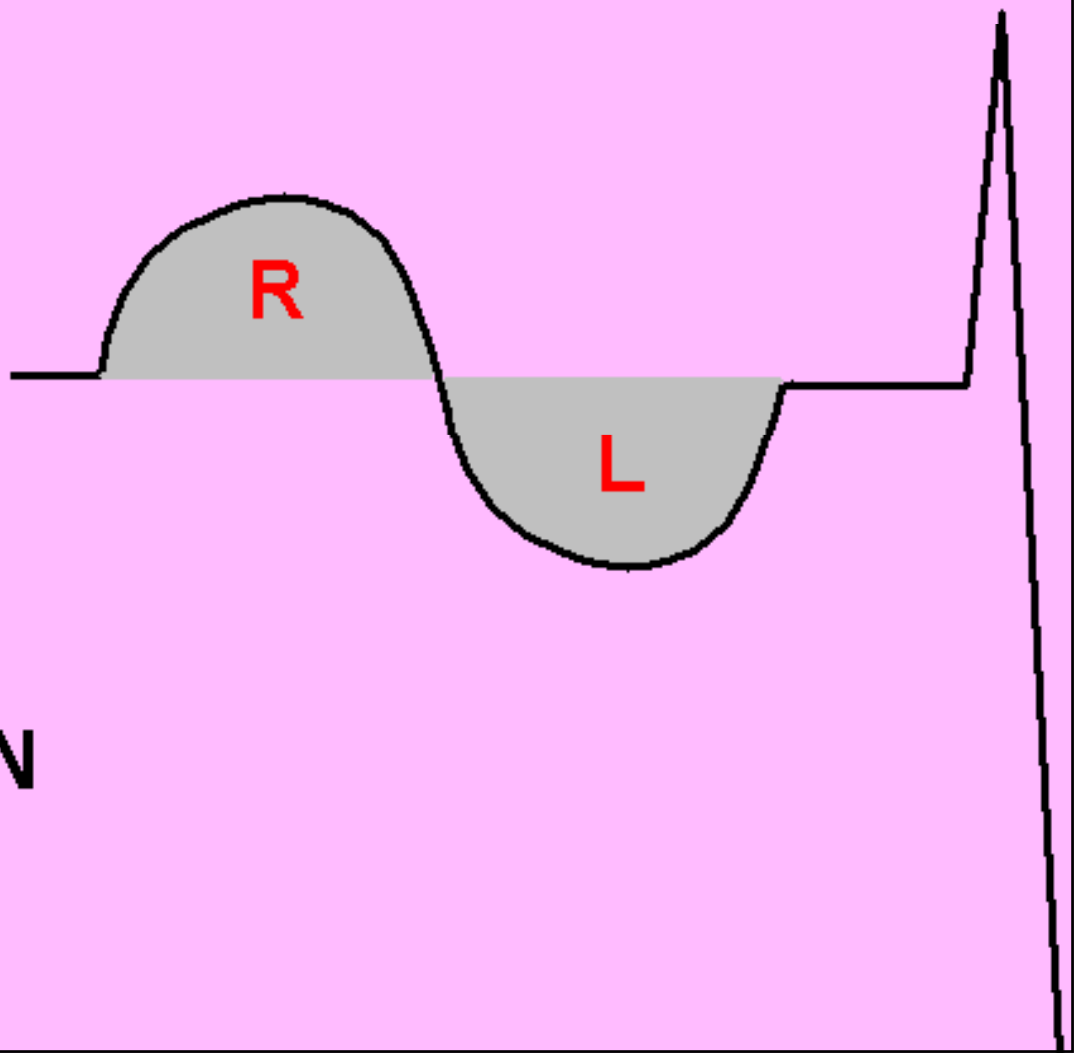
ATRIAL ENLARGEMENT

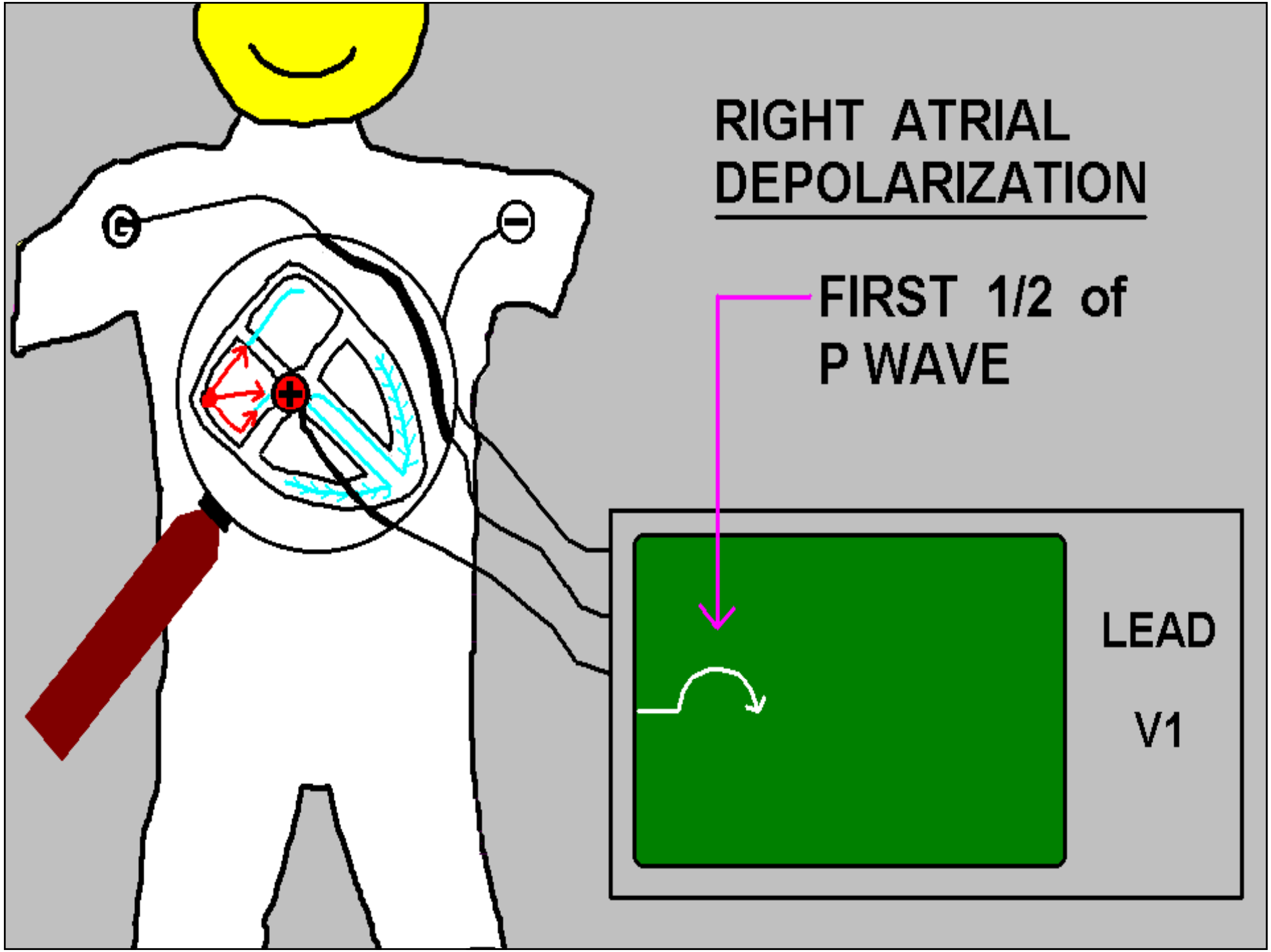
- P-WAVES THAT ARE "POINTY" IN LEAD II (as opposed to rounded) . FAVOR RIGHT ATRIAL ENLARGEMENT

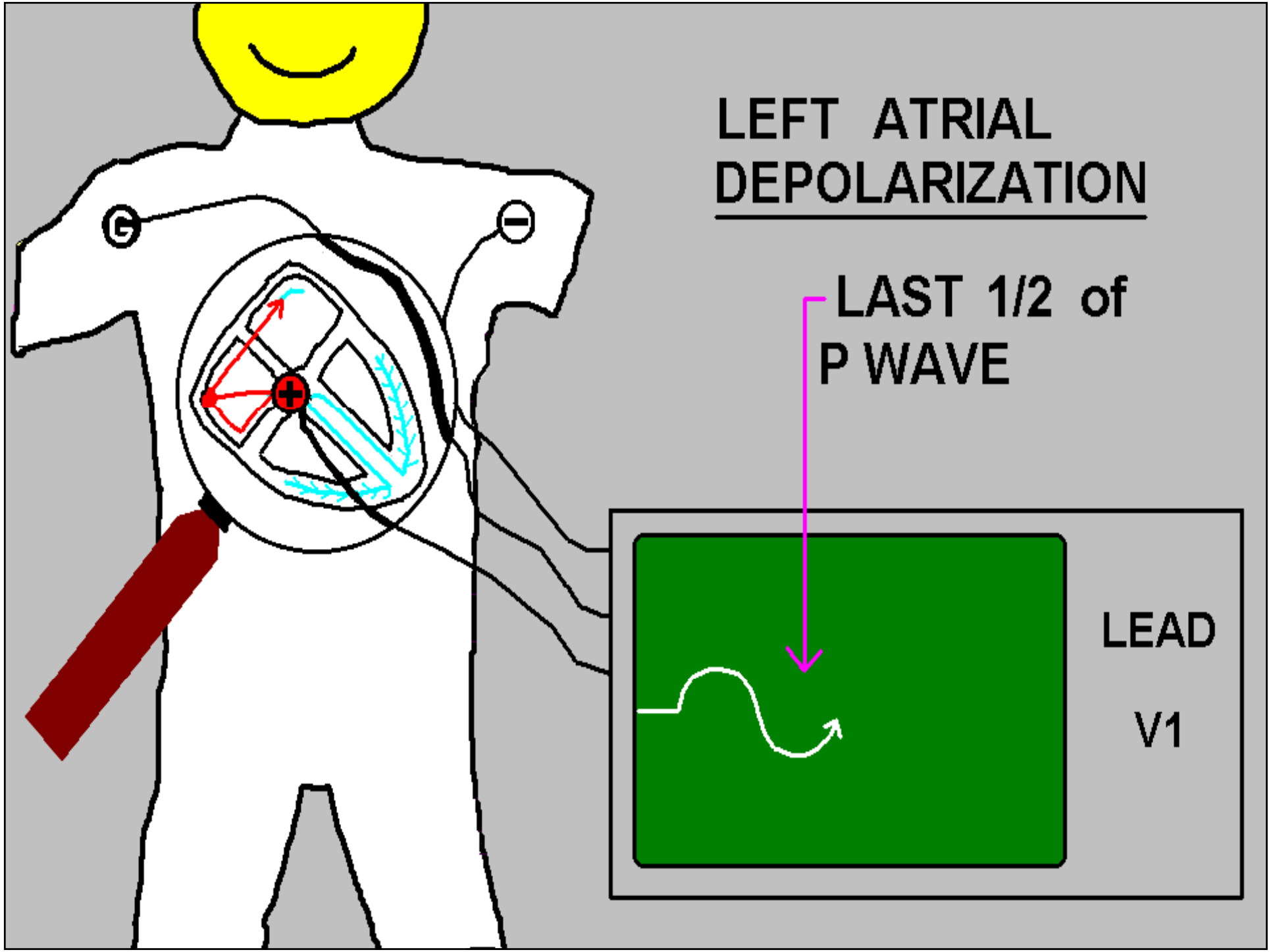
- P-WAVES THAT LOOK LIKE THE LETTER " M " FAVOR LEFT ATRIAL ENLARGEMENT

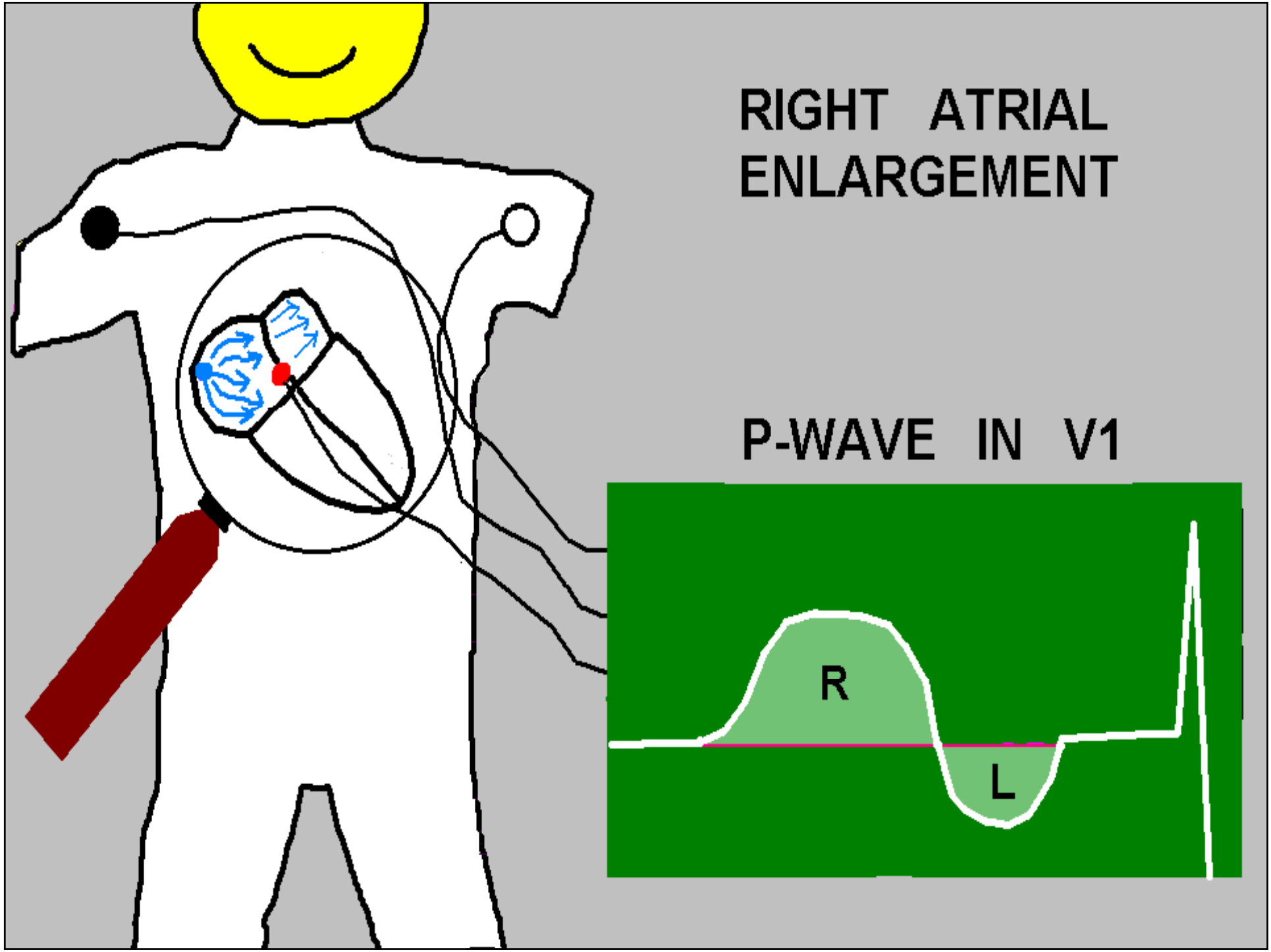
THE P WAVE

- 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
LEAD
V1


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


RIGHT ATRIAL ENLARGEMENT
P-WAVE IN V1
R
L

02–DEC–1998 00:24:45 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

29 yr
Male Black

Room:ER
Loc:3 Option:28

Vent. rate	107	BPM
PR interval	132	ms
QRS duration	80	ms
QT/QTc	310/413	ms
P–R–T axes	67 105	–32

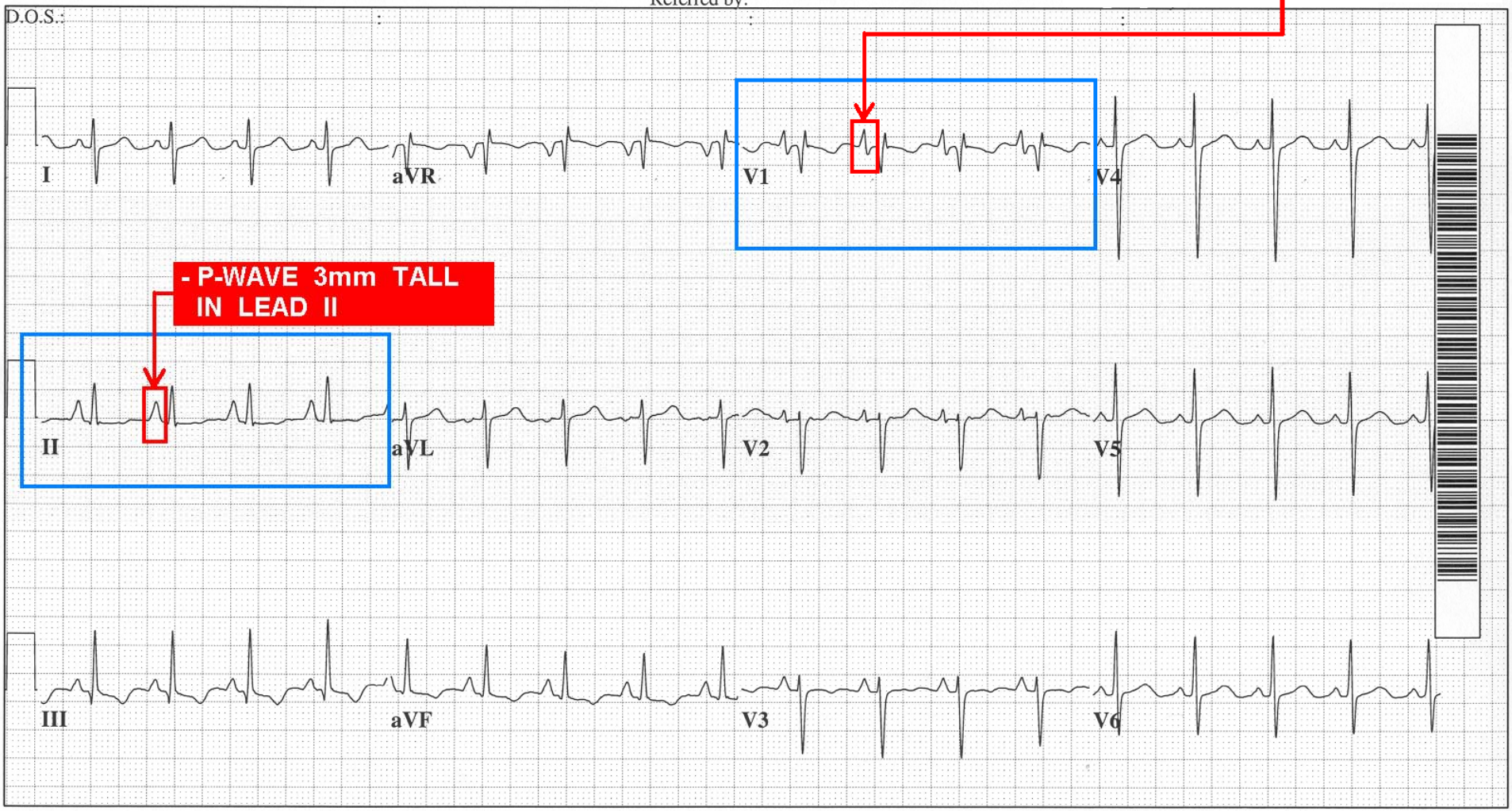
EKG CLASS #WR03446043

Sinus tachycardia
Right atrial enlargement
Rightward axis
Pulmonary disease pattern
RSR' or QR pattern in V1 suggests right ventricular
T wave abnormality, consider inferior ischemia
Abnormal ECG
When compared with ECG of 01–OCT–1998 21:45
T wave inversion more evident in Inferior leads ...

Referred by:

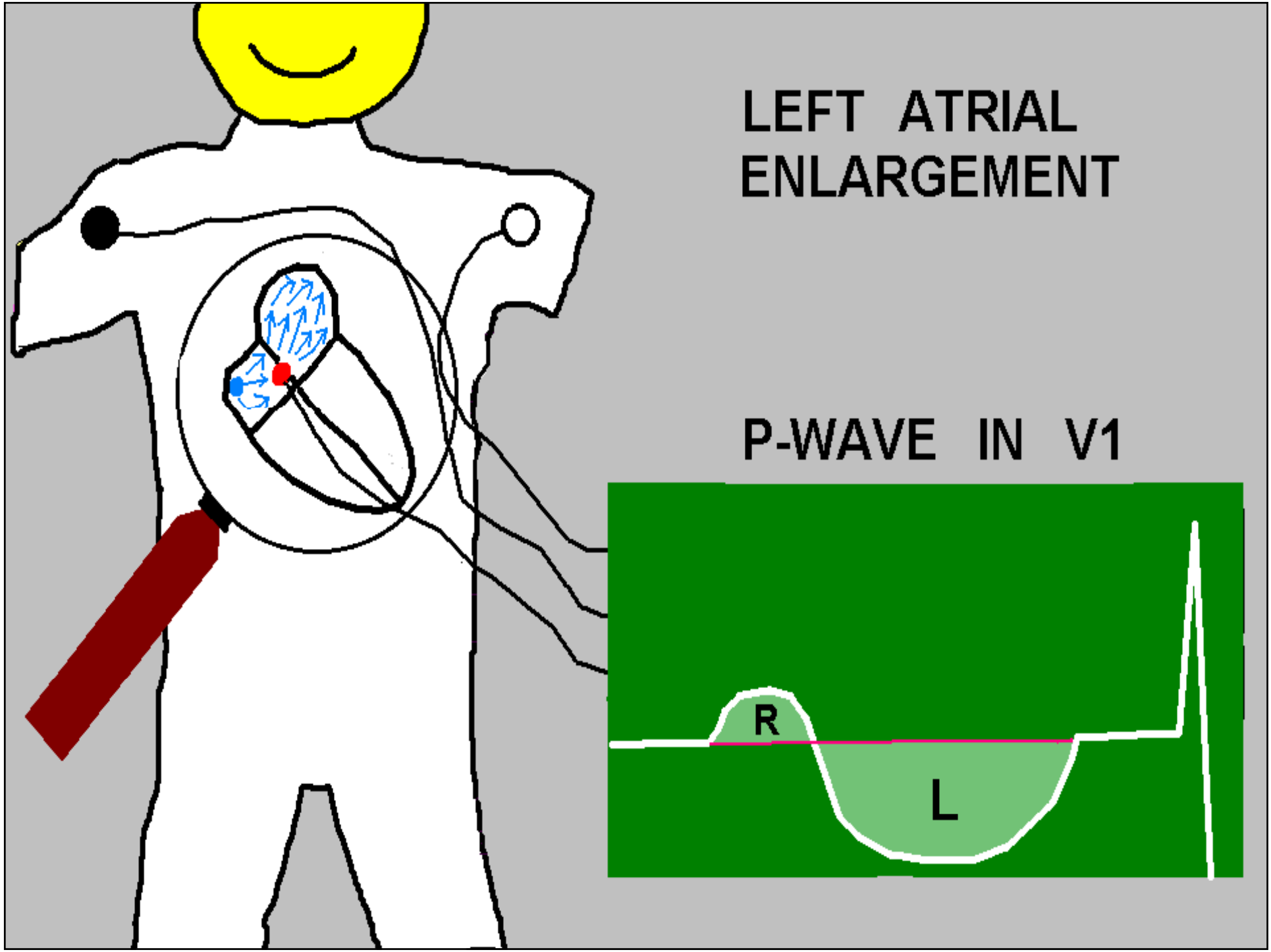
- POSITIVE DEFLECTION TALLER (more dominant) IN LEAD V1

- P-WAVE 3mm TALL IN LEAD II



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

EID:17 EDT: 07:28 02–DEC–1998 ORDER:


LEFT ATRIAL
ENLARGEMENT
P-WAVE IN V1
R
L

01–MAY–1998 03:09:15 ST. JOSEPH'S HOSPITAL–ER ROUTINE RETRIEVAL

77 yr
Male Caucasian

Room:S 1
Loc:3 Option:10

Vent. rate	106	BPM
PR interval	170	ms
QRS duration	104	ms
QT/QTc	374/496	ms
P–R–T axes	67 –66	70

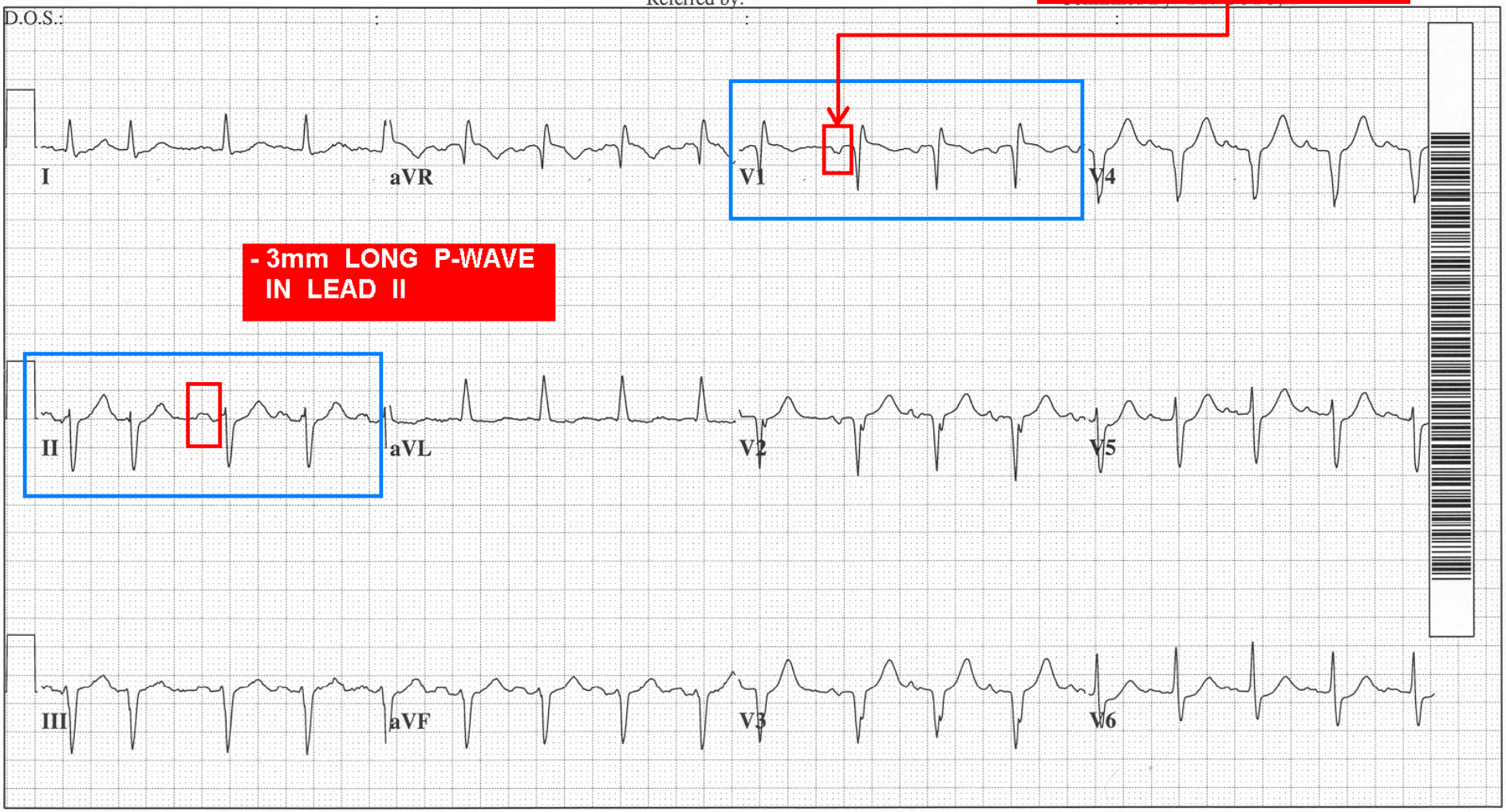
Sinus tachycardia with occasional Premature supraventricular complexes
Left atrial enlargement
Left axis deviation
Incomplete right bundle branch block
Anteroseptal infarct , age undetermined
Abnormal ECG
No previous ECGs available

EKG CLASS #WR03651849

Referred by:

- NEGATIVE DEFLECTION P-WAVE IN LEAD V1

- 3mm LONG P-WAVE IN LEAD II



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

EID:17 EDT: 14:12 02–MAY–1998 ORDER:

CHAMBER ENLARGEMENT

VENTRICULAR ENLARGEMENT

	I	V1
NORMAL		
LVH		
RVH		
LVH & RVH		

CHAMBER ENLARGEMENT

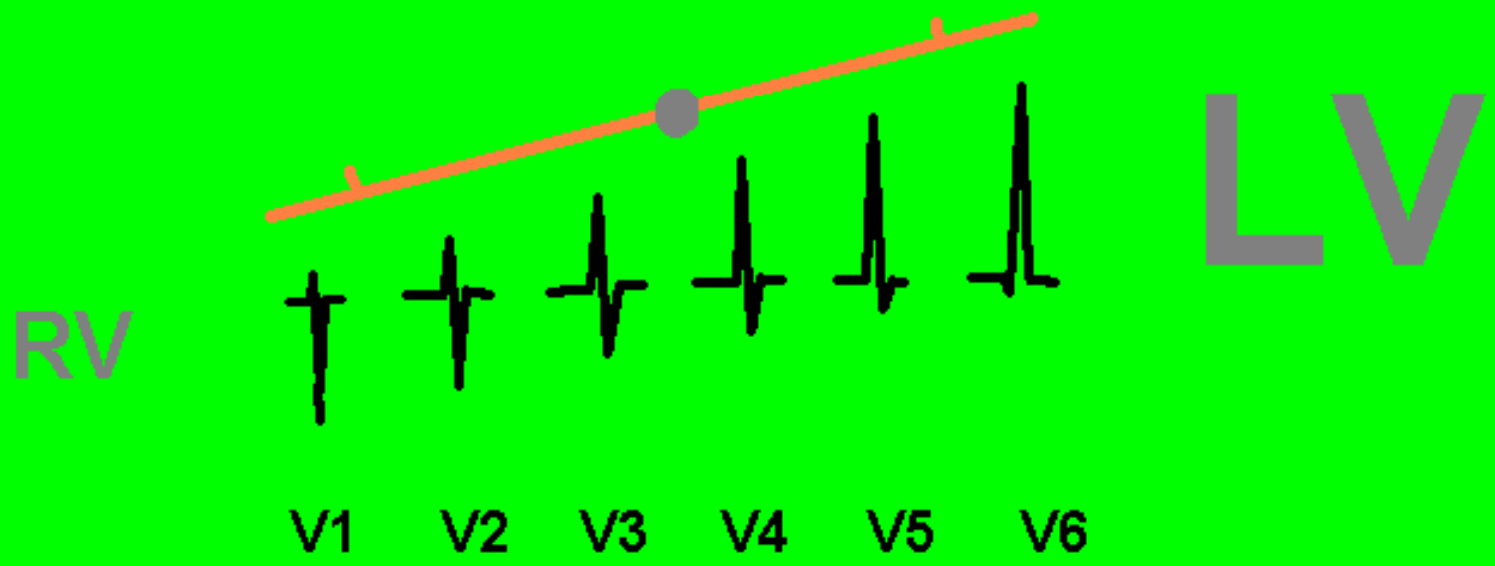
VENTRICULAR ENLARGEMENT

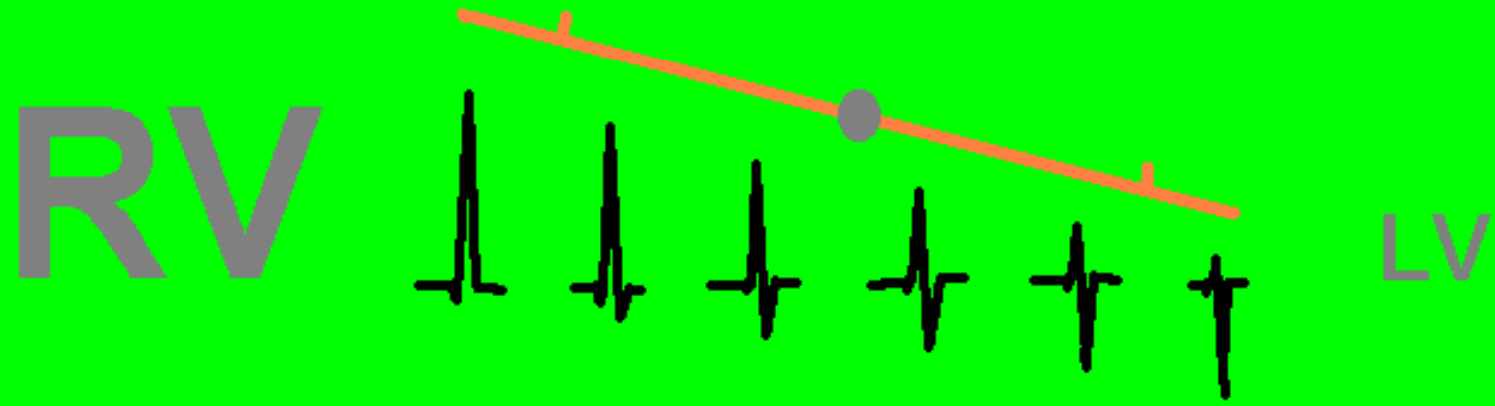
IMPORTANT NOTE !!

ENLARGEMENT OF THE RIGHT OR LEFT VENTRICLE IS FREQUENTLY ACCOMPANIED BY ENLARGEMENT OF THE CORRESPONDING ATRIUM !

- ***THIS MAY BE A HELPFUL CLUE IN DIAGNOSING THE EKG !***

"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

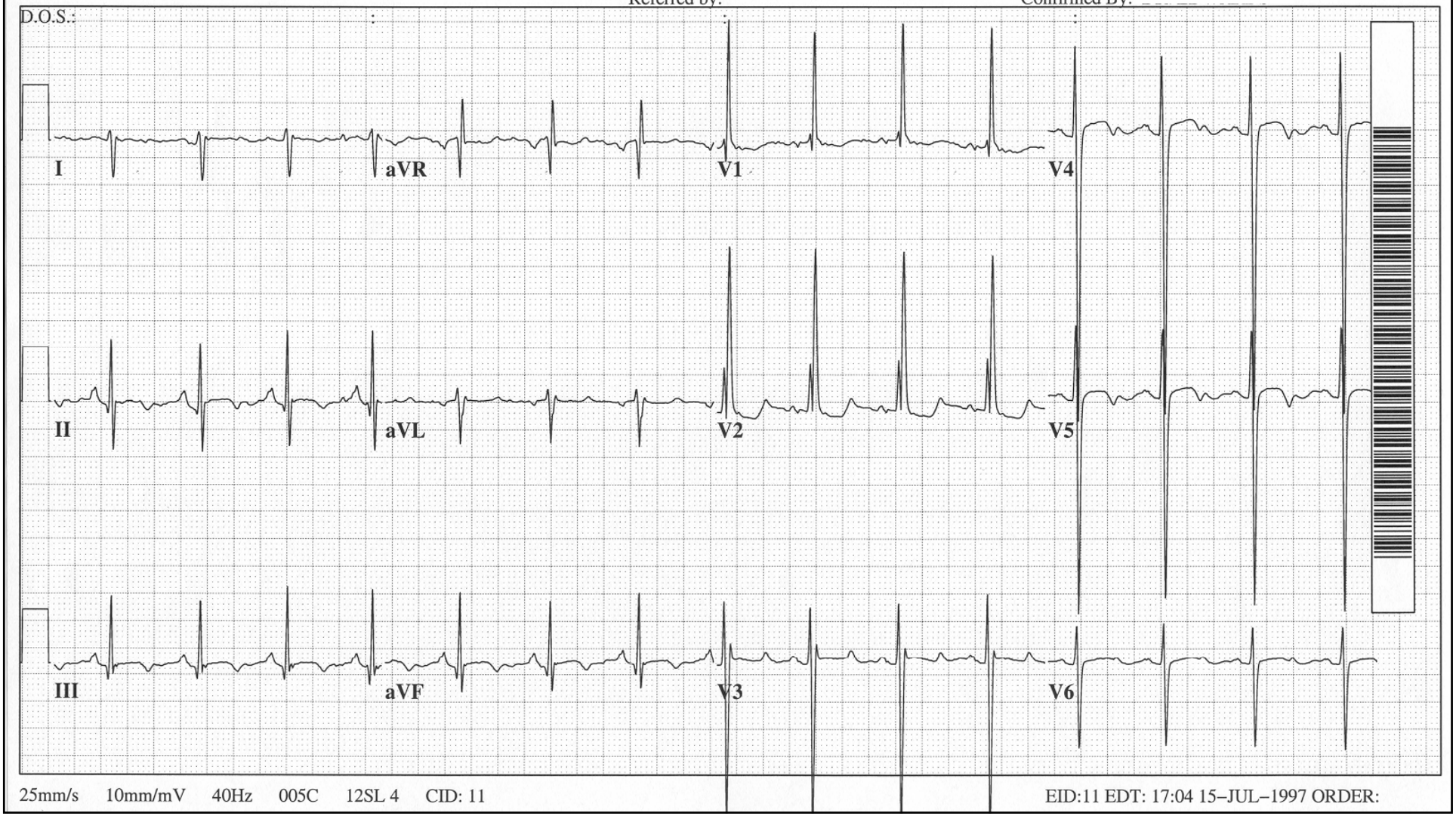
Vent. rate	90	BPM
PR interval	136	ms
QRS duration	94	ms
QT/QTc	378/462	ms
P–R–T axes	77 123	58

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

EKG CLASS #WRO3616941

Referred by: Confirmed By: _____

D.O.S.:



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

EID:11 EDT: 17:04 15–JUL–1997 ORDER:

19-JUN-1997 22:28:08 ST. JOSEPH'S HOSPITAL-ER ROUTINE RETRIEVAL

53 yr
Male Caucasian

Room:ER S3
Loc:3 Option:18

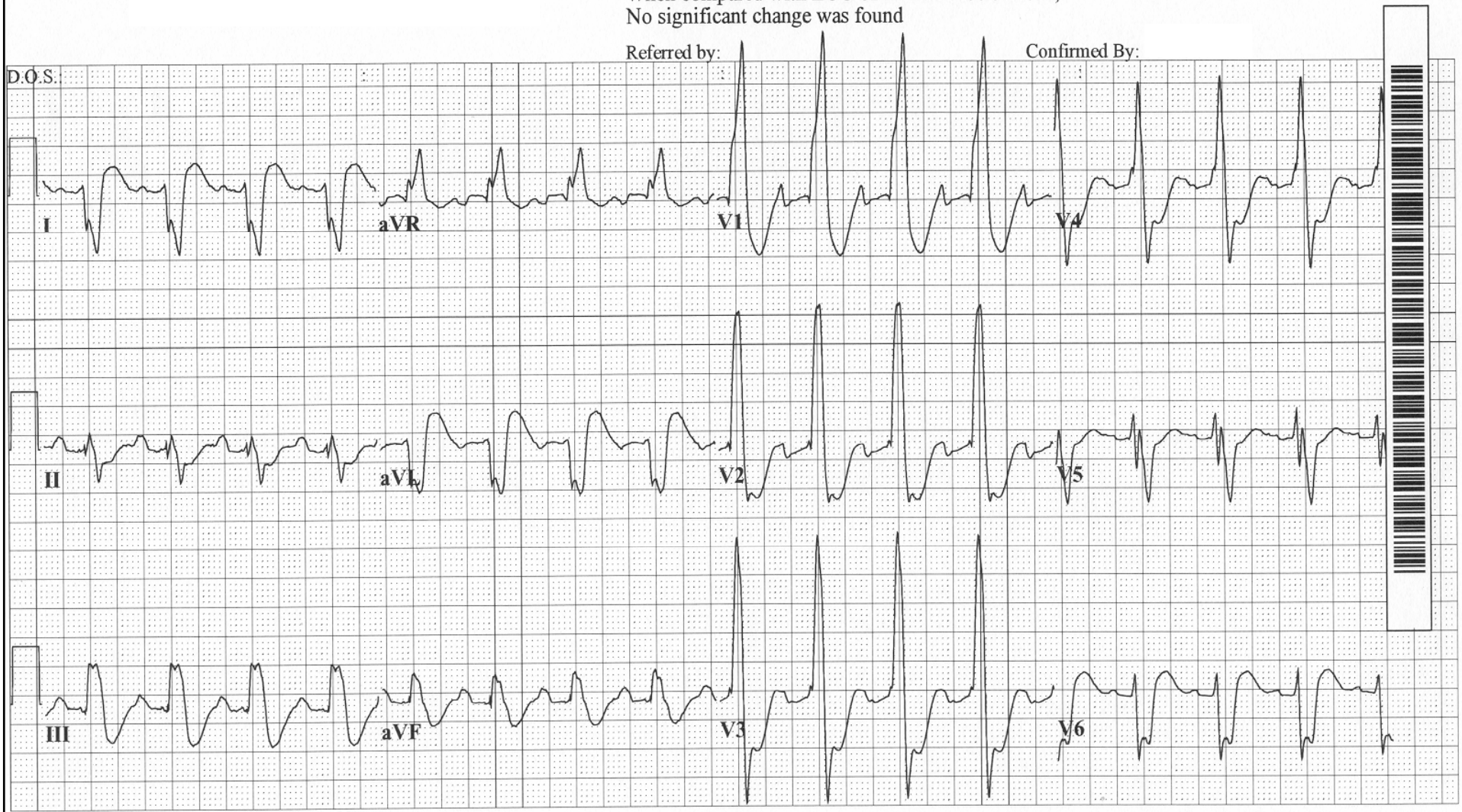
Vent. rate	100	BPM
PR interval	198	ms
QRS duration	186	ms
QT/QTc	380/490	ms
P-R-T axes	79 163 -20	

Normal sinus rhythm
Left atrial enlargement
Right bundle branch block , plus right ventricular hypertrophy
Left posterior fascicular block
*** Bifascicular block ***
NONSPECIFIC ST CHANGES
Abnormal ECG
When compared with ECG of 21-APR-1996 11:44,
No significant change was found

EKG CLASS #WR03028722

Referred by: Confirmed By:

D.O.S.:



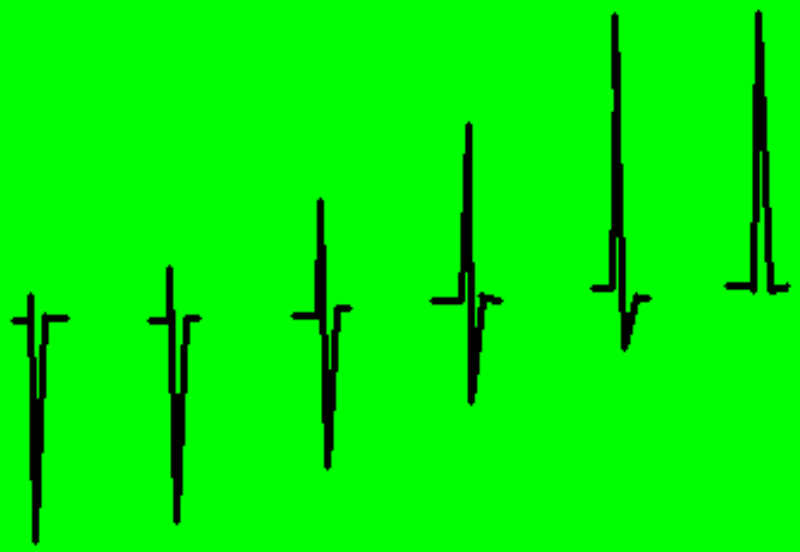
25mm/s 10mm/mV 40Hz 005C 12SL 4 CID: 10

EID:13 EDT: 23:01 20-JUN-1997 ORDER:

"EXAGGERATED" QRS SIZE in V leads FROM LEFT VENTRICULAR HYPERTROPHY

NORMAL

V1 V2 V3 V4 V5 V6



LVH

18–NOV–2002 02:15:46 ST. JOSEPH'S HOSPITAL–ER 1ST PREVIOUS

53 yr
Male Black

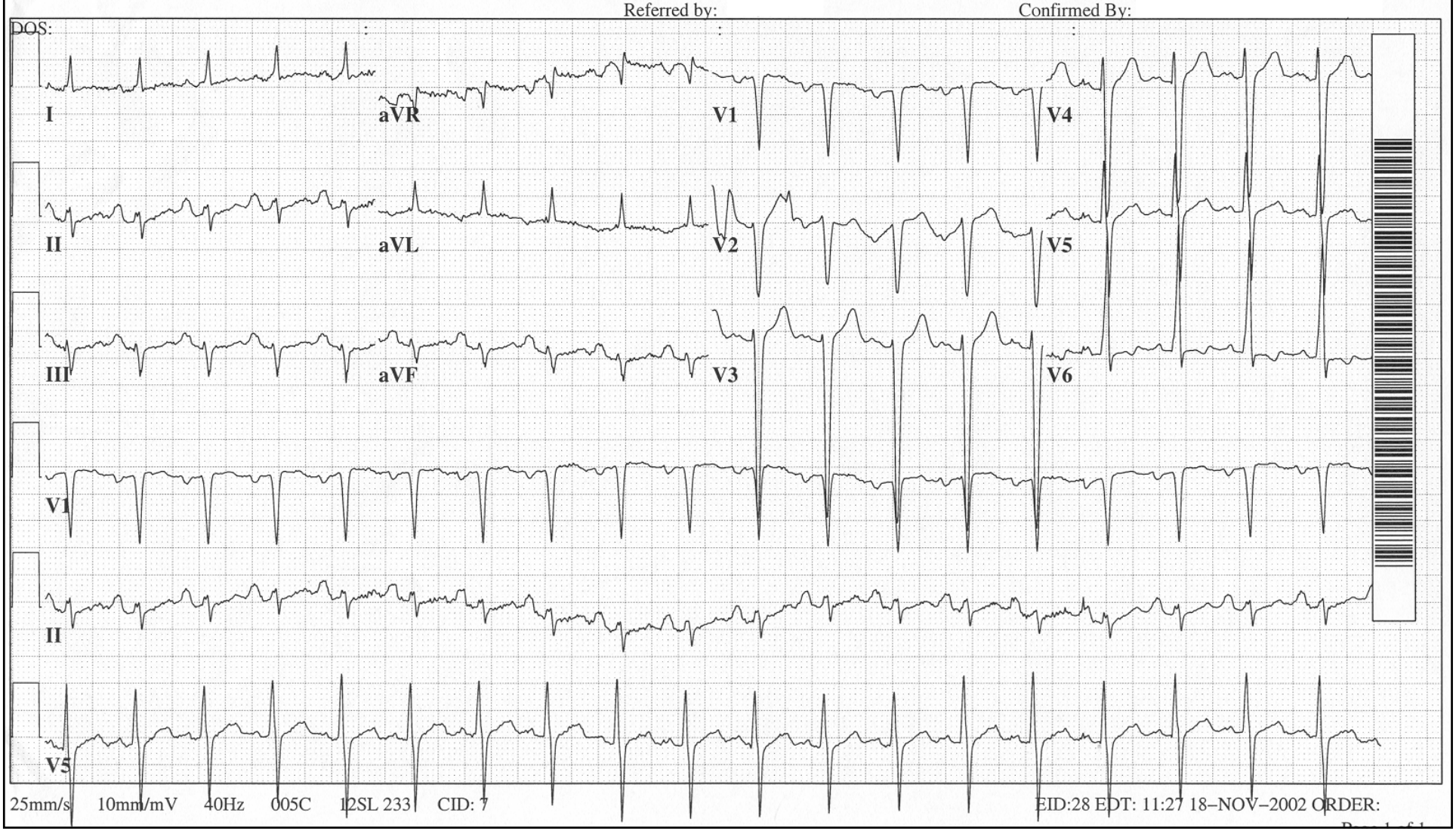
Room:ER
Loc:3 Option:23

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

**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

Referred by: Confirmed By:

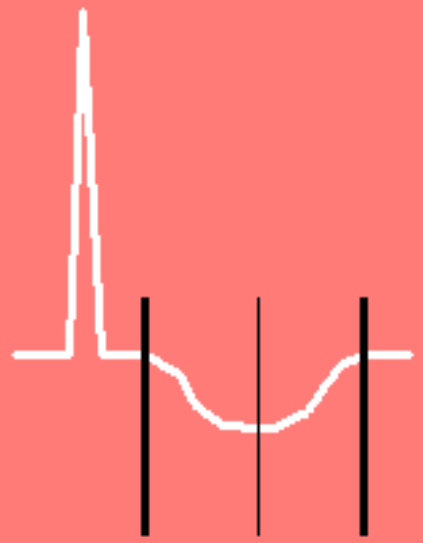


25mm/s 10mm/mV 40Hz 005C 12SL 233 CID: 7 EID:28 EDT: 11:27 18–NOV–2002 ORDER:

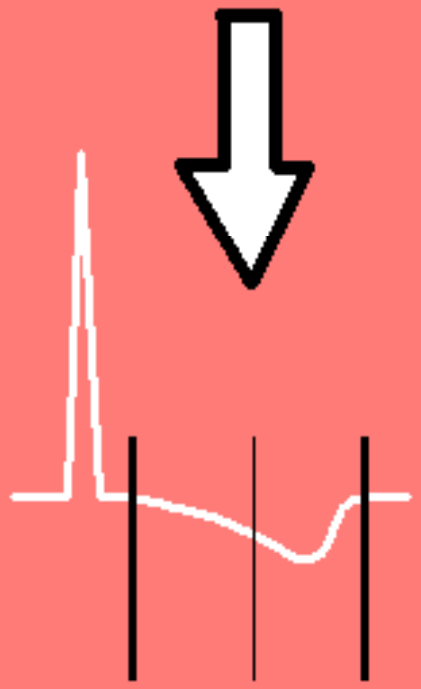
CHAMBER ENLARGEMENT

VENTRICULAR STRAIN PATTERNS

T-WAVES ARE INVERTED
and ASYMMETRICAL



symmetrical

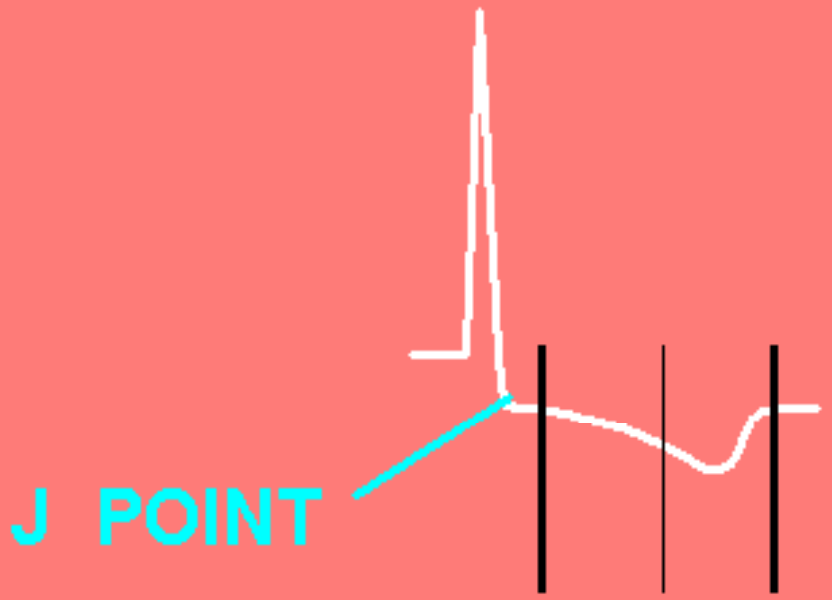


asymmetrical

CHAMBER ENLARGEMENT

VENTRICULAR STRAIN PATTERNS

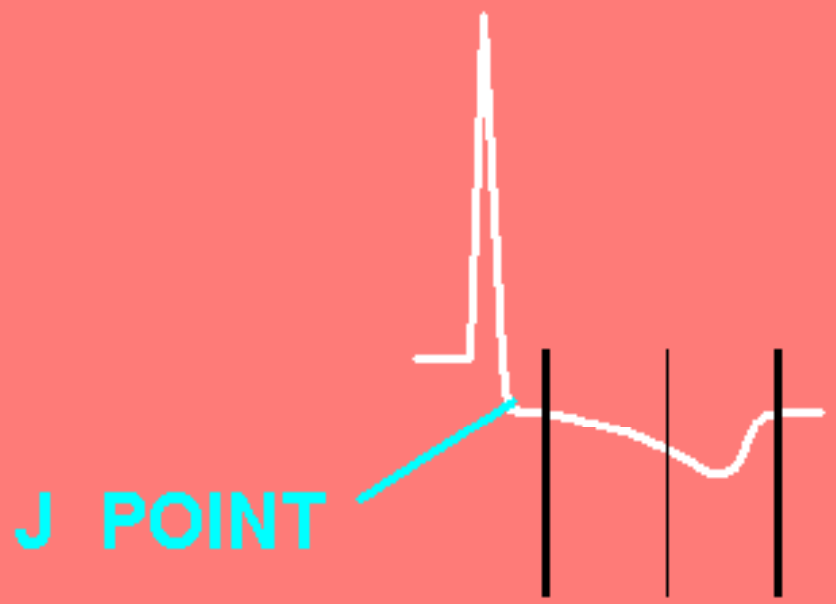
- T WAVES ARE INVERTED AND ASMMETRICAL
- THERE MAY BE S-T SEGMENT DEPRESSION



CHAMBER ENLARGEMENT

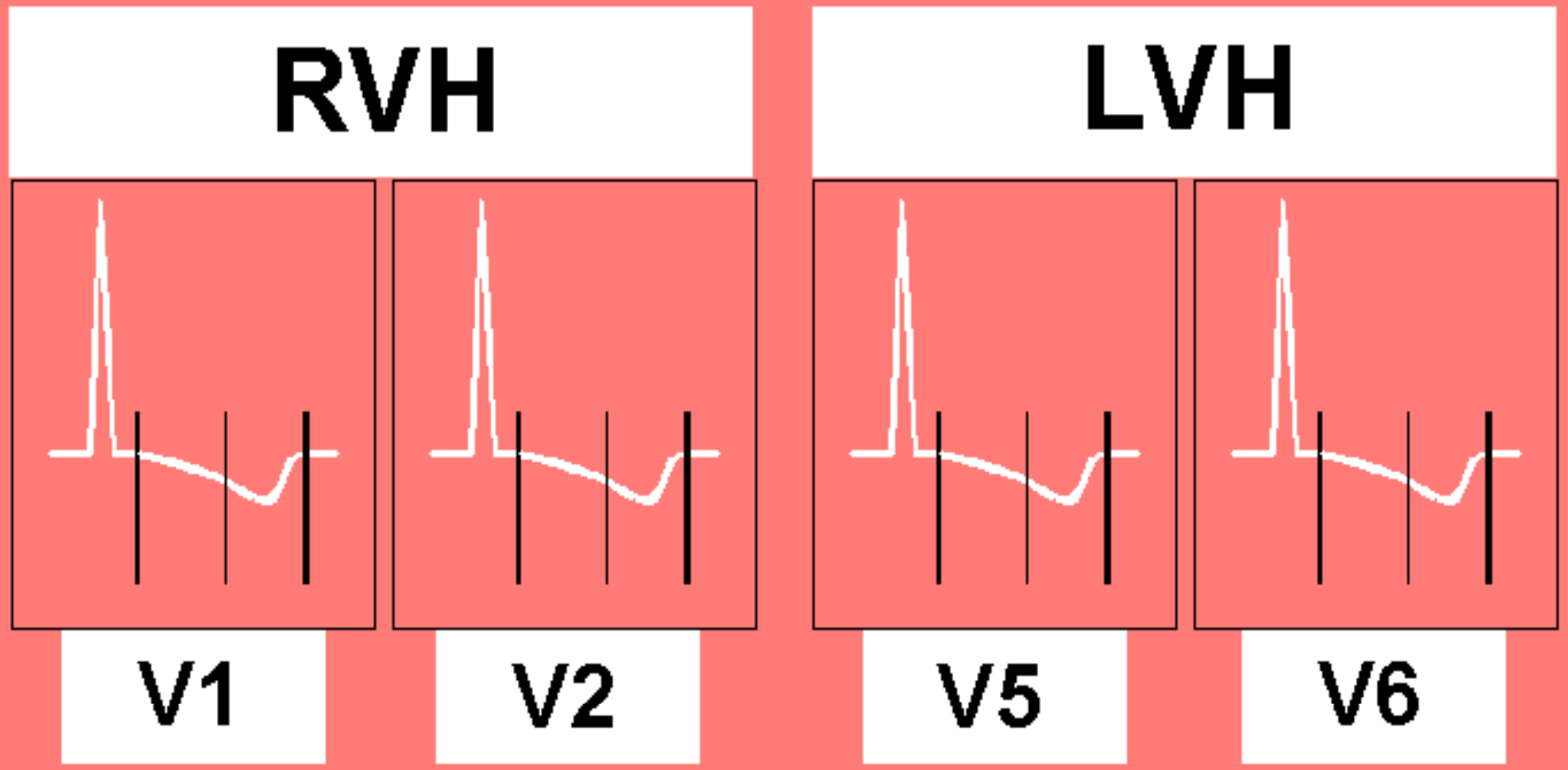
VENTRICULAR STRAIN PATTERNS

STRAIN PATTERNS ARE INDICATIVE OF SYSTOLIC OVERLOAD -- THE VENTRICLES HAVING TO OVERCOME GREAT FORCE TO EXPEL BLOOD.



CHAMBER ENLARGEMENT

VENTRICULAR STRAIN PATTERNS



CHAMBER ENLARGEMENT

VENTRICULAR ENLARGEMENT

I USE SEVERAL TECHNIQUES FOR IDENTIFYING RIGHT AND LEFT VENTRICULAR HYPERTROPHY.

1. AXIS OF LEAD I and V1
2. PRESENCE OF ATRIAL HYPERTROPHY
3. R-WAVE PROGRESSION OF V LEADS
4. STRAIN PATTERN OF T WAVES IN V1 - V2 and V5 - V6
5. MATHEMATICAL FORMULAS

CHAMBER ENLARGEMENT

*MATHEMATICAL FORMULAS FOR DETERMINING LVH and RVH

LVH

- R-WAVE V1 + S-WAVE LEAD III > 25mm
- R-WAVE V5 or V6 > 26mm
- S-WAVE V1 + R-WAVE V5 or V6 > 35mm
- LARGEST R-WAVE + LARGEST S-WAVE in V-LEADS > 45mm

RVH

- R-WAVE V1 + S-WAVE V5 or V6 > 10.5mm
- rSR' in V1 where R' ≥ 10mm

* THIS IS A PARTIAL LIST.

10–APR–2003 11:49:36 ST. JOSEPH'S HOSPITAL–CCR ROUTINE RETRIEVAL

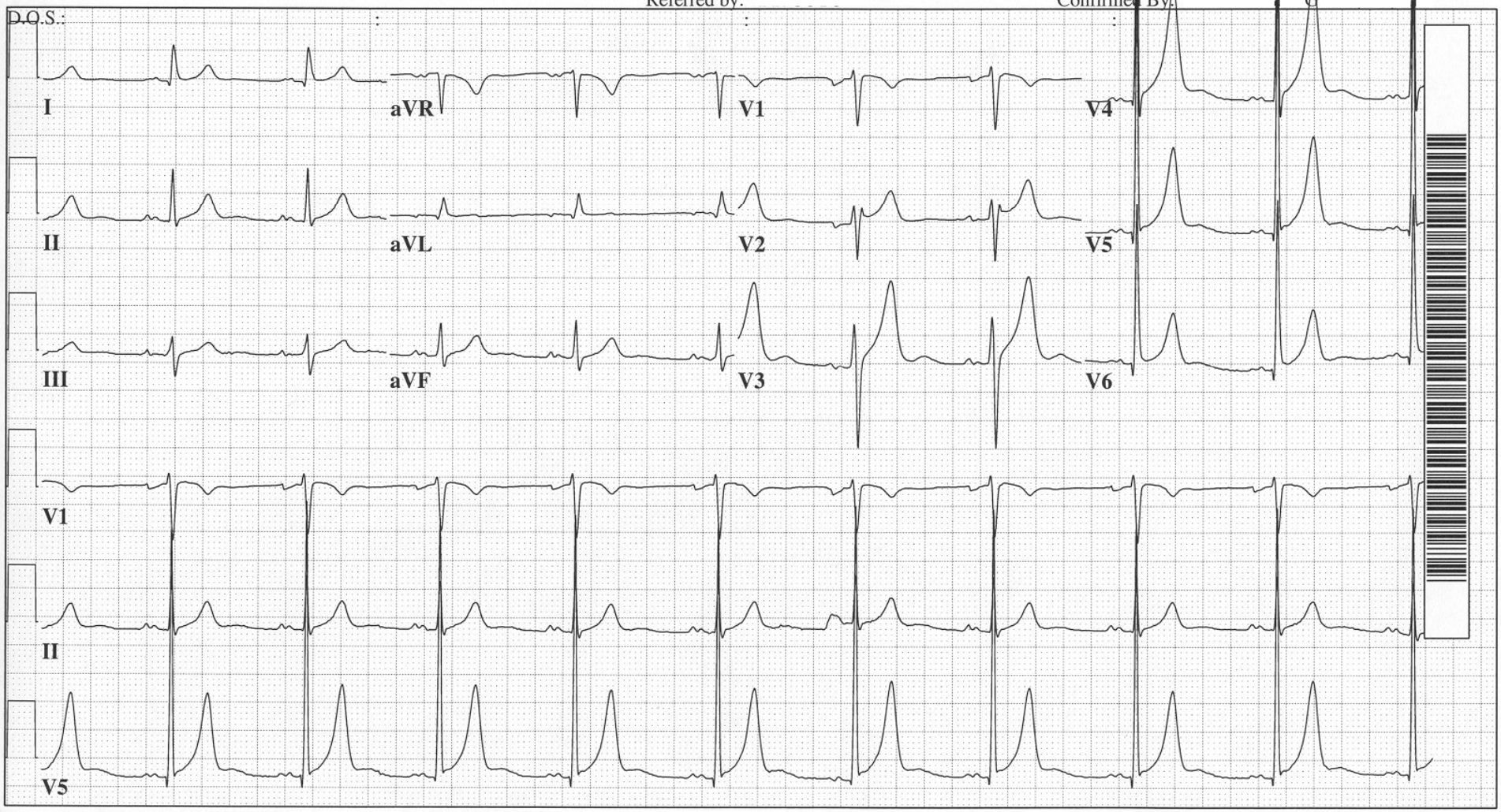
61 yr		Vent. rate	60	BPM
Male	Black	PR interval	176	ms
		QRS duration	90	ms
		QT/QTc	400/400	ms
Loc:7	Option:35	P–R–T axes	62 33	60

Normal sinus rhythm
Voltage criteria for left ventricular hypertrophy
Abnormal ECG
When compared with ECG of 02–SEP–2002 09:00,
Vent. rate has decreased BY 44 BPM

EKG CLASS #WR03503400

Referred by: Confirmed By:

D.O.S.:



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

EID:28 EDT: 10:43 14–APR–2003 ORDER:

10–APR–2003 11:49:36 ST. JOSEPH'S HOSPITAL–CCR ROUTINE RETRIEVAL

61 yr
Male Black

Loc:7 Option:35

Vent. rate	60	BPM
PR interval	176	ms
QRS duration	90	ms
QT/QTc	400/400	ms
P–R–T axes	62 33	60

Normal sinus rhythm
Voltage criteria for left ventricular hypertrophy
Abnormal ECG
When compared with ECG of 02–SEP–2002 09:00,
Vent. rate has decreased BY 44 BPM

- BIGGEST S-WAVE + R-WAVE IN V-LEADS > 45mm (57 mm) ! !

EKG CLASS #WR03503400

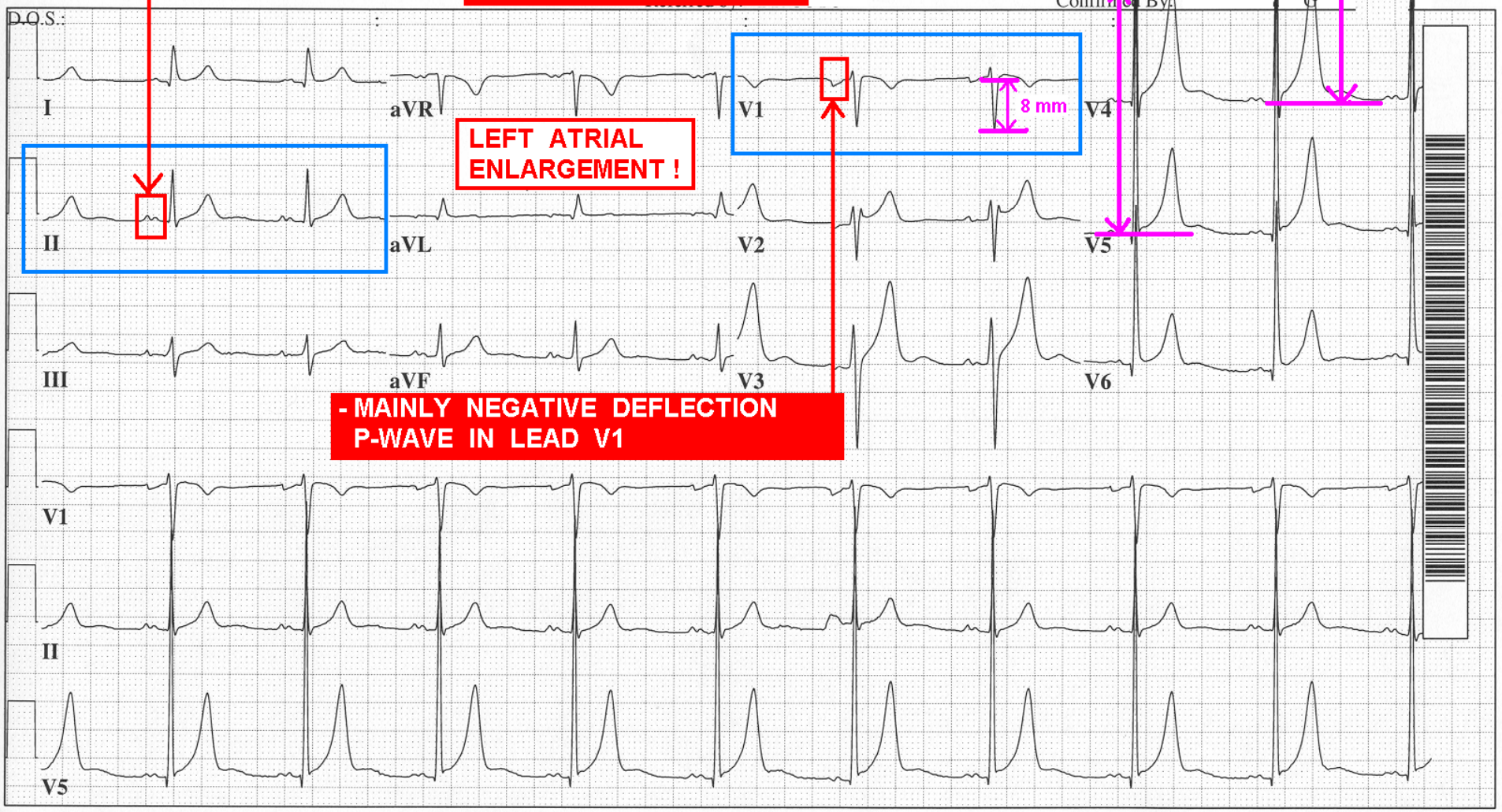
- 3mm LONG, " M " SHAPED P-WAVE IN LEAD II

49 mm

8 mm

LEFT ATRIAL ENLARGEMENT !

- MAINLY NEGATIVE DEFLECTION P-WAVE IN LEAD V1



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

EID:28 EDT: 10:43 14–APR–2003 ORDER:

CHAMBER ENLARGEMENT

CASE STUDY 1:

THE EKG COMPUTER MISSED THE LEFT ATRIAL ENLARGEMENT, WHICH IS A KEY FACTOR IN THE DIAGNOSIS OF THE PATIENT'S CONDITION.

WHAT ARE SOME COMMON CAUSES OF LEFT ATRIAL AND LEFT VENTRICULAR ENLARGEMENT ? ?

CHAMBER ENLARGEMENT

CASE STUDY 1:

COMMON CAUSES OF LEFT ATRIAL and LEFT VENTRICULAR ENLARGEMENT:

- AORTIC VALVE STENOSIS
- COARCTATION OF THE AORTA
- MITRAL REGURGITATION
- SYSTEMIC HYPERTENSION

CHAMBER ENLARGEMENT

CASE STUDY 1:

WHAT ASPECT OF THE PHYSICAL EXAMINATION COULD AID YOU IN MAKING A DIAGNOSIS ?

CHAMBER ENLARGEMENT

CASE STUDY 1:

WHAT ASPECT OF THE PHYSICAL EXAMINATION COULD AID YOU IN MAKING A DIAGNOSIS ?

AUSCULTATION OF HEART SOUNDS . . .

CHAMBER ENLARGEMENT

CASE STUDY 1:

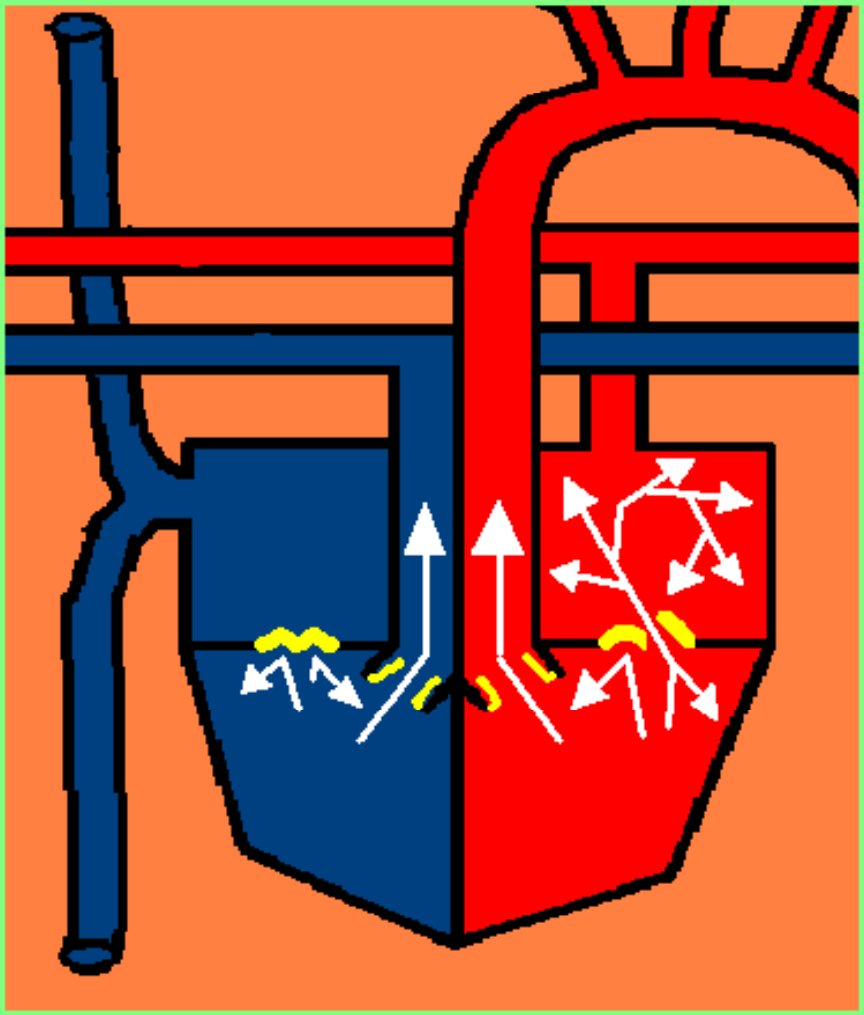
WHAT ASPECT OF THE PHYSICAL EXAMINATION COULD AID YOU IN MAKING A DIAGNOSIS ?

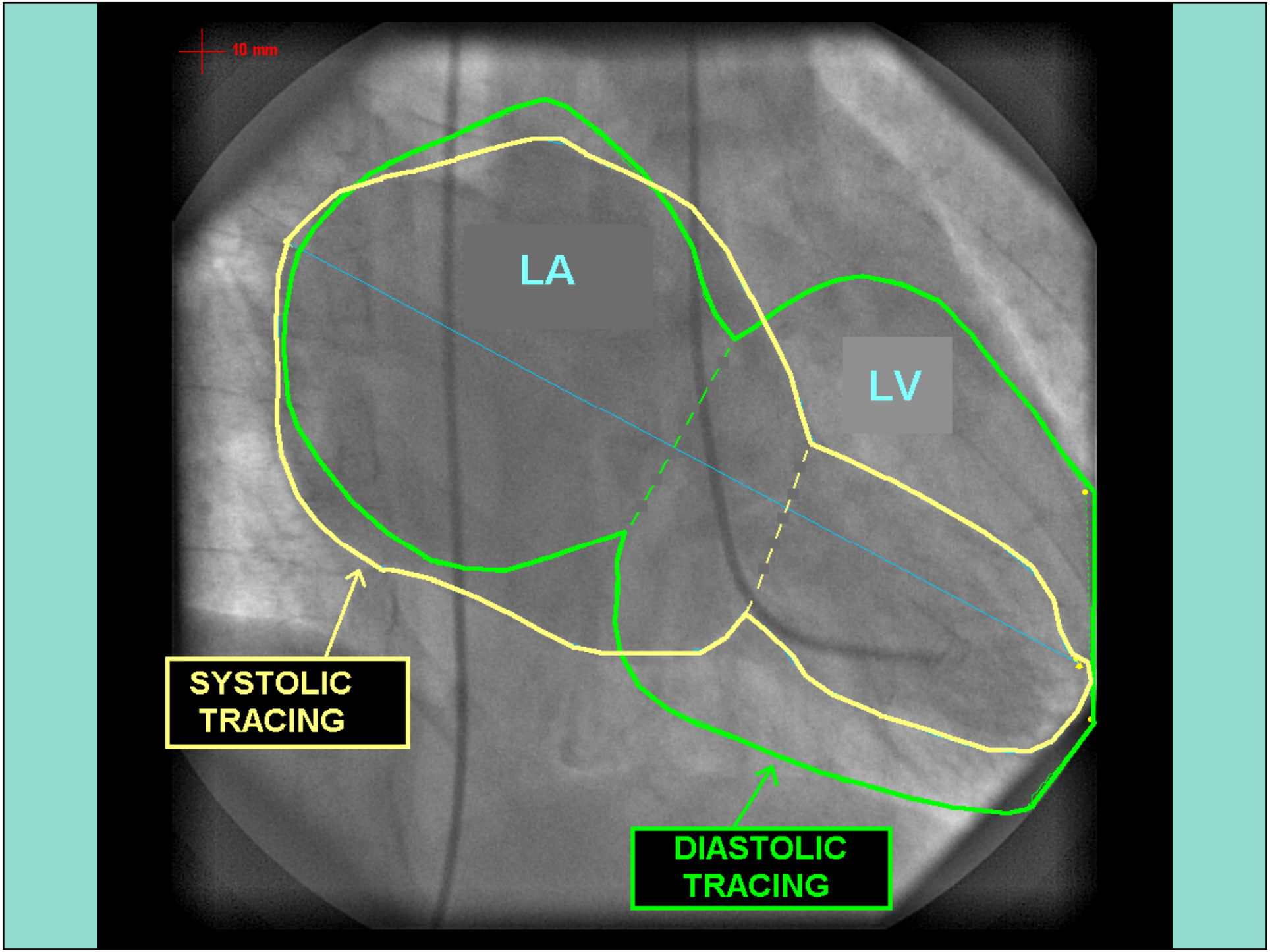
AUSCULTATION OF HEART SOUNDS . . .

THIS PT. EXHIBITED A PRONOUNCED SYSTOLIC (S-1) MURMUR -- STRONGLY INDICATING MITRAL VALVE REGURGITATION.

CAUSE OF SYSTOLIC (S 1) MURMUR

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




10 mm
LA
LV
SYSTOLIC TRACING
DIASTOLIC TRACING

CHAMBER ENLARGEMENT

CASE STUDY 1: SUMMARY

EKG FINDINGS OF LEFT ATRIAL and VENTRICULAR ENLARGEMENT, COMBINED WITH A PRONOUNCED S-1 HEART MURMUR INDICATE MITRAL REGURGITATION. THE LEFT VENTRICULOGRAM OBTAINED DURING CARDIAC CATHETERIZATION CONFIRM THE DIAGNOSIS. THIS PATIENT WAS SENT FOR A SURGICAL CONSULTATION.

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Valvular Heart Disease

CLASS I Recommendations:

1. It is recommended that patients with clinically suspected moderate or greater degrees of valvular stenosis or regurgitation undergo preoperative echocardiography if there has been either:

   1) no prior echocardiography within 1 year or

   2) a significant change in clinical status or physical examination since last evaluation (60). (Level of Evidence: C)

2. For adults who meet standard indications for valvular intervention (replacement and repair) on the basis of symptoms and severity of stenosis or regurgitation, valvular intervention before elective noncardiac surgery is effective in reducing perioperative risk (15). (Level of Evidence: C)

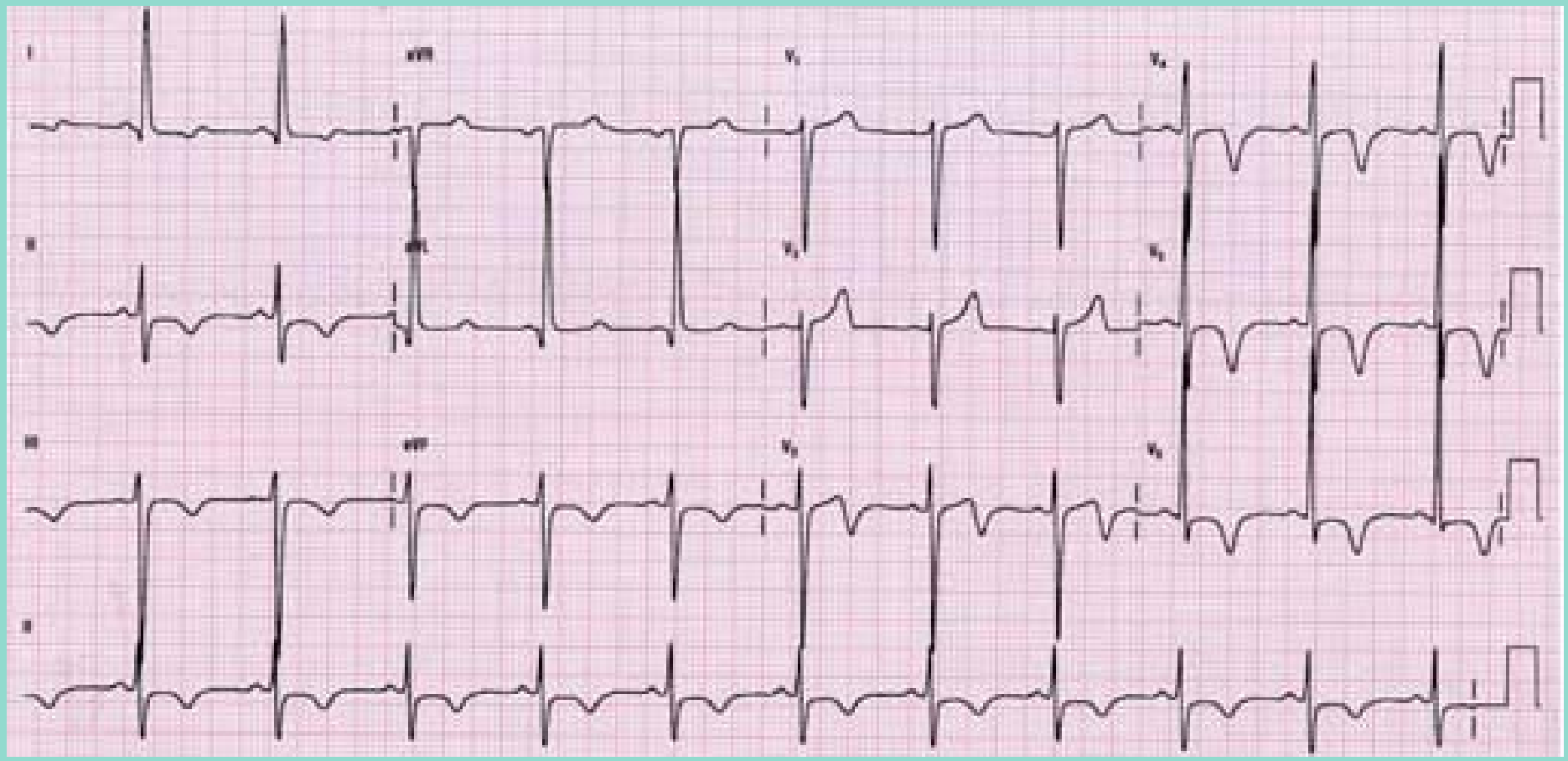
From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Aortic Stenosis: Recommendation

CLASS IIa

Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable to perform in patients with asymptomatic severe aortic stenosis (AS) (48,75–84). (Level of Evidence: B)

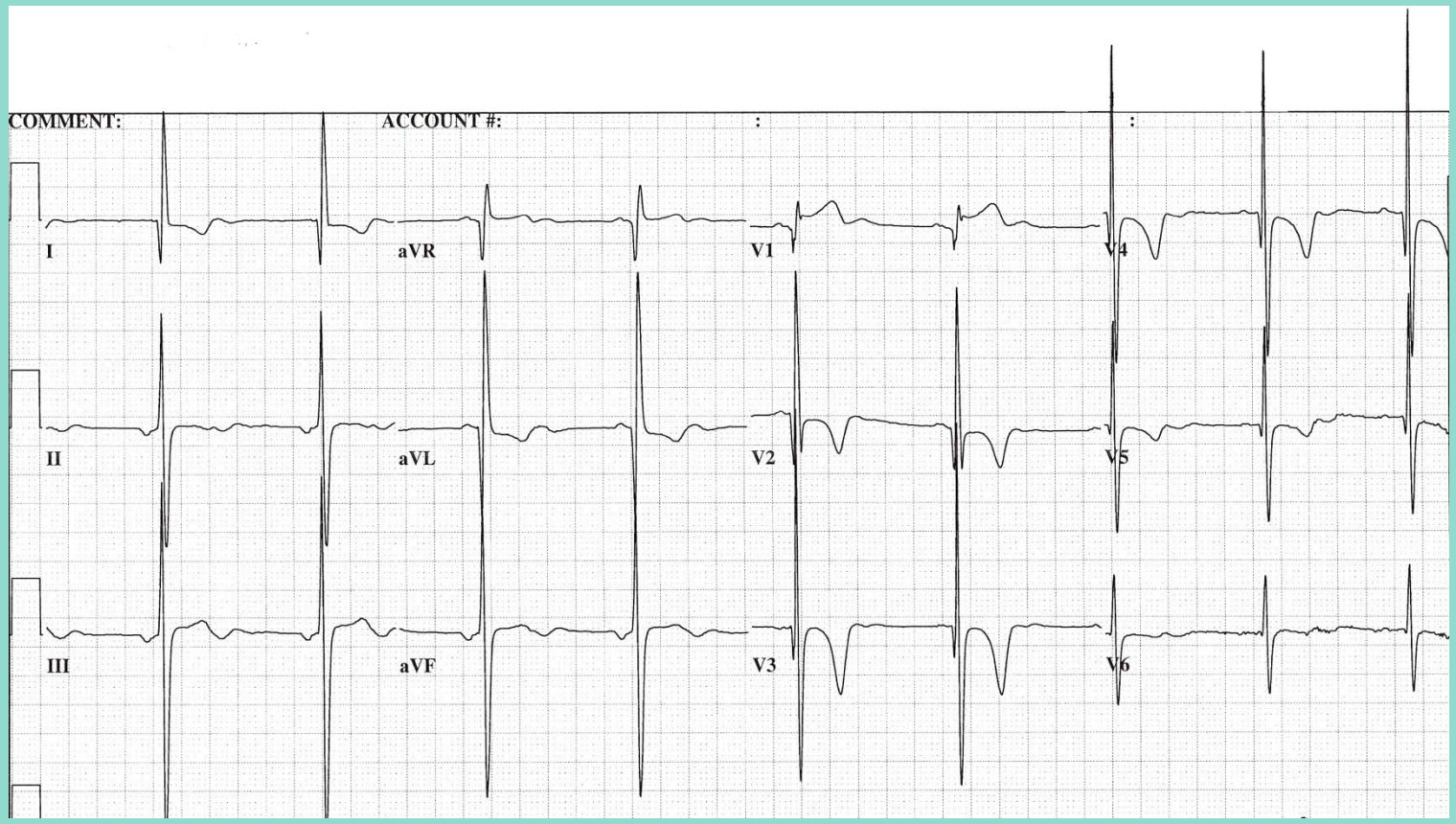
Hypertrophic Cardiomyopathy (HCM)



12 Lead ECG Traits:

- QRS Height -- exceeds normal size, “spearing through QRS in other leads”
- Inverted T waves appear in multiple regions (INFERIOR, ANTERIOR, LATERAL)
- T WAVES are SYMMETRICAL (No STRAIN PATTERN noted).

Hypertrophic Cardiomyopathy (HCM)



12 Lead ECG Traits:

- QRS Height -- exceeds normal size, “spearing through QRS in other leads
- Inverted T waves appear in multiple regions (ANTERIOR, LATERAL)
- BiPHASIC T waves in Inferior Leads.
- T WAVES are SYMMETRICAL (No STRAIN PATTERN noted).

Typical 12 Lead ECG Indicators Suggestive of HCM:

LVH
Inverted T waves (predom V4-V6, II, aVF, I, L)
ST Depression / Strain pattern
Q waves
Left Axis Dev
LAE

Over 90% of patients with HCM will have an abnormal ECG.[19–21] ECG abnormalities include T wave inversion (TWI), ST segment depression, pathological Q waves, conduction delay, left-axis deviation (LAD) and left atrial enlargement (LAE).

In a patient with KNOWN Hypertrophic Cardiomyopathy, OR a patient with NO PREVIOUS DIAGNOSIS OF HCM who presents with an ECG like the one on the previous slide, what DIAGNOSIS of HCM . . . . . .

. . . . . WHAT DIAGNOSTIC TEST would be most appropriate to order next ? ? ?

(HINT….we want to assess Left Ventricular function !)

From: 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

HYPERTROPHIC CARDIOMYOPATHY (HCM) MANAGME NT CONSIDERATIONS:

Decreased systemic vascular resistance (arterial vasodilators), volume loss, or reduction in preload or LV filling may increase the degree of dynamic obstruction and further decrease diastolic filling and cardiac output, with potentially untoward results.

Over diuresis should be avoided, and inotropic agents are usually not used in these patients because of increased LV outflow gradient. Studies have reported mixed results for perioperative risk in patients with hypertrophic obstructive cardiomyopathy.

Patients with HCM are at significant risk for cardiac complications during surgery and anesthesia. Although studies looking specifically at the pediatric population are lacking, one study of adults with HCM undergoing surgery and anesthesia found a 40% risk of experiencing at least one adverse cardiac event. Anesthetic management focuses on maintaining preload and afterload, avoiding increases in contractility and avoiding tachycardia. Ideally patients with HCM should be well hydrated prior to the induction of anesthesia. Agents that maintain afterload without a significant increase in contractility or heart rate are preferable for both induction and maintenance of anesthesia. Appropriate intra-operative monitoring and a postoperative care plan are dependent on the procedure and the severity of HCM.

"Anesthetic Management of Hypertrophic Cardiomyopathy and Challenges in the MRI Suite," Emory University School of Medicine, Children's Healthcare of Atlanta

My top two reasons for giving everything in life the best I have to offer.

Wayne W Ruppert, 352-521-1544 wayne.ruppert@bayfronthealtth.com