



A A P A

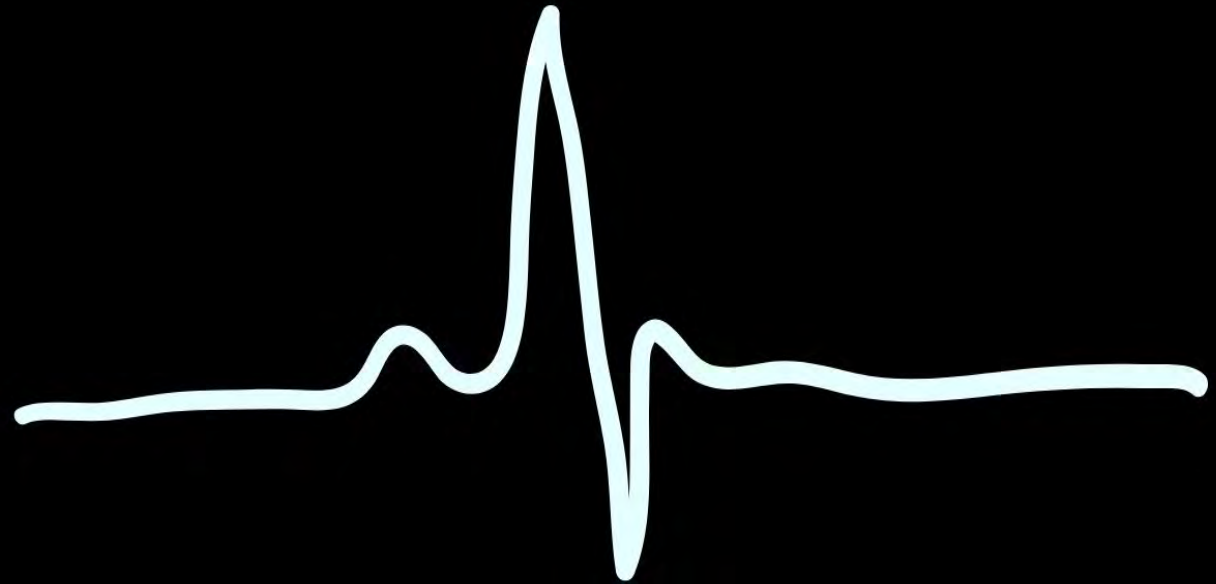
Basic **EKG**
WORKSHOP

WITH
JENNIFER CARLQUIST
PA-C



OBJECTIVES

1. Review the waves
2. Review the "segments"
3. Review coronary artery anatomy
4. Review contiguous leads
5. Review reciprocal changes



♥ EKG Roadmap!

Confidence!



(Basics)

- Waves
- Rhythms
- Intervals

Start at your level

What is a normal EKG?



Coronary Anatomy



STEMI

Subtle STEMI

Mimics

12 Lead:
What do the leads look at?

High Risk Patterns

WHAT HANDOUTS DO YOU HAVE?



NORMAL EKG

We will carve this up and color it

CHEAT SHEET

We will refer to this

EKG WORKBOOK

We will do these together

Syncopal/palpitations Checklist:

- W/pw (Fig 1)
- Brugada's (Fig 2)
- HOCM
- Prolonged QT
- Low Voltage

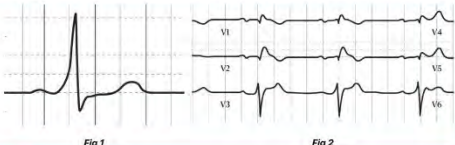
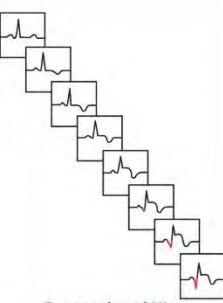


Fig 1 Fig 2

Progression of MI



Rapid Axis and Hemiblock Chart

Axis	Lead I	Lead II	Lead III	Comments
Normal Axis 0 - 90				
Physiologic Left Axis 0 - 40				
Pathological Left Axis 40 - 90				Anterior HemiBlock
Right Axis 90 - 180				Posterior HemiBlock
Extreme Right Axis no man's land				Ventricular in origin

- MIKE TAIGMAN (ADVANCED FIELD CARDIOLOGY)

Common STEMI Mimics

LVH: Big Voltage seen in R waves.

BER: Widespread concave ST elevation, most prominent in the precordial leads with a "notch" that looks like a fish hook at the end of the R wave.

Pericarditis: Widespread ST elevation with no reciprocal changes, may have PR segment depression.

Hyperkalemia: Peaked T's, small or no P waves, long QT, wide QRS complex, bradycardia.

Brugadas: "Ski slope" ST elevation in V1, V2, no reciprocal changes.

Osborne Waves: Large "J" waves at the end of QRS (Fig 3)

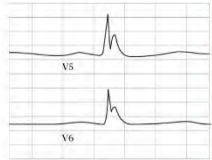


Fig 3

EKG CHEAT SHEET

CARDIOLOGY
MADE EASY



Syncope/palpitations Checklist:

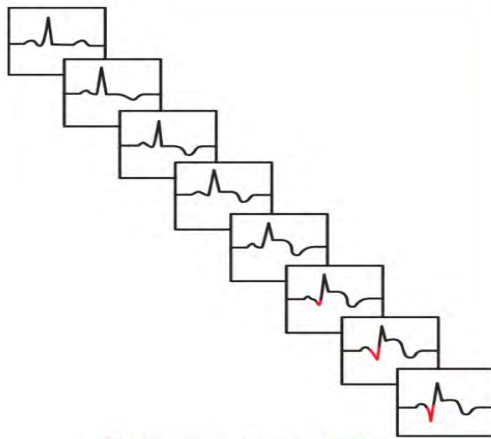
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- Brugada's (Fig 2)
- HOCM
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Fig 1



Fig 2



Progression of MI

Rapid Axis and Hemiblock Chart

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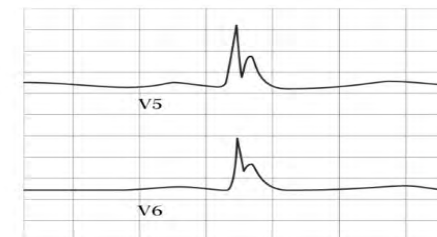
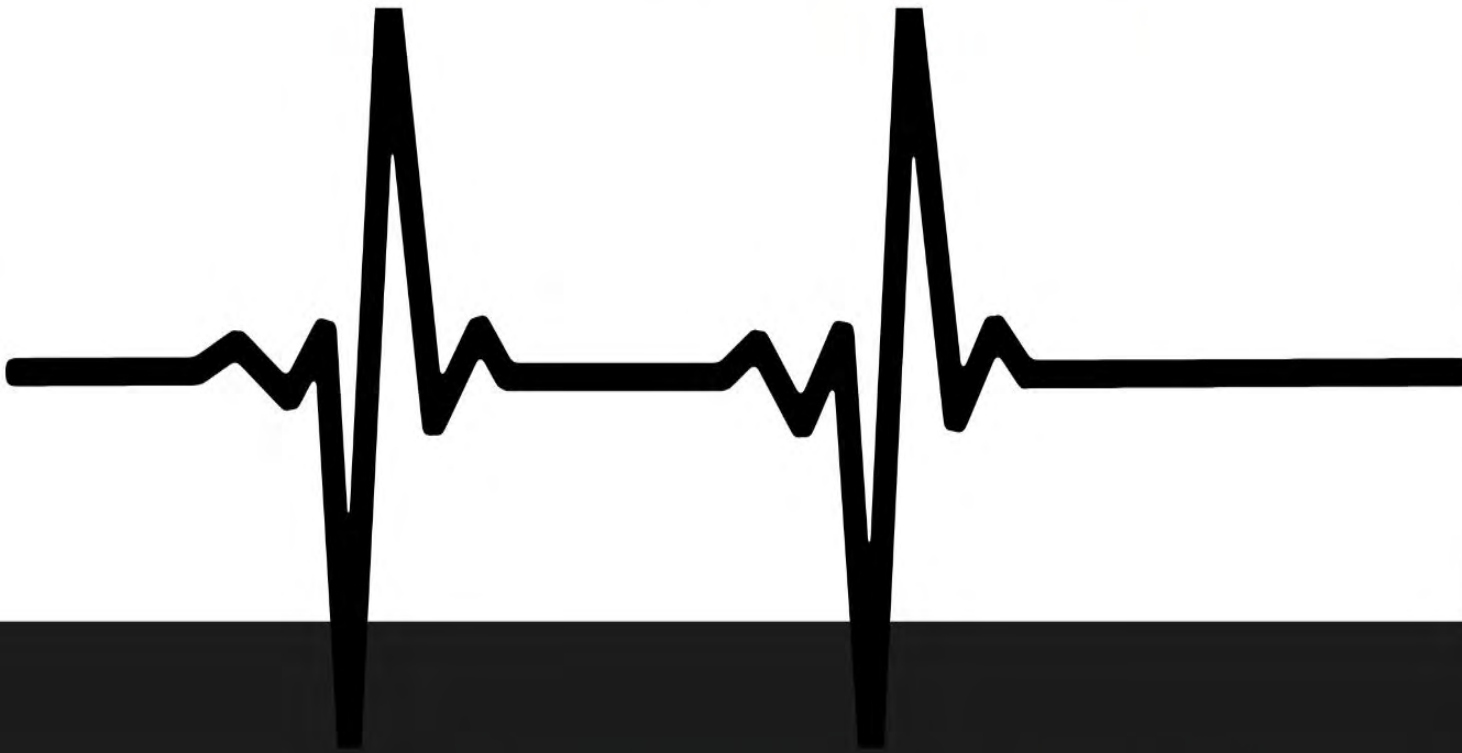


Fig 3

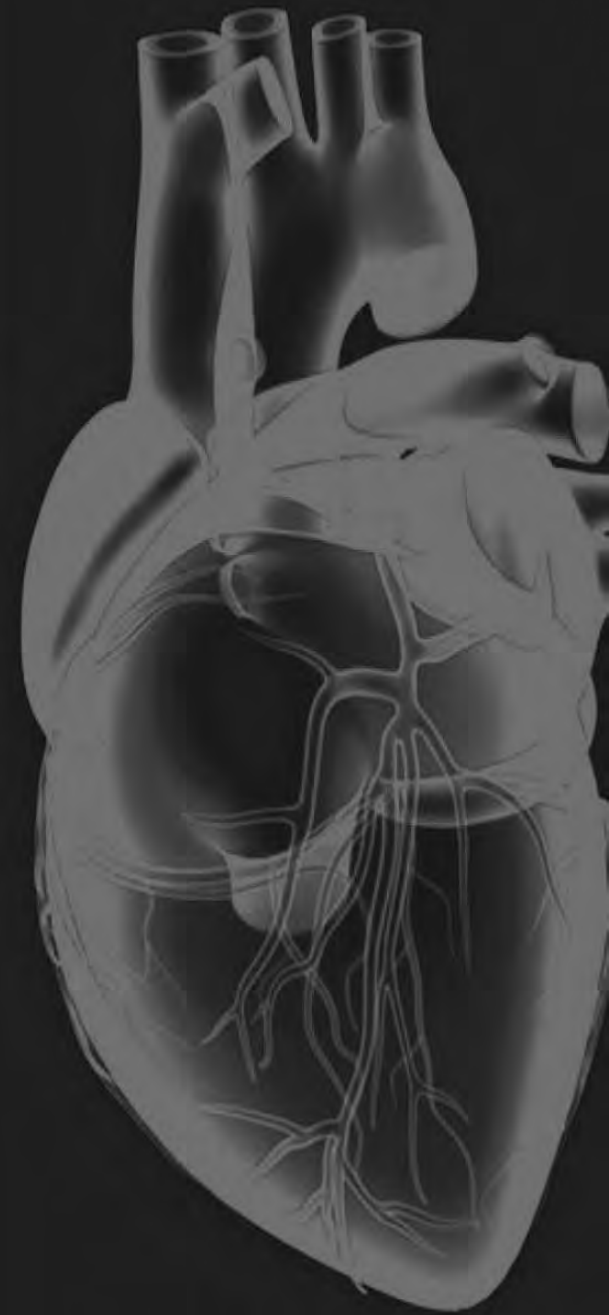


“I WAS SHAKING IN MY BOOTS”

Foundations



Let's go 10,000 foot view...



What questions are we asking?

EKG:

Arteries blocked?

Conduction intact

How big are the walls?

Is there fluid surrounding the heart?

Is the heart lining inflammed?



The heart is like a house.

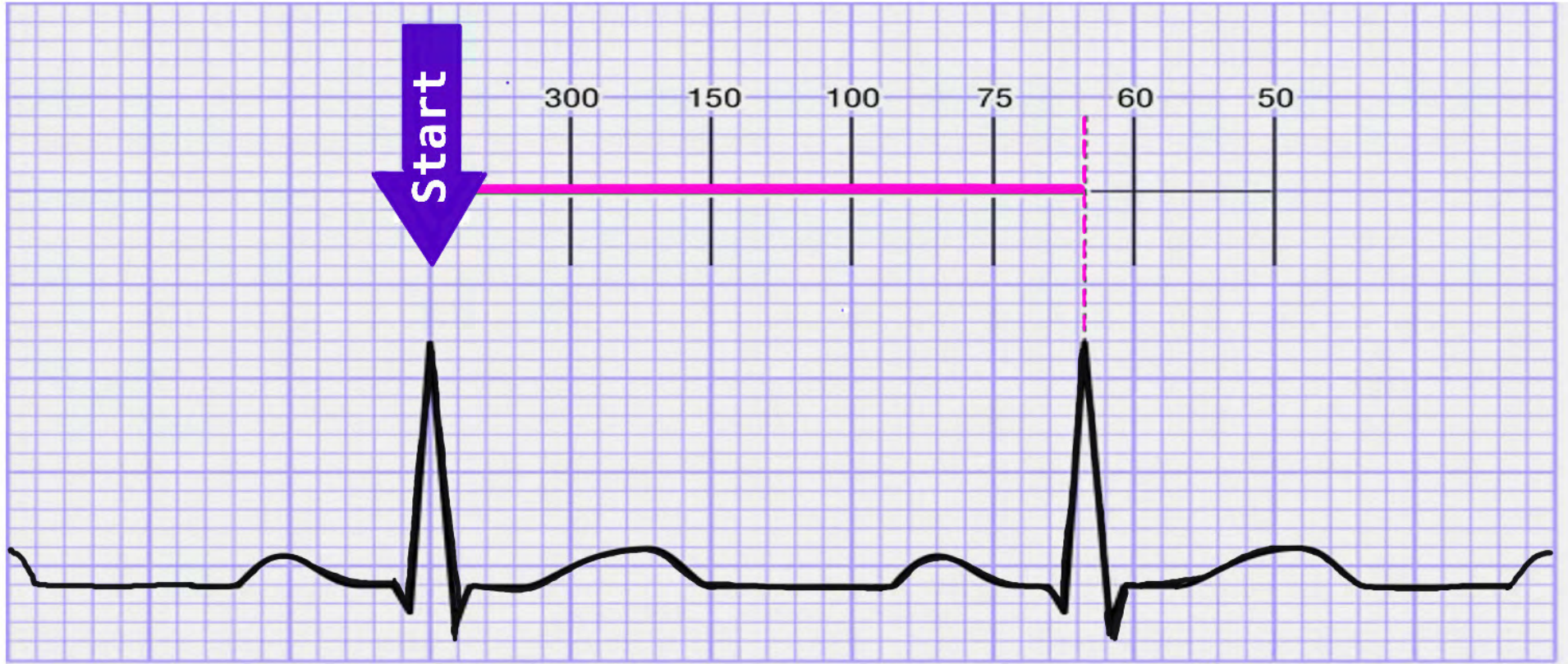


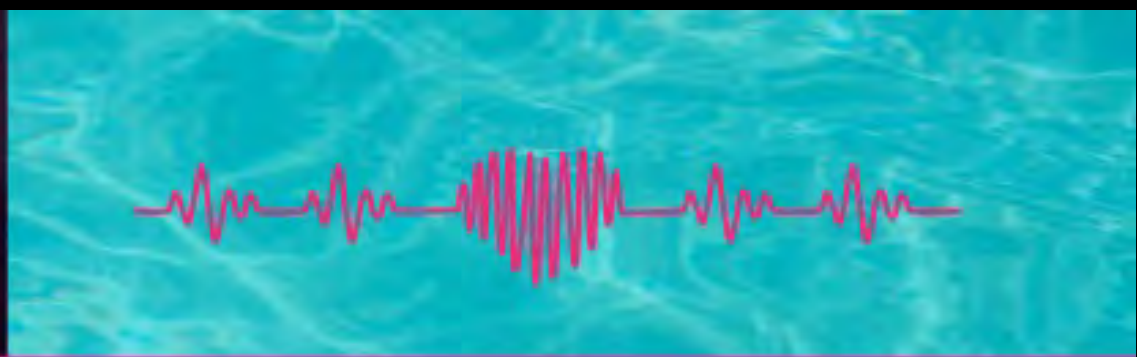
Plumbing: *Vessels*

Electricity: *Conduction*

Walls: *Muscle*

Doors: *Valves*

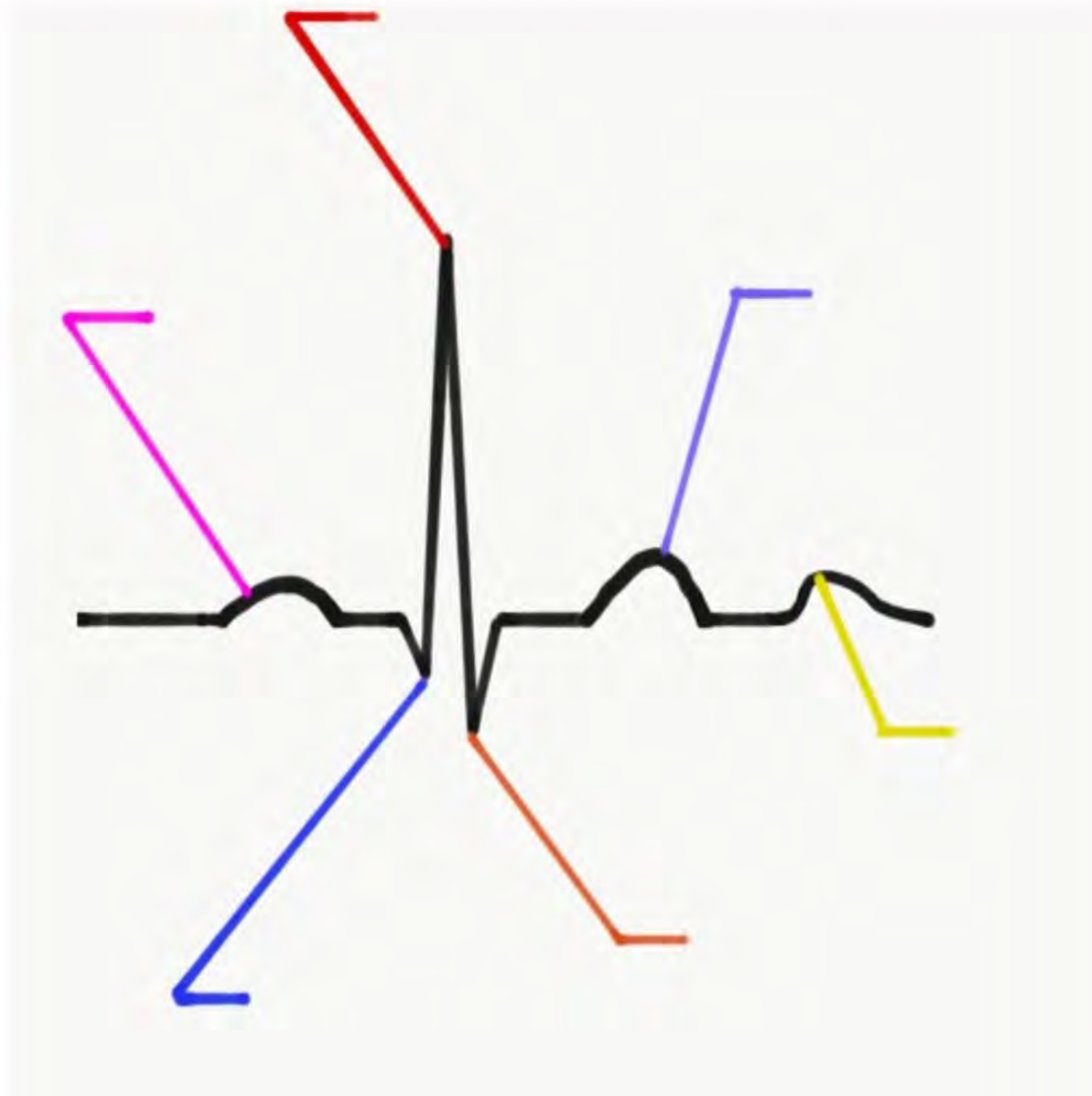




THE WAVES



Let's Define the Waves



1. Not too tall
2. Not too wide

QRS

1. Smooth
2. Don't be needy!

T WAVE

Oh no you didn't!

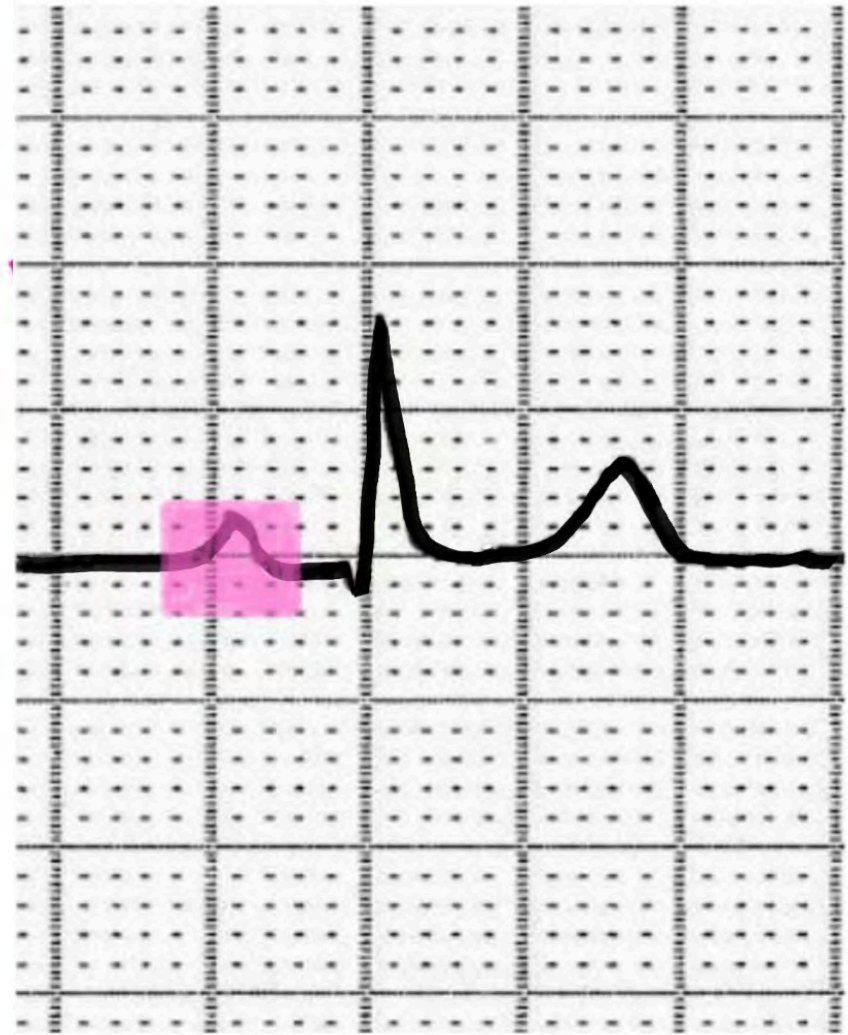
1. Upright
2. Don't be pointy!

P WAVE

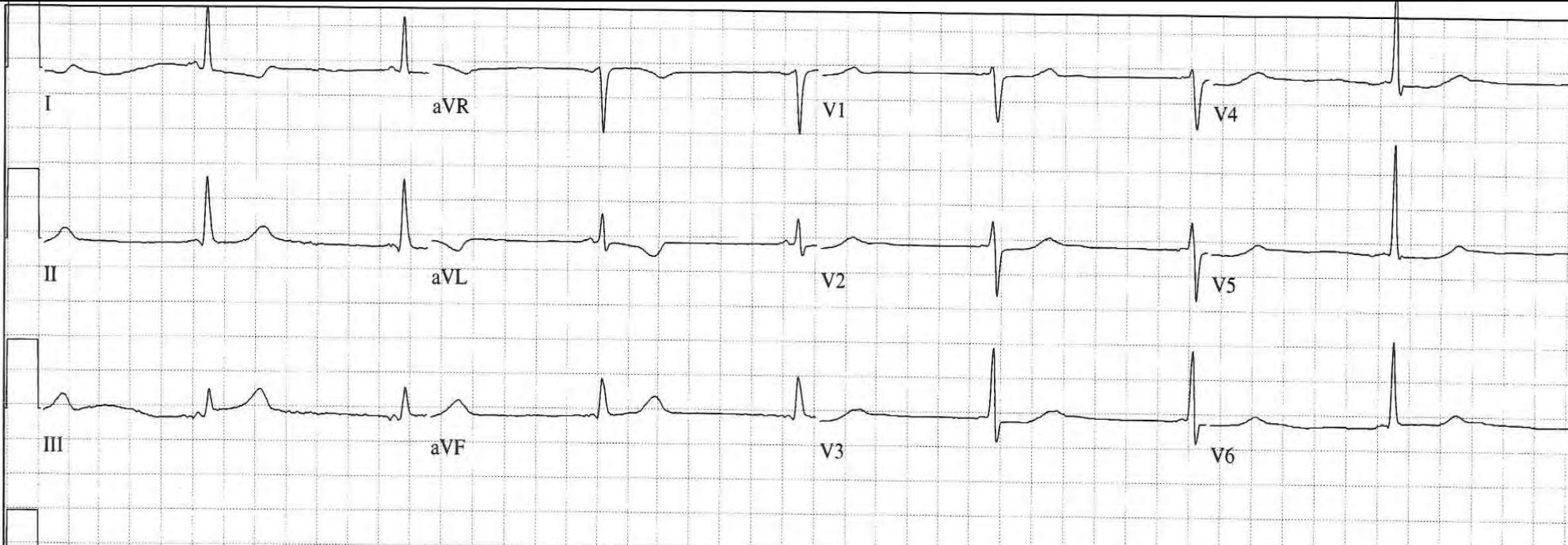


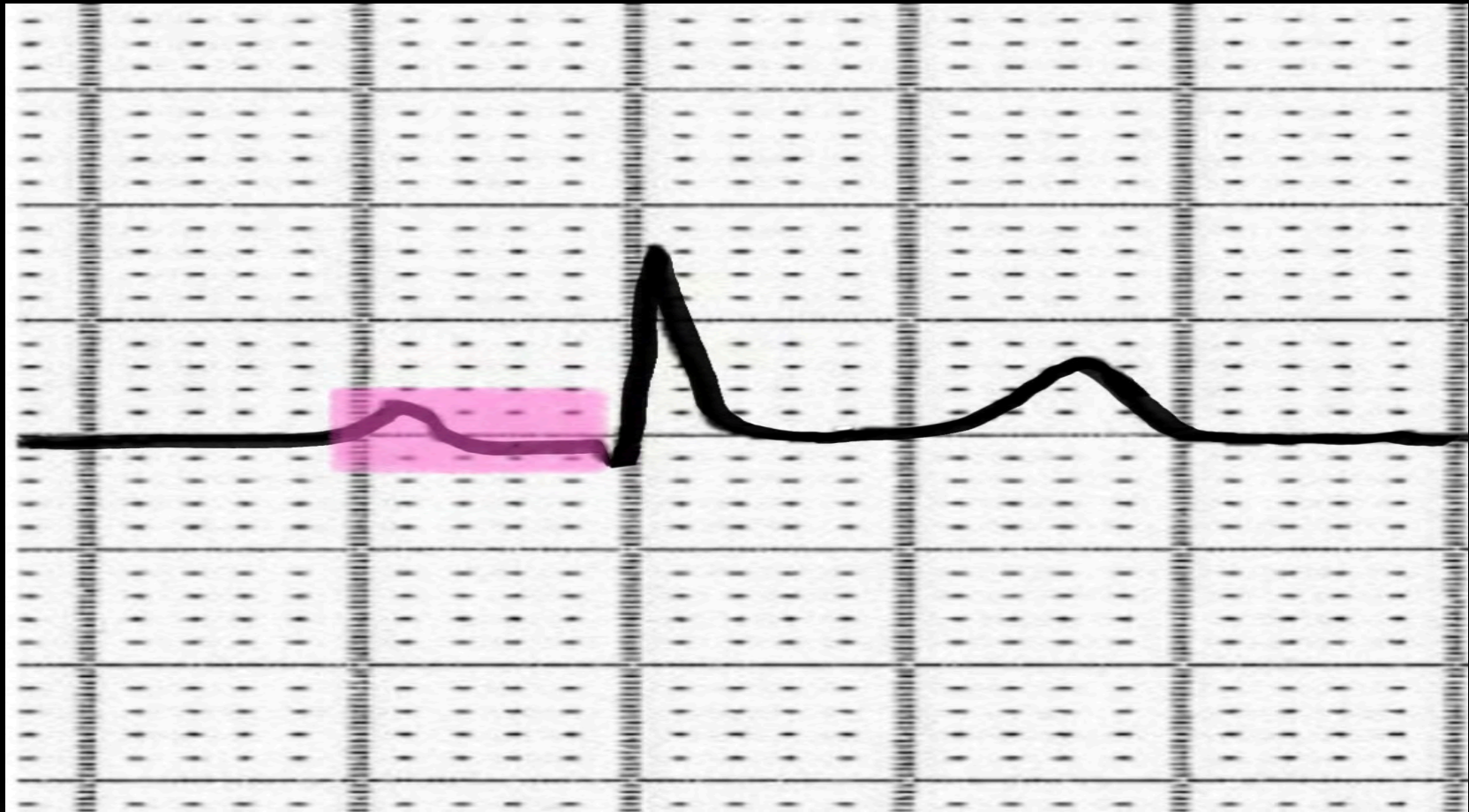
P WAVE

- Is a small deflection wave that represents left and right atrial depolarization and also corresponds to atrial contraction. It occurs when the sinus node, also known as the sinoatrial node, creates an action potential that depolarizes the atria.



Is there a P wave here? If so what do you see?





Measured from the beginning of the P to the Q wave

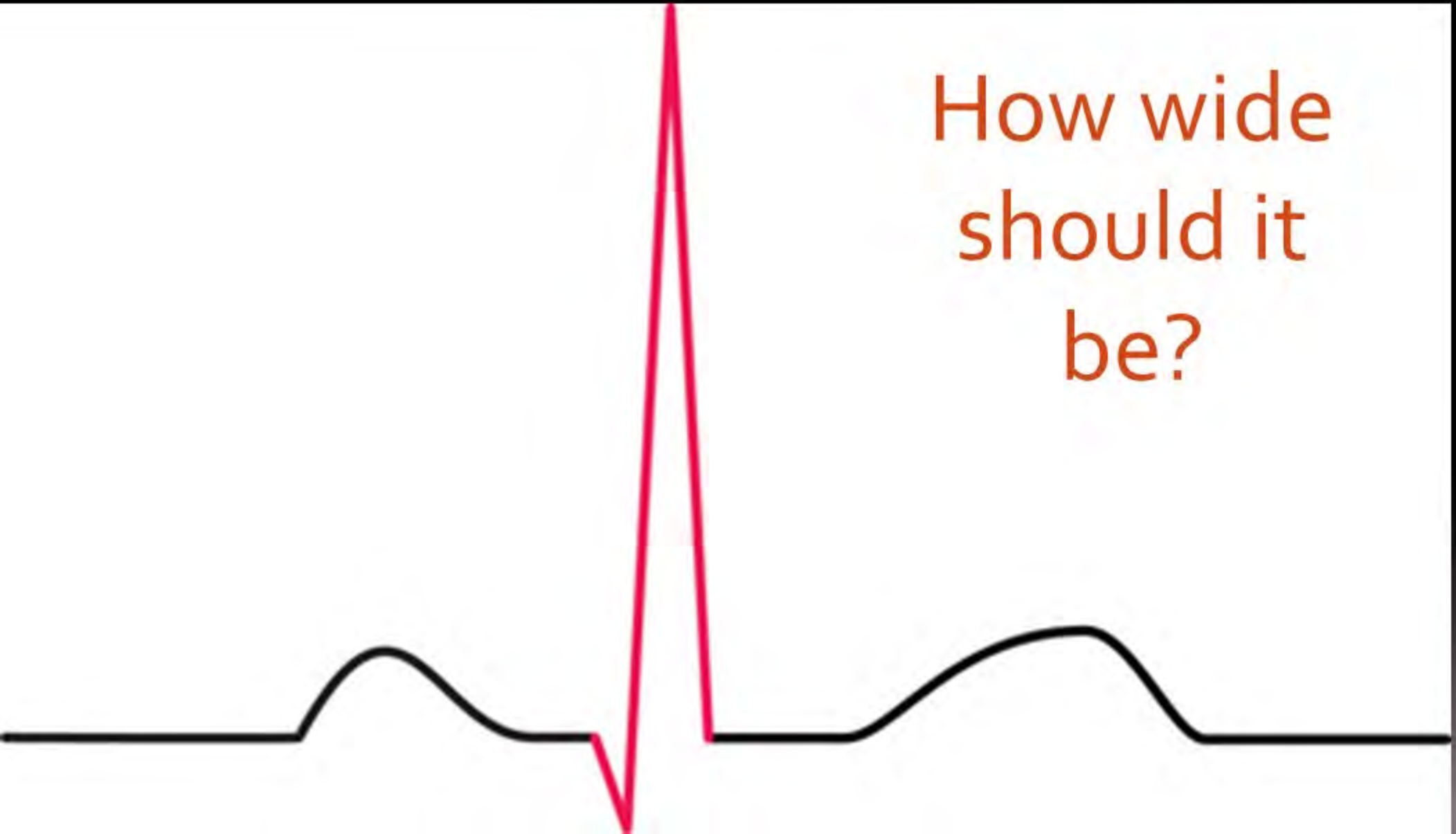
Should be 120 ms – 200 ms

If long = ?

If short = ?

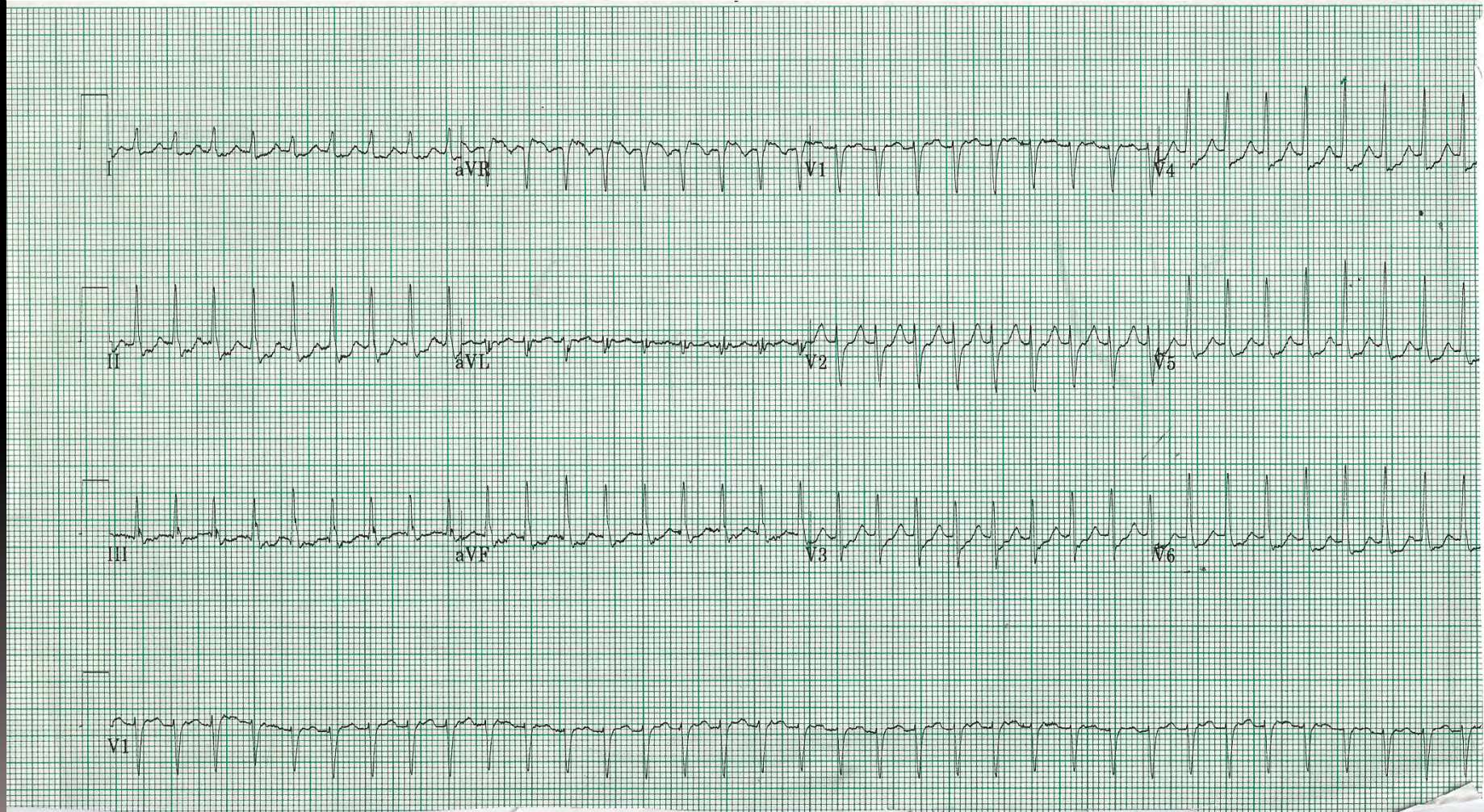
QRS

How wide
should it
be?



Vent. rate 215 bpm
PR interval * ms
QRS duration 90 ms
QT/QTc 210/397 ms
P-R-T axes * 73 -83

Supraventricular tachycardia
Marked ST abnormality, possible inferior subendocardial injury
Abnormal ECG

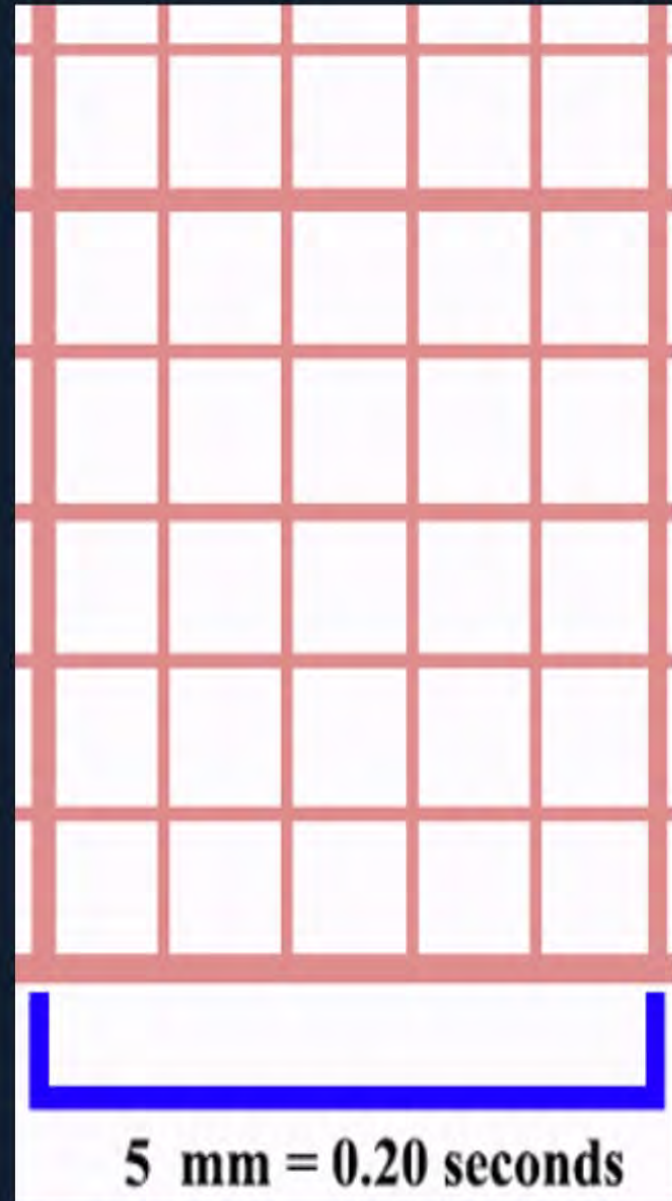


WIDE QRS

More than **3** small boxes

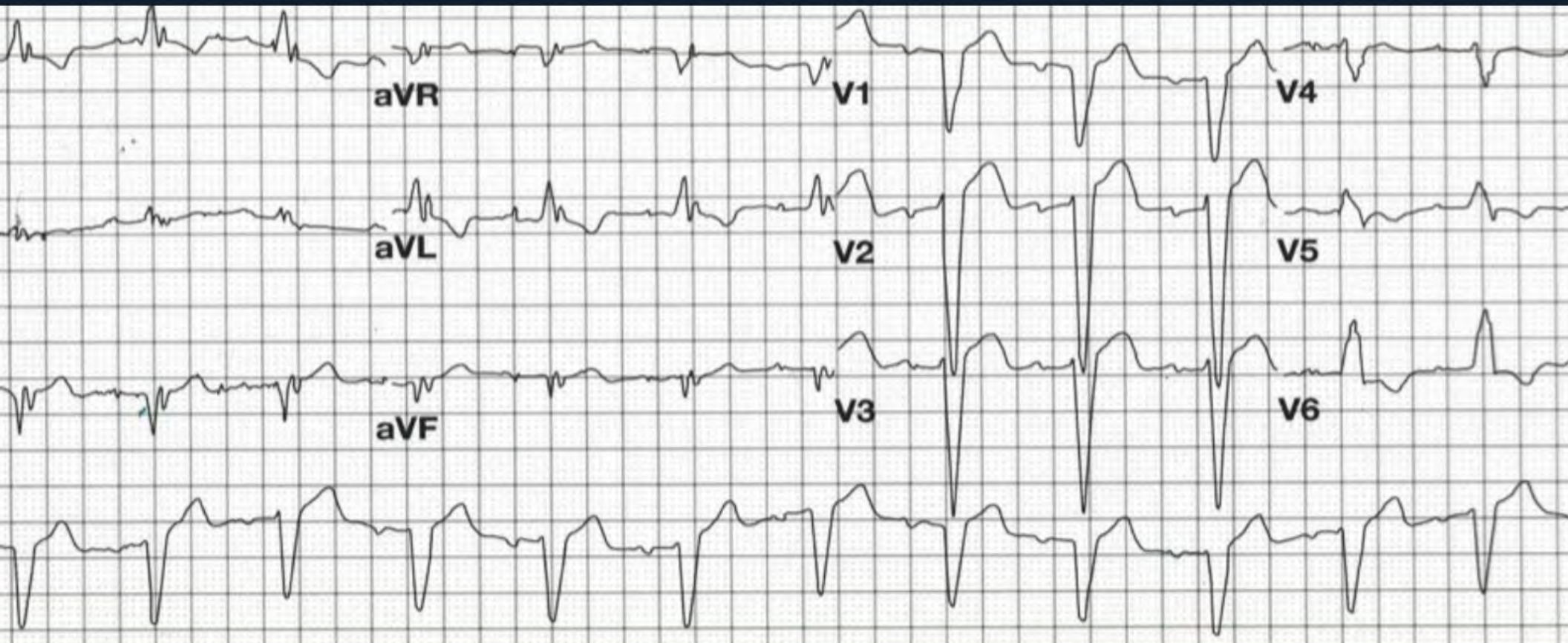
Or

>120 ms



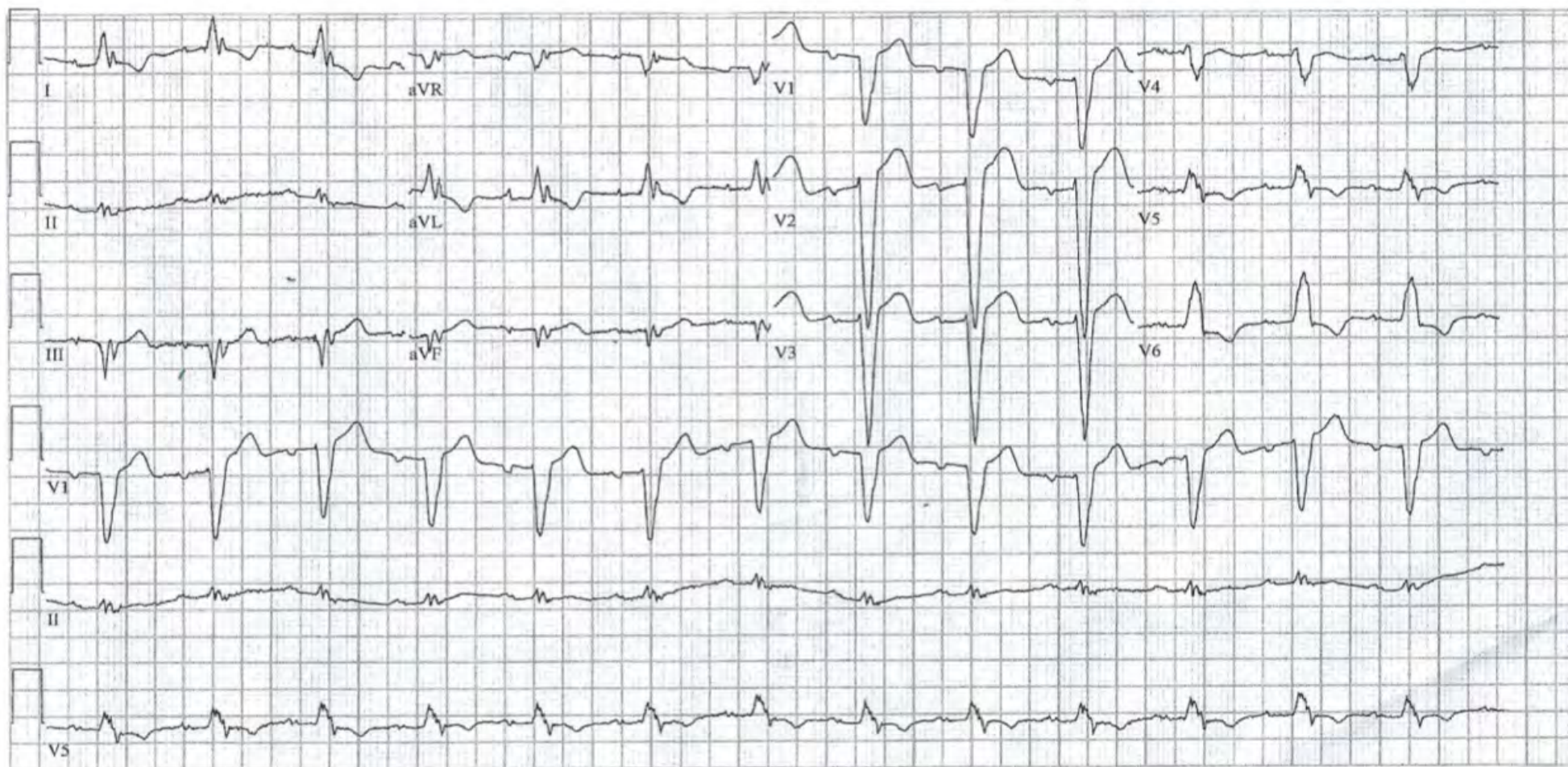
IS THIS QRS WIDE?

QRS: 140



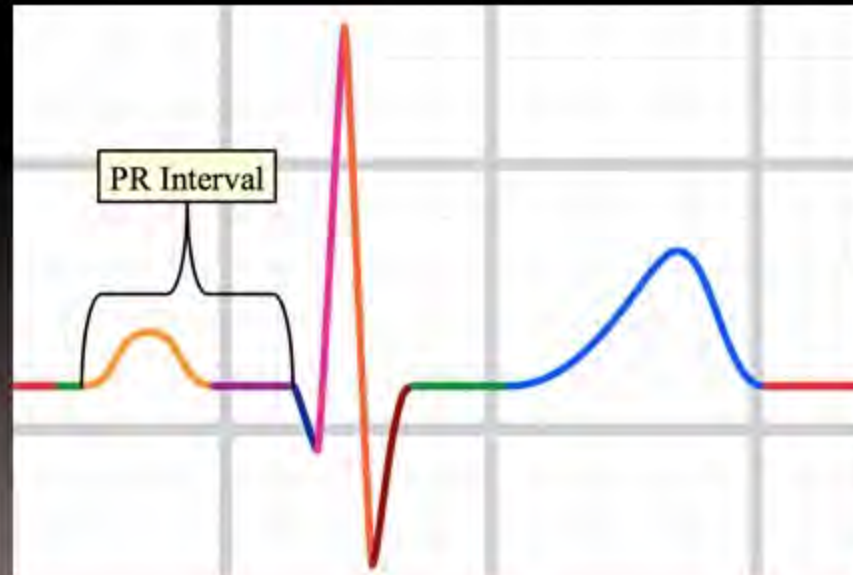
Vent. rate	81	BPM
PR interval	220	ms
QRS duration	150	ms
QT/QTc	414/480	ms
P-R-T axes	34 -26	130

SINUS RHYTHM WITH 1ST DEGREE A-V BLOCK
LEFT BUNDLE BRANCH BLOCK
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE



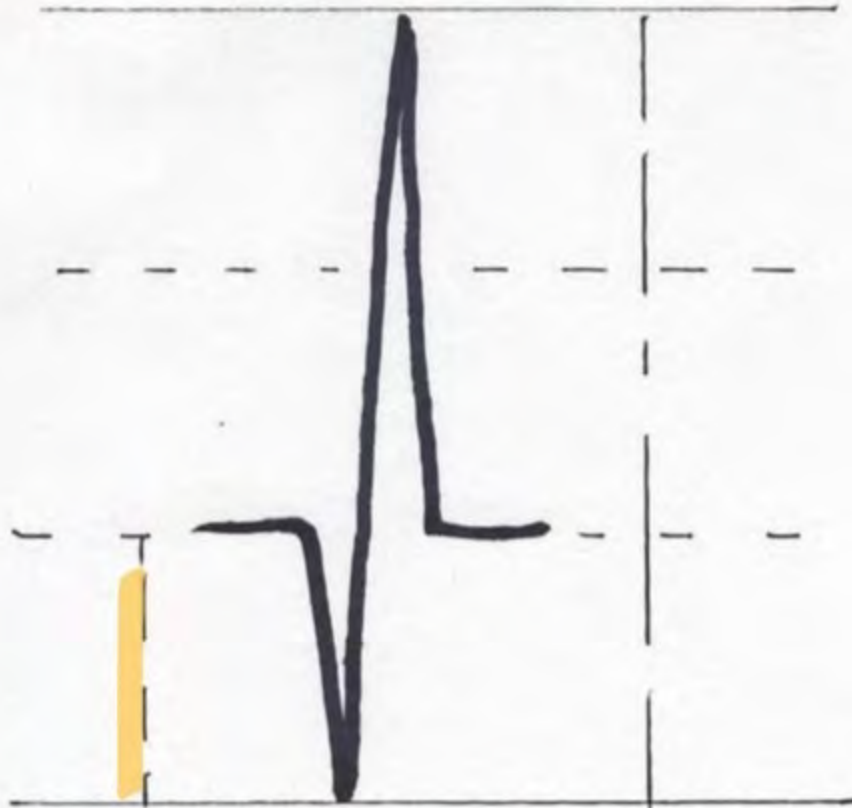
REFRACTORY PERIOD

- Cardiac muscle cells have prolonged refractory periods, to prevent tetany of cardiac muscle. The absolute refractory period is the first half of the T wave and the second half of the T wave is the **relative** refractory period.



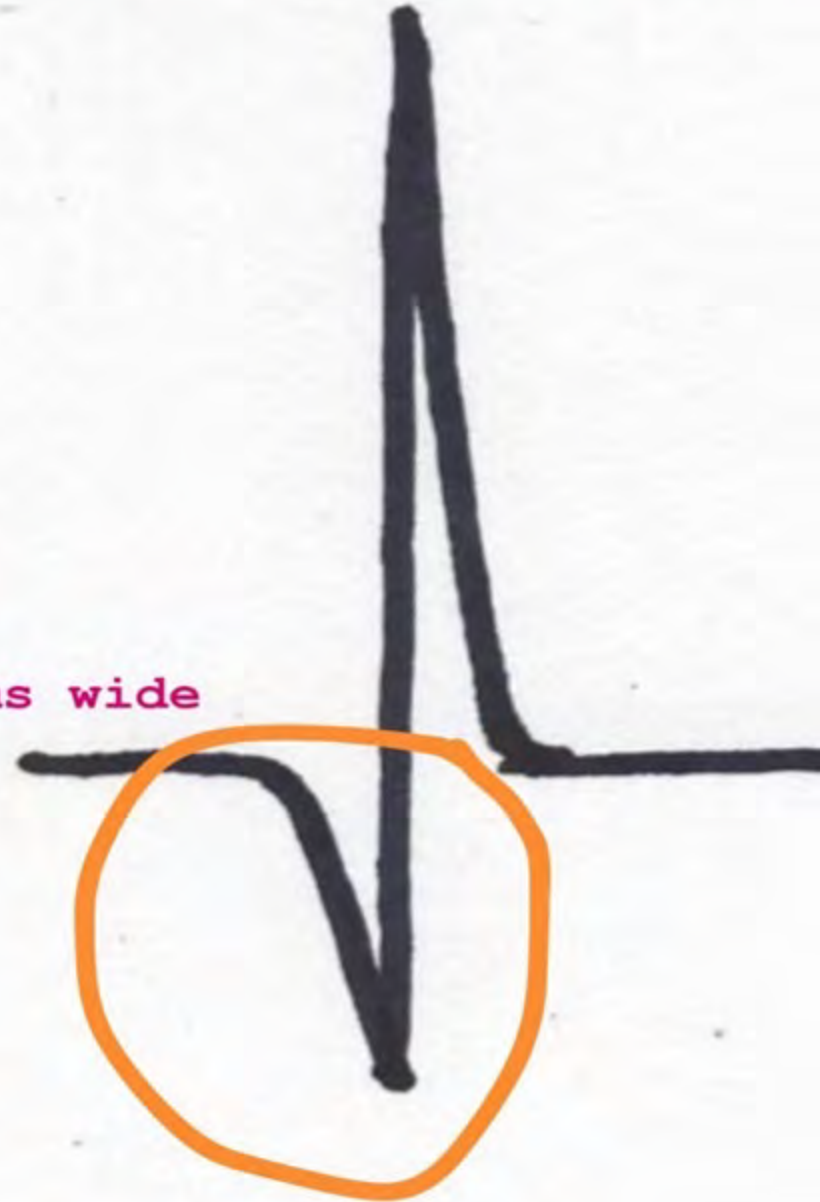
Q WAVE

Pathologic Q Waves



1/3 height of R wave

30 ms wide



110-100

Vent. rate
PR interval
QRS duration
QT/QTc
P-R-T axes

89 BPM
138 ms
100 ms
382 (164) ms
59 (45) ms
-2

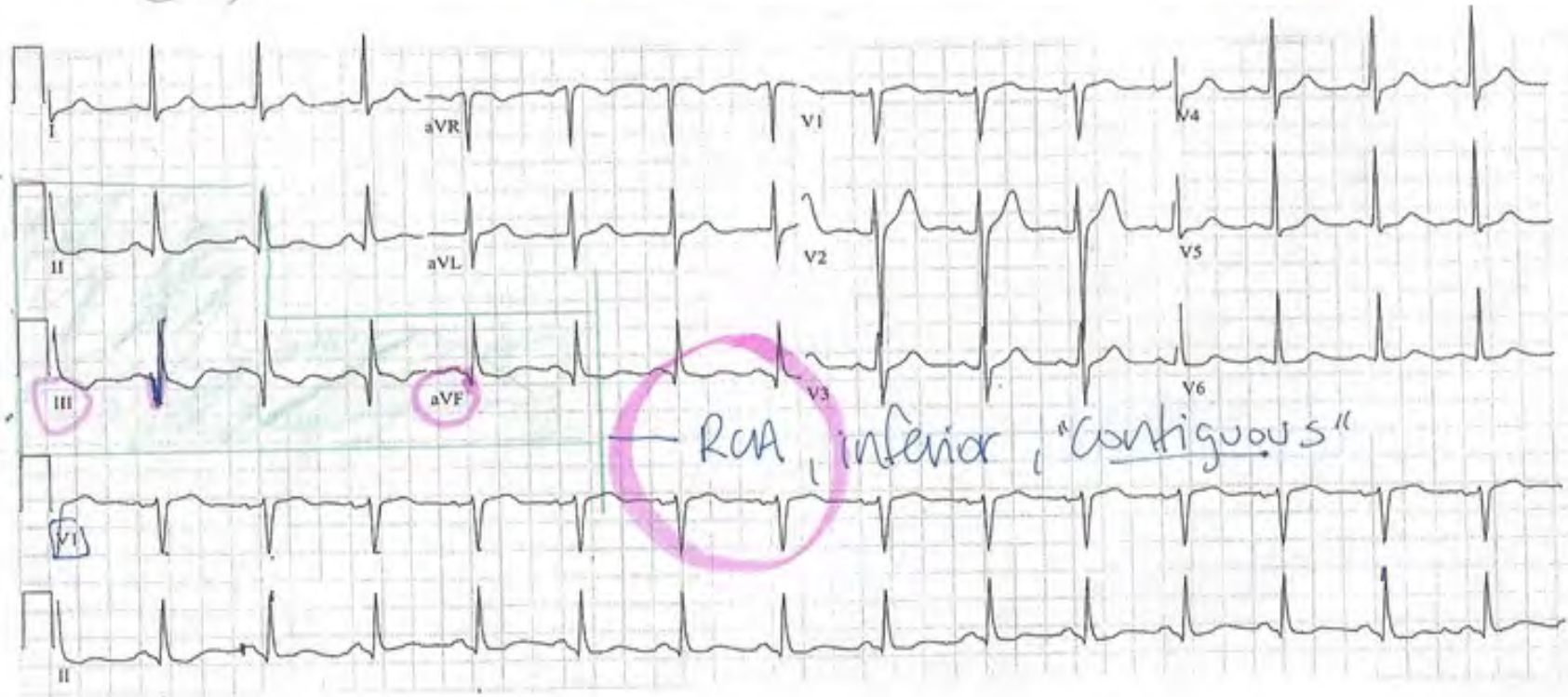
120

0-90

NORMAL SINUS RHYTHM
POSSIBLE INFERIOR INFARCT AGE UNDETERMINED
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE

Q-WAVE
"SCAR"

(4)



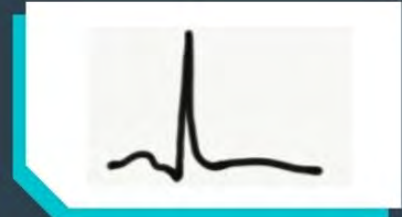
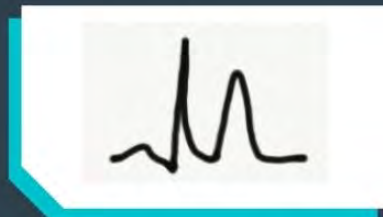
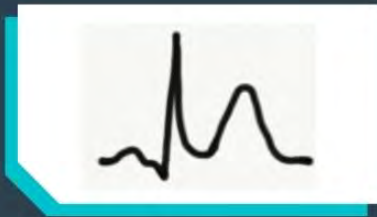
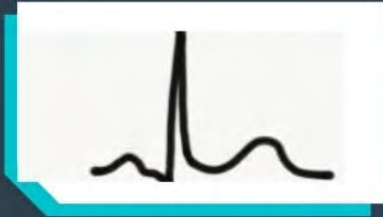
Size matters.



The T wave is the diva of the show – people always want to look at it



Can you name them?



Vent. rate 64 bpm
PR interval 130 ms
QRS duration 70 ms
QT/QTc 408/420 ms
P-R-T axes 57 62 269

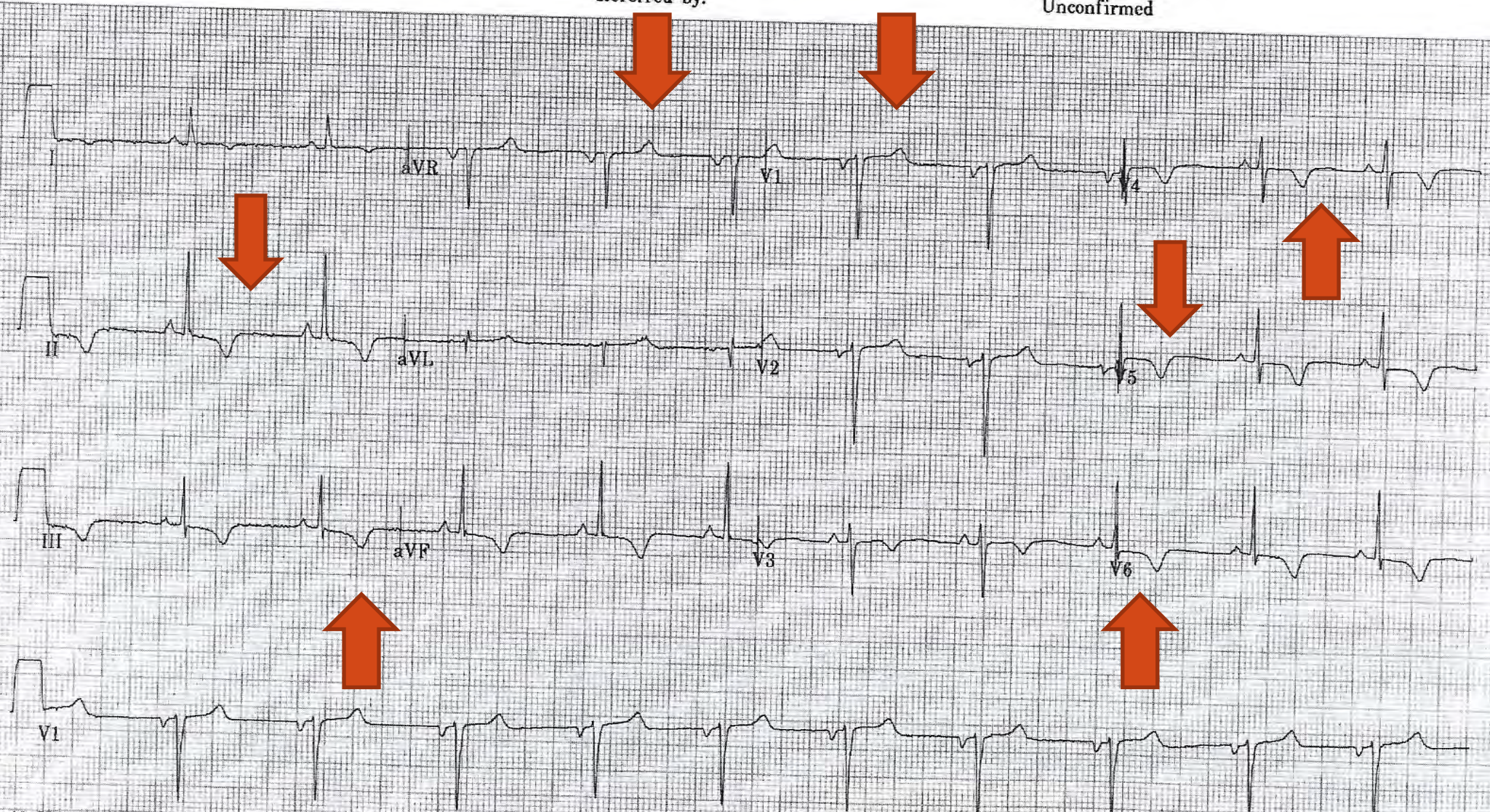
Normal sinus rhythm
Biatrial enlargement
T wave abnormality, consider inferior ischemia
T wave abnormality, consider anterolateral ischemia
Abnormal ECG



Technician:
Test ind:

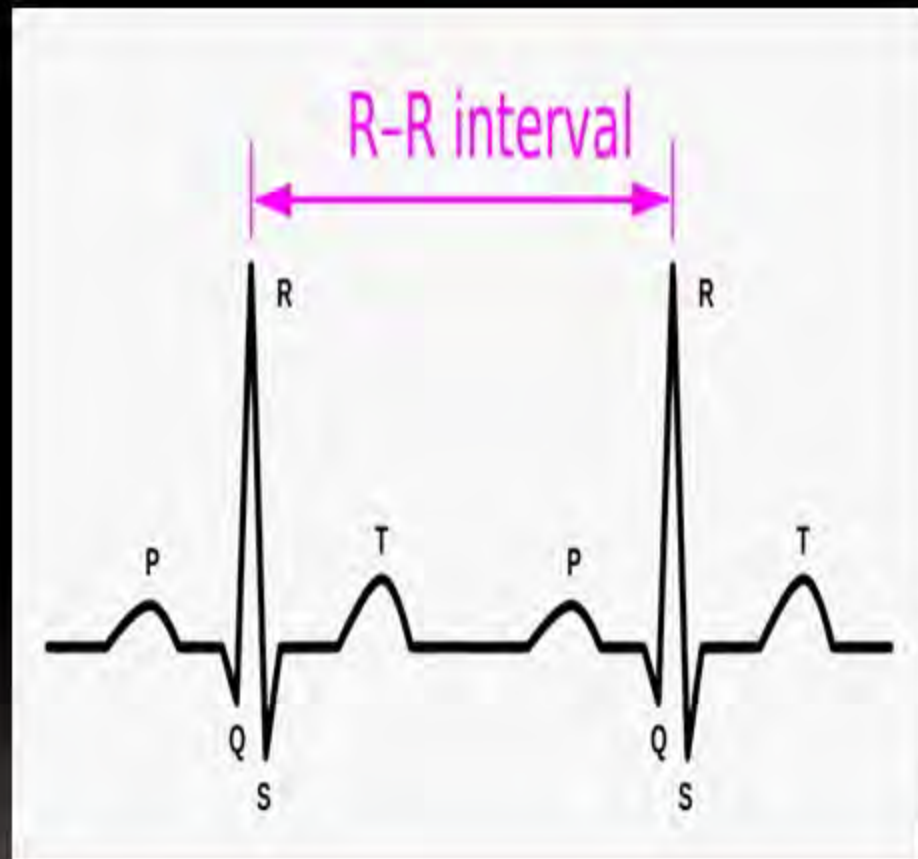
Referred by:

Unconfirmed

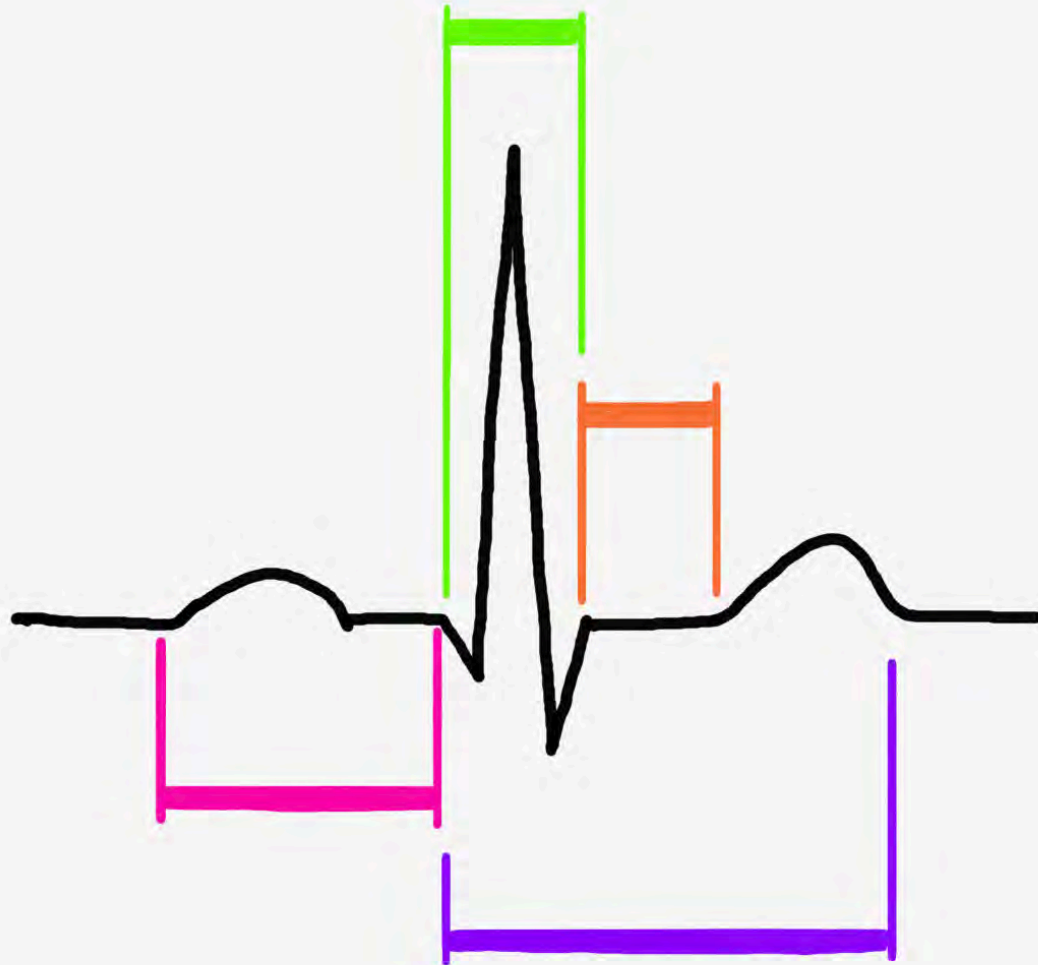


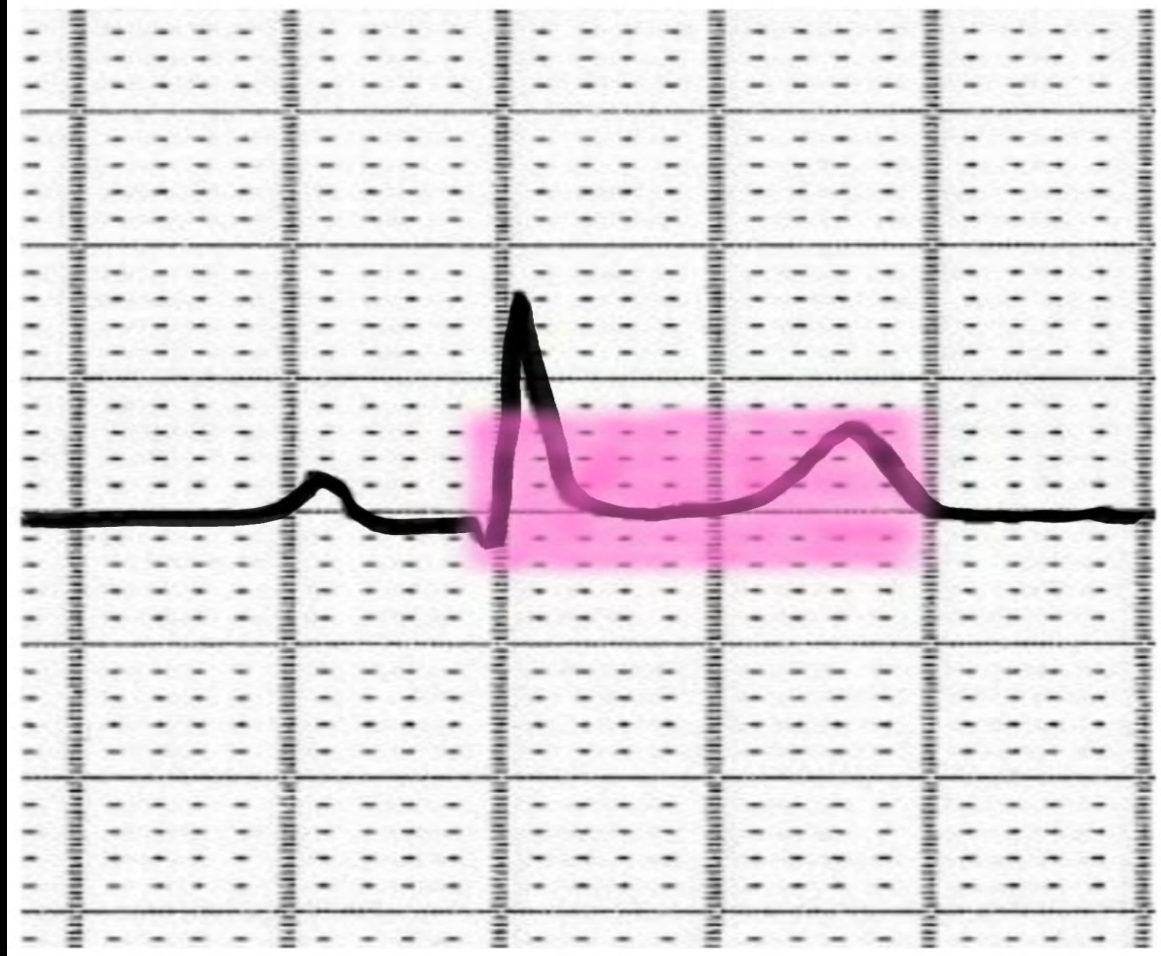
RR-INTERVAL

- Distance between QRS-Complexes, or the distance between heart beats in a normal sinus rhythm.



Let's Talk segments





QT interval:

- Men: under _____
- Women: Under _____

QT-INTERVAL

From beginning of Q-Wave to end of T-Wave. This is the period from beginning of ventricular depolarization to the end of repolarization.



The most prolonged qt ever...

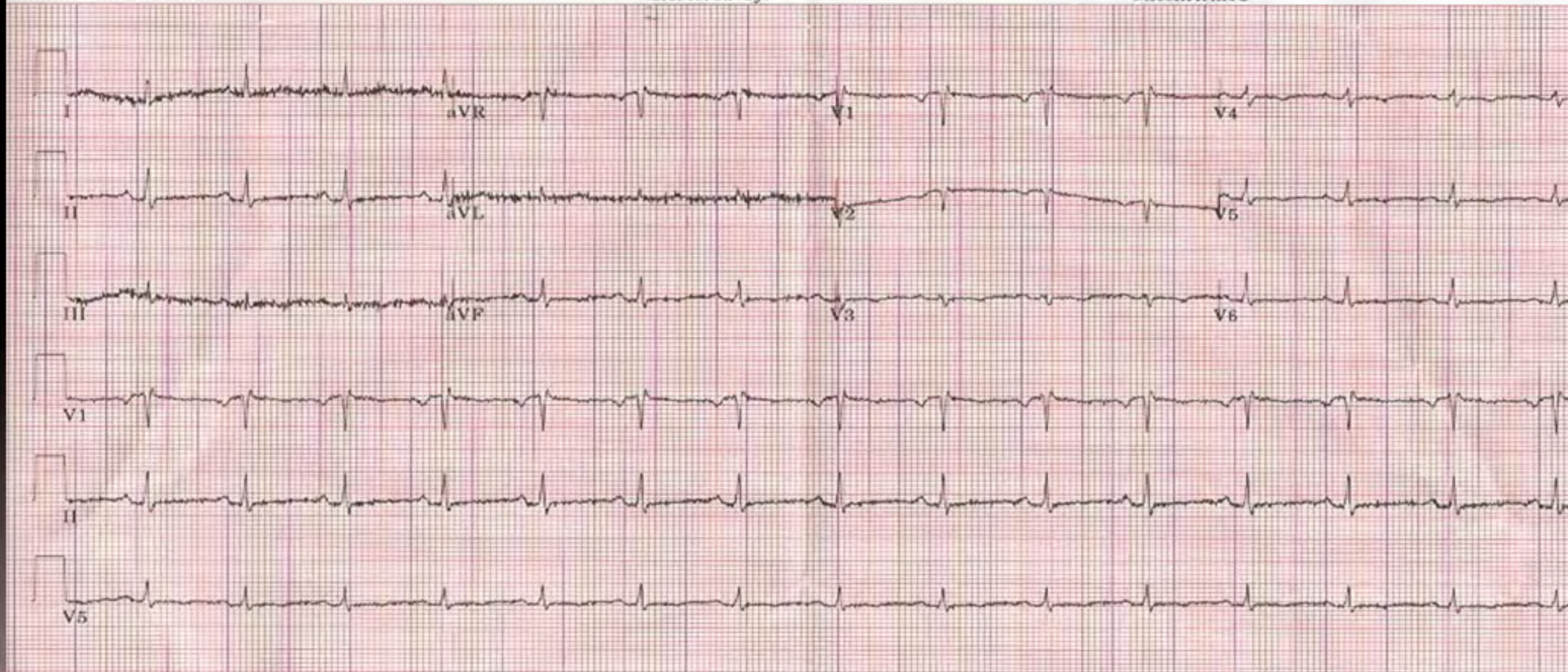
Vent. rate 91 bpm
PR interval 160 ms
QRS duration 78 ms
QT/QTc 580/713 ms
P-R-T axes 60 45 55

Normal sinus rhythm
Possible Left atrial enlargement
Low voltage QRS
Septal infarct, age undetermined
Prolonged QT
Abnormal ECG

Technician:
Test ind:

SCANNED

Referred by:



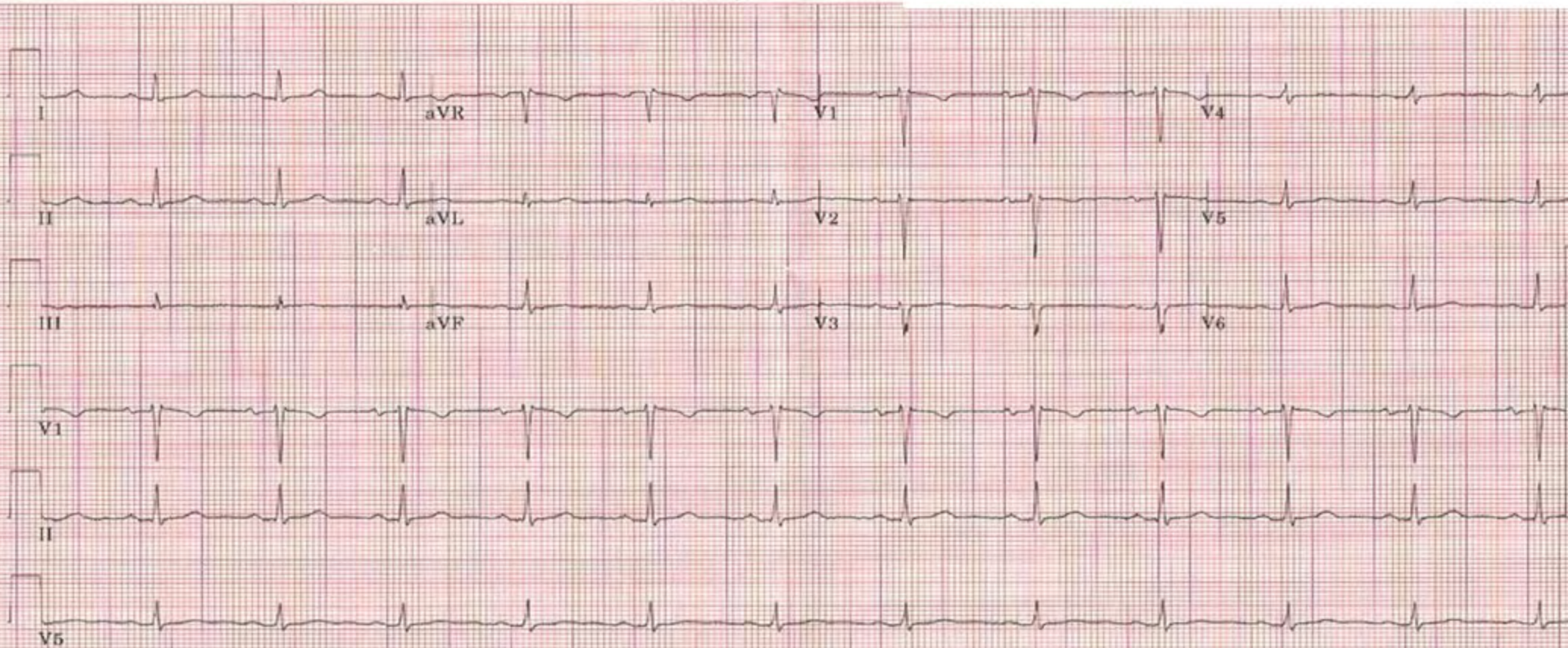
Or was it?

Vent. rate 74 bpm
PR interval 176 ms
QRS duration 86 ms
QT/QTc 400/444 ms
P-R-T axes 35 45 32

Normal sinus rhythm
Cannot rule out Anterior infarct, age undetermined
Abnormal ECG

Technician:
Test ind:

Referred by:



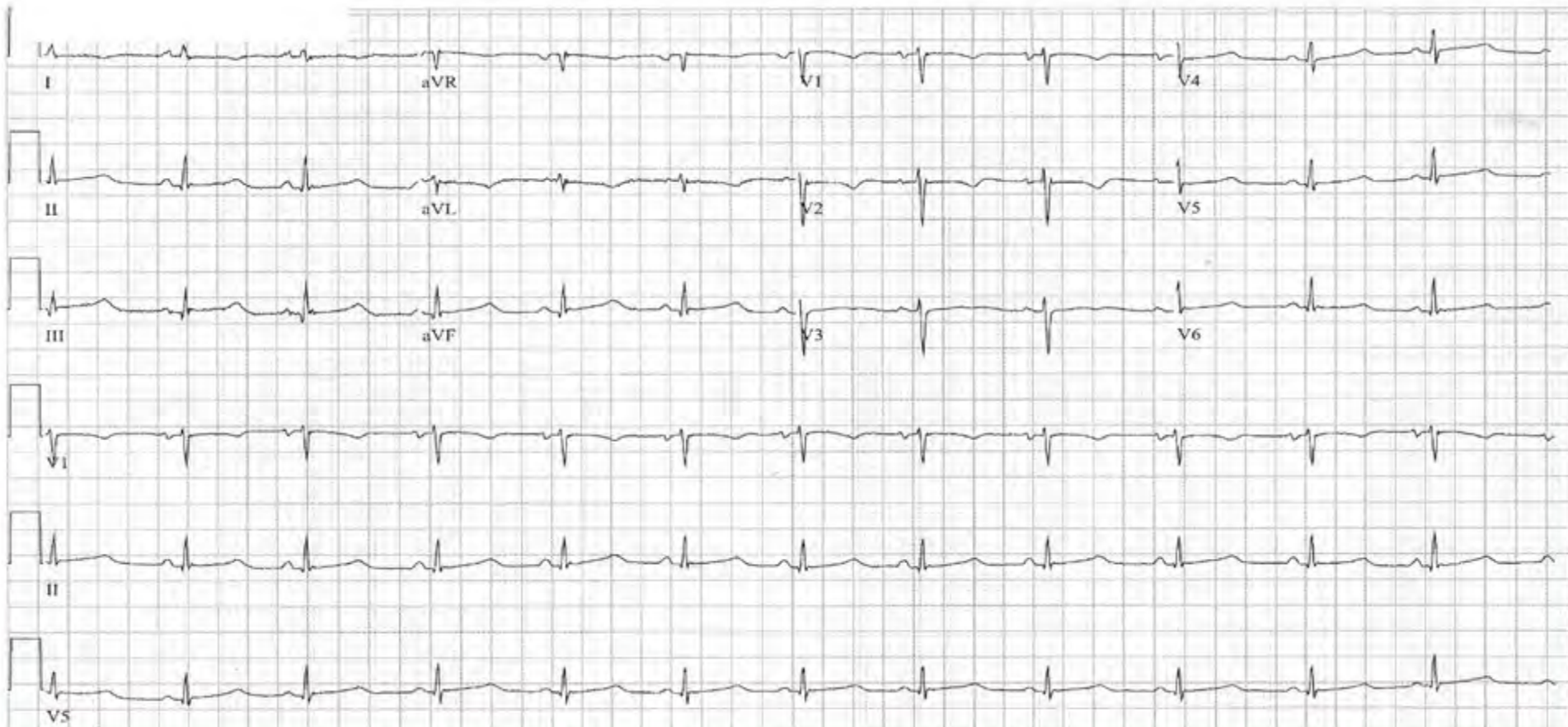
51 year old “general weakness”

- Felt unwell “like the water ran out of me”
- Under stress
- HX: HTN, psyche, chronic neck pain
- Drank alcohol, did cocaine
- Called 911...



There's no free lunch.

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
duration	76	ms	PROLONGED QT



Clinic EKG

Sex: Female BIRTH date: / / years

inch lb / mmHg

Medication 1:

Medication 2:

Room No.

JC

JB

Vent. rate 87 bpm

PR int. 178 ms

QRS dur. 80 ms

QT/QTc int. 366/ 441 ms

P/QRS/T axis 78/ 72/ -30 °

RV5/SV1 amp. 0.815/ 1.370 mV

RV5+SV1 amp. 2.185 mV

Unconfirmed Report

Reviewed by:

10 mm/mV

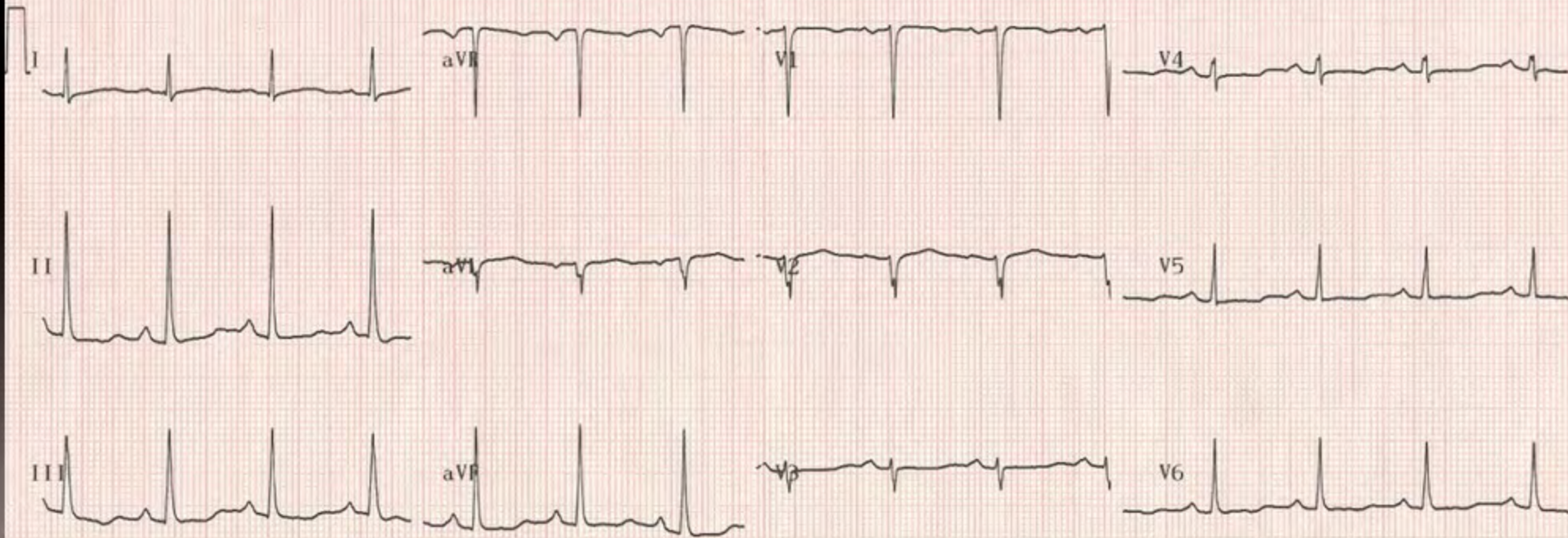
25 mm/s

Filter 100 Hz H 60 d

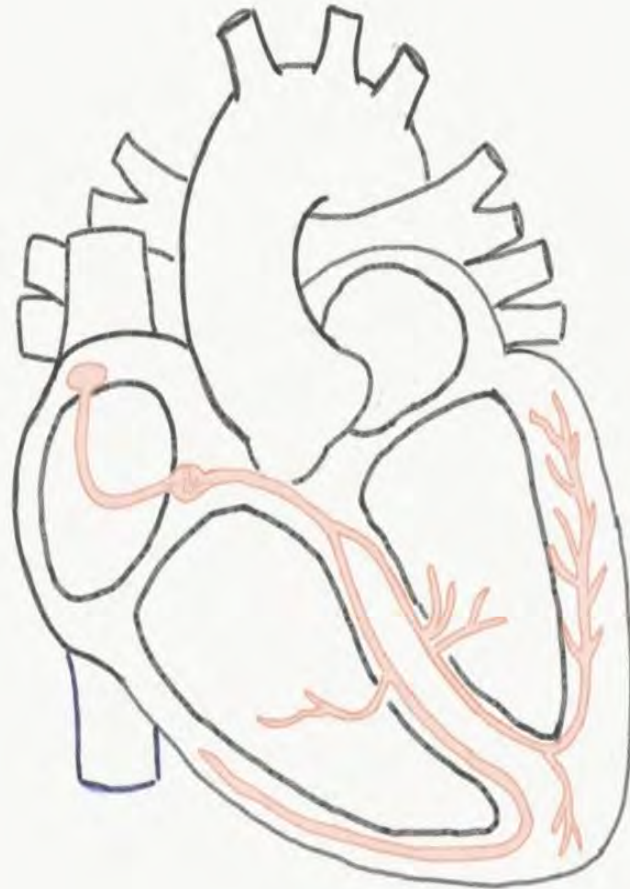
10 mm/mV

10 mm/mV

10 mm/mV



Let's Talk Conduction





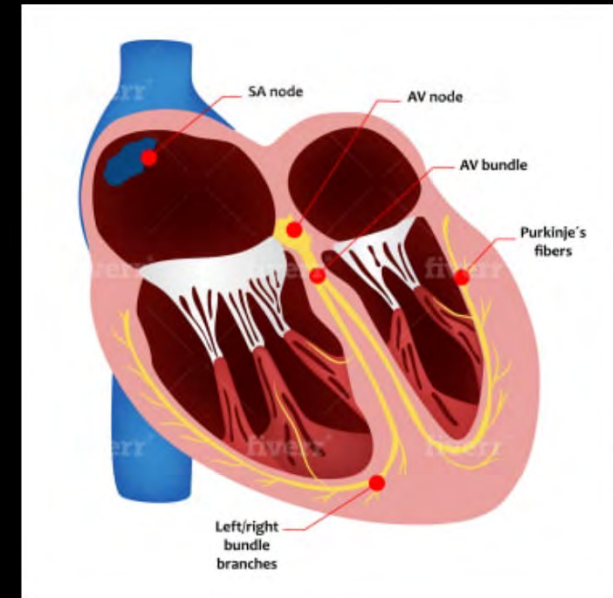
You need 1
"man" in
charge

60-100

40-60

20-40

0-20



Narrow vs. Wide

- **Narrow** - coming from above the ventricles
- **Wide** - Coming from the ventricles

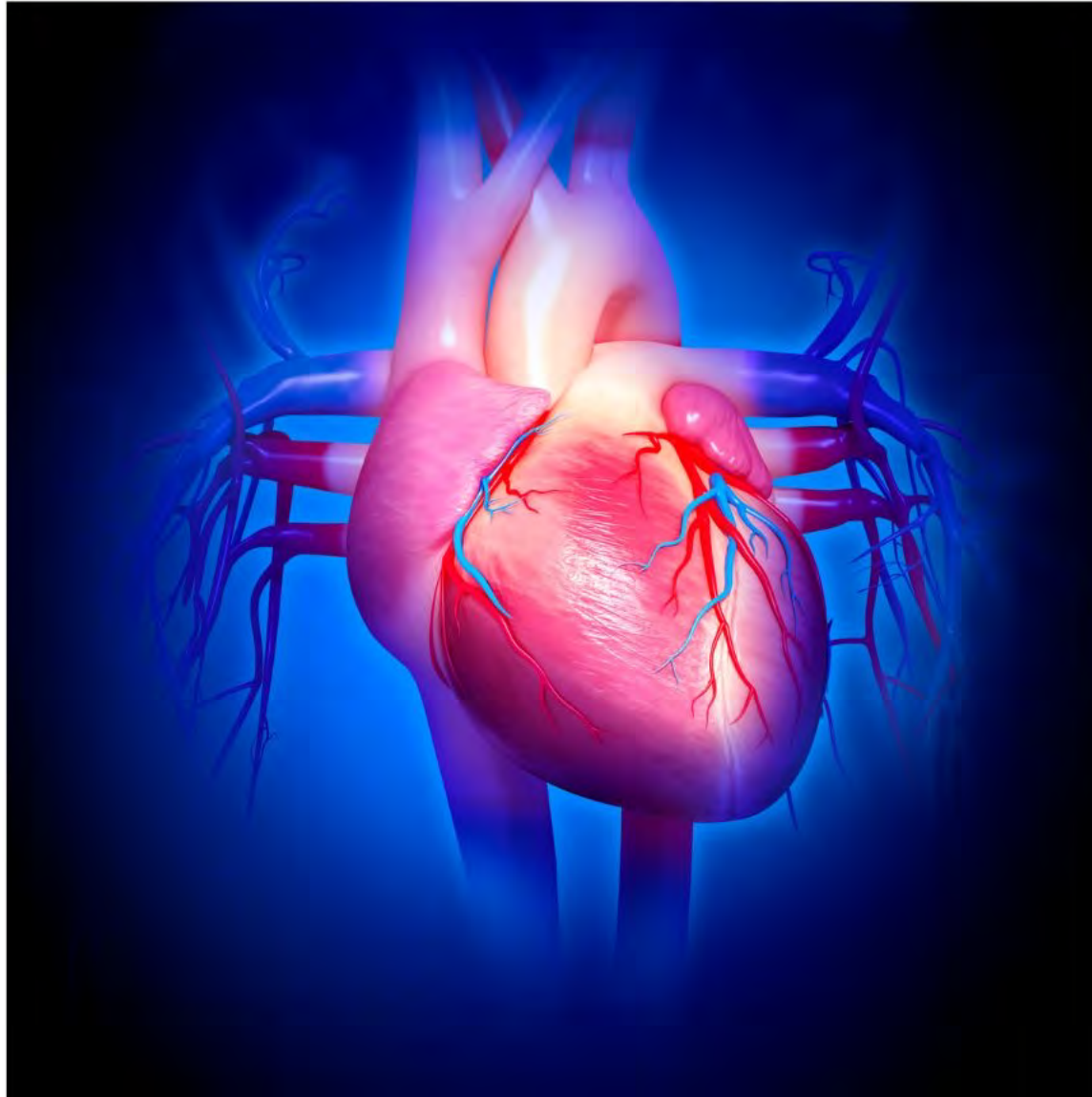
- (**Wide** but.....SVT with aberrancy, Pacer, WPW, hyperkalemia)



PATTERN RECOGNITION

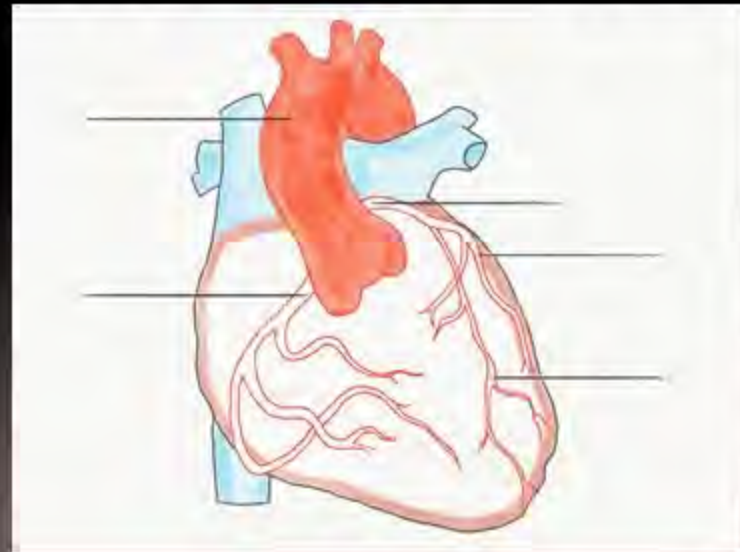


ANATOMY REVIEW



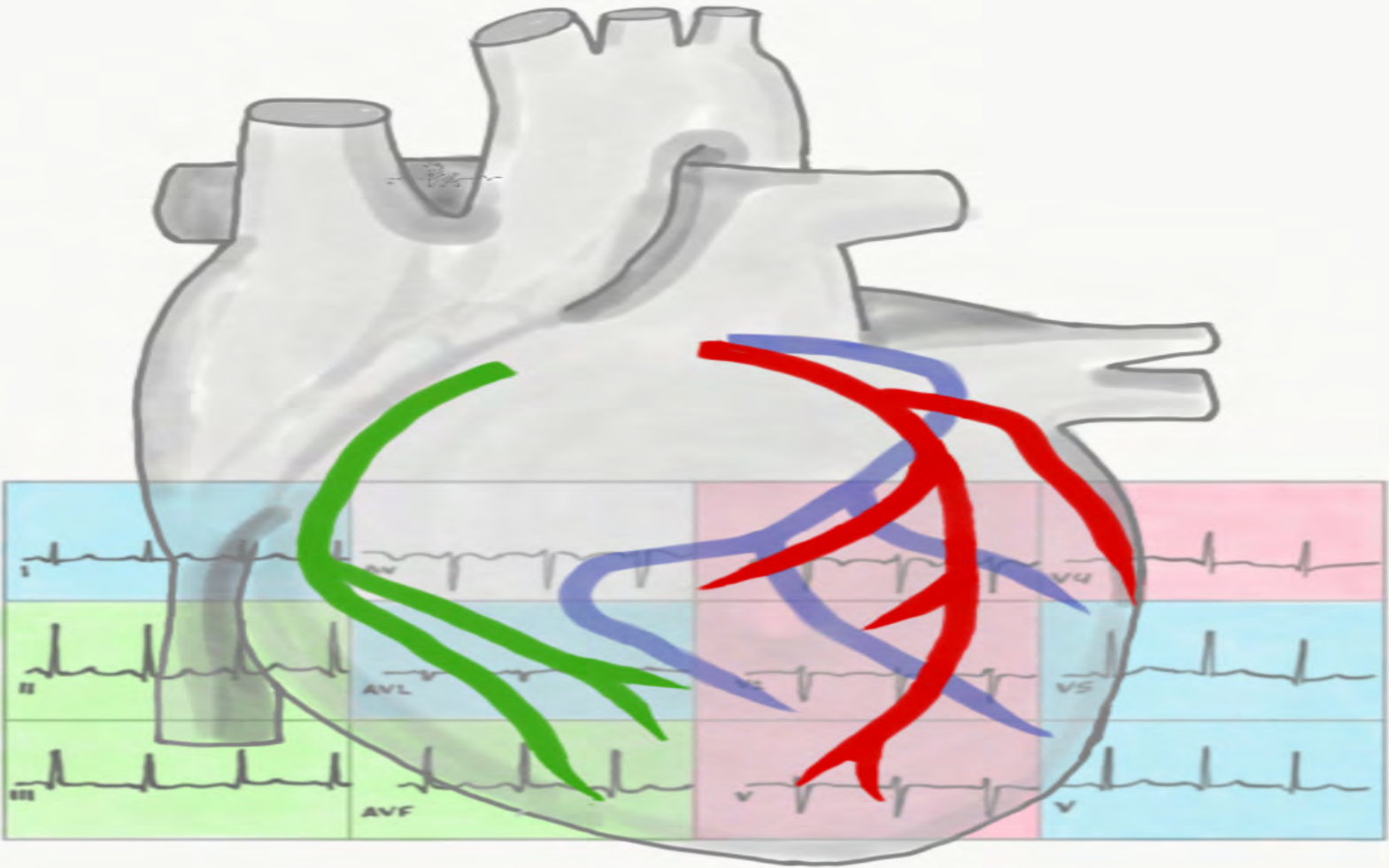
RCA - Right Coronary Artery

- This supplies blood to the right ventricle, the right atrium, and the SA (sinoatrial) and AV (atrioventricular) nodes, which regulate the heart rhythm. The right coronary artery divides into smaller branches, including the right posterior descending artery and the acute marginal artery.
- Inferior
- II, III, AVF



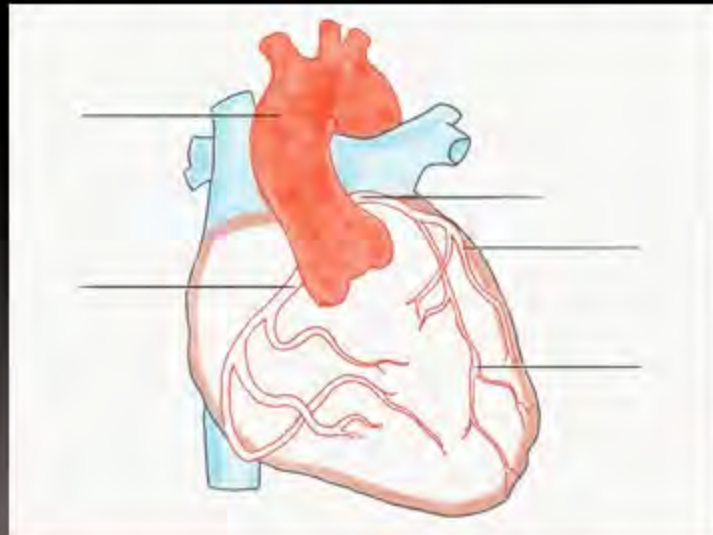
CONTIGUOUS LEADS

- Are next to each other, anatomically speaking. They are all touching, and in the same general region (like the left ventricle, for example).



CIRC - Circumflex Artery

- This branches off of the left coronary artery and supplies most of the left atrium: the posterior and lateral free walls of the left ventricle, and part of the anterior papillary muscle.
- Lateral
- I, AVL, V5, V6

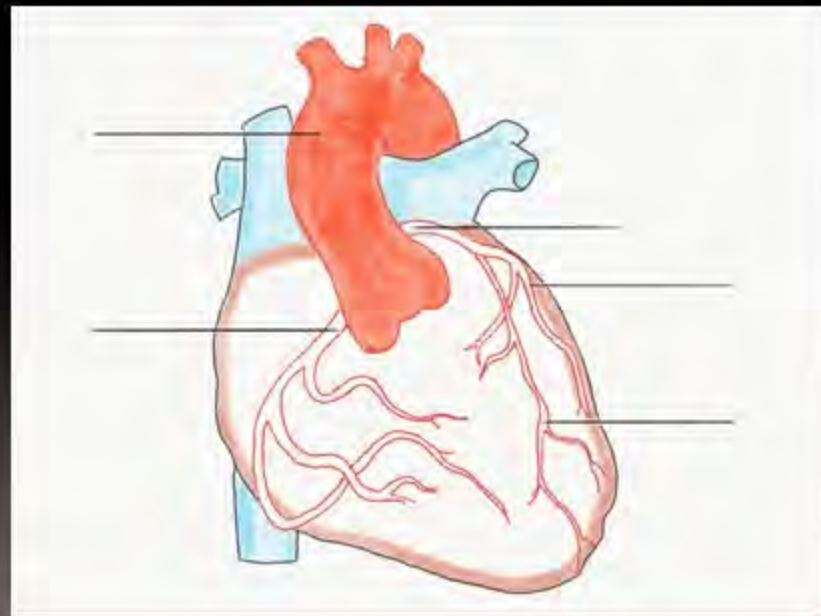


LAD - Left Anterior Descending

This supplies the anterior two-thirds of the septum. The LAD is one of two major branches of the LMCA, (left main coronary artery) with the other being the left circumflex (LCx) coronary arteries. Combined, these two supply blood to the left atrium and left ventricle.

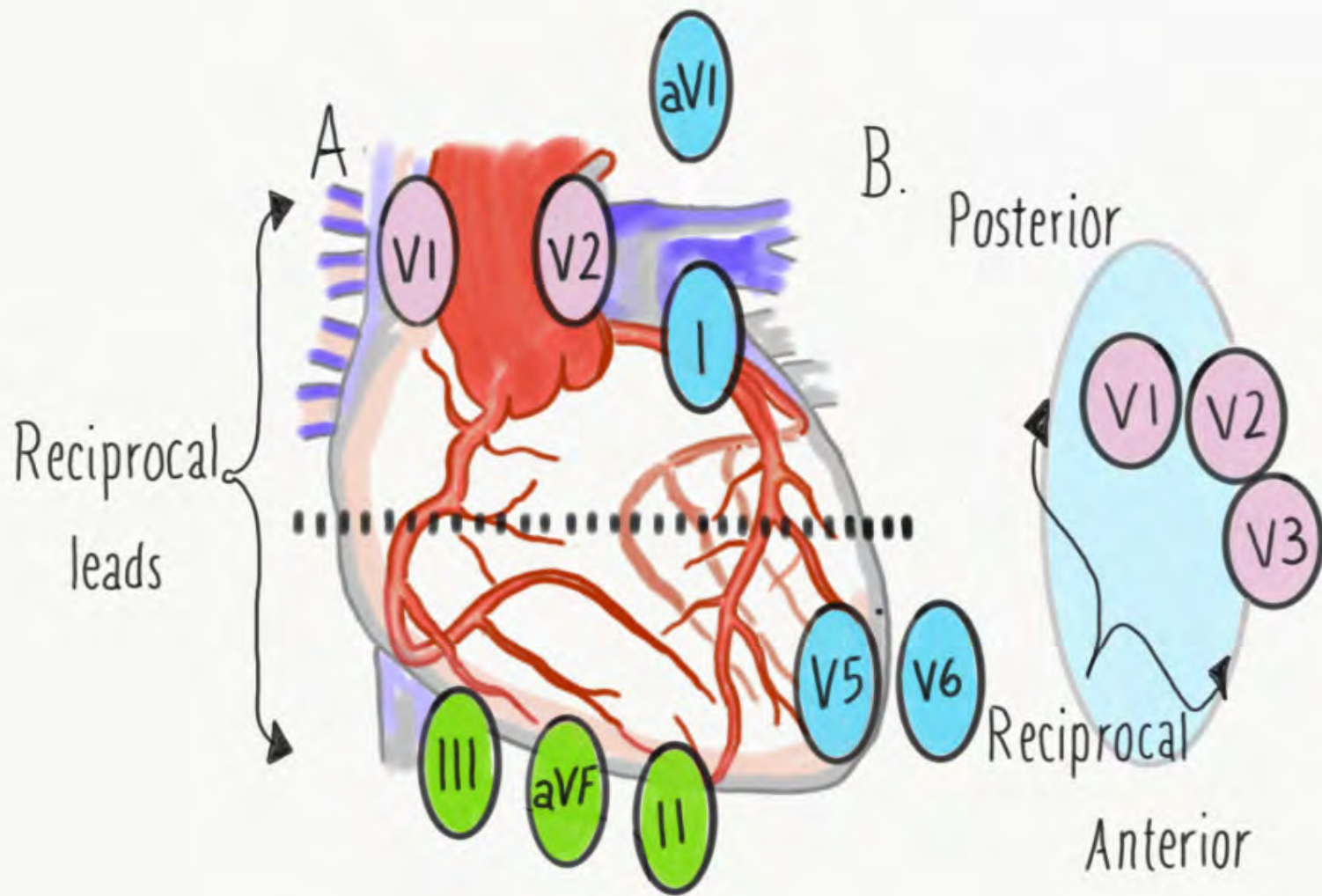
Anterior

V1, V2, V3, V4

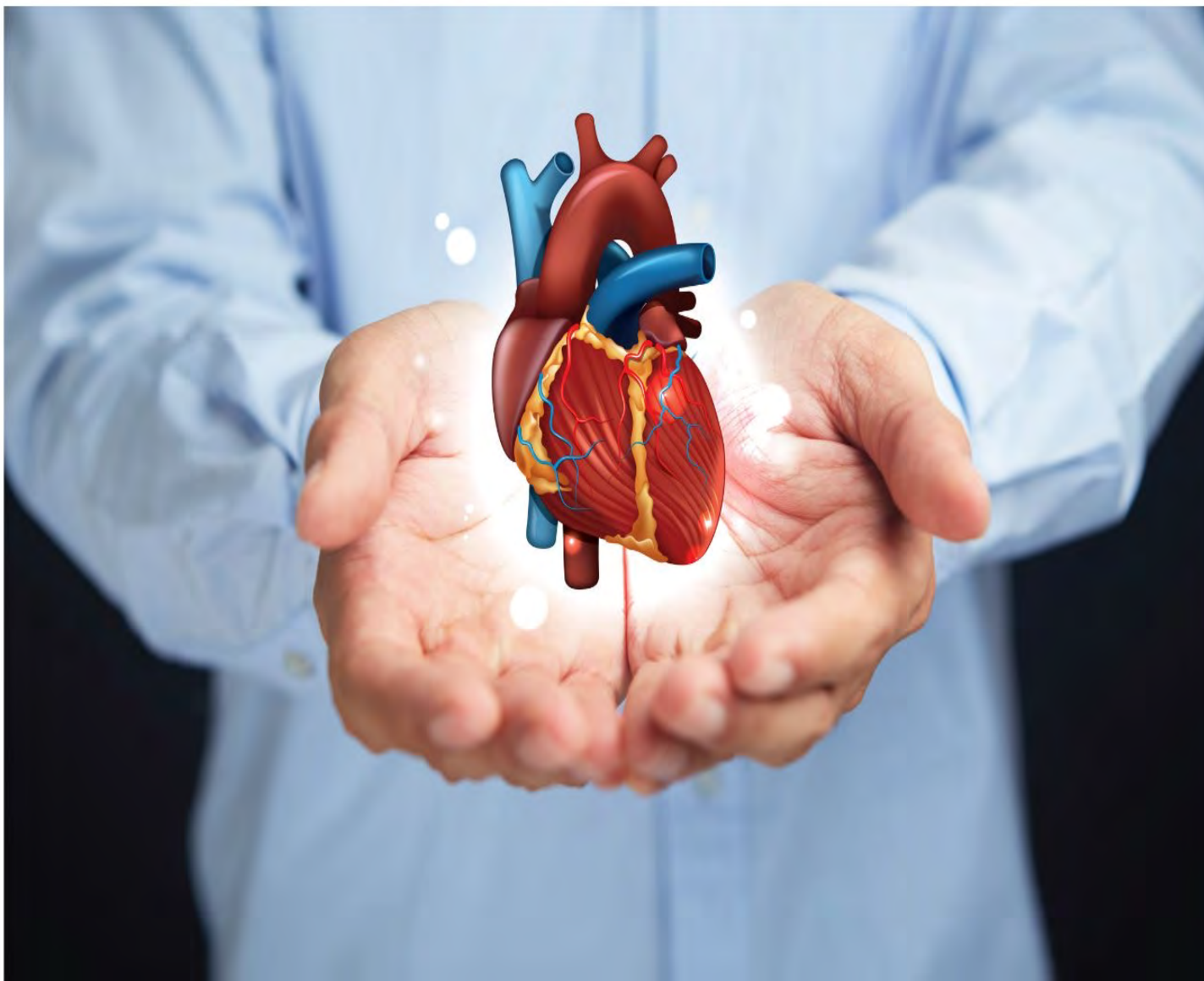


RECIPROCAL CHANGES

- Is defined as ST-segment depression occurring on an ECG which also has ST-segment elevation in at least 2 leads in a single anatomic segment.

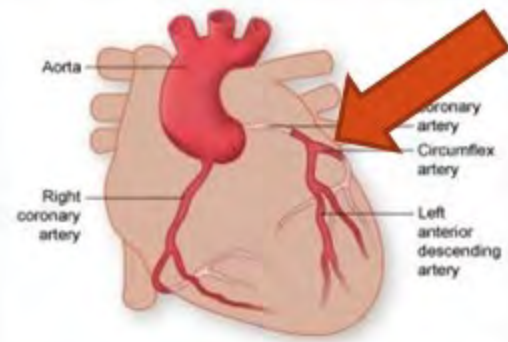


HANDS ON



(60-100) Vent. rate 94 bpm
 (120-200) PR interval 116 ms
 (<120) QRS duration 78 ms
 (<460) QT/QTc 366/457 ms
 (0-90 Axis) P-R-T axes 46 66 35

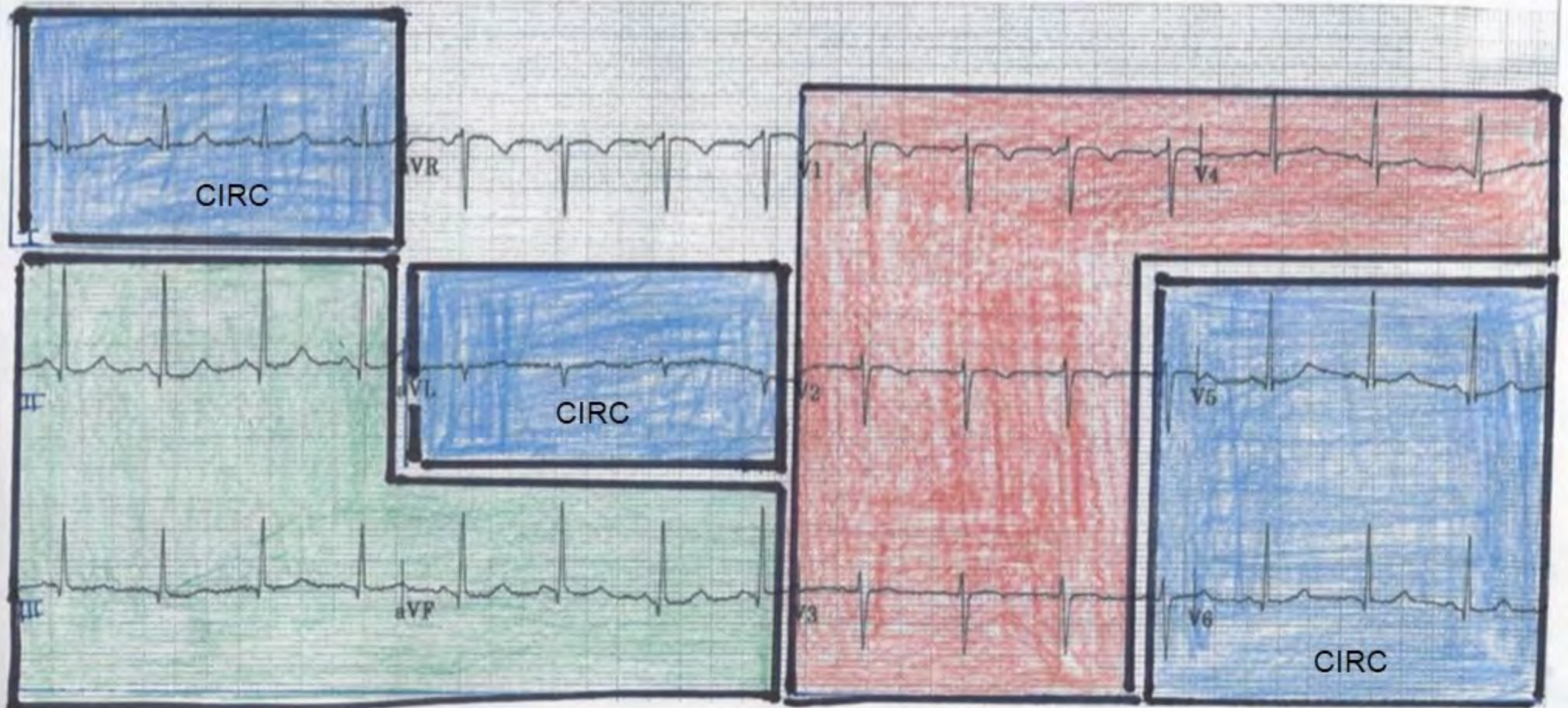
Normal sinus rhythm
 Normal ECG



Technician: 45
 Test ind: SOB

Referred by:

Unconfirmed



(60-100)

(120-200 ms)

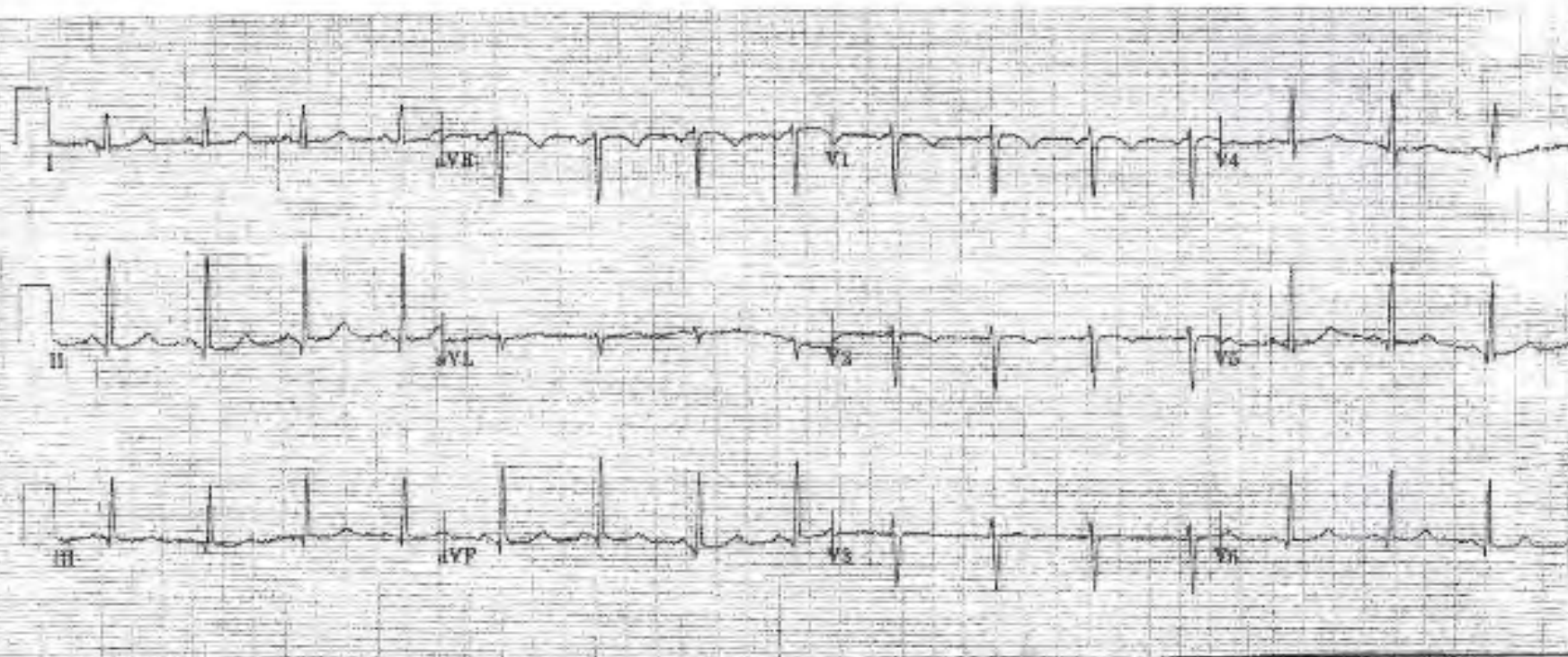
(<120)

(<460)

(0-90)

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Normal sinus rhythm
Normal ECG



(60-100)

(120-200 ms)

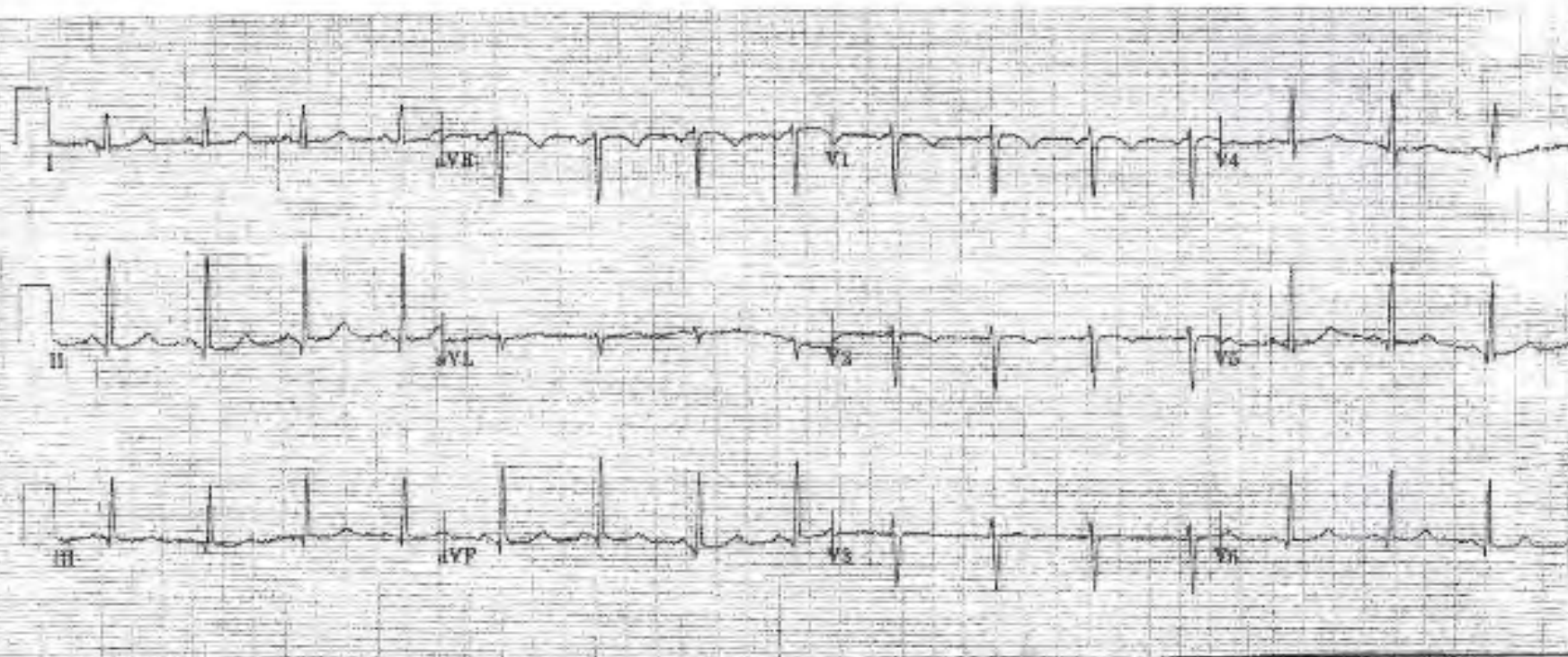
(<120)

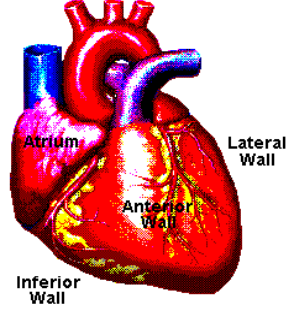
(<460)

(0-90)

Vent rate 94 bpm
PR interval 116 ms
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Normal sinus rhythm
Normal ECG





Green: RCA
Pink: LAD
Blue: Circumflex

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Myocardial Infarction Window

Circle all relevant findings below

Lead I High Lateral	AVR	VI Anteroseptal	v4 Anterior
II Inferior	AVL High Lateral	V2 Anteroseptal	v5 Anterolateral
III Inferior	AVF Inferior	V3 Anterior	V6 Anterolateral

(60 - 100)
(120 - 200)
(< 120)
(< 460)
(0-90 Axis)

Vent. rate 94 bpm
PR interval 116 ms
QRS duration 78 ms
QT/QTc 366/457 ms
P-R-T axes 46 66 35

Normal sinus rhythm
Normal ECG

Technician: 45
Test ind: SOB

Time 17:00
Reviewed L
A

Referred by:

Unconfirmed

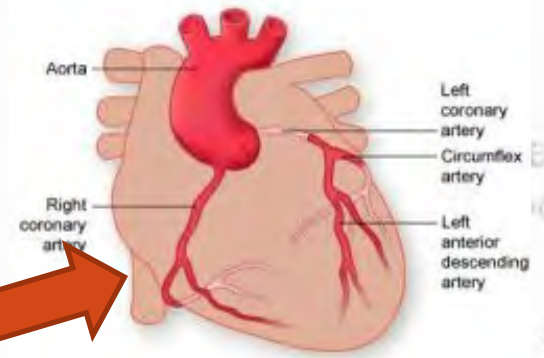
KEEP
IN
PERMANENT
RECORD



(60-100) Vent. rate 94 bpm
 (120-200) PR interval 116 ms
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 (0-90 Axis) P-R-T axes 46 66 35

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 Test ind: SOB

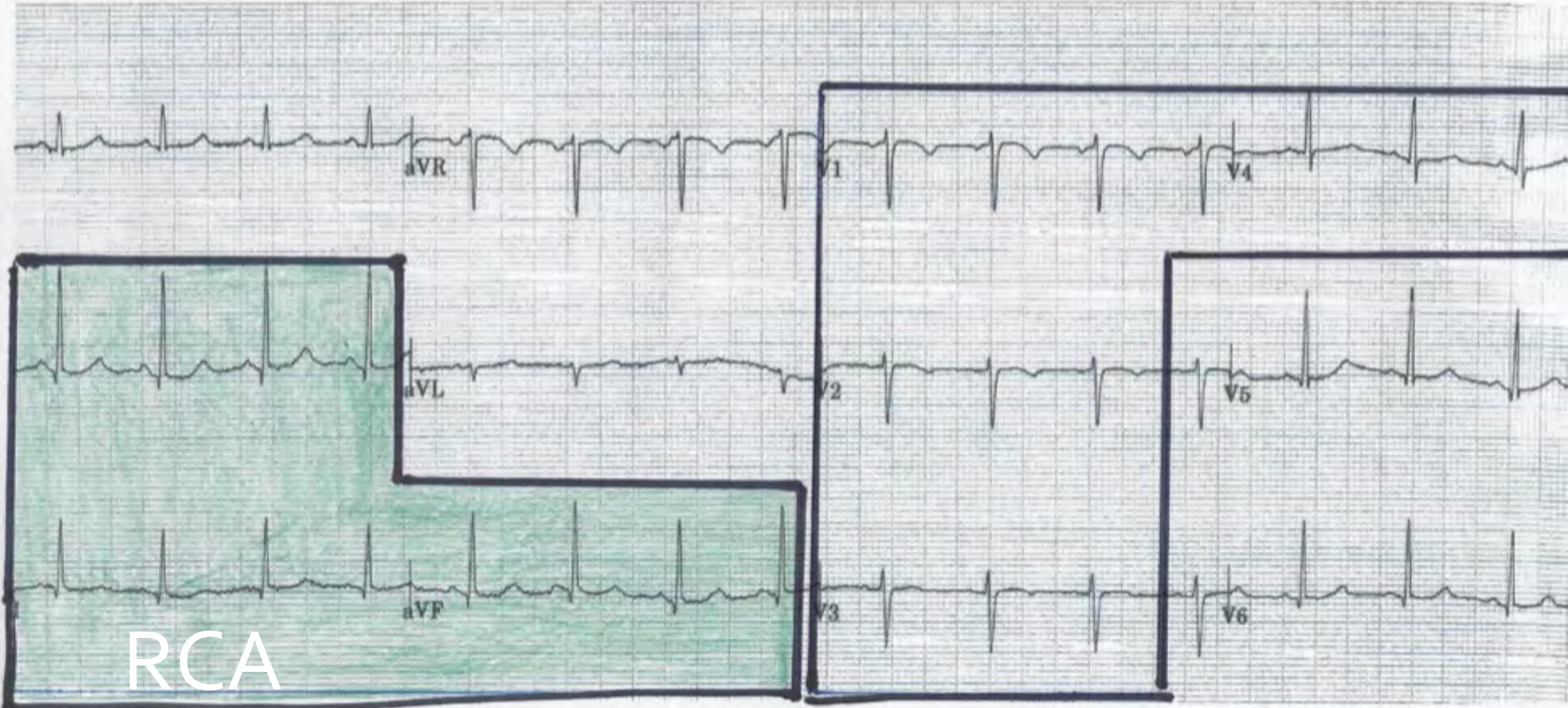
Normal sinus rhythm
 Normal ECG



Referred by:

Unconfirmed

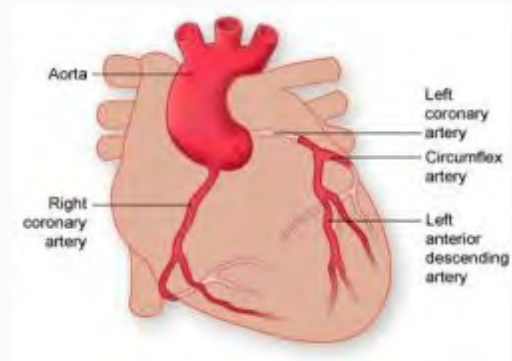
KEEP IN EPIMONITOR RECORD



(60-100) Vent. rate 94 bpm
 (120-200) PR interval 116 ms
 (<120) QRS duration 78 ms
 (<460) QT/QTc 366/457 ms
 (0-90 Axis) P-R-T axes 46 66 35

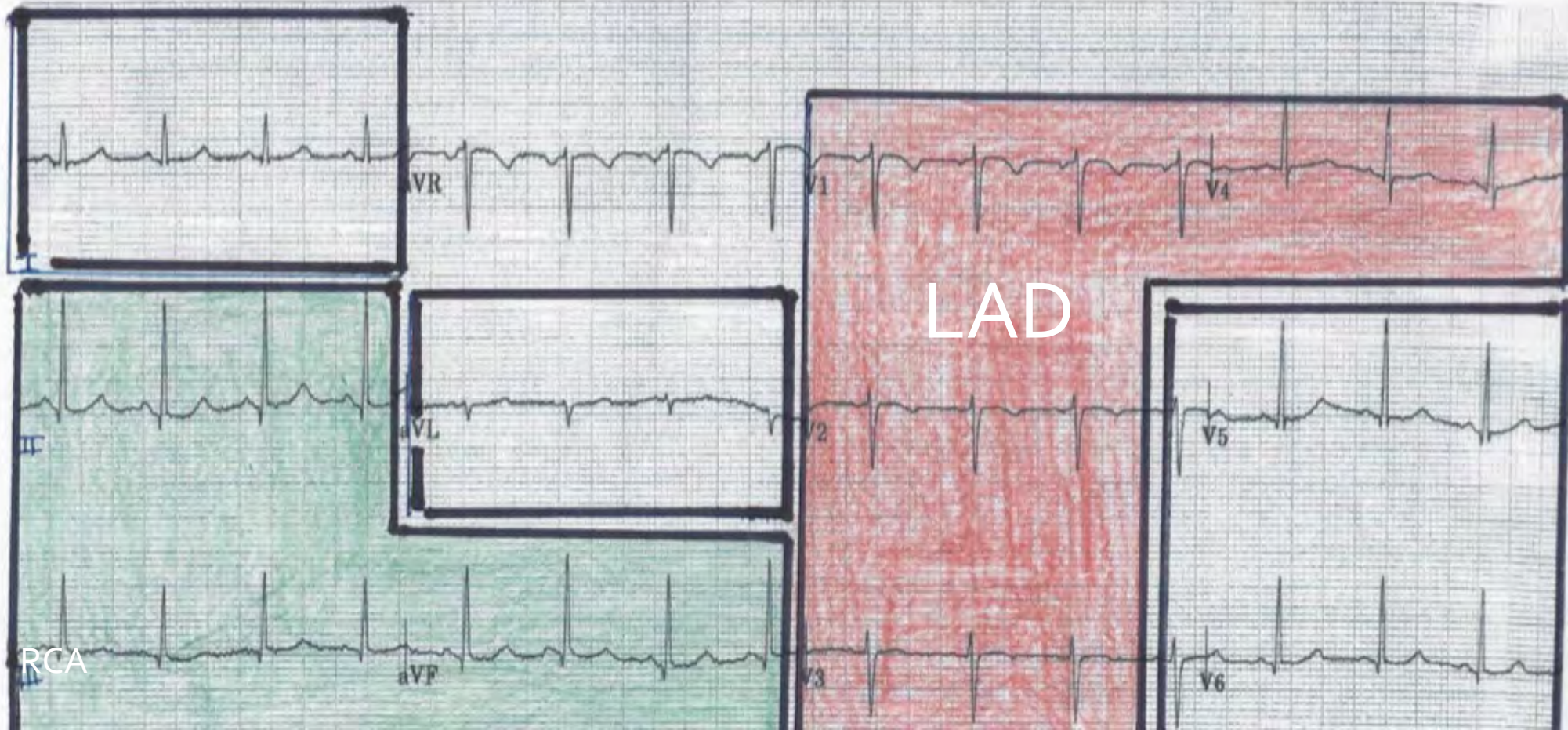
Normal sinus rhythm
 Normal ECG

Technician: 45
 Test ind: SOB



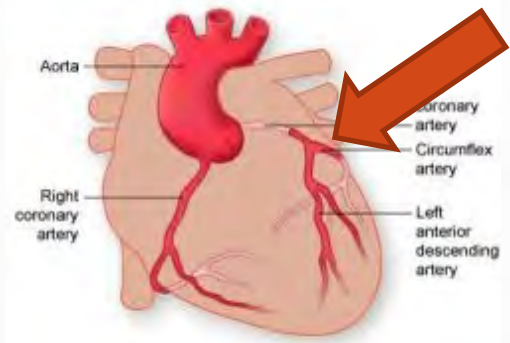
Referred by:

Unconfirmed



(60-100) Vent. rate 94 bpm
 (120-200) PR interval 116 ms
 (<120) QRS duration 78 ms
 (<460) QT/QTc 366/457 ms
 (0-90 Axis) P-R-T axes 46 66 35

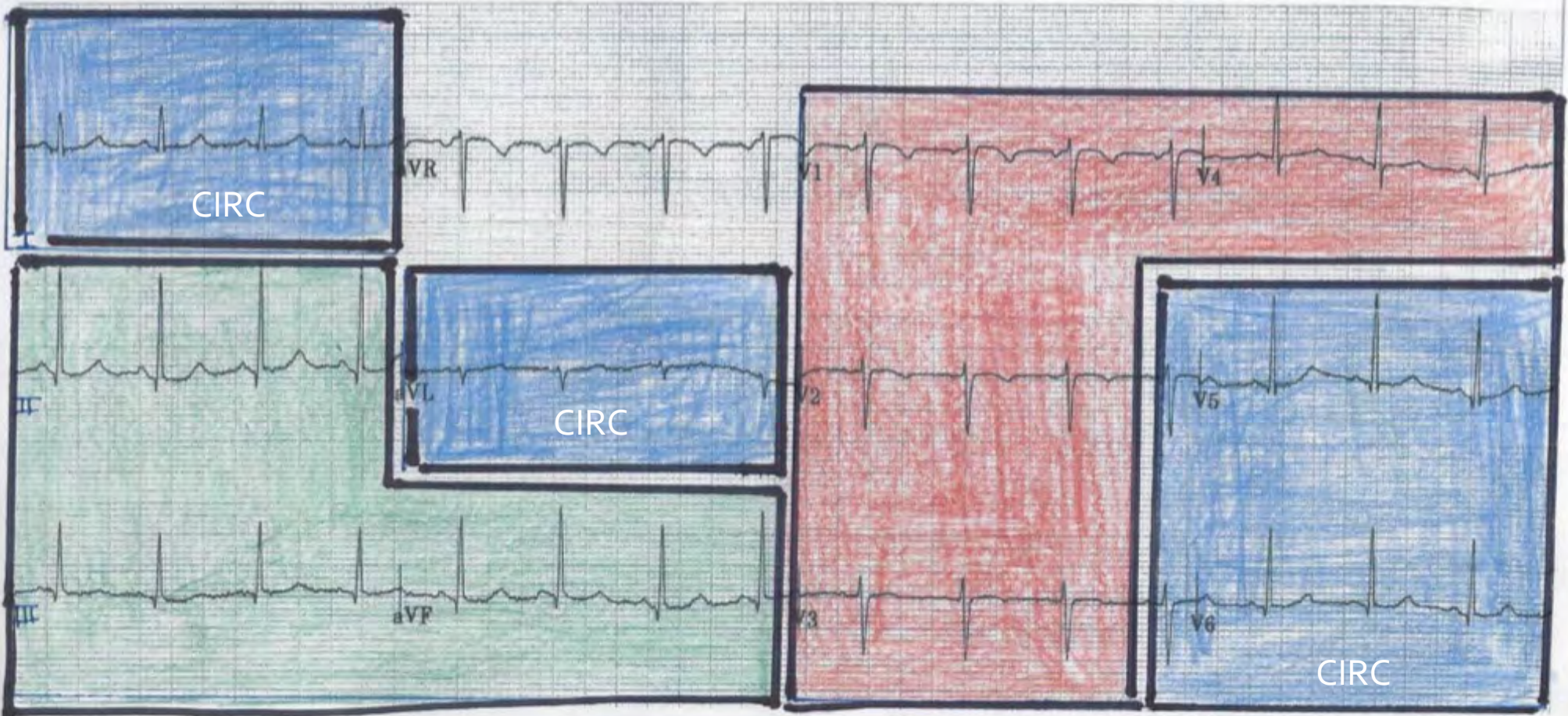
Normal sinus rhythm
 Normal ECG



Technician: 45
 Test ind: SOB

Referred by:

Unconfirmed



WHICH ONE ARE YOU MOST EXCITED

about?



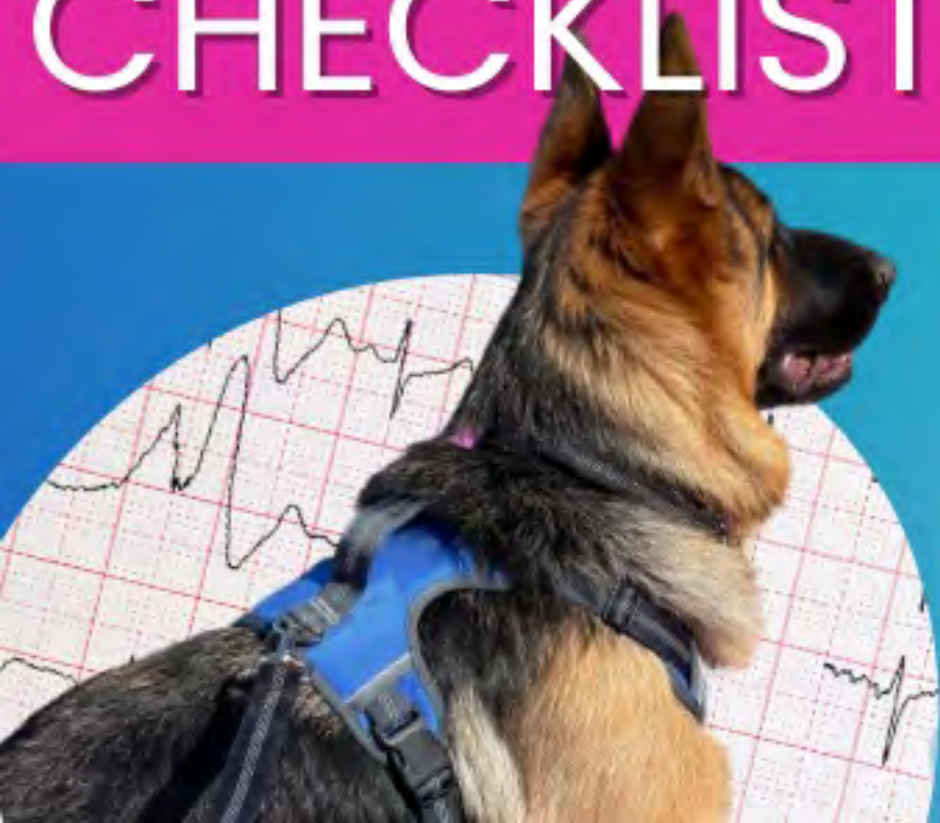


NORMAL

EKG

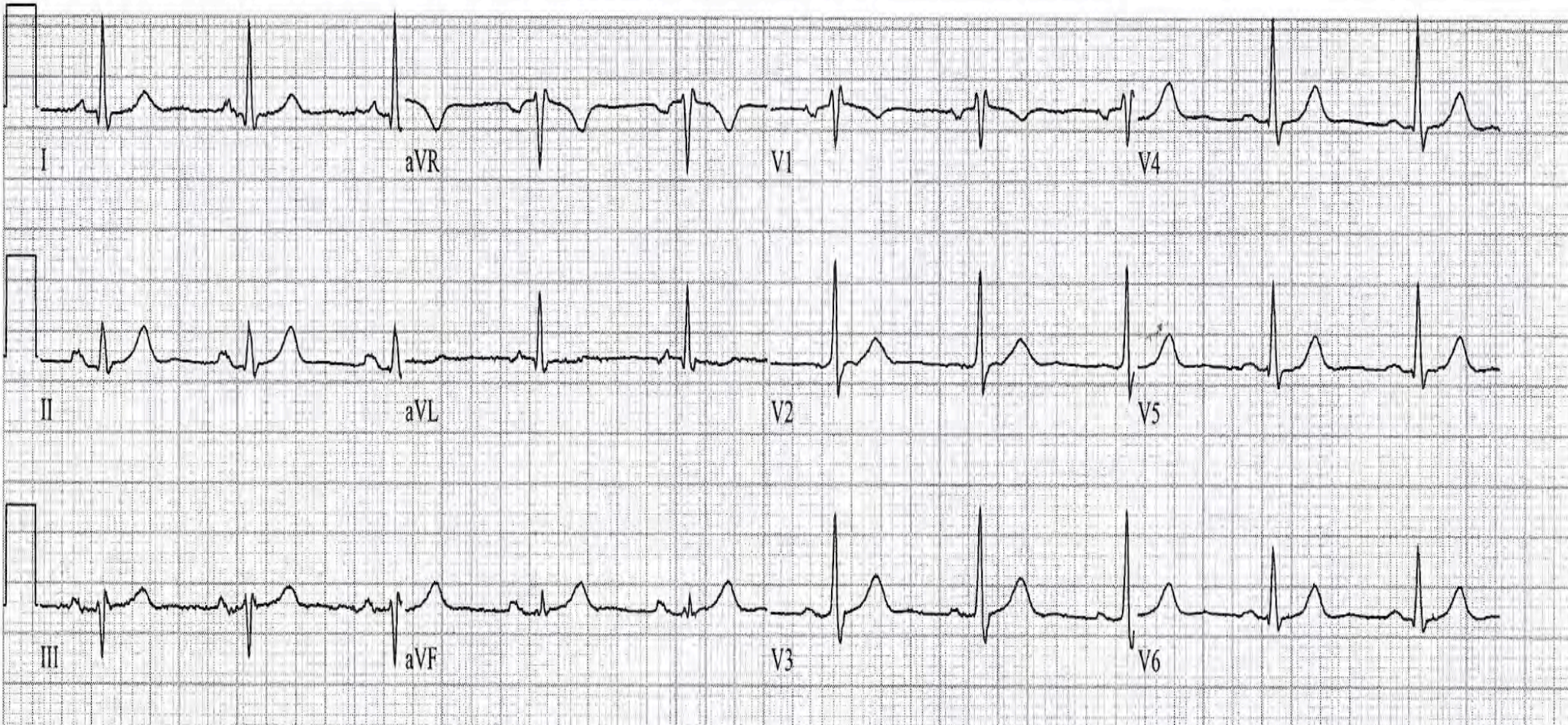
NORMAL EKG

CHECKLIST



- **FAMILY INTACT**
- **ALL WAVES FOLLOWING THE RULES!!**
- **VOLTAGE**
- **AXIS**
- **NO ECTOPY**
- **GOOD QUALITY TRACING**

All T waves need to be upright except for AVR, v1



10-STEP APPROACH TO READING AN EKG



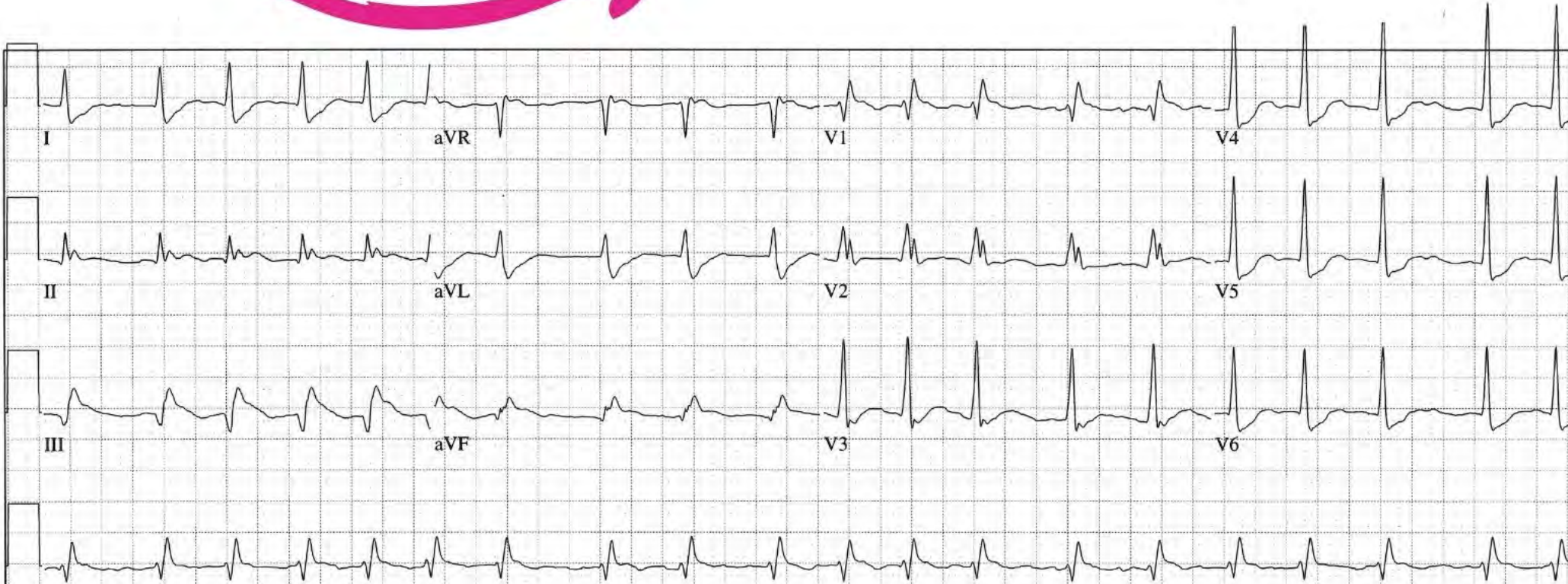
1. **"Big sick" vs "little sick"**
2. **Rate**
3. **Rhythm**
4. **Intervals**
5. **Axis**
6. **ST segments**
7. **Hypertrophy/voltage**
8. **T wave analysis - all wave**
9. **Q waves? Married? Wide?**
10. **Chief-complaint-based approach**

STEP 1: BIG SICK VS LITTLE SICK

*Pro
Tip!*

Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
**** ** ACUTE MI / STEMI ** ****
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



STOP!!!!!!

Don't pass go or collect \$200



Vent. rate 71 BPM
PR interval 164 ms
QRS duration 88 ms
QT/QTc 426/462 ms
P-R-T axes 27 31 83

*** Critical Test Result: STEMI
NORMAL SINUS RHYTHM
ST ELEVATION CONSIDER INFERIOR INJURY OR ACUTE INFARCT
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct

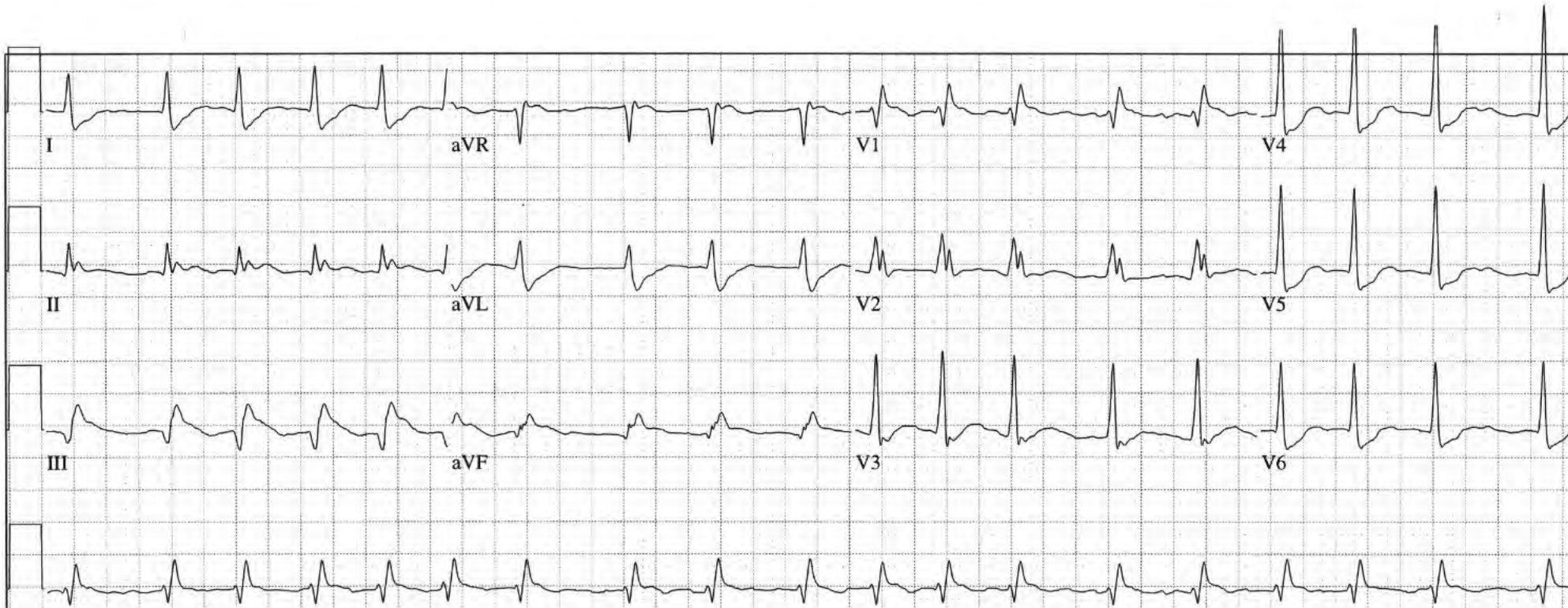




STEP 2: RATE

Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



STEP 3: RHYTHM

Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

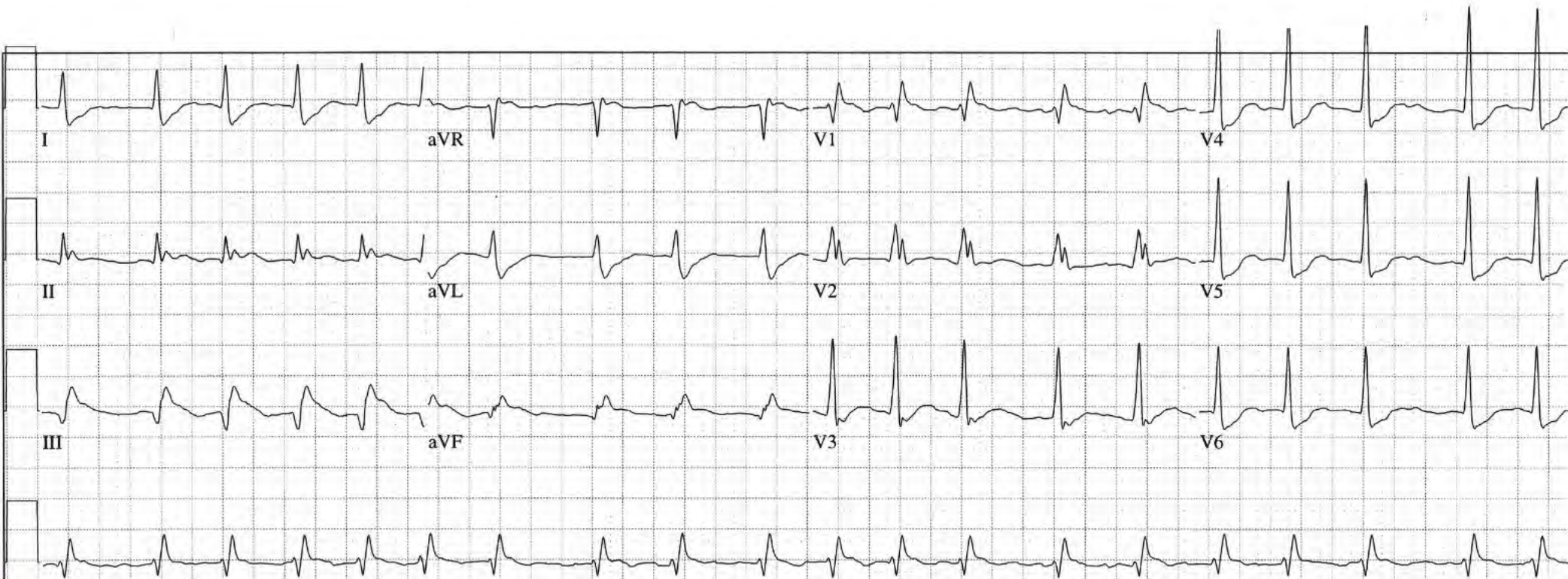
Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



STEP 4: INTERVALS

Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



WHY DO THESE MATTER?

Ventricular rate

84 BPM

(60-100)

PR interval

150 ms

(120-200)

QRS duration

76 ms

(<120)

QT/QTc

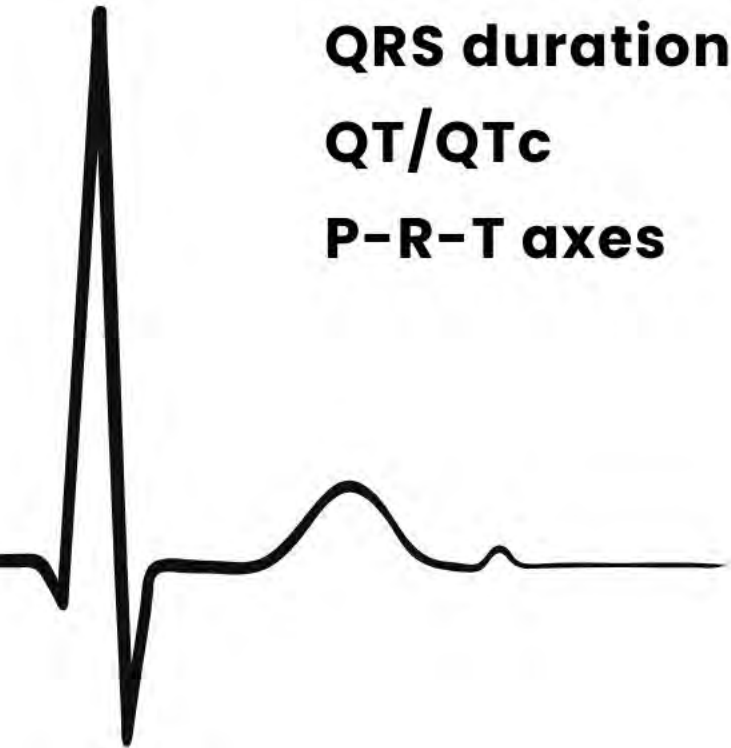
378/446 ms

(<460)

P-R-T axes

38-51-31

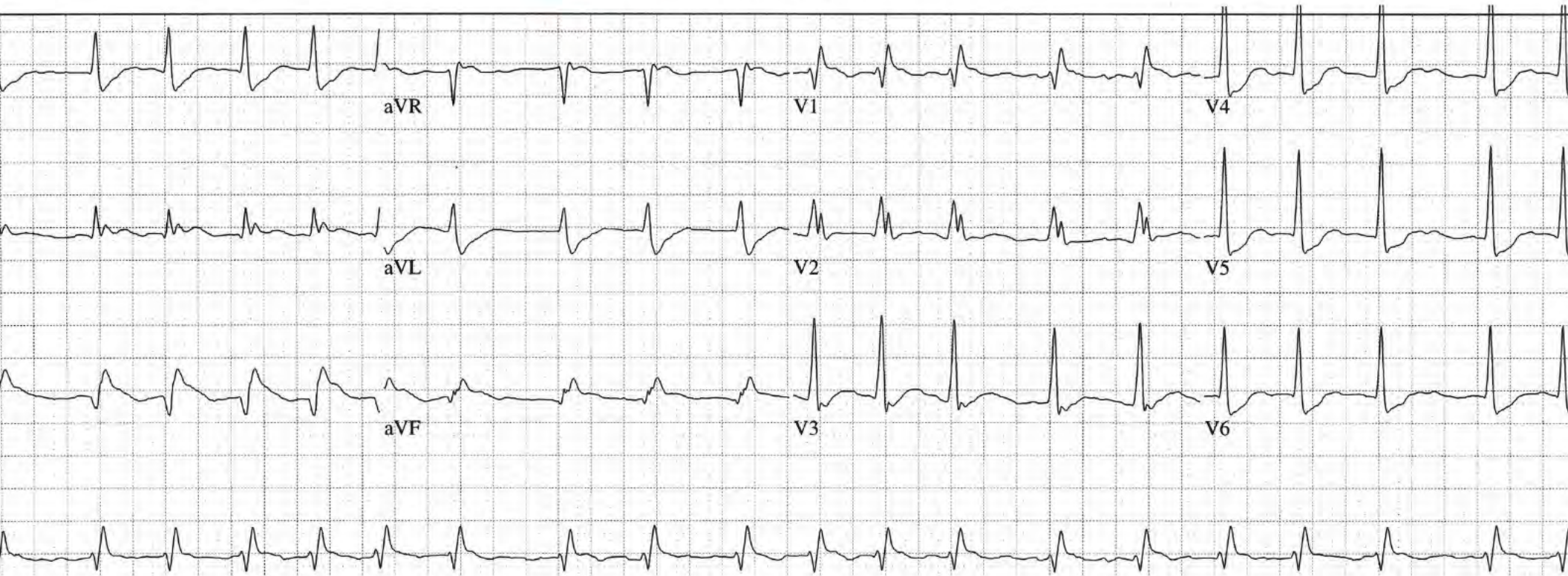
(0-90)



STEP 5: AXIS

Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG

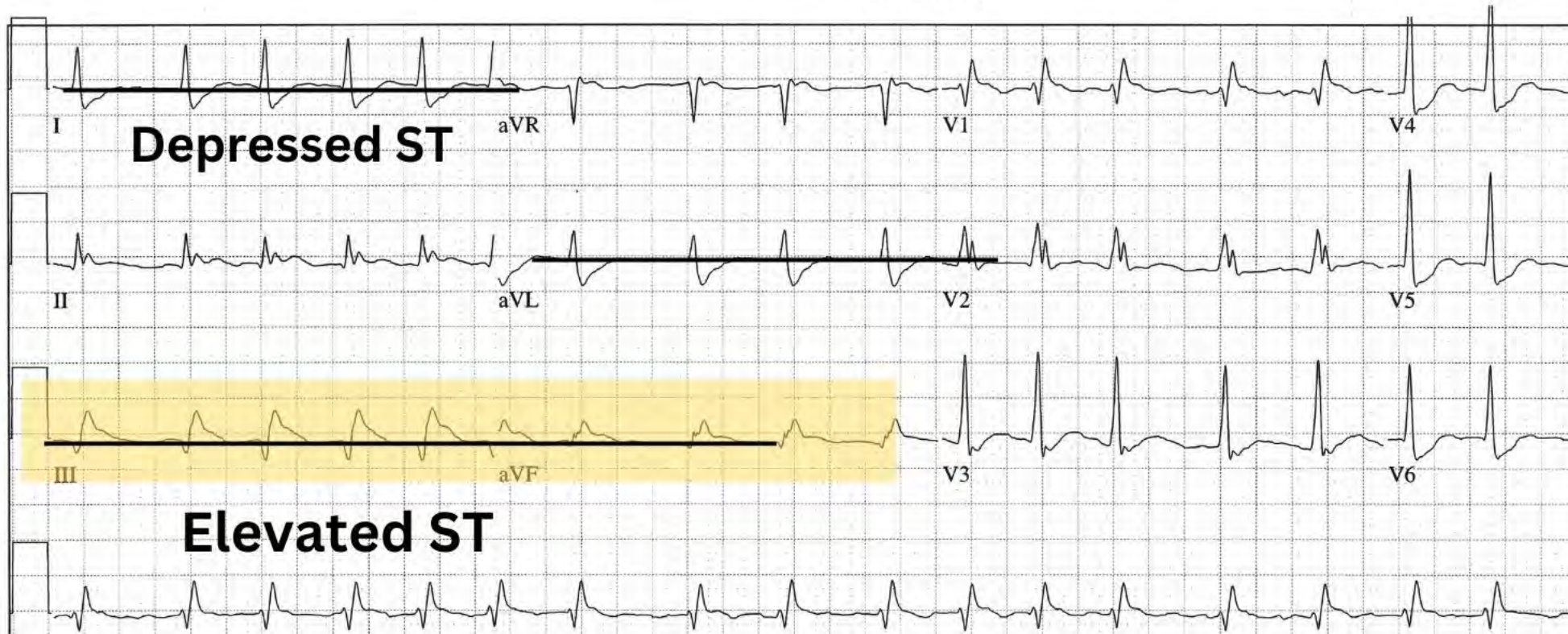


2 & 2

STEP 6: ST SEGMENTS

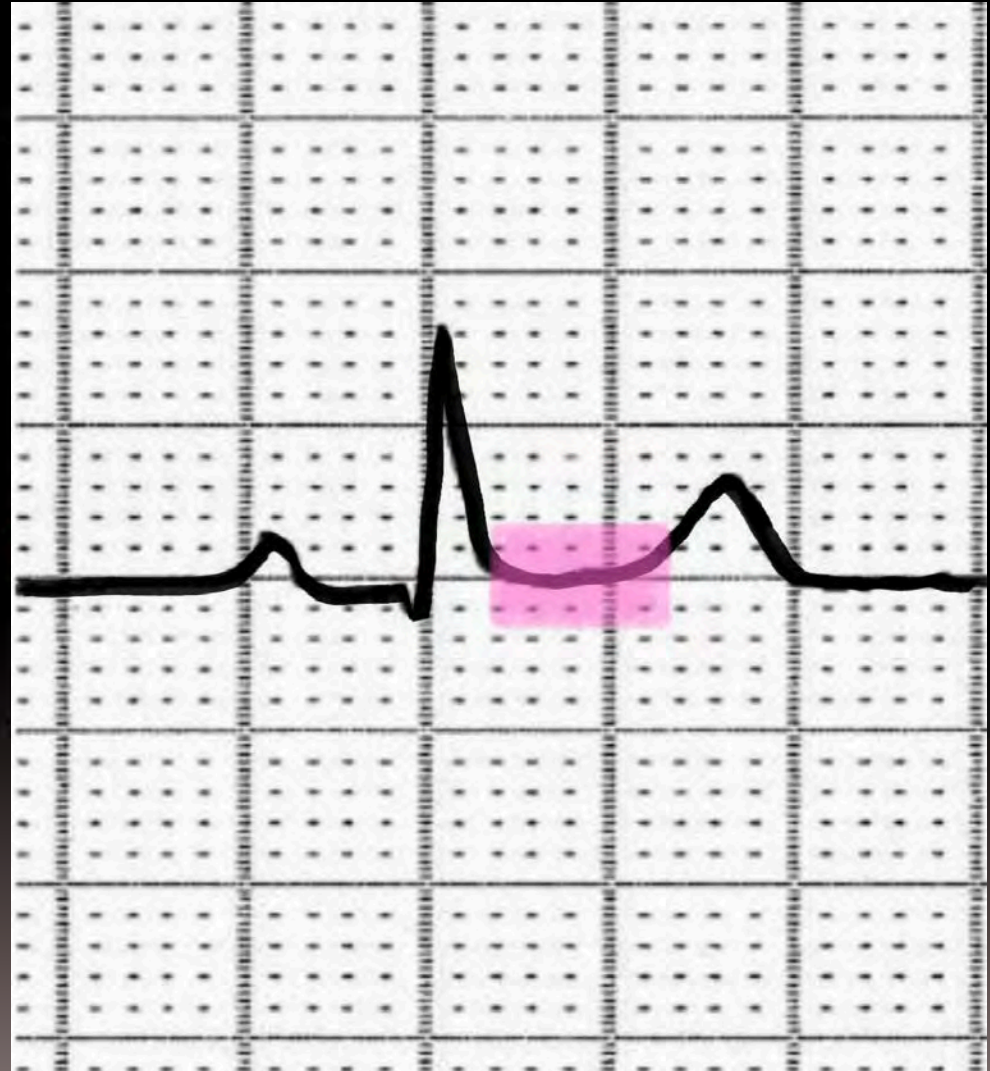
Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



ST-SEGMENT

Short segment from
end of S-Wave to
beginning of T-
Wave.



ST ELEVATION

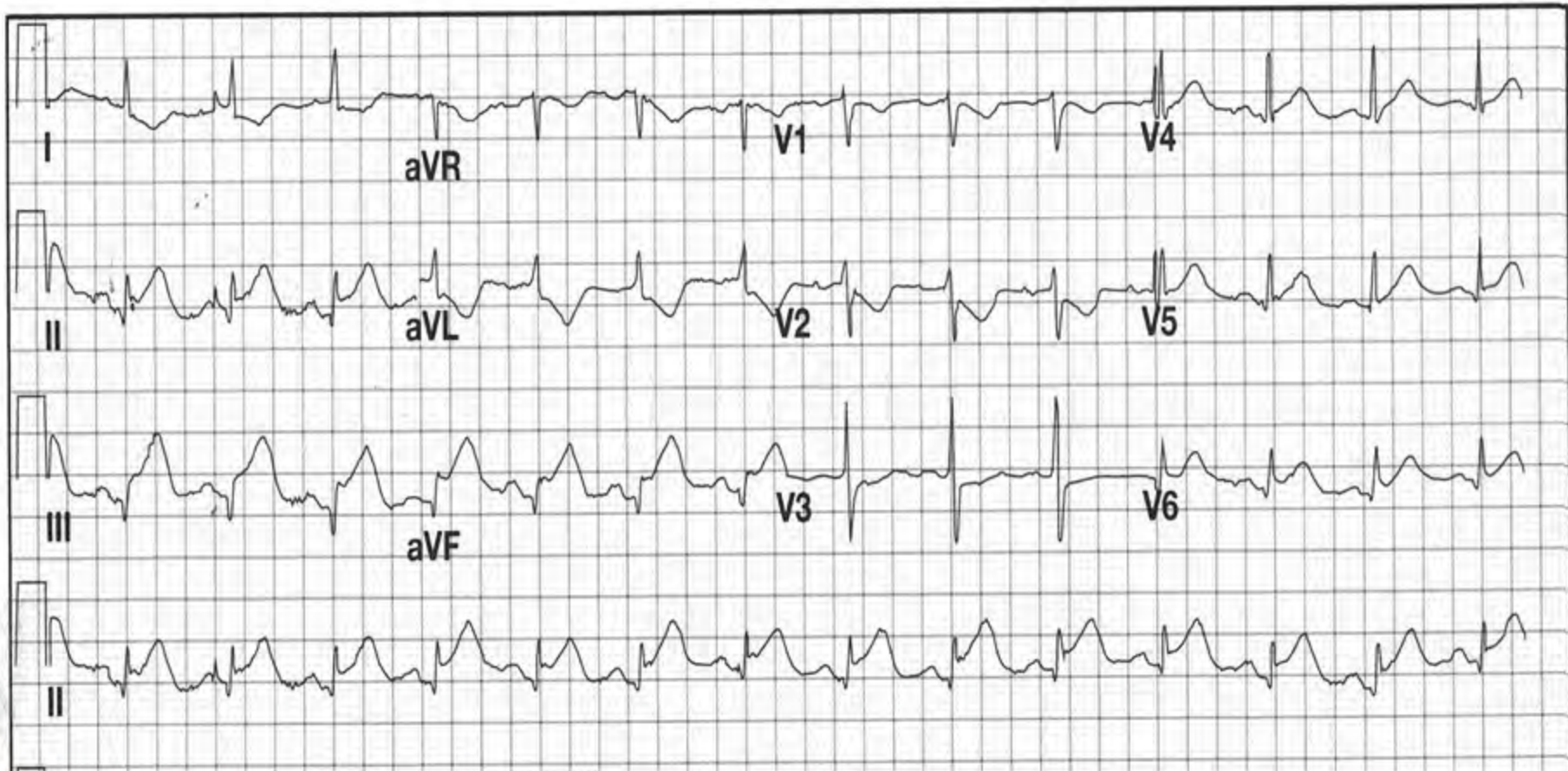
- Occurs when the ventricle is at rest and therefore repolarized, the depolarized ischemic region generates electrical currents that are traveling away from the recording electrode; therefore, the baseline voltage prior to the QRS complex



ST DEPRESSION

- Occurs when the J point is displaced below baseline. Just like ST elevation, not all ST depression represents myocardial ischemia or an emergent condition. Multiple conditions associated with ST depression include hypokalemia, cardiac ischemia, and medications such as digitalis.

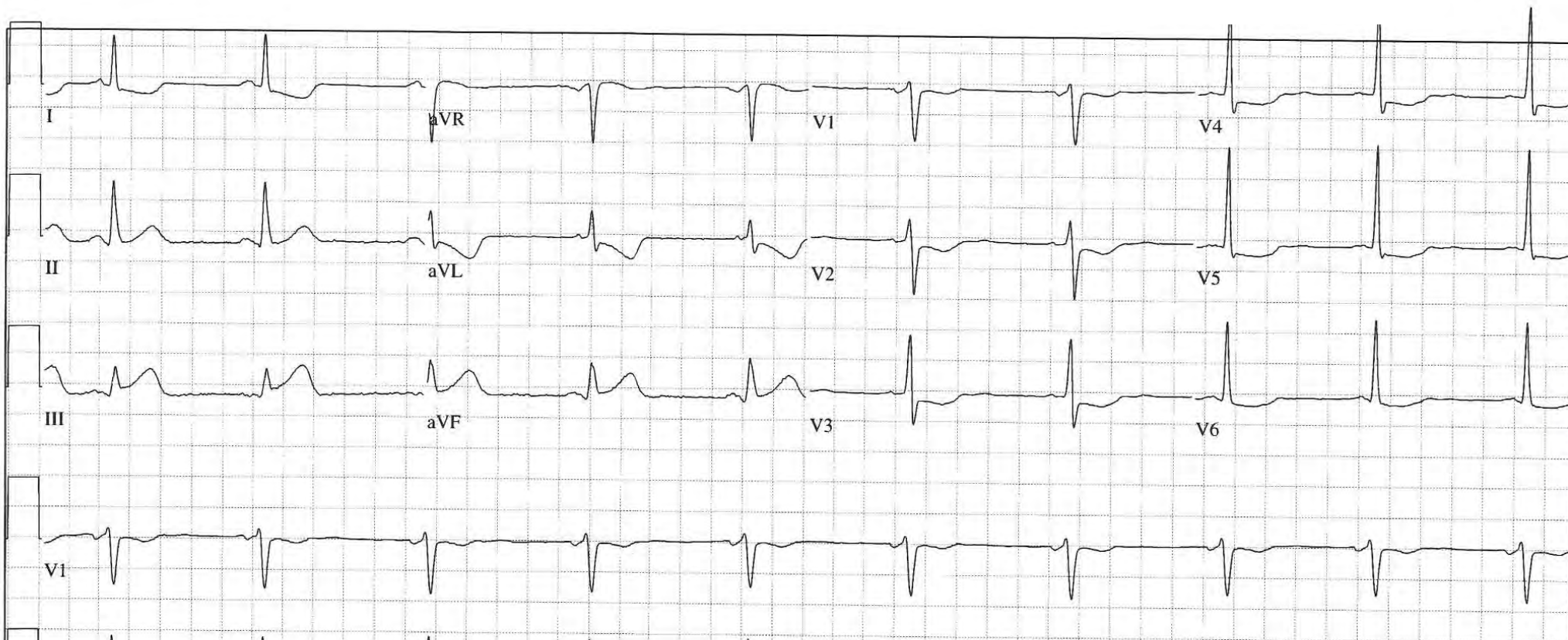




Is this an acute MI?

QRS duration 90 ms
QT/QTc 406/401 ms
P-R-T axes 49 50 109

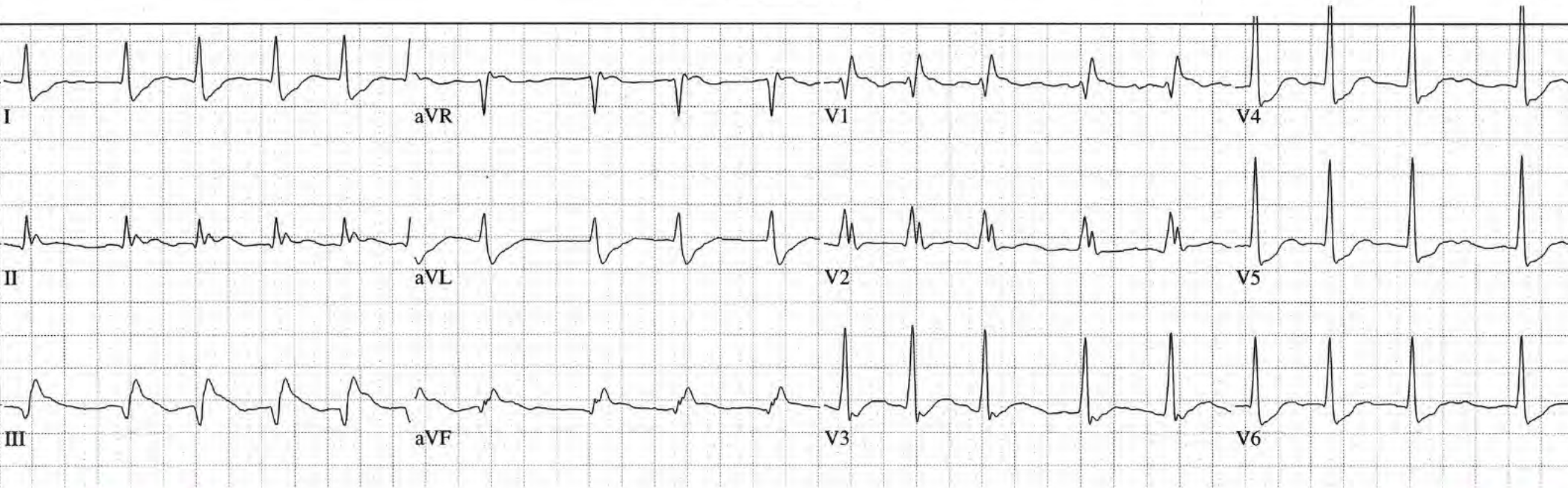
ST elevation consider inferior injury or acute infarct
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



STEP 7: HYPERTROPHY/VOLTAGE

Vent. rate	120	BPM
PR interval	*	ms
QRS duration	104	ms
QT/QTc	328/463	ms
P-R-T axes	* 16	84

Atrial fibrillation with rapid ventricular response
Incomplete right bundle branch block
Inferior infarct (cited on or before 15-APR-2021)
*** ACUTE MI / STEMI ***
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG



not too tall

Low voltage = less than 5 in limb leads

High Voltage = Less than 10 mm in precordial leads

not too small

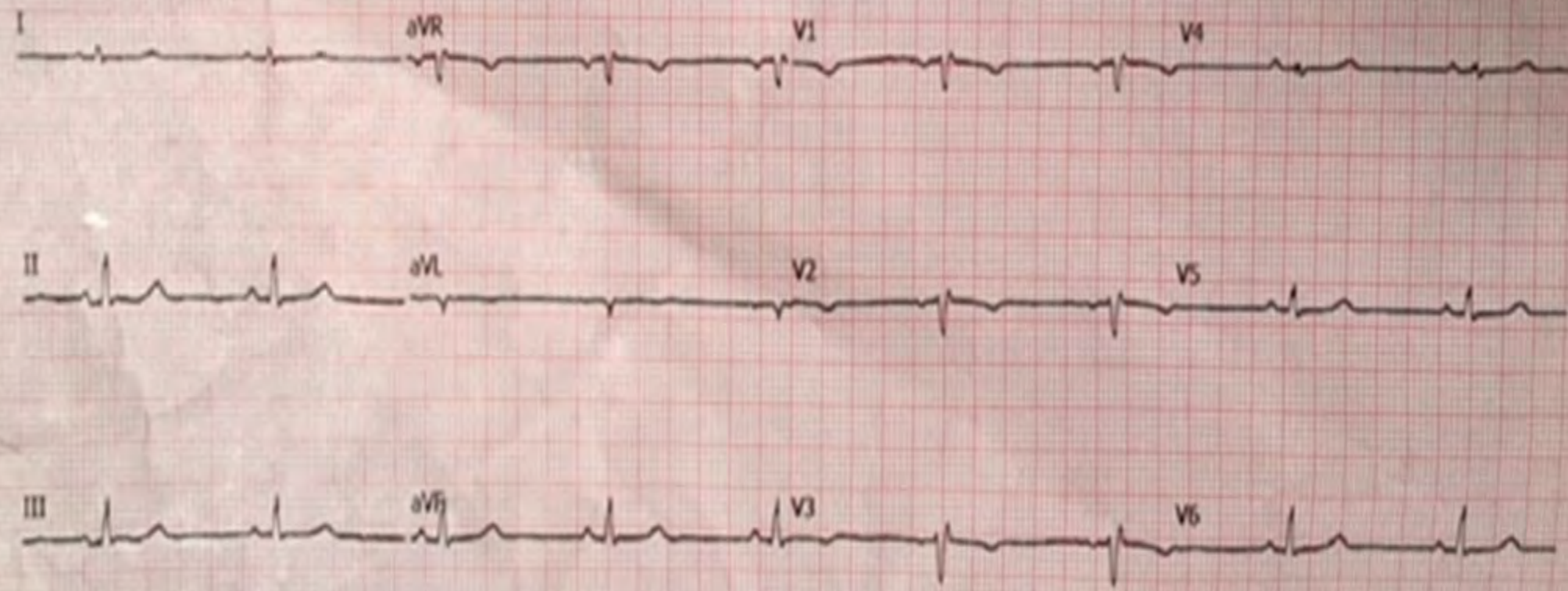
VOLTAGE

- Is measured from the lowest point of the QRS complex to its peak.
- Low voltage may be present in the following situations:
Obesity, COPD, Pericardial



Ascending V1:
QRS : 98 ms
QT / QTcBaz : 462 / 438 ms
PR : 136 ms
P : 84 ms
RR / PP : 1104 / 1111 ms
P / QRS / T : 70 / 86 / 70 degrees

Sinus bradycardia
Low voltage QRS
Cannot rule out Anterior infarct , age undetermined
Abnormal ECG



VOLTAGE

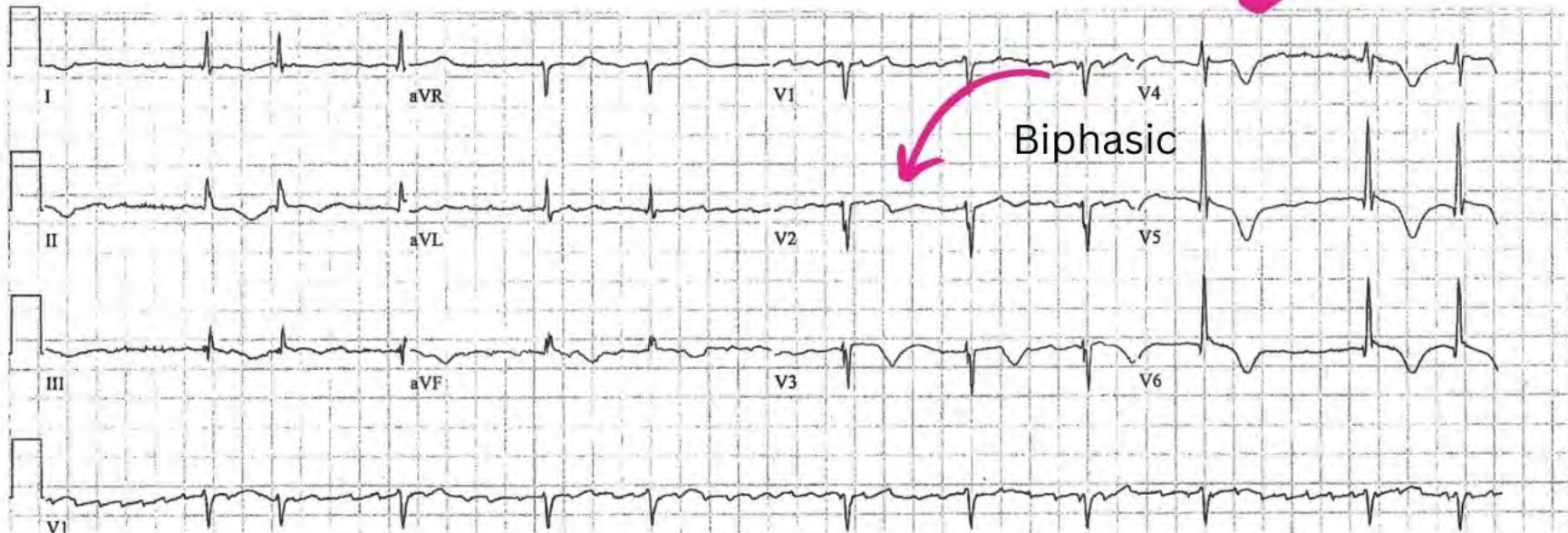


STEP 8: T WAVE ANALYSIS

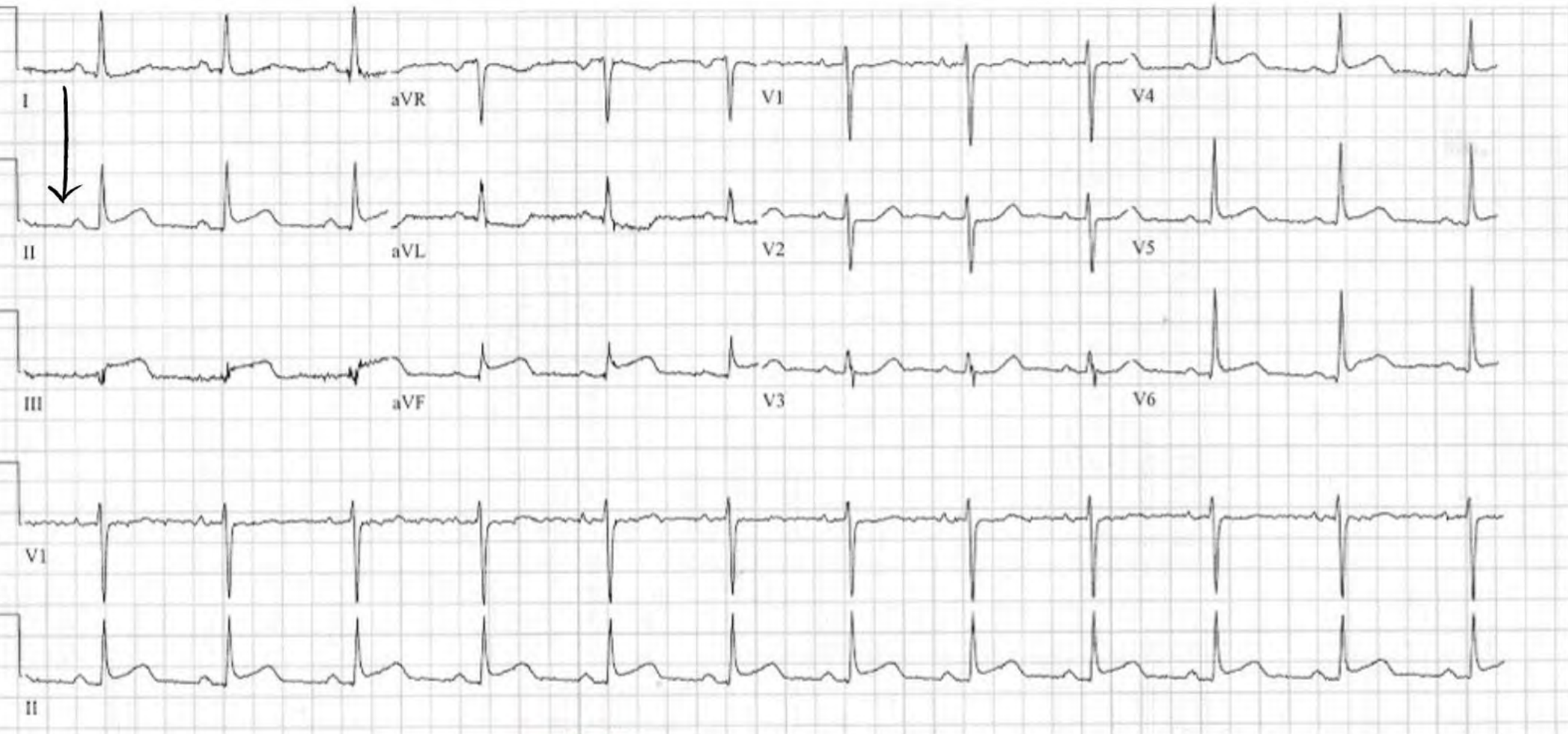
Vent. rate 70 BPM
PR interval * ms
QRS duration 84 ms
QT/QTc 452/488 ms
P-R-T axes * 34 247

ATRIAL FIBRILLATION
ST AND T WAVE ABNORMALITY, CONSIDER ANTEROLATERAL ISCHEMIA
WHEN COMPARED WITH ECG OF 06-SEP-1992 23:06,
ATRIAL FIBRILLATION HAS REPLACED SINUS RHYTHM
T WAVE INVERSION NOW EVIDENT IN ANTEROLATERAL LEADS

Inverted,
symmetric



STEP 9: Q WAVES? QRS WIDTH? MARRIED?



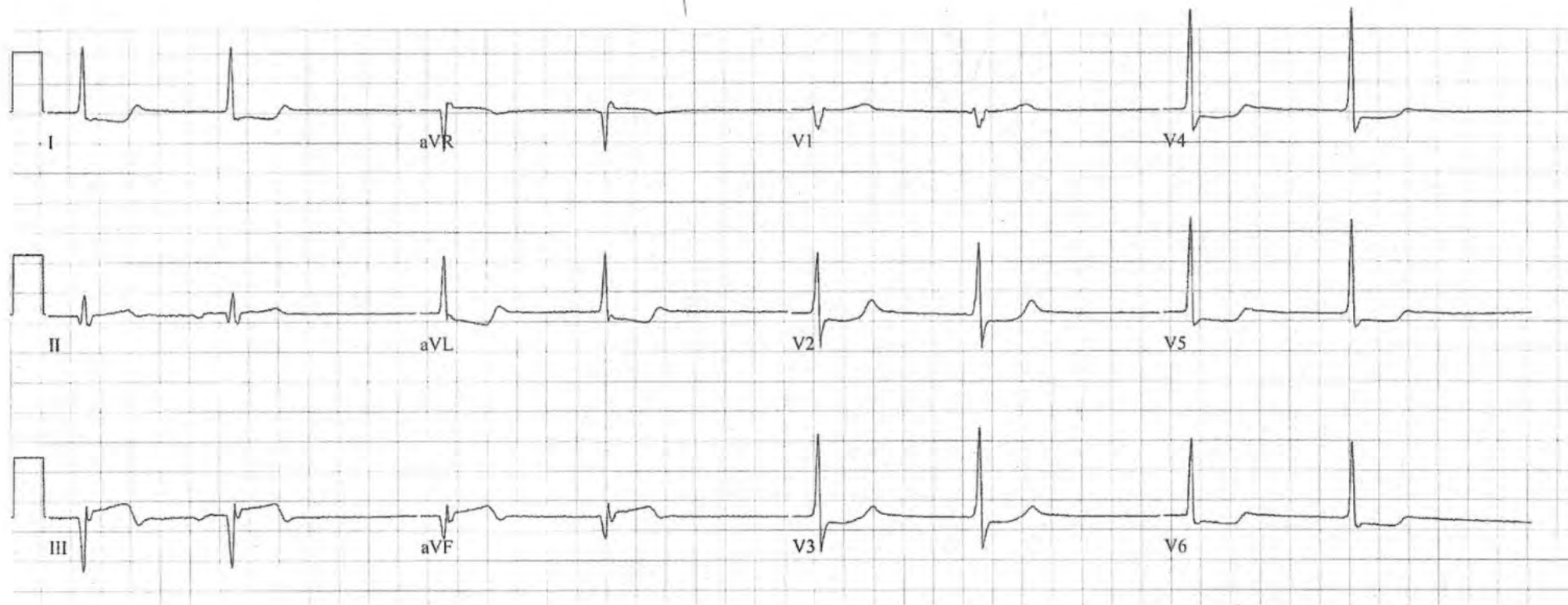
QRS: less than 120 ms

STEP 10: CHIEF COMPLAINT-BASED APPROACH

QT/QTc
P-R-T axes

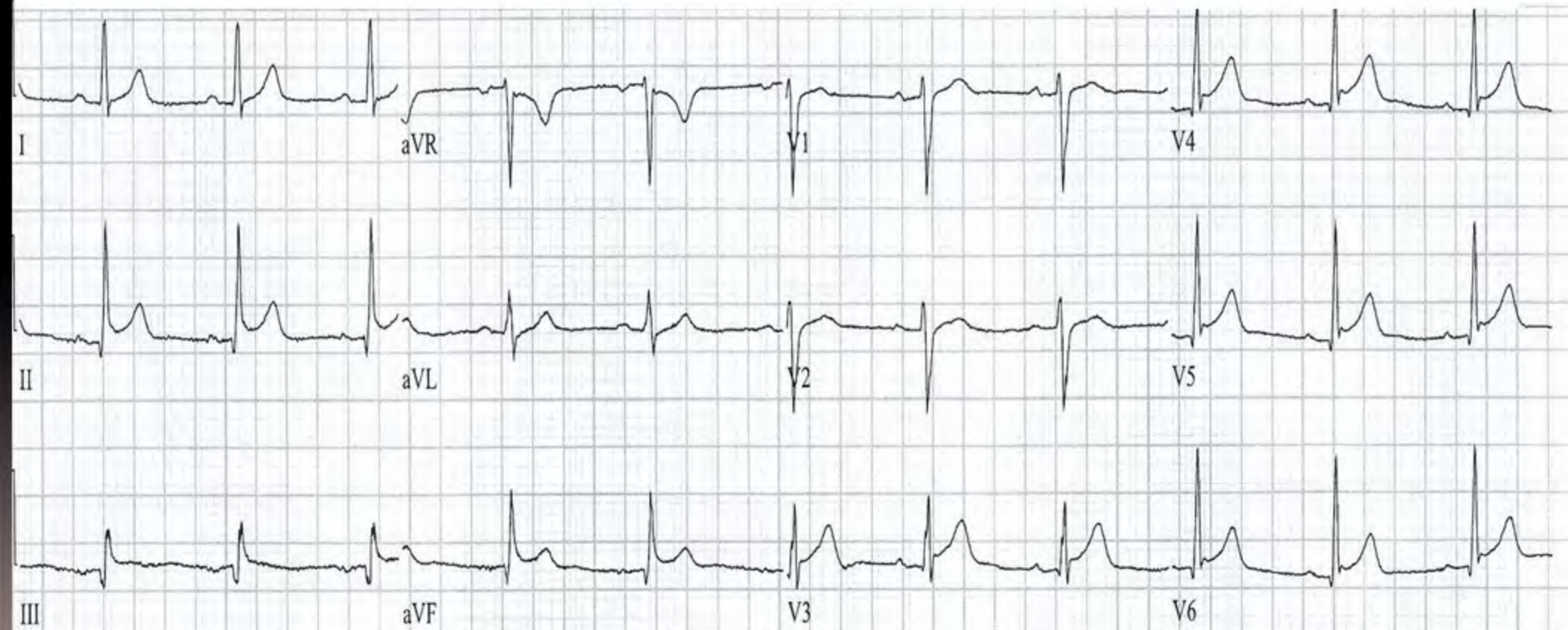
482/435 ms
* -16 122

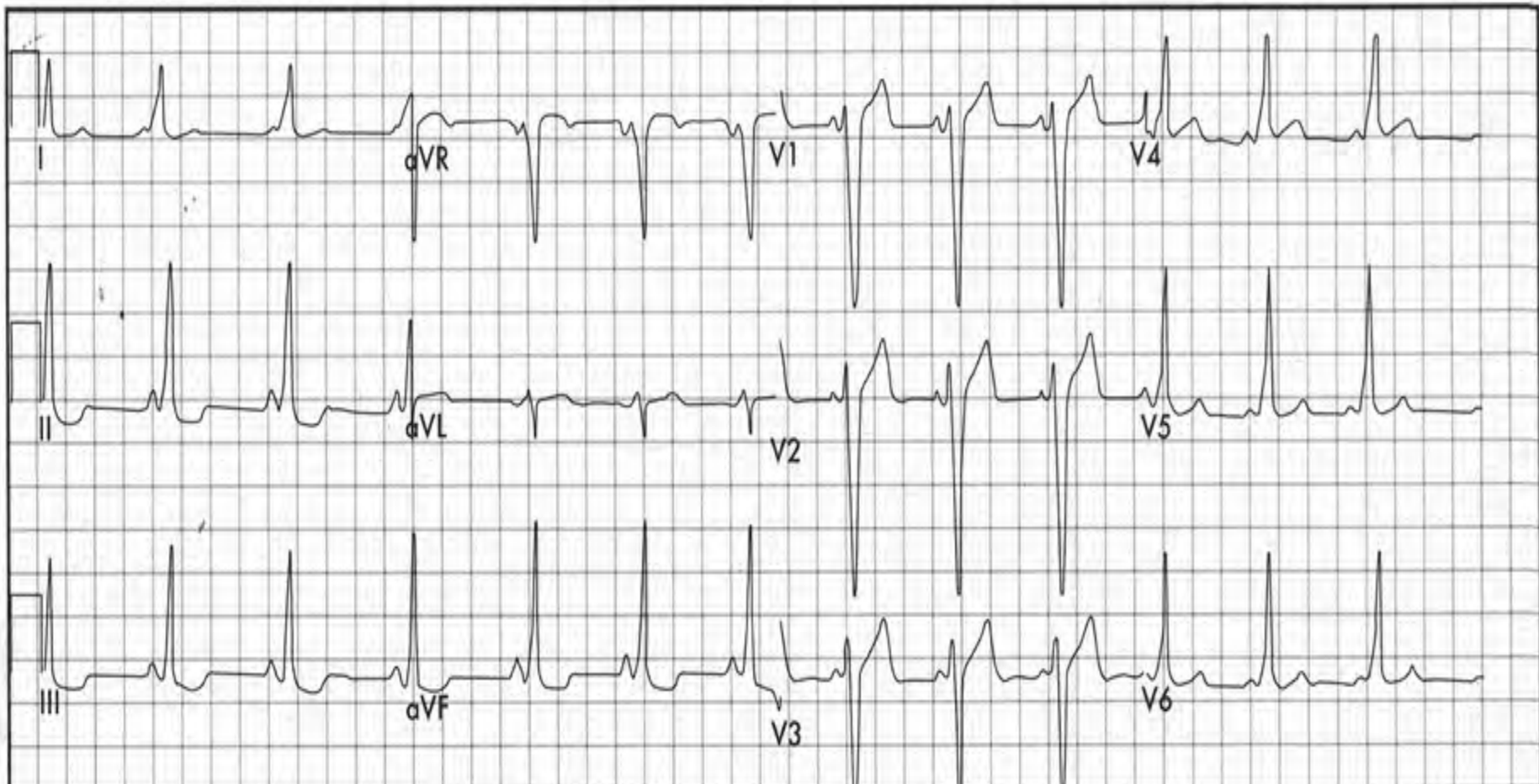
ABNORMAL ECG
WHEN COMPARED WITH ECG OF
JUNCTIONAL RHYTHM HAS REPLACED SINUS RHYTHM
SERIAL CHANGES OF EVOLVING INFERIOR-POSTERIOR INFARCT PRESENT
CLINICAL CORRELATION SUGGESTED
ST MORE ELEVATED IN INFERIOR LEADS



ACS, subtle ischemia, BER, s1 q3, t3, pericarditis

Vent. rate	67	BPM	NORMAL SINUS RHYTHM
PR interval	178	ms	EARLY REPOLARIZATION
QRS duration	92	ms	NORMAL ECG
QT/QTc	374/395	ms	NO PREVIOUS ECGS AVAILABLE





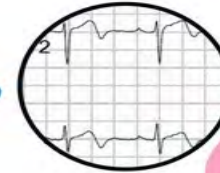


Non specific ST T wave Changes



Posterior MI

Depression in v2, v3
Isolated



Wellens

Biphasic T wave Changes
in v2 v3



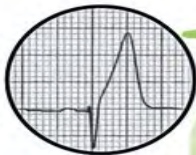
Dewinters

ST depression in V3 v4
with Hyperacute T waves



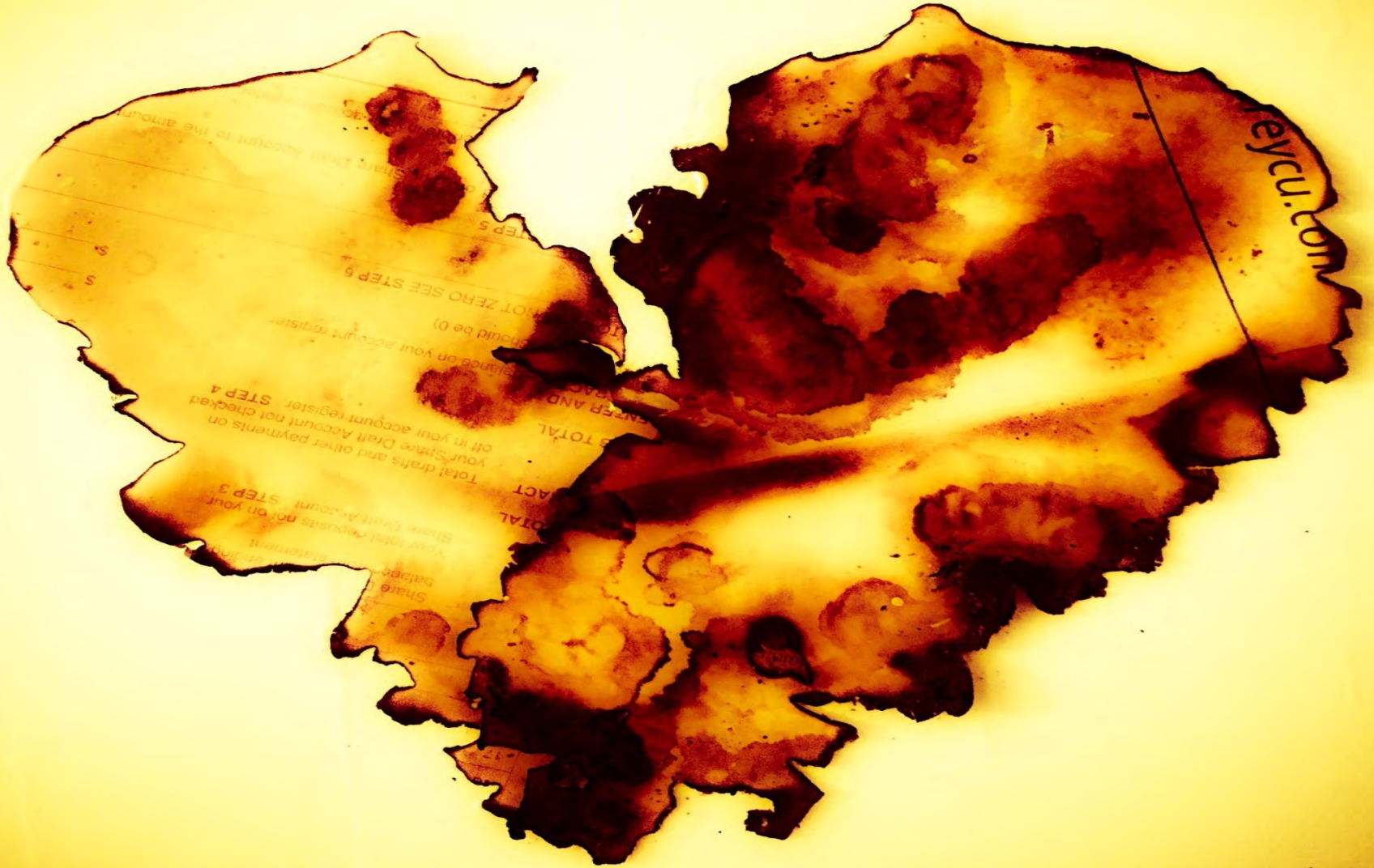
AVR

1 mm elevation in AVR
plus widespread
ST depression



Hyperacute T waves

Large T waves that are
almost as big as the QRS



WORKBOOK

97.8



Basic EKG

Workshop



prepared by

Jennifer Carlquist PA-C 

EKG Waves



P WAVE

- Is a small deflection wave that represents left and right atrial depolarization and also corresponds to _____ contraction.

Q WAVE

- Is an initially _____ deflection of the QRS complex. It is normal if it is _____ of the height of the R wave.

QRS COMPLEX

- The three waves of the QRS complex represent _____ depolarization.
The rule is: if the wave immediately after the P wave is an upward deflection, it is an R wave; if it is a downward deflection, it is a _____ wave.



R-WAVE

- Depolarization of the ventricles. This is the first _____ deflection.

T WAVE

- It should be _____. It should be upright in all leads except _____ & _____.

EKG Waves



P WAVE

- Is a small deflection wave that represents left and right atrial depolarization and also corresponds to atrial contraction.

Q WAVE

- Is an initially — deflection of the QRS complex. It is normal if it is $\downarrow \frac{1}{3}$ of the height of the R wave.

QRS COMPLEX

- The three waves of the QRS complex represent Ventricular depolarization. The rule is: if the wave immediately after the P wave is an upward deflection, it is an R wave; if it is a downward deflection, it is a Q wave.



R-WAVE

- Depolarization of the ventricles. This is the first (+) deflection.

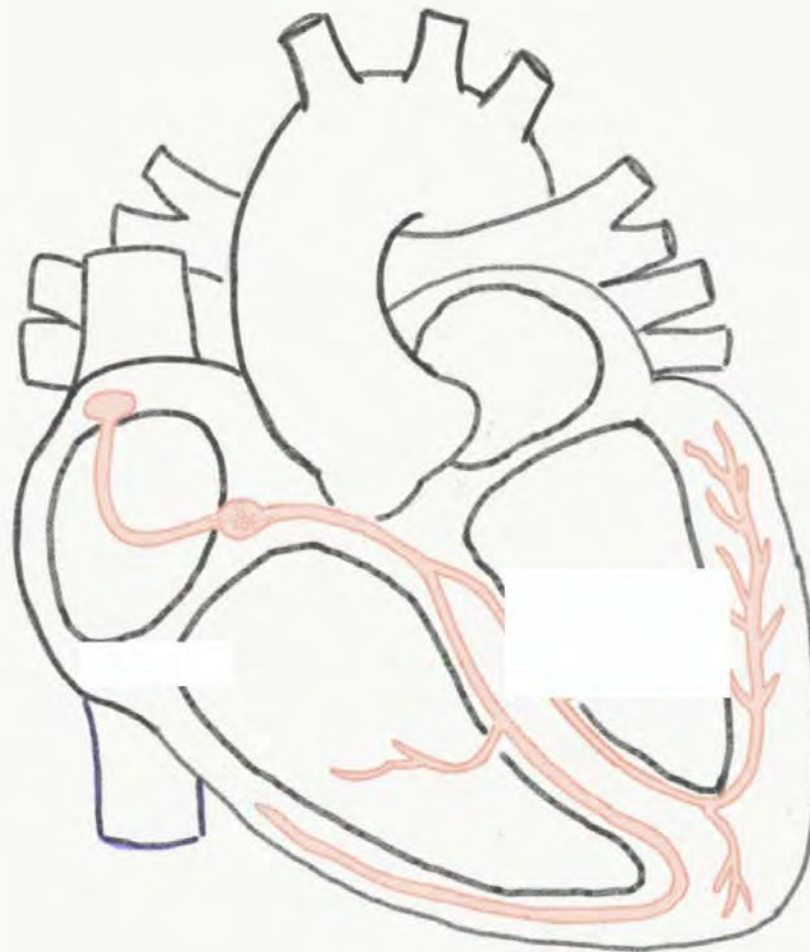
T WAVE

- It should be asymmetric. It should be upright in all leads except AVR & V1.

Label Anatomy



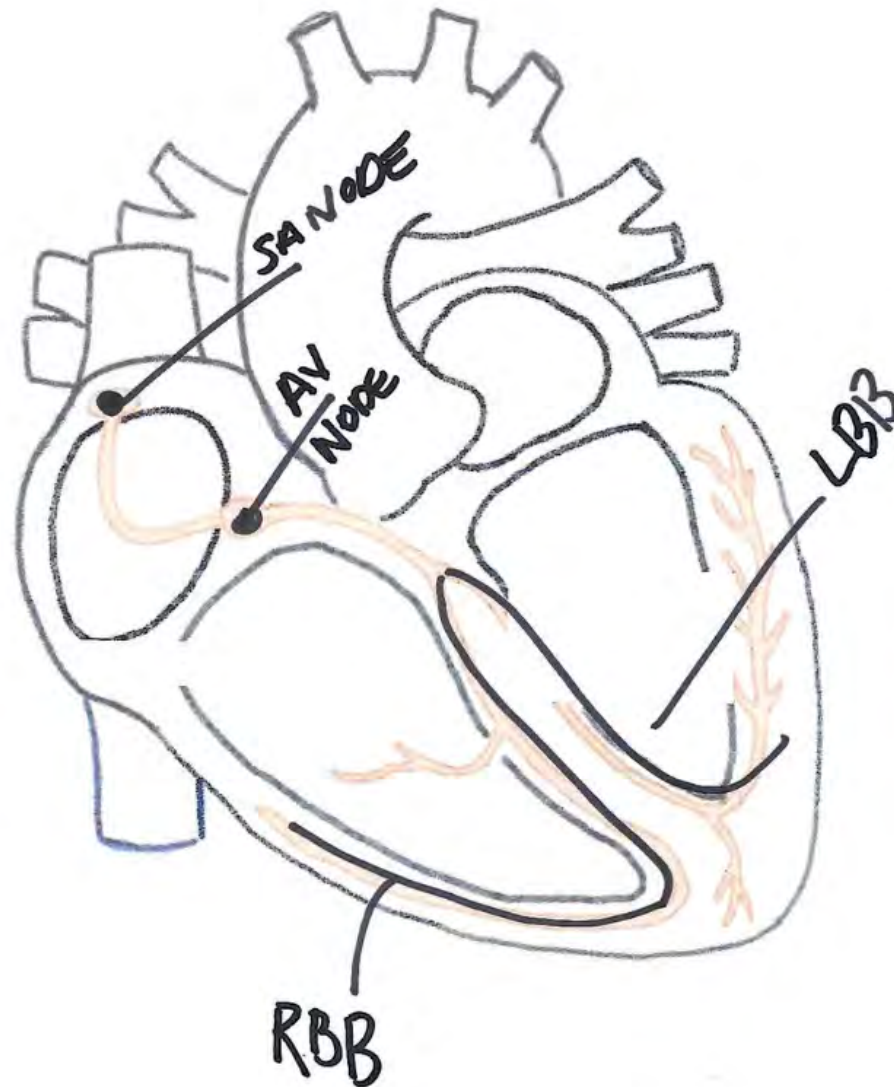
Label the conduction system.



Label Anatomy



Label the conduction system.



Foundations



U WAVE

- Is a small, rounded deflection sometimes seen after the _____ wave. One cause of U waves is _____ kalemia.

DELTA WAVE

- Is a slurred upstroke in the QRS complex often associated with a _____ PR interval. You will see these with _____.

PR - INTERVAL

-Is the distance from the _____ of the P-Wave to the beginning of the R Wave. PR-Interval should be between _____ ms and _____ms.

PR-SEGMENT

- The distance from the end of the _____ Wave and the beginning of the _____ Wave.

ST-SEGMENT

- Short segment from end of S-Wave to beginning of T-Wave. This is where we look for _____ and _____.

ST DEPRESSION

- Occurs when the J point is displaced below baseline. Multiple conditions associated with ST depression include _____ kalemia, cardiac _____, and medications such as _____.

QT-INTERVAL

- From beginning of Q-Wave to end of T-Wave. This is important because long qt can lead to _____.

RR-INTERVAL

- Distance between QRS-Complexes, or the distance between heart beats in a normal sinus rhythm. We use this to see if a rhythm is _____ or _____.

Foundations



U WAVE

- Is a small, rounded deflection sometimes seen after the _____ wave. One cause of U waves is _____ kalemia.

DELTA WAVE

- Is a slurred upstroke in the QRS complex often associated with a _____ PR interval. You will see these with _____.

PR - INTERVAL

- Is the distance from the _____ of the P-Wave to the beginning of the R Wave. PR-Interval should be between _____ ms and _____ ms.

PR-SEGMENT

- The distance from the end of the _____ Wave and the beginning of the _____ Wave.

ST-SEGMENT

- Short segment from end of S-Wave to beginning of T-Wave. This is where we look for _____ and _____.

ST DEPRESSION

- Occurs when the J point is displaced below baseline. Multiple conditions associated with ST depression include _____ kalemia, cardiac _____, and medications such as _____.

QT-INTERVAL

- From beginning of Q-Wave to end of T-Wave. This is important because long qt can lead to _____.

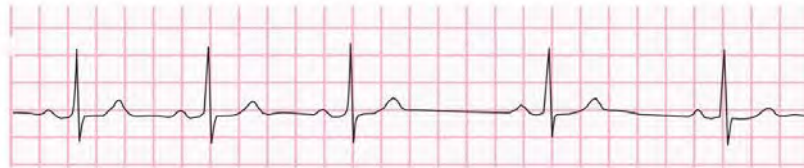
RR-INTERVAL

- Distance between QRS-Complexes, or the distance between heart beats in a normal sinus rhythm. We use this to see if a rhythm is _____ or _____.

Arrhythmias



Label the rhythm: _____



Label the rhythm: _____



Label the rhythm: _____



Label the rhythm: _____

Arrhythmias



Label the rhythm: AFIB



Label the rhythm: SINUS ARRHYTHMIA



Label the rhythm: IDIOVENTRICULAR



Label the rhythm: JUNCTIONAL

Basic 12 Lead

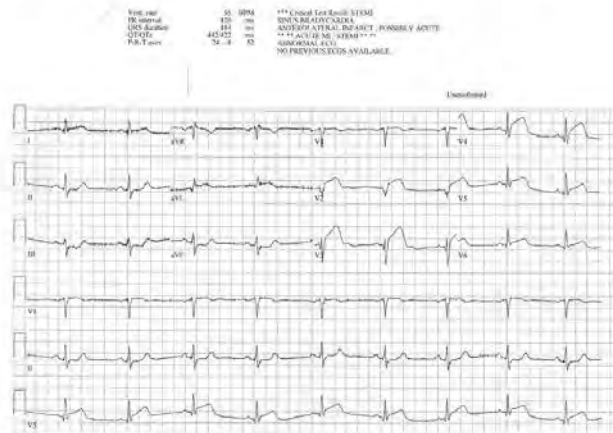


CONTIGUOUS LEADS

- The leads that are fed by the _____ artery anatomically speaking.

RECIPROCAL CHANGES

- ST-segment depression occurring on an ECG which also has ST-segment elevation in at least 2 leads. "You need to have _____ up and _____ down."



INFERIOR LEADS

- Are _____, _____ and _____. They are fed by the _____ artery.

ANTERIOR LEADS

- Are _____, _____, _____ and _____. They are fed by the _____ artery.

LATERAL LEADS

- Are _____, _____, _____, _____ and are fed by the _____ artery.

Basic 12 Lead



CONTIGUOUS LEADS

- The leads that are fed by the SAAME artery anatomically speaking.

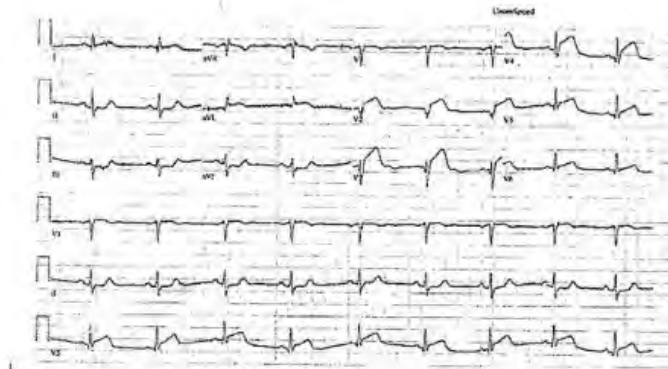
RECIPROCAL CHANGES

- ST-segment depression occurring on an ECG which also has ST-segment elevation in at least 2 leads. "You need to have 2 up and 2 down."

Key: RR
PR interval
QRS duration
QT/QTc
P-R-T axis

55	82ms	*** Could be normal ST-TSE
56	80ms	*** Normal ECG
57	80ms	*** Normal ECG
58	80ms	*** Normal ECG
59	80ms	*** Normal ECG
60	80ms	*** Normal ECG
61	80ms	*** Normal ECG
62	80ms	*** Normal ECG
63	80ms	*** Normal ECG
64	80ms	*** Normal ECG
65	80ms	*** Normal ECG
66	80ms	*** Normal ECG
67	80ms	*** Normal ECG
68	80ms	*** Normal ECG
69	80ms	*** Normal ECG
70	80ms	*** Normal ECG
71	80ms	*** Normal ECG
72	80ms	*** Normal ECG

*** ALL TR LEAD INTERST, POSSIBLY ACUTE
*** ALL TR LEAD INTERST ***
*** ALL TR LEAD INTERST ***
NO PREVIOUS ECGS AVAILABLE



INFERIOR LEADS

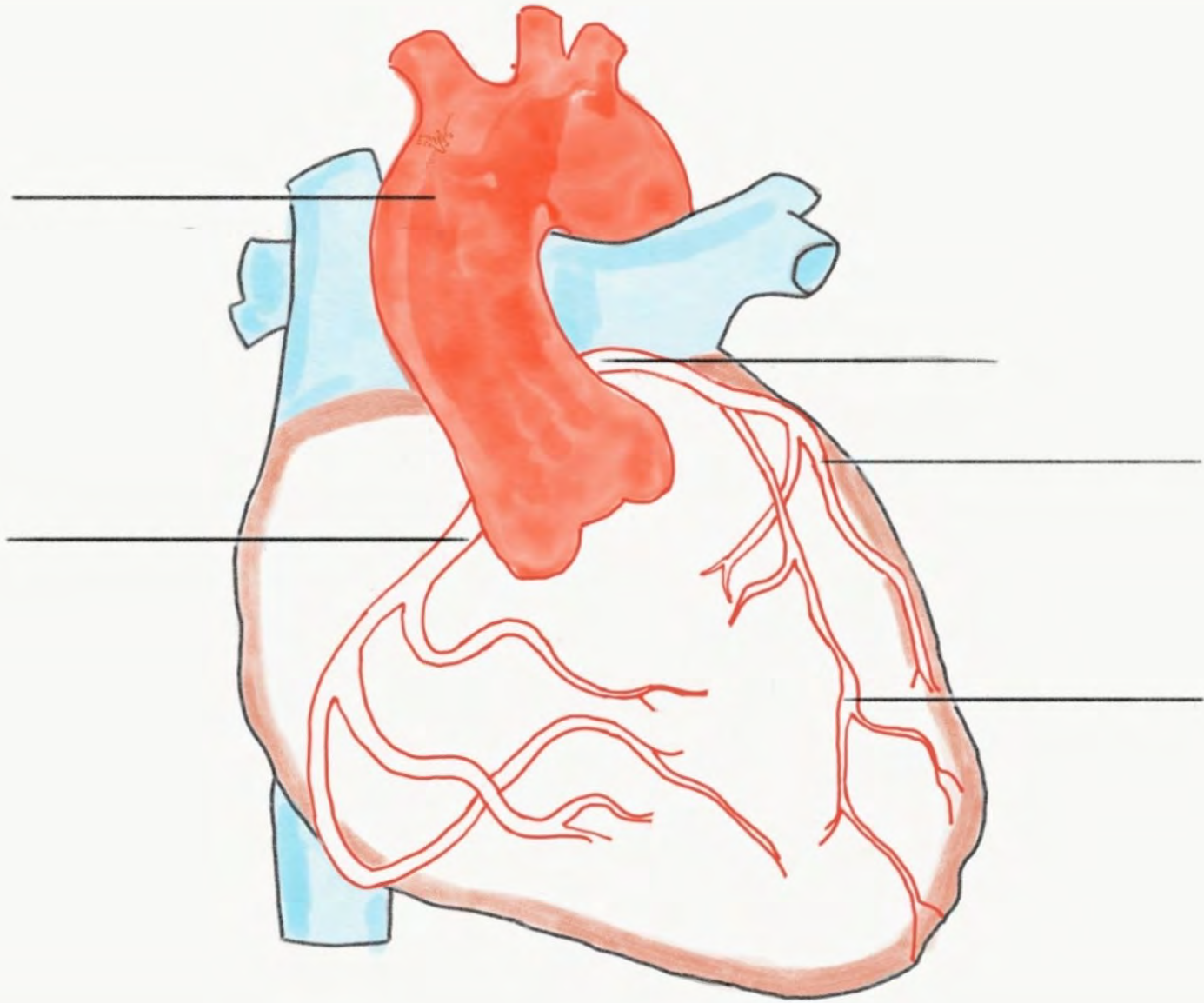
- Are II, III and AVF. They are fed by the RCA artery.

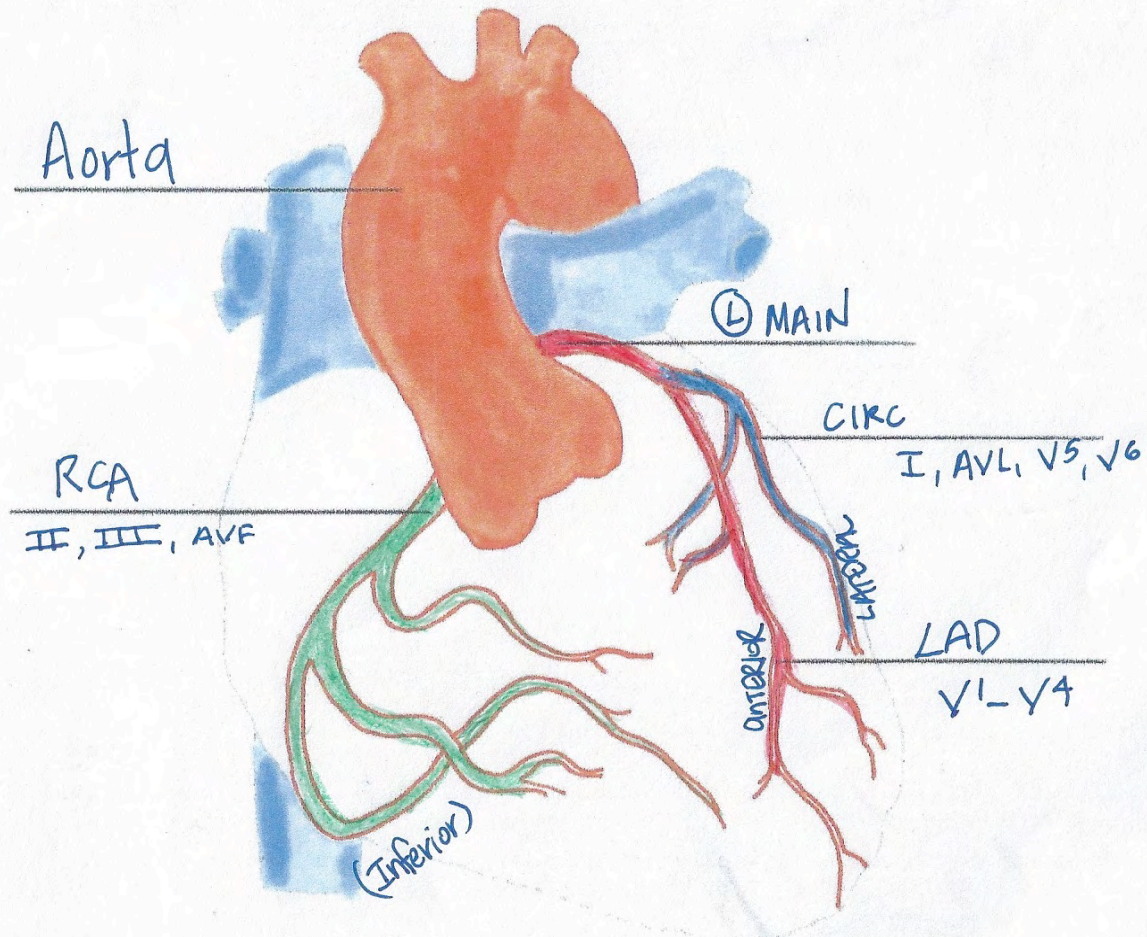
ANTERIOR LEADS

- Are V1, V2, V3 and V4. They are fed by the LAD artery.

LATERAL LEADS

- Are I, AVL, V5, V6 and are fed by the CIRC artery.





"I have chest pain"

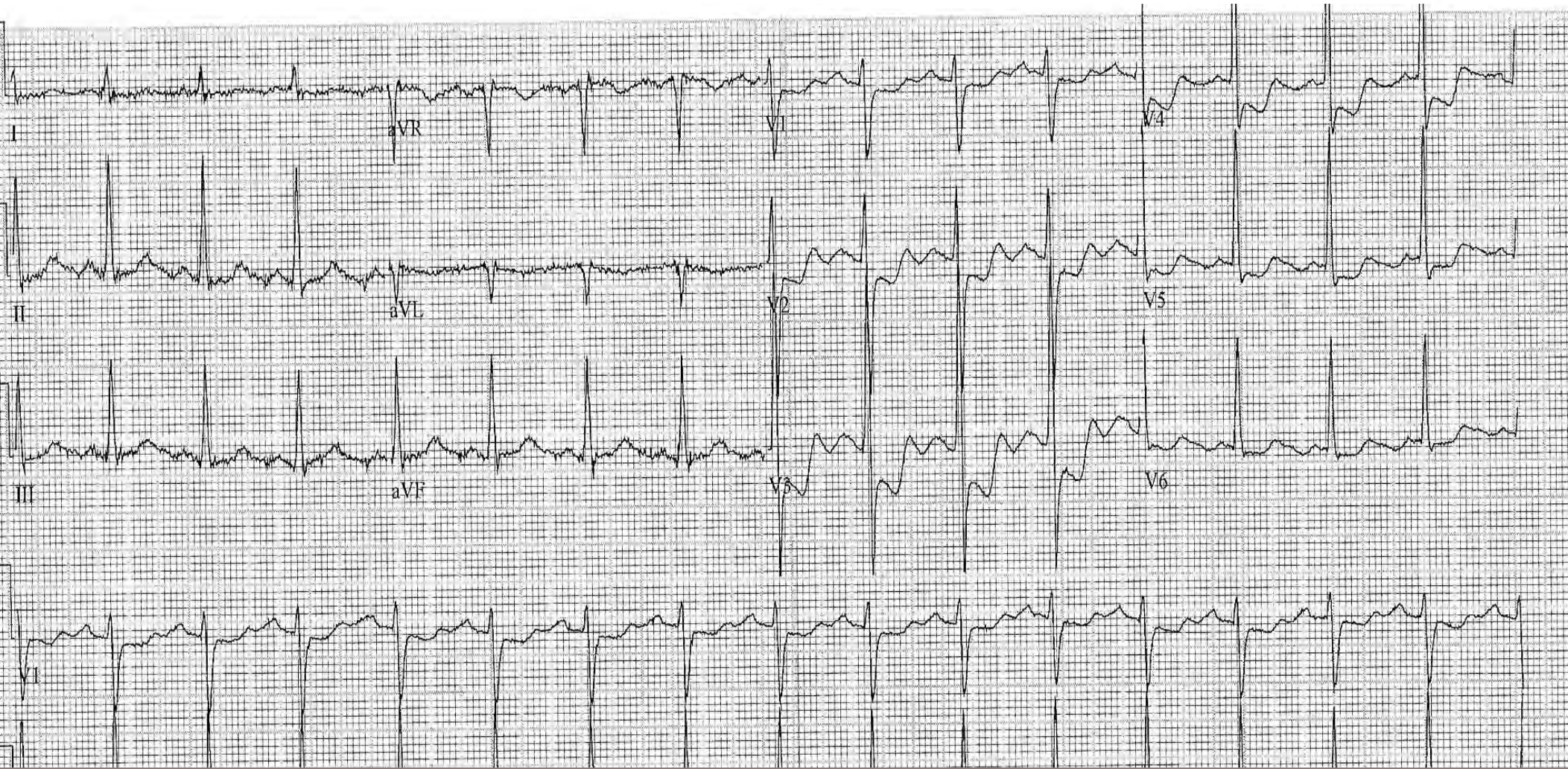
This feels like my last
heart attack.

"weak and short of breath".



Vent. rate 96 BPM
PR interval 216 ms
QRS duration 96 ms
QT/QTc 376/475 ms

SINUS RHYTHM WITH 1ST DEGREE A-V BLOCK
MARKED ST ABNORMALITY, POSSIBLE ANTERSEPTAL SUBENDOCARDIAL INJURY
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE



POSTERIOR STEMI

Vent. rate 96 BPM
PR interval 216 ms
QRS duration 96 ms
QT/QTc 376/475 ms
P-R-T axes 81 88

SINUS RHYTHM WITH 1ST DEGREE A-V BLOCK
MARKED ST ABNORMALITY, POSSIBLE ANTERSEPTAL, SUBENDOCARDIAL INJURY
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE

**PROLONGED
QT'**



10 STEP SYSTEM



10 Step Approach to Reading EKG

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

10 Step Approach to Reading EKG

1. Big Sick vs. Little Sick
2. Rate
3. Rhythm
4. Intervals
5. Axis
6. ST Segments
7. Hypertrophy/Voltage
8. T wave analysis- (all waves)
9. Q Waves? Married? Wide?
10. CC based approach

10 STEP SYSTEM

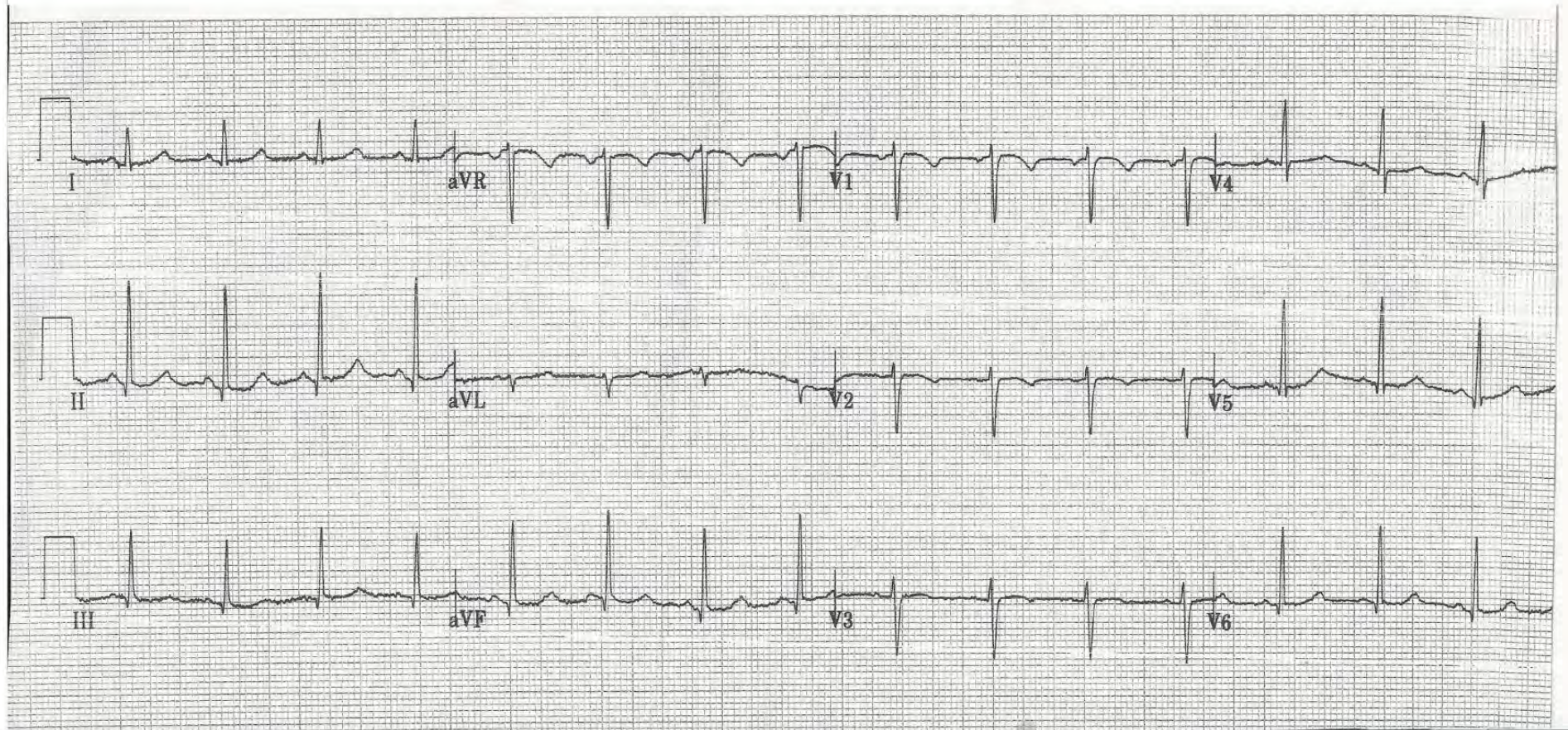


10 Step Approach to Reading EKG

1. BIG SICK VS. LITTLE SICK
2. RATE
3. Rhythm
4. Intervals
5. ST SEGMENTS
6. Q WAVES, P / QRS MARKED?
7. AXIS
8. HYPERTROPHY / VOLTAGE
9. T WAVE RULES
10. CHIEF Complaint BASED APPROACH

Vent. rate 94 bpm
PR interval 116 ms
QRS duration 78 ms
QT/QTc 366/457 ms
P-R-T axes 46 66 35

Normal sinus rhythm
Normal ECG

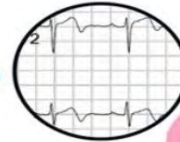


Non specific ST T wave Changes



Posterior MI

Depression in v2, v3
Isolated



Wellens

Biphasic T wave Changes
in v2 v3



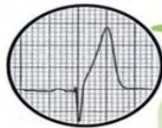
Dewinters

ST depression in V3 v4
with Hyperacute T waves



AVR

1 mm elevation in AVR
plus widespread
ST depression



Hyperacute T waves

Large T waves that are
almost as big as the QRS

Non specific ST T wave Changes



POSTERIOR

Depression in v2, v3
Isolated



WELLEN

Biphasic T wave Changes
in v2 v3



DE WINDERS

ST depression in V3 v4
with Hyperacute T waves



aVR

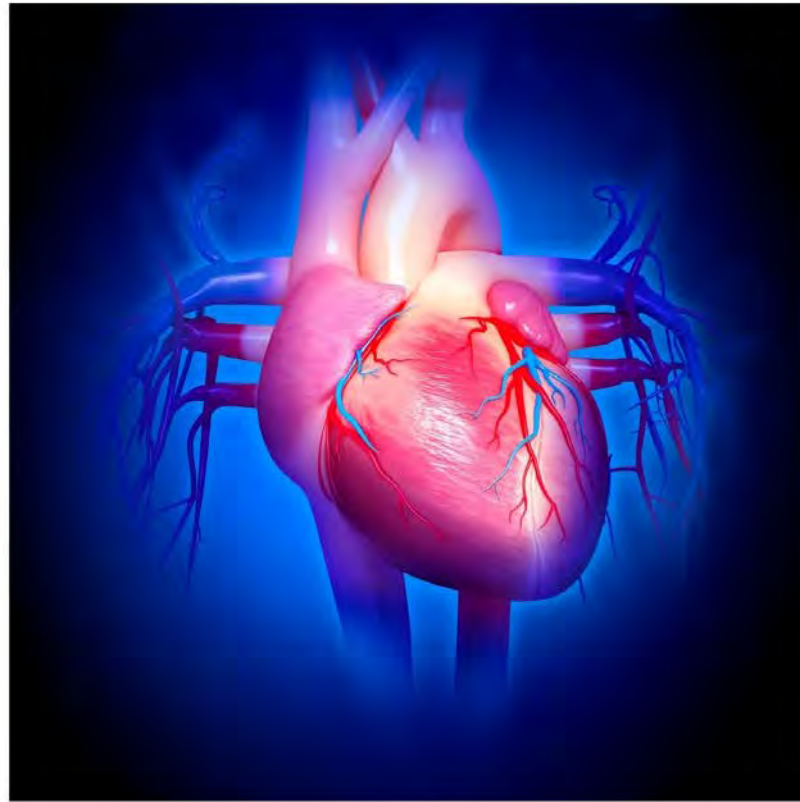
1 mm elevation in aVR
plus widespread
ST depression



Hyperacute

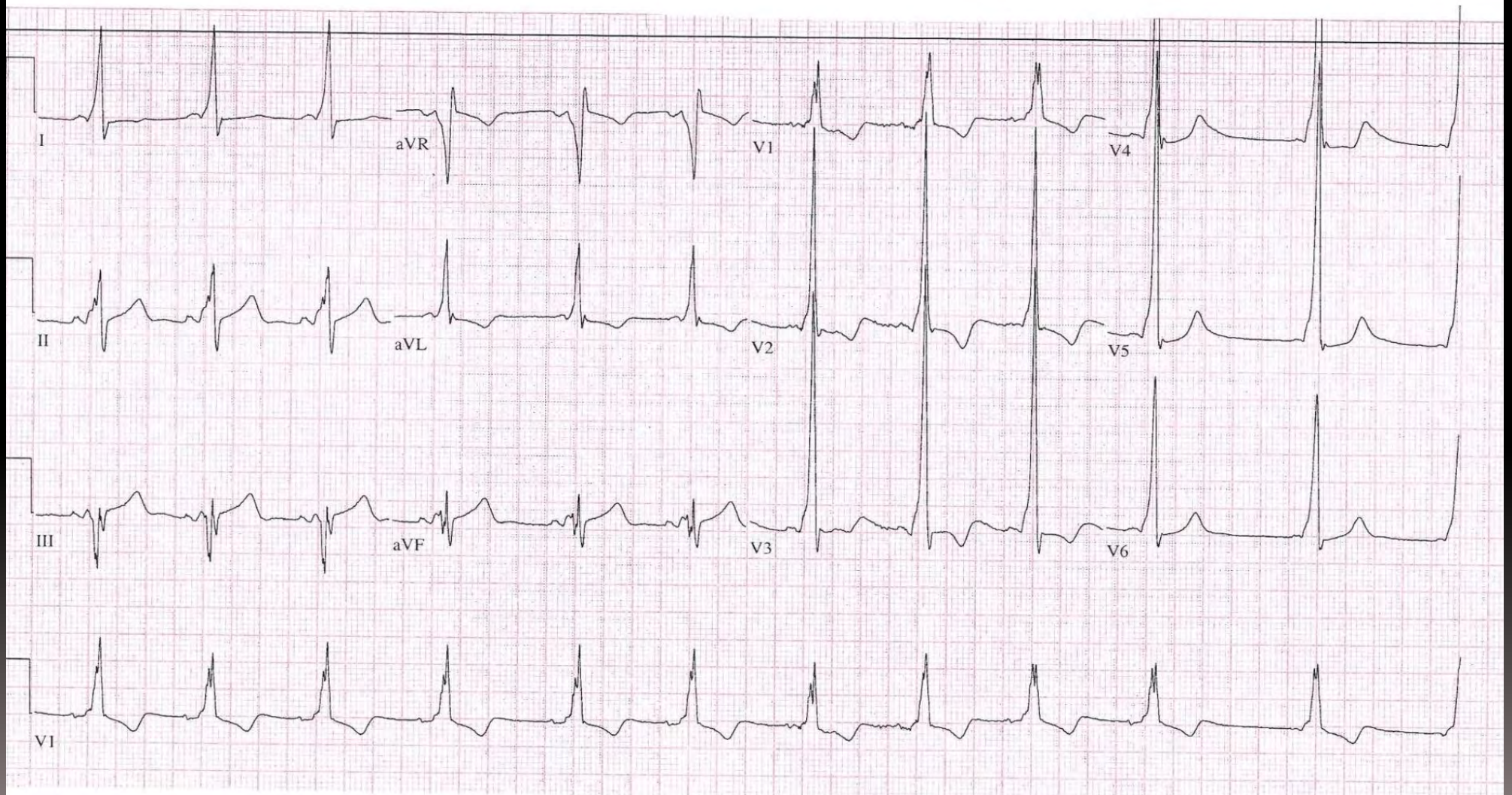
Large T waves that are
almost as big as the QRS

Basic 12 Lead Practice



LET'S GO!

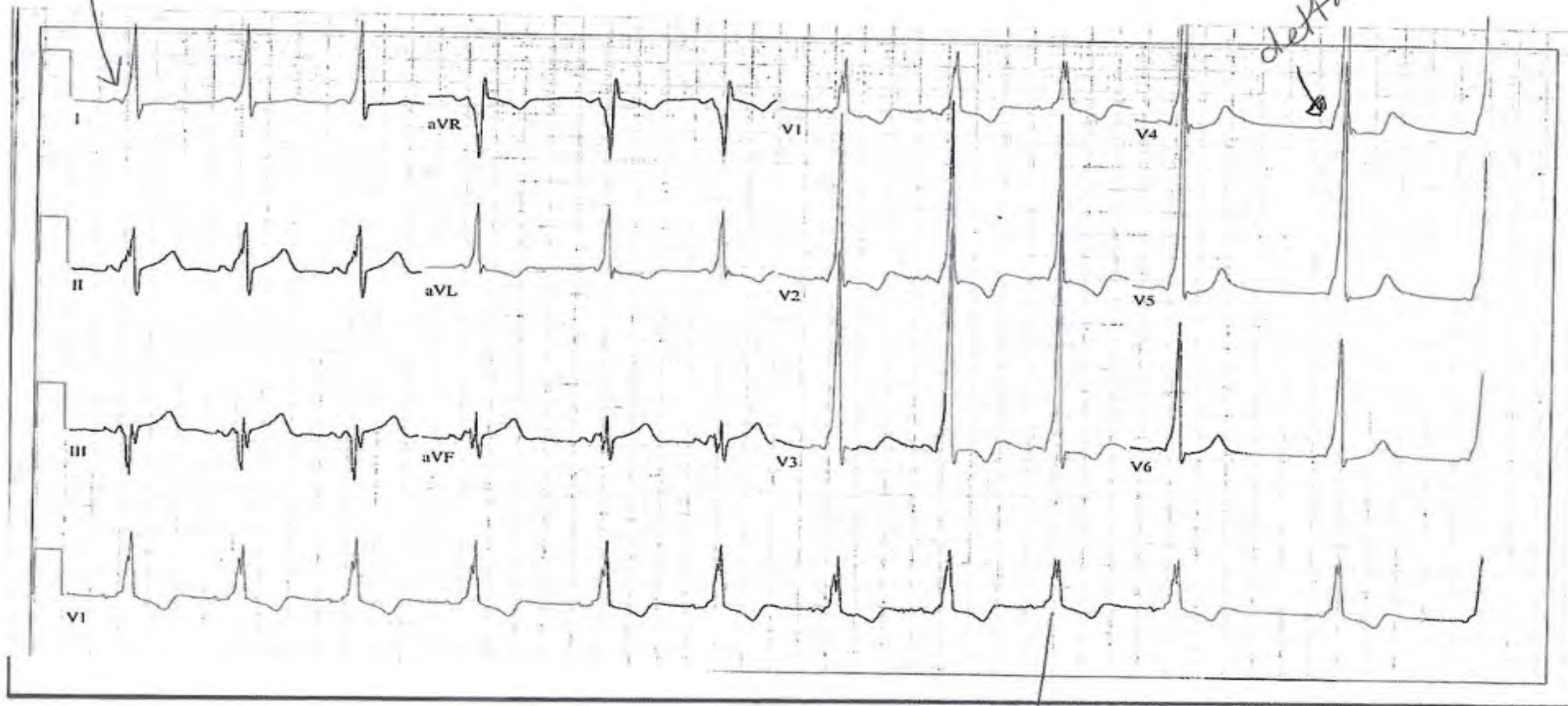
27 y.o F with anxiety



short
PR
interval
 $< 120\text{ms}$

27 y.o F with anxiety

delta wave

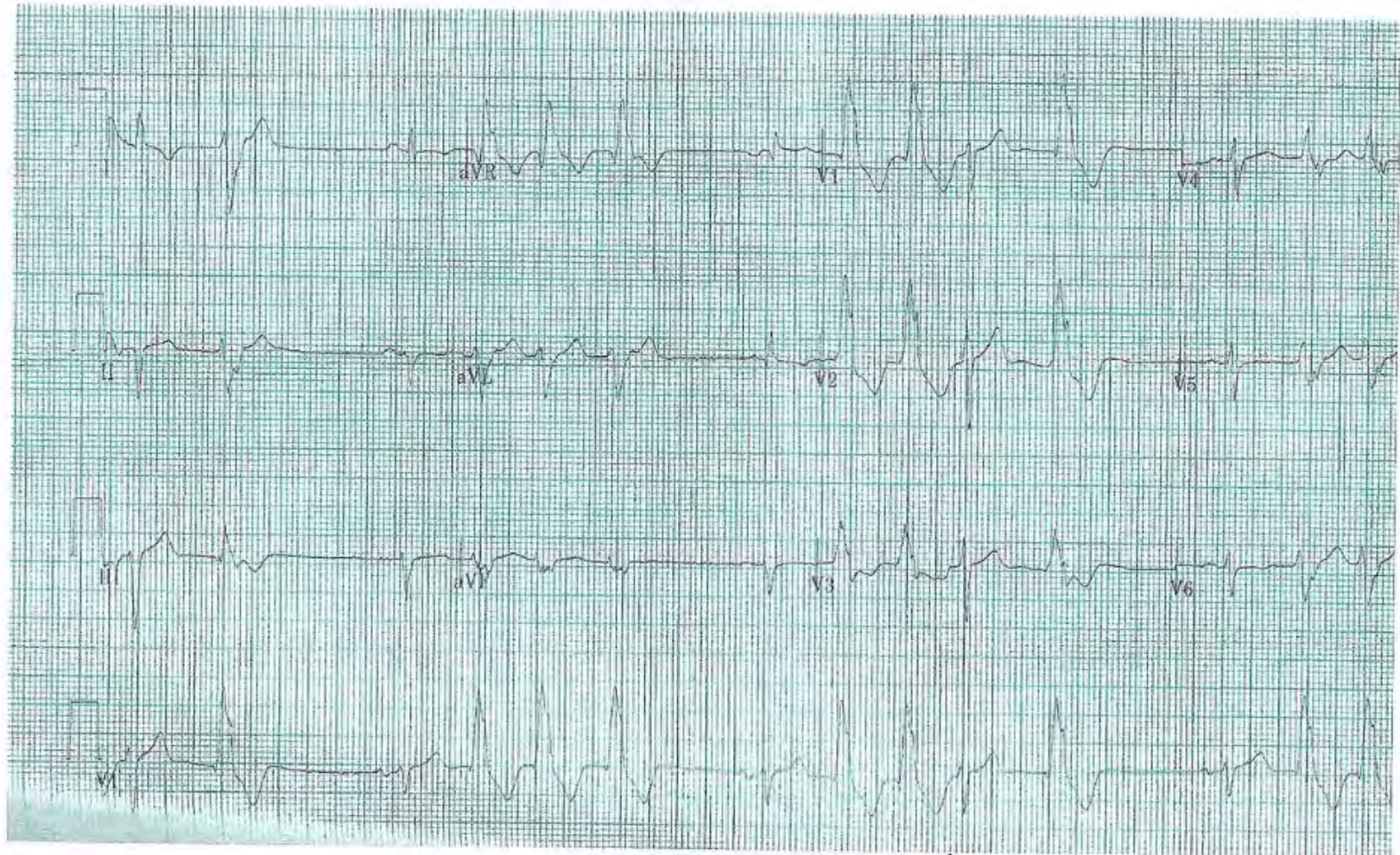


WIDE QRS
 $> 120\text{ms}$

46 y.o M with a cough



46 y.o M with a cough



"Salvo"

(COUPLET)

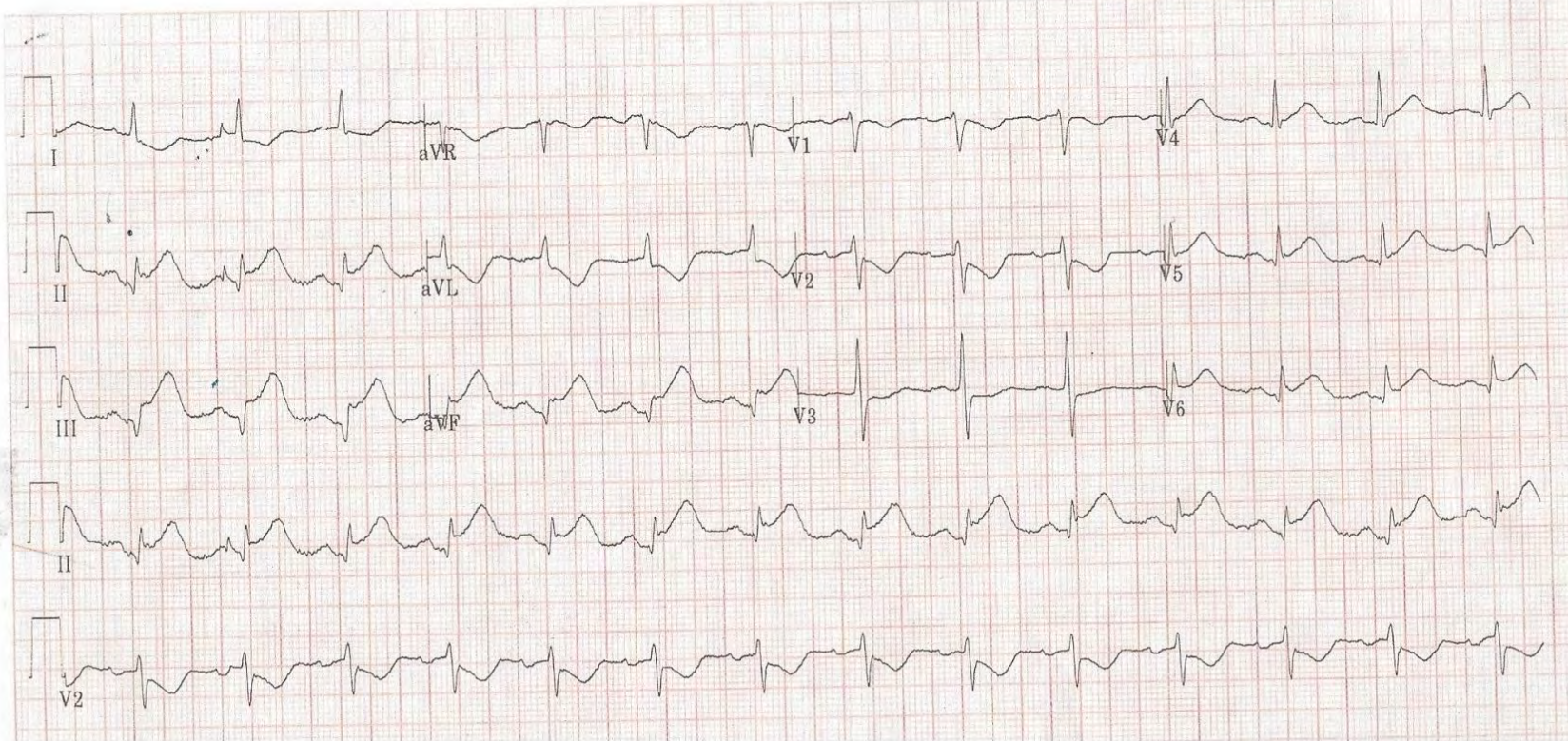
67 y.o F with chest pain

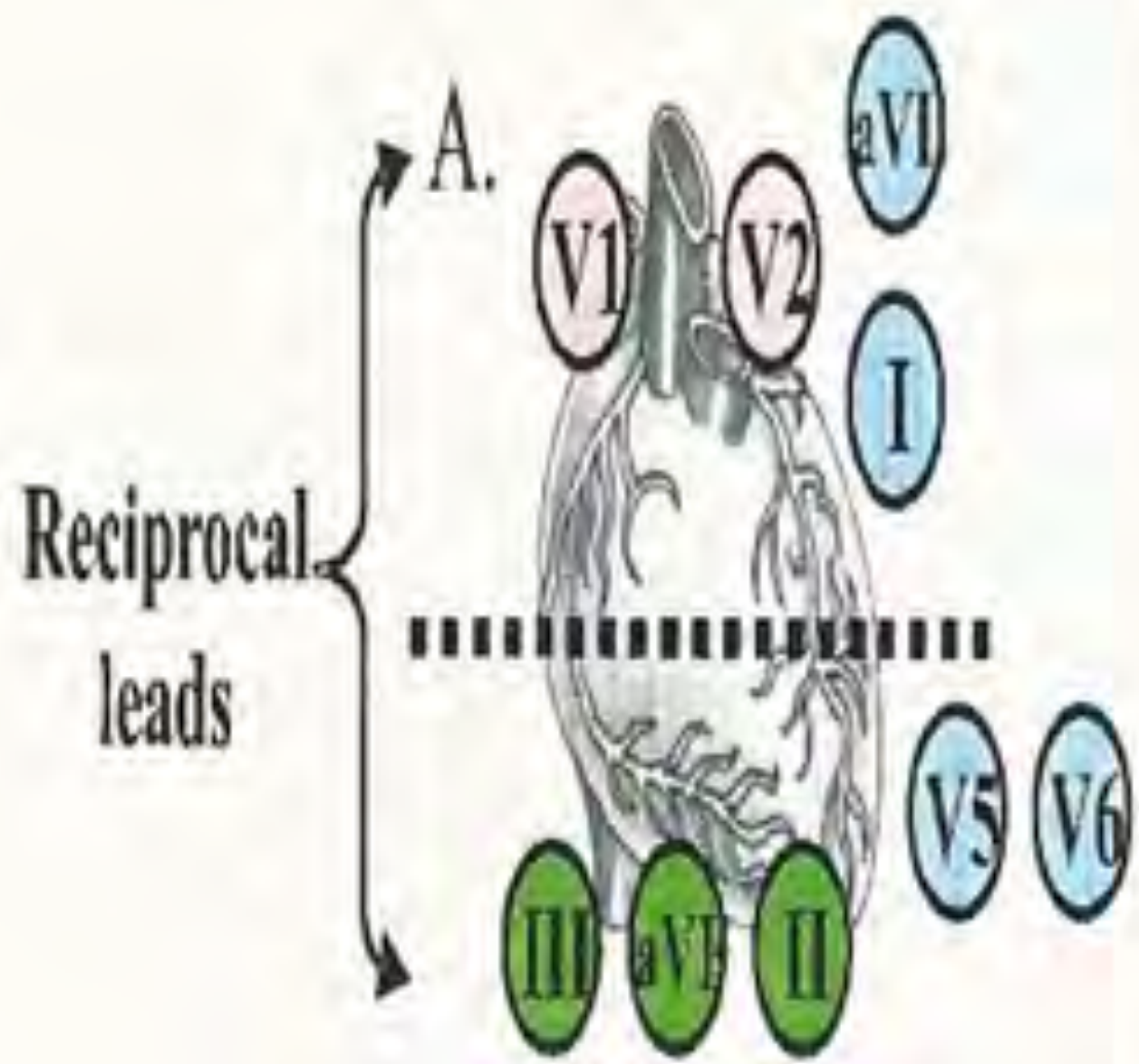
Vent. rate 85 bpm
PR interval 186 ms
QRS duration 92 ms
QT/QTc -402/478 ms
P-R-T axes 75 25 99

Normal sinus rhythm
Inferior infarct, possibly acute
Lateral injury pattern
**** ** ACUTE MI / STEMI ** ****
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG

#2

Reviewed by:





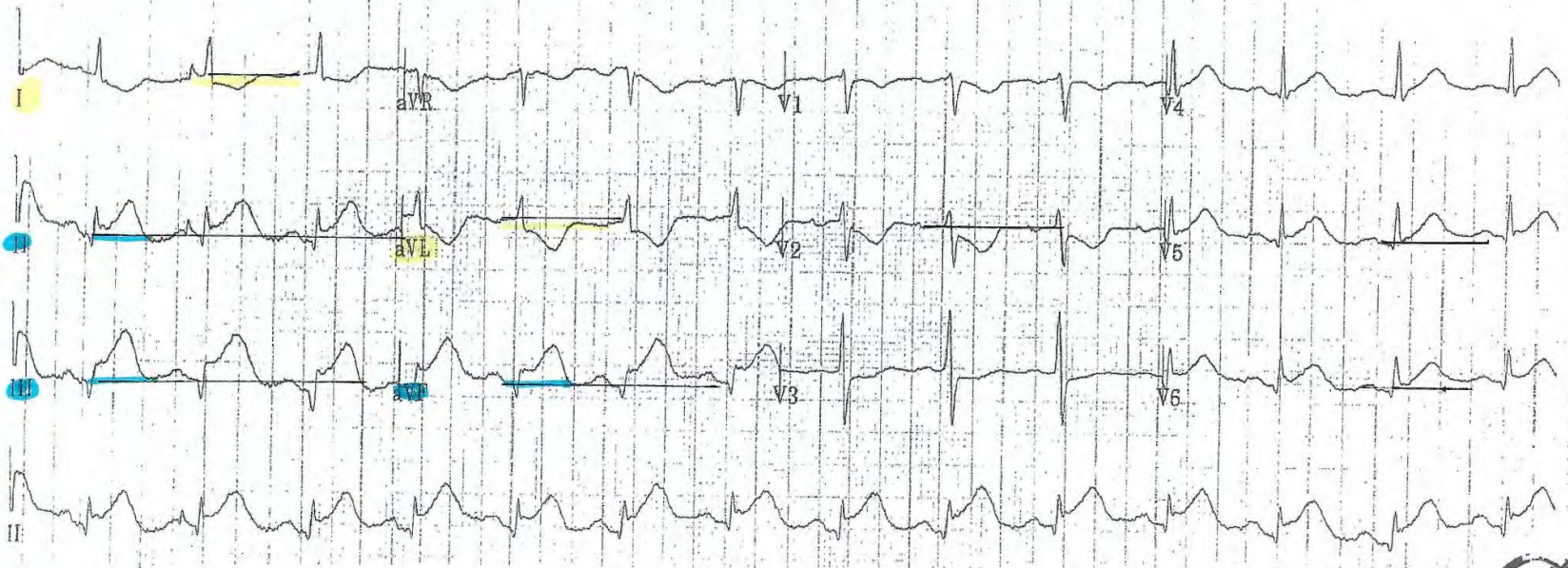
Vent. rate 85 bpm
PR interval 186 ms
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P-R-T axes 75 25 99

Normal sinus rhythm
Inferior infarct, possibly acute
Lateral injury pattern
**** ACUTE MI / STEMI ****
Consider right ventricular involvement in acute inferior infarct
Abnormal ECG

TRUE!
[2 up
2 down]

#2

Reviewed by:

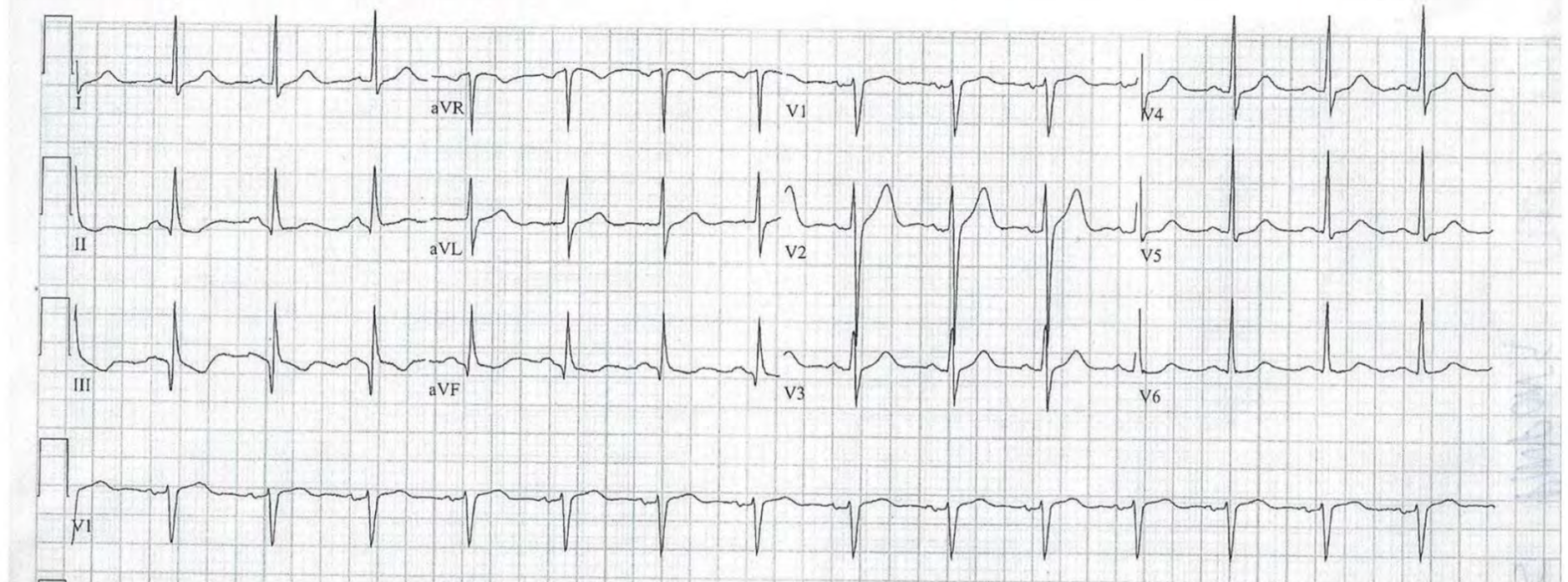


58 y.o F feels weak

Vent. rate	89	BPM
PR interval	138	ms
QRS duration	100	ms
QT/QTc	382/464	ms
P-R-T axes	59 45	-2

NORMAL SINUS RHYTHM
POSSIBLE INFERIOR INFARCT, AGE UNDETERMINED
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE

4



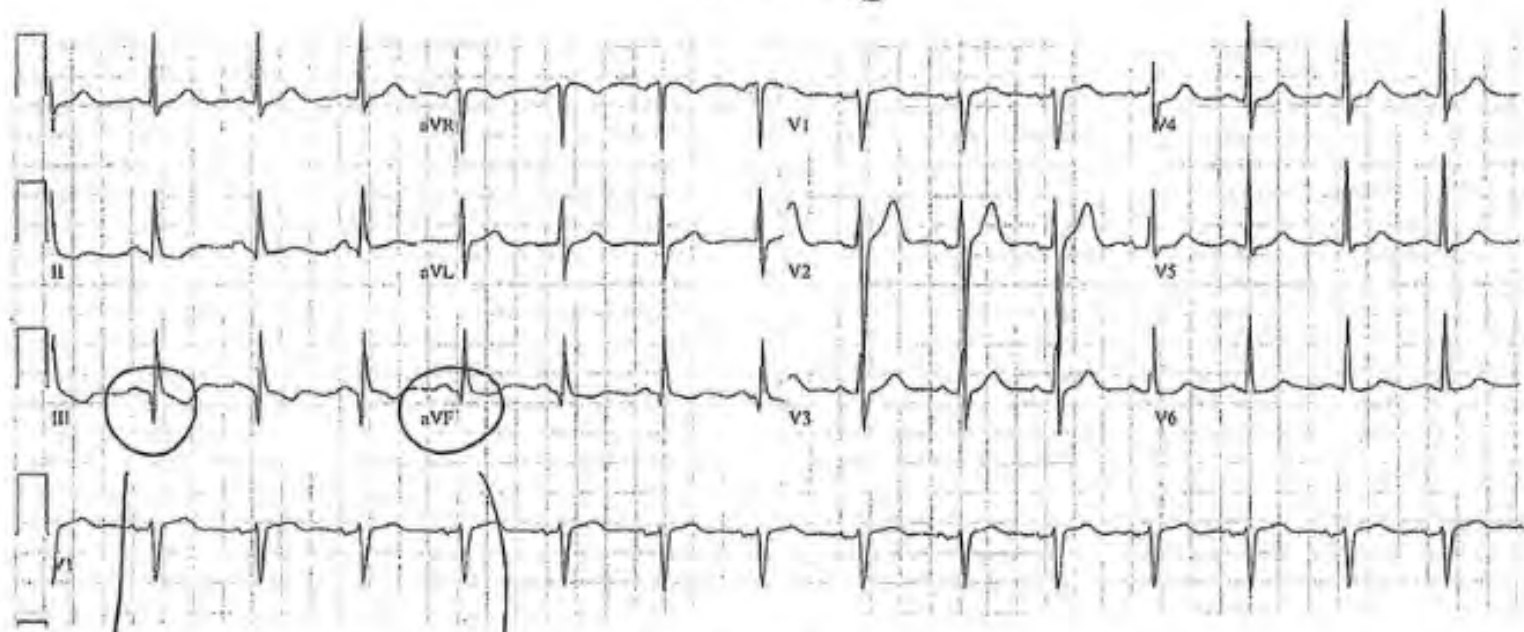
58 y.o F feels weak

Vent. rate 89 BPM
PR interval 138 ms
QRS duration 100 ms
QT/QTc 382/464 ms
P-R-T axes 59 -45 -2

NORMAL SINUS RHYTHM
POSSIBLE INFERIOR INFARCT, AGE UNDETERMINED
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE

4

"1/3 height of R"



Q WAVE

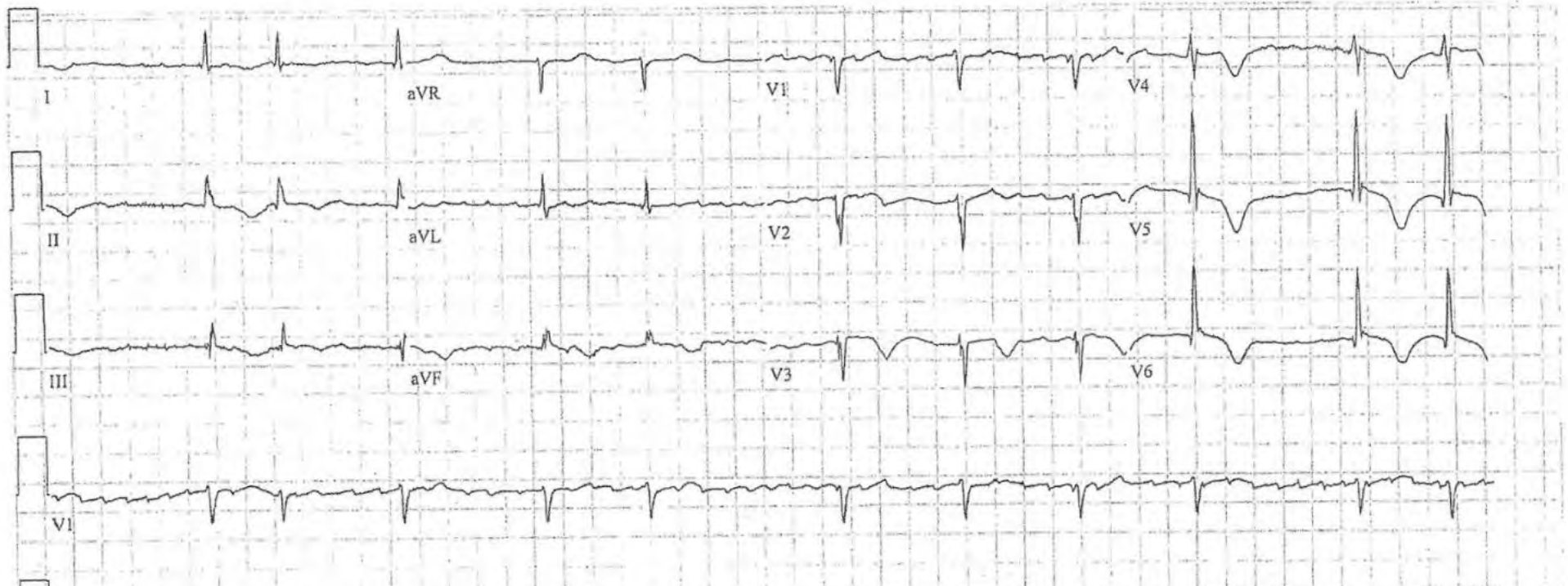
Q WAVE = CONTIGUOUS

89 y.o chest pain

(2)

Vent. rate	70	BPM
PR interval	*	ms
QRS duration	84	ms
QT/QTc	452/488	ms
P-R-T axes	* 34	247

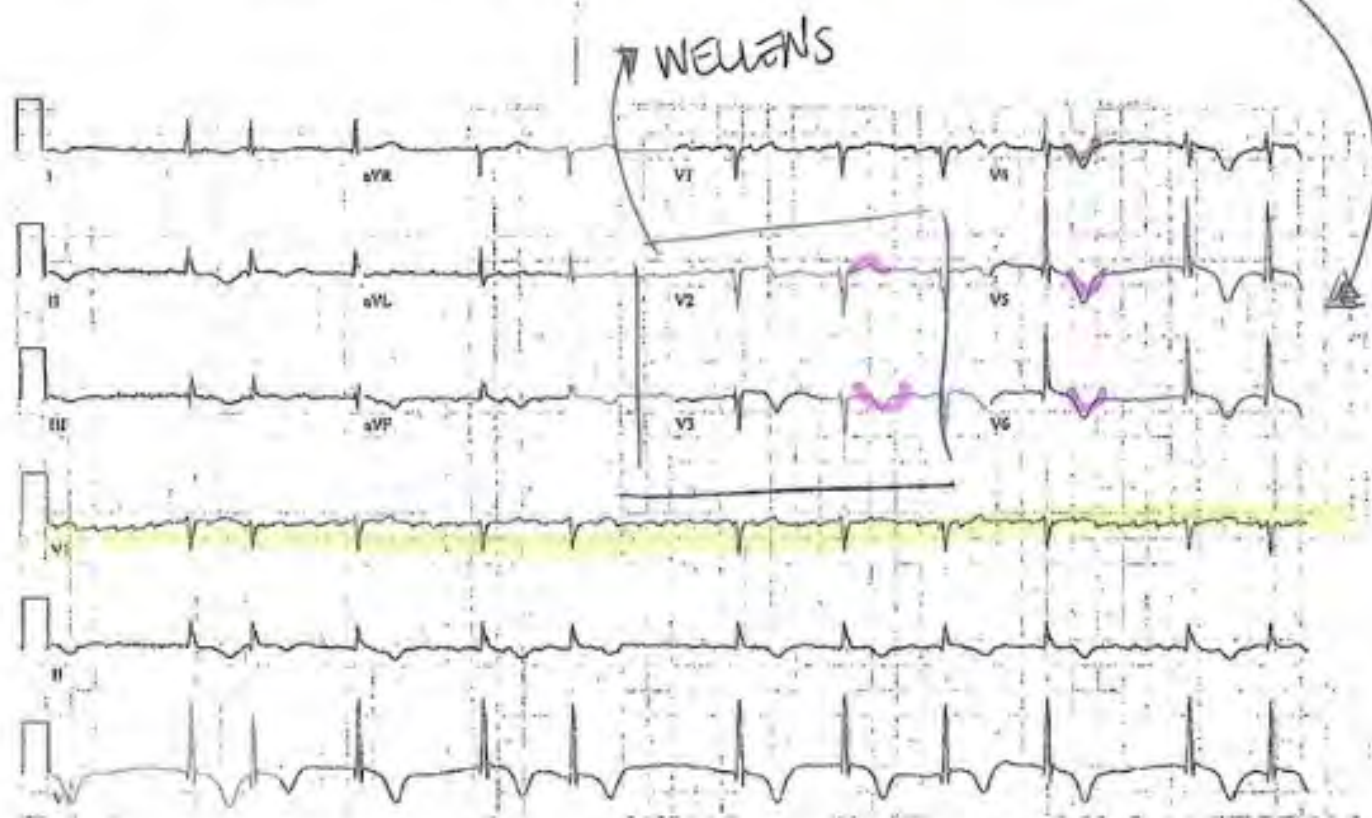
ATRIAL FIBRILLATION
ST AND T WAVE ABNORMALITY, CONSIDER ANTEROLATERAL ISCHEMIA
WHEN COMPARED WITH ECG OF 06-SEP-1992 23:06,
ATRIAL FIBRILLATION HAS REPLACED SINUS RHYTHM
T WAVE INVERSION NOW EVIDENT IN ANTEROLATERAL LEADS



89 y.o chest pain

2
Ventric rate 70 bpm
PR interval 185 ms
QRS duration 84 ms
QT/QTc 432/438 ms
P-R-T axes 34 247

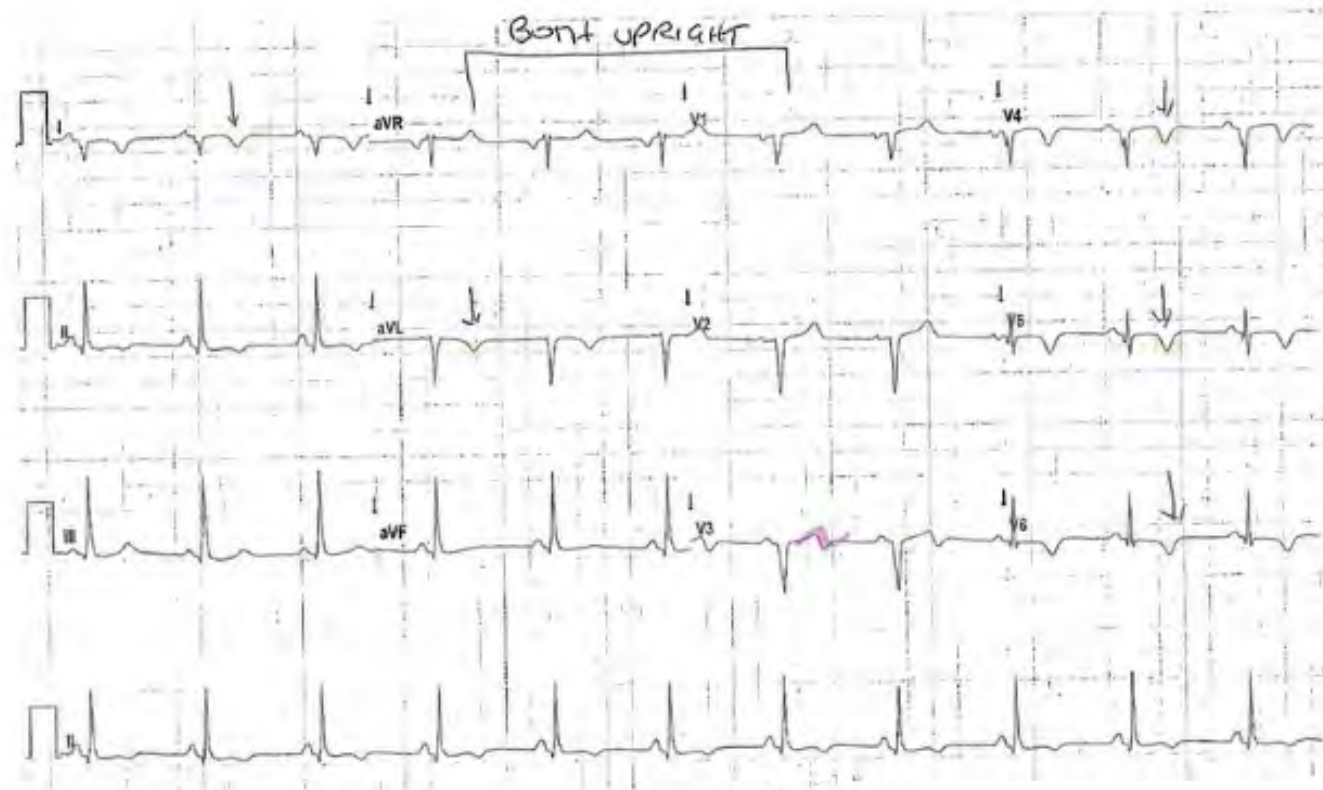
ATRIAL FIBRILLATION
ST AND T WAVE ABNORMALITY, CONSIDER ANTEROLATERAL ISCHEMIA
WHICH COMPARED WITH ECG OF 08-SEP-1992 11:56
ATRIAL FIBRILLATION HAS REPLACED SINUS RHYTHM
T WAVE INVERSION NOW EVIDENT IN ANTEROLATERAL LEADS



52 y.o sudden cardiac arrest

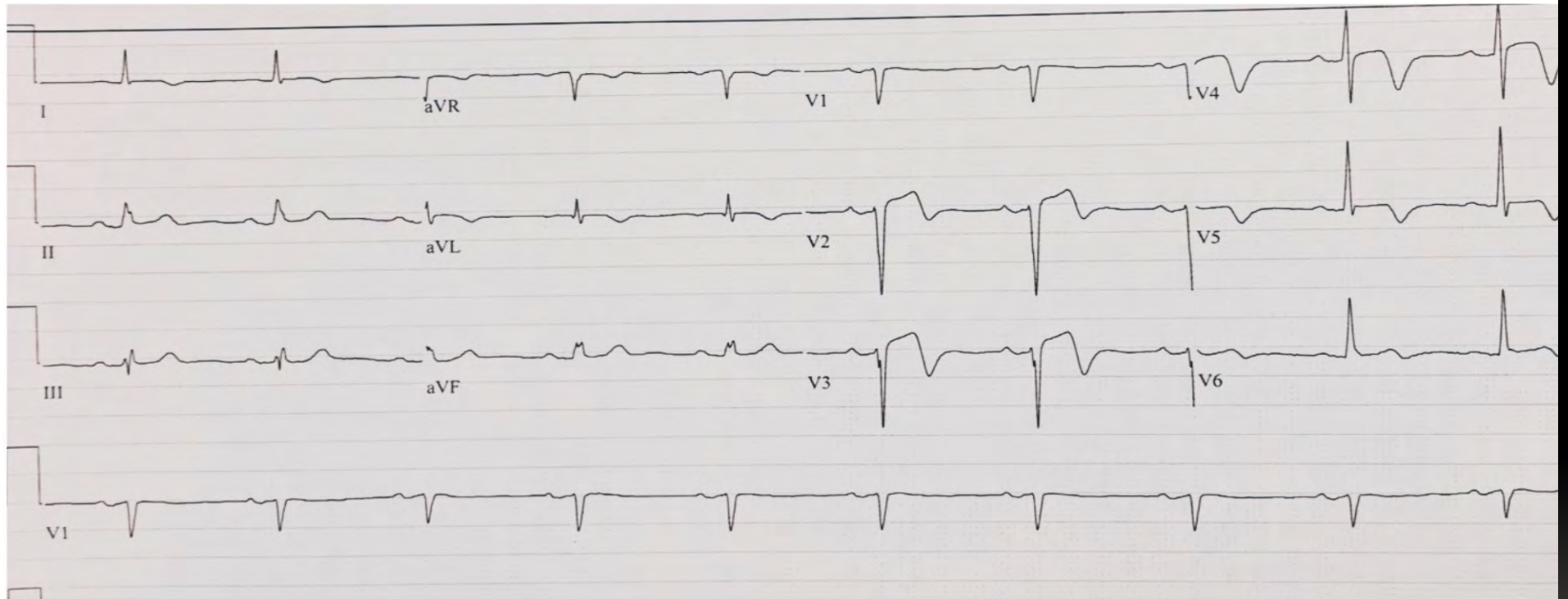


52 y.o sudden cardiac arrest



INVERTED symmetric T WAVES =
ACS
PE
ICH
Cardiomyopathy

60 y.o sudden chest pain



60 y.o sudden
chest pain



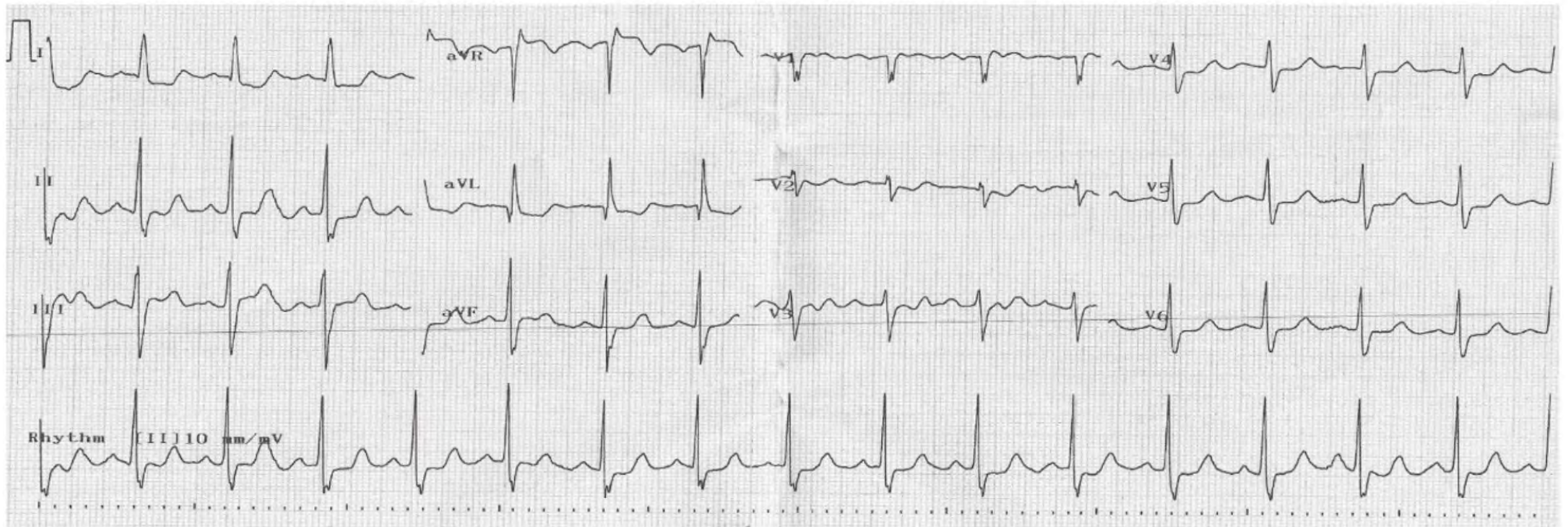
WELWENS

INVERTED
QRS

"HYPERACUTE"

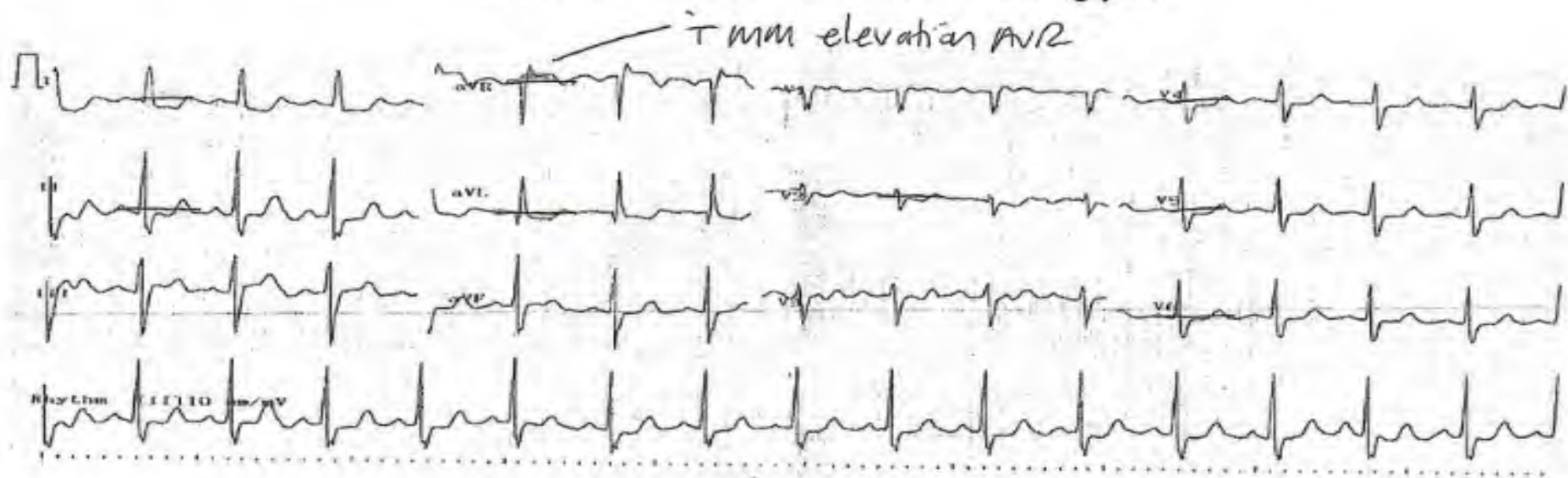
78 Y.O M SHOULDER PAIN

"When I work out at the gym"



78 Y.O M SHOULDER PAIN

"When I work out at the gym"



"WIDESPREAD ST DEPRESSION \pm ↑ 1 mm
ST ELEVATION"

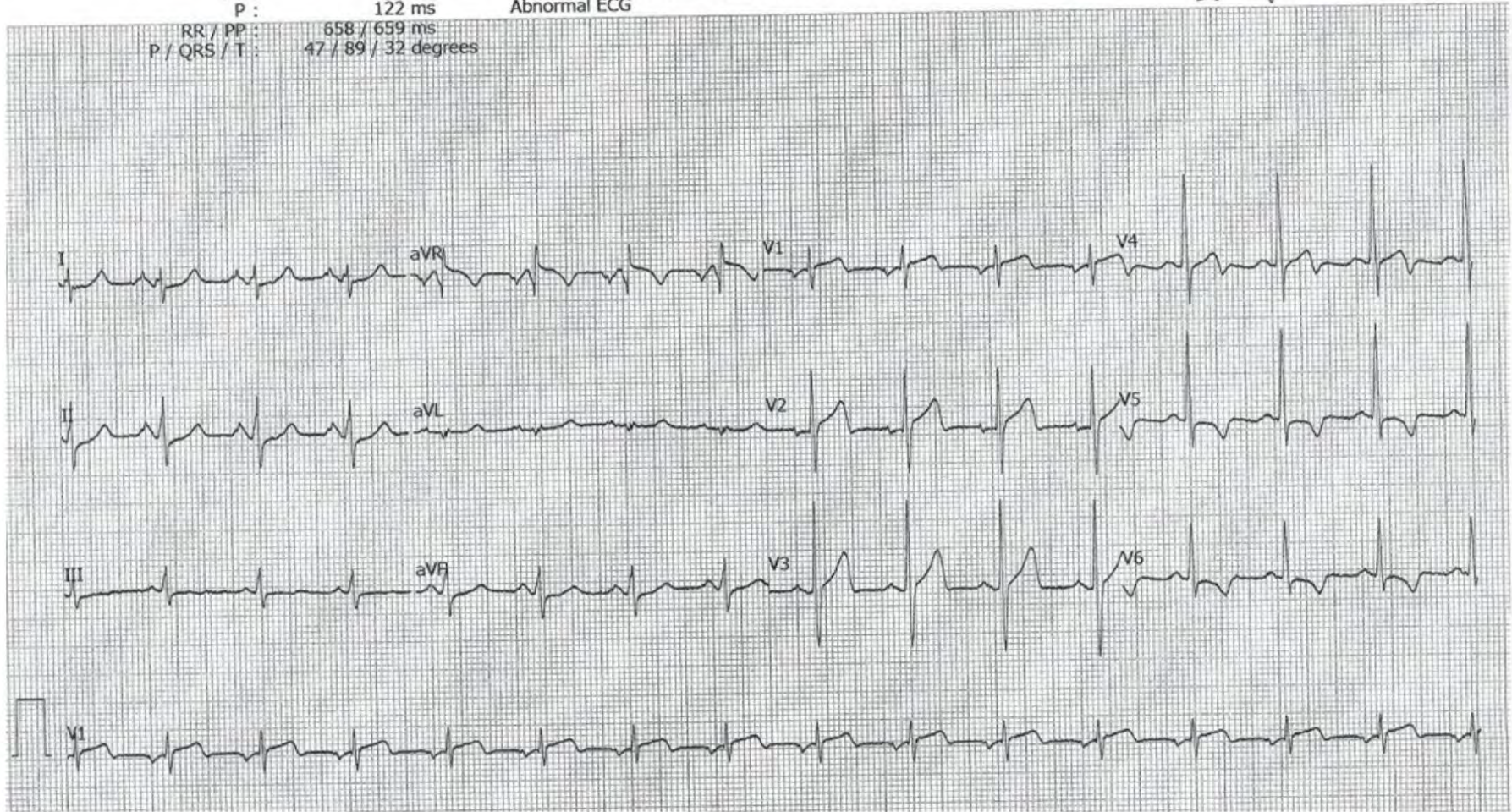
Ordering Ph:
Referring Ph:
Attending Ph:

QRS : 80 ms
QT / QTcBaz : 348 / 428 ms
PR : 144 ms
P : 122 ms
RR / PP : 658 / 659 ms
P / QRS / T : 47 / 89 / 32 degrees

Normal sinus rhythm
Possible Left atrial enlargement
ST & T wave abnormality, consider lateral ischemia
Abnormal ECG



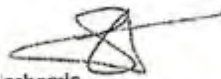
*Symmetric inverted
waves V5 V6
ST depression I, II*



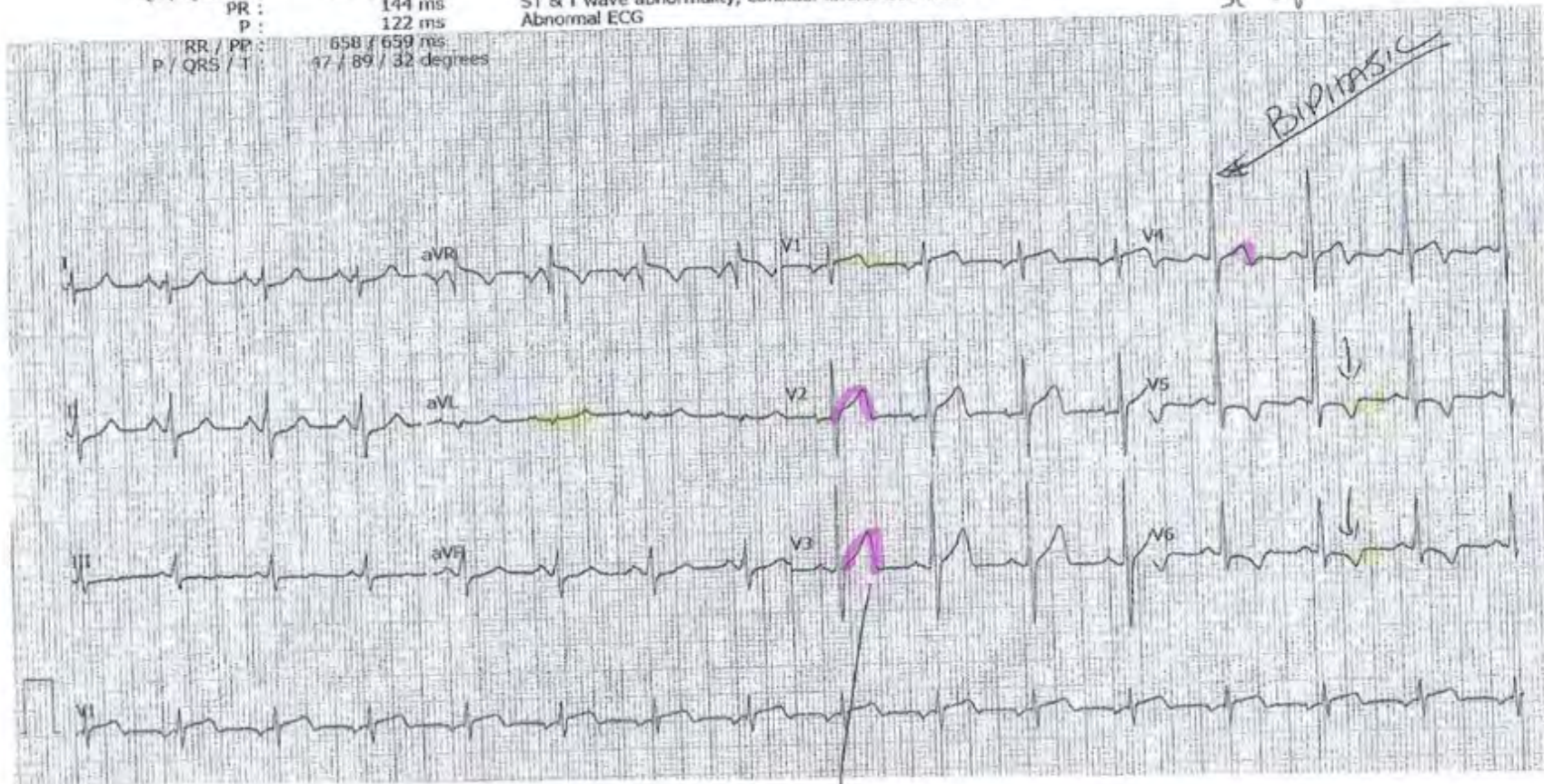
Structuring ref:
Referring Ph:
Attending Ph:

QRS : 80 ms
QT / QTcBaz : 348 / 428 ms
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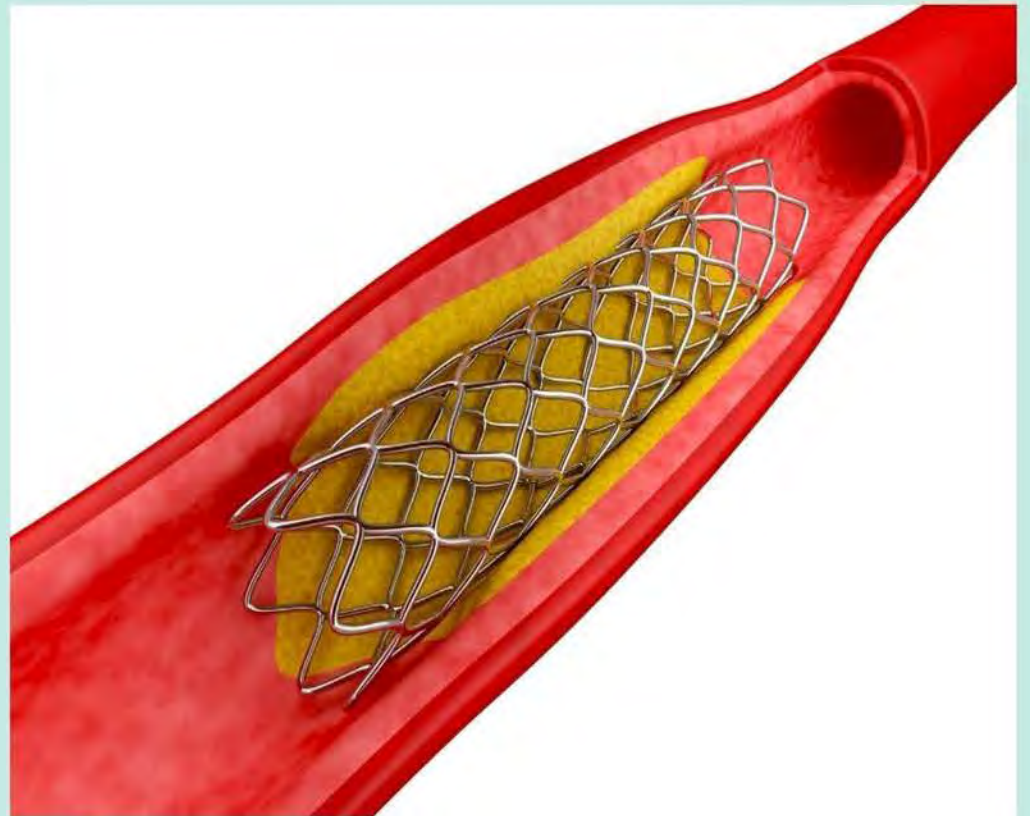
Symmetric inverted waves US V6 SC depression I, II



v2, v3 Hyperacute

Case Progression....

Goes to the cath lab:
Stent to **Circumflex, LAD.**



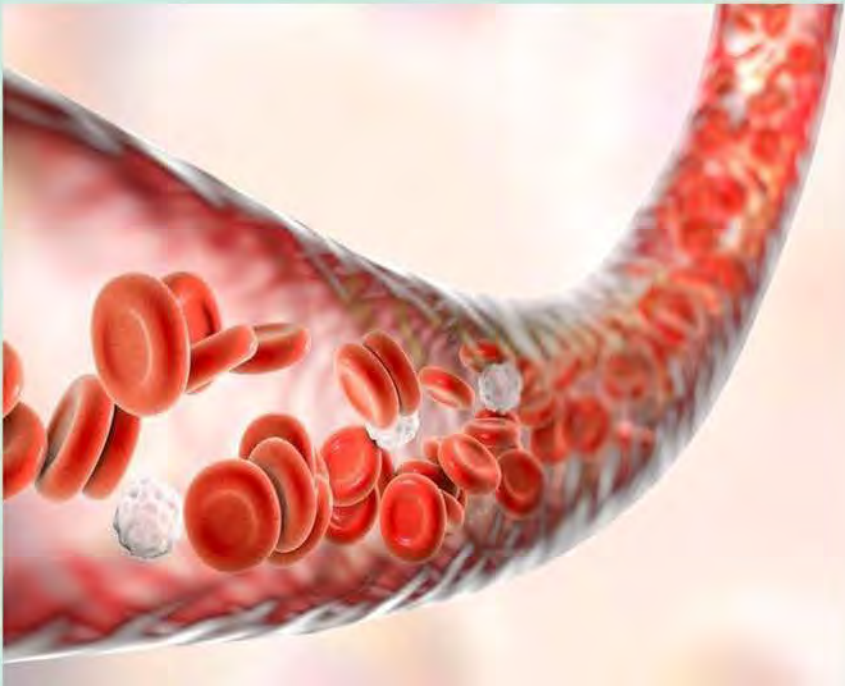
The Next Day...



**"Rapid Response
Heart Center"**

CODE **STEMI** CALLED

Circumflex:
Restented

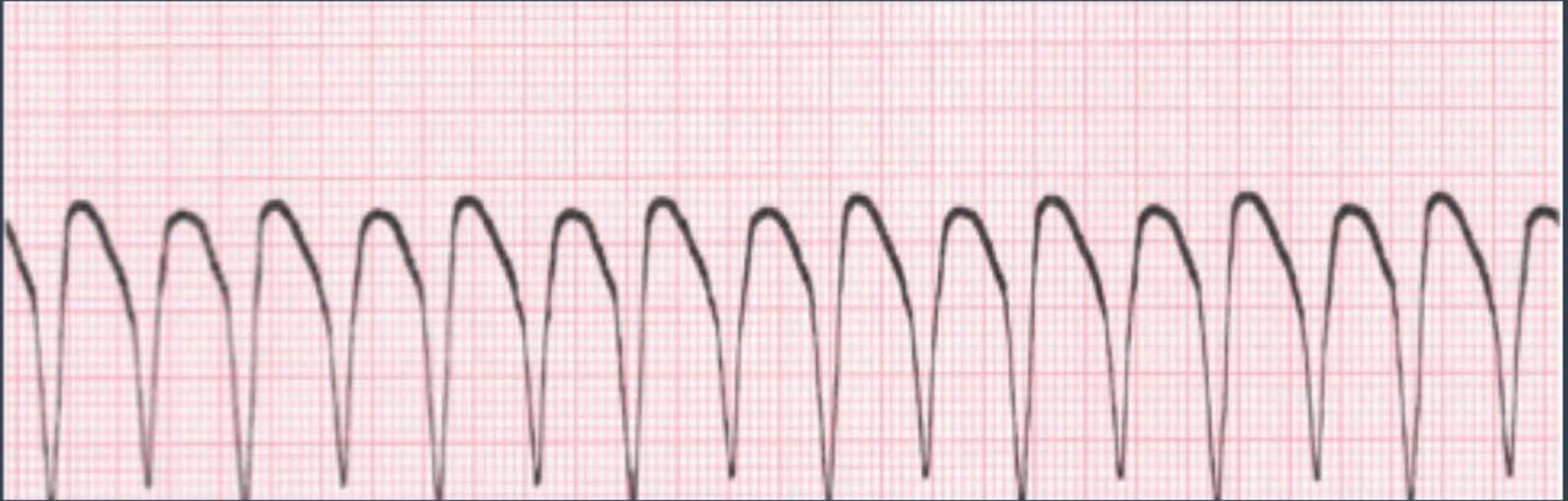


LAD: Couldn't
reopen

The next day...

RAPID
RESPONSE!!!





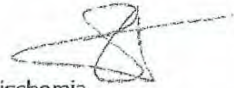
What is **wrong** now?

Ordering Ph:
Referring Ph:
Attending Ph:

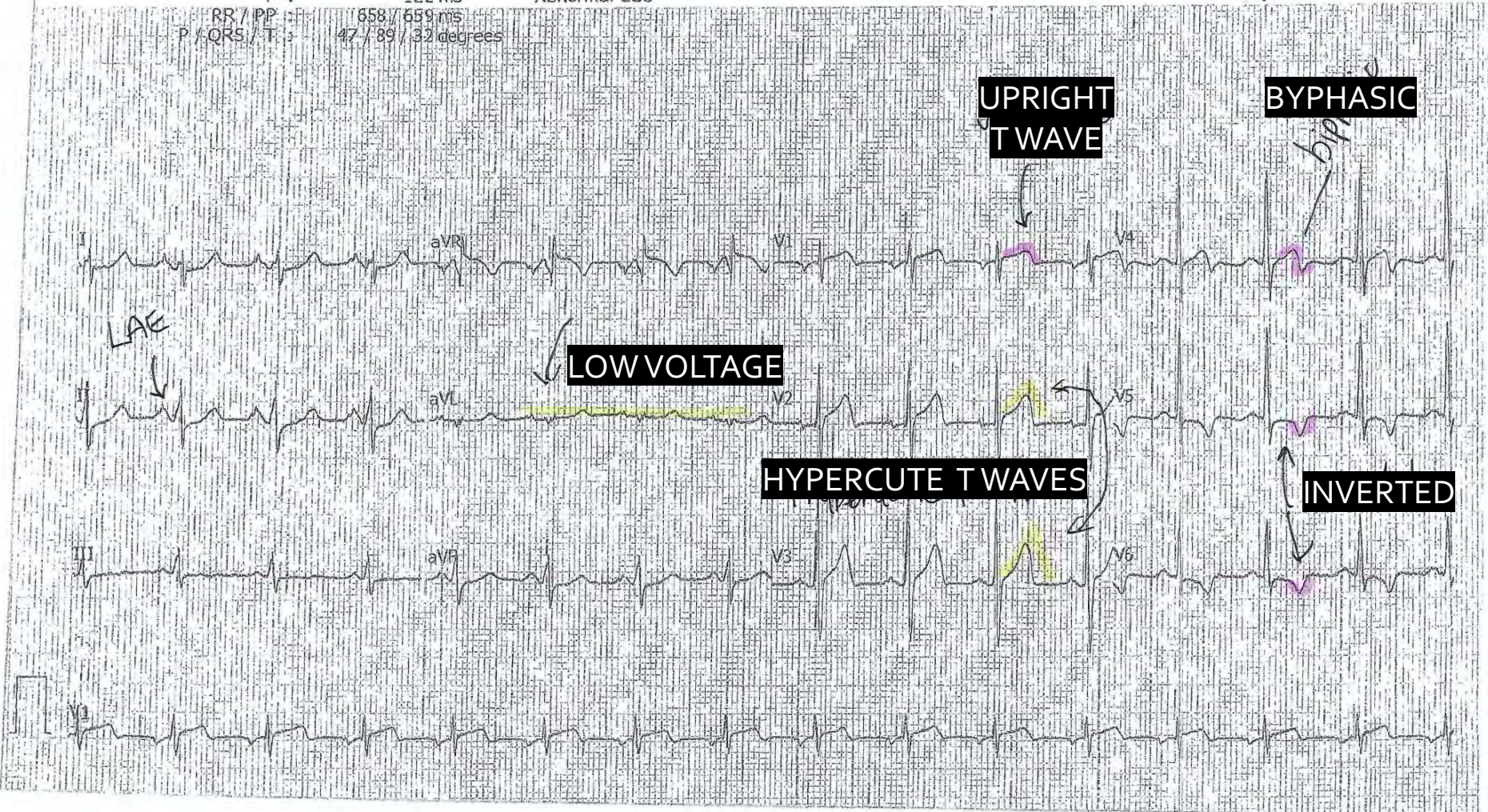
QRS : 80 ms
QT / QTcBaz : 348 / 428 ms
PR : 144 ms
P : 122 ms

RR / PP : 858 / 659 ms
P / QRS / T : 47 / 89 / 32 degrees

Normal sinus rhythm
Possible Left atrial enlargement
ST & T wave abnormality, consider lateral ischemia
Abnormal ECG



Symmetric
waves V5 V6
ST depression I, II



Thank you



Jeneconqueringcardiology.com