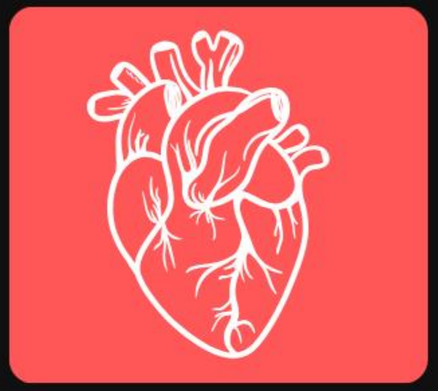
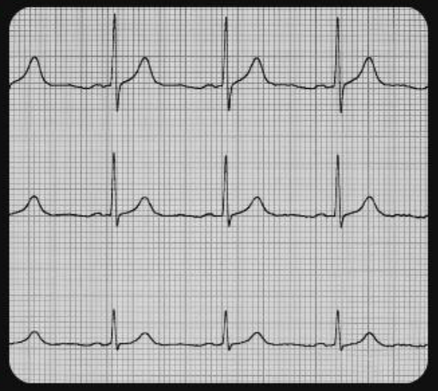








Basic 12 Leads
Demystified

Presented By:
Jennifer Carlquist
PA-C, ER-CAQ



Jen Carlquist PA-C

Cardiololgy and ER PA

INSTRUCTOR

16 years as a **PA**

Trained at UC Davis FNP/PA Program

Former **Paramedic** 13 years

Author in numerous urgent care journals

National Lecturer at PA/NP Conferences

EKG Roadmap!

3 HOUR TRIP

Start at your level

START

(Basics)
- Waves
- Rhythms
- Intervals

What is a normal EKG?

Coronary Anatomy

12 Lead: What do the leads look at?

High Risk Patterns

STEMI

Mimics

Subtle STEMI

Confidence!

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Myocardial Infarction Window

Circle all relevant findings below

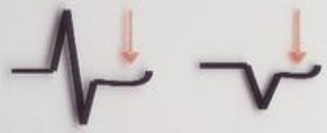
High Lateral		Anteroseptal	Anterior
Inferior	High Lateral	Anteroseptal	Anterolateral
Inferior	Inferior	Anterior	Anterolateral

Inverted T waves = ischemia or reciprocal changes



Ant/Sep
Lateral
Inferior

Depressed ST segments = ischemia or reciprocal changes



Ant/Sep
Lateral
Inferior

ST segment elevation = acute injury (Hyperacute T waves may occur early)



Ant/Sep
Lateral
Inferior

Pathological Q wave (one small box wide) = infarction

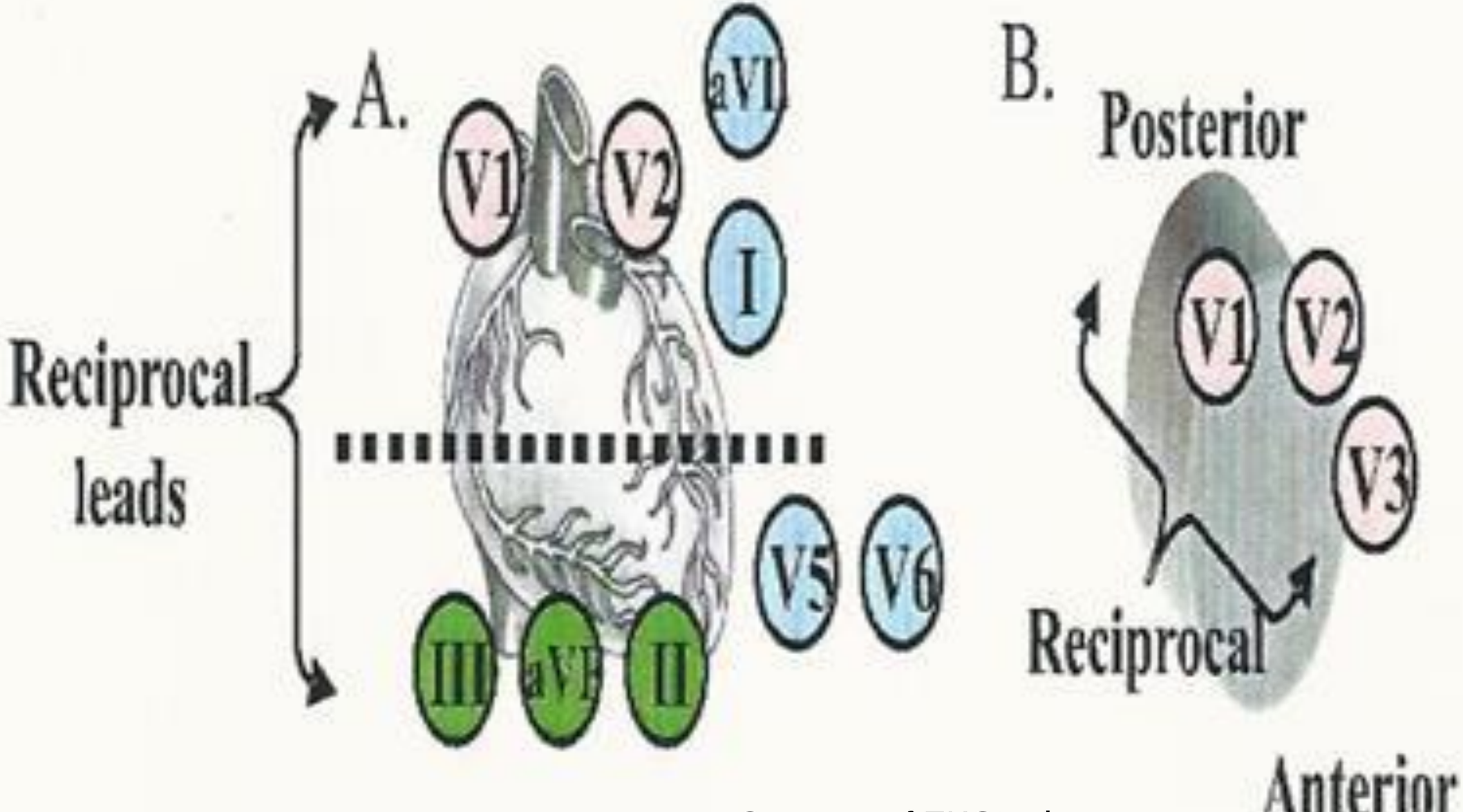


Ant/Sep
Lateral
Inferior

Poor R wave progression/new LBBB = ? infarction
ST elevation in Lead III = Do a right-sided EKG

ST/T changes without ST elevation = Consider NSTEMI
Tall R wave w/ ST depression in V1-V3 = ? Posterior MI

Courtesy of



Courtesy of EKGtools.com

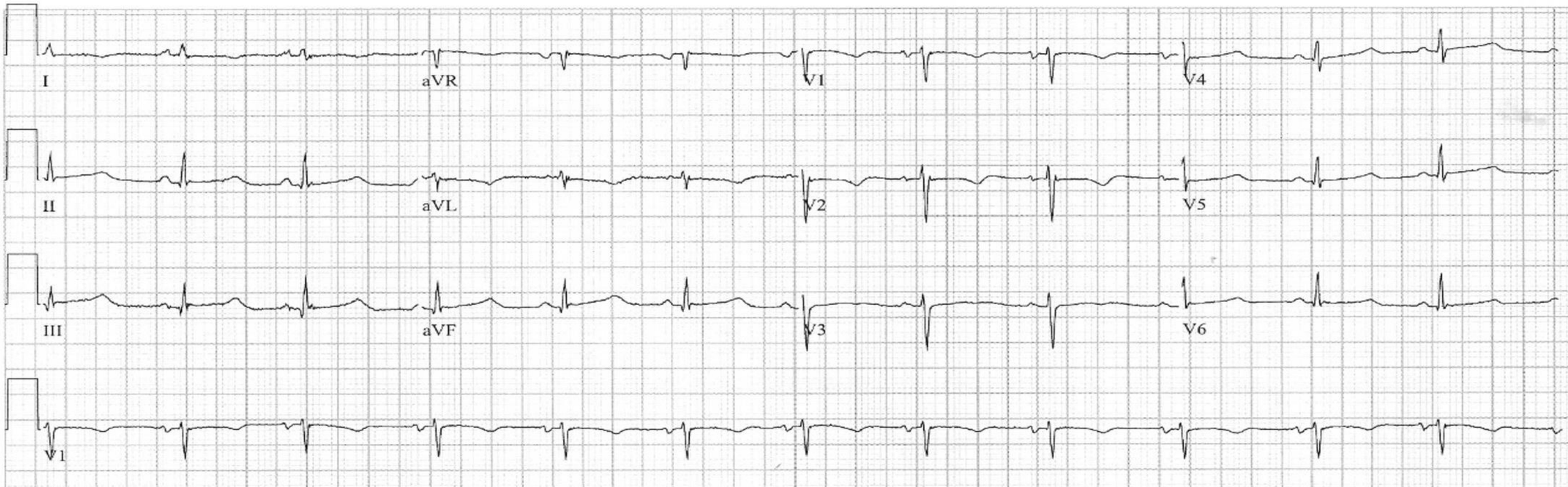

Yeah! You made it!
How is your pt?
12
Did you Vogue?
V1-V2=Brugadas
V2-V3=Posterior, Wellens, DeWinters
11
1
Big Sick/Little Sick?
(u got this, Does the pt situation fit what you are seeing on ECG?)
CC Based Approach
(let's put it all together?)
10
2
Rate
(Normal:60-100)
Q waves? Married? Wide?
(< 1/3 height of R)
(< 30ms wide)
S1q3t3 HOCM
9
3
Rhythm
(Regular/Irregular?)
T Wave Analysis
(Upright in ALL leads, except: avR & V1)
Symmetrical? 4 Differentials
8
4
Intervals
(PRI: 120ms-200ms)
(QRS: 80ms-100ms)
(QTc <460)
7
Hypertrophy
(R Wave Ht: 0.5mV=Limb
R Wave Ht: 1.0mV =Precordial
Not taller Than 2.5-3.0mV)
6
ST segments
(STE/STD)
In Contiguous Leads? 2
Reciprocal Also? 2
5
Axis
(NL: 0-90)

Ten Step Approach to 12 Lead ECG's (Practice)

Step 1: Big Sick vs. Little

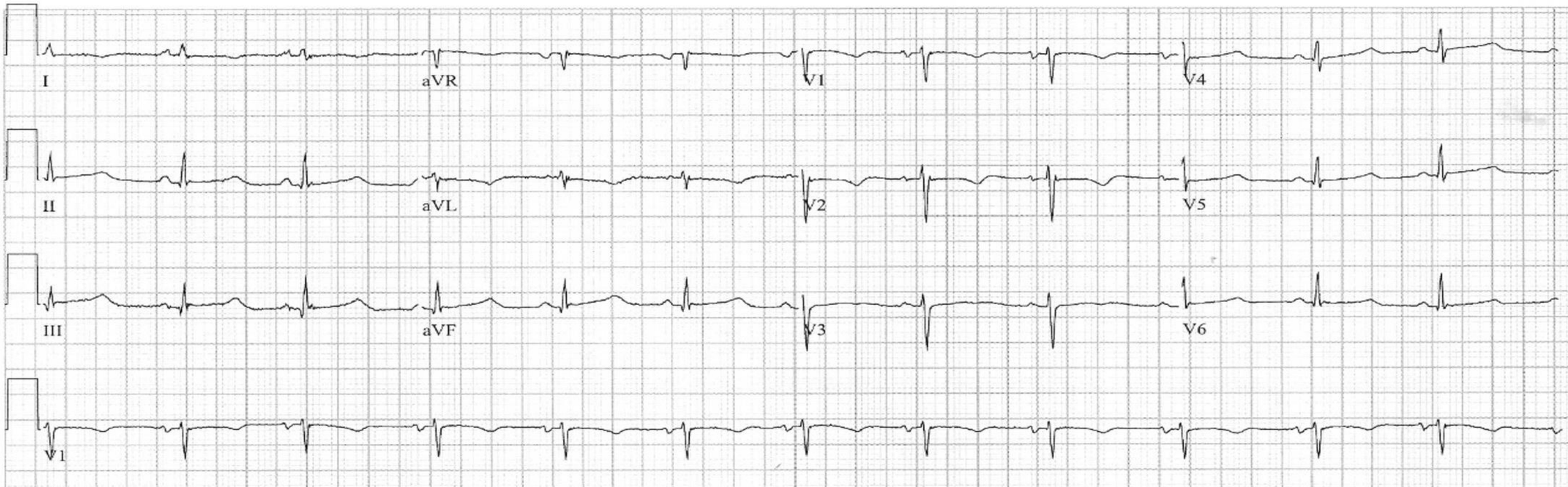
Vent. rate	72	BPM
PR interval	128	ms
QRS duration	76	ms
QT/QTc	474/519	ms
P-R-T axes	51 74	101

N RMAL SINU RHYTHM
NON PE IF C V AVE ABNORMALITY
P DI DN GED (



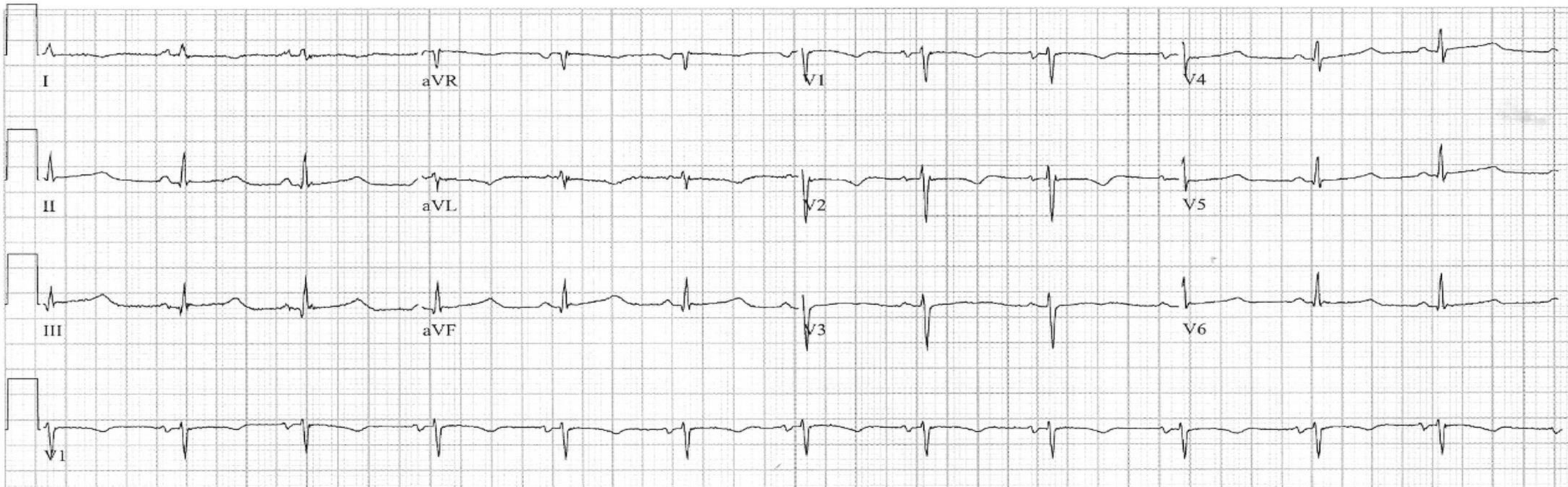
Step 2: Rate

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



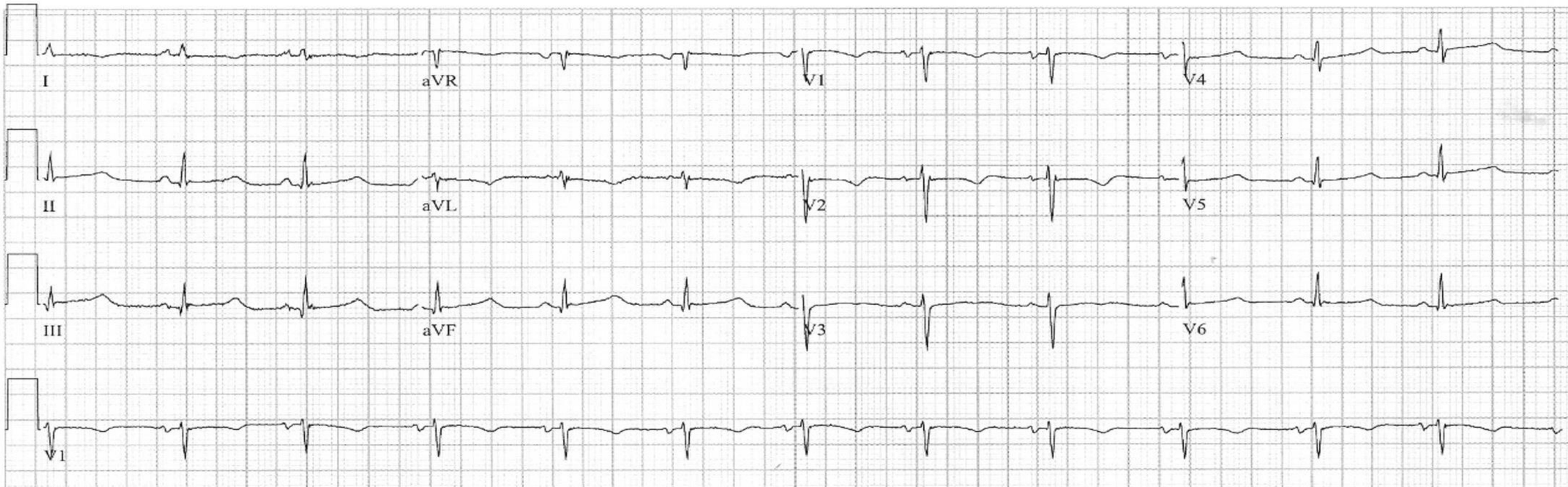
Step 3: Rythmn

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



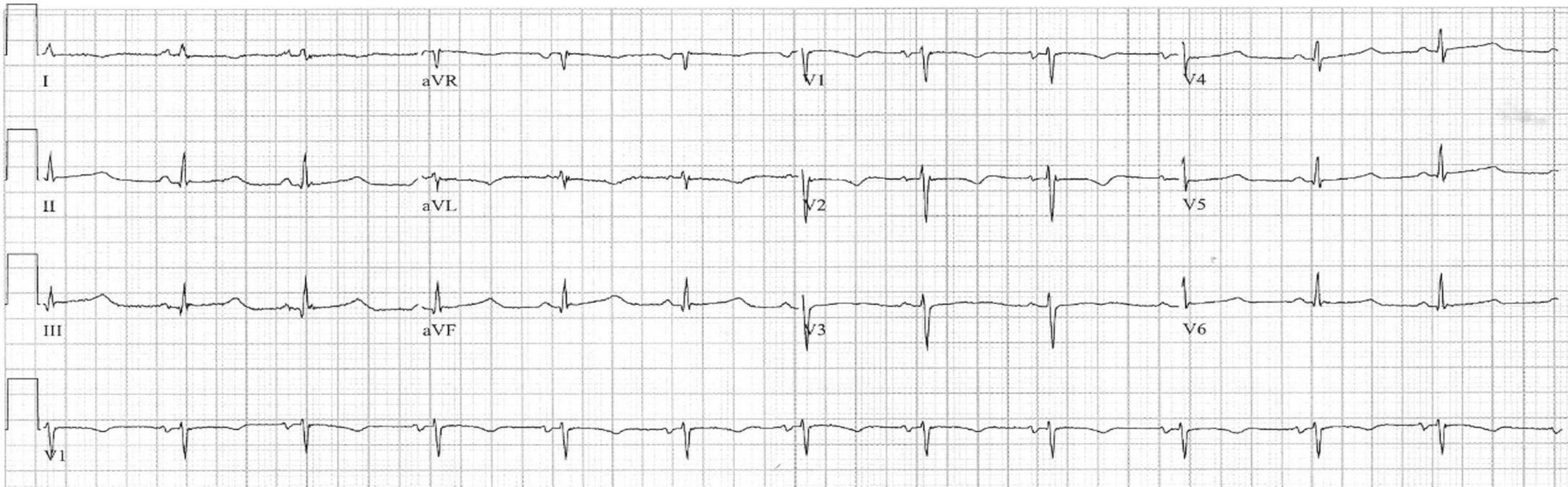
Step 4: Intervals

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



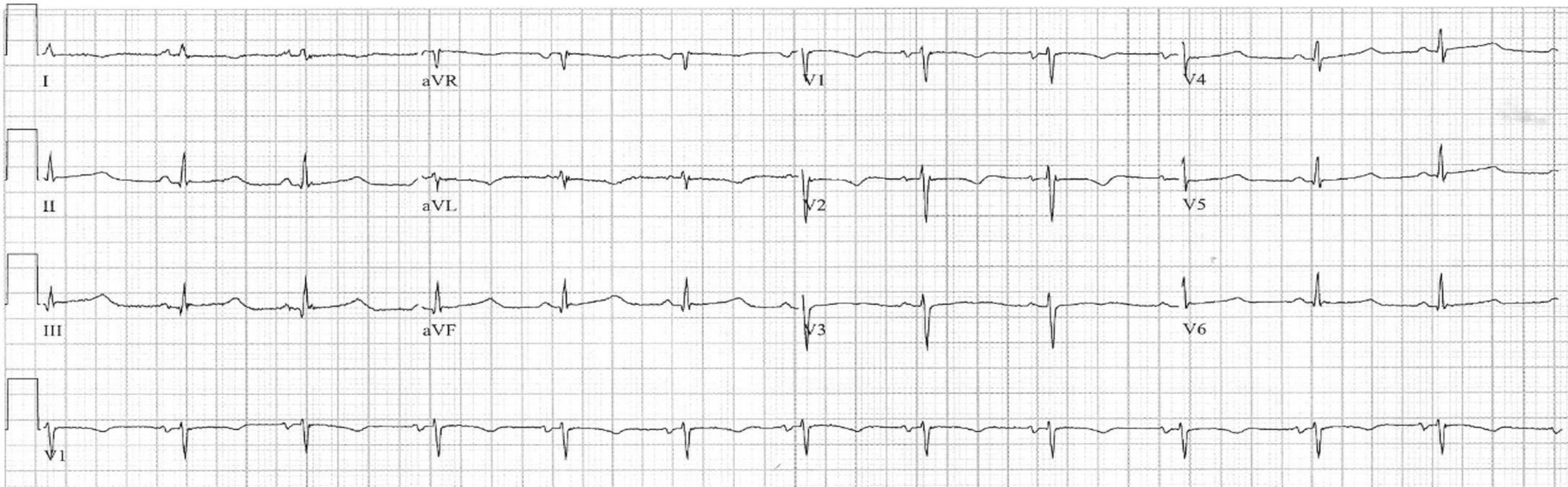
Step 5: Axis

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



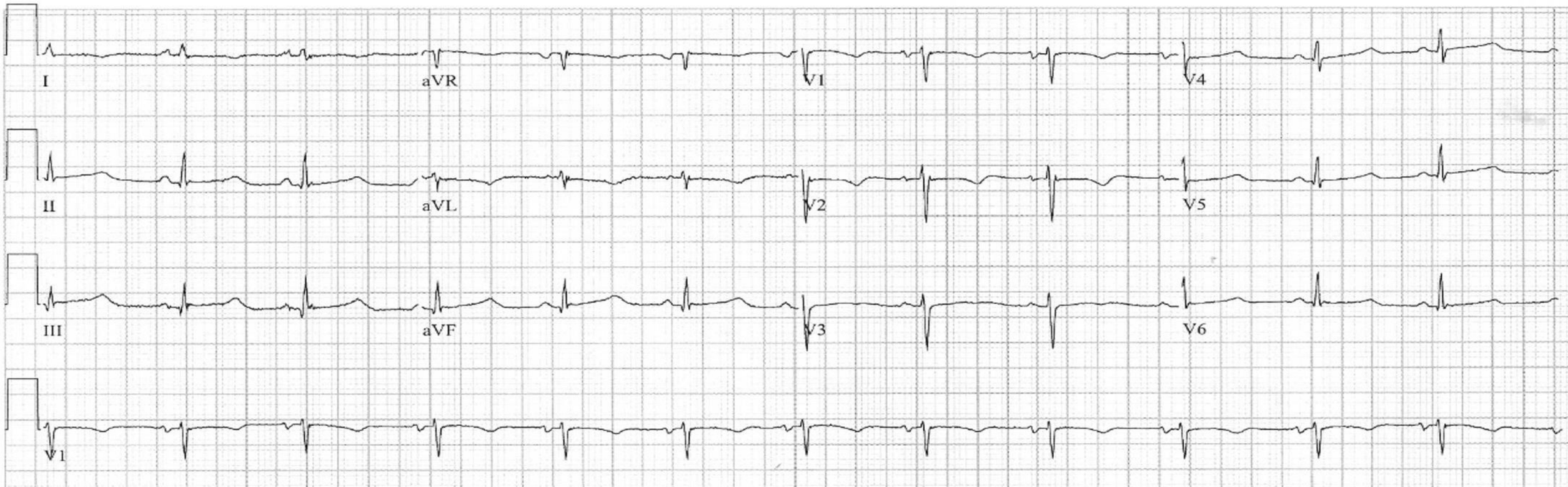
Step 6: ST segments

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



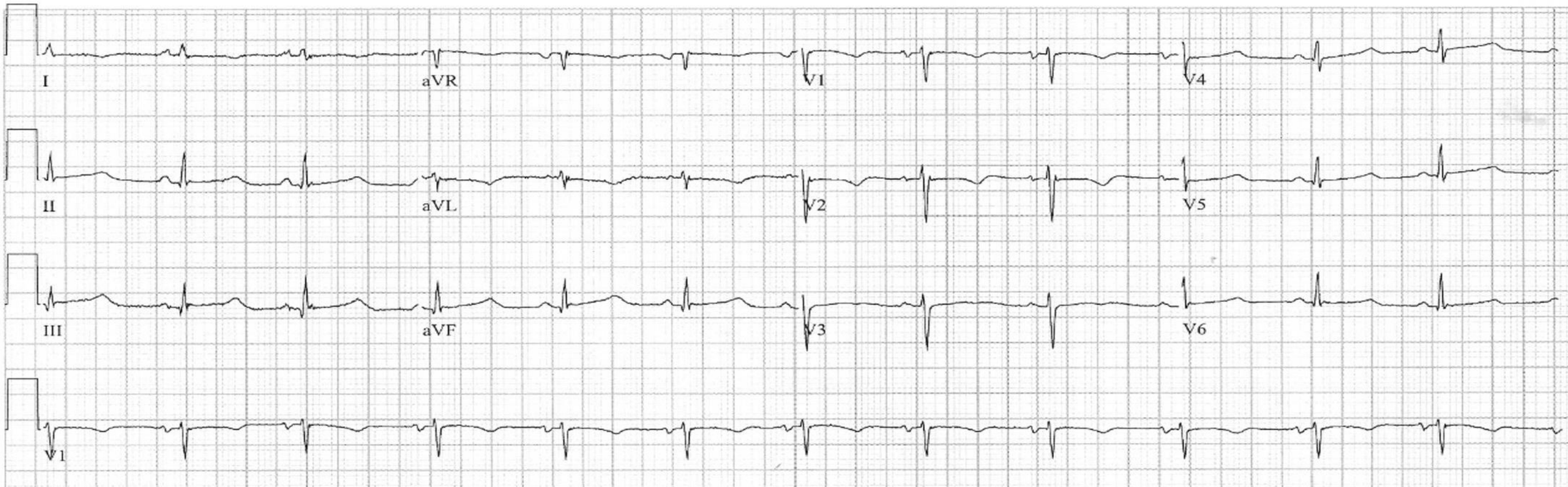
Step 7: Voltage/Hypertrophy

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



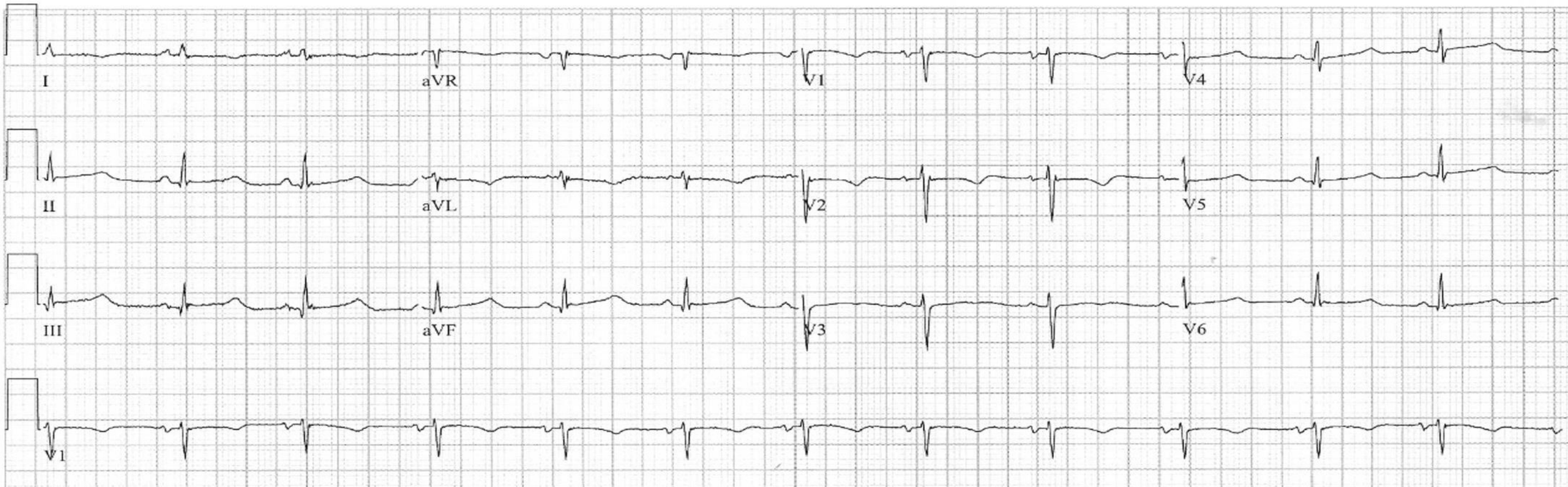
Step 8: T waves

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



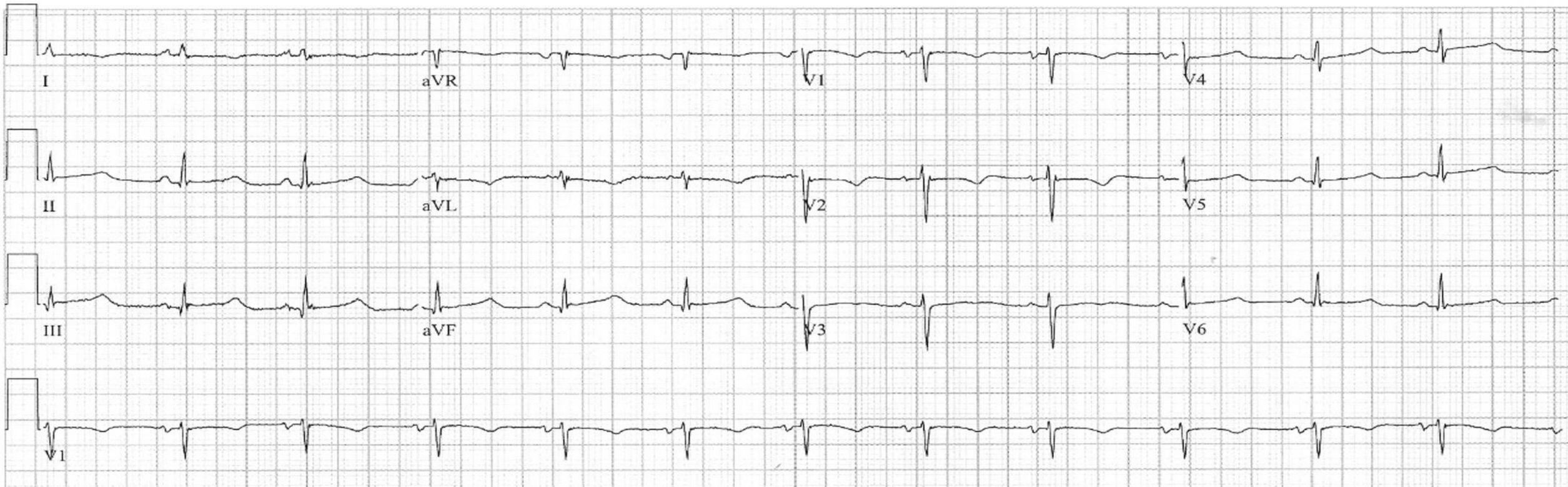
Step 9: Q waves, wide QRS?

Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



Step 10: Chief complaint approach?

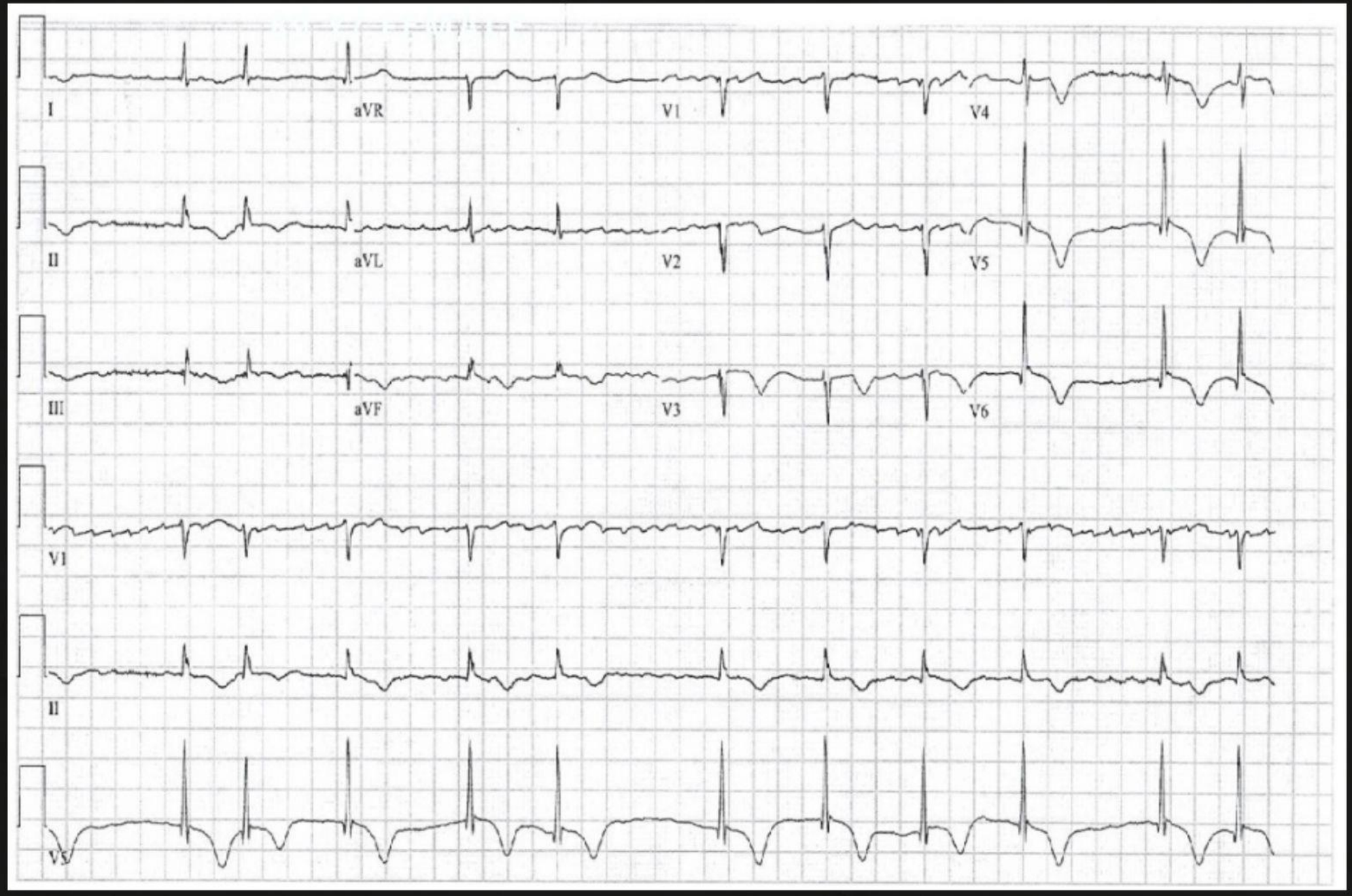
Vent. rate	72	BPM	NORMAL SINUS RHYTHM
PR interval	128	ms	NONSPECIFIC T WAVE ABNORMALITY
QRS duration	76	ms	PROLONGED QT
QT/QTc	474/519	ms	
P-R-T axes	51 74	101	



T wave inversions:

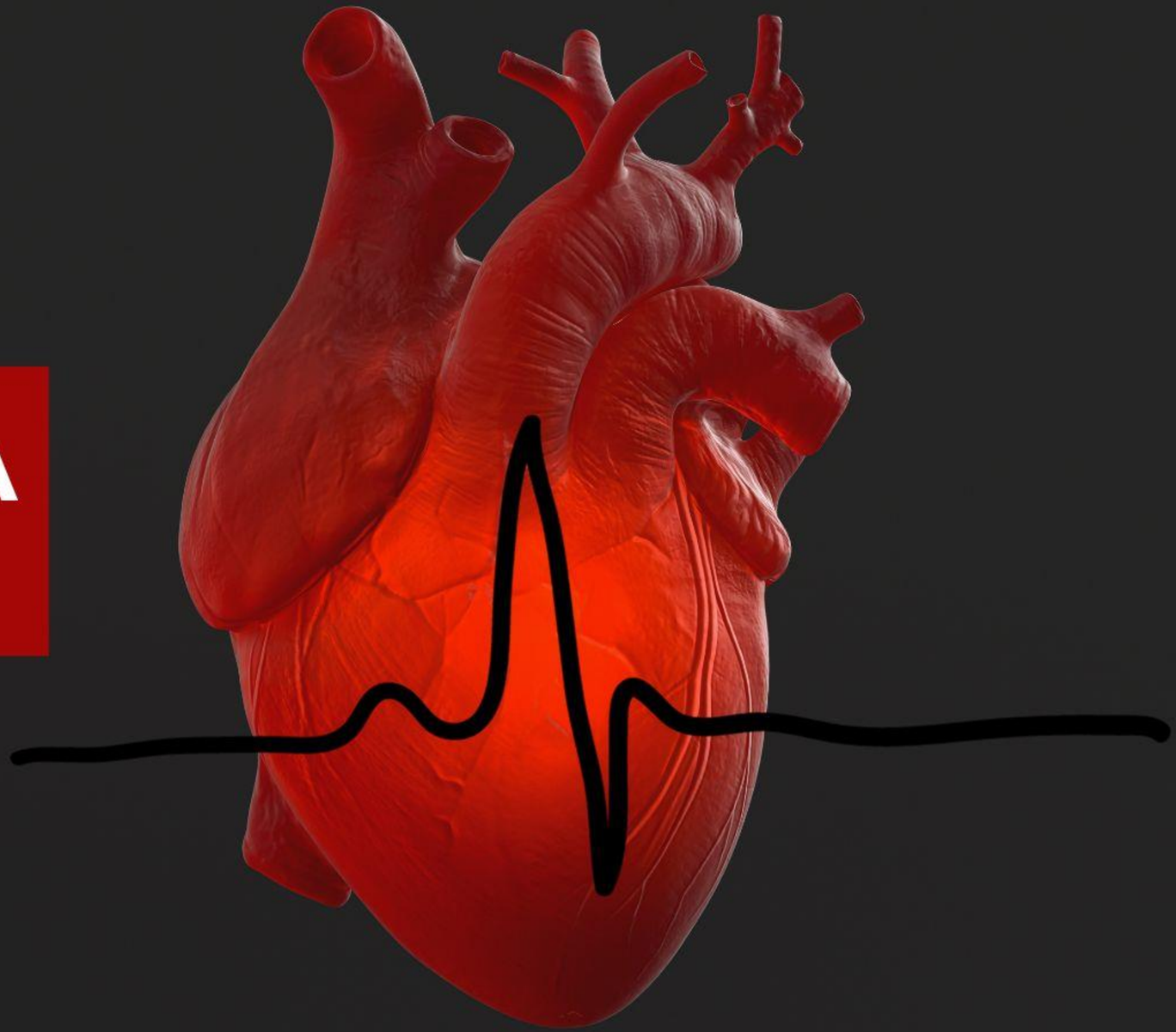
4 things to worry about if they are asymmetricric and inverted

1. ACS
2. Cardiomyopathy
3. PE
4. ICH


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

LET'S DO A

Case!



63 y/o M with chest pain

P- Was shoveling snow

Q- Tight

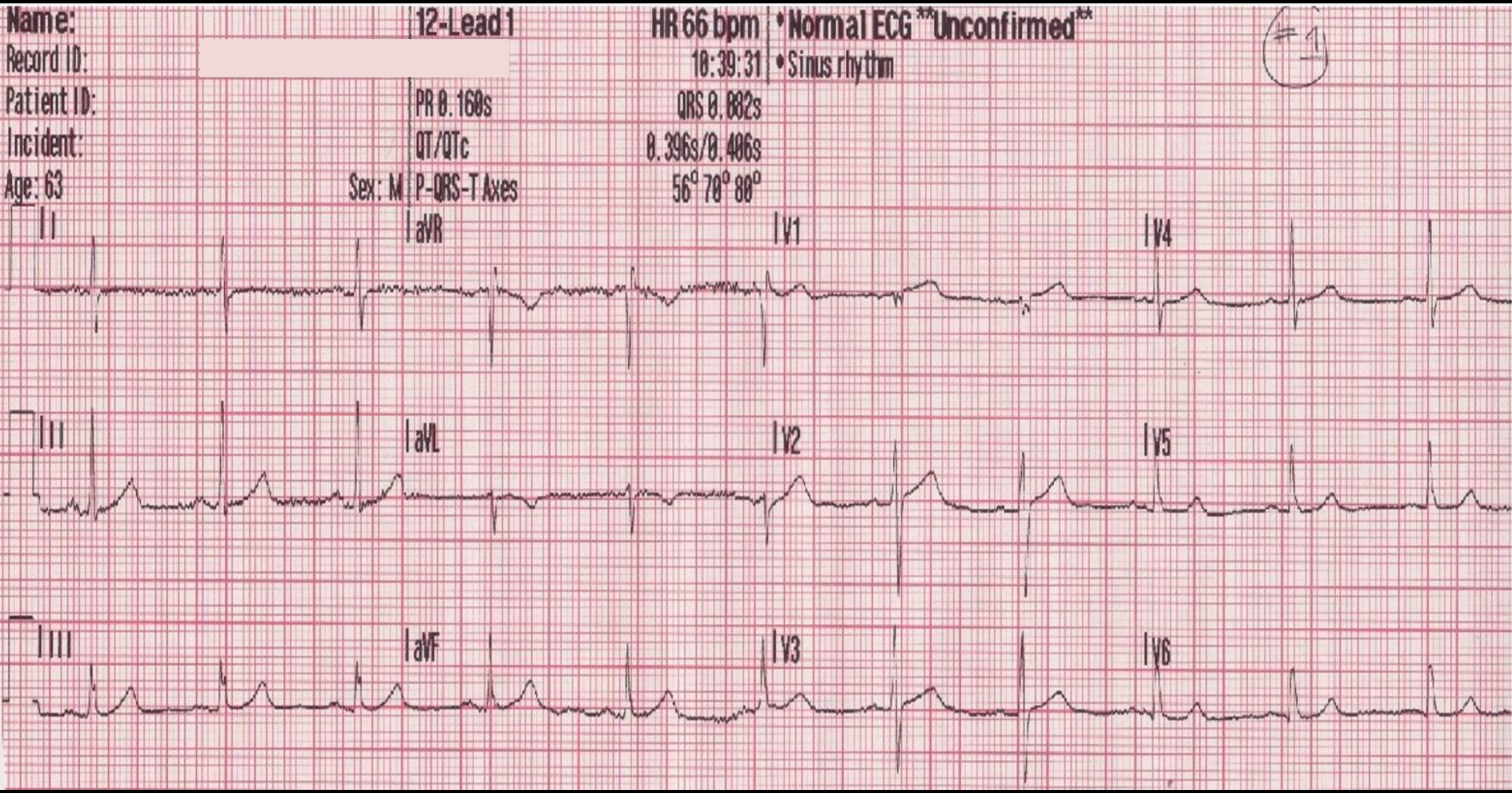
R- To my jaw

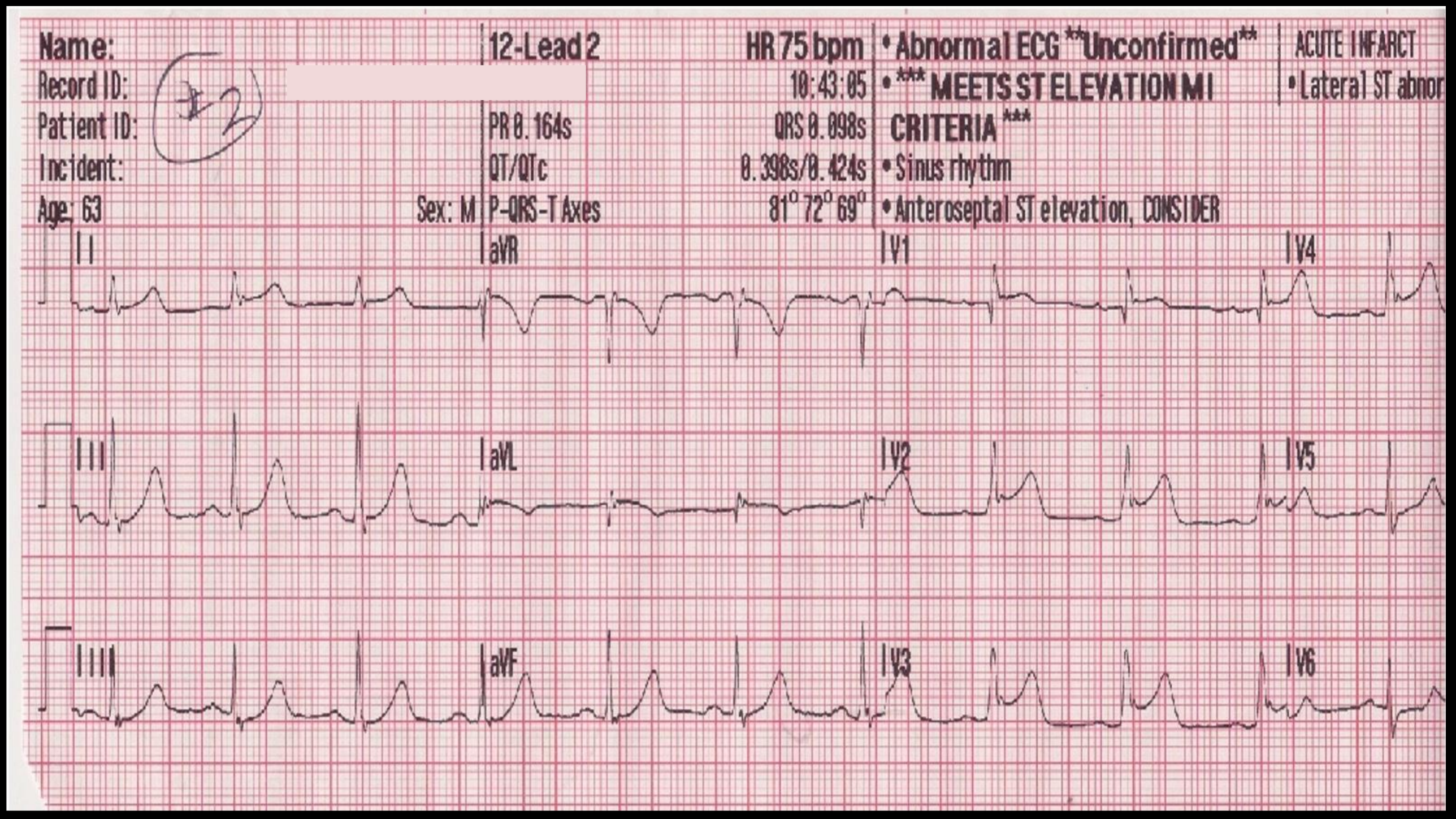
S- 8/10

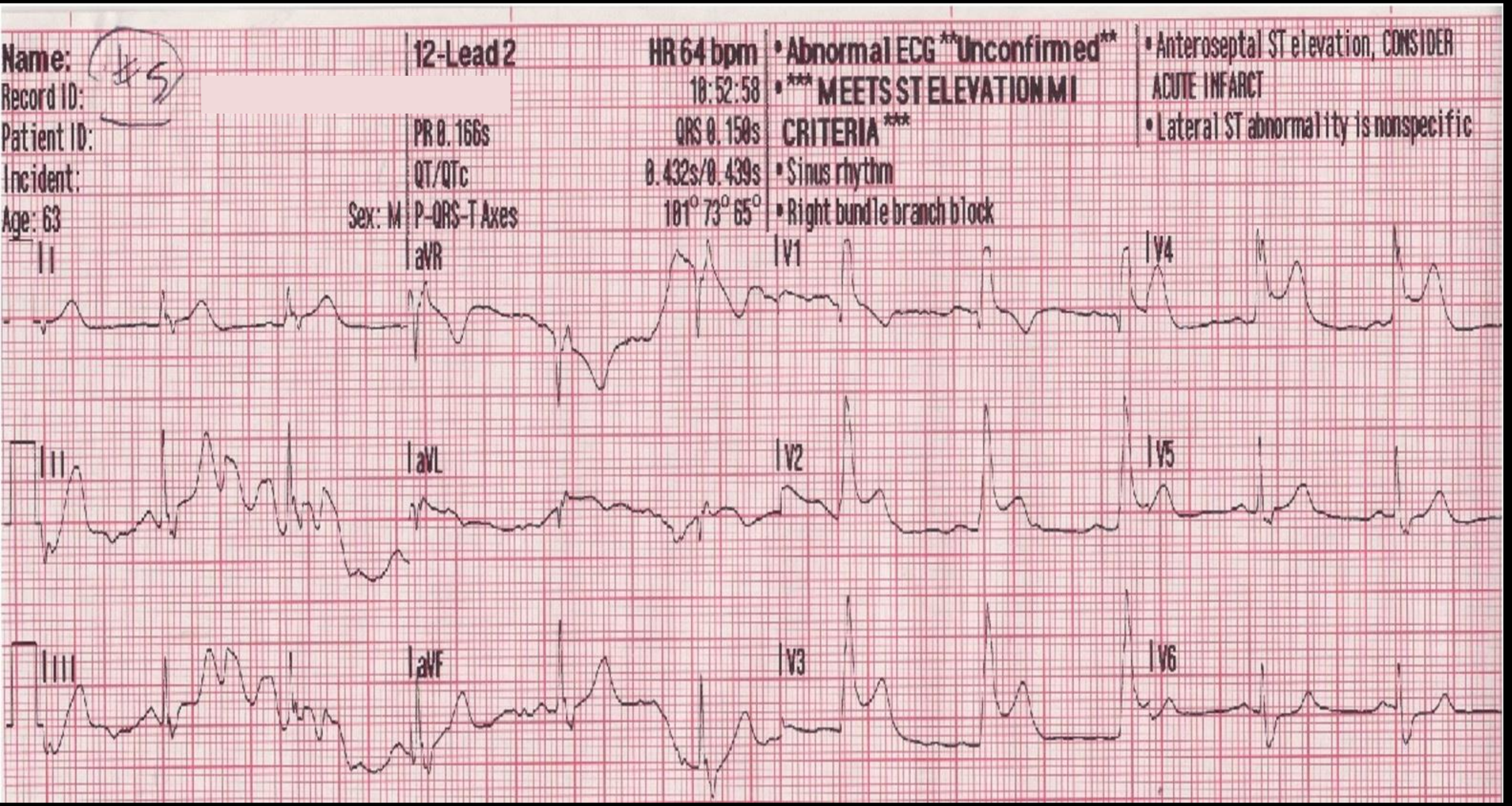
T - 1 hour PTA

Pmhx: Hyperlipidemia, HTN




Name:
Record ID:
Patient ID:
Incident:
Age: 63
Sex: M
12-Lead 1
PR 0.160s
QT/QTc
0.396s/0.406s
P-QRS-T Axes
56° 70° 80°
HR 66 bpm
10:39:31
*Normal ECG **Unconfirmed**
*Sinus rhythm
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


Name:
Record ID:
Patient ID:
Incident:
Age: 63
Sex: M
12-Lead 2
PR 0.164s
QT/QTc
0.398s/0.424s
P-QRS-T Axes
81° 72° 69°
HR 75 bpm
10:43:05
QRS 0.098s
• Abnormal ECG **Unconfirmed**
• *** MEETS ST ELEVATION MI
CRITERIA ***
• Sinus rhythm
• Anteroseptal ST elevation, CONSIDER
ACUTE INFARCT
• Lateral ST abnor
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


Name:
#5
Record ID:
Patient ID:
Incident:
Age: 63
Sex: M
12-Lead 2
PR 0.166s
QT/QTc
0.432s/0.439s
P-QRS-T Axes
101° 73° 65°
HR 64 bpm
10:52:58
QRS 0.150s
• Abnormal ECG **Unconfirmed**
• *** MEETS ST ELEVATION MI CRITERIA ***
• Sinus rhythm
• Right bundle branch block
• Anteroseptal ST elevation, CONSIDER ACUTE INFARCT
• Lateral ST abnormality is nonspecific
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

78 y/o M with chest pain

P- When I work out at the YMCA

Q- Tight

R- To my shoulders

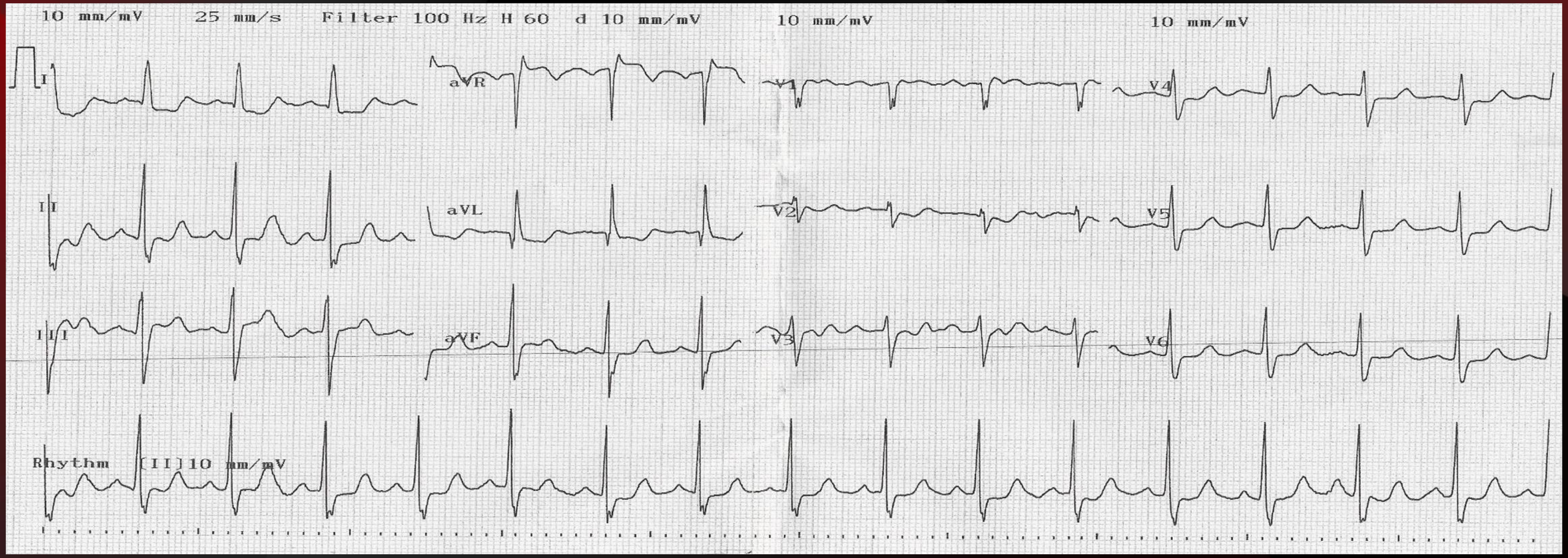
S- 5/10

T - 3 days ago

Pmhx: Previous stent

Meds: ASA, HCTZ




10 mm/mV
25 mm/s
Filter 100 Hz H 60 d 10 mm/mV
10 mm/mV
10 mm/mV
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
Rhythm [II]10 mm/mV

65 y/o M with chest pain x 3 days



Had **positive** nuclear stress test 4 months ago

Did not want therapy

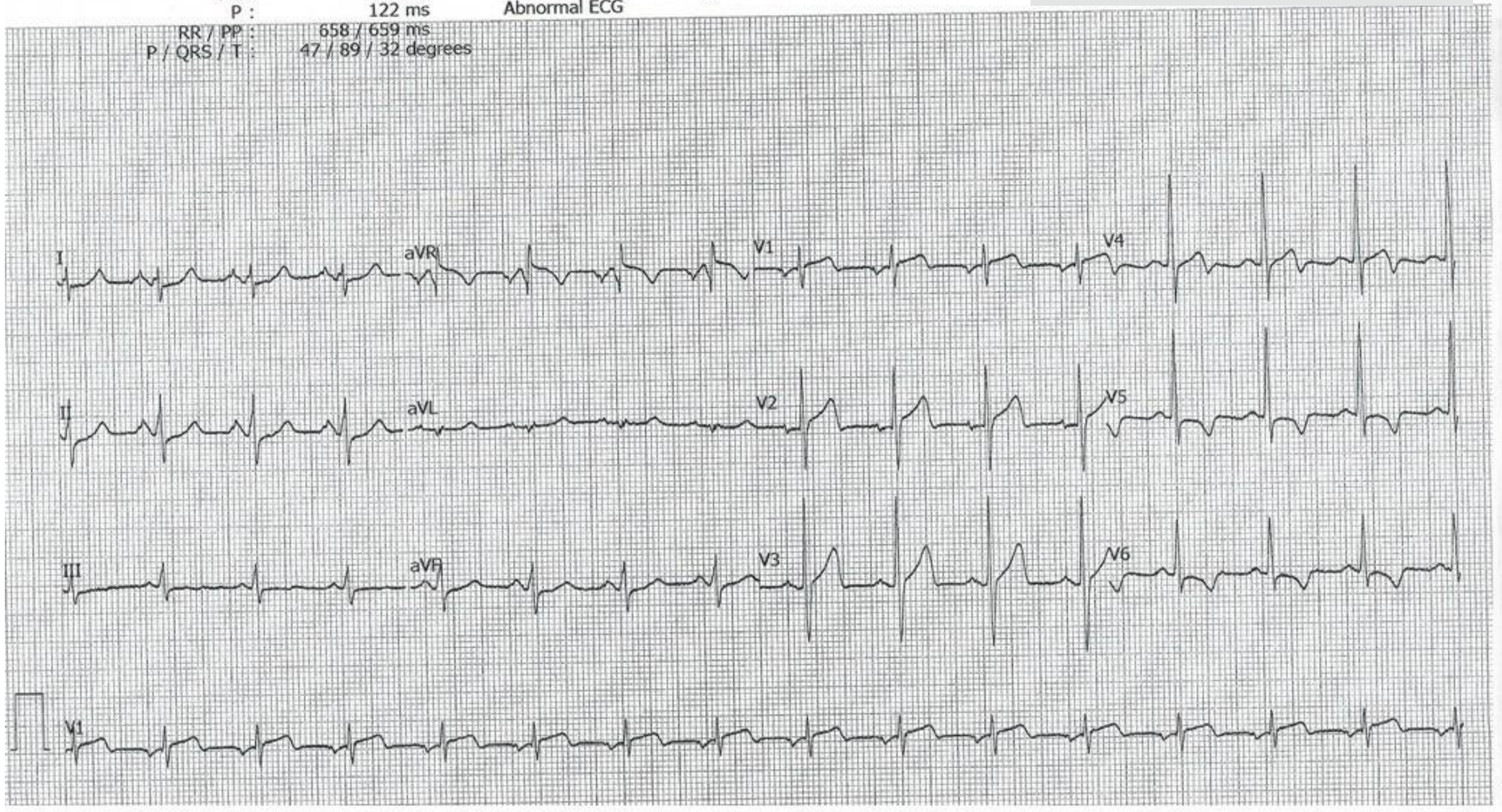
Not better with **5 nitro**

Pmhx: One kidney

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



18 y/o M with syncope

“I was just standing there and I passed out.”

Pmhx: None

FH: Uncle died at age 30




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



73 Y.O M with Chest pain

- Chest heaviness with numbness in arm x 3 days. “I just feel tired”.
- Hx: HLD, Obesity, DM. CABG x 3.
- Sh: Non smoker

Goes to PMD office



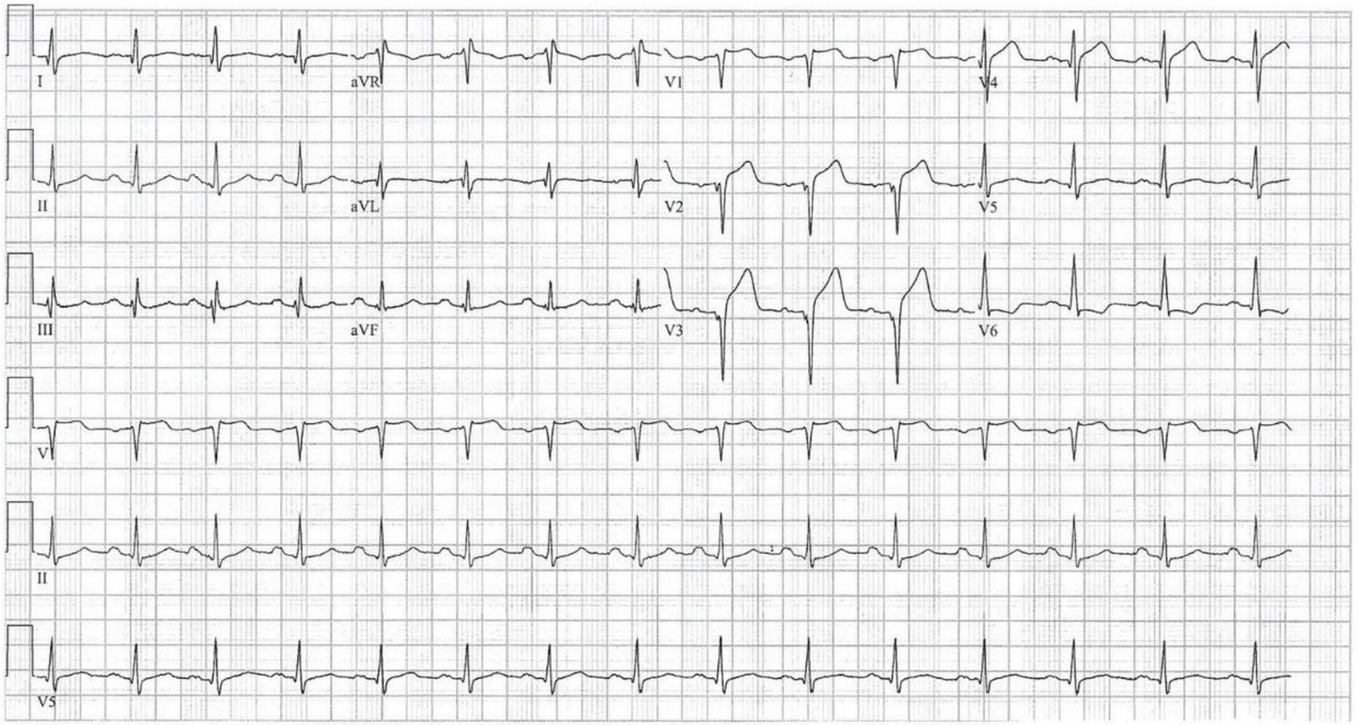
“MY PAIN STARTED WHEN I WAS AT A FUNERAL”

Got sent to the ER..STEMI CALLED....

Vent. rate	88	BPM
PR interval	176	ms
QRS duration	102	ms
QT/QTcB	376/454	ms
P-R-T axes	73 72	64

*** Critical Test Result: STEMI
NORMAL SINUS RHYTHM
ANTEROSEPTAL INFARCT , POSSIBLY ACUTE
** ** ACUTE MI / STEMI ** **
ABNORMAL ECG
NO PREVIOUS ECGS AVAILABLE

STEMI CRITERIA MET!





The Case

48 yo male w/ chest pain

- Pain was pressure 10/10 started at midnight came to er at 3:30 am
- Pain goes to both arms had dyspnea on exertion
- +Diaphoresis

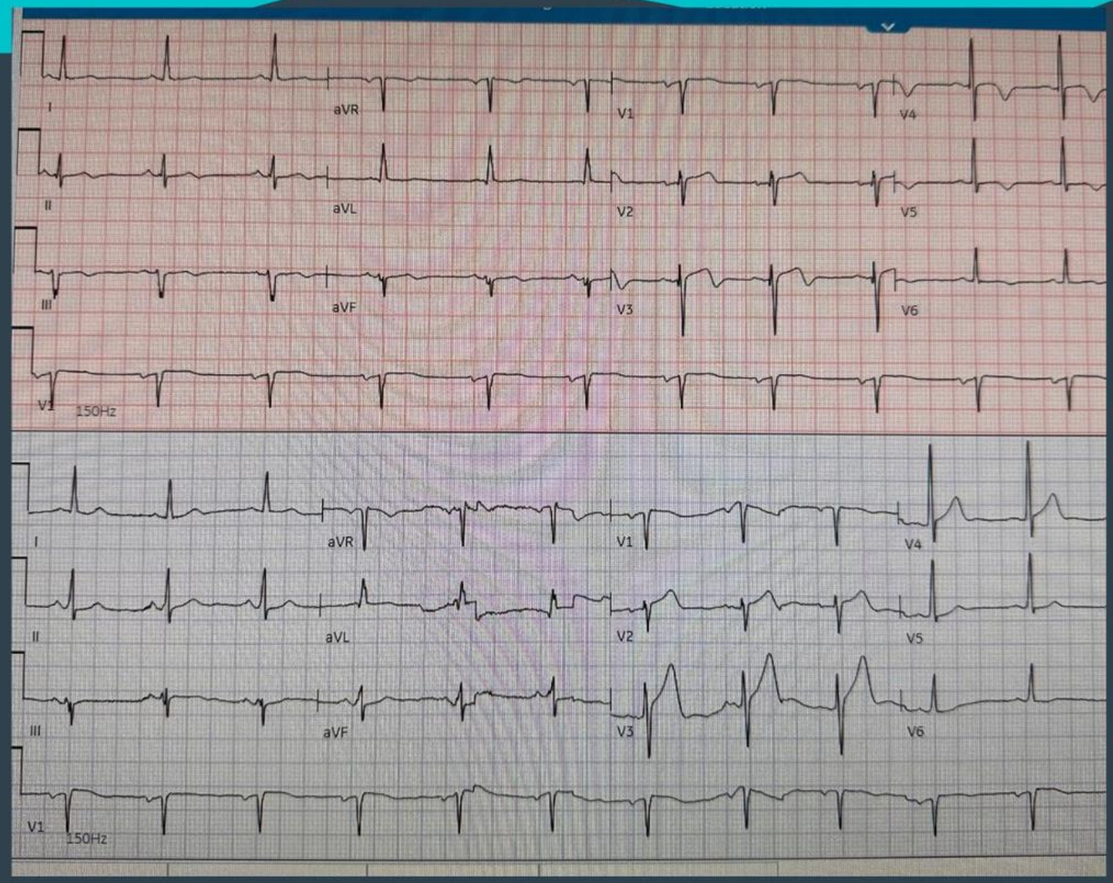
HX:

HTN, HLD, IDDM, previous Nstemi and stents 4 months ago in circ and RCA
Had **moderate disease** in LAD

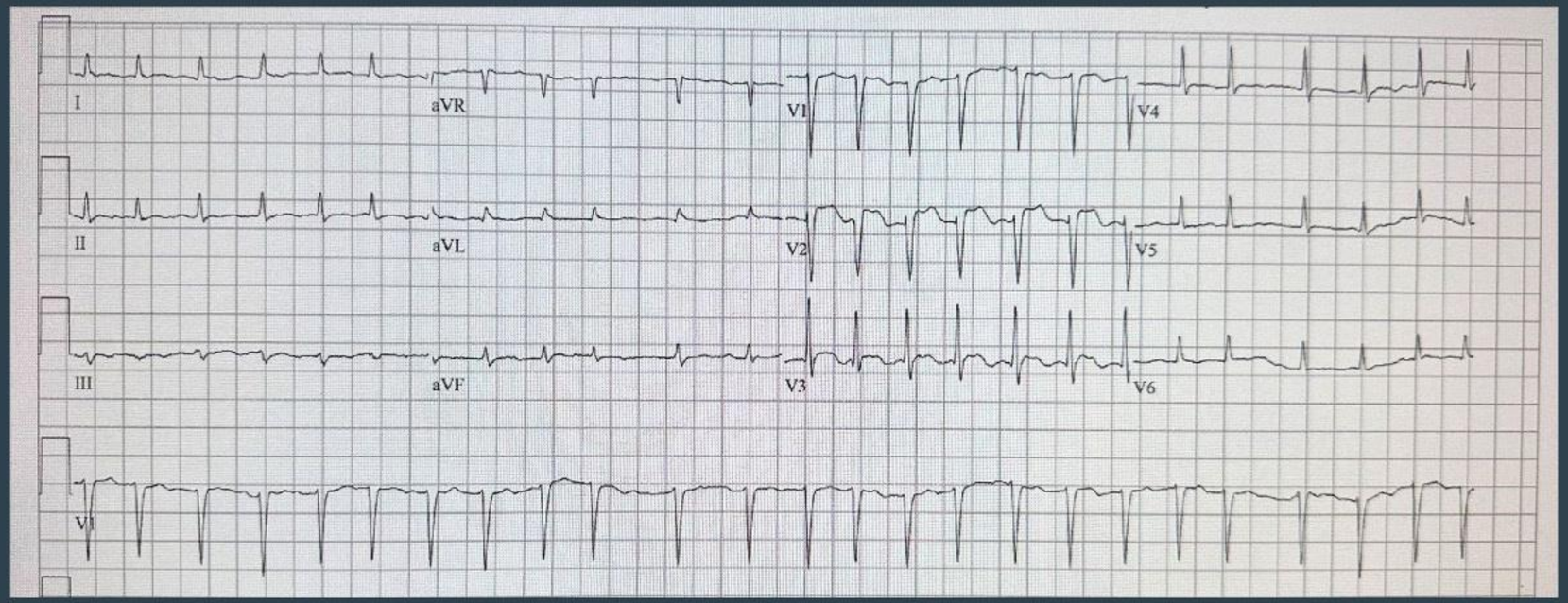

aVL
V2
V5

EKG #1:

EKG #2:


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
150Hz
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
150Hz

EKG 3



What is the rhythm?
Is this a STEMI?



Let’s do the workbook!

EK waves

G

P WAVE

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

Q WAVE

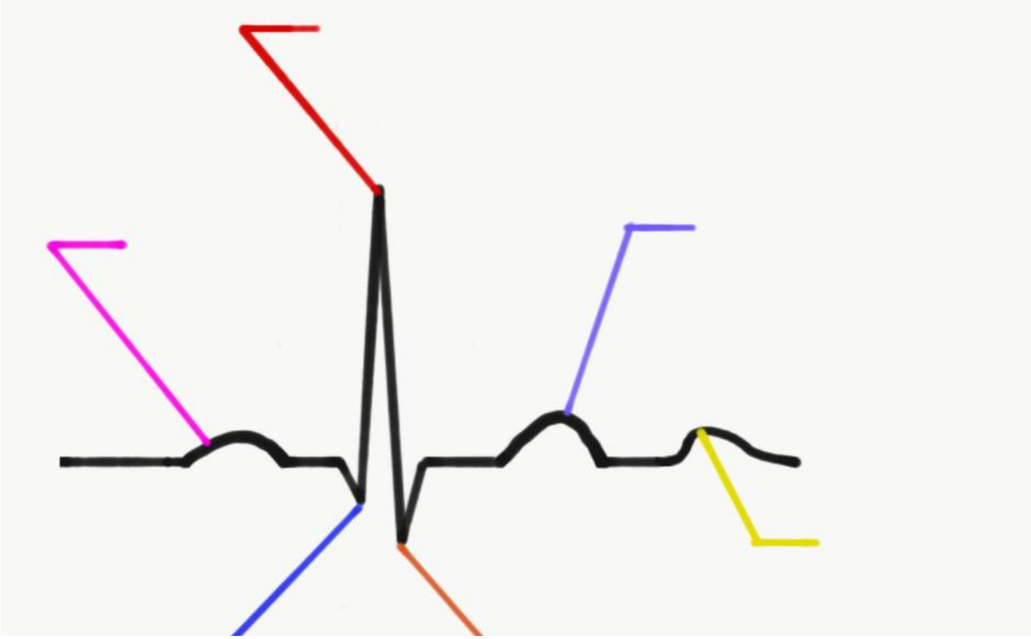
- Is an initially _____ deflection of the QRS complex. It is normal if it is of the height of the R wave.

EK waves

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._____



EK waves

G

R-WAVE

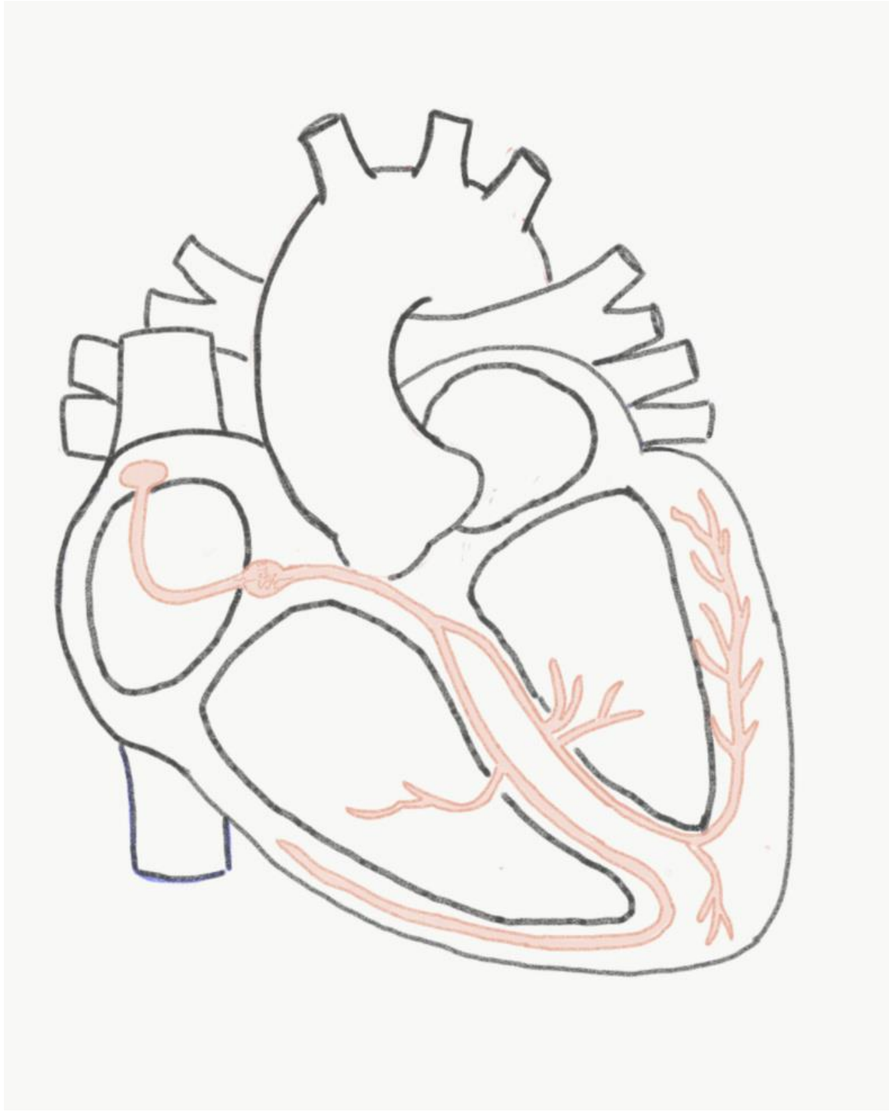
- Depolarization of the ventricles. This is the first _____deflection.

T WAVE

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

LABEL anatomy

Label the conduction system.



BASI 12 lead

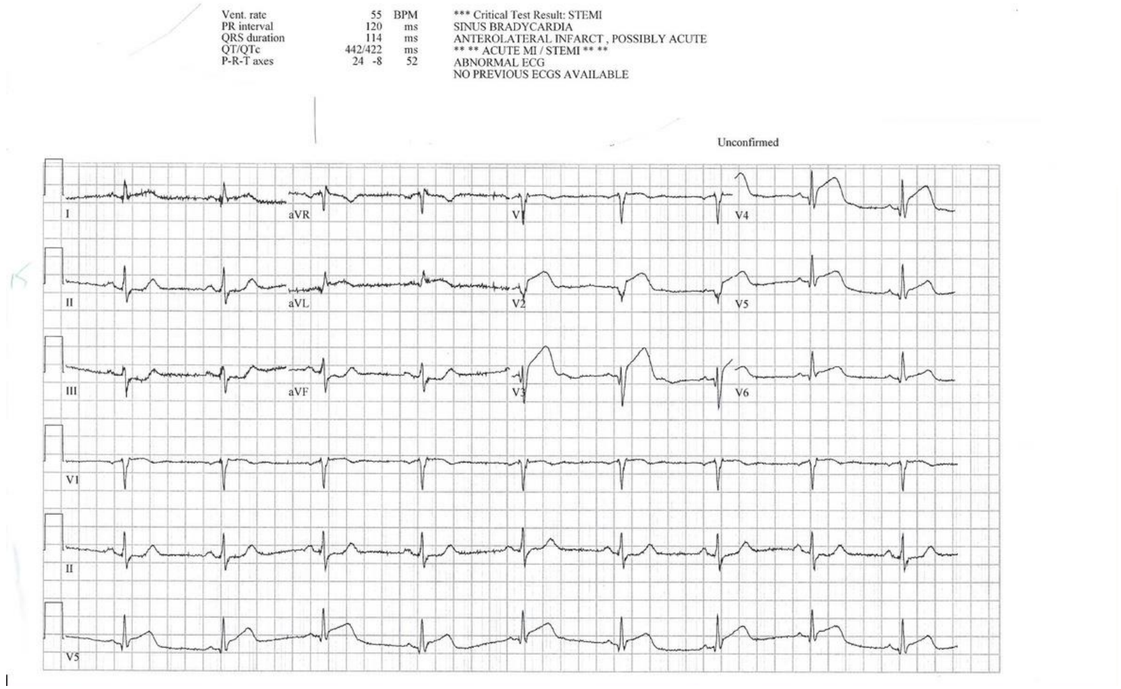
C

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."



BASI 12 lead

C

INFERIOR LEADS

- Are _____ ,_____ and_____ . They are fed by the_____ artery.

ANTERIOR LEADS

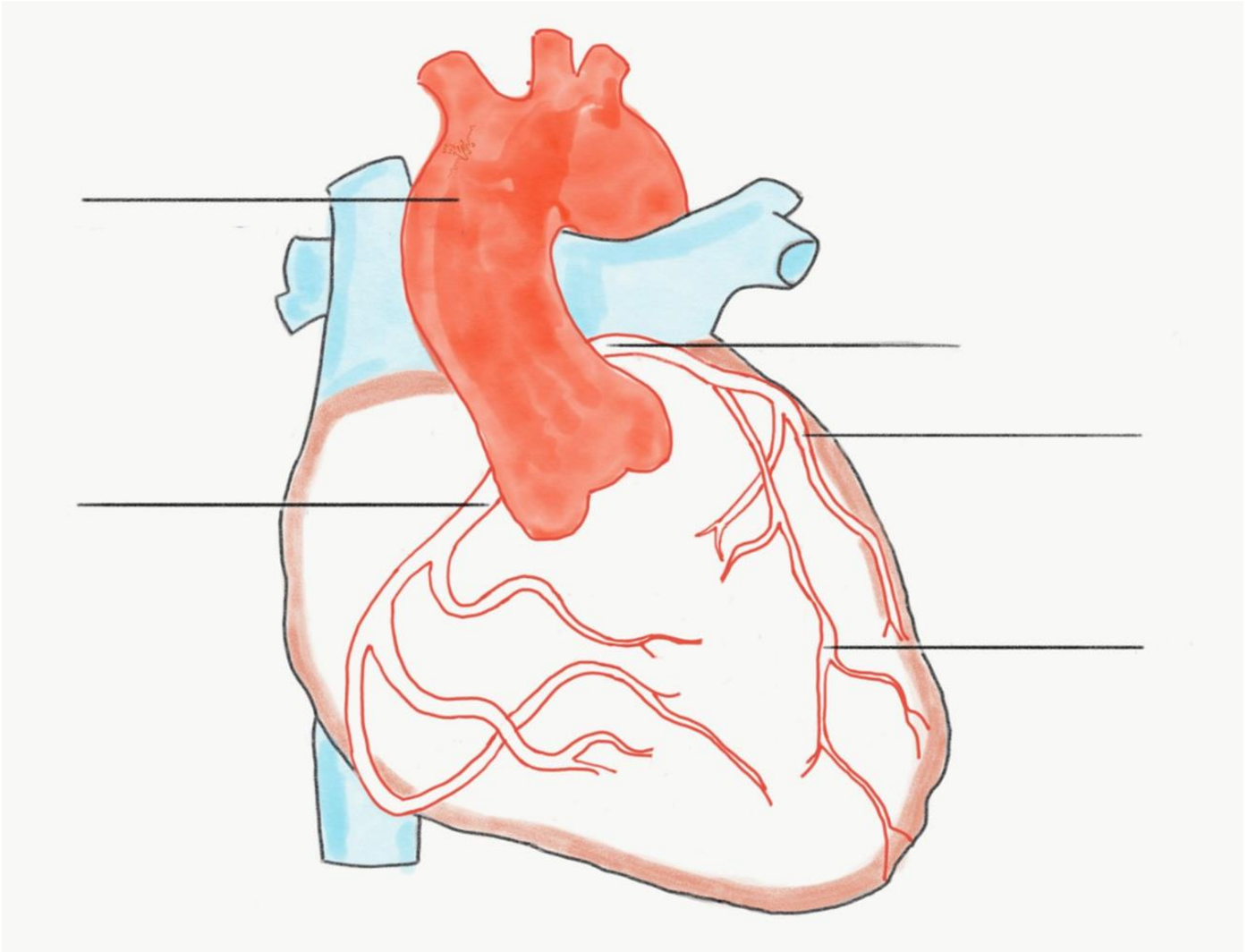
- Are _____ ,_____ ,_____ and_____ . They are fed by the_____ artery.

LATERAL LEADS

- Are _____ ___,_____ _____,_ _____ , _and are fed by the artery.

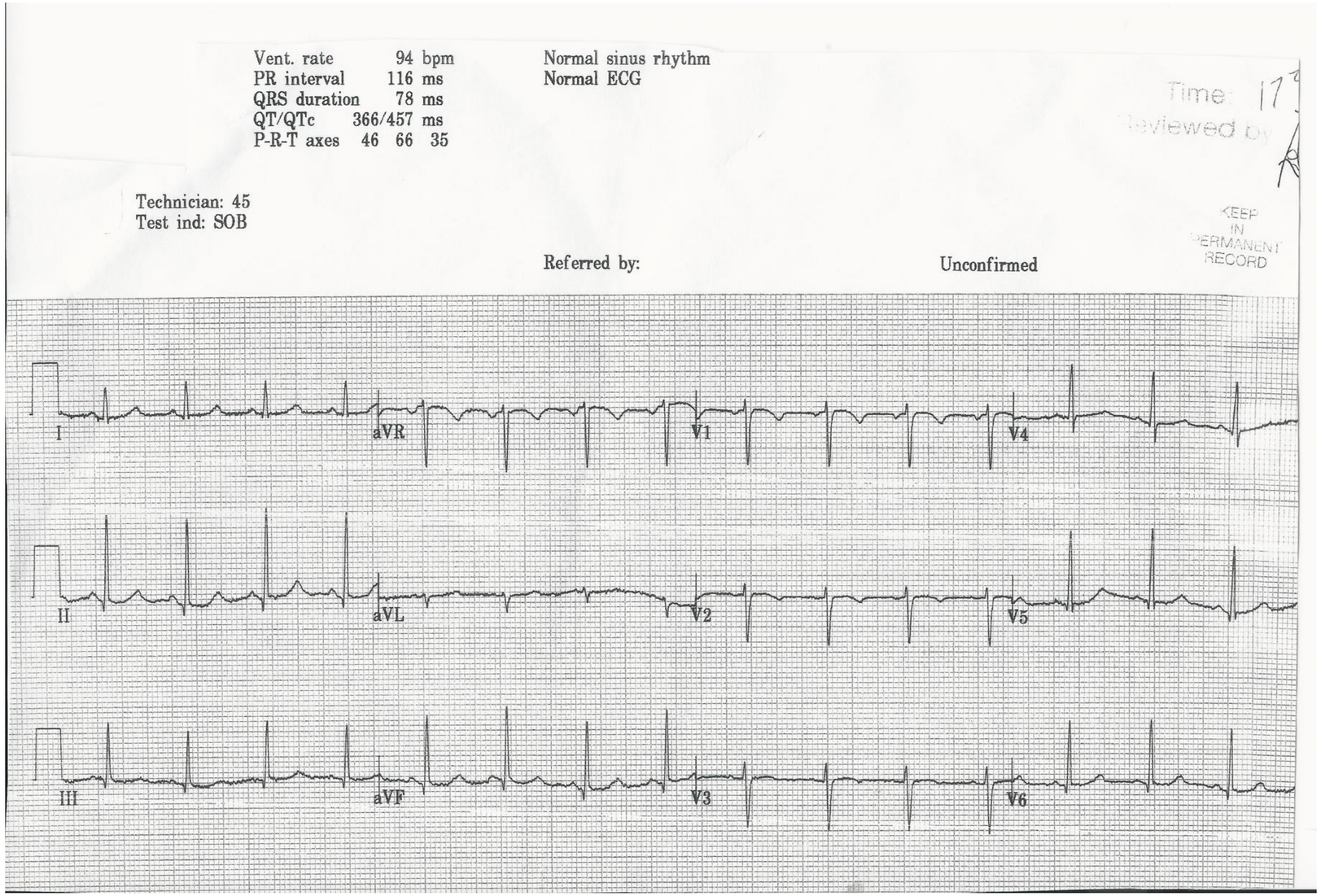
BASI 12 lead

C



BASI 12 lead

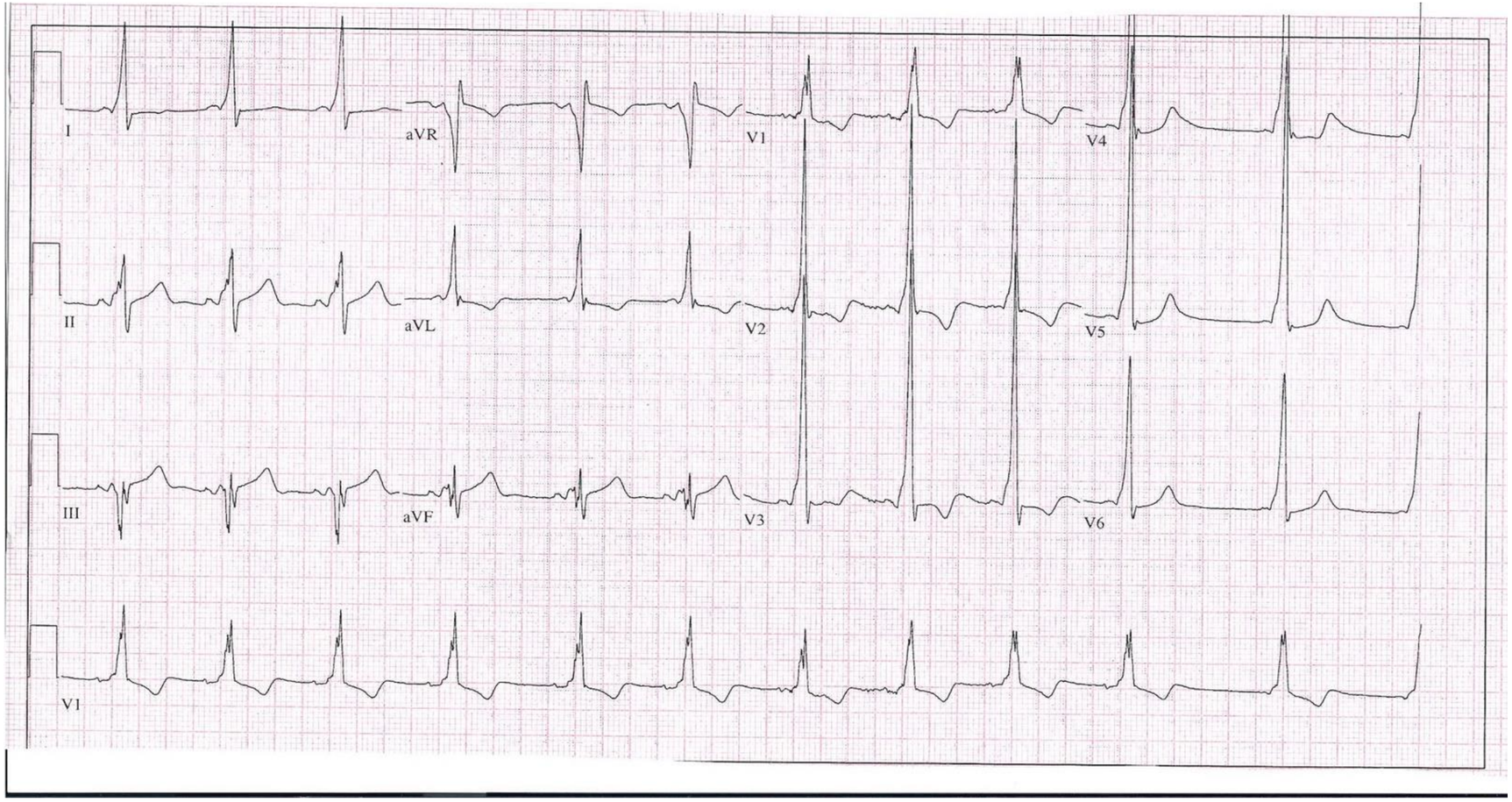
C



BASI 12 lead

C

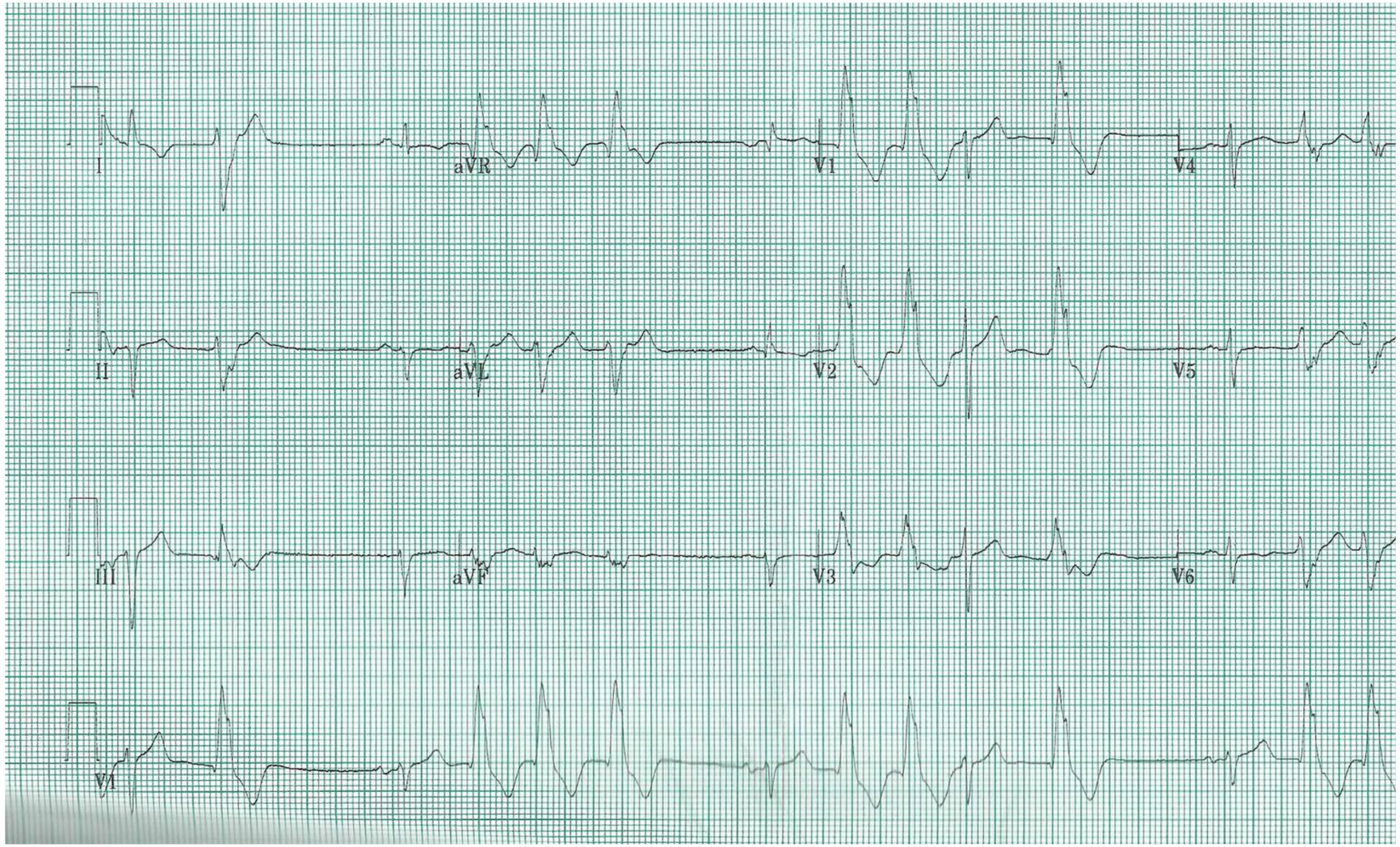
27 y.o F with anxiety



BASI 12 lead

C

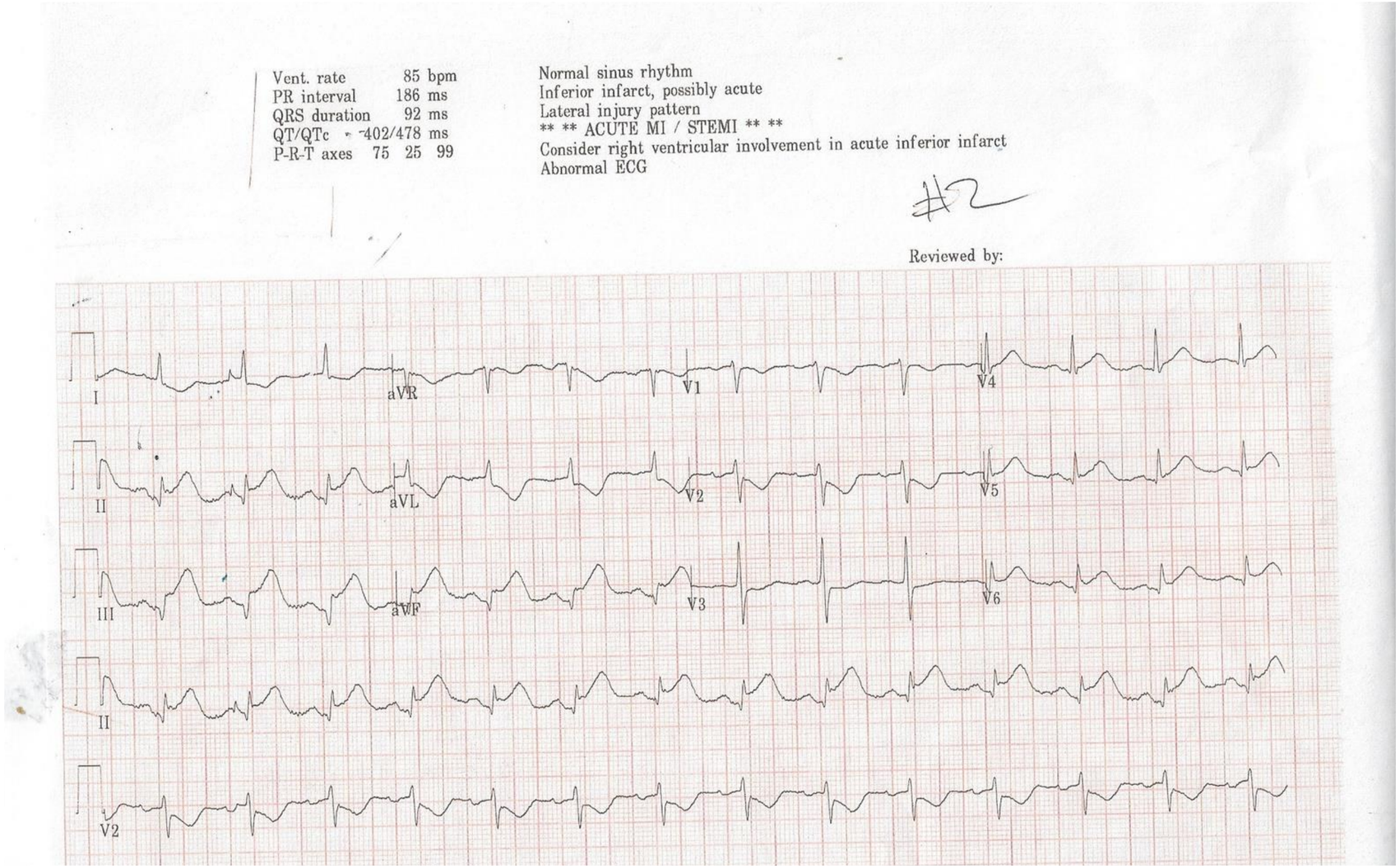
46 y.o M with a cough



BASI 12 lead

C

67 y.o F with chest pain

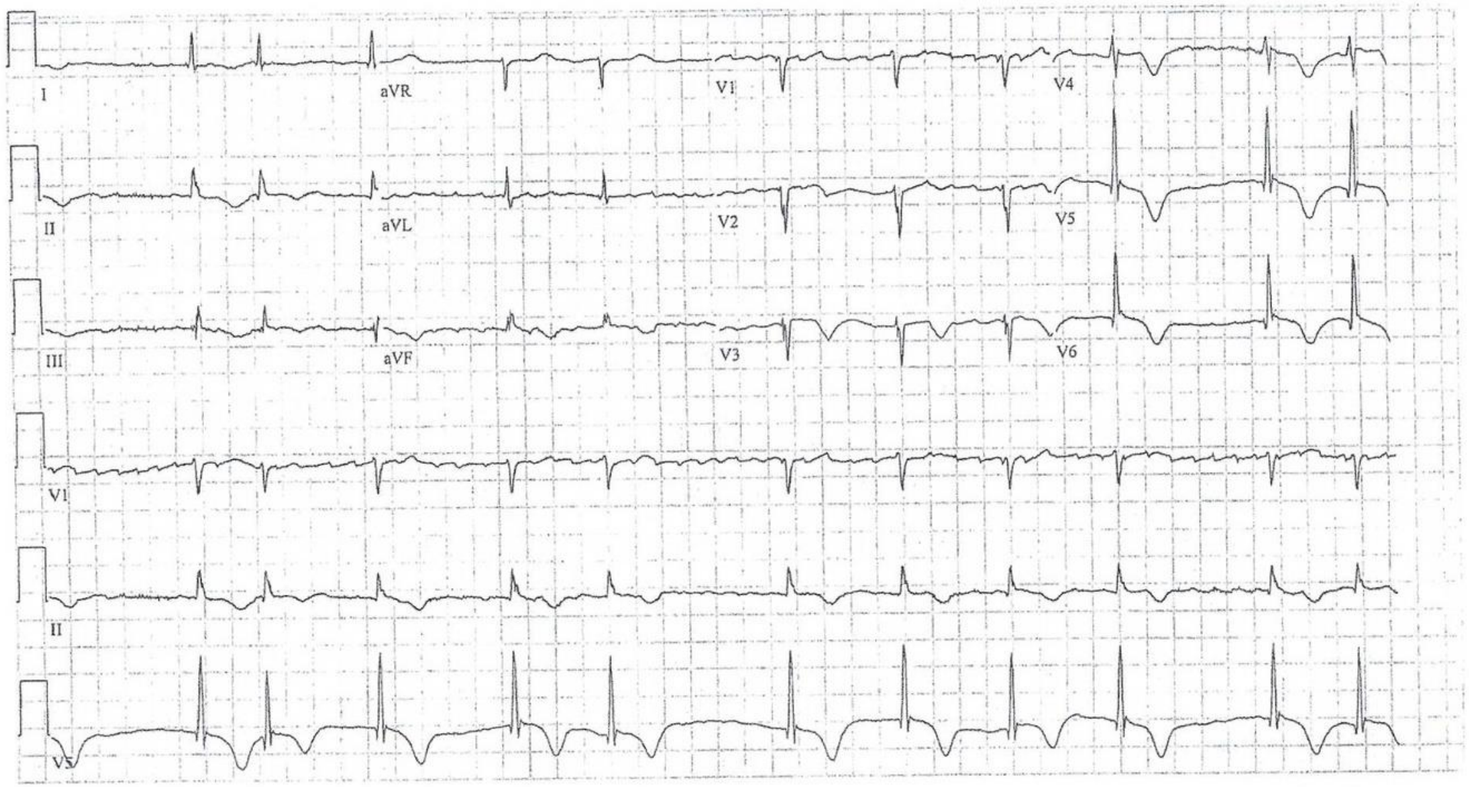


BASI 12 lead

C

89 y.o chest pain

Vent. rate	70	BPM	ATRIAL FIBRILLATION
PR interval	*	ms	ST AND T WAVE ABNORMALITY, CONSIDER ANTEROLATERAL ISCHEMIA
QRS duration	84	ms	WHEN COMPARED WITH ECG OF 06-SEP-1992 23:06,
QT/QTc	452/488	ms	ATRIAL FIBRILLATION HAS REPLACED SINUS RHYTHM
P-R-T axes	* 34	247	T WAVE INVERSION NOW EVIDENT IN ANTEROLATERAL LEADS

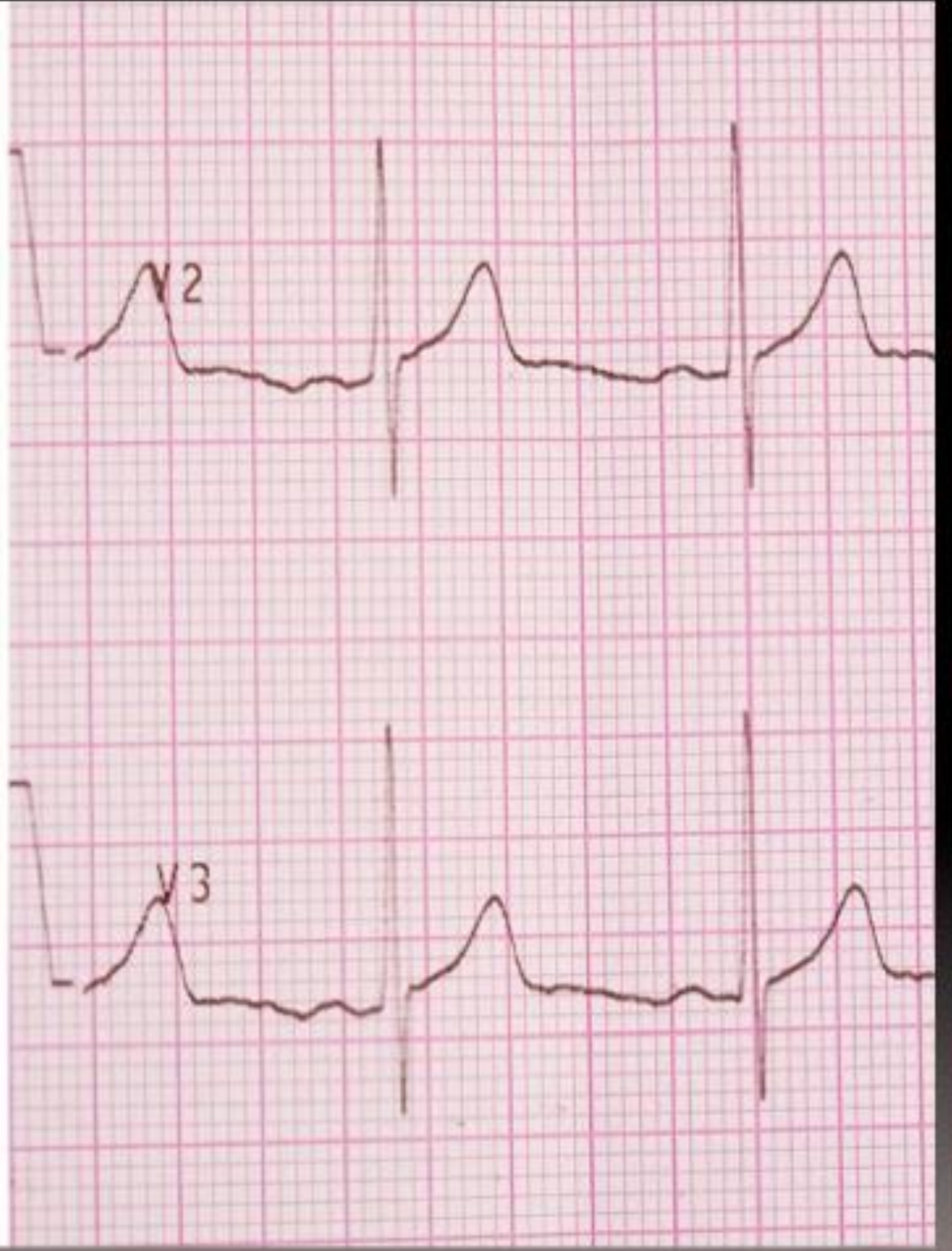


Basic Arrythmias



Three questions

- Fast vs slow
- Wide vs narrow
- Regular vs irregular



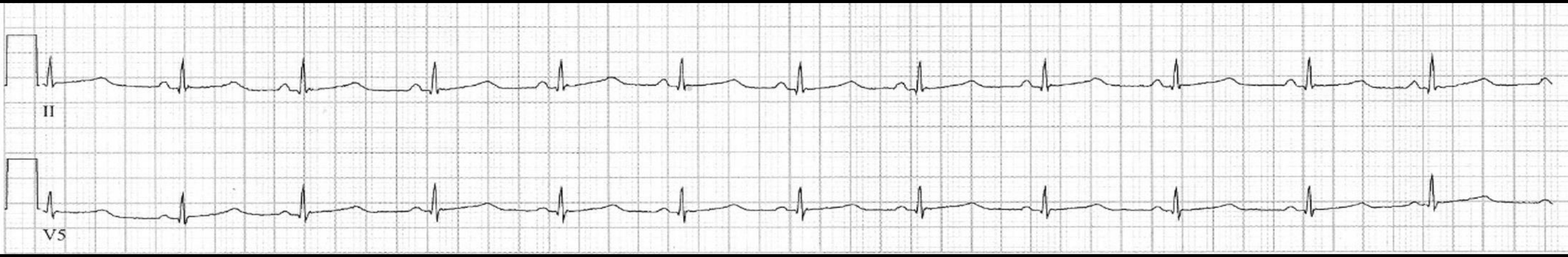
This is a normal sinus.

Rate: 60-100

PR interval: Normal

QRS: Normal (under 120 ms)

R to R: Regular



Sinus Tachycardia

Rate: Over 100

PR interval: None

QRS: Normal (under 120 ms)

R to R: Iregular

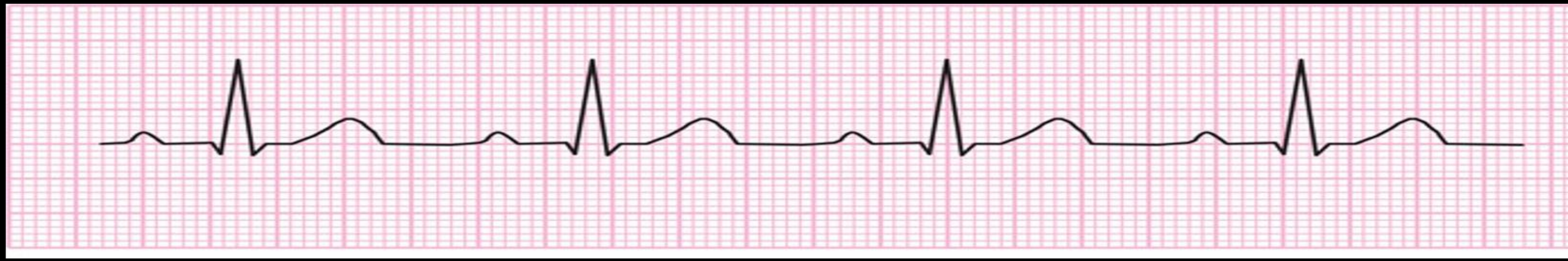


This is 1st degree block

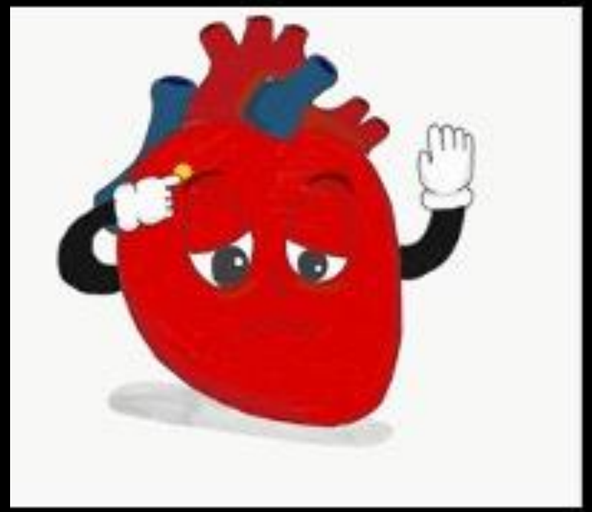
Rate: 60-100

PR interval: Over 200 ms

R to R: Normal



Sinus Pause/Arrest



Rate: Varies

Regularity: Irregular

P wave: Present except in areas of pause/arrest

PR interval: Normal

QRS width: Normal



This is Atrial Fibrillation

Rate: 60-100

PR interval: None

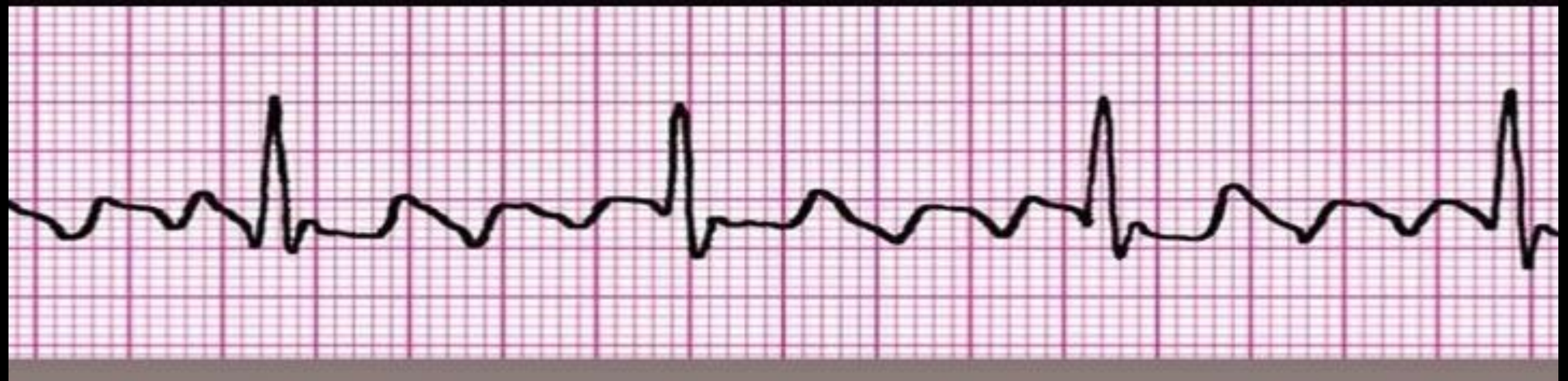
QRS: Normal (under 120 ms)

R to R: Iregular



Atrial Flutter

Rate: Atrial commonly 250–350 BPM
ventricular commonly 125–175 BPM
Regularity: Usually regular
P wave: Saw toothed,
"F waves"
PR interval: Variable
QRS width: Normal



Wandering Atrial Pacemaker (WAP)

Rate: 100 BPM

Regularity: Irregularly irregular

P wave: At least 3 different morphologies

PR interval: Variable depending on focus



Idioventricular Rhythm

Rate: 20–40 BPM

Regularity: Regular

P wave: None

PR interval: None

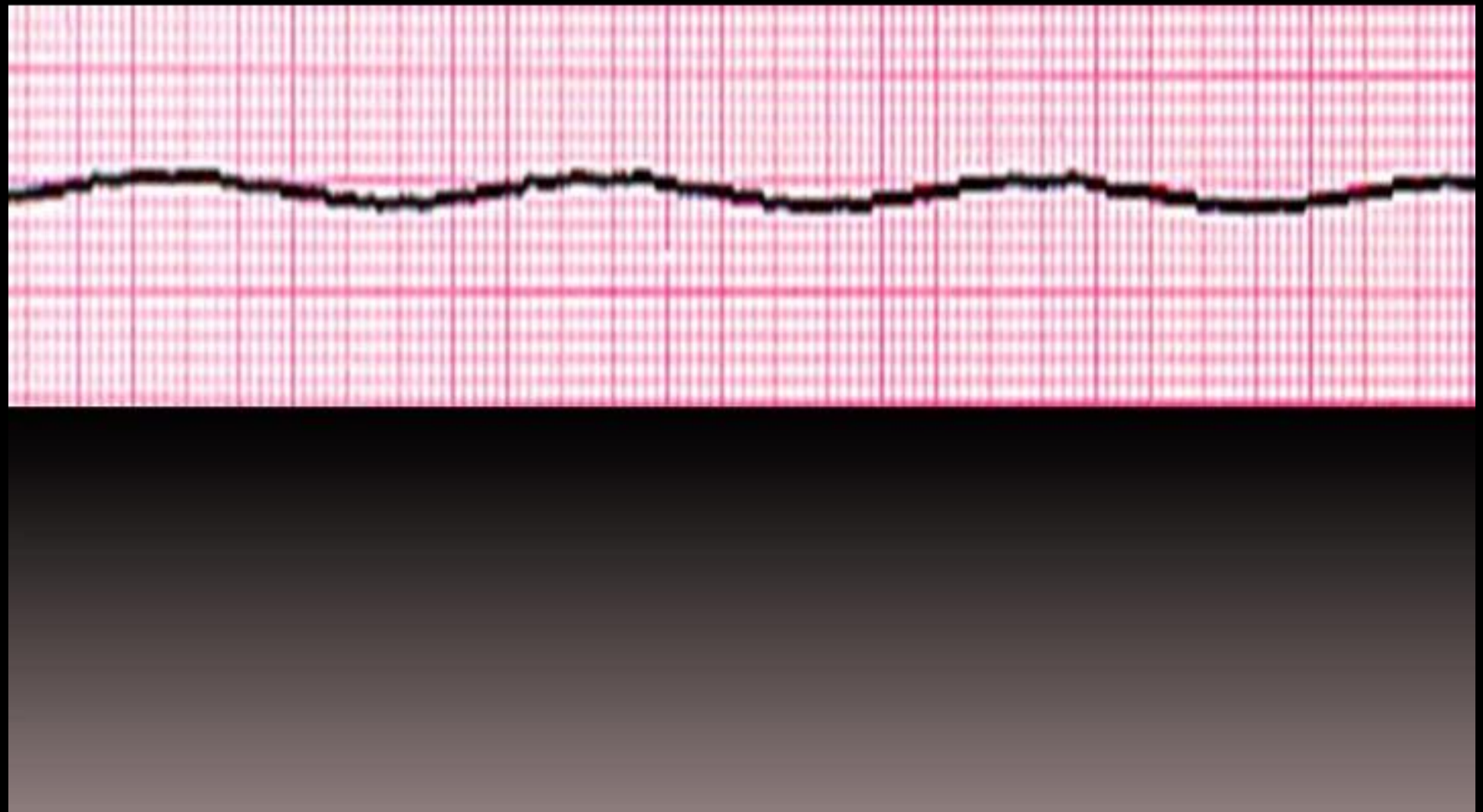
QRS width: Wide (≥0.12 sec), bizarre appearance



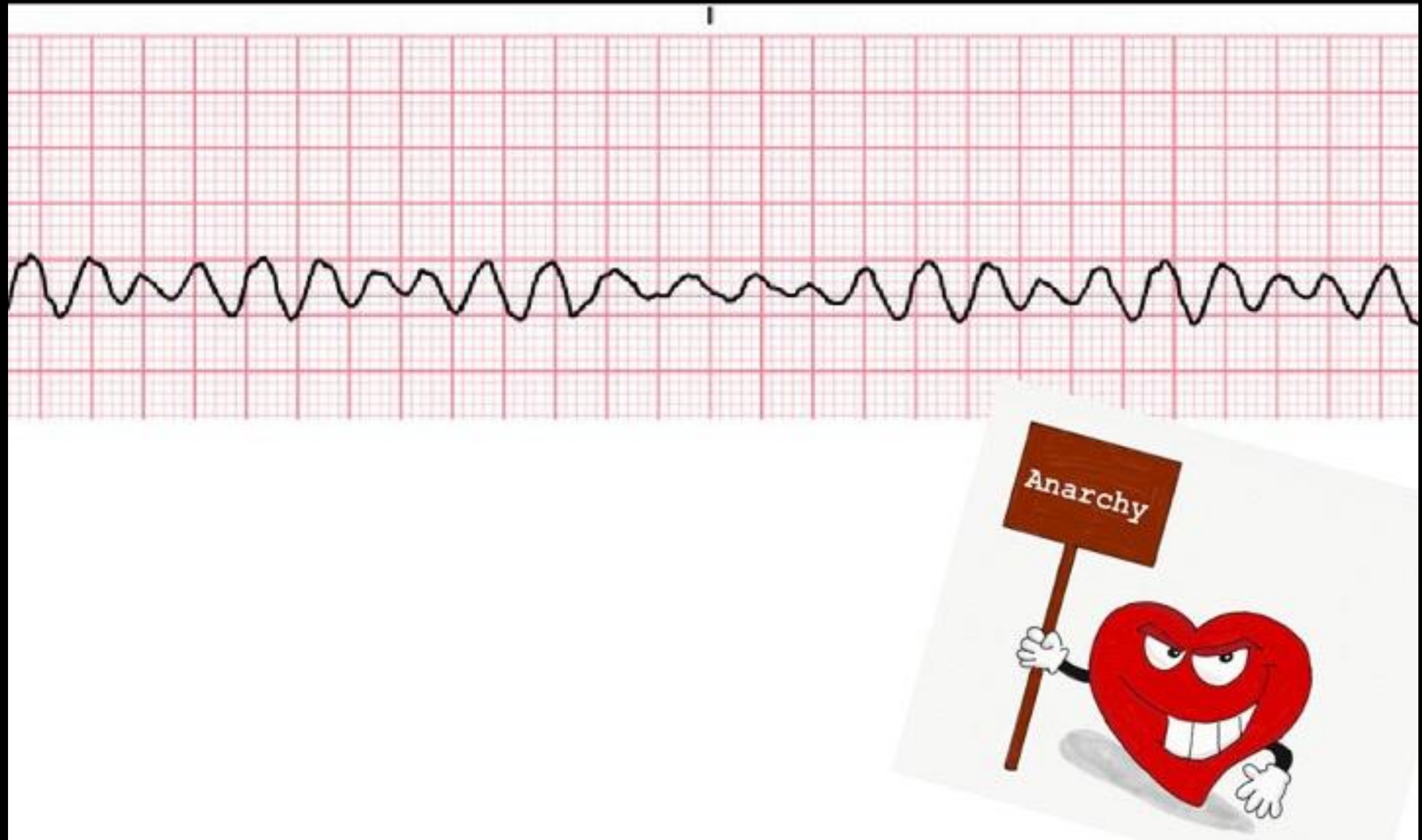
What is this?



GCS of 3



What is this?



Agonal



Rate: 0-20 BPM

P wave: None

PR interval: None

QRS width: Wide (≥0.12 sec), bizarre appearance



Thank you!

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