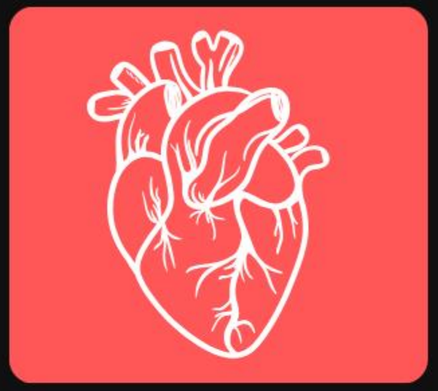
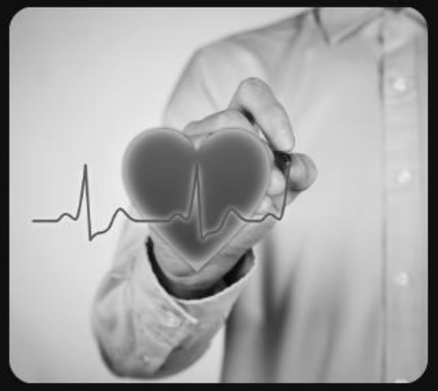








# Sneaky Cases of ACS:

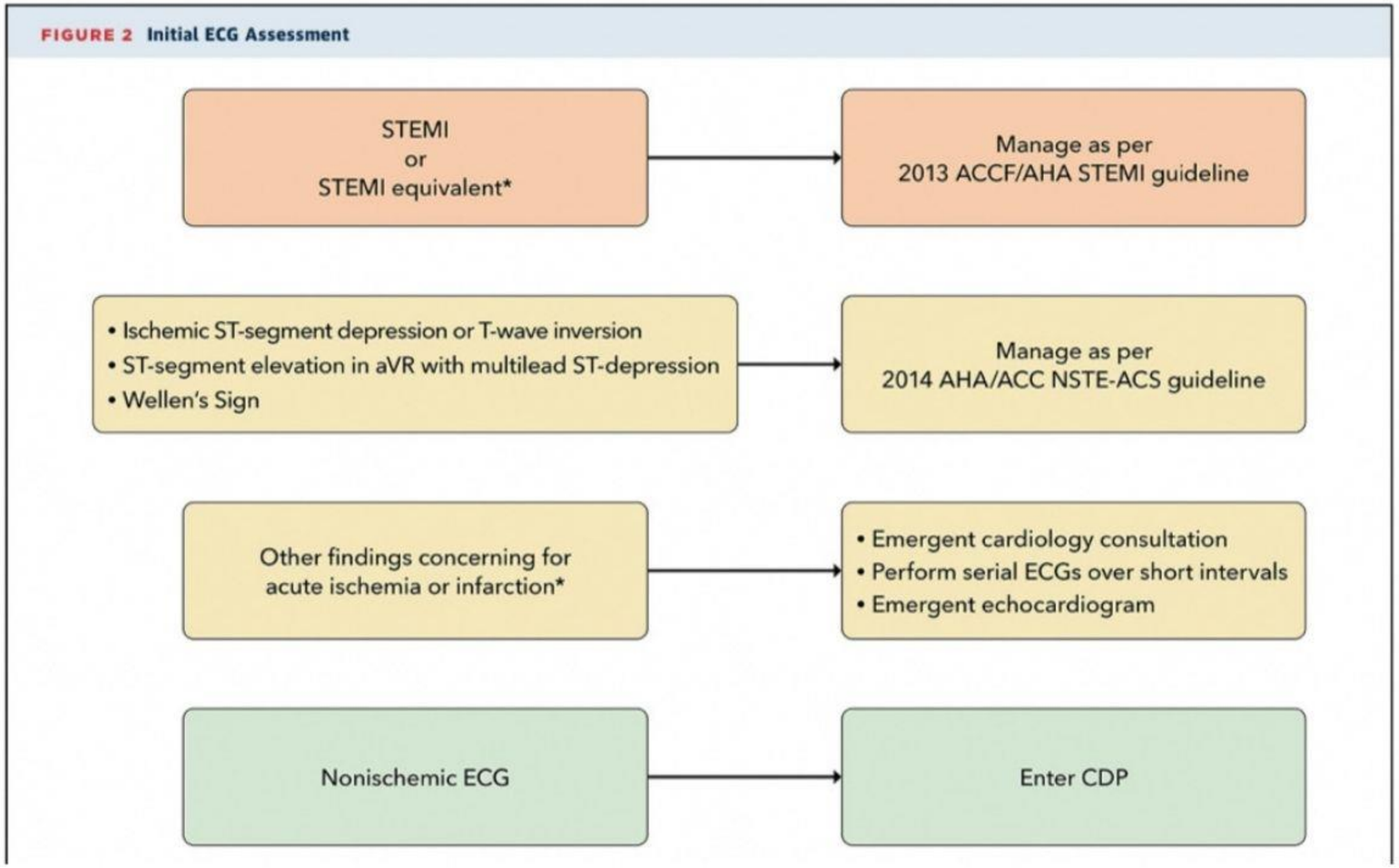
## New STEMI Equivalents You Must Know to Stay Safe


Presented By:

**Jennifer Carlquist**

**PA-C, ER-CAQ**

Kontos M, de Lemos J, et al. 2022 ACC Expert Consensus Decision Pathway on the Evaluation and Disposition of Acute Chest Pain in the Emergency Department. J Am Coll Cardiol. 2022 Nov, 80 (20) 1925–1960.
https://doi.org/10.1016/j.jacc.2022.08.750






Wellen's
Dewinters
Hyperacute T waves

THE LIST

**TABLE 1** Electrocardiogram Findings Suggestive of Ischemia

| FINDING | CRITERIA |
|---|---|
| **STEMI equivalents** | |
| Posterior STEMI | **Criteria:**<br>■ Horizontal ST-segment depression in $V_1$-$V_3$<br>■ Dominant R-wave (R/S ratio >1) in $V_2$<br>■ Upright T waves in anterior leads<br>■ Prominent and broad R-wave (>30 ms)<br>**Confirmed by:**<br>■ ST-segment elevation of ≤0.5 mm in at least 1 of leads $V_7$-$V_9$* |
| Left bundle branch block or ventricular paced rhythm with Sgarbossa Criteria | A total score ≥3 points is required:<br>■ Concordant ST-segment elevation ≥1 mm in leads with a positive QRS complex (5 points)<br>■ Concordant ST-segment depression ≥1 mm in leads $V_1$-$V_3$ (3 points)<br>■ Discordant ST-segment elevation ≥5 mm in leads with a negative QRS complex (2 points)<br>If there is discordant ST-segment elevation ≥5 mm, consider ST/S ratio <−0.25 |
| Left bundle branch block or ventricular paced rhythm with Smith-modified Sgarbossa Criteria | Positive if any of the following are present:<br>■ Concordant ST-segment elevation of 1 mm in leads with a positive QRS complex<br>■ Concordant ST-segment depression of 1 mm in $V_1$-$V_3$<br>■ ST-segment elevation at the J-point, relative to the QRS onset, is at least 1 mm and has an amplitude of at least 25% of the preceding S-wave |
| De Winter Sign | ■ Tall, prominent, symmetrical T waves arising from upsloping ST-segment depression >1 mm at the J-point in the precordial leads<br>■ 0.5-1 mm ST-segment elevation may be seen in lead aVR |
| Hyperacute T waves | Broad, asymmetric, peaked T waves may be seen early in STEMI<br>Serial ECGs over very short intervals are useful to assess for progression to STEMI |
| **ECG findings consistent with acute/subacute myocardial ischemia** | |
| aVR ST-segment elevation | Most often caused by diffuse subendocardial ischemia and usually occurs in the setting of significant left main coronary artery or multivessel coronary artery disease<br>■ ST-segment elevation in aVR ≤1 mm<br>■ Multilead ST-segment depression in leads I, II, Val, and/or $V_4$-$V_6$<br>■ Absence of contiguous ST-segment elevation in other leads |
| ST-segment depression | Horizontal or downsloping ST-segment depression ≥0.5 mm at the J-point in 2 or more contiguous leads is suggestive of myocardial ischemia |
| Wellen's syndrome | Clinical syndrome characterized by:<br>■ Biphasic or deeply inverted and symmetric T waves in leads $V_2$ and $V_3$ (may extend to $V_6$)<br>■ Recent angina<br>■ Absence of Q waves |
| Inverted T waves | May be seen in ischemia (subacute) or infarction (may be fixed and associated with Q waves) in continuous leads |

# BASIC 12 LEAD

## Non specific ST T wave Changes



**Posterior MI**

Depression in v2, v3
Isolated




**Wellens**

Biphasic T wave Changes
in v2 v3



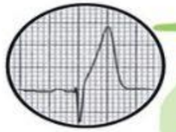

**Dewinters**

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

© Cardiology Made Easy

# 5 Things

DE WINTERS

WELLENS

AVR

HYPERACUTE T WAVES

POSTERIOR MI



NSSTW

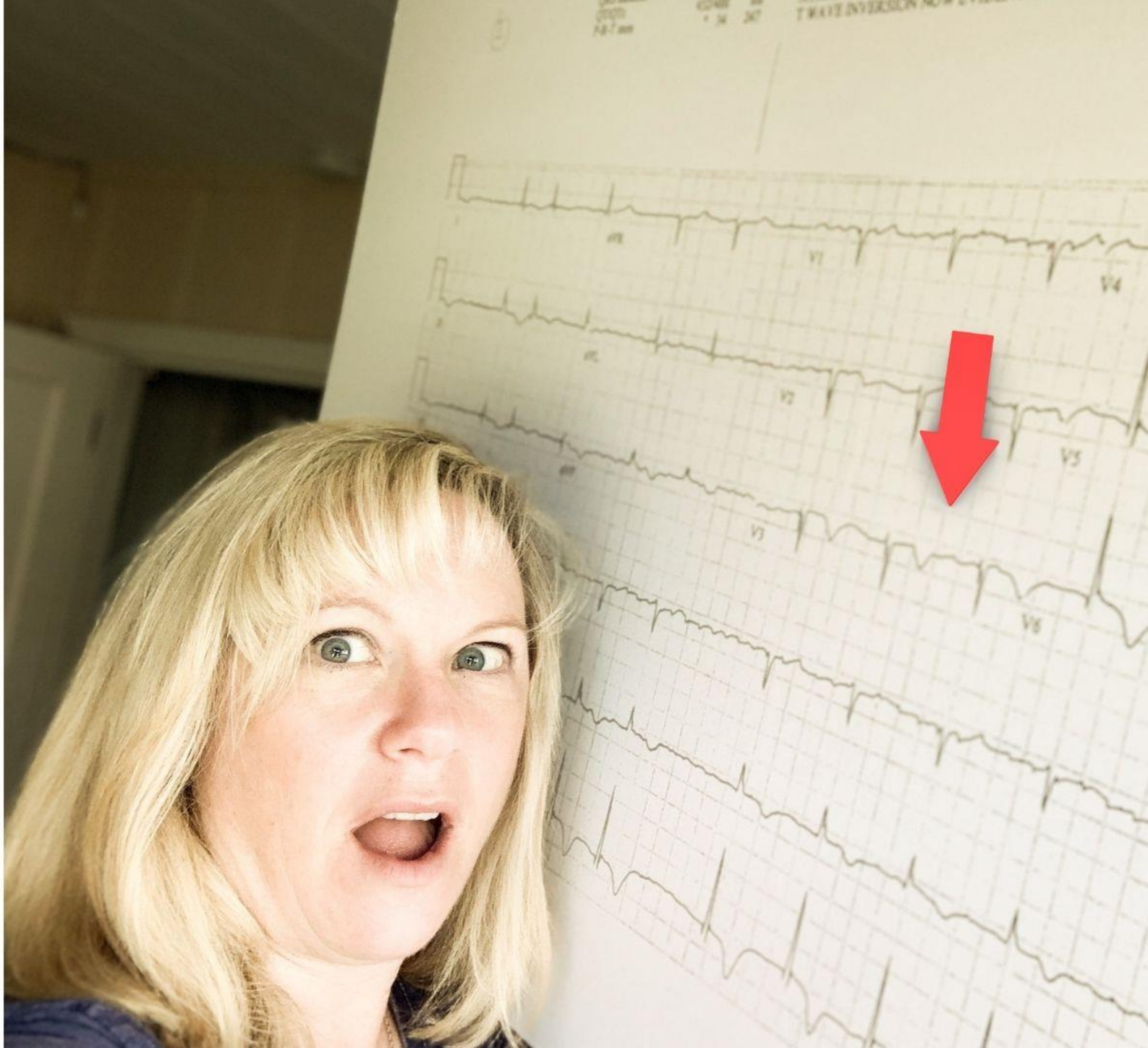
HYPERACUTE

BIPHASIC

INVERTED

SYMMETRIC

DWINTERS





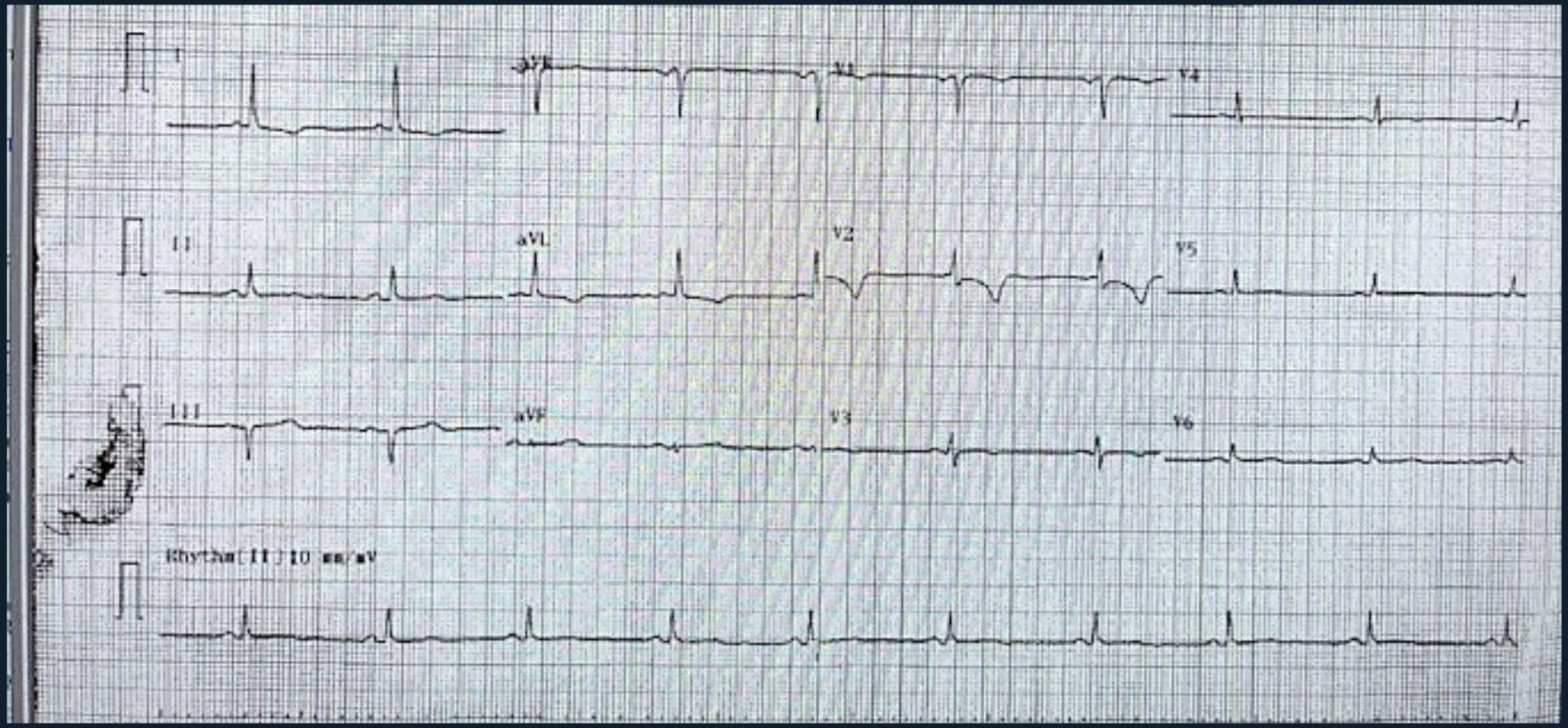
# The Case



# 54 Y/o F Cardio Visit

- Presented to cardiology with chest pain and syncope x 3 this month
- Pain worse with exertion, doe noted
- No longer able to **push through** the walk
- Was given nitro it **helped**

# THE EKG





# MEDICAL HISTORY

- Hyperlipidemia
- Hypertension
- Smoker

## FAMILY HISTORY

- Hypertension
- Brother and mom have pacemaker

## STRESS TEST

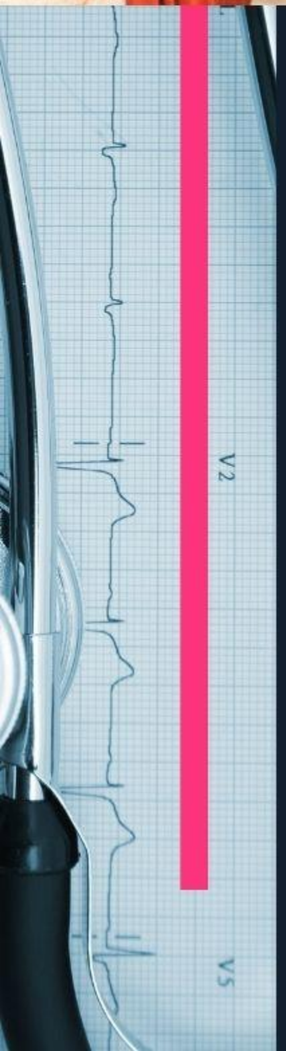
- In stage two ST elevation in **AVR**
- ST depression into **multiple** leads persisting in 23 minutes into recovery




# CATH:

- Complex **multivessel** coronary artery disease
- **Severe** distal **left main stenosis**
- Left anterior descending artery is occluded in its proximal portion and fills to left to left collaterals.
- The circumflex has tandem high grade stenosis in proximal mid and distal portion and appears to be codominant
- The right coronary artery is **occluded at its origin** and the posterior descending trunk feels through faint collaterals from the distal circumflex
- Left ventricular function well-preserved with ejection fraction about **50-60%** with mild apical hypokinesia






# RECOMMENDATION:

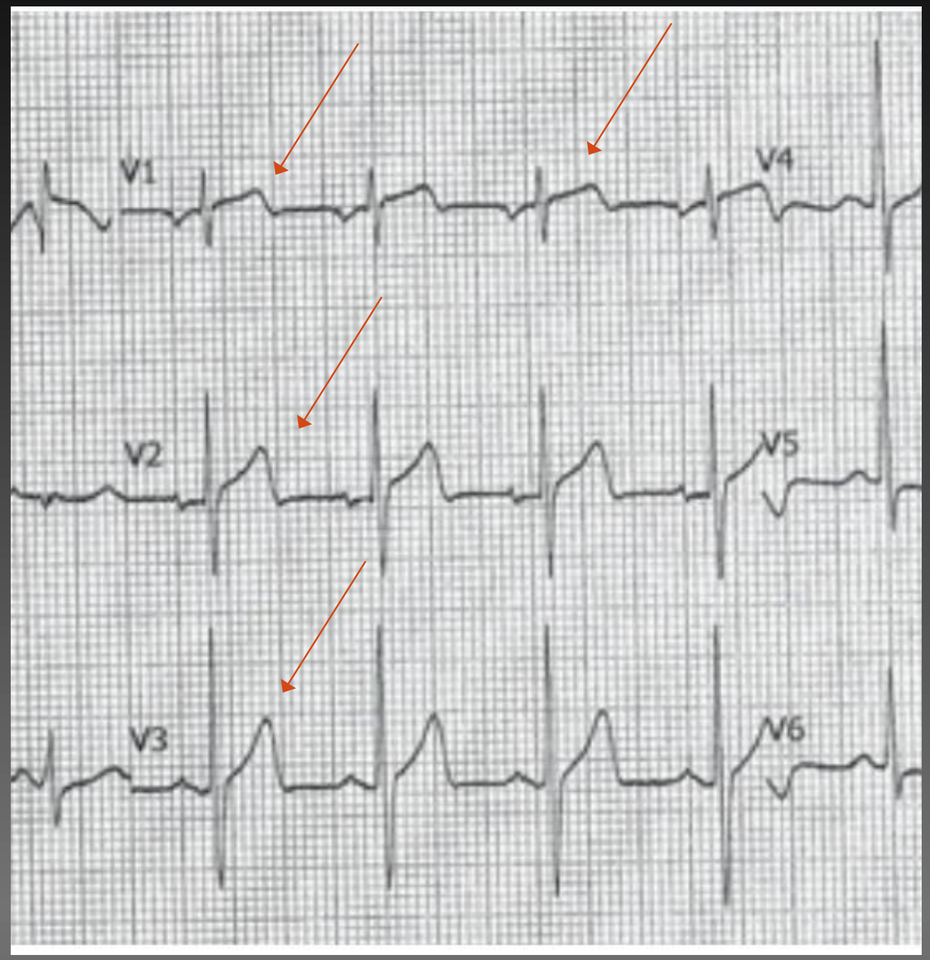
**Conclusions**

- Severe Multi-vessel coronary artery disease with preserved left-ventricular function

- Complex and multi-vessel coronary artery disease best served by coronary artery bypass surgery cardiothoracic's consultation has been sought

# HYPERACUTE T WAVES

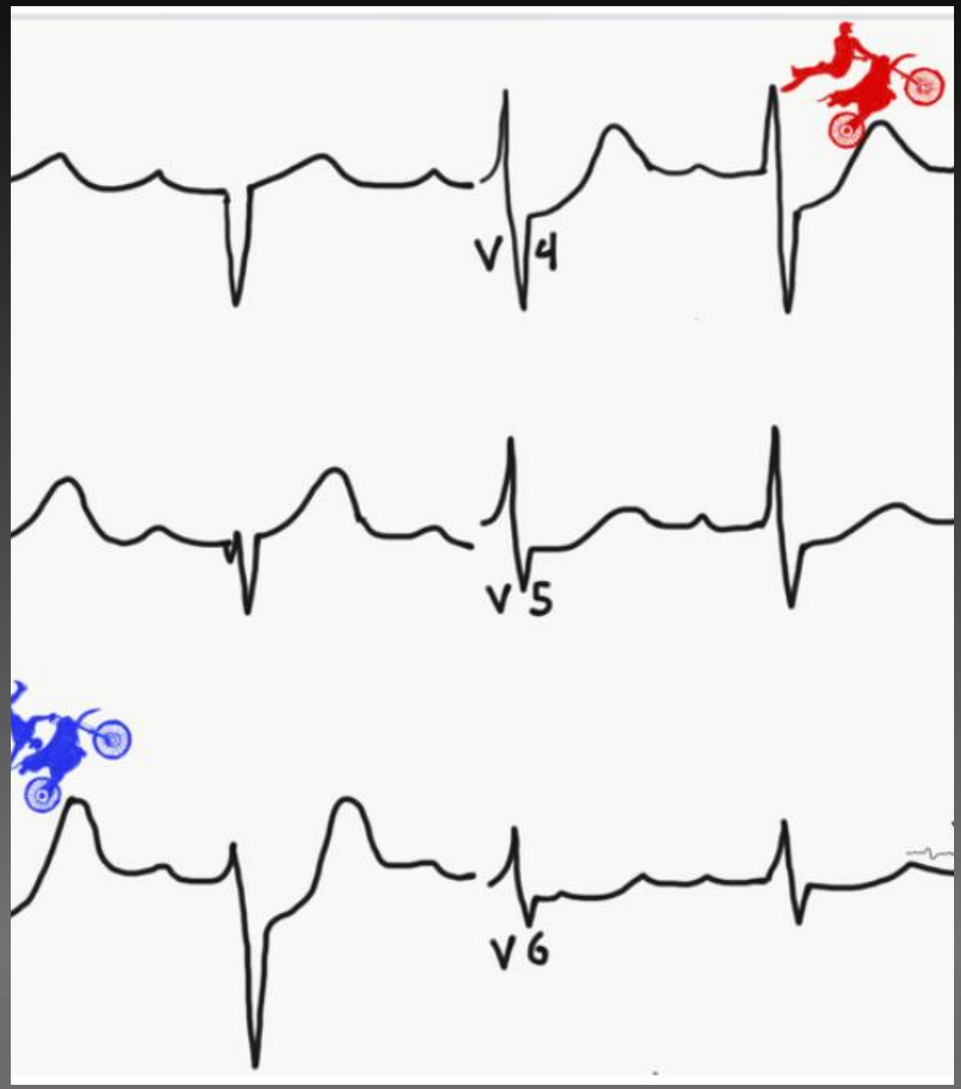
These are broad based T waves that are bigger than they should and precede a STEMI. (Noted in v2, v3.)



# De Winters T Waves

This is indicative of **acute LAD** occlusion.

(Noted in v3, v4. ST depression and peaked T waves in the precordial leads.



# WELLEN'S WARNING

Deeply inverted or biphasic T waves in V2-3, which is highly specific for a critical stenosis of the left anterior descending artery (LAD).

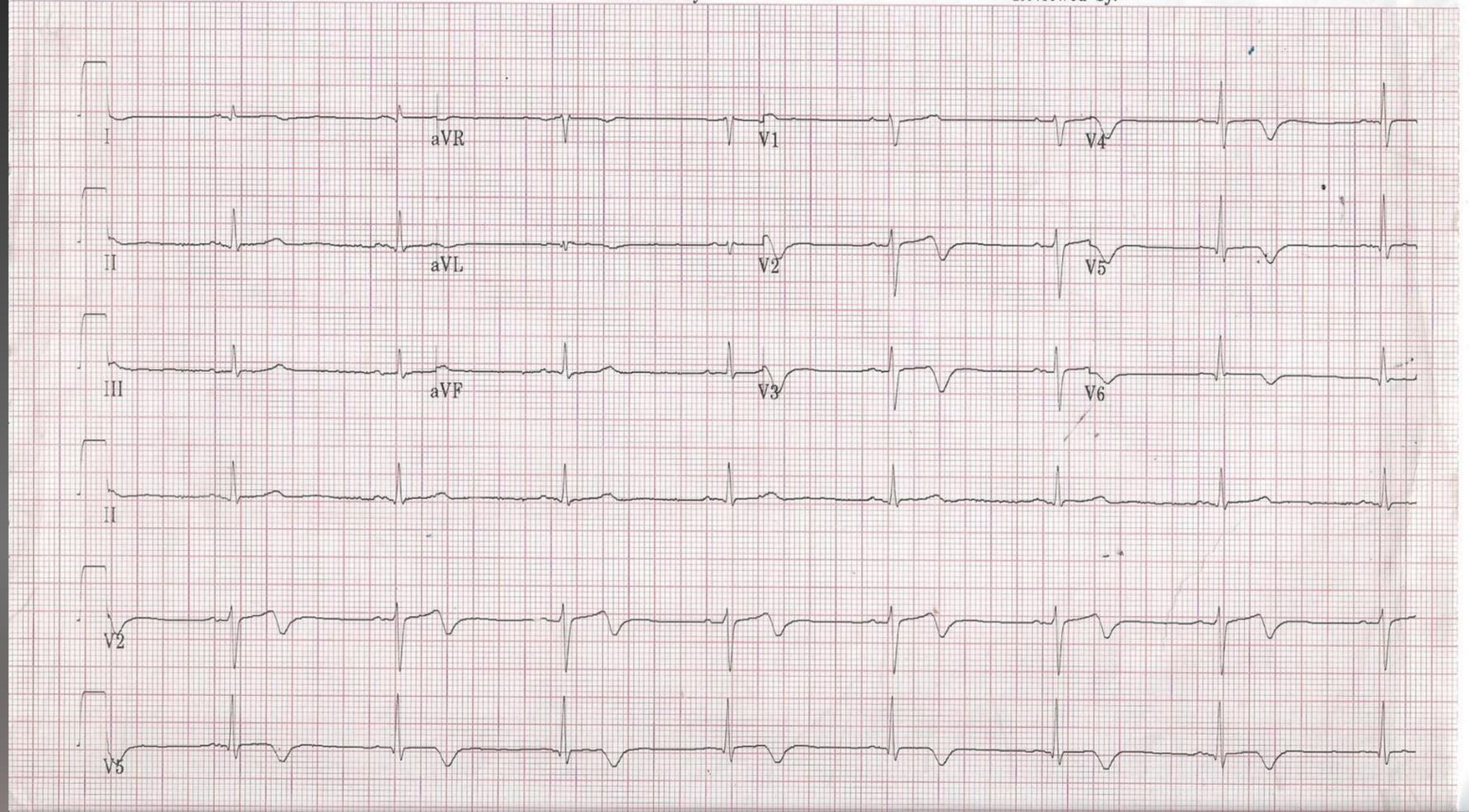
Patients may be pain free by the time the ECG is taken and have normally or minimally elevated cardiac enzymes; however, they are at **extremely high risk** for extensive anterior wall MI within the next few days to weeks.



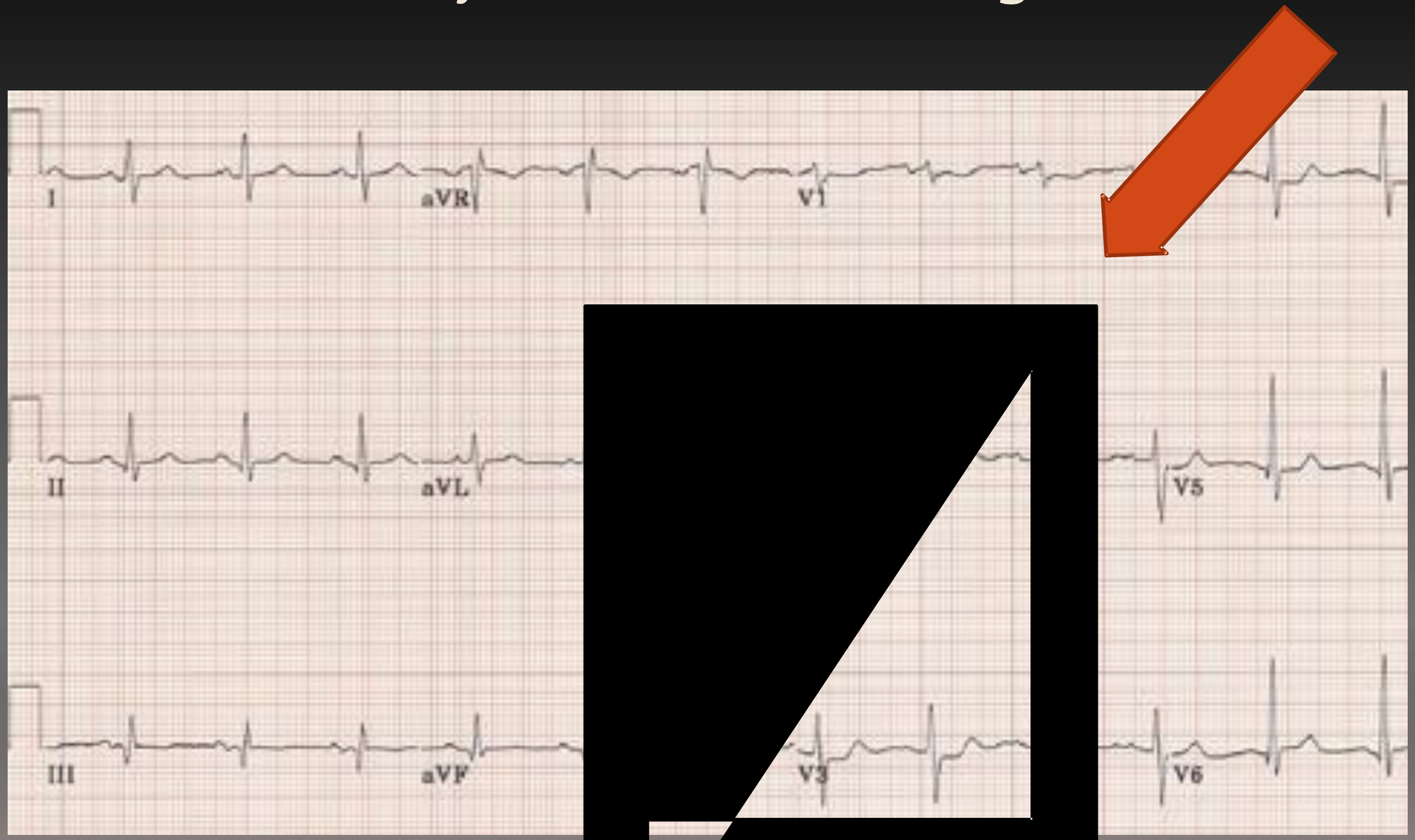
| | | |
|---|---|---|
| Vent. rate | 48 bpm | Sinus bradycardia |
| PR interval | 150 ms | T wave abnormality, consider anterolateral ischemia |
| QRS duration | 92 ms | Prolonged QT |
| QT/QTc | 522/466 ms | Abnormal ECG |
| P-R-T axes | 49 70 77 | |

Referred by:

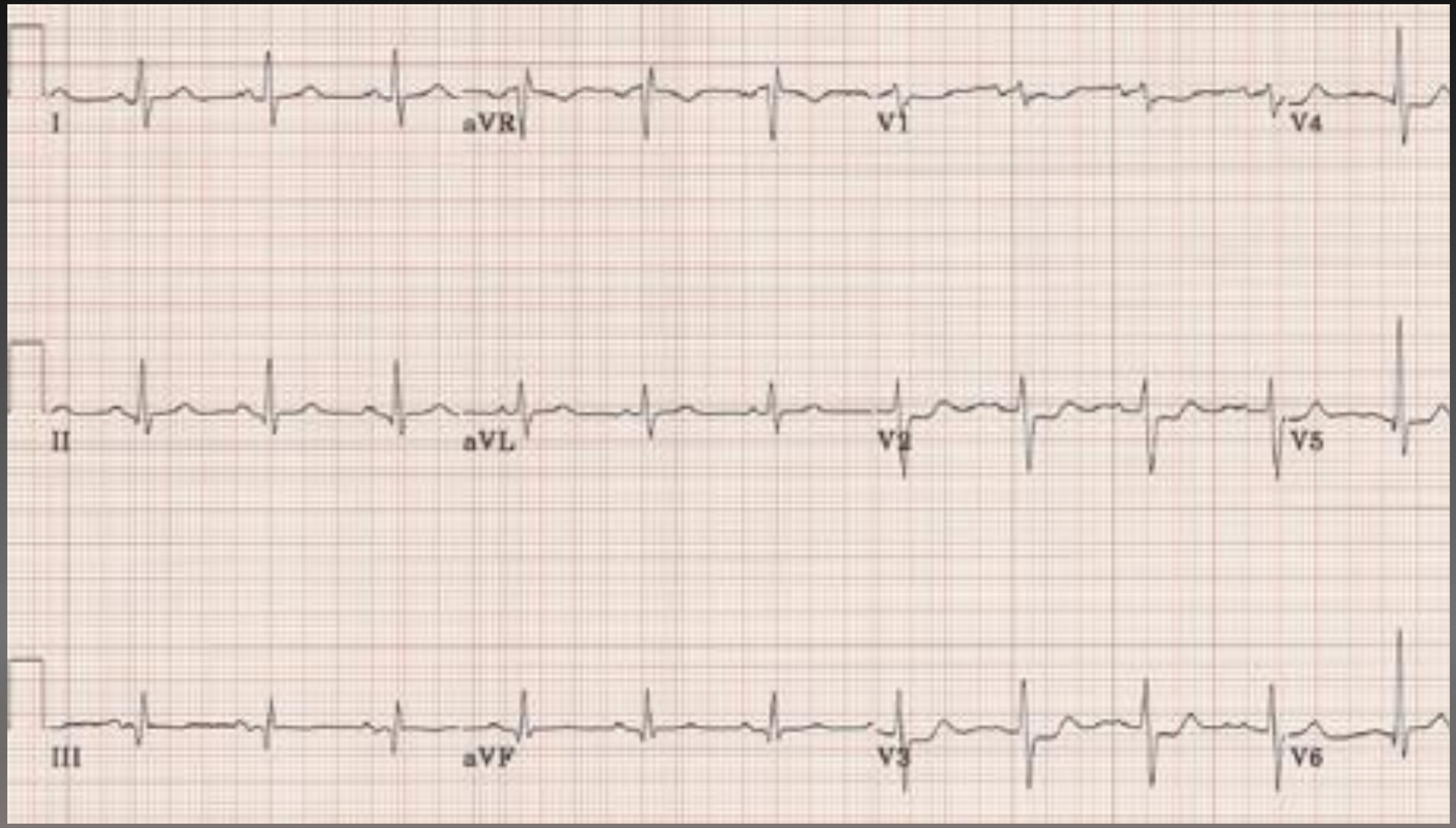
Reviewed by:



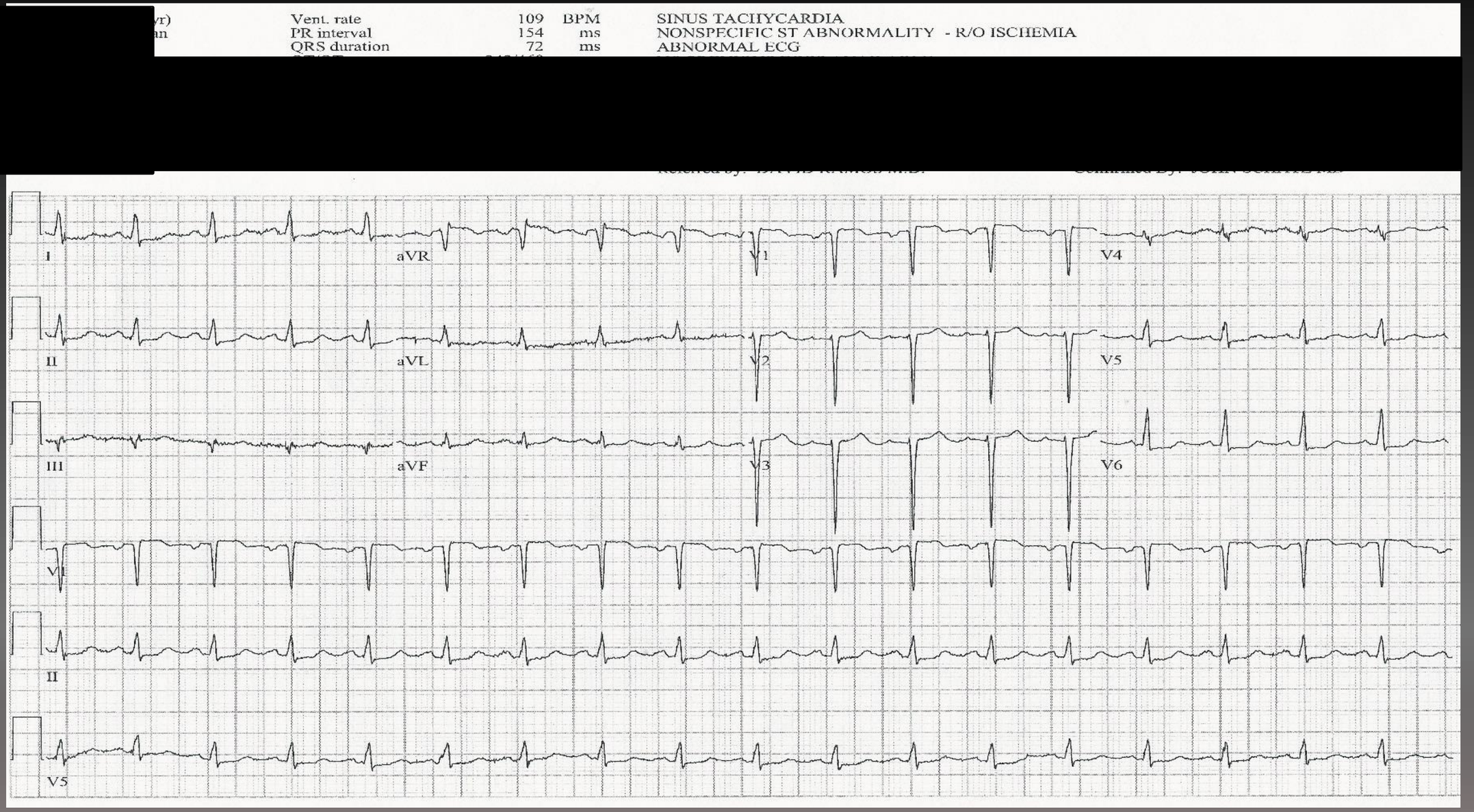
# 50 y/o male with “indigestion”



# 50 y/o male with “indigestion”



# 38 y/o female school teacher – “weak”



# ER note

- Sent to ER by urgent care for “abnormal cxr”

- “Pt. states sent for increasing cough and DOE x 1 week. C/O swelling to legs for 1 week. Denies hx of renal or heart disease. Denies fever, chest pain, abd pain or N/V/D.”

# Diagnostics

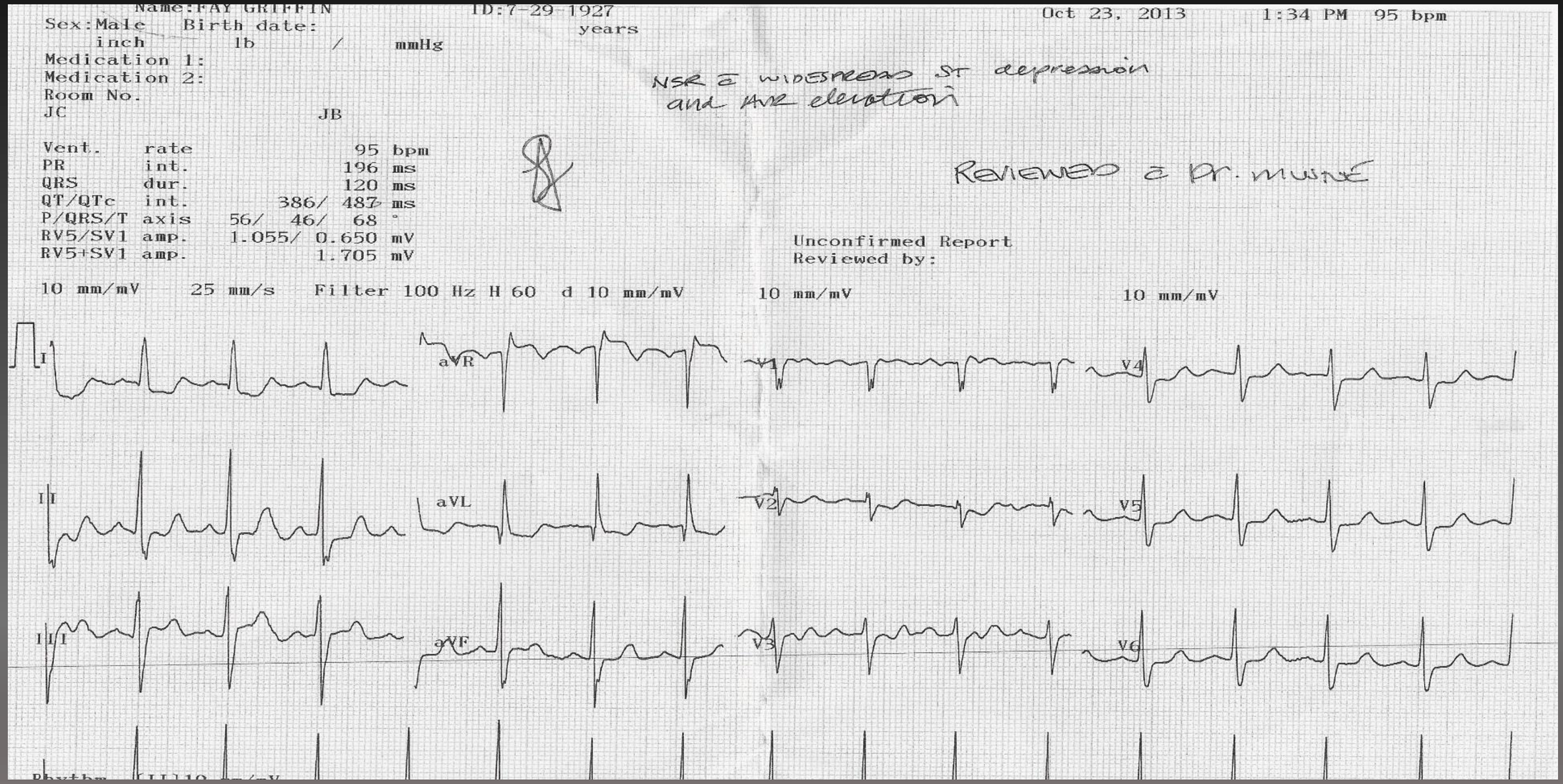
- Labs: TSh 2.2, BNP 6131, Trop <0.015, Glucose 310
- CXR: Left pleural effusion
- CTA: no PE
- Nuclear Stress test: Mod – severe LAD, RCA lesions, EF 20%



# What happened?

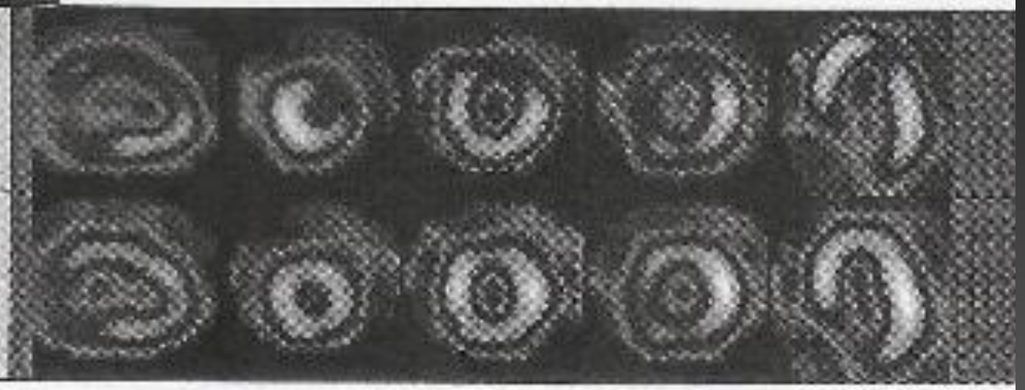
bypass!
EF of 20%
She lived….

# 78 y/o male with shoulder pain when I work out



# His stress test

**PERFUSION FINDINGS**

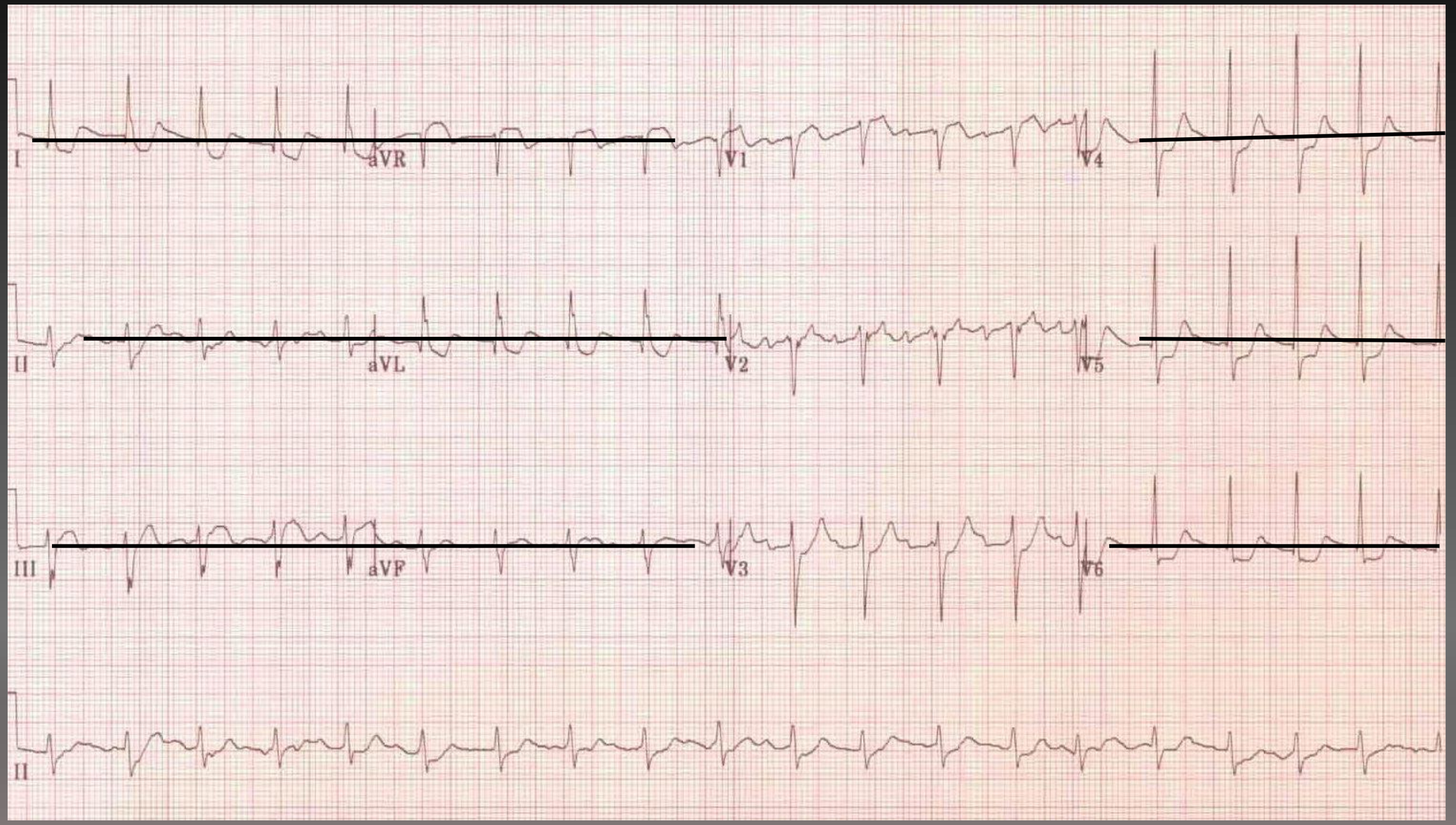
| | |
|---|---|
| **Stress Images** |  |
| **Rest Images** | |

| | |
|---|---|
| **Overall Study Quality:** | good |
| **Extra Cardiac Activity:** | normal |
| **Study Artifacts:** | None |

**LV Myocardial Perfusion Defects:**
(1) Moderate sized moderate to severe anterolateral completely reversible defect consistent
typical of the mid LAD and or LCx.

**Scan Significance:** abnormal and indicates an intermediate risk for hard cardiac events
**Stress/Rest LV Volume Ratio:** 0.97, normal

# AVR





# OMINOUS FINDING!

- Elevation of more than 1mm in aVR in the setting of Acute Coronary syndrome is associated with left main disease
- Not a stemi, but should be treated like one
- PCI
- Associated with an increase in mortality




# CASE

## 42 Y/O MALE PRESENTED WITH INTERMITTENT CHEST PAIN.



HX: HTN, smoking, hyperlipidemia. severe, possible ehlers danlos. High stress lifestyle. Worked as a mechanic. Thin framed.

# 42 year old male C/P – clinic EKG

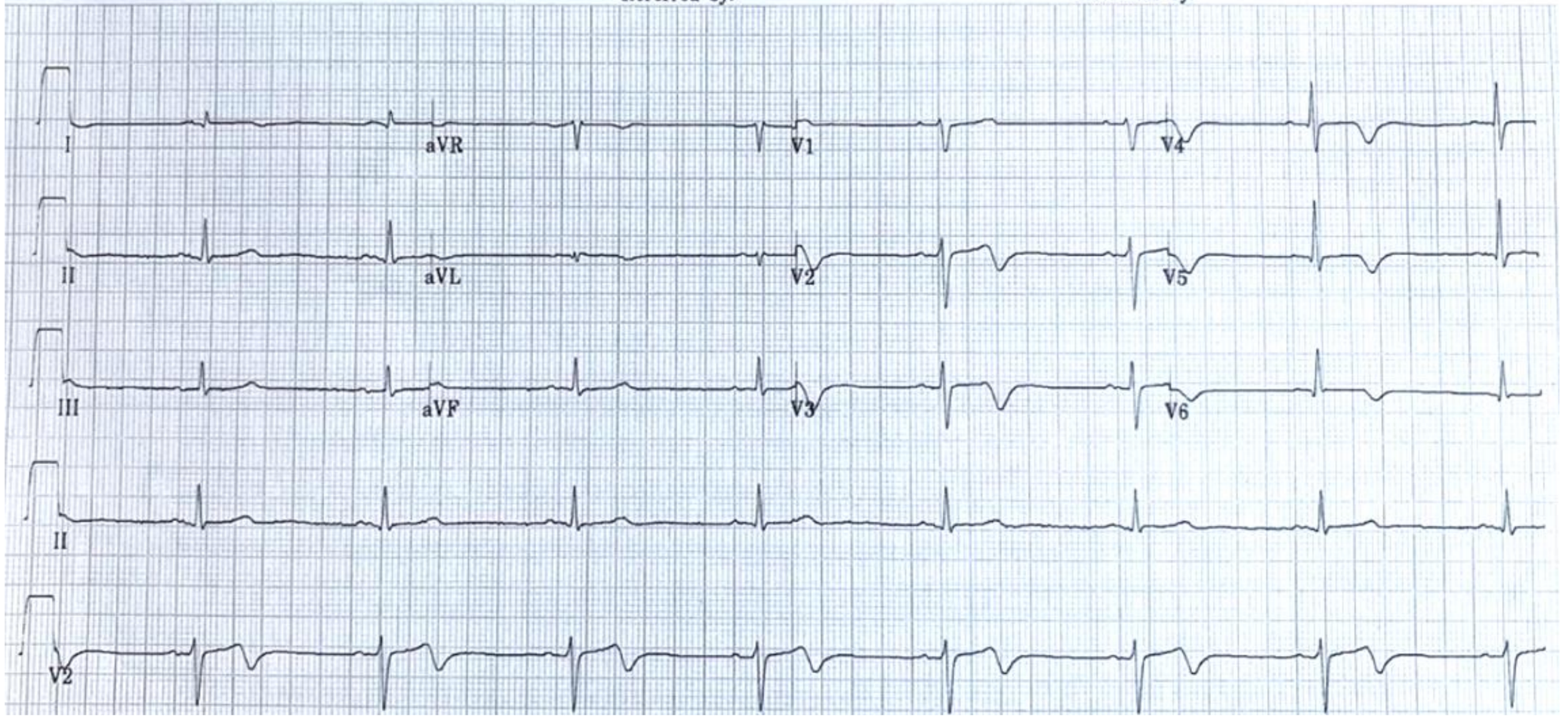


| | |
|---|---|
| Vent. rate | 48 bpm |
| PR interval | 150 ms |
| QRS duration | 92 ms |
| QT/QTc | 522/466 ms |
| P-R-T axes | 49 70 77 |

Sinus bradycardia
T wave abnormality, consider anterolateral ischemia
Prolonged QT
Abnormal ECG

Referred by:

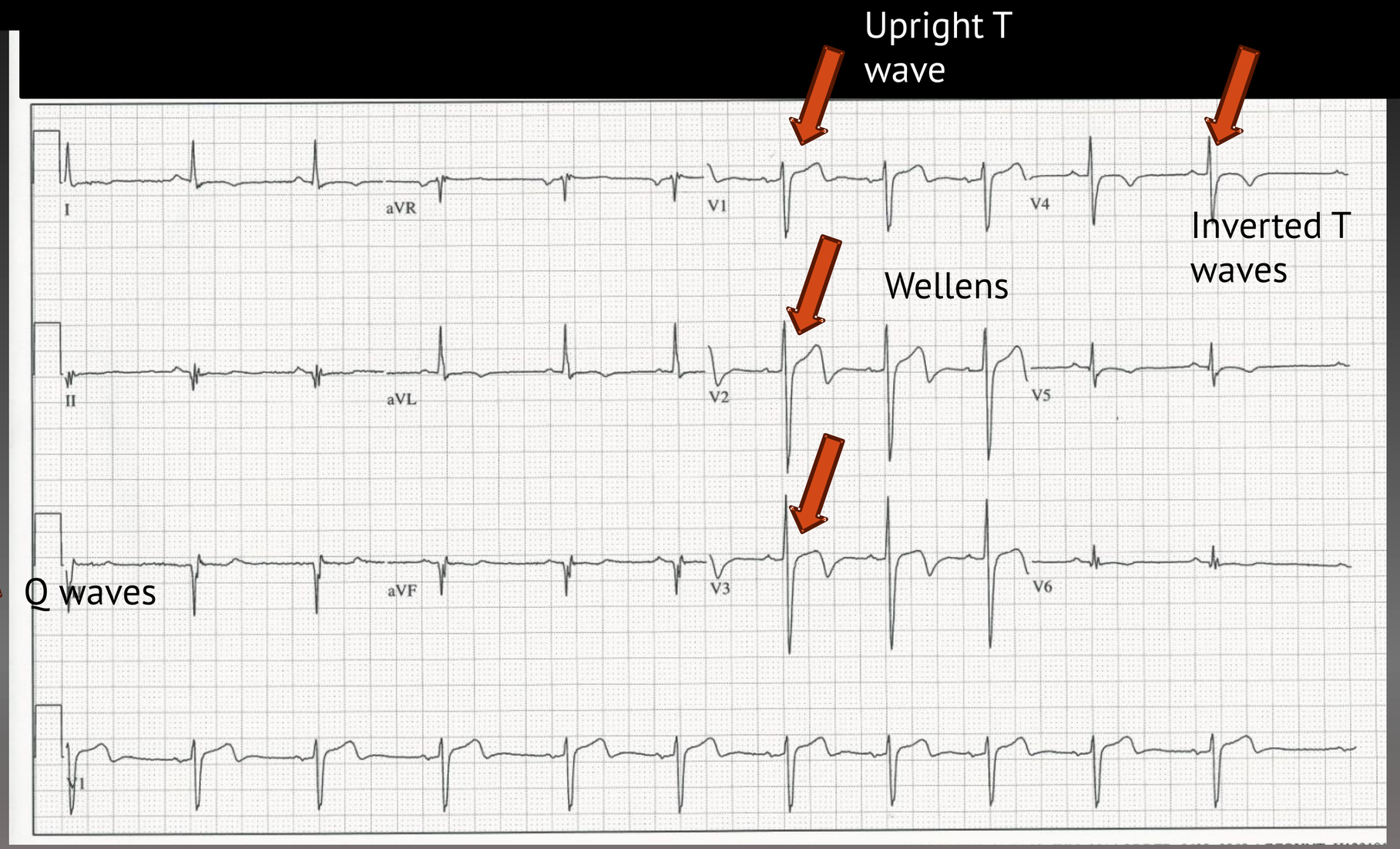
Reviewed by:





# PMD NOTE

- "Has chest tightness after dinner, worse laying down, sometimes when sitting. Connection to activity, but not consistently so. Eases with doing less. No lightheadedness, dizziness, sweats."


Upright T wave
Inverted T waves
Wellens
Q waves
I
aVR
V1
V4
II
aVL
V2
V5
aVF
V3
V6
V1



# What happened?

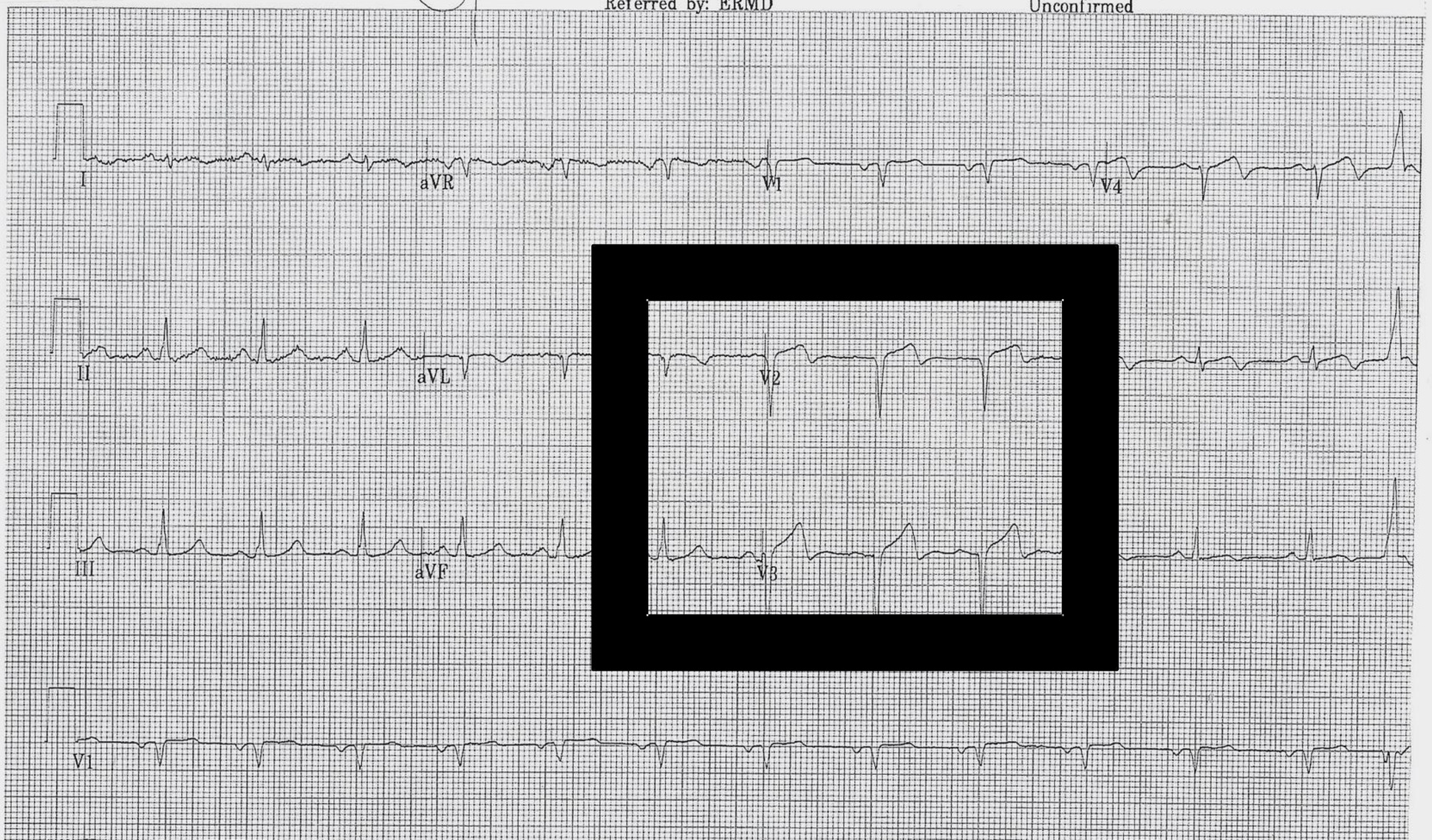
5 vessel bypass.
EF of 40%.

| | | |
|---|---|---|
| Vent. rate | 79 | bpm |
| PR interval | 164 | ms |
| QRS duration | 78 | ms |
| QT/QTc | 400/458 | ms |
| P-R-T axes | 57 91 | 79 |

Sinus rhythm with occasional premature ventricular complexes
Possible Left atrial enlargement
Rightward axis
Septal infarct, age undetermined
T wave abnormality, consider lateral ischemia
Abnormal ECG

Referred by: ERMD

Unconfirmed



# 4 Flavors of Wellens

v2

V3

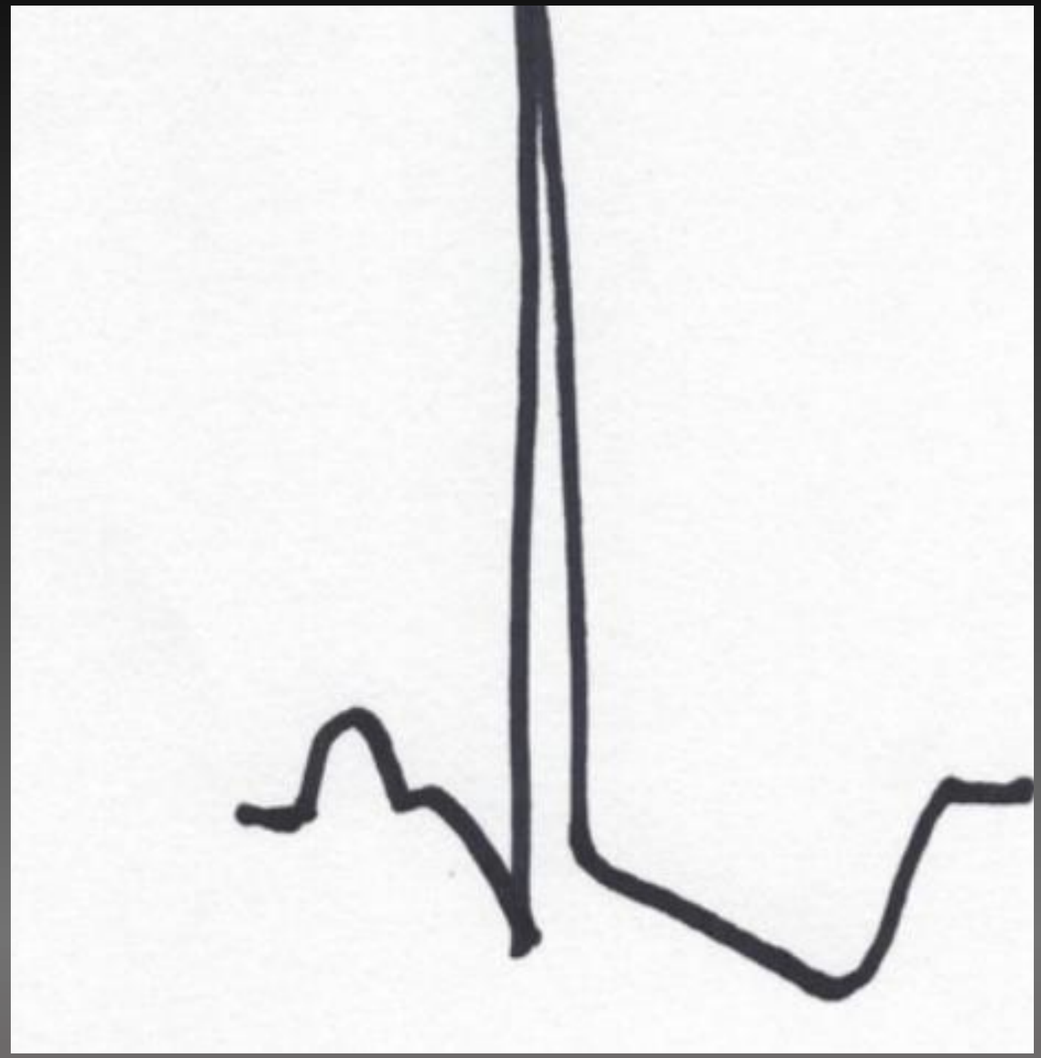


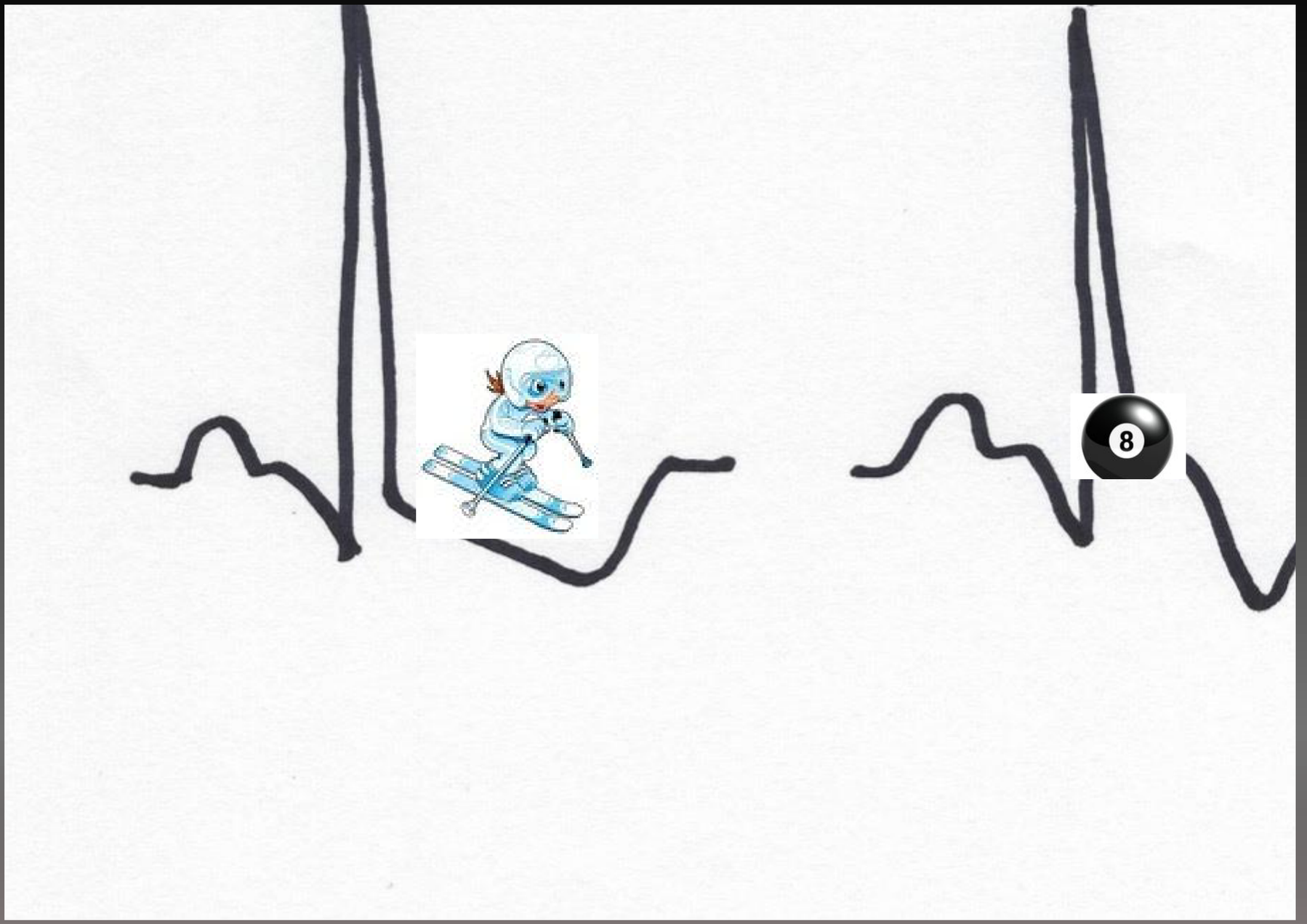



# STRAIN PATTERN

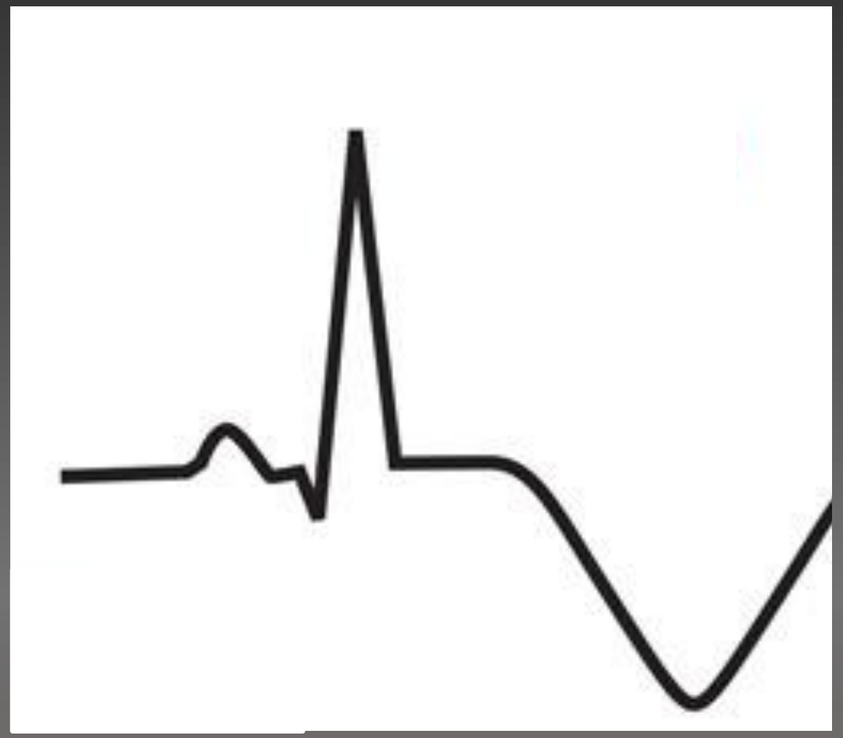
This means the patient has a **large ventricle**.

The appearance of the ST segment is deep, inverted and looks like a **reverse check mark**.





# 4 differentials for flipped T waves

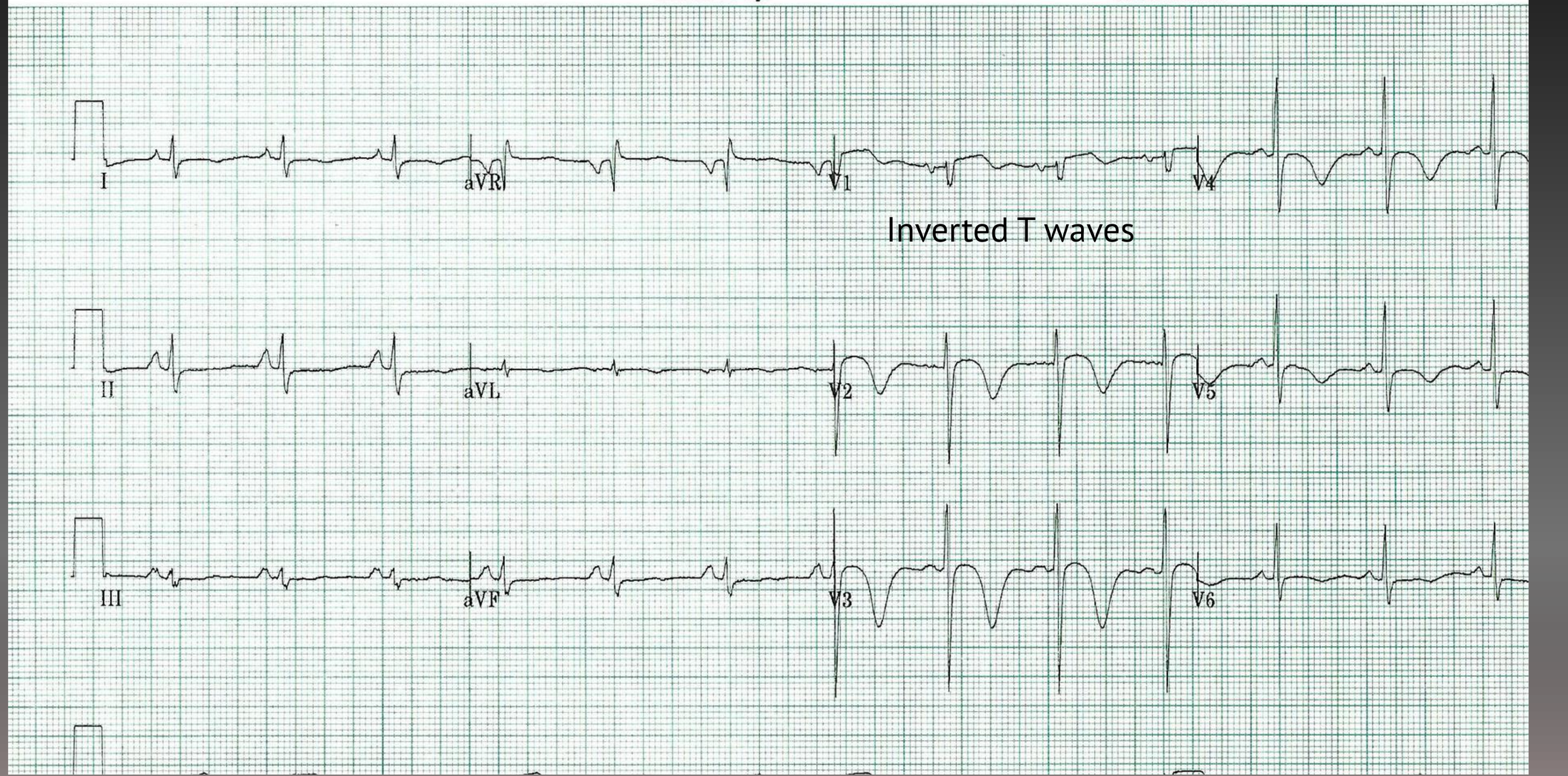


1. **ACS**
2. **PE**
3. **ICH**
4. **Cardiomyopathy**

| | | |
|---|---|---|
| Vent. rate | 79 bpm | Normal sinus rhythm |
| PR interval | 144 ms | Right atrial enlargement |
| QRS duration | 86 ms | ST & Marked T wave abnormality, consider anterolateral ischemia |
| QT/QTc | 462/529 ms | Prolonged QT |
| P-R-T axes | 69 24 238 | Abnormal ECG |

ician:
nd: F

Referred by: Unconfirmed

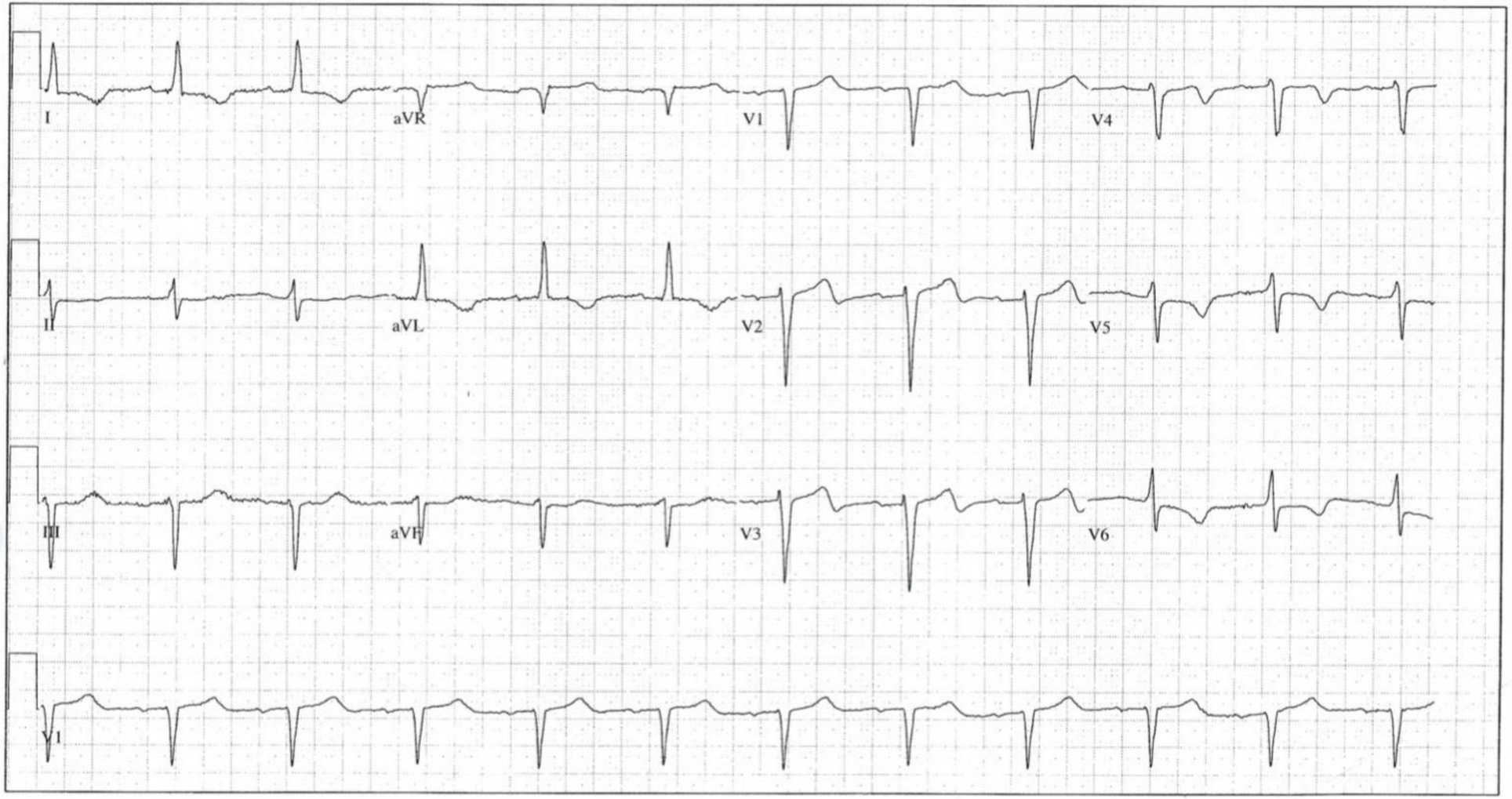


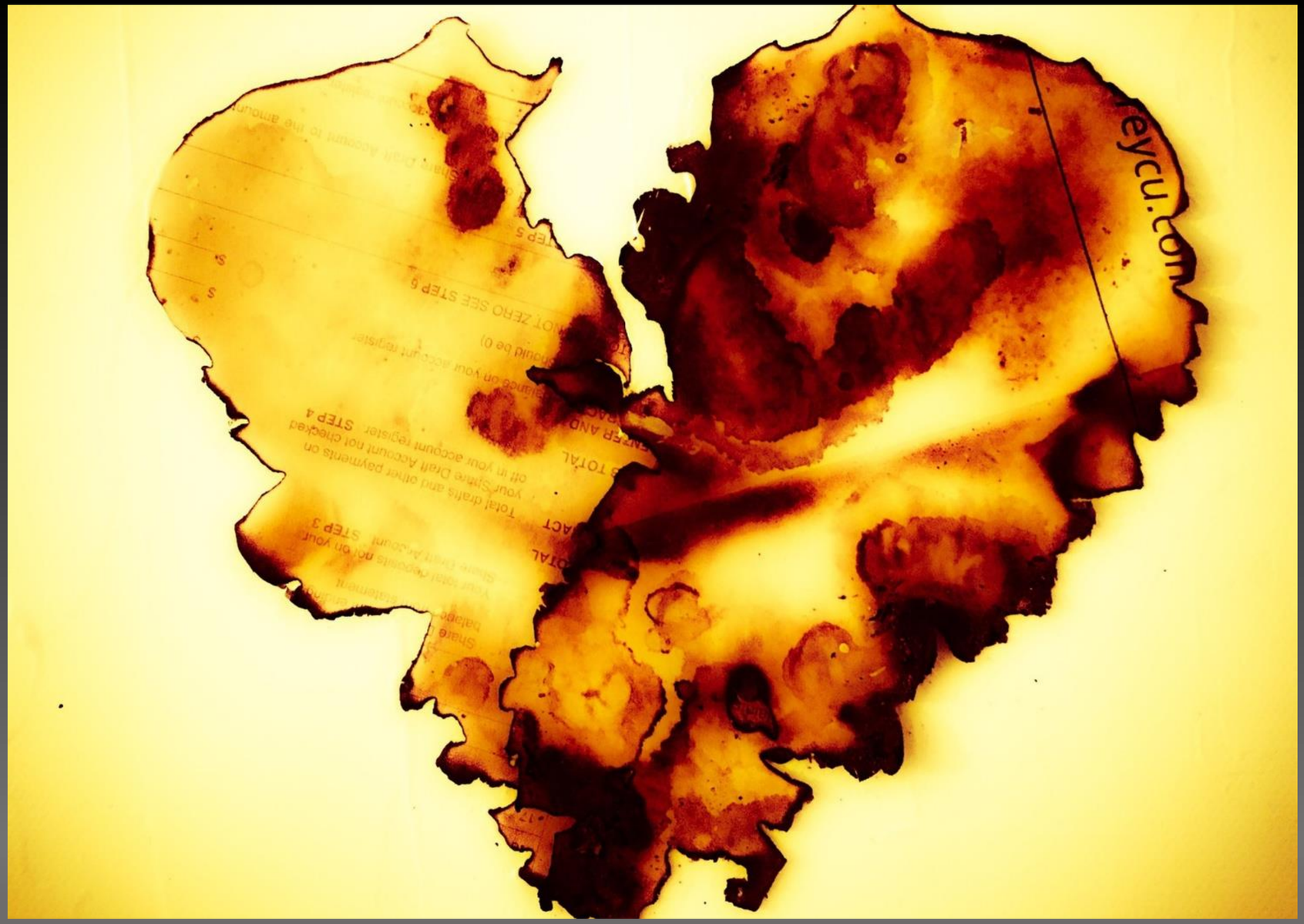

Inverted T waves

| | | |
|---|---|---|
| Vent. rate | 68 | BPM |
| PR interv | 220 | ms |
| QRS dura on | 114 | ms |
| QT/QTc | 492/523 | ms |
| P–R–T axes | –11 –38 | 155 |

SINUS RHYTHM WITH 1ST DEGREE A–V BLOCK
LEFT AXIS DEVIATION
LEFT VENTRICULAR HYPERTROPHY
CANNOT RULE OUT ANTERIOR INFARCT
ST AND T WAVE ABNORMALITY, CONSIDER LATERAL ISCHEMIA
PROLONGED QT
ABNORMAL ECG
WHEN COMPARED WITH ECG OF 07–APR–2019 18:05, (UNCONFIRMED)
NON–SPECIFIC CHANGE IN ST SEGMENT IN ANTERIOR LEADS

17





# Workbook

1. **Big** Sick vs. **Little** Sick

2. Rate

3. Rhythm

4. Intervals (Use the **family**)

5. Axis

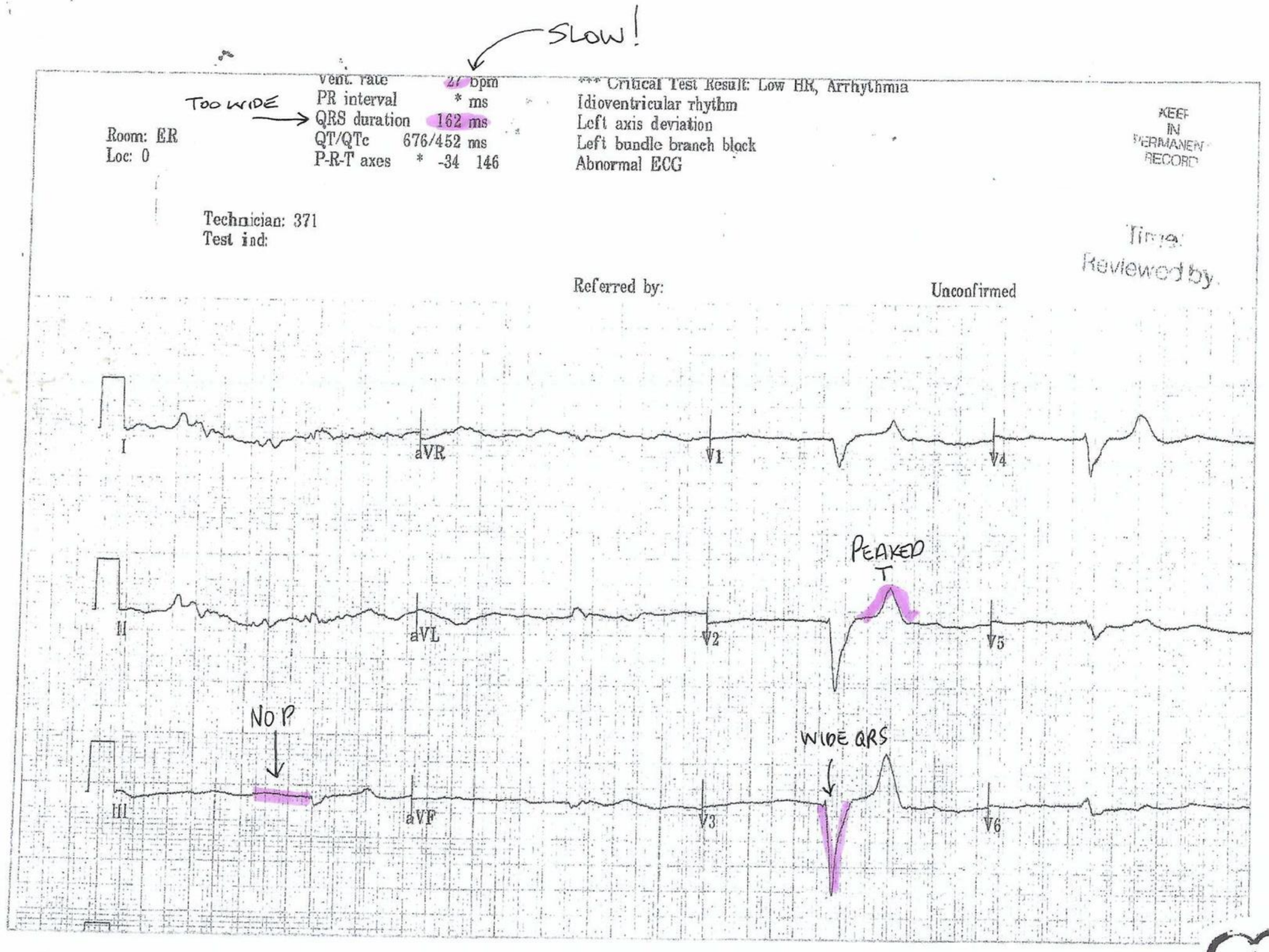
6. **ST Segments**

7. Hypertrophy / Voltage

8. **T** wave analysis- (all waves)

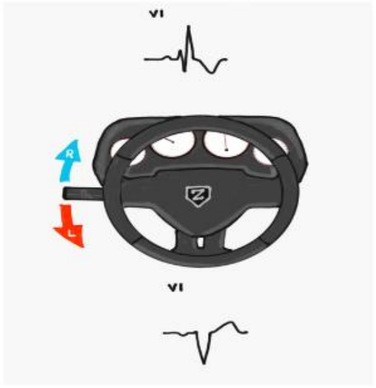
9. **Q Waves?** Married? Wide?

10. Chief Complaint  Based Approach




5. Prolonged QT

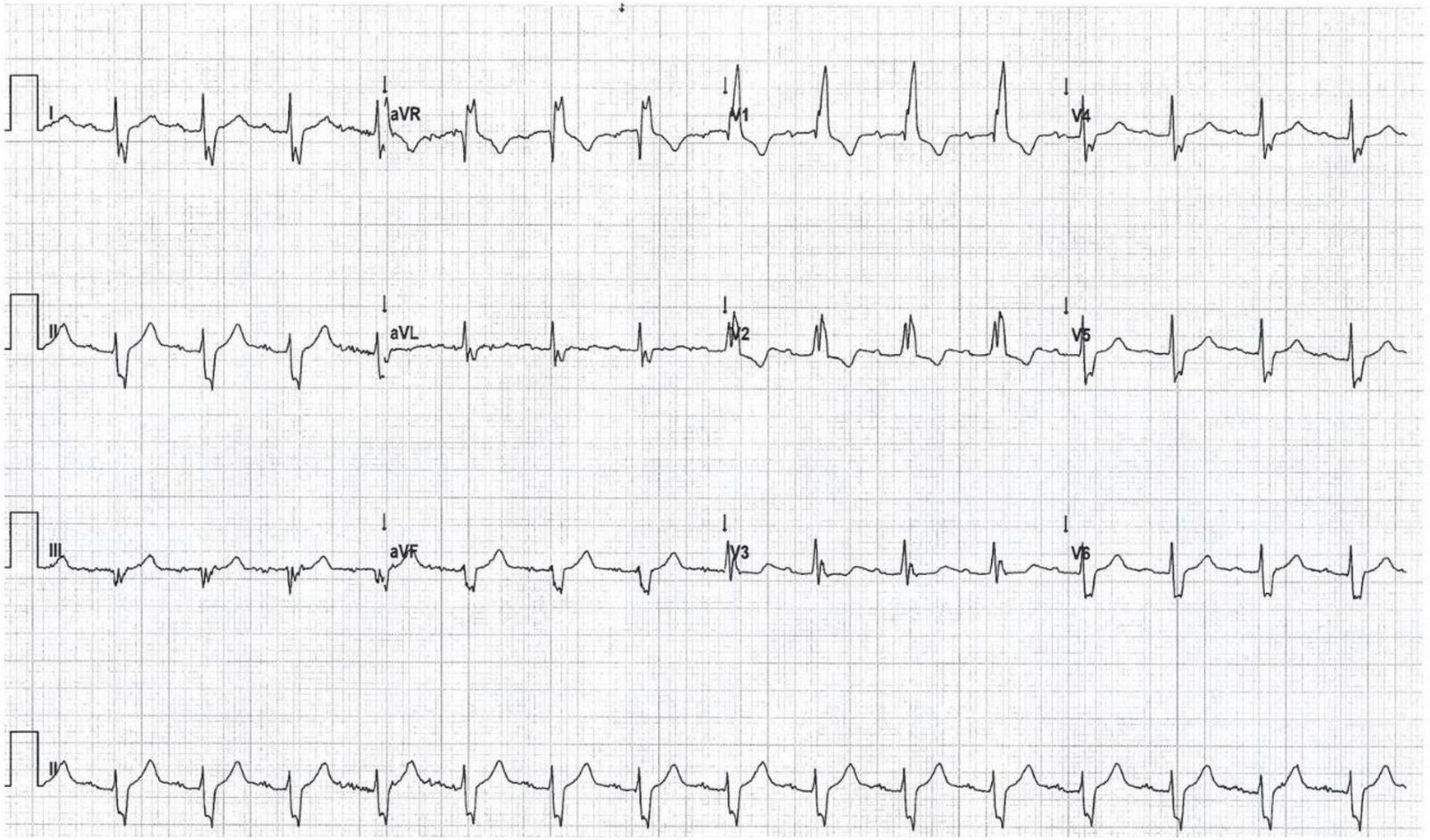
1. Bradycardia 2. WIDE QRS 3. No P wave. 4. PEAKED T



PR int: 203 ms
QRS dur: 146 ms
QT/QTc: 382 / 432 ms
P-R-T axes: 15 -84 56

ABNORMAL ECG

UNCONFIRMED REPORT

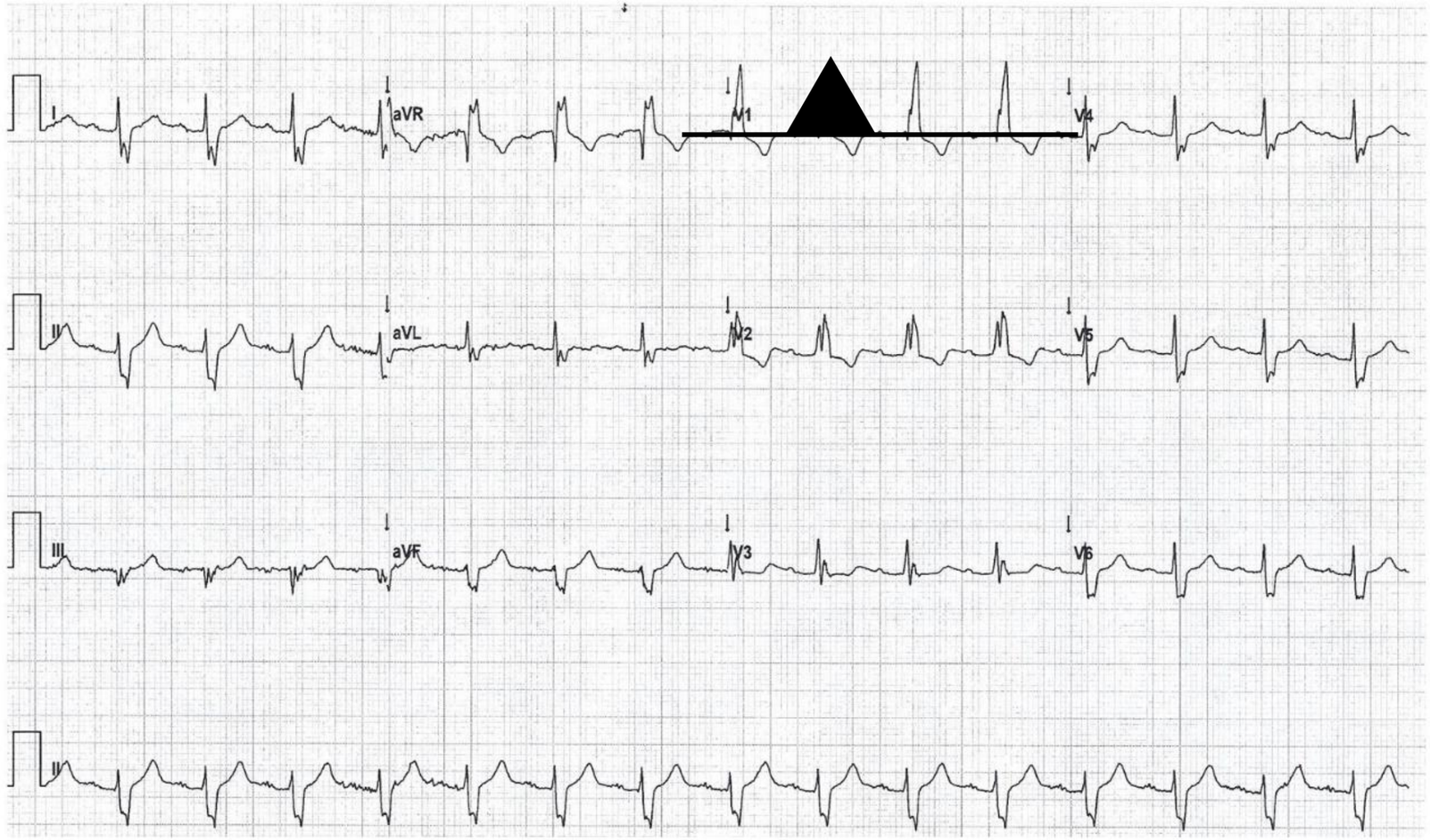


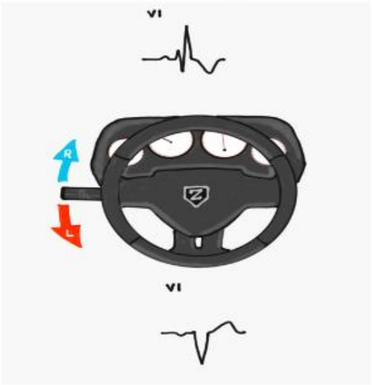

# EKG #2

PR int: 203 ms
QRS dur: 146 ms
QT/QTc: 382 / 432 ms
P-R-T axes: 15 -84 56

ABNORMAL ECG

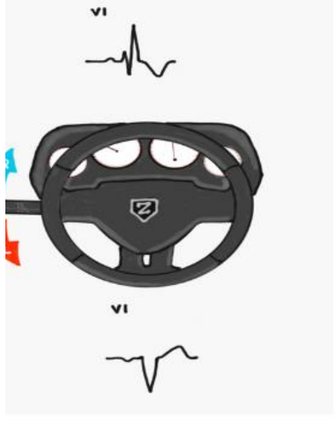
UNCONFIRMED REPORT



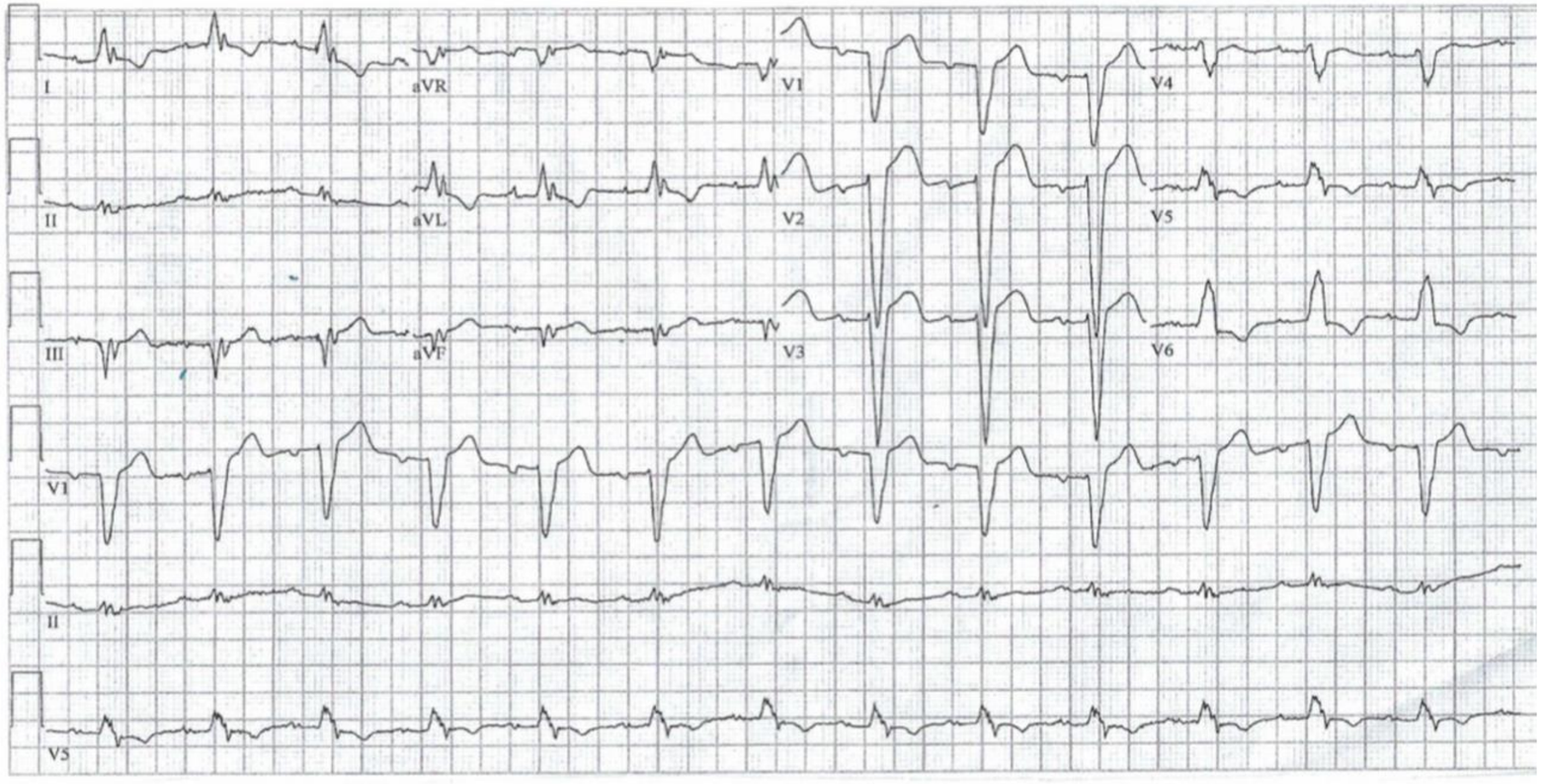




1.QRS must be over 120 ms
2.Go to v1
3.Draw a line
4.Color in the triangle
5.Which way does it point

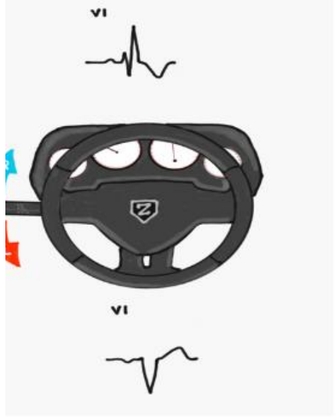
# EKG #2




| | | | |
|---|---|---|---|
| Vent. rate | 81 | BPM | SINUS RHYTHM WITH 1ST DEGREE A-V BLOCK |
| PR interval | 220 | ms | LEFT BUNDLE BRANCH BLOCK |
| QRS duration | 150 | ms | ABNORMAL ECG |
| QT/QTc | 414/480 | ms | NO PREVIOUS ECGS AVAILABLE |
| P-R-T axes | 34 -26 | 130 | |

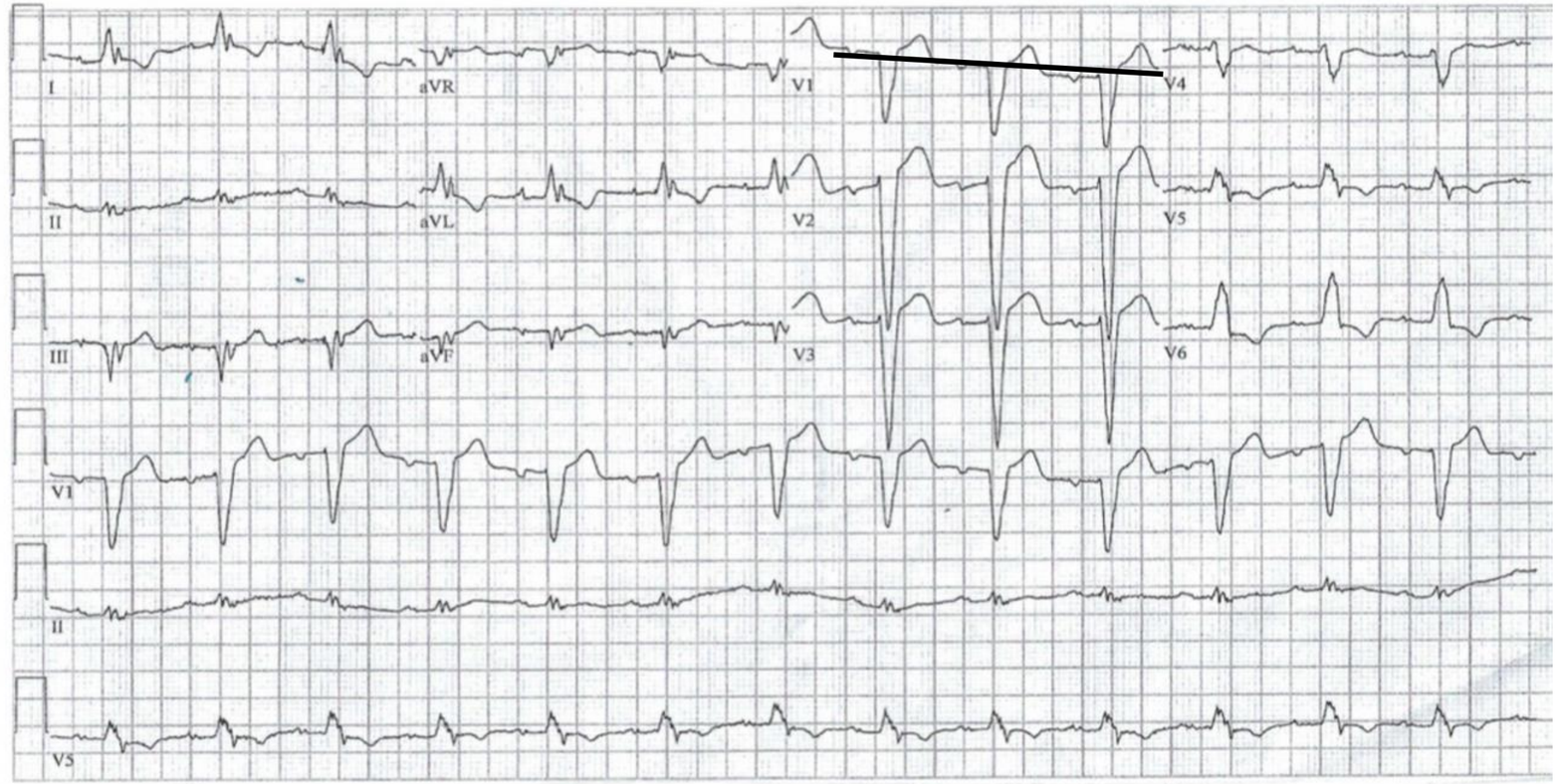



# EKG #3

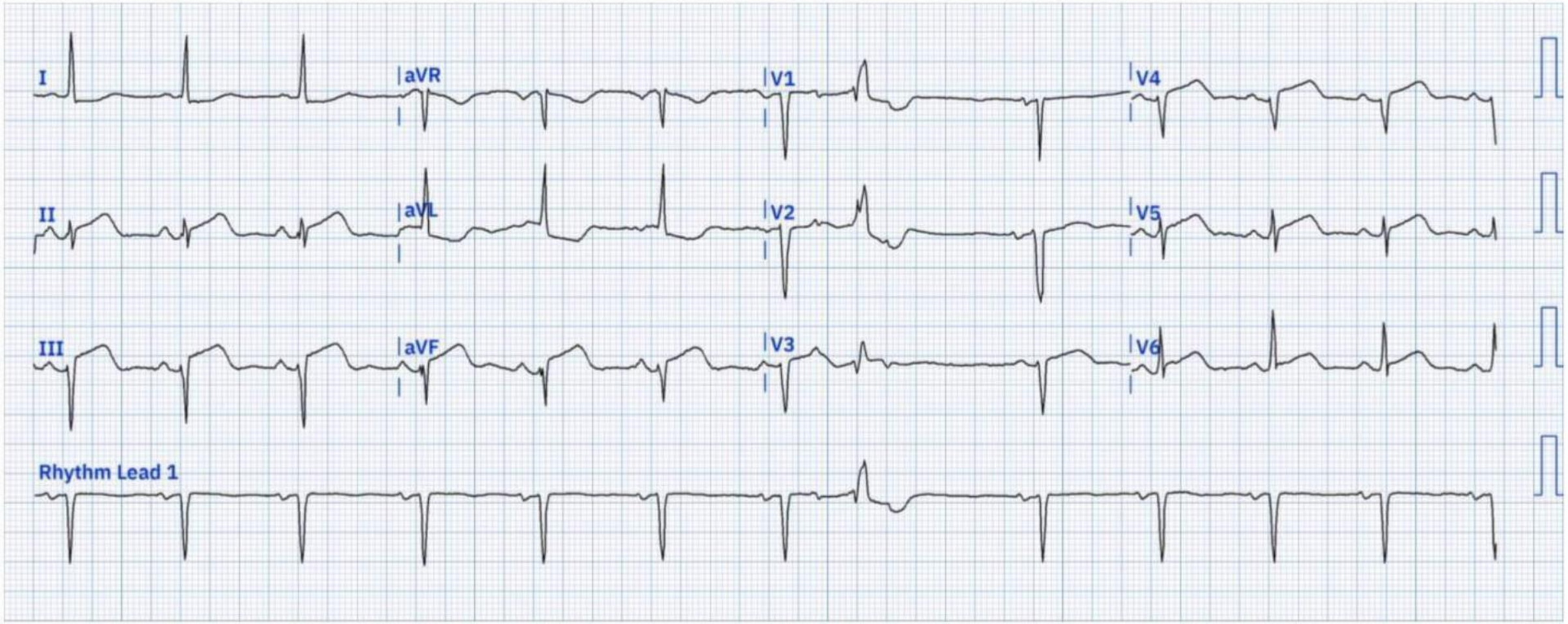


1.QRS must be over 120 ms
2.Go to v1
3.Draw a line
4.Color in the triangle
5.Which way does it point

| | | | |
|---|---|---|---|
| Vent. rate | 81 | BPM | SINUS RHYTHM WITH 1ST DEGREE A-V BLOCK |
| PR interval | 220 | ms | LEFT BUNDLE BRANCH BLOCK |
| QRS duration | 150 | ms | ABNORMAL ECG |
| QT/QTc | 414/480 | ms | NO PREVIOUS ECGS AVAILABLE |
| P-R-T axes | 34 -26 | 130 | |

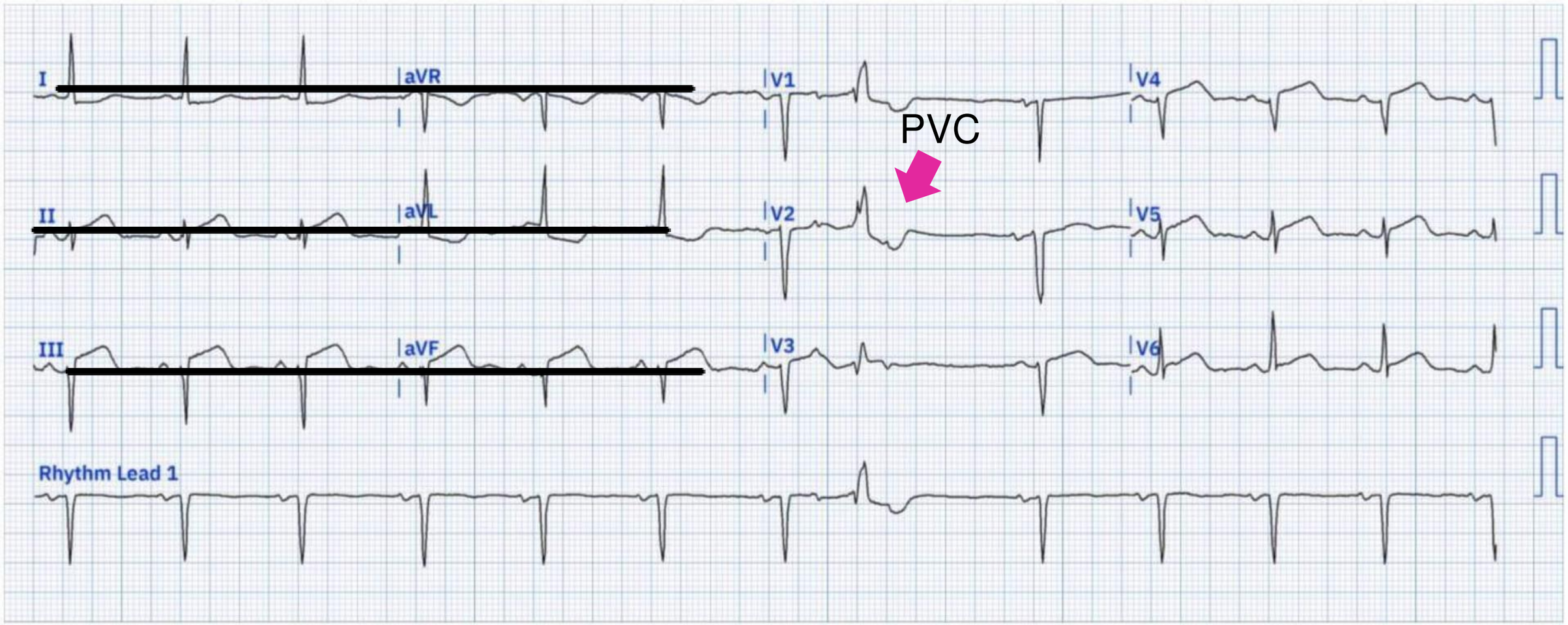



# EKG #3




58 y/o M with chest pain and diaphoresis

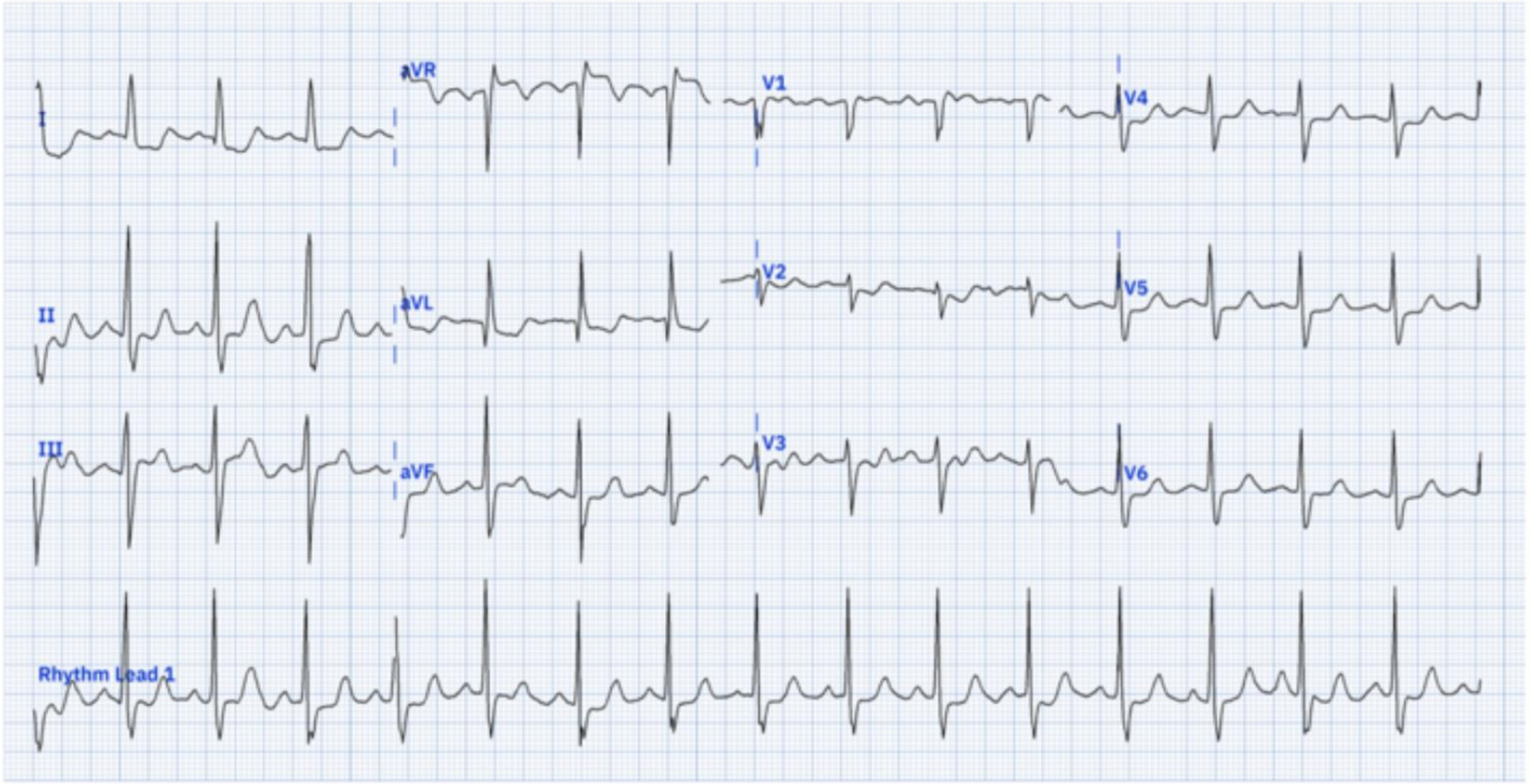
# EKG #4




58 y/o M with chest pain and diaphoresis

# EKG #4

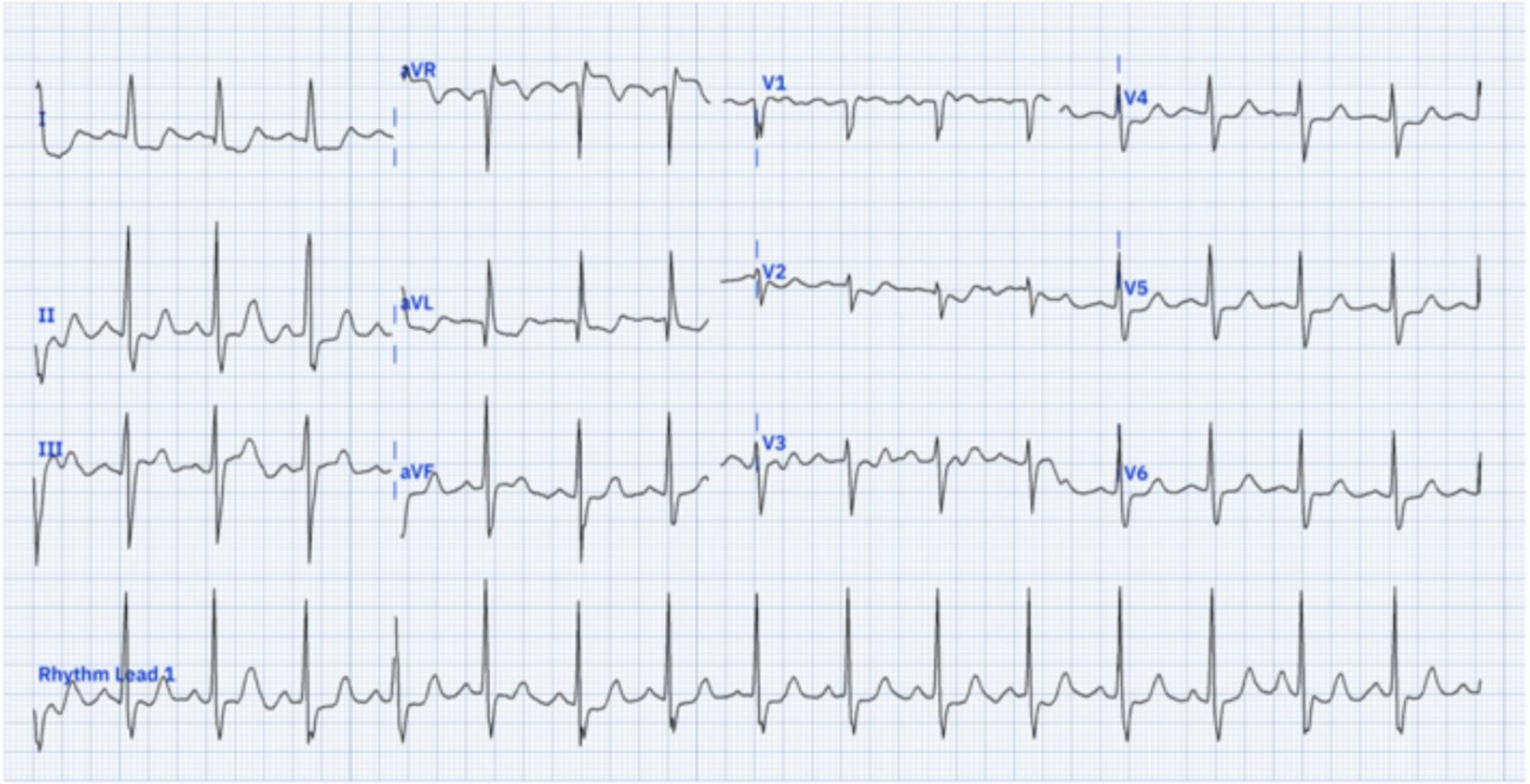
| | | | |
|---|---|---|---|
| 95 bpm | Normal | QRS Duration | 118 ms |
| | | QT / QTcFra | 389 / 446 ms |
| | | PP Interval | 630 ms |




79 y.o M with left shoulder pain “when I work out”

# EKG #5

| | | | |
|---|---|---|---|
| 95 bpm | Normal | QRS Duration | 118 ms |
| | | QT / QTcFra | 389 / 446 ms |
| | | PP Interval | 630 ms |




79 y.o M with left shoulder pain “when I work out”

# EKG #5

| | |
|---|---|
| Vent rate | 70 BPM |
| PR int | 197 ms |
| QRS dur | 97 ms |
| QT/QTc | 376/397 ms |
| P-R-T axes | 59 51 59 |

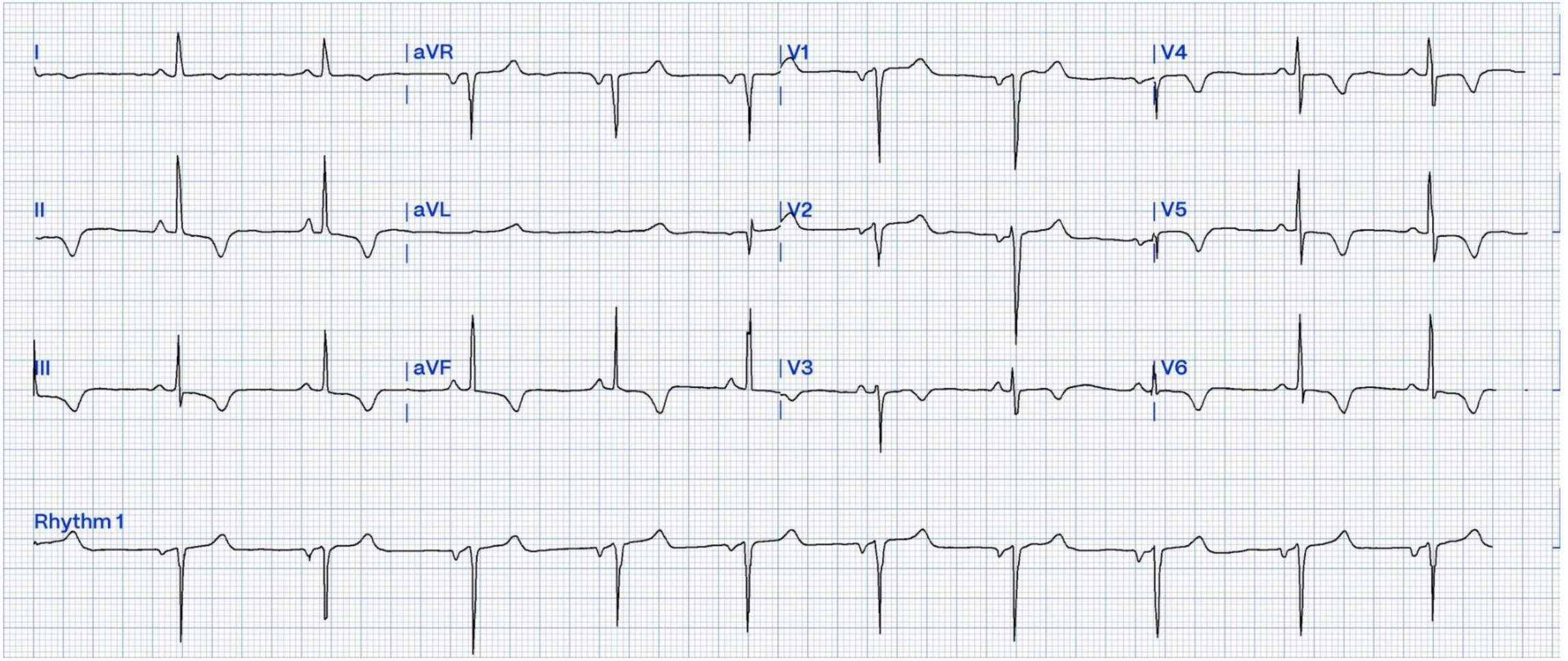
SINUS RHYTHM WITH OCCASIONAL SUPRAVENTRICULAR PREMATURE COMPLEXES
ST ELEVATION, CONSIDER INFERIOR INJURY [MARKED ST ELEVATION W/O NORMALLY INFLECTED T WAVE IN II/aVF]
***ACUTE MI***

UNCONFIRMED REPORT




70 y.o M with back pain radiated to my chest better with Motrin

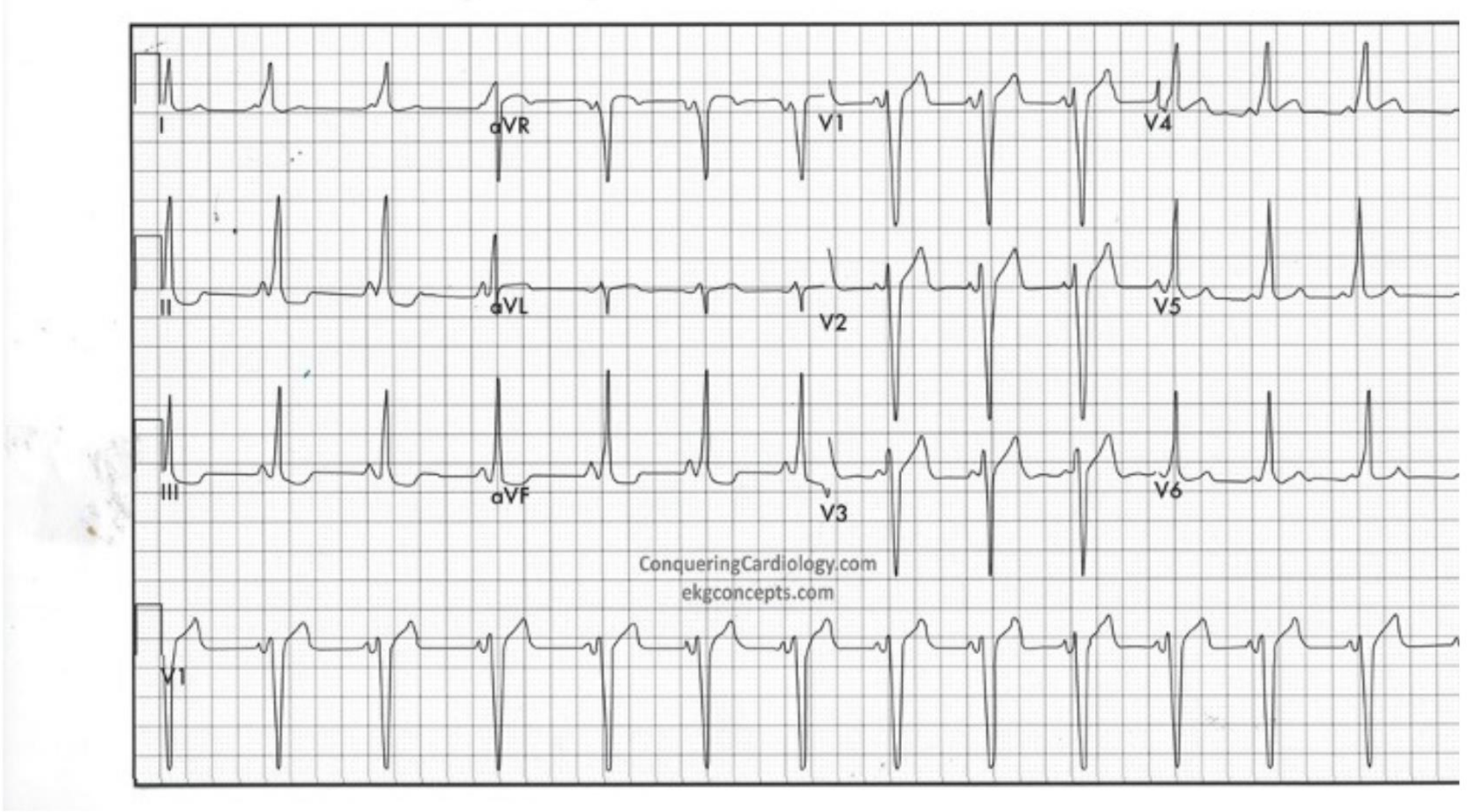
# EKG #6




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

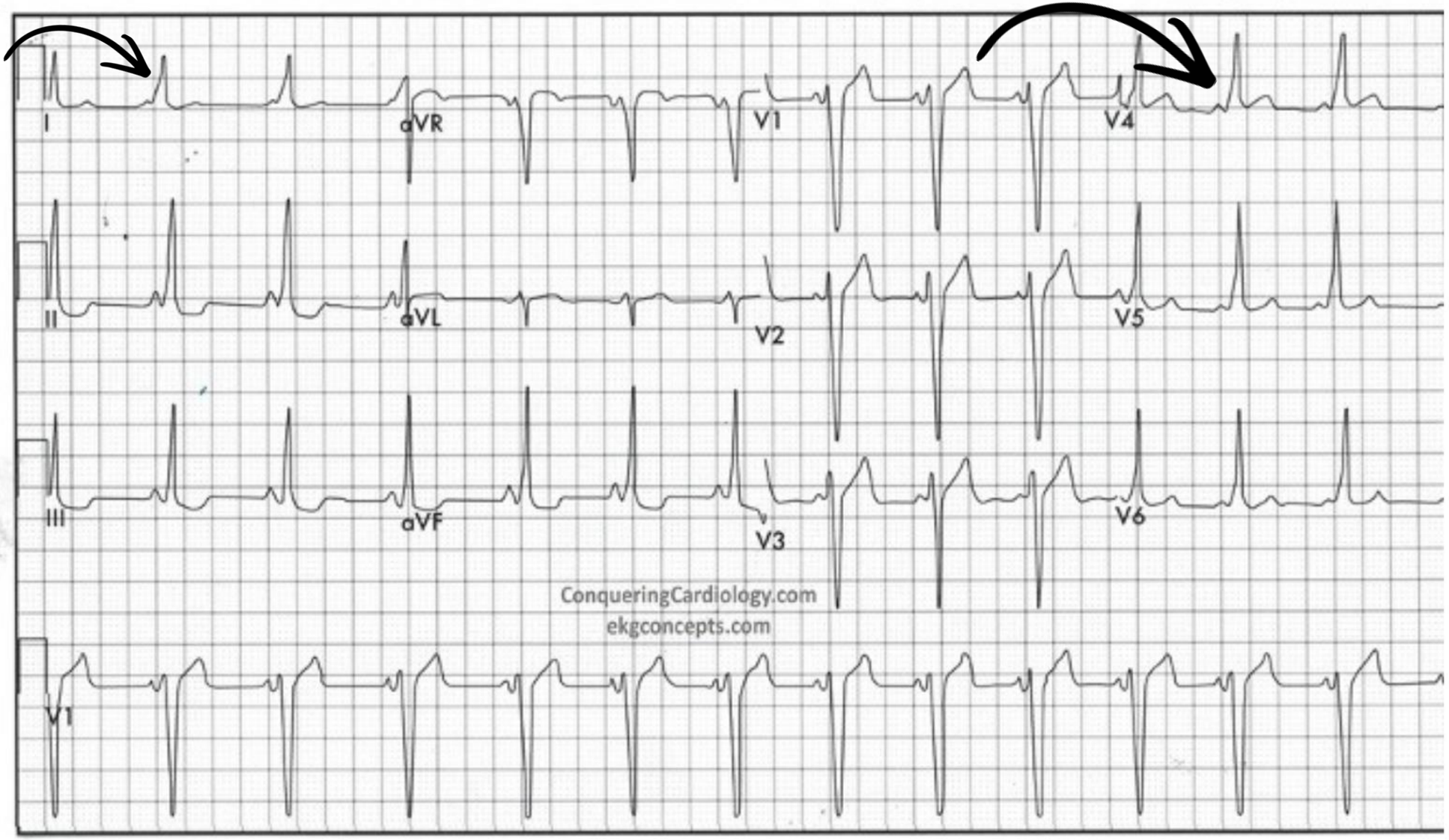
56 y.o Male crushing chest pain

# EKG #7




18 y.o M with palpitations

# EKG #8



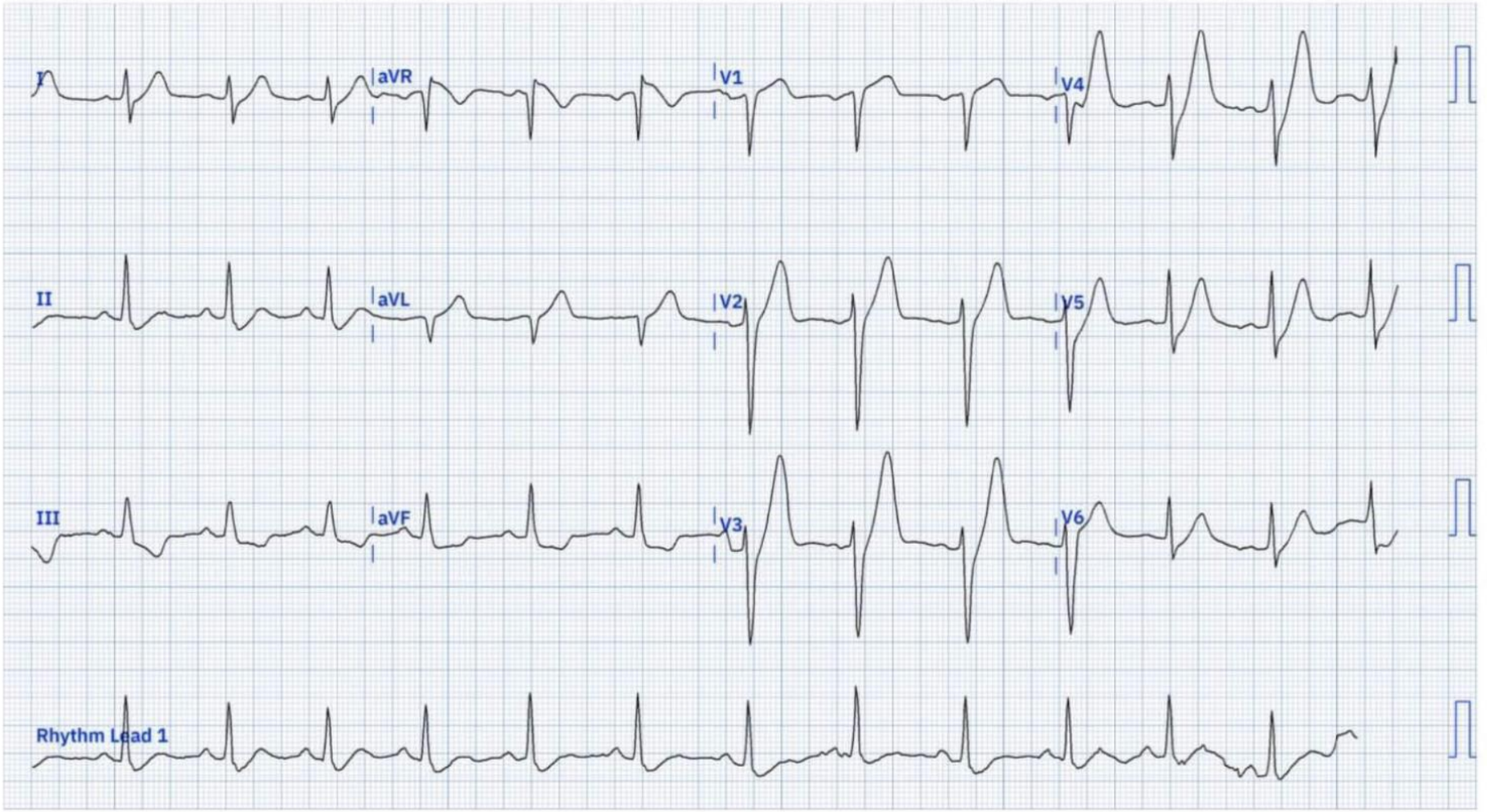

**W**- Wide wave

**P**- Pr interval, short

**W-** Wave, delta

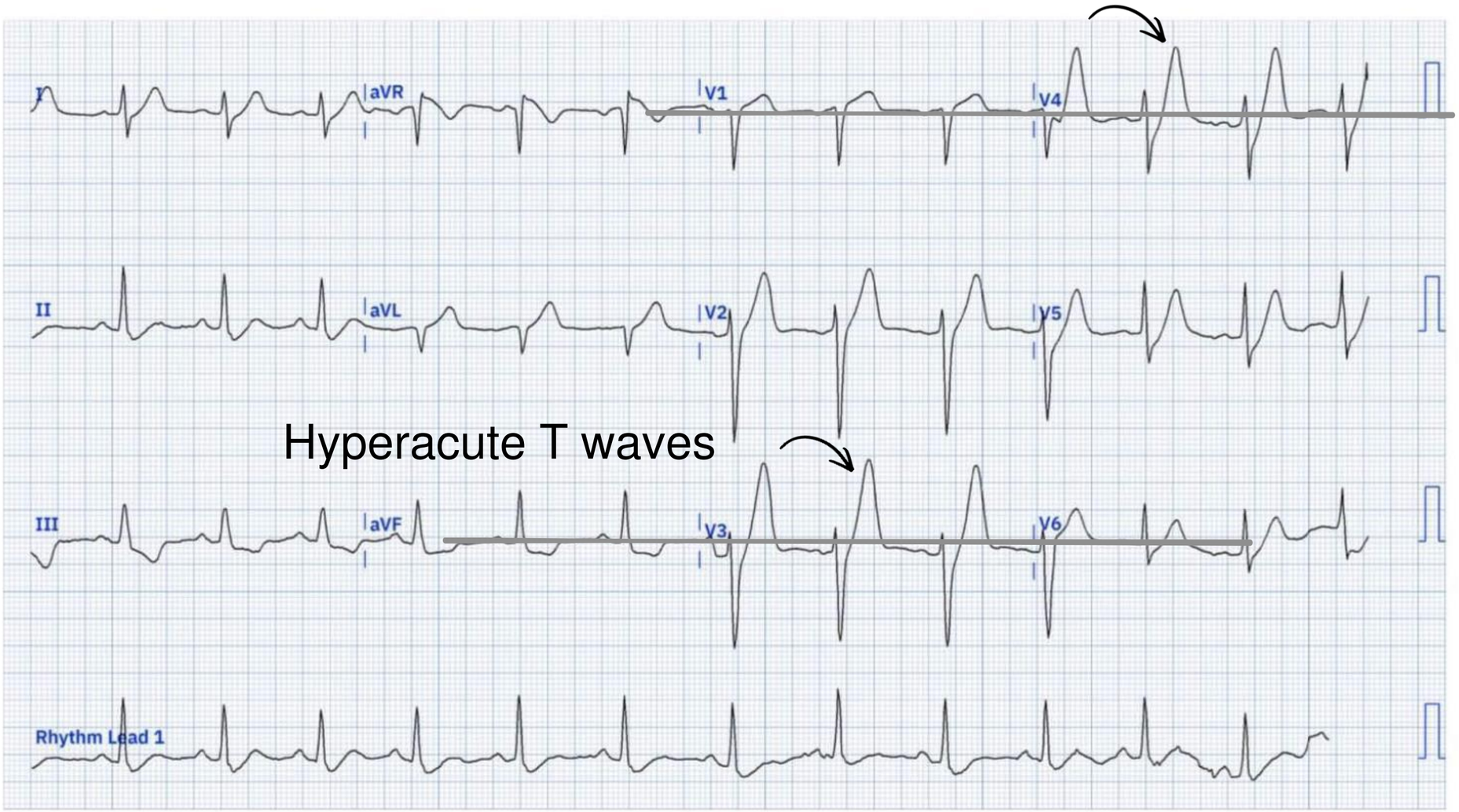
18 y.o M with palpitations

# EKG #8




69 y.o M with chest pain

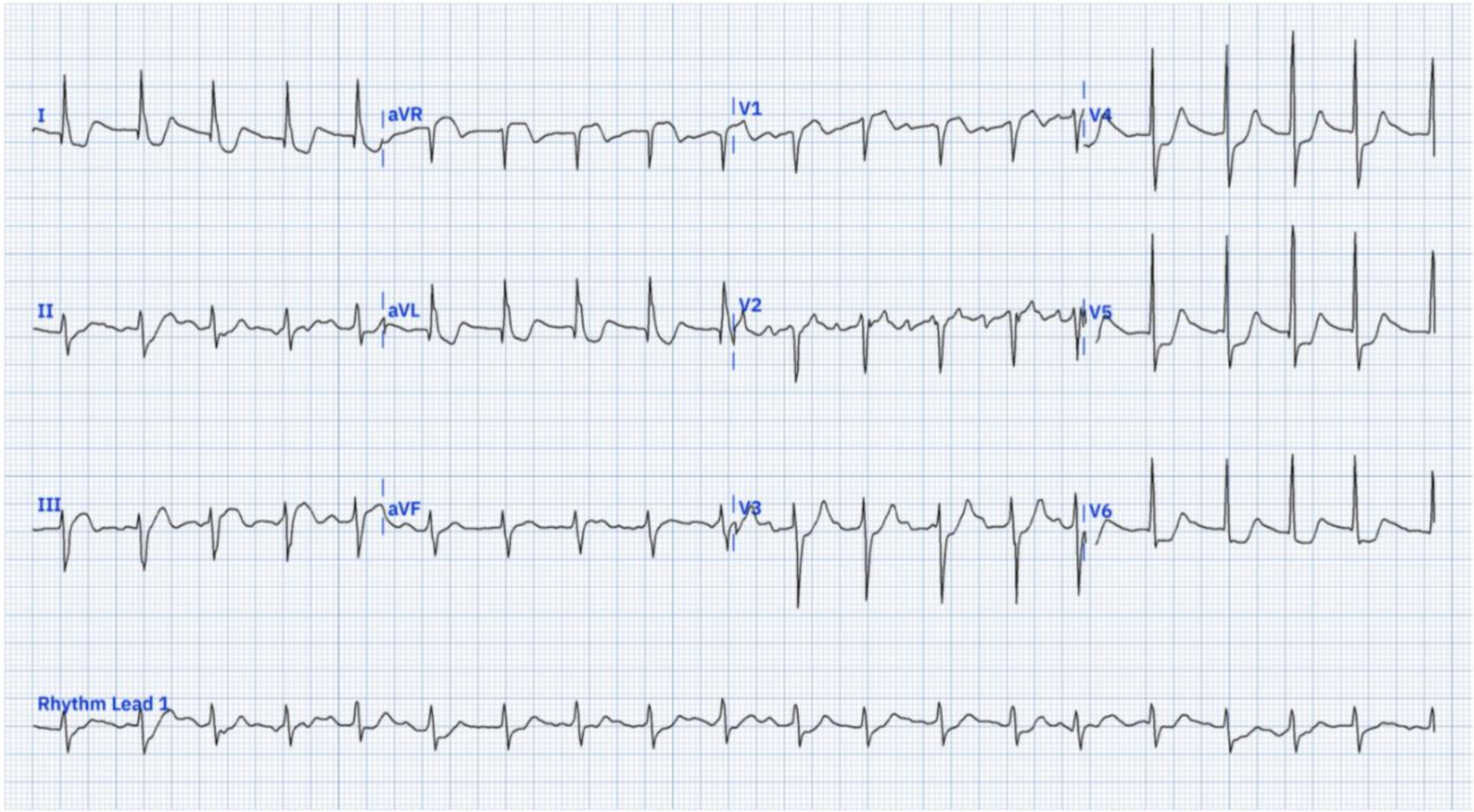
# EKG #9




69 y.o M with chest pain

# EKG #9

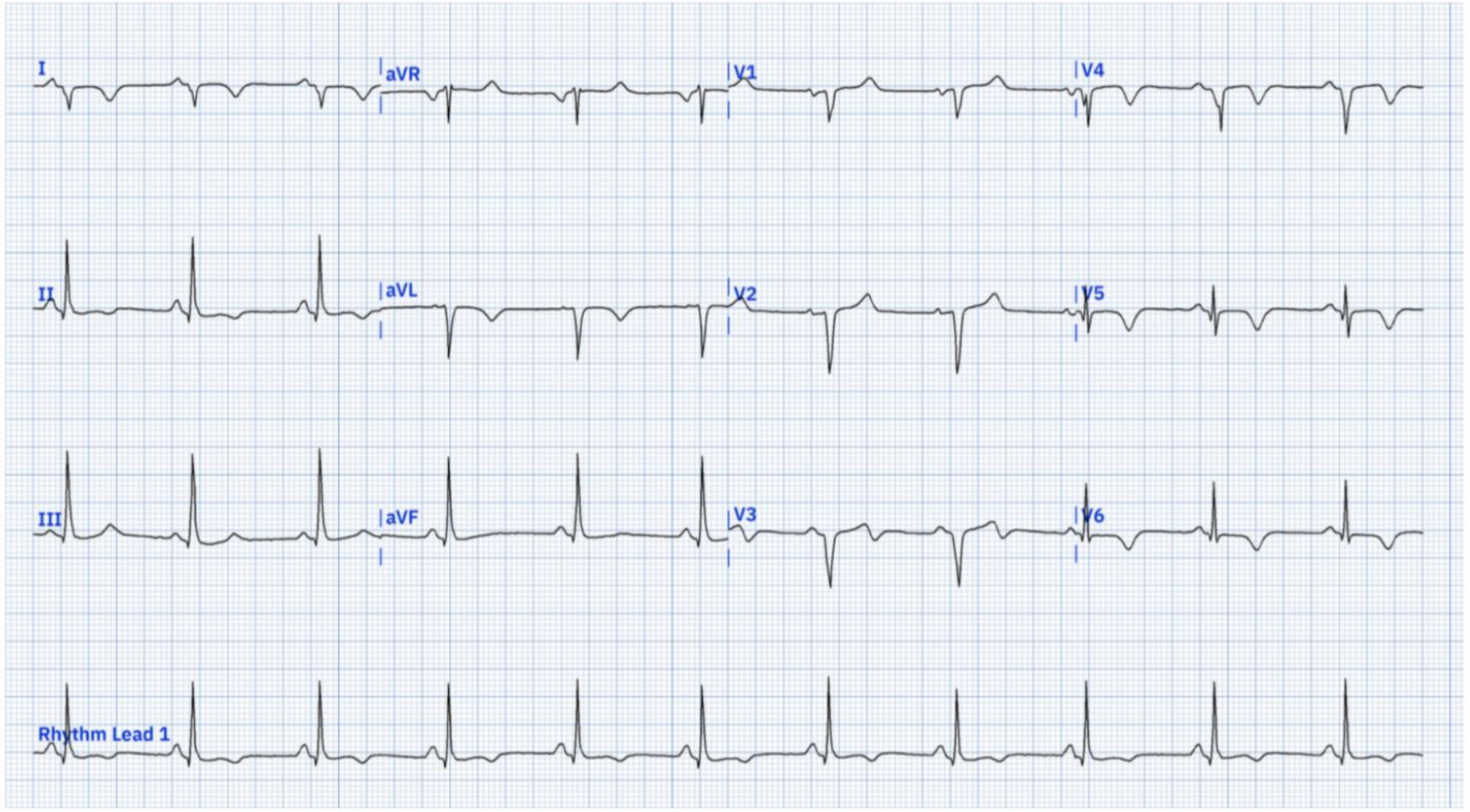
| Heart rate | Cardiac Axis | | | | |
|---|---|---|---|---|---|
| 115 bpm | Normal | PR Interval | 0 ms | RR Interval | 521 ms |
| | | QRS Duration | 92 ms | PP Interval | 0 ms |
| | | QT / QTcFra | 340 / 413 ms | | |




67 y.o M with L shoulder pain “when I work out”

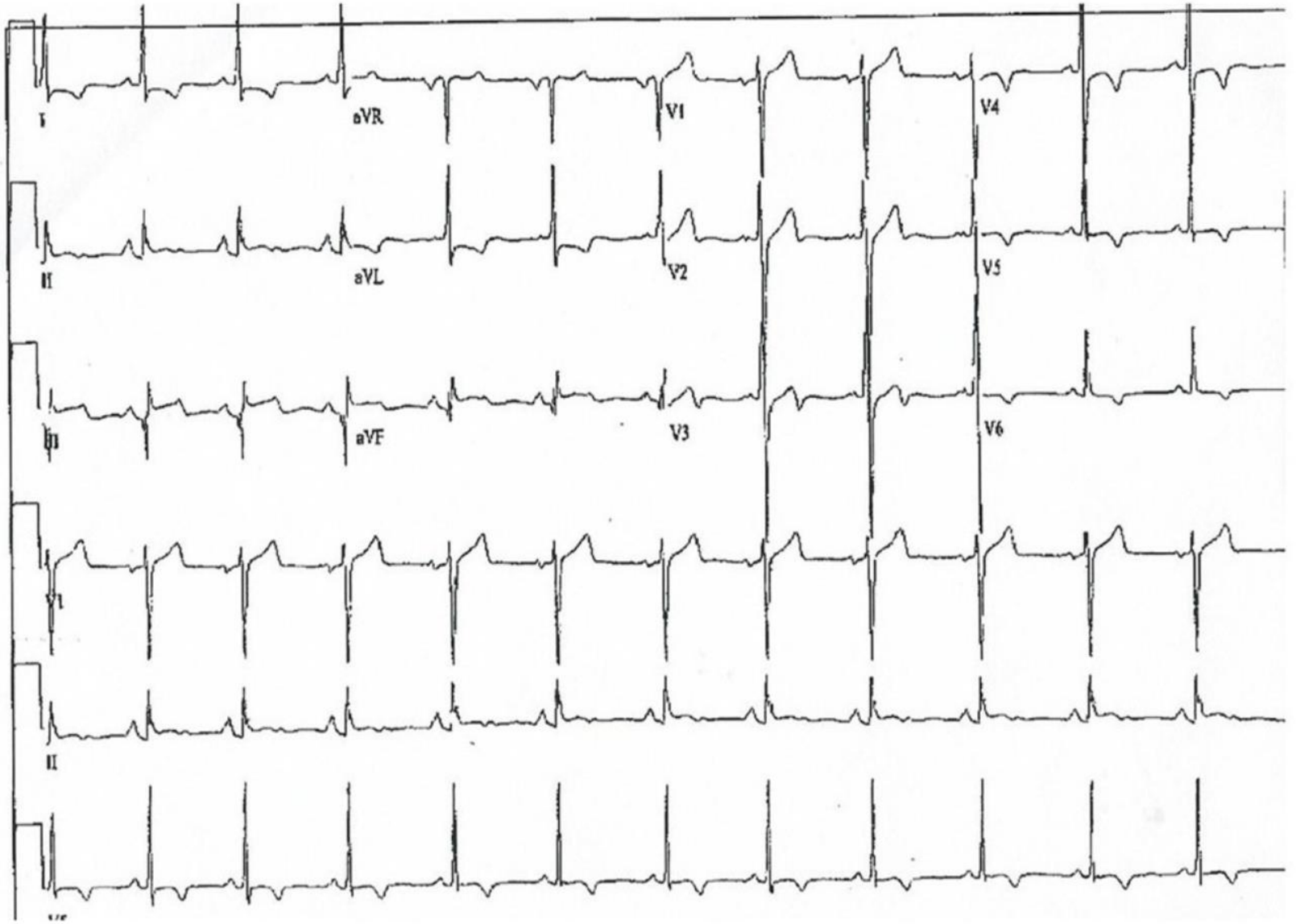
# EKG #10

| Heart rate | Cardiac Axis | | | | |
|---|---|---|---|---|---|
| 65 bpm | Right | PR Interval | 143 ms | RR Interval | 920 ms |
| | | QRS Duration | 95 ms | PP Interval | 920 ms |
| | | QT / QTcFra | 418 / 431 ms | | |



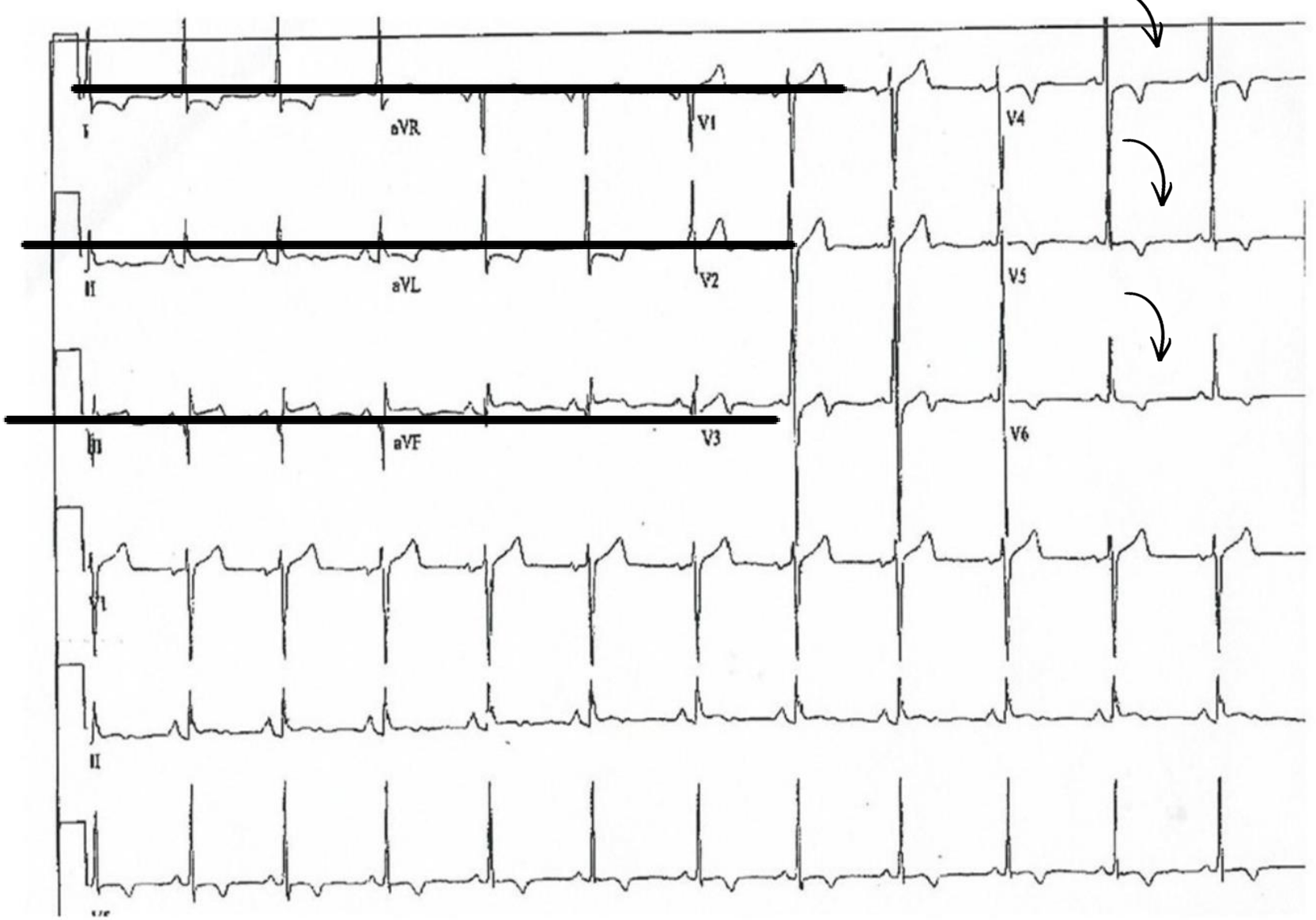

58 y.o M post cardiac arrest

# EKG #11




64 y.o F with chest pain and dyspnea

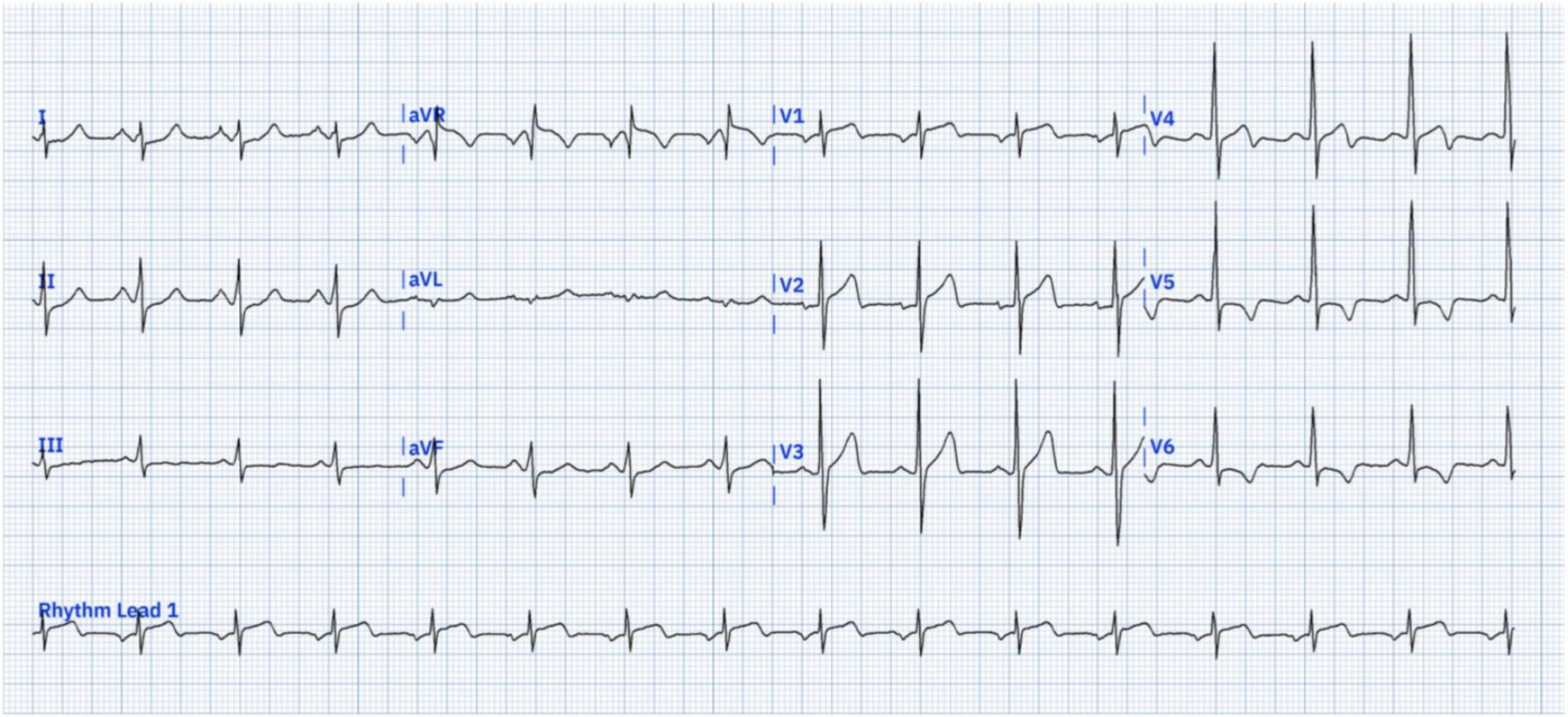
# EKG #12




64 y.o F with chest pain and dyspnea

# EKG #12

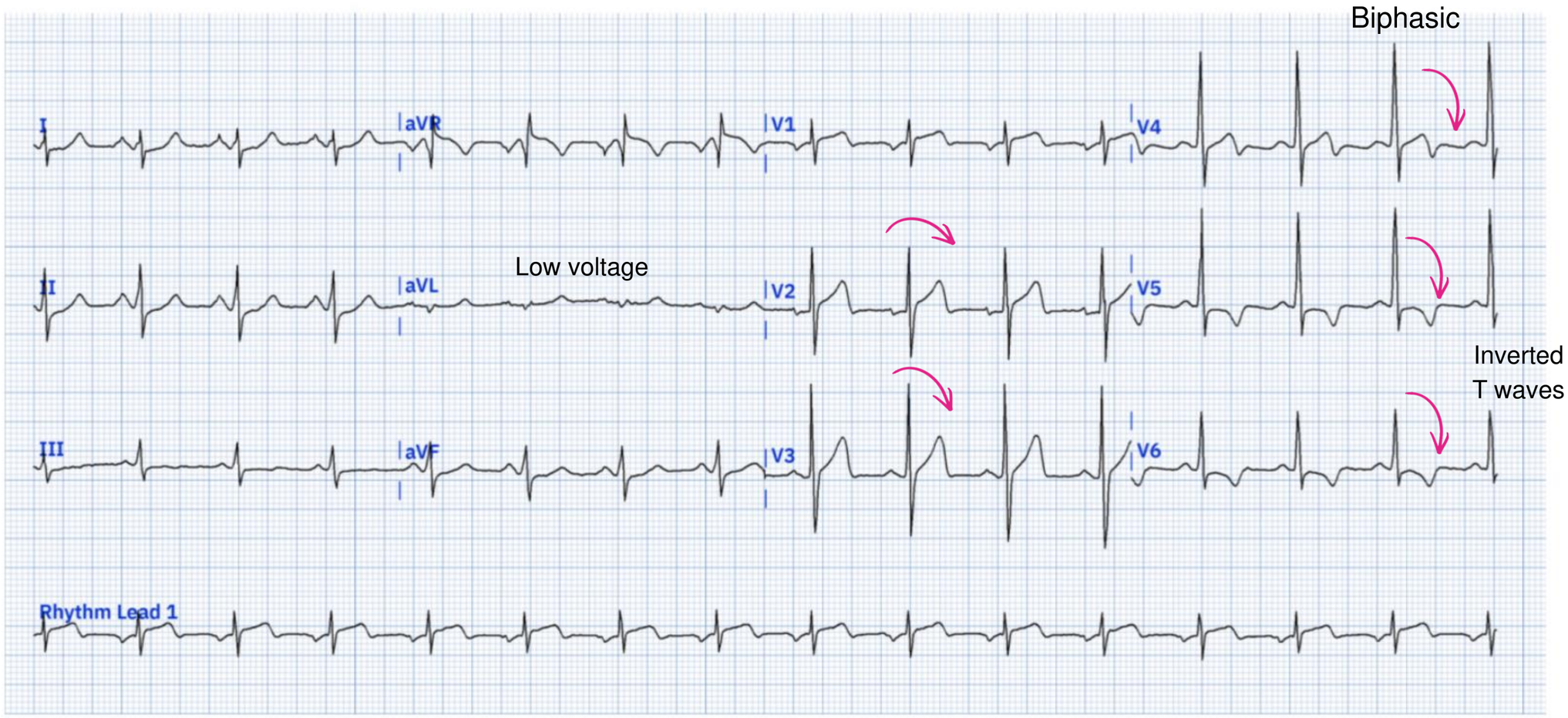
| | | |
|---|---|---|
| QRS : | 80 ms | Normal sinus rhythm |
| QT / QTcBaz : | 348 / 428 ms | Possible Left atrial enlargement |
| PR : | 144 ms | ST & T wave abnormality, consider lateral ischemia |
| P : | 122 ms | Abnormal ECG |
| RR / PP : | 658 / 659 ms | |
| P / QRS / T : | 47 / 89 / 32 degrees | |




66 y.o M chest pain for 3 days won’t go to the ER

# EKG #13

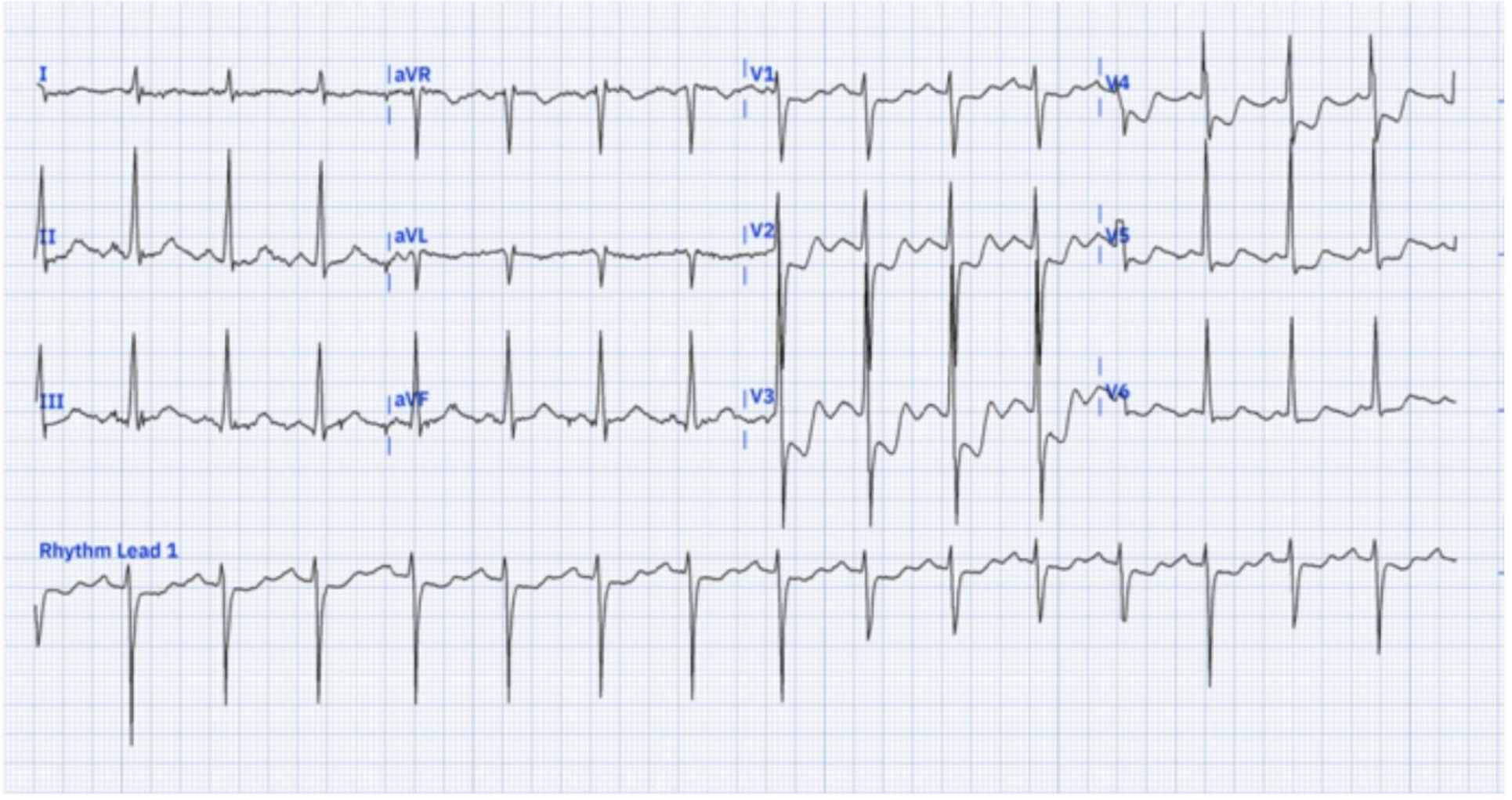
| | | |
|---|---|---|
| QRS : | 80 ms | Normal sinus rhythm |
| QT / QTcBaz : | 348 / 428 ms | Possible Left atrial enlargement |
| PR : | 144 ms | ST & T wave abnormality, consider lateral ischemia |
| P : | 122 ms | Abnormal ECG |
| RR / PP : | 658 / 659 ms | |
| P / QRS / T : | 47 / 89 / 32 degrees | |




66 y.o M chest pain for 3 days won't go to the ER

# EKG #13

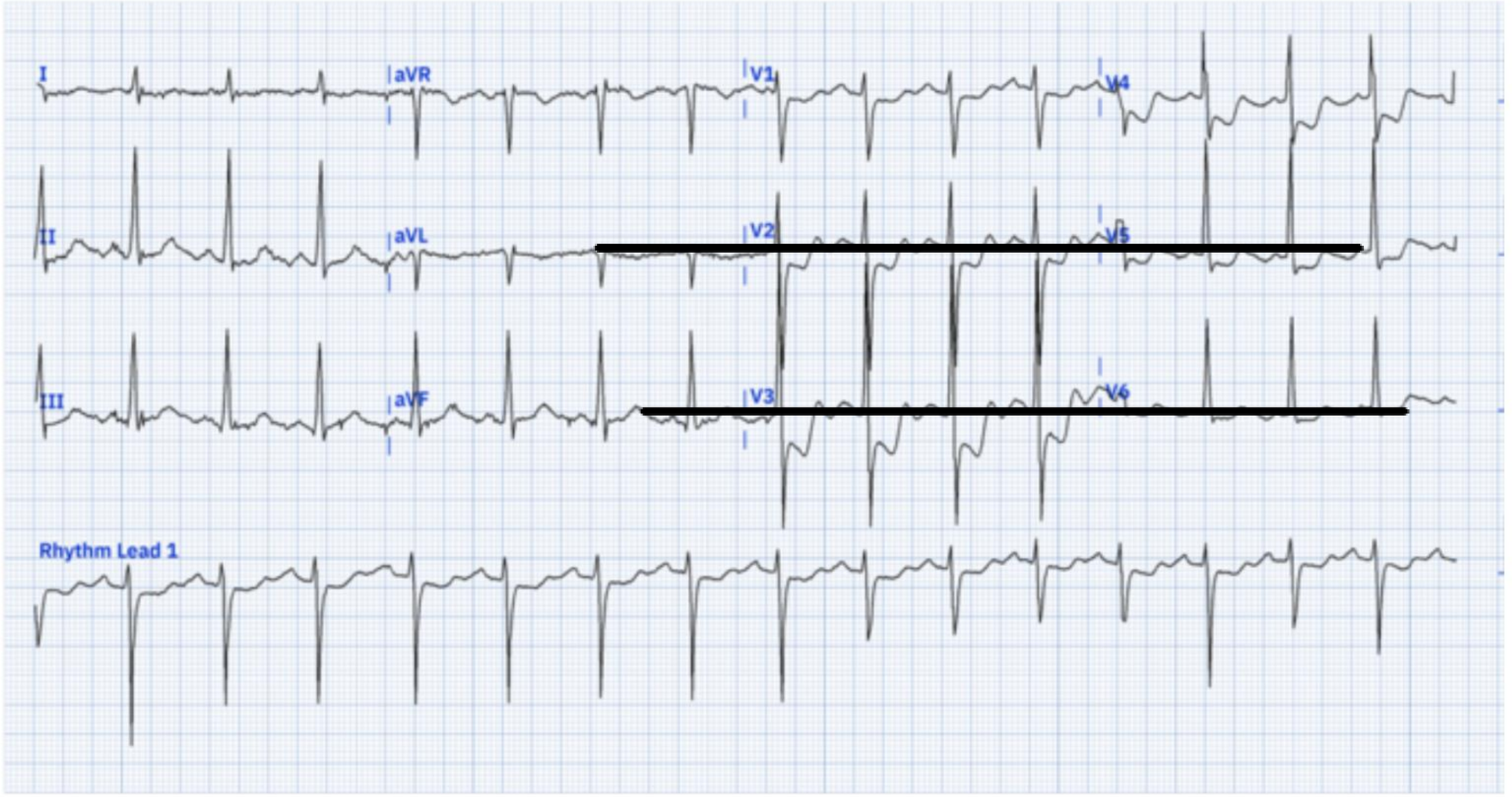
| Heart rate | Cardiac Axis | PR Interval | 163 ms | RR Interval | 604 ms |
|---|---|---|---|---|---|
| 99 bpm | Normal | QRS Duration | 108 ms | PP Interval | 604 ms |
| | | QT / QTcFra | 374 / 435 ms | | |




60 y.o Male with indigestion not better with tums

# EKG #14

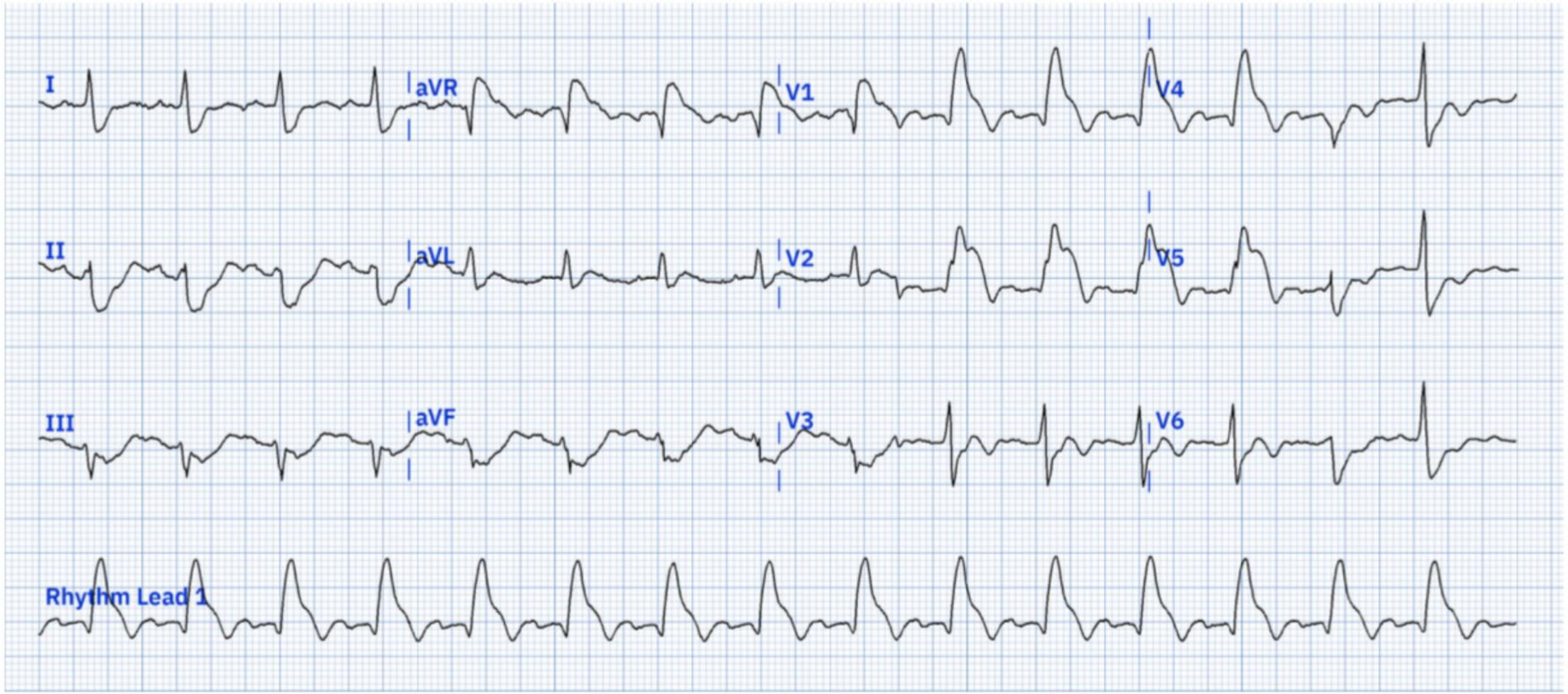
| Heart rate | Cardiac Axis | PR Interval | 163 ms | RR Interval | 604 ms |
|---|---|---|---|---|---|
| 99 bpm | Normal | QRS Duration | 108 ms | PP Interval | 604 ms |
| | | QT / QTcFra | 374 / 435 ms | | |




60 y.o Male with indigestion not better with tums

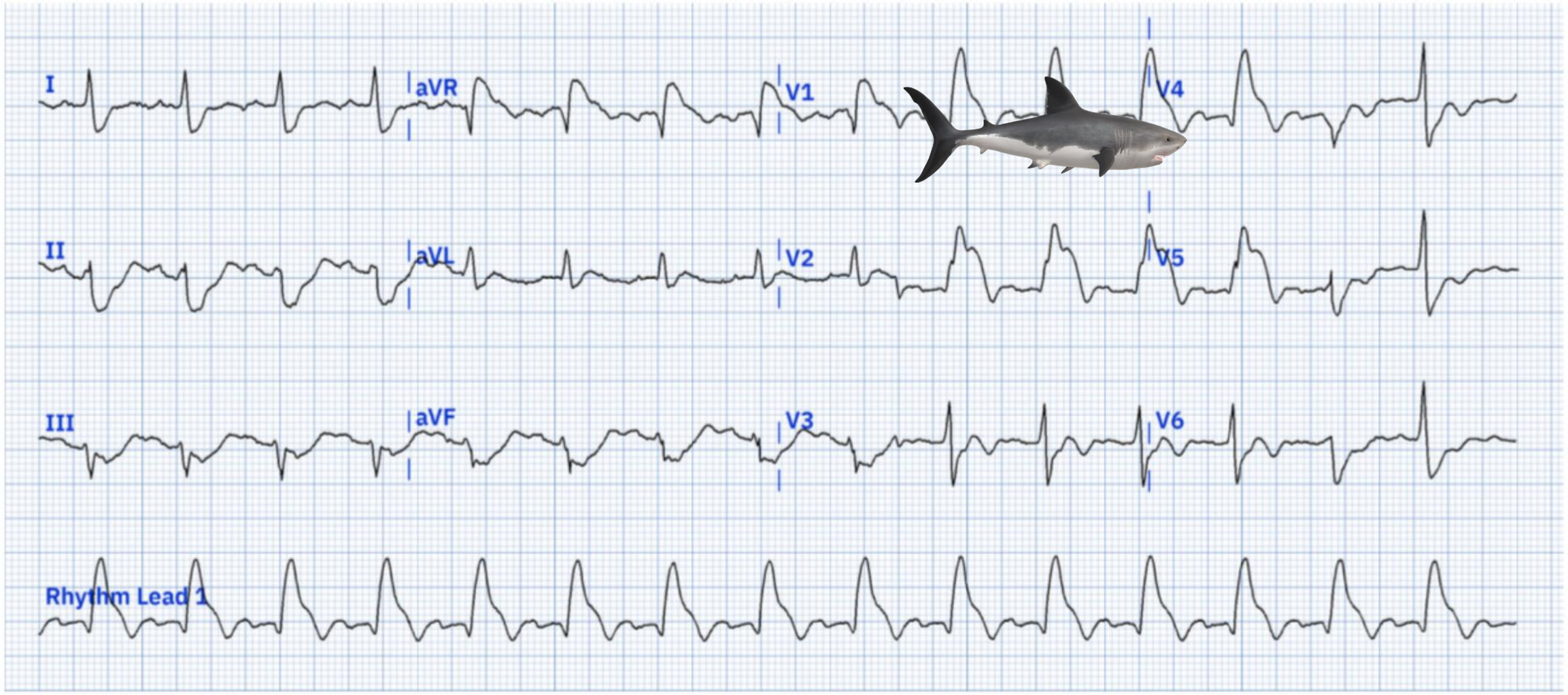
# EKG #14

Posterior STEMI




72 y.o M with chest pain that radiates to the left arm

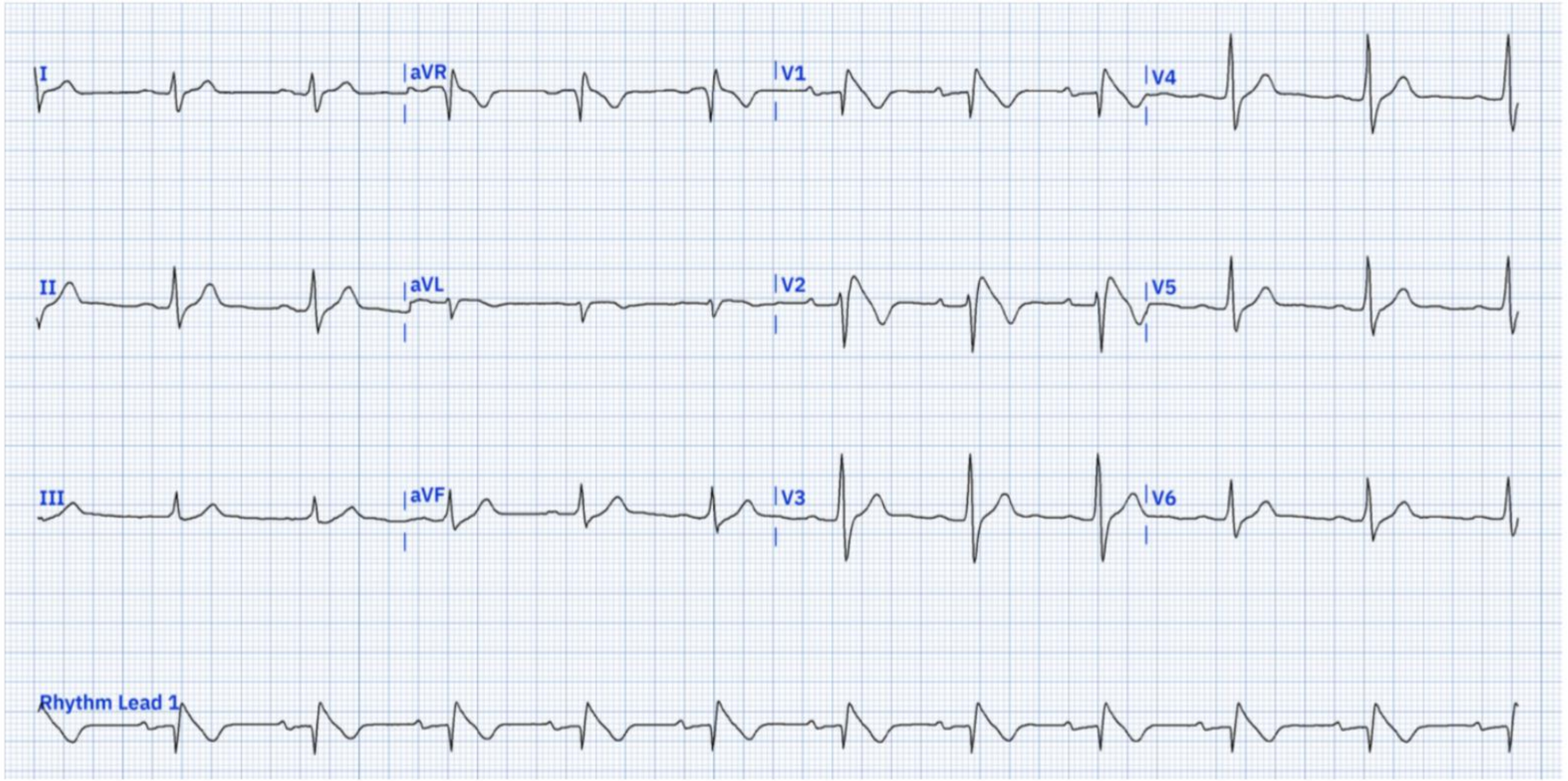
# EKG #15




72 y.o M with chest pain that radiates to the left arm

# EKG #15

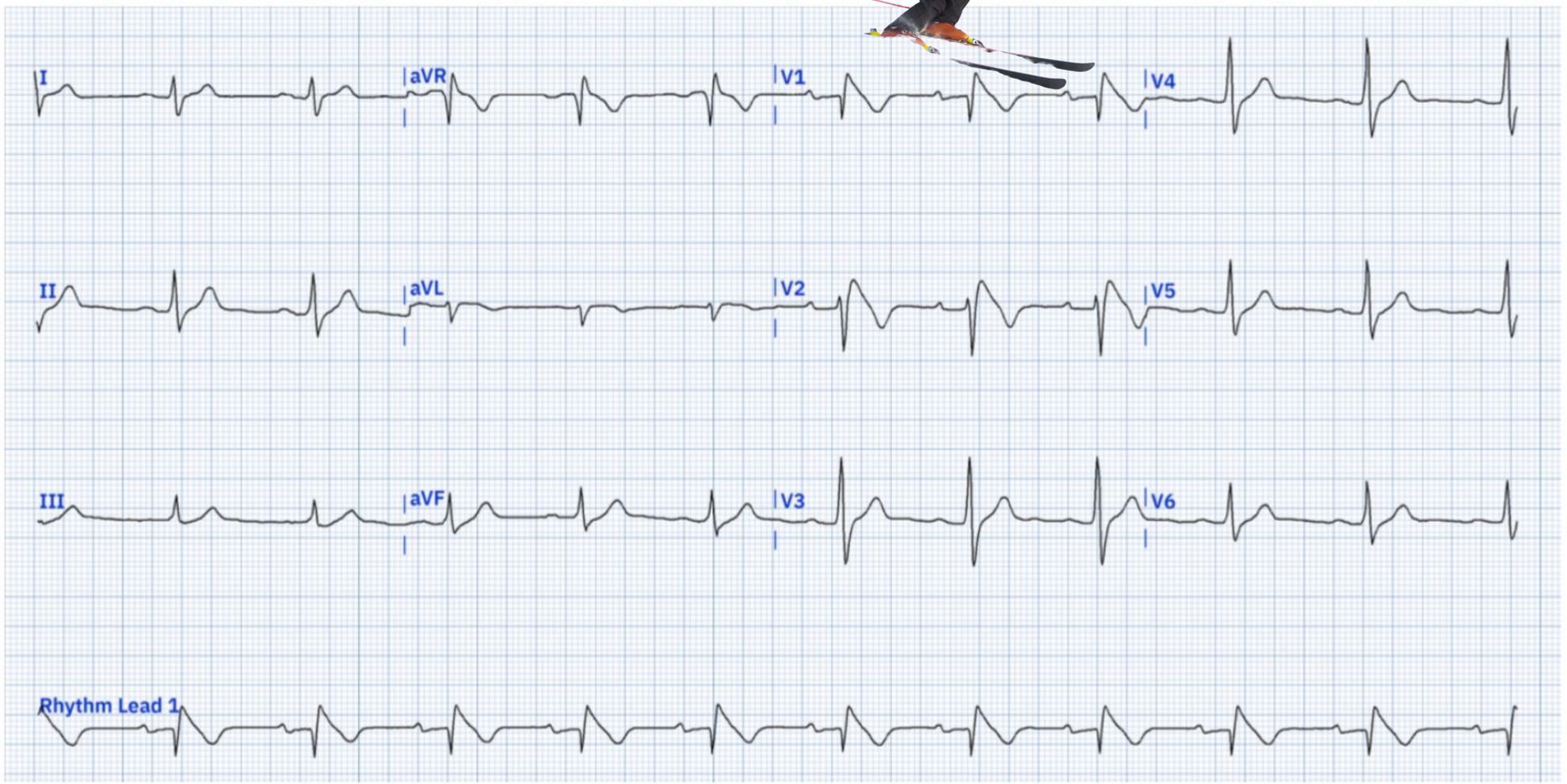
| Heart rate | Cardiac Axis | | | | |
|---|---|---|---|---|---|
| 67 bpm | Normal | PR Interval | 200 ms | RR Interval | 890 ms |
| | | QRS Duration | 123 ms | PP Interval | 890 ms |
| | | QT / QTcFra | 386 / 403 ms | | |




22 y.o M with syncope

# EKG #16

| Heart rate | Cardiac Axis | | | | |
|---|---|---|---|---|---|
| 67 bpm | Normal | PR Interval | 200 ms | RR Interval | ms |
| | | QRS Duration | 123 ms | PP Interval | ms |
| | | QT / QTcFra | 386 / 403 ms | | |




22 y.o M with syncope

# EKG #16

Brugadas