EKG Morphology Lecture

1. Rate
2. Wide or Narrow Rhythm?

Reg

P-QRS relationship?
PR interval constant?
P waves upright II/III/F?

Irreg-Irreg

P- waves seen?
Are P waves same or different?

Patterned

What is the pattern?
Eval P waves & QRS
What is the origin or the pattern?

What is the underlying rhythm and what interupts?

3. Morphology

Axis
Pwave / PR
QRS (tall? / wide?)
ST- T – Q waves (Inf, Ant, Lat)

AXIS

- **NL= -30 to 105**

RULES

- **+I / +F normal**

- **+I / -F to the left**

- **Neg in II to be true LAD**

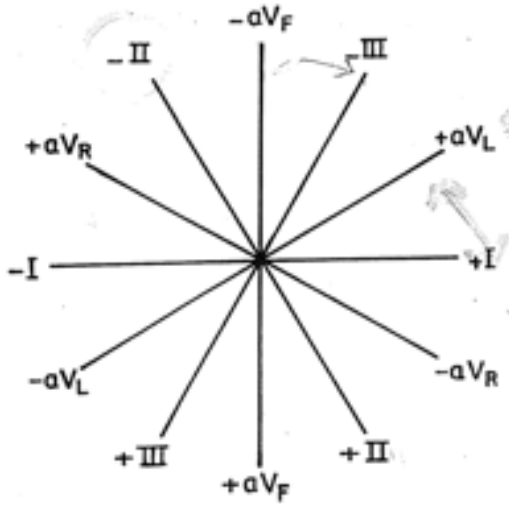
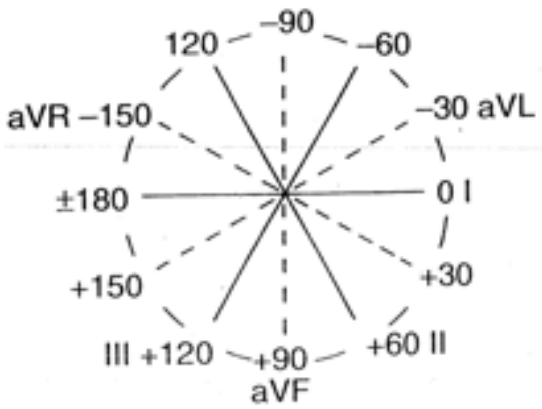
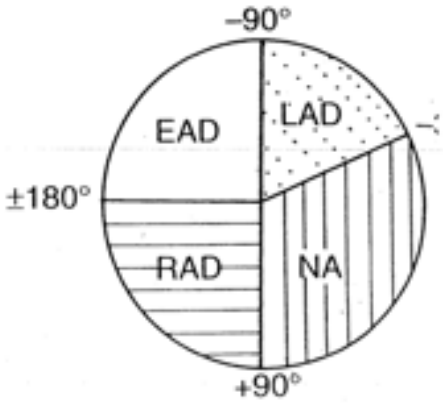


Fig. 1-3. (A) Einthoven's equilateral triangle formed by leads I, II, and III. (B) The unipolar limb leads are added to the equilateral triangle. (C) The hexaxial reference system derived from B.

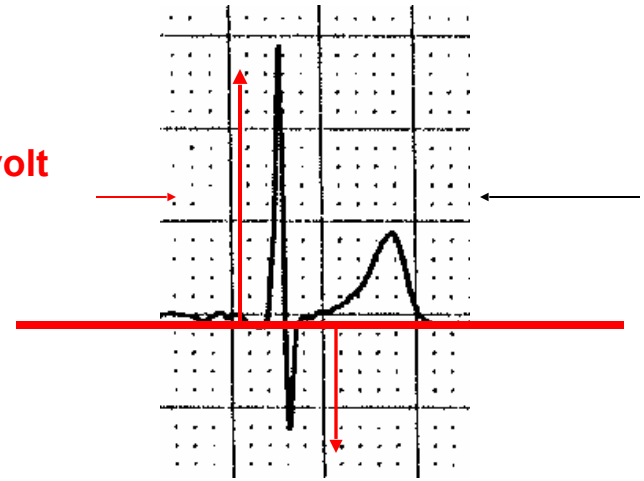




AXIS

-NL= -30 to 105

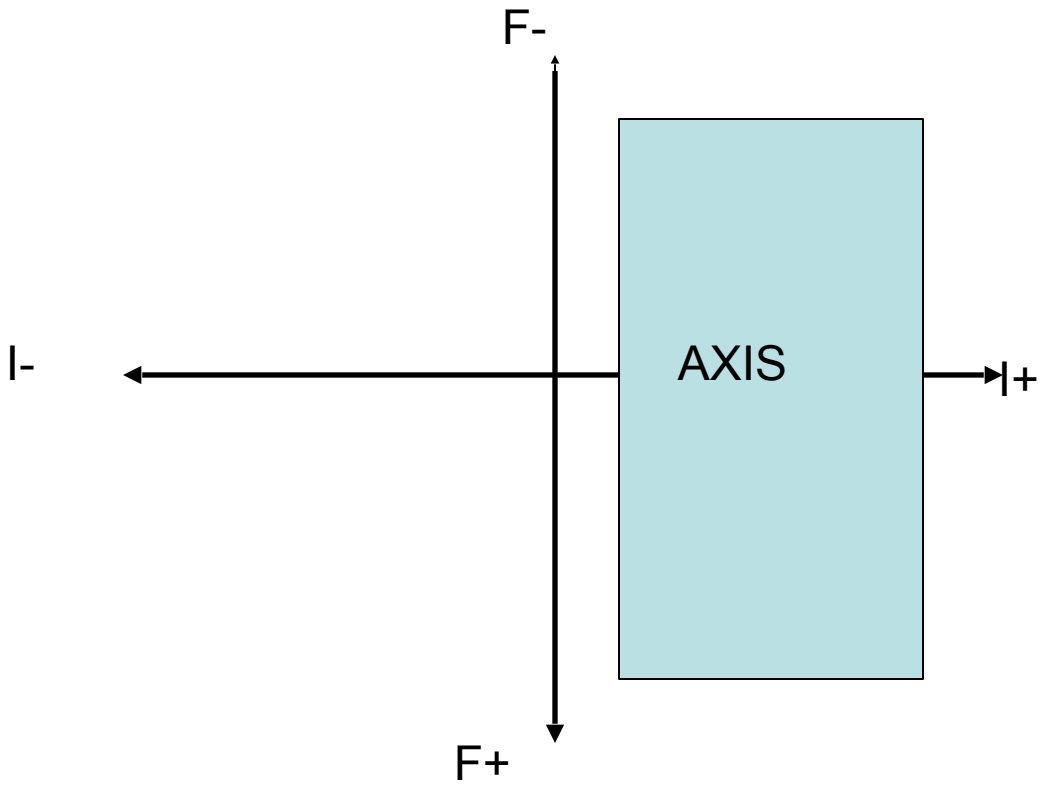
-Assess if the QRS is positive in lead I



More volt above

Positive = more voltage above the isoelectric baseline then below

LEAD I

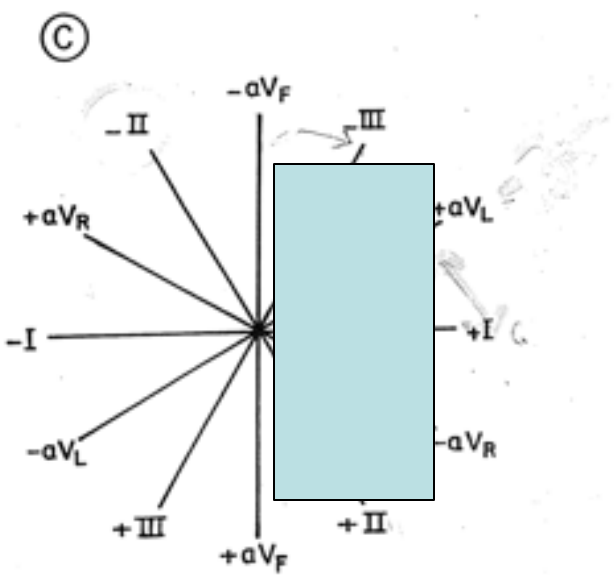


AXIS

- NL= -30 to 105

- Assess if the QRS is positive in lead I

- Assess if the QRS is positive in lead F



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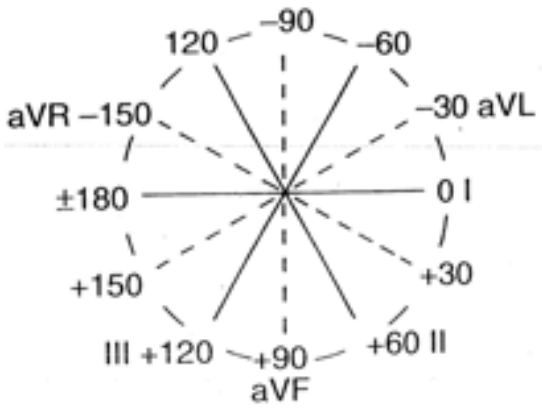

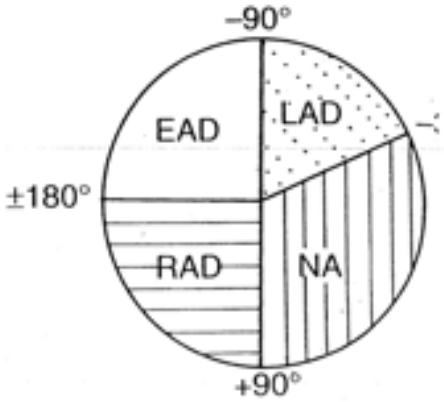

AXIS

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- Assess if the QRS is positive in lead I

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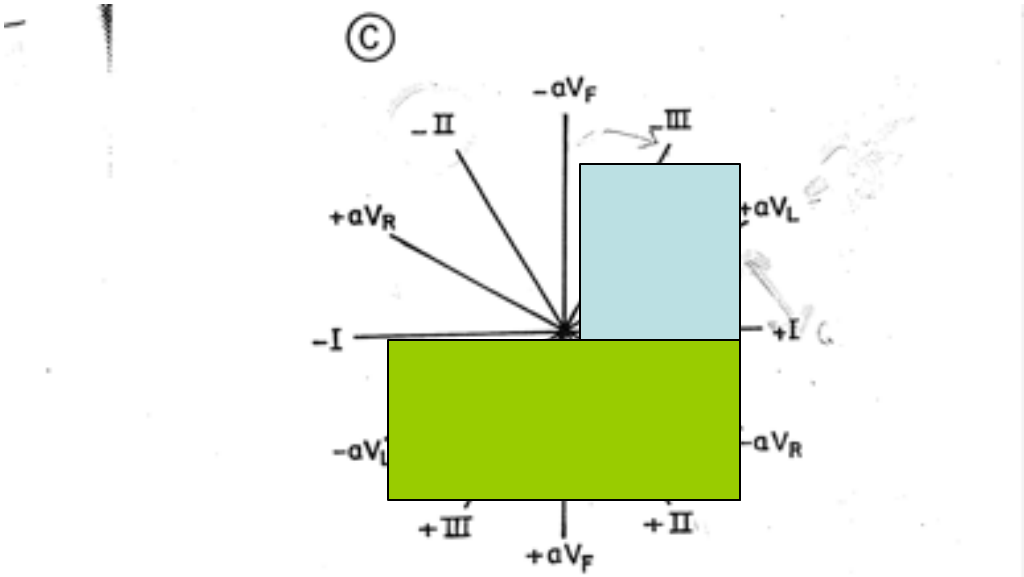

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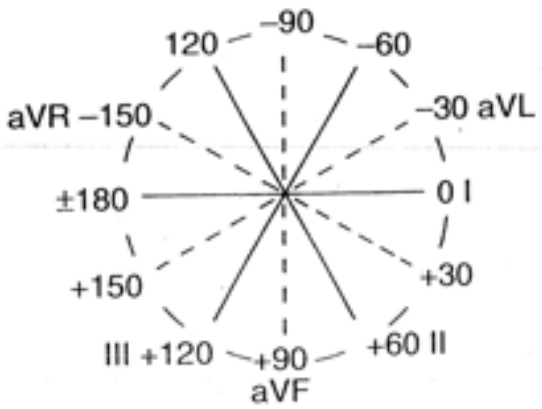
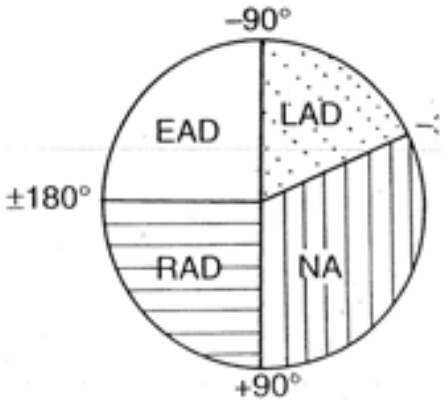




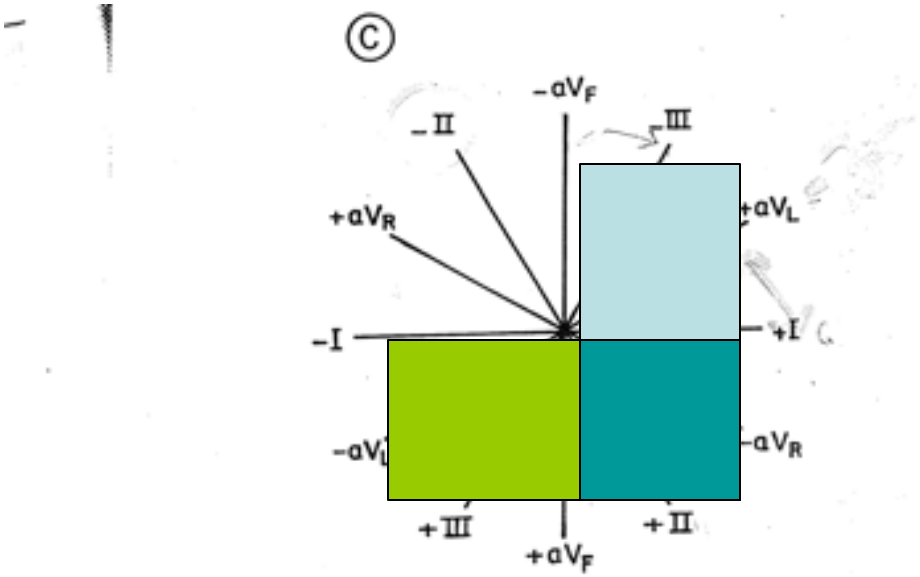
AXIS

- NL= -30 to 105

- Assess if the QRS is positive in lead I

- Assess if the QRS is positive in lead F

-If +I and +F then axis is normal



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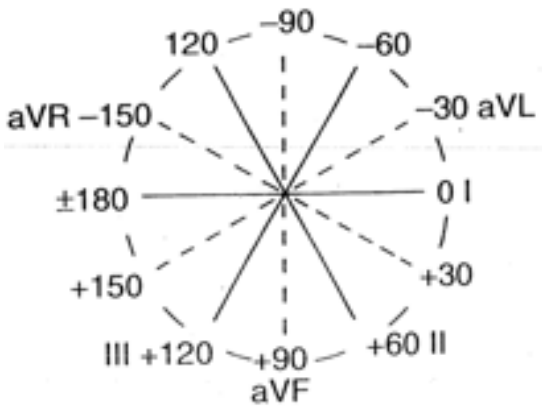
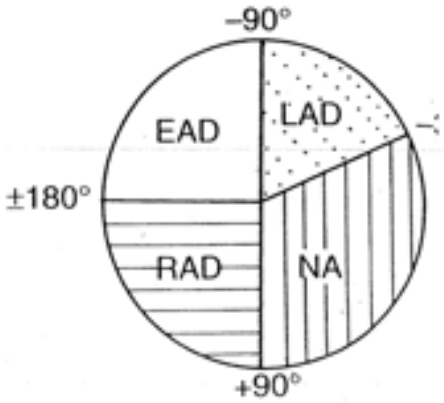




AXIS

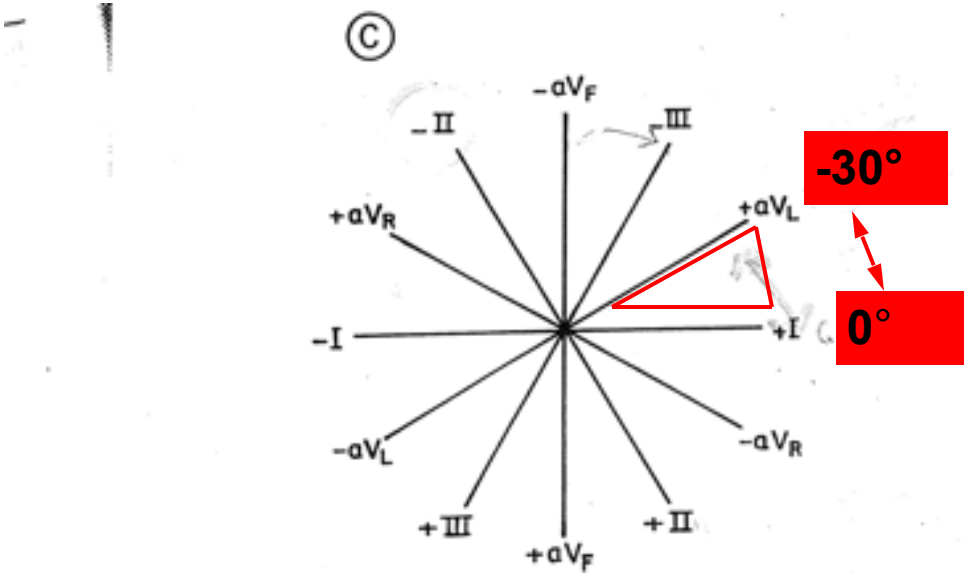
- **NL= -30 to 105**

- **+I / +F normal**

- **+I / -F the axis is leaning to the left**

-Problem:

You can still have a normal axis from 0° to minus 30°



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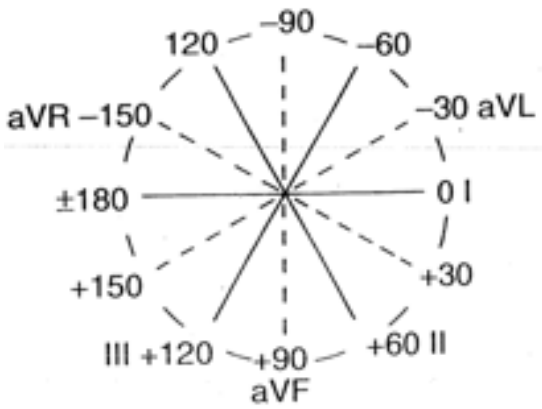
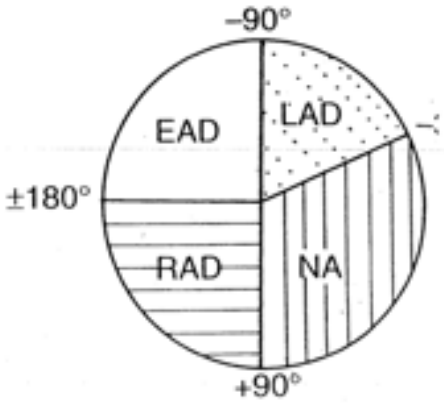




AXIS

- **NL= -30 to 105**

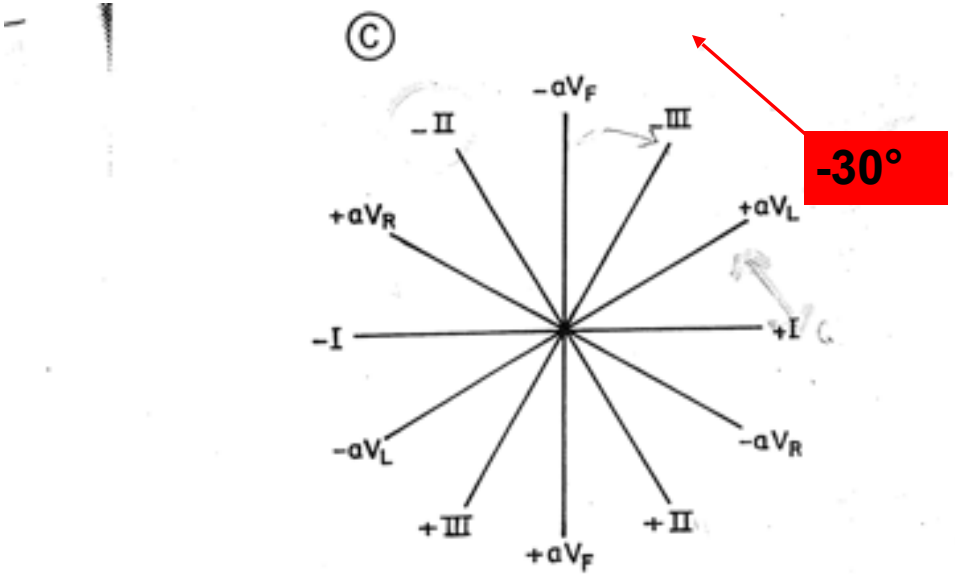
- **+I / +F normal**

- **+I / -F to the left**

  -You can still have a normal axis from 0° to 30°

- **Neg in II for <u>true</u> LAD**

  -Meaning axis is past minus 30°



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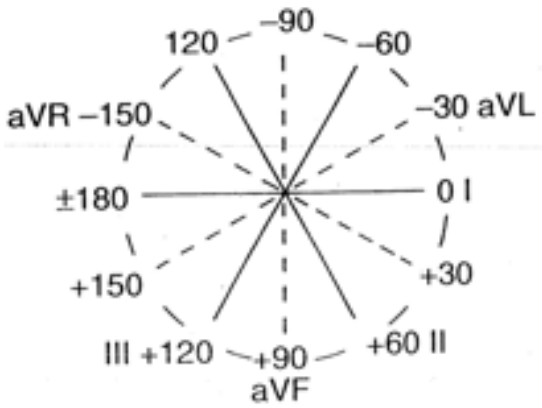
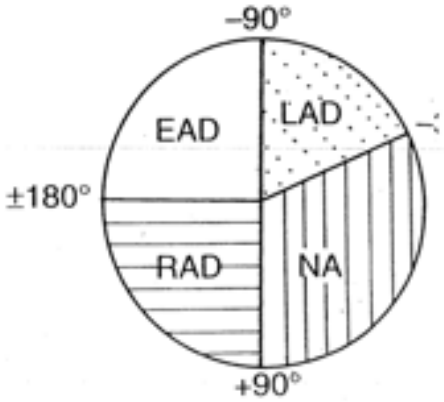




[redacted] ID: 30531482376 6-Jan-1998 16:22:48 55 MIDOS 62

46years
Female Caucasian
62in 144lbs

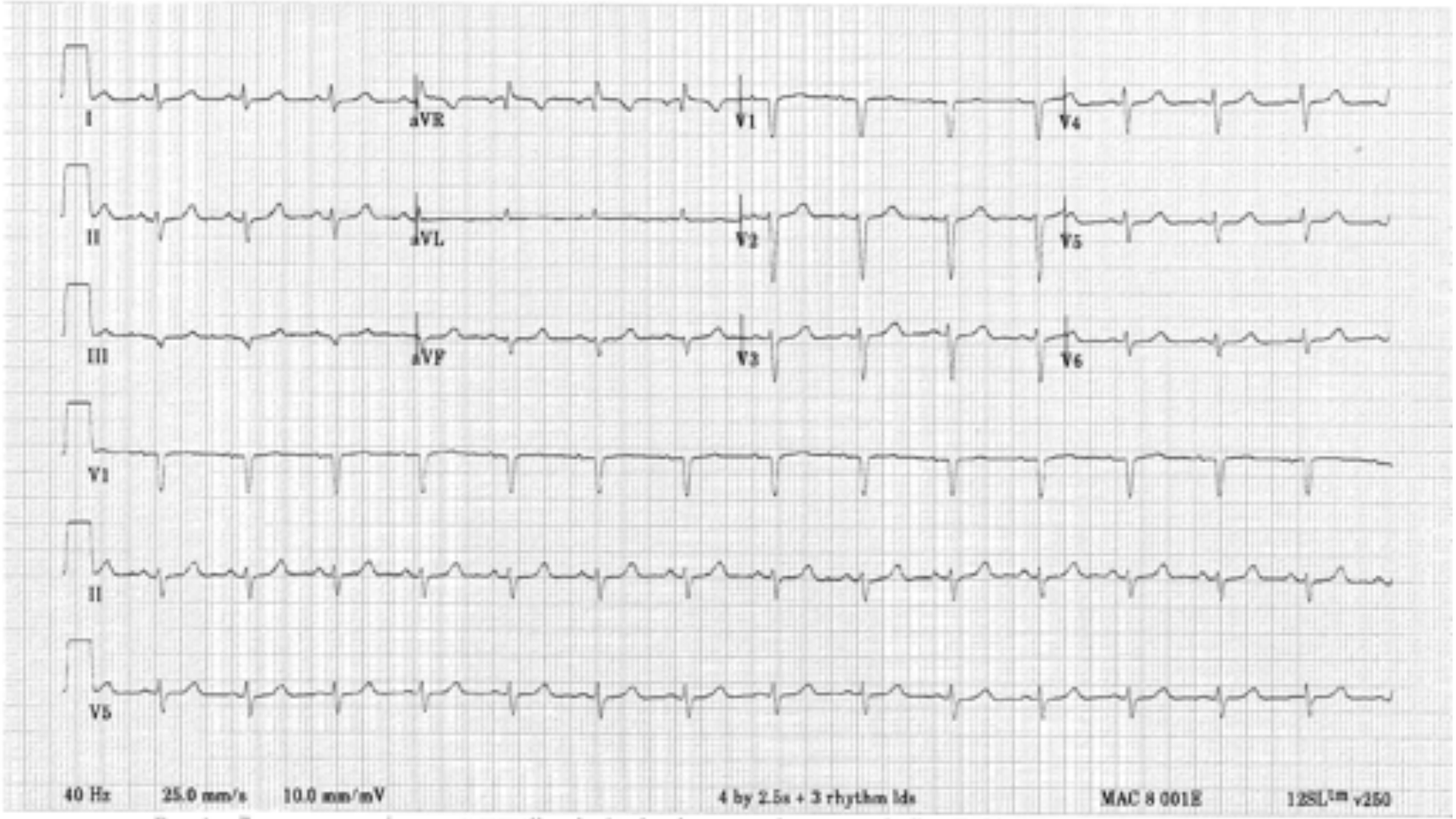
Vent. rate 88 bpm
PR interval 132 ms
QRS duration 82 ms
QT/QTc 346/419 ms
P-R-T axes 42 -76 57

[redacted]

Technician: SB

Referred by: Dr. Reinhert

Unconfirmed



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ID: 3053

46years
Female Caucasian
62in 144lbs

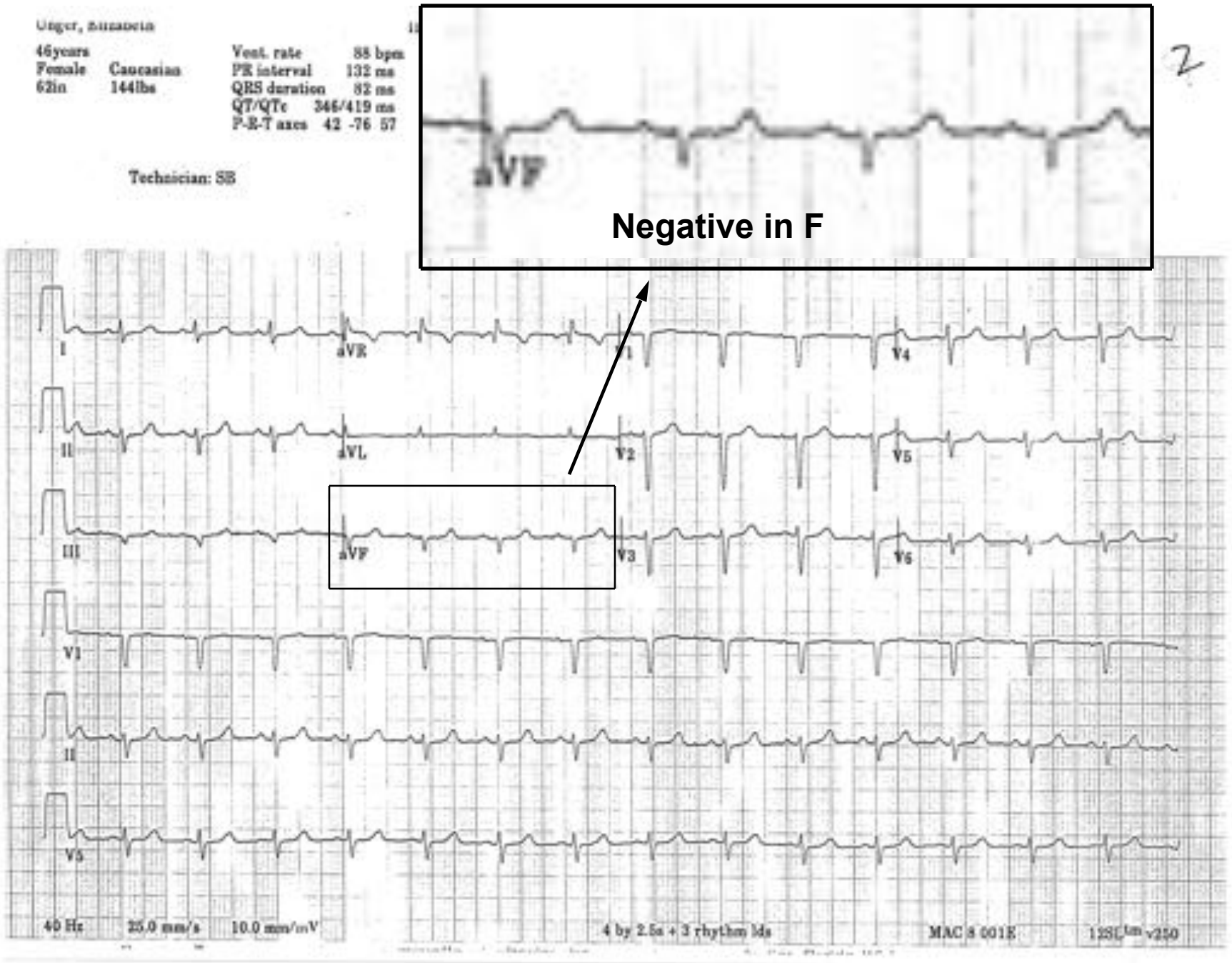
Vent. rate 88 bpm
PR interval 132 ms
QRS duration 82 ms
QT/QTc 346/419 ms
P-R-T axes 42 -76 57

Technician: SB

2

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

40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 3 rhythm lds MAC 8 001E 12SL tm v250


Unger, Elizabeth
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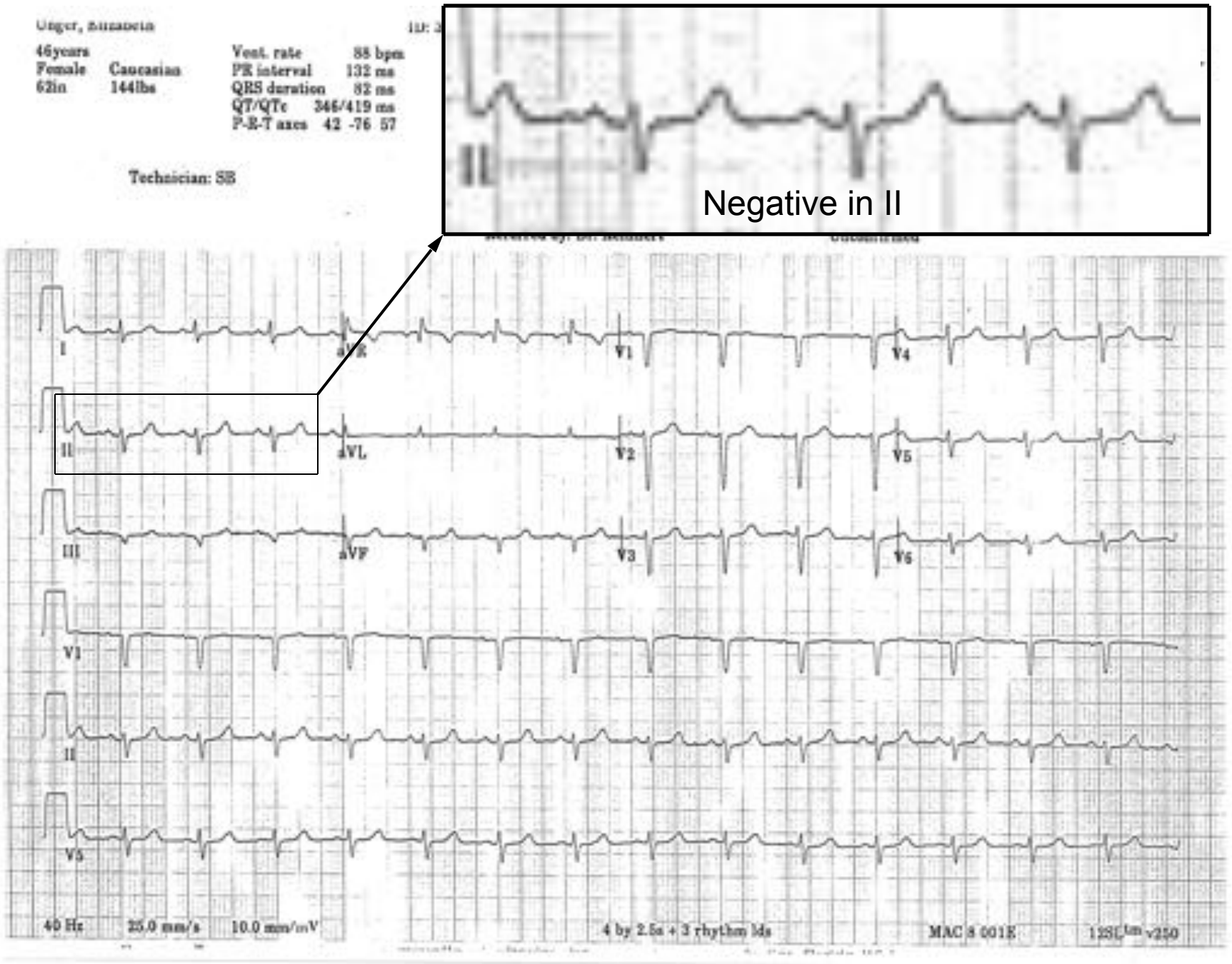
aVF
Negative in F
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
40 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 3 rhythm lds
MAC 5 001E
125Hz v250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Technician: SB
II
Negative in II
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
40 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 3 rhythm lds
MAC 5 001E
12SL Im v250

SO THIS IS TRUE LEFT ACCESS DEVIATION

RHYME for LAD:

Positive in I and Negative if F, axis is to the left

Negative in lead II to be true LAD

P-wave Morphology

RULES

-LAE

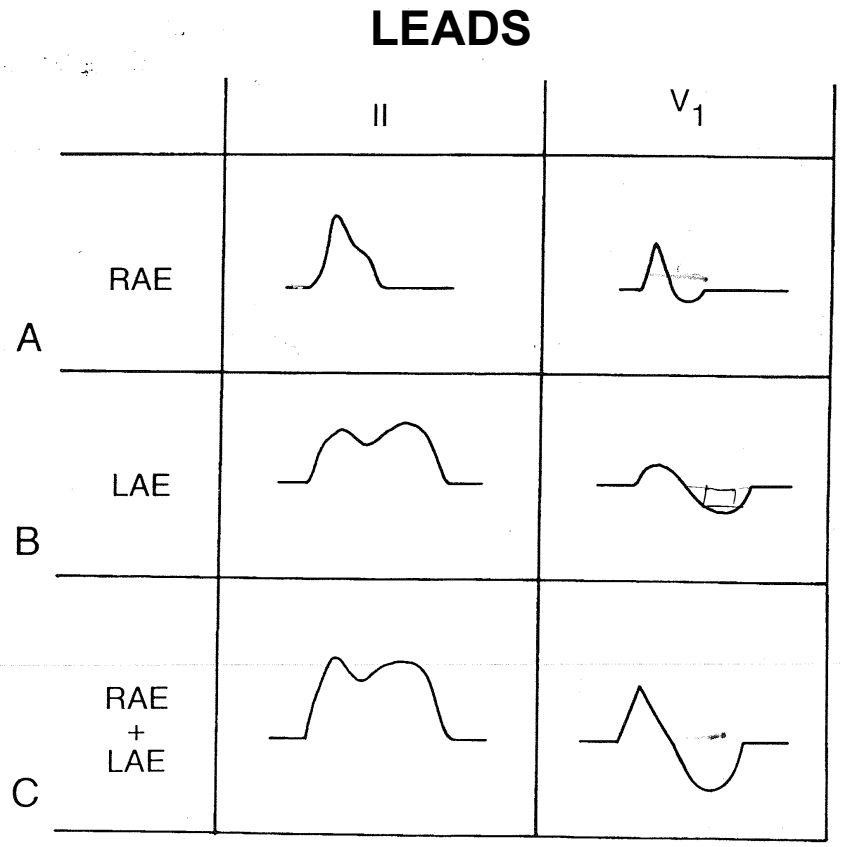
Lead II- wide p wave 2½ blocks wide

V1- deep inversion at end of the p-wave / "terminal negativity

-RAE

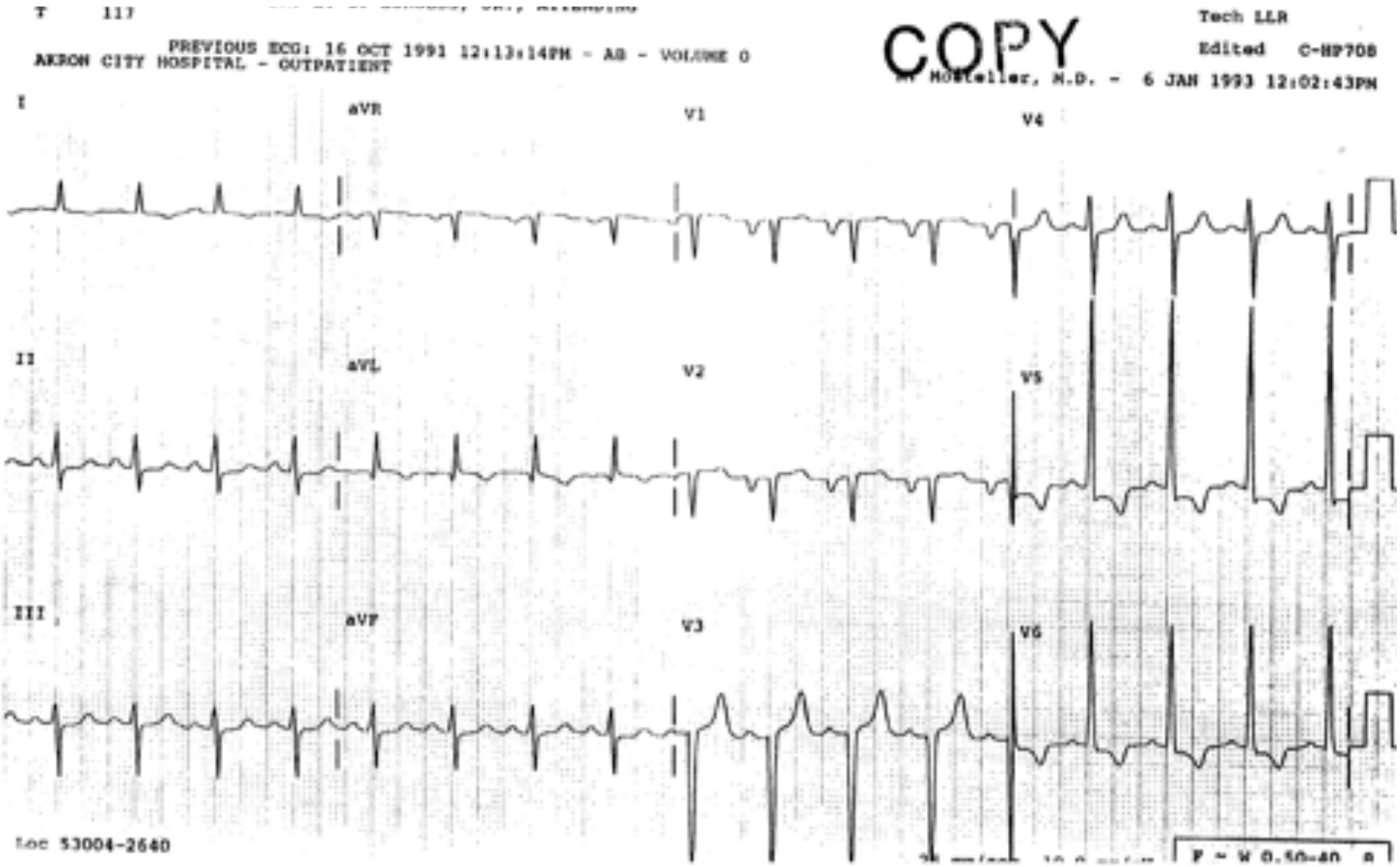
Lead II- tall p wave 2½ blocks tall

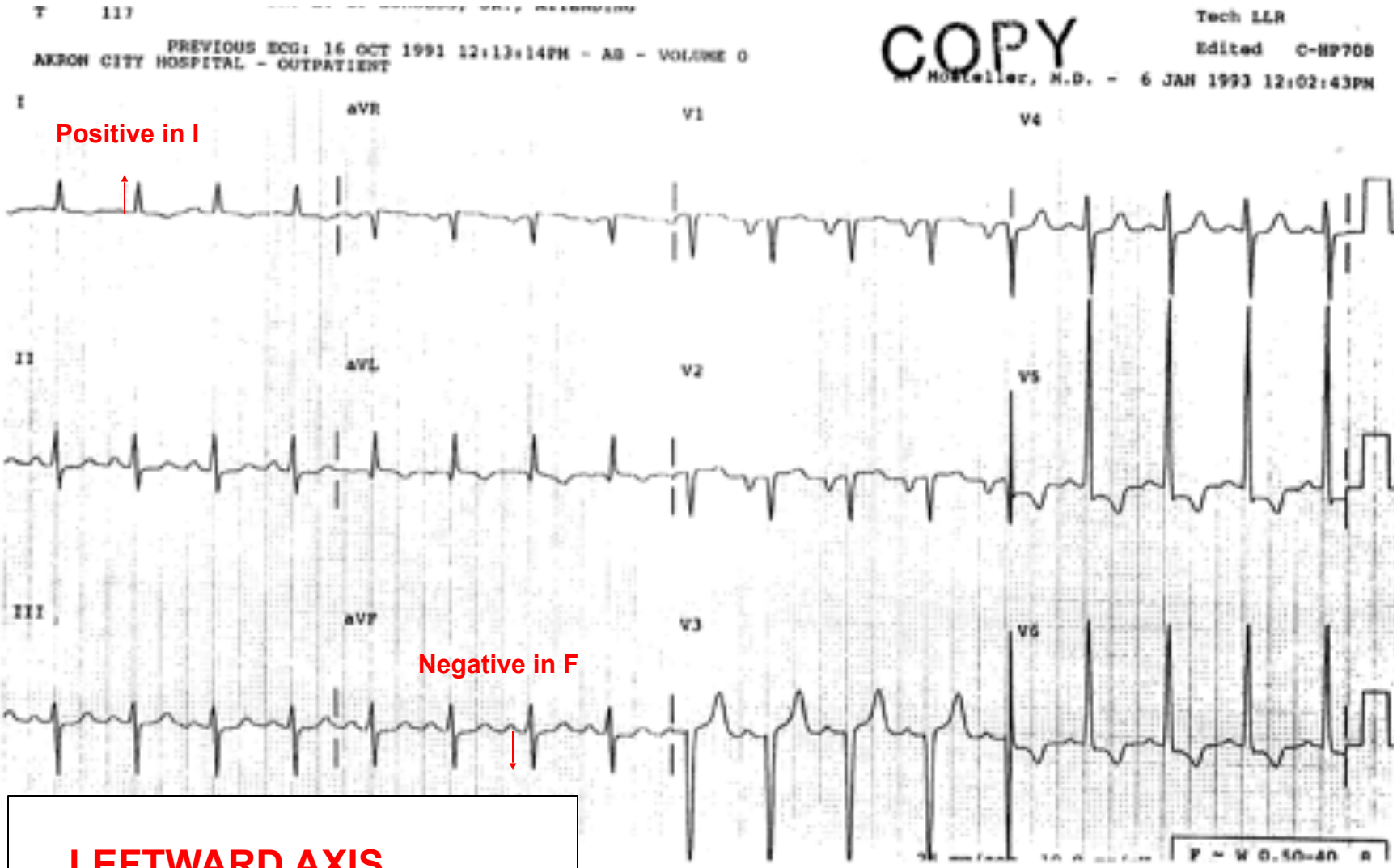
V1- peaked intial portion of p wave



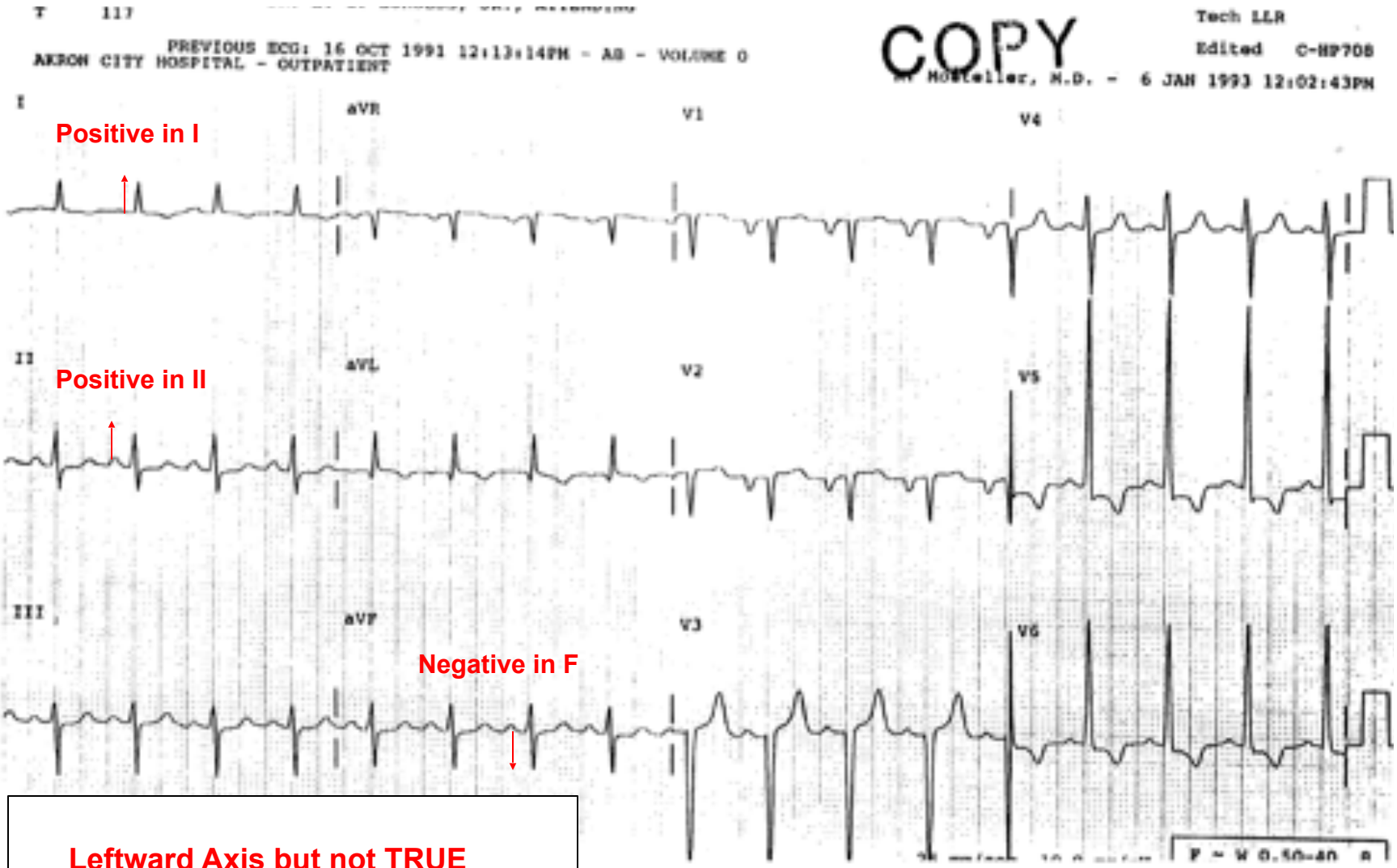
gure 4.1. The changes in P wave morphology, typical of atrial enlargement as they appear leads II and V1. **A.** Right atrial enlargement *(RAE)*. **B.** Left atrial enlargement *(LAE)*. **C.** atrial enlargement *(RAE + LAE)*.

INTERPRET EKG



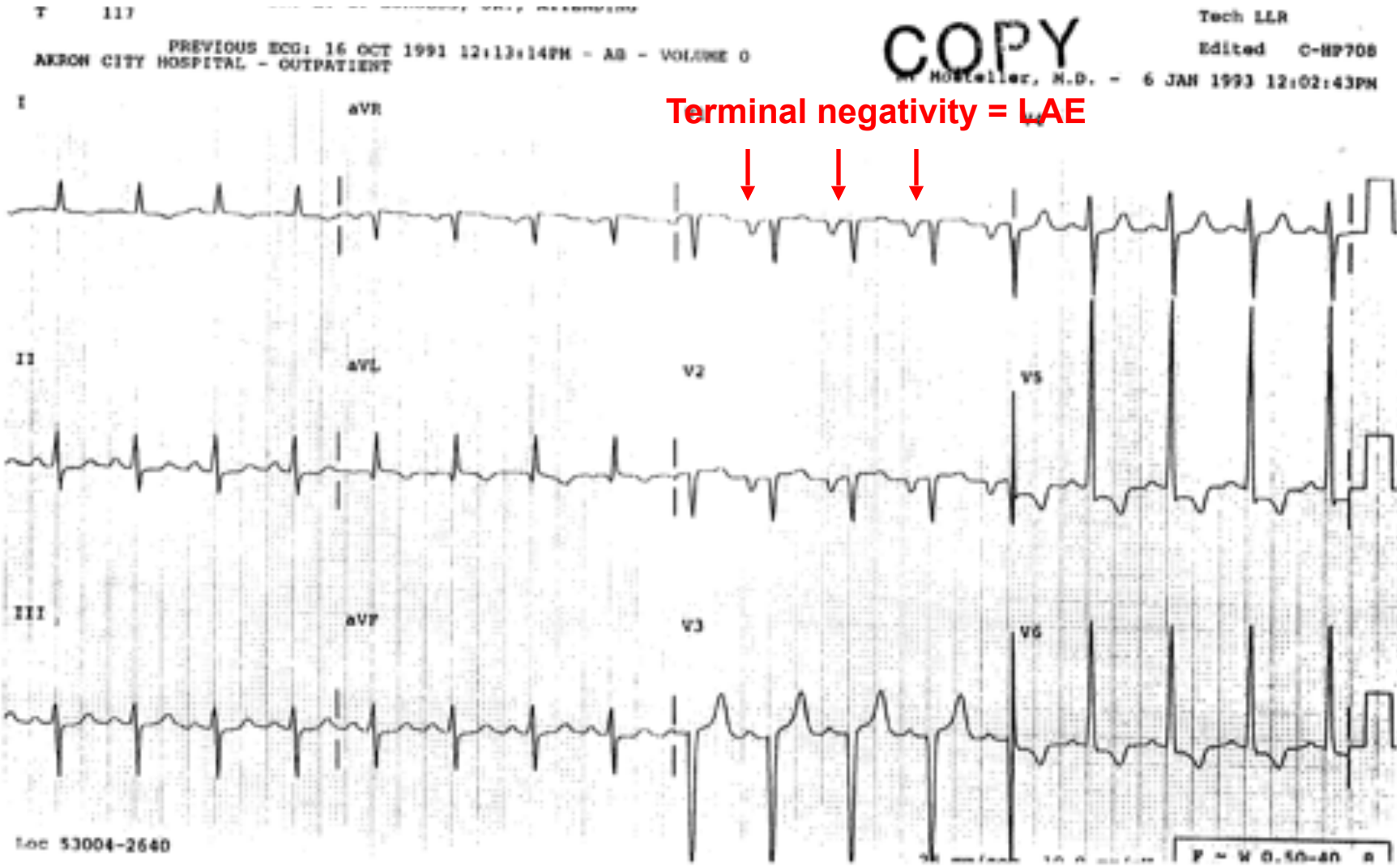


LEFTWARD AXIS



Leftward Axis but not TRUE
LAD / Not beyond -30°

NSR, left ward axis / LAE



1. Rate
2. Rhythm

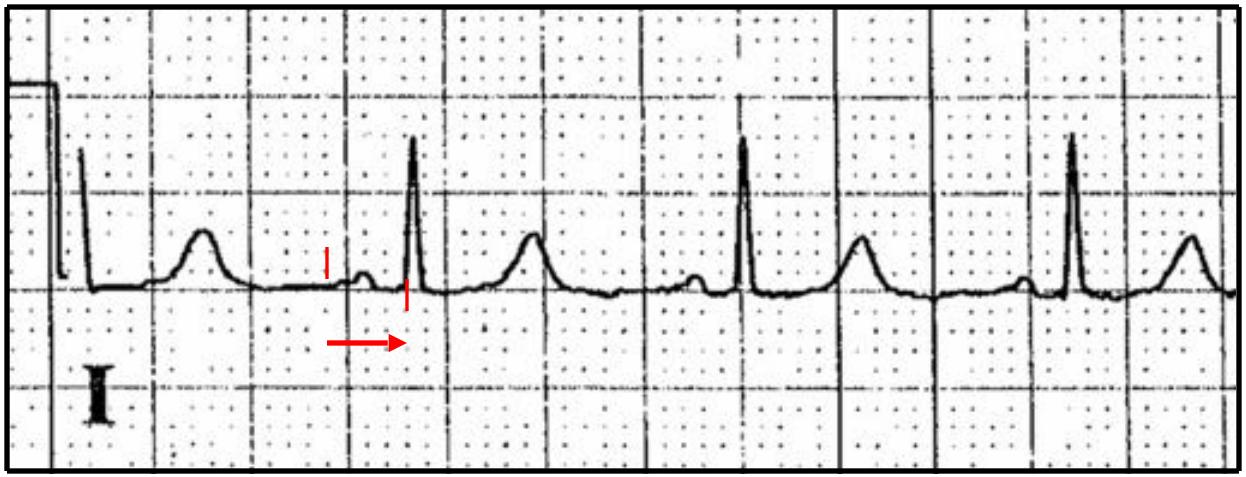
   Reg Irreg-Irreg Patterned

3. Morphology
   a. Axis
   b. P-wave
   c. PR interval (normal <.2sec)
   d. QRS (tall? / wide?)
   e. STsegments & T waves & Q waves (Inf, Ant, Lat)

1° AV Block

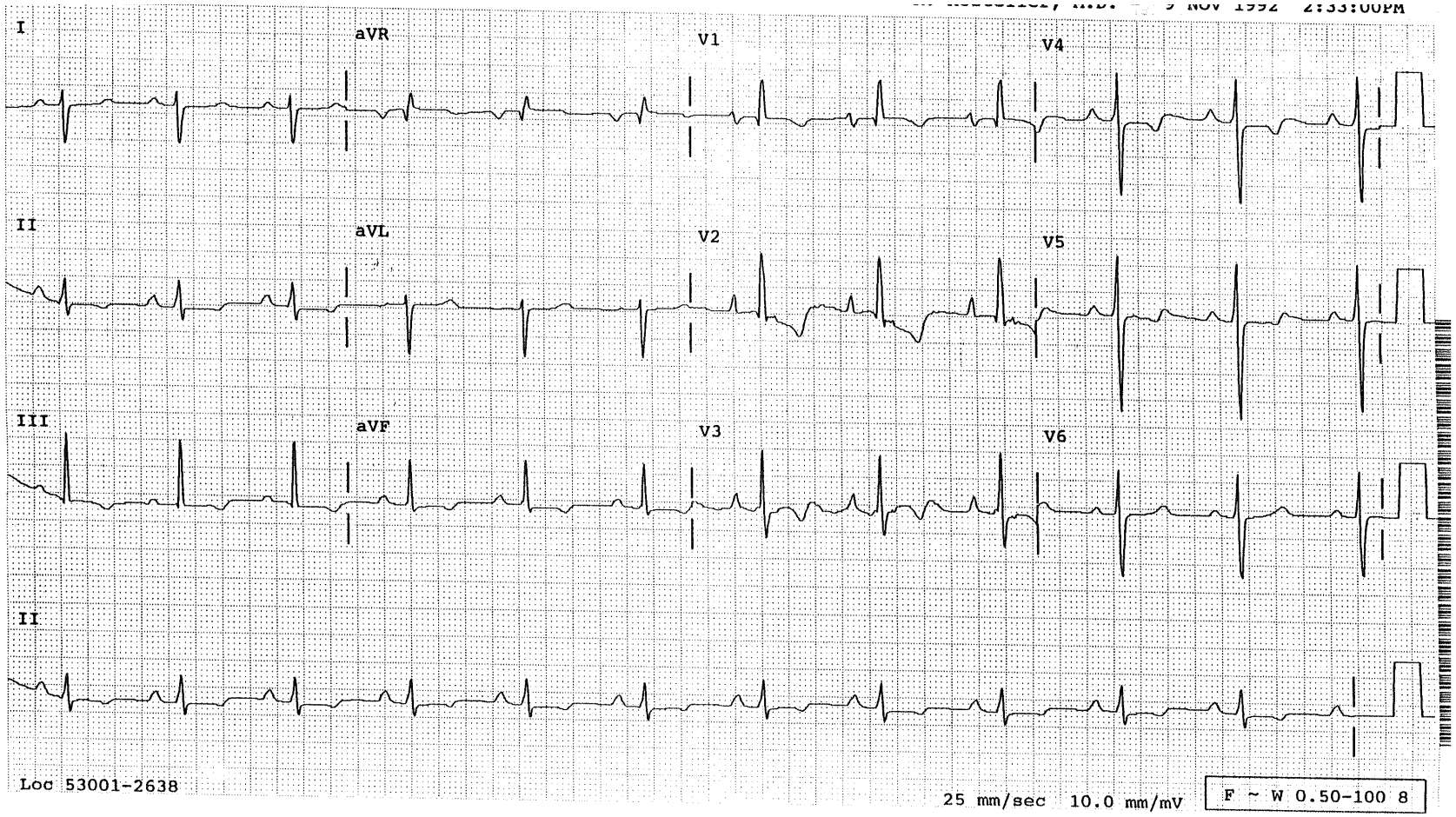
- General Rule: PR interval should be less than .2 sec or 200msec

- Equal to one large block on the EKG

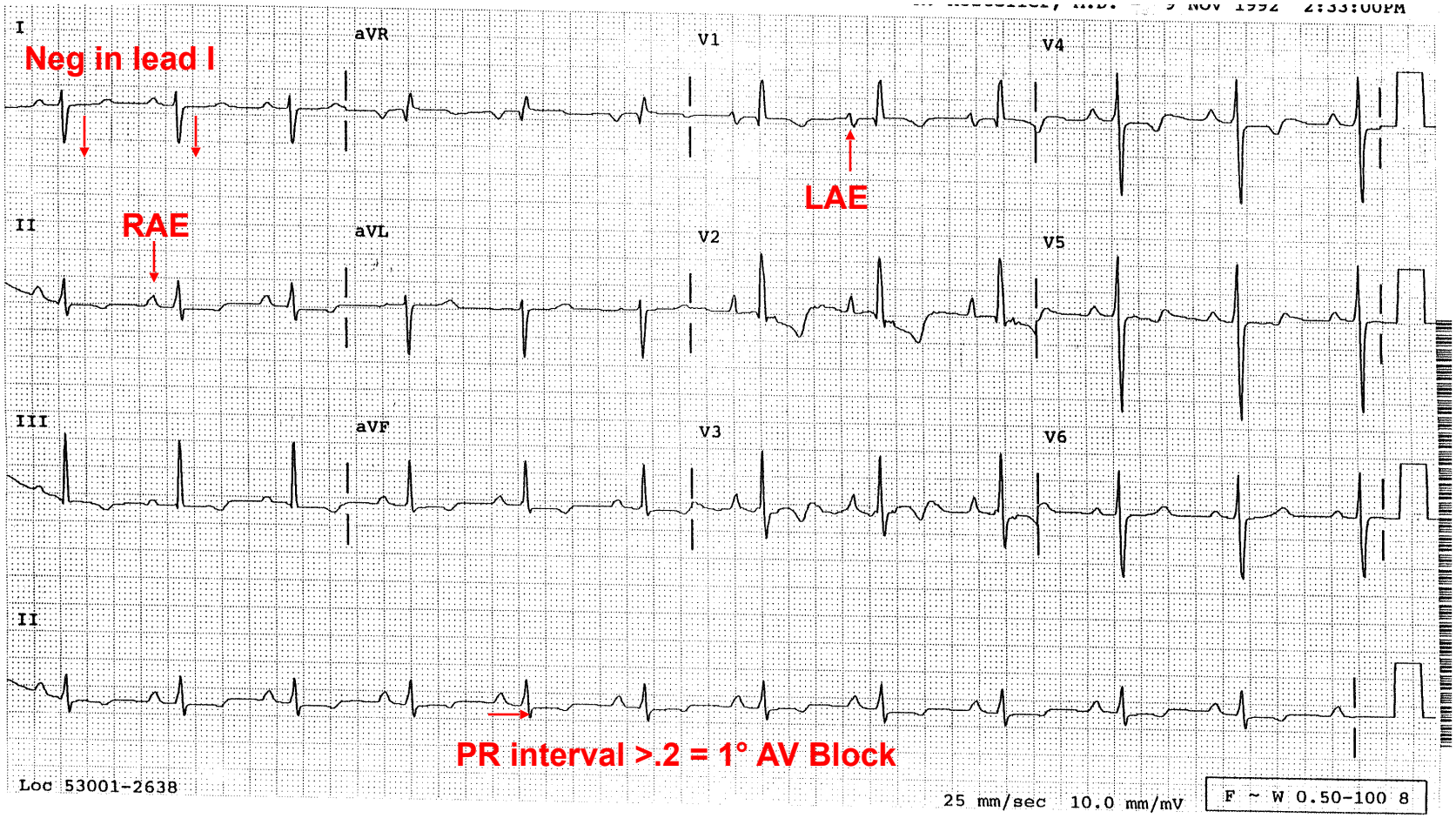


Measure from the beginning of Pwave to beginning of QRS

INTERPRET EKG



NSR, 1° AV Block, RAD, Lae & Rae, (RVH also)



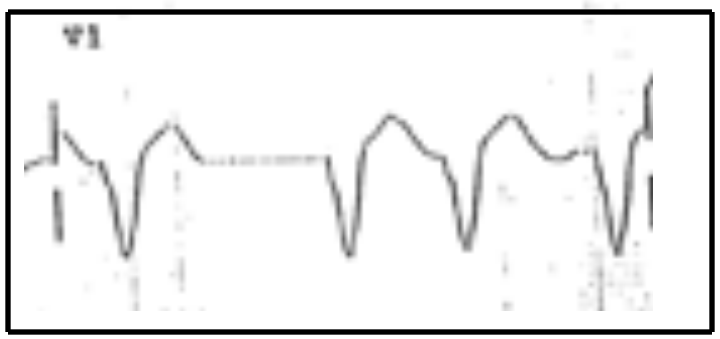
1. Rate
2. Rhythm

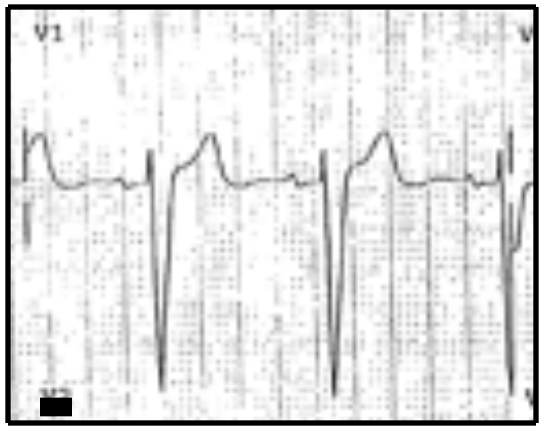
   Reg Irreg-Irreg Patterned

3. Morphology
   a. Axis
   b. P-wave
   c. PR interval (normal <.2sec)
   d. **QRS (wide?** Or tall?)
   e. STsegments & T waves & Q waves (Inf, An

LBBB Criteria

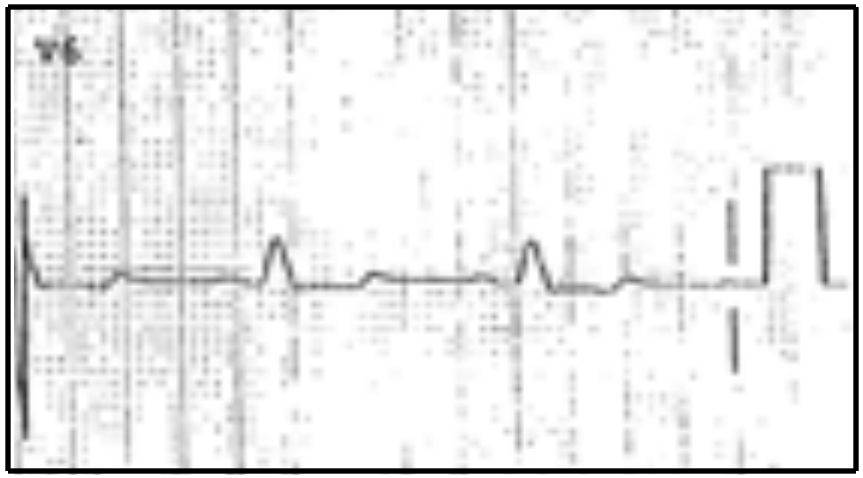
- Prolonged QRS >.12sec (3 small blocks)
- Deep S wave (qS or rS) in V1





LBBB Criteria

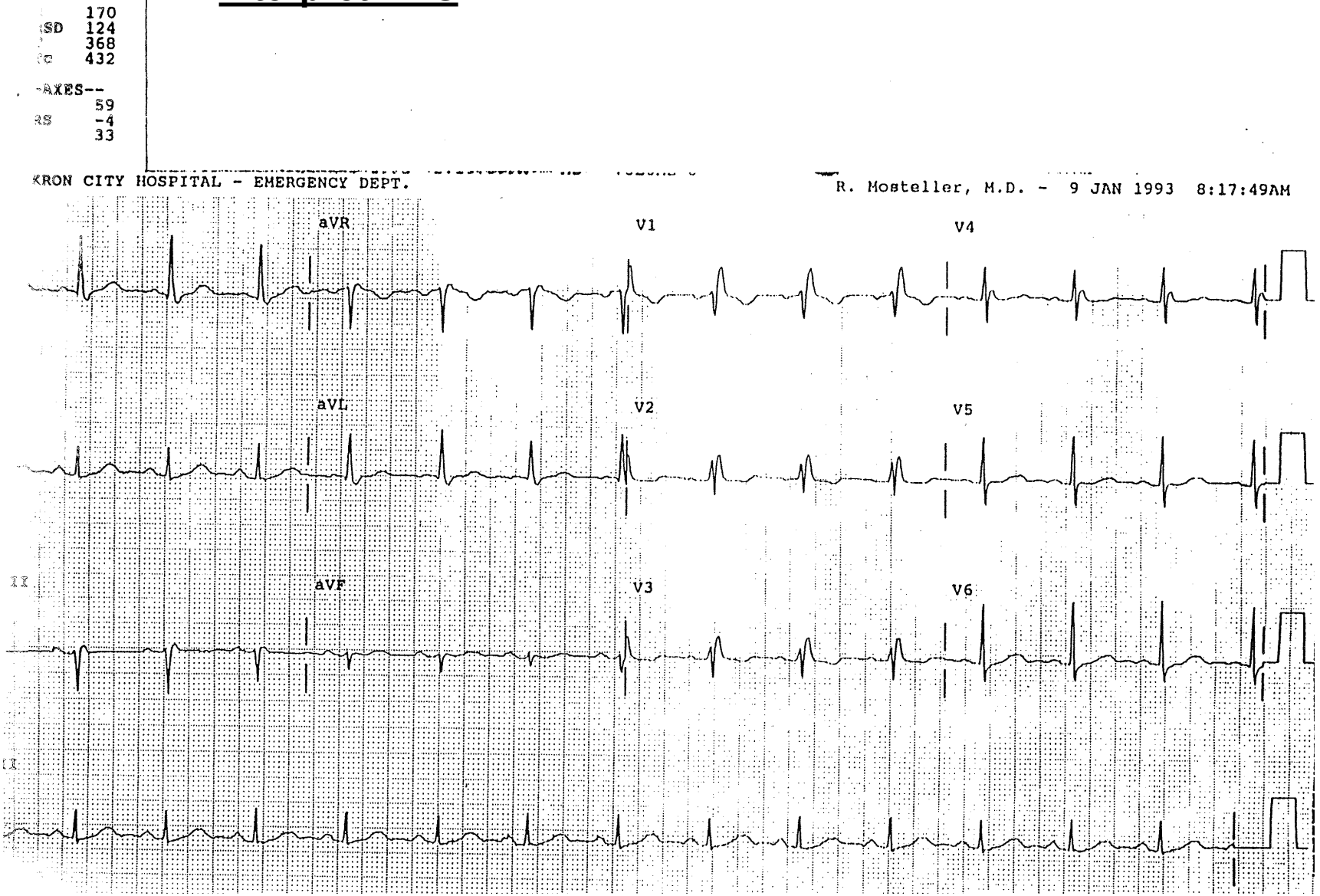
- Prolonged QRS >.12sec (3 small blocks)
- Deep S wave (qS or rS) in V1
- Monophasic R in **I** / V6



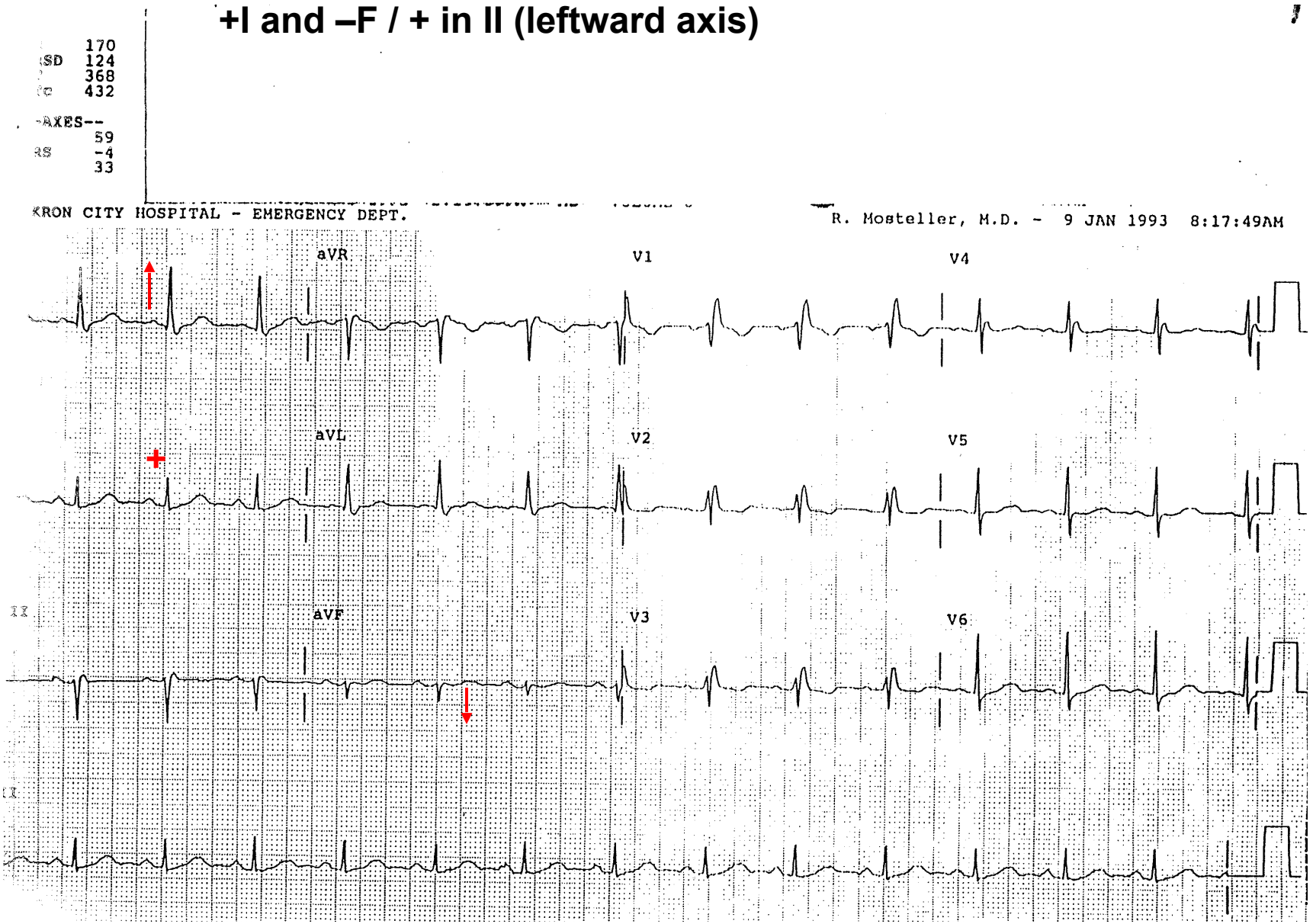
RBBB Criteria

- Prolonged QRS >.12sec (3 small blocks)
- M shaped QRS / rSR´ in V1
  - Simple rule: if you see a wide QRS and an R in V1 it is RBBB
  - R is for Right Bundle Branch Block
- Wide S at end of QRS in I / V6

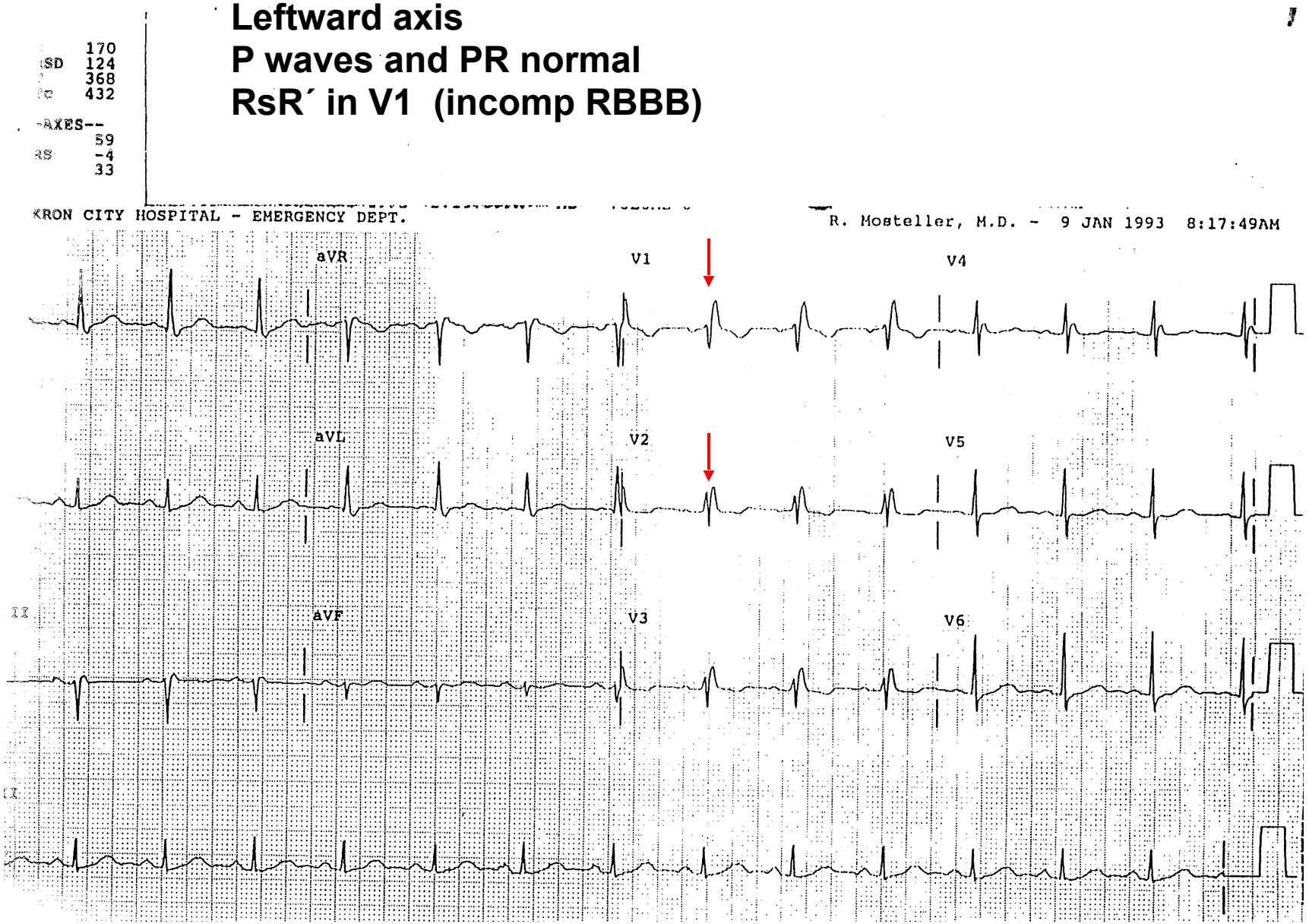
Interpret EKG



+I and –F / + in II (leftward axis)



NSR with rate of 70 - 75
Leftward axis
P waves and PR normal
RsR´ in V1 (incomp RBBB)



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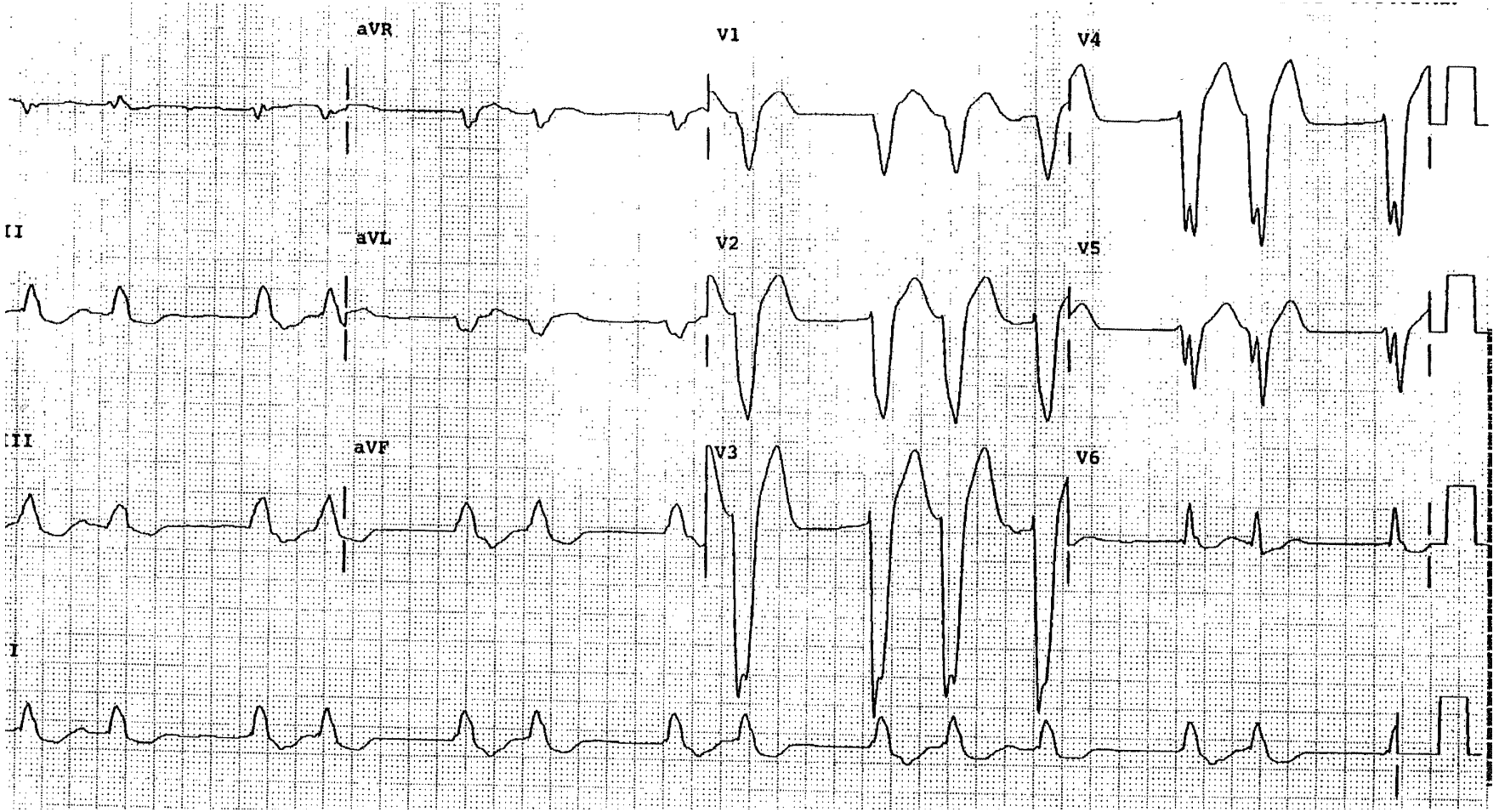
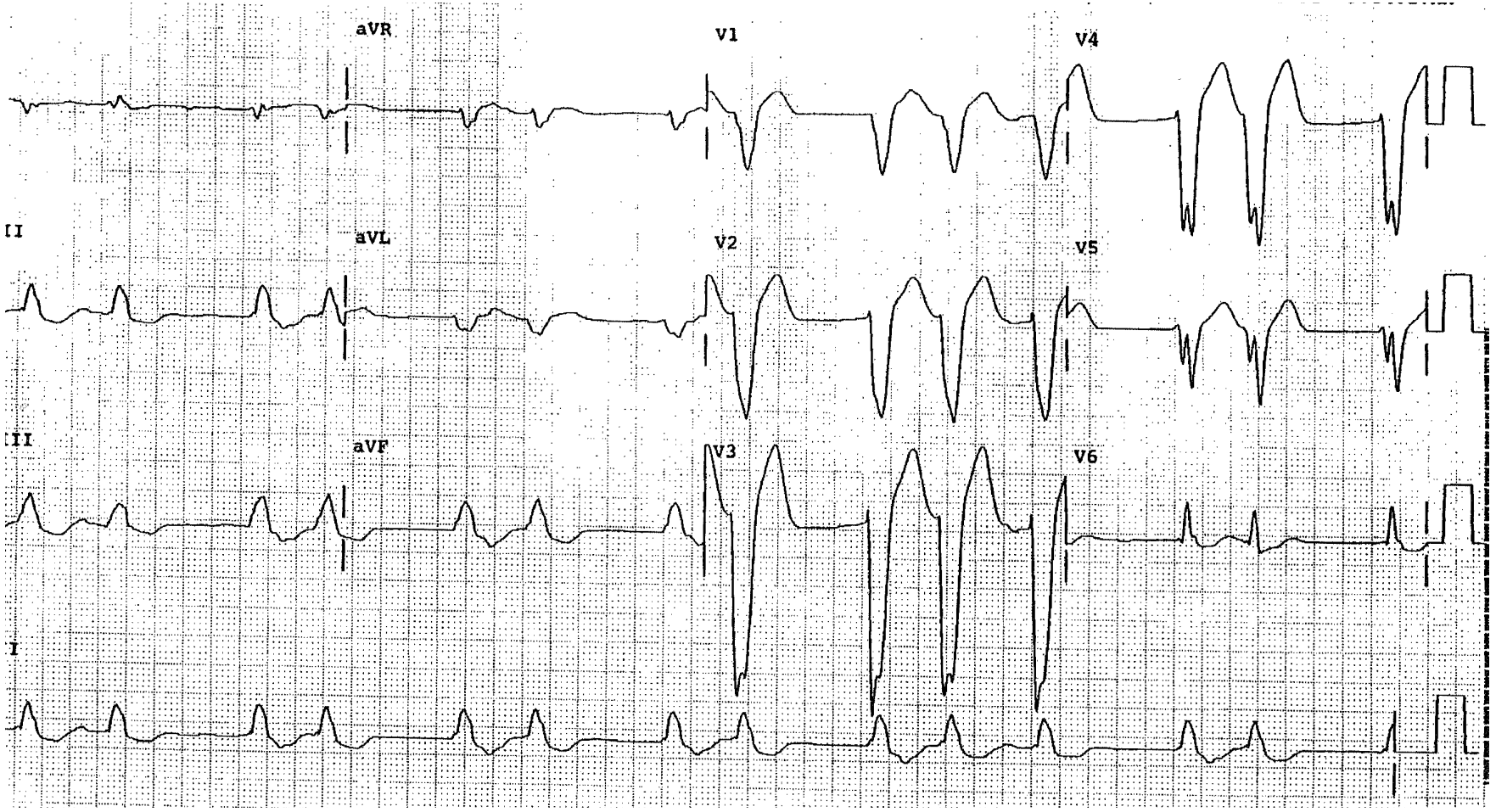


Afib // LBBB



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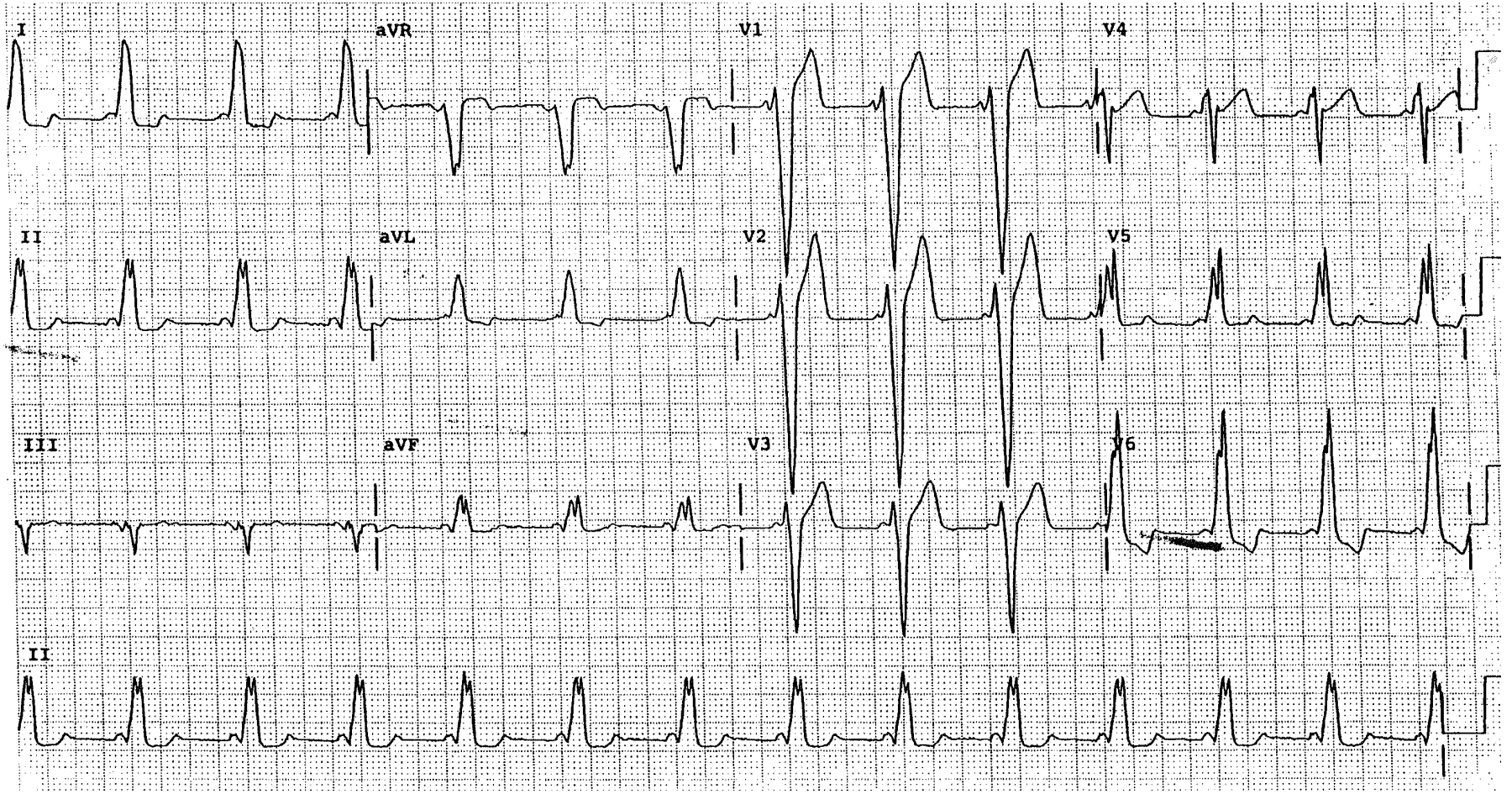
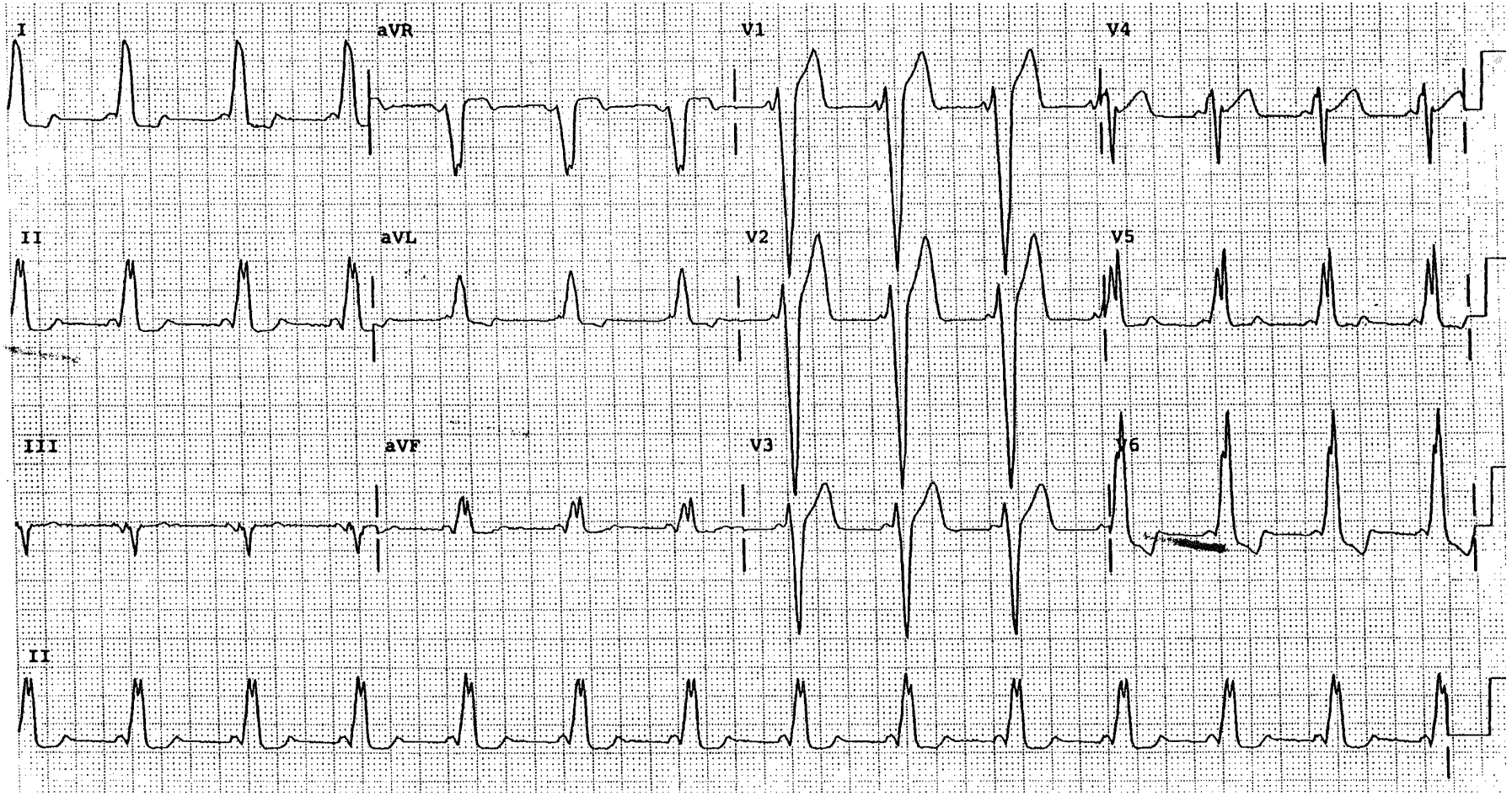
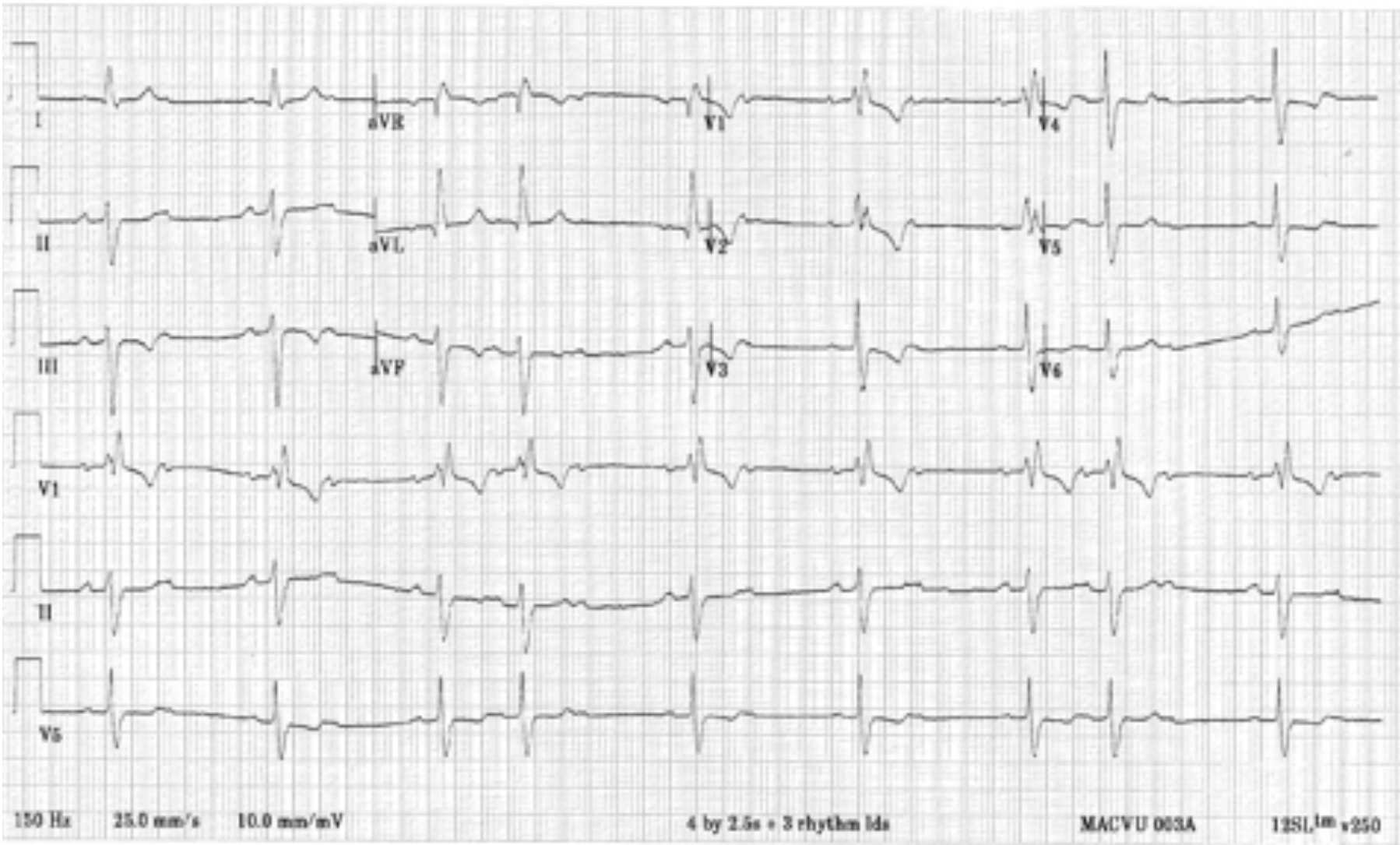


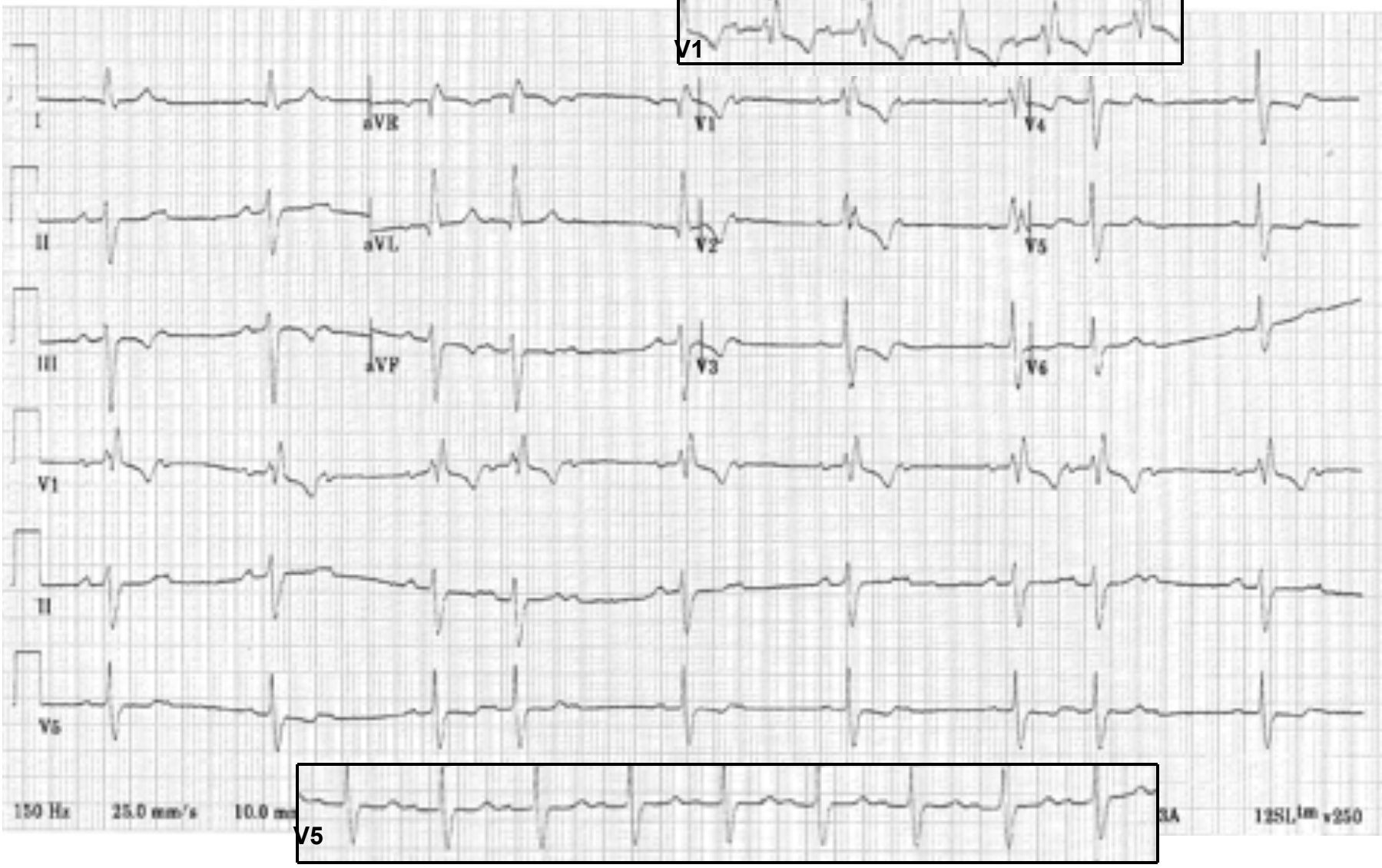
Regular Rhythm / short PR, LBBB



Interpret EKG

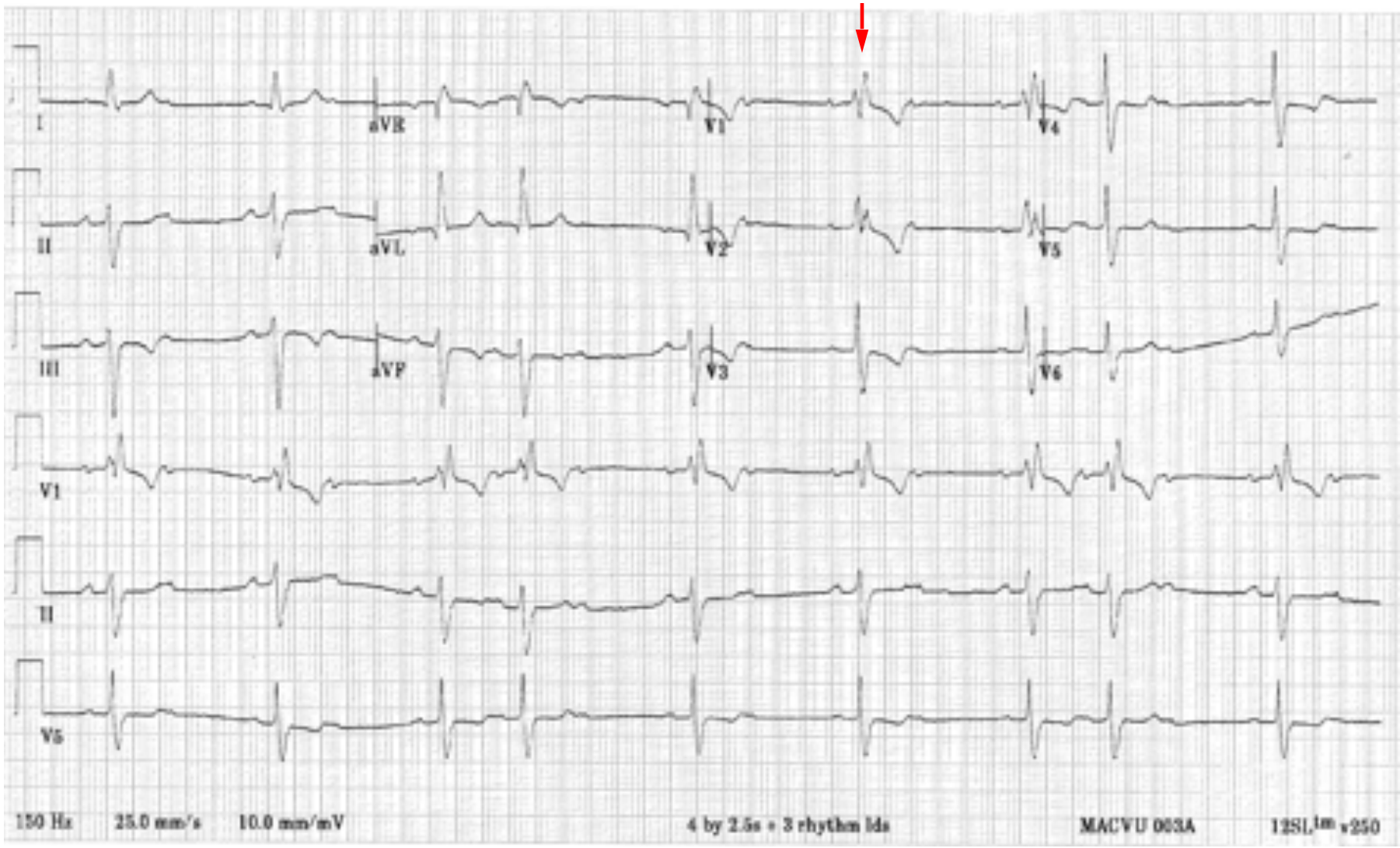


Rhythm strip – same patient



Rhythm strip from the same patient earlier

2° AVB Mobitz type 2, Left Axis Deviation, RSR´ in lead V1 = RBBB / LAFB?



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   c. PR interval (normal <.2sec)
   d. QRS (wide? / tall?)
   e. STsegments & T waves & Q waves (Inf, Ant, Lat)

Left Ventricular Hypertrophy

- EKG = **useful** but **imperfect** tool for detecting LVH.

- EKG = **inexpensive** and widely **available**.

- The limitations of EKG = **moderate sensitivity and specificity**

Left Ventricular Hypertrophy

- Increased QRS Voltage
- Increased QRS duration (“kinda wide” - not BBB)
- Leftward QRS axis
- Left atrial enlargement
- Repolarization abnormality (strain change in ST-T)

Left Ventricular Hypertrophy

- Two main Voltage rules:
  - S wave in V1 & R wave in V5 or V6 ≥35mm
    - Most common
    - Overly sensitive in young folks / especially male
  - R wave in aVL ≥ 11mm
- These = Sokolow-Lyon indices

Left Ventricular Hypertrophy

- Estes-Romhilt Criteria
  - Scoring system to gauge likelihood of LVH
  - More complicated and generally no used clinically by the average practicing physician

  - SEE EXAMPLE next slide

Romhilt-Estes point score system for ECG diagnosis of LVH

Criterion	Points
Any limb R ware or S wave ≥2.0 mV (20 mm)	3
OR S in V1 or S in V2 ≥ 3.0 mV (30 mm)	
OR R in V5 or R in V6 ≥3.0 mV (30 mm)	
ST-T wave changes typical of LVH	
Taking digitalis	1
Not taking digitalis	3
Left atrial abnormality	
P terminal force in V1 is 1 mm or more in depth with a duration 40 ms (0.04 sec)	3
Left axis deviation ≥-30°	2
QRS duration ≥90 ms	1
Intrinsicoid deflection in V5 or V6 ≥50 ms (0.05 sec)*	1

A score of 5 or more indicates "definite" LVH; a score of 4 indicates "probable" LVH.

* Intrinsicoid deflection is defined as interval between beginning of QRS interval and the peak of the R wave.

Score of 5 = “definite” LVH

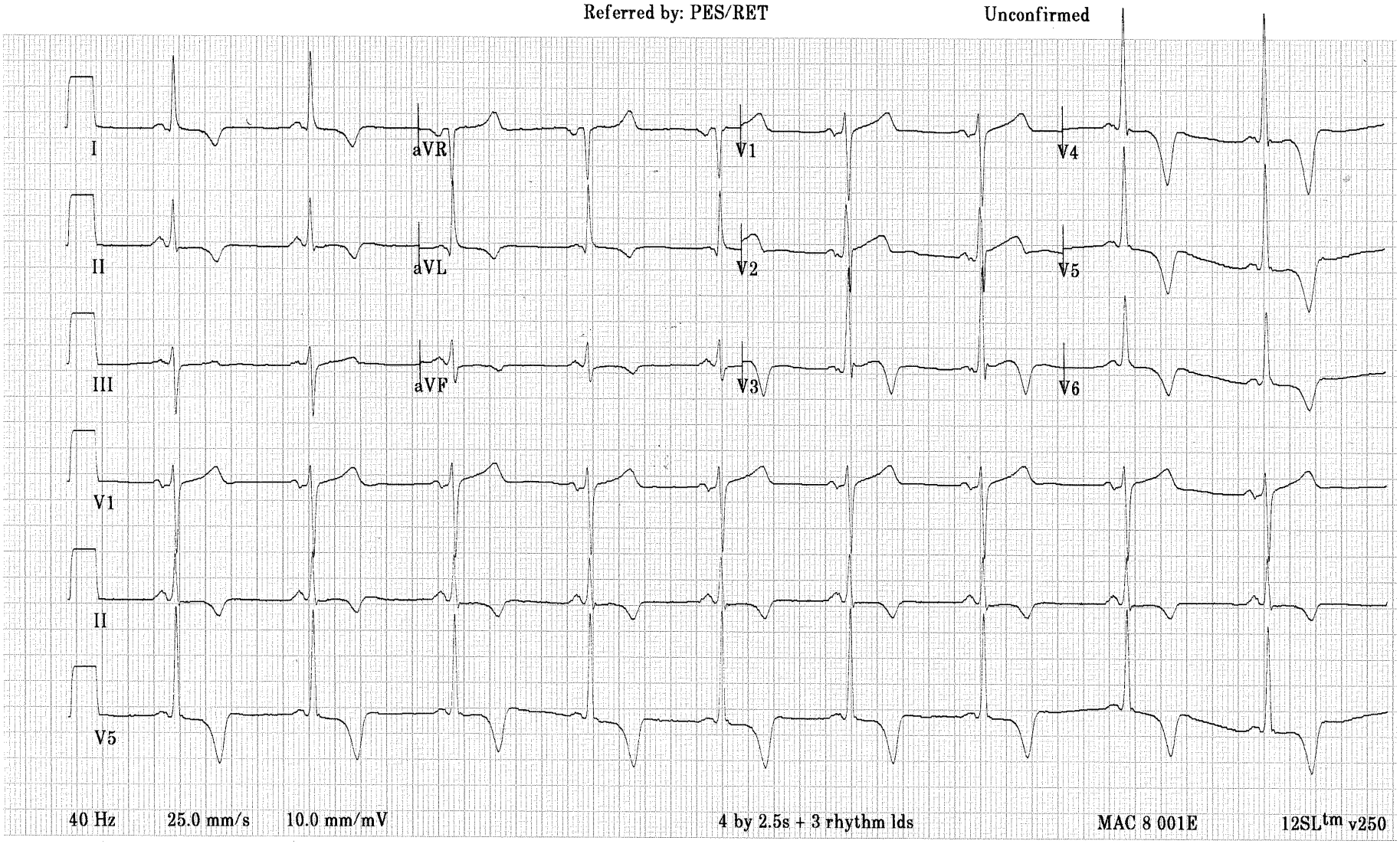
Score of 4 = “probable” LVH

Left Ventricular Hypertrophy

- Increased QRS Voltage
- Increased QRS duration (not BBB)
- Leftward QRS axis
- Left atrial enlargement
- Repolarization abnormality (strain change in ST-T)

- Qs, STs, Ts

INTERPRET EKG

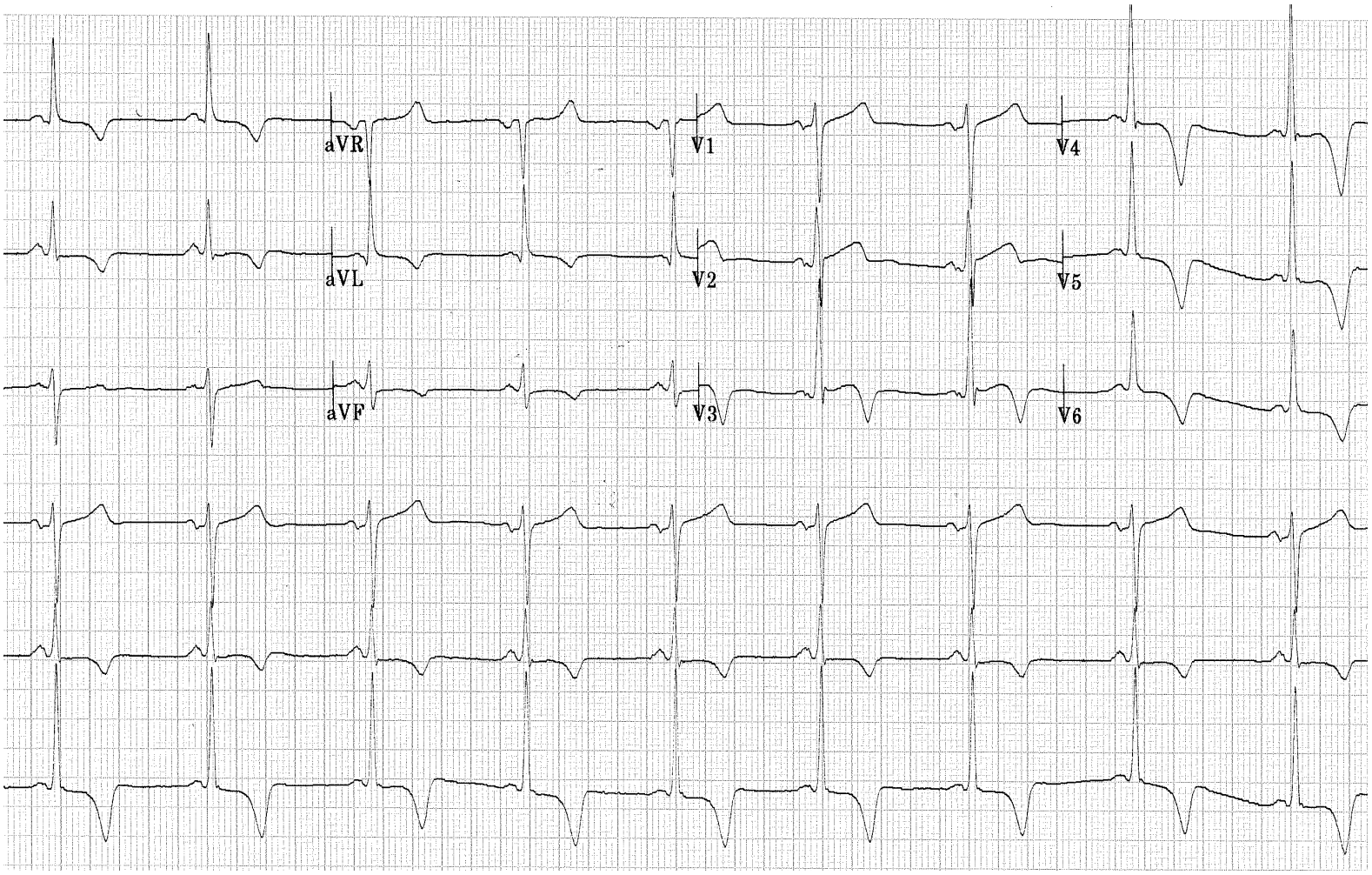


NSR / Normal QRS axis

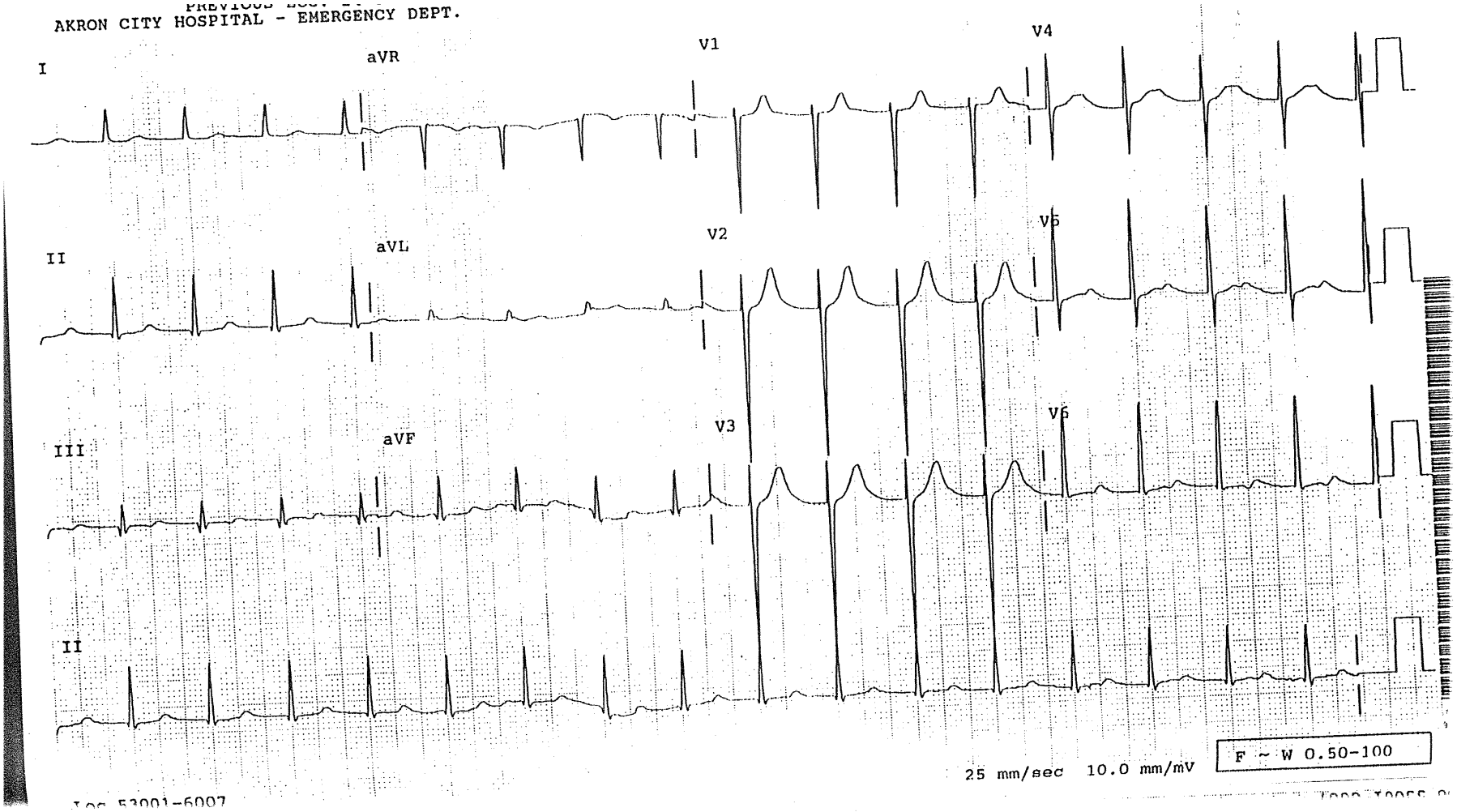
Pwave morphology normal / somewhat short PR interval

No BBB / **Voltage criteria for LVH** = S in V1 + R in V5 > 35 & aVL > 11

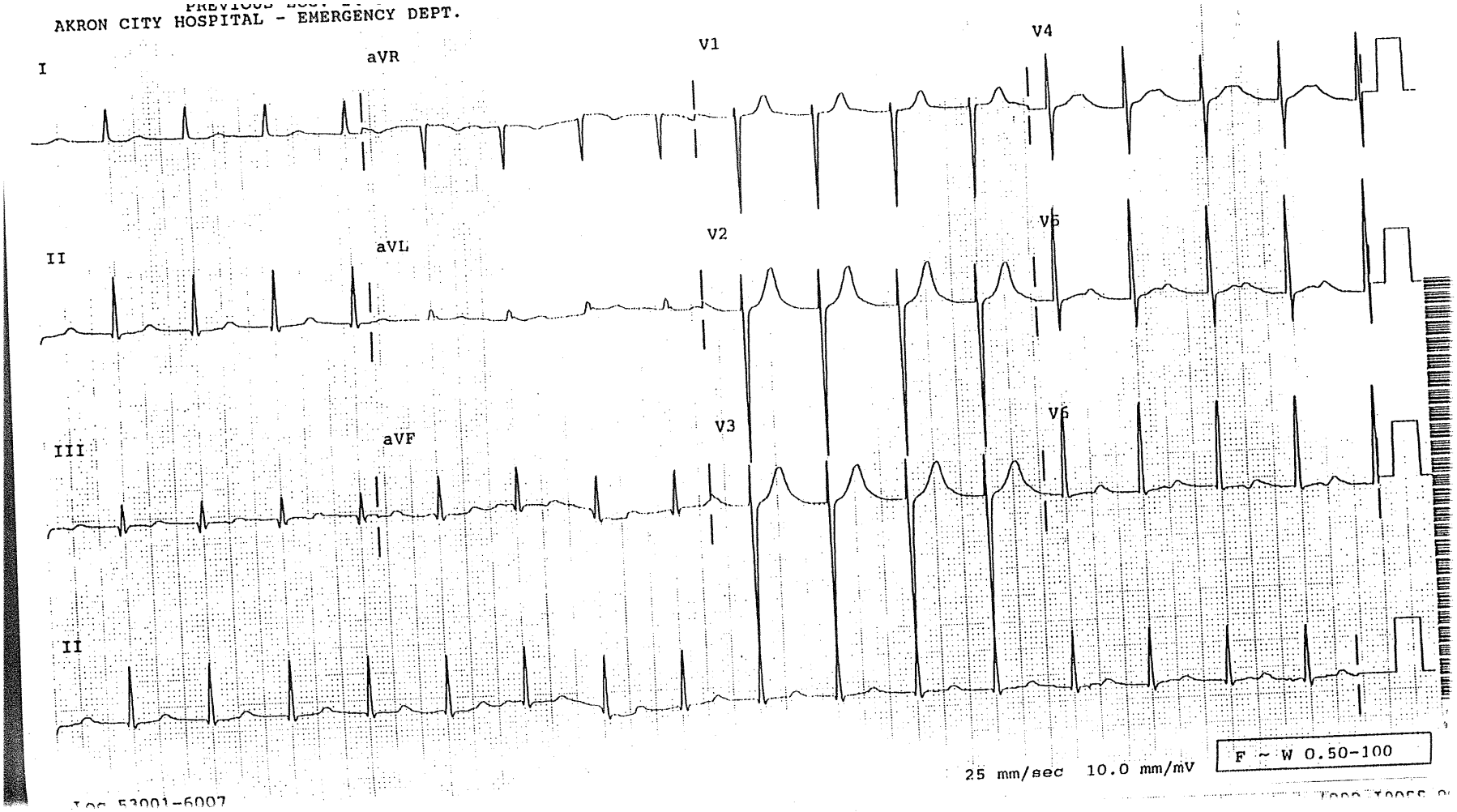
ST & T wave change diffusely c/w LVH Strain but can't R/O ischemia



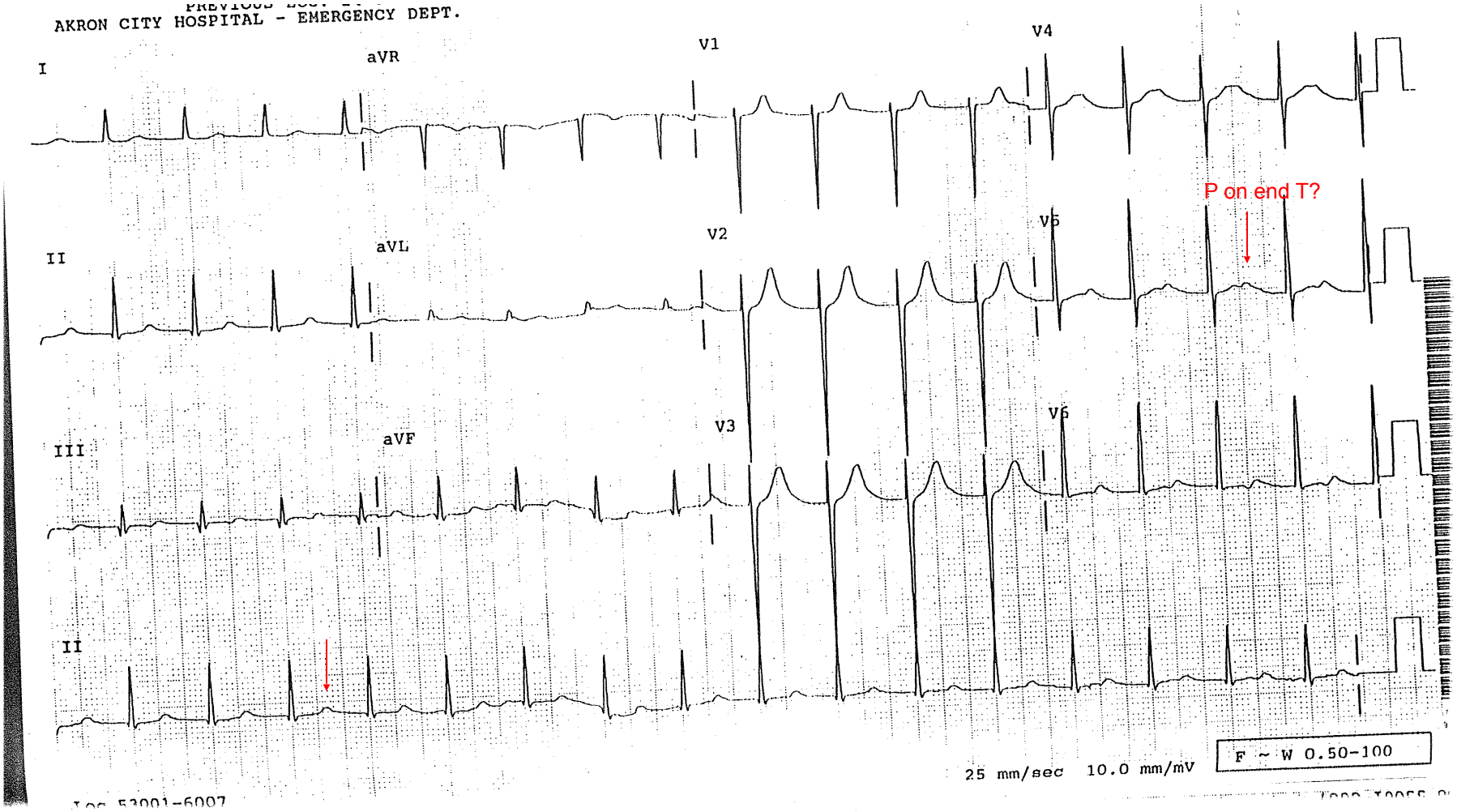
INTERPRET EKG:



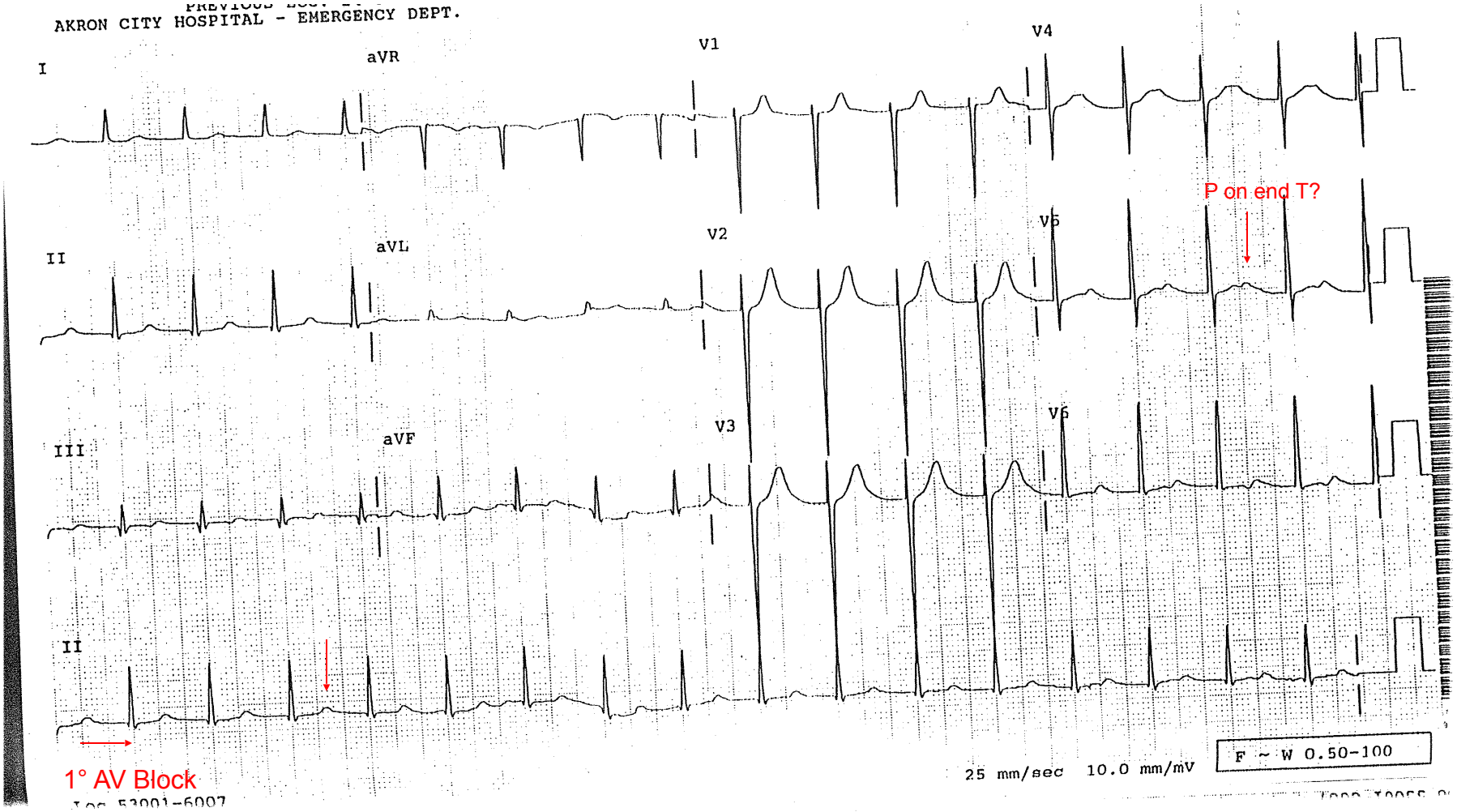
INTERPRET EKG: Rate = 85 / Reg Rhythm = P-QRS relation? Are there Pwaves?..... Are these T waves? Junctional? Sinus? (Next slide)



INTERPRET EKG: Rate = 85 / Reg Rhythm = P-QRS relation? **Are there Pwaves**?.....

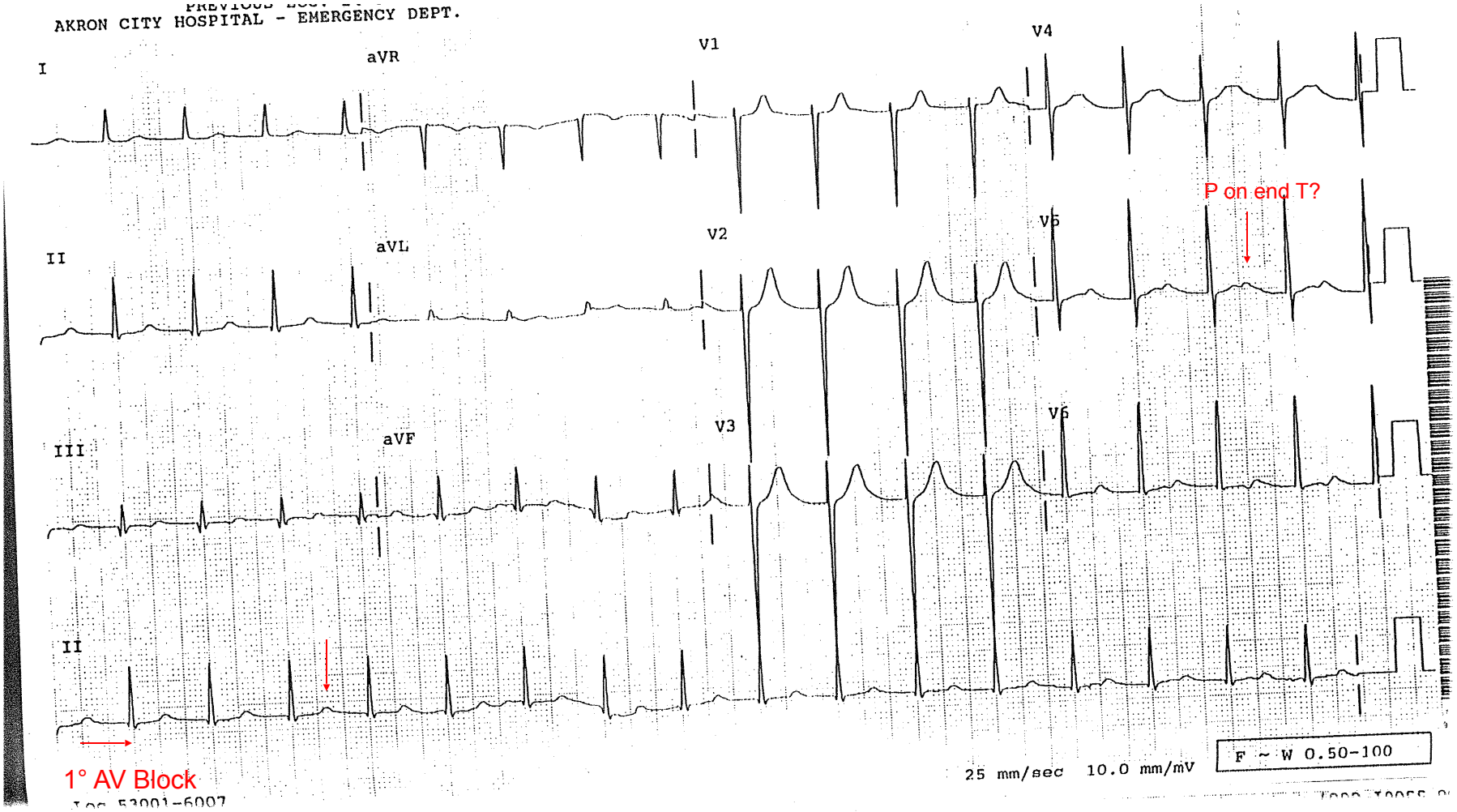


INTERPRET EKG: Rate = 85 / Reg Rhythm = P-QRS relation? YES! Normal Sinus Rhythm with 1° AV block. Normal Axis. Pwave morphology OK. No BBB. Probable Voltage Criteria for LVH with no other criteria, Nonspecific T wave change V5, V6

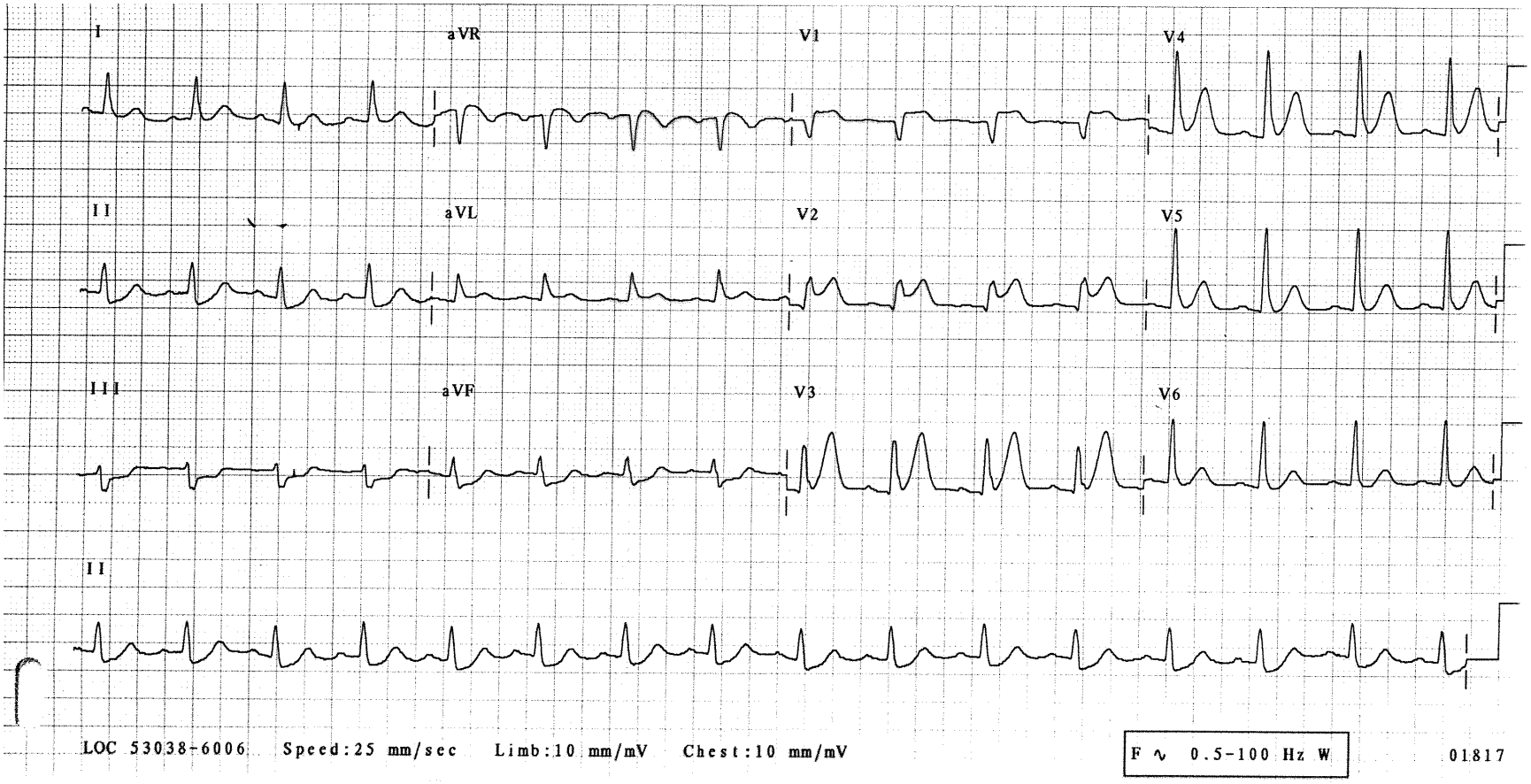


INTERPRET EKG: Rate = 85 / Reg Rhythm = P-QRS relation? YES! Normal Sinus Rhythm with 1° AV block. Normal Axis. Pwave morphology OK. No BBB. Probable Voltage Criteria for LVH with no other criteria, Nonspecific T wave change V5, V6

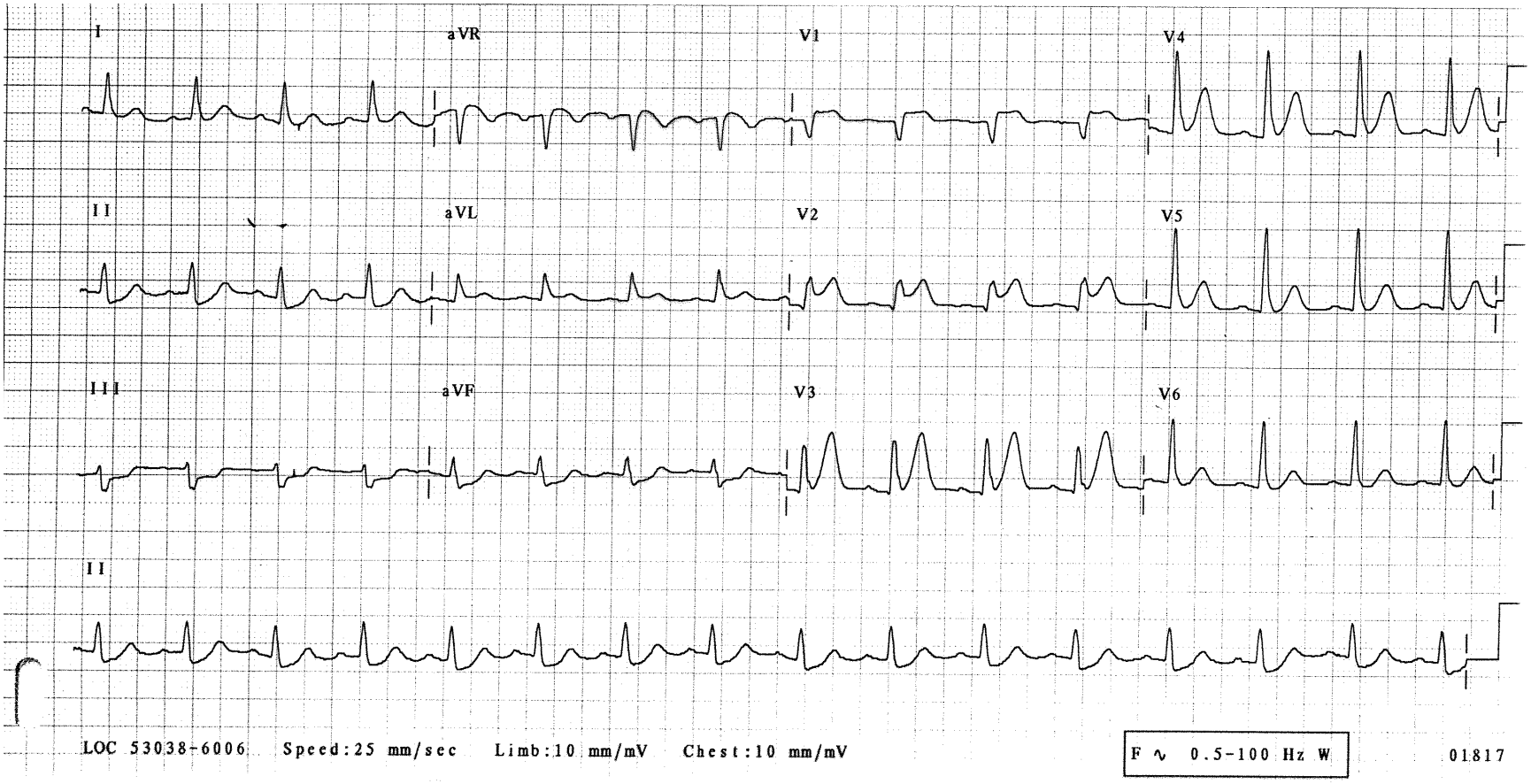
SUMMARY= NSR with 1° AV block, Voltage Criteria for LVH. Nonspecific T wave laterally



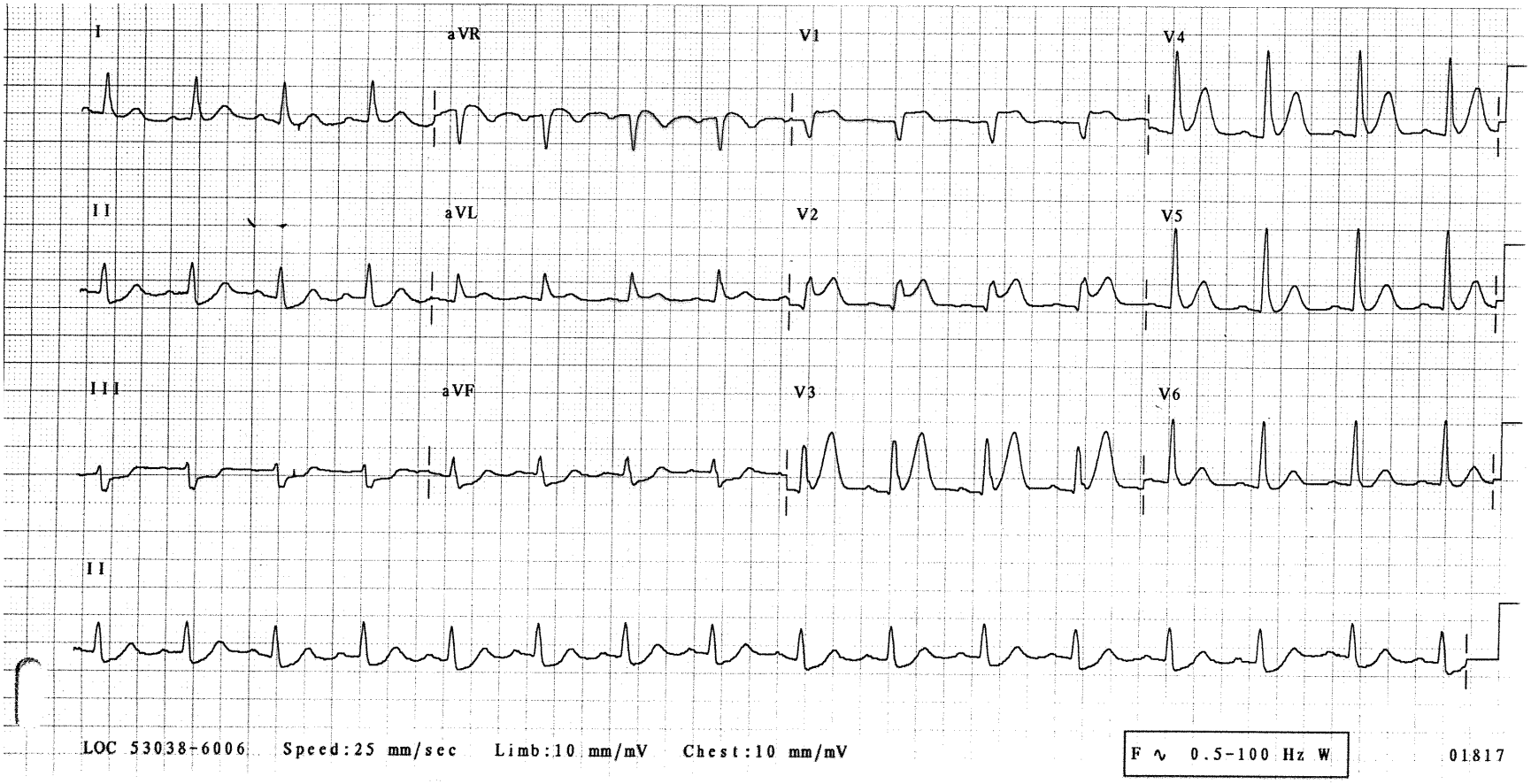
INTERPRET EKG: ?



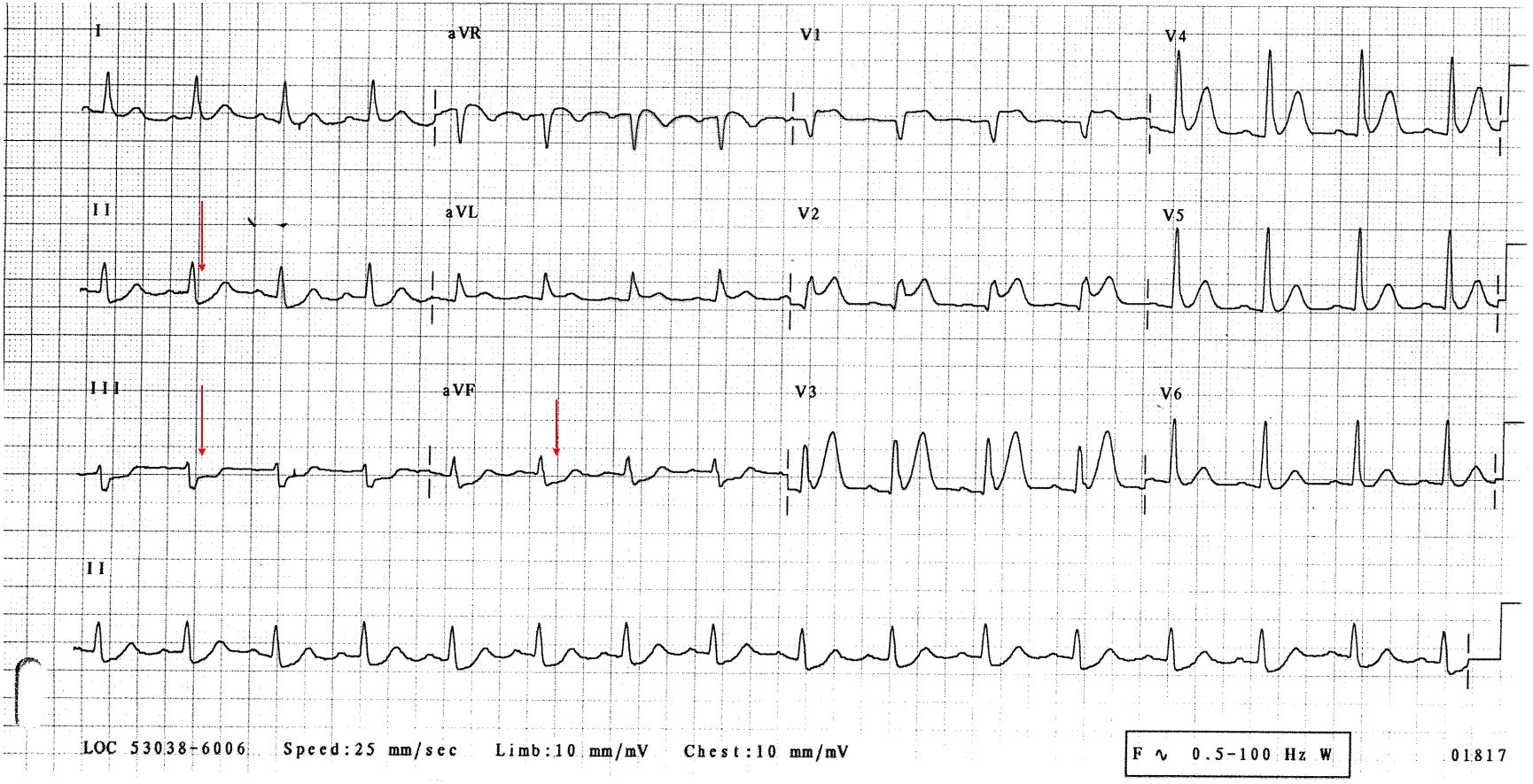
INTERPRET EKG: Rate 80 / Reg / P-QRS = yes / Pwaves up? (see lead 2)



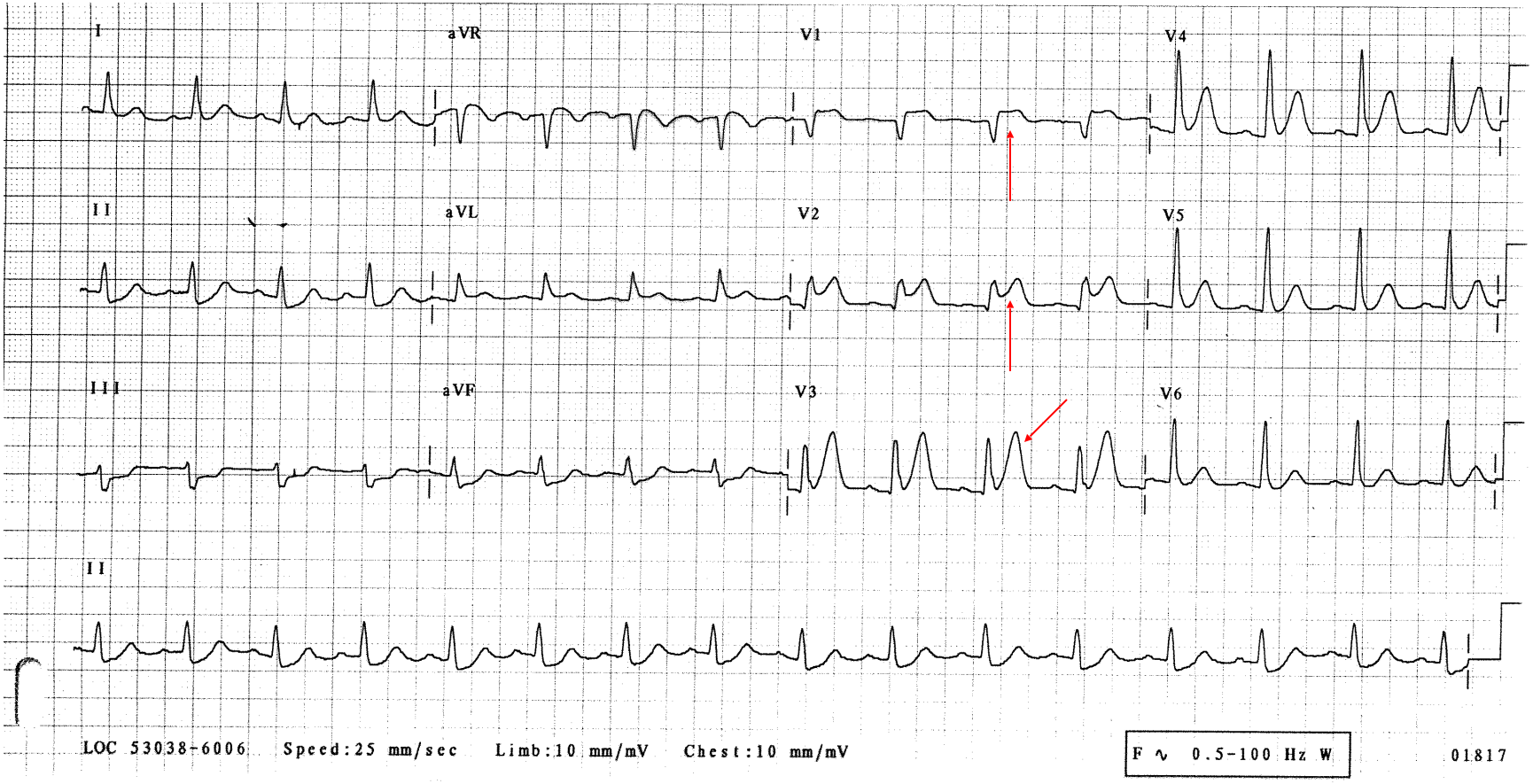
INTERPRET EKG: Rate 80 / Reg / P-QRS = yes / Pwaves up = yes // NSR / Axis Normal / P morphology OK / PR interval OK / BBB? – NO / Voltage? – NO / Q- ST – T wave?....



INTERPRET EKG: Rate 80 / Reg / P-QRS = yes / Pwaves up = yes // NSR / Axis Normal / P morphology OK / PR interval OK / BBB? – NO / Voltage? – NO / Q- ST – T wave = ST Depression inferiorly,

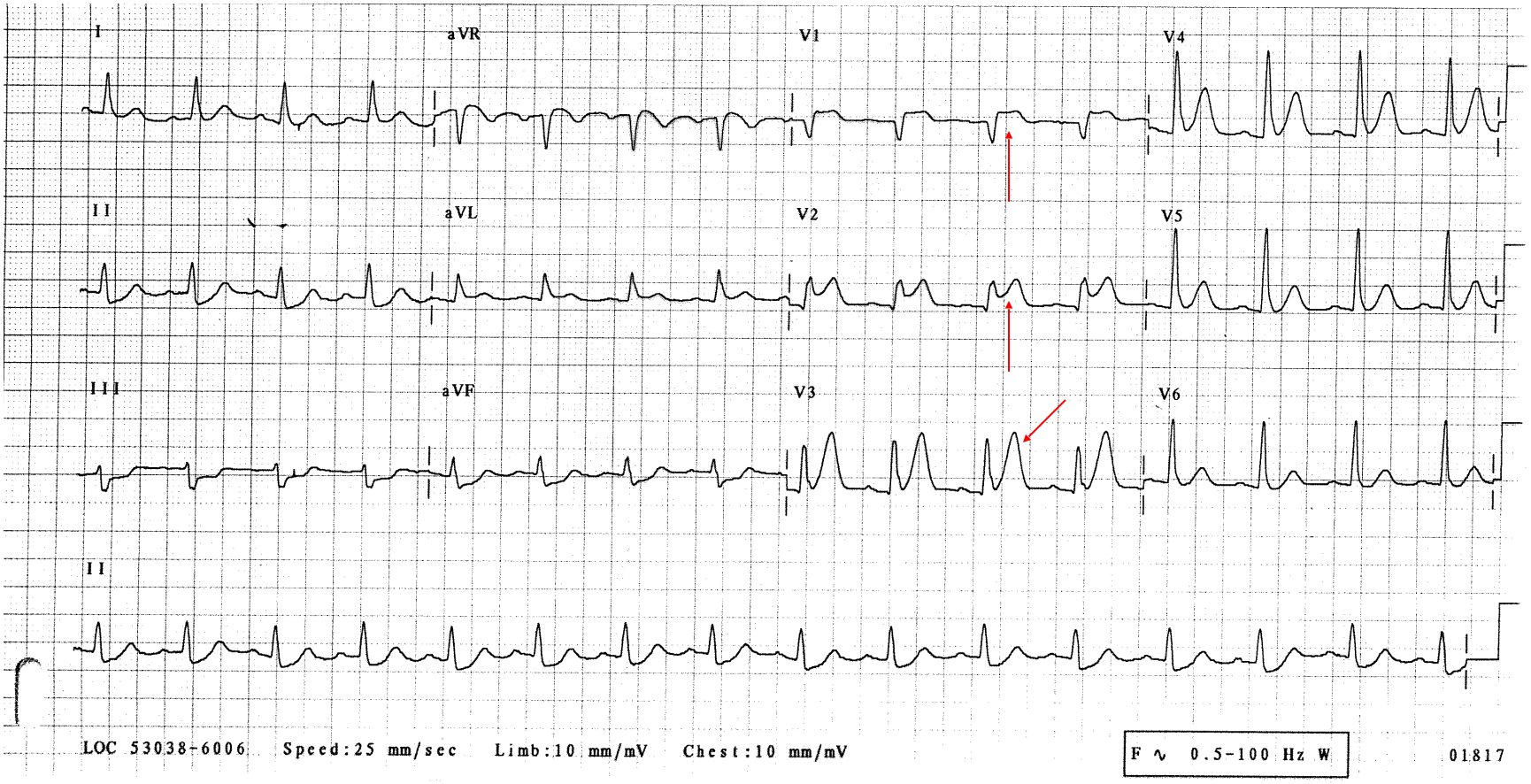


INTERPRET EKG: Rate 80 / Reg / P-QRS = yes / Pwaves up = yes // NSR / Axis Normal / P morphology OK / PR interval OK / BBB? – NO / Voltage? – NO / Q- ST – T wave = ST Depression inferiorly, ST ELEVATION V1-V2 with Q's and HYPERACUTE T V3-V4



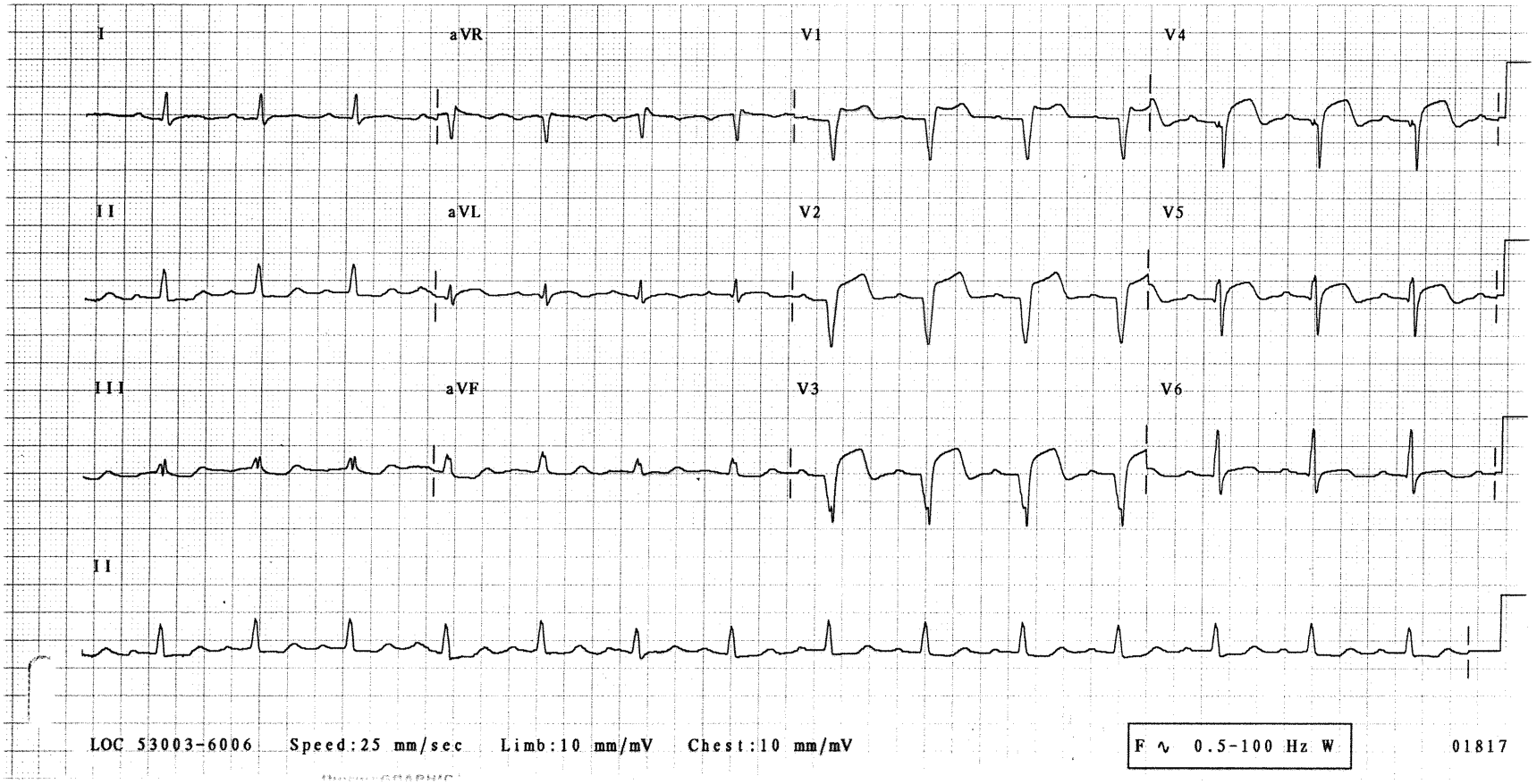
INTERPRET EKG: Rate 80 / Reg / P-QRS = yes / Pwaves up = yes // NSR / Axis Normal / P morphology OK / PR interval OK / BBB? – NO / Voltage? – NO / Q- ST – T wave = ST Depression inferiorly, ST ELEVATION V1-V2 with Q's and HYPERACUTE T V3-V4

SUMMARY: NSR, Acute Anterior wall MI (early) with reciprocal changes inferiorly

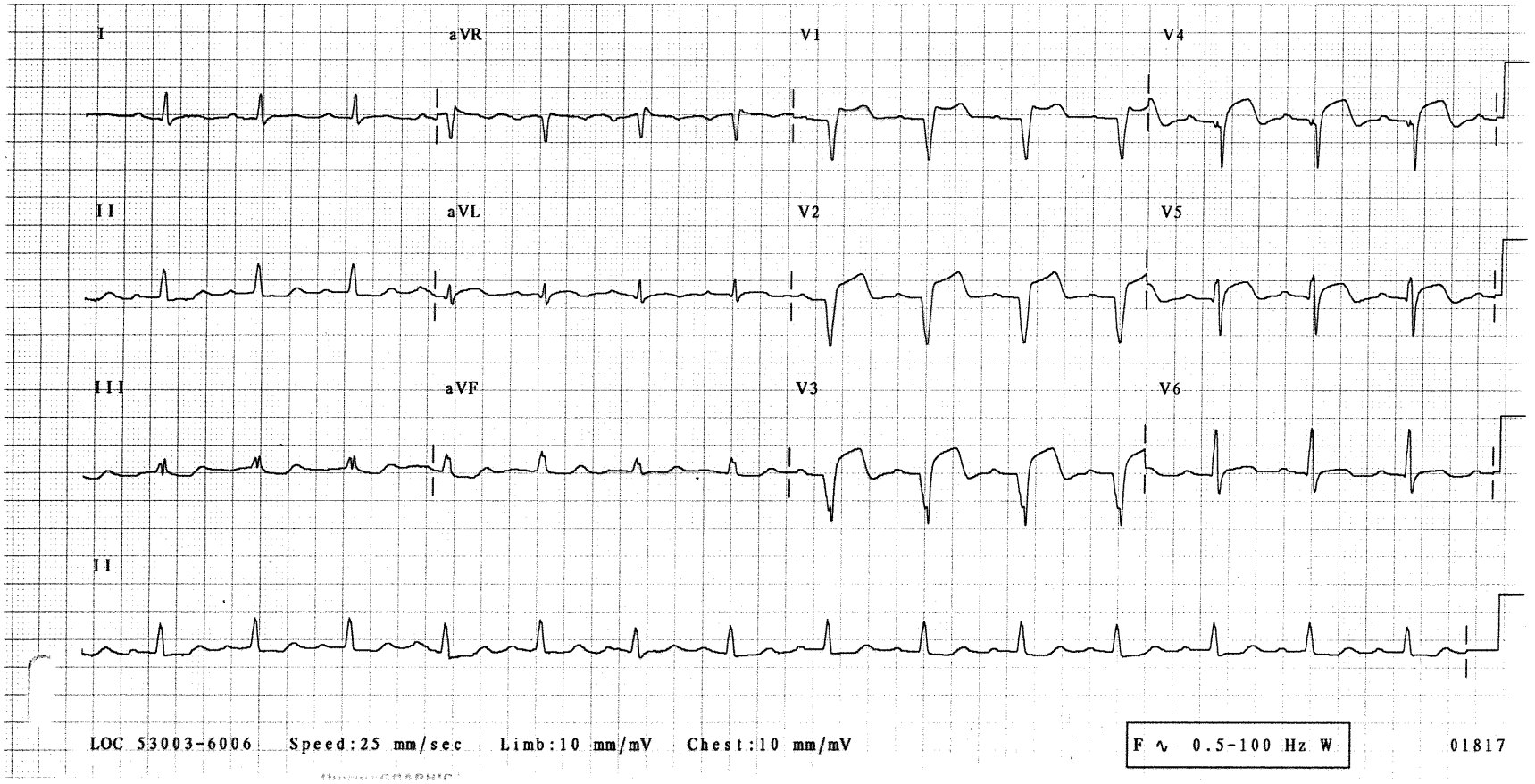


SAME PATIENT AS THE PRIOR EKG.

<u>HOW HAS THE EKG CHANGED?</u>

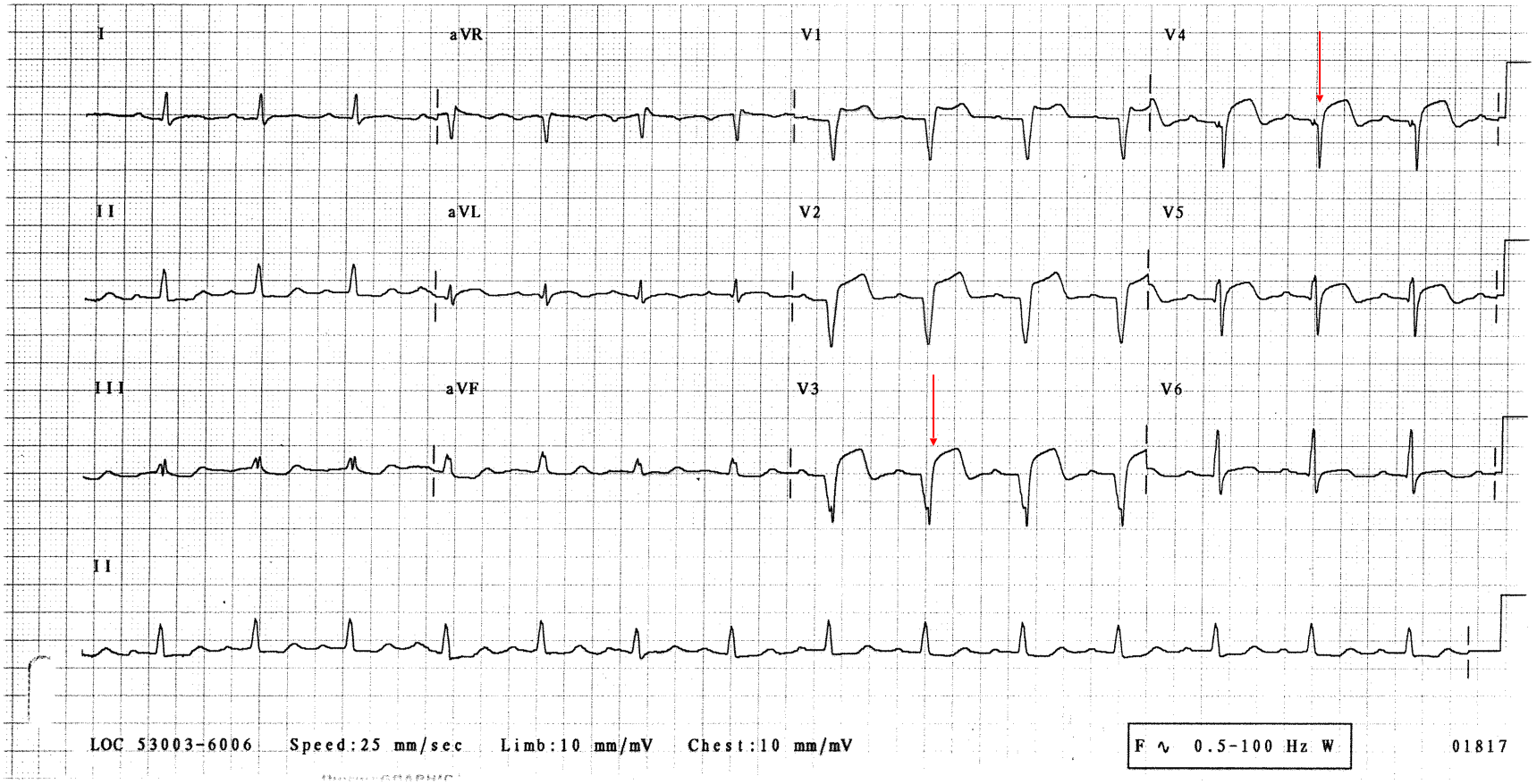


INTERPRET EKG:

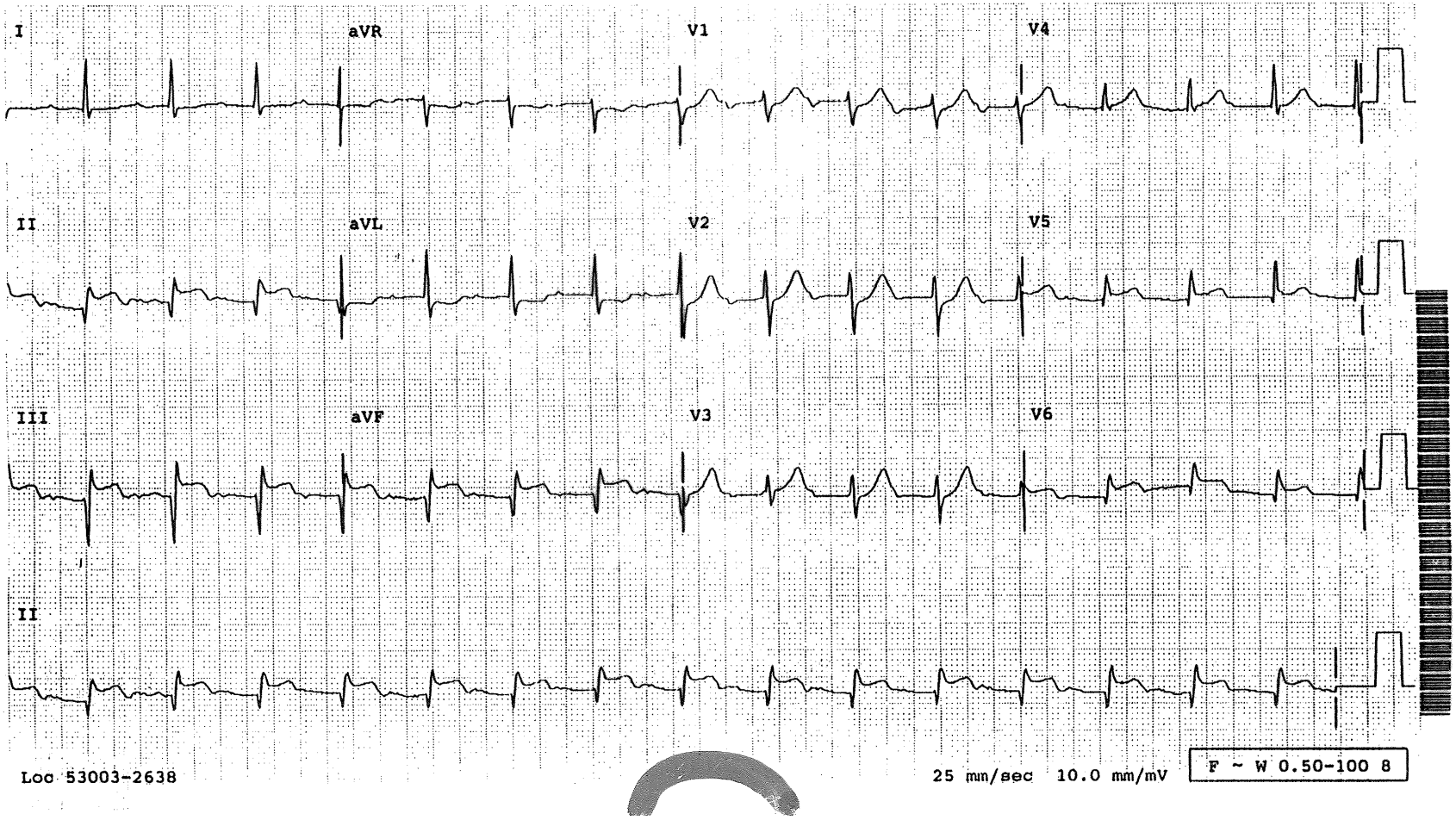


INTERPRET EKG:

Primarily we see the progression of the acute anterior MI with Q waves developing now in V3-V4 as well as ST elevation to replace the hyperacute T wave.



INTERPRET EKG:



INTERPRET EKG:

NSR, 1° AV block, horizontal axis near 0°, Q waves with ST elevations II/III/F and V5- V6 = Acute Inf-Lat Wall MI with reciprocal ST depression in AVL