

All That is Elevated



Is Not an MI

Virginia EMS Symposium
November 9th – 13th, 2011
Norfolk, Virginia

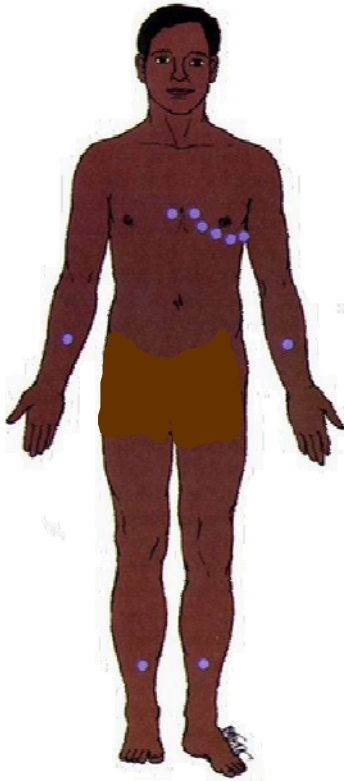
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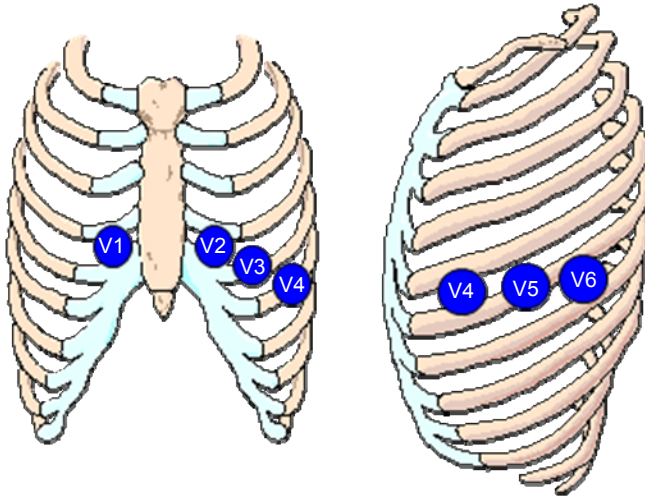
Lead Placement

Bipolar Leads

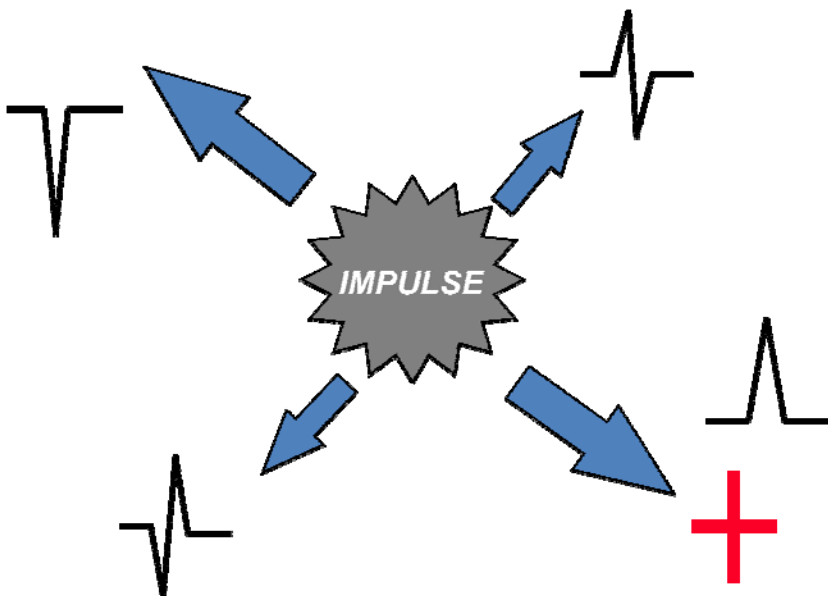
Limb leads **MUST** go on the limbs



Precordial Leads



- V1 4th ICS 1" right of the sternum
- V2 4th ICS 1" left of the sternum
- V3 Inline between V2 and V4
- V4 5th ICS left mid clavicular line
- V5 Inline between V4 and V6
- V6 Left mid axillary line at same level as V4

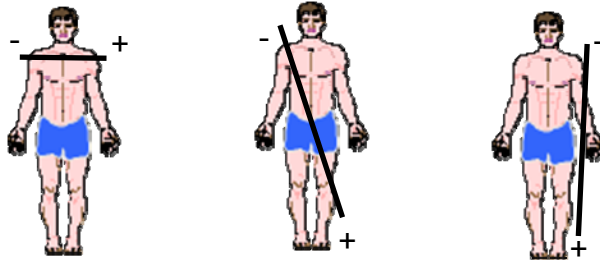


Waveforms are created as a result of their direction of movement in relation to the positive electrode

Leads

Leads “look” at the heart
Record the flow of electricity through the heart

Bi Polar Leads (limb leads)

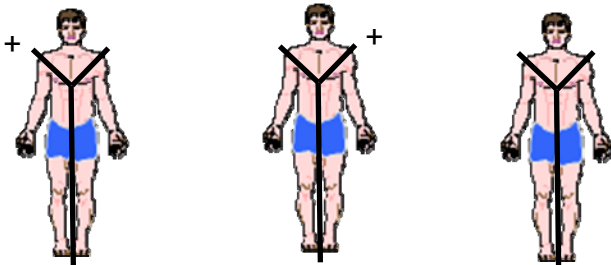


Lead I

Lead II

Lead III

Augmented Leads



aVR

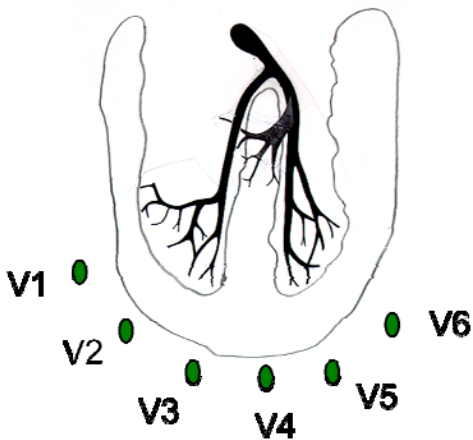
aVL

aVF

Contiguous Leads

Leads	View
II, III, aVF	Inferior
V1, V2	Septal
V3, V4	Anterior
V5, V6, I, aVL	Lateral

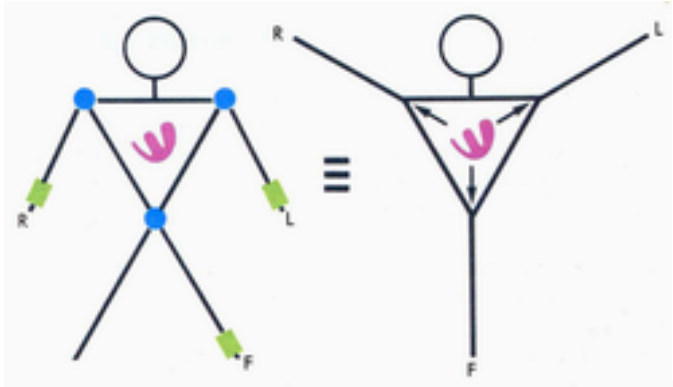
Precordial Leads (V Leads)



R wave progression:

V6 should have a greater positive deflection than V1

Einthoven's Triangle



Limb leads and augmented limb leads view the frontal plane

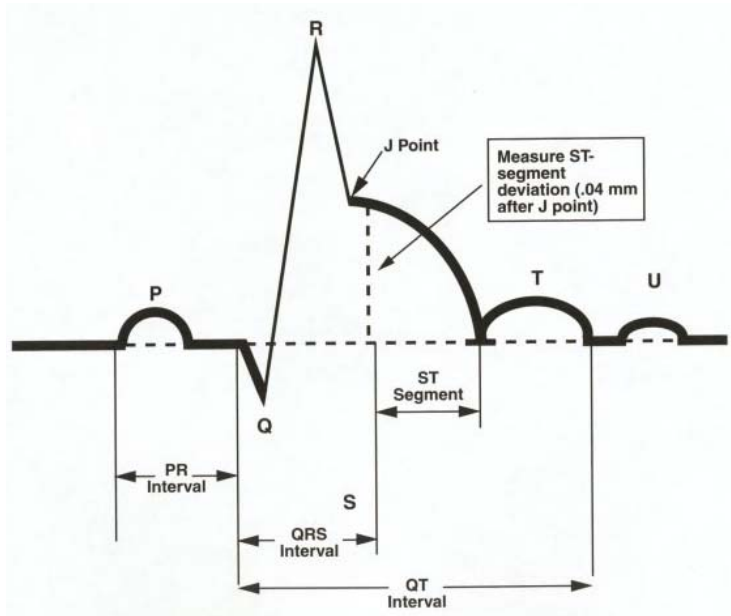
Precordial leads view the horizontal plane

$$\text{Amplitude I} + \text{II} = \text{Amplitude of III}$$

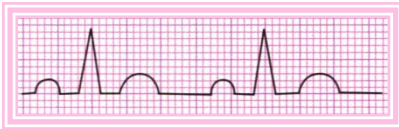
Normal 12 Lead EKG Appearance

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

ST Segment Elevation



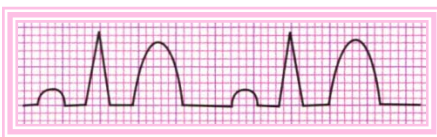
Indicative Changes



Normal



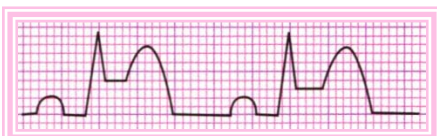
Injury (Cardiac Alert)



Possible Ischemia (No Cardiac Alert)



Injury (Cardiac Alert)



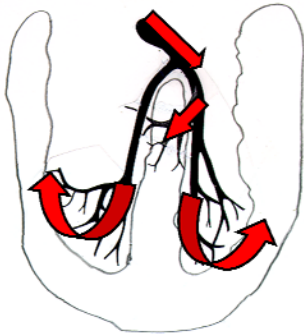
Injury (Cardiac Alert)



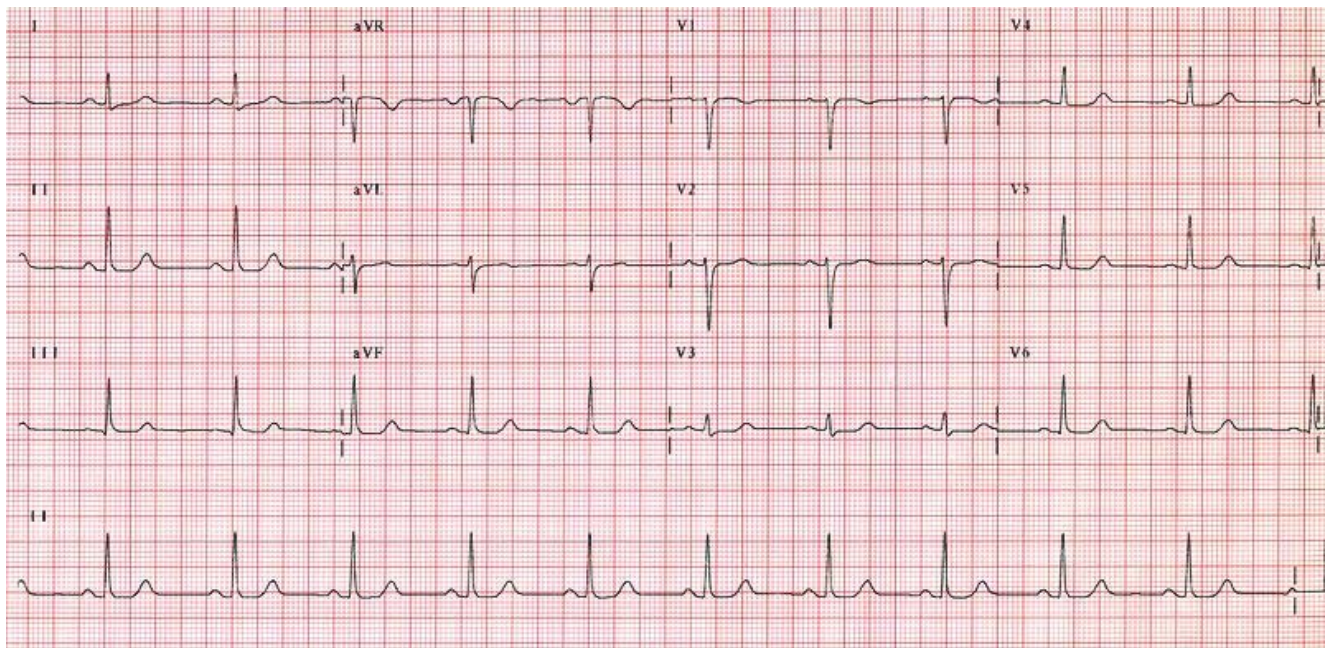
Old Infarction (No Cardiac Alert)

Normal Ventricular Conduction

- From the bundle of His to the bundle branches
 - Right
 - Left
- Ventricular septum depolarizes from the left to the right
- Left and right ventricles depolarize simultaneously



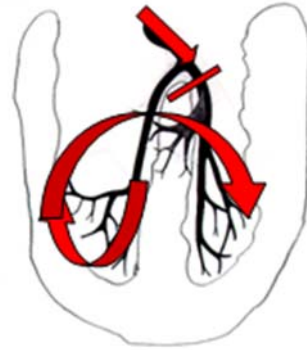
- QRS \leq 0.10 seconds
- rS complex in V1
- Most positive complex in V6



Left Bundle Branch Block

Ventricular Conduction in a Left Bundle Branch Block

- The L bundle branch is blocked and impulses will not travel through it
- Impulse travels through the intact R bundle branch causing depolarization of the R ventricle
- The L ventricle receives no direct depolarization



Depolarization of the Left Ventricle

- The L ventricle is depolarized indirectly
- Impulses cross the intraventricular septum from the R ventricle causing depolarization
- This causes a delay in depolarization and results in a wide QRS complex

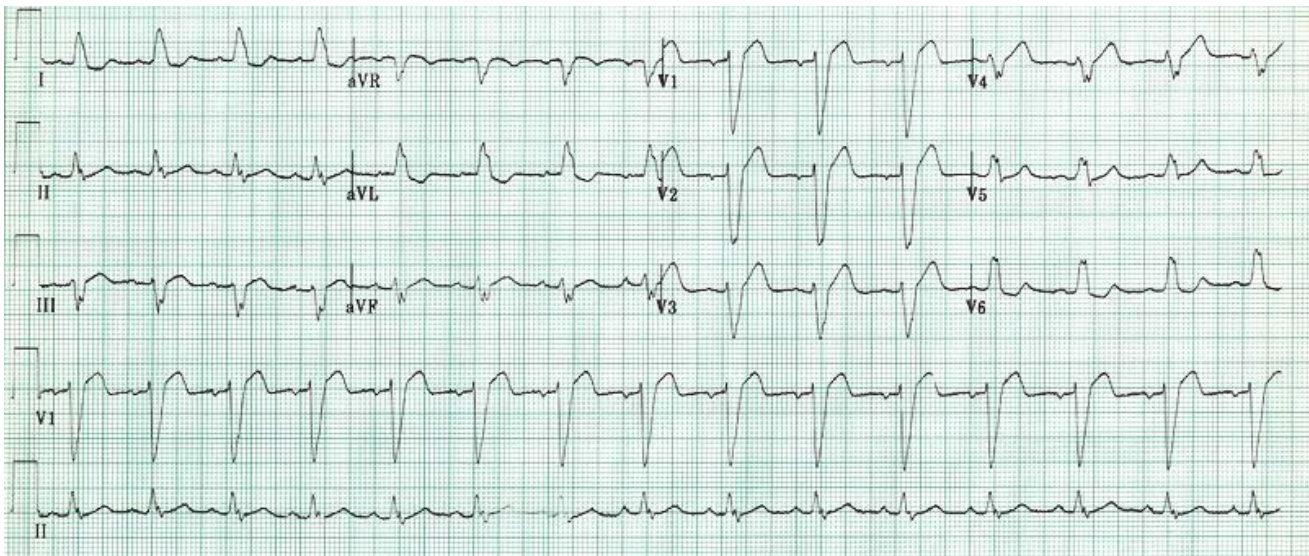
EKG Findings in a Left Bundle Branch Block

Definitive characteristics

- Prolonged QRS; > 0.12 sec
- rS pattern in V₁

Other changes you may see

- Wide R waves in I, aV_L, V₅-V₆
- R waves may be notched
- Deep, wide S waves in V₁ – V₃



Early Repolarization

- Early repolarization describes a pattern of localized or diffuse ST segment elevation. This is especially seen in leads with prominent R wave
- Early repolarization is a cause of ST elevation. This innocent condition typically occurs in young healthy males. The T wave begins early, adding elevation to the ST segment
- Usually, early repolarization shows elevation of the J point (the junction between the end of the QRS and the ST segment) and a concave upward curve towards the T wave. (“Concave upward” means the hollow portion of the curve is on top.)
- Usually seen in the anterior precordial leads of the ECG, but can be seen in limb leads to a lesser degree.
- Early repolarization cannot always be differentiated from myocardial infarction. In the chest pain patient, it’s safest to assume ST elevation to be infarction until proven otherwise by reviewing a previous ECG or by obtaining serial ECGs
- PR depression is absent, and reciprocal changes tend not to be found in lead= s aVR and V1. ST elevation due to early repolarization is said to be more common in young African-American males, and tends to be most apparent at slower heart rates.
- While the ECG can be misleading, the clinical history and physical examination frequently point to the correct diagnosis. The chest discomfort of pericarditis is sharp, pleuritic, and positional, unlike that of acute infarction. A multi component pericardial friction rub is frequently present on physical examination in patients with acute pericarditis.

EKG Findings of Early Repolarization

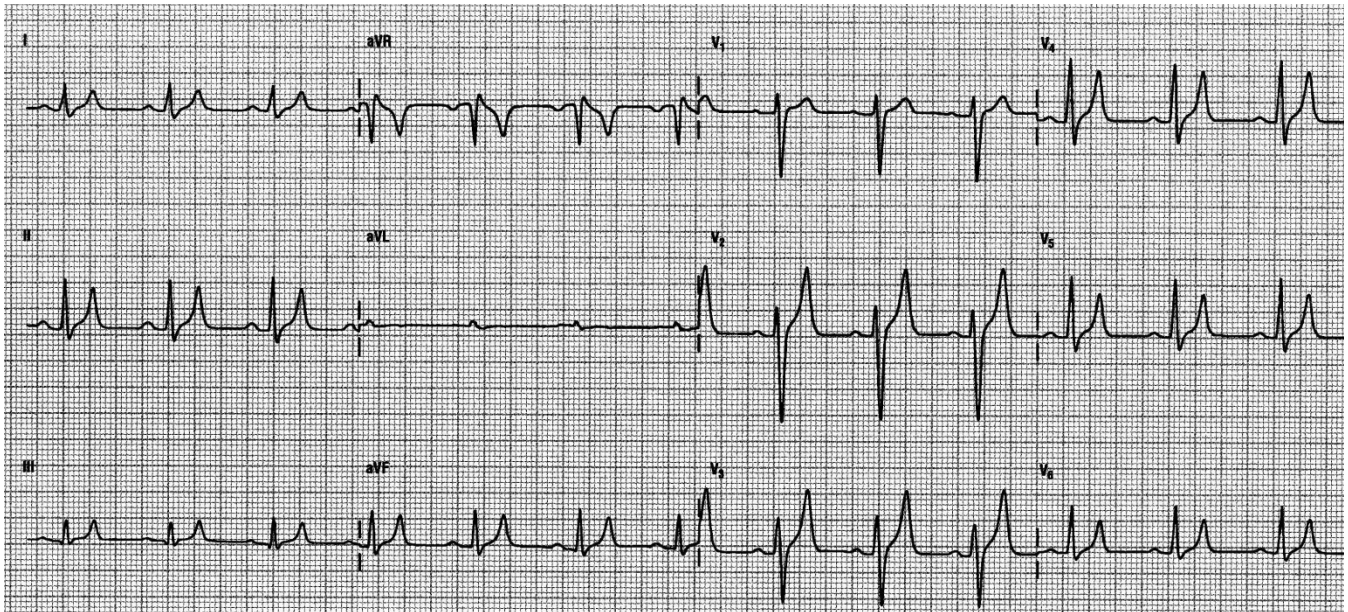
- ST segment elevation commonly seen in I, II, aVF, and V2 – V6
- ST depression may be seen in aVR
- Concave, up sloping ST segments
- J point is frequently elevated
- No reciprocal changes



Hyperkalemia

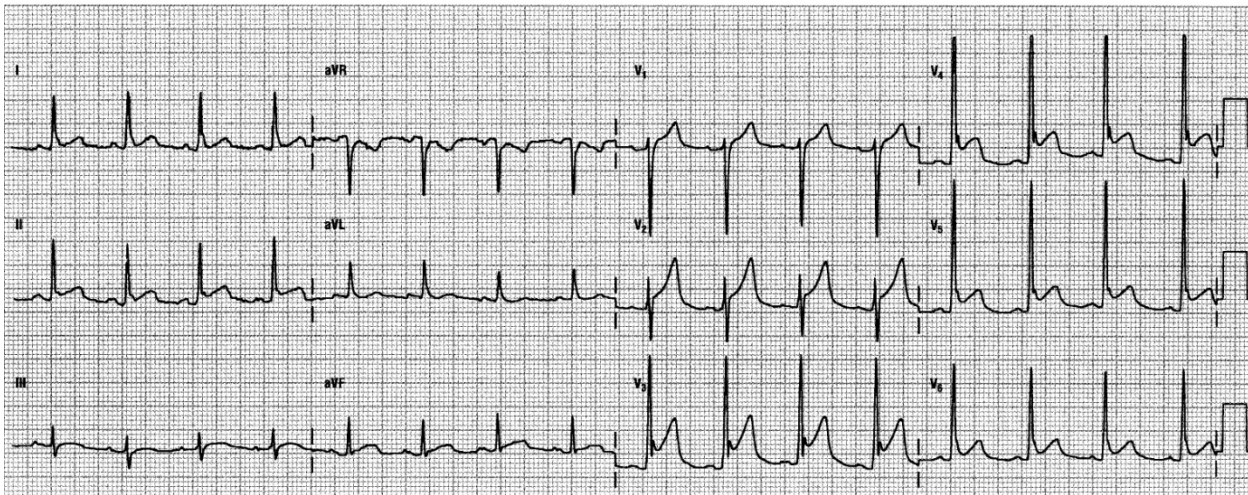
- Caused by elevated serum potassium levels
- Electrolyte imbalances rare in patients with healthy kidneys and access to water
- May mimic an AMI pattern
- The PR interval may be normal or prolonged
- EKG changes are dependent upon potassium levels

K⁺ Level	EKG Change
5.5 – 6.5 mEq/L	T waves become peaked -Earliest T wave changes seen in II, III, and V2 – V6
6.0 mEq/L	ST segments disappear
6.0 – 6.5 mEq/L	QRS complex begins to widen
6.5 mEq/L	P waves begin to flatten out
7.0 – 9.0 mEq/L	P waves disappear
10.0 mEq/L	QRS becomes very wide and slurred. They may merge with the T waves causing the appearance of a sine wave



Pericarditis

- Depressed PRI
- ST elevation all leads (could localize)
- **No reciprocal depression**
- Dry cough
- Positional chest pain
- Recent history of illness
- Presentation is similar to MI



Comparison of ECG Changes Associated with Acute Pericarditis, Myocardial Infarction and Early Repolarization

ECG finding	Acute pericarditis	Myocardial infarction	Early repolarization
ST-segment shape	Concave upward	Convex upward	Concave upward
Q waves	Absent	Present	Absent
Reciprocal ST-segment changes	Absent	Present	Absent
Location of ST-segment elevation	Limb and precordial leads	Area of involved artery	Precordial leads
Loss of R-wave voltage	Absent	Present	Absent
PR-segment depression	Present	Absent	Absent

Ventricular Hypertrophy

Left Ventricular Hypertrophy

Causes

- Systemic hypertension
- Aortic stenosis
- Hypertrophic cardiomyopathy

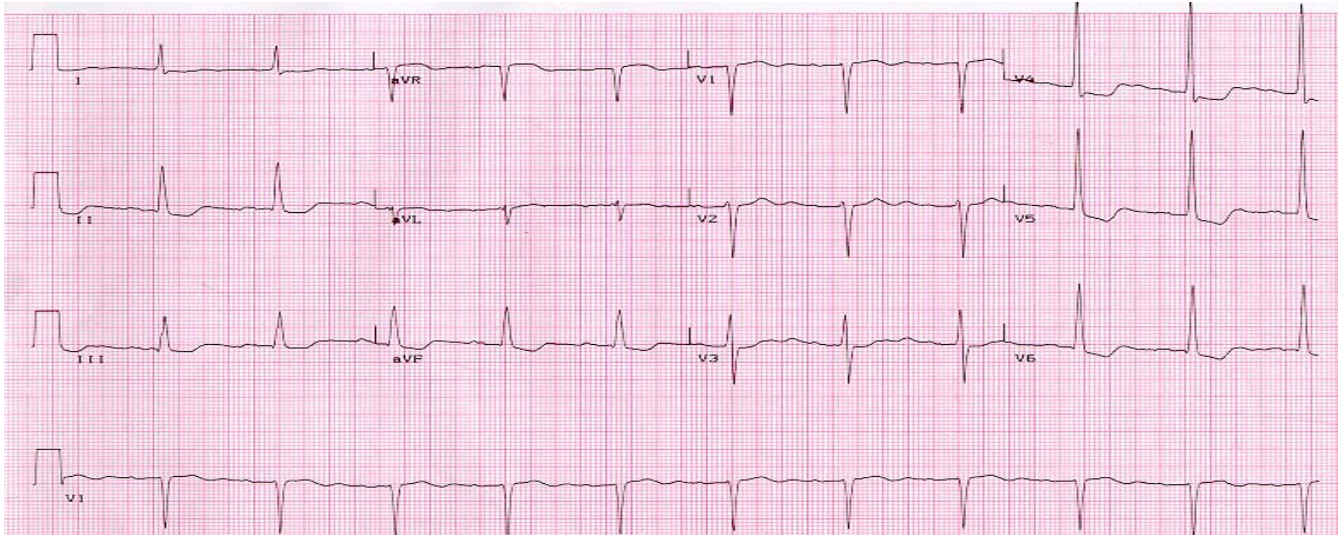
EKG Findings

Wave	I	III	aVL	V1 or V2	V5 or V6
• R Wave	≥ 20 mm		≥ 11 mm		≥ 30 mm
• S Wave		≥ 20 mm		≥ 30 mm	

- Summation
 - $R(I, II \text{ or } III) + S(I, II \text{ or } III) = \geq 20\text{mm}$
 - $R I = S III = \geq 25$ mm
 - $S(V1 \text{ or } V2) + R(V5 \text{ or } V6) = \geq 35\text{mm}$

- Strain Pattern
 - I
 - aVL
 - V5
 - V6





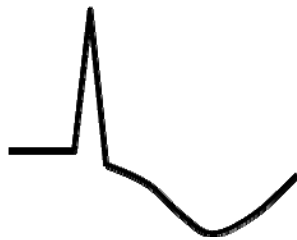
Right Ventricular Hypertrophy

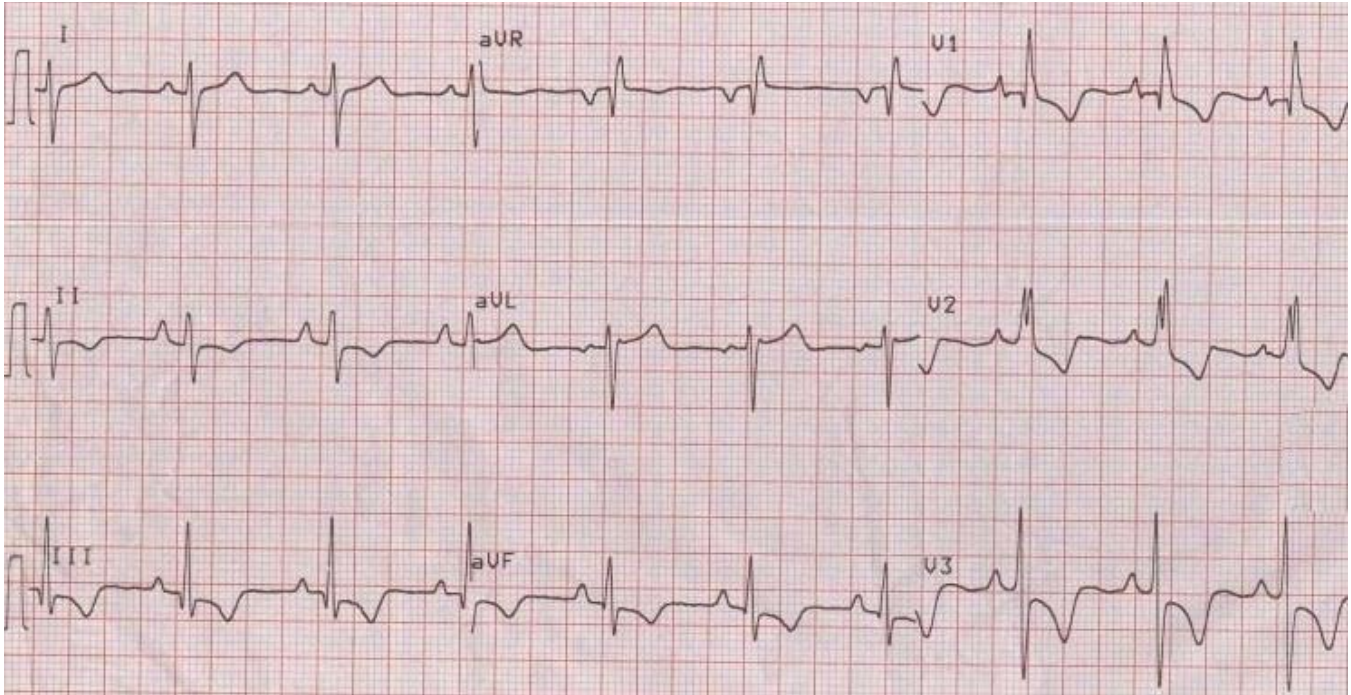
Causes

- Pulmonary hypertension
- COPD
- Mitral valve stenosis
- Pulmonary embolism

EKG Findings

- Q waves may be present in II, III, and aVF
- Tall R waves in II, III, and V1
- R waves in V1 > 7mm and equal to or greater than the depth of the S wave
- Deeper than normal S waves in I and V4 – V6
- In V6 the depth of the S wave may be greater than the R wave
- Strain Pattern
 - II
 - III
 - aVF
 - V1

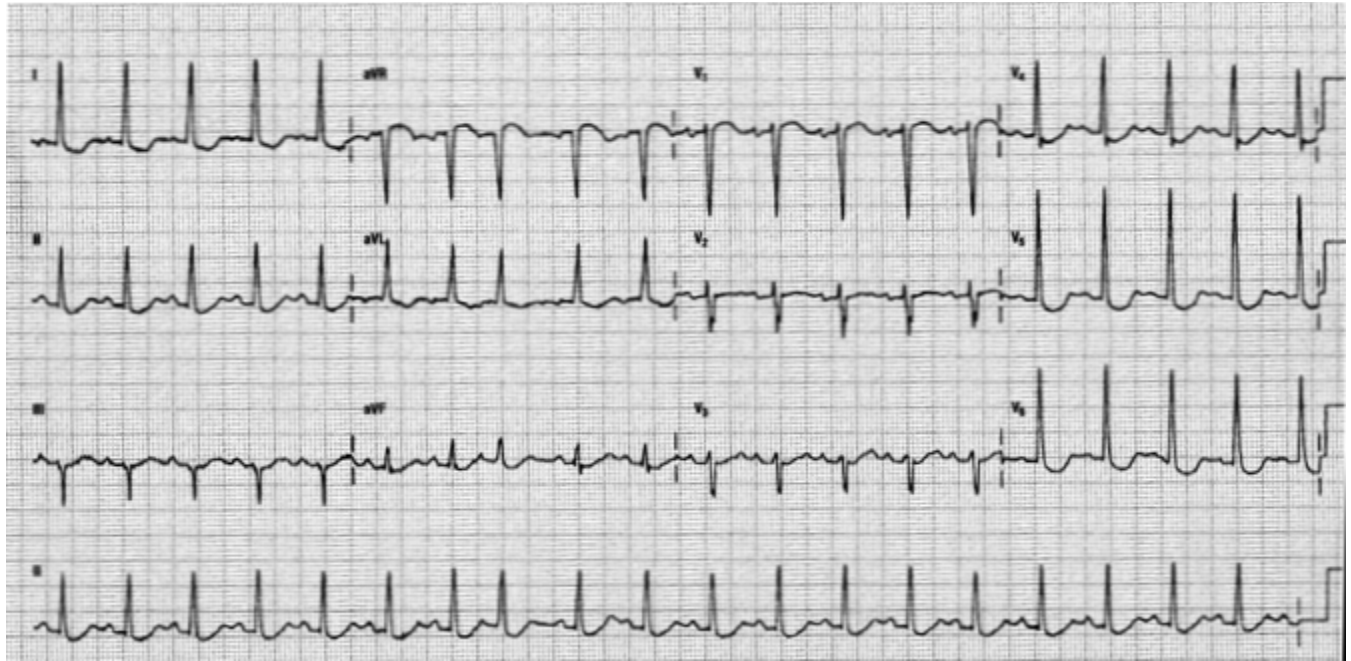




Digitalis

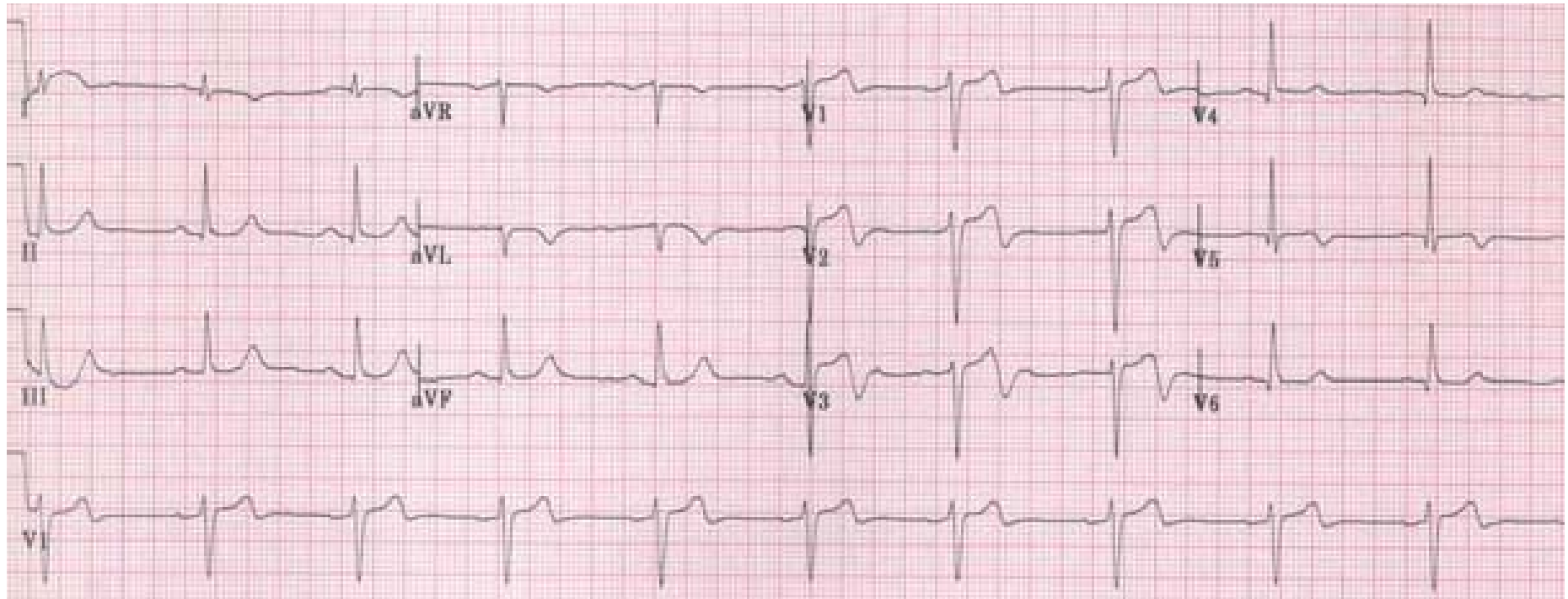
EKG Changes

- Prolonged PRI
- Flattened or inverted T waves
- Shortened QT intervals (0.30 sec)
- ST segments depressed > 1mm
 - “dig scoop”

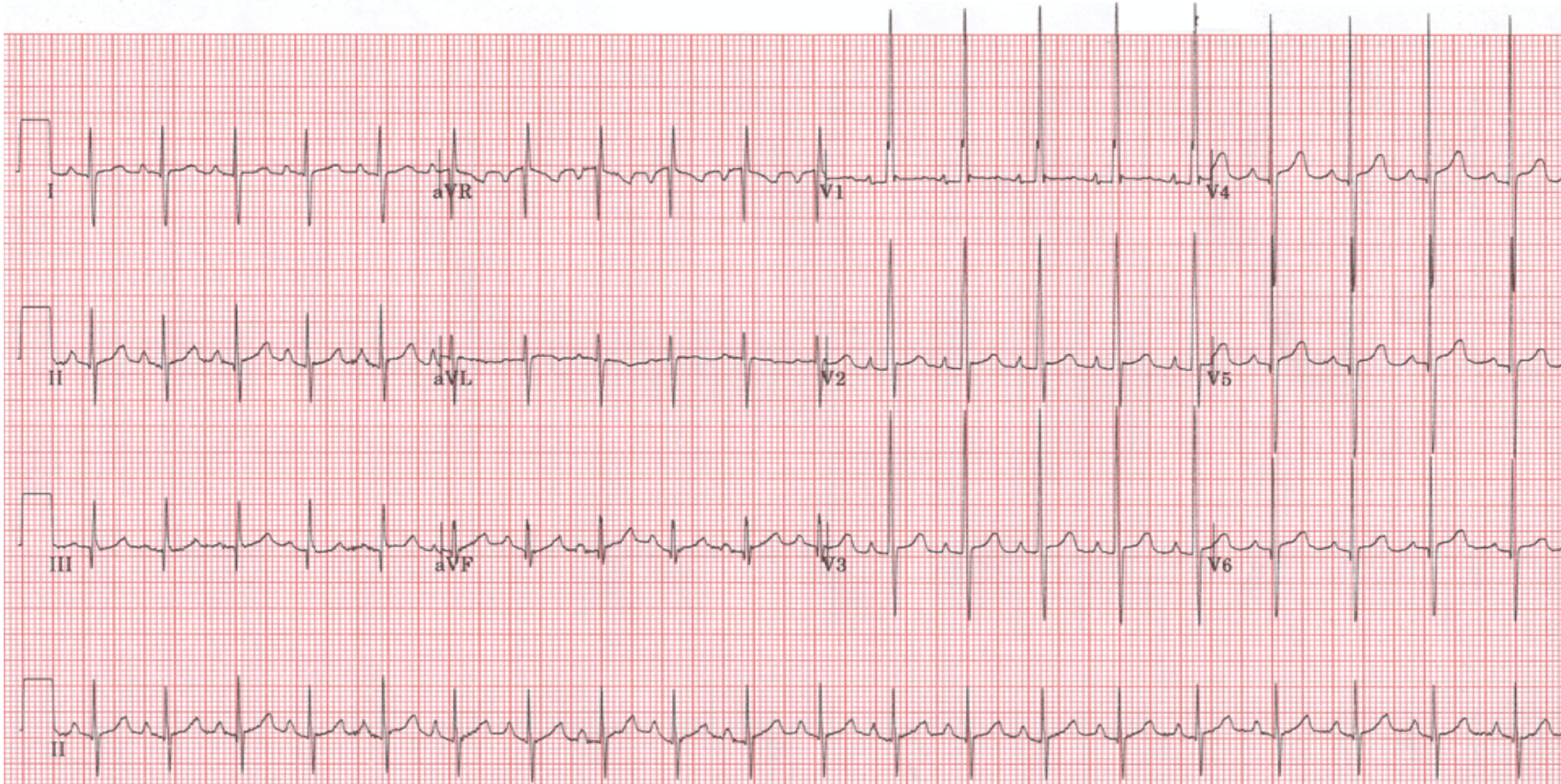


Practice

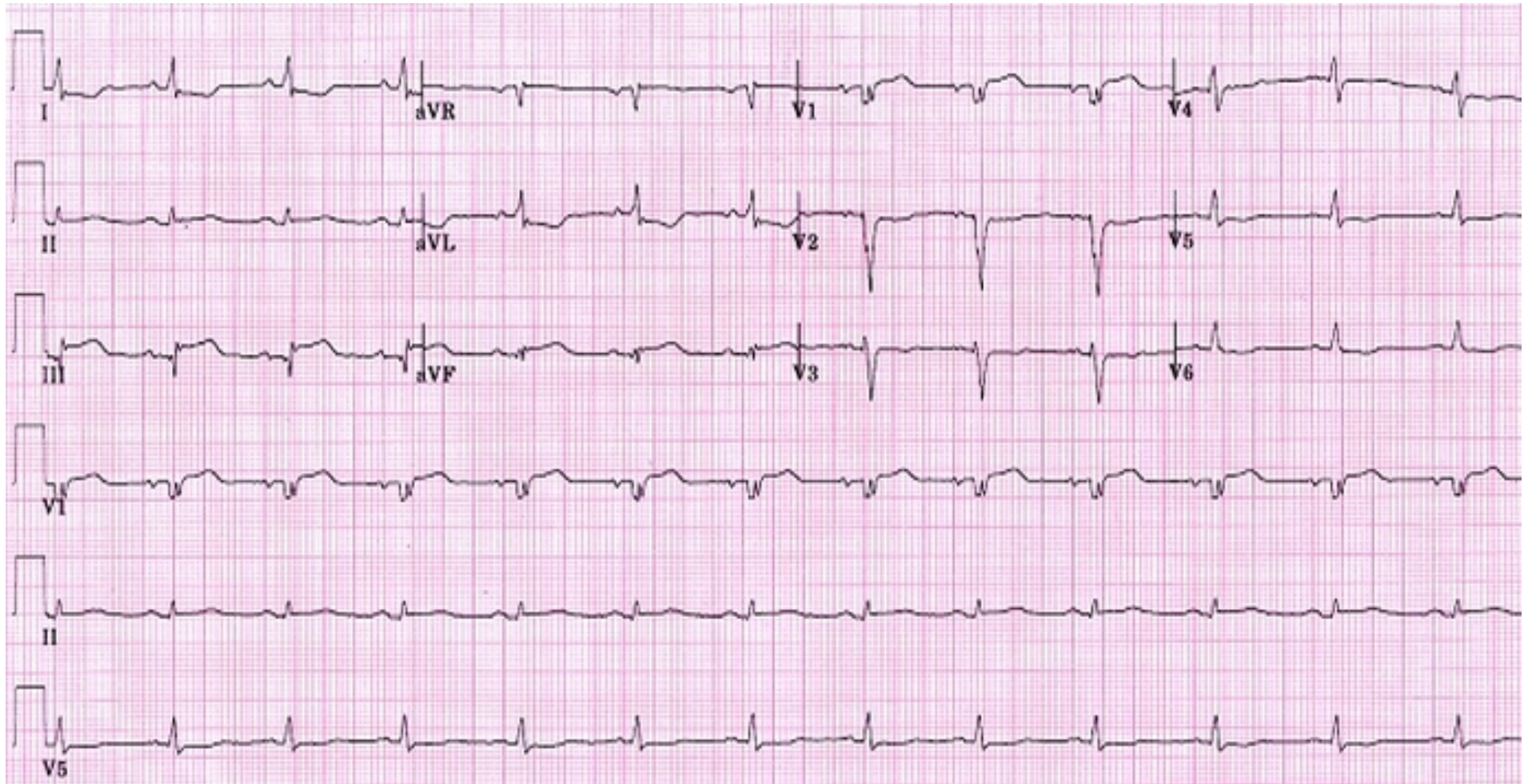
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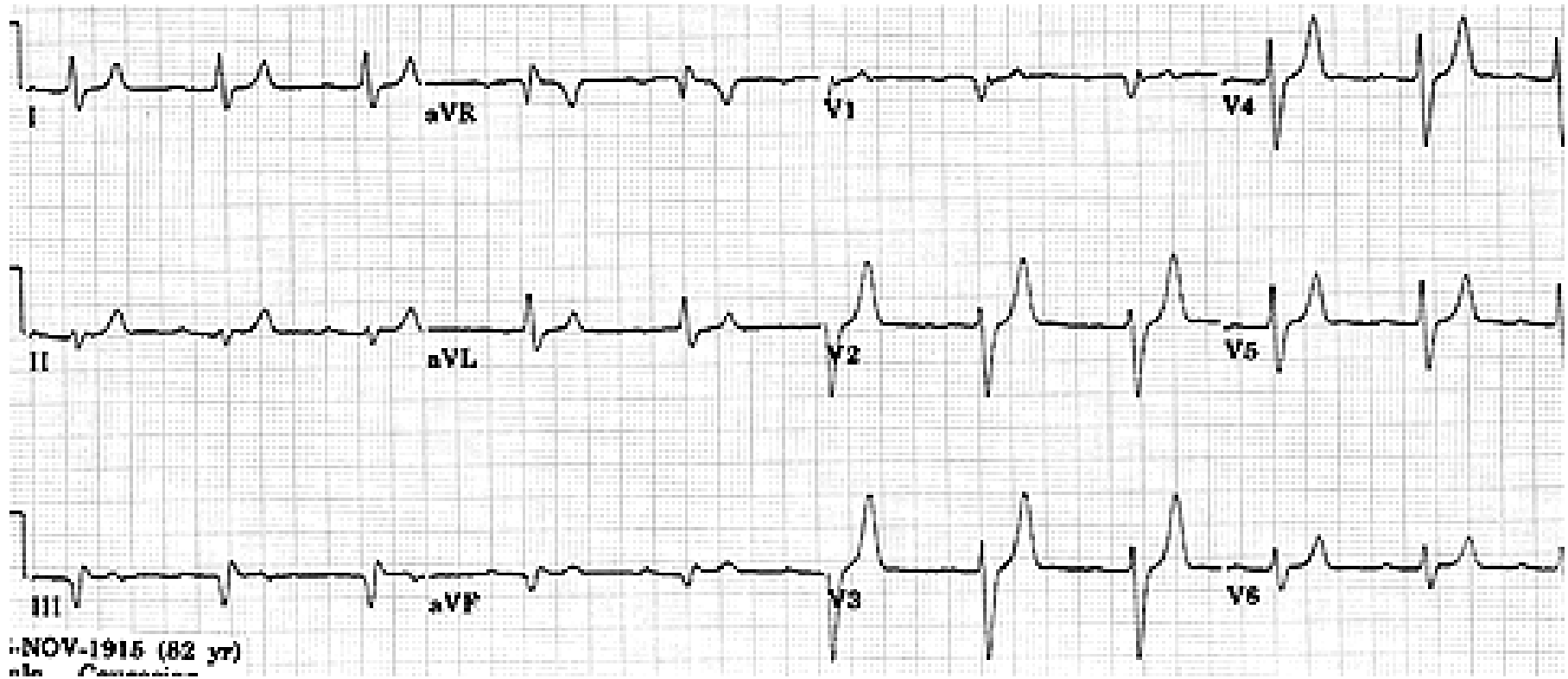
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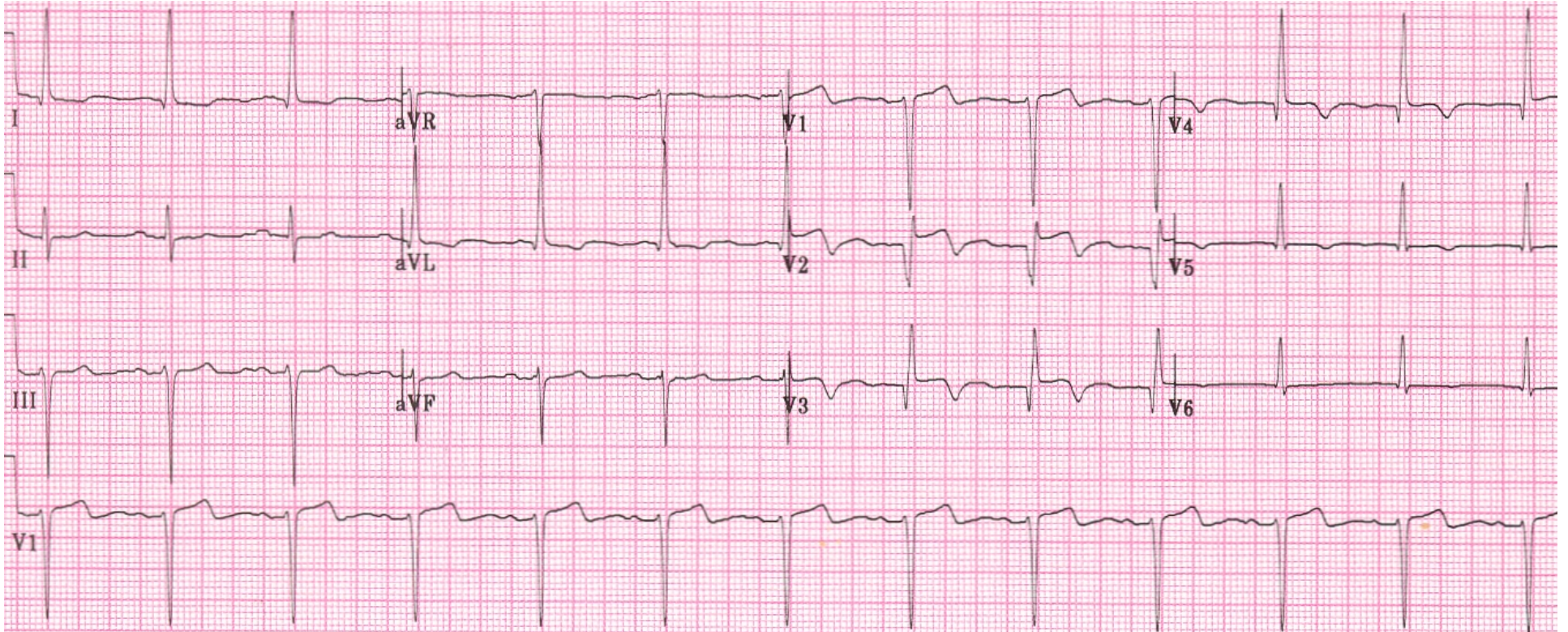
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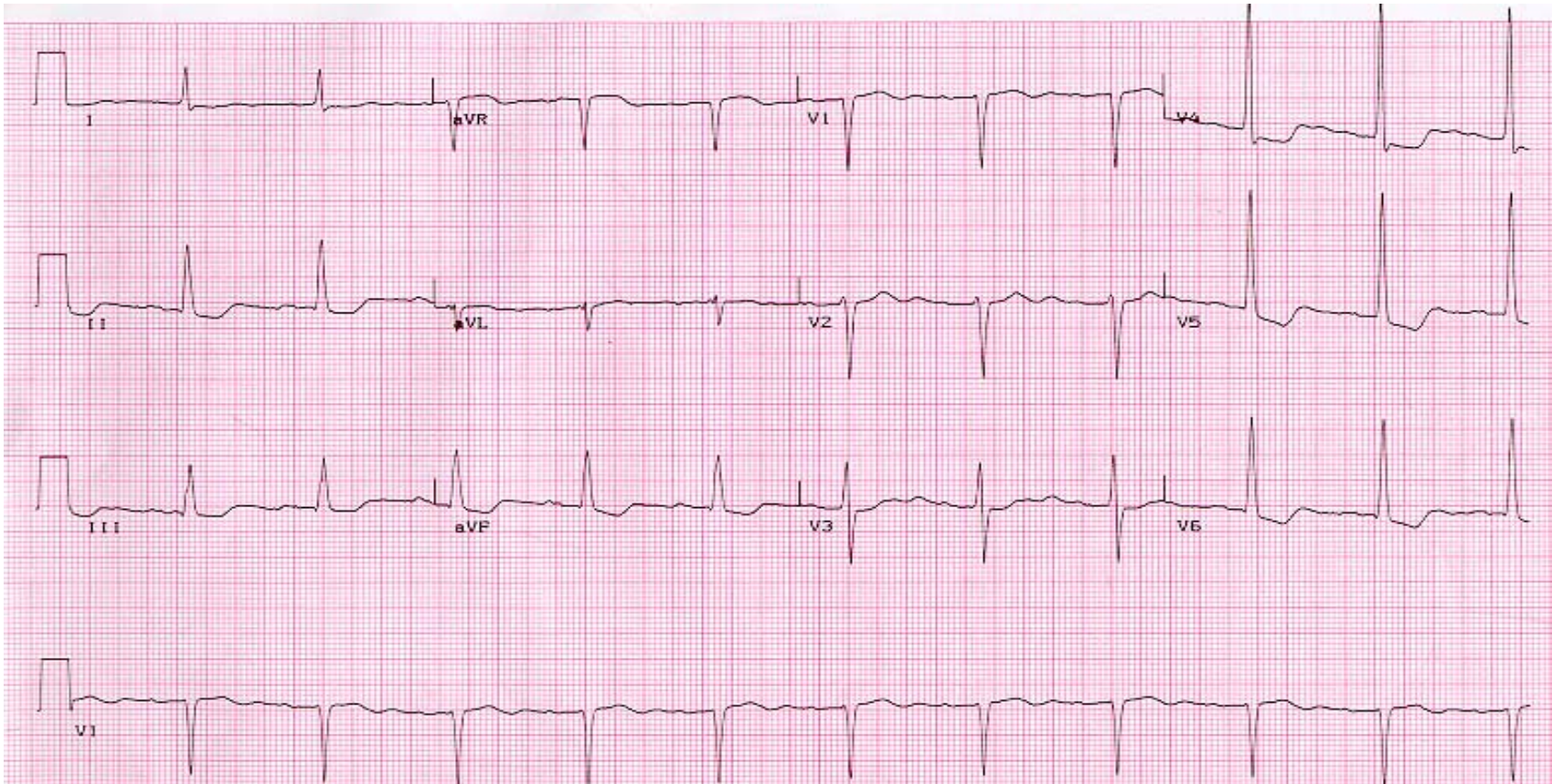
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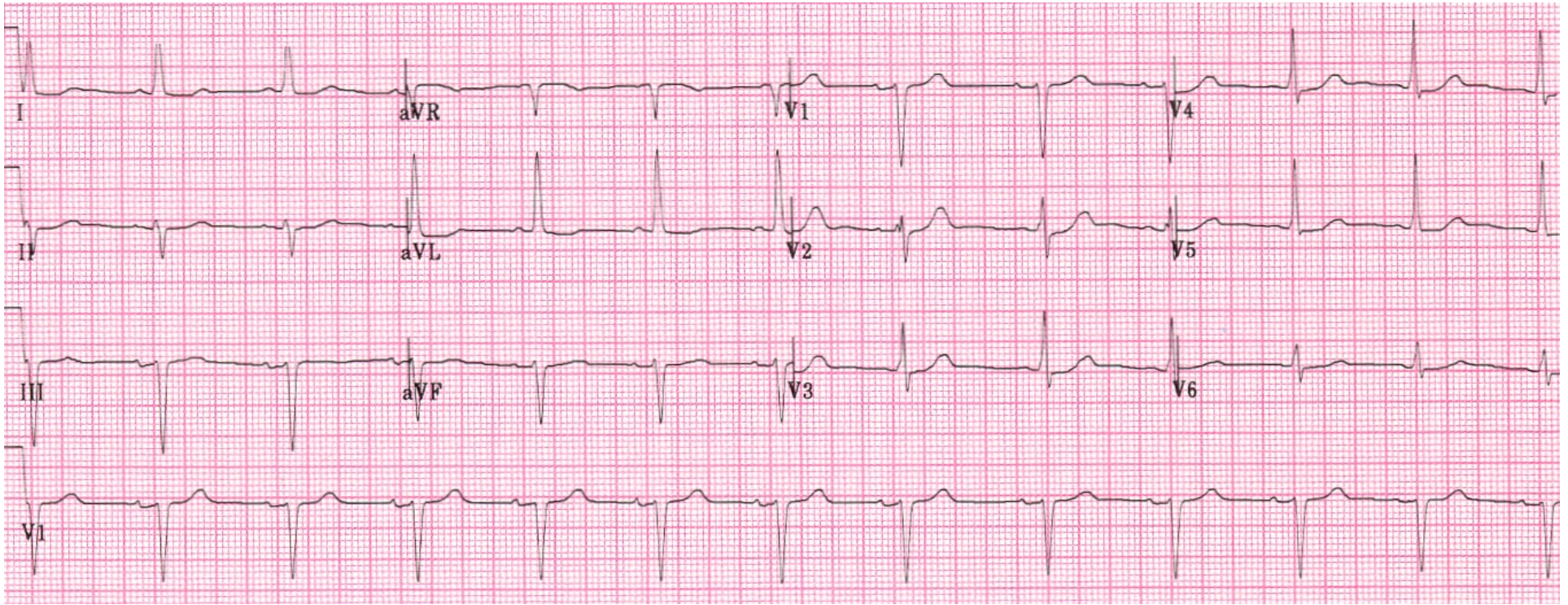
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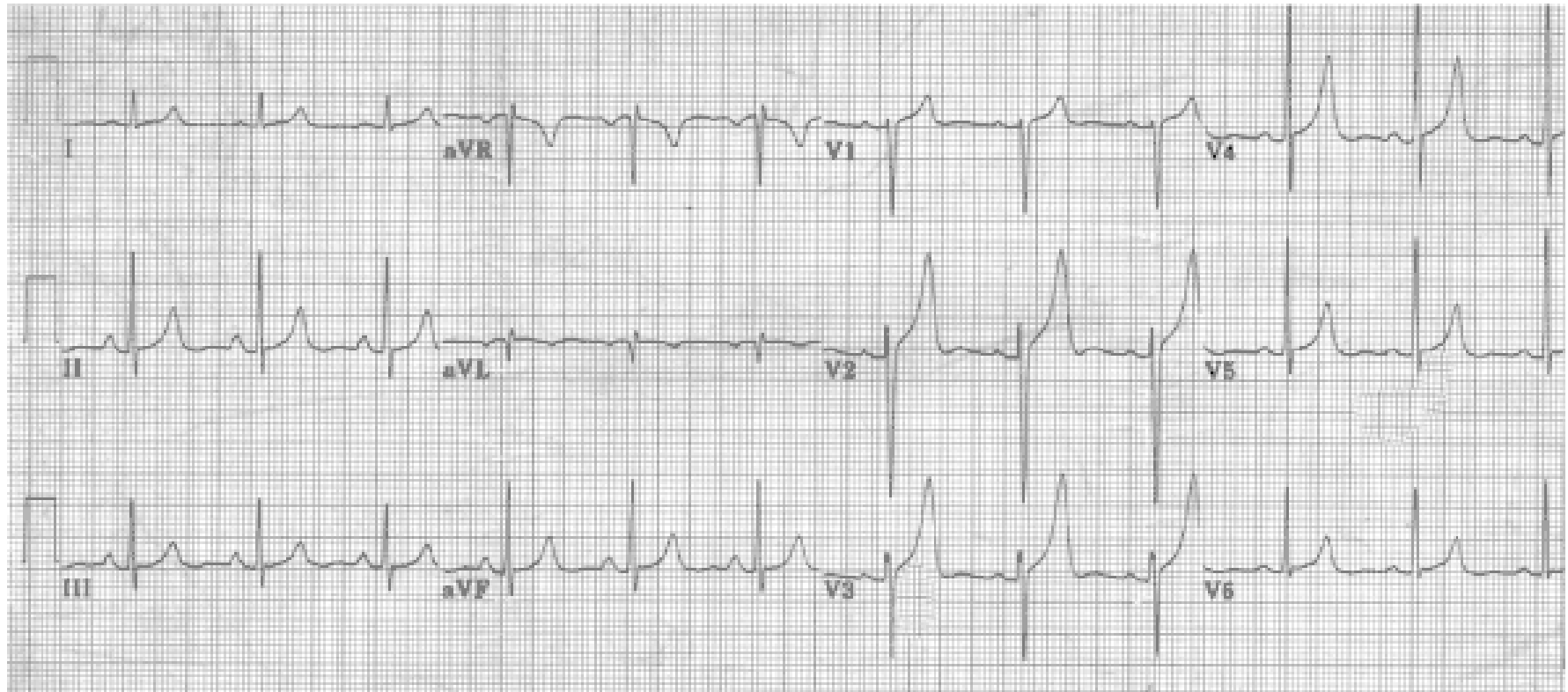
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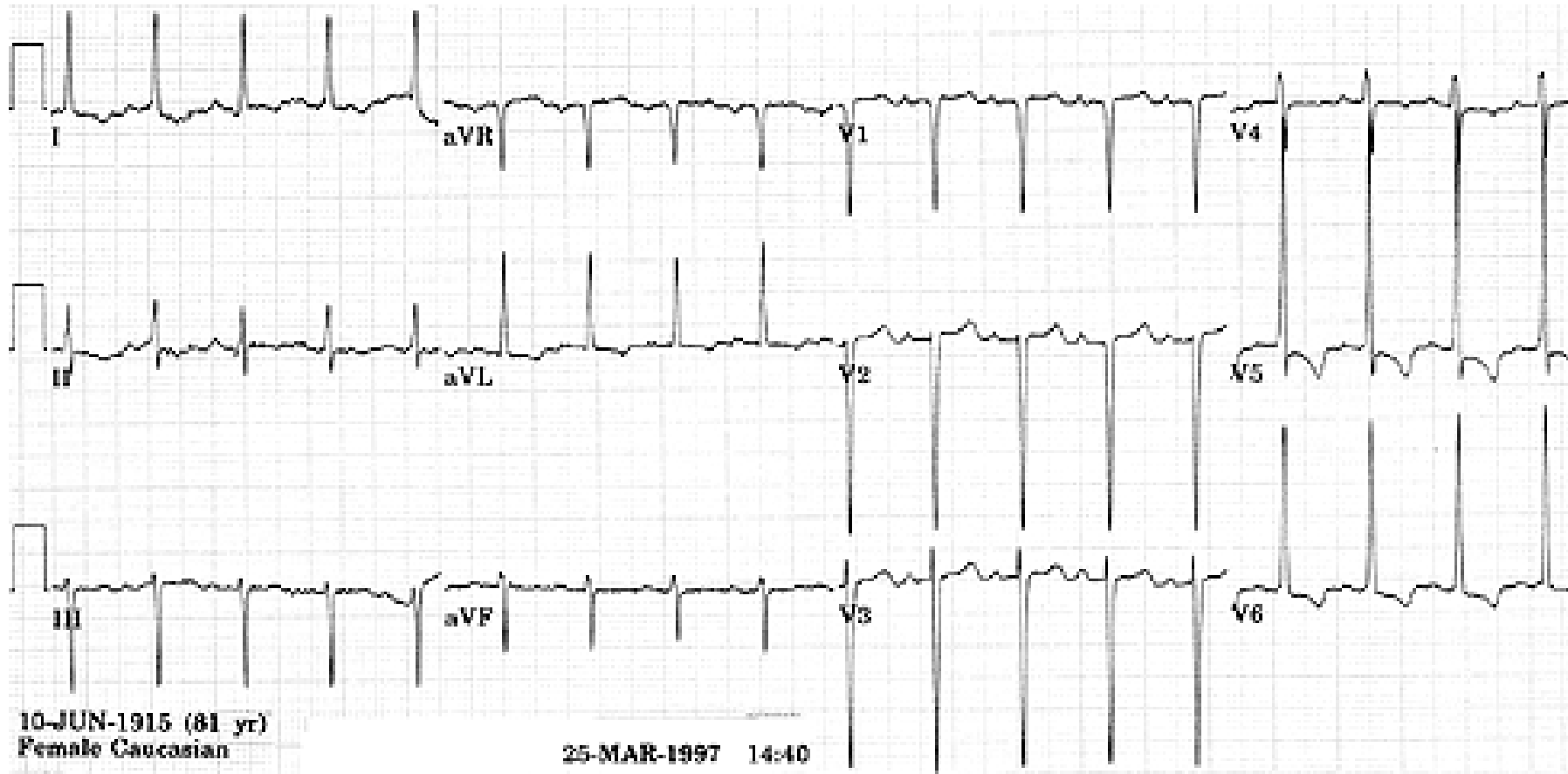
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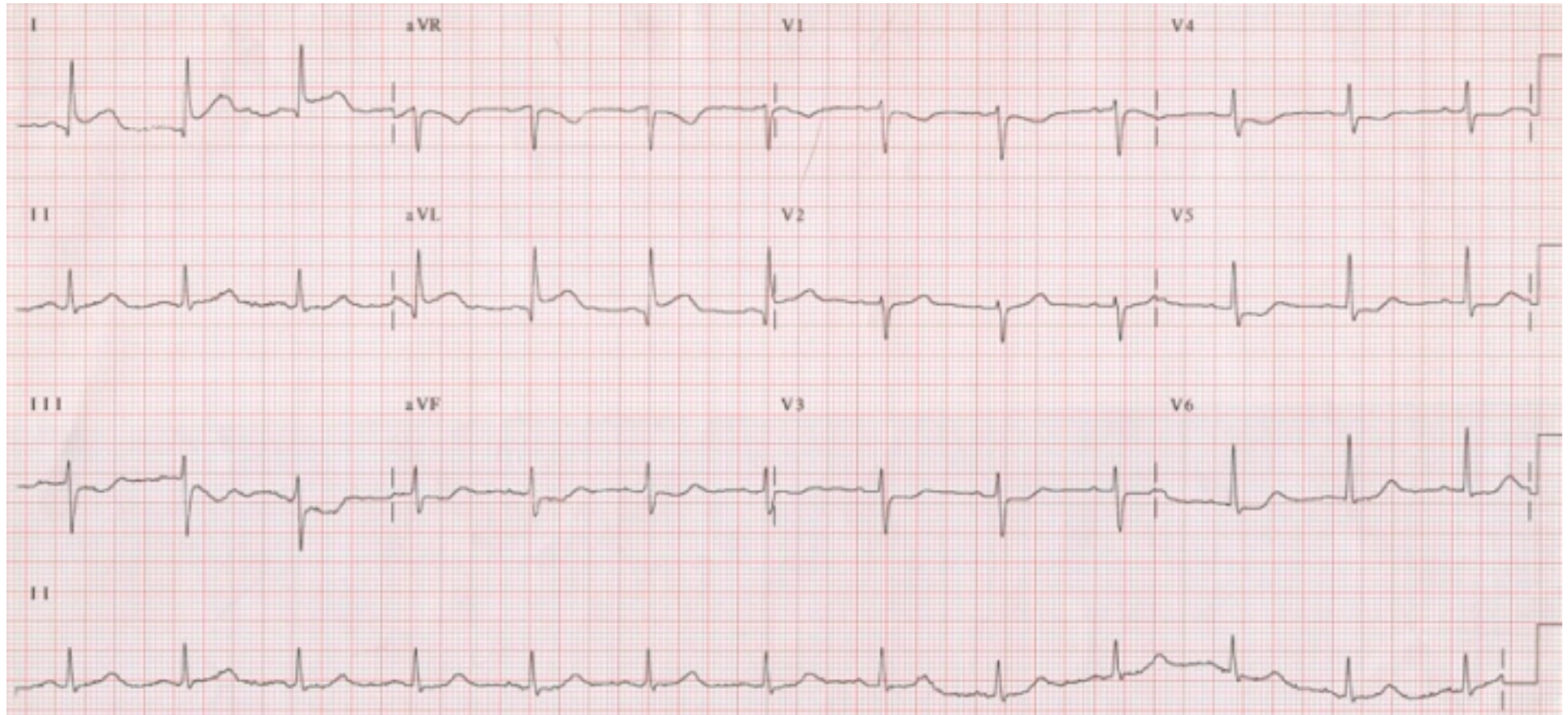
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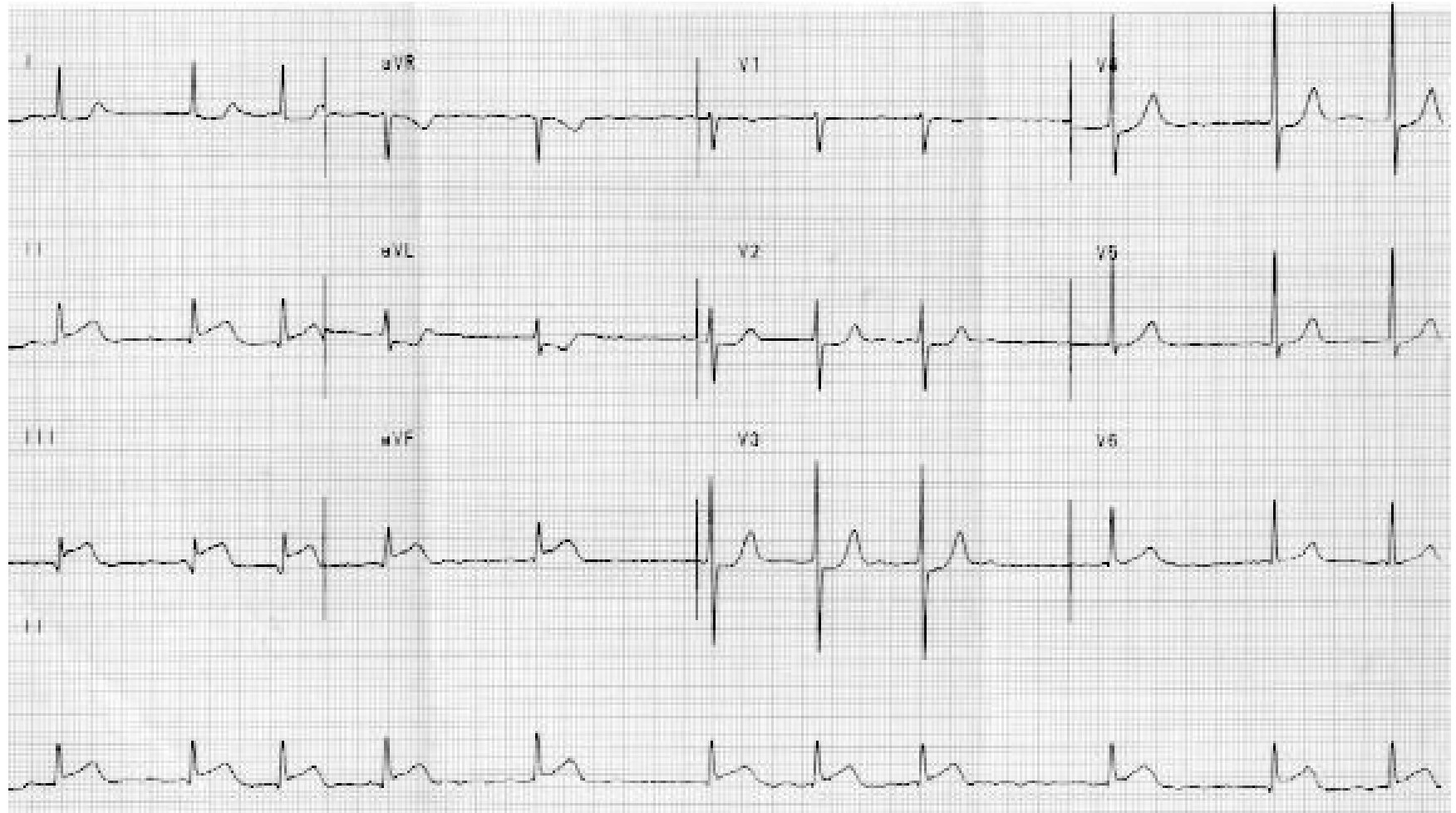
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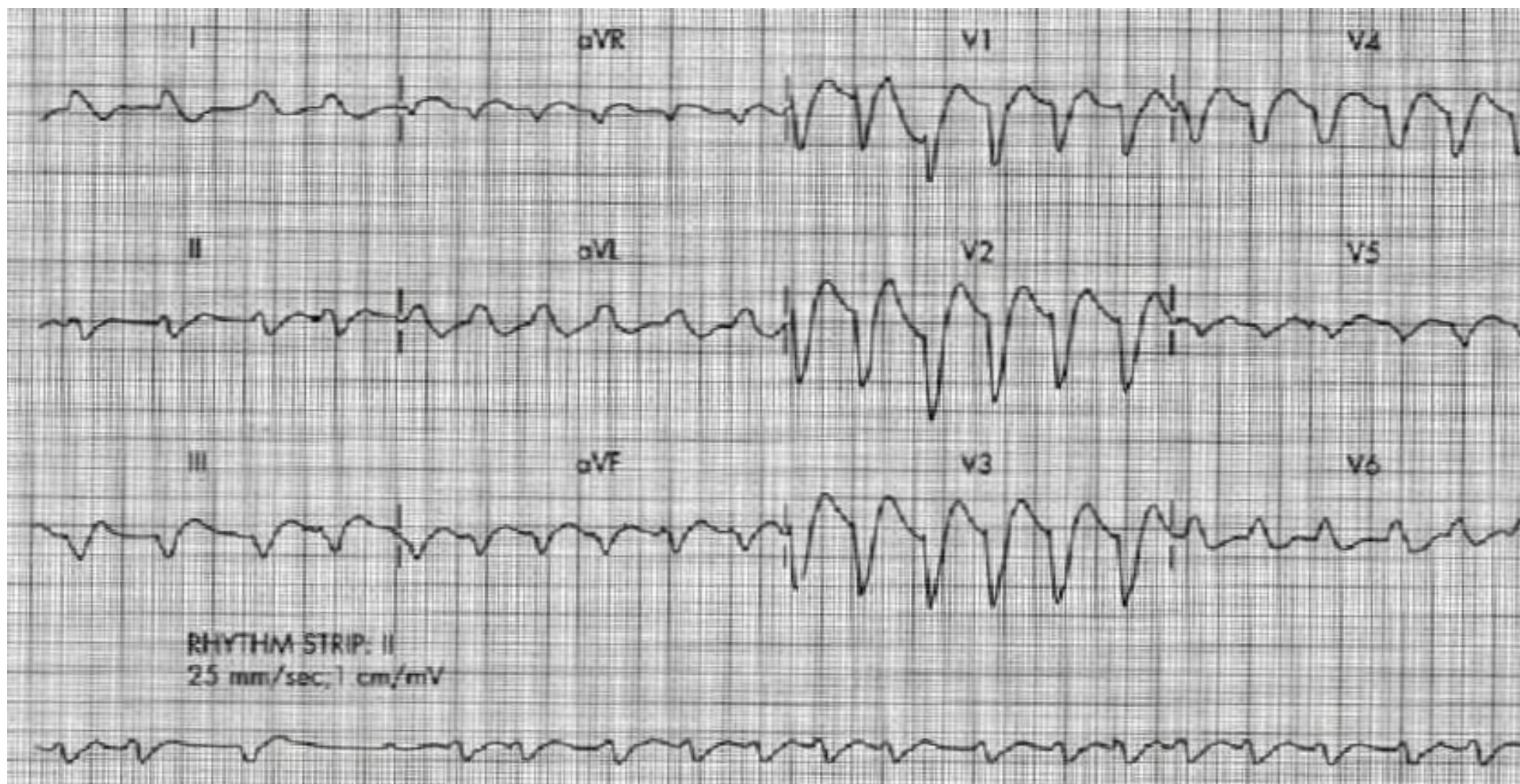
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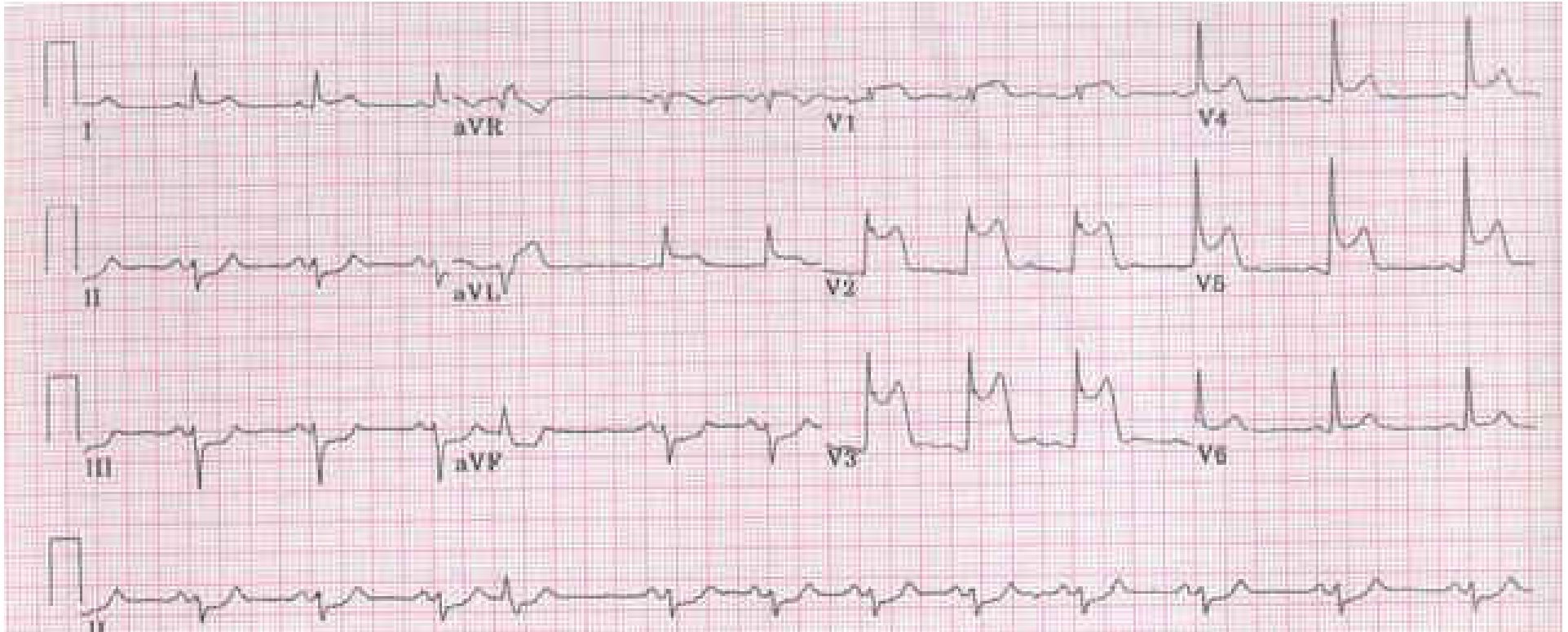
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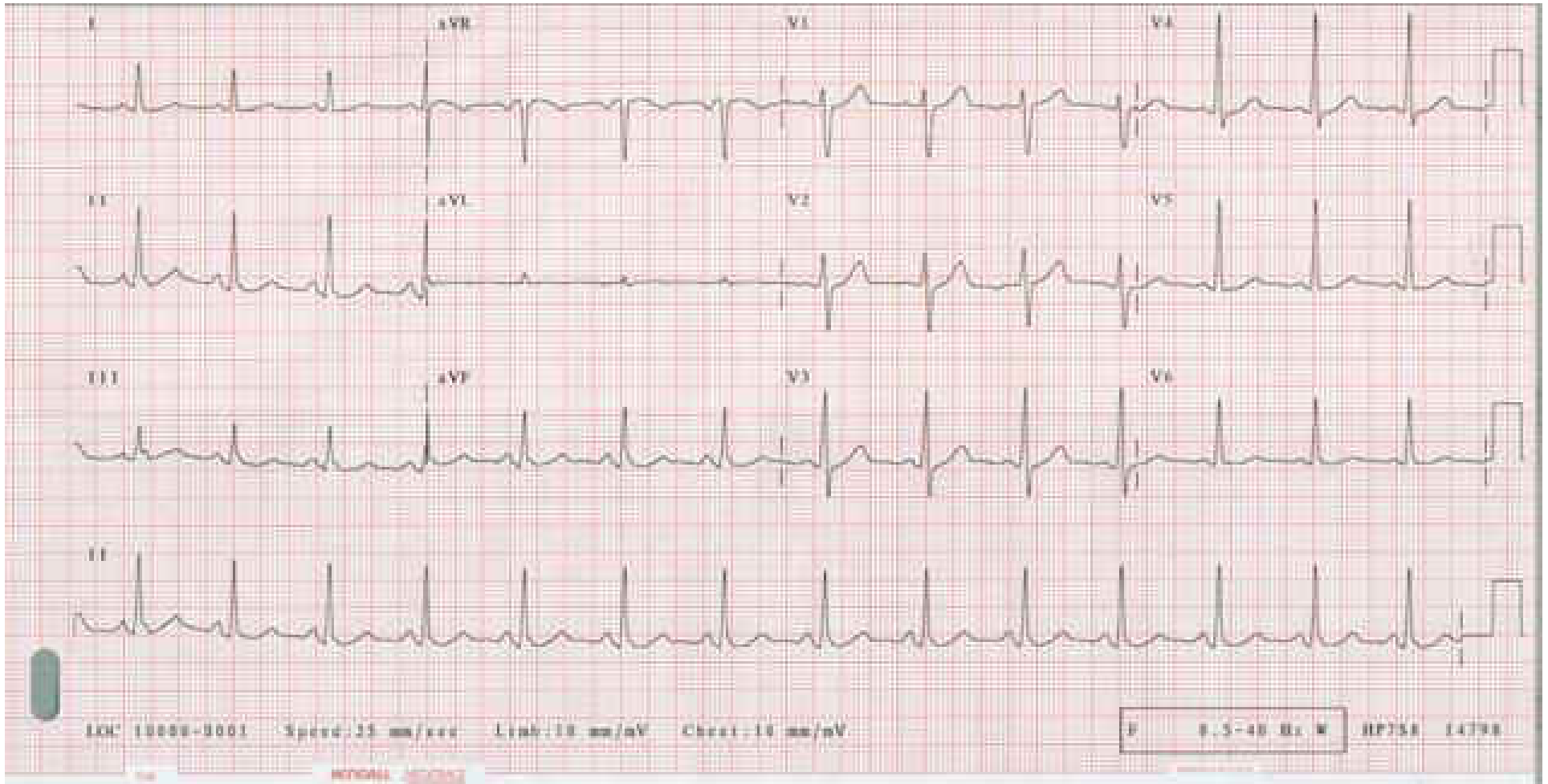
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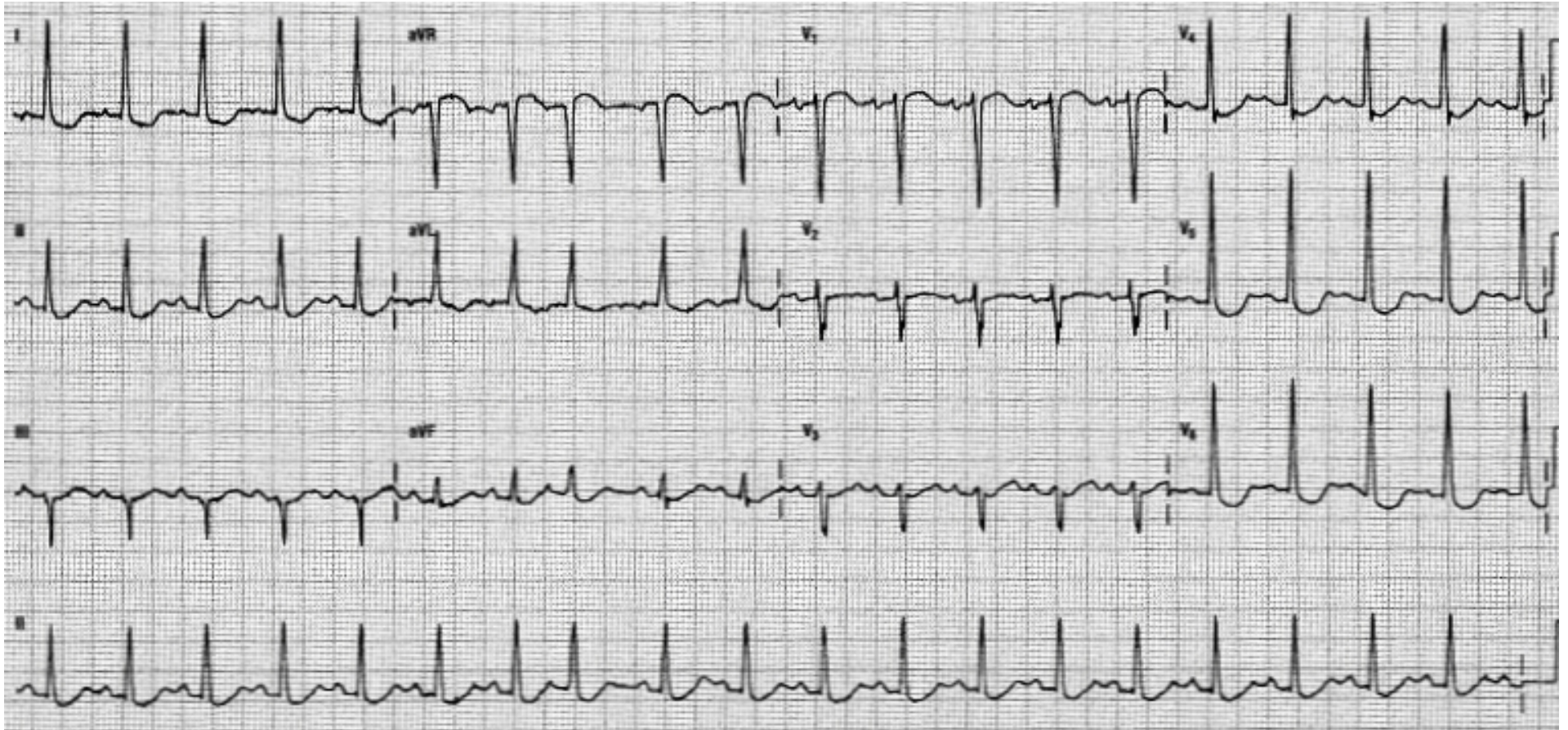
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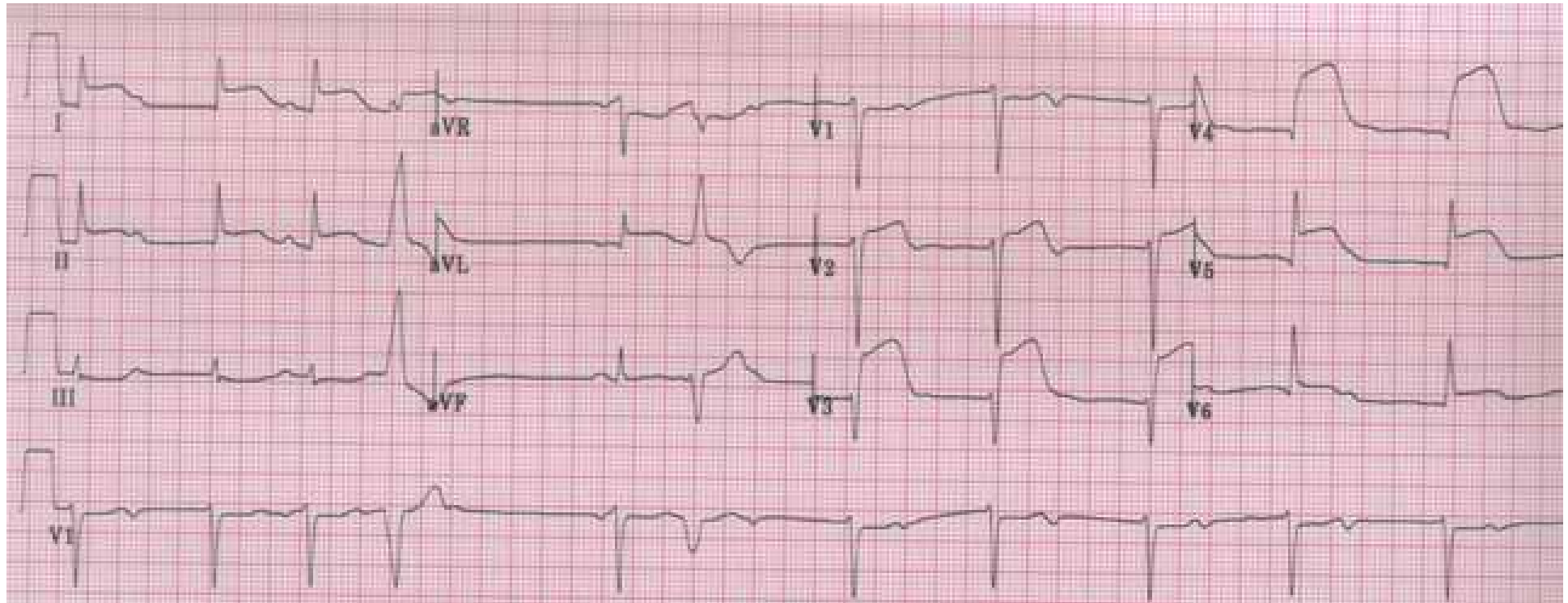
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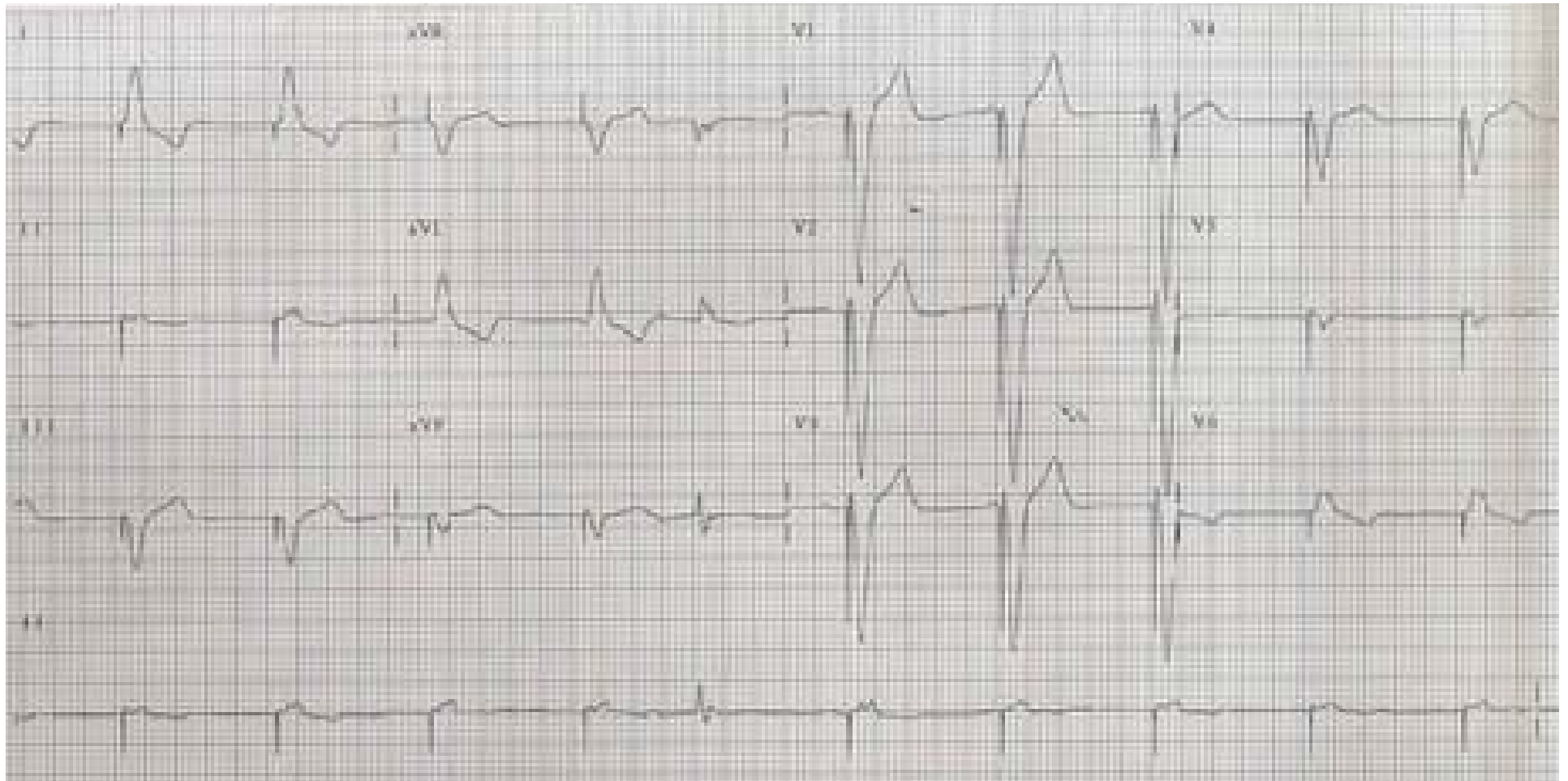
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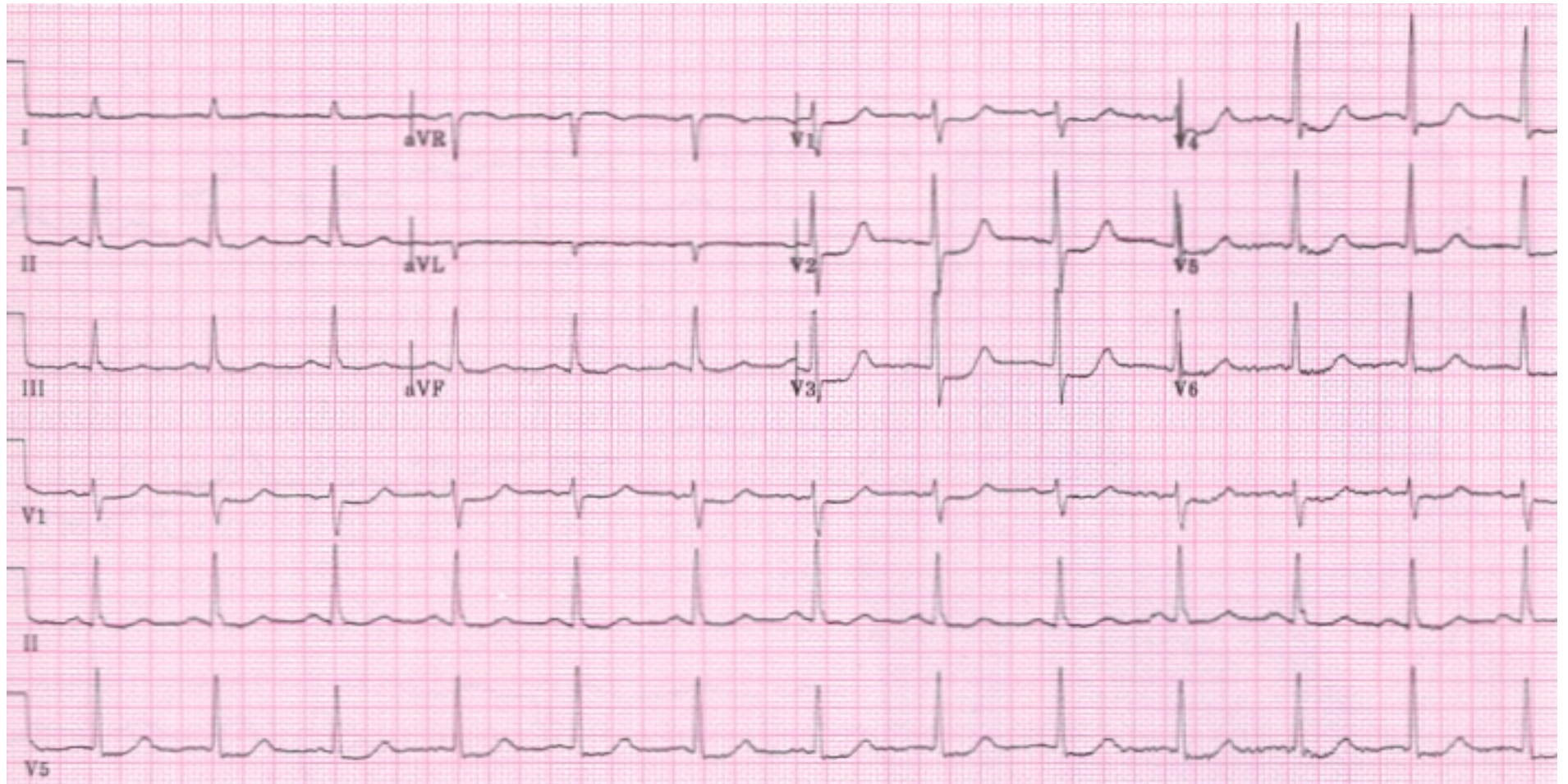
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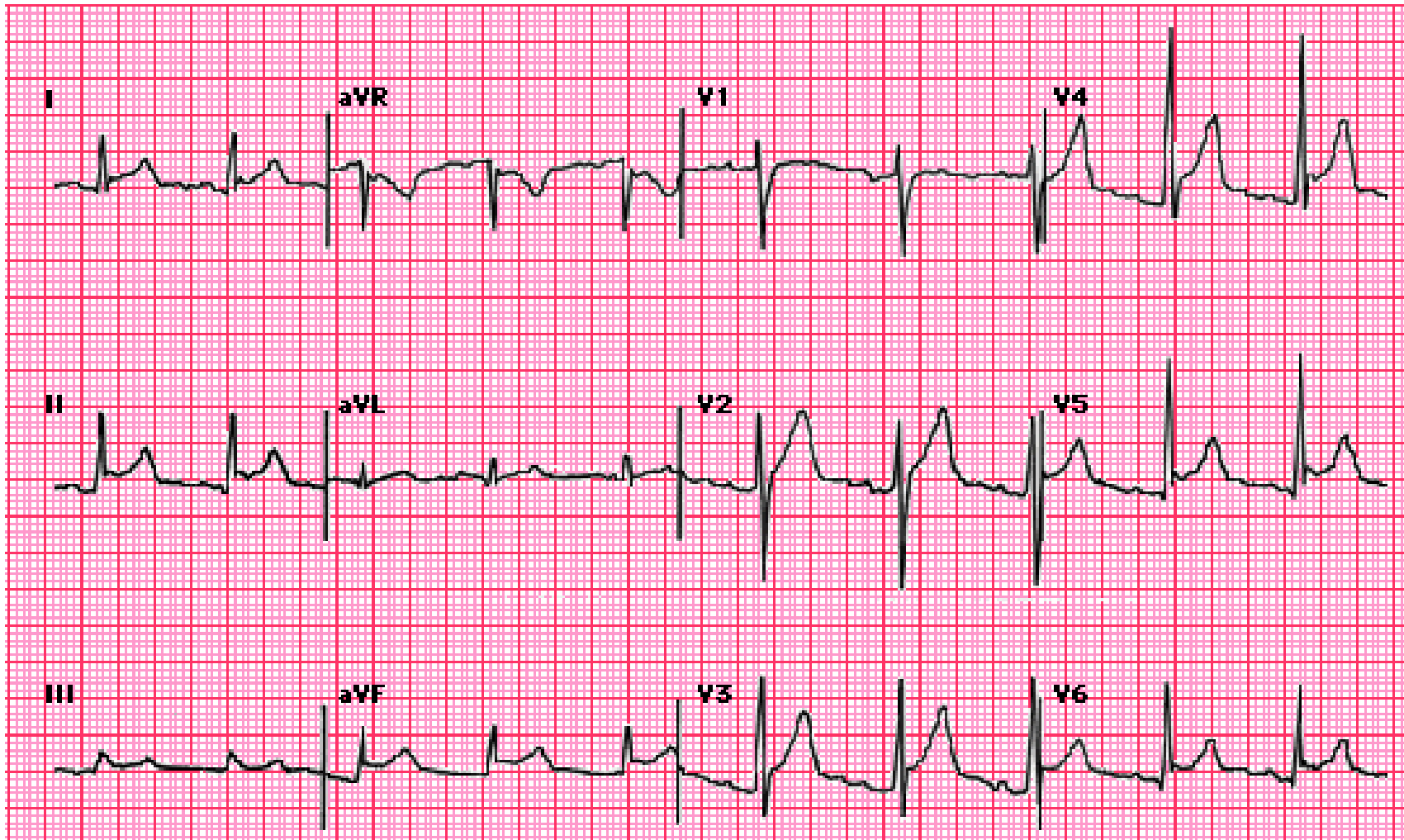
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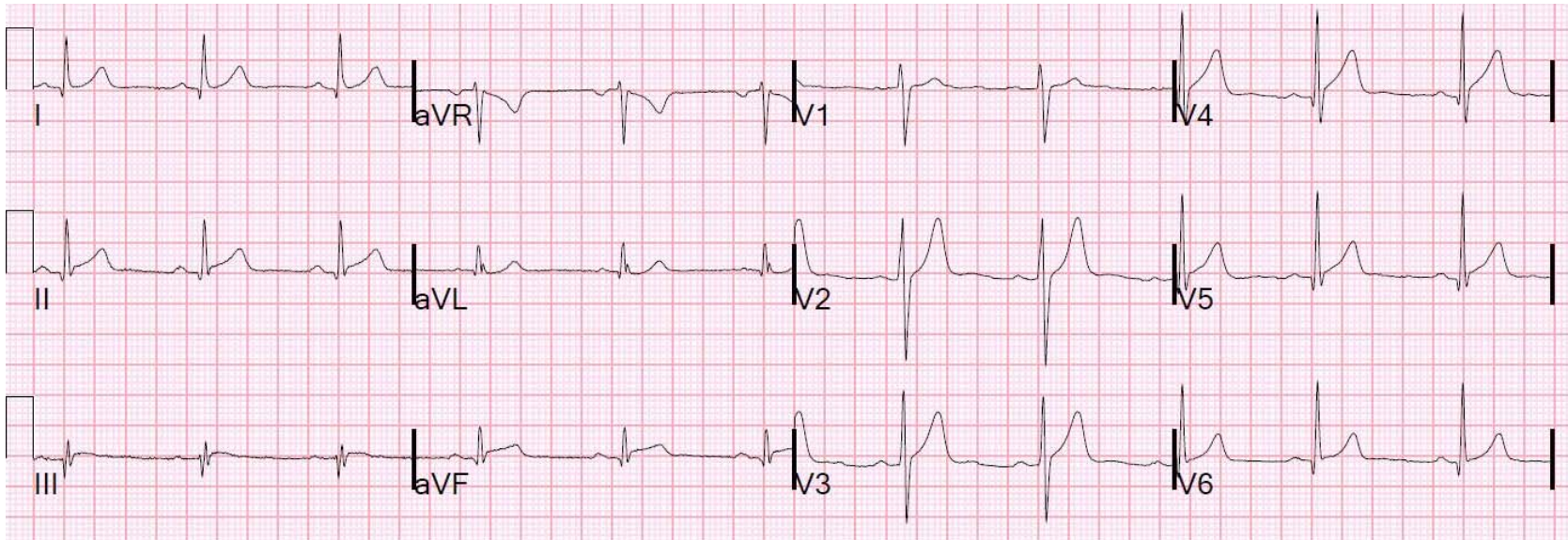
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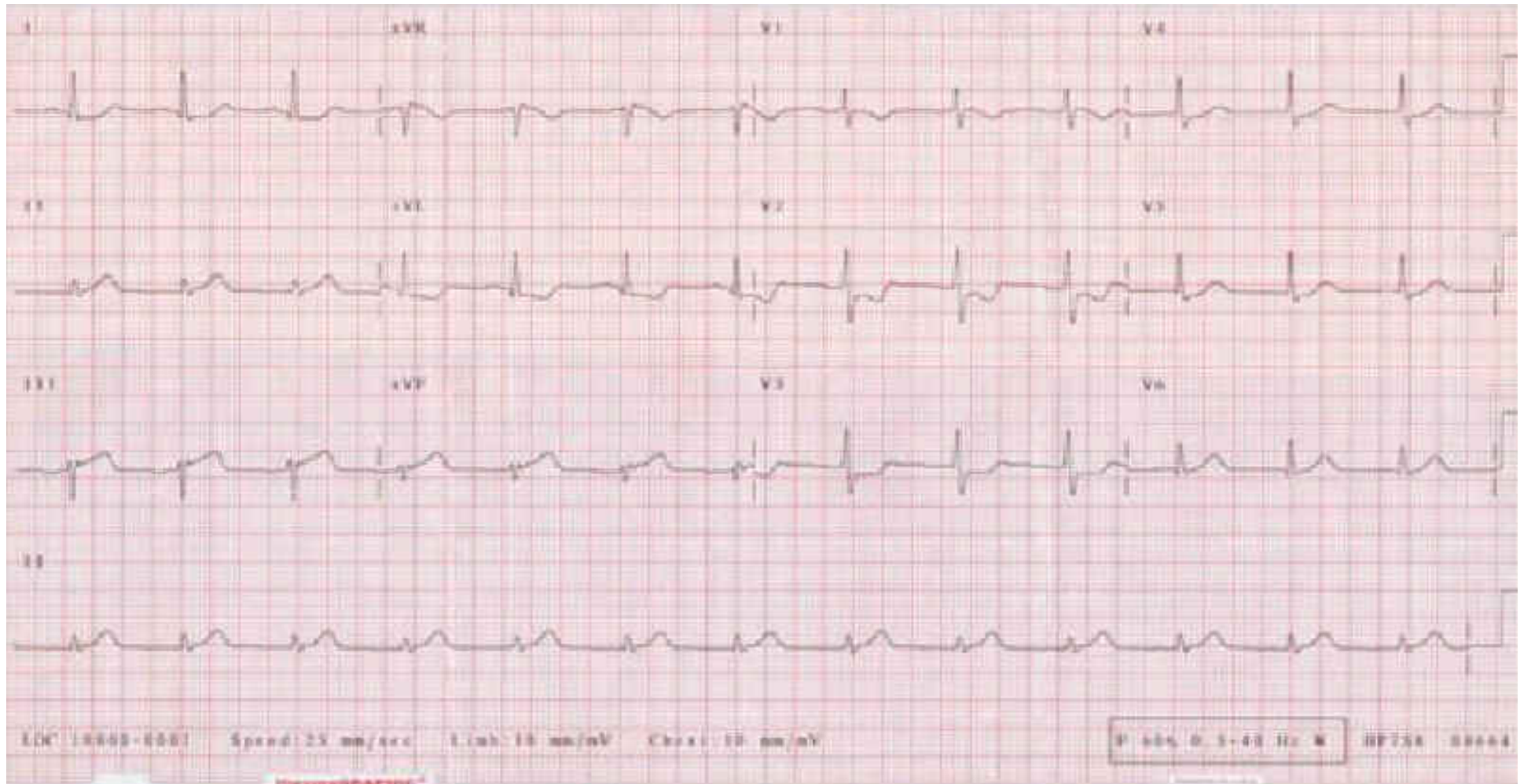
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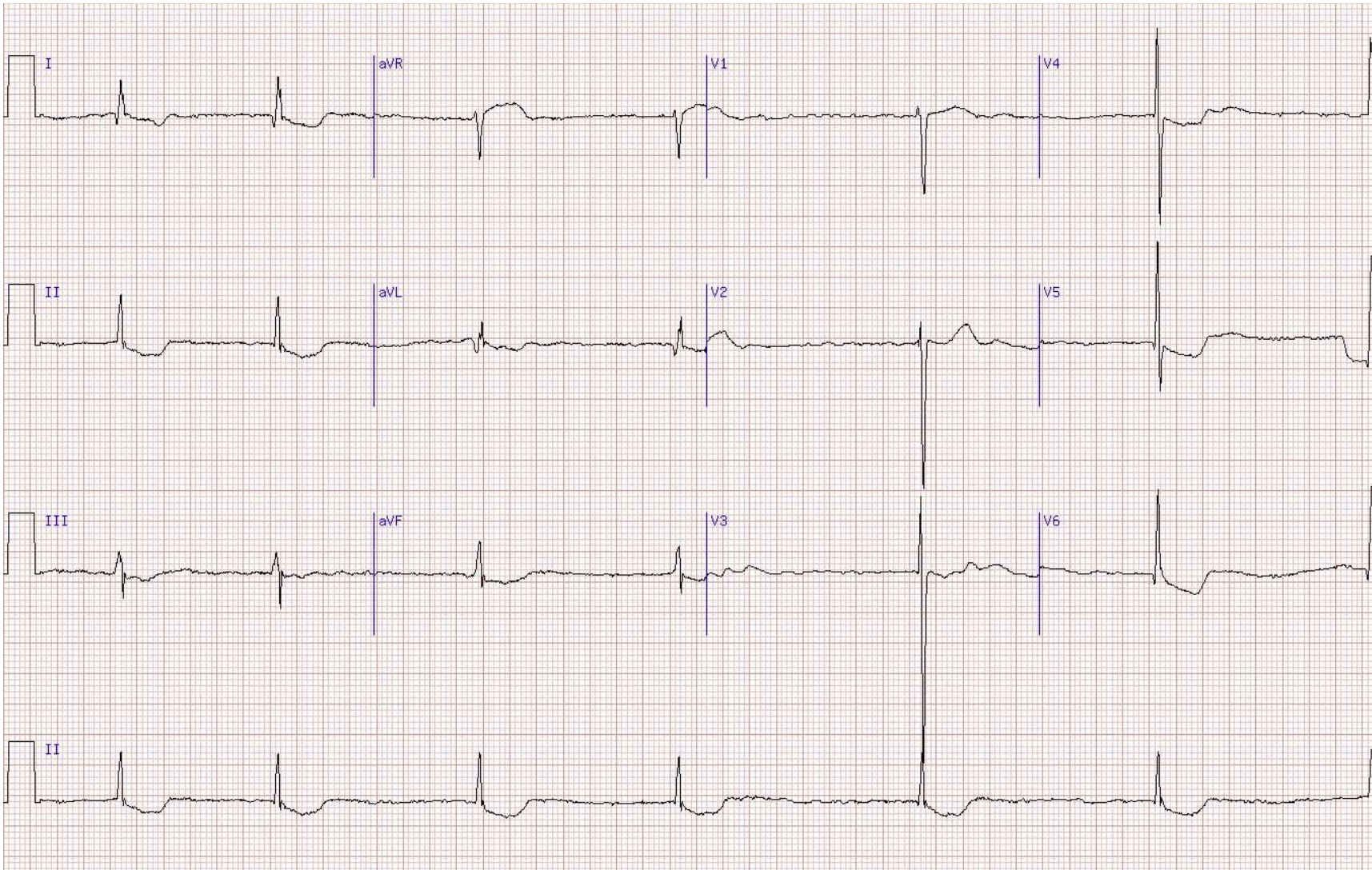
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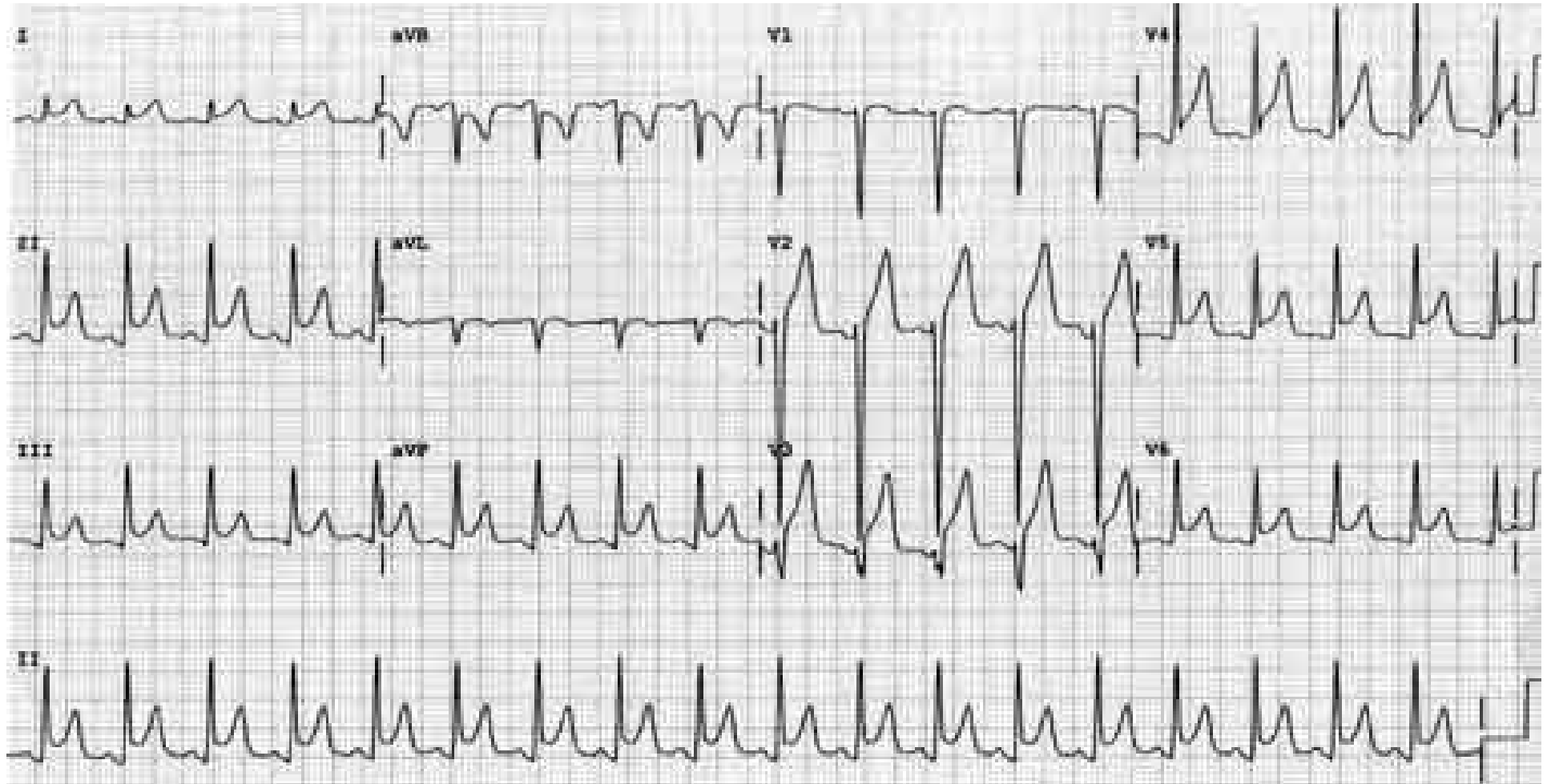
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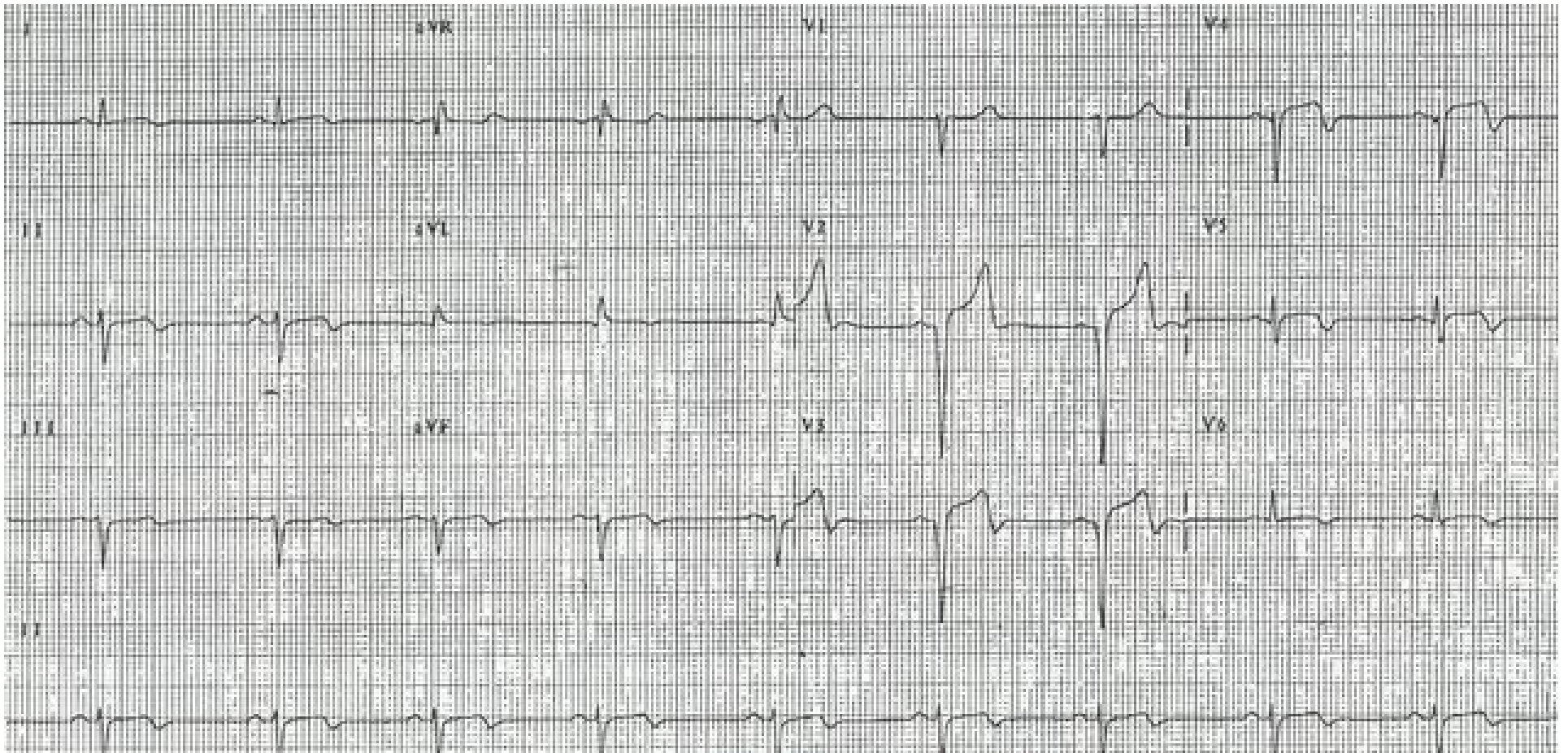
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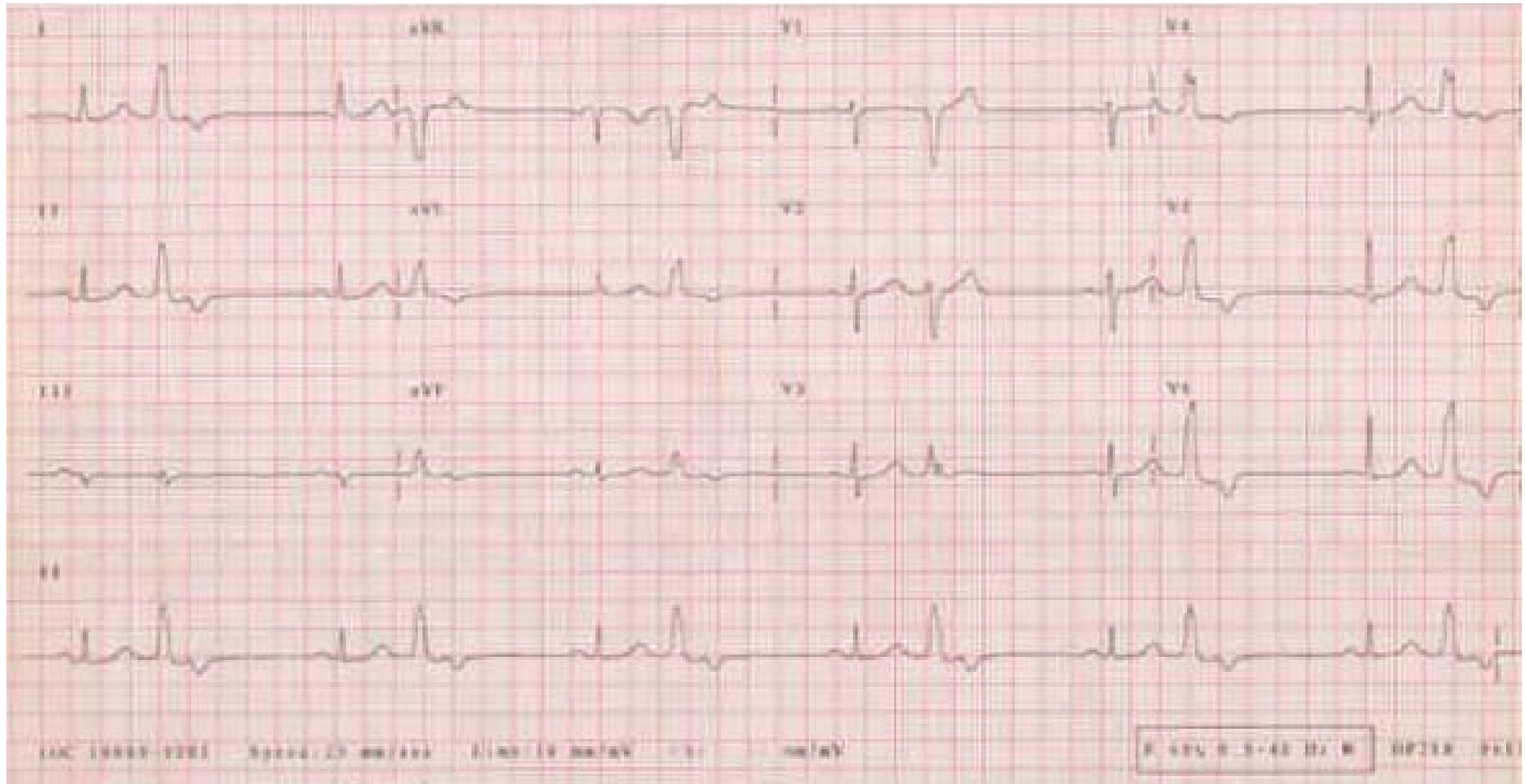
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