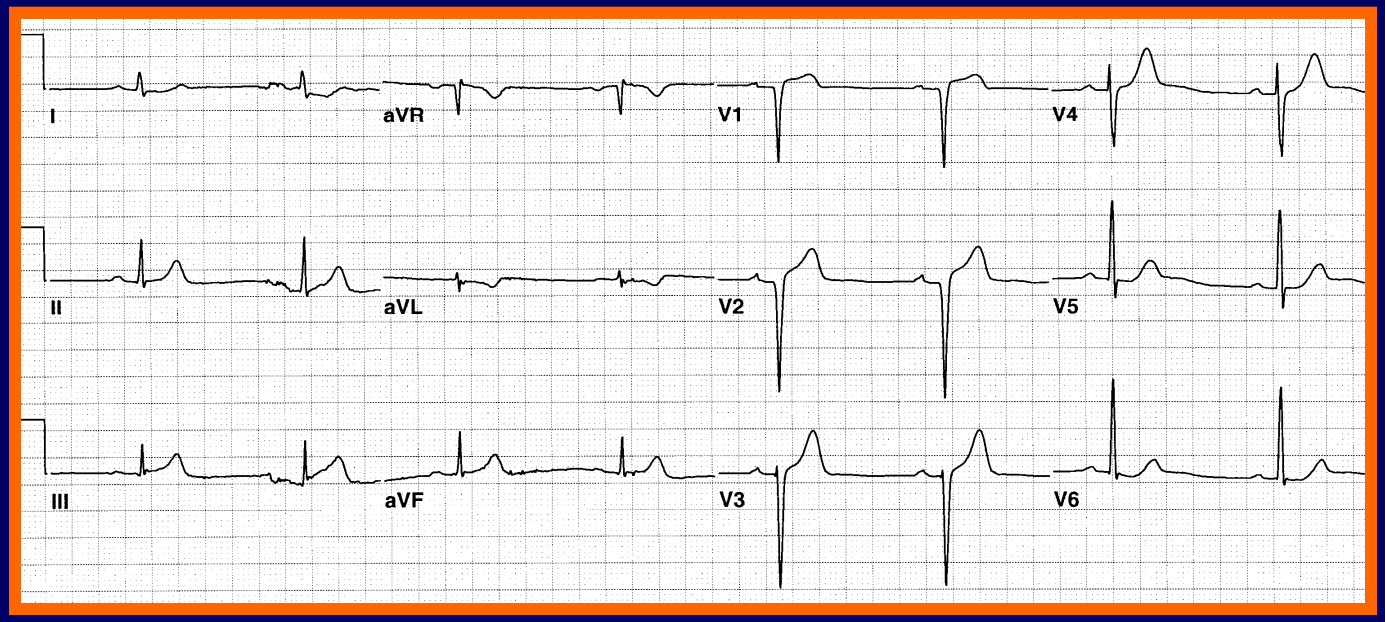
Subtle Manifestations of Deadly Cardiac Disease



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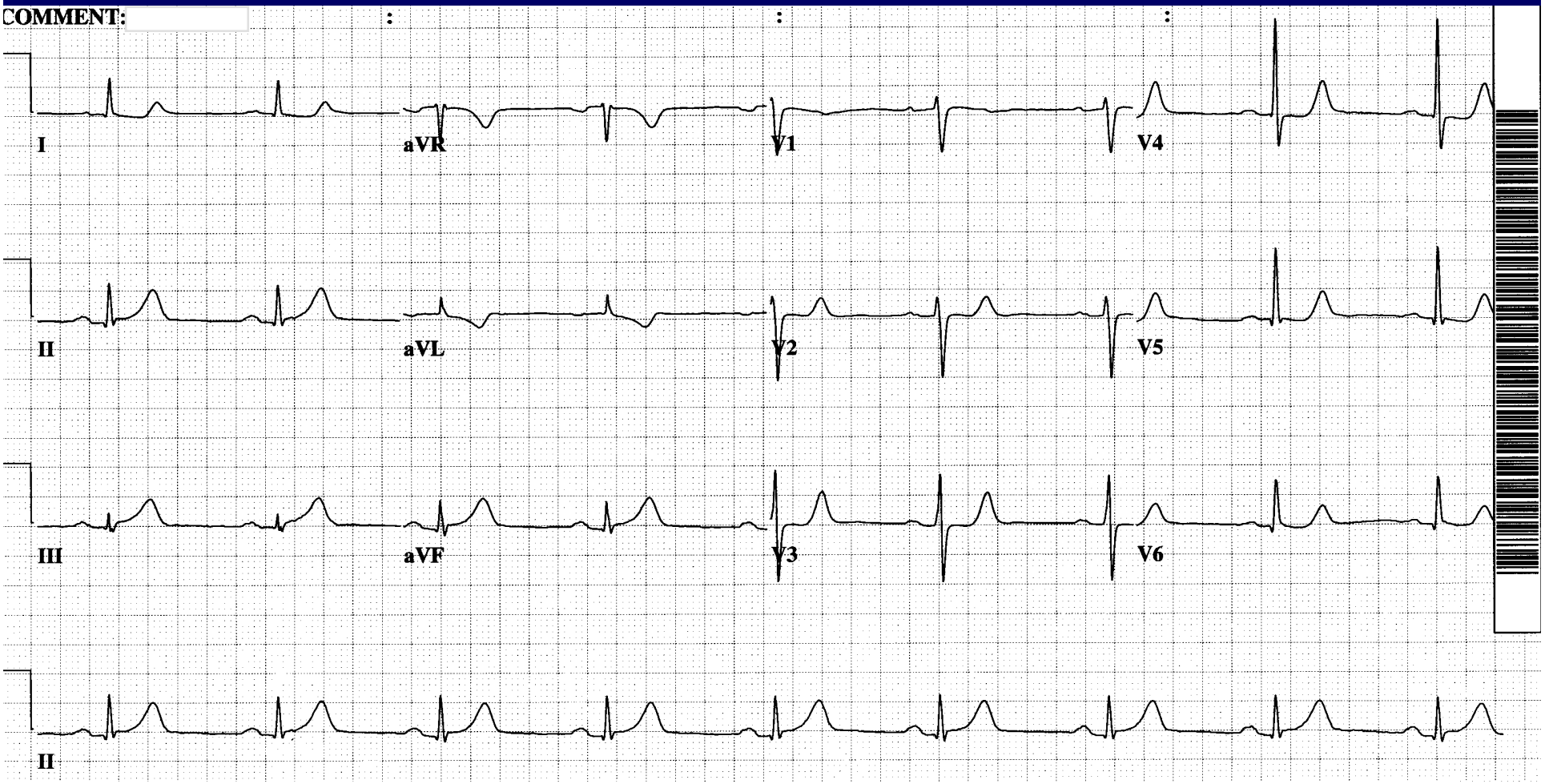
lectures.umem.org/ACEP2010

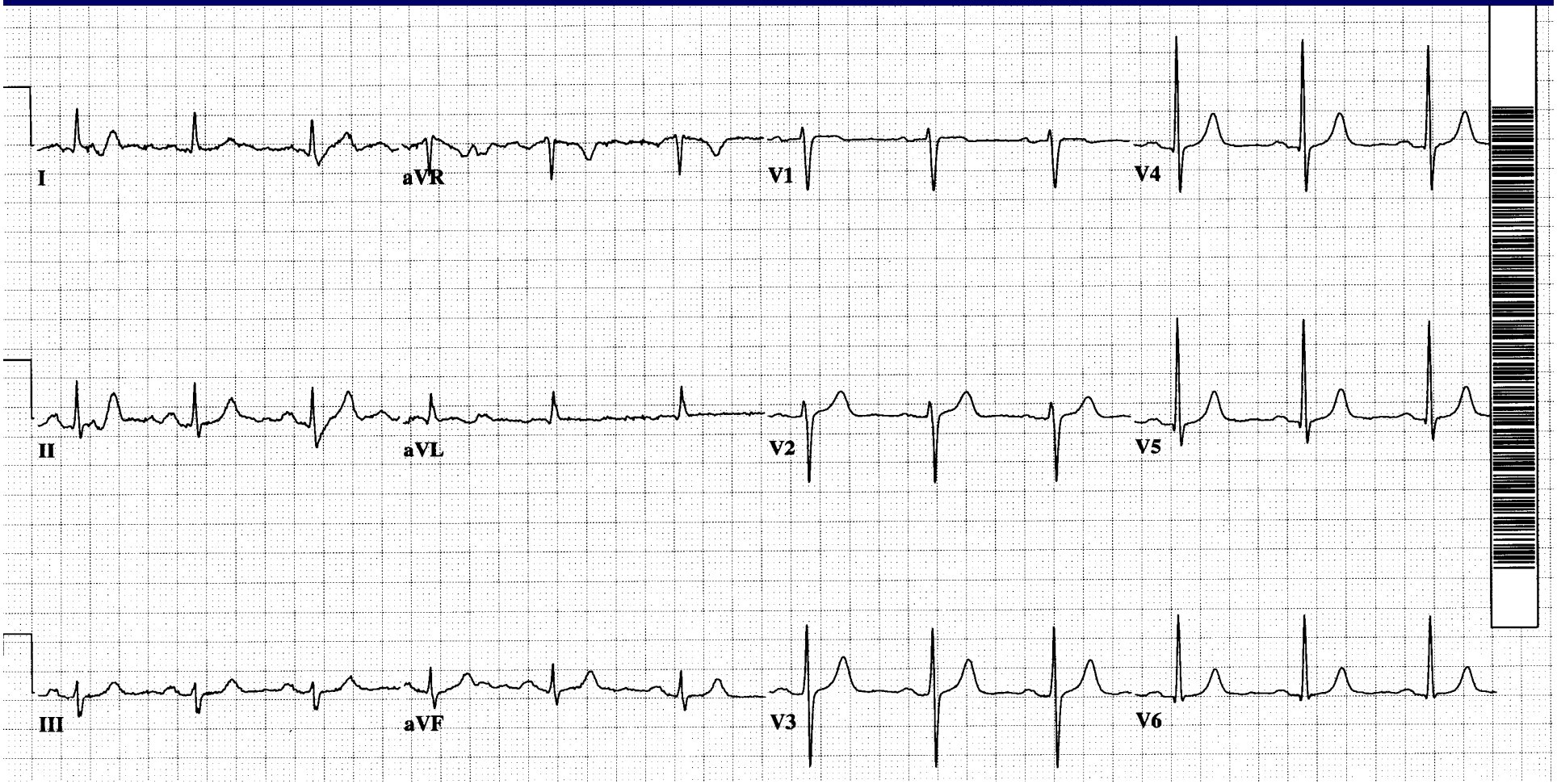
Case 1

- 87 yo. man became nauseous, diaphoretic, and pale while in church
  - No chest pain or dyspnea
  - “Funny feeling under my chest”
  - ECG interpreted as normal in ED
  - Cardiologist reads “NSC from previous ECG” (4 years earlier)

Case 1



Baseline ECG



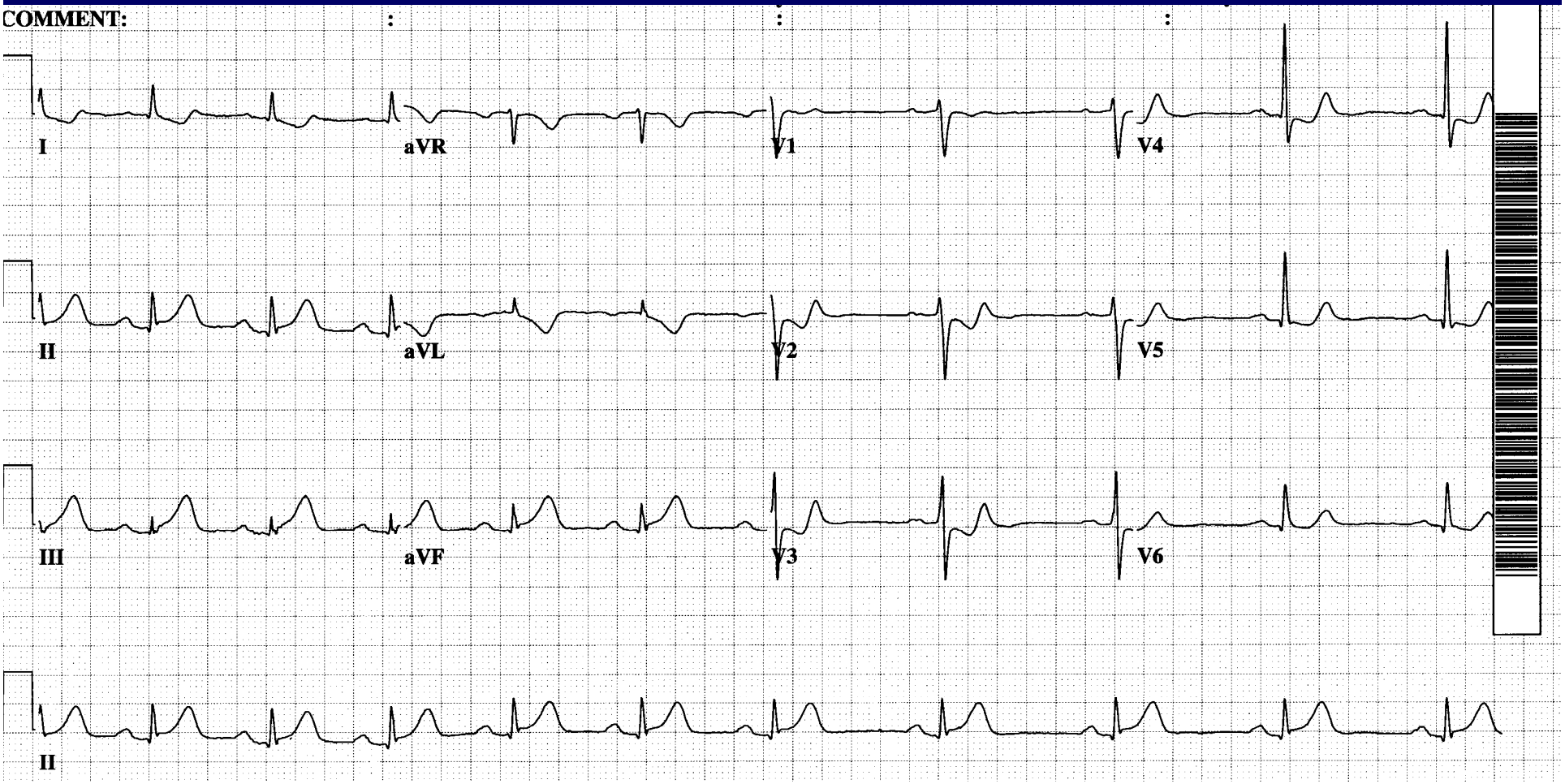
Case 1

- Patient's nausea is treated with antiemetics
- Pallor resolves with IVF
- SL NTG has no effect on "funny feeling" in chest
  - No further interventions/treatment
- Plans are made for admission for "dehydration"

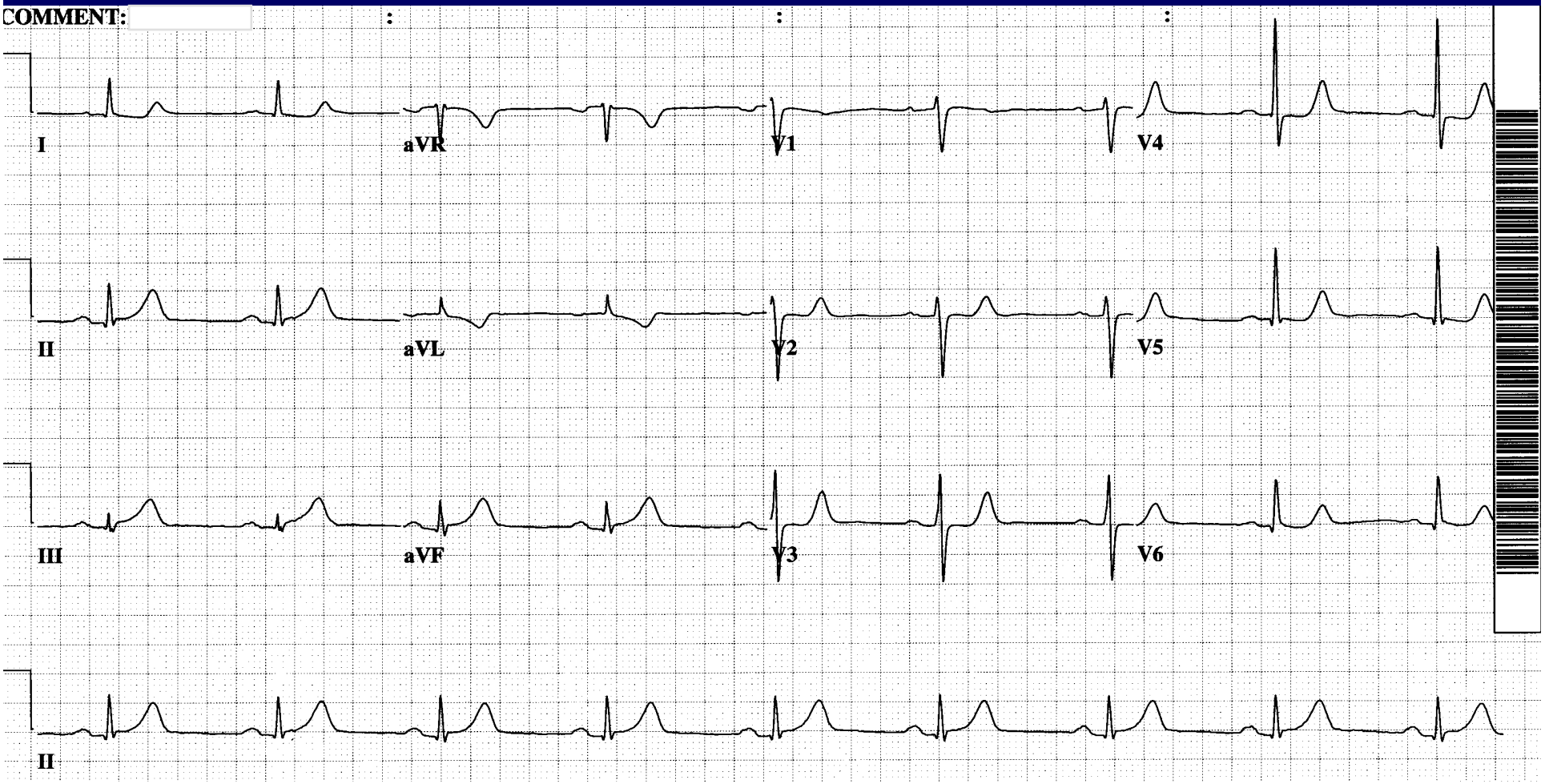
Case 1

- One hour later “funny feeling” still persists
- Pallor recurs, patient becomes diaphoretic
- Repeat ECG is obtained...

Case 1



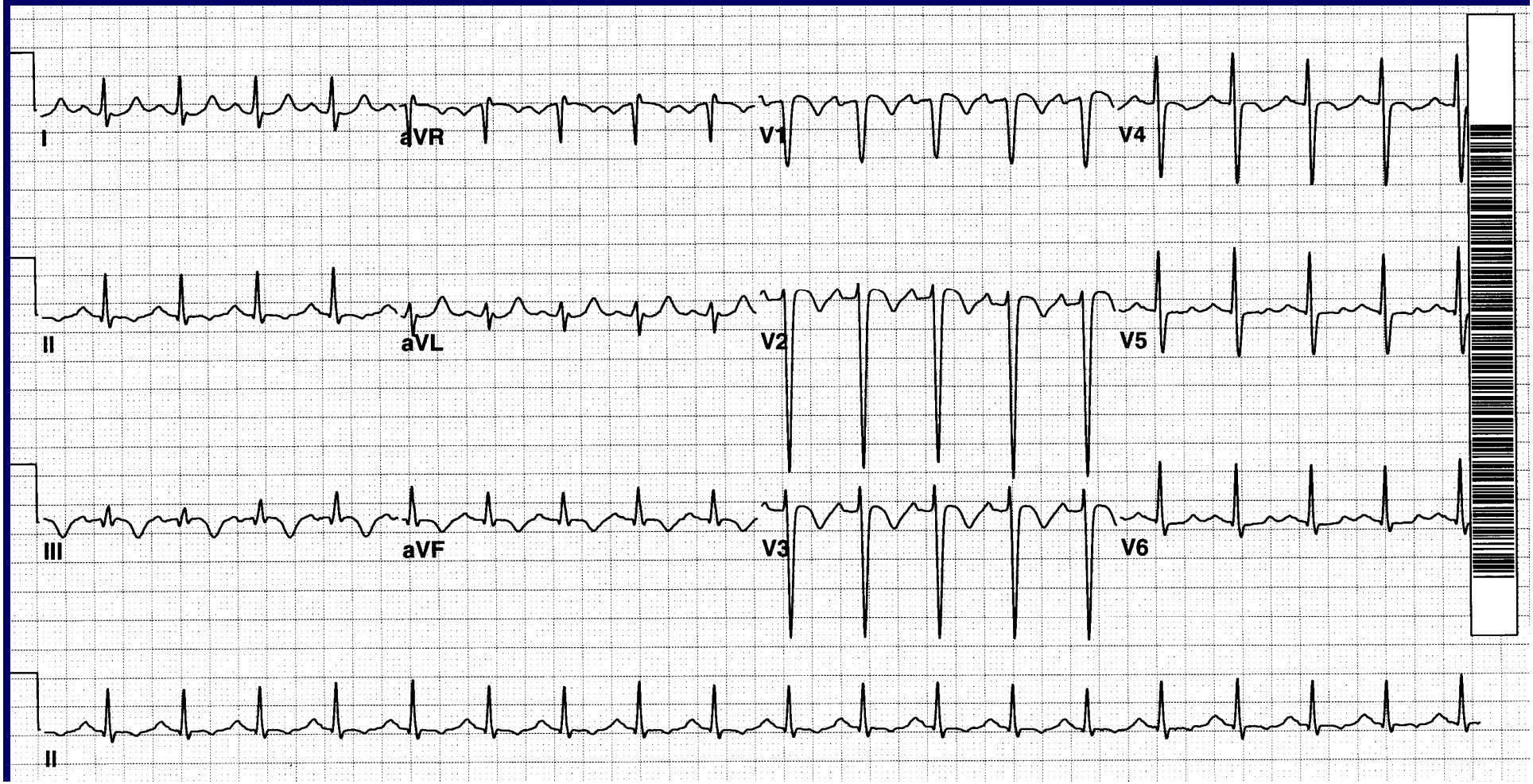
Case 1 — Initial ECG



Case 2

- 32 yo. man presents c/o chest pain and dyspnea
  - Syncope one day prior
  - Family history of early CAD
  - RR 24, HR 110, BP 160/105
  - ECG interpreted as “anterior and inferior ischemia”

Case 2



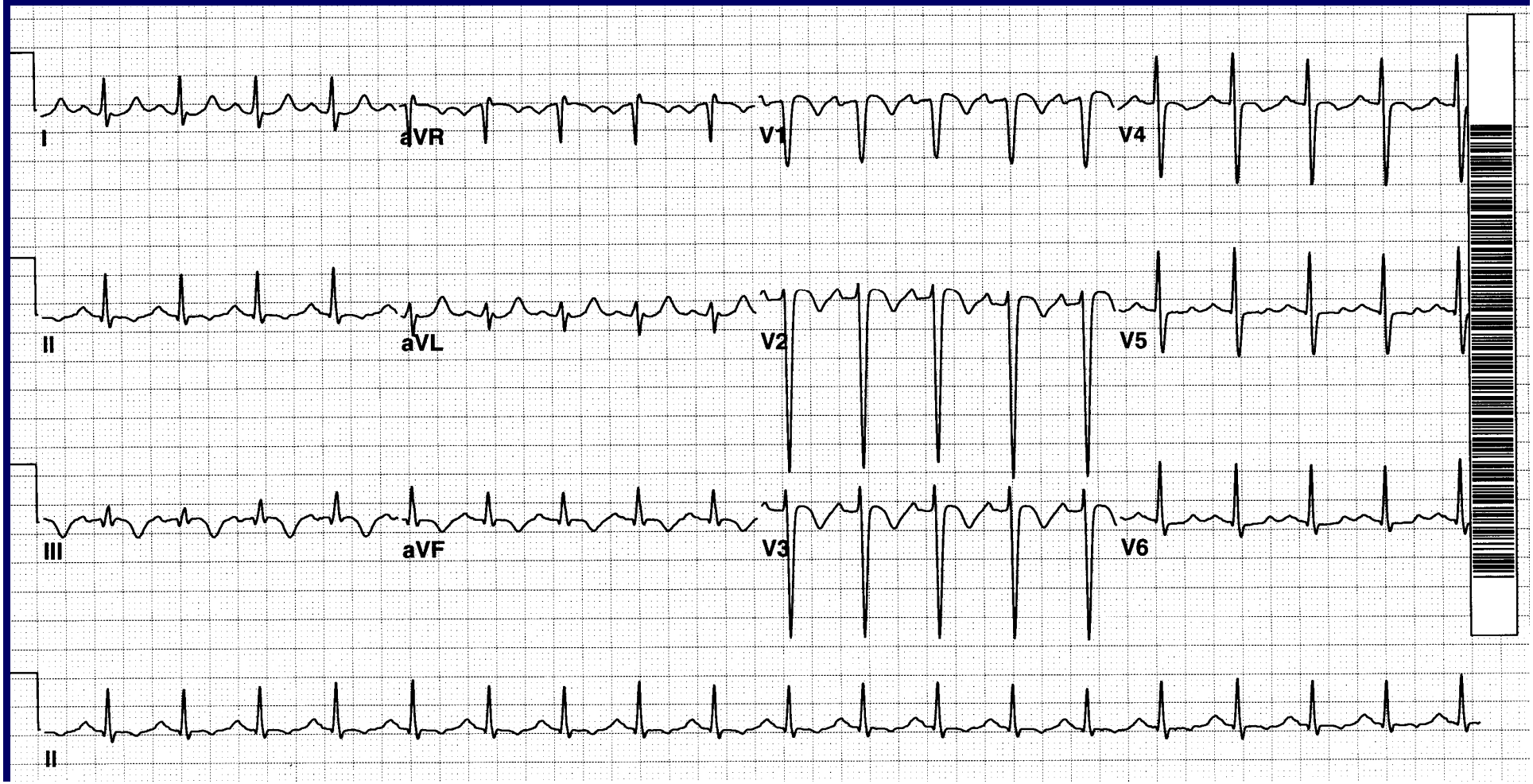
Case 2

- Admitted to chest pain center for ACS
  - Treated with ASA, beta blockers, heparin
- Rules out for AMI
  - Persantine thallium test negative
  - Mild dyspnea and tachypnea persist
    - attributed to “obesity and deconditioning”
  - ECG continues to show T-wave abnormality
    - not addressed in chart

Case 2

- Patient is discharged on beta blockers
- Cardiac arrest 12 hours later
- Autopsy confirms a *non-cardiac* cause...

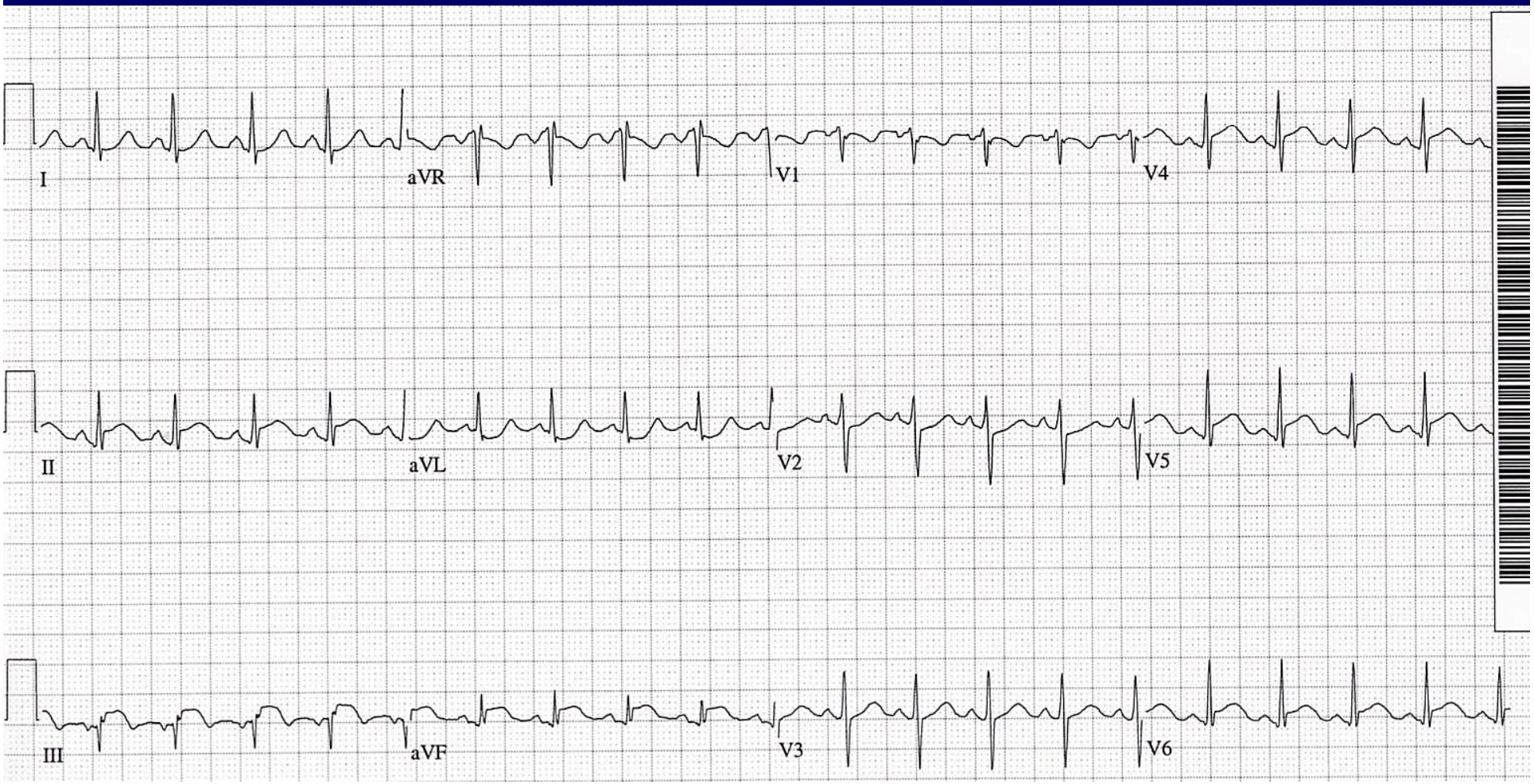
Case 2



Case 3

- 38 yo. woman presents c/o chest pain
  - Only CRF is hypertension
  - Pain worsens with deep inspiration or when laying back, improves sitting upright
  - ECG interpreted as acute pericarditis

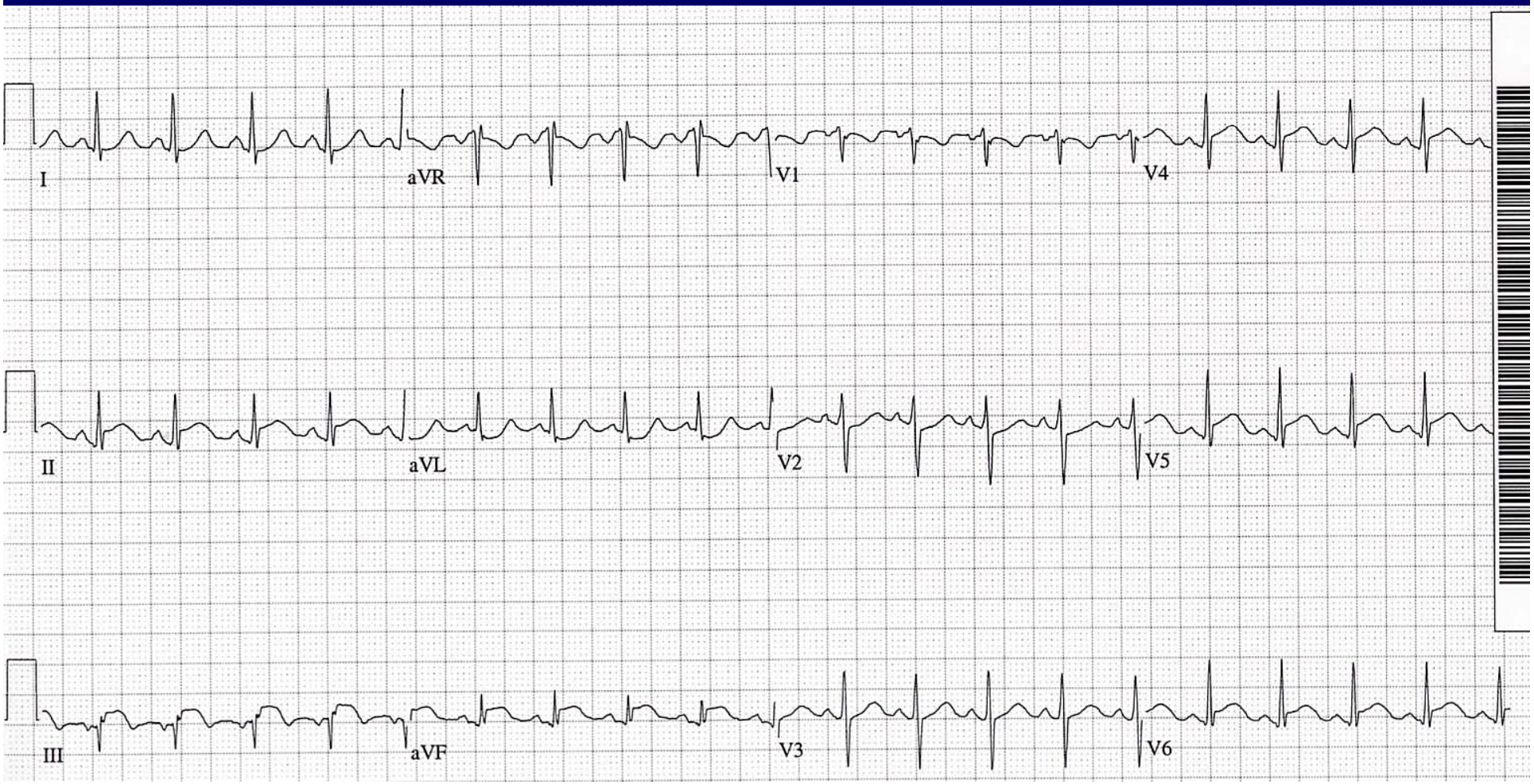
Case 3



Case 3

- Intensive care physicians sees patient, agrees with diagnosis of pericarditis
  - Patient is admitted to ICU
- First set of cardiac enzymes are normal
- Second set of cardiac enzymes are markedly elevated
  - Patient is emergently transferred for PTCA

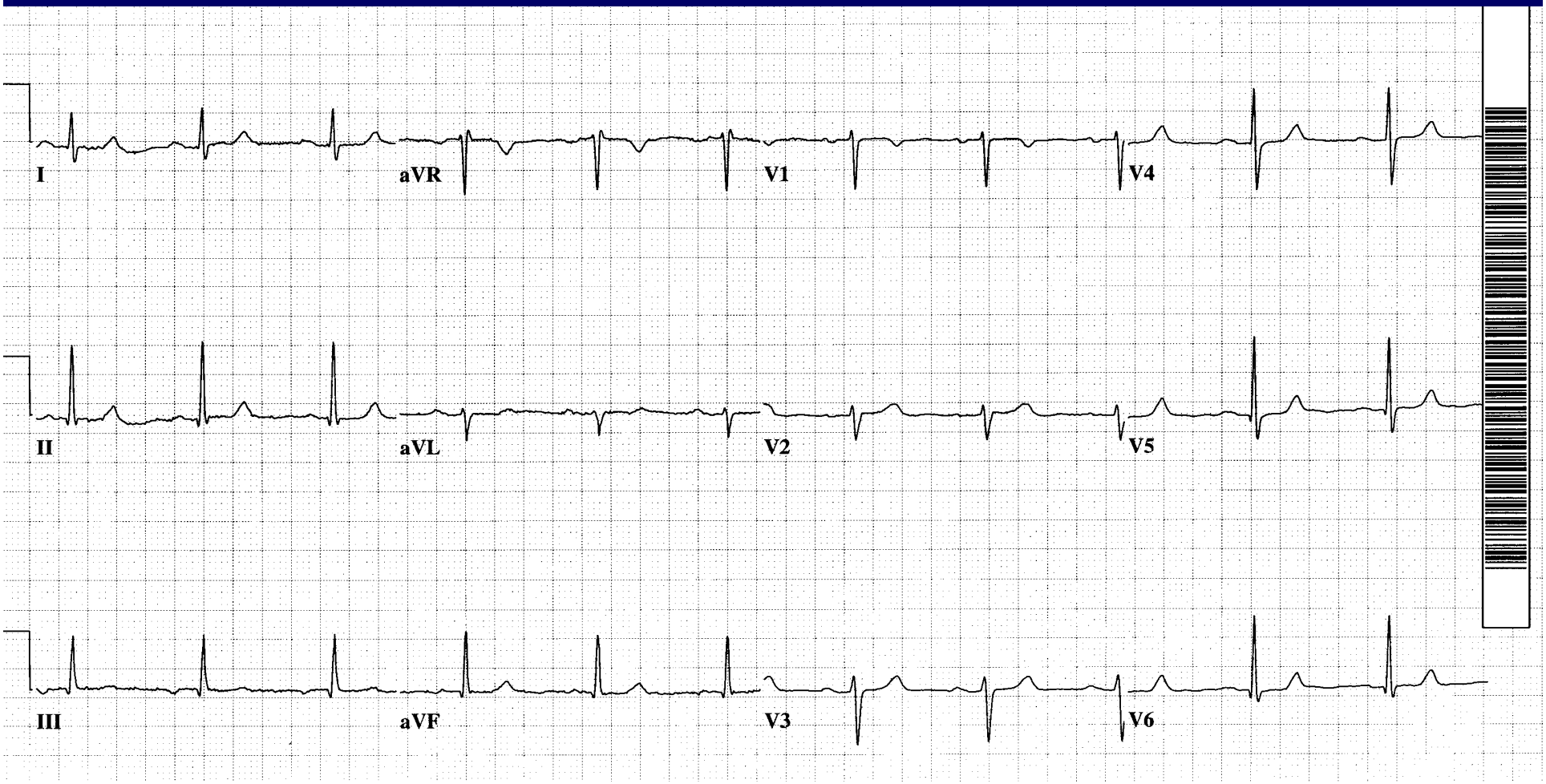
Case 3



Outline

1. Early reciprocal changes in lead aVL
2. Pulmonary embolism simulating ACS
3. Pericarditis vs. AMI
4. Pericardial effusions

Normal ECG



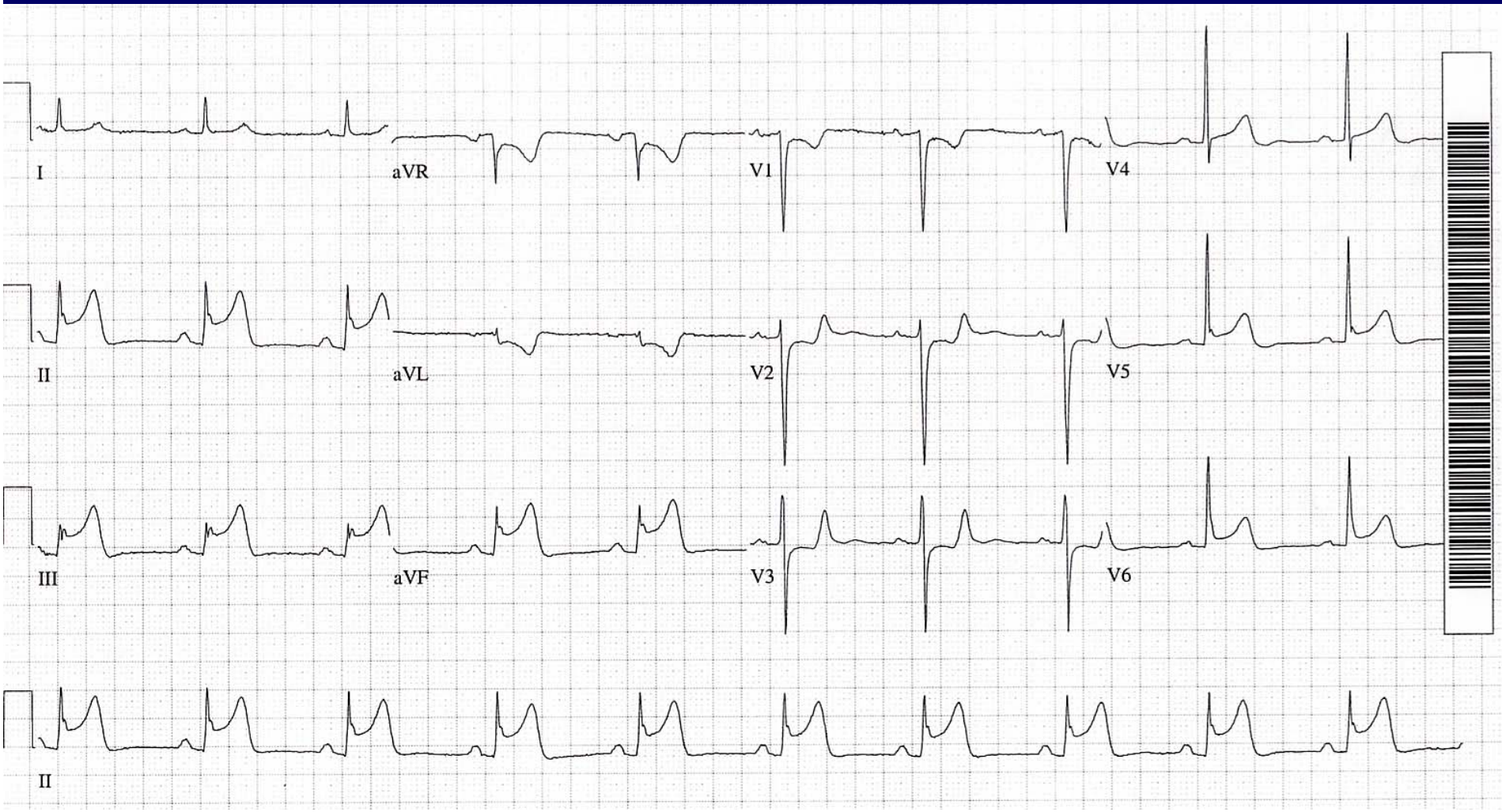
Early Reciprocal Changes in Lead aVL

- The normal ECG lead aVL
  - Isoelectric ST-segment
  - Upright T-wave

Early Reciprocal Changes in Lead aVL

- The normal ECG lead aVL
  - Isoelectric ST-segment
  - Upright T-wave
- Acute inferior wall MIs
  - Common “reciprocal changes”
    - ST-segment downsloping in aVL
    - T-wave inversion in aVL

Acute Inferior Wall MI



Early Reciprocal Changes in Lead aVL

- Marriott — these reciprocal aVL changes can *precede* the development of inferior lead abnormalities

Early Reciprocal Changes in Lead aVL

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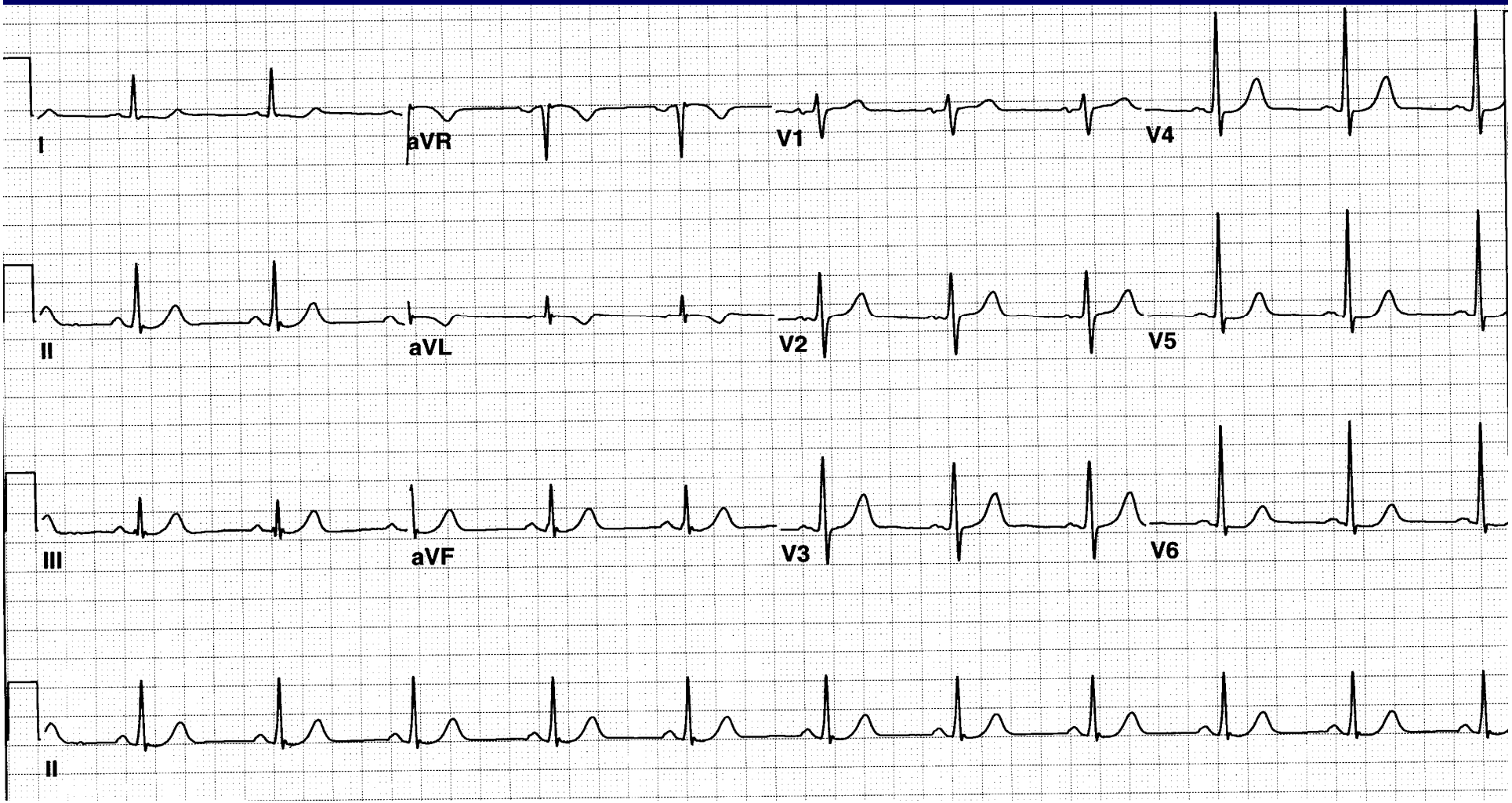
Early Reciprocal Changes in Lead aVL — Case 1

- 56 yo. man presents c/o “throat burning,” nausea, and belching
  - History of hypertension and tobacco use
  - Treated in fast-track with Maalox/viscous lidocaine with mild improvement
  - Patient wants to be discharged

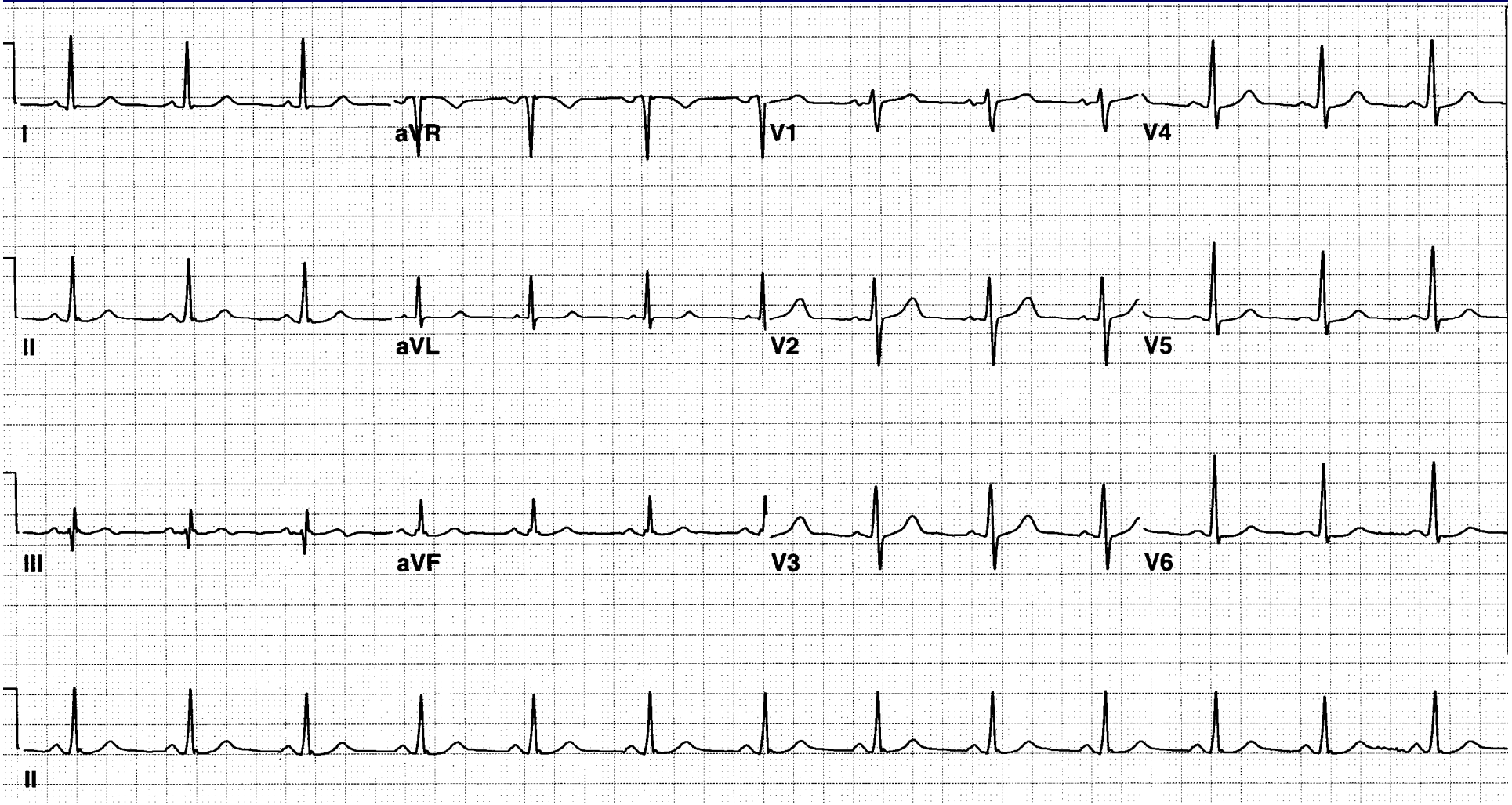
Early Reciprocal Changes in Lead aVL — Case 1

- 30 minutes later symptoms worsen
  - Now with diaphoresis
- ECG is obtained
  - Interpreted as normal (EP and cardiologist)

Early Reciprocal Changes in Lead aVL — Case 1



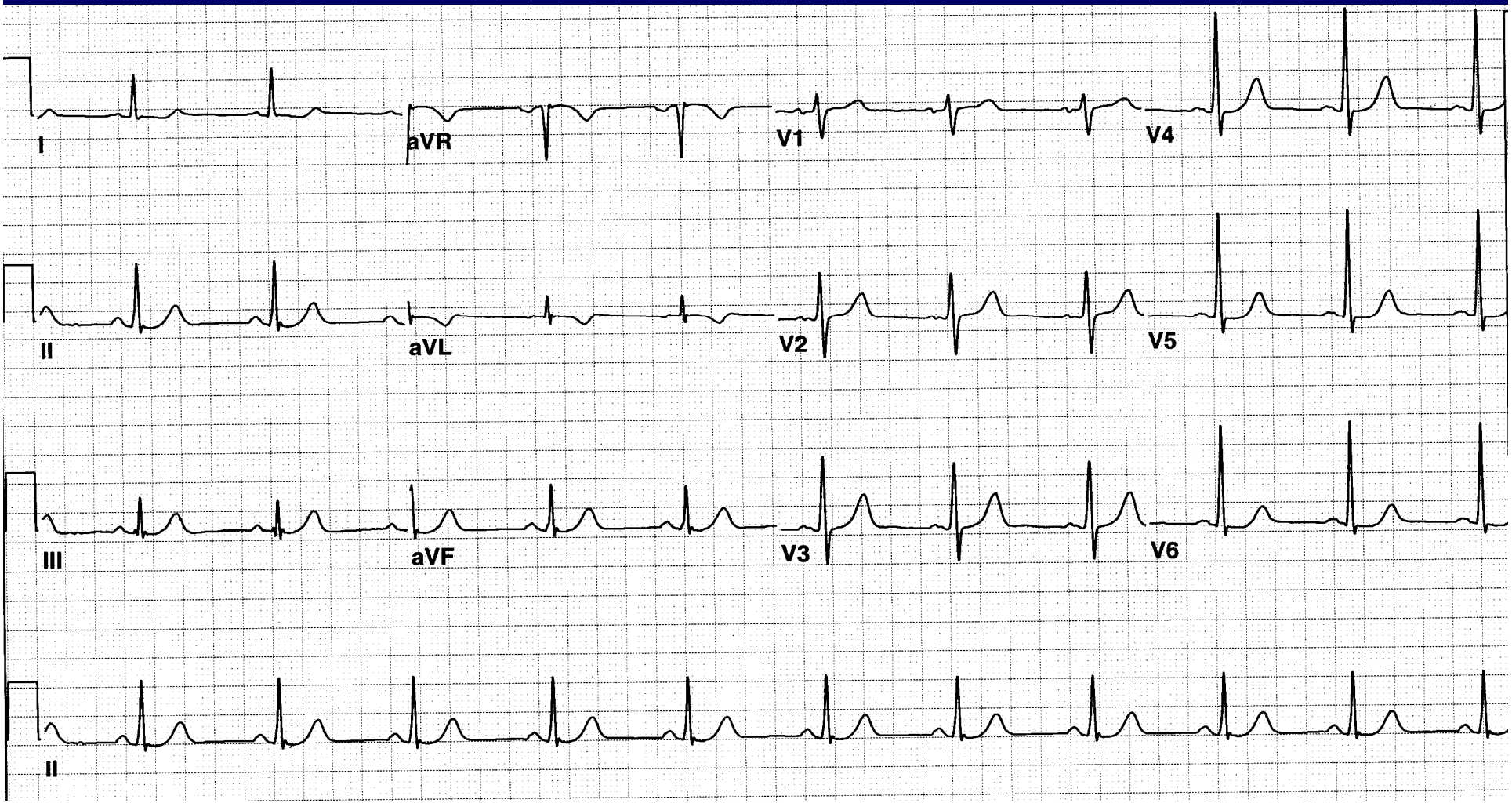
Baseline ECG



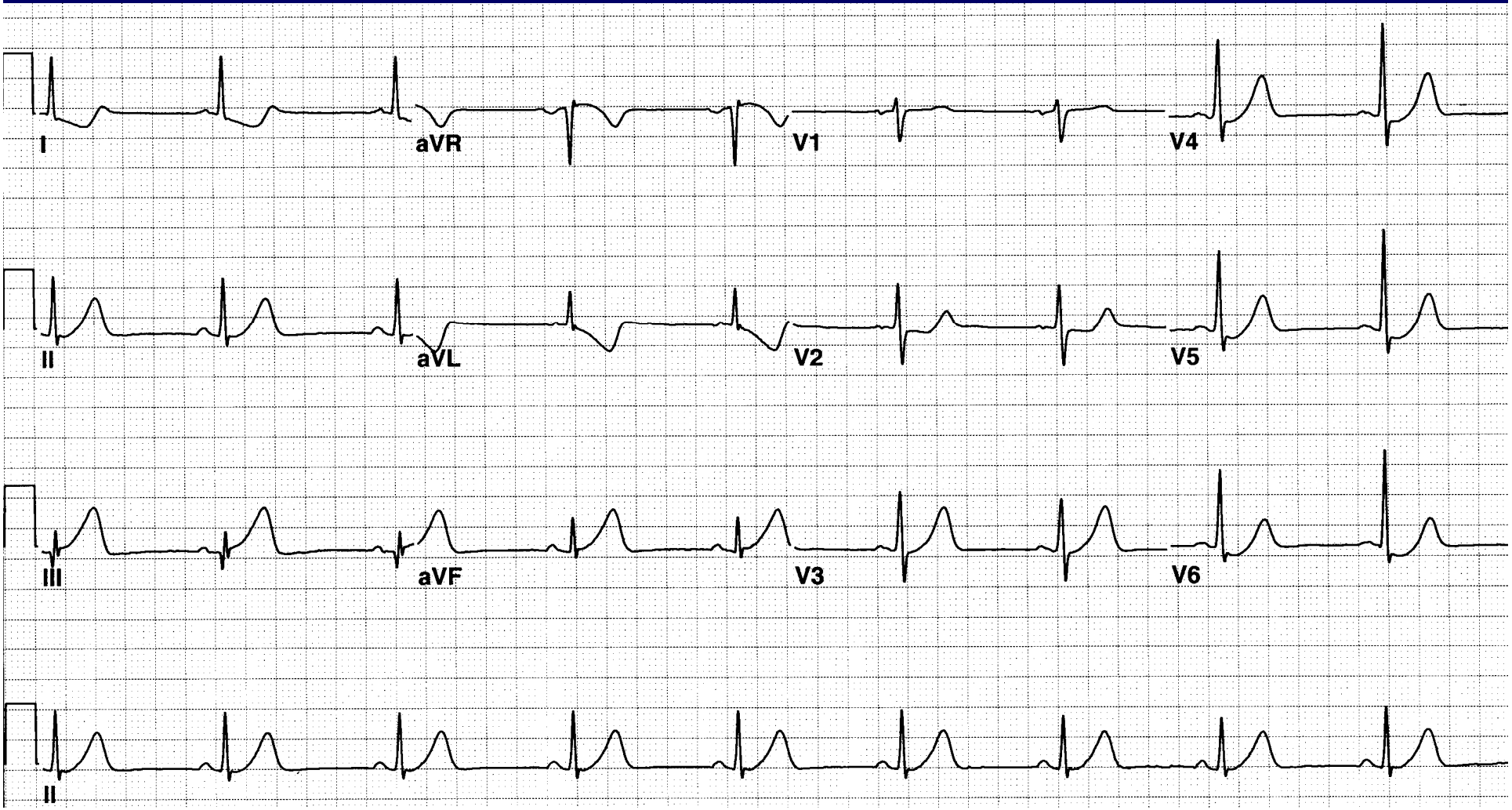
Early Reciprocal Changes in Lead aVL — Case 1

- Patient is given Maalox again
  - Symptoms persist
- Serial ECGs are then performed with the persistent symptoms...

Early Reciprocal Changes in Lead aVL — Case 1



Early Reciprocal Changes in Lead aVL — Case 1



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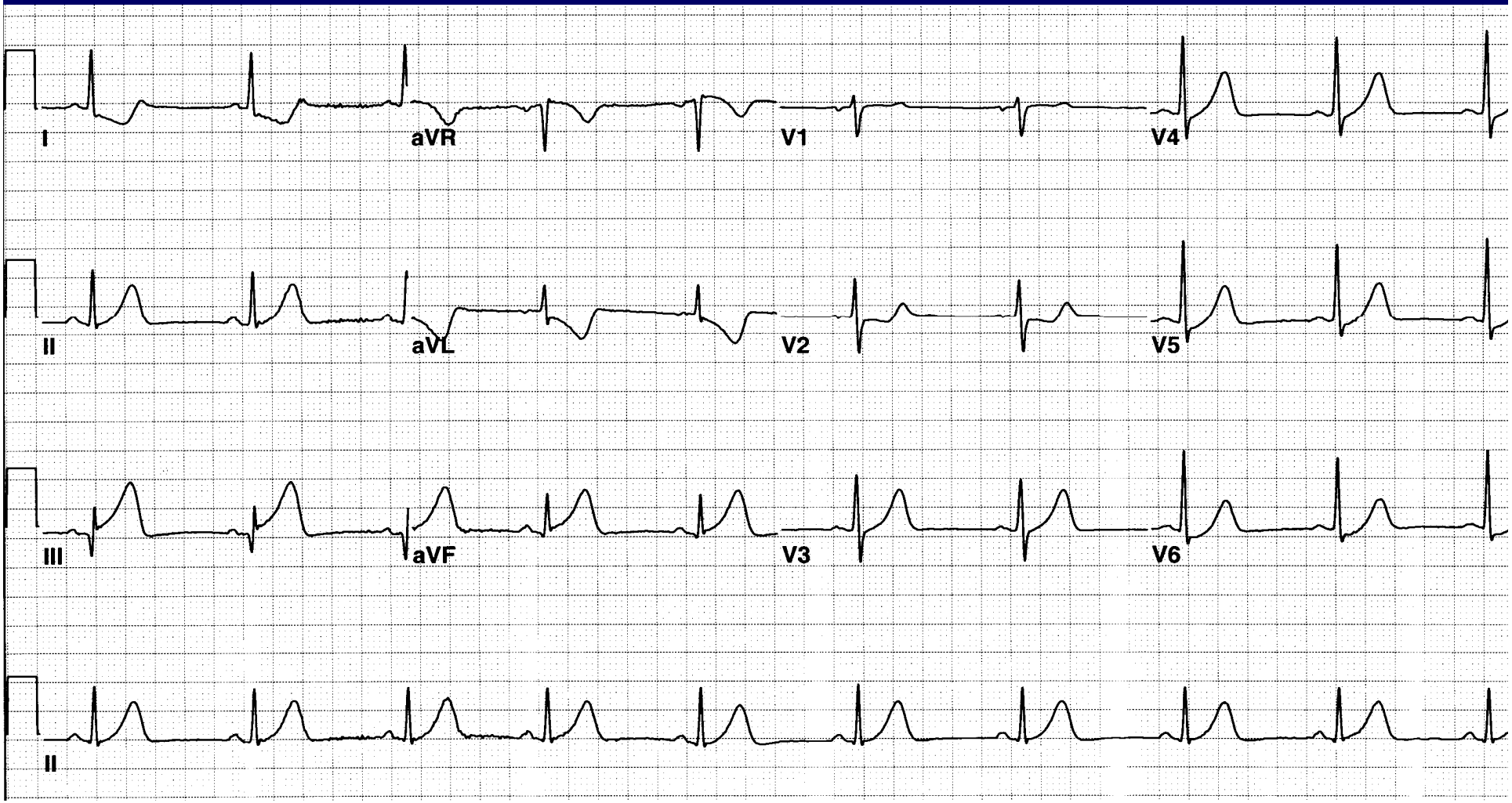
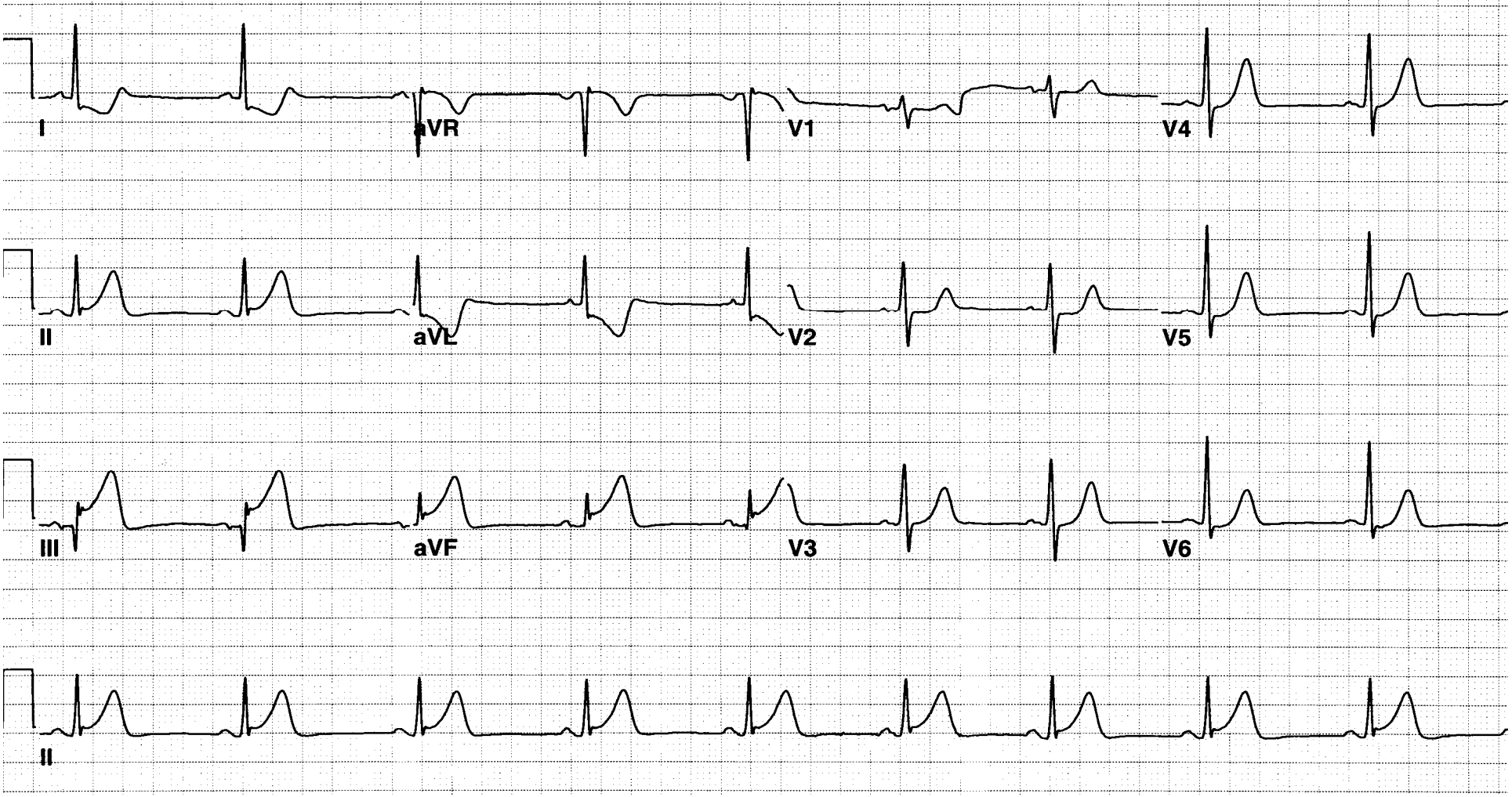


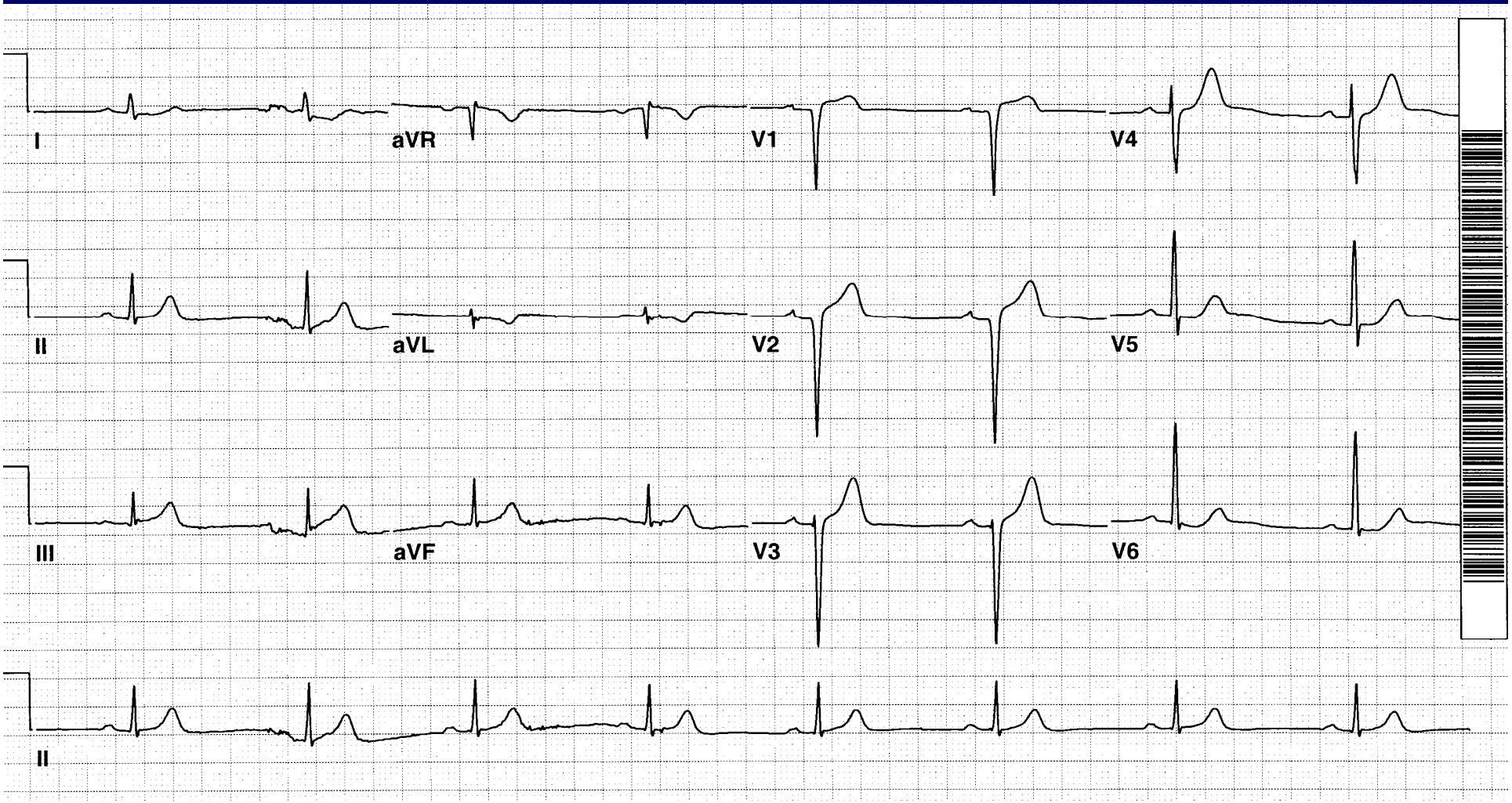
Early Reciprocal Changes in Lead aVL — Case 1



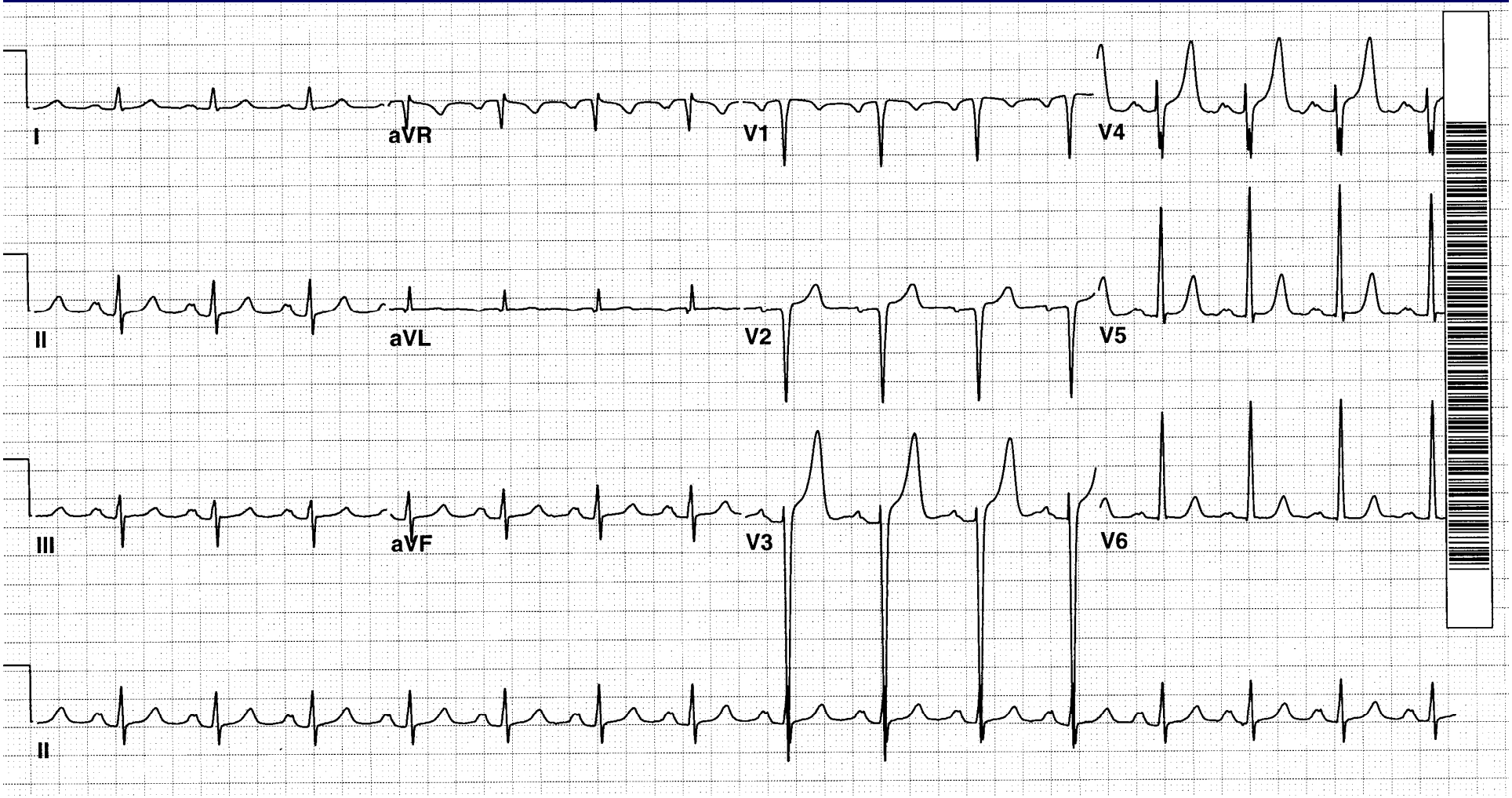
Early Reciprocal Changes in Lead aVL — Case 2

- 47 yo. man presents c/o of severe reflux symptoms “all day”
  - Belching, substernal burning, nausea
  - History of prior septal MI
  - No prior history of GERD
  - Symptoms improve significantly after Maalox and ranitidine
  - ECG interpreted as “old septal MI, o/w normal”

Early Reciprocal Changes in Lead aVL — Case 2



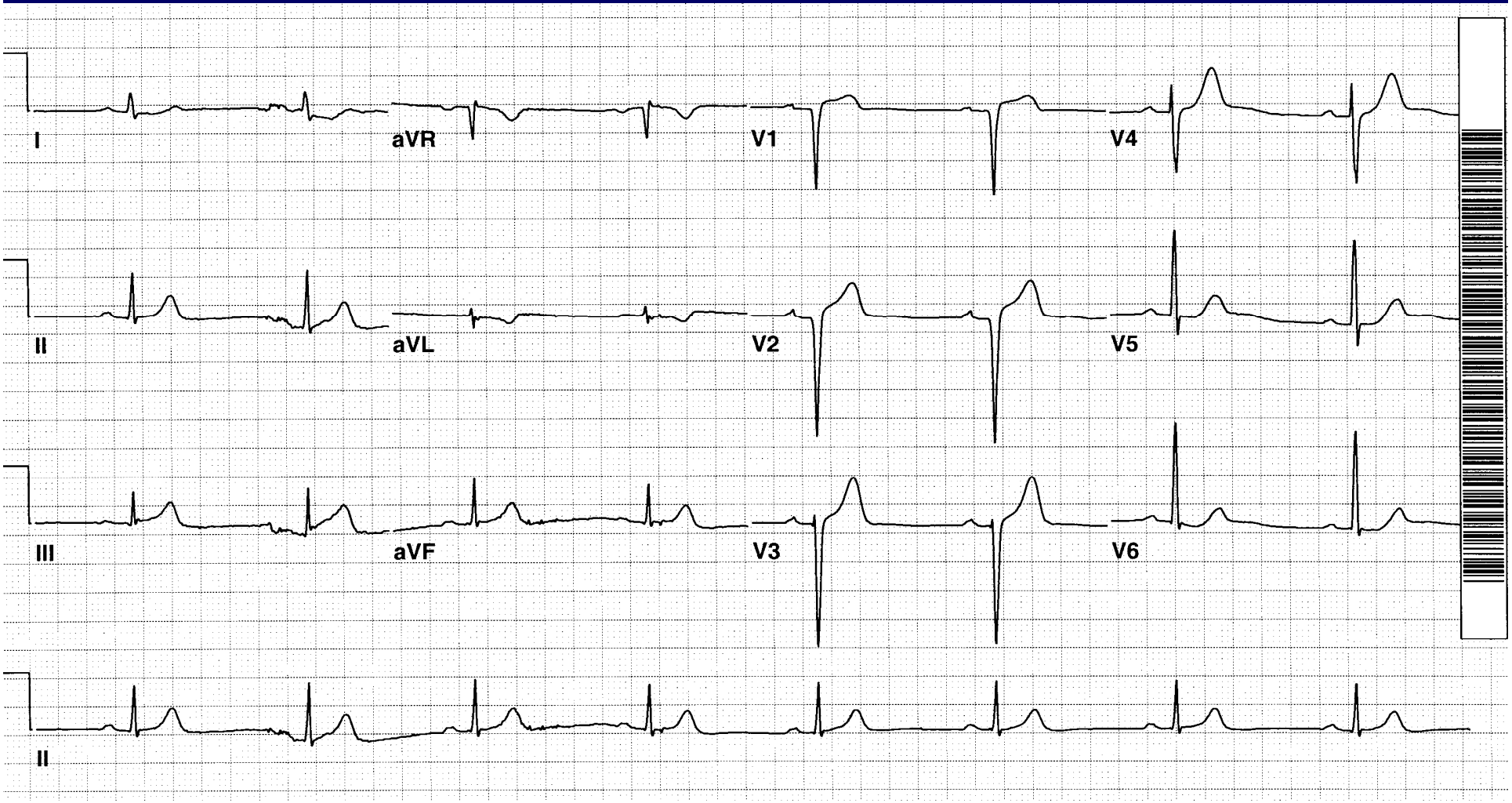
Baseline ECG



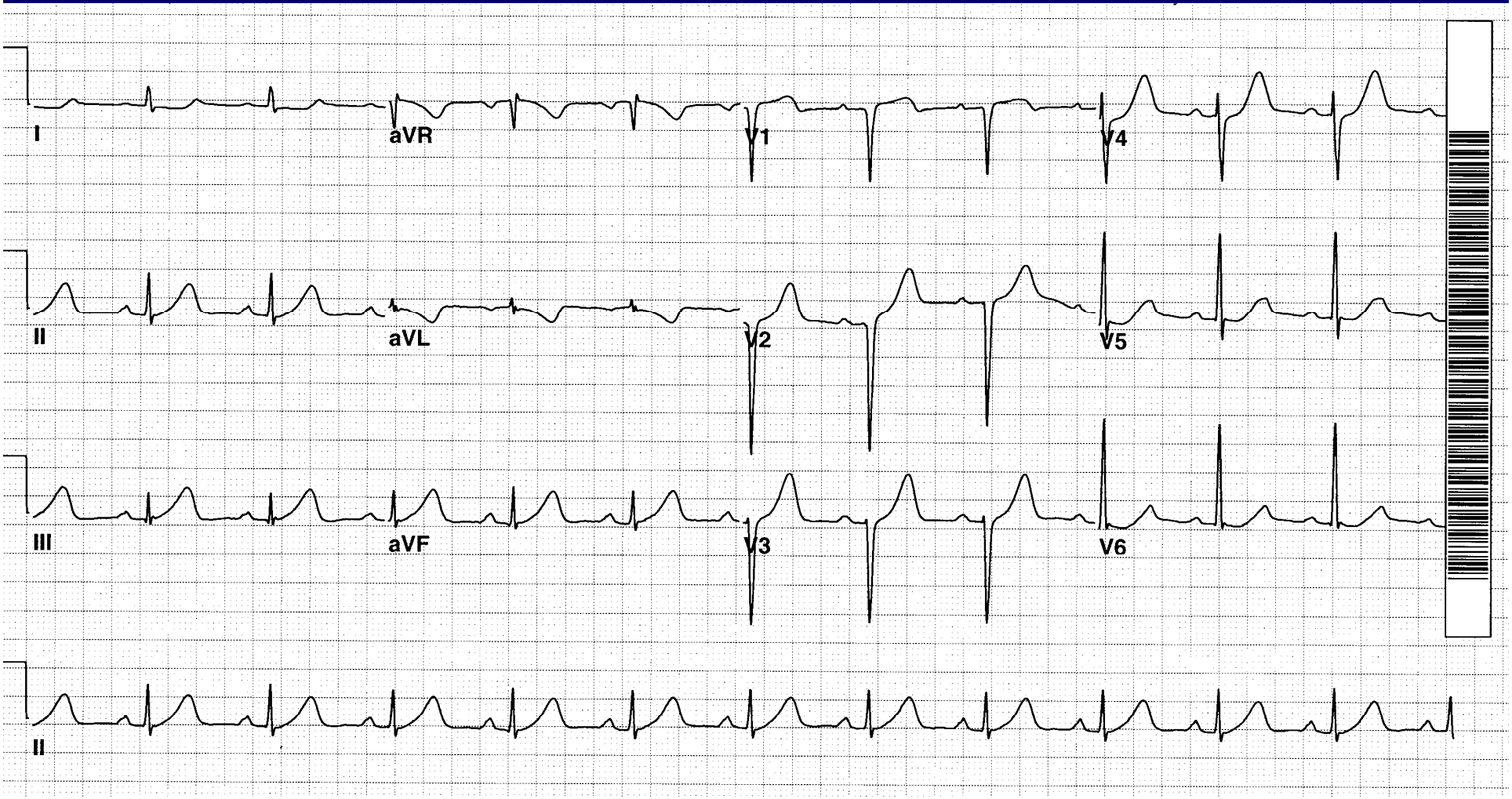
Early Reciprocal Changes in Lead aVL — Case 2

- Patient discharged feeling better
  - Rx for ranitidine
- Patient returns with recurrent symptoms 2 hours later
- ECG…

ECG First Visit



ECG Second Visit



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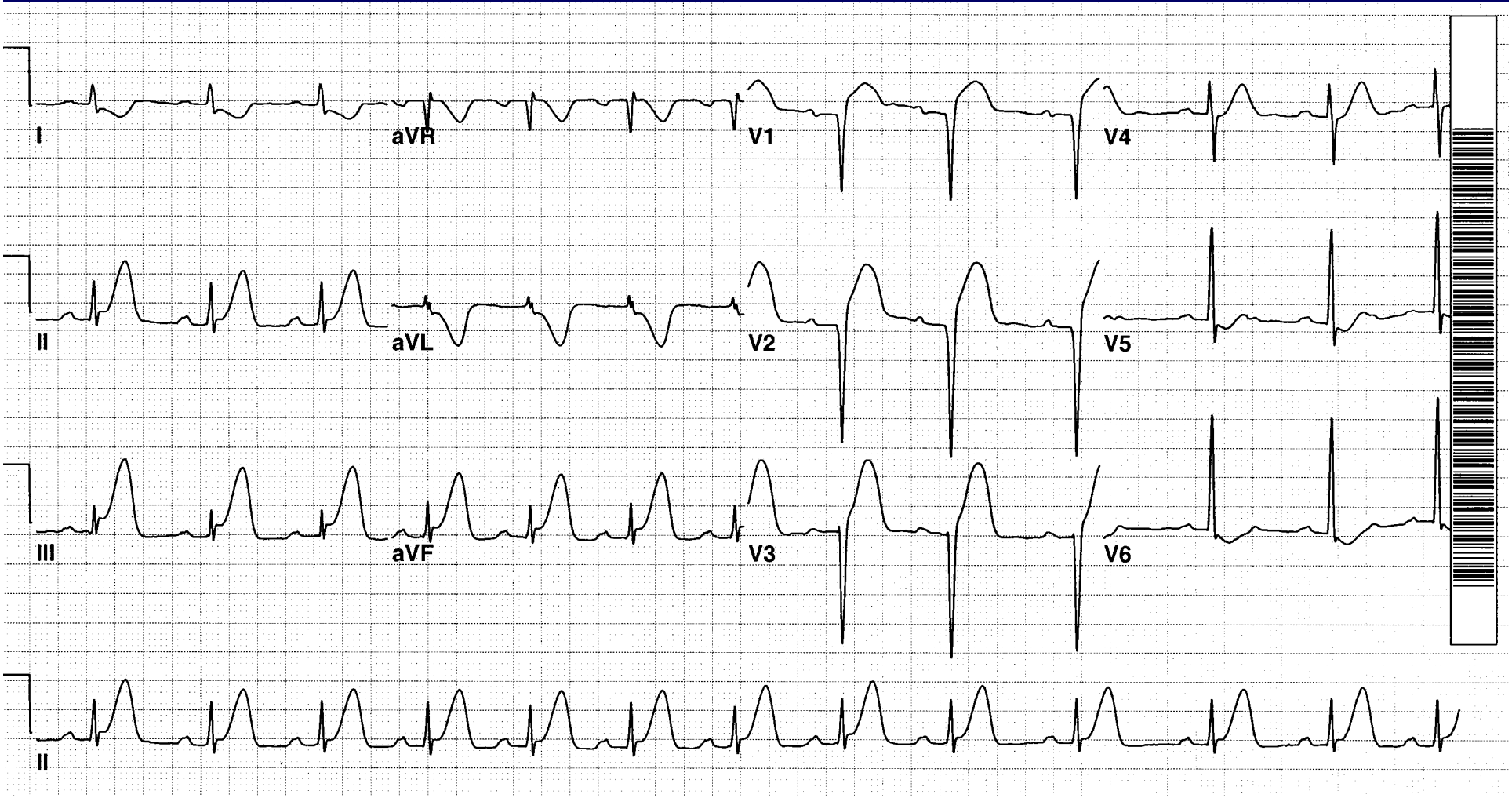
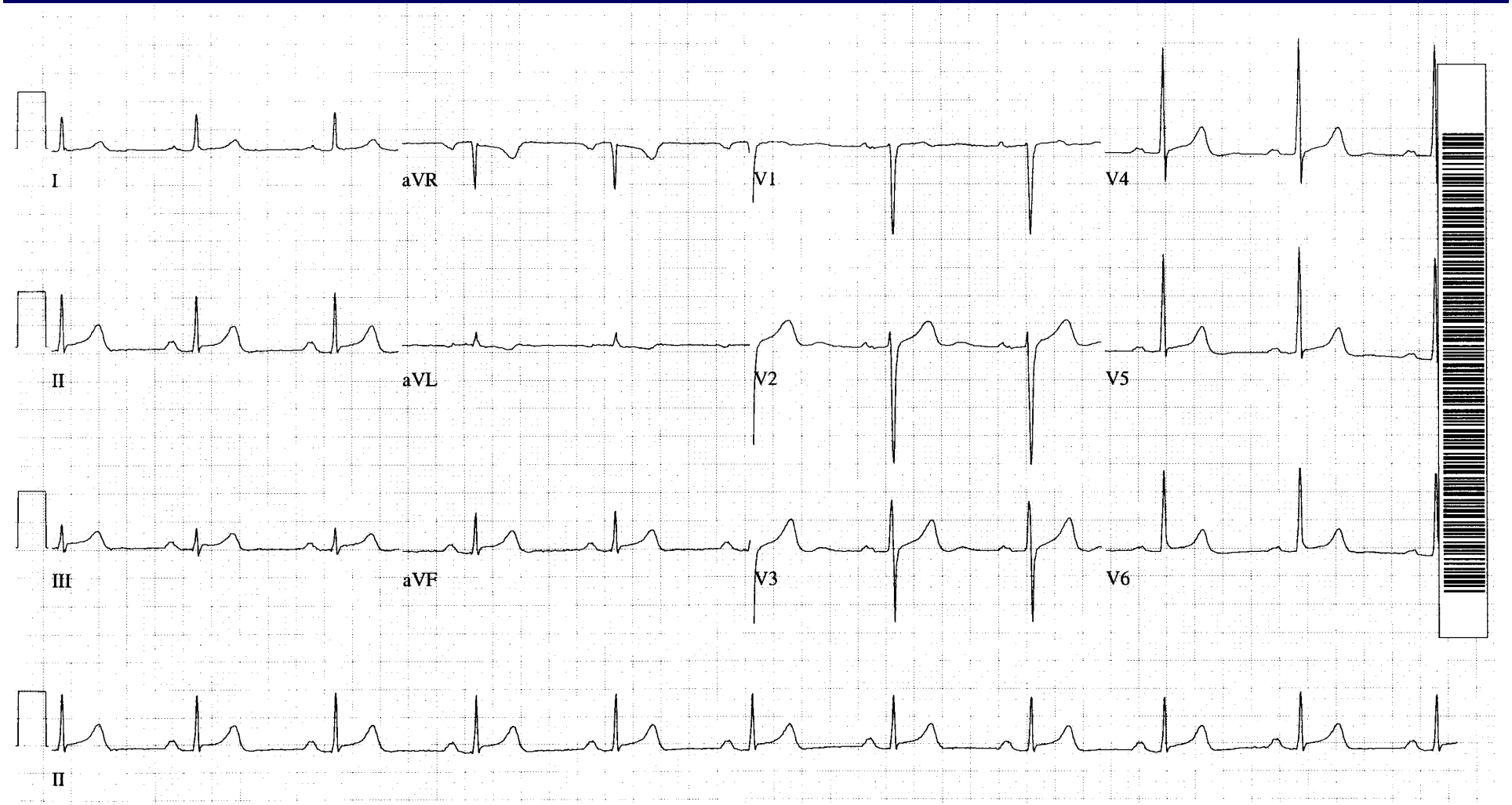


Early Reciprocal Changes in Lead aVL — Case 3

- 46 yo. man presents c/o substernal chest burning and diaphoresis after eating chicken soup few hours earlier
  - History of severe GERD, but *this was worse*
  - Took prevacid, now feeling better
  - ECG interpreted as normal (EP and cardiologist)

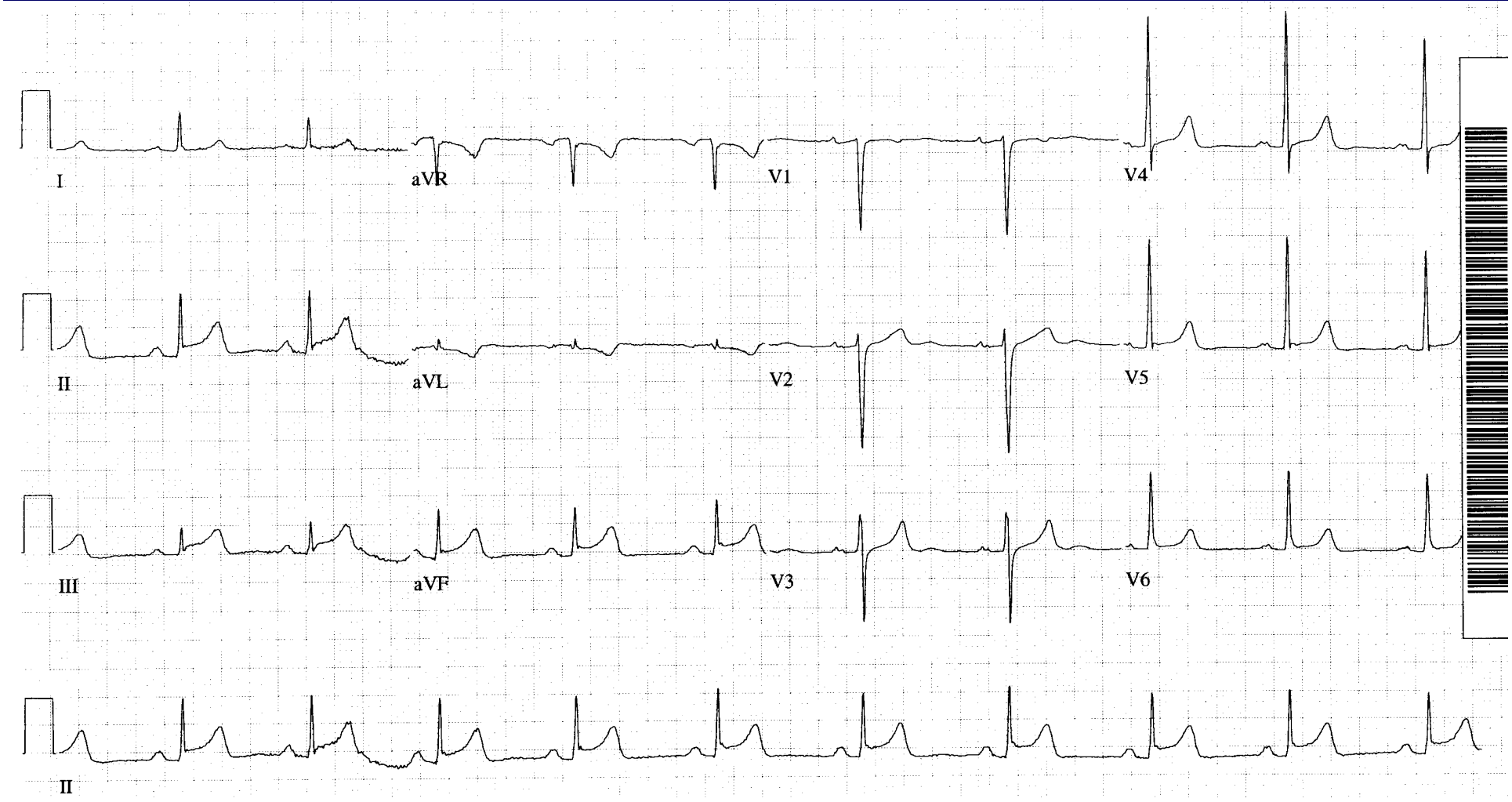
Early Reciprocal Changes in Lead aVL — Case 3



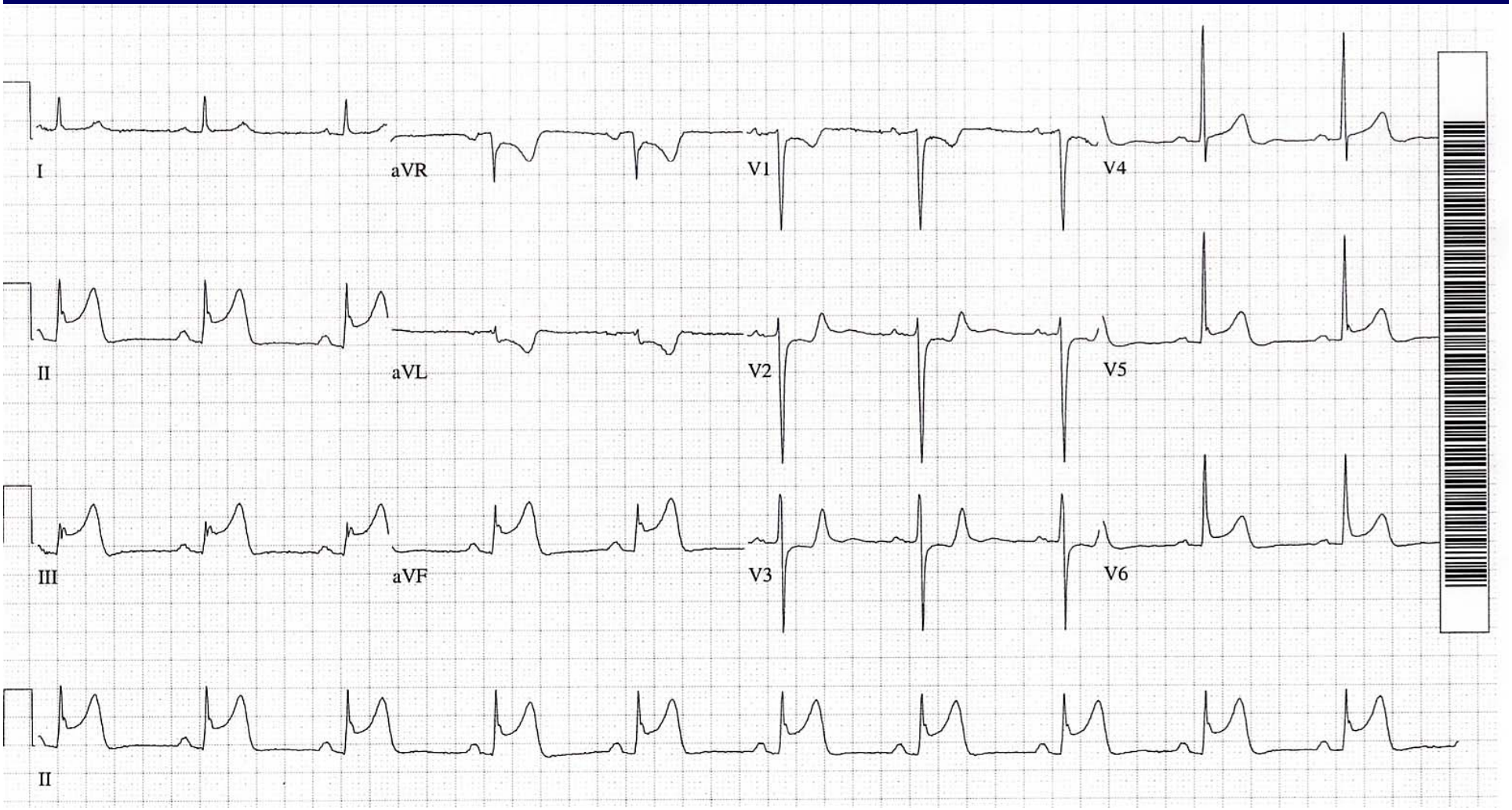
Early Reciprocal Changes in Lead aVL — Case 3

- Emergency physician decides to observe patient, draw labs
  - Pain worsens and serial ECGs demonstrate progressive changes

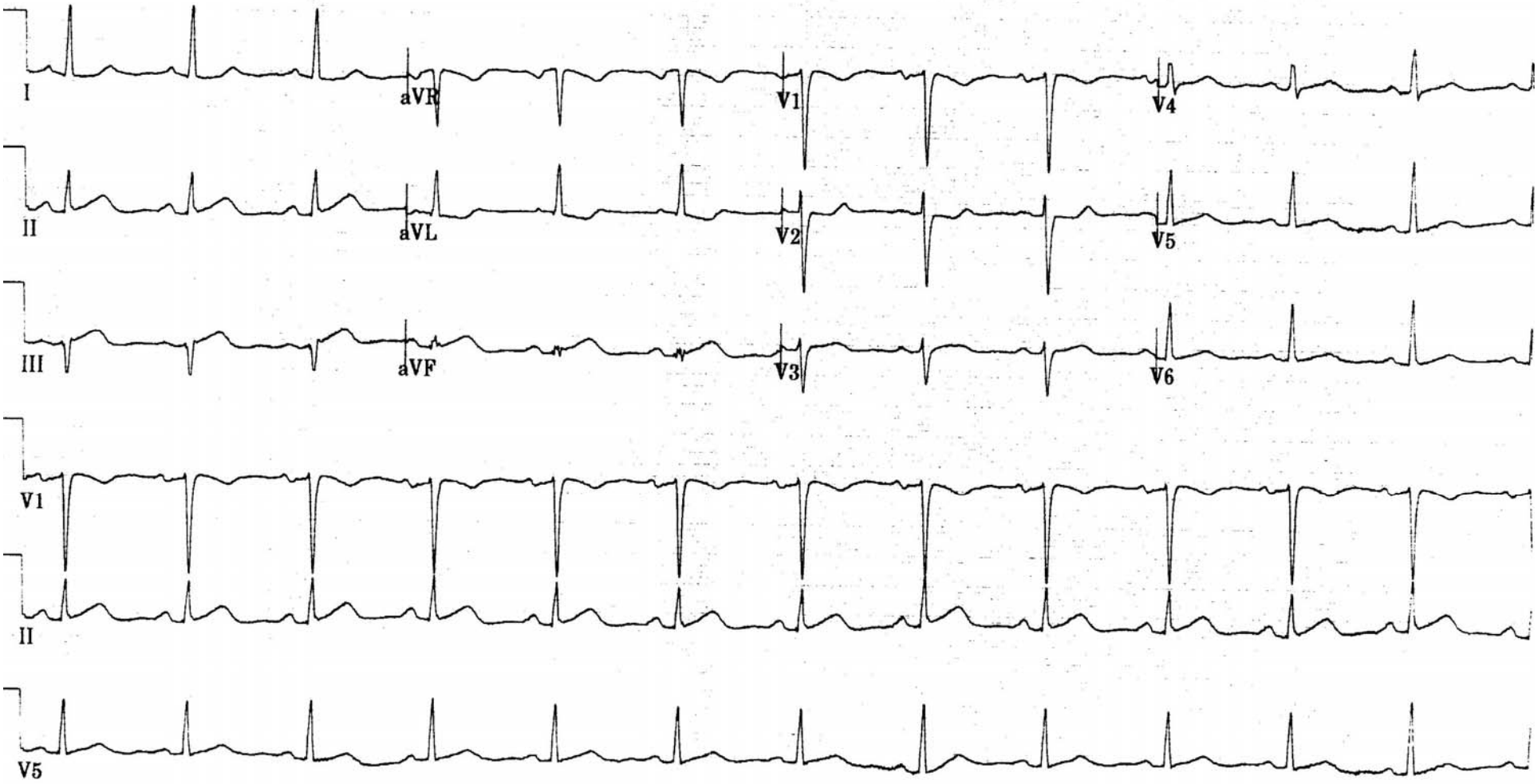
Early Reciprocal Changes in Lead aVL — Case 3



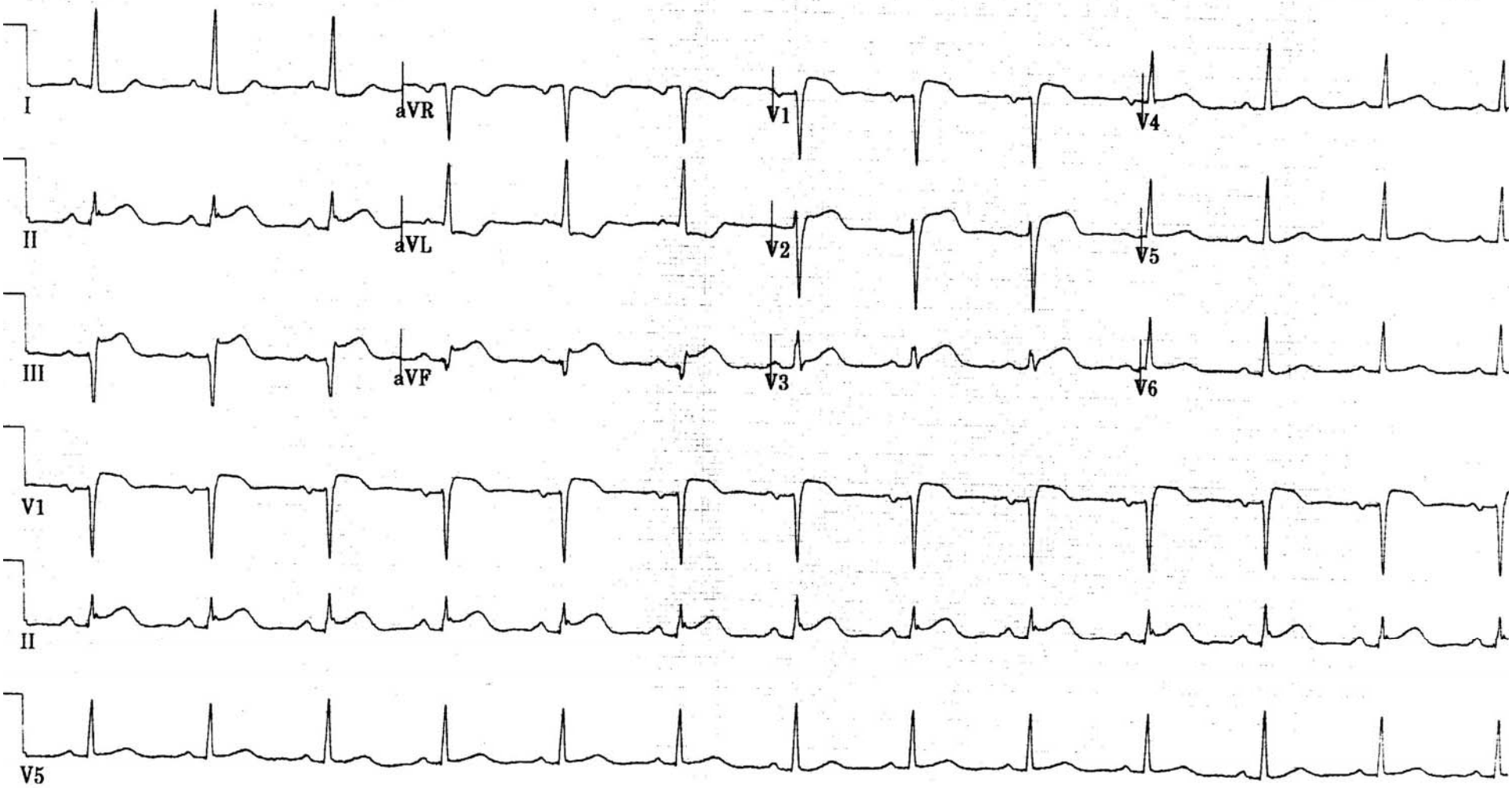
Early Reciprocal Changes in Lead aVL — Case 3



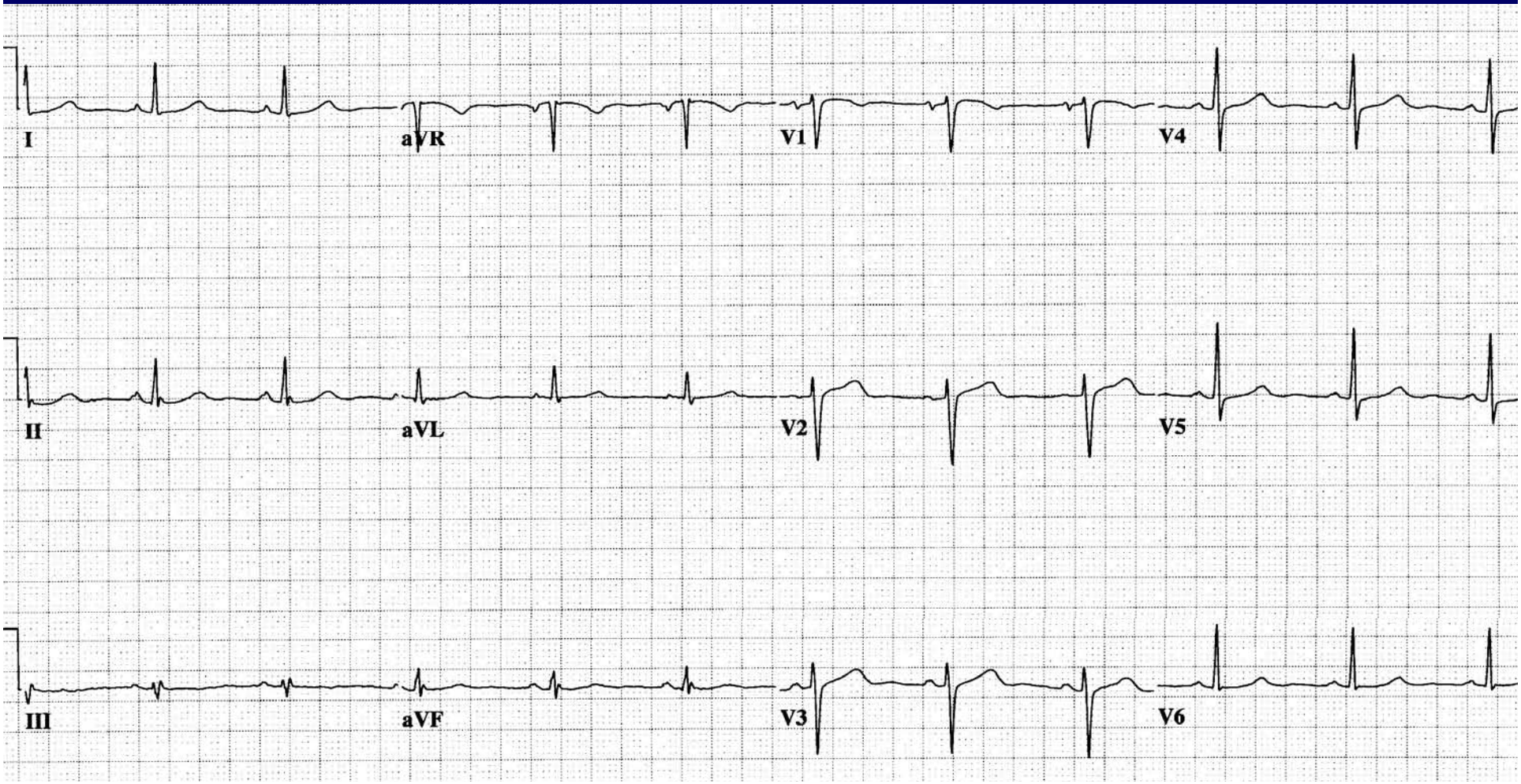
70 yo man with CP
ECG: “non-specific ST/Ts"



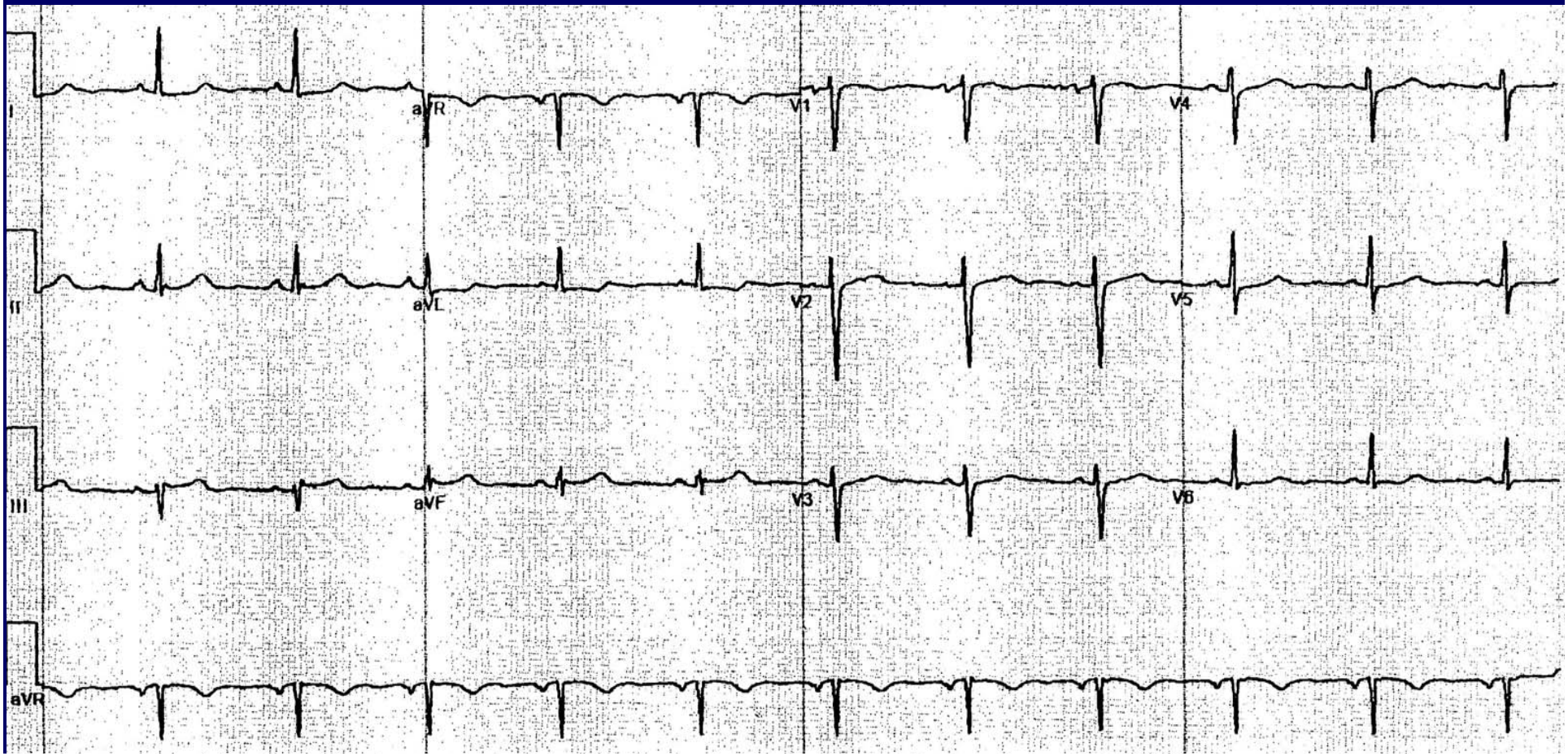
70 yo man with CP (persisting after 1-2 hours)



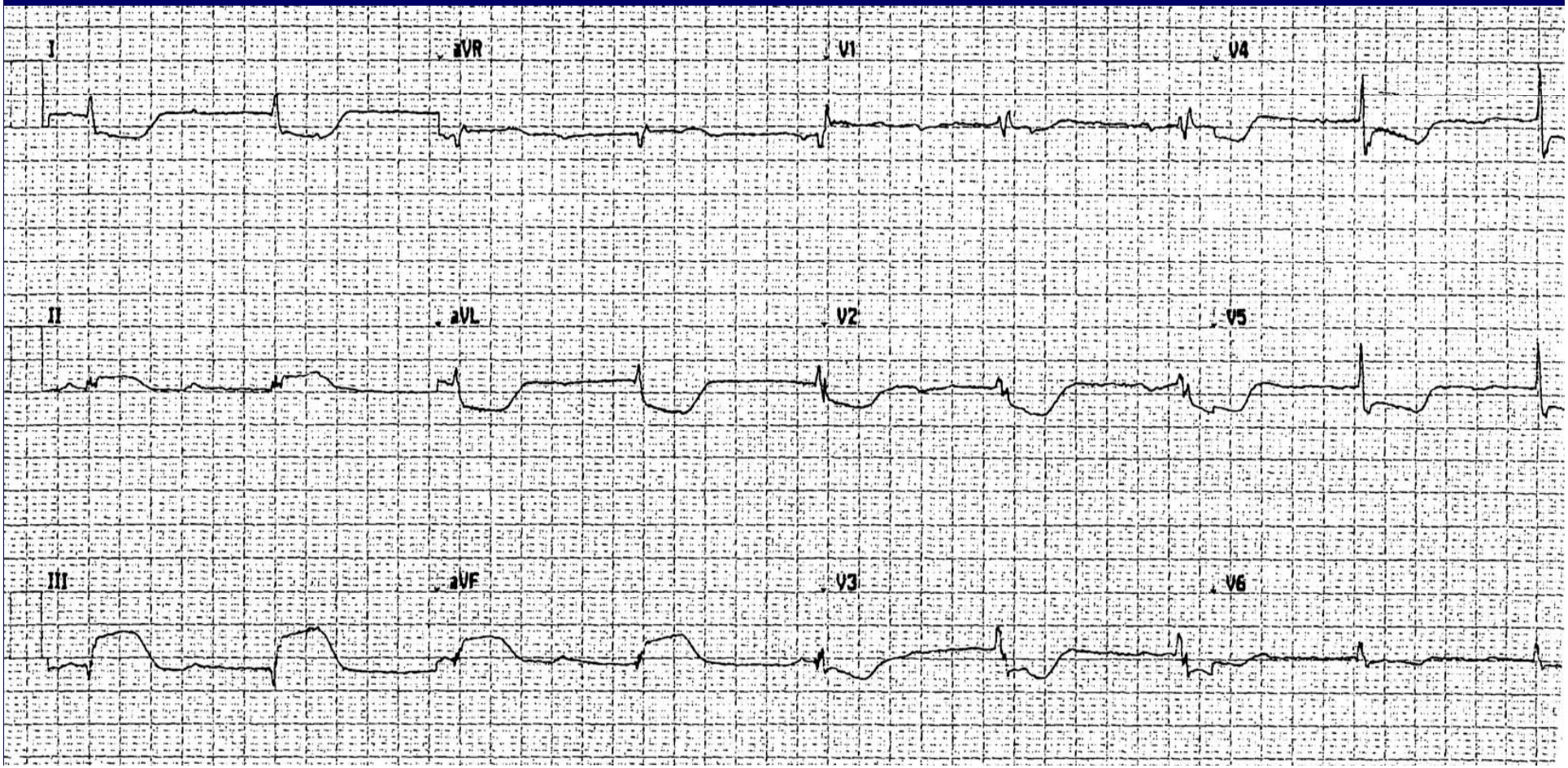
55 yo woman with atypical CP (triage ECG)



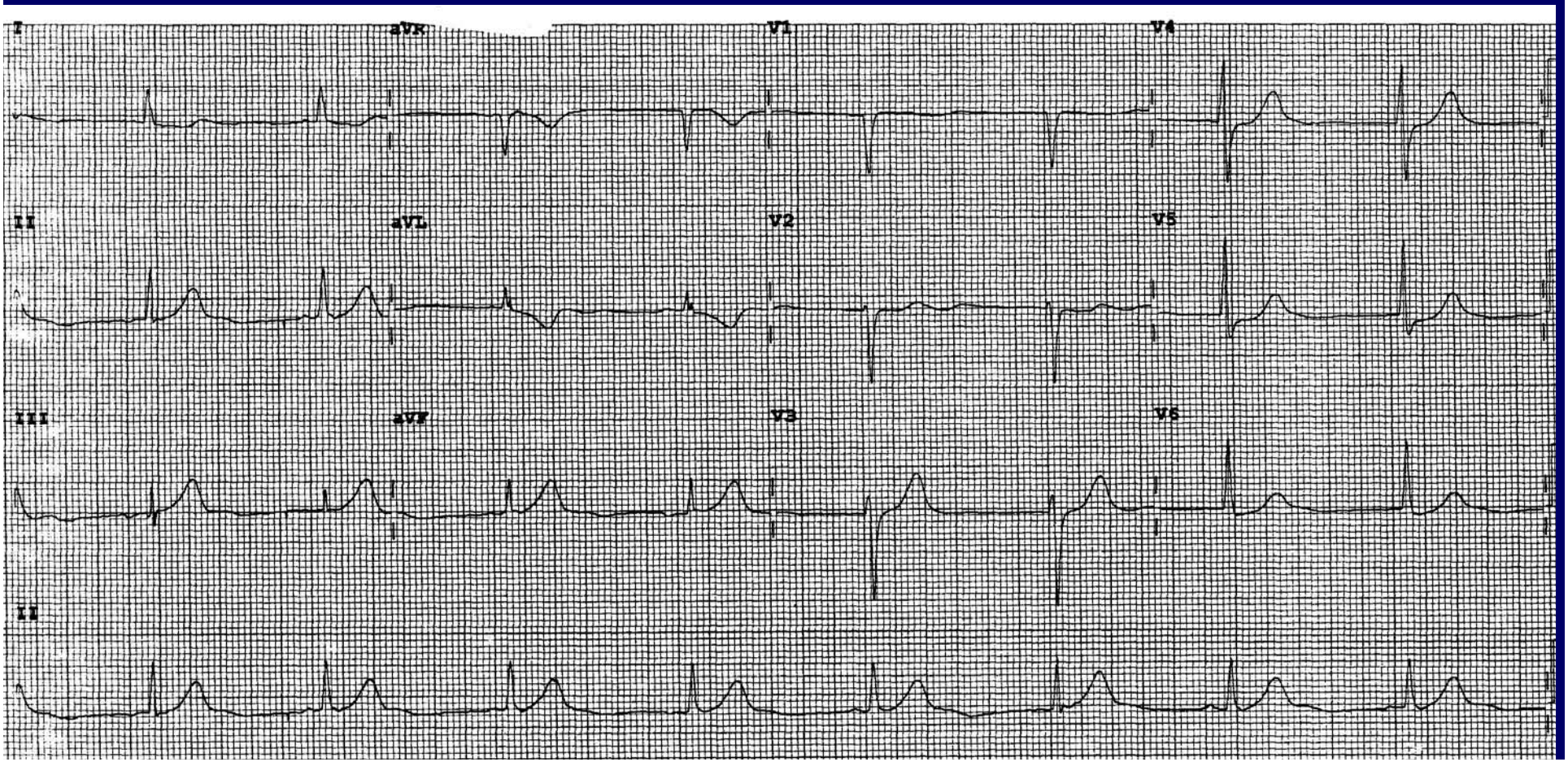
55 yo woman with atypical CP (during evaluation)



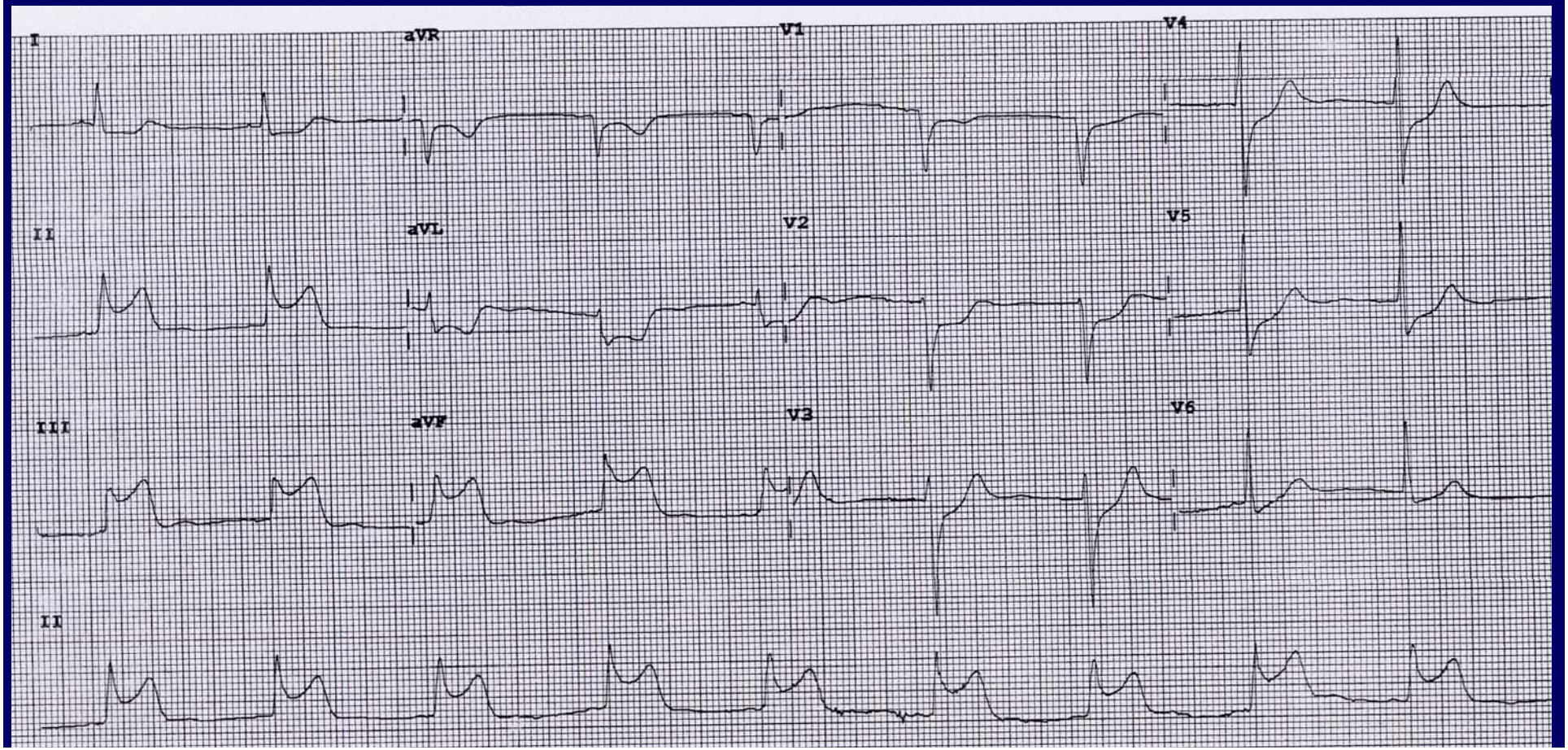
…later…cardiac arrest, resus, cath → 100% RCA



73 yo man with atypical CP, "non-specific Ts"



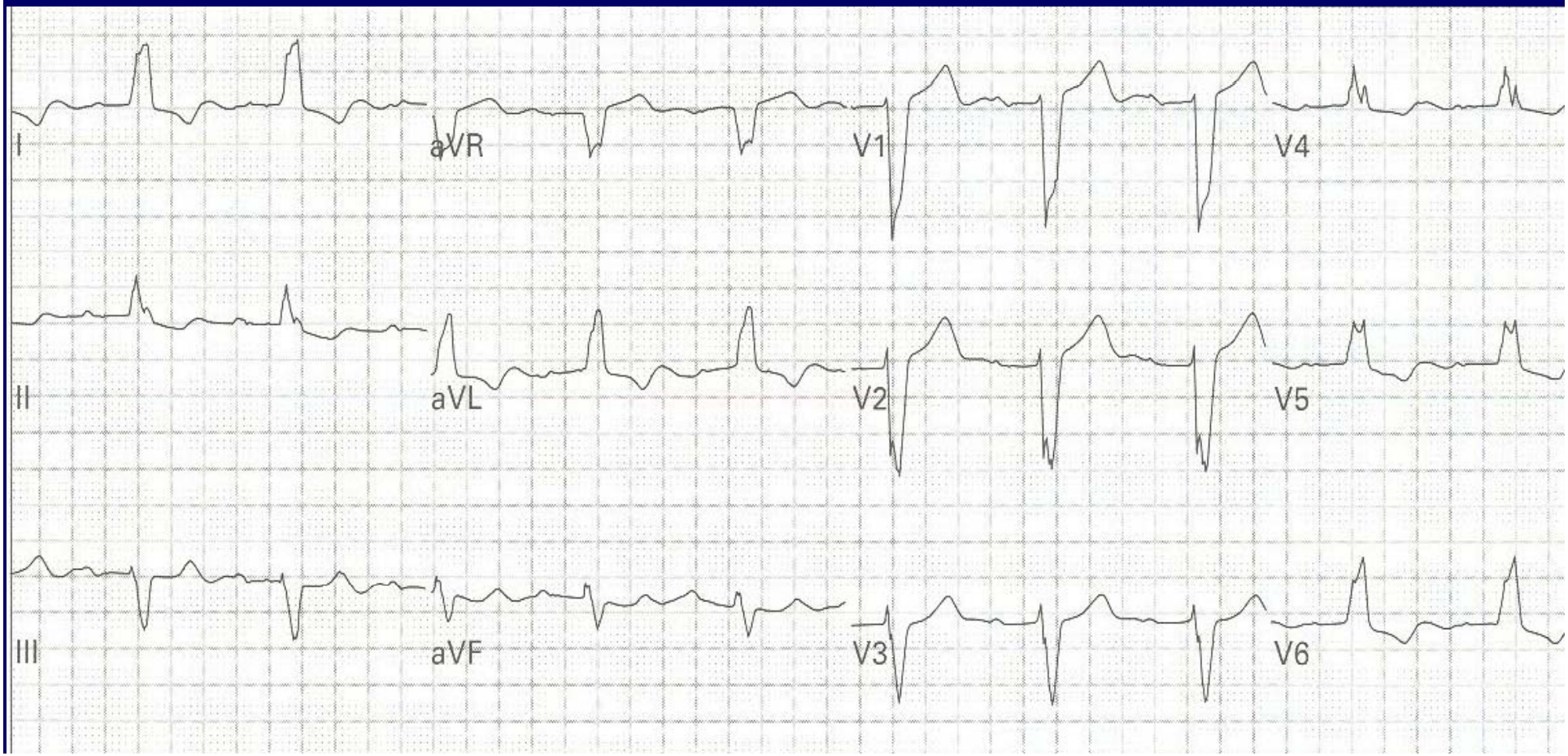
Persistent pain…
40 min later



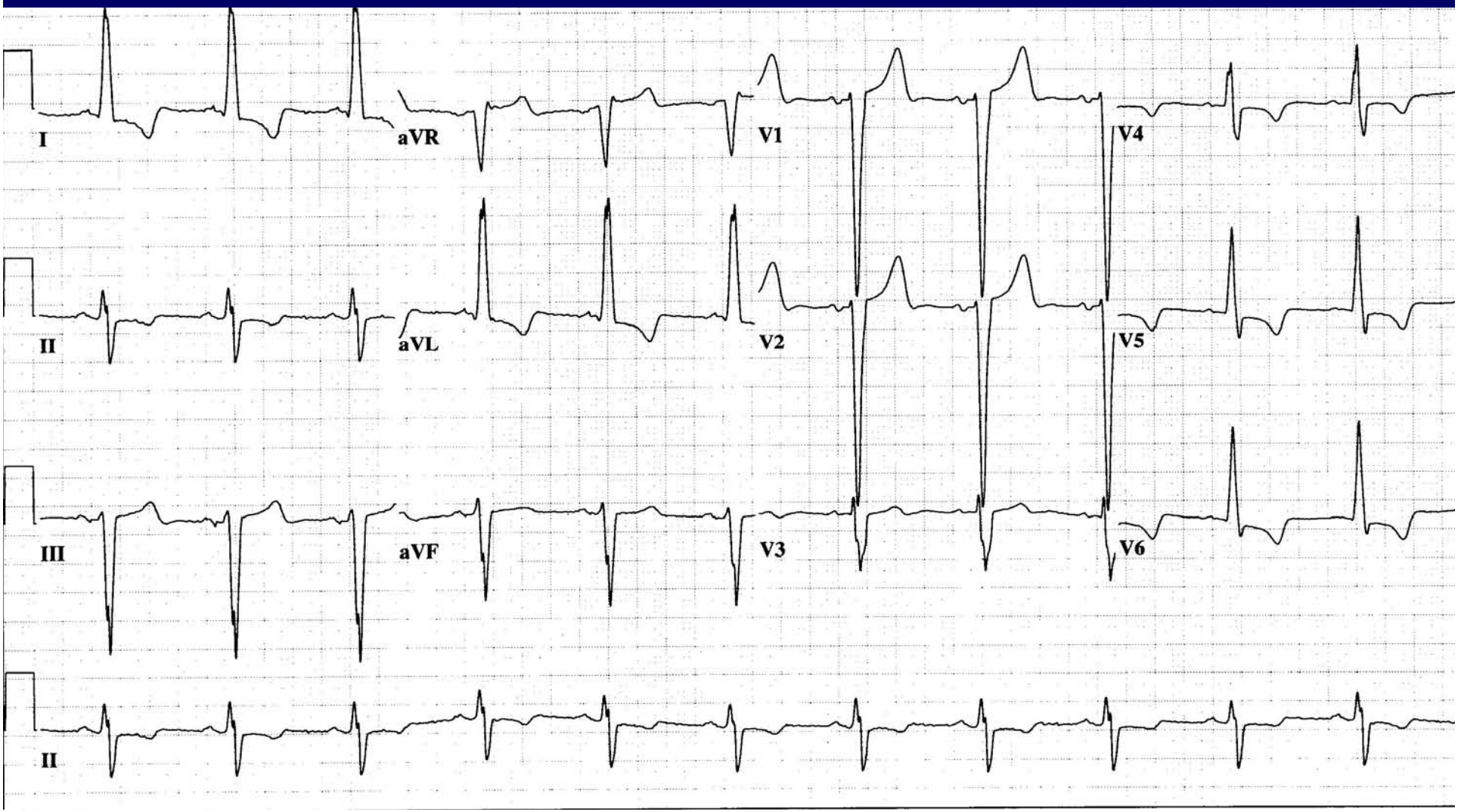
Early Reciprocal Changes in Lead aVL

- Normal variants
  - LBBB
  - LVH

Left Bundle Branch Block



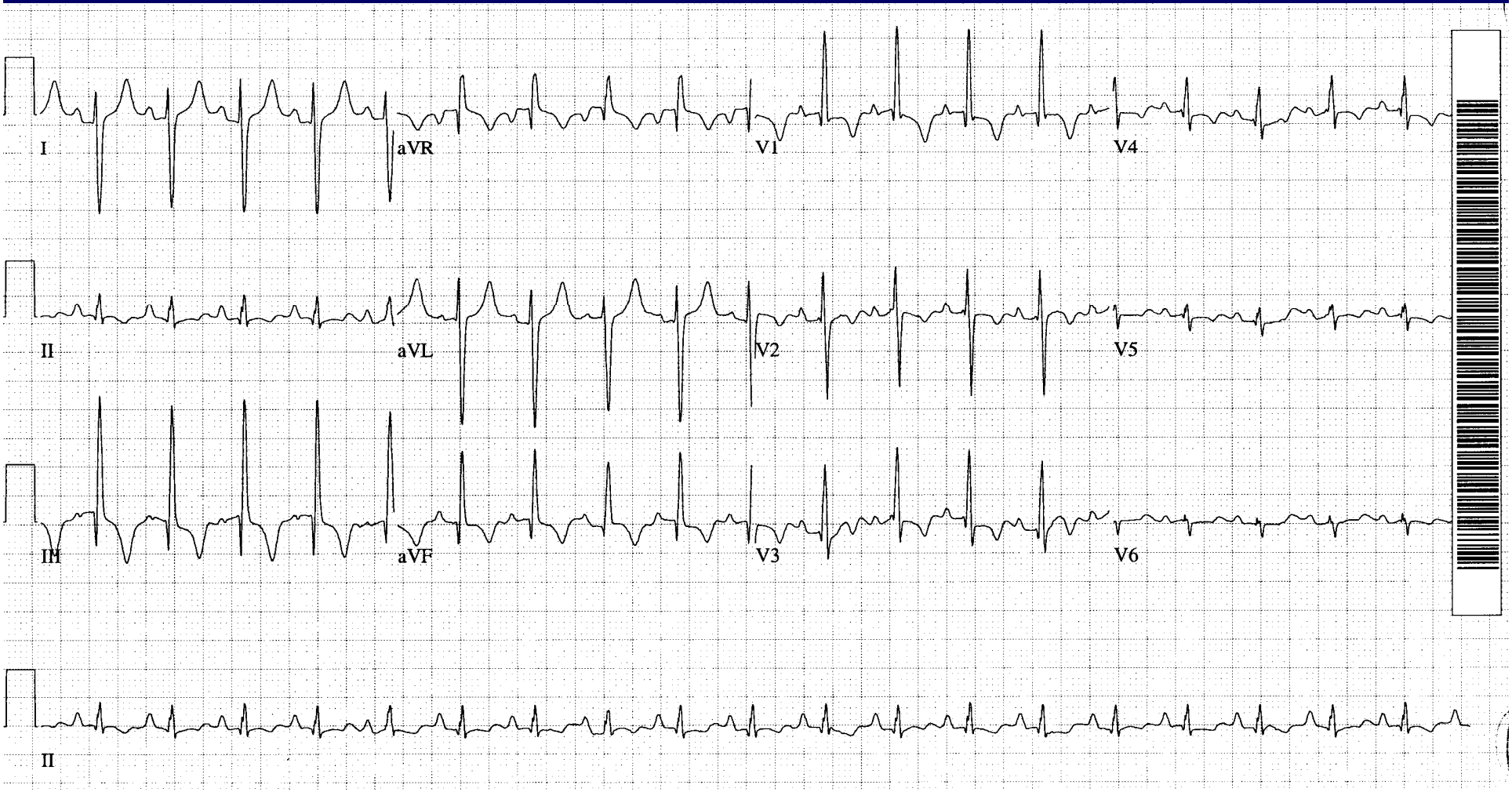
Left Ventricular Hypertrophy



Early Reciprocal Changes in Lead aVL

- Reciprocal changes in lead aVL may be the first sign of inferior myocardial ischemia
- When in doubt, get serial ECGs!

The “Classic” PE ECG



ECG Findings in PE

- $S_I Q_{III}$ or $S_I Q_{III} T_{III}$
- New RBBB or incomplete RBBB
- Rightward axis
- ST-segment elevations or depressions
  - Less common, but important to know!
- T-wave inversions, especially anteroseptal $\pm$ inferior leads

ECG Findings in PE

- T-wave inversions, especially anteroseptal ± inferior leads
  - Common in cases of large PE
  - 30-50% sensitivity

ECG Findings in PE

- T-wave inversions, especially anteroseptal + inferior leads

ECG Findings in PE

- T-wave inversions, especially anteroseptal + inferior leads
  - Marriott → Highly specific for PE
  - Kosuge (Am J Cardiol 2007)
    - 99% specific for PE!

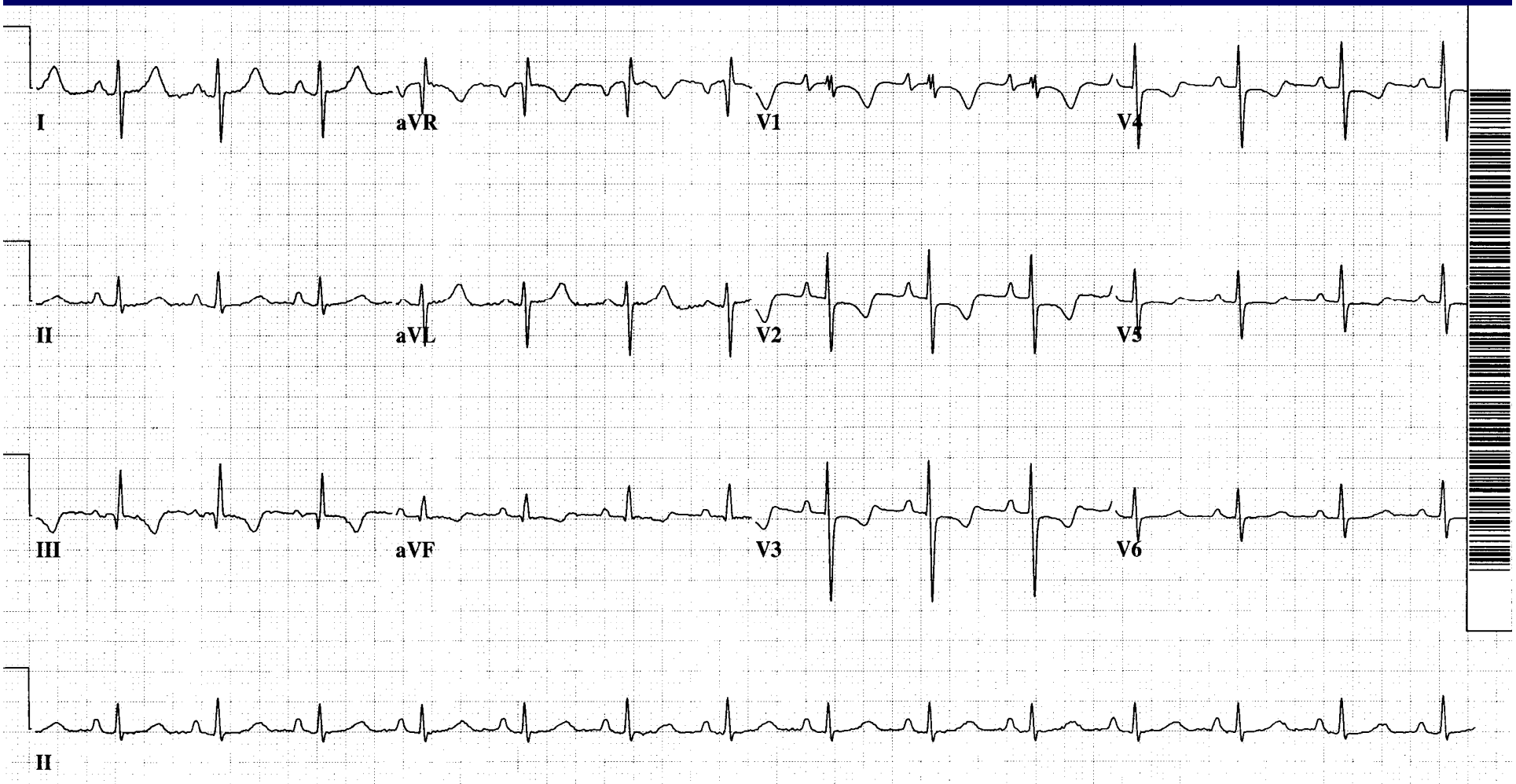
PE Simulating ACS — Case 1

- 33 yo. man presents c/o progressive dyspnea during the past week
  - History of *massive* obesity and CHF
  - Lungs sounds “distant”
  - CXR read in ED as c/w pulmonary edema
    - official reading: “CMG, clear fields”

PE Simulating ACS — Case 1

- 33 yo. man presents c/o progressive dyspnea during the past week
  - History of *massive* obesity and CHF
  - Lungs sounds “distant”
  - CXR read in ED as c/w pulmonary edema
    - official reading: “CMG, clear fields”
  - ECG interpreted as showing “cardiac ischemia”
    - cardiologist: “Anterior-inferior ischemia.”

PE Simulating ACS — Case 1



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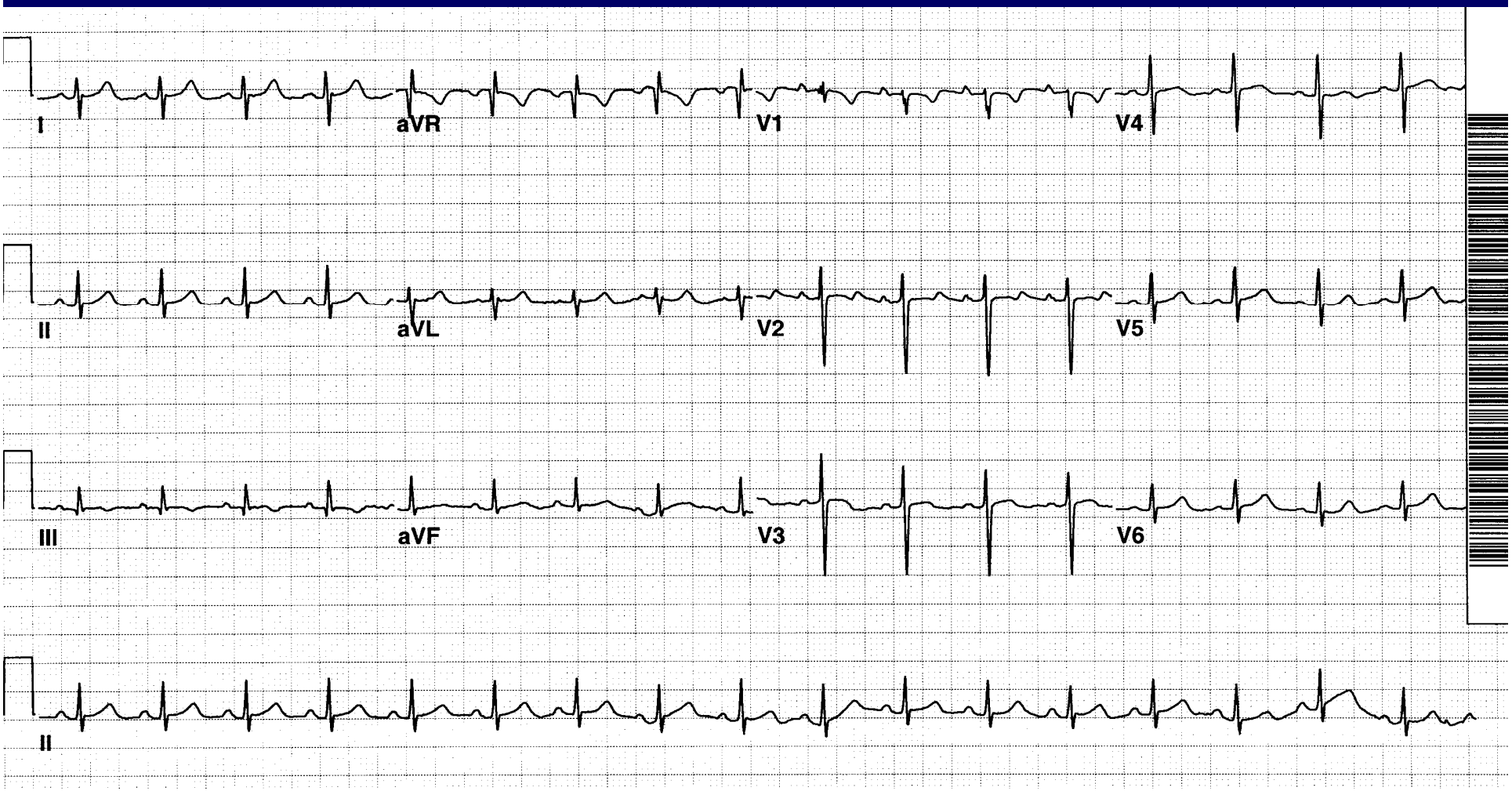


PE Simulating ACS — Case 1

- Patient is treated for CHF with nitrates and furosemide
  - ECG remains unchanged
- Rules out for AMI
- Patient is discharged feeling better

PE Simulating ACS — Case 1

- Patient has cardiac arrest next day
- Autopsy performed
  - Large saddle embolus and 2 other PEs
  - No evidence of CAD

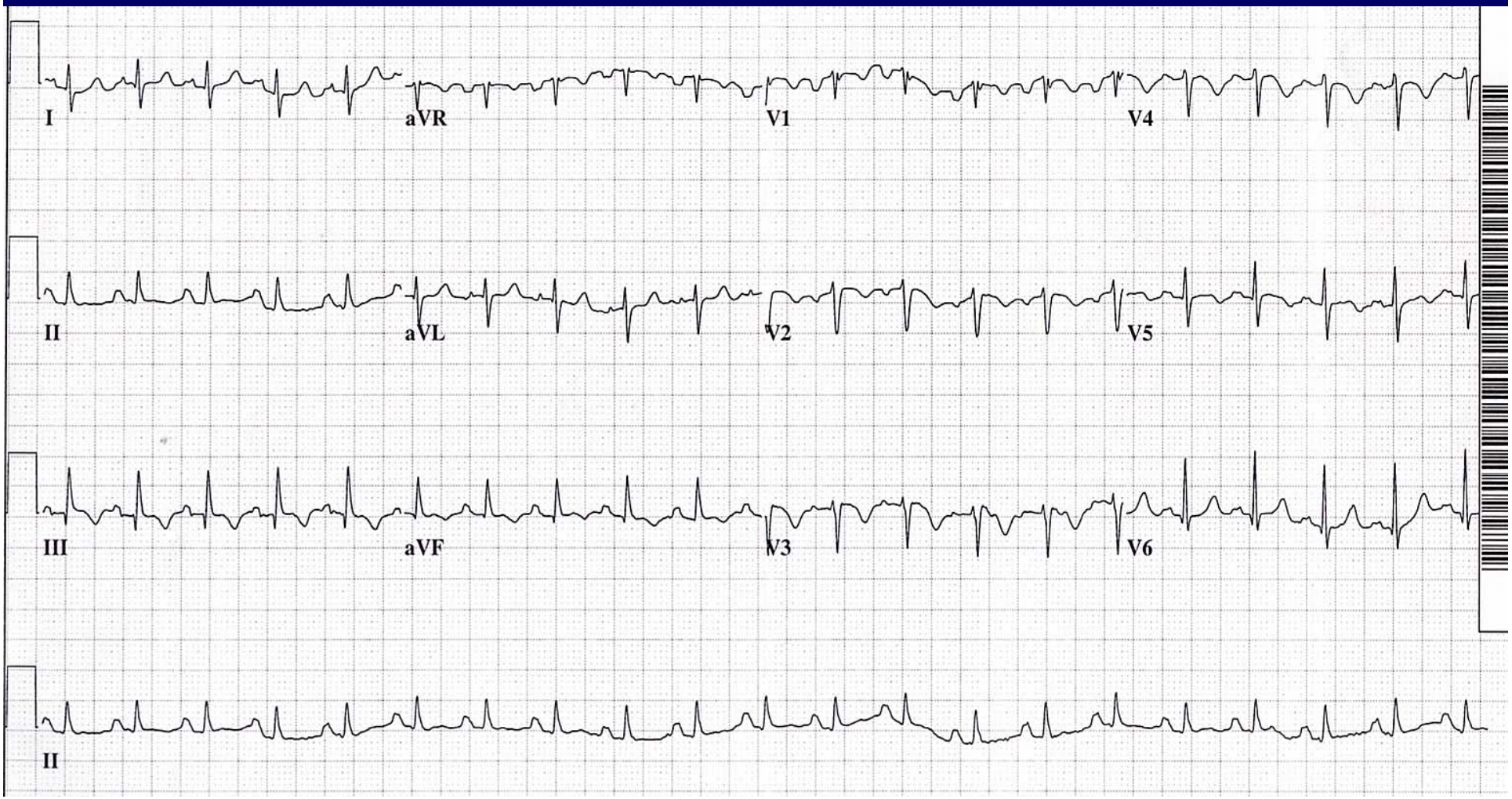
PE Simulating ACS — Case 2

- 81 yo. woman presents c/o dyspnea for 3 days
  - History includes COPD
  - Exam is notable for poor breath sounds and scant wheezes (chronic per records)

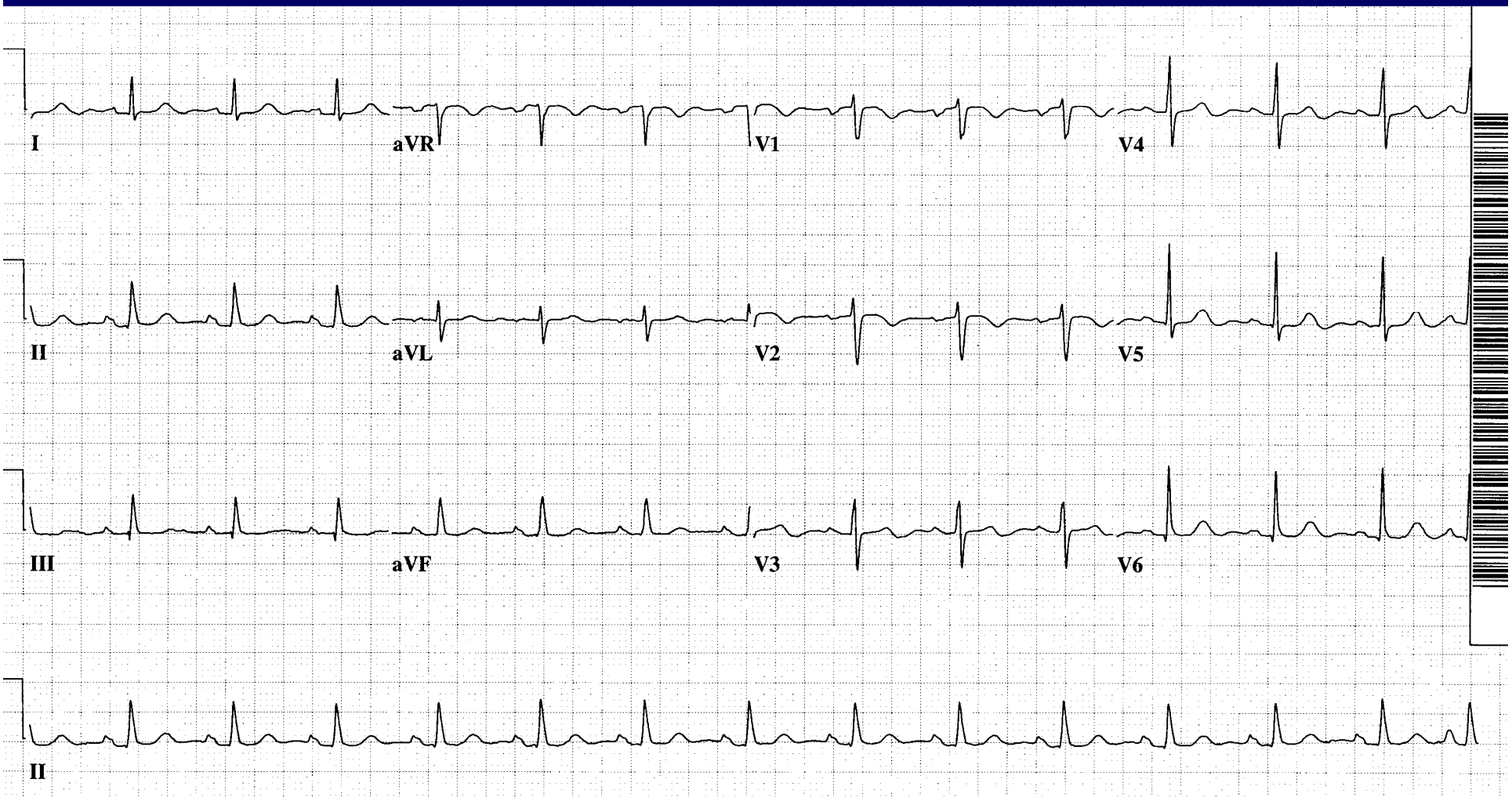
PE Simulating ACS — Case 2

- 81 yo. woman presents c/o dyspnea for 3 days
  - History includes COPD
  - Exam is notable for poor breath sounds and scant wheezes (chronic per records)
  - ECG interpreted as anterior and inferior ischemia

PE Simulating ACS — Case 2



Baseline ECG



PE Simulating ACS — Case 2

- ED treatment focuses on COPD and ACS
  - Nebulizers, steroids, aspirin
- Cardiac enzymes are sent
- Patient rules out for MI
- Dyspnea improves by the next day, but...

PE Simulating ACS — Case 2

- ED treatment focuses on COPD and ACS
  - Nebulizers, steroids, aspirin
- Cardiac enzymes are sent
- Patient rules out for MI
- Dyspnea improves by the next day, but...
  - Patient has a cardiac arrest and dies
  - Autopsy shows massive PE

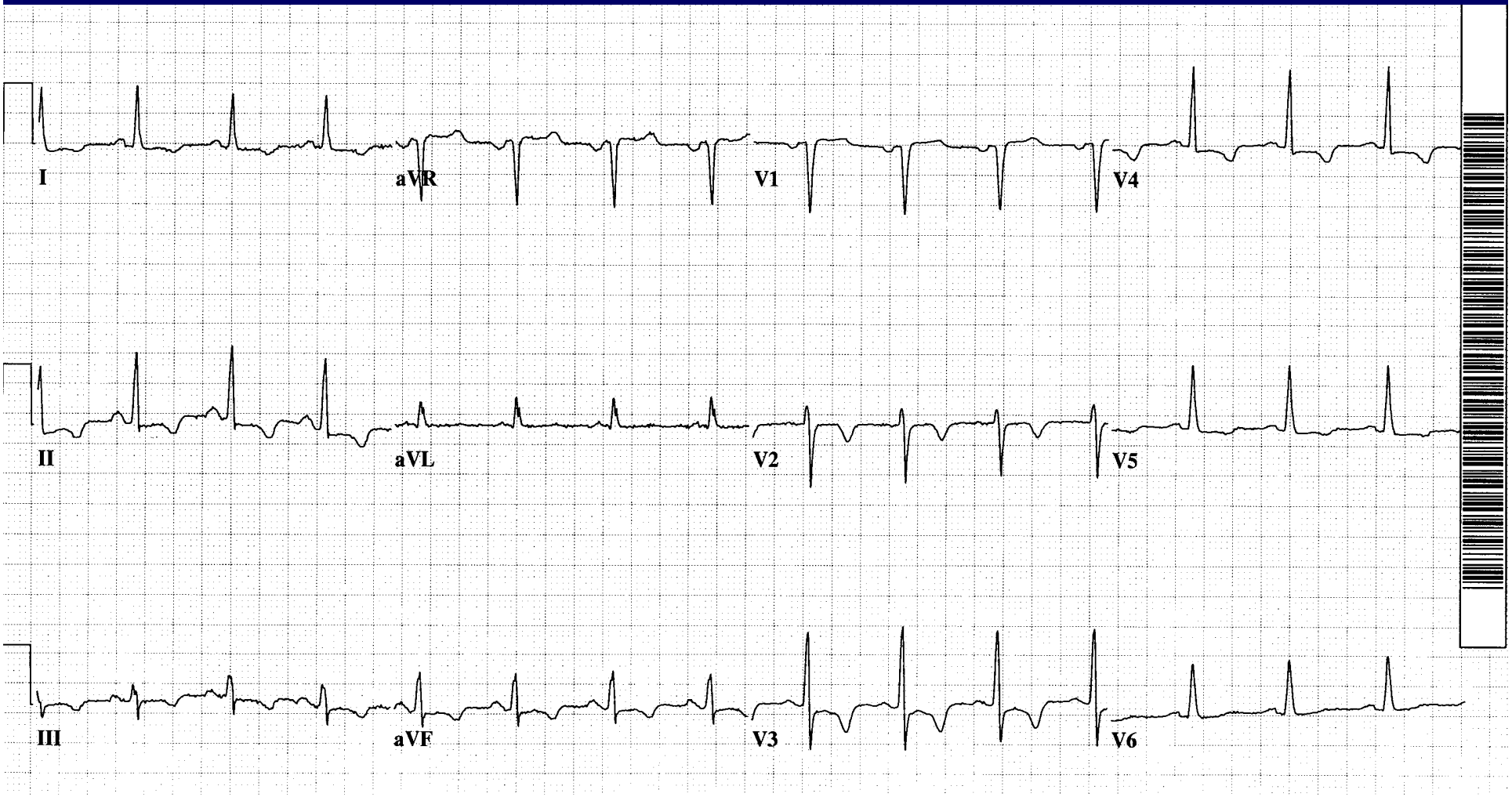
PE Simulating ACS — Case 3

- 51 yo. woman presents c/o dyspnea at rest and with exertion, orthopnea, cough productive of clear sputum
  - History of MI, diabetes, CHF, smoker
  - Normal oxygen saturation, CXR

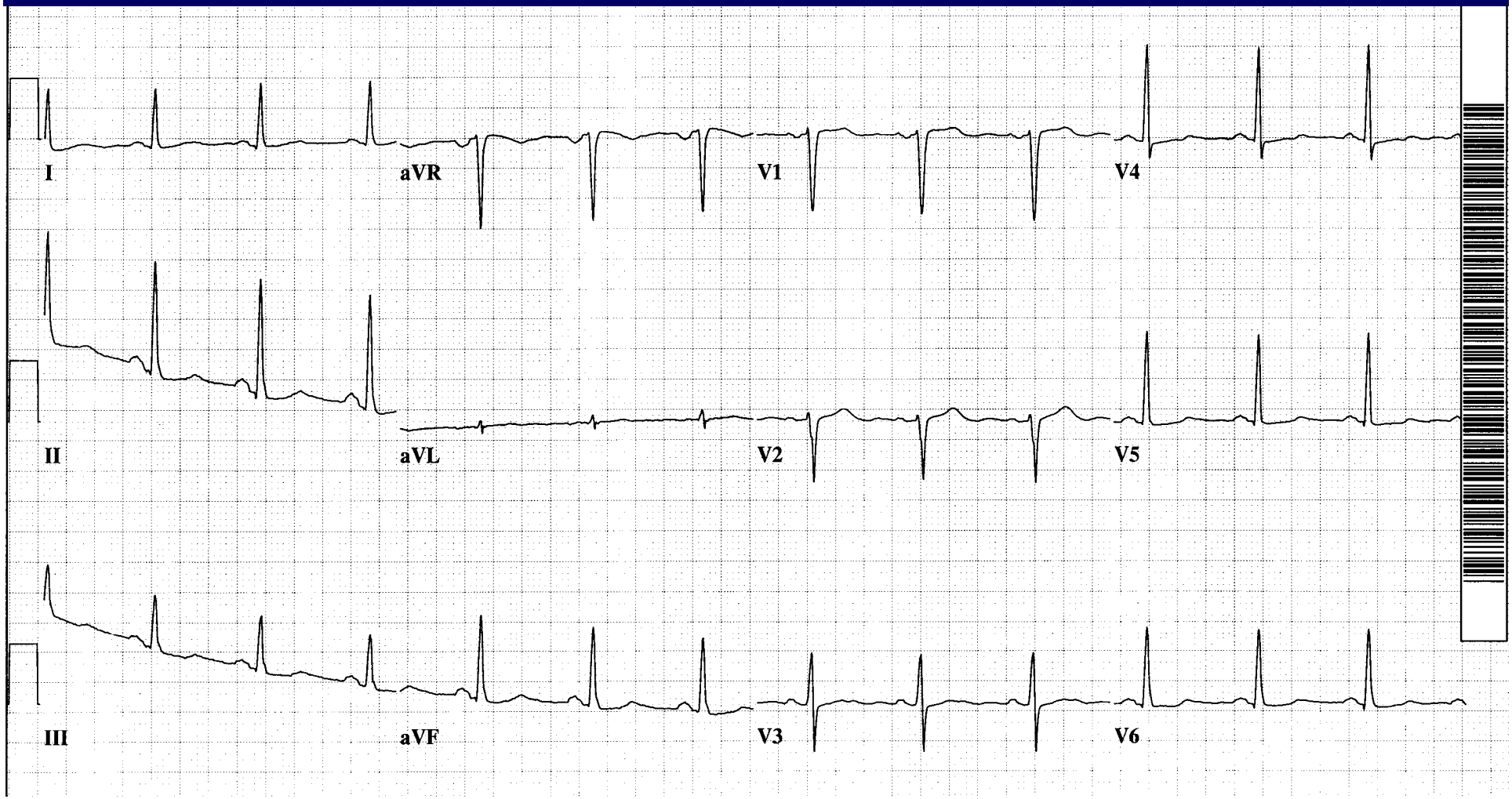
PE Simulating ACS — Case 3

- 51 yo. woman presents c/o dyspnea at rest and with exertion, orthopnea, cough productive of clear sputum
  - History of MI, diabetes, CHF, smoker
  - Normal oxygen saturation, CXR
  - ECG interpreted as “inferior and anterior ischemic changes”
  - Admitted for CHF (?) and ACS

PE Simulating ACS — Case 3



Baseline ECG



PE Simulating ACS — Case 3

- Patient rules out for AMI
- Develops wheezing prior to stress test
  - No prior history of reactive airway disease
- Lung CT is performed
  - Multiple PEs

PE Simulating ACS — Case 4

- 50 yo. man presents with severe substernal chest pain radiating to left upper chest, dyspnea, diaphoresis
  - No cardiac risk factors
  - Exam is notable only for tachycardia (HR 137) and tachypnea (RR 22)

PE Simulating ACS — Case 4

- 50 yo. man presents with severe substernal chest pain radiating to left upper chest, dyspnea, diaphoresis
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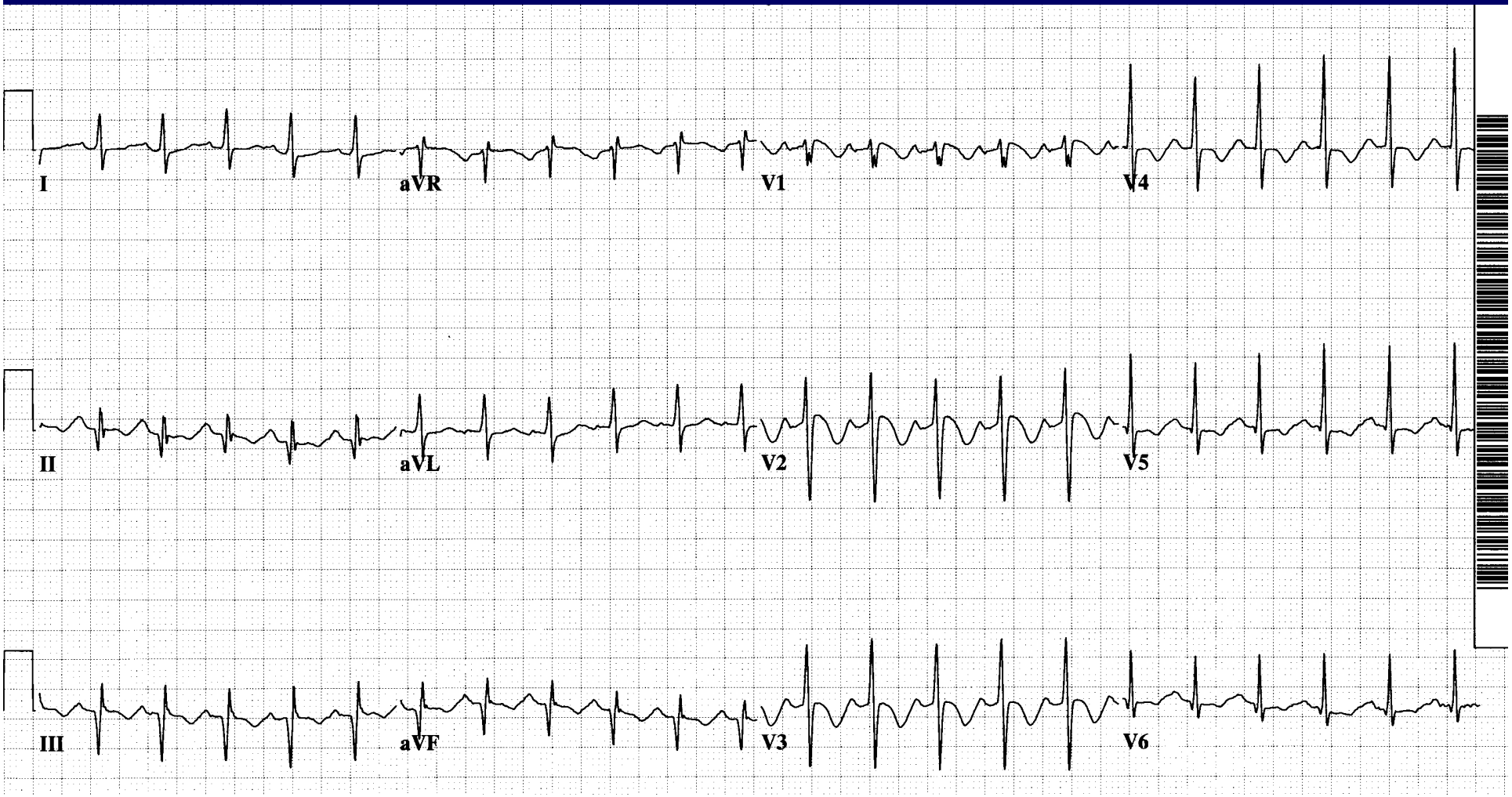
  - ECG interpreted as showing inferior and anterior ischemia

PE Simulating ACS — Case 4



PE Simulating ACS — Case 4

- Patient is treated with ASA, NTG, heparin
  - Chest pain persists
- Cardiologist is consulted
  - Recommends addition of metoprolol, clopidogrel, eptifibitide, and morphine

PE Simulating ACS — Case 4

- Patient is treated with ASA, NTG, heparin
  - Chest pain persists
- Cardiologist is consulted
  - Recommends addition of metoprolol, clopidogrel, eptifibitide, and morphine
  - Arranges transfer for emergent cardiac catheterization

PE Simulating ACS — Case 4

- Catheterization shows no significant CAD
- Pain free with morphine
- Rules out for AMI
- All cardiac medications are discontinued
  - *No further workup for cause of chest pain*
- Patient is discharged

PE Simulating ACS — Case 4

- Patient follows up with initial cardiologist
- Still complaining of dyspnea, especially with exertion
- Repeat ECG shows persistent TWIs
- Cardiologist orders further studies...

PE Simulating ACS — Case 4

- VQ → “positive”
- LE U/S → positive

PE Simulating ACS — Case 5

- 25 yo. woman presents with chest tightness and dyspnea
  - 12 weeks pregnant
  - History of asthma

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- 25 yo. woman presents with chest tightness and dyspnea
  - 12 weeks pregnant
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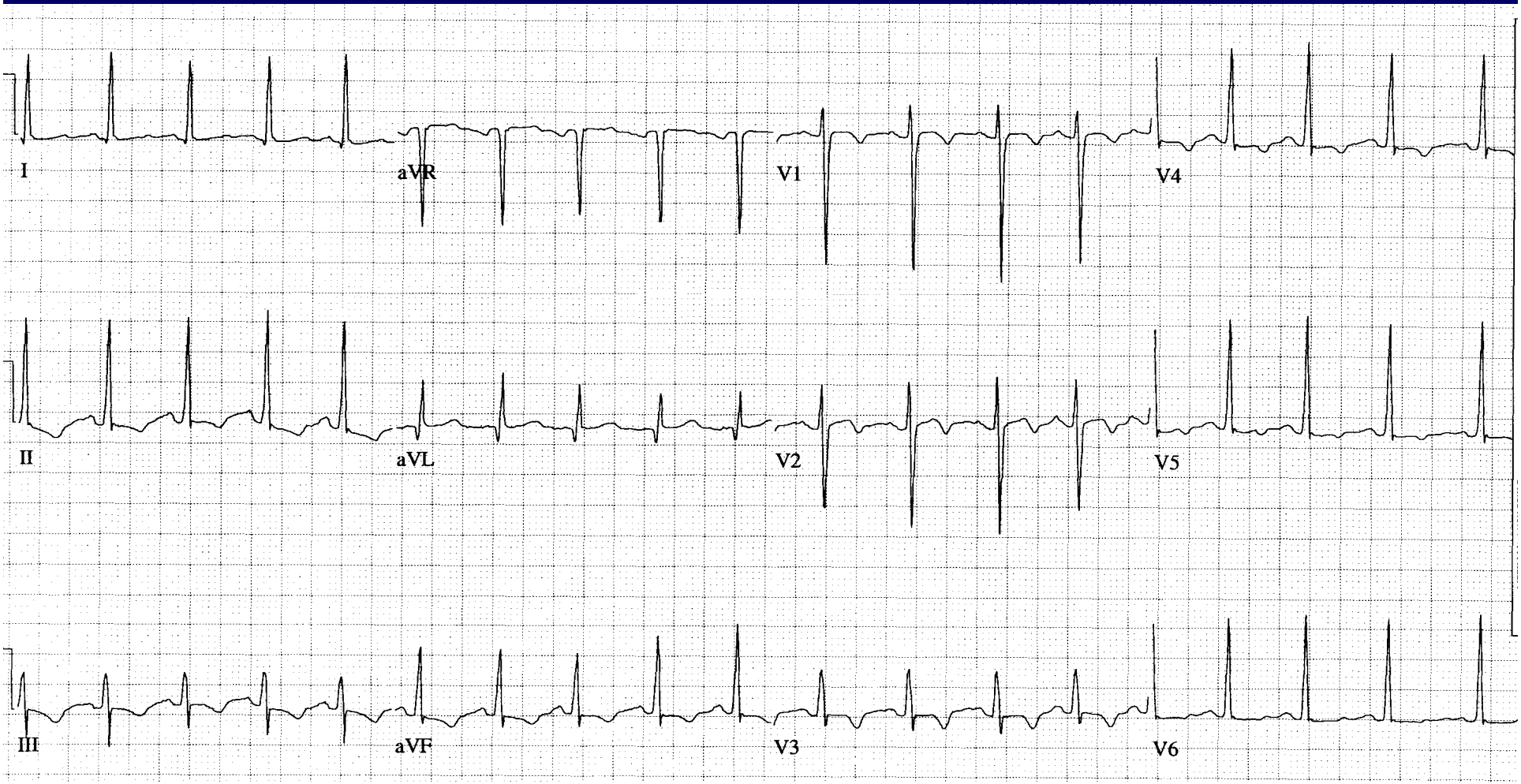
  - Exam notable for tachycardia, mild wheezing, mild chest tenderness; legs normal
  - ECG interpreted as “flipped T waves, likely nonspecific given her age”

PE Simulating ACS — Case 5



PE Simulating ACS — Case 5

- Patient improves with nebulizer therapy
- Patient is discharged home
- Cardiac arrest 12 hours later
  - Autopsy confirms multiple PEs, saddle embolus, large DVT

PE Simulating ACS — Summary

- Pulmonary embolism can cause ECG changes that simulate ACS

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  - Strongly consider PE when the ECG has inverted T-waves simultaneously in the anteroseptal + inferior leads
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Outline

1. Reciprocal changes in lead aVL
2. Pulmonary embolism simulating ACS
3. Pericarditis vs. AMI

Pericarditis

- Classic teaching
  - Diffuse ST-segment elevation
  - ST-segment elevation is concave upwards

Pericarditis

- Classic teaching
  - PR-segment depression (downsloping)
  - PR-segment elevation in aVR

Pericarditis

- Classic teaching
  - Chest pain tends to be positional, pleuritic
  - Friction rub

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Pericarditis

- Classic teaching
  - Diffuse ST-segment elevation
    - may be localized instead of diffuse
    - pearl → no reciprocal ST-segment depression!
  - ST-segment elevation is concave upwards
    - AMI may have similar ST-segment morphology
    - pearl → ST-segment elevation that is convex upwards or horizontal strongly favors AMI

Pericarditis

- Additional pearl: STE
  - STE II > STE III strongly favors pericarditis
  - STE III > STE II very strongly favors AMI

Pericarditis

- Classic teaching
  - PR-segment depression (downsloping)
    - primarily present in *viral* pericarditis
    - often an early, transient finding
  - PR-segment elevation in aVR
    - may also be present in other diseases (e.g. AMI)
    - often absent in constrictive pericarditis

Pericarditis

- Classic teaching
  - Chest pain tends to be positional, pleuritic
    - 16% of AMIs may present with positional or pleuritic pain
  - Friction rub
    - often transient

ECGs and Pericarditis

1. Factors that rule-in STEMI
   - STD except in V1 or aVR
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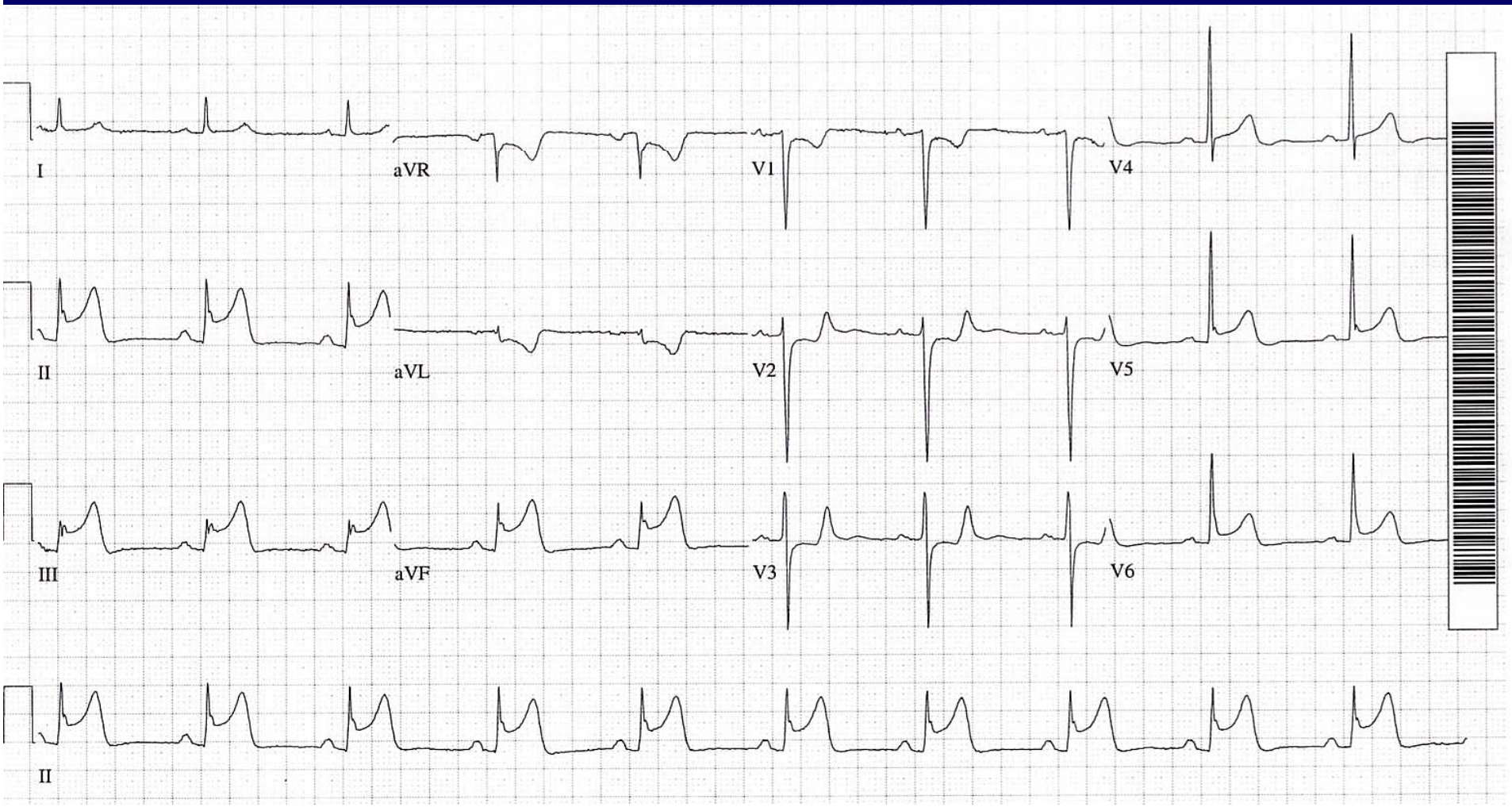
ECGs and Pericarditis

When in doubt, get serial ECGs!

STEMI or AP?



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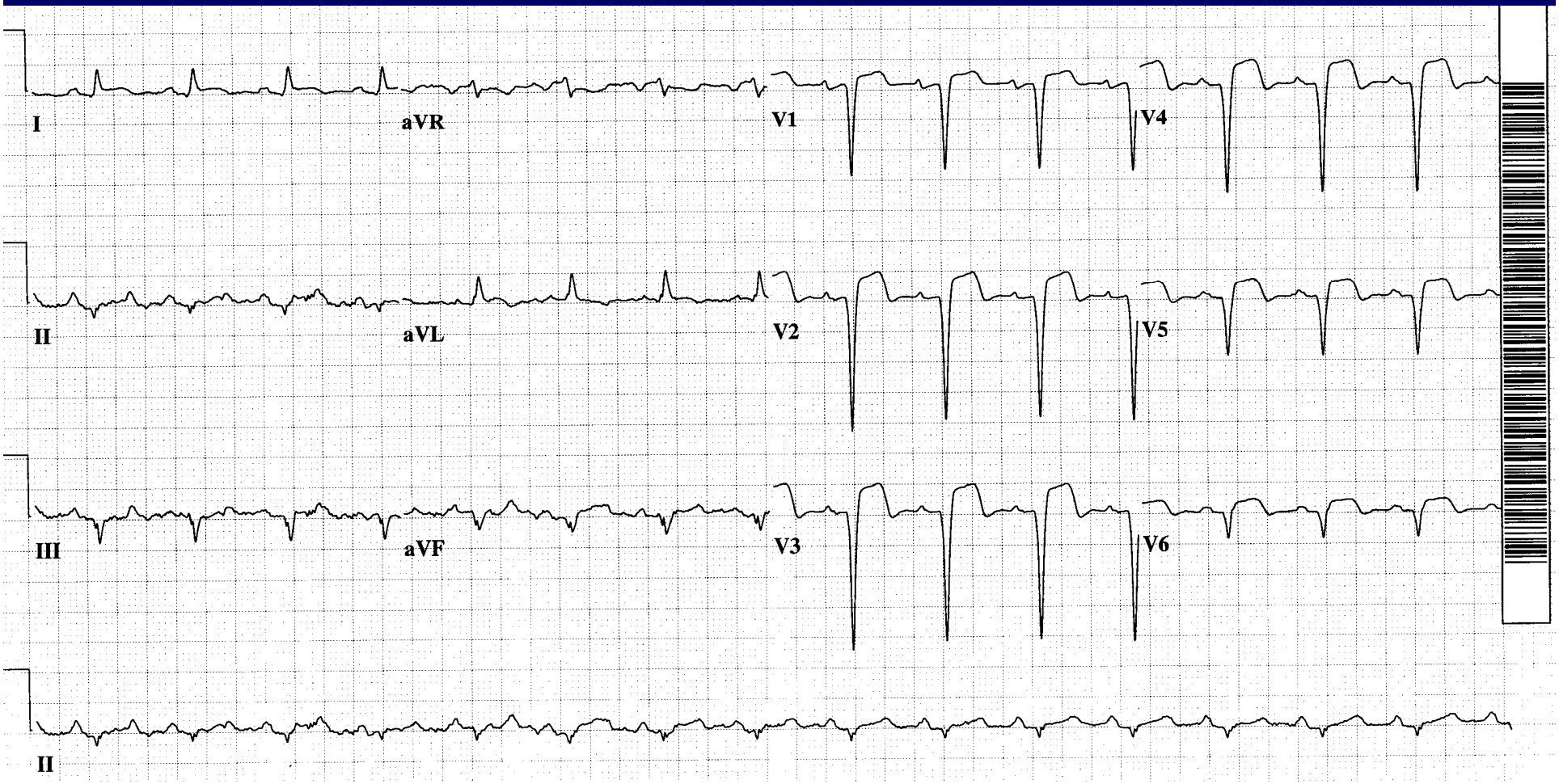

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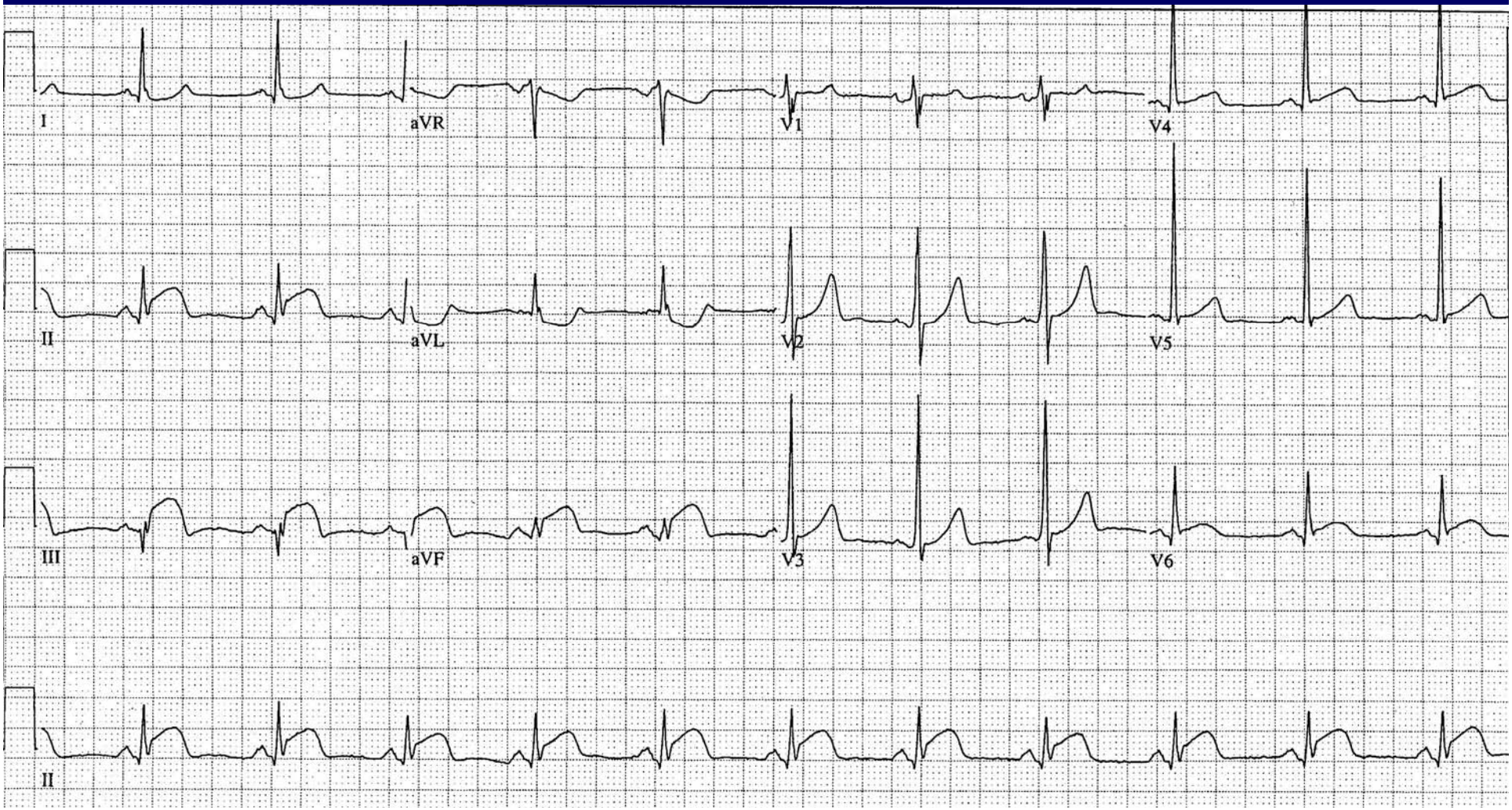

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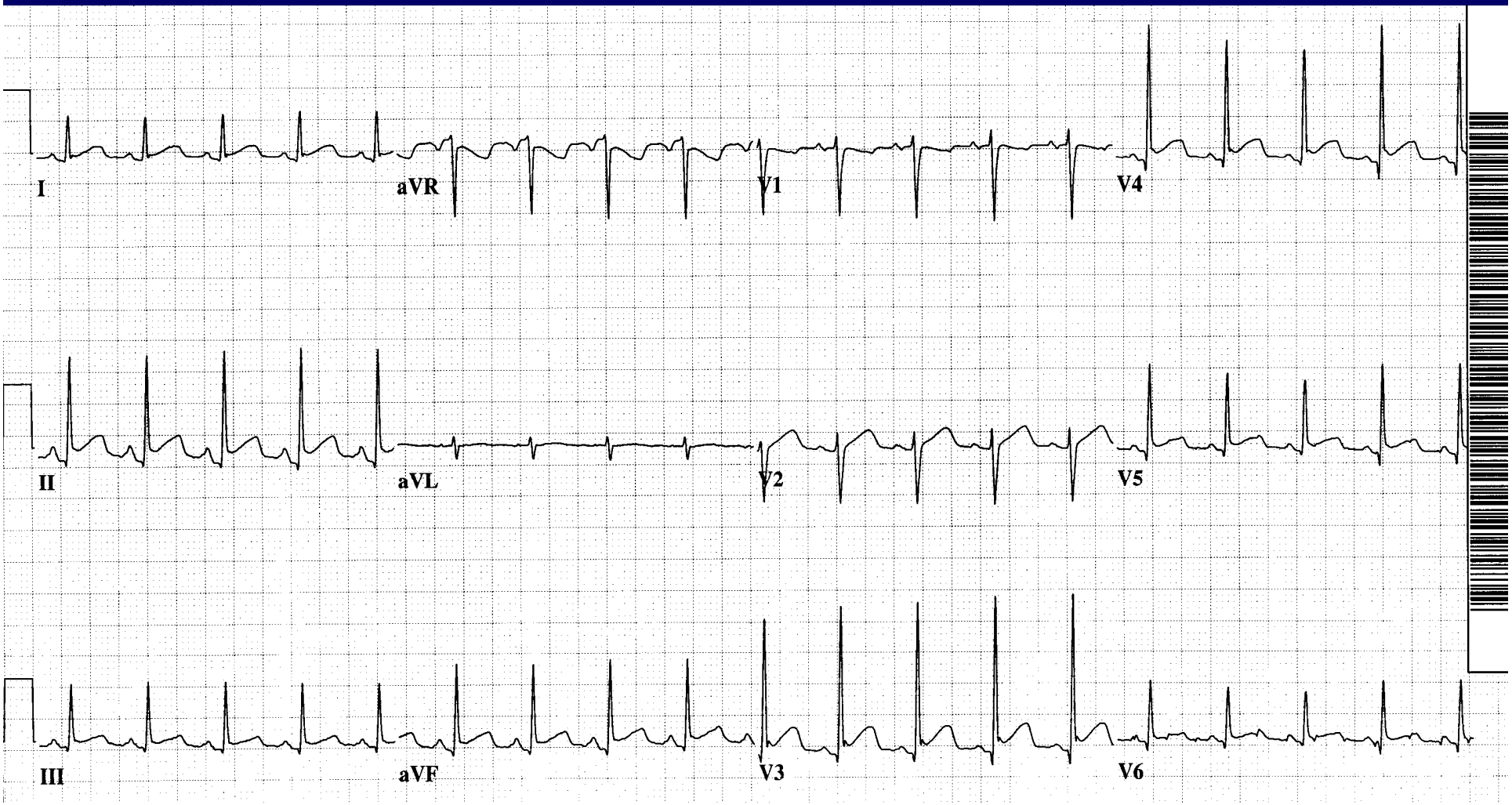

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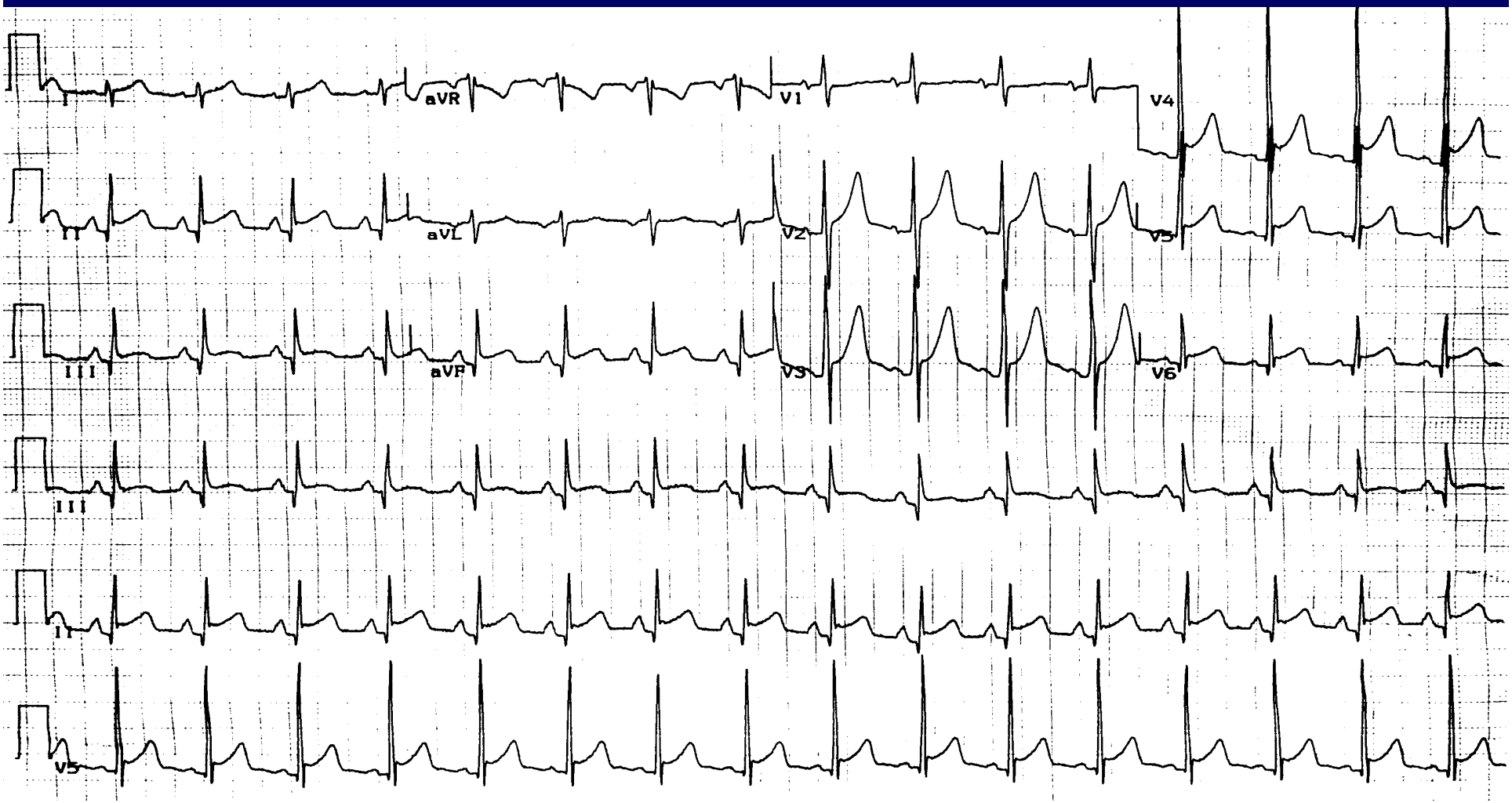

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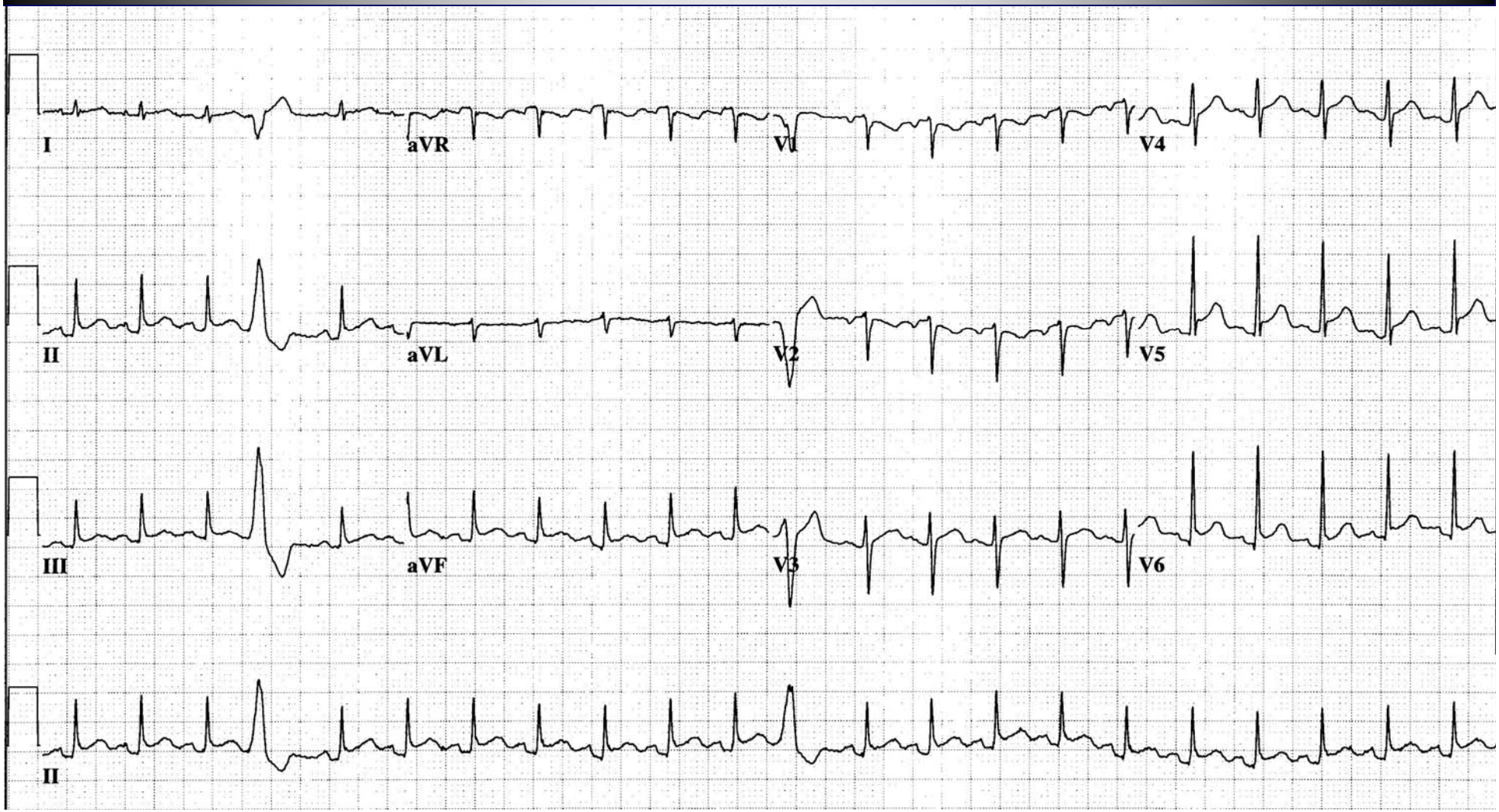

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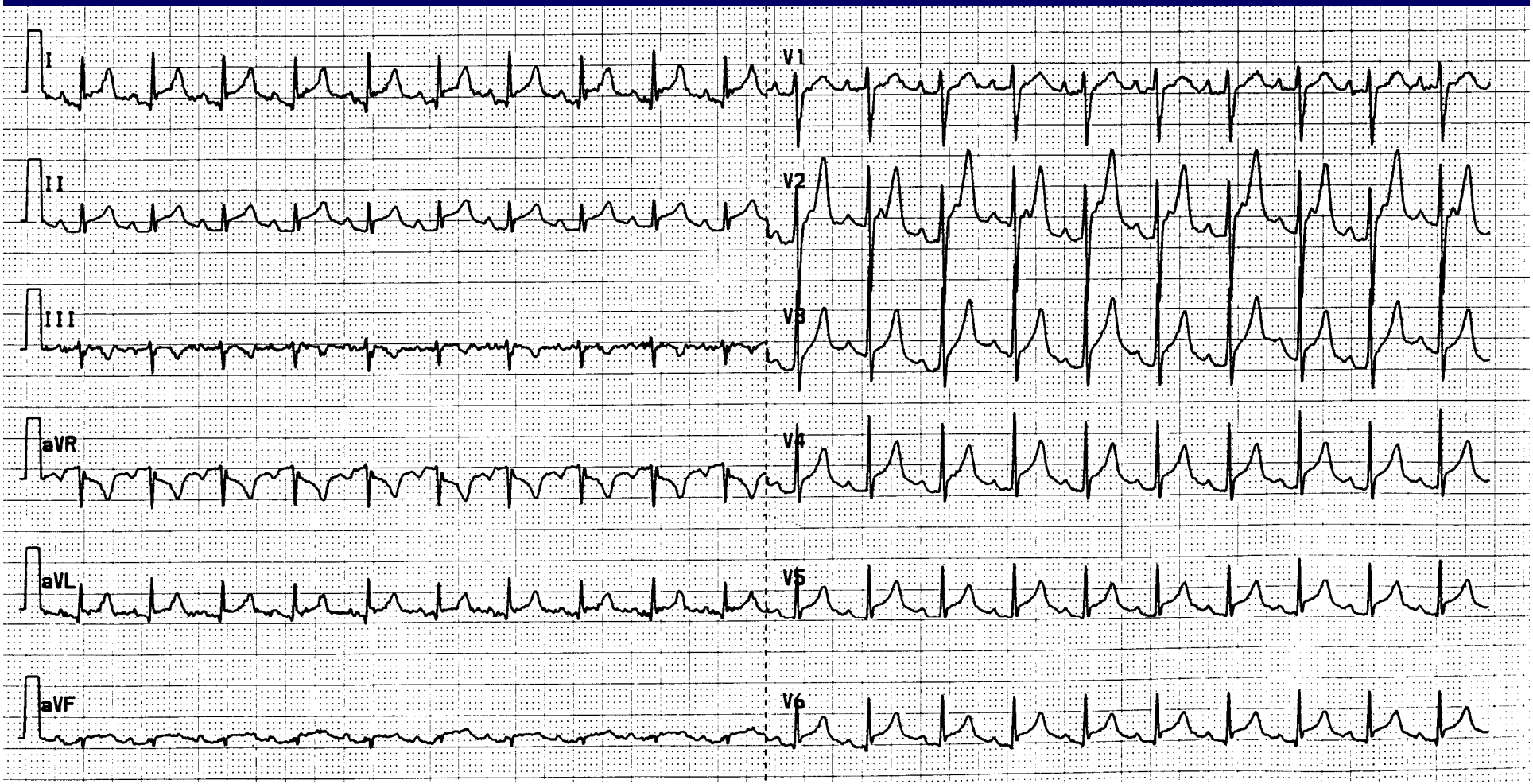

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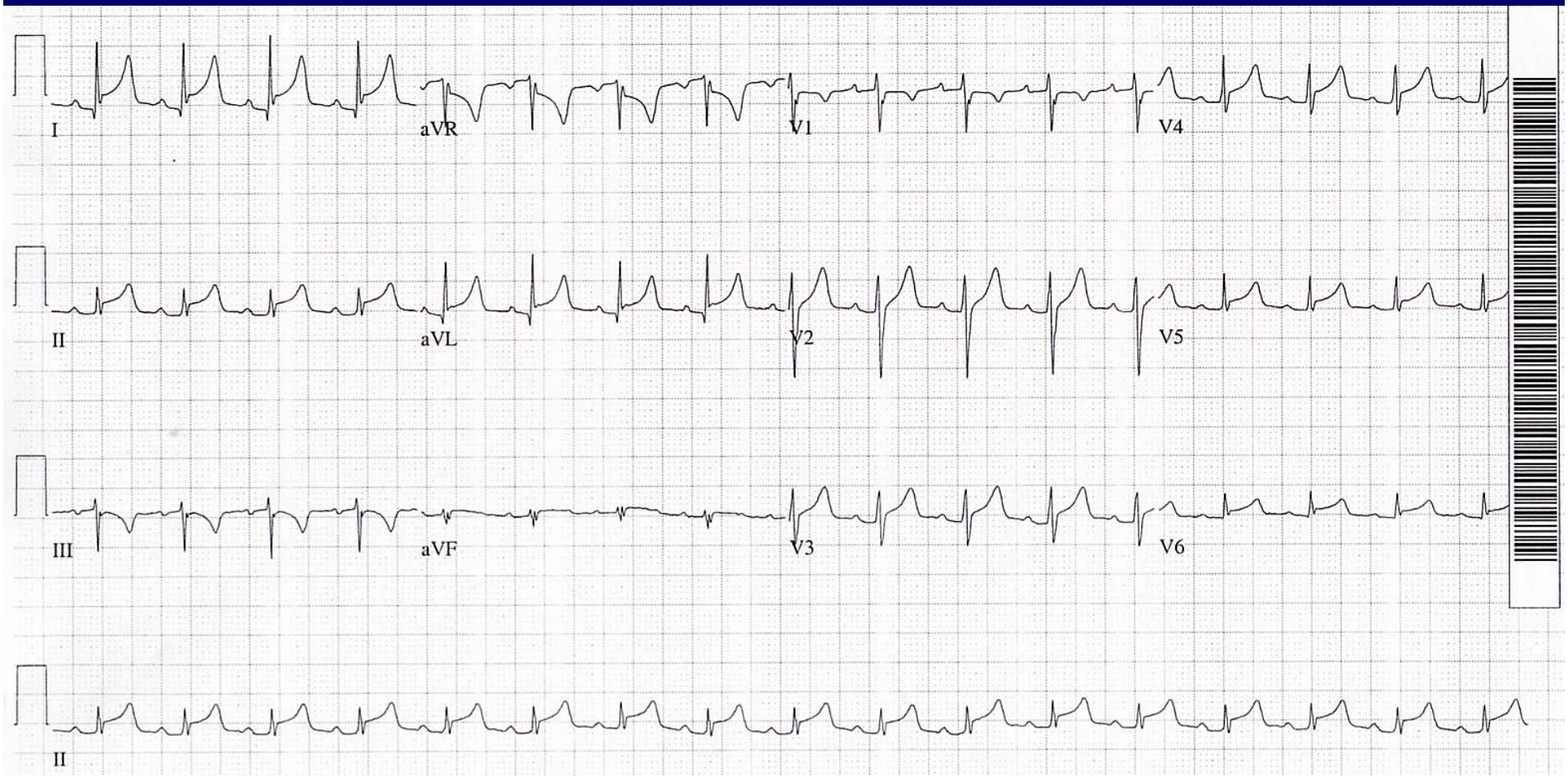

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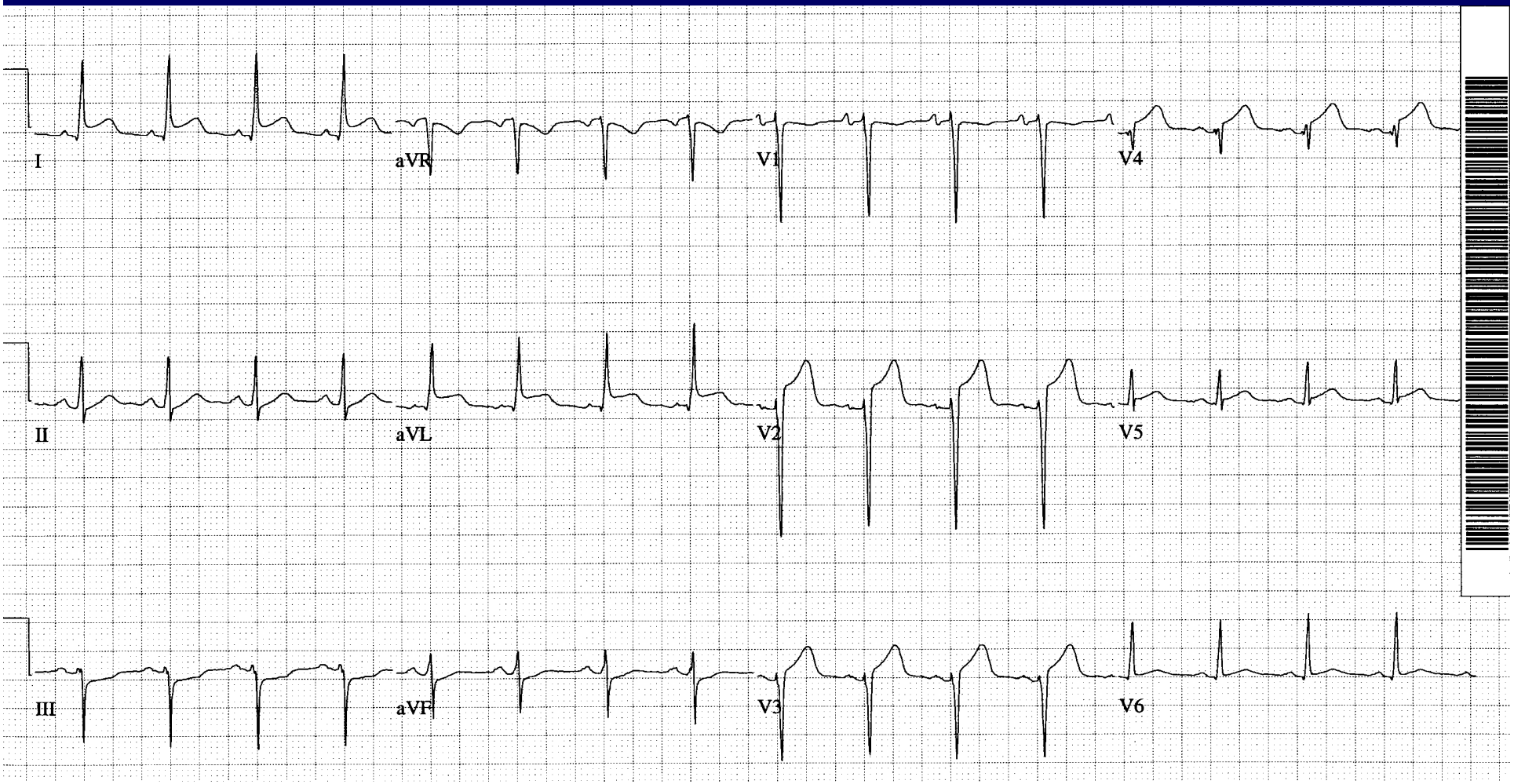

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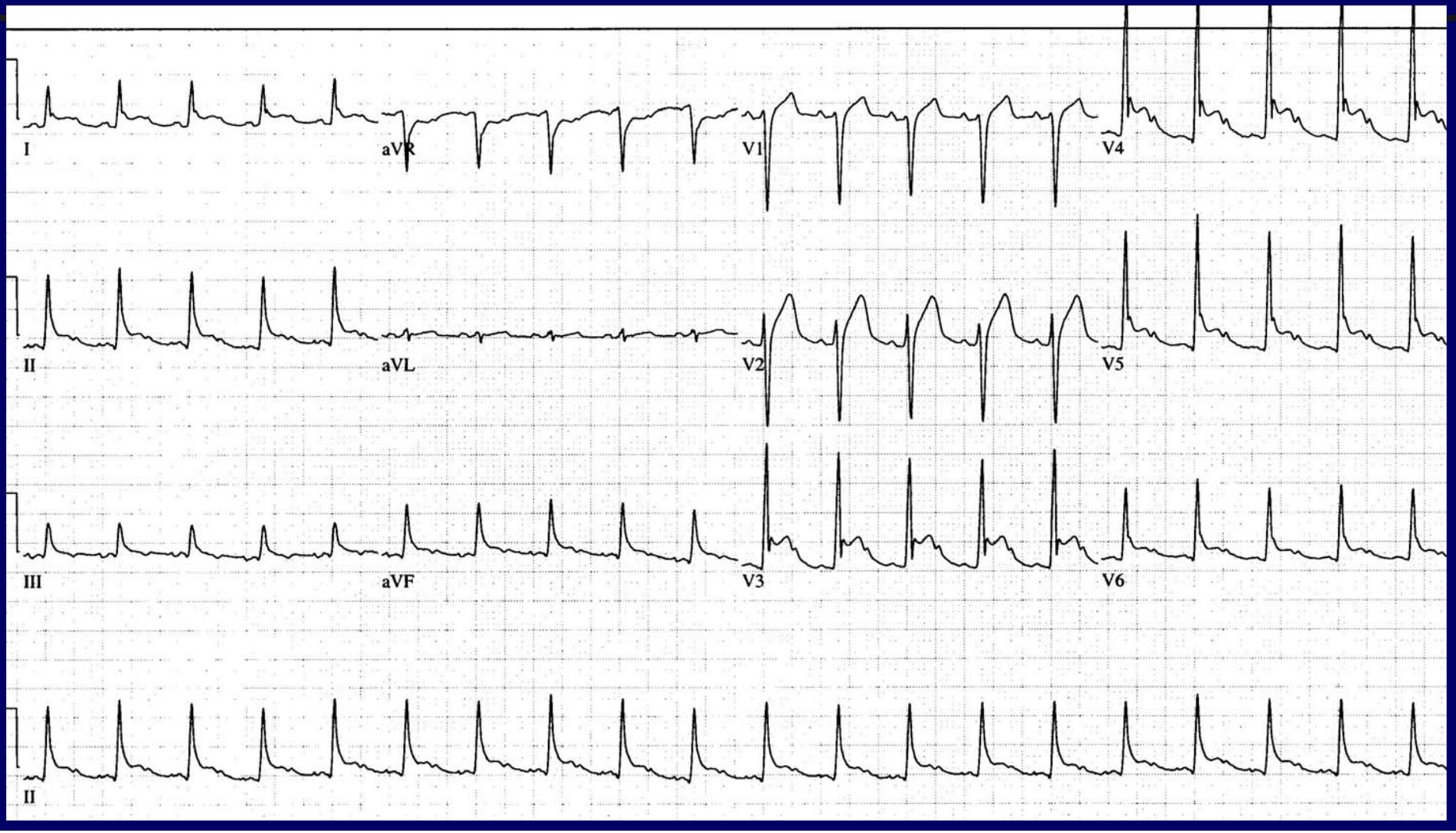

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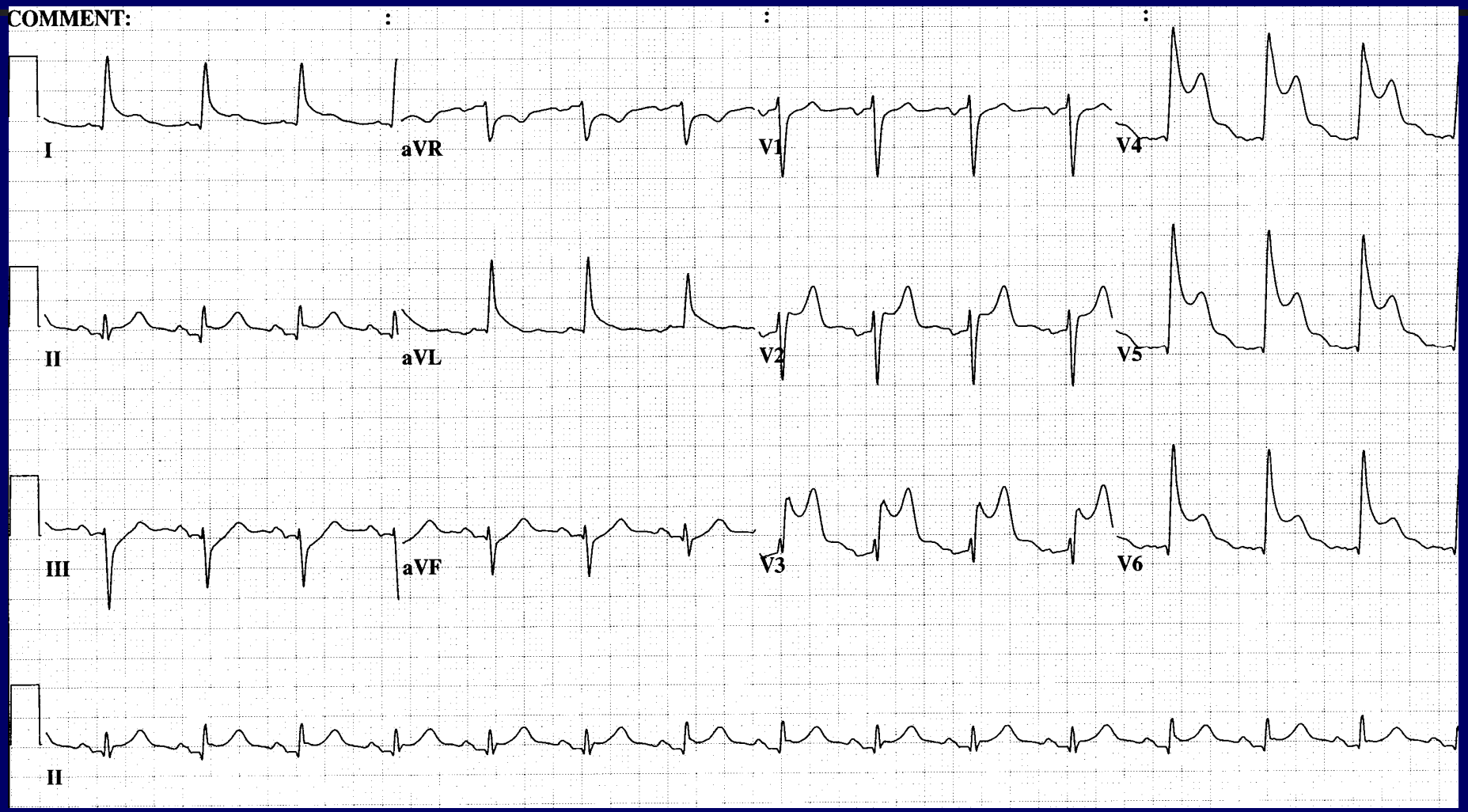

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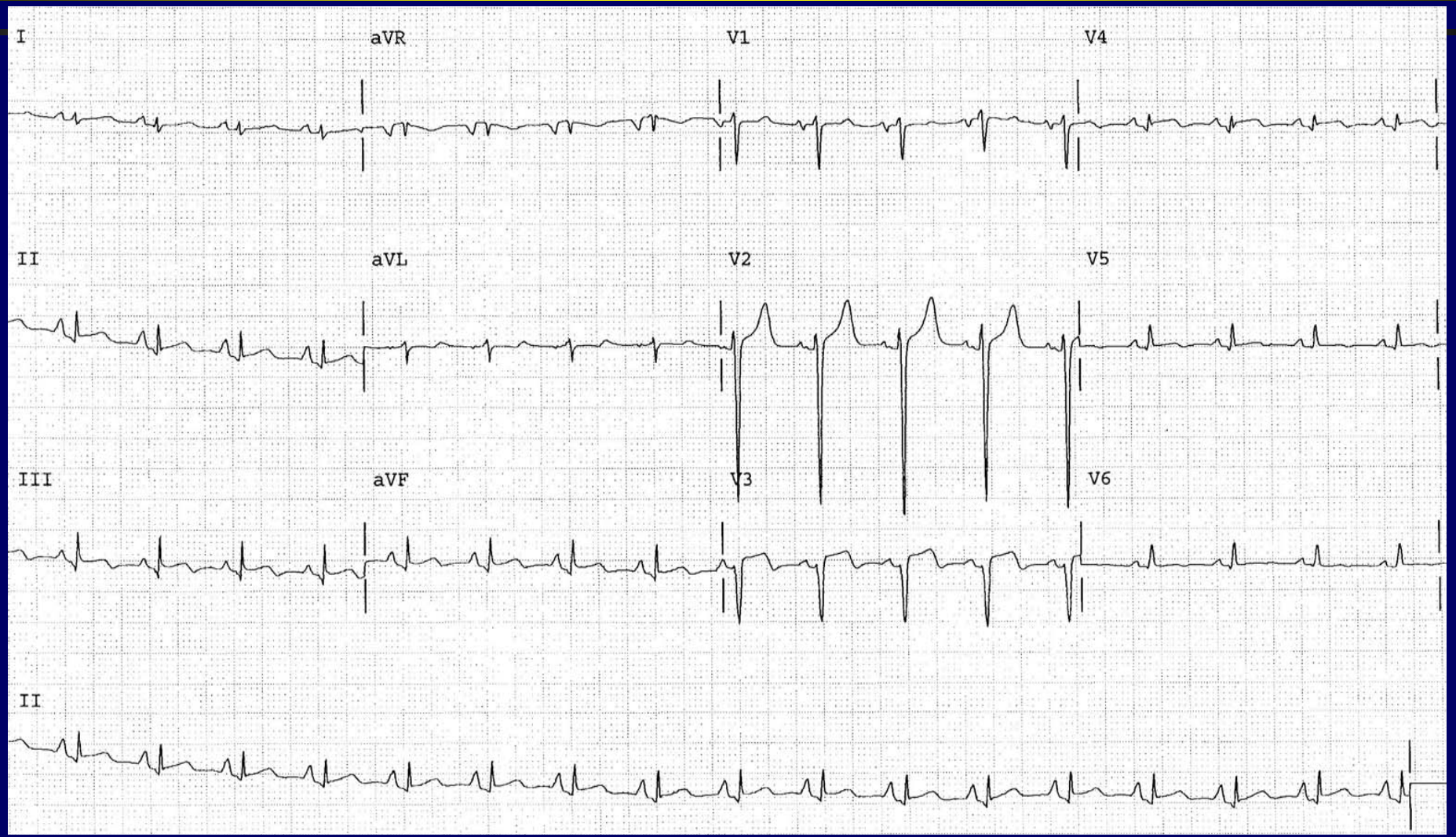

Summary — STEMI vs. Pericarditis

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Summary — STEMI vs. Pericarditis

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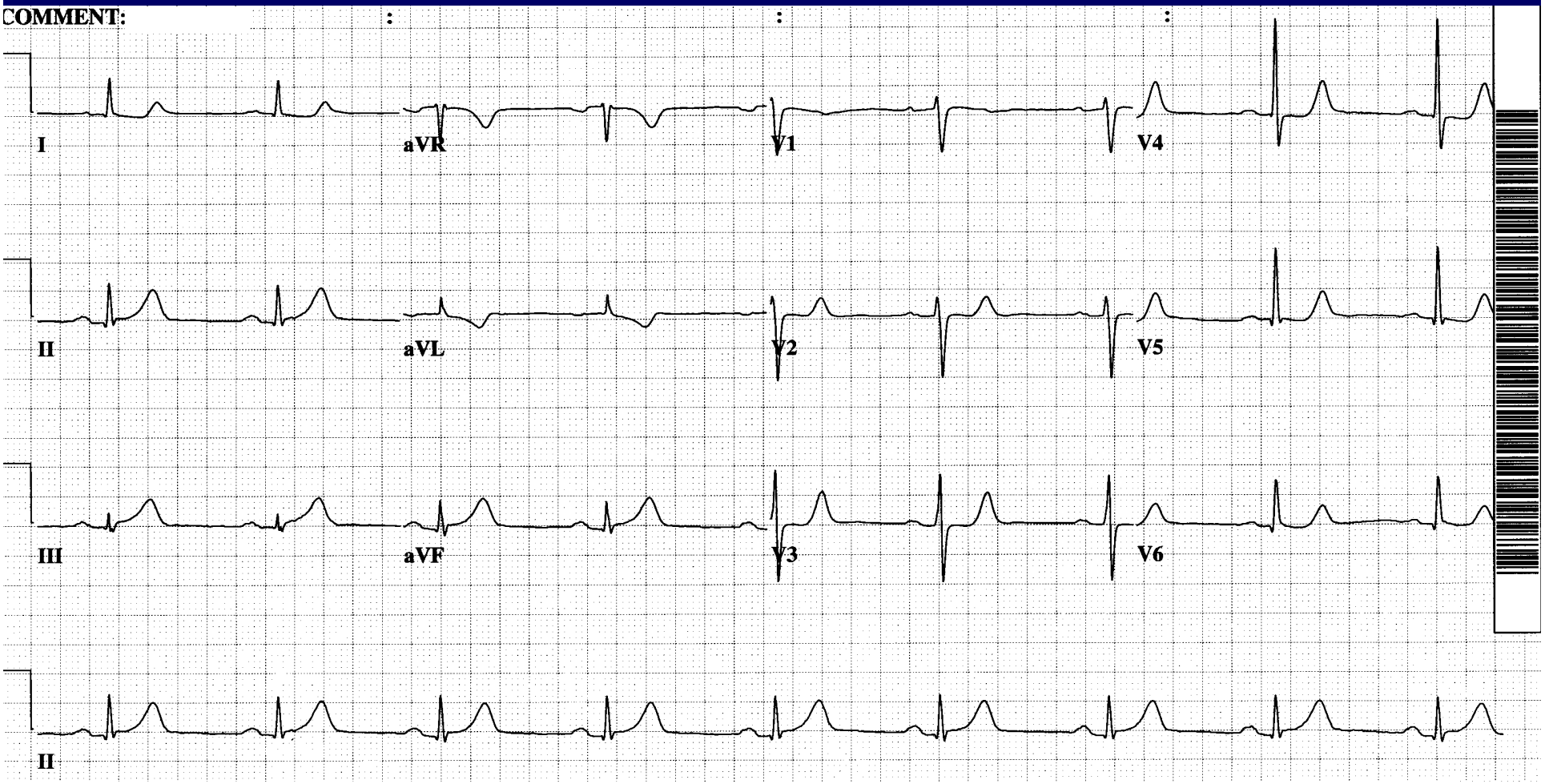
Review of Initial Cases

1. Reciprocal changes in lead aVL
2. Pulmonary embolism simulating ACS
3. Pericarditis vs. AMI

Case 1

- 87 yo. man became nauseous, diaphoretic, and pale while in church
  - No chest pain or dyspnea
  - “Funny feeling under my chest”
  - ECG interpreted as normal in ED
  - Cardiologist reads “NSC from previous ECG” (4 years earlier)

Case 1



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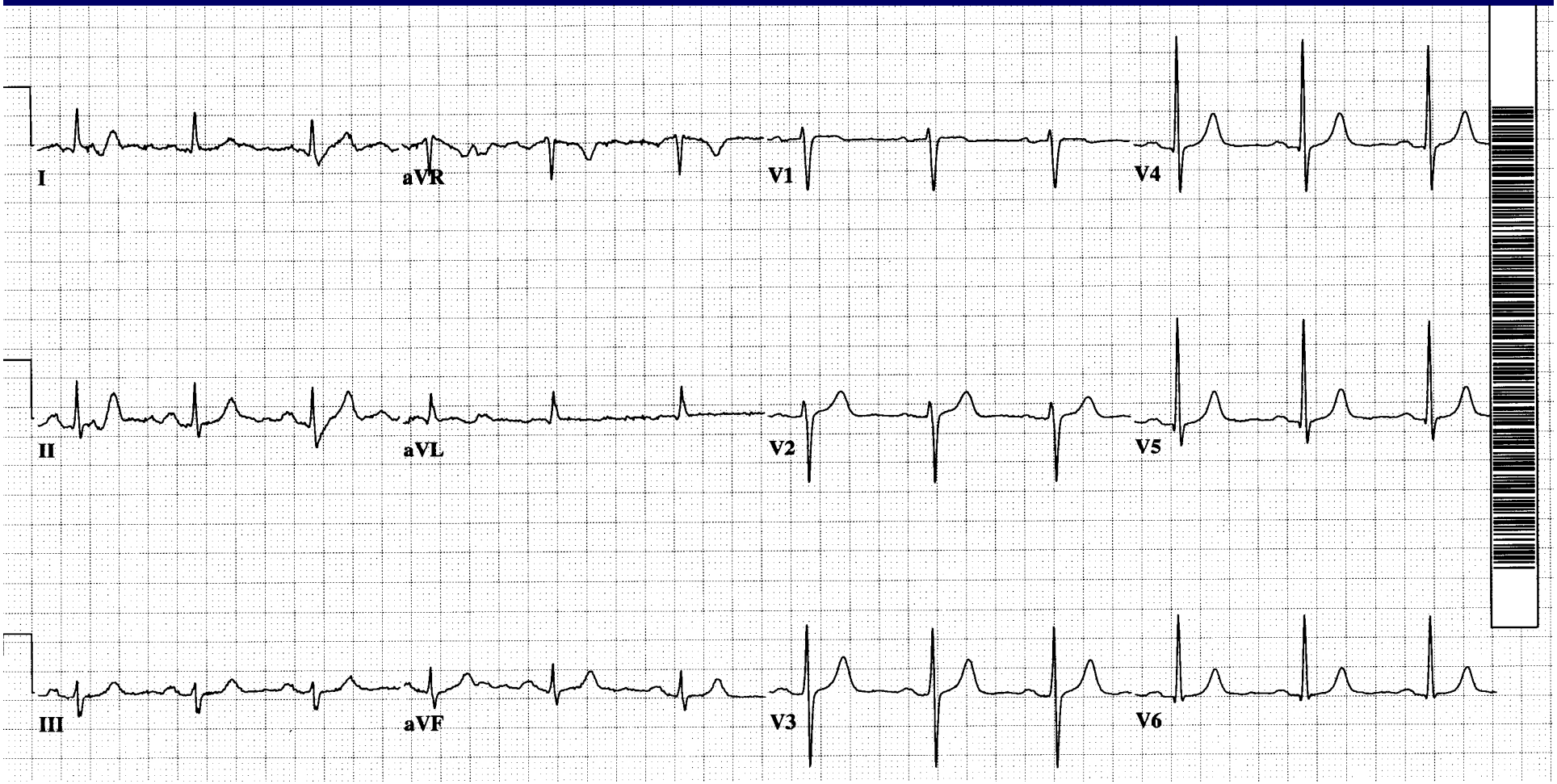


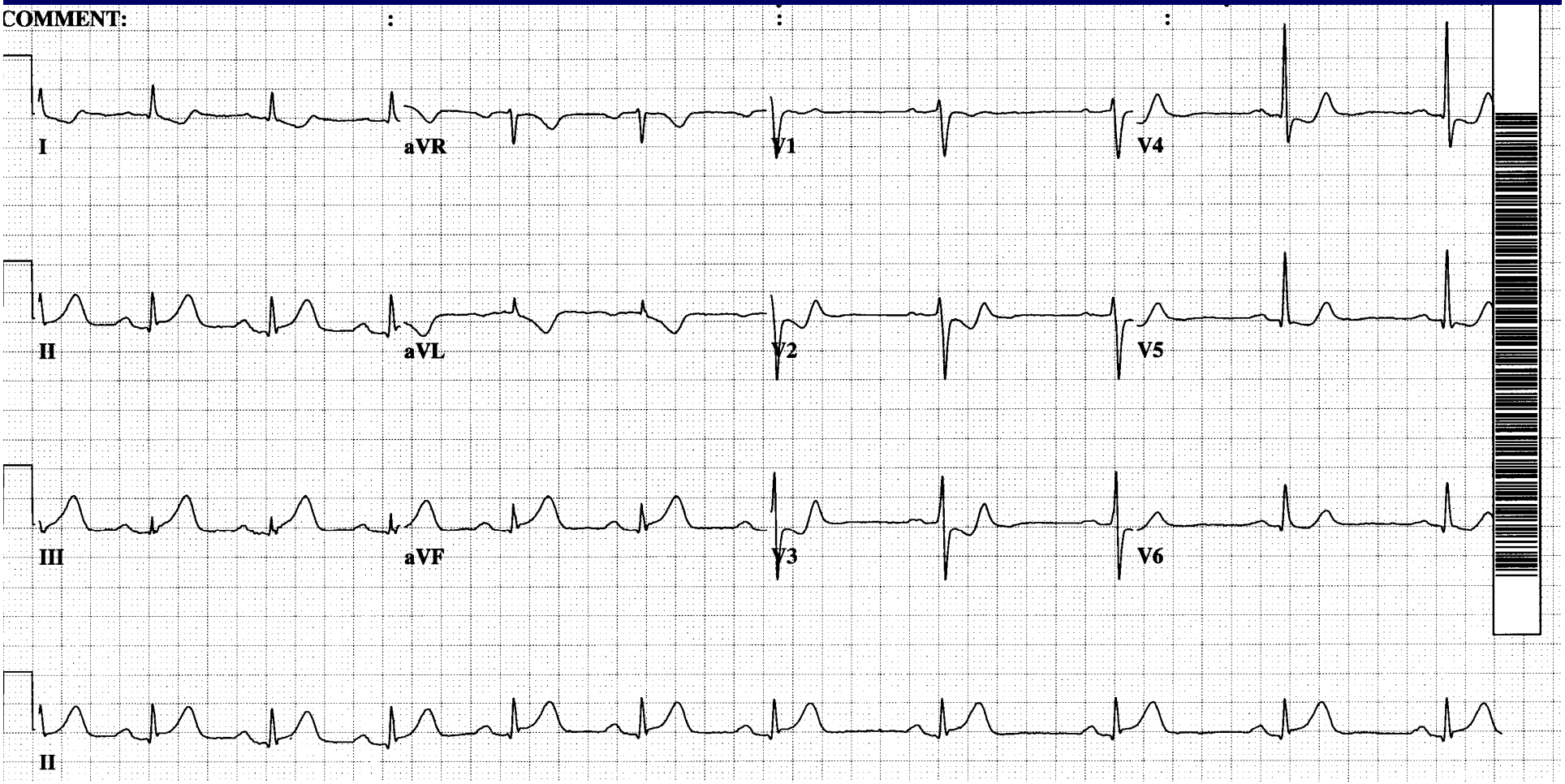
Case 1

- Patient's nausea is treated with antiemetics
- Pallor resolves with IVF
- SL NTG has no effect on "funny feeling" in chest
  - No further interventions/treatment
- Plans are made for admission for "dehydration"

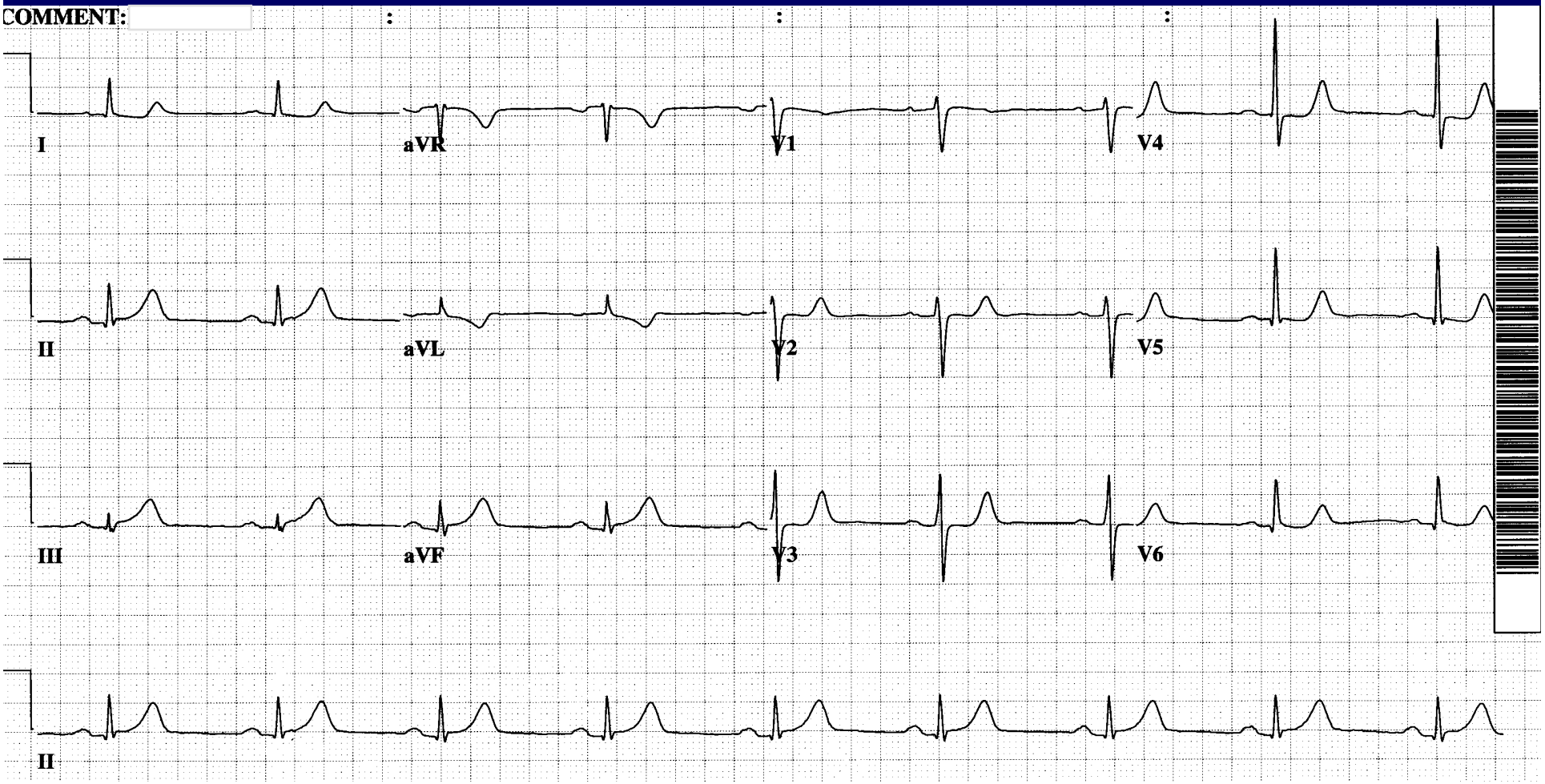
Case 1

- One hour later “funny feeling” still persists
- Pallor recurs, patient becomes diaphoretic
- Repeat ECG is obtained...

Case 1



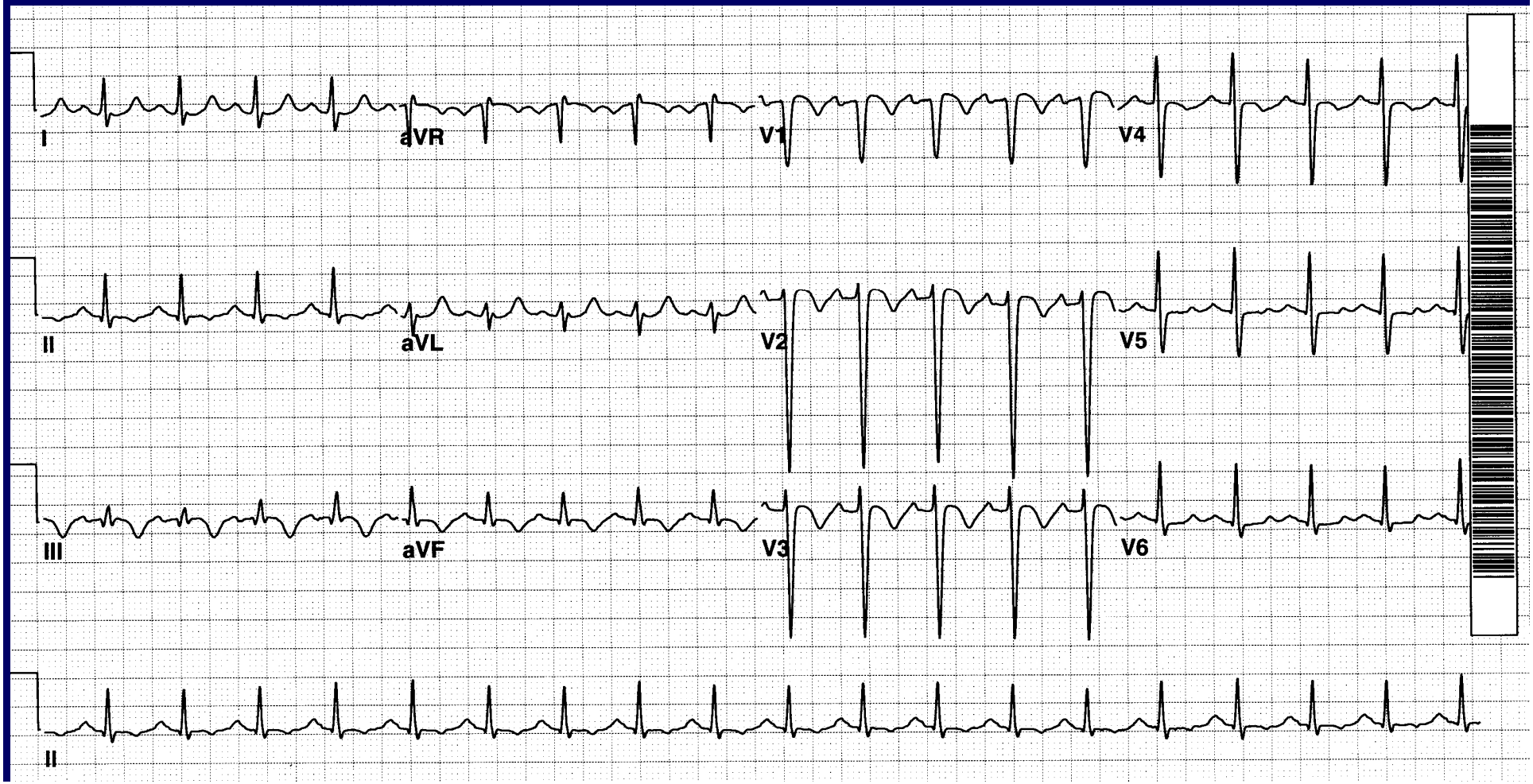
Case 1 — Initial ECG



Case 2

- 32 yo. man presents c/o chest pain and dyspnea
  - Syncope one day prior
  - Family history of early CAD
  - RR 24, HR 110, BP 160/105
  - ECG interpreted as “anterior and inferior ischemia”

Case 2



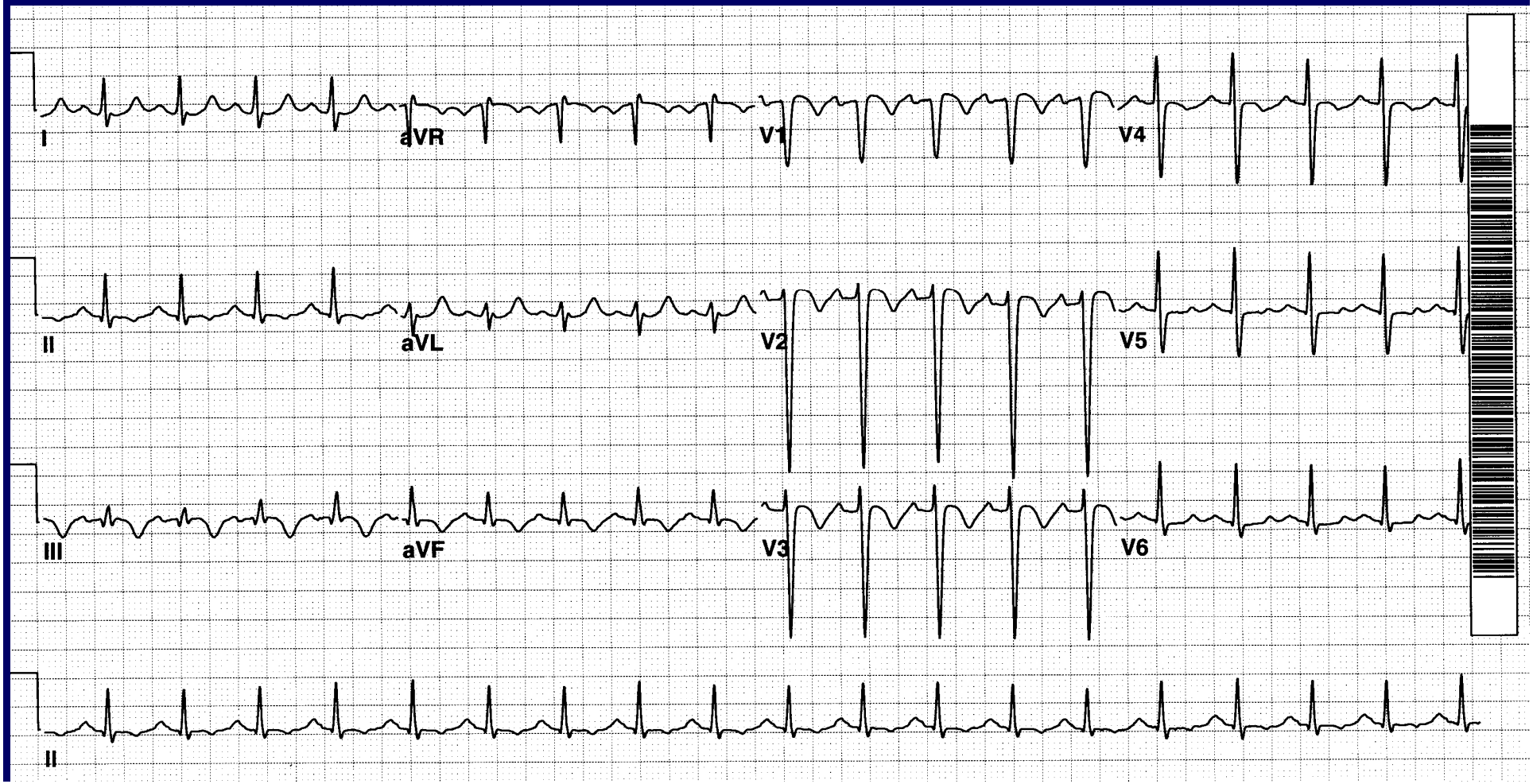
Case 2

- Admitted to chest pain center for ACS
  - Treated with ASA, beta blockers, heparin
- Rules out for AMI
  - Persantine thallium test negative
  - Mild dyspnea and tachypnea persist
    - attributed to “obesity and deconditioning”
  - ECG continues to show T-wave abnormality
    - not addressed in chart

Case 2

- Patient is discharged on beta blockers
- Cardiac arrest 12 hours later
- Autopsy confirms a *non-cardiac* cause...

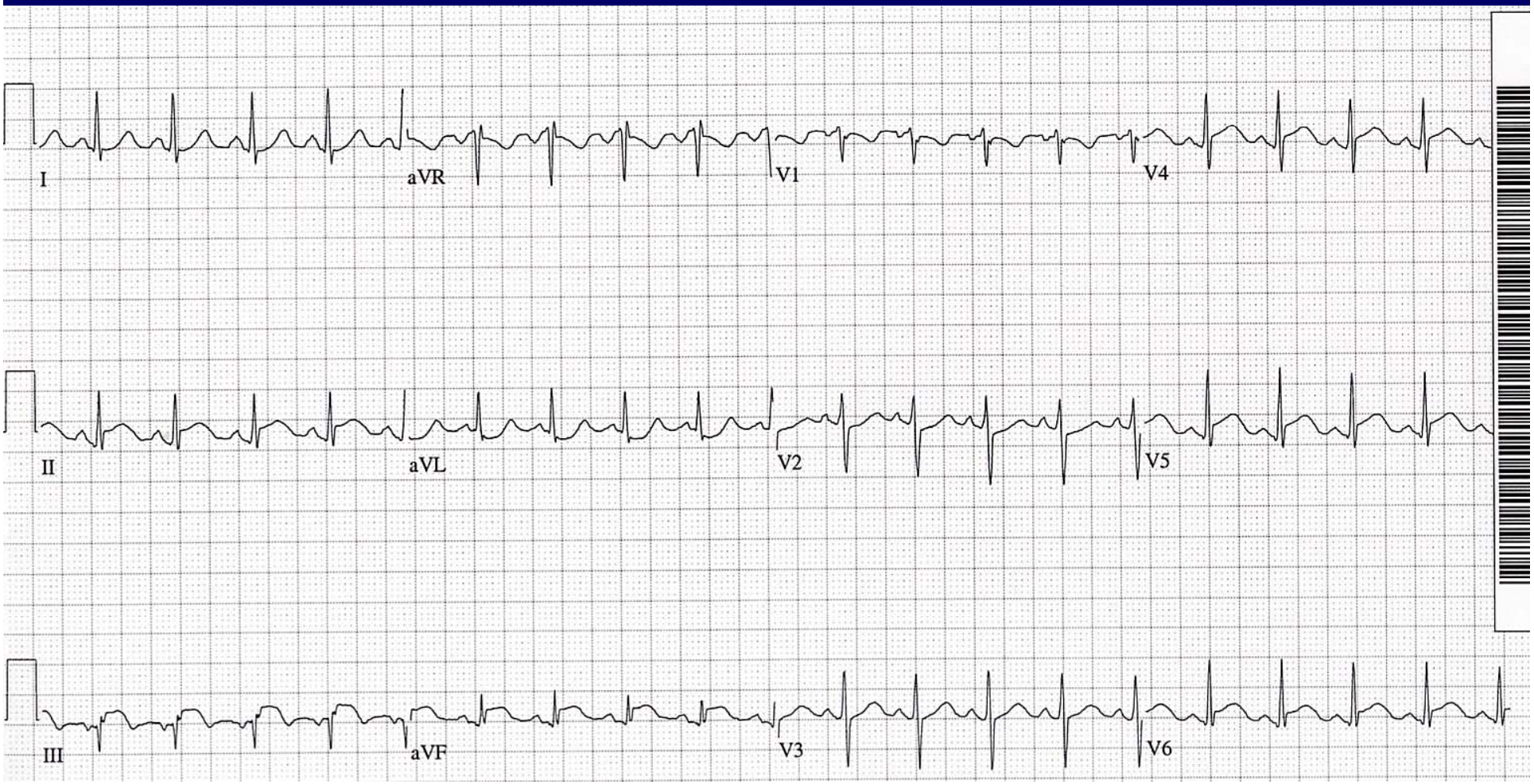
Case 2



Case 3

- 38 yo. woman presents c/o chest pain
  - Only CRF is hypertension
  - Pain worsens when laying back, improves sitting upright
  - ECG interpreted as acute pericarditis

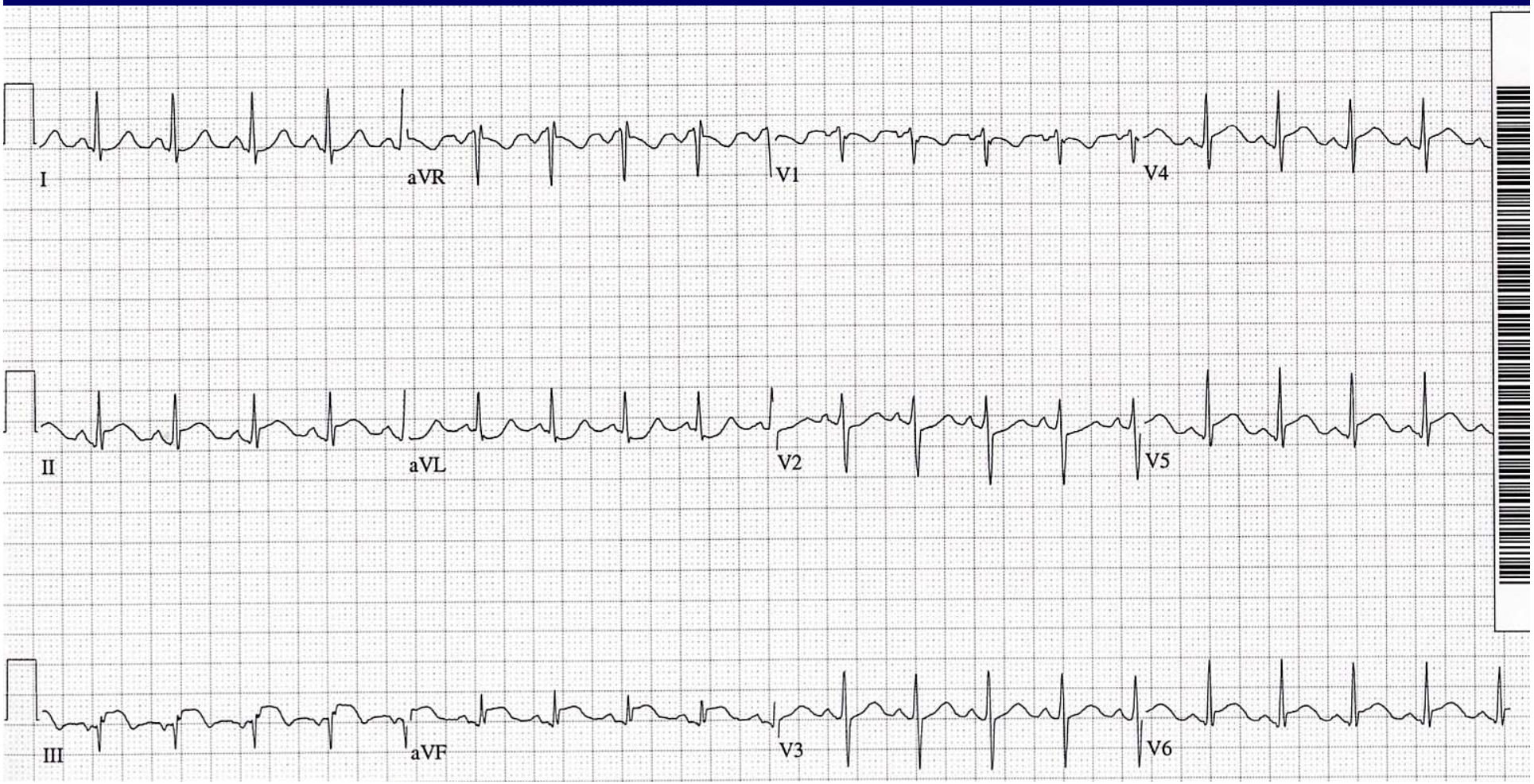
Case 3



Case 3

- Intensive care physicians sees patient, agrees with diagnosis of pericarditis
  - Patient is admitted to ICU
- First set of cardiac enzymes are normal
- Second set of cardiac enzymes are markedly elevated
  - Patient is emergently transferred for PTCA

Case 3



Summary

- Reciprocal changes in lead aVL may be the first sign of inferior myocardial ischemia
- When in doubt, get serial ECGs!

Summary

- Pulmonary embolism can cause ECG changes that simulate ACS
  - Strongly consider PE when the ECG has inverted T-waves simultaneously in the anteroseptal + inferior leads
  - Once you've ruled out ACS in the chest pain patient, you're still not done!!

Summary

- Pericarditis is often not “classic!”
  - Very strongly favoring AMI
    - reciprocal changes
    - convex upwards or horizontal STE
    - STE in III > II
    - *new* Q-waves

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- Pericarditis is often not “classic!”
  - Very strongly favoring AMI
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    - STE in III > II
    - *new* Q-waves
  - Very strongly favoring pericarditis
    - pronounced PR-segment depressions in multiple leads
    - friction rub

Remember…

- Just because electrocardiography is a basic skill in EM doesn't mean that our skills should be *basic*.
- **YOU** must be *the experts* in electrocardiography!