Basic ECG Interpretation Workshop

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Disclosure Statement

- No association or financial arrangement with any vendor or pharmaceutical company.

Objectives

- Analyze the basic ECG components required to assess pathology to include, heart rate, rhythm, axis, and intervals.
- Develop a simple method that will allow you to consistently assess unknown ECGs for common pathologies.
- Identify the common variances within normal ECGs.
- Describe the specific diagnostic criteria for normal ECGs, Bundle branch blocks, IVCDs and Fascicular Blocks.

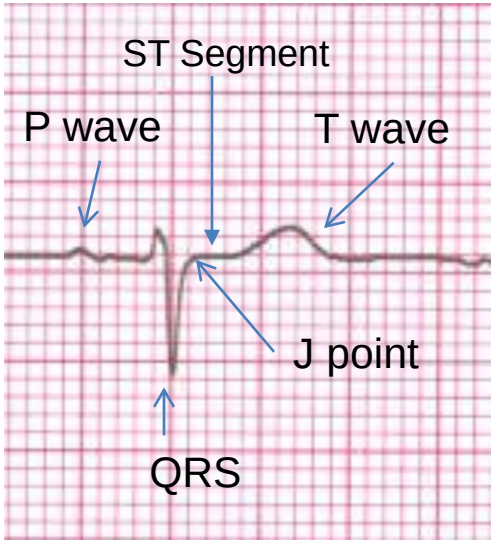
Basic Assumption

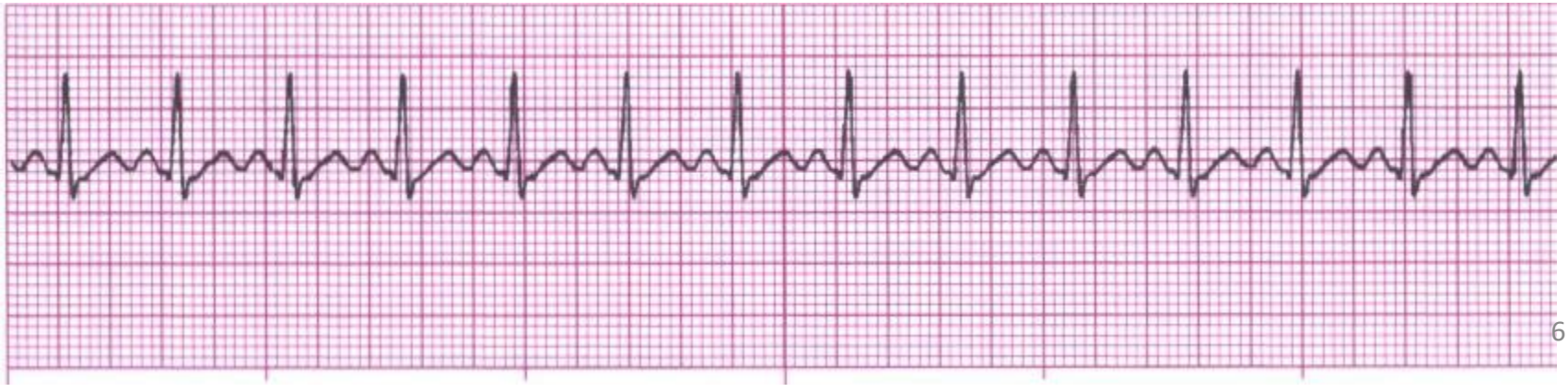
- I assume that you do not know or remember much about ECGs.

First Things First

- Coming from a Primary Care Perspective
- Evaluate an ECG the same way each time
- Develop a system to accomplish this process
- Force yourself to practice

Waveforms

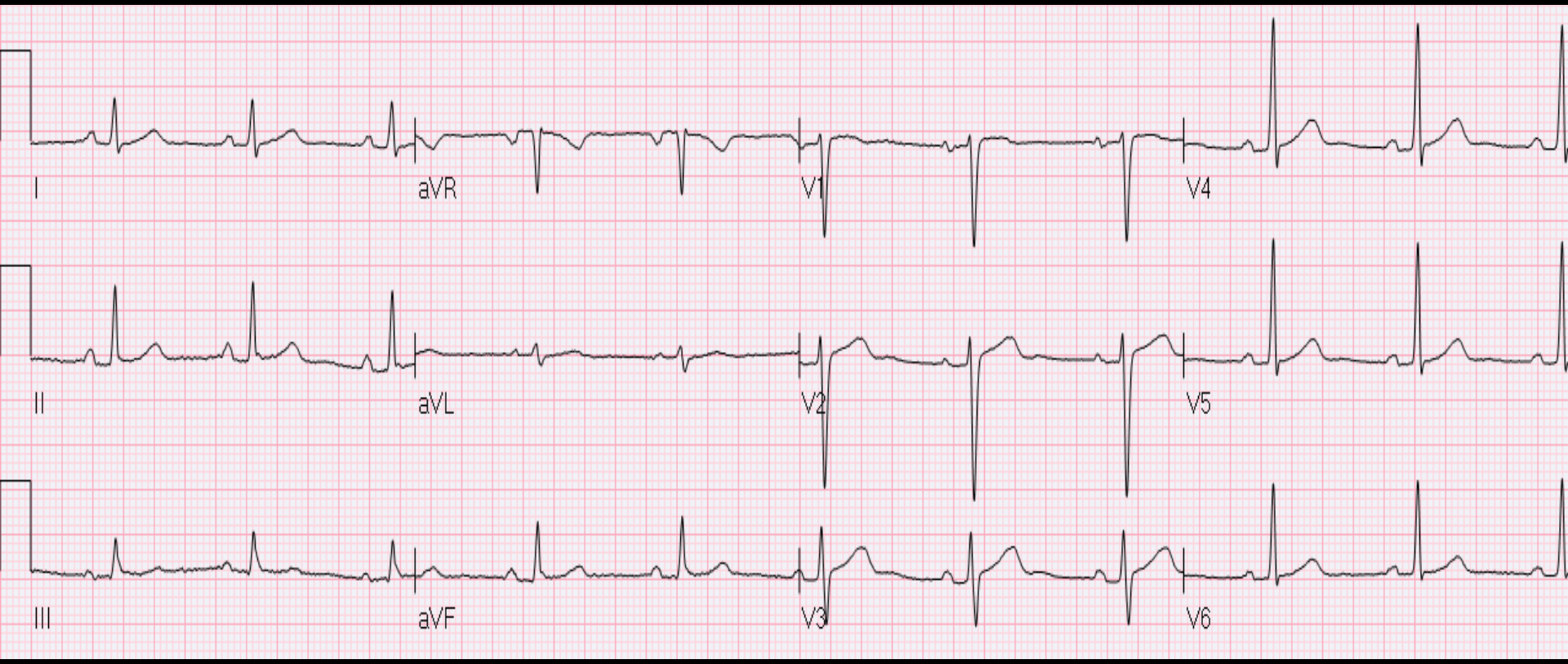




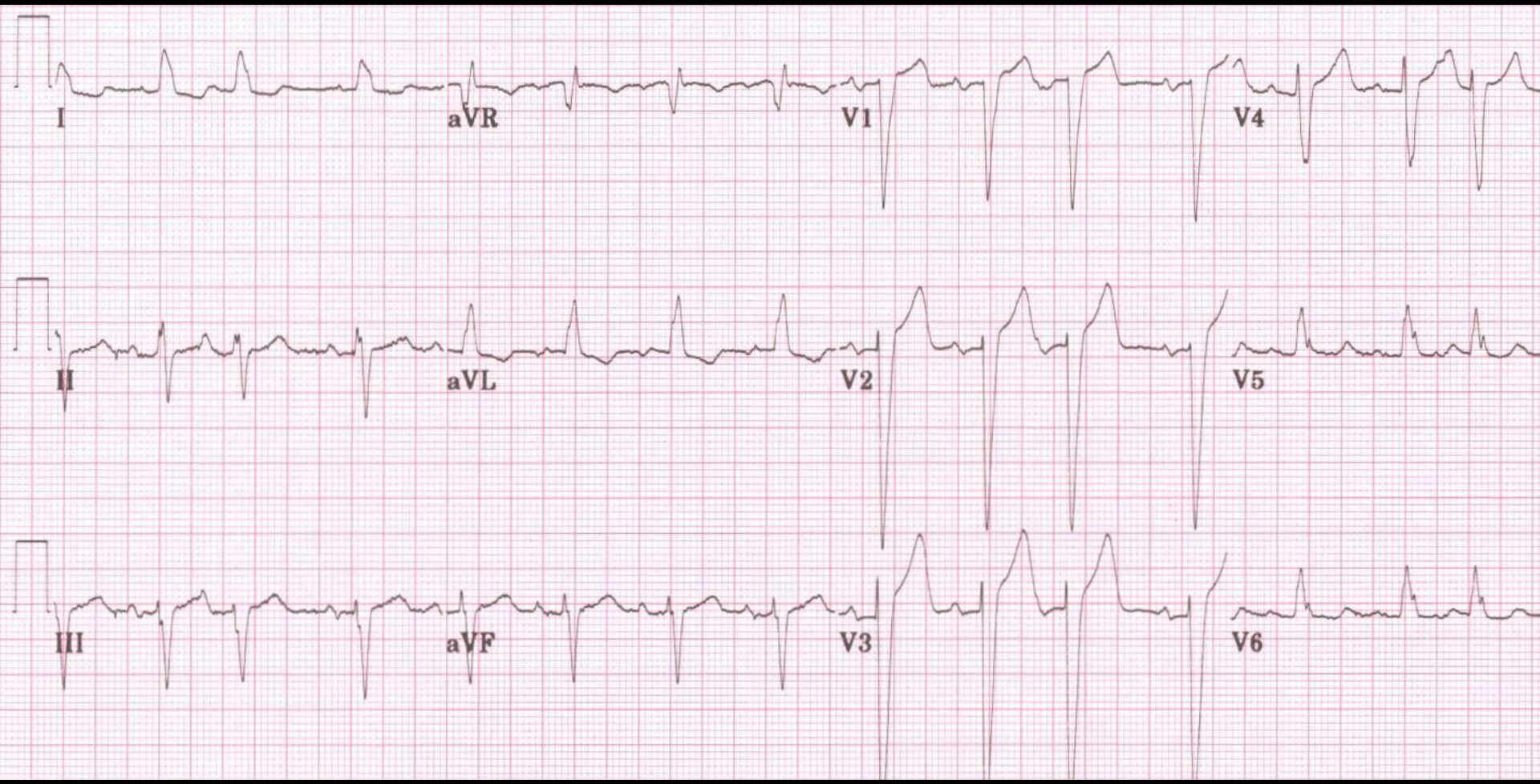
One Method

- **Gestalt or general impression**
- Determine the Heart Rate
- Determine the Rhythm
- Measure the Longest Interval in the Limb Leads
- Determine the Axis
- Assess the R-Wave Progression

Gestalt: Normal



Gestalt: or Abnormal



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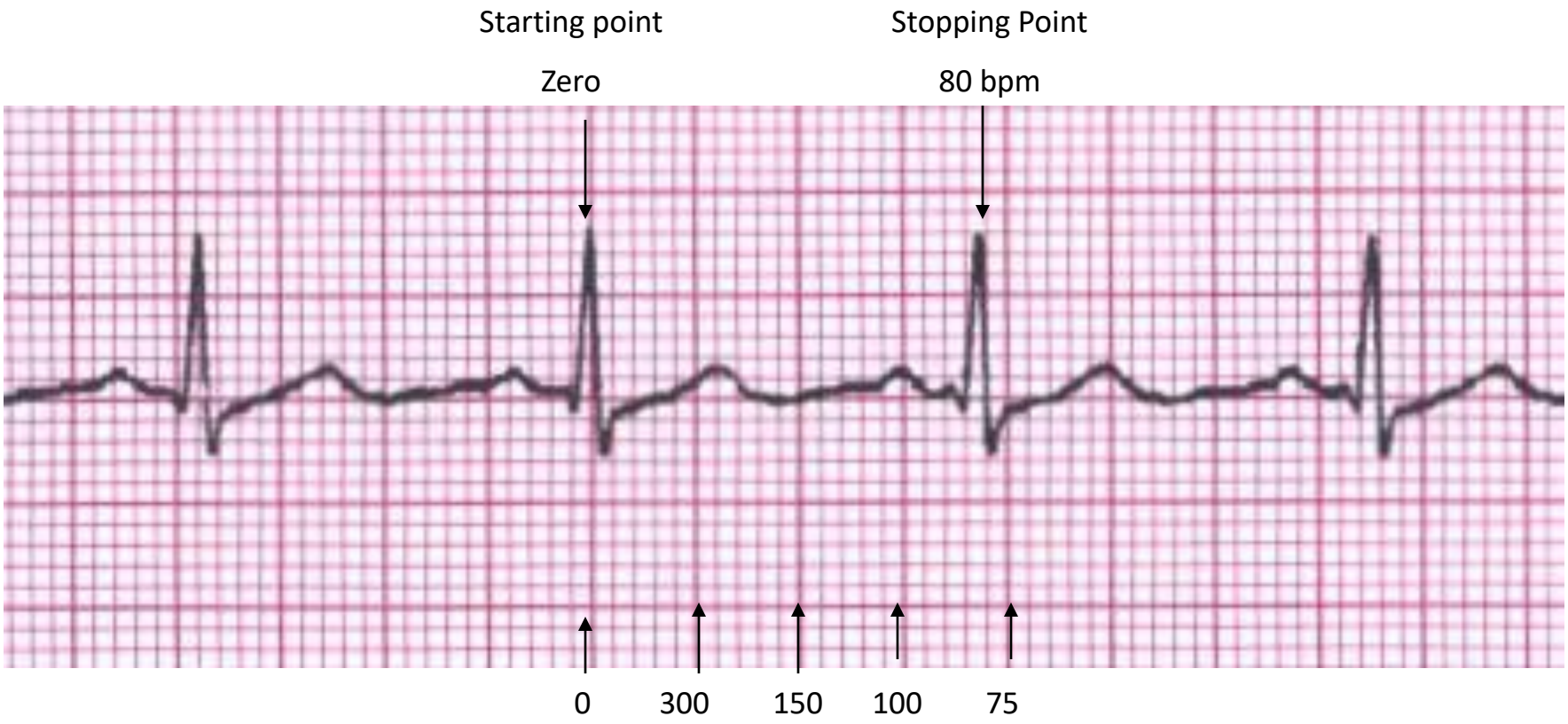
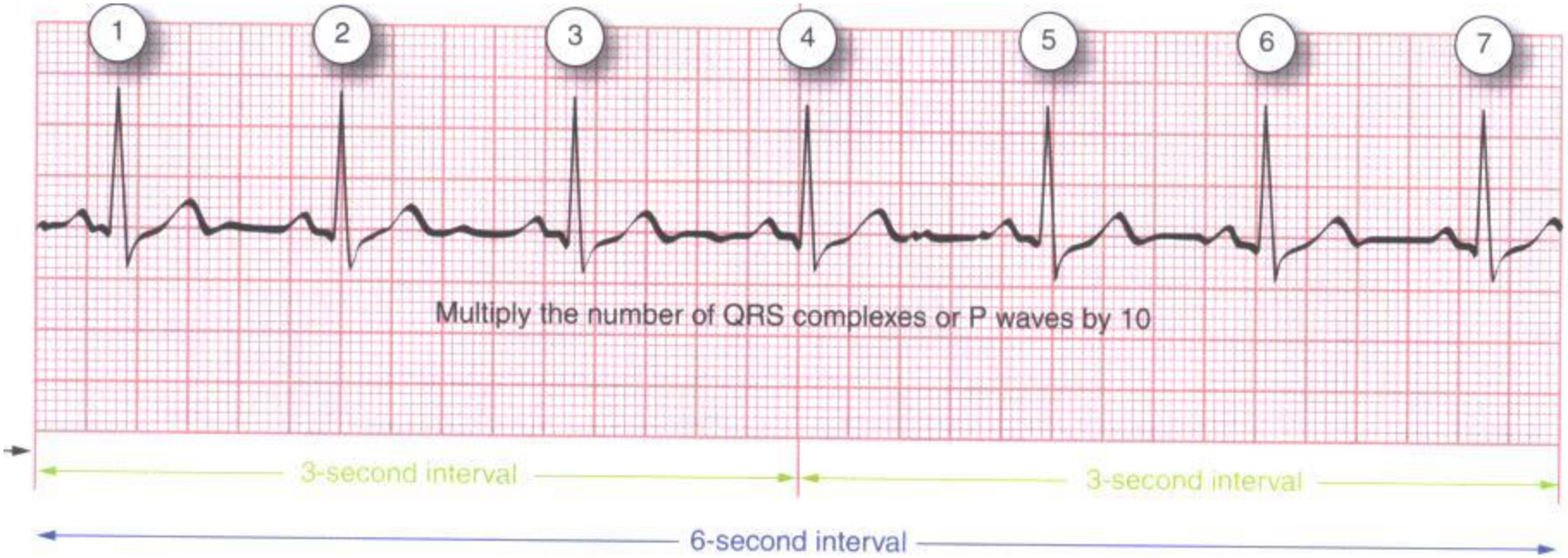
Heart Rate Determination



Heart Rate for Irregular Rhythms



Rhythm Determination

Is the distance between one QRS complex the same as the others?

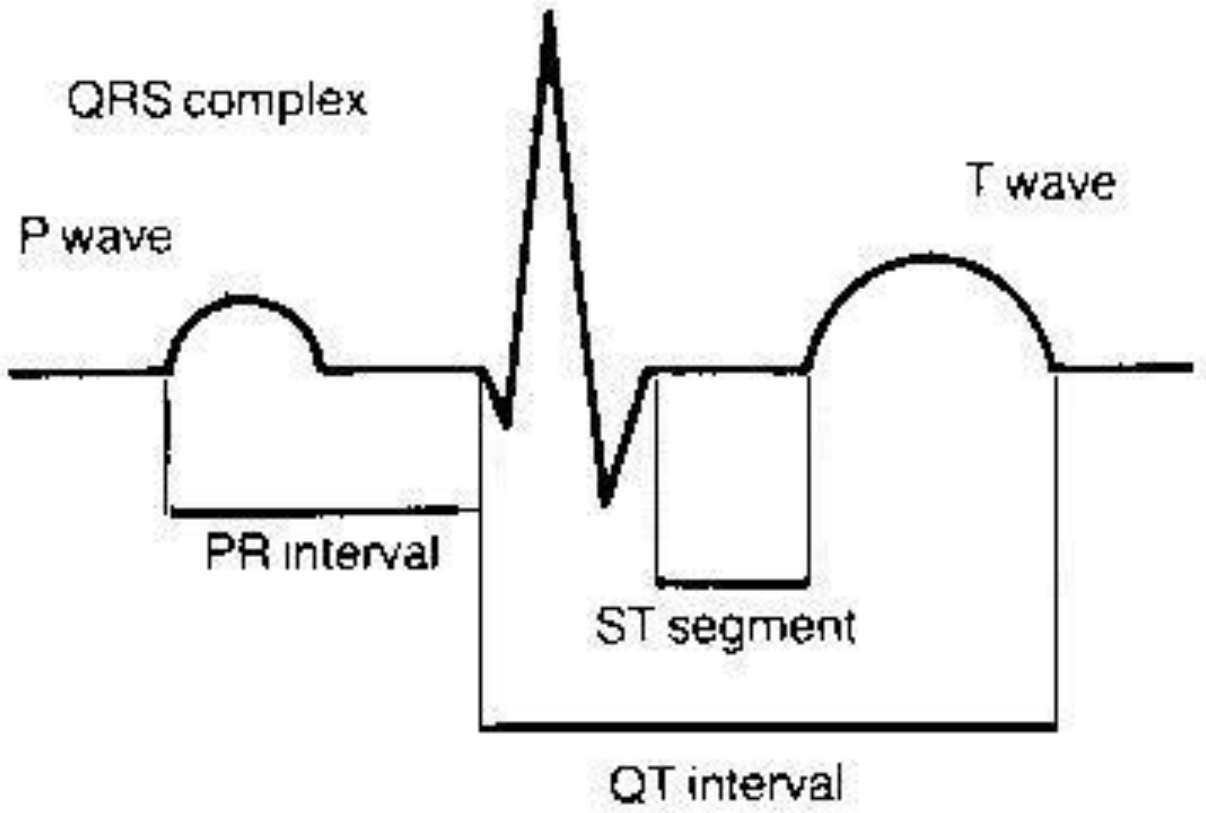
If yes, rhythm is considered Regular.

If no, rhythm is considered Irregular.

One Method

- Gestalt or general impression
- Determine the Heart Rate
- Determine the Rhythm
- **Measure the Longest Interval in the Limb Leads**
- Determine the Axis
- Assess the R-Wave Progression

PR, QRS, QT Intervals



PR Normal: 120 – 200 ms

QRS Normal: < 120 ms

QT Normal: Heart rate dependent:

PR Interval

- Measure from start of P wave to start of QRS
- Best measured in limb lead II
- Conduction through the AV node
- Normal:
  - 120 ms to 200 ms
  - 3 to 5 boxes
- Short PR Interval
  - Preexcitation synd.
    - WPW, LGL
  - PACs
- Long PR Interval
- Lots of causes, don't really care about cause
- Refer to as: "First Degree AV Block"

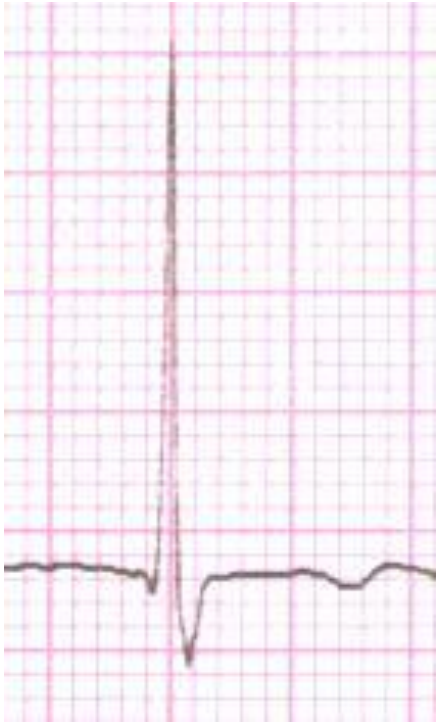
QRS Interval

- Beginning of QRS to the end (J-point)
- Normal: < 120 ms (less than 3 boxes)
- Use the Limb Lead with longest QRS to measure

- Causes of Prolonged QRS interval:
  - Bundle Branch Blocks, IVCD, WPW, LVH, RVH,
  - Rhythm: ventricular tach, PVCs, idoventricular rhythm

QT Interval

- Measures a complete ventricular cycle
    - From beginning of ventricular depolarization to ventricular repolarization
- Measure from start of QRS to end of T-wave
- Normal is defined based on heart rate
    - HR of 60 = 400 ms; HR of 100 = 320 ms
- Simple rule:
  - The QT is probably prolonged if it exceeds more than HALF of the R-R interval.
  - Rule works well as long as HR is not excessive



One Method

- Gestalt or general impression
- Determine the Heart Rate
- Determine the Rhythm
- Measure the Longest Interval in the Limb Leads
- **Determine the Axis**
- Assess the R-Wave Progression

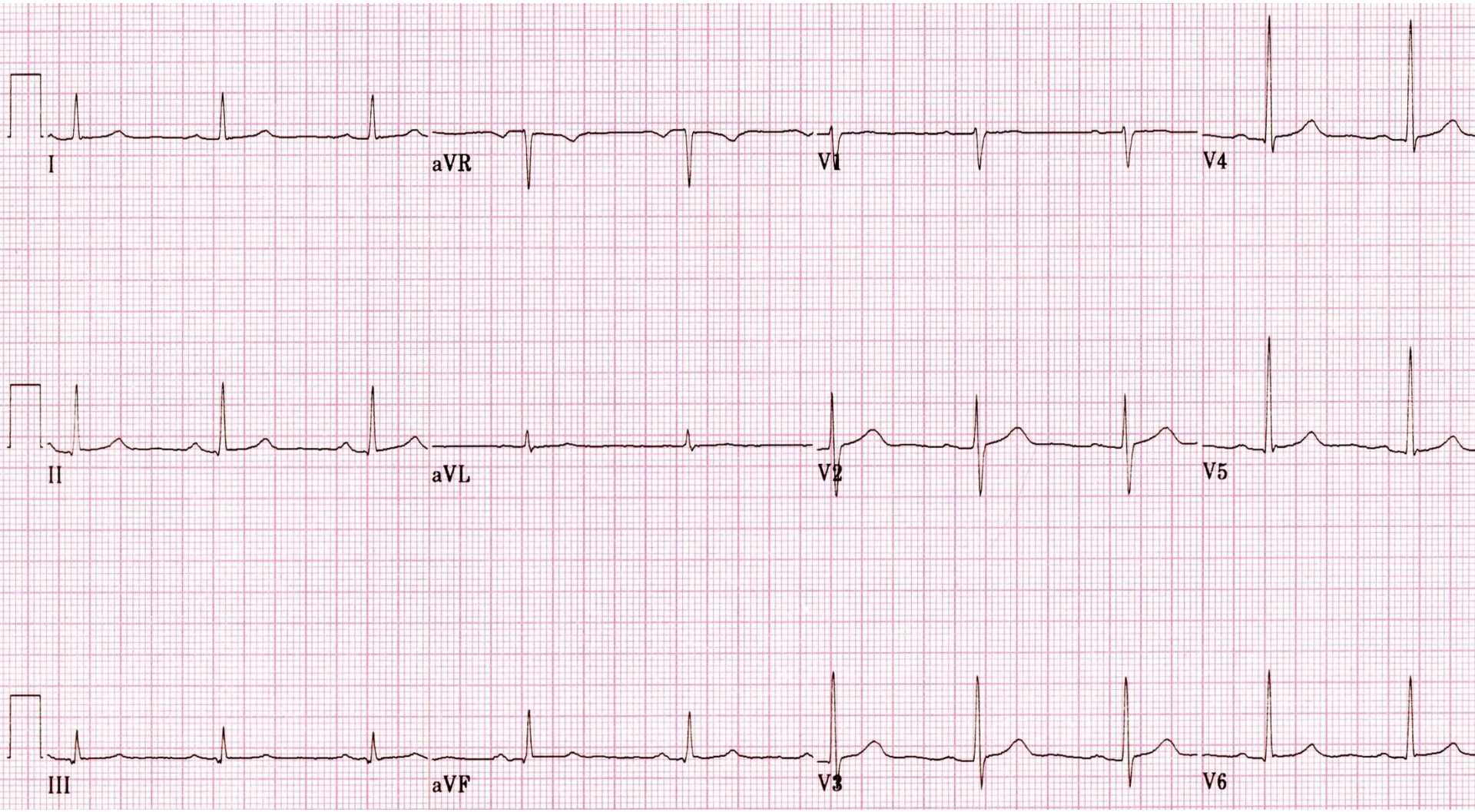
Axis Determination

- Based on the frontal plane (limb leads)
- Ballpark estimates are usually fine, rarely necessary to have specific degrees noted
- Utilize the Quadrant Method
  - Based on two limb leads: I and aVF
  - Normal is based on quadrant

Quadrant Method

- From the ECG, looking at Limb Lead I, determine the net deflection of the QRS complex (Positive, Negative, equal)
- Plot this on your axis diagram
- Next, from the ECG, looking at Limb Lead aVF, determine the net deflection of the QRS complex (Positive, Negative, equal)
- Plot this on your axis diagram

- Where the areas cross over, this is the quadrant in which the axis lies.


I
aVR
V1
V4
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aVF
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V6

Axis Pathology

- Left Axis Deviation
  - Left Bundle Branch Block
  - Left Ventricular Hypertrophy
  - Inferior Wall MI
  - Left Anterior Fascicular Block
- Right Axis Deviation
  - Right Bundle Branch Block
  - Right Ventricular Hypertrophy
  - High Lateral Wall MI
  - Left Posterior Fascicular Block

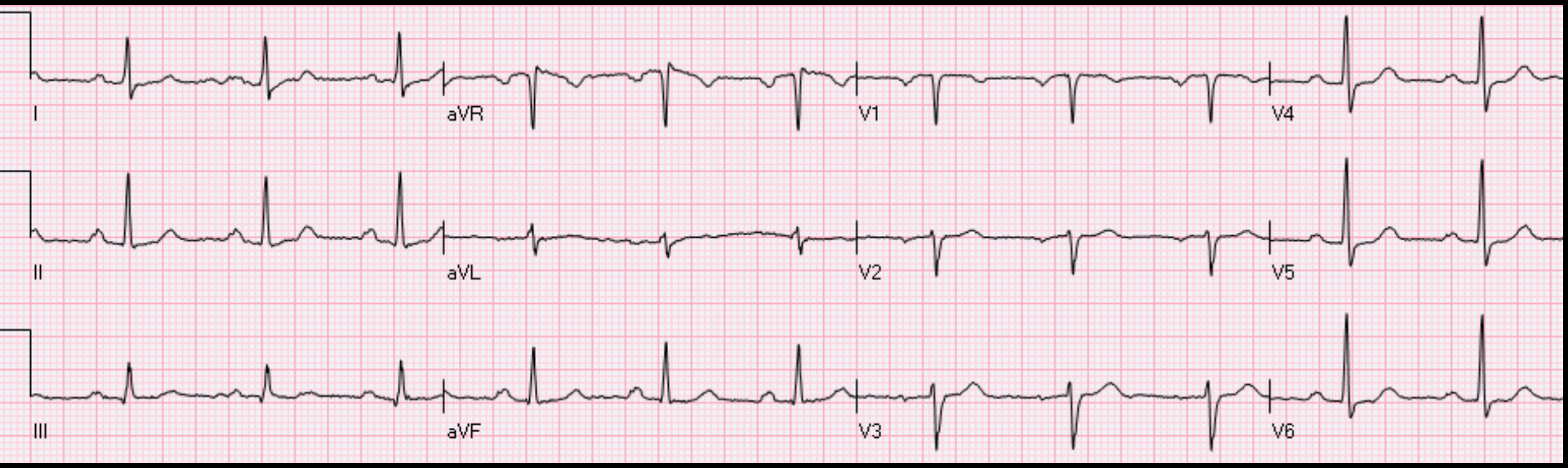
One Method

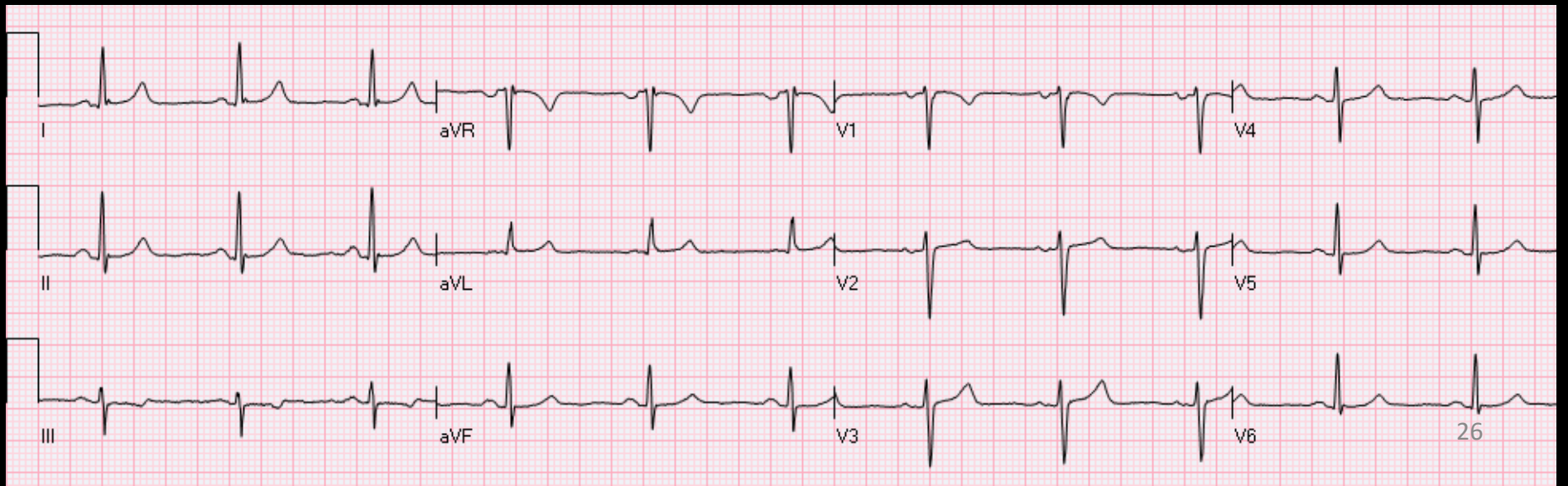
- Gestalt or general impression
- Determine the Heart Rate
- Determine the Rhythm
- Measure the Longest Interval in the Limb Leads
- Determine the Axis
- **Assess the R-Wave Progression**

R-wave Progression

- Precordial Chest leads V1 – V6
- R wave progresses from V1 through V6
- Descriptive term only, does not imply pathology
- Terminology:
  - Normal, early transition, late transition
- Causes:
  - LVH, RVH, MI, Conduction defects, normal variants, lead misplacement….

R-Wave Progression





What Next

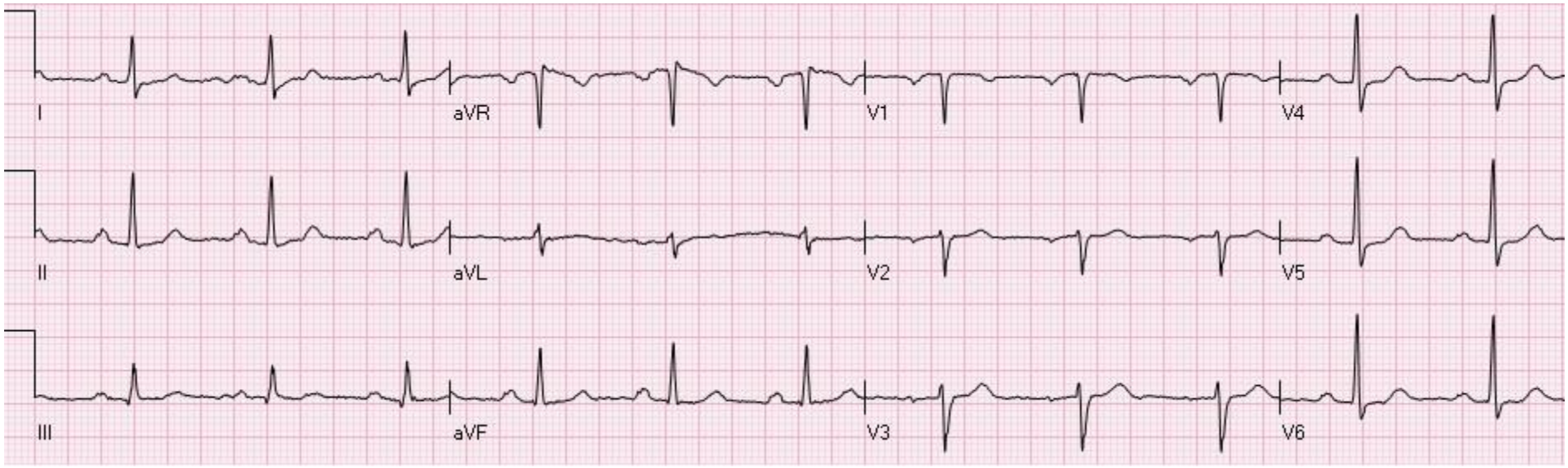
- For each ECG lead, note the following:
  - Location and morphology of P-waves
  - QRS pattern (presence of Q-waves)
  - ST Segment (elevation or depression)
  - T wave changes

  Review all leads except aVR.

Normal ECG:
The 12-lead ECG morphology for a normal individual is not always uniform. A number of constitutional variables can substantially alter a normal ECG, including sex, age, height, race and anatomic position of the heart within the chest. Lead placement, variations in technique and different machines can also distort a normal ECG.

<u>Helpful Criteria:</u>
* P-waves upright in I, II, V2-V6
* T-waves upright in I, II, V3-V6, Inverted in aVR
Variable in III, aVL, aVF, V4-V6

* Small Q-waves normal in I, aVL, V4-V6
* Deep Q-waves (QS) normal in aVR, and occasionally seen in leads III and V_1

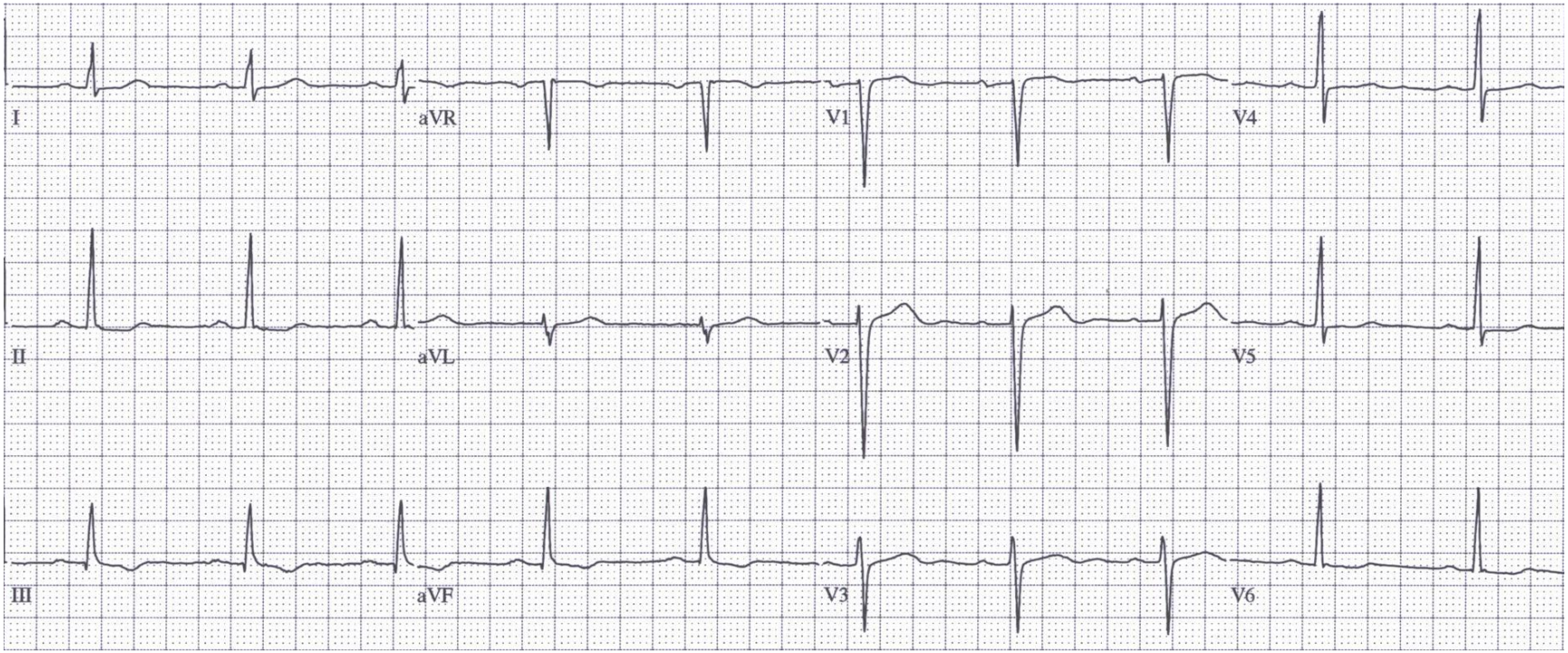


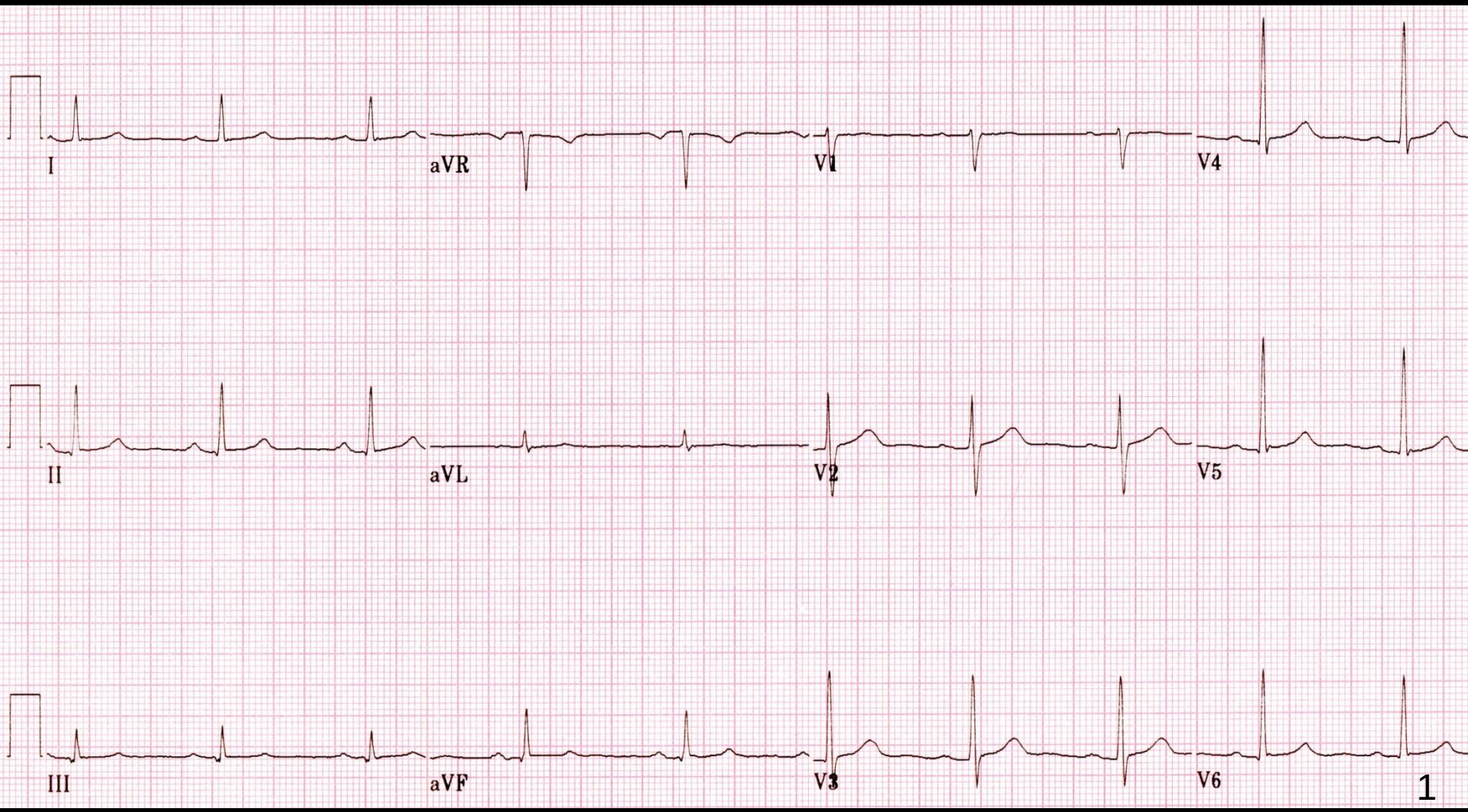
Helpful Criteria:

* P-waves upright in I, II, V2-V6
* T-waves upright in I, II, V3-V6, Inverted in aVR
  Variable in III, aVL, aVF, V4-V6

- Small Q-waves normal in I, aVL, V4-V6
- Deep Q-waves (QS) normal in aVR and occasionally seen in leads III and V1

Let's Practice

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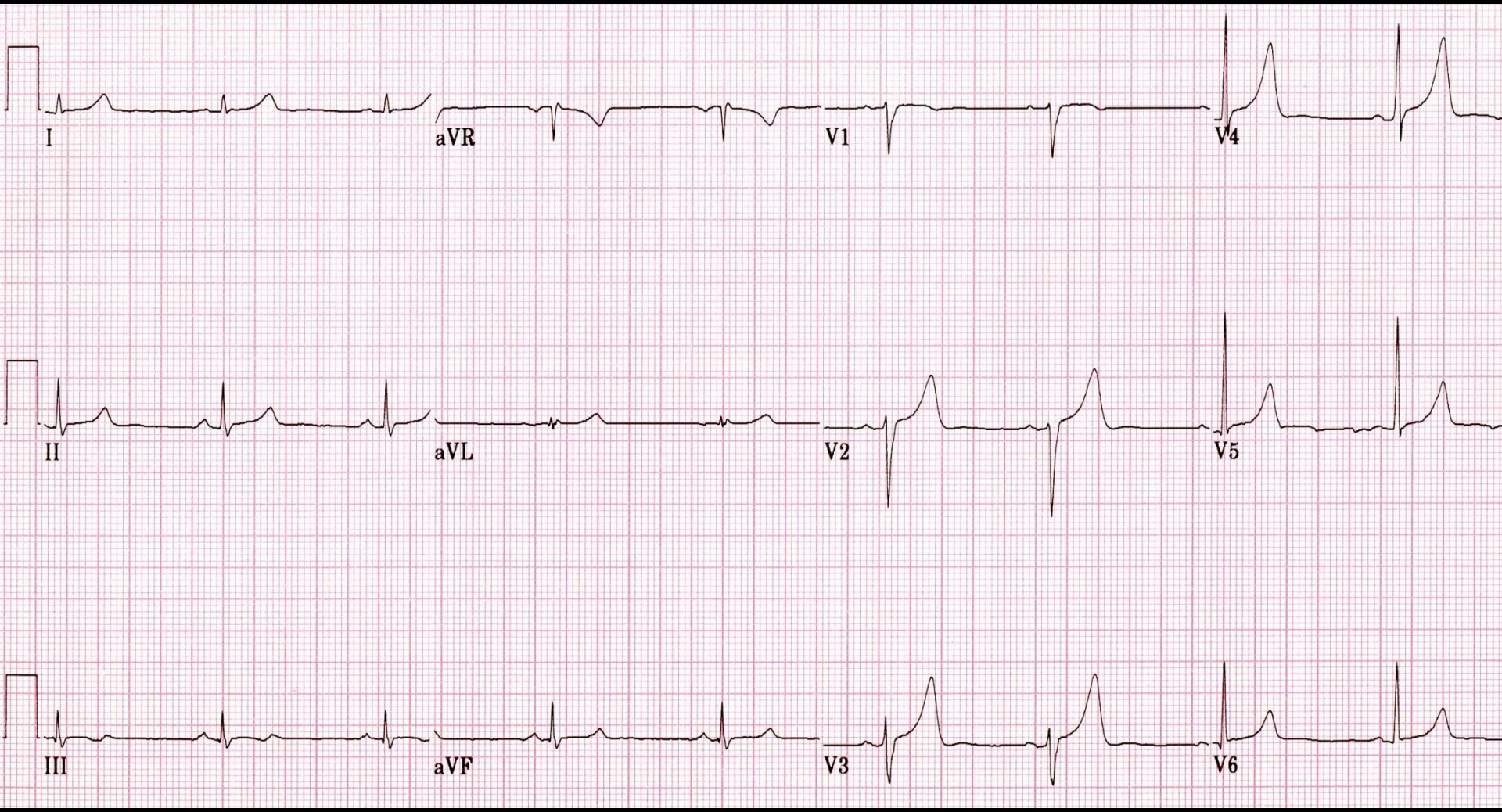
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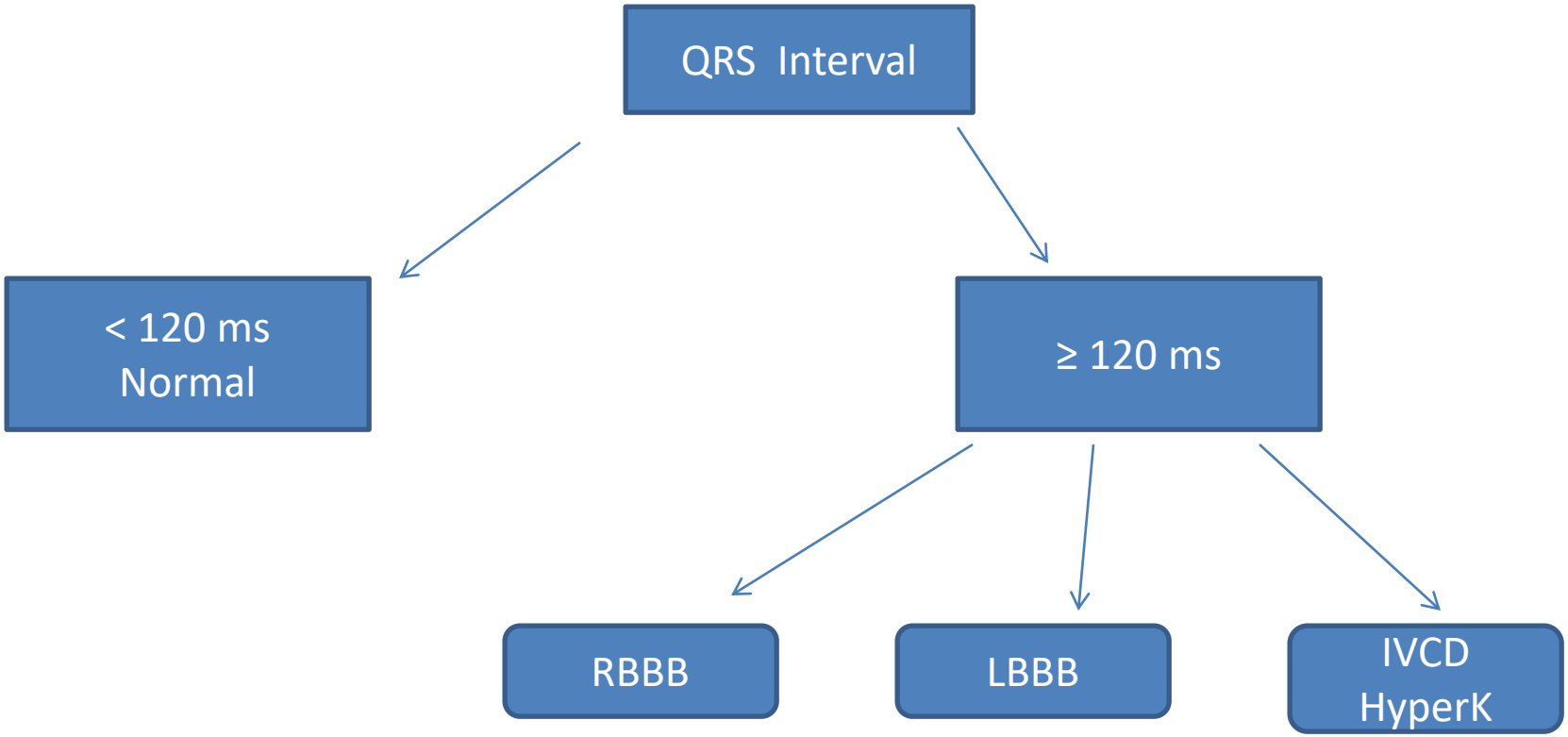
Bundle Branch Blocks

Simplified Diff. Wide-QRS Complex



Differential for Wide-QRS Complex

- Hyperkalemia
- Ventricular tachycardia
- Idioventricular rhythm, including heart block
- Drug effects and overdose (esp. tricyclics)
- Wolff-Parkinson-White
- Bundle Branch Blocks and Idioventricular conduction delays (IVCD)
- Ventricular premature contractions
- Aberrantly conducted complexes
    - In order of descending mortality

Do I have a Bundle Branch Block?

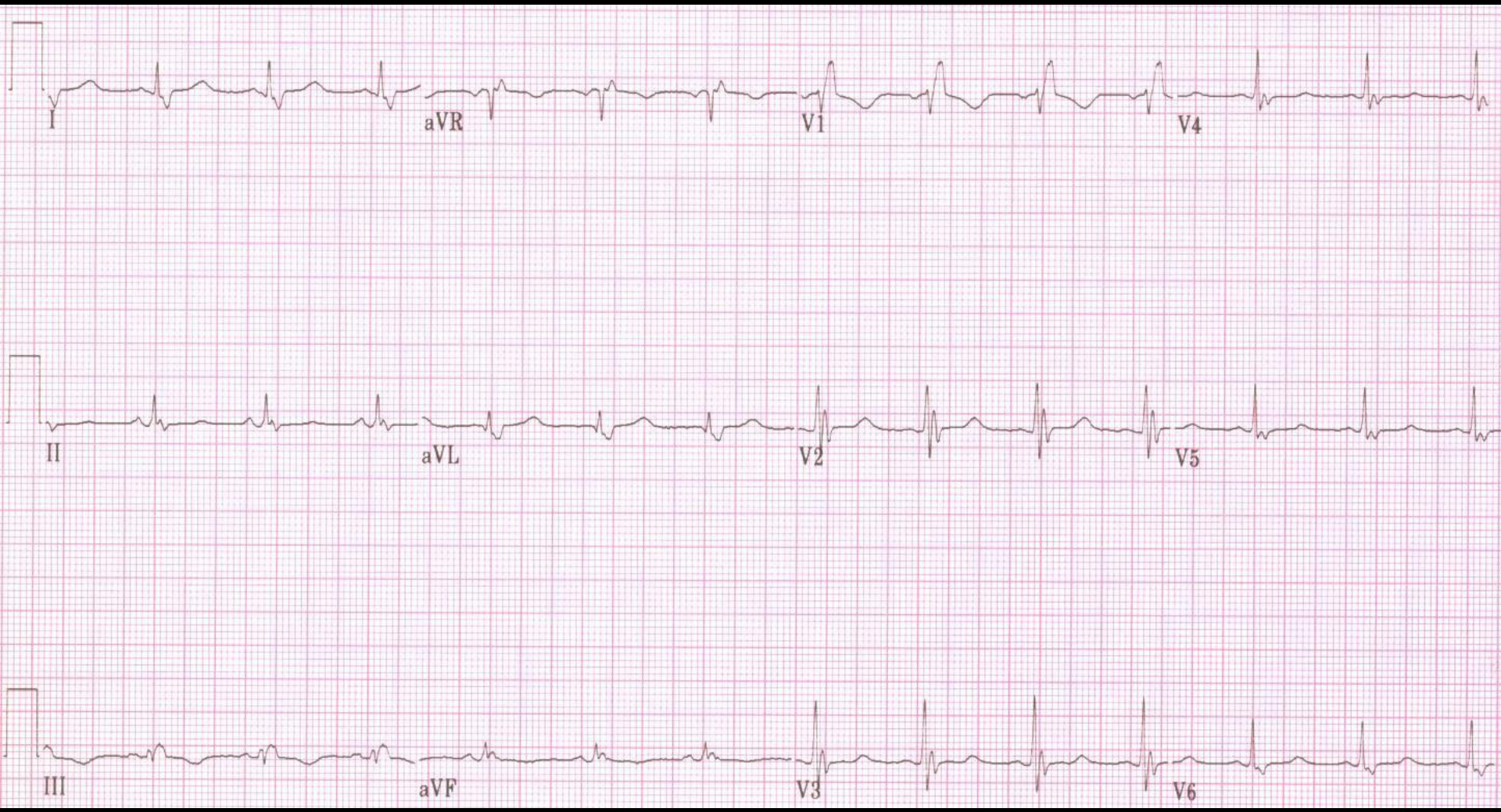
- Diagnostic criteria
  - Width of the QRS complex
    - ≥ 120 ms is Always abnormal
  - If QRS is < 120 ms, NOT a BBB

Right Bundle Branch Block

- Diagnostic criteria:
  - QRS ≥ 120 ms
  - Axis is RAD or Normal (can be LAD with LAFB)
  - rSR' pattern V_1 - V_2
  - Slurred S-wave in I and V_6
  - NSSTT changes in V_1 & V_2

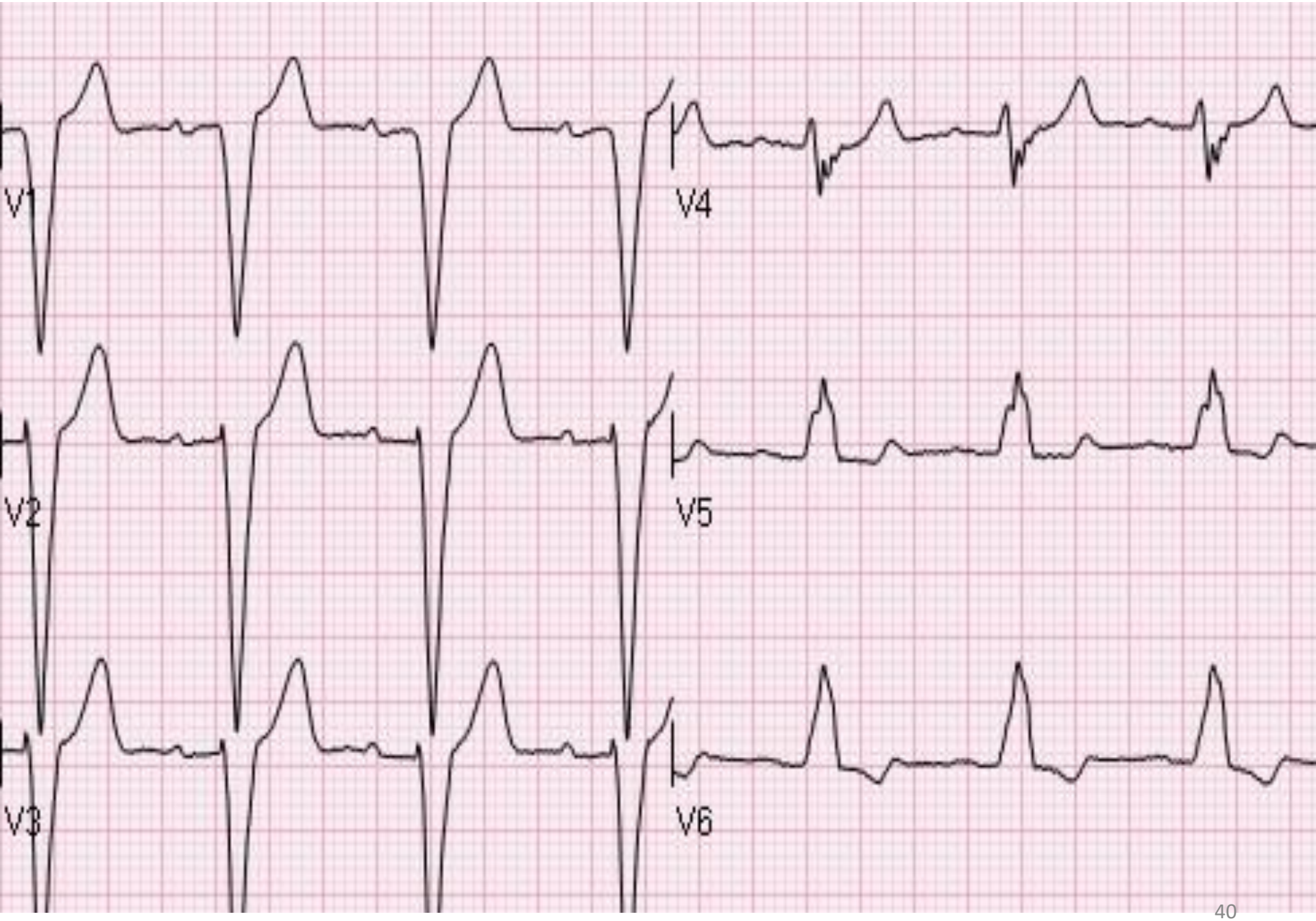
  (Non-specific ST-T wave changes)

RBBB

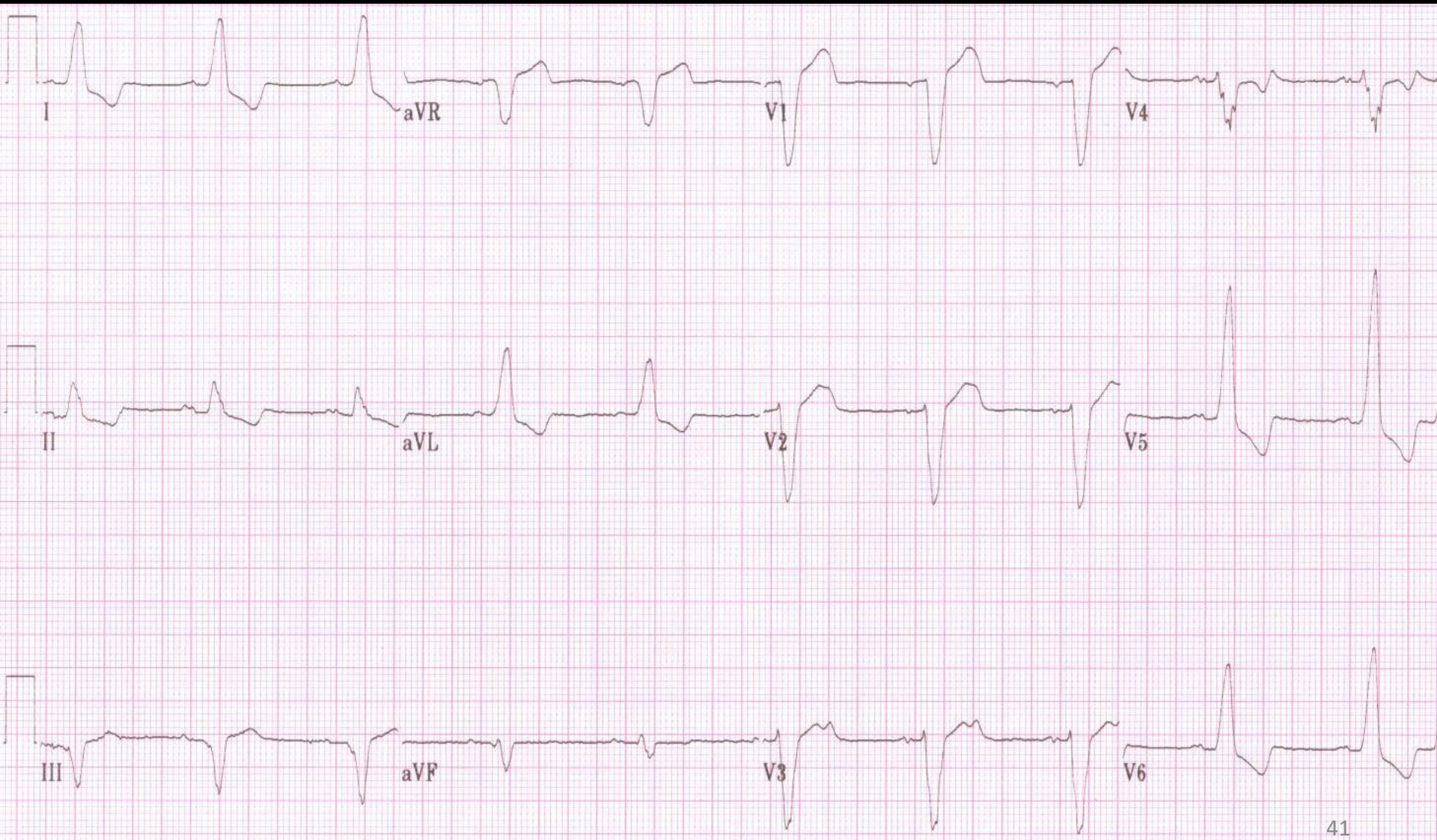


Left Bundle Branch Block

- Diagnostic criteria:
  - QRS ≥ 120 ms
  - Axis is Normal or LAD
  - Wide monomorphic S-waves in V_1 – V_4
  - Wide monomorphic R-wave in I and V_6
  - NSSTT changes in most leads


V1
V4
V2
V5
V3
V6

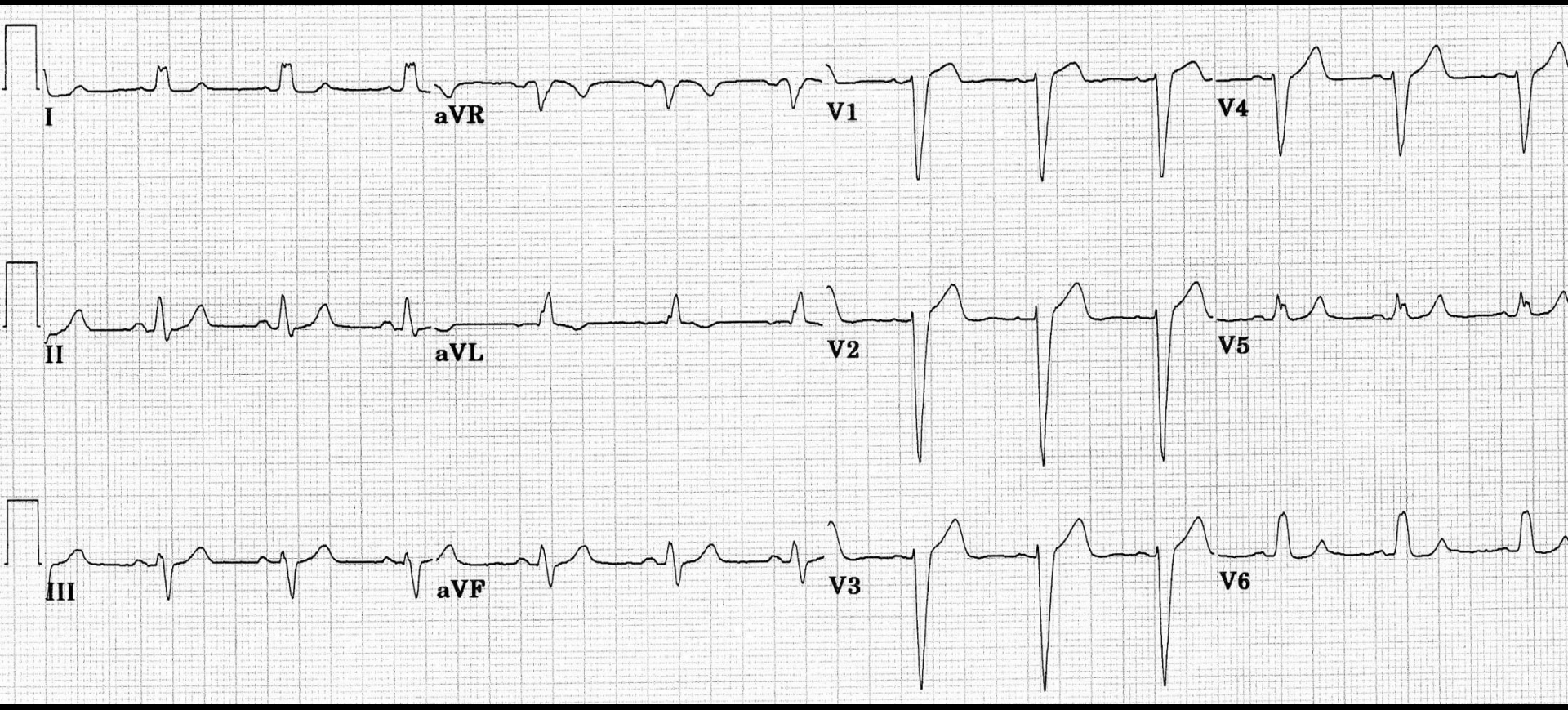
LBBB



How do I Differentiate between Left and Right BBB?

- RBBB
  - QRS ≥ 120 ms
  - Axis is RAD or Normal (can be LAD with LAFB)
  - rSR' pattern V_1 - V_2
  - Slurred S-wave in I and V_6
  - NSSTT changes in V_1 & V_2
- LBBB
  - QRS ≥ 120 ms
  - Axis is Normal or LAD
  - Wide monomorphic S-waves in V_1 – V_4
  - Wide monomorphic R-wave in I and V_6
  - NSSTT changes in most leads

Let's Practice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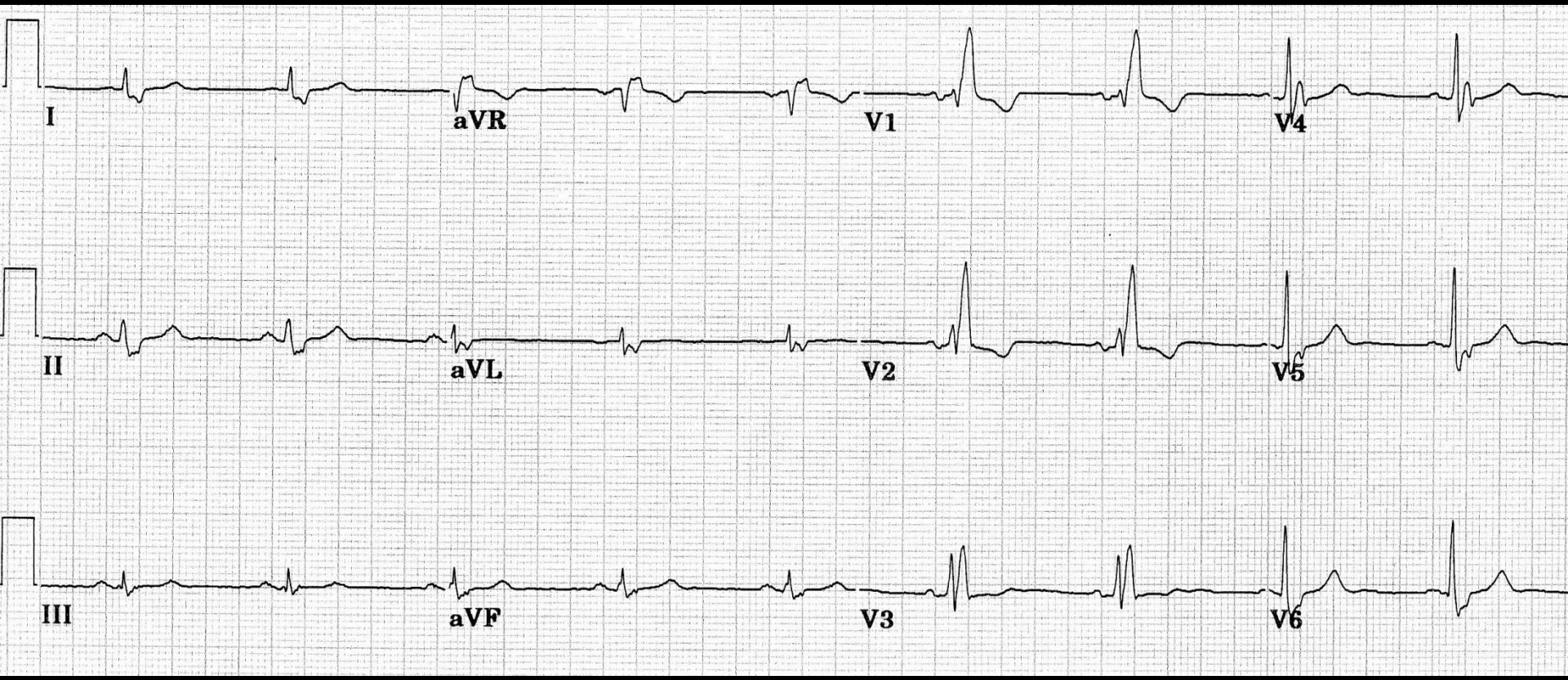
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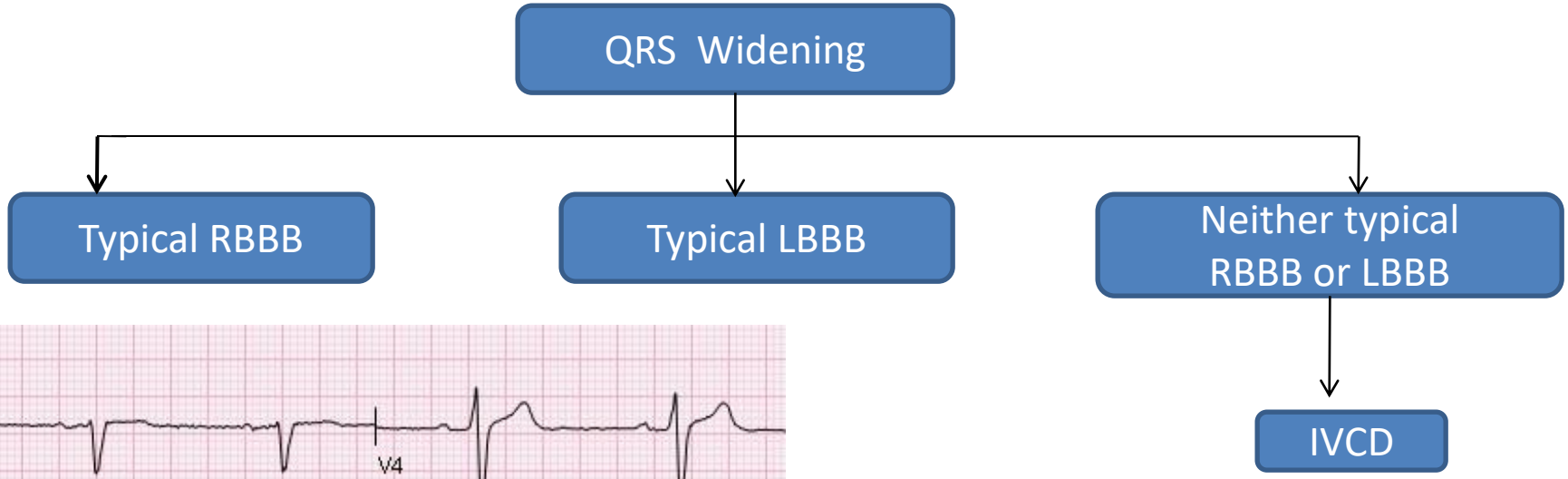
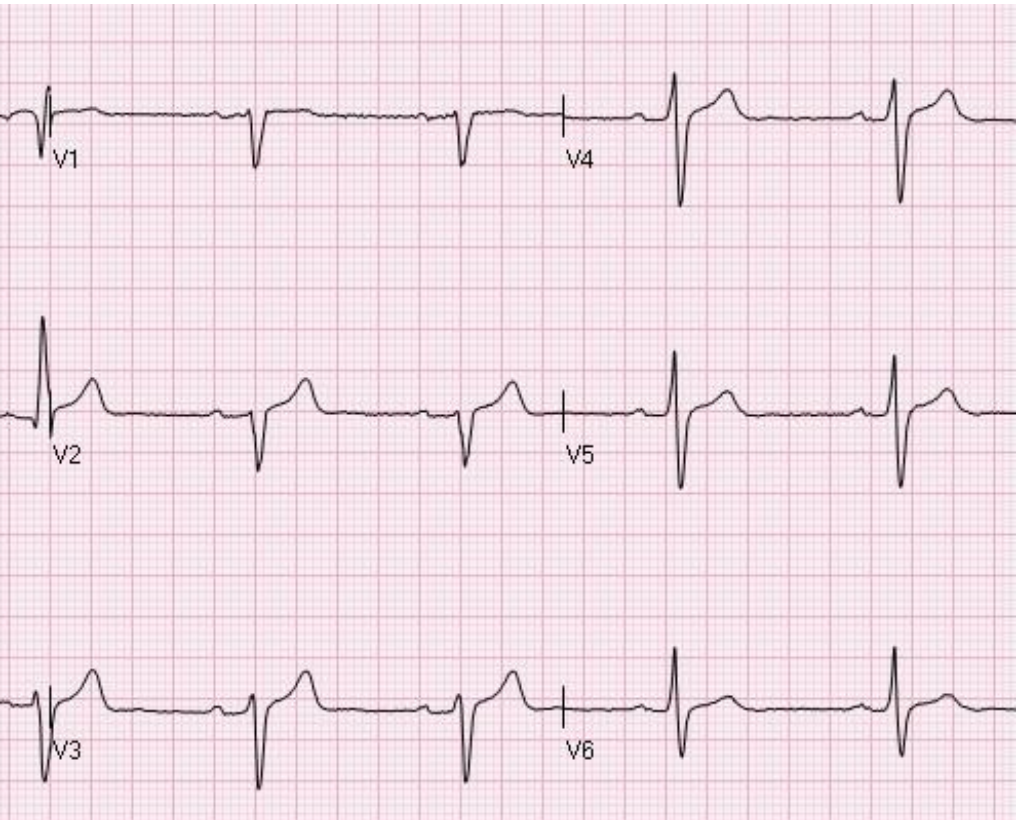
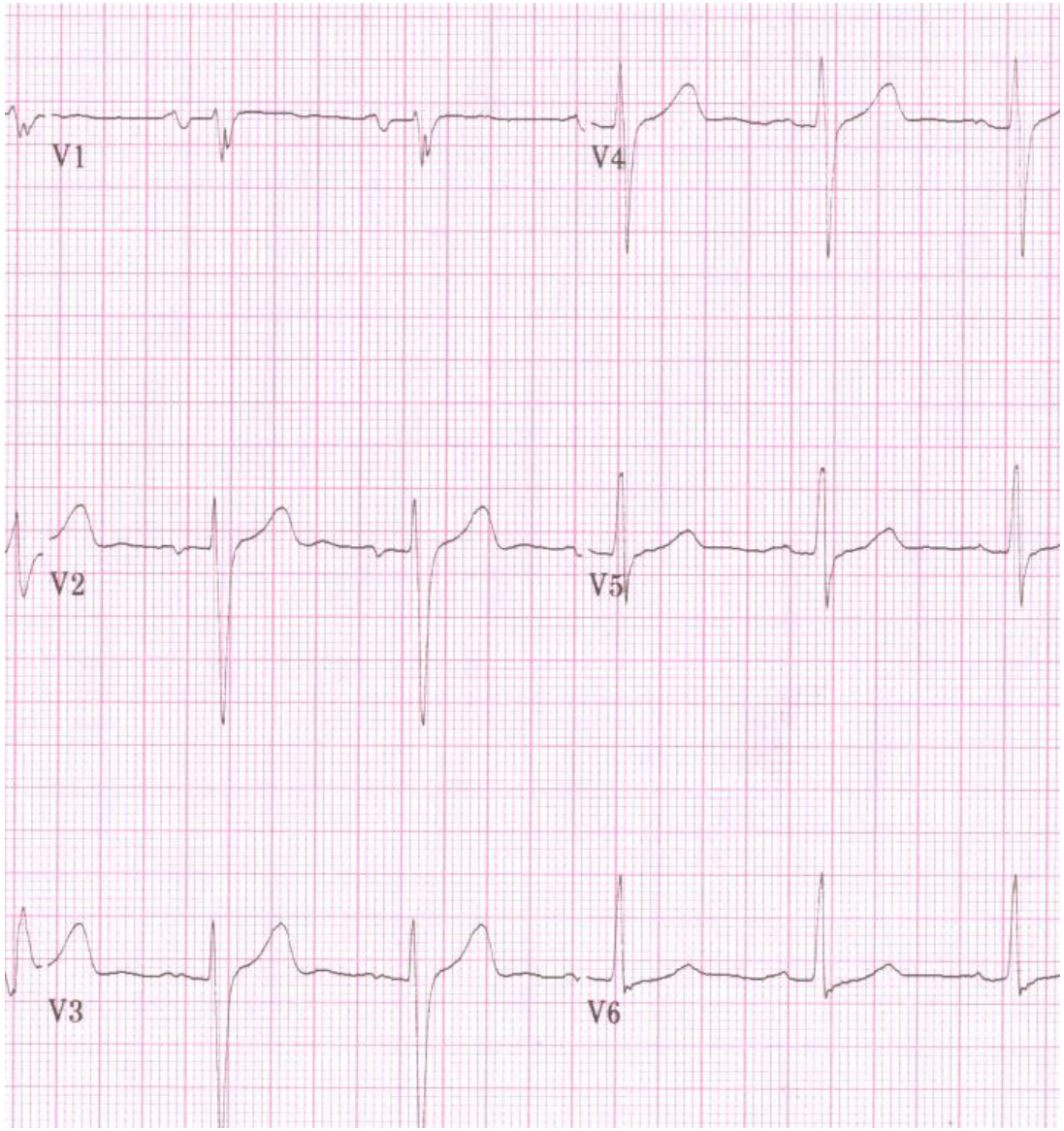
Intraventricular Conduction Delay






V1
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V3
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Fascicular Blocks

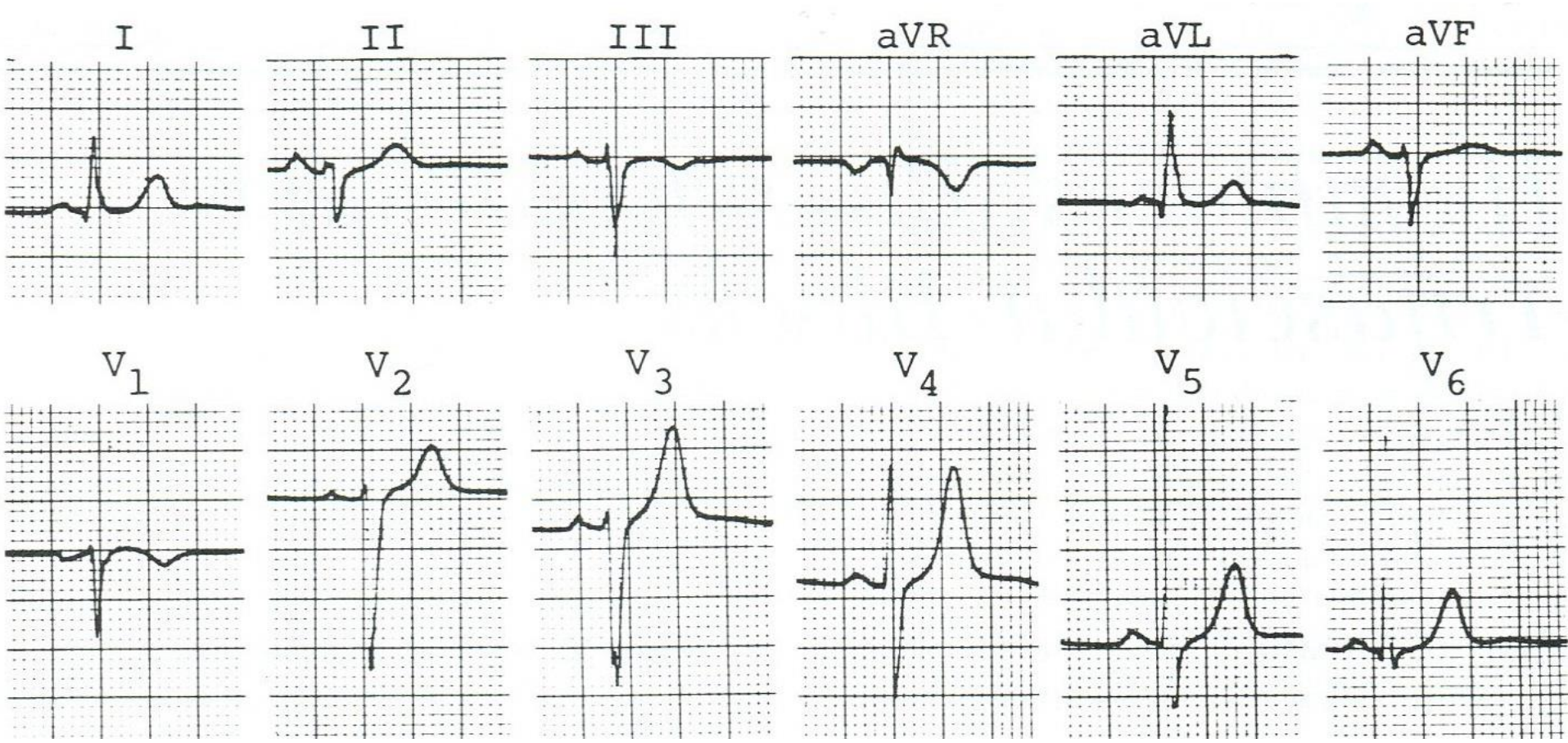
Pathology

- Disruption of the Left Ventricular conduction system, resulting in the ventricles being innervated asynchronously and abnormally. Results in altered vectors produced by the ventricle.

Left Anterior Fascicular Block

- ECG Criteria:
  - Axis ≥ 45°
  - No other cause of axis deviation present
  - Normal QRS duration (100 – 110 ms)
  - Small Q in lead I, small R in lead III (q1r3 pattern)

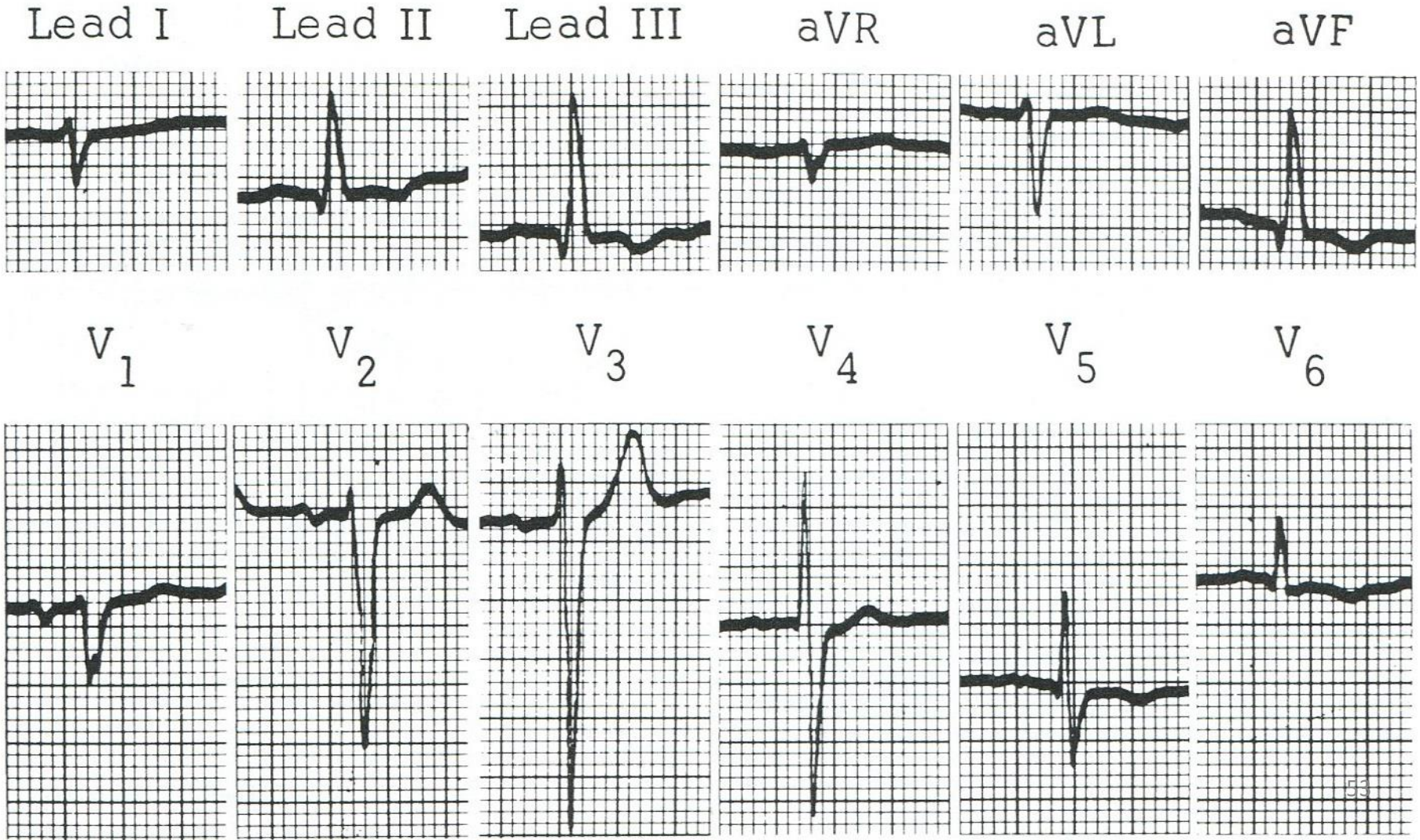
Left Anterior Fascicular Block



Left Posterior Fascicular Block

- ECG Criteria:
  - Axis ≥ 100°
  - No other cause of axis deviation present
  - Normal QRS duration (100 – 110 ms)
  - Small R in lead I, small Q in lead III (r1q3 pattern)

Left Posterior Fascicular Block



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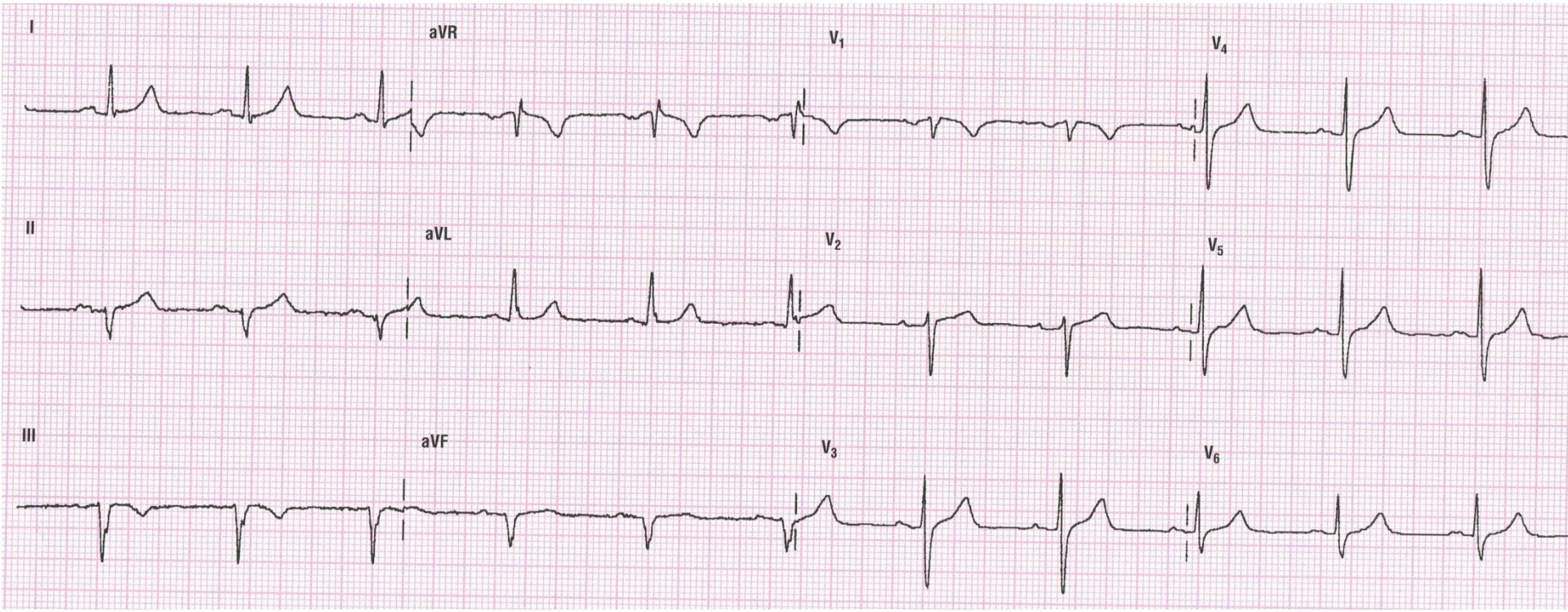

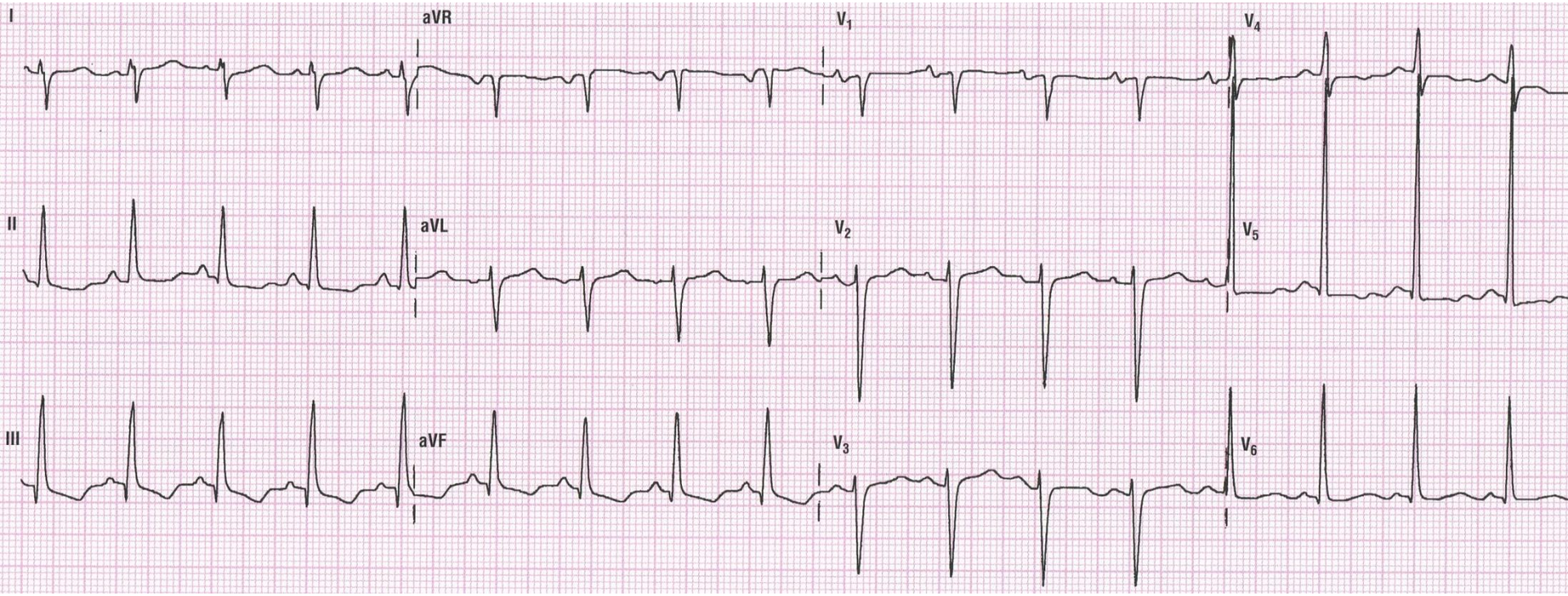

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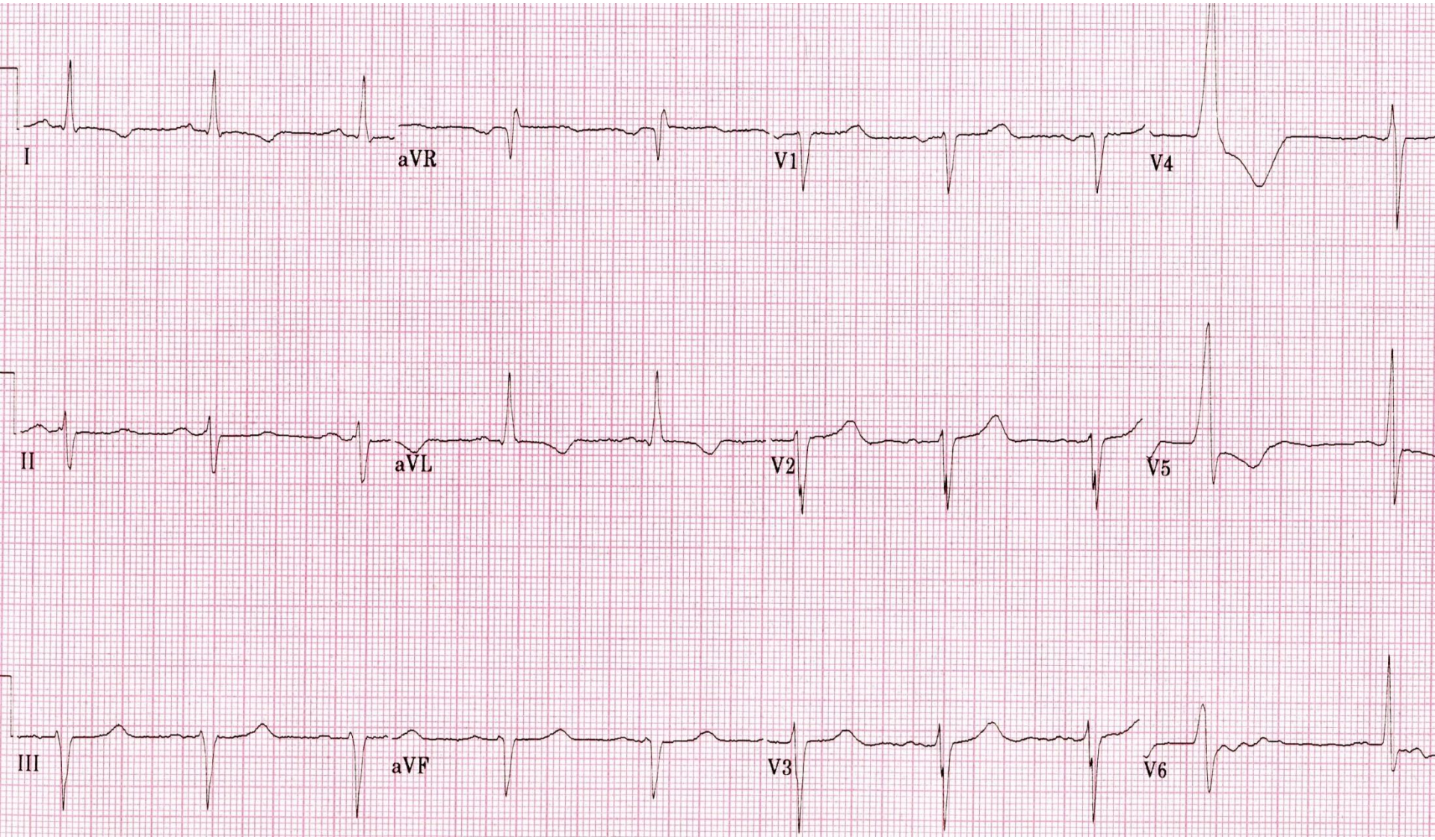

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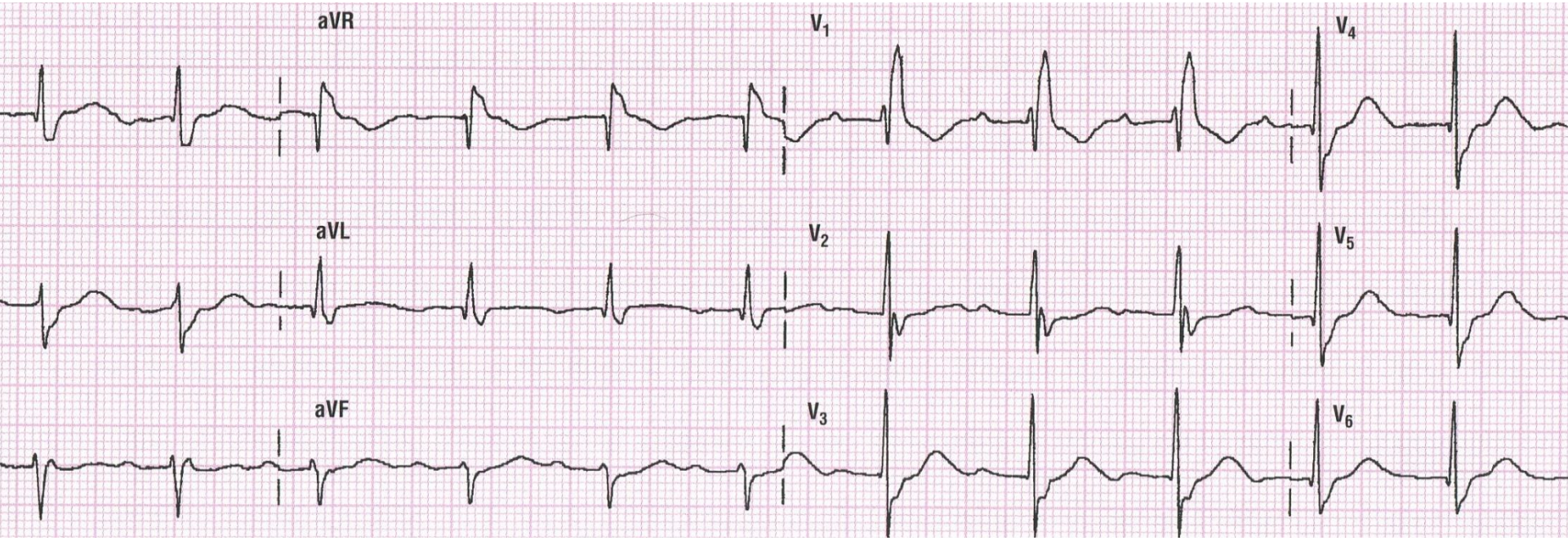
Bifascicular Blocks

- Involves RBBB with either LAFB or LPFB
- RBBB with LAFB is very common and stable
- RBBB with LPFB is also more common than LPFB by itself and is more unstable
- The RBBB is the dominant ECG finding, associated with a axis deviation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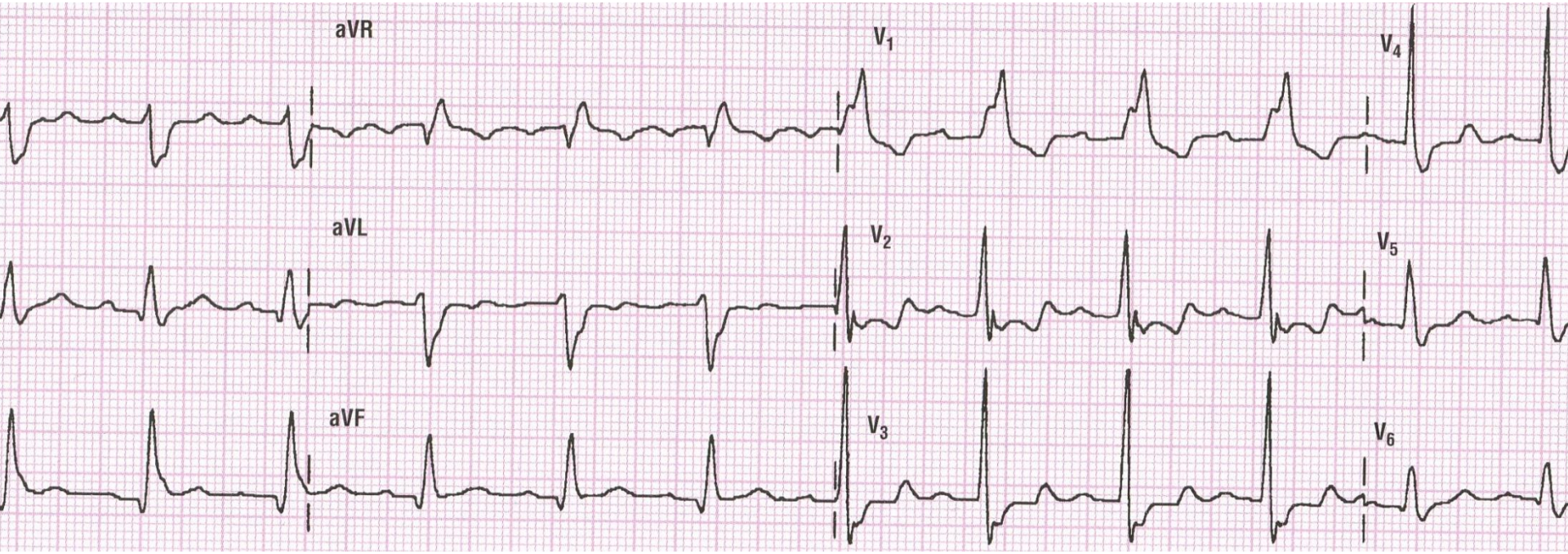
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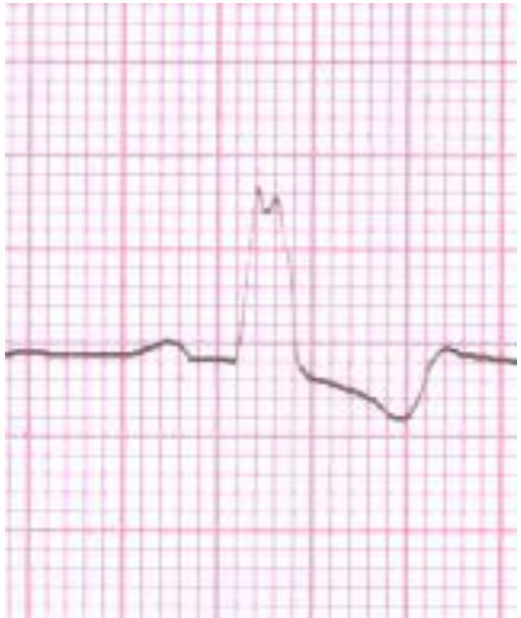
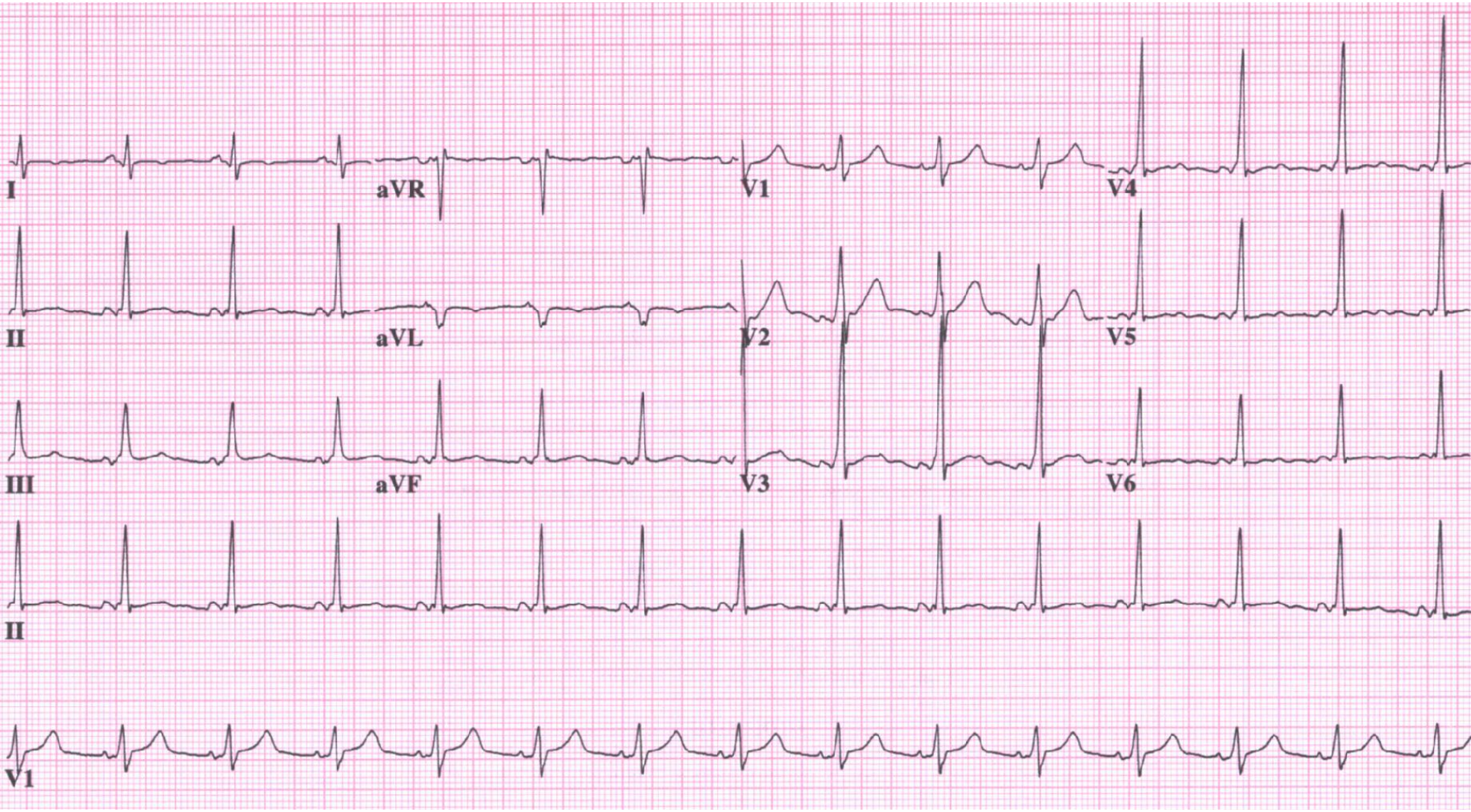
WPW Exception

- Diagnostic criteria for WPW
  - PR interval < 120 ms with a normal looking P-wave
  - Wide QRS complex: 110 ms or greater
  - Presence of “delta-wave” (initial slurring or QRS)
  - Secondary ST-T changes




V6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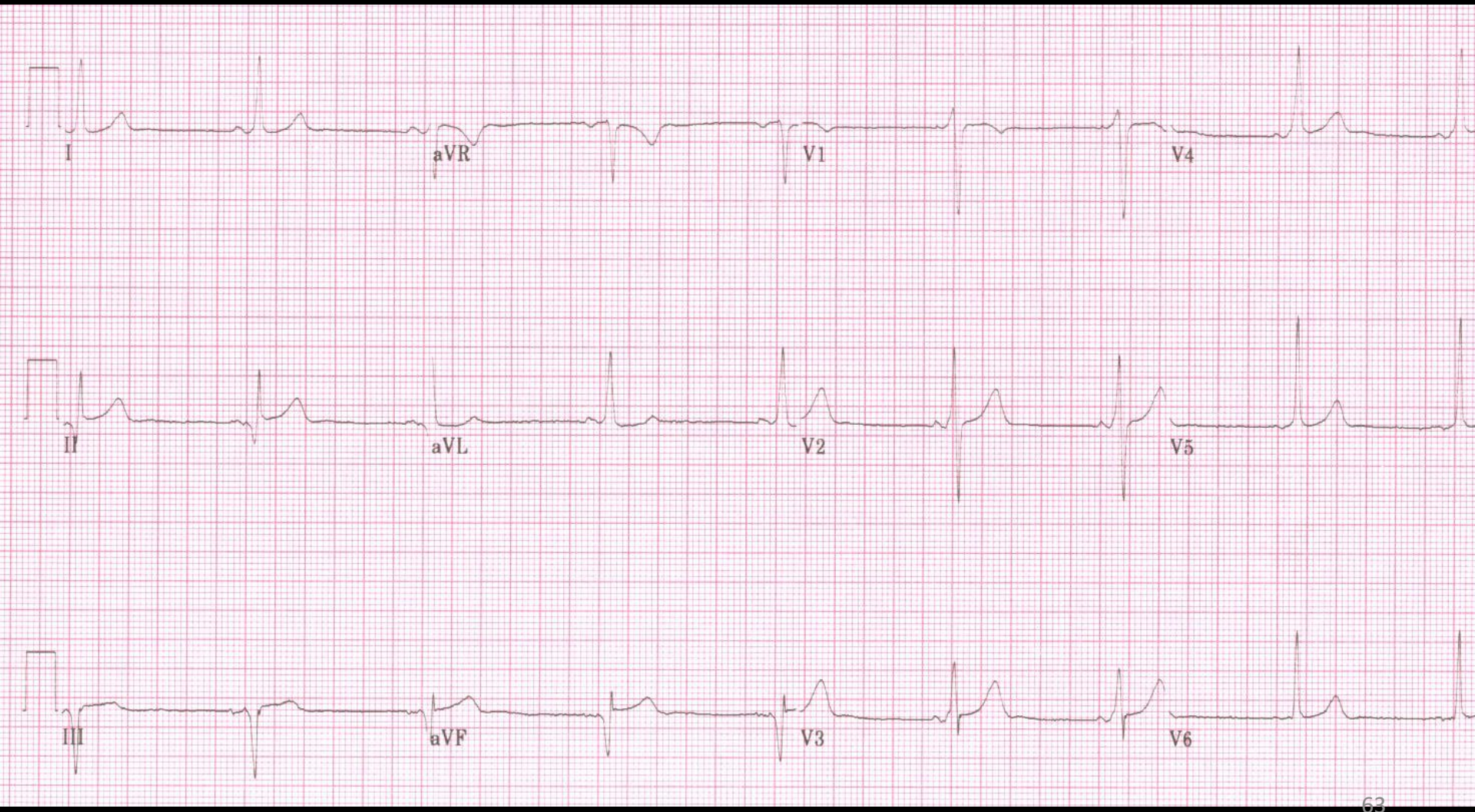
WPW



Summary

- Three important Take Home points!

- Develop a “system” to evaluate ECGs
- Practice does Improve Interpretative abilities
- Work with a good reference to improve skills

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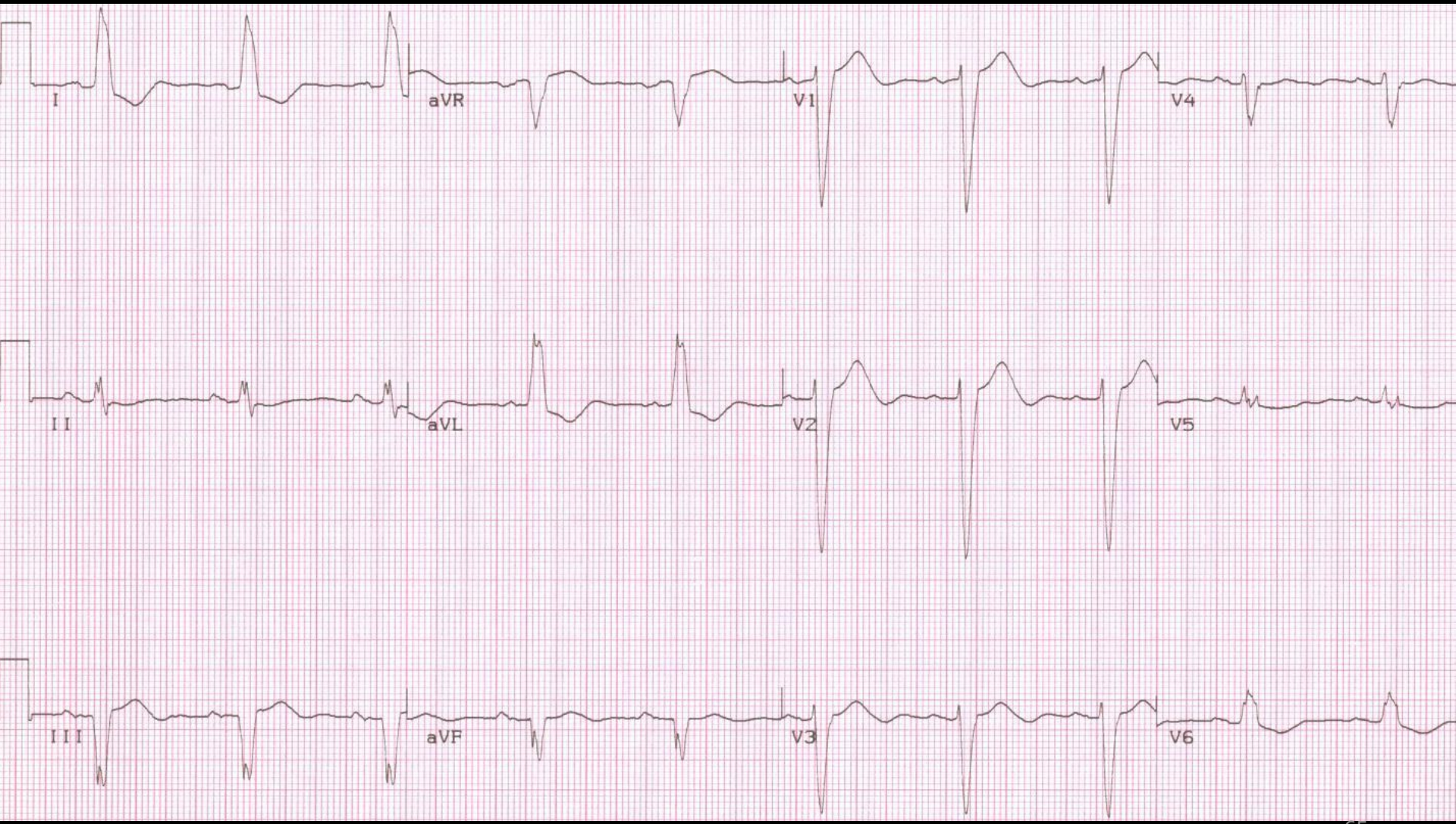

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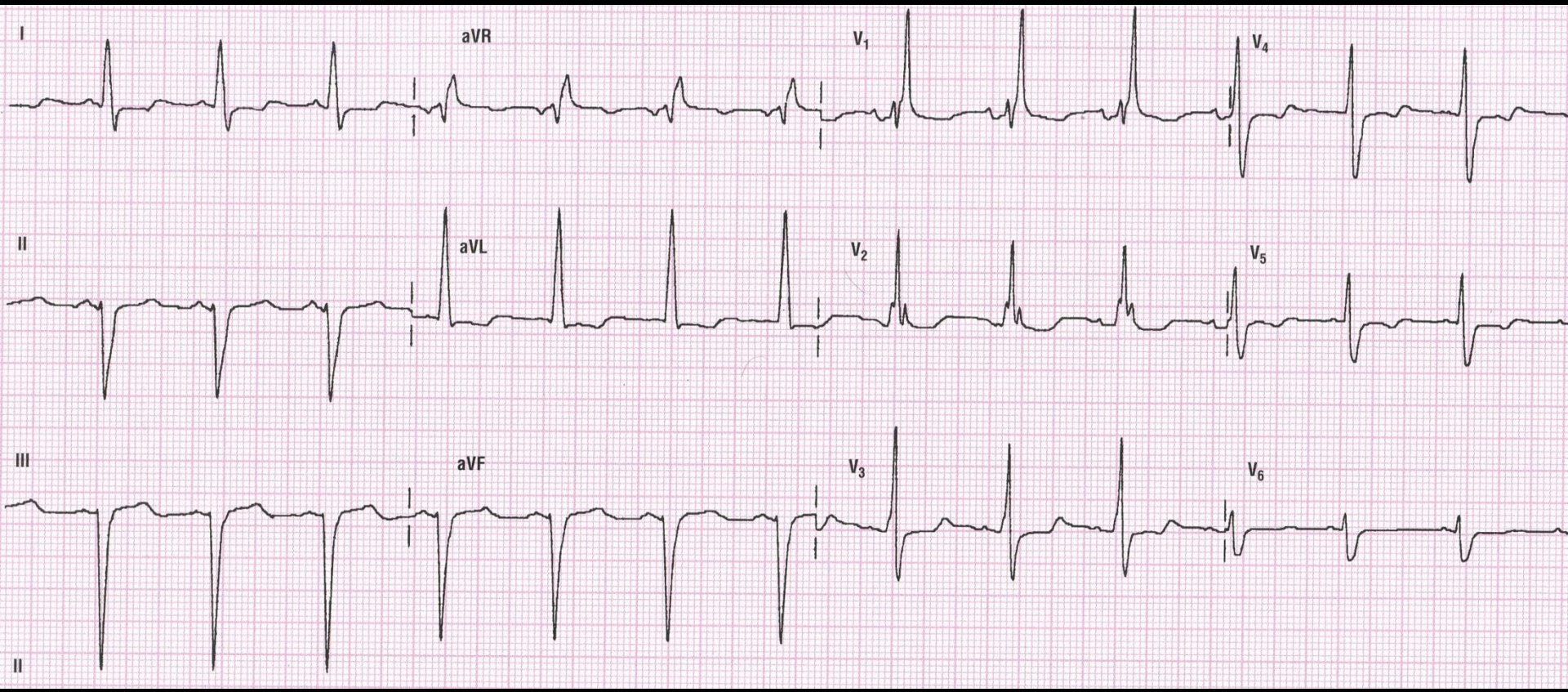

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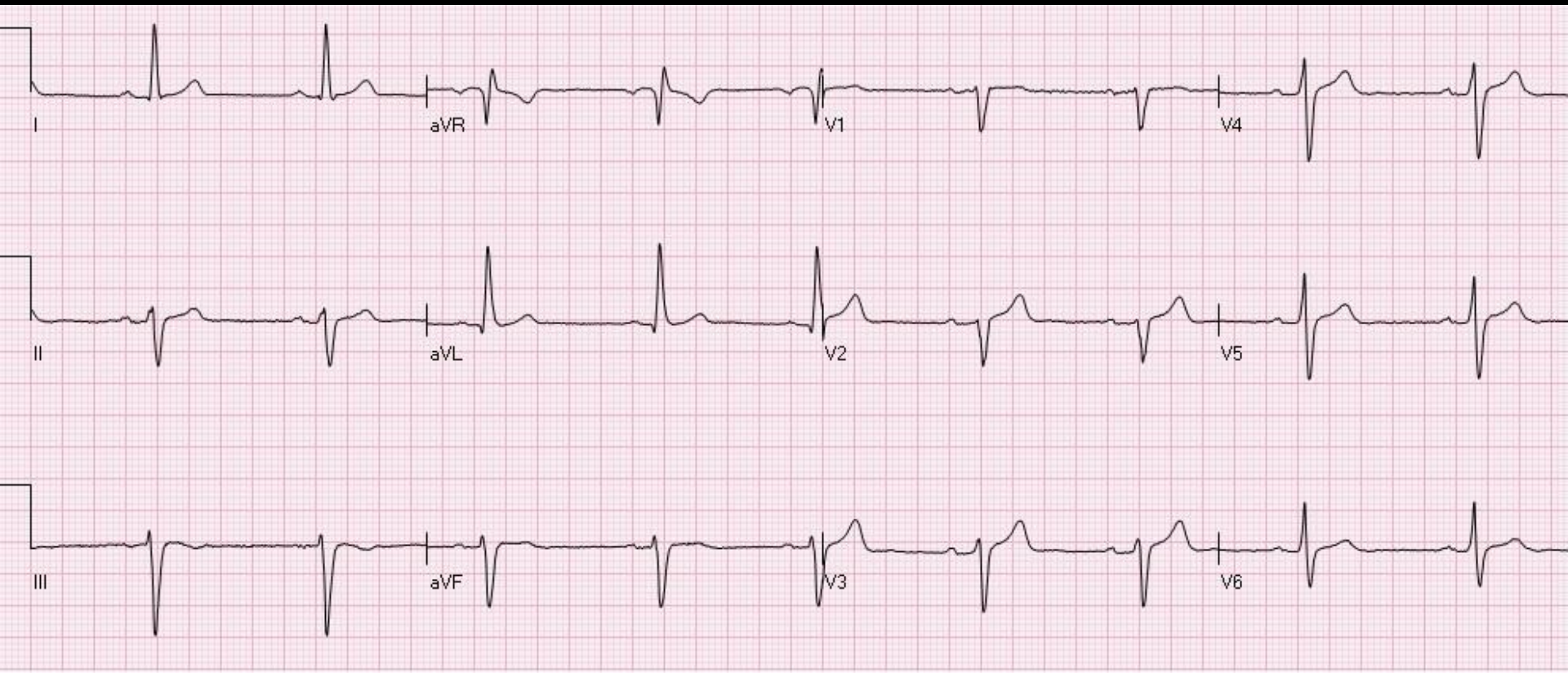

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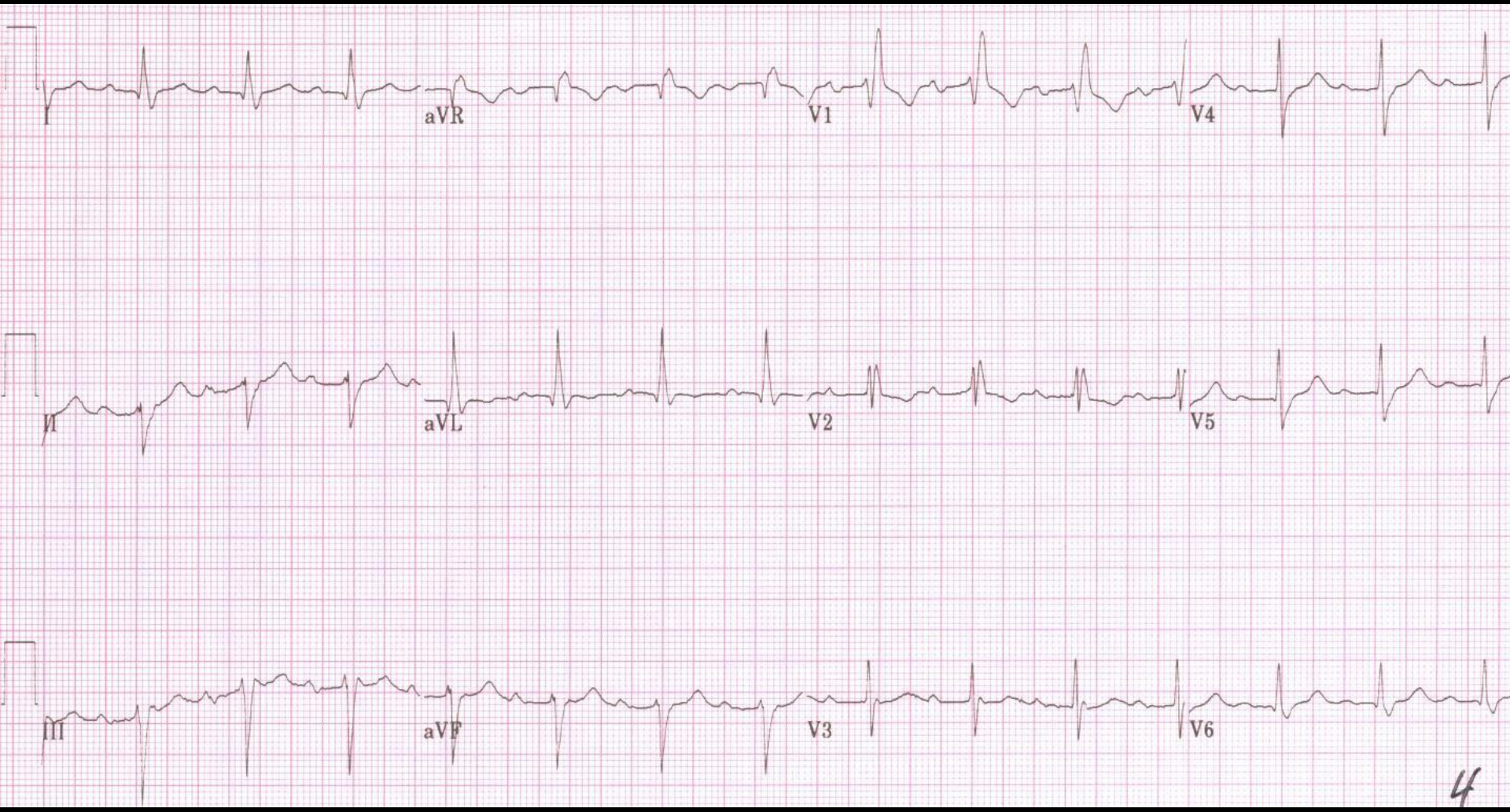

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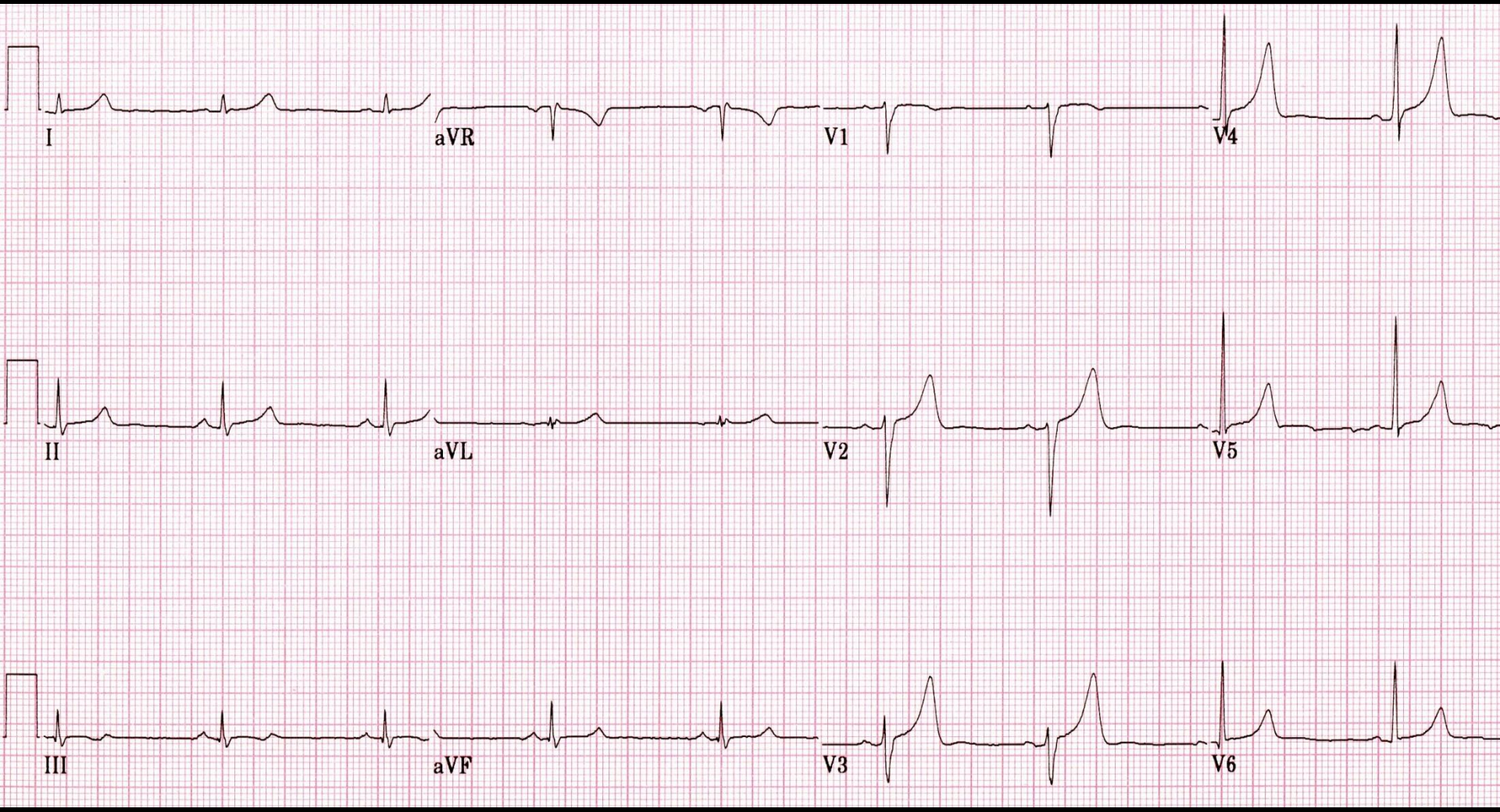

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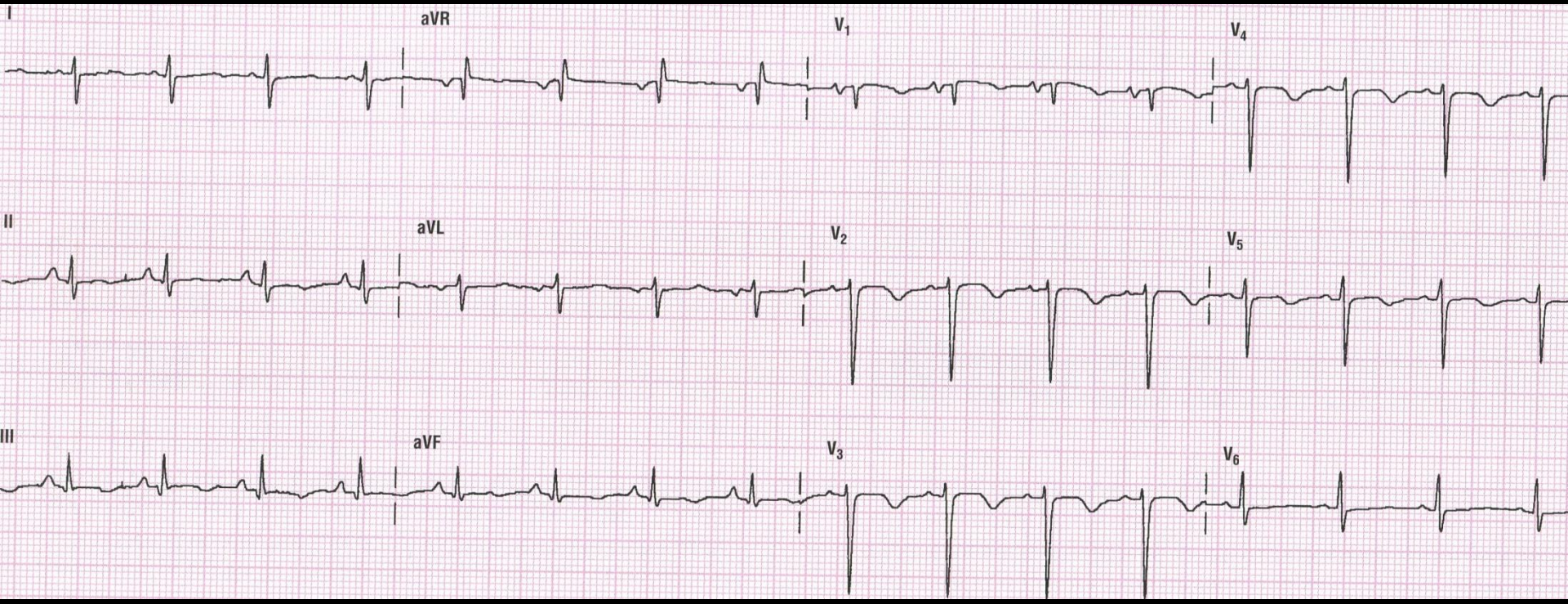

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- Up to date

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