Disclosures

- None

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Puerto Rico ACP Internal Medicine Update and Board Review

ECG Review

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March 8,2019
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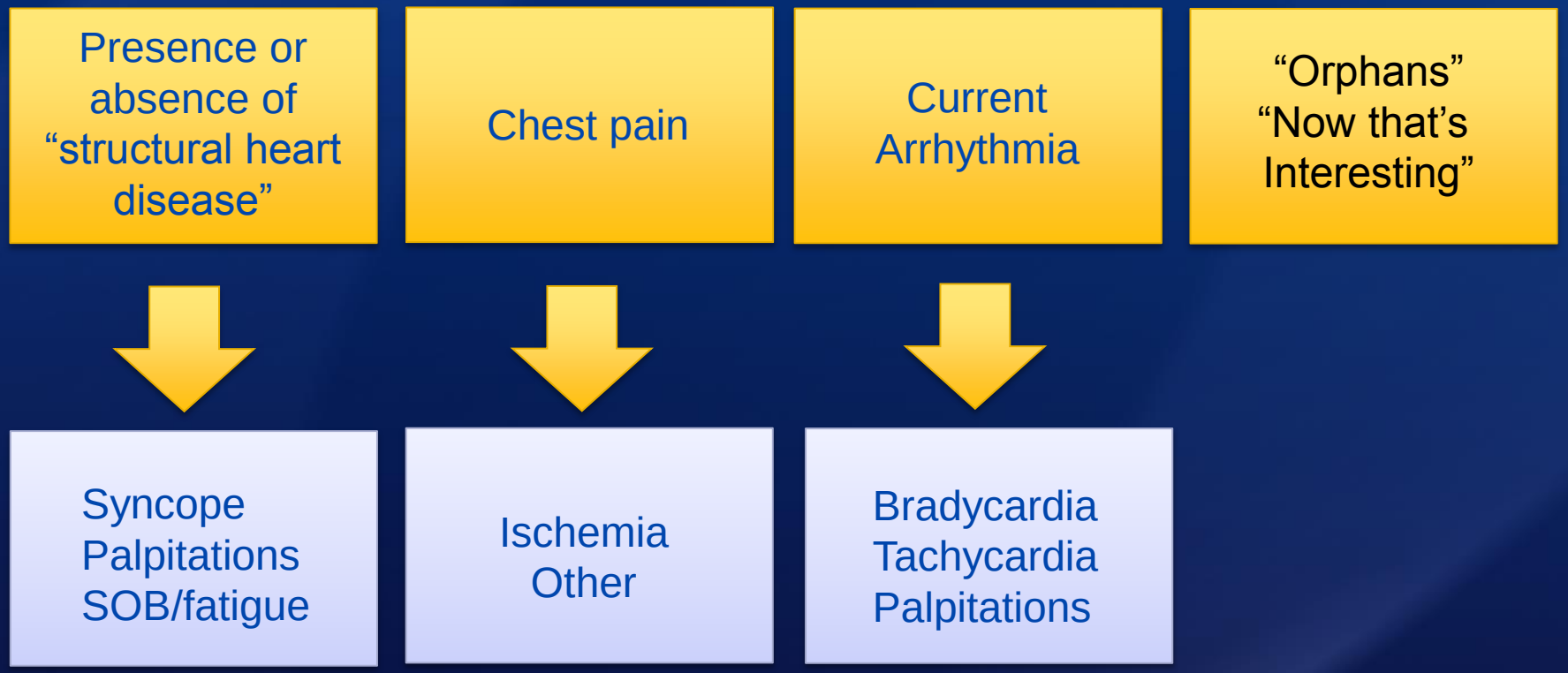
Clinical Use of the ECG



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ECG evaluation in the patient with chest pain

Careful evaluation of symptoms is the most important diagnostic tool

- Characteristic changes with myocardial injury
- "Fake-outs"

T wave abnormalities

New or dynamic
Q waves
Localized T wave peaking

ST segment depression

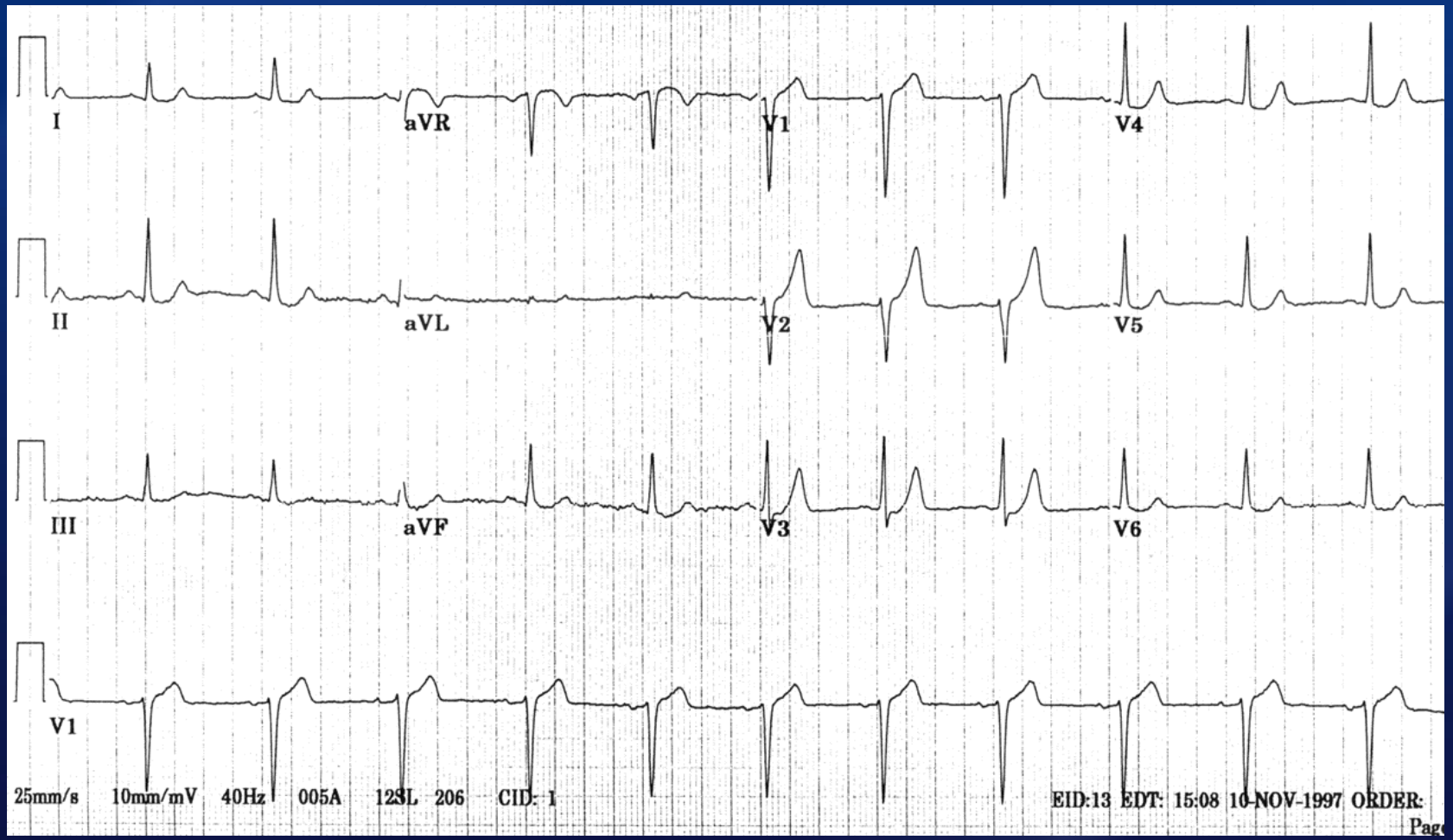
New or dynamic
Q waves

ST segment elevation

Anatomic distribution
Reciprocal changes
Q waves

Left bundle branch block and LVH make the presence of cardiac disease more likely but make the ECG more difficult and sometimes impossible to evaluate

Case #1: 46 year old policeman with "burning" in the chest when riding a bicycle



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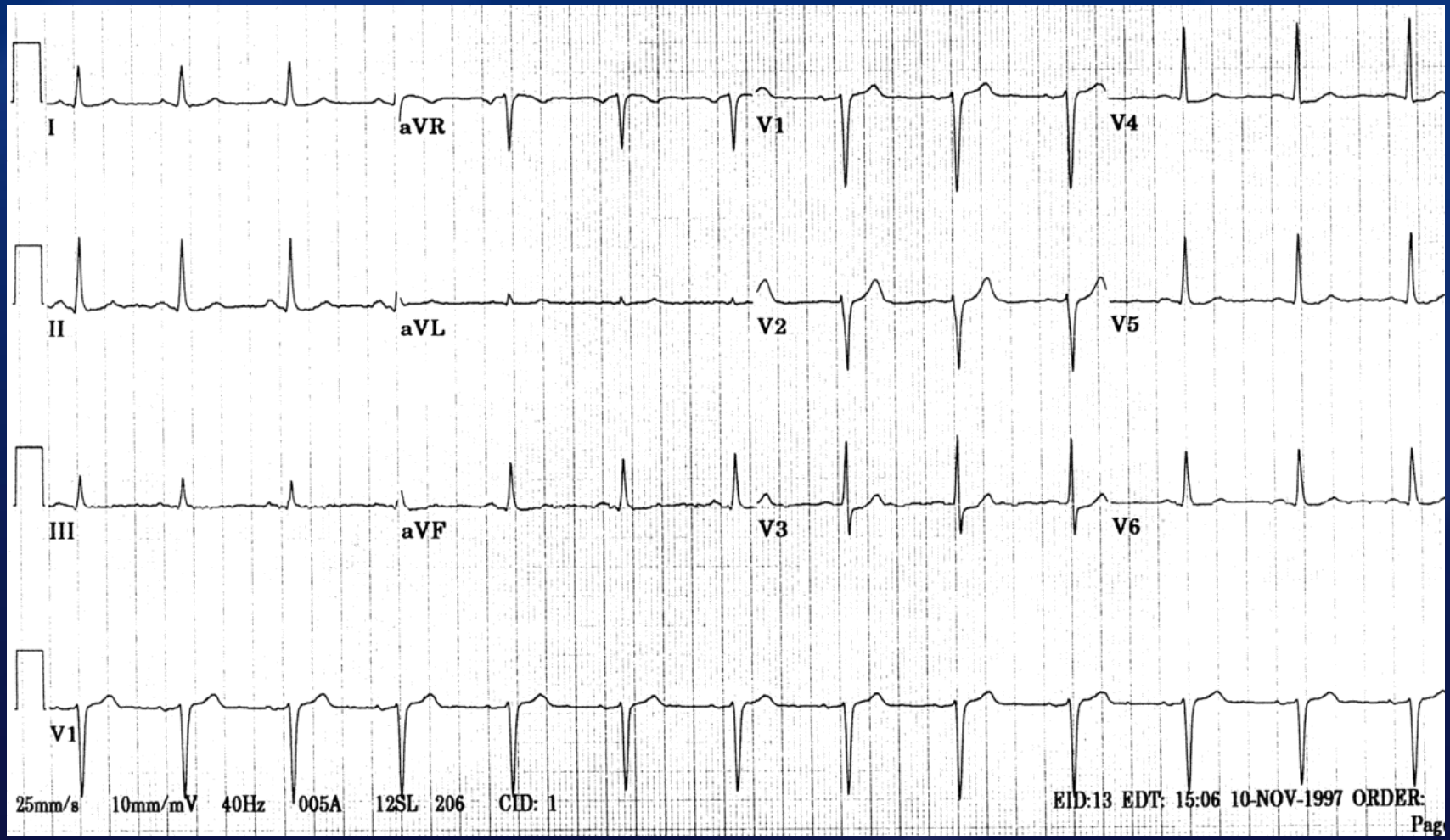
Kusumoto FM. Cardiovascular Pathophysiology Hayes Barton 1999

Case #1 (continued): “Burning” has resolved



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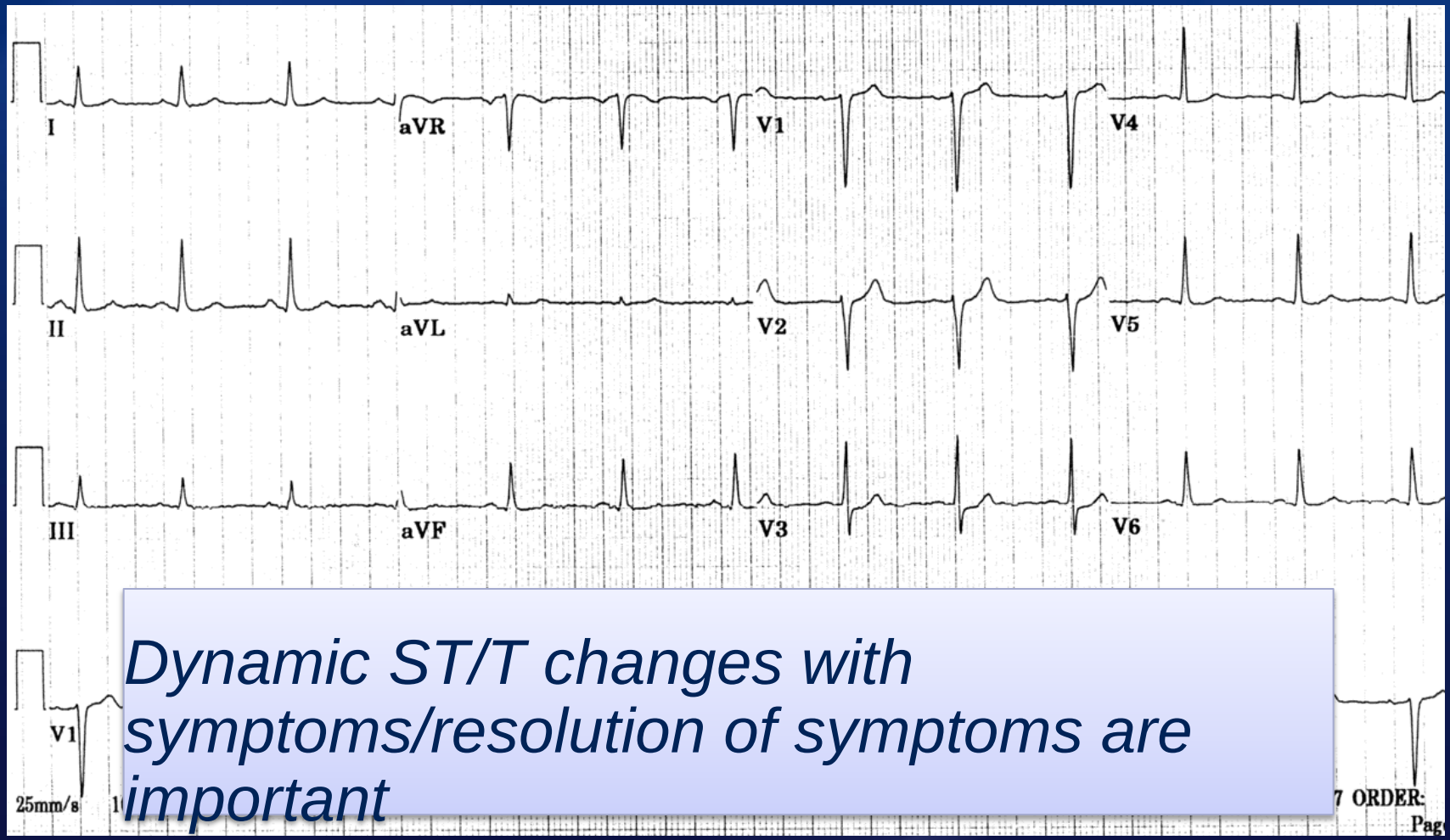
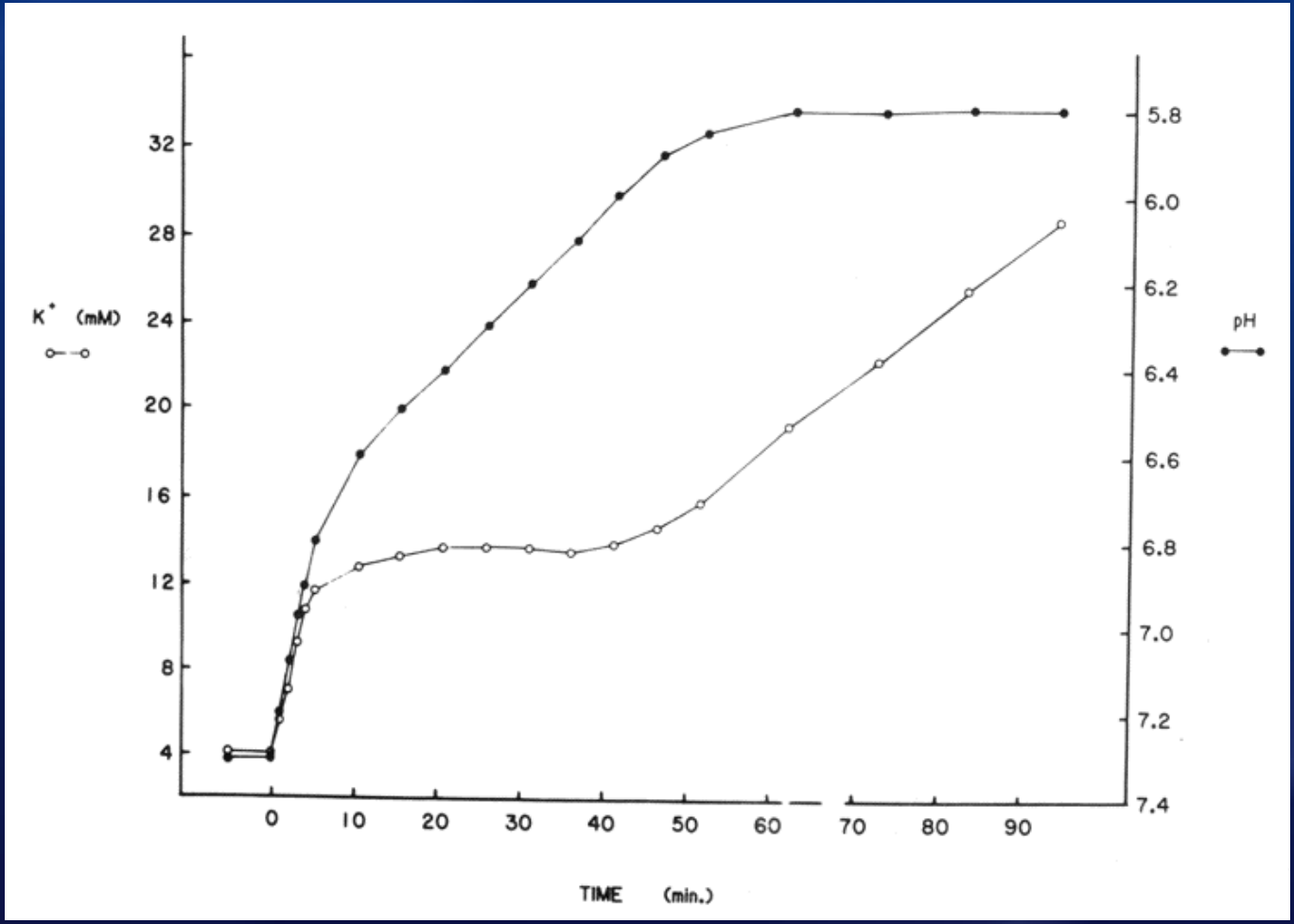


Dynamic ST/T changes with symptoms/resolution of symptoms are important

Kusumoto FM. Cardiovascular Pathophysiology Hayes Barton 1999

Ischemia leads to “localized hyperkalemia”



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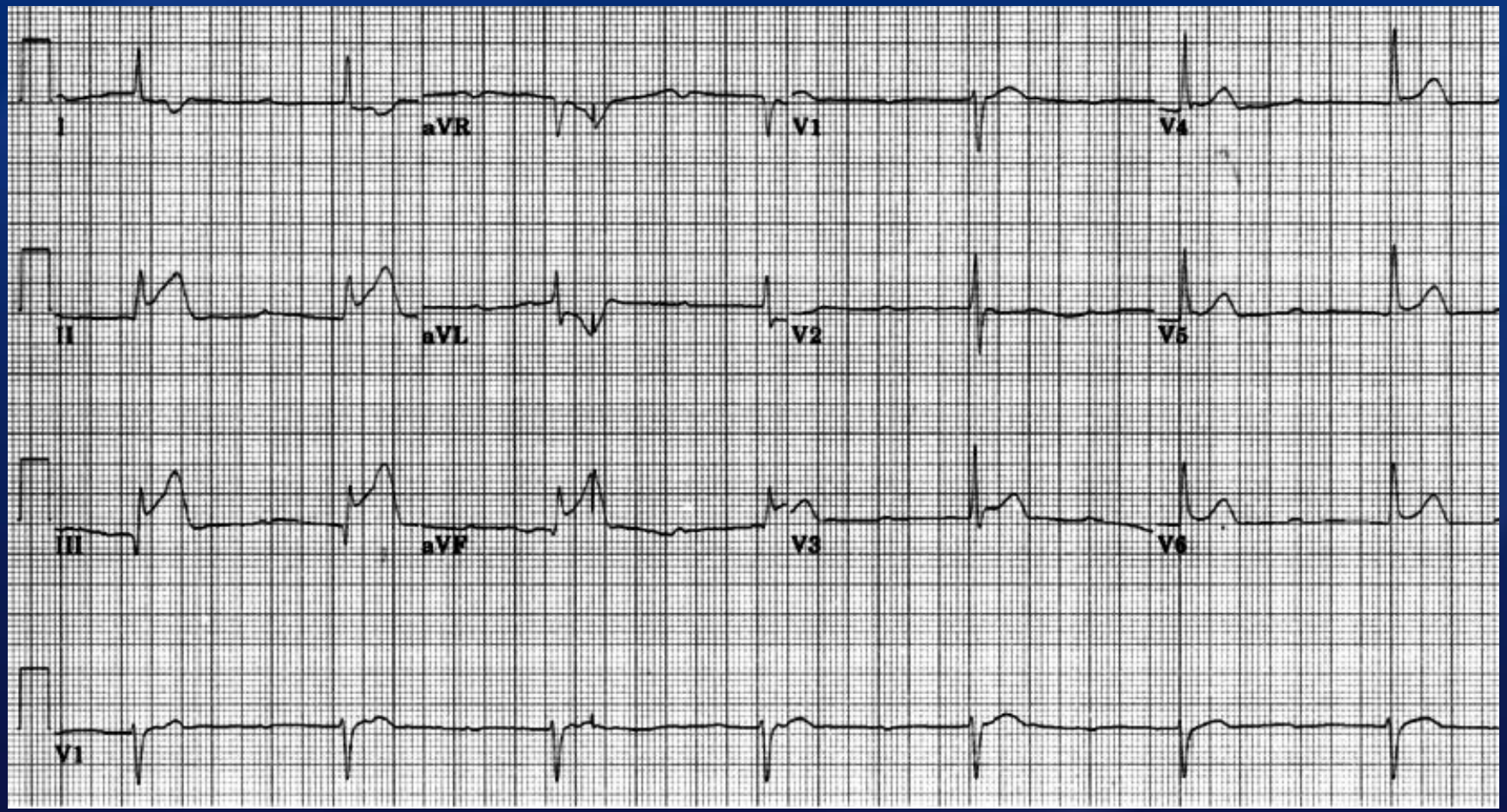
Case #2: 54 year old woman with 4 hours of chest pain presents in the ER



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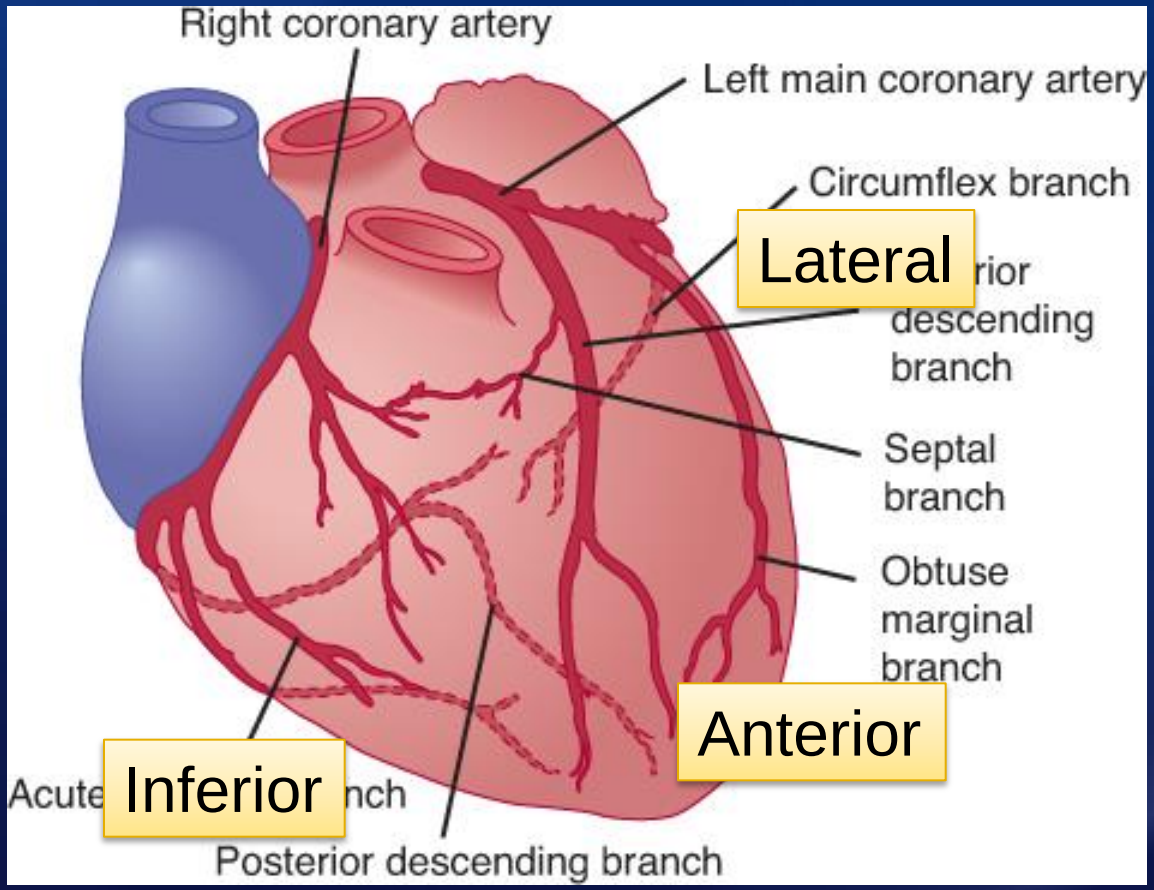
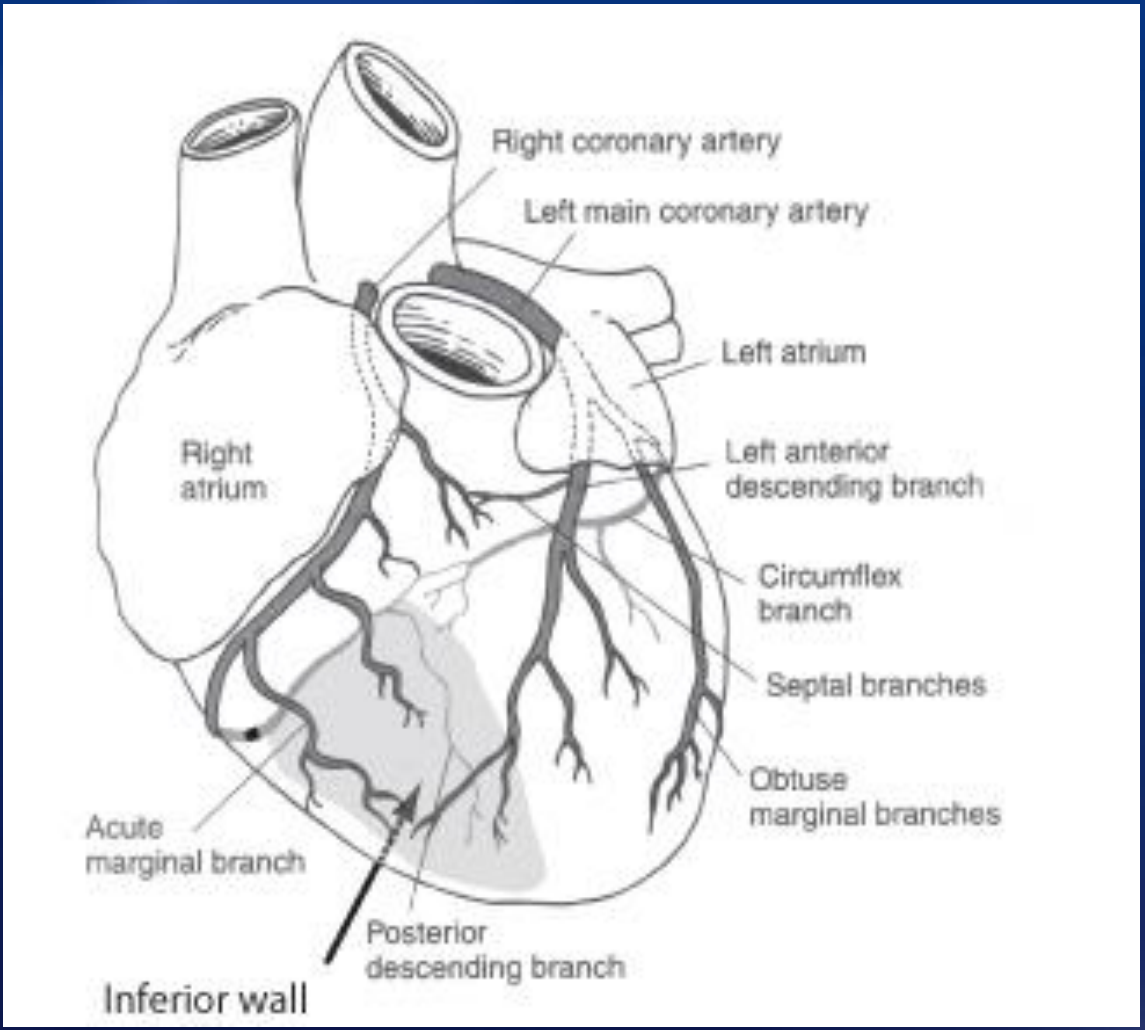
Regionalization/Localization of ST/T Changes (particularly ST segment elevation)



Kusumoto in McPhee Pathophysiology of Disease Lange 2013



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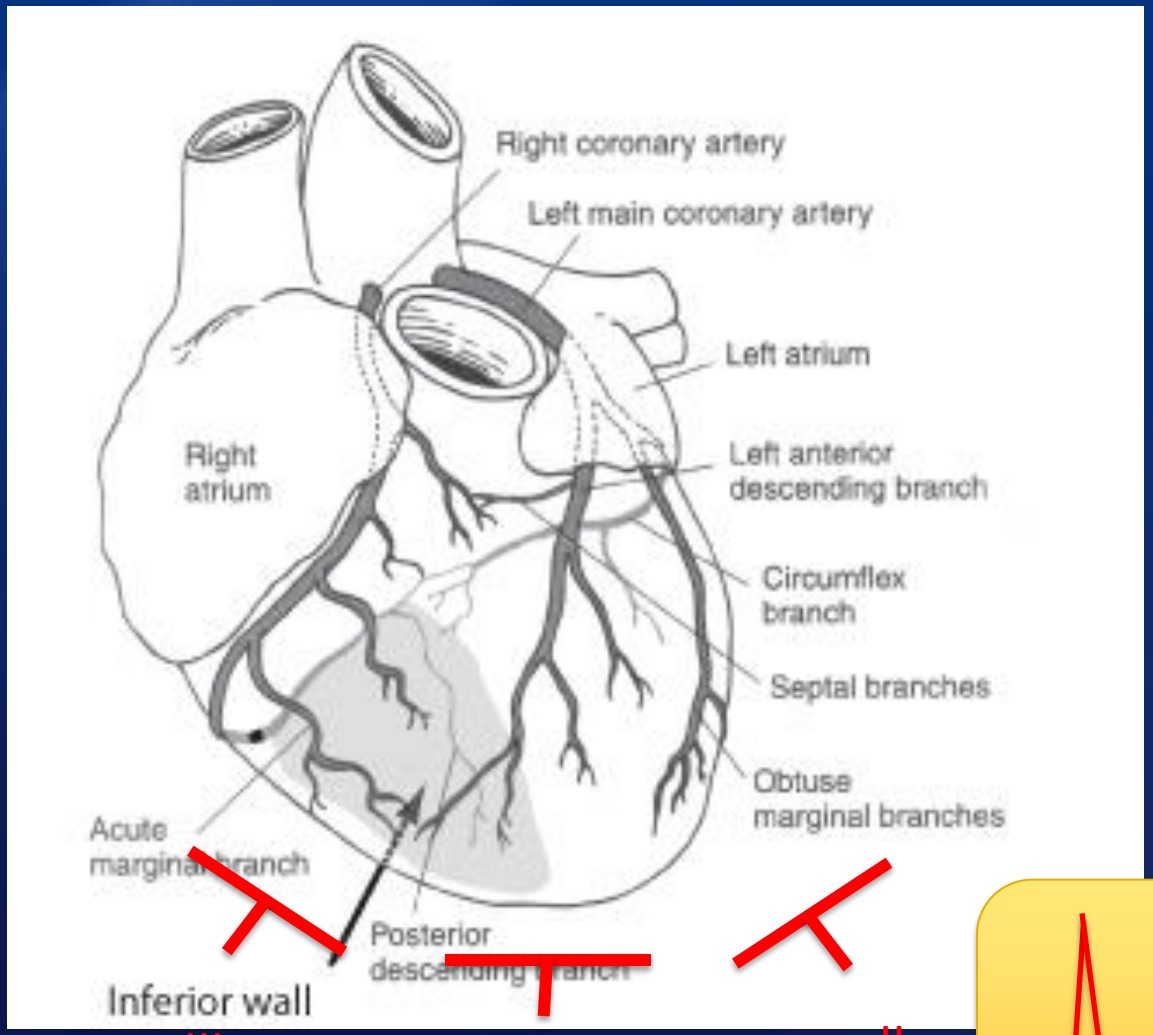
Bernath and Kusumoto. ECG Interpretation for Everyone 2011



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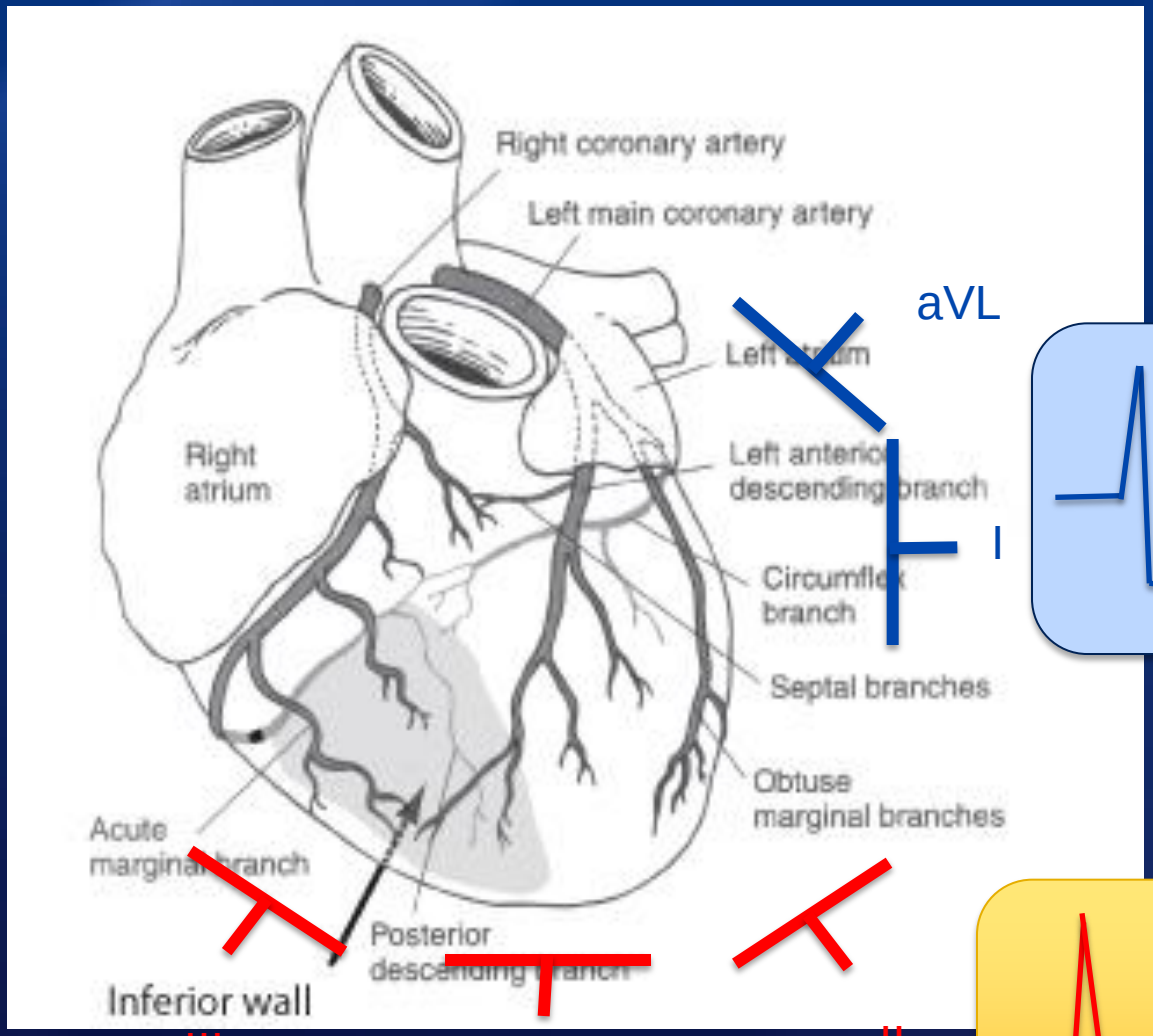

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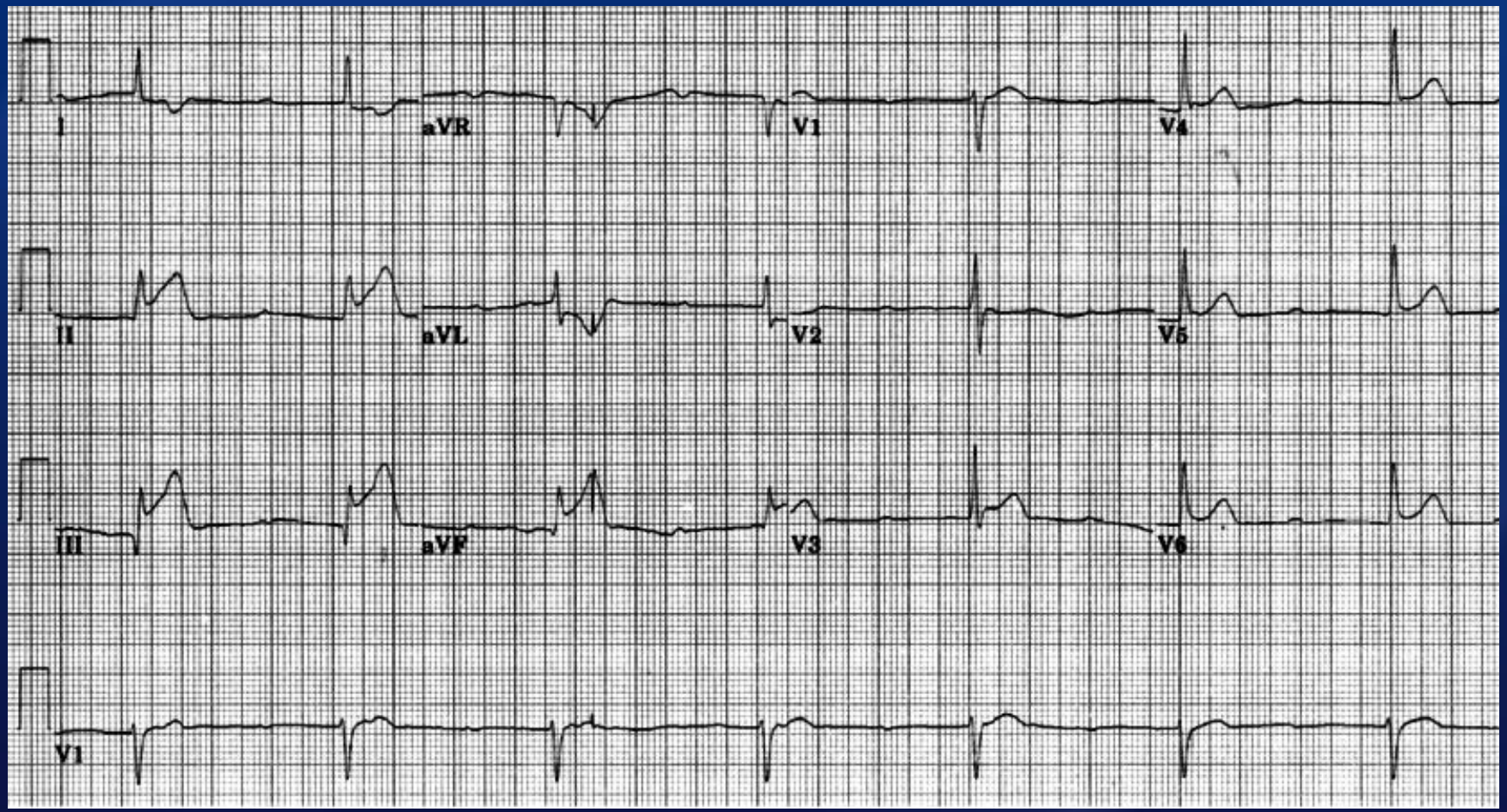

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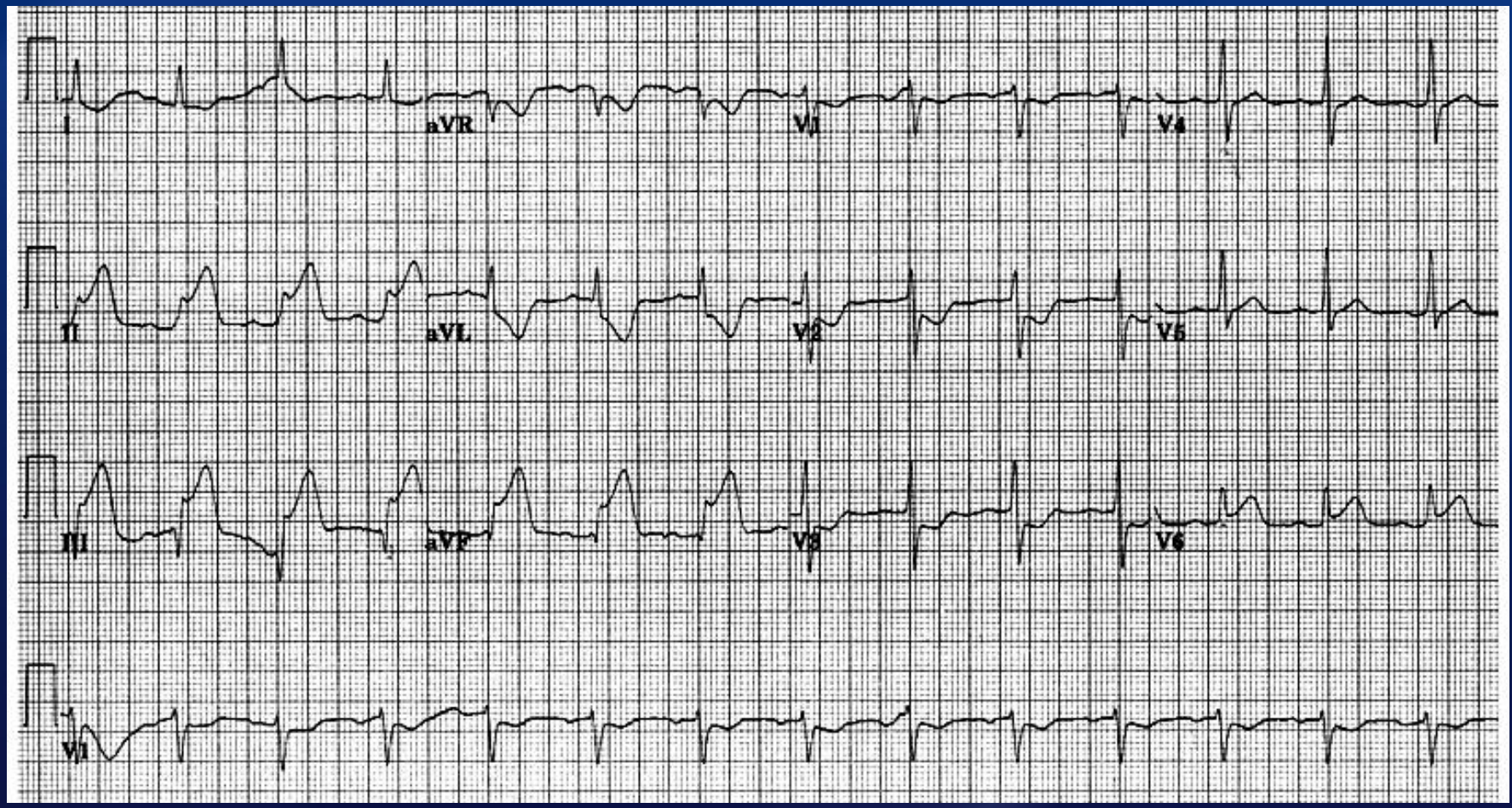
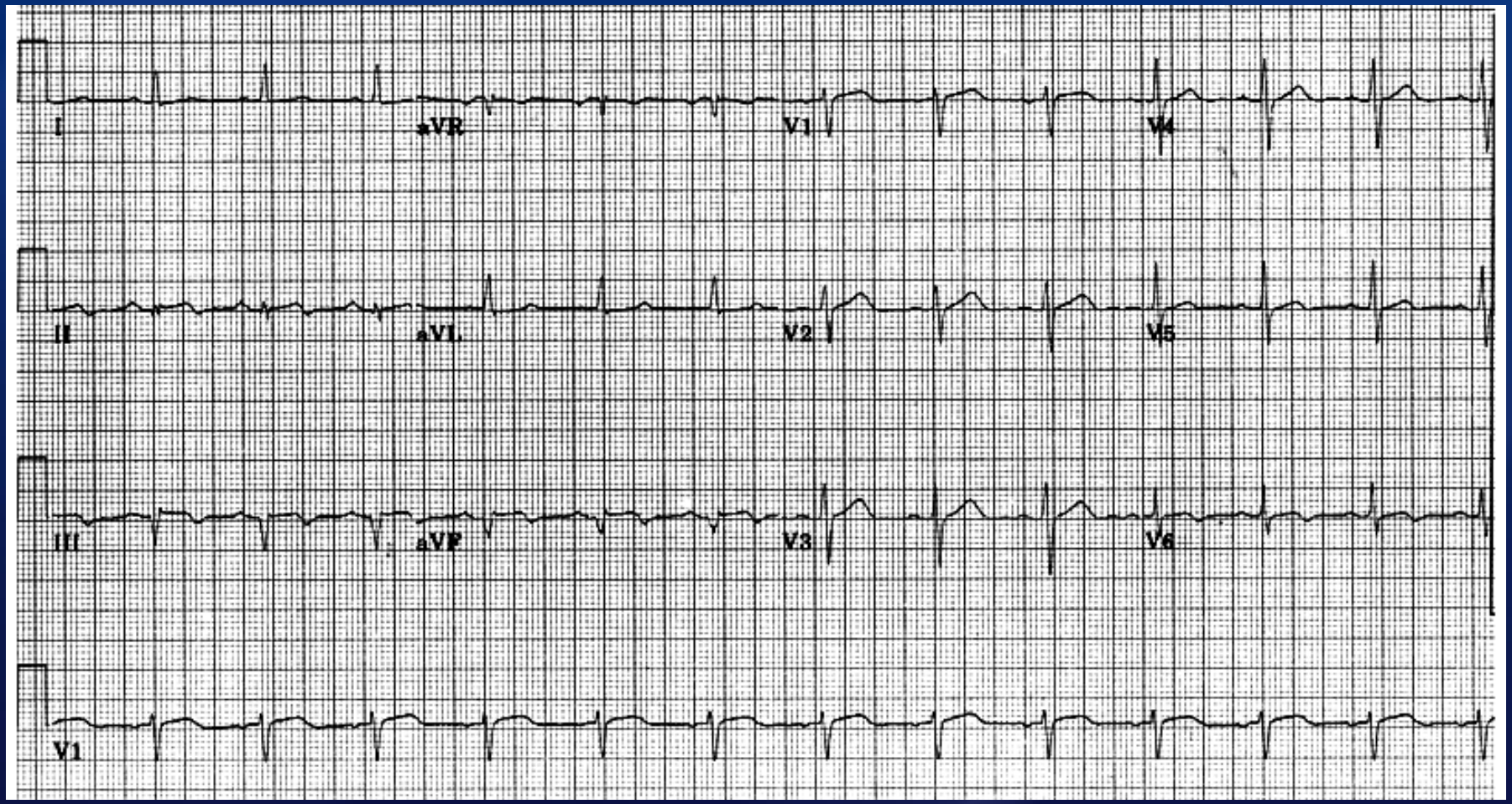
Case #2 (continued): Cardiac catheterization laboratory



Kusumoto FM and Bernath P, ECG Interpretation: for Everyone 2011

Case #2 (continued): Day #1



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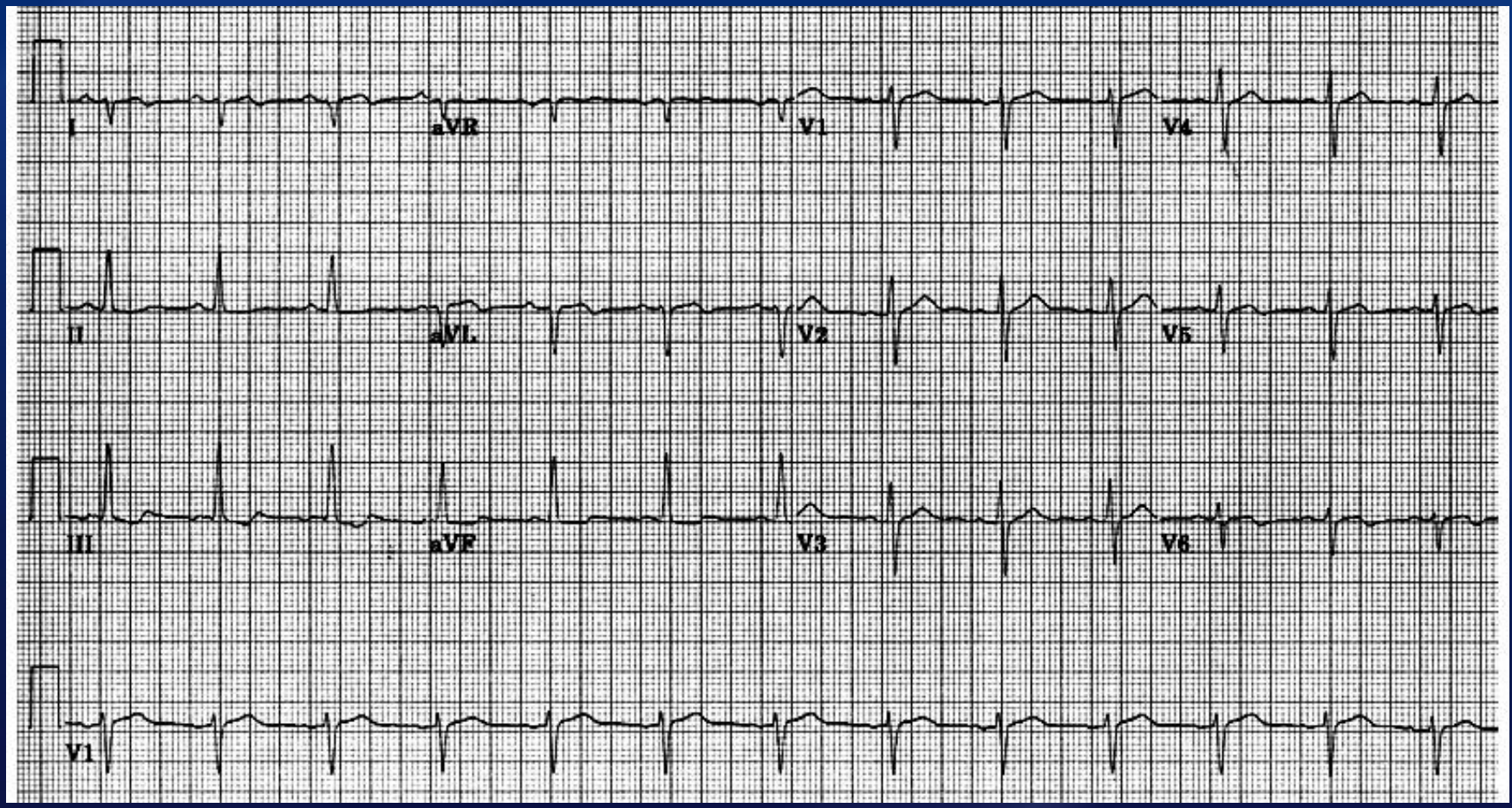
Case #2 (continued): Day #2



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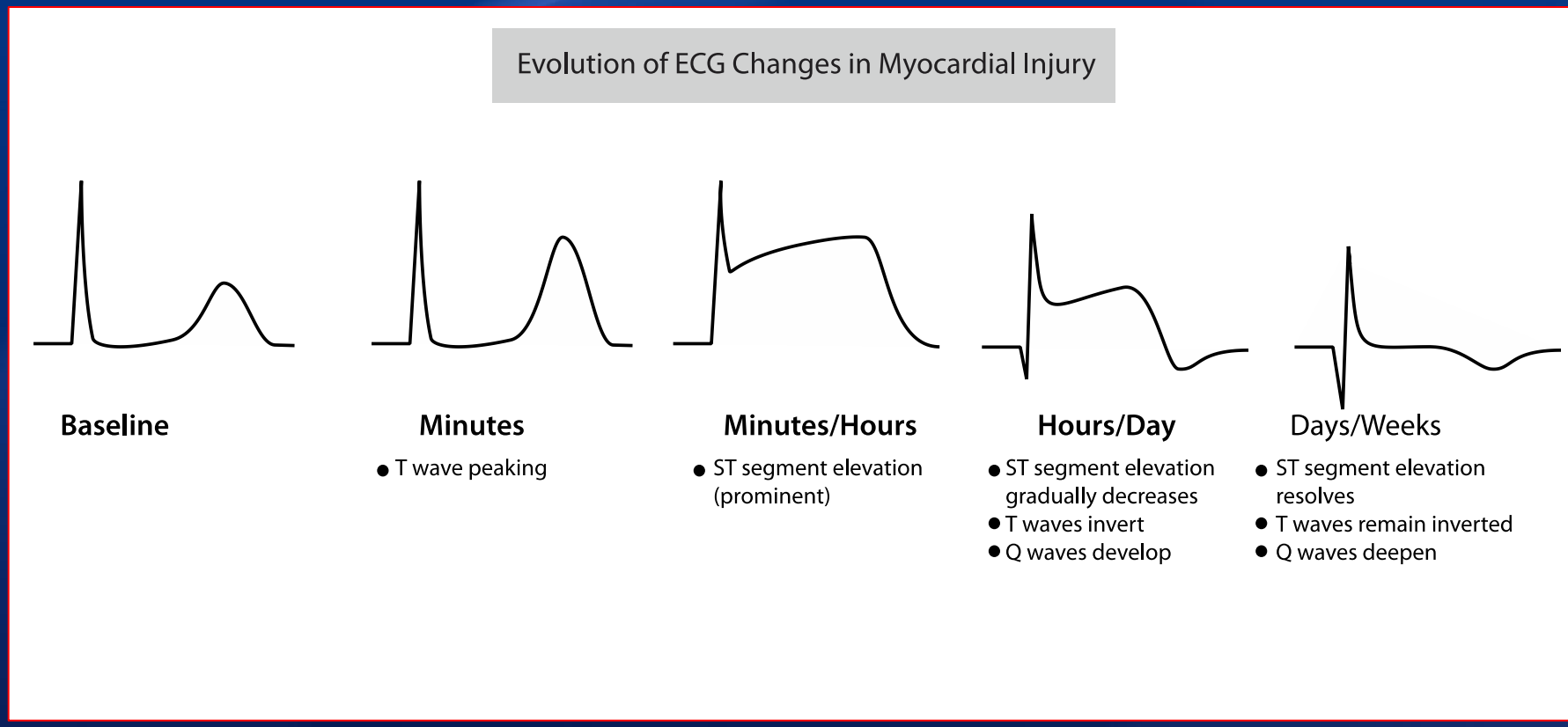

- *Dynamic Changes with symptoms*
- *Regionalization*
- *Reciprocal changes*

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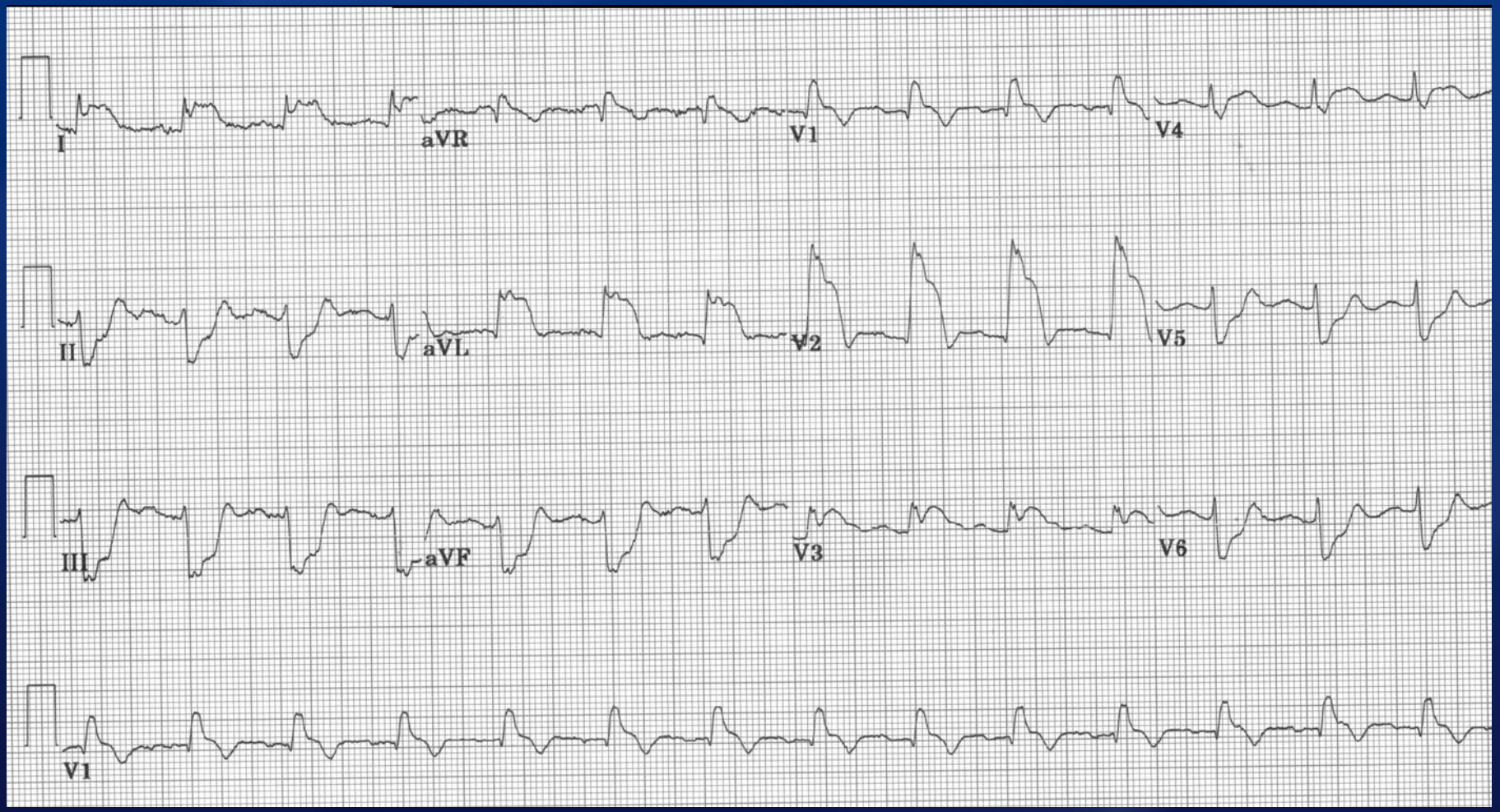
Bernath and Kusumoto. ECG Interpretation for Everyone 2011



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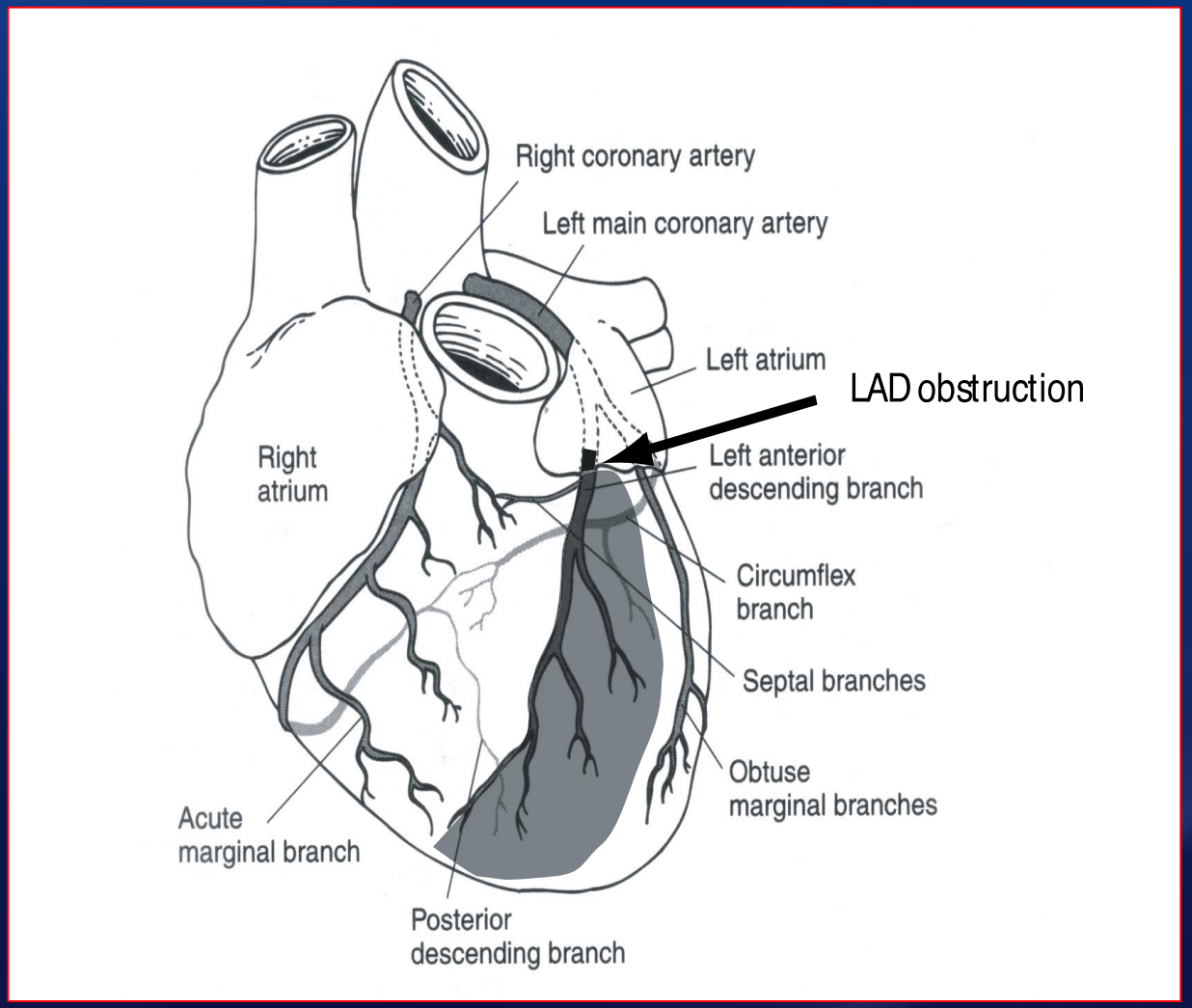
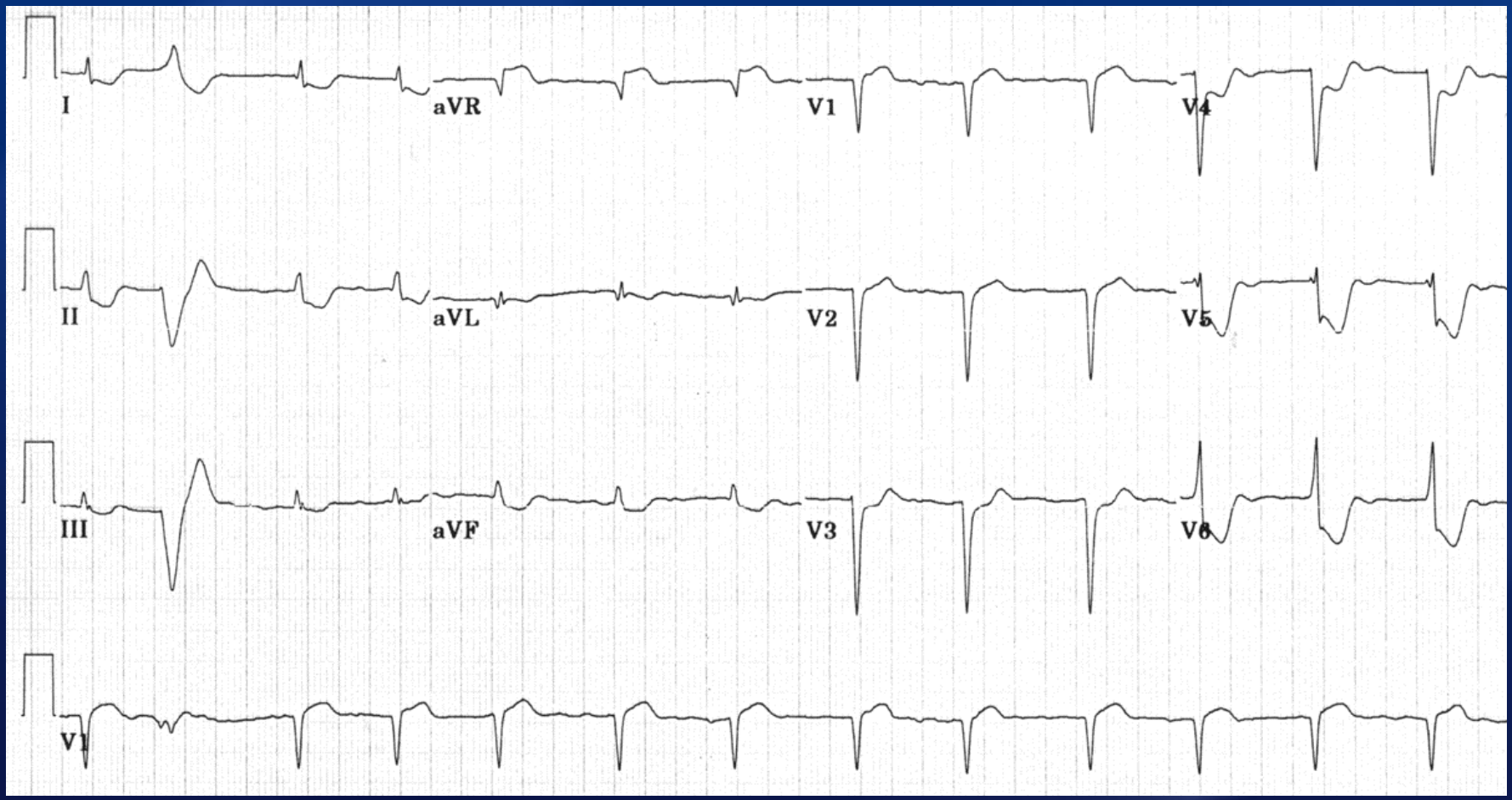


Kusumoto, ECG Interpretation: from Pathophysiology to Clinical Application 2009



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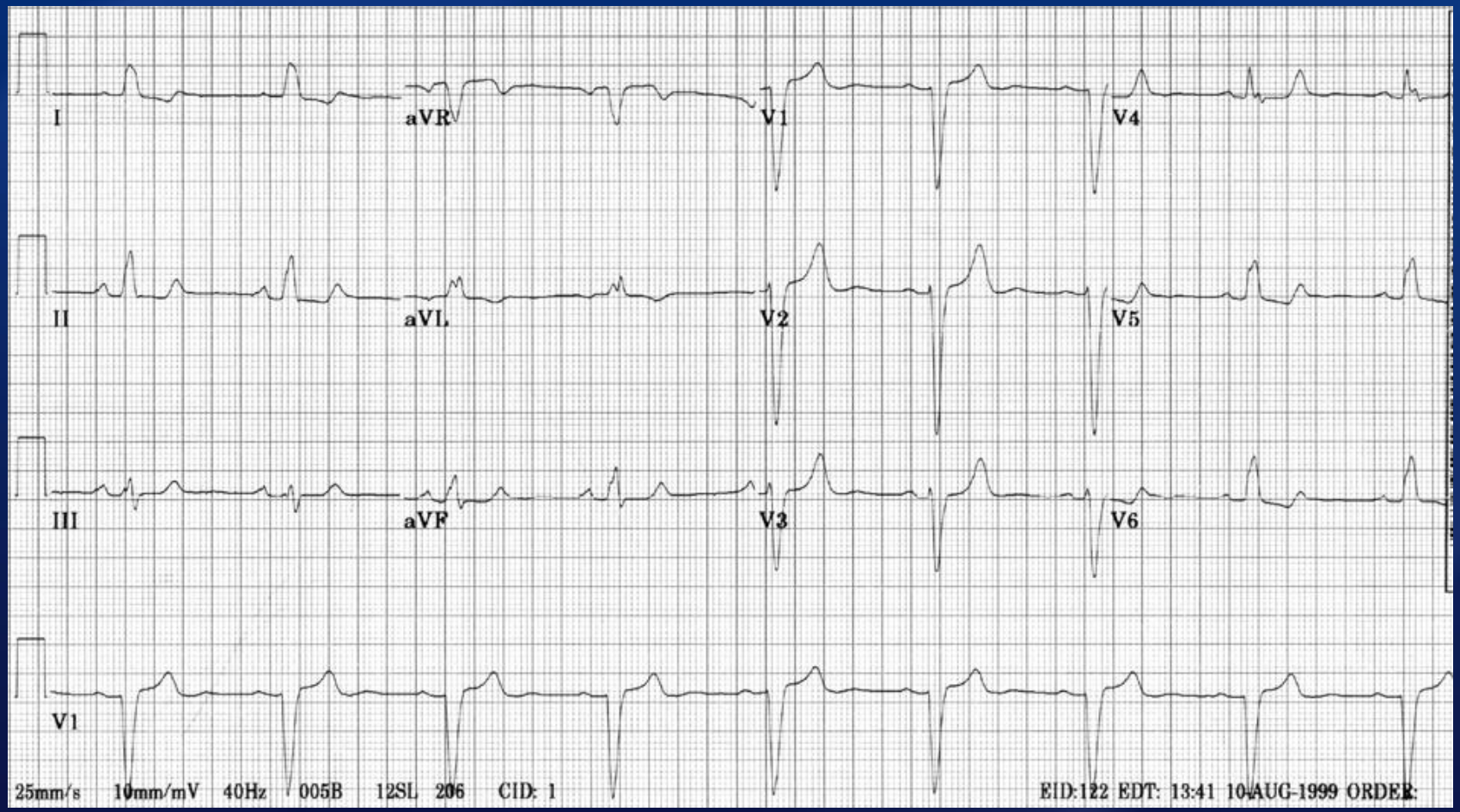

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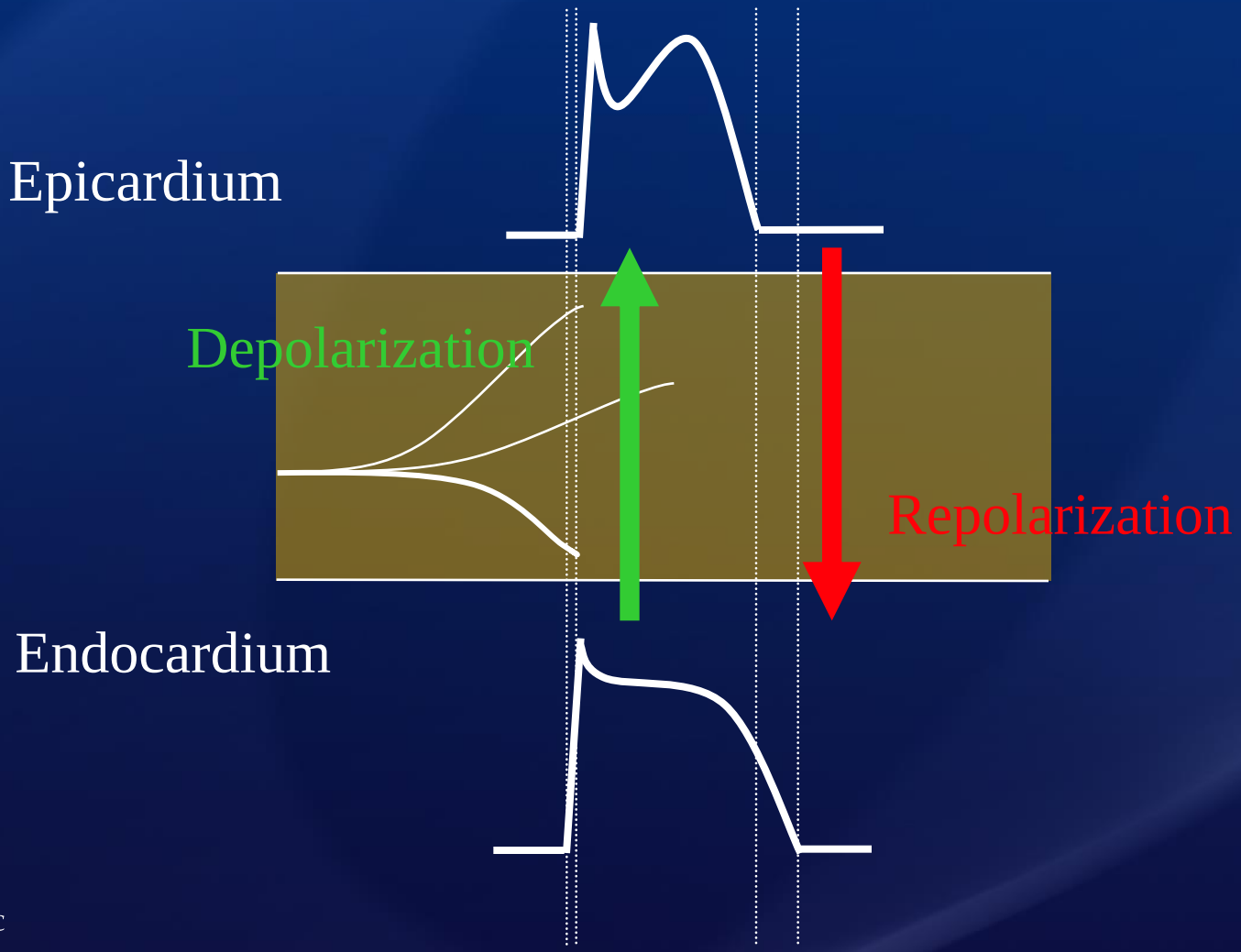
Kusumoto, ECG Interpretation: From Pathophysiology to Clinical Application 2009

“T wave follows the QRS complex” Electrophysiologic mechanism



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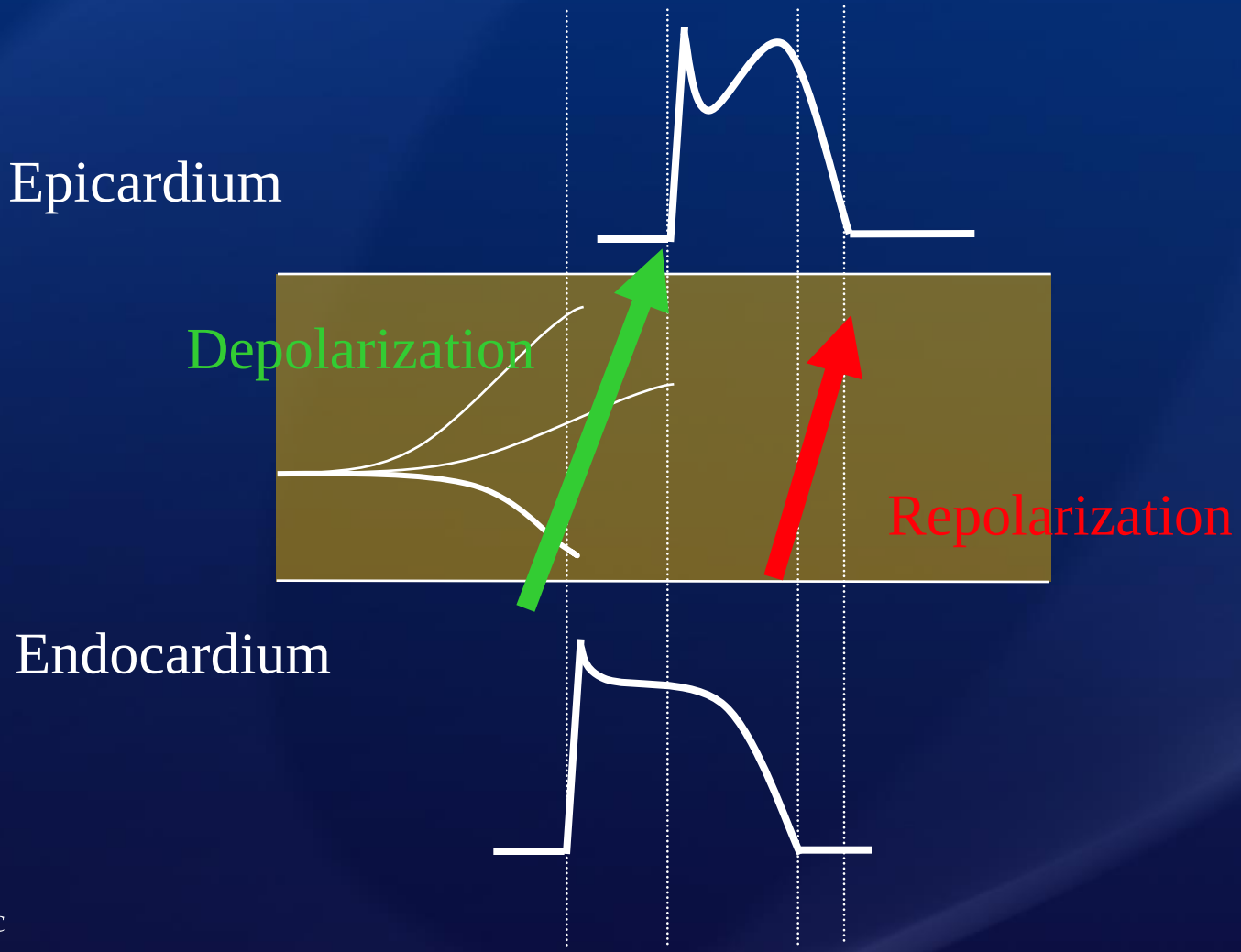
“In conduction block, the T wave is opposite the QRS complex”



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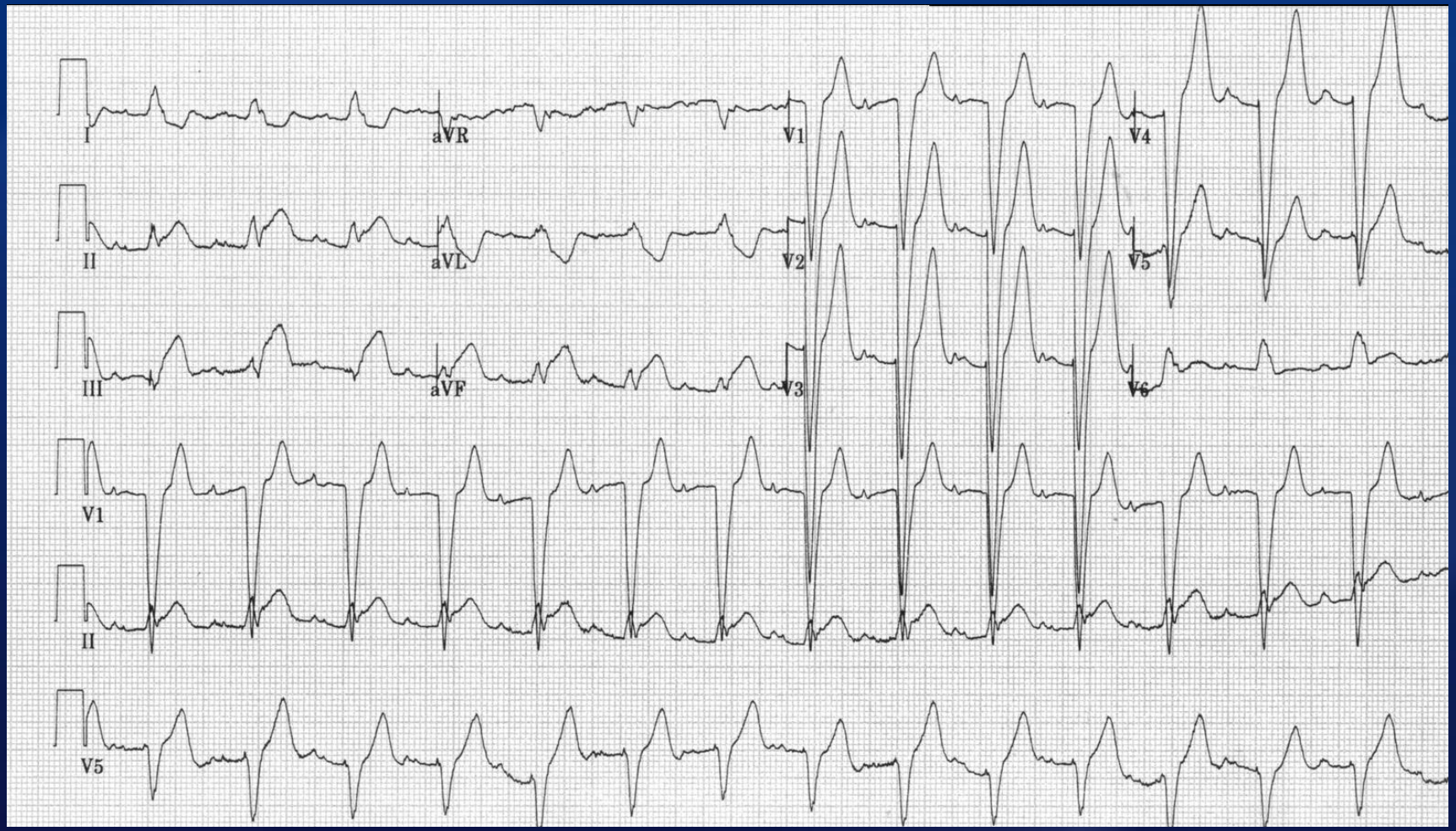

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Kusumoto, ECG Interpretation: From Pathophysiology to Clinical Application 2009

ST segment elevation

- Characteristic changes with myocardial ischemia/injury
  - Dynamic changes with Sx
  - Localization to a specific region of the heart
  - Always look for ST segment elevation first
  - Reciprocal changes
- "Fake-outs"

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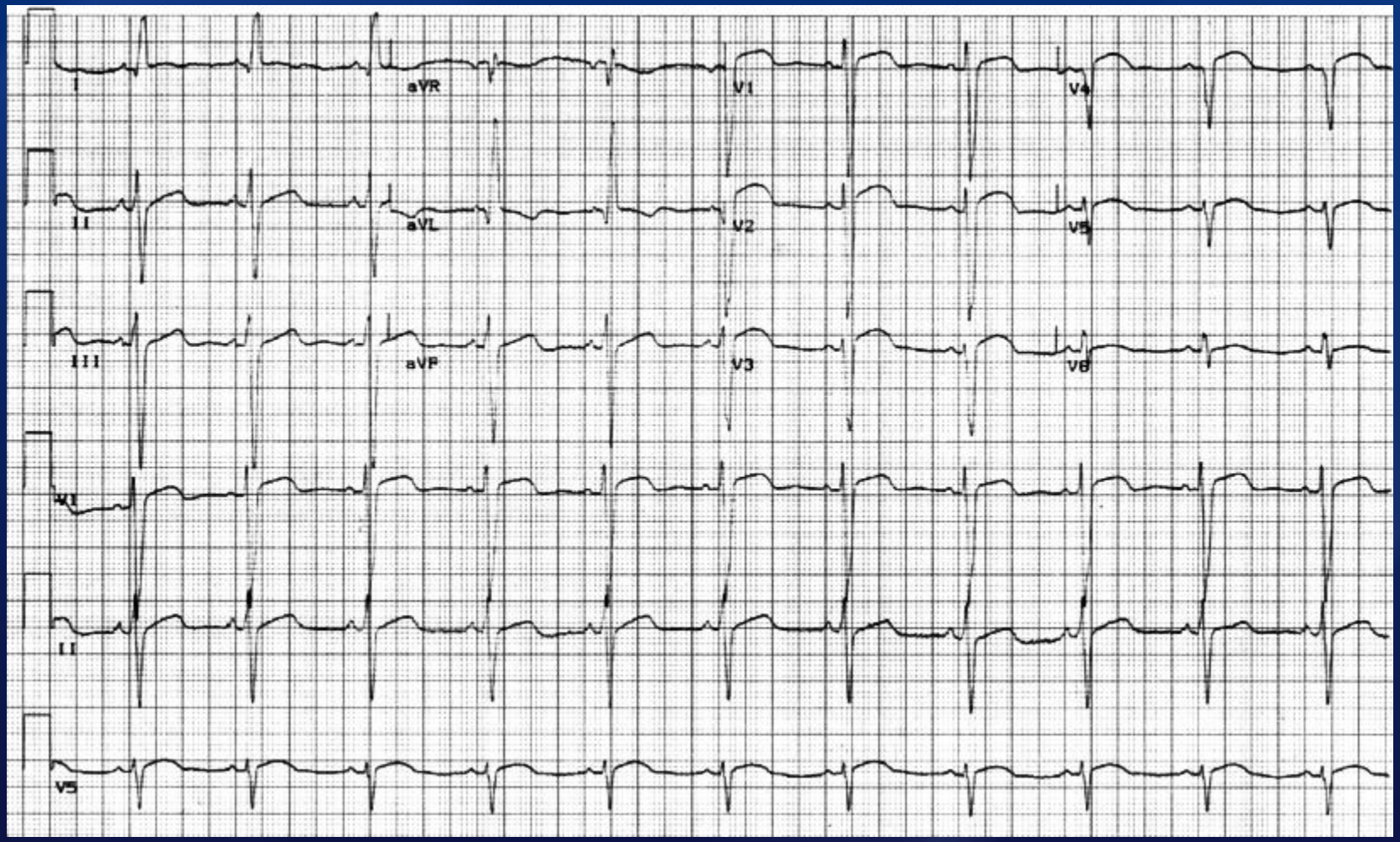
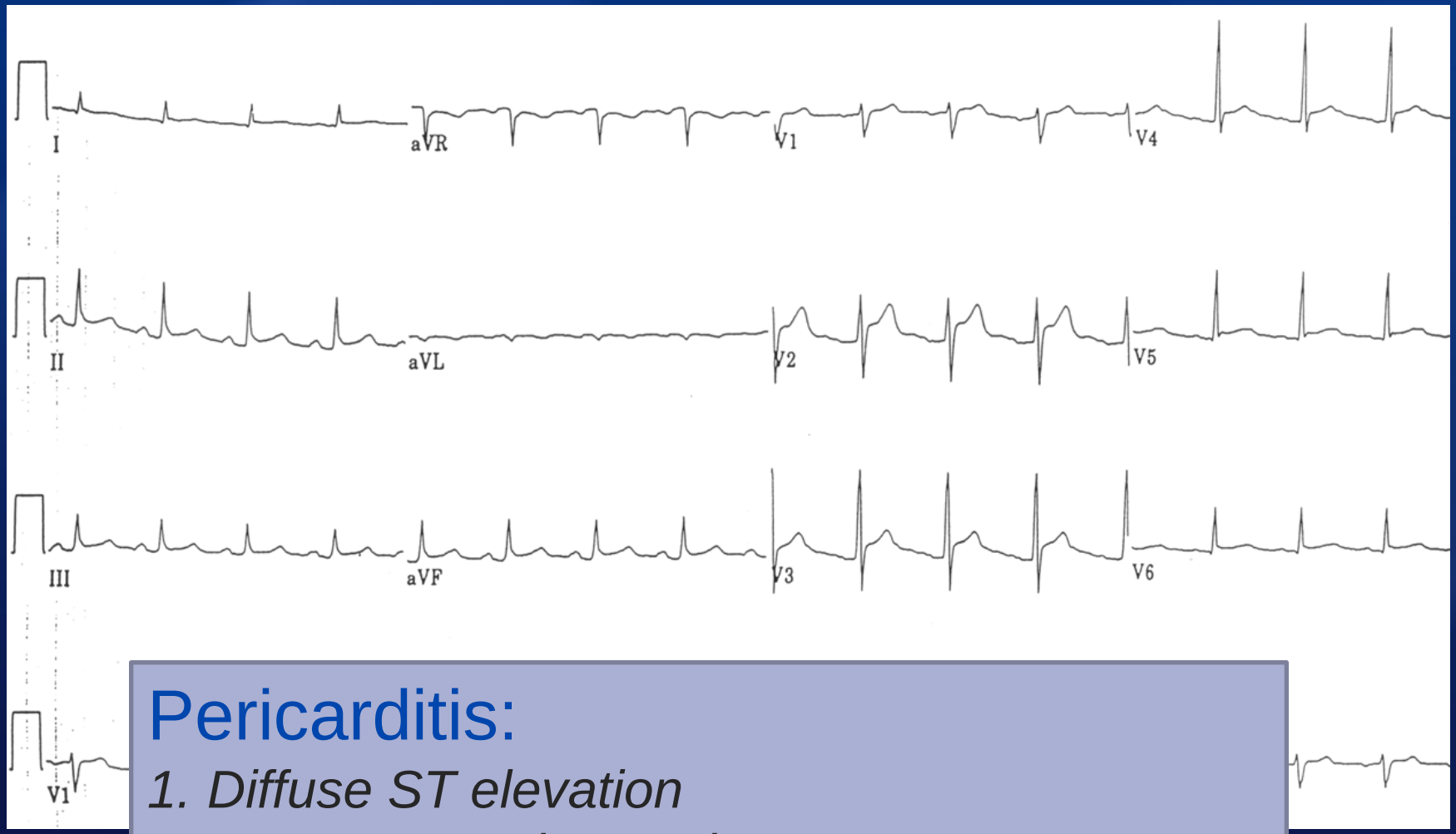
Case #3: 73 year old woman with a prior MI but no chest pain



Kusumoto, ECG Interpretation: From Pathophysiology to Clinical Application 2009



Pericarditis:

1. *Diffuse ST elevation*
2. *PR segment depression*
3. *No Q waves*
4. *aVR: PR segment elevation & ST depression*

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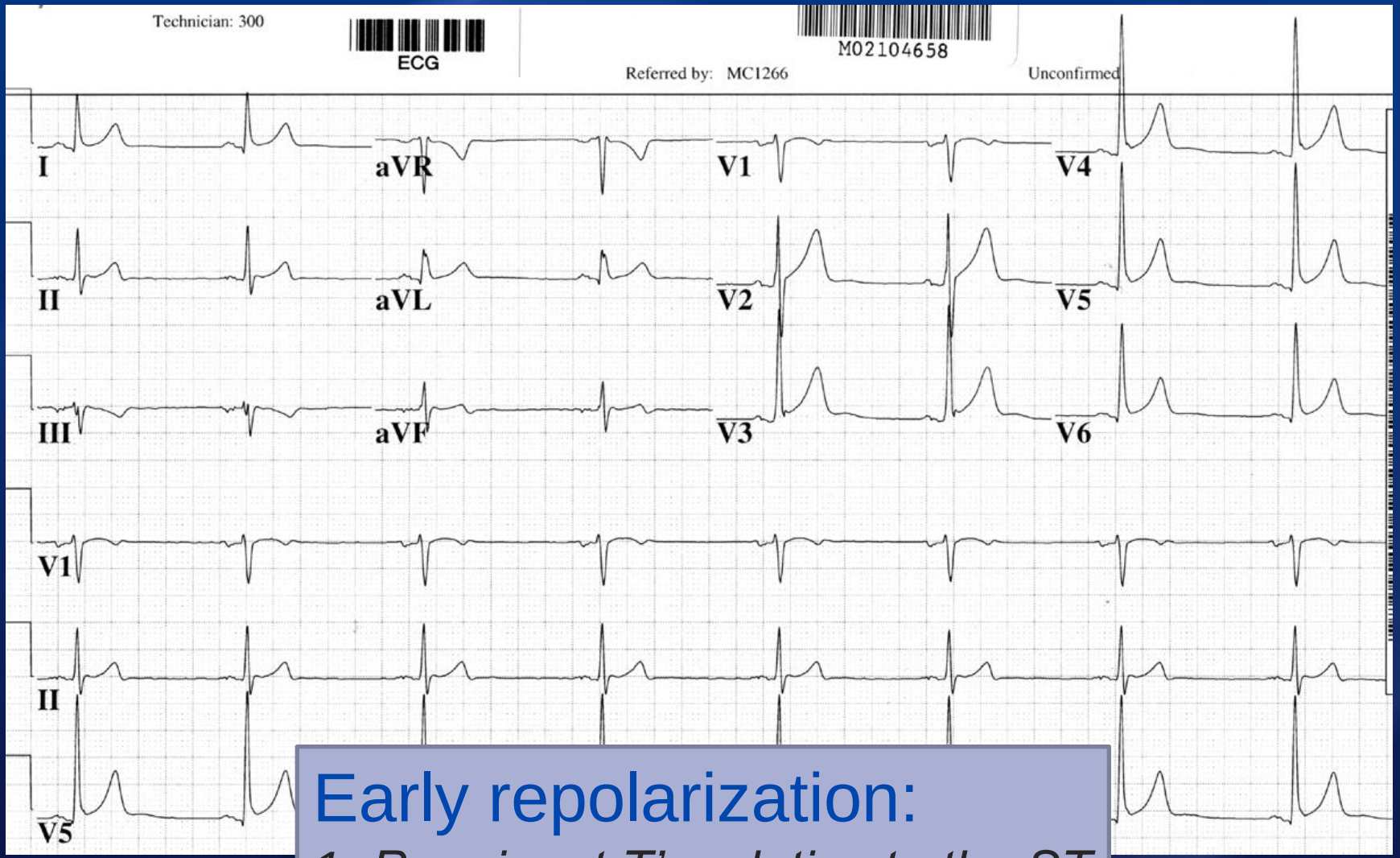
ation 2009



Early repolarization:

1. *Prominent T's relative to the ST*
2. *No reciprocal changes*
3. *No Q waves*

Kusumoto, ECG Interpretation: From Pathophysiology to Clinical Application 2009

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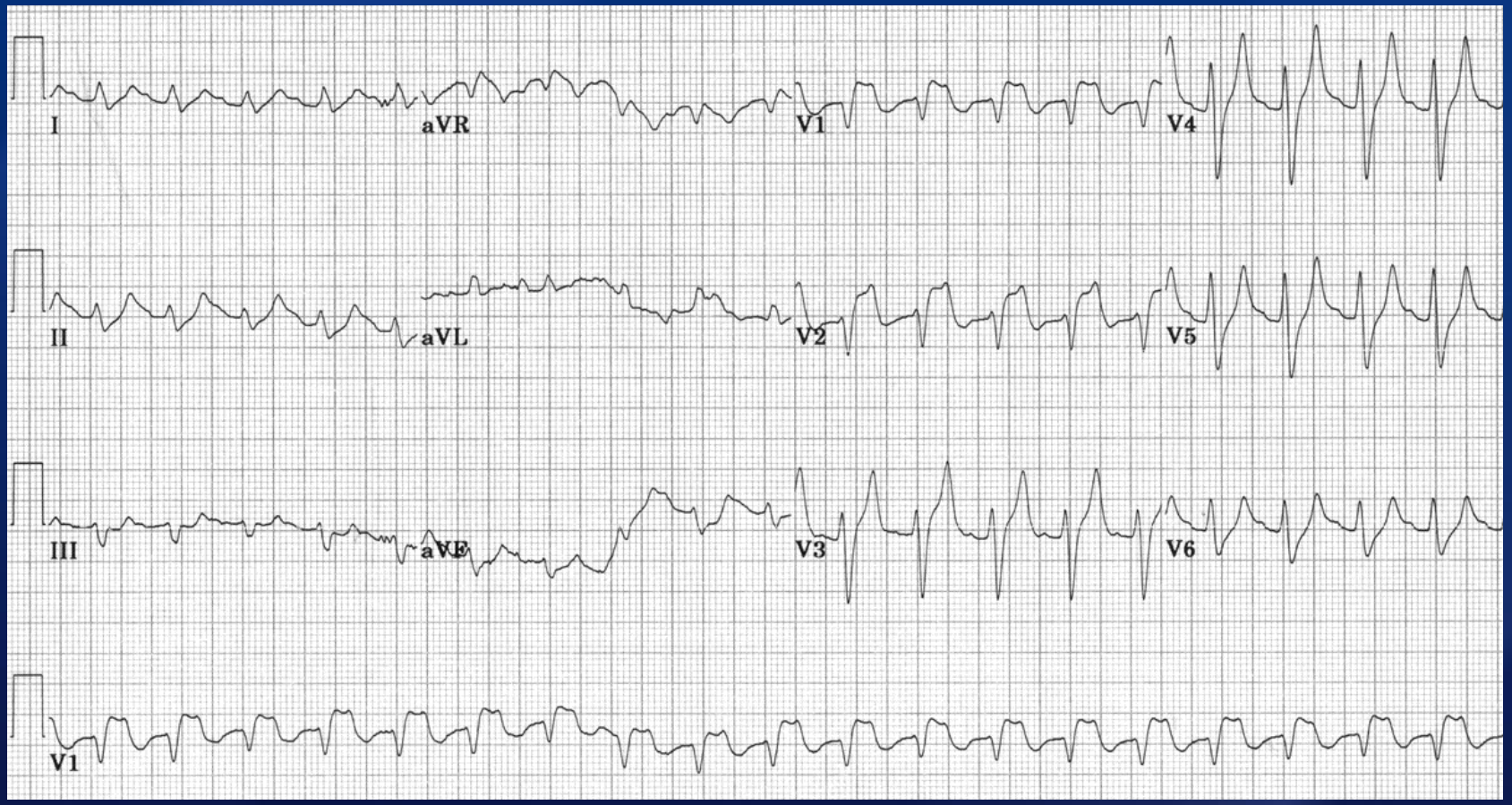

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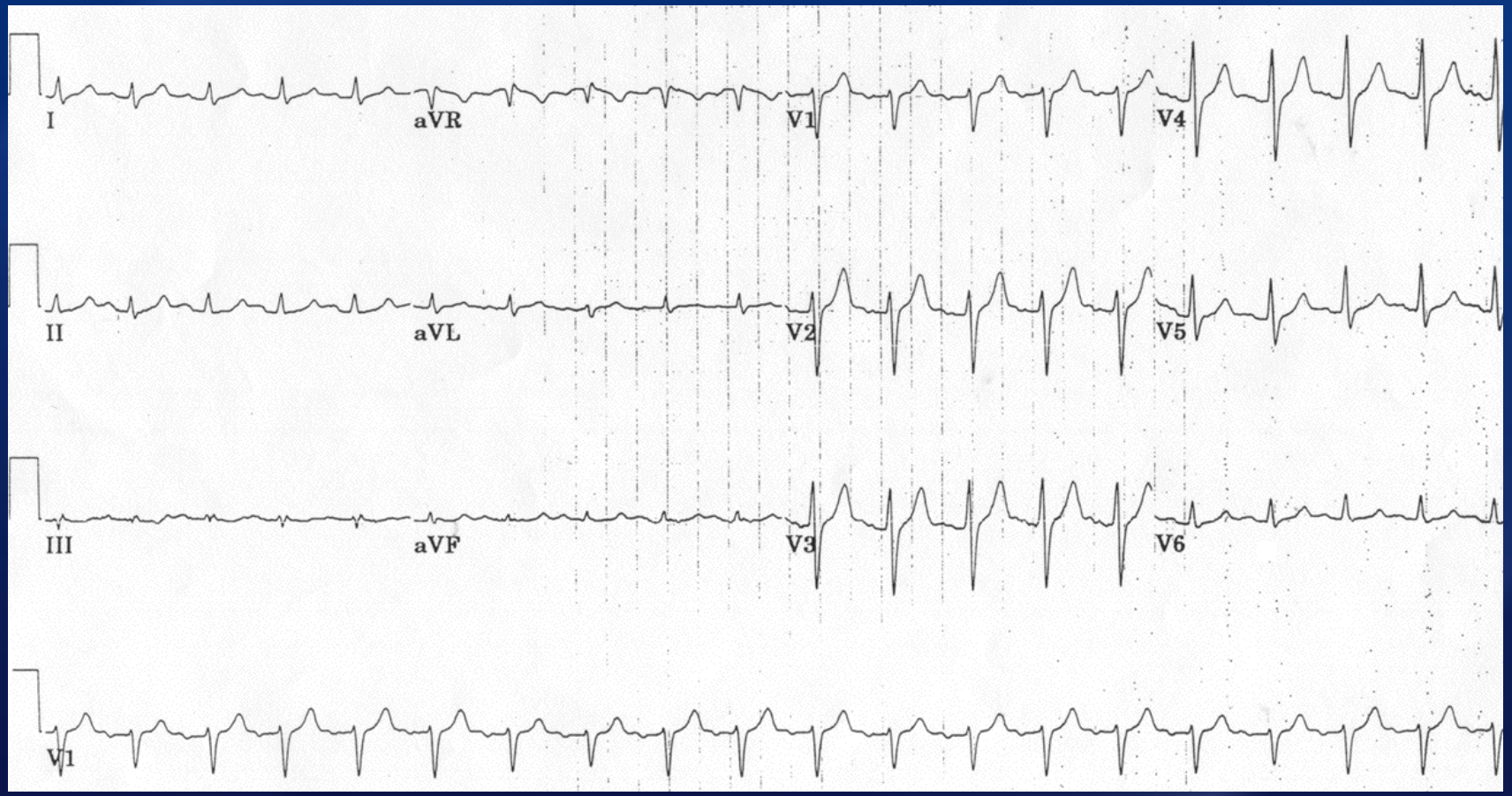


Kusumoto, ECG Interpretation: From Pathophysiology to Clinical Application 2009

Non-infarction causes of ST segment elevation

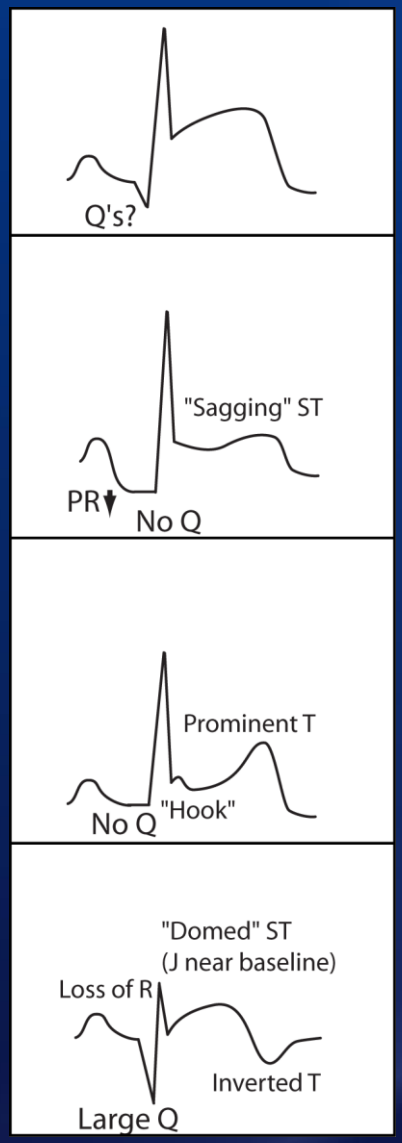
- Cardiac
  - Bundles (Pacing), early repolarization
  - Aneurysm
  - Coronary artery Spasm (Printzmetal's angina)
  - Pericarditis
  - Brugada Syndrome
  - LVH
- Noncardiac
  - Metabolic: Hyperkalemia, Hypercalcemia
  - Pneumothorax

Myocardial injury

Pericarditis

Early repolarization

Aneurysm



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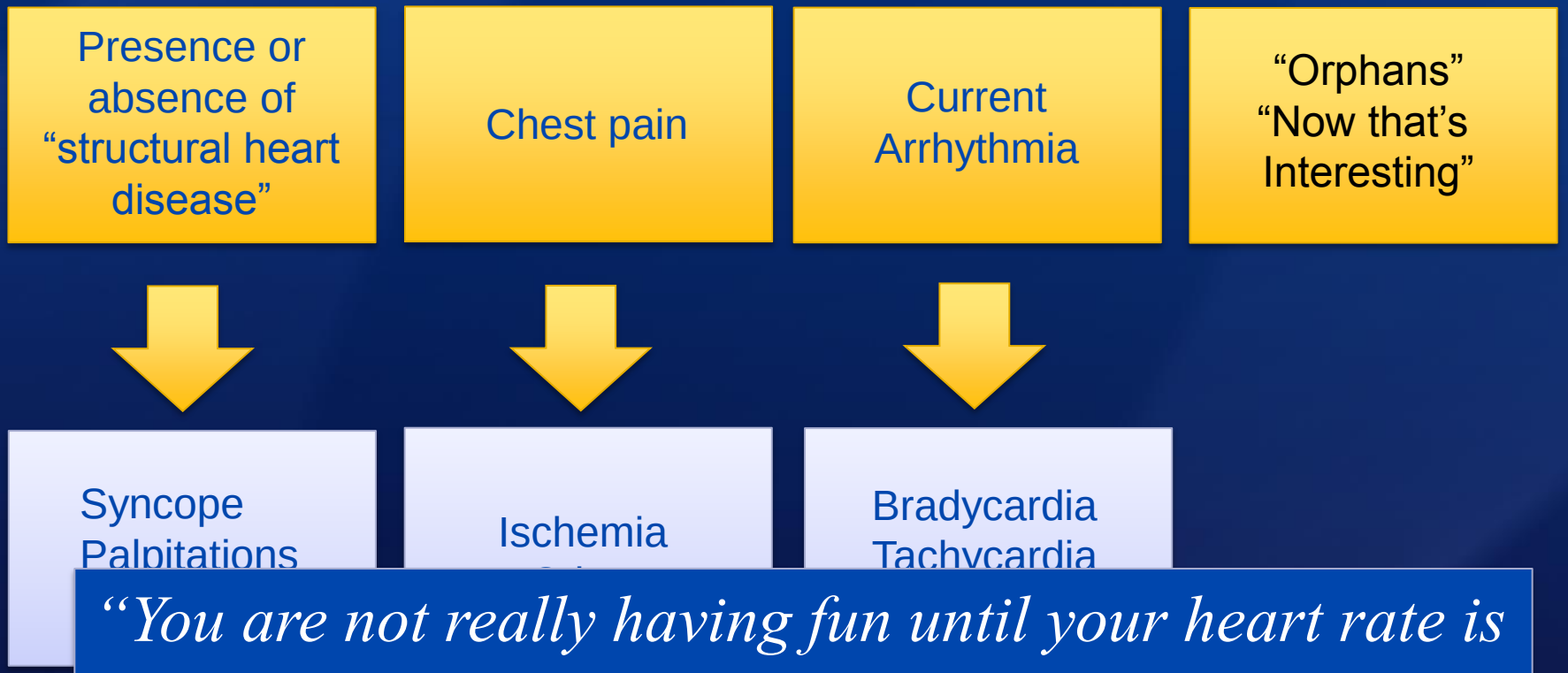
Clinical Use of the ECG



"You are not really having fun until your heart rate is twice normal"

Keith Oken, 2nd Yr Medicine Resident UCSF

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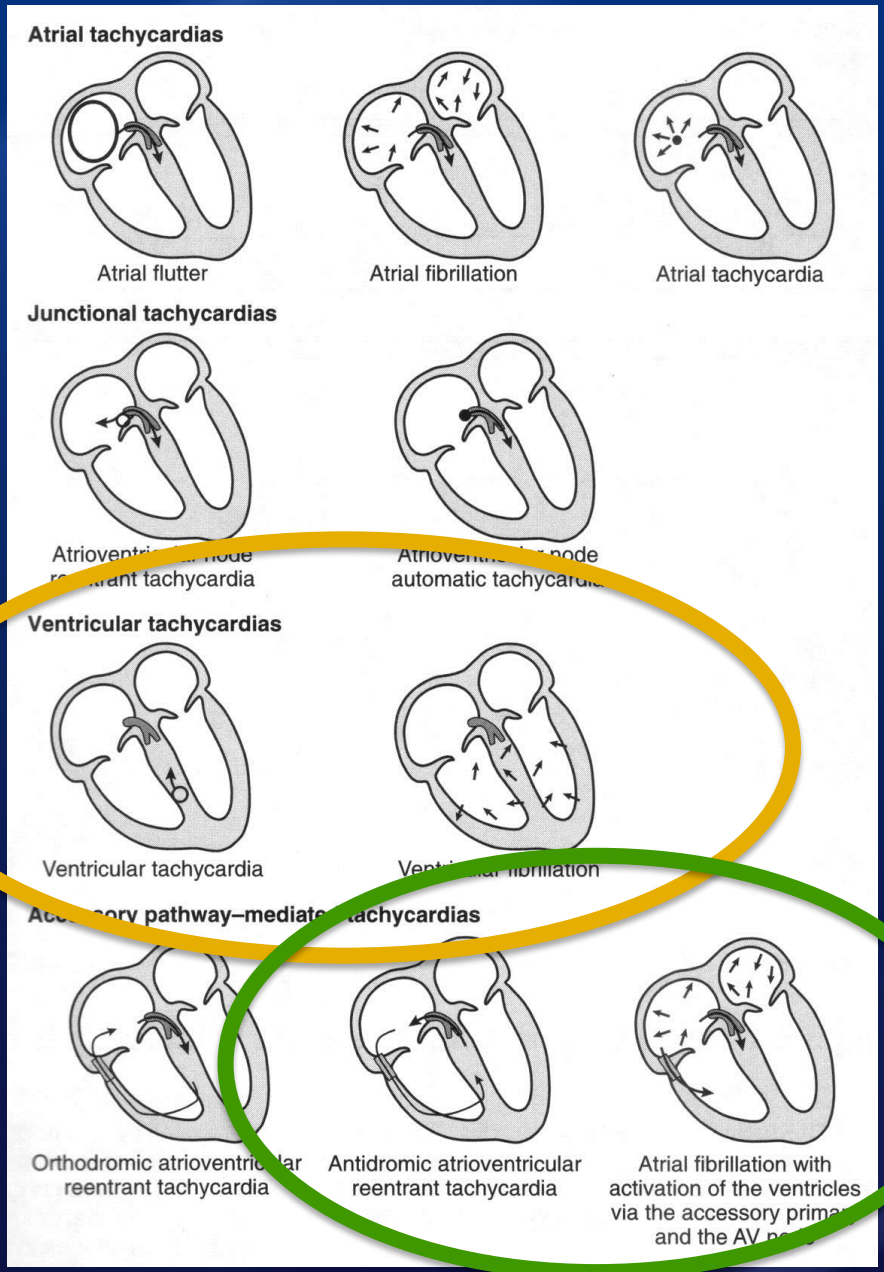
Wide Complex Tachycardia (Only four kinds of tachycardia)



SVT with aberrancy

VT

Anterograde AP conduction

Kusumoto FM, Cardiovascular Pathophysiology Hayes Barton Press 2004

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Causes of WCT

- Ventricular tachycardia
- SVT with aberrant conduction
- Anterograde AP conduction
- Ventricular pacing
- (Metabolic)

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Causes of WCT

- Ventricular tachycardia 81%
- SVT with aberrant conduction 14%
- Anterograde AP conduction 5%
- Ventricular pacing 0
- (Metabolic) 0

Of the patients with VT:

- VT 32%

Ahktar's Rule: "Do you have Heart Disease?" or "Have you had a Heart Attack?"

Ahktar et al Ann Int Med 1988

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ECG evaluation of WCT

- “Homan’s signs”
- A-V relationship
- QRS morphology
- Algorithms

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ECG evaluation of WCT

- "Homan's signs"
  - Rate, regularity
  - Axis ("Northwest" Axis)
  - QRS width ("Wider QRS α Disease")
- A-V relationship
- QRS morphology
- Algorithms

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ECG evaluation of WCT

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ECG evaluation of WCT

- "Homan's signs"
- A-V relationship
  - Use a wide angle lens
  - Initiation?
  - Look for AV dissociation, not AV association"
- QRS morphology
- Algorithms

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ECG evaluation of WCT

- "Homan's signs"
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  - Use a wide angle lens
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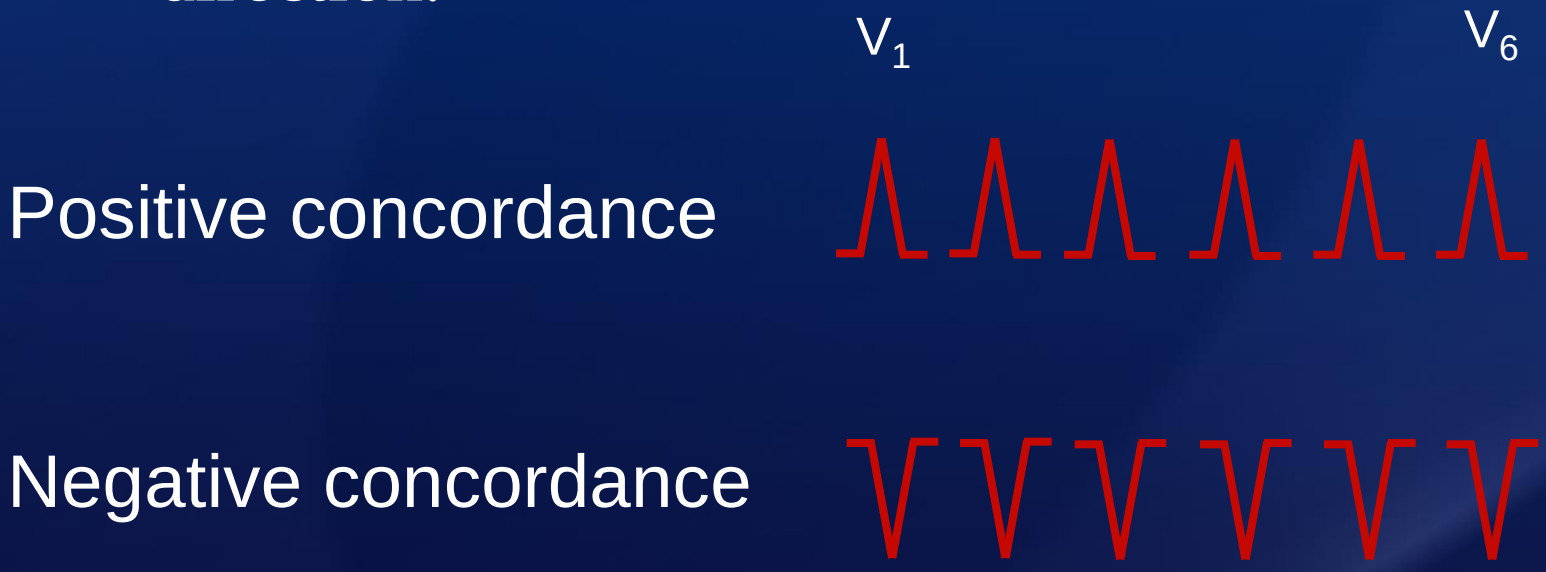
Concordance

- Precordial QRS complexes all in the same "direction."



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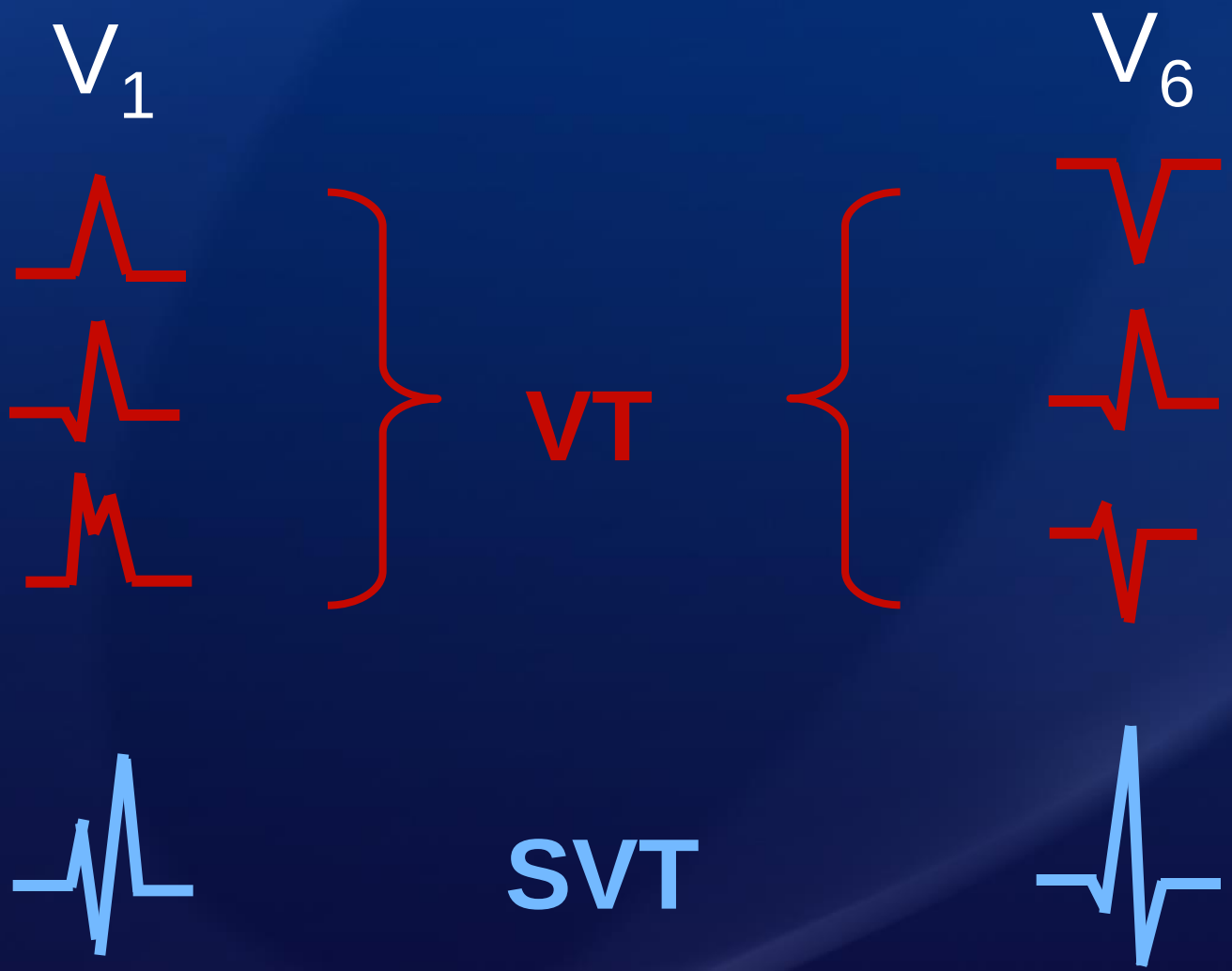
“RBBB Morphology”



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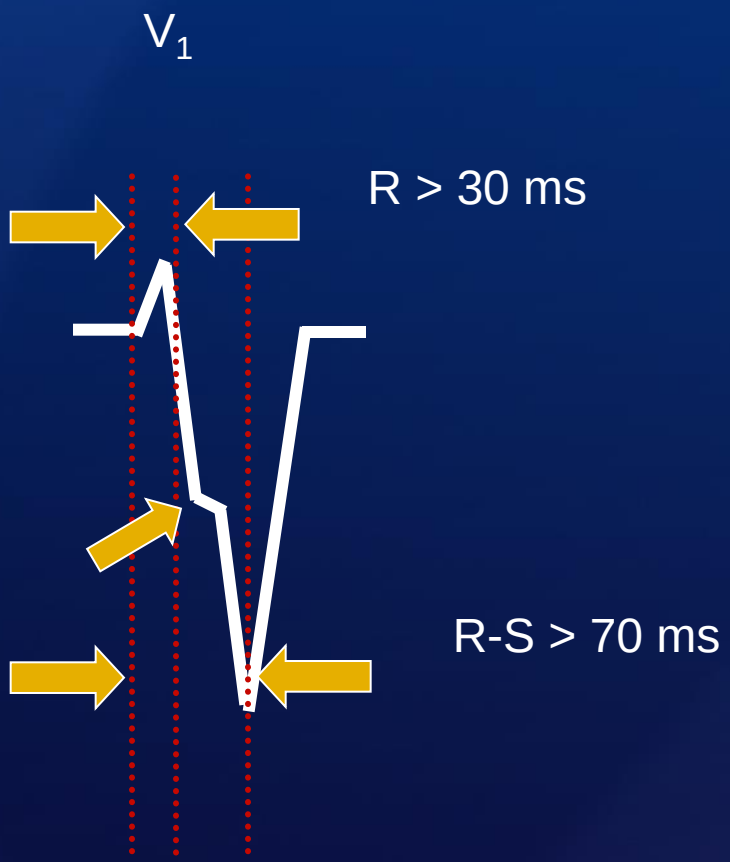
“LBBB morphology”



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ECG evaluation of WCT

- "Homan's signs"
- A-V relationship
- QRS morphology
  - Concordance
  - "plump" initial deflection
  - "Aberrancy looks like aberrancy"
- Algorithms

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What to do?
"A practical approach?"

- Pretest probability
- AV Dissociation
- QRS morphology (aberrancy looks like aberrancy):
  - Concordance
  - Positive in aVR
  - "Plump" initial activation
- Acknowledge shortcomings, treat acutely as VT, EPS?

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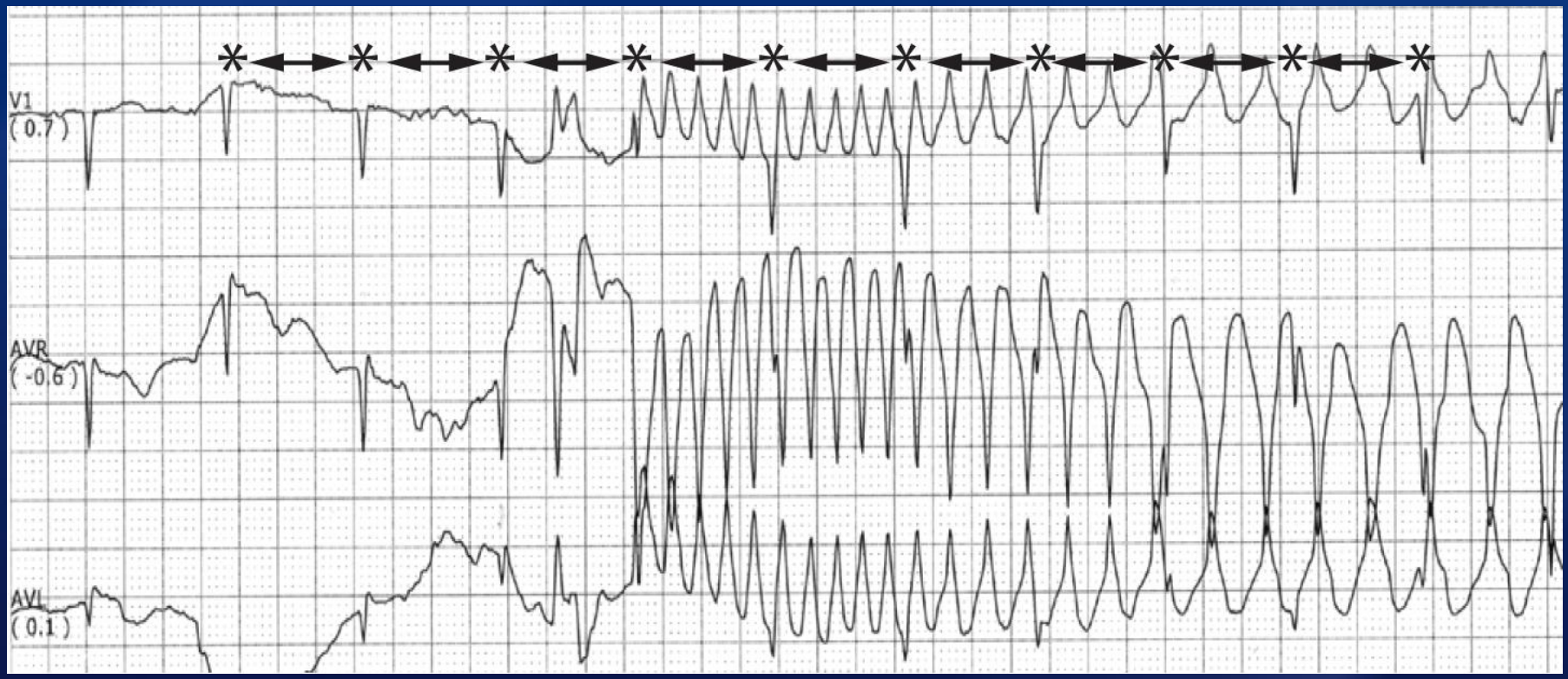

Bernath P and Kusumoto FM. ECG Interpretation on the Spot. Wiley and Sons 2011

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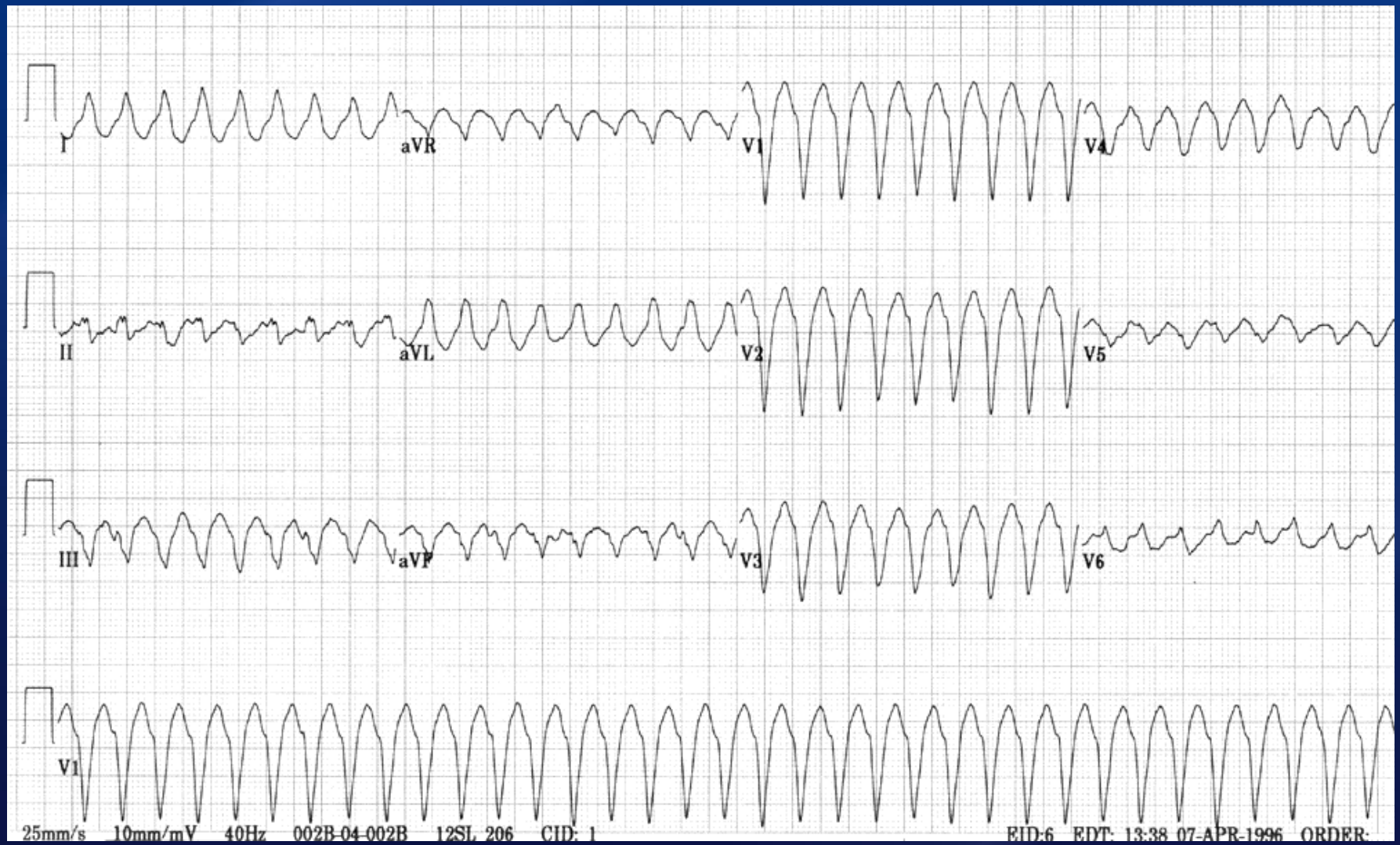

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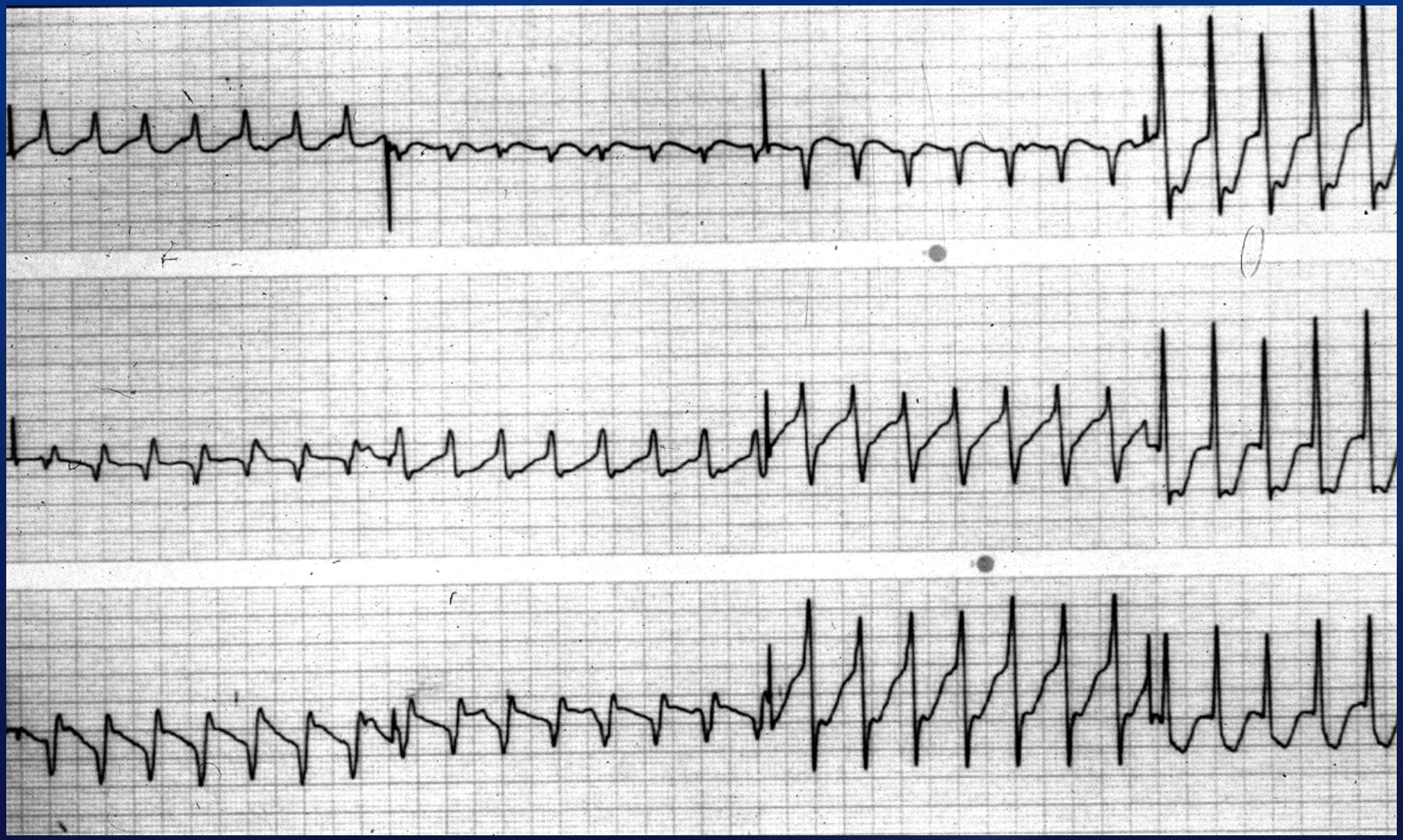

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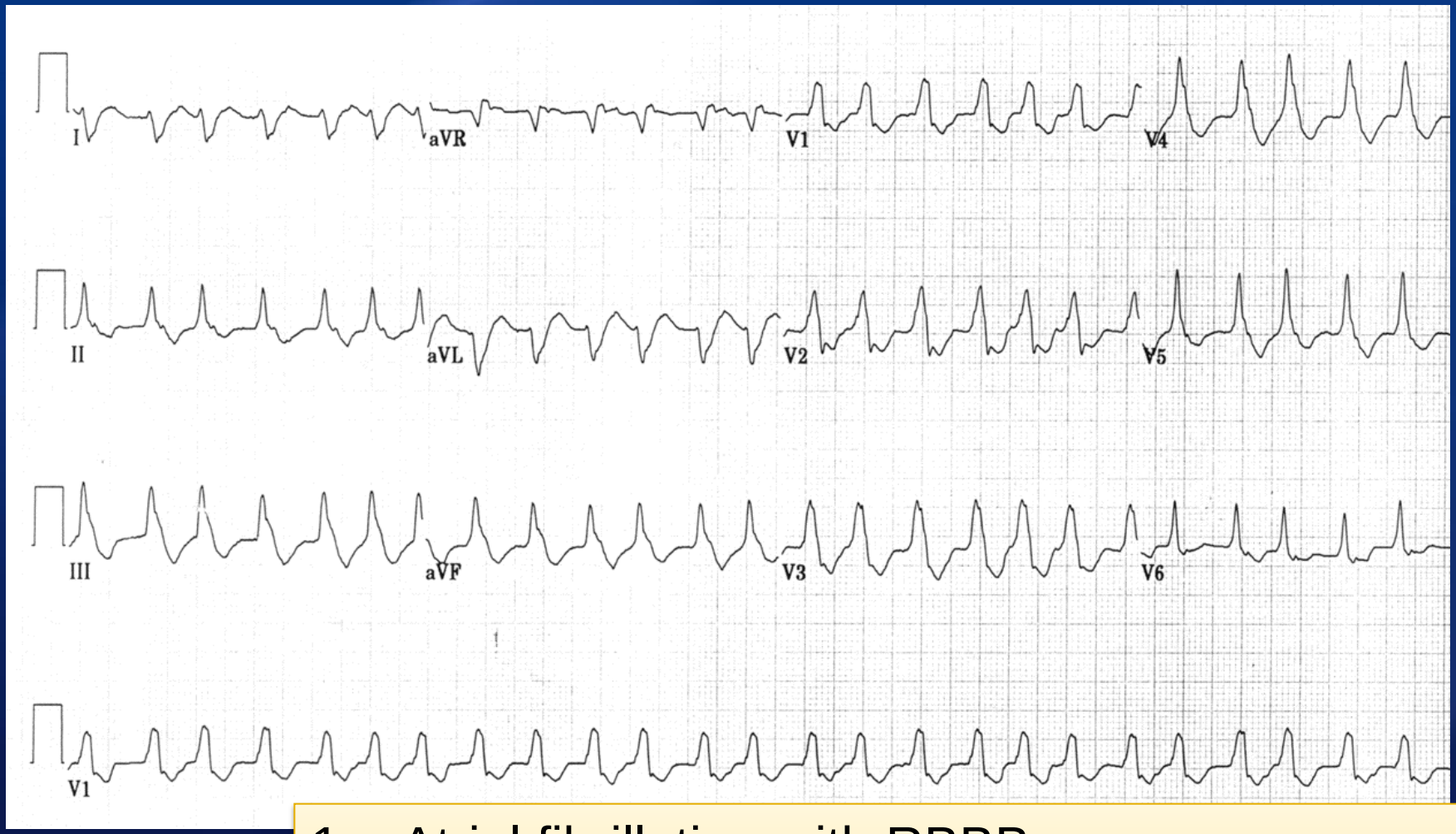

1. Atrial fibrillation with RBBB
2. Multifocal atrial tachycardia with RBBB
3. Ventricular tachycardia

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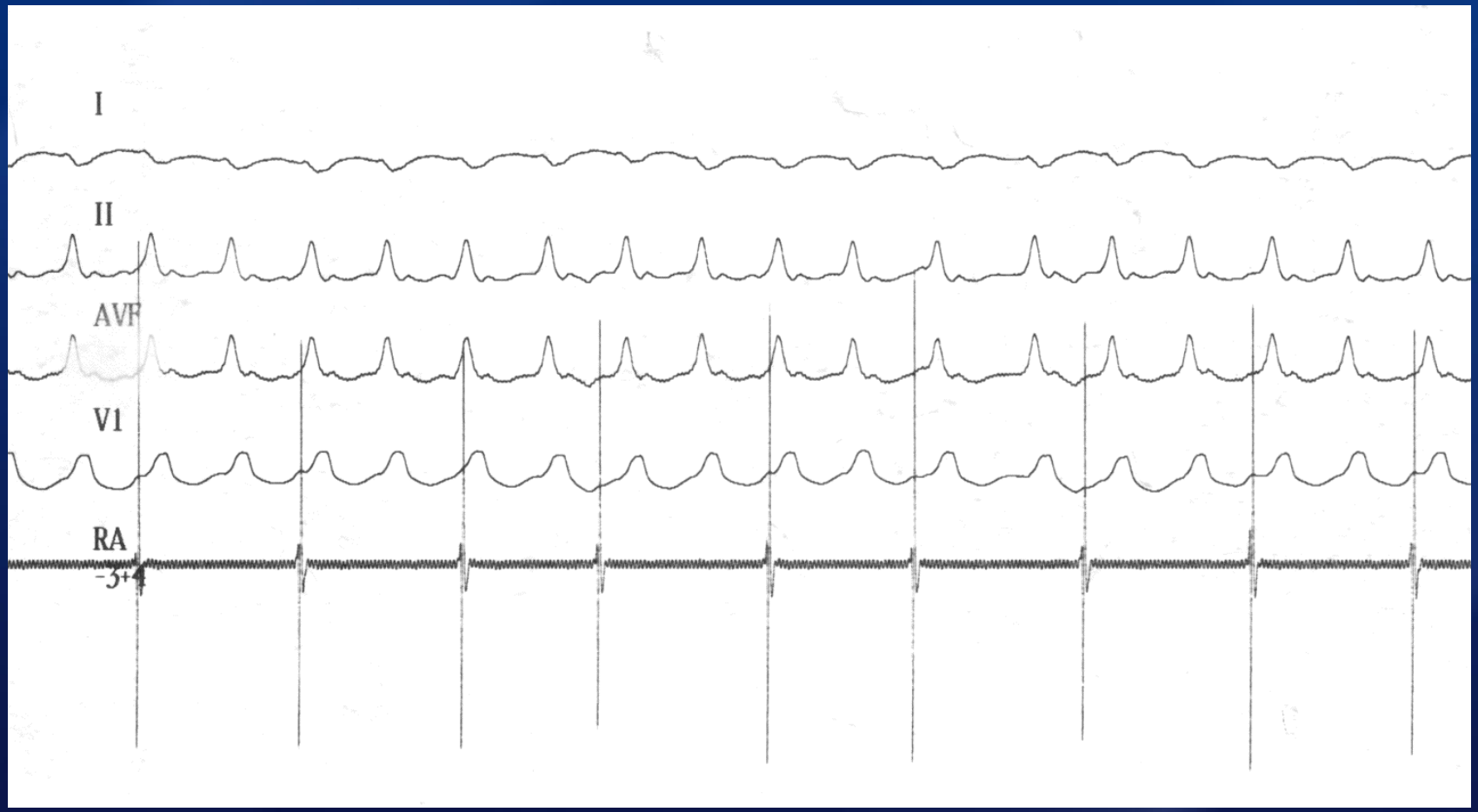

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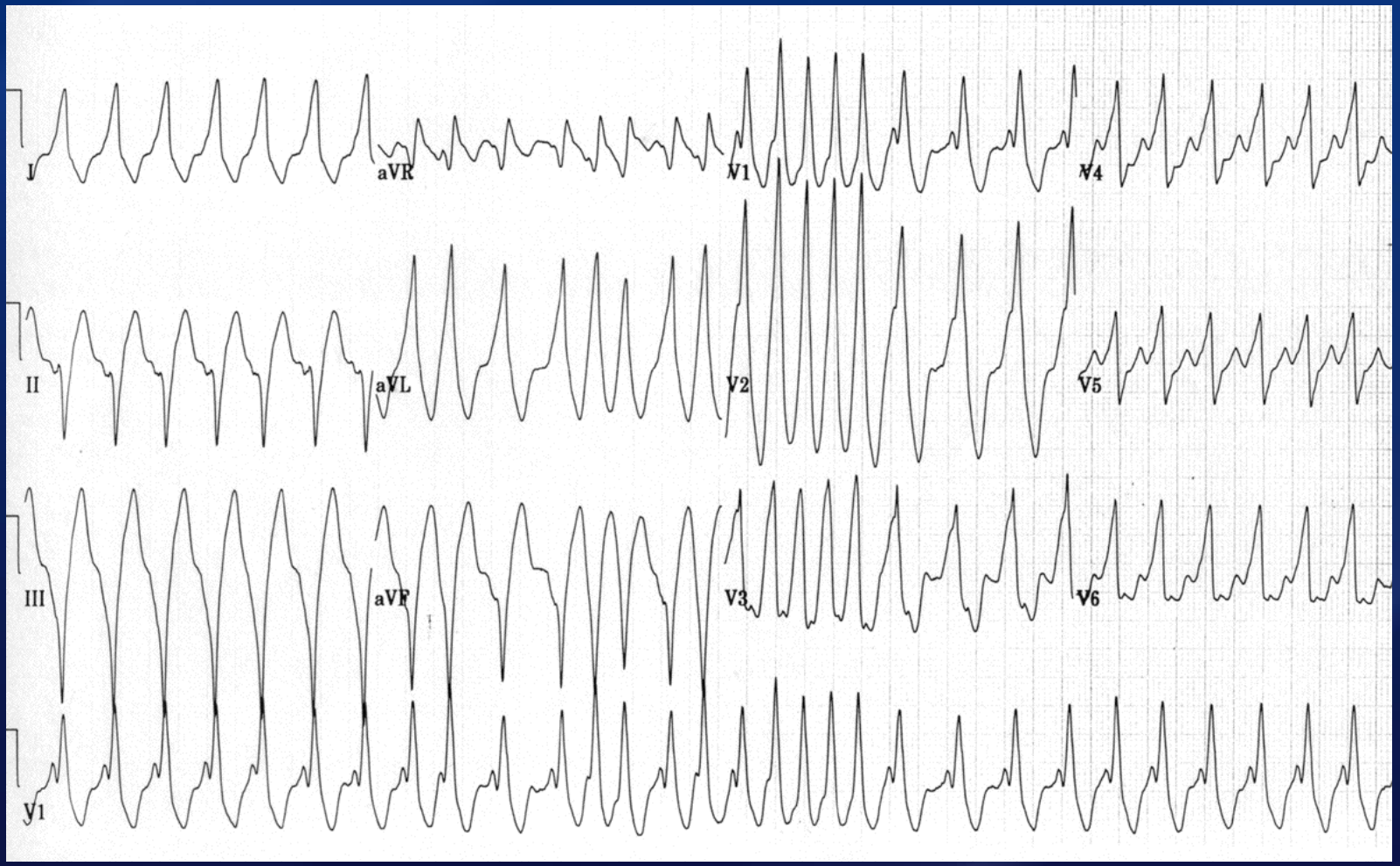
“Wide, irregular, and very very fast”



Kusumoto, ECG Interpretation: from Pathophysiology to Clinical Application 2009

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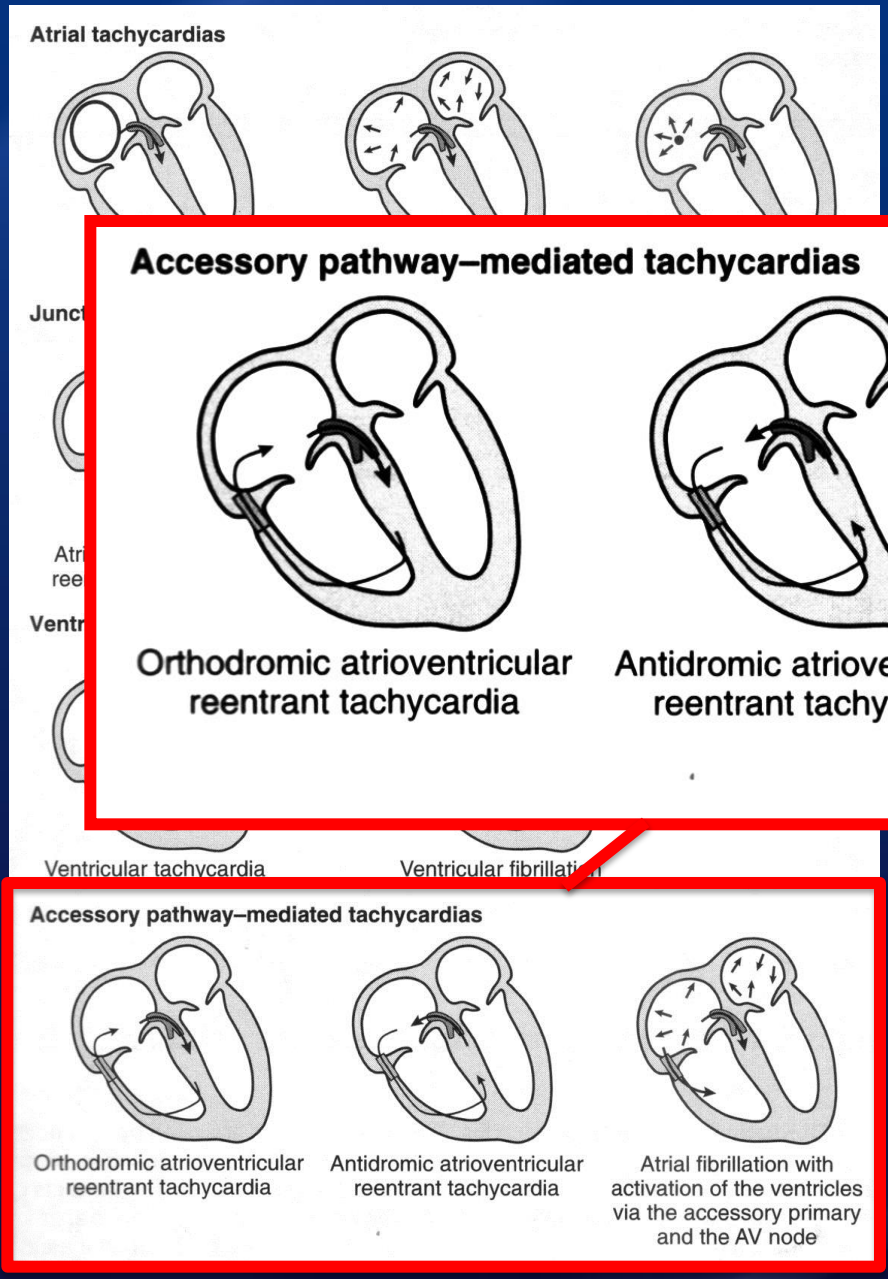
Wide Complex Tachycardia



Accessory pathway–mediated tachycardias
Orthodromic atrioventricular reentrant tachycardia
Antidromic atrioventricular reentrant tachycardia
Atrial fibrillation with activation of the ventricles via the accessory primary and the AV node

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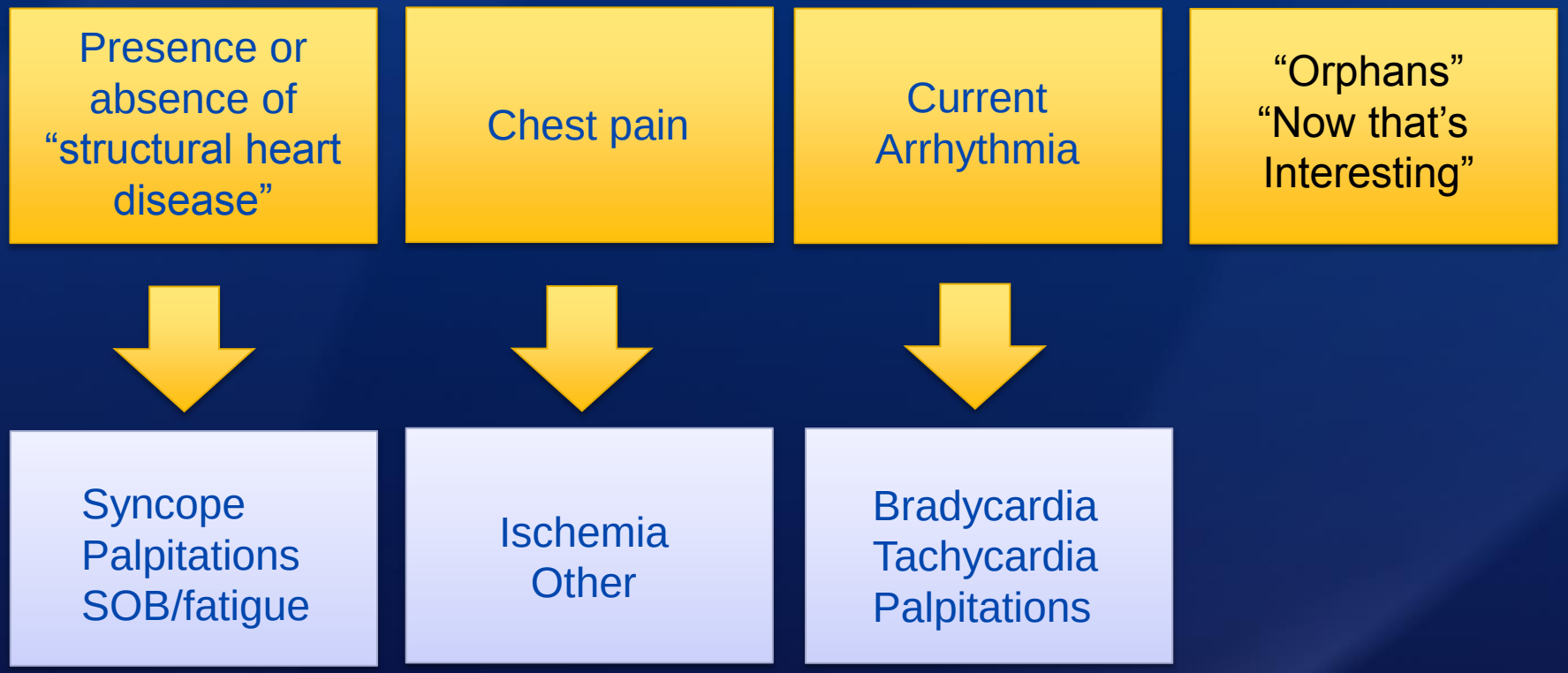
Kusumoto FM, Cardiovascular Pathophysiology Hayes Barton Press 2004

Clinical Use of the ECG



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ECG Interpretation for the Internist: ST changes and Ischemia

- Clinical story first, ECG is adjunctive at best
- Normal Repolarization (T waves)
- Characteristic changes with myocardial ischemia/injury
  - Dynamic changes with Sx
  - Localization to a specific region of the heart
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- Characteristic changes with myocardial ischemia/injury
- “Fake-outs”
  - Aneurysm
  - Pericarditis
  - Early Repolarization
  - Metabolic (Hyperkalemia, Hypercalcemia)

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ECG Summary:
"A practical approach?"

- Pretest probability/pacemaker?
- AV Dissociation
- QRS morphology (aberrancy looks like aberrancy):
  - Concordance
  - Positive in aVR
  - "Plump" initial activation
- Acknowledge shortcomings (understand the algorithms)
- Treat acutely as VT, EPS?

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