Intermediate ECG Course - Part 4

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Topics in Intermediate ECG

- Consolidation of prior information with additional details
- Not “advanced”, but feel free to ask advanced questions
- Causes of axis deviation and wide QRS (1)
- Infarction and causes of ST segment shifts (2)
- Electrolyte effects on the ECG (2)
- Flutter versus fib, and ventricular patterns (3)
- AV conduction and AV dissociation (4)
- Tachyarrhythmias, wide and narrow QRS (5, 6)
- Integrating ECG and clinical information (7,8)

Atrial Flutter

- Organized reentry in the atrium at rate of 250-350 waves/min, consistent
- Waves best in II, III, and aVF, sawtooth
- Ventricular response
  - may be 2:1 AV conduction, regular at 150 beats/min
  - may be variable
  - may alternate 2:1 and 4:1 conduction

Atrial Flutter

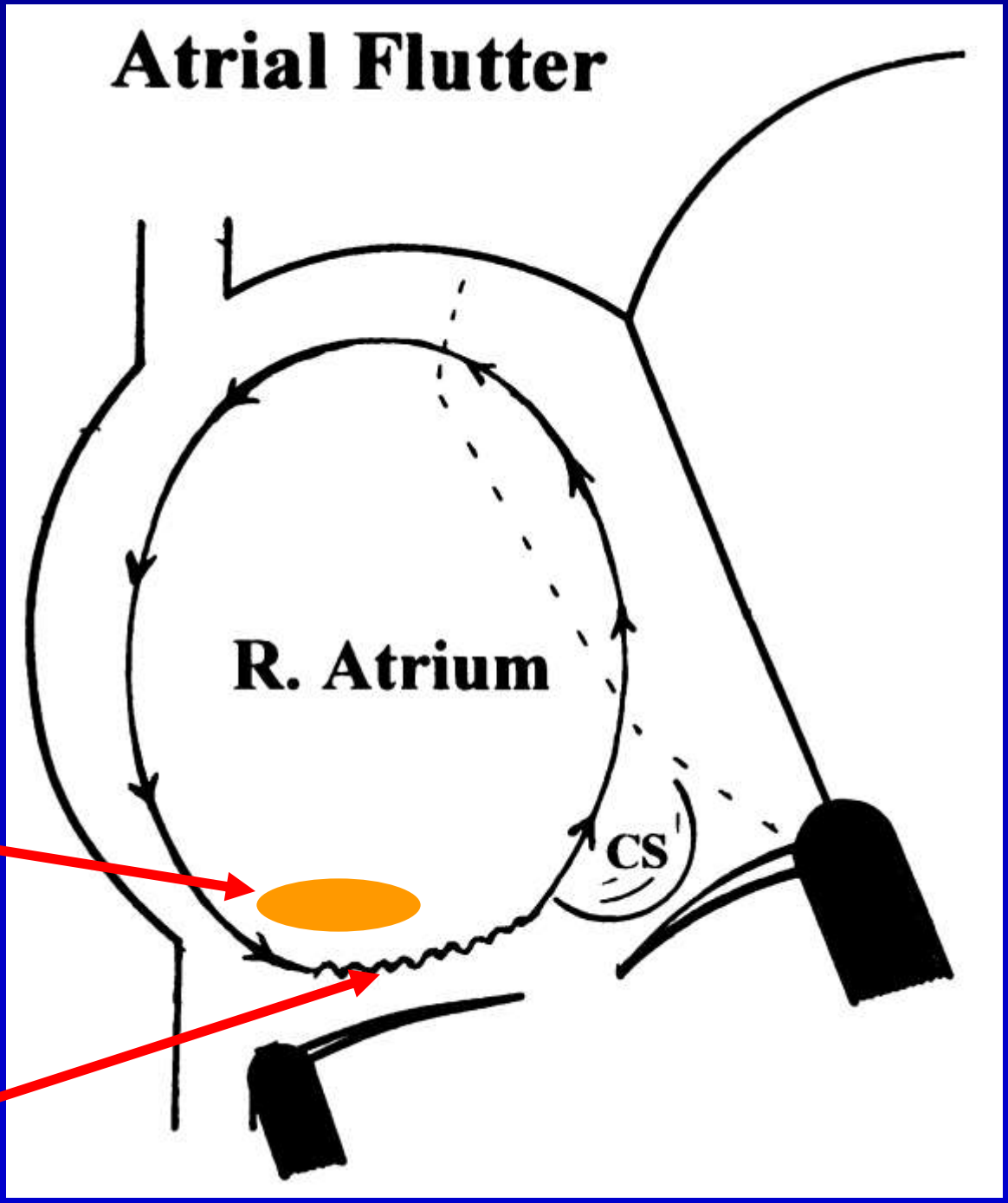
- Classic (Type I, “common”, “typical”) Atrial Flutter: rate 240-350/min, single right atrial macroreentrant circuit including slow conduction in the subeustachian isthmus
  - Usually counterclockwise circuit: up the interatrial septum, down the atrial free wall, and along the crista terminalis counterclockwise
  - Ablation across the subeustachian isthmus, between the TV annulus and the IVC is curative
  - Clockwise circuit in same path may occur
- Type II (“atypical”, “uncommon”) has faster rate (>340), is heterogeneous, transitional to atrial fibrillation

Surawicz B et al. p. 351, Chou’s Electrocardiography in Clinical Practice, 5th ed. 2002.

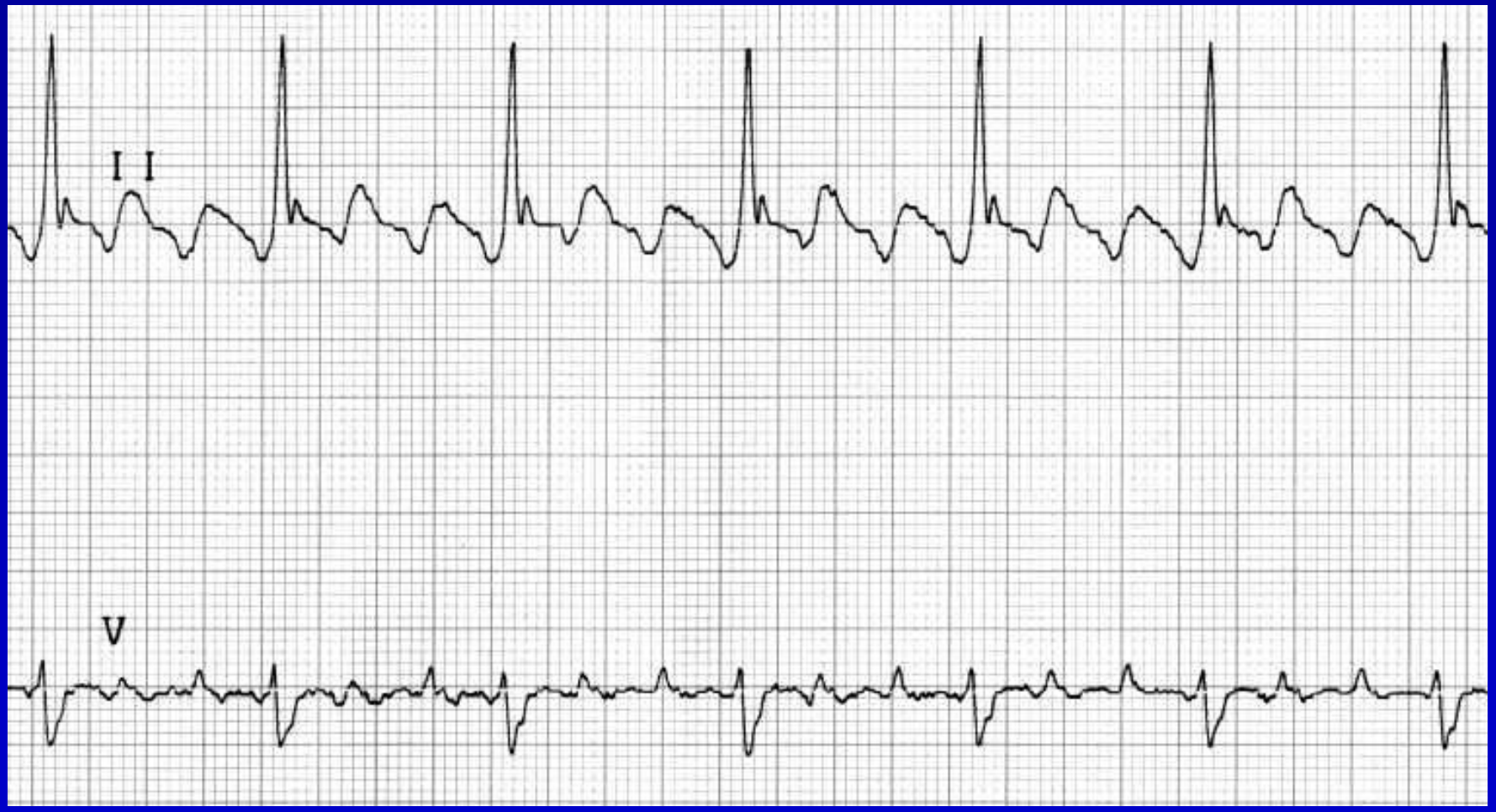
Zipes DP et al. “Genesis of Cardiac Arrhythmias: Electrophysiological Considerations” p. 680. in Braunwald’s Heart Disease, 7th ed. 2005.

Atrial Flutter

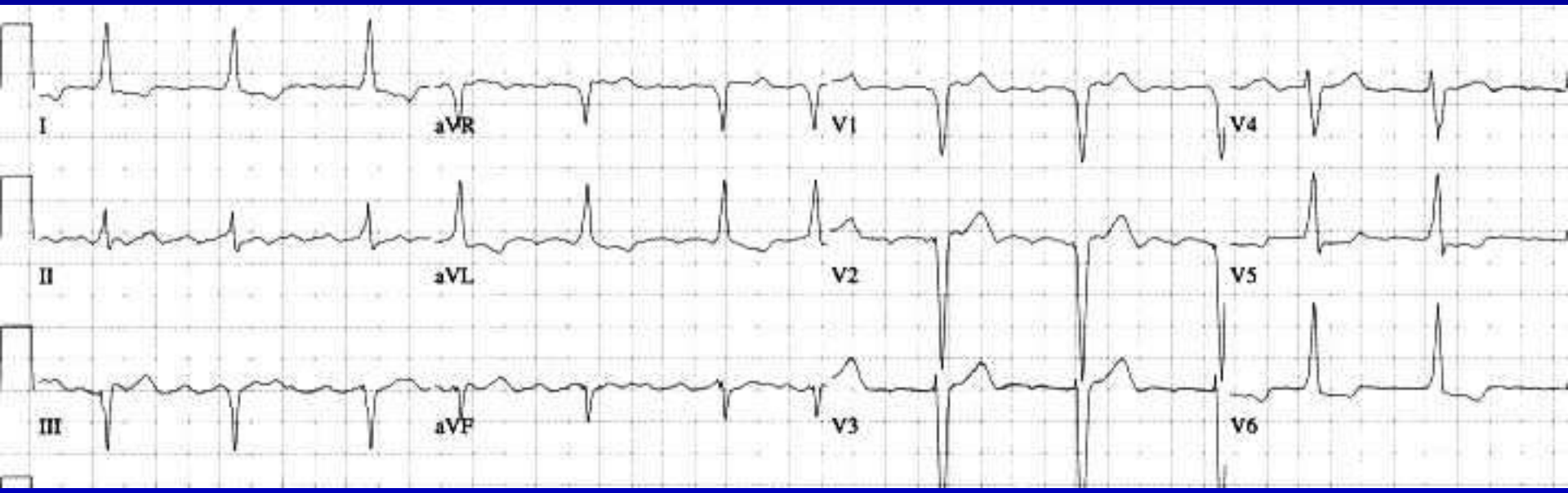
Type I,
common type

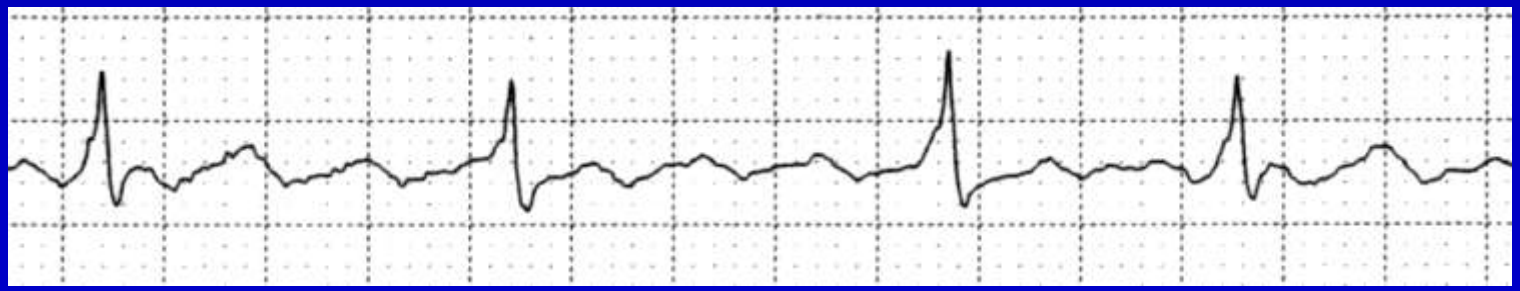


Atrial Flutter

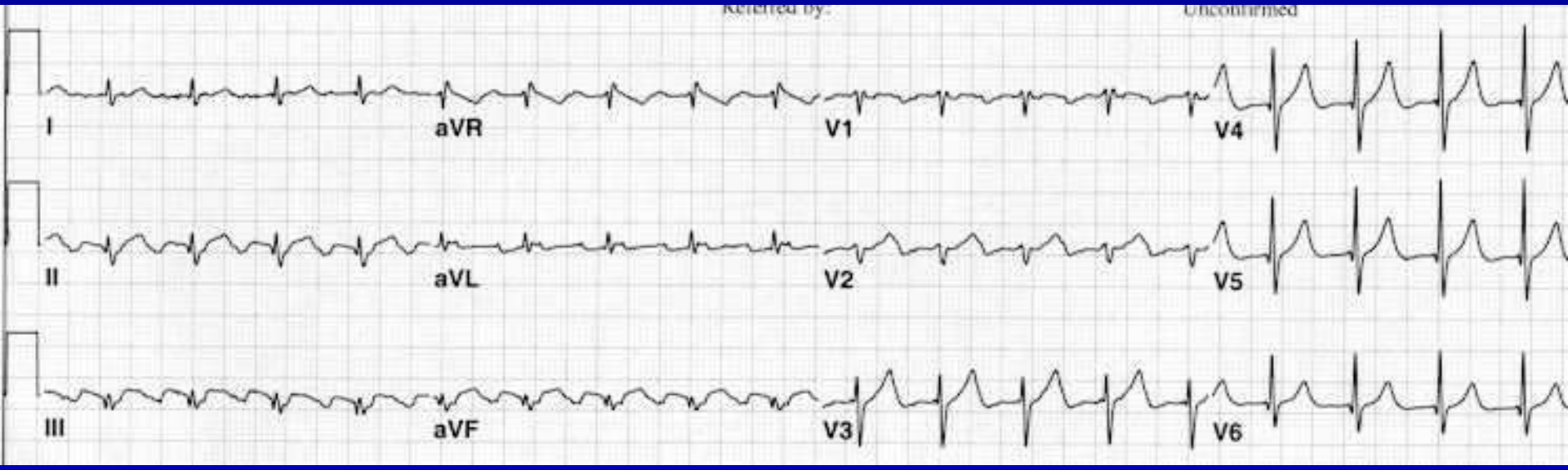


Atrial Flutter

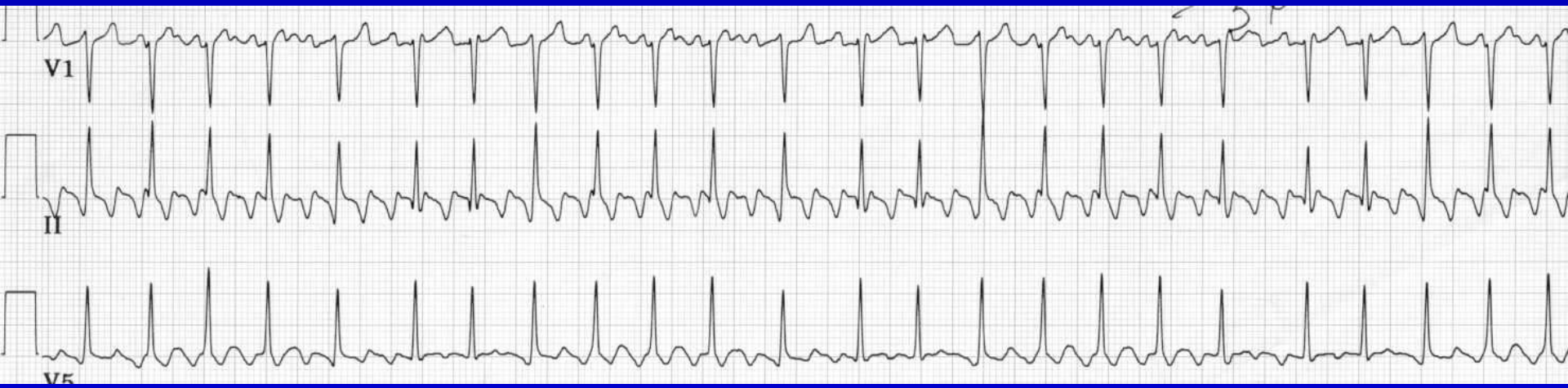




Atrial Flutter



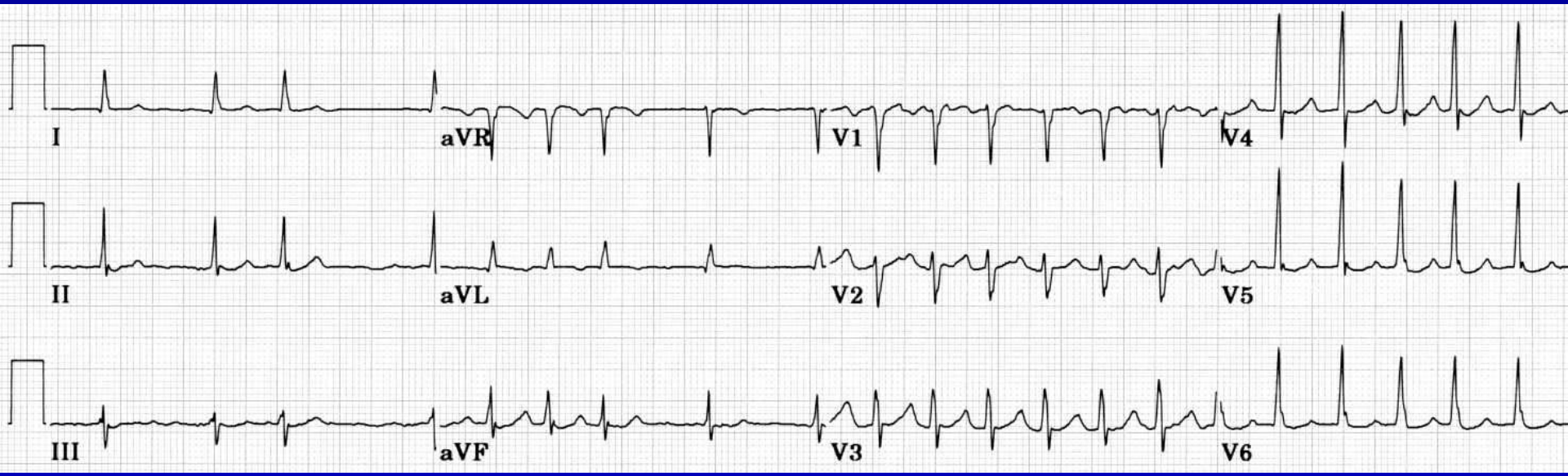
Atrial Flutter



Atrial Fibrillation

- Disorganized atrial rhythm, faster than 350
- Usually best in V1
- Moderate ventricular response is 70-110 beats/min
- Irregularly irregular (no pattern) RR interval
- If regular RR interval, then the ventricle is beating on its own

Atrial Fibrillation




V1
II
V5
V1
II
Atrial Fibrillation
V1
II
V5

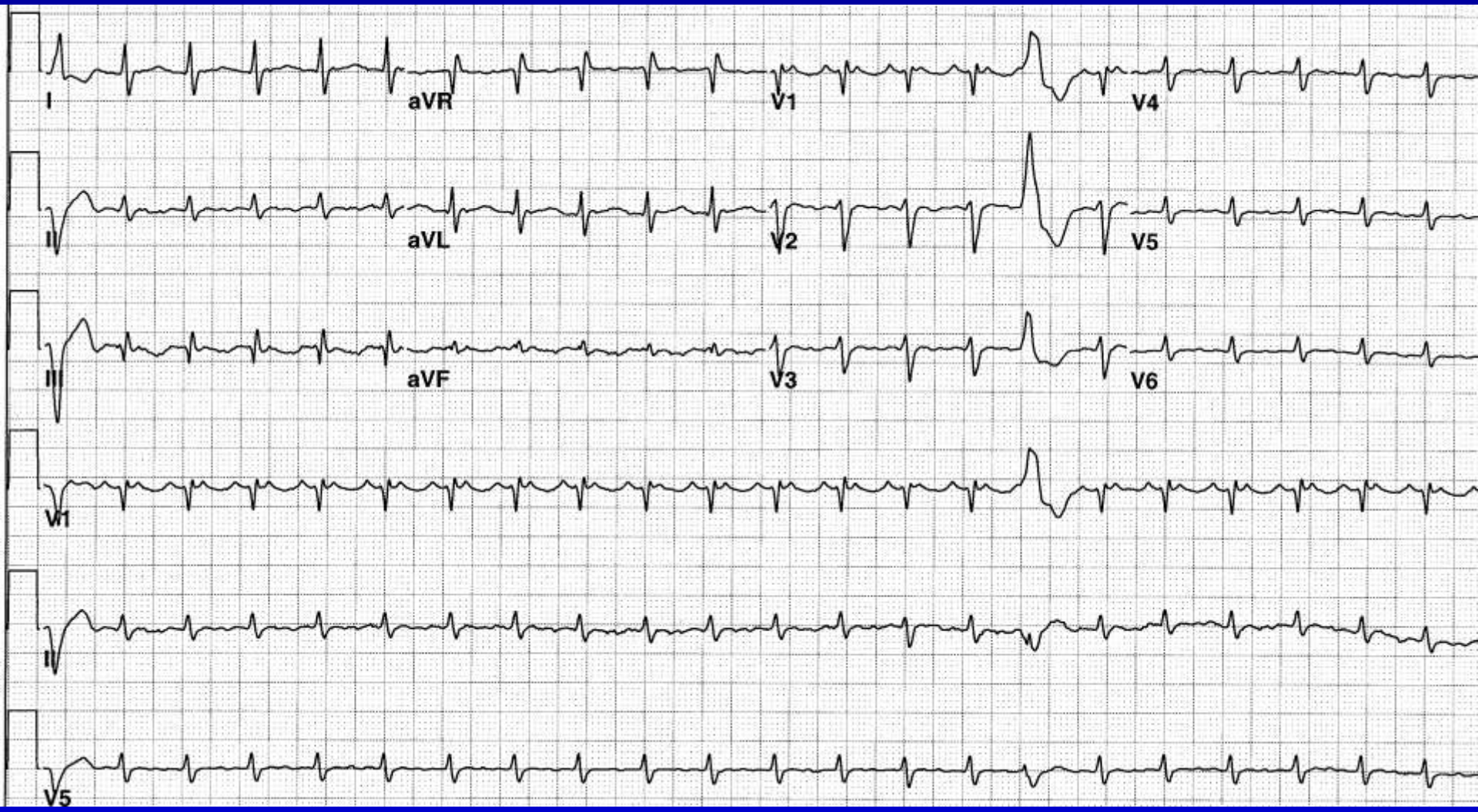
Atrial Fibrillation

Multifocal Atrial Tachycardia

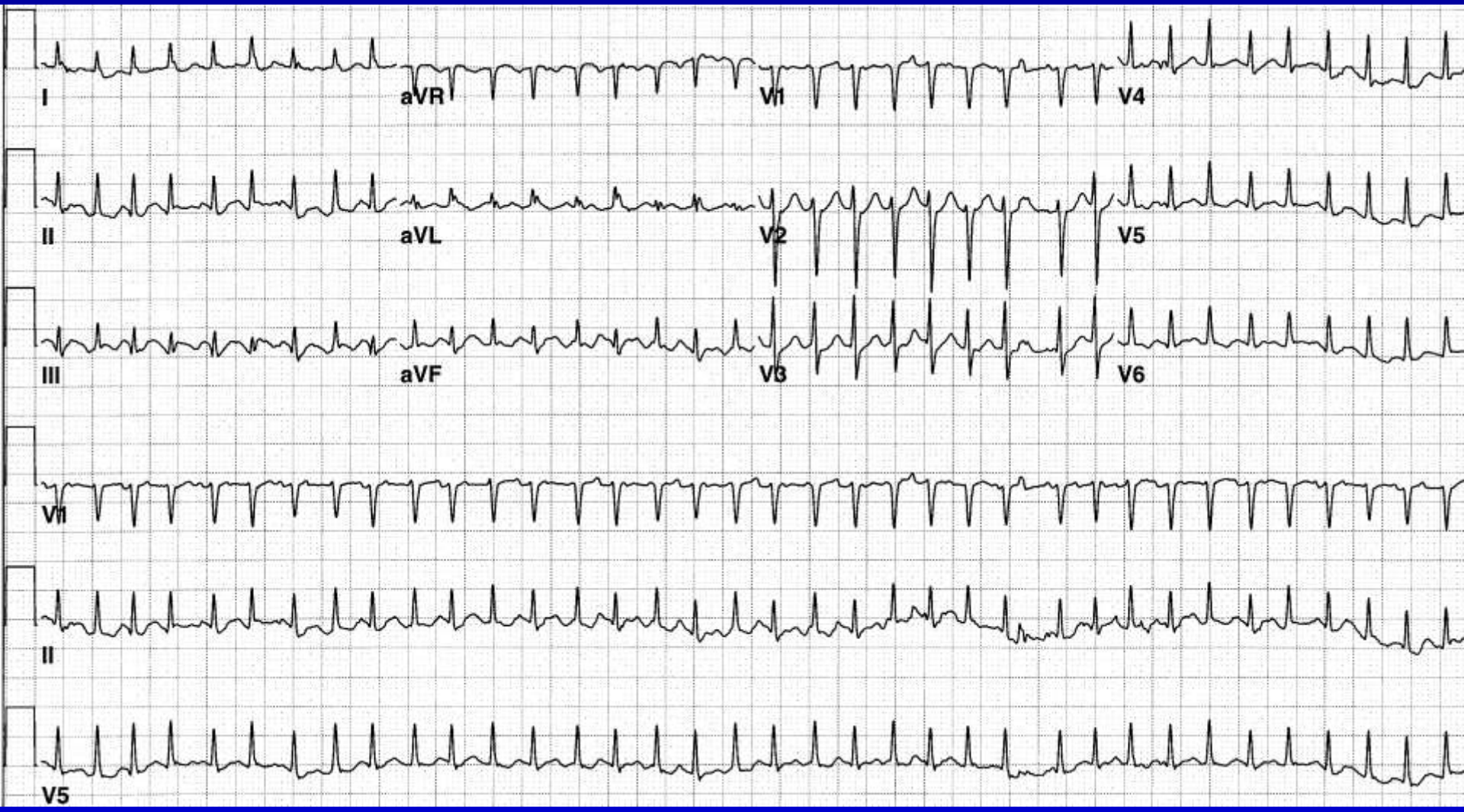
- Variable P morphology and PR interval and P-P interval, not gradual or progressive
- Rate over 100 beats/min
- Often indicates severe end-stage cardiac or pulmonary disease

Multifocal Atrial Tachycardia

Case 4



Case 13



Steps in Arrhythmia Analysis

- Find all the QRS's and check out their rate, regularity, uniformity and shape
- Find all the P's and check out their rate, regularity, uniformity and shape
- Deduce the origin of the P wave from the shape
- Deduce the relationship of the P and QRS by the PR interval characteristics and P wave shape
- Determine the cause of each wave using known electrophysiologic principles (automaticity, triggered activity, reentry, refractoriness, aberrancy)

AV Block: Outline

- Review of anatomy of conduction system
- Description of types of AV block
- Other considerations
  - Distinguishing from AV dissociation without block
  - Information from the QRS
    - Escape mechanism
    - Morphologic information: Injury, Electrolyte
  - Effects on the Atrium
    - Ventriculophasic sinus arrhythmia

Causes of AV Block

- Normal variant; Congenital (isolated, corrected transposition)
- Iatrogenic –vagal, negative dromotropic agents
  –Surgery (VSD, AVR), septal ablation, radiofreq
- Coronary artery disease (acute ant or inf MI)
- Valve disease – calcific aortic stenosis (?Lev)
- Degenerative conduction system disease (Lenegre)
- Cardiomyopathy – sarcoid, primary dilated, amyloid, hemachromatosis, progressive muscular dystrophy,
- Inflammation/infection/metabolic – acute myocarditis, Chaga's cardiomyopathy, lyme disease; lupus, dermatomyositis, scleroderma, Reiter's syndrome, Marfan's syndrome, rheumatoid heart disease, ankylosing spondylitis; hyperkalemia or mag
- Hereditary with DCM
  - Autosomal dominant DCM lamin A/C defect
  - Emerin defects also manifest AV conduction disease

OSA

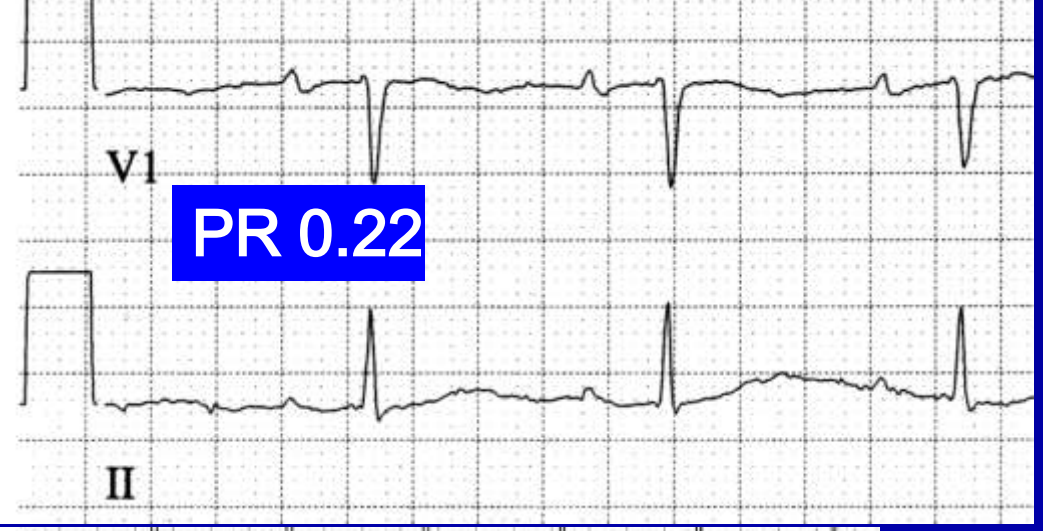
- Isolated CHB in neonate or fetus is ominous, highly associated with anti-Ro and anti La, and with 6% and 43% mortality, respectively; in children, antibody association was 5% and mortality was 0

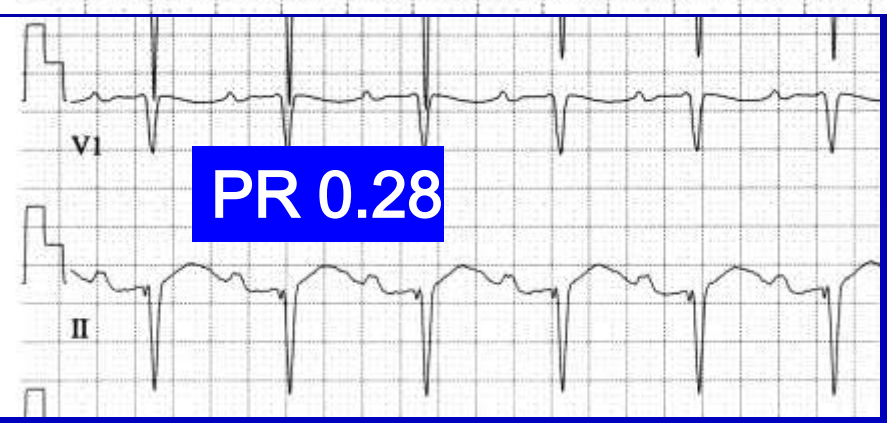
Arbustini E et al. JACC 2002; 39:981; Jaeggi ET et al. JACC 2002; 39:130

Degrees of AV Block

Degree of Block	Which Conduct	PR interval	RR interval
First	All	Constant and long	Regular
Wenckebach (Mobitz I)	Some	Variable, progressive	Grouped beating
2:1	Some	Constant	Regular
Mobitz II	Some	Constant	Pauses
Third	None	Variable, random	Regular

First Degree AV Block





PR interval
Constant
and
Long

Second Degree AV Block, Wenckebach (Mobitz I)

- Some beats don't conduct, so more P's than QRS's
- Progressive Prolongation of the PR interval for the conducted beats
  - increment of prolongation actually decreases
  - progressive shortening of the RR interval
- After pause is shortest PR interval
  - may be a junctional or ventricular escape beat

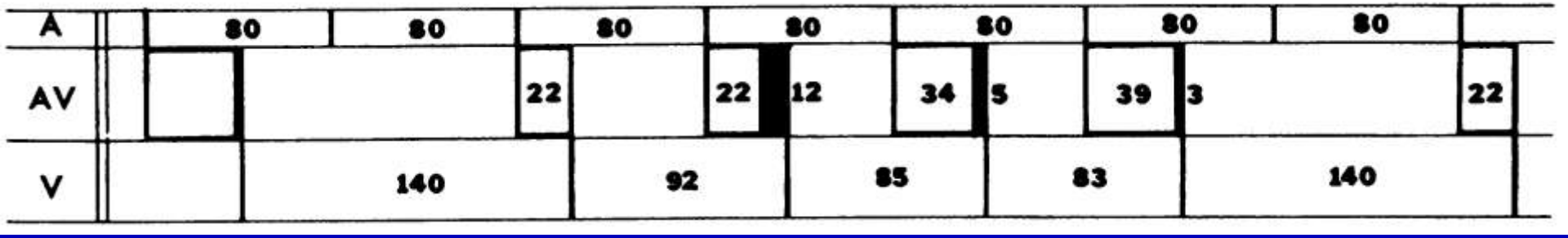
Second Degree AV Block, Wenckebach (Mobitz I)

0.32 0.40 0.45 block 0.32 0.38 block 0.32 0.40

2:1 2:1

Grouped beats

Wenckebach: The RR Decreases
(The PR increases)



Wagner GS. Marriott's Practical Electrocardiography 1994, p.390

Second Degree AV Block, Wenckebach (Mobitz I)

Low grade block

3:2

Non-simultaneous

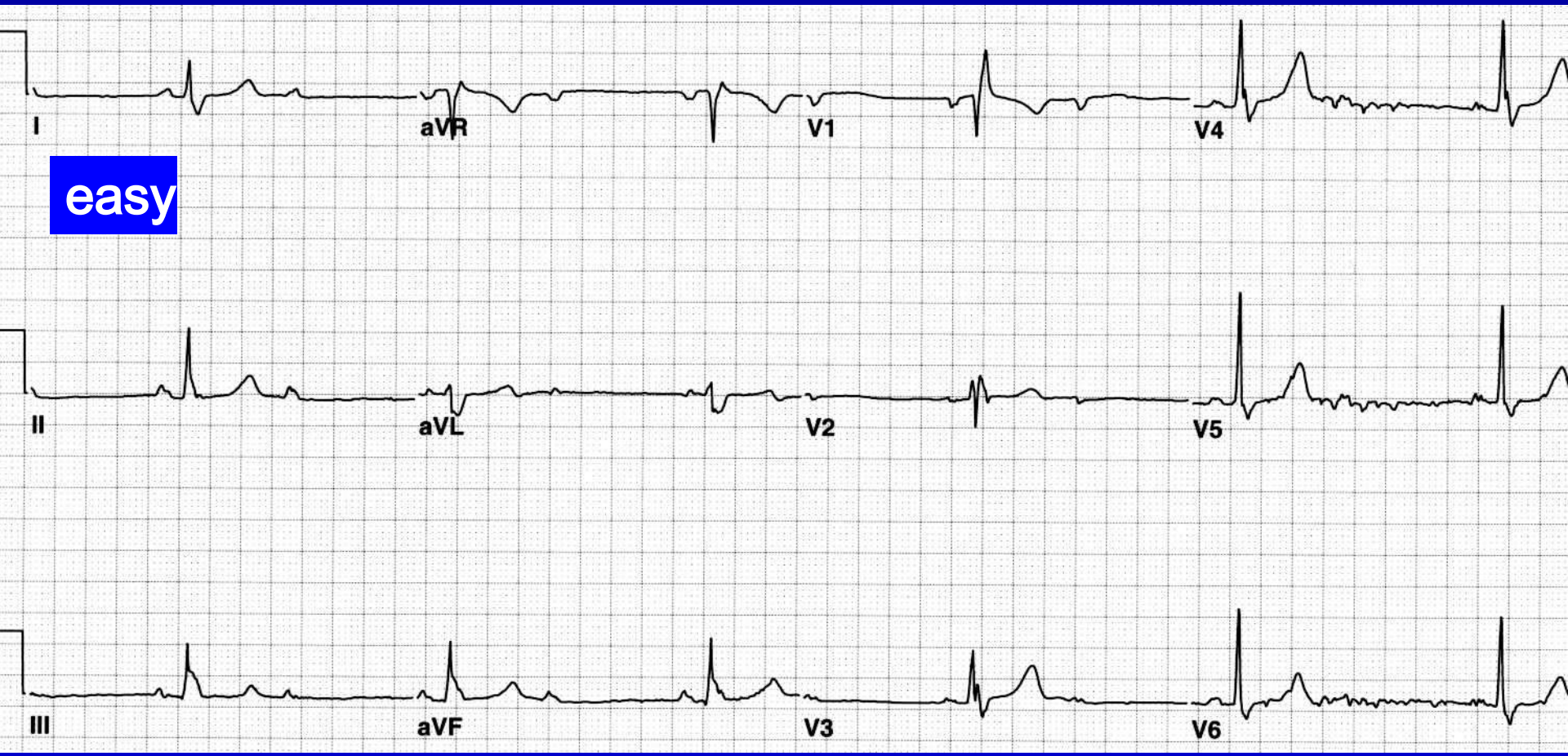
Wenckebach Caveats

- Block is usually in the AV node
- Blocked beat will have no His bundle potential
- If intrahisian, there will be split His potentials and blocked beat will have no second His potential (worsen with Atropine)
- If associated with BBB, still 75% are AV node, and only 25% infranodal
- Exceptions to the usual periodicity are more common than the rule

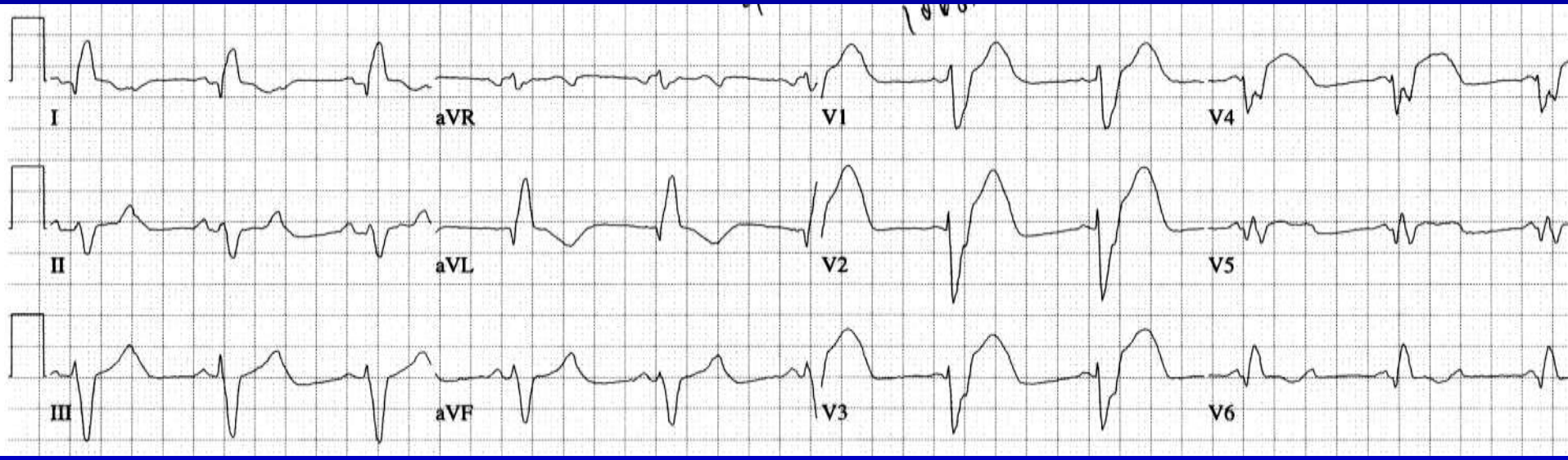
Second Degree AV block, 2:1

- Can be either mechanism of Wenckebach or mechanism of Mobitz II, can't tell
  - if QRS is wide, could be either
  - if QRS is narrow, usually is Wenckebach
- Can be tricky to diagnose, must find the nonconducted P waves (otherwise the mistaken diagnosis will be mere bradycardia)
- "It is advisable to be noncommittal as to the type of Mobitz block when dealing with 2:1 AV block"

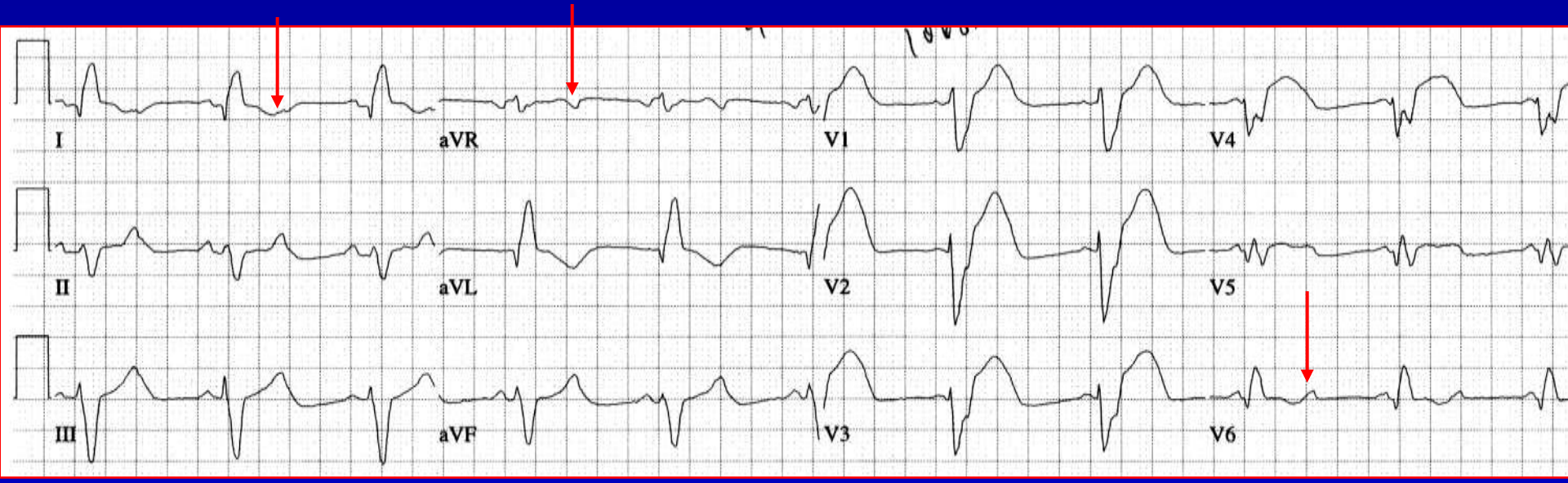
Second Degree AV block, 2:1



Second Degree AV block, 2:1



Second Degree AV block, 2:1



- Not so easy… could misdiagnose as NSR rate 64.
- But actually is sinus tachycardia at rate of 128 (patient is likely sick) with 2:1 block.
- The extra P waves are best seen at the 3 red arrows, and are same shape and axis as the sinus P waves.
- Wide QRS indicates disease below the bundle of His.

Second-Degree AV Block, Mobitz II

- Intermittent blocked P waves
- PR interval constant for conducted beats
- Most are associated with BBB
- About 1/3 of patients with Mobitz II have block located in the His bundle, so QRS is narrow
- Rarely Mobitz II is due to block in the AV node

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Advanced AV block

- Block is 3:1or higher
- Sometimes only occasional ventricular captures are observed, sometimes more frequently

Third Degree AV block (Complete Heart Block)

- No atrial activity conducts to the ventricle
- Atrial rate faster than ventricular rate

Eliminates AV dissociation

- No relationship between P and QRS
  - PR interval is random
  - PR interval may at first glance seem to have a pattern, but don't be fooled
  - Retrograde conduction is possible
- Ventricular rhythm is independent, either junctional or ventricular escape rhythm
  - Regular ventricular rhythm, even in Afib

Third Degree AV Block

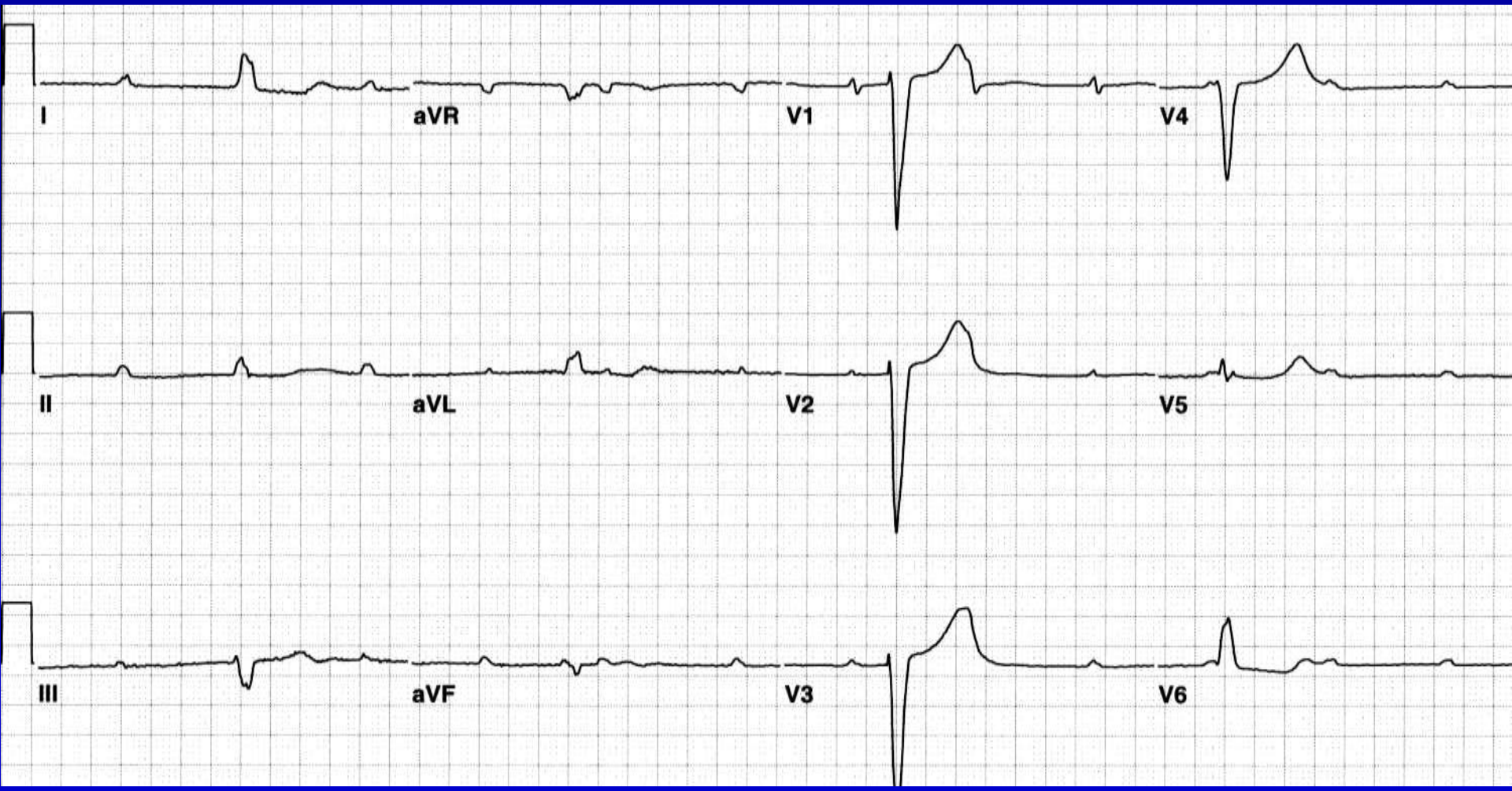
Retrograde conduction

Surawicz B et al. Chou's ECG… 2001, p.439

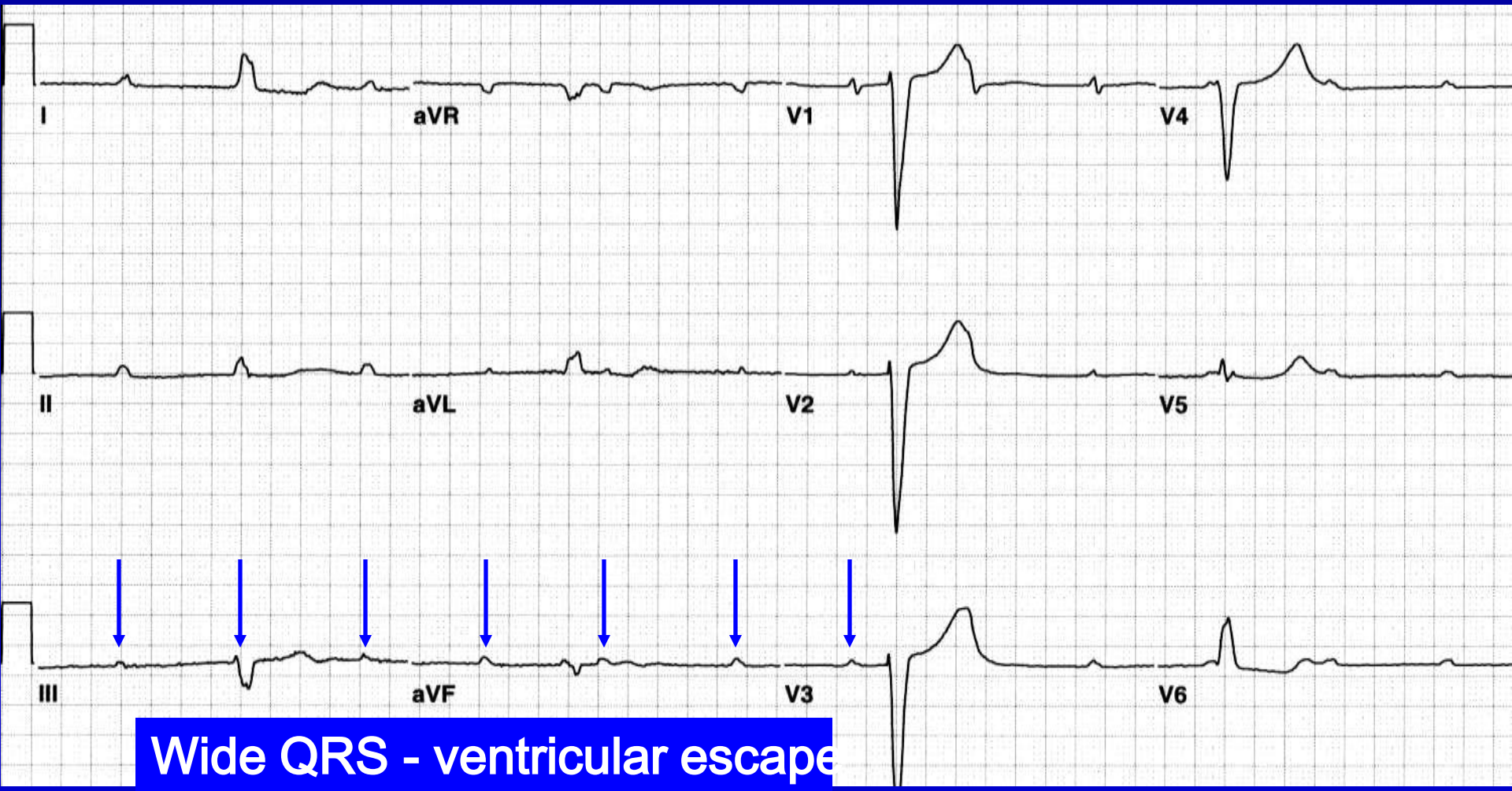
Third Degree AV block - 2

- Site of block: AV junction, His bundle, or bundle branches (either bilateral bundle branch, or trifascicular block)
- Adult acquired chronic: 50-60% are infrahisian and escape complexes are wide
- Acute block from drugs, infection or inferior MI: usually proximal to His bundle
- Anterior MI: usually distal to His bundle

Third Degree AV block (Complete Heart Block)

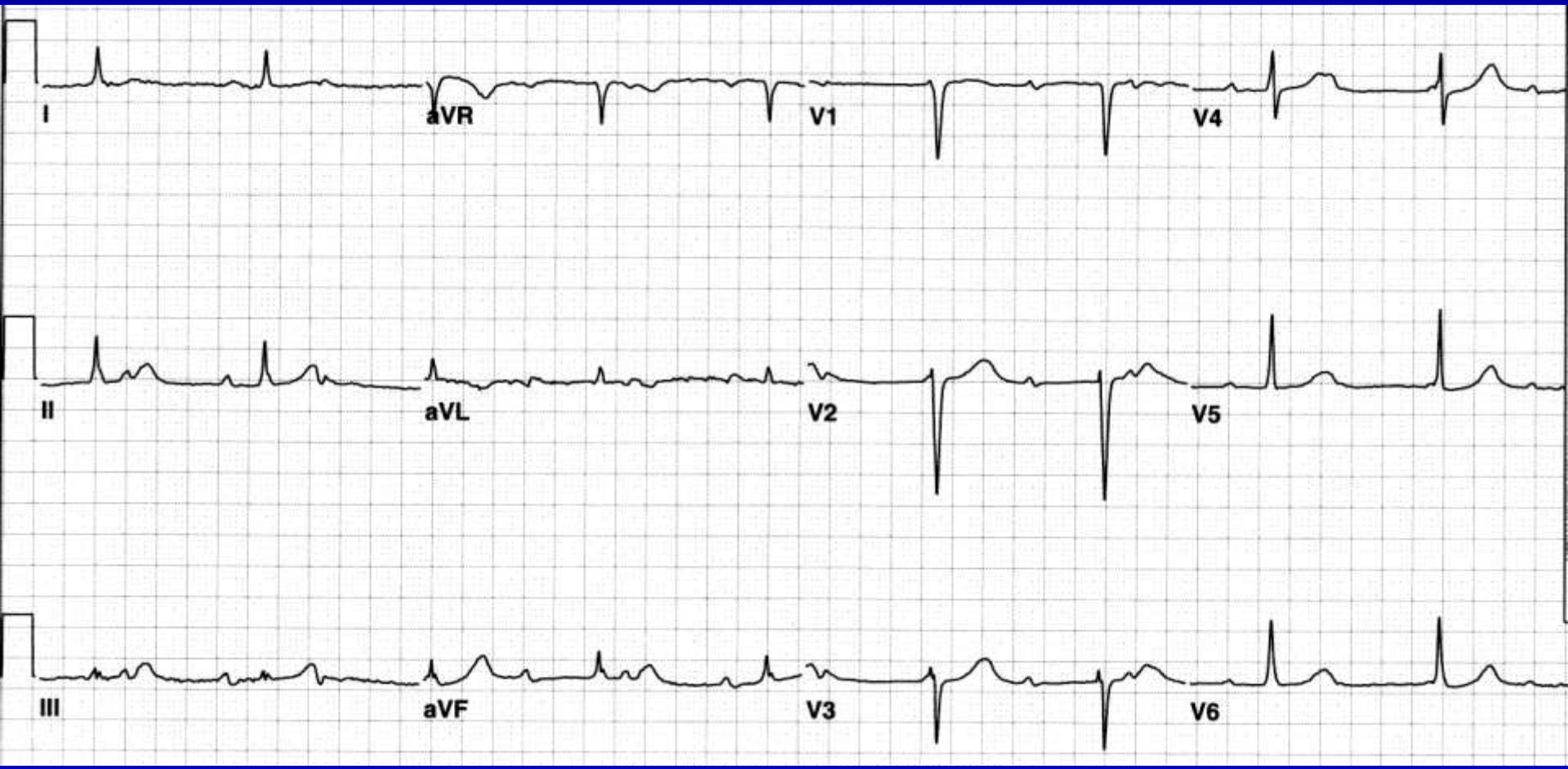


Third Degree AV block (Complete Heart Block)

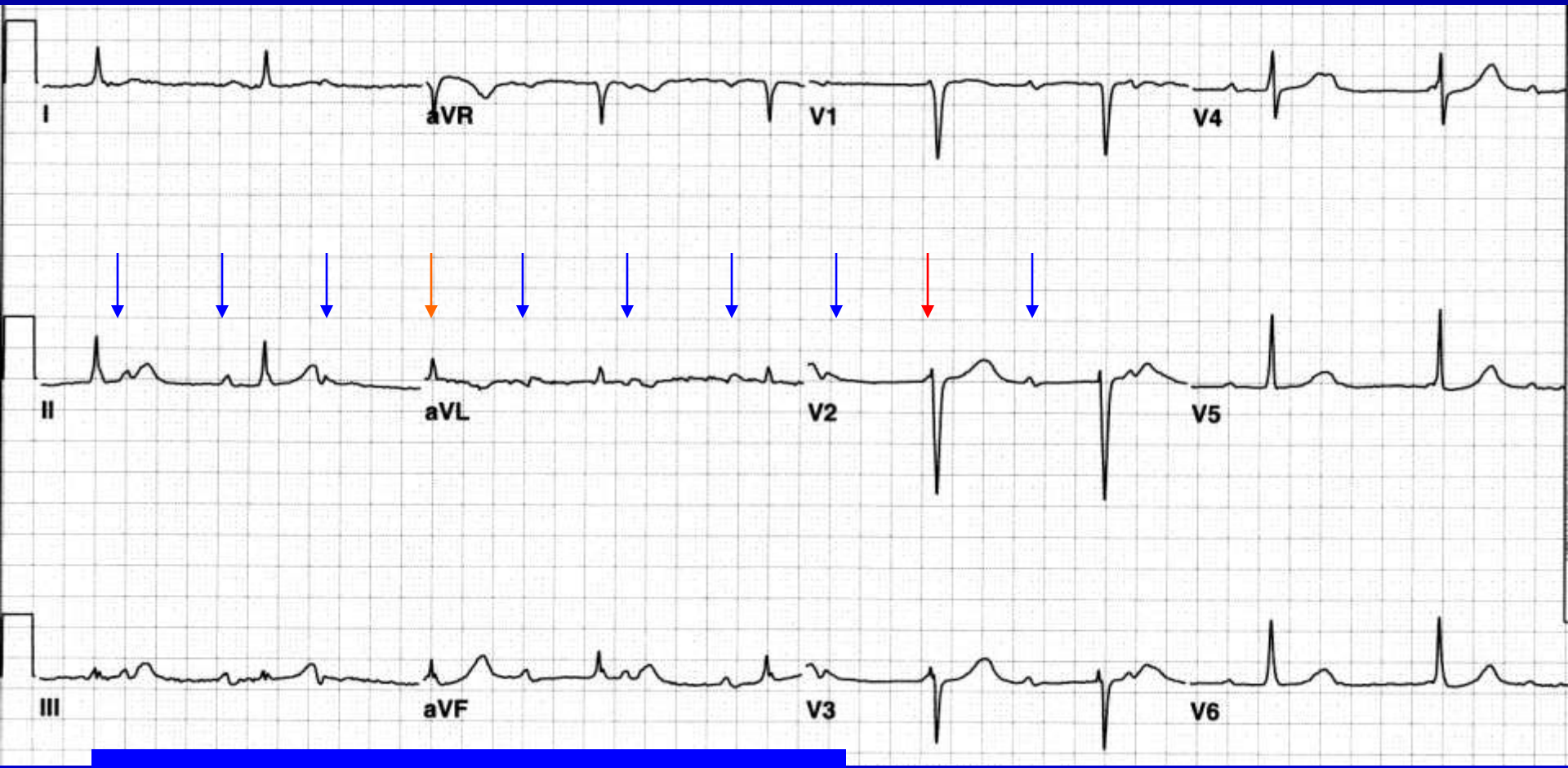


Wide QRS - ventricular escape

Third Degree AV block (Complete Heart Block)

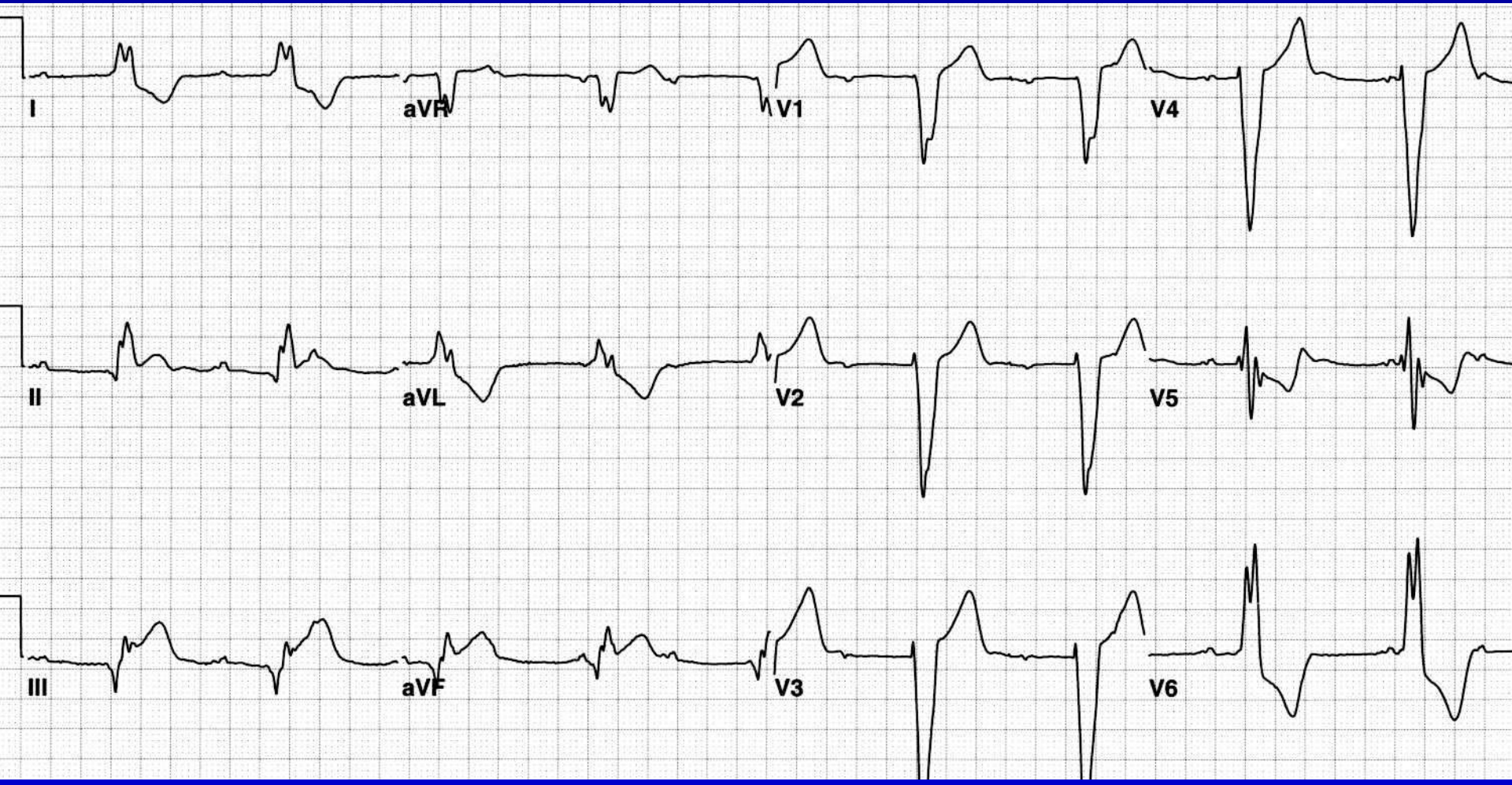


Third Degree AV block (Complete Heart Block)

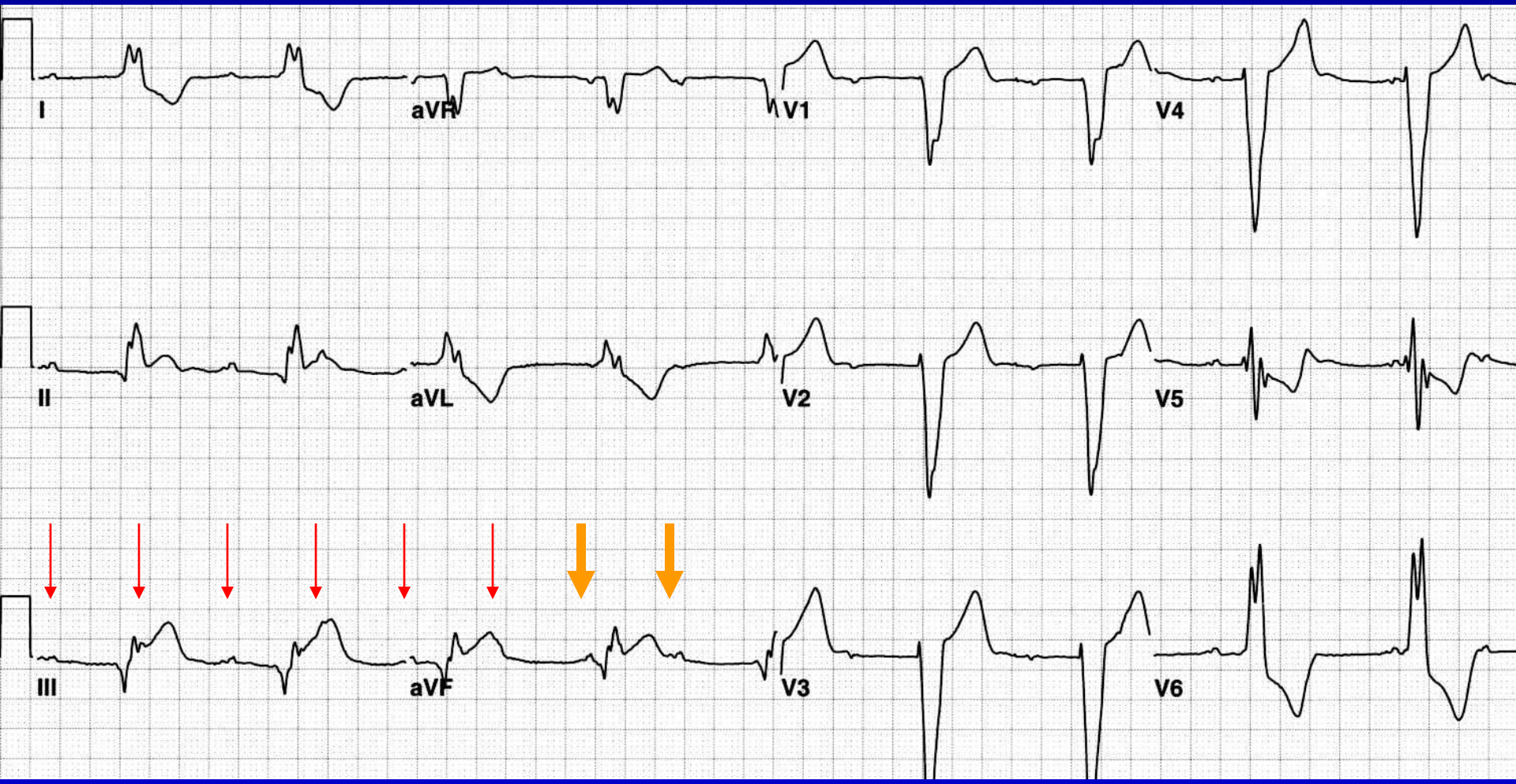


Narrow QRS - junctional escape

Third Degree AV block (Complete Heart Block)

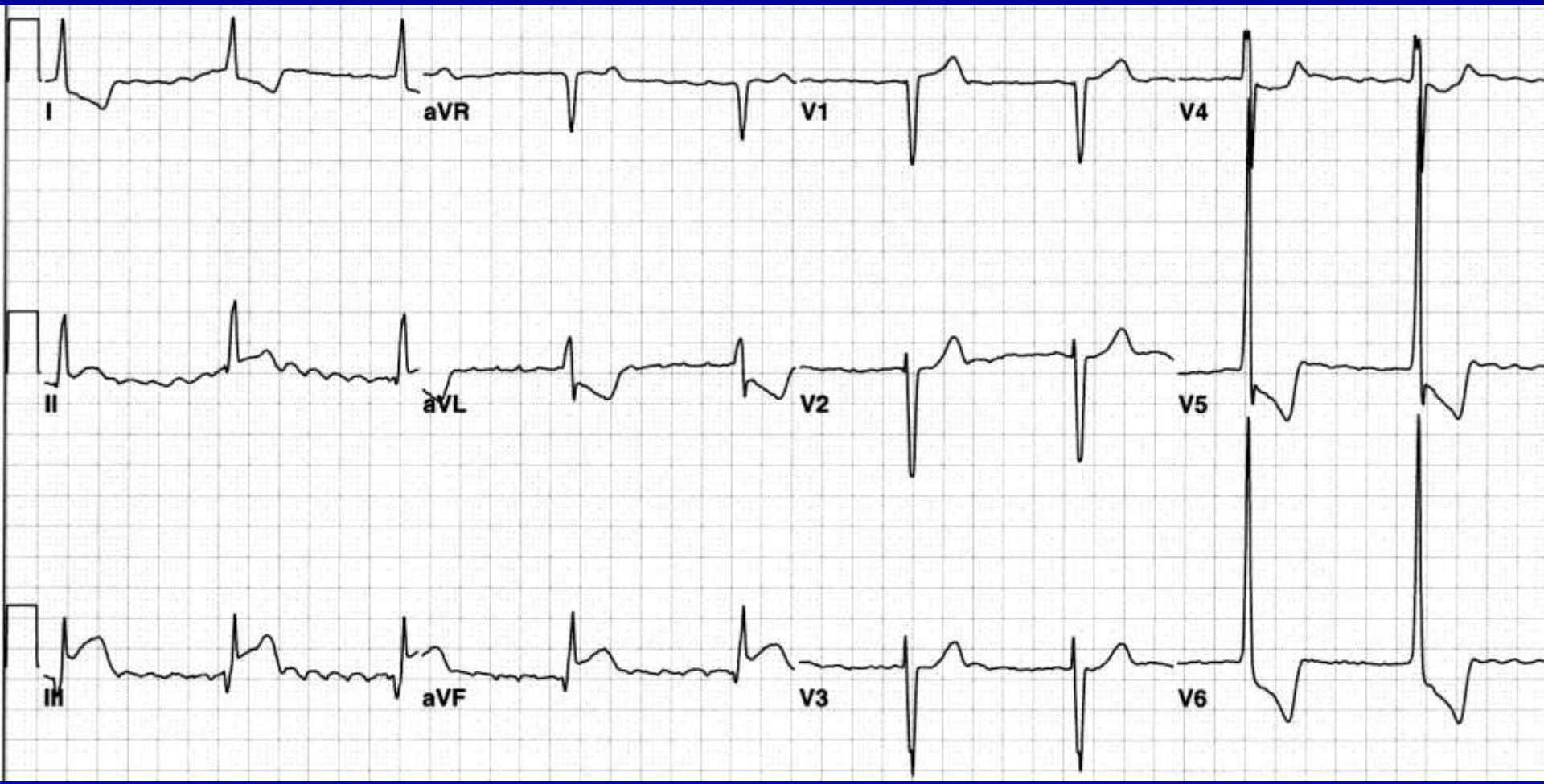


Third Degree AV block



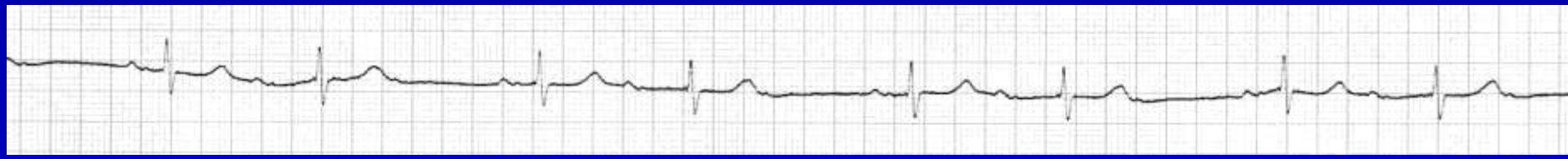
Wide QRS (LBBB pattern) - ventricular escape.
Acute inferior injury pattern!

Third Degree AV block



Atrial fibrillation with narrow QRS - junctional escape.
Acute inferior injury pattern!

Unknown



Pseudo AV Block

- Most common cause of a pause – a non-conducted PAC (but don't be led astray by ventriculophasic sinus arrhythmia)
- Concealed His bundle extrasystole
- AV junctional parasystole with concealed conduction
- Concealed junctional discharges can delay a normal junctional escape rate

AV Dissociation

- Definition: Variability of the PR interval without heart block
  - Atrial and ventricular activities are independent
  - Ventricular rate is faster than atrial
  - No retrograde conduction
- AV dissociation is always a secondary diagnosis, consequent to a primary problem of automaticity or reentry, and the clinical significance is determined by the primary disorder

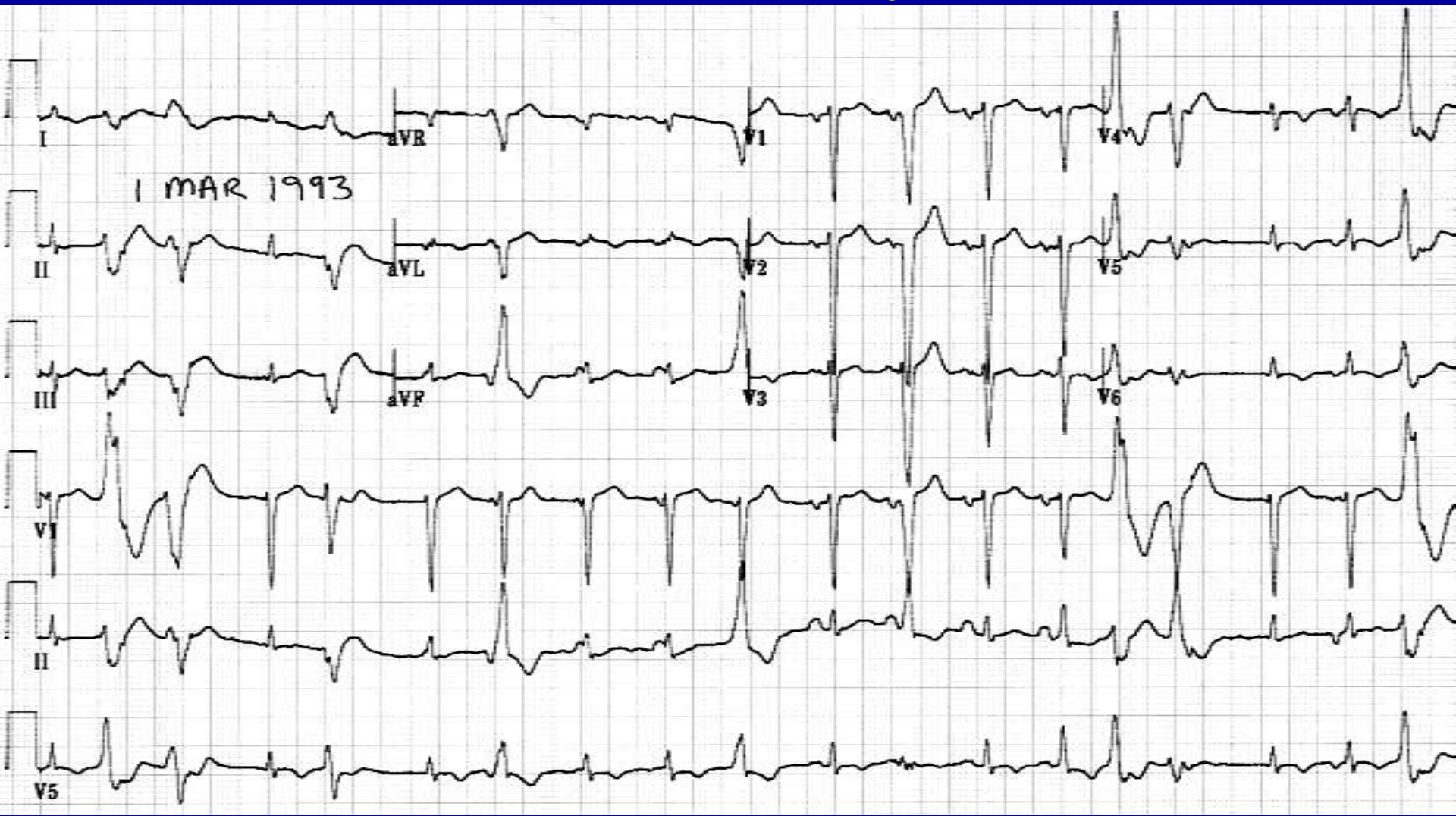
Terminology in AV Dissociation

- **Usurpation**:
  - The ventricular rhythm is too fast, usurping the normal atrial mechanism
  - Ventricular rate is generally normal or fast
- **Default**:
  - The atrial rhythm is too slow, defaulting to the normal escape ventricular mechanism
  - Ventricular rate is generally slow

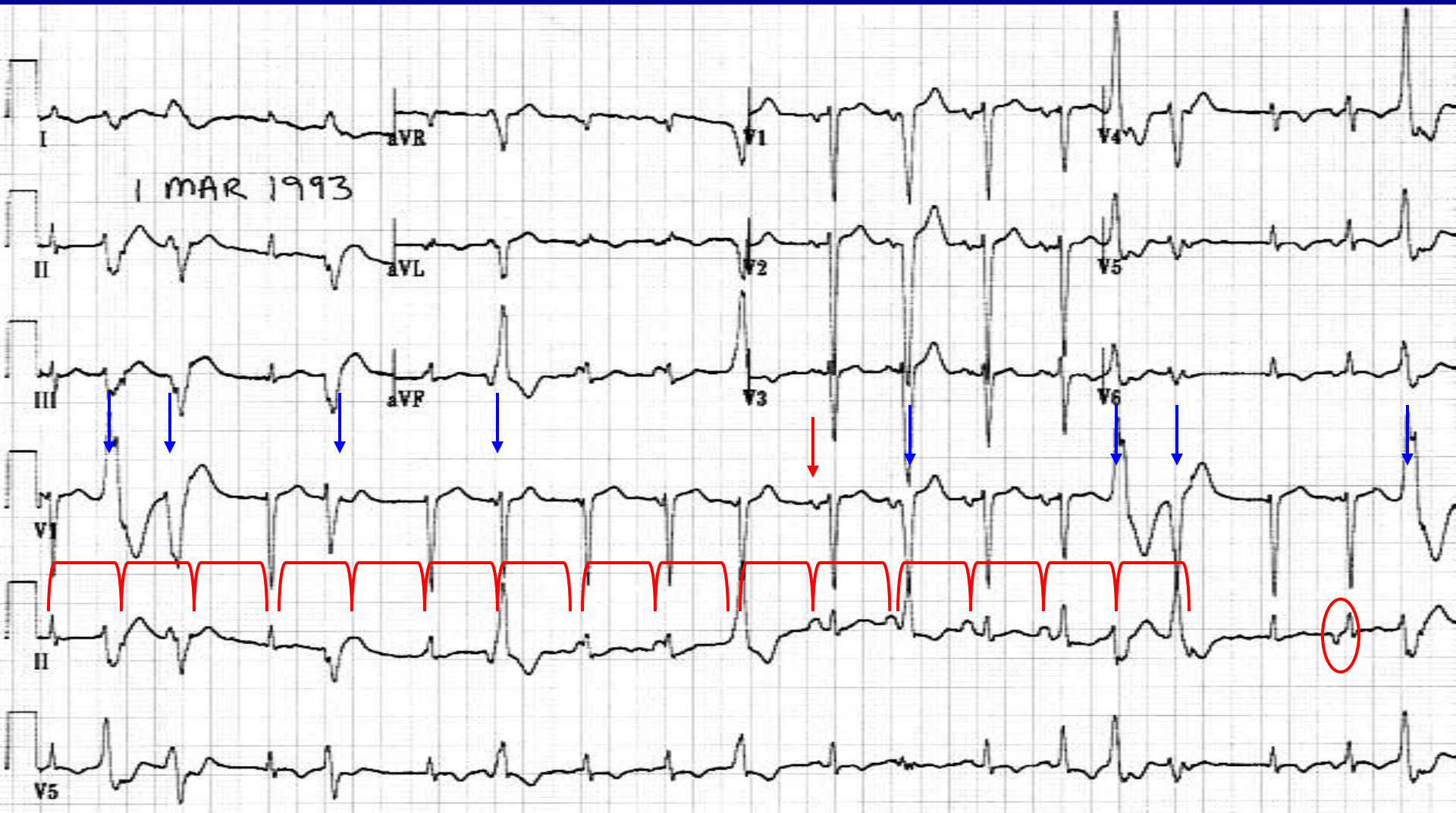
- **Complete** AV dissociation: there is no connection between atrial and ventricular complexes
- **Incomplete** AV dissociation: there is evidence of AV conduction causing an early QRS complex
- **Interference** dissociation: incomplete AV dissociation

- **Isorhythmic** AV dissociation: the PR interval varies but the atrial and venticular rates are identical

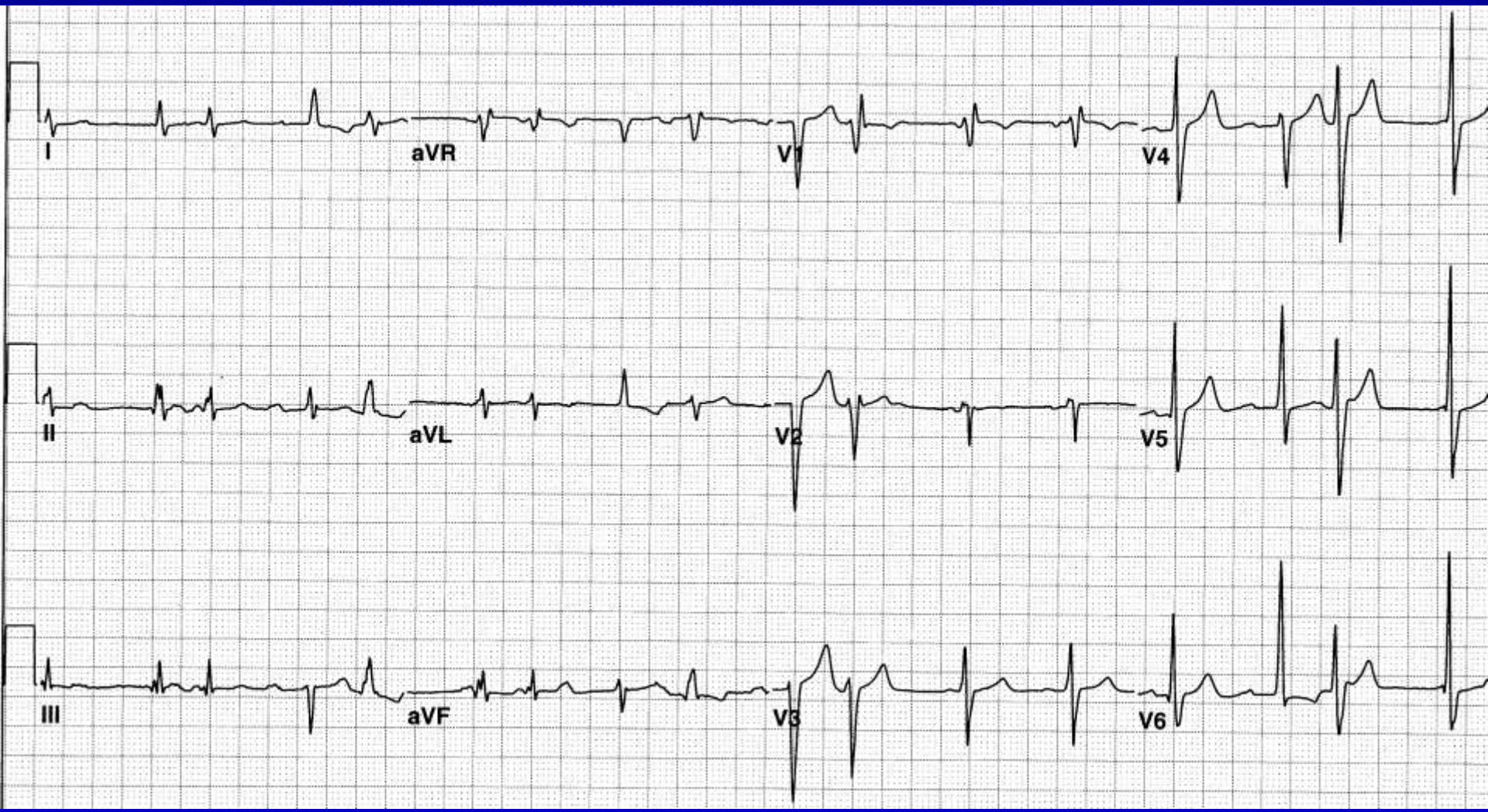
What is the rhythm?



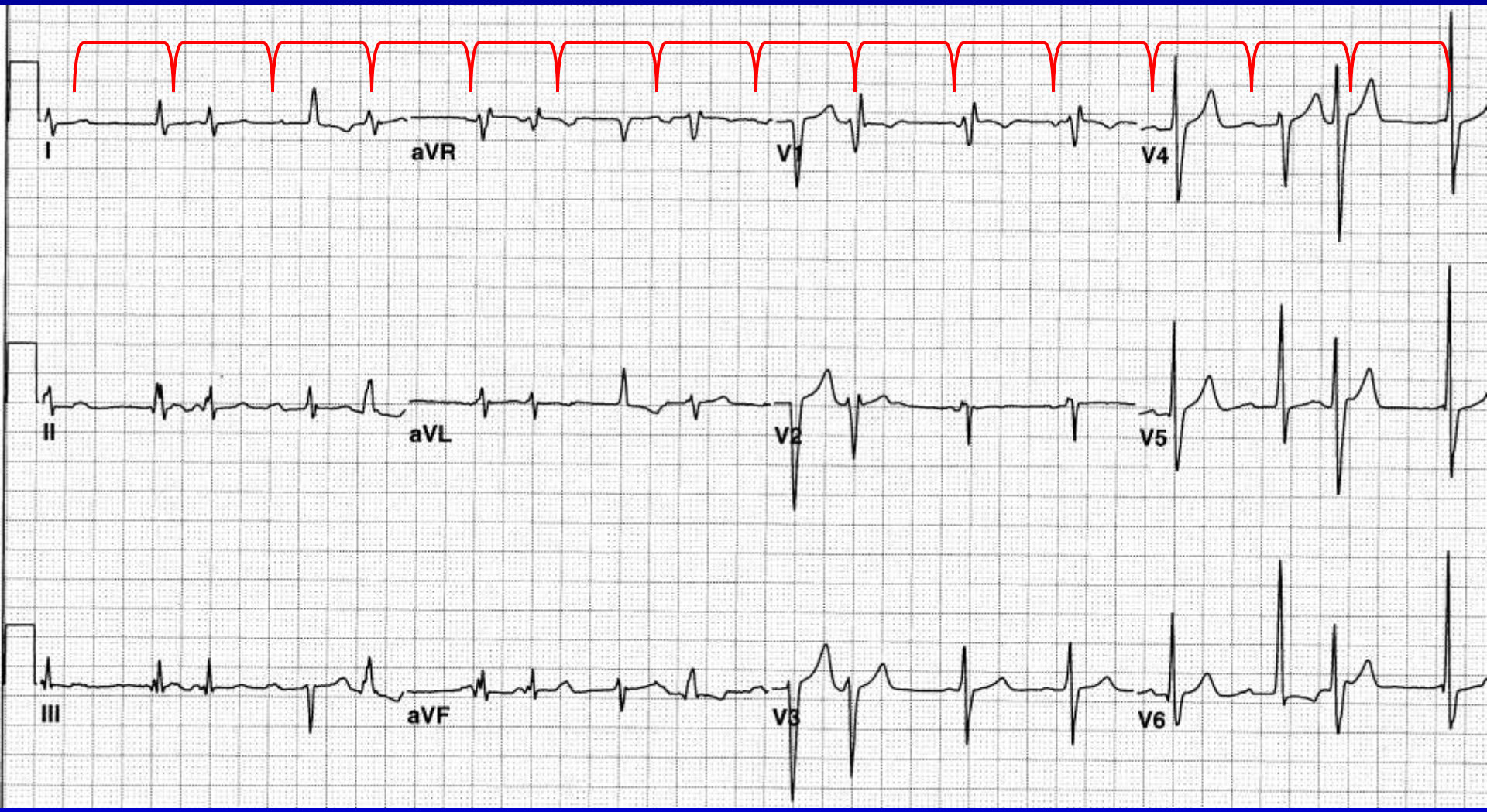
Sinus Tachycardia, PVC's and fusion beats, accelerated junctional rhythm, PAC's



What is the Rhythm?



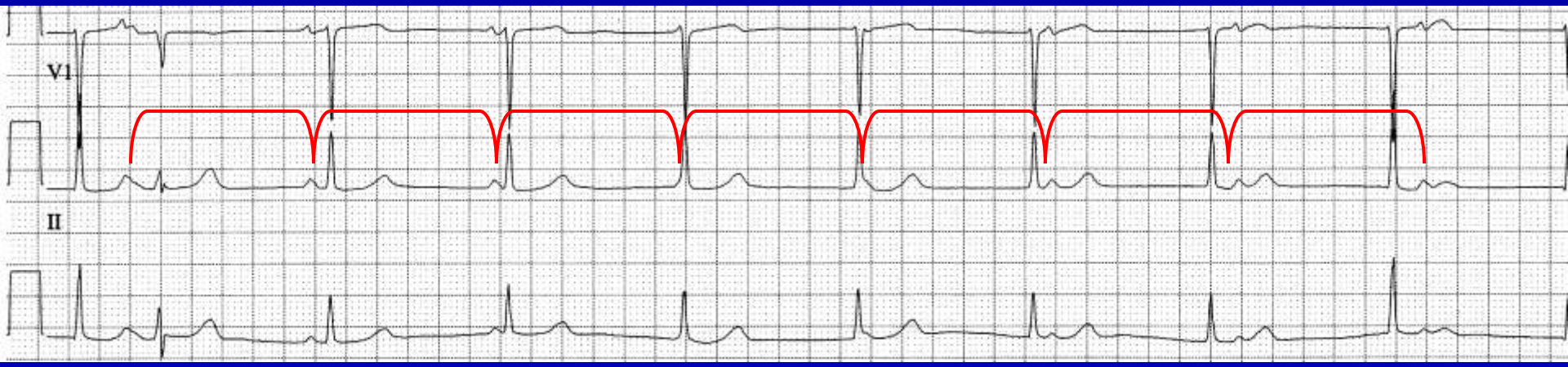
Sinus rhythm, Accelerated Junctional rhythm, PVC's



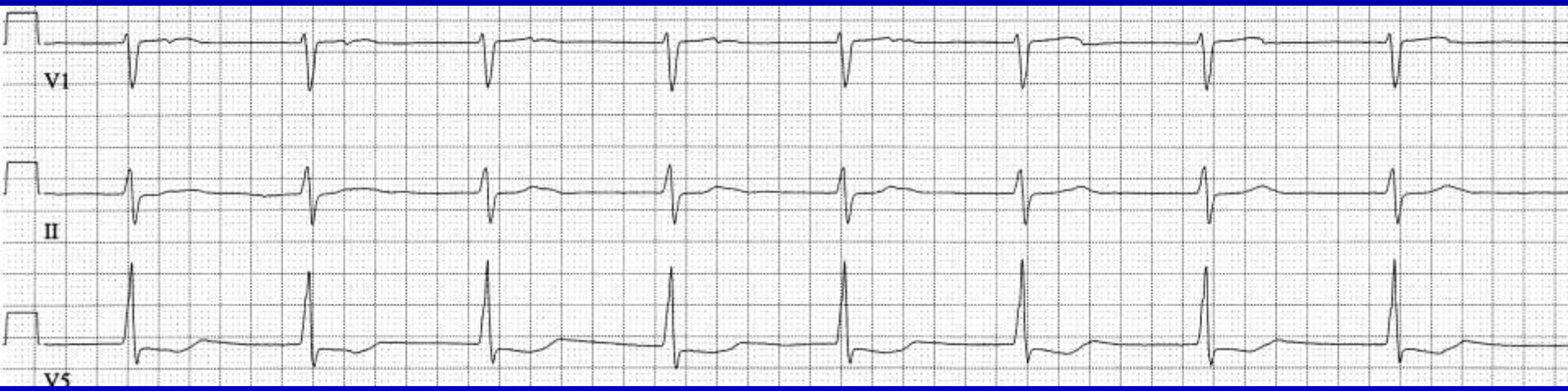
15 P waves, 17 QRS complexes

What is the rhythm?

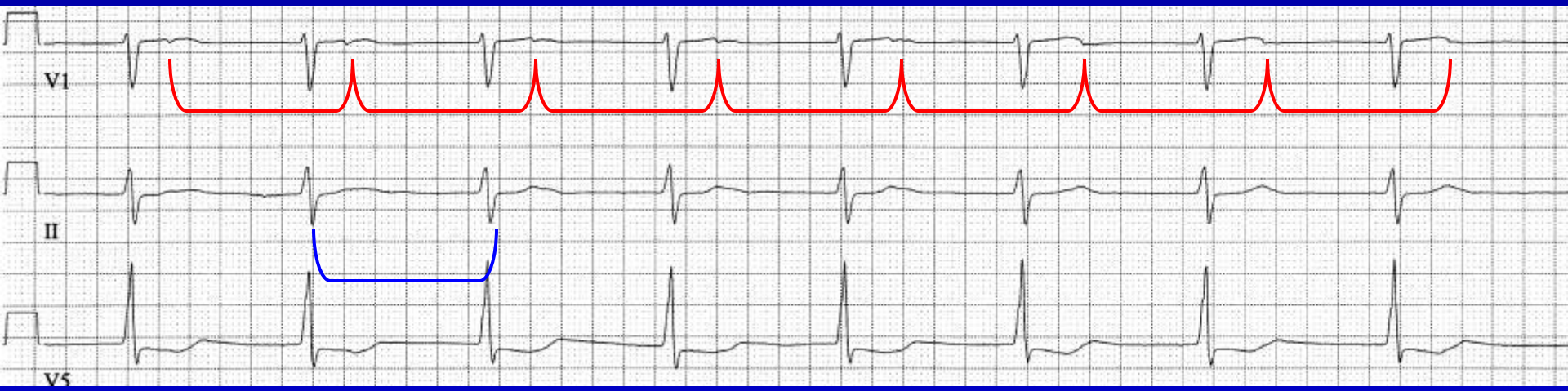
Sinus bradycardia, junctional escape rhythm, AV dissociation with interference (incomplete AV dissociation)



What is the rhythm?

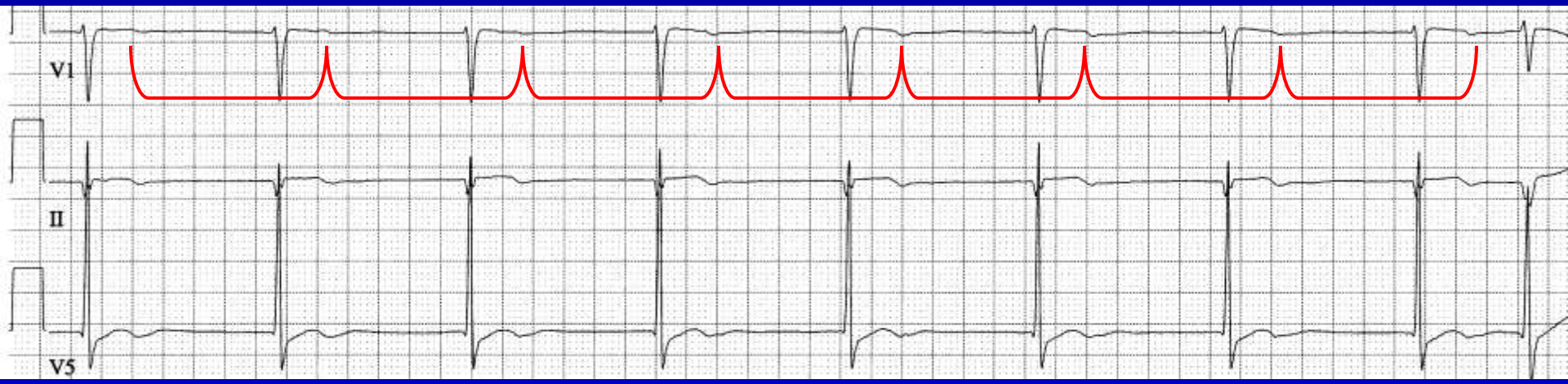


Junctional rhythm, sinus bradycardia, AV dissociation



What is the rhythm?

Sinus bradycardia, junctional escape rhythm, one capture beat



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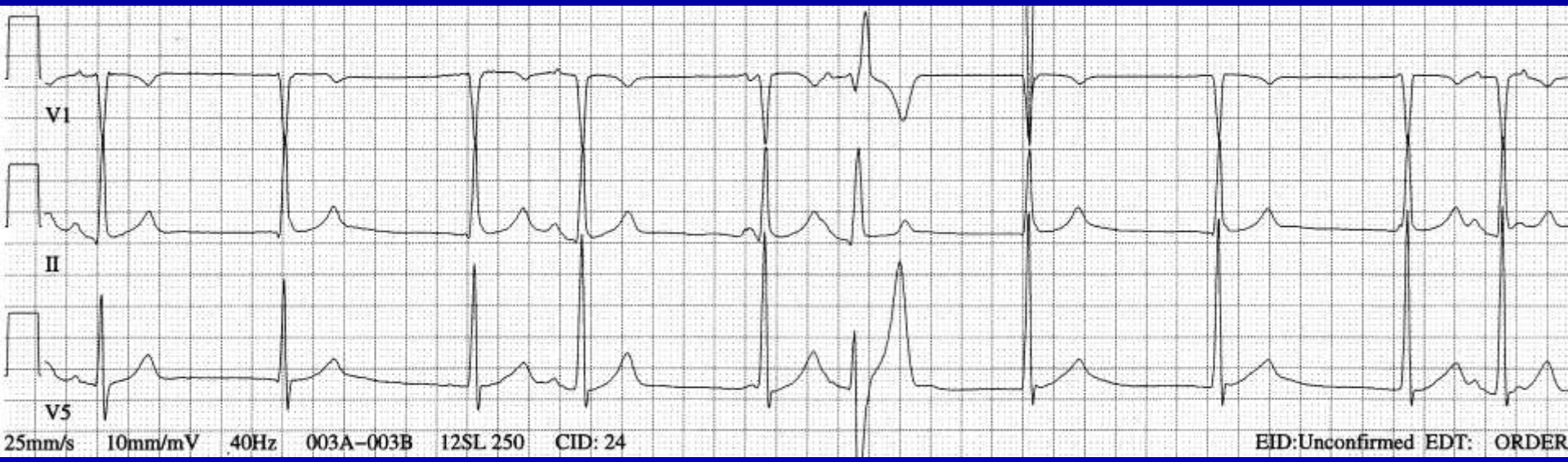
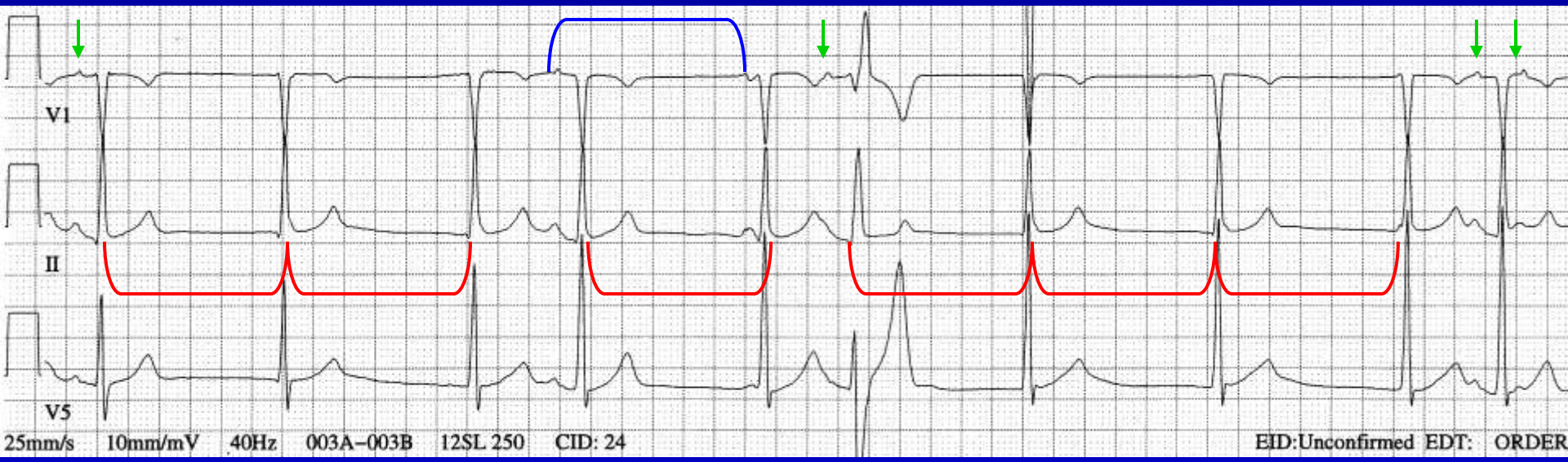


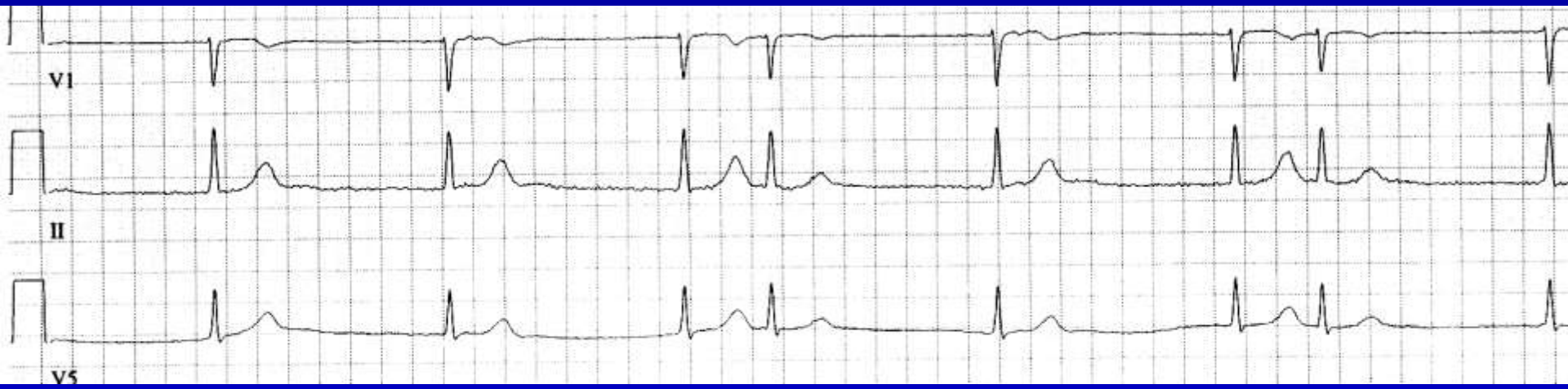
Junctional rhythm, sinus bradycardia, PAC's, some conducted, some aberrant, some nonconducted



What is the Rhythm?

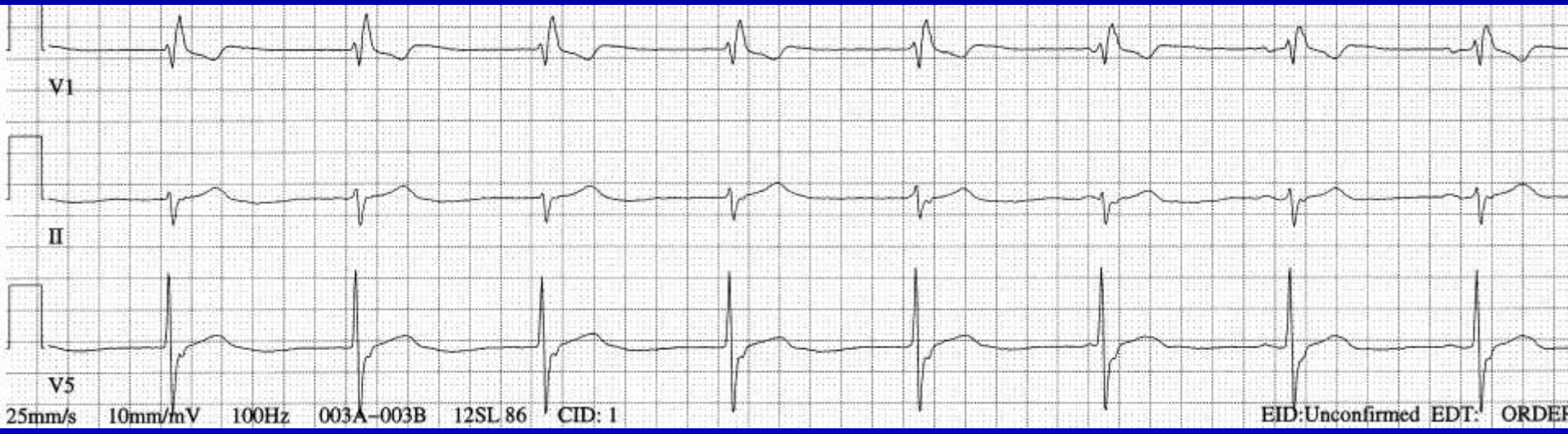
Sinus rhythm, sinus arrhythmia, junctional escape rhythm, isorhythmic AV dissociation

What is the Rhythm?

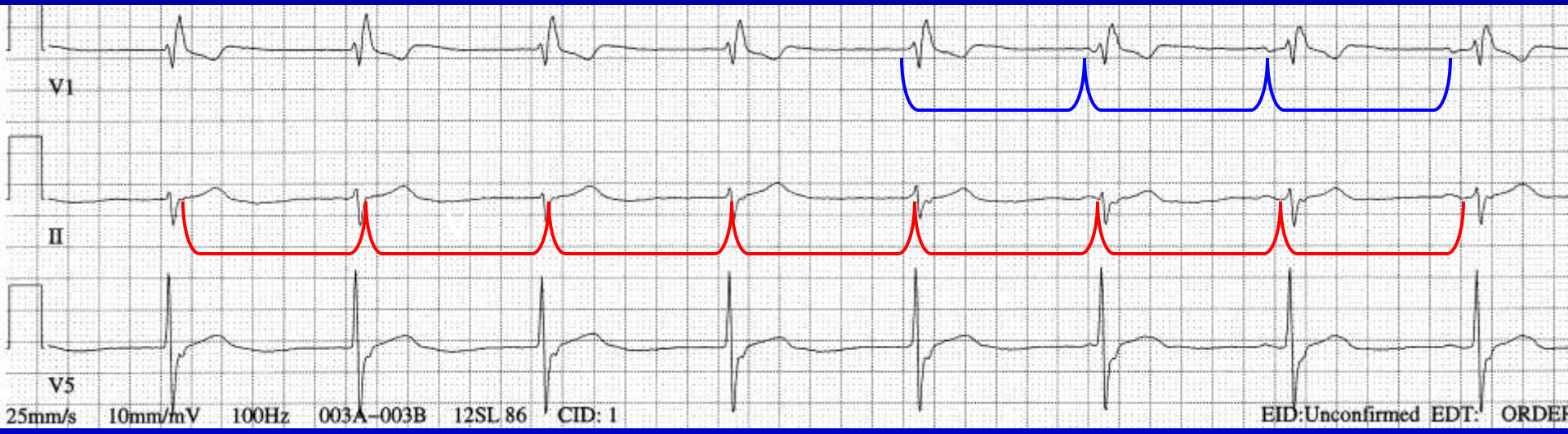


Sinus bradycardia, junctional escape rhythm, AV dissociation with interference, escape capture

What is the rhythm?



Junctional rhythm with RBBB or ventricular escape rhythm, isorhythmic AV dissociation, sinus bradycardia



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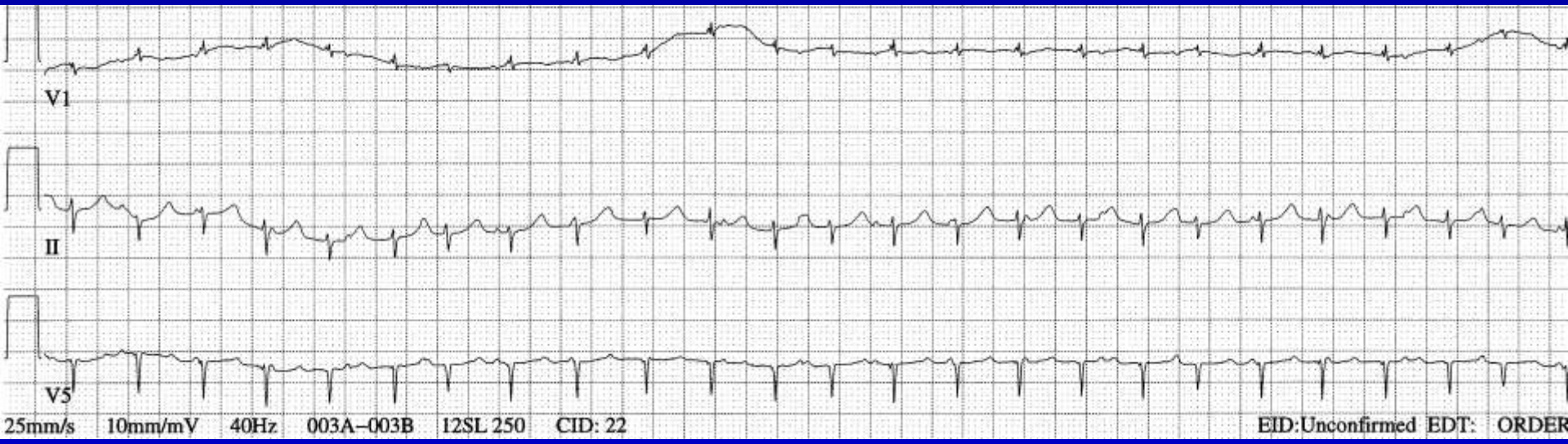
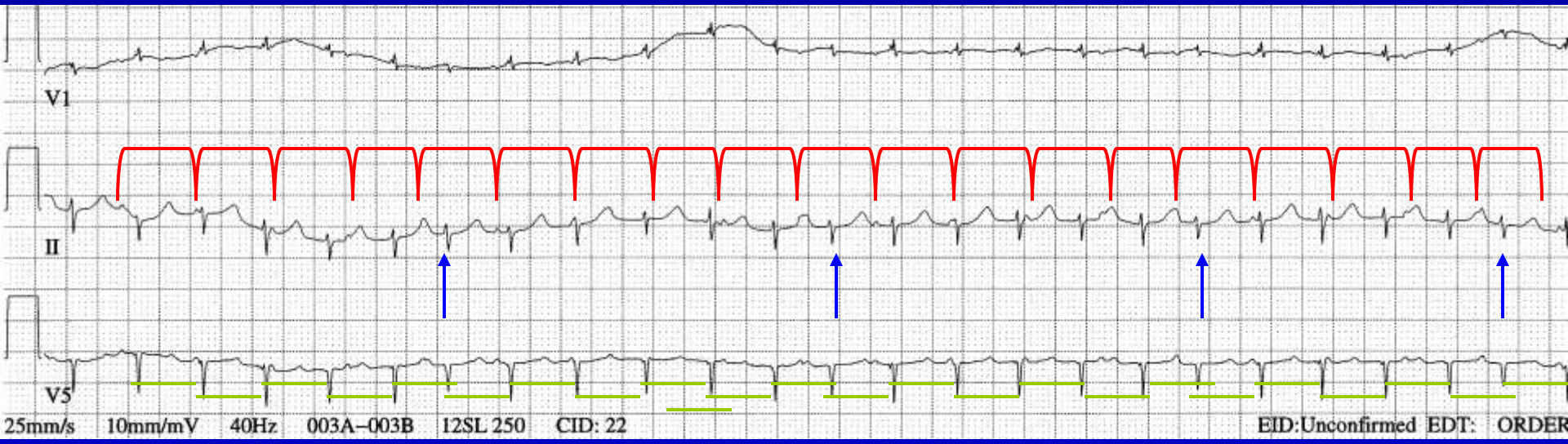


Sinus tachycardia, junctional tachycardia, incomplete AV dissociation



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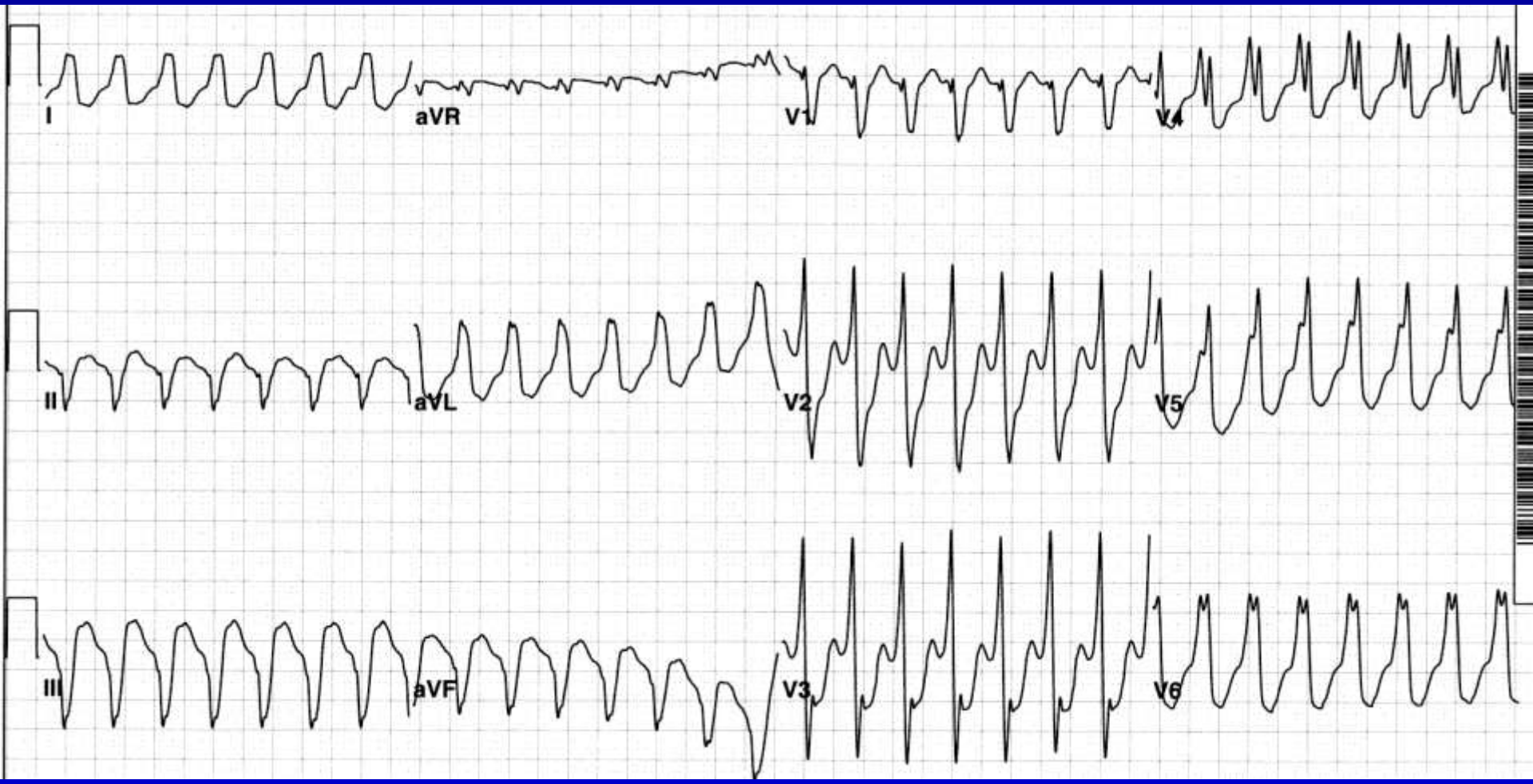

Ventricular tachycardia, sinus rhythm with sinus rate slightly less than half the ventricular rate