Approach to Cardiac Arrhythmias

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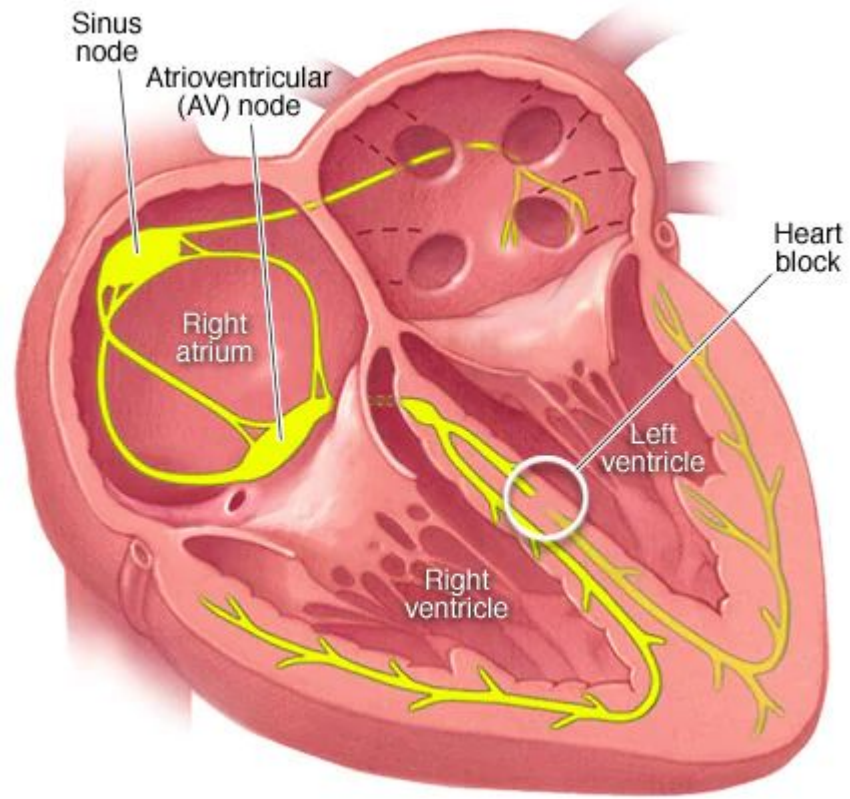
Outline

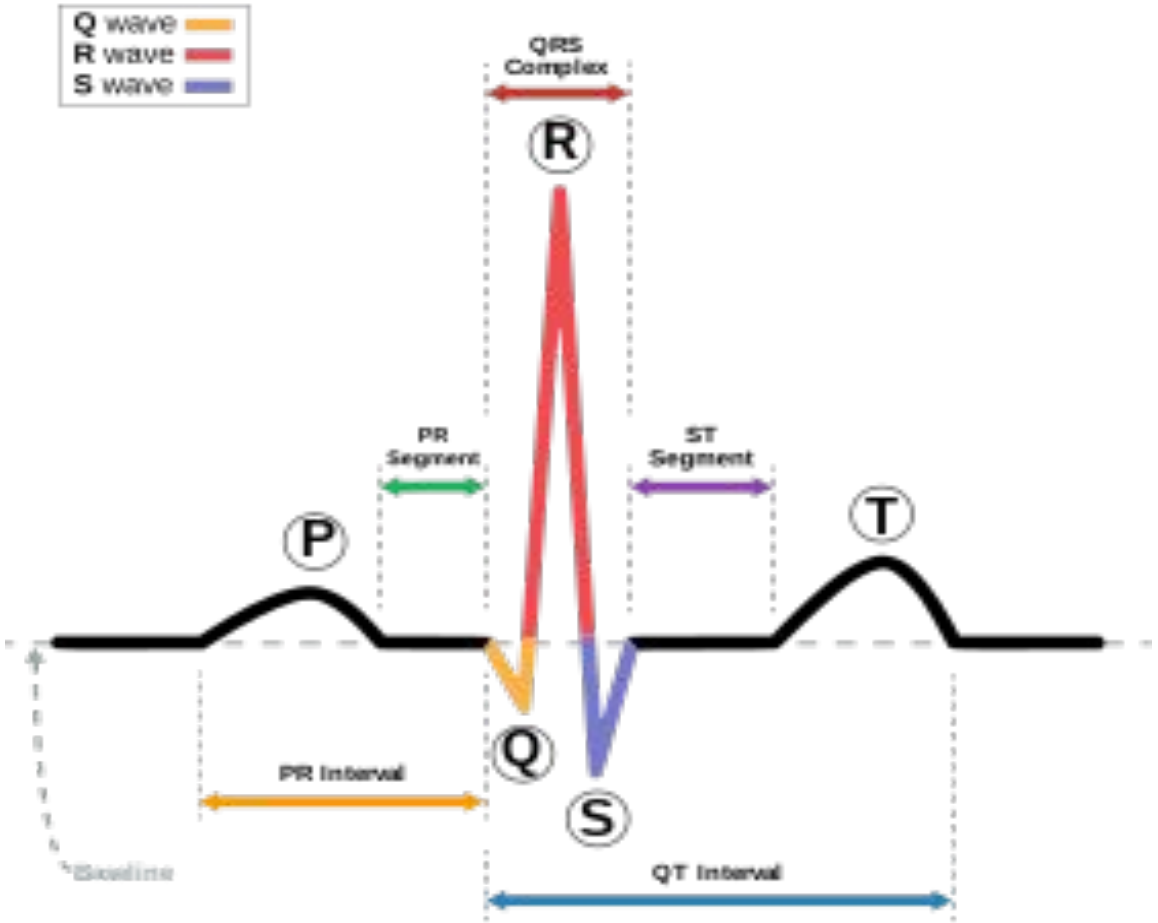
- Overview
- Classification of cardiac arrhythmias
- Approach to diagnosis – EKG interpretation

Overview

Def: Cardiac arrhythmia refers to conditions in which the heart beats irregularly, too slowly, or too quickly.

Conduction Pathway





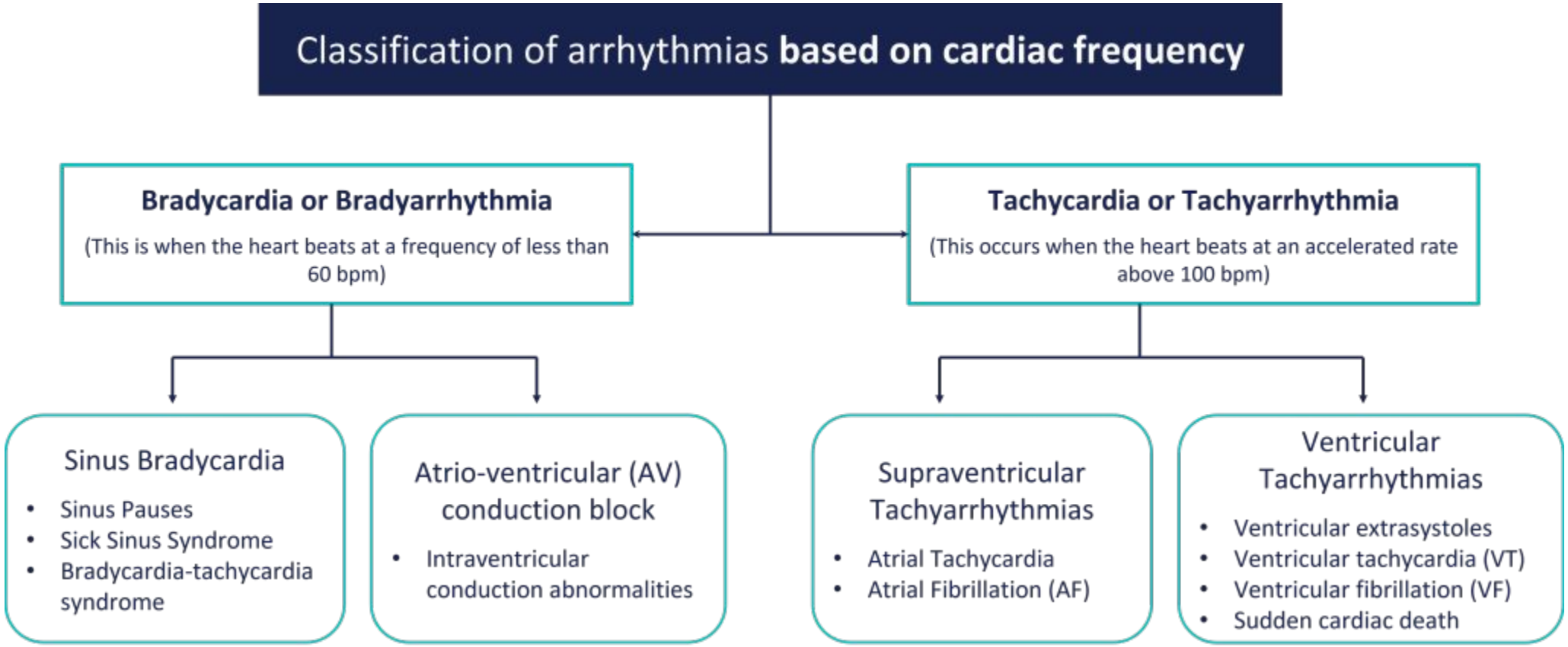
General Causes

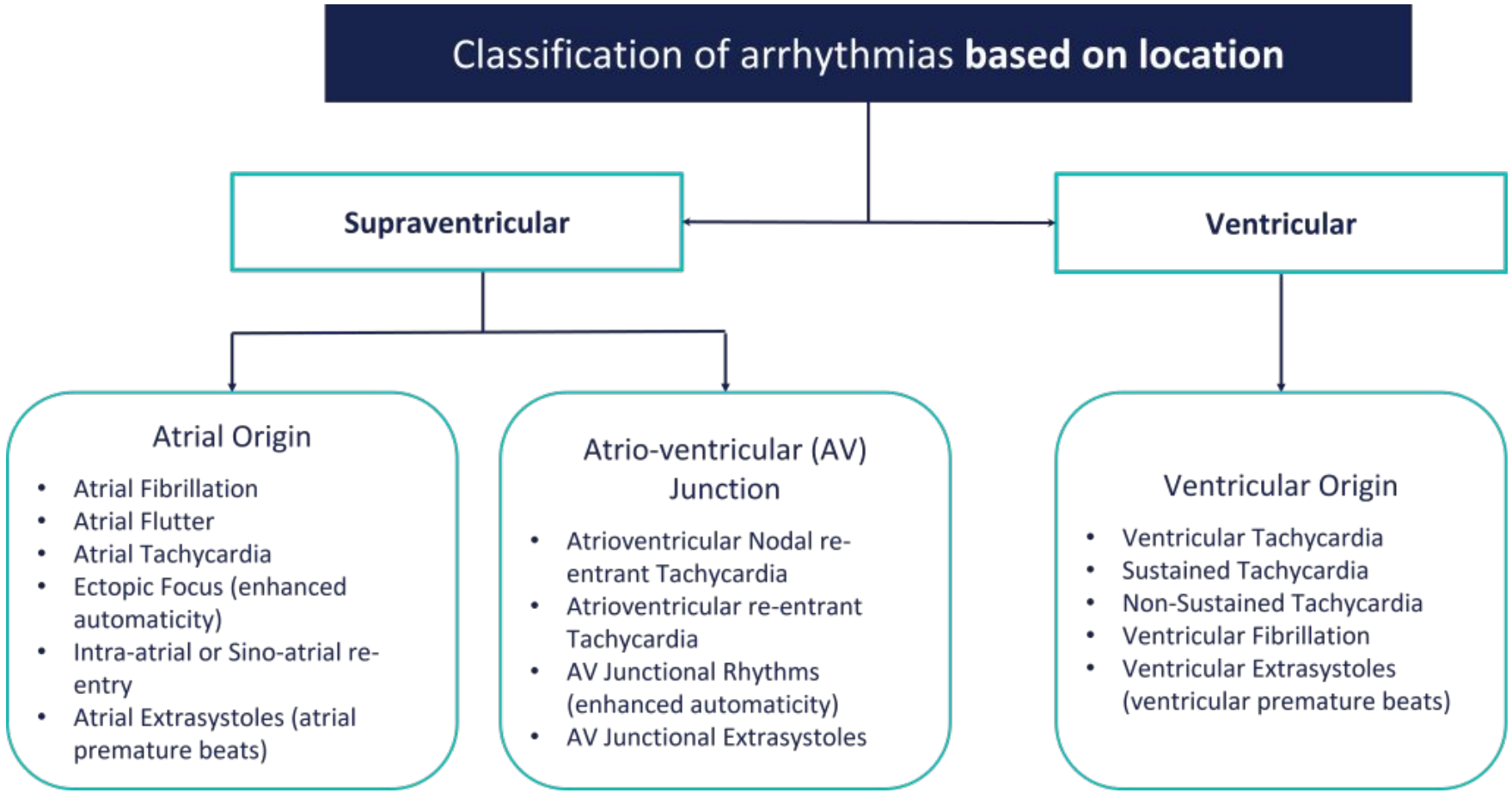
- Electrolyte Imbalances
- Structural heart diseases such as HOCM, valvular heart diseases
- Myocardial ischemia
- Medication
- Stress
- Hormonal changes
- Use of recreational drugs

Clinical Presentation

- Breathlessness
- Dizziness, fainting or nearly fainting
- Fluttering in the chest, known as heart palpitations
- Chest pain
- Lightheadedness, sudden weakness
- Angina, or chest pain
- Confusion
- Difficulty exercising
- Shortness of breath
- Hypotension

Classification of arrhythmias




Classification of arrhythmias based on location
Supraventricular
Ventricular
Atrial Origin
Atrial Fibrillation
Atrial Flutter
Atrial Tachycardia
Ectopic Focus (enhanced automaticity)
Intra-atrial or Sino-atrial re-entry
Atrial Extrasystoles (atrial premature beats)
Atrio-ventricular (AV) Junction
Atrioventricular Nodal re-entrant Tachycardia
Atrioventricular re-entrant Tachycardia
AV Junctional Rhythms (enhanced automaticity)
AV Junctional Extrasystoles
Ventricular Origin
Ventricular Tachycardia
Sustained Tachycardia
Non-Sustained Tachycardia
Ventricular Fibrillation
Ventricular Extrasystoles (ventricular premature beats)

Mechanisms of Arrhythmias

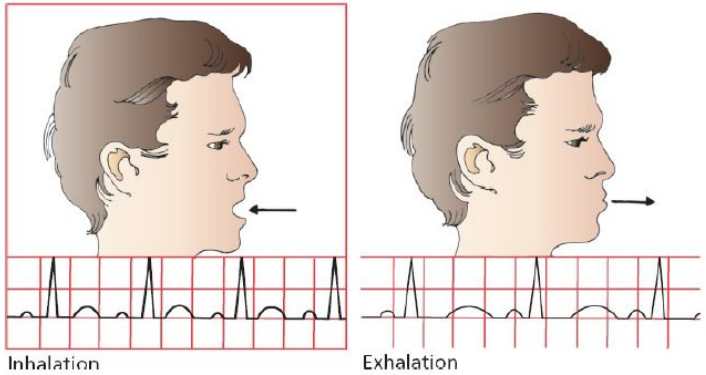
- Arrhythmias of sinus origin

- Ectopic rhythms
- Reentrant rhythms

- Conduction blocks
- Preexcitation syndromes

Arrhythmias of sinus origin

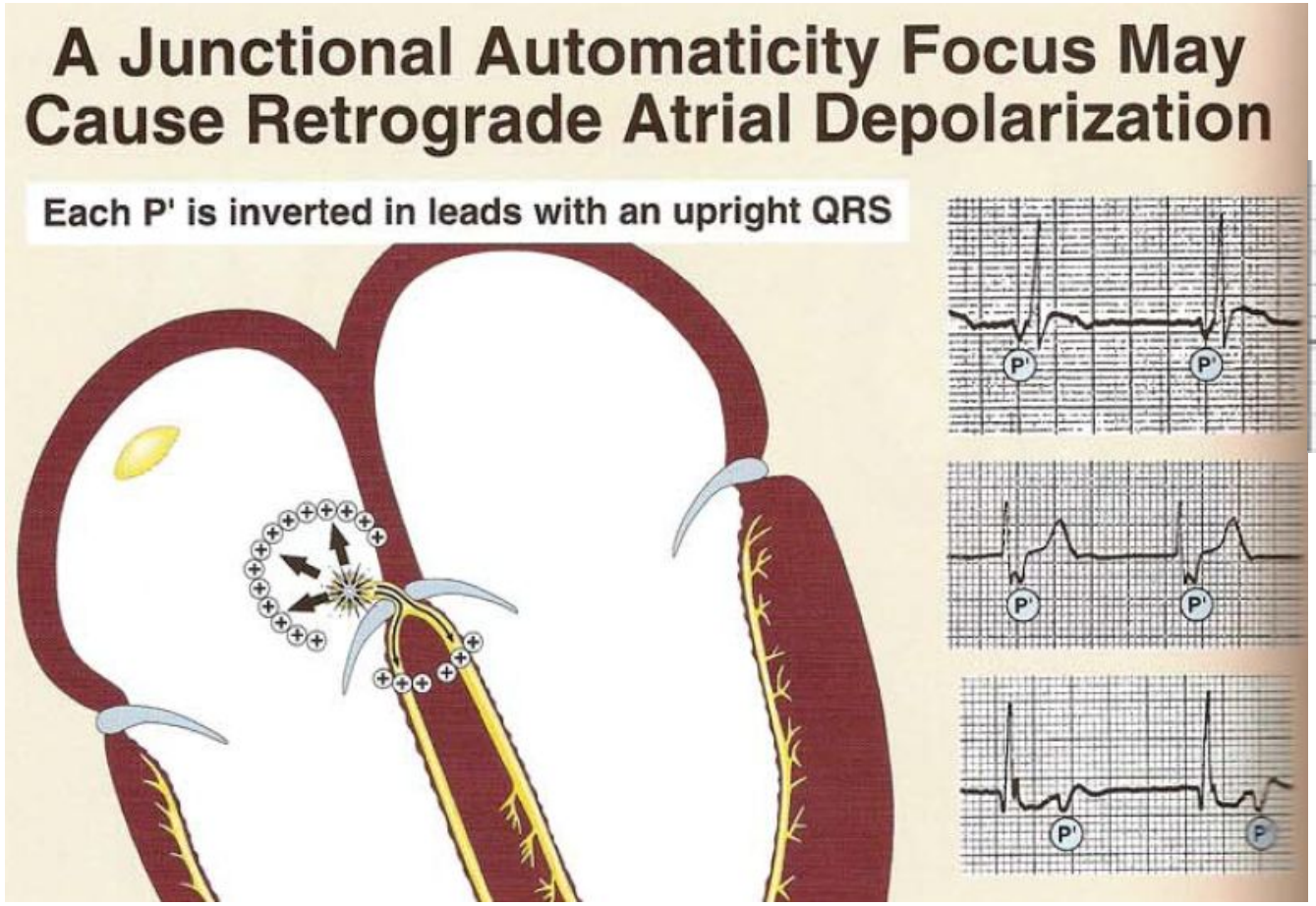
Sinus “arrhythmia”

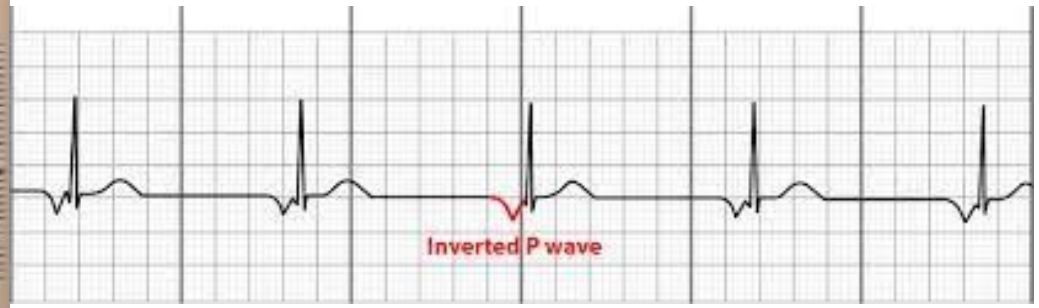


Sinus tachycardia

Sinus bradycardia

Sinus Arrest - Junctional escape





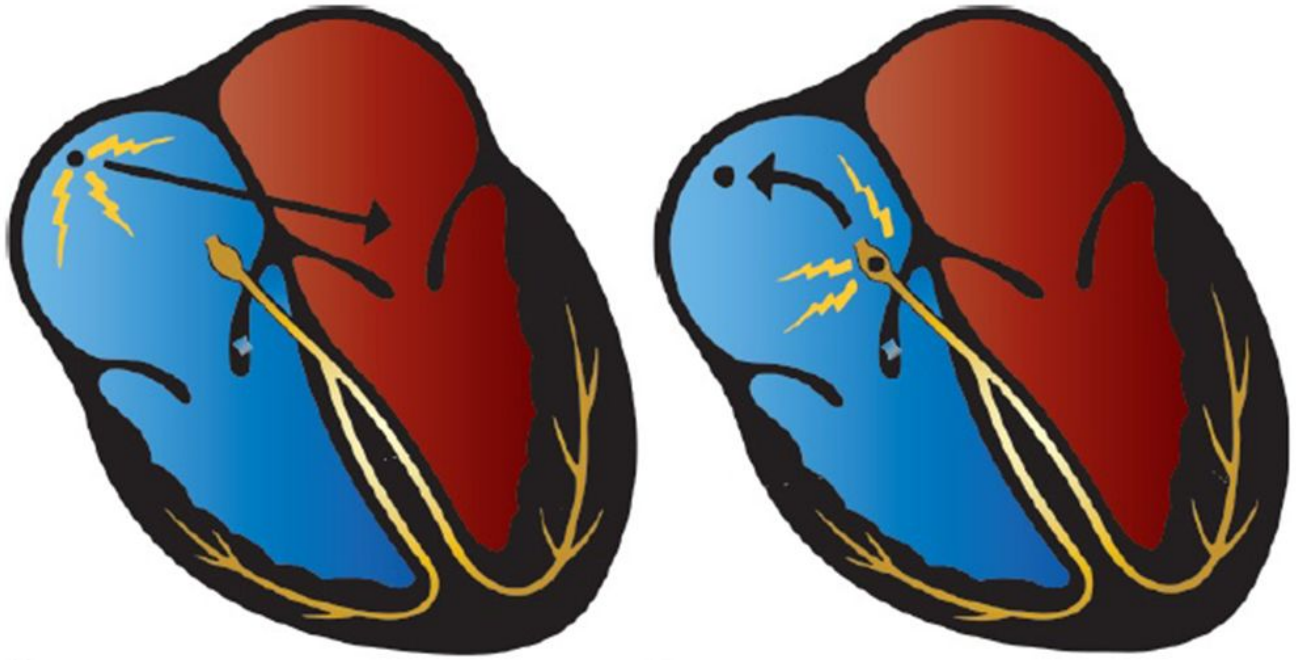
Ectopic rhythms

abnormal rhythms that arise from ***somewhere other than the sinus node***

A disorder of **impulse formation**

Enhanced automaticity

*Non-sinus pacemakers are **stimulated to depolarize faster and faster***



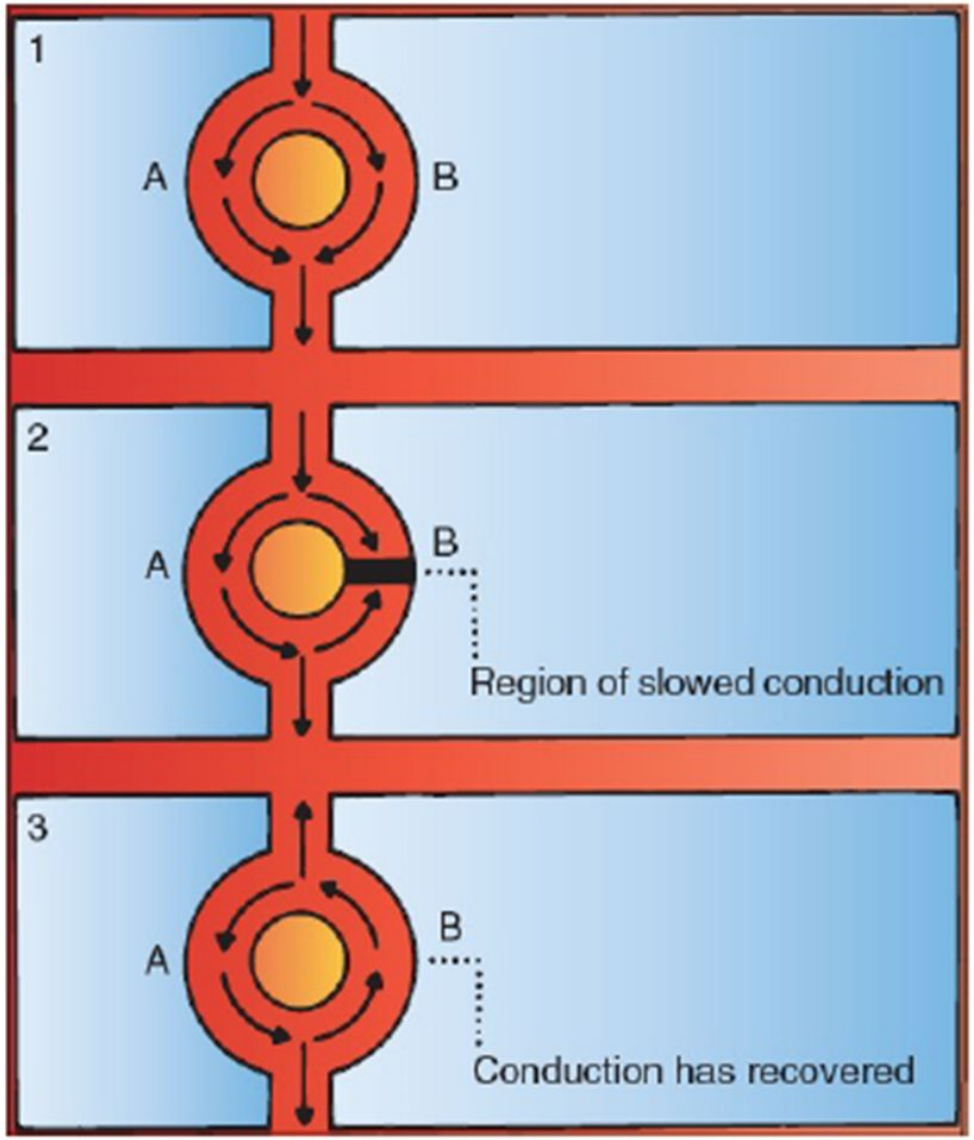
Causes include:

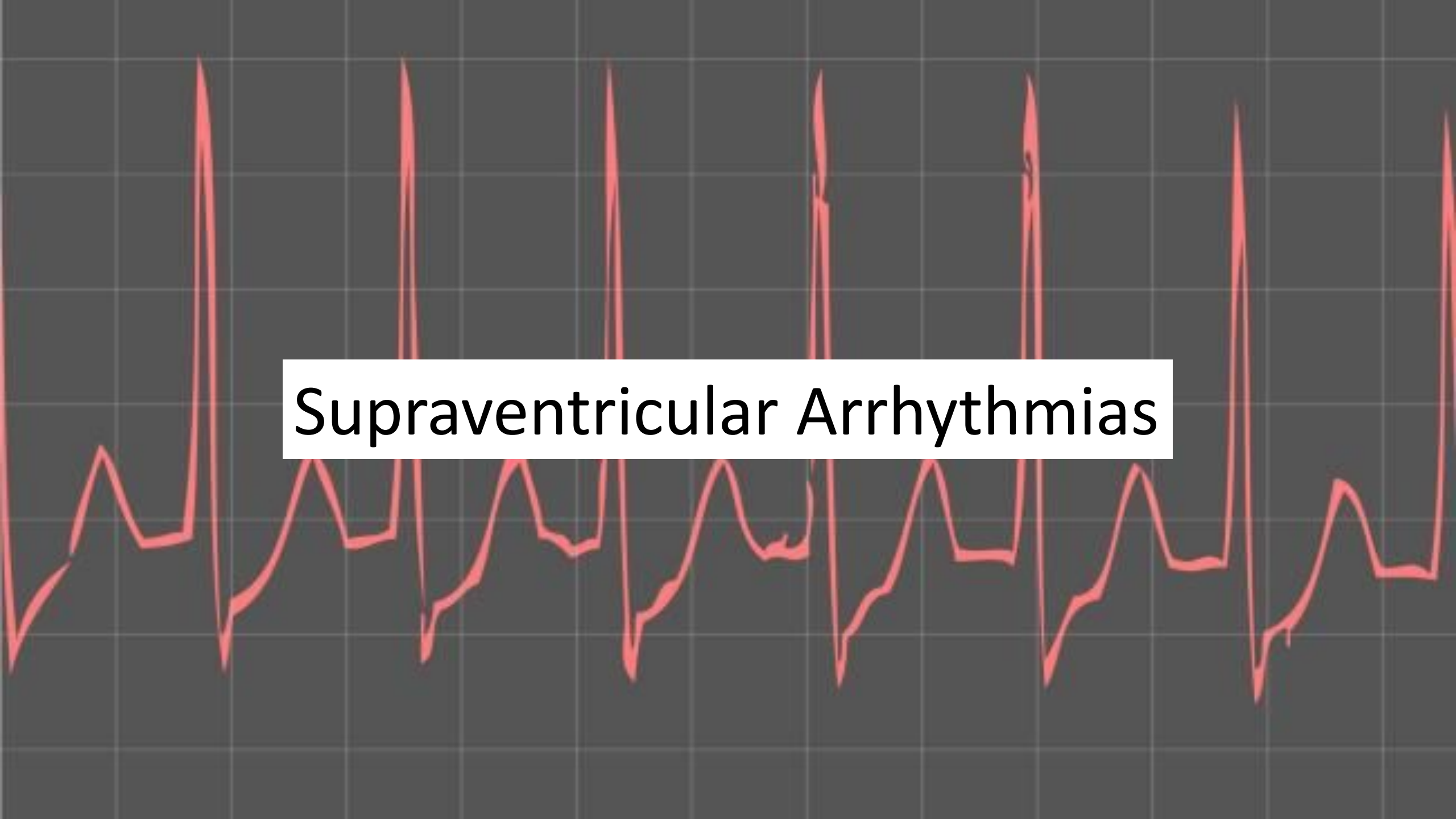
- Beta adrenergic stimulation from inhaler therapies
- Stimulant drugs (cocaine, amphetamines)
- Digitalis toxicity
- Caffeine
- Alcohol

Reentrant rhythms

when ectopic pacemakers
re-excite previously depolarized fibers
before they would become depolarized
in the normal pathway

A disorder of **impulse transmission**





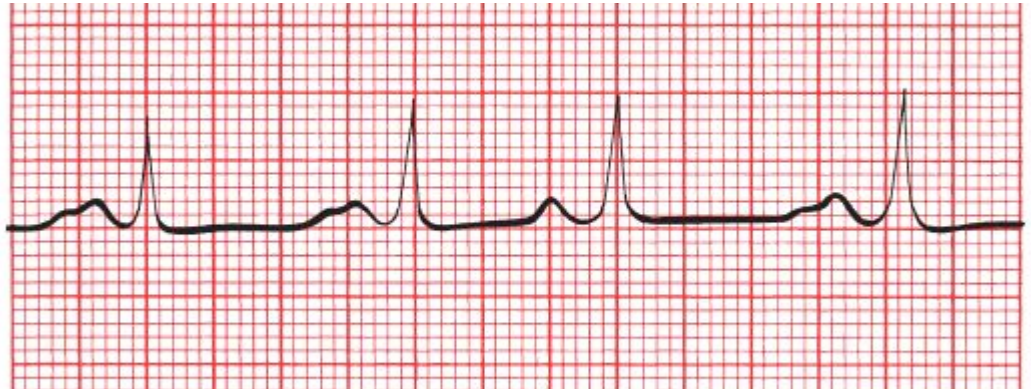
Supraventricular Arrhythmias

Supraventricular Arrhythmias

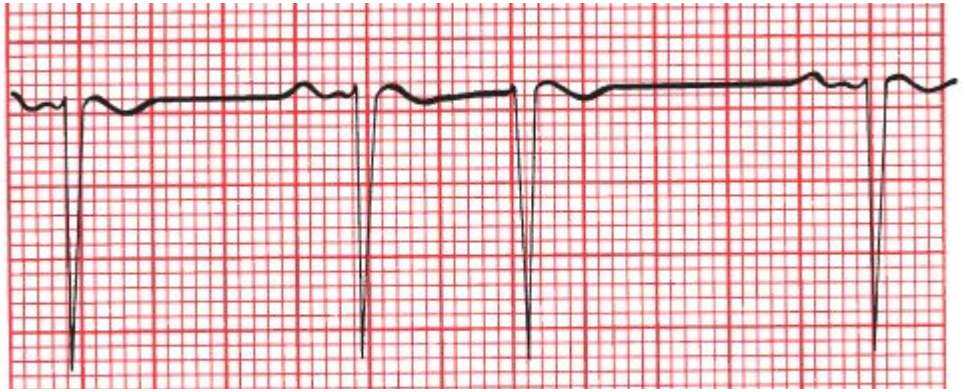
- Premature beats
- AV nodal reentrant tachycardia (AVNRT)
- Atrial flutter
- Atrial fibrillation
- Multifocal atrial tachycardia (MAT)
- Focal atrial tachycardia (FAT)

Premature beats

Atrial premature beat



Junctional premature beat

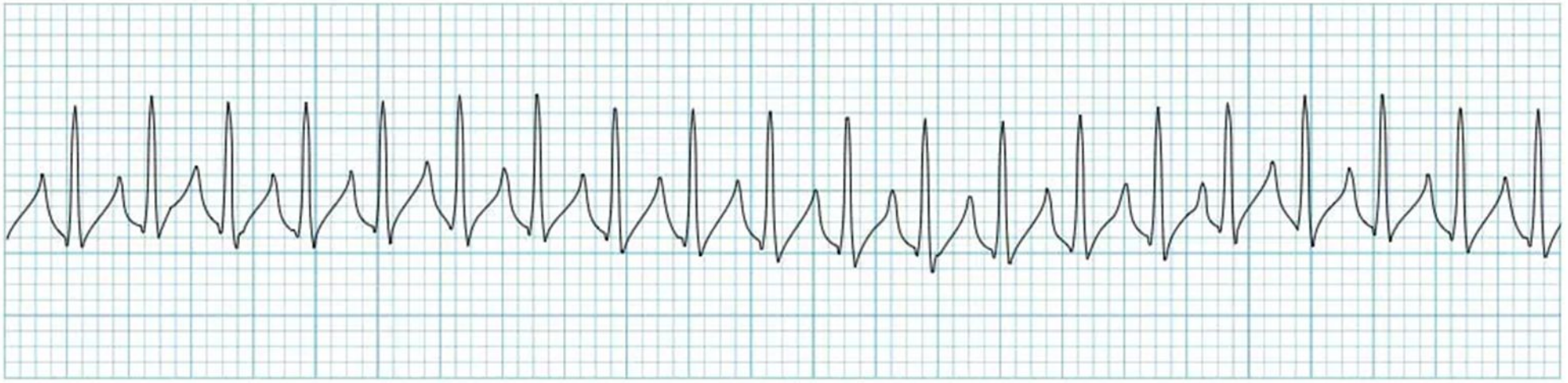


AV Nodal Reentrant Tachycardia (**AVNRT**)

"SVT"

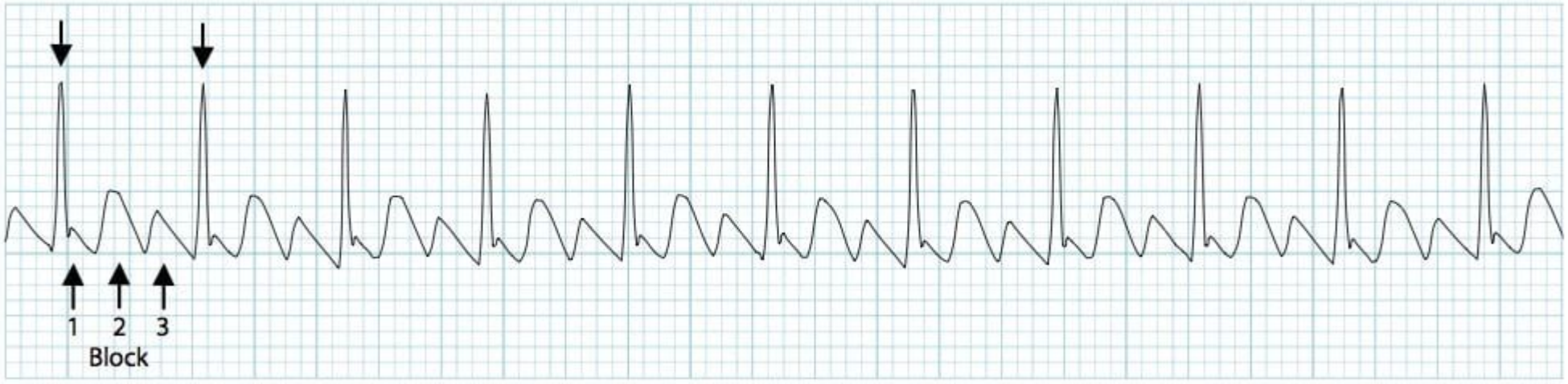
Absolutely regular

- Usual heart rate is **150-250 bpm**



A Flutter

- Regular rhythm
- Reentry circuit around the Right atrium
- Saw-toothed partner of P-waves
- Narrow QRS
- Rapid atrial rate



Atrial fibrillation

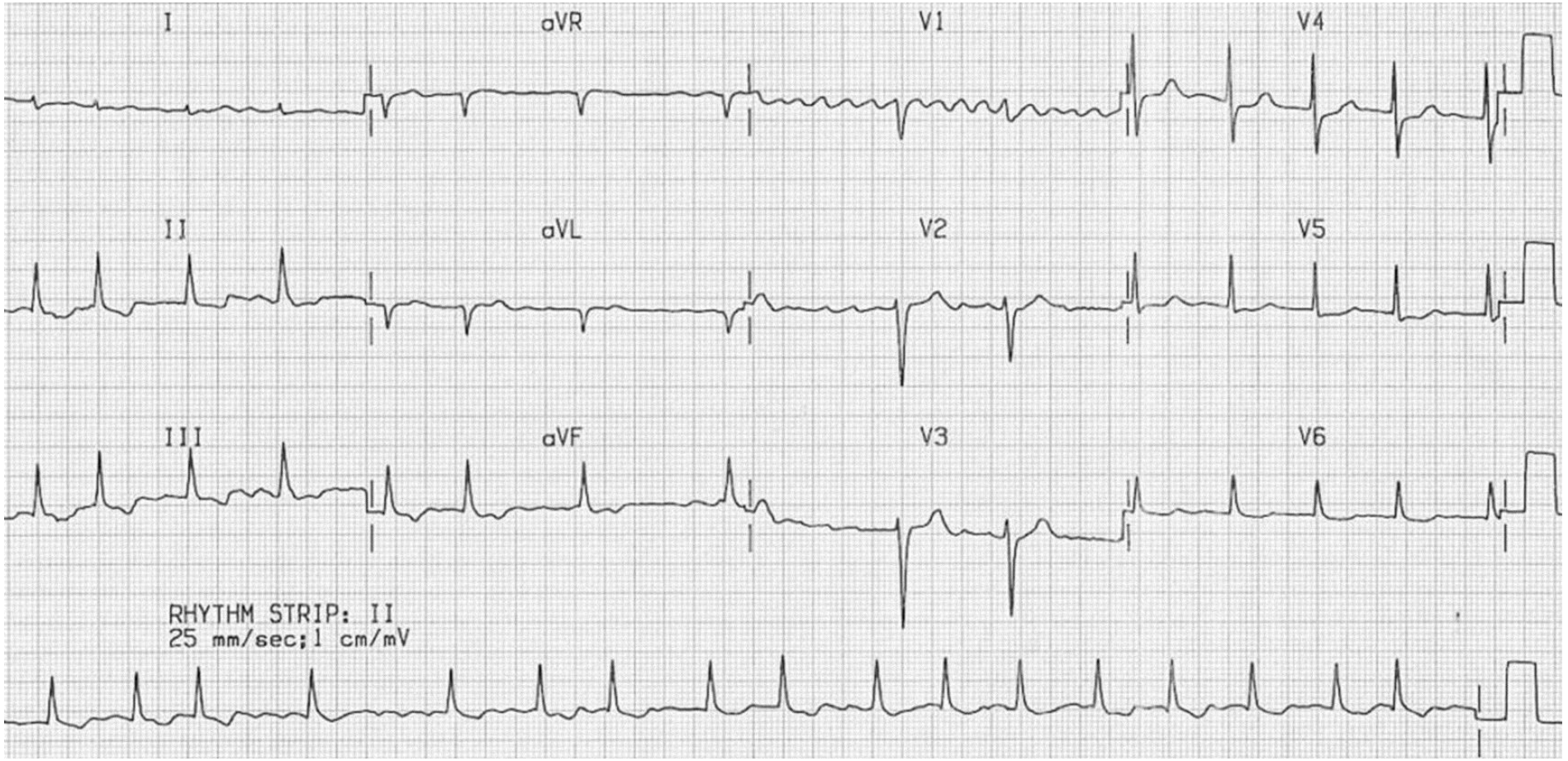
Atrial activity is completely chaotic

No P waves

- Usually 120-180 bpm (but can be slower or faster)

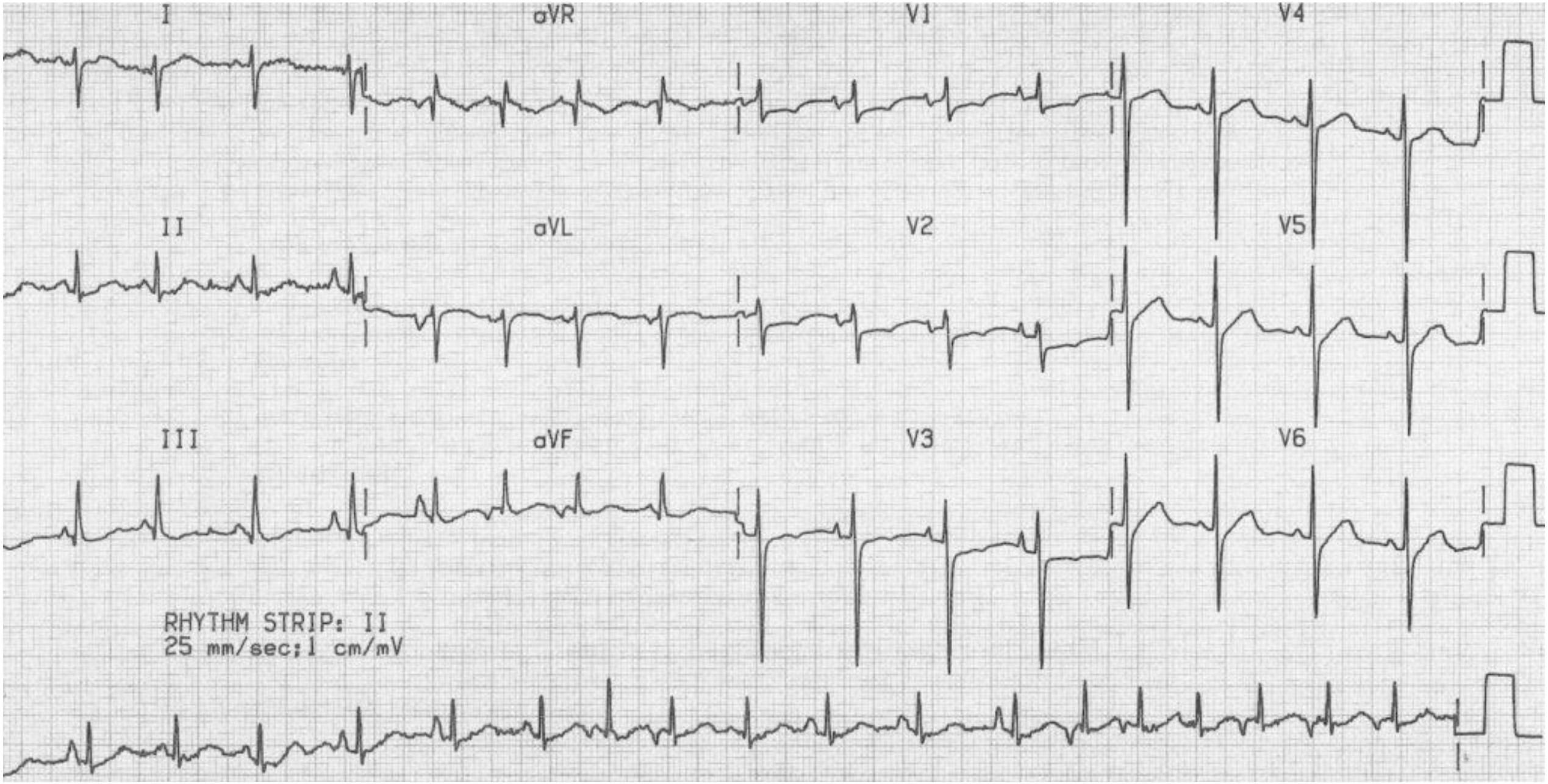
- AV node allows conduction in variable intervals, so ***irregularly irregular*** ventricular rate

Atrial fibrillation with rapid ventricular response (**Afib with RVR**)



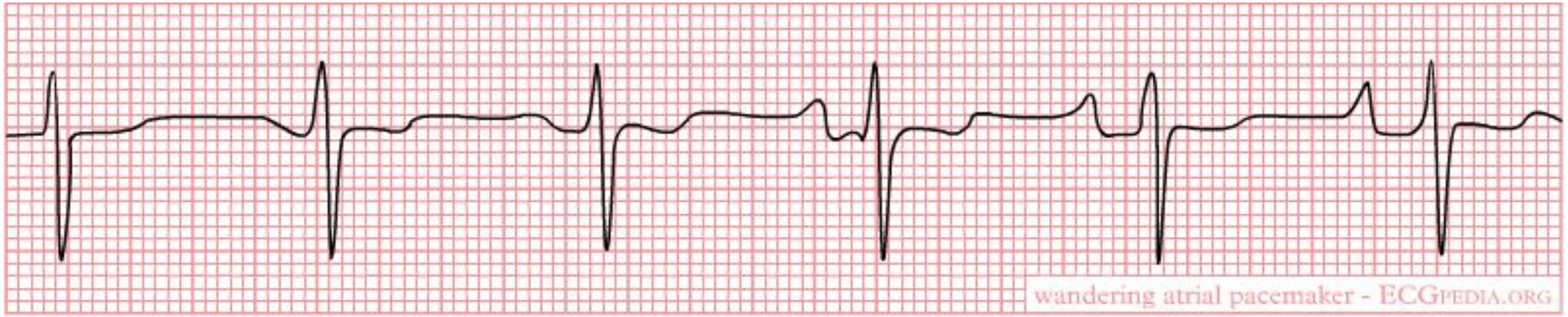
Multifocal Atrial Tachycardia (MAT)

- **Irregular** rhythm at rate of 100-200 bpm
- Common with severe lung disease
- P waves will vary in shape
- Diagnosis requires **at least 3 different P wave morphologies**


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

Wandering atrial pacemaker

- Irregular rhythm at rate of less than 100 bpm
- 2 or 3 beats of one pacemaker before moving to another



Focal Atrial Tachycardia (FAT)

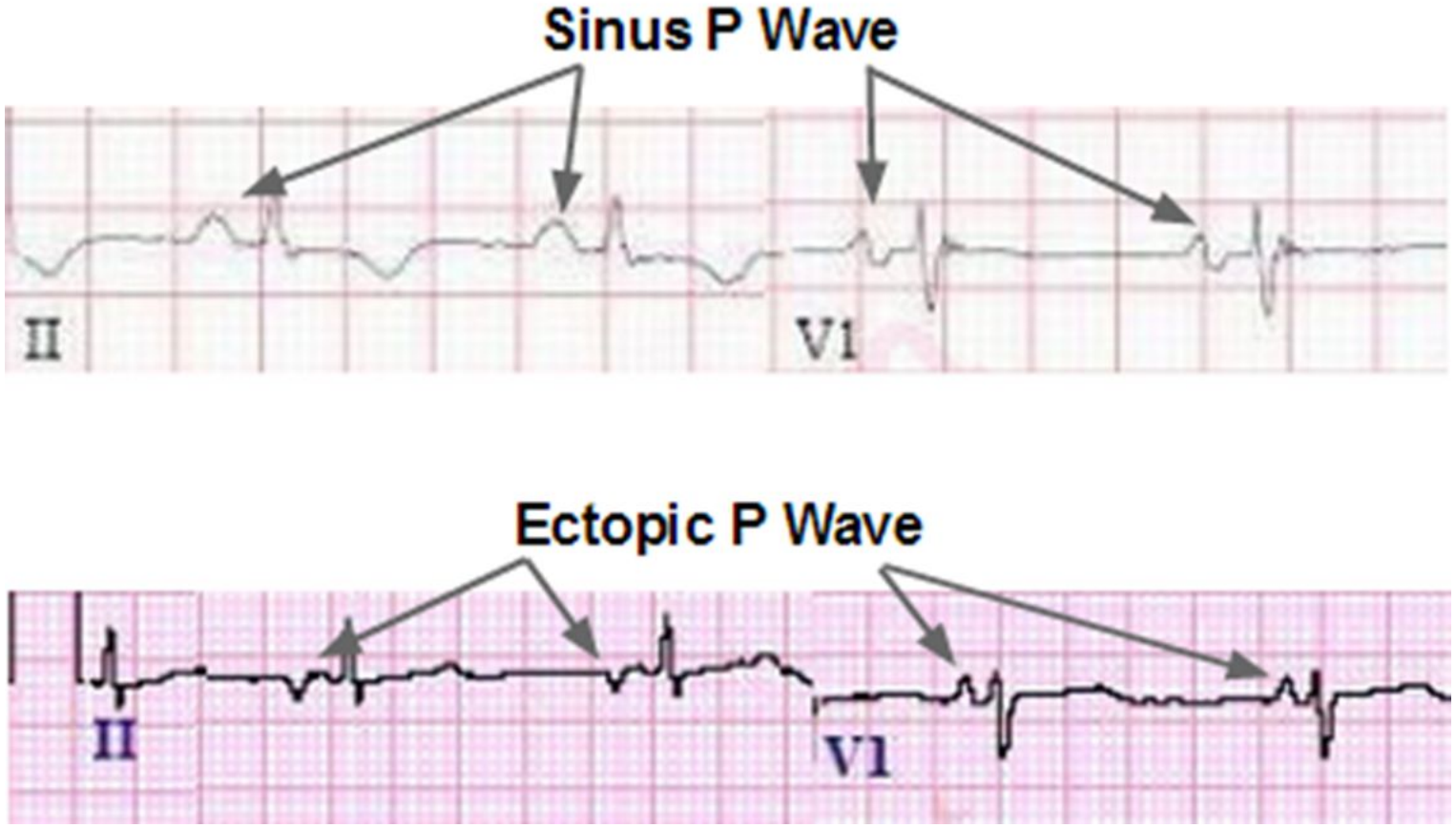
Regular rhythm

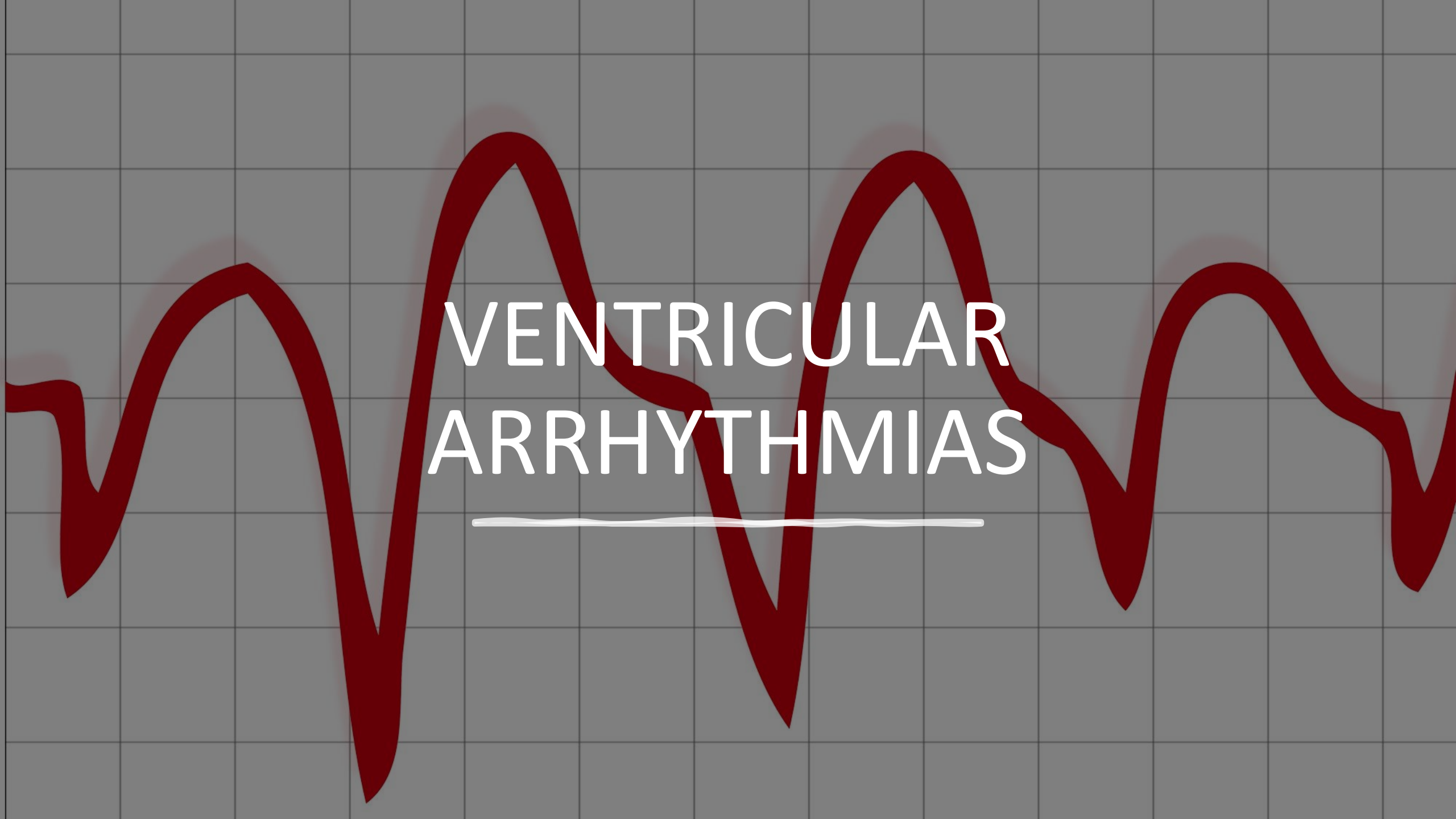
- Rate of 100-200 bpm

- Abnormal P wave morphology (e.g. inverted in inferior leads)
- (P waves not always visible)

- Also known as **“Paroxysmal Supraventricular Tachycardia”**
- Also known as **“Paroxysmal Atrial Tachycardia”**

Focal Atrial Tachycardia (FAT)




VENTRICULAR
ARRHYTHMIAS

Narrow QRS

SUPRAVENTRICULAR

Broad QRS

VENTRICULAR

Ventricular Arrhythmias

- Premature Ventricular Contractions
- Ventricular Tachycardia
- Ventricular Fibrillation
- Accelerated Idioventricular Rhythm
- Torsade de Pointes

Premature ventricular contraction (PVC)

- Most common ventricular arrhythmia
- QRS duration over 120 ms (or 3 small boxes)

- Isolated PVCs are common in normal hearts

- Can occur randomly
- Can alternate one sinus beat for every PVC (called **bigeminy**)
- Can alternate two sinus beats for every PVC (called **trigeminy**)

Premature ventricular contraction (PVC)

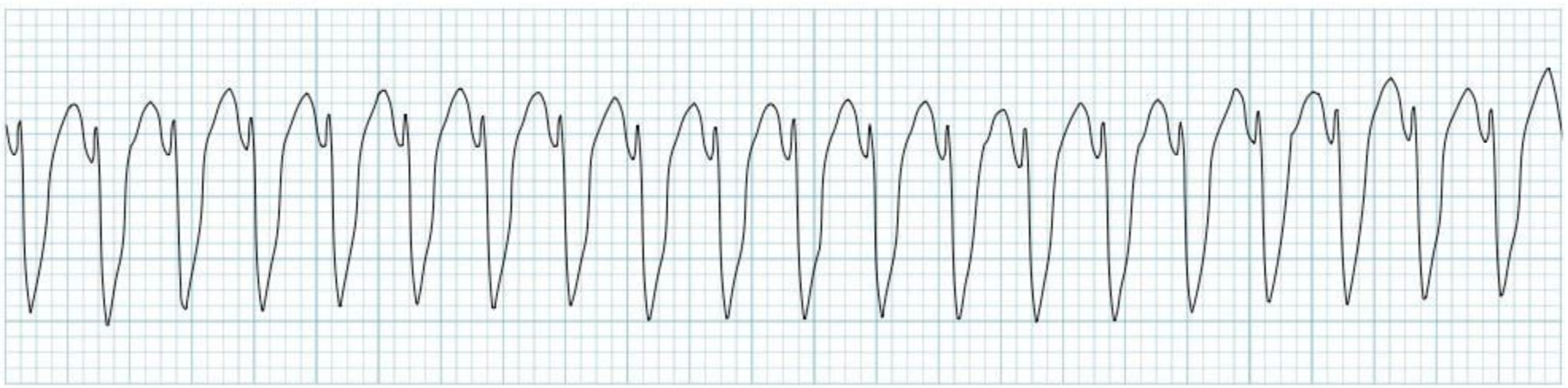
Ventricular tachycardia

- **Regular**, wide complex tachycardia

- Three or more PVCs is called Ventricular tachycardia
- Rate usually **between 120 and 200 bpm**
- May be slightly irregular

- Hemodynamic instability or sustained Vtach (longer than 30 seconds) are emergencies requiring immediate treatment

Monomorphic Ventricular tachycardia




I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
50 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 1 rhythm ld
MAC5K 005A
12SL™v231

Ventricular Fibrillation

- Irregular, chaotic deflections of varying amplitude
- Rate **150 to 500 per minute**

- **No identifiable P waves, QRS complexes, or T waves**

- Amplitude decreases with duration (coarse VF –> fine VF)

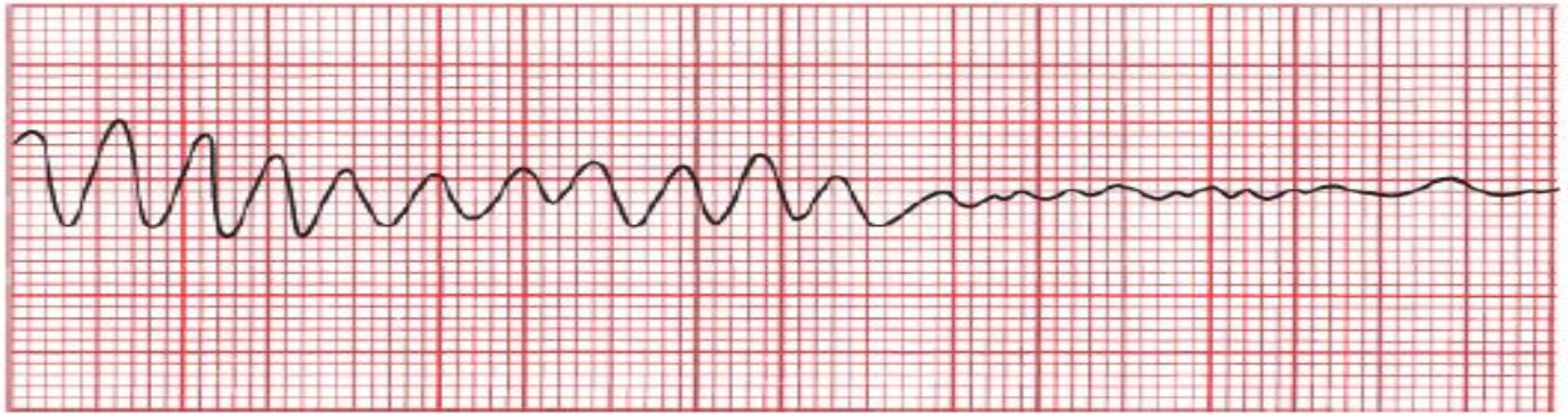
Ventricular Fibrillation

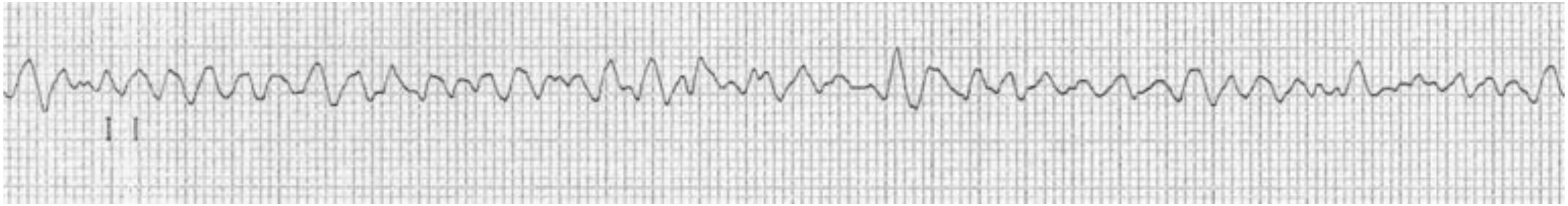
- A preterminal event seen in dying hearts
- Most frequent rhythm in adults who experience sudden death

- ECG jerks wildly (coarse vfib) or ripples gently (fine vfib)

- Heart generates **no cardiac output**

Ventricular Fibrillation





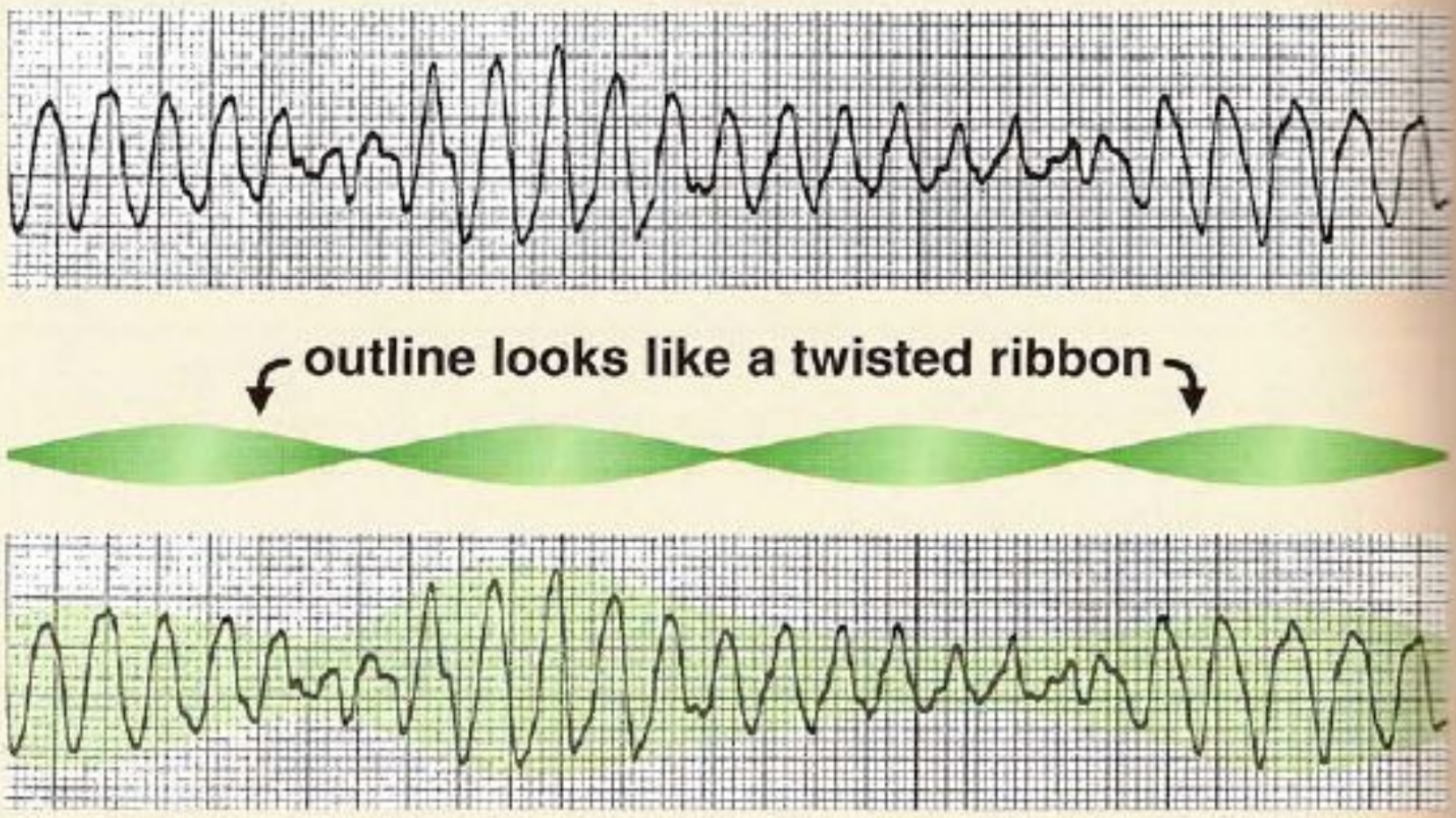
Torsade de Pointes
(twisting of the points)

- A form of **POLYMORPHIC** Ventricular Tachycardia
- QRS complexes spiral around baseline with differing axis and amplitude

- Usually seen in patients with long QT
- Prolonged QT is usually due to prolonged ventricular repolarization

- If a PVC falls on the prolonged T wave, Torsade de Pointes can initiate

Torsades de Pointes



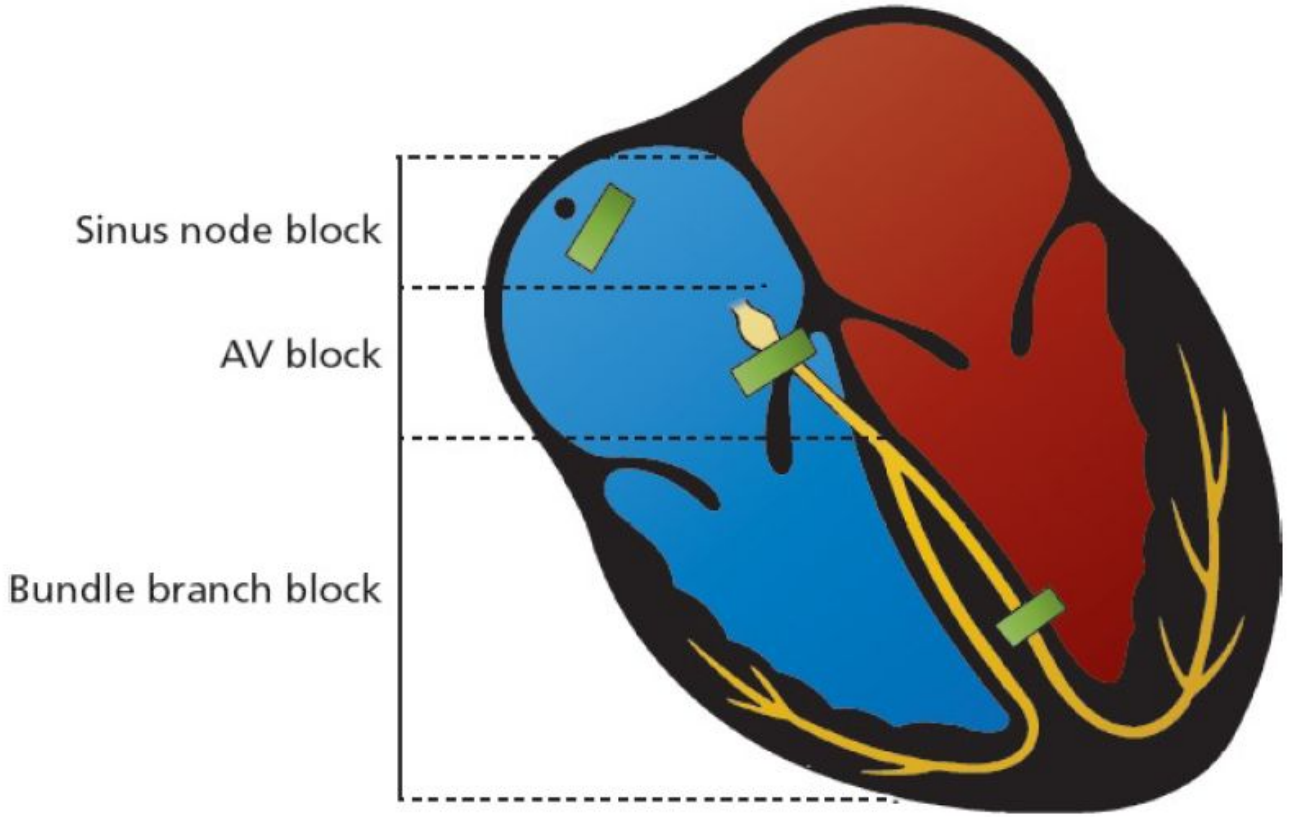
Conduction Blocks

Conduction block

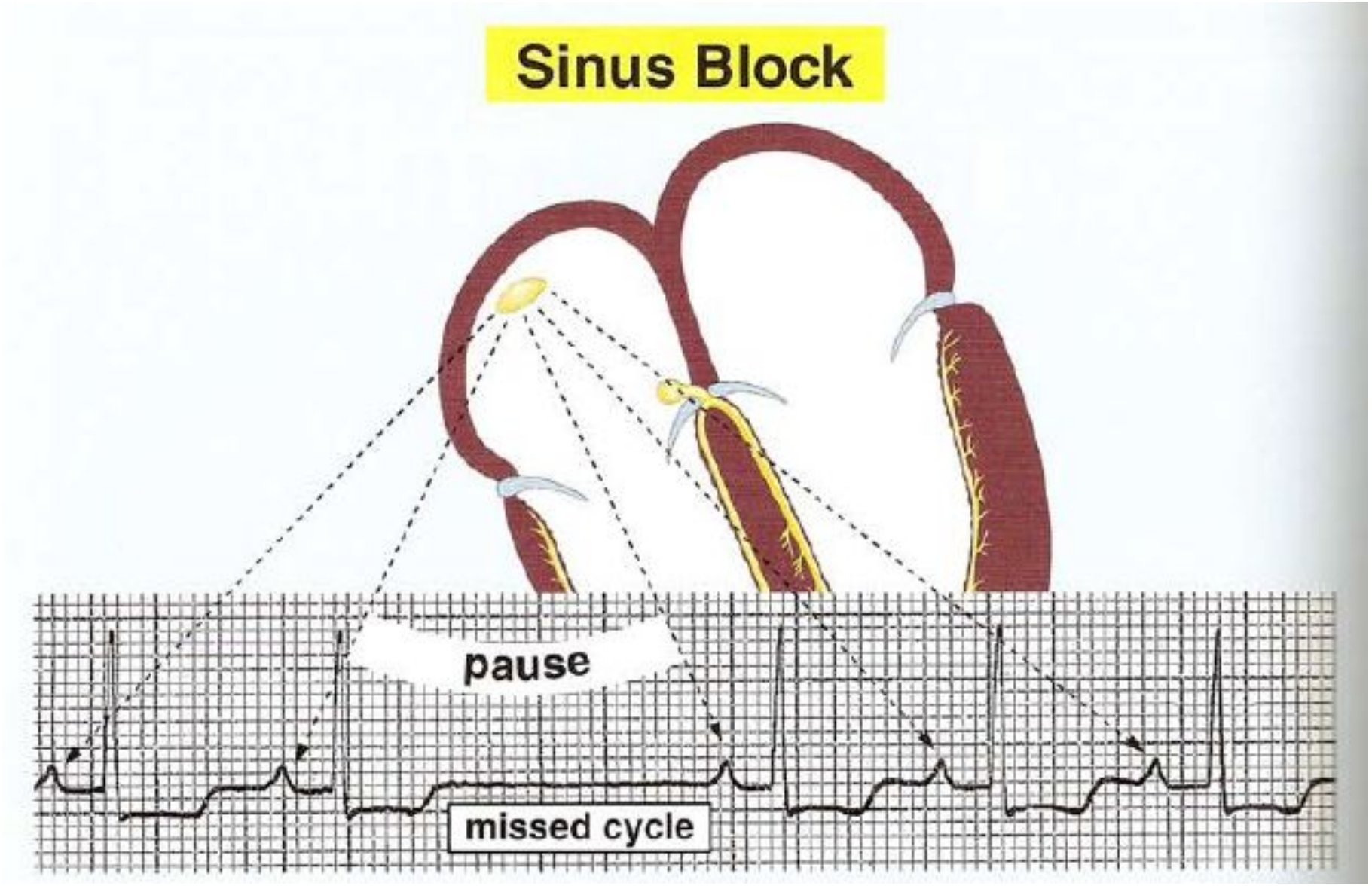
“any obstruction or delay of the flow of electricity along the normal pathways of electrical conduction”

Conduction Blocks

- Sinus node block
- AV block
- Bundle branch block



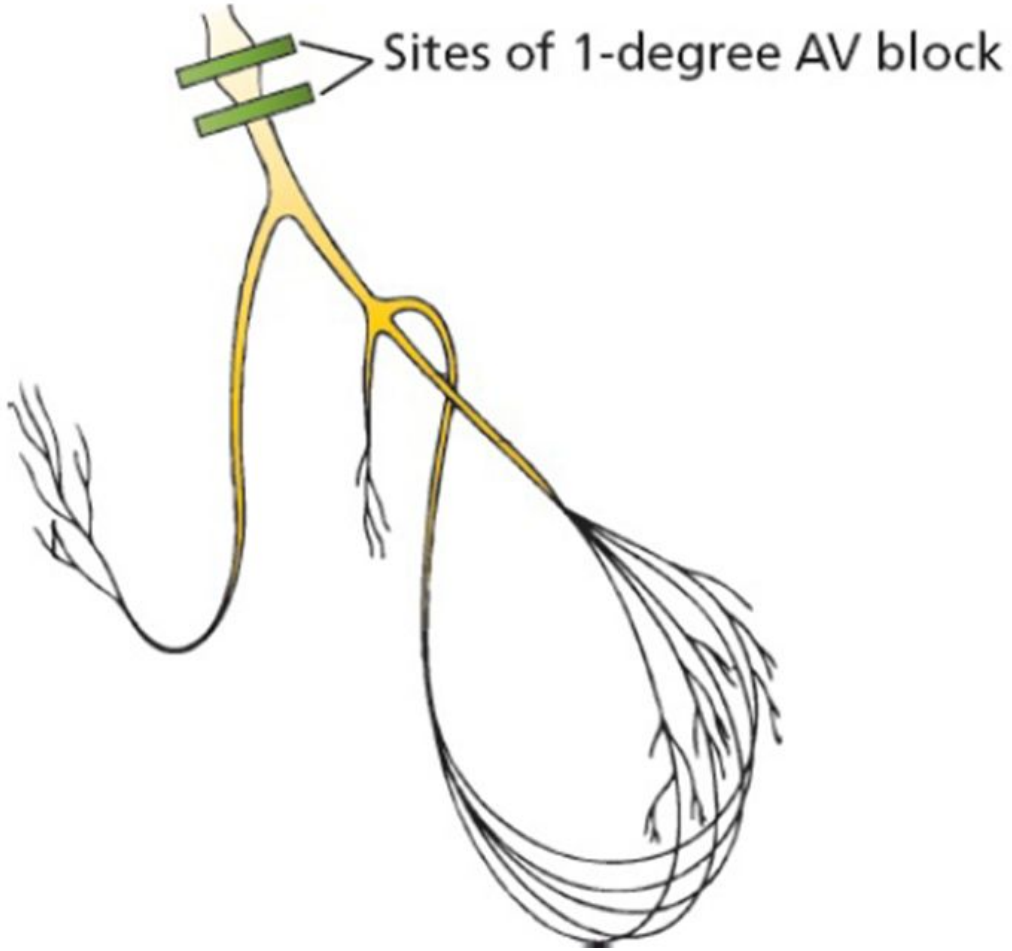
Sinus Block

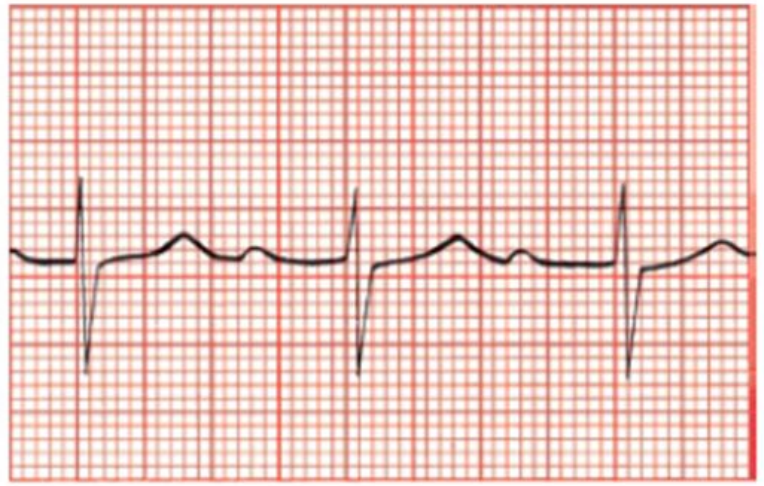


AV Blocks

- First degree
- Second degree
  - Mobitz Type I
  - Mobitz Type II
- Third degree

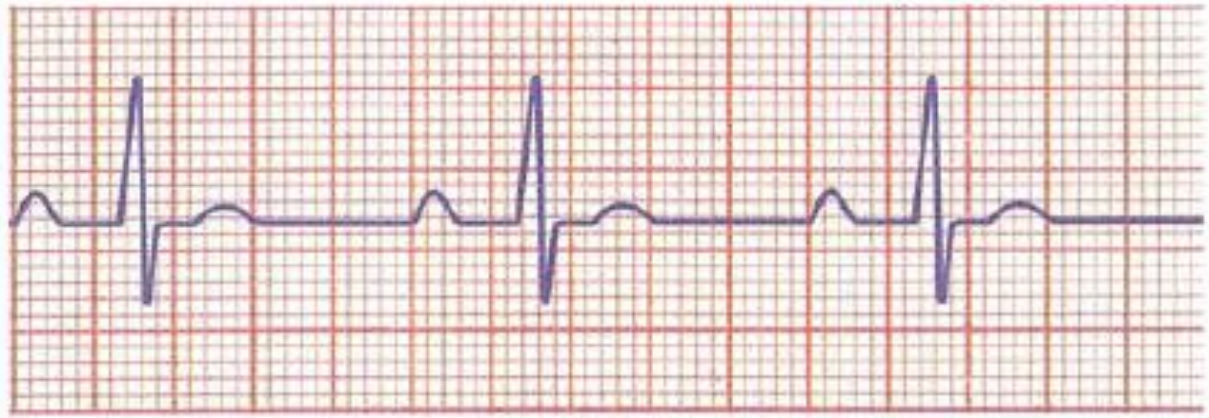
PR interval longer than 1 large box





1° AV Block

"Measure" PR by observation (one large square).



PR remains consistently lengthened cycle-to-cycle.

Second-degree **Mobitz TYPE I**

= Wenckebach Block

Block within the AV node

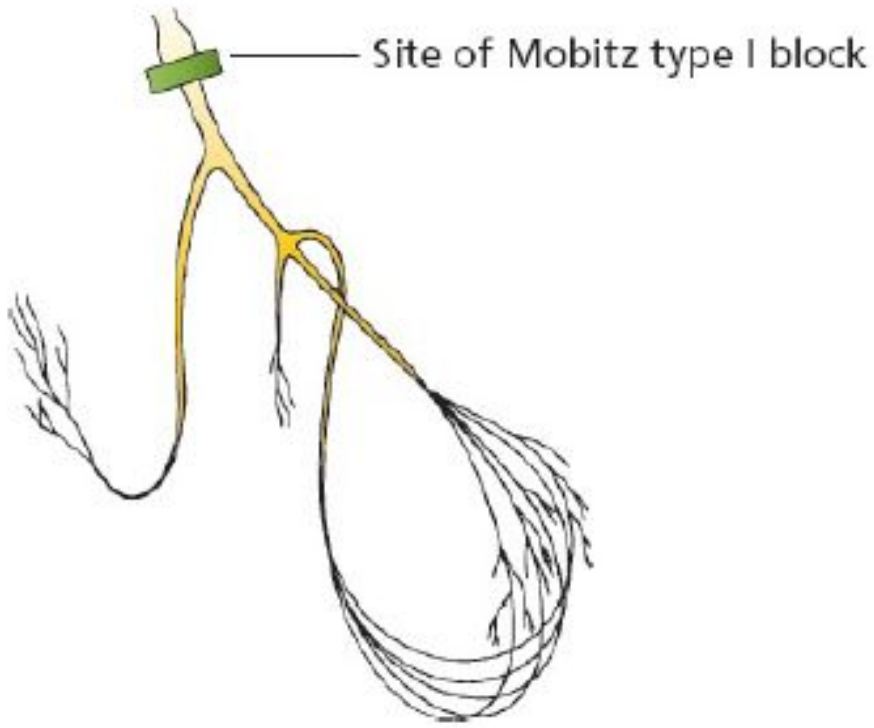
Second-degree **Mobitz TYPE I**

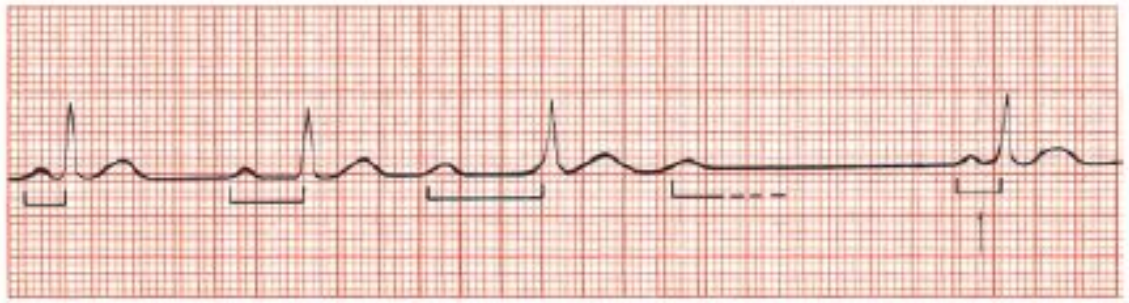
= Wenckebach Block

Block within the AV node

Each atrial impulse meets a longer delay at the AV node than the one before until an impulse doesn't make it through

Each PR interval longer than prior until dropped QRS





Second-degree **Mobitz TYPE II**

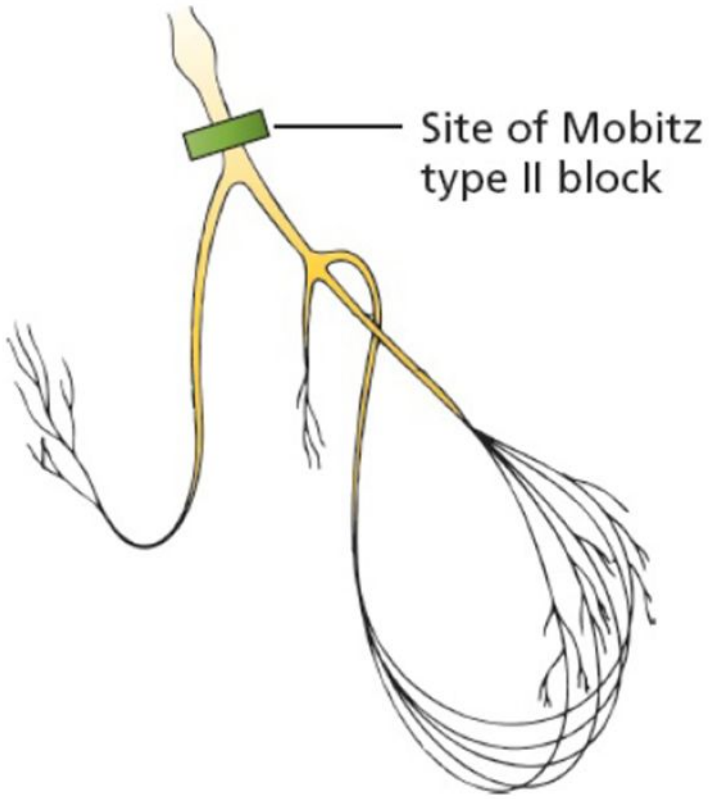
Block below the AV node

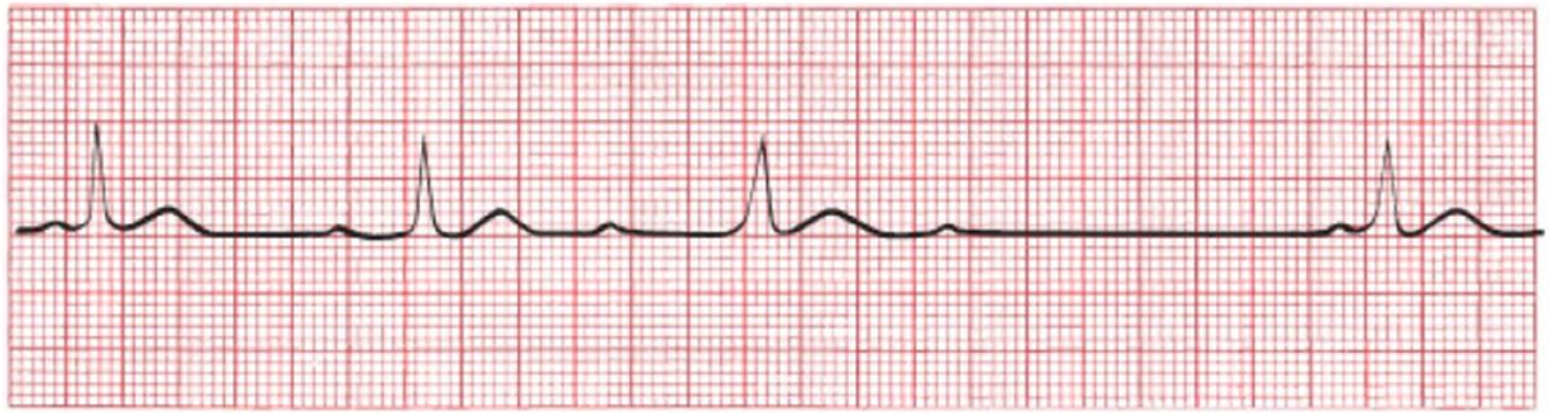
Second-degree **Mobitz TYPE II**

Block below the AV node

- Dropped beat without progressive lengthening of PR interval
- Ratio of P waves to QRS complexes usually varies

Every PR interval identical until dropped QRS

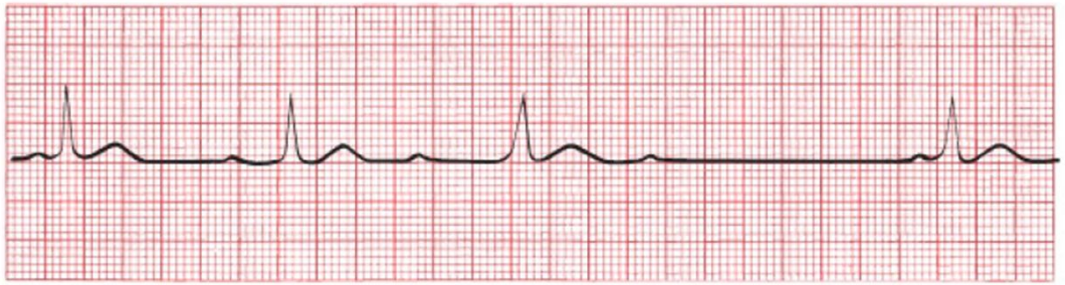




Second-degree MOBITZ blocks

Type I (Wenckebach)

No treatment needed



Type II

Pacemaker needed in most cases

Third-degree AV block

= **Complete Heart Block**

block at AV node or lower

Third-degree AV block

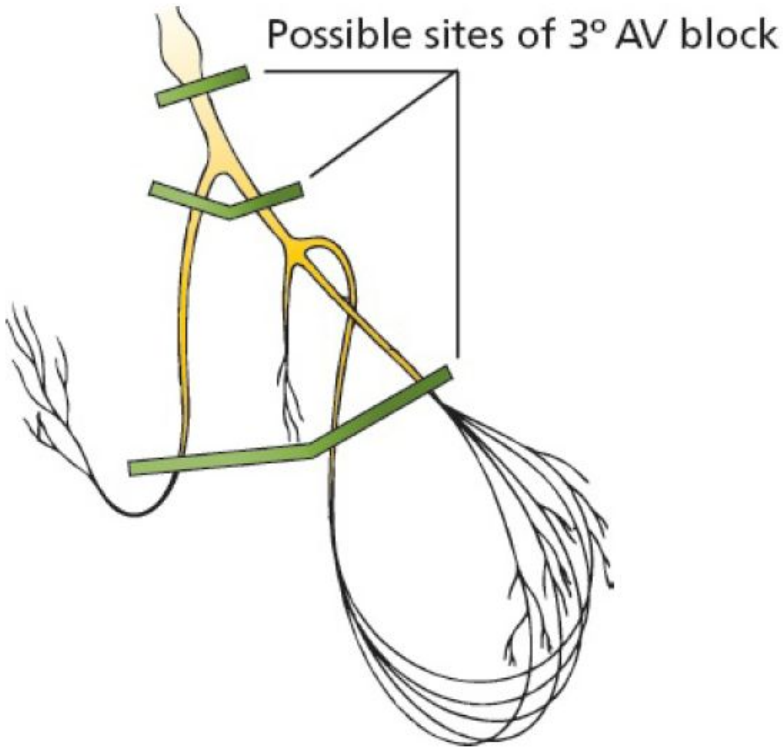
= Complete Heart Block

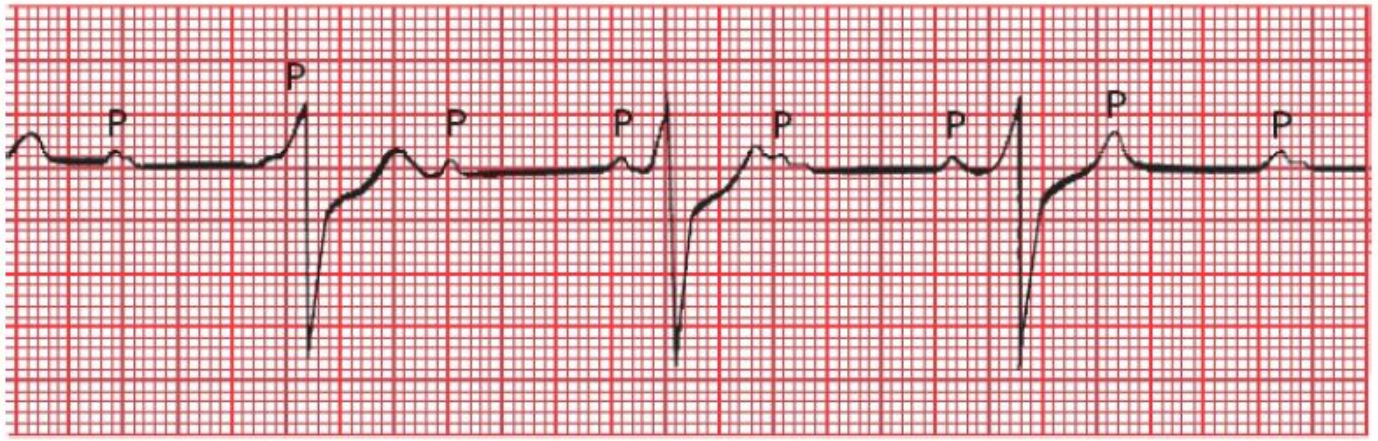
block at AV node or lower

AV Dissociation

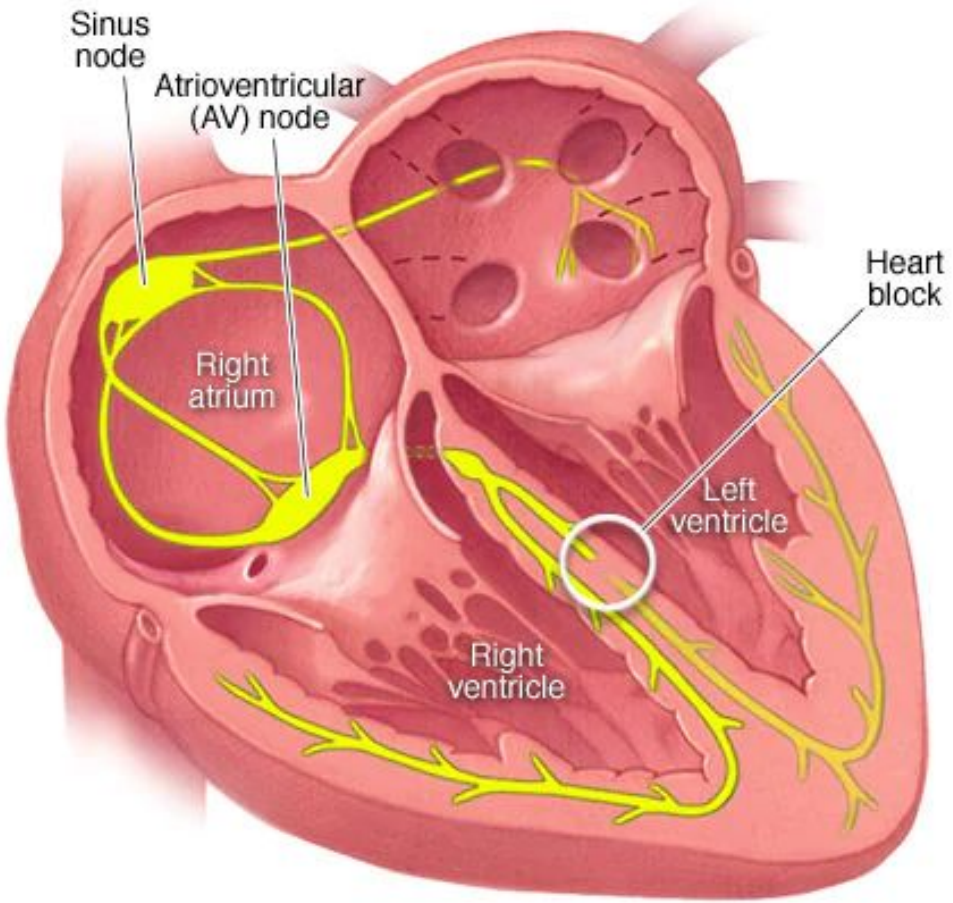
Atria and Ventricles depolarize and contract independent of one another

P waves regular and QRS spacing regular
no relationship between them



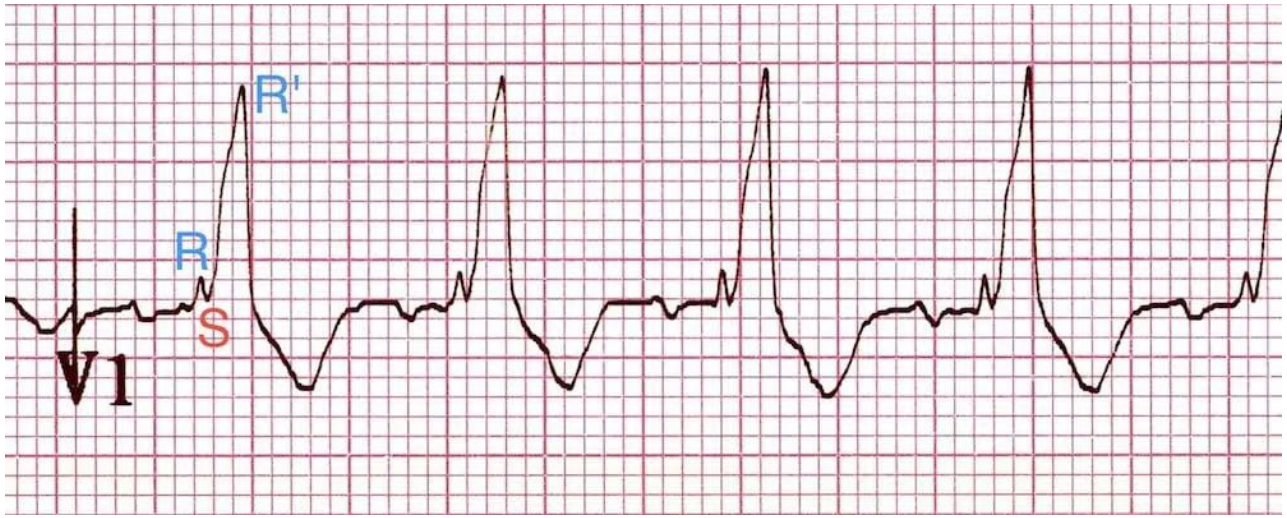


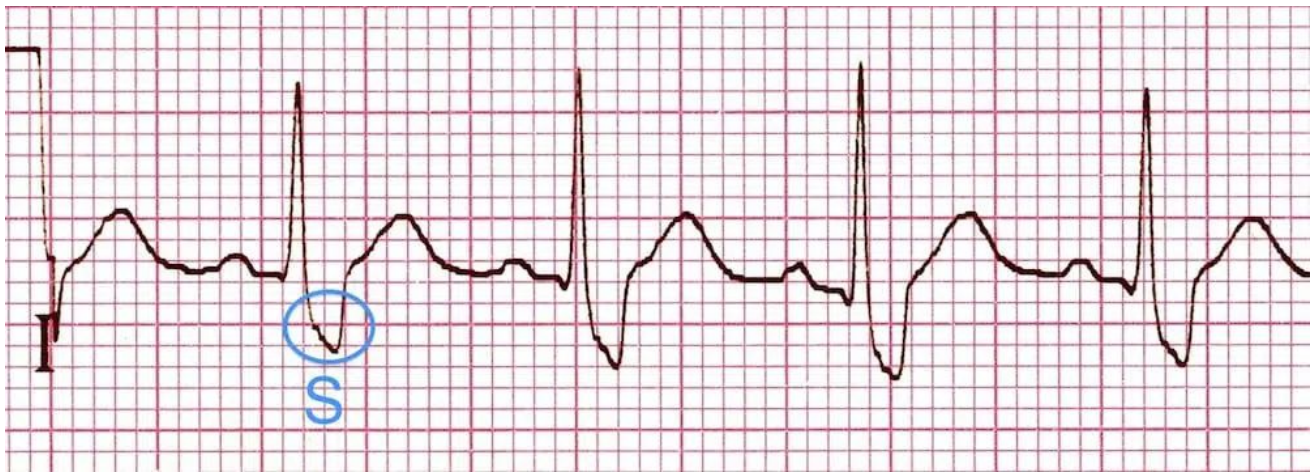
Bundle Branch Blocks



RIGHT Bundle Branch Block

- QRS wider than 120 ms
- Focus on **Leads v1 and v2** (overlying the right ventricle)
- Likely RSR’ (R-S-R prime) in these leads
- Left lateral leads will have deep S wave


R'
R
S
V1


I
S

PreExcitation Syndromes

Wolff-Parkinson-White

EKG shows:

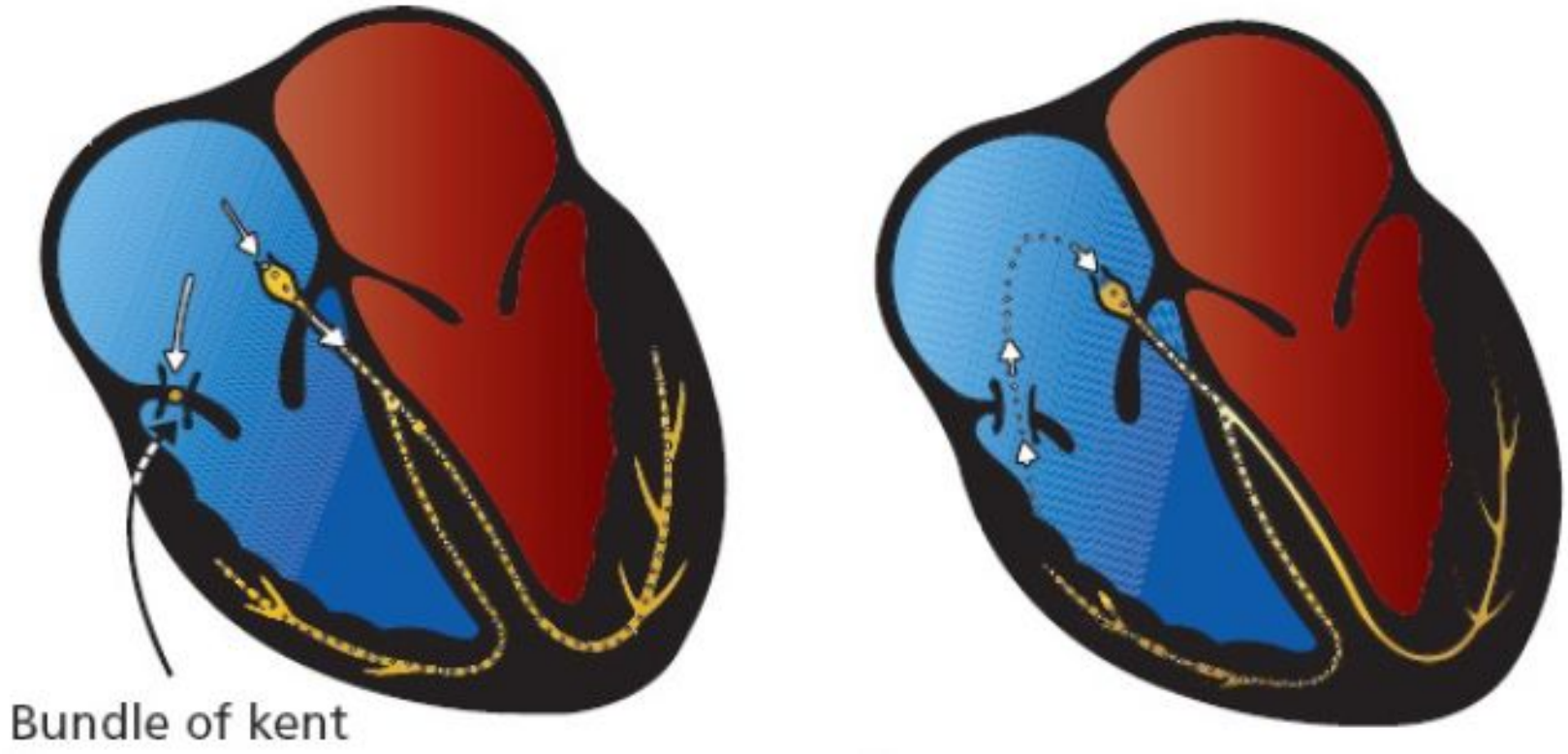
- PR interval less than 0.12 seconds
- QRS complex wider than 0.1 second due to delta wave

EKG changes + symptoms = **WPW Syndrome**

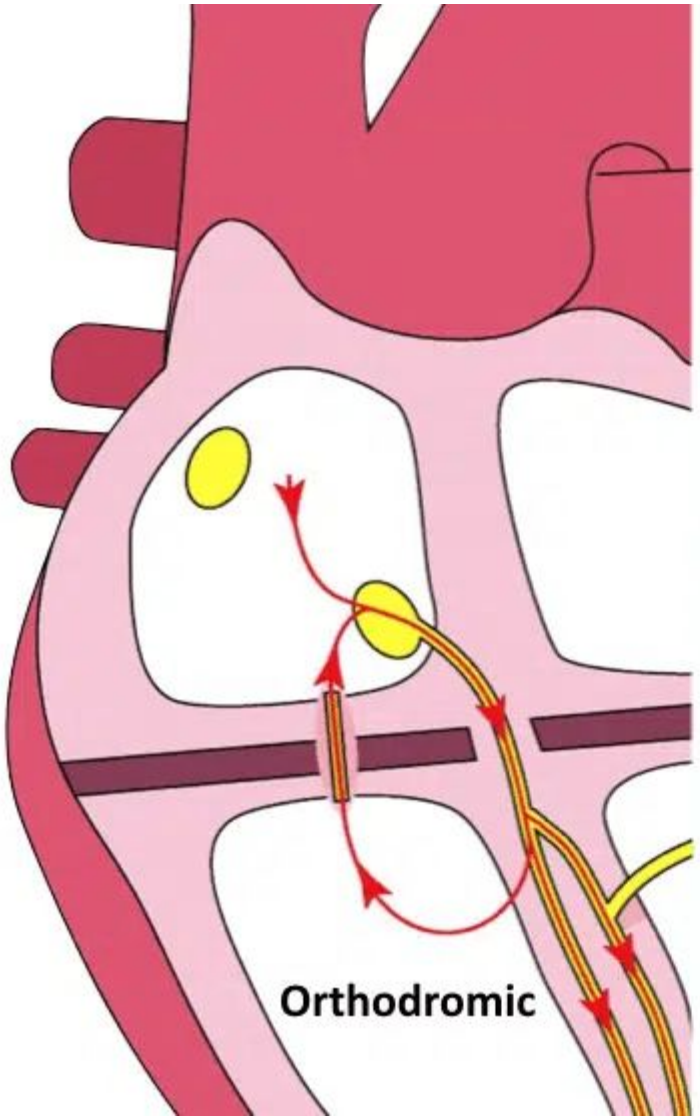
Often seen in WPW:

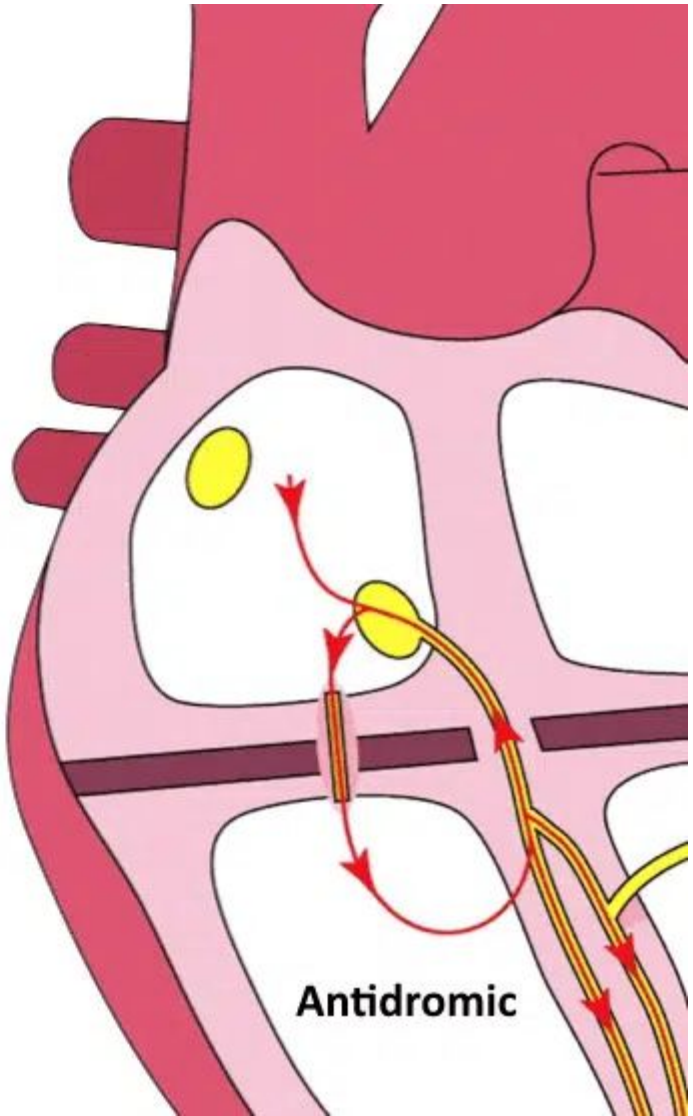
- Supraventricular tachycardia and
- Atrial fibrillation

Accessory pathway leads to reentrant circuit



Atrioventricular Reentry Tachycardia (AVRT)





Orthodromic AVRT (think orthodox)

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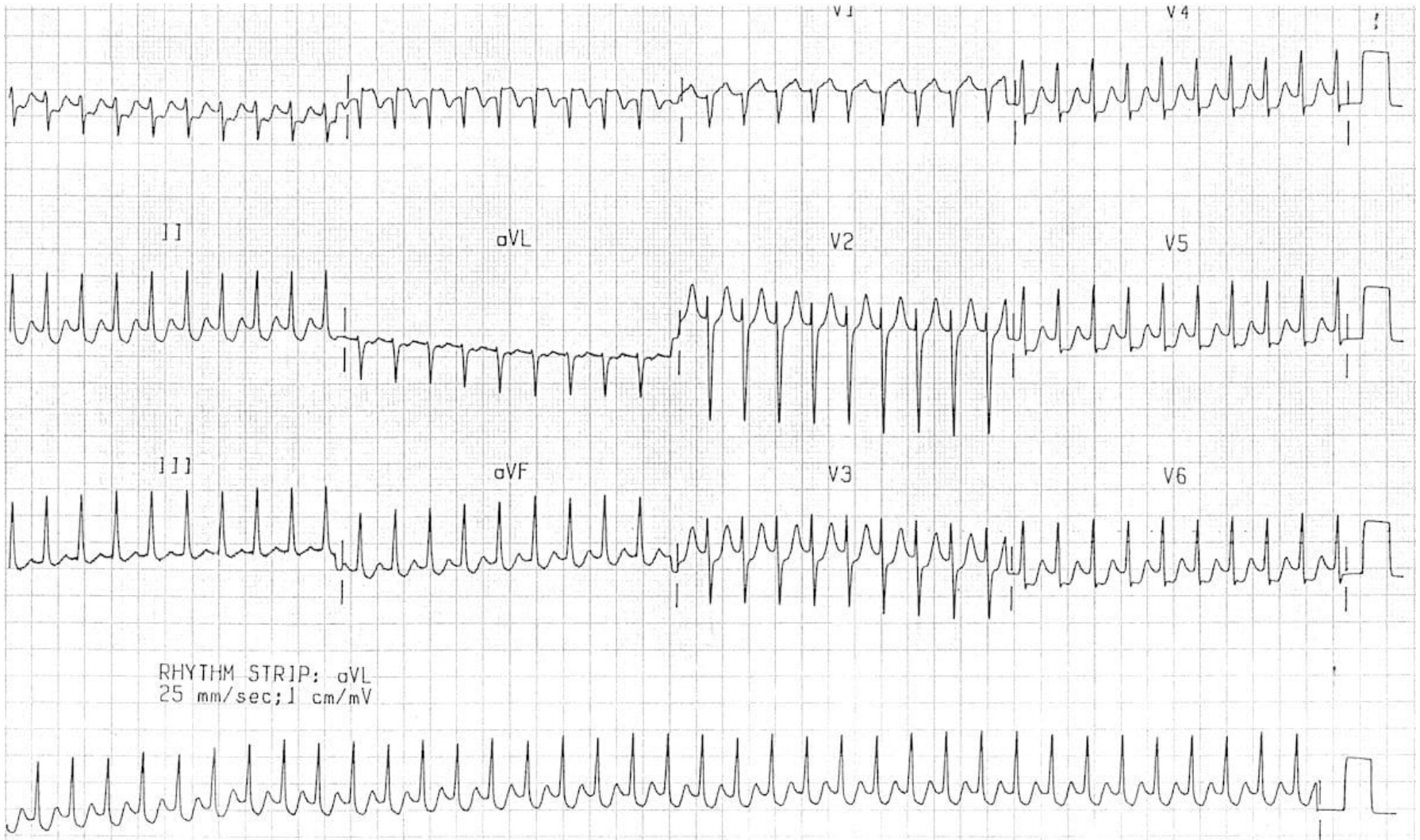
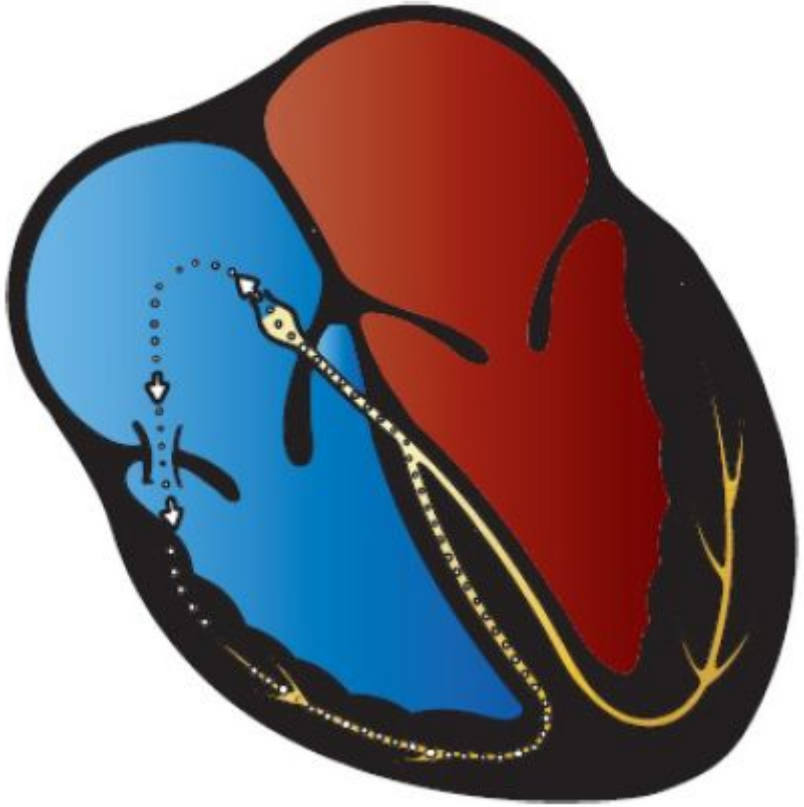
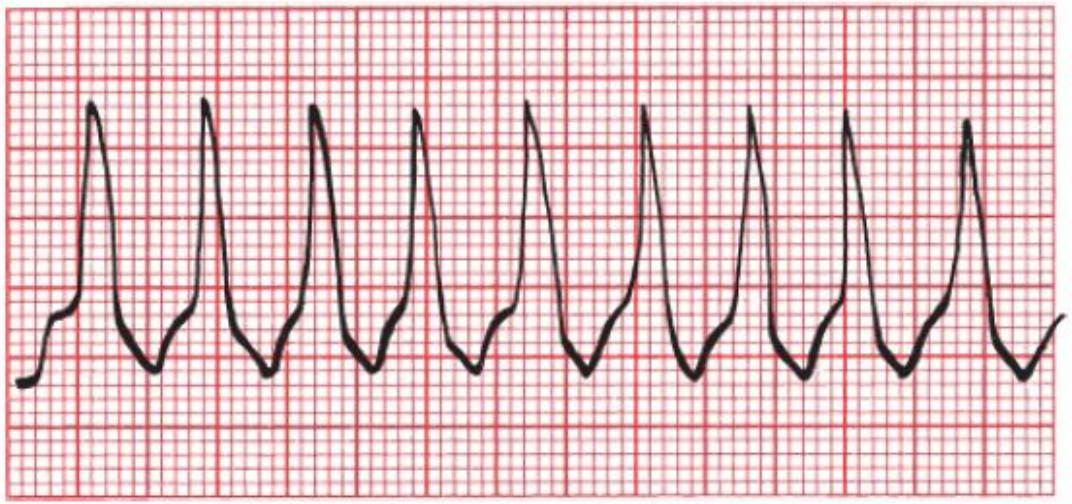
regular, narrow complex tachycardia



Antidromic atrioventricular tachycardia





Antidromic AVRT

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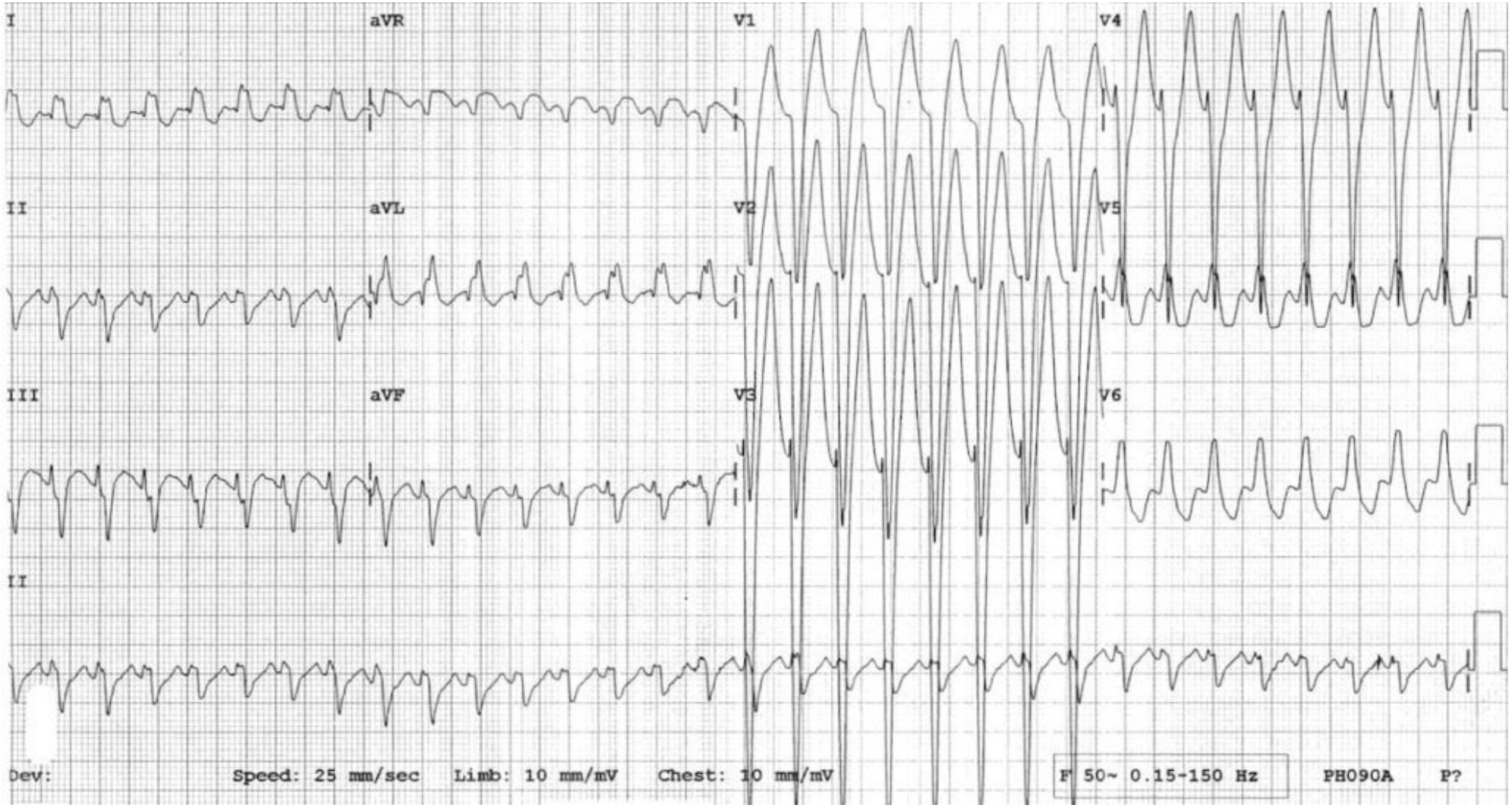
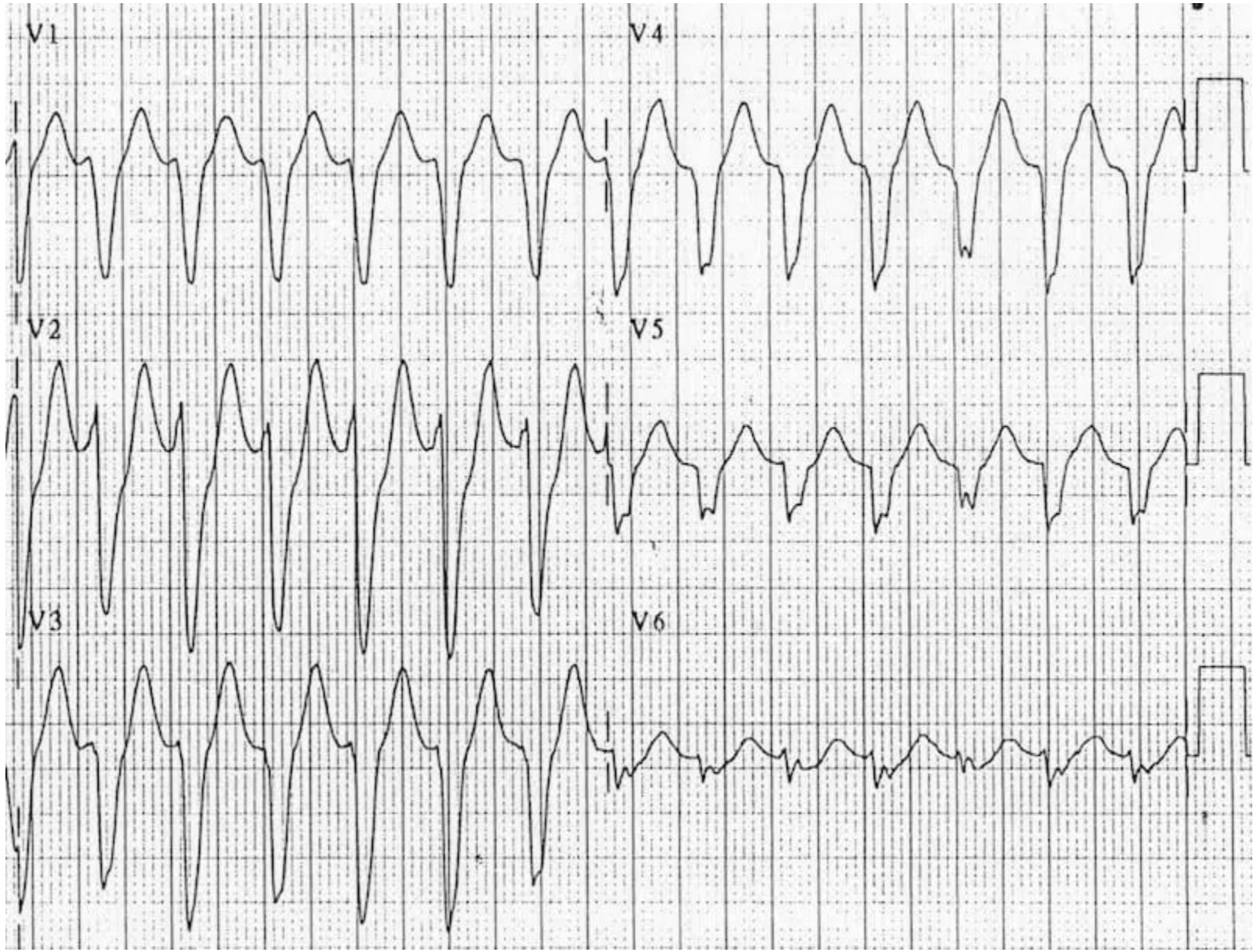
regular, wide complex tachycardia




V1
V4
V2
V5
V3
V6

- **END**

- **Thank you!**