



Pediatric Tachydysrhythmias

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Disclaimers

- No financial disclosures
- Emergency Physician

Lecture Overview

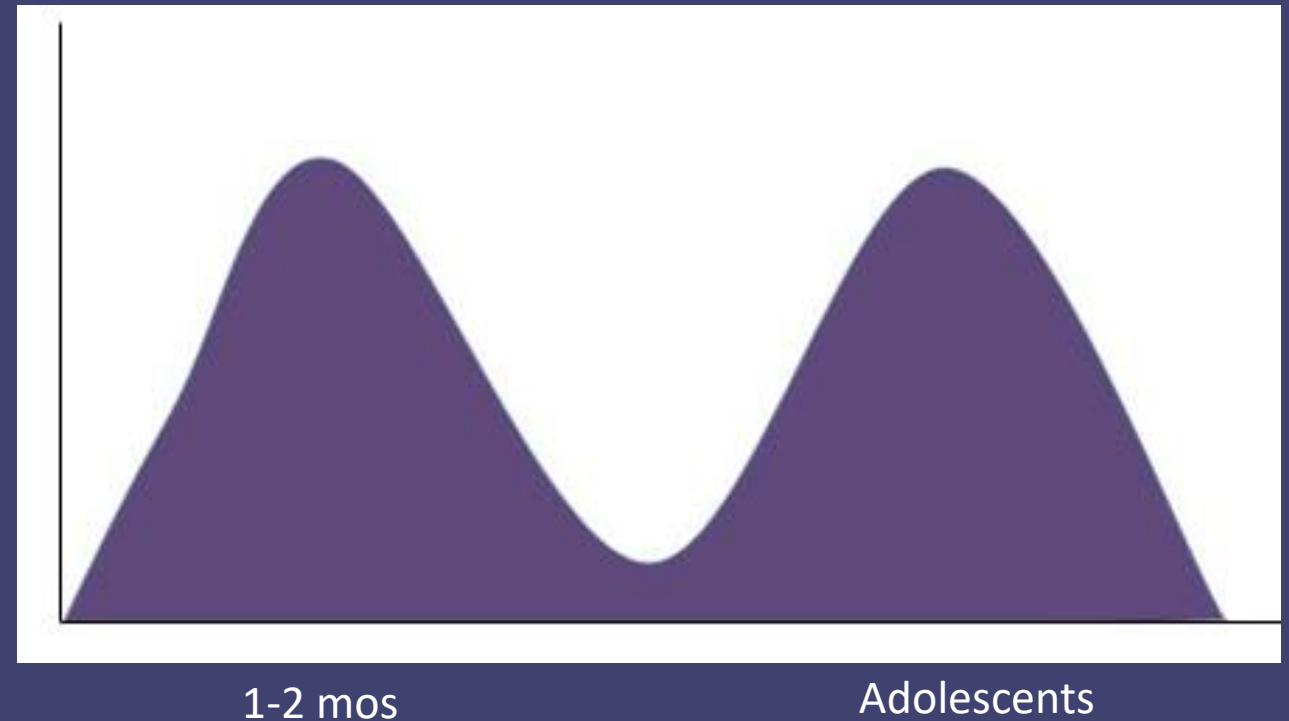
- Introduction and Epidemiology
- Physiology and Pathophysiology
 - Associated conditions
- Pediatric Presentation of Tachydysrhythmias
 - H&P vs ABC
 - Differential
 - EKG interpretation
- Treatment
 - PALS Review+
- Special Circumstances/Considerations
- Disposition

Goals

- 1) Delineate presentation of tachydysrhythmia in children**
- 2) Identify diagnostic challenges**
- 3) Outline treatment options in all settings**
- 4) Review Disposition considers**

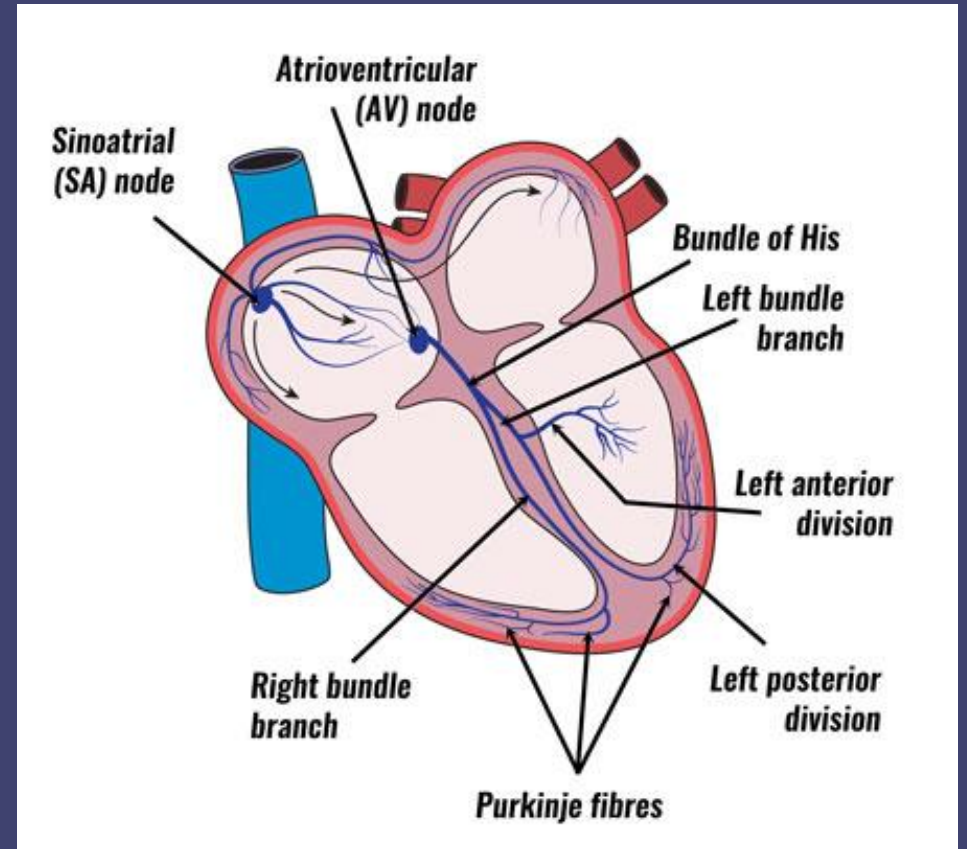
Introduction - Epidemiology

- Much less common vs adults
- Clinically Significant ~22.5/100,000
- Bimodal distribution
- Most resolve spontaneously after 1st year
- Higher in patients with congenital heart disease
 - 29% with arrhythmia
 - #1 nonsustained Vtach
 - #2 nonsustained SVT
- If untreated -> CHF and SCD*



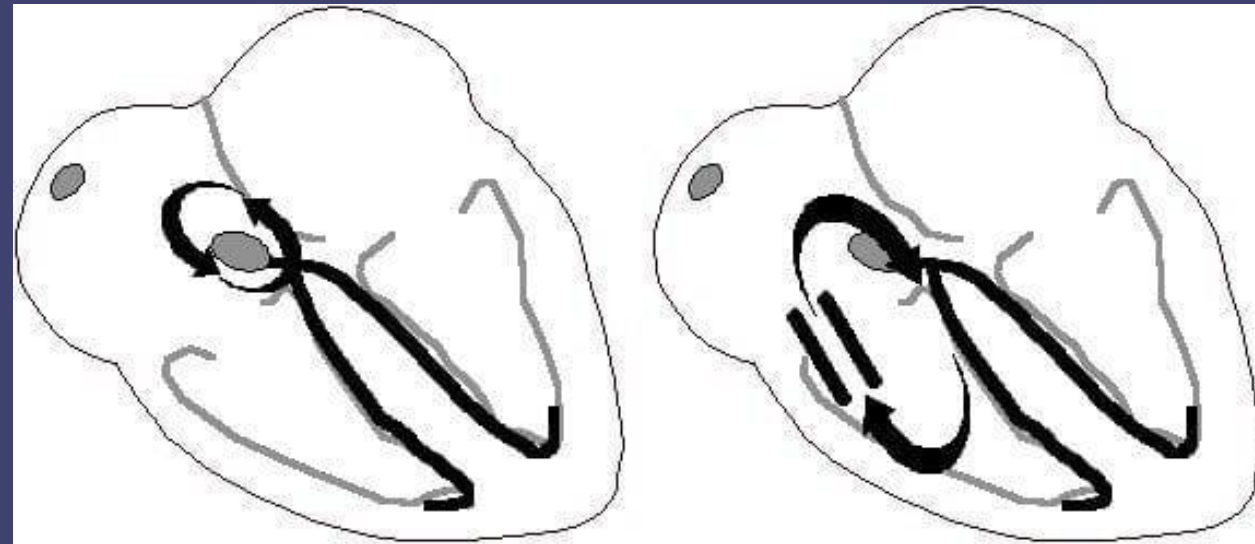
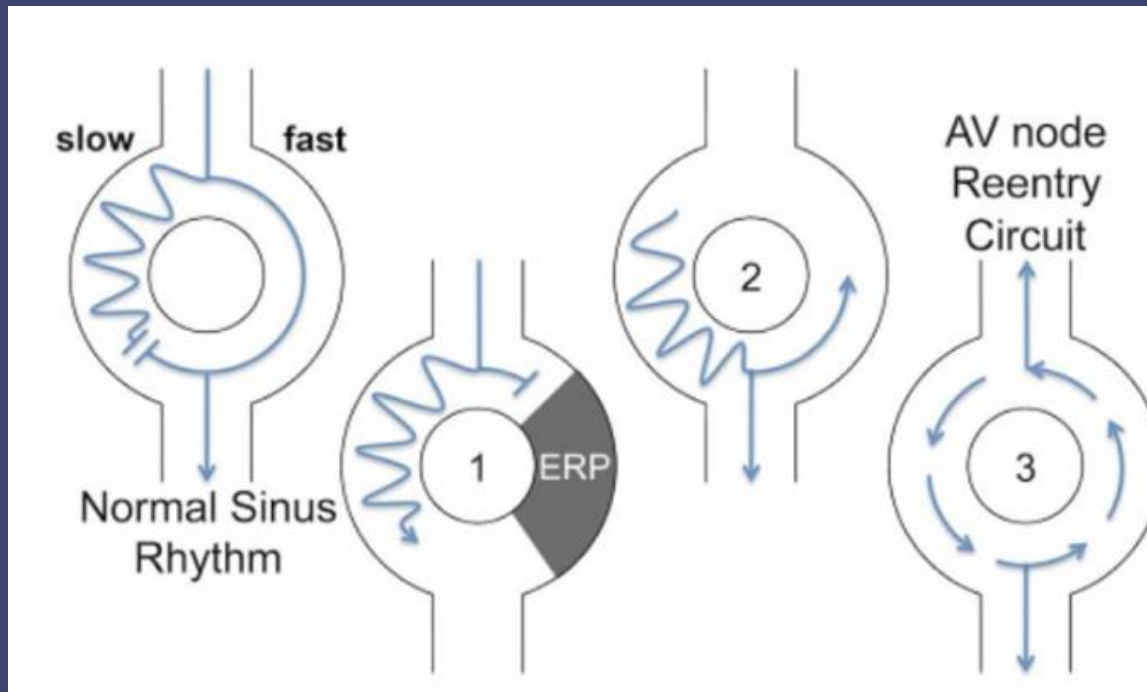
Cardiac Electrophysiology 101

- Impulse generated by specialized cardiac cells (primarily in SA node)
- Impulse travels through the circuit
 - SA node
 - Atria
 - AV node (slows)
 - Bundle of His (slows)
 - Purkinje fibers -> ventricles
- Depolarization followed by a period of repolarization and natural pause

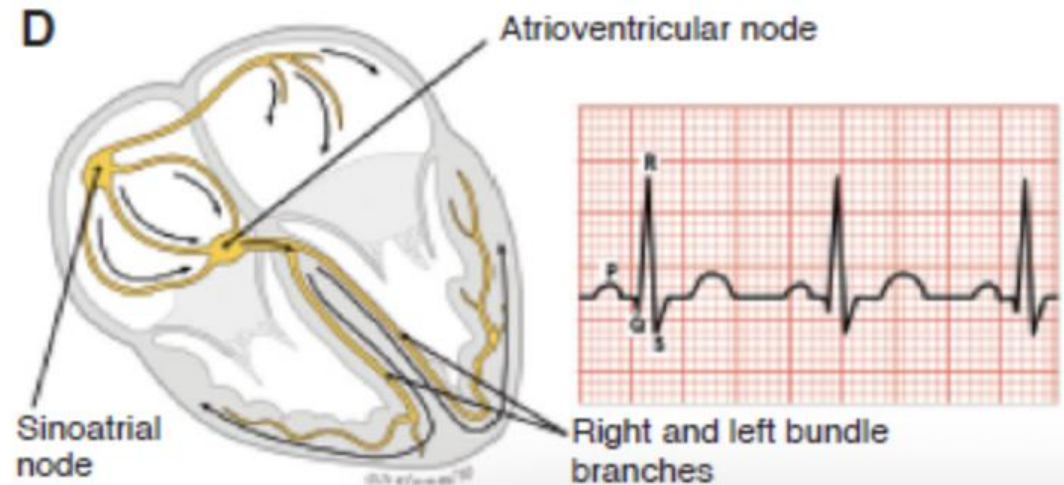
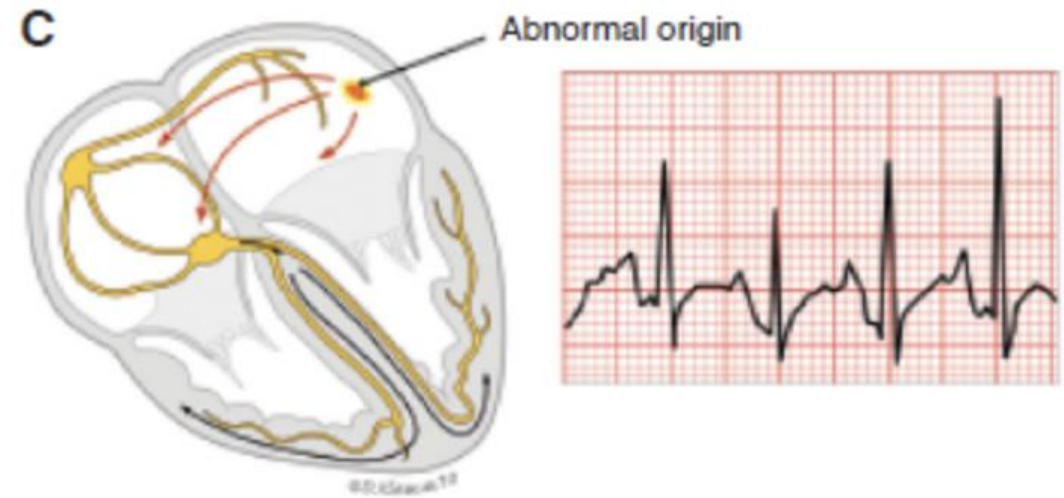
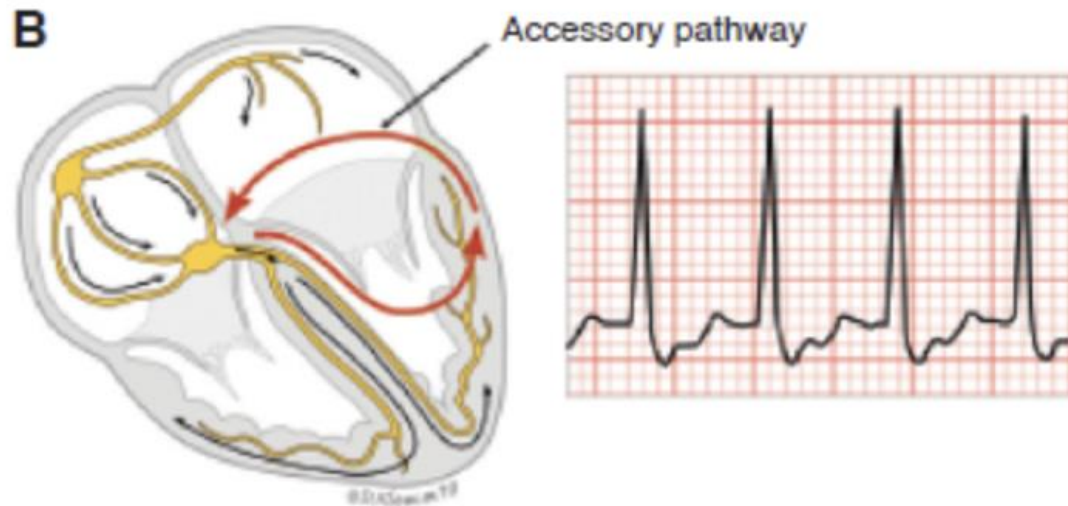
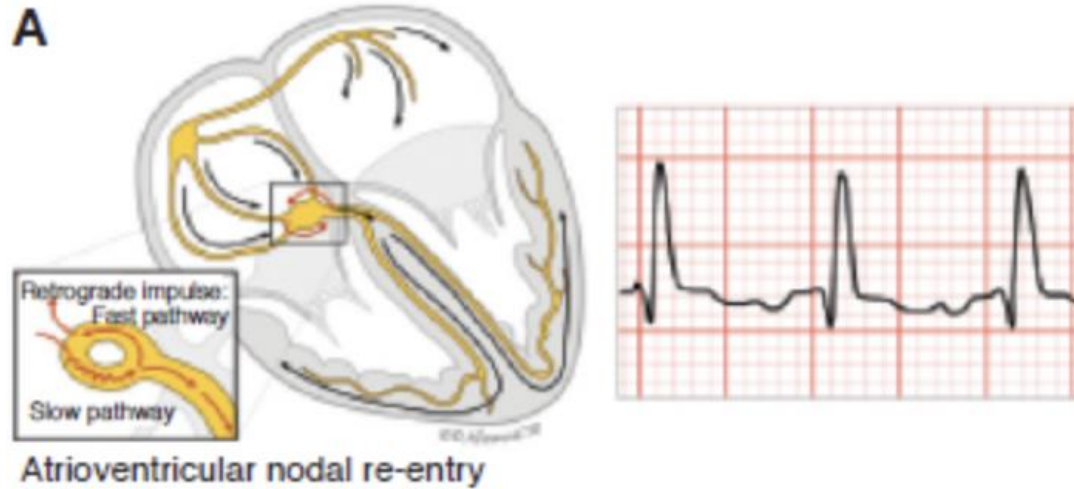


Pathophysiology (SVT)

- Lesion dependent
- Proliferation of an inappropriate depolarization
 - Accessory Pathway
 - AV node



Types of Supraventricular Tachycardia (SVT)



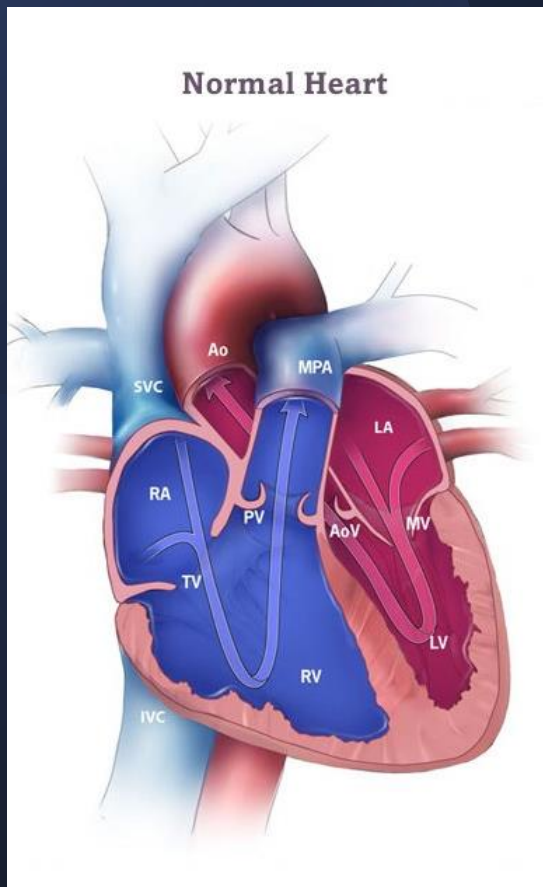
Differential

- Tachydysrhythmias -> structural disease
- Other causes are systemic
- History and context at key
 - Dyspnea > Pain
 - Syncope
 - Palpitations (older)

Table 1. Conditions Associated With Tachyarrhythmia

Heart conditions	Systemic conditions
Postoperative congenital heart disease	Metabolic disturbances
Myocarditis	Electrolyte abnormalities
Kawasaki disease	Endocrine disorders
Cardiomyopathy	Collagen vascular diseases
Muscular dystrophy	Drugs and toxic substances
Muscular dystrophy	
Electrical myopathy	
Long QT syndrome	
Brugada syndrome	
Myocardial tumors	
Coronary abnormalities	
Cardiac trauma	

Differential – Congenital Heart Disease

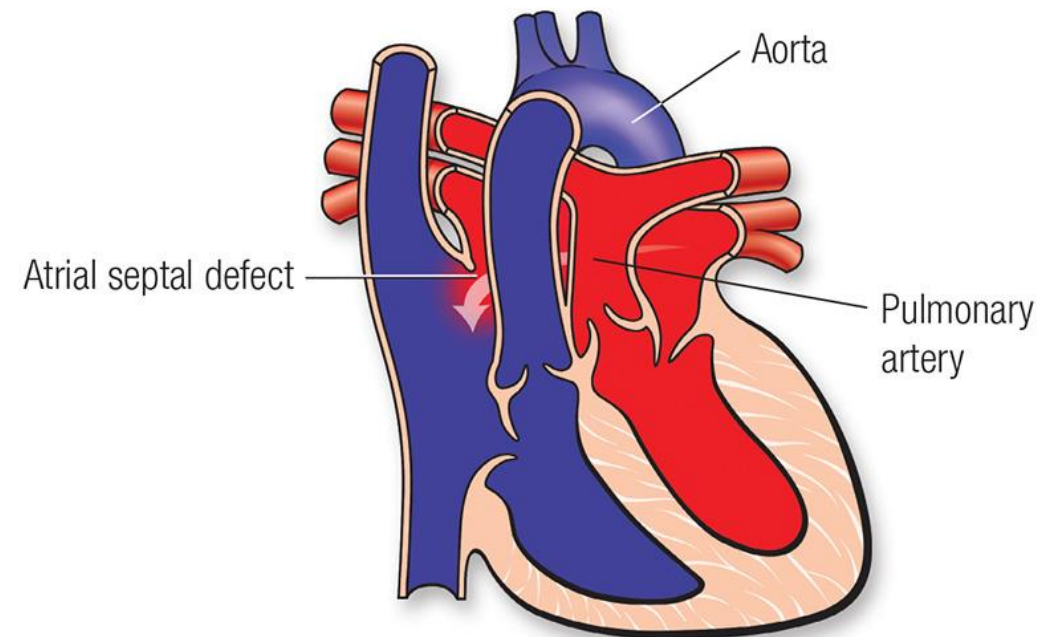


**Table 1. Absolute And Relative
The Most Common Cardiac De**

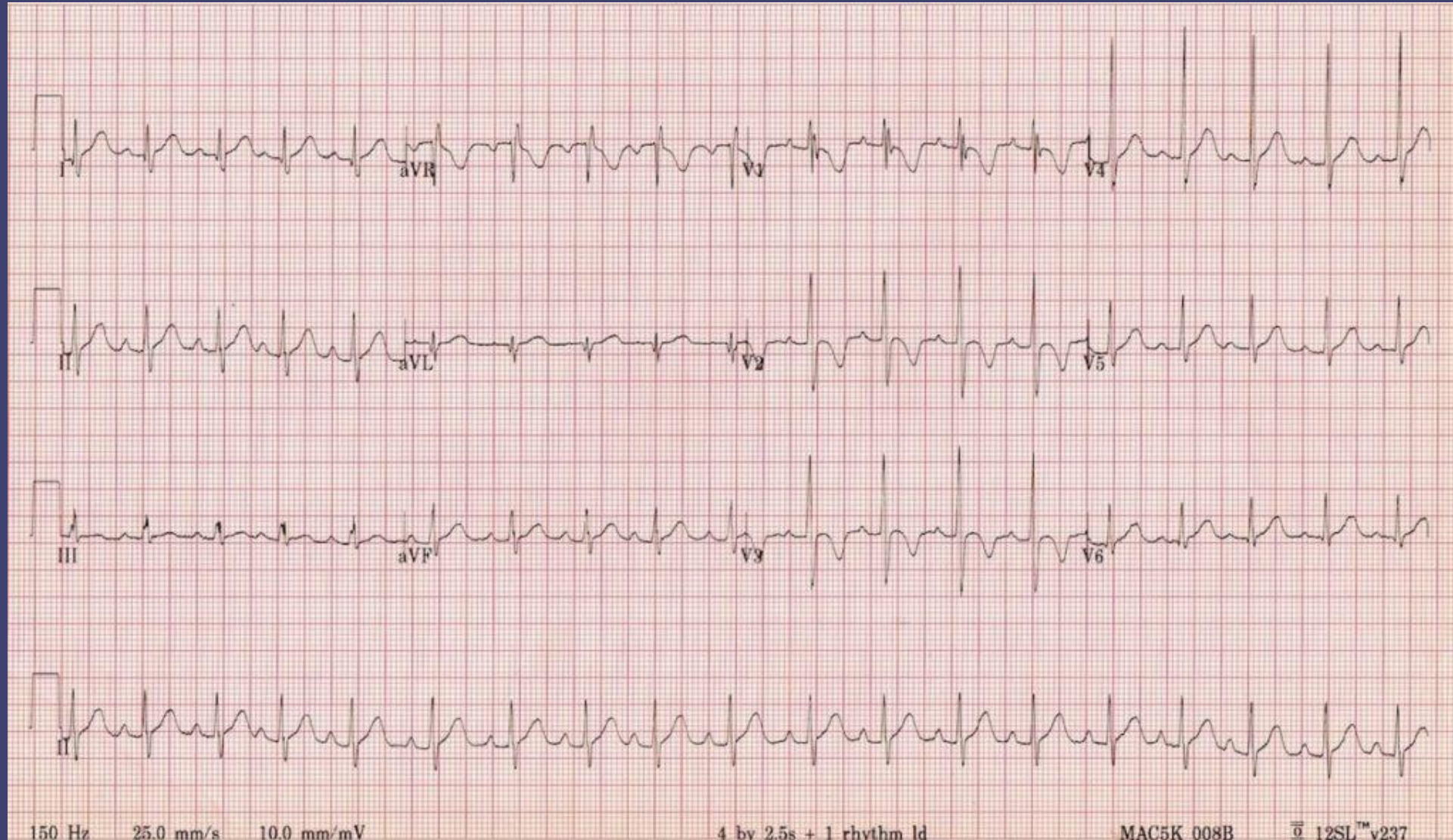
Cardiac Defect	Birth Prevalence Worldwide (#/1000)
Ventricular septal defect	2.62
Atrial septal defect	1.64
Patent ductus arteriosus	0.87
Pulmonic stenosis	0.5
Tetralogy of Fallot	0.34
Coarctation of the aorta	0.34
Transposition of the great arteries	0.31
Aortic stenosis	0.22

Abbreviation: CHD, congenital heart disease.

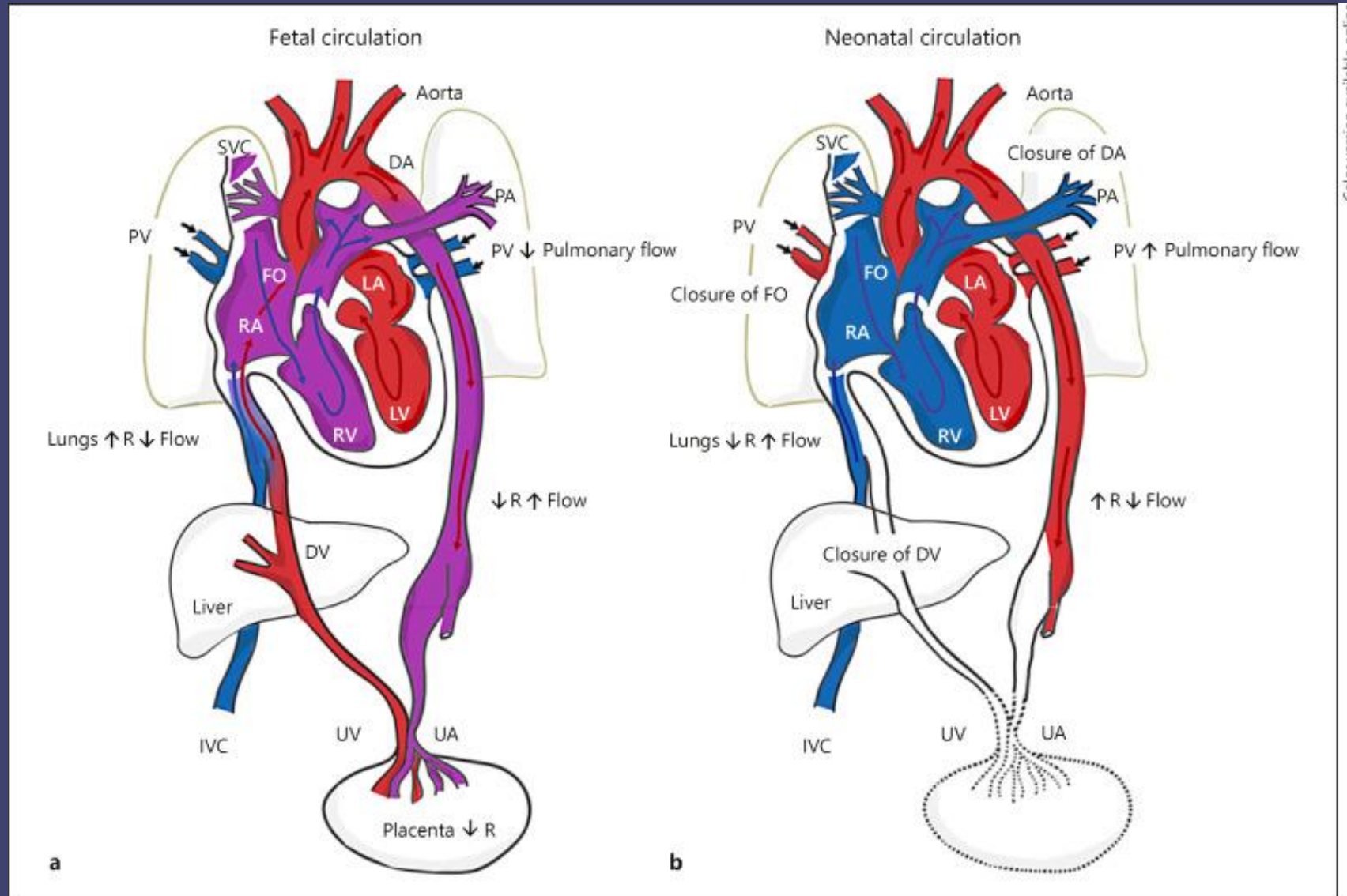
Transposition of the Great Arteries



But wait – What's normal!??



Why is this?



Initial Evaluation – ABC vs H&P



Which one is the sick baby!??

A carved stone skull, possibly a prehistoric artifact, is the central focus of the image. It is light-colored with some reddish-brown staining and features large, circular eye sockets and a prominent nasal cavity. The skull is resting on a dark, textured rock. In the background, a blurred mountain landscape with green vegetation and rocky slopes is visible under a clear sky.

Introduction Take Home Points

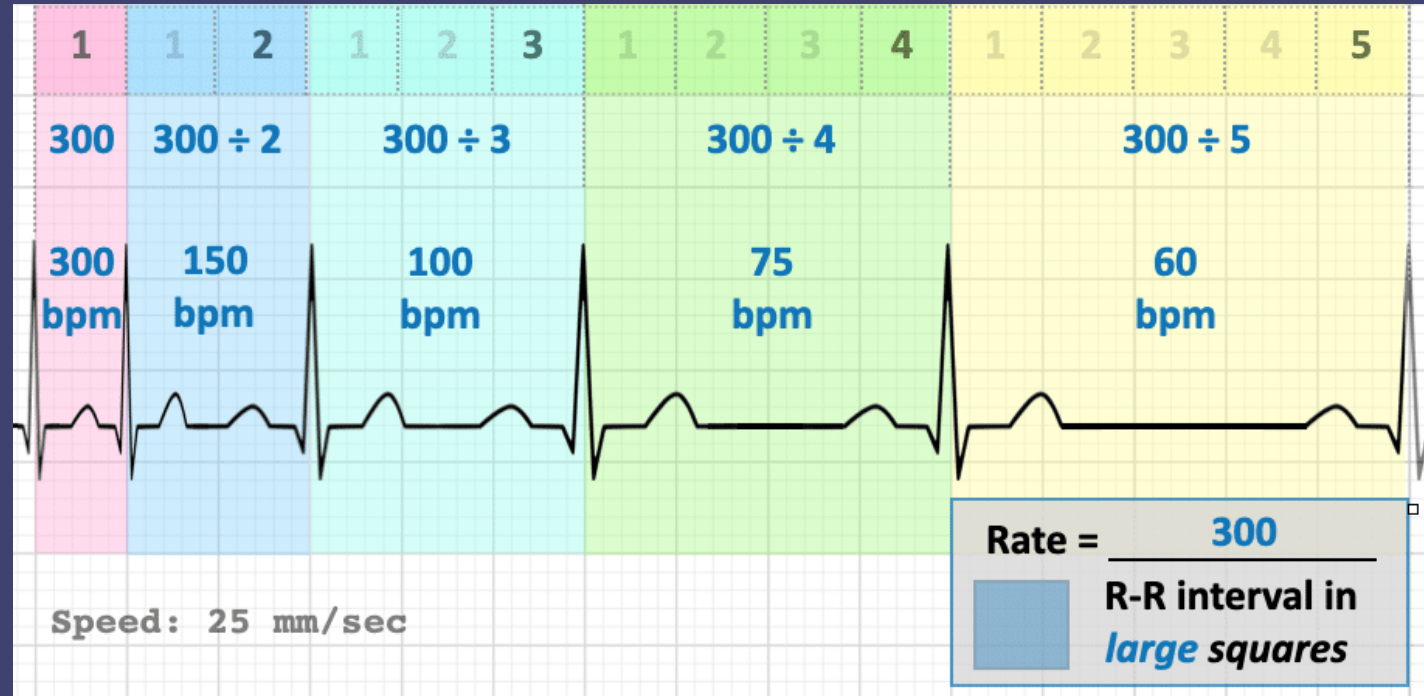
- Tachydysrhythmias are common in pediatric populations
- Associated with congenital heart disease
- Rhythmicity dependent on presence of accessory pathway
- Initial evaluation focus on stability
- Evaluate for signs of poor perfusion on initial assessment

Pediatric EKG interpretation

- Comparable to adults, follow a stepwise approach
 - Rate, Rhythm, Axis, Waves, Intervals, [Amplitude]
 - Primacy of Rate
- Age is crucial to interpretation (<18 is not enough)
- Keep in mind early cardiovascular changes for infants/neonates

Pediatric Rate

- R-R interval most accurate
- Standard EKG (25 mm/s)
 - 10s “Picture”
 - #R waves X 6 (regular)
- Rate Variability
 - Metabolic rate
 - Vagal tone

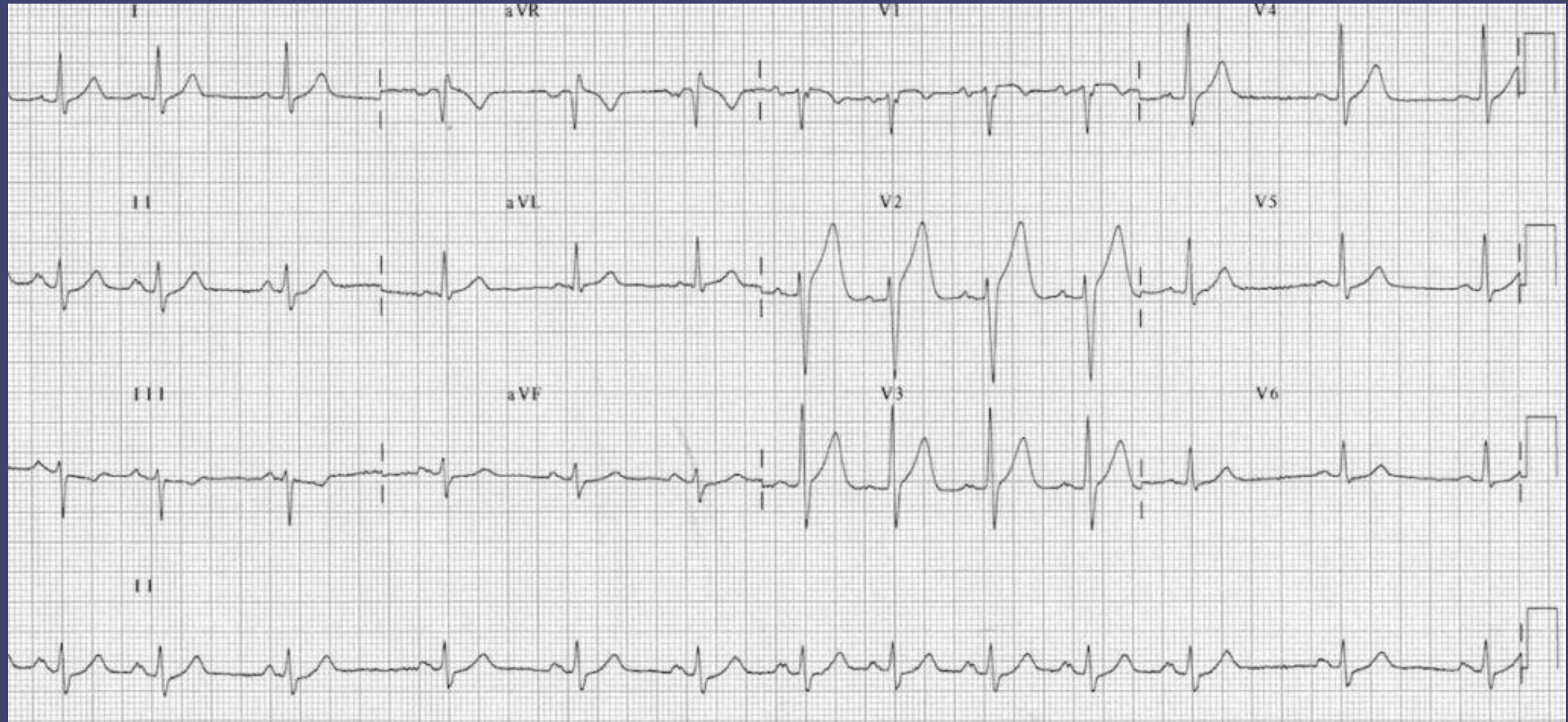


Pediatric Rhythm

- P wave before every QRS with constant PR
- P wave upright in I and aVF

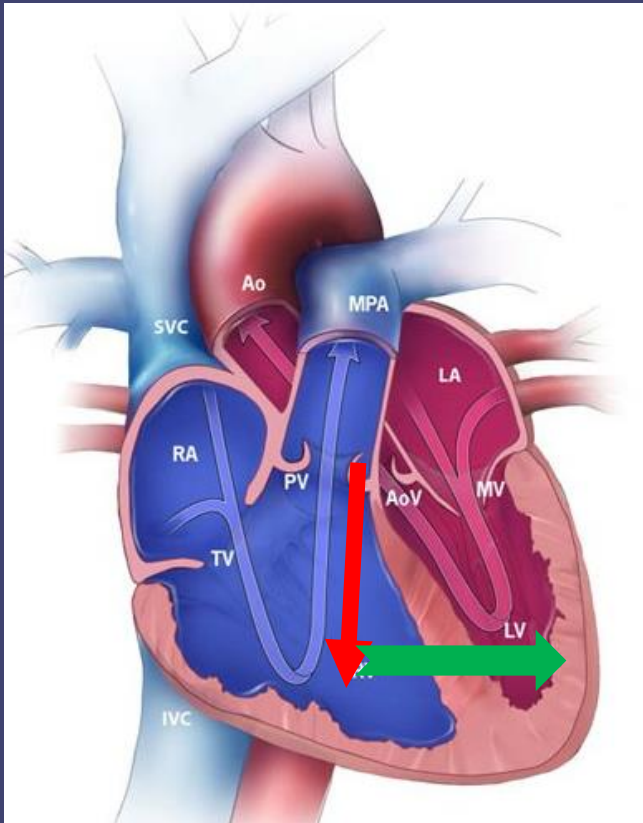


Sinus Arrhythmia



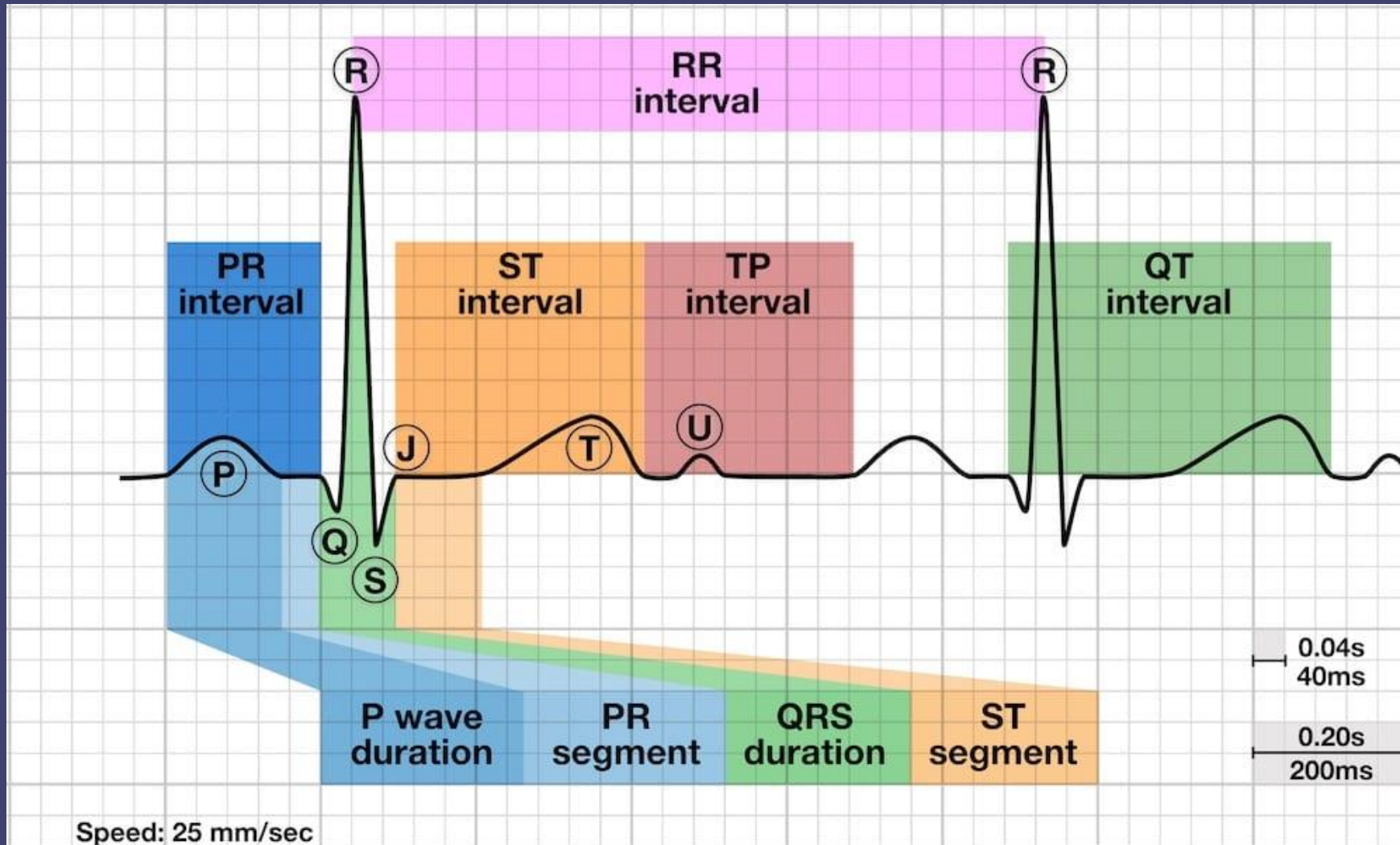
Pediatric Axis

- “Normal” axis varies with age
 - Ex: Right axis deviation



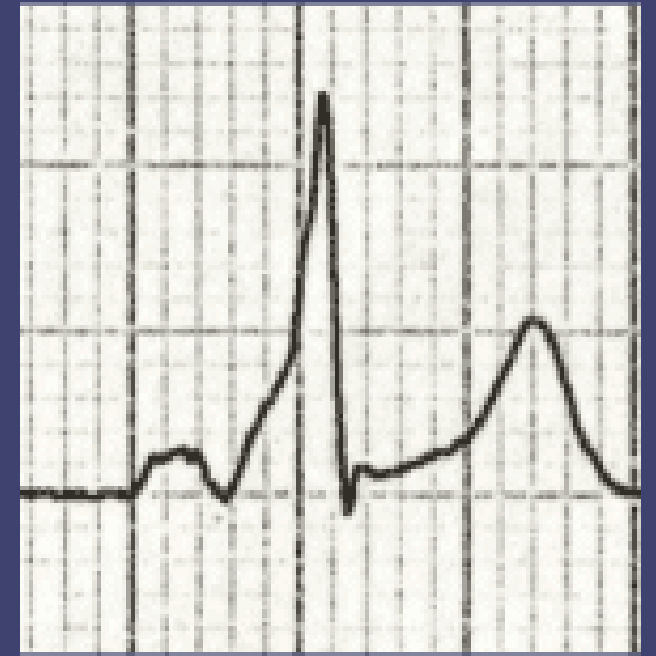
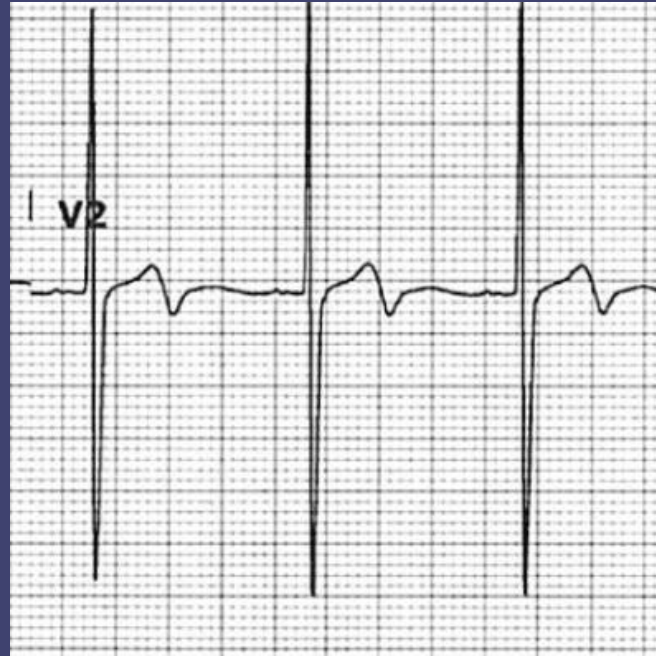
Lead 1	Lead aVF	Quadrant	Axis
POSITIVE	POSITIVE		Normal Axis (0 to +90°)
POSITIVE	NEGATIVE		**Possible LAD (0 to -90°)
NEGATIVE	POSITIVE		RAD (+90° to 180°)
NEGATIVE	NEGATIVE		Extreme Axis (-90° to 180°)

Pediatric Intervals/Waves



Amplitude

- Can help identify pathology in baseline EKG
- High QRS – WPW, HOCM, BBBs
- Low QRS –
Peri/myocarditis,
Hypothyroidism, Normal





Pediatric EKG Take-home Points

- Approach EKGs as you would an adult
- Keep in mind the patient's specific age and development
- Right axis deviation and sinus arrhythmia are common findings
- Add amplitude to your checklist



Questions?

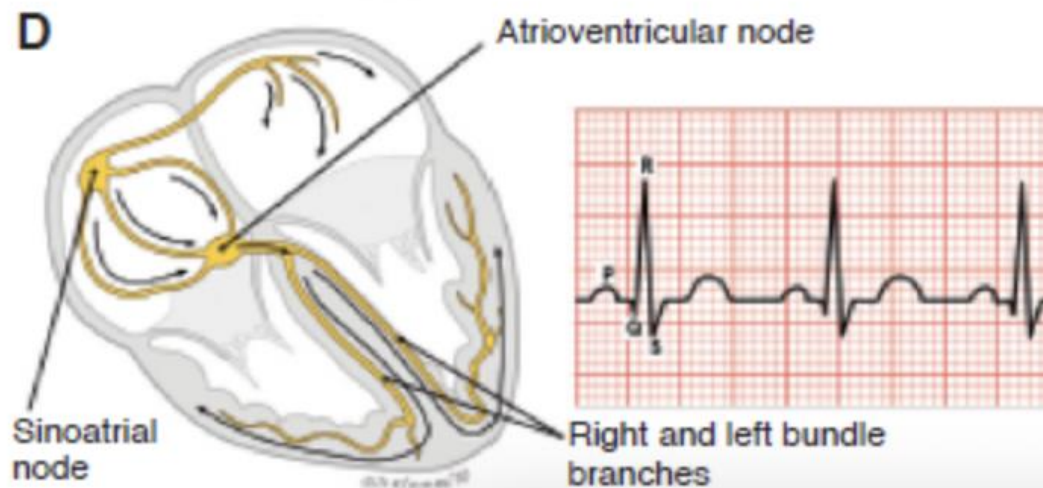
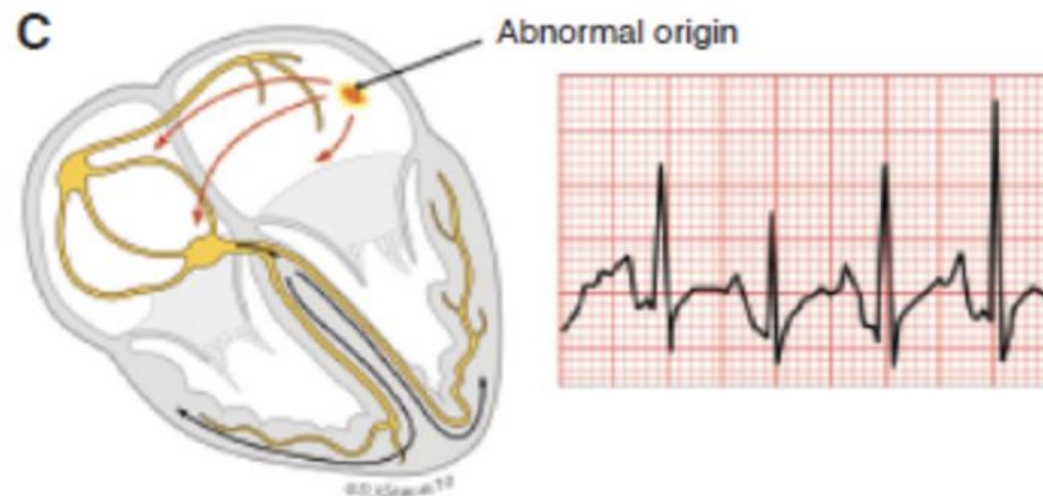
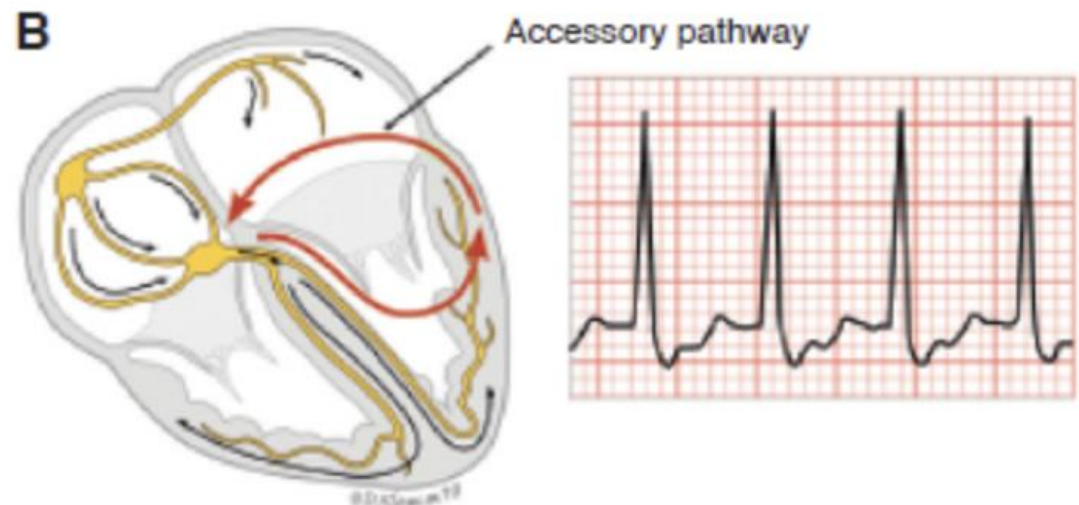
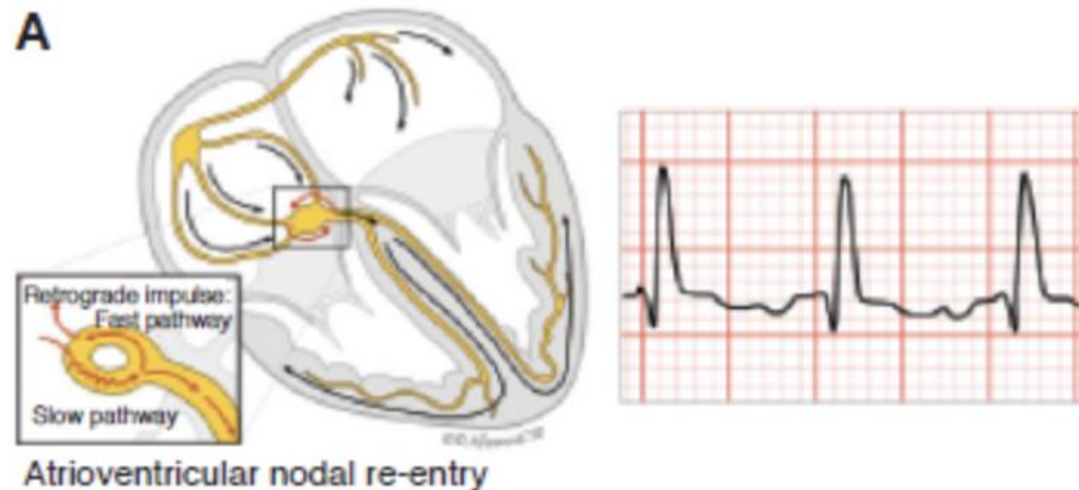
EKG Interpretation Overview

1. Supraventricular Tachycardias
2. Wide Complex Tachycardia
3. Baseline “Abnormals” to watch for
 - Long QT Syndrome
 - Hypertrophic Cardiomyopathy
 - Arrhythmogenic Right Ventricular Dysplasia

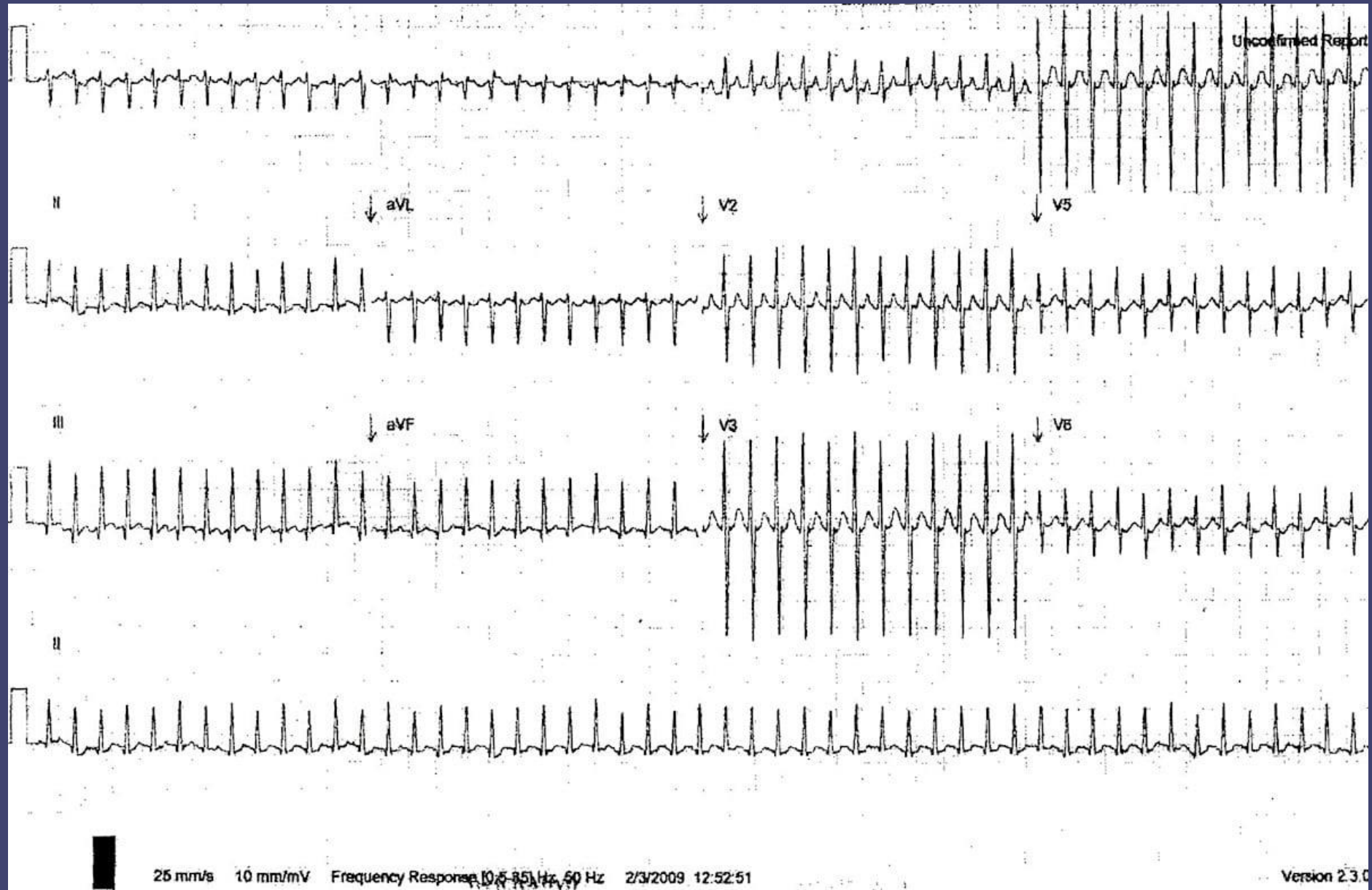
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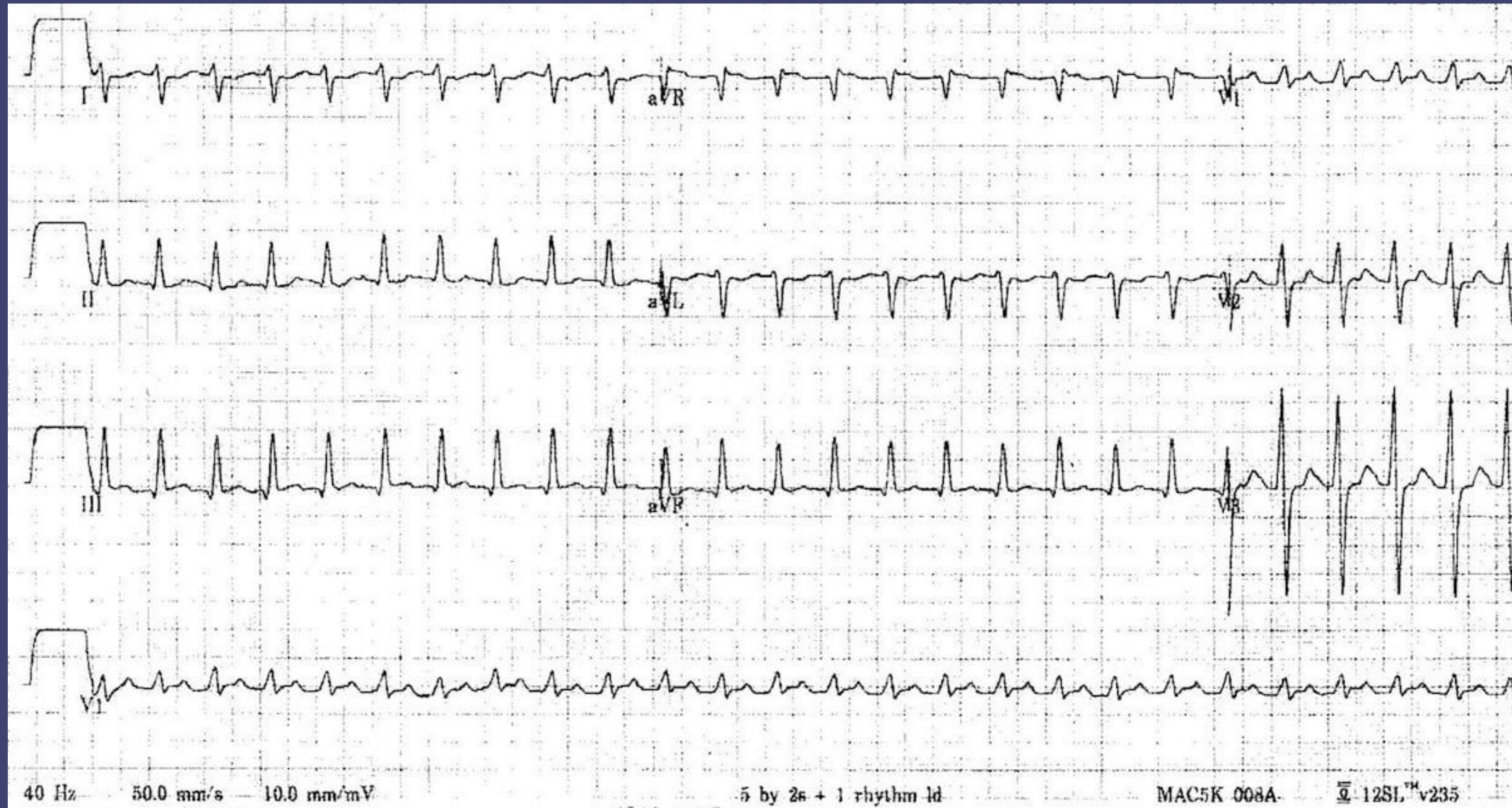
Types of SVT



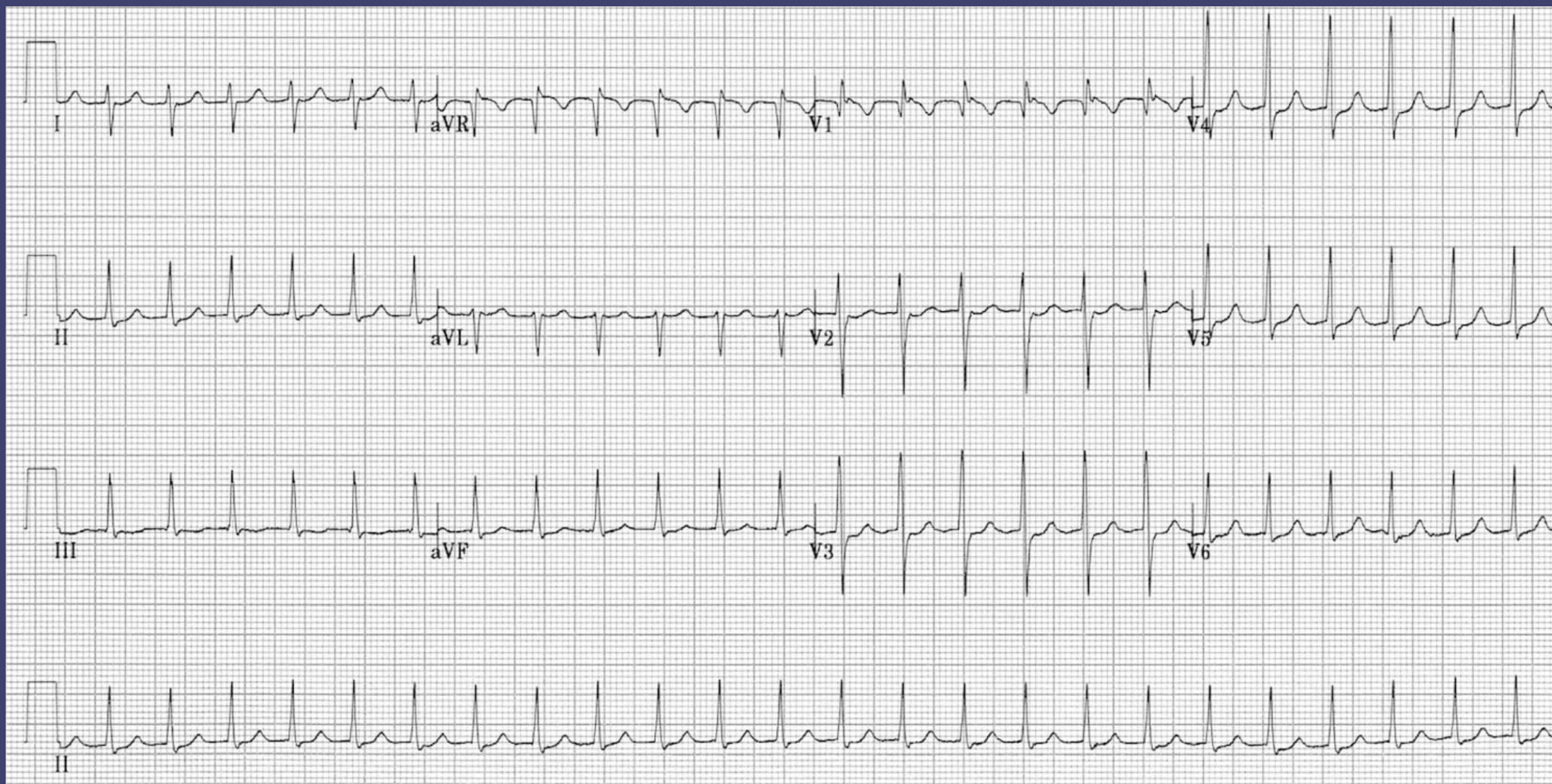
12d M, failure to thrive



Double the rate:



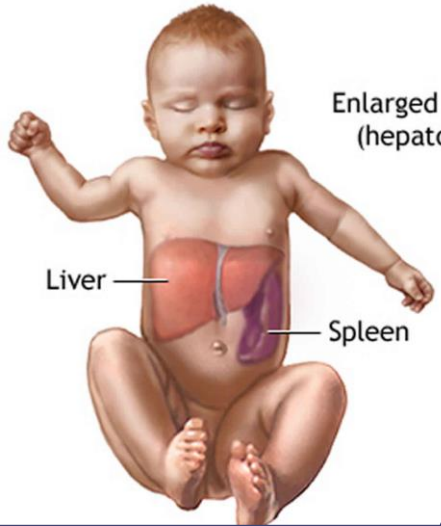
AV Node Re-entry Tachycardia (AVNRT)



Initial Evaluation – ABC vs H&P



Which one is the sick baby!??

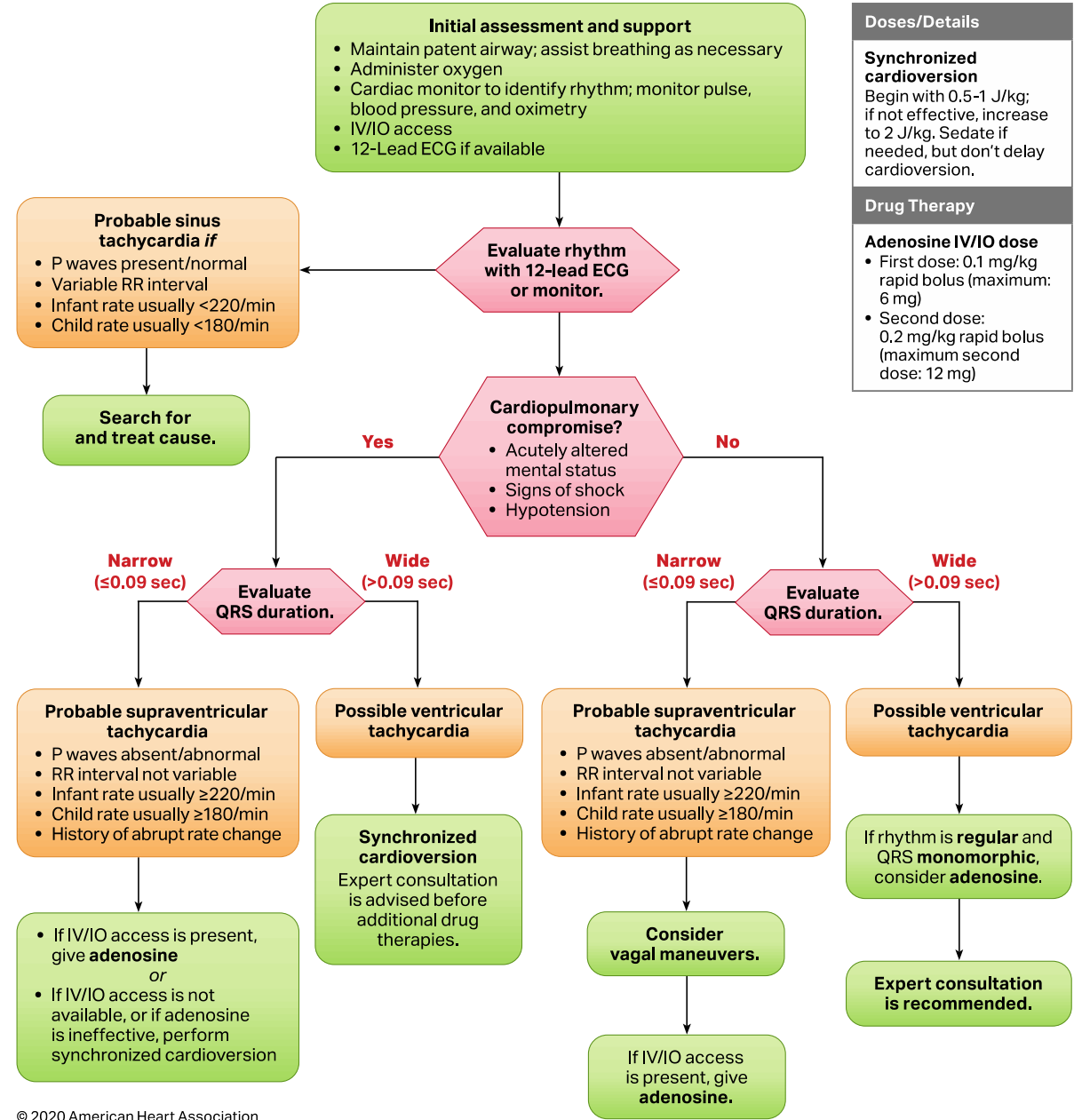


Enlarged spleen and liver
(hepatosplenomegaly)



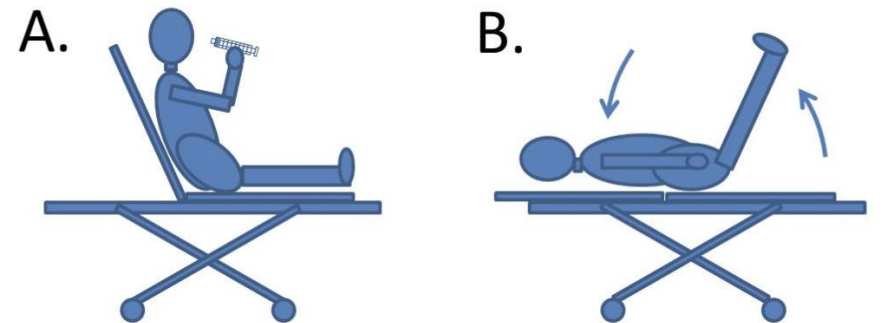
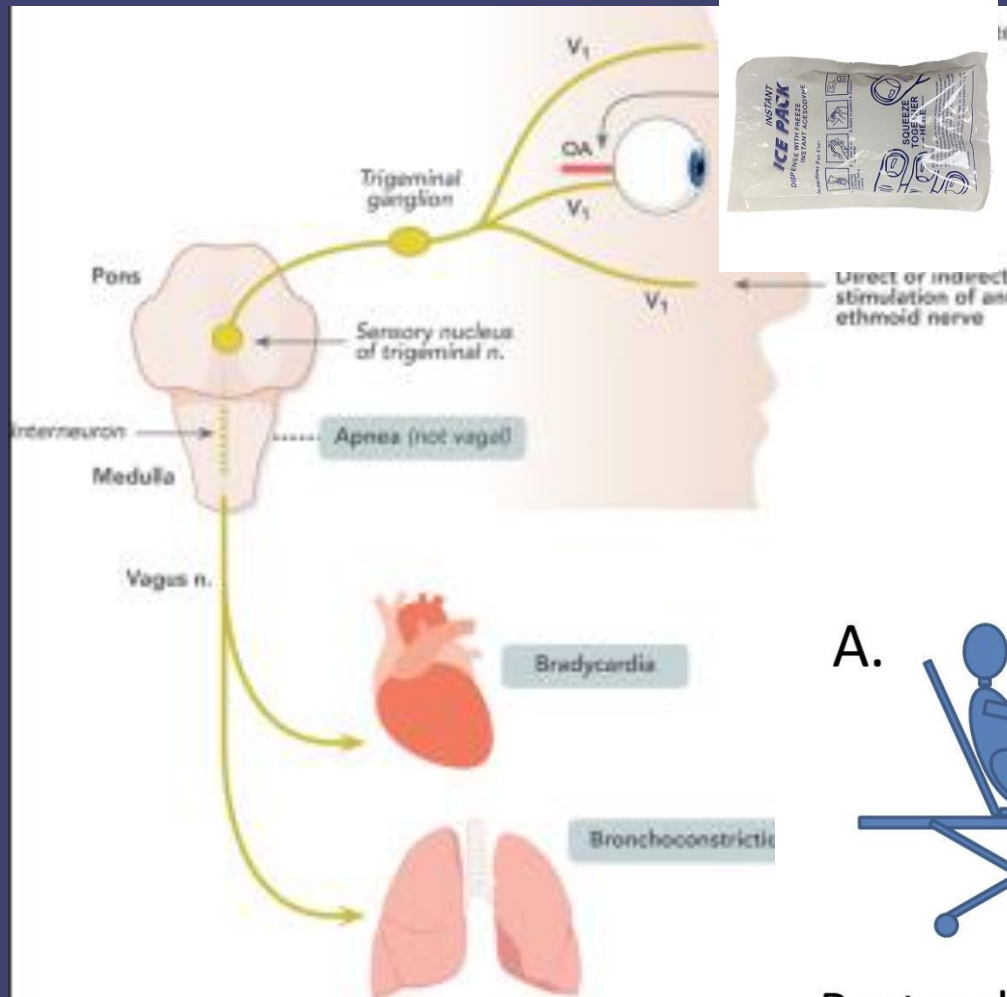
Signs of Poor
Perfusion or
Cardiac Lesions

Pediatric Tachycardia With a Pulse Algorithm



SVT Treatment approach (PALS+)

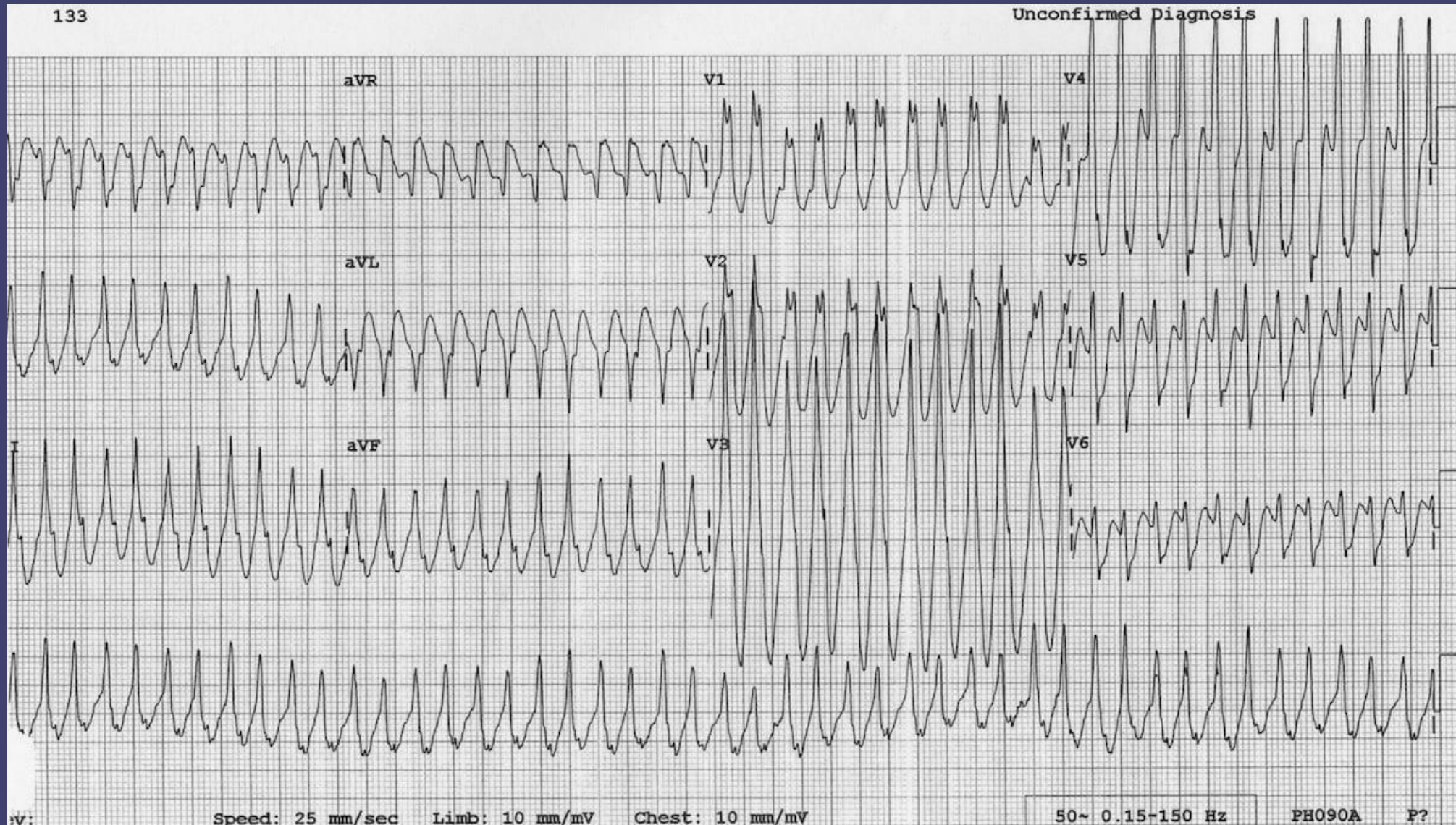
- Vagal maneuvers
 - Diving Reflex
 - Needle stick
 - *Valsalva*
 - *Modified Valsalva*
- Pharmaceuticals
 - Adenosine (max 6mg)
 - 1st - .1 mg/kg
 - 2nd - .2 mg/kg
- Cardioversion
 - Signs of instability



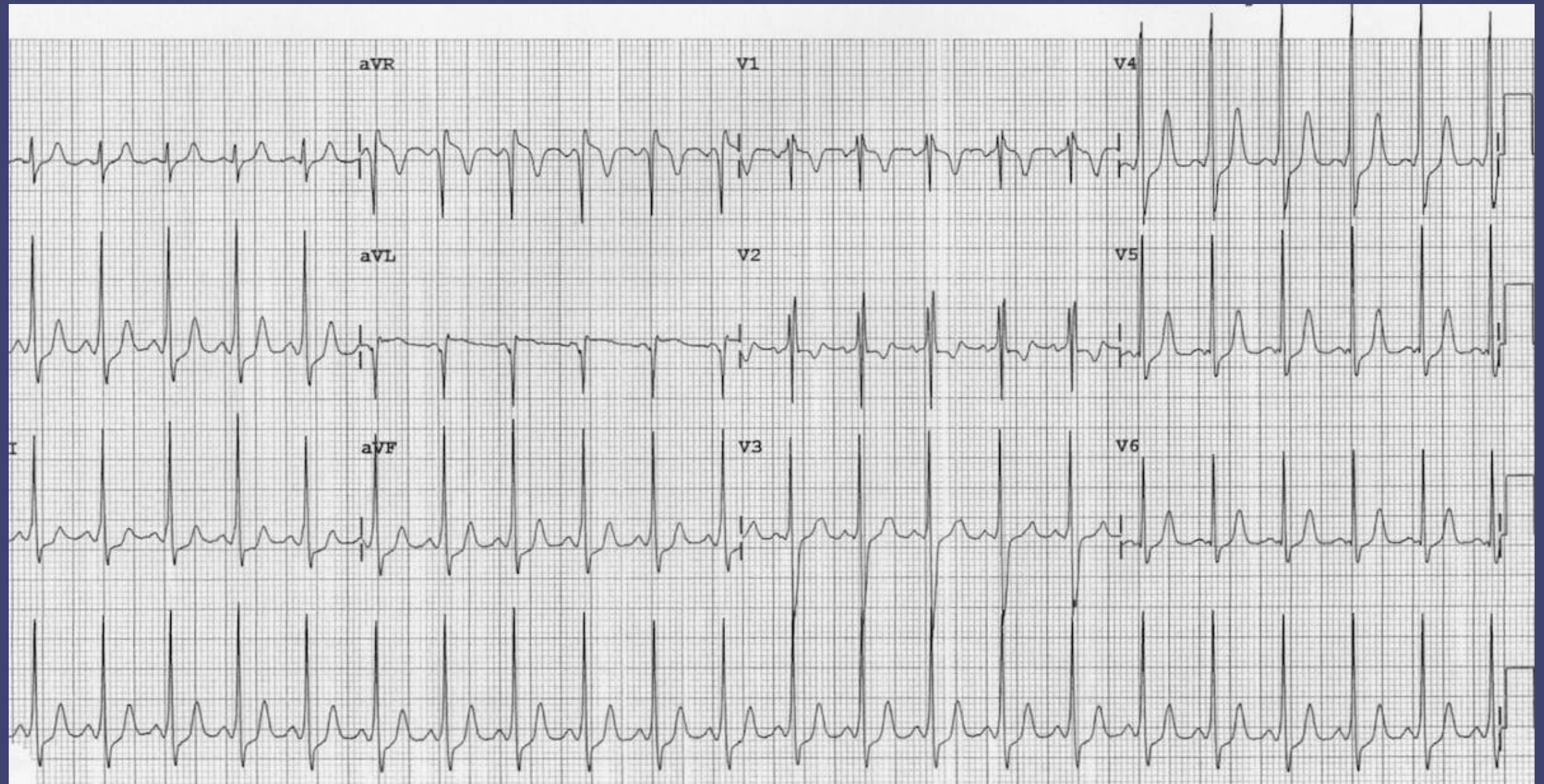
Postural Modification to the Standard Valsalva Maneuver

[Diving reflex Video](#)

5-year old boy with dyspnea

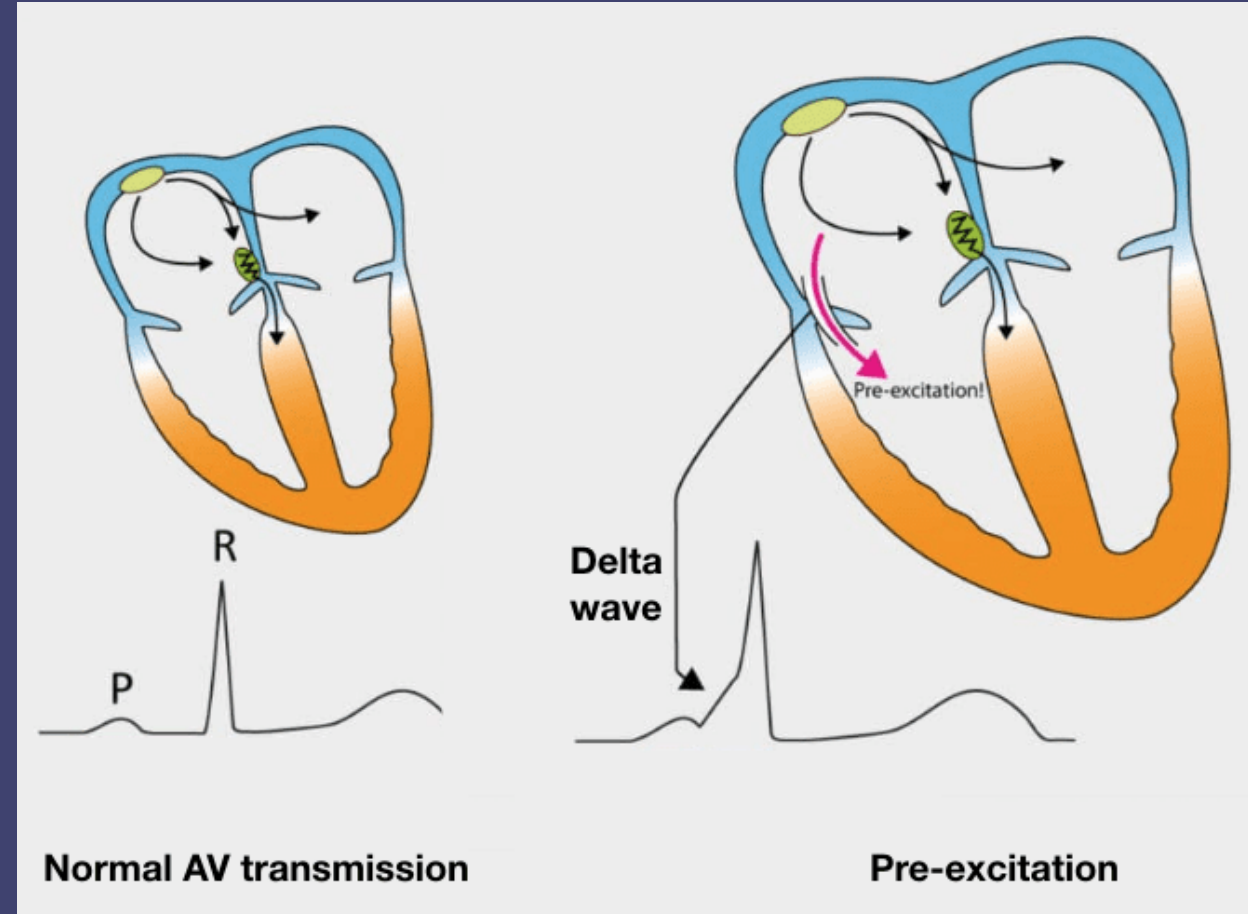


Same patient, baseline EKG

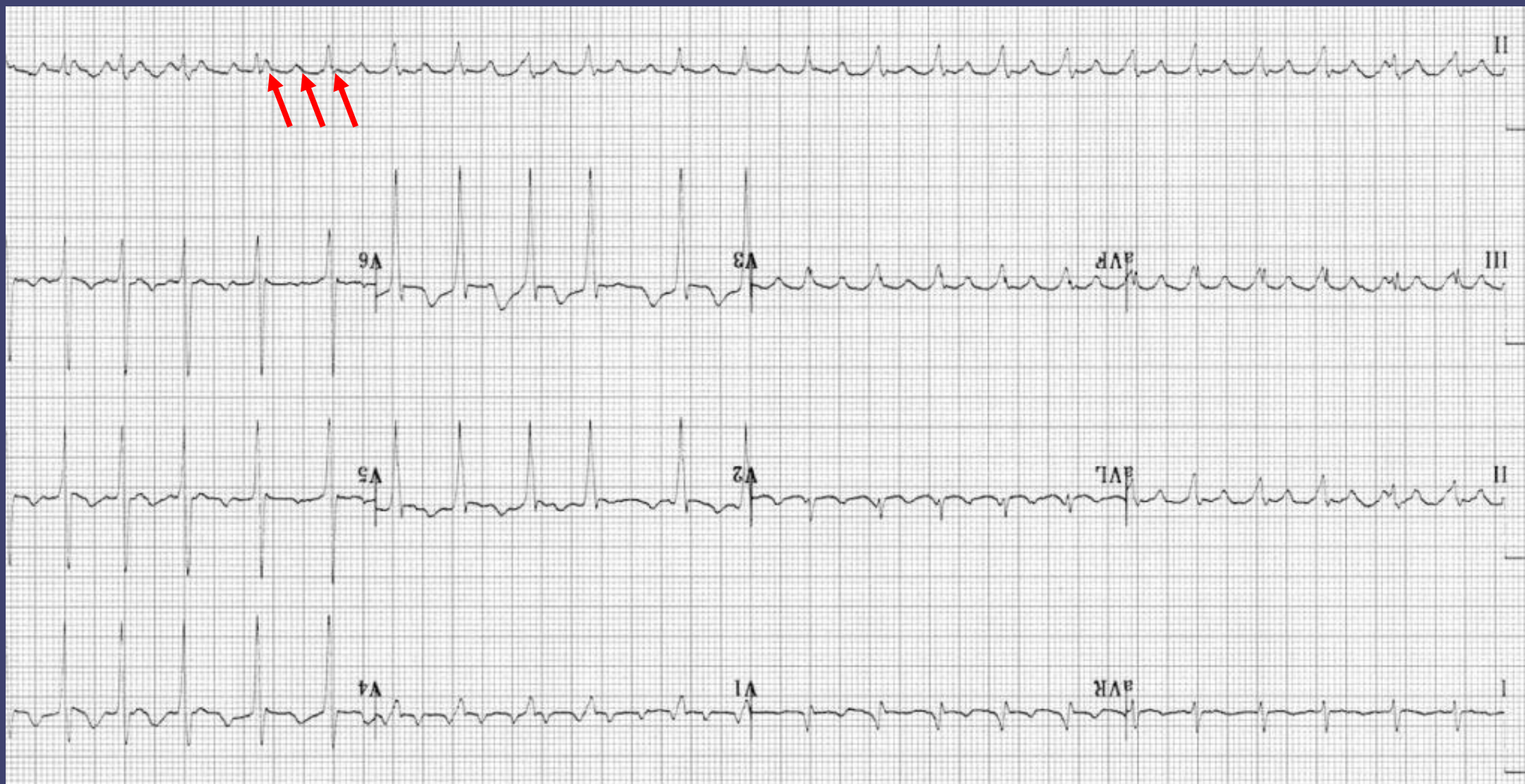


WPW - Wolff-Parkinson-White Syndrome

- Accessory Pathway around AV
 - Anterograde and/or retrograde
 - “Delta wave”
- Can lead to atypical Afib/Flutter or AVNT
- Treatment varies

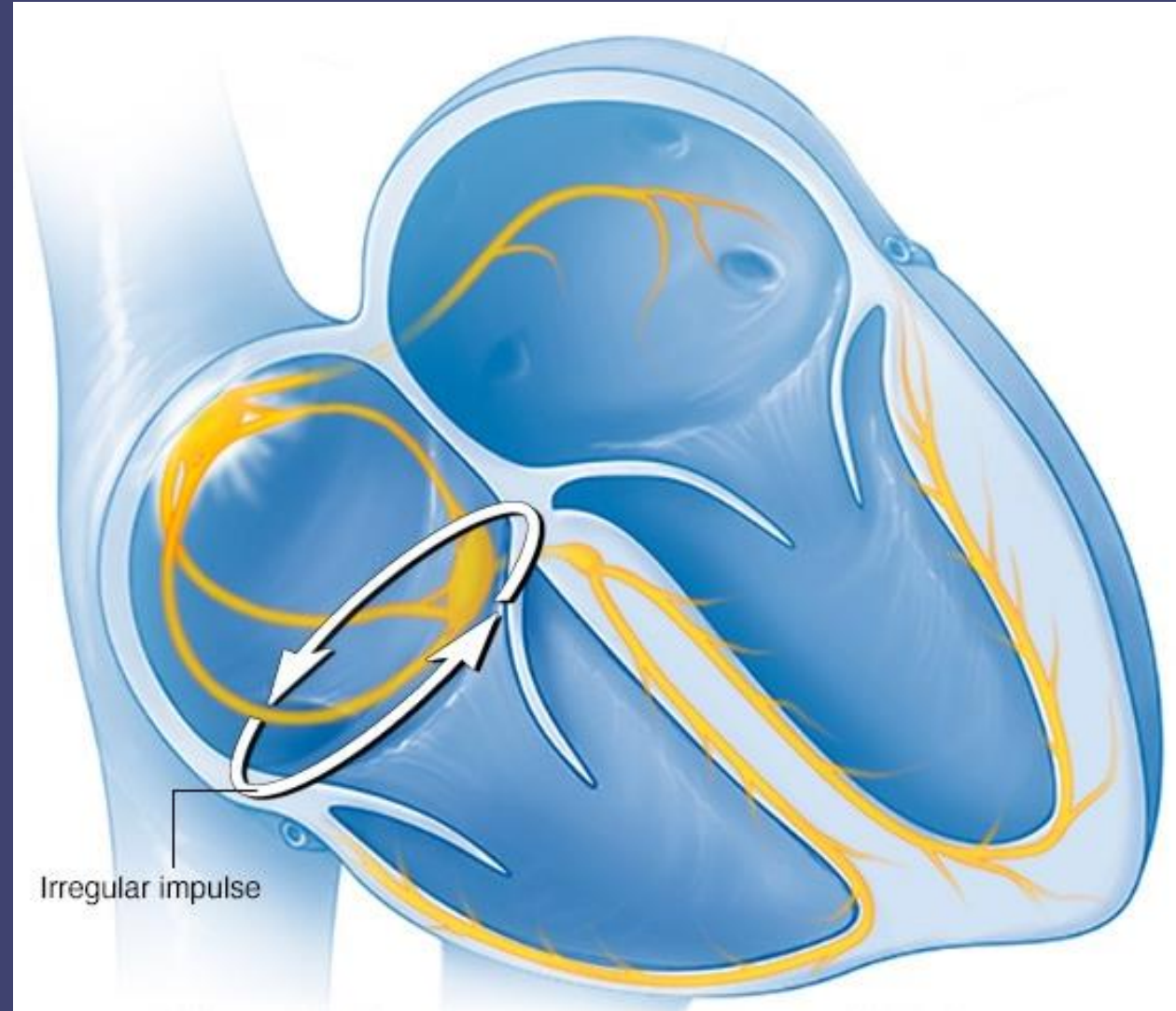
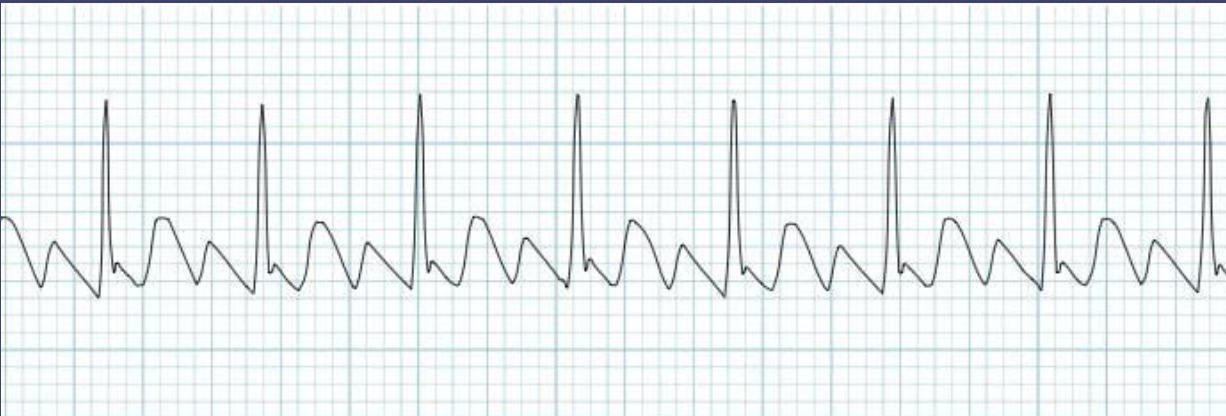


Atrial Flutter



Atrial Flutter

- Common rate is 150 and invariable
- Atrial activity ~280-400bpm
- “Sawtooth Pattern”
- Tx similar to A-fib



EKG Interpretation Overview

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Wide Complex Tachycardias Overview

- Ventricular Tachycardia
- SVT with Aberrancy
- Polymorphic V-Tach



Is it VT or SVT with aberrancy?

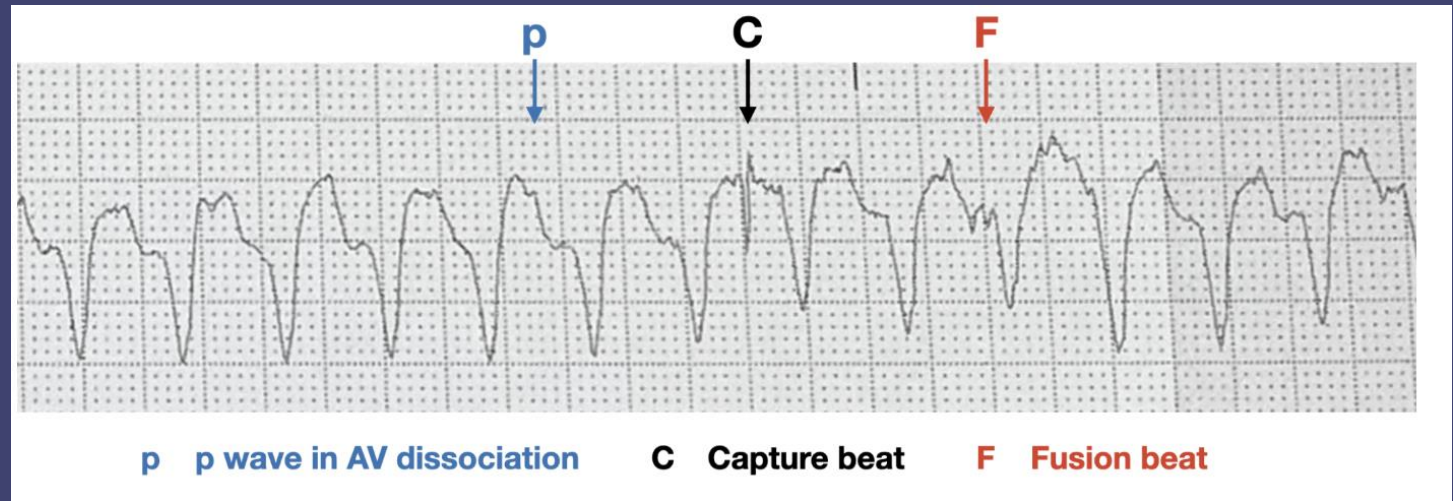
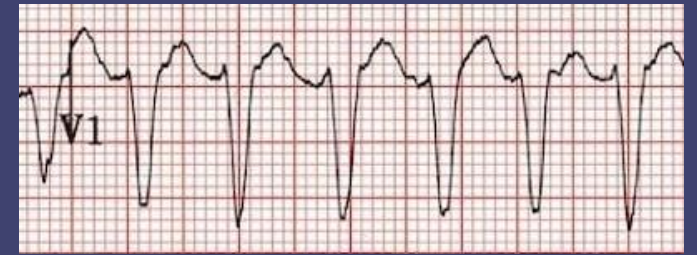
- ECG Characteristics of VT:

- Absence of LBBB or RBBB morphology
- Extreme axis deviation + aVR, - in I and aVF
- Complexes >160ms
- AV dissociation
 - Identifiable P waves
 - Capture and fusion beats:

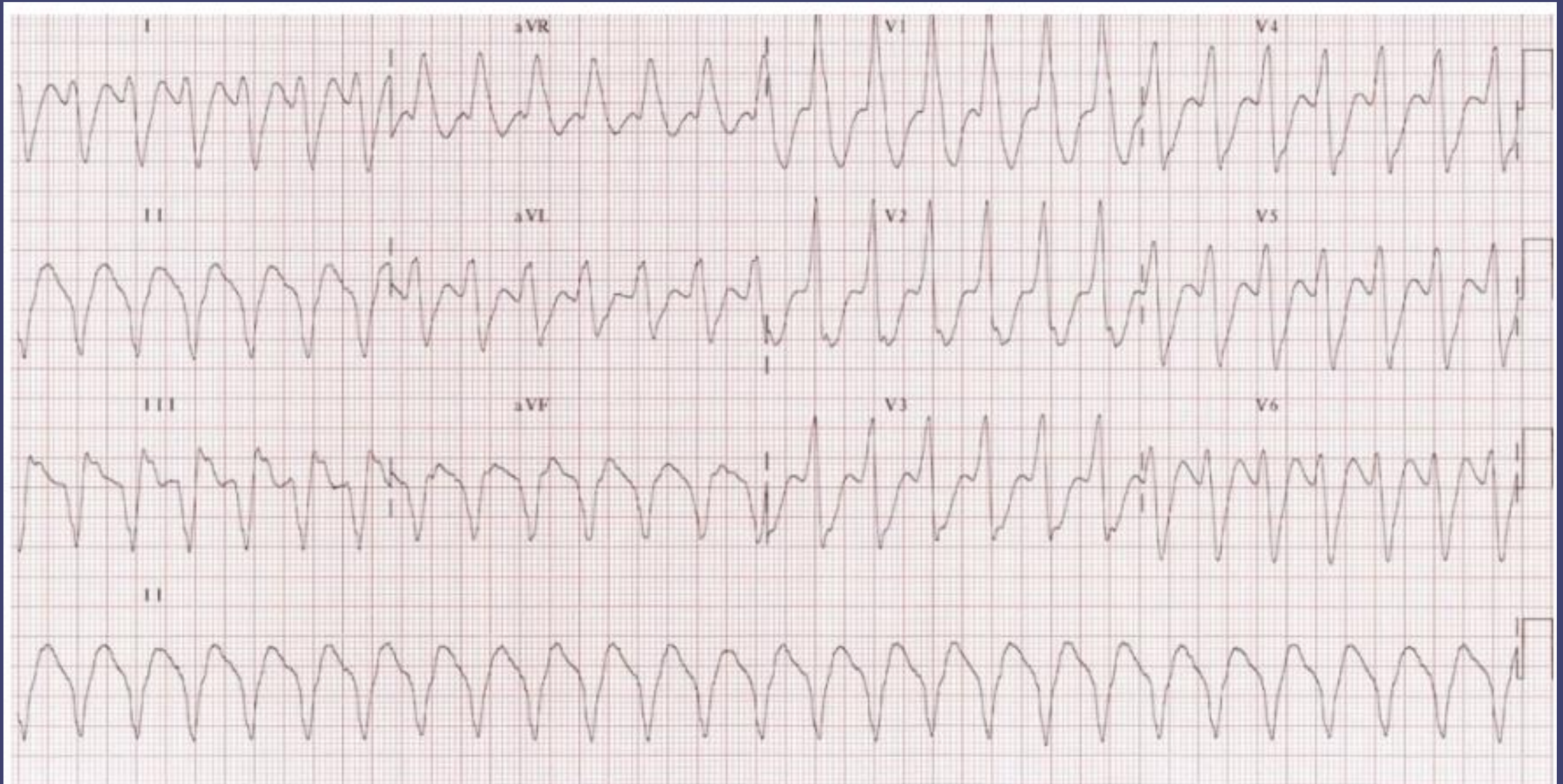
RSr' in RBBB



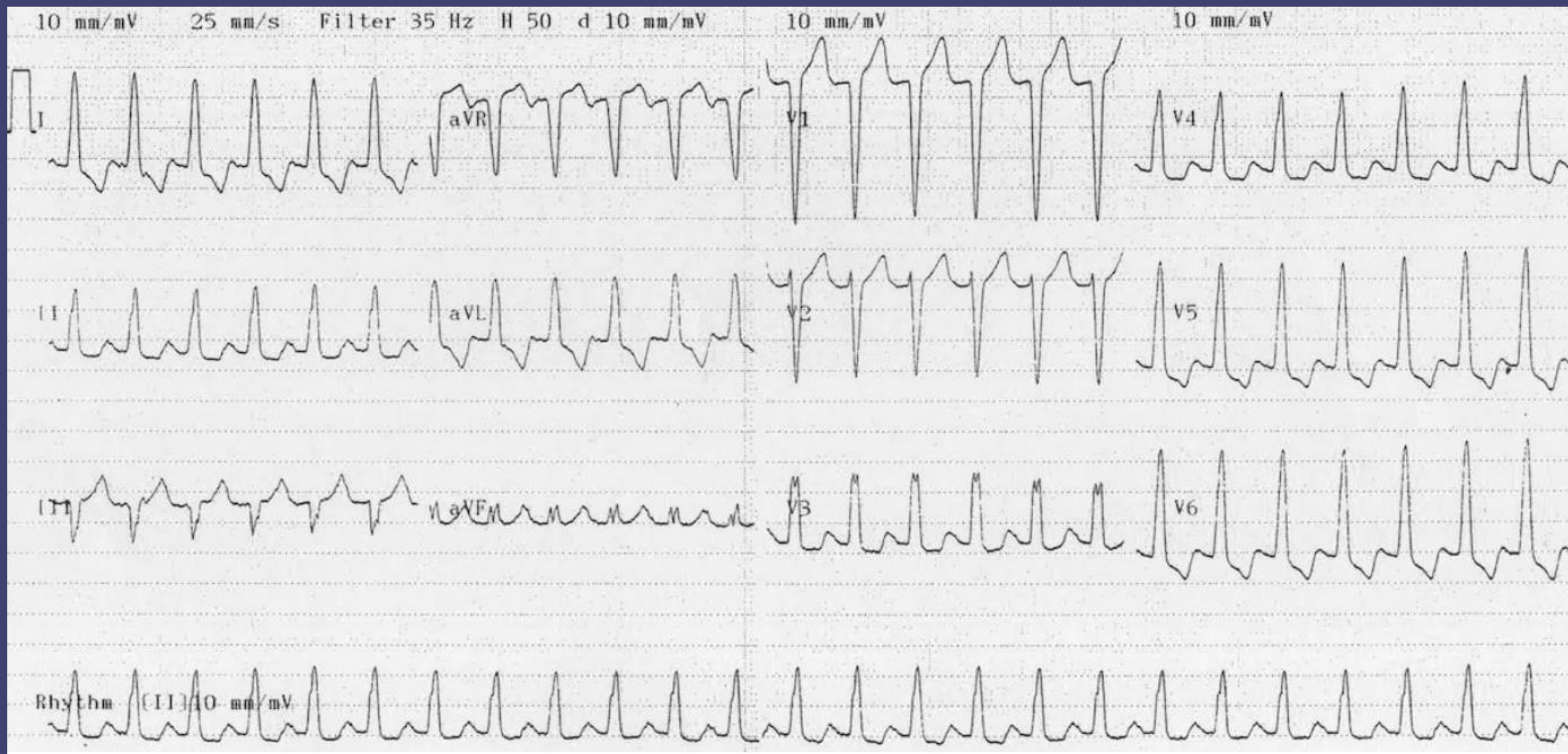
LBBB (Dominant S)



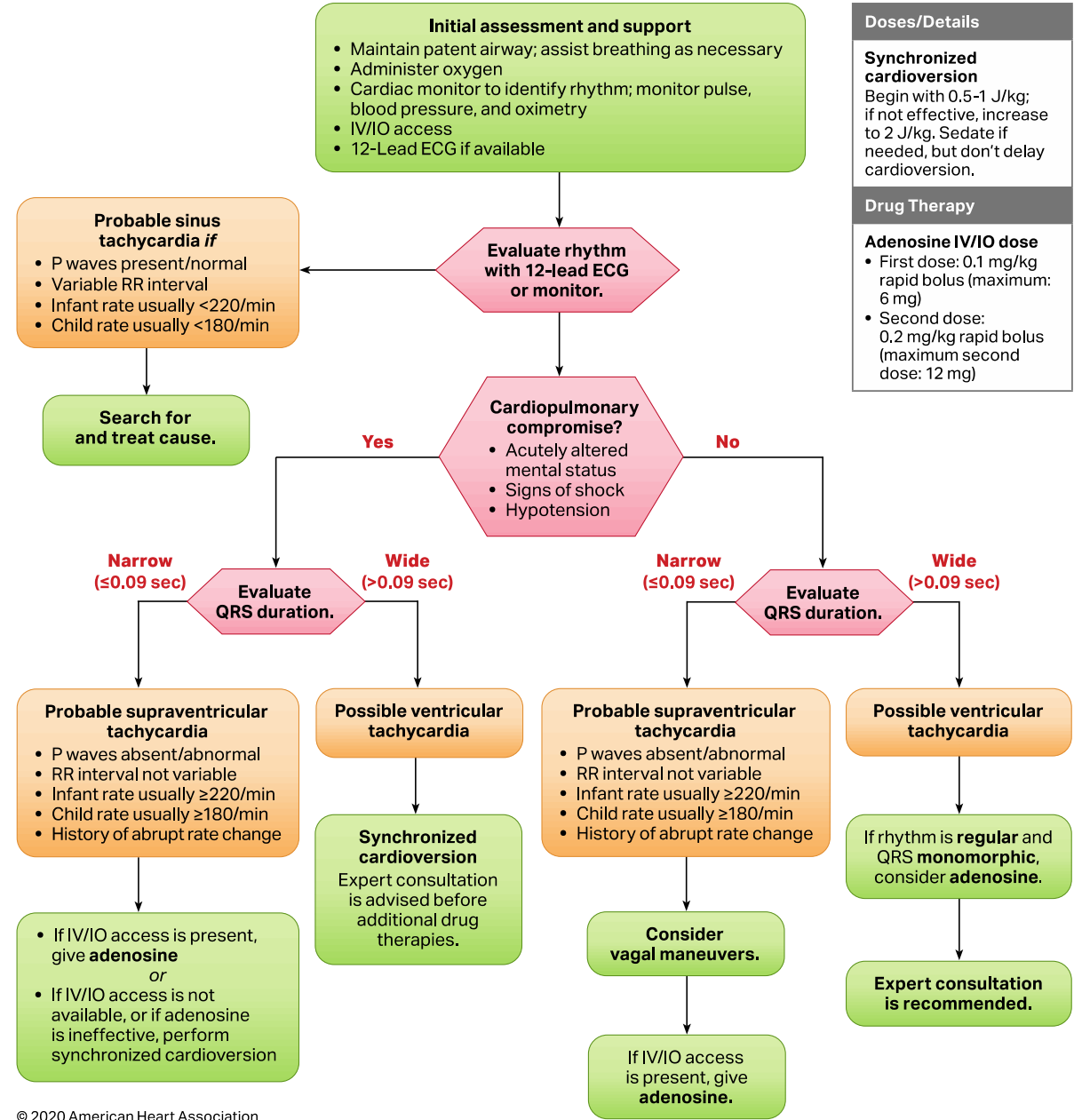
Monomorphic VT



SVT with Aberrancy

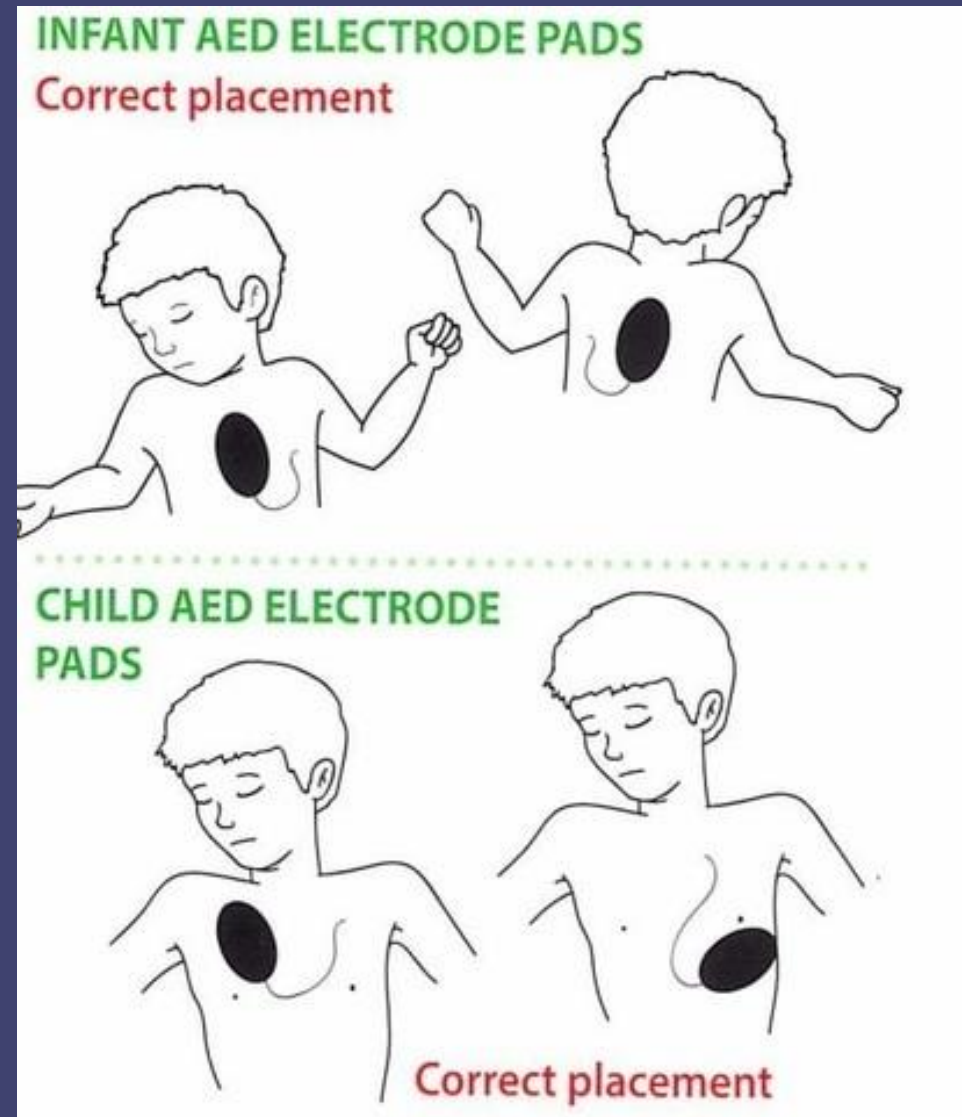


Pediatric Tachycardia With a Pulse Algorithm



Ventricular Tachycardia Treatment

- Pad placement
- Follow PALS and rapid transport
- Cardioversion
 - Pulses – Synchronized 0.5-1.0 J/kg
 - Pulseless – Defib (1-2 J/kg)



Polymorphic Ventricular Tachycardia

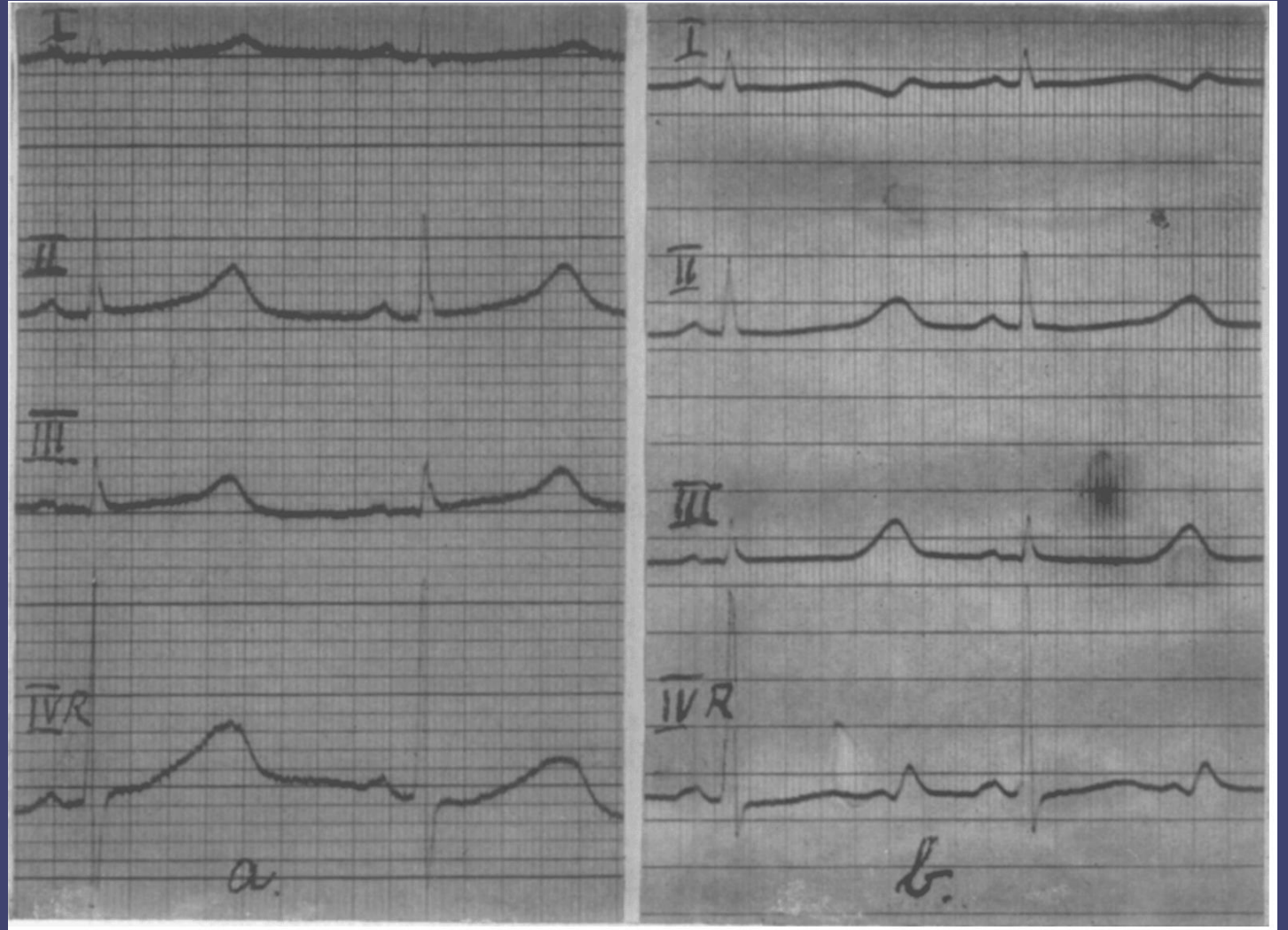


EKG Interpretation Overview

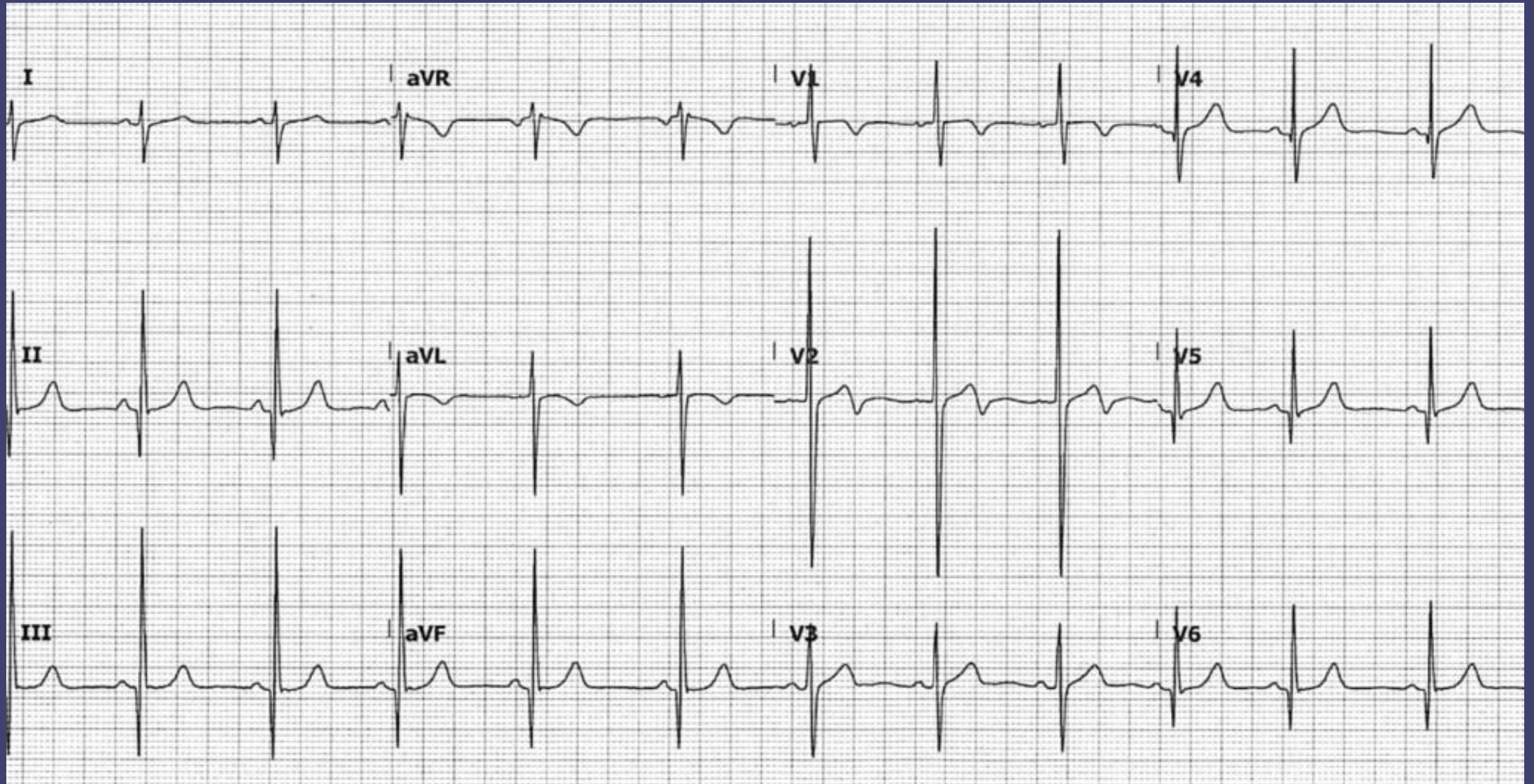
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Long QT Syndrome

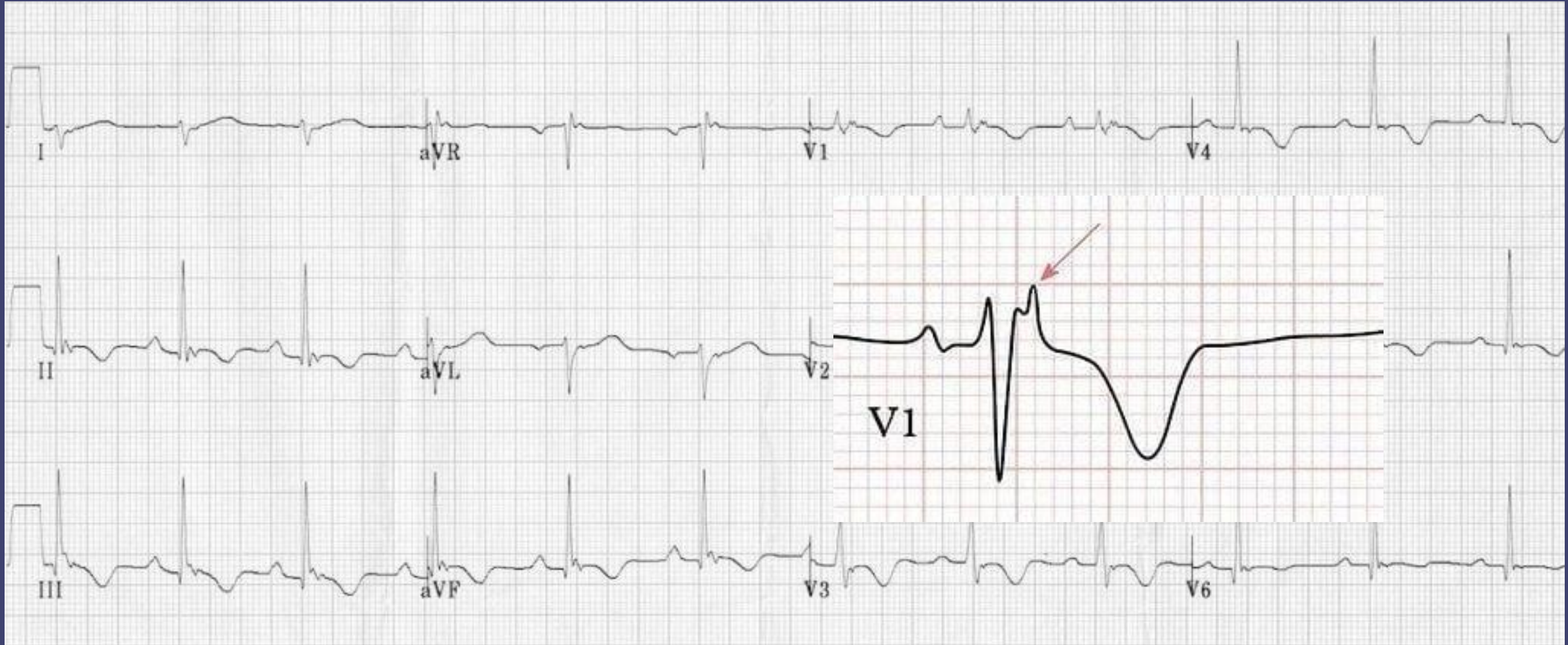
- Congenital or Acquired
- Initially dx from syncopal events
- Exercise may worsen elongation
- Predisposition to Polymorphic VTach



Hypertrophic Cardiomyopathy



Arrhythmogenic Right Ventricular Dysplasia



Baseline “Normals” considerations

- +“Syncope”, place pads
- Ask about familial heart disease/sudden death
- Do not administer QT prolonging medications (i.e. Zofran)
- Rapid transport

Disposition

- Prioritize pediatric hospital if possible
- Closest ED for unstable patients
- Cardiac patients can be transferred after stabilized





Take Home Points

- Tachydysrhythmias are common and can lead to significant morbidity/mortality in children
- Take a standardized approach to evaluating pediatric EKGs
- Consider the primacy of rate, delineate stability early
- Apply pads early in assessment (even in syncope with unusual EKG)
- Rapid transport to a pediatric center is paramount

Thank you for your attention!

Questions?

Sources

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