

SVT and Medical Treatment

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1

- No disclosures



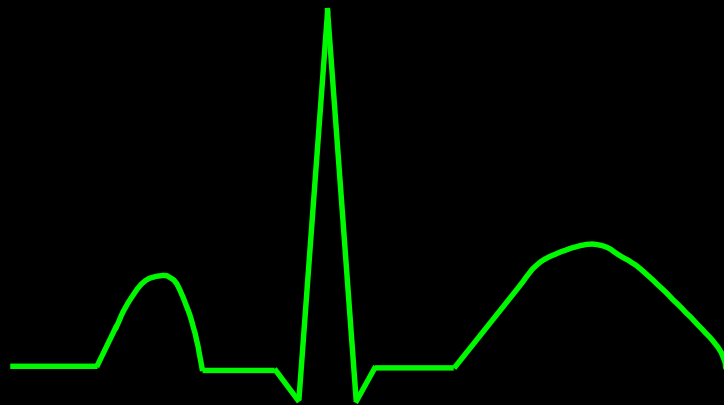
2

Goals

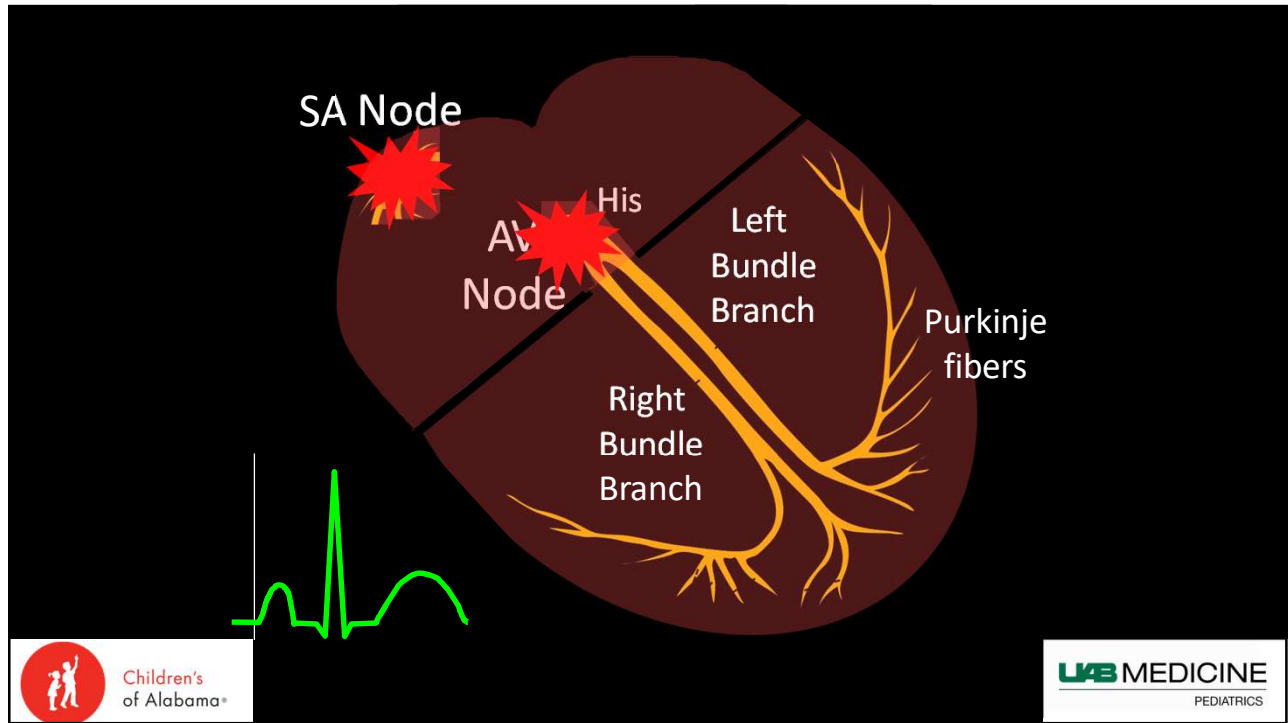
- Diagnose SVT and distinguish it from WPW
- Be able to treat SVT acutely with vagal maneuvers and adenosine
- Review first- and second-line medications to treat SVT



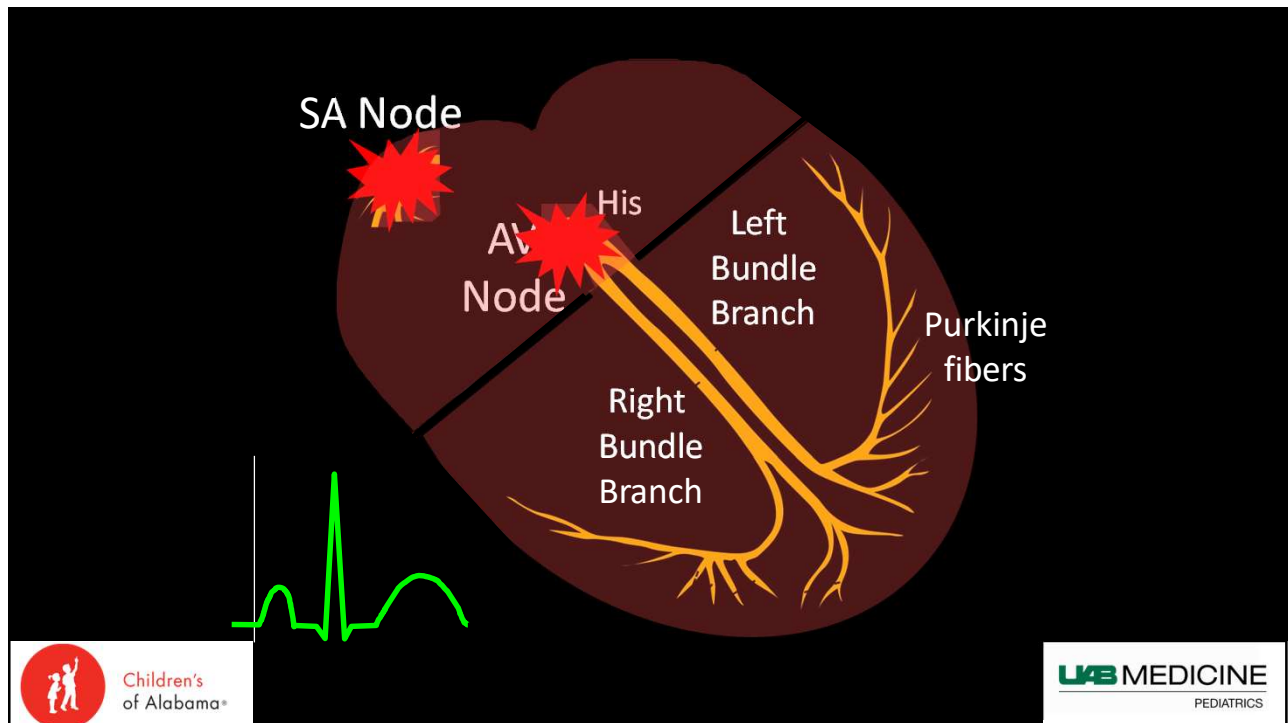
3



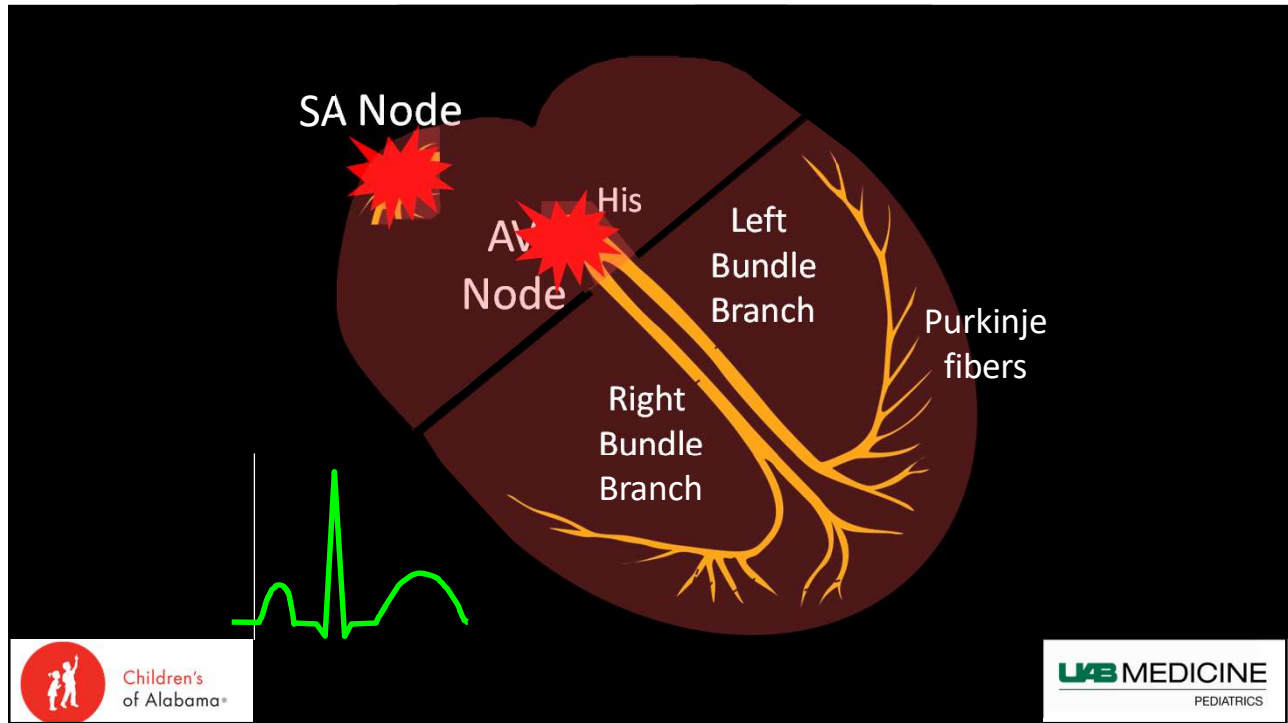
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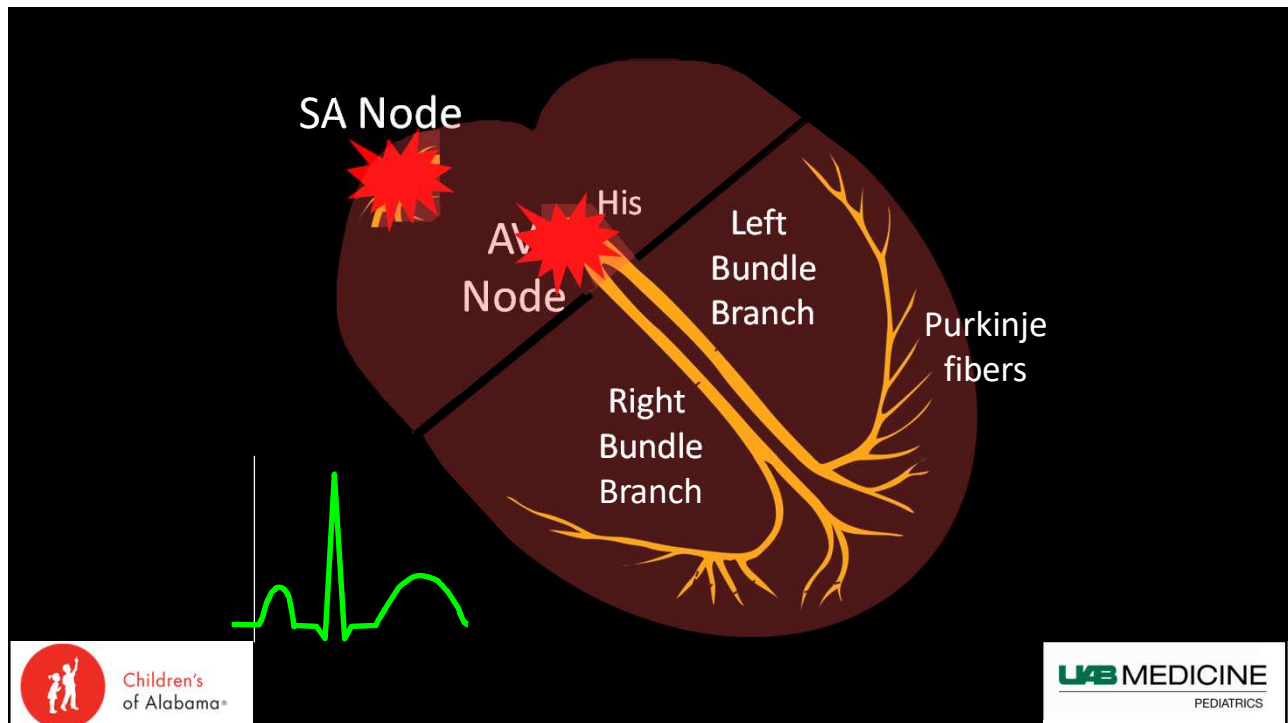
5



6



7



8

SVT

- Most common arrhythmia in pediatrics
- Occurs in normal hearts and abnormal hearts
- Affects all ages from fetal life to adulthood
- Heart rate is often >200 bpm, can be 100s-300 bpm
- Usually has abrupt onset and termination



9

Presentation of SVT

- Palpitations
- Tachycardia
- Heart failure
- Associated symptoms:
 - Shortness of breath
 - Tachypnea
 - Dizziness
 - Nausea
 - Fatigue
 - Poor feeding
 - Decreased activity



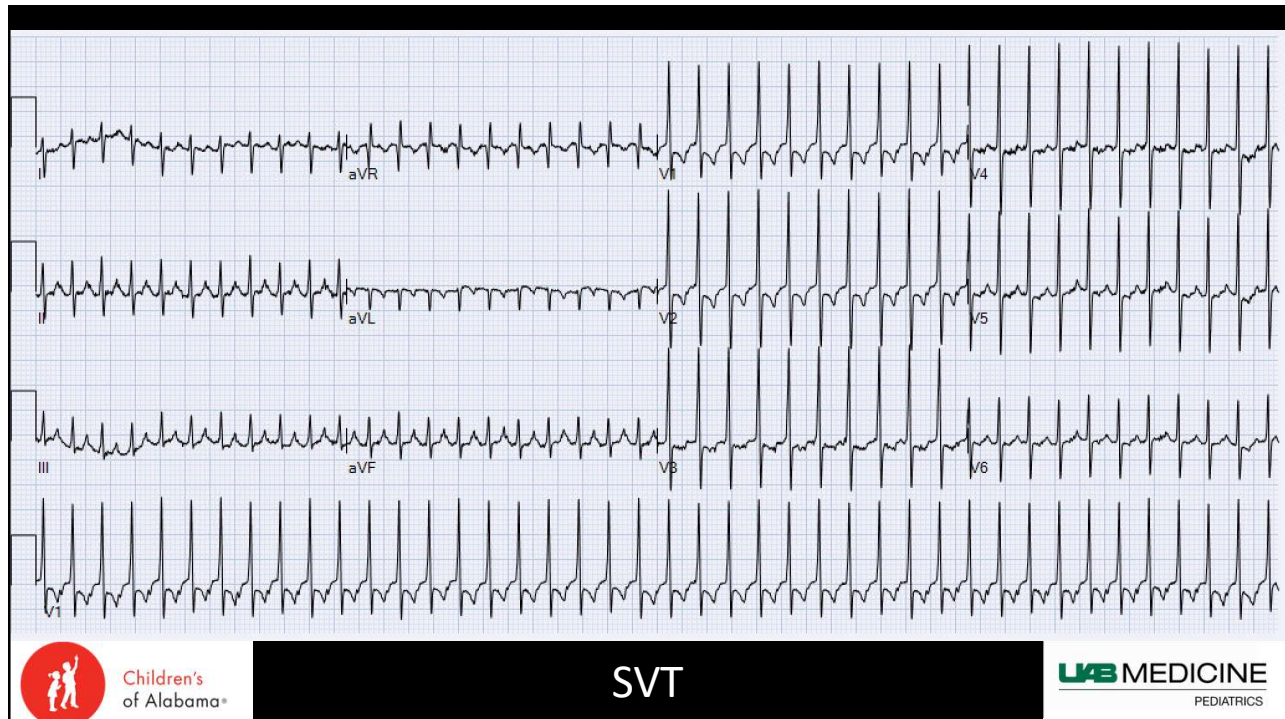
10

ECG in SVT

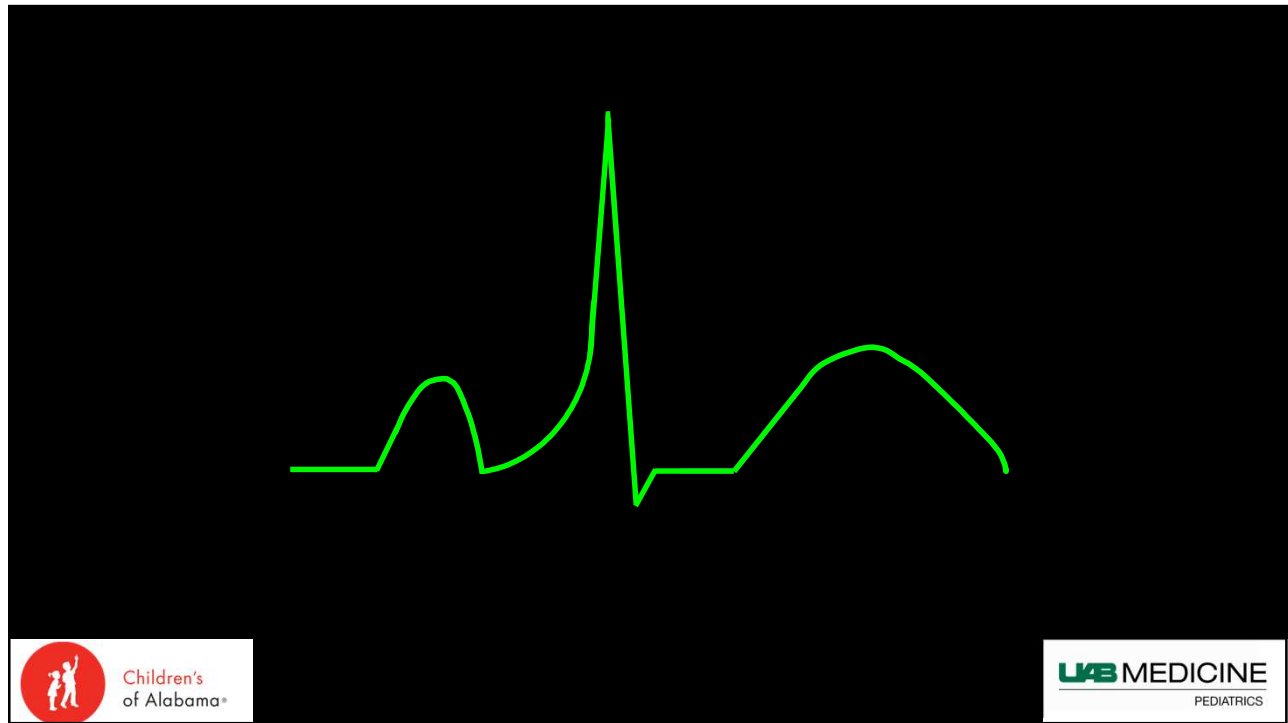
- Heart rate is often >200 bpm, can be 100s-300 bpm
- Narrow QRS complex tachycardia, can have wide QRS*
- P waves are present but often difficult to see
- Usually has abrupt onset and termination



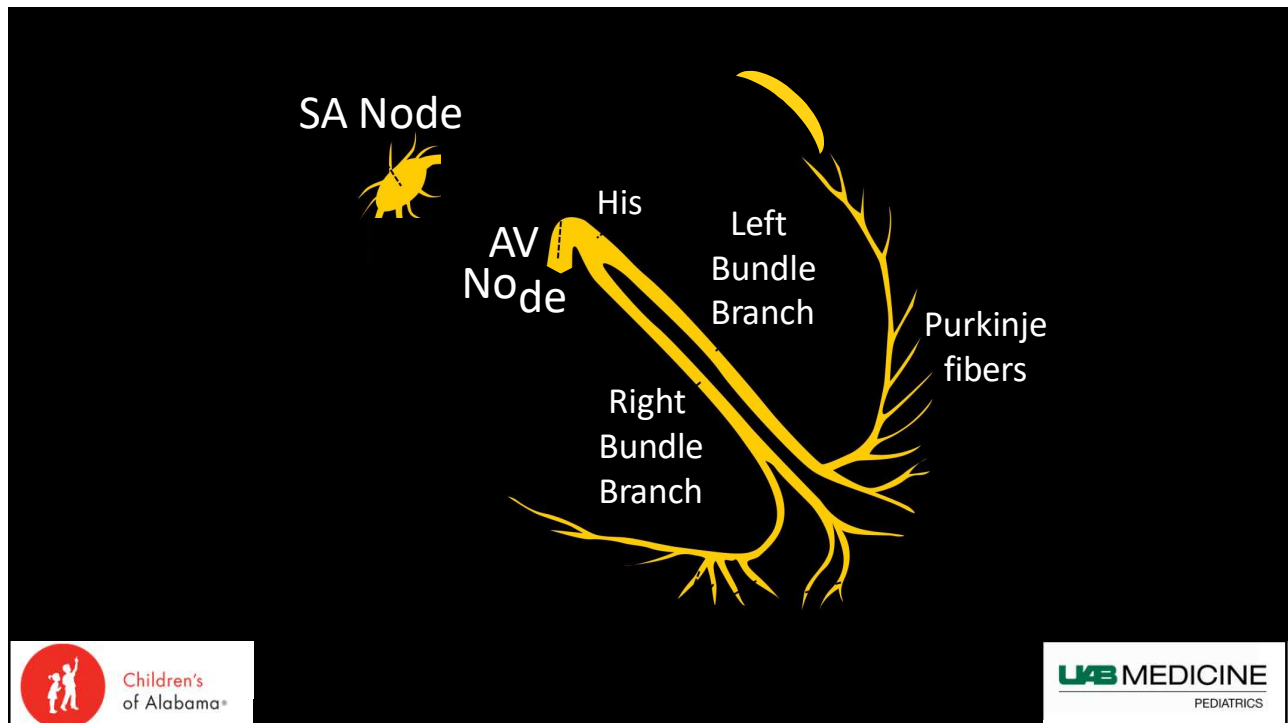
11



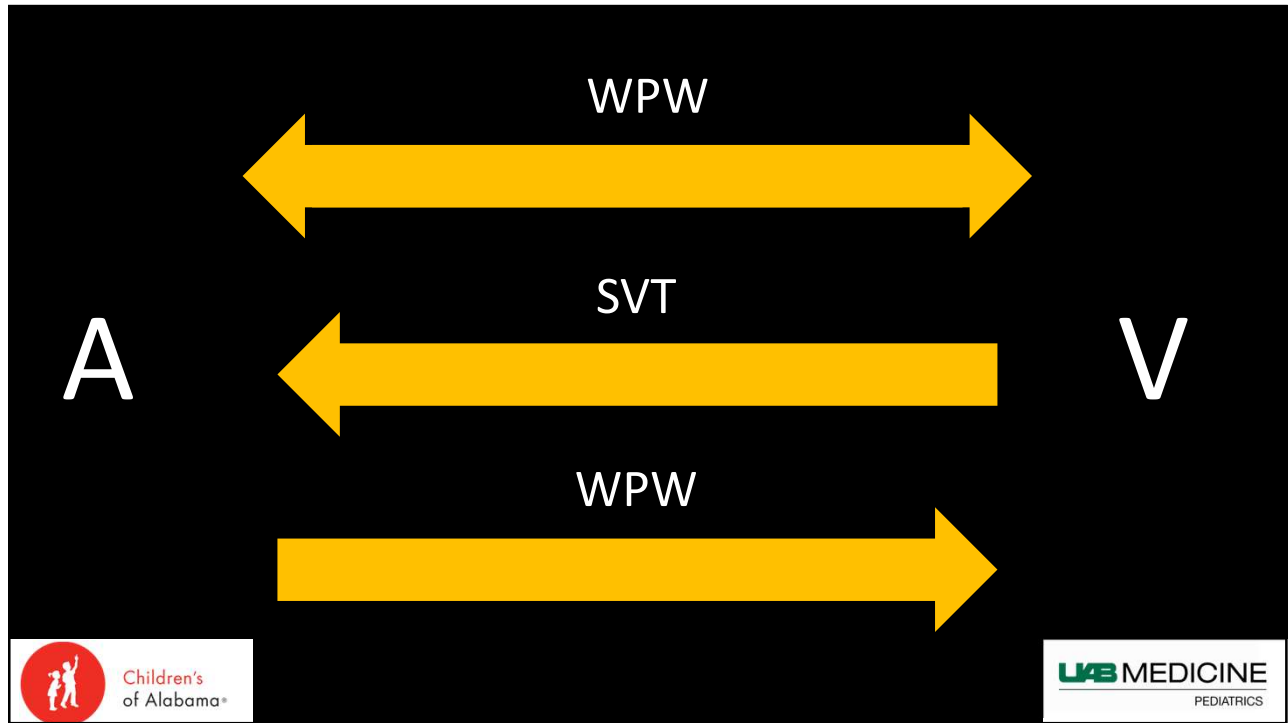
12



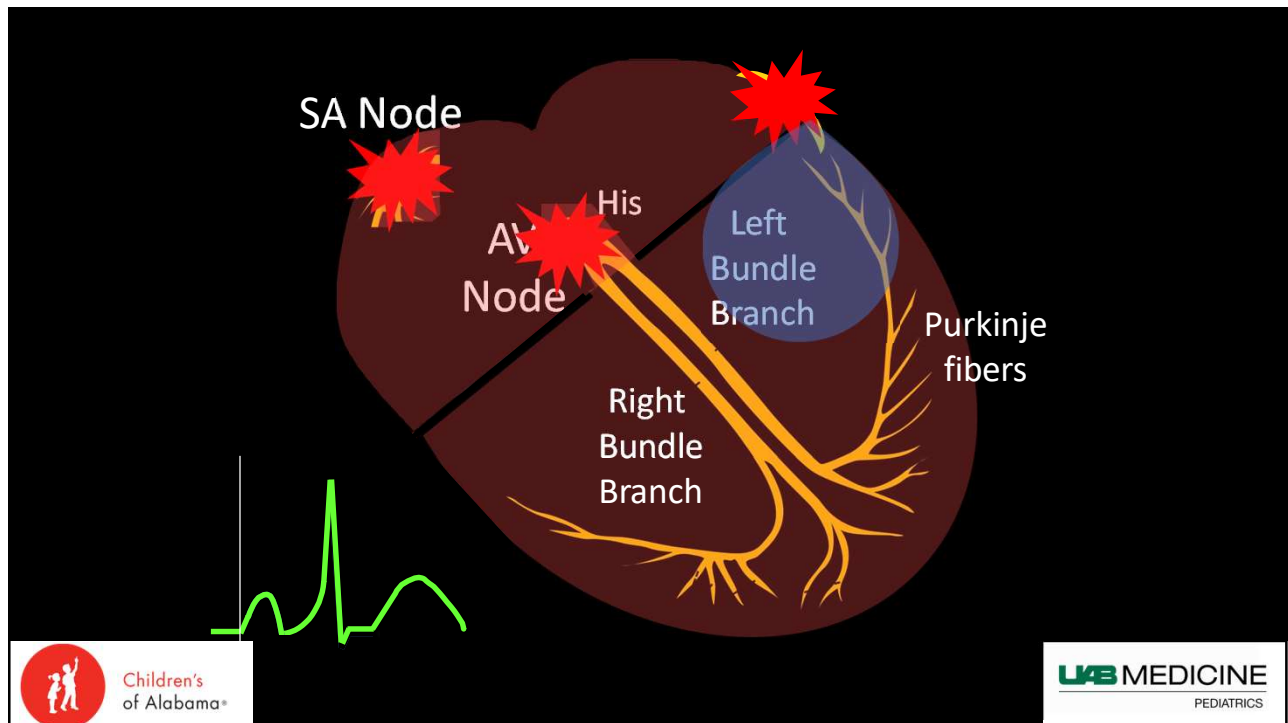
13



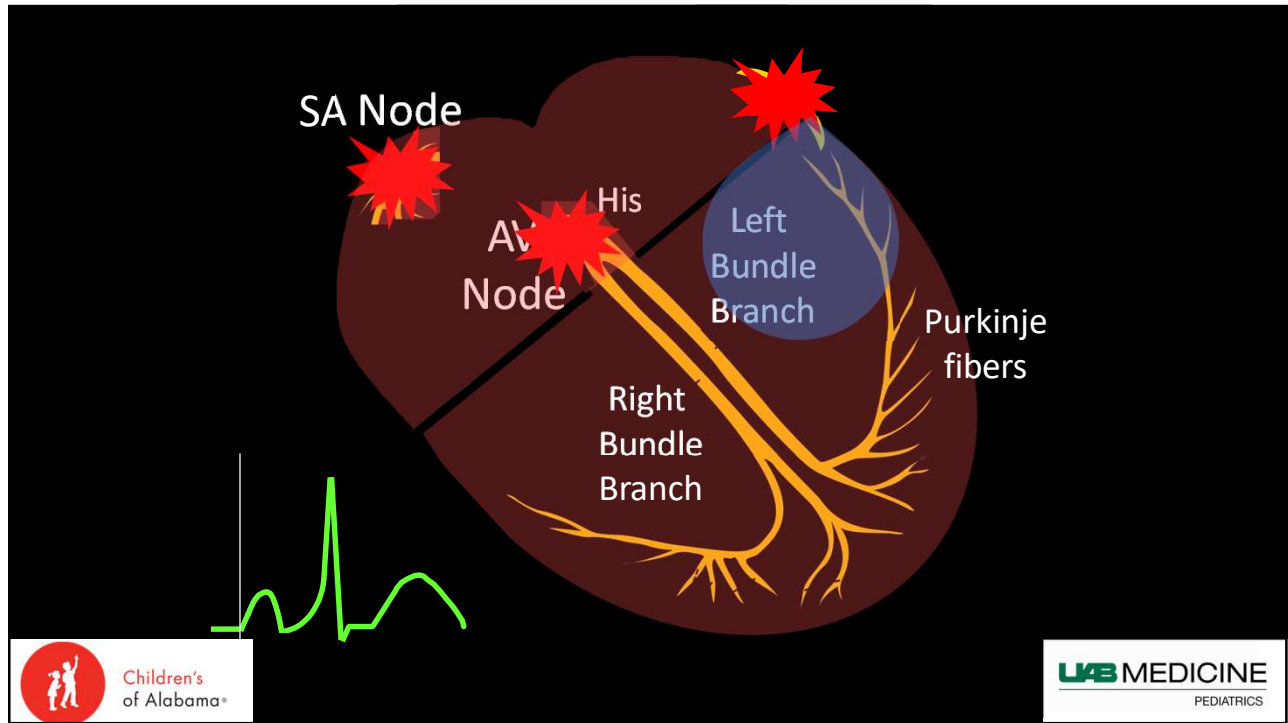
14



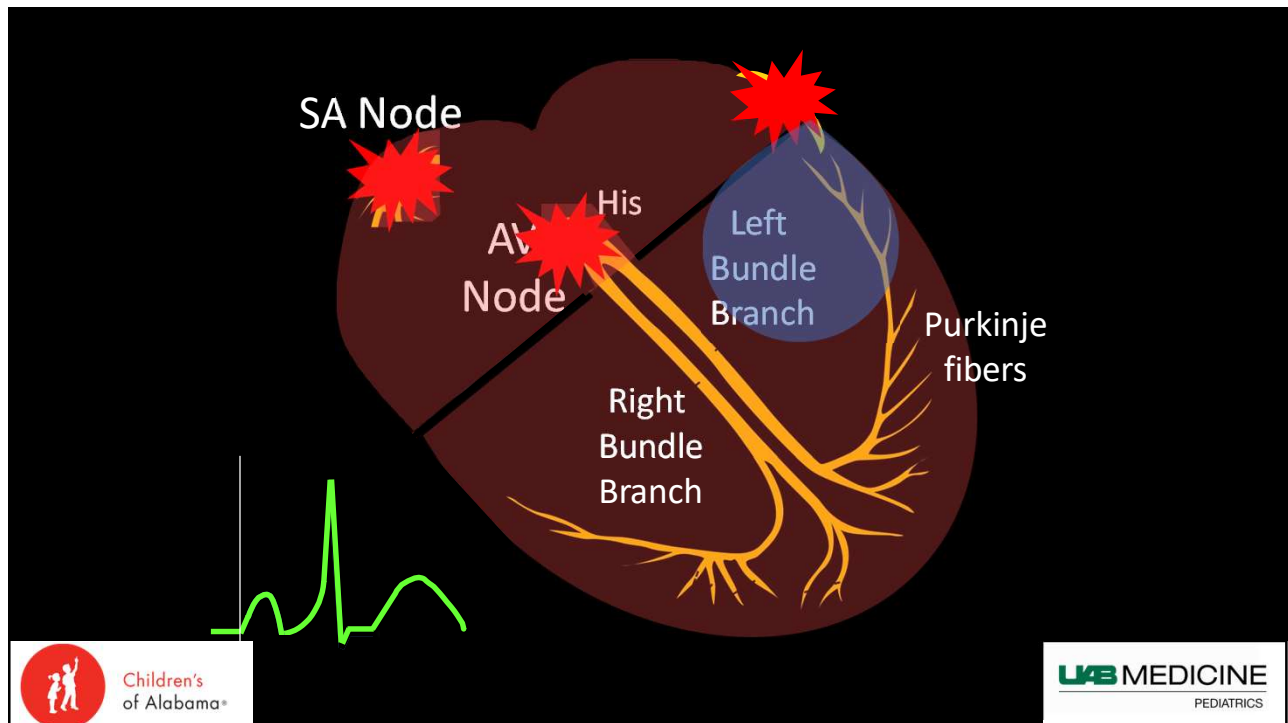
15



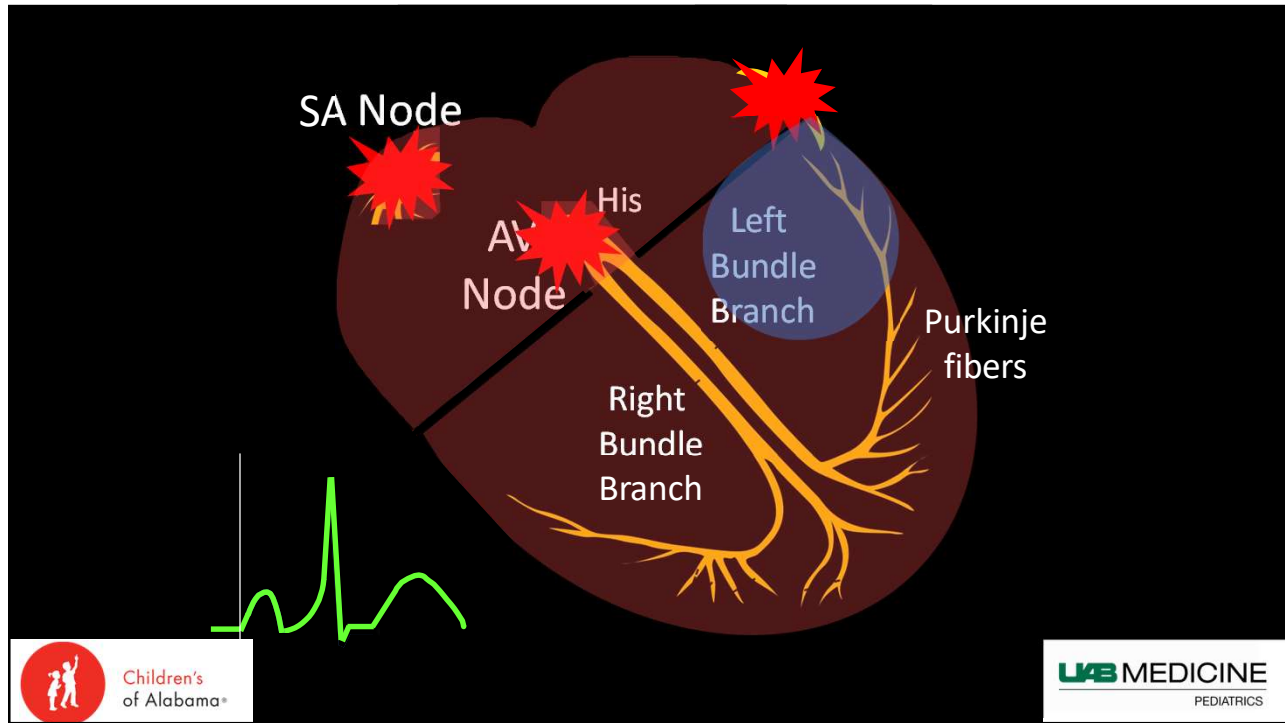
16



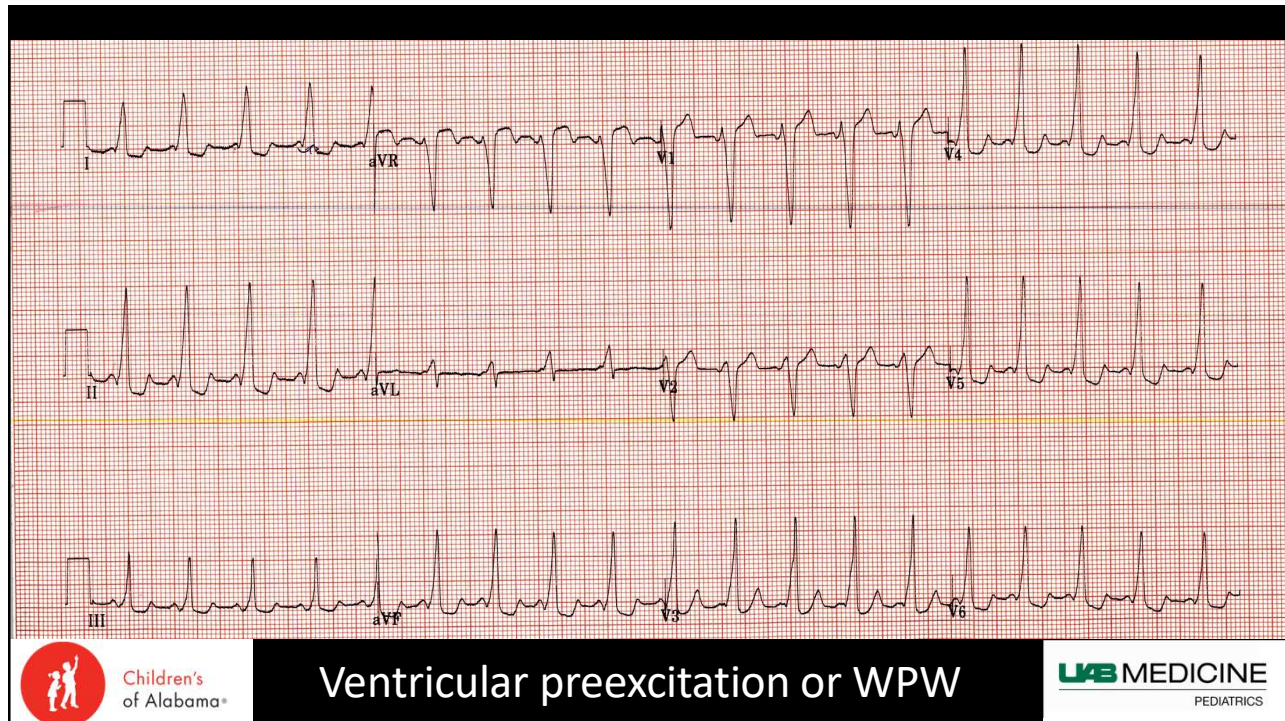
17



18



19



20

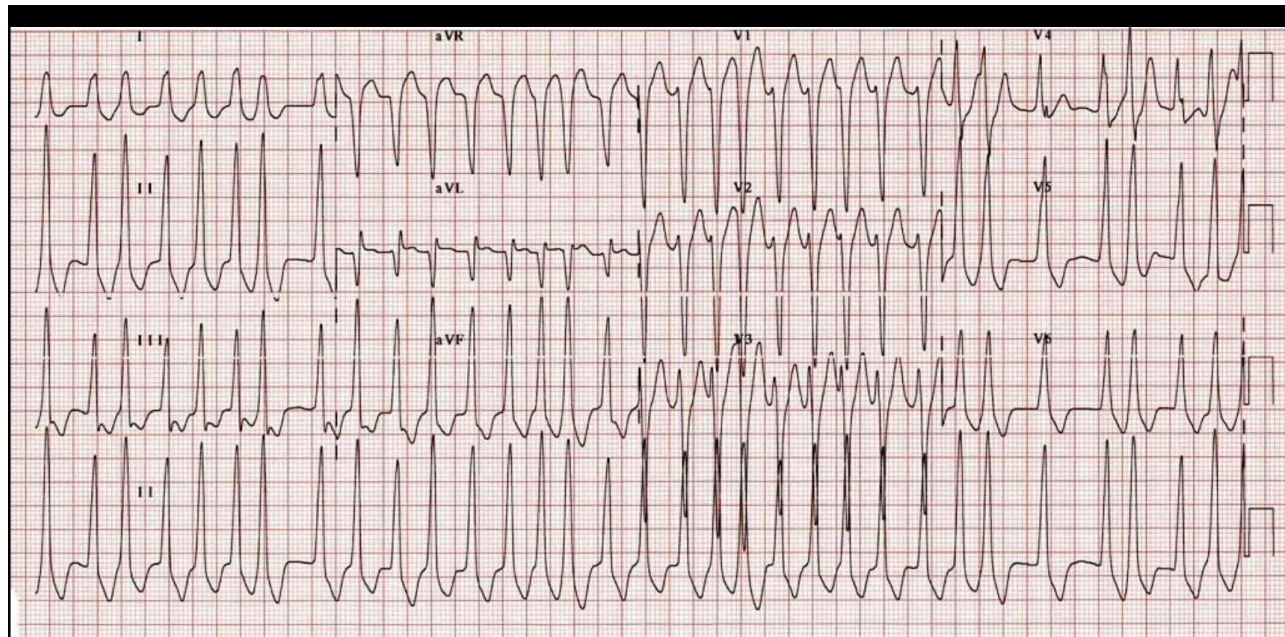
Are SVT and WPW the same?

NO

Risk of cardiac arrest and sudden death



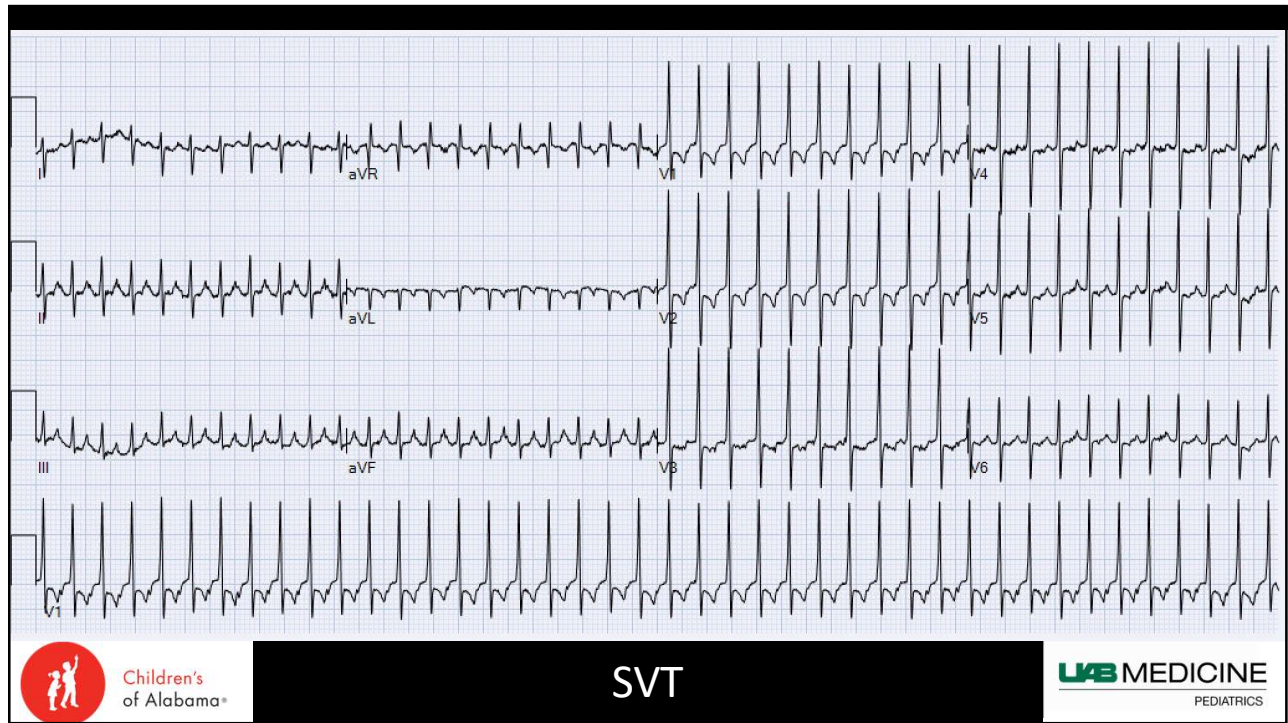
21



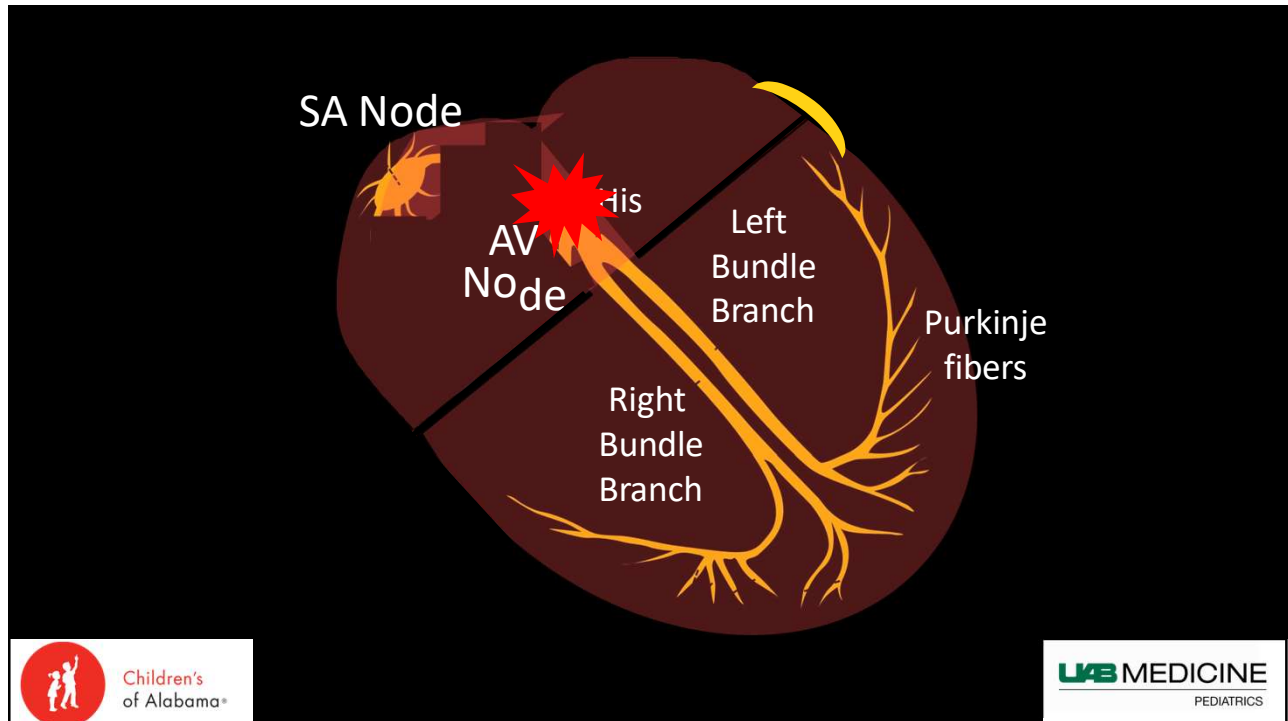
Preexcited atrial fibrillation



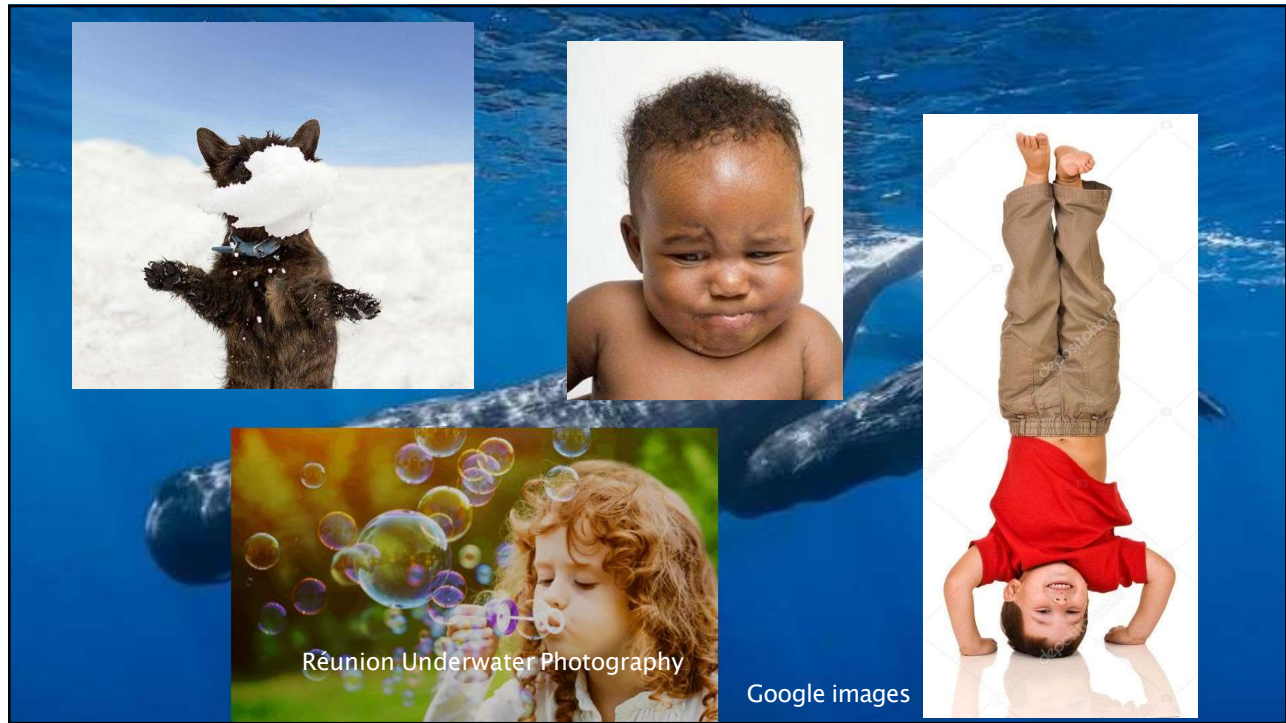
22



23



24



25

Vagal maneuvers

Valsalva maneuver

- Ice to the face
- Inversion
- Carotid massage
- Gag
- Suctioning
- Rectal stimulation
- Ocular pressure



26

Modified Valsalva maneuver

- Semi recumbent Valsalva maneuver followed by supine repositioning and passive leg raise
- More effective at converting SVT to sinus rhythm compared to standard Valsalva maneuver: 43% vs 17%, $p < 0.0001$.
 - Appelboam et al. Lancet. 2015.



27



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28

Reverse Valsalva maneuver

1. Exhale without forcing air out
 2. Pinch the nose and close mouth
 3. Inhale against resistance for 10 seconds
 4. Breathe normally
- Case series documented conversion in 10/11 SVT cases, the unsuccessful patient had heart transplant
 - Gaudart et al. Am J Emerg Med. 2021.



29

When vagal maneuvers fail

Use medical therapy for stable patients in SVT

- Adenosine push
- Oral dose of antiarrhythmic medication
- Intravenous infusion of antiarrhythmic medication



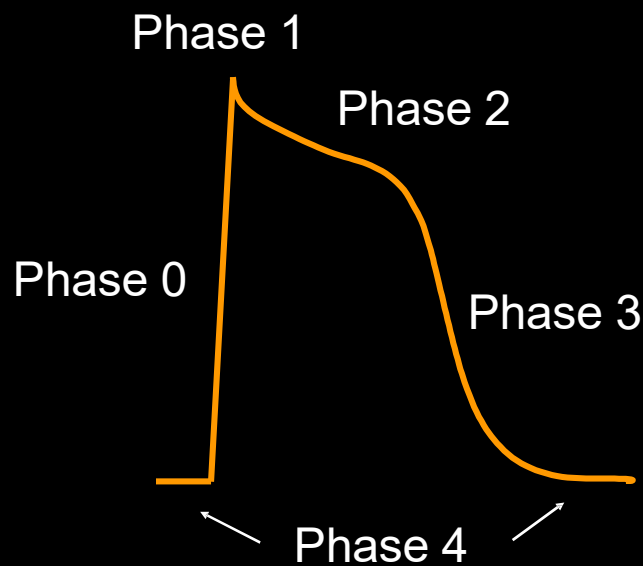
30

adenosine

- Class: other- endogenous nucleoside, act on A₁ adenosine receptors opening potassium channels
- Usual dosing: 0.1-0.2 mg/kg as rapid IV push
- Metabolism: deamination within RBCs, half-life 10 seconds
- Indications: SVT, rhythm diagnosis, WCT
- Contraindications: asthma*
- Potential complications: bronchospasm, vasodilation, AF, sinus pause
- Monitoring: ECG, telemetry



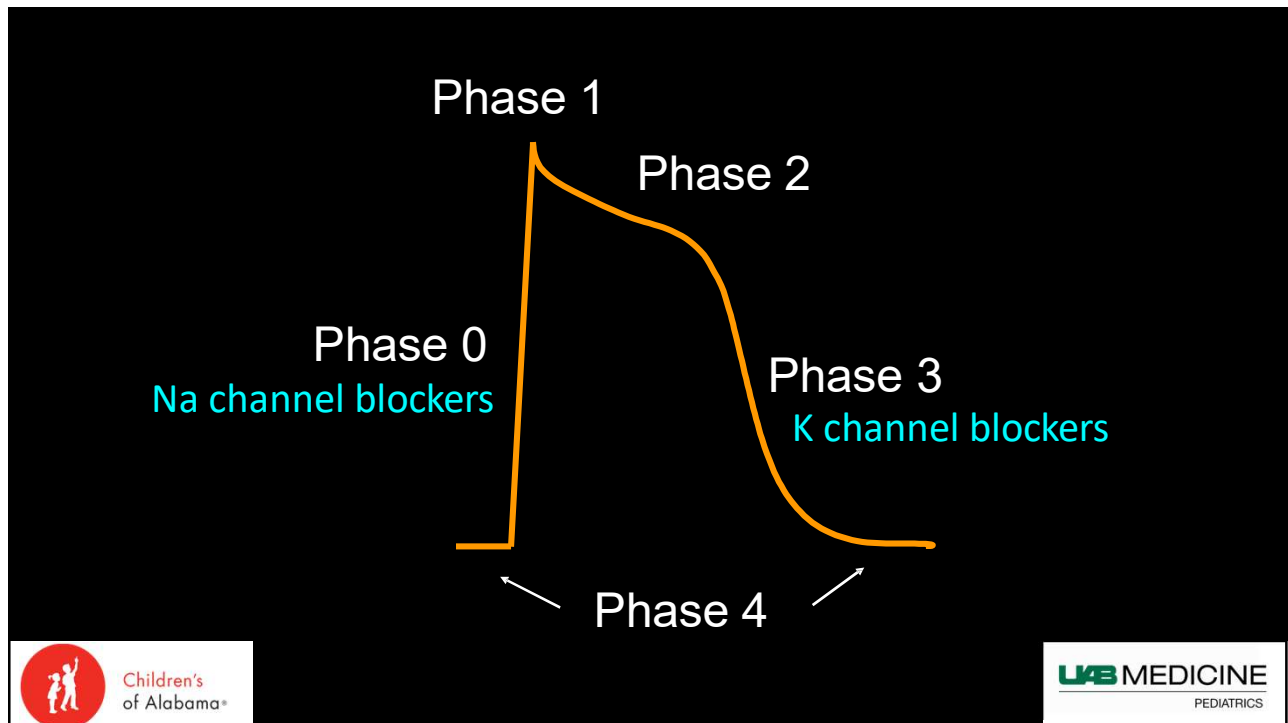
31



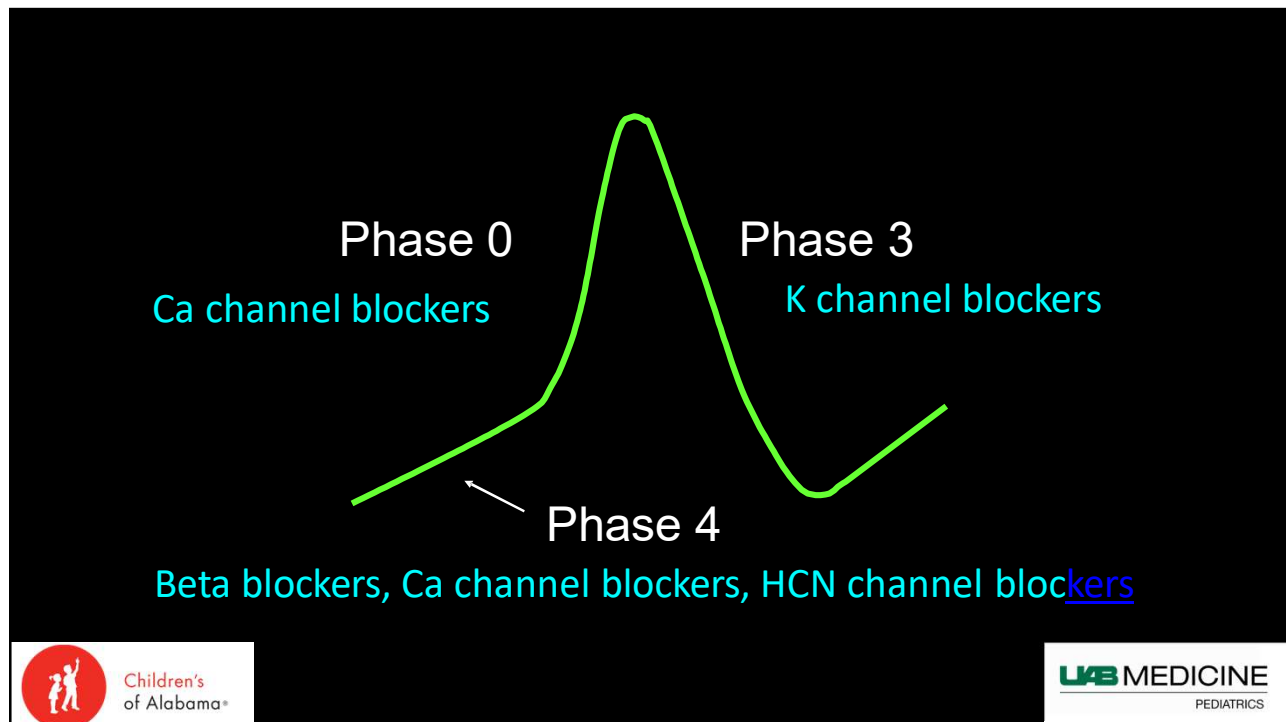
32



33



34



35

Vaughan Williams classification

- Class I (sodium channel blockers)
 - IA- [procainamide](#), [quinidine](#)
 - IB- [lidocaine](#), [mexiletine](#)
 - IC- [flecainide](#), [propafenone](#)
- Class II (beta blockers)
 - [propranolol](#), [nadolol](#)
 - [esmolol](#), [atenolol](#), [metoprolol](#)
- Class III (potassium channel blockers)
 - [amiodarone](#), [sotalol](#)
 - [ibutilide](#), [dofetilide](#)
- Class IV (calcium channel blockers)
 - [verapamil](#), [diltiazem](#)
- Other:
 - [adenosine](#), [digoxin](#), [ivabradine](#), [isoproterenol](#), [dexmedetomidine](#)

36

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37

pediatrics.wustl.edu/cardiology/Antiarrhythmic-Drug-Guide

Department of Pediatrics

Washington University School of Medicine in St. Louis

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Inpatient Services

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Antiarrhythmic Drug Guide

Cardiology I Antiarrhythmic Drug Guide

Antiarrhythmic Drug Dosages and Preparations for Children

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Disclaimers

This Antiarrhythmic Drug Guide was put together as a set of notes derived from elsewhere, with a focus on pediatric considerations. In particular, it answers the most frequent questions that I get concerning the use of these agents in children, and is handy when writing prescriptions or in-patient orders. The purpose was not to be exhaustive in the scope of data included, particularly with respect to interactions and cautions. The PDR is available and should be used if a complete account of prescribing information is desired.

This guide is not a substitute for a cardiology consult. It is organized using the Vaughn Williams classification of antiarrhythmic drug effects. If this is unfamiliar, you could look it up.

Contents

Class Ia Procainamide Quinidine Disopyramide	Class Ib Lidocaine Mexiletine Phenytoin Morizizine	Class Ic Flecainide Propafenone
Class II Propranolol Atenolol Nadolol Metoprolol Pindolol Esmolol	Class III Ibutalide Sotalol Amiodarone	Class IV Verapamil Diltiazem
Others		

38

First-line medications for SVT

- beta blockers
- digoxin
- calcium channel blockers



39

Beta Blockers

- β non-selective beta blockers
 - propranolol
 - nadolol
- α and β blockade
 - carvedilol
 - labetalol
- β -1 selective beta blockers
 - atenolol
 - metoprolol
 - esmolol



40

propranolol

- Class: II, also has sodium-channel blockade
- Usual dosing: 1.5-4 mg/kg/day divided q8h or q6h
- Metabolism: hepatic by CYP2D6, CYP1A2; excreted in urine
- Indications: SVT, VT, sinus tachycardia
- Contraindications: uncompensated heart failure, asthma, risk of hypoglycemia
- Interactions: calcium channel blockers
- Monitoring: ECG



41

nadolol

- Class: II, weak Na channel blockade
- Usual dosing: 0.5-1.5 mg/kg/day given q24h or q12h
- Metabolism: renal excretion unchanged
- Indications: VT, SVT, LQTS, CPVT
- Contraindications: uncompensated heart failure, asthma
- Interactions: calcium channel blockers
- Monitoring: ECG



42

esmolol

- Class: II
- Usual dosing: 50-500 mcg/kg/min
- Metabolism: plasma half-life of 6-8 minutes
- Indications: SVT, VT, sinus tachycardia
- Contraindications: uncompensated heart failure
- Interactions: calcium channel blockers
- Monitoring: telemetry, ECG



43

atenolol

- Class: II
- Usual dosing: 1-2 mg/kg/day given q24h or q12h
- Metabolism: renal excretion unchanged
- Indications: SVT, rate control in AF or AFL
- Contraindications: uncompensated heart failure
- Interactions: calcium channel blockers
- Monitoring: ECG



44

metoprolol tartrate and metoprolol succinate

- Class: II
- Usual dosing: 25-450 mg divided q24h or q12h
- Metabolism: hepatic by CYP2D6
- Indications: SVT, VT, rate control in AF or AFL
- Contraindications: uncompensated heart failure
- Interactions: calcium channel blockers
- Monitoring: ECG



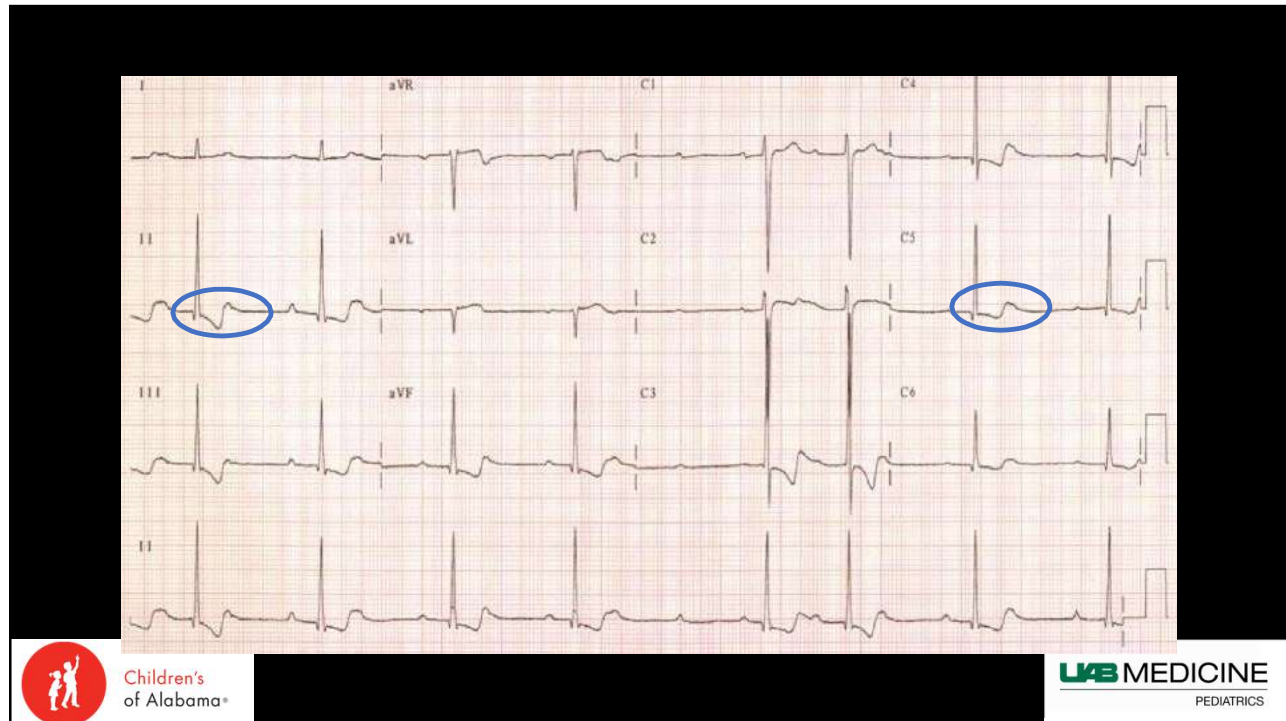
45

digoxin

- Class: other- cardiac glycoside blocks Na/K-ATPase
- Usual dosing: 5-10 mcg/kg/day
- Metabolism: renal excretion mostly unchanged
- Indications: SVT, AF or AFL
- Contraindications: WPW
- Interactions: amiodarone, verapamil, lidocaine, phenytoin, quinidine, beta blockers
- Monitoring: ECG, level



46



47

digoxin toxicity

- Symptoms: vision change, disorientation, GI symptoms
- Proarrhythmic:
 - Atrial arrhythmias
 - AV block
 - Ventricular ectopy
 - Bidirectional VT
- Treatment: discontinuation; digoxin-specific Fab fragments (Digibind); phenytoin or lidocaine



48

verapamil

- Class: IV
- Usual dosing: 4-17 mg/kg/day divided q8h (q12h or q24h)
- Metabolism: extensive hepatic metabolism
- Indications: SVT, fascicular VT, rate control in AFL or AF
- Contraindications: age <12 months, WPW
- Interactions: beta blockers
- Monitoring: ECG



49

diltiazem

- Class: IV
- Usual dosing: 10 mg/hour drip in adults; 120-360 mg/day
- Metabolism: extensive hepatic metabolism
- Indications: SVT, rate control in AFL or AF
- Contraindications: age <12 months, WPW
- Interactions: beta blockers
- Monitoring: ECG



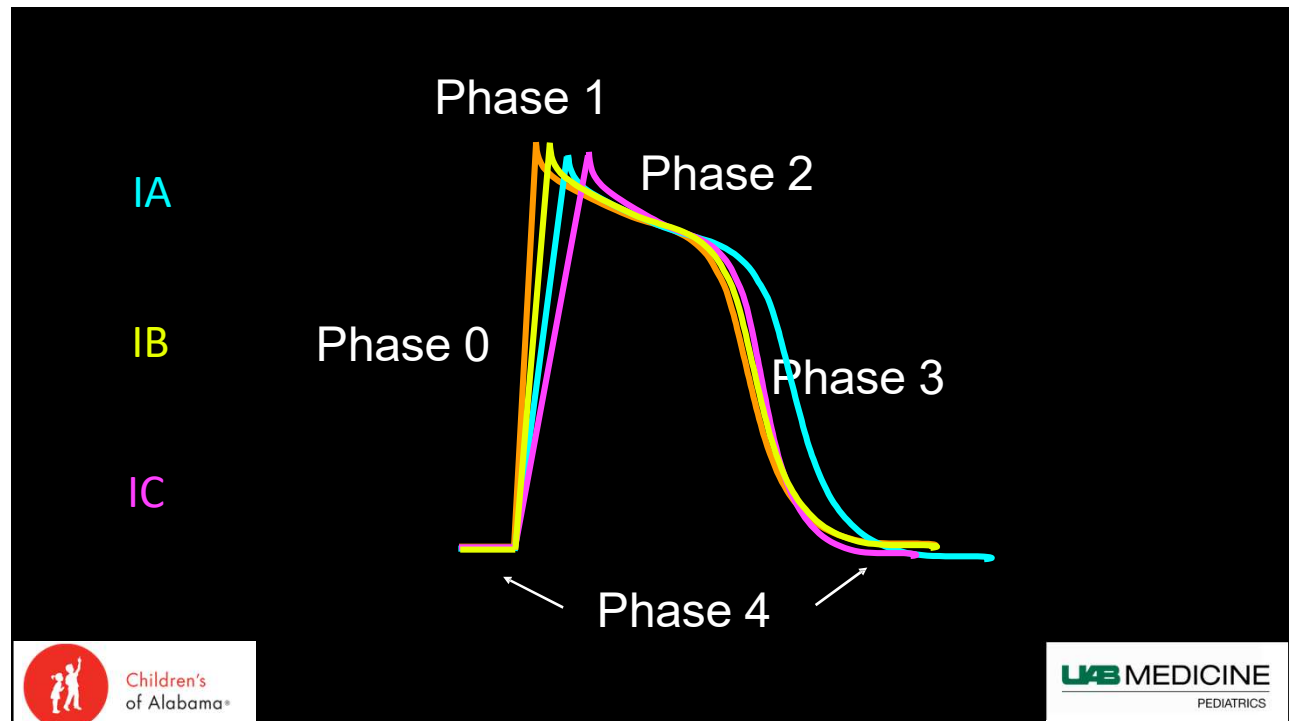
50

Second-line medications for SVT

- sodium channel blockers
- potassium channel blockers



51



52



procainamide

- Class: IA, NAPA metabolite with class III activity
- Usual dosing: bolus of 5-15 mg/kg, drip at 20-80 mcg/kg/min
- Metabolism: hepatic metabolism, renal excretion
- Indications: SVT, VT, JET
- Contraindications: long-term use, prolonged QTc interval
- Potential complications: AV block, cardiac arrest, GI symptoms, drug-induced lupus
- Monitoring: ECG, telemetry, proc and NAPA levels



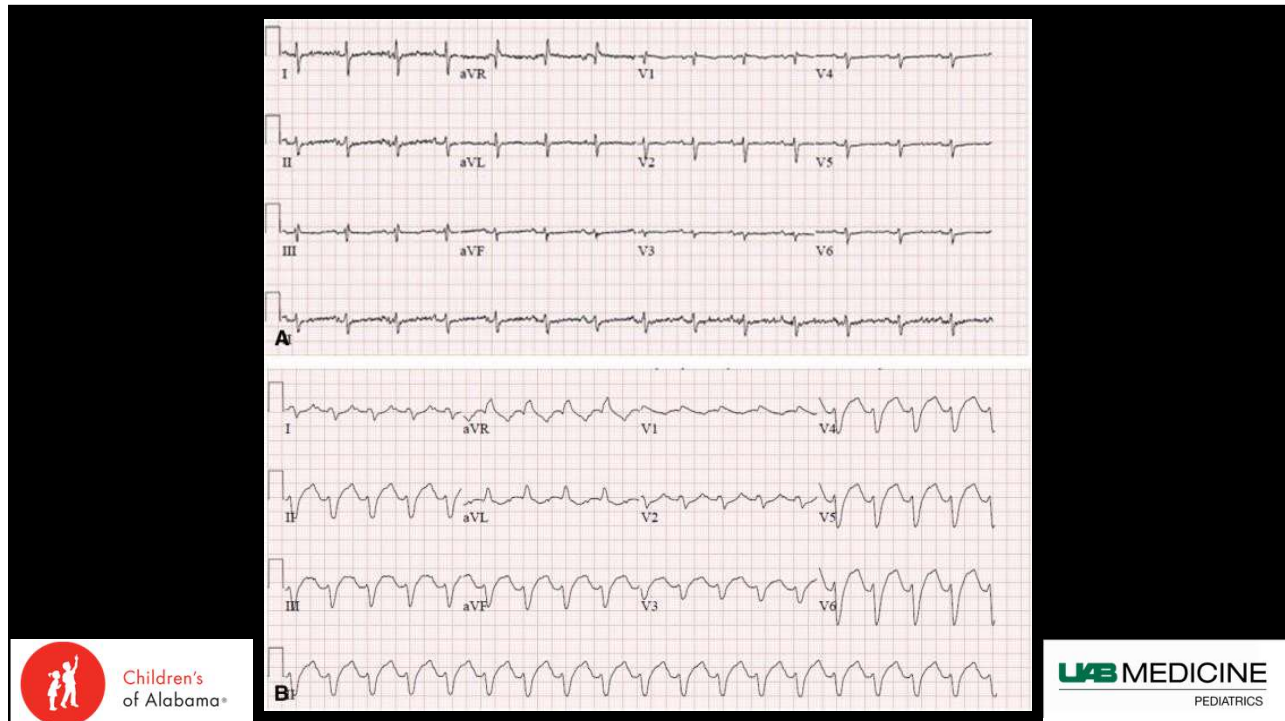
53

flecainide

- Class: IC
- Usual dosing: 80-150 mg/m²/day or 3-6 mg/kg/day divided q8h or q12h
- Metabolism: renal excretion mostly unchanged
- Indications: SVT, VT*, CPVT, JET, AF, LQT3
- Contraindications: ischemic cardiomyopathy, structural heart disease
- Potential complications: AV block, cardiac collapse, vision change; strong interaction with amiodarone
- Monitoring: ECG, trough blood level, telemetry for infants



54



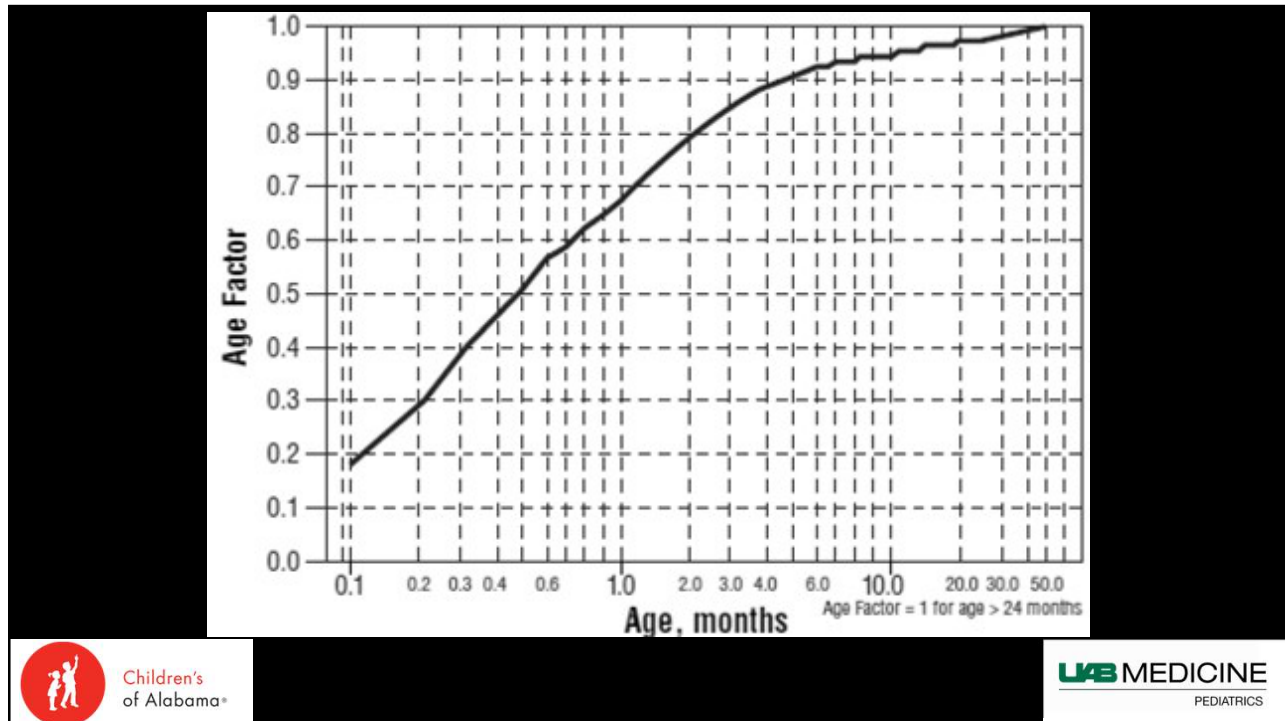
55

sotalol

- Class: II, III
- Usual dosing: 80-180 mg/m²/day or 2-8 mg/kg/day divided q12h or q8h (see nomogram)
- Metabolism: renal excretion unchanged
- Indications: SVT, VT, lowering DFT
- Contraindications: prolonged QTc interval
- Potential complications: dose-related torsade de pointes
- Monitoring: ECG, telemetry upon initiation



56



57

sotalol IV

- Newer IV antiarrhythmic medication option to treat reentrant SVT, AET, VT, JET
- Typically given as 1 mg/kg bolus over 20-60 minutes
- Experience in pediatrics is encouraging
- Case series of patients with and without congenital heart disease (50/50) receiving sotalol 1 mg/kg IV over 60 min. 16/24 had conversion after 1st dose, 5 additional pts converted after second dose; 21/24 (88%). Median time was 33 minutes.
 - Valdes et al. Heart Rhythm. 2018.

58

amiodarone

- Class: III, I, II, IV
- Usual dosing: IV bolus 5 mg/kg and drip at 2.5-10 (7) mcg/kg/min; oral load 100 mg/kg, maintenance 5 mg/kg/day
- Metabolism: hepatic via CYP3A4 and CYP2C8
- Indications: SVT, VT, JET, AF, AFL
- Interactions: digoxin, class I, class II
- Monitoring: ECG, telemetry, blood level, thyroid panel, hepatic panel, PFTs, eye exam



59

amiodarone toxicity

- Bradycardia due to SND or AVB
- Hypothyroidism (can be permanent)
- Hepatitis and cirrhosis
- Corneal deposits (reversible)
- Interstitial pulmonary fibrosis (can be permanent and fatal)
- CNS effects
- Photosensitivity
- Blue-grey skin discoloration



60

Sources

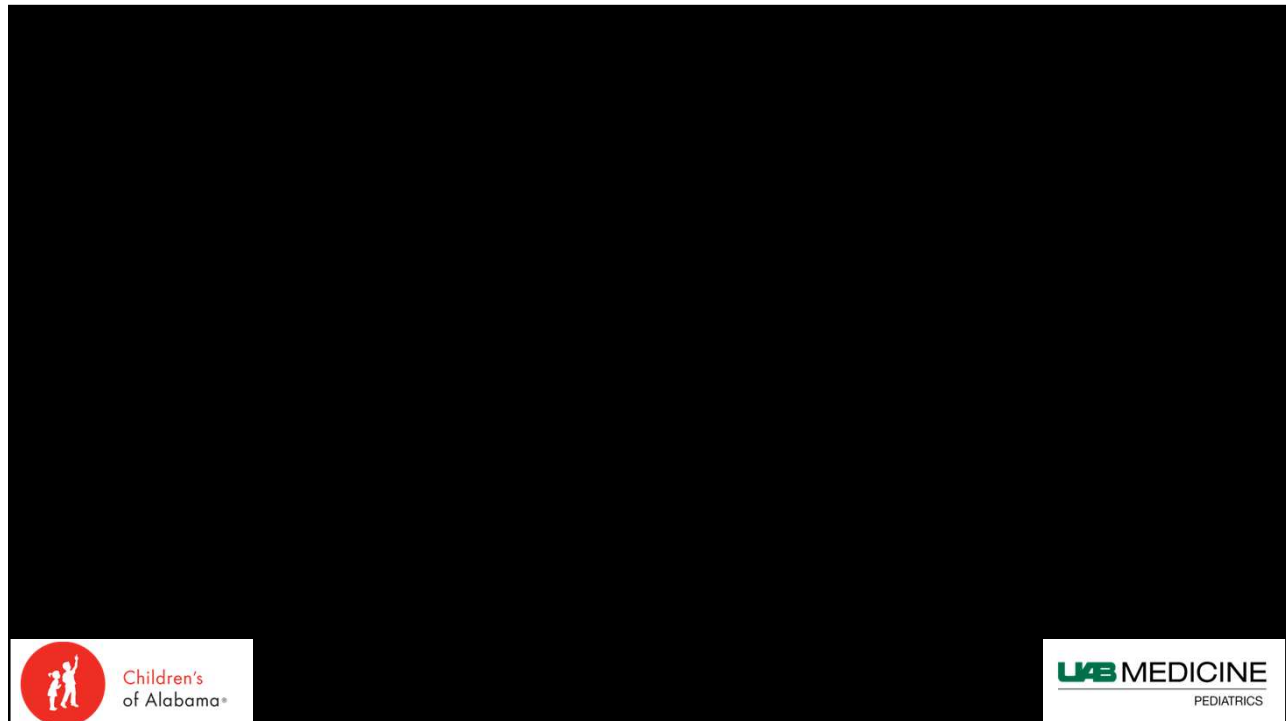
- Dick, M. Clinical Cardiac Electrophysiology in the Young. 2nd edition. 2015.
- WashU antiarrhythmic guide
- Appelboom et al. Postural modification to the standard Valsalva manoeuvre for emergency treatment of supraventricular tachycardias (REVERT): a randomised controlled trial. Lancet. 2015; 386(10005):1747-53.
- Echt et al. Mortality and morbidity in patients receiving flecainide, encainide, or placebo. N Engl J Med 1991; 324:781-788.
- Gaudart et al. The reverse vagal manoeuvre: A new tool for treatment of supraventricular tachycardia? Am. J. Emerg. Med. 41 (2021) 66-69.
- Sanatani et al. The study of antiarrhythmic medications in infancy (SAMIS): a multicenter, randomized controlled trial comparing the efficacy and safety of digoxin versus propranolol for prophylaxis of supraventricular tachycardia in infants. Circ Arrhythm Electrophysiol. 2012, 5(5):984-91.
- Valdes et al. Early Experience with Intravenous Sotalol in Children with and without Congenital Heart Disease. Heart Rhythm. 2018. Dec; 15(12): 1862–1869.



61



62



63

- Phase 0 (upstroke)- I_{Na} (inward Na current) via voltage-gated Na channel
- Phase 1 (notch)- Na channel inactivation and I_{to} (transient outward K current) via $K_v4.2$, $K_v4.3$, and $K_v1.4$
- Phase 2 (plateau)- no net movement of charge due to K out and Ca in from I_{Ca} via L-type Ca channel ($Ca_v1.2$)
- Phase 3 (recovery)- I_{Ks} ($K_v7.1/KCNQ1$), I_{Kr} (hERG/ $KCNH2$), and I_{K1} ($Kir2.x$)
- Phase 4 (resting membrane potential or automaticity)- I_{K1} and I_f (hyperpolarization-activated nonspecific cation (Na) current) [via HCN](#)

64

ivabradine

- Class: other- HCN-blocking agent
- Usual dosing: 0.05-0.3 mg/kg/dose BID
- Metabolism: hepatic by CYP3A4
- Indications: inappropriate sinus tachycardia, JET, AET, VT
- Contraindications: bradycardia
- Interactions: beta blockers
- Monitoring: ECG, telemetry

