Bradycardia

National Pediatric Nighttime Curriculum
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Learning Objectives

- Recognize common pediatric cardiac bradyarrhythmias
- Appreciate the clinical significance of bradycardia
- Initiate management of bradyarrhythmias in the inpatient setting

Case #1

- 9 year old boy admitted for asthma exacerbation, noted to have heart rate of 55.

Thaler 2003

  - What do you think is going on?
  - What is the first thing you would assess in your evaluation of this patient?
  - What work-up would you do?
  - How would you treat this child?

Bradyarrhythmias - Symptoms

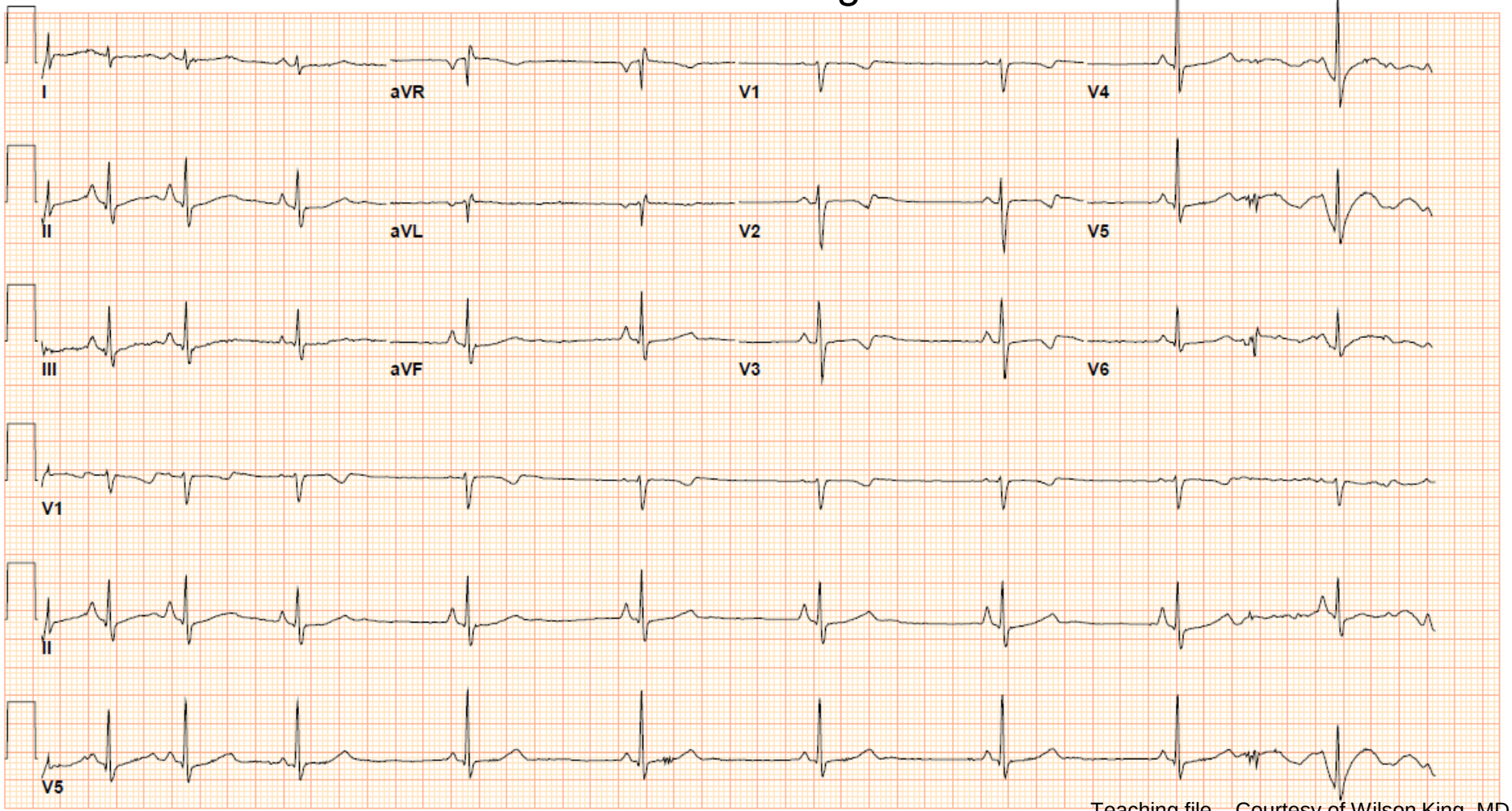
- Symptoms:
  - General: altered LOC, fatigue, lightheadedness, dizziness, syncope
  - Hemodynamic instability: hypotension, poor end-organ perfusion, respiratory distress/failure, sudden collapse

Bradyarrhythmias - Causes

- General causes:
  - 1º: Abnormal pacemaker/conduction system (congenital or postsurgical injury), cardiomyopathy, myocarditis
  - 2º: Reversible **H**s & **T**s:
    - – **H**ypoxia – **H**ypotension – **H**eart block
      – **H**$^+$ ions (acidosis) – **H**ypothermia – **H**yperkalemia
      – **T**rauma (head)
      – **T**oxins/drugs (cholinesterase inhibitors, Ca^{++} channel blockers, β-adrenergic blockers, digoxin, central α_2 adrenergic agonists, opioids)

Case #2

A 7 year old boy with a history of neonatal intraventricular hemorrhage underwent a ventriculoperitoneal shunt revision this afternoon. You are notified by the nursing staff that he is having heart rates down to the 50's.



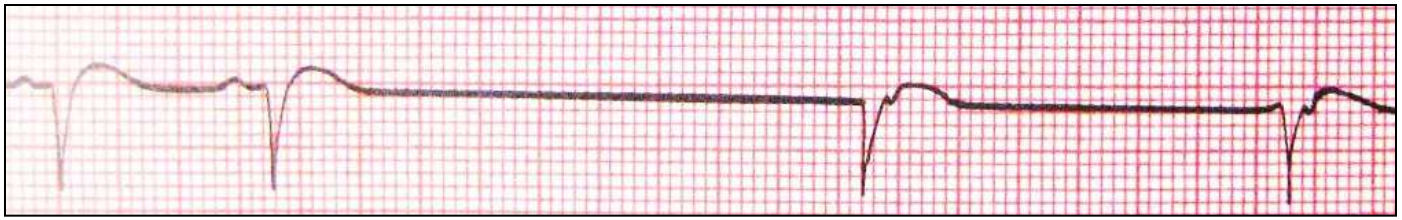
Teaching file – Courtesy of Wilson King, MD

Sinus Bradycardia

- Can be a physiologic consequence of decreased metabolic demand (ie: while sleeping) or increased stroke volume (ie: athletes)
- Other potential causes include:
  - Endocrine: hypothyroidism, hypoglycemia
  - Neurologic: seizures or head trauma causing increased vagal tone; ↑ICP
  - Ingestion: Beta-blockers, Ca^{++} channel blockers, digoxin, antiarrhythmics
  - Hypothermia
  - Infectious: Sepsis
- Sinus bradycardia is almost never primarily cardiac in origin in pediatrics.

Sinus Node Block/Arrest

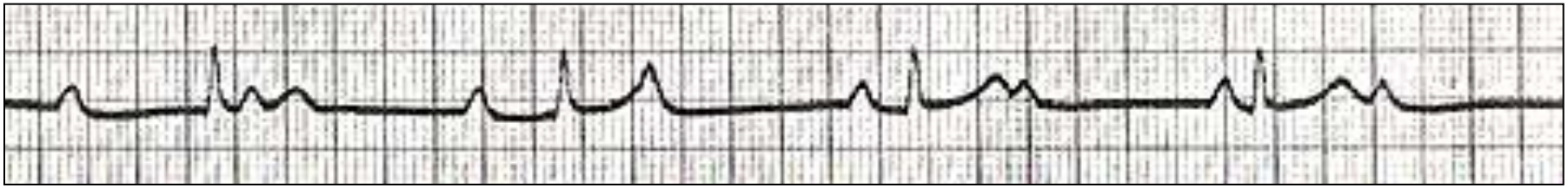
- Caused by absent pacemaker activity in the sinus node with subsidiary pacemakers in the atrium, AV junction/node, or ventricles initiating depolarization:
  - Atrial escape: Late P wave, different P wave morphology
  - Junctional escape: Narrow-complex, +/- retrograde P waves
  - Idioventricular escape: Wide-complex, typical rate 30-40 beats/min



Thaler 2003

Case #3

- A 4 month old boy was transferred from the CVICU earlier in the day, following an uncomplicated repair of his VSD. His nurse notifies you that his rhythm on the cardiac monitor looks odd.



Yanowitz, 2006

  - What do you think is going on?
  - What is the first thing you would assess in your evaluation of this patient?
  - What work-up would you do?
  - How would you treat this child?

AV Blocks

Type	EKG Findings	Causes & Clinical Significance
1st Degree	**Prolonged** PR interval	Causes include AV nodal disease, ↑vagal tone, myocarditis, abn electrolytes (ie: ↑K^+), MI, drugs (ie: Ca^{++} channel blockers, β-blockers, digoxin), acute rheumatic fever. Usually **asymptomatic**.
2nd Degree Mobitz type I Wenchebach	**Progressive prolongation** of PR interval until atrial impulse not conducted to ventricles	Usually due to block within AV node. Caused by ↑parasympathetic tone, MI, drugs (ie: Ca^{++} channel blockers, β-blockers, digoxin). Can cause dizziness. Typically **transient and benign;** rarely progresses to 3rd degree heart block.
2nd Degree Mobitz type II	**Constant prolongation** of PR interval, inhibition of a set proportion of atrial impulses	Usually caused by defect in conduction pathway or acute coronary syndrome, leading to block below AV node & His bundle. Symptoms include palpitations, presyncope, syncope. **Can progress to 3rd degree** heart block; often requires pacemaker.
3rd Degree Complete	**AV dissociation**. No atrial impulses are conducted to the ventricle	Congenital or caused by conduction system disease or injury (ie: surgery, MI). **Most symptomatic** form of heart block: fatigue, presyncope, syncope. Usually **requires pacemaker** (especially if acquired).

AV Blocks

Ralston et al, 2006

1st degree heart block

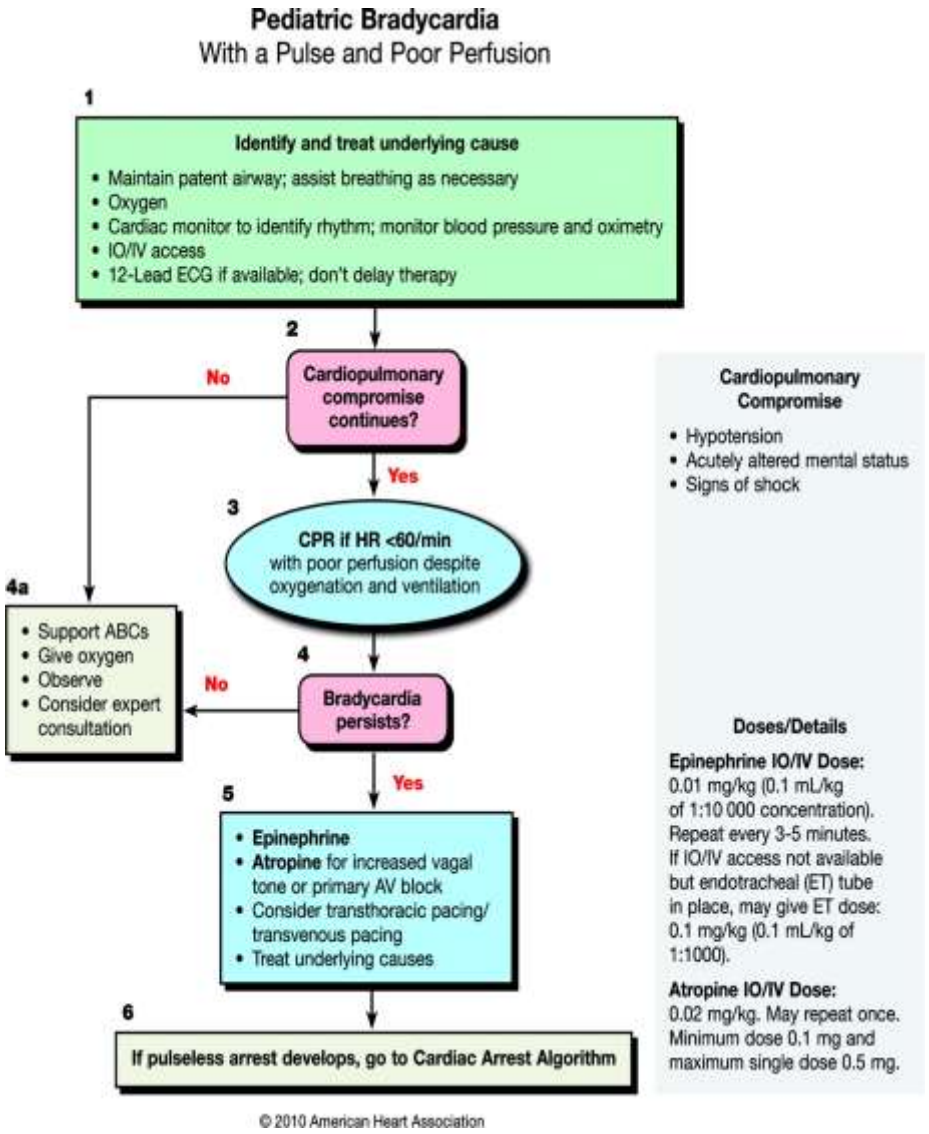
2nd degree heart block, Mobitz I

2nd degree heart block, Mobitz II

3rd degree heart block

Bradyarrhythmias – Management

- Stable patients:
  - 12 lead EKG
  - Consult cardiology
- Unstable patients:
  - ABCs
  - PALS Pediatric Bradycardia Algorithm
- Address reversible causes (Hs & Ts)
  - Consider labs
    - Ie: blood gas, chemistry panel, digoxin level if applicable



Kleinman et al 2010

Take home points

- When evaluating a patient with a bradyarrhythmia, the first step is always to address clinical/hemodynamic stability: airway, breathing, circulation. Further management is guided by the PALS Pediatric Bradycardia Algorithm.
- Sinus bradycardia is rarely due to primary cardiac pathology in children – reversible causes should be sought and addressed.
- Atrial, junctional, and idioventricular escape rhythms are the result of subsidiary pacemakers initiating depolarization in the event of sinus node failure.
- 1st, 2nd, and 3rd degree AV blocks vary in etiology and clinical significance. 1st degree and 2nd degree Mobitz Type I are often minimally symptomatic and even self-resolving. 2nd degree Mobitz Type II is more symptomatic, can progress to 3rd degree, and may require pacemaker. 3rd degree is the most symptomatic, and usually requires pacemaker.

References

- Key References for independent study:
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