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.

- 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?

Thaler 2003
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 Hs & Ts:
    - Hypoxia
    - Hypotension
    - Heart block
    - H+ ions (acidosis)
    - Hypothermia
    - Hyperkalemia
    - Trauma (head)
    - Toxins/drugs (cholinesterase inhibitors, Ca++ channel blockers, β-adrenergic blockers, digoxin, central α2 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.
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.

- 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?

Yanowitz, 2006
## AV Blocks

<table>
<thead>
<tr>
<th>Type</th>
<th>EKG Findings</th>
<th>Causes &amp; Clinical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Degree</td>
<td>Prolonged PR interval</td>
<td>Causes include AV nodal disease, ↑vagal tone, myocarditis, abn electrolytes (ie: ↑K⁺), MI, drugs (ie: Ca²⁺ channel blockers, β-blockers, digoxin), acute rheumatic fever. Usually <strong>asymptomatic</strong>.</td>
</tr>
<tr>
<td>2nd Degree</td>
<td>Progressive prolongation of PR interval until atrial impulse not conducted to ventricles</td>
<td>Usually due to block within AV node. Caused by ↑parasympathetic tone, MI, drugs (ie: Ca²⁺ channel blockers, β-blockers, digoxin). Can cause dizziness. Typically <strong>transient and benign</strong>; rarely progresses to 3rd degree heart block.</td>
</tr>
<tr>
<td>Mobitz type I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wenchebach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Degree</td>
<td>Constant prolongation of PR interval, inhibition of a set proportion of atrial impulses</td>
<td>Usually caused by defect in conduction pathway or acute coronary syndrome, leading to block below AV node &amp; His bundle. Symptoms include palpitations, presyncope, syncope. <strong>Can progress to 3rd degree</strong> heart block; often requires pacemaker.</td>
</tr>
<tr>
<td>Mobitz type II</td>
<td></td>
<td></td>
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<tr>
<td>3rd Degree</td>
<td>AV dissociation. No atrial impulses are conducted to the ventricle</td>
<td>Congenital or caused by conduction system disease or injury (ie: surgery, MI). <strong>Most symptomatic</strong> form of heart block: fatigue, presyncope, syncope. Usually <strong>requires pacemaker</strong> (especially if acquired).</td>
</tr>
<tr>
<td>Complete</td>
<td></td>
<td></td>
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</tbody>
</table>
AV Blocks

1\textsuperscript{st} degree heart block

2\textsuperscript{nd} degree heart block, Mobitz I

2\textsuperscript{nd} degree heart block, Mobitz II

3\textsuperscript{rd} degree heart block

Ralston et al, 2006
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.

- 1\textsuperscript{st}, 2\textsuperscript{nd}, and 3\textsuperscript{rd} degree AV blocks vary in etiology and clinical significance. 1\textsuperscript{st} degree and 2\textsuperscript{nd} degree Mobitz Type I are often minimally symptomatic and even self-resolving. 2\textsuperscript{nd} degree Mobitz Type II is more symptomatic, can progress to 3\textsuperscript{rd} degree, and may require pacemaker. 3\textsuperscript{rd} degree is the most symptomatic, and usually requires pacemaker.
References

- Key References for independent study:

- Additional References used to prepare this presentation:
  - 12 Lead EKG Interpretation Part #2, nursingpub.com.
  - Yanowitz FG. *The Alan E. Lindsay ECG Learning Center in Cyberspace*. University of Utah School of Medicine, 2006.