Diagnosis and Management of Common Pediatric Cardiovascular Urgencies

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Relevant Disclosures: None.
Irrelevant Disclosures: Too Many to List….

The Central Issue
Arriving at a timely diagnosis and instituting appropriate treatment when every minute counts

The Central Problem
Arriving at a timely diagnosis and instituting appropriate treatment when every minute counts

Some Inspiration

"It is not because things are difficult that we do not dare, it is because we do not dare that they are difficult."
Lucius Seneca
4 BC – 65 AD

Some Inspiration

"'Tis not in mortals to command success. But we’ll do more, Sempronius, we’ll deserve it."
Cato, Act 1, Scene 2
Where We Are Going

- Congenital Heart Disease Urgencies
- Acquired Heart Disease Urgencies
  - Kawasaki Disease
  - Rheumatic Heart Disease
- Arrhythmia Urgencies
  - Tachyarrhythmias

Some Basic Facts

Congenital Heart Disease is the MOST common disease of the newborn.

Incidence of Live Birth Congenital Defects Stratified on Organ System, EUROCAT Central Registry

<table>
<thead>
<tr>
<th>Defect</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>6.5/1,000</td>
</tr>
<tr>
<td>Limb</td>
<td>3.8/1,000</td>
</tr>
<tr>
<td>Urinary</td>
<td>3.1/1,000</td>
</tr>
<tr>
<td>CNS</td>
<td>2.3/1,000</td>
</tr>
</tbody>
</table>

Some Basic Facts

Prevalence of Congenital Heart Disease is Rising as More Children Survive to Adulthood

![Graph showing the increase in prevalence over time.](image)

Keys to Success

1. Anticipated Prevalence of Disease
2. Potential Cardiovascular Symptoms
3. Abnormal Screening Examination or Studies
4. Index of Suspicion

Physiologic Approach

<table>
<thead>
<tr>
<th>TOF Physiology</th>
<th>LA Physiology</th>
<th>LV Physiology</th>
<th>Right Cardiac Output</th>
<th>Single Ventricular Physiology</th>
<th>ASD Physiology</th>
<th>VSD Physiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>None-Mild</td>
<td>Mild-Severe</td>
<td>Severe</td>
<td>None-Severe</td>
<td>None-Severe</td>
<td>None-Mild</td>
<td>Mild-Med</td>
</tr>
<tr>
<td>Birth – 3 wk</td>
<td>Birth-3 days</td>
<td>Birth-72 hrs</td>
<td>24 hrs-2weeks</td>
<td>Birth-3-days</td>
<td>72hrs-24hrs</td>
<td>72hrs-12days</td>
</tr>
<tr>
<td>Occasional</td>
<td>Rare</td>
<td>Rare</td>
<td>Rare</td>
<td>Occasional</td>
<td>Occasional</td>
<td>Occasional</td>
</tr>
</tbody>
</table>

Potential Treatments

- N/ L PRR
- N/ L PR
- O2, RSI, Atrial Septectomy
- RSI, O2, Emergent Repair
- RSI, O2,afil. strategies
- O2, RSI,afil. strategies
- Diuretics, Afterload, O2,afil.
Things to Consider

- Those with “hemodynamically significant” physiologies will generally have symptoms
- Presentation of “critical lesions” generally comes early

Things to Consider

- Normal screening O2 saturations doesn’t preclude critical heart disease

Things to Consider

- Respiratory distress is a sensitive, but non-specific sign of CHD, when hemodynamically significant.
Case Example

A six week old infant presents to the emergency room due to maternal concerns for "colic."

Mom Reports:
"He screams every time I try to feed him."
"He eats about ½ ounce and then stops."
"He used to eat 3-4 ounces."
"He seems to breath fast."

Does this sound like “infantile colic?”

Case Example

Physical Examination:
HR: 168     RR: 60     BP: 55/30     SaO2: 95%
• Lethargic-appearing infant, moderate distress
• Nasal flaring, moist mucous membranes without cyanosis, no JVD
• Intercostal and subcostal retractions
• Coarse breath sounds bilaterally
• 1+ pulses upper UE = LE, no delay
• Capillary refill time ~ 3 sec

Are any of these signs specific for CHD?

Case Example

Physical Examination:
• Active precordium, slight heave, no thrill
• Tachycardic, RR with nl S1 & single S2
• III/VI blowing holosystolic murmur at apex
• Soft abdomen with liver edge @ 1 cm below RCM

What is the differential diagnosis (big categories)?
What are the best next tests?

Case Example

Diagnostic Options:
- EKG
- CXR
- ABG/Lactate
- ECHO

Which is most likely to give the answer?

Case Example

Electrocardiogram:

Case Example

Chest Radiograph:
Case Example

**Laboratory Analyses:**

<table>
<thead>
<tr>
<th>Request #: B0535435</th>
<th>Date/Time: 03 Jan 2012 @ 1505</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BLOOD GAS:</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature:</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.14</td>
</tr>
<tr>
<td>pCO2</td>
<td>29.4mmHg (35-45)</td>
</tr>
<tr>
<td>pO2</td>
<td>68.2mmHg (75-100)</td>
</tr>
<tr>
<td>HCO3</td>
<td>10.4mmol/L</td>
</tr>
<tr>
<td>Base Excess</td>
<td>-12.3</td>
</tr>
<tr>
<td>Lactate</td>
<td>9.5 mmol/L, (0.5-2.2)</td>
</tr>
</tbody>
</table>

Case Example

**Echocardiogram:**

The echo tech is busy at the moment...

Physiologic Approach

<table>
<thead>
<tr>
<th>TOF Physiology</th>
<th>TGA Physiology</th>
<th>Obstructive VSD</th>
<th>Low Cardiac Output</th>
<th>Single Ventricle Physiology</th>
<th>ASD Physiology</th>
<th>VSD Physiology</th>
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<td>Occasional</td>
</tr>
<tr>
<td>Birth – 3 wk</td>
<td>Birth-3 days</td>
<td>Birth-18 months</td>
<td>Occasional</td>
<td>Birth-3 days</td>
<td>Birth-18m</td>
<td>Birth-12m</td>
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Physiologic Approach

Symptoms

<table>
<thead>
<tr>
<th>Occasional</th>
<th>Rare</th>
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<th>Rare</th>
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Genetic Abnormalities

<table>
<thead>
<tr>
<th>PGE1, O2</th>
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<tbody>
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<tr>
<td>Diuretics</td>
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</tr>
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<td>±PGE1, ±O2, ±RSI, ±Inotropes</td>
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Potential Treatments

The Anatomic Challenge

Take Home Points

- Index of suspicion needs to drive diagnostic approach
  - Know the epidemiology
- Think of cardiac data collectively
  - Can you paint a complete picture?
- Treatment is dictated by the suspected physiologic state
  - Reassessment is essential
ACQUIRED HEART DISEASE URGENCIES

**Some Basic Facts**
The epidemiology of the two most common acquired cardiac diseases is changing...

**Kawasaki Disease**

**Rheumatic Heart Disease**


Go, AS et al. Circulation 2013;127:e6-e245

**Criteria-Based Approach**
Defining affected versus non-affected can be challenging

<table>
<thead>
<tr>
<th>Jones Criteria</th>
<th>Kawasaki Criteria</th>
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<tr>
<td><strong>MAJOR</strong></td>
<td>Fever &gt; 5 days with...</td>
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<td>• Carditis</td>
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</tr>
<tr>
<td>• Elevated Acute Phase Reactants</td>
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</tr>
<tr>
<td>• Prolonged PR Interval</td>
<td>Evidence of antecedent streptococcal infection</td>
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**One Explains Many**

- Meningitis
- Otitis
- Sinusitis
- Pharyngitis
- Adenitis
- Pneumonia
- Puerperal Fever
- Myositis
- Impetigo
- Endocarditis
- Fascitis
- Erysipelas
- Scarlet Fever

**Many Explain One**

- Adenovirus
- Enterovirus
- EBV
- GABHS
- Parvovirus
- Autoimmune Disorders
- Leptospirosis
- Staphylococcus
- Rickettsia

**Criteria-Based Approach**
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Case Example

A three month old infant presents to the pediatrician with a five day history of fever, but no additional constitutional symptoms except for a polymorphous rash and mild conjunctival injection. Physical examination does not reveal a bacterial cause; subsequent blood work (including cultures) are also negative.

How might one apply diagnostic criteria to this case?

Case Example

“Infants ≤ 6 months old on day 7 of fever without other explanation should undergo laboratory testing and, if evidence of systemic inflammation is found, an echocardiogram should be performed, even if the infants have no clinical criteria.”

Take Home Points

• Criteria-based diagnoses generally result in higher sensitivity but lower specificity
  – Lower false negative rate, but higher false positive rate
• Cardiac evaluations (and to a great extent cardiac management) become "protocolized"
  – Knowledge of the recommended strategies is essential

Some Basic Facts

Supraventricular tachycardia is the most common pathologic arrhythmia in pediatrics

Overall Incidence ~ 1:250 – 1:1,000

Arrhythmia Urgencies
Case Example
A fifteen year old male presents due to concerns for recurrent palpitations that are paroxysmal in nature and that occur with exercise. No syncope reported. When symptoms sustain, he seeks emergency room care.

How should one approach this case?

Case Example
A twelve year old female with palliated Tetralogy of Fallot presents due to concerns for recurrent palpitations. No syncope reported. When symptoms sustain, she seeks ER care.

How should one approach this case?
Take Home Points

- Pattern recognition (with consideration of an index of suspicion) is the goal
  - Know both the pattern and the epidemiology
- When in doubt or in an urgent situation, consider available algorithms
  - Does the algorithm make sense?
- Treatment is dictated by the pattern/algorithm after considering above
  - Reassessment is essential

CONCLUDING THOUGHTS

Where We Have Been

- Congenital Heart Disease Urgencies
- Acquired Heart Disease Urgencies
  - Kawasaki Disease
  - Rheumatic Heart Disease
- Arrhythmia Urgencies
  - Tachyarrhythmias

Index of Suspicion
Criteria Application
Pattern Recognition / Algorithm

Confronting the Problem

"Approach each new problem not with a view of finding what you hope will be there, but to get the truth, the realities that must be grappled with. You may not like what you find. In that case you are entitled to try to change it."

Bernard M. Baruch