Heart Murmurs in Children

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Pediatric Update
September 21, 2013

Objectives
1. To identify clinical features that help distinguish innocent from pathologic murmurs.
2. Recognize common innocent and pathologic murmurs, using audio examples
3. To feel comfortable explaining to parents what an innocent murmur is, and when to refer

Outline
• Background
• Innocent vs. Pathologic
• Diagnostic evaluation
• Common murmurs - audio examples
• Explanation to parents
• When to refer
Background

- Murmur evaluation is the most common reason for referral to pediatric cardiology clinics
- Innocent heart murmurs occur in approximately 50% of children
- Congenital heart disease occurs in ~1% of children

Background

- Heart murmurs are a major source of anxiety for parents (and physicians!)
- Among those referred for cardiology evaluation, parental anxiety is influenced by the explanation provided by the referring physician

Cardiac Examination

- Extremities
  - Pulses, perfusion, clubbing
- Head and Neck
  - Dysmorphic features
  - JVP
- Precordium
  - Inspection, palpation, auscultation
- Liver
Auscultation

• S1
• S2- physiologic split?
• Murmur
  — timing, location, radiation, quality, intensity
• Additional sounds
  — S3, S4
  — Opening snap
  — Systolic click
  — Rub
Part I: Innocent vs. Pathologic

Characteristics of innocent murmurs

- systolic
- ejection
- soft or vibratory
- grade 3 or less in intensity
- normal S2
- no extra sounds
Characteristics of pathologic murmurs

- diastolic (aortic regurg, mitral stenosis)
- holosystolic (mitral regurg)
- harsh
- louder than 3/6 (i.e. thrill)
- associated with abnormal S1 or S2, or other abnormal sound (e.g. click)
- increased intensity when patient stands

Characteristics of pathologic murmurs

- increased precordial activity
- decreased femoral pulses
- may have cardiac symptoms- but not always!

“Cardinal Clinical Signs”

- McCrindle et al.
  - Johns Hopkins
  - 222 infants and children seen for a murmur
  - clinical findings and impression documented after clinical assessment
  - sensitivity 97%, specificity 98%
  - concluded that routine echocardiography is unnecessary

Arch Pediatr Adolesc Med 1996;150:169-74
“Cardinal Clinical Signs”

- Features independently predictive of CHD:

<table>
<thead>
<tr>
<th>Clinical sign</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pansystolic murmur timing</td>
<td>5.4 (1.3-24.4)</td>
</tr>
<tr>
<td>Murmur intensity ≥ 3</td>
<td>4.8 (1.6-14.4)</td>
</tr>
<tr>
<td>Maximal intensity LUSB</td>
<td>4.2 (1.9-9.6)</td>
</tr>
<tr>
<td>Harsh quality</td>
<td>2.4 (1.0-5.6)</td>
</tr>
<tr>
<td>Systolic click</td>
<td>8.4 (2.4-29)</td>
</tr>
<tr>
<td>Abnormal S2</td>
<td>4.1 (1.1-15.8)</td>
</tr>
</tbody>
</table>

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Murmurs in Newborns

From clinical assessment, independent predictors of CHD were:

<table>
<thead>
<tr>
<th>Clinical sign</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harsh quality</td>
<td>9.1 (3.7-22.2)</td>
</tr>
<tr>
<td>Loudest location</td>
<td>2.5 (1.2-5.5)</td>
</tr>
<tr>
<td>(RUS, LLSB, or apex)</td>
<td></td>
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<tr>
<td>Timing</td>
<td>10.4 (1.2-91.7)</td>
</tr>
</tbody>
</table>

Mackie et al. J Peds 2009

Part II:
Diagnostic evaluation
### Role of ECG? CXR?

<table>
<thead>
<tr>
<th></th>
<th>ECG</th>
<th>Chest X-Ray</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noninvasive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cheap</td>
<td></td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insensitive</td>
<td></td>
</tr>
</tbody>
</table>

### Role of exam? ECG?

- Smythe et al.
  - Children's Hospital of Eastern Ontario
  - 161 children age 1 mo-17 yr for murmur eval
  - History and exam ⇒ ECG ⇒ echo in all
  - **Sensitivity** of clinical examination 96%
    - Missed 1 small ASD and 1 small VSD
  - **Specificity** 95%
  - ECG did not change any clinical diagnoses

*Pediatrics 1990;86:497-500*

### Part III:
Examples of murmurs
Still’s murmur

• typically age 2-7 years
• characteristic “vibratory” or “musical” sound in early-mid systole
• medium to low-pitched
• grade 1-3/6
• loudest at the left lower sternal border (LLSB) and apex
• louder supine than sitting

Still’s murmur

• louder with
  — exercise
  — excitement
  — fever
• etiology of this sound is uncertain

Pulmonary flow murmur

• typically age 8-14 years
• “blowing”, low to medium-pitched
• early-mid systole, crescendo-decrescendo
• grade 1-3/6
• loudest at left upper sternal border and lungs
• louder supine and with inspiration
• accentuated by fever, anemia
Cervical venous hum

- age 2-7
- continuous “rumbling” sound, grade 1-3/6
- low anterior neck and at sternoclavicular junctions, R > L
- louder by turning head away from side of murmur and lifting chin
- disappears by pressing lightly over jugular vein, or by lying supine

Cervical venous hum

- differential diagnosis = other continuous murmurs
  - PDA
  - arteriovenous malformation
  - coronary artery fistula
- only a venous hum will respond to the maneuvers listed, so the distinction is easily made

Carotid bruit

- age 2 - adolescence
- crescendo-decrescendo systolic murmur over carotid arteries
- louder R > L
- not affected by posture
- must distinguish from aortic (or subaortic) stenosis with radiation to the carotids
Peripheral pulmonary stenosis

- age 0 - 6 months
- especially common in premature infants
- "blowing", high-pitched
- short, mid-systolic
- heard best in axilla, also LUSB and back (L side > R)
- not affected by patient’s position
- turbulence in branch pulmonary arteries

Ventricular septal defect

- any age, though often not heard before several days or weeks of age
- pansystolic, harsh
- usually grade 2-4/6
- low to high pitched, depending on the pulmonary artery pressure
- may have cardiac symptoms & other signs

Atrial septal defect

- heard at any age
- grade 1-3/6, medium-low pitched
- crescendo-decrescendo
- LUSB ⊆ lung fields
- abnormal S2 (wide, fixed splitting)
- does not decrease in intensity with standing
- may have diastolic rumble, increased precordial activity
**Patent ductus arteriosus**

- any age
- continuous (systolic only in early infancy)
- LUSB and under left clavicle
- usually grade 2-3/6
- “machinery-like” noise
- does not vary with patient position

**Pulmonary valve stenosis**

- any age
- crescendo-decrescendo
- LUSB radiating to lung fields
- if mild, sounds similar to a pulmonary flow murmur or ASD
- however, is associated with a variable early systolic ejection click (heard in expiration)

**Aortic valve stenosis**

- any age
- harsh, crescendo-decrescendo
- heard widely across precordium: apex, left sternal border, 2nd right interspace, carotids
- often an associated click that does not vary with the respiratory cycle
- may be associated with an early diastolic decrescendo murmur (aortic regurgitation)
Split S1 (S1-ES) with Aortic Stenosis

Ejection Sound (ES):
- mobile Ao valve leaflets
  - bicuspid AS
  - easily confused with S1

Midsystolic Murmur:
- begins with ES, not S1
- ends before S2

Compare with S4-S1:
- HCM
- S4 heard at apex with bell

Aortic Regurgitation

Inspection:
- bounding (Corrigan’s) pulse
- head bobbing (Mussel’s sign)
- compare with normal carotid

Auscultation:
- “To- fro” murmur
  - Midsystolic murmur
  - Early diastolic murmur
- 3RICS
  - “To- FRO”
- 2RICS
  - “TO - fro”

Mitral Stenosis

Listening at Base:
- abnormally loud S1 at base
- shorter S2-OS interval indicates severe MS

Listening at Apex:
- crescendo, presystolic murmur
- loud S1
- S2, OS
- mid-diastolic murmur

Inspection:
- JVP is a-wave dominant
- a-wave occurs with loud S1
Compare sounds with split S2, S3

Chronic MR

Inspection:
- apex beat displaced to 7ICS
- outward excursion of stethoscope head during systole

Auscultation:
- blowing murmur with outward excursion of stethoscope
- a thudding sound with inward return of stethoscope
- murmur is holosystolic
  - heard best over LV
- sound is S3

Murmur location

- right upper sternal border
  - aortic stenosis, venous hum
- left upper sternal border
  - ASD, PS, pulmonary flow murmur, PDA
- left lower sternal border
  - Still's murmur, VSD, tricuspid regurgitation, subaortic stenosis, aortic regurgitation
- apex
  - Still's murmur, mitral regurgitation, mitral stenosis
Part IV: Explanation to parents

Explanation to parents

• The explanation provided by the referring M.D. greatly influences the degree of parental anxiety

Explanation to parents

• “A heart murmur is simply an extra sound made by the heart”

• “The presence of a heart murmur does not imply that a problem exists”

• “In fact, heart murmurs are heard in 50% of children, but fewer than 1% of children actually have a heart problem”
Explanation to parents

- “Therefore, the vast majority of children with heart murmurs have completely normal hearts.”
- “Children with heart murmurs and normal hearts have ‘innocent’ murmurs.”
- “These normal sounds are simply caused by vibration of the muscles of the heart that occurs when the heart squeezes.”

Explanation to parents

- “Whether or not the murmur goes away when John is older doesn’t matter; after all, his heart is normal.”
- “When Sarah is an older child, she will not need to be restricted from physical activities in any way, even if the murmur is still there - because her heart is normal.”

Part V:
When to refer
When to refer

• suspected pathologic murmur
• lingering uncertainty about innocent vs. pathologic
• murmur and family history of:
  – congenital heart disease in an immediate family member
  – Marfan's syndrome
  – sudden death in young person

When to refer (cont’d)

• murmur and suspected/known malformation syndrome, e.g. trisomy 21
• parents request referral

Summary: Innocent Murmurs

• systolic
• ejection
• soft or vibratory
• grade 3 or less in intensity
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Summary: Pathologic Murmurs

- diastolic (aortic regurg, mitral stenosis)
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Resources

- Blaufuss multimedia
  - Blaufuss.org
- Podcasts
  - Pedscases.com/ iTunes
  - Texas Heart Institute Heart Sounds Series