Children with Heart Murmurs...When to be Concerned?

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Listening to a heart murmur is a routine practice that every primary care physician encounters on a daily basis while examining children. Virtually, all children demonstrate a heart murmur at some point during their childhood.

The practitioner's experience will determine when to refer the child for further evaluation. Profound knowledge of the characteristics of the common innocent vs. pathologic heart murmurs and the natural history of congenital and acquired heart diseases is necessary to achieve this goal.

In most cases, a thorough history and complete physical examination will be sufficient to exclude any pathological causes.

A heart murmur reflects turbulence of the blood flow through heart structures. It is also related to pressure difference (gradient) as the blood flows through the defects.

Innocent vs. Pathologic

Most children (50-90 percent) have an innocent murmur (benign or functional murmur). All these terms indicate an innocent extra noise of no hemodynamic significance. It also means that the child does not need any activity restriction or special treatment.

An innocent murmur may be accentuated by circumstances that increase cardiac output (hyperdynamic circulation) such as fever, anemia and pregnancy.

Exceptionally, only one percent of children might have an abnormal murmur (pathologic murmur). This murmur can be either congenital or acquired from different etiologies.

Causes of Congenital Murmurs

• atrial or ventricular septal defects, valvular stenosis or regurgitation

Causes of Acquired Murmurs

• infections; e.g. bacterial endocarditis and myocarditis
• immunologic; e.g. rheumatic fever
• familial conditions, e.g. hypertrophic cardiomyopathy with subaortic stenosis

Concerning Symptoms from History

May include:
• cyanosis
• chest pain
• dizziness/syncope
• failure to thrive
• recurrent respiratory infections
• wheezing

Concerning Signs from Physical Examination

May include:
• cyanosis/clubbing/edema
• hepatosplenomegaly
• hyperactive precordium
• palpable thrill or heave
• increased cardiac impulses
• diminished peripheral pulses
• dysmorphic features
• chest deformity
• skin lesions
• joint abnormalities

Characteristics of Innocent Murmur

• systolic ejection murmur (never diastolic)
• grade 2 or less

Absence of: other pathologic sounds
• absence of concerning symptoms and signs
• intermittent (comes and goes)
• minimal radiation
• age beyond neonatal period

When to Refer to a Pediatric Cardiologist

• a continuous murmur that persists in the supine position
• a regurgitant (holosystolic) murmur
• a diastolic murmur
• new onset murmur (+/- stigmata of Rheumatic fever or Infective endocarditis)
• louder murmur than before
• unusual radiation
• a systolic murmur with the following:
  – signs of congestive heart failure or cyanosis
  – significant failure to thrive
  – associated syndrome/anomaly strongly associated with CHD
  – neonates
  – loud (Grade III/VI or higher)
  – associated thrill heard while standing
  – hyperactive precordium
  – single or widely fixed split S2 (? ASD)
  – additional sound(s): (click, gallop, rub)
  – abnormal pulses, absent or weak femoral pulses

Diagnostic Tools

Extra diagnostic tools might be considered, which may include a chest X-ray for evidence of cardiomegaly or pulmonary edema, electrocardiogram (ECG or EKG), echocardiogram for structural and functional abnormalities, exercise stress test if necessary and blood work if necessary.
### TABLE 1: CHARACTERISTICS OF COMMON PATHOLOGIC HEART MURMURS

<table>
<thead>
<tr>
<th>Location</th>
<th>Small VSD</th>
<th>Medium-Large VSD</th>
<th>ASD</th>
<th>Valvar PS</th>
<th>Valvar AS</th>
<th>MR/MVP</th>
<th>CoA</th>
<th>PDA</th>
<th>AI/PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>LL SB</td>
<td>LL SB</td>
<td>LUSB</td>
<td>LUSB</td>
<td>LUSB</td>
<td>RUSB</td>
<td>Apex</td>
<td>Back, apex,</td>
<td>LUSB</td>
<td>LMSB, LUSB</td>
</tr>
<tr>
<td>Pitch</td>
<td>High</td>
<td>Mixed</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Mixed</td>
<td>High</td>
</tr>
<tr>
<td>Grade</td>
<td>I-IV/VI</td>
<td>II-IV/VI</td>
<td>I-III/VI</td>
<td>I-IV/VI</td>
<td>I-IV/VI</td>
<td>I-IV/VI</td>
<td>I-III/VI</td>
<td>I-IV/VI</td>
<td>I-III/IV</td>
</tr>
<tr>
<td>Timing</td>
<td>Early Systole</td>
<td>Holosystolic Ejection</td>
<td>Systolic Ejection</td>
<td>Systolic Ejection</td>
<td>Systolic Ejection</td>
<td>Pansystolic (midsystolic)</td>
<td>Systolic Ejection</td>
<td>Continuous</td>
<td>Early Diastole</td>
</tr>
<tr>
<td>Quality</td>
<td>Soft</td>
<td>Harsh</td>
<td>Soft</td>
<td>Variable</td>
<td>Variable</td>
<td>Soft</td>
<td>Soft</td>
<td>Variable</td>
<td>Harsh</td>
</tr>
<tr>
<td>Other</td>
<td>Hyperdynamic precordium</td>
<td>+/-Variable Ejection click (increases with expiration)</td>
<td>+/--Constant Ejection Click, Murmur radiates to carotid a. and apex</td>
<td>Timing during systole varies. Mid-systolic click heard if MVP (earlier when standing from squat)</td>
<td>Diminished BP and pulses in lower extremities. Click if BAV</td>
<td>Bounding pulses</td>
<td>Best heard with leaning forward in held expiration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Location abbreviations:**
- LL SB – Left lower sternal border
- LUSB – Left upper sternal border
- RUSB – Right upper sternal border
- MR – Mitral regurgitation
- CoA – Coarctation of the aorta
- PDA – Patent ductus arteriosus
- MVP – Mitral valve prolapse
- AI – Aortic incompetence
- PI – Pulmonic incompetence

### TABLE 2: CHARACTERISTICS OF COMMON INNOCENT HEART MURMURS

<table>
<thead>
<tr>
<th>Location</th>
<th>Still’s</th>
<th>Pulmonary Flow</th>
<th>Carotid Bruit</th>
<th>PPS of Infancy</th>
<th>Venous Hum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LL SB</td>
<td>LL SB</td>
<td>LUSB</td>
<td>Supraclavicular fossa</td>
<td>RUSB, LUSB, Back &amp; Axillae</td>
<td>R/L Infraclavicular areas</td>
</tr>
<tr>
<td>Pitch</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>Medium High</td>
<td>Medium</td>
</tr>
<tr>
<td>Grade</td>
<td>I-III/VI</td>
<td>I-III/VI</td>
<td>I-III/VI</td>
<td>I-III/VI</td>
<td>I-III/VI</td>
</tr>
<tr>
<td>Timing</td>
<td>Systolic Ejection</td>
<td>Systolic Ejection</td>
<td>Systole</td>
<td>Systole</td>
<td>Continuous</td>
</tr>
<tr>
<td>Quality</td>
<td>Twanging, Vibratory</td>
<td>Blowing</td>
<td>Harsh</td>
<td>Blowing</td>
<td>Blowing</td>
</tr>
<tr>
<td>Softer</td>
<td>Standing, straining</td>
<td>Standing, inspiration</td>
<td>Shoulder hyperextension</td>
<td>----</td>
<td>Supine position, jugular pressure</td>
</tr>
<tr>
<td>Louder</td>
<td>Supine</td>
<td>Hyperdynamic Circulation state</td>
<td>Standing</td>
<td>Supine</td>
<td>Upright</td>
</tr>
</tbody>
</table>

**Location abbreviations:**
- LL SB – Left lower sternal border
- LUSB – Left upper sternal border
- RUSB – Right upper sternal border

**Differential Diagnosis:**
- HOCM, Small VSD
- ASD, PS

**PPS - Physiologic peripheral Pulmonary branch stenosis**
**AVM – Arteriovenous malformation**

### CLASSIFICATION OF HEART MURMURS

<table>
<thead>
<tr>
<th>Murmur Type</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic Ejection (Diamond)</td>
<td><img src="https://example.com/diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>Holosystolic (Regurgitant)</td>
<td><img src="https://example.com/diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>Early diastolic</td>
<td><img src="https://example.com/diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>Mid diastolic</td>
<td><img src="https://example.com/diagram" alt="Diagram" /></td>
</tr>
<tr>
<td>Continuous</td>
<td><img src="https://example.com/diagram" alt="Diagram" /></td>
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### SUGGESTED READINGS:
3. Rosenthal A, How to distinguish between innocent and pathologic murmurs in childhood? Symposium on Pediatric Cardiology 1986;1229-1240