Evaluation of Chest Pain in Pediatrics

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The Challenge

• Common complaint in children and adolescents

• Much different implication than in adults
  – Most cases of chest pain in children are not cardiac related
  – Cardiac causes of chest pain are relatively few and serious cardiac pathology even more rare

• How do we best evaluate pediatric cardiac chest pain?
Differential Diagnosis

Selbst el al, 1988
Differential Diagnosis

- 168 patients in Belgian PED with chest pain
- 69 patients in cardiology clinic with chest pain

Chest Pain Differential Dx: Noncardiac

• Chest wall
  – Trauma
  – Costochondritis
  – Precordial catch
  – Slipping rib
  – Infection
  – Mastalgia
  – Zoster

• Gastroesophageal
  – Reflux, esophagitis
  – Foreign body

• Obesity

• Pulmonary
  – Asthma
  – Pneumonia/effusion
  – Bronchitis
  – Pneumothorax
  – Pleurisy
  – Pulmonary embolus
  – Malignancy

• Hematologic
  – Sickle cell disease

• Psychogenic

• Idiopathic (20-40%)
Cardiac Differential Diagnosis

• Ischemia
  – Coronary abnormalities
  – Kawasaki disease
  – Hypercoagulable states

• Obstructive heart disease
  – Hypertrophic cardiomyopathy
  – Aortic stenosis

• Pericardial effusion/pericarditis

• Pulmonary HTN

• Arrhythmias
  – SVT most common

• Myocarditis

• Dilated cardiomyopathy

• Cocaine use

• Takayasu arteritis

• Aortic aneurysm, dissection

• Pulmonary embolus

• ? MVP (adolescent females)
Case 1

• A 12-year-old girl presents to the ED with chest pain for 2 days
• Started gradually
• Worse with deep breath
• Had URI last week
• Afebrile
• Tender on both sides of sternum
• Remainder of physical exam normal
Case 1: Costochondritis

• Inflammation of costochondral cartilage

• Cause
  – Overuse
  – Preceding URI with cough
  – Idiopathic

• Sharp pain, worse with movement

• All ages

• Tenderness over costochondral joints
Musculoskeletal Chest Pain

• Tietze’s syndrome
  – Single painful, swollen costochondral junction

• Slipping rib syndrome
  – 8th-10th ribs fibrous connections
  – Diagnostic maneuver: hooking

• Treatment: reassurance, rest, NSAIDs
Case 2

- A 10-year-old boy presents to the ED with recurrent episodes of left chest pain
- Feels like a sudden stab
- Can’t take a deep breath
- Lasts seconds to few minutes
- Occurs at rest
- Not reproducible on exam
- Normal physical exam
Case 2: Precordial Catch Syndrome

• “Texidor’s twinge”
• Most common in 6-12 year olds
• Sudden, brief, localized, sharp
• Occurs at rest
• Exacerbated by deep breath
• No associated symptoms
• No abnormal physical findings
• Treatment: reassurance
Case 3

• A 6-year-old girl comes to the ED after having chest pain at home
• Stopped playing, became clingy, said chest hurt
• Mom thought she looked pale; now looks and feels better
• Abrupt onset and cessation by history
• HR=110, normal physical exam
Case 3: WPW with SVT

- In children >1 year
  - 82% present with palpitations
  - 14% with chest pain
  - Other: diaphoresis, dizziness, pallor
- 1-3% of chest pain complaints in ED
- 6% of chest pain referred to cardiologist
- Diagnosis may be delayed (median 4-5mo)
Arrhythmias in Chest Pain

• May be most common cardiac cause of CP in pediatrics
  – Most arrhythmias don’t present with CP
• SVT most common
  – VT and bradycardia uncommon, but more ominous
• Workup:
  – H&P, ECG, Holter and/or event monitor
  – Stress test & ECHO (WPW)
Case 4

- A 17-YO girl presents to the ED with chest pain that has lasted for 1 hour
- Pain began during soccer practice
  - Has happened previously with exercise
- Midsternal, squeezing, radiates to left arm
- PMH: Admitted to hospital for FOU at age 2 years
What was the FUO?
Case 4: Kawasaki Disease

Coronary aneurysms
- 20-25% if untreated
- 5% if treated with IVIG
- Appear 7 days to 4 weeks after onset of fever
Myocardial Ischemia in Pediatrics

• Coronary artery anomalies
  – Anomalous origin of LCA from PA (ALCAPA)
    • Presents in first months of life
    • Irritability, heart failure, cardiac enlargement
  – Hypoplastic coronary arteries
  – Status post arterial switch for d-TGA
Myocardial Ischemia in Pediatrics

• Anomalous origin from incorrect sinus of Valsalva
  – Presents later in childhood
  – Typically left coronary from right sinus
    • Compression between aorta and PA
    • Associated with sudden death with exertion
  – Echo diagnosis
Myocardial Ischemia in Pediatrics

- Sickle cell disease
- Nephrotic syndrome
  - Thrombotic coronary occlusion
- Long-standing diabetes mellitus
- Familial hypercholesterolemia
- SLE, antiphospholipid antibody syndromes
- Cardiac transplant (vasculopathy)
- Cocaine abuse
- Takayasu’s arteritis
- Coronary arteriospasm
Case 5

- A 16-year-old boy presents to the emergency department after fainting at a track meet
- Remembers having chest pain during the race
- Father died suddenly in his 30's
- Systolic ejection murmur on exam – Louder when standing, softer when lying
Case 5: Hypertrophic Cardiomyopathy

- Autosomal dominant
- Symptoms in 2\textsuperscript{nd} decade
- May present with angina-like pain or syncope
- Risk of sudden death ~6\% in children
- Systolic ejection murmur
  - Increases with decreased LV volume (Valsalva, squatting, standing)
- Echocardiography diagnostic
Case 6

- A 6-year-old girl presents to the ED with cough/URI for 2-3 weeks and chest pain for 1 week
- Feels very tired
- VS: Afebrile, heart rate 160 bpm
- Liver palpable 3 cm below RCM
- “Tick-tock rhythm”, gallop, regurgitant murmur at apex
ECG: low voltage
Echo: dilated and poorly functioning LV, moderate MR, no pericardial effusion
Case 6: Myocarditis

• Presentation
  – Heart failure
  – Chest pain
    • More likely in older children and adults

• ECG
  – Sinus tachycardia
  – Decreased voltages (<5 mm) limb leads
  – Conduction abnormalities
  – ST changes

• Echo/MRI and lab (Tn) confirmatory
Case 7

• You are working in the ED when a nurse asks you to assess a 15-year-old girl with chest pain who seems unwell.
• You recall treating her for pneumonia last week.
• Worsening dyspnea and chest pain for 3 days
• Leaning forward holding her chest
Case 7: Pericarditis

• Pain
  – More common in older children
  – Sharp, substernal
  – Worse when supine, relieved by leaning forward

• Physical findings
  – Friction rub if effusion small
  – Muffled heart sounds, pulsus paradoxus if large effusion

• Echo: effusion
Cardiac Troponin I in Acute Pericarditis

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Serum cardiac troponin I and ST-segment elevation in patients with acute pericarditis

E. Bonnefoy, P. Godon, G. Kirkorian, M. Fatemi, P. Chevalier and P. Touboul

Figure 1 Serum levels of cTnI in patients with and without ST segment elevation.
Approach to Pediatric Chest Pain: “Needles in the Haystack”
Table 2. Comparison of the Diseases Identified in the Outpatient Department vs. the ED or Inpatient Unit

<table>
<thead>
<tr>
<th>Cardiac Pathology</th>
<th>Outpatient Department, n (%)</th>
<th>Emergency Department/Inpatient, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic dissection</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Coronary anomalies</td>
<td>32 (78)</td>
<td>2 (1)</td>
</tr>
<tr>
<td>LCA from right sinus</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>RCA from left sinus</td>
<td>12</td>
<td>0</td>
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<tr>
<td>Coronary artery disease</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Anomalous CA from pulmonary artery</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>High takeoff of RCA</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Coronary artery fistula</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Dilated coronaries</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Dilated cardiomyopathy</td>
<td>0</td>
<td>5 (4)</td>
</tr>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>3 (7)</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>1 (2)</td>
<td>45 (35)</td>
</tr>
<tr>
<td>Pericarditis</td>
<td>4 (10)</td>
<td>58 (45)</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>0</td>
<td>13 (10)</td>
</tr>
<tr>
<td>Pulmonary artery hypertension</td>
<td>1 (2)</td>
<td>5 (4)</td>
</tr>
<tr>
<td>Takayasu arteritis</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total patients</td>
<td>41</td>
<td>130</td>
</tr>
</tbody>
</table>

CA, coronary artery; LCA, left coronary artery; RCA, right coronary artery; ED, emergency department.
History (including PMHx and FHx), PE and critical ECG review are most useful in identifying potential cardiac causes.

Echo most useful additional test.
Approach to Pediatric Chest Pain

• Thorough H&P:
  – Precipitating factors:
    • Exertion
    • Eating
    • Deep breathing
    • Muscle use
    • Trauma
    • Emotional stress
  – Description of pain (not as useful as adults)
Approach to Pediatric Chest Pain

• H&P continued:
  – Frequency and chronicity
    • Longer Hx less concerning
  – Associated symptoms
    • Fever, cough
    • Recent viral illness
    • Shortness of breath
    • Syncope or dizziness
    • Palpitations, subjective tachycardia
Approach to Pediatric Chest Pain

• H&P continued:
  – Past medical history
    • Known heart disease
    • Asthma or atopic conditions
    • Prothrombotic conditions
      – Cancer
      – SLE
      – Nephrotic syndrome
  – Medications and drugs
Approach to Pediatric Chest Pain

• H&P continued:
  – Family history
    • Cardiomyopathy, SCD, premature CAD,
  – Thorough PE:
    • Murmur
    • Rub
    • Breath sounds, wheezing
    • Pulses
    • Chest wall tenderness
Testing in Pediatric Chest Pain

• **CXR**
  – Cardiac findings very uncommon in isolation
    • Cardiomegaly, increased vascular markings

• **ECG**
  – More likely to be abnormal in ED/inpatients
  – Dysrhythmia, WPW, ischemia, other S-T or T-wave changes, A-V block, atrial enlargement, ventricular hypertrophy
  – Incomplete RBBB, early repolarization are normal

• **Holter, treadmill:** low-yield in CHB experience
When to Consider ECHO?

ACC 2014 AUC Guidelines
When to Consider Referral?

- Presence of cardiac signs/symptoms
  - Syncope or dizziness
  - Palpitations or subjective tachycardia
  - Pallor, cyanosis
  - Dyspnea (exclude pulmonary cause)
- Crushing, poorly localized pain radiating to left arm
- Hx of substance abuse
When to Consider Referral?

• Exertional chest pain (asthma excluded)
• Pain limits daily activities
• Concern for Marfan’s or other CT disease
• Hx of prothrombotic conditions, KD, prior coronary surgery (i.e. dTGA)
• Family Hx of HCM, unexplained sudden death, early CAD (+/-)
• Family anxiety or other concern
“He’s complaining of chest pain, shortness of breath, cramps and dizziness. Do you sell earplugs?”