Evaluation of Children with Chest Pain

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Disclosure Statement

- I have no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial services discussed in this CME activity.
Key Points

- Overview of chest pain in pediatric patients
  - From the Emergency Department
- Case Based Discussions
  - Highlighting some important cases not to miss
- Review the important features and work up
Chest Pain

- 0.3-0.6% of Pediatric Emergency Department (ED) visits
- 650,000 physician visits annually
- Mean age of presentation: 12-14 years
- 45% are labeled idiopathic
- Most common diagnosis found is musculoskeletal injury
- Cardiac cause of pain is seen in 0.6%-4% of patients presenting to the pediatric ED
Most Common Causes of Pediatric Chest Pain

- Musculoskeletal conditions
- Chest wall strain
- Costochondritis
- Direct trauma
- Respiratory conditions
- Asthma
- Cough
- Pneumonia

- Gastrointestinal problems
- Esophagitis
- Esophageal foreign body
- Psychogenic causes (stress)
- Cardiac Disease
- Myocarditis
Cardiac Causes of Chest Pain

- Arrhythmia
- Infection
  - Myocarditis
  - Pericarditis
- Structural abnormalities
- Coronary artery disease (ischemia or infarction)
CASES...
Case

- 8 year old female presents with chest pain. Pain last seconds to minutes, recurs several times a hour. Described as sudden, sharp and stabbing. Located in the center of the chest. Made worse by bending over or deep breaths. Denies cough, fever, or dyspnea.
  - Similar pain a few months ago, but this pain has been more frequent and started 2 days ago
- PMHx: Allergic rhinitis
- PSHx: none
- Family Hx: MGM has Atrial fibrillation
Case: Physical Exam

- VS: HR 110, RR 22, BP 98/60, Temp 98.7 POx 98%
- General: well nourished, well appearing
- HEENT: normal
- Lungs: clear without wheeze or rales
- CV: normal S1, S2, RRR no murmurm rub or gallop
  - warm and well perfused, 2+ peripheral pulses
- Abdomen: soft NTND, no organomegaly
EKG
DIAGNOSIS?
Precordial Catch Syndrome
Precordial Catch Syndrome

- Pathophysiology is unknown
  - May originate from parietal pleura and pressure on an intercostal nerve, rib cartilage or chest musculature

- Pain is sudden onset, sharp, stabbing, midsternal or precordial pain without radiation
  - Typical duration is 30 seconds to 5 minutes
  - Exacerbated by deep breaths
Precordial Catch Syndrome

- Most common age is 6-12 years
- Diagnosis made after thorough history, normal PE and normal ancillary testing
  - EKG and chest X-ray are not indicated
- Management and treatment
  - Supportive
  - Reassurance is required
  - Analgesics may not help as pain is self limited
Case

- 13 year old female presents with chest pain. Pain is constant, but worse with swallowing. No change with movement or position changes. Denies shortness of breath, fever, cough, congestion.
- PMHx: Allergic rhinitis, Asthma, & Acne
- PSHx: none
- Family Hx: non contributory
DIAGNOSIS?
Pill Induced Esophagitis
Pill Induced Esophagitis

- **Causes:**
  - Antibiotics: Tetracycline, doxycycline & clindamycin
  - Anti-inflammatories: NSAIDs & Aspirin
- More common with history of esophageal dismotility
- Diagnosis based on history
- Treatment
  - Stop medication
  - Sulcralfate
Case

- 4 year old male presents with chest pain and difficulty breathing. He has had cough and congestion for 3 days. Yesterday started using albuterol every 4 hours. Today his cough worsened and he developed chest pain. Mom states the albuterol does not seem to be helping anymore. Patient also complains of neck pain. No fever, no vomiting.

- PMHx: Allergic rhinitis, Asthma

- PSHx: none

- Family Hx: non contributory
Case: Physical Exam

- VS: HR 150, RR 46, BP 96/54, POx 92%
- General: unwell appearing and in moderate respiratory distress
- HEENT: crepitus palpated on anterior neck
- CV: tachycardia, no murmur, rub or gallop
- Lungs: poor air entry, diffuse inspiratory and expiratory wheeze
Case: Imaging
DIAGNOSIS?
Pneumomediastinum
Pneumomediastinum

- **Clinical presentation**
  - Chest pain (68%)
  - Neck pain (44%)
  - Sore throat (33%),

- **Physical Examination**
  - Subcutaneous emphysema (30-90%)
    - Suprasternal notch, neck, axilla and face
  - Hammon sign (12-50%)
  - Dyspnea
Pneumomediastinum

- **Causes/related disease**
  - Asthma
  - Bronchiolitis
  - Cystic fibrosis
  - Choking/aspiration
  - Inhalation – cocaine or marijuana

- **Differential Diagnosis**
  - Pneumothorax
  - Esophageal perforation
  - Pericarditis
Pneumomediastinum

- **Diagnostic imaging**
  - CXR
  - Chest CT scan
  - Contrast esophagography
    - History of severe retching and marked odynophagia, hypotension +/- pleural effusion
  - Ultrasound
  - Electrocardiographyography
    - Not warranted
Pneumomediastinum

- **Treatment**
  - Treat underlying condition
  - Conservative: analgesia, rest and avoidance of maneuvers that increase pulmonary pressure
  - High concentration oxygen for moderate to severe symptoms

- **Outcome**
  - Typically resolves without complication in 2-15 days
  - 5% recurrence rate – follow up not warranted
  - Poor prognosis if associated with pneumothorax, measles and underlying lung disease
Case

- 14 year old male present with sudden onset of chest pain. Pain is right sided and worsened overnight. He complains of shortness of breath.
- PMHx: none
- PSHX: torn meniscus repair
- Family Hx: sudden death in uncle at 37 years of age
Case: Physical exam

- VS: HR 70, RR 22, BP 110/64, POx 96%
- General: seems anxious and in mild respiratory distress
- HEENT: normal
- CV: normal S1 S2, no murmur
- Lungs: Diminished breath sounds on the right
- Abdomen: soft and NT, no organomegaly
- Extremities: warm and well perfused
Chest X-ray
Chest X-ray
DIAGNOSIS?
Spontaneous Pneumothorax
Spontaneous Pneumothorax

- Pneumothorax and pneumomediastinum account ~ 3% of cases of chest pain

- Clinical presentation
  - Acute onset of sharp chest pain with respiratory distress
  - Pain is worse with inspiration
  - Radiates to the shoulder, neck or abdomen

- Predisposing conditions
  - Asthma
  - Cystic fibrosis
  - Marfan’s syndrome
Spontaneous Pneumothorax

- **Diagnosis**
  - **CXR**
    - Determination of size not standardized in children
      - Large pneumothorax = ≥3 cm of air between the pleural line and apical chest wall, or ≥2 cm between the entire lateral lung edge and the chest wall.
  - **CT** – only warranted if indicated
  - **EKG** – not indicated in children
Tension Pneumothorax
Spontaneous Pneumothorax

**Treatment**
- Conservative management
- Needle decompression
- Chest thoracotomy
  - Large pneumothorax
  - Continuous air aspiration after needle decompression
  - Underlying lung disease: asthma, CF
- Surgical intervention
  - If air leak persists for > 5ds
  - In cases of recurrence in patients with underlying lung disease
Spontaneous Pneumothorax

- **Outcome**
  - Risk of recurrence 50-60%
  - Depends on underlying lung disease
Case

- 11 year old male presents with chest pain. Pain started 3 days ago. Fever started 7 days ago. He complains of cough, fatigue, nausea and vomiting.
- PMHx: none
- PSHx: Tonsillectomy
- Family Hx: no cardiac history
Case: Physical exam

- HR 107, RR 22, BP 109/72, Temp 37.6, Pox 98%
- GEN: well developed, rather well appearing
- HEENT: normal
- Lungs: clear breath sounds
- CV: 3/6 systolic murmur, + friction rub
- Abd: Soft, no organomegaly
- Extremities: Warm and well perfused
Case: imaging
DIAGNOSIS?
Pericarditis
Pericarditis

- Clinical features
  - Chest pain is almost always present
  - Pain is typically sharp & positional
    - Worse when supine and relieved when sitting up or leaning forward

- Physical exam findings
  - Friction rub (pathognomonic, LLSB)
  - Muffled hear sounds
  - Narrow pulse pressures
  - Tachycardia
  - Neck vein distension
Pericarditis

- **Diagnostic testing**
  - CXR: normal except in case of pericardial effusion
  - EKG: changes occur in stages (90% of patients)
    1. Diffuse ST elevation in I, II, III, aVL, aVF, V2- V6; ST segment depression in aVR and V1, Diffuse PR depression
    2. ST and PR normalization with flattened T waves
    3. T wave inversion can become permanent
    4. Low voltage QRS segments with development of effusion
  - Labs: non specific and not always necessary
Pericardial effusion
Case

- 15 year old male present with chest pain. Pain started suddenly while wrestling. He continued to play but became short of breath. The pain persisted and he told his parents
  - Denies fever
  - Endorses fatigue.
  - One week prior had a GI illness with vomiting and diarrhea

- PMHx: none
- PSHx: none
- Family Hx: no cardiac history
Case

- VS: HR 115, RR 28, BP 95/58
- GEN: anxious but cooperative
- HEENT: nml
- Lungs: tachypnea, clear, no rales
- CV: tachycardia, S1, S2 and S3 gallop heard with a holosystolic apical murmur
- Abdomen: soft NTND, + hepatomegaly
- Extremities: warm and well perfused
EKG
Case
DIAGNOSIS?
Myocarditis
Myocarditis

- One of the most common causes of new onset heart failure in a previously healthy child
- One study notes a 0.5 cases per 10,000 ED visits
  - Precise incidence is unknown.
- Causes
  - Viral
Myocarditis

- **Presenting symptoms**
  - Chest pain
  - Lightheadedness/Syncope
  - Seizure
  - Respiratory complaints – more common <10y

- **Exam findings**
  - Tachypnea
  - Hepatomegaly
  - Tachycardia
    - S3 or S4 gallop
    - Murmurs associated with mitral or tricuspid valve insufficiency
Myocarditis

- EKG
  - Sinus tachycardia with low-voltage QRS complexes & inverted T waves
- CXR
  - Cardiomegaly
- Labs
  - Troponin
- Echocardiogram
- Goal of treatment to manage heart failure and arrhythmias
EKG
Case

- 13 year old Female present with chest pain. Pain has been present for several days. She denies lightheadedness, shortness of breath, dyspnea, syncope or headache. She states the pain was worse last night at dance practice.
- PMHx: none
- PSHx: myringotomy tubes x 2
- Family Hx: no cardiac history
Case

- VS: HR 80, RR 20, BP 108/61, Temp 39.8 Pox 100%
- GEN: well appearing but anxious
- HEENT: nml
- CV RRR, nml S1, S2, no murmur, rub or gallop
- Lungs: clear breath sounds
- Abdomen: soft, NTND, no organomegaly
- Extremities: warm and well perfused
Case
Case
DIAGNOSIS?
Costochondritis
Costochondritis

- Accounts for 10-20% of causes of chest pain
- A musculoskeletal disorder that produces tenderness over the costochondral junctions
- Often is bilateral
- Exaggerated by physical activity or breathing
- Reproducible by palpation or moving
Musculoskeletal Chest Pain

- Shown to be up 69% of causes of chest pain presenting to pediatric emergency department
- Typical history of new or intense activity or trauma
- Can appear up to 2 days later
- Pain is typically reproducible on palpation and range of motion
  - Absence of reproducibility does not exclude MSK pain
- Pain resolves/improves with NSAIDs and rest
Review of the Important Features of Chest Pain
Hints from the history to prompt a work up...

- Chest pain with exertion or associated with palpitations, syncope or decreased endurance
- **Important historical aspects**
  - Associated signs and symptoms
  - Location
  - Duration
  - Positions or activities that make the pain better or worse,
- **PMHx, PSHx, Family Hx should include cardiac conditions and the use of drugs**
  - Family hx of sudden death <35y, young onset of ischemic heart disease, inherited arrhythmias such as long QT syndrome or Brugada
Key points from the physical to prompt a work up…

- Palpate the apex – thrills or heaves
- Auscultate for murmurs, clicks, rubs or gallops
- Look for signs of Congestive heart failure
  - Wheeze
  - Rales
  - Jugular vein distension
  - Edema and/or liver enlargement
Another way to look at the Physical Exam

<table>
<thead>
<tr>
<th>Exam Findings</th>
<th>Consider</th>
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</thead>
<tbody>
<tr>
<td>Address abnormal vital signs</td>
<td>Unexplained tachycardia</td>
</tr>
<tr>
<td>Decreased breath sounds, palpable subcutaneous air</td>
<td>Pneumonia, Pneumothorax or Pneumomediastinum</td>
</tr>
<tr>
<td>Abnormal cardiac findings of murmur, rub, arrhythmia</td>
<td>Pericarditis, Myocarditis, SVT, Structural heart disease</td>
</tr>
<tr>
<td>Evidence of trauma</td>
<td>Consider pneumothorax, chest contusion</td>
</tr>
<tr>
<td>Reproducible pain</td>
<td>Musculoskeletal pain, costochondritis</td>
</tr>
</tbody>
</table>
When it’s unlikely to be cardiac

- Chronic pain is more associated with non cardiac conditions
- Improvement with rest or improvement with analgesics
Review of Testing
Chest X-ray

- **Indications**
  - Acute onset of severe pain
    - Especially in the very tall and thin
  - Pain awakening from sleep
  - Cough
  - Fever
  - Dyspnea
  - History or signs of trauma
  - Abnormal pulmonary or cardiac exam
Electrocardiogram (EKG)

- Determine an abnormal heart rate or rhythm
- Identifies ischemia
- **Recommended**
  - Child with chest pain who has an underlying cardiac disorder
  - Family history of sudden death, inherited arrhythmia, cardiomyopathy, ICD/pacemakers
  - Chest pain in a preschool child
  - When suspicion of arrhythmia
  - Present with syncope
  - Chest pain during exercise
  - Fever
  - Physical exam findings of tachycardia, ill appearance, fever and abnormal cardiac exam
When to refer to/consult Cardiology

- Concern for cardiac etiology
- Abnormal EKG
- Potentially inherited cardiac disease
- Abnormal cardiac exam
- Exercise induced syncope or dizziness
- Palpitations
Echocardiogram

- Used to evaluate the structure and function of the heart
- Used to clarify any suspected structural or functional cardiac disorder in a child presenting with chest pain
Exercise Stress Test

- Can document the occurrence of arrhythmia with exercise
- Can determine cardiopulmonary performance
- In the absence of arrhythmia or without ST-T wave changes suggestive of ischemia a cardiac cause of chest pain is unlikely
Lab work

- **Infectious etiology for pericarditis or myocarditis can be investigated**
  - Cultures, PCR

- **Inflammatory markers**
  - CBC, ESR, CRP

- **Cardiac enzymes**
  - Troponin (cardiac specific)
    - Can be elevated with ischemia and myocarditis/pericarditis
Chest Pain is a frequent chief complaint of Pediatric Emergency Departments
Cardiac cause of pain is seen in 0.6%-4% of patients presenting to the pediatric ED
Number 1 cause is musculoskeletal
Electrocardiogram and Chest X-ray can be helpful
Underlying cause is often idiopathic
QUESTIONS???
REFERENCES


References

- Foy AJ. Comparative effectiveness of diagnostic testing strategies in emergency department patients with chest pain: an analysis of downstream testing, interventions and outcomes. JAMA Intern Med. 2015 Mar;175(3):428-36


References

References


