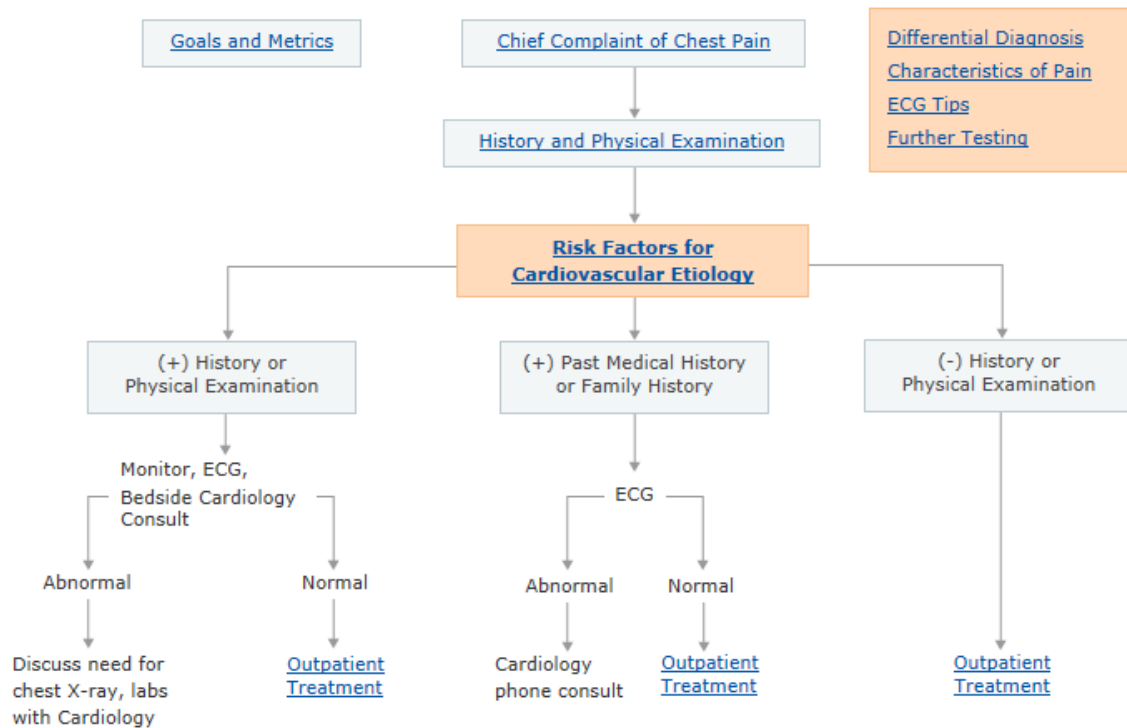


Chest Pain - Clinical Pathway: Emergency

ED Pathway for the Evaluation/Treatment of Chest Pain in Children Without Known Cardiac Disease



Goals

- Decrease:
 - Chest X-ray
 - Lab testing
 - Bedside cardiology consultation
 - ECG
- Decrease ED LOS
- Improve parental satisfaction

Metrics

General

- ED Length of stay

Testing

- Lab testing
- Chest X-ray
- ECG

Volume/Cost

Use of Order Set



Chest Pain - Clinical Pathway: Emergency

Outpatient Treatment

Musculoskeletal	<ul style="list-style-type: none">• NSAIDS with adequate PO• Follow-up with PMD as needed
Respiratory	<ul style="list-style-type: none">• Treat asthma as indicated• Treat pneumonia as indicated• Follow-up with PMD 7 days
GI	<ul style="list-style-type: none">• Ranitidine• Follow-up with PMD 7-10 days
Psychological	<ul style="list-style-type: none">• Decrease stimulants, caffeine• Complete SW Consult to evaluate risk<ul style="list-style-type: none">• BHS when for adolescents > 13• Meditation, relaxation techniques• Follow-up with outpatient MH as needed• Follow-up with PMD 7-10 days
Any Positive Risk Factors for Cardiovascular Etiology	<ul style="list-style-type: none">• Exercise Restriction: no gym, no sports, okay to walk• Click cardiology follow-up box in Chest pain Discharge Smart Set:<ul style="list-style-type: none">○ Within 1 week if positive history or physical exam○ Within 2 weeks if positive past medical history or family history<ul style="list-style-type: none">• Follow-up with PMD 7 days



Chest Pain - Clinical Pathway: Emergency

Chief Complaint of Chest Pain

Population

Use this pathway to guide the evaluation of the chief complaint of chest pain in healthy patients without known cardiac disease.

Exclusions:

- Known cardiac history, cardiac surgery
- Sickle Cell
- Kawasaki
- Asthma

Background Information

Chest pain is a common chief complaint in pediatric outpatient and emergency department visits (0.6-5%) and is the 2nd most common reason for referral to a pediatric cardiologist. Parents and patients are concerned about the possibility of heart disease which could be very serious and/or life-threatening. However, cardiac etiologies are exceedingly rare in healthy children and adolescents, < 1% of those seen in the general outpatient setting or emergency department. In fact, of those referred to a Pediatric Cardiologist, a cardiac etiology will be found on only 2% of patients.

Some other interesting facts:

- Average age of presentation is 13 years with similar frequency in males/females
- Most common etiology is idiopathic (12-85%) or Musculoskeletal (15-31%)
- Patients < 12 years: Cardiorespiratory cause, slightly higher incidence of disease
- Patients > 12 years: Higher incidence of psychogenic cause
- 80% resolve spontaneously

A thorough history and physical examination will elucidate the etiology or generate a short, specific differential diagnosis. Thus routine laboratory and radiographic testing are not routinely indicated.



Chest Pain - Clinical Pathway: Emergency

History and Physical Examination

A thorough history and physical examination will elucidate the etiology or generate a short, specific differential diagnosis. Thus routine laboratory and radiographic testing are not routinely indicated.

Assess VS and general appearance to determine if immediate treatment is needed. Do not immediately assume that the etiology is cardiac. Evaluate the degree of pain and the impact that it has on the patient's life. Determine if the pain is part of an underlying chronic condition. Consider further testing if history or physical exam is concerning. Avoid expensive and invasive testing when pain is chronic and history and physical examination is benign.

History		Physical Exam	
Pain	Onset, frequency, duration Quality, severity Location Radiation, positional	VS	Fever HR, RR, BP Pulse oximetry Peripheral pulse, perfusion
Trigger	Exertional	General	Appearance, acute distress, anxiety, chronic appearance
Associated Symptoms	Dizziness, near syncope or syncope Dyspnea Palpitations Fever, cough History for foreign body Rash, arthralgia, arthritis Associated with foods Alleviating factors Foreign body/caustic ingestion	Chest	Cor <ul style="list-style-type: none">○ Murmur, S2○ Gallop○ Friction Rub Lung <ul style="list-style-type: none">○ Wheeze○ Rales Focal musculoskeletal tenderness Crepitations Asymmetry of chest
Social	Anxiety, depression, substance abuse	Abdomen	HSM, epigastric tenderness
Medications	Recent medications	Other	Rash, arthritis Evaluate for evidence of trauma Thrombophlebitis

Risk Factors for Cardiovascular Etiology

History	Physical Exam	Past Medical History	Family History
Exertional Acute onset, awakens from sleep Substernal crushing pressure Radiation to shoulder, arm, neck, jaw Syncope, dizziness Palpitations Dyspnea Orthopnea Pulmonary embolus risk factors Drug use Age < 12 years	Cyanosis Tachypnea, shortness of breath, WOB Abnormal breath sounds Bradycardia, tachycardia, dysrhythmia HTN, hypotension New murmur, significant murmur Gallop, friction rub Abnormal 2nd heart sound Distant heart sounds Decreased femoral / peripheral pulses Peripheral edema	Rheumatologic disease, SLE Neoplasm Thrombophilia Connective tissue disorder Marfan Behavioral health issue Anemia Diabetes Other chronic medical problems	Sudden death in youth Unexplained death Severe familial hyperlipidemia Cardiomyopathy Pulmonary hypertension Deafness at birth

Chest Pain - Clinical Pathway: Emergency

Pulmonary embolus risk factors

- Central venous catheter
- Clotting disorder
- Family history of DVT or PE
- Fracture
- Immobilization
- Obesity
- OCP use
- Pregnancy, recent childbirth
- Recent major surgery (particularly to abdomen or lower extremities)
- Smoking

Chest Pain - Clinical Pathway: Emergency

Outpatient Treatment

Musculoskeletal	<ul style="list-style-type: none"> • NSAIDS with adequate PO • Follow-up with PMD as needed
Respiratory	<ul style="list-style-type: none"> • Treat asthma as indicated • Treat pneumonia as indicated • Follow-up with PMD 7 days
GI	<ul style="list-style-type: none"> • Ranitidine • Follow-up with PMD 7-10 days
Psychological	<ul style="list-style-type: none"> • Decrease stimulants, caffeine • Complete SW Consult to evaluate risk <ul style="list-style-type: none"> • BHS when for adolescents > 13 • Meditation, relaxation techniques • Follow-up with outpatient MH as needed <ul style="list-style-type: none"> • Follow-up with PMD 7-10 days
Any Positive Risk Factors for Cardiovascular Etiology	<ul style="list-style-type: none"> • Exercise Restriction: no gym, no sports, okay to walk • Click cardiology follow-up box in Chest pain Discharge Smart Set: <ul style="list-style-type: none"> ○ Within 1 week if positive history or physical exam ○ Within 2 weeks if positive past medical history or family history <ul style="list-style-type: none"> • Follow-up with PMD 7 days

Chest Pain - Clinical Pathway: Emergency

Differential Diagnosis of Chest Pain in Children

<p>Cardiac Related Causes</p>	<ul style="list-style-type: none"> • Coronary Artery Disease (ischemia, infarction) <ul style="list-style-type: none"> ○ Anomalous coronary artery ○ Kawasaki disease ○ Diabetes mellitus (long-standing) <ul style="list-style-type: none"> • Arrhythmia <ul style="list-style-type: none"> ○ SVT ○ VT • Structural Abnormalities <ul style="list-style-type: none"> ○ Hypertrophic cardiomyopathy ○ Severe pulmonic stenosis ○ Aortic valve stenosis <ul style="list-style-type: none"> • Infection <ul style="list-style-type: none"> ○ Myocarditis ○ Pericarditis • Aortic Dissection (thoracic)
<p>History</p>	<ul style="list-style-type: none"> • Musculoskeletal Disorders <ul style="list-style-type: none"> ○ Chest wall strain ○ Direct trauma, contusion, rib fracture <ul style="list-style-type: none"> ○ Costochondritis • Respiratory Disorders <ul style="list-style-type: none"> ○ Severe cough ○ Asthma ○ Pneumonia ○ Pneumothorax, pneumomediastinum <ul style="list-style-type: none"> • Psychological Disorders <ul style="list-style-type: none"> ○ Stress-related pain <ul style="list-style-type: none"> • GI Disorders <ul style="list-style-type: none"> ○ Reflux esophagitis ○ Esophageal foreign body, caustic ingestion <ul style="list-style-type: none"> ○ Pill induced esophagitis <ul style="list-style-type: none"> • Miscellaneous <ul style="list-style-type: none"> ○ PE ○ SCD with vasocclusive crisis ○ Abdominal aortic aneurysm (Marfan) ○ Pleural effusion (inflammatory disease) <ul style="list-style-type: none"> ○ Zoster

- Pleurodynia (coxsackie virus)
- Breast tenderness (physiologic, pregnancy)
 - Tietze syndrome
- Texidor's Twinge / Precordial Catch syndrome
 - Chest mass
 - **Idiopathic**

From Selbst SM. Approach to the Child with Chest Pain. *Pediatr Clin North Am.* 2010 Dec;57(6):1221-34.

Chest Pain - Clinical Pathway: Emergency

Characteristics of Pain and Etiology

<p>Pericarditis</p>	<ul style="list-style-type: none"> • Pain <ul style="list-style-type: none"> ○ Sharp, stabbing sternal pain and L shoulder pain <ul style="list-style-type: none"> ○ Improved by leaning forward <ul style="list-style-type: none"> • +/- Cough • Friction rub, muffled heart tones • Pulsus paradoxus, distended neck veins with severe disease <ul style="list-style-type: none"> • ECG • +/- Cardiomegaly on chest X-ray
<p>Myocarditis</p>	<ul style="list-style-type: none"> • Pain <ul style="list-style-type: none"> ○ Dull, substernal • Fever, tachycardia, respiratory distress, fatigue <ul style="list-style-type: none"> • Impending / existing shock <ul style="list-style-type: none"> • Acutely ill-appearing • Gallop, Mitral regurgitation murmur <ul style="list-style-type: none"> • ECG ○ Low voltage precordial leads, ectopy
<p>Arrhythmia</p>	<ul style="list-style-type: none"> • Acute onset and offset of pain, palpitations
<p>Myocardial Infarction</p>	<ul style="list-style-type: none"> • Pain <ul style="list-style-type: none"> ○ Crushing, radiation to neck, jaw ○ Associated diaphoresis, dyspnea, nausea <ul style="list-style-type: none"> • Substance exposure, abuse



Chest Pain - Clinical Pathway: Emergency

ECG Tips

Potentially Concerning ECG Findings in Patients with Chest Pain

1. Ischemia, Myocarditis or Pericarditis:
 - Pathologic ST Segment changes in 2 or more contiguous leads: More than 2mm above baseline
 - Abnormal T wave morphology and axis for age
 - Pathologic Q waves (more than 5mm deep and >40ms wide) in 2 or more contiguous leads 2, 3
 - Low Voltage QRS amplitude (5mm or less in all six limb leads)
2. Right or Left Ventricular Hypertrophy:
 - Right Ventricular Hypertrophy:
 - Upright T wave between 4 days and Puberty in V1
 - Tall R V1 (>20-29 mm) and Deep S V6 (5-20mm)
 - qR pattern in V1
 - Right axis deviation for age
 - Left Ventricular Hypertrophy:
 - Tall R V6 (>25 mm) or Tall R V5 (>35mm) and deep S V1(>25mm)
 - Q in V6 > 4mm
 - Left axis deviation for age
3. Prolonged QTc (calculated per Bazett's Formula) greater than or equal to 450 msec^{1, 4}. Note: Prolonged QTc in of itself rarely is an etiology for chest pain, these patients more often present with syncope
4. Abnormal Rhythm from patient's baseline*
 - Including abnormal P wave axis (outside of 0-90 degrees) in setting of tachycardia
 - Wide QRS for age including a new bundle branch block*
5. Frequent PVCs on a 12 lead ECG or multiform PVCs

*Assuming there is a prior ECG available

References

- Eslick GD. [Epidemiology and risk factors of pediatric chest pain: a systematic review](#). Pediatric Clinics of North America. 2010, 57(6):1211-1219.
- Friedman KG, Kane DA, Rathod RH, et la. [Management of pediatric chest pain using a standardized assessment and management plan](#). Pediatrics. 2011, 28(2):239-245.
- Saleeb SF, Li WY, Warren SZ, et la. [Effectiveness of screening for life-threatening chest pain in children](#) . Pediatrics. 2011, 128(5):e1062-1068.
- Verghese GR, Friedman KG, Rathod RH, et la. [Resource Utilization Reduction for Evaluation of Chest Pain in Pediatrics Using a Novel Standardized Clinical Assessment and Management Plan \(SCAMP\)](#). J Am Heart Assoc. 2012, 1(2).



Chest Pain - Clinical Pathway: Emergency

Further Diagnostic Testing

Laboratory testing is rarely required in patients with chest pain. Please discuss indications for labs with Cardiology.

	History	Physical Exam
ECG	<ul style="list-style-type: none">• Exertional• Acute onset, awakens from sleep• Substernal crushing pressure• Radiation to shoulder, arm, neck, jaw<ul style="list-style-type: none">• Syncope, dizziness• Palpitations• Dyspnea, Orthopnea• Risk Factors for PE• Suspect drug exposure/abuse• Consider with fever	<ul style="list-style-type: none">• Ill appearance• Significant VS abnormality• Abnormal cardiac exam• Consider with fever
Chest X-ray, 2 view	<ul style="list-style-type: none">• Fever• Respiratory distress<ul style="list-style-type: none">• Trauma• Awakens patient from sleep<ul style="list-style-type: none">• Acute onset• History of Kawasaki disease, CTD• Suspect foreign body	<ul style="list-style-type: none">• Fever• Ill appearance• Significant VS abnormality• Abnormal lung exam• Abnormal cardiac exam<ul style="list-style-type: none">• Crepitations
CBC, ESR, CRP	<ul style="list-style-type: none">• Concern for myo/pericarditis	
CK – MB Studies Troponin	<ul style="list-style-type: none">• Concern for ischemia, myo/pericarditis	
BMP	<ul style="list-style-type: none">• Arrhythmia with abnormal ECG	
Drug Screen	<ul style="list-style-type: none">• Suspected drug use	
D-Dimer	<ul style="list-style-type: none">• Concern for PE	

BNP

- Concern for congestive heart failure

