

PEDIATRIC

AND

ADOLESCENT
CHEST PAIN

Pediatric and Adolescent Chest Pain

Chest pain is a common complaint in the pediatric and adolescent populations. Rarely are the complaints associated with cardiac pathology. Several studies have specifically reviewed the incidence of cardiac related chest pain and have demonstrated consistently, the low association to cardiac disease. Despite the low association of these clinical complaints and true pathology, chest pain generates considerable concern in patients and their parents with many expressing concern that major pathology (i.e. myocardial infarction) may be occurring. These concerns result in use of medical resources and physician time in addition to generating anxiety in patients and their families. While this low incidence is well recognized among pediatric cardiologists, vigilance is mandated by the rare finding of true pathology in association with isolated chest discomfort.

Despite the low incidence of associated cardiac pathology, chest pain remains a significant source of outpatient pediatric cardiology and Emergency Departments patient evaluations. The medical literature regarding chest pain in this age population occurred in the 1980s and involved several studies that looked at groups of individuals presenting to Emergency Departments or clinics with enrollment criteria of age (usually less than 20 years) and primary complaint of chest pain. The patients were evaluated extensively for etiology of their chest pain and uniformly, cardiac pathology was found to be the least likely source of their complaints. Of additional interest the specific cause of chest discomfort in these groups of patients (40 - 50%) was never discovered, with much of the pain attributed to musculoskeletal/chest wall pain.

NON CARDIAC CHEST PAIN

When pathology is present, non-cardiac causes of chest pain predominate and can include a variety of causes including:

Pulmonary: pleurisy, pleural effusion, pulmonary embolism, pneumothorax, reactive airway disease

Musculoskeletal: trauma, chondrochondritis, muscle spasm

Gastrointestinal: GE reflux, Hiatal hernia, splenic flexure syndrome, pancreatitis, esophagitis

Psychological: hyperventilation, conversion disorder

Systemic disorders: Sickle cell crisis

CARDIAC CHEST PAIN

Cardiac causes of chest discomfort are uncommon, however do occur and their presentation may not clearly identify a cardiac etiology. Cardiac causes of chest pain include:

Pericarditis - In the population we serve the cause of pericarditis is most commonly infectious (viral or bacterial). Additional causes include auto-immune/rheumatic, post traumatic, and neoplastic. Pericardial effusion may (not necessarily) be present but if so, may cause additional complaints (e.g. respiratory difficulty) allowing an easier appreciation that pathology is present.

Coronary artery abnormalities - There are several coronary artery abnormalities that may result in chest discomfort secondary to diminished myocardial perfusion. *Abnormal coronary artery origins* often present early in life (anomalous left coronary from the pulmonary artery) however anomalous right coronary origin may not manifest until later in life. *Abnormal coronary artery course* may also result in diminished myocardial perfusion/myocardial ischemia. Coronary artery bridge (coronary course into the myocardium with compression during systole) or origin of the left coronary from the right Sinus of Valsalva (left coronary course between the great vessels with potential compression especially during physical activity). *Coronary artery fistula* may result in a coronary "steal" syndrome diverting blood from the myocardium. *Coronary ostia stenosis or atresia* may limit coronary perfusion or require collateral circulation. *Single coronary systems* (left or right) may compromise perfusion (Pete Maravich 1988) *Kawasaki disease* with coronary artery involvement may result in diminished perfusion secondary to coronary stenosis or aneurysm and thrombus formation. Early development of *coronary artery disease* is usually associated with familial hyperlipidemia syndromes, diabetes mellitus or following heart transplantation but may also present with chest discomfort. Cocaine use may exacerbate any of these pathologies with increase in myocardial oxygen consumption and/or coronary artery spasm.

Myocarditis -May also manifest initially as chest discomfort. Dilated and hypertropic myocarditis may present with clinical complaints of chest discomfort. The degree to which chest pain is present as an isolated complaint may associate to the severity of the primary pathology; patients with severe cases of dilated or hypertropic myopathy usually manifest additional symptoms. Isolated acute myocardial inflammation without compromise of function or associated pericardial effusion may be difficult to diagnose.

Cardiomyopathy - Hypertropic and dilated cardiomyopathies may present with complaints of chest discomfort. Symptoms are more likely to occur during physical exertion and may also encompass additional complaints (diminished consciousness, limitation of exercise capacity). Familial patterns of disease in these entities may also lend additional insight to diagnostic awareness.

Valvar pathology - Severe aortic or pulmonary stenosis may present in association with complaints of chest discomfort. Increased intraventricular end diastolic pressures and diminished coronary myocardial perfusion may result in ischemic injury. Valvar obstruction to this extent is commonly associated with additional complaints referable to the cardiovascular system (diminished consciousness, limited exercise capacity) and also is more likely to present during times of physical activity. Mitral valve prolapse has been linked to clinical complaints of chest pain though the etiology of the chest discomfort remains obscure. While also associated with other clinical cardiovascular complaints, mitral valve prolapse does not carry the same potential for clinical compromise as seen with severe aortic and pulmonary valve stenosis.

Rhythm disorders - Cardiac electrophysiologic pathology most often presents with complaints of subjective tachycardia or clinical cardiovascular compromise. Occasional complaints of chest discomfort as presenting complaint may occur.

Despite the low incidence of cardiac related chest pain in the pediatric/adolescent populations, awareness of the potential cardiac and non-cardiac pathologies that may be present is essential to adequately evaluate patients presenting with these complaints. As always, evaluation begins with a good history and physical exam. The history of the event (association to physical activity – subjective complaints – degree of clinical compromise – clinical appearance during the episode – duration and frequency of events - treatment and response) gives insight to associated complaints and the degree of physical activity being performed at the time the event occurred. The history must also include family history for extended family members in younger age ranges experiencing sudden death (including SIDS), syncope or cardiac pathology. Physical exam may direct further investigation particularly when pathology (cardiac or non-cardiac) is present. ECG and Chest X-Ray are commonly performed and may also direct further investigation or provide reassurance if normal. It is not uncommon (particularly in adult oriented Emergency Departments) to obtain cardiac enzymes, though given the low incidence of cardiac related chest pain, these labs provide physician reassurance more often than diagnostic confirmation of pathology. Evaluation to this degree usually defines / suggests the more obvious cardiac (valvar stenosis – cardiomyopathies) or non-cardiac pathologies.

The aspect of these evaluations that generates concern for physicians are patients in whom there is an inability to establish an unequivocal etiology for the chest pain, a not unusual occurrence as many episodes are associated with musculoskeletal etiology for which there is no definitive test. Further generating concern is the recognition that several of the cardiac pathologies that may cause chest pain can result in significant clinical cardiovascular compromise or sudden cardiac death and be difficult to diagnose (e.g. coronary artery pathology - myocarditis). For these reasons patients, especially those who have complaints associated with physical activity, associated cardiovascular signs or symptoms, suggestive family history or those that have no specific etiology established are not uncommonly referred for formal cardiac evaluation. Review of history, physical and ECG Good echocardiographic assessment (directed to assess specific potential causes of chest pain in this population) and exercise treadmill (if there is an association to physical activity) are usually sufficient to exclude most from consideration for cardiac pathology and establish the rare individual who does present with cardiac chest pain. Rarely are invasive evaluations (perfusion studies – cardiac catheterization) performed in the absence of specific delineation of cardiovascular pathology.

Most chest pain in the pediatric and adolescent patient is non cardiac

CHEST PAIN IN THE PEDIATRIC PATIENT

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Chest Pain

- Adolescent Chest Pain

Pantell et. al. (1983 Pediatrics 71(6) 881-887)

Prospective study - 100 pts

Idiopathic	39 %
Musculoskeletal	
Chest wall syndrome	13 %
Traumatic	2 %
Costochondritis	14 %
Ribcage anomaly	2 %
Hyperventilation	20 %
Others	
Breast related	5 %
Respiratory	2 %
Gastrointestinal	2 %
Mitral valve prolapse	1 %

Chest Pain

- Chest Pain in Children

Selbst (1985 Pediatrics 75(6):1068-70)

Prospective - 267 pts (2 - 19 years)

Idiopathic	28 %
Functional (anxiety)	17 %
Musculoskeletal	15 %
Costochondritis	10 %
Gastrointestinal	7 %
Cough / URI	6 %
Asthma	4 %
Trauma	4 %
Arrhythmia	3 %
Pneumonia	2 %
Other	4 %

Chest Pain

- Pediatric Chest Pain

Selbst et. al. (Pediatrics 1988 82(3): 319-323)

Prospective - 407 pts (2 - 19 yrs)

Idiopathic	21 %
Musculoskeletal	15 %
Cough	10 %
Costochondritis	9 %
Psychogenic	9 %
Asthma	7 %
Trauma	5 %
Pneumonia	4 %
Gastrointestinal	4 %
Cardiac	4 %
Sickle cell crisis	2 %
Miscellaneous	9 %

Young children - more likely to have cardiorespiratory problems

Older children (> 12 yrs) more likely psychogenic

- Chest Pain -
A Cardiology Problem?

- What were you afraid caused your pain?

Heart attack	44 %
Heart disease	12 %
Cancer	12 %
Don't know	23 %
Miscellaneous	9 %

Pantell '83

Chest Pain

- Two types

Cutaneous

Sharp or stabbing

Well localized

Provoked by stimulation to the same area

Visceral

Viscera is poorly innervated

More diffuse, dull or pressure like

Chest Pain Non-Cardiac

- Pulmonary
 - Pneumothorax
 - Reactive Airway Disease
- Gastrointestinal
 - GE Reflux
 - Hiatal hernia
- Musculoskeletal
 - Trauma
 - Muscle spasm
 - Costochondritis
- Psychological
 - Panic attacks / hyperventilation
 - Depression
 - Conversion disorder

Non Cardiac Chest Pain

- Chest Wall Pain

Traumatic injury

Intercostal neuralgia

Herpes zoster in prepubescent child (rare)

Tietze Syndrome (rare)

Painful swelling of anterior chest wall cartilage

Rx: reassurance, local heat, NSAID's

Costochondritis (common)

Pain and tenderness without swelling

Self limited

Non Cardiac Chest Pain

- **Chest Wall Pain**

Slipping rib syndrome

Pain at lower costal margin

Increased mobility at anterior end of costal cartilage

Painful click elicited with certain movements

Rx: avoid precipitating movements; analgesics

Trauma to rib cage

Pleuritic - point tenderness

Compression of anterior chest lateral chest wall pain
consistent with fracture →

Non Cardiac Chest Pain

- **Chest Wall Pain**

Muscle strain / tear

Excessive activity (e.g. weight lifting, coughing)

Precordial catch syndrome

Sharp pains ("stitches") in left anterior chest

Duration 30 seconds - 3 minutes

May be precipitated by position or movement (bending over)

Aggravated by deep breathing; relieved by shallow breaths

Benign

Non Cardiac Chest Pain

- **Systemic Diseases**

 - Sickle Cell Crisis

 - Chest wall

Non Cardiac Chest Pain

- **Pulmonary**

 - **Asthma**

 - Dyspnea

 - Muscle strain from coughing

 - Pneumothorax

 - **Inflammation of the Pleura**

 - Inspiratory pain with splinting and/or pleural friction rub

 - Usually follows URI or pneumonia

 - Bimodal course - pain may occur weeks after the acute process

 - **Pleural effusion**

 - Infection or malignancy

Non Cardiac Chest Pain

- **Pulmonary**

- Spontaneous Pneumothorax**

- Intense chest pain

- Diaphragmatic irritation**

- Radiates to shoulder or upper chest

- Consider subphrenic/hepatic abscess / cholecystitis

- Splenic infarct or splenic sequestration

- Pulmonary embolism**

- Fever, shortness of breath, chest pain

- +/- cyanosis

- Running cramp "stitch"**

- Caused by stress on the peritoneal ligaments

- (attached to abdominal viscera and diaphragm)

Non Cardiac Chest Pain

- **Gastrointestinal**

- Heartburn/reflux**

- Odynophagia (pain on swallowing)**

- Esophageal spasm**

- Esophagitis**

- Splenic flexure syndrome**

- Acute pancreatitis**

- Hiatal hernia**

Non Cardiac Chest Pain

- **Psychogenic**

10 - 30 % of all chest pain

Associated to stressful situations

death, separation, aggression or physical disability

frequently with family member having similar vague complaints

Hyperventillation syndrome

Childhood depression

Cardiac Chest Pain

- **Heightened concern**

Presyncope / Syncope

Association with physical exertion

Family history of sudden cardiac death

Prior cardiac surgery

diagnosis of cardiac disease

Cardiac Chest Pain

- **Syndromes**

Marfan - Aortic dilatation/rupture

Turner -

Freidreich ataxia - myocardial fibrosis / hypertrophy

Noonan

Multiple lentiginos - hypertropic Cardiomyopathy

Tuberous sclerosis - intracardiac tumors / LVOTO

- - Xanthomas/Hyperlipoproteinemia - early CAD

Cardiac Chest Pain

- **Pericardial effusion / inflammation**

Infectious - viral or bacterial

Autoimmune or Rheumatic

Post-traumatic

Post-pericardiotomy

Malignancy (rare)

Cardiac Chest Pain

- **Myocardium**
 - Acute myocarditis
 - Dilated cardiomyopathy
 - Hypertrophic cardiomyopathy
 - Myocardial infarction
 - Cocaine
 - Coronary artery anomalies
 - Anomalous origin
 - Coronary artery fistula
 - Ostial atresia / stenosis
 - Kawasaki's disease
 - Early coronary artery disease

Cardiac Chest Pain

- **Valves**
 - Severe aortic stenosis
 - Severe pulmonic stenosis
 - Mitral valve prolapse
- **Electrophysiology**
 - SVT
 - VT

Chest Pain
University of Florida
Cardiology Outpatient Clinic

- Referrals for Chest Pain (5/97 - 5/98)
 - 49 of 3370 patients (1.5 %)
 - Cardiac pathology: 2/49 (4 %)
 - Coronary anomaly - surgical repair
 - Pericardial effusion - surgical drainage

Chest Pain
Cardiac Etiology

- Myocardial infarction / ischemia
 - Kawasaki Disease
 - Coronary artery anomalies (congenital)
- Pericarditis/Pericardial effusion
- Myocarditis
- Mitral Valve Prolapse

Chest Pain

- History*
- Physical*
- Chest X-Ray
- Electrocardiogram
- Serologic testing
CPK / Troponin T
- Echocardiogram
- Exercise stress
- Perfusion study

Bibliography

- 1) The Science and Practice of Pediatric Cardiology, Garson A., Bricker JT, McNamara DG 1990
Lea & Febiger pp. 1947 – 50
- 2) Adolescent Chest Pain: A prospective Study, Pantell RH, Goodman BW, Pediatrics Vol 71, No 6
June 1983 pp 881 – 887
- 3) Chest Pain in Children, Selbst SM, Pediatrics Vol 75, No 6, June 1985 pp 1068 - 1070
- 4) Pediatric Chest Pain: A Prospective Study, Selbst SM, Ruddy RM, Clark BJ, Henretig FM,
Snatulli T, Pediatrics Vol 82, No 3 September 1988 pp 319 - 323