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ORIGINAL ARTICLE

Children with Chest Pain Visiting the Emergency Department

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Background: Chest pain is a common complaint in children visiting the emergency department (ED). True organic problems like cardiac disease are rare. We assess and analyze the etiology of chest pain among children visiting a pediatric ED in one medical center.

Methods: We retrospectively reviewed the medical records of children with chest pain who visited our ED between September 2002 and June 2005. Any case of trauma-associated chest pain was excluded from this study.

Results: A total of 103 patients (64 boys, 39 girls; mean age, 13 years; age range, 4–17 years) were enrolled into this study; 101 patients had chest radiograms (98.1%). Pneumonia was identified in five patients and pneumothorax in three. Eighty-seven patients had electrocardiogram study (84.5%) and four of them showed abnormalities. Additional diagnostic tests were performed in 64 patients (62.1%), including complete blood count analysis and echocardiography. Echocardiograms were performed in 15 (14.6%) patients. Six of them showed minor abnormality. Panendoscopy was done in six (5.8%) patients, and gastroesophageal reflux was found in three. Eleven (10.7%) patients were admitted to hospital because of pneumonia, pneumothorax or arrhythmia. Overall, idiopathic chest pain was the most common diagnosis (59.2%). Other associated disorders were pulmonary (24.3%), musculoskeletal (6.7%), gastrointestinal (5.8%), cardiac (2.0%) and miscellaneous (2.0%).

Conclusion: The most common cause of chest pain prompting a child to visit the ED is idiopathic chest pain. Careful physical examination can reveal important clues and save much unnecessary examinations.

1. Introduction

Chest pain causes widespread fear in adults because of the increased possibility for organic diagnoses such as ischemic heart disease. However, most chest pain in children is associated with benign or self-limited illness, such as costochondritis, muscle strain or lung infections.^{1–8} Genuine cardiac causes of chest pain in children are uncommon, but are potentially dangerous. We reviewed the medical

records of pediatric patients who presented with chest pain and who were evaluated in a pediatric emergency department (ED) during a 3-year period.

2. Methods

Between September 2002 and June 2005, children under the age of 18 years who presented to the ED of China Medical University Hospital with the chief

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complaint of chest pain were retrospectively reviewed by their medical records. Demographic data including age, sex, clinical presentation, chest radiographs, laboratory tests, electrocardiogram (ECG), echocardiography, and final diagnosis were sorted for assessment. Chest radiographs were reviewed by two radiologists. ECGs and echocardiograms were reviewed by a pediatric cardiologist. Diagnoses were grouped into idiopathic chest pain, respiratory origin, cardiac problem, gastrointestinal disorder, musculoskeletal pain and miscellaneous.

3. Results

We identified 103 children who visited our ED with the chief complaint of chest pain in the period of study. Their ages ranged from 4 to 17 years. Mean and median ages were both 13 years. There were 64 boys and 39 girls (1.64:1). None had psychogenic problem, cardiomyopathy, long QT syndrome, congenital heart disease or other congenital abnormalities. Seven (6.9%) patients reported a past history of asthma. Two patients had mental retardation. Sudden death had been experienced in one family only. Two patients reported some psychogenic problems in their family members.

3.1. Clinical presentation and physical examination

The duration of chest pain before visiting our ED had lasted between minutes to 2 days (mean, 17 hours). Ninety-one (88%) children suffered from chest pain for less than 6 hours. Associated symptoms occurred in less than half of these patients, including fever or respiratory symptoms (cough, dyspnea) in 34, gastrointestinal symptoms (epigastric pain, nausea, vomiting) in eight, dizziness in five and palpitation in three. Physical examination disclosed abnormalities in 48.5% of the patients. The most common finding was chest wall tenderness in 56 (54%) patients. Other positive findings were wheezing or crackle breathing sounds in 13 (13%) patients. Heart murmur was first noted in two patients.

3.2. Investigations

Chest radiographs were performed in 101 (98.1%) patients (Table 1). Abnormalities were found in 28 (27.7%) patients, including pulmonary infiltration (13), hyperinflation (7), pneumonia (5) and pneumothorax (3). Eighty-seven (84.5%) patients had ECG study, and four (4.6%) of them showed abnormalities, including first-degree atrioventricular (AV) block, Mobitz type 1 second-degree AV block, premature ventricular contraction and Wolff-Parkinson-White

Table 1 Investigation results in our patients

Examination or laboratory test	Total	Positive results, n (%)
Chest radiography	101	28 (27.7)
Electrocardiography	87	4 (5.0)
Echocardiography	15	7 (47)
Panendoscopy	6	3 (50)
Complete blood count	64	4 (6.3)
Creatine kinase MB	51	1 (2.0)

syndrome. Additional diagnostic tests were performed in 64 (62.1%) patients, which included complete blood count, creatine kinase (CK) MB isoenzyme, and C-reactive protein. Only five (7.8%) patients had positive findings. Four had leukocytosis and one had a high level of CK-MB (14.3U/L; normal range, 3–10U/L in our hospital), and the diagnosis of pneumonia was made in these patients. Echocardiograms were performed in 15 (14.6%) patients. No major anomaly was found; only six showed mitral valve prolapse. Six (5.8%) patients underwent panendoscopy because of epigastric pain. Gastroesophageal reflux was found in three (50%) patients and gastritis in the others.

3.3. Outcome and final diagnoses

The mean stay at our ED was 1.5 hours (15 minutes–6 hours). Chest pain regressed smoothly in 92 patients, and they were discharged. Eleven (10.7%) patients were hospitalized because of pneumonia (5), pneumothorax (3) or arrhythmia (3). The final diagnoses were idiopathic chest pain in 61 (59.2%) patients, pain of respiratory origin in 25 (24.3%), musculoskeletal chest pain in seven (6.7%), gastrointestinal disorders in six (5.8%), cardiac problems in two (2.0%), and other causes in two (2.0%) (Table 2). There was no repeat visit to our ED due to chest pain recurrence.

4. Discussion

Chest pain is a frequent symptom in children, prompting them to visit the ED.¹ According to previous studies, idiopathic cause is the most common diagnosis.^{1–6} Cardiac disease remains an uncommon cause for chest pain in children. However, this study shows relatively rare psychogenic causes for chest pain compared with previous studies.^{1–6} Almost half of our patients were older than 12 years of age, which was different from the series of Driscoll et al,² Selbst³ and Selbst et al.⁴

To ascribe a chest pain as idiopathic, we need to exclude both organic etiologies and psychological

Table 2 Final diagnoses in children with chest pain

Diagnoses	Patients, n (%)
Idiopathic	61 (59.2)
Respiratory	25 (24.3)
Bronchitis	11
Pneumonia	5
Asthma	1
Pneumothorax	3
Hyperventilation	5
Musculoskeletal	7 (6.7)
Costochondritis	1
Muscle strain	6
Gastrointestinal	6 (5.8)
Gastritis	3
Gastroesophageal reflux	3
Cardiac	2 (2.0)
Arrhythmia	2
Miscellaneous	2 (2.0)

factors contributing to the chest pain.⁴ In this study, 59.2% of patients were given a diagnosis of idiopathic chest pain, which is higher than in previous reports.¹⁻⁸ We think this may be due to the ED-based nature of our series.

Pulmonary origins of chest pain in our study included bronchitis, pneumonia, asthma, pneumothorax and hyperventilation. Such chest pain may be caused by severe cough, dyspnea or pleuritis. The three pneumothorax patients were all boys with a tall and thin build. Their chest pains were sharp, of sudden onset and followed by dyspnea. They were admitted for continual observation. One of them required chest tube drainage. Hyperventilation, headache and paresthesia were experienced by another five patients. They recovered smoothly with supportive treatment. Hyperventilation can cause hypocapnic alkalosis, muscle strain, stomach distention, spasm of the left hemidiaphragm or transient arrhythmia and, consequently, chest pain occurs.⁹⁻¹¹ Nevertheless, hyperventilation can be a manifestation of anxiety, stress or depression; thus, some authors group it as a psychiatric cause of chest pain.^{1,4}

Only 6.8% of chest pain in this study was due to musculoskeletal problems, including costochondritis and muscle strain, which is less than the reported rate of 15-64% in previous studies.¹⁻⁸ This result might be a consequence of our exclusion of all trauma-associated chest pain at case enrolment. Most cases of muscle strain are noticed by the patients after they have had intense sports activity; however, it may be difficult to distinguish muscle strain from trauma events retrospectively.¹²

The proportion of gastrointestinal problem-associated chest pain in this study was 5.8%, similar to previous reports,^{1,3,4,6,8} though to make a definite diagnosis of gastrointestinal problem may not be easy. First, chest pain or epigastric pain are usually confused by children. Second, endoscopic study to confirm the diagnosis is invasive and not acceptable for most children.¹³ In Sabri et al's series, they found that most children or adolescents suffering both chest pain and epigastric tenderness had some kind of gastrointestinal problem; 75% were cases of gastritis, 13.6% were duodenitis, 11.4% were gastroduodenitis and 11.4% were esophagitis and gastritis.¹³ Only six patients in our series underwent panendoscopy. Three proved to be gastritis, and three were found to have gastroesophageal reflux. These patients complained of chest pain for only 2 days, but they had been suffering from epigastric pain for more than 1 week.

Unlike adults, chest pain due to cardiac lesion is quite uncommon in children.¹⁻⁸ Many cardiovascular lesions can cause chest pain, such as myocardial ischemia, anatomic lesion, infection and arrhythmias.⁵⁻⁷ Myocardial ischemia is extremely rare in children, while some anatomic lesions like mitral valve prolapse, hypertrophic obstructive cardiomyopathy or dilated cardiomyopathy should be considered. Myocarditis or pericarditis usually present with other symptoms, such as fever, dyspnea, anxiety or fatigue. Furthermore, distant heart sounds or gallop rhythm can be heard by auscultation in myocarditis, while pericardial friction rub or distant heart sounds can be noted in pericarditis. Myocardial infarction in Kawasaki disease due to coronary arterial lesions can also result in chest pain, which usually occurs during the acute stage.¹⁴ However, for Kawasaki disease patients complicated with chronic coronary artery stenosis, chest pain can occur at any age, especially during exercise or stressful events.

Children with arrhythmias may be complaining of palpitations, and it should be documented by ECG. The relationship between mitral valve prolapse and chest pain is not clear, though some ischemic change of the papillary muscle or the left ventricular endocardium has been proposed.¹⁵ Nevertheless, the frequency of mitral valve prolapse was found to be no different between asymptomatic children and children with chest pain.¹⁶⁻¹⁹ Although we did recognize mitral valve prolapse in six patients by echocardiogram, their chest pains were not considered as a manifestation of mitral valve prolapse because their chest pains subsided smoothly simply by rest. Actually, we only identified two patients with chest pain of cardiovascular abnormality origin: one with Mobitz type 1 second-degree AV block and one with Wolff-Parkinson-White syndrome.

Two patients were grouped into "Miscellaneous". Both of them had been under some kind of stressful situation and showed a mood of depression or anxiety at their ED visit. However, we did not categorize them as having psychiatric disorders because they did not have follow-up evaluations at our psychiatric department. We believe that follow-up assessments by a psychiatrist for children with chest pain should be conducted, because many cases being categorized as "idiopathic" or "musculoskeletal" might be associated with some undiagnosed psychological disorders. Furthermore, hyperventilation-related chest pain could also be a manifestation of anxiety or hysteria.

Laboratory investigations including chest radiograph (101), ECG (87), blood analysis (64), echocardiogram (15) and panendoscopy (6) showed positive results at the rates of 27.7%, 4.6%, 7.8%, 47% and 50%, respectively. It seemed that echocardiogram and panendoscopy studies were frequently requested by ED physicians, and they turned out to have high positive predictive rates for abnormalities. On the contrary, ECG and blood analysis can be easily adopted as part of the screening process in the ED, so their positive predictive rates for abnormalities are quite low. Also, the positive predictive rate for chest radiographs (27.7%) sits in the middle of these two extremes, further illustrating the fact that pulmonary abnormalities are relatively easy to recognize during physical examination. Selbst et al suggested that chest radiographs and ECGs should not be screening tools unless indicated by findings from history-taking or physical examination.⁴ Rowe et al also indicated that routine hematologic screening was unrewarding in children with chest pain.⁸

This was a retrospective, single-hospital and ED-based study. Detailed patients' past history, family history and multidisciplinary evaluations may not be possible to obtain. Because we did not arrange urgent child psychiatric consultations at our ED, the psychiatric association with many patients' chest pain remains unknown. Most patients were lost to follow-up after they were discharged, except for those who were admitted. Further prospective study with well-designed questionnaires may be warranted.

Chest pain is a common complaint in children visiting the pediatric ED. In the absence of associated symptoms such as dyspnea, cold sweating, fatigue, excruciating chest pain or long-term upper abdominal pain, it is not likely to reflect a serious

underlying disorder. The most important evaluations are thorough history-taking and detailed physical examination. Laboratory tests are not efficient tools for screening.

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