Most frequent causes of chest pain in children and adolescents attending Assiut University Children Hospital

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Received 13 October 2019
Revised 19 October 2019
Accepted 14 November 2019
Published 16 May 2020

Journal of Current Medical Research and Practice
2020, 5:202–206

Purpose
Chest pain is common in children and adolescents and is a reason for referral to Pediatric Emergency Unit. Although most cases of chest pain in these age groups are benign and do not require treatment, timely diagnosis is important not to miss life-threatening diseases requiring prompt treatment. The authors investigated characteristics of frequent causes of chest pain in children and adolescents attending Assiut University Children Hospital.

Materials and methods
A total of 84 991 patients attending Assiut University Children Hospital between 1 January 2017 and 31 December 2017 were evaluated for presence of chest pain. All patients complaining of chest pain were studied for causes, clinical characteristics, precipitating factors of chest pain, and signs on physical examination.

Results
Overall, 400 patients presented with chest pain with an incidence of 0.4%. Most cases of chest pain were musculoskeletal in origin (42.2%), followed by cases with respiratory (17.2%), psychiatric (10%), cardiac (12.5%), gastrointestinal (8.7%), miscellaneous (8%), and idiopathic (1.2%).

Conclusion
Through this study, we would like to emphasize a careful diagnostic approach for chest pain. A careful history and physical examination must guide the assessment of children and adolescents presenting with chest pain.

Keywords:
adolescent, chest pain, child, musculoskeletal diseases

J Curr Med Res Pract 5:202–206

2357-0121

Introduction

Chest pain is a common symptom that results in visits to the Emergency Department or Outpatient Pediatric Clinics [1,2]. After cardiac murmurs, this is the second most common symptom that is referred to pediatric cardiologists. When chest pain occurs, family members become worried because of the fear of cardiac disease. However, serious illnesses such as severe coronary ischemia appear rarely in children and adolescents [3–5]. The main causes of chest pain are idiopathic and musculoskeletal diseases; therefore, most patients with chest pain do not require any special treatment [6–10]. Moreover, patients who show symptoms of chest pain may not need to undergo all available tests, including echocardiography. However, for patients with a serious disease that requires rapid diagnosis and treatment, failure to perform a timely diagnose may result in fatalities. Careful medical history, performance of relevant medical tests, and physical examination are required to diagnose such diseases. Here, we intended to study clinical characteristics that may be useful in the diagnosis of some critical diseases that may manifest as chest pain in children and adolescents.

Materials and methods

We studied patients within age group of 6–17 years attending Assiut University Children Hospital (AUCH) with chest pain from 1 January 2017 to 31 December 2017. Participants presented with chest pain comprised 400 children. The patients underwent systematic interviews, including the patients' medical history, age, sex, and family history, as well as the chest pain characteristics, symptom duration, and associated symptoms and signs. Laboratory tests, including chest radiography, ECG, echocardiography, blood examinations, and 24-h Holter monitoring, were performed as indicated. We categorized chest pain as 'musculoskeletal' origin when the patient had physical findings of chest wall tenderness, pain aggravated with inspiration, muscle strain or pain that is reproducible with movement, and tenderness on palpation. Chest pain of 'respiratory' origin was categorized based on chest radiography of lung lesion or chest pain secondary to acute onset of cough or asthma with

recent wheezing. When the chest pain was associated with indigestion, heartburn, and vomiting or when patients were diagnosed as gastroesophageal reflux or gastritis in gastroscopy, it was categorized as 'gastrointestinal.' We categorized chest pain as 'cardiac' origin in patients with congenital heart disease; they have a high susceptibility to complications such as infective endocarditis, arrhythmia or this may be related to pressure overload on ventricle, and chronic hypoxia, which decrease coronary microcirculation and oxygen delivery to cardiac muscle. Although patients with chest pain had cardiac disease, we categorized this group of patients as other causes such as 'idiopathic' or 'musculoskeletal' origin in cases that we thought the pain was not originated from cardiac diseases *per se*. Although laboratory findings including ECG, echocardiography, chest radiography, were normal in patients with cardiac diseases when they visited a pediatrician, we categorized these patients as 'cardiac' origin if we could not find other causes of chest pain. When there were clear emotional or psychological causes including school problems and family troubles such as parents' divorce without contributing to organic causes, it was categorized as 'psychogenic.' Patients without any organic etiology or any psychological factors were categorized as 'idiopathic.' This study was approved by Ethical Committee of Faculty of Medicine, Assiut University IRB no:17100818.

Results

Demographic data

During the period from 1 January 2017, till 31 December 2017, ~84 991 children visited the emergency department and the outpatient clinics in AUCH. There were 51 845 male and 33 146 female, with a ratio of 5: 3. Chest pain was the complaint of 400 children, with an incidence of 0.4%, with a male to female ratio of ~5: 3.5. There was no significant statistical difference between the incidence of chest pain in males and females who visited AUCH (X2 1.29P 0.288) (Table 1).

Causes of chest pain among studied cases

The percentages of the most frequent causes of chest pain encountered in the studied cases were musculoskeletal (42.2%), pulmonary (17.2%), psychological (10%), cardiac disease (12.5%), gastrointestinal (8.7%), miscellaneous (8%), and idiopathic (1.2%).

Characteristics of chest pain and associated symptom among studied cases (Figs. 1–4, Tables 2,3)

Table 1 Sex distribution among studied cases with chest pain

	Male [*n* (%)]	Female [*n* (%)]	Total [*n* (%)]
With chest pain	235 (0.45)	165 (0.49)	400 (0.4)
Without chest pain	51610 (0.995)	32981 (0.995)	84569 (0.996)
Total	51845 (–)	33146 (–)	84991 (100)

χ^2=1.29; *P*=0.288. *Significant difference at P<0.05. **Significant difference at *P*<0.01.

Discussion

In this descriptive study, we reported demographic and clinical characteristics, as well as causes of chest pain in children referred to our hospital. Chest pain was found in 400 patients of 84 991 children who attended AUCH with an incidence of 0.4%, with no significant difference between males and females.

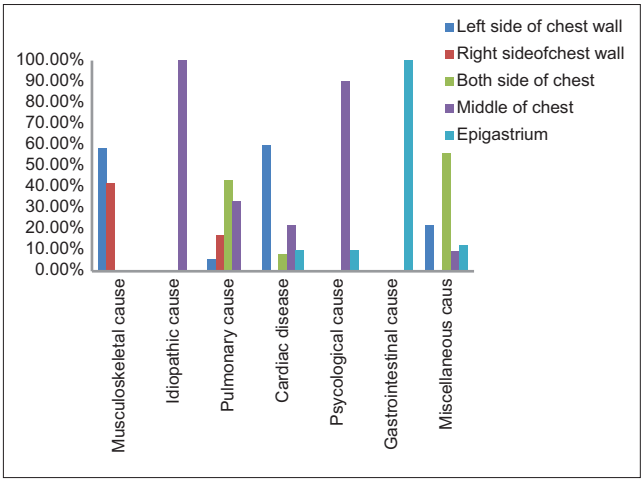
In this study, we would like to emphasize a careful diagnostic approach for chest pain. In this study, we suggest that careful history and physical examination may be enough to diagnose the causes of chest pain.

Musculoskeletal cause of chest pain in children in our study was the most frequent cause of chest pain and was encountered in 42.2%. This result is in agreement with Friedman and Alexander [11] and Sert *et al.* [12], who found that most frequent causes of chest pain in their study were musculoskeletal in 37.1 and 68%, respectively. The second cause of chest pain in our study was respiratory cause, in 17.2%. This result is in agreement with Chun *et al.* [7], who found that respiratory cause of chest pain in their study was encountered in 9.8% of cases, and it was the second most common cause of chest pain in their study.

The third cause of chest pain in our study was the cardiac cause 12.5%. Overall, 7.5% of the cases were previously diagnosed as cardiac disease, whereas new cases with cardiac disease was found in 5% of cases. This result disagrees with Friedman and Alexander [11], who reported in their study, cardiac causes of chest pain in 1.2%. Moreover, Sert *et al.* [12] reported that less common cause of chest pain in their study was cardiac cause of chest pain in only 0.3%, and Angoff *et al.* [13], who reported that less common cause of chest pain in their study was cardiac cause of chest pain in 0.2%. The high incidence of cardiac causes of chest pain in our study may be attributed to high prevalence of rheumatic heart disease in our country.

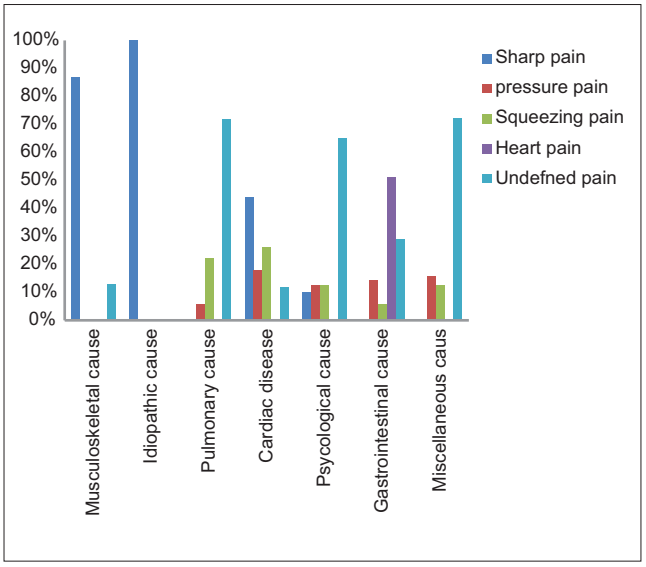
The fourth cause of chest pain in our study was owing to psychiatric disorders, as found in 10% of cases. This result is in agreement with Friedman and

Figure 1



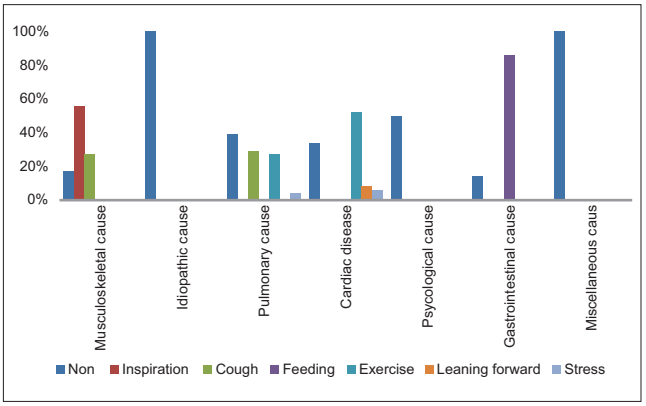
Site of chest pain among the studied cases.

Figure 2



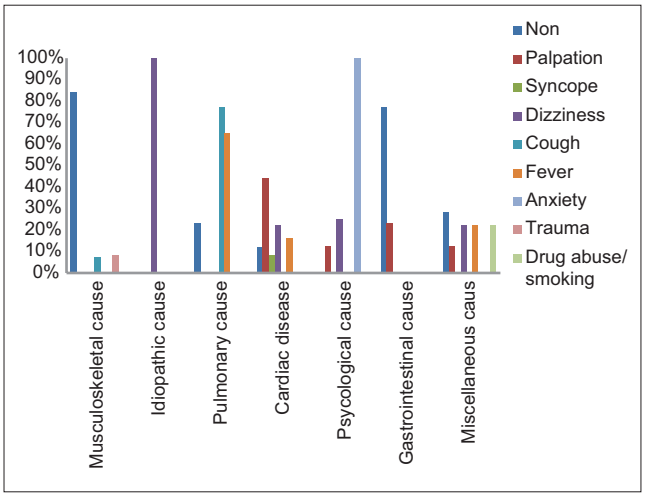
Description of chest pain among the studied cases.

Figure 3



Precipitating factor of chest pain among studied cases.

Figure 4



Associated symptom of chest pain among studied cases.

Alexander [11], who found that chest pain owing to psychiatric disorder was seen in 10% of cases.This is in agreement with Sert *et al.* [12], who reported that psychological cause of chest pain was found in 10.7% of total cases. The chest pain resulting from the gastrointestinal disorder occupies the fifth position among the different causes of chest pain by 8.7%.This is in agreement with Friedman and Alexander [11], who found that the fifth cause of chest pain in their study was gastrointestinal cause, seen in 3%.

Regarding the site of chest pain in our study, the most frequent site of chest pain was left side of chest wall in 35% of cases.This result is in agreement with Sert *et al.*[12] who found that most frequent location of chest pain was left side of chest wall in 59.2%. Regarding the description of chest pain in our study, sharp pain was the most frequent and was present in 178 (44.5%) patients. This is in agreement with Sert *et al.*[12] who found that sharp pain was the most frequent and was present in 70%. Moreover, Chun *et al.*[7] found that sharp pain was the most frequent and was present in 30% of the studied cases. In our study, no resolution of chest pain was reported in 52.2% of the patients. This disagrees with Sert *et al.* [12], who reported pain was relieved with rest in 49.2% and stayed without resolution in 38.7%.

Evaluation of precipitated factors was done in all our patients, where 33.7% of cases had no precipitated cause of chest pain, whereas 66.3% had exacerbation factors to pain. Overall, 23.7% of them had exacerbated pain with inspiration, 11.2% with exercise, 16.2% with cough, and 7.5% with feeding. Sert *et al.*[12] found no precipitating events in 7.6% of patients and reported that pain was exacerbated in 92% of cases; 78% of them had exacerbated pain with exercise, 18% of cases with anxiety, and 3% with eating. Moreover, Angoff *et al.*[13] reported that chest pain was described at

Table 2 Medical history, past history, and family history of studied cases with chest pain

	Musculoskeletal causes (42.2%) [*n* (%)]	Idiopathic cause (1.2%) [*n* (%)]	Pulmonary causes (17.2%) [*n* (%)]	Cardiac causes (11.5%) [*n* (%)]	Psychological causes (10%) [*n* (%)]	Gastrointestinal causes (8.7%) [*n* (%)]	Miscellaneous causes (8%) [*n* (%)]
Medical history of							
Cardiac disease	0	0	0	30 (60)	0	0	0
Asthma	0	0	27 (39)	0	0	0	0
Sickle cell disease	0	0	0	0	0	0	7 (22)
Bronchiectasis	0	0	4 (5.7)	0	0	0	0
Family history of							
Cardiac disease	4 (2.4)	0	2 (3)	10 (20)	4 (10)	4 (11)	0
Asthma	0	0	19 (28)	0	0	0	0
Sickle cell disease	0	0	0	0	0	0	6 (19)
Genetic disorders	0	0	0	2 (4)	0	0	0
History of							
Recurrent tonsillitis	0	0	0	15 (30)	0	0	0
Trauma	15 (8.8)	0	0	0	0	0	0
Drug intake	0	0	0	0	0	0	7 (22)
Lifting heavy object or after vigorous exercise	65 (38)	0	0	0	0	0	0
History exposure to allergen	0	0	10 (14.5)	0	0 (00)	0	0

Table 3 The clinical manifestations recording among the studied cases with chest pain

	Musculoskeletal causes [*n* (%)]	Idiopathic causes [*n* (%)]	Pulmonary causes [*n* (%)]	Cardiac causes [*n* (%)]	Psychological causes [*n* (%)]	Gastrointestinal causes [*n* (%)]	Miscellaneous causes [*n* (%)]
General examination							
No abnormality	73 (43)	5 (100)	65 (94)	45 (90)	31 (77.5)	27 (48.5)	17 (53)
Pallor	0	0	0	3 (6)	9 (22.5)	8 (22)	13 (40)
Tender chest wall	96 (57)	0	0	0	0	0	0
Cyanosis	0	0	4 (6)	0	0	0	2 (6)
Lower limb edema	0	0	0	5 (5)	0	0	0
Rash on body	0	0	0	0	0	2 (5)	4 (12)
Cardiac examination							
No abnormality	169 (100)	0	69 (100)	10 (2)	40 (100)	35 (100)	27 (84)
Murmur	0	0	0	39 (23)	0	0	2 (6)
Accentuated second heart sound	0	0	0	3 (6)	0	0	0
Gallop rhythm	0	0	0	1 (2)	0	0	3 (9)
Chest examination							
No abnormality	169 (100)	5 (100)	0	48 (96)	40 (100)	35 (100)	30 (7.50)
Adventitious sound	0	0	54 (78)	0	0	0	0
Decrease air entry	0	0	15 (22)	2 (4)	0	0	2 (6)

rest without precipitated factor in 51.3% and at peak exercise in 33.7% of patients. Regarding associated symptoms of chest pain in our study, chest pain with associated symptoms occurred in 210 (53%) patients. Cough, which appeared in 65 (31%) cases, was the most frequent associated symptom. Sert *et al.*[12] reported that palpitations were the most common associated symptom with chest pain in 30.5% of patients. No associated symptoms were reported in 23.6% of children. Chun *et al.*[7] reported that chest pain with associated symptoms occurred in 30% of cases. Cough, which appeared in 23.4% of cases, was the most frequent symptom. Moreover, Angoff *et al.*[13] reported that palpitations were the most frequent associated symptom with chest pain in 22.4%.

Regarding physical examination, in our study, general examination was done for all cases. Overall, 65.7% of cases had no abnormality, 24% of cases had tender chest wall, 1.5% of cases had cyanosis, and 1.2% of cases had lower limb edema. Cardiac examination was done for all cases, where 1% of cases had gallop rhythm, 10.7% of cases had murmur, whereas other cases had cardiac symptom-free examination. Chest examination was done for all patients, where 17.2% of the patients had abnormal chest finding.

Regarding investigation in our study, complete blood count was done for 22% of cases. Chest radiography was done for 56%, ECG was done for 76%, and echocardiogram was done for 34%. This is

in disagreement with Sert *et al.*[12] who investigated complete blood count, chest radiography, ECG, and echocardiogram for 100% of cases. Moreover, Freidman *et al.*[2] did ECG in all (100%) patients, echocardiography in 43% of patients, exercise stress testing in 28% of patients, and Holter monitoring in 7% of patients. Angoff *et al.*[13] performed ECG in 98.4% of cases in his study. Chest radiography were done for 8.5% of patients. Echocardiography was performed in 41.6% of patients, and Saleeb *et al.*[1] performed ECGs in all patients and echocardiography in 37.1% of patients in their study. In our study, among the patients who were diagnosed as having musculoskeletal cause of chest pain, myositis was found as the most frequent, whereas Sert *et al.*[12] found in their study reported costochondritis was the most frequent cause. Regarding pulmonary cause of chest pain, we found that asthma, pneumonia, pleural effusion, empyema, pulmonary embolism, and pneumothorax were the most frequent pulmonary causes of chest pain. This is in agreement with Friedman and Alexander[11] who found in their study that causes of chest pain owing to pulmonary cause were asthma, pneumonia, bronchitis, pleuritis, pulmonary embolism, and pneumothorax.

Among the patients who were diagnosed as having cardiac cause of chest pain, we found rheumatic heart disease, cardiomyopathy, postoperative closure of anatomical defect, and pericardial effusion were the most frequent cardiac cause of chest pain. This is in agreement with Saleeb *et al*. [1], who found that causes of chest pain owing to cardiac cause were pericarditis, myocarditis, anomalous right coronary artery, hypertrophic cardiomyopathy, dilated cardiomyopathy, supraventricular tachycardia, ectopic atrial tachycardia, nonsustained ventricular tachycardia, and cardioinhibitory syncope.

Conclusion

In conclusion, although most chest pain cases in the pediatric and adolescent patients were benign, we found that it is important not to miss certain critical underlying diseases in such patients. Chest pain is a common referral complaint in children. In this study, the most common etiologies of chest pain in children were musculoskeletal disorders, followed by respiratory problems, cardiac problems, psychiatric problems, gastrointestinal problems, miscellaneous, and idiopathic. Although a pediatric cardiology referral may provide reassurance to the primary care and emergency department physicians, our results show that cardiac causes of chest pain are rare in children. Our results suggest that many patients in this study could have been adequately evaluated using careful history and physical examination.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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