



Chest Pain in the Pediatric Emergency Department: Evaluation of Clinical and Laboratory Findings of Patients

Çocuk Acil Serviste Göğüs Ağrılı Çocuk Hastaların Klinik ve Laboratuvar Bulgularının Değerlendirilmesi

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ABSTRACT

Aim: Chest pain is a very common complaint in children and adolescents, and it is one of the common reasons for applying to the pediatric emergency department. Determining the etiological causes of chest pain in childhood is necessary to apply the right treatment and relieve the family and child's concerns. This study was planned to retrospectively examine the clinical and laboratory findings of children admitted to the pediatric emergency department with chest pain, evaluate the etiological causes, and investigate the pathological findings detected in cases with a cardiac cause.

Material and Method: The study included pediatric patients aged <18 who presented to the pediatric emergency department with chest pain between January 2019 and January 2022. Patient files were reviewed retrospectively, and age, gender, time of admission and season, symptoms at presentation, physical examination findings, chest X-ray findings, electrocardiography and echocardiography findings, laboratory findings, final diagnosis, hospitalization, and duration were recorded.

Results: Two hundred and forty-eight patients were included in the study, 119 (48%) of whom were male, while 129 (52%) were female. The median age was 14 years (IQR: 10–16). Mostly musculoskeletal, respiratory, and idiopathic causes were identified in the etiology of chest pain. In the cases with a cardiac cause, it was observed that chest pain was accompanied by symptoms such as palpitation and syncope, and pathological physical examination and ECG findings were more common.

Conclusion: Chest pain is one of the most common reasons for referral to the pediatric emergency department. In contrast to adults, chest pain of cardiac origin is extremely rare in childhood, and the cause of chest pain is usually benign. While evaluating patients who present to the pediatric emergency department with chest pain, a detailed anamnesis, and comprehensive physical examination should provide guidance, and detailed tests should be performed in necessary cases.

Keywords: children; chest pain; pediatric emergency department

ÖZET

Amaç: Göğüs ağrısı çocuk ve adolesanlarda oldukça çok görülen bir şikâyet olup, çocuk acil servise sık başvuru nedenlerinden biridir. Çocukluk çağında görülen göğüs ağrıının etiyolojik nedenlerinin belirlenmesi hem doğru tedavinin uygulanması için hem de ailenin ve çocuğun endişelerini gidermek için gereklidir. Çalışmamızda çocuk acil servise göğüs ağrısı nedeniyle başvuran çocukların klinik ve laboratuvar bulguları geriye dönük olarak incelenerek etiyolojik nedenlerin değerlendirilmesi ve kardiyak neden düşünülen olgularda tespit edilen patolojik bulguların araştırılması planlanmıştır.

Materyal ve Metot: Çalışmaya Ocak 2019 – Ocak 2022 tarihleri arasında, yaşları <18 yaş olan, çocuk acil servise göğüs ağrısı nedeni ile başvuran çocuk hastalar dahil edildi. Hasta dosyaları geriye dönük olarak incelenerek; yaş, cinsiyet, başvuru saati ve mevsim, başvuru semptomları, fizik muayene bulguları, akciğer grafisi bulgusu, elektrokardiyografi bulgusu, ekokardiyografi bulgusu, laboratuvar bulguları, son tanı, hastaneye yatış ve süresi kayıt edildi.

Bulgular: Çalışmaya dahil edilen 248 hastanın, 119 (%48)'u erkek, 129 (%52)'u kız cinsiyette ve yaş ortancası 14 (IQR: 10–16) saptandı. Göğüs ağrısının etiyolojisinde sırasıyla en çok kas-iskelet sistemi kaynaklı, solunum sistemi kaynaklı ve idiyopatik nedenler bulundu. Kardiyak neden saptanan olgularda ise; göğüs ağrısına çarpıntı, senkop gibi semptomların eşlik ettiği ve patolojik fizik muayene ve ekg bulgularının daha çok saptandığı görüldü.

Sonuç: Göğüs ağrıları çocuk acil servise sık başvuru nedenlerinden biridir. Erişkinlerin aksine, çocukluk çağında kardiyak kökenli göğüs ağrıları oldukça nadirdir ve göğüs ağrısının nedeni çoğunlukla iyi huyludur. Çocuk acil servise göğüs ağrısı ile başvuran hastaları değerlendirirken; ayrıntılı anamnez ve kapsamlı fizik muayene yol gösterici olmalı ve gereken olgulara ayrıntılı tetkikler yapılmalıdır.

Anahtar Kelimeler: çocuk; göğüs ağrısı; çocuk acil

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Introduction

Chest pain is a very common complaint in children and adolescents, and it is one of the common reasons for applying to the pediatric emergency department. Although the etiological cause is not cardiac in most cases, the pain is important because it may cause absenteeism from school, limitations in sports activities, and high anxiety for the family and the child¹⁻³. Studies have shown that chest pain in children is mostly due to idiopathic, musculoskeletal, gastrointestinal, respiratory, or psychogenic causes^{3,4}. Chest pain is usually associated with angina pectoris and myocardial infarction in adult patients. In childhood, cardiac chest pain is extremely rare, reported at rates ranging from 0% to 10% among all causes of chest pain^{5,6}. Therefore, detailed history and physical examination usually identify the cause of the chest pain and patients requiring acute intervention, and diagnostic testing is needed in very few cases. On the other hand, heart diseases, which can cause chest pain in children, can also cause sudden death^{2,7,8}. Therefore, chest pain in children should be taken seriously, and its differential diagnosis should be performed accurately. Especially in recent years, sudden cardiac death in athletes and adolescents has increased the interest in this subject⁹.

Determining the etiological causes of chest pain in childhood is necessary to apply the right treatment and relieve the family and child's concerns. Therefore, this study was planned to retrospectively examine the clinical and laboratory findings of children who presented to the pediatric emergency department with chest pain, evaluate the etiological causes, and explore the pathological findings detected in cases with a cardiac cause.

Materials and Methods

The study included pediatric patients <18 years who presented to the pediatric emergency department with chest pain between January 2019 and January 2022. Patients with known cardiac pathology taking medication or with a recent history of cardiac surgery were excluded from the study. Patient files were reviewed retrospectively, and age, gender, time of admission and season, symptoms at presentation, physical examination findings, chest X-ray findings, electrocardiography (ECG) and echocardiography (ECHO) findings, laboratory findings, final diagnosis, hospitalization, and duration were recorded. The patients' final diagnoses were divided into groups idiopathic, musculoskeletal, respiratory, gastrointestinal, cardiac, and psychogenic. Before the study, approval was obtained from

the ethics committee of Bakırçay University (Decision no. 569, Research no: 549, Date: 20/04/2022).

IBM Statistical Package for Social Sciences (SPSS) program version 24.0 was used to evaluate the data. All data were calculated as mean or median and percentage (%). The differences between categorical variables were assessed using the chi-square test. Values of $p < 0.05$ were considered statistically significant.

Results

Two hundred and forty-eight patients were included in the study, 119 (48%) of whom were male, while 129 (52%) were female. The median age was 14 years (IQR: 10–16), and 68.1% (n: 169) of the patients were over 12 years of age. Considering the hours of admission to the pediatric emergency service, it was seen that 71.8% (n: 178) of the patients presented during daytime hours. When the seasonal distribution was examined, it was observed that 48% (n: 119) was shown in autumn, with the order of seasonal frequency being autumn, winter, summer, and spring. Of these patients, 69% presented with chest pain only, and chest pain was accompanied mainly by palpitation (n: 70, 28.2%). Pathological physical examination findings were present in 27.8% (n: 69) cases. The most common findings were upper respiratory tract infection (nasal congestion, watery eyes, postnasal discharge, etc.), tachycardia, and lower respiratory tract infection (tachypnea, rales, rhonchi, etc.) at 10.5%, 6%, and 5.6%, respectively. Only one patient showed signs of cardiopulmonary failure. Chest X-rays were taken for 236 patients, and ECG was performed for all of them. As a result, 76.2% (n: 189) of the chest X-rays were normal, consolidation was found in 16.9% (n: 42) of cases, and pneumothorax was found in 2% (n: 5). When the ECG findings were examined, normal sinus rhythm was observed in 94.4% (n: 234) of cases. Supraventricular tachycardia was found in 6 patients (2.4%), sinus tachycardia in 5 patients (2%), ventricular tachycardia in 2 patients (0.8%), and right bundle branch block in 1 patient (0.4%). Thirty-eight patients consulted with pediatric cardiology and, in the echocardiographic evaluations, abnormal findings were identified in 11 cases, with mitral valve prolapse (MVP), patent foramen ovale (PFO), tricuspid regurgitation (TR), and mitral regurgitation (MR) being most common. The patients' laboratory findings and final diagnoses are shown in Tables 1 and 2. Sixteen patients (6.5%) were hospitalized in the pediatric service and 1 (0.4%) in the intensive care unit. The median length of hospital stay was five days (IQR: 2.25–6).

Table 1. Laboratory and imaging findings of patients with chest pain

Diagnostic test	Results
Leukocyte count (white blood cells) ($10^3/\mu\text{L}$)	Normal (n: 128, 51.6%) Leukocytosis (n: 44, 17.7%) Not measured (n: 76, 30.6%)
Neutrophil count ($10^3/\mu\text{L}$)	Mean: 5158 \pm 2360 Min: 1500 Max: 15300
Lymphocyte count ($10^3/\mu\text{L}$)	Mean: 2651 \pm 996 Min: 400 Max: 6100
C-reactive protein (CRP) (mg/dL)	Normal (n: 145, 58.5%) High (n: 15, 6%) Not measured (n: 88, 35.5%)
Troponin T (ng/mL)	Normal (n: 187, 75.4%) High (n: 9, 3.6%) Not measured (n: 52, 21%)
Chest X-ray	Normal (n: 189, 76.2%) Consolidation (n: 42, 16.9%) Pneumothorax (n: 5, 2%) Not performed (n: 12, 4.8%)
Electrocardiography (ECG)	Normal sinus rhythm (n: 234, 94.4%) Sinus tachycardia (n: 5, 2%) Supraventricular tachycardia (n: 6, 2.4%) Ventricular tachycardia (n: 2, 0.8%) Bundle branch block (n: 1, 0.4%)
Echocardiography (ECHO)	Normal (n: 27, 10.9%) Abnormal (n: 11, 4.4%) Not performed (n: 210, 84.7%)

The clinical and laboratory findings of the cases with cardiac causes (n: 19) and those with noncardiac causes (n: 229) were compared. No statistically significant difference was found between the two groups in age, gender, time of admission to the pediatric emergency department, or seasonal distribution ($p>0.05$). When presenting symptoms were considered, chest pain was mostly accompanied by palpitations or syncope in patients with a cardiac cause (73.6%, n: 14), and this finding was statistically significant ($p<0.001$). When the physical examination findings were reviewed, in 13 (68.4%) cardiac cases, positive findings such as tachycardia, high blood pressure, and circulatory disorder were seen, and these were statistically significant ($p<0.001$). Troponin elevation was present in 8 (42%) of the cases with a cardiac cause, which was statistically significant ($p<0.001$). Considering the ECG and ECHO findings, a statistically significant difference was found between cases with cardiac and noncardiac causes (63.1% positive ECG findings, 26.3% positive ECHO findings; $p<0.001$).

Table 2. Etiological classification of patients with chest pain

Diagnosis	n	Percent (%)
Musculoskeletal system	74	29.8
Respiratory system	71	28.6
Idiopathic	53	21.4
Psychogenic	23	9.3
Cardiac	19	7.7
Gastrointestinal system	8	3.2

Discussion

In our study, patients who presented to the pediatric emergency department with chest pain were examined, and two main results were obtained. First, mostly musculoskeletal, respiratory, and idiopathic causes were identified in the etiology of chest pain. Second, in cardiac causes, chest pain was accompanied by symptoms such as palpitation and syncope, and pathological physical examination and ECG findings were more common.

Pediatric chest pain is more common in girls and children over 12 during puberty^{10,11}. In our study, there was no difference in terms of gender, but by the literature, the majority of our patients were found to be above 12 years of age. Studies have shown that chest pain is more common in pubertal children¹⁰. In our study, the included patients were mostly in the pubertal period among boys and girls. This finding may also indicate why chest pain of psychogenic origin is common in children. The absence of gender differences is thought to be due to sociocultural differences in the patient population. Considering the seasonal distribution in our study, it was seen that patients presented to the pediatric emergency department most often in autumn, winter, summer, and spring in order of frequency. Aygun¹² et al., in their study of patients who presented to a pediatric cardiology outpatient clinic with chest pain, found that the adolescent age group presented significantly more often in winter and autumn months. Doğan¹³ et al., in their study of children with chest pain in a pediatric emergency department, found that the most frequent admissions were in the winter and spring months. The data of our study were found to be compatible with the literature. The fact that admission is widespread in autumn and winter suggests that it may be related to increased stress and anxiety with the school.

A good anamnesis and detailed physical examination are basic steps in managing children and adolescents presenting with chest pain in determining the etiology¹⁴. The character and duration of the pain, its relationship with effort and food, other accompanying symptoms, and trauma history should all be considered. In physical examination, vital signs should be evaluated, the chest skin tissue and presence of tenderness should be carefully examined, the lungs and heart should be carefully auscultated, and a detailed circulatory examination should be performed^{15,16}. Auxiliary examinations such as chest X-rays, ECG, and ECHO should be performed to exclude other possible causes. The physical examination is expected to yield abnormal results if a serious organic cause may lead to underlying chest pain^{17,18}. In our study, it was observed that chest pain of cardiac origin was accompanied by palpitations or syncope in 73.6% of the cases, and pathological physical examination findings were found in 68.4% of the cases. However, when the literature is reviewed, it is seen that physical examinations generally yielded normal results in approximately 2/3 of the patients with coronary artery anomalies. Various algorithms have been developed to evaluate children presenting with chest pain and limit the use of invasive tests. If the history, physical examination, and ECG results suggest a possible cardiac etiology, ECHO evaluation is recommended^{19,20}. In our study, ECHO was performed for 15.3% of the patients who presented with chest pain, and pathological findings were found in 28.9% of those ECHO results. For chest pain of cardiac origin, 63% positive ECG and 26.3% positive ECHO findings were detected. These findings show that invasive examinations should be performed in necessary cases after a detailed anamnesis and physical examination.

The most common etiological causes of chest pain in children are idiopathic, musculoskeletal system diseases, psychological causes, respiratory pathologies, and cardiac and gastrointestinal system-related causes^{6,7,10}. Studies have shown that the incidence of cardiac causes in pediatric patients with chest pain is 0–10%^{5,6}. In our study, musculoskeletal system diseases, respiratory system pathologies, and idiopathic causes were seen most frequently, respectively. Cardiac causes were seen at a rate of 7.7%, consistent with the literature. Chest pain caused by the musculoskeletal system is the most common type of chest pain, with an identifiable cause among children. It is detected in 31% of patients complaining of chest pain and is, therefore, the most common specific diagnosis for chest pain in children^{1,2,21}. A history

of strenuous exercise, chest wall tenderness on physical examination, and changes in pain intensity with breathing are helpful in most cases. When we look at the literature, contrary to the studies of Khairandish²² et al. and Lin²³ et al. (musculoskeletal causes at rates of 7.7% and 6.7%, respectively), chest pain caused by the musculoskeletal system generally constitutes nearly half of all cases²⁰. Aygun¹² et al. found that 33% of cases of chest pain originated from the musculoskeletal system. In our study, the most common cause of chest pain was musculoskeletal, identified for 29.8% of the patients who presented with chest pain, and this is consistent with the literature. This finding reflects the necessity of a good anamnesis and a careful physical examination for a correct diagnosis.

Respiratory diseases, including pneumonia and asthma, are common causes of acute pediatric chest pain. These patients usually have a fever, cough, and tachypnea. In addition, there may be crackles and tubular breath sounds on lung examination. Less commonly, chest pain may result from pleuritis, pleural effusion, and pneumothorax. If abnormal respiratory sounds are detected in the physical examination, chest X-rays should be taken, necessary interventions should be performed, and treatment should be started^{24,25}. The incidence of chest pain originating from the respiratory system ranges from 3% to 12%². Lin²³ et al., in their study of 103 patients in an emergency department, found chest pain originating from the respiratory system at a rate of 24.3%, while Doğan¹³ et al. found a rate of 9.1%. In our study, pathologies of the respiratory system were detected at a rate of 28.6%, and the most common observations were pneumonia, asthma, and pneumothorax, respectively. In 21–45% of pediatric and adolescent patients, no cause can be found to explain the chest pain, and these cases are considered idiopathic chest pain. Before diagnosing idiopathic chest pain, a detailed anamnesis should be taken, a physical examination should be performed, and possible organic causes should be excluded by performing the necessary tests^{2,6,9}. Idiopathic chest pains are chronic, recur frequently, and resolve spontaneously. These chest pains are not affected by breathing or position. In a study of 31 children with idiopathic chest pain followed for an average of 4 years, it was observed that chest pain recurred in 45% of cases and wholly regressed in 81% of cases²⁶. Aygun¹² et al. found idiopathic chest pain at a rate of 11.6% among their cases, while Lin²³ et al. reported 59.2% and Doğan¹³ et al. reported 57.9%. In our study, idiopathic chest pain was

found at a rate of 21.4%, consistent with the literature. The variable data in the literature may be due to the different patient populations presenting to pediatric emergency departments.

Chest pain of cardiac origin is extremely rare in children, unlike adults. While myocardial infarction is most common in adults, many factors can cause cardiac chest pain in children. The most common causes are coronary artery of abnormal origin, Kawasaki disease, left ventricular outflow tract obstruction, tachyarrhythmias, myocarditis, pericarditis, and MVP²⁷. Studies show that rates of chest pain of cardiac origin vary in the range of 0–10%^{5,6}. Saleeb⁹ et al., in a cohort study with 3700 patients, found cardiac chest pain at a rate of 1%. Chon²⁰ et al., in their study with 203 patients in a pediatric cardiology clinic, found the rate of chest pain of cardiac origin to be 2.5%, and they reported that the main cardiac causes were pericarditis, myocarditis, and MVP. Friedman¹⁴ et al. identified pericarditis and arrhythmia as the main cardiac causes, while Drossner¹⁸ et al. identified arrhythmia, myocarditis, and pericarditis. Viral myocarditis is associated with chest pain in children, but other symptoms are also often present, such as fever, respiratory distress, malaise, tachycardia, and poor circulation. Arrhythmias may present as chest pain. Chest pain can result from changes in cardiac output. In children with arrhythmias, palpitations are often seen together with chest pain^{27,28}. In our study, 19 (7.7%) cases of chest pain of cardiac origin were detected, and 11 of the cases were evaluated as myocarditis, while 8 were arrhythmia. These findings are compatible with the literature. In childhood chest pain, the frequency and type of cardiac disease vary according to the center and methodology of the study.

There are some limitations of our study. First of all, it was a retrospective, single-center study. It was thus not possible to obtain detailed patient history, family history, or multidisciplinary evaluations. In addition, the majority of patients were excluded from follow-up after discharge. Therefore, prospective and multicenter studies are needed to provide more detailed results.

Conclusion

In conclusion, chest pain is one of the most common reasons for referral to the pediatric emergency department. In contrast to adults, chest pain of cardiac origin is extremely rare in childhood, and the causes of chest pain are mostly benign. While evaluating patients who present to the pediatric emergency department with

chest pain, a detailed anamnesis, and comprehensive physical examination should provide guidance, and detailed tests should be performed in necessary cases.

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