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Clinical Characteristics of Children and Adolescents Admitted with Chest Pain

Göğüs Ağrısı ile Başvuran Çocuk ve Ergenlerin Klinik Özellikleri

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Abstract

Aim: Chest pain is a common symptom in children. Chest pain is the second most common symptom referred to by paediatric cardiologists after cardiac murmurs. In this prospective study, we aimed to evaluate clinical characteristics and causes of chest pain in children admitted to our paediatric cardiology outpatient clinics.

Material and Method: We conducted this prospective study among 446 patients with chest pain in a tertiary care hospital from 1 June 2017 to 1 June 2020. The demographic data and clinical characteristics of the patients were analysed. All patients were evaluated with a medical history, physical examination, laboratory tests, electrocardiogram and echocardiogram and if necessary telecardiogram, 24-hour electrocardiogram monitoring, exercise stress test and psychological evaluation were made.

Results: The ratio of admissions with acute chest pain was 4% when 20% of the patients had chronic chest pain. The most common symptoms associated with chest pain were shortness of breath and palpitations. The non-cardiac causes were as follows: 25% musculoskeletal, 14% psychological, 9% respiratory, and 7% gastrointestinal, respectively. We found cardiac chest pain in 49 (11%) of patients. Idiopathic chest pain was found in 153 (34%) patients.

Conclusions: Our study showed that the aetiology of chest pain in children and adolescents admitted with chest pain is mostly due to non-cardiac causes. We found the slightly frequency of elevated rate for cardiac aetiologies of paediatric chest pain compared to the literature. We suggest that in addition to anamnesis and careful examination, further investigation, if necessary, is important in determining the aetiology of chest pain.

Keywords: Adolescent, aetiology, child, chest pain, echocardiogram

Öz

Amaç: Göğüs ağrısı çocuklarda sık görülen bir semptomdur. Göğüs ağrısı, pediatrik kardiyologlar tarafından kardiyak üfürümlerden sonra en sık belirtilen ikinci semptomdur. Bu prospektif çalışmada, çocuk kardiyoloji polikliniğimize başvuran çocuklarda göğüs ağrısının klinik özelliklerini ve nedenlerini değerlendirmeyi amaçladık.

Gereç ve Yöntem: Bu prospektif çalışmayı 1 Haziran 2017 - 1 Haziran 2020 tarihleri arasında üçüncü basamak bir hastanede göğüs ağrısı olan 446 hasta arasında gerçekleştirdik. Hastaların demografik verileri ve klinik özellikleri analiz edildi. Tüm hastalar anamnez, fizik muayene, laboratuvar testleri, elektrokardiyogram ve ekokardiyogram ile değerlendirildi ve gerekirse telekardiyogram, 24 saatlik holter elektrokardiyogram monitorizasyonu, egzersiz stres testi ve psikolojik değerlendirme yapıldı.

Bulgular: Akut göğüs ağrısı ile başvuru oranı %4 iken hastaların %20'sinde kronik göğüs ağrısı vardı. Göğüs ağrısı ile ilişkili en yaygın semptomlar nefes darlığı ve çarpıntı idi. Kalp dışı nedenler %25 kas-iskelet, %14 psikolojik, %9 solunum ve %7 gastrointestinal idi. Hastaların 49'unda (%11) kardiyak nedenli göğüs ağrısı bulduk. Yüz elli üç (%34) hastada idiyopatik göğüs ağrısı saptandı.

Sonuç: Çalışmamız göğüs ağrısı ile başvuran çocuk ve ergenlerde göğüs ağrısı etiyolojisinin daha çok kalp dışı nedenlere bağlı olduğunu göstermiştir. Literatüre kıyasla pediatrik göğüs ağrısının kardiyak etiyolojileri daha yüksek oranda bulduk. Göğüs ağrısı etiyolojisinin belirlenmesinde anamnez ve dikkatli muayeneye ek olarak gerekirse ileri tetkiklerin önemli olduğunu düşünüyoruz.

Anahtar Kelimeler: Adölesan, çocuk, ekokardiyogram, etiyoloji, göğüs ağrısı

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INTRODUCTION

Chest pain is a common symptoms in children. Chest pain is the second most common symptom referred to by paediatric cardiologists after cardiac murmurs.[1] It may be benign and non-cardiac reasons. In many cases, relatives become concerned due to the fear of cardiac disease. In spite of the fact that the number of severe cardiac conditions reported in childhood is relatively small, determining the aetiology of chronic or benign chest pain and convincing the family that the state is not life-threatening can sometimes take a long time. [1] Idiopathic and musculoskeletal causes of childhood chest pain are most commonly reported and do not require further investigation.[2] However, a meticulous physical examination and anamnesis are essential to rule out severe cardiac diseases. Although there were large sample retrospective studies about chest pain in children. [3] the number of prospective studies with a large cohort is limited in the literature.[4] There has yet no study in the literature comparing the characteristics and causes of chest pain in children and adolescence by gender. This study is also one of the most comprehensive prospective studies evaluating chest pain features in children and adolescents. In this prospective study, we aimed to evaluate clinical characteristics and causes of chest pain in children admitted to our paediatric cardiology outpatient clinics and to compare the results according to gender.

METHOD AND MATERIAL

Study Population

The present study was conducted prospectively between June 2017 and June 2020 in the Department of Paediatric Cardiology. There were approximately 10000 patients who visited the paediatrics department during the study period. 500 patients who applied to the pediatric cardiology outpatient clinic with complaints of chest pain were evaluated. The study included 446 outpatients who met the eligibility criteria. Children between the ages of 6 and 18, patients complaining of chest pain and patients with parental consent were included in the study. To evaluate whether there were differences in chest pain characteristics between age groups, patients were divided into three groups: 6-11 years old, 11-15 years old and 15-18 years old. Clinically unstable patients who presented to the emergency department and patients under 6 years of age who unable to describe the characteristics of chest pain were excluded from the study. The data of the patients who applied with the complaint of chest pain were recorded in the patient evaluation form prepared by us. Records of patients' complaints, physical examination findings, and personal and family histories were kept. All patients underwent an electrocardiogram and if necessary echocardiogram examination was performed. Haemogram, biochemistry, thyroid function tests, acute phase reactants, fasting lipid profile were also examined in patients with necessary indications. Cardiac enzyme levels were measured in patients with suspected heart-related chest pain based on anamnesis and physical examination. In the presence of abnormal anamnesis or family history, pathological physical examination, and electrocardiogram findings suggestive of cardiac pathology, telecardiogram was taken. 24-hour electrocardiogram monitoring was applied to patients with chest pain accompanied by palpitations and rhythm abnormalities. An exercise stress test was performed in patients with exertional chest pain that was not explained by other respiratory causes.

Test Interpretation

Electrocardiogram interpretation was based on documented findings in the paediatric cardiologist's clinic note. Echocardiogram and exercise stress test results were obtained from reports generated at the time of the study. Diagnoses that were considered potential cardiac causes of chest pain included coronary artery anomalies, cardiomyopathies, myocarditis, pericarditis, pulmonary hypertension, mitral valve prolapses with moderate-severe mitral regurgitation, aortic dissection, arrhythmia, and moderate or greater left ventricular outflow tract obstruction. Findings considered to be positive on the exercise stress test included ST-segment or T-wave changes concerning ischaemia or tachyarrhythmia. Arrhythmias on 24-hour electrocardiogram monitoring were considered to be positive findings.

Causes of chest pain were categorised mainly as cardiac-related causes and non-cardiac-related causes – musculoskeletal, respiratory, psychological, gastrointestinal, and miscellaneous disorders and idiopathic chest pain – as previously reported by Selbst (21). Chest pain lasting for 2 days or less was considered acute, intermittent chest pain for more than 6 months was considered chronic, 2 days to 6 months were subacute, and persistent for a long time was persistent chest pain.

Ethical approval was obtained for the study from the Local Ethics Committee on 17.01.2018 with the protocol number 2018/29. The recommendations of the Declaration of Helsinki for biomedical research involving human subjects were followed.

Statistical Analysis

Data were analyzed using tam SPSS 20.0 (SPSS Inc., Chicago, Illinois, USA). The data obtained by measurement were shown as mean ± standard deviation, data obtained by counting (%) and (n) in cases with normal distribution. Relationships between categorical variables according to age groups and gender were tested with the chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 244 (54%) of the patients were boys. The mean ages of boys and girls were 12.4±3 and 12.6±3.2 years, respectively. The mean age of girls and boys was similar (p >0.05). The symptoms and characteristics of children and adolescents with chest pain comparing by gender were displayed in **Table 1**.

Table 1. Symptoms and characteristics of children and adolescents with chest pain according to gender

	Gender		χ^2	p*
	Boy (n:244) n (%)	Girl (n:202) n (%)		
Triggers of Chest Pain				
Exercise	108 (44.3)	78 (38.6)	4.742	0.448
Digestion	11 (4.5)	9 (4.5)		
Trauma	5 (2.0)	1 (0.5)		
Emotional stress	27 (11.1)	31 (15.3)		
Rest	90 (36.9)	81 (40.1)		
None	3 (1.2)	2 (1.0)		
Nature of Chest Pain				
Sharp	116 (47.5)	86 (42.6)	2.234	0.327
Pressure Feeling	48 (19.7)	36 (17.8)		
Jamming	80 (32.8)	80 (39.6)		
Location of Chest Pain				
Left of chest	90 (36.9)	92 (45.5)	5.070	0.535
Right of chest	5 (2.0)	3 (1.5)		
Bilateral	59 (24.2)	43 (21.3)		
Middle of chest	71 (29.1)	47 (23.3)		
Lower left chest	10 (4.1)	10 (5.0)		
Epigastrium	8 (3.3)	7 (3.5)		
Mastalgia	1 (0.4)	0 (0.0)		
Spread of Chest Pain				
Back	23 (9.4)	20 (9.9)	7.180	0.208
Shoulder	19 (7.8)	13 (6.4)		
Left arm	12 (4.9)	22 (10.9)		
Jaw	1 (0.4)	1 (0.5)		
None	189 (77.5)	146 (72.3)		
Duration of Chest Pain				
<1 Minutes	56 (22.9)	56 (27.7)	2.689	0.442
1-5 Minutes	114 (46.7)	91 (45.0)		
6-60 Minutes	59 (24.2)	48 (23.8)		
>60 Minutes	15 (6.1)	7 (3.5)		

Chest pain was most commonly localized on the left side of the chest in both genders (p:0.535). Sharp chest pain was the most common type of chest pain in both girls and boys (p:0.337). The duration of chest pain was similar in both sexes and was most frequently 1-5 minutes (p:0.448). The form of chest pain was non- spread type in both sexes (p:0.208). When compared to gender groups it was not found statistically significant in terms of significant triggering factors, nature, location, spread, and duration of chest pain. Symptoms accompanying chest pain, conditions that relieve pain, previous diseases and history of drug use were summarised in **Table 2.**

When compared in terms of gender, chest pain accompanied by dizziness and dyspnea was statistically significantly more common in girls than boys. There was no statistical difference between the two groups in terms of palpitations accompanying chest pain, stomach ache and conditions that relieve chest pain (p >0.05).

Table 2. Symptoms accompanying chest pain, conditions that relieve pain, previous diseases and history of drug use according to gender

	Gender		χ^2	p*
	Boy n (%)	Girl n (%)		
Is chest pain accompanied by dizziness?				
Yes	19 (7.8)	36 (17.8)	10.294	0.001
No	225 (92.2)	166 (82.2)		
Is chest pain accompanied by palpitation?				
Yes	64 (26.2)	69 (34.2)	3.320	0.068
No	180 (73.8)	133 (65.8)		
Is chest pain accompanied by dyspnea?				
Yes	71 (29.1)	87 (43.1)	9.429	0.002
No	173 (70.9)	115 (56.9)		
Is chest pain accompanied by stomach ache?				
Yes	29 (11.9)	30 (14.9)	0.847	0.357
No	215 (88.1)	172 (85.1)		
Have you received treatment for chest pain?				
Yes	7 (2.9)	8 (4.0)	0.405	0.524
No	237 (97.1)	194 (96.0)		
What conditions relieve chest pain?				
Rest	133 (54.5)	96 (47.5)	2.608	0.625
Massage	10 (4.1)	8 (4.0)		
Eating	3 (1.3)	2 (1.0)		
Sleep	5 (2.0)	6 (2.9)		
None	93 (38.1)	90 (44.6)		
Predisposition diseases				
Congenital heart disease	1 (0.4)	2 (1)	6.722	0.242
Acquired heart disease	5 (2)	2 (1)		
Previous cardiac surgery	1 (0.4)	1 (0.5)		
Infection	1 (0.4)	5 (2.5)		
Asthma	12 (4.9)	16 (7.9)		
None	224 (91.8)	176 (87.1)		

Comparison of findings of physical examination, electrocardiogram, telecardiogram and 24-hour electrocardiogram monitoring by gender were indicated in **Table 3**.

Table 3. Comparison of findings of physical examination, electrocardiogram, telecardiogram and 24-hour electrocardiogram monitoring by gender

	Gender		χ^2	p*
	Boy n (%)	Girl n (%)		
Heart sounds and murmurs				
Murmur	24 (9.8)	28 (13.9)	1.739	0.187
None	220 (90.2)	174 (86.1)		
Respiration system findings				
Ral	1 (0.4)	2 (1.0)	2.763	0.598
Wheeze	1 (0.4)	0 (0.0)		
Decreased breathing sound	2 (0.8)	1 (0.5)		
None	240 (98.4)	198 (98.0)		
Electrocardiogram				
Arrhythmias	6 (2.5)	2 (1.0)	3.236	0.357
Conduction Abnormalities	2 (0.8)	0 (0.0)		
Abnormal T and Q wave	2 (0.8)	1 (0.5)		
None	234 (95.9)	199 (98.5)		
Telecardiogarm				
Cardiomegaly	1 (0.4)	0 (0.0)	3.454	0.178
Normal	45 (18.4)	26 (12.9)		
None	198 (81.2)	176 (87.1)		
24-hour electrocardiogram monitoring				
SVE	0 (0.0)	1 (0.5)	7.742	0.459
Moderate often monomorphic VES	1 (0.4)	0 (0.0)		
Very often VES	0 (0.0)	1 (0.5)		
Normal	8 (3.3)	3 (1.5)		
None	235 (96.3)	197 (97.5)		

ECG: eleoctrokardiogram, SVE: supraventricular extrasystole, VES: ventricular extrasystole

Cardiac murmur was heard in 24 (9.8%) of boys and 28 (13.9%) of girls. The respiratory system examination revealed rales in 3 patients, wheezing in one patient, and decreased respiratory sounds in three patients. When gender groups were compared, no statistically significant difference was found in abnormal physical examination findings (p>0.05).

Arrhythmia was detected in six (2.5%) boys and two (1%) girls in the electrocardiogram. There were two patients with supraventricular tachycardia, three with frequent premature ventricular complexes, and three with Wolff Parkinson White Syndrome. In total, two patients have conduction abnormalities, three patients have abnormal Q-T waves. When gender groups were compared, no statistically significant difference was found in abnormal electrocardiogram findings (p>0.05). 24-hour electrocardiogram monitoring revealed arrhythmia in three patients with palpitation.

A telecardiogram was taken in 72 patients. Cardiomegaly due to cardiomyopathy was only detected in one boy patient on telecardiogram. When gender groups were compared, no statistically significant difference was found in abnormal echocardiogram findings (p>0.05). Echocardiogram was performed in all patients.

Thyroid function tests of 103 patients with chest pain accompanied by palpitation were within normal limits. We detected dyspidemia in two of 36 patients whose fasting lipid profiles were examined. Troponin I was studied in 43 (9.6%) patients. Troponin I level was found to be elevated in 9 of these patients who had seven pericarditis and two myocarditis.

The causes of chest pain in children and adolescents with chest pain were indicated in **Table 4**.

Table 4. The causes of chest pain in children and adolescents with chest pain

	n	%
Idiopathic	153	34.3
Musculoskeletal	112	25.11
Precordial Capture	44	9.86
Muscle Tension	32	7.17
Costochondritis	24	5.38
Trauma To the Chest	10	2.24
Cough-Related Muscle Pain	2	0.004
Psychogenic	60	13.45
Daily Stress	47	10.53
Depression	6	1.34
Conversion	4	0.89
Somatization	2	0.44
Hyperventilation	1	0.22
Cardiac	50	11.21
Ventricular Dysfunction	26	5.82
Inflammatory Conditions	19	4.26
Arrhythmias	5	1.21
Respiratory	41	9.19
Exercise-Related Asthma	38	8.52
Pneumonia	3	0.67
Gastrointestinal	30	6.72
GER	15	3.63
Gastritis	15	3.63

GER: gastroeusofagyal reflux

The chest pain was non-cardiac in 244 (55%) patients. The non-cardiac causes were as follows: 25% musculoskeletal, 14% psychological, 9% respiratory, and 7% gastrointestinal, respectively. We found cardiac chest pain in 49 (11%) of patients. We could not identify a cause that could explain chest pain in the remaining 152 (34%) patients. In this case, we classified it as idiopathic chest pain.

The proportions of patients according to age groups were 30.7% in the 6-11 age group, 37% in the 11-15 age group, and 32.3% in the 15-18 age group, respectively.

The patient's laboratory results determined that hemoglobin, creatine cinase (CK), and creatine cinase isoenzyme MB were higher in boy patients (p=0.001).

DISCUSSION

There is a high prevalence of chest pain among children that results in referrals to physicians. Some patients may experience recurrent or severe pain, affecting their daily activities. Currently, news and media reports about the sudden deaths of athletes have caused concern among families and physicians. Medical professionals have feared about missing cardiac pathology. In this prospective study, we assessed the demographic and clinical characteristics of a paediatric population with chest pain as well as the causes of chest pain in a paediatric cardiology outpatient clinic. Here we present one prospective of the most comprehensive studies that have been conducted on chest pain in the pediatric population.

Paediatric chest pain is most commonly seen between the ages of 10 and 21 and is associated with a wide variety of causes and symptoms.[2,5] Accordingly, the average age of the sample in our study was 12 years, and the frequency of chest pain did not differ significantly by gender. Our study showed the greatest prevalence of chest pain among 11 to 15-year-olds.

There has been a persistent finding in the paediatric population that chest pain occurs predominantly in the left hemithorax and is not diffuse.[5,6] The vast majority of patients in our study experienced chest pain primarily on the left side of the chest, and the pain did not spread widely. In our study most of the patients described the pain as sharp (45.2%), and the duration of chest pain was from 1 to 5 minutes in most patients, which was similar to the previous reports that paediatric chest pains last about one minute.[5,7] In our study, having chest pain for more than 1 month, and less than 6 months was prevalent among the cases (36% boy and 35% girls). Approximately 2% of the patients complained of persistent chest pain. Considering that the study included outpatient patients we expected that vast of the patients would complain of long-term pain. Studies including patients who were admitted to both the paediatric emergency room and paediatric cardiology department have reported a sharp and new beginning chest pain up to 70%.[8] Other studies reported chronic chest pain maintained over 1 and 3 months.[9,10]

A rate from 0 to 19% for the prevalence of cardiac abnormalities[11,12] and a rate of 4-6% for cardiac original chest pain was reported in the previous retrospective[2] and prospective studies.[9] Our results present a slightly elevated rate for cardiac aetiologies of paediatric chest pain compared to the literature. This may be due to the fact that the study was conducted in a tertiary hospital, resulting in a high rate of detecting the underlying cause.

The most common detected etiological causes of chest pain in our study were musculoskeletal disease, psychiatric disorders, respiratory diseases and GIS diseases, respectively. Patients with chest pain whose cause could not be identified constituted 34% of all patients. Previous studies report idiopathic chest pain rates of up to 45%.[7,8] We believe that diagnostically advancements and detailed examinations have led to a gradual increase in diagnosis rates and a decrease in idiopathic diagnosis.

According to previous study reports, the most common causes of chest pain among patients with heart-related chest pain were rheumatic heart disease, cardiomyopathy, postoperative closure of anatomical defects, and pericardial effusion.[7,14] We detected cardiac origin pain in 11% of all patients with chest pain. Chest pain in mitral valve prolapses leads to a palpitation sensation that can be perceived as pain due to microvascular perfusion defect associated with papillary and endocardial ischemia and could be accompanying ventricular and premature beats. In our study, patients with mitral valve prolapses comprised causes of 13% of cardiac chest pain. Chest pain due to mitral valve prolapses can be atypical and not triggered by effort, distinguishing it from anginal pain. Patients with mitral valve prolapses who were considered hemodynamically significant mitral regurgitation and had an electrocardiograpic sign of myocardial ischemia were included cardiac causes for chest pain but mild mitral valve prolapses did not. Six patients had moderate to severe mitral regurgitation and negative T wave on D2, D3 and AVF derivations. In our study, we detected pericarditis in 15 patients (3.3%) and myocarditis in 2 patients (0.04%). Girl patients had a 60% higher prevalence of the rheumatic heart disease. Most patients with pericarditis and myocarditis report chest pain at rest, which accounts for 64.7% of the cases. In 47.1% of cases, the chest pain was sharp and in 41.2%, it was accompanied by a pressure sensation. According to our study, structural cardiac disorders accounted for 3.5% of all cardiac causes of chest pain (aortic stenosis, pulmonary stenosis, cardiomyopathy), followed by 3.3% pericarditis, 1.3% mitral valve prolapses, 0.04% myocarditis, and 1.1% arrhythmias. The underlying diseases of the patients have been treated and followed.

Feeling chest pain at rest was the most common type of pain among girls rather than boys (40.1%, and 36.9% respectively). Boys experienced exercise-induced chest pain more than girls (44.3% and 38,6% respectively). Chest pain following emotional stress was the second most common cause of chest pain (11.1% boy and 15.3% girl). Postdigestion (4.5%) and traumatic causes (2%) for chest pain followed.

Psychogenic aetiology for chest pain, psychosomatics with chest discomfort, and finally psychogenic cardiac diseases in children are widely evaluated.[15-17] The rates of chest pain related to gastrointestinal symptoms differ from 3-9%.[7,18] Gastroesophageal flux is reported as the most common cause of chest pain in children, both in the literature similar to our study.[19,21]

The strength of our study lies in the fact that it is a prospectively designed study with a large patient cohort. The present study's particular limitation is that we could not follow up with children with psychological problems after diagnosis and treatment.

CONCLUSION

Our study showed that the aetiology of chest pain in children and adolescents presenting with chest pain is mostly due to non-cardiac causes. We found the slightly frequency of elevated rate for cardiac aetiologies of paediatric chest pain compared to the literature. We suggest that in addition to anamnesis and careful examination, further investigation, if necessary, is important in determining the aetiology of chest pain.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Selçuk University Faculty of Medicine Ethics Committee (Date: 17.01.2018, Decision No: 2018/29).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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