Cardiac chest pain in children

Çocuklarda kardiyak göğüs ağrısı

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ABSTRACT

Objective: Chest pain (CP) is a common cause of referral to hospital, not always directly related with cardiac diseases (CD). We investigated the causes for cardiac CP in children.

Methods: A hundred and twenty children, admitted consecutively to pediatric cardiology clinic with CP, were evaluated in two groups (5-12 and 13-16 age-group) in a cross-sectional and a retrospective way. Chest X-ray, electrocardiography, and echocardiography were performed. In case of necessity, 24-hour Holter monitoring, exercise stress test, tilt-table test were performed, and hemogram, serum glucose, electrolytes were evaluated. Statistical analysis was performed using Chi-square test and risk ratio [(Odds-ratio (OR, (95% CI)] in groups were evaluated.

Results: Most children with CP were older. Cardiac diseases were established in 52 (42.5%) patients. Cardiac diseases, which may cause CP (aortic stenosis, mitral valve prolapse, arrhythmias, etc.) were found in 23.3% (n=28) of patients. Compared with the younger, the risk of structural CD was found to be 2.84 times higher (OR=2.84, 95%CI 1.24-6.48, p=0.011) and risk of arrhythmia was 3.53 times higher in the elder age group (OR=3.53, 95%CI 0.93-13.38, p=0.051). When all CD were evaluated, elder children were found to have 4.12 times more risk of having CD (OR=4.12, 95%CI 1.89-9.01, p<0.0001).

Conclusion: Most children with CP were older than 12 years old. CDs were frequent and about half of them were thought to directly cause pain. So, further investigations according to standard algorithms are needed in the evaluation of children with CP. Other important result is the increased risk of CD found in elder children. *(Anadolu Kardiyol Derg 2009; 9: 401-6)*

Key words: Chest pain, heart diseases, children

ÖZET

Amaç: Göğüs ağrısı sık bir şikâyet ve hastaneye başvuru nedenidir. Her zaman kalp hastalığı ile doğrudan ilişkili değildir. Bu çalışmada, çocuklardaki göğüs ağrılarının kardiyak nedenlerinin araştırılması amaçlandı.

Yöntemler: Pediatrik kardiyoloji polikliniğine göğüs ağrısı şikayeti ile başvuran ardışık yüz yirmi çocuk enine-kesitsel ve retrospektif olarak değerlendirmeye alındı. Yaşlarına göre iki grupta incelendi (5-12 ve 13-16 yaş grubu). Hastaların tümüne fizik muayeneyi takiben telekardiyografi, elektrokardiyografi ve ekokardiyografi yapıldı. Gerektiğinde, 24 saat Holter monitorizasyon, egzersiz testi ve tilt testi yapıldı, hemogram, serum glukoz ve elektrolitleri değerlendirildi. Gruplarda göğüs ağrısına neden olabilecek kalp hastalıkları belirlendi ve yapısal kalp hastalığı ve aritmi sıklığındaki farklılık (Ki-kare testi) ve artmış risk oranı (Odds ratio (OR) (%95 güven aralığı, GA)) değerlendirildi.

Bulgular: Göğüs ağrısı ile başvuran çocukların çoğu ileri yaştaydı. Toplam 52 hastada (42.5%) kalp hastalığı vardı. Hastaların %23'ünde (n=28) göğüs ağrısına neden olabilecek kalp hastalığı (aort stenozu, mitral kapak prolapsusu, aritmiler, v.s) vardı. Yaşları fazla olan grupta diğer gruba göre yapısal kalp hastalığı 2.84 kat (OR=2.84, %95GA 1.24-6.48, p=0.011) aritmi istatistiksel olarak anlamlı olmamakla birlikte yaklaşık 3.53 kat fazlaydı (OR=3.53, %95GA 0.93-13.38, p=0.051). Tüm kalp hastalıkları değerlendirildiğinde ise ileri yaştaki risk 4.12 kat fazla bulundu (; OR=4.12, %95GA 1.89-9.01, p<0.0001).

Sonuç: Çalışmamızda göğüs ağrısı ile başvuran çocukların çoğunun yaşı 12 üstündeydi. Bu çocuklarda kalp hastalıklarının sık olduğu, saptanan kalp hastalıklarının da yaklaşık yarısının göğüs ağrısına doğrudan neden olduğu düşünüldü. Bu nedenle, çocuklarda göğüs ağrısının değerlendirilmesinde standart algoritmalara göre ileri tetkiklerin yapılması gereklidir. Çalışmamızdaki diğer bir önemli sonuç da, çocuklarda artan yaşla birlikte kalp hastalığı riskinin artmasıdır. *(Anadolu Kardiyol Derg 2009; 9: 401-6)*

Anahtar kelimeler: Göğüs ağrısı, kardiyak hastalıklar, çocuk

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Introduction

Chest pain is a common complaint in childhood. It occurs at all ages, but is more common in older children, with a mean age of 13 at presentation (1).

Primary goal in the evaluation is to discriminate the life-threatening causes of chest pain, especially the cardiac ones (2). According to the published data, cardiac causes account for less than 20% of chest pain cases in the community and primary care settings (3-6). Cardiac chest pain may be caused by ischemic ventricular dysfunction, pericardial and myocardial inflammatory processes, or arrhythmias.

In the children with chest pain, diagnostic cardiac evaluation requires further specialized studies such as echocardiography, exercise stress test, Holter monitoring, or even cardiac catheterization and electrophysiological study. Even these diagnostic evaluations may not reveal the exact cause of the chest pain. For example mild mitral regurgitation in a child with chest pain could not be the cause of his chest pain.

Our aim was to investigate the cardiac diseases in children with chest pain in order to reveal the cardiac causes which are directly related with their pains.

Methods

A hundred and twenty children who were consecutively admitted to the pediatric cardiology clinic were evaluated from 2005 March to 2006 May. Their ages were between 5-16 years and were evaluated in two groups according to age (the 5-12 years age group and 13-16 years age group), because children elder than 12 years of age are thought to be more likely to have psychogenic pain (7). This study is a cross-sectional and a retrospective analysis.

The center where patients were evaluated is a tertiary subspecialty clinic. Chest X-ray, electrocardiography (ECG) and echocardiography were performed to all patients (8, 9). Hemogram (10), serum glucose and electrolytes (11) were evaluated and 24 hour Holter monitoring, exercise and tilt table tests were performed in case of necessity. The algorithm of the evaluation is presented in Figure 1.

Statistical analysis

All statistical analysis were performed using commercially available software, SPSS 11,0 (SPSS, Inc., Chicago, IL, USA). Analysis of differences in variables of groups was performed by Chi-square test. The significant level was set at p value smaller than 0.05. Odds ratio values (95% CI) were given in order to compare the risk between the groups.

Results

Mean age of the children admitted with chest pain was 12.34±2.9 years. The age dispersion and the clinical characteristics of patients with chest pain are shown in Figure 2 and Table 1, respectively. Eleven patients (9.2%) had history of

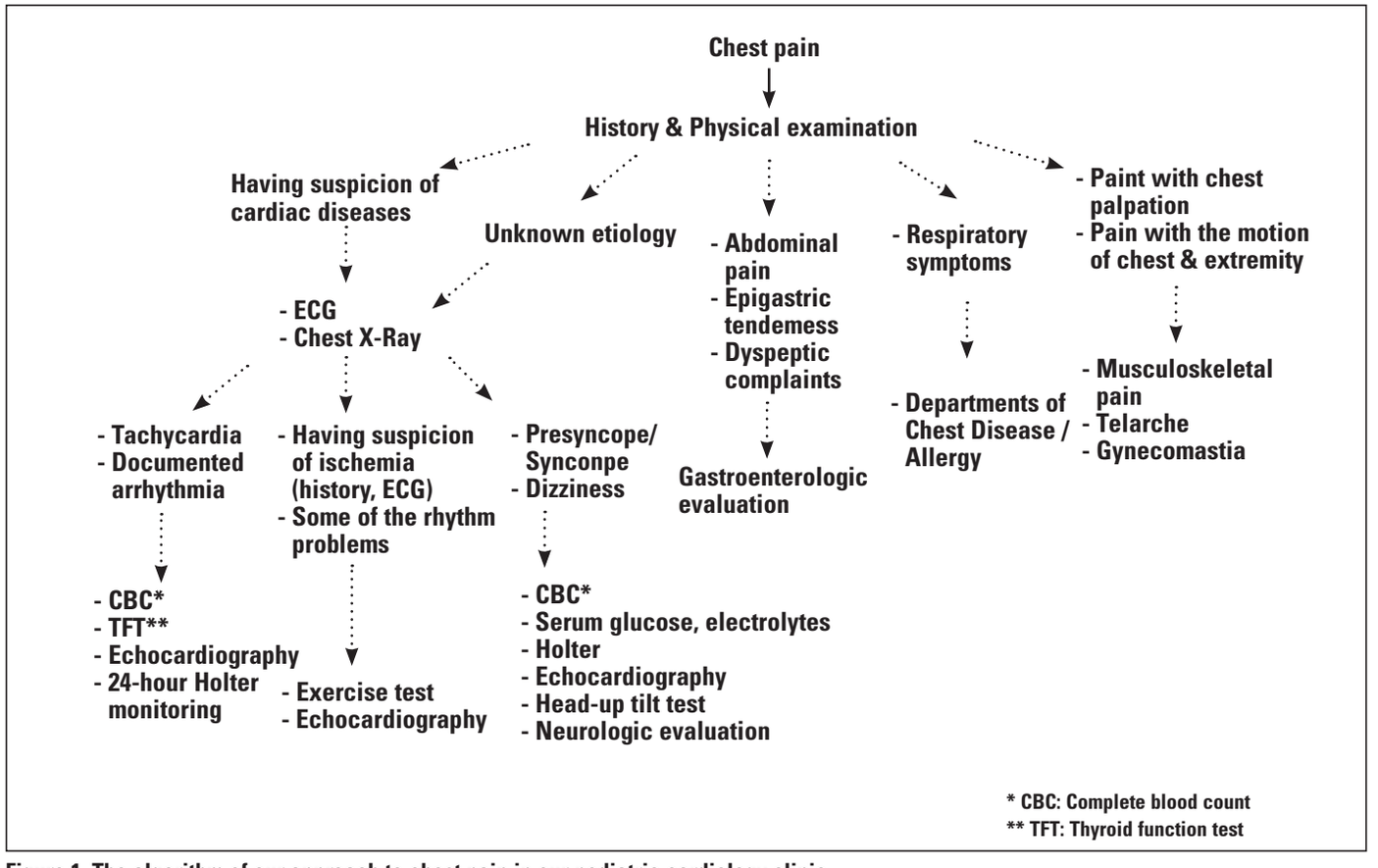

Figure 1. The algorithm of our approach to chest pain in our pediatric cardiology clinic

cardiac disease on admission including three patients with ventricular septal defect (VSD), two with atrial septal defect (ASD), two with aortic stenosis, two with rheumatic valvular heart disease, one with Wolff-Parkinson-White Syndrome (WPW), and one with noncompaction cardiomyopathy (CMP).

On physical examination, 19 patients had pathological murmur, 16 patients had innocent murmur, eight had arrhythmia, five had telarche/gynecomastia, five had pectus excavatum, and one had pneumonia.

Electrocardiographic abnormalities were recorded in eight patients including six patients with either frequent supraventricular or ventricular ectopies (SVE or VE) and two patients with ischemic changes. Eleven patients (9.1%) were found to have abnormality on chest X-ray such as cardiomegaly, prominent pulmonary conus and pneumonia.

Structural cardiac diseases and arrhythmias found in children with chest pain are presented in tables 2 and 3, respectively.

Holter monitorization was performed to 38 patients who had symptoms of palpitation and dizziness/presyncope/syncope or documented arrhythmia on ECG. Fourteen out of these 38 patients (36.8%) had various kinds of arrhythmias on Holter monitorization (Table 3). Most of the children had frequent SVE and/or VE. These ectopies required no treatment and subsided by time. There were two patients with WPW syndrome. Electrophysiologic study and successful radiofrequency catheter ablation were performed to one of these patients having syncope and persistent supraventricular tachycardia.

Four of the 26 patients (15%), who underwent the exercise test had abnormal findings. In the first patient, we evaluated

Table 1. Characteristics of children with chest pain according to the history

Characteristics		Patients	
		n	%
Age	≤12 years	55	45.8
	>12 years	65	54.2
Gender	Female	54	45
	Male	66	55
Cardiac disease on admission	Present	11	9.16
Initiation	<1 week	35	29.2
	1 week-1 month	14	11.7
	>1 month	71	59.1
Duration	0-5 min.	103	85.8
	6-30 min.	11	9.2
	>30 min.	6	5
Location	Left side of the chest	103	85.8
	Right side of the chest	4	3.3
	Both side of the chest	2	1.7
	Middle of the chest	4	3.4
	Under the chest	7	5.8
Type of pain	Like pinning	35	29.2
	Like stabbing	31	25.8
	Like compression	52	43.3
	Other	2	1.7
Timing	During rest	33	27.5
	With exercise	37	30.8
	Both during rest and with exercise	50	41.7
Associating presyncope/syncope	Present	16	13.3
Associating palpitation	Present	34	28.3
Associating fatigue	Present	68	56.7
Associating dyspnea	Present	54	45
Respiratory tract infection, fever or cough	Present	20	16.7
Chest pain with the movements of arms and chest	Present	26	21.7
Relation with the inspiration	Present	40	33.3
Gastric burn	Present	21	17.5
Relation with meal times	Present	13	10.8
Associating abdominal pain	Present	26	21.7

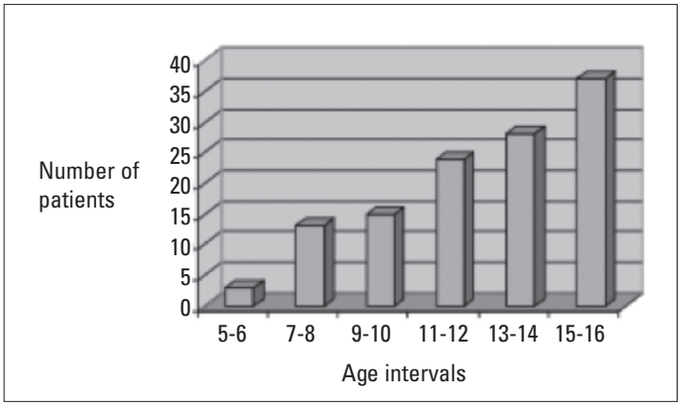

Figure 2. Age dispersion of children with chest pain

bradycardia on ECG and Holter monitorization, and diagnosed inappropriate sinus bradycardia on exercise test. The second patient's evaluation was normal, considered as early repolarization. The third patient had pathology resembling isolated noncompaction of left ventricle. Abnormal muscle bundles were seen on transthoracic echocardiography in this patient. 3-D echocardiography was performed and showed that there were multiple chambers in left ventricle. Cardiac scintigraphy revealed nonhomogeneous perfusion in left ventricle. The fourth patient had ASD and her left main coronary artery was compressed by the dilated pulmonary artery (PA). Surgical correction of the ASD and the dilated PA was performed. After the operation chest pain and ECG findings were resolved.

Six of 16 patients who had syncope and chest pain were found to have cardiac diseases, which may be related with their symptoms including one patient with WPW Syndrome and two with frequent SVE and VE, and unrelated with their symptoms including two patients with mitral regurgitation (MR), one with patent foramen ovale (PFO). The neurologic evaluations were normal in all. Head-up tilt test was performed in the remaining 13 patients of whom we could not explain the symptoms. All were considered as vasovagal syncope with either history or positive tilt test.

Twenty eight of the sixty eight patients who had fatigue and chest pain, were found to have cardiac diseases, including five patients with either SVE or VE, one patient with WPW, six with mitral valve prolapse (MVP), six with rheumatic heart disease, one with noncompaction CMP, one with hypertrophic CMP, one with dilated CMP, one with multiple chambers in left ventricle, two with AS, two with VSD, one with ASD and one patient with PFO.

Ten of 40 patients who had gastrointestinal complaints associating chest pain had also cardiac diseases, including five patients with mild MR, one with MVP, one with decreased systolic function, one with hypertrophic CMP on echocardiography, one patient with frequent SVE on Holter monitorization and one with ST elevation on exercise test.

Of patients evaluated for cardiac murmurs, including innocent, 16 patients were found to have structural cardiac disease, including ten patients with rheumatic MR, two with PFO, one with noncompaction, one with multi-chamber left ventricle, one with hypertrophic CMP, one with cardiomyopathy findings.

Five patients with frequent SVE and VE had normal cardiac auscultation findings and ECG, and they were diagnosed only after 24 hour Holter monitoring.

There were cardiac diseases in 52 (42.5%) of 120 patients (Table 2, 3). In 28 (23.3%) patients cardiac diseases were thought to directly cause chest pain. Fourteen of them (11.6%) had structural cardiac disease, including seven patients with MVP, two with AS (one of the three patients with AS had mild AS), one with hypertrophic CMP, one with decreased systolic function, one with noncompaction, one with multiple chambers in left ventricle, one with ASD with left main coronary compression. Remaining fourteen patients (11.6%) had various types of arrhythmias (Table 3).

The children with structural CD and arrhythmia were evaluated according to the ages (5-12 and 13-16 age groups) (Table 2, 3). When compared with the younger group, the risk of structural cardiac diseases wwas found to be 2.84 times higher (OR= 2.84, 95%CI 1.24-6.48, p=0.011); and though borderline statistically significant, the risk of arrhythmia was 3.53 times higher in the elder group (OR=3.53, 95%CI 0.93-13.38, p=0.051). When all kinds of cardiac diseases (both the structural cardiac diseases and arrhythmias) were evaluated, the elder children were found to have 4.12 times more risk of having cardiac disease (OR=4.12, 95%CI 1.89-9.01, p<0.0001).

Discussion

In the evaluation of children with chest pain, the aim of the clinician is usually to rule out the cardiac causes of pain. Main cardiac causes are congenital and acquired structural heart diseases and arrhythmias.

There are many case reports and studies dealing with cardiac chest pain in children (5,12,13). Danduran et al. (13) reported that 27 patients (10%) had atrial and premature ventricular contractions and six patients had nonspecific T-wave inversion in 263 children with chest pain. There was no significant abnormalities identified echocardiograms. Most of the patients (70%) were evaluated by echocardiography, but Holter monitorization was not performed to any patients.

As our aim was to identify cardiac causes of chest pain, we evaluated all children with echocardiography and 38 patients (31.6%) with Holter monitorization. The frequencies of structural cardiac diseases and arrhythmias which may cause chest pain were found to be 11.6% and 11.6% respectively. These ratios are higher than those in other studies (3-7, 13).

The frequency of cardiac pathology was reported to be 4% in children who admitted to the emergency department with chest pain (7). This may not reflect the real frequency of cardiac pathology, because in this study about half of the patients were not evaluated by ECG, and 2/3 of the patients were not evaluated by echocardiography.

Above-mentioned study (7) suggested that young children are more likely to have cardiorespiratory problems, and children

Table 2. Frequency and risk of structural cardiac diseases according with age in patients with chest pain

Groups	Structural Cardiac Disease				p$^{\alpha}$	Odds Ratio$^{\beta}$ (95% CI)
	Present			Absent		
	Type	n	Total, n(%)	Total, n(%)		
5-12 years old (n=55)	RVHD	5	11 (20)	44 (80)	0.011	2.84$^{\delta}$ (1.24-6.48)
	MVP	3				
	CMP	1				
	ASD	1				
	PFO	1				
13-16 years old (n=65)	RVHD	12	27 (41.5)	38 (58.5)		
	MVP	4				
	CMP	3				
	VSD	3				
	AS	3				
	ASD	1				
	PFO	1				

$^{\alpha}$Chi-square test, $^{\beta}$Risk analysis, $^{\delta}$Reference group is taken as 5-12 years age group
AS- valvular aortic stenosis, ASD- atrial septal defect, CMP- cardiomyopathy, MVP- mitral valve prolapse, PFO- patent foramen ovale, RVHD- rheumatic valvular heart disease, VSD- ventricular septal defect

Table 3. Frequency and risk of arrhythmia according with age in patients with chest pain

Groups	Arrhythmias				p$^{\alpha}$	Odds Ratio$^{\beta}$ (95% CI)
	Present			Absent		
	Type	N	Total, n(%)	Total, n(%)		
5-12 years old (n=55)	Frequent VE and SVE	3	3 (5.5)	52 (94.5)	0.05$^{\varepsilon}$	3.53$^{\delta}$ (0.93-13.38)
13-16 years old (n=65)	Frequent VE and SVE	7	11 (16.9)	54 (83.1)		
	WPW Syndrome	2				
	Sinus bradycardia	1				
	Sinus pause	1				

$^{\alpha}$Chi-square test, $^{\beta}$Risk analysis, $^{\delta}$Reference group is taken as 5-12 years age group
SVE - supraventricular ectopy, VE - ventricular ectopy, WPW syndrome - Wolff-Parkinson-White syndrome

older than 12 years of age are more likely to have psychogenic pain. We found in our study that there is statistically higher risk of structural cardiac disease in older children (p=0.011). On the other hand, the risk of arrhythmia was not found to be statistically insignificant, although it was 3.53 times more frequent in the elder group. There may be two reasons of this result. First, the patients with infrequent SVE and VE were not included in the study. Second, there is limited number of patients evaluated with Holter monitorization. When all of the cardiac diseases were evaluated in groups, the older children were found to have 4.12 times more risk of having cardiac disease. We consider that this high rate of cardiac disease in elder children may be due to the increase in the level of consciousness about cardiac symptoms of chest pain or due to the increase in the symptoms of structural cardiac diseases and the risk of arrhythmia with aging (14).

Another finding of our study is that admission with chest pain is more frequent in the elder children. The prevalence of pain peaks in middle age and decreases thereafter (15) according to the epidemiologic studies about the complaints of pain.

The cardiac diseases in children with chest pain were found to be frequent in our study. Fifty two (42.5%) patients were found to have cardiac diseases, and 28 (23.3%) patients' cardiac diseases were thought to directly cause their chest pain. This high ratio may be due to the high frequency of some cardiac diseases in children such as MVP or ventricular and supraventricular ectopies. Mentioned diagnoses may or may not be related to reasons of chest pain all the time.

In some studies, gastro-esophageal reflux disease is the most common cause of non-cardiac chest pain (16-18). In the study of Sabri et al. (18), 93.2% of 44 patients who had chest pain and epigastric tenderness were found to have esophagitis, gastritis, duodenitis and gastroduodenitis. In our study, 40 of 120 children had dyspepsia and/or abdominal pain and/or epigastric tenderness on physical examination. Ten of these 40 children

had also cardiac problem either related or unrelated with their chest pain. This finding shows that the patients may have even more than one reason for their chest pain.

Seventeen out of 120 children were found to have rheumatic valvular heart disease. Evaluation of all the children in the study groups with echocardiography provided us opportunity to diagnose these patients. The importance of echocardiography in the evaluation is also emphasized in the study of Marijon et al (19). The prevalence of rheumatic heart disease detected by echocardiographic screening were about 10-15 times higher than the prevalence detected by clinical examination in randomly selected school children.

We evaluated the study group according to our algorithm. Some authors suggest that this kind of evaluation causes some unnecessary workup (1). However, 16 patients (13.3%) who were found to have structural cardiac disease by further evaluation had only innocent murmur on physical examination. And 5 patients (4.1%) who had normal cardiac auscultation and ECG were found to have arrhythmia (frequent SVE and VE) after evaluated by 24-hour Holter monitoring.

Tanzi et al (20) reported that minimal set of diagnostic tools that should be applied in case of acute chest pain in emergency departments is lacking and no guidelines are available. They also reported that there is no single feature of a patient's history, physical examination, or diagnostic test results that can discriminate cardiac and non-cardiac chest pain in some patients. Some authors suggested the constitution of chest pain units which will be helpful and prevent unnecessary costs to the health care system (21, 22). We inform according to our study that idiopathic and unknown causes may account less when the children with chest pain are evaluated in detail. We suggest the use of standard algorithms for this kind of evaluation.

Limitations in the Study

Studies with larger cohort are needed for the evaluation of the chest pain in children. Other limitation of our study is the high ratio of cardiac disease compared with other studies (3-7, 13) which may be due to the evaluation of most of the patients in other clinics before they admitted.

Conclusion

In our study, cardiac diseases were found to be frequent in children who admitted with chest pain. We observed that the admission rate with chest pain in children is increased with the increasing age. Another finding was the increased risk of cardiac disease in older children.

Echocardiography should be performed to the children if there is doubt about cardiac cause, and to the children with idiopathic chest pain.

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