Paediatrica Indonesiana
Paediatr Indones 2000;41:42-46

Original article

Evaluation of cardiac murmurs in 8647 children at primary school-age children in the Province of Malatya, Eastern Turkiye

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ABSTRACT We assessed prospectively the prevalence of pathologic and innocent murmurs in childhood, to determine the efficacy of clinical evaluation, to compare the results of physical examinations performed by pediatricians and pediatric cardiologists and echocardiographic evaluations, and to contribute to the determination of the limits of echocardiography indications in children with murmurs. A number of 8647 children, aged 6.5-15 years, 4092 females, 4455 males in ten different primary schools belonging to different socioeconomic levels in Malatya, Eastern Turkey. Those children with a murmur were evaluated by a pediatric cardiologist. Chest X-ray, electrocardiography, and echocardiography were obtained in all subjects having a murmur. The results of physical examinations performed by the pediatricians and the pediatric cardiologist were compared, and the final diagnoses were reached by evaluation of chest X-ray, ECG and echocardiography. The incidencec of innocent murmurs was found to be 3.4% and that of pathological murmurs 0.54% in the population exımaned. The statistical comparison of the results revealed that pediatricians have a tendency toward innocent murmurs in the interpretation of murmurs ($p<0.05$). There was not a statistically significant difference between the results of physical examinations of the pediatric cardiologist and the results of echocardiographic examination. Pediatricians can diagnose pathojogic cases with a sensitivity of 63.8% whereas pediatric cardiologiss could diagnose those cases with a sensitivity of 95.7% and specificity of 99.7%. Our findings support the policy that children with a cardiac murmur should be referred to a pediatric cardiologist, in order to verify clinical diagnosis. **[Paediatr Indones 2001;41:42-46]**

Keywords: Childhood, heart murmurs, echocardiography

HEART MURMURS ARE COMMONLY NOTED IN CHILDHOOD by cardiac examinations and may be classified as innocent or pathological murmurs. Those murmurs which are enhanced in conditions of high cardiac output such as fever, infection or anxiety and do not result in hemodynamic deterioration are named functional, physiologic, innocent, vibratory or benign murmurs.[1-4] The murmurs that are the result of hemodynamically effective and organic disorders are called pathologic murmurs. The differentiating features of innocent murmurs are that are heard mainly during systole, the intensity is not more than third degree, not heard in diastole, not associated with a click, and are not continuous with the exception of venous hum.[4] The recent developments in echocar-

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diography have drawn attention to the parallelism between clinical and echocardiographic evaluations and these developments have helped in the identification of diagnostic characteristics of echocardiography. The studies have shown that only insignificant numbers of patients may be missed with clinical evaluation of pathologic murmurs. In this mass screening, our goals were to assess the prevalence of pathologic and innocent murmurs in childhood, to determine the efficacy of clinical evaluation, to compare the results of physical examinations performed by pediatricians and pediatric cardiologists and echocardiographic evaluations, and to contribute to the determination of the limits of echocardiography indications in children with murmurs.

METHODS

The study was carried out in randomly chosen primary schools in several districts of different socioeconomic levels in Malatya. A total of 8647 children, 4555 males and 4092 females, were enrolled in the study. The first examinations were made by a pediatrician in the form of auscultation in a silent environment. The children with murmurs were referred to the Department of Pediatrics at the University Hospital. The referred children were examined by a pediatric cardiologist and their chest X-rays, electrocardiograms and echocardiograms were obtained. Echocardiographic examinations were performed using a Hewlett-Packard 1000 color Doppler echocardiograph with a 3.5 mHz transducer. A detailed history was taken to exclude rheumatic heart disease. Those children with a history of acute rheumatic fever and those with thickened-regurgitating mitral valves were identified as having rheumatic valve disease. The results of physical examinations of the pediatricians and pediatric cardiologist were compared, these were also compared with echocardiographic findings. The results were statistically evaluated with chi square testing of paired samples, and criticized for sensitivity and specificity.

RESULTS

Total number of subjects was 8647; of these 4092 (47.3%) were females and 4555 (52.7%) were males, 345 (4.0%) out of 8647 subjects were found to have murmurs. Of these, 156 (46.2%) were girls and 189 (53.8%) were boys, the average age was 10 (SD 2.2) years. 315 subjects (91.3%) had innocent, and 30 subjects (8.7%) had pathological murmurs according to pediatricians' evaluations. The median age at which innocent murmurs were observed was 8 years; 345 subjects with murmurs detected by pediatricians were referred to the pediatric cardiologist. The pediatric

TABLE 1. COMPARISON OF THE RESULTS OF PHYSICAL EXAMINATION OF THE PEDIATRICIANS, PEDIATRIC CARDIOLODISTS AND ECHOCARDIOGRAPHY

	Ped	P Card	p	Ped	Echo	p	P Card	Echo	p	Echo (%)
Innocent murmur	315	299	<0.05	315	298	<0.05	299	298	>0.05	3.45
Pathologic murmur	30	46	<0.05	30	46	0,044				
ASD	7	12	<0.05	7	12					
VSD	9	9	>0.05	9	9					
MR	8	14	<0.05	8	14					
MVP+innocent murmur	2	4	>0.05	2	4					
MVP+MR	2	4	>0.05	2	4					
AS	1	1	>0.05	1	1					
AR	1	1	>0.05	1	1					
PS	0	1	>0.05	0	1					
Total										

Abbreviations: Ped = pediatrician; P Card = pediatric cardiolgist; Echo = echocardiography; ASD = atrial septal defect; VSD = ventricular septal defect; MR = mitral regurgitation; MVP = mitral valve prolapse; AS =aortic stenosis; AR = aortic regurgitation; PS = pulmonary stenosis.

cardiologist found 299 (86.7) subjects with an innocent murmur and 46 (13.3%) subjects with pathologic murmurs. In 298 out of 315 subjects thought to have innocent murmur by the pediatricians were also classified as having innocent murmurs by the pediatric cardiologists, and 16 subjects were classified as having pathologic murmurs. One subject was thought to have an innocent murmur by both the pediatricians and the pediatric cardiologist, but later shown to have organic heart disease by echocardiography. Thirty subjects with organic murmurs were also reported to have pathologic murmurs by the physical examination of the pediatric cardiologist and with echocardiography. Furthermore, the murmurs of 17 subjects previously reported by the pediatrician as innocent were related to organic causes by the pediatric cardiologist (except one) and results were confirmed by echocardiography. The difference was statistically significant ($p<0.05$) (Table 1). Of these 17 subjects, 4 had atrial septal defect, 5 had mitral regurgitation, 3 had innocent murmur and mitral valve prolapse, 3 had mitral valve prolapse and mitral regurgitation, 1 had ventricular septal defect and 1 had pulmonary stenosis echocardiographically. The most frequent pathologic murmur detected by physical and echocardiographic examinations of the pediatric cardiologist was mitral regurgitation. There was a significant difference in the identification of atrial septal defect and mitral regurgitation between the physical examinations of pediatricians and the pediatric cardiologist ($p<0.05$) (Table 1). There was also a significant difference in the identification of atrial septal defect, mitral regurgitation and mitral valve prolapse and innocent murmur between the pediatrician and echocardiography ($p<0.05$) (Table 1), whereas no such significant differences were observed between the examinations of the pediatric cardiologist and echocardiography ($p<0.05$) (Table 1). Of the 12 subjects labeled as atrial septal defect by the pediatric cardiologist, one was found to have a closing ventricular septal, defect, and one of the 14 subjects was thought to have mitral regurgitation and mitral valve prolapse with echocardiography. The distribution and evaluation of the subjects with murmurs are depicted in Table 1.

When the diagnoses were evaluated for sensitivity and specificity, it was found that pediatricians were able to diagnose only 63.8% of the subjects with pathologic murmurs and they could diagnose all subjects with innocent murmurs correctly. The pediatric cardiologist could diagnose 95.7% of the subjects with pathologic murmurs and 99.7% of the subjects with innocent murmurs. The positive predictive value of pediatricians' examinations was 100%, whereas their negative predictive value was 94.6%. The positive predictive value of the pediatric cardiologist was 97.8%, and the negative predictive value was 99.6%. These results are summarized in Table 2.

DISCUSSION

Evaluation of heart murmurs constitutes an important aspect of the practice of pediatric cardiology. The purpose of this study was to determine the prevalence of murmurs, differentiation of normal and pathologic cardiovascular states, to evaluate the pathological conditions with the most reasonable cost, to educate and relieve the families of children with innocent murmur.[3] Mass screening programs in this field will help to determine the prevalence of these disorders in the population and to detect and follow the symptomatic children through early diagnosis.

TABLE 2. COMPARISON OF THE SENSITIVITY, SPECIFICITY, AND PREDICITVE DIAGNOSTIC CAPACITY OF PEDIATRICIANS AND PEDIATRIC CARDIOLOGISTS ACCORDING TO ECHOCARDIOGRAPHIC EVALUATION

	Sensitivity	Specificity	PPV	NPV
Pediatrician	63.8%	100.0%	100%	94.6%
Pediatric cardiologist	95.7%	99.7%	97.8%	99.0%

Abbreviations: PPV = positive predictive value; NPV = negative predictive value

The prevalence of innocent murmurs in childhood has been reported in the range between 6-90% in the literature.[2-8] Fogel has reported the incidence of innocent murmurs in the pediatric population referred for cardiologic evaluation as 63% in the year 1960.[7]

Various studies have previously been performed in Turkey. The prevalence of innocent murmurs was reported to be 1.47% in Adana and 1.4-2.3% in Diyarbakir.[9-11] Our figure of 3.44% is higher than the results of other studies, although it is lower than the figures in the literature.

The incidence of congenital heart disease in schoolchildren has been reported between 0.27-0.51% in various studies.[12-15] In Turkey, this incidence has been reported as 0.20-0.44% in Diyarbakir, 0.14 in Adana.[9-11,15] In our study, the incidence of congenital heart disease was 0.33% and no cyanotic heart disease were encountered in this age group. Our results are similar to the results in our country and in the world literature.

The incidence of rheumatic heart disease in schoolchildren has been reported as 0.03-0.71% in the literature.[14,16,17] This incidence was reported as 0.03-0.41 in different studies in our country.[9,10,18,19] The prevalence of rheumatic heart disease in our study was 0.21%. Recent advances in echocardiography have focused attention on the value of clinical evaluation.[20,21] Newburger[1] et al have shown that the contribution of M-mode echocardiography in the identification of heart disease is very little as compared to clinical evaluation. After the development of two-dimensional echocardiography Geva et al[22] showed that clinical evaluation and echocardiogra-phic confirmation of the patients suspected to have heart disease or pathologic murmurs had a sensitivity of 96% and a specificity of 89%. After the introduction of pulsed and color Doppler echocardiographic modalities, Smythe[23] et al reported that clinical evaluation had a sensitivity of 96% and specificity of 95%, with a positive predictive value of 88% and a negative predictive value of 98%.

In this study, pediatric cardiologist was able to diagnose 95.7% of subjects with pathologic murmurs and 99.7% of innocent murmurs in healthy children. The positive predictive value of the pediatric cardiologist was 97.8%, and the negative predictive value was 99.6%. The difference between the examinations of pediatricians and the pediatric cardiologist was statistically significant ($p<0.05$).

There was also a statistically significant difference between the results of echocardiographic evaluation and pediatrician's examinations ($p<0.05$), while no such significant differences were observed between echocardiography and the results of examinations of pediatric cardiologist (Table 2). No false positive diagnoses (i.e., innocent murmurs labeled as pathologic) were made in the study, whereas the rate of false negative diagnoses (i.e., pathologic murmurs labeled as innocent) was %.[6]

It has been shown in these studies that pediatric cardiologist can differentiate innocent and pathologic murmurs by clinical evaluation with high sensitivity and specificity.[2,5,20-26] When the clinical evaluations of murmurs are compared with echocardiography, it can be seen that the cost of clinical consultations are lower.[20,21]

Since echocardiography is time consuming and expensive, it should be limited in certain cases, such as patients with suspicious cardiac pathology or organic murmurs. Careful physical examination by an experienced pediatric cardiologist is essential.

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