Diagnostic accuracy of clinical diagnosis versus echocardiography in evaluating heart murmurs in Iraqi children

Mahmood D. Subhi, *DCH, FICMS.*

ABSTRACT

Objective: To assess the diagnostic accuracy of clinical diagnosis versus echocardiography in evaluating childhood heart murmurs.

Methods: We investigated 107 children under the age of 10 years with heart murmurs admitted to 3 hospitals in Baghdad (Al-Khadimyiah Pediatric Hospital, Al-Karama Teaching Hospital/Pediatric Department and Al-Noor Teaching Hospital/Pediatric Department) during the period of January 1998 to January 2002. Data on age, gender, provisional clinical diagnosis and final echocardiographic diagnosis were taken. Statistical analysis through Chi-square was carried out.

Results: There were more males than females (58.9% versus 41.1%, $p<0.05$). Provisionally, diagnoses of pathological murmurs were made in 88.8% of patients compared with 11.2% for innocent murmurs. The most common pathological murmur was that of ventricular septal defect (58.9%) and the least was aortic stenosis (1.9%). Echocardiographically, pathological findings were seen in 62.6% of patients compared with 37.4% for normal results. Provisional and echocardiographic diagnoses were concordant in 52.3% of patients and discordant in 47.7%, a difference of highly statistical significance ($p<0.001$). The most common concordant and discordant diagnoses were ventricular septal defect and innocent murmurs.

Conclusion: Though echocardiography can be used to precisely evaluate heart murmurs, the role of comprehensive history taking and meticulous physical examination must not be neglected. Defect in specific accuracy of clinical acumen noted by the pediatricians who cared for the studied patients probably reflects their different standards in medical education and clinical training. Developing and implementing advanced physical diagnosis curriculum, establishing training programs in cardiology for pediatricians and provision of well-trained pediatric echocardiographers seem crucial. These options will eventually contain medical expenses.

Saudi Med J 2006; Vol. 27 (5): 672-675

Congenital heart disease (CHD) occurs in 0.5-0.8% of live births.[1] Heart murmurs signify stenosis or regurgitation of valves and left to right shunt lesions at the atrial, ventricular or great arterial level.[2] However, proper approach revealed innocent murmurs in as many as 60-83% of all school age children.[3,4]

Pathological murmurs are defined as murmurs caused by an underlying structural abnormality of the heart. Early diagnosis is desirable to: 1. prevent serious complications in conditions that would otherwise be mild if treated; 2. identify adjuvant diagnostic or treatment interventions; 3. reduce the risk of bacterial endocarditis when indicated; 4. reassure parents of children with innocent murmurs.[5]

With the advent of color Doppler, echocardiography approaches near-perfect sensitivity and specificity

From the Department of Pediatrics, Al-Kindy College of Medicine, Baghdad University, Baghdad, *Iraq*.

Received 15th October 2005. Accepted for publication in final form 28th February 2006.

Address correspondence and reprint request to: Dr. Mahmood D. Subhi, Department of Pediatrics, Al-Kindy College of Medicine, Baghdad University, Al-Jadiryiah, PO Box 47188, Baghdad, *Iraq*. E-mail: malmendalawi@yahoo.com

in assessing heart murmurs.[6] However, studies have shown that skill and confidence of history and physical examination among students, trainee residents and practicing physicians have waned.[7,8]

Heart murmurs were evaluated in Iraqi adults,[9] however, a debate still exists whether echocardiography remains the golden diagnostic means[10,11] or clinical diagnosis[12-14] is adequate in elucidating the nature of childhood heart murmurs. We, therefore, sought in this study to examine the issue in Iraqi children.

Methods. We investigated the medical records of 107 children aged below 10 years with heart murmurs admitted to 3 hospitals in Baghdad (Al-Khadimyiah Pediatric Hospital, Al-Karama Teaching Hospital, Pediatric Department and Al-Noor Teaching Hospital, Pediatric Department) during the period of January 1998 to January 2002. Data on age, gender, provisional diagnosis made clinically by the pediatricians who cared for the studied children in the aforementioned hospitals and final diagnosis made echocardiographically by pediatric echocardiographers were sought. Statistical analysis of data was performed using Chi-square. A $p \leq 0.05$ was regarded statistically significant.

Results. The studied sample involved 63 (58.9%) males and 44 (41.1%) females with a male to female ratio of 1.4: 1. The mean age was 4.9 ± 2.81 (range 4 months-10 years). Those below age of 4 years constituted nearly two thirds of cases 64 (59.8%) compared to one third 34 (31.8%) within age group of 4-8 years while the least was noted above 8 years of age 9 (8.4%). Males significantly predominated females in studied sample ($p<0.05$) (**Table 1**).

Table 2 depicts the provisional diagnosis in studied sample. Diagnoses of pathological murmurs were established in 95 (88.8%) patients compared to 12 (11.2%) for innocent murmurs. The most common CHD diagnosed provisionally was that of VSD 63 (58.9%) followed by PDA 11 (10.3%) while the least was AS 2 (1.9%).

Table 3 illustrates the echocardiographic findings in relation to provisional diagnoses. Pathological findings were observed in 67 (62.7%) patients and normal findings in the remaining 40 (37.4%).

Table 4 shows the state of concordance between provisional and echocardiographic diagnoses in studied sample. Both diagnoses were concordant in 50 (52.3%) patients and discordant in the remaining 56 (47.7%). Such difference was of highly statistical significance ($p<0.001$). The most common concordant diagnosis was VSD 32 (29.9%) while the most common discordant one was innocent murmurs 34 (31.9%).

Discussion. For many years, clinical judgment has been a useful diagnostic tool and a key component of the patient-physician interaction. However, with the eruption of advanced medical technologies, clinical judgment and precision in approaching health problems have been questioned.[15] Proper assessment of heart murmur is beneficial for several reasons: accuracy of diagnosis, physicians intellectual satisfaction, parental confidence in the physicians, avoidance of stress for the patient and parents and appropriate cost-effective use of medical resources.[16]

The provisional diagnoses of pathological murmurs were made in 88.8% of patients compared to 11.2% for innocent murmurs but echocardiographically, pathological findings were found in 62.7% of patients and normal results were seen in the remaining 47.4%. Both diagnoses were concordant in 52.3% of patients and discordant in 47.7%. Such difference was of highly statistical significance ($p<0.001$). This discrepancy can be attributed to examiners misinterpretations or absence of classical findings.

The most common concordant diagnosis was VSD in 29.9% of patients. This may be due to observation

Table 1 - Distribution of studied patients according to age and gender.

Age (years)	Male N (%)		Female N (%)		Total N (%)	
<4	43	(40.2)	21	(19.6)	64	(59.8)
4-8	13	(12.1)	21	(19.6)	34	(31.8)
>8	7	(6.5)	2	(1.9)	9	(8.4)
Total	**63**	**(58.8)**	**44**	**(41.1)**	**107**	**(100)**
$X^2 = 10.85$, DF = 2, $p<0.05$						

Table 2 - Distribution of studied patients according to provisional diagnosis.

Provisional diagnosis	N	(%)	Total N	(%)
Ventricular septal defect	63	(58.9)	95	(88.8)
Patent ductus arteriosus	11	(10.3)		
Atrial septal defect	7	(6.5)		
Tetralogy of fallot	5	(4.7)		
Mitral regurgitation	4	(3.7)		
Pulmonary stenosis	3	(2.8)		
Aortic stenosis	2	(1.9)		
Innocent murmurs			12	(11.2)
Total			**107**	**(100)**

Table 3 - Echocardiographic findings of studied patients in relation to provisional diagnosis.

Provisional diagnosis	Echocardiographic findings
Ventricular septal defect (VSD) (N=63)	VSD (N=32), normal (N=26), TOF (N=2), MR (N=2), ASD (N=1)
Patent ductus arteriosus (PDA) (N=11)	PDA (N=5), normal (N=4), ASD (N=1), VSD (N=1)
Atrial septal defect (ASD) (N=7)	ASD (N=3), normal (N=3), PS (N=1)
Tetralogy of fallot (TOF) (N=5)	TOF (N=4), isolated VSD (N=1)
Mitral regurgitation (MR) (N=4)	MR (N=3), MV prolapse and regurgitation (N=1)
Pulmonary stenosis (PS) (N=3)	PS (N=2), normal (N=1)
Aortic stenosis (AS) (N=2)	AS (N=1), PS (N=1)
Innocent murmurs (N=12)	Normal (N=6), PS (N=2), VSD (N=2), ASD (N=1), PDA (N=1)
Pathological murmurs N=95 (88.8%)	Pathological findings N=67 (62.6)
Innocent murmurs N=12 (11.2%)	Normal results N=40 (37.4)

Table 4 - State of concordance between provisional and echocardiographic diagnoses in the studied sample.

Lesion	Concordance		Discordance		Total	
	N	(%)	N	(%)	N	(%)
VSD	32	(29.9)	4	(3.7)	**36**	**(33.6)**
PDA	5	(4.7)	1	(0.9)	**6**	**(5.6)**
ASD	3	(2.8)	3	(2.8)	**6**	**(5.6)**
TOF	4	(3.7)	2	(1.9)	**6**	**(5.6)**
MR	3	(2.8)	3	(2.8)	**6**	**(5.6)**
PS	2	(1.9)	4	(3.7)	**6**	**(5.6)**
AS	1	(0.9)	0	(0)	**1**	**(0.9)**
Innocent murmurs	6	(5.6)	34	(31.9)	**40**	**(37.5)**
Total	**56**	**(52.3)**	**51**	**(47.7)**	**107**	**(100)**

$X^2 = 37.69$, DF=7, $p<0.001$
VSD - ventricular septal defect, PDA - patent ductus arteriosus, ASD - atrial septal defect, TOF - tetralogy of fallot, MR - mitral regurgitation, PS - pulmonary stenosis, AS - aortic stenosis

that VSD constitutes 25-30% of all CHD and that its characteristic holosystolic murmur can be easily distinguished from other heart murmurs.[1] On the other hand, the most common discordant diagnoses was innocent murmurs in 31.9% of patients. Considering other studies, innocent murmurs constitute nearly 60-83% of all heart murmurs.[3,4] This augments the observation of increasing dependence of physicians on non-invasive tests rather than clinical judgment in approaching heart diseases.[7,8]

Three elements are required for definitive diagnosis of innocent murmurs: 1. Pediatricians must recognize with confidence the auscultatory features of a specific innocent murmurs, notably still's murmur, innocent pulmonary flow murmur, innocent pulmonary branch murmur of infancy, supraclavicular bruit, venous hum, mammary souffle and cardio-respiratory murmur. 2. A detailed history must be taken and found negative for symptoms that might be attributed to a CHD. 3. A detailed physical examination must be performed searching for other signs of CHD and these signs must be absent. If these 3 elements are met, further laboratory confirmation with ECG, chest x-ray and echocardiography is usually unwarranted. Absence of any of these elements is an indication for further evaluation.[17-19]

Sets of investigators found that direct referral for echocardiography was an expensive way to evaluate children with heart murmurs.[20,21] Others announced that pediatric echocardiograms performed in adult laboratories were questionable in terms of being unnecessary in some, of inadequate quality in others and resulted in an erroneous impression of the nature or presence of pathological disease.[22,23]

The reported defect in specific accuracy of the clinical diagnosis probably reflects the training skills and experiences of the pediatricians. It is fortuitous time to pursue the development, implementation and evaluation of advanced physical diagnosis curriculum for medical students and establishing specific training programs in cardiology for pediatricians. Moreover; echocardiography must be carried out by well-trained pediatric echocardiographers. These options will eventually save unnecessary financial loss.

Acknowledgment. Great thanks are due to all staff in the aforementioned hospitals in Baghdad for their kind help in accomplishing this study.

References

1. Bernstein D. Epidemiology and genetic basis of congenital heart diseases. In: Behrman RE, Kliegman RM, Jenson HB, editors. Nelson Textbook of Pediatrics. 17th edition. International edition. Philadelphia (PA): Saunders; 2004. p. 1499-1502.

2. Shaver JA. Cardiac auscultation. In: Fuster V, Alexander RW, Rourke RA, editors. Hurst's The Heart. New York (NY); McGraw Hill: 2001. p. 240-280.
3. Clements GC, Crossland DS, Abu-Harb M. Are innocent murmurs innocent? ***Arch Dis Child*** 2002; 86 (Suppl 1): A44-45.
4. McGrindle BW, Shaffer KM, Kan JS, Zahka KG, Rowe SA, Kidd L. Cardinal clinical signs in the differentiation of heart murmurs in children. ***Arch Pediatr Adolesc Med*** 1996; 150: 169-174.
5. Yi MS, Kimball TR, Tsevat J, Mrus JM, Kotagel UR. Evaluation of heart murmurs in children: cost-effectiveness and practical implications. ***Pediatr*** 2002; 141: 504-511.
6. Kimball TR, Meyer RA. Echocardiography. In: Allen HD, Moss AJ, Adams FH, editors. Moss and Adam's heart diseases in infants, children and adolescents: including the fetus and young adults. 6th edition. Philadelphia: Lippincot Williams and Wilkins; 2001. p. 204.
7. Gaskin PR, Uwenes SE, Talner NS, Sanders SP, Li JS. Clinical auscultation skills in pediatric residents. ***Pediatr*** 2000; 105: 1184-1187.
8. Mangione S, Nieman LZ. Cardiac auscultatory skills of internal medicine and family practice trainee: a comparison of diagnostic accuracy proficiency. ***JAMA*** 1997; 278: 717-722.
9. Al-Hergani Z. The significance of systolic murmurs in adults. ***J Fac Med Baghdad*** 2001; 43: 277-279.
10. Prendergast A, Thompson G, Cormack L, Kelsall W. A one-stop echocardiography clinic as an efficient means of investigating childhood heart murmurs. ***Arch Dis Child*** 2002; 86 (Suppl 1): A44-45.
11. Manes MT, Pintaudi C, Balsano M, Giglo M, Plastina F, Russo F. Functional heart murmur and echocardiography: a solved problem? ***Ital Heart J*** 2000; 1 (Suppl 12): 1582-1585.
12. Klewer SE, Samson RA, Donnerstien RL, Lax D, Lamora R, Goldberg SJ. Comparison of accuracy of diagnosis of congenital heart disease by history and physical examination versus echocardiography. ***Am J Cardiol*** 2002; 89: 1329-1331.
13. Bloch A, Crittin J, Jaussi A. Should functional cardiac murmurs be diagnosed by auscultation or by Doppler echocardiography. ***Clin Cardiol*** 2001; 24: 767-769.
14. Mahnke CB, Vowalk A, Hofkosh D, Zuberbuhler JR, Law YM. Comparison of two educational interventions on pediatric resident auscultation skills. ***Pediatr*** 2004; 113: 1331-1335.
15. La Combe MA. On bed side teaching. ***Ann Int Med*** 1997; 115: 217-220.
16. Gessner IA. What makes a heart murmur innocent? ***Pediatr Ann*** 1997; 26: 82-91.
17. Danford DA. Effective use of the consultant, laboratory testing and echocardiography for the pediatric patient with heart murmur. ***Pediatr Ann*** 2000; 29: 842-848.
18. Advani N, Menahem S, Wilkinson JL. The diagnosis of innocent murmur in children. ***Cardiol Young*** 2000, 10: 340-342.
19. Poddar B, Basu S. Approach to a child with a heart murmur. ***Indian J Pediatr*** 2004; 71: 63-66.
20. Danford DA, Nasir A, Gumbier C. Cost assessment of the evaluation of heart murmurs in children. ***Pediatr*** 1993; 91: 365-368.
21. Bensky AS, Covitz W, Du Rant RH. Primary care physician's use of screening echocardiography. ***Pediatr*** 1999; 103: e40.
22. Hurwitz RA, Caldwell RL. Should pediatric echocardiography be performed in adult laboratories. ***Pediatr*** 1998; 102: 365-368.
23. Stanger P, Siverman NH, Foster E. Diagnostic accuracy of pediatric echocardiograms performed in adult laboratories. ***Am J Cardiol*** 1999; 83: 908-913.