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Paediatric Echocardiography in Jos University Teaching Hospital: Problems, Prospects and Preliminary Audit

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Summary

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Background and Objectives: The pattern of paediatric heart diseases at the Jos University Teaching Hospital has not been described previously. The objective of this study was to document the pattern of heart diseases in children undergoing echocardiography at Jos University Teaching Hospital during an eight-month period and to identify the problems encountered.

Patients and Methods: The indications and findings in 48 children undergoing routine transthoracic echocardiography from December 1999 to July 2000 were retrospectively analyzed. The problems encountered were also noted.

Results: The main indications for echocardiography were rheumatic heart disease (RHD) in 15 (31.5 percent), acyanotic congenital heart disease (CHD) in 10 (20.8 percent) and cyanotic CHD in six (12.5 percent) children. Others were evaluation of cardiac murmurs in six (12.5 percent), unexplained heart failure in three (6.3 percent), pericardial effusion in two (4.2 percent) and cardiac arrhythmia in two (4.2 percent). Significant abnormalities were found in 38 (79.2 percent) of the patients; these were congenital heart diseases in 16 (33.3 percent) and acquired heart diseases in 22 (45.8 percent). Ventricular septal defect (VSD) was an isolated lesion in six (37.5 percent) but was associated with other congenital lesions in nine others. Fallot tetralogy was the commonest cyanotic heart condition encountered. Doubling of cost during the second half of the period of review reduced the access of our patients to the investigation by one third. Excessive strain on the machine from overuse, multiple users and power fluctuations were identified as some of the factors that led to the breakdown of the equipment after only eight months.

Conclusions: The pattern of paediatric heart disease in the hospital is similar to those reported from other parts of the country. The cost of paediatric echocardiography should be kept to a minimum, while the lifespan of the machine could be prolonged by restricting its use to echocardiography and vascular procedures and by the provision of stable power supply.

Key Words: Echocardiography, Children, Heart, Lesions

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Introduction

HEART diseases constitute a major cause of childhood morbidity and mortality in Nigeria.[1] Although the overall incidence is largely unknown in much of the developing world, it is thought that it may be twice that of developed countries. This has been attributed mainly to the high incidence of rheumatic heart disease in many developing countries.[2] While a few workers have published accounts of their experiences with some of the types of heart disease that affect Nigerian children,[3-6] and some relatively rare conditions have

been reported,[7,8] data on the overall pattern of heart disease in children in our area are rare. Moreover, as has also been noted in respect of adult patients,[9] there is a paucity of data on the echocardiographic findings in children with various categories of heart disease. This is attributable to the fact that paediatric echocardiography has not been widely available in this country. Even where available, the optimal use of this diagnostic tool is often hampered by factors such as cost, scarcity of skilled personnel and the absence of appropriate probes.

Echocardiography has been available intermittently for over 10 years at the Jos University Teaching Hospital (JUTH). Most of the equipment used were donated to the hospital. Whenever it was available, paediatric patients had also to some extent, benefited from its use, even though the available probes were not usually ideal for the younger children. This, and the fact that the earlier equipment lacked Doppler capabilities limited the use of such equipment in making some specific diagnoses, especially those related to complex intracardiac anatomy, the assessment of valvular incompetence and/or the direction of blood flow. However, to the best of the authors' knowledge, no report of the pattern of echocardiographic findings among paediatric patients in our hospital has previously been published.

For a period of eight months, [November 1999 - July 2000], a refurbished ultrasound imaging system donated to the hospital was in use. Its standard 2-dimensional (2D), M-mode and colour flow imaging capabilities were intact, but neither the pulsed wave (PW) and continuous wave (CW) Doppler, nor the video and still cameras, were functional. Although to some extent deficient, this equipment while in use, provided more specific cardiac diagnoses than had hitherto been available to us. In this report, we present the preliminary results of echocardiographic findings in the 48 children who underwent this investigation in JUTH during the period stated, with particular reference to the pattern of structural heart disease. We also highlight some of the problems that we encountered with the use of this diagnostic tool.

Patients and Methods

Forty eight children with clinical indications for echocardiography, and whose parents were able to pay for the procedure, underwent routine transthoracic echocardiographic examinations during the eight-month period, December 1999 - July 2000. The examinations were performed using an HP model 77020 Ultrasound Imaging System, fitted with either a 5 or a 3.5 MHz transducer, depending on the age and size of the patient. For each patient, intracardiac

Table I

Indications for Echocardiography in 48 Children

	No of Patients			
Clinical Indication	***Male***	***Female***	***Total***	***% of Total***
RHD	3	12	15	31.3
CHD (acyanotic)	4	7	11	22.9
CHD (cyanotic)	4	2	6	12.5
Unexplained CCF	2	1	3	6.3
Cardiac murmur	2	4	6	12.5
Arrhythmia	1	1	2	4.2
Pericardial effusion	2	0	2	4.2
Others	2	1	3	6.3
Total	20	28	48	100.0

RHD = rheumatic heart disease
CHD = congenital heart disease
CCF = congestive cardiac failure
Others = one case each of: suspected endomyocardial fibrosis, suspected infective endocarditis, infantile systemic hypertension, post-Fallot tetralogy (TOF) repair

anatomy was studied using the standard 2D echocardiographic (2DE) views,[10] while valve motion was studied and intracardiac dimensions measured using standard m-mode methods.[10] Valvular incompetence and various shunts were qualitatively assessed using colour flow imaging, but no quantitative assessment was made since the appropriate pulsed wave (PW) and continuous wave (CW) Doppler facilities were not functioning; likewise, no pictures were taken.

Being the only ultrasound equipment in use at the time, this same appliance was utilized for all other hospital ultrasound studies. After eight months in use, the equipment broke down. Furthermore, the cost of echocardiography per patient increased after the first four months, from ₦750.00 to ₦1,500.00.

Results

Although 48 children underwent echocardiography during the period, the procedure was repeated for the purpose of monitoring their disease processes in five patients (once in four patients, twice in the fifth), bringing the total number of procedures to 54. Thirty-six of the 48 children had the investigation carried out during the first four months when the cost was ₦750.00, compared with 12 in the succeeding four months when the cost was ₦1,500.00. This reflected a decrease in the number of parents willing or able to pay for the echocardiogram after the increase in cost was effected.

Clinical characteristics

The 48 children ranged in age from two months to 16 years (mean 6.5±5.2 years) and comprised 20 males and 28 females (M:F ratio = 0.7:1). The indications for echocardiography are summarised in Table I. One of the patients already had his heart lesion (Fallot tetralogy) repaired in a British hospital and was being followed up. Additional clinical conditions or problems encountered in some of the patients included: dysmorphic features consistent with chromosomal anomalies (trisomies 18 and 21, respectively) in two infants with suspected ventricular septal defects (VSD), and sickle cell anaemia (SCA) in two of the six children evaluated for heart murmurs. One of the latter also had central cyanosis, digital clubbing and a loud second heart sound, suggesting pulmonary complications of the disease with pulmonary hypertension.

Echocardiographic findings

Table II summarizes the echocardiographic findings in the 48 children. Thirty-eight (79.2 percent) of them had evidence of structural heart disease (SHD), of which 16 (42 percent) were adjudged to be congenital and 22 (58 percent) acquired. The remaining 10 patients (20.8 percent) had either normal echocardiograms or trivial abnormalities of little or no clinical significance (minimal pericardial effusions in two, and trivial atrioventricular valvular incompetence in the third).

Congenital Heart Disease (CHD)

Table III shows the specific lesions identified in the 16 children with CHD. Ten (62.5 percent) of these were acyanotic CHD, while six (37.5 percent) were associated with cyanosis. Ventricular septal defect, the commonest CHD encountered, was an isolated lesion in six children (37.5 percent). It was however, also associated with all the other CHD encountered, except in one 12-year-old girl who had an isolated ostium

Table II

Summary of Echocardiographic Findings in 48 Children and Mean Ages

Major Findings	*No of Cases*	*% Echo (n=48)*	*% SHD (n=38)*	*Mean Age(±SD)*
Normal echocardiogram	7	14.6	-	5.9±5.6
Trivial abnormalities*	3	6.3	-	6.5±5.0
Congenital heart disease	16	33.3	42.0	2.5±3.2
Acquired heart disease	22	45.8	58.0	9.4±4.5
Total	48	100.0	100.0	6.5 ±5.2

Minimal *pericardial effusions in two patients, and minimal mitral and tricuspid valvular incompetence in one SHD = structural heart disease*

Table III

Specific Lesions in 16 Children with Congenital Heart Disease

Lesions	*No of Patients*	*% of CHD (n = 16)*	*% of SHD (n = 38)*
Acyamptoc CHD	10	62.5	26.3
* VSD (isolated)	6	37.5	15.8
* VSD + ASD II	1	6.25	2.6
* ECD	2	12.5	5.3
* ASD II (isolated)	1	6.25	2.6
Cyanotic CHD	6	37.5	15.8
* TOF*	4	25.0	10.5
* D-TGA**	2	12.5	5.3
Total (individual lesions)	16	100.0	42.1

CHD *congenital heart disease*
SHD: structural heart disease
VSD: ventricular septal defect
ECD: endocardial cushion defect
ASD II: ostium secundum atrial septal defect
TOF: Fallot tetralogy
D-TGA: dextro-transposition of great arteries
**already repaired in one child*
***VSD and ASD present in both cases; dextrocardia present in one case*

secundum atrial septal defect (ASD II). Fallot tetralogy (TOF) was the commonest cyanotic lesion. It accounted for 67 percent of the cyanotic CHD and 25 percent of all the CHDs. The two patients with dextro-transposition of the great arteries (D-TGA), aged three and 13 years respectively, had significant associated shunt lesions.

Rheumatic Heart Disease (RHD)

This accounted for 15 (68 percent) of the 22 cases of acquired heart disease (AHD), and for 39.5 percent of all the structural heart diseases (SHD). Mitral incompetence (MI) was present in all the 15 children with RHD. It was an isolated lesion in six (40 percent) of the cases – three of these showed evidence of pulmonary hypertension (Table IV). The remaining nine patients had multiple valvular pathology, usually incompetence, which included MI in all the cases. Tricuspid incompetence (TI) was present in seven children and pulmonary incompetence (PI) in six. All the six children with PI exhibited other features of pulmonary hypertension such as flattening of the interventricular septum and paradoxical septal motion. Aortic incompetence (AI) was seen in three children. Valvular stenosis was present as part of multiple pathology, in only three cases: mitral stenosis (MS) in two cases, and aortic stenosis in one.

Other Acquired Heart Diseases (AHD)

In seven patients, AHD other than RHD were encountered. Two of these had massive pericardial effusions (PE) showing signs of organisation and evidence of cardiac tamponade. Two young children, presenting with heart failure, a three-year old girl and a four-year old boy respectively, had dilated cardiac chambers with poor myocardial contractility, suggesting dilated cardiomyopathy (DCM) or myocarditis. Cor pulmonale was the diagnosis in two other children; one was a nine-month old infant with chronic lung pathology and the other, a 16-year old girl with pulmonary complications of SCA mentioned earlier. The seventh patient with AHD was a four-year old boy that had recurrent episodes of fever and heart failure since the age of 14 months. He had echocardiographic evidence of right ventricular (RV) endomyocardial fibrosis (EMF).

Table IV

Details of Specific Valvular Lesions in 15 Patients with Rheumatic Heart Disease

Lesion(s)	*No of Patients*	*% of Total*
Mitral incompetence only*	6	40.0
Mitral, aortic, tricuspid and pulmonary incompetence	3	20.0
Mitral incompetence and stenosis with tricuspid and pulmonary incompetence	2	13.3
Mitral incompetence with minimal tricuspid incompetence	1	6.7
Mitral incompetence with tricuspid and pulmonary incompetence	1	6.7
Mitral and aortic incompetence	1	6.7
Mitral incompetence with aortic incompetence and stenosis	1	6.7

*includes 3 with evidence of pulmonary hypertension (PHT)

Intervention/Outcome

The two children with cardiac tamponade from purulent PE, benefited from pericardial surgery and antimicrobial therapy and improved. The parents of four children accepted referral to another centre for possible enrolment in a humanitarian programme offering heart surgery outside Nigeria.[1] A four-month old infant with a large VSD died in hospital of intractable heart failure before a similar referral could be effected. None of the other parents could afford the envisaged cost of travel to, and initial care at the referral centre. The majority of these patients have subsequently been lost to follow-up.

Discussion

This report has to some extent, highlighted a few of the difficulties encountered in the diagnosis and management of cardiac diseases in Nigerian children. These include scarcity of specific diagnostic equipment, skilled manpower, and the frequent breakdown of such equipment even when available. Excessive strains on the machine from overuse, multiple users and power fluctuations were some of the factors identified as contributing to the breakdown of the equipment used in this study. The first two problems could have been circumvented by the provision of a second ultrasound equipment in the hospital, so that the more sophisticated machine such as that used in this study could have been dedicated exclusively to echocardiography and vascular studies, while the simpler one was used for general ultrasound purposes. The provision of a stable power supply and the use of UPS (uninterrupted power supply) equipment, in addition to the voltage stabilizer that was in use, would also have helped to prolong the life of the machine.

Even though the number of patients studied was few and our figures therefore tentative, the high prevalence of AHD in our series relative to CHD is in keeping with the general trend in the developing world, as opposed to developed countries where CHD form the bulk of SHD in children.[2] It is also a reflection of the continued high prevalence of communicable diseases in our society and the fact that these take their toll on the heart as well. Some of these, such as RHD, which accounted for 67 percent of our cases of AHD and almost 40 percent of all the SHD seen, are almost entirely preventable. An improvement in housing conditions and the sensitization of health workers such that cases of streptococcal pharyngitis and acute rheumatic fever are identified early and treated

appropriately, should lead to a fall in the prevalence of RHD as has been the experience of many developed nations. The fact that we identified two cases of DCM and one of EMF in young children during the short period covered by this report, suggests that these cardiomyopathies though commonly seen in older patients, may actually begin their natural histories much earlier in life.

The relative frequencies of individual CHDs in this small series is generally consistent with reports from other parts of Nigeria[3,4] and the world,[11-14] with VSD being the commonest lesion and TOF the commonest cyanotic lesion. The two cases of d-TGA (aged four and 13 years, respectively) that we identified shows that a few of such cases, usually those associated with large shunt defects as in these two children, may survive early childhood even without surgical intervention. The importance of echocardiography in differentiating the condition from TOF and other less common CCHDs cannot be overemphasized.

This report has also highlighted the fact that specific diagnostic and treatment modalities are still outside the reach of the majority of our children with heart disease. Since these are very commonly encountered problems in paediatric practice, they should receive greater attention from our health planners than they currently do. While the efforts of a few non-governmental organisations in funding the surgery that was undertaken outside the country for some of the affected children must be commended, the demand for such treatment is much more than these NGOs alone can cope with. Therefore, our health planners must be convinced of the need not only to control communicable diseases, but also to allocate resources for the diagnosis and treatment of the non-communicable diseases such as CHD, that have for too long, been neglected in our health care delivery system. As a first step in this regard, paediatric echocardiography as a diagnostic tool should be made more widely available, especially in the tertiary health facilities. Centres currently lacking the purpose-built echocardiographic equipment could in the short term, improvise by using the general purpose ultrasound machines that are currently available in many centres. Although they are usually fitted with the rather large abdominal probes that may not be ideal for the paediatric chest, and may not be equipped to provide detailed haemodynamic information, such machines are still useful in the confirmation of simple abnormalities such as large septal defects or pericardial effusions. With some practice and/or additional training, these could be undertaken by personnel conversant with, and who currently carry out upper abdominal ultrasonography. As the user gains more experience and confidence in cardiac ultrasound, there is likely to be a demand for more appropriate probes/instruments. In order to stimulate paediatricians' interest and improve proficiency in this procedure, it is recommended that short courses in paediatric echocardiography be organized for the benefit of interested paediatricians and residents. Because of the high clinical workload in the face of high demand for echocardiography, it is also recommended that other health care personnel such as radiographers be trained to perform basic echocardiography. Video recordings where possible, could be made of such procedures for later review and interpretation by the clinician, as is currently being done in other countries. Finally, for the benefit of the maximum number of children, the cost should be kept to a minimum.

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