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ECHOCARDIOGRAPHIC CHARACTERISTICS OF CHILDREN WITH RHEUMATIC HEART DISEASE AT MOI TEACHING AND REFERRAL HOSPITAL (MTRH), ELDORET, KENYA

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ABSTRACT: *This study sought to determine the echocardiographic profile of paediatric patients with RHD at Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya. It employed a cross sectional study carried out between October 2009 and October 2010 in the general peadiatric wards, paediatric outpatient clinic and cardiology clinic at the MTRH. The study subjects were children with RHD aged 3 to 15 years, in total, Eighty four children (28 boys and 56 girls) with RHD were enrolled. Consecutive sampling was done. Data was collected in a structured questionnaire and analyzed using Genstat discovery. From the study findings, most new patients presented in NYHA class 3 and 4. Mitral regurgitation alone was the commonest lesion, followed by mitral regurgitation + aortic regurgitation. New patients had echocardiographic evidence of severe valvular disease and complication implying late presentation. Since most of the new patients had severe disease at diagnosis, emphasis should be put on early detection and primary prevention.*

KEYWORDS: Echocardiographic, profile, paediatric, Children

INTRODUCTION

Rheumatic heart disease (RHD) is the commonest acquired heart disease and a major cause of morbidity and mortality among children in developing countries. In the past 50 years, it has remained a major paediatric public health problem in developing countries. There are 2.4

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million children aged 5–14 years who have RHD worldwide. According to the WHO programme, the global average prevalence rate of rheumatic heart disease was 2.2 per 1000 (range between 0.1 and 12.6) with the highest prevalence occurring in Sub-Saharan Africa with a prevalence of 5.7 per 1000 [the highest prevalence rates were Zambia (12.6), Sudan (10.2)], compared with 1.8 per 1000 in North Africa, and 0.3 per 1000 in developed countries (WHO, 2001). In Kenya, a prevalence of 2.7 /1000 was documented (WHO, 1992). Earlier. large scale population studies in Cambodia and Mozambique found prevalence of 21.5/1000 and 30.4/1000 respectively (Halim & Jacques, 1961).

RHD accounts for 12–65% of hospital admissions related to cardiovascular disease, and for 2.0–9.9% of all hospital discharges (WHO, 2001; 1992). It is a major cause of morbidity, disability and mortality in developing countries.

The disability-adjusted life years (DALYs) lost to RHD ranged from 27.4 DALYs per 100 000 population in the World Health Organization (WHO) Region of the Americas, to 173.4 per 100 000 population in the WHO South-East Asia Region. An estimated 6.6 million DALYs are lost per year worldwide (WHO, 2001). An estimated 60 000 children and young adults die annually from rheumatic heart disease. The mortality rate per 100 000 population varied from 1.8 in the WHO Region of the Americas, to 7.6 in WHO South-East Asia Region. A case fatality rate of, 9.7% has been reported in Fiji. The annual mortality is 1.5% per year which is a conservative estimate. The most devastating effects are on children and young adults in their most productive years (WHO, 2001; Nkomo, 2007; Steer, Adams, Carlins, Nolan, & Shann, 1999).

The key to accurately diagnosing rheumatic heart disease is to widen the availability of echocardiographs and to standardize a screening approach. To date, many cases of rheumatic heart disease have been diagnosed with a stethoscope, but these pick up the worst cases only! Advantages of echocardiography include the fact that it allows the valve structure to be detected, which should prevent patients with carditis from being misclassified as non carditis and vice versa (Nainggolan, 2006).

RATIONALE

Currently, echocardiography profiles of rheumatic heart disease in children at the Moi Teaching and Referral Hospital have not been documented. The recent acquisition by M.T.R.H of an echo machine (Macuine 2D-echomodel HP 2500 by Hewlett Packard) should enable clinicians to further refine their diagnosis of RHD into the various valvular lesions.It is envisaged that 2D- echocardiography will define the pattern of valvular damage, extent of complication and more importantly facilitate processes geared towards early medical and surgical management of RHD.

This study therefore sought to determine the echocardiographic profile of paediatric patients with RHD at Moi Teaching and Referral Hospital in order to establish the extent and magnitude of valvular damage and complication of RHD. The new knowledge acquired from

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this study will also be used to inform future medical and surgical interventions prescribed to these patients.

MATERIALS AND METHODS

The study was conducted at MTRH paediatric wards, outpatient clinic and paediatric and adult cardiac/ echocardiography clinic of the Moi Teaching and Referral Hospital (MTRH) using a cross-sectional study design. Paediatric patients with rheumatic heart disease aged 3-15 years at MTRH paediatric outpatient clinic, cardiology clinic and echocardiographic laboratory between October 2009 to October 2010 were the target population. Children aged 3-15 years were chosen because the incidence of pharyngeal infections, rheumatic fever and RHD is highest in this age group. RHD is uncommon before 3 years of age.

All children who met the clinical diagnosis and American heart association diagnostic criteria of RHD during the study period were included. A diagnosis of RHD was based on a combination of history, clinical examination, and WHO diagnostic criteria of RHD defined by an expert panel convened under the auspices of the WHO and the National Institutes of Health in September 2005. Using the American heart association combined criteria for diagnosis of RHD Children seen in the clinics and wards with a suspected or known diagnosis of RHD were re-evaluated by the principal investigator and those with symptoms and signs suggestive of rheumatic heart disease were selected for investigation for possible inclusion into the study.

The author sensitized the pediatric wards, pediatric outpatient, echocardiographic laboratory and cardiology clinic staff on the study. When children with rheumatic heart disease were admitted or seen in the clinic the principal investigator was alerted and she evaluated them for possible inclusion in the study.

The author then evaluated all children with a diagnosis of RHD for the following symptoms and signs; cough, haemoptysis, dyspnea, paroxysmal nocturnal dyspnea, orthopnea, chest pain, palpitation, syncope, body swelling, easy fatigability, abdominal distention, oedema, murmurs, wasting, tachypnea, cyanosis, tender hepatomegally, thrill basal crepitations, and the heart rate and rhythm. New York Hear association Classification was uses in this study to estimate the functional capacity of what the patient's heart will allow the patient to do [NYHA developed as functional classification for patients with heart disease] (The Criteria Committee of the New York Heart Association, 1994) .

A transthoracic, M- Mode, two dimensional 2D-echodoppler and colour flow Doppler echo cardiography was done by two trained technicians in conjunction with the principal investigator and the results recorded on a video tape that was reviewed by a cardiologist.

FINDINGS

The demographic characteristics of the patients who were included in the study are presented in Table 1. A total of eighty four children with rheumatic heart disease were enrolled in the study (46 new patients and 38 on follow-up treatments).

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Table 1; the demographic characteristics of patients with rheumatic heart disease

	Patient type		
	No. of patients with an initial diagnosis of RHD	No. of patients on follow up	Total
Female	32(38.10%)	24(28.57%)	56(67%)
Males	14(16.67%)	14(16.67%)	28(33%)
Total	46(54.76%)	38(45.23%)	84

Overall, there were more female patients 56(67%) than males 28 (33%), with a male to female ratio of 1:2.The median age was 11 yrs. (3.5, 15). There were more new patients than those already on treatment who were being followed up.

There were no significant differences in nutritional status by gender, with 50 % (14) and 52 % (29) of males and females respectively having normal weight for age. Forty three percent of both male and female were underweight while only 5% of the females and 7% of the male had marasmus.

The distribution of patients by age group and nutritional status is presented in Figure 1.

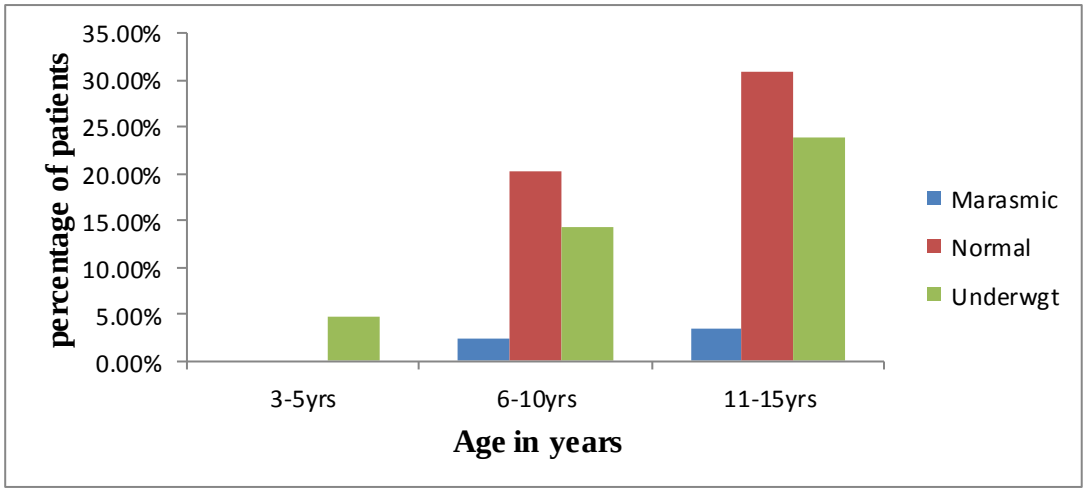

Figure 1. Percentage of patients with Rheumatic heart disease (y-axis) having different nutritional status within each age group of the population studied

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There were 49(58.33%) children aged >10yrs, 31(36.90%) between 6-10yrs and four (4.76%) aged less than 5 years.From the population studied, half of the patients (51.19%) had a normal weight for age, 42.68% were under weight and 5.95% were marasmus.

Valvular Lesions

Different types of valvular lesions and the percentage of patients exhibiting combinations of the lesions are presented in Table 2.

Table 2 : Frequency distribution of valvular lesions in total study population

Valvular lesion type	Number of patients	Percentage of total number of patients (T=84)
MR	39	46.43%
MR+AR	30	35.71%
MR+MS	5	5.95%
MR+MS+AR	3	3.57%
MS+AR	3	3.57%
MR+MS+AR+AS	2	2.38%
MS	1	1.19%
AR	1	1.19%

The most common lesion was isolated MR present in 39 (46.43%) patients followed by combined MR+AR present in 30 (35.71%) of the patients.

Overall more patients had more than one type of valvular lesion 43(51.19%) compared to those who had only one diseased valve 41(48.81%).

Mixed mitral valve and mixed aortic valve disease were present in 40(47.62%) and 38(45.24%) of the patients of respectively.

MR was present in 94.04% of the patients (only 5 patients did not have MR). No patients had lesions in all the 4 valves.

A Wilkin score was determined for all patients with Mitral stenosis either alone or in combination with other lesions, and differences exhibited by patients on secondary

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prophylaxis and patients not on prophylaxis, patients of different gender and NYHA classes were tested to determine whether or not they were significant (Table 3)

Patients with a score < 8 are more favorable candidates for balloon valvotomy while those with a score of >8 are candidates for surgery.

Table 3: Proportions of patients with mitral stenosis with different characteristics

Characteristic	Observations with Wilken score<8	Observations with Wilken score>8	Total number of observations	P value
Gender				0.700[2]
Male	4	1	5	
Female	6	3	9	
NYHA class 1	1	-	1	0.006[2]
2	2	-	2	
3	3	3	6	
4	4	1	5	
New patients	5	1	6	0.004[2]
Patients on follow-up				0.028[2]
Adherent	3	1	4	
Not adherent	2	2	4	

[1]chisquare test , [2] fishers' exact test

MS was present in 16.67% of the patients aged 8-15 years. Most patients (71.48%) with MS had a Wilkin score of <8, with significantly more non-compliant patients than patients compliant to secondary prophylaxis presenting with Wilkin score >8. Patients in NYHA class 3 and 4 were more likely to have a Wilkin score >8

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Table 4: Severity of valvular lesion

Valvular lesion	New patients	Patients on secondary prophylaxis			Total
		Adherent	Not adherent	P value	
MR				0.135[2]	
Mild	6(13.04%)	6(21.43%)	0		12
Moderate	7(15.22%)	6(21.43%)	1(11.11%)		14
Severe	30(65.22%)	13(46.43%)	7(77.78%)		50
Normal	3(6.52%)	4(14.29%)	1(11.11%)		8
MS				**0.011**[2]	
Mild	1(2.17%)	0	1(11.11%)		**2**
Moderate	2(4.34%)	4(13.79%)	3(33.33%)		**9**
Severe	3(6.52%)	0	4(44.44%)		**7**
Normal	40(86.96%)	25(96.15%)	1(11.11%)		**66**
AR					
Mild	6(13.04%)	5(17.86%)	1(11.11%)	**0.024**[2]	**12**
Moderate	11(23.91%)	3(10.71%)	0		**14**
Severe	23(50%)	1(3.57%)	4(44.44%)		**28**
Normal	6(13.04%)	20(71.43%)	4(44.44%)		**30**
AS				0.425[2]	
mild	0	0	1(11.11%)		1
Moderate	1(2.17%)	0	0		1
Severe	0	0	0		0
Normal	45(97.83%)	29(100%)	8(88.89%)		82

[1]chisquare test , [2] fishers exact test

Non- compliant to secondary prophylaxis had an association with more severe MS and AR with p values of 0.011 and 0.024 respectively. However since this study was not powered enough to determine the significance of this association, larger studies need to be done to find out if this associations significant.

Most new patients had severe valvular disease especially those with mitral regurgitation and aortic regurgitation.

Complications found on echocardiography

Pulmonary hypertension was the commonest complication (52%) followed by functional tricuspid regurgitation. There were no patients with left ventricular diastolic dysfunction

Occurrence of vegetation's did not differ significantly with gender, NYHA class or nutritional status. However, vegetation's were more common among patients with severe valvular lesions ($p < 0.05$), the significance of this association need to be determined by larger studies.

ISSN 2053-406X(Print), ISSN 2053-4078(Online)

Table 5; Complications versus valvular lesion

	Pulmonary Hypertension	TR	LV systolic dysfunction	Vegetation	PI
MR	16(36.36%)	13(32.5%)	4(36.36%)	1(20%)	1(50%)
MR+AR	15(34.09%)	17(42.5%)	6(54.54%)	2(40%)	1(50%)
MR+MS	5(11.36%)	4(10%)	0	1(20%)	0
MR+MS+AR	2(4.54%)	1(2.5%)	1(11.11%)	0	0
MS+AR	3(6.82%)	2(5%)	0	1(20%)	0
MS	1(2.27%)	2(5%)	0	0	0
AR	1(2.27%)	0	0	0	0
MR+MS+AR +AS	1(2.27%)	1(2.5%)	0	0	0
Total	44(52.38%)	40(47.62%)	11(13.10%)	5(5.95%)	2(2.38%)

Complications were commoner in patients with isolated MR and MR with AR than in those with other valvular lesions.

Analyses of factors affecting pulmonary hypertension

Results from the analysis of variance for factors influencing the severity of pulmonary hypertension are presented in Table 6 respectively.

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Table 6: Levels of significance for various patient characteristics (factors) influencing the severity of pulmonary hypertension in patients with RHD

Patient Characteristic	Severity of pulmonary hypertension			Total	Significance level (P value)
	Mild	Moderate	Severe		
Gender					**0.033[2] (*)**
Male	2	4	6	12	
Female	3	8	21	32	
NYHA Class					
1	0	1	0	1	
2	2	2	3	7	**<0.001[2](***)**
3	3	2	13	18	
4	0	7	11	18	
New patients	2	9	18	29	0.096[2] (ns)
Adherence					
Yes	3	1	4	8	**0.039[2] (*)**
No	0	2	5	7	
Severity of valvular lesions (Covariate)					**<0.001[2] (***)**

ns = not significant, * = significant at 95%, *** = significant at >99%
[1]chisquare test , [2]fisher's exact test

More female patients had severe pulmonary hypertension than their male counterparts ($p<0.05$).The severity of pulmonary hypertension was greater for patients in the NYHA classes 3 and 4($p<0.001$). A large number of new patients had severe pulmonary hypertension (18), but this was not statistically significant. Compliant to the secondary prophylaxis was associated with normal pulmonary pressure for a large number of patients ($p<0.039$), with only four of the patients on follow-up treatment having severe pulmonary hypertension.

Severe pulmonary hypertension was higher in patients with more severe valvular lesions ($p=<0.001$).

DISCUSSIONS

Demographic characteristics of patients with rheumatic heart disease

Rheumatic heart disease continues to be a major health problem in the developing countries. It accounts for a large percentage of cardiovascular disease related pediatrics admissions in Kenya. The last prevalence study that was done in 1992-1994 in Kenya showed a high prevalence (27/1000) of RHD, results which are consistent with recent studies in other developing countries (Steer et al., 1999). However; this is in contrast to its virtual extinction

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in the developed world.

Results from this study revealed that there were more females, than male with RHD, with a male to female ratio of 1:2.This is similar to Karen Sliwa's *et al.* study in Soweto, South Africa where African females had a prevalence of 68%, Essein (2008) in Nigeria and Paar *et al* (2010) in Nicaragua. Other recent studies have however depicted either no difference in the prevalence of RHD amongst males and females, or depicted females as the dominant patient population while others depicting males as the most predominant gender (Halim &Jacques, 1961; Sadiq et al, 2009; Hasab et al., 1997; Danbauchi et al., 2004; Folger et al., 1992; Sani et al., 2007; Ayub, 2009; Veasy et al., 1994; Siddig et al., 1992). Rheumatic fever and RHD are more severe and have a worse prognosis in females than in males. Women produce more vigorous immune response and increased antibody production and estrogen significantly increases proinflammatory cytokine productions thus the elevated immune response in females may even further amplify the adjuvant effect of infection thus putting them more at risk of chronic autoimmune diseases (Fairweathe & Rose, 2004). This may account for the high number of females in this study, because they are more likely to be symptomatic and hence brought into hospital for treatment (Chin et al., 2010).

Children aged less than 5 years were the least prevalent forming 4.8% of those with RHD while those aged 5-15yrs had a prevalence of approximately 95%. This is similar to what was found by Yuko- Jowi at Kenyatta National Hospital who found that 76.4% of cases were aged between 5 and 15 years, while only 3% were less than 5 years old (Yuko-Jowi & Bakari, 2005).

Almost half of children studied had a weight that was less than 80% weight for age (either underweight or marasmic). This could be because of the disease process. Patients with rheumatic heart disease, especially mitral valve disease, are most likely to have cardiac cachexia, but nearly all patients with cardiac disease demonstrate wasting of body fat and skeletal muscle, with muscular weakness and easy fatigability. This is due to disturbances in neuroendocrine, inflammatory, and metabolic systems; anorexia from chronic illness, the unpalatability of a low salt diet, and to a great extent to poor cardiac output due to heart failure. In this study evidence for cardiac cachexia may be seen in the fact almost half of the patients had advanced tricuspid regurgitation which is one of the major criteria for diagnosis of cardiac cachexia in patients with mitral valve diseases. Sadif et al. (2009) in Pakistan found a higher prevalence (67%) of undernourished children with RHD.

Echocardiographic characteristic

This study revealed that the most common lesions seen in patients with rheumatic heart disease were of regurgitant type with mitral valve leading, followed by, aortic valves and the least common was functional pulmonary regurgitation. However, TR and pulmonary regurgitation were all functional. Functional TR was secondary to pulmonary hypertension. This is consistent with previously reported data from different countries (Eissen, 2008). Mixed mitral, mixed aortic and mixed tricuspid (functional TR) valvular lesions were commoner than their respective stenotic valve lesions. A slightly different pattern was

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reported by a study by Yuko-Jowi and Bakari (2005) in KNH that found that a combination of MR and AR was the most common lesion followed by isolated mitral regurgitation. The least common lesions were isolated AR and MS and those mixed with AR and PI.

The most common stenotic lesion was mitral stenosis with a prevalence of 16.7%, with an age range between 8-15 yrs. This prevalence is high compared to other studies done for patients of the same age because in general rheumatic mitral stenosis is seldom encountered before adolescence and is not usually recognized until adult life. However, the natural history of mitral stenosis varies across geographical areas. In developing countries, mitral stenosis progresses much more rapidly, perhaps because of more severe or repeated streptococcal infections, genetic influences, or economic conditions, and may lead to symptoms in the late teens and early twenties (WHO, 1992). Higher prevalences of mitral stenosis have been found in India of up to 50% in some studies mainly in children aged 10-20yrs (Ravish et al., 2003; Andy & Soomrothe, 2001) . Al-Khalifa et al. (2008) in Sudan found mitral stenosis in 9% of the patients. A study at Kenyatta national hospital found a lower prevalence of MS at 2.7% in children aged up to 20 yrs (Yuko-Jowi & Bakari, 2005). This difference may be due to low detection rate related to slow stenotic process and subtle sign, genetic and geographical variations.

Only one patient had aortic stenosis and none had tricuspid stenosis and pulmonary stenosis. This finding was similar to a study by Aurakzai et al. (2009) in Pakistan. A different picture was observed in 1999 in a study in India that found that 50% of patients with rheumatic tricuspid disease had tricuspid stenosis with or without tricuspid regurgitation whereas 50% had isolated tricuspid regurgitation. Isolated tricuspid stenosis was present in 7.4% of these cases. All patients had associated mitral stenosis (Goswami et al., 1999).

Complications detected on echocardiography

Complications of RHD observed included secondary pulmonary hypertension in more than half of the patients and functional tricuspid regurgitation almost half of the patients, this may because most of the patients had severe valvular lesion. Few patients had left ventricular systolic dysfunction and vegetation. Yuko-Jowi &Bakari (2005) in KNH also found pulmonary hypertension as the most common complication commonly seen in mitral valve disease. Sani MU in Nigeria found pulmonary hypertension in 72.19%, cardiomyopathy in 31.8% and functional TR in 30.20% of the patients (Sani et al., 2007).

Almost three quarters of the new patients had pulmonary hypertension at diagnosis most of whom (more than 90%) had moderate to severe pulmonary hypertension. Severe MR, MS and TR were associated with severe pulmonary hypertension. Seventy five percent of the patients that were non–compliant to secondary prophylaxis had moderate to severe pulmonary hypertension compared to just a few of the compliant patients. This may be because secondary prevention of recurrent acute RF prevents development of severe valvular lesion and hence pulmonary hypertension. None of the patients had left ventricular diastolic dysfunction.

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CONCLUSION AND RECOMMENDATIONS

From the study findings, it is evident that most new patients with RHD at MTRH present in NYHA class 3 and 4 with moderate to severe valvular lesion and complicated disease on echocardiography implying very late presentation.

On echocardiography isolated MR was the commonest valvular lesion, while pulmonary hypertension functional TR were commonest complication in patients with RHD at MTRH. Other complications found were pulmonary insufficiency and left ventricular systolic dysfunction.

The author thus recommend further study using Mixed methods studies (qualitative and quantitative) to better understand reasons why children with RHD present at MTRH with severe disease to facilitate intervention.

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