

Research

Characterization of Cardiac Disease in Children (Aged 2 Month to 16 Years) with Congestive Heart Failure in Harare, Zimbabwe: A Cross-Sectional Study

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Abstract

Introduction

The pattern of congestive heart failure varies throughout the world especially between industrialized and developing nations. In children, the burden of congestive heart failure, a significant cause of morbidity and mortality is underestimated in resource limited communities due to lack of documentation. The objective of the study was to characterize the causes of congestive heart failure (CCF) in children.

Methods

An analytical cross-sectional study, conducted at Harare and Parirenyatwa Teaching Hospitals in Harare, Zimbabwe. A total of 112 children aged two month to 16 years with CCF were studied from March to November 200. Diagnosis was made based on symptoms, signs, electrocardiography and echocardiography.

Results

Cor pulmonale and rheumatic heart disease were diagnosed in 27 (24 %) and 24 (21 %) children respectively. Ventricular septal defect was diagnosed in 13 (11 %) children. The prevalence of CCF was 150/100000 per hospital visits. Children with acquired heart lesions were more likely to be HIV infected (86 versus 14 %, p value = 0.019) and admitted into hospital (57 % versus 33 %, p value = 0.01). Acquired heart lesions were more common among the HIV infected children compared to their uninfected peers p value = 0.019. Case fatality among admitted patients was 25 %.

Conclusion

Acquired heart disease was a significant cause of congestive heart failure among the children admitted with heart failure. In resource limited settings, effort to prevent acquired heart lesions may reduce the burden of CCF in children.

Introduction

Heart failure, the inability of the heart to pump blood in a quantity commensurate with the body requirements is a clinical syndrome which has a grave prognosis in its advanced stage [1]. The clinical expression of cardiac failure consisting of signs of pulmonary and systemic venous congestion with altered cardio circulatory performance, is a diagnostic challenge in the pediatric population [1]. The pattern of congestive heart failure varies throughout the world especially between industrialized and developing nations. In children, the burden of congestive heart failure, a significant cause

of morbidity and mortality is underestimated in resource limited communities due to lack of documentation. On average, cardiovascular admissions due to congestive heart failure accounted for 8-10 % of adult medical admissions in West, Central, and Southern Africa [3-6]. Studies done in West Africa estimated the prevalence of heart failure among hospital admitted children at between 3-5 % [7].

The causes of heart failure in children are varied. Whilst children from developed communities succumb invariable to congenital heart pathologies, [8] those from resource constrained communities have an additional burden from largely preventable acquired conditions such as rheumatic heart disease [9-11]. Rheumatic heart disease was the commonest cause of congestive heart failure (CCF) in adult series in Kenya (31.9 %), whilst hypertension and ischemic heart disease contributed to CCF in the U.S. [4]. In developing countries, constrained financial resources limit the proportion of children with surgical correction of congenital heart disease thereby increasing the burden of un-operated congenital heart disease and antecedent morbidity from heart failure [12]. Two studies conducted in Zimbabwe implicated RHD and HIV as important contributor to acquired heart disease [13,14]. However information is scant on the etiological causes of CCF in children.

In a study investigating the pattern of admissions to the paediatric at a tertiary hospital in Harare, Zimbabwe, congestive heart failure contributed to 1 % of all the admissions and had a case fatality of 28.7 % (15). Strategies to improve child survival in developing communities run the risk of neglecting non communicable conditions such as CCF at the expense of communicable diseases. Data on CCF in children is limited despite the fact that it is a common cause of morbidity and mortality.

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The aim of the study was to characterize the causes of congestive heart failure in children presenting to Harare and Parirenyatwa tertiary hospital in Harare.

Methods and Materials

This was a cross-sectional study was conducted from 1st March 2003 to 30th November 2003 at Parirenyatwa and Harare hospitals, tertiary. At both hospitals, paediatric admissions are up to the age of 12 and referrals are from municipal clinics and health centers in the surrounding provinces. Children older than 12 years were admitted to the adult wards. The study was carried out in paediatric and adult medical wards, the outpatient departments and paediatric cardiac clinics.

From March 2003 and November 2003, a total of 74 297 patients aged one month up to 16 years seen at both Parirenyatwa and Harare Hospital, of whom 117 were diagnosed as having clinical congestive heart failure. Five children were not included in the study as 3 of them died soon after admission, one refused to take part in the study and one was discharged before full investigations were done. This left 112 who were recruited for the study.

The investigator identified patients with clinical congestive heart failure, admitted to the medical paediatric and adult wards daily, except on weekends, by examining and reviewing case notes of patients. For children up to 2 years, the Ross score [16] was used for defining heart failure and for those older the modified Framingham criteria was applied [17].

Patients' functional status was classified according to the New York Heart Association Functional classification [18]. This is primarily an adult classification of the severity of heart failure. In infants the historical component of the Ross score for grading of severity of heart failure was applied [19]. Mild heart failure was NYHA score of 1 and 2, moderate heart failure a score of 3 and severe heart failure a score of 4. A Ross score of 3 to 6 was mild heart failure; a score of 7 to 9 moderate heart failure and a score of 10 to 13 was severe heart failure [19].

Patients were evaluated for paediatric clinical case definition of AIDS using WHO guidelines [20]. At the time of the study HIV testing was not routinely offered, but the patients were referred for counseling and testing if the parents of guardian consented. Children with suspected HIV infection as classified according to WHO clinical case definition for paediatric AIDS were referred for pretest counseling at the hospital counseling services and testing for HIV antibodies if their mothers and or fathers agreed. If available the children HIV results were documented. No HIV testing was done for the purpose of the study due to resource constraints. Growth was assessed by measurement of weight (in kilograms) using a Salter weight scale (model Salter 9145 tracker scale) and height on a height board. Weight for height of above -2 Z score for age was normal; between <- 2 and - >3 Z score was moderate wasting and < -3Zscore was severe wasting [20].

Laboratory investigations, as ordered by attending physician, were recorded. Patient treatment details were recorded from patients' case files. No alteration was made to the patients' case files.

Full blood counts were determined in admitted children using a fully automated blood cell counter, SMART-1, Kinghawk, Shandong, China. Anaemia was classified according to WHO recommendations as mild if haemoglobin (hb) level was >8-11 g/l, moderate if hb was 5-8 g/l and severe if hb was <5 g/L, (21).

A twelve lead resting ECG and rhythm strip, a chest radiograph, a complete 2 dimensional echocardiogram and Doppler examination was carried out on most patients, according to local protocol for the investigation of heart failure at no additional cost to the patient. A paediatric cardiologist read the electrocardiograms. He was not blinded to the clinical details of the participants.

The same paediatric cardiologist did the echocardiograms on all patients. The Doppler unit for the study was model SIEMENS 45 27 750 EH 405 German 1997, while the echocardiograph machine was SIEMENS GM6500A2E00. The transducer frequency used was 3.5MHZ. The echocardiograms were carried out with the patient positioned for standard echocardiogram views. Full Echocardiography and Doppler examinations was carried out on all patients with measurements taken as recommended by the American Society of Echocardiography. The echocardiogram and Doppler examinations were carried out for diagnosis of an etiology of congestive heart failure. Anemia with no structural heart lesion was classified as acquired heart disease.

Patients were eligible if they met the following criteria: age above one month and up to 16 years irrespective of gender; if the case definition of congestive heart failure was met and if parents or caregivers gave consent to participate in the study. Each case was entered into the study only once regardless of the number of readmissions or subsequent clinic visits.

Neonates were excluding because of non-specific nature and variation of presenting symptoms in this age group. Children with edema secondary to primary hepatic disease, renal disease, severe malnutrition due to an established inadequate nutritional intake and children who died before investigations were done were excluded

All children meeting the case definition of heart failure were consecutively sampled due to the infrequency of heart failure in children. Enrolled children were followed up to the time of discharge or death. Deaths that occurred outside the hospital were not traced because of difficulties with follow up and reporting.

Data Collection

A predesigned data collection tool that had been pretested in a pilot study was used to collect data. The baseline description of children's socio demographic information, medical history and physical findings on examination were recorded. The study sample size was calculated using the population survey method in Epi Info version 6 statistical package. Based on an estimated 35 000 hospital admissions and visits during the 9 month period, a sample size of 95 was calculated at 95 % Confidence Interval to give a power of 80 % [22].

Data Analysis

Data were entered and analyzed using Statistical Package for Social

Scientists (SPSS version 12.0, Chicago, IL, USA). The baseline description of children was presented. The Pearson Chi-square test was used compare categorical variables between children with congenital and acquired heart lesions; in the case of small sample sizes, the Fisher’s exact test was used. Student’s t-test was used for comparing continuous variables. A p value of 0.05 or less was considered significant.

Permission to carry out the study was sought from the hospitals’ Medical Ethics Board. Informed written consent was sought from participating care-givers and assent was obtained from the participants. Patients who refused to participate in the study or to give their details still got all the necessary treatment and were not prejudiced in any way.

Results

Of the 112 children presenting in CCF, 53 (47 %) were inpatients. The median age in years was 4.8 (Q1 1.8, Q3 9.0) and 62 (55 %) were boys. Eight two (73 %) children lived in urban low income area, 27 (24 %) in rural areas, two (1.8 %) from mining towns and only one from urban high income area. Of the children’s parents or care givers, 72 (65 %) were employed, table 1. The prevalence rate

of congestive heart failure in this series was 150 /100 000 hospital attendances. Thirteen of the children (11 %) died during the study period giving an inpatient case fatality of 25 %.

At presentation 29 children were in mild heart failure (NYHA class 1 and 2), 51 in moderate (NYHA class 3 and 31 in severe heart failure (NYHA class 4). None had undergone corrective cardiac surgery for either congenital or acquired heart lesions. Two cases of congenital rubella were diagnosed by serological tests.

The commonest presenting symptom in this study was night cough (66 %) and cardiomegaly the most frequent clinical sign (85 %), table 2. Feeding difficulty was reported six infants. Twenty two children satisfied the WHO clinical case definition for paediatric AIDS. HIV status was known in 51 children: 21(19 %) HIV infected versus 30 (27 %) HIV uninfected. Among the children with known HIV status, acquired heart lesions was significantly more in children with HIV infection, p value = 0.04 HIV infection. Full blood count reports were available in 47 children of the admitted children and were as follows: 11 % (5/47) severe anaemia (hb < 5 g/dl); 21 % (10/47) moderate anaemia (hb 5-8 g/dl); 45 % (21/47) mild anaemia (hb 8-11 g/dl) and 23 % (11/47) with no anaemia. The five children in the severe anaemia group had no structural heart lesion.

Table 1: Socio demographic, clinical features and HIV status of the 112 children presenting in congestive cardiac failure.

Factor	Acquired heart lesion N=69	Congenital heart lesion N=43	P value
<i>Child factors</i>	<i>n(%)</i>	<i>n(%)</i>	
<i>Median age in months</i>	24 (2-132)	72 (6-168)	-
<i>Sex</i>			
<i>Male</i>	33 (53)	29 (47)	0.16
<i>Female</i>	20 (40)	30 (60)	
<i>Area of residence</i>			
<i>Urban</i>	41(49)	42(51)	0.46
<i>Rural/mining/farming</i>	12(41)	17(59)	
<i>Care giver employment status</i>			
<i>Employed</i>	36 (50)	36 (50)	0.45
<i>Unemployed</i>	17 (43)	23 (57)	
<i>Previous hospital admissions</i>			
<i>Yes</i>	53 (48)	57 (52)	0.34
<i>no</i>	0	1 (100)	
<i>Weight/age</i>			
<i>Normal weight</i>	20 (50)	20 (50)	0.67
<i>Weight ≤-2 Z Score</i>	32 (46)	38 (54)	
<i>Child HIV status</i>			
<i>uninfected</i>	15 (50)	15 (50)	0.49
<i>Infected</i>	12 (47)	9 (43)	
<i>Unknown status</i>	35 (58)	26 (42)	
<i>Disease severity</i>			
<i>Mild</i>	2 (100)	0	0.5
<i>Stage 1</i>	14 (52)	13 (48)	
<i>Stage 2</i>	22 (41)	32 (59)	
<i>Moderate</i>	5 (17)	24 (83)	0.048
<i>Stage 3</i>			
<i>Stages 4</i>			

Table 2: Presenting clinical features classified by age group for the 112 children

Factor	Age< 1 year, N=24	1 year–5years, N=41	Over 5 years, N=47
Symptoms	n(%)	n(%)	n(%)
Night cough	14 (19)	27 (36)	33 (45)
Failure to thrive	14 (20)	28 (40)	28 (40)
Exertional dyspnea	9 (14)	23 (36)	31 (49)
Fast breathing	14 (26)	20 (36)	21 (38)
Paroxysmal nocturnal dyspnea	5 (10)	21 (42)	24 (48)
Peripheral oedema	2 (4)	21 (45)	24 (51)
Cyanosis	1 (7)	7 (54)	5 (39)
Wheeze	2 (25)	2 (25)	4 (50)
Feeding difficulty	6 (100)	0	0

Congenital heart lesions were identified in 43 (38 %) children and acquired heart lesion in 69 (62 %) children. The predominant acquired heart lesions were as follows: cor pulmonale 24 %, rheumatic heart disease (RHD) 14 %, cardiomyopathy 6 % and pericardial effusion 6 %. Congenital heart lesions were identified in 43(38 %) children: 13(11 %) Ventricular septal defect, 7 PDA, 5 AVSD, 5 DOV, 3 ASD and others, table 3. Acquired heart lesions were more common among the HIV infected children compared to the uninfected children 86 versus 14 %, p value = 0.019. Children

with acquired heart lesions were more likely to be admitted into hospital 57 % vs.33 %, p value = 0.01.

Ninety-nine children were discharged home and 13 died in hospital, giving a case fatality rate in admitted patients of 25 %. Of the deceased children nine were boys. Twelve of the children indicated Harare high-density area as their usual place of residence. Acquired heart lesions compared to congenital heart lesions were more common in deceased patients: 11(15.9 %) versus 2 (4.7 %), though not statistically significant p value = 0.12

Table 3: Heart lesion classification for 112 children.

Factor	Total (N)
Congenital heart lesion	
VSD	13
PDA	7
AVSD	5
Double outlet ventricular	5
ASD	3
Pulmonary stenosis	2
Tetralogy of fallot	2
Truncus arteriosus	2
Arrhythmias	
Complex heart lesion	3
Dextrocardiac	2
Congenital rubella	2
Acquired Heart lesion	
Corpulmonale	27
Rheumatic Heart disease	16
Acute Rheumatic fever	8
Cardiomyopathy	7
Anaemia	5
Pericardial effusion	4
Endocarditis	1
Myocarditis	1
Rhythm disorders*	10

* 4 sinus tachycardia, 2 first degree atrial block, 2 atrial fibrillation, 1 ventricular ectopics, 1 low voltage

Discussion

The study documented a congestive heart failure among children aged between 2 months and 16 years of 150 /100 000 per hospital attendances. Despite advances in the past 30 years on diagnosis and management, heart failure still remains a major cause of morbidity and mortality worldwide .In a study in Ibadan, congestive heart failure constituted 5 % of the total paediatric admissions [7] while prevalence among admitted paediatric patients was 1 % in Harare at a tertiary hospital [23]. Our estimates might be an under representation of the burden of CCF as children with mild symptoms were probably not referred for diagnosis ;children being managed in the private sector were not captured in this study and children who came and died before a diagnosis was made were not included, hence contributing to the low prevalence rate in this study.

Acquired heart lesions were identified in 62 % of the children. The predominant acquired heart lesion were cor pulmonale (27 %) and rheumatic heart disease (16 %) This pattern is different from that seen in previous studies on adult black South African where RHD was the commonest underlying cause of heart failure [5]. In a study conducted in 100 Nigerian admitted children aged 8 days to 12 years, acute respiratory tract infections (31 %) and severe anaemia (28 %) were reported among the causes of CCF [7] in contrast to our finding of 11 % of the admitted children with severe anaemia. In different studyconducted among Kenyan admitted patients aged 13 years and above, 32 % of the patients in heart failure had underlying rheumatic heart disease [4]. A study among 50 Zimbabwean infants with HIV infection, who underwent echocardiography examination, identified cor pulmonale in 60 % of the children in that

series [10]. HIV infection is associated pulmonary hypertension from secondary recurrent bronchopulmonary infection or pulmonary arteritis. Before the use of highly active antiretroviral therapy, pulmonary hypertension had an incidence of 1/200 in HIV infected people [24]. None of the patients on this study was on antiretroviral treatment because of cost and availability. As the use of antiretroviral drugs becomes more widespread, further research is needed on their cardiovascular effects on children. Perhaps part of routine workup of a patient with HIV infection for whom treatment is considered should include a baseline echocardiogram.

The contribution of HIV infection to the pathogenesis of congestive heart failure is well described [25]. Since HIV testing was not routinely available at the time of the study we opted to use the WHO clinical paediatric case definition for AIDS as a simple tool for identifying possibly HIV infected children. No association was found between specific heart lesions such as corpulmonale, pericardial effusion or cardiomyopathy and clinical AIDS case definition possible due to the small size that may have prevented a true difference from being detected.

Patients with acquired heart lesions were more likely to be admitted in this study. Since most of the conditions are preventable, the burden of looking after patients with acquired heart disease can be avoided. Control measures to arrest the expanding HIV epidemic, early treatment and prophylaxis against Group A β hemolytic streptococcal are all but simple way of trying to curtail the incidence of CCF secondary to acquired causes.

Unlike in adult studies, congenital heart lesions contribute significantly to heart failure. In infancy and childhood, structural lesions such as left to right shunts, left sided obstructive lesion occur commonly. Un-operated congenital heart disease contributes significantly to morbidity and mortality from heart failure. Septal defects were the commonest congenital lesions in this study 22 %. This is comparable to previous studies [26-28].

Two cases of congenital Rubella were diagnosed by serological tests. It is not national policy to vaccinate adolescent girls and or women of childbearing age against Rubella. In 1999, WHO Region of the Americas found 20 % of all suspected measles cases to be due to rubella [29] and in Zimbabwe data from measles surveillance indicated a proportion of 23 %. Caring for congenital rubella cases is costly and there is need for the strengthening of vaccination program.

Case fatality due to CCF in admitted paediatric patients at Harare Central Hospital was 28.7 % in a previous study (23). The rate is lower in this study since a number of children with CCF may have died on admission before full diagnosis of CCF had been made and therefore excluded in analysis. This gives an underestimation of the contribution of CCF to mortality. During the strike by hospital staff, very few patients were referred to hospital and it is possible that some children might have died at home.

The study had the following limitations: During the study period there were 2 hospital industrial actions by the nursing staff and

medical doctors; one lasted for over 6 weeks. During that time most patients were turned away from the hospitals.

Since patients included in the study were initially screened by the admitting doctor before being referred to the investigator, the true prevalence of cardiac failure in children might be underestimated as some patients in heart failure were missed. Neonates were excluded from the study and as a result congenital causes of heart failure were not captured in the analysis. All patients had ECHO done by one paediatric cardiologist and intra-observer or operator bias was not controlled for. The study was conducted at two referral hospitals, which on general caters for the low-income group. This may have biased towards the low socio-economic class.

The study was done in the middle of national economic hardship characterised by high inflation rates. At the beginning of the study and echocardiogram was ZW \$2 976, 00 and nine months later it cost ZW \$76 000. Lack of funding for the study could have chased away poorer children and those with mild symptoms might have stayed at home. This might also have impacted on the functional classification at presentation and the mortality. No patient was refused ECHO due to lack of money. Chest X-rays were not interpreted by a radiologist due to financial constraints. However, guidelines from standard radiology textbooks were followed.

HIV status of infants under 18 months of age as given by parents or guardians was based on antibody tests, which in some cases reflects transferred maternal antibodies and not HIV infection. A PCR DNA was not offered due to cost. This posed a diagnostic dilemma as a total of 5 infants were less than 18 months.

We recommend a larger community-based study looking at the precipitating factors for heart failure, as early detection and appropriate therapy of children at high risk for heart failure will prevent irreversible myocardial damage. Furthermore, the prevalence of congestive heart failure in children might have changed since this study was conducted a decade ago.

Conclusion

Acquired heart disease was a significant cause of congestive heart failure. The prevalence rate of congestive heart failure among hospital attendees aged 2 to 16 years at Harare and Parirenyatwa hospitals was 150 /100 000. National health programmers aimed at educating the public on early identification of signs and symptoms of preventable heart disease may reduce the burden of CCF in children.

Author's Contribution

Gwendoline Q Kandawasvika: contributed to conception and design, acquisition of data, analysis and interpretation of data, drafting the article or revising it critically for important intellectual content.

Isidore E Pazvakawambwa: contributed to conception and design, acquisition of data, interpretation of data.

Simba Rusakaniko: Provided statistical support, drafting the article and revising it critically for important intellectual content.

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