

Heart Failure in Nigerian Children

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Abstract: Heart failure is an important cause of morbidity and mortality among children. There are very few reports on heart failure among the children living in developing countries. This informed the decision to study heart failure among the children at the hospital. The objectives of this study were to determine how common heart failure is its aetiologies and contribution to morbidity and mortality in childhood. The study was prospective in design and was carried out on consecutive children presenting with heart failure between 1st of April and the 30th of September 2007 at the paediatric emergency unit of Ladoke Akintola University of Technology Teaching Hospital, Osogbo, Nigeria. A total 391 children presented at the paediatric emergency in this 6 months period. Of the 391 subjects, 35 (9.0%) presented with heart failure. The 35 children consisted of 21 boys and 14 girls giving a male to female ratio of 1.5:1. The age range of the children studied was between 1 month and 13 years and the mean age was 3.1 ± 3.5 years. Total 13 (37.1%) children were in the age range 1 month to 1 year while 15 (42.7%) were aged between >1-5 years and 7 were aged >5-12 years. Anaemia, bronchopneumonia, lobar pneumonia, ventricular septal defect, transposition of the great arteries, acute glomerulonephritis, rheumatic fever, myocarditis and septicemia were identified as causes in 57.1, 28.6, 8.6, 2.9, 2.9, 2.9 and 2.9% of cases, respectively. Most cases of anemic heart failure were due to malaria. Of the 28 children aged below 5 years, pneumonia and malaria induced anaemia was responsible for CCF in 26 (92.9%) compared with the equivalent 3 (42.9%) amongst the total 7 subjects aged over 5 years. This difference is statistically significant. $p = 5.52$, $\chi^2 = 0.02$, Yate's correction applied. The average number of hospitalization days was 3.2 and 6.2 for patients with heart failure secondary to anaemia and pneumonia, respectively. Of the 35 children studied 29 (82.9%) had good recovery, 3 (8.6%) died, 2 (5.7%) were discharged against medical advice and one (2.9%) was referred to the university college hospital for further management.

Key words: Childhood, heart failure, good recovery, anaemia, pneumonia, hospitalization, Nigeria

INTRODUCTION

Congestive heart Failure (CCF) is a state in which the heart cannot deliver adequate output for the metabolic needs of the body (Behrman *et al.*, 2000). Heart failure may arise from structural or non structural heart diseases which may be congenital or acquired. Non cardiac causes of congestive cardiac failure include conditions such as renal diseases or hypertension. Anaemia and pneumonia are also capable of reducing the oxygen carrying capacity of blood while septicemia increases the metabolic demand. Accurate diagnosis of the cause of the CCF is essential for treatment and prognosis (Sharma *et al.*, 2003; James and Smith, 2005). It is thus imperative to determine the causes of heart failure among children in order to

prevent or manage them well when they occur. The aetiology of CCF varies with age groups and geographical settings. It also varies across the developing or developed world (Sharma *et al.*, 2003; James and Smith, 2005). Previous studies have shown that most cases of CCF in the neonates are due to congenital heart diseases while those in the school age group are due to lower respiratory tract infections and acquired heart diseases in the developing countries (Sharma *et al.*, 2003; Lagunju and Omokhodion, 2003). Most cases of heart failures in children from developing countries are due to severe anaemia secondary to malaria or respiratory tract diseases (Lagunju and Omokhodion, 2003; Adekanmbi *et al.*, 2007). Infections and anaemia are rarely implicated as causes of heart failure in developed

countries (James and Smith, 2005) because the advances in the health systems of the developed world which place a lot of emphasis on prevention, early detection, prompt and effective management of infectious processes (James and Smith, 2005; Lagunju and Omokhodion, 2003; Adekanmbi *et al.*, 2007).

A lot still needs to be done by health sectors in the developing countries in terms of provision of facilities equipments and manpower in order to manage patients with cardiac diseases. However, a few cardiac centers exist in developing countries, capable of managing individuals with heart failure or disease and this is usually at an exorbitant cost. Thus, there is a need for a regular audit of diseases that can induce heart failure in order to assist practicing physicians to make informed decisions bordering on diagnosis and management of CCF in similar regions.

MATERIALS AND METHODS

Consecutive children aged between 1 month and 12 years with heart failure at the children emergency unit of Ladoke Akintola University of Technology Teaching hospital were studied. These children were studied between the 1st of April 2007 and 30th September 2007. The criteria for making a diagnosis of heart failure were based on the presence of at least 3 out of the 4 cardinal features of heart failure however, the first stated criterion was made mandatory. The four cardinal features are:

- Presence of a tender hepatomegaly of at least 3 cm below the right costal margin
- Presence of tachypnoea at rest in which the respiratory rate is above 50 cycles min^{-1} in infants aged between 2 and 12 months and a respiratory rate above 40 cycles min^{-1} for the older children
- Presence of a tachycardia at rest in which the heart rate is above the upper limit for the age. This would translate to a heart rate >160 beats min^{-1} at infancy, a heart rate above 140 in children aged $>1-2$ years, a heart rate above 120 in the age group $>2-4$ years and above 100 beats min^{-1} in the age groups above 4 years
- Presence of cardiomegaly was defined as an apex beat displaced laterally beyond the mid clavicular line or beyond the 4th intercostals space in children below 5 years and a lateral displacement beyond the mid clavicular line or below the 5th intercostals space in children above 5 years

A detailed history was obtained from the informants or the subjects who met these criteria. Information

obtained includes their names, ages, sexes and other socio-demographic details. Other information obtained after a comprehensive review of the patient include the cause of the heart failure and possible complications.

The details of the length of their hospital stay and outcome were also obtained and recorded in a proforma. Clinical evaluation of the children to determine the cause of the heart failure was by a detailed comprehensive examination. Further more laboratory tests such as pack cell volume were carried out in all patients.

Those with anaemia were further investigated as indicated including the genotype, glucose 6 phosphodehydrogenase enzyme assays and blood film examination for malaria parasites. Blood culture was carried out in subjects with suspected septicemia, endocarditis and pneumonia. The electrolytes, urea and creatinine, urinalysis, urine microscopy, culture and sensitivity were done in all patients with suspected renal diseases.

Plain chest radiographs were also done in patients with suspected pneumonia. Structural heart diseases were confirmed by echocardiography. All patients were managed promptly as emergencies following standard hospital guidelines and protocols for different disease conditions and heart failure. Cases that required transfers or referrals were managed accordingly after stabilization.

RESULTS

Age and sex distribution of the population studied: A total 391 children were seen over 6 months. The 391 children were aged between 1 month and 12 years. Total 35 (9.0%) of the children had heart failure. There were 21 males and 14 females giving a male to female ratio of 1.5:1. The age and sex distribution of the 35 is shown in Table 1.

Aetiology of the heart failure and age predilection: Anaemia was the most common cause of heart failure followed by pneumonia. Other causes of heart failure include ventricular septal defect, transposition of the great arteries, rheumatic fever, hepatitis virus induced myocarditis, septicemia and acute glomerulonephritis. Some patients had more than a single condition for instance 4 of the subjects had both severe anaemia and pneumonia.

Table 1: Age and sex distribution

Age group	Male	Female	Total (percentage of 35)
1-12 months	6	7	13 (37.1)
>1-5 years	11	4	15 (42.9)
>5-12 years	4	3	7 (20.0)
Total	21	14	35 (100.0)

Table 2: Causes of the heart failure

Cause	No.	Total (percentage of 35)
Anaemia	20	57.1
Bronchopneumonia	10	28.6
Lobar pneumonia	3	8.6
Ventricular septal defect	1	2.9
Transposition of the great arteries	1	2.9
Rheumatic fever	1	2.9
Hepatitis induced myocarditis	1	2.9
Septicemia	1	2.9
Acute glomerulonephritis	1	2.9

Table 2 shows the causes of heart failure. Over 85% of the causes were attributable to severe anaemia and pneumonia. Malaria induced anaemia and pneumonia were common in the under 5 age groups. The two children with ventricular septal defect and transposition of the great arteries were aged below 12 months while those with rheumatic fever, septicemia, virus induced myocarditis and acute glomerulonephritis were aged above 5 years. Pneumonia and malaria induced anaemia were responsible for CCF amongst 26 (92.9%) of the 28 children under the age of 5 years compared with the 3 (42.9%) equivalent cases amongst the 7 subjects aged over 5 years. This difference is statistically significant. The $p = 5.52$, $\chi^2 = 0.02$, Yate's correction applied.

Pack cell volumes in the children studied: The pack cell volumes ranged from 7-23% among the 17 patients in whom anaemia alone was identified to be the cause for heart failure. The average pack cell volume among these 17 subjects was 15.4%. Of these 17 patients, 6 had a pack cell volumes ranging between 7-10%, 3 had pack cell volumes between 11-15% also 4 had a pack cell volumes ranging between 16 and 20% and the remaining 4 had pack cell volumes between 21 and 23%. The cause of anaemia in all the 17 patients was malaria although 3 of the patients also had haemoglobin SS disease and another patient had underlying glucose-6-phosphate dehydrogenase enzyme deficiency.

Amongst the 5 children who presented with both anaemia and pneumonia, 4 had pack cell volumes ranging between 21 and 25% while the remaining patient that had a pack cell volume of 13%. The haemoglobin genotype of the patient with the 13% packed cell volume was SS. The other subjects had haemoglobin genotype AA. The pack cell volumes of the remaining patients in whom pneumonia alone was identified as the cause of heart failure ranged between 30 and 38% and the average was 33.5%.

The pack cell volumes of the patients with transposition of the great arteries, ventricular septal defect, acute glomerulonephritis, rheumatic fever, hepatitis virus induced myocarditis and septicemia were 40, 32, 31, 30, 28 and 26%, respectively.

Number of days admitted: The range of the numbers of days spent on admission by the patients with severe anaemia secondary to cardiac failure ranged from 2-4 days with an average of 3.2 days. On the other hand, the patients with cardiac failure secondary to pneumonia stayed between 4-10 days on admission. The average duration of hospitalization was 6.2 days. The lengths of hospitalization among the remaining patients with heart failure secondary to ventricular septal defects, acute glomerulonephritis, septicemia, hepatitis virus induced, transposition of the great arteries and rheumatic fever were 4, 7, 8, 10, 13 and 15 days, respectively.

Outcome: About 3 months old infant with transposition of the great arteries was transferred to the University College Hospital, Ibadan for further care while the patient with rheumatic heart disease was taken away on discharge against medical advice by the mother because of financial problems. An infant with severe anemia secondary to malaria was also discharged against medical advice on the grounds of maternal financial constraints. Two infants and a teenager died. One of the infants that died had both anaemia and pneumonia while the other had a ventricular septal defect. The teenager that died had septicemia from an extensive and poorly treated leg injury. No organisms were retrieved from the blood culture analysis of this patient probably because the patient had started antibiotics long before the blood culture test was carried out.

DISCUSSION

Congestive cardiac failure continues to be a common cause of morbidity and mortality among Nigerian children (Lagunju and Omokhodion, 2003; Adekanmbi *et al.*, 2007; Ayoola *et al.*, 2005). In the present study CCF accounted for 9.0% of paediatric admissions at the emergency unit and this figure is high when compared to the 5.8 and 7.0% obtained at Ibadan and Sagamu, respectively (Lagunju and Omokhodion, 2003; Adekanmbi *et al.*, 2007). The high prevalence figure for CCF may indicate that childhood CCF is a growing problem. The exclusion of neonates in the age groups covered in the present study gives an implication that the figures might have been higher.

Most of the heart failures in the present study were due to anaemia and pneumonia. Anaemia presumably due to malaria was the most common cause of CCF in the present study while pneumonia was the second most common cause of heart failure. Of course, malaria at presentation may have been only the last straw that broke the camels back since the pack cell volume prior to the

presenting attack was not known and we are in a malaria endemic environment. Previous studies among children from developing countries have documented malaria induced anaemia and pneumonia as the leading causes of CCF in Nigerian children (Lagunju and Omokhodion, 2003; Adekanmbi *et al.*, 2007). Lagunju and Omokhodion reported that lower respiratory tract infections were the most common cause of CCF in contrast to findings in the present study and at Sagamu (Adekanmbi *et al.*, 2007) which implicated malaria induced anaemia as the most common cause of heart failure.

This observed difference with Lagunju Omokhodion findings may be due to the fact that the study was conducted at the peak of the rainy season when malaria transmission and infection was at its peak. The duration of hospitalization ranged from 3-15 days. The average hospital stay of 3.2 days by children with anaemia complicated by heart failure on admission appears quite short but can be reduced or even avoided. A previous study has showed that prompt institution of anti-malarials was capable of preventing children with malaria from developing anaemia and the consequent malaria induced heart failure (Oyededeji *et al.*, 2009). The children with pneumonia spent an average of 6.2 days on admissions. These admissions were also preventable because CCF could have been prevented by promptly treating the respiratory tract infection before it became severe or complicated (Azubike and Nkangnieme, 2007). The organisms causing the pneumonia could not be identified in the present study.

Previous studies have shown that *Streptococcus pneumoniae* and *Haemophilus influenzae* are the most common causes of lower respiratory tract infection in children (Azubike and Nkangnieme, 2007; Adegbola *et al.*, 1994). These organisms are preventable by immunization. Vaccines against *Streptococcus pneumoniae* and *Haemophilus influenzae* have been included in the routine national immunization schemes of most developed countries. However, *Haemophilus influenzae* and the pneumococcal vaccine are yet to be adopted into the routine childhood national immunization scheme in most developing countries probably because of the financial implications.

The advent of antibiotics has drastically reduced the prevalence of rheumatic fever which used to be the most common structurally acquired heart disease in developing countries. This may explain the reason why there was only a single case of rheumatic fever recorded in the present study. Ventricular septal defects and Transposition of the great arteries were the only cases of structural congenital heart diseases recorded in the present study. These diseases are chronic heart diseases and their management can be tasking. Furthermore, the cost of managing them is usually enormous. This high

cost was a problem in one of these two children who died. Echocardiography is an important investigative tool in the evaluation of all structural heart diseases. Its cost may however, pose limitations to its use when indicated in resource poor setting such as Nigeria (Ibadin *et al.*, 2005; Bode-Thomas *et al.*, 2007). Furthermore the management of such children may include surgery in specialized cardiac centers which is capital intensive and beyond the means of the families of such children.

RECOMMENDATIONS

In order to reduce the burden of CCF among children in the study area, it is suggested that facilities for prompt diagnosis and treatment of malaria be provided. A study by Oyededeji *et al.* (2010) on children admitted with severe malaria suggests that prompt diagnosis and treatment of malaria with effective drugs may reduce the chances of uncomplicated malaria developing to complicated malaria. Additional reasonable control measures and efforts should be made to curtail the scourge of childhood malaria for example by ensuring the provision and use of insecticide treated bed nets among the children at risk of severe malaria (Oyededeji *et al.*, 2009). Concerted efforts should also be made to increase the scope and coverage of routine immunization so as to include *Streptococcus pneumoniae* and *Haemophilus influenzae* vaccines. A social scheme should also be provided by the government for its less privileged individuals in the society with cardiac diseases needing specialized care.

CONCLUSION

It is stated that most cases of heart failure in Nigerian children are induced by infections. Thus they are preventable. Prompt recognition and management of the underlying causes of heart failure will go a long way in drastically reducing the morbidities and mortalities arising from cardiac decompensation.

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