Underlying congenital heart disease in Nigerian children with pneumonia

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Abstract

Background: Pneumonia is a common cause of childhood morbidity and mortality globally. Some congenital heart disease (CHD) may predispose their sufferer to bronchopneumonia.

Objective: To evaluate the contribution of CHD to pneumonia in children seen in a tertiary hospital.

Methods: Over a year, consecutive children diagnosed radiologically with pneumonia were evaluated echocardiographically for CHD. Certain characteristics in children with pneumonia and CHD were compared to those without CHD.

Results: There were 121 children with pneumonia of which 61(50.40%) were males and their mean age was 10.2 ± 10.93 months. The prevalence of CHD was 14(11.57%), the commonest CHD was ventricular septal defect (VSD) in 7(50.00%). Most of the CHD with septal defect had moderate to large defects. Children with CHD were 3 and 256 times more likely to have heart failure and murmur respectively compared to those without CHD, p = 0.084 and <0.0001. Children with CHD stayed longer in the hospital 11.50 ± 7.03 days than those without CHD 7.38 ± 5.34 days, p = 0.012.

Conclusion: The children with CHD were more likely to have heart failure and murmur compared to those without CHD. Prevalence of CHD in children with pneumonia in this study is high, evaluation of children with pneumonia for CHD is therefore recommended.

Keyword: pneumonia, congenital heart disease, congestive heart failure

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Introduction

Pneumonia is a major cause of childhood morbidity and mortality worldwide. This is even more so in the developing countries and in under-five years of age[1]. In Nigeria pneumonia is estimated to be responsible for 20% of under-five mortality[2]. In a study of acute respiratory infections among children in Northern Nigeria, the rate of pneumonia was estimated to be 1.3 episodes per child per year[3]. Pneumonia is caused mostly by viruses but bacterial, viral, fungal and other agents are important causes of pneumonia[1]. Several predisposing factors for pneumonia have been identified, the major and common ones include disorders of immunity as seen in severe malnutrition, congenital and acquired immune deficiency states especially human immune-deficiency virus (HIV)[4]. Some congenital heart diseases (CHD) that cause increased pulmonary blood flow is a common predisposing factor for pneumonia in children[4].

Ventricular septal defect (VSD), patent ductus arteriosus (PDA) and atrioventricular septal defect (AVSD) are common acyanotic CHD in childhood that predispose to bronchopneumonia[5-7]. Others such as truncus arteriosus (TA) and total anomalous pulmonary venous return (TAPVR) are examples of cyanotic CHD[8]. In the acyanotic CHD because of a left to right shunting of blood, via a septal defect or the arterial duct, there is pulmonary overcirculation and pulmonary oedema[9]. The pulmonary oedema leads to congestive heart failure and becomes a nidus of infection for the lower respiratory tract[10]. The patients with CHD with increased pulmonary blood flow thus presents with pneumonia and congestive cardiac failure (CCF) amongst other features. Thus pneumonia and CCF may be the first signs of an underlying CHD.[4] Most previous reports identified CHD as an underlying cause of recurrent pneumonia i.e. when there are two or more pneumonia episodes in a year.[4,11] Studies that identify features that predict underlying CHD in children with pneumonia at the first pneumonia episode will thus be worthwhile, since pneumonia is a major contributor to under five mortality. This is

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more so as the co-existence of pneumonia and CHD may increase the mortality associated with pneumonia in children. The age at onset of and the severity of symptoms in children with CHD is dependent on the size of the defects. Children with large sized VSD and PDAs tend to present early and have more severe disease including pneumonia.

In this study, children with pneumonia at a tertiary health centre had echocardiography to identify those with underlying CHD. The prevalence of CHD amongst the children with pneumonia was determined. Some characteristics of the children such as the presence of CCF and murmur were evaluated in children with pneumonia and CHD in comparison with those without CHD.

Methods

Consecutive patients presenting to the children's emergency room of the University of Benin Teaching Hospital (UBTH) with pneumonia between March 2011 and February 2012, were recruited for the study. Pneumonia was diagnosed on typical history, physical findings and confirmed on chest radiographic findings of pneumonic infiltrates in either or both lung fields. The biodata of each patient was documented. They included age, gender and socioeconomic class (SEC). The SEC was determined using the method described by Olusanya et al[12]. Each patient was clinically evaluated and findings noted. Other parameters obtained for each patient were duration of admission and outcome. The information was obtained with the aid of a proforma. Ethical approval was given by the Ethics Committee of the UBTH

A chest radiograph was done for each patient as part of the routine investigation for pneumonia in the centre. The radiograph was read by the radiologist and the paediatric pulmonologist (WOO). Pneumonia was confirmed when both reports were positive. All the cases of pneumonia underwent transthoracic 2 Dimensional (2D) and Doppler echocardiography, done by the paediatric cardiologist (WES). Any congenital heart disease so found was noted. The type and size of the defects were documented. The ventricular septal defects were classified based on the site and size. The size of the patent ductus arteriosus was also determined. These measurements were taken to evaluate the impact of defect size on pneumonia. The type of the other CHD were determined and noted.

Heart failure was diagnosed when the patient fulfilled the clinical diagnostic criteria of heart failure outlined below[13].

1. Significant tachycardia for age (>160 beats/min in infancy, >140/min at 2 years, >120/min at 4 years and >100/min above 6 years.) Where fever was present, a 10/ min for every 1^0 C rise in temperature was allowed for.
2. Significant tachypnea for age(>60 cycles/min in the newborn, >40 cycles/ min <24 months, 30 cycles/ min in 2 – 5 years, >28 cycles/ min in 5-10 years and >25 cycles/ min in >10 years)
3. Cardiomegaly(displaced apex beat with a central trachea or cardiothoracic ratio >60% in <5 years and >50% in >5 years)
4. Tender hepatomegaly of at least 3cm size below the right costal margin.

The fulfillment of at least three of the four criteria above was diagnostic of congestive heart failure. The diagnosis of heart failure was made by a senior registrar or a consultant. The patients with pneumonia were treated with antibiotics, those who also had heart failure had diuretics.

Statistical analysis

The data were coded and entered into and analysed using SPSS 16 (Chicago IL). Simple proportions were represented in percentage, continuous variables were presented in means ± standard deviation. The difference in means was tested by student t test, comparison between proportions were done with chi^2 or Fischer's exact test as appropriate. Odds ratio was used to determine the likelihood of children with CHD developing heart failure and having murmur compared to those without CHD. The level of significance was set at $p < 0.05$.

Results

Over the study period, 131 patients were evaluated for pneumonia, pneumonia was confirmed in 121 (92.37%). Of the other 10(7.63%), 8 had bronchiolitis and 2 had croup. The 121 patients with pneumonia were analysed for the study and consisted of 61(50.40%) males and 60(49.60%) females. The patients' ages ranged from 1 – 48 months with a mean of 10.2 ± 10.93 months. The mean age of the male patients 11.95 ± 12.34 months was higher than their female counterpart 9.08 ± 9.78 months. The difference was not statistically significant $p = 0.159$. The majority of the patients 90(74.38%) were <1 year, the age group distribution of the patients are shown in table 1. Most of the patients 54(44.60%)

were in the low SEC, 36(29.80%) are in the middle SEC and 31(25.60%) in the high SEC.

Table 1: Age group and gender distribution of the study population

Age groups (mo)	Male	Female	Total	% of population
<12	44	46	90	74.38
12 – 23	7	7	14	11.57
24 – <36	3	4	7	5.79
>36	7	3	10	8.26
	61	60	121	100.00

mo = months

Of the 121 patients with pneumonia, 14 had congenital heart disease, giving a prevalence of 11.57%. The mean age of the children without CHD 10.67 ± 11.26 months was not significantly higher than those with CHD 6.35 ± 6.74 months, p = 0.16. The age and SEC distribution of the children with and without CHD are shown in table 2. Most cases 10(71.43%) were acyanotic CHD while 4(28.57%) were cyanotic CHD. VSD was the commonest acyanotic CHD in 7(50.00%) while truncus arteriosus was the commonest cyanotic CHD found in 3(21.34%) cases. The distribution of the other CHDs are shown in table III. Of the seven patients with VSD, six (85.71%) had moderate to large size defects while one (14.21%), a trabecular VSD had small size defect. The PDA patients had moderate defect. The cases of Truncus arteriosus were all type I. The mitral stenosis involved valvular and supravalvular membrane.

Of the 14 patients with CHD, more patients 9(64.29%) had their pneumonia complicated by congestive heart failure while of the 107 children without CHD, 40(37.38%) had pneumonia and congestive heart failure, the difference was not statistically significant, p = 0.084. The odds of the children with pneumonia and CHD developing heart failure was 3 folds compared to children without CHD. OR = 3.02. The fractional shortening of the children with CHD 30.6 ± 4.2 (range; 24 – 40) % was lower than that of those without CHD 33.2 ± 5.0 (range; 24 – 41) %. It was not significant, p = 0.11.

Table 2: Socio-demographic characteristics of children with pneumonia and congenital heart disease

Characteristics	without CHD	CHD	p value
Mean Age	10.67 ± 11.26	6.35 ± 6.74	0.164
Male	55	6	0.55
Female	52	8	
High SEC	26	5	
Middle SEC	33	3	0.61
Low SEC	48	6	

CHD = congenital heart disease

Table 3: Distribution of congenital heart diseases in patients with pneumonia

Type of CHD	Number	%
Ventricular septal defect	7	50.00
Truncus arteriosus	3	21.43
Patent ductus arteriosus	2	14.29
Tricuspid atresia	1	7.14
Mitral Stenosis	1	7.14
	14	100.00

CHD = congenital heart disease

The mean age at presentation of the patients with various CHD was highest in patients with VSD 8.57 ± 8.77 months, patients with truncus arteriosus presented at a mean age of 4.67 ± 0.58 months and the patients with PDA presented at a mean of 2.25 ± 1.06 months. The difference was not statistically significant, p = 0.504. The patient with Mitral stenosis and Tricuspid atresia presented at 1 and 4 months respectively. Most of the CHD patients 13(92.86%) had murmurs while only 5(4.67%) of those without CHD had murmurs. The difference was statistically significant, p = <0.0001, OR = 256.20, (95% confidence interval = 28.69 – 2451.1). The patient with CHD who did not have a murmur was 9 months old with truncus arteriosus and a large VSD. Of the four cases of cyanotic CHD, two with truncus arteriosus, had no visible cyanosis. The patient with Mitral stenosis had a diastolic murmur. One of the two patients with truncus arteriosus presented twice with pneumonia over the study period. Thus there was one case of recurrent pneumonia.

The mean duration of admission was 7.72 ± 5.57 days with a range of 2 – 28 days. The mean duration of admission of patients with CHD 11.50 ± 7.03 days was significantly longer than those without CHD 7.38 ± 5.34 days, p = 0.012 (CI = 0.99, 7.24). Of the 121 cases of pneumonia, there were 9(7.4%) mortality. None of the children with CHD 0/14 (0.0%) died and 9/107 (8.7%) without CHD died. Three (21.4%) of the children with CHD have had surgery. Those who had surgery were one case each of truncus arteriosus, VSD and PDA. Except for the truncus arteriosus where a post-surgical mortality was recorded, the others are alive and well.

Discussion

In this study, over a tenth of cases of pneumonia had an underlying CHD. This underpins the importance of CHD as a predisposing factor in the causation of pneumonia in children. Ventricular septal defect was the commonest CHD found in this study being the commonest CHD causing left to right shunting of blood and thus increased pulmonary blood flow[10,14]. The majority of VSDs in this study had moderate to large sized defects. Unrestrictive VSDs and large PDAs are known to present early with symptoms and they are most likely to predispose the children to pneumonia[6,9,14].

The odds of children with CHD developing heart failure were higher than in children without CHD in this study. It did not reach statistical significance perhaps because of the small sample size. The finding is however mirrored in previous studies that identify the contribution of CHD to causation of heart failure in children.[10,15] The size of the defect plays a major role in the proneness to heart failure and pneumonia; this is exemplified by the finding of moderate to large sized defects in most of the children with CHD in this study.

The odds of children with pneumonia and CHD having a murmur were quite high compared to those without CHD. Most of the CHD that predisposes to pneumonia and heart failure will produce a murmur because of turbulent blood flow across the defects. Some of the children without CHD in this study may have developed murmurs from the stretched and regurgitant atrio-ventricular valves as a result of the heart failure. The murmurs may also have been flow murmurs from hyperdynamic circulation.

In clinical practice, the findings of cardiomegaly and increased pulmonary vascular markings on chest radiograph in children with pneumonia were indicators to evaluate further for possible CHD. However this is not always this simple, because in the evaluation of the child, the clinical manifestations of cough, tachypnoea and respiratory difficulty, are the same symptoms that bronchopneumonia presents with[16]. The fine crepitations heard in the lung fields of children with pulmonary eodema should be differentiated from the coarse crepitation on ausculating the chest with bronchopneumonia. It may be confusing[16]. The finding of pulmonary infiltrates on chest radiograph which suggests pneumonia may be confused with similar radiographic findings in pulmonary oedema where the expected finding is mostly increased pulmonary vascular markings[16]. Features of both conditions do co-exist when CHD and pneumonia occurs together which may further compound the situation. Thus it may be difficult to identify children with underlying CHD who present with pneumonia clinically. In this study however, the presence of murmur (which were mostly systolic) and CCF were pointers to the presence of underlying CHD. These features could be used clinically in identifying children with possible underling CHD in children with pneumonia.

The small sized VSD seen in this study may not have contributed to the pneumonia and could very well have been incidental finding on evaluating the child. Small size defects are reported to be picked up on examination of the infants when a systolic

murmur is heard[17]. The systolic murmurs heard in restrictive defects are loud. Small trabecular VSD are common at birth and tend to close spontaneously with age and often have little or no haemodynamic consequence[18]. The presence of murmur should be evaluated thoroughly to exclude innocent murmurs which are not uncommon in children.

Truncus arteriosus is a CHD with common mixing of oxygenated and deoxygenated blood within the truncus. It is associated with increased pulmonary blood flow and thus pulmonary oedema. It may not present with cyanosis as seen in two cases in this study. The absence of visible cyanosis is a reflection of the degree of pulmonary blood flow. In situation of high pulmonary blood flow, the resulting increased oxygenation reduces the degree of cyanosis while worsening cyanosis is the case with decreased blood flow to the lung[8].

The age at presentation of the children with VSD was the oldest in the study, this may have been due to the inability of most patients with CHD to afford surgery in our environment[19]. They are thus exposed to recurrent pneumonia until they eventually have surgery or the defects closes spontaneously. Unfortunately the history of previous pneumonia was not obtained in this study to ascertain this. Truncus arteriosus with increased pulmonary blood flow is commonly associated with recurrent pneumonia[8] as shown in this study as the only case of recurrent pneumonia had truncus arteriosus.

Conclusion

The prevalence of CHD in children with pneumonia is 11.57%, most of the patients had moderate to large sized VSD. The children with pneumonia and CHD were more likely to have a murmur, heart failure and stay longer in the hospital compared to children without CHD. Heart failure and murmur are possible pointers to CHD in children with pneumonia.

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