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Aetiology and Outcome of Community Acquired Pneumonia among Children at a Specialist Hospital in North – Central Nigeria

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SUMMARY

Pneumonia is the commonest and the most severe form of the lower respiratory tract infection. With increasing needs and dwindling resources, the knowledge of the burden of disease in an area will be critical to health-care planning, resource mobilization and allocation of same. This study seeks to identify the pathogens responsible for this devastating childhood disease so as to guide choice of anti-microbial and as such preventing the development of resistance and wasteful spending.

This was a descriptive cross sectional study of children aged < 18 years admitted with the diagnosis of Pneumonia at a tertiary health facility in Lafia North-central Nigeria from the 1st of January to the 31st of December 2019. We obtained relevant data using a standard pre-tested study proforma and analyzed using SPSS v.20.0

Results: Community acquired pneumonia accounted for 11.3% of the overall admissions and most of the children (94.3%) were below age five. Pneumonia accounted for 19.6% of the overall mortality with a case fatality of 15.6%. Blood culture was positive in 33.1% of cases while *Klebsiella sp.* and *Staphylococcus aureus* were responsible for two-third (69.8%) of the pathogens

isolated. Sensitivities were more to the Quinolones and the Aminoglycosides, while resistances were more to the Penicillin (Ampicillin and Amoxicilin). Community acquired pneumonia remains a common cause of under five morbidity and mortality with a positive blood culture in a third of cases. *Klebsiella sp* and *Staphylococcus aureus* were the leading pathogenic cause of pneumonia in this study. The Quinolones in addition to the aminoglycosides should be considered as the first line antibiotics in management of childhood pneumonia.

Introduction

Pneumonia is the inflammation of the lung parenchyma that is usually of infectious origin (Hassen et al 2019). It is one of the leading infectious causes of deaths among children under five years of age especially in developing countries that are still ravaged with vaccine preventable diseases (Salih et al 2011). Pneumonia is the commonest and the most severe form of the lower respiratory tract infection (Shin et al 2018 & Dembele et al 2019).

Close to five million annual deaths among children below the age of five years are attributed to Pneumonia (Gritly et al 2018). With the increasing needs and dwindling resources, the knowledge of the burden of disease in an area will be critical to health-care planning, resource mobilization and allocation of same (Yiltok et al 2017). Understanding the pathogens responsible for this devastating childhood disease will guide choice of anti-microbial and as such preventing the development of resistance and wasteful spending (Dembele et al 2019).

Pneumonia can be diagnosed clinically by constellation of symptoms and signs that includes; cough, fever, pleuritic chest pain and fast breathing (Nirmolia et al 2018). Others which connotes severity includes chest wall in-drawing, flaring of alae nasi, grunting, titubation and cyanosis (Ramezani et al 2015). It can be classified based on source of infection; as community acquired or nosocomial pneumonia, and based on duration; as acute or chronic, based on aetiology; as bacterial, viral and fungal pneumonia and based on anatomic; as lobar, bronchopneumonia and interstitial pneumonia (Olowu et al 2015). Risk factors for pneumonia includes malnutrition, low birth weight, non exclusive breastfeeding and low maternal education among others (Nirmolia et al 2018).

Apriori, there are no previous study in our locality to determine the actual burden and outcome of childhood pneumonia, the aetiological agents including antibiotics resistance, all of which may differ from other parts of Nigeria. The study will guide health-care workers prescription pattern and policy makers on measures that need to be put in place. Hence, we determined the prevalence, bacterial aetiology, sensitivities, resistances and the outcome of community acquired pneumonia among children admitted at the Emergency Paediatrics Unit (EPU).

Material and methods

This was a Hospital based descriptive cross-sectional study.

The study was conducted at the Emergency Paediatrics Unit (EPU) of Dalhatu Araf Specialist Hospital (DASH) Lafia in Nasarawa State.

The state is one of the six North Central States. It shared boundaries with the Federal Capital Territory (FCT) Abuja in the West, Kaduna State in the North, Plateau and Taraba States in the East, Benue and Kogi States in the South. It

has a landmass of 27,117km^2 (10,470 sq m). Its total population according to the 2006 National Population Census was 1,869,377. Nasarawa State's mainstay of economy is predominantly agriculture.

We studied children aged < 18 years admitted for pneumonia at the Emergency Paediatrics Unit DASH Lafia in Nasarawa State Nigeria from 1st January 2019 to the 31st December 2019.

We included children admitted with clinical diagnosis of pneumonia and excluded those whose parents declined consent.

Clinical Characteristics

The clinical manifestations of children with acquired pneumonia included fever, cough, fast breathing, breathing difficulty, easy fatigability, abdominal pain, vomiting, diarrhea, loss of appetite and early satiety etc.

Parents / care-givers of children admitted for pneumonia within the study period were approached for participation. Detailed information about the study, its benefit, risk factors and its confidentiality were explained. A written informed consent was gotten before enrolment of the children into the study. Those enrolled have questionnaire administered by the researchers or a trained research assistant (a house officer). Data generated from the questionnaire included the age, gender, clinical presentation, diagnoses, complications and blood culture results.

Ethical approval was obtained from the Hospital Research Ethics Committee.

Data collection was done through a purposely designed register of all children admitted for pneumonia within the study period. The register contained their names, age, hospital number, date of admission, preliminary and final diagnoses, requested investigations, complications at admission and outcome of care. The bio-data was used in retrieving the folders and tracing their results of investigations from the laboratory department records.

Culture was done using the blood culture media with results available in 3 – 5 days but allowed to stay in an incubator for 10 – 14days before discarding as negative. A positive culture result is further tested for antibiotic susceptibility testing, done using Kirby Bauer technique. The discs of commonly used antibiotics of different concentrations were placed on the nutrient agar.

Data Analysis

We coded the data and enter into an excel spreadsheet before transferring to a Statistical Package for Social Sciences (SPSS) version 20. Categorical variables were presented using frequency and percentages. The age was not normally distributed and was summarized in median and inter-quartile range. Association between categorical variables was determined using chi square test. Results were arranged in tables. The p value was considered significant at < 0.05.

Results

Age and gender distribution of the children with pneumonia

One hundred and thirty-three (94.3%) of the children with childhood pneumonia were aged five years and below. The median age (inter-quartile range) is 6.2 (0.3 – 18) years. There were more males 90 (63.8%) but not statistically significant (p = 0.712). The gender was comparable across the age groups as shown in **Table 1**.

Bacteria Distribution in the children studied

A hundred and thirty (92.2%) of the study population had

their blood culture sample taken at presentation. Of these, forty-three (33.1%) had a positive blood culture. The distribution of various isolates is comparable in males and females as shown in **Table 2**.

Isolated Bacterial Pathogens and Sensitivity Pattern

The commonest bacterial aetiology of community acquired pneumonia isolated in this study was Klebsiella sp, followed by Staphylococcus aureus accounting for 41.9% and 27.9% respectively. Sensitivity were more to the quinolones (Ciprofloxacin, Ofloxacin), Aminoglycosides (Gentamycin, Streptomycin), Macrolides (Erythromycin) and chloramphenicol in that order while resistance are more to Penicillin 'unenhanced' (Ampicillin, Amoxicillin), Co-trimoxazole and Nalidixic acid **Table 3. Bivariates analysis of factors associated with the duration of admission**

Approximately half of the admitted children stayed on admission for 3 – 7 days with only few (14.9%) patients staying beyond seven days. Bivariates analysis showed that the duration of admission was not related to gender or age group. Community acquired pneumonia accounted for 11.3% of the total admission in the year under review. The case fatality rate for pneumonia was 15.6% while it accounted for about one out of every five (19.6%) childhood deaths **Table 4.**

Table 1: Age and gender distribution of the children with pneumonia (Percentages calculated across columns)

Variables	Males n (%)	Females n (%)	Total N (%)	χ^2	p value
Age (years)					
< 1 year	**50 (55.5%)**	**25 (49.0%)**	**75 (53.2%)**	**36.460**	**0.712**
< 5 years	**34 (37.8%)**	**24(47.1%)**	**58 (41.1%)**		
>5 years	**6 (6.7%)**	**2 (3.9%)**	**8 (5.7%)**		

Table 2: Bacteria Distribution in the children studied (Percentage calculation done across rows)

Blood culture results	Male N (%)	Female N (%)	Total N (%)	Percentage
Positive	**23 (53.5%)**	**20 (46.5%)**	**43 (100%)**	**30.5%**
Negative	**56 (64.4%)**	**31 (35.6%)**	**87 (100%)**	**61.7%**
Culture not done	**11 (100%**	**0 (0.0%)**	**11 (100%)**	**7.8%**
Total	**90 (63.8%)**	**51 (36.2%)**	**141 (100%)**	**100.0%**
Staphylococcus aureus	**4 (33.3%)**	**8 (66.7%)**	**12 (100%)**	**4.176**
Klebsiella sp	**10 (55.6%)**	**8 (44.4%)**	**18 (100%)**	
Escherichia coli	**4 (57.1%)**	**3 (42.9%)**	**7 (100%)**	
Proteus sp	**5 (83.3%)**	**1(16.7%)**	**6 (100%)**	

Table 3: Isolated Bacterial Pathogens and Sensitivity Pattern

Aetiology	N (%)	Sensitivity	Resistant
Staphylococcus aureus	12(27.9%)	Ciprofloxacin, Gentamycin, Erythromycin, Chloramphenicol, Nalidixic acid, Streptomycin and Augmentin	Amoxycilin, Cotrimoxazole, Nalidixic acid
Klebsiella sp	18(41.9%)	Ofloxacin, Pefloxacin, Chloramphenicol, Gentamycin and Cefuroxime	Cotrimoxazole and Ampicillin
Escherichia coli	7 (16.2%)	Ciprofloxacin, Gentamycin and Augmentin	Amoxicillin and Nalidixic acid
Proteus sp	6 (14.0%)	Ciprofloxacin, Pefloxacin, Chloramphenicol, Gentamycin and Erythromycin	Ampicillin and Cefuroxime
Total	43 (100%)		

Table 4: Bivariates analysis of factors associated with the duration of admission (Percentages calculated across rows)

Variable	< 3 days N (%)	3 – 7 days N (%)	≥ 7 days N (%)	χ^2	p value
Age (years)					
< 1	11 (24.4%)	25 (55.6%)	9 (20.0%)	21.620	0.352
1 – 5	19 (21.6%)	59 (67.0)	10 (11.4%)		
≥ 5	1 (12.5%)	5 (62.5%)	2 (25%)		
Gender					
Male	32 (35.6%)	41 (45.5%)	17 (18.9%)	16.349	0.516
Female	24 (47.1%)	23 (45.1%)	4 (7.8%)		

Table 5: The burden of community acquired pneumonia

Variables	Total admission	Pneumonia	Percentages (pneumonia)	95% confidence interval CI (%)
Admissions	1243	141	11.3%	9.70 to 13.22
Discharges	1096	116	10.6%	8.90 to 12.54
SAHA	19	3	15.8%	5.52 to 37.57
Deaths	112	22	19.6%	13.31 to 27.95

SAHA- signed against Hospital admission. Percentages calculated across rows

The burden of community acquired pneumonia

Community acquired pneumonia accounted for 11.3% (95% CI, 9.70 to 13.22%) of the total admission over a 12 month. Pneumonia accounted for about one out of every five (19.6%) childhood deaths. The case fatality rate for pneumonia (22 / 141 x 100) was 15.6%) **Table 5**

Discussion

Most (94.3%) of the children with pneumonia in this study

were aged five years and below. This is comparable to 86.3% reported earlier by Yiltok *et al (2017)* in Jos. The similarity may be due to the study population and proximity in terms of geographical location as the two states share border with similar culture and lifestyle.

The present study showed that pneumonia accounted for 11.3% of the total admission. This Hospital prevalence of pneumonia is similar to the 13.3% reported in Ilorin North – Central Nigeria (Abdulkarim et al 2013). In contrast, a retrospective study in Ife South – Western Nigeria found a higher prevalence of 23.3% among children (Kuti and Oyelami 2015). Although, we could not ascertain the reasons for the variations in the studies, the differences in the age of the study population may partly account for it; the present study included children up to the age of 18 years compared with the Ife study which was limited to children aged 15 years. The differences in the geographical areas of the studies may also contribute to the observed differences in the prevalence, while Ife is in South – Western Nigeria, the present study is in North – Central Nigeria. The similarity of our study finding with the Ilorin study may be due to similar study population, admission patterns and geographical region in the two studies.

The prevalence of pneumonia in the current study is lower compared to the 16.3% reported in India (Shin et al 2018). The difference in the study age group may account for the discrepancy. The preponderance of the male gender in the current study is comparable to the observation in the other studies (Yiltok et al 2017 & Olowu et al 2015). Earlier reports have shown that males are generally more prone to infections and tend to constitute a larger percentage of admissions and hence their higher proportion in children with pneumonia (Yiltok et al 2017 & Acacio et al 2015).

Pneumonia accounted for 19.6% of childhood mortality in this study, which is comparable to the global prevalence of 20% (Olowu et al 2015). The case fatality rate of 15.6% in the current study is higher than the 4.7% found in the Philippines by Dembele *et al* (2019). The difference may be due to the variation in study design as well as population. The means of assessing bacteremia in the current study is the "traditional" blood culture bottle that takes 7 – 10 days thereby delaying clinical decisions that may warrant antibiotic change. This may also lead to needless deaths among such children.

The prevalence of bacteremia in this study is 33.1% which is comparable to the 27.5% earlier reported by Abdulkarim *et al* (2013) in Ilorin. The specific bacteria aetiology found to be commoner in the current study were *Klebsiella species* closely followed by *Staphylococcus aureus*. This is similar to the Ilorin study that found predominantly *Staphylococcus aureus* and *Klebsiella species* respectively. Although, our findings are similar but the current study

reported more of *Klebsiella specie* compared with the Ilorin study that found more *Staphylococcus aureus*. The implication of our findings is that the choice of empirical antibiotics in children with pneumonia in our locality should cover the two organisms especially where there are no accesses to blood culture. Most of the cultured organisms were sensitive to the Quinolones, the aminoglycosides and macrolides. Resistant on the other hand is more to the penicillin (Amoxicillin and Ampicillin) and cotrimoxazole. The observation of the resistant to the penicillin may be due to the widespread abuse of these drugs, as over the counter drugs that can be easily procured in most drug outlets in Nigeria.

Conclusion

Our study showed that Pneumonia remains a leading cause of childhood morbidity and mortality especially among the under five and with a high case fatality rate. *Klebsiella species* and *Staphylococcus aureus* were the commonest bacteria pathogens causing pneumonia with sensitivity to the quinolones, aminoglycosides and macrolides as well as resistance to the penicillin (Amoxicillin and Ampicillin) and cotrimoxazole.

Conflict of interest

There is no conflict of interest

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