Full length research paper

Prevalence of bacterial pathogens isolated from sputum cultures of hospitalized adult patients with community-acquired pneumonia at the cape coast teaching hospital, Ghana

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Pneumonia continues to contribute to the causes of infectious disease-related death globally and appropriate antibiotic therapy has been associated with improved survival, but data are limited regarding the etiologic agents for pneumonia in Ghana. The purpose of the study was to assess the prevalence of bacterial pathogens isolated from sputum cultures of hospitalized adult patient's with community-acquired pneumonia (CAP). This study was a cross-sectional study conducted from 1st January, 2013 to 31st December, 2013. The study population consisted of all in-patients aged 18 years and above whose sputum specimens were presented to the hospital laboratory for analysis on suspicious of pneumonia or within 48hours of admission. The criteria for pneumonia used for this study was according to the (American thoracic society guidelines,2007).All patients admitted with suspected CAP were included in the study. Data on age, sex, pathogen isolated were obtained. Specimens for Acid-Fast Bacilli (AFB) and patients with suspected pulmonary tuberculosis were excluded from the study because of the challenges of the laboratory to carry out AFB smears and cultures for Mycobacterium tuberculosis at the hospital. Majority of patients whose sputum samples were analyzed were within the 30-49 age group. The incidence of infection was more in the males (62.2%). Of the total 106 sputum specimens that were submitted for analysis, 84.9% were positive with a microbial isolate, the remaining recorded no growth. The commonest microbes isolated were *Streptococcus species* (*spp*.) followed by *Citrobacter diversus*, *Moraxella catarrhalis* and *Staphylococcus spp*. Out of the 90 positive cultured samples, the ratio of gram-positive isolates to gram-negative was 1:1.5. There was a high prevalence of gram-negative bacteria. Although the sample size is not large, the study reveals that the incidence of infection was age-dependent, with more of the youth being infected. The life-threatening nature of *pneumonia* underscores the importance of using timely surveillance data to guide the effective choice of empirical therapy which will have great impact on morbidity and mortality of patients.

Keywords: community-acquired pneumonia; sputum culture; cape coast

Introduction

Community-acquired pneumonia (CAP) remains important cause of morbidity and mortality despite advances in antimicrobial therapy, and the use of a wide-range of preventive measures (Niederman *et al.*,2001). Highest morbidity and mortality occurs in elderly patients and immune compromised hosts (Torres and Rello, 2010) .CAP is mostly caused by a spectrum of bacterial pathogens (Mandell, 1995). *Streptococcus pneumoniae* is the most commonly identified pathogen in community-acquired pneumonia. Other pathogens that have been reported include *Haemophilus influenza*, *Mycoplasma pneumonia*, *Staphylococcus aureus*, *Legionella spp.*, *Moraxella*

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catarrhalis, Mycobacterium tuberculosis and some gram-negative bacilli (Mandell et al., 2003). Knowledge of the etiologic agents allows for specific narrower-spectrum treatment directed at the particular microorganism, and through collection of information on the various etiological pathogens responsible for pneumonia in a particular community hospital with knowledge of their susceptibility patterns, a database can be generated that can be useful in the development of strategies for local, state or national treatment guidelines.

The main objective of this study was to assess the prevalence of bacterial pathogens isolated from sputum cultures of hospitalized adult patients with community-acquired pneumonia. The specific objectives were to: (1) determine the difference in the microbial isolates between males and females; (2) investigate the variation in the microbial isolates among different age groups; and (3) to ascertain whether there are unique features of local epidemiology.

Materials and Methods

This study was a cross-sectional study conducted between 1st January through 30th December, 2013 to find out the types of microbes that are isolated from sputum specimens cultured at the Cape Coast Teaching Hospital, Ghana. Specimens for Acid Fast Bacilli (AFB) and patients with suspected pulmonary tuberculosis were excluded from the study because of the challenges of the laboratory to carry out AFB smears and cultures for Mycobacterium tuberculosis at the hospital. From 1st January, 2013, all patients admitted to the male and female medical wards suspected of having pneumonia on admission or within 48 hours of admission were screened for eligibility into the study by checking with the medical doctors daily for patients with diagnosis of or suspected pneumonia. The criteria for pneumonia used for this study was according to the (American thoracic society guidelines,2007). Patients were excluded if they were <18 years old, transferred from another hospital (to avoid colonization from other facilities which may affect the type of microbe isolated), or refuse to give consent. A total of 106 patients were recruited in the study. The following data were recorded for each participates: age; sex; date sputum specimen collected and microbial isolate. Sputum collection for microbiology culture was supervised by a nurse or a medical doctor and applying the same standard each time. The sputum sampling technique used involved collection of first morning sputum preferably, before brushing teeth but ensuring that the mouth was rinsed with water on an empty stomach. Patients were coached by a nurse on cough technique to minimize throat irritation and possible contamination of sample

with blood. The patient was instructed to take in a deep breath,filling the lungs as completely as possible followed by contraction of the upper abdominal muscles to expel all the air in one forceful cough. The process was repeated once or twice until mucus was loosened (Richardson,2003). Sputum samples were collected in labeled containers and transported immediately to the lab. Samples with saliva, contaminated specimen with blood, food or mouth wash were rejected. Quantitative sputum culture analysis was carried out at the Microbiology Laboratory of the hospital using the calibrated loop method. A calibrated sterile nichrome wire loop— 4.0 mm diameter to deliver 0.01 ml—was used for the plating. A loopful of the well mixed sputum sample was inoculated on Blood and MacConkey agar plates. The plates were then incubated at 37 oC aerobically for 24 h. They were then examined for bacterial growth. A significant bacterial count was taken as any count equal to or in excess of 100,000 CFU/ml. A less than 100 CFU/ml was interpreted as negative. Bacterial isolates were identified generally using conventional biochemical tests (MacFaddin, 2000).

Data analysis

Inferential statistics were carried out using the GraphPad Prism 5 software. The Student tTest was used to compare the means of the male and female victims of the CAP. One-way analysis of variance (ANOVA) was used to compare the means of the patients under the various age groups against the pathogens. A p-value<0.05 was considered as significant.

Results

A total of 106 patients participated in the study (62.2% males; 37.8% females). Majority were within the 30-49 age group (Table 1). Of the total 106 sputum specimens that were submitted for analysis that year, 90 (84.9%) were positive with a microbial isolates (Table 2), the remaining recorded no growth. The number and proportion of microbes isolated is presented in Table 2. The commonest microbe isolated was Streptococcus spp. followed by Citrobacter diversus and Moraxella catarrhalis. Esherichia coli (E.Coli) was the least microbe isolated. Out of the 90 positive cultured samples, 40 % were gram-positive isolates and 58 % gram-negative isolates respectively. The number of isolates in males was higher for the species of Staphylococcus, Enterobacter, Klebsiella, Moraxella, and Pseudomonas than the females. The females, on the other hand, recorded higher for Streptococcus spp.,Citrobacter species and E.Coli than

Table 1: Demography of patients with positive sputum culture (N=90)

Characteristic	Frequency	Proportion (%)
Age class (years)		
18-29	20	24.4
30-49	39	40.0
50-64	16	16.7
65+	15	18.9
Sex		
Male	56	62.2
Female	34	37.8

Table 2: Number and proportion of microbial isolates

Organism	Number and proportion of isolates (%)		
	Male	**Female**	**Total**
*Staphylococcus*spp *[1]	10 (17.9)	2 (5.9)	12 (13.3)
Streptococcus spp *[2]	11 (19.6)	13 (38.2)	24 (26.7.)
*Citrobacter diversus*θ	7 (12.5)	9 (26.5)	16 (17.8)
*Escherichia coli*θ	0 (0.0)	1 (2.9)	1 (1.1)
Enterobacter spp θ	6 (10.7)	2 (5.9)	8 (8.9)
Klebsiella sppθ[3]	8 (14.3)	2 (5.9)	10 (11.1)
*Moraxella catarrhalis*θ	11 (19.6)	3 (8.8)	14 (15.6)
*Pseudomonas aeruginosa*θ	2 (3.6)	1 (2.9)	3 (3.3)
Candida spp[†]	1 (1.8)	1 (2.9)	2 (2.2)
Total	56 (100)	34 (100)	90 (100)

Note: [*] = Gram-positive bacteria; θ = Gram-negative bacteria; [†] = Other species (fungus)[1] *Staphylococcus* spp included *Staphylococcus aureus* and *Staphylococcus epidermidis*.[2] *Streptococcus* spp included alpha-hemolytic *Streptococcus*; *Streptococcus pneumonia*; *Streptococcus viridians* and *Streptococcus pyogenes*.[3] *Klebsiella* spp included *Klebsiella pneumonia* and *Klebsiella oxytoca*.

Table 3. Age distribution of patients in relation to pathogens

Pathogens	Number and proportion (%) in age class			
	18-29	**30-49**	**50-64**	**65+ years**
Staphylococcus spp[*][1]	2 (10)	4 (0.3)	1 (6.7)	5 (31.3)
Streptococcus spp[*][2]	9 (45)	8 (20.5)	2(6.7)	5 (31.3)
*Citrobacter diversus*θ	3 (15)	7 (17.9)	5 (33.3)	1 (6.7)
*Esherichia coli*θ	0	1 (2.6)	0	0
Enterobacter sppθ	1 (5)	5 (12.8)	2 (13.5)	0
Klebsiella spp[3]	1 (5)	4 (10.3)	4 (10.3)	1 (13.3.)
*Moraxella catarrhalis*θ	2 (10)	7 (17.9)	2 (13.3)	3 (18.8)
*Pseudomonas aeruginosa*θ	2 (10)	1 (5)	0	0
Candida spp[†]	0	2 (13.3.)	0	0
Total	20(100)	39 (100)	16 (100)	15(100)

the males. There was no significant difference between the means of the genders (t-Test, t= 1.777, df = 8, p = 0.113). There was a pattern in the microbial isolates among the age classes, as shown in Table 3. More isolates was found in the younger age classes 18-29 and 30-49 than the older age classes, which recorded similar microbial isolates. The differences in the means of the isolates among the various age classes were not significant ($F_{3, 32}$ = 2.523, p=0.0753).

Discussion and Conclusions

The selection of antimicrobials to be used for empiric therapy should be based on the local results of isolated pathogens and their susceptibility, since early initiation of appropriate antimicrobial treatment is critical in decreasing morbidity and mortality among patients with community-acquired pneumonia. In this study, Streptococcus spp. was the most common sputum culture isolates, which agrees with other bacteriology reports from western countries, consistently identifying Streptococcal spp. as the commonest causative agent for community-acquired pneumonia (File, 2003; Lim *et al*, 2001; Socan *et al*, 1999). In this study, the higher proportion of gram-negative bacteria as against gram-positive bacteria is consistent with Feldman,(2005). Amongst the gram-negative bacteria, Citrobacter diversus was the commonest. No Hemophilus influenza was identified which shows that it is less common cause of pneumonia in our community or environment. Also, the high prevalence of gram-negative bacteria may be as a result of factors such as patient recent hospitalization history, prior antibiotic exposures and other co-morbidities which may have biased our results towards higher rates of gram-negative organisms. The life-threatening nature of pneumonia underscores the importance of using timely surveillance data to guide the effective choice of empirical therapy which will have great impact on morbidity and mortality of patients. Although there was high prevalence of gram-negative organisms in the current study, the collection of data was restricted to patients admitted in the Cape Coast Teaching Hospital, therefore this study may not reflect the true prevalence of the various organisms that were isolated in the Cape Coast metropolis. However, this may be close since most referral cases from the metropolis are sent to the Cape Coast Teaching Hospital.

In conclusion, the study has shown that streptococcus spp. Was the predominant pathogen isolated with also high prevalence of gram-negative organisms. Also males were more susceptible to microbial infection than females. It further reveals that the incidence of infection was age-dependent, with more of the youth being infected though the sample size in this study was not very large. It is recommended that in future, efforts should be made to collect antibiotic susceptibility data which will help create a local prescribing policy which will reduce the mortality and morbidity in patients with community-acquired pneumonia.

Acknowledgements

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