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Original Research Article

Bacteriology and Resistance Patterns of Community Acquired Lower Respiratory Tract Infections

Adekunle O.T.[1], Shittu O.B.[2], Alabi B.L.[3], Adeniyi N.A.[4], Ogunfolakan O.O.[5], Alabi A.O.[6], Agunlejika A.S.[7]

[1]Department of Medical Microbiology and Parasitology, Faculty of Basic Medical Sciences, College of Health Sciences, Obafemi Awolowo University, Ile Ife, Nigeria.
[2]Department of Microbiology, College of Biosciences, Federal University of Agriculture, Abeokuta, Nigeria
[3]Department of Medical Laboratory Science, Medical Microbiology unit, University of Calabar, Nigeria
[4]Department of Medical Laboratory Science, Ladoke Akintola University Hospital, Osogbo, Nigeria
[5]Department of Medical Laboratory Science, Afe Babalola University, Ado Ekiti, Nigeria
[6]Department of Medical Laboratory Science, Ladoke Akintola University, Ogbomosho, Nigeria.
[7]Department of Medical Laboratory Science, State Specialist Hospital, Asubiaro, Osogbo, Nigeria.

Corresponding Author: Adekunle O.T.

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ABSTRACT

Background: Lower respiratory tract infections are considered as one of the major public health problems in Nigeria. They are responsible for high morbidity and mortality rates in children and adults. This study was aimed at isolating organisms obtained from sputum with a view to identifying the organism, and to determine the resistance patterns of the isolated pathogens to conventional antibiotics used.
Methods: Sputa samples were collected from 300 patients with signs and symptoms of LRTIs. Standard microbiological procedures were performed to isolate and identify the organisms. They were subjected to antimicrobial susceptibility testing using disc diffusion technique.
Results: Out of 300 sputa analysed, 55% yielded bacteria growth. *Streptococcus pneumoniae* was the most prevalent accounted for 64.7%, *Klebsiella pneumoniae* 25.1%, *Pseudomonas aeruginosa* 7.0%, *Proteus mirabilis* 2.1%, *Escherichia coli* and *Enterococcus* accounted for 0.5%. Organisms were isolated more in men (56.4%) than in females (43.6%). Mixed organisms were observed in 13.3% of the patients with *S. pneumoniae* and *K. pneumoniae* being the most prevalent and *K. pneumoniae* and *Enterococci* being the least. Age group 26 - 45 had the highest prevalence rate (32.1%).
Conclusion: Fluoroquinolones seemed to be the most effective. High rate of antimicrobial resistance was observed in this study and it has become a significant public health problem. It is paramount to develop measures to curb the increasing prevalence of LRTIs in Nigeria.

Key words: LRTIs, antimicrobial resistance, Prevalence, Sputum.

INTRODUCTION

Lower respiratory tract infections (LRTIs) are considered as one of the major public health problems in developing countries. It includes infection of trachea, bronchi and lungs. It usually occurs when infecting organisms reach the airway of pulmonary parenchyma by bypassing the mechanical and other nonspecific barriers of the upper respiratory tract. These infections occur both among children and adults. [1] It is also one of the leading causes of the morbidity and mortality in the world. [2] In developing countries 30% of all patients' consultation and 25% of all pediatric admissions are of acute

respiratory tract infections [3] which have caused 3.5 million deaths in children every year. [4] The aetiological agents of LRTIs agents vary from area to area, so do their antibiotic susceptibility profiles. [5] Organisms like *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Pseudomonas*, *Acinetobacter*, *Klebsiella*, *Escherichia coli*, have been isolated from cases of respiratory tract infections. [6] Shrestha *et al*. [7] Nweze *et al*. [8] Egbagbe and Mordi, [9] and Kim *et al*. [10] have conducted studies to derive information about etiological agents of LRTI and their antimicrobial susceptibility patterns. The problem of increasing antimicrobial resistance of bacterial species commonly isolated from community-acquired respiratory tract infections is of growing concern to microbiologists and infectious disease physicians. [6] As there is difficulty in establishing bacterial etiology at the time of prescription, antibacterial therapy of LRTIs are usually empirical considering the presence of risk factors and severity of disease. In doing so, this misuse of antibiotics has led to the development of antibiotic resistant bacteria. [1] Resistance of antimicrobials in respiratory tract infection is also a common health problem both for adult and children in Nigeria. Previous institutional and local studies had also hinted at the extent of the problem in Nigeria and some other countries such as the Australia, Europe, Asia, Pacific region and Singapore. [11, 12] The aim of this study is to isolate and identify organisms obtained from sputum and to determine their susceptibility patterns to conventional antibiotics.

MATERIALS AND METHODS

Study design and sample size: Three hundred (300) sputa samples were collected for bacterial examination from hospitalized in and out -patients admitted to the Wesley Guild Hospital, Ilesa in South West Nigeria between the periods of January 2012 to May 2012. Consent of the patients were sought and enrolment criteria used for the study were patients who presented with the signs and symptoms of LTRIs and should not have taken antibiotics 15 days prior to the day of sputum collection.

Microscopy: The quality of the sputum specimens were evaluated based on the Gram's staining detection of more than 25 leucocytes and fewer than 10 epithelial cells per low power field of microscope which is an indication of a true infection [13] These sputa samples were screened for *Mycobacteria tuberculosis* using Ziehl Neelson staining technique. All samples tested were negative.

Culture and Sensitivity testing: Samples were inoculated onto blood agar, Chocolate agar, and MacConkey agar (Oxoid, England). Chocolate plates were incubated in CO_2 incubator (10% CO_2) at 37°C for 24 hours while Blood agar and MacConkey plates were incubated at 37°C for 24 hours in aerobic atmosphere. Bacterial isolates recovered from the sputa samples were identified using biochemical tests like Gram staining, haemolysis on Chocolate and Blood agar, Optochin test and bile solubility tests. They were subjected to antibacterial agents using the Kirby-Bauer disc diffusion method (Oxoid, England) on Mueller Hinton agar and interpreted as recommended by Clinical and Laboratory Standards Institute guidelines (CLSI, 2007). Antimicrobial agents used for this study include: Augmentin (AUG, 30μg), Cloxacillin (CXC, 30μg), Erythromycin (ERY, 30μg), Gentamycin (GEN, 30μg), Ciprofloxacin (CIP, 5μg), Ofloxacin (OFL, 5μg), Tetracycline (TET, 30 μg), Chloramphenicol (CHL, 10 μg). Clarithromycin (CLM, 30 μg), Streptomycin (STR, 10 μg), Co-trimoxazole (COT, 25 μg) and Ocefix (OCF, 30 μg).

RESULTS

Sputa specimens were collected from a total of 300 patients with LRTI during the period of study. Out of 300 sputa analysed, 165(55%) were positive with established bacterial etiology and 135(45%) yielded no growth (Table 1). These patients consisted of 93(56.4.5%) males and 72(43.6%) females (Table 2). The result showed that LRTIs were more prevalent in males than in females.

Table 1: Frequency of isolated pathogens from sputum samples collected.

Respiratory pathogens	Number of patients	Percentage (%)
Positive	165	55
Negative	135	45
Total	300	100

Table 2: Gender distribution of patients with positive sputum specimens.

Gender	Number of patients	Percentage (%)
Male	93	56.4
Female	72	43.6
Total	165	100

Among the isolates, *S. pneumoniae* 121(64.7%) was the most isolated organism, *K. pneumoniae* 47(25.1%) was next, followed by *P. aeruginosa* 13(7.0%), *P. mirabilis* 4(2.1%), *Escherichia coli* 1(0.5%) and *Enterococcus* 1(0.5%) being the least as shown in Table 3.

Table 3: Distribution of bacterial respiratory pathogens in lower respiratory tract infections.

Respiratory pathogens	Number of isolates	Percentage (%)
S. pneumoniae	121	64.7
K. pneumoniae	47	25.1
P. aeruginosa	13	7.0
P. mirabilis	4	2.1
E. coli	1	0.5
Enterococcus	1	0.5
Total	187	100

Table 4: Frequency of patient with mixed growth

Mixed growth of pathogens	Number of patients	Percentage (%)
S. pneumoniae + K.pneumoniae	12	54.6
K. pneumonia + P. aeruginosa	5	22.7
S. pneumoniae + P. aeruginosa	2	9.1
K. pneumonia + P. mirabilis	2	9.1
K. pneumonia + Enterococci	1	4.6
Total	22	100

Table 5: Distribution of patients' sex who had mixed growth

Sex	Number of patients	Percentage (%)
Male	14	63.6
Female	8	36.4
Total	22	100

Table 6: Prevalence of bacteria isolated among age groups

	Age groups (years)					
Species	**15 – 25 No (%)**	**26 – 45 No (%)**	**46 – 65 No (%)**	**66 – 85 No (%)**	**86 – 105 No (%)**	**Total No (%)**
S. pneumoniae	31(25.6)	47(38.8)	23(19.0)	19(15.7)	1(0.8)	121(64.7)
K. pneumoniae	6(12.8)	11(23.4)	12(25.5)	16(34.0)	2(4.3)	47(25.1)
P. aeruginosa	1(7.7)	-	2(15.4)	9(69.2)	1(7.7)	13(7.0)
P. mirabilis	-	2(50.0)	2(50.0)	-	-	4(2.1)
E. coli	-	-	-	1(100)	-	1(0.5)
Enterococci	-	-	-	1(100)	-	1(0.5)
Total	38(20.3)	60(32.1)	39(20.9)	46(24.6)	4(2.1)	187(100)

Table 7: Resistance Patterns of the isolates to antibiotics

Antibiotics	Number of bacteria Pathogens isolated					
	***S. pneumoniae* (n=121)**	***K. Pneumoniae* (n=47)**	***P. aeruginosa* (n=13)**	***E. coli* (n=1)**	***P. mirablis* (n=4)**	***Enterococci* (n=1)**
Cloxacillin	118(97.5%)	47(100%)	13(100%)	1(100%)	4(100%)	0 (0%)
Erythromycin	99(81.8%)	40 (85.1%)	13(100%)	1(100%)	3(75%)	1(100%)
Tetracycline	108(89.3%)	39(83.0%)	13(100%)	0(0%)	3(75%)	1(100%)
Chloramphenicol	59(48.8%)	31(66.0%)	12(92.3%)	1(100%)	3(75%)	1(100%)
Streptomycin	106(87.6%)	37(79%)	12(92.3%)	1(100%)	3(75%)	1(100%)
Gentamycin	88 (72.7%)	18(38.3%)	1(7.7%)	0(0%)	0(0%)	1(100%)
Cotrimoxazole	111(91.7%)	40 (85.1%)	13(100%)	0(0%)	2(75%)	1(100%)
Augmentin	48 (40.0%)	36(76.6%)	4(30.7%)	1(100%)	3(75%)	1(100%)
Clarithromycin	79(65.3%)	30 (64.0%)	6(46.2%)	1(100%))	3(75%)	1(100%)
Ocefix	93(77.0%)	25 (53.1%)	8(61.5%)	0(0%)	3(75%)	1(100%)
Ciprofloxacin	38 (31.4%)	7 (15%)	0 (0%)	0(0%)	1(25%)	1(100%)
Ofloxacin	33 (27.3%)	11(23%)	1 (7.7%)	0(0%)	0(75%)	1(100%)

Out of the 187 bacterial pathogens recovered, 122(65.2%) were Gram-positive and 65(34.8%) were Gram-negative organisms. A total of 143 patients' yielded growth of single pathogen and 22 patients yielded mixed

growth of pathogens. Table 4 showed the distribution of these mixed growth and Table 5 showed the distribution of these mixed growth among the sexes with higher prevalence in males greater than that of the females.

Table 6 showed the prevalence of LRTIs among age groups. Age group 26-45 years had the highest prevalence 60(32.1%) of LRTI while, age group 86 - 105 had the least 4(2.1%).

DISCUSSION

Out of 300 sputa samples analysed, 165(55%) were positive for cultures compared to the negative result of 135(45%). This finding is similar to study carried out by Okesola and Ige [6] that had a prevalence rate of 53.9% in Nigeria and Egbagbe and Mordi, [9] reported as high as 47.2% from his study conducted at the University of Benin Teaching Hospital, Benin City, Nigeria. Mishra *et al* [13] reported a lower prevalence rate of 44.4% in a tertiary care centre, Nepal. This negative result may be attributed to viral or other etiological agents [14,15] as the causative agent of LRTIs. The bacteria isolates recovered were ranked in decreasing order: *S. pneumoniae* 121(64.7%), *K. pneumoniae* 47(25.1%), *P. aeruginosa* 13(7.0%), *P. mirabilis* 4(2.1%), *E. coli* 1(0.5%), *Enterococcus* 1(0.5%). *S. pneumoniae* was the most frequent organism isolated organism as reported by Buccheri [16] in Italy and Amin *et al.* [1] in Bangladesh which accounted for 28.7% and Egbagbe and Mordi, [9] accounted for 52.5%.

In this study, our result showed that LRTIs caused by bacteria were more prevalent in males 93(56.4%) than in females 72 (43.6%). Shrestha *et al.* [7] Egbe *et al,* [17] Eldeeb and Khashan, [18] Humphrey *et al.* [19] in their studies reported high prevalence in males than females. According to Gauchan *et al.* (2006) and reported by Akingbade *et al.* [14] the reason for the high risk in males of LRTIs are attributable to decreased non-specific immunity in the respiratory tract due to smoking, use of tobacco, alcohol consumption etc.

Out of the 165 bacterial isolates, Gram positive cocci organisms were the highest of the isolates, accounting for 122(65.2%), while Gram-negative had 7(17.5%). This findings correlates well with Egbagbe and Mordi, [9] earlier study that reported Gram-positive bacteria isolates to be higher than Gram negative bacteria.

Mixed organisms were isolated in 22 patients accounting for 13.3 % of sputum samples that yielded growth. Okesola and Ige, [20] reported mixed isolates in their study. The most frequent mixed infection in this study was *K. pneumoniae* and *S. pneumoniae* accounting for 54.5% while the least was *K. pneumoniae* and *Enterococci* accounting for 4.6%.

Our data showed a high resistance pattern to cloxacillin, a drug known to have anti beta lactamase activity which we suggest is related to its abuse because of the affordability and accessibility of these drugs in the market. This study is consistent with the studies of Oyetunde *et al.* [21] where 70% of respondents in Lagos, Nigeria abused Ampiclox. The antimicrobial susceptibility testing of the isolates showed high resistance to two or more antibiotics. Ciprofloxacin and ofloxacin, a relatively new fluoroquinolones in Nigeria had the highest sensitivity patterns against the isolates including *P. aeruginosa* known to be resistant to majority of antibiotics available. These antibiotics can serve as empirical treatment only if the illness is not severe enough for urgent medical attention; measures need to be in place to curb the abuse of these antibiotics to avoid resistance. High resistance patterns were also recorded for conventional antibiotics such as Co-trimoxazole, Augmentin, Erythromycin, Gentamicin, Tetracycline,

Chloramphenicol, Clarithromycin, Streptomycin and Cefix which are used for treating LRTIs in public and private hospitals in Nigeria.

CONCLUSION

This study showed a high antimicrobial resistance which has a serious public health implication on the citizens. Currently, antibiotics are the major solutions in treating LTRIs in comparison to vaccinations which are limited to few infectious agents. There is a need to address the rising occurrence of LRTIs in Nigeria. Taking medications without doctor's prescriptions should be discouraged by enhancing strict laws that will guard the selling of antibiotics to the public.

Competing interests: The authors have no competing interests to declare.

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