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Drug Resistance Patterns of Bacterial Pathogens from Adult Patients with Pneumonia in Arba Minch Hospital, South Ethiopia

By Belayneh Regasa
Arba Minch University, Ethiopia

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Methods: A cross sectional study conducted at Arba Minch Hospital, Southern Ethiopia from February to December 2013. Sputum specimens were collected; microbiological investigations and antimicrobial susceptibility testing were performed using standard procedures. Data was processed and analyzed with SPSS version16.0.

Results: Out of 170 cases, only 73 (42.9%) were culture positive. Majority of tested bacterial isolates (>86%) were sensitive to Ceftriaxone and Ciprofloxacin. Most Streptococcus pneumoniae isolates (60%) were resistant to Oxacillin. Most of Staphylococcus aureus and gram negative bacterial isolates were resistance to Tetracycline (100%), Penicillin (83.3%), Ampicillin (50-100%), Doxycycline (50-100%), and Trimethoprim-sulfamethoxazole (83.3-100%). Multidrug resistance (MDR) was observed to most (60.3%) bacterial isolates.

Keywords: *pneumonia, bacterial pathogens and antimicrobial susceptibility pattern.*

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Conclusion: Antimicrobial resistance including Multidrug resistance was observed to a number of commonly used antibiotics, such as trimethoprim- sulfamethoxazole, penicillin groups and doxycycline. Hence, periodic monitoring of drug resistant pattern is essential for better management of community acquired pneumonia.

Keywords: pneumonia, bacterial pathogens and antimicrobial susceptibility pattern.

I. Introduction

Pneumonia affects 3–5 adults per thousand per year with a mortality of 7–14% in hospitalized patients (1). It is associated with high mortality. About 5.6 million cases of Community acquired pneumonia are reported in the United States each year, with an associated mortality rate of approximately 14% (2, 3). Despite the advent of potent antibiotic over the last decades, significant mortality is still associated with pneumonia (4). Increased antibiotic resistance in frequently isolated bacterial pathogens from pneumonia patients has complicated the selection process of antimicrobial agents (5) and the clinical presentation is usually not specific enough to make a firm etiologic diagnosis (6). The resistant strains of bacteria can quickly multiply and spread within a community where antibiotic use is common. Consequently, antibiotic resistance often results in various societal costs, including increased drug costs, additional health-service costs (such as laboratory tests and hospitalizations), greater drug resistance-related morbidity and mortality, and productivity losses (7). So it is wise to determine antimicrobial susceptibility pattern of bacterial pathogens and this might help for the management of the case in case of emergency and helps for the rational utilization of antimicrobial agents.

II. Methods and Materials

During the period February to December 2013 a total of 170 adults (above 15 years old) with typical symptoms of the disease, such as productive cough, fever, chest pain and the presence of consolidate on the chest radiograph consistent with pneumonia was included in this study. Sputum samples were inoculated onto Blood, MacConkey, Manitol Salt agar (MSA) and Chocolate agar (Oxoid Ltd, UK) plates (8). The bacterial isolates were then identified and subjected to antimicrobial susceptibility testing according to Clinical Laboratory Standards Institute (CLSI) recommendations (9, 10). The antibiotic discs used and their concentration were:- Ceftriaxone (CRO, 30µg), Ciprofloxacin (CIP, 5µg), Tetracycline (TE, 30µg), Chloramphenicol (C, 30µg), Erythromycin (E, 15µg), Doxycycline (DO, 30µg), Penicillin (P, 10µg), Gentamycin (CN, 10µg), Trimethoprim-sulfamethoxazole (TMP-SMX, 1.25+23.75µg), Ampicillin (AMP, 10µg) and Oxacillin (OXA, 1µg) All antibiotic were obtained from Oxoid Limited, Basingstoke Hampshire, UK. A standard inoculum adjusted to 0.5 McFarland was swabbed on to Muller- Hinton agar (Oxoid Ltd. Bashingstore Hampaire, UK); antibiotic disc were dispensed after drying the plate for 3-5 min and incubated at 37°C for 24 hours. For *S. pneumoniae*, MHA supplied with 5% sheep blood and for *H. influenzae*, MHA chocolate agar was used. Quality control strains that were used include: *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, and *Pseudomonas aeruginosa* ATCC

Author: Department of Medical Microbiology, Arba Minch University, Arba Minch, Ethiopia . e-mail: belayjanimen@gmail.com

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27853 (10). Selected Socio-demographic characteristics like age and sex were obtained. Data were entered and analyzed using SPSS version 16.0 computer software.

The proposal of this study was ethically approved by the Institutional Ethical Review Committee (IRC) of Arba Minch University. Permission was obtained from Medical director of Arba Minch Hospital. Written informed consent was obtained from each patient participated in the study.

III. Result

A total of 170 adult patients clinically diagnosed to have pneumonia in Arba Minch Hospital were selected and participated in this study (Table 1). Of these, 95 (55.9%) were males and 75 (44.1%) were females.

Table 1 : Distribution of pneumonia by sex and age (n=170)

Variables		Number (%)
Sex	Male	95 (55.9)
	Female	75 (44.1)
Age	15-25	23 (13.5)
	26-45	67 (39.5)
	46-65	63 (37)
	>65	17(10)

The isolated bacteria were, *Streptococcus pneumoniae* 20 (11.8%), *Staphylococcus aureus* 18 (10.6%), *Pseudomonas aeruginosa* 12 (7.1%), *Klebsiella pneumoniae* 11 (6.5%), *Escherichia coli* 5 (2.9%), *Proteus mirabilis* 2 (1.2%), *Proteus vulgaris* 1 (0.6%) *and Haemophilus influenzae* 4 (2.4%).

Streptococcus pneumoniae isolates showed relatively high resistance (60%) to Oxacillin (penicillin group representative) and all isolates were sensitive against Trimethoprim-sulfamethoxazole. High resistance rate *S. aureus* was observed to Tetracycline (100%), Oxacillin (83.3%), Ampicillin (83.3%), Penicillin (83.3%), Trimethoprim-sulfamethoxazole (83.3%), Erythromycin (50%) and Doxycycline (50%). *Pseudomonas aeruginosa* isolates showed that 50% resistant to Gentamycin. The antimicrobial testing of *K. pneumoniae* and *H. influenzae* isolates indicated that all isolates showed resistance (100%) to Tetracycline, Ampicillin and Trimethoprim-sulfamethoxazole. *Proteus and E. coli* isolates showed resistance to Tetracycline, Chloramphenicol, Doxycycline, Gentamycin, Ampicillin and Trimethoprim-sulfamethoxazole (Table 2).

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Table 2 : Drug resistance pattern of bacterial isolates from adult patients with pneumonia in Arba Minch Hospital, 2013

Bacterial isolates	Drugs tested No(%) resistance											
	No	CRO	CIP	TE	C	E	DO	P	CN	TMP-STX	AMP	OXA
S. pneumoniae	20	NA	NA	10 (50)	1 (5)	1 (5)	NA	NA	NA	1 (5)	NA	12 (60)
S. aureus	18	4 (22.2)	4 (22.2)	18 (100)	5 (27.8)	9 (50)	9 (50)	15 (83.3)	5 (27.8)	15 (83.3)	15 (83.3)	15 (83.3)
P. aeruginosa	12	1 (8.3)	1 (8.3)	NA	NA	NA	NA	NA	7 (58.3)	NA	NA	NA
K. pneumoniae	11	0	0	11 (100)	2 (18.2)	NA	1 (9.1)	NA	2 (18.2)	11 (100)	11 (100)	NA
P. mirabilis	2	1 (50)	1 (50)	2 (100)	2 (100)	NA	2 (100)	NA	2 (100)	2 (100)	2 (100)	NA
P. vulgaris	1	0	0	1	1	NA	1	NA	1	1	1	NA
E. coli	5	0	0	5 (100)	5 (100)	NA	5 (100)	NA	1 (20)	5 (100)	5 (100)	NA
H. influenzae	4	1 (25)	1 (25)	4 (100)	1 (25)	NA	NA	NA	NA	4 (100)	2 (50)	NA
Total	73	7 (13.2)	7 (13.2)	51(83.6)	18 (29.5)	10 (26.3)	18 (48.6)	15 (83.3)	18 (36.7)	39 (63.9)	36 (87.8)	27 (71.1)

Note: NA- Note applicable, CRO- Ceftriaxone, CIP- Ciprofloxacin, TE- Tetracycline, C- Chloramphenicol, E- Erythromycin, DO- Doxycycline, P- Penicillin, CN- Gentamycin, TMP-STX- Trimethoprim-sulfamethoxazole, AMP- Ampicillin and OXA- Oxacillin

Multidrug resistance was also observed to a number of antimicrobial agents (Table 3)

Table 3 : Multi-drug resistance Antibiogram of bacterial isolates from adult patients with pneumonia in Arba Minch Hospital, 2013

Bacterial Isolates	Resistance Antibiogram	No (%)
S. pneumoniae (n=20)	OXA, TE	2 (10)
	OXA, TE, C, E	1 (5)
S. aureus (n=18)	OXA, TE, P, AMP	2 (12.5)
	OXA, AMP, E, DO, TMP-STX	1 (6.3)
	P, TE, E, DO, TMP-STX	1 (6.3)
	OXA, AMP, TE, E, DO, TMP-STX	2 (12.5)
	OXA, AMP, P, TE, E, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, DO, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, DO, E, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, DO, C, E, CIP, TMP-STX	1 (6.3)
	OXA, AMP, P, TE, C, E, CN, CRO, TMP-STX	2 (12.5)
	OXA, AMP, P, TE, C, E, CN, CRO, CIP, TMP-STX	4 (25)
P. aeruginosa (n=12)	CN, CRO	2 (20)
	CN, CRO, CIP	2 (20)
K. pneumoniae (n=11)	AMP, TE, TMP-STX	5 (45.5)
	AMP, TE, CRO, TMP-STX	2 (18.9)
	AMP, TE, CN, TMP-STX	2 (18.9)
	AMP, TE, C, TMP-STX	1 (12.5)
	AMP, TE, CN, CRO, TMP-STX	1 (12.5)
P. mirabilis (n=2)	AMP, TE, DO, C, CN, TMP-STX	1 (50)
	AMP, TE, DO, C, CN, CRO, CIP, TMP-STX	1 (50)
P. vulgaris (n=1)	AMP, TE, DO, C, TMP-STX	1 (100)

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E. coli (n=5)	AMP, TE, DO, C, TMP-STX	3 (60)
	AMP, TE, DO, C, CN, TMP-STX	2 (40)
H. influenzae (n=4)	AMP, TE, TMP-STX	1 (33.3)
	AMP, TE, C, CIP, TMP-STX	1 (33.3)
Total (n=73)		44 (60.3)

IV. Discussion

The importance of knowing susceptibility patterns of bacterial isolates in patients with pneumonia has been identified as a key step towards limiting unnecessary antibacterial prescribing and treating patients effectively, which was the main purpose of this study.

S. pneumoniae, which was the commonest isolate in this study, showed 60% resistant to oxacillin which is representative to penicillin group. This finding is comparable to studies conducted in USA (53%) (11) and Iran (30-57%) (12). In this study, most tested *S. pneumoniae* isolates showed that 95% susceptible to trimethoprim-sulfamethoxazole, but studies conducted in Nigeria (100%) (13) and Kenya (54%) (14), showed high resistance rate of *S. pneumoniae* to trimethoprim-sulfamethoxazole. In addition, 95% of tested *S. pneumoniae* isolates were susceptible to chloramphenicol and erythromycin. These findings are comparable to a study conducted in Kenya (>97%) (14). The second most causative agent *S. aureus* showed 77.8% susceptible to ceftriaxone and ciprofloxacin, and 72.2% to gentamycin and chloramphenicol. This result is comparable to studies conducted in Ibadan, Nigeria (66.7% ciprofloxacin and 66.7% gentamycin) (13) and Benin City, Nigeria (66.7% ceftriaxone, 66.7% ciprofloxacin, and 66.7% chloramphenicol) (15). In addition 83.3% of tested *S. aureus* showed resistance to penicillin, ampicillin, oxacillin and trimethoprim-sulfamethoxazole; which is comparable to studies conducted China (88.7% resistance to penicillin) (16) and Nigeria (resistance rate of 66.7% for penicillin) (13), but lower than study conducted in Nigeria (100% for trimethoprim-sulfamethoxazole) (13).

Most of tested gram negative bacilli isolates were sensitive (90%) to ceftriaxone and ciprofloxacin. These findings are comparable to studies conducted in Benin City, Nigeria (66-100%) (15) and Ibadan, Nigeria (60-100%) (13). Majority of gram negative bacilli was resistance (100%) to tetracycline, chloramphenicol, doxycycline (except *K. Pneumoniae*, 90% susceptible), trimethoprim-sulfamethoxazole and ampicillin. Similar study conducted in Nigeria (60-100%) (15), supports these findings. The commonest causative agent among gram negative bacilli, *P. aeruginosa*, showed 58.3% resistance to gentamycin, which is comparable to study conducted in Nigeria (53.6%) (13). However, it showed low resistance (8.3%) to ceftriaxone and ciprofloxacin; but study conducted in Nigeria (39.3% resistance for ciprofloxacin) (13), showed high resistance. *K. pneumoniae* and *E. coli* showed 100% resistance to tetracycline, ampicillin and trimethoprim- sulfamethoxazole. These findings are comparable to studies conducted in Benin City, Nigeria (100% resistance to tetracycline) (15) and Ibadan, Nigeria (100% resistance to trimethoprim- sulfamethoxazole) (13). All tested *Proteus* species isolates were resistance (100%) to doxycycline, tetracycline, ampicillin and trimethoprim-sulfamethoxazole. These findings are comparable to study conducted in Ibadan, Nigeria (100% resistance to trimethoprim- sulfamethoxazole) (13).

All *H. influenzae* isolates tested for antimicrobial sensitivity showed low resistance (25%) to ceftriaxone, ciprofloxacin and chloramphenicol. These findings are comparable to study conducted in Nigeria (chloramphenicol 30.3% and ciprofloxacin 26.1%) (13). In most of tested *H. influenzae* isolates, high resistance rate to tetracycline (100%), ampicillin (50%) and trimethoprim-sulfamethoxazole (100%) were observed. These findings are similar with studies conducted in USA (47% resistance to ampicillin) (17) and Nigeria (93.7% resistance to trimethoprim-sulfamethoxazole) (13), but is not as high as that observed in other countries such as in China (>90% susceptibility to most antibiotics) (16).

The differences in antibiotic resistance patterns may be due to variations in the antibiotic prescribing habits in different geographical regions.

V. Conclusion

In the present study, most bacterial isolates were susceptible to ceftriaxone and ciprofloxacin. However, antimicrobial resistance including Multidrug resistance was observed to a number of commonly used antibiotics, such as trimethoprim-sulfamethoxazole, penicillin group and doxycycline. Hence, it is important to periodically monitor the antibiotic resistance patterns to aid physicians to choose empirical treatments for better management of pneumonia.

VI. Acknowledgements

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Competing interest

The author declared that there is no any relevant competing interest to disclose in this research.

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