Plant Archives Volume 20 No. 2, 2020 pp. 9078-9082 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

PREVALENCE AND ANTIBIOTIC SUSCEPTIBILITY PATTERN OF BACTERIAL AGENTS INVOLVED IN LOWER RESPIRATORY TRACT INFECTIONS IN A TERTIARY CARE TEACHING HOSPITAL

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Abstract

The present study aims to assess the antibiotic susceptibility pattern of pathogens causing LRTIs in general medicine in-patient department of a tertiary care hospital, Dakshina Kannada district, Karnataka. A prospective observational study was carried out for a period of eight months. All the culture and antibiotic sensitivity test reports of patients who were undergone treatment for lower respiratory tract infection were collected and analysed carefully in order to find out the organisms isolated and their antibiotic sensitivity pattern. A total of 152 patients were enrolled in to the study. 79 were male and 73 were female patients. The mean age of total study population was 54.95±14.71. Cough was found to be most prevalent clinical presentation of LRTI (92.11%). The microbial culture test was carried out in 110 patients. A total of 74 organisms were found in 66 patients and antibiotic sensitivity test was carried out in each of them. The most common pathogen isolated was *Pseudomonas aeruginosa* which accounted 24.32%, followed by *Klebsiella pneumoniae* 21.62%, *Acinetobacter baumannii* 21.62% and *Staphylococcus aureus* 14.86%. Most of the organisms were sensitive to imipenem, piperacillin/tazobactam, colistin and polymyxin B and there was an increase in resistance with routinely used drugs like Cephalosporins, hence these drugs should not be considered as first line therapy.

Key words: lower respiratory tract infections (LRTIs), *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, Antibiotic sensitivity test.

Introduction

Lower respiratory tract infections (LRTIs) are among the most common infectious diseases affecting humans worldwide (Carroll, 2002). Out of the total acute respiratory diseases, 20–24% of all deaths are accounted for by Lower Respiratory Tract infections. LRTIs are important causes of morbidity and mortality for all age groups, and each year approximately 7 million people die as a direct consequence of acute and chronic respiratory infections (Ozyilmaz *et al.,* 2005).

LRTI is not a single disease but a group of specific infection each with different epidemiology, pathogenesis, clinical presentation and outcome (Mishra *et al.,* 2012). The most prevalent lower respiratory tract infections were acute bronchitis, acute exacerbation of COPD, pneumonia and the same were selected for the study. The majority of the patients consulting a general practitioner with signs of an LRTI are treated with antibiotics without undergoing additional diagnostic tests (Willy *et al.,* 2004).

Since the etiological agents of LRTI cannot be determined clinically, microbiological investigation is critical for both treatment and epidemiological purpose. Because microbiological results do not become available for 24 to 72 hours, initial therapy for infection is often empirical and guided by the clinical presentation. Therefore, a common approach is to use broad-spectrum antimicrobial agents as initial empirical therapy (sometimes

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with a combination of antimicrobial agents as initial empiric therapy) with the intent to cover multiple possible pathogens commonly associated with the specific clinical syndrome (Leekha *et al.,* 2011). The etiologic agents of LRTIs vary from area to area. So the susceptibility profile will also differ between geographical locations. Knowing the local susceptibility profile is important, as antimicrobial therapies for LRTIs are frequently empirical and presumptive. Current knowledge of the organisms that cause LRTIs and their antibiotic susceptibility profiles are therefore necessary for the prescription of appropriate therapy (Egbe *et al.,* 2011).

Materials and Methods

Study Design

The prospective observational study design was adopted for this study. The data was collected at General Medicine inpatient department of a tertiary care teaching hospital located in Dakshina Kannada district, Karnataka for a period of eight month. The Institutional Ethical Committee permission was taken to conduct this study.

Inclusion and Exclusion Criteria

Inpatients of either gender in general ward of Medicine and chest department, who is undergoing antibiotic treatment for lower respiratory tract infection (acute bronchitis, acute exacerbation of COPD, pneumonia) were enrolled in the study. Patients with other respiratory tract diseases and TB were excluded from the study.

Study procedure

A suitable data collection form was designed to collect all the necessary and relevant information. In-patients of the general ward of Medicine and chest department, who is undergoing antibiotic treatment for lower respiratory tract infection, were reviewed on a daily basis. A total of 152 patients were enrolled during the study. Those patients who met the study criteria were enrolled into the study. Demographic details of patient such as name, age, sex; clinical data such as diagnosis, clinical condition, microbiological culture reports, comorbidities; therapeutic data such as name of antibiotic, dose, route, frequency, duration of therapy and other relevant information such as patients length of hospital stay were collected and recorded by reviewing the patients case records and by interviewing the patient

Statistical analysis

All the data was subjected to analysis in order to assess the pattern of utilization of antibiotics and also the sensitivity pattern of antibiotics. Comparison were made between acute bronchitis, acute exacerbation of COPD, pneumonia in terms of presenting signs, pathogens isolated, antibiotics prescribed, etc. Analysis of the data was carried out by using Statistical Package for Social Science (SPSS) 16.0 for windows.

Results and Discussion

Out of the 152 patients enrolled in to the study there were 59 patients with acute bronchitis, 47 patients with acute exacerbation of COPD and 46 with pneumonia. Of the 152 patients, there were 79 (51.97) male and 73 (48.03) female patients. While considering the total LRTI, prevalence was non significantly more for male than female. But there are various studies which show a high prevalence of men for getting infected by lower respiratory tract infections than women (Humphreys *et al.,* 2010; Victor *et al.,* 2011).

The age group distributions of lower respiratory tract infection have been depicted in the table 1. The table shows that the age group of 56-65 had the highest prevalence (32.24%) of LTRI while age group of 16-25 (3.29%) had the least. This clearly indicates that there was an association between age and prevalence of LRTI which was found to be statistically significant using Kruskal-wallis test (p value = 0.003). There were studies which has some similarities to findings of the current study (Akingbade *et al.,* 2012; Okesola *et al.,* 2008).

The microbial culture test was carried out in 110 (73.33%) patients. The common lower respiratory tract specimens used were sputum, blood, and pleural fluid.

Table 1: Age group distribution of lrti patients.

Age Group	AB				Aecopd				PNA				Total			
	Male		Female		Male		Female		Male		Female		Male		Female	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
16-25	1	3.85	1	3.03	0	0	0	0	3	12.5	0	0	4	5.06	1	1.37
26-35	3	11.54	7	21.21	0	0	0	0	2	8.33	2	9.09	5	6.33	9	12.33
36-45	2	7.69	3	9.09	3	10.34	2	11.11	3	12.5	5	22.73	8	10.13	10	13.7
46-55	6	23.08	7	21.21	5	17.24	4	22.22	8	33.33	3	13.64	19	24.05	14	19.18
56-65	12	46.15	9	27.27	7	24.14	7	38.89	7	29.17	7	31.82	26	32.91	23	31.51
66-75	2	7.69	4	12.12	12	41.38	4	22.22	1	4.17	4	18.18	15	18.99	12	16.44
76-85	0	0	2	6.06	2	6.9	1	5.56	0	0	1	4.55	2	2.53	4	5.48

Table 2: Pathogens isolated from lrti patients and their corresponding mean age ± SD.

Isolated Pathogen	Mean Age ± SD	Patients N	Patients %
Single Pathogen			
P.Aeruginosa	52.53±11.49	15	22.73
K.Pneumoniae	52.67±13.71	12	18.18
Acinetobacter. Spp	58.33±15.84	12	18.18
S.Aureus	58.88±19.43	8	12.12
E.Coli	63±4	2	3.03
S.Pneumoniae	43.67±11.59	3	4.55
Candidia.Albicans	59±7	3	4.55
Enterococcus. Spp	38.50±27.58	2	3.03
P.Mirabilis	-	1	1.52
Multiple Pathogen			
P.Aeruginosa + S.Aureus	57±12.73	2	3.03
K.Pneumoniae + Acinetobacter	50.50±6.364	2	3.03
P.Aeruginosa + Acinetobacter	-	1	1.52
K.Pneumonia + C.Albicans	-	1	1.52
K.Pneumoniae + P.Mirabilis	-	1	1.52
S.Aureus + Acinetobacter	-	1	1.52
Total	54.33±14	66	100

Table 3: Sensitivity and resistance pattern of most common pathogens.

Antibiotics	*P.Aeruginosa*		*K.Pneumoniae*		*Acinetobacter.* Spp		*S.Aureus*	
	S	R	S	R	S	R	S	R
Cefipime	100	0	75	25	53.33	46.67	ND	ND
Cefotaxime	100	0	57.14	42.86	50	50	ND	ND
Ceftriaxone	ND	ND	56.25	43.75	50	50	ND	ND
Ceftazidime	100	0	62.5	37.5	56.25	43.75	ND	ND
Cefuroxime	ND	ND	ND	ND	0	100	ND	ND
Ciprofloxacin	100	0	81.25	18.75	71.43	28.57	36.36	63.64
Levofloxacin	94.44	5.56	85.71	14.29	75	25	ND	ND
Amikacin	100	0	93.75	6.25	68.75	31.25	0	100
Gentamycin	94.12	5.88	81.25	18.75	73.33	26.67	55.56	44.44
Penicillin	ND	ND	ND	ND	ND	ND	18.18	81.82
Piperacillin + Tazobactam	100	0	93.75	6.25	73.3	26.67	ND	ND
Methicillin	ND	ND	ND	ND	ND	ND	100	0
Oxacillin	ND	ND	ND	ND	ND	ND	37.5	62.5
Meropenem	94.12	5.88	8.33	91.66	76.92	23.08	ND	ND
Imipenem	100	0	100	0	100	0	ND	ND
Colistin	100	0	ND	ND	100	0	ND	ND
Polymyxin B	100	0	ND	ND	100	0	ND	ND
Cotrimox	0	100	85.71	14.29	78.57	21.43	77.78	22.22
Tigacyclin	90.91	9.09	ND	ND	100	0	ND	ND
Linizolid	ND	ND	ND	ND	ND	ND	88.89	11.11
Clindamycin	ND	ND	ND	ND	ND	ND	70	30
Vancomycin	ND	ND	ND	ND	ND	ND	50	50
Tetracycline	ND	ND	ND	ND	ND	ND	88.89	11.11
Erythromycin	ND	ND	ND	ND	ND	ND	36.36	63.64

The current study showed that there was no significant growth for 44 (40%) patients. While 66 patients (60%) were positive for different pathogens in which 71.62% were isolated from sputum, 16.22% from blood and 12.16% from pleural fluid. A total of 74 organisms were found in 66 patients and antibiotic sensitivity test was carried out in each of them. The negative result may attribute to viral or other etiological agents.

Out of the 74 pathogens the isolated gram-negative organisms were the highest isolate, accounting for 77.03%. Gram positive pathogens were 18.92% most of these caused by *S. aureus*. Only 4.05% pathogens were belonged to class fungi. This finding correlates well with earlier study that reported Gram-negative bacteria isolates to be higher than Gram positive bacterial isolates (Akingbade *et al.,* 2012; Gauchan *et al.,* 2006).

Among the 66 patients who had a positive growth, 58 patients were having single pathogen while 8 patients were infected with two pathogens. The most common single pathogen isolated was *Pseudomonas aeruginosa* which was isolated 15 (22.72%) patients, followed by *Klebsiella pneumoniae* 12 (18.18%), *Acinetobacter* spp. 12 (18.18%) and *S. aureus* 8(12.12%). There were various studies illustrated that *Pseudomonas aeruginosa* as the most prevalent organism. The organisms isolated from LRTI patients are listed in table 2. The difference observed in the prevalence of bacterial isolates in studies elsewhere is attributable to age, season, the type of population at risk, and other factors.

Table 3 summarizes the sensitivity and resistance pattern of the 4 most frequently isolated specimen in the study. The susceptibility pattern of each class of antibiotics towards lower respiratory tract pathogens were mentioned below.

Cephalosporins

P. aeruginosa showed higher susceptibility to the 4th generation Cephalosporins (100%) and also to the cefotaxime and ceftazidime. This was similar to the study conducted by Akingbade *et al.,* (2012) in which ceftazidime showed 100% sensitivity towards *P. aeruginosa* (Akingbade *et al.,* 2012). *Klebsiella spp* showed resistance to all cephalosporins, with the highest resistance to ceftriaxone (43.75%) followed by ceftazidime (37.5%). The *Klebsiella* spp. was most susceptible to cefipime (75%), followed by cefotaxime (57.14%). *Acinetobacter* showed

high resistance to cefuroxime (100%), ceftriaxone (50%), cefotaxime (50%) and the least to ceftazidime (43.75%). In case of other pathogens like *E. coli* and *Enterococci*, both were 100% resistant to cephalosporins while *S. pneumoniae* and *P. mirabilis* were susceptible. On the whole, cefipime was the better choice of treatment in infections caused by *Klebsiella* spp., whereas ceftazidime was found to be better choice against *Acinetobacter* spp. Both of these drugs were effective while considering the patient infected with *P. aeruginosa*.

Quinolones

Among the Quinolones which were tested ciprofloxacin showed high resistance towards majority of isolates, except *P. aeruginosa* (0%). This was in correlation with the findings of Nidhi *et al.,* 2009. The study conducted by Walker *et al.,* (1999) reported that ciprofloxacin was the most potent quinolone against *P. aeruginosa*, which is consistent with the current findings. *S.aureus* showed highest resistance (63.64%) towards the ciprofloxacin. *E. coli* and *S. pneumoniae* were highly resistant to ciprofloxacin while enterococci and *P. mirabilis* were susceptible. However, these observations were found only in a minor population (13.51%). Levofloxacin demonstrated lesser resistance rate in comparison to the ciprofloxacin among all the isolated pathogens except for *P. aeruginosa* where ciprofloxacin was found to have lesser resistance rate which was in contrast to that which was reported by Victor *et al.,* (2011), in which the least sensitivity was shown by *Pseudomonas aeruginosa* (36.4%) as compared to other isolates. But the study conducted by Ahmed *et al.,* (2013) supported the present study. The levofloxacin was most resistant towards *Acinetobacter* spp. (25%).

Aminogycosides

Among the gram-negative pathogen's amikacin showed relatively higher resistance in *Acinetobacter* (31.25%) which was similar to the study conducted by Nidhi *et al.,* (2009), followed by *Klebsiella* (6.25%). The *S. aureus* was shown high resistance towards amikacin while *P. aeruginosa* was highly sensitive to amikacin contrast to various studies which showed resistance to amikacin. These reports were very similar to the study conducted by Ahmed *et al.,* (2013). In case of gentamycin *S. aureus* is highly resistant (44.44%) followed by *Acinetobacter* (26.67%) and least resistant to *P. aeruginosa* (6.25%) followed by *K. pneumoniae* (18.75%). There was far lesser resistance that was reported by Nidhi *et al.,* (2009). The minor pathogens like *E. coli, S. pneumoniae, Enterococci, P. mirabilis* were sensitive to amikacin while *S. pneumoniae, E. coli* and *Enterococci* showed resistance towards gentamycin 100%, 66.7% and 50% respectively.

Penicillin/Beta Lactam Inhibitors

S.aureus showed high resistance to penicillin (81.2%) followed by oxacillin (62.5%). The piperacillin + tazobactam combination was highly susceptible to *P. aeruginosa* (100%) followed by *K. pneumoniae* (93.75%) and least sensitive to *Acinetobacter* spp. (73.3%). Minority pathogens like *E. coli* and *P. mirabilis* also showed high susceptibility towards piperacillin + tazobactam combination. This shows that piperacillin + tazobactam is the best combination for treating LRTIs which are induced by gram negative bacilli, as was also reported by Manjari *et al.,* (1999), in contrast to the higher resistance which was reported by Nidhi *et al.,* (2009).

Carbapenems

Imipenem showed high susceptibility (100%) towards the gram-negative pathogens. This is very less than that which was reported by Nidhi *et al.,* (2009). But in case of meropenem highest resistance (91.66%) showed by *K. pneumoniae* followed by *Acinetobacter* spp. (23.08%) and by *P. aeruginosa* (5.88%).

Other Antibiotics

During the study colistin and polymyxin B showed high susceptibility towards *P. aeruginosa* and *Acinetobacter* spp. This was very similar to the study conducted by Giorgiana *et al.,* (2011) in which susceptibility of *P. aeruginosa* and *Acinetobacer spp.* towards colistin were 76.92% and 100% respectively. Tigacyclin also showed higher sensitivity towards *Acinetobacter* (100%) followed by *P.aeruginosa* (90.91%). Cotrimoxazole were highly resistant to *P. aeruginosa* (100%), *S. aureus* (22.22%), *Acinetobacter* spp. (21.43%) and then to *K. pneumoniae* (14.29%). *S.aureus* was susceptible to linizolid (88.89%), clindamycin (70%), vancomycin (50%). They showed high resistance to erythromycin (63.64%) followed by cotrimoxazole (22.22%), and then to tobramycin (11.11%). The study conducted by Giorgiana et al (2011) showed that vancomycin (72.72%), linizolid (100%) were susceptible to *S. aures*. Antifungal antibiotics like cotrimazole, fluconazole, and ketoconazole showed 100% resistance towards *Candida albicans* while amphotericin B and nystatin reported 100% susceptibility.

Conclusion

Lower respiratory tract infections are among the most common infectious diseases in humans. The morbidity and mortality still remain significantly high in patients with severe lower respiratory tract infections. But data related

to the offending organisms and their antibiotic sensitivity pattern is limited. This study was carried out to reveal relevant demographic information, antibiotic prescribing patterns and the common organisms isolated including their antibiotic sensitivity patterns. Gender did not affect the prevalence of LRTI but there was a significant association between age and prevalence of LRTI. *P. aeruginosa* was the most predominant bacteria isolates and imipenem, piperacillin + tazobactam, colistin and polymyxin B were the most sensitive antibacterial agents.

Acknowledgment

The authors are thankful to NITTE (Deemed to be University), Justice K S Hegde Charitable Hospital and NGSM Institute of Pharmaceutical Sciences.

Conflict of interest

Authors declare no conflict of interest.

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