Study of Bacterial Profile and Susceptibility Pattern of Lower Respiratory Tract Infections in a Tertiary Care Hospital

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ABSTRACT

BACKGROUND

Lower respiratory tract infections (LRTI) are one of the commonest health problems demanding frequent consultation and hospitalization. Unnecessary and inappropriate initial antibiotic therapy is a potentially modifiable factor that is associated with increased mortality in patients with serious infections. We wanted to study the bacterial profile and susceptibility pattern of lower respiratory tract infection in a tertiary care hospital.

METHODS

This was a retrospective study done in the department of Microbiology at ESIC Medical College and Hospital, over a period of one year, from April 2018 to March 2019. A total of 122 samples from respiratory tract were studied for bacterial isolates and antibiotic susceptibility.

RESULTS

A total of 122 cases were studied. The male female ratio was 2.9:1. Sputum samples were the most common type of sample. Majority of the samples were from the chest ward (39.4%) followed by RICU (9.8%). On culture, *Klebsiella* pneumonia was most prevalent followed by *Acinetobacter baumannii*, *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*.

CONCLUSIONS

The present study was based on the pattern of resistance to commonly used antibiotics by organisms causing lower respiratory tract infections (LRTIs) in our Institute. This may help us to study the more susceptible group of drugs in our institute which would help prepare an antibiogram and develop a policy for rational prescribing of antibiotics in LRTI cases and thereby ensuring early recovery of patients and help in reducing the further spread of antibiotic resistance.

KEYWORDS

LRTIs, Bacterial Profile, Susceptibility Pattern.

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BACKGROUND

Respiratory tract infections are one of the most important infectious diseases worldwide. This infection is the leading cause of morbidity and mortality in critically ill patients in developing countries.[1] In India, acute lower respiratory tract infection is responsible for one million deaths.[2] LRTIs are responsible for 4.4% of all hospital admissions and 6% of all general practitioner consultations.[3] The incidence and associated mortality due to LRTI can be influenced by several factors including characteristics of the population at risk, standard of the health care facilities available, immunosuppressive drugs, inappropriate antibiotic therapy, distribution of causative agents, and prevalence of antimicrobial resistance.[4]

The causative agents of LRTIs vary from area to area and in their antibiotic susceptibility profile. Gram-positive bacteria such as *Staphylococcus aureus*, *Streptococcus pneumoniae*, etc. and gram-negative bacteria e.g. *Pseudomonas* spp, *Escherichia coli*, *Klebsiella* spp. are identified commonly in the LRTI patients.[5]

The aetiology and symptomatology of respiratory diseases vary with age, gender, season, the type of population at risk and other factors. These are frequently the first infections to occur after birth and pneumonia is too often the final illness to occur before death.[5] Unnecessary and inappropriate initial antibiotic therapy is a potentially modifiable factor that has been associated with increased mortality in patients with serious infections.[6] Out of the total acute respiratory diseases, 20 to 24% of all deaths are accounted for by Lower Respiratory Tract infections.[7]

METHODS

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all the cases included in the study. This was a retrospective study carried out in the department of Microbiology at ESIC Medical College and Hospital, Sanathnagar, Hyderabad, over a period of one year from April 2018 to March 2019. There were a total of 342 cases of which 122 were studied.

Inclusion Criteria

- Patients who were willing to participate in the study.
- Age from 1 year to 80 years.
- Both genders.
- Patients clinically suspected for LRTIs.
- Positive culture.

Exclusion Criteria

- Patients who were unwilling to participate in the study.
- Patients suffering from tuberculosis.
- Patients who had received antibiotics before sputum could be sent for culture and sensitivity.

All the patients included in the study had attended general medicine and/or pulmonology outpatient departments. A thorough history was taken and those with clinical evidence of respiratory tract infection were selected randomly and were asked for all relevant investigations including routine investigations such as hemogram. Complete urine exam (CUE) and relevant biochemical investigations. Findings were recorded in a predesigned proforma.

In the microbiology laboratory, specimens such as sputum and throat samples were received, and bacterial culture and antimicrobial susceptibility testing were done.

Specimen Collection

A total of 342 samples were collected from patients admitted in various departmental wards with clinical evidence of respiratory tract infections. All patients were instructed on how to collect the sputum samples. These samples were sent to the microbiology laboratory immediately for analysis. The sputum samples were collected into well labelled sterile, wide mouthed glass bottles with screw cap tops.

Out of 342 total samples, 122 were pathogenic and only these 122 samples were considered in the study.

Bacteriological Investigation

In the Microbiology laboratory, under aseptic measures, the sputum samples were inoculated onto Blood agar plates, Chocolate agar plates and MacConkey agar plates. Blood agar plates and MacConkey agar plates were incubated aerobically at 37-degree Celsius for 24 hours. The inoculum on the plate was streaked with a sterile wire loop and observed for growth of colonies while Chocolate agar plates were incubated in an atmosphere containing extra carbon dioxide (in candle jar). All the bacteria were isolated and identified using morphology, microscopy and biochemical tests according to standard recommendations.[8,9]

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed by modified Kirby Bauer method as per the Clinical Laboratory Standards Institute (CLSI) guidelines.[10,11] For gram negative organisms, antibiotics tested were ampicillin (AMP), piperacillin (PC), amoxycillin-clavulanic acid (AMC), ampicillin-sulbactam (AS), ceftriaxone (CTR), cefotaxime (CTX), ceftazidime (CAZ), cefoxitin (CN), cefepime (CPM), piperacillin- tazobactam (PT), gentamicin (GM), amikacin (AK), imipenem (IMP), meropenem (MRP), ciprofloxacin (CIP) and trimethoprim-sulphamethoxazole (COT). For Gram positive organisms, antibiotics tested were penicillin (P), amoxycillin-clavulanic acid (AMC), ceftriaxone (CTR), cefoxitin (CN), erythromycin (ER), clindamycin (CD), vancomycin (VA), linezolid (LZ), gentamicin (GM), amikacin (AK), ciprofloxacin (CIP). The antibiogram of each confirmed isolate was studied and the susceptibility results were compiled.

RESULTS

A total of 342 samples were collected of which 122 were pathogenic. Data was made for these 122 cases. There were 91/122 (74.5%) male patients and 31/122 (25.4%) female patients. The male to female ratio was 2.9:1.

Age (Years)	Number of Patients Having LRTI n = 122	Percentage of Patients Having LRTI (%)
1 - 14	05	4 %
15 - 30	03	2.4 %
31- 45	25	20.4 %
46 - 60	46	37.7 %
61 - 80	43	35.2 %
Total	**122**	**100 %**

Table 1. Age Wise Distribution of Patients with LRTI

Type of Sample	No. of Samples	Percent (%)
Sputum	82	67.2 %
Endotracheal tube secretions	09	7.3 %
Bronchioalveolar fluid	19	15.5 %
Tracheal aspirate	60	4.9 %
Pleural fluid	06	4.9 %
Total	**122**	**100 %**

Table 2. Distribution of Various Types of Samples

In the present study the maximum number of LRTI samples were received from the age group of 46 to 60 years.

In the present study male patients 91/122 (74.5%) in comparison to females being 31/122 (25.4%). The maximum number of samples processed were sputum samples 82/122 (67.2%) followed by bronchoalveolar fluid.

Sample GPC	CX	CTX	E	CD	COT	TE	VA*	LZ	AMP	LE
Staphylococcus aureus	25%	NT	58.30 %	50%	33.40 %	16.60 %	-	0	100	50
Streptococcus pneumoniae	N/A	35.3 %	53%	N/A	86.50 %	53 %	2.60 %	1.5 %	45.30 %	64.80 %

Table 4. Antibiotic Susceptibility in Gram Positive Cocci

Staphylococcus aureus strains were 100% susceptible to Vancomycin. Amongst the gram-positive cocci, *Streptococcus pneumoniae* was highly resistant to, trimethoprim – sulphamethoxazole (COT) followed by fluoroquinolones, reduced susceptibility to penicillins and ampicillin. Good susceptibility was seen to Vancomycin and ampicillin; linezolid. On the contrary, *Staphylococcus aureus* strains showed maximum susceptibility to tetracyclines and ampicillin; trimethoprim – sulphamethoxazole (COT). 25% of the isolates were found to be methicillin resistant *Staphylococcus aureus* (MRSA).

Organism	CFM	CAZ	CTX	CPM	CIP	LE	TE	MI	ETP	IPM	PIT	A/S	COT	GEN	AK	TOB	AMP
Escherichia coli	100	100	100	100	92.3	85.%	46.2	40	21.5	28.5	50	91.6	80	30	14.3	10	100
Klebsiella pneumoniae	53.3	43.3	43.3	43.33	33.3	33.3	13%	10	16.7	20.3	23.3	33.3	43.3	26.7	23.33	20	100
Pseudomonas aeruginosa	N/A	11.7%	NT	11.7 %	11.7 %	11.7 %	N/A	N/A	5.8 %	5.8 %	NT	23.5 %	N/A	5.8 %	5.8 %	5.8 %	N/A
Acinetobacter baumannii	N/A	67 %	NT	63 %	75 %	62.5 %	N/A	N/A	25 %	28.5 %	35 %	35 %	75%	70%	50 %	55 %	N/A
Citrobacter freundii	50	50	50	50	50	50	25	25	25	25	25	50	25	25%	25 %	25 %	75.%
Morganella morganii	0	0	0	0	100 %	100 %	50 %	50 %	0 %	0%	0%		100.%	50 %	50 %	50 %	NT

Table 3. Antibiotic Resistance (%) Pattern of Various Gram-Negative Bacilli Isolated from Various Sputum Samples

CFM - Cefixime (10 µg), CAZ - Ceftazidime (30 µg), CTX - Cefotaxime (30 µg), CPM - Cefepime (30 µg), CIP - Ciprofloxacin (5 µg), LE - Levofloxacin (5 µg), TE -Tetracycline (10 µg), MI - (30 µg), ETP - Ertapenem (10 µg), IPM - Imipenem (10 µg), PIT-Piperacillin / Tazobactam (100 / 10 µg), A/S – Ampicillin / Sulbactam (10/10 µg), COT - Cotrimoxazole 25 µg (23.75 / 1.25 µg), GEN - Gentamicin (10 µg), AK - Amikacin (30 µg), TOB - Tobramycin (10 µg), AMP - Ampicillin (10 µg).

DISCUSSION

According to the Global Burden of Disease 2015 study (GBD 2015), chronic obstructive pulmonary disease (COPD) and lower respiratory tract infections (LRTIs) represent the third and fourth most common causes of death respectively, after ischemic heart disease and cerebrovascular disease.

In the present study, LRTI was seen to be more prevalent in males than females which is in accordance with other studies from India. [12,13] This may be due to more prevalence of associated risk factors seen in the male population like smoking, chronic alcoholism, COPD than in females.[14] Data from a review article suggested that females are more commonly affected with infections of the upper respiratory tract, specifically sinusitis, tonsillitis, and otitis externa rather than LRTIs.

On the other hand, males are more commonly affected with otitis media, croup, and most important, lower RTIs. It is also evident from the reviewed evidence that the course of most RTIs is more severe in males than in females, leading to higher mortality in males, especially in community-acquired pneumonias.[15]

In our study, maximum number of patients (37.7%) were from older age group (46- 60 years), and the older patient population from 46 to 0 years combinedly accounted for 73% cases. This is consistent with other studies done in South India[12,16] and from Finland [17] where the rate of pneumonia increased for each year of age over 50 years.

In our study, we observed that *Klebsiella pneumoniae* was most prevalent (24.5%) and similar observation was reported by a study conducted at Vellore[16] Karimnagar, South India[18] and in Nigeria[19] who also reported that H. influenzae was the second most common pathogen in LRTIs. This was in contrast to the current study, which revealed *Acinetobacter baumannii* (18.85%) as the next common bacterium isolated. The next in line were *Streptococcus pneumoniae* (16.4%), *Pseudomonas aeruginosa* (14%) and *Escherichia coli* (11.5%) as the most predominant pathogens. Predominantly, a variety of Gram negative bacilli were isolated than gram positive cocci. In our study, K. *pneumoniae* has a similar sensitivity pattern with third generation cephalosporins found in an Indian study. This shows reduced sensitivity of third generation cephalosporins.

Among the aminoglycosides, tobramycin was the most effective, followed by amikacin and gentamicin. In another study, it was found that amikacin had higher susceptibility followed by gentamicin and tobramycin. The difference may be due to greater use of amikacin than gentamicin. *Acinetobacter* is an emerging organism in nosocomial infections that has been reported in many studies and is known to be widely resistant. In our study also *Acinetobacter baumannii* was found to be resistant to cephalosporins, fluoroquinolones, cotrimoxazole, ampicillin and aminoglycosides.[20,21]

The presence of a multi-drug resistant (MDR) microorganism is troublesome even when only colonizing, because of its social and economic impact and also due to the required contact isolation measures. Worldwide, antibiotic resistance is a major contemporary public health threat due to rapid emergence of resistant bacteria that endangers the efficacy of antibiotics.[22]

Amongst *Staphylococcus aureus* isolates, MRSA isolates were 25%. A study done in Canada, revealed that MRSA now accounts for 20%–40% of all hospital-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP) cases and are difficult to treat.[23]

CONCLUSIONS

This study reveals that a wide range of organisms are responsible for causing LRTI other than the usual organisms of Community acquired pneumonia. Moreover, the identification and antibiotic susceptibility pattern are important in understanding our own hospital flora and creating a syndromic antibiogram.

This helps in early recovery and prevention of complications in patients. It also reduces the burden on the ever-growing antimicrobial resistance and prevents the misuse of high end antibiotics. The likelihood that the antibiotic resistance will be reduced by this approach is plausible. This will facilitate to develop a policy for rational prescribing of antibiotics in LRTI thereby ensuring early recovery of patients and reduce the further spread of antibiotic resistance.

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