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Direction of Analysis and Antibiotic resistance of Lower Respiratory Tract Infections (LRTIs) : A Study at Tertiary Care Hospital in North India

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ABSTRACT

Pneumonia or lower respiratory tract infection is a prevalent issue in respiratory treatment. This study was conducted to determine the Analysis Direction and Antibiotic resistance of Lower Respiratory Tract Infections (LRTIs). This is a study conducted from March 2021 to October 2023 in the Department of Microbiology in a teaching hospital that provides special list care. A total of 610 samples were obtained from both hospitalised and non-hospitalized individuals, of all age groups and both genders, who were provisionally diagnosed with lower respiratory tract infections. The samples consisted of 384 sputum, 54 bronchial wash, 107 endotracheal tube secretions, and 65 pleural fluid. Of the 610 samples analysed, 384 were sputum, 107 were endotracheal aspirates, 54 were bronchial wash and 65 were pleural fluid. The majority of the samples analysed, 442 (72.4%), were from inpatients, whereas 168 (27.5%) were from outpatients. Out of the samples analysed, 352 (57.7%) exhibited the growth of several types of bacteria. The table-1 displays the distribution of the samples and their positivity. Culture-negative cases were suspected to have a viral cause or be tuberculosis patients. Certain antibiotics have a decreased susceptibility, possibly as a result of widespread and improper usage, drug addiction, drug adulteration, microbial mutation, and inadequate infection control measures. Regular antimicrobial monitoring is necessary to keep the guidelines up to date for appropriate empirical and targeted antibiotic therapy. It is determined that gramme negative bacilli were the most prevalent isolates found in lower respiratory tract infections, with Klebsiella species being the most frequently identified. The presence of ESBLs, MBLs and MRSA-producing bacteria in our investigation, although infrequent, is worrisome.

INTRODUCTION

Infections in the lower respiratory tract typically happen when the infecting organisms bypass the mechanical and other non-specific barriers of the upper respiratory tract and reach the lower airways or pulmonary parenchyma. Pneumonia, also known as lower respiratory tract infection, is a common issue in the field of respiratory care[1]. In the late 1800s, Sir William Osler commented that pneumonia is referred to as the 'leader of the men of death' due to its unfavourable outlook in the time before antibiotics. Pneumonia continues to be a significant contributor to illness and death globally, even after more than one hundred years. The majority of infections are confined to the upper respiratory tract, whereas just 5% affect the lower respiratory tract [2-4]. When it comes to upper respiratory tract infections (URTI), just 25% of cases are caused by bacteria, while the majority are caused by viruses[5,6]. URTI is commonly used to describe acute infections that affect the nose, paranasal sinuses, pharynx, larynx, trachea and bronchi. It is considered a general word and does not specify the exact nature of the infection[7,8]. The time it takes for most upper respiratory tract infections to develop after being exposed is usually a few hrs to 3 days, but the symptoms might persist for 7-10 days or possibly much longer[9]. The illness primarily linked to a rise in body temperature, coughing, a painful throat and a runny nose. However, upper respiratory tract infections (URTI) are commonly considered to be moderate and resolve on their own. However, there have been reports of URTIs causing serious consequences that can be life-threatening[7,10,11]. Age, sex and time of year are the factors that have been suggested as possible causes of RTI. Environmental factors and transmission from other individuals have been linked to respiratory tract infections (RTIs). Microorganisms that are bigger than 10µm get caught by the nasal hair and cilia that cover the epithelium. Coughing and sneezing are the natural responses that remove the bacteria from the nose and mouth, respectively[12]. The majority of respiratory tract infections are confined to the upper tract, with about 5% affecting the lower respiratory tract. Lower respiratory tract infections (LRTIs) have been identified as causing over 20% of deaths from infectious diseases in India, according to the World Health Organisation (WHO). The upper respiratory tract includes the nasal passages, throat, tonsils and epiglottis. The lower respiratory tract includes the bronchi and alveoli. These illnesses have a notable effect on the economy in terms of productivity and lead physicians to prescribe needless medications even when the cause is viral. The causes of lower respiratory tract infections (LRTIs) differ depending on the location and the period. Quick identification of the microorganism responsible for respiratory tract infections is important in decreasing illness and preventing unnecessary and incorrect antibiotic usage, which contributes to the emergence of antimicrobial resistance. This study was conducted to determine the Analysis Direction and Antibiotic resistance of Lower Respiratory Tract Infections (LRTIs).

MATERIALS AND METHODS

This is a study that was carried out from March 2021 to October 2023 at the Department of Microbiology in a teaching hospital that provides specialised medical care. A combined total of 610 samples were gathered from both hospitalised and non-hospitalized individuals, spanning all age groups and both genders, who were tentatively diagnosed with lower respiratory tract infections. The samples consisted of 384 sputum, 54 bronchial wash, 107 endotracheal tube secretions, and 65 pleural fluid. Samples were collected using sterile wide-mouthed containers with screw covers and brought to the laboratory promptly.

Study population: All individuals visiting the outpatient department and those admitted to the General Medicine and Department of TB and RD of the Hospital with indications of respiratory tract infection were included in the study.

Inclusion criteria: Participants aged 15 yrs and older, who had a verified diagnosis of respiratory tract infection by a healthcare professional, were included in the study. Patients who had not received any antibiotics within the preceding week were included in the trial. The study also included individuals with pre-existing lung diseases in addition to any previous history of RTI.

Exclusion criteria:

- Bacterial isolates from repeat culture of previously
- recruited patients
- Bacterial isolates identified as commensals or
- contaminants
- Mixed bacterial growth

Bacteriology: Movies were created from the samples and dyed using Gram's technique. Gramme stain was performed on a sample with <10 squamous epithelial cells and >25 leucocytes per low power field (100x magnification). The sample was then subjected to cultural investigation[13]. Every sample was placed on blood, chocolate and MacConkey agar plates. The plates were kept at a temperature of 37 °C for a period of 24-48 hrs. Emerging colonies were detected using

conventional techniques[7,8]. The antibiotic discs used were Ampicillin (10µg), Amoxycillin-clavulanate (20/10 µg), Piperacillin (100 µg), Piperacillin–Tazobactam (100/10 µg), Gentamicin (10 µg), Amikacin (30 µg), Cefazolin (30 µg), Ceftriaxone (30 µg), Cefuroxime (30 µg), Cefoxitin (30 µg), Cefepime (30 µg), Ceftazidime (30 µg), Cotrimoxazole (1.25/23.75 µg), Tetracycline (30 µg), Ciprofloxacin (5), Imipenem (10), Penicillin (10U), Erythromycin (15 µg), Clindamycin (2 µg), Linezolid (30 µg), and Vancomycin (30 µg). Methicillin resistant Staphylococcus aureus (MRSA) were identified using a Cefoxitin 30 µg disc. Strains with a zone size of 21 mm were classified as MRSA[15]. The sensitivity of Str.pneumoniae to penicillin was determined using a 1 µg disc of Oxacillin, with a zone size of 20mm being deemed as indicative of sensitivity. ATCC control strains of Esch.coli ATCC 25922, S.aureus ATCC 25923, and P.aeruginosa 27853 were employed for the purpose of quality control in disc diffusion assays.

Statistical analysis: Descriptive statistics were employed for analysis. The data was inputted into MS-Excel and analysed using SPSS 17 software. The results were presented as percentages.

RESULTS

Among the 610 samples that were analysed, 384 were sputum, 107 were endotracheal aspirates, 54 were bronchial wash and 65 were pleural fluid. The majority of the samples analysed, 442 (72.4%), were from inpatients, where as 168 (27.5%) were from outpatients. Out of the samples tested, 352 (57.7%) exhibited the growth of several types of bacteria. The table-1 displays the distribution of the samples and their positivity.Culture-negative cases were suspected to have a viral cause or be tuberculosis patients. The data contained information about risk factors, age group, comorbid lung illnesses, diabetes, smoking and so on. Among the 610 patients that tested positive for culture, 380 (62.29%) were males and 230 (37.70%) were girls (Table 2).

The bacterial isolate's antibiotic susceptibility profile is displayed in table-3. Imipenem and amikacin demonstrated higher efficacy against gramme negative bacterial isolates, while vancomycin, amikacin, and ofloxacin were effective against gramme positive isolates.

DISCUSSIONS

The causes of lower respiratory tract infections (LRTIs) differ depending on the location and period. Dealing with LRTIs is difficult because of the rise of multi drug resistance. In this investigation, 58.9% of

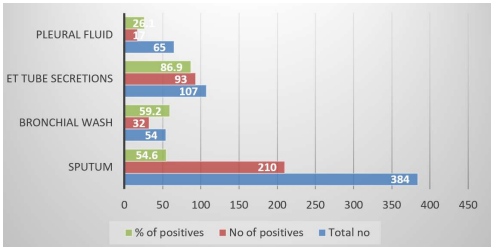

Fig. 1: Positivity of the Sample

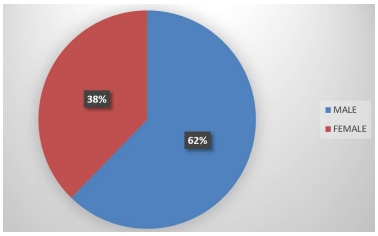

Fig. 2: Gender wise distribution of cases

Table.1 Distribution and positivity of the samples

Samples	Total no	No of positives	% of positives
Sputum	384	210	54.6
Bronchial wash	54	32	59.2
ET tube secretions	107	93	86.9
Pleural fluid	65	17	26.1

Table.2Gender wise distribution of cases

Gender	No	%
Male	380	62.29
Female	230	37.70
Total	610	

the samples exhibited bacterial growth, which aligns made up 46.1% of all the isolates, making it the most common organism found. This was followed by Staphylococcus aureus, which had a similar prevalence as the study conducted by Supriya panda *et al*.[16] In our study, we found 16 MRSA strains, accounting for 22.5% of the total, slightly higher than the reported rate. Additionally, the prevalence of ESBL producers in our study was 32.7%, slightly higher than what was reported previously[17]. The MBL producers in our investigation had a similarity of 3.9% to the study conducted[18]. Our research also revealed that most of the strains that were resistant came from secretions in the ET tube, similar to what was described in reference[19]. The current investigation demonstrated favourable susceptibility to aminoglycosides and fluroquinol ones in comparison to the other medicines that were examined[20]. Other research indicated that S.pyogenes and S.pneumoniae were the most common isolates[21-26]. Therefore, Gramme positive cocci were the prevalent isolates maybe because the respiratory tract infection is caused by airborne pathogens that can last in dry environments for extended periods. Gram-positive bacteria are more resilient to drying than Gram-negative bacteria due to their thicker and

Table.3 Sensitivity of the isolates to commonly used antibiotics

Antibiotics	Klebsiella S %	Staphylococcus aureus S %	CONS S%	Pseudomonas S %
Ceftriaxone	80.8	79.2	87.3	59.1
Ceftazidime	71.5%	73.7	77.2	84.3
Azithromycin	-	64.1	69.2	-
Amikacin	86.2%	66.9	72.1	81.4
Ofloxacin	76.1%	95.6	74.8	78.2
Amoxyclav	67.1	73.7	56.2	-
Cotriamoxazole	64.5	-	-	-
Vancomycin	-	88.8	85.2	-
Imipenem	85.8	-	-	84.8
Tobramycin	-	-	-	65.2
Piperacillin	-	-	-	75.1

more rigid cell wall. Additionally, human diseases such as Staphylococcus and Streptococcus may survive well under dry conditions and remain viable in dust for extended periods of time[21]. However, certain investigations indicated that Gram-negative bacteria, particularly Klebsiella pneumoniae, were the most often identified isolates[2,27]. Possible factors for the variation in bacteria spread could include differences in climate and geography. Based on the clinical history, it was shown that most of the children came from low socioeconomic backgrounds. Factors such as overcrowding, poor cleanliness, low immune state and malnutrition may have contributed to the increased transmission of viruses. An imbalance in oral microbial flora can occur due to excessive use of wide spectrum antibiotics, which remove competing bacteria and alter the naturally balanced ecology of oral microorganisms. Similarly, taking corticosteroids as treatment might also make patients more susceptible to upper respiratory tract infections (URTIs).with the findings of Banerjee *et al*. The results of our investigation indicated that the infection rate caused by gramme negative bacilli (65.5%) was higher compared to that caused by gramme positive cocci (34.5%), which aligns with the findings of a previous study. Our research indicated that Klebsiella species

CONCLUSION

In this research, several antibiotics exhibit a significant decrease in susceptibility, which could be attributed to the indiscriminate and improper use of medications, drug addiction, drug adulteration, microbial mutation and inadequate infection control techniques. Regular antimicrobial monitoring is necessary to keep the guidelines up to date for appropriate empirical and targeted antibiotic therapy. It may be determined that gramme negative bacilli were the most frequently found organisms in cases of lower respiratory tract infection, with Klebsiella species being the most commonly identified. The presence of ESBLs, MBLs and MRSA-producing bacteria in our investigation, although infrequent, is worrisome. The study revealed that the isolates obtained from secretions of ET tubes were shown to have a greater resistance to drugs compared to isolates from other respiratory samples. This suggests that there is a higher utilisation of antibiotics in the critical care units. We stress the importance of timely clinical diagnosis, combined with microbiological observations, and suitable treatment options in managing both community and hospital-acquired lower respiratory tract infections (LRTIs).

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