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EVALUATING THE CLINIC-DEMOGRAPHIC AND ANTIMICROBIAL SUSCEPTIBILITY PROFILES OF LOWER RESPIRATORY TRACT INFECTIONS IN ICU PATIENTS

Medicine

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ABSTRACT

Introduction: Lower respiratory tract infections (LRTIs) are a significant health issue affecting the trachea, bronchi, and lungs, and include conditions such as pneumonia, influenza, bronchitis, and acute exacerbations of chronic obstructive pulmonary disease (COPD). These infections contribute substantially to morbidity and mortality rates and are responsible for a considerable percentage of hospital admissions and outpatient visits. The management of LRTIs in intensive care units (ICUs) is complicated due to the varied patient profiles. This study aims to assess the clinic-demographic characteristics and antimicrobial susceptibility profiles of LRTIs in ICU patients over six months in a teaching hospital. **Methodology:** This retrospective study was carried out at Shri Ram Murti Smarak Institute of Medical Sciences. It included 200 ICU patients with positive cultures for LRTIs over six months. Patients over 18 years old were included, while those with negative cultures, multiple species of the same organism isolated, or incomplete records were excluded, leaving 100 patients for analysis. Data on demographics, bacterial isolates, and antimicrobial susceptibility were collected from medical records. Descriptive statistics were used, and chi-square or Fisher's exact tests were applied to assess statistical significance, with a p-value of less than 0.05. Analysis was conducted using MedCalc® software.**Results:** Among the 100 patients, 70% were male and 30% female. The largest age group was those over 60 years (30%). Major underlying conditions included diabetes mellitus (40%), respiratory pathology (30%), and nephrological pathology (15%). Most bacterial isolates came from tracheal aspirates (85%), with a predominance of gram-negative organisms (88%). The most frequent pathogens were Acinetobacter baumannii (30%), Pseudomonas aeruginosa (24%), and Klebsiella (22%). A. baumannii showed high susceptibility to colistin (93.34%) but low susceptibility to carbapenems. P. aeruginosa was most susceptible to doripenem (62.5%), and Klebsiella had the highest sensitivity to colistin (90.90%). Staphylococcus aureus and Enterococcus were highly susceptible to linezolid and vancomycin. **Conclusion:** The study found a higher prevalence of LRTIs among males and older adults, especially those over 60. Conditions such as diabetes mellitus and respiratory pathologies significantly contributed to the incidence of LRTIs. The predominance of gram-negative bacteria, particularly A. baumannii, P. aeruginosa, and Klebsiella, highlights the need for targeted antimicrobial therapies. The findings underscore the importance of continuous monitoring of antimicrobial resistance and careful use of antibiotics to manage LRTIs effectively in ICU settings.

KEYWORDS

LRTI, ICU, antimicrobial susceptibility, gram-negative bacteria, antibiotic resistance.

INTRODUCTION

Lower respiratory tract infections (LRTIs) affect the trachea, bronchi, and lungs, encompassing conditions like pneumonia, influenza, bronchitis, acute exacerbations of chronic obstructive pulmonary disease (COPD), and bronchiolitis. Despite the lack of a standardized definition, LRTIs are recognized for their significant impact on human health, contributing notably to morbidity and mortality. They account for approximately 4.4% of all hospital admissions and 6% of outpatient visits.[1] Managing LRTIs in intensive care units (ICUs) is particularly challenging due to the varied epidemiological, clinical, and microbiological profiles of the patients. In hospitalized individuals, common pathogens include gram-negative bacteria like Klebsiella, Escherichia coli (E. coli), Acinetobacter baumannii (A. baumannii), Pseudomonas aeruginosa (P. aeruginosa), as well as gram-positive bacteria such as Staphylococcus aureus (S. aureus), and occasionally, fungi.[2]

This study aims to evaluate the clinic-demographic characteristics and antimicrobial susceptibility profiles of LRTIs in ICU patients over a six-month period at a teaching hospital. By analyzing the distribution of these infections and their resistance patterns, the research seeks to identify the most prevalent pathogens and their susceptibility to various antimicrobial agents. This information is essential for developing effective treatment strategies and improving the management of LRTIs in critically ill patients, ultimately aiming to reduce the associated morbidity and mortality in this vulnerable population.

MATERIAL & METHODS

This retrospective study was conducted over six months at Shri Ram Murti Smarak Institute of Medical Sciences, an academic teaching hospital and a tertiary referral center. The study focused on 200 patients admitted to the medical and surgical intensive care units (ICUs) who required intensive care and had positive cultures for lower respiratory tract infections (LRTIs). Patients eligible for the study were aged over 18 years, of either gender. Exclusion criteria included patients with negative cultures, those with more than one species of the same organism isolated, and those with incomplete case records. Based on these criteria, 100 patients were ultimately included in the study.

Data were collected retrospectively from medical records using a structured data collection tool. The collected demographic data included age and gender. Age was categorized into five groups: 18-30 years, 31-40 years, 41-50 years, 51-60 years, and over 60 years. Information on bacterial isolates was also collected, including the region of the lower respiratory tract from which the sample was taken, gram stain results, the identity of the bacterial isolates, and their antimicrobial susceptibility patterns. Consistent and uniform procedures were followed for sample collection, culture, and sensitivity testing.

For the descriptive analysis, frequency (n) and percentage (%) were used to represent qualitative variables. Comparisons were made between the types and numbers of bacterial isolates. The chi-square test or Fisher's exact test was employed to test for statistically significant differences between qualitative variables. Statistical significance was set at a p-value of less than 0.05, with a 95% confidence interval. Data analysis was performed using MedCalc® software.

The aim of this study was to evaluate the clinic-demographic characteristics and antimicrobial susceptibility profiles of lower respiratory tract infections (LRTIs) in ICU patients. By analyzing the

distribution and resistance patterns of bacterial isolates, the research focused on identifying the prevalent pathogens and their susceptibility to various antimicrobial agents. This evaluation is essential for developing effective treatment strategies and improving the management of LRTIs in critically ill patients.

RESULTS

Table 1:

Characteristics	Number of Patients (n)	Percentage (%)
Total Patients	100	100
Gender		
Male	70	70
Female	30	30
Age Groups		
18-30 years	12	12
31-40 years	18	18
41-50 years	20	20
51-60 years	20	20
Above 60 years	30	30

Table 1 represents the demographic characteristics of the 100 patients included in the study. Out of the total patients, 70% were male and 30% were female. The age distribution shows that the largest group of patients was above 60 years old, accounting for 30% of the total. Patients aged 41-50 years and 51-60 years each made up 20% of the study population. Those in the 31-40 years age group comprised 18%, while the smallest group was patients aged 18-30 years, representing 12% of the total. This distribution highlights a higher prevalence of lower respiratory tract infections among older adults, particularly those above 60 years of age.

Table 2:

Underlying Medical Conditions	Number of Patients (n)	Percentage (%)
Diabetes mellitus	40	40
Respiratory pathology	30	30
Nephrological pathology	15	15
Other medical conditions	15	15
Total	100	100

Table 2 represents the underlying major medical conditions of the 100 patients with lower respiratory tract infections. It shows that 40% of the patients had diabetes mellitus, 30% had respiratory pathology, and 15% had nephrological pathology. Additionally, 15% of the patients suffered from other medical conditions, which included electrolyte imbalance, hormonal imbalance, or miscellaneous causes such as poisoning.

Table 3:

Source of Bacterial Isolate	Number of Isolates (n)	Percentage (%)
Tracheal aspirate	85	85
Broncho-alveolar lavage	15	15
Total	100	100

Table 3 represents the sources of bacterial isolates in patients with lower respiratory tract infections. It shows that the majority of bacteria were isolated from tracheal aspirates (85%), while a smaller proportion (15%) were isolated from broncho-alveolar lavage. This indicates a statistically significant difference between the two sources of bacterial isolation.

Table 4:

Isolated Organisms	Number of Isolates (n)	Percentage (%)
Acinetobacter baumannii	30	30
Pseudomonas aeruginosa	24	24
Klebsiella	22	22
Staphylococcus aureus	4	4
Enterococcus	4	4
Escherichia coli	12	12
Pneumococcus	2	2
CONS (Coagulase-negative Staphylococci)	2	2
Total	100	100

Table 4 represents the distribution of isolated organisms from patients with lower respiratory tract infections. Acinetobacter baumannii was the most frequently isolated organism, accounting for 30% of cases, followed by Pseudomonas aeruginosa (24%) and Klebsiella (22%). Staphylococcus aureus and Enterococcus each accounted for 4% of isolates. Escherichia coli was found in 12% of cases, while Pneumococcus and coagulase-negative staphylococci (CONS) were each isolated in 2% of cases, highlighting the diverse bacterial profile in these infections.

Table 5:

Organism	Antibiotic	Susceptibility (%)
Gram-Negative Isolates		
Acinetobacter baumannii	Colistin	93.34
	Minocycline	80
	Amikacin	66.66
Pseudomonas aeruginosa	Doripenem	62.5
Klebsiella	Colistin	90.90
	Doripenem	72.72
	Meropenem	68.18
	Tigecycline	63.64
Gram-Positive Isolates		
Staphylococcus aureus	Linezolid	75
	Vancomycin	75
Enterococcus	Vancomycin	100

Table 5 represents the antibiotic susceptibility patterns for various gram-negative and gram-positive isolates from patients with lower respiratory tract infections. Among the gram-negative isolates, Acinetobacter baumannii showed the highest susceptibility to colistin (93.34%), followed by minocycline (80%) and amikacin (66.66%). Pseudomonas aeruginosa was most susceptible to doripenem (62.5%). Klebsiella demonstrated the greatest sensitivity to colistin (90.90%), with notable susceptibility to doripenem (72.72%), meropenem (68.18%), and tigecycline (63.64%). For gram-positive isolates, Staphylococcus aureus showed equal susceptibility to linezolid and vancomycin (75% each), while Enterococcus was fully susceptible to vancomycin (100%).

DISCUSSION

Lower respiratory tract infections (LRTIs) are prevalent in intensive care units (ICUs), with incidence rates ranging from 10% to 25% and associated mortality rates between 22% and 71%.[12,13] Antibiotic resistance poses a significant public health challenge, particularly in settings with limited resources. The emergence of antibiotic-resistant bacterial strains complicates infection control efforts, leading to increased mortality and healthcare costs.[1] Recent reports have underscored the severity of antimicrobial-resistant organisms, often referred to as "nightmare" bacteria due to their deadly impact and the financial burden they impose.[3]

In our study, LRTIs were more common in males, likely due to differences in lifestyle and various anatomical, behavioral, and socioeconomic factors. Factors such as smoking, tobacco use, alcohol consumption, and environmental exposures contribute to decreased local immunity in the respiratory tract by impairing mucociliary clearance, causing mucous plugging, airway collapse, and respiratory muscle weakness.[6,7] Similar findings were reported by **Humphrey et al.** [8], reinforcing the notion that these factors play a significant role in the susceptibility to LRTIs. Additionally, our study found that elderly patients were at a higher risk for LRTIs. The age distribution indicated that individuals over 50 years old were particularly vulnerable, likely due to diminishing immunity and pulmonary defense mechanisms, as well as the presence of chronic conditions such as malnutrition, diabetes mellitus, emphysema, and uremia.

Our study observed a predominance of gram-negative organisms (88%) compared to gram-positive organisms (12%), consistent with findings by Khan et al.[9] This trend highlights the increasing incidence of gram-negative pathogens causing LRTIs in ICUs. However, contrasting results were reported in a study conducted in Bangladesh, where 89% of the isolates were gram-positive.[10] Among the gram-negative isolates in our study, Acinetobacter baumannii was the most frequently isolated pathogen (30%), followed by Pseudomonas aeruginosa, Klebsiella, and Escherichia coli. These findings align with the study by Parajuli et al. [11], which also identified A. baumannii as a

common respiratory pathogen in ICUs. The antimicrobial susceptibility patterns observed in our study revealed that A. baumannii had low susceptibility to most tested antibiotics, including carbapenems such as doripenem (20.6%), imipenem (23.5%), and meropenem (32.4%). This resistance pattern has been noted globally in recent times. However, most multi-drug resistant A. baumannii isolates remained susceptible to colistin. P. aeruginosa exhibited resistance to commonly used antibiotics but showed the highest susceptibility to doripenem (51.7%). Similar resistance patterns for P. aeruginosa have been reported in other studies conducted in India and worldwide.[12,13] Among the gram-negative bacteria, Klebsiella and E. coli showed the highest sensitivity to colistin.[13,14] A general lower susceptibility was observed towards aminoglycosides, cephalosporins, fluoroquinolones, and penicillin group antibiotics, likely due to extensive use and the development of drug resistance mechanisms such as enzyme production, decreased drug uptake, and efflux pumps.[15]

Among gram-positive bacteria, Staphylococcus aureus and Enterococcus were the most common isolates, with both demonstrating maximum susceptibility to linezolid (75%). Similar results were observed in a study by Singh et al. conducted in North India [14,15], underscoring the efficacy of linezolid against these pathogens. This study provides critical insights into the clinic-demographic and antimicrobial susceptibility profiles of LRTIs in ICU patients, highlighting the importance of continuous surveillance and tailored antibiotic therapy to combat the growing threat of antibiotic-resistant infections.

CONCLUSION

In our study the demographic analysis of the 100 patients were included indicate a higher prevalence of lower respiratory tract infections (LRTIs) among males (70%) compared to females (30%). The age distribution reveals that older adults, particularly those above 60 years, are more susceptible to LRTIs, accounting for 30% of the cases. This trend underscores the importance of targeted preventive measures and interventions for older populations. The data also highlight that significant underlying medical conditions such as diabetes mellitus (40%) and respiratory pathologies (30%) contribute to the incidence of LRTIs, indicating the need for comprehensive management of these comorbidities to reduce infection risks.

The microbiological findings demonstrate a predominance of gram-negative organisms (88%) over gram-positive organisms (12%) in LRTIs. Acinetobacter baumannii emerged as the most common pathogen (30%), followed by Pseudomonas aeruginosa (24%) and Klebsiella (22%). The antibiotic susceptibility patterns reveal critical insights into resistance trends, with A. baumannii showing high susceptibility to colistin (93.34%) but low susceptibility to carbapenems. P. aeruginosa exhibited the highest susceptibility to doripenem (62.5%), while Klebsiella was most sensitive to colistin (90.90%). Among gram-positive isolates, Staphylococcus aureus and Enterococcus demonstrated substantial susceptibility to linezolid and vancomycin. These findings emphasize the need for ongoing surveillance of antimicrobial resistance and the judicious use of antibiotics to effectively manage LRTIs in ICU settings.

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