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Original Article

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Clinical Profile, Risk Factors and Outcome of Hospital Acquired Peumonia at a Teritary Care Center: A Prospective Study

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Abstract

Objective: To investigate the clinical profile, risk factors, outcomes, microbiological patterns, and antibiotic resistance in hospital-acquired pneumonia (HAP) patients at a tertiary care centre. ***Design:*** Prospective observational study. ***Subjects/Patients:*** A total of 138 patients were diagnosed with HAP at a tertiary care hospital in Mumbai. ***Methods:*** Patients developing HAP ≥48 hours after admission were enrolled. Clinical data, comorbidities, risk factors, and microbiological cultures were recorded. Outcomes were analysed using standard statistical tests, with $p < 0.05$ considered significant. ***Results:*** The mean age was 44.2 ± 17.7 years; 65.2% were male. Major risk factors included obesity (48.6%), steroid use (46.4%), hypertension (41.3%), diabetes (30.4%), and smoking (31.2%). *Klebsiella pneumoniae* (30%) was the most common isolate, followed by *Acinetobacter baumannii and Pseudomonas aeruginosa*. Pan-resistance was observed in 9.4% of cases, predominantly involving *Klebsiella pneumoniae* (69.2%), *Acinetobacter baumannii* (15.4%), and *Pseudomonas aeruginosa* (15.4%). Death occurred in 26.8% of patients, predominantly in older patients and those requiring ICU care and ventilator support. A CPIS ≥8 was significantly associated with mortality ($p < 0.05$). ***Conclusion:*** HAP remains a serious cause of morbidity and mortality, especially in older and critically ill patients. Early identification of risk factors and region-specific antimicrobial strategies are essential for improving outcomes.

Keywords: ***Drug Resistance, Microbial, Intensive Care Units, Mortality, Pneumonia, Ventilator-Associated.***

Introduction

Hospital-acquired pneumonia (HAP), a serious infection occurring 48 hours or more after hospital admission. A significant subset of HAP is ventilator-associated pneumonia (VAP), which develops in intensive care unit (ICU) patients who require mechanical ventilation [1]. HAP is one of the most common nosocomial infections, accounting for 13% to 18% of all hospital-acquired infections and leading to high morbidity, mortality (20%-50%) [2], and increased healthcare costs due to prolonged hospital stay. The prevalence of HAP is particularly high among critically ill patients and those receiving mechanical ventilation, as intubation increases the chances of infection by 7 to 21 times compared to non-intubated patients [3]. Several risk factors contribute to the development of HAP, including prolonged mechanical ventilation (>48 hours), severity of underlying illness, comorbidities, and extended ICU stays [2]. Common pathogens causing HAP include aerobic gram-negative bacilli (e.g., *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Acineto*bacter species), as well as Staphylococcus aureus, particularly methicillin-resistant strains (MRSA) [4,5]. A variety of antimicrobial agents are used to manage these cases of HAP, including cephalosporins, aminoglycosides, fluoroquinolones, carbapenems, and newer broad-spectrum drugs such as linezolid and ceftobiprole [6,7]. Hospital-acquired pneumonia (HAP) is associated with substantial morbidity, mortality, and healthcare costs, making it a major concern, particularly in intensive care unit (ICU) settings [8,9]. Despite the high burden of HAP, especially in Asia, data on its prevalence, causative pathogens, and antibiotic resistance patterns remain limited. This lack of regional data highlights the importance of studies that can provide insights into local trends and help shape effective healthcare strategies. A better understanding of the clinical presentation, risk factors, outcomes, and management of HAP can contribute to improved treatment protocols and patient care. Therefore, this study aims to address this knowledge gap.

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Materials and Results

This prospective study was conducted over a period of 18 months among patients in the Department of General Medicine at King Edward Memorial Hospital (KEMH), Mumbai, Maharashtra, India. Approval was obtained from the Ethical Committee prior to conducting the study and patients were enrolled after obtaining written informed consent. The study included patients above 12 years of age who were admitted to the hospital and developed clinical features of HAP after 48 hours of hospitalization in accordance with the standard criteria recommended by the Centers for Disease Control and Prevention (CDC) [10]. For ventilator-associated pneumonia (VAP), a Clinical Pulmonary Infection Score (CPIS) greater than 6 was considered diagnostic. Patients with lower respiratory tract infection before or within 48 hours of admission, those admitted with upper respiratory tract infections, and pregnant patients were excluded from the study.

Detailed clinical data were recorded for all enrolled patients. This included demographic characteristics, comorbidities, and risk factors such as aspiration, use of proton pump inhibitors, emergency intubation, and tracheostomy. A thorough general physical and systemic examination was performed, and findings were documented. Laboratory investigations, including biochemical, radiological, and microbiological parameters, were obtained as per standard clinical practice. Specimens including sputum, bronchoalveolar lavage fluid, endobronchial secretions, endotracheal tube secretions, and blood were collected for culture using standard microbiological techniques.

Upon being diagnosed with HAP, the timing of symptom onset, temperature, leukocyte counts, chest radiographic findings, and interventional details, including oxygen supplementation, need for mechanical ventilation, use of suction devices, nasogastric tube placement, stress ulcer prophylaxis, administration of steroids, sedatives, and antibiotics were systematically recorded. Patients were followed until discharge or death, and outcomes including length of hospital stay were noted. Importantly, as this was an observational study, no investigations were performed solely for research purposes, and all management decisions were at the discretion of the treating physician.

Data were collected using a structured proforma and digitalised using Microsoft Excel. Statistical analysis was performed using SPSS version 24.0 (IBM, USA). Qualitative variables were expressed as proportions, while quantitative data were summarized as mean and standard deviation (SD). Associations between categorical variables were analysed using Chi-square test or Fisher's exact test as appropriate. The unpaired t-test was used for comparison of means between groups. Receiver Operating Characteristic (ROC) curve analysis was performed for relevant predictive variables. A p-value <0.05 was considered statistically significant, and $p<0.001$ was considered highly significant.

A total of 138 patients with a mean age was 44.2 ±17.7 years and a mean body mass index of 24.7 ± 3.8 kg/m² were enrolled in the study. Amongst these 65.2% were males and 34.8% were females. The cohort required mechanical ventilation for a mean duration of 14.6 ± 3.3 days. Glycemic parameters demonstrated a mean fasting blood sugar of 105.4 ± 23.6 mg/dL and a mean hemoglobin A1c of 6.3 ± 1.5%. Inflammatory response was reflected by a mean C reactive protein level of 132.4 ± 38.1 mg/L on day 5 following the onset of hospital acquired pneumonia (**Table 1**).

The incidence of HAP was highest in patients more than 50 years old (38.4%) (**Table 2**). Majority of the patients developed symptoms of HAP >5 days after admission (63%). Fever was the most common presenting complaint, with other signs and symptoms including breathlessness, cough, hypotension, and tachycardia.

Table 1: Details of study participants

Variable	Mean	Std. Deviation	Minimum	Maximum
Age (year)	44.22	17.72	14	87
Wt in Kg	66.70	13.46	34	90
Ht in centimetres	162.57	11.04	130	176
BMI	24.69	3.81	17	32
FBS	105.43	23.58	76	160
HBA1C (%)	6.34	1.54	4.6	10.1
Hb	10.38	2.36	7.00	18.20
WBC	18260.73	5919.30	860	42000
Duration of mechanical ventilation (days)	14.63	3.26	8	24
CRP (on day 5 of developing symptoms of HAP) (mg/L)	132.41	38.06	60	209

Table 2: Distribution According to Age Group

Age Group (Years)	Frequency	Percent (%)
12–18	15	10.9
21–30	22	15.9
31–40	23	16.7
41–50	25	18.1
>50	53	38.4
Total	**138**	**100.0**

Patients with comorbidities such as obesity, hypertension, diabetes, previous history of smoking/intake of steroids, and history of previous hospital admission were found to be at increased risk of developing HAP. The incidence was highest in those requiring ICU admission and mechanical ventilation (63%). On investigation, majority of patients had unilocular involvement on Chest X ray (CXR) and the most common organism isolated from sputum was *Klebsiella pneumonia* (44.2%).

Deaths occurred in 37 of the 138 enrolled patients (26.8%), with the majority seen in males and individuals over 50 years of age (**Table 3**). However, gender did not have a significant impact on the outcome (death or discharge) ($p > 0.05$). Mortality was significantly higher among patients who required ICU admission compared to

those who did not, and all patients who died required ventilator support.

Distribution of outcome according to Clinical Pulmonary infection score revealed that 29.7% of the cases with the score of 8 succumbed to deaths as against 17.8% of the discharged cases. 45.9% of the cases with the score of 9 succumbed to deaths as against 4% of the discharged cases. 18.9% of the cases with the score of 10 succumbed to deaths as against 1.0% of the discharged cases. This difference in the score was found to be statistically significant ($p<0.05$) (**Table 3**).

Table 3: Distribution of Outcome According to Clinical Pulmonary Infection Score

Clinical Pulmonary Infection Score	Death		Discharge		Total
	Number	%	Number	%	
Score 6	0	0.0	9	8.9	9
Score 7	2	5.4	69	68.3	71
Score 8	11	29.7	18	17.8	29
Score 9	17	45.9	4	4.0	21
Score 10	7	18.9	1	1.0	8
Total	**37**	**100.0**	**101**	**100.0**	**138**

When outcomes were stratified by infective organisms, the proportion of patients infected with *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and *Pseudomonas aeruginosa* was significantly higher among those who died compared to those who were discharged ($p < 0.05$) (**Table 4**). Pan resistance to the following antibiotics: ceftriaxone, ceftazidime, ampicillin sulbactam, piperacillin tazobactam, cefosulbactam, meropenem, colistin, gentamicin, vancomycin, levofloxacillin and teicoplanin, was found in 9.4% cases in our study. Out of 13 cases of pan resistance, 69.2% were infected with *Klebsiella pneumonia*, and 15.4% each with *Acinetobacter Baumanii* and *Pseudomonas aeruginosa*.

Table 4: Distribution of Outcome According to Sputum Culture Isolates

Sputum Culture Isolate	Death		Discharge		Total
	Number	%	Number	%	
Acinetobacter baumannii	8	21.6	8	7.9	16
Streptococcus pneumoniae	1	2.7	38	37.6	39
Klebsiella pneumoniae	23	62.2	38	37.6	61
No growth	1	2.7	5	5.0	6
Pseudomonas aeruginosa	4	10.8	1	1.0	5
Staphylococcus aureus	0	0.0	11	10.9	11
Total	**37**	**100.0**	**101**	**100.0**	**138**

Discussion

Werarak P. *et al.*[11] showed that the incidence of HAP was highest amongst males more than 60 years of age. However, the mean age of the study population was quite higher than our study. This could be attributed to the geographical variances in the prevalence of HAP. A study by Berba *et al.*[12] confirmed that age more than 60 years is one of the risk factors for the development of HAP. A high incidence (38.4%) of HAP among the age group more than 50 years was also observed in our study. However, this could be due to the bulk of the study population in this study being more than 50 years old as another study by Muhammad *et al.*[13] reported that the highest incidence was among 41 to 60 years of age group. Nonetheless, the mortality rates amongst this age group in our study (47.2%) aligned with global estimates (30%-70%) [3].

The present study showed that the incidence of HAP was higher among male patients than females. This finding was similar to the study by Mukhopadhyay *et al.*[14] from Lucknow. But Berba *et al.*[12] showed that the male sex had a protective effect against the development of HAP. Dey *et al.*[15] reported that gender had no significant role in the development of HAP.

Fever and breathlessness were the most common presenting complaints, consistent with findings from previous studies [11,16]. However, elderly patients often lacked these symptoms, and this atypical presentation makes the diagnosis of HAP in this population challenging for physicians.

In our study, common risk factors among HAP patients included obesity (48.6%), hypertension (41.3%), diabetes mellitus (30.4%), smoking (31.2%), and steroid use during admission (46.4%), with smaller proportions having ischemic heart disease (7.2%), chronic kidney disease (5.1%), COPD (0.7%), or preceding URTI (0.7%). These findings are consistent with previous studies [11,16,17], where comorbidities such as diabetes, obesity, and pre-existing respiratory morbidity have been frequently reported as significant risk factors for HAP.

Incidence of death in our study was 26.8%. The HAP clinical survey results of 13 large Chinese teaching hospitals showed that the average all-cause mortality rate of HAP was 22.3%, of which that of VAP was 34.5% [18] However, a recent 3- year prospective multicentre cohort study conducted in Japan and a recent retrospective study conducted in China showed HAP mortality rate (13.6% and 14.5%, respectively) which is again less as compared to our study findings [19,20]. A higher mortality rate in our study could be attributed to the clinical criteria used however its highly unlikely that any of the patients with HAP was missed as sputum/ tracheal aspirate cultures were done for every patient. Older age, ICU, and tracheal cannula were associated with higher mortality due to HAP, which was consistent with the finding of previous studies [18-20].

Most of the HAP patients who expired had bilateral infiltrates on chest x-ray, similar to the studies by Wuderine RG *et al.*[21] and Saroja *et al.*[16]. Also, the distribution and antimicrobial susceptibilities of causative pathogens isolated from patients with HAP differ in each region and individual situation [22]. The proportion of infective organisms identified via sputum/tracheal aspirate culture were similar to the studies previously conducted [16,22-24]. *Klebsiella Pneumoniae* & MRSA were most commonly

isolated organisms according to microbial prediction of ATS/IDSA 2005 and in review article done by CHOA-HSIEN LEE *et al.* in 2008 [25]. In our study, *Klebsiella pneumoniae* was the predominant isolate (30%). Multidrug-resistant (MDR) pathogens were also observed, and most patients who died were infected with MDR organisms, in line with findings from earlier studies [26].

Hospital-acquired pneumonia (HAP) continues to be a significant contributor to morbidity and mortality, particularly among older adults, males, and patients requiring ICU admission and mechanical ventilation. In our study, age over 50 years and ICU stay were associated with higher mortality, while gender did not significantly affect outcomes. Comorbidities such as obesity, diabetes, hypertension, and prior steroid use were common among HAP patients, aligning with known risk factors. *Klebsiella pneumoniae* emerged as the most frequent pathogen, with multidrug-resistant organisms notably contributing to adverse outcomes. These findings emphasize the importance of early risk stratification, tailored antimicrobial therapy based on local pathogen patterns, and stringent infection control practices to reduce the impact of HAP and improve survival.

Abbreviations

HAP: Hospital-acquired pneumonia
VAP: Ventilator-associated pneumonia
ICU: Intensive care unit
MRSA: Methicillin-resistant Staphylococcus aureus
CDC: Centers for Disease Control and Prevention
CPIS: Clinical Pulmonary Infection Score
SD: Standard deviation
ROC: Receiver Operating Characteristic
CXR: Chest X-ray
COPD: Chronic Obstructive Pulmonary Disease
URTI: Upper Respiratory Tract Infection
ATS: American Thoracic Society
IDSA: Infectious Diseases Society of America
MDR: Multidrug-resistant

Disclosures

Ethical Approval and consent

The study was approved by the Institutional Ethics Committee of Seth GS Medical College and KEM Hospital, Mumbai, Maharashtra, India. Written informed consent was obtained from all participants included in the study.

Consent for publication

Consent for publication was obtained from the participants prior to data collection.

Availability of supporting data

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Dr Nitin Sarate and Dr Kamaraju K conceptualized the study and were the principal investigators. Dr Kamaraju K also assisted with data interpretation and literature review. Vineet Chandak assisted with manuscript writing. Dr. Alhad Mulkalwar assisted in the final review of the manuscript. All authors read and approved the final manuscript.

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