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Original Research Article

Clinical and Microbiological Profile of Ventilator-Associated Pneumonia in Intensive Care Unit of Tertiary Care Hospital

Pooja Sidam Panthakey[1], Shweta Thakur[2], Shilpa Kocheker[3]

[1]Demonstrator, Department of Microbiology, Chhindwara Institute of Medical Sciences, Chhindwara, MP, India

[2]Demonstrator, Department of Pathology, Chhindwara Institute of Medical Sciences, Chhindwara, MP, India

[3]Demonstrator, Department of Community Medicine, Chhindwara Institute of Medical Sciences, Chhindwara, MP, India

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Corresponding Author: Dr. Shilpa Kocheker

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Abstract:

Introduction: In patients on mechanical ventilation, ventilator-associated pneumonia (VAP) is a frequent hospital-acquired ailments that raises mortality, intensive care unit stays, and medical expenses. The main cause of VAP is the aspiration of oropharyngeal organisms into the distal bronchi, which can happen directly or by stomach reflux. In order to effectively manage this illness, preventative measures are essential.

Methods: In Central India, a Medical College Hospital served as the study's setting. Patients were chosen from ICUs according to inclusion and exclusion criteria after receiving approval from the institutional ethical committee. Clinical, microbiological, and radiological indicators were taken into consideration when assigning a score to clinically suspected patients using the Chronic Pulmonary Infection Score (CPIS), in accordance with CDC guidelines. Age, gender, CPIS, diagnosis at ICU admission, length of ventilation, antibiotics received, samples submitted for etiological agent confirmation, suction tip culture, endotracheal aspirate, type of organism recovered, susceptibility profile, and clinical outcome were among the variables noted for each patient.

Results: Out of the 362 patients that were chosen, 99.7% of them were in the supine position as their major risk factor, 99.44% had a nasogastric tube in place, and 98.1% were sedated. 39.23% of the patients experienced VAP following a minimum of 48 hours of intubation and mechanical ventilation. For patients who acquired VAP, the average length of time they were on mechanical ventilation was 9.09 ± 2.747 days. Just 1.56% of the isolated bacteria were gram-positive, whereas gram-negative bacteria made up the majority of the isolates (98.44%). Acinetobacter Baumannii (21.09%) and Klebsiella pneumoniae (41.40%) were the two most prevalent of the 128 identified species. Compared to patients without VAP, individuals with VAP experienced much longer stays in the ICU and hospital.

Conclusion: The present study offers a thorough examination of the epidemiology, microbiological etiology, antibiotic resistance, and clinical consequences of ventilator-associated pneumonia (VAP). The majority of VAP cases are caused by gram-negative bacteria, which are MDR. The primary causal agent of VAP in the current study, K. pneumoniae, did not have a common source of infection that would have indicated possible endogenous origins. The results highlight the need for customized preventive and treatment plans to enhance patient outcomes and support continued monitoring and evidence-based methods to combat this difficult illness.

Keywords: CDC; ICU; MDR; VAP.

Introduction

A serious ICU ailment known as ventilator-associated pneumonia (VAP) is characterised by fever, aberrant white blood cell counts, abnormalities in sputum, and the presence of a causal infection. It manifests more than 48 hours after intubation and mechanical breathing.[1] It considerably raises the rates of morbidity and death and affects between 9% and 27% of ventilated ICU patients.[2] The crude mortality rate for pneumonia in ICU patients in India is 67.4%, and infections like VAP account for 40% of these deaths.[3]

Two onset patterns exist for VAP:

- Early-onset VAP (within 96 hours after MV), which is antibiotic-responsive.
- Late-onset VAP (beyond 96 hours after MV), caused by multidrug-resistant bacteria like Pseudomonas aeruginosa and Acinetobacter

baumannii, which increases mortality and morbidity.[4]

The risk of VAP is highest during the first five days of ICU admission, when it is 3% daily; after that, it drops to 2% daily for days five through ten, and then to 1% daily.[2] Prompt antibiotic therapy and early diagnosis are essential since delays lead to higher fatality rates.[2,4]

In order to make a diagnosis, samples from non-bronchoscopic (such as endotracheal aspirates) or bronchoscopic (such as BAL) procedures are evaluated clinically, radiologically, and microbiologically.[5] Nonetheless, endotracheal aspirates may be less sensitive than bronchoscopic techniques.[6] VAP emphasizes the importance of efficient diagnosis and treatment plans by having a substantial influence on clinical outcomes and healthcare expenditures.

Aim and Objectives: The current study was out to ascertain the incidence, clinical characteristics, and microbiological profile of ventilator-associated pneumonia in tertiary care hospital intensive care units.

Material and methods:

At a medical college hospital in Central India, an observational cross-sectional study was carried out with approval from the institutional ethical committee. 362 patients in critical care units who needed ventilator assistance for more than 48 hours were included in the study.

Inclusion Criteria:

1. Individuals above the age of 12 years
2. Individuals who have been on mechanical ventilation for more than 48 hours and have clinical and radiological signs of ventilator-associated pneumonia.

The criteria include at least two of the following characteristics: temperature higher than 38°C, leukocytosis or leukopenia, along with purulent lower respiratory secretions. They also need the presence of a newly acquired or progressive radiographic infiltrate.

Exclusion Criteria:

1. Pneumoniac patients before mechanical ventilation
2. Individuals who have pneumonia 48 hours after starting mechanical ventilation
3. Patients in the terminal phase of cancer and those with severe immunocompromised states, HIV positive patients or receiving organ transplants.

Methodology:

Patient data includes date of admission, gender, age, and address. It also includes clinical details such as the patient's level of consciousness, underlying diseases, risk factors (such as enteral nutrition, nasogastric tube, antacid, or histamine type 2 blocker therapy), and length of time on mechanical ventilation, date of intubation or tracheostomy, and history of antibiotic use. Therapy and other pertinent activities were also meticulously documented.

Endotracheal aspirates were acquired using a 22-inch No. 12 F suction catheter while adhering to aseptic measures and the mucus was collected in a mucus collector. The endotracheal tube was used to carefully insert the catheter, which had a minimum length of 25 to 26 cm.

After removing the catheter from the ET tube and gently aspirating the exudate without injecting saline, 2 mL of normal saline was administered using a sterile syringe to flush the exudate into a sterile container for collection.[7] Samples were taken from the patients under aseptic and antiseptic procedures, and they were sent right away to the hospital's bacteriology department for sensitivity and culture testing.

Statistical analysis: A Microsoft Excel spreadsheet was used to capture the data, and the IBM SPSS Statistics for Windows, Version 23.0 Statistical Package was used to analyze it. The mean plus standard deviation was used to display continuous data. Percentages were used to convey categorical data.

Using an independent t-test, numerical variables with a normally distributed sample were examined. The chi square test was used to analyze categorical data. P-value was defined as statistically significant if it was less than 0.05. Relevant conclusions were drawn when the data were examined and contrasted with those of earlier research.

Results:

Table 1: Demographic data

Variables		Number (N)	Percentage (%)
Age (years)	≤40	91	25.13
	41-60	140	38.67
	61-80	122	33.70
	>80	09	2.48
Gender	Male	230	63.53
	Female	132	36.46

Incidence of VAP	Yes	141	38.95
	No	221	61.04
VAP types	Early onset (within 96 hours of MV)	112	30.93
	Late onset (after 96 hours of MV)	30	8.28

Table 2: Distribution of organisms in VAP

Type of organism	Early onset VAP	Late onset VAP
Klebsiella Pneumonia	37	16
Enterobacter cloacae complex	17	04
Acinetobacter Baumannii	19	08
Pseudomonas aeruginosa	12	03
Staph aureus	03	01
Proteus mirabilis	02	01
Enterobacter Aerogenes	02	00
Sphingomonas Paucimobilis	01	00
Serratia Marcescens	01	00

Table 3: Survival outcomes based on VAP status

VAS Status	Survived	Not survived	P-value
VAS Present	59	83	<0.001 **(S)**
VAS Absent	152	68	

S- Significant

Discussion:

In line with earlier research by Chastre and Fagon, 131/362 (36.2%) of the 362 patients in our study were female and 231/362 (63.8%) were male. [10] According to Bouadma et al. [11] and Kollef et al. [12], there is a greater male prevalence of VAP because of elements like smoking, immune response abnormalities, hormonal differences, and chronic lung disorders. The age distribution in this study matched that of Koenig and Truwit's research.[14] and Vincent et al. [15] showing a greater frequency of VAP in middle-aged and older persons, who have a worse immune system, more co-morbidities, and are more likely to be in critical care.

In line with studies by Vincent et al.[15] and Girou et al., the most common co-morbidities in the current research were hypertension (53.9%) and Type II diabetes mellitus (52.8%).[16] Additional noteworthy co-occurring conditions included of CAD (19.1%) and OSA (14.08%), in agreement with research conducted by Restrepo et al.[17]

The most common risk factors for VAP were lying down (99.7%), using a nasogastric tube (99.44%), being sedated (98.1%), and using antacids (97.5%). Comparable to findings made by Herzig et al. [18], who connected the usage of antacids to elevated stomach pH and bacterial overgrowth that encouraged aspiration. VAP was examined in relation to the Clinical Pulmonary Infection Score (CPIS). Of the 362 patients we examined, 39.2% had a CPIS score higher than 6, suggesting a strong probability of a VAP diagnosis; the remaining patients, or 60.8%, had a CPIS score lower than 6. A threshold score of 6 or above on the CPIS indicates a greater likelihood of VAP, making it a useful diagnostic tool. 39.23% of the 362 patients who were a part of our study experienced VAP following a longer than 48-hour period of intubation and mechanical ventilation. According to a research by Papazian et al.[22], among patients on mechanical ventilation, the incidence of ventilator-associated pneumonia (VAP) varies from 5% to 40%, with the early stages of hospitalization carrying the largest risk.

Out of the 142 individuals who received a VAP diagnosis, 113 (79.57%) had early-onset VAP, which materialized within 96 hours of mechanical breathing, and 29 (20.42%) experienced late-onset VAP, which emerged beyond 96 hours of ventilation. According to a research by Kollef et al.[23], 27% of VAP patients had a late beginning, whereas 73% of cases had an early onset.

According to the distribution of organisms recovered from VAP patients, Klebsiella pneumoniae accounted for 41.40% of all isolates. According to a research by Reechaipichitkul W. et al.[24], Gram-negative bacteria accounted for 97.4% of the causal pathogens of VAP. According to the clinical results, 42.25% of our VAP patients made it through, whilst 57.74% did not. This high death rate is in line with earlier research by Torres et al.[25], which discovered a 44.4% death rate.

According to our research, 3.5% of VAP patients smoked, and 64.78% of patients were drinkers. This is consistent with findings by Rello et al. [28] and Nseir et al. [27], who noted alcohol misuse as a risk factor for VAP. Escherichia coli (E. coli) isolates' antibiotic susceptibility testing data was analyzed, and the results showed that different

antibiotics had varying degrees of sensitivity and resistance. The sensitivity to carbapenems and aminoglycosides ranged from 42.9% to 71.4%, but the resistance rates to cephalosporins, fluoroquinolones, and other antibiotics were startlingly high—nearly 100%. These results align with research conducted by Livermore et al. [29], which emphasizes the dynamic character of antibiotic resistance in E. Coli isolates and emphasizes the necessity of continuous monitoring and customized antimicrobial approaches.

Likewise, our evaluation of Pseudomonas aeruginosa isolates' antibiotic susceptibility tests indicated different antibiotic efficacies. A range of antibiotics showed varying degrees of efficiency, ranging from 53.3% to 73.3% for carbapenems and aminoglycosides, to 100% for total resistance.

These results are in line with research conducted by Livermore et al. [29], which highlighted the difficulties caused by Pseudomonas aeruginosa infections that are resistant to drugs and the requirement for innovative treatment approaches. The isolates of Klebsiella pneumoniae that we studied showed a wide range of antibiotic susceptibility, indicating considerable difficulties in treating infections carried on by this bacterium. These results are consistent with research by Lautenbach et al. [30]

Nonetheless, alarming resistance levels were observed for a number of medications, suggesting a multidrug resistant profile. Our study revealed a notable gender difference in survival rates for ventilator-associated pneumonia (VAP), with females showing significantly greater survival rates. Moreover, our research highlights the critical role that age plays in determining the survival results of patients with VAP. The findings showed a noticeable decrease in survival rates with age, which is in accordance with important studies by Rello et al. [28] and Kollef et al. [23]. These results highlight the need for age-specific care strategies that are specifically designed to improve clinical outcomes for VAP patients across a range of age cohorts.

Conclusion

Our results highlight how important customized preventive and treatment strategies are to reducing the cost of VAP on healthcare systems and enhancing patient outcomes. In particular, we found strong relationships between a number of clinical characteristics and the survival results of VAP patients, underscoring the need of careful observation and focused treatments in clinical practice.

According to gender, age, and the administration of different antimicrobial drugs, our study showed considerable differences in survival rates, which highlights the need for individualized patient treatment. We have improved our understanding of VAP care and highlighted the significance of ongoing monitoring and evidence-based approaches to combat this difficult nosocomial infection by comparing our results with previous studies.

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