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A STUDY OF INCIDENCE OF VENTILATOR-ASSOCIATED PNEUMONIA WITH OUTCOMES

Medicine

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ABSTRACT

INTRODUCTION
Ventilator-associated pneumonia (VAP) is a significant complication in mechanically ventilated patients, with incidences ranging from 6% to 52% and potentially reaching 76% in certain settings. The condition poses diagnostic challenges and contributes to poor outcomes, with risks peaking early in the hospital stay. This study aims to critically evaluate the incidence and outcomes of VAP, identify risk factors, and suggest preventive measures. **Methodology** This six-month study, conducted from March 2023 to August 2023 in a tertiary care ICU, involved 157 randomly selected patients on mechanical ventilation for over 48 hours. Exclusion criteria included those with pneumonia within 48 hours of admission, pre-existing pneumonia, or ARDS. Data collection covered patient demographics, clinical details, and mechanical ventilation parameters. VAP diagnosis relied on the modified Clinical Pulmonary Infection Scoring system. Statistical analysis was performed using univariate analysis with a significance level set at P<0.05. **Results** Out of 157 patients, 35 developed VAP, with a mean age of 34 years and a predominantly male population. VAP incidence was 22.2%, higher than recent reports, possibly due to the lower case count and inadequate nursing staff. Significant risk factors included prolonged ventilation (>15 days), supine positioning, and stuporous or comatose states. The overall mortality rate for VAP patients was 54%, with higher mortality observed in late-onset VAP cases. Acinetobacter Bamunnii was the most prevalent organism identified. **Conclusion** The study concludes that VAP incidence correlates strongly with the duration of mechanical ventilation and re-intubation. Strategies to reduce ventilation duration, proper patient positioning, and early identification through monitoring PaO2/FiO2 ratios are crucial. Preventive measures, including optimized weaning protocols, appropriate antibiotic use, and effective infection control practices, are essential to improving patient outcomes in the ICU.

KEYWORDS

INTRODUCTION

Ventilator-associated pneumonia (VAP) refers to bacterial pneumonia developed in patients who have been mechanically ventilated for a duration of more than 48 hours. The incidence of VAP ranges from 6% to 52% and can reach 76% in specific settings. Hospital-acquired pneumonia (HAP) is defined as pneumonia occurring 48 hours or more after admission, which was not present or incubating at the time of admission. [1,2]

The risk of VAP is highest early in the hospital stay, estimated at 3% per day during the first five days of ventilation, decreasing to 2% per day during days 5 to 10, and 1% per day thereafter. [3] A significant challenge in managing VAP is the lack of a gold standard for diagnosis, which contributes to poor outcomes. Clinical diagnosis often relies on the presence of purulent sputum following intubation or oropharyngeal secretion leakage around the airway, along with chest X-ray changes. However, these signs can also be indicative of other conditions such as pulmonary edema, pulmonary infarction, atelectasis, or acute respiratory distress syndrome. [1,2]

Furthermore, colonization of the airway is common, and the presence of pathogens in tracheal secretions without clinical findings does not necessarily indicate VAP. The Clinical Pulmonary Infection Scoring system (CPIS), originally proposed by Pugin and colleagues, improves the diagnostic accuracy for VAP with a sensitivity of 72% and specificity of 80%. This study aims to critically review the incidence and outcomes of VAP, identify various risk factors, and propose specific measures to prevent VAP. [4,5]

MATERIALS & METHODS

The study was conducted over a period of six months, from March 2023 to August 2023, in an intensive care unit (ICU) of a tertiary care center. A total of 157 patients who were on mechanical ventilation were randomly selected for the study.

Inclusion criteria included patients of both sexes who were on mechanical ventilation for more than 48 hours and were aged over 15 years. Patients who died or developed pneumonia within 48 hours, those who were admitted with pneumonia at the time of admission, and patients with Acute Respiratory Distress Syndrome (ARDS) were excluded from the study. Most patients on ventilator support were initially treated elsewhere with antibiotics either in an indoor ward or at other healthcare centers, which was not traceable.

Data collection involved recording the age, sex, date of ICU admission, date of initiating mechanical ventilation, and the mode of airway access (either orotracheal or tracheostomy). The indication for mechanical ventilation was noted for each patient. Ventilator modes and settings were recorded, and any changes in settings were documented daily. Regular monitoring of patients' vitals, general and physical examinations, oxygen saturation, and patient positioning were conducted. During the initial stage of ventilation, patients were adequately sedated, and all necessary measures were taken to prevent hospital-acquired infections.

Routine investigations were performed, and special investigations such as culture of the tracheal tube, blood, and urine, as well as serum cholinesterase levels when needed, were conducted. Sputum samples were collected from the tip of the suction catheter and transported to the laboratory in a sterile tube. VAP was diagnosed on clinical grounds based on the modified Clinical Pulmonary Infection Scoring (CPIS) system developed by Pugin and colleagues.

For statistical analysis, the study cohort was classified into two groups: early-onset VAP (onset after 48 hours but within 96 hours) and late-onset VAP (onset after 96 hours). With a sample size of 157, calculated based on the results of a previous study, the power of the study was set at 80%. Data were subjected to univariate analysis using the chi-square test, and the level of significance was set at P<0.05.

Table 1: Clinical pulmonary infection scoring system

CPIS points	0	1	2
Tracheal secretions	Rare	Abundant	Purulent
Leukocyte count (mm^3)	>4,000 and <11,000	<4,000 and >11,000	<4,000 or >11,000 + band forms
Temperature (°C)	>36.5 and <38.4	>38.5 and <38.9	>39 or <36
PaO_2/FIO_2 ratio (mmHg)	>240 or ARDS	-	≤240 and no ARDS
Chest radiograph	No infiltrate	Diffuse infiltrate	Localized infiltrate
Culture of tracheal aspirate	Negative	-	Positive

CPIS: Clinical pulmonary infection scoring

RESULTS

Table 1: Demographic and Clinical Characteristics

Characteristics	Values
Mean Age (years)	34
Male Population (%)	Predominant

Table 1 presents the demographic and clinical characteristics of the study cohort, comprising 157 patients with various cases of poisoning, neurological disorders, sepsis, and other conditions. The mean age of the patients was 34 years, with a predominant male population. Out of the 157 patients, 35 developed ventilator-associated pneumonia (VAP) during their ICU stay. The mean duration of mechanical ventilation was 11 days for the non-VAP group and 19 days for the VAP group, indicating a longer duration of ventilation among patients who developed VAP.

Table 2: Risk Factors for VAP

Risk Factors	Incidence	P-value
Prolonged Ventilator Support (>15 days)	Significantly Higher	0.001
Supine Position	High Incidence	0.003
Stuporous/Comatose Patients	High Incidence	0.0023

Table 2 highlights the identified risk factors for developing VAP among the study cohort. Prolonged ventilator support of more than 15 days showed a significantly higher incidence of VAP with a P-value of 0.001. Additionally, the supine position and the condition of being stuporous or comatose were also identified as significant risk factors for VAP, with P-values of 0.003 and 0.0023, respectively.

Table 3: PaO2/FiO2 Ratio in VAP Patients

PaO2/FiO2 Ratio	Percentage of Cases
<240 mmHg	86
>240 mmHg	14

Table 3 provides the PaO2/FiO2 ratio among patients who developed VAP. The majority of VAP patients (86%) had a PaO2/FiO2 ratio of less than 240 mmHg, indicating significant impairment in oxygenation. The remaining 14% had a ratio higher than 240 mmHg.

Table 4: VAP Onset and Mortality

Type	Number of Patients	Percentage	Mortality (%)
Early-onset VAP	10	28.5	20
Late-onset VAP	25	71.42	66.67

Table 4 categorizes the patients who developed VAP into early-onset and late-onset groups and compares the mortality rates between these two groups. Out of the 35 VAP patients, 10 (28.5%) developed early-onset VAP, while 25 (71.42%) developed late-onset VAP. The overall mortality rate for VAP patients was 54%. The mortality rate for early-onset VAP was 20%, whereas the late-onset VAP group had a significantly higher mortality rate of 66.67%, indicating a strong association between late-onset VAP and increased mortality (P=0.0234).

Table 5: Prevalence of Organisms in VAP Patients

Organism	Percentage
Acinetobacter Bamunnii	43.2
Pseudomonas	18.91
Klebsiella	-
MRSA	-
E. coli	-
MSSA	-
S. pneumoniae	-

Table 5 lists the prevalence of different organisms identified in VAP patients. The most prevalent organism was Acinetobacter Bamunnii, found in 43.2% of cases, followed by Pseudomonas in 18.91% of cases. Other organisms identified include Klebsiella, MRSA, E. coli, MSSA, and S. pneumoniae, although specific prevalence percentages for these organisms were not provided.

DISCUSSION

In our study, the male population predominated, although this was not statistically significant. The mean age of the patients was 34 years, with a notable representation of younger individuals, likely due to the predominance of poisoning cases. The incidence of VAP in our setting was 22.2%, which is higher than the 15-20% reported in recent studies. [3,4] This discrepancy could be attributed to the lower number of cases (157) and the lack of adequate nursing staff, which may have adversely affected patient care quality. Additionally, a significant number of organophosphorous poisoning cases required prolonged ventilation, a known risk factor for VAP, showing a statistically significant correlation with its incidence.

The mean duration of mechanical ventilation was 11 days for non-VAP patients and nearly 19 days for those with VAP, aligning with findings from other studies.[5] This indicates that the duration of mechanical ventilation is a crucial risk factor for VAP, corroborated by similar studies where the mean ventilation duration was around 10 days, with a 9.3% incidence of VAP.[6] Reintubation emerged as a significant independent risk factor, with a high VAP incidence, likely due to impaired reflexes or altered consciousness increasing aspiration risks.[7] Although our study had only four reintubated patients, half developed VAP, underscoring the risk. [8]

Level of consciousness significantly impacted VAP incidence, with higher rates in stuporous (62.5%) and comatose (50%) patients compared to conscious (35.75%) and drowsy (18.42%) patients, likely due to increased aspiration risks in comatose patients. Early and planned tracheostomy was observed to significantly reduce VAP incidence, although further acceptance and implementation of this practice are needed. The use of sucralfate for stress ulcer prophylaxis appeared to offer a protective effect against VAP, as it does not increase gastric pH like H2 receptor antagonists, suggesting its potential preference over H2 antagonists. [6]

The PaO2/FiO2 ratio was monitored during ventilation and observed to decline 12-24 hours before clinical signs of VAP, suggesting its utility as an early indicator. Acinetobacter Bamunnii was the most common organism associated with VAP (43.24%), followed by Pseudomonas (18.91%) and Klebsiella. The overall mortality rate was higher in the Acinetobacter Bamunnii group (62.5%), consistent with other studies reporting its prevalence at 15-25%. [9] However, susceptibility testing was limited due to the lack of routine clinical microbiological support. Early-onset VAP incidence in our study was 27.02%, lower than the 40% reported in other studies, [10] possibly due to prior antibiotic use before ICU admission, which reduces early-onset VAP but increases multidrug-resistant pathogens, as reflected in our findings. Early-onset VAP had a better prognosis compared to late-onset VAP in terms of mortality, emphasizing the importance of early detection and intervention. The overall mortality rate in VAP patients was 54.05%, compared to 41.2% in non-VAP patients, though this difference was not statistically significant. Measures such as hand washing [10], as recommended by CDC guidelines, and oropharyngeal [12] decontamination with chlorhexidine [11] have shown effectiveness in reducing VAP incidence, highlighting their importance in infection control practices.

CONCLUSION

In conclusion, our study found that the incidence of ventilator-associated pneumonia (VAP) is directly proportional to the duration of mechanical ventilation, with re-intubation emerging as a significant risk factor. Therefore, reducing the duration of ventilation is crucial to minimizing morbidity and mortality associated with mechanical ventilation, achievable through proper weaning protocols and tailored sedation regimens. Nasogastric feeding, while necessary for critically ill patients, should be administered with the patient in a semi-recumbent position, with the head elevated to 45°, to prevent aspiration. A decrease in the PaO2/FiO2 ratio was identified as an early predictor of VAP. Acinetobacter Bamunnii was the most common organism identified in our institution. Additionally, late-onset VAP was associated with a poorer prognosis compared to early-onset VAP. The inappropriate use of antibiotics before ventilatory support was found to decrease early-onset VAP but predisposed patients to a higher incidence of multidrug-resistant (MDR) pathogens. These findings underscore the importance of optimizing ventilation strategies and antibiotic use to improve patient outcomes in the ICU.

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