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A STUDY TO ASSESS THE PREDICTORS OF VENTILATOR ASSOCIATED PENUMONIA (VAP) IN ELDERLY PATIENTS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background –

Ventilator Associated Pneumonia (VAP) is defined as the development of pneumonia more than 48 hours after the initiation of Mechanical Ventilation (MV). VAP also results in atelectasis, mechanical ventilator-related lung injury, respiratory tract obstruction, and barotrauma. The aim of the study was to evaluate the predictors influencing the occurrence of Ventilator associated pneumonia (VAP) among patients receiving mechanical ventilation at a tertiary care hospital in Chennai.

Methods –

A retrospective study involving 50 patients who were on MV for more than 48 hrs in ICU.

Results –

Majority of the patients were males 64%. The level of CRP was > 8mg/L in 62% of patients. The procalcitonin levels > 0.25ng/mL in 24% of the patients. In our study VAP developed in 16% of them.

CONCLUSION –

Our study investigating the predictors of Ventilator Associated Pneumonia (VAP) in elderly patients within a tertiary care hospital has provided valuable insights into the factors contributing to this critical healthcare concern. Through rigorous analysis of patient data and clinical parameters, several key predictors have emerged.

KEY WORDS –

Ventilator associated pneumonia, Elderly patients, Ventilator care, Tertiary care hospital, Predictors.

INTRODUCTION

Ventilator Associated Pneumonia (VAP) is defined as the development of pneumonia more than 48 hours after the initiation of mechanical ventilation. Pneumonia that occurs within 48 hours after extubation from Mechanical Ventilation (MV) is also included in VAP [1]. It is a common and serious complication in critically ill patients requiring mechanical ventilation, contributing to increased morbidity, mortality, and healthcare costs. VAP also results in atelectasis, MV-related lung injury, respiratory tract obstruction, and barotrauma. Elderly patients are particularly vulnerable to VAP due to age-related physiological changes, comorbidities, and immunosenescence. Delayed diagnosis of VAP can prolong treatment, promote the overuse of high-end antimicrobials and affect outcome. Every year the number of elderly patients requiring ventilator support is being increasing, because of decline in immune system function, and are more prone to opportunistic infections, which increase the possibility of VAP [2]. Several risk factors, including age, history of severe chronic obstructive pulmonary disease (COPD) and ICU admission have been identified as being associated with VAP [3, 4].

The prevalence of VAP, globally is 15.6% [5]. The presence of VAP is associated with an increased risk of hospital morbidity and most frequent infection among patients hospitalized in the ICU.[6]. Patients with VAP develop many complications like severe sepsis, septic shock, acute respiratory distress syndrome (ARDS), atelectasis, and infection with MDR organisms, which in turn increase cost, morbidity, and mortality [7–9]. It is associated with high economic costs, longer attributable lengths of stay in the hospital, and high mortality, especially when lung infection is caused by high-risk pathogens [10-12]

While numerous studies have investigated predictors of VAP in various patient populations, there is limited research specifically focusing on elderly patients in tertiary care settings. Therefore, this study aims to assess the predictors of VAP in elderly patients admitted to a tertiary care hospital, providing valuable insights to inform clinical practice and improve patient outcomes.

METHODS –

It is a retrospective study conducted on 50 patients which presented to the department of respiratory medicine of Saveetha Medical College and Hospital, Chennai, India, over a period of 6 months (November 2023 to May 2024), whom on MV for more than 48 hrs in ICU.

Inclusion Criteria:

Ventilator use ≥48 hours, Age ≥65 years.

Exclusion Criteria:

Pneumonia diagnosed before MV, Discharged, or transferred within 48 hours.

Data Collection

Data was collected retrospectively from the electronic medical records (EMRs) of patients admitted to the ICU. The collection process included multiple steps to ensure comprehensive and accurate data acquisition.

Steps in Data Collection:

1. Patient Identification: Using the hospital's EMR system, patients who met the inclusion criteria were identified. An initial query was run to list all patients aged 65 and above who were on MV for more than 48 hours during the specified period.

2. Data Extraction: Relevant data were systematically extracted from EMRs. This involved collecting:

a. Demographic Details: Age, gender, and comorbidities (such as diabetes, chronic obstructive pulmonary disease (COPD), and heart disease).

b. Clinical Parameters: Severity of illness scores (such as Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment (SOFA)).

c. Mechanical Ventilation Details: Duration of MV, type of ventilator settings (e.g., mode of ventilation, positive end-expiratory pressure (PEEP) levels).

d. VAP Diagnosis: Timing of VAP onset (early onset within 96 hours vs. late onset), microbial cultures and their sensitivities, antibiotic regimens used.

e. Patient Outcomes: Length of ICU stay, mortality rates, and any complications arising during ICU stay.

3. Data Verification: Cross-verification with patient charts and other hospital records was done to ensure the accuracy and completeness of data. Any discrepancies were resolved through consultation with clinical staff or by reviewing additional records.

4. Data Entry: The extracted data were entered into a secured database designed for the study. Data entry was double-checked to prevent errors.

Statistical Analysis

The data were analysed using statistical software (such as SPSS) to identify predictors of VAP.

Inferential Statistics:

Chi-Square Tests: Applied for categorical variables to examine associations between potential risk factors (e.g., presence of comorbidities) and VAP occurrence.

T-Tests or Mann-Whitney U Tests: Used for continuous variables to compare means between groups with and without VAP.

Ethical considerations

The study was approved by ethical review committee of the institution. Names and any other identifying information were removed from the final analysis sheets

RESULTS –

Patient characteristics

We recruited 50 patients who satisfied our study criteria. The majority were male (64%) (figure1). The mean age of the study population was 75.6 ±6.3 years. Their ages ranged from 65 to 92 years. Diabetes mellitus was the most common comorbidity (46%) followed by chronic obstructive pulmonary disease (38%) and cardiovascular diseases (34%). The most common reason for ICU admission was septic shock (32%), stroke (20%), acute myocardial infarction (16%), acute exacerbation of COPD (14%) and other reasons (9%) which included pancreatitis- (18%), post major surgery- (6%) patients, decompensated heart failure- (4%) patients and polytruama-1patient.

Incidence of VAP- Among the 50 cases, 8 (16%), developed VAP (figure 2). The mean time to develop VAP was 6.2 ± 2.1 days. Among these 2 were classified to have early onset VAP 2 (24%), and 6 (76%) to have late onset VAP, where early onset is less than 96 hours and late onset more than 96 hours after intubation and mechanical ventilation.

Analysis of risk factors

Age- patients aged 75 years and above had a higher incidence of VAP (56%) compared to those aged 65-74 years (32%) (p=0.03).

Comorbidities: When compared to those patients without COPD (32%), patients with COPD developed VAP more frequently (62%), this difference was statistically significant (p=0.02). Likewise, those with diabetes mellitus 48%), developed VAP more frequently than those without (38%), (p=0.28).

Severity of Illness:

Higher APACHE II scores were significantly associated with the development of VAP. Patients with scores ≥20 had a VAP incidence of 65% compared to 29% in patients with scores <20 (p=0.01). Similarly, SOFA scores ≥8 were associated with higher VAP rates (58%) compared to scores <8 (30%) (p=0.02).

Biomarker Analysis

C-Reactive Protein (CRP):- 62% of patients who developed VAP had CRP values greater than 8 mg/L. (figure 3).

Procalcitonin: -24% of patients who developed VAP had procalcitonin levels greater than 0.25 ng/mL (figure 4). There was a significant association between Procalcitonin levels and development of VAP ($p<0.05$) (figure 5).

Microbiological Findings

The predominant pathogens isolated from Ventilator-associated pneumonia (VAP) patients were Gram-negative bacteria, including Pseudomonas aeruginosa (28%), Klebsiella pneumoniae (24%), and Acinetobacter baumannii (20%), as well as the Gram-positive Staphylococcus aureus (18%), of which 60% were methicillin-resistant (MRSA). Antibiotic susceptibility testing revealed high rates of resistance, particularly among Gram-negative bacteria, with multi drug resistant organisms (MDROs) identified in 38% of VAP cases.

Outcomes

The overall mortality rate among the study cohort was 24%. Patients who developed VAP had a significantly higher mortality rate (38%) compared to those who did not develop VAP (14%) (p=0.01). The mean ICU stay was also longer for patients with VAP (18.4 ± 5.6 days) compared to non-VAP patients (10.2 ± 3.7 days) ($p<0.001$).

DISCUSSION –

Ventilator-associated pneumonia (VAP) is a prevalent and severe complication in intensive care units (ICUs), particularly among the elderly. This study aimed to identify the predictors and outcomes of VAP in elderly patients who received mechanical ventilation (MV) in a tertiary care hospital in Chennai. Our findings highlight the multifactorial nature of VAP development and underscore the importance of vigilant monitoring and targeted interventions in this vulnerable population.

Incidence and Onset of VAP

The incidence of VAP in our study was 16%, with a mean onset time of 6.2 ± 2.1 days. This is consistent with previous research indicating VAP rates between 10% and 20% in ICU settings (13; 14). The division between early-onset (24%) and late-onset VAP (76%) aligns with other studies, suggesting that late-onset VAP is more prevalent and often associated with higher morbidity and mortality due to the involvement of multidrug-resistant organisms (MDROs) [15].

Age as a Predictor of VAP

Age was a significant predictor of VAP, with patients aged 75 years and above showing a higher incidence (56%) compared to those aged 65-74 years (32%) (p=0.03). This aligns with existing literature that associates advanced age with increased susceptibility to infections due to immunosenescence and a higher burden of comorbid conditions [16]. Age-related changes in respiratory physiology, such as decreased mucociliary clearance and weakened cough reflex, further exacerbate the risk of VAP in the elderly [17]

Impact of Comorbidities

COPD and diabetes mellitus emerged as significant comorbid conditions influencing the development of VAP. Patients with COPD had a significantly higher incidence of VAP (62%) compared to those without COPD (32%) (p=0.02). This finding is supported by previous studies indicating that COPD patients are more prone to VAP due to factors like impaired mucociliary function and frequent exacerbations requiring mechanical ventilation [18].

Diabetes mellitus, although not reaching statistical significance in our study (p=0.28), was associated with a higher incidence of VAP (48% vs. 38%). Diabetes is known to impair immune response and wound healing, which could contribute to an increased risk of infections including VAP [19]. However, the lack of statistical significance suggests that other factors might also play crucial roles in VAP development among diabetic patients.

Severity of Illness

Higher APACHE II and SOFA scores were significantly associated with the development of VAP. Patients with APACHE II scores ≥20 had a VAP incidence of 65% compared to 29% in patients with scores <20 (p=0.01). Similarly, SOFA scores ≥8 were associated with higher VAP rates (58%) compared to scores <8 (30%) (p=0.02). These severity scores are well-established predictors of adverse outcomes in critically ill patients, reflecting the overall burden of illness and organ dysfunction [20,21].

Biomarker Analysis

In our study, elevated levels of C-reactive protein (CRP) and procalcitonin were observed in patients who developed VAP. Specifically, 62% of VAP patients had CRP values greater than 8 mg/L, and 24% had procalcitonin levels greater than 0.25 ng/mL. These biomarkers are widely used to detect and monitor infections in critically ill patients. Elevated CRP and procalcitonin levels are indicative of systemic inflammation and bacterial infection, respectively, and have been associated with VAP in several studies [22,23].

Microbiological Findings

The predominant pathogens isolated from VAP patients were Gram-negative bacteria, including Pseudomonas aeruginosa (28%), Klebsiella pneumoniae (24%), and Acinetobacter baumannii (20%), along with Gram-positive Staphylococcus aureus (18%), of which 60% were methicillin-resistant (MRSA). The high prevalence of these pathogens, especially MDROs, underscores the challenge of treating VAP in the ICU setting [24]. The antibiotic resistance patterns observed highlight the need for judicious use of antibiotics and robust infection control practices [25]

Outcomes

The overall mortality rate in our cohort was 24%, with a significantly higher mortality rate among VAP patients (38%) compared to non-VAP patients (14%) (p=0.01). This finding is consistent with other studies that report increased mortality associated with VAP, reflecting the severe impact of this complication on patient outcomes [26]. Additionally, the mean ICU stay was longer for VAP patients (18.4 ± 5.6 days) compared to non-VAP patients (10.2 ± 3.7 days) (p<0.001), indicating the substantial healthcare burden associated with VAP.

CONCLUSION

This study highlights the multifactorial nature of VAP development in elderly ICU patients. Our findings indicate that advanced age, COPD, high APACHE II scores, and prolonged mechanical ventilation are significant predictors of VAP. These results align with previous research, emphasizing the increased susceptibility of elderly patients to VAP due to immunosenescence, comorbidities, and physiological changes associated with aging [16,17]. The identification of these risk factors underscores the need for targeted interventions, such as early mobilization, optimized ventilation strategies, and vigilant monitoring, to mitigate the risk of VAP in this vulnerable population.

Furthermore, the study emphasizes the impact of VAP on patient outcomes, including higher mortality rates and prolonged ICU stays. The high prevalence of multidrug-resistant organisms among VAP pathogens further complicates treatment and necessitates robust infection control measures [24,25]. These findings highlight the critical need for judicious antibiotic use and the implementation of comprehensive preventive strategies tailored to the elderly ICU population. Future research should focus on developing and validating these interventions to reduce VAP incidence and improve patient outcomes in this high-risk group.

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Figure 1- gender distribution

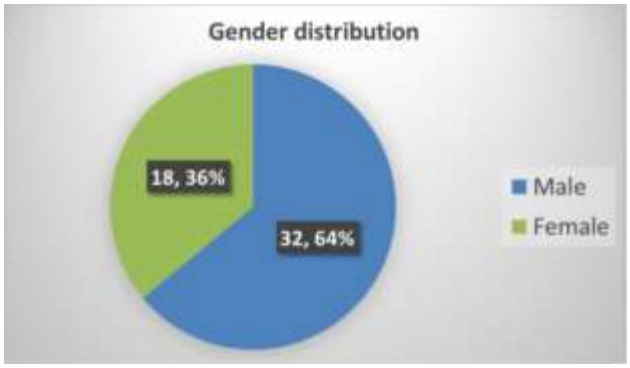

figure 2- Development of VAP

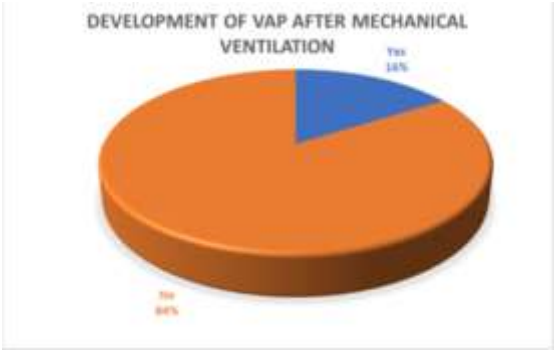

FIGURE- 3 – Level of CRP

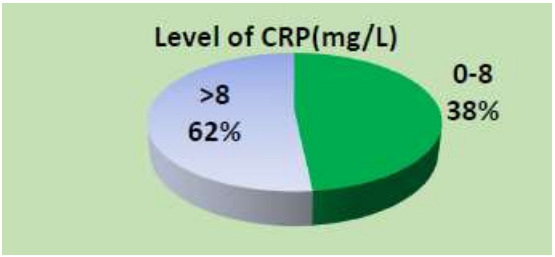

FIGURE 4- Level of Procalcitonin

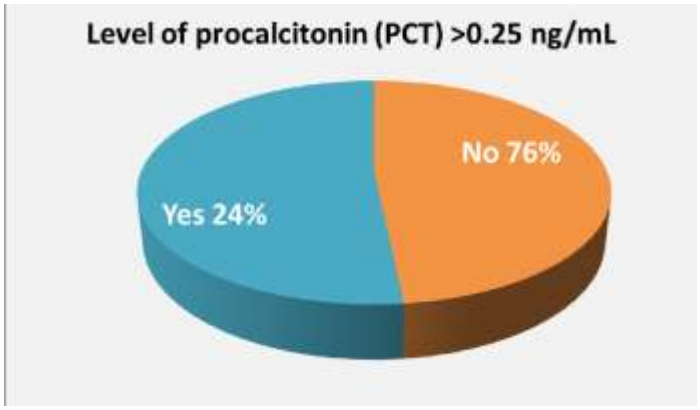

Figure 5- comparison of Procalcitonin with occurrence of VAP