Comparative Outcomes of Ventilator-Associated Pneumonia in Diabetic and Non-Diabetic Patients: A Prospective Observational Study

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***Abstract*- Background: Ventilator-associated pneumonia (VAP) is a leading nosocomial infection in intensive care units (ICUs), with significant morbidity and mortality. Diabetes mellitus (DM) is a potential risk factor, but its impact on VAP outcomes remains underexplored.**
Objective: To compare outcomes (survival, recovery time, and microbial profiles) of VAP in diabetic and non-diabetic patients.
Methods: A prospective observational study was conducted from June 2022 to June 2024 at ASRAM Medical College, Eluru, involving 50 mechanically ventilated patients (25 with Type 2 DM, 25 non-diabetic) who developed VAP. Data on demographics, microbial cultures (blood and tracheal), survival, and recovery duration were analyzed using SPSS version 26, with a p-value < 0.05 considered significant.
Results: Diabetic patients had a significantly lower survival rate (24% vs. 80%, p = 0.000166) and longer recovery time (7 days vs. 5 days, p < 0.05) compared to non-diabetic patients. Pathogens such as Streptococcus pneumoniae, Pseudomonas aeruginosa, and various Staphylococcus species showed 100% mortality in diabetic patients, while non-diabetic patients had lower mortality rates (e.g., P. aeruginosa: 28%). Poor glycemic control (HbA1c > 10%) was associated with higher mortality (91.7% vs. 61.5%, p < 0.05).
Conclusion: Type 2 DM is a significant risk factor for adverse VAP outcomes, with increased mortality and prolonged recovery. Tailored antimicrobial strategies and glycemic control are critical for improving prognosis in diabetic VAP patients.

***Index Terms*- Ventilator-associated pneumonia, Diabetes mellitus, Mortality, Microbial profile, Intensive care unit**

I. INTRODUCTION

Ventilator-associated pneumonia (VAP) is a common nosocomial infection in intensive care units (ICUs), affecting approximately 27% of mechanically ventilated patients and accounting for 86% of hospital-acquired pneumonias [1, 2]. Defined as pneumonia occurring >48 hours after endotracheal intubation, VAP is associated with high mortality (up to 62% treatment failure rates) and increased healthcare costs [3]. Risk factors include prolonged intubation, aspiration, and comorbidities such as chronic obstructive pulmonary disease (COPD) [4].

Diabetes mellitus (DM), particularly Type 2, may exacerbate VAP risk due to impaired immune responses and hyperglycemia-induced susceptibility to infections [5]. However, limited data exist on its specific impact on VAP outcomes. Early-onset VAP (within 48-96 hours) is typically caused by antibiotic-sensitive pathogens, while late-onset VAP (>96 hours) involves multidrug-resistant organisms, complicating treatment [6].

This study aimed to compare VAP outcomes (survival, recovery time, and microbial profiles) in diabetic and non-diabetic patients, addressing a critical gap in understanding the role of DM in critical care settings. The findings may inform tailored preventive and therapeutic strategies to improve patient outcomes.

II. MATERIALS AND METHODS

Study Design and Population

This prospective observational study was conducted at the Department of General Medicine, ASRAM Medical College, Eluru, from June 2022 to June 2024. The study included 50 patients on mechanical ventilation for >48 hours who developed VAP, with 25 having Type 2 DM and 25 being non-diabetic. Ethical approval was obtained from the ASRAMS Bioethics and Research (BHR) Ethics Committee, and informed consent was secured from all participants or their legal representatives.

Inclusion and Exclusion Criteria

- Inclusion Criteria: Patients on mechanical ventilation for >48 hours with a clinical diagnosis of VAP (based on Clinical Pulmonary Infection Score [CPIS] ≥ 6) [7].
- Exclusion Criteria: Patients with pre-existing respiratory illness, pediatric population, or pregnant women.

Data Collection

Demographic data (age, sex), clinical history (DM status, HbA1c), and risk factors (e.g., hypertension, intubation duration) were recorded. Blood and tracheal cultures were obtained for microbial identification. Outcomes assessed included survival (recovered vs. deceased) and recovery time (days to discharge).

Statistical Analysis

Data were analyzed using SPSS version 26. Chi-square tests assessed categorical variables (e.g., survival by DM status), with $p < 0.05$ considered statistically significant. Sensitivity and specificity were calculated where applicable.

Ethical Considerations

Confidentiality was maintained with unique proforma identifiers, and participation was voluntary with no invasive procedures involved.

III. RESULTS

Demographic Characteristics

The mean age was 54.2 years, with 46% (n = 23) aged 40-59, 34% (n = 17) aged 60-79, 16% (n = 8) aged 20-39, and 4% (n = 2) aged ≥80. Males comprised 56% (n = 28) and females 44% (n = 22). Mortality increased with age, reaching 76.5% in the 60-79 age group and 100% in those ≥80 ($p < 0.05$).

Survival Outcomes

Diabetic patients had a significantly lower survival rate (24%, n = 6/25) compared to non-diabetic patients (80%, n = 20/25), with a p-value of 0.000166. Among diabetic patients, poor glycemic control (HbA1c > 10%) was associated with higher mortality (91.7%, n = 11/12) versus well-controlled DM (HbA1c < 10%, 61.5%, n = 8/13, $p < 0.05$).

Recovery Time

Recovered diabetic patients had a mean recovery time of 7 days, compared to 5 days for non-diabetic patients ($p < 0.05$), indicating a prolonged hospital stay in the DM group.

Microbial Profiles and Mortality

- Diabetic Patients: S. pneumoniae, P. aeruginosa, and various Staphylococcus species (e.g., coagulase-negative Staphylococcus, S. aureus) showed 100% mortality. Klebsiella pneumoniae and E. coli had mortality rates of 83% and 60%, respectively.
- Non-Diabetic Patients: S. pneumoniae and K. pneumoniae had mortality rates of 33% and 50%, respectively, while P. aeruginosa had a 28% mortality rate. E. coli and coagulase-negative Staphylococcus showed 0% mortality.

Tracheal cultures in diabetic patients highlighted K. pneumoniae (48%) as the predominant pathogen with a 52.63% mortality rate, followed by P. aeruginosa (16%) with 21.05% mortality. In non-diabetic patients, K. pneumoniae (33%) and P. aeruginosa (25%) were prevalent, with mortality rates of 60% and 20%, respectively.

IV. DISCUSSION

This study confirms that Type 2 DM significantly worsens VAP outcomes, with a 76% mortality rate in diabetic versus 20% in non-diabetic patients ($p = 0.000166$). The prolonged recovery time (7 vs. 5 days) in diabetic patients aligns with previous reports of diabetes-related complications in critical illness [5]. Poor glycemic control (HbA1c > 10%) further exacerbated mortality, emphasizing the need for strict glucose management.

Microbial analysis revealed a higher virulence of pathogens in diabetic patients, with 100% mortality from P. aeruginosa and S. pneumoniae, consistent with studies linking DM to increased susceptibility to multidrug-resistant organisms [8]. In contrast, non-diabetic patients showed lower mortality rates, suggesting a protective effect of the absence of DM-related immune dysfunction.

These findings corroborate global data on VAP pathogens (e.g., Jean Francois et al., 2017) [9], reinforcing the need for tailored antimicrobial therapy. Limitations include the small sample size (n = 50) and single-center design, which may limit generalizability.

Future studies should explore larger cohorts and investigate preventive strategies like subglottic drainage and glycemic optimization.

V. CONCLUSION

Type 2 DM is a significant risk factor for adverse VAP outcomes, associated with higher mortality, prolonged recovery, and increased pathogen virulence. Tailored antimicrobial strategies and rigorous glycemic control are essential to improve prognosis in diabetic VAP patients. These findings underscore the need for personalized critical care protocols in ICUs.

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Conflicts of Interest

The authors declare no conflicts of interest.

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