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Original Research Article

VENTILATOR ASSOCIATED PNEUMONIA-STUDY OF DEMO-GRAPHIC PROFILE, RISK FACTORS, PATHOGENS AND MORTALITY IN CRITICAL CARE UNIT IN A TERTIARY CARE CENTER

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ABSTRACT

Background: Admission to the critical care unit carries high chances of acquiring Ventilator-Associated Pneumonia (VAP) in mechanically ventilated patients. Presence of risk factors like variety of illnesses, immunocompromised states, number of organ involvement and duration of invasive mechanical ventilation increases the hospital mortality and morbidity, the cost of the treatment and duration of ICU stay with VAP. **Objective:** The aim of Our study is to calculate the incidence and identify risk factors, pathogens and attributable mortality associated with VAP in the critical care areas. **Materials and methods:** The present prospective observational study was conducted over a period of one year in the department of critical care of our tertiary care hospital. Patients more than 18 years of age who developed pneumonia after 48 hours of mechanical ventilation were included in the study. Modified clinical pulmonary infection score (CPIS) was followed as a screening method to diagnose VAP. **Result:** In our study at the tertiary care center, the incidence of VAP was 27.1 8% and the incidence density of VAP was 19 per 1000 ventilator days. The mean age for VAP was 48.1 2 +/-15.21 years. The most common etiology associated with VAP was Trauma followed by malignancies and respiratory failure patients. Previous use of broad-spectrum antibiotics within 7 days of ICU admission and mechanical ventilation, previous use of steroid and immunosuppressive drugs was significantly associated with the development of VAP. Microbiological analysis showed the majority of Gram-negative bacterial isolates (Klebsiella Pneumoniae and Acinetobacter species) which were responsible for approximately 50% of total VAP cases. The overall mortality observed among the VAP group was 39.20% and among the non-VAP group was 24% (significantly low). **Conclusion:** Our study showed VAP are highly fatal infections and are a common cause of longer ICU stay, increased morbidity and mortality and higher cost of treatment. We found a significant association of prior use of antibiotics, steroids and immunosuppressive agents with VAP.

Keywords: Risk factors, morbidity, mortality, incidence, ventilator-associated pneumonia.

INTRODUCTION

Admission to the Critical Care Unit carries high chances to acquire Nosocomial Infections, also called as Hospital-acquired Infection. Ventilator-associated pneumonia (VAP) is the most common Nosocomial infection diagnosed in ICU. Patients requiring mechanical ventilatory support have a very high risk for the development of Ventilator-associated pneumonia depending upon risk factors like patient immunity, variety of illness, number of organ involvement and duration of invasive mechanical ventilation. These complication increases mortality, cost of the treatment and ICU stay. **(1)**

Ventilator-associated pneumonia is defined as Pneumonia that occurs after 48 hours of invasive mechanical ventilation and caused by an infectious agent that is not present or incubating at the time of

the start of mechanical ventilation **(2)**. The chances of acquiring VAP increases by 1-3% per day of mechanical ventilation. **(3)** The incidence rate of VAP ranges from 6 to 50% but in some cases, it can reach as high as 74%. The incident rates are calculated using 1000 ventilator days as the denominator, reflect more accurately VAP risk rate.

VAP rate ranges from 4-14/ 1000 ventilator days in the USA and 10- 52.7/1000 ventilator days in developing countries. (4) The global crude mortality rate of VAP ranges from 24 % to 50%.**(5)** Mortality depends upon the etiological agent, drug susceptibility, age, comorbidities and type of illness. Based on the time of onset, VAP is classified into Early-onset VAP that occurs within 4 days of ventilatory support and Late-onset VAP that occurs more than 4 days of ventilator support. Early VAP is less severe and has a better outcome and Late VAP is associated with multidrug-resistant pathogens. **(6)**

VAP is clinically suspected on the basis of new infiltrates on chest X-ray with the presence of fever, leukocytosis, purulent tracheobronchial secretions, and increased oxygen requirement and CPIS **(7)** however, chest radiographic changes can also be due to ARDS, pulmonary edema, infarction And atelectasis.

Pseudomonas spp., Acinetobacter spp., Escherichia coli, Klebsiella pneumoniae, and Staphylococcus aureus are the common pathogens associated with VAP. Most of them showed Multidrug Resistance. **(8,9)**

The primary aim of the study was to know the incidence of VAP and to identify the risk factors, attributed mortality and various bacterial pathogens associated with VAP in Critical Care areas.

MATERIALS AND METHODS

The present prospective observational study was conducted in the Department of Respiratory and Critical Care of our tertiary Care Hospital which has a 48 bed multidisciplinary ICU complex. This study was conducted for a duration of one year from June 2018 to July 2019. Institutional ethics committee clearance was sought before the start of the study and written informed consent was taken from the participant.

Patients of both sex, age above 18 years who developed pneumonia after 48 hours of mechanical ventilatory support, were included in the study. Modified Clinical Pulmonary Infection Score (CPIS) was followed as a screening method to diagnose VAP. Patients who had pneumonia prior to or within 48hrs of mechanical ventilatory support, pulmonary edema or ARDS were excluded.

Patient's demographic data like Sex, Age, Comorbidities, Risk factors, Duration of ICU stay, duration of mechanical ventilation, Primary disease, history of previous antibiotic uptake and clinical outcome were registered and VAP rates were defined as a number of VAP/ 1000 ventilator days.

Clinical suspicion of VAP has considered if the CPIS score was more than 6. Endotracheal aspirate (ETA) and/or Bronchoalveolar lavage (BAL) samples were collected from all patients requiring ventilatory support for more than 48 hours on the 2nd and 5th day. Bacterial growth of more than 10^5CFU/ ml was taken as a cutoff threshold for ETA and growth of more than 10^ 4 CFU/ml was taken cutoff for BAL.

Statistical analysis was performed using SPSS v22 software. Fisher exact test was applied to compare two variables. P-value of less than 0.05 was considered to be statistically significant.

RESULTS

In this study total of 206 patients were enrolled out of which 142 were male and 64 were female. The mean age for VAP was 48.12±15.21 yrs while for NonVAP it was 53.87±16.23 yrs. Of the 206 cases who were on mechanical ventilation for more than 48 hours, a total of 56 patients were diagnosed to have VAP following clinical and microbiological criteria. The incidents of VAP in our study was 27.18% and the incidence density of VAP was 19 per 1000 ventilator days.

Out of these 56 cases, 26(46.42%) categorized as Early-onset VAP and 30 (53.57%) cases developed Late-onset VAP. The mean age of cases who developed VAP was 48.1 2 ± 15.21 years while age in a non-VAP group it was 53.8 7 ± 16. 23years.

Among the different etiologies for which the patient was put on mechanical ventilatory support, Trauma(40%), COPD (25%), Renal failure (20%) and Malignancy(33.3%) were the most common diseases in VAP. In Non-VAP group Cerebrovascular accidents, poisoning, Snakebite and post-operative admissions were common.

Patients with previous use of a broad-spectrum antibiotic (P<0.010) within 7 days of ICU admission and mechanical ventilation, Previous use of steroid and immunosuppressive drugs (P=0.013) were significantly associated with the development of VAP.

The incidence of developing VAP increased in patients who were on mechanical ventilation for more than 15 days. These Patients with VAP had a longer duration of mechanical ventilation (P=0.001) and duration of ICU stay(P=0.045).

Microbiological analysis of ETA and BAL samples showed a majority of Gram-Negative bacterial isolates. Klebsiella pneumoniae and Acinetobacter species were responsible for approximately 50% of cases. Other Gram-Negative bacilli isolates were Pseudomonas aeruginosa, E. coli, Citrobacter and Serretia marcesence. Few Gram-Positive Bacteria were also isolated including Staphylococcus aureus (MRSA) and Enterococcus species.

The overall mortality among the VAP group was 39.20% while in the non-VAP group it was significantly low (24%) because these two groups are not similar in other aspects so severity adjusted mortality could not be evaluated.

Table-1: Demographic profile of the study population

Demographic parameters	VAP(n=56)	NonVAP(n=150)	P Value
Mean Age (years) ±SD	48.12 (± 15.21)	53.87 (± 16.23)	
Sex (%)			
Male	38 (67.85)	104 (69.33)	
Female	18 (32.14)	46 (30.66)	
Risk Factors (%)			
Smoking	22 (39.2)	40 (26)	0.057
Prior use of Broad Specturm Antibiotics	14 (25)	16 (10.6)	0.01
Prior use of Steroids/ immunosuppressant	11 (19.6)	11 (7.33)	0.013
Diabetes	12 (21.42)	24 (16)	0.23
Alchoholism	19 (33.9)	30 (20)	0.03
Outcomes (%)			
Duration of machenical ventilation (day)	16.03 ± 11.3	9.98 ± 5.24	0.001
Duration of ICU Stay	21.72 ± 18.02	16.04 ± 10.73	0.049
Mortality (%)	22 (39.2)	36 (24.0)	

Table-2: Patients with VAP according to underlying diseases.

Underlying Disease	Total no. of patients n	Total no. of patients developing VAP	Percentage of patients developing VAP (%)
COPD	28	7	25.0
Trauma	30	12	40.0
Neurological Illness	24	6	25.0
Liver failure	11	1	9.09
Renal Failure	20	4	20.0
Poisioning	7	2	28.5
Snake Bite	5	1	20.0
Respiratory failure	21	6	28.5
Post Operative Patients	20	5	25
Malignancy	12	4	33.3
Miscellaneous	28	8	28.5

DISCUSSIONS

In this present study out of 206 patient which were enrolled, 142 were male and 64 female. VAP rate was more common in male (67.85%) cases as compared to females (32.14%) but no significant association made. The overall incidence of VAP was 27.18% and incidence density in our study was calculated 19/ 1000 ventilator days which were comparable to other study **(7)**. The higher incidence of VAP in our study could be due to lack of adequate nursing staff and a high workload. Nurses- patient ratio ideally should be 1:1 as compared to 1:3 in our Institute which may affect the care of patients and increase nosocomial infection. High workload and low staffing which is very common in ICU of a developing country, increases the risk of poor patient outcome and development of nosocomial infections. **(10)**

Our study also showed that the use of steroids, immunosuppressive drugs and previous use of broad-spectrum antibiotics within 7days of intubation were common risk factors among the VAP and association was statistically significant. Noor et al identified prior to the use of steroids as a risk factor for developing VAP. **(11)** Langer M et al showed that prior antimicrobial therapy markedly increased the rate of VAP. **(12)** Long use of broad-spectrum antibiotics increases subsequent colonization with resistant pathogens responsible for MDR infections.

Table-3: Distribution of organisms isolated from patients with VAP

Bacterial isolates	Number	Percentage(%)
Gram-Positive Bacteria		
MRSA	1	1.78
Enterococcus spp	2	3.57
Gram-Negative Bacteria		
Klebsiella pneumoniae	17	30.35
Acinetobacter baumannii	14	25.00
Pseudomonas aeruginosa	12	21.42
Serretia marcescens	1	1.78
Escherichia coli	2	3.57
Citrobacter freundii	4	7.14
Candida spp.	3	5.35
Total	56	100

Klebsiella, Acinetobacter, and Pseudomonas account for almost 75% of Gram-Negative bacterial isolates of VAP cases, who have previously received antibiotics.

Ranjan N et al. also reported similar bacterial isolate as found in our study. **(13)** Joseph et al reported Acinetobacter and P aeruginosa as dominant organisms causing VAP. **(14)** In a study by Gupta et al. the most common pathogen was Pseudomonas aeruginosa. **(15)** We found Klebsiella and Acinetobacter were the most common pathogen associated with late-onset VAP while Giantsou et al. found multidrug-resistant Pseudomonas aeruginosa as the most common isolate pathogen in late-onset VAP.**(16)**

Patients of Trauma, Malignancy, COPD and Renal failure were commonly associated with ventilator-associated pneumonia. A similar association of Trauma with a high incidence of VAP was also mentioned by Ranjan N et al. **(12)**

The outcome of patients in our study was significantly affected by longer duration of mechanical ventilation and longer ICU stays which is similar from another study by Saravu K et al. **(17)** It was observed that the incidence of VAP increased in a patient who requires mechanical ventilation for more than 15 days.

We also found late-onset VAP is more common as compared to early-onset VAP which is similar to the previous study by Gadani H.et al. **(18)**

The overall mortality among VAP group was 39.20% while in nonVAP group it was significantly low (24%) which is similar to previous studies. **(19,20)**

CONCLUSION

Ventilator-associated pneumonia is a serious nosocomial infection causing longer ICU to stay, higher treatment cost, and increased mortality and morbidity. Prior use of antibiotics, steroid and immunosuppressive drugs increase the risk of ventilator-associated pneumonia with drug-resistant pathogens. Trauma, Malignancy and COPD are associated with higher VAP chances. Knowledge of institute pattern of antibiogram helps the clinician to manage these patients. Effective nursing care and adequate staffing also impact on VAP prevention.

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