Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 05, 2023

Study of clinical profile and risk factors in adult patients with ventilator associated pneumonia at ICU in tertiary hospital

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Received Date: 20/03/2023 ***Acceptance Date: 22/05/2023***

Abstract

Background: Ventilator-associated pneumonia (VAP) refers to bacterial pneumonia developed in patients who have been mechanically ventilated for a duration of more than 48 hours. VAP is the leading cause of nosocomial mortality for patients with respiratory failure and crude mortality rates are reported between 20-70%. Present study was aimed to study clinical profile and risk factors in adult patients with ventilator associated pneumonia at a ICU in tertiary hospital. **Material and Methods:** Present study was single-center, prospective, observational study, conducted patients of age > 18 years, either gender, having received mechanical ventilation for more than 48 hours. **Results:** In present study, among total 80 cases, 75% were males and 25% were females. Mean age of patients in the study was 45.65 years. Age of the patients varied from 18 to 78 years, majority were from the age group of 18 to 30 (25 %) & 41 to 50 years (24 %) of age. The overall prevalence of VAP patients is 44% and that of VAP negative patients is 56%. Of the poisoning cases, 60% were VAP positive followed by hanging 17% cases, acute encephalopathy 11%, snake bite and acute CVA accounts for 6% of cases. About 80% of patients who were ventilated for more than 5 days developed VAP, association was statistically significant. Of the VAP positive cases, 71% cases survived and 29% cases expired. Of the VAP positive cases, 60% cases had growth in tracheal aspirate culture and 40% cases were growth negative. Pseudomonas aeruginosa accounts for 43% of growth among VAP patients, followed by Klebsiella oxytoca (24%), Klebsiella pneumonia (19%), Acinetobacter species (10%), Escherichia coli (5%). **Conclusion:** The incidence of VAP is more in diabetic patients, increased duration of intubation is more and majority developed VAP within 96 hours of ventilation.

Keywords: Ventilator-associated pneumonia (VAP), intubation, mechanical ventilation, ICU setup

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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.[1,2] Nosocomial infections are common complications of hospital stay. Of these, ventilator-associated pneumonia (VAP) represents 5%– 18% of all infections. Early-onset pneumonia may account for as many as 50% of cases of ventilator-associated pneumonia, and most etiologic organisms represent common respiratory tract pathogens or normal oropharyngeal flora.[3]

VAP consistently has the highest mortality and morbidity, and it typically prolongs the duration of hospitalization for an average of 7–9 days per patient. Common causative pathogens of VAP include gram negative bacteria such as *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Acinetobacter* species, and gram-positive bacteria such as *Staphylococcus aureus.*[4,5]

The risk of VAP is highest early in the course of hospital stay, and is estimated to be 3%/day during the first 5 days of ventilation, 2%/day during days 5–10 of ventilation and 1%/day after this.[5,6] VAP is the leading cause of nosocomial mortality for patients with respiratory failure and crude mortality rates are reported between 20-70%.[5,6] Present study was aimed to study clinical profile and risk factors in adult patients with ventilator associated pneumonia at a ICU in tertiary hospital.

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Material And Methods

Present study was single-center, prospective, observational study, conducted in department of medicine, at intensive medical care unit at Chengalpattu Medical College, Chengalpattu, India. Study duration was of 1 year (October 2018 to September 2019). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients of age > 18 years, either gender, having received mechanical ventilation for more than 48 hours

Exclusion criteria

- Age less than 18 years
- Patients receiving mechanical ventilation for pulmonary indication.
- Patients on cancer chemotherapy and immunosuppressive drugs.
- Patient with chronic lung disease, chronic hepatic disease, chronic cardiac disease and chronic kidney disease.
- Patients with AIDS and neutropenia.
- Patients intubated and mechanically ventilated outside the ICU before admission.

Study was explained to patient's relatives in local language & written consent was taken for participation & study. Detailed demographic data, clinical history, examination findings were noted in caserecord proforma. All patients underwent laboratory/radiological/microbiological investigations such as complete blood count, urine routine, renal function test, liver function test, ECG, chest X ray, quantification of tracheal secretions & culture of tracheal aspirate. CPIS score was calculated the patients and a diagnosis of ventilator associated pneumonia was made based on that i.e. patients with CPIS score more than or equal to 6 were taken as VAP positive cases.

The data were collected and analysed for prevalence of ventilator associated pneumonia diagnosed by using CPIS score, association between ventilator associated pneumonia cases and their co- morbidities, risk factors, outcome of ventilator associated pneumonia & microbiological profile of ventilator associated pneumonia.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.05 was considered as statistically significant.

Results

In present study, among total 80 cases, 75% were males and 25% were females. Mean age of patients in the study was 45.65 years. Age of the patients varied from 18 to 78 years, majority were from the age group of 18 to 30 (25 %) & 41 to 50 years (24 %) of age.

Table 1: General characteristics

Age groups (in years)	No. of patients	Percentage
18~30	20	25%
31~40	14	18%
41~50	19	24%
51~60	14	18%
61~70	9	11%
>71	4	5%
Mean age (mean±SD)	45.65 years	
Gender		
Male	60	75%
Female	20	25%

The overall prevalence of VAP patients is 44% and that of VAP negative patients is 56%.

Table 2: Prevalence of VAP

	Cases	Percentage
VAP positive	35	44%
VAP negative	45	56%

The prevalence of VAP among 18 to 40 years is 38%, 41 to 60 years is 48%, and that of 61 to 80 years is 46%. The p values when comparing the age groups were > 0.05. So there is no statistical significance in the incidence of VAP among different age groups in our study.

The incidence of VAP in males in our study is 77% and females is 23%. Though the incidence is higher in males, the p value is 0.698 which is not statistically significant.

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Table 3: Age & gender wise prevalence of VAP

Age Group	No of cases	VAP Positive	Prevalence
18~40	34	13	38%
41~60	33	16	48%
61~80	13	6	46%
Gender			
Male	60	27	45%
Female	20	8	40%

Of the poisoning cases, 60% were VAP positive followed by hanging 17% cases, acute encephalopathy 11%, snake bite and acute CVA accounts for 6% of cases and there were no VAP cases among scorpion sting and seizure disorder cases.

Table 4: Cause of Intubation among VAP Patients

Cause for intubation	No of cases	%
Poisoning	21	60%
Hanging	6	17%
Acute encephalopathy	4	11%
Snake bite	2	6%
Acute CVA	2	6%

Prevalence of early onset VAP i.e. VAP which occurs within 96 hours of mechanical ventilation is 25% and that of late onset VAP, which occurs after 96 hours of mechanical ventilation is 19%.

Table 5: Prevalence of early & late onset VAP

Total cases Intubated	Early onset		Late Onset	
	No of cases	%	No of cases	%
80	20	25%	15	19%

About 76% of total diabetic patients are VAP positive in our study. The p value is <0.05 which is statistically significant, thus incidence of VAP is higher in diabetes mellitus patients.

Of the total systemic hypertension patients, 50% were VAP positive and 50% were VAP negative. The p value is > 0.05 which is not statistically significant.

Table 6: Factors associated with VAP: Type 2DM

Patients with	No of cases	VAP Positive		VAP Negative		P Value
		No of cases	%	No of cases	%	
Type 2 DM	17	13	76%	4	24%	0.00218
Systemic hypertension	8	4	50%	4	50%	0.7071

About 80% of patients who were ventilated for more than 5 days developed VAP, the p value is < 0.05 which is statistically significant meaning the incidence of VAP is increased when the duration of ventilation is more.

Table 7: Factors associated with VAP: Duration of Intubation

Total cases of VAP	<= 5 days on ventilator		>5 days on ventilator		P Value
	No of cases	%	No of cases	%	
35	7	20%	28	80%	**0.000662**

Of the VAP positive cases, 71% cases survived and 29% cases expired. Among the total VAP positive patients, 57% developed early onset VAP that is developed VAP within 96 hours of ventilation and 43% developed late onset VAP i.e. developed VAP after 96 hours of ventilation. Of the 20 early onset VAP cases 65% cases survived and 35% cases expired. Of the 15 late onset VAP cases 80% cases survived and 20% cases expired.

Table 8: Outcome of VAP Patients: Early Vs Late Onset VAP

	Total Cases	Survived		Expired	
		No of cases	%	No of cases	%
Early Onset	20	13	65%	7	35%
Late Onset	15	12	80%	3	20%
Total	35	25	71%	10	29%

Of the VAP positive cases, 60% cases had growth in tracheal aspirate culture and 40% cases were growth negative. Pseudomonas aeruginosa accounts for 43% of growth among VAP patients, followed by Klebsiella oxytoca (24%), Klebsiella pneumonia (19%), Acinetobacter species (10%), Escherichia coli (5%).

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Table 9: Bacteriology of VAP Patients

Growth types	No of cases	%
Pseudomonas aeruginosa	9	43%
Klebsiella oxytoca	5	24%
Klebsiella pneumonie	4	19%
Acinetobacter	2	10%
Escherichia coli	1	5%

Discussion

Ventilator associated pneumonia (VAP) is a nosocomial infection that occurs in patients who are critically ill and on ventilator or TRACHEOSTOMY ventilation. It is a major cause of significant mortality and morbidity in the ICU setup. VAP is different from other types of pneumonia in its peculiarity of the causative organisms, multi drug resistance, use of antibiotics, varied presentation and difficulty in diagnosis.

CPIS score is used to diagnose ventilator associated pneumonia. The total score of CPIS scoring system was 0-12 when it was first described. It includes the following 6 clinical assessments namely fever, leukocyte count, quantity and purulence of tracheal secretions, oxygenation, radiologic abnormality and results of sputum culture and gram stain. Each clinical assessment was given a score of 0-2 and the total score amounting to 12. A score of > or =6 implies that VAP is present.[7]

The study population comprised predominantly of patients of snake bite, poisoning, scorpion sting, encephalopathy, seizure disorder, acute CVA cases. In our study there was a male predominance of cases, about 75% were males. In the study by Amartej Singh Sohal et al.,[8] there was also male predominance noted but the incidence of VAP was not significant in them.

In present study majority were from age group of 18~30 and 40~50 years of age. The predominance of cases in younger age group may be due to the fact that most of the cases in our study were poisoning cases. The mean age in our study was 45 years of age. In the study by Hina Gadani et al.,[9] the mean age was 34 years having a predominance of male population.

Of the cases about 20% were early onset VAP cases (i.e.) they developed VAP within 96 hours of mechanical ventilation, whereas 15% were late onset VAP cases (i.e.) They developed VAP after 96 hours of mechanical ventilation. The predominance of early onset VAP cases may be due to shorter duration of mechanical ventilation in our patients.

In the study by Baba sahib Deshmukh et al.,[10] the incidence of VAP was 78%. In the study by Hina Gadani et al.,[9] the incidence of VAP was 37% which was much less compared to the study by Baba sahib Deshmukh et al.,[10]. The incidence of early onset VAP was 27% were as that of late onset VAP was 73%. In another study by Ahmed Abdul Razik Othman et al.,[11] the incidence of VAP was 35.4% whereas in a similar study by Rehaman M Elkolaly et al.,[12] the incidence was 38.4%.

Regarding the co-morbidities present in our study population 71% had no comorbidities, because most of the patients included in our study were young patients and about 21% had type 2DM and 8% had systemic hypertension. Of the patients with type 2DM 76% were VAP positive. The p value is < 0.05 which was significant, which means the incidence of VAP is high among diabetic patients. In an observation study by Jimenez – Trujillo et al.,[13] found out that VAP incidence was higher in Type 2DM patients. However, in their study they concluded that Type 2DM does not predict higher mortality on VAP during hospitalization. In the study by Baba sahib Deshmukh et al.,[10] 44% of Type 2DM patients developed VAP.

In our study the mean duration of ventilations was higher in VAP cases compared to non VAP cases. In the study by Hina Gadani et al.,[9] the mean duration of mechanical ventilation in non VAP group was 11 days while that of VAP patients was 19 days. In our study the mean duration was relatively less because most of the cases were ventilated for poisoning, snake bike, scorpion sting where the recovery is quick.

In the study by Hina Gadani et al.,[9] about 75% of cases who were ventilated for more than 15 days developed VAP whereas only 30% of patients who were ventilated for less than or equal to 15 days developed VAP. Thus in the above study the incidence of VAP is more in those ventilated for more number of days, which is same as our study. The cutoff was taken as 5 days in our study because the mean duration of ventilation was less in our study i.e. 7 days.

Regarding the outcome of patients of VAP in our study, out of the 35 cases of VAP, 25 patients survived while 10 expired i.e. 71% of patients survived while 29% of cases expired. Among 45 non VAP cases, 37 cases survived while 8 cases expired i.e. 82% of non VAP cases survived while 18% of cases expired. Thus it is evident that mortality in VAP cases were higher that non VAP cases. In the study by Hina Gadani et al.,[9] the mortality of non VAP cases is 41% where as in VAP cases it was 54%. In the study by Amartej Sinjh Sohal et al.,[8] the mortality was 19% in VAP patients which was much less compared to the study by Hina Gadani et al.,[9]

About the microbiological profile of VAP patients, of the 35 VAP positive patients, 60% patients are culture positive and 40% patients are culture negative. In present study, the microbiological results of endotracheal Aspirate in VAP positive patients showed that, majority 43% had Pseudomonas aeruginosa, 24% had Klebsiella oxytoca, 19% had Klebsiella pneumoniae, 10% had Acinetobacter, 5% had Escherchia coli. In the study by Amartej Sinjh Sohal et al.,[8] the organism prevalence was Pseudomonas (40%) Kelebseilla (18%) , MRSA E Coli,

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 05, 2023

Acinetobacter, S.aureus and S Pneumoniae. In the study by Baba sahib Deshmukh et al.,[10] majority 36% had pseudomonas, 26% had acinetobacter, 22% had no growth, 14% staphylococci, 2% proteus mirabilis.

The limitations of this study is that the sample size is 80 only and the results cannot be extrapolated to a large population. Tracheal culture by broncho-alveolar lavage could not be done due to lack of technical expertise.

Conclusion

The incidence of VAP is more in diabetic patients, increased duration of intubation is more and majority developed VAP within 96 hours of ventilation. Pseudomonas aeruginosa accounts for majority of the growth in VAP patients. Ventilator associated pneumonia is a major cause of significant mortality and morbidity in the ICU setup. It is a major cause of prolonging the ICU stay and responsible for half of the antibiotic used in the ICU setup.

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