EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 6
Issue: 8
377-381
Year: 2019

A STUDY OF VENTILATOR ASSOCIATED PNEUMONIA: INCIDENCE AND OUTCOME

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Article Received on 12/06/2019 **Article Revised on 03/07/2019** **Article Accepted on 24/07/2019**

ABSTRACT
Background: Ventilator-associated pneumonia (VAP) is leading cause of death among hospital acquired infections. Nearly one-third of nosocomial pneumonia cases, VAP being most common, develop in the ICU. Its incidence varies from 13–51 per 1,000 ventilator days depending on hospital setting and patient group. Typically patients' develop VAP within first week of mechanical ventilation. HAP and, most importantly, VAP increase duration of hospitalisation and healthcare costs. The nosocomial pneumonia mortality rate can reach up to 70%. There are multiple studies suggestive of 30-50% mortality due to VAP being consequence of infection and even higher when that infection is due to Pseudomonas aeruginosa and Acinetobacter spp. The present study was planned to study the incidence and outcome of VAP. **Material and methods:** This prospective study was conducted over a period of one and half year. 70 patients above 18 years of age of either sex subjected to new intubation at MICU of SRMSIMS and mechanical ventilation for more than 48 hours in Critical Care Facility not having Pneumonia prior to initiation of mechanical ventilation and not with known HIV seropositivity were considered for the study. A detailed history was taken and all cases were subjected to hemogram, hepatic and renal function tests, blood sugar, and chest X-ray (PA view). Chest radiograph was taken after 48 hours of mechanical ventilation. Endotracheal aspirate were taken from all the patients 48hrs after being mechanically ventilated and sent for culture and sensitivity to the Microbiology lab of SRMS IMS. The statistical analysis was done using IBM SPSS. The values were represented as Number (%). Appropriate statistical test were used where required. **Result:** Incidence of VAP was 14.3%. Commonest finding on X-Ray after development of VAP was bilateral pneumonia followed by unilateral pneumonia to the right side. Commonest organism isolated in the cultures of patients who developed VAP was Klebsiella pneumoniae followed by Acinetobacter baumanii. Out of 10 (14.3%) patients who developed VAP, 7 patients suffered mortality whereas 60 (85.7%) patients didn't develop VAP, 17 patients from them suffered mortality.

KEYWORDS: Ventilator associated pneumonia, VAP, ICU, Mechanical ventilation, Klebsiella pneumoniae, Acinetobacter baumanii.

INTRODUCTION
Ventilator-associated pneumonia (VAP) is leading cause of death among hospital acquired infections. Intensive care unit (ICU) hospitalizations impose a high risk of acquiring healthcare-associated infection (HAIs), most commonly nosocomial pneumonia. In many cases, the patient's underlying disease and critical condition necessitates invasive procedures and diagnostics, which may contribute unavoidably to the patient's risk of colonization by the exogenous microbes.[1-3]

Nearly one-third of nosocomial pneumonia cases, VAP being most common, develop in the ICU. Epidemiological studies report an incidence of VAP of 2–16 episodes per 1000 ventilator-days.[4,5] According to the International Nosocomial Infection Control Consortium (INICC) report data summary, the overall incidence of VAP is 13.6 per 1,000 ventilator days.[5] Its incidence varies from 13–51 per 1,000 ventilator days depending on hospital setting and patient group.[6] Typically patients' develop VAP within first week of

mechanical ventilation. High mortality rates are associated with VAP ranging from 24–76 percent and even higher in terminally ill patients.[7]

HAP and, most importantly, VAP increase duration of hospitalisation and healthcare costs. A recent matched case–control study from a large US database demonstrated longer durations of mechanical ventilation, ICU stay and hospitalisation in patients with VAP than in those without. Worse outcomes have been consistently reported over the years and mean hospital charges per VAP patient have increased by approximately US$40000.[8,9,12] In a systematic review of economic analyses of healthcare-associated infections, the mean attributable cost of VAP was US$9969.[13]

In the UK, a conservative estimated cost was found to be equivalent to 7 extra days of ICU care while the estimated price of any preventive measure was nearly 30 times less. Similarly in Turkish University Hospitals, the mean cost of ICU patients with VAP was four times greater compared with those without VAP.[14]

The nosocomial pneumonia mortality rate can reach up to 70%.[15] There are multiple studies suggestive of 30-50% mortality due to VAP being consequence of infection and even higher when that infection is due to Pseudomonas aeruginosa and Acinetobacter spp.[16,17] Recent studies have re-emphasised the effect of VAP on mortality.[18,19,20] As stated earlier, the risk and chances of developing VAP in a patient depend on length of ICU stay, newer studies account nearly 10% mortality to VAP with greater risk in surgical patients and patients with mid-range illness severity.[20,21]

With the above facts in mind, the present study was planned to study the incidence and outcome of VAP.

MATERIAL AND METHODS

This prospective study was conducted over a period of one and half year at Department of Pulmonary Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, a tertiary care referral centre.

Study population included patients admitted in the Intensive Care Unit of Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, who were on mechanical ventilation for more than 48hrs.

All patients above 18 years of age of either sex subjected to new intubation at MICU of SRMSIMS and mechanical ventilation for more than 48 hours in Critical Care Facility not having Pneumonia prior to initiation of mechanical ventilation and with no known HIV seropositivity were considered for the study. Total number of 274 patients were admitted in ICU from 1st Nov, 2016 to 30th Apr, 2018. Of these 70 patients qualified the inclusion and were enrolled for the study.

Approval for the study was obtained from Institute's Ethical Committee. Informed consent was obtained from all the subjects.
A detailed history was taken and information in detail was taken with reference to demographic information, thorough general physical and systemic examination were carried out. All cases were subjected to hemogram, hepatic and renal function tests, blood sugar, and chest X-ray (PA view).

Chest radiograph was taken after 48 hours of mechanical ventilation. Later serial chest radiographs were taken to look for evidence of pneumonia. Endotracheal aspirate were taken from all the patients 48hrs after being mechanically ventilated and sent for culture and sensitivity to the Microbiology lab of SRMS IMS.

The statistical analysis was done using IBM SPSS (Statistical Package for Social Sciences) Version 20.0 statistical Analysis Software. The values were represented as Number (%). Appropriate statistical test were used where required.

OBSERVATIONS

Table 1: Distribution of study subjects according to age and sex.

Age	Female		Male		Total	
≤30	**2**	**8.7%**	**4**	**8.5%**	**6**	**8.6%**
31 - 45	6	26.1%	7	14.9%	13	18.6%
46 - 60	7	30.4%	11	23.4%	18	25.7%
> 60	8	34.8%	25	53.2%	33	47.1%
Total	23	100.0%	47	100.0%	70	100.0%
Mean±SD	54.09 ± 16.42		58.91 ± 17.14		57.33 ± 16.94	

Majority of the study subjects were males (47, 67.1%) with mean age of 58.91±17.14 years. the remaining patients were females (23, 32.9%) and had mean age of 54.09±16.42 years. Most of the ventilated patients fell in the geriatric age group i.e. above 60 years of age (33, 47.1%) with decreasing proportions as the age decreased. The mean age of the study population was 57.33±16.94 years.

Table 2: Distribution of study subjects according to development of VAP.

VAP	N	%
Developed	10	14.3
Not developed	60	85.7
Total	70	100.0

In the present study it was observed that incidence of VAP was as high as 14.3%.

Table 3: Distribution of study subjects according to positive chest x-ray findings

Chest X-ray finding	After Development of VAP	
B/L Pneumonia	8	80.0%
Rt. side pneumonia	2	20.0%
Total	10	100.0%

The most common finding on chest x-ray was bilateral pneumonia present in 8, 80.0% of the patients followed by unilateral pneumonia to the right side (2, 20.0%).

Table 4: Distribution of study subjects according to organism isolated in culture of tracheal aspirate

Organism	VAP				Total	
	Developed VAP		Didn't develop VAP			
	n	%	n	%	n	%
Acinetobacter baumanii	2	20.0%	2	3.3%	4	5.7%
E coli	1	10.0%	8	13.4%	9	12.9%
Klebsiella pneumoniae	4	40.0%	5	8.3%	9	12.9%
Pseudomonas aeruginosa	1	10.0%	5	8.3%	6	8.6%
Staph aureus	2	20.0%	1	1.7%	3	4.3%
Sterile	0	0.0%	39	65.0%	39	55.7%
Total	10	100.0%	60	100.0%	70	100.0%

Table 4 shows the organisms which were grown, identified and isolated in the cultures sent from tracheal aspirates of the patient population. It was observed that cultures of 39, 55.7% of the patients were sterile and the remaining 31, 44.3% of the patient population showed growth of one or the other organisms.

The commonest organisms isolated in the cultures was Klebsiella pneumoniae (9, 12.9%) and E. coli (9, 12.9%), followed by Pseudomonas aeruginosa (6, 8.6%), Acinetobacter baumanii (4, 5.7%), Staphylococcus aureus (3, 4.3%).

Among the patients who developed VAP, the most common organism found in isolates from trachea was Klebsiella pneumoniae (4, 40.0%) followed by Acinetobacter baumanii (2, 20.0%), followed by E. coli, Pseudomonas aeruginosa and Staphylococcus aureus (2, 20.0% each).

Table 5: Distribution of study subjects according to outcome

Outcome	VAP				Total	
	Developed VAP		Didn't develop VAP			
	n	%	n	%	n	%
Death	7	70.0	17	28.3	24	34.3
Result not known	1	10.0	5	8.3	6	8.6
Recovered	2	20.0	38	63.3	40	57.1
Total	10	100.00%	60	100.00%	70	100.00%

p-value 0.0071

Table 5 shows the outcome of patients observed on following the patient population over time even after discharge from the intensive care unit. It was seen that nearly half of the patients (24, 34.3%) suffered mortality followed by those who recovered (40, 57.1%) and got discharged from the hospital followed by those who left against medical advice (LAMA) and (6, 8.6%) and could not be followed for final outcome of current admission.

Mortality in the patients who developed VAP was much higher (7, 70.0%) as compared to those who didn't develop VAP (17, 28.3%). Association of mortality with development of VAP in the final outcome of the patients was statistically significant (p-value 0.0071).

DISCUSSION

A prospective observational study entitled "A study of Ventilator Associated Pneumonia: Incidence, Outcome and Culture Sensitivity profile of isolated organisms" was conducted in the Department of Pulmonary Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly including a total of 70 patients who were taken on mechanical ventilation.

VAP is the most common nosocomial infection among patients receiving Mechanical Ventilation in our ICU. Out of the total 274 patients admitted to the ICU of our hospital during the study period, a total of 70 patients who were on Mechanical Ventilation for more than 48 hours were included in this study. Out of these 70 patients 10 (14.3%) patients were diagnosed to have VAP. These findings were nearly similar to 15.8%

reported by Rosenthal et al[4] in their study on 3,13,008 patients whereas it was much lower than 30.67% reported by Joseph et al[6] in Indian medical intensive care units. They have given neurological disorders and CNS infections along with emergency intubation and intravenous sedatives as reasons for higher incidence of VAP in their units.

Majority of the study subjects were males (47, 67.1%) with mean age of 58.91±17.14 years the remaining patients were females (23, 32.9%) and had mean age of 54.09±16.42 years. Most of the ventilated patients fell in the geriatric age group i.e. above 60 years of age (33, 47.1%) with decreasing proportions as the age decreased. The mean age of the study population was 57.33±16.94 years. In demographic distribution of the study population, proportion of males was lower and mean age was higher to that reported by Rosenthal et al[5] who reported 73.7% males and mean age 48.11 ± 18.2 years probably because much of our patient-base is made by retired army personnel and their dependent family.

In this study it was observed that patients who developed VAP as well as those who didn't develop VAP were above 60 years of age (7; 70.1% and 26; 43.3% respectively). The proportion of subjects in both VAP and non-VAP groups, decreased as the age decreased. On applying statistical tests, no association was observed in development of VAP and increasing age (p-value 0.3305). Similar analysis was given by **Blot et al[10]** who stated that Logistic regression analysis could not demonstrate older age as a risk factor for ventilator-associated pneumonia.

It was also observed in the current study that most of the study subjects in both VAP and non-VAP groups were males (8; 80.0% and 39; 65.0% respectively) followed by females (2; 20.0% and 21; 35.0% respectively). On applying statistical tests, no association was observed in development of VAP and male gender (p-value 0.3499). **Charles et al[11]** reported males in VAP and non-VAP groups as 83.3% and 70.7% respectively and females in VAP and non-VAP groups as 16.7% and 23.3% respectively. Their findings were similar to our study that no association was observed in development of VAP and male gender.

On chest x-ray it was observed that most common finding on chest x-ray was bilateral pneumonia present in 8, 80.0% of the patients followed by unilateral pneumonia to the right side (2, 20.0%).

In the present study the organisms which were grown, identified and isolated in the cultures sent from tracheal aspirates of the patient population. It was observed that cultures of 40, 57.1% of the patients were sterile and the remaining 30, 42.9% of the patient population showed growth of one or the other organisms.

The commonest organisms isolated in the cultures was Klebsiella pneumoniae (9, 12.9%) and E. coli (9, 12.9%), followed by Pseudomonas aeruginosa (6, 8.6%), Acinetobacter baumanii (4, 5.7%), Staphylococcus aureus (2, 2.9%). Our results were slightly different from those of Charles et al[11] who reported Pseudomonas aeruginosa (33.3%) was the most common organism isolated from VAP patients followed by Klebsiella pneumoniae (20.8%), Staphylococcus aureus (8.3%), Candida albicans (8.3%), Escherichia coli (8.3%) and Acinetobacter baumannii (4.2%) whereas Bekaert et al[19] also reported Pseudomonas aeruginosa 17.9% as the most common organism isolated, other organisms to follow were MSSA 9.7%, Acinetobacter sp. 8.2%, Escherichia coli 7.6%, Haemophilus influenzae 7.3%, MRSA 5.6%, Streptococcus pneumonia 5.2%, Klebsiella sp. 4.4%.

In the present study the outcome of patients was observed by following the patient population over time even after discharge from the intensive care unit. It was observed that nearly a third of the patients (24, 34.3%) suffered mortality while (40, 57.1%) got recovered and got discharged from the hospital followed by those who left against medical advice (LAMA) (6, 8.6%) and could not be followed for final outcome of current admission.

Mortality amongst patients who developed VAP was found to be 70.0% while in those who did not develop VAP was 28.3%. Observed mortality in the current study was higher than the study done by **Rodríguez et al[22]** who reported 90-day in-hospital mortality rate of 47.5 % of VAP patients.

Relation of mortality with development of VAP in the final outcome of the patients was statistically significant (p-value 0.0071).

CONCLUSION

VAP is the most common nosocomial infection among patients receiving Mechanical Ventilation in our ICU. Incidence of VAP was 14.3%. Commonest finding on X-Ray after development of VAP was bilateral pneumonia followed by unilateral pneumonia to the right side.Commonest organism isolated in the cultures of patients who developed VAP was Klebsiella pneumoniae followed by Acinetobacter baumanii.

A total of 274 patients were admitted to the Intensive Care Unit of SRMS IMS, Bareilly during the study period of which 70 mechanically-ventilated patients meeting the inclusion criteria were included in the study. Out of which 10 (14.3%) developed VAP and 7 patients from them suffered mortality whereas 60 (85.7%) patients didn't develop VAP, 17 patients from them suffered mortality.

REFERENCES

1. Kalanuria AA, Ziai W, Mirski M. Ventilator-associated pneumonia in the ICU. Crit Care, 2014; 18(2): 208.
2. Kollef MH, Morrow LE, Niederman MS, Leeper KV, Anzueto A, Benz-Scott L, et al. Clinical characteristics and treatment patterns among patients with ventilatorassociated pneumonia. Chest, 2006; 129(5): 1210–8.
3. Wałaszek M, Kosiarska A, Gniadek A, Kolpa M, Wolak Z, Dobros W, et al. The risk factors for hospital-acquired pneumonia in the intensive care unit. Przegl Epidemiol, 2016; 70(1): 15–20.
4. Rosenthal VD, Maki DG, Mehta Y, Leblebicioglu H, Memish ZA, Al-Mousa HH, et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004–2009. Am J Infect Control, 2012; 40: 396–407.
5. Rosenthal VD, Maki DG, Jamulitrat S, Medeiros EA, Todi SK, Gomez, et al. International Nosocomial Infection Control Consortium(INICC) report, data summary for 2003-2008, issued June 2009. Am J Infect Control, 2010; 38: 95-104.
6. Joseph NM, Sistla S, Dutta TK, Badhe AS, Parija SC. Ventilator-associated pneumonia in a tertiary care hospital in India: incidence and risk factors. J Infect Dev Ctries, 2009; 3: 771–7.
7. Choudhuri AH. Ventilator-Associated Pneumonia: When to hold the breath? Int J Crit Illn Inj Sci, 2013; 3: 169–74.
8. Rello J, Ollendorf DA, Oster G, Vera LM, Bellm L, Redman R, et al. Epidemiology and outcomes of ventilator-associated pneumonia in a large US database. Chest, 2002; 122: 2115–2121.
9. Asehnoune K, Seguin P, Allary J, Feuillet F, Lasocki S, Cook F, et al. Hydrocortisone and fludrocortisone for prevention of hospital-acquired pneumonia in patients with severe brain injury (Corti-TC): a double blind multicenter phase 3, randomised placebo-controlled trial. Lancet Respir Med, 2014; 2: 706–716.
10. Blot S, Koulenti D, Dimopoulos G, Martin C, Komnos A, Krueger WA, et al. Prevalence, risk factors, and mortality for ventilator-associated pneumonia in middle-aged, old, and very old critically ill patients*. Critical Care Medicine, 2014; 42(3): 601-609.
11. Charles MP, Easow JM, Joseph NM, Ravishankar M, Kumar S, Umadevi S. Incidence and risk factors of ventilator associated pneumonia in a tertiary care hospital. The Australasian Medical Journal, 2013; 6(4): 178-182.
12. Warren DK, Shukla SJ, Olsen MA, Kolef MH, Hollenbeak CS, Cox MJ, et al. Outcome and attributable cost of ventilator-associated pneumonia among intensive care unit patients in a suburban medical center. Crit Care Med, 2003; 31: 1312–1317.
13. Stone PW, Braccia D, Larson L. Systematic review of economic analyses of health care-associated infections. Am J Infect Control, 2005; 33: 501–509.
14. Erbay RH, Yalcin AN, Zencir M, Serin S, Atalay H. Costs and risks factors for ventilator-associated pneumonia in a Turkish University Hospital's Intensive Care Unit: a case-control study. BMC Pulm Med, 2004; 4: 1–7.
15. American Thoracic Society, Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med, 2005; 171: 388–416.
16. Micek ST, Wunderink RG, Kollef MH, Chen C, Rello J, Chastre J, et al. An international multicenter retrospective study of Pseudomonas aeruginosa nosocomial pneumonia: impact of multidrug resistance. Crit Care, 2015; 19: 219.
17. Garnacho-Montero J, Ortiz-Leyba C, Fernández-Hinojosa E, Albado PT, Cavuela A, Marguez VJA, et al. Acinetobacter baumannii ventilator-associated pneumonia: epidemiological and clinical findings. Intensive Care Med, 2005; 31: 649–655.
18. Melsen WG, Rovers MM, Bonten MJ. Ventilator-associated pneumonia and mortality: a systematic review of observational studies. Crit Care Med, 2009; 37: 2709–2718.
19. Bekaert M, Timsit JF, Vansteelandt S, Depuydt P, Vesin A, Garrouste OM, et al. Attributable mortality of ventilator-associated pneumonia: a reappraisal using causal analysis. Am J Respir Crit Care Med, 2011; 184: 1133–1139.
20. Melsen WG, Rovers MM, Koeman M, Bonten MJ et al. Estimating the attributable mortality of ventilator-associated pneumonia from randomized prevention studies. Crit Care Med, 2011; 39: 2736–2742.
21. Nguile-Makao M, Zahar JR, Français A, Tabah A, Garrouste OM, Allaouchiche B et al. Attributable mortality of ventilator-associated pneumonia: respective impact of main characteristics at ICU admission and VAP onset using conditional logistic regression and multi-state models. Intensive Care Med, 2010; 36: 781–789.
22. Heredia-Rodríguez M, Peláez MT, Fierro I, Gomez SE, Gomez PE, Lorenzo M, et al. Impact of ventilator-associated pneumonia on mortality and epidemiological features of patients with secondary peritonitis. Ann Intensive Care, 2016; 6(1): 34. doi:10.1186/s13613-016-0137-5