ORIGINAL ARTICLE

Prevalence of Ventilator Acquired Pneumonia in an Intensive Care Unit (ICU)

Syed Aftab Haider*, Muhammad Azam Mushtaq*, Zaheer Akhtar**, Atqua Sultan*, Zaira Salman*, Salman Waris*

*Nishtar Medical University/Hospital Multan, Pakistan
**Pulmonology, Gulab Devi Chest Hospital Lahore

Abstract

Objective
To determine the incidence of ventilator acquired pneumonia (VAP) and its etiological factors and outcomes of VAP patients in a local hospital setting.

Methods
This cross-sectional study was conducted in ICU of Nishtar Medical Hospital. We collated the data of 100 patients who admitted in ICU of the hospital between Jan-2017 to Jan-2018. Patients who underwent mechanical ventilation >48 hours in ICU having age > 20 years were included in analysis. Occurrence of Pneumonia more than 48 hours after mechanical ventilation was diagnosed as VAP. Microbial spectrum causing VAP was determined.

Results
There were 59% male patients and 41% female patients. Regarding causes of admission, 38% patients presented with respiratory disease and 24% with cardiovascular disease, 23% with neurological disease and 7.0% post-surgery. VAP was diagnosed in 31% patients admitted in ICU. Hospital stay, incidence of tracheostomy, sepsis and mortality was significantly high in VAP patients as compared to Non-VAP (P-values <0.001, 0.005, 0.005 and <0.001 respectively). *Pseudomonas aeruginosa* was the commonest organism diagnosed in 38.7% VAP patients, *Acinetobacter baumanni* in 22.5%, and *MRSA* in 19.3%.

Conclusion
Ventilator acquired pneumonia is a common complication in patients admitted in ICU. It is associated with high morbidity and mortality. *Pseudomonas aeruginosa*, *Acinetobacter baumanni* and *MRSA* are common bacteria in VAP patients.

Keywords
Ventilator acquired pneumonia, Hospital stay, Mortality, Microbial spectrum.

Correspondence Author: Syed Aftab Haider,
Assistant Professor of Anesthesia,
Intensive Care Unit and Pain Management,
Nishtar Medical University/Hospital,
Multan, Pakistan
Email: draftab.nishtar@gmail.com

Introduction

There is a high risk of mortality in patients admitted in intensive care units (ICU). This mortality is not only because of seriousness of illness but also due to some secondary complications such as nosocomial infections.[1] Nosocomial pneumonia affects about 27.0% of patients admitted in ICU and the prevalence rate is increased to 86% if patients is on mechanical ventilation.[2] Despite huge advances in the management of patients admitted in ICUs, ventilator acquired pneumonia (VAP) is still the commonest infection in ICU admitted patients.[3]

According to IDSA/ATS guidelines, VAP is a hospital acquired pneumonia (HOP) that occurs after 48-72 hours of tracheal intubation.[4,5] VAP occurs in about 6.0% to 52% ventilated patients, risk is higher among first five days of ventilation.[6-8] Antibiotic treatment in 50% of patients admitted in ICU is because of VAP.[9] Reported incidence of mortality due to VAP in ventilated patients ranges from 09% to 19%.[10,11] Mortality due to VAP has reduced a little due to advancements in antibiotic regimens and better ICU care management. Mortality rate is higher if the causing organism is *pseudomonas aeruginosa* or *Acinetobacter baumannii*as compared to other organisms.[12] VAP is a major risk factor for prolonged hospitalization and increased economic burden on hospital resources especially in developing countries.[13] Studies have reported varying frequency of VAP among ventilated patients. This may be due to different ICU settings, etiological spectrum of causing organisms in admitted patients and the definitions to diagnose VAP. So there is a need to conduct a local study for determining the incidence of VAP and its etiological factors and outcomes of VAP patients in a local hospital setting. This study will help to determine the frequency of common causative organisms and will help to utilize the antimicrobial regimens in a better way.

Methods

This cross-sectional study was conducted in ICU of Nishtar Medical Hospital. We collated the data of 100 patients who were admitted in ICU of the hospital between Jan-2017 to Jan-2018. Patients who underwent mechanical ventilation >48 hours in ICU having age > 20 years were included in analysis. Patients admitted in ICU without mechanical ventilation were excluded.

VAP was diagnosed according to the IDSA/ATS guidelines, occurrence of Pneumonia more than 48 hours after mechanical ventilation was diagnosed as VAP. Presence of new pulmonary

infiltrates on chest X-rays, fever >38 ºC, leukocyte count >12000 mm^3, or development of purulent secretions in bronchial tree was used to diagnose VAP. After making diagnosis culture samples were sent to the laboratory for confirmation of +ve blood cultures. Microbial spectrum causing VAP was determined by the central laboratory of the hospital.

Prevalence of VAP was primary study endpoint. Data regarding reason for admission in ICU, causing micro-organism and complications of mechanical ventilation was also calculated. Data analysis was done using SPSS Version 23. Outcomes of VAP and Non-VAP patients ware compared using Fisher's exact test and Chi-square test. P-value of 0.05 was taken as cut-off point.

Results

There were 59% male patients and 41% female patients who were admitted in the ICU of the hospital during the study period fulfilling the enrolment criteria. Regarding causes of admission, 38% patients presented with respiratory disease and 24% with cardiovascular disease, 23% with neurological disease and 7.0% post-surgery. VAP was diagnosed in 31% patients admitted in ICU (Table 1).

On comparison of hospital outcomes, there was no considerable difference in the frequency of re-intubation, atelectasis and pneumothorax in VAP versus Non-VAP patients. Frequency of tracheostomy was 19.3% in VAP versus 2.9% in non-VAP patients (p-value 0.005). Incidence of Sepsis and Mortality was also high in VAP patients. Overall mortality rate in study patients was 17.0%, whereas it was 25.80% in VAP and 13.04% in Non-VAP patients (p-value <0.001) (Table 2).

Table 1. Baseline Characteristics of Patients.

Variables	Value
Age of Patients (Y)	53.91+10.56
Gender	
Male	59
Female	41
Co-morbidities	
Respiratory Disease	38
Cardiovascular Disease	24
Neurological Disease	23
Post-Surgery	07
Malignancy	3
Hepatic Disease	5
Ventilator Acquired Pneumonia	
Yes	31
No	69

Regarding microbial spectrum in VAP patients, *pseudomonas aeruginosa* was the commonest organism diagnosed in 38.7% VAP patients, *acinetobacter baumannii* in 22.5%, and *MRSA* in 19.3%. Full detail of causing organisms is given in Table 3.

Table 2. Comparison of Baseline Demographics and In-Hospital Outcomes in VAP versus Non-VAP Patients.

	VAP (n=31)	Non-VAP (n=69)	P-value
Age of Patients	54.06+10.48	52.89+11.01	Insig.
Male Gender	17 (54.84%)	42 (60.86%)	Insig.
Female Gender	14 (45.16%)	27 (39.13%)	
Hospital Stay	14.8+4.6	5.9+2.1	<0.001
Complications			
Re-intubation	5 (16.1%)	4 (5.78%)	Insig.
Tracheostomy	6 (19.35%)	2 (2.9%)	0.005
Pneumothorax	1 (3.22%)	0 (0.0%)	Insig.
Atelectasis	8 (25.8%)	10 (14.49%)	Insig.
Sepsis	10 (32.25%)	6 (8.69%)	0.002
Mortality	8 (25.80%)	9 (13.04%)	<0.001

Table 3. Causing microorganisms of VAP.

Causing Organism	Frequency
Pseudomonas aeruginosa	12 (38.7%)
Acinetobacter baumannii	7 (22.5%)
MRSA	6 (19.35%)
Klebsiella pneumoniae	3 (9.67%)
Streptococcus pneumoniae	2 (6.45%)
Escherichia coli	1 (3.22%)

Discussion

Ventilator acquired pneumonia (VAP) has been reported as the commonest noso-comial infections, with very high morbidity and mortality in effected patients.[14,15] The wide spectrum of bacteria has been reported in different studies causing VAP. The spectrum varies from country to country and even hospital to hospital in same countries. In present study, we reported the incidence of VAP, incidence of adverse complications in VAP patients and spectrum of microbes causing VAP.

In present study, incidence of VAP in patients admitted in ICU was 31.0%. In another study conducted in an Army hospital the incidence of VAP was 22.5%.[16] One more study from Karachi, Pakistan found the VAP incidence of 30.5% in ICU patients.[17]A study conducted in Egypt reported the incidence of VAP was 35.41%. A large multicenter study have concluded

that incidence of VAP is higher among patients admitted in smaller hospitals, than medium and large hospitals.[18]

In present study, hospital stay, frequency of tracheostomy, atelectasis and mortality rate were significantly high in VAP patients. Othman et al. also found higher hospital stay, frequency of atelectasis and tracheostomy rate in VAP patients.[19] However in their study, hospital mortality rate was not significantly high in VAP versus non-VAP patients. Rose *et al*. found 44.3% mortality rate in VAP patients.[20]

In present study, *pseudomonas aeruginosa* was the commonest organism diagnosed in 38.7% VAP patients, *acinetobacter baumannii* in 22.5%, and *MRSA* in 19.3%. Rose *et al*. found *Klebsiella pneumoniae* in 19.6% VAP patients, *Acinetobacter baumannii* in 18.3% patients and *Pseudomonas aeruginosa* in 14.0% patients.[20] In a study conducted by Ishtiq *et al*. reported *Acinetobacter baumannii* as the commonest organism causing VAP in 30.2% patients, *Klebsiella pneumoniae* in 27.4% patients, *MRSA* in 15.1% and *Pseudomonas aeruginosa* in 9.4% patients.[16] Barbier *et al*. found *staphylococcus aureus*, followed by *pseudomonas aeruginosa* and *Enterobacteriaceae* as the commonest organisms responsible for VAP.[21]

The spectrum of microbes causing VAP is different in different hospital settings, proper recognition of the bacterial spectrum may help in deciding the most appropriate antibiotic regimens for treatment of VAP and may help to reduce mortality in these patients.

Conclusion

Ventilator acquired pneumonia is a common complication in patients admitted in ICU. It is associated with high morbidity and mortality. *Pseudomonas aeruginosa*, *acinetobacter baumannii* and *MRSA* are common bacteria in VAP patients.

References

1. Dasgupta S, Das S, Chawan NS, Hazra A. Nosocomial infections in the intensive care unit: Incidence, risk factors, outcome and associated pathogens in a public tertiary teaching hospital of Eastern India. *Indian J CritCare Med* 2015;19(1):14-20.
2. Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial infections in medical intensive care units in the United States. *CritCare Med* 1999;27(5):887-92.
3. Alp E, Voss A. Ventilator associated pneumonia and infection control. *AnnClin MicrobiolAntimicrob* 2006;5(1):7.
4. Erb CT, Patel B, Orr JE, Bice T, Richards JB, Metersky ML, *et al*. Management of Adults with Hospital-acquired and Ventilator-associated Pneumonia. *Ann Am Thorac Soc* 2016;13(12):2258-60.
5. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, Napolitano LM, O'grady NP, Bartlett JG, Carratalà J, El Solh AA. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clin Infect Dis* 2016;63(5):e61-111.
6. Richardson CJ, Rodriguez JL. Identification of patients at highest risk for ventilator-associated pneumonia in the surgical intensive care unit. *Am J Surg* 2000;179(2):8-11.
7. Koenig SM, Truwit JD. Ventilator-associated pneumonia: diagnosis, treatment, and prevention. *Clin Microbiol Rev* 2006;19(4):637-57.
8. Rello J, Ollendorf DA, Oster G, Vera-Llonch M, Bellm L, Redman R, *et al*. Epidemiology and outcomes of ventilator-associated pneumonia in a large US database. *Chest* 2002;122(6):2115-21.
9. Chastre J, Fagon J-Y. Ventilator-associated pneumonia. *Am J Respir Crit Care Med* 2002;165(7):867-903.
10. Kasuya Y, Hargett JL, Lenhardt R, Heine MF, Doufas AG, Remmel KS, *et al*. Ventilator-associated pneumonia in critically ill stroke patients: frequency, risk factors, and outcomes. *J Crit Care* 2011;26(3):273-9.
11. Kalanuria AA, Zai W, Mirski M. Ventilator-associated pneumonia in the ICU. *CritCare* 2014;18(2):208.
12. Jones RN. Microbial etiologies of hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia. *Clin Infect Dis* 2010;51(Supplement_1):S81-S7.
13. Stergiopoulos S, Calvert SB, Brown CA, Awatin J, Tenaerts P, Holland TL, *et al*. Cost Drivers of a Hospital-Acquired Bacterial Pneumonia and Ventilator-Associated Bacterial Pneumonia Phase 3 Clinical Trial. *Clin Infect Dis* 2018;66(1):72-80.
14. Medell M, Hart M, Duquesne A, Espinosa F, Valdés R. Nosocomial ventilator-associated pneumonia in Cuban intensive care units: bacterial species and antibiotic resistance. *MEDICC Rev* 2013;15:26-9.
15. Quartin AA, Scerpella EG, Puttagunta S, Kett DH. A comparison of microbiology and demographics among patients with healthcare-associated, hospital-acquired, and ventilator-associated pneumonia: a retrospective analysis of 1184 patients from a large, international study. *BMC Infect Dis* 2013;13(1):561.
16. Ishtiaq W, Ilyas A, Assad S, Qadeer A, Ghazanfar H, Sulehria T, *et al*. Spectrum of ventilator associated pneumonia with effect on intensive care unit's patient outcome. *Pak Armed Forces Med J* 2017;67(4):518-23.
17. Kumar A, Ghauri MI, Razzaque S, Jamali A, Mohammad JS. Ventilator associated pneumonia; prevalence and microbial patterns. *Pak J Chest Med* 2015;20(2).
18. Lee MS, Walker V, Chen LF, Sexton DJ, Anderson DJ. The epidemiology of ventilator-associated pneumonia in a network of community hospitals: a prospective multicenter study. *Infect Control Hospital Epidemiol* 2013;34(7):657-62.
19. Othman AA, Abdelazim MS. Ventilator-associated pneumonia in adult intensive care unit prevalence and complications. *Egypt J Crit Care Med* 2017;5(2):61-3.
20. Delle Rose D, Pezzotti P, Fortunato E, Sordillo P, Gini S, Boros S, *et al*. Clinical predictors and microbiology of ventilator-associated pneumonia in the intensive care unit: a retrospective analysis in six Italian hospitals. *Eur J Clin Microbiol Infect Dis* 2016;35(9):1531-9.
21. Barbier F, Andremont A, Wolff M, Bouadma L. Hospital-acquired pneumonia and ventilator-associated pneumonia: recent advances in epidemiology and management. *Curr Opin Pulmon Med 2013*;19(3):216-28.