Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2017/14

Original Article

Ventilator Associated Pneumonia-Incidence and Outcome in Adults in Medical Intensive Care Unit of a Tertiary Care Hospital of North India

Muzaffar Maqbool[1], Afshan Shabir[2], Henna Naqash[2], Akhter Amin[2], Rakesh K Koul[3], P A Shah[4]

[1]Assistant Professor, Postgraduate Department of Medicine, Government Medical College, Srinagar, Jammu and Kashmir, India, [2]Registrar, Postgraduate Department of Medicine, Government Medical College, Srinagar, Jammu and Kashmir, India, [3]Associate Professor, Postgraduate Department of Medicine, Government Medical College, Srinagar, Jammu and Kashmir, India, [4]Professor, Postgraduate Department of Medicine, Government Medical College, Srinagar, Jammu and Kashmir, India

Abstract

Background: Various studies reveal that pneumonia complicates a majority of patients in intensive care units (ICUs) who are on invasive mechanical ventilation (MV). Up to 50% of such patients die of this disease, however, the mortality varies in different population groups, different underlying indicator diseases and also among different ICUs. This study was carried out to observe the profile of ventilator associated pneumonia (VAP) and its mortality among our patients, as per age and sex, admitted in the ICU of a tertiary care hospital.

Methods: A 14 months study of admitted patients was conducted in our ICU to see the pattern of pneumonia among ventilated patients. VAP was diagnosed according to clinical pulmonary infection score (CPIS) scoring system where a score > or =6 was taken as significant.

Results: The study showed that among a total of 178 patients admitted in the ICU, 92 (51.68%) were managed with invasive MV. Out of these 92 patients, 12 (13.04%) developed VAP as per CPIS scoring system. Out of 12 patients, 6 died, revealing 50% mortality among VAP patients.

Conclusion: VAP occurred in our ICU setup in 13.04% patients on MV over a period of 13-month with a VAP rate of 17.09/1000 days on MV. The mortality among VAP patients in our ICU was 50% in comparison to overall mortality of 48.91% in all mechanically ventilated patients.

Key words: Incidence, Intensive care unit, Mechanical ventilation, Mortality, Ventilator associated pneumonia

INTRODUCTION

Ventilator-associated pneumonia (VAP) is defined as pneumonia occurring more than 48 h after patients have been intubated and received mechanical ventilation (MV). However, the appropriate definition of VAP is subjective as significant variability among observers is noted.[1,2] VAP is classified as early- and late-onset disease occurring during the first 4 days or beyond 4 days of patient admission. Pneumonia is the second most common nosocomial infection in critically ill patients, affecting 27% of all critically ill patients.[3] 86% of nosocomial pneumonia are associated with MV and are termed VAP. VAP typically affects critically ill persons that are in an intensive care unit (ICU).[4] Persons with VAP have increased lengths of ICU hospitalization and have up to a 20-30% death rate.[5] The mortality attributable to VAP has been reported to range between 0% and 50% in various studies.[6-10] As shown by Hunter, VAP occurs in 9-27% of mechanically ventilated patients, with about five cases per 1000 ventilator days.[11] The condition is associated with increased ICU and hospital stay and has an estimated attributable mortality of 9%.[11] According to Chastre and Fagon, despite major advances in techniques for the management of ventilator-dependent patients and the routine use of effective procedures to disinfect respiratory equipment, VAP continues to

Access this article online

www.ijss-sn.com

Month of Submission : 11-2016
Month of Peer Review : 12-2016
Month of Acceptance : 12-2016
Month of Publishing : 01-2017

Corresponding Author: Dr. Muzaffar Maqbool, Department of Medicine, GMC Srinagar, Jammu and Kashmir, India. Phone: +91-9419076927. E-mail: rather.maqbool@gmail.com

complicate the course of 8-28% of the patients receiving MV.[12] Rates of pneumonia are considerably higher among patients hospitalized in ICUs compared with those in hospital wards, and the risk of pneumonia is increased 3- to 10-fold for the intubated patient receiving MV.[12] The chance of getting VAP has been described as 3% per day during the first week of MV, 2% per day during the second week and 1% per day in the ensuing weeks.[13] VAP occurrence is also increased with prolonged length of ICU stay.[14,15] A method to reduce the risk of VAP is to extubate patients as soon as possible as various randomized, and observational studies have shown that the risk of developing VAP increases with the duration of an endotracheal tube remaining in place.[16] The use of appropriate weaning protocols and the regular assessment of sedation requirements are effective in reducing the duration of MV and hence the incidence of VAP.[17-20] VAP must be suspected clinically in an ICU setting, and quick assessment must be done for its diagnosis as the delay can increase both morbidity and mortality among such patients. Delays in the administration of appropriate antibiotic therapy for VAP have been associated with excess mortality.[21-23] In one study, a delay in appropriate therapy for 24 h or more was associated with a 69.7% mortality, compared to 28.4% in patients treated without the delay ($P < 0.001$).[22] Hence, a prompt decision needs to be taken, and antibiotics must be started empirically, which can later be changed as directed by the culture and sensitivity reports. According to Luna *et al*., mortality rates vary with patient population and infecting organism, mortality increasing when the infecting organism is multidrug resistant.[24] The probability for multi-drug resistant pathogens is higher in the subset of patients including those recently hospitalized in acute care facility (<90 days), residents in a nursing home or long-term care facility; recipients of recent intravenous antibiotic therapy, chemotherapy, or wound care within the last 30 days of the current infection; or who have attended a hospital or hemodialysis clinic.[25] Starting appropriate antibiotics is a simple and effective way to improve clinical outcomes while minimizing side effects and maintaining quality of care.[26,27] Above all, education of health-care personnel is important and is widely viewed as a fundamental step in reducing the occurrence of VAP.[25,28]

METHODS

A prospective observational study of admitted patients was conducted in our medical ICU over a period of 14-month from October 2014 to December 2015 to see the pattern of pneumonia among ventilated patients. Besides routine investigations, we did the tracheal aspirate cultures with sensitivity in these patients. The progressive monitoring of chest radiographs was also performed. VAP was diagnosed according to clinical pulmonary infection score (CPIS) scoring system where a score > or = 6 was taken as significant. The calculation of CPIS is shown in Table 1.

Statistical Analysis

Data were analyzed using EpiInfo 7.0. Relationship between two categorical variables was analyzed using Chi-square test. Two-sided *P*-values were reported and a $P < 0.05$ was considered statistically significant.

RESULTS

The study showed that among a total of 178 patients admitted in the ICU, 92 (51.68%) were managed with invasive MV. Out of these 92 patients, 12 (13.04%) developed VAP as per CPIS scoring system with a VAP rate of 17.09/1000 days on MV. Out of 12 patients, 6 died, revealing 50% mortality among VAP patients. The results obtained are tabulated in Table 2.

A total number of patients admitted to the ICU were 178 out of whom 92 (51.68%) were put on invasive MV. Out of the admitted patients, 100 were males and 78 were females. 44 male patients and 48 females were put on MV. VAP

Table 1: CPIS calculation

Parameters	Points
Temperature, °C	
≥36.1 and ≤38.4	0
≥38.5 and ≤38.9	1
≥39.0 and ≤36.0	2
Blood leukocytes, mm^3	
≥4,000 and ≤11,000	0
<4,000 or >11,000	1
+Band forms ≥50%	Add 1
Tracheal secretions	
Absence of tracheal secretions	0
Presence of non-purulent tracheal secretions	1
Presence of purulent tracheal secretions	2
Oxygenation: PaO_2/FiO_2, mmHg	
>240 or ARDS (defined as PaO_2/FiO_2≤200, PCWP ≤18, and acute bilateral infiltrates)	0
≤240 and no ARDS	2
Pulmonary radiography	
No infiltrate	0
Diffuse (or patchy) infiltrate	1
Localized infiltrate	2
Progression of pulmonary infiltrate	
No radiographic progression	0
Radiographic progression (after CHF and ARDS excluded)	2
Culture of tracheal aspirate	
Pathogenic bacteria cultured in rare or light quantity or no growth	0
Pathogenic bacteria cultured in moderate or heavy quantity	1
+Same bacteria seen on Gram-stain	Add 1
Total score	

Reference: Am J Respir Crit Care Med 2000;162:505-11. ARDS: Acute respiratory distress syndrome, CHF: Congestive heart failure, PaO_2/FiO_2: Ratio of arterial oxygen pressure to fraction of inspired oxygen, PCWP: Pulmonary capillary wedge pressure

developed in 6 out of 44 males and in 6 out of 48 females. Tracheal aspirates were taken in the 12 patients who developed VAP. Out of these 12, 7 aspirates were positive, of which 5 grew *Acinetobacter* species, 1 was positive for *Pseudomonas aeruginosa* and other for *Klebsiella*. The sensitivity patterns showed maximum sensitivity for colistin and amikacin. 4 males and 2 females with VAP died. Thus, a total of 12 out of 92 ventilated patients developed VAP and 6 died. VAP was seen in patients who were on MV for at least 1 week.

DISCUSSION

This study showed that among patients admitted in the ICU, 51.68% were managed with invasive MV. Out of these, 13.04% developed VAP with a VAP rate of 17.09/1000 MV days, and 50% was the mortality among VAP patients.

The duration of MV affects the occurrence of VAP. As per the study by Cook in 2000, VAP occurs most often in the first week of MV.[5] Fagon *et al*. suggested that the incidence of VAP increases by 1% per day of IMV.[29] However, Cook *et al*., in 1998, found that the incidence per day varies over time, with 3% per day during first 5 days of IMV, 2% for the second 5 days, and 1% for the subsequent 5-day period.[30] This observation is supported by Ibrahim *et al*., who identified an incidence rate of VAP of 11.5%, 56% of which were early onset (≤5 day).[31] Hence, the greatest attack rates appear to be during the initial days of MV. In addition, significant risk factors for early-onset VAP include cardiopulmonary resuscitation and continuous sedation.[32] In our study, VAP was seen in patients who were on MV for at least 1 week, and VAP occurrence showed an increasing trend with the increase in duration of ventilation (Table 3). There is some evidence for gender differences in the course of VAP: Men have been found to get VAP more often, but women are more likely to die after contracting VAP.[33] In our study, 44 male patients (out of 100) and 48 females (out of 78) were put on MV. VAP developed in 6 out of 44 males and in 6 out of 48 females. 4 males and 2 females with VAP died (Table 4).

In summary, all possible steps should be taken to decrease the incidence of VAP in ICUs. Clinicians must focus on eliminating or minimizing the incidence of VAP through preventive techniques. The focus should be addressing modifiable risk factors.[34-39] Zack *et al*. have demonstrated that a multifaceted and multidisciplinary approach to VAP prevention can indeed reduce the incidence.[40]

CONCLUSION

In our ICU setup, VAP occurred in 13.04% of mechanically ventilated patients admitted over a period of 14-month with a VAP rate of 17.09/1000 days on MV. The mortality among VAP patients in our ICU was 50%. VAP was seen in patients who were on MV for at least 1 week and VAP occurrence showed an increasing trend with the increase in duration of ventilation. More males developed and died from VAP as compared to females. Keeping into consideration the burden of increased morbidity, lengthening of ICU stay and increased mortality due to VAP, We recommend that appropriate measures ensuring application of VAP bundle, hand hygiene, and proper suctioning methods be employed to reduce the prevalence of VAP in ICU.

Table 2: Gender distribution of VAP among admitted ICU patients

Gender	Number of cases	VAP	Percentage of VAP	*P*-value
Male	100	6	6.00	0.655
Female	78	6	7.69	
Total	178	12	6.74	

VAP: Ventilator-associated pneumonia, ICU: Intensive care units

Table 3: Distribution of VAP cases as per the duration of ventilation

Days on ventilator	Number of cases	VAP	Percentage	*P*-value
<15	83	7	8.43	<0.001
>15	9	5	55.55	
Total	92	12		

VAP: Ventilator-associated pneumonia

Table 4: Outcome of VAP versus non-VAP among ventilated patients

Outcome	Total VAP	Non-VAP	*P*-value
Expired	6	38	0.872
Survived	6	42	
Total	12	80	

VAP: Ventilator-associated pneumonia

REFERENCES

1. Schurink CA, Van Nieuwenhoven CA, Jacobs JA, Rozenberg-Arska M, Joore HC, Buskens E, *et al*. Clinical pulmonary infection score for ventilator-associated pneumonia: Accuracy and inter-observer variability. Intensive Care Med 2004;30:217-24.
2. Klompas M, Platt R. Ventilator-associated pneumonia – The wrong quality measure for benchmarking. Ann Intern Med 2007;147:803-5.
3. Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial infections in medical intensive care units in the United States. National nosocomial infections surveillance system. Crit Care Med 1999;27:887-92.
4. Michetti CP, Fakhry SM, Ferguson PL, Cook A, Moore FO, Gross R; AAST Ventilator-Associated Pneumonia Investigators. Ventilator-associated pneumonia rates at major trauma centers compared with a national benchmark: A multi-institutional study of the AAST. J Trauma Acute Care Surg 2012;72:1165-73.
5. Cook D. Ventilator associated pneumonia: Perspectives on the burden of illness. Intensive Care Med 2000;26 Suppl 1:S31-7.
6. Baker AM, Meredith JW, Haponik EF. Pneumonia in intubated trauma

patients. microbiology and outcomes. Am J Respir Crit Care Med 1996;153:343-9.
7. Craig CP, Connelly S. Effect of intensive care unit nosocomial pneumonia on duration of stay and mortality. Am J Infect Control 1984;12:233-8.
8. Cunnion KM, Weber DJ, Broadhead WE, Hanson LC, Pieper CF, Rutala WA. Risk factors for nosocomial pneumonia: Comparing adult critical-care populations. Am J Respir Crit Care Med 1996;153:158-62.
9. Kappstein I, Schulgen G, Beyer U, Geiger K, Schumacher M, Daschner FD. Prolongation of hospital stay and extra costs due to ventilator-associated pneumonia in an intensive care unit. Eur J Clin Microbiol Infect Dis 1992;11:504-8.
10. Papazian L, Bregeon F, Thirion X, Gregoire R, Saux P, Denis JP, *et al.* Effect of ventilator-associated pneumonia on mortality and morbidity. Am J Respir Crit Care Med 1996;154:91-7.
11. Hunter JD. Ventilator associated pneumonia. BMJ 2012;344:e3325.
12. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med 2002;165:867-903.
13. Cook DJ, Kollef MH. Risk factors for ICU-acquired pneumonia. JAMA 1998;279:1605-6.
14. Bercault N, Boulain T. Mortality rate attributable to ventilator-associated nosocomial pneumonia in an adult intensive care unit: A prospective case-control study. Crit Care Med 2001;29:2303-9.
15. Heyland DK, Cook DJ, Griffith L, Keenan SP, Brun-Buisson C. The attributable morbidity and mortality of ventilator-associated pneumonia in the critically ill patient. The Canadian critical trials group. Am J Respir Crit Care Med 1999;159:1249-56.
16. Cook D, De Jonghe B, Brochard L, Brun-Buisson C. Influence of airway management on ventilator-associated pneumonia: Evidence from randomized trials. JAMA 1998;279:781-7.
17. Kollef MH, Shapiro SD, Silver P, St. John RE, Prentice D, Sauer S, *et al*. A randomised, controlled trial of protocol directed versus physician-directed weaning from mechanical ventilation. Crit Care Med 1997;25:567-74.
18. Marelich GP, Murin S, Battistella F, Inciardi J, Vierra T, Roby M. Protocol weaning of mechanical ventilation in medical and surgical patients by respiratory care practitioners and nurses: Effect on weaning time and incidence of ventilator-associated pneumonia. Chest 2000;118:459-67.
19. Brook AD, Ahrens TS, Schaiff R, Prentice D, Sherman G, Shannon W, *et al.* Effect of a nursing-implemented sedation protocol on the duration of mechanical ventilation. Crit Care Med 1999;27:2609-15.
20. Quenot JP, Ladoire S, Devoucoux F, Doise JM, Cailliod R, Cunin N, *et al.* Effect of a nurse-implemented sedation protocol on the incidence of ventilator-associated pneumonia. Crit Care Med 2007;35:2031-6.
21. Alvarez-Lerma F. Modification of empiric antibiotic treatment in patients with pneumonia acquired in the intensive care unit. ICU-acquired pneumonia study group. Intensive Care Med 1996;22:387-94.
22. Iregui M, Ward S, Sherman G, Fraser VJ, Kollef MH. Clinical importance of delays in the initiation of appropriate antibiotic treatment for ventilator-associated pneumonia. Chest 2002;122:262-8.
23. Luna CM, Vujacich P, Niederman MS, Vay C, Gherardi C, Matera J, *et al.* Impact of BAL data on the therapy and outcome of ventilator-associated pneumonia. Chest 1997;111:676-85.
24. Luna CM, Blanzaco D, Niederman MS, Matarucco W, Baredes NC, Desmery P, *et al.* Resolution of ventilator-associated pneumonia: Prospective evaluation of the clinical pulmonary infection score as an early clinical predictor of outcome. Crit Care Med 2003;31:676-82.
25. 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.
26. Rello J, Lipman J Antibiotic prescription for respiratory tract infections in ventilated patients: Where are we heading? Intensive Care Med 2013;39:1644-6.
27. Rello J. Antibiotic stewardship in hospital-acquired pneumonia. Chest 2013;143:1195-6.
28. Coffin SE, Klompas M, Classen D, Arias KM, Podgorny K, Anderson DJ, *et al.* Strategies to prevent ventilator-associated pneumonia in acute care hospitals. Infect Control Hosp Epidemiol 2008;29 Suppl 1:S31-40.
29. Fagon JY, Chastre J, Domart Y, Trouillet JL, Pierre J, Darne C, *et al.* Nosocomial pneumonia in patients receiving continuous mechanical ventilation. Prospective analysis of 52 episodes with use of a protected specimen brush and quantitative culture techniques. Am Rev Respir Dis 1989;139:877-84.
30. Cook DJ, Walter SD, Cook RJ, Griffith LE, Guyatt GH, Leasa D, *et al.* Incidence of and risk factors for ventilator-associated pneumonia in critically ill patients. Ann Intern Med 1998;129:433-40.
31. Ibrahim EH, Ward S, Sherman G, Kollef MH. A comparative analysis of patients with early-onset vs late-onset nosocomial pneumonia in the ICU setting. Chest 2000;117:1434-42.
32. Rello J, Paiva JA, Baraibar J, Barcenilla F, Bodi M, Castander D, *et al.* International conference for the development of consensus on the diagnosis and treatment of ventilator-associated pneumonia. Chest 2001;120:955-70.
33. Sharpe JP, Magnotti LJ, Weinberg JA, Brocker JA, Schroeppel TJ, Zarzaur BL, *et al.* Gender disparity in ventilator-associated pneumonia following trauma: Identifying risk factors for mortality. J Trauma Acute Care Surg 2014;77:161-5.
34. Bryan CS, Reynolds KL. Bacteremic nosocomial pneumonia. Analysis of 172 episodes from a single metropolitan area. Am Rev Respir Dis 1984;129:668-71.
35. Craven DE, Kunches LM, Kilinsky V, Lichtenberg DA, Make BJ, McCabe WR. Risk factors for pneumonia and fatality in patients receiving continuous mechanical ventilation. Am Rev Respir Dis 1986;133:792-6.
36. Koerner RJ. Contribution of endotracheal tubes to the pathogenesis of ventilator-associated pneumonia. J Hosp Infect 1997;35:83-9.
37. Kollef MH. Ventilator-associated pneumonia. A multivariate analysis. JAMA 1993;270:1965-70.
38. Niederman MS, Craven DE, Fein AM, Schultz DE. Pneumonia in the critically ill hospitalized patient. Chest 1990;97:170-81.
39. Sutherland KR, Steinberg KP, Maunder RJ, Milberg JA, Allen DL, Hudson LD. Pulmonary infection during the acute respiratory distress syndrome. Am J Respir Crit Care Med 1995;152:550-6.
40. Zack JE, Garrison T, Trovillion E, Clinkscale D, Coopersmith CM, Fraser VJ, *et al.* Effect of an education program aimed at reducing the occurrence of ventilator-associated pneumonia. Crit Care Med 2002;30:2407-12.

How to cite this article: Maqbool M, Shabir A, Naqash H, Amin A, Koul RK, Shah PA. Ventilator Associated Pneumonia-Incidence and Outcome in Adults in Medical Intensive Care Unit of a Tertiary Care Hospital of North India. Int J Sci Stud 2017;4(10):73-76.

Source of Support: Nil, **Conflict of Interest:** None declared.