International Journal of Advances in Medicine
Dube M et al. Int J Adv Med. 2018 Apr;5(2):442-445
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20181086

Original Research Article

Pattern and incidence of ventilator associated pneumonia among mechanically ventilated patients

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Received: 02 February 2018
Accepted: 07 March 2018

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ABSTRACT

Background: Initial empirical therapy of ventilator-associated pneumonia (VAP), which is based on organisms recovered, can be modified based on the knowledge of local microbiological data, patient characteristics, and sensitivity pattern of expected pathogens at the institution. Aim of this study was conducted to observe the regional the incidence of VAP among mechanically ventilated patients.
Methods: All the patients who conformed to the inclusion criteria of the study, and who were in the ICU settings and put on ventilatory support, underwent vigorous aseptic precautions and later on developed VAP were taken into the study.
Results: Total 374 admitted patients were needed mechanically ventilation. Among 31 developed LRTI. The Overall incidence rate of VAP was computed to be 8.2% with highest rate among patients of age group 31-50 years. The incidence rates of VAP were found highest for Acinetobacter (54.8%) with second highest mortality (47%) whereas maximum mortality (66.66%) was caused by Klebsiella, the second most common incidence of VAP. Twenty-one patients developed early VAP whereas remaining 10 subjects developed late VAP. Mortality was higher between early VAP (57.14%) compared to the late VAP cases (30%). Majority of organisms were sensitive to Cefoperazone + Sulbactum (29), Imipenem (24) and Meropenem (22).
Conclusions: Despite advances in diagnostic and treatment modalities of VAP, its management still continues to be a challenge for clinicians. The findings emerging out of this investigation will help in initial selection of antibiotics for the empiric treatment of VAP. Later on, therapy can be modified based on the knowledge of pattern and profile of VAP patients along with sensitivity pattern of expected pathogens.

Keywords: Intensive care unit, Mechanical ventilation, Ventilator-associated pneumonia

INTRODUCTION

Pneumonia is the second most common nosocomial infection in critically ill patients, affecting 27% of all critically ill patients. Eighty-six percent of nosocomial pneumonias are associated with mechanical ventilation and are termed ventilator-associated pneumonia (VAP).[1] VAP refers to bacterial pneumonia developed in patients who have been mechanically ventilated for a duration of more than 48 h.[2] It ranges from 6 to 52% and can reach 76% in some specific settings.[3] Lack of a gold standard for diagnosis is the major culprit of poor outcome of VAP.

The incidence of VAP varies among different studies, depending on the definition, the type of hospital or ICU, the population studied, and the level of antibiotic exposure.[4] Knowledge of the incidence of VAP and their associated risk factors are imperative for development and use of more effective preventive measures. While critically ill patients experience a life-threatening illness, they commonly contract VAP. This nosocomial infection increases morbidity and likely mortality as well as the cost of health care. Aggressive surveillance is vital in understanding local factors leading to VAP and the microbiologic milieu of a given unit.[5]

Organisms recovered have an impact on outcome, with higher mortality rates seen in VAP. Judicious antibiotic usage is essential, as resistant organisms continue to plague intensive care units and critically ill patients. The initial empirical therapy can be modified based on the knowledge of local microbiological data, patient characteristics, and sensitivity pattern of expected pathogens at the institution.[6] Considerable controversy still surrounds treatment for patients with VAP, which depends on organisms recovered. Therefore, the present study was planned to analyse and ascertain the incidence of ventilator-associated pneumonia among mechanically ventilated patients from Northern India.

METHODS

In this present study, author did a study on 31 patients of the 374 patients who were admitted in the respiratory care unit and the intensive care unit of a tertiary care health centre from September 2005 to January 2008. The subjects consisted of a group of 374 patients who presented with acute respiratory failure due to a variety of causes (head injury, poisoning, Guillain Barre syndrome, chronic obstructive airway disease, tetanus, etc.) and required mechanical ventilation for >48 hours.

Exclusion criteria were any patient who either developed lower respiratory tract infection (LRTI) within 48 hours or had preexisting LRTI was excluded from the study. All enrolled patients were then closely monitored till their death or discharge from the ICU. The patients were followed-up with repeated arterial blood gas analysis (ABG), total leucocyte count (TLC), chest radiographs when appropriate and pulse oximetry. The VELA Lung ventilator was used in this study.

All the patients who conformed with the inclusion criteria of the study, and who were in the ICU settings and put on ventilatory support, underwent vigorous aseptic precautions and later on developed ventilator associated *Pneumonia* (VAP) were taken into the study. To confirm the diagnosis, the serial X-rays and ET cultures and other tests were done. Post empirical therapy, they were put on antibiotics according to ET culture and sensitivity report. Quantitative culture / sensitive of endotracheal secretions were done.

The study adhered to the tenets of the declaration of Helsinki for research in humans. Informed consent was obtained from study subjects after discussing advantages and risks. Permission of institutional ethics committee (IEC) was sought before the commencement of the study. This prospective study entailed very little danger to the patient and would result in improvement of therapy.

As the patients have opted by choice for treatment in the hospital, no additional burden is being put on the patients for this study and neither the hospital shall bear any additional expense. This study is being conducted in the institute and is not being funded by any agency. After compilation of the collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 20 (IBM, Chicago, USA). The results were expressed using appropriate statistical methods. One-way ANOVA, Fisher's exact and Student t-test were used to test level of significance. A two-tailed $p < 0.05$ was considered statistically significant.

RESULTS

Three hundred and seventy-four patients were admitted in the respiratory care unit and the intensive care unit that needed mechanically ventilation. Thirty-one patients who had been mechanically ventilated for a period of average 12.9 days with a mean age of 49.5 years with male: female ratio of 1.06:1. The incidence rate of LRTI was computed to be 8.2%. The incidence of VAP was found highest among patients of age group 31-50 years followed by 51-70 years (Table 1).

Table 1: Age Group wise incidence of VAP.

Age group	No. of patients developing vap
10-30 years	5
31-50 years	13
51-70 years	9
71-90 years	4

Twenty-one patients developed early VAP whereas remaining 10 subjects developed late VAP. Mortality was higher between early VAP (57.14%) compared to the late VAP cases (30%) (Table 2).

Table 2: Mortality among early and late VAP.

VAP ststus	Survivors	Non-survivors	Percentage
Early VAP	9	12	67.75
Late VAP	7	3	32.25

The comparative mortality and survival rate along with incidence of different infectious organisms was also analyzed. The incidence rates of VAP were found highest for Acinetobacter (54.8%) with second highest mortality (47%) whereas maximum mortality (66.66%) was caused by Klebsiella, the second most common incidence of VAP (Table 3).

Table 3: Organism wise distribution of VAP.

Organism	Survivors	Non-survivors	Total	Incidence rate (%)
Klebsiella	3 (33.33%)	6 (66.66%)	9	29.0
Acinetobacter	9 (53%)	8 (47%)	17	54.8
Pseudomonas	3 (66.66%)	2 (33%)	5	16.12
Staph. aureus	1 (100%)	-	1	3.20
Citrobacter	-	2 (100%)	2	6.40
Candida	-	1 (100%)	1	3.20
Streptococcus	1 (100%)	-	1	3.20
E. coli	1 (100%)	-	1	3.20

Majority of organisms were sensitive to Cefoperazone + Sulbactum (29), Imipenem (24) and Meropenem (22) and hence empirically they were started for the treatment of ventilator associated pneumonia (Table 4).

Table 4: Antibiotic Sensitivity in VAP patients.

Antibiotic	No. of patients found sensitive
Cefoperazone + sulbactum	29
Imipenem	24
Meropenem	22
Chloramphenicol	07
Netilmycin	04
Piperacillin + Tazobactum	03
Amikacin	03
Linezolid	02
Cotrimoxazole	02
Ciprofloxacin	01
Cefpirome	01
Vancomycin	01
Cefotaxim	01
Ampicillin	01
Tobramycin	01

DISCUSSION

Three hundred and seventy-four admitted patients were mechanically ventilated. Thirty-one patients who had been mechanically ventilated for a period of average 12.9 days developed LRTI. In this study, the Overall incidence rate of VAP was computed to be 8.2%. This correlates with other similar studies in which the incidence of VAP was 15.5-47%, depending on the diagnostic criteria used.[7,8] On the other hand, in other Asian countries like Thailand and Japan, the incidence rate is relatively less, ranging from 9 to 12 per 1,000 ventilator days.[9,10]

Of the 31 patients who developed LRTI during ventilation; twenty-one (67.75%) developed early VAP (within 3 days 96 hours) and remaining 10 patients (32.25%) developed late VAP (>3 days, >96 hours). This temporal profile of development of LRTI is consistent with the findings of Cook et al. Cook et al in their study of incidence of risk factors for ventilator associated pneumonia arrived at a rate of incidence of pneumonia of 3% per day in the first week of mechanical ventilation.[11] The result of this study is in agreement with previous studies they observed early-onset VAP in almost half of all VAP episodes.[12] Mortality was higher between early VAP (57.14%) compared to the late VAP cases (30%). the exhaustion of most vulnerable patients during the first few weeks leads to the decline in the occurrence of VAP in later days as observed in Athens.[13]

Acinetobacter (54.8%) followed by *Klebsiella* (29%) were two dominant pathogens isolated from VAP patients in this study. Although this may be in contrary to other studies but considering that *Enterobacteriaceae* are mostly isolated from urinary sources of infections, our results are not far from others. *Acinetobacter* indeed has a wonderful ability to grow in various inserted catheters in patients in ICU particularly endotracheal tube.[14] Josef et al showed that *Enterobacteriaceae, Haemophilus influenzae, Staphylococcus aureus, Streptococcus pneumoniae*, and *Candida* were more common in early-onset VAP, while non-fermenters (*Pseudomonas* and *Acinetobacter*) were significantly associated with late-onset VAP.[15]

However, in this study we showed that Acinetobacter could truly be a major determinant of VAP mortality in patients under ventilator. This is not in contrast to previous reports that actually mentioned the ability of Acinetobacter to colonize inside ventilators in ICU.[16] In the study by Celis R, high risk microorganism was found to be *Pseudomonas, Enterobacter*, gram negative bacilli, *Streptococcus fecalis, Staphylococcus aureus, Candida.*[17] Another study from northern India observed that the 2 most common organism isolated were *Pseudomonas aeruginosa* and *Methicillin-resistant Staphylococcus aureus* (MRSA).[4] Considerable controversy still surrounds treatment (monotherapy or combination) for patients with VAP, which depends on organisms recovered. The primary reasons for combination therapy are to prevent the development of resistance, improve outcomes, provide synergy, and provide sufficient antibiotic coverage should the pathogen be resistant to the agent that would have been chosen as single therapy. The former two arguments, while logical, have yet to be proven.[18] In this study, majority of the organisms found

to be causing VAP, were found to be sensitive for cefoperazone + sulbactum (93.54%), followed by imipenem (77.42%) and meropenem (71%).

This study has several strengths. Author studied pattern and incidence of VAP among mechanically ventilated patients, an underexplored entity. No such study has been reported from the state of Madhya Pradesh till date. It will add to existing literature. This study also generated local epidemiological data, which will help in initial selection of antibiotics for the empiric treatment of VAP. Regarding limitations of this study, this study is failing in identifying the risk factors of VAP properly. Small sample size is another constraint of this study. Findings emerging out of this study may not be generalized as a single centre study limits the generalizability of the findings to other regions of the country. More studies with bigger sample size are warranted.

CONCLUSION

Despite advances in diagnostic and treatment modalities of VAP, its management still continues to be a challenge for clinicians. The findings emerging out of this investigation will help in initial selection of antibiotics for the empiric treatment of VAP. Further therapy can be modified based on the knowledge of pattern and profile of VAP patients along with sensitivity pattern of expected pathogens. Local epidemiological data thus generated can be used to plan and modulate the potential intervention measures while managing VAP.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Koenig SM, Truwit JD. Ventilator-Associated Pneumonia: Diagnosis, Treatment, and Prevention. Clin Microbiol Rev. 2006;19(4):637-57.
2. Davis KA. Ventilator-associated pneumonia: a review. J Intensive Care Med. 2006;21:211-26.
3. Koenig SM, Truwit JD. Ventilator-associated pneumonia: diagnosis, treatment, and prevention. Clin Microbiol Rev. 2006;19:637-57.
4. Masih SM, Goel S, Singh A, Tank R, Khichi SK, Singh S. Incidence and risk factors associated with development of ventilator- associated pneumonia from a tertiary care center of northern India. Int J Res Med Sci. 2016;4:1692-7.
5. Niederman MS, Craven DE. 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.
6. Chastre J, Combes A, Luyt CE. The invasive (quantitative) diagnosis of ventilator-associated pneumonia. Respir Care. 2005;50:797-812.
7. Rakshit P, Nagar VS, Deshpande AK. Incidence, clinical outcome, and risk stratification of ventilator-associated pneumonia-a prospective cohort study. Indian J Crit Care Med. 2005;9:211-6.
8. Panwar R, Vidya SN, Alka KD. Incidence, clinical outcome and risk stratification of ventilator- associated pneumonia: a prospective cohort study. Indian J Crit Care Med. 2005;9:211-6.
9. Suka M, Yoshida K, Uno H, Takezawa J. Incidence and outcomes of ventilator-associated pneumonia in Japanese intensive care units: the Japanese nosocomial infection surveillance system. Infect Control Hosp Epidemiol. 2007;28:307-13.
10. Thongpiyapoom S, Narong MN, Suwalak N, Jamulitrat S, Intaraksa P, Boonrat J, et al. Device-associated infections and patterns of antimicrobial resistance in a medical- surgical intensive care unit in a university hospital in Thailand. J Med Assoc Thai. 2004;87:819-24.
11. Cook D, Walter S, Cook R, Griffith L, Guyatt G, Leasa D, et al. Incidence and risk factors for ventilator associated pneumonia in critically ill patients. Ann Int Med. 1998;129:433-40.
12. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med. 2002;165:867-903.
13. Apostolopoulou E, Bakakos P, Katostaras T, Gregorakos L. Incidence and risk factors for ventilator-associated pneumonia in 4 multidisciplinary intensive care units in Athens, Greece. Respir Care. 2003;48:681-8.
14. Coppadoro A, Berra L, Bigatello LM. Modifying endotracheal tubes to prevent ventilator-associated pneumonia. Curr Opin Infect Dis. 2011;24(2):157-62.
15. Joseph NM, Sistla S, Dutta TK, Badhe AS, Rasitha D, Parija SC. Ventilator-associated pneumonia in a tertiary care hospital in India: role of multi-drug resistant pathogens. J Infect Dev Ctries. 2010;4(4):218-25.
16. Villegas MV, Hartstein AI. Acinetobacter outbreaks, 1977-2000. Infect Control Hosp Epidemiol. 2003;24: 284-90.
17. Celis R, Torres A, Gatell JM, Almela M, Rodriguez RR, Vidal AA. Nosocomial pneumonia. A multivariate analysis of risk and prognosis. Chest. 1988;93:318-24.
18. Cometta A, Baumgartner JD, Lew D, Zimmerli W, Pittet D, Chopart P, et al. Prospective randomized comparison of imipenem monotherapy with imipenem plus netilmicin for treatment of severe infections in nonneutropenic patients. Antimicrob Agents Chemother. 1994;38:1309-13.

Cite this article as: Dube M, Goswami S, Singh A, Raju BM, Dube P, Bhatia GC. Pattern and incidence of ventilator associated pneumonia among mechanically ventilated patients. Int J Adv Med 2018;5:442-5.