



Microbiological Profile of Ventilator Associated Pneumonia Cases in a Tertiary Care Hospital, in Dehradun India

KEYWORDS

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ABSTRACT

Background Ventilator-associated pneumonia (VAP) is a leading cause of death in hospitalized patients, but there has been no systematic analysis of the incidence, microbiology, and outcome of VAP in developing countries.

Methods The aim of the study is to critically review the incidence and outcome, identify various risk factors and conclude specific measures that should be undertaken to prevent VAP. We studied 40 patients randomly, kept on ventilator support for more than 48 hours. After excluding those who developed pneumonia within 48 hours, VAP was diagnosed when a clinical pulmonary infection score of \geq six was obtained. Endotracheal aspirates (ETA) were collected from patients with suspected VAP.

Findings In this study, incidence of VAP was found to be 70% of which 50% were polymicrobial. Multidrug resistant bacteria, mainly *Acinetobacter baumannii*, and *Pseudomonas aeruginosa* were the most common pathogens isolated. While *Klebsiella pneumoniae* has emerged as the most resistant strain showing sensitivity only to polymyxin B of the drugs tested.

Interpretation The observations of this study indicate that occurrence of VAP in patients on mechanical ventilation with no other predisposing factors is still a major concern in developing countries. Repeated monitoring of the endotracheal aspirates for early diagnosis, and its antibiogram will guide for an approach to targeted treatment. Thus assist in tackling the serious problem of MDR faced in ICU environment.

Introduction

The care of critically ill patients in intensive care unit is a primary component of modern medicine. Intensive care units create potential for recovery in patients who otherwise may not have survived. However, they are associated with problem of Nosocomial Infections (NI). Nosocomial infections are those which manifest in patients 48 hours after admission to hospital. Nosocomial infections are directly related to diagnostic, interventional or therapeutic procedures a patient undergoes in hospital and are also influenced by the bacteriological flora prevailing within a particular unit or hospital.

Ventilator-Associated Pneumonia (VAP) is generally defined as a nosocomial pneumonia which develops in patients who have received mechanical ventilation (MV), either by endotracheal intubation or tracheostomy, for greater than 48 hours.¹⁻²

The mortality with VAP is considerably high, varying from 24-50% and can reach as high as 76% in some specific settings or when lung infection is caused by high risk pathogens.²

Specific bacterial pathogens have provided new insight into the adaptability of these pathogens, with an emphasis on multidrug-resistant (MDR) bacterial pathogens, such as *Pseudomonas aeruginosa*, *Acinetobacter species*, and *Methicillin-resistant Staphylococcus aureus*.

In the absence of a gold standard, VAP is assumed to be

diagnosed more accurately by bronchoscopic sampling and microbiological cultures of the lower respiratory tract. Bronchoscopy, being invasive, at times is found to be associated with complications, especially in patients on high respiratory supports. This has paved the way for less invasive tests such as taking endotracheal aspirates (ETA) and quantitative ETA cultures with a threshold of 10^5 to 10^6 bacteria per milliliter of exudates that is considered as optimal for the microbiological confirmation of VAP.³

With this background, this prospective study was conducted to assess the prevalence and microbiological profile of VAP in Surgical Intensive Care Unit of our hospital.

Method

This prospective study was conducted in the Department of Microbiology and Immunology, Shri Guru Ram Rai Institute of Medical & Health Sciences, Dehradun Uttarakhand, India from January 2013 to February 2014.

Study design and patients

Inclusion criteria

All previously healthy adult patients who had undergone neurosurgery and had no other apparent foci or sign of infection (trauma cases) were included in this study. These patients were electively transferred on mechanical ventilation for more than 48 hours.

Exclusion criteria

Paediatric population was excluded from the study. Subjects suffering from any other predisposing condition which

could be a source of infection were excluded from the study.

At the time of admission to the ICU all demographic details and relevant clinical data was collected in the Case Record Form. Consent was acquired from next of kin.

All endotracheal secretions were collected by using suction cannula attached to a mucus extractor. Approximately 2-5 ml of secretions was collected and sample was processed directly from the mucous extractor using all aseptic precautions. Sample was collected from subjects on 3rd and 5th day after starting of the MV.

The samples were processed according to standard protocol after Gram staining and assessed on the basis of Composite Quality Score for evidence of contamination with upper respiratory tract secretions.

Only the samples having the Composite Quality Score as Q3 were processed further and for the rest resampling was done.

This was followed by aerobic bacterial culture, identification of the isolates and antibiotic sensitivity of the isolates was carried out as per standard recommended methods.^{4,6}

Statistical analysis

The interpretation and analysis of the obtained results were carried out using standard statistical test of significance i.e., Chi square test and mean calculations.

Role of the funding source

The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

A total of 40 patients were studied and 28/40(70%) patients were diagnosed with VAP and 12/40(30%) patients without VAP. 11/40 (27.5%) were found in the age group of 31-40 years. 19/29(65.5%) of the total male population and 9/11 (81.8%) of the total female population were diagnosed with VAP. These observations were found to be statistically significant. (p value<0.001)

The early onset VAP was observed clinically in 7/40 (17.5%) cases. During the study period five patients who had no indications of VAP were extubated and one case of early onset VAP had to undergo tracheostomy after 48 hours hence could not be followed up at 96hrs, therefore excluded from the study. Therefore, 27/34 (79.41%) were diagnosed with late onset of VAP. Statistically this finding was highly significant (p value<0.001) (Table 1).

All the causative agents of early onset VAP were bacterial. Bacterial isolates dominated as the causative agent of late onset VAP 23/27(85.18%). Bacterial along with fungal agents were isolated in 3/27(11.11%) cases, while only 1/27(3.7%) case was attributed purely to fungal infection (Figure 1).

Predominantly *Acinetobacter baumannii* 7/17(41.2%) and *Pseudomonas aeruginosa* accounted for 3/17 (17.7%) cases of VAP. While 2/17 (11.8%) isolates were *Escherichia coli* and *Citrobacter freundii*. MRSA, *Klebsiella pneumoniae*, and *Candida albicans* accounted for 1/17 (5.9%) as sole patho-

gens responsible for causing VAP as mono-microbial infection (Table2).

On the contrary, there was predominance of *Escherichia coli* with *Pseudomonas aeruginosa*, and *Staphylococcus aureus* with *Escherichia coli* 4/17(23.5%) each as polymicrobial aetiologies in VAP cases. Multiple organisms such as *Staphylococcus aureus* with *Acinetobacter baumannii*, *Staphylococcus aureus* with *Klebsiella pneumoniae* and *Acinetobacter baumannii* with *Candida albicans* were observed in 2/17 (11.8%) cases each. While *Acinetobacter baumannii* with *Pseudomonas aeruginosa*, *Staphylococcus aureus* with *Citrobacter freundii*, and *Escherichia coli* with *Candida albicans* were observed in 1/17 (5.9%) cases each (Table 2).

It was also observed that MRSA strains showed resistance to all the drugs tested except vancomycin. On the other hand 3 MSSA strains showed 100% resistance to ampicillin, amoxicillin – clavulanate and ciprofloxacin (Figure 2).

Amongst the Gram negative bacterial isolates, *Klebsiella pneumoniae* has emerged as the most resistant strain showing sensitivity to polymyxin B only of the drugs tested. Polymyxin B has been found to be sensitive in all strains tested (Figure 3).

Discussion

Of the 40 patients studied a total of 28 patients fulfilled the clinical and microbiological criteria for diagnosis of VAP. The overall incidence of VAP in present study was 70%. This observation when analysed statistically, was found to be statistically highly significant (p value< 0.01). Higher incidence in the present study could be due to the stringent criteria for selection of cases and the method of specimen collection employed in the present study. In otherwise healthy but head injury cases, impaired consciousness, emergency intubation, reintubation, H2 blockers, supine head position, steroid usage, and use of naso-gastric tube may have been independent risk factors for development of VAP. Further studies are required to analyse these variables.

The incidence of VAP reported in studies conducted at various centres varies from 24% to 67%.^{7,8,9,10,11,12,13,14} This variation in the incidence of VAP as observed above is probably related to several factors, like differences in patient populations (medical, surgical vs combined ICUs), differences in infection control and critical care practices and variability in data collection methods as well as variability in the definition of VAP.

In the present study it was observed that 7/40 (17.5%) cases developed early onset VAP while 27/34(79.4%) developed late onset VAP (Table 1). The loss of six patients has been explained earlier. These observations when analysed were found statistically significant with a p value <0.001. The low incidence of early onset VAP can be attributed to use of broad spectrum antibiotics before admission to the ICU. Thus, changing the picture from early onset VAP to increasing the incidence of late onset VAP due to multi-drug resistant pathogens. This emphasizes a direct correlation between the duration of mechanical ventilation and development of VAP. Such findings have been observed by other workers also.^{12,13,15,16}

In this study, Gram negative bacilli dominated with 32/34 (94.12%) and predominance of enterobacteriaceae family was observed. The resistance patterns show that the

majority of the isolates from the ICU have significantly increased in vitro resistance against most of the antibiotics tested and were multi-drug resistant. Hence, steps must be taken to prevent the development and spread of the drug resistant strains. Alterations and rotation in antibiotic prescribing patterns might decline the development and acquisition of antibiotic resistance. Thus, the present study gives importance of knowing the pathogens and their antibacterial susceptibility pattern, prevalent in the particular ICU, to initiate the empirical antibacterial therapy for patients on mechanical ventilation. Although Polymyxin B is still effective against most resistant Gram-negative isolates and vancomycin is still holding the fort against Gram-positive organisms, caution should be observed against rampant use of these drugs.

Conclusion

Ventilator associated pneumonia (VAP) continues to be a major challenge to the critical care physicians. It is the leading cause of morbidity and mortality in intensive care units. Most of the risk factors of VAP are preventable and are increasingly associated with MDR pathogens. Aspiration of colonized pathogenic microorganisms on the oropharynx and gastrointestinal tract is the main route for the development of VAP. On the other hand, the major risk factors for VAP are intubation and the duration of mechanical ventilation. Diagnosis remains difficult and studies show the importance of early initiation of appropriate antibiotic for prognosis.

Current guidelines for the management of VAP strongly recommend the use of early, appropriate empirical antibiotic therapy based on patient risk factors for multidrug-resistant pathogens. An alternative model focused on Ventilator associated tracheobronchitis, using serial surveillance of endotracheal aspirate specimens to identify multidrug-resistant pathogens and their antibiotic susceptibilities, would allow earlier, targeted antibiotic treatment that could improve outcomes in patients, prevent VAP and provide an attractive model for clinical research trials.

The American Thoracic society endorses the initiation of a broad spectrum antibiotic and changing to a narrow spectrum after the sensitivity results are made available, will reduce inappropriate antibiotic use and subsequently the drug resistant pathogens.

Vigilance is required for patients admitted in the ICU and on mechanical ventilation. The endotracheal aspirate of patients on mechanical ventilation should be sent for routine culture and sensitivity.

VAP causes extra length of stay in hospital and intensive care units and increases hospital cost. Consequently, stringent infection control policies will go a long way in preventing VAP and reducing the economic burden on patients apart from reducing hospital stay.

Table 1: Distribution of early and late onset VAP cases

TIME OF ONSET	NUMBER OF VAP CASES	NUMBER OF NON-VAP CASES	TOTAL	
Early onset	7(17.5%)	33(82.5%)	40	=0.0051
Late onset	27(79.41%)	7(20.6%)	34*	<0.001

*by 5th day of the study 6 cases were excluded from the study due to tracheostomy, or extubation.

Table 2: Comparison of time of onset of VAP with the aetiology of VAP cases

ISOLATES	EARLY ONSET	p value	LATE ONSET	
Staphylococcus aureus	0	NA	1	0.32
Klebsiella pneumoniae	0	NA	1	0.32
Acinetobacter baumannii	3	0.07926	4	0.040653
Citrobacter freundii	0	NA	2	0.155939
Escherichia coli	2	0.155939	0	NA
Pseudomonas aeruginosa	0	NA	3	0.07926
Pseudomonas aeruginosa & Escherichia coli	0	NA	4	0.040653
Staphylococcus aureus & Klebsiella pneumoniae	2	0.155939	0	NA
Staphylococcus aureus & Acinetobacter baumannii	0	NA	2	0.155939
Escherichia coli & Staphylococcus aureus	0	0.32	4	0.040653
Acinetobacter baumannii & Pseudomonas aeruginosa	0	NA	1	0.32
Staphylococcus aureus & Citrobacter freundii	0	NA	1	0.32
Candida albicans	0	NA	1	0.32
Escherichia coli & Candida albicans	0	NA	1	0.32
Acinetobacter baumannii & Candida albicans	0	NA	2	0.155939
TOTAL	7	-	27	-

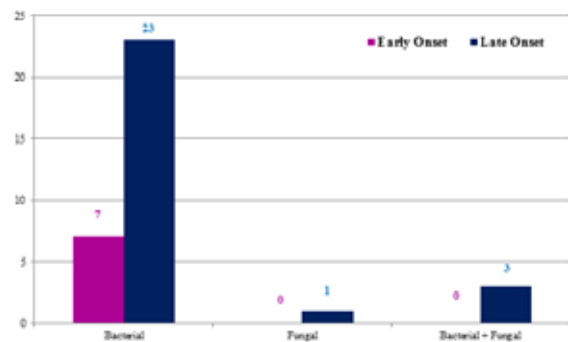


Figure 1: Organism wise Distribution of Early & Late Onset VAP

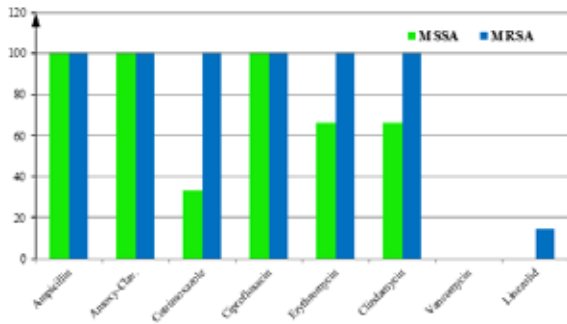


Figure 2: Resistance pattern (in percentage) of Gram positive bacterial isolates

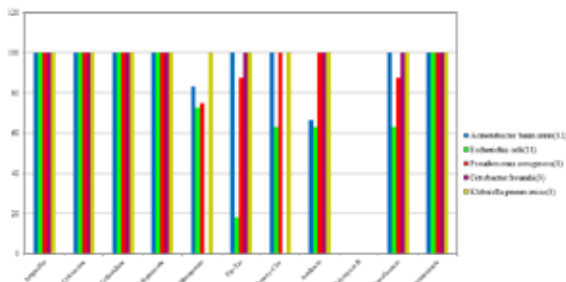


Figure 3: Resistance pattern of Gram negative isolates from cases of VAP

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