



Ventilator Associated Pneumonia in A Tertiary Care Hospital in South India

KEYWORDS

Ventilator-associated pneumonia, intensive care unit

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ABSTRACT Introduction

Ventilator-associated pneumonia (VAP) is one of the most common nosocomial infections in mechanically ventilated patients and causes a lot of morbidity and mortality. The aim of the study was to determine the bacterial causes of VAP in an intensive care unit (ICU) of a tertiary care hospital.

Materials and Methods

Endotracheal aspirates and bronchoalveolar lavage samples were collected from patients who were under mechanical ventilation for > 48 h in the ICU. Microscopy and culture were performed and the isolates were subjected to biochemical and antibiotic sensitivity tests.

Results

The incidence of VAP in our setting was found to be 42%. More patients (64.29%) were found to be in the late-onset VAP group (VAP after > 4 days of mechanical ventilation). Males (69.04%) were found to suffer more from VAP. Most of the bacterial isolates were found to be Gram negative bacilli (86.54%).

Conclusions

VAP is a potentially lethal condition in the ICU patients. A combination of clinical, microbiological and radiological factors will help to manage and prevent these cases.

Introduction

One of the most important nosocomial infections among the mechanically ventilated patients is ventilator associated pneumonia (VAP). Although the incidence of VAP is steadily decreasing in the developed countries, it continues to be a major worry of the critical care units in developing countries^[1]. The incidence of VAP in developing countries is 20 times of that in developed world with significant morbidity, mortality and enhanced cost of care^[2]. VAP has been defined as pneumonia that occurs after 48 hours or more following endotracheal intubation or tracheostomy, characterized by the presence of infectious agents not present or incubating at the time of starting the mechanical ventilation. There is the presence of a new or progressive infiltrate, signs of systemic infection (fever, altered white blood cell count) and changes in sputum characteristics^[3].

VAP can be of two types: (i) early-onset (VAP within the first four days of ventilation), and (ii) late-onset (VAP that occurs more than four days after initiation of mechanical ventilation^[4]). Despite major advances in critical care and disinfection procedures of equipment, nosocomial pneumonia complicates the course of about 7- 41% of patients receiving continuous mechanical ventilation^[5]. VAP is the second most common nosocomial infection in the ICUs and the most common in mechanical ventilation^[6]. The risk for ventilator-associated pneumonia is the greatest in the first five days of mechanical ventilation (3%)^[3, 7]. The attributable risk of death has decreased considerably and is recently estimated to be 9-13%^[8]. About 50% of the antibiotics administered in the ICUs are for the treatment of VAP^[6]. Incidence rates calculated using 1000 ventilator days as

denominator reflect more accurately the risk rates of VAP. VAP rates range from 10-52.7/ 1000 days in developing countries^[9]. Some of the independent risk factors for development of VAP are admission for trauma and intermediate disease severity.

The aim of the present study was to determine the microbiological spectrum of organisms causing VAP in an ICU of our institute and their incidence.

Materials and Methods

The present prospective observational study was conducted in the Department of Microbiology, in association with 13-bedded multidisciplinary ICU of our institute for the period of June 2015 to July 2016. Patients who had received mechanical ventilation for more than 48 hours were included in our study. Modified clinical pulmonary infection score (CPIS) was followed as a screening method to clinically diagnose VAP^[10]. Detailed history, including the name, age, sex, underlying clinical condition, date of admission to the ICU, date of indoor admission, any history of antibiotic intake, the treatment being administered in the ICU and clinical outcome of each patient was noted. The lower respiratory tract infection that developed after 48 hours of mechanical ventilation was taken as VAP. The diagnosis of VAP was based on clinical and microbiological criteria. A clinical suspicion of VAP was made in patients with modified CPIS score of >6^[10]. The diagnosis was confirmed when significant growth was obtained in the samples.

Endotracheal aspirates (ETA) and bronchoalveolar lavage (BAL) samples were collected from all patients admitted to the ICU requiring mechanical ventilation of more than 48 hours^[11]. Patients who were already on ventilation be-

fore admission to the ICU or those who died within 48 h were excluded from the study. All the samples were transported to the laboratory immediately. Gram stain preparations were made from the samples to determine the presence and type of cells and the presence of microorganisms. KOH mounts were made to determine the presence of fungal elements. All the samples were inoculated onto blood agar, MacConkey agar and chocolate agar. Semi-quantitative cultures were done. The MacConkey agar plates were incubated at 37°C and blood agar and chocolate agar plates were incubated at 37°C in the presence of 5-10% CO₂. Growth of > 10⁵ CFU/ml was taken as the cut-off threshold for ETA samples whereas growth of > 10⁴ CFU/ml was taken as the cut-off for BAL samples. The samples that showed less than the threshold value of colony-forming units was assumed to be due to colonization or contamination. In the case of significant growth, the isolated colonies were subjected to Gram stain, biochemical tests for identification and antibiotic sensitivity testing according to standard guidelines.

Statistical Analysis

The statistical analysis was done using standard SPSS software version 21.0. Significant P value was set at < 0.05.

Results

A total of 100 patients, who were on mechanical ventilation for more than 48 h were included in our study. A total of 42 patients fulfilled the clinical and microbiological criteria for the diagnosis of VAP. The incidence of VAP in our study was 42%. Out of the 42 cases, 15 (35.71%) were categorized under early onset group and 27 (64.29%) under the late onset group. The incidence of VAP was more among males (69.04%) than females (30.96%). The incidence of VAP was more in patients who were on mechanical ventilation for > 15 days [P < 0.01]. Most of the patients were on broad spectrum antibiotics preceding their admission in the ICU.

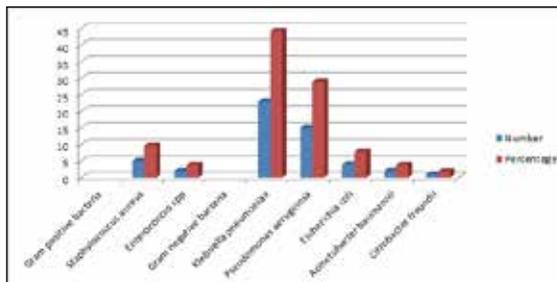
There was complete congruency between the ETA and BAL samples. The majority, i.e. 86.54% of the bacterial isolates were found to be Gram negative bacilli. *Klebsiella pneumoniae* accounted for 44.23% of VAP cases followed by *Pseudomonas aeruginosa*, which was responsible for 28.85% cases. Other important Gram negative bacilli were *Escherichia coli*, *Acinetobacter baumannii* and *Citrobacter freundii*. Out of 52 total isolates, only 7 isolates were Gram positive cocci, with 5 isolates of *Staphylococcus aureus* and 2 *Enterococcus* spp [Table 1; Chart 1]. Among the total 42 episodes of VAP reported, 10 episodes of VAP were polymicrobial and 32 were monomicrobial.

Table 1: Bacterial Isolates from the samples

Bacterial Isolates	Number	Percentage
Gram positive bacteria		
<i>Staphylococcus aureus</i>	5	9.61
<i>Enterococcus</i> spp	2	3.85
Gram negative bacteria		
<i>Klebsiella pneumoniae</i>	23	44.23
<i>Pseudomonas aeruginosa</i>	15	28.85
<i>Escherichia coli</i>	4	7.69

<i>Acinetobacter baumannii</i>	2	3.85
<i>Citrobacter freundii</i>	1	1.92
Total	52	100

Chart 1: Comparative isolation of bacteria from ETA and BAL samples



Discussion

The incidence of VAP in our study was found to be 42%, which is towards the higher end of the range of 15-58% as reported by other investigators [4]. The incidence of VAP varies due to several factors like differences in the study population and the use of preventive strategies. Patient-related risk factors include male sex, pre-existing pulmonary disease, coma, AIDS, head trauma and multiple-organ system failure [12]. The most important factor in the development of nosocomial pneumonia in an ICU patient is the presence of an endotracheal tube. There is violation of natural defence mechanisms (the cough reflex of the glottis and larynx) against micro aspiration around the cuff of the tube [6, 13]. Infectious microorganisms gain access to the lower respiratory tract via micro aspiration, development of a biofilm, pooling and trickling around the cuff and impairment of mucociliary clearance of secretions [13, 14, 15].

The causative organisms of VAP vary with the duration of mechanical ventilation. Bacteria causing early-onset VAP include *Streptococcus pneumoniae*, methicillin-sensitive *Staphylococcus aureus* (MSSA), *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter* spp etc. Late-onset VAP is caused by multi-drug resistant bacteria like *Pseudomonas aeruginosa*, *Acinetobacter* spp and methicillin-resistant *Staphylococcus aureus*. The prevalence of resistant organisms varies with the institution and also within the institution [16]. We found microorganisms that are sensitive to most antibiotics, as our ICUs follow standard antibiotic policy guidelines. Drug resistance is more in nursing home residents, patients receiving chemotherapy or antibiotics and undergoing dialysis at out-patient centres [6]. VAP can be polymicrobial in many cases. Fungal and viral causes of VAP have very low incidence, especially in the immunocompetent host [12]. We did not find any cases of VAP due to fungal origin in our study.

Appropriate antimicrobial therapy is crucial for the management of VAP. Third generation cephalosporins and fluoroquinolones are used in early-onset VAP whereas carbapenems, beta-lactam-beta lactamase inhibitor combinations, cephalosporins etc are used for late-onset VAP. The antibiotics are administered for about 8 days in case of early-onset but longer therapy is required for late-onset VAP. De-escalation of empiric therapy is essential to reduce the emergence of resistant organisms [17]. Antibiotic sensitivity testing with anti-pseudomonal antibiotics and combination

regimens are recommended for VAP due to *Pseudomonas aeruginosa*.

Conclusion

VAP is associated with significant morbidity in critically ill patients. There is no definite gold standard criterion for the diagnosis of VAP. A combination of clinical, radiological and microbiological data is used to diagnose and manage these cases. Multi-drug resistance results as a consequence of management based on empirical broad spectrum antibiotics. Thus, timely awareness and intervention can potentially reduce VAP and thus suffering in these patients.

Conflicts of Interest: The authors declare no conflicts of interest.

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