"Ventilator associated pneumonia: Incidence and microbiology in a tertiary care hospital in Maharashtra"

Prasana Chhagan Nakate[1,*], Virendra Ashok Kashetty[2], Mangala Prakash Ghatole[3]

[1]Assistant Professor, [2]Associate Professor, [3]Professor & Head, Dept. of Microbiology, Ashwini Rural Medical College, Solapur

***Corresponding Author:**
Email: prasannanakate@gmail.com

Abstract

Background: Ventilator associated pneumonia (VAP) is common complication in patients receiving mechanical ventilation. The causative organisms of VAP are diverse and many times multidrug resistant. An early, appropriate antibiotic therapy depending on the likely pathogens is a key to VAP management. The present study aims at finding the incidence of VAP and identifying prevalent microbial pathogens associated with VAP in a tertiary care hospital.

Methods: Endotracheal aspirates from clinically suspected VAP patients were subjected to microbiological analysis. Isolated pathogens were identified by standard microbiological techniques.

Results: A total of 330 patients received mechanical ventilation for more than 48 hours with a total of 1490 ventilator days. 78 (23.63%) patients were clinically suspected to have VAP. The rate of VAP was 52.34 cases per 1000 ventilator days. With microbiological analysis, significant pathogens were isolated from 74 patients, with predominance of Gram negative bacteria. The most prevalent organism isolated was Klebsiella species from 29 patients (39.18%), followed by Pseudomonas aeruginosa, Acinetobacter species, Citrobacter species, Proteus species, E. coli and S. aureus in that order.

Conclusion: Knowledge of prevalent organisms causing VAP (e.g. Gram negative organisms in our study) is useful to formulate an effective empirical antibiotic policy, to reduce the morbidity, hospital stay and cost of the treatment of these patients.

Keywords: Ventilator associated pneumonia, VAP, Pneumonia, Mechanical ventilation, Endotracheal aspirates

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Introduction

Nosocomial infections are one of the most important causes of morbidity and mortality in critically ill patients admitted in intensive care units (ICU). One of these nosocomial infections is pneumonia, affecting about 27% of all critically ill patients.[1] 86% cases of nosocomial pneumonias occur in patients receiving mechanical ventilation.[1] Ventilator associated pneumonia (VAP) is defined as pneumonia occurring more than 48 hours after the patient has been intubated and received mechanical ventilation. It occurs in 6 to 52% of patients receiving mechanical ventilation for more than 48 hours.[2]

The diagnosis of VAP is always difficult because of varied clinical manifestations, associated clinical conditions and lack of well-defined clinical criteria for diagnosis. The mortality attributable to VAP varies in the range between 0 and 50%, which depends on many factors such as age of the patient, nature of trauma, development of acute respiratory distress syndrome (ARDS), patient's medical and surgical conditions and the empirical medical therapy provided to them. Moreover, the organisms isolated from these patients also have an impact on the prognosis of these patients. Higher mortality rates are seen in VAP caused by Pseudomonas aeruginosa, Acinetobacter spp., Klebsiella species and Stenotrophomonas maltophilia.[3] Many times, the organisms recovered from VAP cases are multidrug resistant which again worsens the problem. Therefore rapid diagnosis of VAP and initiation of appropriate antimicrobial therapy based on the likely pathogens is of utmost importance as any delay would adversely affect the patient's prognosis. Accordingly, the present study was carried out in a tertiary care hospital to know the incidence of VAP and to identify the prevalent microbial pathogens associated with it.

Materials and Methods

The present study was a prospective, observational study carried out in a tertiary care hospital over a period of 12 months (from January 2015 to December 2015). The study was approved by the institutional ethics committee.

Patient inclusion criteria: All the patients who received mechanical ventilation for more than 48 hours during the study period were included in this study.

Patient exclusion criteria: Patients who were diagnosed to have pneumonia before the start of mechanical ventilation were excluded from the study.

Clinical diagnosis of VAP: VAP was suspected in patients receiving mechanical ventilation for more than 48 hours who developed new or progressive pulmonary infiltrates (>48 hours) on chest radiograph plus two or more of the following criteria[1, 4]:

1. Fever > 38.3°C
2. Leucocytosis of >12 x 10^9/ml
3. Purulent tracheobronchial secretions

Specimen collection (airway sampling): With all the necessary aseptic precautions, a trained respiratory therapist or intensivist collected airway samples from these suspected VAP patients. Using an appropriate suction catheter, endotracheal aspirates were collected through the endotracheal tube or the tracheostomy tube. Using sterile blades, the suction catheter tubes containing mucoid secretions were cut into smaller pieces and put into sterile sample containers. These specimens were transported to the clinical microbiology laboratory without delay.

Processing of specimens in laboratory: In the laboratory, the samples were initially processed for direct examination with preparation of smear and Gram staining (for all specimens). In addition, KOH mount and Ziehl Neelsen stain were performed when fungal etiology or tuberculosis was clinically suspected respectively. The specimens showing >25 pus cells and <10 epithelial cells per low power field microscope and plenty of organisms under oil immersion were processed for semi-quantitative culture[1,5]. For this, the specimens were inoculated on blood agar, MacConkey agar, nutrient agar and chocolate agar using 4 mm diameter inoculation loop which holds 0.01 ml of specimen. The culture plates were incubated at 37°C overnight in an aerobic incubator. The specimens showing growth of 10^5 CFU/ml of pathogenic organisms were considered significant[1,6]. The organisms isolated were identified based on their Gram staining properties, cultural characteristics and biochemical reactions.

Results & Observations

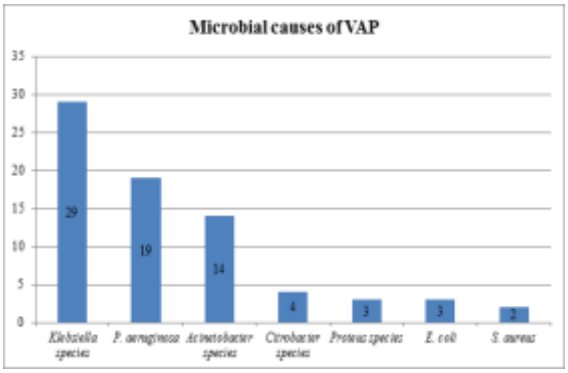
During the study period, a total of 330 patients received mechanical ventilation for more than 48 hours. The total ventilator days for these patients were 1490. Out of these 330 patients, 78 (23.63%) were clinically suspected to have ventilator associated pneumonia as per the above mentioned criteria. The rate of VAP was 52.34 cases per 1000 ventilator days. Microbiological analysis of endotracheal aspirates was done for all these 78 patients. Significant bacterial pathogens were isolated from 74 patients (growth of 10^5 CFU/ml of pathogenic organisms). Different organisms isolated from cases of VAP are shown in Table 1.

Table 1: Organisms isolated from VAP cases

Organism isolated	Number of patients (n=74) & %
Klebsiella species	29 (39.18%)
Pseudomonas aeruginosa	19 (25.67%)
Acinetobacter species	14 (18.91%)
Citrobacter species	4 (5.40%)
Proteus species	3 (4.05%)
E. coli	3 (4.05%)
Staphylococcus aureus	2 (2.70%)

The commonest bacterial pathogen isolated from VAP cases was found to be *Klebsiella species*, which was isolated from 29 patients (39.18%), followed by Pseudomonas aeruginosa, Acinetobacter species, Citrobacterspecies, Proteus species, E. coli and S. aureus in that order (Chart 1).

Chart 1



Discussion

Ventilator associated pneumonia is a common complication in patients receiving mechanical ventilation for various reasons and is associated with increased morbidity and mortality, increased duration of hospital stay and the cost of treatment. It is very important to be aware of common causative organisms of VAP at our hospital settings, as this is helpful in selecting an empirical antibiotic therapy for patients receiving mechanical ventilation. Some of these organisms such as *Pseudomonas, Acinetobacter* and *Stenotrophomonas species* display high levels of antimicrobial resistance.[7] Timely administration of appropriate empirical antibiotics to patients on ventilator decreases their bacterial load, minimises the risk of developing VAP and also the potential devastating consequences of delay in therapy.

In our study, 78 patients developed VAP out of 330 patients who received mechanical ventilation during the study period. The incidence of VAP was 23.63%. In a study carried out by Gadani H. et al, the incidence of VAP was reported to be 37%.[2] In another study carried out by Manoel da Silva J. et al, the incidence of VAP was found to be 20.7%.[8] The rate of VAP in our healthcare settings was found to be 52.34 cases per 1000 ventilator days. In a study carried out by Manoel da Silva J. et al the rate of VAP was 21.6 cases per 1000 mechanical ventilation days.[8]

In our hospital setting, Gram negative organisms were predominant pathogens isolated from VAP patients, the most common organism being *Klebsiella species*, which was isolated from 29 patients (39.18%), followed by *Pseudomonas aeruginosa* in 19 patients

(25.67%). In a study conducted by Trouillet J. L. et al, *Staphylococcus aureus* (21.3%) was the most frequent organism isolated from VAP cases followed by Enterobacteriaceae (17.9%) and *Pseudomonas aeruginosa* (15.9%).[9] A study by Chi S. Y. et al also reported *S. aureus* (44%) to be the most commonly isolated organism followed by *A. baumanii*, *P. aeruginosa*, *S. maltophilia*, *K. pneumoniae*, and *Serratia marcescens* in that order.[10] Gadani H et al have reported *Pseudomonas species* (43.2%) as the most prevalent organisms associated with VAP followed by *Klebsiella* (18.91%)[2].

Conclusion

Ventilator associated pneumonia is a life threatening complication occurring in patients receiving mechanical ventilation. An early, appropriate, empirical antibiotic therapy in adequate doses depending on the likely pathogens followed by de-escalation depending on the microbiological culture results and clinical response of patients is a key for management of VAP. The prevalence of causative organisms responsible for VAP varies with different healthcare settings. Most of these organisms, especially isolated from patients in tertiary care hospitals are multi-drug resistant. Knowledge of these prevalent organisms in the given healthcare facility (e.g. Gram negative organisms in our study) is useful to formulate an effective empirical antibiotic policy for patients who may be at risk of developing VAP, which will also reduce their hospital stay and cost of the treatment.

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