Review Article

Ventilator-associated pneumonia (VAP)-An overview

Dr. Kotgire. Santosh. A

Associate Professor, Department of Microbiology, Indian institute of medical sciences and research, Badnapur, Jalna, Maharashtra, India

*Corresponding author
Dr. Kotgire. Santosh. A
Email: santosh_kots2001@yahoo.com

Abstract: Patients in the intensive care unit (ICU) are at increase risk for dying not only from their critical illness but also from secondary processes such as nosocomial pneumonia. Pneumonia is most common infection in ICU compared with those in hospital wards and risk of pneumonia increases considerably in patients on mechanical ventilation were it termed as Ventilator-associated pneumonia (VAP).Ventilator-associated pneumonia represents a major health problem not only in terms of excess morbidity, mortality and personal distress but also contribute to significant economic loss. The incidence of VAP ranges from 10-65% depending on the definitions ,severity of illness ,type of patients studied, type of ICU/or hospital, prophylactic antibiotics administration, the techniques, and criteria used for diagnosis and can reach 78% in some specific settings or when lung infection is caused by high risk pathogens. The predominant organisms responsible for infection are Staphylococcus aureus, Pseudomonas aeruginosa, and Enterobacteriaceae, but etiologic agents widely differ according to the population of patients in an intensive care unit, duration of hospital stay, and prior antimicrobial therapy .Choosing appropriate therapy for VAP include knowledge of organisms likely to be present, local resistance patterns within the ICU, a rational antibiotic regimen, and a rationale for antibiotic de-escalation or stoppage.
Keywords: Intensive care unit (ICU); nosocomial infection; ventilator-associated pneumonia (VAP)

INTRODUCTION

"It seems a strange principle to enunciate as the very requirement in a hospital that it should do the sick no harm" quoted by Florence nightingale in 1863 holds true even to this day. The hospital while fulfilling its role as health care institute, sometimes present its patients with unwanted gifts of hospital-acquired infection.

Hospital acquired infection (HAI) or Nosocomial infection(NI) is defined as the infection acquired by a patient as a result of hospitalization or contact with the hospital environment, that were neither present nor incubating at the time of the patient's visit or admission to the hospital [1,2,3,4].

Kollef MH 1965[5] and Vincent J *et al.;* 1995 [6] observed that the common types of nosocomial infection encountered in any institution depends on a number of factors including the type of hospital or ward, the age, underlying illnesses and/or comorbid conditions of the patients, the severity of illness of individual cases and the treatment instituted.

In the study of El-ebiary M *et al.;* 1993[7] .found the most common HAI are urinary tract infection, respiratory infection, blood stream infection, skin and surgical site infections.

According to the surveillance data from the National Nosocomial Infection Surveillance System (NNIS) of the Center for Disease Control and Prevention (CDC), Hospital acquired pneumonia (HAP) or Nosocomial pneumonia (NP) is the most common infection in the intensive care units (ICUs), second most common hospital infection and leading cause of death among hospital acquired infection [8,9,10].

Nosocomial pneumonia or hospital acquired pneumonia (HAP) is defined as the parenchymal lung infection occurring $\geq$ 48 hrs after the admission that was neither present or incubating at the time of admission , incidence of HAP varies from 9-78% depending on severity of illness, type of patients studied the techniques and criteria used for the diagnosis of pneumonia[1,11,12,13,14].

The occurrence of pneumonia is high in the intensive care units(ICU) mainly because of high utilization of invasive procedure like mechanical ventilation also patients admitted to ICUs are critically ill have deranged vital functions requiring

interventional procedure which results in breach in natural barriers providing environment for infection resulting in hospital acquired pneumonia[15,16] .

Hospital acquired pneumonia is most common nosocomial infection reported among ventilated patients admitted in ICU where it is termed as "ventilator associated pneumonia" (VAP) [1, 5, 6].

Ventilator associated pneumonia (VAP) refers to pneumonia developing in mechanically ventilated patients more than 48 hrs after tracheal intubation or tracheostomy. The incidence of VAP ranges from 10-65% and can reach 78% in some specific settings or when lung infection is caused by high risk pathogens [15, 16, 17, 18].

In contrast to infections of more frequently involved organs (e.g. urinary tract, skin) for which mortality is low, ranging from 1to 4% the mortality associated with VAP ranges from 20-40% [19, 20].

Conceptually VAP is defined as an inflammation of lung parenchyma caused by infectious agents not present or incubating at the time mechanical ventilation was started [20].

It is conclusively shown that prior to the development of VAP, the pathogenic organisms the source of which could be exogenous or endogenous colonize trachea. Some studies show oropharynx to be the source of colonization, while other shows the stomach to be the source of colonization [20, 21].

The primary risk factor for development of VAP is mechanical ventilation with its requisite endotracheal intubation or tracheostomy.

VAP is complex and multifactorial and clinical criteria for the suspicion of VAP is usually seen in patients who are mechanically ventilated for more than 48 hrs and includes as per according to American Thoracic Society guidelines [4].

New or persistent or progressive radiographic infiltration plus two of at least of following:-
1. Temperature $\geq 38°c$ or $\leq 35°c$.
2. Total Leukocyte count$\geq$ 10000mm³ or $\leq$4000mm³.
3. Purulent tracheal secretions.

In ICU patients especially those who are intubated, the signs of pneumonia are relatively subtle and thus the diagnosis often is relatively complex. Clinical criteria lack both sensitivity and specificity moreover there are many causes that mimic these clinical manifestations of VAP leading to a high rate of misdiagnosis and unnecessary misuse of antibiotics [23, 24, 25].

Thus microbiological diagnosis achieves major importance in the diagnostic strategy of ventilator associated pneumonia. The method of choice for laboratory diagnosis, whether invasive bronchoscopic methods such as protected specimen brush (PSB) or bronchoalveolar lavage (BAL), or non-invasive endotracheal aspirate remains controversial [24, 25]. Many studies have shown that performance of invasive and non-invasive techniques have varied considerably and no technique could consistently be shown to achieve a superior diagnostic yield as compared with another, thus there is no "gold standard method" for diagnosis of VAP [2, 5, 23,24].

In the intubated patients with suspected VAP lower airway secretions are easily available with routine endotracheal aspiration and is considered adequate specimen when strict definitional criteria (organisms on gram stain and fewer than 10 squamous epithelial cells per low power field and more than 25 neutrophils per high power field)[5,7,9] .

Advantage of non-invasive techniques includes less invasiveness, less compromise of oxygenation, ventilation and respiratory mechanics during the procedure, less likely to induce arrhythmias [7, 9].

ETA is least expensive, most readily available, requires least experience and easily repeatable and many authors have concluded that the diagnostic accuracies of non-invasive and invasive techniques are similar and comparable [22, 23].

Additionally, non quantitative or qualitative culture of ETA are sensitive but not specific method for evaluating etiological agents because many patients are commonly colonized pathogenic organisms and mere recovery of potential pathogen from an ETA cannot determine whether the organism is pathogen or simply colonizing or contaminant [22,24].

To avoid the problem of diagnosis and over treatment by separating colonizers from pathogenic organism many studies have suggested quantitative culture of ETA should be used to avoid false positive results [15, 16].

As per American thoracic society guidelines VAP can be studied as early onset i.e. (occurring<5 days or within 96 hrs of mechanical ventilation) and late onset (occurring> 5 days or after 96 hrs of mechanical ventilation) [4].

The causative organisms vary according to the patient's demographics in ICU, methods of diagnosis,

the duration of hospital and ICU stay, and the antibiotic policy. Several studies have shown that aerobic gram negative bacteria are the most common pathogens responsible for VAP. The most common aerobic gram negative bacteria are Pseudomonas aeruginosa , E-coli, Klebsiella pneumoniae, Acinetobacter spp, Enterobacter spp and less commonly Proteus spp, Citrobacter spp, H.influenza although many studies have also reported along with aerobic gram negative bacteria the dominance of gram positive bacteria especially Staphylococcus aureus in causing VAP is well documented other gram positive bacteria responsible for VAP are Streptococcus pneumoniae , Staphylococcus epidermidis , Enterococci spp, Streptococci spp [2,5,6,8,18].

Overall rate of positive blood culture in VAP ranges from 8-20% and some studies reports that bacteremia in this patients is not always related to pulmonary infection and may have other additional source of infection [5,7,9]. The American Thoracic Society guidelines for hospital-acquired pneumonia recognize that blood cultures may be of value both to isolate an etiologic pathogen and also to define the severity of illness [4].

Laboratory investigations of microbial cause are important because in absence of such identification of organisms, antibiotic therapy may not be optimal. At the same time increasing antibiotic resistance among the bacterial pathogens associated with VAP [9, 10].

There is increasing trend of multiple drug resistant (MDR) isolates in ICU setup such as Extended spectrum β-lactamases (ESBL) by Enterobactericae , Methicillin resistant Staphylococcus aureus (MRSA), Metallo-β lactamases (MβL) producing Pseudomonas aeruginosa , Acinetobacter spp which considerably increases morbidity, mortality and increase in days of mechanical ventilation among the hospitalized patients [11,13,14].

The occurrence of MDR in ICU and hospital environment poses not only therapeutic problem but also serious concern for infection control management [2, 4, 5].

The major goals in treating the VAP should emphasize on early and appropriate antibiotic in adequate doses based on microbiologic culture and clinical response of patient. The literature shows that inadequate antibiotics for 48-72 hrs. Is associated with increase morbidity and mortality and several studies shown that appropriate antimicrobial treatment of patients with VAP significantly improves the outcome [8, 9, 12].

Therefore, knowledge about the commonest etiological pathogens causing VAP and their antimicrobial susceptibility pattern at the institute level will definitely useful in formulating its antibiotic policy and optimal management of patients. A local surveillance program at each centre is essential as knowledge of local resistant patterns is vital for selecting appropriate agents for treating infections.

CONCLUSION

Occurrence of MDR in the ICU and hospital environment poses not only therapeutic problem but also serious concern for infection control management. A local surveillance program at each centre is essential as knowledge of local resistant patterns is vital for selecting appropriate agents for treating infection.

Lastly exact bacteriological profile and antibiotic susceptibility pattern of ventilator associated pneumonia in an ICU should be known to plan strategies for treatment and better patient's management.

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