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VENTILATOR ASSOCIATED PNEUMONIA: RISK FACTORS, CLINICAL OUTCOME AND BACTERIOLOGICAL PROFILE IN INTENSIVE CARE UNIT PATIENTS AT A TERTIARY CARE TEACHING HOSPITAL.

Microbiology

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ABSTRACT

Background: Ventilator associated pneumonia (VAP) is the second common health care associated infection. It is associated with with high morbidity and mortality rates, prolonged hospital stays and increased healthcare cost. There is marked variation noted in the trend of pathogens as per duration of mechanical ventilation, type and geographical location of the healthcare setup and compliance with infection prevention and control policies including bundle care and hand hygiene. The present study was planned at tertiary care teaching hospital with an aim to determine microbial profile, risk factors and clinical outcome of patients with clinically suspected VAP cases in ICU of tertiary care teaching hospital. **Methods:** A total of 100 clinical suspected cases of VAP were included in the study. Endotracheal aspirate (ETA) obtained from these patients were obtained and subjected to Gram staining and culture. Patient's demographic characteristics, relevant clinical features, medical history, assessment of level of consciousness, risk factors and radiological and pathological investigations were recorded and analysed. The clinical condition of the patients was followed up from the time of inclusion in the study to the date of discharge from hospital or death. **Results:** As per the clinical pulmonary infection score (CPIS) confirmed cases of VAP was diagnosed 29% of patients. Majority of confirmed VAP cases were from age group 18-30 years. VAP developed in 13 (44.8%) patients with diffuse chest infiltration, 12 (41.4%) patients with localised chest infiltration and 4 (13.8%) patients with no chest infiltration. A total of 19 (65.5%) patients had late onset VAP whereas 10 (34.5%) had early onset VAP. Nil fermenters like Acinetobacter baumannii and Pseudomonas aeruginosa followed by Enterobacterals like Klebsiella pneumoniae and E. coli were common bacterial pathogens isolated from VAP cases. the mortality rate was found to be 31.1%. **Conclusion:** Ventilator associated pneumonia (VAP) is a common adverse iatrogenic event in mechanically ventilated patients associated with high morbidity and mortality rates. Gram negative bacilli belonging to nil fermenting group and Enterobacterals are common etiological agents of VAP. Reintubation is an important risk factor for VAP. The continuous surveillance of healthcare associated infections including VAP is extremely important to understand the epidemiology, diagnosis and effective implementation of prevention and control policies.

KEYWORDS

Ventilator Associated Pneumonia, Healthcare Associated Infection, Bacteriological Profile, Risk Factors.

INTRODUCTION

Of late, with the remarkable advancements in medical technology, the incidence of healthcare associated infections (HAI) has increased sharply especially in patients admitted to intensive care units (ICU). HAI are deleterious as they are significantly associated with high morbidity and mortality, prolonged hospital stays and incremental healthcare cost.[1]

As per definition, "HAI is an infection that is acquired in an acute care setting which was not present or incubating at the time of admission". These infections arise after 48 hours of admission and may be become evident during the hospital stay or even after discharge of patient.[2]

As per studies, the HAI burden is quite high in developing countries and concern approximately 9.6 to 17.7% of patients admitted to critical care units of Indian hospitals.[3] Many factors like invasive medical devices, broad spectrum antibacterial therapy, compromised immune and health status and use of corticosteroids increases the risk of HAI in ICU patients.[3]

Nearly more than half of HAI are due to presence of invasive medical devices like mechanical ventilator, central line and urinary catheters.[4] Ventilator associated pneumonia (VAP) is the second common HAI, estimated to occur in 9-27% patients on mechanical ventilator. It is associated with high mortality rate (33-55%), which is highly depended on patient's underlying medical conditions.[5]

VAP is usually caused by multidrug resistant pathogens which complicates the clinical outcome of the patient. Researchers have highlighted a marked variation in trend of pathogens as per duration of mechanical ventilation, type and geographical location of the healthcare setup and compliance with infection prevention and control policies including bundle care and hand hygiene.[6] The present study was planned at tertiary care teaching hospital with an aim to determine microbial profile, risk factors and clinical outcome of patients with clinically suspected VAP cases in ICU of tertiary care teaching hospital.

MATERIAL AND METHODS

This cross-sectional descriptive study was prospectively carried in the Department of Microbiology of Public teaching Hospital of Latur, Maharashtra for a period of 21 months (October 2019 – June 2021) after obtaining the institutional and ethical clearance from Institutional Ethics Committee.

A total of 100 clinical suspected cases of VAP were included in the study. Following were the inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
• Adult patients (≥ 18 years) of both sexes. • On mechanical ventilation for >48 hours • Radiological, haematological and clinical parameters indicative of VAP • Tracheostomised patients with suspected VAP. • Extubated patients with suspected VAP.	• Patients < 18 years of age • Known case of pulmonary tuberculosis. • Patients with pneumonia prior to mechanical ventilation or <48 hours of mechanical ventilation. • Patients with other causes of radiological infiltrates like pulmonary embolism, pulmonary hemorrhage, atelectasis, congestive heart failure and adult respiratory distress syndrome • Patients with severe immunocompromised conditions like AIDS, organ transplant, terminal stages of malignancy.

Endotracheal aspirate (ETA) obtained from these patients were obtained and subjected to Gram staining and culture. For culture, the ETA samples were diluted with sterile normal saline 1/10, 1/100, 1/1,000 times and further analysed for identification and categorization of pathogens and colonizers. A concentration of 0.01 ml of the above dilutions was aseptically inoculated on culture media including 5% sheep blood agar, nutrient agar, Macconkey agar and chocolate agar. The inoculated media were incubated at 37°C for 24-48 hours. After incubation the colony count was made number of colony forming units per ml (CFU/ml) was estimated.[7]

The pathogenic threshold was set at 10^5 CFU/ ml for endotracheal aspirates. Growth of any organism below this. threshold was considered colonizers or contaminants.[8,9] Bacteria at pathogenic threshold were identified as per standard microbiological protocol.

Gram-stained smears were examined directly to assess the presence of

squamous cells, polymorphonuclear cells, Gram-positive and Gram-negative bacteria and their morphology. The criteria for inclusion and rejection of ETA samples based on Gram staining were as follows.

Threshold for Diagnosis of VAP	Rejection of ETA Samples
• >10 PMNs / high power field • ≥ 1 bacterium / oil immersion field • Presence of intracellular bacterial inclusions	• Squamous epithelial cells >10/ low power field • No organism / oil immersion field

Patient's demographic characteristics (age, sex), relevant clinical features (date of admission, date of intubation/tracheostomy, clinical diagnosis, underlying diseases, duration of mechanical ventilation, prior antibiotic therapy, etc.), medical history (chief complaint, past history, general examination, systemic examination), assessment of level of consciousness, risk factors (e.g. presence of nasogastric tube, enteral nutrition, antacid or histamine type 2 i.e. H2 blocker therapy) and radiological and pathological investigations (Chest x-ray, CT scan, WBC count) were recorded and analysed. The clinical condition of the patients was followed up from the time of inclusion in the study to the date of discharge from hospital or death.

The data obtained from the study was entered in the Microsoft ® Excel spreadsheet program. Descriptive statistics (percentages, frequencies) was represented by constructing relevant tables, graphs and pie charts. For summarising continuous variables mean, standard deviation and ratio were used whereas categorical variables were summarized by percentages and frequencies. Statistical analysis was performed by SPSS version 20.0, IBM, USA.

RESULTS

For the purpose of the study, the patients were divided into 5 groups as per the age. Majority of patients belonged to age group 51-60 years followed by 31-40 years and 51-60 years (Table 1). Out of 100 patients included in the study, 65 were males and 35 were females.

Table 1. Age Wise Distribution of Patients.

Age	Frequency (%)
18-30	15 (15)
31-40	21 (21)
41- 50	16 (16)
51-60	20 (20)
>60	28 (28)
Total	100

The clinical spectrum wise distribution of patients is shown in Figure 1.Neurological disorders (20%) followed by poisoning (18%) and sepsis (6%) were common clinical spectrum in patients admitted to ICU.

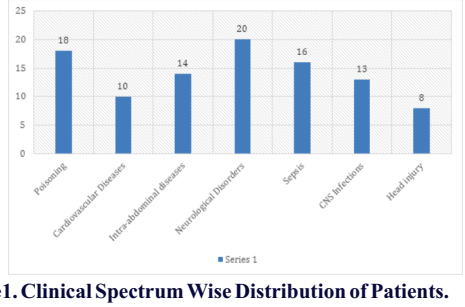

Figure1. Clinical Spectrum Wise Distribution of Patients.

As per radiological findings, 42% of patients had diffuse chest infiltration whereas 26% had localised chest infiltration. There was no evidence of chest infiltration in 32% of patients. A total of 89% of patients were intubated whereas tracheostomy was performed in 11% of patients. In 29 % the clinical pulmonary infection score (CPIS) was >6 and hence these patients were diagnosed as confirmed cases of VAP.

Majority of confirmed VAP cases were from age group 18-30 years (8%) age, followed by 41-50 years (7%) and 51-60 years (5%). A total of 4 cases were age group 31-40 years whereas remaining 5 belonged to age group >60 years. Majority of confirmed VAP patients were females (n=19, 65.5%). VAP developed in 13 (44.8%) patients with diffuse chest infiltration, 12 (41.4%) patients with localised chest infiltration and 4 (13.8%) patients with no chest infiltration. A total of 19 (65.5%) patients had late onset VAP whereas 10 (34.5%) had early onset VAP.

The risk factors in confirmed VAP cases are shown table 2. Presence of nasogastric tube, impaired consciousness and reintubation were common risk factors noted in confirmed cases of VAP.

Table 2. Risk Factors in Confirmed VAP Cases

Risk Factors	Frequency (%)
Tracheostomy	3 (10.3)
Stress ulcer prophylaxis	3 (10.3)
Impaired consciousness	5 (17.2)
IV sedation	4 (13.7)
Reintubation	5 (17.2)
Nasogastric tube	6 (20.7)
Emergency intubation	3 (10.3)
Total	29

Bacteriological profile of VAP cases is shown in table 3. Nil fermenters like Acinetobacter baumannii and Pseudomonas aeruginosa followed by Enterobacterals like Klebsiella pneumoniae and E. coli were common bacterial pathogens isolated from VAP cases. In the present Citrobacter freundii was not isolated from cases with late onset VAP.

Table 3. Bacteriological Profile of VAP Cases.

Organisms	Total (%)	Early onset VAP	Late onset VAP
Acinetobacter baumannii	7 (24.1)	3 (30)	4 (21.1)
Pseudomonas aeruginosa	5 (17.2)	2 (20)	3 (15.8)
Klebsiella pneumoniae	5 (17.2)	1 (10)	4 (21.1)
E. Coli	4 (13.8)	1 (10)	3 (15.8)
Staphylococcus aureus	4 (13.8)	1 (10)	3 (15.8)
Coagulase negative Staphylococci	2 (6.9%)	-	2 (10.5)
Citrobacter freundii	2 (6.9)	2 (20)	-
Total	29	10	19

A total of 9 (31.1%) patients succumbed to the condition, 12 (41.4%) were treated and discharged from the facility whereas 8 (27.6%) opted for discharge against medical advice (DAMA).

DISCUSSION

VAP is defined as "infection of the pulmonary parenchyma in patients exposed to invasive mechanical ventilation for at least 48 h and is part of ICU-acquired pneumonia.[10] In spite of intensive care and accurate management VAP remains as the important cause of criticality and morbidity in mechanically ventilated patients. Like other HAI, VAP is a preventable infection which can be prevented by robust vigilance and strict compliance to infection prevention and control protocols.

There is marked variation in the rate of VAP as per the patient risk factors, hospital setting and criteria used for diagnosis. In this study, as per the clinical pulmonary infection score (CPIS) confirmed cases of VAP was diagnosed 29 out of 100 patients included in the study. Therefore, the rate of VAP in this study was 29%. The reported incidence of VAP varies between 5 to 40% depending on the setting and diagnostic criteria.[10]

In this study, the majority of the confirmed VAP cases are in the age group of 18-30 years which is in line to that of Gupta et al.[11] This finding was in contrast to other researchers VAP cases were found in patients belonging to age group of >50 years.[12,13] This variation may be due to random selection of the study subjects. In the current study, majority of confirmed VAP cases was found in poisoning cases which similar to the observation of Rakshit et al.[14]

In present study, VAP developed in 13 patients out of 42 patients (30.9%) with diffuse chest infiltration, 12 patients out of 26 patients (46.2%) with localised chest infiltration and 4 patients out of 32 patients (12.5%) with no chest infiltration. So, chest infiltration on radiograph cannot confirm the diagnosis of VAP. This study has similarity with the study by Butler K et al where also radiographic chest infiltration could not confirm the presence or absence of VAP.[15] In consistent to study of Mukhopadhyay et al.,[12] majority of patients in this study had late VAP onset (65.5%)

When risk factors for development of VAP were studied, it was noted that insertion of nasogastric tube followed by reintubation and impaired consciousness were risk factors associated with VAP. Similarly, Gupta A et al had reported an increased risk of VAP in patients who underwent reintubation [16]. Identifying these risk factors

may provide valuable insights for screening patients at increased risk for VAP and guide in implementation of appropriate preventive measures during management.

Acinetobacter baumannii 7 (24.14%), followed by Pseudomonas aeruginosa 5 (17.24%) and Klebsiella pneumoniae were common bacterial pathogens isolated from VAP cases. Similar results were found in the study of Craven et al.[17] In the present study, the mortality rate was found to be 31.1% which is comparable to that reported by Patil et al.[18]

CONCLUSION

From the present study it can be concluded that ventilator associated pneumonia (VAP) is a common adverse iatrogenic event in mechanically ventilated patients associated with high morbidity and mortality rates. Gram negative bacilli belonging to nil fermenting group and Enterobacterals are common etiological agents of VAP. Reintubation is an important risk factor for VAP. The continuous surveillance of healthcare associated infections including VAP is extremely important to understand the epidemiology, diagnosis and effective implementation of prevention and control policies.

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