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PREVENTING VENTILATOR-ASSOCIATED PNEUMONIA: STRATEGIES AND OUTCOMES IN INTENSIVE CARE UNIT IN A TERTIARY CARE HOSPITAL

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Abstract: BACKGROUND: Ventilator-associated pneumonia (VAP) is one of the most frequent ICU-acquired infections. Mechanically ventilated patients are at a high risk of acquiring respiratory infections due to complex interplay between the endotracheal tube, host immunity and virulence of invading bacteria.

AIM: It was a prospective hospital-based study carried out in the Department of Microbiology in collaboration with Department of Anaesthesia at Dr. Rajendra Prasad Government Medical College, Kangra at Tanda (H.P.), for a period of 12 months with effect from September 2021 to August 2022.

RESULT: A total of 32 endotracheal aspirate samples were obtained from clinically suspected VAP cases among 100 patients admitted in Anaesthesia intensive care units. Predominate growth of Gram negative organisms was isolated, the most common was *Acinetobacter baumannii* (16; 42.1%) followed by *Pseudomonas aeruginosa* (6; 15.79%).

CONCLUSION: Gram-negative bacteria were the predominant isolates in ET secretions of ventilated patients. A rational use of antibiotics, regular monitoring of antibiotic resistance and use of right combination of drugs, in addition to refining of existing infection control practices are critical to control the emergence of drug-resistant strains

INTRODUCTION:

VAP is pneumonia that occurs 48-72 hours or thereafter following endotracheal intubation or mechanical ventilation, characterized by presence of new or progressive infiltrates, signs of systemic infections, worsening of oxygenation, change in sputum characteristics and microbiological detection of causative agents.[1] The second most common nosocomial infection (after UTI) is healthcare associated pneumonia accounting for 15 – 20%. It is the most common cause of death among hospital acquired infections (HAI), with mortality rate up to 40%. Hospital-acquired pneumonia (HAP) is the pneumonia after 48 h or more after admission, which did not appear to be incubating at the time of admission.[2]

These complications often result in increases in the duration of ventilation, length of stay in the ICU and hospital, cost of care, risk of disability, and risk of mortality. Patients are often in bad condition and the invasive procedure of intubation may contribute to the patient‘s risk of colonization by exogenous microbes. They can come from contaminated bronchoscopes, water supply, respiratory equipment, humidifiers, ventilator temperature sensors, respiratory nebulizers, or a contaminated environment.[3] The majority of infections occur within 48–72 hours of subjecting the patient to a mechanical ventilator.[4,5]

Early-onset VAP occurs in ventilated patients within the first four days (≤ 4 days) of mechanical ventilation (MV), which is usually caused by antibiotic-sensitive bacteria. Late-onset VAP refers to VAP that developed in mechanically ventilated patients from the fifth day (≥ 5 days) of MV and it is caused by multidrug-resistant (MDR) pathogens.[6]

MATERIALS AND METHOD:

Study Design: It was a prospective hospital-based study.

Study Area: The study was carried out in the Department of Microbiology in collaboration with Department of Anaesthesia at Dr. Rajendra Prasad Government Medical College, Kangra at Tanda (H.P.). The study was conducted for a period of 12 months with effect from September 2021 to August 2022. Inclusion criteria: patient above the age of 18 years who were on mechanical ventilators for more than 48 hours. Exclusion criteria: Patients who died or developed pneumonia within 48 h or those who were admitted with pneumonia at the time of admission were excluded from the study.

Endotracheal aspirate: The sample was collected by introducing a catheter through the larynx into the trachea. If endotracheal tube was in place, endotracheal secretions were aspirated under aseptic conditions, as per standard microbiology protocol. The samples were inoculated on Blood agar and MacConkey agar plates. The plates were then incubated overnight at 37˚C for 24 hours. The growth of the organisms was observed on blood agar medium and MacConkey agar medium. The colonies were identified from colony characters like size, shape, surface, edges, margin, consistency, emulsifiability, opacity, colour and any odour. Further growth was confirmed by Gram staining, biochemical reactions and other specific confirmatory tests. Antimicrobial susceptibility testing was performed on Mueller Hinton Agar (MHA) by Kirby Bauer disc diffusion method as per CLSI guidelines.[7]

RESULTS

A total of 32 endotracheal aspirate samples were obtained from clinically suspected VAP cases among 100 patients admitted in Anaesthesia intensive care units, out of which 22(68.75%) samples yielded pathogenic organisms while 10 (31.25%) were sterile.

Most common diagnosis observed in all the patients admitted in ICU was neurological diseases with a count of 14. There were 6, 7 and 5 patients who had gastrointestinal system involvement, post COVID patients and respiratory system involvement respectively. Twenty four patients had hospital stay of ≥6 days while rest of 8 patients had a hospital stay of 2- 5days.

Among 7 Gram positive organisms isolated, there were 4 (57.2%) Methicillin resistant *Staphylococcus aureus* and 3 (42.8%) Methicillin Sensitive *Staphylococcus aureus*. The endotracheal aspirate yielded 2 yeast isolates, of Candida albicans and Non Candida albicans (Figure 1). A total of 38 Gram negative organisms were isolated, the most common Gram-negative isolate was *Acinetobacter baumannii* (16; 42.1%) followed by *Pseudomonas aeruginosa* (6; 15.79%). *Klebsiella pneumoniae* was isolated among 4 (10.5%). *Citrobacter freundii, Enterobacter aerogenes, Escherichia coli* and Non fermenter group of organisms were isolated from 2 (5.26%) samples each (Figure 2).

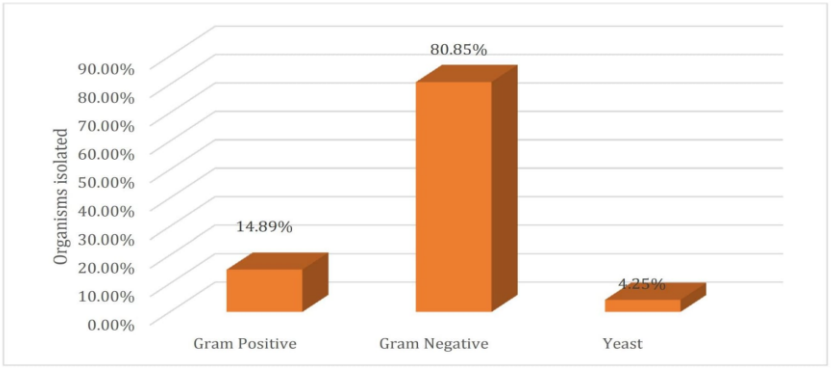

Figure 1: Distribution of pathogens in endotracheal aspirate samples

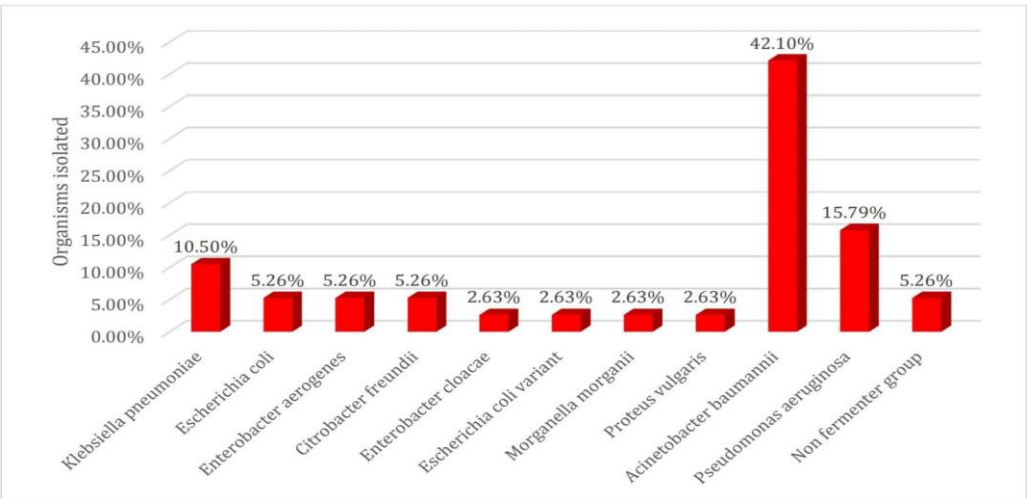

Figure 2: Distribution of Gram negative isolates in suspected cases of ventilator associated pneumonia

Among all *Staphylococcal* spp. isolated was 100% sensitive to vancomycin and linezolid. Maximum resistance was seen for penicillin (85%), cotrimoxazole and clindamycin (57%) each. Candida albicans was isolated from 1 sample which was sensitive to both fluconazole and voriconazole while non-Candida albicans isolated was resistant to both drugs.

Among *Enterobacterales*, maximum resistance was seen for cotrimoxazole (50%) followed by doxycycline, ampicillin and ceftazidime (42.8% each). All isolates were sensitive to levofloxacin and colistin.

Among non- fermenter group of organisms, maximum resistance was seen for ciprofloxacin (75%) followed by ceftazidime (70.8%), gentamicin (70.8%), piperacillin/tazobactam (66%) and tobramycin (50%). No resistance was seen for colistin.

Overall mean ventilator associated pneumonia rate was 14.29 per 1000 ventilator days (Figure 3). Institutions or ICUs may observe a reduction in VAP rates by utilizing a 'VAP-bundle' approach.[8]

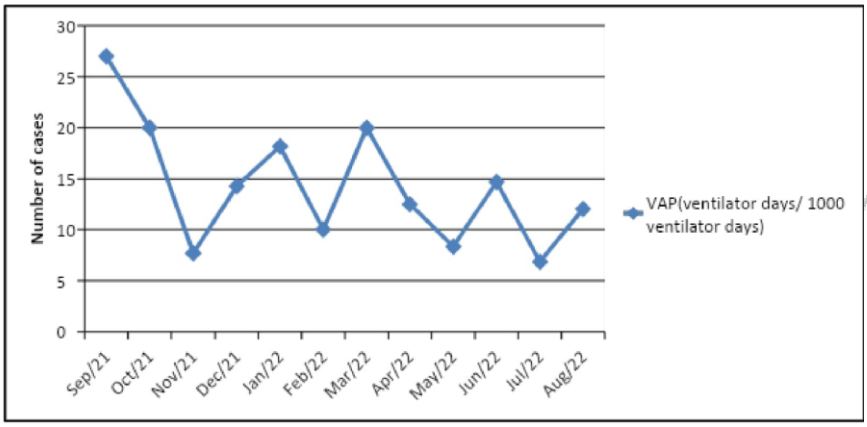

Figure 3: Monthly trend of VAP cases

DISCUSSION

Late onset VAP (> 4 days) requires broad spectrum antibiotics whereas early onset (≤ 4 days) can be treated with limited spectrum antibiotics. An updated local antibiogram for each hospital and each ICU based on local bacteriological patterns and susceptibilities is essential to guide optimally dosed initial empiric therapy.[9]

We observed that 24 patients had hospital stay of ≥ 6 days while rest of 8 patients had a hospital stay of 2-5days. In a study by Vincent JL et al [10], they observed that there was a significant relationship between the number of days spent in the ICU and the rate of infection: the infection rate increased from 32% for patients with ICU stay of 0 or 1 day to more than 70% for patients with ICU stay of more than 7 days.

Gram negative isolates with *Acinetobacter baumannii* being the most common followed by *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. Sannathimmappa MB et al[11] observed that gram-negative bacilli (GNB) were predominantly isolated. This can probably be explained by the fact that these organisms are

found as the normal commensals of the human body, which makes them one of the most important endogenous bacteria causing infections, most commonly in immunocompromised patients. Increased colonization of *Enterobacterales* in the respiratory tract of the patients on prolonged mechanical ventilation also contributes to higher infection.

In the present study, ventilator associated pneumonia rate was 14.26 per 1000 ventilator days. It was consistent with study done by Dima et al in which ventilator associated pneumonia rate was 12.5 per 1000 device days.[12]

CONCLUSION

VAP occurs frequently and is associated with significant morbidity in critically ill patients. The major goals of VAP management are early, appropriate antibiotics in adequate doses followed by de-escalation based on microbiological culture results and the clinical response of the patient. Microbiological data should be used for tailoring antibiotic therapy and not be restricted only to diagnosis. Antimicrobial stewardship program provides optimize antibiotic selection, dose, and duration to increase efficacy in targeting causative pathogens and allow the best clinical outcome.

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