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Original Article

Ventilator Associated Pneumonia and Bacterial Pathogens among Patients of Intensive Care Unit in a Tertiary Care Hospital

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Abstract

Background: Ventilator associated pneumonia (VAP) is a major cause of higher morbidity and mortality among hospitalized patients especially in the Intensive Care Unit (ICU).

Objective: This study was conducted to explore the bacterial pathogens among ICU patients with Ventilator Associated Pneumonia (VAP).

Methods: This was a descriptive type of cross sectional study conducted during the period of twelve months (January to December 2018) among clinically suspected VAP patient admitted in Intensive Care Unit at Rajshahi Medical College and Hospital. A total of 80 endo-tracheal aspirate (ETA) samples were collected purposively from clinically suspected VAP cases during study period.

Results: Among the respondents males were 48 (60%) and female were 32 (40%). Maximum 20% cases were within age group of 21-30 years. Majority of the patients were admitted with primary diagnosis of head injury (36.25%) followed by stroke (26.25%). Among 80 ETA samples, 75 (93.75%) samples were culture positive. Out of 75 culture positive cases 72(96.0%) were single isolates and 3(4.0%) were multiple isolates. Among the total 78 isolates were identified higher gram negative organisms (74.36%) than that of gram positive (25.64%). Moreover, among 78 isolates, Pseudomonas aeruginosa were the predominant 35.9%.

Conclusion: VAP was an important nosocomial infection among ICU patients receiving mechanical ventilation and most of cases gram negative organism are responsible for this infection.

Keywords: Ventilator, Pneumonia, Microorganism

Introduction

Ventilator associated pneumonia (VAP) is defined as pneumonia that arise more than forty eight hours (48hrs) after initiation of mechanical ventilation by tracheostomy or endotracheal intubation. Ventilator Associated Pneumonia (VAP) is the most common nosocomial infection in the ICU and contributes disproportionately to both poor outcomes and the high cost of care in critically ill patients. It has emerged as an important challenge in ICU as it contributes to approximately half of all cases of hospital acquired pneumonia. VAP is estimated to occur in 9-27% of all mechanically ventilated patients with the highest risk being early in the course of hospitalization and mortality ranges between 20-50% and may reach more than 70% when the infection is caused by multidrug resistant and invasive pathogens.[1,2,3,4.]

Mechanical ventilation itself serves as a major risk factor for an infection in ICU. Endotracheal tube bypass natural upper airway filter and therefore intervenes with laryngeal and cough reflexes and impair mucocilliary clearance. Pharyngeal flora breaks around the cuff of endotracheal tube and bypass into the lungs and cause pneumonia.[5] Aspiration of oropharyngeal pathogens and the leakage of secretions containing bacteria around the endotracheal tube are principal factor for the development of VAP.[6] Reintubation, hospital stay for more than 2 days, any surgery, presence of nasogastric tube, use of stress ulcer prophylaxis, intravenous sedatives, impaired consciousness, neurological disorder, steroid therapy are several risk factors for developing VAP.[7]

The clinical condition of VAP is suspected usually on the basis of the presence of fever or hypothermia, leukocytosis or leucopenia, purulent tracheal secretion and the presence of a new or persistent radiographic infiltrate. But these

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clinical parameters individually have limited diagnostic value. In several studies, clinical pulmonary infection score (CPIS) was used as a diagnostic tool for pneumonia and calculated on the basis of points assigned for 6 clinical criteria including body temperatures, leukocyte count, volume and appearance of endotracheal aspirate, oxygenation, chest X-ray and culture and gram staining of endotracheal aspirate.[8] Cultures of the lower respiratory tract secretions obtained by bronchoscopy such as Broncho Alveolar Lavage (BAL) or Protected Specimen Brush (PSB) are essential for deciding the antibiotic susceptibility of the etiological agent.[8] But bronchoscopy is an invasive procedure which cannot be performed in all suspected cases of VAP. Bronchoscopy may lead to cardiac arrhythmias, hypoxemia or bronchospasm. So it is usually performed only in the later stages of VAP.[9] But any delay in the administration of appropriate antibiotic therapy is associated with higher morbidity and mortality. So there is a need for a non-invasive technique which can be performed in patients suspected to have VAP.[10] Therefore this study is a modest attempt to explore the current bacterial pathogens towards appropriate therapeutic measures in minimizing morbidity and mortality.

Material and Methods

This was a descriptive type of cross sectional study conducted from January to December, 2018 among clinically suspected VAP patient admitted in Intensive Care Unit of Rajshahi Medical College Hospital. Sampling technique was purposive in nature and endo-tracheal aspirate was collected from patient under mechanical ventilation by endotracheal tube or tracheostomy tube for more than 48 hours. There were exclusions criteria where patient's attendant refused to give consent and patients were without infection. A narrow soft sterile disposable suction catheter was introduced through the endo-tracheal tube or tracheostomy tube after taking all aseptic precautions. A 10 cc disposable syringe was used for aspiration and 3 to 5ml aspirates were collected in a sterile test tube. The tube was then brought to the laboratory for further processing accordingly. The generated laboratory data were collected using a checklist and a prior verbal consent was taken from the relatives/guardians as available.

Results

After analysis results were presented as follows:

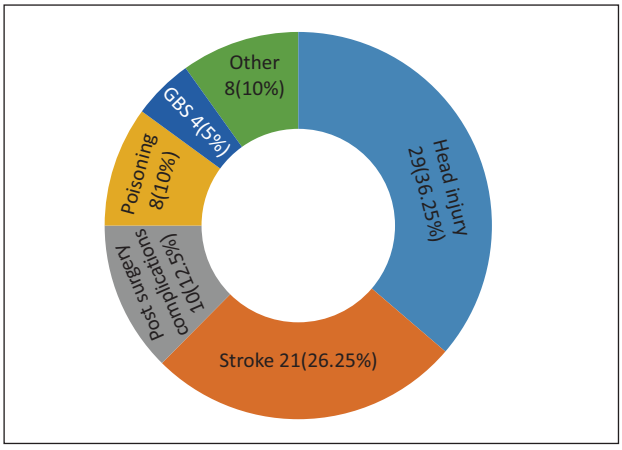


Figure1: Distribution of the respondents by Primary diagnosis of patients under study (n=80)

Figure 1 shows that majority of the patients' primary diagnosis was head injury(36.25%) followed by Stroke 21 (26.25%), Post Surgery complications 10 (12.5%), Poisoning 8 (10%), Guillian Barre syndrome (GBS) 4(5.0%) and others 8 (10.0%) (Eclampsia, Encephalitis and Myasthenia gravis).

Table 1: Distribution of the respondents by culture positivity result (n=80)

Culture positivity	Single isolated (%)	Multiple isolated (%)	Total (%)
Positive	72 (90%)	3 (3.75%)	75 (93.75%)
Negative	-	-	5 (6.25%)
Total			80 (100%)

Table 1 shows that among 80 cases 75 (93.75%) cases were culture positive and 5 (6.25%) cases were culture negative. Single and multiple isolated cases were 72 (90%) and 3 (3.75%) respectively among the culture positive cases.

Figure 2: Distribution of respondents by gram positive and gram negative isolates (n=78)

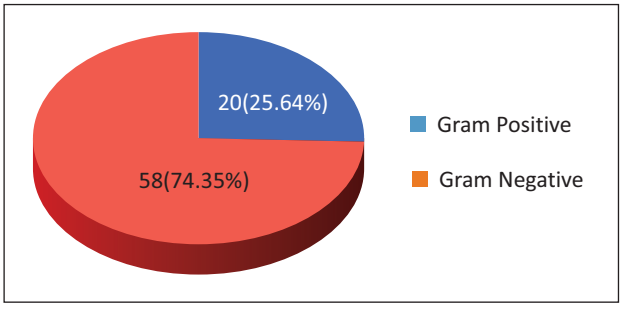
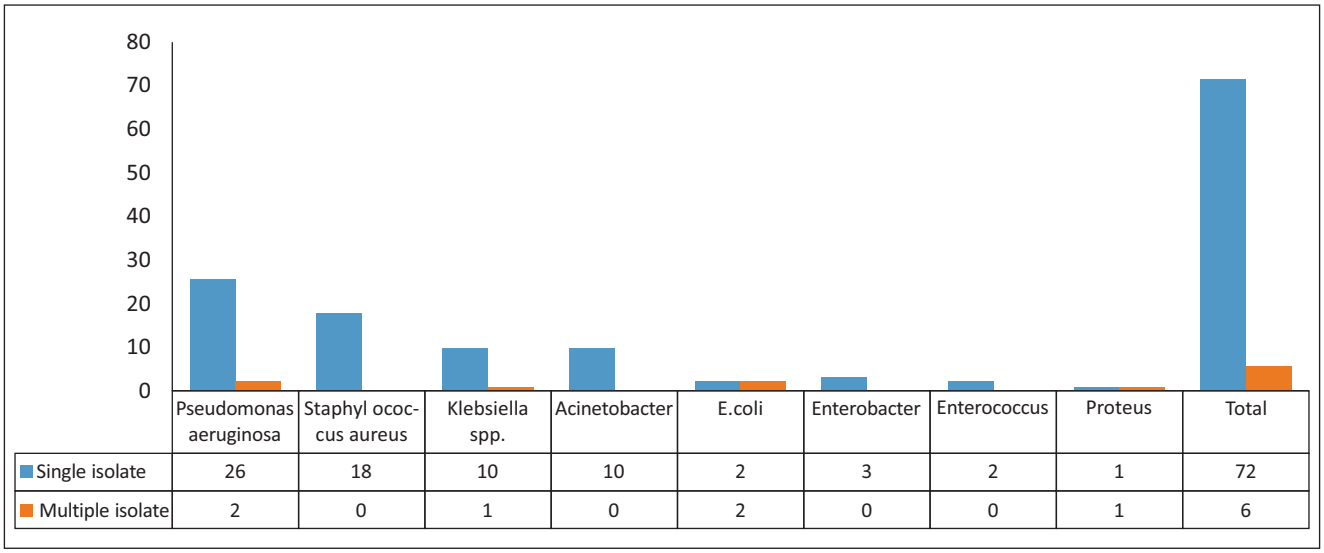


Figure 2 shows that among the total 78 isolates, gram negative bacteria predominated at 58 (74.36%) and gram positive bacteria were only 20 (25.64%).



	Pseudomonas aeruginosa	Staphyl ococcus aureus	Klebsiella spp.	Acinetobacter	E.coli	Enterobacter	Enterococcus	Proteus	Total
Single isolate	26	18	10	10	2	3	2	1	72
Multiple isolate	2	0	1	0	2	0	0	1	6

Figure 3: Distribution of the organisms by nature of isolation (n=78)

Figure 3 shows a total of 78 isolates, where *Pseudomonas aeruginosa* was the predominant organisms 28 (35.9%) followed by *Staphylococcus aureus* 18 (23.1%), *Klebsiella spp.* 11 (14.1%), *Acinetobacter spp.* 10 (12.8%), *Escherichia coli* 4 (5.1%), *Enterobacter spp.* 3 (3.8%), *Enterococcus spp.* 2 (2.6%), *Proteus spp.* 2 (2.6%).

Discussion

Ventilator Associated Pneumonia (VAP) remains a major contributor to hospital-acquired infection in Asia. VAP is an important nosocomial infection among ICU patients receiving mechanical ventilation [9]. It is a major cause of hospital morbidity and mortality despite recent advances in diagnosis and accuracy of management [11].

A total of 80 patient's endotracheal aspirates were collected from clinically suspected VAP cases of Intensive Care Unit of RMCH. The occurrence of VAP in different age groups and sexes were analyzed and among them male were more affected 48 (60%) compared to female 32 (40%). This study was nearly similar with Mallick*et al.,* 2015 in Bangladesh ; Sohal sing *et al.*, 2018 in India; Ali *et al.,* 2016 in Middle East [12,13,14] where male were predominant with 60%, 60% and 80.2% respectively. In my study most of the patient admitted in ICU with primary diagnosis head injury due to Road Traffic Accident (RTA) and construction work. In our country ratio of male employee are more than the female employees. This may be the reason of male predominance of the study. In the present study majority of the patient (85%) were between (21-60) years. This finding was consistent with studies done by Mallick *et al.,* 2015 in Bangladesh[12] who had reported a high incidence in the same age group. It may be a result of greater exposure, experimental and risks taking age as well as many in that group are beginning employees. Minimum numbers of cases (15%) were found in age group above 60 years. Dissimilarity was observed by Uddin *et al.,* 2018 in Bangladesh[15] and Rafiq*et al.,* 2015 in Pakistan[16] where the majority of the patients were above 60 years. This variation may be because most patients were admitted with primary diagnosis of stroke. In this study most founded primary diagnosis was head injury 29 (36.25%) which was similar with Soma Sarkar, 2012 in Bangladesh, Ali *et al.,* 2016 in Middle East. But findings of this study does not match with Gadani*et al.,* 2010 and Sarkar*et al.,* 2016 in India[11, 17] where highest number of cases were organophosphorus (OP) poisoning and post operative complication respectively. This variation may be due to the fact that in our country road traffic accidents are very common because of poor management of traffic system and incognizance of common people.

In present study monomicrobial infection occurred in 72 of 75 (96%) patients and polymicrobial infection in 3(4%) patients (Figure-II), all of them were infected with two pathogens. This finding was in agreement with De *et al,* 2018[18] in India where the incidence of polymicrobial infection were 7.5% and 5.7% respectively. This lower incidence of polymicrobial infection is due to less contamination of sample and wide use of antibiotics. Dissimilarity was observed by Turkovic*et al*, 2015 in Croatia [19] where the incidence were 41.9% and 33.33% respectively. Higher incidence of polymicrobial infection may be due to hospital settings and contamination during sample processing.

Regarding the pattern of bacterial isolates causing VAP, *Pseudomonas aeruginosa* was the highest 28 (35.9%) followed by *Staphylococcus aureus, Klebsiella spp.,Acinetobacter spp., Escherichia coli, Enterobacter spp., Enterococci spp.* and *Proteus spp.* The similar pattern of isolation was also noted by Selina*et al.*, 2009 in Bangladesh[3] (*P. aeruginosa* 35%, *S. aureus* 19%, *Klebsiella spp.* 16.3%, *Acinetobacter spp.* 15%) and Kalanuria*et al.,* 2014 in Washington[2] the pattern of bacterial isolates were *P. aeruginosa*24.4%, *S.aureus* 20.4%, *Klebsiella spp.*14.1%.

Our findings concerning the high frequency of *P. aeruginosa*(35.9%) greatly coincide with Sohal*et al.*, 2018 in India [13] and their observation were 40% and 36% respectively. In recent study Ali *et al.*, 2016 [14] in Middle East also noted *Pseudomonas* as the most predominant organism causing VAP. On the other hand, a lower isolation of *Pseudomonas* was observed by Uddin*et al.*, 2018 in Bangladesh [15] Ahmed*et al.,* 2014 in Pakistan [4,] Sarkar*et al.*, 2016 in India[17] in their observations the predominant organism were *Acinetobacter spp.* (29%), *Acinetobacter spp*. (36.1%), *Klebsiellaspp.* and *Enterobacteriaceae* (25%) respectively, though the 2nd Predominant organism was *P. aeruginosa.* in most of the cases. The high prevalence of *P. aeruginosa* may be because it is an opportunistic pathogen and one of the leading causes of nosocomial infection. It causes severe airway infections and while colonizing the human airways *P. aeruginosa*could acquire genetic mutations that often lead to its better adaptability to the host environment (Wang *et al.,* 2017)[20] and develops resistant to commonly used antimicrobial agent.

In the present study *Staphylococcus aureus*was 18 (23.1%) the 2nd most frequently recovered bacterial isolate followed by *Klebsiella spp.* 11 (15.4%), *Acinetobacter spp.* 10 (12.8%), *Eshcherichia coli* 4 (5.1%), *Enterobacter spp.* 3 (3.8%), *Enterococci spp.* 2 (2.6%) and *Proteus spp.* 2 (2.6%). The present study was similar with other studies conducted by kalanuria*et al* [2], 2014 in USA and Aykac*et al.*, 2017 in Middle East[21]. Dissimilarity was observed with Rafiq*et al.*, 2017 in Pakistan[16] (*Acinetobacter spp.* 54.2%, *MRSA* 18.6%, *Klebsiella spp.* 15.2%, *P. aeruginosa* 8.47%); Bonell*et al.*, 2018 in UK[22] (*Acinetobacter* 26%, *P. aeruginosa*22%, *S. aureus* 14%). This variation may be due to multifactorial causes such as geographical location, presence of many systemic diseases, longer stay in hospital and duration of ventilation.

Conclusion

Ventilator Associated Pneumonia (VAP) was a significant cause of morbidity and mortality in critically unwell patients. Male below the age of 60 years and above 21 years were mostly affected. Majority of the patient admitted with primary diagnosis were head injury and stroke. Most of the clinically suspected cases are culture positive which has accentuated the significance of this clinical condition. Gram negative bacteria are predominant over gram positive bacteria. *Pseudomonas aeruginosa*is the most frequent organism causing VAP. The study recommends the need of careful attention and strict management protocol for cases having head injury and stroke to avoid VAP associated morbidity and mortality in deed.

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