ORGANISM CAUSING VENTILATOR-ASSOCIATED PNEUMONIA IN CHILDREN PRESENTING AT TERTIARY CARE HOSPITAL, KARACHI

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ABSTRACT

Objective: To determine the prevalence of organism causing ventilator associated pneumonia (VAP) in children presenting at Tertiary Care Hospital, Karachi.

Study Design: A cross-sectional descriptive study.

Place and Duration of Study: The study has been conducted at MICU of Zia Uddin Hospital Karachi, from Aug 2015 to Jul 2016.

Material and Methods: Patients required mechanical ventilation were included in the study from the age range of 6 months to 15 years. Information for the assessment was retrieved from the hospital databases with hospital's ethical approval and consent from patients' parents or guardians.

Results: Prevalence of VAP had been high among males and the children belonging to age range of 6 months to 4 years. Out of 83 patients, Pseudomonas aeruginosa (38.6%), *E. coli* (30.1%), *Staphylococcus aureus* (9.6%), *Klebsiella* (9.6%), *Streptococcu*s (7.2%) and *Acinobacter* (4.8%) with VAP.

Conclusion: The need for preventive measures and treatment options to avoid the bacterial colonization in the patients undergoing mechanical ventilation.

Keywords: Children, Mechanical ventilation, Ventilator-associated pneumonia.

INTRODUCTION

Ventilator - associated pneumonia or VAP is basically a hospital acquired pneumonia[1]. The nosocomial pneumonia has been noted to be highly prevalent among the patients who undergo the treatment of mechanical ventilation or MV. It occurs following 48 to 72 hours of MV within a clinical setting. Mechanical ventilation serves to assist gaseous exchange without inducing any trauma to the respiratory system. However, it has still been noted that MV can stress the lungs due to high volume and pressure[2]. As per International Nosocomial Infection Control Consortium, the prevalence of VAP has been estimated to be 13.6 in 1000 days on ventilation[3]. On the other hand, incidence of the condition tends to vary with regard to the group of subjects within a particular clinical setting. According to an estimation, the occurrence of ventilator - associated pneumonia accounts for 5 to 7 days on average. Moreover, the associated morality rate has recorded to be about 24% to 76%, which is attributed to rise if the patients are presented with critical condition[4]. Subsequently, the condition is also known to increase the duration of intensive care unit admission that ultimately exerts burden on the cost management.

Ventilator - associated pneumonia is categorized into two formations based on the time of onset. As the name indicates, early onset VAP occurs within the initial four days with MV, which is often triggered due to the bacteria that are sensitive to antibiotics; while, late onset VAP occurs after five or more days of MV, which is usually triggered in response to the pathogens that express multidrug resistance. It has been realized that early diagnosis can assist in applying antibiotic therapies in a more efficient manner[5].

Diagnosis of VAP has been subjected to clinical criteria that include the indications of

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fever, increased white blood cells, persistent or new x-ray infiltrates, purulent bronchial secretions and impaired oxygenation. High clinical suspicion, along with radiological examination, and culture of respiratory secretions are required for the diagnosis of VAP. Due to the commonly occurring nature of these symptoms, VAP has been found to be misdiagnosed in a number of patients in the hosiptals[6,7]. Micro-biological characteristics are presumed to vary with the differences of hospitals and suscepti-bility of the patient. It has been deemed over and again that authentic diagnosis of VAP and identification of the causative agent can significantly help in reducing the morality rate and health care expenses[7].

Pathogenesis of VAP among children is a poorly understood modality of the disorder[8]. Studies have suggested various associated factors concerning the occurrence of VAP in children, however there is still a need to collect evidences on the local grounds. The study aims to evaluate the patients of ventilator - associated pneumonia in the children ward for identifying the causative microorganisms presenting with the disease. It has been presumed that the data was collected from a tertiary care hospital of Karachi city, Pakistan, will provide the local data that can be further analysis assessed. It can assist in developing future plans for managing and preventing the disease occurring in the region.

PATIENTS AND METHOD

A cross-sectional descriptive study was conducted at Medical Intensive Care Unit (MICU) of Ziauddin Hospital, Karachi, from the period of August 2015 to July 2016. Eighty-three sample size was calculated according to visiting patients. The inclusion criteria for the study stated and selected children through proper sampling technique from the age range of 6 months to 15 years. All the individuals were selected on the basis of confirmed diagnosis of ventilator – associated pneumonia by the clinic. It was ascertained that the identified patients were on mechanical ventilation for more than 48 hours and presented any two of the following clinical features:

At least two of the symptoms suggesting nosocomial infection, not previously observed: unexplained fever >101°F, total leukocyte count <4000 or >15000 per mm, neutrophils >80%, serum CRP >48 mg/L or new chest findings

Table-I: Distribution of age and gender among the study group (N=83).

	Gender		
Age	**Male N (%)**	**Female N (%)**	**Total N (%)**
6 Months - <4 Years	19 (65.5%)	10 (34.5%)	29 (34.9%)
4 - <6 Years	14 (70%)	6 (30%)	20 (24.1%)
7 - <9 Years	5 (33.3%)	10 (66.7%)	15 (18.1%)
10 - <12 Years	10 (71.4%)	4 (28.6%)	14 (16.9 %)
13 - <15 Years	2 (40%)	3 (60%)	5 (6%)
Total N (%)	50 (60.2%)	33 (39.8%)	83 (100%)

Table-II: Diestribution of VAP associated micro-organisms with the gender of patients (N=83).

	Gender		
Organisms	**Male N= 50 (%)**	**Female N=33 (%)**	**Total N=83 (%)**
PSEUDOMONAS	21 (65.6%)	11 (34.4%)	32 (38.6%)
ESCHERICHIA COLI	16 (64%)	9 (36%)	25 (30.1%)
KLEBSIELLA	6 (75%)	2 (25%)	8 (9.6%)
STAPYLOCOCCI	3 (37.5%)	5 (62.5%)	8 (9.6%)
STREPTOCOCCI	0 (0%)	6 (100%)	6 (7.2%)
ACINETOBACTER	4 (100%)	0 (0%)	4 (4.8%)

on examination suggestive of pneumonia, or purulent tracheal secretions;

Radiological evidence of new or progressive and persistent infiltrates.

Reports of microbiological examination were retracted from the official databases, for these patients. The study was approved by ethical committee and was following the declaration of Helsinki guidelines. The confidentiality and consent patients were the main criteria to follow. Moreover, consent was obtained from the parents or guardians of the recruited patients prior to the data collection. Identity of the patients was kept anonymous while extracting and analysing the data. Data has been entered in the SPSS version 16 after coding. Descriptive statistics was used to calculate the frequencies of categorical variables, and to compute means and standard deviations of continuous variables.

RESULTS

A total of 83 patients confirmed to the inclusion criteria of the study, presenting with VAP within the selected clinical setting during the study period. Out of 83 patients, the mean age of the patients is 5.32 ± 2.1 years. The study group consisted of 50 males (60.2%) and 33 females (39.8%). Table-I displays the age and gender distribution among the study participants.

Average duration of a hospital stay in the intensive care unit, for the study group, was estimated to be 8.36 ± 3.32 days. Amongst 83 individuals, 15 (18.1%) of the patients developed the ventilator associated pneumonia within 5 days of MV application. While, 68 (81.9%) of them developed VAP after 5 days of MV intervention. Out of total 83 patients, 32 (38.6%) were admitted with surgical problems whereas, 51 (61.4%) were presented with other medical problems.

Apart from basic record of the patient, the study also retrieved results of the blood samples tested for micro-organisms. The observations presented that 62 (74.7%) expressed mono - microbial growth while, 21 (25.3%) showed poly - microbial growth in the provided samples. Pseudomonas aeruginosa was identified as the most commonly occurring micro - organism among the samples of study group. Figure shown the prevalence of all the micro - organisms recorded in the study.

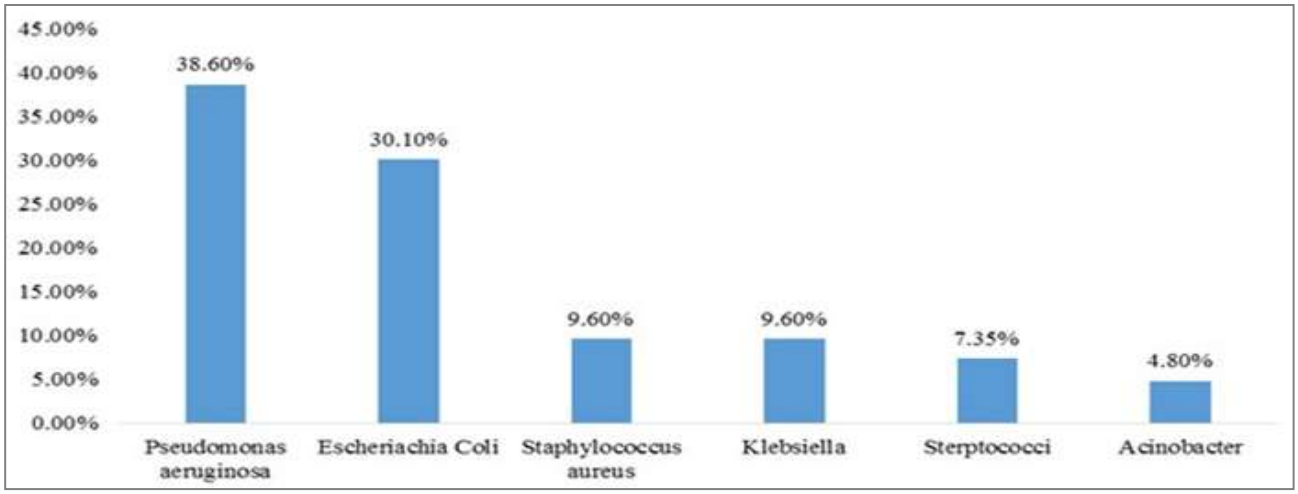

Figure: The prevalence of all the micro – organisms recorded in the study.

The result of the study indicates that VAP is more prevalent in males as compared to the females. The incidence of VAP associated micro–organisms among the genders has been presented in table-II.

Moreover, the prevalence has been recorded to be high among the children, who belonged to age range of 6 months to <4 years. The incidence

of VAP associated micro – organisms among the age groups has been presented in table-III.

DISCUSSION

Ventilator-associated pneumonia (VAP) is recognized as the most common nosocomial infection in patients on mechanical ventilation that results in an increase in the mortality, length of hospital stay, duration of ventilation and health costs. Factors for VAP are well-documental and evidence based, yet remain poorly implemented in most intensive care units. Further, VAP is also known to deliver added complication to the patient presenting in paediatric intensive care unit. Even though, VAP has been observed to occur commonly among intensive care units (ICU), attention is being provided more to the paediatric population due to the lack of research and evidences[9,10]. This study was performed to evaluate the presenting association between children with VAP and micro – organism for providing an insight of the local incidence.

Table-III: Distribution of VAP associated micro-organisms with the age of patients (N=83).

Organisms	Age					
	6 Months -<4 Years N (%)	**4 - <6 Years N (%)**	**7 – <9 Years N (%)**	**10 - <12 Years N (%)**	**13 - <15 Years N (%)**	**Total N (%)**
Pseudomonas	11 (34.3%)	10 (31.3%)	6 (18.8%)	3 (9.4%)	1 (3.1%)	32 (38.6%)
Escherichia Coli	8 (32%)	3 (12%)	6 (24%)	5 (20%)	3 (12%)	25 (30.1%)
Klebsiella	2 (25%)	4 (50%)	0 (0%)	2 (25%)	0 (0%)	8 (9.6%)
Stapylococci	3 (37.5%)	2 (25%)	1 (12.5%)	2 (25%)	1 (12.5%)	8 (9.6%)
Streptococci	3 (50%)	1 (16.7%)	2 (33.3%)	0 (%)	0 (%)	6 (7.2%)
Acinetobacter	2 (50%)	0 (0%)	0 (0%)	2 50%)	0 (0%)	4 (4.8%)

This study indicated that VAP was more common in male than female patients, as presented in another studies. For instance, Malhotra, Mehra & Siddque (2015) conducted a serological study in India where they indicated male dominance in the presenting patients of VAP[11]. Despite of the fact that females acquire VAP comparatively less likely than males, it has been noted that they tend to be the most affected group. Mortality rate associated with VAP inclines to be higher in females along with the increase severity in the condition[12].

It has been identified that ventilator associated pneumonia develops in response to the bacterial colonization in the lower respiratory tract, or particularly the pulmonary parenchyma, in the patient who has been undergoing the mechanical ventilation. Bacteria can form colony in the lower respiratory tract despite of the sterile environment. It is known that the bacteria encouraged to colonize within the breathing system due to the influence of secretory mediums within the tract, aerial bacteria carried to the patient and contamination of the equipment used for patient's treatment[13]. In addition, gastric content, nebulisers, and circuits forming the ventilators can also provide the medium needed for bacterial colonization[5].

Normally, respiratory system clears the secretions from the respiratory tract by the action of mucus - cilia lining the pharynx and larynx, and by coughing reflex. Patients on mechanical ventilation remains in an unconscious state that deprives their system from clearing the oropharyngeal tract secretions. While, the immune system also remains in an ineffective state, the bacteria get encouraged to form colonies. These bacteria normally inhabits the respiratory system but due to declined immune response they are stimulated to grow and spread[5].

Children on mechanical ventilation appear to be at greater risk of developing VAP than adults. Studies have identified that the most common micro - organism associated with VAP has been Pseudomonas aeruginosa, Staphylococcus aureus, and Haemophilus influenzae[13].

Results of this study has also provided the similar results for the pathogen Pseudomonas[14].

Microbiology of VAP has been deemed as extremely essential to plan appropriate management. This study showed high prevalence of gram negative bacteria with Pseudomonas, Klebsiella and *E. coli* being common. Amongst gram positive organism Staphylococcus aureus and Streptococcus pneumoniae were prevalent. Gram negative bacteria normally inhabit the lower digestive tract of the body. Antibiotic treatment is known to suppress the normal expression of normal flora in the gastrointestinal tract that stimulates the pathogens to multiply in number and enhance the colonization. These bacteria expressed resistance towards penicillin and cephalosporin. Moreover, they are known to be associated with the extended spectrum beta lactamase (ESBL). Gram positive bacteria are recognized as the significant micro – organism contributing to the condition of VAP and other hospital acquired infections. These bacteria forms their colonies in the anterior nares and are commonly observed in the patients of young age. These bacteria are known to be sensitive towards the administration of penicillin. However, these pathogens have been recognized to develop towards methicillin thus, adding to the complications. Preceding factors for the gram negative colonization may include the previous treatment with antibiotics and bronchoscopy, chronic obstructive pulmonary disease, extended period on mechanical ventilation and presenting steroidal intervention[5].

Effective infection controls measures should be taken to reduce the chance of infection. Non- invasive ventilation should be used in selected cases with respiratory failure whenever possible. Studies have indicated that non-invasion ventilation is an effective treatment. It has been incorporated in the treatment approaches of the conditions like cardiogenic pulmonary edema, exacerbation of chronic obstructive pulmonary disease and acute respiratory failure. The non - invasive modality has indicated lesser complications that commonly occurs with ventilation. Further, it has also demonstrated improvements in the survival rates of the patients[15].

It should be considered highly necessary for the healthcare practitioners to seek education and awareness for the possible preceding factors of ventilator associated pneumonia, particularly in children and infants. The study has emphasized on the significant role of micro – organisms in causing the condition. These pathogens have been identified in the previous studies conducted in other location and thus, this study provides the evidence of similar pattern occurring in the local hospitals of Karachi. It is now essential to outline and develop preventive measures and identify treatment alternatives for mechanical ventilation for avoiding the presenting risk factors and complications.

CONCLUSION

Prevalence of ventilator associated pneumonia has been majorly observed with the incidence of gram negative bacilli. As observed in the literature, the prevalence of VAP has been observed to be high amongst infants and children. The condition is known to add burden on the patient and further create debilities by expressing resistance towards the anti – microbial treatment. It has been deemed necessary to organize efforts for enhancing the efficacy of medical and paramedical staff to identify and control the risk of VAP. Knowledge of local agents is considered of great value in this context that can serve to form a helpful setup for dealing with the complications of VAP.

CONFLICT OF INTEREST

Authors hold no conflict of interest in this study.

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