Original Article

Frequency and Etiology of Ventilator-Associated Pneumonia in Pediatric Intensive Care Unit of Services Hospital Lahore

Muhammad Saleem, Muhammad Abbas, Muhammad Khalid Masood, Muhammad Idris Mazhar, Ayesha Abbas and Zainab Abbas

Objective: To determine the frequency of ventilator associated pneumonia in children and to find out the common causative organisms involved in ventilator associated pneumonia.

Methods: This cross sectional study was conducted in department of Pediatrics, Services Hospital Lahore over a period of one year from July 2014 to June 2015. Ethical approval was taken from institutional review committee. A total of 200 children were included in study after taking informed consent. Data was collected by using predesigned questionnaire. The data was analyzed by SPSS version 21.

Results: Out of total 200 children, 43.5 % (n=87) were between 1-6 years of age, while 56.5% (n=113) were between 7-12 years of age, mean ±SD was 6.63±3.12 years. 59.5 % (n=119) were males and 40.5 %(n=81) females. Frequency of ventilator associated pneumonia in children was 8.5% (n=17). Causative organism in cases with VAP in children shows 52.94% (n=9) Pseudomonas, 29.41% (n=5) Klebsiella, 11.77% (n=2) E.Coli and 5.88%(n=1) other causative organism.

Conclusions: The frequency of VAP is quite high in children on mechanical ventilation. A high suspicion and timely intervention can reduce morbidity and mortality associated with this disorder.

Keywords: ventilator associated pneumonia, frequency, common causative organisms.

Introduction

Ventilator-associated pneumonia (VAP) is a type of nosocomial pneumonia that occurs in patients who receive mechanical ventilation. It is usually acquired in the hospital setting approximately 4872 hours after mechanical ventilation.[1] VAP is different from community acquired pneumonia not only from etiological point of view but also in context with its pathophysiology, risk factors, management strategies and outcome.[2] It is of two types, early onset and late onset. Early-onset VAP occurs during the first four days of mechanical ventilation and is usually caused by antibiotic sensitive bacteria. Late-onset VAP develops five or more days after initiation of mechanical ventilation and is caused by multidrug-resistant (MDR) pathogens.[3]

The frequency of VAP varies in different age groups and intensive care settings. It is the second most frequent nosocomial infection in pediatric intensive care units (PICUs) in the United States. The incidence of VAP ranges from 1351 per 1,000 ventilation days.[4] A number of risk factors like duration of mechanical ventilation, recurrent change in ventilator tubing, kind of circuit used, feeding tube, reintubation etc. has been studied as some important risk factors for VAT.[5,6,7]

The mean duration of occurrence of VAP is around 57 days. The mortality associated with VAP ranges from 2476 per cent, and is even higher among critically ill patients.[8]Much work has been done on VAP in adults, but research data on VAP in children is sparse.[9]

Diagnosis of VAP has been a subject of on-going debate. High clinical suspicion along with radiological examination and culture of respiratory secretions are required for the diagnosis of VAP. VAP is not only associated with increased mortality but also increases the length of ICU stay, the cost of treatment and the chances of ventilator dependence.[10]

It is important to identify the burden of VAP in any setup, so that prevention strategies can be implemented and strengthened. Amongst the challenges in any intensive care settings, curtailing nosocomial infections like VAP is an important issue. The prevalence of VAP in different setups varies.[11,12]

A recent study[8] conducted in Pakistan shows that out of the 93 children requiring mechanical ventilation, 16 developed VAP (17%), 23 (25%) show positive culture on tracheal aspirate and common organisms isolated were Pseudomonas 15 (65%), Klebsiella 5 (22%), E. Coli 2 (8%) and other 1 (4%).[13] While another study[2] reported that overall VAP occurs in 3 to 10% of ventilated pediatric ICU (PICU) patients.

As all above mentioned studies are showing a significant difference in frequency of VAT in different set ups so there is a need to further study this subject in local set up so that the burden of VAP and its causative organisms in our population may be identified, and prevention strategies can be implemented and empirical therapy can be started based on identified organism.

Methods

This cross sectional study was conducted in Pediatric Intensive Care Unit of Services Hospital Lahore from July 2014 to June 2015, after getting approval from Institutional review board.

Convenient non probability sampling technique was used and a total of two hundreds children admitted in Pediatric Intensive Care Unit of Services Hospital, Lahore who underwent mechanical ventilation, were included. Already diagnosed cases of pneumonia (on history and medical record), patients presenting with cardiac failure (on physical examination i.e edema, raised Jugular Venous Pressure and basal crepitations in chest) were excluded from study. Informed consent was taken from parents. Demographic profile (age and gender) was recorded. Every child on mechanical ventilator was followed till complete treatment on ventilator. The patients were assessed for the development of ventilator-associated-pneumonia. Tracheal aspirate were taken from the tip of endotracheal tube and sent to laboratory for culture and sensitivity. Chest x-rays were done in all cases. All this information was recorded by the researcher himself on a pre-designed proforma. The data was analyzed through SPSS version 21. Mean +SD was calculated for age. Frequency and percentages were calculated for categorical variables. Stratification for age and gender was done to control the effect modifiers. Post stratification chi-square test was applied. P-value ≤0.05 was considered significant.

Results

A total of 200 cases fulfilling the inclusion /exclusion criteria were enrolled to determine the frequency of ventilator associated pneumonia (VAP) in children along with causative organisms.

Age distribution of the patients shows that 43.5% (n=87) were between 1-6 years of age while 56.5% (n=113) were between 7-12 years of age, mean +SD was calculated as 6.63+3.12 years.**(Table-1)**

Patients were distributed according to gender showing 59.5% (n=119) male and 40.5% (n=81) F[illegible] **(Table-2)**

Table-1: Age distribution (n=200).

Age (in years)	No. of Patients	Percentage (%)
21 - 6	87	43.5
7-12	113	56.5%
Total	200	100%
Mean±SD	6.63± 3.12	

Table-2: Gender distribution (n=200).

Sex	No. of Patients	Percentage (%)
Male	119	59.5%
Female	81	4.05%
Total	200	100%

Table-3: Frequency of ventilator associated pneumonia in children (n=200).

VAP	No. of Patients	Percentage (%)
Yes	17	8.5%
No	183	91.5%
Total	200	100%

Table-1: Frequency of causative organisms in cases with ventilator associated pneumonia in children (n=17).

Causative Organisms	N.o of Patients	Percentage (%)
Pseudomonas	09	52.94%
Klebsiella	05	29.41%
E.Coli	02	11.77
Staphylococcus Auresus	01	5.88%

Table-5: Stratification for ventilator associated pneumonia in children with regards to age (n=200).

Age (in years)	VAP (n=17)		P-Value
	Yes	No	
1-6	08	79	
7-12	09	104	0.75

Table-6: Stratification for ventilator associated pneumonia in children with regards to gender (n=200).

Gender	VAP (n=17)		P-Value
	Yes	No	
Male	07	112	
Female	10	71	0.10

Frequency of ventilator associated pneumonia in children was recorded in 8.5% (n=17) while 91.5% (n=183) cases did not develop VAP. **(Table-3)**
Frequency of causative organisms in cases with ventilator associated pneumonia in children was recorded where out of 17 cases of VAP, 52.94% (n=9) had Pseudomonas, 29.41% (n=5) had Klebsiella, 11.77% (n=2) had E.Coli and 5.88% (n=1) had Staphylococcus aureus **(Table-4).** Stratification for VAP in children with regards to age shows that out of 17 cases, 8 were between 1-6 years and 9 were 7-12 years of age, p-value was calculated as 0.75 **(Table-5).** Stratification for ventilator associated pneumonia in children with regards to gender shows that out of 17 cases, 7 were male and 10 were female, p-value was calculated as 0.10 **(Table-6).**

Discussion

Healthcare-associated infections (HAIs) are associated with morbidity, mortality, and prolonged hospitalization, and represent a serious threat to patient safety. Hospitalized children especially admitted in PICU are more vulnerable. The use of invasive devices in PICUs, such as central vascular lines and mechanical ventilation make them more prone to develop pneumonias and sepsis. In this study, we planned to find out the causative organism and the frequency of ventilator associated pneumonia in children admitted in PICU Services Hospital Lahore. In our study, 43.5% (n=87) were between 1-6 years of age while 56.5% (n=113) were between 7-12 years of age, mean $\pm$SD was calculated as 6.63$\pm$3.12 years, 59.5% (n=119) male and 40.5% (n=81) females. Frequency of ventilator associated pneumonia in children was recorded in 8.5% (n=17). Causative organism in cases with ventilator associated pneumonia in children shows that out 17 cases of VAP, 52.94% (n=9) had Pseudomonas, 29.41% (n=5) had Klebsiella, 11.77% (n=2) had E.Coli and 5.88% (n=1) had Staphylococcus aureus. A recent study by Hamid et al[13] conducted in Pakistan, out of the 93 children requiring mechanical ventilation, 16 developed VAP (17%), 23 (25%) show positive culture on tracheal aspirate and common organisms isolated were Pseudomonas 15 (65 %), Klebsiella 5 (22%) and E.Coli 2 (8%), other 1(4%).[13] These findings regarding frequency of VAP are quite different from present study but causative organisms are similar. Regarding etiology the results are similar. Foglia and others[2] reported that overall VAP occurs in 3 to 10% of ventilated pediatric ICU (PICU) patients; our findings are consistent with this study. Shaath and others[14] investigated the incidence of VAP in children after cardiac surgery and its impact on morbidity and mortality. One hundred thirty-seven patients were recruited, 65 (48%) female and 72 (52%) male and recorded VAP occurred in 9 patients (6.6%); these findings are similar to our study although these children had associated cardiac disease. Gautam [15] determined the incidence, risk factors and impact of ventilator-associated pneumonia (VAP) in a mixed tertiary paediatric intensive care unit. Out of 692 invasively ventilated patients, 269 (38.9%) were ventilated for > 48 hours. Eighteen (6.7%) patients had episodes of VAP. Yankov and others[16] are of the view that Ventilator-associated pneumonias have been estimated to be the second most common nosocomial infections among children treated in intensive care units. They occur in mechanically ventilated patients through endotracheal tube or tracheostomy. The ventilator associated pneumonia is associated with a longer antibiotic treatment, greater duration of mechanical ventilation (MV) and higher mortality rates in children. The condition is also associated with a higher cost of the treatment. The common causative organism of nosocomial infections in this age are P. aeruginosa, E. coli and K. pneumoniae. The pathogenesis of the condition is inadequately studied but the aspiration of gastric contents and immune deficiency are proven risk factors. Two mechanisms have a major role in the development of the disease: micro-aspiration of gastric contents and colonization of the lower airways with pathogens. The above discussion reflects that frequency of ventilator associated pneumonia in children varies greatly among different authors from 6 % to 17%. In our clinical setup, the result is comparable to other studies.

Conclusion

The frequency of ventilator associated pneumonia is high among children. High clinical suspicion along with radiological examination and culture of respiratory secretions are required for the diagnosis of VAP. So, it is recommended that every child who is on mechanical ventilator for >48 hours, suspicion of VAP should be high. As Pseudomonas is a leading causative organism followed by Klebsiella and E.Coli, it is also required that every set-up should have their surveill- ance in order to know the frequency of the problem.

Department of Paediatric Medicine
SIMS/Services Hospital, Lahore.

References

1. Rello J, Diaz E. Pneumonia in the intensive care unit. Crit Care Med. 2003;31:254451.
2. Foglia E, Meier MD, Elward A. Ventilator-associated pneumonia in neonatal and pediatric intensive care unit patients. Clin Microbiol Rev 2007;20:409-25.
3. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med. 2002;165:867903.
4. Joseph NM, Sistla S, Dutta TK, Badhe AS, Parija SC. Ventilator-associated pneumonia in a tertiary care hospital in India: incidence and risk factors. J Infect Dev Ctries. 2009;3:7717.
5. Kostadima E, Kaditis AG, Alexopoulos EI, Zakynthinos E, Sfyras D. Early gastrostomy reduces the rate of ventilator-associated pneumonia in stroke or head injury patients. Eur Respir J. 2005;26:10611.
6. Ibrahim EH, Ward S, Sherman G, Kollef MH. A comparative analysis of patients with early-onset vs late-onset nosocomial pneumonia in the ICU setting. Chest. 2000;117:143442.
7. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit Care Med. 2002;165:867903.
8. Choudhuri AH. Ventilator-Associated Pneumonia: When to hold the breath? Int J Crit Illn Inj Sci. 2013;3:16974.
9. Sachdev A ,Asselin J, Gildengorin G, PhDc J. A Prospective Study of Ventilator-Associated Pneumonia in Children. Pediatrics 2009;123:1108-15.
10. Katherason SG, Naing L, Jaalam K, Musa KI, Mohamad NAN, Aiyar S. Ventilator-associated nosocomial pneumonia in intensive care units in Malaysia. J Infect Dev Ctries 2009;34:76.
11. Srinivasan R, Asselin J, Gildengorin G, Wiener-Kronish J, Flori HR. A prospective study of ventilator-associated pneumonia in children. Pediatrics 2009;123:1108-15.
12. Patra PK, Jayashree M, Singhi S, Ray P, Saxena AK. Nosocomial pneumonia in a pediatric intensive care unit. Indian Pediatrics 2007;44:511-8.
13. Hamid MH, Malik MA, Masood J, Zia A, Ahmad TM. Ventilator-Associated Pneumonia in Children. JCPSP 2012;22(3):155-8.
14. 14.Shaath GA, Jijeh A, Faruqui F, Bullard L, Mehmood A, Kabbani MS. Ventilator-associated pneumonia in children after cardiac surgery. Pediatr Cardiol. 2014;35(4):627-31.
15. Gautam A, Ganu SS, Tegg OJ, Andresen DN, Wilkins BH, Schell DN. Ventilator-associated pneumonia in a tertiary paediatric intensive care unit: a 1-year prospective observational study. Crit Care Resusc. 2012;14(4):283-9.
16. Yankov IV, Shmilev TI. Ventilator-associated pneumonias in children (I)--diagnostic criteria, etiology and pathogenesis. Folia Med (Plovdiv).