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**ORIGINAL ARTICLE**

# Mortality Rate and Causing Factors in Ventilator Associated Pneumonia in Children

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## ABSTRACT

**Aim:** To estimate the incidence of ventilator-associated pneumonia (VAP) and to identify causing microbiological organismsand VAP related mortality rate in children admitted to the ICU.

**Study design:** This was a Cross-sectional and an observational study.

**Study place and duration:** In the Pediatric department of Abbasi Shaheed Hospital, Karachi, for one-year duration from May 2020 to May 2021.

**Methodology:** All admitted children to the pediatric ICU (PICU) and ventilated were selected and observed for any features suggestive of VAP. All suspected children have Partial septic signs. A VAP will be categorized ifchild remains on ventilator for more than 48 hours and when a patient had 2 of these signs of nosocomial infection - TLC <4,000 or> 15,000 mm3 , fever> 101 ° F, CRP> 48 mg / L, neutrophils> 85% or a new chest X-rayexhibited pneumonia withradiological sign of progressive, persistent or new infiltrates. The chi-square test was used for comparison of percentages with a value of Less than 0.05 p.

**Results:** Of all the cases admitted, the average length of ICU stay was 8.65 ± 6.45 per day. Children who needed VAP required 14.2 ±9.5 days of ventilation and 7.5± 5.2 days for children who have not VAP progression. Of 100 cohort of children necessitating ventilation, 22 died and 2 were left without advice or serious illness, with a total mortality of 22%.

**Conclusion:** The VAP incidence in this study was 22%. Features related with a higher incidence of ventilator-associated pneumonia include age <1-year, continuous intravenous sedation and unplanned intubation in emergency situation. Features suggestive of underlying VAP encompassed, CRP> 48 mg / L, purulent tracheal secretions, positive tracheal culture of aspirate and positive X-ray results.

**Key words:** Ventilator-associated pneumonia (VAP), Nosocomial infections,PICU and Children.

## INTRODUCTION

Mechanical ventilation is the keystone of the treatment of serious patients and patients in the PICU. This system has its peculiarhazards and complications[1-2]. One of these complications is the possibility of developing ventilator-associated pneumonia (VAP)[3]. A patient with ventilator-related pneumonia is defined as pneumonia that occurs after being on a ventilator for more than 48 hours. VAP differs not only in the etiology of environmental pneumonia, but also in pathophysiology, risk factor, management strategy, and outcomes[4-5]. The diagnosis of VAP is a constant topic of discussion. The diagnosis of VAP in combination with radiological examination and culture of respiratory secretions requires high clinical suspicion. In the field of intensive care, a major concern is the reduction of nosocomial infections such as VAP[6]. The prevalence of VAP varies with different constellations. It is important to determine the exposure to VAP at each facility in order to implement and strengthen prevention strategies. VAP is associated not only with an increase in deaths, but additionallyenhance the stay time in the intensive care unit, cost of treatment and increase the chances of ventilation dependence[7]. Several causing factors have been recognized that may stimulus the VAP development. Alike other nosocomial infections, the VAP microbiology may differ from site to site, and certainly the pattern of antibiotic susceptibility may not differ from entity to entity, but it may change periodically from entity to entity[8-9]. Mechanical ventilatory services are becoming popular in new developing centers in Pakistan for children[10]. Therefore, it is significant to recognize the features of ventilation-associated pneumonia in the local setting. In this background, this analysis was conducted to assess the prevalence of VAP and to identifyetiological factors, risk factorsand VAP outcomes among children in PICU.

## METHODOLOGY

This was a Cross-sectional and an observational study held in the Pediatric department of Abbasi Shaheed Hospital Karachi, one-year duration from May 2020 to May 2021. Children who require surgical ventilation and have heart disease are admitted to different intensive care units. All children who were mechanically ventilated throughout the analysis were encompassed in this study. They were examined for features that suggestnosocomial infections or VAP, particularly of the tracheal purulent secretions, persistent and new changes in the chest on auscultation, and instability in body temperature. All patientsendured partial septic examination, TLC and DLC, urine and blood cultures, CRP (serum C-reactive protein), chest X-ray and tracheal aspirate culture. The tips of the tracheal tubers were sent for the culture and sensitivity if the tube required

replacement or at extubation. Criteria for diagnosing VAP have been adjusted and modified in line with CDC guidelines. A VAP will be categorized if child remain on ventilator for more than 48 hours and when a patient had 2 of these nosocomial infections - TLC <4,000 or> 15,000 mm3 each, fever> 101 ° F, CRP> 48 mg / L, neutrophils> 85% or a new chest X-ray exhibited pneumonia and there is radiological sign of progressive, persistent or new infiltrates. There has been change in empiric antibiotic therapy depending on the blood or tracheal cultures.

In other studies, with a frequency of 12%, a worst frequency acceptable of 18% and an annual admissionrate (approximately 500 inhabitants), the sample size was calculated at the 95% confidence level using the Epi statistical program (version 6.0). the total sample size calculated was 100 patients. All clinical, demographic, microbiological and radiological data are entered in SPSS 22.0. To calculate standard deviations, mean of continuous variables and frequency of categorical data;Descriptive statistics were used. The Fisher exact test and Chi-square test were used to test categorical variables (ventilation mode, gender, sedation, etc.). The student test was used to know the varianceamongst continuous variables (ventilation time, stay time etc.). A p value < 0.05 was measured significant statistically. The two groups were made of all children hospitalized during the study time: children with ventilator-associated pneumonia and children without ventilator-associated pneumonia. A 2x2 table was created for each categorical variable andforcomparisonof the incidence of this variable in the two groups. The chi-square test was used to calculate p-values in all of these 2x2 tables, and risk estimation was performed by calculating with a 95% CI of the odds ratio.

## RESULTS

During the study, 100 children in the PICU needed mechanical ventilation. The age varies from 30 days to fifteen years, and the M:F ratio is 1.2: 1. Almost 50% of children were under the 1-year.Respiratory failure was the most communal cause of ventilation(67%) (P-value = 0.01), paralysis and neuromuscular block was the cause of ventilation in 24% (24), 7 (7%) required ventilation due to apnea. Slightly more than half were on pressure-controlled mode of ventilation (p-value = 0.01), and 28 (28%) were on volume-controlled mode, continuous positive airway pressure needed in 8 (8%) patients and synchronized intermittent mandatory ventilation needed in 15 (15%).

Of all the cases admitted, the average length of ICU stay was 8.65± 6.45 per day. Children who needed VAP required 14.2±9.5 days of ventilation and 7.5± 5.2 days for children who have not VAP progression. All cases have endotracheal tip cultures positive, with or without VAP. Tracheal aspirates were indicated for cultural sensitivity in all cases and 25 cases (25%) have positive cultures. 15 of them (60%) established a VAP. 20 children (20%) have positive Blood cultures and VAP was among 8 (40%) cases. The purulent tracheal secretions were noticed in 18 patients and positive VAP were in 6 cases (47%).

By investigating several variables to know probable related factors, it was observed that age <1-year (p = 0.04), continuous IV sedation (p = 0.004) and unplanned emergency intubation (p = 0.04) were related with augmentedrisk of VAP progression. Factors such as sex, mode of expression and ventilation as well as its time were not associated significantly with the progression of VAP (p> 0.05, Table I). The children were examined for features that suggest nosocomial infections or VAP, particularly of the tracheal purulent secretions, persistent and new changes in the chest on auscultation, and instability in temperature of the body (Table II). Of 100 cohorts of child necessitating ventilation, 22 died and 2 were left without advice or serious illness, with a total mortality of 22%.

Table I: Probable risk factors related with VAP

| Risk Factor | Frequency of | Chi-square | Odds ratio |
|---|---|---|---|
| | VAP | (p-value) | (95% CI) |
| Age < 1 year | 13/48 | 3.90 | 3.089 |
| | (27.1%) | (0.04) * | (0.95-9.65) |
| Male gender | 13/52 | 0.59 | 1.53 |
| | (25%) | (0.40) | (0.50-4.54) |
| Unplanned emergency intubation | 1/4 | 5.34 | 11.23 |
| | (25%) | (0.04) * | (0.919-124) |
| Duration of ventilation > 15 days | 14/76 | 0.033 | 1.14 |
| | (18.4%) | (0.86) | (0.29-4.35) |
| Continuous sedation | 14/40 | 8.70 | 5.545 |
| | (35%) | (0.004) * | (1.56-17.89) |
| Indication of ventilation | - | NS | - |
| Mode of Ventilation | - | NS | - |
| Duration of ventilation | - | 3.60 | - |
| Overall | - | (0.170) | - |

Table II: Topographies indicative of VAP (predictors of VAP)

| Features | Frequency of | Chi-square | Odds ratio |
|---|---|---|---|
| | VAP | (P-value) | (95% CI) |
| Purulent tracheal secretions | 6/18 | 10.89 | 6.69 |
| | (33.33%) | (0.001) * | (1.80-21.88) |
| CRP > 48 | 8/16 | 12.80 | 7.55 |
| | (50%) | (< 0.001) * | (2.21-24.09) |
| Positive tracheal aspirate culture | 15/25 | 41.1 | 52.09 |
| | (60%) | (< 0.0001) * | (11.30-269.6) |
| Positive ETT tip culture | 16/96 | 0.08 | 0.809 |
| | (16.7%) | (0.7) | (0.154-4.12) |
| Raised TLC | 10/40 | 1.61 | 2.02 |
| | (25%) | (0.20) | (0.64-5.65) |
| High poly count | 11/45 | 2.04 | 2.21 |
| | (24.44%) | (0.14) | (0.79-6.60) |
| Positive blood culture | 8/20 | 4.09 | 3.14 |
| | (40%) | (0.02) | (0.96-10.35) |
| Suggestive CXR | 18/30 | 45.11 | - |
| | (60%) | (< 0.002) * | |

Table III: Microbial isolates from tracheal and blood aspirate

| Isolate | Blood | Tracheal aspirate |
|---|---|---|
| | (n= 20/100) | (n=25/100) |
| Pseudomonas | 07 | 16 |
| E coli | 02 | 01 |
| Klebsiella | 05 | 04 |
| Streptococcus | 02 | 01 |
| Staphylococcus aureus | 03 | 00 |
| Acinetobacter | 01 | 03 |

## DISCUSSION

Nosocomial infections are very difficult challenges facing contemporary ICUs, especially when it comes to resource constrained setup[11-12]. The VAP frequency in children enrolled in ICU was 22% in this study. ICU monitoring studies have shown that VAP occurs in 4-33% of patients on ventilator. The frequency of ICU associated VAP g in the reports of adults is much higher to 15-32%[13]. VAP is associated with the severity of the disease, prolonged stay and ventilation, which is also seen in this series. Not only that, the only VAP suspicion should be managed by the use of essential antibiotics[14]. This demonstrates the importance of meeting the clinical criteria in preventing inappropriate antibiotic therapy in the diagnosis of VAP[15]. VAP microbiology is very important to characterize and plan for proper management. However, the topic and method of microbiology-based diagnosis has been the subject of ongoing debate. In terms of isolate spectrum, the majority of bacteria which are Gram-negative are Klebsiella, E. coli and Pseudomonas[16]. Additionalanalysishas shown that gram-negative bacteria are the commonest isolates (43-66%). Though, few studies have likewise reported organisms such as Streptococcus pneumoniae, Hemophilus influenzae and Staphylococcus aureus. A Malaysian analysis showed the isolation of organisms such as Acinetobacter[17-18]. The one isolates from this study was also Acinetobacter[19-20]. Formerly, local researches showed a comparable gram-negative bacteria pattern in children with nosocomial infections compared to gram-positive organisms. Identifying predictors and risk factors is essential to taking the right steps in this direction. Tang et al havestated being at greater risk of VAPwere under one year[21]. One study found that conditions like genetic syndromes and burns were risk factors, but no relation was identified in this study. If intubation is not provided, this may increase the risk of VAP. Additionalanalysishas shown that intubation is a VAP risk factor. Several other measures are also related with an augmenteddanger of VAP, such as central venous catheterization, tracheostomy, thoracocentesis, transfusions and bronchoscopy[22]. The VAP prevalence in children with continuous sedation was higher compared to continuous boluses.Inconstantoutcomes were presented by other authors. In addition, the use of other medications has also been stated as a probablecausing factor for VAP[23]. They include parenteral nutrition (TPN), steroids, H2 blockers and neuromuscular agents. In a potential study by Srinivasan et al. found that the increase in TLC was not related to VAP but to new radiographic changes, factors related to fever, rejuvenation, blood transfusion, drug use and enteral nutrition were related to VAP[24].Respiratory associated Pneumonia was related with longer ventilation times, longer ICU stay, and higher mortality. Several other investigations also examined the facts[25].

## CONCLUSION

The VAP incidence in this study was 22%. Features related with a higher incidence of ventilation-associated pneumonia include age <1-year, continuous intravenous sedation and unplanned intubation in emergency situation. Features suggestive of underlying VAP encompassed, CRP> 48 mg / L, purulent tracheal secretions, positive tracheal culture of aspirate and positive X-ray results.

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