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Impact of Ventilator Associated Pneumonia in Hospitalized Children in A Tertiary Care Center In Western Rajasthan

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Abstract

Objectives : To determine the impact of ventilator-associated pneumonia in Pediatric intensive care unit and Neonatal intensive care unit patients.

Methods : Patients aged between 0-14 years admitted in Intensive Care Unit (NICU/PICU) or transferred to these units from pediatric wards for any medical conditions/complication and kept on mechanical ventilation for >48 hours. Study was conducted in the Department of Pediatrics, Sardar Patel Medical College and P.B.M Hospital Bikaner. Study duration was12 months (August 2016 to July 2017). Sample size was calculated to be 145 mechanically ventilated patients. For the diagnosis of VAP Criteria of Centers for Disease Control and Prevention (CDC) was used.

Results: Out of total 145 ventilated patients, VAP occurred in 44.9% males and 42.9% females. Overall mortality in ventilated patients was 57.9%. 74.4% mortality was observed in VAP group as compared to 50.8% in ventilated neonates who did not develop VAP (p=0.016) while 71.4% mortality was observed in VAP group as compared to 33.3% in Non VAP group (p=0.010) in PICU. VAP significantly increased mean duration of hospital stay (24.88±4.05 days) as compared to 16.95±1.29 days in Non VAP group.VAP significantly increased mean duration of stay on ventilator as compared to patients who did not develop VAP. (3.67± 1.36 v/s 4.67± 1.92 days).

Conclusion: VAP is a serious and potentially lethal complication in patients on mechanical ventilation.VAP significantly increased the mortality, duration of stay on ventilator and duration of stay in hospital.

Keywords: VAP, Mortality Children

Background

A specific aspect of intensive care units is the use of advanced medical techniques involving invasive monitoring and mechanical support of the activities of failing organs or systems, including the respiratory system. One of the most commonly performed therapeutic procedures in ICU is mechanical ventilation which remains the mainstay of the management of critically ill children. This modality has its own complications. One of the complications is the chance of developing pneumonia termed as ventilator-associated pneumonia (VAP).The presence of the endotracheal tube is the most important risk factor for development of VAP. Creating an artificial respiratory tract deprives a patient of the possibility to heat, humidify and purify inhaled air. This in turn, generates a series of nursing and medical interventions that may be conducive to developing VAP[1].

VAP is defined as pneumonia occurring after the patient has been on ventilator for more than 48 hours[2]. The pneumonia must neither be present nor incubating at the time of intubation.

Approximately 10-28% of critical care patients develop VAP[3]. It can increase length of stay in ICU up to 28% and each incidence of Ventilator-associated pneumonia (VAP) increases cost, duration on mechanical ventilation, frequency of intubation and length of stay in hospital. Mortality rate is found to be 24%-71%[4].

VAP is the second most common cause of the nosocomial infection and the most common reason for antibiotic use in the pediatric intensive care unit[5].

Ventilator-associated pneumonia (VAP) is defined by the Center for Disease Control and Prevention (CDC)as new and persistent radiographic infiltrates and worsening gas exchange in patients who are mechanically ventilated for at least 48 h and who exhibit at least 3 of the following criteria: temperature instability with no other recognized cause, leucopenia or leucocytosis ,change in the characteristic of respiratory secretions, respiratory distress or new onset cough along with microbiological confirmation by use of Bronchoalveolar lavage, Tracheal suction, ET tip or Blood culture.

VAP is also a serious and potentially lethal complication in neonates on mechanical ventilation. Around 6.8 - 32.2 % of health-care associated infections have been estimated in NICU[6,7]. It has a large impact on neonatal morbidity, mortality, duration of stay in NICU and health care cost[7,8]. The effect of VAP on health care costs is especially significant in developing world, whereas most studies of VAP have been conducted in developed countries[9,10].

Methodology

This was a hospital based cross sectional study with a duration of 12 months from August 2016 to July 2017 at Department of Pediatrics, S.P. Medical College and Associated Group of Hospital, Bikaner (North-West Rajasthan).

The review of literature shows prevalence of VAP in 0-14 years of age group to be around 30%. In our study we expect prevalence to be around 40%. With allowable error fixed at 20% of prevalence, sample size is calculated to be 145.

Inclusion criteria

Patients aged between 0-14 years admitted in Intensive Care Unit (NICU/PICU) or transferred to these units from pediatric wards for any medical conditions/complication and kept on mechanical ventilation for >48 hours.

Exclusion criteria

Patients already having pneumonia at the time of admission and patients who developed pneumonia in the first 48 hours of mechanical ventilation as well as patients with Congenital pneumonia, severe birth asphyxia and congenital anomalies were excluded from the study.

For the diagnosis of VAP Criteria of Centers for Disease Control and Prevention (CDC)[11] was used.

1. Radiology Signs

Two or more serial chest radiographs with at least one of the following - new or progressive and persistent Infiltrate -consolidation–cavitation-air bronchograms-pneumatocele

2. Clinical signs: At least 1 of the following: -

a. Fever (temperature > 38 degree Centigrade) or Hypothermia (<36.5 degree centigrade) –

b. Leukopenia (WBC < 4000per mm^3) or Leukocytosis (WBC > 12000per mm^3)

c. Plus at least 2 of the following - new onset of purulent sputum, or change in character of sputum - increased respiratory secretions or increased suctioning requirements or new-onset or worsening cough or dyspnea or tachypnea - rales or bronchial

sounds - worsening gas exchange - increased oxygen requirements.

3. Microbiological criteria

At least one of the following:

a. Positive growth in blood culture not related to another source of infection

b. Positive quantitative culture from bronchoalveolar lavage (> 10^4 CFU/ml).

c. Five percent or more of cells with intracellular bacteria on direct microscopic examination of Gram-stained bronchoalveolar lavage fluid.

d. Histopathological evidence of pneumonia

Results

Table 1: Distribution of cases according to age and sex

Age Group	Gender			
	Female		Male	
	No.	%	No.	%
<30 days (n=100)	35	62.5	65	73.0
1month to 1 year (n=16)	8	14.3	8	9.0
>1 Year (n=29)	13	23.2	16	18.0
Total(n=145)	56		89	

In present study, out of total 145 ventilated patients, 56 were females and 89 were males. Out of total 56 females, 62.5% were <30 days while 14.3% were between 1 month to 1 year and remaining 23.2% females had their age >1 year.

Out of total 89 males, 73% had their age <30 days while 9% and 18% patients had their age 1 month to 1 year and >1 year respectively.

Table 2: Distribution of ventilated cases according to their outcome

Outcome	No.	%
Death	84	57.9
Planned Extubation	61	42.1
Total	145	

In present study, out of total 145 ventilated patients, 57.9% deaths were registered.

Table 3: VAP in relation to outcome

Outcome	Non VAP		VAP	
	No.	%	No.	%
Death (n=84)	37	45.7	47	73.4
Planned extubation (n=61)	44	54.3	17	26.6
Total(n=145)	81		64	
χ^2	11.304			
P	0.001			

In our study 84 ventilated patients expired, 73.4% deaths were observed in VAP group as compared to 45.7% deaths in Non VAP group. This difference in mortality between VAP and Non VAP group was also found statistically significant (p=0.001).

Table 4: Outcome of patients with VAP in different age groups

Age Group (days)	Non VAP				VAP				χ^2	P
	Death		Planned extubation		Death		Planned extubation			
	No.	%	No.	%	No.	%	No.	%		
≤30	29	47.5	28	71.8	32	52.5	11	28.2	5.7097	0.0168
>30	8	34.8	16	72.7	15	65.2	6	27.3	6.5040	0.010
Total	37	51.9	44	48.1	47	65.6	17	34.4	11.300	0.001

VAP significantly increased the mortality (p=.0007). Overall 65.6% mortality was observed in VAP group as compared to 51.9% in ventilated patients who did not develop VAP. This significant increase in mortality in the presence of VAP was observed in neonates (p=0.016) as well as in PICU patients (p=0.010)

Table 5: **Outcome in patients with VAP in relation to mean birth weight in neonates**

Parameters	Death		Planned		t	P
	Mean	SD	Mean	SD		
Birth Weight	1.74	0.59	2.24	0.83	2.185	0.035

Mean birth weight in died patients of VAP group was 1.74±0.59 kg while in extubated patients it was 2.24±0.83kg and the difference was found statistically significant (p<0.05).

Table 6: VAP in relation to mean duration of hospital stay

	NON VAP (n=44)	VAP (n=17)
Mean duration of Hospital stay	16.95±1.29	24.88±4.05 days
T	11.674	
P	<0.001	

Mean duration of hospital stay was found to prolong significantly in the patients who developed VAP (24.88±4.05 days) as compared to 16.95±1.29 days in Non VAP group.

Table 7: Relation of mean duration of ventilation with VAP

Days on ventilation	Non VAP		VAP	
	No.	%	No.	%
≤4 (n=91)	61	67.0	30	33.0
>4 (n=54)	20	37.0	34	63.0
Total (n=145)	81		64	
Mean	4.42		6.00	
SD	2.28		3.72	
T	2.242			
P	0.027			

In this study, out of 145 patients on ventilator, 37.2% were on ventilator for >4 days. The incidence of VAP was 63% in those patients who were on ventilator for >4 days while only 33% cases developed VAP whose duration on ventilator was <4 days. The mean duration of ventilation in VAP group was 6.00±3.72 as compared to 4.42±2.28 in non VAP group. The longer mean duration of ventilation was significantly associated with higher risk of development of VAP (p=0.027)

Discussion

Nosocomial infection comprises infection in hospital setting. In recent years ICU care has become an integral part of advanced medical care. Critically ill patients who require mechanical ventilation are given another chance at survival at the risk of volutrauma and barotraumas leading to development of complications like air leaks, Interstitial emphysema, Subglottic stenosis and Ventilator associated pneumonia. VAP is a major nosocominal infection in ICU. Intubation leads to damage to mucosa of trachea and oropharynx which exposes lower airways to aspirated oral and gastric secretion. It causes further damage and allows invasion of organisms to lower airways and lung parenchyma[12].

A total of 145 patients (aged 0-14 years) admitted in NICU and PICU were included who were on mechanical ventilator for more than 48 hours, fulfilling the exclusion and inclusion criteria. Study was conducted over 1 year and CDC criteria was used for diagnosis of VAP.

Out of total 145 ventilated patients, 68.96% were neonates (<30 days) and 31.03% were >30 days to 14 years of age. Males were 61.37%.

In present study, overall mortality in ventilated patients was 57.9% while 73.4% patients with VAP expired and the mortality was 45.7% in non VAP group. This difference was found statistically significant (p<0.01). This significant increase in mortality in the presence of

VAP was observed in neonates (p=0.016) as well as in PICU patients (p=0.010).

The mean duration of hospital stay in VAP group is 24.88±4.05 days as compared to 16.95± 1.29 days in non VAP group. This difference is found statistically significant.

The mean duration of stay on ventilator in VAP group is 6±3.72 days as compared to 4.42±2.28 days in non VAP group. This difference is found statistically significant.

In present study 42.4% low birth weight neonates developed VAP after staying for >4 days on ventilator as compared to 40% neonates of >2.5kg birth weight. Duration of ventilation was not significantly related to birth weight in neonates with VAP.

VAP significantly increased the mortality, duration of stay on ventilator, duration of stay in hospital. These results agreed with many studies done previously. Safdar et al[13] observed that mortality rate was increased (pooled odds ratio, 2.03; 95% confidence interval, 1.16-3.56) in patients who developed VAP. Patients with VAP have significantly longer intensive care unit lengths of stay (mean = 6.10 days; 95% confidence interval, 5.32-6.87 days) and is associated with substantial morbidity, a two-fold mortality rate, and excess cost.

Akash et al[14] reported that most of the patients developed Nosocomial infection after 96 hours of stay on ventilator due to more number of invasive procedures, higher chances of exposure to microorganisms and longer contact of patient to health care personal. The incidence of VAP was increased with duration on ventilator. Infectious particles are dislodged into distal airways during suction procedures.

Apisarnthanarak et al[15] reported increment of 11% risk of VAP for every week in extremely premature neonates. Koskol et al[16] concluded that longer stay on ventilator poses the patient to higher risk of infection due to exposure to devices. Khattab et al[12] reported that neonates who developed VAP had prolonged mean duration of stay in nursery and longer mean duration of stay on ventilator. Hamid et al[2] reported that the patients who developed VAP, the mean duration of stay on ventilator was 13.5 ±10.1 days as compared to 7.7± 5.5 days in patients who did not develop VAP.(p=0.04) Their study concluded that VAP was associated with prolonged stay on ventilator, prolonged stay in ICU and increased mortality.

In the year 2015 Gupta et al[17] concluded that patients with ventilator-associated pneumonia had a longer ICU length of stay ($p < 0.0001$) and prolonged stay on mechanical ventilator by more than 11 days ($p < 0.0001$). After adjustment for patient factors, length of stay in ICU ($p = 0.03$) and length of stay on ventilator ($p = 0.001$) remained significant. Patients with ventilator-associated pneumonia were almost three times more likely to die ($p = 0.007$). Independent risk factors for ventilator-associated pneumonia were reintubation and part-time ventilation. They concluded that pediatric ventilator-associated pneumonia is common in mechanically ventilated pediatric patients. These patients have longer length of stay, longer duration of mechanical ventilation, and increased risk for mortality.

Lee et al[18] in a retrospective observational study reported that low birth weight neonates and neonates with lower gestational age had longer duration of intubation (odds ratio: 1.35, 95% confidence interval).

Mean birth weight in expired patients of VAP group was 1.74±0.59 kg while in extubated patients it was 2.24±0.83kg and the difference was found statistically significant ($p<0.05$).

Lee et al[18] reported that mean birth weight was 944.4±268.4 g in VAP group as compared to 1340±455.4 g in non VAP group ($p<0.001$). However mortality rate was similar in both groups. (13.3% v/s 17.2%) (p=0.710.)

Conclusion

VAP is a serious and potentially lethal complication in patients on mechanical ventilation. VAP significantly increased the mortality, duration of stay on ventilator and duration of stay in hospital.

References

1. Hryniewicz W, Kusza K, Ozorowski T. Strategia lekooporności w OIT. Narodowy Program Ochrony Antybiotyków na lata 2011-2015.
2. Hamid MH, Malik MA, Masood J, Zia A, Ahmad TM. Ventilator-Associated Pneumonia in Children. J Coll Phy Surg Pak 2012; 22(3):155-158.
3. Acharya D, Wagh H. Ventilator Associated Pneumonia - An Overview. Brit J Med Pract. 2009; 2(2):16-19.
4. Scott R. Ventilator-Associated Pneumonia. Arch Intern Med. 2000; 160:1926-36.
5. Venkatachalam V, Hendley JO, Douglas F. The diagnostic dilemma of ventilator-associated pneumonia in critically ill children. Pediatr Crit Care Med 2011; 12(3).pp 286-9.
6. Van der Zwet WC, Kaiser AM, van Elburg RM, Berkhof J, Fetter WP, Parlevliet GA, et al. Nosocomial infections in a Dutch neonatal intensive care unit: surveillance study with definitions for infection specifically adapted for neonates. J Hosp Infect. 2005; 61:300–11.
7. Gaynes RP, Edwards JR, Jarvis WR, Culver DH, Tolson JS, Martone WJ. Nosocomial infections among neonates in high-risk nurseries in the United States. Pediatrics. 1996; 98:357–61.
8. Stoll BJ, Hansen NI, Adams-Chapman I, Fanaroff AA, Hintz SR, Vohr B, et al. National Institute of Child Health and Human Development Neonatal Research Network. Neuro-developmental and growth impairment among extremely low birth weight infants with neonatal infection. JAMA. 2004; 292:2357–65.
9. Al-Tawfiq JA, Abed MS. Decreasing ventilator-associated pneumonia in adult intensive care units using the Institute for Healthcare improvement bundle. Am J Infect Control. 2010; 38:552–6.
10. Blamoun J, Alfakir M, Rella ME, Wojcik JM, Solis RA, Anees KM, et al. Efficacy of an expanded ventilator bundle for the reduction of ventilator-associated pneumonia in the medical intensive care unit. Am J Infect Control. 2009; 37:172–5.
11. CDC. Ventilator-Associated Pneumonia (VAP) Event. CDC guidelines. 6-1 TO 6-14.
12. Khattab AA, El-Lahony DM, Fathy W. Ventilator associated pneumonia in A neonatal intensive care unit. J Am Sci 2013; 9(11):251-258.
13. Safdar N, Dezfulian C, Collard HR, Saint S. Clinical and economic consequences of ventilator-associated pneumonia: a systematic review. Crit Care Med 2005; 33:2184-2193.
14. Deep A, Ghildiyal R, Kandian S, Shinkre N. Clinical and microbiological profile of nosocominal infections in the pediatric intensive care unit (PICU). Ind Pediatr 2004; 41(17):1238-46.
15. Apisarnthanarak A, Holzmann-Pazgal G, Hamvas A, Olsen MA, Fraser VJ. Ventilator-associated pneumonia in extremely preterm neonates in a neonatal intensive care unit: characteristics, risk factors, and outcomes. Pediatrics. 2003; 112:1283–9.
16. Koksal N, Mustafa H, Celebi S, et al. The Non-bronchoscopic bronchoalveolar-lavage for diagnosing ventilator-associated pneumonia in newborns. Turkish J Pediatr; 2006; 48(2):213-220.
17. Gupta S, Boville BM, Blanton R, Lukasiewicz G, Wincek J, Bai C, Forbes ML. A multicentered prospective analysis of diagnosis, risk factors, and

outcomes associated with pediatric ventilator-associated pneumonia. Pediatr Crit Care Med. 2015; 16(3):e65-73.

18. Lee PL, Lee WT, Chen HL. Ventilatory associated pneumonia in low birth weight neonates at a neonatal intensive care unit: A retrospective observational study. Pediatr Neonatol 2017; 58(1):16-21.