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Study of Ventilator Associated Pneumonia in Neonates: Risk Factors and Outcomes

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ABSTRACT
Ventilator-associated pneumonia (VAP) is pneumonia in mechanically ventilated patients that develops later than or at 48 hrs after the patient has been placed on mechanical ventilation. The aim of this study is to compare the incidence, risk factors and outcomes of Ventilator Associated Pneumonia (VAP) and non-VAP conditions in neonates. Prospective Observational hospital based time bound study. All neonates (inborn and out born) admitted in NICU at GMERS Medical College and General hospital, Gotri, Vadodara. It's conducted from October 2020 to April 2021. Total 70 patients are included in this study. About 22.86% of the patients in the study developed VAP. There was a statistically significant association for development of VAP in patients with low birth weight, prematurity (GA<32 weeks) and number of re intubations. Comparision of both groups for primary disease distribution, use of medications, invasive procedures and feeding pattern did not show any statistical difference. No statistically significant difference was noted as regards mortality and duration of NICU stay. However patients with VAP had longer duration of ventilation. Patients on ventilators should routinely have their endotracheal aspirates tested for culture sensitivity and if VAP develops, the patient should receive a different course of antibiotics. We may be able to increase the success rate for patients on mechanical ventilation by utilizing aseptic precautions while handling ventilated patients and empirical antibiotics in accordance with our NICU's endotracheal aspirate sensitivity pattern in the case of patients who develop nosocomial pneumonia. In order to create interventions to stop neonatal VAP, more research is required.

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Key Words
VAP, Re intubations, nosocomial infections and risk factors

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INTRODUCTION

Ventilator-associated pneumonia (VAP) is pneumonia in mechanically ventilated patients that develops later than or at 48 hrs. After the patient has been placed on mechanical ventilation[1]. It is associated with longer durations of ICU stay and high rates of morbidity and mortality. Ventilator-associated pneumonia (VAP) is one of the most common device and healthcare associated infections in the critical care setting[2].

VAP is the second most common Hospital acquired infection among Paediatric Intensive Care Units (PICU) and Neonatal Intensive Care Unit (NICU) patients[3,4]. Therefore, there is a vital need to study the aetiology and risk factors associated with VAP in neonates. The exact rate of neonatal VAP is difficult to establish because the radiographic identification of pneumonia is difficult and diagnostic procedures commonly used in adults are rarely used in neonatal patients.

Overall, VAP occurs in 3-10% of ventilated paediatric ICU (PICU) patients[5].Surveillance studies of nosocomial infections in NICU patients indicate that pneumonia comprises 6.8-32.3% of nosocomial infections[6,7]. NICU VAP rates vary by birth weight category as well as by institution. In 1998, a cross-sectional study of hospital acquired infections in 50 children's hospitals was performed by the Paediatric Prevention Network in which 12 hospitals provided VAP rates stratified by birth weight groups. In this cross-sectional survey, VAP rates were highest for the 1,001-1,500 g and 1,000 g birth weight categories[8].

Ventilator-associated pneumonia (VAP) is relatively common in mechanically-ventilated children, but there is a wide variation in reported VAP rates, depending on settings and geographical regions.

Several risk factors have been identified to be related to neonatal VAP. Respiratory diseases are very common among neonates that require mechanical ventilation for long period. Duration of mechanical ventilation has been found to be an important risk factor[9]. In a retrospective cohort study that was conducted on 259 patients who developed 52 episodes of VAP, Yuan *et al*.[10] found that re-intubation, duration of mechanical ventilation, treatment with opiates and endotracheal suctioning were significant risk factors for neonatal VAP. Ahmed *et al*.[11] listed several risk factors of neonatal VAP including: Low birth weight, prematurity, prolonged mechanical ventilation, opiate treatment for sedation, frequent suctioning and re intubation, bloodstream infection, invasive procedures and steroid use.

MATERIALS AND METHODS

Study area: All neonates (inborn and out born) admitted in NICU at GMERS Medical College and General hospital, Gotri, Vadodara.

Source of data: All neonates (inborn and out born) admitted in NICU at GMERS Medical College and General hospital, Gotri, Vadodara requiring mechanical ventilation.

Study design:

- Prospective Observational hospital based time bound study

Study Period:

- October 2020 to April 2021

Study material: Pre-designed, pre-tested and semi-structured questionnaire used for data collection.

Inclusion criteria: All inborn and out born neonates (0-28 days) requiring mechanical ventilation:

- Patients intubated and on mechanical ventilation for more than 48 hrs
- Corrected gestational age between 23 0/7 and 43 6/7 weeks

Exclusion criteria:

- Age of infants more than 28 days
- Patients who developed pneumonia within 48 hrs of mechanical ventilation and surgical problem related to respiratory tract/congenital malformations
- Consent denied

RESULT

Majority of neonates who developed VAP were admitted for RDS as a primary disease (43.75%), followed by prematurity, MAS and Birth Asphyxia. No significant difference between primary disease distribution was found between both the VAP and non VAP groups ($p>0.05$). No significant difference was observed in prior use of medication between both the groups ($p>0.05$). It was observed that 93.75% patients in VAP group were administered inotropes while in Non-VAP group 90.74% patients were given inotropes (Table 1). Use of inotropes was predominant in all patients who required ventilation in both groups. Commonest indication of inotropes was Shock followed by cardiac support in PPHN, birth asphyxia etc. In our study, 16 cases who developed VAP had 48 episodes of re- intubation while 54 cases in the Non-VAP group had 94 episodes of re- intubation. In terms of re-intubations on univariate analysis in the present study, it was observed that the re-intubation in VAP group (3.19±1.67) was significantly more than that of Non-VAP group (1.67±0.48). The comparison between both the group was significant ($p<0.01$) (Table 2).

Totla 13 (81.25%) patients were diagnosed as early onset VAP (VAP developing within first 5 days of

Table 1: Primary disease and medications distribution of cases

	VAP (n = 16)		Non-VAP (n = 54)		
	No. of Case	Percentage	No. of Case	Percentage	p-value
Primary disease					
Respiratory distress syndrome	7	43.75	18	33.33	0.8561
Prematurity	5	31.25	17	31.48	
Meconium aspiration syndrome	2	12.5	10	18.52	
Birth Asphyxia	2	12.5	9	16.67	
Total	16	100	54	100	
Medications					
Inotropes	15	93.75	49	90.74	0.7658
Sedatives	3	18.75	10	18.52	
Surfactant	6	37.5	14	25.93	
Steroids	0	0	1	1.85	
Blood transfusion	3	18.75	4	7.41	

Table 2: Risk association of Re-Intubation with development of VAP

Re-intubation	Mean	SD	Median	p-value
VAP	3.19	0.83	3.00	0.0001
Non-VAP	1.67	0.48	2.00	

Table 3: Early onset versus late onset VAP profile

	VAP (n = 16)	
Day of diagnosis VAP	No. of case	Percentage
<5 days (Early onset)	13	81.25
>5 days (Late onset)	3	18.75
Total	16	100

Table: Distribution of clinical signs in VAP

	VAP (n = 16)	
Clinical signs	No. of case	Percentage
Tachycardia (HR >200)	10	62.50
Increased secretions	16	100.00
High Fio2	16	100.00
High Fio2 and PIP	8	50.00
Prolonged CRT	10	62.50

ventilation) while 3(18.75%) patients developed VAP after 5 days of ventilation. Diagnosis of VAP was based on the clinical criteria as defined by CDC (Table 3). It was observed that 100% patients with VAP had manifestations such as increased secretions and increase in requirement in fraction of inspired oxygen (Fio2), 62.50% patient presented with tachycardia, while 50% patients required change in 2 parameters (increase in Fio2 and Peak inspiratory pressure). Prolonged CRT was noted in 62.50% neonates (Table 4).

ETA is 100% in patients with VAP were positive for single microorganism while 62.9% ETA were positive in non VAP group. It was observed that maximum patients in both the groups showed presence of Acinetobacter species with 68.75% in ETA of VAP neonates while 44.44% in non-VAP group. About 6.25% and 9.26% also showed Acinetobacter species in blood culture of VAP and Non-VAP group respectively. Klebsiella was observed in 18.75% ET aspirates in VAP group and 18.52% in Non-VAP group. About 3.70% patients in non- VAP group showed Klebsiella in blood culture also. Enterobacter was present in blood culture of VAP group while absent in non-VAP group. Enterococcus was present in 6.25% in blood culture of VAP group and 1.85% patients of Non-VAP group. Candida and E.Coli was observed in ET culture in VAP group in 1 patient each (6.5%), while not isolated in blood culture. Isolation proportion was 1.85% in Non-VAP group in blood culture. None of the patients in VAP group showed the presence of Pseudomonas, Staphylococcus aureus and Gram -ve coccobacilli while Non-VAP showed their colonies in 1.85%, 7.41% and 1.85% patients respectively in blood culture.

DISCUSSION

This study was a prospective observational hospital based study performed on patients admitted in NICU (0-28 days) on mechanical ventilation for more than 48 hrs to find the incidence and compare risk factors and outcomes of ventilator associated pneumonia (VAP).

Patients enrolled in study were subjected to detailed examination. The data source was pre-designed proforma containing information regarding details of mechanical ventilation, no. of re-intubation, use of various invasive procedures and medication and baseline and follow through markers for Sepsis and CXR. Diagnosis of VAP was based on CDC criteria for diagnosis of Nosocomial Pneumonia -2016. Data was entered in Microsoft Excel and analysis was done using SPSS statistical package.

Out of the 70 patients on mechanical ventilation, 16 patients developed VAP and 54 patients did not develop VAP (Non-VAP or control group). The Incidence in our study of VAP was 22.86%.

During comparison of the Patients with VAP vs. control group for Risk factors, significant association was found with respect to Low Birth weight (LBW), Prematurity (GA <32 weeks) and no. of re intubations and occurrence of VAP.

Comparison of both groups for primary disease distribution, use of medication and invasive procedures and feeding pattern did not show statistically significant difference.

Outcomes were compared in terms of survival, increased duration of ventilation and total duration of NICU stay between both groups. No significant difference was observed between both the groups with respect to mortality. Analysis of patients in VAP group showed significant association between prematurity and Low birth weight with mortality.

Newborns in VAP group had longer total duration of ventilation as compared to control group which was statistically significant.

Difference in total duration of NICU stay was not statistically significant between the 2 groups.

CONCLUSION

Patients on ventilators should routinely have their endotracheal aspirates tested for culture sensitivity and if VAP develops, the patient should receive a different course of antibiotics, according to the paper. We may be able to increase the success rate for patients on mechanical ventilation by utilizing aseptic precautions while handling ventilated patients and empirical antibiotics in accordance with our NICU's endotracheal aspirate sensitivity pattern in the case of patients who develop nosocomial pneumonia. In order to create interventions to stop neonatal VAP, more research is required.

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