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INCIDENCE OF VENTILATOR-ASSOCIATED PNEUMONIA AND THEIR SOCIO-DEMOGRAPHIC PROFILE AMONG CHILDREN ADMITTED IN NEONATAL AND PEDIATRIC INTENSIVE CARE UNITS IN A TERTIARY CARE CENTER OF NORTH INDIA.

Paediatric Medicine

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ABSTRACT

Introduction: Ventilator-associated pneumonia (VAP) continues to pose serious complications in patients in patients who are on mechanical ventilators especially for neonates. The present study has been conducted to evaluate the Ventilator-Associated Pneumonia as well as the socio-demographic profile of children admitted to the Neonatal and Pediatric Intensive Care Unit in IGMC Shimla.

Material & Methods: This prospective observational study has been conducted for a tenure of 365 days (1st July 2015 till June 2016), in the intensive care units (NICU and PICU) of the Department of Pediatrics, IGMC, Shimla. All patients admitted to PICU and NICU, who required mechanical ventilator support for 48 hours or more were included in the study. Center of disease control and prevention criteria has been taken to diagnose VAP.

Results: Out of 1750 children (0-18 years) who were admitted in NICU and PICU of children ward of IGMC, Shimla in the study period, 85 required ventilatory support. Out of these 85 cases, only 10 fulfilled the diagnostic criteria. So the incidence of VAP observed was 11.7 %. Incidence of VAP in Newborns was found to be significantly high (23.3%) compared to (3.2%) infants between 1 Month to 1 year of age ($p = 0.020$). Among diagnosed cases majority were males, with a male: female ratio of 3:2, however, the gender difference was statistically not significant.

Conclusion: The results of this present study point that hospital stay duration and mechanical ventilation of children (neonates, infants, and children 1 to18 yrs) admitted in Neonatal and Pediatric Intensive Care unit because these factors have a critical association with Ventilator-Associated Pneumonia and its complications. It clearly emphasizes that proper selection of antibiotics targeted on predominant bacteria present in a clinical setting, information based on examination of pulmonary secretions is crucial to minimize the hospital stay and thereby decrease morbidity and mortality.

KEYWORDS

Incidence, Ventilator-associated Pneumonia, NICU, PICU.

INTRODUCTION

Ventilator-associated pneumonia is defined as hospital-acquired pneumonia that develops in patients who have been treated with mechanical ventilation for ≥48 hours and who had no signs or symptoms of lower respiratory infection before they were intubated and started on mechanical ventilation.[1]

VAP is considered to be a serious healthcare-related infection in critical care settings and accounts for a range starting from 7% to 33% of healthcare-associated infections among neonates.[2] VAP is one of the common causes of nosocomial infection after urinary tract infection and skin infection among neonatal and pediatric intensive care unit) patients.[3]

Infants mechanically ventilated in the NICU are at an increased risk of developing Ventilator-associated pneumonia because of host factors like poverty, related diseases, increased use of mechanical ventilation, inadequate pulmonary toilet, and extensive use of invasive devices and procedures.[4]

There is no data available from our institution on VAP in PICU and NICU. Therefore we plan to know the incidence of VAP in our PICU and NICU at IGMC Shimla because it varies in different clinical settings.

Aim & Objectives

1. To find the prevalence of VAP in children and infants requiring ventilator support in NICU and PICU at IGMC Shimla (0-18y).
2. To study the risk factors for the development of VAP.
3. For planning preventive strategies for VAP.

MATERIAL & METHODS

Study Design – Tertiary hospital-based, observational and prospective study.

Study Duration – 365 days (starting from 1st July 2015 till 30 June 2016)

Study Settings –All patients (0-18 years) admitted in PICU and NICU at I.G.M.C. and K.N.H. Shimla on ventilator support for more than 48 hours.

Inclusion Criteria:

All the patients were admitted to PICU and NICU at IGMC Shimla and on ventilator support for more than 48 hrs.

Exclusion Criteria:

a) Severe acute malnutrition.
b) Chronic diseases (heart, kidney, lung).
c) Congenital or acquired immune suppression.

Method of Data Collection:

All enrolled patients were subjected to detailed history and clinical examination.

Diagnostic Criteria:

Center of disease control and prevention defined criteria[5] has been taken to diagnose VAP in our study.

1. Two or more abnormal chest radiographs with a minimum of one of the following symptoms.
2. Fever (>38°C) with no focal cause.
Or
Leucopenia (<4,000 white blood cells [WBC]/mm^3) or leucocytosis (≥12,000 WBC/mm^3)

And
Two of the underlying criteria:
A. New onset of purulent sputum,
B. Change in the character of sputum,
C. Increase in respiratory secretions,
D. Increased suction requirements;
E. Signs of respiratory distress such as cough, dyspnea, or tachypnea; rales or bronchial breath sounds; and deteriorating gas exchange, increasing oxygen requirements, or ventilation demand.

NNIS/CDC criteria have no requirement of Microbiology opinion to diagnose pneumonia.

RESULTS

This prospective observational study was conducted for 365 days (1st July 2015 till June 2016), in the intensive care units (NICU and PICU) of the Department of Pediatrics, IGMC, Shimla. All patients admitted to PICU and NICU, who required ventilator support for ≥ 48 hours were enrolled for the study. The patients on the ventilator were examined twice daily by the resident in charge under the supervision of a Consultant for signs and symptoms suggestive of VAP; Fever / Hypothermia increased respiratory efforts / ET secretions/requirement of oxygen and appearance of new chest signs. Routine investigations included X-ray chest, ABG, complete hemogram, etc as per protocol. The cases were classified into suspected VAP or VAP cases as per inclusion and exclusion criteria.

During the one-year study period, all 1750 children (0-18 years) were admitted to NICU and PICU of children ward of IGMC, Shimla. Of these 85 required ventilatory support for more than 48 hours and constituted the study cohort.

Out of these 85 cases, 15 (17.6%) developed clinical features suspicious of VAP but only 10 of these fulfilled the diagnostic criteria and were labeled VAP. So the incidence of VAP observed was 11.7 % (Table 1).

Table 1. Incidence Of VAP In Children (0- 18 Years) On Ventilator.

Category	Number of patients	Percent (%)
No VAP	60	70.5
Suspected VAP	15	17.6
VAP	10	11.7
Total Patients on Ventilator	85	100

Amongst the study cohort, 30 (35.3%) were newborns (0 to 28 days) and 7(23.3%) of them developed VAP, 31(36.4%) were infants (1 mo – 1 year), and 1(3.2%) of this acquired VAP while 24 (28.3%) were between 1 to 18 years of age and 2(8.3%) of them developed VAP (Table 2).

Table 2: Age Wise Distribution Of Patients On Ventilator & VAP

Age of patients	Patients on ventilator (n=85)	VAP Cases n= 10
Newborns (0 to 28 days)	30 (35.3 %)	7 (23.3 %)
Infants (1 mo – 1 year)	31(36.4 %)	1 (3.2 %)
1-18 years	24 (28.3%)	2 (8.3 %)

Of all the patients (n=85) on ventilatory support, 54 (63.5%) were males and 31(36.5%) females. Amongst males, 6/54 (11.1%) developed VAP while 4/31 (12.9%) of females had VAP. However, there was no significant difference (p = 0.81) in the development of VAP in males vs females. Out of the total of 30 neonates on ventilatory support, 7 (23.3%) acquired VAP. Of these 17.4 % (4/ 23) were males and 42.9% (3/7) females Table 4 & Fig. 4). Though the incidence was more in females the difference was not statistically significant. Out of 24 (28.3%) patients between 1 to 18 years of age 2(8.3%) babies developed VAP. Of all the cases requiring ventilator support, 13.1 % (8/61) who developed VAP were up to 1 year of age, but only 8.3 % (2/24) above 1 year of age had features of VAP. Though the difference was not statistically significant amongst them (p = 0.54). Out of 31 babies between 1 month to1year of age, only one baby developed VAP. Interestingly, the incidence of VAP in Newborns was found to be significantly high (23.3%) compared to (3.2%) infants between 1 Mo to 1 year of age (p = 0.020). (Table-3)

Table 3: Age & Gender Wise Distribution

Variables	(n=85)	VAP (%)	x^2	OR (95 % CI)	P value
Gender (Total)					
Male	54 (63.5 %)	6 (11.1%)	0.060	0.84 (0.21-3.26)	0.81
Female	31 (36.5 %)	4 (12.9%)			
Total	85 (100%)	10 (11.8 %)			
Gender (Neonates only)					
Male	23 (76.7%)	4 (17.4%)	1.95	0.28 (0.04-1.78)	0.16
Female	7 (23.3%)	3 (42.9%)			
Total	30 (100%)	7 (23.3%)			
Age groups (Total)					
Up to 1 year	61 (71.8%)	8 (13.1%)	0.37	1.66 (0.33-8.45)	0.54
≥ 1 year	24 (28.2%)	2 (8.3%)			
Total	85 (100%)	10 (11.8 %)			
Age Group(Neonates vs Infants)					
< 1 Mo	30 (49.2)	7 (23.3%)	5.41	9.13 (1.09-79.54)	0.020*
1 Mo. -1 year	31 (50.8%)	1 (3.2%)			
Total	61 (100%)	8 (13.1 %)			

On further analysis, it was found that preterm births (<37 weeks of gestation) were having more chances (31.6 %) of developing VAP compared to term neonates (9.1 %). However, the incidence observed was not statistically significant (p = 0.160) Similarly, Low birth weight (LBW) babies (< 2.5 Kg of B. Wt.) were having more chances (23.8 %) of developing VAP compared to normal birth weight neonates (22.3 %). However, the observed difference in incidence was not statistically significant (p = 0.92)(Table-4)

Table 4 :- Gestation , Birthweight Wise Distribution Of VAP Cases In Neonates

Parameters	Total	VAP (%)	x^2	OR (95 % CI)	P value
Gestation					
PT(Preterm)	19 (63.3%)	6 (31.6%)	1.969	4.61 (0.47 – 44.75)	0.160
FT(Full term)	11(36.7%)	1(9.1%)			
Birth weight					
<2.5kg(LBW)	21(70%)	5 (23.8 %)	0.01	1.09 (0.17 – 7.06)	0.92
≥2.5kg(NBW)	9 (30%)	2 (22.2 %)			
Total	30 (100)	7 (23.3%)			

DISCUSSION

During the one-year study period, all 1750 children (0-18 years) were admitted to NICU and PICU of children ward of IGMC, Shimla. Of these 85 required ventilatory support for more than 48 hours and constituted the study cohort. Among these 15 were suspected to be suffering from VAP but only 10 cases fulfilled the diagnostic criteria and were diagnosed as VAP. So the incidence of VAP observed was 11.7%.

The overall incidence of VAP among pediatric patients in published literature varies from 10 to 50%. [6-9] VAP incidence of 11.7% in the present study is lower than the studies done by various parts of the world.[6-9]

We included children from 0-18 years of age in our study and further grouped them into Newborns, 1m to one year age, and one to 18 year age groups.

Neonates in comparison to pediatric patients are more vulnerable to develop VAP as is evident from various studies. We observed 35.3% VAP incidence among neonates which are lower than that reported by Seham FA et al, Moradi M et al and Mohammad A Badr et al (51 %, 42 %, and 57 % respectively).[10-12] However our observations are nearer to Tripathi et al who found VAP incidence to be 31%.[9] While some of the workers have reported low VAP incidence to the tune of 9% (Cernada M et al)[13] and 11.4% (Su BH et al)[14] in neonates.

In the present series, VAP developed in 36.4% of babies of 1 month to 1 year age, which is quite higher than 8 % reported by Modi et al[6] but lower than Mohammad et al[7] of 46 %.

In the 1 to 18 years age group VAP developed in 28.3% of children in our study which is higher than that observed by Modi Payal et al (12%)[6] but lower than Mohammad Haroon Hamid et al (54%)[7].

VAP percent distribution amongst males and females is variable

amongst different studies. We observed ratio in favor of males (M: F 60:40) as seen in studies by Shalini Tripathi et al (M: F 73:27)[9] and Seham FA et al (69:31)[10] while it is reverse in studies by Mohammad Haroon Hamid et al (M: F 20:80)[7] and Vedavathy .S et al (M: F 58:41)[15] Low birth weight babies (<2.5 kg) are shown to have increased incidence of VAP in comparison to normal birth weight babies (>2.5kgs) as observed by Edwards et al (7.2:1.2%)[16], Rosenthal et al (36.4:6.2%) [17], Stover et al (9.5:0.9%) [18] and Shalini Tripathi et al (2:28%)[9].Similarly in our study VAP occurred more (72%) in neonates < 2.5kg and less (28%) in babies weighing > 2.5kg (72:28%) and is comparable to the above-mentioned studies.

Prematurity is characterized by the immaturity of lungs anatomically and functionally along with immature immune and defense systems, which leads to an increased tendency for infection and prolonged need for respiratory support all of which contribute to the appearance of VAP.

In the present study incidence of VAP among premature neonates was 31.6%, which is higher than the observation by Shalini Tripathi et al (23%)[9] while lower than Seham FA et al (77%).[10]

We found a statistically significant difference in the incidence of VAP among babies < 1 month of age (23.3%) and between 1 month to 1 year of age (3.2%). The difference in incidence in the two age groups is following Modi Payal et al (80:8%)[6] and Deng et al (33.5:5.2%)[19], however, as such incidence in one month age group is higher in these studies in comparison to ours.

In our study, there were more infants in comparison to 1- 18 years age group children who acquired VAP (13.1% vs 8.3%). While in studies done by Modi Payal et al, Mohammad Haroon Hamid et al and Vedavathy .S, it was reverse with more patients in 1-18 yrs age in comparison to infants: 8:12%, 25.6:28.5%, and 28.5:72.4% respectively[6,7,15].

We found VAP more common among female neonates which are similar to observations by Deng et al (M 33.5%).[19] and Yuan et al (M, 20.1%)[20] while Seham FA et al (M: F 69.3:64.1%)[10], Shalini Tripathi et al (M: F 73:27%)[9.] observed VAP be more common in male neonates.

CONCLUSION

Our findings in the present study point out that the duration of hospital stay and mechanical ventilation of children (neonates, infants, and children 1 to 18 yrs) admitted to NICUs and PICUs have a significant association with ventilator-associated pneumonia, which in turn, leads to an increase in the mortality rate. Prevention and timely treatment of this nosocomial infection is critical for improving the prognosis of these infants.

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