Ventilator Associated Pneumonia in NICU at a Tertiary Care Centre of Surat: A cross sectional analytic study

Dr. Vipul Bhageria[1§], Dr. Rajeev Prasad[2], Dr. Vibhuti Kantharia[3]

[1]Resident, Department of Pediatrics, SMIMER, Surat (Gujrat) India
[2]Additional Professor, Department of Pediatrics, SMIMER, Surat (Gujrat) India
[3]Assistant Professor, Department of Pediatrics, SMIMER, Surat (Gujrat) India
§Corresponding author's Email: vipulbhageria@gmail.com

Abstract— *Ventilator associated Pneumonia (VAP) occurs in about 9-27% of intubated neonate patients and has a mortality rate of 27% to 43% depending on the causative agent. Such high mortality, increased morbidity, increased hospital stay and costs make the VAP crucial. This present study was conducted to determine the proportion of VAP among Neonatal Intensive Care Unit (NICU) with risk factors of acquiring VAP with the outcomes of these cases. This prospective observational study was conducted from October 2016 to October 2017 at a tertiary care center attached with a medical college. Total of 85 neonates of both sexes who have been intubated for >48 hours, were studied. Outcome of these patients was assessed in terms of onset of symptoms and the result of treatment given and survival of patient. In present study, 45.9% was the proportion of VAP among NICU neonates. Out of these 67% cultures were sterile while 33% showed growth. Most common causative organism being Pseudomonas (31%) followed by CONS (23%), Acinobacter, Klebsiella (15% each), E. Coli and S. Aureus (8% each). In terms of disease onset 23% subjects developed VAP within 5 days and regarding mortality 18% patients with VAP died & 72% were discharged.*

Keywords: Ventilator associated Pneumonia (VAP), Neonatal Intensive Care Unit (NICU), Neonates.

I. INTRODUCTION

The CDC defines Ventilator associated pneumonia (VAP) as nosocomial infection occurring in patients admitted to critical care units for more than 48 hours after endotracheal intubation and initiation of mechanical ventilation[1].

VAP occurs in 9-27% of all intubated patients. It is associated with increased morbidity, length of stay in hospital and costs. The mortality rate attributable to ventilator associated pneumonia is 27% and has been as high as 43% when the causative agent is antibiotic resistant[2]. The high prevalence of VAP in the NICU compels a thorough assessment of causative agents, progress and outcomes of VAP.

Studies have also been done to determine microorganisms involved with VAP. Poonam et al (2005) studied ventilator associated pneumonia and demonstrated the high incidence of pneumonia caused by Pseudomonas spp. and E. coli spp.[3] and Joseph et al (2009) showed that Pseudomonas aeruginosa, A.baumannii and Staphylococcus aureus were the most common pathogen associated with ventilator associated pneumonia.[4] Continuous meticulous collection of epidemiological data of incidence, organisms and outcomes is necessary in each ICU in order to initiate adequate antimicrobial therapy and to improve outcomes.

One significant study done on the subject by Joseph et al[4] found that the crude mortality rate of patients with VAP was 16.2%. There was no statistically significant difference in mortality between VAP and non VAP groups. (16.2% vs. 20.5%).[5]

This present study was carried out at SMIMER Hospital, Surat (Gujarat) India, to find out the proportion of VAP among Neonatal Intensive Care Unit (NICU) with risk factors of acquiring VAP with the outcomes of these cases.

II. METHODOLOGY

This prospective hospital based observational study took place between October 2016 to October 2017 on 85 patients admitted in NICU at SMIMER Hospital, Surat (Gujarat) India.

Patients of either sex under mechanical ventilation for more than 48 hours were enrolled after obtaining written consent. Ethical approval was obtained from the institutional ethics committee. Pre designed semi structured proforma was used for data collection. Patients were assessed for primary illness and VAP. Then samples for culture and sensitivity were taken and analyzed. Patients were followed prospectively until they were either successfully treated or died.

Diagnosis of VAP was based on two or more chest radiographs showing new infiltrates, consolidation, cavitations or pneumatoceles; worsening gas exchange with an increase in oxygen or ventilatory requirements; and at least three clinical signs and symptoms which include temperature instability, wheezing, tachypnea, new onset cough, abnormal heart rate, change in secretions (new onset purulent sputum), or an abnormal leukocyte count ($<4000/mm^3$ or $>15000/mm^3$).

Other factors that were assessed for with respect to developing VAP include: birth weight, gestation, stay in the NICU, mode of delivery, temperature instability, TLC, CRP, Blood Culture, ET culture, indication for mechanical ventilation.

Qualitative variables were expressed as a percentage of study while quantitative variables were expressed as mean+/-SD. For comparison of two independent continuous variables, independent t-tests were done. For associations between incidences of two qualitative variables, Pearson Chi-Square test with Yates correction and Fisher exact test were used. Analysis was done by SPSS 16 and open EPI software.

Sample size was calculated by conducting a 1 month pilot study in Department of Pediatrics, SMIMER, Surat (Gujarat) India, calculation of sample size was as follows:

p =proportion of VAP patients as per pilot study =11.76%
q = 1 – p with 95% level of significance ($Z\ \alpha / 2 = 1.96$) with allowable error as 7% (L)
$N = (Z\ \alpha / 2)^2 pq / L^2$
N = 85

III. RESULTS

Out of total 85 among intubated neonates were enrolled, 39 (45.9%) were with VAP whereas 46 (54.1%) were without VAP. (Figure1)

3.1 According to cultures:

In the VAP group, out of 39. 26 (67%) of the blood cultures were sterile, while in 33% growth was seen. In the Non VAP group, out of 46, 39 (85%) of the blood cultures were sterile, while in 15% growth was seen. These values were statistically not significant. (Table 1)

Table 1
Comparison of VAP and Non-VAP group as per culture status

S. No.	Culture Status	VAP Groups (N=39)	Non-VAP Groups (N=46)	P Value LS
1	**Sterile**	26	39	0.088 NS
2	**Growth**	13	7	

3.2 Causative Organism

The most common organism in ET cultures was Klebsiella (41%), followed by Pseudomonas and E. coli 24% each, followed by Acinetobacter (11%). (Figure 2)

Figure 1

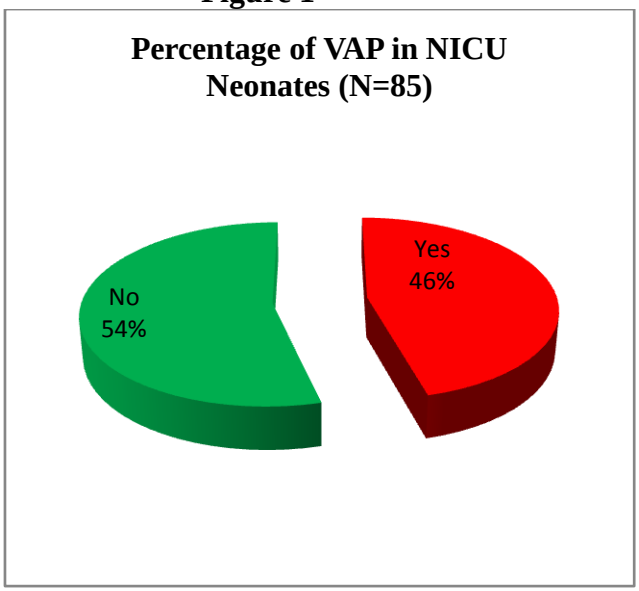
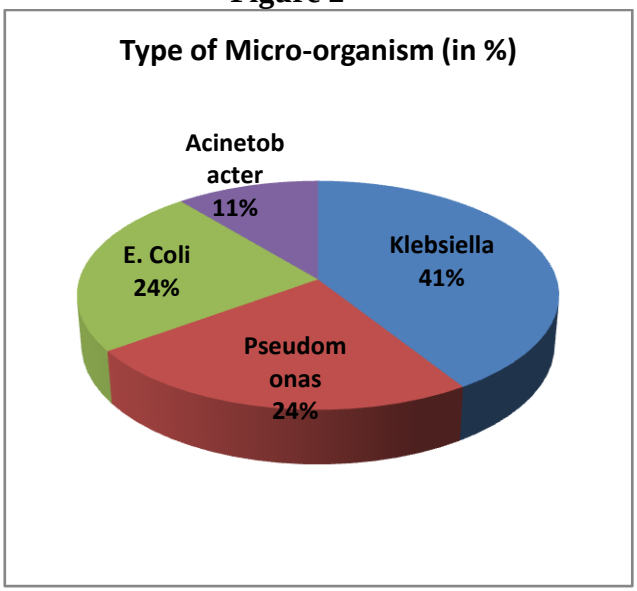


Figure 2



3.3 According to Outcome

In the VAP group of patients, out of 39 patients, 7 (18%) of the patients were expired, while in the Non VAP group, 20% of the patients were expired. This difference in outcome of cases in both group was not statistically significant. (Table 2)

Table 2
Comparison of VAP and Non-VAP group as outcome

S. No.	Culture Status	VAP Groups (N=39)	Non-VAP Groups (N=46)	P Value LS
1	**Cured**	32	37	0.930 NS
2	**Death**	7	9	

3.4 Late vs. Early onset VAP

Out of the 39 patients who developed VAP, 9 patients(23.1%) developed VAP within 5 days, termed as early- onset VAP. Rest 30 patients (76.9%) developed after 5 days, termed as late- onset VAP.

3.5 According to Birth Weight

In the present study, in VAP group low birth weight babies were 64% whereas in non VAP group it was 56%. Although LBWs were more in VAP group but it was not found significant. (Table 3)

3.6 According to gestation

In the present study, in VAP group preterm babies were 59% whereas in non VAP group it was 37%. Although preterm babies were more in VAP group but it was not found significant. (Table 3)

3.7 According to NICU stay

In the present study, 31% of the VAP patients had an NICU stay of upto 7 days, while in 69% of the patients with VAP the duration of NICU stay was more than 7 days. In Non VAP group, 41% patients had NICU stay of upto 7 days, while in 59% of patients the duration of NICU stay was more than 7 days. These values were not found with statistically significant. (Table 3)

3.8 Indication of intubation

In the VAP patients, 39% of the patients were put on ventilator support due to perinatal asphyxia, 36% patients due to MAS, 25% patients due to HMD. In the Non VAP group, 37% patients due to perinatal asphyxia, 48% of the patients were put on ventilator support due to MAS and 15% patients due to HMD. This difference in both group was also not found statistically significant. (Table 3)

Table 3
Associating factors of VAP

S. No.	Culture Status		VAP Groups (N=39)	Non-VAP Groups (N=46)	P Value LS
1	**Birth Weight**	**LBW**	25	20	0.093 NS
		Normal weight	14	26	
2	**Gestation**	**Preterm**	23	17	0.071 NS
		Full Term	16	29	
3	**NICU stay**	**upto 7 Days**	12	19	0.436 NS
		> 7 Days	27	27	
4	**Indication of intubation**	**Perinatal asphyxia**	15	17	0.393 NS
		MAS	14	22	
		HAD	10	7	

IV. DISCUSSION

The proportion of VAP in present study was 45.9% which was comparable other studies conducted by authors like Apisarnatharak[6]et al (28.3%), Petdachai[7] et al 50% and Yuan[8] et al 20.1%. The variation in proportions is due to differences in diagnostic criteria, variable sensitivity and specificity of the diagnostic tests used, lack of gold standard for diagnosis of VAP, condition of the ICU, care available, variation in hospital flora, fumigation policies, maintenance of equipment.

In this study, out of the 39 patients who developed VAP, 9 patients (23.1%) developed VAP within 5 days, termed as early- onset VAP. Rest 30 patients (76.9%) developed after 5 days, termed as late- onset VAP. In a study by Tripathi[8] et al, late onset VAP (> 5 days of MV) was more common than early onset VAP (< 5 days of MV) in the ratio of 53.3 % vs. 46.7 %.

In present study we found that, VAP was more common in preterm (59%) patients, while 41% of patients having VAP were full term. In the patients not having VAP, 37% patients were pre term, 63% of the patients were full term. The correlation between VAP and prematurity was statistically significant. In terms of birth weight, VAP was more common (64%) in low birth weight babies as compared to babies (36%) with normal weight. The correlation between VAP and birth weight in our

study was not statistically significant but the Odds Ratio of ELBW and VLBW were 2.6 and 2.3 respectively which means that Odds of ELBW and VLBW in VAP group were more than two times that in Non-VAP group. A study done by Apisarnthanarak et al[6] also found similar results showing high rates of VAP in extremely preterm neonate. Very low birth weight (VLBW), described by Afjeh[9] et al. and Tripathi et. al. as an additional independent risk factor for developing VAP.

In the studies conducted by Foglia[10] et al., and Chastre[11] et al , VAP rates increases significantly with decreasing gestational age. Stover[12] et al reported in a cross sectional study that VAP rates were higher for the 1.0-1.5 kg birth weight.

In terms of other risk factors, other studies confirm that VAP is associated with increased morbidity, a longer duration of MV, and a longer hospital and/or ICU length of stay.

With respect to clinical presentation, we found that the correlation between temperature instability and VAP was statistically significant. We also found strong association between leucocytopenia and VAP. This is in agreement with study conducted by Povoa[13] et al .

In terms of microorganisms involved, we found that our results were similar to Apisarnthanarak[6] et al, Petdachai[7] et al, Koksal[14] et al and Tawfik et al, who mentioned predominance of gram negative infection in their units. However, the reported species isolated differed from one study to another. This can be explained by the fact that the distribution of microorganisms differs from NICU to another and also, differs within same place from one period of time to another. While we found Pseudomonas to be the most common causative organism, Koksal et al.[14] mentioned that Acinetobacter was the most predominating causative agent, whereas Petdachai[7] reported that Pseudomonas spp. was the most common organism isolated. Tawfik et al.[15] reported that Klebsiella was the most predominating causative agent. The use of broad-spectrum antibiotics is partly responsible for development of resistance to the major groups of antibiotics.

In terms of outcome, in the VAP group of patients, 18% of the patients expired, while in the Non VAP group, 20% of the patients expired. 72% of the patients were discharged in both VAP and Non VAP group. These values were statistically not significant. Similar observations were made by Yuan TM, et al.16.

V. CONCLUSION

It can be concluded from this present study that proportion of VAP among intubated neonates in the NICU was 45.9%. Low birth weight, early gestation, increased the risk of VAP was not found to be associated with VAP. No statistical significance difference was seen with respect to increased morbidity, longer duration of hospital stay and MV. No significant difference was noted in mortality between the two groups. The most common causative agents were Pseudomonas, Acinobacter, Klebsiella, E. Coli and S. Aureus.

CONFLICT OF INTEREST

None declared till now.

REFERENCES

[1] R.M. Saldanha Dominic et al A clinico-microbiological study of ventilator-associated pneumonia in a tertiary care hospital. Int J Biol Med Res. 2012; 3(2):1651-1654

[2] Usman SM et al. associated Clinical and microbiological facets of ventilator associated pneumonia; Int J Res Med Sci. 2014 Feb;2 (1):239-245

[3] Poonam C. Sharma et al. The microbiological profile of ventilator associated pneumonia. Journal of Evolution of Medical and Dental Sciences /Volume1/ Issue3/July-Sept 2012 Page 192.

[4] Joseph NM, Sisttla S, Dutta TK et al. "Ventilator associated pneumonia in a tertiary care hospital in India- role of multidrug resistant pathogens" J Infect DevCtries 2010; 4(4): 218-225.

[5] Erbay RH, Yalcin AN, Zencir M, et al. "Costs and risk factors for VAP in a Turkish university hospital ICU – a case control study" Bio Med Central pulmonary Medicine 2004; 3(4): 10-1

[6] 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: 1283–1289.

[7] Petdachai W. Ventilator-associated pneumonia in a newborn intensive care unit. Southeast Asian J Trop Med Public Health. 2004 Sept;35(3):724-9.

[8] Yuan TM, Chen LH, Yu HM: Risk factors and outcomes for ventilator-associated pneumonia in neonatal intensive care unit patients. J Perinat Med 2007;

[9] Afjeh SA, Sabzehei MK, Karimi A, Shiva F, Shamshiri AR: Surveillance of ventilator-associated pneumonia in a neonatal intensive care unit: characteristics, risk factors, and outcome. Arch Iran Med 2012; 15: 567–571.

[10] Foglia E, Meier M, Elward A. Ventilator associated pneumonia in neonatal and pediatric intensive care units. ClinMicrobiol J2007; 20 (3): 409-25.

[11] Chastre J, Fagon JY "Ventilator –associated pneumonia" Am J RespCrit Care Med 2002; 165: 667-903.

[12] Stover BH, Shulman ST, Bratcher DF, et al. Nosocomial infection rates in the US children's hospitals, neonatal and pediatric intensive care units. Am Infect Control J2001; 29:152-7.22.

[13] Povoa P, Coelho L, Almeida E. C-reactive protein as a marker of infection in critically ill patients. Clin Microbial Infect J 2005; 11:101-8

[14] Koksal N, Hacimustafaoglu M, Celebi S, et al. Non-bronchoscopicbronchoalveolar lavage fordiagnosis of ventilator associated pneumonia in newborn. Turk J Pediatr 2006;48:213–220.

[15] Tawfik M, Soad F, Bahaa S, et al. (2009): The incidence of ventilator associated pneumonia in neonatal intensive care unit at Alexandria university children's hospital. MSc 24:6.