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ORIGINAL ARTICLE

Frequency and risk factors of ventilator associated pneumonia at neonatal intensive care unit of Nishtar Hospital, Multan.

Afaq Hussain[1], Muhammad Anwar[2], Ali Amjad Sheikh[3], Azam Khan[4]

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ABSTRACT… Objective: To determine the frequency and risk factors of ventilator associated pneumonia at neonatal intensive care unit (NICU). **Study Design:** Cross-sectional study. **Setting:** NICU of Nishtar Hospital Multan, Pakistan. **Period:** January 2023 to June 2023. **Material & Methods:** We analyzed babied of both genders aged between 1 to 28 days admitted in NICU and undergoing mechanical ventilation (MV) due to any reasons for a minimum duration of 2 days. Information like gender, age, residential status, gestational age, birth weight and mode of delivery were noted. During MV period, neonates were closely observed for VAP. **Results:** In a total of 189 neonates, 104 (55.0%) were boys. The mean age at the time of NICU admission was 4.6±4.2 days while 128 (67.7%) neonates were aged below 7 days. The mean gestational age was 33.5±4.6 weeks while 156 neonates were pre-term. The mean birth-weight was 1914±640 grams. Residential status of 113 (59.8%) neonates was rural. Mode of delivery was lower segment cesarean section in 160 (84.7%). The frequency of VAP was found in 51 (27.0%) neonates who underwent MV. Relatively young age (below 7 days, p=0.0089), pre-term birth (37 weeks, p=0.0342) and low birth weight (<2500 grams, p<0.0001) were found to have significant association with VAP. **Conclusion:** The frequency of VAP was high among neonates. Younger age, less gestational age and low birth weight were associated with VAP.

Key words: Gestational Age, Low Birth Weight, Mechanical Ventilation, Neonatal Intensive Care Unit, Pneumonia.

INTRODUCTION

Pneumonia is one of the commonest causes of hospitalization among children and a primary reason for antibiotic prescriptions in pediatric healthcare facilities.[1] Ventilator-associated pneumonia (VAP) is the most common hospital-acquired infection in neonates, while bloodstream infections following closely.[2] Neonates admitted to neonatal intensive care units (NICUs) requiring mechanical ventilation (MV) are at increased risk of developing VAP, affecting 10-20% of ventilated patients.[3,4]

VAP has a high incidence of morbidity and death, and it can lengthen the time that patients need to be hospitalized and get respiratory support, and negatively impact outcomes in NICUs.[5,6] Higher susceptibility to developing VAP is associated with factors such as younger age, compromised immunity, emergency intubations/reintubations, respiratory distress, ongoing enteral feeding, and the use of intermittent sedation.[7-9] A study from Iran revealed that the frequency of VAP among neonates undergoing MV in NICU was 22.9%.[3] A local study from Agha Khan Hospital, Karachi noted that 31.4% neonates developed VAP in NICU.[10] Gram positive as well as non-Enterobacterales gram negative isolates are recognized to be the most commonly involved isolates in CAP.[11,12]

According to the susceptibility pattern, individuals with VAP are more likely to have bacteria that are widely and multiple-drug resistant.[13] This makes managing VAP in any NICU difficult. In order to enhance and execute preventative efforts, it is critical to understand the impact of VAP in every environment. That's why we planned this study

1. MBBS, FCPS (Pediatrics), Clinical Fellow Neonatology, Senior Registrar Neonatology, Nishtar Hospital & Medical University, Multan.
2. DCH, FCPS (Pediatrics) FCPS (Neonatology), Associate Professor Neonatology, Quaid e Azam Medical College, Bahawalpur.
3. FCPS (Pediatrics), Clinical Fellow Neonatology, Senior Registrar Neonatology, The Children's Hospital & Institute of Child Health, Multan.
4. FCPS (Pediatrics), Professor and Head Pediatrics, Nishtar Hospital & Medical University, Multan.

Correspondence Address:
Dr. Afaq Hussain
Department of Neonatology
Nishtar Hospital & Medical University, Multan.
drafaqhussain@yahoo.com

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and our objective was to determine the frequency and risk factors of VAP at NICU.

MATERIAL & METHODS

This cross-sectional study was conducted at NICU of Nishtar Hospital, Multan Pakistan from January 2023 to June 2023 after getting approval from Institutional Ethical Committee (Ref. No. 13123/NMU). Considering the frequency of VAP among neonates admitted in NICU as 22.9% with 95% confidence level and 6% margin of error, the required sample size turned out to be 189. Informed and written consents were obtained from parents/caregivers of all neonates. We analyzed babies of both genders aged between 1 to 28 days admitted in NICU and undergoing MV due to any reasons for a minimum duration of 2 days. Patient having pneumonia at the time of admission in NICU or at the time of initiation of MV were not included. Parents/caregivers unwilling for their child to be part of this research were also not included.

Demographic and clinical information were noted. Gestational age below 37 weeks of gestation was labeled as pre-term, between 37-41 weeks as full term and equal or above 42 weeks as post-term. Birth weight below 1500 grams was labeled as very low birth weight (VLBW), between 1500 grams and 2499 grams as low birth weight (LBW) and above or equal to 2500 grams as normal birth weight. X-ray chest was done in all neonates. During MV period, neonates were closely observed for VAP. Blood tracheal aspirates were also sent for culture analysis. VAP was labeled as any 2 of the following: i) unexplained fever (>101^{0}F), total leukocyte count below 4000 mm^3 or above 15,000 per mm^3, neutrophils above 80%, serum c-reactive protein above 48 mg/dL or chest x-ray suggesting pneumonia or purulent tracheal secretions; and ii) radiological depiction of new or progressive and persistent infiltrates. Neonates having VAP were treated with empirical antimicrobials and treatment was modified depending upon the findings. A special format was made to record study data. Data analysis was done using "IBM-SPSS Statistics", version 26.0. Effect modifiers were controlled through stratification. Chi-square test was applied to see their effect on the frequency of VAP taking $p<0.05$ as significant.

RESULTS

In a total of 189 neonates, 104 (55.0%) were boys. The mean age at the time of NICU admission was 4.6±4.2 days while 128 (67.7%) neonates were aged below 7 days. The mean gestational age was 33.5±4.6 weeks while 156 neonates were pre-term. The mean birth-weight was 1914±640 grams. Residential status of 113 (59.8%) neonates was rural. Mode of delivery was lower segment cesarean section in 160 (84.7%), as shown in Table-I.

Characteristics		Frequency (%)
Gender	Boys	104 (55.0%)
	Girls	85 (45.0%)
Age at the time of admission (days)	<7	128 (67.7%)
	≥7	61 (32.3%)
Gestational Age	Pre-term	156 (82.5%)
	Full Term	33 (17.5%)
Birth weight	Normal	56 (29.6%)
	LBW	96 (50.8%)
	VLBW	37 (19.6%)
Residential status	Urban	76 (40.2%)
	Rural	113 (59.8%)
Mode of delivery	Vaginal delivery	29 (15.3%)
	Cesarean section	160 (84.7%)

Table-I. Demographic and clinical characteristics of neonates (n=189)

The frequency of VAP was found in 51 (27.0%) neonates who underwent MV. Relatively young age (below 7 days, $p=0.0089$), pre-term birth (37 weeks, $p=0.0342$) and LBW ($p<0.0001$) were found to have significant association with VAP (Table-II).

DISCUSSION

The last few decades have shown significant improvements in NICU care that has contributed to much improved outcomes, yet, neonatal period is highly prone to complications especially related to various kinds of infections. In the present study, the frequency of VAP was noted to be 27.0%. Another study's frequency of VAP was found to be 30.6% in an investigation done in India.[14]

Study Variables		Ventilator Associated Pneumonia		P-Value
		Yes (n=51)	No (n=138)	
Gender	Boys	29 (56.9%)	75 (54.3%)	0.7577
	Girls	22 (43.1%)	63 (45.7%)	
Age at the time of admission (days)	<7	42 (82.4%)	86 (62.3%)	0.0089
	≥7	9 (17.6%)	52 (37.7%)	
Gestational Age	Pre-term	47 (92.2%)	109 (79.0%)	0.0342
	Full Term	4 (7.8%)	29 (21.0%)	
Birth weight	Normal	8 (15.7%)	45 (32.6%)	<0.0001
	LBW	15 (29.4%)	81 (58.7%)	
	VLBW	28 (54.9%)	9 (52.2%)	
Residential status	Urban	21 (41.2%)	55 (40.0%)	0.8694
	Rural	30 (58.8%)	83 (60.0%)	
Mode of delivery	Vaginal delivery	9 (17.6%)	20 (14.5%)	0.5933
	Cesarean section	42 (82.4%)	118 (85.5%)	

Table-II. Comparison of various demographic and clinical characteristics with respect to ventilator associated pneumonia (n=189)

According to studies by Apisarnatharak et al.[15], Petdachai et al.[16], and Yuan et al.[17], the frequency of VAP was 28.3%, 50%, and 20.1%, respectively. Aseptic precautions in the critical care unit, different diagnostic criteria being applied, and varying diagnostic test sensitivity and specificity are all contributing factors to this discrepancy. A local study by Sultan MA et al determining frequency of VAP in pediatric ICU reported this to be 19.8% which is relatively less than what we observed in NICU in this study.[18] Another local study by Hamid MH et al found the frequency of VAP in NICU to be 17%.[19] These local studies show that frequency of VAP is relatively less among children of higher age groups when compared to what we noted among neonates in this study. A local study from Karachi found the frequency of VAP in NICU to be 31.4% which is quite close to what we observed.[9]

This study revealed that age below 7 days (p=0.0089), pre-term birth (37 weeks, p=0.0342) and LBW (p<0.0001) were found to have significant association with VAP. Various studies have analyzed risk factors linked with VAP in NICU settings. Tripathi S et al observed that VLBW (p=0.002) and prematurity (p=0.010) were associated with VAP.[14] Gohr et al from Egypt shared that lower gestational age and LBW were significantly linked with VAP.[20] Local data by Hamid MH et al recorded that relatively younger age was linked with VAP.[19] Recent data from tertiary care NICU of Bulgharia found the frequency of VAP to be 31.0% while birth weight below 1500 grams (p=0.043) and gestational age below 32 weeks (p=0.009) were found to have significant association with VAP.

There were few limitations of this study. We were unable to record outcomes in the present set of neonates. Finding outcomes and its relationship with the frequency of VAP would have further added value to this research. Single center study design and a relatively modest sample size were some of the other limitations.

CONCLUSION

The frequency of VAP was high among neonates. Younger age, less gestational age and low birth weight were associated with VAP.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Afaq Hussain	Data collection, Drafting.	
2	Muhammad Anwar	Study Concept, Proof reading.	
3	Ali Amjad Sheikh	Literature review, Discussion.	
4	Azam Khan	Methodology, Critical Revisions.	