



FREQUENCY AND FACTORS IN NEONATAL PNEUMONIA AND ITS COMPLICATIONS IN ADMITTED ICU PATIENTS OF TERTIARY CARE HOSPITAL OF PESHAWAR. A CROSS-SECTIONAL ANALYTICAL STUDY

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ABSTRACT

Background : Neonatal pneumonia is one of the leading causes of neonatal morbidity and mortality in neonatal intensive care units, particularly in developing countries. Some of the known factors include maternal infection, low birth weight, and premature birth. Early identification of associated risk factors and complications can increase the chance of surviving as a neonate and having a better clinical outcome.

Objective: To find out the prevalence of neonatal pneumonia, factors, and complications of the neonates who were admitted to the ICU of a tertiary care hospital in Peshawar.

Methodology: The study was cross-sectional and analytical in the Neonatal Intensive Care Unit of a tertiary care hospital in Peshawar for six months. One hundred neonatal cases aged 0-28 days with clinical and radiological signs of pneumonia were recruited using a non-probability consecutive sampling. A structured proforma was used to obtain the data on the demographic characteristics, maternal and neonatal risk factors, and complications. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 26. Quantitative variables were analyzed using mean $\pm$ standard deviation, and qualitative variables were analyzed using frequency and percentage. The data were analyzed by the Chi-Square test, and a p-level of < 0.05 was regarded as statistically significant.

Result: The mean age of neonates was 12.4 ± 6.2 days. Male neonates accounted for 61% of cases, while 56% were preterm and 63% had low birth weight. Prolonged rupture of membranes was present in 35% of mothers, and mechanical ventilation was required in 29% of neonates. Prolonged hospital stay (40%) and sepsis (31%) were the most common complications. Mortality was observed in 17% of patients. Prematurity and low birth weight showed significant association with adverse outcomes ($p=0.02$ and $p=0.03$ respectively).

Conclusion: Neonatal pneumonia is also a serious complication and cause of death in the neonate admitted to the NICU. Prematurity and low weight are significant risk factors for poor outcomes. Early diagnosis and enhanced neonatal care can bring down the burden of disease and death.

Keywords: Neonatal pneumonia, Prematurity, NICU, Complications

Introduction

Worldwide, neonatal pneumonia is a major cause of neonatal morbidity and mortality, especially in developing countries where healthcare centers are sparse and neonatal intensive care is not easily available. It is an inflammation of the lungs that develops in the first 28 days of life and is due to bacterial, viral, or fungal infection. Neonatal pneumonia can be considered early onset (up to 72 hours after birth) or late onset (after 72 hours); late onset is often due to hospital-acquired infections. The disease is a significant cause of admission to the neonatal intensive care unit (NICU) and is a major problem for pediatricians/neonatologists [1,2]. In the world, neonatal infections are a significant cause of neonatal mortality, including pneumonia. The World Health Organization estimates that neonatal infection is responsible for around one-third of the world's neonatal deaths. Poor maternal health care, poor infection control practices, low uptake of antenatal care, and delayed diagnosis are some of the main reasons why the burden is so high in low- and middle-income countries. Pakistan has one of the highest neonatal mortality rates in South Asia, in which respiratory infection and prematurity are found to be the responsible factors [3,4]. There are a number of maternal and neonatal risk factors for neonatal pneumonia. Risk factors for the mother are prolonged rupture of membranes, maternal fever, UTIs in pregnancy, chorioamnionitis, foul-smelling liquor, and poor antenatal care. These factors make it easier for pathogens to be transferred from the mother to the baby during childbirth. The susceptibility to pulmonary infections is further increased by neonatal factors, including prematurity, low birth weight, birth asphyxia, male gender, prolonged hospitalization, and mechanical ventilation. The immature lungs, surfactant deficiency, and immature immune system of premature neonates make them highly susceptible [5,6]. The clinical features of neonatal pneumonia are vague and can involve retraction, poor feeding, apnea, high respiratory rate, grunting, instability of temperature, and lethargy. The diagnosis is typically made by clinical examination, imaging, and routine blood tests, including a complete blood count, C-reactive protein, blood culture, and sepsis blood tests. Chest radiography is an important imaging modality for the recognition of pulmonary infiltrates and consolidation that are suggestive of pneumonia [7]. Neonatal pneumonia is a complication that can have a significant impact on the morbidity of neonates and can be serious. The most common complications are: sepsis, ventilator-associated pneumonia (VAP), respiratory failure, extended hospital stay, and death. Neonates admitted to the intensive care unit will often have oxygen therapy, intravenous antibiotics, and mechanical ventilators, which can increase their risk of nosocomial infection and poor outcomes. Preterm and low birth weight babies are generally more likely to die because they have weakened immunity and multisystem involvement [8,9]. Neonatal pneumonia significantly adds to the burden of care in tertiary hospitals by resulting in more admissions to NICUs, extended hospital stays, and the cost of treatment. Early identification of risk factors and prompt action will help to minimize morbidity and mortality. Better antenatal care, disease prevention, and evidence-based neonatal care protocols can have a significant impact on reducing disease burden. Neonatal pneumonia is an important clinical condition, limited local data are available on the prevalence, associated factors, and complications of neonatal pneumonia in tertiary care hospitals of Peshawar. To design preventive strategies and to enhance neonatal care services, it is important to understand these determinants. Hence, this study was done to find the incidence of neonatal pneumonia, the associated maternal risk factors, the associated neonatal risk factors, and complications of neonatal pneumonia in the ICU of a tertiary care hospital, Peshawar [10].

Study Objectives

To find out the incidence, risk factors, and complications of neonatal pneumonia among neonates admitted in the Intensive Care Unit (ICU) of a tertiary care hospital in Peshawar.

Materials And Methods

study design and setting.

It was a cross-sectional analytical study that was carried out in the Neonatal Intensive Care Unit of a tertiary-level hospital in Peshawar for six months from January 2023 to June 2023.

Participants

The neonates aged 0–28 days diagnosed with pneumonia were sampled by a non-probability consecutive sampling technique to get 100 neonates. The neonates who were admitted to the ICU with clinical and radiological findings of pneumonia were included after informed parental consent during the study period.

Sample Size Calculation

The sample size of 100 neonates was calculated based on the WHO sample size formula for the prevalence of neonatal pneumonia (around 80%), 5% margin of error, and 95% confidence level. The technique of non-probability consecutive sampling was used to select the eligible participants who were admitted during the period of study.

Inclusion Criteria

- Neonates aged 0–28 days
- The clinical signs suggestive of pneumonia included the following:
- The ability of the blood to cope with current and past radiation exposure. Radiological proof of pneumonia.
- Neonates admitted to the Intensive Care Unit (ICU), both term and preterm

Exclusion Criteria

- Congenital lung anomalies
- Congenital heart disease
- Other than infection, the meconium aspiration syndrome refers to the aspiration of meconium into the lungs.
- Incomplete medical records
- A parent's refusal of consent to the procedure. Parental refusal of procedure.

Diagnostic and Management Strategy

Clinical examination, chest radiographs, complete blood count, C-reactive protein, and blood culture were used to obtain a diagnosis. Management comprised oxygen therapy, intravenous antibiotic therapy as needed, ventilatory support when needed, and supportive NICU care as per hospital guidelines.

Statistical Analysis

Data were analyzed with SPSS version 26. The quantitative variables, such as age and hospital stay, were statistically analyzed using mean and standard deviation. Frequencies and percentages were used for qualitative variables. The association between risk factors and complications was evaluated using the chi-square test. A p-value of ≤ 0.05 was taken as statistically significant.

Ethical Approval

Results

A total of 100 neonates diagnosed with pneumonia were included in the study. The mean age of neonates was 12.4 ± 6.2 days. Male neonates constituted 61% of the study population, while females

accounted for 39%. Preterm neonates represented 56% of cases, and low birth weight was observed in 63% of patients. Cesarean section delivery was reported in 58% of cases. Maternal risk factors, prolonged rupture of membranes was identified in 35% of mothers, while maternal fever was present in 18% of cases. Mechanical ventilation was required in 29% of neonates admitted to the ICU. Respiratory distress, tachypnea, chest retractions, and cyanosis were the most frequent presenting clinical features. Regarding complications, prolonged hospital stay was the most common complication observed in 40% of patients, followed by sepsis in 31%, respiratory failure in 24%, ventilator-associated pneumonia in 11%, and pneumothorax in 5% of neonates. Mortality occurred in 17% of patients during hospitalization. Statistical analysis demonstrated a significant association between prematurity and development of complications ($p=0.02$). Low birth weight also showed statistically significant association with respiratory failure and mortality ($p=0.03$). These findings suggest that prematurity and low birth weight are major predictors of adverse clinical outcomes in neonatal pneumonia.

Intervention Outcome

Clinical response was obtained for the majority of neonates and was related to early diagnosis and aggressive antibiotic and oxygen therapy, and ventilatory support. But pre-term and low-birth-weight babies experienced relatively higher rates of complications, lengthy hospital stays, and death despite intensive care treatment.

Table 1: Demographic Characteristics of Neonates with Pneumonia (n=100)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	61	61%
Female	39	39%
Gestational Age		
Preterm	56	56%
Term	44	44%
Birth Weight		
Low birth weight (<2.5 kg)	63	63%
Normal birth weight (≥ 2.5 kg)	37	37%
Mode of Delivery		
Cesarean Section	58	58%
Vaginal Delivery	42	42%

Table 1 demonstrates the demographic and baseline neonatal characteristics of ICU-admitted neonates diagnosed with pneumonia.

Table 2: Maternal and Neonatal Risk Factors Associated with Neonatal Pneumonia (n=100)

Risk Factor	Frequency (n)	Percentage (%)
Prolonged rupture of membranes	35	35%
Maternal fever	18	18%
Prematurity	56	56%
Low birth weight	63	63%
Birth asphyxia	22	22%
Mechanical ventilation	29	29%
Delayed breastfeeding initiation	27	27%
NICU stay >7 days	40	40%

Table 2 illustrates maternal and neonatal risk factors identified among neonates admitted with pneumonia in the ICU.

Table 3: Complications Observed in Neonatal Pneumonia Patients (n=100)

Complication	Frequency (n)	Percentage (%)
Prolonged hospital stays	40	40%
Sepsis	31	31%
Respiratory failure	24	24%
Ventilator-associated pneumonia	11	11%
Pneumothorax	5	5%
Mortality	17	17%

Table 3 shows the frequency of complications and adverse outcomes among neonates diagnosed with pneumonia.

Table 4: Association of Prematurity and Low Birth Weight with Complications

Variable	Complications Present n (%)	Complications Absent n (%)	p-value
Prematurity	38 (67.9%)	18 (32.1%)	0.02
Term Neonates	17 (38.6%)	27 (61.4%)	
Low Birth Weight	45 (71.4%)	18 (28.6%)	0.03
Normal Birth Weight	10 (27.0%)	27 (73.0%)	

Table 4 demonstrates the statistically significant association of prematurity and low birth weight with complications among neonatal pneumonia patients admitted to the ICU.

Discussion

Neonatal pneumonia continues to be a major contributor to neonatal morbidity and mortality, particularly in intensive care units of developing countries. The present study aimed to evaluate the prevalence, risk factors, and complications of neonatal pneumonia in admitted neonates in the ICU department of a tertiary care hospital in Peshawar [11]. The results showed that adverse outcomes were significantly associated with prematurity, low birth weight, prolonged rupture of membranes, and mechanical ventilation, and that sepsis and prolonged hospital stay were the most common complications [12]. The current study showed male predominance of neonates with pneumonia (61%). Recently, other studies in tertiary care NICUs reported similar results, with male gender found to be a risk factor for neonatal infections because of immunological and hormonal differences. The vulnerability of male neonates to respiratory infections and sepsis has been consistently shown by studies performed over the past five years [13]. In our study, 56% of the neonates were observed to be premature, and this was statistically significantly associated with complications ($p=0.02$). Similar results have been reported in more recent international study that showed that premature birth was one of the strongest risk factors for neonatal pneumonia and poor NICU outcomes. Premature infants have underdeveloped lungs, less surfactant production, and underdeveloped immune systems, making them more susceptible to respiratory infections and respiratory failure [14,15]. Neonates with low birth weight (LBW) accounted for 63% and were significantly correlated with respiratory failure and mortality ($p=0.03$). Low birth weight has also been proven to be a risk factor for neonatal pneumonia and poor neonatal outcomes in recent studies in China and other developing countries. Xu et al. found that babies weighing less at birth had a significantly higher risk of pneumonia and NICU complications. These results corroborate the fact that LBW babies display a weak immune system and reduced pulmonary defense mechanisms, and thus are more susceptible to severe infections [16,17]. Other risk factors for mothers were also found to be significant for the development of neonatal pneumonia. In the present study, the long rupture of membranes was observed in 35% of mothers, and fever in the mother in 18% cases. These observations have been echoed in recent neonatal studies, which have shown that maternal infections and prolonged rupture of membranes are risk factors for neonatal sepsis and pneumonia due to vertical transmission of infection during birth [18]. In our study, 29% of neonates needed mechanical ventilation. The incidence of ventilator-

associated pneumonia (VAP) was 11%, which is higher than the risk of nosocomial infection in neonatal mechanical ventilation. Other, more recent, studies also cited from the NICU have shown that longer ventilation and repeated intubation are associated with increased pulmonary complications and bronchopulmonary morbidity in very-low-birth-weight infants [19]. In terms of complications, the most common was the prolonged hospital stay (40 %), followed by sepsis and respiratory failure. The results are corroborated by recent studies of outcomes in the NICU, which have shown that neonatal pneumonia was linked to greater length of stay and health care costs. Pulmonary infection is often followed by systemic infection, and this continues to be a major complication, sepsis [20]. Mortality in the present study was 17%, similar to the mortality rates reported in recent studies conducted in tertiary care hospitals of the developing countries. In the past, mortality was between 15% and 25% in neonates admitted to the NICU who had severe respiratory infections, especially in preterm and low-birth-weight infants. Infections in newborns and premature birth have also been listed as one of the top causes of neonatal mortality by the World Health Organization.

Limitations

This was a single tertiary care hospital setting with a small number of patients involved in this study, which may restrict the generalizability of the results. In some patients, the causative organisms did not have a microbiological confirmation. Long-term follow-up of neonates after discharge was not carried out either, which restricts long-term assessments of complications and outcomes.

Conclusion

Neonatal pneumonia is one of the major causes of morbidity and mortality of neonates admitted to the ICU. Low birth weight and maternal risk factors were very strongly linked to complications and poor outcomes, with prematurity also showing such a strong association. The key to minimizing complications, hospital stays, and mortality rates is to diagnose early, implement appropriate infection control measures, and manage newborns immediately.

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Reference

1. Zhang L, Qiu Y, Yi B, Ni L, Zhang L, Taxi P, Li H, Zhang Q, Wang W, Liu Z, Li L, Zhao L, Wang H, Sun B; and Collaborative Northwest Neonatal Network. Mortality of neonatal respiratory failure from Chinese northwest NICU network. *J Matern Fetal Neonatal Med.* 2017 Sep;30(17):2105-2111. doi: [10.1080/14767058.2016.1238894](https://doi.org/10.1080/14767058.2016.1238894).
2. Yang SM, Liu Y, Liu C, Yin AH, Wu YF, Zheng XE, Yang HM, Yang J. Hearing-loss-associated gene detection in neonatal intensive care unit. *J Matern Fetal Neonatal Med.* 2018 Feb;31(3):284-288. doi: [10.1080/14767058.2017.1282454](https://doi.org/10.1080/14767058.2017.1282454).
3. Yun ZY, Dong LJ, Fu W, Peng YQ, Wang YH, Yu YP, Shen BY. [An analysis of various diseases and hearing screening in NICU infants]. *Lin Chuang Er Bi Yan Hou Tou Jing Wai Ke Za Zhi.* 2016 Jul 20;30(14):1134-1136. Chinese. doi: [10.13201/j.issn.1001-1781.2016.14.011](https://doi.org/10.13201/j.issn.1001-1781.2016.14.011).
4. Brooks B, Olm MR, Firek BA, Baker R, Thomas BC, Morowitz MJ, Banfield JF. Strain-resolved analysis of hospital rooms and infants reveals overlap between the human and room microbiome. *Nat Commun.* 2017 Nov 27;8(1):1814. doi: [10.1038/s41467-017-02018-w](https://doi.org/10.1038/s41467-017-02018-w).

5. Sammons JS, Graf EH, Townsend S, Hoeg CL, Smathers SA, Coffin SE, Williams K, Mitchell SL, Nawab U, Munson D, Quinn G, Birenbaum G. Outbreak of Adenovirus in a Neonatal Intensive Care Unit: Critical Importance of Equipment Cleaning During Inpatient Ophthalmologic Examinations. *Ophthalmology*. 2019 Jan;126(1):137-143. [doi: 10.1016/j.ophtha.2018.07.008](https://doi.org/10.1016/j.ophtha.2018.07.008).
6. Yap PS, Ahmad Kamar A, Chong CW, Yap IK, Thong KL, Choo YM, Md Yusof MY, Teh CS. Intestinal carriage of multidrug-resistant gram-negative bacteria in preterm-infants during hospitalization in neonatal intensive care unit (NICU). *Patho Glob Health*. 2016 Sep;110(6):238-246. [doi: 10.1080/20477724.2016.1229884](https://doi.org/10.1080/20477724.2016.1229884).
7. Liao N, Luo J, Zhou X, Qin J. [Therapeutic effect of one-day outpatient on gestational diabetes mellitus patients]. *Zhong Nan Da Xue Bao Yi Xue Ban*. 2017 Aug 28;42(8):966-972. Chinese. [doi: 10.11817/j.issn.1672-7347.2017.08.015](https://doi.org/10.11817/j.issn.1672-7347.2017.08.015).
8. Yusef D, Shamakhi T, Awad S, Algaroba H, Khazanah W. Clinical characteristics and epidemiology of sepsis in the neonatal intensive care unit in the era of multi-drug-resistant organisms: A retrospective review. *Pediatric Neonatol*. 2018 Feb;59(1):35-41. [doi: 10.1016/j.pedneo.2017.06.001](https://doi.org/10.1016/j.pedneo.2017.06.001).
9. Lu L, Yan Y, Yang B, Xiao Z, Feng X, Wang Y, Ji W, Mize M, Hao C, Chen Z. Epidemiological and clinical profiles of respiratory syncytial virus infection in hospitalized neonates in Suzhou, China. *BMC Infect Dis*. 2015 Oct 15; 15:431. [doi: 10.1186/s12879-015-1155-x](https://doi.org/10.1186/s12879-015-1155-x).
10. Vayalthirikkovil S, Vorhies E, Stritzke A, Bashir RA, Mohammad K, Kamaluddeen M, Thomas S, Al Awad E, Murthy P, Sora Isham A. Prospective study of pulmonary hypertension in preterm infants with bronchopulmonary dysplasia. *Pediatric Pulmonol*. 2019 Feb;54(2):171-178. [doi: 10.1002/ppul.24211](https://doi.org/10.1002/ppul.24211).
11. Das I, Das RN, Paul B, Mandal B, Mukherjee S, Chatterjee U. A study of spectrum of pulmonary pathology and expression of thyroid transcription factor-1 during neonatal period. *Indian J Patho Microbiol*. 2018 Jul-Sep;61(3):334-338. [doi: 10.4103/IJPM.IJPM_650_17](https://doi.org/10.4103/IJPM.IJPM_650_17).
12. Kurek Eken M, Tuten A, Oz kaya E, Dinçer E, Şenol T, Karatekin G, Karateka A. Evaluation of the maternal and fetal risk factors associated with neonatal care unit hospitalization time. *J Matern Fetal Neonatal Med*. 2016 Nov;29(21):3553-7. [doi: 10.3109/14767058.2016.1138466](https://doi.org/10.3109/14767058.2016.1138466).
13. Chen SW, Fu W, Liu J, Wang Y. Routine application of lung ultrasonography in the neonatal intensive care unit. *Medicine (Baltimore)*. 2017 Jan;96(2): e5826. [doi: 10.1097/MD.0000000000005826](https://doi.org/10.1097/MD.0000000000005826).
14. Ibrahim M, Omran A, Abdallah NB, Ibrahim M, El-Sharkey S. Lung ultrasound in early diagnosis of neonatal transient tachypnea and its differentiation from other causes of neonatal respiratory distress. *J Neonatal Perinatal Med*. 2018;11(3):281-287. [doi: 10.3233/NPM-181796](https://doi.org/10.3233/NPM-181796).
15. Chiu Chetta FS, Munhoz TN, Santos IS, Menezes AM, Albernaz E, Barros FC, Matijevic A. Neonatal ventilatory support and respiratory diseases in children up to six years of age: the 2004 Pelotas (Brazil) Birth Cohort study. *Cad Saude Publica*. 2015 Jul;31(7):1403-15. English, Portuguese. [doi: 10.1590/0102-311X00087614](https://doi.org/10.1590/0102-311X00087614).
16. Cagan E, Kirya Baş E, Asker HS. Use of Colistin in a Neonatal Intensive Care Unit: A Cohort Study of 65 Patients. *Med Sci Monit*. 2017 Jan 30; 23:548-554. [doi: 10.12659/msm.898213](https://doi.org/10.12659/msm.898213).
17. Cantey JB, Wozniak PS, Pruszyński JE, Sánchez PJ. Reducing unnecessary antibiotic use in the neonatal intensive care unit (SCOUT): a prospective interrupted time-series study. *Lancet Infect Dis*. 2016 Oct;16(10):1178-1184. [doi: 10.1016/S1473-3099\(16\)30205-5](https://doi.org/10.1016/S1473-3099(16)30205-5).
18. Rodríguez-Fanjul J, Balcells C, Aldecoa-Bilbao V, Moreno J, Iriondo M. Lung Ultrasound as a Predictor of Mechanical Ventilation in Neonates Older than 32 Weeks. *Neonatology*. 2016;110(3):198-203. [doi: 10.1159/000445932](https://doi.org/10.1159/000445932).
19. Zhou F, Ning H, Chen F, Wu W, Chen A, Zhang J. Burkholderia gladioli infection isolated from the blood cultures of newborns in the neonatal intensive care unit. *Eury J Clin Microbial Infect Dis*. 2015 Aug;34(8):1533-7. [doi: 10.1007/s10096-015-2382-1](https://doi.org/10.1007/s10096-015-2382-1).

20. Thakur S, Thakur K, Sood A, Chaudhary S. Bacteriological profile and antibiotic sensitivity pattern of neonatal septicemia in a rural tertiary care hospital in North India. Indian J Med Microbial. 2016 Jan-Mar;34(1):67-71. [doi: 10.4103/0255-0857.174108](https://doi.org/10.4103/0255-0857.174108).