International Journal of Contemporary Pediatrics
Syeda A et al. Int J Contemp Pediatr. 2023 Feb;10(2):227-233
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20230089

Original Research Article

A study of risk factors and clinical characteristics of neonatal pneumonia in a tertiary care centre

Arshiya Syeda[1]*, Lohith Reddy[2], Ksl Sowmya[2], Santosha Manta[2], Nisar Ahmed[3]

[1]Department of Paediatrics, Malla Reddy Institute of Medical Sciences, Hyderabad, Telangana, India
[2]Department of Paediatrics, Gandhi Hospital, Secunderabad, Telangana, India
[3]PGDBA, IIM Calcutta, IIT Kharagpur, ISI Kolkata, West Bengal, India

Received: 16 December 2022
Revised: 06 January 2023
Accepted: 10 January 2023

***Correspondence:**
Dr. Arshiya Syeda,
E-mail: drarshiyasyed69@gmail.com

ABSTRACT

Background: Neonatal pneumonia accounts for significant morbidity and mortality, especially in developing countries. Throughout childhood, the greatest risk of death from pneumonia is in the neonatal period. This study is done to study the risk factors and clinical characteristics of neonatal pneumonia. Aim of the study was to study the risk factors and clinical characteristics of neonatal pneumonia.
Methods: This was a hospital-based observational study conducted in the department of paediatrics, Gandhi medical college and hospital, Hyderabad. A detailed antenatal and postnatal risk factors were taken, and the clinical signs and symptoms of neonatal pneumonia were noted.
Results: Of the 100 neonates 30% of cases had early onset pneumonia and 70% had late onset pneumonia.50% of early onset pneumonia cases had antenatal risk factors. There is a statistically significant association of age of onset of pneumonia with gestational age (p=0.002) late onset pneumonia being more common >37 weeks of gestational age. 80% of early onset pneumonia cases were associated with septicaemia.
Conclusions: Pneumonia is one of the most common causes of respiratory distress in neonates. Late onset pneumonia was more common. Major predisposing factors for early onset pneumonia are antenatal risk factors like premature rupture of membranes, maternal fever, major predisposing factors for late onset pneumonia are pre-lacteals, oil instillation in the nose, and aspiration of milk. Cough as a symptom was observed in late onset pneumonia.

Keywords: Risk factors, Clinical signs and symptoms, Early onset pneumonia, Late onset pneumonia

INTRODUCTION

Pneumonia is an important cause of neonatal infection and accounts for significant morbidity and mortality, especially in developing countries.[1,2] In resource-rich settings, the estimated incidence of pneumonia is <1% among full-term infants and approximately 10% in preterm infants.[3,4] By contrast, the incidence of neonatal pneumonia at autopsy ranges from 20 to 32% of live born and from 15 to 38% of stillborn infants.[4] In resource-limited settings, pneumonia is major contributor to infant mortality.

WHO estimated that in 2015 pneumonia caused >900,000 deaths worldwide in children under five years old, with the majority of deaths occurring in infants <1 year old.[5] In one study conducted in a rural area in central India, mortality secondary to pneumonia in the first month was 29 per 1000 live births; more than one-half of all pneumonia deaths in children occurred in newborns.[6] These figures may underestimate the burden of neonatal pneumonia in resource-limited settings because many new-borns do not receive medical care.

Congenital pneumonia is a common cause of mortality among extremely low birth weight (ELBW) infants (i.e.,

BW <1000 gm), accounting for nearly 30 per cent of deaths in one series.[7] Pneumonia caused by maternal enteric organisms frequently accompanies chorioamnionitis and or funisitis in these congenital infections.

Throughout childhood, the greatest risk of death from pneumonia is in the neonatal period. In a field trial of community-based management of childhood pneumonia in India, more than half of all child deaths from pneumonia occurred among neonates.[8]

Pneumonia is the single largest cause of death in children worldwide accounting for almost one fifth of the under-five child deaths.[9] Ninety per cent of these occur in developing countries; mostly in South Asia and Sub-Saharan Africa.[10, 11] India accounts for the greatest number of childhood pneumonia deaths among high burden countries.[11]

India also contributes to a greater proportion of global neonatal deaths than any other country, and neonatal mortality comprises over half of national under-five deaths.[12,13] In India, pneumonia accounts for 16% of neonatal deaths, compared with just 3% of global neonatal deaths, highlighting it as a serious cause for concern.[14]

With 57% of India's under-five deaths occurring in the neonatal period and high burden of pneumonia, effectively tackling neonatal pneumonia is important in controlling the national and regional neonatal mortality rate.[15] However, there remains a lack of consolidated research for factors responsible for neonatal pneumonia, especially from the Indian context.

Hence this study is done to know the risk factors and clinical characteristics of neonatal pneumonia.

Objectives

Objectives of the study were to study the risk factors for neonatal pneumonia and to study the clinical characteristics of neonatal pneumonia.

Definition

A definition of neonatal pneumonia was proposed in one Indian study.[16]

A neonate with respiratory distress (any of rapid, noisy, or difficult breathing; respiratory rate 60/min; chest retractions; cough; grunting) who has: (a) a positive blood culture or (b) any two or more of the following: (1) Predisposing factors-maternal fever (38˚C)-foul smelling liquor-prolonged rupture of membranes (24 hours), (2) Clinical picture of sepsis-poor feeding-lethargy-poor reflexes-hypothermia or hyperthermia-abdominal distension, (3) radiograph suggestive of pneumonia (nodular or coarse patchy infiltrate, diffuse haziness or granularity, air Broncho gram, lobar or segmental consolidation); radiological changes not resolved within 48 hours and (4) positive sepsis screen (any of the following): Bands 20% of leucocytes-leucocyte count out of reference range-raised C reactive protein-raised erythrocyte sedimentation rate.

Classification

Neonatal pneumonia can be classified into two categories based on onset of pneumonia: a) Early-onset neonatal pneumonia-occurring in new-borns within 72 hrs of life and b) Late-onset neonatal pneumonia-occurring in new-borns more than 72 hrs of life.

METHODS

This is an observational study conducted from June 2017 to January 2019 at Gandhi medical college/hospital, Secunderabad. All neonates with a diagnosis of pneumonia were included in this study. Demographic details of the patients were collected using a semi-structured questionnaire. Analytical tests were performed using Chi-square test.

This prospective observational study was done on neonates with a diagnosis of neonatal pneumonia, admitted at NICU Gandhi hospital, Secunderabad, after taking the informed consent of the parents. This study was approved by the institute ethics committee.

A questionnaire was filled for each participant which included the medical information of the mother and the baby, such as the maternal history (age, parity, past medical history, blood type, Rh disease), labour status (route of delivery, PROM, oxytocin administration), and the neonatal history (birth weight, blood grouping and typing and Rh disease).

A detailed antenatal history was taken with emphasis on antenatal risk factors for neonatal pneumonia like prolonged rupture of membranes, maternal fever, prolonged labour, UTI, foul smelling liquor. Detailed birth history including resuscitation details, Apgar score and gestational age assessment were noted. Postnatal risk factors (oil instillation in the nose, pre-lacteals, aspiration of the milk) were taken.

The neonate's weight, gestational age, the clinical signs and symptoms of respiratory distress (RR>60 /min, apnoea, cough, nasal flaring, cyanosis, grunting, chest retractions, decreased air entry, additional sounds) were noted in detail. Associated signs and symptoms of septicaemia like fever, hypothermia, abdominal distension, lethargy, decreased acceptance of feeds, vomiting, bradycardia, shock, and convulsions also noted.

Data is entered in Microsoft excel software and analysed by SPSS version 10.0. Parametric data is expressed as percentage. Chi-squared test was used to test associations

between all categorical variables. P<0.05 was taken as statistically significant.

Selection of cases

The 100 neonates admitted in our hospital with a diagnosis of neonatal pneumonia were included in this study. Neonates admitted in our hospital from outpatient department and neonates born in our hospital were included in this study.

Inclusion criteria

All neonates (≤ 28 days of life) with gestational age ≥ 35 weeks admitted in NICU Gandhi hospital with a diagnosis of neonatal pneumonia have been included in this study.

Case definition of pneumonia (modified from Mathur et al).[17]

Neonates presenting with all the following- 1) Respiratory distress (RR >60/min with retractions/grunting) or gasping or respiratory failure, 2) Need for oxygen / invasive /non-invasive respiratory support for maintaining saturation >90% and 3) Radiological evidence of pneumonia on chest x ray at the time of admission to the hospital.

Exclusion criteria

Neonates with gestational age<35 weeks, hyaline membrane disease, neonates with major congenital malformations including congenital heart diseases, meconium aspiration syndrome, PPHN, pulmonary haemorrhage, transient tachypnoea of new-born, pneumothorax, ventilation associated pneumonia and infant of diabetic mother were excluded from the study.

RESULTS

Of the 100 cases with neonatal pneumonia 53 % are males and 47% are female babies (Figure 1).

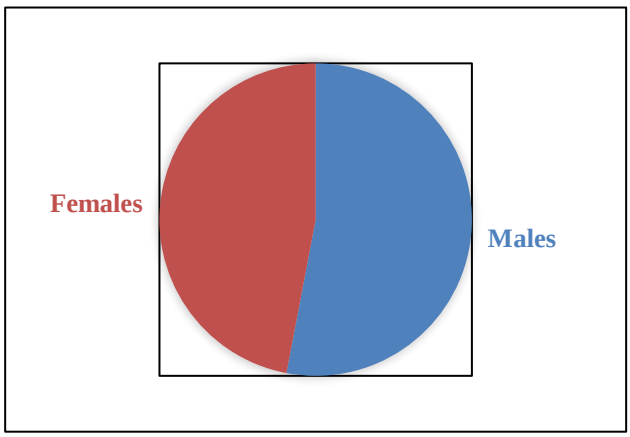

Figure 1: Distribution of cases according to gender.

The 86% of cases had institutional deliveries and 14% had home deliveries. The 69% were born by normal vaginal delivery and 31 % were born by LSCS. 30% of cases had early onset pneumonia and 70% had late onset pneumonia (Figure 2).

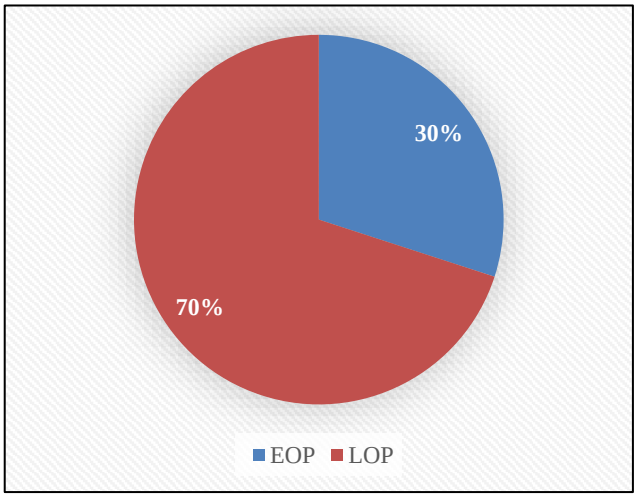

Figure 2: Distribution of cases according to age of onset of pneumonia.

The 65% of cases were ≥37 weeks of gestational age and 35% were ≤ 37 weeks of gestational age.

Early onset pneumonia was more common in < 37 weeks of gestational age (60%). Late onset pneumonia was more common in ≥37 weeks of gestational age (75.7%) (Figure 3). There is a statistically significant association of age of onset of pneumonia with gestational age (p=0.002).

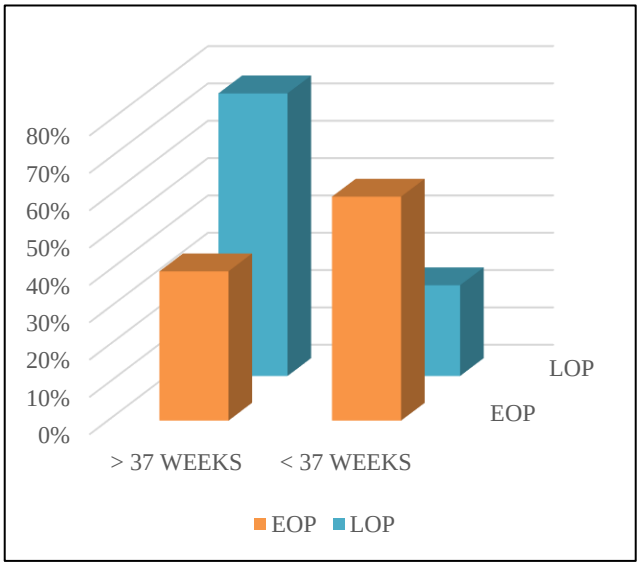

Figure 3: Distribution of cases according to onset of pneumonia and gestational age.

The 55% of cases were more than 2.5 kg birth weight. 45% of cases were less than 2.5 kg birth weight.

Early onset pneumonia was common in <2.5 kg birth weight babies (63.3%) (Table 1). There is a statistically significant association of onset of pneumonia with birth weight p=0.015.

Table 1: Distribution of cases according to birth weight.

Onset of pneumonia	>2.5 kg birthweight (%)	<2.5 kg birthweight (%)
Early onset pneumonia	11 cases (36.6%)	19 cases (63.3%)
Late onset pneumonia	44 cases (62.8%)	26 cases (37.1%)

The 50% of early onset pneumonia cases had antenatal risk factors and 28.5% of late onset pneumonia cases had antenatal risk factors (Figure 4).

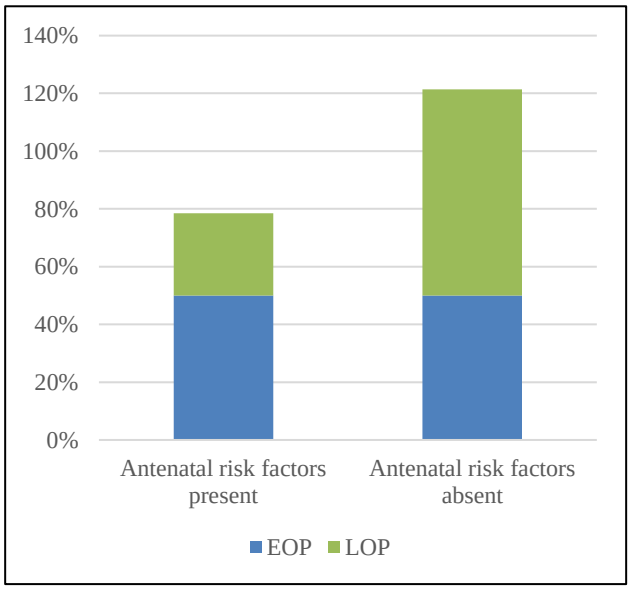

Figure 4: Distribution of cases according to onset of pneumonia and antenatal risk factors.

Of the 30 cases of EOP, 15 cases (50%) had antenatal risk factors. Of which PROM was present in 6 cases (20%) followed by Maternal fever present in 4 cases (13.3%), foul smelling liquor in 4 cases (13.3%) UTI was present in 1 case (3%).

Of the 70 cases of late onset pneumonia antenatal risk factors were present in 20 cases (28.5%). Of which, PROM was present in 10 cases (14.2%) maternal fever was present in 7 cases (10%), foul smelling liquor in 1 case (1.4%) and UTI was present in 2 cases (2.8%).

Of the 30 cases of early onset pneumonia, pre-lacteals were given 5 cases (16.6%) and oil instillation in the nose was present in 2 cases (6.6%). Of the 70 cases of late onset pneumonia, 20 babies (28.5%) received pre-lacteals, oil instillation in the nose was present in 13 cases (18.5%).

Of the 30 cases of early onset pneumonia, 24 cases (80%) were associated with septicaemia. Of the 70 cases of late onset pneumonia 42 cases (60%) were associated with septicaemia.

Out of 30 cases of early onset pneumonia, chest retractions were the most common finding present in 76.6% of cases. Tachypnoea was present in 10% of cases. Grunting was present in 56.6% of cases, nasal flaring was present in 63.3% of cases, gasping was present in 20% of cases, cyanosis was present in 30% of cases, additional lung sounds were present in 20% of cases and decreased air entry was present in 23.3% of cases, apnoea was present in 10% of cases. Cough was not observed in the early onset pneumonia. Out of 70 cases of late onset pneumonia most common sign was tachypnoea present in 80% of cases, chest retractions were present in 70% of cases, nasal flaring was present in 51.4% of cases, decreased air entry was present in 25.7% of cases, additional lung sounds were present in 27.1%, grunting was present in 40% of cases, cyanosis was present in 34.2%, cough was present in 21% of cases, gasping was present in 17% of cases. Least common symptom of late onset pneumonia was apnoea present in 8.5% of cases.48 % of cases required oxygen inhalation, 32% required CPAP and 20% required mechanical ventilation as the respiratory support.

DISCUSSION

Neonatal pneumonia is a pulmonary infection presenting with a clinical picture of respiratory distress, associated with chest radiological findings suggesting pneumonia and persisting for at least 48 hours. Infections may be transmitted via the placenta, by aspiration, or acquired postnatally.

Neonatal pneumonia can be subdivided into two categories-1) Early-onset pneumonia (due to an ascending infection "vertically"), 2) Late-onset pneumonia (due to organisms acquired noscomially ("horizontally") or in the community.[18]

Early-onset pneumonia-Early-onset pneumonia, generally within three days of birth, is acquired from the mother by one of three routes: Intrauterine aspiration of infected amniotic fluid, trans placental transmission of organisms from the mother to the foetus through the placental circulation. Aspiration during or after birth of infected amniotic fluid.

The neonate can aspirate vaginal organisms, leading to respiratory colonization and, in some cases, pneumonia. Vaginal colonization with such organisms as group B *Streptococcus* (GBS) does not necessarily result in overt maternal infection.

Late-onset pneumonia-Late-onset pneumonia, which occurs during hospitalization or after discharge, generally arises from organisms colonizing the hospitalized

newborn or is nosocomially acquired from infected individuals or contaminated equipment. Microorganisms can invade through injured tracheal or bronchial mucosa or through the bloodstream.

The clinical signs and symptoms of neonatal pneumonia can be pulmonary or systemic.[19] Many extrapulmonary findings are nonspecific and may be seen in many other common neonatal conditions. Some signs of respiratory distress cannot be manifested if the infant is affected by other processes that result in apnoea, such as poor tolerance of labour, exposure to transplacental respiratory depressants, or CNS anomaly or injury.

Pulmonary findings of neonatal pneumonia-all findings not necessarily present in all affected infants.

Persistent tachypnoea (respiratory rate >60/min). Expiratory grunting may occur. Accessory respiratory muscle recruitment, such as nasal flaring and retractions at subcostal, intercostal, or suprasternal sites, may occur. Airway secretions may vary substantially in quality and quantity but are most often profuse and progress from serosanguineous to a more purulent appearance. White, yellow, green, or haemorrhagic colours and creamy or chunky textures are not infrequent. Rales, rhonchi, and cough are all observed much less frequently in infants with pneumonia than in older individuals. If present, they may be caused by noninflammatory processes, such as congestive heart failure, condensation from humidified gas administered during mechanical ventilation, or endotracheal tube displacement. Although alternative explanations are possible, these findings should prompt careful consideration of pneumonia in the differential diagnosis. Cyanosis of central tissues is consistent with severe derangement of gas exchange from severe pulmonary dysfunction as in pneumonia, although congenital structural heart disease, hemoglobinopathy, polycythaemia, and pulmonary hypertension (with or without other associated parenchymal lung disease) must be considered. Infants may have external staining or discoloration of skin, hair, and nails with meconium, blood, or other materials when they are present in the amniotic fluid. The oral, nasal, and, especially, tracheal presence of such substances is particularly suggestive of aspiration. Increased respiratory support requirements such as increased inhaled oxygen concentration, positive pressure ventilation, or continuous positive airway pressure are commonly required before recovery begins. Infants with pneumonia may manifest asymmetry of breath sounds and chest excursions, which suggest air leak or emphysematous changes secondary to partial airway obstruction.

Systemic findings of neonatal pneumonia: Similar to signs and symptoms seen in sepsis or other severe infections: Temperature instability, skin rash, jaundice, tachycardia, glucose intolerance, abdominal distension, hypoperfusion, oliguria and sclerema.

Early-onset pneumonia commonly presents with respiratory distress beginning at or soon after birth. Infants may have associated lethargy, apnoea, tachycardia, and poor perfusion, sometimes progressing to septic shock. Some infants develop pulmonary hypertension. Other signs include temperature instability, metabolic acidosis, and abdominal distension. None of these signs is specific for pneumonia, and respiratory distress also can be caused by non-infectious causes. Late-onset pneumonia is marked by changes in the overall condition of the newborn and can include nonspecific signs of apnoea, tachypnoea, poor feeding, abdominal distension, jaundice, emesis, respiratory distress, and circulatory collapse.

The present study is undertaken to study the predisposing factors for neonatal pneumonia, to evaluate clinical signs and symptoms for diagnosis of neonatal pneumonia. In this study 100 neonates with a diagnosis of neonatal pneumonia were included and risk factors a clinical signs and symptoms were noted in detail. In our study late onset pneumonia was more common than the early onset pneumonia. Early onset pneumonia was more commonly observed in late preterm (< 37 weeks.) neonates and late onset pneumonia was more common in term neonates (>37 weeks). There is a statistically significant association of age of onset of pneumonia with gestational age (p=0.002). In low-birth-weight babies early onset pneumonia was commonly observed in this study. There is a statistically significant association of onset of pneumonia with birth weight p=0.015.

The 50% of early onset pneumonia cases had antenatal risk factors and 28.5% of late onset pneumonia cases had antenatal risk factors. Of the antenatal risk factors, PROM was the most common involving 16% of the cases followed by maternal fever present in 11% of the cases; foul smelling liquor was present in 5% of the cases. Least common antenatal risk factor was UTI 3%. There is a statistically significant association between predisposing factors and the onset of pneumonia (p=0.0017). Antenatal risk factors were associated more commonly with early onset pneumonia and postnatal risk factors (aspiration of milk, oil instillation in the nose, pre-lacteals) were commonly associated with late onset pneumonia.

In Mathur et al study PROM was present in 34%, maternal fever was present in19.4% and foul-smelling liquor was present in 15.5%.[19] In Haney et al PROM was present in 93%, maternal fever was present in 30% and foul-smelling liquor was present in 20% cases.[20]

In the present study PROM was present in 16%, maternal fever was present in 11% and foul-smelling liquor was present in 5%. The present study is in more consistent with Mathur et al study.

In the Mathur et al study, pneumonia was associated with septicaemia in 58% of the cases and pneumonia was not associated with septicaemia in 455 of the cases.[19]

In the present study pneumonia with septicaemia was present in 66% of the cases and pneumonia without septicaemia was present in 34% of the cases. Early onset pneumonia was more commonly associated with septicaemia than late onset pneumonia which is statistically significant (p=0.025).

In the Mathur et al study the most common sign was chest retractions present in 93.2% of cases, tachypnoea was present in 88.3% of cases, adventitious sounds were present in 57.2% of cases, nasal flaring and cyanosis was present in 48.5% of cases and cough was present in 13.5% of cases.[19]

In the present study chest retractions and tachypnoea were observed in 77% of cases. Nasal flaring was present in 55% of cases, cyanosis was present in 33% of cases, adventitious sounds were present in 25% of cases and cough was present in 15% of cases.

In the present study, chest retractions were the most common finding in early onset pneumonia cases. Cough was absent in the early onset pneumonia. In Late onset pneumonia cases, most common sign was tachypnoea, which is present in 80% of cases, cough was present in 21% cases. Least common symptom of late onset pneumonia was apnoea present in 8.5% cases.

Limitations

The study sample size was small, it is not found to be statistically significant and no control was taken. The study was done only in one hospital-based setting, which did not represent the whole country. Many signs and symptoms were subjective.

CONCLUSION

Pneumonia is one of the most common causes of respiratory distress in neonates. Late onset pneumonia was more common than the early onset pneumonia. Major predisposing factors for early onset pneumonia are antenatal risk factors like PROM, maternal fever, foul smelling liquor, UTI. Major predisposing factors for late onset pneumonia are pre-lacteals, oil instillation in the nose, and aspiration of milk. Pneumonia was associated with septicaemia in early onset cases. Retractions of the chest involved equally in early and late onset pneumonia. Cough as a symptom was observed only in late onset pneumonia. Managing antenatal risk factors effectively help in reduction of early onset or congenital pneumonias. Late onset pneumonias can be prevented by maternal hygiene, hand washing and exclusive breastfeeding.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Stoll BJ. The global impact of neonatal infection. Clin Perinatal. 1997;24:1.
2. Duke Neonatal pneumonia in developing countries. Arch Dis Child Fetal Neonatal Ed. 2005;90:F211.
3. Sinha A, Yokoe D, Platt R. Epidemiology of neonatal infections: experience during and after hospitalization. Pediatr Infect Dis J. 2003;22:244.
4. Nissen MD. Congenital and neonatal pneumonia. Paediatr Respir Rev. 2007;8:195.
5. World Health Organization, Pneumonia fact sheet. Available at: http://www.who.int/mediacentre/factsheets/fs331/en. Accessed on 25 Nov, 2022.
6. Bang AT, Bang RA, Morankar VP. Pneumonia in neonates: can it be managed in the community? Arch Dis Child. 1993;68:550.
7. Barton L, Hodgman JE, Pavlova Z. Causes of death in the extremely low birth weight infant. Pediatrics. 1999;103:446.
8. Bang AT, Bang RA, Tale O. Reduction in pneumonia mortality and total childhood mortality by means of community-based intervention trial in Gadchiroli, India. Lancet. 1993;336:201-6.
9. World Health Organisation (WHO). Maternal, new-born, child and adolescent health news Archive. Pneumonia is the leading cause of death in children. Available at: http://www.who.int/. Accessed on 1 Sep, 2022.
10. Wardlaw TM, Johansson EW, Hodge MJ. Pneumonia: the forgotten killer of children: UNICEF. 2006.
11. Rudan I, Boschi-Pinto C, Biloglav Z. Epidemiology and etiology of childhood pneumonia. Bull World Health Organ. 2008;86:408-16.
12. United Nations Children's Fund (UNICEF). Committing to Child Survival: A Promise Renewed, Progress Report 2015. New York, USA: UNICEF. 2015.
    Million Death Study Collaborators. causes of neonatal and child mortality in India: a nationally representative mortality survey. The Lancet. 2010;376:1853-60.
13. World Health Organisation (WHO). Department of Maternal Newborn Child and Adolescent Health. India: Neonatal and Child Health Profile, 2013. Available at: http://www.who.int/. Accessed on 19 Nov, 2022.
14. Department of Health and Family Welfare. Part A: Chapter 5: Child Health Program. Ministry of Health and Welfare, Government of India. Annual Report 2014-15. 2015. Available at: http://www.mohfw.nic.in/. Accessed on 18 Nov, 2022.
15. Mathur NB, Garg K, Kumar S. Respiratory distress in neonates with special reference to pneumonia. Indian Pediatr. 2002;39(6):529-37.

16. Mathur NB, Garg K, Kumar S. Respiratory distress in neonates with special reference to pneumonia. Indian Pediatr. 2002;39(6):529-37.
17. Moxon I. Pneumonia. Ch. 9 in Handbook of Neonatal Infections-a practical guide. WB Saunders: London. 1999.
18. Mathur NB, Garg K, Kumar S. Respiratory distress in neonates with special reference to pneumonia. Indian Pediatr. 2002;39(6):529-37.
19. Haney PJ, Bhlman M, Chen-Chih JS. Radiographic findings in neonatal pneumonia. AJR. 1984;143:24.

Cite this article as: Syeda A, Reddy L, Sowmya K, Manta S, Ahmed N. A study of risk factors and clinical characteristics of neonatal pneumonia in a tertiary care centre. Int J Contemp Pediatr 2023;10:227-33.