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Original Research Article

# Study to Determine Causes of Respiratory Distress, Pattern of Respiratory Modality Used and its Outcome among Admitted Preterm Newborns

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**Abstract**

**Aim:** The aim of the present study was to determine causes of respiratory distress, pattern of respiratory modality used and its outcome among admitted preterm newborns.

**Methods:** A retrospective descriptive study was conducted in the Department of Neonatology, over a period of two years targeting all neonates admitted to neonatology department. A Total of 100 patients were admitted in NICU during the study.

**Results:** Mean gestational age was 32.38±2.48 weeks. Most of the newborns (62%) belonged to the gestational age within 28 - <34 weeks category. Mean birth weight was 1635.45±570.55 g among them very low birth weight infants were 42%. Male out numbered female newborns (55% vs 45%). Total 6 (6%) infants had Apgar scores <7 at 5 minutes who required some degree of resuscitation just after birth. After admission 4 (4%) patients got single dose of surfactant. Most of the mother (66%) was multiparous and 51% of them did not receive even a single dose of antenatal corticosteroid. All of them were inborn and cesarean section was the mode of delivery for 80% of the enrolled neonates. Maternal hypertension and diabetes mellitus were present in 70 (70%) and 32 (32%) of mother respectively. Maternal risk factors for sepsis were present in 24 (24%) of infants admitted to the NICU. The respiratory distress syndrome (RDS) was the most common cause 51 (51%) following TTN 23 (23%), congenital pneumonia 20 (20%) and PNA 6 (6%).

**Conclusion:** Respiratory distress syndrome is the commonest cause of respiratory distress.Two third of preterm newborns required respiratory support. Most common mode of respiratory support was non invasive mode in the form of supplemental oxygen, Heated humidified high flow nasal cannula and continuous positive airway pressure. Short term morbidities like nasal trauma, sepsis, septic shock, disseminated intravascular coagulation, necrotising enterocolitis and intraventricular haemorrhage were more common in newborns who required invasive respiratory support (p <0.05). Retinopathy of prematurity and mortality was significantly higher in invasive respiratory support group.

**Keywords:** Neonates, Preterm, Mechanical ventilation, Non-invasive ventilation



## Introduction

Respiratory Distress Syndrome (RDS) is the commonest cause of respiratory distress in preterm infants. Deficiency of pulmonary surfactant is one of the most important factors contributing to the development of respiratory RDS. In immature lungs, the elevated surface tension resulting from surfactant deficiency leads to alveolar collapse at the end of expiration, atelectasis, uneven inflation and regional alveolar over distension. If untreated, this will result in epithelial injury and pulmonary edema which further interfere with surfactant function, producing the clinical picture of RDS. The main risk for RDS is prematurity. Other factors that increases the risk of RDS are perinatal asphyxia, maternal diabetes, lack of labour, absence of antenatal steroid administration to the mother and male gender. [1]

In preterm infants with respiratory distress syndrome (RDS), the application of continuous positive airway pressure (CPAP) is associated with benefits in terms of reduced respiratory failure and reduced mortality. Positive pressure therapy was first used by Poulton, and Oxan in 1936 who used facemask to treat acute ventilatory insufficiency. [2] Harrison was the first to recognize the use of an increased alveolar pressure during expiration in infants with respiratory distress syndrome (RDS). [3] He observed that grunt appears in cases of RDS, which increases progressively with increasing severity of disease and abolition of this grunt by use of endotracheal tube led to decrease in partial arterial pressure of oxygen (PaO2) and further worsening of the disease. Gregory, et al. first described two methods of delivery of CPAP in 1971 for treatment of RDS: through endotracheal tube and by pressure chamber around infant's head. [4] Subsequently facemask and nasopharyngeal tube have been used. [5]

Respiratory distress syndrome (RDS) in newborns is the most common cause of morbidity and mortality and is an indication for ventilation in preterm infants. [6] In recent years, the widespread implementation of nasal continuous positive airway pressure (CPAP) as the initial means of respiratory support for preterm infants has fundamentally changed respiratory management in the first hours of life. The universal use of CPAP has reduced the need for endotracheal intubation and mechanical ventilation (MV) [7] and their associated lung injuries. [8,9] The American Academy of Pediatrics [10] and the European Consensus Guidelines for the Management of RDS [11] recommended that the initial application of CPAP be considered as the optimal mode of respiratory support.

The aim of the present study was to determine causes of respiratory distress, pattern of respiratory modality used and its outcome among admitted preterm newborns.

## Materials and Methods

A retrospective descriptive study was conducted in the Department of Neonatology, Yashvi Children Hospital, Patna, Bihar, India over a period of two years targeting all neonates admitted to neonatology department. A Total of 100 patients were admitted in NICU during the study.

All inborn preterm neonates having gestational age of <37 weeks and admitted with respiratory distress were included in the study. Neonates with incomplete data and or lethal congenital anomalies were excluded from the study. Data were collected from the neonatal admission, discharge and death registers. The register contained each neonate's date of admission and discharge or death, sex, weight at admission or at birth, gestation age at birth, mode of delivery, duration of stay at the hospital, diagnosis and outcomes. The primary causes of admissions and deaths were defined as the underlying obstetric and neonatal factors or conditions, which resulted in the admission or death of the neonate. Standard definitions of the medical conditions were used for diagnosis. [12] All medical and nursing staff working at the neonatal unit was oriented on recording of the neonatal admission, discharge and death registers, clinical guidelines of diagnosis and compilation of monthly summaries for presentation at monthly perinatal mortality meetings. Extracted data included: mode of delivery, multiple gestations, use of antenatal corticosteroid, gestational diabetic mellitus (GDM), Pregnancy induced hypertension (PIH), risk factor for sepsis, sex of the baby, gestational age (weeks), birth weight (g), APGAR score at 5th minutes, Silverman- Anderson score (SAS), neonatal resuscitation, surfactant administration, fetal growth at birth (SGA, AGA, LGA), respiratory distress, cause of respiratory distress, mode of respiratory support (NIV, MV) and days of hospitalization.

Neonates born at less than 37 completed weeks (less than 259 days) of gestation were termed as preterm and those having birth weight of < 2500 g were defined Low birth weight (LBW).[12] Newborns was defined small for gestational age (SGA) if the birth weight less than the 10th percentile. Resuscitation was defined as need for intermittent positive pressure ventilation and/or cardiac compression and/or drug administration in the neonatal stabilization period. Respiratory distress in newborn was labelled when a baby had one or more signs of increased work of breathing, such as tachypnea, nasal flaring, chest retractions, or grunting.8 Severity of respiratory distress was categorized using Silverman-Anderson scoring system where Score ≥ 4 indicate clinical respiratory distress and score ≥ 7 indicate respiratory failure.[13]

Respiratory distress syndrome (RDS) was defined in neonates with increasing oxygen dependence during the first 24 h, typical radiological findings: like reduced air content, reticulo-granular pattern of the lungs, air bronchogram and/or white out lung. When newborns developed respiratory distress soon after birth and resolves within 18-24 hours of life with normal chest X-ray finding or show reduced translucency, infiltrates and hyperinflation of the lungs were labelled as Transient Tachypnea of newborn (TTN). Breathing pauses that last for > 20 seconds or for > 10 seconds if associated with bradycardia or oxygen desaturation was termed as apnea. Bronchopulmonary Dysplasia (BPD) was defined when a neonate was requiring oxygen at 36 weeks of post gestational age for babies born < 32 weeks of gestation or 28 days of age for neonates born ≥ 32 weeks of gestation or later. [13]

Maternal characteristics included as maternal age, maternal diseases like gestational and non-gestational diabetes mellitus, Pregnancy induced hypertension, infections and use of antenatal corticosteroids. Deliveries were categorized as vaginal or Cesarean Section (CS). The Data on respiratory support such as oxygen therapy administered through nasal-cannula, nasal continuous positive airways pressure (CPAP), heated humidified high flow nasal cannula (HHHFNC) and mechanical ventilation (MV) was collected. When analyzing the data, for each neonate only the highest level of respiratory support was considered. The need for specific adjunctive therapy (surfactant Administration) and the short-term outcome including morbidities and in hospital mortality were recorded. Respiratory support was divided into two groups as Invasive (Mechanical ventilation) and noninvasive which included supplemental oxygen through nasal cannula, head box, High flow nasal cannula and continuous positive airway pressure (CPAP). All the variables and mortality were compared between the two groups

Statistical analysis: Data entry and analysis was carried out by using the Statistical Package of Social Science Software program (SPSS), version 22. Categorical variables were expressed in frequency and statistical analysis was done by Chi-Square test or Fisher exact test. Continuous variable was seen in mean ± SD and statistical analysis was done by student t-test. P value <0.05 was considered statistically significant.

**Results**

**Table 1: Baseline neonatal characteristics in studied neonates**

| Parameter | Value |
|---|---|
| Gestational age (weeks), Mean ±SD | 32.38±2.48 |
| Gestational age category, n (%) | |
| <28 weeks | 6 (6) |
| 28-<34 weeks | 62 (62) |
| 34-<37 weeks | 36 (36) |
| Birth weight (g), Mean ± SD | 1635.45±570.55 |
| Birth weight category, n (%) | |
| <1000 g | 10 (10) |
| 1000-1499 g | 42 (42) |
| 1500-2499 g | 40 (40) |
| ≥2500 g | 8 (8) |
| Sex of the baby, n (%) | |
| Male | 55 (55) |
| Female | 45 (45) |
| Multiple birth, n (%) | 22 (22) |
| Neonatal resuscitation, n (%) | 6 (6) |
| APGAR score at 5th minute | |
| ≥7 | 94 (94) |
| <7 | 6 (6) |
| Silverman Anderson Score at randomization | |
| <4 | 14 (14) |
| 4-7 | 86 (86) |
| >7 | 0 |
| Surfactant administration, n (%) | 4 (4) |

Mean gestational age was 32.38±2.48 weeks. Most of the newborns (62%) belonged to the gestational age within 28 - <34 weeks category. Mean birth weight was 1635.45±570.55 g among them very low birth weight infants were 42%. Male out numbered female newborns (55% vs 45%). Total 6 (6%) infants had Apgar scores <7 at 5 minutes who required some degree of resuscitation just after birth. After admission 4 (4%) patients got single dose of surfactant.

**Table 2: Baseline maternal characteristics in studied group**

| Parameter | Value |
|---|---|
| Consanguinity present, n (%) | 2 (2) |
| Parity, n (%) | |
| Primipara | 34 (34) |
| Multipara | 66 (66) |
| Exposure to ACS, n (%) | |
| Complete | 17 (17) |
| Incomplete | 32 (32) |
| None | 51 (51) |
| Mode of delivery, n (%) | |
| NVD | 20 (20) |
| LUCS | 80 (80) |
| GDM, n (%) | 32 (32) |
| PIH, n (%) | 70 (70) |
| Risk factors for sepsis, n (%) | 24 (24) |

Most of the mother (66%) was multiparous and 51% of them did not receive even a single dose of antenatal corticosteroid. All of them were inborn and cesarean section was the mode of delivery for 80% of the enrolled neonates. Maternal hypertension and diabetes mellitus were present in 70 (70%) and 32 (32%) of mother respectively. Maternal risk factors for sepsis were present in 24 (24%) of infants admitted to the NICU.

**Table 3: Primary disease requiring respiratory support**

| Parameter | Value |
|---|---|
| RDS, n (%) | 51 (51) |
| Transient tachypnoea of newborn, n (%) | 23 (23) |
| Congenital Pneumonia, n (%) | 20 (20) |
| Perinatal asphyxia, n (%) | 6 (6) |
| Meconium aspiration syndrome, n (%) | 0 |

The respiratory distress syndrome (RDS) was the most common cause 51 (51%) following TTN 23 (23%), congenital pneumonia 20 (20%) and PNA 6 (6%).

**Table 4: Level of respiratory support**

| Parameter | Value |
|---|---|
| Noninvasive support, n (%) | 65 (65) |
| Invasive support, n (%) | 35 (35) |

Among total of 100 patients, 65 (65%) patients required NIV support including oxygen, CPAP or HFNC and 35 (35%) need Invasive support during the hospital course.

**Table 5: Associated mortality and morbidity of neonates who required respiratory support**

| Parameters | NIV group (n=65) | IV group (n=35) | P value |
|---|---|---|---|
| PDA, n | 20 | 16 | 0.45 |
| Sepsis, n | 28 | 18 | <0.001 |
| Septic Shock, n | 12 | 14 | <0.001 |
| DIC, n | 4 | 12 | <0.001 |
| AKI, n | 11 | 8 | 0.36 |
| NEC, n | 6 | 10 | 0.001 |
| In-hospital mortality, n | 6 | 26 | <0.001 |

Among the associated mortality and morbidity, sepsis, septic shock, DIC, NEC and in-hospital mortality occurred significantly higher in the invasive support group (IV) in comparison to the NIV support group and the p-value were <0.05.

**Table 6: Complication of Respiratory support modality in preterm neona**tes

| Parameters | NIV group (n=65) | IV group (n=35) | P value |
|---|---|---|---|
| Nasal trauma, n | 7 | 12 | 0.001 |
| Pneumothorax, n | 0 | 1 | 0.12 |
| ROP, n | 4 | 8 | 0.016 |
| BPD, n | 1 | 3 | 0.097 |
| IVH, n | 0 | 5 | 0.001 |

Among the complication of respiratory support only nasal trauma, sepsis, ROP and IVH occurred significantly higher in the MV support group in comparison to the NIV support group and the p-value were <0.05.

## Discussion

The first 28 days of life, defined as neonatal period is the most vulnerable time for a child's survival. Every year an estimated 4 million babies die in the first 4 weeks of life [14] accounting for more than half of the under-five child deaths in most regions of the world. [15] Almost all (99%) neonatal deaths are happening in developing countries. [16] Neonatal mortality rate is one of the indicators for measuring the health status of a nation. The mortality and morbidity of preterm neonates are significantly higher than those of full-term neonates because preterm neonates are more prone to develop respiratory failure. [17] The functional immaturity of their lung structure, can lead to impaired gas exchange and requires respiratory support. [18]

Mean gestational age was 32.38±2.48 weeks. Most of the newborns (62%) belonged to the gestational age within 28 - <34 weeks category. Mean birth weight was 1635.45±570.55 g among them very low birth weight infants were 42%. Male out numbered female newborns (55% vs 45%). Total 6 (6%) infants had Apgar scores <7 at 5 minutes who required some degree of resuscitation just after birth. After admission 4 (4%) patients got single dose of surfactant. Nemr CN, et al. showed 100 cases with gestational age ranging from 27 to 40 weeks having mean of 33.98 ± 3.44 weeks. Mean birth weight in our study was 1631.44 ± 578.57g which was comparable with the same study where mean birth weight was 1580 gm. [19] Male outnumbered female newborns (54.2% vs 45.8%). Similar finding was found by Nemr CH where sixty- three (63%) were boys and thirty-seven (37%) were girls and by Iqbal Q (60% males). [20]

Most of the mother (66%) was multiparous and 51% of them did not receive even a single dose of antenatal corticosteroid. All of them were inborn and cesarean section was the mode of delivery for 80% of the enrolled neonates. Maternal hypertension and diabetes mellitus were present in 70 (70%) and 32 (32%) of mother respectively. Maternal risk factors for sepsis were present in 24 (24%) of infants admitted to the NICU. In Lategan I, et al [21] 17.3% infants of < 34 weeks had optimal ANS, birth by Cesarean Section done in 60.3% of cases, maternal hypertension was present in 43.6% of mothers.

The respiratory distress syndrome (RDS) was the most common cause 51 (51%) following TTN 23 (23%), congenital pneumonia 20 (20%) and PNA 6 (6%). Among total of 100 patients, 65 (65%) patients required NIV support including oxygen, CPAP or HFNC and 35 (35%) need Invasive support during the hospital course. Among the associated mortality and morbidity, sepsis, septic shock, DIC, NEC and in-hospital mortality occurred significantly higher in the invasive support group (IV) in comparison to the NIV support group and the p-value were <0.05. Among the complication of respiratory support only nasal trauma, sepsis, ROP and IVH occurred significantly higher in the MV support group in comparison to the NIV support group and the p- value were <0.05. Nemr CN, et al. showed 72% of the studied patients underwent CPAP, 14% underwent oxygen support by nasal cannula and 14% underwent mechanical ventilation. The need of invasive support was less than our study as they utilize non-invasive respiratory support as most widely used modality and practiced different ways of delivering CPAP.

In the current study, non- invasive respiratory support was given by nasal cannula, head box, CPAP and invasive support by mechanical ventilation. We used nasal CPAP with preterm neonates with recurrent apneas or early features of RDS. Those who had a failure of nasal CPAP therapy or had respiratory acidosis were ventilated. This is similar to the results of Iqbal Q, et al. in which all the preterm neonates with gestational age < 32 weeks or recurrent apnea or early features of RDS were given nasal CPAP therapy, and those who had a failure of nasal CPAP therapy were ventilated.[20] Judicious ventilator strategies, proper sedation, timely extubation and readily available X-ray and surgical facilities will help to control these problems. Mortality among sick neonates in NICU is high, but mortality among mechanically ventilated neonates is even higher. In this study, mortality in ventilated neonates was 60%, which is comparable to mortality by Hossain et al. 70.6 %. [22]

## Conclusion

Respiratory distress syndrome is the commonest cause of respiratory distress.Two third of preterm newborns required respiratory support. Most common mode of respiratory support was non invasive mode in the form of supplemental oxygen, Heated humidified high flow nasal cannula and continuous positive airway pressure. Short term morbidities like nasal trauma, sepsis, septic shock, disseminated intravascular coagulation, necrotising enterocolitis and intraventricular haemorrhage were more common in newborns who required invasive respiratory support (p <0.05). Retinopathy of prematurity and mortality was significantly higher in invasive respiratory support group.

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