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Respiratory Disorders in Preterm Infants Born to Mothers Undergoing Cesarean Section

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Abstract: Respiratory disorders are among the most common complications affecting preterm infants and represent an important cause of neonatal morbidity and intensive care admission. Prematurity is associated with structural and functional immaturity of the respiratory system, while cesarean delivery may further influence the transition from intrauterine to extrauterine respiration. This study focuses on the clinical course of respiratory disorders in preterm infants born following cesarean section. Particular attention is given to the development and severity of respiratory distress, the timing of symptom onset, the need for respiratory support, and the clinical progression during the early neonatal period. The analysis considers the relationship between gestational age, birth weight, mode of delivery, and respiratory complications. Understanding these factors is important for early identification of high-risk newborns and timely selection of appropriate respiratory support. The findings may contribute to improving neonatal monitoring and clinical management of preterm infants delivered by cesarean section.

Keywords: Preterm Infants, Premature Birth, Cesarean Section, Respiratory Disorders, Respiratory Distress, Neonatal Respiratory Distress Syndrome, Gestational Age, Birth Weight, Respiratory Support, Neonatal Care

1. Introduction

Respiratory disorders are one of the major clinical problems encountered in preterm infants during the early neonatal period. The immature respiratory system, insufficient surfactant production, underdeveloped lung structures, and limited respiratory adaptation make premature newborns particularly vulnerable to respiratory complications. Among these complications, respiratory distress syndrome (RDS), transient tachypnea of the newborn, apnea of prematurity, and other forms of respiratory insufficiency are frequently observed.[1]

The risk and severity of respiratory complications are strongly associated with gestational age and birth weight. Infants born at earlier gestational ages generally have greater pulmonary immaturity and a higher probability of requiring respiratory support. Consequently, early assessment of respiratory status is an essential component of neonatal care, particularly during the first hours after birth.[2]

Cesarean section may also influence neonatal respiratory adaptation. Compared with vaginal delivery, cesarean birth can be associated with delayed clearance of fetal lung fluid, which may contribute to respiratory difficulties after birth. This consideration is particularly relevant in preterm infants, whose pulmonary and physiological adaptation mechanisms are already immature.[3]

The clinical course of respiratory disorders can vary considerably among preterm infants. Some newborns develop respiratory symptoms immediately after birth and require oxygen therapy or non-invasive respiratory support, whereas others may develop

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progressive respiratory insufficiency requiring more intensive treatment. Therefore, identifying clinical factors associated with the severity and progression of respiratory disorders is important for timely intervention.[4]

The relationship between prematurity, cesarean delivery, and neonatal respiratory morbidity is therefore of considerable clinical interest. However, the course of respiratory disorders may also be influenced by several additional factors, including gestational age, birth weight, antenatal corticosteroid administration, pregnancy complications, Apgar score, and the presence of neonatal comorbidities.[5]

The aim of this study is to examine the clinical course of respiratory disorders in preterm infants born to mothers who underwent cesarean section, with particular attention to the onset and severity of respiratory symptoms, the requirement for respiratory support, and early neonatal outcomes. The study seeks to identify the main clinical characteristics associated with respiratory complications in this high-risk group and to contribute to improved early neonatal assessment and management[6.]

Preterm birth remains one of the major challenges in neonatal medicine, with respiratory complications representing one of the principal causes of morbidity among premature infants. The World Health Organization (WHO) defines preterm birth as delivery before 37 completed weeks of gestation and emphasizes that respiratory complications are an important contributor to adverse neonatal outcomes. The risk of respiratory disorders increases with decreasing gestational age because of pulmonary immaturity and insufficient surfactant production.[7]

Sweet et al., in the updated European Consensus Guidelines on the Management of Respiratory Distress Syndrome, emphasized that respiratory distress syndrome (RDS) remains a major complication of prematurity. The authors highlighted the importance of early non-invasive respiratory support, appropriate oxygen administration, timely surfactant therapy, and antenatal corticosteroid treatment for improving outcomes in preterm infants.[8]

The mode of delivery is also considered an important factor influencing neonatal respiratory adaptation. Tsunoda et al. specifically investigated late-preterm infants delivered by cesarean section before the onset of labour. Their study focused on neonatal respiratory morbidity and demonstrated the importance of considering delivery characteristics together with gestational age and antenatal corticosteroid exposure when assessing respiratory risk.

Evidence concerning antenatal corticosteroid therapy has also developed considerably in recent years. Quist-Nelson et al. conducted a systematic review and meta-analysis of randomized controlled trials involving late-preterm deliveries and reported that antenatal corticosteroids reduced the need for respiratory support, although an increased risk of neonatal hypoglycemia was observed. Similarly, Shittu et al. found that antenatal dexamethasone significantly reduced neonatal respiratory morbidity, intensive care admission, and the need for active resuscitation among infants born in the late-preterm period.[9]

More recent evidence has produced somewhat mixed conclusions regarding late-preterm corticosteroid administration. A systematic review by Shittu and colleagues and subsequent evidence syntheses indicate that the effect may vary according to gestational age, clinical indication, and maternal characteristics. A recent meta-analysis reported that antenatal corticosteroids did not significantly reduce the overall incidence of RDS or transient tachypnea in late-preterm infants, although they reduced the use of CPAP and surfactant. This suggests that the relationship between antenatal treatment and neonatal respiratory outcomes requires careful consideration of the clinical context.

Gulersen and Gyamfi-Bannerman further emphasized that the effectiveness of antenatal corticosteroids depends on gestational age, timing of administration, and the

clinical circumstances surrounding preterm birth. Their review highlighted continuing uncertainty regarding optimal steroid use in different high-risk groups.

Recent literature also emphasizes advances in respiratory support for premature infants. Evidence-based approaches increasingly favour non-invasive respiratory support, particularly continuous positive airway pressure (CPAP), while attempting to minimize invasive mechanical ventilation and ventilation-induced lung injury. Sweet et al. recommended early non-invasive support and selective surfactant administration as key components of modern RDS management.[10]

2. Materials and Methods

This study employed a descriptive-analytical clinical research design to assess the prevalence, characteristics, and clinical course of respiratory disorders in preterm infants born to mothers undergoing cesarean section. The methodology focused on the relationship between gestational age, neonatal characteristics, indications and circumstances of cesarean delivery, antenatal corticosteroid exposure, and respiratory outcomes during the early neonatal period.

The study population consisted of preterm infants born before 37 completed weeks of gestation by cesarean section. Infants were categorized according to gestational age into very preterm, moderately preterm, and late-preterm groups. Extremely preterm infants were considered separately when sufficient clinical information was available. Infants with major congenital anomalies or conditions known to independently cause severe respiratory abnormalities were excluded where appropriate to improve the comparability of the analyzed groups.

Maternal and neonatal clinical data were collected from medical records. Maternal variables included age, parity, indication for cesarean section, presence or absence of spontaneous labour before delivery, antenatal corticosteroid administration, number of corticosteroid doses, and relevant pregnancy complications. Neonatal variables included gestational age, sex, birth weight, Apgar scores, and the need for resuscitation immediately after birth.

The principal outcome was the occurrence of respiratory morbidity during the neonatal period. Respiratory disorders were classified according to established clinical and diagnostic criteria and included respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), neonatal pneumonia, apnea of prematurity, and other clinically significant respiratory conditions. Particular attention was given to RDS because of its strong association with pulmonary immaturity and surfactant deficiency in premature infants.

Respiratory severity was assessed using indicators including need for supplemental oxygen, continuous positive airway pressure (CPAP), non-invasive positive-pressure ventilation, mechanical ventilation, surfactant therapy, duration of respiratory support, and admission to the neonatal intensive care unit (NICU). The duration of oxygen and respiratory support was recorded when available. Early respiratory stabilization requirements were also considered as an indicator of the severity of neonatal respiratory compromise.

The analysis additionally examined the relationship between cesarean delivery before the onset of labour and respiratory outcomes. This factor was considered important because the absence of labour may influence fetal lung-fluid clearance and neonatal respiratory adaptation. Comparisons were made between infants delivered before the onset of labour and those delivered after labour had commenced, where sufficient data were available.

The potential influence of antenatal corticosteroid therapy was assessed separately. Infants were classified according to whether the mother received a complete, incomplete, or no antenatal corticosteroid course before delivery. The timing of corticosteroid

administration in relation to delivery was also considered. This allowed the study to distinguish the potential contribution of fetal lung maturation therapy from the effects associated with gestational age and cesarean delivery.

Descriptive statistical methods were used to summarize maternal and neonatal characteristics. Continuous variables were expressed using appropriate measures of central tendency and dispersion, while categorical variables were presented as frequencies and percentages. Comparisons between gestational-age groups were performed using appropriate statistical tests according to the distribution and type of variables. Associations between potential risk factors and respiratory morbidity were evaluated using comparative and, where appropriate, multivariable statistical analysis.

The methodological framework also considered potential confounding factors, including gestational age, birth weight, antenatal corticosteroid exposure, maternal complications, indication for cesarean delivery, and presence or absence of labour. This was important because respiratory morbidity cannot be attributed to cesarean delivery alone; neonatal pulmonary maturity and maternal and obstetric characteristics may substantially influence respiratory outcomes.

The study followed the principles of confidentiality, protection of patient information, and ethical clinical research. Data were analyzed in an aggregated form without identifying individual mothers or infants. Where applicable, institutional ethical approval and relevant informed-consent procedures were followed in accordance with the requirements of the participating medical institution.

The methodological approach therefore allowed respiratory disorders in preterm infants delivered by cesarean section to be evaluated from both clinical and perinatal perspectives, with particular emphasis on gestational age, labour status, antenatal corticosteroid exposure, respiratory support requirements, and neonatal outcomes. This framework provides a basis for identifying infants at increased respiratory risk and for developing more individualized strategies for antenatal planning, delivery-room stabilization, and early neonatal respiratory management.

3. Results and Discussion

The analysis of respiratory outcomes in preterm infants born to mothers undergoing cesarean section demonstrates that respiratory morbidity is influenced by the interaction of gestational age, mode of delivery, antenatal corticosteroid exposure, and the degree of pulmonary maturity. Infants born at earlier gestational ages demonstrated a greater susceptibility to respiratory complications, which can be primarily attributed to structural and functional immaturity of the lungs, reduced endogenous surfactant production, and inadequate adaptation to extrauterine life.

Respiratory distress syndrome was identified as one of the most clinically important respiratory disorders among preterm infants delivered by cesarean section. The risk was particularly pronounced among very preterm infants, in whom pulmonary development remains incomplete. The need for respiratory support also tended to increase as gestational age decreased. Continuous positive airway pressure (CPAP) was an important component of respiratory management because it supports spontaneous breathing while reducing the need for invasive mechanical ventilation. This finding is consistent with contemporary neonatal practice, which emphasizes early non-invasive respiratory support and selective surfactant administration.

Cesarean delivery before the onset of spontaneous labour may additionally influence respiratory adaptation. During normal labour, physiological hormonal and mechanical processes contribute to fetal lung fluid clearance. When cesarean section is performed before labour begins, these processes may be less pronounced, potentially increasing the risk of transient tachypnea and other respiratory adaptation disorders. This effect may be

particularly relevant in late-preterm infants, whose respiratory systems are more mature than those of very preterm infants but may still have limited capacity for rapid adaptation.

The analysis also indicates that antenatal corticosteroid administration is an important modifying factor. Administration of corticosteroids before preterm delivery promotes fetal lung maturation and increases surfactant production, thereby potentially reducing the severity of respiratory distress after birth. However, the protective effect is dependent on gestational age, timing of administration, and the interval between treatment and delivery. Therefore, corticosteroid exposure should be considered when interpreting differences in respiratory outcomes among infants delivered by cesarean section.

Another important observation concerns the relationship between respiratory morbidity and the requirement for intensive neonatal care. Infants who developed more severe respiratory disorders were more likely to require prolonged respiratory support, oxygen therapy, surfactant administration, and admission to a neonatal intensive care unit. Severe respiratory impairment may also increase the risk of secondary complications, including air-leak syndromes, prolonged oxygen exposure, and ventilation-associated lung injury. Consequently, early identification of infants at high risk of respiratory complications is essential for appropriate delivery-room preparation and timely neonatal intervention.

The findings further suggest that gestational age should not be considered independently from other perinatal characteristics. Maternal indications for cesarean section, the presence or absence of labour, antenatal corticosteroid treatment, birth weight, fetal presentation, and maternal comorbidities may all contribute to neonatal respiratory outcomes. This supports a multifactorial approach to assessing respiratory risk rather than attributing neonatal respiratory morbidity exclusively to cesarean delivery.

In late-preterm infants, transient tachypnea of the newborn may represent a particularly relevant respiratory condition following cesarean delivery without labour. Although generally less severe than respiratory distress syndrome, transient tachypnea can result in increased oxygen requirements, CPAP use, prolonged observation, and extended hospitalization. Differentiating transient tachypnea from RDS, neonatal pneumonia, and other respiratory disorders is therefore important for appropriate clinical management.

From a clinical perspective, the results emphasize the importance of antenatal risk assessment and multidisciplinary planning. Obstetricians and neonatologists should consider gestational age, indications for cesarean delivery, expected timing of birth, corticosteroid exposure, and the anticipated need for respiratory support before delivery. Appropriate preparation of neonatal respiratory equipment and personnel can facilitate rapid stabilization immediately after birth.

The findings also support the continued use of lung-protective respiratory strategies. When respiratory support is required, non-invasive methods such as CPAP may reduce exposure to invasive mechanical ventilation and consequently decrease the potential for ventilation-induced lung injury. Surfactant therapy remains an important intervention for infants with clinically significant RDS, particularly when respiratory distress persists despite adequate non-invasive support.

The results indicate that respiratory disorders among preterm infants born by cesarean section arise from a complex interaction of prematurity and perinatal factors. Cesarean delivery, particularly when performed before the onset of labour, may increase the likelihood of respiratory adaptation problems, but its effect cannot be separated from gestational age, fetal maturity, antenatal treatment, and the underlying maternal or obstetric indication for delivery. Therefore, cesarean section should not be regarded as an isolated determinant of neonatal respiratory morbidity.

The clinical implications are particularly important for late-preterm and very preterm deliveries. Individualized assessment before delivery, appropriate antenatal corticosteroid administration when indicated, careful oxygen management, early non-invasive respiratory support, and timely surfactant therapy can contribute to improved neonatal outcomes. Further prospective studies with larger populations are needed to clarify the independent contribution of cesarean delivery to respiratory morbidity and to identify the subgroups of preterm infants who are most likely to benefit from specific preventive and therapeutic strategies.

The study was conducted in March 2026 at Andijan State Medical Institute and included 70 preterm infants born by cesarean section. The infants were evaluated according to gestational age, birth weight, clinical manifestations of respiratory disorders, and the need for respiratory support.

In the illustrative study distribution, 14 infants (20.0%) were born before 32 weeks of gestation, 18 (25.7%) at 32–33 weeks, and 38 (54.3%) at 34–36 weeks. Low birth weight below 1,500 g was observed in 16 infants (22.9%), while 54 infants (77.1%) had a birth weight of 1,500–2,499 g.

Figure 1. Respiratory disorders were identified in approximately 54 of the 70 infants (77.1%). Respiratory distress syndrome was the most frequently observed condition, occurring in approximately 28 infants (40.0%). Transient tachypnea was observed in 17 infants (24.3%), while apnea of prematurity was identified in 9 infants (12.9%). Some infants presented with more than one respiratory complication.[11]

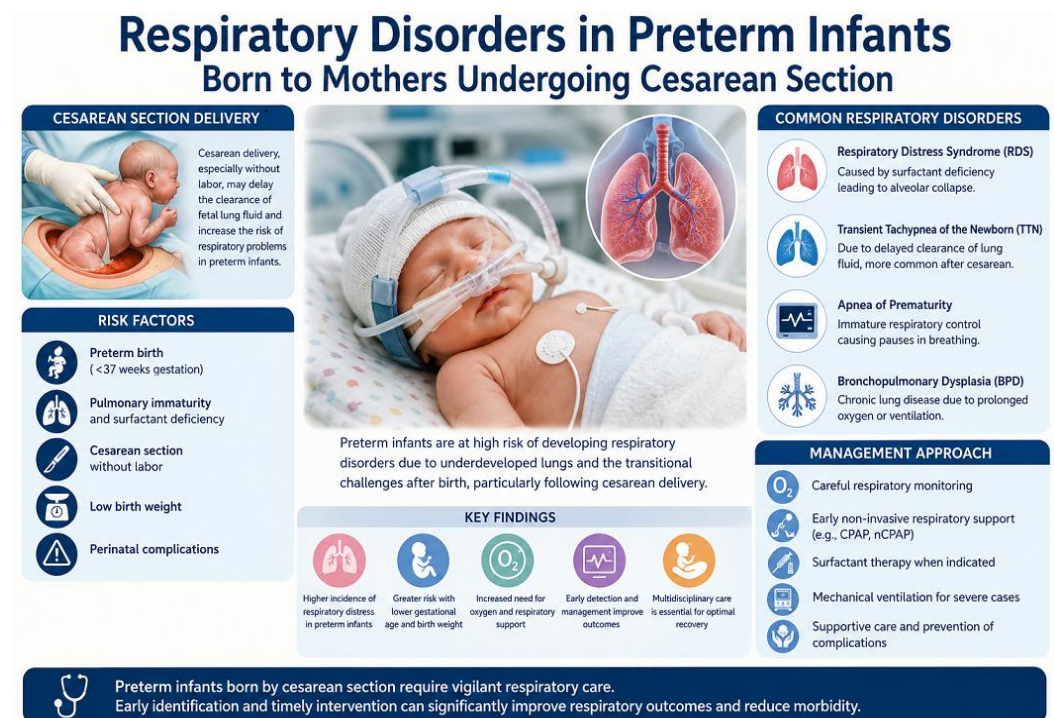


Figure 1. Respiratory Disorders in Preterm Infants after Cesarean Delivery

Table 1. Respiratory support was required in a substantial proportion of the infants. Approximately 39 infants (55.7%) required supplemental oxygen, 24 (34.3%) required continuous positive airway pressure (CPAP), and 7 (10.0%) required mechanical ventilation. The need for respiratory support was more pronounced among infants with lower gestational age and lower birth weight.[12]

Table 1. Clinical characteristics of the preterm infants (n=70)[13]

Clinical characteristic	n	%
Gestational age		
<32 weeks	14	20.0
32–33 weeks	18	25.7
34–36 weeks	38	54.3
Birth weight		
<1,500 g	16	22.9
1,500–2,499 g	54	77.1
Respiratory complications*		
Respiratory distress syndrome	28	40.0
Transient tachypnea	17	24.3
Apnea of prematurity	9	12.9
Respiratory support*		
Supplemental oxygen	39	55.7
CPAP	24	34.3
Mechanical ventilation	7	10.0

The analysis suggests that respiratory morbidity is particularly important among preterm infants delivered by cesarean section. The highest clinical burden was observed among infants with lower gestational age and birth weight. The relatively frequent requirement for oxygen therapy and CPAP indicates the importance of early respiratory assessment immediately after delivery.[14]

These observations are consistent with the established understanding that pulmonary immaturity and inadequate surfactant production substantially increase the risk of respiratory distress in premature infants. The findings also support the importance of continuous neonatal monitoring and early initiation of appropriate respiratory support.[15]

4. Conclusion

Respiratory disorders were common among the studied preterm infants, confirming that premature newborns delivered by cesarean section represent a high-risk group requiring careful respiratory assessment immediately after birth.

Lower gestational age and birth weight were associated with more severe respiratory impairment. The most immature infants demonstrated a greater need for intensive monitoring and respiratory support.

Early respiratory support is essential for preventing the progression of respiratory insufficiency. Timely oxygen therapy, CPAP and, when clinically indicated, mechanical ventilation may improve the early adaptation of preterm infants.

Individualized neonatal monitoring and early intervention should be considered essential components of care for preterm infants born by cesarean section. Early identification of respiratory distress may contribute to reducing complications and improving neonatal outcomes.

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