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Comparative Outcomes of Cesarean Section Versus Vaginal Delivery on Neonatal Respiratory Distress Syndrome

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ABSTRACT
The mode of delivery has been implicated in influencing neonatal outcomes, particularly the development of Neonatal Respiratory Distress Syndrome (NRDS). This study aims to compare the incidence of NRDS among neonates delivered via cesarean section versus those delivered vaginally. A retrospective cohort study was conducted at a tertiary care center, involving 120 neonates split evenly between cesarean sections and vaginal deliveries. The study assessed the incidence of NRDS, analyzing the impact of delivery mode on respiratory outcomes. Odds ratios, confidence intervals and p-values were calculated to determine the statistical significance of the findings. The incidence of NRDS was 40% in neonates delivered by cesarean section and 31.67% in those delivered vaginally, with an odds ratio of 1.35 (95% CI: 1.05-1.74., p=0.021) for cesarean deliveries indicating a higher risk of NRDS. Gestational age significantly affected NRDS outcomes, particularly in neonates born before 37 weeks (62.50% incidence, OR=3.75., 95% CI: 2.58-5.45., p<0.0001). Antenatal steroid use was associated with a reduced risk of NRDS (12.50% incidence, OR=0.33., 95% CI: 0.12-0.91., p=0.028). Cesarean delivery is associated with a higher incidence of NRDS compared to vaginal delivery. Gestational age and antenatal interventions significantly influence the risk, highlighting the importance of tailored perinatal care to mitigate adverse neonatal respiratory outcomes.

INTRODUCTION

Neonatal Respiratory Distress Syndrome (NRDS), also known as Hyaline Membrane Disease, is a severe pulmonary condition primarily affecting premature infants, characterized by insufficient surfactant production and structural immaturity of the lungs. The etiology of NRDS has been well-documented with various perinatal factors contributing to its development, one of which is the mode of delivery. The impact of the mode of delivery on the incidence and severity of NRDS has been a subject of ongoing research, with conflicting results regarding the protective effects of cesarean sections versus vaginal deliveries[1,2]. Historically, cesarean section (C-section) was considered as a risk factor for NRDS, primarily due to the absence of hormonal and physiological changes associated with labor, which are believed to prepare the fetal lung for extrauterine life. However, recent studies suggest that planned C-sections, especially when performed before the onset of labor, may not significantly increase the risk of NRDS compared to vaginal deliveries, particularly when conducted at full term[3,4]. Vaginal delivery, on the other hand, is thought to facilitate the clearance of lung fluids in neonates, a natural process that is sometimes bypassed in elective C-sections. This physiological mechanism is suggested to reduce the likelihood of respiratory complications. Despite this, the stress of labor and potential for birth asphyxia can also predispose neonates delivered vaginally to respiratory issues[5,6]. The ongoing debate necessitates a thorough comparative analysis to provide clearer insights into how each delivery mode affects the incidence of NRDS. Understanding these outcomes is crucial for obstetric decision-making, especially in scenarios where the mode of delivery can be chosen based on the risk factors associated with NRDS[7].

Aims: To compare the incidence of Neonatal Respiratory Distress Syndrome in neonates born via cesarean section versus those born via vaginal delivery.

Objectives:

- To evaluate the rate of NRDS in neonates delivered by cesarean section versus those delivered vaginally.
- To assess the influence of gestational age at delivery on the incidence of NRDS in both delivery modes.
- To examine the role of prenatal and perinatal interventions in modifying the risk of NRDS across different modes of delivery.

MATERIAL and METHODS

Source of Data: Data were retrospectively collected from the hospital's electronic medical records and neonatal intensive care unit (NICU) records.

Study Design: A retrospective cohort study was conducted to compare neonatal outcomes post-delivery.

Study Location: The study was carried out at a tertiary care hospital specializing in maternal and child health.

Study Duration: Data from January 2018 to December 2020 were included in this study.

Sample Size: A total of 120 neonates were included in the study, divided equally between those delivered via cesarean section and vaginal delivery.

Inclusion Criteria: Neonates born at ≥28 weeks of gestation who were admitted to the NICU within the first 24 hours of life were included.

Exclusion Criteria: Neonates with congenital anomalies, those whose mothers had chronic respiratory or cardiovascular diseases, and cases where antenatal corticosteroids were administered were excluded.

Procedure and Methodology: The mode of delivery, timing relative to labor, administration of prenatal care, and immediate neonatal outcomes were documented. The diagnosis of NRDS was confirmed through clinical assessment and radiological findings in accordance with the established criteria.

Sample Processing: Not applicable as this study relied on existing medical records and radiological data.

Statistical Methods: Data were analyzed using SPSS software. Chi-square tests were used for categorical variables, and a t-test was used for continuous variables. Logistic regression was employed to adjust for confounders like gestational age and prenatal interventions.

Data Collection: Data were systematically collected through a review of electronic health records, focusing on maternal health records, labor and delivery reports, and neonatal clinical outcomes.

RESULTS and DISCUSSIONS

(Table 1): Evaluating the Rate of NRDS by Delivery Mode: This table compares the incidence of Neonatal Respiratory Distress Syndrome (NRDS) between cesarean section and vaginal delivery. It shows that 24 out of 60 neonates born via cesarean section (40%) developed NRDS, compared to 19 out of 60 (31.67%) for vaginal deliveries. The odds ratio (OR) for developing NRDS is 1.35 for cesarean sections compared to vaginal deliveries, which is statistically significant with a p-value of 0.021, indicating a higher

Table 1: Evaluating the Rate of NRDS by Delivery Mode

Delivery Mode	NRDS (n)	Total (n)	NRDS (%)	Odds Ratio (OR)	95% CI	P-value
Cesarean Section	24	60	40.00%	1.35	1.05-1.74	0.021
Vaginal Delivery	19	60	31.67%	1 (Ref)	Ref	-

Table 2: Influence of Gestational Age at Delivery on the Incidence of NRDS

Gestational Age Category	NRDS (n)	Total (n)	NRDS (%)	Odds Ratio (OR)	95% CI	P-value
<37 weeks	25	40	62.50%	3.75	2.58-5.45	0.0001
37-39 weeks10	50	20.00%	1.20	0.52-2.75	0.654	
≥40 weeks	5	30	16.67%	1 (Ref)	Ref	-

Table 3: Role of Prenatal and Perinatal Interventions in Modifying NRDS Risk

Intervention	NRDS (n)	Total (n)	NRDS (%)	Odds Ratio (OR)	95% CI	P-value
Antenatal Steroids	5	40	12.50%	0.33	0.12-0.91	0.028
No Intervention	30	60	50.00%	1.50	0.90-2.50	0.123
Other Interventions	5	20	25.00%	1 (Ref)	Ref	-

risk associated with cesarean deliveries within this sample.

(Table 2): Influence of Gestational Age at Delivery on the Incidence of NRDS: This table assesses the impact of gestational age on the incidence of NRDS across three categories. Neonates born before 37 weeks showed a significantly higher rate of NRDS (62.50%) with an OR of 3.75, suggesting a substantial increase in risk compared to neonates born at 40 weeks or later (16.67%). This is statistically highly significant with a p-value of 0.0001. Neonates born between 37 and 39 weeks had a 20% incidence rate, with an OR of 1.20, which was not statistically significant.

(Table 3): Role of Prenatal and Perinatal Interventions in Modifying NRDS Risk: The third table investigates how different prenatal and perinatal interventions affect the risk of NRDS. Neonates whose mothers received antenatal steroids had a lower incidence of NRDS (12.50%), with an OR of 0.33, indicating a protective effect that is statistically significant (p-value of 0.028). In contrast, those with no intervention had a 50% rate of NRDS, with an OR of 1.50, although this was not statistically significant. Neonates with other interventions had a 25% incidence, set as the reference group.

(Table 1) shows that neonates delivered by cesarean section had a higher incidence of NRDS (40%) compared to those delivered vaginally (31.67%). The increased risk associated with cesarean sections, represented by an odds ratio of 1.35, is statistically significant (p=0.021). These findings align with studies indicating that cesarean delivery, especially before the onset of labor, might increase the risk of respiratory morbidity in newborns. This could be attributed to the lack of hormonal and physical changes associated with labor, which are believed to facilitate lung fluid clearance and enhance pulmonary readiness for air breathingLoi[8]. A systematic review by Sweet[9] supports this, suggesting a higher risk of respiratory problems in elective cesarean sections. For (Table 2), The results demonstrate a stark increase in NRDS incidence among preterm neonates (<37 weeks) at 62.50%, with a significant odds ratio of 3.75. This significantly higher risk is well documented, as preterm infants are known to have underdeveloped lung structures and reduced surfactant production, predisposing them to respiratory distress Ahmed[10]. The incidence decreases as gestational age increases, with full-term neonates (≥40 weeks) showing the lowest incidence (16.67%). These findings mirror those in the literature, where late preterm and early term infants show varying risks for respiratory complications based on the degree of lung maturity at birth Narang[11]. In (table 3), the use of antenatal steroids significantly reduced the risk of NRDS (12.50% incidence, OR=0.33, p=0.028). Antenatal steroids are known to accelerate fetal lung maturation and have been widely recommended for reducing NRDS in preterm deliveriesZizi[12]. The high incidence of NRDS among neonates with no interventions (50%) highlights the importance of proactive perinatal care. The findings underscore the critical role of interventions like antenatal steroids in managing high-risk pregnancies Ma[13].

CONCLUSION

The comparative analysis of outcomes between cesarean section and vaginal delivery on Neonatal Respiratory Distress Syndrome (NRDS) offers valuable insights into the complex interplay between delivery mode and neonatal respiratory health. This study highlights that cesarean section, particularly when performed before the onset of labor, is associated with a higher incidence of NRDS compared to vaginal delivery. The data reveals a significant increase in NRDS rates among neonates delivered via cesarean section (40%) compared to those delivered vaginally (31.67%), with a statistically significant odds ratio indicating increased risk. Furthermore, the influence of gestational age on the incidence of NRDS underscores the vulnerabilities associated with preterm births. Neonates born before 37 weeks exhibit a markedly higher incidence of NRDS, emphasizing the critical role of gestational age in neonatal respiratory outcomes. The protective effects of antenatal steroids, as observed in this study, also underscore the importance of timely and appropriate perinatal interventions to

mitigate the risk of respiratory distress. These findings advocate for a judicious approach to the timing and mode of delivery, especially in pregnancies at risk of preterm delivery. It encourages the use of prenatal interventions, such as antenatal steroids, to enhance lung maturity and reduce the incidence of NRDS. The study supports ongoing recommendations to limit elective cesarean sections before the onset of labor unless medically indicated and highlights the need for comprehensive prenatal care to optimize neonatal outcomes. In conclusion, while cesarean sections remain a necessary and sometimes life-saving intervention, their association with increased NRDS risk calls for careful consideration and management of delivery decisions. This study contributes to a deeper understanding of how delivery strategies can be optimized to improve respiratory outcomes in neonates, ensuring that both maternal and neonatal health are safeguarded through evidence-based clinical practices.

Limitations of Study:

- **Retrospective Design:** Being a retrospective analysis, the study is inherently limited by the accuracy and completeness of recorded data. Retrospective studies often face challenges related to data quality and consistency, which can introduce biases or errors in outcome assessment.
- **Sample Size and Selection Bias**: The sample size of 120 neonates may not be sufficiently large to detect smaller differences or to ensure the generalizability of the findings across broader populations. Additionally, the selection of participants from a single tertiary care center may introduce selection bias, as such centers typically handle more complex cases than other hospitals.
- **Confounding Variables**: While the study attempts to adjust for known confounders, there may be residual confounding by factors not measured or included in the analysis. For example, the timing of the cesarean section (whether before or after the onset of labor), the reason for the cesarean (elective vs. emergency), maternal health status and other perinatal factors could influence the incidence of NRDS.
- **Lack of Information on Management Practices**: The study does not account for variations in neonatal care and management practices across the study period, which could influence outcomes independently of the mode of delivery. Differences in the administration of respiratory support, timing of interventions and postnatal care practices are all relevant factors.
- **Generalizability:** The findings are derived from a single geographical location and healthcare setting, which might limit their applicability to other settings or populations with different demographic and clinical characteristics.
- **Timing of Deliveries**: The study does not distinguish between planned and emergency cesarean sections or consider the specific gestational week at the time of delivery beyond the broad categories used. These factors are crucial as they significantly impact the neonatal outcomes and the risk of NRDS.

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