

Assessment Hospitalization Neonates Outcomes in Comparison between Cesarean Section and Vaginal Delivery: Neonatal Respiratory and Metabolic Cases

Dr. Mohammed Haitham Habbas¹, Dr. Mustafa Mohammed Hila² and Dr. Muhsen Hilo Hamdulla³

¹M.B.Ch.B., C.A.B.P. \ (Pediatrics), Iraqi Ministry of Health, Al-Karkh Health Directorate, Senior Pediatrician, Pediatric Ward in Abu Ghraib General Hospital, Baghdad, Iraq.

²M.B.Ch.B., F.I.C.M.S. \ (Pediatrics), Iraqi Ministry of Health, Al-Karkh Health Directorate, Senior Pediatrician, Pediatric Ward in Abu Ghraib General Hospital, Baghdad, Iraq.

³M.B.Ch.B., C.A.B.P. \ (Pediatrics), Iraqi Ministry of Health, Al-Karkh Health Directorate, Senior Pediatrician, Pediatric Ward in Abu Ghraib General Hospital, Baghdad, Iraq.

Abstract: Comparing cesarean section (CS) with vaginal delivery (VD) has different effects on the newborn's respiratory and metabolic health. This study was designed to compare respiratory and metabolic outcomes of neonatal birth, based on cesarean section and vaginal delivery, and investigate the differences according to the type of CS subtype (elective or emergency), where the study described was a cross-sectional cohort study conducted at Baghdad, Iraq, hospitals in 12 months between June 2024 and June 2025. The respiratory outcomes, metabolic outcomes, CS subtype (elective and emergency), NICU admission and overstay, and cord or first-hour arterial blood gas parameters were measured using this study. Results indicated that there was significantly more respiratory morbidity in CS (29.4% vs. 6.5% in VD), with TTN (23.5% vs. 4.8%) and an increased use of CPAP (11.8% vs. 1.6% evaluated) as causes and that metabolic disturbances were greater in VD with higher hypoglycemia in CS (23.5% vs. 8.1) and lower 2-hour mean glucose (53 vs. 62 mg/d Neonates of CS were more likely to be admitted to NICU (31.4% vs. 8.1) and spend longer time in hospitals (5.4 vs. 3.2 days). Cord blood gas analyses demonstrated a decrease in pH and an increase in PCO₂ in CS, which was in line with an increase in respiratory compromise. In the CS group, elective CS registered numerical superior respiratory morbidity in comparison to emergency CS. The research finds that cesarean section is linked to the neonatal respiratory morbidity (TTN) and increased metabolic disturbance (reduced glucose at 2 hours and reduced glucose levels) in comparison to vaginal birth. In CS, there were overlapping patterns between elective and emergency subtypes with no distinct and statistically significant differences in the majority of outcomes, but elective CS was more likely to have respiratory morbidity.

Keywords: Cesarean section (cs), vaginal delivery, admission to nicu, and hospital stays.

INTRODUCTION

The mode of delivery is known to be one of the decisive factors of neonatal respiratory and metabolic adaptation, and cesarean section (CS) and vaginal delivery (VD) pose different physiological issues to the newborn [Angolile, C. M. *et al.*, 2023]. Although VD has traditionally been linked to a more efficient evacuation of fetal lung fluid, and some hormonal and mechanical indicators of readiness to pass the barrier to the extrauterine existence, CS [Nahar, Z. *et al.*, 2022], particularly non-elective or unwanted cesareans done prior to the onset of labor, can affect the latter. Relative lack of labor contractions, decreased release of catecholamines, as well as reduced chest compression in CS, may cause the delay of lung aeration and the rise in threat of transient tachypnea of the newborn (TTN) in certain instances, meconium aspiration in certain instances, and related respiratory issues [Elnakib, S. *et al.*, 2019]. Cesarean birth, on the other hand, might have its own benefits, including the reduction of the exposure of the newborn to perinatal hypoxic stress, although not always; the results are improved in all groups. These actions

promote faster stabilization of the oxygenation and gas exchange, where there is a possibility of alleviating respiratory distress in early term babies [Wilink, F. A. *et al.*, 2019; Tadevosyan, M. *et al.*, 2019].

Nevertheless, VD has no risks, and when the changes persist in the second stages, fetal distress, or chorioamnionitis, this can affect the status of respiration of the newborn and his metabolic homeostasis [Mahadik, K. 2019]. The immediate neonatal outcomes on metabolic patterns are also influenced by mode of delivery, whereby hormonal milieu, glucose regulation, and acid-base balance are predisposed to the stressors of labor delivery and birth [Khasawneh, W. *et al.*, 2020]. Metabolic changes are induced by labor, such as changes in glucose use, cortisol and catecholamine secretion, and insulin sensitivity, which may influence the level of glucose and energy stores in the neonate [Tefera, M. *et al.*, 2020]. The relation of respiratory condition to metabolic control is complex; respiratory distress is capable of affecting the acid-base level, and metabolic disorders are susceptible of making respiratory

inadequacy even worse, especially in preterm or growth-restricted newborns [Sandall, J. et al., 2018; Buyuk, G. N. et al., 2021]. Innovations in obstetric anesthesia, fetal monitoring, and care of newborns have expanded the opportunities to reduce the detrimental effects of CS and maximize the results regardless of the mode of delivery [Al Riyami, N. et al., 2020]. Such methods, which recreate some of the hormonal and mechanical stimuli of labor, improved intrapartum monitoring to identify distress in its early stages and bedside resuscitation guidelines to aid respiratory support and immediate metabolic judgments, are a part of the modern practice [Wilink, F. A. et al., 2012].

METHOD

The cross-sectional study involved hospitals in Baghdad, Iraq, between June 2024 and June 2025, wherein consecutive live-born neonates were recruited in the study, having mothers who either delivered vaginally or by cesarean section (CS). The aim of the study was to compare the respiratory and metabolic outcomes in the neonatal period based on the mode of delivery. The exclusion criteria were significant congenital anomalies, prenatal diagnoses that would likely influence the outcome of the neonatal care, and preterm birth at a gestation period of less than 37 weeks. Mother-related factors such as age, parity, and gestational age at delivery, and the neonatal factors such as birth weight, sex, Apgar scores, initial level of glucose, and arterial blood gas,

which was taken at the cord blood or in the first hour of delivery, were taken into account. The respiratory morbidity interventions comprised CPAP and mechanical ventilation requirements. All deliveries were divided into vaginal delivery (VD), cesarean section (CS), and CS (subtypes) (elective and emergency). A comparison of baseline characteristics was done by using a t-test on continuous variables and chi-square tests on categorical variables. Measures of outcomes were any respiratory diathesis, TTN, RDS, CPAP necessity, mechanical ventilation necessity, metabolic consequences (hypoglycemia, mean glucose 2 hours, hypocalcemia), NICU hospitalization, and length of stay. The parameters of the blood gases (pH, PCO₂, bicarbonate) were studied on the sample of the cord blood or on the first-hour arterial samples. Possible risk factors were assessed by means of univariate analyses, and odds ratios (ORs) having 95% confidence intervals (CI) were estimated to trace the association between CS and adverse outcomes. The estimation of the sample was made out of preliminary data purporting that respiratory morbidity is higher in the case of CS deliveries. It was considered sufficient to have about 110 neonates (rounded to the nearest whole number) as a total sample size to assume a two-sided alpha of 0.05 and power of 0.80 that could detect some difference in the respiratory morbidity between the two modes of delivery.

RESULTS

Table 1. Distribution of the demographic and clinical characteristics in the patients who participated in the study.

Characteristic	Total Cohort (N=113)	Vaginal Delivery (n=62)	Cesarean Section (n=51)
Maternal Age, years (Mean ± SD)	29.4 ± 5.1	28.7 ± 4.8	30.2 ± 5.4
Gestational Age, weeks (Mean ± SD)	38.6 ± 1.3	38.8 ± 1.1	38.4 ± 1.5
Birth Weight, grams (Mean ± SD)	3250 ± 415	3280 ± 390	3210 ± 445
Male Infant, n (%)	58 (51.3%)	33 (53.2%)	25 (49.0%)
Primiparous, n (%)	49 (43.4%)	23 (37.1%)	26 (51.0%)

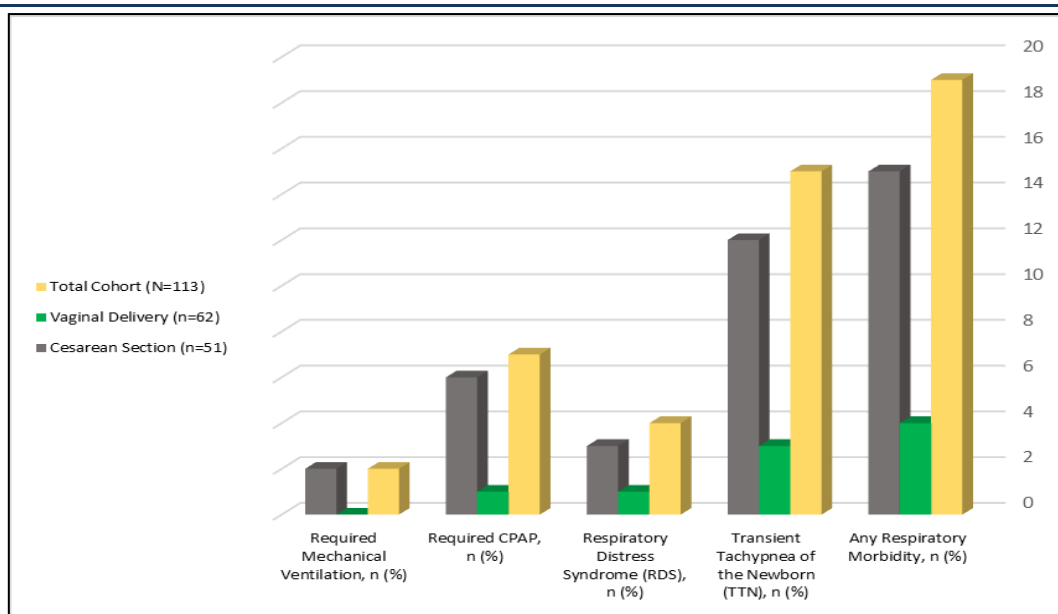


Figure 1. Distribution the outcomes of respiratory according to the mode of delivery.

Table 2. Distribution the outcomes of metabolic according to the mode of delivery.

Variables	Total Cohort (N=113)	Vaginal Delivery (n=62)	Cesarean Section (n=51)
Hypoglycemia (Glucose < 45 mg/dL), n (%)	17 (15.0%)	5 (8.1%)	12 (23.5%)
Mean Glucose at 2h, mg/dL (Mean ± SD)	58 ± 12	62 ± 10	53 ± 13
Hypocalcemia (Ca ²⁺ < 8 mg/dL), n (%)	8 (7.1%)	2 (3.2%)	6 (11.8%)

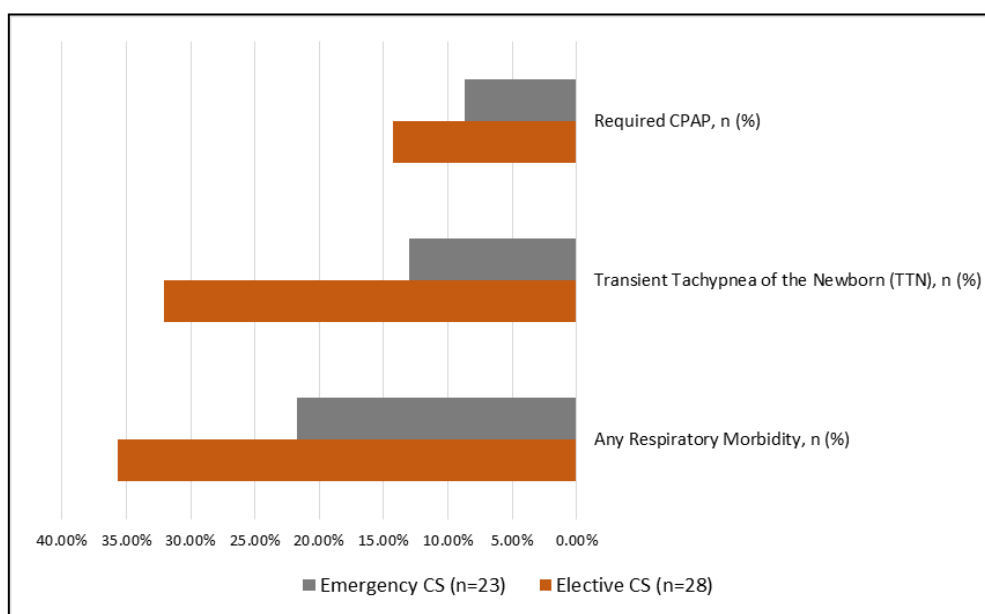


Figure 2. Enroll clinical outcomes of respiratory based on the cesarean subtype.

Table 3. Determining metabolic findings in terms of the cesarean mode.

Variables	Elective CS (n=28)	Emergency CS (n=23)	p-value (CS subtypes)
Hypoglycemia, n (%)	8 (28.6%)	4 (17.4%)	0.359
Mean Glucose at 2h, mg/dL (Mean ± SD)	51 ± 14	56 ± 11	0.158

Table 4. Clinical outcomes of neonates in the Hospital.

Outcome	Vaginal Delivery (n=62)	Cesarean Section (n=51)	p-value
Admitted to NICU, n (%)	5 (8.1%)	16 (31.4%)	0.002
Length of Stay, days (Mean \pm SD)	3.2 \pm 0.8	5.4 \pm 3.5	<0.001
Received IV Fluids, n (%)	8 (12.9%)	17 (33.3%)	0.009

Table 5. Enroll clinical outcomes of arterial blood gas.

Parameter (Mean \pm SD)	Vaginal Delivery (n=62)	Cesarean Section (n=51)	p-value
pH	7.28 \pm 0.05	7.25 \pm 0.06	0.002
PCO ₂ (mmHg)	45.2 \pm 5.8	49.1 \pm 7.2	0.001
Bicarbonate (mmol/L)	21.5 \pm 2.1	20.8 \pm 2.5	0.092
Base Excess	-3.5 \pm 1.8	-4.2 \pm 2.3	0.063

Table 6. Analysis of univariate factors related to patients' risk factors.

Parameters	Odds Ratio (CS vs. VD)	95% Confidence Interval	p-value
Any Respiratory Morbidity	5.94	[1.85 - 19.10]	0.001
Transient Tachypnea of the Newborn (TTN)	6.06	[1.61 - 22.80]	0.003
Hypoglycemia	3.50	[1.15 - 10.66]	0.022
NICU Admission	5.20	[1.76 - 15.34]	0.002

DISCUSSION

The most interesting result is that the percentage of any respiratory morbidity among CS children (29.4) is higher than in VD children (6.5), and with most of it concentrated on TTN (23.5 CS and 4.8 VD). This finding is in accordance with considerable literature that refers to TTN as the major respiratory complication after CS that is associated with the late clearance of fetal lung fluid, as well as distorted catecholamine burst at birth [Kureshi, A. *et al.*, 2022; Uno, K. *et al.*, 2020]. The difference in magnitude ($p=0.001$) supports the strong connection existing between CS and temporary respiratory dysfunction. Combining the data with RS D (where the difference in absolute values is smaller; 5.9% CS and 1.6% VD; $p=0.226$) indicates that the major source of CS-related respiratory risk in this group is not RDS, but TTN. These findings are a validation of certain previous studies [Olicker, A. L. *et al.*, 2021; Baseer, K. A. A. *et al.*, 2020; Samouilidis, A. 2022] that have continuously indicated a high incidence of TTN risk due to CS, and RDS has been found to be relatively rare in term or near-term babies born without comorbid risk factors.

Hypoglycemia was more common in CS infants (23.5) compared to VD infants (8.1), and this was statistically significant ($p=0.022$). Hypocalcemia demonstrated the non-significant tendency of more prevalence with CS (11.8% vs 3.2%; $p=0.073$). A disposition to reduced calcium in CS reports have been inconsistent in the literature. Some of the studies describe temporary metabolic adaptations

to cesarean birth, such as delayed glucose mobilization triggered by catecholamine and the change in fluid/insulin relationships during the early neonatal period. Hypoglycemia of the CS infants, albeit of small proportional magnitude, is clinically important considering that it may have neurodevelopmental consequences in cases of recurrent or severe [Horiuchi, S. *et al.*, 2021].

Arterial blood gas results reveal worse acid-base conditions in CS infants: poorer PH (7.25 vs 7.28; $p=0.002$) and high pCO₂ (49.1 vs 45.2 mmHg; $p=0.001$) in CS than in VD, with bicarbonate tending to be low in CS. These results reveal that CS neonates are likely to experience mild acidosis and relative hypoventilation or poor gas exchange during the immediate postnatal phase. Although these small differences need attention to the clinical significance, they correlate with a study [Nakahara, M. *et al.*, 2020] that indicates that CS relates to ineffective fetal-to-neonatal change into respiratory activity, which may be because of the lack of childbirth-related catecholamine spurts that may favor mucolytic clearance of lung fluid and thoracic functional gain. These transitional trials may be indicated by the weakened buffering (reduced bicarbonate) and increased CO₂ in models of CS births, despite the supposedly full-term delivery [Ramachandrappa, A., & Jain, L. 2008; Hansen, A. K. *et al.*, 2008].

The rates of CS infants were greater in NICU admissions (31.4 vs 8.1; $p=0.002$), and LOS (5.4 vs 3.2 days; $p<0.001$). The increased resource use in the CS group must be due to the accumulative impact of respiratory morbidity (especially TTN)

and impaired metabolic states that need to be monitored and provided with supportive care. These results are in line with Uzbek research that records higher usage of the NICU and prolonged hospitalization in cases of cesarean deliveries, especially when the first postnatal hours are complicated by TTN or hypoglycemia [Nakashima, J. I. et al., 2014].

In CS subtypes, the numeric rate of respiratory morbidity was higher in elective CS (35.7% vs 21.7% in emergency CS), but the difference was not enough to be considered statistically significant ($p=0.286$). Its non-statistical significance might be due to the insufficient number of samples of subgroups ($n=28$ elective, $n=23$ emergency) and indicates that both types of CS present respiratory danger [Thomas, J. et al., 2021; Tita, A. T. et al., 2009; Morrison, J. J. et al., 1995], with TTN being predominant in elective CS where there is no labor-onset physiology. Labor exposure can lower TTN risk, but some American studies have found that elective CS remains associated with high TTN risk as compared to VD, although it is lesser than emergency CS when labor is already underway, but pregnancy becomes emergent due to stress. Univariate analysis illustrates high odds of any respiratory morbidity (OR 5.94; 95% CI 1.85-19.10; $p=0.001$), of TTN (OR 6.06; 95% CI 1.61-22.80; $p=0.003$), hypoglycemia (OR 3.50; 95% CI 1.15-10.66; $p=0.022$), and of these strong connections support the clinical importance of delivery mode as a predictor of neonatal physiologic stressors to reflect general literature that CS correlates with increased neonatal morbidity during the initial neonatal postnatal phase.

CONCLUSION

CS infants had much higher rates of TTN (23.5% vs 4.8%), hypoglycemia (23.5% vs 8.1%), and NICU hospitalization (31.4% vs 8.1%), with low but consistent deviations in the cord blood gas parameters indicative of delayed transition of cardiopulmonary function. Elective CS demonstrated the tendency towards neonatal adaptation to have a higher respiratory load in comparison to emergency CS.

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