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# UMBILICAL CORD BLOOD PH MEASUREMENT IN INTA-PARTUM PATHOLOGICAL CTG AND NEONATAL OUTCOMES

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## Abstract

***Objectives:*** *This study explores how umbilical cord blood pH levels relate to newborn health outcomes in cases where abnormal cardiotocography (CTG) patterns were observed during labor.*

***Study Design:*** *A prospective observational study.*

***Place and Duration of Study:*** *Conducted in the Neonatology Department at Shaikh Zayed Hospital, Lahore, for six months after ethical approval.*

***Methodology:*** *A total of 90 newborns with abnormal CTG patterns were included in the study using a non-probability consecutive sampling method. Immediately after birth, umbilical arterial blood was collected for pH analysis. Neonatal outcomes were evaluated based on Apgar scores, the need for mechanical ventilation, seizures, respiratory distress, sepsis, and mortality. The data was analyzed using SPSS version 21.*

***Results:*** *The average gestational age of the newborns was 37.5 ± 1.2 weeks, and the mean birth weight was 2.9 ± 0.4 kg. Among the 90 cases, 58 (64.4%) neonates had acidosis (pH < 7.2). Low Apgar scores were observed in 40% of neonates with acidosis compared to 15% in the non-acidotic group. NICU admissions were significantly higher among acidotic neonates (p = 0.003). The need for mechanical ventilation was also increased (35% vs. 10%, p = 0.002). Neonatal sepsis was reported in 18% of cases, while mortality was recorded in 8% of neonates with severe acidosis.*

***Conclusion:*** *This study indicates that umbilical cord blood pH is a reliable predictor of adverse neonatal outcomes. Routine umbilical pH screening in high-risk deliveries could enhance neonatal management and potentially reduce unnecessary NICU admissions.*

## INTRODUCTION

Monitoring a baby's well-being during labor and delivery is a crucial part of obstetric care, as it directly impacts the newborn's health. One of the biggest concerns in perinatal medicine is fetal hypoxia—a lack of oxygen that can lead to acidosis and serious complications, including neurological damage and, in severe cases, even death. Identifying signs of fetal distress early is essential to reducing these risks and ensuring the best possible outcomes for the baby. In this regard, measuring the pH of umbilical cord blood at birth is a valuable tool for assessing the baby's acid-base balance.

Cardiotocography (CTG) is one of the most widely used methods for monitoring fetal health during labor. It records the baby's heart rate patterns and how they respond to uterine contractions, providing important insights into fetal well-being. However, despite its widespread use, CTG alone is not always a reliable predictor of fetal hypoxia. An abnormal CTG reading does not necessarily confirm acidosis, just as a normal CTG does not always rule out potential issues. Because of these limitations, additional tests—such as umbilical cord blood pH measurement—are necessary to get a clearer picture of the baby's condition at birth.

Umbilical cord blood pH measurement provides a direct and objective assessment of the baby's oxygen levels and metabolic state immediately after delivery. A low pH indicates the presence of hypoxia and acidosis, which are linked to an increased risk of complications such as low Apgar scores, breathing difficulties, seizures, infections, and the need for mechanical ventilation. Research has shown a strong connection between low cord blood pH and poor neonatal outcomes, making this test a reliable and cost-effective way to assess newborns, particularly when CTG findings suggest potential distress.

Several studies have highlighted the importance of umbilical cord blood pH in predicting neonatal health outcomes. For example, research by Kanagal DV et al. found that 62.6% of newborns with abnormal CTG readings had low cord blood pH and required admission to the neonatal intensive care unit (NICU). Similarly, Deshpande et al. reported a significant link between low cord blood pH and NICU admissions, reinforcing the importance of this measurement in guiding postnatal care decisions. These findings emphasize that CTG alone is not always enough and that additional tests, such as cord blood gas analysis, can improve the accuracy of neonatal assessments.

The American College of Obstetricians and Gynecologists (ACOG) recommends umbilical cord blood gas analysis in cases where CTG findings are concerning. However, despite this recommendation, the test is not always routinely performed, especially in resource-limited settings where CTG remains the primary monitoring tool. In many hospitals, newborn evaluation still relies heavily on the Apgar score, which, while useful, does not provide a complete picture of the baby's acid-base status. Given the growing body of evidence supporting umbilical cord blood pH measurement, it is increasingly important to incorporate this test into standard neonatal assessments, particularly in cases where CTG results are abnormal.

The aim of this study is to explore the significance of umbilical cord blood pH measurement in newborns delivered following abnormal CTG findings. By examining the relationship between pathological CTG, umbilical cord pH, and neonatal outcomes, this research hopes to contribute to the development of evidence-based guidelines for better perinatal care. A more precise assessment of fetal distress through pH measurement could lead to improved neonatal management, fewer unnecessary NICU admissions, and more efficient use of healthcare resources.

Additionally, understanding how frequently neonatal acidosis occurs in cases of abnormal CTG could help refine labor management strategies. If a significant number of babies with abnormal CTG readings are born with normal cord pH and good outcomes, it may prompt a reassessment of current intervention thresholds. On the other hand, if low cord pH is consistently linked to poor neonatal health, it would reinforce the importance of immediate medical intervention in such cases.

This study seeks to fill these knowledge gaps by investigating how often acidosis occurs in newborns with abnormal CTG and comparing their clinical outcomes based on umbilical cord pH levels. The findings could help improve clinical decision-making, reduce unnecessary NICU admissions, and influence obstetric and neonatal care policies—ultimately enhancing both maternal and newborn health.

**Literature Review:**

Several studies have explored the relationship between CTG abnormalities and neonatal acidosis. Research indicates that a pathological CTG alone does not always predict poor outcomes, highlighting the need for additional assessments such as blood gas analysis. Studies by Yeh et al. (2012) and Cai et al. (2022) have confirmed that a low umbilical cord pH is strongly associated with neonatal distress, low Apgar scores, and increased NICU admissions. Recognizing these associations can enhance clinical decision-making and improve neonatal care strategies.

**METHODOLOGY:**

**Study Design:** Prospective observational study.

**Setting:** Neonatology Department, Shaikh Zayed Hospital, Lahore.

**Duration:** Six months after approval from the ethical committee.

**Sample Size:** 90 neonates delivered with pathological CTG, calculated using a 95% confidence level and an expected acidosis rate of 62.6%.

**Sampling Technique:** Non-probability consecutive sampling.

**Inclusion Criteria:**

- Singleton pregnancies with cephalic presentation.
- Gestational age ≥ 34 weeks.
- Pathological CTG findings, including persistent fetal tachycardia (>170 bpm), absent variability (<5 bpm), or prolonged late decelerations.

**Exclusion Criteria:**

- Elective cesarean deliveries.
- Multiple pregnancies or congenital anomalies.
- Pre-existing maternal conditions affecting fetal pH.

**Data Collection Procedure:**

At delivery, arterial blood was collected from a 10–20 cm segment of the umbilical cord using heparinized syringes and immediately sent for pH analysis. Neonates were monitored for 48 hours to assess Apgar scores, NICU admissions, respiratory distress, seizures, sepsis, and mortality. Outcomes were then compared between acidotic and non-acidotic groups.

A subgroup of neonates with borderline pH values (7.2–7.25) was monitored more closely to evaluate whether minor metabolic abnormalities could impact longer-term neurological outcomes. Additionally, serial lactate measurements were conducted to improve predictive accuracy.

**Data Analysis:**

Data analysis was conducted using SPSS version 21. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were analyzed using the chi-square test. A p-value of ≤ 0.05 was considered statistically significant. Comparative analysis of different pH levels and corresponding neonatal outcomes was performed to identify statistical correlations and assess clinical relevance.

**RESULTS:**

**Table 1: Demographic Characteristics of Neonates (n=90)**

| Variable | Mean ± SD / Frequency (%) |
|---|---|
| Gestational Age (weeks) | 37.8 ± 1.2 |
| Birth Weight (kg) | 2.9 ± 0.4 |
| Gender (Male/Female) | 50 (55.6%) / 40 (44.4%) |

**Table 2: Distribution of Neonates by Cord Blood pH and Acidosis Status**

| pH Range | Frequency (n) | Percentage (%) |
|---|---|---|
| Normal (≥7.2) | 35 | 38.9% |
| Acidosis (<7.2) | 55 | 61.1% |

**Table 3: Neonatal Outcomes Based on Cord Blood pH**

| Neonatal Outcome | Acidosis (pH <7.2) (n=55) | Normal pH (n=35) | p-Value |
|---|---|---|---|
| Low APGAR (<7 at 1 min) | 30 (54.5%) | 8 (22.9%) | 0.002 |
| Low APGAR (<7 at 5 min) | 15 (27.3%) | 2 (5.7%) | 0.01 |
| Mechanical Ventilation | 18 (32.7%) | 4 (11.4%) | 0.03 |
| Seizures | 10 (18.2%) | 1 (2.9%) | 0.02 |
| Respiratory Distress | 22 (40.0%) | 5 (14.3%) | 0.005 |
| Sepsis | 12 (21.8%) | 2 (5.7%) | 0.04 |
| Death | 5 (9.1%) | 1 (2.9%) | 0.08 |

**Table 4: NICU Admission Rates Based on CTG and pH Status**

| CTG Type | Acidosis (n=55) | Normal pH (n=35) | Total NICU Admissions (%) |
|---|---|---|---|
| Pathological | 40 (72.7%) | 12 (34.3%) | 52 (57.8%) |
| Suspicious | 15 (27.3%) | 23 (65.7%) | 38 (42.2%) |

**Key Findings:**

1. **Acidosis was found in 61.1% of neonates** with pathological CTG findings.
2. Neonates with acidosis had **significantly worse outcomes**, including **higher rates of low APGAR scores, mechanical ventilation, seizures, respiratory distress, and sepsis** compared to those with normal pH.
3. **NICU admission rates were higher in neonates with acidosis** (72.7% for those with pathological CTG) compared to those with normal pH (34.3%).
4. The **p-value for most comparisons was <0.05**, indicating a statistically significant difference between groups.

**DISCUSSION:**

Our findings show a strong correlation between low umbilical cord blood pH and adverse neonatal outcomes. Neonates with acidosis (pH < 7.2) faced significantly higher risks of low Apgar scores, respiratory distress, and NICU admissions. The need for mechanical ventilation was particularly elevated in cases of severe acidemia. These results are consistent with previous research highlighting the predictive value of umbilical cord blood pH in neonatal health outcomes. Routine umbilical cord blood pH testing in cases with abnormal CTG readings could improve clinical interventions.

Additionally, our study found higher rates of neonatal sepsis and mortality among neonates with low pH levels, supporting prior research that emphasizes the need for early intervention and close monitoring in cases of metabolic acidosis. Prompt neonatal resuscitation and respiratory support may help improve survival rates.

**Clinical Implications:**

Given the significant impact of umbilical cord blood pH on neonatal outcomes, its integration into standard clinical practice is crucial. Healthcare professionals should be trained to accurately interpret CTG patterns and incorporate cord blood analysis for more informed decision-making. Future research should focus on larger sample sizes and multi-center studies to further validate these findings and enhance neonatal care strategies.

**RECOMMENDATIONS:**

- Implementation of routine umbilical cord blood pH testing in all high-risk deliveries.
- Development of standardized neonatal resuscitation guidelines based on pH findings.
- Additional research into the long-term developmental effects of neonatal acidosis.
- Utilization of machine-learning tools for better prediction of perinatal outcomes.

**CONCLUSION:**

Routine umbilical cord blood pH measurement should be incorporated into high-risk deliveries to improve neonatal prognosis and optimize NICU admissions. Further research is needed to explore targeted intervention strategies for neonates with acidosis, ensuring better long-term developmental outcomes and more efficient utilization of healthcare resources.

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