Original Article

Cord Blood pH in Meconium-Coated Neonates: A Cross Sectional Study

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ABSTRACT

Objective: To investigate the relationship between cord blood pH and meconium-stained amniotic fluid.
Study Design: A cross sectional study.
Place and Duration of Study: This study was conducted at the Department of Obstetrics and Gynecology, Central Park Teaching Hospital Lahore from January 2022 to June 2022.
Methods: A cross sectional study was conducted from January 2022 to June 2022 in which 100 females at term who had meconium-stained liquor were recruited for the study after signing a prior written informed consent form in Urdu language. Chi-square test and correlation was employed and a p value less than 0.05 was regarded as significant.
Results: A total of 100 women were recruited for the study with the mean age of 29.85+7.37 years and age range of 18 to 40 years. Among 32(32%) neonates cord blood pH was low while the remaining 68(68%) neonates had normal cord blood pH. BMI of patients had no significant association with cord blood pH levels p-value=0.359.
Conclusion: Cord blood pH monitoring can serve as a diagnostic tool for identifying neonates at risk of complications related to meconium exposure.

Key Words: Cord blood, meconium, neonates, pH, liquor.

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INTRODUCTION

Neonatal health is a subject of paramount importance in the field of medicine, as it directly affects the well-being of newborns and sets the stage for their lifelong development [(1)]. One critical aspect of neonatal care is the monitoring of various physiological parameters that can provide insights into the newborn's overall health and potential complications. Among these parameters, cord blood pH has emerged as a valuable diagnostic tool, particularly in neonates born in the presence of meconium-stained amniotic fluid [(2,3)].

Meconium is the first stool produced by a newborn, typically occurring within the first few days of life. However, in some cases, meconium can be expelled into the amniotic fluid before birth, a condition known as meconium-stained amniotic fluid (MSAF)[(4)]. Meconium staining can result from various factors, such as fetal stress or hypoxia, and can lead to respiratory and gastrointestinal complications in neonates[(5)]. The pH level of cord blood, collected from the umbilical cord immediately after birth, has been recognized as an important indicator of the baby's intrauterine environment and overall health status [(6)].

Studies have shown that neonates born in the presence of meconium-stained amniotic fluid are more likely to have lower cord blood pH levels. These lower pH levels are indicative of fetal distress, which can occur due to the meconium itself or underlying factors that triggered the meconium passage into the amniotic fluid [(7)]. In such cases, monitoring cord blood pH becomes crucial for early identification of neonates at risk of respiratory complications.

Low cord blood pH levels in meconium-coated neonates can have significant clinical implications. It often necessitates immediate and specialized neonatal care to address potential respiratory and metabolic acidosis [(8)]. Additionally, a low cord blood pH may also signal the need for further diagnostic tests and interventions to assess the extent of meconium aspiration and its impact on the baby's health.

Cord blood pH in neonates born in the presence of meconium-stained amniotic fluid serves as a critical parameter for assessing the baby's intrauterine environment and the potential risks associated with meconium exposure. Understanding the significance of cord blood pH in this context is essential for early detection and appropriate management of neonatal complications. Through this research study, we aim to contribute valuable insights that can aid healthcare providers in delivering the best possible care to this

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vulnerable population of neonates. The aim of this exploratory study is to investigate the relationship between cord blood pH and meconium-stained amniotic fluid.

METHODS

A cross sectional study was conducted from January 2022 to June 2022 in the department of Obstetrics and Gynecology at Central Park Medical College after taking ethical approval from institutional review board under the guidelines of Helsinki Declaration. By using WHO sample size calculator, a sample size of 100 was calculated by setting prevalence of meconium-stained liquor at term to 7 percent, confidence interval at 95% and margin of error at 5 percent. So, 100 females at term who had meconium-stained liquor were recruited for the study after signing a prior written informed consent form in Urdu language. While pre-term pregnancies, anomalous fetus and pregnancy with intrauterine demise were excluded from the study.

A detailed sociodemographic history including age, parity, gestational age, history of diabetes, hypertension and anemia were recorded. All patients who had meconium staining of liquor at term weather in labour or had pre labour rupture of membranes were included. A 3cc sample of cord blood was saved in heparinized vial immediately after delivery and was sent to laboratory at the same time for analysis of cord blood pH. Cord blood pH, measured on a scale of 0 to 14, is a quantitative measure of the blood's acidity or alkalinity. A normal cord blood pH typically falls within a range of 7.20 to 7.40. Values below this range are considered acidic, while values above it is alkaline. Deviations from the normal pH range can provide valuable information about the baby's oxygenation status during labor and delivery. APGAR score of neonates was calculated at 1 minute and at five minutes of birth.

Statistical Analysis: Data was entered into Microsoft Excel and was checked for errors and omissions and was exported into SPSS version 23 for data analysis. Qualitative data was assessed by calculating frequencies and percentages and was presented as bar charts and graphs. Chi-square test and correlation was employed to assess group differences for cord blood pH on the basis of age, gestational age and parity. A p value less than 0.05 was regarded as significant.

RESULTS

A total of 100 women were recruited for the study with the mean age of 29.85+7.37 years and age range of 18 to 40 years. Gestational age was calculated for all the study participants with mean gestational age of 38.98+0.86 weeks where as range for gestational age was 38 to 40 weeks and number of patients presenting in 38^{th}, 39^{th} and 40^{th} week were recorded as explained in table 1. In this study 26(26%) women's BMI was normal, 40(40%) were overweight and 34(34%) were obese. Among these women 18(18%) were nulliparous and 21(21%) were primiparous (Table 1). While the remaining women were multiparous. Mean cord blood pH was 7.200 + 0.11. Minimum and maximum cord blood pH was 7.01 and 7.38 respectively.

Table No. 1: Assessment of Gestational Age, BMI and Parity among Study Population.

Parameters	Study Groups	n	%
Gestational Age	38 weeks	38	38
	39 weeks	26	26
	40 weeks	36	36
BMI	Normal (18.5-24.9 kg/m^2)	26	26
	Overweight (24.9-29.9 kg/m^2)	40	40
	Obese (>30kg/m^2)	34	34
Parity	Nulliparous	18	18
	Primiparous	21	21
	Multiparous	51	51

Among 32(32%) neonates cord blood pH was low while the remaining 68(68%) neonates had normal cord blood pH as explained in pie chart (figure 1). Age stratification was done by taking the cut off of 30 years; Group 1 (age range:18-30 years, n=48) and group 2 (age range of 31 to 40 years, n=52) no significant difference and association for age and cord blood pH was noticed with chi-square p of 0.482.

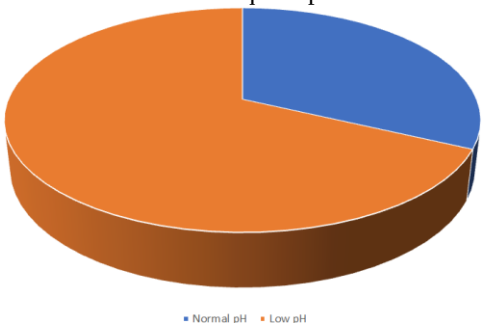

Figure No. 1: Frequencies of Normal and Low pH in Cord Blood in Meconium Stained Liquor

Gestational age was stratified and 3 groups were made based on gestational age i.e. Group 1 (gestational age 38 weeks, n=38), group 2 (gestational age 39 weeks, n=26) and group 3 (gestational age 20 weeks, n=36) and were compared for cord blood pH, no significant difference and association was found on appliance of chi-square as explained in table 2. BMI of patients had no significant association with cord blood pH levels p-value=0.359. However, patients who were overweight and obese among them highest frequency of low cord blood pH was seen. Similarly, multiparous women had the highest frequency of low cord blood pH. However, no significant association was seen between parity

status of women and cord blood ph. (p-value=0.710) as explained in table 2.

Table No. 2: Assessment of Cord Blood in Study Groups based on Gestational Age and Parity

Parameters	Study Groups	Cord Blood pH n, (%)		p-value
		Low	No	
Gestational Age	38 weeks	11, (34.4)	27, (39.7)	0.460
	39 weeks	8, (25)	18, (26,2)	
	40 weeks	13, (40.6)	23, (33.8)	
Parity	0	5, (15.6)	13, (19.11)	0.710
	1-2	12 (37.5)	29, (42.6)	
	3-4	15 (46.9)	26, (38.2)	

DISCUSSION

The study investigated the relationship between cord blood pH and neonates born in the presence of meconium-stained amniotic fluid (MSAF). This exploratory study is crucial in shedding light on the potential health implications of meconium exposure during birth and its impact on neonatal outcomes. The findings of this study reveal a mean cord blood pH of 7.200 ± 0.11 in neonates born in the presence of MSAF. This result indicates that a significant portion of neonates in the study had lower cord blood pH levels, with 32% falling below the normal range (7.20 to 7.40). This is consistent with previous research that has identified MSAF as a risk factor for lower cord blood pH. The passage of meconium into the amniotic fluid can occur due to fetal distress, and this distress can lead to acidosis in the neonate [9, 10]. Monitoring cord blood pH in such cases is essential for early detection and intervention to mitigate potential complications.

The study also examined potential associations between maternal factors and cord blood pH levels. It considered variables such as maternal age, gestational age, BMI, and parity. Interestingly, the study did not find significant associations between maternal age and cord blood pH, suggesting that meconium-related fetal distress is not strongly age-dependent. However, the lack of a significant association could be influenced by the relatively small sample size. Gestational age, a critical factor in neonatal outcomes, was also investigated. The study found no significant difference in cord blood pH based on gestational age [11, 12]. This indicates that the passage of meconium, when it occurs, can affect neonates at various gestational stages [13, 14].

The study also noted that maternal BMI and parity had no significant association with cord blood pH levels. However, it is worth noting that overweight and obese women showed a higher frequency of low cord blood pH, which could be indicative of a trend that may require further investigation with a larger sample size [15, 16]. The lack of significant association with parity suggests that meconium-related fetal distress is not influenced by the number of previous pregnancies.

The findings of this study underscore the importance of monitoring cord blood pH in neonates born in the presence of MSAF. A significant proportion of these neonates exhibited low cord blood pH levels, which can be indicative of fetal distress and the need for immediate medical attention. Timely intervention and specialized neonatal care can be crucial in mitigating respiratory and metabolic acidosis, which are potential consequences of meconium aspiration. The relatively small sample size may limit the generalizability of the results. Additionally, this study focused on a single medical center, which might not represent the broader population. Future research with larger, more diverse samples is warranted to confirm these findings.

CONCLUSION

Cord blood pH monitoring can serve as a diagnostic tool for identifying neonates at risk of complications related to meconium exposure. Understanding the role of cord blood pH in neonatal care can contribute to better health outcomes for this vulnerable population.

Author's Contribution:

Concept & Design of Study:	Nayyer Sultana
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Final Approval of version:	Nayyer Sultana

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