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Correlation of umbilical cord arterial blood pH with meconium stained liquor

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ABSTRACT

Background: Intrauterine passage of meconium may be due to fetal hypoxia, or it may simply indicate a normal gastrointestinal tract maturation. Umbilical cord blood pH is the best available criterion for detecting fetal hypoxia and making appropriate decisions about care after birth.

Objectives: To determine the correlation of umbilical cord arterial blood pH with meconium stained liquor and neonatal outcome. To determine whether the mode of delivery had any influence on the occurrence of acidemia in the neonate complicated with meconium stained liquor.

Materials and Methods: A prospective observational study was conducted for a period of 6 months. Immediately following delivery in pregnancies complicated with meconium stained liquor, blood was drawn from the umbilical artery and sent for arterial blood gas (ABG) analysis. Neonatal outcome parameters and mode of delivery were then recorded in a pre-designed proforma.

Results: There was a statistically significant correlation between abnormal pH (acidosis) and thick meconium stained liquor. Neonatal outcome parameters like Apgar scores at 1 minute and 5 minutes, intravenous antibiotic administration, NICU admission and oxygen supplementation were statistically significant when correlated with the pH level.

Conclusion: The degree of meconium thickness independently correlates with the composite adverse neonatal outcome. Cases with meconium stained liquor should be monitored vigorously with timely interventions and proper neonatal resuscitation, especially the ones with thick meconium stained liquor, in order to prevent adverse neonatal outcome.

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1. Introduction

Three etiological theories may explain the association between meconium passage and neonatal mortality.¹

1. Firstly, fetuses may pass meconium in response to hypoxia, and meconium therefore signals fetal compromise.
2. Second, in-utero passage of meconium may represent normal gastrointestinal tract maturation under neural control.

3. A final theory posits that common but transient umbilical cord entrapment leads to vagal stimulation, increased bowel peristalsis, and meconium passage.

In 1958, James et al. recognized that umbilical cord blood gas analysis can give an indication of preceding fetal hypoxic stress.² It has since become widely accepted that umbilical cord blood gas analysis can provide important information about the past, present and possibly the future condition of the infants. Though the umbilical cord blood gas analysis is now recommended in all high risk deliveries by both the British and American College of Obstetrics and Gynaecologist, it is a far reaching solution in developing countries. All meconium deliveries do not need NICU

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admission but it is difficult to isolate those cases that will have complications.³

Traditionally, meconium has been viewed as a sign of impending or ongoing fetal compromise; however, some investigators believe that it is not always associated with fetal hypoxia, acidosis or fetal distress. Many babies born with meconium stained amniotic fluid have normal umbilical artery pH, so recent literature tends to disregard the importance of intra-partum meconium as a sign of fetal hypoxia. Hence, clear liquor is an indication of fetal wellbeing and meconium staining of amniotic fluid is not always associated with an ill infant.⁴

Meconium stained neonates are more prone to develop respiratory distress than neonates born with clear fluid. Meconium stained amniotic fluid predisposes perinatal mortality even in women with very low risk for obstetric complications. Meconium stained amniotic fluid is associated with higher rate of caesarean delivery, instrumental delivery, NICU admission rate, fetal distress, low birth weight and neonatal death.⁵

There is a significant relation between umbilical cord pH and low Apgar score with the incidence of selective neonatal outcomes like Neonatal Intensive Care Unit (NICU) admission and need for advanced resuscitation. Normal range of umbilical cord pH is 7.40 ± 0.20 and pH less than 7 is important because in this range, a chance of seizure, intubation, NICU admission and mortality increases.⁴

The aim of our study was to

1. Establish the correlation between umbilical cord arterial blood pH and meconium stained liquor, and neonatal outcome.
2. Determine whether the mode of delivery had any influence on the occurrence of acidemia in the neonate complicated with meconium stained liquor.

2. Materials and Methods

A prospective observational study was conducted at Nazareth hospital, Shillong, among 45 deliveries with gestational ages between 37+0 weeks to 40+6 weeks complicated with meconium stained liquor. The study was conducted between 1st October 2020 to 31st March 2021. After fulfilling the inclusion & exclusion criteria, all women in labour diagnosed with meconium stained liquor were enrolled in the study.

2.1. Inclusion criteria

1. All pregnant women with gestational age between 37+0 weeks to 40+6 weeks (confirmed by dates, clinical examination or ultrasound) diagnosed with meconium stained liquor.
2. Live singleton pregnancy.

2.1.1. Exclusion criteria

1. Elective caesarean sections
2. Anomalous babies
3. Breech presentation

The study consisted of an analysis of umbilical cord arterial blood pH following spontaneous or artificial rupture of membranes which included both vaginal deliveries and emergency caesarean sections.

Arterial cord blood sample was obtained from a segment of cord approximately 10-20 cm in length clamped at both the ends soon after delivery of the baby. Blood was drawn in pre-heparinized syringe and sent for analysis as soon as possible, preferably within 10 minutes. If there was a delay in sending the sample for analysis, it was preserved in an ice bath.

The demographic variables like period of gestation, labour events, classification of meconium stained liquor as per RCOG intrapartum care guideline, umbilical cord arterial blood pH and mode of delivery were recorded. These findings were then correlated with the neonatal outcome parameters like birth asphyxia, NICU admission, oxygen requirement, and administration of IV antibiotics according to the institutional protocol, Apgar score and neonatal mortality.

All selected patients were explained about the study and written informed consent was taken from them. Data collection was done as per institute ethics committee guidance.

2.2. Grading of meconium stained liquor

According to RCOG intrapartum care guidelines, meconium stained liquor is classified as–

1. Thin or non-significant: Yellow or light green in colour.
2. Thick or significant: Thick dark green or black in colour, with lumps of meconium suspended in liquor.

2.3. Operational definition of acidosis

According to the American Association for Clinical Chemistry (AACC), acidosis is characterized by a pH of 7.35 or lower.

2.4. Statistical analysis

The data entry was done in Microsoft EXCEL spreadsheet and the final analysis was done with the use of SPSS software, IBM manufacturer, Chicago, USA, version 21.0. Correlation between umbilical cord arterial blood pH and meconium stained liquor was found out using Pearson's coefficient, and association using Chi square test or Fisher's exact test. Correlation between pH, Apgar score, meconium stained liquor and perinatal outcome was found. For

statistical significance, p value of less than 0.05 was considered as significant.

3. Results

In our study, 45 deliveries with meconium stained liquor, whose deliveries were conducted in the Department of Obstetrics and Gynaecology, Nazareth Hospital, between 1st October 2020 to 31st March 2021 were included.

Table 1 reveals the distribution of study subjects according to the levels of pH and the grades of meconium stained liquor. Meconium stained liquor was classified as ‘Thin’ and ‘Thick’ according to the RCOG intrapartum care guideline.⁶ Umbilical cord arterial blood pH was then divided into 3 categories – 7.35 and above, between 7.35 – 7.20 and less than 7.20, based on our findings, and with reference to studies done by Kumar N et al.⁴ and Bailey EJ et al.⁷

At pH above 7.35, 3 (60%) were ‘thin’ MSL and 2 (40%) were ‘thick’ MSL. In the category with pH between 7.35 – 7.20, 18 (62.07%) were ‘thin’ MSL and 11 (37.93%) were ‘thick’ MSL. And in the group categorized as pH less than 7.20, 2 (18.18%) were ‘thin’ MSL and 9 (81.82%) were ‘thick’ MSL. Using Fisher’s exact test, we found that the relation between abnormal pH (acidosis) and thick meconium stained liquor was statistically significant (p value 0.048).

Out of the six neonatal outcome parameters studied, four were found to be statistically significant.

Table 2 reveals the correlation of Apgar scores with umbilical cord arterial blood pH levels. Apgar score at 1 minute and 5 minutes were recorded, and this was correlated with the umbilical cord arterial blood pH level. Apgar scores were categorized as 0-3, 4-6 and 7 and above. It was found that both the scores at 1 minute and 5 minutes were statistically significant when correlated with the pH level (p value 0.012 and 0.022 for 1 minute and 5 minutes respectively).

Other parameters like intravenous antibiotic administration, NICU admission and oxygen supplementation also correlated well with low levels of umbilical cord arterial blood pH, and were all found to be statistically significant (Figures 1, 2 and 3). Figure 4 shows there was no difference in the occurrence of acidemia in the neonates delivered vaginally or by caesarean section.

4. Discussion

According to our study, it was seen that out of 45 babies, only 5 had umbilical cord arterial blood pH above the normal reference range, i.e., 7.35, and that meconium stained liquor was persistently associated with an abnormal pH (acidosis), i.e., <7.35. However, it was found that mild degree of acidosis (pH between 7.35 – 7.20) was not associated with any significant neonatal morbidity. It was

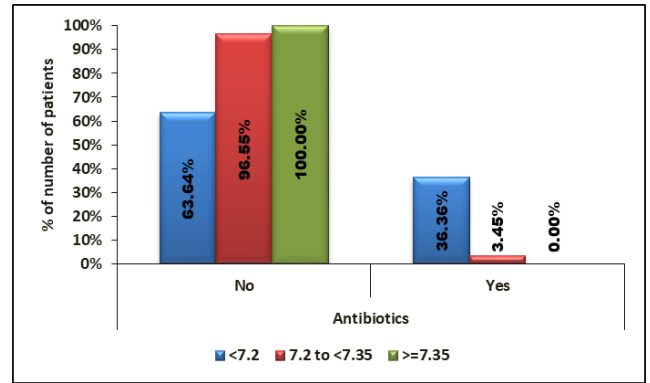


Fig. 1: Correlation of intravenous antibiotics administration with umbilical cord arterial blood pH

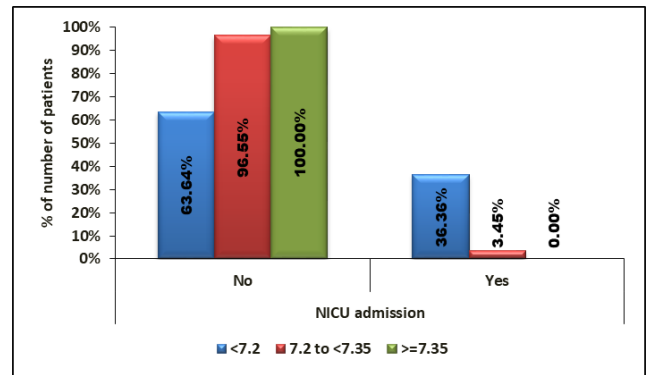


Fig. 2: Correlation of NICU admission with umbilical cord arterial blood pH

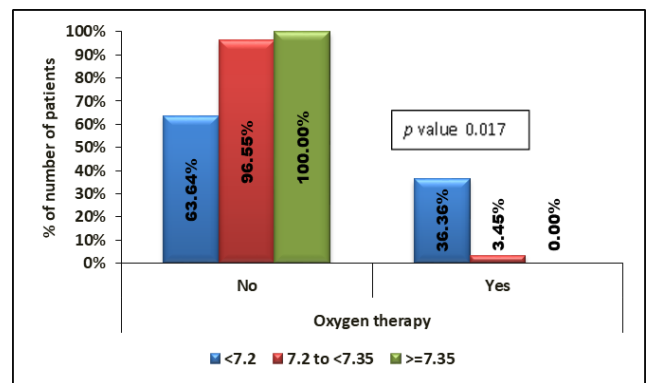


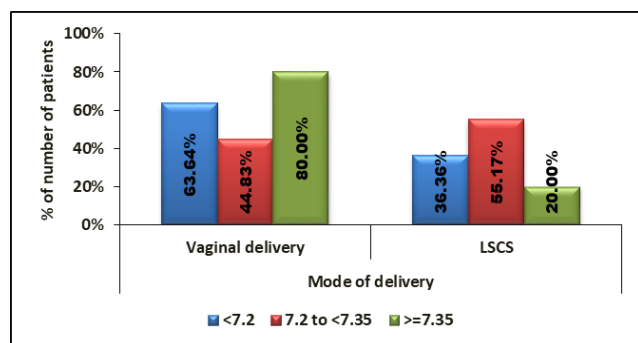
Fig. 3: Correlation of oxygen supplementation with umbilical cord arterial blood pH

Table 1: Correlation of umbilical cord arterial blood pH with grade of meconium stained liquor

Grading of Meconium Stained Liquor	<7.2 (n=11)	7.2 to <7.35 (n=29)	>=7.35 (n=5)	Total	P value
Thin	2 (18.18%)	18 (62.07%)	3 (60%)	23 (51.11%)	0.048*
Thick	9(81.82%)	11 (37.93%)	2 (40%)	22(48.89%)	
Total	11 (100%)	29 (100%)	5 (100%)	45 (100%)	

Table 2: Correlation of Apgar score with umbilical cord arterial blood pH

APGAR score	<7.2 (n=11)	7.2 to <7.35 (n=29)	>=7.35 (n=5)	Total	P value
At 1 minute					
Mean ± SD	6.45 ± 2.38	7.86 ± 0.74	8 ± 0	7.53 ± 1.42	0.012 ^ḍ
Median (25th-75th percentile)	8(6-8)	8(8-8)	8(8-8)	8(8-8)	
Range	2-8	4-8	8-8	2-8	
At 5 minutes					
Mean ± SD	7.91 ± 2.02	8.93 ± 0.37	9 ± 0	8.69 ± 1.1	0.022 ^ḍ
Median (25th-75th percentile)	9(8-9)	9(9-9)	9(9-9)	9(9-9)	
Range	4-9	7-9	9-9	4-9	

**Fig. 4:** Correlation of mode of delivery with umbilical cord arterial blood pH

only at pH <7.20 that significance was noted, indicated by various factors such as increased incidence of low Apgar score, NICU admission, IV antibiotic requirements, and need for oxygen supplementation.

This was consistent with the findings reported by Kumar N et al.⁴ and Bailey EJ et al.,⁷ where they demonstrated an increased risk of neonatal morbidity at pH levels <7.2. However, there are slight differences in opinion regarding the level at which the umbilical cord arterial blood pH becomes significant. Goldaber KG et al.⁸ reported that neonatal death was much more likely at pH <7.0, and the cut off at which seizures became more likely was at pH <7.05. Modarressnejad V,⁹ Yeh P et al.¹⁰ and Perveen F et al.¹⁰ considered pH <7.10 as significant.

In the category with pH above 7.35, 3 (60%) were ‘thin’ MSL and 2 (40%) were ‘thick’ MSL. In the category with pH between 7.35 – 7.20, 18 (62.07%) were ‘thin’ MSL and 11 (37.93%) were ‘thick’ MSL. And finally, in the group categorized as pH less than 7.20, 2 (18.18%) were ‘thin’

MSL and 9 (81.82%) were ‘thick’ MSL. According to our study, correlation between thick meconium stained liquor and abnormal umbilical cord arterial blood pH (acidosis) was statistically significant (p value 0.048).

Our findings were similar to studies done by Kumar N et al.,⁴ Mohammad N et al.,⁵ Singh P et al.,³ Rodríguez Fernández V et al.,¹¹ Gluck O et al.¹² and Maisonneuve E et al.,¹³ where they all found that ‘thin’ MSL was not significant in relation to fetal acidosis and poor neonatal outcome, and that it was only in cases with ‘thick’ MSL which was significantly associated with fetal acidosis and poor neonatal outcome.

Modarressnejad V¹⁴ in a study of 400 singleton term infants delivered by vaginal delivery or caesarean section found that there was no difference between neonates born by caesarean section and those born by normal vaginal delivery in the occurrence of acidemia. Contag SA et al.¹⁵ studied the outcome of 999 deliveries, either by ventouse, forceps or caesarean section. According to their study, the occurrence of significant fetal acidemia was not different among the three delivery methods regardless of the indication.

In our study population of 45 patients, 24 delivered vaginally, while the remaining 21 were taken up for emergency caesarean section. We found that there was no difference in the occurrence of acidemia in the neonates delivered vaginally or by caesarean section, which was similar to the findings of the two studies.

5. Conclusion

Risk of fetal complications increases as the staining and consistency of the liquor evolves. It is very difficult to isolate and predict those cases that will have complications, and the degree of meconium thickness independently correlates with the composite adverse neonatal outcome. Hence, cases

with meconium stained liquor should be monitored more vigorously with timely interventions and proper neonatal resuscitation, especially the ones with thick meconium stained liquor, in order to prevent adverse neonatal outcome.

6. Source of Funding

None


7. Conflict of Interest

None

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