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Original Research Article

Association between clinical diagnosis of foetal distress with umbilical artery acidemia at birth in women undergoing caesarean section for foetal distress

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ABSTRACT

Background: The risks of maternal morbidity and mortality associated with a caesarean section may not be reasonably justified by the degree of neonatal compromise at birth associated with caesarean section done for clinically diagnosed foetal distress. The aim was to study the association of clinical diagnosis of non-reassuring foetal status with umbilical artery acidemia at birth in women undergoing caesarean section for foetal distress and to evaluate outcomes in neonates born by caesarean section performed for foetal distress.

Methods: Prospective observational study of all the women undergoing emergency caesarean section for foetal distress at a tertiary care teaching facility over 2 months. Criteria for diagnosis of foetal distress were thick meconium stained liquor only or foetal heart rate abnormality with or without meconium stained liquor. Testing for pH was done on arterial blood drawn from umbilical cord at the time of birth. Acidemia was defined as cord blood pH less than 7.2. Severe acidemia was defined as cord blood pH less than 7.0.

Results: Cord blood pH was analysed in 110 caesareans done for foetal distress. Incidence of neonatal acidemia at birth in study population was 53.6%.

Conclusions: Much lower incidence of actual acidemia and low Apgar scores in neonates born by caesarean section done for clinical diagnosis of foetal distress than previously reported indicate the need for more stringent criteria and more objective tests for diagnosis of foetal distress.

Keywords: Caesarean, Cord blood pH, Foetal distress

INTRODUCTION

Birth asphyxia is an important cause of neonatal mortality and serious morbidities such as hypoxic ischemic encephalopathy, seizures, intraventricular haemorrhage, cerebral palsy and delayed development. Various methods have been devised for evaluation of a newborn's condition, of which a commonly used method is Apgar

scoring. However, this is not appropriate for evaluation of birth asphyxia as it may be affected from several other causes such as prematurity where the score may be low without any birth asphyxia. Also, in deliveries complicated by thick meconium stained liquor (MSL), tracheal intubation and suctioning may lower the Apgar score, which may give a false impression of birth asphyxia.¹ This may have profound medico legal implications.

Hence, there is a need for more objective tests for evaluation of the neonate particularly when there is a suspicion of birth asphyxia. Neonatal cord blood acid base analysis is one of these important tools. Umbilical cord blood gas levels are believed to be best predictor of foetal acid base balance immediately before the birth.² As per American College of Obstetricians and Gynaecologists committee opinion on umbilical cord blood gas analysis, cord blood sampling for acid base status is advisable when an intrapartum event might be associated with an adverse outcome.³ Cord blood gas analysis is an essential criterion for determining a causal relationship between intrapartum asphyxia and subsequent development of cerebral palsy.

When the oxygen supply to the foetus is significantly disrupted, tissue oxygen deprivation with consequent acidosis occurs, and acidaemia results. Development of metabolic acidosis in the foetus reflects in low pH of the blood obtained from umbilical artery soon after birth and hence the most useful umbilical cord blood parameter is pH. The identification of hypoxic cases may guide giving oxygen to these neonates in order to prevent the development of cerebral lesions as well as aid in identification of the foetuses at risk of neonatal problems such as hypoglycaemia. Thus, cord blood gas analysis complements the role of Apgar scoring in the assessment of neonate. It provides an objective tool for the audit of intrapartum care and for risk management.

The incidence of Caesarean section is rising these days and one of the commonest indications cited for the same is foetal distress.^{4,5} The diagnosis of foetal distress is commonly clinical in resource constrained settings. Abnormal foetal heart rate, especially if associated with thick MSL, is frequently interpreted as an implication of foetal hypoxia.⁶ This assumption may not be always correct and may result in unnecessary obstetric interventions in order to expedite the delivery of the foetus.⁷

As caesarean section is associated with a higher incidence of maternal morbidity and mortality, the indication for the same should be justifiable.⁸⁻¹⁰ We sought to assess the condition of the neonates born by caesarean section done for foetal distress, by evaluation of the cord blood pH and other neonatal parameters. The purpose was to determine the incidence of actual acidaemia in these neonates and hence determine the accuracy of clinical diagnosis of foetal distress.

METHODS

This was a prospective observational study of cord blood pH and adverse neonatal outcomes in all consecutive emergency caesarean sections primarily indicated by clinically diagnosed foetal distress over a two month period (July-August 2010) at Lok Nayak Hospital and associated Maulana Azad Medical College, New Delhi, India.

Diagnosis of non reassuring foetal status during labour was clinical, either by detection of foetal heart rate abnormality by intermittent auscultation with stethoscope (with or without associated MSL) and or detection of thick meconium in amniotic fluid on pelvic examination. This clinical diagnosis was made by the obstetrician at the level of registrar or above.

Type of foetal heart rate abnormality was noted. Foetal bradycardia was defined as foetal heart rate persistently less than 110 beats per minute for more than 10 minutes while foetal tachycardia was defined as foetal heart rate persistently more than 160 beats per minute for more than 10 minutes. Recurrent foetal heart decelerations were defined as recurrent drop of foetal heart rate greater than fifteen beats per minute from the base line and the drop persisting for more than 15 seconds. During the study period, there was no facility for electronic foetal heart rate monitoring or foetal scalp blood pH testing at our institute.

During caesarean, at birth of baby, a segment of umbilical cord was double clamped and 1 ml of blood was taken from the umbilical artery in a pre heparinized syringe which was immediately sent to the laboratory for pH testing. Acidaemia was defined as cord blood pH less than 7.2.^{11,12} severe acidaemia was defined as cord blood pH less than 7.0.

All neonates born by caesarean section were attended to by a senior resident of the neonatology unit of the hospital. Apgar score of all the neonates was assessed at one and five minutes. Apgar score less than seven was termed as low Apgar score. All neonates were prospectively followed until discharge from the hospital or otherwise till death. Incidence and causes of neonatal morbidities were noted.

Adverse neonatal outcomes in terms of need for resuscitation, neonatal intensive care unit (NICU) admission, ventilator requirement and neonatal mortality were noted from the neonate's case sheet as recorded by the paediatrician. The correlation between non reassuring foetal status and umbilical artery acidaemia was analysed.

Maternal variables recorded included: age, parity, and antenatal booking status, adequacy of antenatal care, gestational age, and any pre existing medical disorders, nature of labour onset and use of oxytocin for augmentation of labour, intrapartum complications and meconium staining of amniotic fluid. Any known foetal or placental high risk factors such as foetal growth restriction, oligohydramnios or polyhydramnios were also recorded.

Statistical analysis

Incidence of umbilical artery acidaemia and other neonatal outcomes are expressed as percentages. Fisher's exact test (GraphPad software, San Deigo, CA, USA)

was used to compare the incidence of acidaemia among MSL and foetal heart rate abnormality cases. All p values are two tailed and were considered significant at values of <0.05 . Incidence of various adverse neonatal outcomes was compared between the acidaemic and non acidaemic neonates using Fisher's exact test.

RESULTS

During the study period, the total number of deliveries in our institute was 1,973, of which 323 (16.4%) were caesarean births. Caesarean sections primarily indicated for foetal distress numbered 128 (Figure 1), accounting for 39.6% of all caesareans and 6.5% of all deliveries. Cord blood pH analysis could not be done in 18 cases out of 128 for reasons that included clotted blood sample, technical error in blood pH analyser machine and other miscellaneous reasons. Consequently, these 18 cases were excluded from the analyses.

Most of the women in the study group were between 20 to 35 years of age ($n=108$); 78 women (70.9%) were registered cases and 69 (62.7%) had adequate antenatal care; 65 women (59%) were nulliparous; 93 women (85.5%) had term pregnancies; and 79 (71.8%) had spontaneous labour and all were singleton births. Eighty five pregnancies (77.3%) were considered high risk before the onset of labour, owing to various maternal,

foetal and placental factors. The most common maternal high risk factors were previous caesarean section (23.6%), preeclampsia (22.7%) and anaemia (20.9%).

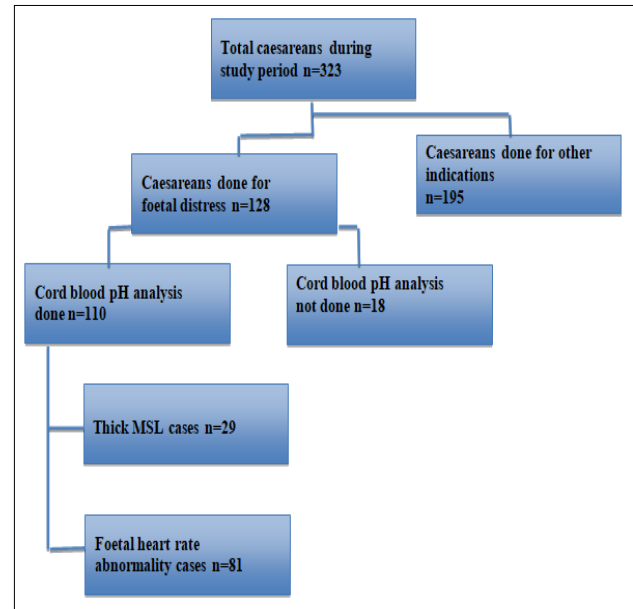


Figure 1: Distribution of cases in the study.

Table 1: Relationship between clinically diagnosed foetal distress and umbilical artery acidaemia.

| Total number of neonates according to indicator of foetal distress (n=110) | Umbilical artery acidaemia (pH < 7.2) | |
|--|---|------------|
| | Yes | No |
| Thick MSL (n=29) | 59 (53.6%) | 51 (46.4%) |
| Foetal heart rate abnormality (n=81) | 13 (44.8%) | 16 (55.2%) |
| | 46 (56.8%) | 35 (43.2%) |

P value 0.1195(Not Significant) as per Fisher's exact test

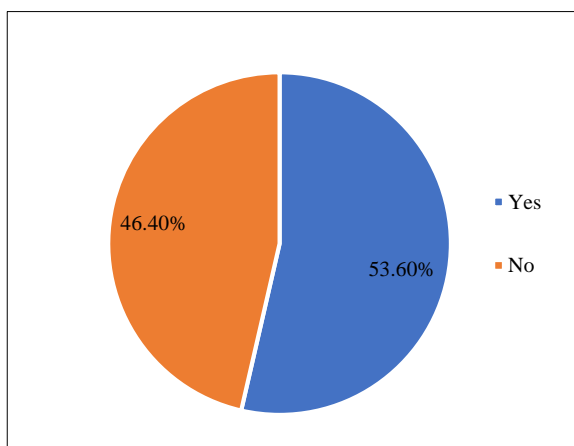


Figure 2: Incidence of umbilical artery acidaemia (pH <7.2).

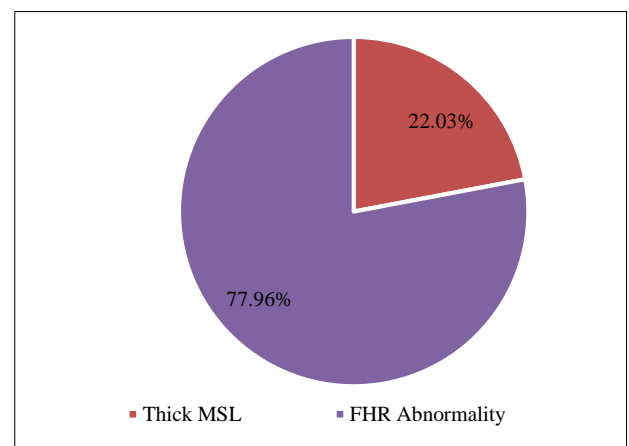


Figure 3: Indication of caesarean in acidaemic neonates.

Foetal high risk factors were foetal growth restriction (15.5%) and prematurity (15.5%) while placental high risk factors were oligohydramnios (15.5%) or polyhydramnios (2.7%). Foetal bradycardia was the commonest foetal heart rate abnormality, detected in 43.6%, followed by recurrent late deceleration detected in 28.2%. Foetal tachycardia was the foetal heart rate abnormality in only two cases (1.8%) while foetal heart rate was normal in 29 cases (26.4%) and the diagnosis of non reassuring foetal status was based on detection of thick MSL in early labour. Majority of caesareans (87.3%) were done under spinal anaesthesia.

Neonatal outcomes

The incidence of umbilical artery acidaemia in cases with clinically diagnosed foetal distress according to the indicator of foetal distress is shown in Table 1. Umbilical artery acidaemia was observed in 53.6% of neonates in the study population. There was no statistically significant difference in the occurrence of neonatal acidaemia in caesareans done for thick MSL compared to those done for foetal heart abnormality.

The distribution of cord blood pH values in the study population are shown in Table 2. Severe acidaemia (pH < 7.0) was observed in nearly 10% of the neonates in the abnormal foetal heart rate group while none of the neonates in the thick MSL group had severe acidaemia.

The percentages of occurrence of various adverse neonatal outcomes in the study population are shown in Table 3. Eleven neonates (10%) in the study population had low Apgar scores and 9 of those required immediate neonatal resuscitation. Fifteen neonates were admitted to NICU, of which 3 required ventilator support. As depicted in Table 4, a significantly higher proportion of acidaemic neonates (16.9%) had low Apgar scores when compared to Apgar scores in neonates with normal cord blood pH (2.4%).

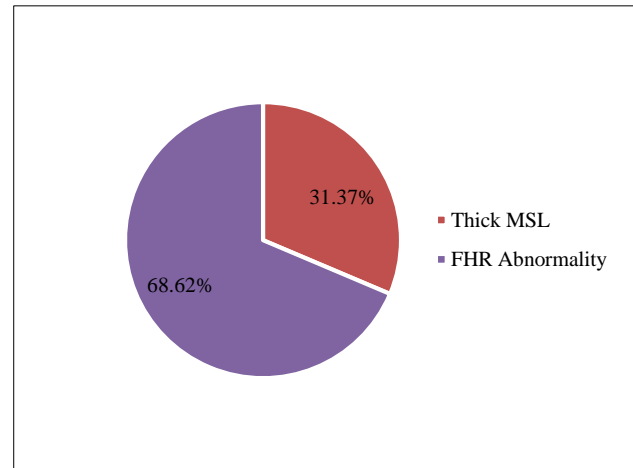


Figure 4: Indication of caesarean in non acidaemic neonates.

Table 2: Distribution of cord blood pH according to the method of diagnosis of non-reassuring foetal status.

| Indication of caesarean | Cord blood pH | | | | Total |
|----------------------------|---------------|------------|--------------|------------|----------|
| | <7.0 | 7.0 to 7.1 | 7.11 to 7.19 | ≥ 7.2 | |
| Thick MSL | 0 | 1 (3.4%) | 12 (41.4%) | 16 (55.2%) | 29 (100) |
| Abnormal foetal heart rate | 8 (9.9%) | 10 (12.3%) | 28 (34.6%) | 35 (43.2%) | 81(100) |

Table 3: Comparison of adverse outcomes in neonates with or without acidaemia. Percentage of various adverse neonatal outcomes in study population.

| Parameters of neonatal outcome | Acidaemia | | Total number of neonates having adverse outcomes | Percentage of studied neonates (n=110) having adverse outcomes |
|---|-----------|----|--|--|
| | Yes | No | | |
| Low Apgar score | 10 | 1 | 11 | 10% |
| Need for neonatal resuscitation | 6 | 3 | 9 | 8.18% |
| NICU Admission | 9 | 6 | 15 | 13.64% |
| Asphyxia related neonatal morbidity | 7 | 1 | 8 | 7.27% |
| Non asphyxia related neonatal morbidity | 7 | 5 | 12 | 10.9% |
| Ventilator support requirement | 2 | 1 | 3 | 2.72% |
| Neonatal mortality | 3 | 0 | 3 | 2.72% |

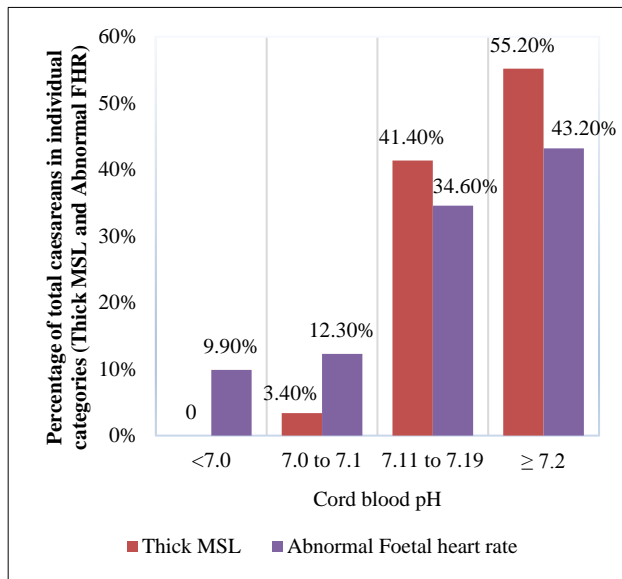


Figure 5: Distribution of cord blood pH according to the method of diagnosis of non reassuring foetal status.

Table 4: Comparison of incidence of Low Apgar Scores between acidemic and non acidemic neonates.

| Acidaemia | Low Apgar score | |
|------------|-----------------|----|
| | Yes | No |
| Yes (n=59) | 10 | 49 |
| No (n=51) | 1 | 50 |

P value 0.0101 (Significant) as per Fisher's exact test

Causes of neonatal morbidity in the study population were classified as asphyxia related and non asphyxia related (Figure 6). Low birth weight (less than 2500 grams) was found in 45 (40.9%) neonates. Among the neonates admitted to NICU, the mean duration of NICU stay was 6.4 days.

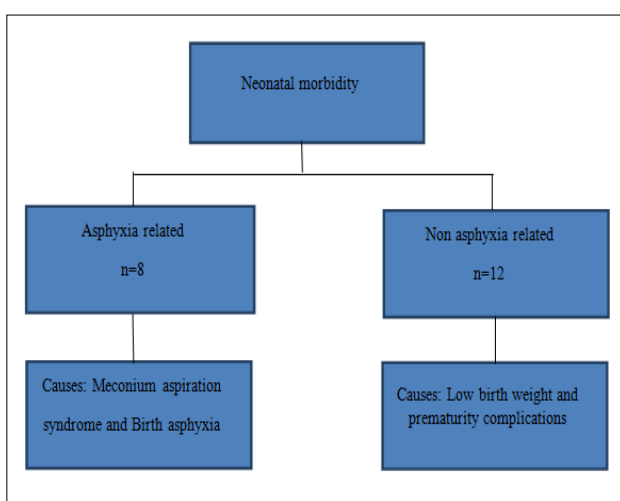


Figure 6: Causes of neonatal morbidity in study population.

Table 5: Comparison of incidence of neonatal mortality between acidemic and non acidemic neonates.

| Acidaemia | Neonatal mortality | |
|------------|--------------------|----|
| | Yes | No |
| Yes (n=59) | 3 | 56 |
| No (n=51) | 0 | 51 |

P value 0.2471 (Not Significant) as per Fisher's exact test

All 3 neonatal fatalities in the study population were in the acidemic neonates (Table 5). Of these, one was due to abruptio placentae causing severe birth asphyxia resulting in neonatal death within 30 minutes of the birth. The second neonate had low birth weight due to prematurity as well as foetal growth retardation and died from sepsis and severe metabolic acidosis on the third day of the birth. The third neonate died from severe birth asphyxia, persistent pulmonary hypertension and aspiration pneumonia after 3 days of birth.

DISCUSSION

The incidence of caesarean section and hence the associated morbidities is rising these days. Therefore, there is a need to audit the indications for the caesarean sections, of which foetal distress is one of the commonest. In our institute, during the study period, foetal distress contributed to nearly 40% of all the caesareans while other studies have reported clinical foetal distress to be the indication in nearly 20% of all caesareans.^{6,13} The contribution of foetal distress to overall caesarean section rate in our study was comparable to that reported in a study from the Indian Council of Medical Research.⁵ In this study, information was obtained from 30 medical colleges/teaching hospitals of India and it was found that foetal distress contributed to 33.4% of all caesarean sections.

In the present study, umbilical artery acidemia was observed in nearly 54% of neonates while 46% had normal cord blood pH indicating that foetal distress was likely over diagnosed in the study population. The clinical diagnosis of non reassuring foetal status didn't correlate well with adverse neonatal outcomes in our study. Furthermore, low Apgar scores were observed in only 10% of neonates. When the incidence of various adverse neonatal outcomes was compared between acidemic and non acidemic neonates, it was observed that there was a statistically significant correlation between low Apgar scores and neonatal acidemia, suggesting that these two parameters of neonatal outcome complement each other in the evaluation of a distressed neonate. Among other parameters of adverse neonatal outcomes, there was a clinically significant higher incidence of asphyxia related neonatal morbidity and occurrence of neonatal mortality in acidemic neonates. However, this correlation was not significant when analysed statistically, likely secondary to the low incidence of neonatal acidemia. There was no

statistically significant difference in the need for neonatal resuscitation, NICU admission, ventilator support requirement and non asphyxia related neonatal morbidity between acidaemic and non acidaemic neonates.

The results of our study are comparable to those of Roy et al, who conducted a prospective observational study to evaluate the efficacy of continuous foetal heart monitoring by analysing the cases of caesarean section for non reassuring foetal heart in labour, detected by cardiotocography (CTG) and correlating those with the perinatal outcome.¹⁴ In their study, foetal bradycardia was the most common foetal heart rate abnormality, detected in 48.8% of cases, similar to the 43.6% in our study; low Apgar score was detected in 15% of the neonates versus 10% in our study; and 15.2% of the newborns required NICU admission comparable to the 13.6% in our study. They concluded that non reassuring foetal heart rate detected by CTG did not correlate well with adverse neonatal outcome. This is in contrast to the observation by Oladapo et al, who used the Apgar score to assess the accuracy of the clinical diagnosis of foetal distress indicated caesarean section and found the clinical diagnosis of foetal distress valuable in identifying fetuses in need of expedited delivery as low Apgar scores were observed in nearly 96% of the neonates.¹⁵ They diagnosed foetal distress by detection of abnormal foetal heart rate or rhythm by intermittent auscultation with a Pinard foetal stethoscope and / or the presence of meconium in the amniotic fluid.

A retrospective study was conducted at Federal Teaching Hospital, Abakaliki, Nigeria to evaluate the clinical diagnosis of foetal distress and the perinatal outcome. While 8.9% of all caesareans were done for foetal distress, clinical diagnosis of foetal distress was found to be accurate in only 29.1% of cases.¹⁶ Similarly, in a prospective study done by Naina Kumar et al, to determine the relationship between immediate postpartum umbilical cord blood pH and foetal distress, it was concluded that neither non reassuring foetal heart rate, nor thin meconium stained liquor correlate with adverse neonatal outcome.¹⁷

Rotich et al, performed a study to determine early perinatal outcomes in cases delivered through caesarean section following the clinical diagnosis of severe foetal distress at Kenyatta National Hospital and found acidaemia in 71% and low Apgar scores in 59% of these newborns; they concluded that intrapartum passage of meconium, and foetal heart rate abnormality signify clinical foetal distress and carry a bad prognosis.⁶ Our study results differ from theirs.

The strength of our study was in it being a prospective study. Also, all the caesareans done during the study period for foetal distress were included without any bias. The limitations of our study include a lack of objectivity in the diagnosis of foetal heart rate abnormality as intermittent auscultation of foetal heart rate is prone to

inter observer bias. Another limitation is that umbilical cord blood pH was not assessed in caesareans done for other indications, which could have provided a suitable control group for comparison.

CONCLUSION

Authors found that foetal distress contributes to nearly 40% of all caesarean sections and the incidence of acidaemia is 53.6% in babies born by caesarean section for foetal distress, at our tertiary care hospital. Low incidence of actual acidaemia and low Apgar scores in neonates born by caesarean section primarily indicated for clinical diagnosis of foetal distress suggests the need for more stringent criteria and more objective tests for diagnosis of foetal distress. Further studies are warranted to evaluate the validity of clinical diagnosis of foetal distress. Objective tests like CTG monitoring and foetal scalp blood pH assessment can be of help in doing so.

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Conflict of interest: None declared

Ethical approval: Not required

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