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Research Article

Relationship between immediate postpartum umbilical cord blood pH and fetal distress

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ABSTRACT

Background: Umbilical cord pH is best indicator of fetal hypoxemia. Objectives: To establish relation between cord blood pH and fetal distress, diagnose true fetal distress retrospectively, reduce caesarean section rates.
Methods: Prospective study of 30 term women reporting to labour room of department of Obstetrics Gynecology of a rural tertiary care centre of Central India with complaints of labour pains and during labour who developed fetal distress was conducted between April - May 2015. Immediately after delivery, umbilical cord arterial blood sample was collected. Maternal demographic profile, neonatal outcomes in terms of APGAR score, cord pH, immediate ventilation, NICU admissions were recorded. The correlation between non-reassuring fetal hearts, meconium stained liquor and neonatal outcome was analyzed using SPSS version 20.
Results: Of 30 cases, 2 (6.67%) women had fetal bradycardia, 13 (43.34%) abnormal non-stress test, 5 (16.67%) meconium stained liquor and 10 (33.34%) fetal bradycardia/tachycardia with meconium stained liquor. Of all delivered babies, 10 (33.34%) had acidosis, with one having severe hypoxemia and acidosis (pH 6.85). Of these, 7 (70%) required NICU admission, one intubated for severe birth asphyxia. Rest 23 (76.67%) were born healthy, cared by mother. Of 13 women having abnormal NST, 10 (76.92%) underwent emergency cesarean section, 3 (23.07%) delivered vaginally. Of these, only 3 (23.07%) babies had acidosis and required NICU admission. All mothers were discharged with their babies healthy.
Conclusions: Neither Non-reassuring fetal heart rate, nor thin meconium stained liquor correlate with adverse neonatal outcome. Furthermore NST resulted in unnecessary increased cesarean sections.

Keywords: Acidosis, Asphyxia, Cesarean section, Meconium

INTRODUCTION

Suspected fetal distress detected by cardiotocography (CTG) or Non stress test (NST) and by presence of meconium stained liquor had been the most common indications for cesarean section (CS) for the past few decades. Fetal distress may be defined as a physiological state in which there is metabolic acidosis secondary to hypoxia.[1] When CTG was introduced in 1970s it was hoped that this technique would reduce the incidence of cerebral palsy and mental retardation by 50%.[2] Disappointingly, the results of randomized trials showed little or no benefit with respect to long-term neurological outcome, despite widespread use of the CTG.[2] It was found that CTG results in no long term benefit in neonatal outcome, on contrary it results in four folds increase in cesarean section rates.[3,4] Various studies implicate that CTG interpretation is inconsistent, is at times inaccurate, may fail to predict early neonatal outcome and is subject of influence by the medico-legal climate.[5,6] Furthermore the significance of meconium in

amniotic fluid is also a widely debated subject.[7] Traditionally meconium has been viewed as a sign of impending or ongoing fetal compromise; however some investigators believe that it is not associated with fetal hypoxia, acidosis or fetal distress.[8] Many babies born with meconium stained amniotic fluid have normal umbilical artery pH, so recent literature tends to disregard the importance of intrapartum meconium as a sign of fetal hypoxia.[7] Hence, clear liquor is an indication of fetal wellbeing and meconium staining of amniotic fluid is not always associated with an ill infant.[9]

Umbilical cord blood pH is the best available criterion for detecting fetal hypoxaemia during labour and making appropriate decisions about care after birth.[10,11] Lactate and pH values provide the best parameters to distinguish between asphyxiated and normal new-borns, with lactate having the most discriminating power.[12] Arterial and venous cord blood gases provide evidence of fetal and placental oxygenation at birth. In accordance with the SOGC "Attendance at Labour and Delivery Guidelines," arterial and venous cord blood gas analysis is recommended routinely for all births, as they may help in providing appropriate care to the newborn at birth and in planning subsequent management.[13] There was also 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.[14] Normal range of umbilical cord pH is 7.40±0.20 mixed and pH less than 7 is important because in this range chances of seizure, intubation, NICU admission, mortality increases.[15] Metabolic acidosis in umbilical cord arterial blood at birth is commonly defined as pH <7.00 (or <7.05) and base deficit (BD) ≥12.0 mmol/L.[16] There is a growing attitude for using umbilical cord blood gas (UCBG) analysis on all deliveries to have an idea of neonatal status and to know even if the fetus has been exposed to hypoxia.[17] Reducing fetal distress and fetal morbidity and mortality is a golden aim in obstetrics. At the same time decreasing unnecessary cesarean sections is also important. With this issue in mind we carried out this study to evaluate the cases of both vaginal delivery including instrumental delivery and emergency cesarean sections done for non-reassuring fetal heart and or meconium stained liquor and its correlation with perinatal outcome using cord blood pH.

The main aims and objectives of this study as follows.

(1) To establish a relation between umbilical cord blood pH and fetal distress.
(2) To diagnose true fetal distress retrospectively.
(3) To reduce the overall unnecessary caesarean section rate in future.

METHODS

This was a prospective study conducted in the department of Obstetrics and Gynecology of a rural tertiary care centre of Central India for a short duration of 2 months, between April and May 2015 after proper approval by the Institutional research ethics committee. The study randomly included 30 full term pregnant women during a period of 2 months between April and May who reported to labour room of department of Obstetrics and Gynecology with chief complaints of labour pains. All the included women having signs of fetal distress (fetal bradycardia, tachycardia, sleeping pattern, late and persistent decelerations on NST, etc., meconium stained liquor on artificial or spontaneous rupture of membranes) during active or latent phase of labour were considered as study cases.

Inclusion criteria

All full term babies of mothers showing in-utero:

- Fetal tachycardia or bradycardia
- Non-reactive/abnormal non stress test
- Meconium stained liquor

Exclusion criteria

- Reactive NST
- Clear liquor
- Bradycardia with activity (contraction) of uterus.
- Women with preterm labour pains (Gestation < 37 weeks)
- Women with Intrauterine fetal demise
- Women with anomalous baby

All the women in labor pain were monitored by electronic fetal heart rate monitor (EFM)/ CTG. All the patients delivered either vaginally or by cesarean section and immediately after delivery, umbilical cords were clamped and an arterial blood sample was collected anaerobically in a pre-heparinized insulin syringe. pH, base excess, carbon dioxide pressure (PCO_2) and HCO_3 were measured at 37^o C by blood gas analyzer. The gas analysis was done within 30 minutes of sampling. These results were then entered in computerized database along with other relevant information such as gestational age, duration of labour, mode of delivery, APGAR scores, birth weight and admission to NICU.

APGAR score was assessed by a trained paediatrician at 1st and 5th minute after birth. In case of an APGAR score less than 8, additional APGAR scores were taken at 10th and 15th minute. All resuscitated babies were transferred to NICU or newborn services for post resuscitation care. Fetal distress was defined by an umbilical cord pH <7.20.

Analysis was performed using SPSS for windows version 20. Student's t-test, the Mann-Whitney test were used for analysis. Linear regression was used to control potential confounding variables. P<0.05 was considered statistically significant.

RESULTS

Of total 30 cases, 16 (53.34%) women belonged to 20-25 years age group, 8 (26.67%) to 26-30 years and 6 (20%) belonged to 30-35 years of age group. Of all included women, 21 (70%) were primigravida, 8 (26.67%) gravida 2 (out of which 7 with one living child and one with previous one loss) and one (3.34%) was gravid 3 with only one live child and one neonatal loss. 22 (73.34%) women belonged to 37-40 weeks of gestation and 8 (26.67%) more than 40 weeks of gestation. Of all, 2 (6.67%) women had severe fetal bradycardia (FHR <100 bpm), 13 (43.34%) had abnormal non-stress test (Late and persistent decelerations, absent beat to beat variability) and 5 (16.67%) had meconium stained liquor, of which 3 (60%) had thick meconium and 2 (40%) thin meconium stained liquor and 10 (33.34%) had both fetal bradycardia / tachycardia with meconium stained liquor, as depicted in Table 1 with relation to NICU admission. Total of 30 women, 3 (10%) had vaginal delivery, one (3.34%) instrumental delivery (forceps) and 26 (86.67%) underwent cesarean section.

Table 1: Frequency distribution of fetal complications.

Complication	N*	Mode of delivery		NICU admission
		Cesarean section	Vaginal delivery / Forceps	
Fetal Bradycardia/Tachycardia	2	2 (100%)	0 (0%)	2 (100%)
Abnormal NST	13	10 (76.92%)	3 (23.07%)	3 (23.07%)
Meconium stained liquor	5	4 (80%)	1 (20%)	2 (40%)
• Thick	3	2 (66.67%)	1 (33.33%) [Forceps]	2 (66.67%)
• Thin	2	2 (100%)	0 (0%)	0 (0%)
Meconium with fetal tachycardia/ bradycardia	10	10 (100%)	0 (0%)	0 (0%)
Total	30	26 (86.67%)	3 Vaginal (10%) + 1 Forceps (3.34%)	7 (23.33%)

***** Number of subjects.

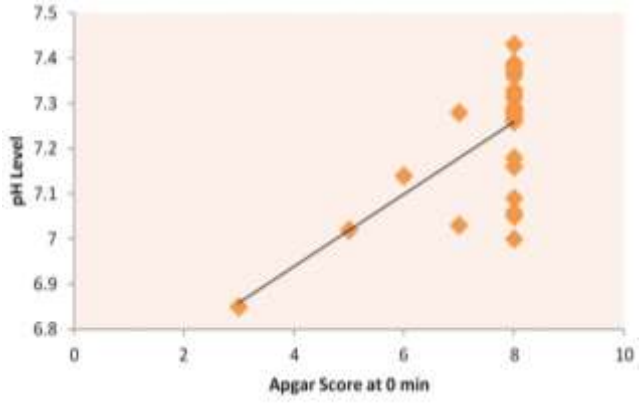

Figure 1: Scatter plot of relation between cord blood pH and APGAR score at birth.

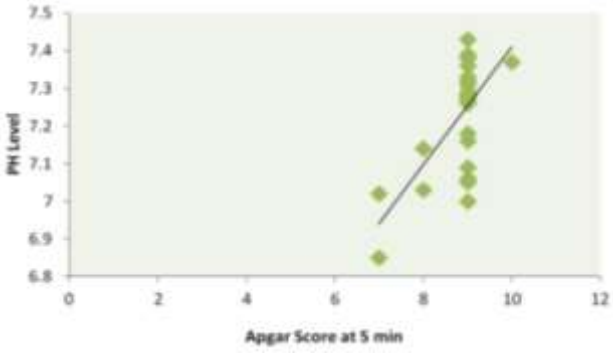

Figure 2: Scatter plot of relation between cord blood pH and APGAR score at 5 minutes.

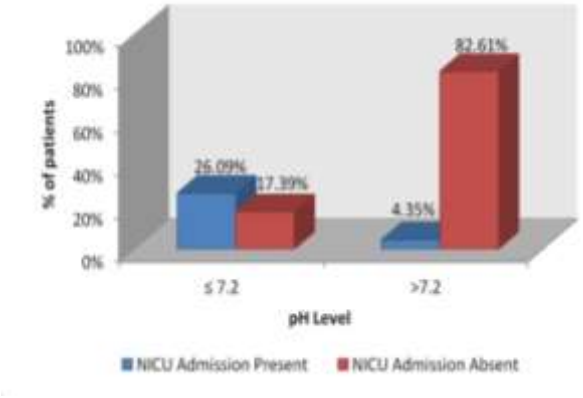

Figure 3: Bar diagram showing relation of cord blood pH at birth and NICU admission.

Of all delivered babies, 3 (10%) babies had birth weight <2 kg, 9 (30%) between 2- <2.5 kg, 14 (46.67%) between >2.5-3 kg and 4 (13.34%) had >3 kg birth weight. Majority of babies cried stat at birth and had good APGAR score of 8,9,9, except for one which had severe birth asphyxia with an APGAR score of 3,5,7. Table 2 shows relation of birth weight, APGAR score (0 and 5 minutes) and mean of pH values of umbilical cord arterial blood at birth with NICU admission and final neonatal outcome. Of all babies, 10 (33.34%) had acidosis (pH <7.2) at the time of birth, of which one had severe hypoxemia and acidosis with pH 6.85. Rest 20 (66.67%) babies had their pH in the range of 7.40±0.20, with no signs of hypoxemia and acidosis, as shown in Table 3,4 and 5. The relation between APGAR score at 0 and 5

minutes with Umbilical cord blood pH is shown in Figure 1 and 2. Of all the delivered babies, 7 (23.33%) required NICU admission (6 for acidosis and 1 for low birth weight), of which one was intubated in view of severe birth asphyxia. Rest 23 (76.67%) babies were born healthy and cared for by mother, as depicted in Figure 3. All mothers were discharged with their babies. There were no neonatal deaths.

Table 2: Fetal outcome and relation with cord blood pH, APGAR score and birth weight.

Birth weight	N*	Mean APGAR (0)	Mean APGAR (5)	Mean cord blood pH	NICU Admission
1.5- 2 Kg	3	6.33±1.52	8±1	7.15±0.13	3 (42.85%)
>2-2.5 Kg	9	7.89±0.33	9±0	7.2±0.12	2 (28.57%)
>2.5-3 Kg	14	7.6±1.81	8.85±1.65	6.73±1.14	1(14.28%)
>3 Kg	4	7.75±0.50	9±0.81	7.25±0.15	1(14.28%)

*Number of subject.

Table 3: Correlation of APGAR score and NICU admission.

	NICU admission	N*	Mean	Standard deviation (SD)	Mean standard error (SE)
APGAR 0 min	Present	7	6.42	1.90	0.71
	Absent	23	7.95	0.20	0.04
APGAR 5 min	Present	7	8.14	0.89	0.34
	Absent	23	9.04	0.20	0.04

*Number of subjects

Table 4: Correlation between cord blood pH (acidosis) and fetal distress.

pH (acidosis)	NICU Admission Present	NICU Admission Absent	z-value
≤ 7.2	6 (26.09%)	4 (17.39%)	11.27 p=0.001,S**
>7.2	1 (4.35%)	19 (82.61%)	
Total	7	23	

**Significant

Table 5: Correlation of pH and NICU admission.

NICU Admission	N*	Mean	SD	Mean SE	t-value	p-value
Present	7	7.05	0.13	0.04	5.18	0.000 p<0.05, S**
Absent	23	7.27	0.09	0.01		

*Number of subjects; ** Significant.

DISCUSSION

The cord pH has been considered as a definitive factor for fetus evaluation. Evidence show that Lactate and pH values provide the best parameters to distinguish between asphyctic and normal new-borns, with lactate having the most discriminating power.[12] The present study revealed that umbilical cord blood pH is the best indicator of fetal hypoxemia during labour. Out of 10 babies having acidosis (pH <7.20) at birth, 6 got admitted in NICU due to birth asphyxia. One baby with severe birth asphyxia with cord blood pH 6.85 went on ventilator, but could be survived. Similar results were reported by Goldaber et al, who studied the association between umbilical arterial acidosis and adverse neurological events among 3506 term, singleton infants with cord arterial pH <7.20.[18] They reported that the neonatal death was much more likely at pH <7.00, the cut-off at which seizures became more likely was pH <7.05, and for unexplained seizures was pH <7.00. Williams et al, also found that a threshold of pH <7.00 was the best independent predictor of neonatal seizures when compared with other indices.[19] Another study by Goodwin et al, also found that hypoxic-ischaemic encephalopathy occurred in 12% of infants with cord pH <7.0, 33% with pH <6.9, 60% with pH <6.8, and 80% with pH <6.7.[20] They also concluded that no infant was born live with cord blood pH <6.6.[19] Several other studies also concluded increasing morbidity with worsening acidosis.[21,22] Furthermore a similar study reported that umbilical cord blood gas measurement in comparison with the fetal scalp pH monitoring could better detect a hypoxic baby.[23]

Also in the present study it was found that presence of thick meconium in amniotic fluid is associated with poor fetal outcome and acidosis in comparison to thin meconium stained liquor. This was supported by studies which concluded that the moderate and thick meconium group has a significantly greater risk of an abnormal FHR tracing, a 1 and 5 minute Apgar score less than 7, a cord

blood pH of less than 7.2, sepsis, need for O_2 support and level III NICU admission of babies.[7] A similar study concluded that fetal distress had a highly significant relationship with acidaemia (P <0.0001) and the risk of acidaemia in neonates with fetal distress was 7.7 times higher than neonates without fetal distress. The presence of meconium in the amniotic fluid had a highly significant relation with neonatal acidaemia; the risk of acidaemia was 5.8 times higher in neonates with meconium-stained amniotic fluid than those with clear fluid. Moreover, the concentration of meconium had a direct relation with acidaemia.[24] A study comprising of 69 cases with meconium-stained amniotic fluid, revealed that the risk of acidaemia in those with thick meconium was 12.5 times higher.[24] A similar study reported a higher rate of acidaemia in cases of meconium stained amniotic fluid, and suggested a weak correlation between meconium stained amniotic fluid and umbilical cord blood pH.[25] On contrary to this another study reported no significant difference between neonates with meconium stained amniotic fluid and normal amniotic fluid in both mean umbilical cord blood pH and acidaemia.[26]

Furthermore, fetal distress accounts for up to 40% of instrumental deliveries, and 30% of caesarean sections.[27,28] This was also found in our study which concluded that NST has no significant effect on perinatal outcome, rather it resulted in increased rate of unnecessary cesarean sections. Out of 13 women having abnormal NST results, 10 (76.92%) were shifted for emergency cesarean section and 3 (23.07%) delivered vaginally. Out of 13 babies of these mothers, only 3 (23.07%) showed acidosis (fetal distress in true sense) and required NICU admission. Many studies have shown that NST/CTG is not an effective diagnostic test for detecting fetal distress. A Cochrane review on antenatal CTG for fetal assessment concluded that "antenatal CTG has no significant effect on perinatal outcome.[29] Another study reported that the use of electronic fetal heart rate (FHR) monitoring (NST) instead of intermittent auscultation has not led to a reduction in the prevalence of cerebral palsy (RR 1.74, 95% CI 0.97-3.11), on contrary it has led to higher operative delivery rates (cesarean delivery RR 1.66, 95% CI 1.30-2.13; instrumental vaginal delivery RR 1.16, 95% CI 1.01-1.32) without an associated neonatal benefit.[2] In particular, compared to intermittent auscultation, continuous electronic FHR monitoring was associated with a two-fold increase in risk of cesarean delivery performed because of a non-reassuring FHR (RR 2.37, 95% CI 1.88-3.00).[2] Similar studies reported that Electronic fetal monitoring (EFM) is an indirect measure of fetal oxygenation whose sensitivity is high, while specificity is low.[30,31] Another study concluded that EFM during labour is associated with a reduction in neonatal seizures but with no significant differences in long-term squeal, including cerebral palsy, infant mortality, and other standard measures of neonatal well-being.[32,3]. EFM neither reduces perinatal mortality nor cerebral palsy and that while it reduces incidence of neonatal seizures, it does so at the cost of increased cesarean and instrumental vaginal deliveries.[34,35] Similar results were noted in other study also, which concluded that EFM is associated with an increase in interventions, including caesarean section, vaginal operative delivery, and the use of anaesthesia.[36] Moreover, despite large clinical trials, it was found that neither electronic fetal monitoring nor auscultation has been proven to reduce mortality.[32,37,38] A similar study compared two groups of patients based on CTG and found no significant difference between the fetal-distress and normal groups in terms of umbilical cord blood gas findings and Apgar scores and concluded that although CTG is an important test during labor for birth management, it is insufficient for predicting the perinatal outcome.[39]

Hence, it is more important to differentiate between the fetus who requires prompt delivery and the fetus not in acute distress, who could be reflecting recent or remote insults, the after effects of which would be unaffected by speedy delivery. Therefore, in addition to CTG, other technologies for intrapartum fetal monitoring may be helpful to detect actual fetal distress. Also cord blood pH analysis should be conducted in all deliveries, so as to diagnose the fetuses at increased risk of suffering from acidosis and its ill effects and for their timely management.

CONCLUSIONS

The present study reveals that fetal tachycardia and or bradycardia on NST, thin meconium stained liquor were not associated with fetal acidosis and poor neonatal outcome. It was only in cases of thick meconium and NST showing persistent and late decelerations that fetus had asphyxia and acidosis. In present study it was found that majority of cesarean sections (86.67%) which were done for fetal distress, did not had fetal distress in real sense, as majority of babies (66.67%) after delivery had cord blood pH within normal range (7.40±0.20). All babies who had pH <7.2 showed signs of birth asphyxia and were admitted in NICU. Hence, it was found that cord blood pH is the most sensitive parameter for diagnosis fetal asphyxia and should be performed in all high risk births, as this may help in providing appropriate care to the newborn at birth and in preventing as well as decreasing neonatal morbidity and mortality.

Limitations

The only limitation of this study was that it was done for a very short duration (2 months) and included only 30 women, so the results are not generalizable. In future we will try to conduct such study for a longer duration with more sample size. Moreover, we will also try to follow those babies who had severe birth asphyxia with umbilical cord blood acidosis for their neurological development. We will also try in future to develop means of better detection of fetal distress and to cut short the rate of cesarean sections.

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