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Correlation of cord ABG and lactate levels after delivery with NST/CTG in singleton non-high risk pregnant patients

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Abstract

Timely management of fetal distress is of utmost importance for an obstetrician. It would be very helpful to study parameters that help predict fetal distress and their efficiency in assessing fetal well-being. In our study, 120 singleton non-high risk pregnancies were included. All patients underwent CTG/NST, measurement of cord ABG and lactate levels after delivery. Out of them, 69% babies had normal ABG & 11%, 7%, 7%, 6% had respiratory, metabolic, mixed, lactic acidosis respectively. 78% babies showed normal & 22% babies showed high levels cord blood lactate. 26% babies required NICU admission. After statistical analysis, correlation between NST/CTG and cord lactate levels was highly significant. So we recommend measurement of cord arterial blood lactic acid after every delivery to be included as a standard protocol of neonatal assessment at birth.

Keywords: CTG/NST, ABG, cord blood lactate, NICU, acidosis

Introduction

NST (non-stress test) / CTG (Cardiotocography) is the most widely used means of assessing FHR because its easily available. It is assessed using a cardiotocograph/ Electronic fetal monitor^[1]. Non stress test is done after 28 weeks of pregnancy and it is called 'non-stress' test because no stress is put on the fetus during the test. It is commonly used for antepartum evaluation of the fetus. It is a non-invasive, easily performed, inexpensive and very well accepted by the patients. Adequate fetal movements lead to a strong fetal heart rate due to its direct correlation to sympathetic and parasympathetic autonomic nervous system. But this correlation is seen only after 26-27 weeks and not before. Results obtained on NST plays a very important role in determining the management in labour room^[2]. The distressed fetus produces different patterns on the CTG in response to the stress it is exposed to^[1]. Degree of metabolic acidosis can be determined by the base excess which provides further information regarding neurological injury to the newborn^[3]. Paired cord blood samples if tested routinely can give valuable information regarding status of the fetus and the needful management and also important in cases of medicolegal studies. Umbilical cord blood analysis for evaluation of the newborn's acid-base status immediately after delivery is the most objective way of assessing fetal metabolic condition at birth^[4]. Allows distinguishing between respiratory and metabolic acidosis. For all practical purpose, arterial blood should be sampled rather than venous blood for assessment of the fetal status. APGAR score and blood gas levels from umbilical arterial cord help in evaluating the state of the newborn. Parameters like pH and SBE have been used to assess fetal acidosis and hypoxia.

Aim: To assess fetal well-being by using Cord blood ABG levels, blood lactate levels and NST/CTG.

Objectives

1. Correlation of cord blood Fetal ABG levels and lactate levels taken after delivery with NST findings acquired before delivery.

2. Assessing fetal well-being based on cord blood ABG levels and cord blood lactate levels and comparing it with the NST findings.

Material and Methods

Material: Data collected from antenatal patients coming to the labor room

Methods: Institutional Ethical committee Clearance was obtained before the start of the study

Type of study: prospective observation study

Sample size: 120 studies

Period of study: June 2017 to May 2018

Period required for data collection: 1 year

Period required for data analysis and reporting: 6 months

Place of study: Dr. D.Y. Patil Medical College, Pimpri, Pune

Source of data: Labor room of Dr. D.Y. Patil medical college, Pimpri, Pune

Inclusion criteria

- All full term, normotensive, non-high-risk patients admitted in the labour room/ward of Obstetrics and Gynecology
- Age groups from 20-35 years
- Patients having singleton pregnancy

Exclusion criteria

- Age group less than 20 and more than 35 years
- Multiple pregnancy
- High risk patients
- Patients with chronic diseases like HTN and DM
- Patients not willing to participate in the study

Procedure

After examining the selected patients, they were observed during labour and fetal heart was monitored constantly on NST machine by Philips. After delivery of the placenta, blood was withdrawn using a 10 ml syringe from the umbilical artery of the placenta and filled into two bulbs containing heparin and sent for ABG analysis and lactate level analysis to the pathology department.

Statistical analysis

Quantitative variables were described using percentages, ranges, means and standard deviations. Students independent t-test, analysis of variance test and Spearmens correlation analysis were performed using the statistical package for the social sciences, SPSS version 20 (SPSS Inc., Chicago, IL, USA) as appropriate. A two-tailed probability value of 0.05 or less was considered significant.

Observation and Results

Fetal outcome depends majorly on series of events which occur during labor. The results obtained were as follows:

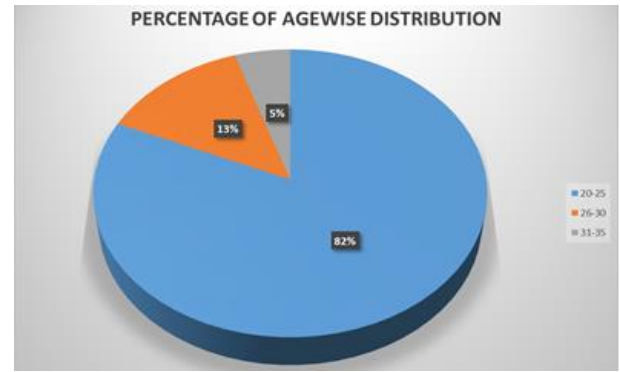


Fig 1: Age-wise distribution

Out of a sample size of 120 patients, patients in the age group of 20-25 years was found in majority of 82%, patients in the age group of 26-30 years was found to be 13% and patients in age group of 31-35 years was 5%.

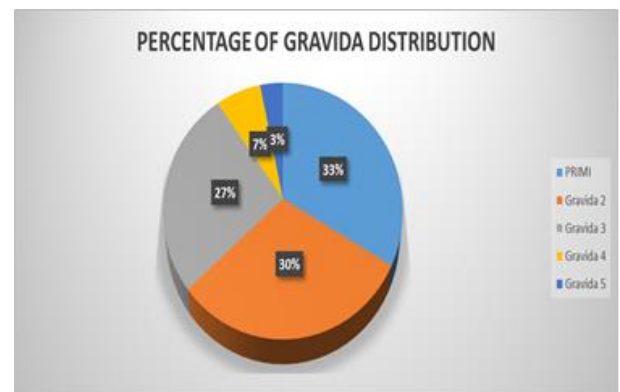


Fig 2: Gravida-wise distribution

Out of a sample size of 120 patients, Primigravidas were present in majority, gravida 2 were next in majority followed by gravida 3 while gravida 4 and gravida 5 were in minority.

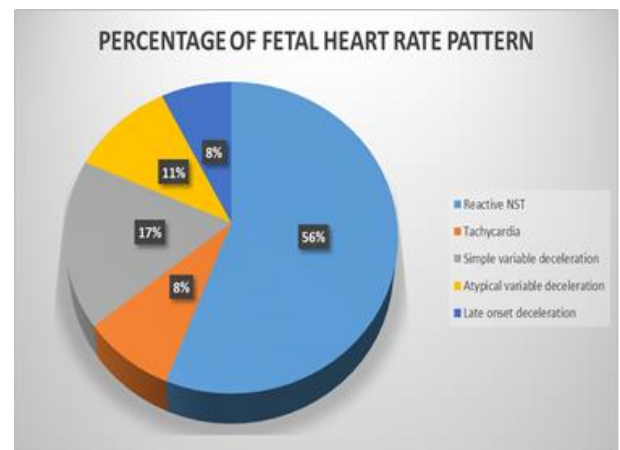


Fig 3: Frequency of fetal heart rate pattern

Different Non-stress test patterns were obtained after maternal surveillance which played an important role in making decisions like deciding the route of delivery.

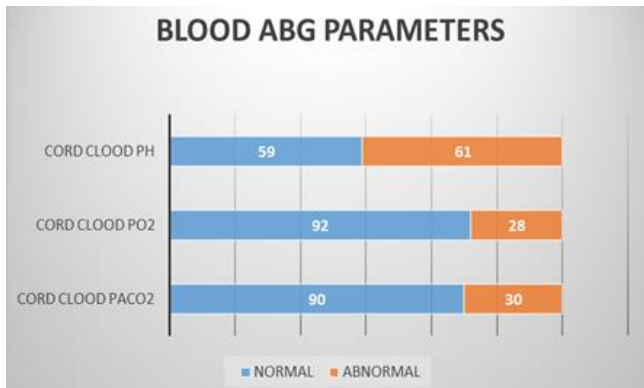


Fig 4: Percentage of blood ABG parameters

Cord blood of the delivered baby was sent for ABG analysis within 5 minutes of delivery.

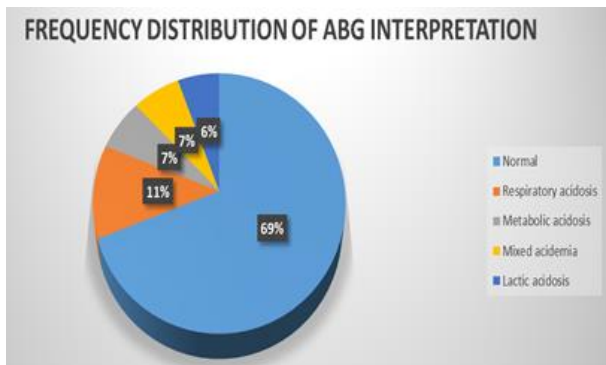


Fig 5: Frequency wise distribution of ABG interpretation

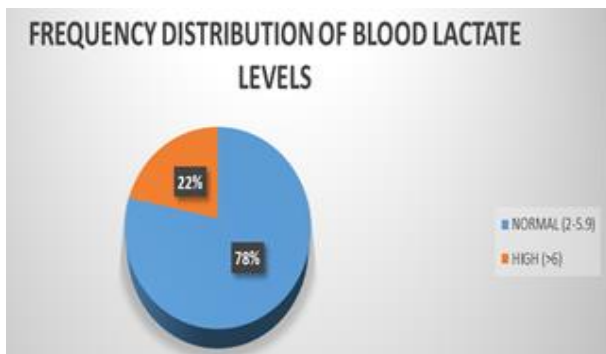


Fig 6: Frequency wise distribution of Cord blood lactate levels

Cord Blood lactate levels are measured by collecting cord arterial blood immediately after delivery and sent for analysis for lactate levels.

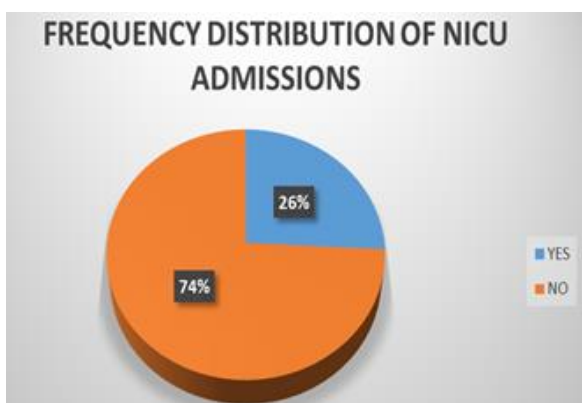


Fig 7: Frequency of NICU admissions

It was observed that a majority of babies were healthy at birth with a good APGAR score and did not require NICU admissions.

Table 8: Association between Cord blood pH and NST findings

CTG/NST Cord Blood PH	Reactive	Non-reactive	Chi-square value	P value
	Normal cord PH (7.2)	37		
Abnormal cord PH (<7.2)	32	29		
Total	69	51		

It was observed in this study that an insignificant (p value=0.25) association was found between cord blood pH and NST findings

Table 9: Association between cord blood paCO2 and NST findings

	Reactive NST	Non-reactive NST	Chi-square value	P value
Normal cord Co2(32-69mmhg)	53	39	0.02	0.98
Abnormal cord Co2	16	12		
Total	69	51		

In this study it was observed that an insignificant (p value=0.98) association was found between cord blood CO2 levels and NST findings.

Table 10: Association between cord blood O2 levels and NST findings

	Reactive NST	Non-reactive NST	Chi-square value	P value
Normal cord o2(50-70mmhg)	54	36	.92	0.33
Abnormal cord o2	15	15		
Total	69	51		

In this study a insignificant (p value=0.33) association was found between cord blood PaO2 levels and NST findings.

Table 11: Association between cord blood HCO3 levels and NST findings

	Reactive NST	Non-reactive NST	Chi-square value	P value
Normal cord HCO3(17-27)	44	32	0.03	0.90
Abnormal cord HCO3	25	19		
Total	69	51		

In this study it was found that an insignificant association was found between cord blood bicarbonate levels and NST findings (p value=0.90).

Table 12: Association between cord blood lactate levels and NST findings

	Reactive NST	Non-reactive NST	Chi-square value	P value
Normal lactate levels	59	34	5.97	.015
High lactate levels (6>/=)	10	17		
Total	69	51		

In this study, significant (p value 0.015) association was observed between cord blood lactate levels and NST findings.

Table 13: Association between NICU admissions and NST findings

	Admission	NO Admission	Chi-square value	P value
Reactive NST	14	55	2.60	0.10
Non-reactive NST	17	34		
Total	31	89		

In this study, an insignificant (p value= 0.10) association was found between NST findings and NICU admissions.

Table 14: Association between cord blood lactate and NICU admissions

	Admission	NO Admission	Chi-square value	P value
High lactic acid level	19	8	36.067	<0.001
Normal lactic acid level	12	81		
Total	31	89		

In this study, a highly significant (p value <0.001) association was found between cord blood lactate levels and NICU admissions.

Table 15: Association between cord blood pH levels and NICU admissions

	Admission	NO Admission	Chi-square value	P value
Abnormal PH	21	40	4.78	0.02
Normal PH	10	49		
Total	31	89		

In this study a significant (p value=0.02) association was found between cord blood pH and NICU admission.

Discussion

The parameters that were considered in this study are very important for assessment of fetal well-being and to assure a good fetal outcome.

This study was conducted to draw associations between parameters like NST findings which were obtained intranatally and Cord blood pH, pacO₂, paO₂ and lactic acid levels which were obtained postnatally. Each of this parameter was also associated with NICU admissions to find out how efficient each individual parameter was for assessment of fetal well-being.

The sample size of the study was 120 and patients were majorly in the age group of 20-35 years with majorly primigravidas^[5].

Subsequent growth of the fetus increases the carbon dioxide production of the growing fetus and thus increases the carbon dioxide load. There is also a reduced gas exchange because of ageing placenta as the pregnancy progresses. Thirdly, high amounts of fetal hemoglobin hampers with the buffering capacity of the fetus. As a result of these three factors, there is a physiological derange in the cord blood pH of the newborn baby. Similar findings were seen in our study where majority of the newborn babies of the 120 patients had a deranged cord blood pH most of which was physiological. (Figure: 4)

ABG interpretation was made based on individual parameters like paO₂, pacO₂, pH, lactic acid, bicarbonates. Accordingly evaluation of respiratory and metabolic status of the sample was made. Respiratory acidosis is less severe, occurs due to uteroplacental/ fetoplacental insufficiency which is short lived. There is rarely an adverse outcome to respiratory acidosis. If the stress is prolonged, anaerobic glycolysis sets in and metabolic acidosis occurs. On further persistence of stress, mixed acidemia sets in which has grave prognosis. In our study different types of ABG interpretations were made which is also comparable to a study conducted by Arnold and Stenson^[6]. (Table 5)

Anaerobic metabolism causes production of lactic acid. Increase in lactic acid causes subsequent increase in the metabolic acidosis which causes tissue hypoxia. Lactate concentration in umbilical cord blood at delivery might be a more precise tool in assessment of fetal metabolic acidosis as it measures the metabolic acidosis rather than the respiratory acidosis^[7]. In our study a minority of 22% had a high lactic acid levels which is comparable to a study conducted by Shirey T. *et al.* wherein 85 cord blood samples were taken to test for pH and lactic acid levels out of which 45 samples had increased lactic acid levels. (Figure: 6)

NICU admissions were decided based on the Apgar score.

Babies with poor Apgar score were shifted to NICU for further evaluation (Fig 7). Very little information about the cause of acidosis is given by Apgar score. It is not very efficient in determining the long term morbidity of the baby because factors such as malformations, secretions which obstruct the airway and anesthetic drugs affect it. It is affected by other factors such as malformations, obstruction by secretions or anesthetic drugs. As a result, Apgar score is considered a simple and repeatable method to quickly and summarily assess the health of the newborn children regardless of the cause. This view is supported by both the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, who have challenged the use of Apgar score to define birth asphyxia^[8].

In a study conducted by Dr Naina Kumar *et al.*, out of 13 women having abnormal NST results, 10 were shifted for emergency cesarean section and 3 delivered vaginally. Out of 13 babies of these mothers, only 3 (23.07%) showed acidosis (fetal distress in true sense) and required NICU admission^[9]. They thus concluded that NST wasn't a very effective tool for fetal assessment and correlation between cord blood pH and NST was not significant. In our study too the correlation between Cord blood pH and NST came out to be insignificant with p value= 0.25 (Table 8). Also when paO₂, pacO₂, bicarbonate was individually correlated with NST, an insignificant correlation was found in this study (Table 9, 10, 11).

In a study conducted by Hossam O. Hamed on Umbilical cord lactate in relation to fetal heart rate patterns, it was found that abnormal CTG patterns were seen in cases of high lactic acid levels. Late onset deceleration and atypical variable deceleration were the abnormal CTG patterns seen associated with increased lactic acid levels in the study by Hossam O. Hamed^[7]. Deranged pH levels did not produce any abnormal CTG findings in their study. Similar findings are seen in this study where in lactic acidosis is associated with deranged NST especially showing late onset deceleration. Significant association is seen between cord blood lactate levels and NST with a p value of 0.015. (Table 12)

A very poor association was seen between NST and NICU admissions with a statistically insignificant p value of 0.10 (Table 13). Some newborns who were admitted in NICU also had reactive NSTs.

Study was conducted by Richa U. Lohana *et al.* in which correlation was shown between fetal outcome and non-stress test. They had a contrary result. The conclusion they drew was: NST was found to be a good predictor of the healthy foetus even in normal pregnancies between 37-42 weeks of gestation and the probability of an adverse outcome such as meconium-stained amniotic fluid and asphyxia increases with a non-reactive strip. It is evident from this study that NST is a useful tool to avoid obstetric litigation as parental expectation of a good outcome is extremely high^[10].

In our study, correlation between lactic acid and NICU admissions is highly significant with a p value of <0.001 (Table 14). Mostly all newborns in our study with increased levels of lactic acid required NICU admission. In a study conducted by Hamed O. similar result was obtained: they concluded that the cord blood lactate is reliable and easily measured marker for intrapartum fetal asphyxia with good correlation with cord acid-base status. It has better prediction value than cord pH for newborns with low Apgar score^[7]. Another similar study was conducted by Methodius Tuuli *et al.* on Umbilical cord arterial lactate compared with pH for predicting neonatal morbidity at term. Their conclusion they drew was: umbilical cord arterial

lactate is a more discriminating measure of neonatal morbidity at term than pH. Lactate was more sensitive and specific than pH and has the additional advantage of simplicity of measurement [11].

In our study association between cord blood pH and NICU admissions was statistically significant with p value of 0.02. In a study conducted by Mojibian Mahdiah and *et al.* poor association was found between cord blood pH and its ability to detect fetal distress. As per their study, no significant correlation was seen between Apgar score and cord blood pH levels [12]. In another study by Methodius Tuuli comparisons were made between cord blood lactate and cord blood pH in terms of indicator for fetal assessment and they concluded that cord blood lactate was a better predictor of neonatal status than cord blood pH [11].

In our study too if cord blood lactate and cord blood pH is to be compared, association between cord blood lactate with NICU admission is more significant (p value < 0.001) than association between cord blood pH and NICU admissions (p value = 0.02). This suggests that Cord blood lactate is a better indicator of fetal assessment compared to cord blood pH and NST. This finding is consistent with a majority of other studies conducted.

Conclusion

Timely management of fetal distress is of utmost importance for an obstetrician. It would be very helpful to study parameters that help predict fetal distress and their efficiency in assessing fetal well-being.

In our study, we conclude that there is no significant correlation present between cord blood ABG and NST findings but a significant correlation exists between cord blood lactate levels and NST findings. Also if individual parameter were to be judged for accurate detection of fetal status, cord blood lactate was the most significant followed by cord blood ABG levels and NST was least useful.

Measurement of cord arterial blood pH and cord arterial blood lactic acid after every delivery should be included in the standard protocol of neonatal assessment to evaluate the health status of the newborn. Role of cord blood lactate measurement for diagnosis of well-being of the new born is confirmed in this study.

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