

ESTIMATION OF CORD BLOOD LACTATE LEVELS IN FETUSES WITH ABNORMAL FETAL HEART RATE PATTERN AND THEIR PERINATAL OUTCOME

¹Dr.D.V.K. Durga, ²Dr.Gaddam Shamili, ³Dr.Kandukuri Malavika, ^{4*}Dr. Polugari Anand Vijaya Bhasker.

¹Associate Professor: Department of Obstetrics and Gynaecology: Gandhi Medical College, Secunderabad, Telangana, India.

²Assistant Professor: Department of Obstetrics and Gynaecology, Government medical College Sangareddy, Tadlapalle, Sangareddy, Telangana, India.

³Assistant Professor: Department of Obstetrics and Gynaecology: Gandhi Medical College, Secunderabad, Telangana, India.

^{4*}Associate Professor: Department of Anaesthesia, Government Medical College, Jangaon, Telangana, India.

*Corresponding Author

Dr. Polugari Anand Vijaya Bhasker,
Associate Professor,
Department of Anaesthesia,
Government Medical College,
Jangaon, Telangana.

ABSTRACT

Aims: To estimate cord blood lactate levels in fetuses with abnormal fetal heart rate pattern and their perinatal outcome.

Materials and methods: Pregnant women with term gestation with abnormal CTG were taken as study group admitted for a period of 2 years . Total of 90 Pregnant women with term gestation with abnormal CTG, Singleton pregnancy and Cephalic presentation.

Results: There is positive correlation between cord blood lactate levels and NICU admission. Increase in cord blood lactate levels were associated with more number of NICU admissions. Positive correlation is also noted between and cord blood lactate levels and meconium stained liquor. 158 babies had meconium stained liquor, out of 58 babies, increase in cord blood lactate levels were noted in babies.

Conclusion: Cord blood lactate levels assessment in pregnant women with abnormal CTG is the most sensitive parameter for diagnosing fetal asphyxia, should be performed in all high risk births as this may help in providing appropriate care to the newborn at birth and decreasing as well as preventing neonatal morbidity and mortality.

Keywords: Cardiotocograph, Meconium Stained Liquor, Cord blood lactate levels

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INTRODUCTION

Millions of women and their babies die every year around the time of childbirth and improving this statistic remains a priority of Sustainable Development Goals[SDG]. Lack of quality of intrapartum care around the time of childbirth leads to adverse outcomes, frequently as a result of hypoxia and its sequelae, which in low and middle-income countries is a significant contributor to both stillbirths and early neonatal deaths. Fetal distress is a common neonatal problem and contributes significantly to neonatal morbidity and mortality. Globally, hypoxia of the newborn (birth asphyxia) or the fetus (fresh stillbirth) is estimated to account for 2-3% of the 4 million neonatal deaths and 26% of the 3.2 million still births each year. Perinatal mortality remains one of the most pressing global health problems, and improvements in the quality of care around the time of childbirth have the potential to save millions of women's and newborn lives, particularly in low and middle-income countries. One of the major contributors to perinatal mortality in low and middle-income countries is intrapartum hypoxia and its sequelae, for which the lack of consistently available quality intrapartum care is a significant contributor. Intrapartum hypoxia can be considered the intermittent or permanent fall in fetal blood oxygen levels during labour, which may lead to intrapartum hypoxia, or a fall in oxygen levels in organs. With the influence of maternal, fetal, and care factors, this can lead to acidosis[increase in hydrogen ions in the tissues], and finally to intrapartum asphyxia, a conglomerate of clinical features including a neurologically depressed neonate at birth, as well as intrapartum or early neonatal deaths. Therefore decreasing fetal distress and possible side effects of it is a golden aim in obstetrics. So diagnosis of fetal distress is important in labour. Reducing intrapartum hypoxia requires accurate recognition of the condition, followed by an appropriate clinical response.

Interventions to achieve this include electronic fetal heart rate monitoring, access to instrumental deliveries and caesarean section facilities, and effective neonatal resuscitation, in addition to adequate staffing with access to teaching and case reflection. While electronic fetal heart rate monitoring is frequently used with the aim of detecting fetal hypoxia and compromise, there are several limitations to CTG that may limit its impact on intrapartum outcomes. Depending on the system used for interpretation, specificity for CTG and fetal acidosis can be as low as 18%, with positive predictive values around 35%. Apgar score is used universally to assess the fetus after delivery. Though it has a high value in diagnosing fetal distress, but it is not precisely a predictive factor. Studies on umbilical cord blood for determination of lactate indicate that high levels seem to be correlated to fetal metabolism for anaerobic glycolysis taking place in oxygen-deprived tissues of the fetus. Conventionally for many years the diagnosis of intrapartum hypoxia has been based on the clinical signs of fetal distress (like meconium staining of liquor and fetal heart rate abnormalities on auscultation) and the assessment of Apgar scores at birth. However, poor specificity and low positive predictive value of these conventional methods propelled the search for a better diagnostic test. However the sensitivity of electronic fetal heart rate monitoring may be improved with umbilical cord blood sampling to assess acid-base balance immediately after delivery. In this context, the umbilical cord blood biochemical analysis attracted special attention, as it is thought to mirror the intrapartum and immediate postpartum hypoxic events. Umbilical artery blood gas measurement allows an objective assessment of the metabolic state of the fetus prior to delivery and provides a biochemical representation of fetal acid-base status in the intrapartum period. [1,2]

It is conventionally performed using a measurement of Ph. Whilst umbilical artery Ph is the gold standard for measurement of fetal hypoxia that has resulted in acidosis. An alternate way to measure acidosis is with umbilical artery cord blood lactate levels. As lactate

levels may be considered a true reflection of the metabolic acidosis status, it may be of value in diagnosing genuine cases of intrapartum fetal hypoxia and this was the prime aim of our study. Study aims at establishing the relationship between cord blood lactate levels and fetal distress in the form of abnormal fetal heart rate pattern as recorded on CTG and their perinatal outcome. CTG is a technical means of recording fetal heart rate and uterine contractions during pregnancy. Variables of CTG are used to indicate fetal distress. Intraobserver and interobserver variations in the interpretation of CTG is common. Blood gas parameters and lactate levels of cord blood have been used to evaluate the status of newborn. Studies on umbilical cord blood for determination of lactate indicate that high levels seems to be correlated to fetal metabolism for anaerobic glycolysis which lead to metabolic acidosis.[3,4] As lactate levels may be considered as a true reflection of metabolic acidosis status, study aims to know correlation between umbilical cord blood lactate levels with intrapartum abnormal fetal heart rate monitoring.

MATERIALS AND METHODS

Pregnant women with term gestation with abnormal CTG were taken as study group admitted in Department of Obstetrics and Gynaecology from January 2021 to June 2022. Total of 90 women with singleton live term pregnancy.

Inclusion Criteria : Pregnant women with term gestation with abnormal CTG, Singleton pregnancy and Cephalic presentation.

Exclusion Criteria: Elective LSCS, Malpresentations, Multifetal gestation and Fetus with congenital anomalies.

We collected a total of 90 women with singleton live term pregnancy with abnormal CTG in the department of Obstetrics and Gynaecology. All these patients satisfied inclusion and exclusion criteria. Details of the patients were noted in the proforma. Ours is a Hospital based Prospective observational type of study. In our study, we have collected details of 90 women with singleton live term pregnancy with abnormal CTG based on inclusion and exclusion criteria. Their mode of delivery, presence or absence of meconium stained liquor, APGAR score of fetus at 1 minute and 5 minutes, NICU admission. We also calculated umbilical cord blood lactate levels And data was entered in to excel sheet. We tried to find correlation between fetal distress and umbilical blood lactate levels and their perinatal outcome.

All obstetric patients of inclusion criteria were subjected to CTG, in the active phase of labour. The CTG used in the study was Philips Avalon FM30 with the paper speed being 1cm/min with an external transducer. Uterine contractions were recorded simultaneously. Patients with abnormal CTG are included in the study.

RESULTS

Table-1: Patient details in present study

| Age | Frequency | Percentage |
|------------------------|-----------|------------|
| <20 years | 2 | 2.222222 |
| 20-24 years | 33 | 36.66667 |
| 25-29 years | 41 | 45.55556 |
| 30 and above | 14 | 15.55556 |
| Total | 90 | 100 |
| Gestational age | | |

| | | |
|---------------------------|----|----------|
| <36 weeks | 4 | 4.444444 |
| 36 weeks -37weeks | 3 | 3.333333 |
| 37 weeks-38weeks | 18 | 20 |
| 38 weeks -39weeks | 20 | 22.22222 |
| 39 weeks -40weeks | 32 | 35.55556 |
| >40 weeks | 13 | 14.44444 |
| Obstertric formula | | |
| Primi gravida | 57 | 63.33333 |
| Gravida II | 22 | 24.44444 |
| Gravida III | 8 | 8.888889 |
| Gravida IV | 3 | 3.333333 |
| Mode of delivery | | |
| FTNVD with LMLE | 32 | 35.55556 |
| LSCS | 58 | 64.44 |

In our study, mean maternal age was 25.68years. Majority of cases were in the age group of 25 to 29 years (45%). Majority of subjects were between 39 to 40weeks (35%). In our study, majority of subjects (63%) were primigravida. 64% delivered by LSCS,35 % delivered by FTNVD.

Table-2: Birth weight distribution

| Birth weight in kgs | Frequency | Percentage |
|---------------------|-----------|------------|
| 1.5-2.0 | 8 | 8.888889 |
| 2.1-2.5 | 25 | 27.77778 |
| 2.6-3.0 | 43 | 47.77778 |
| 3.1-3.5 | 11 | 12.22222 |
| >3.5 | 3 | 3.333333 |
| Total | 90 | 100 |

In our study, majority of newborns were weighing 2.6 -3kg.

Table-3: APGAR score distribution at 1and 5 minute

| APGAR at 1 min | Frequency | Percentage |
|-----------------------|-----------|------------|
| 3 | 1 | 1.111111 |
| 5 | 35 | 38.88889 |
| 6 | 5 | 5.555556 |
| 7 | 48 | 53.33333 |
| 8 | 1 | 1.111111 |
| APGAR at 5 min | | |
| 5 | 1 | 1.111111 |
| 7 | 36 | 40 |
| 8 | 3 | 3.333333 |
| 9 | 50 | 55.55556 |

In our study , 38 % had apgar score of 5 at 1min,5% had apgar score of 6 at 1min, 53% had apgar score of 7 at 1 min. 40% had apgar score of 7 at 5 min,3% had apgar score 8 at 5 min, 55% had apgar score of 9 at 5 min.

Table-4: Meconium stained liquor and cord blood lactate levels distribution

| MSL | Frequency | Percentage |
|---------------------------|-----------|------------|
| Absent | 32 | 35.55556 |
| Present | 58 | 64.44444 |
| Cord blood Lactate levels | | |
| <2.55 | 2 | 2.222222 |
| 2.55-4.63 | 37 | 41.11111 |
| >4.63 | 51 | 56.66667 |

In our study, 64% had meconium stained liquor. 56 % had cord blood lactate levels >4.63meq/l (above normal range). 41% had levels in the normal range i.e., 2.55 – 4.63meq/l.

Table-5: Correlation between cord blood lactate levels and NICU admission and MSL

| Parameter | Sub groups | Mean± SD | P value |
|-------------------------|------------|-----------|----------|
| NICU admission | Yes(n=58) | 5.50±1.47 | <0.00001 |
| | No(n=32) | 3.86±0.92 | |
| Meconium Stained Liquor | Yes(n=58) | 5.33±1.56 | 0.0003 |
| | No(n=32) | 4.16±1.1 | |
| Outcome | LSCS(n=58) | 4.92±1.55 | 0.97 |
| | NVD(n=32) | 4.91±1.47 | |

In our study, 64 % had NICU admission. There is positive correlation between cord blood lactate levels and NICU admission. Increase in cord blood lactate levels were associated with more number of NICU admissions. Positive correlation is also noted between and cord blood lactate levels and meconium stained liquor. In our study, 58 babies had meconium stained liquor , out of 58 babies, increase in cord blood lactate levels were noted in babies.

DISCUSSION

Birth asphyxia is an imprecise term, usually defined as lack of blood flow or exchange of gases from the fetus or to the fetus in the period immediately before during or after the birth process. Birth asphyxia creates anxiety for most birth attendants. Due to decreased blood flow or oxygen flow to fetus or infant during peripartum period ,It can result in profound systemic and long term neurological damage to the newborn which is associated with huge costs of financial compensation for the families who have to suffer the emotional distress along with the care for a possibly lifelong handicapped child. if placental (prenatal) or pulmonary (immediate) postpartum exchange of gases is compromised or ceases altogether, there occur partial hypoxia or complete lack of oxygen (anoxia) to vital organs which results in progressive hypoxemia and hypercapnia. If hypoxemia is severe enough, vital organs (muscle, heart, liver and finally brain) and tissues develop oxygen debt which ultimately lead to anaerobic glycolysis and lactic acidosis.[5]

Birth asphyxia contribute to large number of neonatal deaths and long term disabilities in children worldwide. It leads to about 4 million deaths every year around globe. Over the last decades, different criteria (apgar score, umbilical arterial blood gas analysis) have been used in an attempt to identify the neonates exposed to intrapartum asphyxia. Recent advances in obstetrics, radiology and neonatology have helped health care professionals to prevent some cases of birth asphyxia ,improvement in its management with the aim to assess disability and to correctly assess the prognosis for long term neurological development of child. From an obstetric point of view, accurate intrapartum fetal monitoring based on national guidelines ,good communication and evidence based management hold the key for successful outcomes with avoidance of adverse events. The present study highlights the importance of estimation of cord blood lactate levels, one of the criteria to identify neonates exposed to intrapartum asphyxia with the establishment of metabolic acidosis.[6]

In our study, mean maternal age was 25.68 years. Majority of subjects were in the age group of 25 -29 years. In the last decades, maternal age at childbearing has shifted dramatically due to wide range of social and cultural determinants. Both extremes of reproductive age are at risk for adverse pregnancy outcomes (preterm delivery, low birth weight, low apgar score, perinatal deaths) as corroborated by Londero, A.P., Rossetti, E.,Pittini, C.et al.[6] More number of higher aged women reflect more complicated pregnancies requiring elective caesarean births as age advances ,has been corroborated by Herstad et al. and Timofeev et al.[7] however in our study women beyond 30yrs age constituted by only 15%.

Lactate concentrations in arterial venous umbilical cord blood are increasing significantly with advancing gestational age as stated by N Wiberg et al[8]. In our study only 14 % were post term, remaining 86 % were term pregnancy. Highest values of lactate are noted between 39 and 41weeks gestational age as stated by Vincent D Gaertner et al[9]. In our study only 35 % were between 39 – 40weeks gestational age. No Correlation was seen between gestational age and cord blood lactate levels at term in our study as also stated by Watt et al[10].

In our study, 64% had meconium stained liquor. Even though, passage of meconium considered as weak indicator of intrapartum asphyxia as compared to nonreassuring fetal heart rate as stated by Upadhayay M et.al[11]. Positive correlation between increased cord blood lactate levels and meconium stained amniotic fluid with the development of MAS leading to more NICU admissions was seen in our study as stated by Nalan Karabayir et al.[12]

Cord blood lactate levels are significantly related to mode of delivery and is equivalent to cord arterial pH in predicting adverse neonatal outcome with similar efficacies as stated by S Revathy Natesan et.al.[13] In our study 64% delivered by LSCS and 36% were delivered by FTNVD.

The apgar score was devised by Virginia Apgar as a simple and repeatable method to quickly assess the health of newborn children. However, it gives no information of acidosis /hypoxia and has a very low predictive value in identifying long term morbidity. In our study, In our study , 53 % had apgar score of 7 at 1min,38% had apgar score of 5 at 1min, 5% had apgar score of 6 at 1 min. In our study, 55 % had apgar score of 9 at 5 min,40% had apgar score 7 at 5 min, 3% had apgar score of 8 at 5 min.

All babies who had low apgar score at 5 min had metabolic acidosis and need for admission to NICU suggesting that high neonatal cord blood lactate is a significant predictor of low Apgar score and the same has been demonstrated by Khoshnow and Mongelli[14]. In our study, there were less number of babies with low apgar score out of all the babies who had lactic acidosis. It may be due to fetal catecholamine surge which occurs as a result of hypoxia may also help in the improvement of apgar scores by causing general neonatal arousal.

In our study, 64% of newborns were admitted in NICU. In our study among 58 NICU admission babies, 42 babies had higher values of cord blood lactate. Significant positive correlation noted in our study showing that umbilical cord blood lactate is more specific in predicting adverse neonatal outcome As stated by Suman Shivanagouda Patil, Sukanya, Suman Rath, Carolin Elizabeth George.[15]

In our study, 51 babies had lactate values $>4.63\text{meq/l}$, out of which 42 babies had NICU admission. Gjerris and colleagues[16] suggested that lactate levels in arterial umbilical cord blood might be a more correct indicator of fetal asphyxia at delivery than pH. Study by Nickelsen showed that Lactate in arterial umbilical cord blood might be a more direct and more correct indicator of fetal asphyxia at delivery than pH. Study by Ashish kumar Simalti , Vandana Negi[17] showed that cord blood lactate can be used as a predictor for perinatal hypoxia and could be better marker for perinatal asphyxia than apgar and cord blood Ph.

CONCLUSION

Lactate is produced by cells under anaerobic conditions, fetal production of lactate, a subject of interest. Hyperlactatemia is an elevated lactate concentration. lactic acidosis is an elevated lactate concentration accompanied by decrease in systemic blood pH. Most commonly ,lactic acidosis is produced as a result of tissue hypoperfusion and hypoxia that can occur with shock ,severe anemia ,respiratory distress and hyper metabolic states.

Biochemical fetal lactic acidosis is an important indicator of fetal hypoxia which may or may not manifest clinically. Fetal hypoxia occurs as a result of compromised maternal oxygenation, reduced maternal placental perfusion or impedance to the delivery of oxygenated blood from the placenta to the fetus. If adequate fetal oxygenation doesnot occur anaerobic metabolism takes place with the production of organic acids such as lactic acid. Lactic acid accumulation can deplete the buffer system and can result in metabolic acidosis with associated fetal distress ,poor apgar score and low fetal pH. Biochemical fetal lactic acidosis has 100 % negative predictive value.

In our present study, there was positive correlation between cord blood lactate levels and NICU admissions, higher cord blood lactate levels were associated with more NICU admissions. Hence it was found that cord blood lactate levels assessment in pregnant women with abnormal CTG is the most sensitive parameter for diagnosing fetal asphyxia, should be performed in all high risk births as this may help in providing appropriate care to the newborn at birth and decreasing as well as preventing neonatal morbidity and mortality.

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