Original Article

Umbilical Artery Blood Acid-Based Status in Fetal Growth Restriction with Normal and Abnormal Doppler Studies

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ABSTRACT

Objective: The objective of this study was to determine and compare the acid-base status of the umbilical artery blood in growth restricted fetuses having normal and abnormal Doppler studies at the time of C-Section via Doppler velocimetry.

Study Design: Descriptive / Cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Obstetrics & Gynecology, Women Medical College, Abbottabad, and Women & Children Hospital Abbottabad from June 2019 to December 2019.

Materials and Methods: Patients attending the antenatal OPD Clinic, with singleton pregnancy were enrolled for the study and patients with structural anomalies were excluded. Consents from the patients were obtained and history was recorded. IUGR fetuses were divided into two groups; group A (normal Doppler flow) and group B (abnormal Doppler flow).These patients were followed up till delivery and at the time of C- section umbilical artery sampling was done .The data was scored and analyzed statistically.

Results: Doppler Studies results indicated that the mean pulsatility index of Group A was 0.622± 0.148 and that of group B was 0.862±0.120 which is statistically significantly different. Acid Base study Patients with abnormal Doppler had significantly more frequent abnormal acid base status. The abnormal ABGs in patients with abnormal Doppler was 6.231 (95% C1 2.351=16.513). The mean pH of the patients in the normal doppler group was 7.14±.098 and that in the abnormal Doppler group was 7.03±0.14. This difference in pH was statistically significant, the abnormal Doppler group having significantly more acidosis. APGAR score. 1min in the abnormal ABG group 15 (34.9%) babies had an APGAR score of > 7 at 01 minute as opposed to 22 (59.4%) in the normal ABG group. In the abnormal ABG group 28 (65.1%) babies had an APGAR score of 0-6 at 01 minute as opposed to 15 (40.5%) in the normal ABG group. The mean APGAR score at 05 minute in the abnormal Doppler flow group was 6.901±.23 and the mean APGAR score at 05 minute in the normal Doppler flow group was 7.55±.75.The differences in 05minute APGAR score was statistically significant between the two groups; p=0.006

Conclusion: Babies with abnormal umbilical artery Doppler had significantly more frequent chances of having abnormal blood gas status on cord umbilical artery bloodanalysis. Therefore, acid-base at the time of birth help to improve fetal surveillance.

Key Words: umbilical artery blood, acid-based status, fetal growth restriction, doppler studies, fetal surveillance.

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INTRODUCTION

IUGR is a sonographic predictableof fetal weight that is less than 10th percentile of the gestational age. Increased risk of perinatal mortality, morbidity, and impaired neurological development is associated with growth restricted fetuses. IUGR fetuses areprone to intrauterine death & asphyxia at birth stage.

The main objective of antenatal care is rightly estimation of compromised IUGR fetuses for timely intervention. Doppler ultrasound plays an important role in the management of IUGR fetuses. The rate of growth of the restricted fetuses with reversed or absent blood circulation speed in the umbilical artery are at respiratory distress, higher risk of cesarean section, chronic lung disorder, necrotizing enterocolitis, acute renal failure and ultimately death. There are ample of evidence in obstetric patients that Doppler index of fetal circulation can reliably identify future perinatal consequences. Growth restricted fetuses with abnormal and normal PI of umbilical artery causes 15% and 34 % incidence of acidosis respectively by authors[1-3]. Assessment of fetal growth and wellbeing is important key objectives of antenatal care. In human pregnancies,

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placental inadequacy is the driving reason for asymmetrical IUGR. There are various methods of surveillance of fetal growth restriction[4-6]i.e. clinical assessment, fetal biometry, estimated fetal weight, biophysical profile, and Doppler velocimetry. The positive predictive value of clinical assessment, abdominal circumference and fetal weight are lower as compared to that of Doppler or blood gas analysis results in detecting fetal growth restriction once diagnosed and severity of risk predicted, the neonatal outcome can be improved.

Estimates of fetal acid-base balance and oxygenation are not shown in fetuses with restricted growth if the velocimetry is normal. Abnormal velocimetry, on the other hand, causes fetal blood sampling, which can only be recognized from hypoxia and acidosis by growth retardation. Several authors have reported, the important role of Doppler sonography in predicting risk for poor neonatal outcomes in IUGR fetuses[7-15]. Umbilical cord pH has long been used, as a surrogate measure of fetal oxygenation, with most authors agreeing that severe acidosis at birth is associated with an increased incidence of neonatal complications. The present study was carried out using fetal umbilical artery Doppler examination on a cohort of fetuses suspected of having fetal growth restriction and then followed their acid base status and subsequent antenatal courses to assess early neonatal outcomes. The purpose of this research work was to understand umbilical artery Doppler precisely predict acid-base status at birth stage to enhance fetal surveillance.

MATERIALS AND METHODS

This was a descriptive case study conducted in the Department of Obstetrics & Gynecology, Women Medical College, Abbottabad, and Women & Children Hospital Abbottabad from June 2019 to December 2019.Sample size was 80 patients with IUGR calculated by using WHO Sample Size Calculator for studies. Prior to the investigations, all patients informed consents were taken. Patients attending the antenatal OPD Clinic, with singleton pregnancy and small for gestational age were enrolled for the study. Patients with structural anomalies on anomaly scan were excluded from the study. Detailed history and examination of each patient was performed. Patient's gestational age was calculated by their last normal menstrual period, urine pregnancy test and first trimester dating scan. Patient's symphysis fundal height was measured by tape. Measuring tape was placed on the symphysis pubis and with the centimeter marks face down, measure to the previously noted top of the fundus. The patients in which symphysis fundal height was corresponding to gestational age were evaluated for IUGR by ultrasound. Ultrasound measurements, femur length, biparietal diameter, abdominal perimeter, head circumference, amniotic fluid content, and placental maturity were measured for the confirmation of IUGR. Gestational age was confirmed by ultrasound results on the first day of the final menstrual period and 20 weeks before pregnancy. The heads and abdominal perimeters of these fetuses measured by ultrasound were less than 5^{th} percentile of standard values for fetuses of same ages. Less than 10^{th} percentile neonatal weight was considered growth retardation according to standard birth weights and gestational age criteria. Patients diagnosed as IUGR fetuses was referred for Doppler flow studies for umbilical artery pulsatility index (PI), resistance index (RI), and systolic to diastolic ration (S/D ratio) then study patients were distributed into two groups, in group A (IUGR with normal Doppler flow studies) and group B (IUGR with abnormal Doppler flow studies). Blood circulation from fetal umbilical-artery was performed prior to the Doppler fetal test and coaxial pulsed Doppler velocimeter having a sample volume of 5 mm and high pass filters were set at 100 HZ for testing. Three consecutive wave forms were used for each reading to measure results on hard copies by utilizing computerized planimeter. The simplified gosling formula was applied for computing the pulsatility index (PI) as shown in equation 1.

Pulsatility Index=(systolic velocity - diastolic velocity) / mean velocity Eq1.

Decrease diastolic velocity of quantified PI was accepted as an indication of placental impedance to blood flow, however, the absence of end diastolic flow showed the presence of severe placental damage. The study patients were followed till the time of delivery. Only those patients were further selected for the study in whom mode of delivery by C-section either emergency or elective. At the same time of C-section umbilical artery by surgeon using heparinized syringe within 5 minutes of taking sample blood gas parameters pH, PO_2, PCO_2 and base excess were measured. Sample was sent to hospital lab and reported. Collected blood samples were obtained in heparin treated syringes, sealed, and stored in ice. Radiometer ABL 300 analyzers were used to determine levels of respirator gases within 5 to 10 minutes after sampling. The outcome variable noted at delivery was state birth weight and APGAR score at one and five minutes after delivery and results were documented on proforma find further analysis**.**

RESULTS

80 patients were included in this research and result indicated asymmetric fetal growth restriction on ultrasound criteria. 40 patients had normal Doppler parameters and 40 had abnormal Doppler parameters. The age ranged from 20 to 39 years with a mean age of 27.57± 4.6 years. The mean age of the patients with normal Doppler was 26.3±2.89 and those with abnormal Doppler was 28.8±5.61 years ; the two groups were mean age of the patients with normal ABGs was

27.7±4.29 and those with abnormal ABGs was 27.44±4.92 years; both groups were not significantly diverse to their age distribution; p=0.783. The gestational age ranged from 235 to 283 days with a mean gestational age of 258.57±10.82 days; the two groups were not significantly different with respect to their gestational age distribution; p=0.294. The mean gestational age of the patients with normal ABGs was 258.7+10.57 and those with abnormal ABGs was 260.83±11.04 days; both groups were not significantly different with respect to their age distribution; p=0.783.40 patients had an abnormal and remaining 40 patients had a normal Doppler flow in umbilical artery. The pulsatility index ranged from 0.647 to 2.95. The mean pulsatility index was 1.457±0.617. The mean pulsatility index of Group A (normal Doppler) was 0.622+ 0.148 and that of group B (abnormal Doppler) was 0.862±0.120.The SD ratio ranged from 1.02 to 4.4. The mean SD ratio was 2.61±1.00. The mean SD ratio of Group A (Normal Doppler) was 1.84±0.100 and that of group B (Abnormal Doppler) was 3.38±0.649.The mean pulsatility index of normal ABGs group was 1.34±0.633 and that of abnormal ABGs was 1.55±0594. This difference was statistically non-significant; p=0.121.The mean resistivity index of normal ABGs group was 0.699±0.183 and that of abnormal APGs was 0.778±0.171. This difference was statistically significant p=0.005.The mean SD ratio of normal ABGs group was 2.2±0.955 and that of abnormal ABGs was 2.96±0.917. This difference was statistically significant p=0.001(46.25%) had normal ABGs and 43 (53.75) had abnormal ABGs out of 40 patients with normal doppler 27 (67.5%) had normal ABGs and 13 (32.5%) had abnormal ABGs. Out of 40 patients with abnormal Doppler 10 (25%) had normal ABGs and 30 (75%) had abnormal ABGs. Therefore, patients with abnormal Doppler had significantly more frequent abnormal acid base status. The OR for having abnormal ABGs in patients with abnormal Doppler was 6.231 (95% C1 2.351=16.513) t he mean pH of the patients in the normal Doppler group ranged 7.14±.098 and that in the abnormal Doppler group was 7.03±0.14. This difference in pH was statistically significant, the abnormal Doppler group having significantly more acidosis. The mean PCO_2 of the patients in the normal Doppler group was 44.35±7.07 and that in the abnormal Doppler group was 52.07±8.66. This difference in the CO2was statistically significant; the abnormal Doppler group having significantly more hypercapnia. The mean PO_2 of the patients in the normal Doppler group was 16.90±1.81 and that in the abnormal Doppler group was 14.17±2.64. This difference in thePO_2 was statistically significant; the abnormal Doppler group having significantly more hypoxia. The mean base deficit of the patients in the normal Doppler group was 4.25±8.43 and that in the abnormal Doppler group was -2.71±7.63. This difference in the base deficit was statistically significant; the abnormal Doppler group having significantly more acidosis.

DISCUSSION

Failure to achieve normal growth index in the fetus is characterized as fatal growth restriction. Fetus with growth restriction is designed as small for gestational age (SGA). Intrauterine growth restriction is major cause related perinatal mortality and morbidity. These infants have increased risk of handicap in later part of the life. There is no intrauterine therapy at present to treat such affected fetus. Doppler ultrasound is a known invasive method to investigate uteroplacental circulation. On serial Doppler ultrasound, changes in velocimetry valuesis helpful for the progress in circulation with therapy or to tell the need for the delivery. Few studies show the significance of umbilical artery Doppler velocimetry. The aim of this research work was to compare umbilical artery doppler velocimetry with biochemical measurements gained from fetal blood sampling in group of fetuses with growth hindrance. This study also helped to clarify the role of above investigation in the management of pregnancy having growth retardation fetuses. In our study out of 40 patients with normal Doppler 27 (67.5%) had normal ABGs and 13 (32.5%) had abnormal ABGs. Out of 40 patients with abnormal Doppler 10 (25%) had normal ABGs and 30 (75%) had abnormal ABGs. Therefore, patients with abnormal Doppler had significantly more frequent abnormal blood gas status. All biochemical parameters including pH, PCO_2, PO_2 and base deficit were significantly different between the two groups: the abnormal Doppler group having significantly more acidosis, hypercapnia, hypoxia, and baser deficit. The mean birth weight was not different between normal and abnormal ABG groups. The APGER score at 01 minute significantly more babies were distressed (scores 0-6) in both abnormal Doppler and abnormal ABG groups; $p< 0.05$. However, the 5-minuteAPGAR scores were significantly shorter abnormal Doppler group, but this association was not present in the abnormal ABG group. We therefore concluded that babies with abnormal umbilical artery Doppler had considerably more frequent chances of having abnormal blood gas status on cord umbilical artery blood gas analysis. Therefore, umbilical artery Doppler helps to predict acid-base status and improve fetal condition at the time of birth. Although, acid-base assessment from cord helps to measure neonatal condition at the time of birth but contrary there are lack of improvement of neonatal condition with other measures (APGAR scores, resuscitation, neonatal morbidity). Additionally, acidosis is defined according to the values of pH ranging from 7.20 down to 7.00. However, few attempted have been done to distinguish respiratory and metabolic causes of acidosis. Cord blood gases and pH

should be mentioned in all neonates with low APGAR scores. It helps to differentiate metabolic acidosis from hypoxemia, or any other causes related to APGAR scores. Although, metabolic acidosis confirm on cord blood is not a good indicator to predict long-term neurological injuries, however, it helps to exclude intrapartum or birth events causing acidosis. It is recommended that umbilical cord blood sampling soon after delivery should immediately be transported in heparin-containing syringe in plastic pack with cursed ice. The results of ABGs remain a questionable. Fetal hypoxia-acidosis is a part of pathway that may lead to intrauterine fetal demise. Antepartum surveillance is important for timely identification and delivery of the fetus having hypoxia or acidosis, so to prevent intrauterine fetus demise and long-term neurological damages. There is no optimal method to identify fetal hypoxia-acidosis to be determined. Umbilical artery Doppler velocimetry was best option for these outcomes. Arterial and venous specimens are used to check insights to ethology acidosis of newborn and umbilical cord blood provide a picture based on acid-base balance of the infant movement at the time of birth when umbilical circulation is caused to stop by the clamping of the cord. If the umbilical cord blood continues to flow along the umbilical cord, it continues to flow along the umbilical cord, indicating progressive changes in the acidity of the umbilical cord due to changes in gas exchange and metabolism. Minor changes have been noted in umbilical pH values occurring within 60 min of delivery and for 60 min cord arterial or venous pH have been dropped over than 0.2pH units. Similarly, placental surface vessels have been occurred in the blood samples. Additionally, changes have not been observed in the samples if the cord was doubly clamped at the time of birth, isolate a portion of blood from the both the placenta and environment. pH was remained comparatively constant at room temperature for an hour. Local data on the subject is sparse. More studies on a larger scale are required to document the role of umbilical artery blood gas analysis in the management of growth delimited fetuses. Babies containing abnormal umbilical artery Doppler had significantly more frequent chances of having abnormal blood gas status on cord umbilical artery blood analysis. Therefore, the umbilical artery Doppler can predict acid-base at birth time to improve fetal surveillance

CONCLUSION

Babies with abnormal umbilical artery Doppler had significantly more frequent chances of having abnormal blood gas status on cord umbilical artery bloodanalysis. Therefore, acid-base at the time of birth help to improve fetal surveillance.

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