Original Article

ABG Status in Fetal Growth

Outcome of Arterial Blood Gas (ABG) Status in Fetal Growth Restriction with Normal and Abnormal Doppler Studies

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ABSTRACT

Objective: To determine the outcome of arterial blood gas (ABG) status of fetuses with IUGR with both normal and abnormal doppler velocimetry studies. Umbilical cord blood was drawn for this purpose.

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 July 2017 to August 2018.

Materials and Methods: 80 women with singleton pregnancy and IUGR fetuses who were delivered by Cesarean section were included in this study. Umbilical cord blood sampling was done immediately after doppler velocimetry which was done at the time of delivery. The study participants were divided into two groups based on their doppler velocimetry status. Different indices such as pulsatility index, resistivity indices and SD ratios were stratified by doppler velocimetryresults and ABG results.

Results: Mean pulsatility and resistivity indices were higher in babies with abnormal doppler velocimetry (p=0.00). Similarly, SD ratio was higher in abnormal doppler group (p=0.00). Babies with abnormal ABG values had a higher SD ratio and resistivity index (p=<0.05).75% of neonates who had abnormal doppler velocimetry had abnormal ABG values (p=0.00). Babies with abnormal doppler had a statistically significant reduction in blood pH and oxygen content and increased PCO2 ($p < 0.05$). Likewise, the APGAR score of infants with abnormal doppler velocimetry studies was lower compared to those with normal doppler studies ($p < 0.05$).

Conclusion: Abnormal doppler velocimetry in IUGR fetuses is associated with acidosis, hypoxemia and hypercapnia in new-born. Anticipation of metabolic abnormalities in neonates with abnormal Doppler velocimetry can help in prompt management and as a result, decreased morbidity in these neonates.

Key Words: IUGR, Small-for-gestational age, birth asphyxia, Acute respiratory Distress, Hypoxia,perinatal mortality, Eclampsia

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INTRODUCTION

Although Intrauterine growth restriction (IUGR), as the name implies, is fetal growth below "normal", it can be defined in a number of ways[1], for example, growth of the fetus below the potentially normal rate of growth that is specific for the gender or race of a fetus, or, a decrease in or a deviation from the expected pattern of growth for a fetus usually resulting from causes related to the fetus itself i.e., growth anomalies or as a result of one or many adverse events affecting fetus in uterus.

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IUGR results from a number of causes such as chromosomal abnormalities, infections, maternal and placentalfactors, drug exposure, illicit drug use by the mother during pregnancy, co-morbid such as maternal hypertension and anemia etc[2–4], IUGR places the fetuses at an increased risk of death in-utero and birth-asphyxia[5,6]. Prompt diagnosis of IUGR can increase the chances of fetal survival by allowing for timely intervention. Doppler ultrasound of umbilical artery has been used as a surveillance tool for detection of IUGR and prediction of adverse peri-natal outcomes in such cases[7,8]. Doppler ultrasound of umbilical artery canidentify reduction in or absence of umbilical artery blood flow indicating an increased risk of respiratory distress, cesarean section, chronic lung disease later on in life, deterioration in acute renal function, necrotizing enterocolitis and / or death[7]. There is a higher risk of developing intra-uterine hypoxia / acidosis in a pregnancy with IUGR fetus[9]. It is known that fetal lactate levels are higher than maternal lactate levels in human pregnancies[10,11], and it has been shown that the lactate concentration of umbilical artery and umbilical vein and the difference in lactate concentration of umbilical vein and umbilical artery at the time of birth

have a correlation with APGAR scores at one and five-minutes after birth in IUGR pregnancies[12,13]. Fetal lactate concentrations have been deemed a better indicator of acidemia in fetus than pH measurements[14,15]. However, measurement of umbilical vessels pH is a well-known method for assessment of fetal oxygenation in light of association of birth acidosis with increased incidence of complications inneonates[16]. Sampling of fetal blood for determination of acid-base status and oxygenation can help differentiate between fetuses with IUGR and concomitant acidosis and / or hypoxia from fetuses with IUGR only. Since IUGR is one of the leading causes of perinatal mortality and is responsible for significant morbidity, and it is also known that acidosis at birth results in neonatal complications, this study was designed to assess early neonatal outcomes in fetuses with IUGR by performing umbilical artery doppler ultrasound and determining their acid-bases status via measurement of arterial blood gases. The study also aimed to assess the utility of umbilical artery doppler ultrasound in predicting the birth acid base status of fetuses with IUGR.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at the Department of Obstetrics & Gynecology, Women Medical College, Abbottabad and Women & Children Hospital Abbottabad from July 2017 to August 2018. 80 pregnant women with a singleton pregnancy and IUGR fetuses and / or small for gestational age fetuses were enrolled in the study and who were delivered by emergency or elective cesarean sections were included in the study. Patients with fetuses who had structural anomalies onanomaly scans were excluded from the study. IUGR was confirmed by a detailed history and a thorough physical examination including measurement of symphysio-fundal height followed by ultrasonography in which biparietal diameters, length of femur, circumference of abdomen, circumference of head, placental maturity and amniotic fluid index were measured for confirmation of IUGR. Neonatal weightless than 10th percentile according to age and weight was used for diagnosis of IUGR at the time of birth. Umbilical artery doppler studies for pulsatility index (PI), resistive index (RI), and systolic diastolic ratio (S/D Ratio) were performed on neonates with IUGR. The study participants were subdivided into two groups based on doppler flow results. All patients with IUGR but normal doppler flow studies were segregated into one group while those with abnormal doppler flow and IUGR were put in the second group. Fetal blood sampling was performed immediately after doppler velocimetry was done via a co-axial pulsed doppler velocimeter with a sample volume of 5 ml using high-pass filters at 100Hz (Ultra mark 5, ATL Corp). The simplified Gosling formula was used to determine pulsatility index. Umbilical artery blood gases were analyzed by drawing a sample of blood from umbilical artery in a heparinized syringe at the time of cesarean section. Birth weight and APGAR scores at 1- and 5-minutes were recorded afterwards. Data recorded was analyzed using SPSS 20. Numerical variables were described as mean and standard deviation while categorical variables were described as frequencies and percentages. Data was stratified by SD ratio, birth Weight, APGAR score and perinatal outcome. Post stratification chi-square test was done and a $p \leq 0.05$ was taken as significant.

RESULTS

The mean±SD age of pregnant women was 27.6±4.6 years with a range of 20-39 years. Patients with abnormal doppler were older than patients with normal doppler ultrasound (p=0.013). Age did not appear to affect the acid-base status of the study participants (p=0.8). Similarly, while the mean±SD gestational age of study participants was 260±11 days and the difference between doppler andabnormal acid-base groups in terms of gestational age was not statistically significant ($p > 0.05$).The mean±SDpulsatility index was 1.46±0.62. The pulsatility index of study participants with normal doppler was significantly low than that in participants with abnormal doppler flow (0.98±0.22 vs 1.98±0.51 respectively; p=0.00). Similar trend was observed for resistive index which was significantly lower in participants with normal doppler flow than those with abnormal doppler flow (0.62±0.15 vs 0.86±0.12 respectively; p=0.00), and for SD ratio (1.84±1 in normal doppler group vs 3.38±0.65 in abnormal doppler group; p=0.00).While no statistically significant difference was seen in pulsatility index of participants based on their acid-base status ($p > 0.05$), a statistically significant difference was observed in the resistivity index of patients with normal and abnormal ABG values (p =0.05). The mean± SD resistivity index of patients with normal ABG was 0.7±0.2 and of patients with abnormal ABG values was 0.78±0.2. Similarly, the SD ratio was significantly higher in patients with abnormal ABG (2.96±0.2) than those with normal ABGs (2.2±0.96) (p=0.001).While majority (43; 53.75%) of the study participants were found to have abnormal ABGs, the prevalence of abnormal ABGs was higher in participants with abnormal doppler flow studies where as much as 75% of the participants had abnormal ABGs (30 (75%) out of 40). On the other hand, only 13(32.5%) patients with normal doppler flow studies had abnormal ABG values (p=0.00; OR 6.23; 95%CI 2.35-16.51). A statistically significant difference was seen in the mean±SD blood pH of patients with normal doppler flow studies (7.14±0.98) and abnormal doppler flow studies (7.03±0.14) ($p < 0.05$). Study participants with abnormal doppler had significantly high hypercapnia (52.07±8.66 vs

44.35±7.07 in patients with normal doppler flow studies; p< 0.05), more hypoxia (O2 content 14.17±2.64 vs 16.90±1.81 in those with normal doppler flow; p < 0.05) and a stronger base deficit (-2.71±7.6 vs 4.25±8.43 in those with normal doppler flow; p < 0.05).There was no statistically significant difference in birth weight of neonates in both doppler and ABG groups (p > 0.05). The difference between APGAR score of abnormal doppler group (5.35±1.3) and normal doppler flow group (6.5±1.2) at 1 minute was statistically highly significant (p=0.00). On the other hand, no statistically significant difference was observed between APGAR scores of patients with normal ABGs and patients with abnormal ABG values (p > 0.05). Upto three-fourth (30) of babies in abnormal doppler group had an APGAR score of upto 6 at one minute compared to 13 in normal doppler flow group (p = 0.000).Of the 43 patients with abnormal ABGs, 28 (65%) had an APGAR score of more than 7 at 5 minutes compared to 30 (80%) patients in normal ABG group. Conversely, 15 (35%) babies in abnormal ABG group had an APGAR score of upto 6 at 5 minutes after delivery compared to 7 (19%) babies with normal ABG values (p > 0.05).

DISCUSSION

The main feature of IUGR is delayed or no growth of fetus in the uterus. Infants born with IUGR havean increased of handicap later in their life. Now, the only effective treatment for IUGR fetuses is delivery. A clinical role has been suggested for doppler sonography, a non-invasive method for evaluation of uteroplacental circulation[17], for measuring the fetal blood-flow wave-forms, inumbilical artery via doppler velocitometry[18,19]. Coupled with this non-invasive approach, the ability to sample cord blood either in-utero or immediately after birth allows the physicians to evaluate them etabolic stressors that the fetus may have faced before and at the time of delivery. Cordocentesis has been used to diagnosis several conditions such as lactic acidosis and anemia[20], hypoxia[21], lowamino acid concentrations[22], and endocrine diseases23 in fetuses with IUGR.In our study, statistically significant differences were seen in ABG values between babies with normal doppler and babies with abnormal doppler studies. Babies with abnormal doppler studies had more severe hypoxia, hypercapnia, acidosis and stronger base deficit compared to the other group (p < 0.05).Similarly, babies with abnormal doppler and abnormal ABGs were more distressed at 1 minutes afterbirth (p < 0.05). However, this difference was not seen when APGAR scores at 5 minutes were compared (p > 0.05). The pulsatility index, resistive index and the SD ratio were increased in babies with abnormal doppler flow (p < 0.05). Similarly, the resistivity index and SD ratio were abnormal in babies with abnormal ABG values, while pulsatility index was not affected by abnormal ABGs. Interestingly, a study from Iran reported that there was no significant correlation between umbilical artery blood gases and abnormal color doppler in IUGR infants[24]. The researchers evaluated 100 patients with IUGR and compared the results of umbilical artery blood gas analysis with abnormal color doppler. On the other hand, Blackwell and colleagues have reported that neonates with IUGR arehypoxemic and have acidosis when compared with normal neonates[25]. Similar findings have been reported by Ferrazzi*et al.* and colleagues who also reported hypercapnia in their study cohort in addition to acidosis and hypoxia.[26] A study from the US reported that oxygen saturation, partial pressure of oxygen and blood pH of neonates with IUGR were significantly lower than neonateswithout IUGR, while opposite was seen for partial pressure of carbon dioxide (PCO2)[27].A study from Turkey reported that Doppler velocimetry is a reliable tool for predicting adverse perinatal outcomes for neonates[28].

CONCLUSION

The studies concur with results of this study suggesting that abnormal Doppler velocimetry could be used as a prognostic tool in fetuses with IUGR. IUGR babies have deranged acid base status, and we observed a statistically significant association between abnormal ABGs and abnormal doppler velocimetry of umbilical artery.

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Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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