ORIGINAL ARTICLE

COMPARISON OF PERINATAL OUTCOME IN GROWTH RESTRICTED FETUSES RETAINING NORMAL UMBILICAL ARTERY DOPPLER FLOW TO THOSE WITH DIMINISHED END-DIASTOLIC FLOW

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Background Intrauterine growth restriction /retardation (IUGR) is defined as birth weight below the 10th percentile for a given gestational age. Placental insufficiency is the primary cause of intrauterine growth retardation in normally formed fetuses and can be identified using umbilical artery Doppler velocimetry which is a non-invasive technique. The objective of this study was to compare perinatal outcome in growth restricted fetuses retaining normal umbilical artery doppler flow to those with diminished or severely reduced/absent end-diastolic flow. **Methods:** This cross sectional study was conducted at Radiology department of Pakistan Navy Ship (PNS) Shifa Hospital, Karachi over one year period from. Established cases of asymmetrical IUGR, having estimated fetal weight <10th percentile for gestational age and between 28–40 weeks of gestation were included in the study. Pulsatility index (PI) was calculated for each case. Perinatal outcomes like early delivery, caesarean section, respiratory distress syndrome, necrotizing enterocolitis, admission to neonatal ICU, prenatal and neonatal death were evaluated. Chi-square test was used to compare proportion difference of perinatal outcomes for normal and abnormal umbilical artery velocimetry, with 0.05 level of significance. **Results:** Umbilical artery doppler velocimetry showed a significant correlation with the perinatal outcome. In 90% of cases of IUGR having abnormal waveform, poor perinatal outcome was seen as compared to only 33.3% retaining normal doppler flow. **Conclusion:** Growth restricted fetuses with normal umbilical artery doppler velocimetry were at lower risk than those with abnormal waveforms.

Keywords: Umbilical artery Doppler; Intrauterine growth restriction; Perinatal outcome

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INTRODUCTION

Intrauterine growth restriction /retardation (IUGR) is defined as birth weight below the 10th percentile for a given gestational age[1]. Placental insufficiency is the primary cause of intrauterine growth retardation in normally formed fetuses and can be identified using umbilical artery Doppler velocimetry[2] which is a non-invasive technique.[3]

Umbilical artery Doppler is an easily available, non-invasive technique and is free from ionizing radiations.[4] It is very useful in cases of IUGR where it can predict the possible perinatal outcome, thus aiding in timely management. Studies have shown that for clinical purposes, pulsatility index (PI) is more accurate for situations where there is low absent or reversed end-diastolic flow.[5]

The purpose of this study was to assess the efficacy of umbilical artery doppler in identifying the fetuses with established IUGR who are at risk of developing perinatal complications, i.e., those with reduced, absent or reversed diastolic flow so that timely management may be offered. In our country little work has been done on this subject.

In Radiology department of PNS SHIFA we receive large numbers of patients for doppler study of uterine artery for the evaluation of intrauterine growth restriction. In our study we hypothesized that Umbilical artery doppler is not a good predictor of perinatal outcome in growth restricted fetuses (Null Hypothesis).

MATERIAL AND METHODS

This cross-sectional descriptive study was conducted in Radiology Department of PNS SHIFA Hospital Karachi, which is one of the largest referral hospitals for Armed forces personnel and their families. Total duration of study was one year. During this period 60 patients were included in the study. Patients were referred from obstetric department. Ultrasound was performed on Toshiba (Nemio 20) Model SSA-550A Colour Doppler Ultrasound Machine using 3.5 and 5.0 MHs convex and 7.5 MHz linear transducers on real time scanners. Inclusion criteria were:

- Maternal age between 20–40 years.
- Established cases of asymmetrical IUGR diagnosed on ultrasound having estimated weight <10th percentile for gestational age.
- Between 28–40 weeks of gestation.

Following patients were excluded from the study:

- Twin/multiple pregnancies
- Malformed fetuses

Data collection was prospective and specifically for the purpose of this study. All patients referred from Obstetrics and Gynecology department of PNS Shifa as established cases of asymmetrical IUGR, diagnosed on ultrasound having estimated weight <10th percentile for gestational age and between 28 to 40 weeks of gestation were included in the study. An informed consent was obtained from all patients prior to carrying out the procedure. Umbilical artery Doppler was done with 3.5–5 MHz convex transducer. Measurements were obtained from umbilical artery from a free loop during periods of fetal apnea. Pulsatility index (PI) was calculated for each case. Procedure was carried out under the supervision of a consultant Radiologist. Serial Doppler ultrasounds were done where required, i.e., if first scan showed diminished flow and in such cases only the last measurement before the delivery was used for the analysis. Perinatal outcomes including early delivery, caesarean section, respiratory distress syndrome , necrotizing enterocolitis (NEC), admission to neonatal ICU (NICU), prenatal and neonatal death were evaluated in cases having normal Doppler flow and those with diminished , reversed or absent end-diastolic flow. Patients were contacted through telephonic call after discharge for fallow up.

Biparietal diameter (BPD) and Femur length (FL) were taken to calculate the gestational age. Abdominal Circumference (AC), biparietal diameter (BPD) and femur length (FL) were used for assessment of fetal weight. BPD measurements were taken from the outer edge of the proximal fetal skull bone to the inner edge of distal skull. The abdominal circumference was measured in standard transverse planes at the level of the stomach and umbilical vein-ductus venosus complex. The FL was measured from the proximal end of the greater trochanter to the distal metaphysis. PI of 0.8 was considered as normal at 28 weeks with gradual reduction with advancing gestational age reaching 0.5 at 40 weeks.[6] Any value of PI above these values were considered abnormal.

Statistical analysis was performed on a personal computer using SPSS-10). Frequencies and percentages were calculated for good and poor perinatal outcome in cases having both normal and abnormal umbilical artery Doppler flow (UADF). Chi square test was applied to compare the categorical data of perinatal outcome in two groups, i.e., with normal and abnormal UADF. Mean and standard deviations were calculated for quantitative variables like gestational age and maternal age.

RESULTS

A total of 60 patients were studied. Patients were divided into two groups each with 30 cases of established IUGR. One group had patients in which abnormal umbilical artery Doppler velocimetry was observed, whereas second group retained normal umbilical artery Doppler flow (UADF). It was observed that cases retaining normal UADF had better perinatal outcome .Out of 30 such cases only 5 babies were delivered early, 9 underwent caesarean sections. 8 babies were admitted to NICU, only 1 developed RDS. Abnormal UADF resulted in poor perinatal outcomes. Out of 30 cases included in the study, 11 were delivered before time, 25 through Caesarean section. 18 babies had neonatal ICU admission, 6 cases developed respiratory distress syndrome (RDS), 2 developed NEC. There were 2 cases of prenatal death and 1 case of neonatal death. It was observed that as the end-diastolic flow became poor, i.e., absent or reversed, the perinatal outcomes also became worst. It was observed that in 3 cases with absent UADF, one suffered prenatal death and one baby died in NICU during the neonatal period at third day of life. Early delivery through Caesarean section had to be done for 2 out of 3 cases. 1 out of 3 suffered from NEC and 1 developed RDS. Only one case of reversed UADF was encountered and resulted in prenatal death at 32 weeks of gestation. There were no cases of prenatal or neonatal deaths in patients with only reduced UADF, i.e., not having absent or reversed flow in umbilical arteries.

Distribution of cases of having normal and abnormal umbilical artery Doppler flow according to perinatal outcome is given in table-1.

Percentage and frequencies of perinatal outcomes of cases having normal and abnormal umbilical artery Doppler flow are given in table-2.

Out of 30 cases having abnormal UADF, 27 had bad/poor perinatal outcome as compared to 10 cases in which normal flow is retained. Out of 60 case 37 (61.7%) had bad outcome and the remaining 23 (38.3%) had good outcome. Chi square test proved that this difference between two groups was statistically significant (p=0.000). Thus, null hypothesis was rejected.

The normal UADF group has a mean maternal age of 26.57 while the abnormal UADF group has a mean age of 25.7 years difference of maternal ages between the two groups, i.e., normal and abnormal UADF, was not found to statistically significant (p=0.452).

Table-1: Distribution of cases of having normal and abnormal umbilical artery doppler flow according to perinatal outcome

Perinatal outcome	Raised PI	Normal PI
Early delivery	11	5
Caesarean section	25	9
RDS	6	1
NEC	2	-
NICU admission	18	8
Prenatal death	2	-
Neonatal deaths	1	-

Table-2: Percentages and frequencies of perinatal outcome with normal and abnormal Umbilical artery Doppler flow (UADF)

Perinatal Outcome	UADF			*p*-value
	Abnormal No. (%)	Normal No. (%)	Total No. (%)	
Poor	27 (90.0)	10 (33.3)	37 (61.7)	0.000
Good	3 (10.0)	20 (66.7)	23 (38.3)	

DISCUSSION

Both low birth weight and excessive fetal weight at delivery are associated with an increased risk of newborn complications during labor and the puerperium. IUGR is the second leading contributor to the prevailing morbidity and mortality; affecting 23.8% newborns around the world and75% of these neonates are born in Asia.[7] The perinatal complications associated with low birth weight are attributable to preterm delivery, intrauterine growth retardation (IUGR), or both. In my study, I found that reduced, absent or reversed end-diastolic blood flow velocity in the umbilical artery is associated with an increased risk of neonatal death and morbidity including respiratory distress syndrome, necrotizing enterocolitis as well as admission to neonatal ICU. The data augments other studies suggesting that absent or reversed end-diastolic flow velocities in the umbilical artery of growth-restricted fetuses is associated with an increased risk of perinatal mortality and morbidity.

In one of the retrospective study by Shand AW[8], cases with reduced and absent UADF were delivered significantly more preterm. Similarly in another study by Ghosh GS[9], it was observed that abnormal UADF was associated with poor perinatal outcomes including caesarean delivery, premature delivery (<37 weeks of gestation) and admission of the newborn to a neonatal intensive care. In my study, the results were similar with considerably higher cases of early deliveries and caesarean sections in group with abnormal UADF. Work done by Rana MJ[1] revealed 23 out of 28 cases with abnormal UADF were delivered by caesarean section and were delivered preterm as well. Cases of RDS were seen in situations where early delivery was done. According to McCowan *et al*[10], the progressive reduction of UADF, as measured by Doppler analysis, reflects the severity of growth retardation. These authors drew their conclusions from a cohort study of small-for-gestational-age infants mostly delivered at term or moderately preterm. In my study, I confirmed that increasing resistance in the umbilical artery was directly related with the severity of poor perinatal outcomes. However, degree of growth restriction was not assessed in this study.

Baschat *et al*[11], in a multi-center study determined the relationships between various perinatal variables, which also included arterial Doppler, and major neonatal complications including NEC and mortality. In Pakistan a few studies have been done in this regard. In my study, NEC was only seen in two cases and they were with abnormal UADF One of this case had absent EDFV.

Vergani P *et al*[12] studied that absent end-diastolic blood flow in the umbilical artery identifies growth-restricted fetuses at high risk of perinatal mortality and severe morbidity. Relationship of reversed UADF with mortality was also established by Cosmi E[13]. In my study it was also observed that as the end-diastolic flow became poor, i.e., absent or reversed, the perinatal outcomes also became worst. It was observed that in 3 cases with absent UADF, one suffered prenatal death and one baby died in NICU during the neonatal period at third day of life. Early delivery through Caesarean section had to be done for 2 out of 3 cases. 1 out of 3 suffered from NEC and 1 developed RDS. Only one case of reversed UADF was encountered and resulted in prenatal death at 32 weeks of gestation. There were no cases of prenatal or neonatal deaths in patients with only reduced UADF. This means absent or reversed UADF carries the worst prognosis. This was also evident from the work of Yildirim G *et al.*[14]

In a study by Rizvi SMR[15], it was concluded that Doppler ultrasound is a very helpful tool in the management of small for gestational age fetuses & it reduces perinatal morbidity and mortality.

In my study, I was able to demonstrate a significant prognostic value of abnormal Doppler velocimetry of the umbilical artery in the presence of fetal growth restriction. Considerably fewer cases had poor outcome in group with normal UADF.

The early detection and monitoring of fetuses that are at risk from intrauterine growth retardation using umbilical artery Doppler as a tool would assist obstetricians in managing these cases so that the fetus completes its maximum development possible in uterus. Once a fetus is identified with IUGR, the mother may undergo close clinical follow-up, antepartum testing and serial umbilical artery Doppler scans.

CONCLUSION

The study underlines the existence of a strict correlation between umbilical Doppler velocimetry (normal or abnormal) and an increased incidence of perinatal complications in IUGR fetuses. As the UADF worsens, the perinatal outcome also becomes worse as was shown in my study where cases with absent and reversed EDFV were having the worst of the outcomes, namely prenatal and post natal deaths. Cases retaining adequate UADF had less poor perinatal outcome. Null hypothesis stating that Umbilical artery Doppler is not a good predictor of perinatal outcome in growth restricted fetuses was

rejected .Umbilical artery Doppler was found to be a convenient, non-invasive technique, carrying no potential risk to the mother or the fetus. No ionization radiations are involved in it. This should be offered to all cases of IUGR so that the fetuses at risk can be picked early and perinatal outcome is predicted. This will definitely result in less perinatal morbidity and mortality.

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