ORIGINAL RESEARCH PAPER
Volume-6 | Issue-11 | November-2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ROLE OF COLOUR DOPPLER IN THE EVALUATION OF FETAL GROWTH RESTRICTION: A PROSPECTIVE STUDY

Gynaecology

Dr. Amita Mahajan Associate Professor, Department of Obstetrics & Gynaecology, Punjab Institute of Medical Sciences, Jalandhar, (Punjab).

Dr. Sunil Seth* Assistant Professor, Department of Radiodiagnosis, Punjab Institute of Medical Sciences, Jalandhar, (Punjab). *Corresponding Author

ABSTRACT

Foetal growth restriction is responsible for several fold increase in pregnancy wastage in the form of preterm labour, birth asphyxia, perinatal mortality etc. A prospective observational longitudinal study was conducted on antenatal women diagnosed with foetal growth restriction at/after 26 weeks of gestation. Doppler flow studies of the umbilical artery (UA) and middle cerebral artery (MCA) were done on all patients. Significant number of women with fetal growth restriction had abnormal doppler flow studies. AREDFV was seen in 16% women and brain sparing effect was seen in 58% fetuses. In umbilical artery doppler examination; PI (pulsatility index) had the highest sensitivity (75%), PI of middle cerebral artery had the highest specificity and the resistivity index (RI) had the highest positive predictive value in prediction of adverse perinatal outcome. In growth restricted fetuses early Doppler changes were seen in the umbilical artery followed by centralization of blood flow (brain sparing effect). We suggest that all the Doppler indices (S/D, PI, RI) should be considered while optimizing the time of delivery because as per our study umbilical artery PI had the highest sensitivity, middle cerebral artery, PI had the highest specificity while RI had the highest positive predictive value in the prediction of adverse foetal outcome.

KEYWORDS

Fetal growth restriction, Umbilical Artery, Middle Cerebral Artery

INTRODUCTION:

Foetal growth restriction refers to a condition in which the foetus is unable to achieve its genetically determined potential size[1] and an estimated foetal weight is less than the 10th percentile corresponding to the gestational age[2]. Foetal growth restriction is a serious anomaly in the antenatal period and is responsible for several fold increase in pregnancy wastage in the form of preterm labour, birth asphyxia, hypoglycemia, hypothermia, respiratory distress syndrome, meconium aspiration, neonatal sepsis and immediate neurological abnormalities. Perinatal mortality rates are substantially higher for growth-restricted infants. Diverse factors; including foetal condition as well as maternal and environmental factors can lead to FGR. Doppler ultrasound has an important contribution to make to the surveillance of growth-restricted fetuses. The Doppler patterns follow a longitudinal trend with early changes in the umbilical artery and middle cerebral artery followed by other peripheral arteries[3]. They indicate the redistribution of blood flow in growth-restricted fetuses and need for close monitoring of the foetus.

MATERIAL AND METHODS:

This was a prospective observational longitudinal study conducted on antenatal women diagnosed with foetal growth restriction at/after 26 weeks of gestation, who presented in the Department of Obstetrics and Gynaecology at Punjab Institute of Medical Sciences, Jalandhar. The study was approved by institutional ethical committee.

Inclusion Criteria:

a) Women with singleton pregnancy of ≥ 26 weeks of gestation, with a discrepancy of more than 4 weeks on clinical evaluation, irrespective of the maternal disease.
b) Antenatal cases, ≥ 26 weeks of gestation with EFW less than 10th percentile of the corresponding gestational age on ultrasonography, irrespective of the maternal disease.

Exclusion Criteria:

a) Fetuses with diagnosed chromosomal abnormalities or structural anomalies.
b) Multiple gestations.
c) Intrauterine foetal demise at the time of first visit.

Detailed history including medical history and detailed clinical examination was carried out. All the patients were subjected to ultrasound and pulse wave Doppler examination. Doppler flow studies of the umbilical artery (UA) and middle cerebral artery (MCA) were done. For the purpose of analysis, study population was divided into three groups: a normal Doppler group, abnormal umbilical artery end diastolic flow group and group with abnormal MCA flow. Management was done depending on the Doppler findings and maternal disease. Data regarding pregnancy and pregnancy outcome in terms of period of gestation at birth, mode of delivery, neonatal birth weight, Apgar score, NICU admissions, still births and neonatal deaths was recorded. The perinatal outcome was divided into adverse and non-adverse outcomes. The Doppler indices were evaluated and correlated with the foetal outcome. Correlation was made by comparing the perinatal characteristics in the normal and abnormal Doppler group for each individual vessel under study. The foetal outcome in women with diminished/absent/reversal flow in the umbilical artery was compared with the foetal outcome in patients with normal Doppler findings. In the middle cerebral artery Doppler analysis, the foetal outcome in brain sparing effect was compared with the foetal outcome in normal MCA flow. Data was statistically analyzed using chi-square test and student test wherever applicable. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were determined for all Doppler indices.

RESULTS:

Most of the cases were between 21 and 25 years of age group comprising 47% of the total number of cases. PIH constituted 35% of total cases while oligohydramnios was seen in 27% cases. In our study 46% patients were less than 34 weeks of gestation depicting an early onset of fetal growth restriction. Significant number of women with fetal growth restriction (83%) had abnormal Doppler flow studies. The difference was statistically significant ($p<0.01$). In our study, maximally affected foetal vessel was the umbilical artery showing abnormal velocimetry in 81% doppler flow studies. Reduced end diastolic flow velocity in the umbilical artery was seen in 65% women. AREDFV was seen in 16% women and brain sparing effect was seen in 58% fetuses. Women admitted with fetal growth restriction had a higher cesarean section rate. 97% babies were live born and 3% were still born. 56% of babies were low birth weight, 35% were VLBW and 9% were ELBW babies. 37% neonates with fetal growth restriction had adverse perinatal outcome, which included 10% perinatal mortalities, 10% babies with low Apgar score and 30% babies with prolonged NICU stay. Maximum perinatal mortality (40%) was seen in 26-30 weeks of gestation and minimum at term (3%). As the gestational age advanced, incidence of abnormal umbilical artery Doppler findings decreased from 84.6% in 26-30 weeks of gestation to 73% at ≥37 weeks. Of all the cases of perinatal mortality, 90% of the cases had an abnormal umbilical artery doppler, while only 10% cases of perinatal mortality had a normal umbilical artery Doppler as shown in table 1. The difference was statistically significant (p value < 0.01). Perinatal mortality rate in REDFV (33.3%) was more than the AEDFV (12.5%). Of the 30 neonates with prolonged NICU stay (>7days), 26

had abnormal umbilical artery Doppler. All the 3% babies who had a stillbirth had an abnormal umbilical artery Doppler. In umbilical artery Doppler examination; PI had the highest sensitivity (75%) and specificity (80%) while S/D ratio had the highest diagnostic accuracy (70%) in the prediction of adverse perinatal outcome.

Table 1: Correlation Of Umbilical Artery Doppler With Foetal Outcome

Foetal Outcome	Total	Normal Doppler (n=19)	Abnormal Doppler (n=81)
Low Apgar(5 min score <7)	5	2	3
Intubated	23	3	20
Still Birth	3	0	3
Expired	7	1	6
NICU Stay >7 days	30	4	26

Fetuses with abnormal MCA Doppler had a higher perinatal mortality (13.1%) as compared to fetuses with normal MCA Doppler (5.2%). 80% of the neonates with low Apgar score had abnormal MCA flow while only 20% of the neonates with low Apgar score had a normal MCA flow as shown in table 2. More neonates (61.5%) with prolonged NICU stay had a brain sparing effect in color Doppler. 27.9% of newborns with centralization of blood flow were intubated as compared to 15.3% of babies with normal MCA flow.

Table 2: Correlation of Middle Cerebral Artery Doppler With Foetal Outcome

Foetal Outcome	Total	Normal Doppler (n=39)	Abnormal Doppler (n=61)
Low Apgar(5min score < 7)	5	1	4
Intubated	23	6	17
Still Birth	3	0	3
Expired	7	2	5
NICU Stay > 7 days	30	9	21

In the middle cerebral artery Doppler examination, PI was found to be the most specific indicator (85.00%) in the prediction of adverse perinatal outcome while RI (83%) had the highest positive predictive value.

DISCUSSION:

Doppler flow velocity analysis is valuable in antepartum foetal surveillance. In our study, 83% women were booked whereas 17% women were unbooked. Danish et al[4] concluded that antenatal check-ups improve the detection rate of fetal growth restriction. We have observed that 46% of the women were at less than 34 weeks of gestation depicting early onset fetal growth restriction. Deshmukh et al[5] noted similar findings and concluded that perinatal outcome was better in fetuses with late onset fetal growth restriction. In our study, foetal growth restriction maximally affected umbilical artery, showing abnormal velocimetry in 81% fetuses.FitzGerald[6] made similar findings and concluded that umbilical artery Doppler waveforms reflect the status of the foetoplacental circulation and increased placental resistance is strongly associated with FGR. In our study AREDFV was seen in 16% fetuses as compared to 10% by Arora et al [7]. Increased placental resistance leads to fetal hypoxemia resulting in centralization of blood flow (brain-sparing effect), which was seen in 58% fetuses with fetal growth restriction. Radhika et al[8] noted 68% brain sparing effect in fetuses with growth restriction. The total number of live births in our study was 97% as compared to 3% stillbirths. Visentin et al[9] observed all live births in their study while Mazarico et al[10] observed 85% live births and 15% stillbirths. The variation in the sample size and the risk factors included can be attributed to the difference in the studies. 56% of babies were low birth weight, 35% were VLBW and 9% were ELBW babies. Similar findings were made by Visentin et al[9] and Mazarico et al[10]. Adverse perinatal outcome was seen in 38% fetuses and maximum perinatal mortality rate (40%) was in 26-30 weeks of gestation that declined to 3% at term. Similar findings were made by Peter Holmqvist et al[11]. The incidence of abnormal umbilical artery Doppler decreased from 86% in 26-30 weeks of gestation to 71% in ≥ 37 weeks of gestation in our study which was in consonance with other studies[5.7]. Significantly more fetuses with abnormal umbilical artery velocimetry had prolonged NICU stay (30% vs. 16%) and increased perinatal mortality (18.75% vs. 12.5%) as compared to fetuses with normal Doppler. Deshmukh A et al[5], Mandruzzato et al[12], Seyam et al[13] and Mc Cowen et al[14] also noticed similar poor perinatal outcome. In foetal hypoxemia, there is compensatory cerebral vasodilatation. In the present study 57% fetuses were found to have brain sparing effect. The changes in MCA were preceded by changes in umbilical artery Doppler flow studies. Hershkovitz R et al[15] noted similar findings. In the present study the umbilical artery flow waveforms were studied and S/D, PI and RI indices were calculated .The sensitivity and specificity for the prediction of adverse perinatal outcome was 62.8% and 72.7% respectively. Rao et al[16] conducted a similar study and found that umbilical artery S/D ratio >3 had a sensitivity of 76.5% and specificity of 100% for the prediction of adverse perinatal outcome. Variation in the sample size taken can be attributed to the differences in the two studies. Chan et al[17] found the sensitivity and specificity of umbilical artery S/D ratio to be 64% and 74% with a diagnostic accuracy of 69.80% respectively; similar to our study. In the present study, umbilical artery PI had a sensitivity of 77.5% and specificity of 80.00% in the prediction of adverse perinatal outcome. According to Gramellini et al[18], the sensitivity was found to be 64% and specificity of 90.7%. There were more number of preeclampsia cases in our study; probably this explains the difference noted. Umbilical artery RI values were found to have sensitivity of 70% and specificity of 45% in prediction of adverse perinatal outcome as compared to the study done by Coleman et al[19] where the sensitivity was found to be 83% and specificity of 45%. We observed that PI had the highest sensitivity and S/D ratio had the highest diagnostic accuracy in the prediction of adverse perinatal outcome. The findings were similar to the study done by Chan et al[17]. The pulsatility index of the foetal MCA had specificity of 85%. These results are similar to the findings of Lakhar et al[20], Radhika et al[8], Arduini et al[21]and Khanduri et al [22]. We observed that the pulsatility index (PI) of middle cerebral artery had the highest specificity and the resistivity index (RI) had the highest positive predictive value in prediction of adverse perinatal outcome.

CONCLUSION:

Doppler technology provides the first opportunity for repetitive noninvasive hemodynamic foetal monitoring. We have observed that in growth restricted fetuses early Doppler changes were seen in the umbilical artery followed by centralization of blood flow (brain sparing effect.) AREDFV indicates severe foetal compromise. Doppler thus helps to optimize the timing of delivery. We suggest that all the Doppler indices (S/D, PI, RI) should be considered while optimizing the time of delivery because as per our study umbilical artery PI had the highest sensitivity , middle cerebral artery, PI had the highest specificity while RI had the highest positive predictive value in the prediction of adverse foetal outcome. Doppler reveals hypoxic changes earlier than non stress test and biophysical profile. Hence growth restricted foetuses with Doppler changes require a more vigilant surveillance using multiple testing modalities so as to prolong the pregnancy and to minimize the risk of prematurity. In umbilical artery Doppler examination; PI had the highest sensitivity (75%) and specificity (80%) while S/D ratio had the highest diagnostic accuracy (70%) in the prediction of adverse perinatal outcome.

REFERENCES:

1. Malhotra N, Puri R, Malhotra J, Malhotra N and Rao JP. Maternal-foetal work up and Management in intrauterine growth restriction, Donald School. J Ultrasound Obs & Gynae 2010; 4: 427-32.
2. ACOG Practice Bulletin ; Clinical Management Guidelines for Obstetrician and Gynaecologists; 2000:95.
3. Krishna U, BhalearaoS. Placental Insufficiency and Foetal Growth Restriction. J Obstet Gynecol India. 2011; 61: 505-11.
4. Danish N, Fawad A, Abbasi N. Assessment of pregnancy outcome in primigravida:A comparison between booked and unbooked patients. J Ayub Med Coll Abottabad. 2010; 22(2):23-5.
5. Deshmukh A, Soni N, Gokhale S. Significance of umbilical artery Doppler velocimetry in the perinatal outcome of growth restricted fetuses. J Obstet Gynecol. 2010; 60(1):38-43.
6. FitzGerald DE, Drumm JE, Non-invasive measurement for human fetal circulation using ultrasound: A new method. BMJ. 1977;2: 450-51.
7. Arora D, Desai S, Seth PN, Kania P. Significance of umbilecal artery velocimetry in perinatal outcome of growth restricted foetuses. J Obstet Gynecol India. 2005; 55(2): 138-43.
8. Radhika P, Shetty C, Rai L. Multivessel foetal Doppler and perinatal outcome in IUGR and severe preeclampsia. J Obstet and Gynecol. 2006; 11(2) 106-109.
9. Visentin S, Cavallin F, Zanardo V, Cosmi E. Neonatal outcome in intrauterine growth restricted and small for gestational age fetuses. Ultrasound Obstet Gynecol. 2010; 36(10):52-67.
10. Mazarico E, Roig Gomez M, Sabria J, Ancel Martin A, Vela A, Lailla J. Perinatal outcomes in gestations with intrauterine growth restriction and small for gestational age foetuses. Ultrasound Obstet Gynecol. 2010; 36(1): 52-167.
11. Holmqvist P, Ingemarsson E, Ingemarsson I. Intrauterine growth retardation and gestational age: Acta Obstet and Gynecol Scand. 1986; 65: 633-38.
12. Mandruzzato GP, Boggati P, Fischer L, Gigli C. The clinical significance of absent or reverse end diastolic flow in the foetal aorta and umbilical artery. Ultrasound Obstet Gynecol.1991; 1: 192-96.
13. Seyam YS, Al-Mahmeid MS, Al-Tamimi HK. Umbilical artery Doppler flow velocimetry in intrauterine growth restriction and its relation to perinatal outcome. Int J

Obstet Gynecol.2002; 77: 131-37.
14. Mc Cowen LM, Harding JE, Roberts AB. A pilot randominized controlled trial of two regimes of foetal surveliance for small for gestational age foetuses with abdominal umbilical artery Doppler. Ultrasound Obstet Gynecol. 2002; 19:225-28.
15. Hershkovitz R, Kingdom JC, Geary M, Rodeck CH. Foetal cerebral blood flow redistribution in late gestation : Identification of compromise in small foetuses with normal umbilical artery doppler. Ultratsound Obstet Gynecol. 2000; 15: 209-12.
16. RaoJH, Arathi AP, Ashwani AP. A clinical study of role of colour doppler imaging in pregnancies at risk. Int J Biomed Res. 2013; 4:09.
17. Chan FY, Pun TC, Lam P, Lam C, Lee CP, Lam YH. Foetal cerebral Doppler as a predictor of perinatal outcome and subsequent neurological handicap. Obstet Gynecol. 1996; 87: 981-88.
18. Gramellini D, Folli MC, Raboni S, Vadora E, Merialdi A. Cerebral umbilical Doppler ratio as a predictor of adverse perinatal outcome. Obstet Gynecol. 1992; 79:419-20.
19. Coleman MA, McCowen LM, North RA. Mid trimester uterine artery Doppler screening as a predictor of adverse pregnancy outcome in high-risk women. Ultrasound Obstet Gynecol. 2000; 15(1): 4-6.
20. Lakhar BN, Rajagopal KV, Gourisankar PT. Doppler prediction of adverse perinatal outcome in PIH and IUGR. Ind Radiol Imag. 2006; 1: 109-16.
21. Arduine D, Rizzo G. Prediction of foetal outcome in small gestational age fetus: Comparison of Doppler measurements obtained from different foetal vessels. J Perinat Med. 1992; 20: 29-38.
22. Khanduri S, Parashari UC, Bashir S, Bansal S, Bansal A. Comparison of diagnostic efficacy of Umbilical artery and Middle cerebral artery waveform with colour Doppler study for detection of intrauterine growth restriction. J Obstet Gynecol. 2013; 63(4):249-55.