

**Perinatal Outcome in Growth Restricted Fetus: Middle Cerebral Artery Vs Umbilical Artery Doppler**¹Dr. Amita Mahajan, Associate Professor, Department of Obstetrics & Gynaecology²Dr. Sunil Seth, Assistant Professor, Department of Radiodiagnosis**^{1,2}Punjab Institute of Medical Sciences, Jalandhar, (Punjab).**Correspondence Author:** Dr. Sunil Seth, Assistant Professor, Department of Radiodiagnosis, Punjab Institute of Medical Sciences, Jalandhar, (Punjab).**Type of Publication:** Original Research Paper**Conflicts of Interest:** Nil**Abstract**

Foetal growth restriction is associated with increased perinatal mortality and morbidity, possibly extending also into the adult life. A prospective observational longitudinal study was conducted on antenatal women diagnosed with foetal growth restriction at/after 26 weeks of gestation to compare the diagnostic efficacy of the umbilical artery (UA) and middle cerebral artery (MCA) doppler in predicting the foetal outcome. PI (pulsatility index) of umbilical artery had the highest sensitivity, PI of middle cerebral artery had the highest specificity and the umbilical artery SD ratio 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).

Keywords: Fetal growth restriction, Umbilical Artery, Middle Cerebral Artery.**Introduction**

The development of a good uteroplacental circulation is essential for achievement of a normal pregnancy. Fetal growth restriction (FGR) is associated with an increased risk of perinatal mortality, morbidity and impaired neurodevelopment. The correct detection of the compromised FGR fetus to allow for timely intervention is the main objective of antenatal care. The most common

methods for evaluating health in compromised fetuses are the biophysical profile and the non-stress test. Unfortunately, neither of these tests is particularly sensitive for the predicting poor outcome in FGR pregnancies. Doppler can be considered as one of the important non invasive technique to assess fetomaternal and uteroplacental circulation. Due to its feasibility and safety it can be used in antepartum surveillance in high risk cases to know pregnancy outcome and also formulate plan of management for optimum fetal and maternal outcome. The Doppler patterns follow a longitudinal trend with early changes in the umbilical artery followed by middle cerebral artery and other peripheral arteries. Venous changes follow the arterial pattern and occur in severely compromised fetus and predicts poor perinatal outcome.

Material and Methods

This prospective observational longitudinal study was 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. All 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 and antenatal cases, ≥ 26 weeks of gestation with

EFW less than 10th percentile of the corresponding gestational age on ultrasonography, irrespective of the maternal disease were included in the study. All pregnancies with fetuses with diagnosed chromosomal abnormalities or structural anomalies, multiple gestations and intrauterine foetal demise at the time of first visit were excluded from the study. After a detailed history and clinical examination; 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. 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. Data was statistically analyzed using chi-square test. The sensitivity, specificity and positive predictive value were determined for all doppler indices.

Results

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. AREFV was seen in 16% women and brain sparing effect was seen in 58% fetuses. 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. A higher perinatal mortality (13.1%) was seen in fetuses

with abnormal MCA doppler as compared to fetuses with normal MCA doppler (5.2%). Perinatal mortality rate in REDFV (33.3%) was more than the AEDFV (12.5%).

Table 1: Correlation of Umbilical Artery Doppler and Middle Cerebral Artery Doppler with Foetal Outcome

Adverse Foetal Outcome	Number of Patients	Abnormal Umbilical Artery Doppler	Abnormal Middle Cerebral Artery Doppler
Low Apgar(5 min score <7)	5	3(60%)	4(80%)
Intubated	23	20(86.9%)	17(73.9%)
Still Birth	3	3(100%)	3(100%)
Expired	7	6(85.7%)	5(71.4%)
Perinatal Mortality	10	9(90%)	8(80%)
NICU Stay >7 days	30	26(86.7%)	21(70%)

As shown in table 1, of all the cases of perinatal mortality, 90% of the cases had an abnormal umbilical artery doppler, while 80% cases had an abnormal middle cerebral artery doppler. The difference was however statistically not significant. Of all the 30 neonates with prolonged NICU stay (>7days), 86.7% had abnormal umbilical artery doppler as compared to 70% neonates with abnormal middle cerebral artery doppler. 80% of the neonates with low Apgar score had abnormal MCA flow while 60% of the neonates with low Apgar score had an abnormal umbilical artery flow. Middle cerebral artery PI was found to be the most specific indicator (85%) in the prediction of adverse perinatal outcome while umbilical artery PI had the highest sensitivity. Umbilical artery SD had the highest positive predictive value of 89% as shown in table 2.

Table 2: Evaluation of Doppler Parameters in prediction of adverse perinatal outcome.

Doppler Index	TP	TN	FP	FN	Sensitivity	Specificity	PPV
UA SD	49	16	6	29	62.8%	72.7%	89.1%
UA PI	60	17	4	19	75.9%	80.9%	88.5%
UA RI	56	9	11	24	70.0%	45.0%	83.6%
MCA SD	28	20	4	48	36.8%	83.3%	87.2%
MCA PI	28	17	6	49	36.7%	85.0%	82.3%
MCA RI	40	13	7	40	50.0%	65.0%	85.1%

Discussion

Doppler velocimetry identifies normal and abnormal blood flow velocity in umbilical and middle cerebral artery and is responsive to changes in placental resistance. It is a utility through which we can monitor the blood supply from the mother to the foetus. Perinatal morbidity and mortality are significantly greater in growth restricted fetuses with abnormal Doppler as compared to those with normal Doppler. In our study, foetal growth restriction was diagnosed in 81% cases showing abnormal umbilical artery velocimetry. It has been observed that umbilical artery Doppler waveform reflect the status of the foetoplacental circulation and increased placental resistance is strongly associated with FGR [1]. In our study AREDFV was seen in 16% fetuses as compared to 10% in other studies [2]. 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. 68% brain sparing effect in fetuses with growth restriction has been noted in other studies [3]. Adverse perinatal outcome was seen in 37% fetuses and maximum perinatal mortality rate (40%) was in 26-30 weeks of gestation that declined to 3% at term. Similar findings were made in other studies [4]. 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. Poor perinatal outcome was recorded by different researchers [5,6,7]. 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 as in other studies[8]. The sensitivity and specificity of umbilical artery S/D ratio for the prediction of adverse perinatal outcome was 62.8% and 72.7% respectively. It has been found that 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 [9]. The sensitivity and specificity of umbilical artery S/D ratio has been found to be 64% and 74% respectively in other study [10]. Umbilical artery RI values were found to have sensitivity of 70% and specificity of 45% in prediction of adverse perinatal outcome as compared to other study [11] where the sensitivity was found to be 83% and specificity of 45%. We observed that umbilical artery PI had the highest sensitivity and umbilical artery S/D ratio had the highest positive predictive value in the prediction of adverse perinatal outcome. The findings were similar to the study done by other researchers [10]. We observed that the pulsatility index of the foetal MCA had the highest specificity of 85%. These results are similar to the findings made by other researchers [12,13,14].

Conclusion

Doppler technology provides the first opportunity for repetitive noninvasive hemodynamic foetal monitoring. Doppler thus helps to optimize the timing of delivery. Since the goal of management in foetal growth restriction is to deliver the most mature foetus, we suggest that multiple doppler indices should be considered while optimizing the time of delivery because as per our study umbilical artery PI had the highest sensitivity (78.5%), middle cerebral artery; PI had the highest specificity (85.7%) and umbilical artery SD ratio had the highest positive predictive value (90.6%) in the prediction of adverse foetal outcome.

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