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**RESEARCH ARTICLE**

# ROLE OF ABNORMAL UMBILICAL ARTERY AND MIDDLE CEREBRAL ARTERY FLOW VELOCITY WAVEFORMS IN PREDICTING ADVERSE PERINATAL OUTCOME IN INTRAUTERINE GROWTH RESTRICTION (IUGR) FETUSES

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**ABSTRACT**

**Introduction:**Arterial Doppler abnormalities, at the level of umbilical artery (UA) & middle cerebral artery (MCA), confirm the presence of hypoxemia in the growth restricted fetus & present early warning signs.Intrauterine growth restriction (IUGR) is associated with an increased risk of perinatal mortality, morbidity.

**Purpose**: The purpose of this study is to study role of abnormal umbilical artery & middle cerebral artery flow velocity waveforms in predicting adverse perinatal outcome in intrauterine growth restriction (IUGR).

**Materials and Methods:** Study of 50 suspected IUGR fetuses between 30 to 41 weeks of gestation using high resolution ultrasound machines. The Doppler studies of UA and MCA's were performed and results were analysed.

**Results and Conclusion:**
In perinatal outcomes, the incidence of low Apgar score, NICU admissions and perinatal mortality was higher in abnormal umbilical artery S/D ratio group and abnormal middle cerebral artery S/D ratio.Hence abnormalities in the Umbilical artery flow velocity waveform should encourage closer fetal surveillance as fetal compromise seems to be very likely in this scenario.



## INTRODUCTION

Intrauterine growth restriction (IUGR) is associated with an increased risk of perinatal mortality, morbidity, and impaired neurodevelopment. The correct detection of the compromised IUGR fetus is important as it allows timely intervention and helps in proper management. Intrauterine growth restriction (IUGR) is most commonly defined on the basis of weight below 10th percentile for that gestational age (Campbell and Wilkin, 1975; Hadlock *et al*., 1982). Ultrasound is useful for evaluating and monitoring growth of the fetus. But it cannot tell us about the hemodynamic status of the fetus in utero.It is here that Doppler plays an important role, as it offers the potential to evaluate the feto-placental blood flow. Arterial Doppler abnormalities, at the level of umbilical artery (UA) & middle cerebral artery (MCA), confirm the presence of hypoxaemia in the growth restricted fetus & present early warning signs (Callan Peter W). In the present study we have evaluated the usefulness of abnormal Doppler of the umbilical artery (UA) and fetal middle cerebral artery (MCA) in predicting intrauterine growth restriction (IUGR).

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### AIMS AND OBJECTIVES

The purpose of this study is

1) To study correlation between abnormal umbilical artery & middle cerebral artery flow velocity waveforms with low Apgar score.
2) To study correlation between abnormal umbilical artery & middle cerebral artery flow velocity waveforms with NICU admissions.
3) To study correlation between abnormal umbilical artery & middle cerebral artery flow velocity waveforms with perinatal mortality.

## MATERIALS AND METHODS

The study was conducted in Department of Radiodiagnosis, with the main aim to show the usefulness abnormal Doppler findings of umbilical artery & fetal middle cerebral artery in predicting adverse perinatal outcome in intrauterine growth restriction (IUGR) fetuses. This study included 50 suspected IUGR pregnancies, who were referred to department of Radiodiagnosis. All pregnant women studied were between 30 to 41 weeks of gestation. The study was conducted using colour Doppler machine with 3 to 5 MHz transabdominal probe.

Detailed previous menstrual & present obstetrical history was asked for all 50 patients. Special stress was given on menstrual history, LMP, and accordingly gestational age was calculated. Patients were then subjected to routine obstetrical ultrasound examination in terms of Bi-parietal diameter (B.P.D.), Head–circumference (H.C.), Abdominal circumference (A.C.), Femur length (F.L.) along with Amniotic fluid index (A.F.I.),Placental location and expected fetal weight. All the 50 patients were then subjected to Doppler examination. Doppler examination was done with the patients in a semi recumbent position and fetus in a quite resting state. Flow velocity waveforms were recorded from the umbilical artery and fetal middle cerebral artery. The umbilical artery was identified and flow velocity waveforms were obtained from free floating loop of cord. Recording were obtained from the umbilical artery by placing the sample volume in the lumen of the artery at a site away from the placental & total cord insertion (McCallum *et al*., 1978). After recording a technically satisfactory Doppler waveforms, the S/D ratio was noted.

S/D (systolic/diastolic) ratio of the fetal middle cerebral artery was noted using a transverse section of the fetal head at the level of the thalami and the cavum septum pellucidum. By moving the probe caudally, on a plane parallel to the previous one, we identified the flow of the middle cerebral artery in the sylvian fissure. After recording a technically satisfactory Doppler waveform, S/D ratio was noted.

**Interpretation of Doppler flow velocitimetries**

**Umbilical artery:** Abnormal flow velocimetry considered when reduced diastolic flow with S/D (systolic/diastolic) ratio >=3 and Absent or reversed end diastolic flow Middle cerebral artery: Increased diastolic flow with S/D (systolic/diastolic) ratio <=3

**Measurement of perinatal outcome:** Outcome was measured in terms of Mode of delivery (vaginal/LSCS), Gestational age at delivery, Birth Weight, Apgar score at 5 min, NICU admission and Perinatal mortality.

## RESULTS

1) Maximum subject of study population were of age group 20-24 yrs. (44%).

**Table No 1. Showing age wise distribution of study population**

| Age (years) | No. of patients |
|---|---|
| <20 | 03(6%) |
| 20-24 | 22 (44%) |
| 25-29 | 17 (34%) |
| 30 and above | 08(16%) |

2) 31 (62%) patients were of 33 wks to 36.6 wks gestational age.

**Table No 2. Showing Gestational age wise distribution of study population**

| Gestational age (wks) | No. of patients |
|---|---|
| 30-32.6 | 15(30%) |
| 33-36.6 | 31 (62%) |
| 37-41 | 04 (8%) |

3) Most of studied patients were multigravida.

**Table No 3. Showing Gravida wise distribution of study population**

| Gravida | No. of patients (%) |
|---|---|
| Primigravida | 16(32%) |
| Multigravida | 34 (68%) |

36 (72%) of the 50 patients showed abnormal Doppler flow-velocity wave forms (FVWs). Of these all showed abnormal umbilical artery flow-velocity wave forms and only 15 (30%) showed abnormal middle cerebral artery flow velocity wave forms.

**Table No 4. Showing S/D (systolic / diastolic) ratio**

| | No. of patients |
|---|---|
| Abnormal UA S/D Ratio | 36 (72%) |
| Normal UA S/D Ratio | 14 (28%) |
| Abnormal MCA S/D Ratio | 15 (30%) |
| Normal MCA S/D Ratio | 35 (70%) |

Out of total 36 patient which showed abnormal UA FVWs, 24 (67%) undergone LSCS for fetal distress. Only 4 (28%) patients undergone LSCS for fetal distress, in other group showing normal UA FVWs. This difference was statistically significant. Low Apgar score was more frequently seen in infants of abnormal UA FVWs group (26/36=73%) Compared to infants of normal UA FVWs group(6/14=42%). Although the difference did not achieve statistical significance. Infants in abnormal UA FVWs group had statistically significant higher admission rate in NICU. (73% in abnormal UA FVWs group and 28% in normal UA FVWs group). There were 4 perinatal death in abnormal UA FVWs group and none in women with normal UA FVWs. Of these 3 had absent UA diastolic flow.

Frequently the fetuses in abnormal MCA FVWs were delivered by caesarean section. 86% (13/15) patients showing abnormal MCA FVWs undergone LSCS for fetal distress compared to 42% (15/35) patients showing normal MCA FVWs. The difference was statistically significant.The infants of abnormal MCA FVWs, showed statistically significant increased incidence of low Apgar score at 5 min (< 7) compared to infants of normal MCA FVWs group. Frequently the infants of abnormal MCA FVWs group had increased NICU admission rate (12/15) compared to normal MCA FVWs group (18/35). Although the difference did not achieve statistical significance. There were 4 perinatal deaths in abnormal MCA Doppler group (27%). No Perinatal death observed is normal MCA Doppler group.

## DISCUSSION

Accurate assessment of the fetal condition in intrauterine growth restricted (IUGR) pregnancies is important if perinatal mortality, morbidity and unwarranted intervention in pregnancy are to be reduced. The addition of color flow imaging is an exciting recent development which facilitates quicker and more accurate examination. Doppler velocimetry identifies normal and altered blood flow velocity in the umbilical artery, fetal middle cerebral artery, other peripheral arteries and fetal venous system.

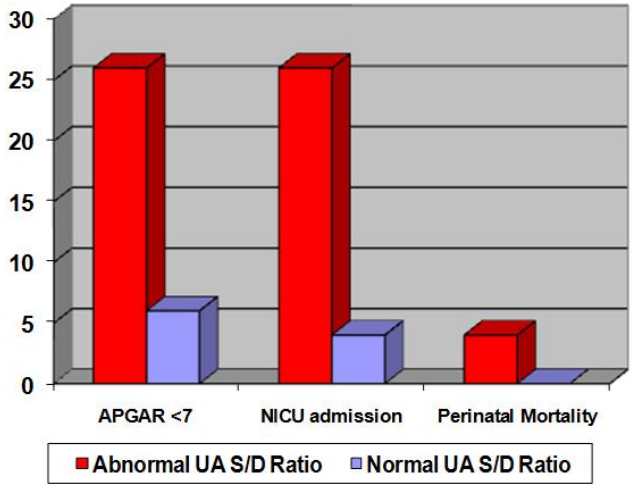
**Table 5. Showing Correlation of abnormal umbilical artery (UA) S/D ratio with Neonatal parameters**

| Neonatal Paratermers | Abnormal UA S/D ration=15 | Normal UA S/D ration=35 | p value |
|---|---|---|---|
| Apgar score (<7 at5 min) n=32 | 26 (73%) | 6(42%) | >0.05 |
| NICU admission n=30 | 26(73%) | 4(28%) | <0.05 * |
| Perinatal mortality n=4 | 4(11%) | 0 | >0.05 |

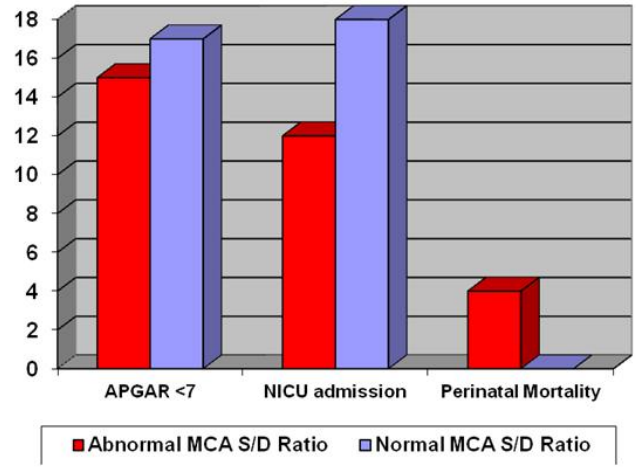
**Table 6. Showing Correlation of abnormal middle cerebral artery (MCA) S/D ratio with Neonatal parameters**

| Neonatal Paratermers | Abnormal MCA S/D ration=15 | Normal MCA S/D ration=35 | P value |
|---|---|---|---|
| Apgar score (<7 at5 min) n=32 | 15 (100%) | 17(48%) | <0.05 * |
| NICU admissions n=30 | 12(80%) | 18(51%) | >0.05 |
| Perinatal mortality n=4 | 4(27%) | 0 | <0.05 * |

* p< 0.05 = Statistically significant.




**Graph No 1. Showing Correlation of abnormal umbilical artery (UA) S/D ratio with Neonatal Parameters**




**Graph No 2. Showing Correlation of abnormal middle cerebral artery (MCA) S/D ratio with Neonatal parameters**

The umbilical artery (UA) is the most studied vessel in the fetal circulation. It has been shown by various workers that perinatal morbidity and mortality were significantly greater in IUGR fetus with abnormal umbilical artery Doppler studies than in those with normal studies.

Fong Ketherinc *et al*. (1999) studied fetal cerebral, renal and umbilical arteries. Two hundred ninety three small for gestational age fetuses were prospectively examined with Doppler ultrasound of the umbilical artery, middle cerebral artery and renal artery. He concluded that in suspected intrauterine growth restriction, abnormal umbilical artery PI is better predictor of adverse perinatal outcome than an abnormal MCA or renal artery PI. They stated that a normal MCA PI might help to identify fetuses without major adverse perinatal outcome, especially before 32 weeks gestational age.

Mc Cowen *et al*. (2000) studied whether umbilical artery Doppler Newborn morbidity and mortality were compared between small for gestational age babies with normal and abnormal umbilical Doppler velocimetries. Babies with abnormal velocimetries were likely to experience more morbidity than those with normal velocimetries. When birth weight and gestational age at delivery entered in logistic regression analysis model, abnormal Doppler was not independent predictor of prolonged NICU admissions.

Seyam *et al*. (2002) made retrospective analysis to compare pregnancy outcomes in growth-restricted fetuses retaining normal umbilical artery Doppler flow and the outcomes of pregnancies with end-diastolic velocity either diminished or severely reduced/absent. The diagnosis-to-delivery interval was significantly shorter, and the average birth weight and gestational age at delivery were significantly lower, for fetuses with abnormal Doppler velocimetry (showing diminished or severely reduced/absent end-diastolic velocity) than for those in the normal Doppler group. Fetuses with abnormal Doppler velocimetry also had a significantly higher incidence of oligohydramnios, low-birth weight (<10th percentile), and admission to the Neonatal Intensive Care Unit.

Soregaroli *et al*. (2002) studied pregnancies with a diagnosis of IUGR referred for Doppler velocimetry. Their study showed existence of a strict correlation between umbilical Doppler velocimetry and an increased incidence of perinatal complications in IUGR fetuses.

Arora *et al*. (2005) studied patients with growth-restricted fetuses by umbilical artery velocimetry between 28 to 41 weeks of pregnancy. It was observed that women with abnormal umbilical artery S/D ratio group had

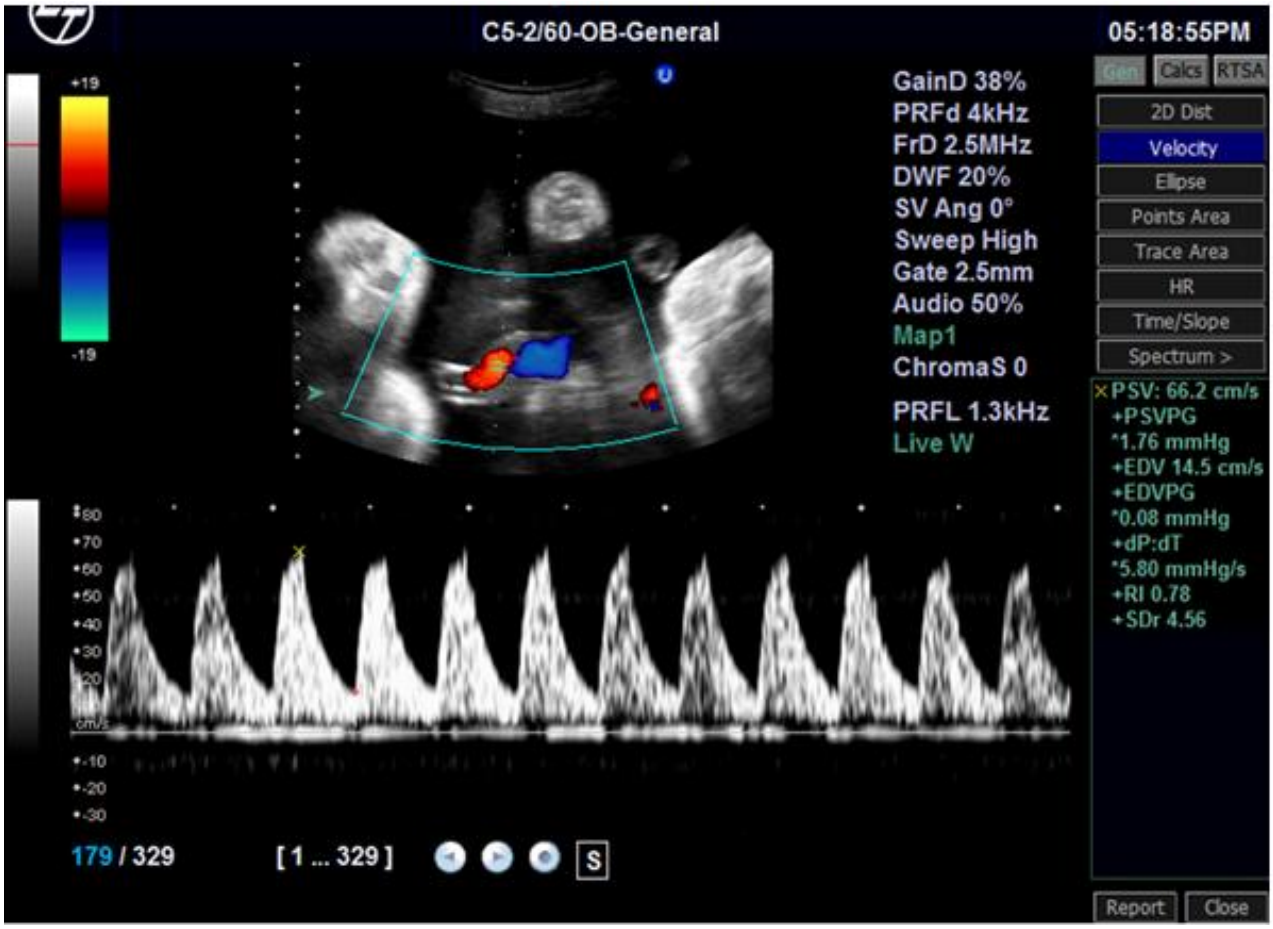



**Fig. 1. Showing reduced diastolic flow in Umbilical artery and raised S/D ratio**

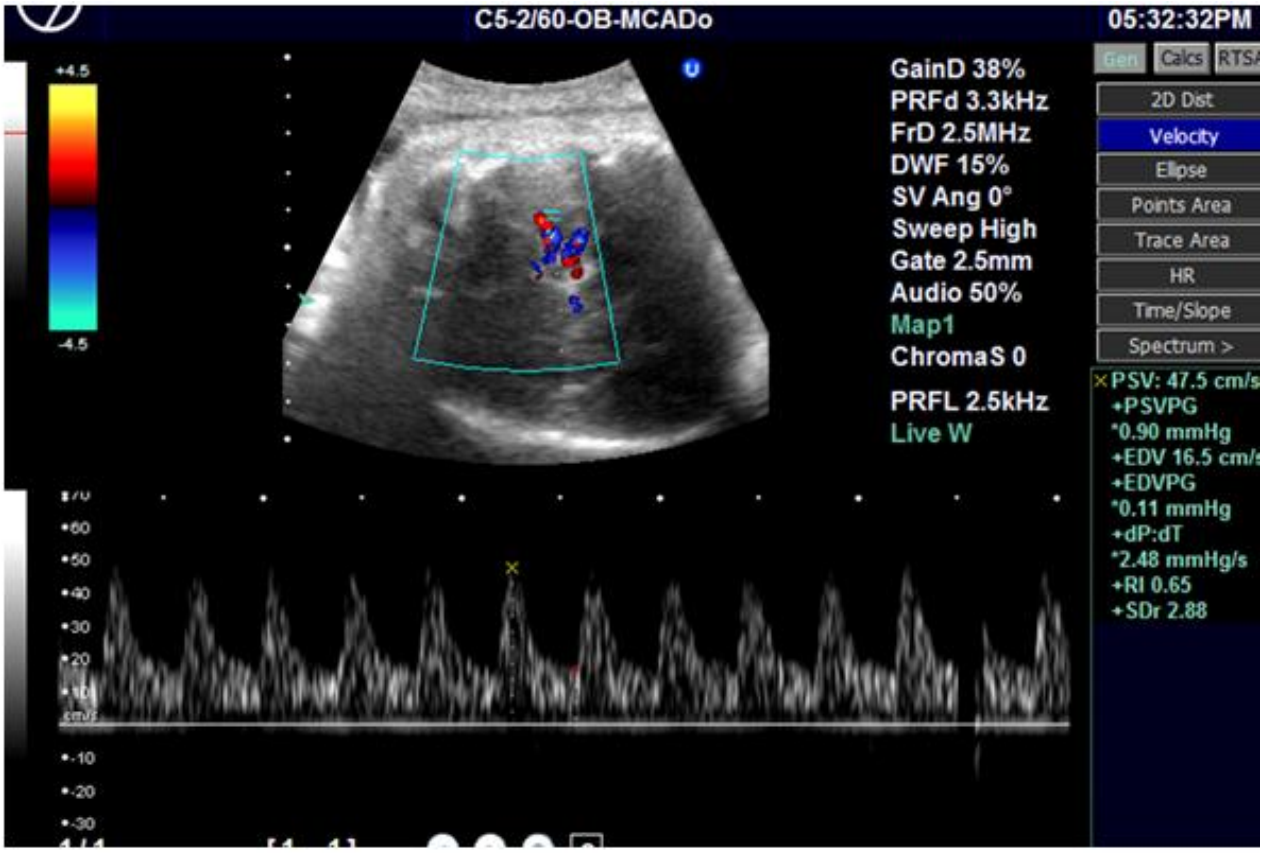



**Fig. 2. Showing raised diastolic flow in MCA and reduced S/D ratio**

higher incidence of oligohydramnios and abnormal NST as compared to fetuses with normal umbilical flow. The average birth weight, diagnosis to delivery interval, and gestational age at delivery were comparatively lower with higher incidence of admission to neonatal intensive care unit in fetuses with abnormal umbilical Doppler velocimetry. Szymanski *et al*., (2005) studied pregnancies using pulse and color Doppler. They concluded that Doppler investigations by measure of parameters of blood flow in umbilical cord artery (PI, RI, S/D) can be predictive to fetal threat and useful in estimation of newborn state. Lakhkar *et al*. (2006) examined Fifty-eight Singleton pregnancies beyond 30 weeks of gestation complicated by intrauterine growth restriction and severe pre-eclampsia or both prospectively with Doppler US of the UA, MCA, DAA, UV and IVC. They concluded that S/D ratio of MCA/UA is the most sensitive and specific index in predicting major perinatal adverse outcome (83% and 75%), while umbilical artery S/D ratio is the most sensitive index (66.6%) in predicting any adverse perinatal outcome i.e. including both major and minor outcome. MCA pulsatility index (P.I) is the most specific index (90.9%) for predicting in any adverse perinatal outcome. The sensitivity of the Doppler studies can be significantly increased by studying multiple vessels (91.6%).

In present study Apgar score of < 7 at 5 min was taken as indication of neonatal hypoxia. Incidence of low Apgar score was higher in the group with abnormal umbilical Doppler study compared to normal (73% Vs 42%). Although the difference was not statistically significant. (P>0.05). These results are consistent with those of Arora *et al.* (2005) and Berkowitz *et al.* (1988). NICU admissions in present study were more frequent in abnormal umbilical Doppler group than normal group (73% v/s 28%). This difference was statistically significant (P <0.05).

Thus it is seen that perinatal morbidity in terms of low Apgar score and admission to NICU was more commonly associated with reduced diastolic flow in umbilical artery (increased S/D ratio) which suggested feto-placental insufficiency. Difference between the infants with normal versus abnormal umbilical artery Doppler were manifold and clinically significant. Perinatal mortality was found more in abnormal umbilical artery Doppler group than normal, although, the difference did not achieve statistical significance likely due to small sample size. 3 perinatal deaths out of 4 had absent end diastolic flow in umbilical artery. So it can be seen that absent diastolic flow is more serious condition.

In present study significantly more women with abnormal umbilical artery Doppler study underwent LSCS for fetal distress (67%). In the present study, 28% of the growth retarded fetuses had normal flows with no significant perinatal problems implying that IUGR associated with normal umbi-lical flow velocity waveform is a relatively benign condition that requires no immediate intervention but necessitates adequate follow up. The type of umbilical artery flow velocity waveform abnormality, as seen in our study, could serve as an useful prognostic guide. Perinatal mortality was seen in those with absent end diastolic flow in umbilical artery, If timely obstetric intervention was not done, those with severe flow velocity abnormalities were also the fetuses with a significant risk of developing perinatal complications. Blood flow studies of middle cerebral artery are also of prognostic and diagnostic significance. Prenatal cerebral vasodilation is a sensitive marker for growth restriction and it seems to be a physiologic response to hypoxia (Chan *et al*., 1996). In response to hypoxia fetus uses a compensatory mechanism to redistribute the cardiac output and blood supply to brain to maintain constant oxygen delivery to this vital organ. This increase in flow may be reflected in elevated diastolic velocities in Doppler wave forms obtained from cerebral blood vessels. Incidence of low Apgar score was higher in the group with abnormal middle cerebral artery Doppler than normal (100% Vs 48%).This difference was statistically significant (p<0.05). NICU admissions in present study were more frequent in abnormal middle cerebral artery Doppler group than normal group (80% v/s 51%). Although the difference did not achieve statistical significance (p>0.05).

**Conclusion**

In perinatal outcomes, the incidence of low Apgar score, NICU admissions and perinatal mortality was higher in abnormal umbilical artery S/D ratio group and abnormal middle cerebral artery S/D ratio. Hence abnormalities in the Umbilical artery flow velocity waveform should encourage closer fetal surveillance, as fetal compromise seems to be very likely in this scenario. Intrauterine growth restriction associated with normal umbilical flow velocity waveform is largely a benign condition, usually associated with good perinatal outcome.

## REFERENCES


Arora Devendra, Desai Sadhana, K., ShethPrem, N., Kaniaprema, Significance of umbilical artery velocimetry in perinatal outcome of growth restricted fetuses. *J. ObstetGynecol India,* 2005. 55 (2): 138-43.

Callan Peter, W., Ultrasonography in Obstetrics and Gynecology.(5th edition).

Campbell, S., Wilkin, D. *et al* :Ultrasonic measurement of fetal abdominal circumference in the estimation of fetal weight.Br. Jour. Obst. Gynaec ; 1975, vol 82(9) : 689-697.

Chan F. Y., Pun T.C, Lam P *et al*.: Fetal cerebral Doppler as a predictor of perinatal outcome and subsequent neurological handicap.ObstetGynecol 1996. 87: 981-988

Fong Ketherinc, W., Ohlesson A. and Grisaru, S. *et al*.: Prediction of fetal outcome suspected to have intrauterine growth restriction: Doppler US study of fetal cerebral, renal and umbilical arteries. *Radiology.*, 1999. 213: 681-89.

Hadlock, F. P., Dete,r R.L., Harrist, R. B. *et al*.: Fetal abdominal circumference as predictor of menstrual age. *Am. J. of Radiology.*, 1982. 139: 367-70.

Lakhkar, B.N., Rajagopal, K.V., Gourisankar, P.T. *et al*.: Doppler prediction of adverse perinatal outcome in PIH and IUGR. *Indian Journal of Radiology and Imaging*, 2006.Volume:16 109-116.

Mc Cowan, L.M., Harding, I.E. *et al*. Umbilical artery Doppler studies in small for gestational age babies reflect disease severity. *Br. J. Obstet Gynecol,* 2000. 107: 916-25.

McCallum, Vv.D., Williams, C.S., Napel, S. *et al*. Fetal blood velocity waveforms. Am Jour ObstetGynecol; 1978. 132; 425.

Seyam, Y.S., AI-Mahmeid, M.S., AI-Tamimi, H.K. *et al*. Umbilical artery Doppler flow velocimetry in intrauterine growth restriction and its relation to perinatal outcome. *Int J. Gynaecol Obstet*.2002. 77(2):131-7.

Soregaroli, M., Bonera, R., Danti, L., Dinolfo, D., Taddei, F. Volcamonica A,Frusca T.*et al*.: *J Matern Fetal Neonatal Med*., 2002. 11(3):199-203.

Szymanski, M., Szymanski, W., Semenczuk, M. and Skublicki, S. *et al*. Relationship between doppler velocimetry at middle cerebral artery and umbilical artery and status of newborn after delivery.Ginepol.2005. 76(9):713-9

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