

Original Research Article

Role of obstetric Doppler in prediction of adverse perinatal outcome in intrauterine growth retardation

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ABSTRACT

Background: Objective of current study was to determine and compare accuracy of various Doppler parameters for perinatal outcome. Umbilical artery (UA), middle cerebral artery (MCA), and ductus venosus (DV) for predicting adverse perinatal outcome in patients of intrauterine growth retardation.

Methods: 200 singleton pregnancies between 34 to 36 weeks of gestation complicated by intrauterine growth restriction were prospectively examined with Doppler ultrasound of the umbilical artery, middle cerebral artery and ductus venosus. Patients kept under surveillance till confinement. According to increasing severity of Doppler indices categorized the cases into six grades from grade 0 to grade 5.

Results: Out of 200 cases, 169 were live born and 24 were neonatal death. There were 5 cases of intrauterine death of foetuses and 2 were still born. Out of the live born 32 had increased perinatal morbidity like poor APGAR score, development of necrotizing enterocolitis, hypoxic ischemic encephalopathy, meconium aspiration syndrome, hyperbilirubinemia, and prolonged admission in neonatal care unit for reasons like sepsis / birth asphyxia.

Conclusions: Absent end diastolic flow (EDF) / reversal in umbilical artery had high positive predictive value in predicting adverse foetal outcome. Ductus venosus changes seem to be an ominous sign of a severely compromised foetus with poor perinatal outcome. Doppler investigation of the MCA, UA and DV plays an important role in monitoring the compromised foetuses and helps to determine the optimal time of delivery.

Keywords: Adverse perinatal outcome, Doppler grading, Pregnancy IUGR

INTRODUCTION

Fetal growth and development rely on normal uteroplacental and fetoplacental circulation to supply oxygen and nutrients from the maternal circulation.¹ Doppler sonography offers a unique tool for the noninvasive evaluation of physiological haemodynamic fetoplacental blood flow information.²⁻⁷ There are specific abnormalities in Doppler parameters in asymmetric intrauterine growth retardation. Doppler flow velocimetry, particularly of the middle cerebral artery and

umbilical arteries is an earlier predictor of hypoxemia, when compared to biophysical profile (BPP)/ non stress test (NST).³⁻¹² Ductusvenosus flow study is an accurate predictor for academia.¹⁵ Nearly 70% of patients with IUGR may be classified as having an asymmetrical growth pattern. These cases may be at greater risk for perinatal hypoxia and neonatal hypoglycemia. However, their long-term prognosis with appropriate management is good. The aim of the study was to detect any abnormalities in fetoplacental unit and fetal circulation in IUGR fetus, to correlate the occurrence of adverse

perinatal outcome with degree of abnormality in Doppler indices.⁸ And to identify the hypoxemic fetus and timing delivery so as to precede acidemia.

METHODS

200 singleton pregnancies with abdominal circumference less than 5th percentile and estimated fetal weight less than 10th percentile for that gestational age were selected for study. In cases with risk factors, serial sonography was done to identify fetal growth restriction. Initial dating scan followed by follow up scan was done at around 34 to 36 weeks.

The study was conducted for a period of 3 years 8 months from January 2013 to August 2016. The patients were referred from Department of Obstetrics and Gynecology, Government Kilpauk Medical College and Hospital, Chennai to Department of Radiodiagnosis, Kilpauk Medical College and Hospital, Chennai, India for radiological evaluation.

Patients with irregular cycles, unknown dates, those with restricted growth from the 1st trimester onwards by ultrasound, multiple gestation and congenital anomalies were excluded from the study groups as were those with history of viral exanthematous fever, intake of drugs like antiepileptics, antipsychotics and anticoagulants. All these cases were kept under surveillance till confinement. A careful search for cases of IUGR like smoking, alcoholism, and hypertension were made.² Anemia, if present, was corrected and PIH, if detected, was managed appropriately.⁹ The cases were monitored by fetal kick count, cardiotocography, serial measurements of fetometry, AFI and Doppler studies. Doppler studies were done on umbilical artery, middle cerebral artery, and ductus venosus with a real time colour Doppler ultrasound machine. Umbilical cord was located in the pool of amniotic fluid and values were taken at the mid cord or placental insertion. Middle cerebral artery was localized in transverse section of fetal skull, at the level of thalamus in the sylvian fissure. The ductus venosus was sampled in the abdominal circumference section, where it joins the umbilical vein to IVC.

Doppler was considered as abnormal when there was absent or reverse diastolic flow in umbilical artery or PI values were above the 95th percentile for that gestational age.¹² Cerebroplacental ratio less than one was also taken as abnormal.¹⁴

Those cases where fetal assessment was normal were monitored fortnightly till delivery. Those with absent and reverse flow were taken up for termination of pregnancy. In those cases with low diastolic flow in umbilical artery, where fetal maturity was adequate for survival, the pregnancy was terminated.

In cases where fetal maturity was not reached monitoring was done with NST and BPP daily or twice weekly

depending upon the severity of abnormality and associated complications.¹⁶ Pregnancy was terminated when there were abnormal readings from CTG or a low score on the bio-physical profile. In those cases where differential shunting of blood flow to fetal brain was present, termination was done even before NST or BPP were found to be abnormal.

Mode of delivery was planned depending on the weight and gestational age and amount of liquor present. Outcome of pregnancy was recorded in detail including intrauterine demise, neonatal death, birth weight, Apgar score, development of neonatal complications and presence of congenital anomalies, placental weight and pathology. These details were entered in a proforma and the data was statistically analyzed and evaluated.

RESULTS

The study was conducted on 200 third trimester women with ultrasonographically confirmed IUGR cases and the following observations were made.

Among the 200 cases that were confirmed to be IUGR by B-Mode ultrasound, 179 cases showed abnormalities in the Doppler wave forms. 21 cases revealed normal Doppler wave forms.

Table 1: Distribution of cases based on normal and abnormal Doppler parameters.

Total number of IUGR cases	200	Percentage
Normal Doppler	21	10.5
Abnormal Doppler	179	89.5

Grading of Doppler abnormalities

According to the increasing severity of altered Doppler indices in the 200 IUGR cases, we categorized the cases into six grades from grade 0 (normal) to grade 5.

Table 2: Grading of Doppler abnormalities.

Grades	No.	%
0 Normal Doppler	21	10.5
1 Increased UA PI alone	38	19
2 CPR reversal	93	46.5
3 Absent/ reversed EDF in UA with decreased MCA PI	19	9.5
4 Absent/ reversed EDF in UA with increased MCA PI	23	11.5
5 Ductusvenosus alteration	6	3

Out of the 179 cases, 42 cases showed absent/reversed diastolic flow in umbilical artery, out of which 19 had compensated MCA flow while 23 had gone in for decompensated MCA flow (hypoxic and decompensated fetus), 38 cases showed only low diastolic flow in umbilical artery, 93 cases showed low diastolic flow in umbilical artery and increased diastolic flow in middle

cerebral artery (hypoxic and compensated fetus), 6 cases showed increased PI in the ductus (acidotic fetus).

postdates, bronchial asthma, anemia, hypothyroidism, or chronic hepatitis, 102 patients (54 %) had no risk factors.

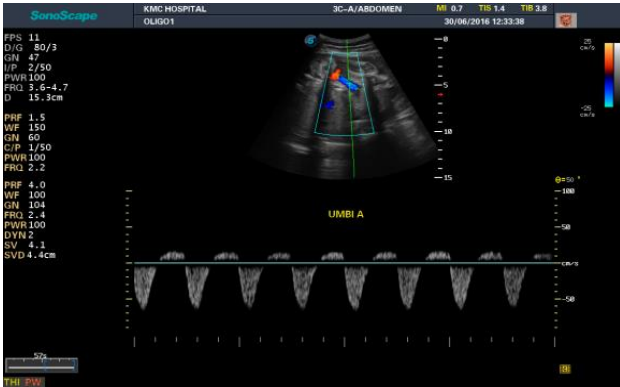


Figure 1: Reversal of flow in umbilical artery.

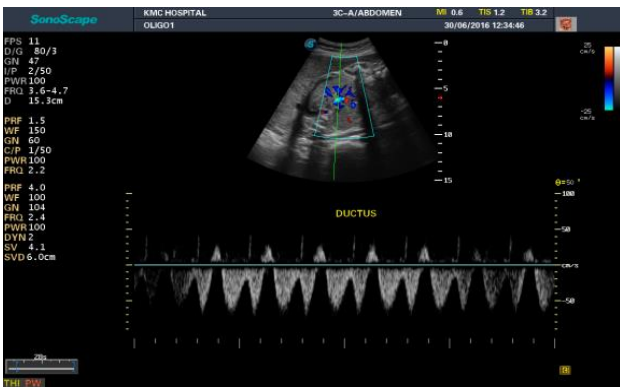


Figure 2: Doppler showing reversal of flow in ductus venosus.

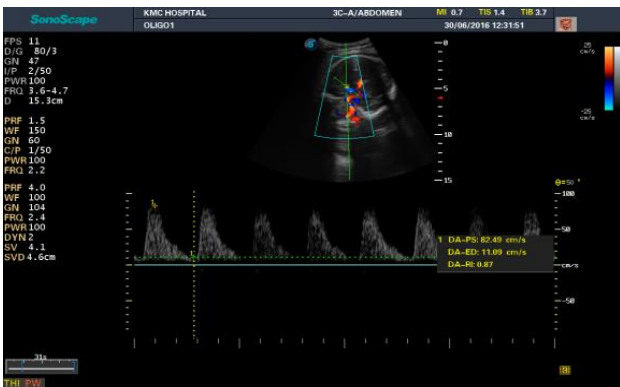


Figure 3: High resistance flow pattern in middle cerebral artery.

Risk factors

This table shows the distribution of risk factors in the study group. 67 (33.5%) of them had pregnancy induced hypertension as the risk factor.⁹ In 5 cases (2.5%) gestational diabetes was the identified risk factor. 6 cases (3%) had heart disease complicating pregnancy.¹¹ 48 cases (24%) had one of the other risk factors like breech,



Figure 4: Normal Doppler waveform of middle cerebral artery.

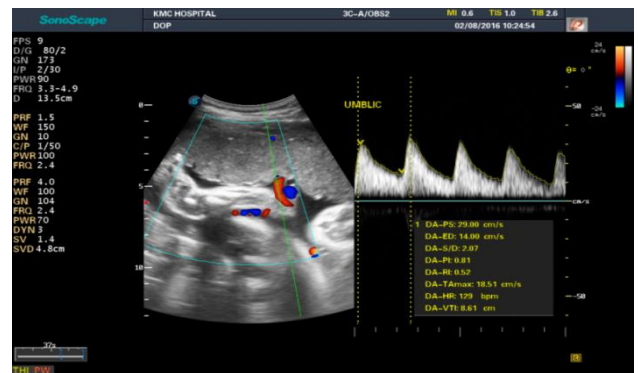


Figure 5: Normal Doppler waveform of umbilical artery.

Table 3: Distribution of risk factors.

Risk factors	No. of patients	Percentage
Preeclampsia	67	33.5
Gestational diabetes	5	2.5
Heart disease	6	3
Epilepsy	5	2.5
Others	48	24
None	102	51

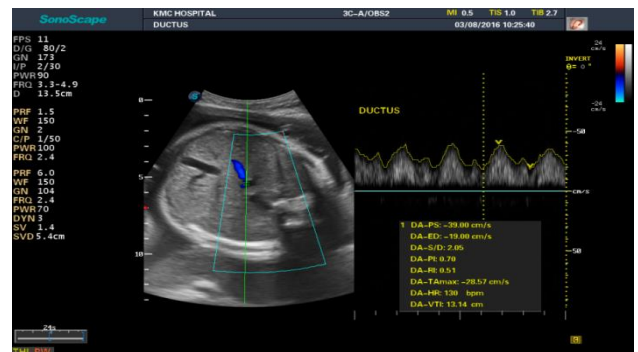


Figure 6: Normal Doppler waveform of ductus venosus.

Outcome

Out of 200 cases, 169 were live born and 24 were neonatal death. There were 5 cases of intrauterine death of fetuses and 2 were still born. Out of the live born 32 had increased perinatal morbidity like poor APGAR

score, development of necrotizing enterocolitis, hypoxic ischemic encephalopathy, meconium aspiration syndrome, hyperbilirubinemia and prolonged admission in neonatal care unit for reasons like sepsis/birth asphyxia. Outcome data were correlated with doppler finding in the table given below.

Table 4: Distribution of perinatal outcome.

Perinatal outcome	Number of patients grade						Total
	0	1	2	3	4	5	
IUD	0	0	0	0	2 (9%)	3 (50%)	5 (3%)
Stillborn	0	0	0	0	2 (9%)	0	2 (1%)
NND	0	1 (3%)	0	3 (16%)	17 (74%)	3 (50%)	24 (12%)
Increased perinatal morbidity	0	0	15 (16%)	15 (79%)	2 (9%)	0	32 (16%)
No significant adverse outcome	21 (100%)	37 (97%)	78 (84%)	1 (5%)	0	0	137 (68%)

DISCUSSION

Fetometry by B-mode ultrasound is a reliable method of investigation to distinguish between IUGR and normal fetuses.¹ This is probably because in IUGR fetuses, the earliest feature is reduced growth that is readily assessed by a measurement of abdominal circumference that will show consistently lower values than those expected for the particular gestational age.¹⁻³ However the B-Mode ultrasound did not reliably detected the adverse perinatal outcome.⁴⁻⁶ Predictive capability of doppler of adverse outcome in USG confirmed IUGR cases, was analyzed.

Table 5: Predictive value of Doppler study in perinatal outcome.

	Perinatal outcome		
	Adverse	Good	Total
Doppler abnormal	63	116	179
Doppler normal	0	21	21

- Sensitivity of Doppler predicting adverse perinatal outcome: 100%
- Specificity of Doppler in predicting adverse perinatal outcome: 15.3%
- Predictive value of an abnormal Doppler study: 35.19%
- Predictive value of a normal Doppler study: 100%
- But on grading the abnormalities from 0 to 5 based on increasing severity of altered Doppler indices, we got the following statistics.
- Grade 0: Had a negative predictive value of 100%
- Grade 1: Also had a negative predictive value of 100% and that one neonatal death in this grade was due to an unrelated cause namely hand prolapse.
- Grade 2: Negative predictive value of 84%

- Grade 3: 95% positive predictive value for adverse outcome
- Grade 4: 100% positive predictive value for adverse outcome
- Grade 5: 100% positive predictive value for adverse outcome, 100% mortality.

We also found that the patients who had mild abnormalities on Doppler (Grade 0, 1, 2) did not have any mortality related to severity of IUGR, nor did they have any significant morbidity. There was a significant increase in occurrence of adverse perinatal outcome with increasing severity of Doppler abnormalities (P value 0.001). 97.91 % of the patients with marked Doppler abnormalities (Grade 3 or more) had adverse perinatal outcome, compared to 10% of those with mild Doppler abnormalities (grade 0, 1, 2). This again was significant (P value 0.001). There was a significant increase in perinatal mortality with increasing grades of Doppler (including intrauterine demise, neonatal deaths and stillbirths), with a P-value of 0.001. All the cases with intrauterine demise and still births as also 23 out of 24 neonatal deaths all had grade 3 or more Doppler abnormalities. There was also a significant rise in perinatal morbidity with increasing grades of Doppler (P value 0.001). These observations show us that Doppler can accurately prognosticate IUGR cases and can help in optimizing the time of intervention in a hypoxic fetus.¹⁰⁻¹² Among the 200 USG confirmed IUGR cases, 179 cases revealed Doppler abnormalities (89.5%). 21 cases revealed normal Doppler findings. No adverse perinatal outcome was observed in these cases. It means that if the Doppler is normal, in an IUGR case, the possibility of an abnormal perinatal outcome is very rare.¹²⁻¹⁴ The normal Doppler result has more importance than an abnormal Doppler result. The explanation for these observations is probably that fetal growth retardation can be either due to

low intrinsic growth potential or due to defective placental nutritive and circulatory functions, of which Doppler can investigate only the circulatory components.

Gestational age

All the IUGR cases in our study were 34 weeks or more by gestational age. This is explained by the following reasons.

Patients who were diagnosed to have IUGR at peripheral hospitals were referred late for delivery and NICU (neonatal intensive care unit) care, by which time they had an advanced gestational age

Patients with preterm IUGR were not included in the study. This was done to eliminate the added risk of prematurity on the perinatal outcome of these IUGR babies.

CONCLUSION

Diagnosis of IUGR was done by clinical assessment and serial sonography. With the use of Doppler of umbilical and middle cerebral arteries it is possible to predict that an IUGR fetus is not hypoxic. With ductus venosus evaluation detection of fetal academia is possible. Predictive value of normal Doppler is 100%. There is a strict correlation between abnormal umbilical Doppler velocimetry and an increased incidence of perinatal complications in an IUGR fetus. In cases with absent and reversed diastolic flow in umbilical artery the perinatal morbidity is nearly 100%.

The perinatal mortality in cases of ductus venosus alteration is 100%. In cases with differential shunting of blood flow to fetal brain, frequent monitoring and early delivery should be done. Thus, Doppler can be used as a prognostic tool in IUGR fetus as it gives an accurate prediction of potentially compromised IUGR fetus.

Absent end diastolic flow (EDF)/reversal in umbilical artery had high positive predictive value in predicting adverse fetal outcome. Ductus venosus changes seem to be an ominous sign of a severely compromised fetus with poor perinatal outcome. Doppler investigation of the MCA, UA and DV plays an important role in monitoring the compromised fetuses and helps to determine the optimal time of delivery.

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