

ORIGINALARTICLE

Role of Colour Doppler Studies in Antenatal Surveillance in Pregnancies with Fetal Growth Restriction in a Rural Tertiary Health Centre: A Prospective StudyVaishaliKorde Nayak¹, Rohan Krishnakumar¹, Jaya Barla¹, Santosh Sabnis¹¹Department of Obstetrics &Gynecology,¹MIMER Medical College and Dr. BSTR Hospital, TalegaonDabhade, Pune -410507, Maharashtra, India.**Abstract:**

Background: Fetal growth restriction (FGR) is often diagnosed late in developing countries like India, especially in rural areas. It leads to perinatal morbidity and mortality and is an additional burden to the already limited resources. Doppler ultrasonography can help to predict a timely delivery and prevent additional morbidity due to prematurity. However, correct interpretation of Doppler is essential for the management of the foetus. This study was conducted to evaluate the role of Doppler in the management of fetal growth restriction and to study the changes in uteroplacental, fetoplacental, fetal circulation and changes in ductus venous and their effect on the outcome of the baby. **Material and Methods:** A prospective study was done on 200 patients of clinically suspected FGR. The cases were followed till delivery; the Doppler and grey scale findings were analysed and correlated with the perinatal outcome. **Results:** In our study 118 fetuses with FGR had at least one adverse perinatal outcome. There were 114 neonatal intensive care unit (NICU) admission and average birth weight was 1.94kg. The umbilical artery had maximum sensitivity of 81.48% and the Cerebro-placental ratio had the highest specificity 44.07%. **Conclusions:** The Doppler study of various vessels help in antepartum surveillance of fetal growth restriction and also helps in determining the optimum timing of delivery and the perinatal outcome.

Keywords: antenatal colour Doppler, developing countries, NICU, perinatal morbidity

Introduction:

With gradual reduction in maternal mortality rates in both developing and developed countries, attention has shifted to perinatal outcome. The perinatal mortality and morbidity rates are indicators of obstetric and paediatric services available in a country. A progressive increase in both perinatal mortality and morbidity is observed as birth weight falls. Fetal Growth Restriction (FGR) is a term used to describe the condition if its

weight is less than tenth percentile for its gestational age. FGR is associated with increased mortality and morbidity which possibly may extend into adult life as compared to fetuses and new-borns presenting with characteristics of normal growth. The recent UNICEF data suggests a 25-30% incidence of low birth weight in India.^[1] Out of this, approximately 10-15% comprises of growth restricted neonates. Most common association is found with hypertensive disorders of pregnancy, placental insufficiency and in women with previous history of FGR.^[2] Doppler blood flow velocities are the gold standard to diagnose fetal growth restriction in the antenatal women at an early stage, so that the affected fetus can be delivered without any significant compromise.^[2,3] The Doppler ultrasound gives us information on vascular resistance and indirectly, on blood flow. Doppler ultrasonography helps to screen high risk pregnancies for detection of FGR and to time the intervention, depending on the extent of fetal involvement in FGR. The aim of this study was to evaluate the role of various Doppler parameters in the management of clinically suspected cases of fetal growth restriction and also to find potential Doppler parameters as predictors of unfavorable perinatal outcome.

Material and Methods:

This prospective study was conducted over a period of 5 years between October 2012 to October 2017 at a rural tertiary health care in Western Maharashtra. Institutional Ethics Committee approval was taken for the study. The sample size was calculated using the Andrew Fisher formula $N = (Z^2 \times p(1-p))/d^2$ using 85% confidence level and a standard deviation 0.5 and confidence interval of 5%. It came out to be 207. However, 7 patients were lost to follow up. The study population comprised of 200 singleton pregnancies that were diagnosed as having a fetus with a clinically suspected FGR and based on grey scale ultrasound findings. All the women were included in the study after their due consent. All the patients were then followed up with ultrasound measurements as well as fetal Doppler

velocimetry parameters of various vessels till delivery. Gestational age was determined based on the last menstrual period (LMP) and fetal biometry in the first trimester, so that the dating was accurate. Patients who were clinically diagnosed as a case of FGR, based on the findings such as insufficient weight gain, static or no increase in the abdominal circumference, and decrease or no increase in the symphysio-fundal height and fetal biometry on ultrasonography, were included in our study. Women with multiple pregnancies and fetuses with congenital anomalies were excluded. All examinations were performed on the Toshiba Medical System NEMIO – XG (SSA-58A) Sr. No. – I7B1185568. PH/C.SP/RHVM/12/2012 with 3.5 MHz transducer. The Pulsatility Index, Resistance Index, Systolic/Diastolic ratio in umbilical artery and Cerebro-placental ratio (CPR) were calculated. Doppler velocimetry evaluation was performed following a detailed clinical history and examination, along with fetal biometry. If clinically indicated, follow up Doppler velocimetry studies were performed, to determine a favorable or worsening trend in the Doppler waveform indices. Only the results of the latest Doppler velocimetry were considered for analysis of perinatal outcome. Doppler velocimetry results were analysed for predictors of perinatal outcome. The management algorithm was guided by the severity of the maternal and fetal condition and by gestational age. It includes arterial and venous Doppler studies and determination of biophysical profile. Therapeutic interventions were dictated by the maternal and fetal condition as well as gestational age, while also respecting the wishes of the parents. Delivery was conducted when the results of fetal testing were grossly abnormal, when fetal lung maturity was documented (34 weeks), or when maternal disease posed a serious risk to the mother. Before 34 weeks, steroids were given to ameliorate neonatal respiratory disease and reduce the risk of intraventricular hemorrhage. We considered Apgar score at birth and at 5 minutes, birth weight, emergency caesarean section for fetal distress, admission to neonatal intensive care unit (NICU) for complications of FGR like low birth weight, respiratory distress, bronchopulmonary dysplasia, intraventricular hemorrhage, necrotizing enterocolitis, circulatory failure and perinatal death, as perinatal outcomes. Adverse outcome was defined as perinatal death, 5-minute APGAR score of less than 7, or admission to NICU for above mentioned complications.

Results:

The mean birth weight in our study was 1.94 kg and the mean gestational age at delivery being 37 weeks and 5

days. Out of the total 200 new-borns, 41 % had an uneventful outcome and 59 % had an adverse perinatal outcome. One hundred fourteen neonates required NICU admission for various indications like low birth weight, respiratory distress, bronchopulmonary dysplasia, intraventricular hemorrhage, necrotizing enterocolitis, circulatory failure; out of which 16 neonatal deaths occurred. There were 4 intrauterine demises which occurred in our study. Early onset FGR (less than 32 weeks) had worse prognosis as compared to late onset FGR. Six women were between 28 to 32 weeks at delivery and had the worst adverse outcome which included 4 neonatal deaths (NND) and 2 intrauterine demises (IUD). Gestational age and perinatal outcome are summarized in Table 1. In the 98 women with raised uterine artery RI, 66 (67.3%) neonates had an adverse perinatal outcome, compared to 52 (50.9%) neonates with adverse outcome in the normal uterine artery group. Thirty-two (32.6%) neonates had an uneventful outcome in the raised RI group. In the table 3, it is seen that a total of 78 women showed brain sparing effect (BSE) and 122 showed a normal flow in the middle cerebral artery (MCA). Fifty-six (71.79%) neonates had an adverse perinatal outcome among the 78 women with BSE and 22 (28.2%) had an uneventful outcome. Out of the 122 women with normal MCA flows, 62 (50.81%) had an adverse perinatal outcome and 60 (49.18%) had an uneventful outcome. Sixty-eight women out of 200 had a CPR (MCA/Umbilical A PI ratio) of less than 1.08 in the current study. Among these 68 women, 52 (76.47%) neonates had an adverse perinatal outcome and 16 (23.52%) had an uneventful outcome. In the 132 women with a normal CPR (MCA/Umbilical A PI ratio), 66 (50%) had an adverse outcome. The table-5 shows the number of women with raised umbilical artery PI.

Table 1: Perinatal Outcome

Sr. No.	Variable	No	%
1.	Mean Birth weight	1.94 kg	
2.	Mean Gestational Age	37.05 weeks	
3.	Uneventful Outcome	82	41%
4.	NICU Admission and recovered	98	57%
5.	Neonatal Death in NICU	16	08%
6.	Intrauterine Death	04	02%

In our study 132 women had a raised umbilical PI out of which 88 (66.66%) had an adverse perinatal outcome, among which 72 were admitted to the NICU,

Table 1.1 Distribution of gestational age and perinatal outcome

Gestation al age	NND	IUD	NICU admission and recovery	Une vent ful	No of wom en(n)
28-32 weeks	4	2	0	0	6
32-34 weeks	4	0	0	6	10
Above 34 weeks	8	2	98	76	184
Total	16	4	98	82	200

Table 2: Uterine artery RI with perinatal outcome

Uterine A RI	No. of Pts.	Adverse Outcome	Uneventful Outcome
Normal	102	52 (50.9%)	50 (49%)
Raised	98	66 (67.3%)	32 (32.6%)

Table 3: Middle Cerebral Artery with perinatal outcome

Sr. No	MCA	Number of patients n=200	Adverse outcome	Uneventful
1.	BSE Present	78	56 (71.79%)	22 (28.2%)
2.	BSE Absent	122	62 (50.81%)	60 (49.18%)

BSE- Brain Sparing Effect

Table 4: Cerebra-placental ratio in relation to perinatal outcome

Sr. No.	CP Ratio	Number of patients n=200	Adverse Outcome	Uneventful
1.	< 1.08	68	52 (76.47%)	16 (23.52)%
2.	Normal	132	66 (50%)	66 (50%)

12 had a neonatal death (NND) and 4 were intrauterine deaths (IUD), whereas 44 (33.3%) had an uneventful outcome. When compared to the 68 women who had a normal umbilical artery PI, 30 (44.11%) had an adverse perinatal outcome, i.e., 26 NICU admissions, 4 NND's and 38 (55.8%) fetuses had an uneventful outcome.

Table 5: Umbilical Artery Raised PI with perinatal outcome

Sr. No.	Umb ilical PI	No. (n=200)	NI C U	N N D	I U D	ADV ERSE	UNE V ENTF UL
1.	Nor mal	68	26	04	0	30 (44.11%)	38 (55.8%)
2.	Rais ed	132	72	12	04	88 (66.66%)	44 (33.3%)

Table 6: Table showing comparison of Doppler indices of various vessels with perinatal outcome

Sr. No	Vesse l	T P	T N	F P	F N	Sensit ivity %	Spec ificit y%	PP V %	NPV %
1	Uteri ne A. RI	66	50	32	52	55.93	60.97	67.3	49.01
2	Umbi lical. A. PI	88	38	44	30	81.48	46.34	75.00	55.88
3	MCA PI	56	62	22	60	47.46	73.17	71.71	49.18
4	CPR	52	66	16	66	44.07	80.49	76.47	50.00

TP-True positive, TN- True negative, FP-False positive, FN-False negative

Table 7: Involvement of Ducts Venuses in relation to perinatal outcome

Sr . N o	Ducts Venous	No. Cases n=200	NI CU	NND (in NICU)	IUD	UN	Non Reassu ring NST
1.	Involv ed	14	12	04	02	00	8
2.	Norma l	186	102	12	02	82	30

Discussion:

In our study, 118 fetuses had at least one adverse perinatal outcome. Remaining 82 fetuses had a favorable outcome. There were 4 Intra uterine deaths and 16 had neonatal deaths. Out of the 4 IUDs, two had reversal of diastolic flow at 30 weeks and the other 2 IUD had only a raised PI in the umbilical artery and non-reactive NST. The mortality in cases of reversed and absent end

diastolic flow was 50% and 33.3% respectively, indicating grave prognosis. Of the 196 live births, 114 neonates were admitted to NICU, 16 neonatal deaths were recorded. Twelve among the 16 neonatal deaths had various Doppler changes including absent end diastolic flow, CPR less than the 5th percentile and reversal of flow in ductus venous. Four out of the 16 NND's had normal Doppler velocimetry findings and yet had an adverse perinatal outcome. Two among the 4 NNDs with normal Doppler findings had meconium-stained amniotic fluid which indicates fetal distress. As seen in cases of late onset FGR in which a substantial proportion of cases with normal umbilical artery Doppler waveforms may still have true growth restriction and are at risk of adverse perinatal outcome. [2,3] CPR is now found to be more sensitive marker of late onset fetal growth restriction. As seen from the above comparative tables the umbilical artery PI has the maximum sensitivity and the CP ratio has the maximum specificity of 80.49% in our study. This specificity closely matches that seen in studies by B.N. Lakhkar et al [4], Novac et al [5], and other authors. As seen in many studies such as Yoon et al [6], Baschat A et al [7], Doppler velocimetry changes predict fetal compromise earlier than NST or Biophysical profile. [8, 9, 10, 11] Barcelona classification reemphasizes the importance of Doppler parameters in the diagnosis and treatment of FGR and also the importance of CPR in diagnosing and treating late onset FGR. [12] Our study matches closely to that of B.N Lakhkar and the study of multiple vessels is better in predicting perinatal outcome. [4] The mean birth weight in our study was

1.94 kg and mean gestational age at delivery was 37 weeks and 5 days. 59% out of the 200 fetuses had at least one adverse perinatal outcome. There were in all 4 intra uterine deaths and 196 live births. Out of the 196 live births, 114 had NICU admissions and 16 neonatal deaths. Seventy-four had Apgar score less than 7 at 5 minutes. The umbilical artery PI had a sensitivity of 81.48% in predicting the adverse perinatal outcome and MCA/Umbilical Artery PI ratio had the highest specificity of 80.49%. No other conventional method effectively predicts fetal deterioration prospectively. Doppler studies provide good longitudinal assessment and the BPP refines the relationship with fetal. This combined approach provides the most accurate fetal assessment, and guides about the timing of delivery, especially in preterm fetuses with growth restriction. In different Doppler assessments, the umbilical artery PI has maximum sensitivity to predict adverse perinatal outcome. The presence of absent or reversed diastolic flow in umbilical artery is an ominous sign as it has high mortality. The combined assessment of middle cerebral artery and umbilical artery PI ratio i.e. Cerebro-placental ratio (CPR) is more specific to predict fetal outcome than assessment of either parameter alone. Hence, we conclude that study of multiple vessels by Doppler velocimetry in antenatal surveillance of pregnancies with FGR yields the best results with respect to monitoring, timing of delivery and predicting the adverse perinatal outcome

Sources of supports: Nil

Conflicts of Interest: Nil

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How to cite this article: VaishaliKordeNayak, Rohan Krishna Kumar, Jaya Barla, Santosh Sabnis. Role of Colour Doppler Studies in Antenatal Surveillance in Pregnancies with Fetal Growth Restriction in a Rural Tertiary Health Centre: A Prospective Study. *Walawalkar International Medical Journal* 2023;10(1):41-45.
<http://www.wimjournal.com>.

Received date:09/11/2022

Revised date:21/07/2023

Accepted date: 22/07/2023

