

Role of Colour Doppler in High Risk Pregnancy

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ABSTRACT

This was a prospective study conducted in pregnant patients with high risk factors who got admitted in the Department of Obstetrics and Gynaecology at Care Hospital, Jamnagar during the period from May 2018 to September 2020.

Background: High-risk pregnancies cause many adverse perinatal outcomes. Doppler ultrasound is a non-invasive technique to study the feto-maternal circulation to guide the clinical management.

Objective: This study aims at evaluating the role of colour Doppler in high-risk pregnancies and their perinatal outcome.

Materials and Methods: This was a prospective study carried out for 29 months in the Department of Radiology with antenatal women in the age group of 18-35 years with singleton pregnancy of gestational age of <28 weeks to >35 weeks having high-risk factors considered in study. The risk factors considered were pregnancy induced hypertension (PIH), gestational diabetes, anemia, oligohydramnios, polyhydramnios and IUGR. Doppler study of umbilical artery and fetal middle cerebral artery (MCA) arteries was done and amniotic fluid index (AFI) was measured. Parameters in the form of resistive index, pulsatility index, and systolic/diastolic ratio were taken. Obstetric history was taken with regular interval follow up.

Results: The study was carried out with 50 patients. High-risk pregnancy was more common in the age group of 21-25 years. The most common high-risk factor in pregnancy was oligohydramnios which accounted for 30% of cases. Out of 50 high-risk pregnancies, 5 (10 %) of cases resulted in intrauterine growth restriction (IUGR). Out of 50 high-risk cases, in 36 cases, umbilical artery findings were abnormal. 3 patients had intrauterine death

(IUD) and 27 patients had poor perinatal outcome. Umbilical artery abnormality showed significant sensitivity and negative predictive value for adverse (poor + IUD) perinatal. Correlation was seen between high risk pregnancy and need of emergency caesarean section and induction and associated adverse perinatal outcome.

Conclusion: Combination of different arterial waveform study enhances the diagnostic accuracy in identifying those intrauterine growth restricted fetuses that were at risk.

Keywords: Colour Doppler, high risk pregnancy, perinatal outcome.

INTRODUCTION

Normal fetal growth during intrauterine life and normal pregnancy outcome, its ability to withstand the stress of labour and delivery, and its healthy development during the neonatal period depends to a great extent upon the integrity of the fetoplacental circulatory system, adequate umbilical and uterine circulation. During intrauterine life, this system transports the essential elements from the mother across the placenta to the fetal tissues and of returning to the placenta, fetal catabolic products, to be eliminated. With Doppler ultrasound, studying these circulatory beds in a non-invasive and safe way is possible. An insufficient uterine, placental or fetal circulation results in an adverse pregnancy outcome. These abnormalities can be identified with the use of Doppler Velocimetry with evaluation of hemodynamic adjustments arising in some clinical complications of pregnancy.^[1,2]

Prolonged fetal hypoxic stress results in circulatory adaptation with redistribution of the cardiac output to provide a constant oxygen supply to the brain and other essential organs. These compensatory adjustments are associated with changes in Doppler parameters. Intrauterine growth restriction (IUGR) is one of the most common abnormalities of fetal growth which affects development of fetus and is associated with increased risk of perinatal morbidity and mortality. It's defined as an estimated weight below the 10th percentile for gestational age. Any baby who is smaller than normal can be diagnosed with the condition. Decreasing diastolic flow, absent diastolic flow and reversed diastolic flow in umbilical artery during a cardiac cycle are signs of worsening IUGR.^[3,4]

MATERIALS AND METHODS

This was a prospective study carried out in the Department of radio-diagnosis. G.G. hospital, attached to M.P.Shah Medical College, Jamnagar, Gujarat from May 2018 to September 2020

Selection of Cases

Patients who attended the antenatal clinic were included in this study. First a baseline study of Doppler ultrasound was done on 50 patients to get acquainted with the proper technique. Then pregnant women with a clinical suspicion of IUGR (patients with decreased fundal height as compared to gestational age by LMP, a bad obstetrics history, PIH, gestational diabetes and severe anemia were taken

Exclusion Criteria

- Patients diagnosed with anomalous foetus.
- Patients with previous >1 LSCS.
- Patients not giving consent for the study.

Equipments Used In Our Study

- 500 MD MR3 color Doppler Machine,
- Frequency of the probe proposed it 3-5 MHz, wall of the filter kept at minimum near to 0°

METHODOLOGY

All the selected patients were evaluated with detailed clinical history, clinical examination and relevant laboratory investigations like Hb, Platelet counts, LFT, KFT and Blood pressure; the gestational age was calculated by L.M.P or from crown-rump length in the first trimester ultrasound.

The pregnant women were placed in supine position. Bed sheet was put to cover rest of the body. Patient was made comfortable by explaining the procedure and its utility in her own language and a written consent was given by the patient. Sonographic jelly was applied on the abdomen to achieve acoustic coupling and ultrasound transducer was placed. Amniotic fluid index is obtained by measuring the vertical depth (cm) of the largest cord free amniotic fluid pocket in the four quadrants of the uterus and sum of the four measurements is the index. Umbilical artery was identified within the amniotic fluid by the appearance of parallel line echoes; which display a pulsatile activity on real-time images. The recording was taken close to the placental site of the umbilical cord. Middle cerebral artery was identified by locating the circle of Willis in the axial section of the fetal skull.

Post-natal follow up were taken in the form of induction, lower (uterine) segment caesarean section (LSCS), and termination of pregnancy. Fetal outcome were recorded in the form of birth weight, intrauterine death (IUD), intrauterine growth retardation (IUGR), survival in neonatal intensive care unit (NICU), and death in NICU.

RESULTS

In our study, 50 patients with enrolled high-risk factors were subjected to Doppler study and their perinatal outcome and other various parameters were studied.

Table 1: Age wise distribution of cases

Age (in years)	Study	(%)
18-20	4	8
21-25	23	46
26-30	20	40
31-35	3	6
TOTAL	50	100

Table 1 shows age wise distribution of cases, maximum number of cases in our study were in age group of 21-25 years of age group with 23/50 patients. Minimum numbers of cases in our study were in age group of 31-35 years of age with 3/50 in each group.

Table 2 shows distribution of cases as per clinical presentation. Maximum number of cases had oligohydramnios with

15/50 patients. Minimum number of cases had gestational diabetes with 4/50 patients.

Table 2: Distribution of cases as per clinical presentation

Clinical Presentation	Study	%
PIH	12	24
Gestational diabetes	4	8
anemia	6	12
IUGR	5	10
Oligohydroamnios	15	30
Polyhydroamnios	8	16
TOTAL	50	100

Table 3: Correlation of parameters of UMBILICAL ARTERY with respect to perinatal outcome

Perinatal outcome.	Resistance Index (RI)		Pulsatility Index (PI)		S/D ratio		
	Normal	Raised	Normal	Raised	Normal	Raised	Absent
IUD	-	3	-	3	-	2	1
POOR	3	24	3	24	2	21	3
GOOD	12	9	12	9	12	9	-
Total	14	36	14	36	14	32	4

- Out of 50 patients, 36 patients had raised RI and PI and 14 patients had normal RI and PI values.
- Of 36 patients with raised RI and PI, 3 had IUD, 24 had poor perinatal outcome and 9 had good perinatal outcome.
- Of 14 patients with normal RI and PI, only 2 had poor perinatal outcome and 12 had good perinatal outcome.
- Out of 50 patients, 32 patients had raised S/D ratio, 14 patients had normal S/D ratio and 4 had absent S/D ratio.
- Of 32 patients with raised S/D ratio, 2 had IUD, 21 had poor perinatal outcome and 9 had good perinatal outcome.
- Of 14 patients with normal S/D ratio, 2 had poor perinatal outcome and 12 had good perinatal outcome.
- Of 4 patients with absent S/D ratio, 1 had IUD and 3 had poor perinatal outcome.

Table 4: Analysis of UMBILICAL ARTERY

Perinatal outcome	BAD (POOR+ IUD)			
	Analysis for raised RI	Analysis for raised PI	Analysis for abnormal S/D ratio	
			Raised	Absent
Sensitivity	90%	90%	92%	66%
Specificity	57%	57%	57%	85%
Positive predictive value	75%	75%	71%	66%
Negative predictive value	80%	80%	85%	85%

Table 5: Correlation of parameters of MIDDLE CEREBRAL ARTERY with respect to perinatal outcome

Perinatal outcome.	Resistance Index (RI)		Pulsatility Index (PI)		S/D ratio		
	Normal	Reduced	Normal	Reduced	Normal	Reduced	Absent
IUD	-	3	-	3	-	3	-
POOR	14	12	14	12	14	12	-
GOOD	21	-	21	-	21	-	-
Total	35	15	35	15	35	15	-

- Out of 50 patients, 35 patients had reduced RI, PI and S/D ratio and 15 patients had normal RI, PI and S/D ratio.
- Of 35 patients with normal RI, PI and S/D ratio 14 had poor perinatal outcome and 21 had good perinatal outcome.
- Of 15 patients with reduced RI, PI and S/D ratio, 3 had IUD, 12 had poor perinatal outcome.

Table 6: Analysis of MIDDLE CEREBRAL ARTERY

Perinatal outcome	BAD (POOR+ IUD)		
	Analysis for Reduced RI	Analysis for Reduced PI	Analysis for abnormal S/D ratio
Sensitivity	57%	57%	57%
Specificity	100%	100%	100%
Positive predictive value	100%	100%	100%
Negative predictive value	60%	60%	60%

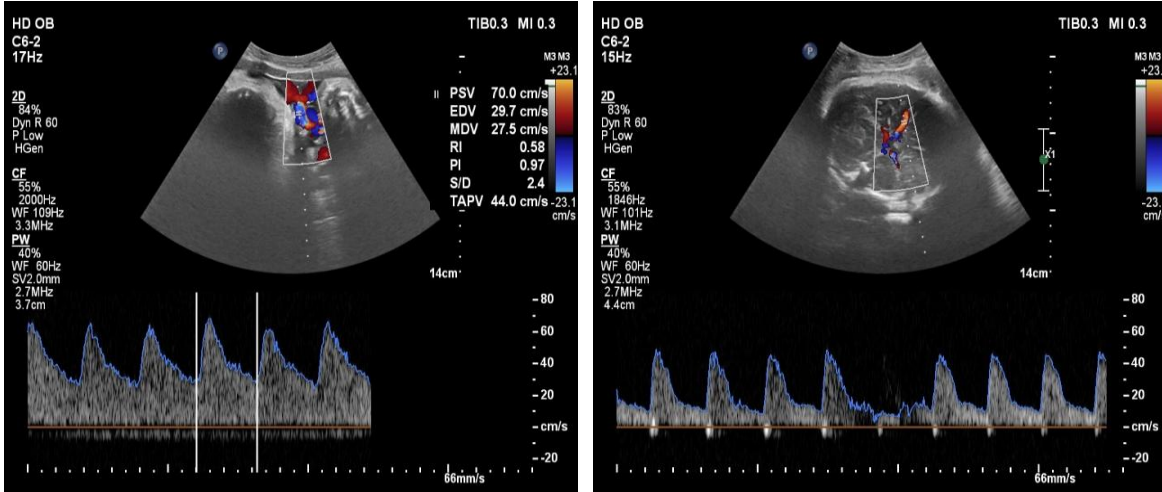


Figure 1 and 2: 26 years old female patient presented with anemia showing normal forward diastolic flow in fetal umbilical and fetal MCA artery respectively.

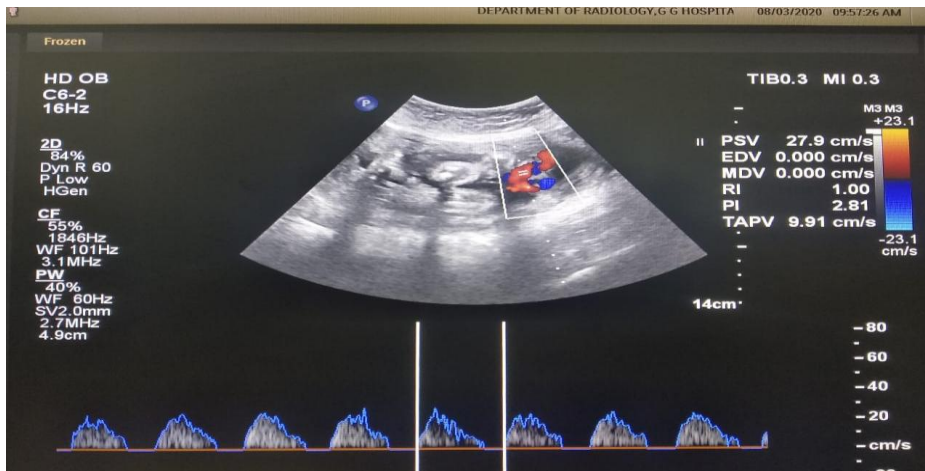


Figure 3: 30 years old female patient presented with pregnancy induced hypertension showing absent end diastolic flow in fetal umbilical artery.

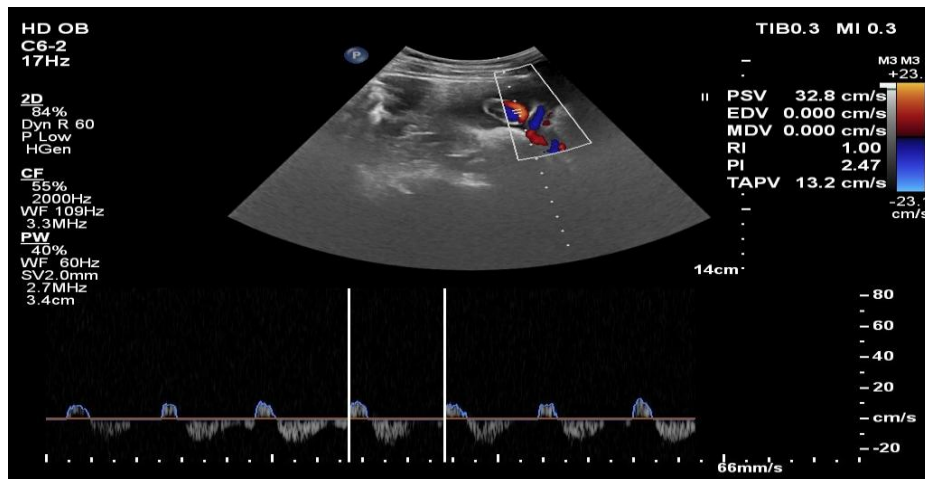


Figure 4: 26 years old female patient presented with pregnancy induced hypertension showing reversed end diastolic flow in fetal umbilical artery.

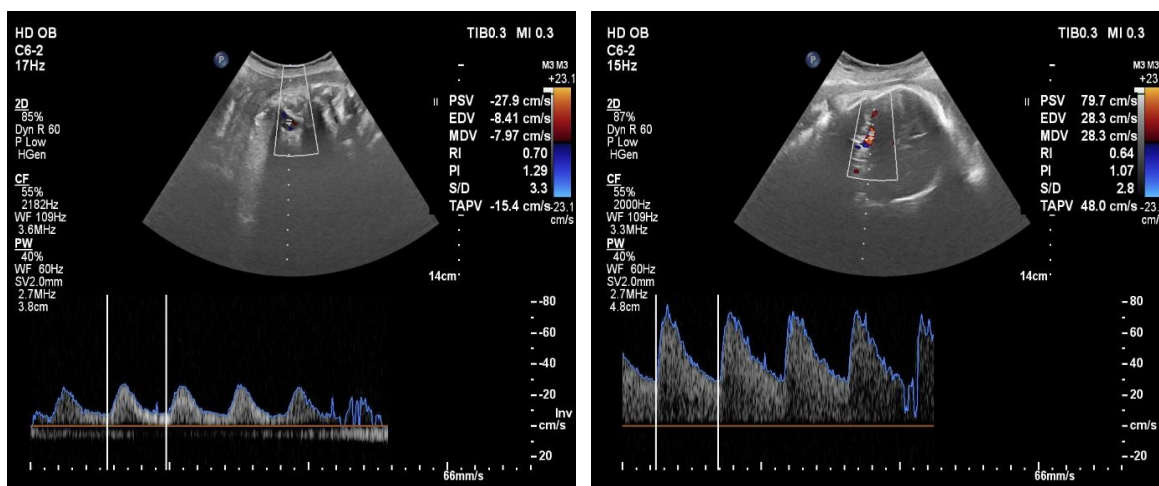


Figure 5 and 6: 22 years old female patient with IUGR showing reduced end diastolic flow in fetal umbilical artery and compensatory raised diastolic flow in fetal middle cerebral artery.

DISCUSSION

Doppler findings were correlated with the perinatal outcome which was categorized as IUD, poor and good based on the need of NICU stay.

Patient's Age

In our study maximum number of patients was between 21-25 years with 46% patients. In study done by Tabitha S. et al⁽¹⁾ studied patients with high risk pregnancy maximum number of patients (40.62%) were between 21-25 years of age. In study by Bilqees A et al⁽²⁾ mean age of patients was 31.9±4.03 years, majority were in the age group of 25-40 years.

Umbilical Artery Doppler Analysis

1. Raised Umbilical Artery Resistance Index (RI)

In our study raised value for RI showed 90% sensitivity and 80 % negative predictivity for adverse perinatal outcome. It had 57% specificity and 75% positive predictivity. Mc Cowan et al³ evaluated 186 women and compared umbilical artery Doppler parameters between SGA fetuses with normal and abnormal Doppler parameters. He showed that abnormal umbilical artery Doppler studies reflect earlier onset and more severe growth restriction and are not independently associated with newborn morbidity. SGA babies with normal Doppler studies had a high rate of NICU admission and malnutrition at birth.

2. Raised Umbilical Artery Pulsatility Index (PI)

In the present study, raised value for PI showed 90% sensitivity, 57% specificity, 75% positive predictivity and 80 % negative predictivity for bad perinatal outcome. Gramellini et al⁴ gave sensitivity of 64%, specificity of 90.7%, positive predictive value of 72.7% and negative predictive value of 86.7% for raised PI value in predicting adverse perinatal outcome. Erksine et al⁵ studied 15 normal and 09 clinically suspected IUGR and found that no fetus with normal umbilical artery resistance was growth retarded and no severely growth retarded fetus maintained normal resistance.

3. Diastolic Flow In the Umbilical Artery

In the present study reversed diastolic flow was 100% specific and positive predictive for IUD, however it was 50% sensitive. Adverse perinatal outcome was most sensitive with reduced end diastolic flow and most specific with reversed and absent end diastolic flow. Arabin and colleagues⁶ studied 137 high risk fetuses and found that there was evidence of high rate of perinatal mortality in patients with absent end diastolic flow and also there was evidence of higher rate of caesarean section in the group in which absent diastolic flow. Lakhkar B.N et al⁷ studied Doppler waveforms in 58 growth restricted fetuses and revealed absent or reversed end

diastolic flow in the umbilical artery to be a bad predictor.

4. Raised Umbilical Artery S/D Ratio

In the present study, raised S/D ratio was 92 % sensitive for adverse perinatal outcome. Specificity was 57%. It had a positive predictive value of 71.0% and a negative predictive value of 85%. Burton L. Rochelson, Harold Schulman et al⁸ described that patients with abnormal systolic/diastolic ratio had a significantly higher incidence of abnormal fetal heart distress. There were 06 perinatal deaths with elevated ratio and none in the group with normal ratio. Trudinger B.J et al⁹ concluded in their studies that significant association was noted between abnormal flow velocity waveforms and the birth of an infant who was IUGR. Preterm infants with high or infinite S/D ratios spent twice the time in NICU (poor perinatal outcome) than those with normal S/D ratios. He gave a sensitivity of 75.4% and positive predictive value of 52%.

Middle Cerebral Artery Doppler Analysis

1. Resistance Index RI

In the present study sensitivity of reduced RI value was 57% while specificity was 100% for adverse perinatal outcome. Mathias et al¹⁰ in his studies also showed that raised value of RI in middle cerebral artery is an indicator for chronic fetal hypoxia and poor perinatal outcome. He obtained a specificity of 79% for raised RI value in predicting poor perinatal outcome.

2. Pulsatility Index (PI)

In the present study reduced value of PI was 57% sensitive, 100% specific for adverse outcome with 100% positive predictivity. Detti et al¹¹ stated that in IUGR fetuses with MCA PI below the normal range, there is a greater incidence of adverse perinatal outcome. The disappearance of the brain sparing effect seems to precede fetal death and showed a significant specificity for IUD (70.1%) and poor perinatal outcome (85 %). Spinillo A et al¹² studied

184 singleton pregnancies & concluded that an MCA pulsatility index below the 10th percentile was a risk factor for fetal/neonatal death or brain damage. He said that vasodilatation of the MCA is a risk factor for neonatal death or brain damage.

3. S/D Ratio

In our study reduced value for S/D ratio had a sensitivity of 57% for poor perinatal outcome. In studies done by Sterne G et al¹³ abnormal values S/D were highly predictive for poor outcome and there was an emergent need form delivery for raised value of S/D ratio.

SUMMARY AND CONCLUSIONS

A baseline study for the evaluation of umbilical artery and fetal Middle Cerebral Artery Doppler was done which comprised of 50 patents. 50 singleton pregnancies with clinical suspicion of IUGR comprised the study group which included patients with decreased fundal height as compared to gestational age by LMP (5), PIH (12), gestational diabetes (4), anemia (6), oligohydramnios (15) and polyhydramnios (8). Perinatal outcome was assessed on the bases of need of NICU stay. Maximum numbers of patients were in the age group of 21-25 years. Raised RI, PI and S/D ratio of umbilical artery could predict Intrauterine Death with significant sensitivity. For poor perinatal outcome, raised value of RI and raised S/D ratio of umbilical artery showed maximum sensitivity and positive predictive value which suggests high diagnostic accuracy. Raised umbilical artery PI and RI and absent/reversed diastolic flow in umbilical artery showed significant specificity and negative predictive value for poor perinatal outcome which helped us to exclude IUGR. Abnormal values of RI, PI and S/D in the fetal MCA also showed a significant specificity and positive predictive value for poor perinatal outcome.

To conclude, however a single artery Doppler evaluation can predict the perinatal outcome, combination of different arterial

waveform study enhance the diagnostic accuracy in identifying those Intrauterine restricted fetuses that were at risk.

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Ethical Approval: Approved

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