Section: Obstetrics and Gynaecology

Original Research Article

DOPPLER STUDY OF UMBILICAL ARTERY IN HIGH RISK PREGNANCY IN A TEACHING HOSPITAL

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ABSTRACT

Background: Abnormal blood flow patterns in fetal circulation detected by Doppler ultrasound may indicate poor fetal prognosis. It is also possible that false positive Doppler ultrasound findings could lead to adverse outcomes from unnecessary interventions, including preterm delivery. **Aim of the study:** To study Doppler study of umbilical artery in high risk pregnancy.
Material and Methods: Prospective study done in the department of Obstetrics and gynaecology on 100 women with high risk factors like PIH, IUGR, Oligohydramnios, Rh isoimmunisation, anaemia, twins and post-date, who attended Antenatal clinic and were referred from peripheral hospitals over a period of 2 years i.e., from, June 2022 to November 2024.
Results: The study group comprised of patients between the age group 21-35 years. Maximum number of patients were >25 years. Average age was 28 years. This study shows that with increasing maternal age the high risk factors increase and the abnormality in Doppler study also increases.28 out of 52 (53.8%) in abnormal Doppler group were hypertensive compared to 27 out of 48 (56.2%) in normal Doppler group. Oligohydramnios was present in10 of 52 (19.2%) women with abnormal Doppler group, whereas it was15 of 48(31.2 %) women in normal Doppler group.
Conclusion: Doppler should be used as a routine investigation as a part of antenatal surveillance in high risk cases like PIH, IUGR and oligohydramnios. Serial Doppler studies should be done to detect the efficacy of medical management given to these patients and more frequently when required to detect improving or deteriorating trend and timely obstetrics intervention in fetal interest.
Keywords: Doppler study, umbilical artery.

INTRODUCTION

Antepartum fetal surveillance of high risk pregnancies like PIH, IUGR, and diabetes mellitus with pregnancy, post term pregnancy, multiple pregnancy, Rh incompatibilities, anaemia etc. and to obtain a fruitful outcome has been a biggest challenge to obstetrician. Antenatal care in the developed world places great emphasis on the prediction, detection and treatment of maternal disease and the prevention of the birth of babies with major fetal anomalies.[1,2,3] The two major conditions associated with placental dysfunction, IUGR and pre-eclampsia, account for most cases of adverse perinatal outcome, but there has been surprisingly little progress, globally, in their prevention and detection. There is now proof that there is fourfold advantage to the health of the fetus that has been prenatally diagnosed with IUGR and who has, as a consequence, benefited from appropriate surveillance instituted thereafter, as opposed to the outcome for the undiagnosed one.[4]

Doppler velocimetry is a rapid non-invasive test that provides valuable information about the hemodynamic situation of the fetus. It is an efficient diagnostic test of fetal jeopardy and helps in the management of high risk pregnancy. To reduce the

perinatal morbidity and mortality of fetuses associated with high risk pregnancies their early detection and therapeutic intervention are important. Though the failure of a fetus to attain or exceed its expected growth potential may result from numerous different pregnancy complications, the final common pathway most commonly encountered in practice is via uteroplacental insufficiency. There is significant association between the umbilical arterial Doppler waveform analysis and clinical outcome. Awareness of an increased. Doppler determined umbilical artery resistance is associated with a reduction in perinatal morbidity and mortality in populations at high risk for adverse perinatal outcomes.

Umbilical artery Doppler defines this high risk subgroup among fetuses diagnosed as SGA.[5,6]

Color Doppler study of various vessels helps in determining the

1. Predictive value of fetal outcome
2. Provide an indication of induction of labor in interest of a compromised fetus with the combined use of other means of fetal surveillance like USG and NST, it is possible to detect both acute and chronic insults to the fetus and to provide appropriate management for positive outcome.

Aim of The Study: To study Doppler study of umbilical artery in high risk pregnancy.

Its Objectives

- To evaluate the utility of Doppler as a diagnostic aid in fetal surveillance and improved fetal outcome in high risk pregnancy like PIH, IUGR, oligohydramnios etc.
- To study the Systolic / Diastolic ratio (S/D ratio), pulsatility index (PI) and resistance index (RI) of umbilical artery in high risk pregnancies.
- To evaluate the role of these blood flow indices in the prediction of adverse fetal outcome.
- To study the mode of delivery and predict perinatal outcome in terms of birth weight, Apgar score and admission to neonatal intensive care unit.

MATERIALS AND METHODS

Prospective study done in the department of Obstetrics and gynecology on 100 women with high risk factors like PIH, IUGR, Oligohydramnios, Rh isoimmunization, anemia, twins and postdate, who attended Antenatal clinic or were referred from peripheral hospitals over a period of 2 years i.e. from, June 2022 to November 2024.

Inclusion Criteria

1. Gestational age >28weeks
2. Patients with reliable dates of last menstrual bleeding and first trimester scan gestational age assessment. Exclusion criteria 1. Patients with fetal congenital anomaly
3. Wrong dates
4. Gestational age

Exclusion Criteria

1. Patients with fetal congenital anomaly
2. Wrong dates
3. Gestational age <28weeks

High risk factors included in the study were:

1. Preeclampsia
2. IUGR
3. Oligohydramnios
4. Rh isoimmunization
5. Anemia
6. Diabetes mellitus
7. Twins

Methodology

Personal history, menstrual history, obstetrics history as well as complaints of patients during antenatal period were noted in details. Routine investigations like Hb, blood group Rh, urine albumin were done in every patient. Specific investigations like serum uric acid, coagulation profile, were performed. A fetal anatomy scan and a biometry were both performed for every patient before the Doppler examination.

The fetal anatomy scan excluded congenital anomalies and the fetal biometry included biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL).

Amniotic fluid volume, which was semi quantitatively assessed, oligohydramnios was considered if AFI < 5. All women included in the study were subjected to umbilical artery Doppler measurements in addition to growth parameter, liquor and placental grading. Pulsed wave Doppler ultrasound examination of the umbilical artery was performed using colour Doppler (GE 700 MR with 3.5 MHz curvilinear transducer).

The umbilical artery was identified and flow velocity waveforms were obtained from free-floating loop of cord. Recordings were accepted for analysis only after a clear steady state was obtained for at least two consecutive pulsatile waveforms.

No waveforms were recorded during periods of fetal breathing and body movements.

The Systolic/diastolic (S/D) ratio, resistance index (RI) and pulsatility index (PI) was determined for any waveform and an absence of end diastolic velocity was noted.

The angle between the ultrasound beam and the direction of the blood flow was less than 35°.

the study population was distributed into two groups- a normal Doppler group (Group 1) and an abnormal Doppler group. Abnormal Doppler group was subdivided into diminished end

Diastolic flow group (Group II), and an absent or reversed diastolic group

(Group III).

Doppler examinations were repeated weekly or biweekly according to the severity of the reduction of the end diastolic flow in the umbilical artery. Patients with S/D ratio equal to or more than three and those with absent diastolic or reversed diastolic flow were admitted for further evaluation and delivery. Conservative treatment that was offered to the

patients in the hospital with low end diastolic velocimetry consisted of
bed rest, daily fetal movement count, non-stress test. Steroids were administered as single dose to women between 28 and 34 weeks of gestation to enhance fetal lung maturity.

RESULTS

Age distribution: The study group comprised of patients between the age group 21-35 years. Maximum number of patients were >25 years. Average age was 28 years. This study shows that with increasing maternal age the high risk factors increase and the abnormality in Doppler study also increases.
Distribution of Causes of high risk pregnancy: Out of the 100 cases, 55 patients had PIH, 25 had oligohydramnios, 6 were IUGR and others included anaemia, twins and postdate. The study shows maximum number of cases who were associated with abnormal Doppler study were cases of PIH and hypertension followed by oligohydramnios.

Parity distribution: 60% patients were primigravida and rest 40 5were multigravida. Amongst the primi patients, most of them had PIH followed by oligohydramnios.
Doppler characteristics in the study population: 48 fetuses (48%) had normal umbilical artery waveforms, eighteen (18%) fetuses had diminished end diastolic flow, and 26fetuses (34%) had severe reduction absent or reversal of end diastolic flow.
Mode of delivery: Out of the 100 cases, there were 60 normal vaginal deliveries and 40 LSCS. Among the 52 cases with abnormal Doppler study, 28 cases (70%) underwent LSCS and the rest 18 (30%) had normal vaginal delivery. Among the 48 cases with normal Doppler study, 42 (70%) had normal vaginal delivery and 12 (30%) underwent LSCS. Increased incidence was noted in cases with abnormal Doppler study. Significantly more women with severe reduction/AEDV, 28 of 40 (70%), underwent Caesarean section, compared with 12 of 40(30%) women in the normal.

Table 1: Maternal characteristics in normal Doppler and abnormal Doppler

Characteristics	Abnormal Doppler (52)	Percentage (%)	Normal Doppler (48)	Percentage (%)
PIH	**28**	**53.8**	**27**	**56.2**
Oligohydramnios	**10**	**19.2**	**15**	**31.2**
IUGR	**5**	**9.6**	**1**	**2.08**
Anemia	**3**	**5.76**	**1**	**2.08**
Twins	**3**	**5.76**	**1**	**2.08**
Others	**3**	**5.76**	**3**	**6.25**

28 out of 52 (53.8%) in abnormal Doppler group were hypertensive compared to 27 out of 48 (56.2%) in normal Doppler group. Oligohydramnios was present in10 of 52 (19.2%) women with abnormal Doppler group, whereas it was15 of 48(31.2 %) women in normal Doppler group. Similarly anemia, IUGR, twins and other factors like Rh isoimmunization, postdate are mentioned in the above table.

Table 2: Doppler characteristics in abnormal Doppler group and normal Doppler group

Characteristics	Abnormal Doppler (52)	Percentage (%)
Umbilical artery PI	1.52 ± 0.18	0.83 ± 0.11
Umbilical artery RI	0.76 ± 0.08	0.5 ± 0.09
S/D ratio	**4.46** ± 0.76	2.73 ± 0.24

The means and standard deviations (S.D) for the Doppler indices at delivery (PI, RI and S/D ratio) for these patients are presented in Table 2. The mean Doppler indices for normal and abnormal Doppler groups were 0.83+ 0.12 and 1.52 +0.18 (PI), 0.50+0.09 and 0.76 +0.08 (RI), 2.73 +0.24 and 4.46 +0.76 (S/D ratio) respectively.

Table 3: Gestational age at delivery and birth weight in abnormal Doppler and normal Doppler

Characteristics	Abnormal Doppler (52)	Percentage (%)
Gestational age at delivery(weeks)	35.8 ± 2.2	37.1 ± 1.9
Birth weight(grms)	1700± 350	2100± 550

The mean birth weight is 1.70 kg ±0.35 SD for fetuses in the abnormal Doppler group and 2.1kg±0.55 SD for those in the normal Doppler group. There is a significant decrease in PI of umbilical artery as birth weight increases, the birth weight being higher in the normal Doppler group and lowest in the absent/ reversed end diastolic flow group

Labor outcome in abnormal Doppler and normal Doppler group: Out of the 100 cases, there were 60 normal vaginal deliveries and 40 LSCS. Among the 52 cases with abnormal Doppler study, 28 cases (70%) underwent LSCS and the rest 18 (30%) had normal vaginal delivery. Among the 48 cases with normal Doppler study, 42 (70%) had normal vaginal

delivery and 12 (30%) underwent LSCS. Increased incidence was noted in cases with abnormal Doppler study.

Table 4: Neonatal outcome with umbilical artery Doppler velocimetry in 3 group

Characteristics	Normal Doppler Group I (48)	Low EDF Group II (18)	REDF/AEDF Group III (34)
Delivery <36 weeks	**23**	**10**	**20**
Live/ still birth	**48/0**	**16/2**	**27/7**
Birth weight	**2.1±0.55**	**1.75**±0.33	**1.55**±0.37
APGAR<6	**4**	**10**	**13**
NICU admisssion	**12**	**9**	**13**
Neonatal death	**2**	**9**	**11**
Discharge in good condition	**46**	**7**	**16**

13 of 34 new-born, (38.23 %) who had had AEDV / reversal of flow were admitted to NICU, and eight of them (72.7%) required PPV.

By comparison, whereas 9 of 18 (50%) new-born who had diminished end-diastolic flow were admitted to NICU, 12 of 48(25%) new-born who had had normal Doppler readings went to the NICU with three of them requiring PPV. There was two stillbirths in group 2 and seven stillbirths in group 3 (abnormal Doppler group), whereas there was no stillbirth in the normal Doppler group. The number of neonatal deaths were 2 (4.1%), 9 62 (50%) and 11 (32.35%) in group 1, 2 and 3 respectively. The results of

our study show that increased incidence of caesarean section were found in patients with abnormal umbilical artery Doppler study. Also fetuses with abnormal umbilical artery velocimetry had early delivery at less than 36 weeks of gestation, increased NICU admission, need for PPV, low Apgar score than those with normal Doppler.

Table 5: NICU admission rate in abnormal Doppler and normal Doppler group

Characteristics	Abnormal Doppler (52)	Percentage (%)	Normal Doppler (48)	Percentage (%)
With NICU admission	22	42.3	12	25
Without NICU admission	30	57.6	32	66.6

Out of 48 cases in the normal Doppler group, 12 newborns (33.4%) required NICU admission. Three newborns of 12 admitted in NICU required PPV .whereas 30 of 52 (80 %) newborns in the abnormal Doppler group, required NICU admission. Of the thirty, 18 of them required PPV. Patients with AEDF/REDF had poor perinatal outcome. Stillbirths are not included in the above table. The mean gestational age at delivery is 35.8 + 2.2 for fetuses in the abnormal Doppler group whereas it is 37.1 + 1.9 for fetuses in the normal Doppler group. The mean birth weight is 1.70 g +0.35 SD for fetuses in the abnormal Doppler group and 2.10 kg +0.55 SD for those in the normal Doppler group.

DISCUSSION

The pregnancies most likely to be benefitted from the use of umbilical artery velocimetry are those with the diagnosis of intrauterine growth retardation (IUGR) whether as an idiopathic processor in presence of gestational hypertension. Screening a low risk or unselected population by umbilical artery Doppler, however, does not reduce perinatal mortality or morbidity.[7]

Westergaard HB et al, reexamined the reported trials on doppler ultrasound velocimetry in order to define those populations that can truly benefit from its use. In these high risk pregnancies, application of doppler technology can reduce the number of perinatal deaths.[8]

Hence, one of our inclusion criteria was the presence of intrauterine growth retardation in our patients at examination.

Table 6: Comparative studies related to absent end diastolic flow

	Johnstone et al	Pattison et al	Battalgia et al	Present study
No. of patients	380	342	46	100
AEDF	24	150	26	8
Percentage	6.3	34.0	56.0	8

The above table shows various comparative studies with absent end diastolic flow.

In the present study Absent end diastolic flow noted in 8 cases where as in Jhonstone et al ,[9] noted in 24 cases ,, Pattison et al,[10] 150 cases and batalgia et al,[11] 26 cases

Absent end diastolic flow and reversed end diastolic flow were associated with poor perinatal outcome in terms of need for LSCS for fetal distress, Apgar <7 at 1 min, and admission to NICU. In the present study, Forty eight fetuses (48%) had normal umbilical artery waveforms, eighteen (18%) fetuses had diminished end-diastolic flow, and twenty six fetuses (34%) had severe reduction absent or reversal of end diastolic.

Out of 52 patients with abnormal umbilical artery Doppler 15 patients developed IUGR with a sensitivity of 25% for both SD and RI. It is similar to opinion by Beattie Dorman et al 12Sensitivity of absent diastolic flow was 100%.

Table 7: Comparative study of Doppler characteristics

Doppler parameters	Present study	Deshmukhanshul et al	Wladimiroff et al	Khurana et al
Umbilical artery PI in abnormal group	1.52 ± 0.18	1.345	1.452	-
Umbilical artery PI in normal group	0.83 ± 0.11	0.954	0.867	-
Umbilical artery RI in abnormal Doppler	0.76 ± 0.08	-	0.65	-
S/D ratio	4.46 ± 0.76	-	-	2.64

In our study group, the umbilical artery PI in the normal Doppler group was 0.83 and in the abnormal Doppler group was 1.52. This was c comparable to the study done by Deshmukh Anshul et al,[13] who found that PI of umbilical artery was 1.345 in abnormal Doppler group and 0.954 in the normal Doppler group.

In a study of 156 normal pregnancies and 42 cases of high risk cases, Wladimiroff et al,[14] found gestational age related fall in PI in umbilical arteries in normal pregnancies. In growth retarded fetuses, there was raised PI in umbilical artery. Similarly, Wladimiroff et al,[14] Lakhkar et al,[15] and Ahamed et al,[16] calculated mean RI values at different gestational age which was 0.7 at 28 weeks and 0.65 at 37 weeks.

Khurana et al,[17] calculated S/D ratios as 3.07 at 28 weeks and 2.64 at 37 weeks. Present study showed mean S/D ratio of 4.46 which is higher when compared to above studies. The findings of study are comparable to published literature on umbilical artery index in high risk pregnancies

Comparative studies related to distribution of birth weight. In our study the mean birth weight is 1.70 kg ±0.35 SD for fetuses in the abnormal Doppler group and 2.1kg±0.55 SD for those in the normal Doppler group. There is a significant decrease in PI of umbilical artery as birth weight increases, the birth weight being higher in the normal Doppler group and lowest in the absent/ reversed end diastolic flow group. This is in accordance with Fleischer et al,[18] who demonstrated that those fetuses with lower birth weight (<25th percentile) had higher placental vascular resistance than those with higher birth weight (>25th percentile).

Comparative studies related to distribution of gestational age at delivery.

The mean gestational age at delivery is 35.8 + 2.2 for fetuses in the abnormal Doppler group whereas it is 37.1 + 1.9 for fetuses in the normal Doppler group. In our study, new-born with increased SD ratio groups, the AEDF and REDF groups have delivered significantly more preterm compared with the normal Doppler group (medians 35.8 weeks versus medians 37.1 weeks, respectively,) and have lower birthweight (medians 1700 g versus medians 1950 g, respectively). This result is comparable to the study done by Shand AW et al.[19]

Comparative studies related to distribution of Labor outcome in abnormal Doppler and normal Doppler group.

In our study there were 60 normal vaginal deliveries and 40 LSCS. Among the 52 cases with abnormal Doppler study, 28 cases (70%) underwent LSCS and the rest 18 (30%) had normal vaginal delivery. Among the 48 cases with normal Doppler study, 42 (70%) had normal vaginal delivery and 12 (30%) underwent LSCS. Increased incidence was noted in cases with abnormal Doppler study.

A study by Draper et al.[20] produced gestation- and birth weight-specific survival rates from 24 weeks of gestation, taking into account factors such as fetal sex, ethnicity and singleton or twin. Use of these tables, rather than ones based on gestation or estimated birth weight alone, is likely to lead to be more accurate estimation of survival. The EPICURE study produced data on developmental disability for extremely preterm

infants. Although the data were not specific to growth-restricted infants, they have provided useful information on morbidity when extremely premature delivery is considered.

Trudinger BJ et al [5] study Fetal umbilical artery velocity waveforms and subsequent neonatal outcome. suggest that in the most extreme waveform 60 abnormality, there is REDF or AEDF which is considered a very ominous sign of placental compromise and is associated with high perinatal mortality rates. Recent meta-analysis of randomized controlled trials suggest that incorporation of

umbilical artery Doppler waveform analysis into management protocols for intrauterine growth restricted fetuses significantly decreased perinatal mortality.

Recent meta-analysis of randomized controlled trials suggest that incorporation of umbilical artery Doppler waveform analysis into management protocols for intrauterine growth restricted fetuses significantly decreased perinatal mortality.

CONCLUSION

Doppler velocimetry of umbilical and fetal arteries are useful diagnostic test for fetal jeopardy, IUGR, increased perinatal mortality, fetal distress acidosis, low Apgar score and increased LSCS. And we can predict 80% of adverse neonatal outcome by the color Doppler. The use of Doppler velocimetry of fetal cerebral arteries and venous system in clinical management of high risk pregnancies still awaits its evaluation in trials. Some new techniques like power Doppler increases sensitivity for flow detection. Doppler should be used as a routine investigation as a part of antenatal surveillance in high risk cases like PIH, IUGR and oligohydramnios. Serial Doppler studies should be done to detect the efficacy of medical management given to these patients and more frequently when required to detect improving or deteriorating trend and timely obstetrics intervention in fetal interest.

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