e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(10); 554-557

Original Research Article

Role of Color Doppler in High-Risk Pregnancy

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Received: 01-07-2025 / Revised: 15-08-2025 / Accepted: 21-09-2025

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Conflict of interest: Nil

Abstract

Introduction: Antepartum surveillance of high risk pregnancy and to obtain a best outcome has always been a challenge. Among these innovations, color Doppler imaging is the latest and most significant advancement in obstetric care. According to Callen's Ultrasonography in Obstetrics and Gynecology "abnormalities in one or more of these vascular systems occur prior to the clinical and laboratory appearance of, or as a result of, many pathological conditions of pregnancy". Newer technological advances such as "power" or "pulsed" Doppler make the diagnosis easier and more accurate by enabling more accurate assessment of blood flow dynamics.

Aims and Objectives:

1. To evaluate the utility of color Doppler as a diagnostic aid in fetal surveillance in high risk pregnancies.
2. To study the significance of umbilical, uterine and middle cerebral artery flow indices as prognostic indicators of fetal wellbeing.
3. To study the outcome of high risk pregnancy in patients with normal v/s abnormal color indices.

Results: The commonest indication for Doppler in present study was hypertensive disorder of pregnancy of which 81 cases were of GHTN, 19 of chronic Hypertension followed by DM (13), Postdatism(11),Twin Pregnancy (7), Cardiac Disease (7), severe anemia(6), incompatibility (6). Abnormal Doppler flow leads to increase in caesarean section rate. Incidence of neonatal death was higher in patients with abnormal diastolic flow than normal Doppler indices. Incidence of perinatal mortality in patients with both abnormal uterine and umbilical Doppler was 37.76% reflecting the severely compromised state of the fetus.

Conclusion: Color Doppler ultrasound is a multifaceted tool in prediction and management of high risk pregnancies non-invasively. Among the various Doppler parameters, umbilical artery Doppler is particularly predictive of perinatal outcomes. Doppler velocimetry is the key for early detection, monitoring and timely decision making in management of high risk pregnancies.

Keywords: Color Doppler, Pulsatility Index, Cerebroplacental Ratio.

Introduction

Antepartum surveillance of high-risk pregnancy and to obtain a best outcome has always been a challenge. With the advent of technological advancements, the concept of fetal health forecasting has emerged, positioning the fetus as a distinct patient within the clinical paradigm.

New refinements, techniques and modalities are being developed for timely recognition of fetal compromise, thereby improving perinatal outcomes. Among these innovations, color Doppler imaging is the latest and most significant advancement in obstetric care. The fetomaternal circulation is constantly changing in order to adapt to the increasing needs of the fetus. According to Callen's Ultrasonography in Obstetrics and Gynecology "abnormalities in one or more of these vascular systems occur prior to the clinical and laboratory appearance of, or as a result of, many pathological conditions of pregnancy". [1] Through color Doppler; Blood flow can be studied, interpreted, quantified and recorded - giving a

direct impression of the structure, thickness, caliber and pulsatility of the imaged vessel non-invasively.

Thus, Doppler may be an appropriate modality for selection and timely intervention of high-risk pregnancies that can mitigate adverse perinatal outcomes. In various high-risk pregnancies; subtle changes in almost every fetal vessels can be studied by different type of color Doppler flow patterns. [2] The aim of our study is to understand the association between high risk pregnancies with changes in Doppler indices of umbilical, uterine and middle cerebral arteries of fetus. The significance of Doppler ultrasound in evaluating pregnancies that have the risk for preeclampsia, intrauterine growth restriction, fetal anaemia, and umbilical cord abnormalities has become indispensable. Newer technological advances such as "power" or "pulsed" Doppler make the diagnosis easier and more accurate by enabling more accurate assessment of blood flow dynamics. Color Doppler has thus allowed unprecedented insight into pathophysiology of human fetal response to in utero stress. So by identifying compromised fetuses and timely intervention we can improve perinatal outcomes.

Aims and Objectives

1. To evaluate the utility of color Doppler as a diagnostic aid in fetal surveillance in high risk pregnancies.
2. To study the significance of umbilical, uterine and middle cerebral artery flow indices as prognostic indicators of fetal well-being.
3. To study the outcome of high risk pregnancy in patients with normal v/s abnormal color indices.

Methods

This is a retrospective observational study conducted from March 2024 to February 2025 in the department of obstetrics and gynecology at a tertiary care teaching hospital involving 150 patients PIH, anemia, diabetes, post term pregnancy, oligohydramnios.

Inclusion Criteria:

1. Patients with following high risk pregnancies were selected for the study

2. Pregnancies with gestational age of 26 weeks to term were taken.

Exclusion Criteria

1. Patients with unreliable LMP details and not confirmed by first trimester scan.

2. Patients who had not given consent.

With all due permission from authorities records were taken from OPD and wards. History regarding personal data, duration of pregnancy, obstetric history, past history regarding mode of previous delivery, any associated medical illness was noted.

General examination and systemic examination done. Detailed USG study including biometry, liquor and Doppler was noted.

Details of delivery and fetal outcome noted.

Results

Table 1: Distribution of High-Risk Pregnancies according to causes (n-150)

High Risk Pregnancy	No. of Cases	Percentage
Gestational hypertension	81	53.75%
Chronic hypertension	19	12.5%
DM(Diabetes Mellitus)	13	8.75%
Post Dated Pregnancy	11	7.5%
Twin pregnancy	7	5.0%
Cardiac disease	7	5.0%
Severe Anemia	6	3.75%
Rh incompability	6	3.75%
TOTAL	150	100%

The majority of adverse perinatal outcomes in developing countries are placental-associated diseases.
Hypertension during pregnancy results in uteroplacental insufficiency. It is considered a major contributing factor in adverse post-delivery outcomes such as newborn intensive care unit (NICU) admission, low birth weight, birth asphyxia, preterm birth, perinatal death, intrauterine growth restriction and stillbirth. [3]

Table 2: Comparison of Doppler indices in various high risk Pregnancies

Sr. No.	Total No. of patient of high risk pregnancies having abnormal doppler indices	Abnormal flow in umbilical artery (No. of patients)	Abnormal flow in uterine artery(No. of patients)	Abnormal flow in both arteries (umbilical and uterine) (No. of patients)	Abnormal flow in middle Cerebral Artery (No. of patients)
1	GHTN(44)	37	26	17	26
2	Chronic hypertension(9)	7	5	4	4
3	DM(8)	8	8	8	2
4	Twins(4)	4	4	4	-
5	Cardiac disease(2)	1	-	-	1
6	Severe anaemia(2)	-	2	-	2
Total	69				
Percentage	(46.25%)	(82.6%)	(65.21%)	(49.27%)	(50.72%)

In the present study 69(46.25%) patients out of 150 patients had abnormal Doppler whereas 81(53.75%) had normal Doppler. Among abnormal Doppler abnormalities like, high pulsatile index (PI), ARDEV (Absent/Reversal of end diastolic flow), CPR<1 (Cerebroplacental ratio) were found.

Table 3: Abnormal Color Doppler flow indices and gestational age at diagnosis (n-150) (n-69)

Gestational age	No of patients	Abnormal doppler
<= 34 weeks	86	56(81%)
>34 weeks	64	13(19%)

Doppler has the ability to detect fetus stress in utero at younger gestational age. Thus timely intervention at younger gestational age can improve perinatal outcome. Doppler investigation of umbilical artery in combination with middle cerebral artery seems to improve prediction of adverse outcome in near-term pregnancies. [4]

Table 4: Association of oligohydramnios and FGR with Doppler Flow Indices (n-150)

Doppler Study	AFI<5 cm (n=38) in the present study	FGR (n=56) in the present study	FGR(n=43) Shah et al. study [5]
Abnormal doppler indices	25(65.0%)	41(73.33%)	38(88%)
Normal doppler indices	13(35.00%)	15(26.67%)	5(12%)

Thus from above table, we can say that it is very important to carry out a Doppler study of all high risk pregnancies to find FGR cases with abnormal doppler and successive follow up with doppler till delivery.[6]

Table 5: Route of Delivery and Doppler Indices (n-150)

Doppler Study	Present study Vaginal Route (n=78)	Present study LSCS (n=72)	Messawa et al. - Vaginal route (n=100) (Total patients=200)	Messawa et al. LSCS(n=100)
Abnormal diastolic flow (69)	21(32.43%)	48(67.56%)	24(24%)	76(76%)
Normal Diastolic flow(n=81)	57(71.8%)	24(28.39%)	78(78%)	22(22%)

In the present study, out of 150 patients of high-risk pregnancies, 81 patients with normal diastolic flow, 57(71.8%) patients delivered vaginally and 24(28.39%) delivered by LSCS.

Out of 150 patients of high-risk pregnancies, 48(67.56%) patients of abnormal Doppler delivered by emergency/elective cesarean to salvage hypoxic fetuses with AREDV and abnormal Doppler, and 21(32.43%) patients delivered vaginally. Which corresponds to a study done by messawa [7], in which 76% patients of abnormal Doppler flow indices were delivered by LSCS and 24% of patients delivered by vaginal route.

Table 6: Association of Doppler Indices and Perinatal Outcome (n-150)

Doppler Indices	Live Birth	Live Birth Percentage	Expired	Percentage
Normal(n=81)	79	97.67%	2	2.32%
Abnormal(n=69)	41	59.45%	28	40.54%

In the present study, 28(40.54%) patients with abnormal Doppler had poor neonatal outcome. Whereas 79(97.67%) high risk pregnancies with normal Doppler had a good perinatal outcome, in which only 2(2.32%) babies expired out of 81.

Discussion

The present study was conducted from January 2023 to December 2024 in the department of obstetrics and gynecology at a tertiary care teaching hospital, involving 150 patients. The commonest indication for Doppler in present study was hypertensive disorder of pregnancy of which 81 cases were of GHTN, 19 of chronic Hypertension followed by DM (13), Postdatism (11), Twin Pregnancy (7), Cardiac Disease (7), severe anemia (6), Rh incompatibility (6). From which Abnormal Doppler flow in present study was 46.25% (69 patients) Out of 69 cases of high-risk pregnancies having abnormal flow indices about 82.60% had abnormality in umbilical artery flow and 65.21% had abnormal uterine flow, while 49.27% had abnormality in both. In the present study 67.56% patients with abnormal Doppler flow required delivery by caesarean section. Incidence of neonatal death (40.54%) was higher in patients with abnormal diastolic flow than normal Doppler indices (2.32%). Incidence of perinatal mortality in patients with both abnormal uterine and umbilical Doppler was 37.76% reflecting the severely compromised state of the fetus.

Conclusion

Color Doppler ultrasound is a multifaceted tool in prediction and management of high risk pregnancies non-invasively. Color Doppler ultrasound facilitates the assessment of uteroplacental and fetoplacental circulation, enabling early identification of abnormalities and detecting circulatory disturbances, including fetal hypoxia, blood flow redistribution, cerebral edema, acidosis, and cardiac decompensation.

Among the various Doppler parameters, umbilical artery Doppler is particularly predictive of perinatal outcomes. The presence of absent or Reversed End-Diastolic Velocity (AREDV) in the umbilical artery is of primary clinical significance. Additionally, a low cerebroplacental ratio (CPR < 1) is recognized as a sensitive, acute predictor of adverse perinatal outcomes. Doppler ultrasound serves as a vital decision-making tool. Regular follow-up of those with abnormal findings is essential for early detection of fetal compromise and for guiding timely obstetric interventions to improve perinatal outcomes. Doppler velocimetry is the key for early detection, monitoring and timely decision making in management of high risk pregnancies.

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