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### Key Words

High-risk Pregnancy, ultrasonography, color doppler, fetal outcome, intrauterine growth restriction, prenatal monitoring, fetal biometry, umbilical artery doppler, middle cerebral artery doppler

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**Received:** 1 May 2024

**Accepted:** 28 May 2024

**Published:** 11 July 2024

**Citation:** Sarita Jha, 2024. Role of Ultrasonography and Color Doppler in the Assessment of High-Risk Pregnancies and their Accuracy in Predicting Fetal Outcome. Res. J. Med. Sci., 18: 101-104, doi: 10.36478/makrjms.2024.8.101.104

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## Role of Ultrasonography and Color Doppler in the Assessment of High-Risk Pregnancies and their Accuracy in Predicting Fetal Outcome

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### Abstract

High-risk pregnancies require meticulous monitoring to ensure maternal and fetal well-being. Ultrasonography (USG) and Color Doppler are invaluable tools in the assessment of such pregnancies, providing critical information on fetal development, placental function and uterine blood flow. This study aims to evaluate the role of USG and Color Doppler in high-risk pregnancies and their accuracy in predicting fetal outcomes. A prospective study was conducted on 100 high-risk pregnant women from May 1, 2022, to April 30, 2023, at the Department of Radiology, Darbhanga Medical College and Hospital, Darbhanga. Inclusion criteria encompassed pregnancies complicated by factors such as preeclampsia, gestational diabetes, intrauterine growth restriction (IUGR) and previous adverse pregnancy outcomes. Each participant underwent routine USG and Color Doppler examinations. Parameters assessed included fetal biometry, amniotic fluid index, umbilical artery Doppler indices and middle cerebral artery Doppler indices. Fetal outcomes were recorded at birth and compared with the prenatal findings. Out of 100 high-risk pregnancies, 70% exhibited abnormal Doppler findings. Of these, 60% were diagnosed with IUGR, 25% with oligohydramnios and 15% with altered umbilical artery resistance indices. The sensitivity and specificity of USG combined with Color Doppler in predicting adverse fetal outcomes were 85% and 90%, respectively. The positive predictive value (PPV) was 88%, and the negative predictive value (NPV) was 87%. Fetal distress at birth correlated significantly with abnormal Doppler findings ( $p < 0.05$ ). USG and Color Doppler are effective in the early detection of fetal compromise in high-risk pregnancies. These modalities provide crucial information that aids in the timely intervention, potentially improving fetal outcomes. Routine incorporation of these imaging techniques in the management of high-risk pregnancies is recommended to enhance prenatal care and fetal surveillance.

## INTRODUCTION

High-risk pregnancies pose significant challenges to both maternal and fetal health, necessitating vigilant monitoring and timely interventions to prevent adverse outcomes. The advent of advanced imaging techniques, such as ultrasonography (USG) and Color Doppler, has revolutionized prenatal care by enabling detailed assessment of fetal well-being and placental function. These tools are particularly valuable in high-risk pregnancies, where early detection of complications can lead to better management and improved outcomes.

USG is a non-invasive imaging modality that provides real-time visualization of fetal anatomy, biometry, and amniotic fluid volume. It plays a crucial role in diagnosing conditions such as intrauterine growth restriction (IUGR), oligohydramnios and congenital anomalies<sup>[1]</sup>. Complementing USG, Color Doppler ultrasonography offers detailed insights into fetal and placental blood flow dynamics, helping to identify compromised pregnancies through parameters like umbilical artery resistance indices and middle cerebral artery Doppler studies<sup>[2]</sup>.

Several studies have highlighted the importance of these imaging techniques in the management of high-risk pregnancies. For instance, abnormal Doppler findings have been associated with increased perinatal morbidity and mortality, underscoring the need for regular surveillance in this population<sup>[3,4]</sup>. The integration of USG and Color Doppler in routine prenatal care for high-risk pregnancies allows for early intervention, which can significantly improve fetal outcomes.

This study aims to evaluate the role of USG and Color Doppler in the assessment of high-risk pregnancies and their accuracy in predicting fetal outcomes. By analyzing data from 100 high-risk pregnancies monitored at the Department of Radiology, Darbhanga Medical College and Hospital, we seek to establish the diagnostic value of these modalities and their impact on clinical decision-making.

## MATERIALS AND METHODS

**Study Design and Setting:** This prospective study was conducted at the Department of Radiology, Darbhanga Medical College and Hospital, Darbhanga, from May 1, 2022, to April 30, 2023. The study aimed to evaluate the role of ultrasonography (USG) and Color Doppler in the assessment of high-risk pregnancies and their accuracy in predicting fetal outcomes.

**Study Population:** The study included 100 high-risk pregnant women who met the inclusion criteria. High-risk pregnancies were defined as those complicated by conditions such as preeclampsia, gestational diabetes, intrauterine growth restriction

(IUGR), oligohydramnios, polyhydramnios and a history of previous adverse pregnancy outcomes. Participants were selected through convenience sampling from the antenatal clinic.

### Inclusion Criteria:

- Pregnant women diagnosed with high-risk conditions.
- Gestational age between 20 and 40 weeks.
- Willingness to participate in the study and provide informed consent.

### Exclusion Criteria:

- Pregnancies with known major congenital anomalies.
- Multiple pregnancies (twins or more).
- Patients unwilling to participate or follow-up.

**Data Collection:** Upon enrollment, detailed medical and obstetric histories were recorded. Each participant underwent a comprehensive USG and Color Doppler examination at the time of inclusion and as per clinical indications during the pregnancy.

**Ultrasonography:** USG was performed using a high-resolution ultrasound machine with a 3.5-5 MHz transducer. Parameters assessed included fetal biometry (biparietal diameter, head circumference, abdominal circumference, and femur length), amniotic fluid index (AFI) and placental location and maturity.

**Color Doppler Ultrasonography:** Color Doppler studies were conducted to evaluate fetal and placental blood flow. Parameters assessed included:

- Umbilical artery Doppler indices (systolic/diastolic ratio, pulsatility index and resistance index).
- Middle cerebral artery Doppler indices (pulsatility index and resistance index).
- Uterine artery Doppler (pulsatility index and resistance index).

**Outcome Measures:** The primary outcome was the accuracy of USG and Color Doppler in predicting adverse fetal outcomes, defined as low birth weight, preterm birth, fetal distress, and perinatal mortality. Fetal outcomes were recorded at birth and compared with prenatal findings.

**Statistical Analysis:** Data were analyzed using statistical software. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of USG and Color Doppler in predicting adverse fetal outcomes were calculated. The association

**Table 1: Ultrasonography Findings**

Parameter	Number of Cases (n=100)
Normal Biometry	40
Intrauterine Growth Restriction (IUGR)	60
Oligohydramnios	25
Polyhydramnios	10
Placental Abnormalities	15

**Table 2: Color Doppler Findings**

Doppler Parameter	Normal Range	Abnormal Findings (n=100)
Umbilical Artery S/D Ratio	<3	30
Umbilical Artery Resistance Index (RI)	<0.6	25
Middle Cerebral Artery PI	>1.5	20
Uterine Artery PI	<1.2	35

**Table 3: Fetal Outcomes**

Outcome	Number of Cases (n=100)
Normal Birth Weight	50
Low Birth Weight	50
Preterm Birth	30
Term Birth	70
Fetal Distress at Birth	40
Perinatal Mortality	10

**Table 4: Diagnostic Accuracy of USG and Color Doppler**

Measure	Value (%)
Sensitivity	85
Specificity	90
Positive Predictive Value (PPV)	88
Negative Predictive Value (NPV)	87

between Doppler findings and fetal outcomes was assessed using chi-square tests, with a  $p < 0.05$  considered statistically significant.

**Ethical Considerations:** The study protocol was approved by the Institutional Ethics Committee of Darbhanga Medical College and Hospital. Informed consent was obtained from all participants after explaining the study's purpose and procedures.

## RESULTS AND DISCUSSIONS

Out of the 100 high-risk pregnancies assessed in this study, significant findings were observed in various ultrasonography (USG) and Color Doppler parameters. These findings were analyzed to determine their correlation with fetal outcomes.

**Analysis of Doppler Findings and Fetal Outcomes:** The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of USG and Color Doppler in predicting adverse fetal outcomes were calculated based on the collected data.

Abnormal Doppler findings were significantly correlated with adverse fetal outcomes. For example, among the 30 cases with abnormal umbilical artery S/D ratio, 25 (83%) had low birth weight and 15 (50%) experienced fetal distress at birth. A chi-square test indicated a significant association between abnormal Doppler parameters and adverse fetal outcomes ( $p < 0.05$ ).

These results underscore the importance of USG and Color Doppler in the early detection and management of complications in high-risk pregnancies,

facilitating timely interventions and potentially improving fetal outcomes.

The assessment of high-risk pregnancies is crucial for ensuring maternal and fetal well-being. This study aimed to evaluate the role of ultrasonography (USG) and Color Doppler in predicting adverse fetal outcomes in high-risk pregnancies. The findings indicate that these imaging modalities are highly effective in detecting fetal compromise, thereby facilitating timely interventions.

USG is a fundamental tool in obstetric care, providing essential information on fetal biometry, amniotic fluid volume and placental morphology. In this study, USG identified intrauterine growth restriction (IUGR) in 60% of the cases, underscoring its utility in monitoring fetal growth<sup>[1]</sup>. Similarly, oligohydramnios was detected in 25% of the cases, which aligns with previous studies highlighting the significance of amniotic fluid volume as a predictor of adverse outcomes<sup>[2]</sup>.

Color Doppler ultrasonography enhances the diagnostic capabilities of standard USG by assessing fetal and placental blood flow. Abnormal Doppler findings, such as elevated umbilical artery resistance indices and altered middle cerebral artery pulsatility indices, were significantly associated with adverse fetal outcomes in our study. Specifically, 30% of the cases showed abnormal umbilical artery S/D ratios, which correlated with low birth weight and fetal distress. These findings are consistent with existing literature, where abnormal Doppler indices are linked to increased perinatal morbidity and mortality<sup>[3,4]</sup>.

The diagnostic accuracy of USG and Color Doppler in predicting adverse fetal outcomes was notable, with a sensitivity of 85% and a specificity of 90%. The positive predictive value (PPV) and negative predictive value (NPV) were 88% and 87%, respectively. These values suggest that USG and Color Doppler are reliable tools for identifying high-risk pregnancies that may benefit from closer monitoring and intervention. This is corroborated by other studies that report similar diagnostic accuracy in predicting adverse perinatal outcomes<sup>[5,6]</sup>.

The significant association between abnormal Doppler parameters and adverse fetal outcomes emphasizes the importance of incorporating these imaging techniques into routine prenatal care for high-risk pregnancies. Early detection of compromised fetal conditions allows for timely management, which can include closer surveillance, early delivery, or other interventions aimed at improving fetal and maternal outcomes<sup>[7]</sup>.

Despite the strengths of this study, certain limitations must be acknowledged. The sample size was relatively small and the study was conducted at a single center, which may limit the generalizability of the findings. Future research should include larger, multicenter studies to validate these results and explore the potential of integrating other advanced imaging modalities in the assessment of high-risk pregnancies.

## CONCLUSION

In conclusion, USG and Color Doppler are invaluable tools in the management of high-risk pregnancies. Their ability to detect fetal compromise early enables timely interventions, potentially improving perinatal outcomes. Routine use of these imaging techniques in high-risk pregnancies is recommended to enhance prenatal care and fetal surveillance.

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