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To evaluate the role of ultrasonography in management of high-risk pregnancy

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Abstract
High-risk pregnancies contribute significantly to maternal and fetal complications. This study assesses the role of ultrasonography, including Doppler imaging, in managing such pregnancies. Conducted on 50 high-risk pregnant women, the study found a strong correlation between abnormal Doppler findings and adverse fetal outcomes. The findings support ultrasonography as a crucial tool for early diagnosis and intervention in high-risk pregnancies.

Keywords: High-risk pregnancy, ultrasonography, Doppler studies, maternal outcome, fetal outcome, intrauterine growth restriction, pregnancy complications

Introduction

Pregnancy is a complex physiological state, and while many pregnancies proceed without complications, a significant number are classified as high-risk due to various medical or obstetric conditions. High-risk pregnancies (HRPs) are those in which the mother, fetus, or both face increased risks of morbidity or mortality. Conditions contributing to HRP include anemia, hypertension, diabetes mellitus, hypothyroidism, renal disease, and multiple gestations. Ultrasonography (USG) has become an indispensable tool in the management of HRPs. It allows real-time, non-invasive assessment of fetal growth, amniotic fluid volume, placental location, and vascular flow dynamics through Doppler imaging. The technique is especially vital for early detection of intrauterine growth restriction (IUGR), fetal anomalies, and placental insufficiency.

The integration of routine USG and Doppler assessments during antenatal care enables clinicians to plan timely interventions, such as hospitalization, medical therapy, or elective delivery. In resource-limited settings, however, accessibility to high-quality imaging remains a barrier, emphasizing the need for targeted research.

Materials and Methods

This prospective observational study was conducted in the Department of Radiodiagnosis at a tertiary care government hospital in Jamnagar, Gujarat. The study was carried out over a 14-month period, from March 2024 to April 2025, and included 50 pregnant women who were classified as high-risk based on medical and obstetric parameters. Participants were enrolled using a consecutive sampling method. Inclusion criteria targeted women aged 18 years or above with gestational ages between 24 and 40 weeks and presenting with predefined high-risk factors such as anemia, hypertensive disorders, diabetes mellitus, hypothyroidism, renal disease, Rh incompatibility, obesity, underweight, elderly primigravida, grand multiparity, and preeclampsia/eclampsia.

A semi-structured, pre-tested questionnaire was administered to collect socio-demographic information, medical and obstetric history, and menstrual patterns. Physical examinations included measurement of blood pressure using a mercury sphygmomanometer (3 readings averaged), random blood sugar using a glucometer, height using a portable stadiometer, and weight using a digital scale. BMI was calculated accordingly.

Ultrasonography was performed using the Samsung RS EVO80 ultrasound machine with a curvilinear probe. Assessments included gestational age estimation, amniotic fluid index (AFI), fetal biometry, placental position, and fetal well-being. Doppler studies included evaluation of uterine artery, umbilical artery, and middle cerebral artery (MCA) flow velocities.

Ethical clearance was obtained from the institutional ethical committee prior to initiating data collection. Verbal informed consent was taken from each participant, and all data were anonymized and securely stored. Data were analyzed using Jamovi statistical software (version 2.3.28). Descriptive statistics were computed for all variables, and associations were evaluated using Fisher's exact test, with significance set at $p < 0.05$.

Inclusion Criteria

- High-risk pregnant females (GA 24–40 weeks)
- Medical factors: anemia (Hb < 10), hypertension, diabetes, hypothyroidism, renal disease, Rh incompatibility, obesity (BMI > 25), underweight (BMI < 18)
- Obstetric factors: elderly primigravida, grand multipara, recurrent pregnancy loss, preterm labor, pre-eclampsia/eclampsia, gestational diabetes
- Trauma-related cases
- Age >18 years with informed consent

Exclusion Criteria

- Women who refused consent
- Congenital anomalies or intrauterine fetal demise prior to admission

- Medical or obstetric conditions not listed in the inclusion criteria

Study Methodology Flowchart

Step 1: Study Planning and Ethical Clearance
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Step 2: Selection of High-Risk Pregnant Women (n = 50)
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Step 3: Informed Consent and QuestionnaireAdministration
↓
Step 4: Clinical and Biometric Assessments
↓
Step 5: Ultrasonography with Doppler (Uterine, Umbilical, MCA)
↓
Step 6: Data Entry and Statistical Analysis using Jamovi
↓
Step 7: Correlation of Doppler Findings with Maternal and Fetal Outcomes

Results

This section presents the analysis of demographic characteristics, biometric indices, Doppler findings, and their association with maternal and fetal outcomes among the 50 high-risk pregnant women included in the study.

Table 1: Age Distribution of Study Participants

Age Group (years)	Frequency	Percentage
≤20	6	12%
21–25	11	22%
26–30	13	26%
>30	20	40%

The majority of the study participants (40%) were aged above 30 years, indicating increased maternal age as a potential risk factor.

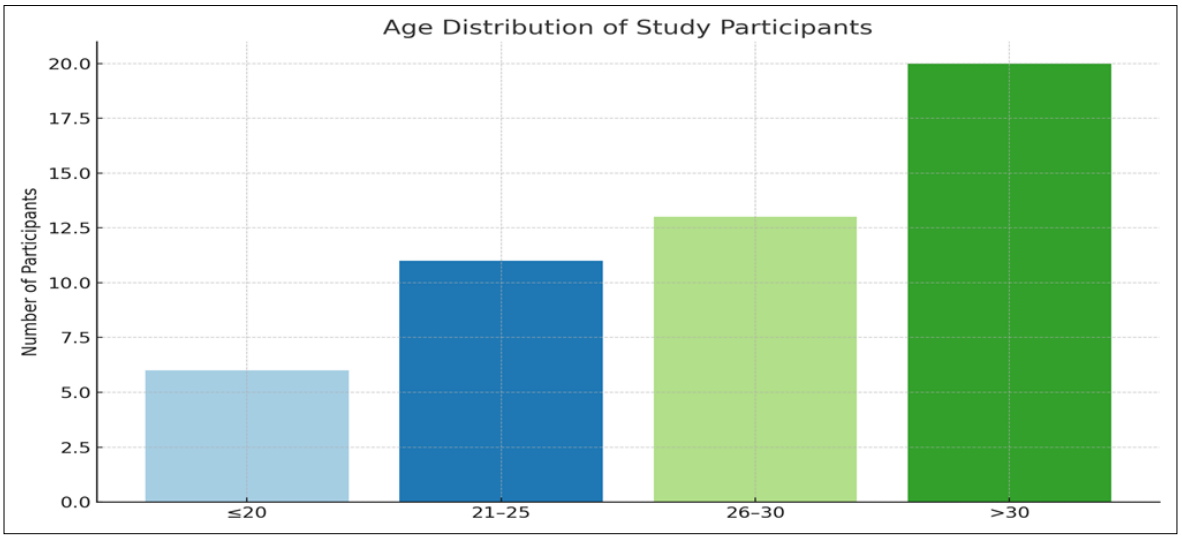


Fig 1: Age Distribution of Study Participants

Table 2: BMI Distribution of Study Participants

BMI Category	Frequency	Percentage
Underweight (<18.5)	13	26%
Normal (18.5–24.9)	35	70%
Overweight (25–29.9)	1	2%
Obese (≥30)	1	2%

The majority of study participants (70%) had a normal BMI, while 26% were underweight. A small percentage were classified as overweight or obese, highlighting a nutritional imbalance among the study population.

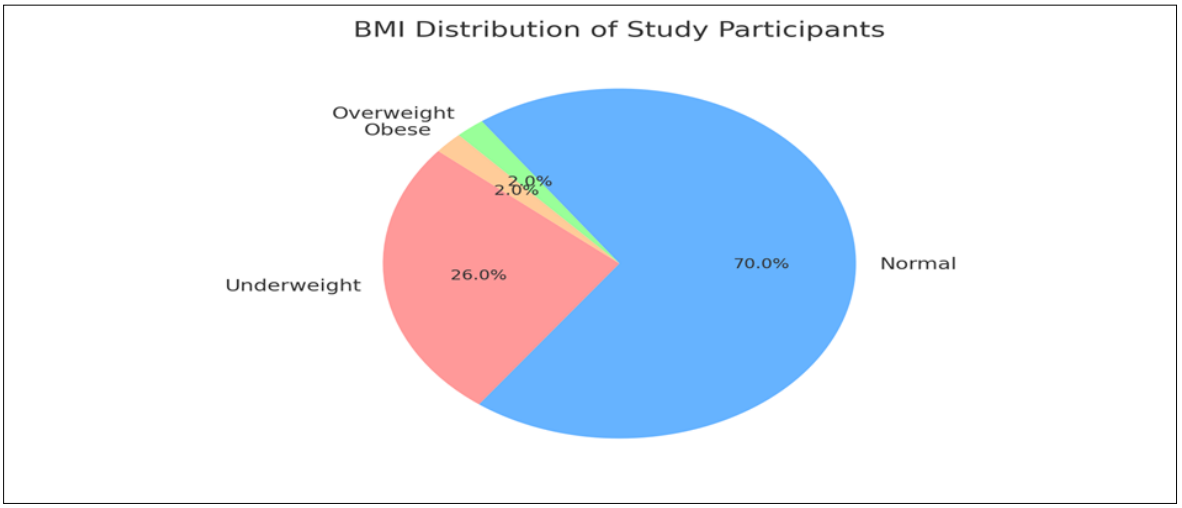


Fig 2: BMI Distribution of Study Participants

The pie chart below illustrates the BMI categories among the study participants:

A significant proportion of the participants were anemic, with 26% having severe anemia, which underscores the importance of nutritional and hematologic support during pregnancy.

Table 3: Distribution According to Anemia Severity

Severity	Frequency	Percentage
No Anemia	5	10%
Mild	17	34%
Moderate	15	30%
Severe	13	26%

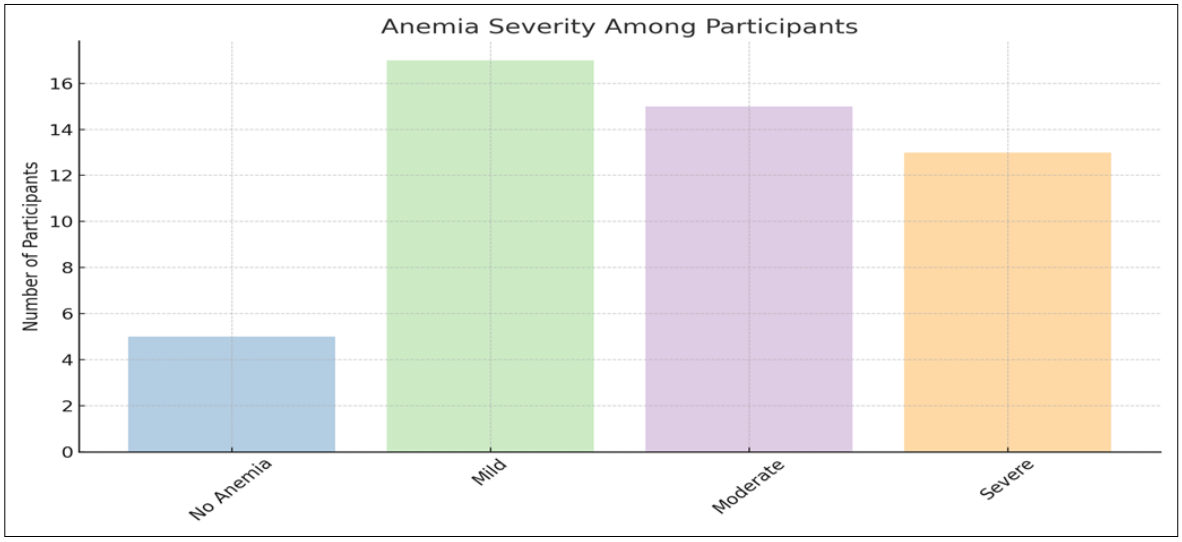


Fig 3: Anemia Severity Among Participants

Table 4: Umbilical Artery Doppler Findings vs Fetal Outcome

Doppler Finding	Healthy Baby	LBW	Fetal Death
Altered	4 (23.5%)	11 (64.7%)	4 (23.5%)
Normal	24 (72.7%)	6 (18.2%)	3 (9.1%)

This table highlights that altered umbilical artery Doppler findings were strongly associated with low birth weight and fetal death, whereas normal Doppler readings correlated with better outcomes.

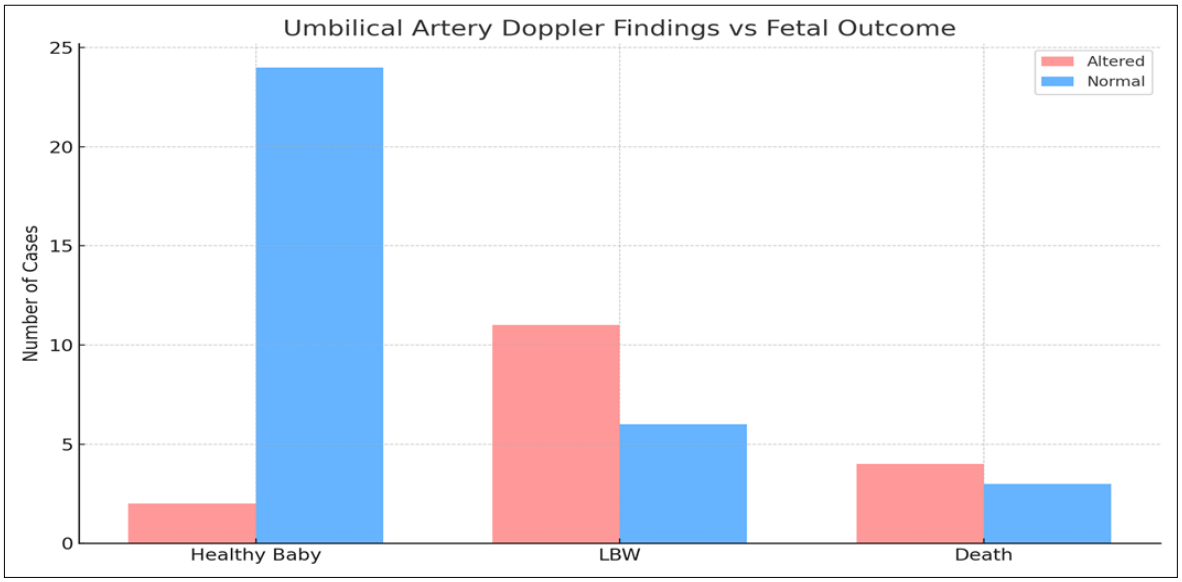


Fig 4: Umbilical Artery Doppler vs Fetal Outcome

This chart illustrates a strong association between altered umbilical artery Doppler findings and adverse fetal outcomes. Among altered cases, 64.7% resulted in low birth weight and 23.5% in fetal death.

In contrast, normal Doppler cases had better outcomes with 72.7% resulting in healthy babies.

Table 5: MCA Doppler Findings vs Fetal Outcome

Doppler Finding	Healthy Baby	LBW	Fetal Death
Altered	0 (0%)	3 (42.9%)	4 (57.1%)
Normal	26 (60.5%)	14 (32.6%)	3 (7.0%)

This table reveals a significant association between altered MCA Doppler findings and poor fetal outcomes. Notably, none of the altered MCA cases resulted in healthy babies, and the majority (57.1%) ended in fetal death. This highlights the prognostic significance of MCA Doppler in assessing fetal compromise.

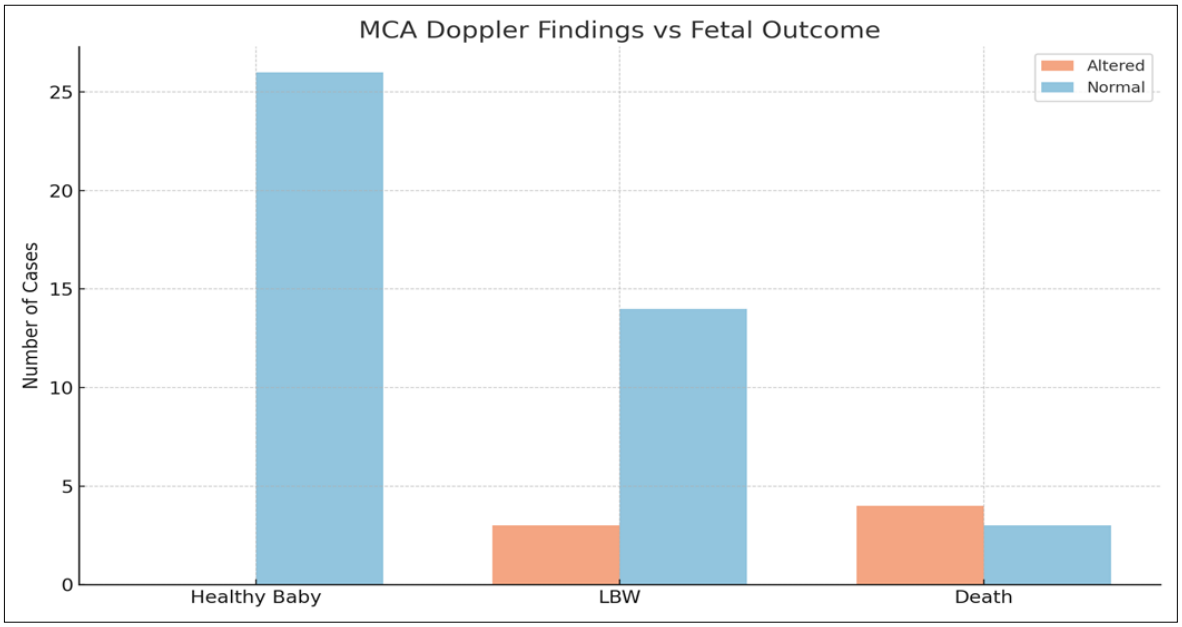


Fig 5: MCA Doppler Findings vs Fetal Outcome

This chart demonstrates a clear relationship between altered MCA Doppler findings and adverse fetal outcomes. All cases with altered MCA Doppler results resulted in either low birth weight (42.9%) or fetal death (57.1%). None resulted in a healthy outcome, suggesting its strong prognostic utility in detecting fetal compromise.

Table 6: Uterine Artery Doppler Findings vs Fetal Outcome

Doppler Finding	Healthy Baby	LBW	Fetal Death
Altered	13 (56.5%)	7 (30.4%)	3 (13%)
Normal	13 (48.1%)	10 (37%)	4 (14.8%)

Although there was no statistically significant association, altered uterine artery Doppler findings showed a trend toward increased incidence of low birth weight and fetal death.

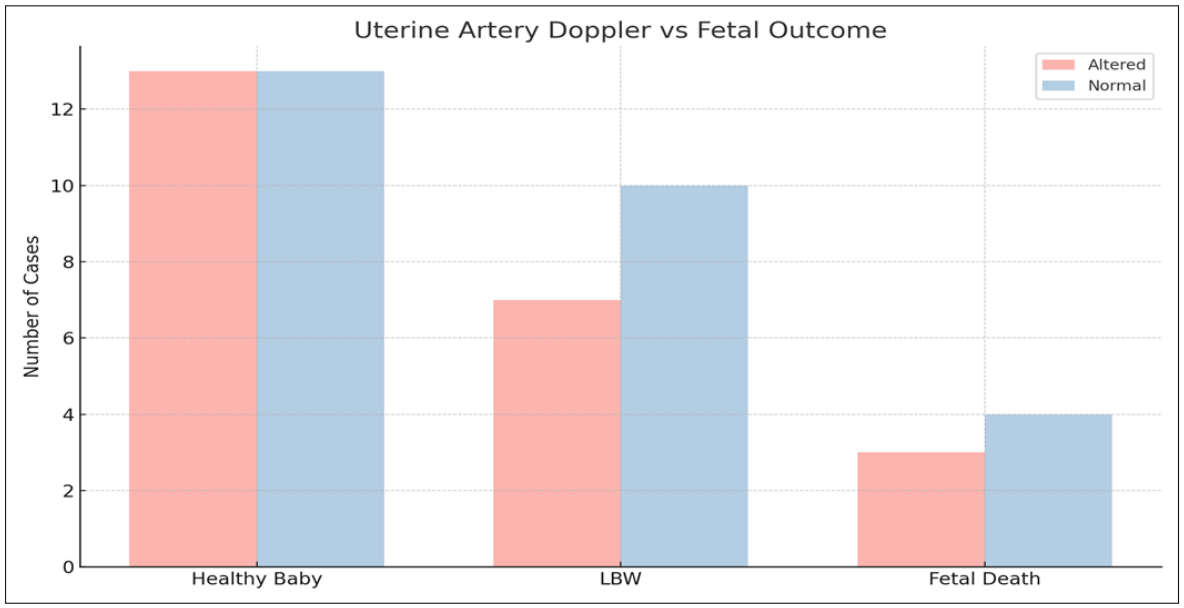


Fig 6: Uterine Artery Doppler vs Fetal Outcome

Table 7: Uterine Artery Doppler Findings vs Maternal Outcome

Doppler Finding	Vaginal Delivery	LSCS	Induction	MTP
Altered	17 (73.9%)	3 (13%)	2 (8.7%)	1 (4.3%)
Normal	8 (29.6%)	11 (40.7%)	6 (22.2%)	2 (7.4%)

This table demonstrates that altered uterine artery Doppler findings were associated with a greater frequency of vaginal deliveries. In contrast, normal Doppler findings showed a higher rate of caesarean sections and inductions.

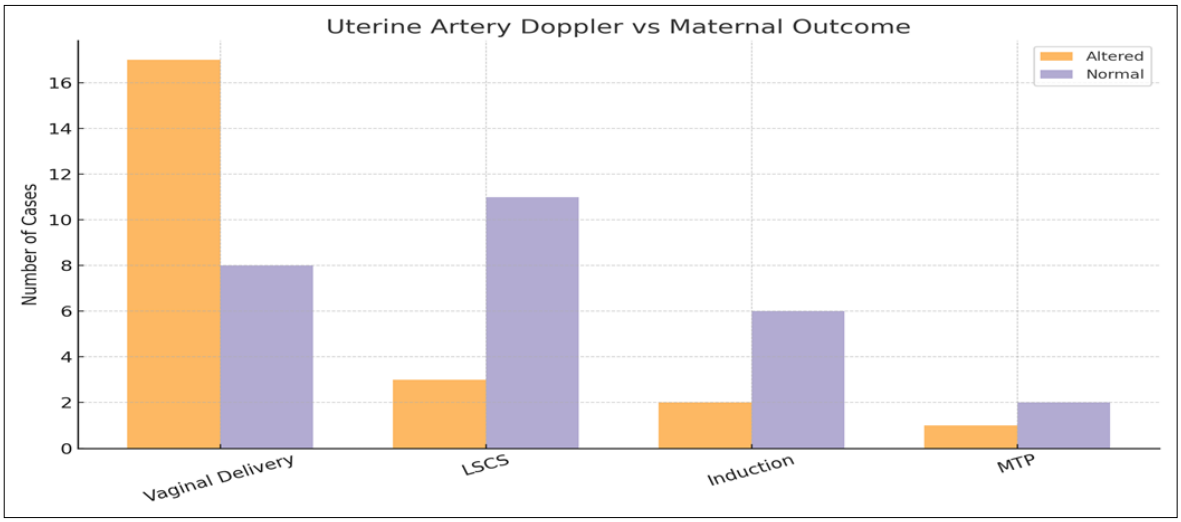
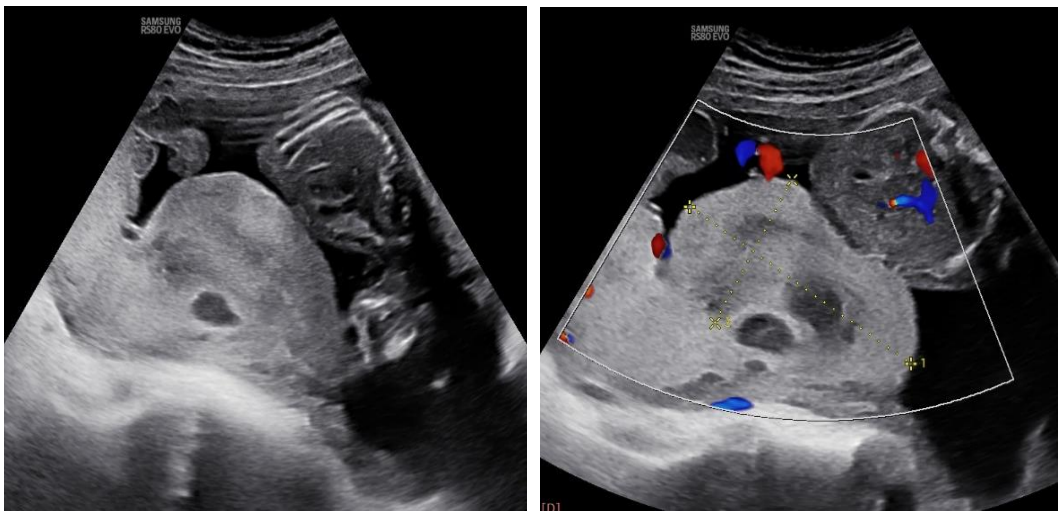


Fig 7: Uterine Artery Doppler vs Maternal Outcome

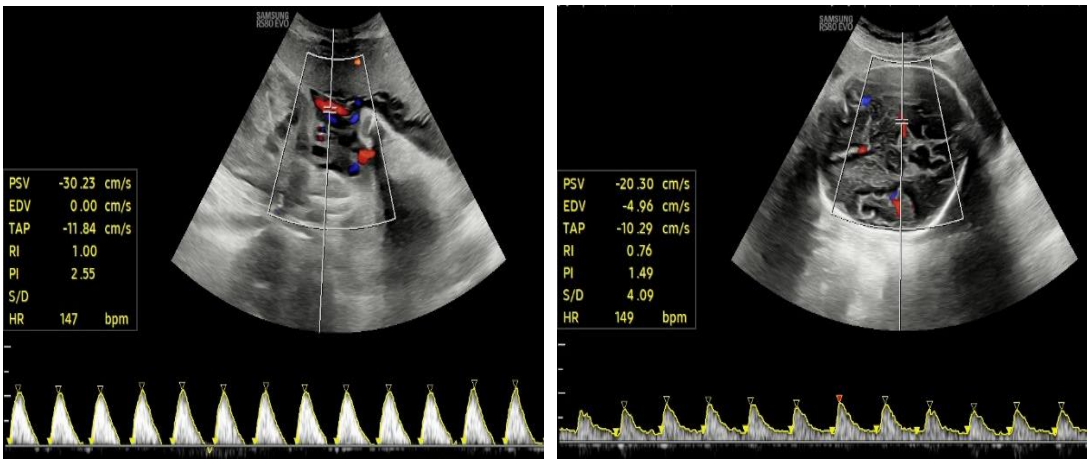
The graph supports the observation that altered uterine artery Doppler findings were linked with increased vaginal delivery rates, while normal Doppler findings correlated more with operative and induced deliveries.

Case Images

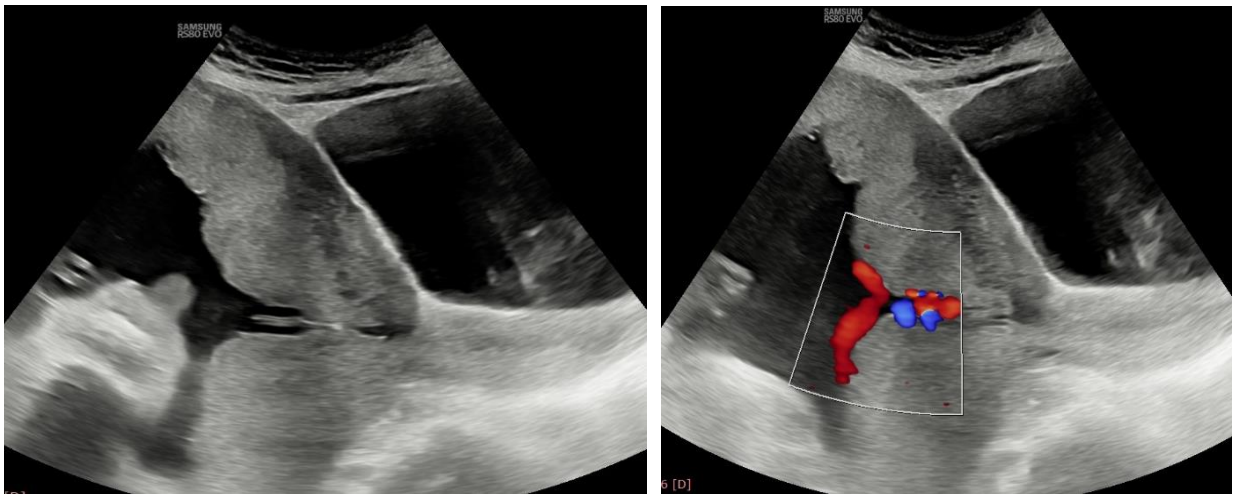
1. Subchorionic Hematoma



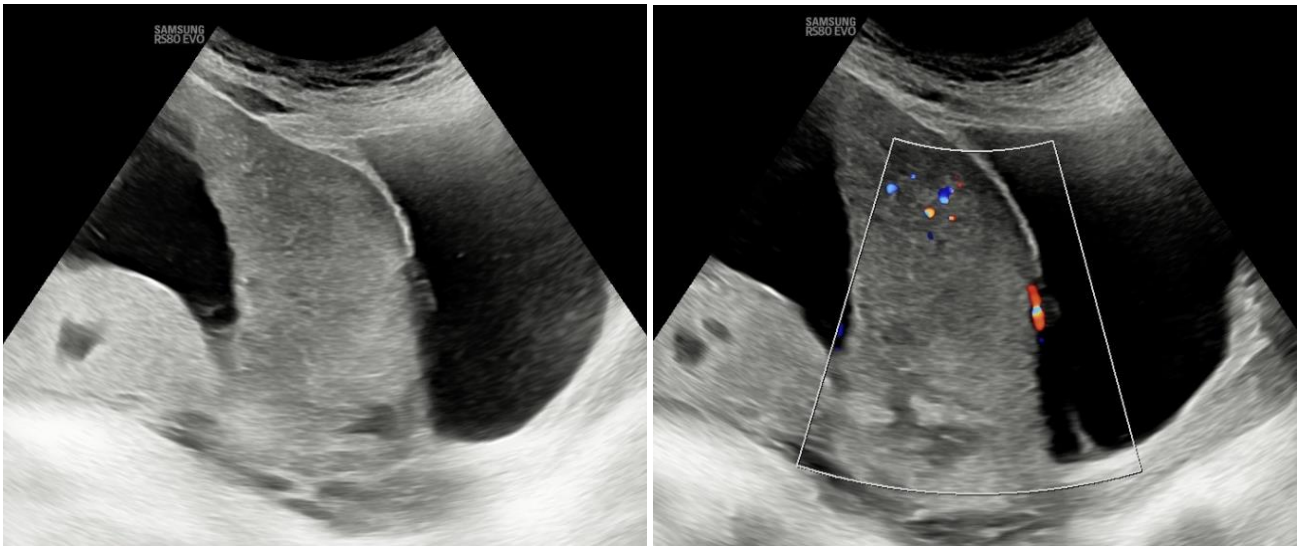
2. High Resistance Umbilical Artery Doppler with Absent end Diastolic Flow and CPR > 1



3. Grade 3 Placenta Previa with Vasa Previa



4. Grade 4 Placenta Previa



5. Grade 4 Placenta Previa with Placenta Increta

6. High Resistance Umbilical Artery Doppler With Cpr Ratio >1

7. Retroplacental Hematoma

Discussion

This prospective study evaluated the role of ultrasonography, particularly Doppler imaging, in the management of high-risk pregnancies. The findings underscore the diagnostic value of fetal Doppler studies, especially umbilical and middle cerebral artery (MCA) waveforms, in predicting adverse fetal outcomes such as low birth weight (LBW) and intrauterine fetal demise. A strong correlation was noted between altered Doppler indices and poor fetal outcomes. Specifically, altered umbilical artery Doppler was associated with a significantly higher incidence of LBW (64.7%) and fetal death (23.5%). Altered MCA Doppler showed the most dramatic findings, with 57.1% resulting in fetal death and none resulting in a healthy outcome. These results are in alignment with previously published studies by Alfirevic *et al*. (2017) [3] and ACOG guidelines, emphasizing the importance of Doppler in fetal surveillance.

The study population also showed a high prevalence of anemia (90%), and a considerable proportion (26%) were severely anemic. This, coupled with the presence of growth restriction and hypertensive disorders, reflects the multifactorial nature of high-risk pregnancies in low-resource settings.

While uterine artery Doppler did not show statistically significant associations with fetal or maternal outcomes, it did reveal trends that warrant further exploration with a larger sample size.

Overall, the use of ultrasonography allowed early detection of complications and enabled timely clinical interventions, contributing to improved perinatal outcomes.

Conclusion

Ultrasonography, particularly when integrated with Doppler velocimetry of the uterine, umbilical, and MCA arteries, is a vital tool in the management of high-risk pregnancies. It

facilitates timely diagnosis of fetal compromise, growth restriction, and placental insufficiency. The incorporation of such imaging modalities into routine antenatal care can significantly reduce perinatal morbidity and mortality. Given the high prevalence of anemia and other comorbidities observed in this study, a comprehensive approach including nutritional support, serial imaging, and individualized delivery planning is recommended for all high-risk pregnancies.

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