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Clinical Study of Foetal and Maternal Outcomes in Patients With Abnormal Antenatal Doppler Changes in Rural Tertiary Health Center

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ABSTRACT

Abnormal antenatal Doppler changes play a vital role in evaluating the foetus's and mother's health. These changes can indicate placental insufficiency and fetal hypoxia, which may lead to maternal and fetal complications. Also, they can be detected using Doppler ultrasonography, a non-invasive imaging technique that assesses the blood flow in the umbilical artery, uterine artery and ductus venosus. By closely monitoring these Doppler changes, doctors can intervene early, significantly enhancing the well-being of both the mother and the child. This study aimed to assess the fetal and maternal outcomes among patients with abnormal antenatal Doppler changes within a rural tertiary health center.35 pregnant participants with abnormal antenatal Doppler changes were included in this retrospective clinical study. Comprehensive assessments of both maternal and fetaloutcomesincluding gestational age at delivery, birth weight, mode of delivery and maternal complications were carried out. The mean age of the mothers in the study was 25 years. The mean gestational age at delivery was 37 weeks and the mean birth weight was 2558 grams. The most common mode of delivery wasa cesarean section, in 31 cases (88.6%). Maternal complications reported were preeclampsia (3, 8.6%), gestational hypertension (4, 11.4%), gestational diabetes mellitus (3, 8.6%) and hypothyroidism (1, 2.8%). Also, 12 (34.3%) experienced respiratory distress among the newborns. This study highlights the vital role of antenatal Doppler assessments in the early detection and monitoring of abnormal changes. Conducted in a rural tertiary health center, it emphasizes the significance of such evaluations in resource-limited settings. The high prevalence of cesarean sections underscores the necessity for specialized interventions, emphasizing the urgency for tailored care protocols.

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Key Words
Clinical, maternal, antenatal doppler, rural tertiary

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INTRODUCTION

Pregnancy involves a complex interplay of physiological processes, demanding thorough monitoring to ensure the well-being of both the mother and the developing fetus. Intrauterine growth restriction (IUGR), marked by fetal growth below anticipated potential[1], is a serious concern for healthy pregnancy, impacting around 5-10% of all pregnancies worldwide[2].When there is a dysfunction of placental vascular activity, itincreases resistance in the placenta's blood vessels, leading to inadequate uteroplacental perfusion. This results in placental insufficiency and compromises oxygen and glucose delivery, resulting in fetal hypoxia, hypoglycemia and ultimately, IUGR[3]. While numerous factors contribute to IUGR, uteroplacental insufficiency stands out as a major one among them and thus emerges as an independent risk factor linked to morbidity and mortality among both preterm neonates and mothers[4,5]. Also, IUGR, regardless of preterm birth, often results in low birth weight, the risk is higher when in combination with maternal conditions like preeclampsia or chronic diseases. IUGR is significantly more prevalent in developing countries compared to wealthier nations[6,7]. According to WHO, 20 million babies are born with low birth weight globally each year, with around 95% of these cases occurring in developing countries[8]. In India, one in every five infants was born with low birth weight[9]. These statistics underscore the necessity for effective early detection and management strategies especially in resource-poor settings.

In this context, the early identification of IUGR through antenatal monitoring becomes crucial, enabling optimized management and enhancing neonatal outcomes. A key player in this process is antenatal Doppler assessment, a valuable tool for evaluating placental blood flow and screening for several IUGR-associated complications. Doppler ultrasonography is a non-invasive diagnostic tool, that utilizes ultrasound waves combined with the Doppler effect to meticulously assess blood flow in crucial vessels like the umbilical artery, uterine artery and ductus venosus, providing clinicians with critical insights into the dynamics of maternal-fetal circulation[10,11].Early intervention based on Doppler interpretation can be for optimizing maternal and fetal outcomes. This approach probatively identifies potential complications and facilitates the implementation of tailored management plans, potentially altering the course of pregnancy care.

Thus, in this study we aim to assess the fetal and maternal outcomes among patients with abnormal antenatal Doppler changes attending antenatal care at the rural tertiary health centerThis will further shed light on the relationship between abnormal Doppler changes and pregnancy outcomes in a rural population, contributing valuable knowledge to the field of prenatal care.

MATERIALS AND METHODS

This retrospective observational study was conducted at AIMS,BG NAGARA from September 2022-2023.The inclusion criteria included pregnant women attending antenatal care at the rural tertiary health centerwith a singleton pregnancy and also diagnosedwith abnormal antenatal Doppler changes in at least one major fetal artery, such as the umbilical, middle cerebral, or ductus venosus. Exclusion criteria involved individuals with known fetal anomalies or chromosomal abnormalities, multiple pregnancies and those with a history of previous fetal interventions or surgeries that could impact Doppler readings.

Data Collection: All mothers satisfying the inclusion criteria and admitted to the labor room during the study period were invited to participate. Written informed consent was obtained before data collection. Data was retrieved from hospital case sheets. Low birth weight is defined by WHO as weight at birth of <2.5 kg[12]. The American College of Obstetricians and Gynaecologists (ACOG) defines gestational hypertension as sustained systolic blood pressure ≥140 mmHg or diastolic ≥90 mmHg after 20 weeks in a normotensive woman, measured on two separate occasions at least four hours apart. Preeclampsia, based on ACOG guidelines, includes this hypertension criterion alongside either ≥300mg protein excretion in 24 hours or a protein/creatinine ratio ≥0.3[13]. CXAny degree of glucose intolerance arising during pregnancy is classified as gestational diabetes mellitus[14].

Doppler Ultrasonography: All eligible participants had undergone standard antenatal Doppler ultrasonography examinations conducted by trained sonographers. Doppler was considered abnormal when,

Uterine Arteries

Elevated Resistance: Mean Resistance Index (RI) greater than 0.56 on the uterine artery side of the placenta; or Systolic/Diastolic (S/D) ratio exceeding 2.6.

Umbilical Artery

Increased Pulsed Flow: S/D ratio surpassing 3; or S/D value above the 95th percentile of reference values for gestational age. Absent or Reversed Diastolic Flow: AEDF (Absent End-Diastolic Flow) or REDF (Reversed End-Diastolic Flow) is present.

Middle cerebral Artery

Reduced Perfusion Ratio: MCA/UA Pulsatility Index (CPI) ratio falling below 2 standard deviations (SD) from the expected value. Decreased Systolic/Diastolic

Ratio: MCA/UA S/D ratio falling below 1.Data collected includes maternal characteristics and comorbidities, mode of delivery, days of NICU admission, gestational age, days of hospital stay, gender and weight of child, and neonatal complications. Gestational age was obtained based on the last menstrual period and first-trimester ultrasound scan. All the newborns were followed up for various neonatal complications.

Statistical Analysis: Data was entered into Microsoft Excel and analyzed using SPSS version 16. Descriptive statistics were performed. Continuous data were summarized using mean and standard deviation, while categorical data were summarized using frequency and proportion.

RESULTS AND DISCUSSIONS

A total of 35 mothers were included in the study. The mean (SD) age of the mothers was 24.5 (3.7). Table 1provides an overview of the characteristics of pregnant women in the study. The majority of participants were between the ages of 21-24 (45.7%), with the age group of 25-30 accounting for 31.4%. Oligohydramnios were present in 20% of participants, and the distribution of gravidity showed that 51.4% were G1, 31.4% were G2, 11.4% were G3 and 5.7% were G4. A history of abortions was noted in 14.3% of cases. Gestational hypertension, gestational diabetes mellitus (GDM) and pre-eclampsia were reported in 11.4%, 8.6% and 8.6% of cases, respectively. One (2.8%) had hypothyroidism. The median (IQR) number of days of hospital admission was 6 (2) days and the majority (57.1%) had a hospital stay of less than 7 days.

(Table 2) outlines the neonatal outcomes of the participants. Regarding gestational age, 37.1% of participants delivered before 37 weeks, while 62.9% delivered between 37 weeks and 40 weeks 2 days. The predominant mode of delivery was a Caesarean section (91.4%), with only 8.6% having a normal vaginal delivery. One baby died during the study. The gender distribution of the babies was almost equal, with 51.4% male and 48.6% female. The mean (SD) weight of the babies is 2.5 kg (0.6).Most babies (51.4%) weighed more than 2.5 kg and the majority (71.4%) were born at term. Also, 17 (48.6%) had low birth weight. The duration of NICU stay varied, with 60.0% not having NICU admission, 22.9% for 1-7 days and 14.3% for >7 days. Respiratory distress was observed in 12 (34.3%) of newborns. This retrospective observational study aimed to assess fetal and maternal outcomes in patients with abnormal antenatal Doppler changes in a rural tertiary health center. The findings provide valuable insights into the relationship between abnormal Doppler changes and pregnancy outcomes in a resource-limited setting.

This study included 35 mothers with a mean age of 25 years, with the majority falling within the age range of 21-24 years. Maternal complications included preeclampsia (8.6%), gestational hypertension (11.4%), gestational diabetes mellitus (8.6%) and hypothyroidism (2.8%). A study by Umesawa *et al*. reported the prevalence of gestational hypertension and pre-eclampsia to be 1.8-4.4% and 0.2-9.2% respectively[15]. According to the IDF Indian Diabetes Atlas, the overall global prevalence of GDM was 14.0% (95% CI- 13.97-14.04%), while in low- and middle-income countries, it was estimated to be 12.7% (11.0-14.6%) and 9.2% (9.0-9.3%) respectively[16].In India, this prevalence was reported to be 1.3% (1.1-1.5%)[17].However, this study, involving only 35 mothers, cannot be directly compared to these larger estimates due to sample size limitations.

Shenoy *et al*. conducted a similar study in Kerala among pregnant women with suspected fetal complications (fetal weight less than the 10th percentile). They compared various characteristics between groups with abnormal and normal Doppler findings, with 28 out of 82 participants in the Doppler abnormal group. Notably, they found that the mean birth weight for the abnormal Doppler group was 1.9 kg, and the mean NICU stay among them was 8 days. Also, fetal growth restriction, shorter decision-to-delivery interval, longer NICU stay and low birth weight were significantly associated with abnormal Doppler indices[18].

In terms of neonatal outcomes, our study revealed a mean gestational age at delivery of 37 weeks and a mean birth weight of 2.5 kg (0.6). Also, 48.6% had low birth weight. NFHS 5 (2019-21) reported the prevalence of low birth weight to be 17.1 % in India[9].Cesarean section was the most common mode of delivery (88.6%). This high prevalence of cesarean sections suggests the complexity and potential urgency associated with pregnancies marked by abnormal Doppler changes. According to NFHS 5 (2019-21), the caesarean section prevalence was found to be 21.5% which increased from 17.2% of NFHS 4 (2015-19)[19].While cesarean sections are often necessary for the well-being of both mother and child,

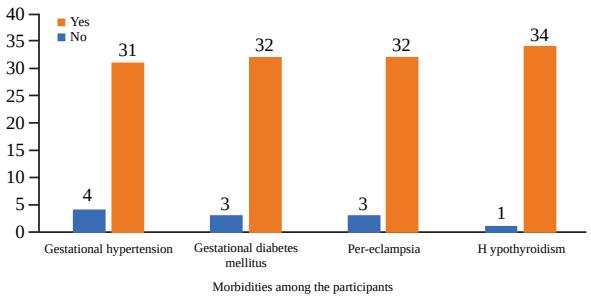

Fig. 1: Morbidities among pregnant women with abnormal antenatal Doppler changes attending antenatal care at the rural tertiary health center.

Table 1: Maternal characteristics of pregnant women with abnormal antenatal Doppler changes attending antenatal care at the rural tertiary health center

Characteristics	No.	Percentage
Maternal Age		
18-20	5	14.3
21-24	16	45.7
25-30	11	31.4
>30	3	8.6
Oligohydramnios		
Yes	7	20
No	28	80
Gravida		
G1	18	51.4
G2	11	31.4
G3	4	11.4
G4	2	5.7
Abortions		
Yes	5	14.3
No	30	85.7
Gestational hypertension		
Yes	4	11.4
No	31	88.6
Gestational diabetes mellitus		
Yes	3	8.6
No	32	91.4
Pre-eclampsia		
Yes	3	8.6
No	32	91.4
Gestational age		
<37 weeks	13	37.1
37-40 weeks 2 days	22	62.9
No. Of days of hospital stay		
<7	20	57.1
7-14	12	34.3
>14	3	8.6

Table 2: Neonatal outcomes of the participant's pregnant women with abnormal antenatal Doppler changes attending antenatal care at the rural tertiary health center

Characteristics	No.	Percentage
Type of Delivery		
Normal vaginal delivery	4	11.4
Cesarean Section	31	88.6
Gender of the baby		
Male	18	51.4
Female	17	48.6
Weight of the baby		
<1.5	3	8.6
1.5-2.4	14	40.0
>= 2.5	18	51.4
SGA		
Yes	17	48.6
No	18	51.4
Term of birth		
Preterm	3	8.6
Term	25	71.4
Late Term	7	20.0
Duration of nicu stay (days)		
0	21	60.0
1-7	8	22.9
>7	5	14.3
Respiratory distress		
Yes	12	34.3
No	23	65.7

their frequency prompts the consideration of tailored care protocols and the exploration of factors influencing the mode of delivery in this specific context. Also, it's important to note that this study was conducted in a tertiary care center serving as a referral point for high-risk pregnancies. Therefore, a higher occurrence of adverse neonatal and maternal outcomes is expected due to the nature of the population studied. Among newborns, 34.3% experienced respiratory distress, indicating potential challenges in neonatal adaptation. The duration of NICU stay varied, with 60.0% not requiring NICU admission, 22.9% staying for 1-7 days and 14.3% staying for >7 days. These findings highlight the importance of preparedness for neonatal complications and the need for adequate NICU facilities in the management of pregnancies with abnormal Doppler changes. Keshuraj *et al*. demonstrated that main pulmonary artery Doppler indices are relevant non-invasive tools for identifying babies at risk of respiratory distress[20].This paves the way for further research exploring the potential of Doppler assessments in comprehensive risk profiling of pregnancies, ultimately improving outcomes for both mothers and their babies.

This study shed light on the vital role of Doppler assessments in detecting and monitoring potential risks for both mothers and babies. Doppler ultrasonography offers a safe and painless way to examine blood flow between mother and baby, providing clinicians with critical insights into maternal-fetal circulation dynamics. Early intervention based on Doppler interpretation can significantly improve outcomes and regular Doppler assessments should be an essential part of routine prenatal care. Also, the setting being a rural area reinforces the importance of affordable and well-equipped healthcare facilities, readily available trained personnel and clear guidelines for managing pregnancies with abnormal Doppler changes. More research and dedicated resources are crucial to improve outcomes for mothers and babies affected by these findings, especially in regions with limited resources.

While limited by its small size and retrospective design, this study sheds light on the crucial role of Doppler assessments in resource-limited settings. Though focused on only 35 mothers, it reveals valuable insights into the association between abnormal Doppler changes and pregnancy outcomes in rural areas. While the observed rates of complications like low birth weight and C-sections may be influenced by the referral nature of the center, the emphasis on improved NICU preparedness and tailored care protocols for these high-risk pregnancies remains vital. Ultimately, this study calls for further research with larger samples to solidify findings and optimize care for mothers and babies affected by abnormal Doppler changes, especially in regions struggling with limited resources.

CONCLUSION

In a rural setting with limited resources, this study sheds light on the vital role of Doppler assessments in identifying high-risk pregnancies and optimizing outcomes for mothers and babies. Early detection of abnormal Doppler changes calls for strengthened NICU

preparedness and tailored care protocols to address potential complications like low birth weight and C-sections. Further research with larger samples is crucial to refine our understanding and improve care for pregnancies impacted by these findings, especially in resource-constrained regions.

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