e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(7); 1666-1680

Original Research Article

Color Doppler Imaging Study in High Risk Pregnancy during Antenatal Period and Its Perinatal Outcome at Tertiary Care Centre

Puja Shirgave[1], Kalpana Sukalkar[2], Maansi Kathaley[3], Aryan Shinde[4], Dhruv Deshmukh[5], Jeetendra Singh[6]

[1]Post Graduate Resident, Department of Obstetrics and Gynecology, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Adgaon, Nashik-422003

[2]Associate Professor, Department of Obstetrics and Gynecology, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Adgaon, Nashik-422003

[3]Professor and Head, Department of Obstetrics and Gynecology, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Adgaon, Nashik-422003

[4]Phase II MBBS, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Adgaon, Nashik422003

[5]Phase II MBBS, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Adgaon, Nashik 422003

[6]Professor and Head, Department of Pharmacology, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Adgaon, Nashik-422003

Received: 10-05-2023 / Revised: 13-06-2023 / Accepted: 25-07-2023

Corresponding author: Kalpana Sukalkar

Conflict of interest: Nil

Abstract:

Introduction: Assessment of fetal wellbeing in high risk pregnancy is done by various of methods which includes NST, biophysical profile and daily fetal movement. Color doppler imaging is receipt advance in ultrasound technology. Doppler velocimetry provides valuable information in detection of placental and fetal dysfunction since the haemodynamic changes in uteroplacental and fetal vessels.

Aim: 1. To study the role of color doppler imaging in high risk pregnancies.

2. To study perinatal outcome in high risk pregnancies.

Method: A total of 246 patients with High Risk Pregnancy underwent Doppler study after 28 weeks of gestation and were evaluated prospectively at our institute during study period. We recorded maternal age, gestational age, high-risk factors, mode of delivery, maternal complications, maternal outcomes and neonatal birth weight, perinatal outcomes, causes of neonatal death, and causes of NICU admission. Reports of color Doppler and perinatal outcomes assessed.

Result: As per this study, high risk pregnancy shows change in Doppler finding more as compared to low risk pregnancy. There is Correlation between abnormal colour Doppler findings with adverse neonatal outcomes.

Conclusion: Doppler provides a safe, non-invasive, relatively cheap, easily available, and very effective method in feto-maternal surveillance. It helps to predict perinatal outcome and in appropriate intervention which results in significant decrease in perinatal mortality and morbidity.

Keywords: NICU, DU, OPD/IPD

Introduction

Pregnancy is a special natural and physiological event that is not always normal and is responsible for morbidity and preventable mortality. High risk pregnancy is defined as one which is complicated by a factor(s) that negatively affect the pregnancy outcomes, both maternal and/or perinatal.[1] Among mothers seen prenatally, only 10 to 30% are classified as high-risk. Among these mothers, 70 to 80% have mortality or perinatal morbidity.[2] Every year nearly 529,000 women die globally due to pregnancy related causes. With each death, nearly 118 women suffer from life threatening events or severe acute morbidity.[4] High-risk pregnancy causes almost 20% of the total disease burden in women residing in developing countries.[5] Prevalence of HRP is higher in multigravida (57.20%) as compared to primigravida (40%). [6] As per the sample registration system (SRS) reporting by Registrar General of India, the maternal mortality rate (MMR) of India been reduced from 130/lakh live births in 2014–2016 to 122 in 2015–2017 and 113 in 2016–2018.[7] India has registered an overall decline in MMR of 70% between 1990 and 2015 in comparison to a global decline of 44%.

Although India made considerable progress in the reduction of maternal and infant mortality, every year approximately 44,000 women die due to pregnancy-related causes and approximately 6.6 lakh infants die within first 28 days of life.[7]

Pradhan Mantri Surakshit Matritva Abhiyan is an initiative of Ministry of Health and Family Welfare, Government of India, was launched on June 09, 2016, to identify high-risk pregnancies early and follow them so that they can be referred to health care centers with proper facilities so that these women may have healthy antenatal period and deliveries without complications. The program aims to provide assured, comprehensive, quality antenatal care, free of cost, universally to all antenatal women on the 9th day of every month.[6,7]

In these pregnancies, perinatal outcome can be significantly changed by early detection followed by special intensive care. All pregnancies should, therefore, be evaluated to know whether there are or will be risk factors.[8] Age, parity, social class, mothers who have a history of chronic disease (diabetes, hypertension, heart disease etc.) or those with a history of previous pregnancy problems (abortion and still birth), multiple pregnancies, and gestational age under 18 or over 35 years are some of the factors that should be taken into account while assessing the risk in any pregnant woman.[9] Early age at pregnancy, frequent pregnancies compounded with close spacing and continuum of pregnancy after the age of 35 years contribute to higher fertility that lead to serve health consequences in both mother and child.[10] The most common causes of maternal mortality are severe hemorrhage, hypertension-related disorders of pregnancy such as preeclampsia and eclampsia, sepsis, unsafe abortions and medical complications such as cardiac conditions, HIV/AIDS, and diabetes complicating pregnancy.[11]

The pregnancy is constantly observed by clinical examination, laboratory investigations, and radiographic examinations at specific intervals throughout its course. The use of Doppler ultrasound (DU) has been recently introduced for the study of fetal circulation and various vessels including both uterine artery (UtA), umbilical artery (UA) and middle cerebral artery (MCA).[12] The principle of DU was described Johann Christian Doppler in 1842. Identification of the pregnancies at risk for preventable perinatal morbidity and mortality is primary goal of the obstetric care.[13] The development of DU evaluation of uteroplacental and fetoplacental circulation is one of the important achievements of modern obstetrics. Doppler velocimetry is rapid non-invasive test that provides valuable information about the hemodynamic situation of the fetus and is an efficient diagnostic test of fetal jeopardy that helps in the management of high-risk pregnancy.[14] It has been assumed that insufficient uterine, placental and fetal circulations result in adverse pregnancy outcome and that those abnormalities can be detected by the use of DU.[15] Thus, DU would be a useful in antenatal fetal well-being and timely intervention. On basis of abnormal DU findings, obstetrical decision making may improve and prevent intrauterine death because hypoxic cerebral damage may begin before labor and intrapartum asphyxia is probably more damaging when superimposed on underlying hypoxia. Perinatal outcome can be improved by timely prediction of antenatal risk factors contributing to these complications, by providing appropriate antenatal surveillance and if required, therapeutic intervention.[16]

Risk for intrauterine growth restriction (IUGR) and preeclampsia are predicted more efficiently in comparison to other possible unfavorable outcome by Ut A DU studies. Doppler abnormalities in venous circulation of fetuses like ductus venosus (DV) and umbilical vein are indicators of severely affected fetuses, who are at the highest risk of death. Abnormalities in the Doppler findings of the UA and MCA are seen at an early stage of improper peripheral and central circulatory systems of fetus followed by pulsatile umbilical venous-flow and reversal-flow in the DV.[16]

Elevated impedance to blood flow in the placenta is reflected by abnormal UA velocimetry.[17]The absence or reversal of end-diastolic flow in the UA is suggestive of the poor fetal condition.[18] Fetal MCA Doppler assessment plays an important role in determining cardiovascular distress, fetal anemia, or fetal hypoxia. The Ut A Doppler waveform is unique and increased resistance to the flow and development of a diastolic notch has been associated with high-risk pregnancy.[14]

Color doppler technique also offers greater ease is delineating small intracranial vessels resulting in quicker and more accurate examinations. Fetal hypoxia can be assessed with the abnormal wave patterns obtained from this vessel.[19] Abnormal venous changes occur in severely compromised fetus and are more likely to predict poor perinatal outcome. Fetal Doppler velocimetry studies of the fetal circulation play a crucial role in the monitoring of high-risk pregnancies and help to evaluate the optional time for delivery. The information provided by Doppler study is the one which is not readily obtained from other conventional tests of fetal well-being.[16] Therefore, it has a very crucial role to play in the management of high-risk pregnancies. Based on these findings, the present study was performed to evaluate the role of color Doppler imaging in high-risk pregnancies and assess the perinatal outcomes in such pregnancies.

Aims

1. To study the role of color doppler imaging in high-risk pregnancies.
2. To study Perinatal outcome in high-risk pregnancies.

Objectives

Primary Objective

To evaluate color doppler findings in high-risk pregnancy and perinatal outcome.

Secondary Objective

To study the incidence of high-risk factors.

Materials and Methods

Type of Data- Qualitative Data

Study Design- Observational Prospective Study

Study Duration- From August 2020 to December 2022

Study Setting- This study will be conducted in the department of Obstetrics and Gynaecology and department of Radiology in tertiary health center.

Study Population- All high-risk pregnant women presenting in the Department of Obstetrics and Gynecology of a tertiary care teaching hospital over a period of 2 years.

Eligibility Criteria:

Inclusion Criteria

1. Those belonged to Age group above 18 years
2. Presence of one of the following high risk factors
   a) Pregnancy induced hypertension
   b) Gestational Diabetes
   c) Iron deficiency anemia
   d) Heart disease

3. Gestational age from 28 wks to patient goes in labor or termination of pregnancy

Exclusion Criteria:

1. Twins or multiple gestational pregnancy
2. Anomalous fetus
3. Patient not willing

Characteristics of Patients

At the time of enrolment, following parameters were noted in all the patients.

Maternal Characteristics: Included age, gestational age, high-risk factors, mode of delivery, maternal complications, maternal outcomes, and causes of maternal mortality.

Neonatal Characteristics:

Included birth weight, perinatal outcomes, causes of neonatal death, and causes of NICU admission.

Radiological Characteristics: Included Doppler findings.

Methodology

This study will be conducted in the Department of Obstetrics and gynecology and Department of Radiology of a medical college and tertiary health care center. Total 246 patients after satisfying inclusion and exclusion criteria will be included in the study. As high risk pregnancy includes variety of diseases this study includes Pregnancy induced hypertension , gestational diabetes , iron deficiency anemia , heart diseases . Written informed consent will be taken. All ANC patients coming in OPD/IPD/Casualty with high risk pregnancy will be included. Detailed history, examination will be done and recorded in proforma (Annexure 1).

All routine ANC investigations and special investigations will be done according to high risk factor. Complicating pregnancy will undergo doppler study. Follow up will be done depending on findings. Doppler study will be repeated depending on findings of report. Doppler will be advised upto termination of pregnancy. Perinatal outcome will be assessed under following heads baby weight, delivery, APGAR score and NICU admission. Outcome of color doppler and perinatal outcome will be assessed. The data collected will be analyzed by Appropriate software.

Sample Size

Sample size was calculated to be 246 patients.

Statistical Analyses

Data was collected and graphics were designed by Microsoft Office Excel 2019. The descriptive statistics were used. The categorical and continuous variables are represented as frequency (percentage) and mean (standard deviation, SD), respectively.

Observation and Results

Table 1: Distribution of patients according to age groups

Age groups (years)	N (=246)	%
18 – 25	118	47.97
26 – 30	104	42.28
31 – 35	15	6.09
36 – 40	9	3.66

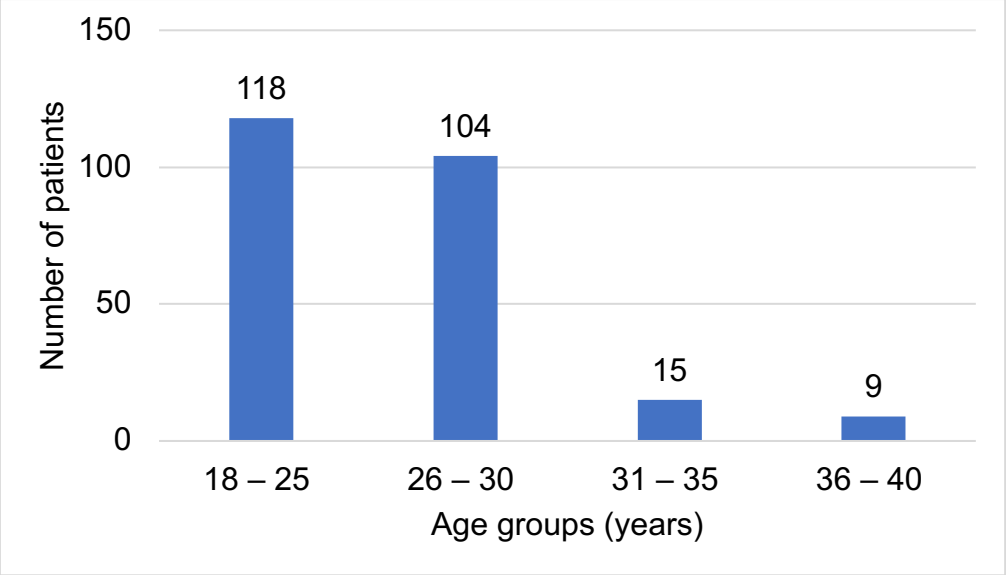

Figure 1: Distribution of patients according to age groups

Table 7 and Figure 14 depict the distribution of patients according to age. Majority of the patients were in the age group of 18 – 25 years (47.97%) followed by 26 – 30 years (42.28%) and 31 – 35 years (6.09%). While, least number of patients were in the age group of 36 – 40 years (3.66%). The age of the patients ranged from 18 to 39 years with a mean of 25.66 ± 4.64 years.

Table 2: Distribution of patients according to gestational age

Gestational age (weeks)	N (=246)	%
28 – 34	43	17.48
34 – 37	152	61.79
37 – 41	51	20.73

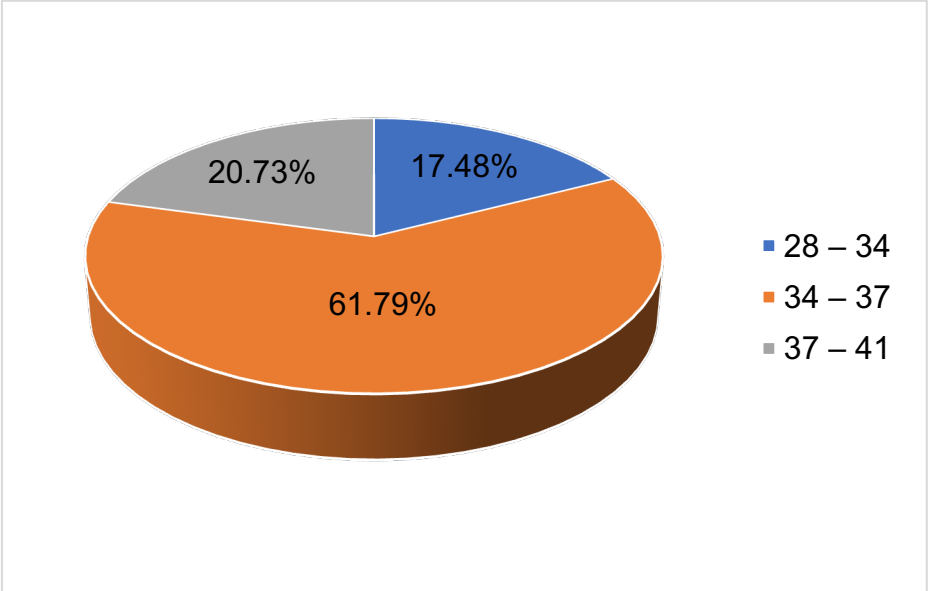

Figure 2: Distribution of patients according to gestational age

Table 8 and Figure 15 depict the distribution of patients according to gestational age. Majority of the patients had a gestational age of 34 – 37 weeks (61.79%) followed by 37 – 41 weeks (20.73%). While, least number of patients had a gestational age of 28 – 34 weeks (17.48%). The gestational age of the patients ranged from 28 to 42 weeks with a mean of 35.74 ± 2.79 years.

Table 3: Distribution of patients according to high-risk factors

Risk factors	N (=246)	%
PE	127	51.63
GDM	48	19.51
IUGR	42	17.07
CVD	29	11.79

PE: Preeclampsia; GDM: Gestational diabetes mellitus; IUGR: Intrauterine growth retardation; CVD: Cardiovascular disorders

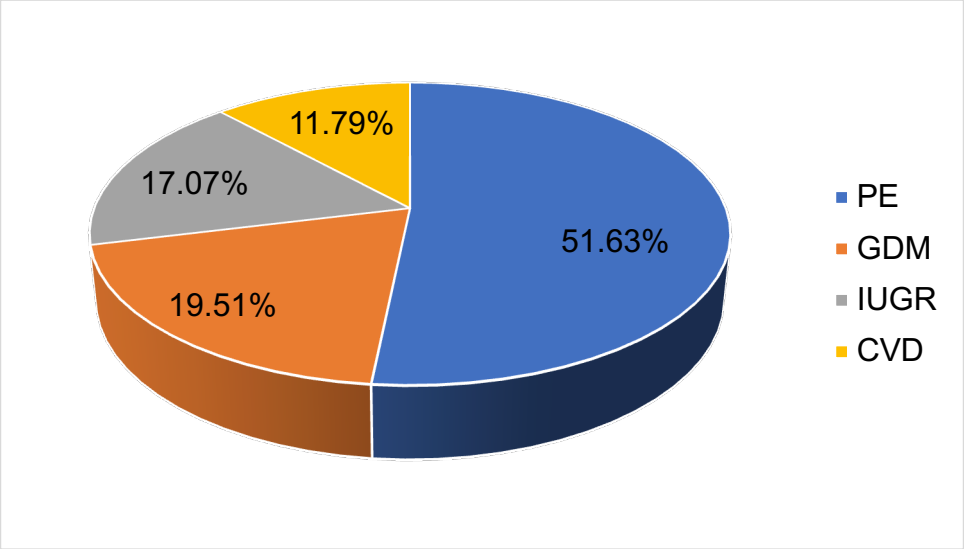

Figure 3: Distribution of patients according to high-risk factors

Table 9 and Figure 16 depict the distribution of patients according to high-risk factors. The most common high-risk factor was PE (51.63%) followed by GDM (19.51%) and IUGR (17.07%). While, least common high-risk factor was CVD (11.79%).

Table 4: Distribution of patients according to mode of delivery

Mode of delivery	N (=246)	%
NVD	45	18.29
LSCS	201	81.71

: Normal vaginal delivery; LSCS: Lower segment Caesarean section

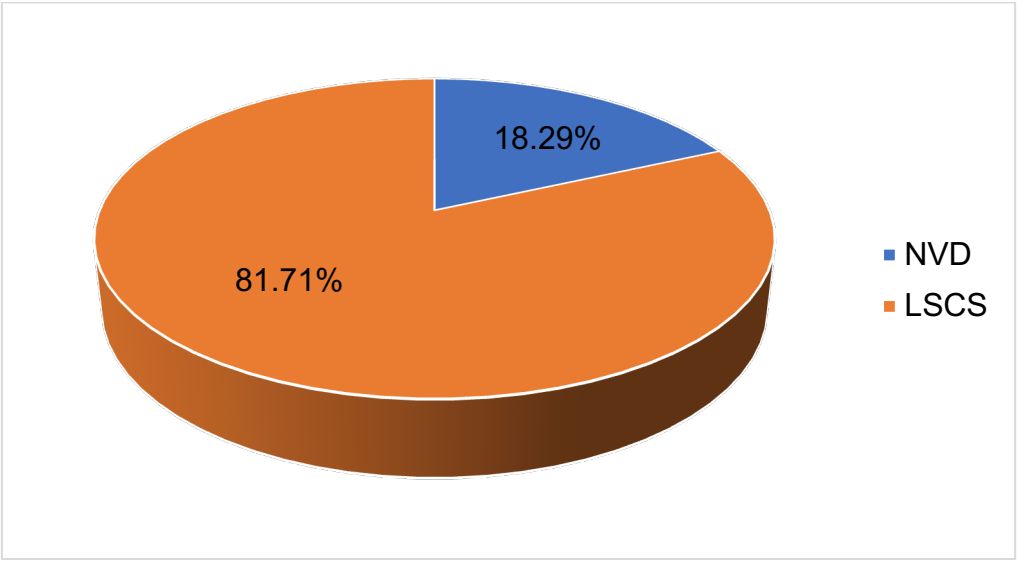

Figure 4: Distribution of patients according to mode of delivery

Table 10 and Figure 17 depict the distribution of patients according to mode of delivery. Of 246 patients, 201 (81.71%) delivered by LSCS and 45 (18.29%) delivered by NVD.

Table 5: Distribution of patients according to maternal complications

Maternal complications	N (=246)	%
Yes	30	12.19
No	216	87.81

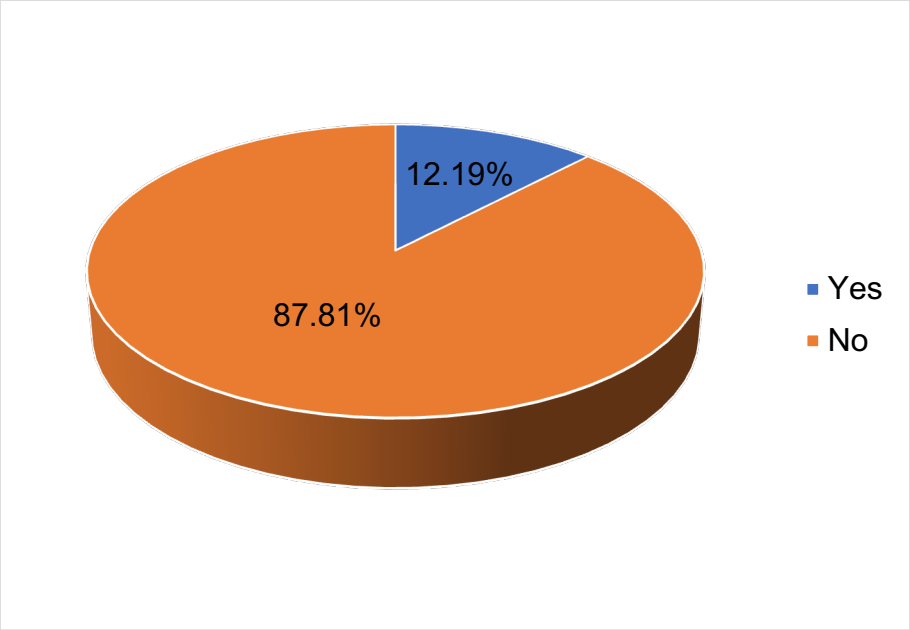

Figure 5: Distribution of patients according to maternal complications

Table 11 and Figure 18 depict the distribution of patients according to maternal complications. Of 246 patients, 216 (87.81%) had no complications, while remaining i.e., 30 (12.19%) had complications.

Table 6: Distribution of patients according to nature of maternal complications

Nature of maternal complications	N (=30)	%
Eclampsia	19	63.33
Uncontrolled diabetes mellitus	7	23.33
Heart failure	4	13.33

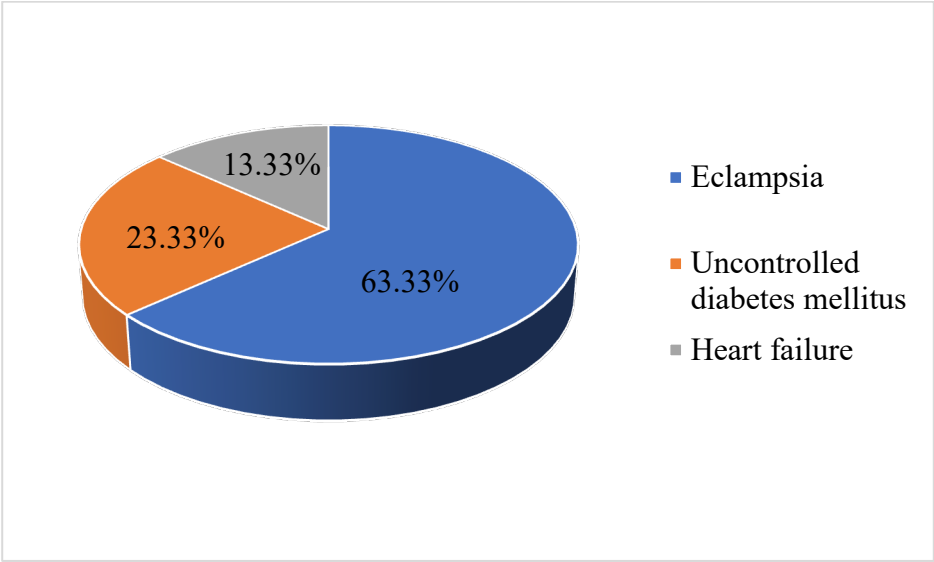

Figure 6: Distribution of patients according to nature of maternal complications

Table 12 and Figure 19 depict the distribution of patients according to nature of maternal complications. Of 30 patients with complications, most common was eclampsia (63.33%) followed by uncontrolled diabetes mellitus (23.33%). While, the least common maternal complication was heart failure (13.33%).

Table 7: Distribution of patients according to maternal outcome

Maternal outcome	N (=246)	%
Death	5	2.03
Shifted to ICU	25	10.16
Discharge	216	87.81

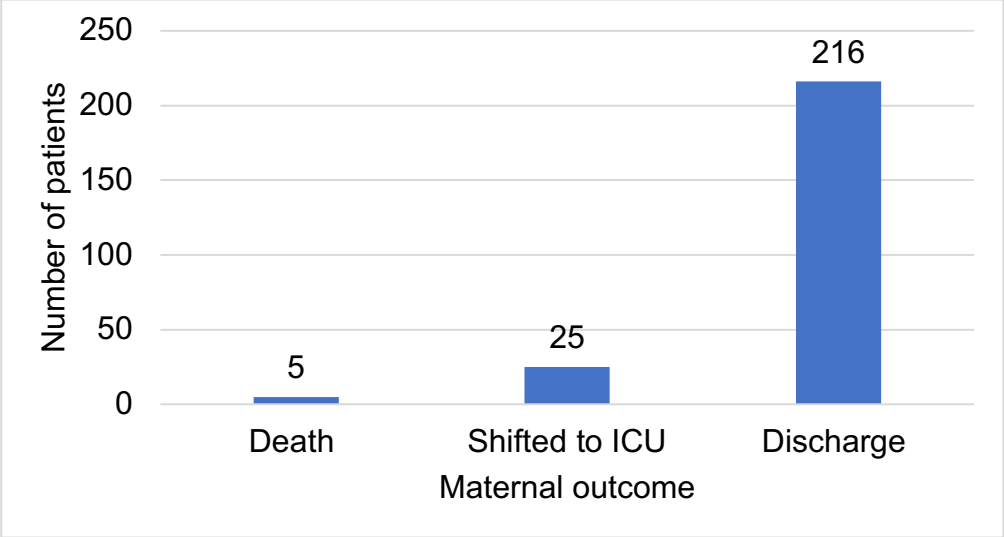

Figure 7: Distribution of patients according to maternal outcome

Table 13 and Figure 20 depict the distribution of patients according to maternal outcome. Majority of the patients were discharged (87.81%). Moreover, 25 (10.16%) patients were shifted to ICU and 5 (2.03%) died.

Table 8: Distribution of patients according to causes of maternal death

Causes of maternal death	N (=5)	%
Eclampsia	4	80
Heart failure	1	20

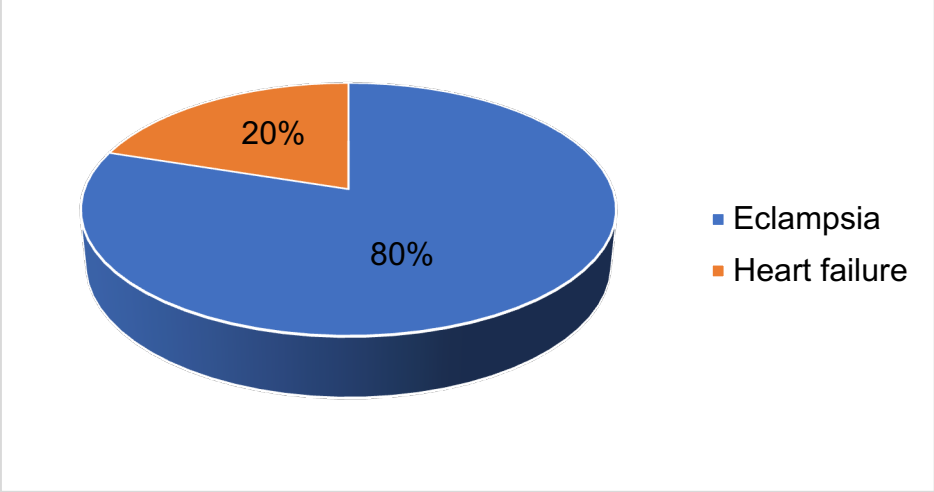

Figure 8: Distribution of patients according to causes of maternal death

Table 14 and Figure 21 depict the distribution of patients according to causes of maternal death. Of 5 maternal deaths, 4 (80%) patients died due to eclampsia and 1 (20%) died due to heart failure.

Table 9: Distribution of patients according to Doppler findings

Doppler findings	N (=246)	%
Brain sparing effect	97	39.43
Uteroplacental insufficiency	94	38.21
Fetoplacental insufficiency	35	14.23
Normal	20	8.13

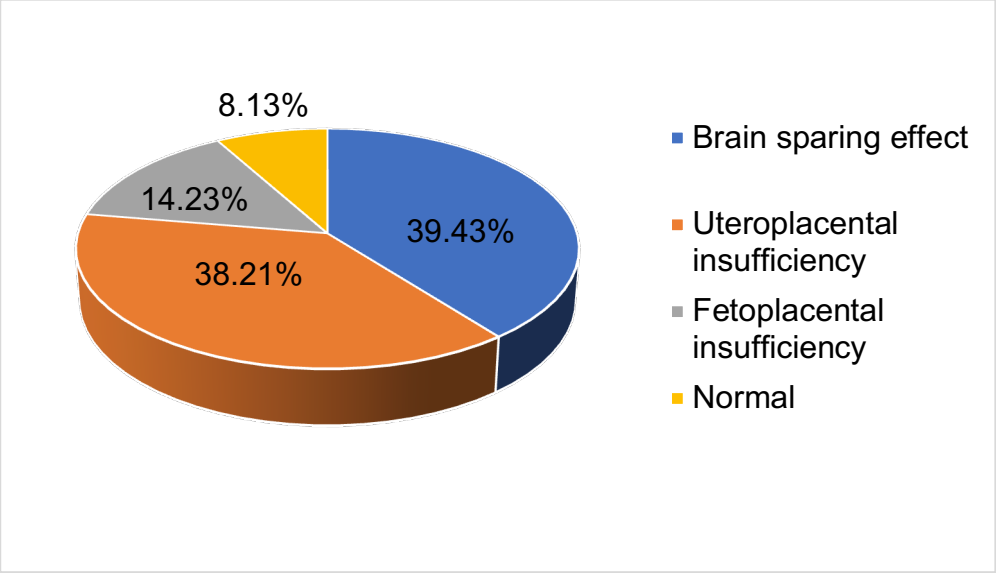

Figure 9: Distribution of patients according to Doppler findings

Table 15 and Figure 22 depict the distribution of patients according to Doppler findings. Most common Doppler finding was brain sparing effect (39.43%), uteroplacental insufficiency (38.21%), and fetoplacental insufficiency (14.23%). While, the least common Doppler finding was normal (8.13%).

Table 10: Distribution of patients according to Doppler vascular findings

Doppler vascular findings	N (=246)	%
Normal	216	87.81
Absent flow	24	9.76
Flow reversal	6	2.43

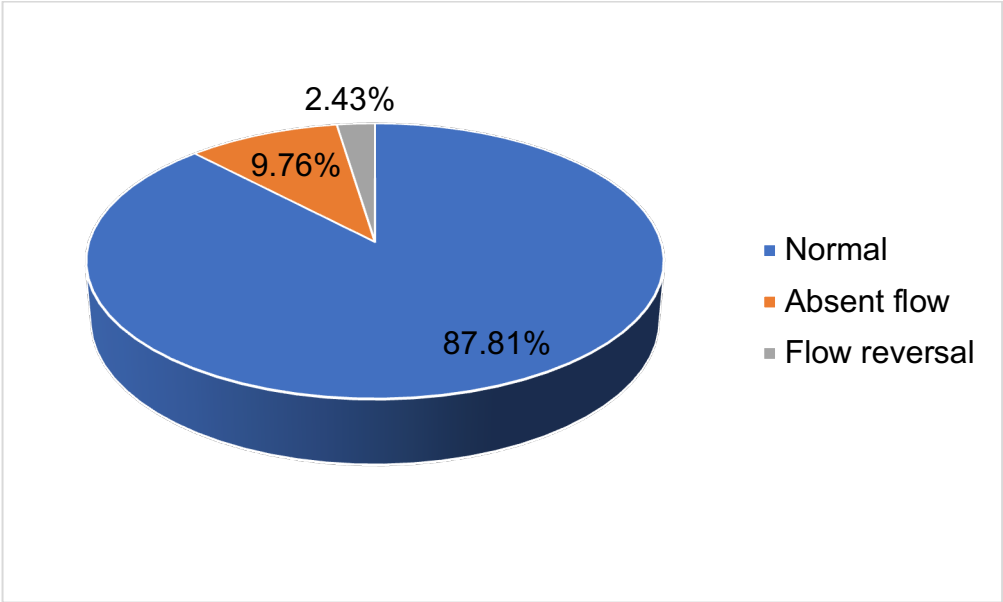

Figure 10: Distribution of patients according to Doppler vascular findings

Table 16 and Figure 23 depict the distribution of patients according to Doppler vascular findings. Most common Doppler vascular finding was normal (87.81%), and absent flow (9.76%). While, the least common Doppler vascular finding was flow reversal (2.43%).

Table 11: Distribution of patients according to neonatal birth weight

Neonatal birth weight	N (=246)	%
< 1500	34	13.82
1500 – 2500	128	52.03
> 2500	84	34.15

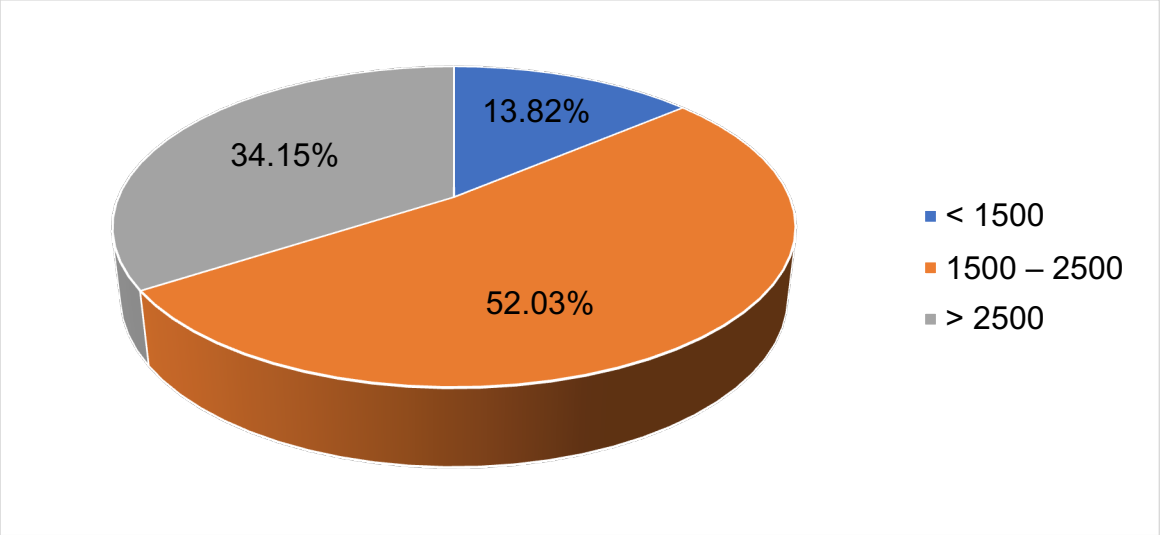

Figure 11: Distribution of patients according to neonatal birth weight

Table 17 and Figure 24 depict the distribution of patients according to neonatal birth weight. Majority of the neonates had a birth weight of 1500 – 2500 (52.03%), and > 2500 (34.15%). While, the least number of neonates had birth weight of < 1500 (13.82%).

Table 12: Distribution of patients according to perinatal outcome and Doppler findings

Perinatal outcome	Total	Doppler findings	
	N (=246)	Abnormal (n=30)	Normal (n=216)
Death	15 (6.09%)	11 (36.67%)	4 (1.85%)
Shifted to NICU	72 (29.27%)	19 (63.33%)	53 (24.54%)
With mother	159 (64.63%)	0 (0%)	159 (73.61%)
p-value	< 0.0001		

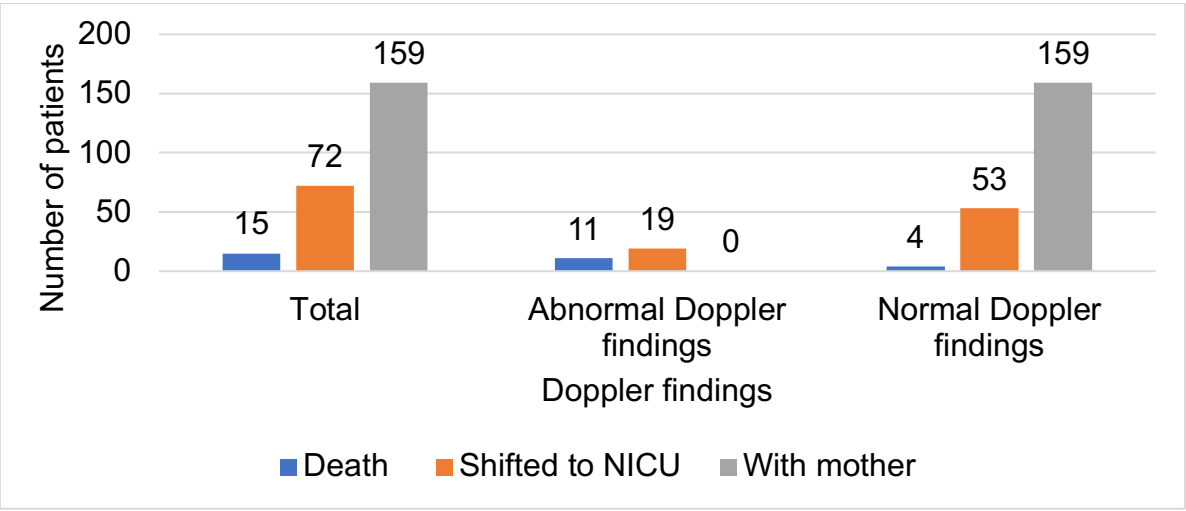

Figure 12: Distribution of patients according to perinatal outcome and Doppler findings

Table 18 and Figure 25 depict the distribution of patients according to perinatal outcome and Doppler findings. Majority of the neonates were with mother (64.63%). Moreover, 72 (29.27%) neonates were shifted to NICU and 15 (6.09%) died. Of 30 neonates with abnormal Doppler findings, 11 died and 19 were shifted to NICU. Moreover, of 216 neonates with normal Doppler findings, 4 died and 53 were shifted to NICU. Significantly greater proportion of patients with abnormal Doppler died (p-value < 0.0001).

Table 13: Distribution of patients according to causes of neonatal death

Causes of neonatal death	N (=15)	%
Insufficient blood supply	7	46.67
Very low birth weight	4	26.67
Birth asphyxia	4	26.67

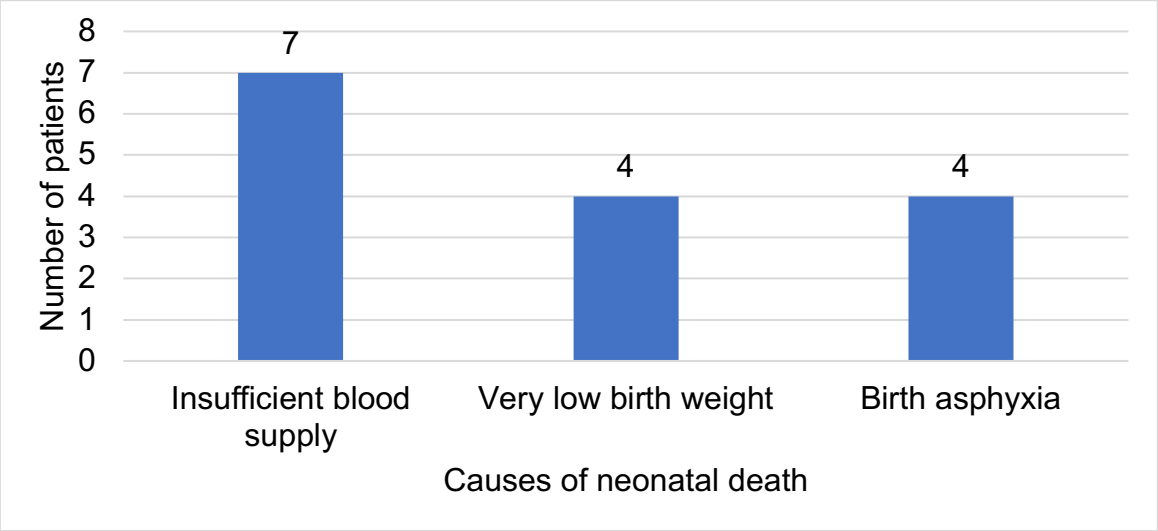

Figure 13: Distribution of patients according to causes of neonatal death

Table 19 and Figure 26 depict the distribution of patients according to causes of neonatal death. Of 15 neonatal deaths, 7 (46.67%) neonates died due to insufficient blood supply, 4 (26.67%) due to very low birth weight, and 3 (26.67%) due to birth asphyxia.

Table 14: Distribution of patients according to causes of NICU admission

NICU admission	N (=72)	%
Preterm	38	52.78
IUGR	23	31.94
Large for gestational age	6	8.33
Low birth weight	5	6.94

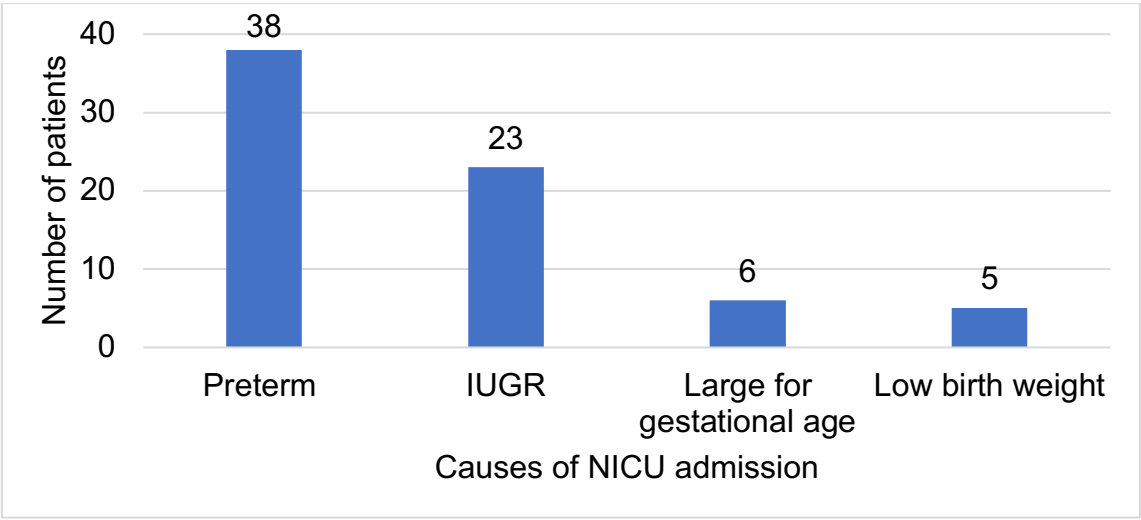

Figure 14: Distribution of patients according to causes of NICU admission

Table 20 and Figure 27 depict the distribution of patients according to causes of NICU admission. Among 72 neonates requiring NICU admission, most common cause was preterm (52.78%) followed by IUGR (31.94%), and large for gestational age (8.33%). While, the least common cause of NICU admission was low birth weight (6.94%).

Discussion

The HRP group are categories of pregnancies where the mother, the fetus or the neonate is in the state of increased jeopardy. About 20%–30% of the pregnancies belong to this category. To improve the obstetric result, this group must be identified and given extra care. Even with the adequate antenatal and intra-natal care, this small group is responsible for 70%–80% of perinatal mortality and morbidity. [20]

The principle of Doppler ultrasound was described in 1842 by Johann Christian Doppler. Identification of the pregnancies at risk for preventable perinatal morbidity and mortality is a primary goal of the obstetric care.[13] The development of Doppler ultrasound evaluation of uteroplacental and fetoplacental circulation is one of the most important achievements of modern obstetrics. Doppler velocimetry is a rapid non-invasive test that provides valuable information about the hemodynamic situation of the fetus and is an efficient diagnostic test of fetal jeopardy that helps in the management of HRP.[14]

It has been long assumed that insufficient uterine, placental, and fetal circulations result in adverse pregnancy outcomes and that those abnormalities can be detected by the use of Doppler ultrasonography.(15) Elevated impedance to blood flow in the placenta is reflected by abnormal UA velocimetry.[17] The absence or reversal of end-diastolic flow in the UA is suggestive of the poor fetal condition.[18] Fetal MCA Doppler assessment plays an important role in determining cardiovascular distress, fetal anemia, or fetal hypoxia. The UtA Doppler waveform is unique and increased resistance to the flow and development of a diastolic notch has been associated with HRP.[14]

The information provided by Doppler study is the one which is not readily obtained from other conventional tests of fetal well-being.(21) Based on these findings, we evaluated the role of CD imaging in HRPs and simultaneously assessed the perinatal outcome in this population.

The findings of the present study are discussed under the following headings:

1. Maternal Age

In the present study, most of the patients were in the age group of 18 – 25 years (47.97%) followed by 26 – 30 years (42.28%) and 31 – 35 years (6.09%). The age of the patients ranged from 18 to 39 years with a mean of 25.66 ± 4.64 years. In agreement with the present study, Parekh et al. observed that most of the patients were in the age group of 18 – 25 years (54%) followed by 26 – 30 years (40%) and 31 – 35 years (6%). In their study, Shah et al. found that 69% patients belonged to the age group of 20 – 25 years, and 31% of patients belonged to 26 – 30 years age group.[12] In another study, Tabitha et al. reported that women with HRP were predominantly in the age group of 21 – 25 years (40.62%).[22] In their study, Kumari et al. demonstrated that HRPs were mostly found in women aged 20 – 25 years (70%) followed by 26 – 30 years (22%), and > 30 years (8%). Moreover, Bilqees et al. reported a mean age of 31.9 ± 4.03 years, with majority of the patients belonging to the age group of 25-40 years.(23) Thus, women with HRPs predominantly belong to the age group of 18 – 25 years.

2. Gestational Age

In the present study, most of the patients had a gestational age of 34 – 37 weeks (61.79%) followed by 37 – 41 weeks (20.73%). While, least number of patients had a gestational age of 28 – 34 weeks (17.48%). The gestational age of the patients ranged from 28 to 42 weeks with a mean of 35.74 ± 2.79 years. In agreement with the present study, Singh et al. observed that most of the patients had a gestational age of 34.1 – 37.0 weeks (61.67%) followed by 32.0 – 34.0 weeks (20%) and 37.1 – 41.0 weeks (18.33%), and mean gestational age was 35.5 weeks. In another study, Singh et al. reported that 11.76% patients belonged to gestational age of 32.0 – 34.0 weeks, 55.88% belonged to gestational age of 34.1 – 37.0 weeks, and 32.35% belonged to gestational age of 37.1 – 41.0 weeks. The mean gestational age was 36.06 ± 1.59 weeks.[24] In their study, Amin et al. found that the mean gestational age of women with HRP was 34.3 ± 1.9 weeks. Thus, in the present study, the distribution of patients according to gestational age is consistent with the existing literature.

3. High-Risk Factors

In the present study, most common high-risk factor was PE (51.63%) followed by GDM (19.51%) and IUGR (17.07%). While, least common high-risk factor was CVD (11.79%). In their study, Shah et al. found that pregnancy-induced hypertension (PIH, 49%) followed by oligohydramnios (16.3%), and diabetes mellitus (12.7%), and iron deficiency anemia (11%) were the most common high-risk factors.[12] In another study, Parekh et al. observed that oligohydramnios (30%), PIH (24%), polyhydramnios (16%), and anemia (12%) were the predominant high-risk factors.(80) Moreover, Kavitha et al. reported that PIH (50%), oligohydramnios (20%), diabetes mellitus (18%), and iron deficiency anemia (12%) were the most

frequently implicated high-risk factors. The difference in the distribution of high-risk factors could be attributed to the fact that the present study included only the pregnant women with PE, GDM, IUGR, and CVD.

4. Mode of Delivery

In the present study, 201 (81.71%) delivered by LSCS and 45 (18.29%) delivered by NVD. In agreement with the present study, Singh et al. observed that most of the patients underwent LSCS (75%), while remaining underwent NVD (25%).

In another study, Singh et al. reported that 26.47% patients had NVD, 64.71% had LSCS, 5.88% had PTVD, and 2.94% had instrumental delivery. Moreover, Urmila et al. demonstrated that women with HRPs mostly underwent LSCS (78%), normal delivery (16%), and preterm normal delivery (6%).[14] Also, Nagar et al. found that 58% of patients had vaginal delivery and 42% of patients had LSCS.[25] Thus, a significantly high proportion of women with HRPs undergo LSCS.

5. Maternal Complications And Outcomes

Obstetric complications may occur anytime during pregnancy, labor, birth, and puerperium, ranging from mild to severe, sometimes life-threatening. The most accurate estimates of at–risks women can be made during late periods of pregnancy. Women with risk factors for high-risk pregnancies have a one in four chance of developing complications than those with a low risk of high-risk pregnancies who have nearly one in ten.[26] PE, pregnancy infections, miscarriage, stillbirth and low birth weight are some of the known complications in developing countries.[27]

In the present study, 216 (87.81%) had no complications, while remaining i.e., 30 (12.19%) had complications. Of those with complications, most common was eclampsia (63.33%) followed by uncontrolled DM (23.33%). While, the least common maternal complication was heart failure (13.33%). Moreover, most of the patients were discharged (87.81%). Moreover, 25 (10.16%) patients were shifted to ICU and 5 (2.03%) died. Moreover, 80% patients died due to eclampsia and 20% died due to heart failure.

In their study, Hamid et al. did not specify the total number of patients with complication. However, they reported that 64% patients had PE and 14% had diabetes during pregnancy, 5% had antepartum hemorrhage associated with decreased fetal movements while 17% of women presented with postdate pregnancies. In another study, Jikamo et al. reported that maternal mortality, ICU admission, and complications, including antepartum hemorrhage, postpartum hemorrhage, acute kidney injury, placenta abruption, requirement of blood transfusion, and adverse maternal outcomes, were significant high among women with PE relative to those with normal pregnancy.[28] Moreover, Hinkosa et al. found a higher proportion of maternal deaths (4.5%) were observed among women with PE compared to normotensive women (1%).[29] Legesse et al. revealed that the top three adverse maternal outcomes were reported as maternal death (2.8%), eclampsia (6.6%), and renal failure (1.1%).[30]

Pregnant women with any form of dysglycemia experience higher morbidity and mortality rates compared with normal pregnancies. The mortality rate in pregnant women with T1DM is twofold to threefold higher than for nonpregnant women with T1DM, and 5 to 20 times higher than the general obstetric population.[31] Recent evidences suggest GDM increases long-term maternal cardiovascular disease, chronic kidney disease, and cancer risks.[32] Muche et al. reported that women with GDM had a higher risk of composite adverse maternal outcome, caesarean delivery, pregnancy induced hypertension, premature rupture of membranes, antepartum hemorrhage, and postpartum hemorrhage compared to women without GDM.[33]

Moreover, approximately 700 women die from pregnancy-related complications in the USA every year with cardiovascular conditions being responsible for over 33% of pregnancy-related deaths. Pregnancy-related cardiometabolic conditions can result in more severe cardiovascular outcomes.[34] Thus, HRPs result in greater maternal morbidity and mortality.To the best of our knowledge, none of the available studies assessing the Doppler findings have reported maternal complications. Moreover, most of the available studies have reported perinatal outcomes; however, maternal outcome has not been reported. Thus, the findings of the present study add to the existing literature. Moreover, the maternal complications observed in the present study are restricted to four HRP groups. Further studies involving other HRPs are required in future.

6. Neonatal Birth Weight

In the present study, most of the neonates had a birth weight of 1500 – 2500 (52.03%), and > 2500 (34.15%). While, the least number of neonates had birth weight of < 1500 (13.82%). The mean birth weight was 2250.81 ± 660.87 gm. In consensus with the present study, Singh et al. observed that most of the neonates had a birth weight of 1500 – 2500 gm (71.67%), >2500 gm (15%), and 1000 – 1500 gm (10%). While, the least number of neonates had birth weight of <1000 (3.33%). The mean birth weight was 2010 gram. In another study, Singh et al. reported that 9.80% neonates had birth weight between 1000 – 1500 gm, 81.37% had between 1500 – 2500 gm, 8.82% had >2500 gm. The mean birth

weight was 1.98 ± 0.38 kg. Moreover, Urmila et al. reported that the mean birth weight was 2310 ± 610 gm.[14] Thus, the birth weight observed in the present study is consistent with the existing literature.

7. Doppler Vascular Findings and Perinatal Outcome

In the present study, most common Doppler vascular finding was normal (87.81%), and absent flow (9.76%). While, the least common Doppler vascular finding was flow reversal (2.43%). Majority of the neonates were with mother (64.63%). Moreover, 72 (29.27%) neonates were shifted to NICU and 15 (6.09%) died. Of 30 neonates with abnormal Doppler findings, 36.67% died and 63.33% were shifted to NICU. Moreover, of 216 neonates with normal Doppler findings, 1.85% died and 24.54% were shifted to NICU. Significantly greater proportion of patients with abnormal Doppler died. In consensus with the present study, Amin et al. found that 54% and 46% patients had normal and abnormal Doppler findings, respectively. Among patients with abnormal Doppler, the perinatal mortality and morbidity was 41.3% and 23.9%, respectively, as compared to patients with normal Doppler waveforms with 3.7% perinatal mortality and 11.1% morbidity. In their study, Merchant et al. showed that 44% patients had abnormal Doppler and only 30.3% of these had an uncomplicated outcome as compared to 81% of those with normal flows. The mortality in cases with abnormal flows was 43% as compared to 7% in those with normal flows.[35] Moreover, Hamid et al. reported that 77% patients had normal Doppler and 23% had abnormal Doppler. The proportion of early neonatal death was significantly higher in women with abnormal Doppler findings compared with those with normal Doppler findings. The rate of neonatal intensive care unit admission was significantly higher in women with abnormal Doppler findings than in those with normal Doppler findings. Similar studies by Hetcher et al.,[36] and Burke et al.[37] also showed increased perinatal mortality and morbidity with abnormal color Doppler waveform.

8. Causes of Neonatal Death and NICU Admission

In the present study, of 15 neonatal deaths, 7 (46.67%) neonates died due to insufficient blood supply, 4 (26.67%) due to very low birth weight, and 3 (26.67%) due to birth asphyxia. Moreover, among 72 neonates requiring NICU admission, most common cause was preterm (52.78%) followed by IUGR (31.94%), and large for gestational age (8.33%). While, the least common cause of NICU admission was low birth weight (6.94%).To the best of our knowledge, none of the available studies with similar design have reported the causes of neonatal death and NICU admission. Thus, the findings of the present study add to the existing literature.

9. Study Limitations

1. The limitation is small sample size compared to other studies.
2. This was a single center study, which can affect the external validity of the study.
3. The data was limited to the third trimester of gestation, and we did not consider other maternal variables, such as other comorbidities and habits, which may influence the findings.
4. Serial changes in Doppler indices with the progression of pregnancy from diagnosis to delivery were not recorded.

Hence, large-scale prospective studies are required covering all these variables to prove the power of color Doppler in integrated approaches of clinical practice.

Summary

The present study entitled **"Color Doppler Imaging Study in High-Risk Pregnancy during Antenatal Period and Its Perinatal Outcome at Tertiary Care Centre"** was performed in the Department of Obstetrics and Gynecology, and Department of Radiology of a tertiary care teaching hospital. The study involved 246 singleton pregnant women aged 18 years or more, with gestational age from 28 weeks to termination of pregnancy, and presence of one of the high-risk factors, including PE, GDM, IUGR, and CVD.

Following conclusions can be drawn from the present study:

- Most of the patients were in the age group of 18 – 25 years (47.97%) and had a gestational age of 34 – 37 weeks (61.79%).
- The most frequent high-risk factor was PE (51.63%) followed by GDM (19.51%) and IUGR (17.07%).
- Patients were predominantly delivered by LSCS (81.71%).
- Only 30 (12.19%) women had complications.
- Of 30 patients with complications, most common was eclampsia (63.33%) followed by uncontrolled DM (23.33%), and heart failure (13.33%).
- Majority of the patients were discharged (87.81%). Moreover, 25 (10.16%) patients were shifted to ICU and 5 (2.03%) died.
- Of 5 maternal deaths, 4 (80%) patients died due to eclampsia and 1 (20%) died due to heart failure.
- Most common Doppler vascular finding was normal (87.81%), and absent flow (9.76%). While, the least common Doppler vascular finding was flow reversal (2.43%).
- Majority of the neonates had a birth weight of 1500 – 2500 (52.03%), and > 2500 (34.15%).

- Majority of the neonates were with mother (64.63%). Moreover, 72 (29.27%) neonates were shifted to NICU and 15 (6.09%) died.
- Most common cause of neonatal death was insufficient blood supply (46.67%) followed by very low birth weight (26.67%), and birth asphyxia (26.67%).
- Most frequent cause of NICU admission was preterm (52.78%) followed by IUGR (31.94%), large for gestational age (8.33%), and low birth weight (6.94%).
- Of 30 neonates with abnormal Doppler findings, 11 died and 19 were shifted to NICU. Moreover, of 216 neonates with normal Doppler findings, 4 died and 53 were shifted to NICU. Significantly greater proportion of patients with abnormal Doppler died (p-value < 0.0001).

Conclusion

Doppler provides a safe, non-invasive, relatively cheap, easily available, and an effective method in feto-maternal surveillance in cases of high risk pregnancies (HRPs), also assessing the fetal and maternal circulation during HRP, and thus helps to improve feto-maternal outcome in HRPs. It helps to know the accurate changes in uteroplacental and fetal circulation to predict perinatal outcome and help in appropriate intervention and results in significant decrease in perinatal mortality and morbidity. The use of color Doppler should be encouraged in clinical obstetric practice.

Bibliography

1. Krishna U, Tank DK, Daftary S. (2001) Pregnancy at Risk Current Concepts. 4th Edition, Jaypee Brothers (P) Ltd, New Delhi.
2. Mufti S, Mufti S. Identification of High Risk Pregnancy by a Scoring System and Its Correlation with Perinatal Outcome. Indian Journal for the Practicing Doctor.2008; 5:1-7.
3. Sylvie YT, Mariette KK, Pichou KT, de Dieu TKJ, Blaise IK, Michel KN. Prevalence and Factors Associated with High-Risk Pregnancies in Lubumbashi, Democratic Republic of Congo. Open Access Library Journal.2017; 4: e4162.
4. Samar KH, Dorgham LS, Suheir AM. Profile of High Risk Pregnancy among Saudi Women in Taif-KSA. World Journal of Medical Sciences. 2014; 11(1):90-7.
5. Malik S, Sinha S. High Risk Pregnancy. Biomed J Sci & Tech Res.2017; 1:5.
6. Arjariya R, Tiwari P. Prevalence of High Risk Pregnancy: in A Tertiary Care Centre of Sagar Division of M.P. International Journal of Physiology, January-March 2021; 9:1.
7. Prajapati AK, Kumar V, Soni K, Singh NP, Jain PK, Ruchi. Prevalence of high-risk pregnancy among pregnant women enrolled under Pradhan Mantri Surakshit Matritva Abhiyan in government health facilities of district Etawah, Uttar Pradesh: A cross-sectional study. J Family Med Prim Care 2022;11: 1876-82.
8. Bharti Vijay K, Amandeep K, Sumit C, Manisha M. Prevalance and correlates of high risk pregnancy in rural Haryana: A community based study. IJBAMS.2013; 3(2):212-7.
9. Firozi S. The rate of the prevalence of high-risk pregnancy and the results on pregnant mothers and the effect on parameters after the birth. IJPSR.2012;3(10):3735-41.
10. Paudel IS, Singh SP, Jha N, Vaishya A, Mishra RN. High risk pregnancy and its correlates among the women of eastern Nepal. Indian J Prev Soc Med.2008; 39:3-4.
11. World Health Organization 10 Facts on Maternal Health. World Health Organization. Available at: http:// www.who.int/features/factfiles/maternal_health/en/. [Accessed on 29 July 2022].
12. Shah D, Shah C, Shastri M, Desai E, Patel D, Chitara M. A prospective study of role of colour Doppler in high risk pregnancies in a tertiary care hospital. Int J Med Sci Public Health 2017; 6(8):1330-1335.
13. Anshul D, Neelu S, Suneeta G. Significance of umbilical artery Doppler velocimetry in the perinatal outcome of the growth restricted fetuses; The Journal of Obstetrics and Gynecology of India 2010;60:38-43.
14. Urmila S, Beena B. Triple vessel wave pattern by Doppler studies in normal and high risk pregnancies and perinatal outcome. J Obstet Gynecol India 2010; 60:312-6.
15. Gómez O, Figueras F, Martínez JM, del Río M, Palacio M, Eixarch E, et al. Sequential changes in uterine artery blood flow pattern between the first and second trimesters of gestation in relation to pregnancy outcome. Ultrasound Obstet Gynecol 2006;28:802-8.
16. ArunaKumari B, SumanChandra A. Role of foetal Doppler in High Risk Pregnancy with Relation to Perinatal Outcome.Indian J Obstet Gynecol.2019;7(3):459–470.
17. Divon MY. Umbilical artery Doppler velocimetry: Clinical utility in high-risk pregnancies. Am J Obstet Gynecol 1996; 174:10-4.
18. Miller J, Turan S, Baschat AA. Fetal growth restriction. Semin Perinatol 2008; 32:274-80.
19. Aparna G, Suvarna V. A study of colour doppler in high risk pregnancies. International Journal of Contemporary Medical Research 2018; 5(4):D13-D17.
20. Bansal A, Choudhary J, Gupta H. Role of panvessel Doppler study in high risk pregnancy. J Dent Med Sci 2015;14:90-3.
21. Kumari BA, Chandra S. Role of Foetal Doppler in High Risk Pregnancy with Relation to

Perinatal Outcome. Indian J Obstet Gynecol. 2019; 7(3):459–470.
22. Tabitha S, Madishetti R. The study of arterial and venous Doppler in high risk pregnancies and its role in perinatal outcome. Int J Reprod Contracept Obstet Gynecol. 2018; 7(3):1116-1122.
23. Bilqees A, Shayesta R, Arshad B, Mir Mudasir S, Amina B. Color Doppler Ultrasonography in High Risk Pregnancies. International Journal of Obstetrics and Gynaecology Research. 2016; 3(9):481-490.
24. Singh H, Agrawal M, Bhake A, Gupta N. Colour Doppler evaluation in high-risk pregnancy and perinatal outcome. Journal of Evolution of Medical and Dental Sciences. 2018; 7(43).
25. Nagar T, Sharma D, Choudhary M, Khoiwal S, Nagar RP, Pandita A. The Role of uterine and umbilical arterial doppler in high-risk pregnancy: a prospective observational study from india. Clinical Medicine Insights: Reproductive Health 2015; 9:1–5.
26. Rajbanshi S, Norhayati MN, Nik Hazlina NH (2020) High-risk pregnancies and their association with severe maternal morbidity in Nepal: A prospective cohort study. PLOS ONE 15(12): e0244072.
27. Abedin S, Arunachalam D. Maternal autonomy and high-risk pregnancy in Bangladesh: the mediating influences of childbearing practices and antenatal care. BMC Pregnancy Childbirth 2020; 20:555.
28. Jikamo B, Adefris M, Azale T, et al. The effect of preeclampsia on adverse maternal outcomes in Sidama region, Ethiopia: a prospective open cohort study. Sci Rep 2022; 12:19300.
29. Hinkosa L, Tamene A, Gebeyehu, N. Risk factors associated with hypertensive disorders in pregnancy in Nekemte referral hospital, from July 2015 to June 2017, Ethiopia: Case-control study. BMC Pregnancy Childbirth. 2020; 20:16.
30. Legesse AY, Berhe Y, Mohammednur SA, Teka H, Goba G. Prevalence and determinants of maternal and perinatal outcome of preeclampsia at a tertiary hospital In Ethiopia. Ethiop. J. Reprod. Health (EJRH). 2019; 11(4):8.
31. Silva CM, Arnegard ME, Maric-Bilkan C. Dysglycemia in Pregnancy and Maternal/Fetal Outcomes. J Womens Health (Larchmt). 2021; 30(2):187-193.
32. Chong S, Yu-Mei W, Chen W, Hui-Xia Y. Updates in Long-term Maternal and Fetal Adverse Effects of Gestational Diabetes Mellitus. Maternal-Fetal Medicine 2019; 1(2):91-94.
33. Muche AA, Olayemi OO, Gete YK. Effects of gestational diabetes mellitus on risk of adverse maternal outcomes: a prospective cohort study in Northwest Ethiopia. BMC Pregnancy Childbirth 2020; 20:73.
34. Marschner S, von Huben A, Zaman S, et al. Pregnancy-related cardiovascular conditions and outcomes in a United States Medicaid population. Heart 2022; 108:1524-1529.
35. Merchant RH, Lulla CP, Gharpure VP. Color Doppler evaluation of uteroplacentofetal circulation in management of high risk pregnancies. Indian Pediatr. 1994; 31(5):511-7.
36. Hetcher K, Campbell S, Doyle P, Harington K, Nicolaides K. Assessment of fetal comprise by Doppler ultrasound investigation of the fetal circulation. Circulation. 1995; 91:129-138.
37. Burke G, Stuart B, Crowley P, Scanaill SN, Drumm J. Is intrauterine growth retardation with normal umbilical artery blood flow a benign condition? BMJ Clinical research 1990; 300(6731):1044-5.