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PREDICTING NEONATAL WELL-BEING IN PREECLAMPSIA: AN IN-DEPTH ANALYSIS OF CEREBROPLACENTAL AND CEREBROUTERINE RATIOS

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Abstract
Introduction: High-risk pregnancies are a major health issue worldwide, especially in India, where they cause a lot of perinatal mortality. IUGR, which affects low-birth-weight babies, is a major risk factor. Doppler ultrasound is a cutting-edge technology for monitoring IUGR's complex dynamics. This study examines the complementarity of cerebroplacental (CP) and cerebrouterine (CU) ratios in predicting infant outcomes, using Doppler ultrasound to improve antenatal foetal well-being monitoring and timely intervention in high-risk pregnancies.
Material and Methods: This prospective observational study at a tertiary care centre examined 34–37-week pregnancies with pre-eclampsia from January 2020 to June 2022. It measured the cerebroplacental ratio (CPR) and cerebrouterine ratio using Doppler ultrasound. Labour discomfort and congenital abnormalities were omitted from the 100-person trial. Complete data collection included permission, demographics, and physical exams. Statistics were performed using SPSS V 15.0 and several tests. Informed permission, participant freedom, and secrecy ensured ethics. Krishna Hospital's facilities sponsored the study after Institutional Ethics Committee permission.
Result: The study found incorrect CPR and CUR ratios in 5 of 8 intrauterine deaths (IUDs). In 54 cases, live births had normal ratios. Using both ratios enhanced perinatal outcome prediction sensitivity. A 100-case study found that inadequate CPR and CUR ratios predicted poor outcomes. The findings confirmed that Doppler ratios influence neonatal outcomes. The debate emphasised these ratios' diagnostic relevance, supporting past research. The study stressed the need of integrating Doppler results to predict unfavourable outcomes more accurately.
Conclusion: Overall, standard foetal biometry fails to detect foetal impairment and hemodynamic changes, limiting gestational age and growth information. Doppler ultrasound can measure uterine and umbilical arteries and reveal uteroplacental and fetoplacental circulations. Doppler investigations detect utero-placental insufficiency and acid-base status earlier than other tests due to hemodynamic alterations in response to foetal hypoxemia. The study found that cerebroplacental (CP) and cerebrouterine (CU) ratios are equally accurate, highlighting the sensitivity of combined Doppler results. For quick foetal distress intervention, doppler ultrasonography is essential.
Keywords: Hemodynamic changes, foetal hypoxemia, foetal distress, timely intervention, perinatal outcomes, foetal biometry, uteroplacental circulation, intrauterine growth restriction (IUGR)

I. INTRODUCTION

High-risk pregnancies are a major health problem, particularly in India where they make up 20–30% of pregnancies and are mostly responsible for 75 percent of postnatal morbidity and death. According to this concept, intrauterine growth restriction (IUGR) puts newborns weighing less than 2500 grammes at risk for both perinatal and long-term mortality and morbidity. Globally, the prevalence of IUGR varies; rates in wealthier nations are usually between 4 and 8%, whereas rates in underdeveloped countries can reach as high as 40%. About 35–40% of IUGR instances are caused by risk factors such as a history of preeclampsia, low socioeconomic status, infections, cardiovascular disease, diabetes, placental insufficiency, and maternal hypertension. Preeclampsia affects 2-5% of pregnancies and is a major cause of morbidity and mortality for both moms and foetuses. The uteroplacental and fetoplacental circulations are essential for the best possible outcomes throughout pregnancy, and preeclampsia affects them. It is linked to decreased organ perfusion due to vasospasm and endothelial dysfunction, and it is a critical factor in the development of IUGR and preterm delivery. Throughout pregnancy, the maternal, placental, and foetal vasculatures undergo complex alterations. Inadequate adaptation might result in aberrant vascular resistance patterns, putting the foetus's health in jeopardy and causing IUGR. As the fetus's primary source of nutrients, a healthy utero-placental circulation is essential to a successful pregnancy. Maternal, placental, and foetal vascular patterns must be thoroughly assessed in order to detect and forecast IUGR early on.

The most popular techniques for assessing foetal well-being in high-risk pregnancies include non-stress tests (NST), biophysical profiles, and daily assessments of foetal movement; nevertheless, their sensitivity and specificity may not be optimal. In this context, colour Doppler flow velocimetry—a unique non-invasive method for monitoring placental blood flow—is disclosed. By enabling the early diagnosis of abnormal tendencies, this approach aids in the determination of the optimal timing to deliver a baby in order to reduce perinatal mortality. Colour Doppler flow velocimetry helps improve prenatal outcomes by monitoring blood flow in the umbilical artery and middle cerebral artery. This is particularly true in high-risk pregnancies associated with diseases including intrauterine growth restriction (IUGR), gestational diabetes, and preeclampsia. Doppler ultrasonography offers a comprehensive way to assess the potential for intrauterine growth restriction during gestation, especially when looking at indices using colour Doppler flowmetry. A few of the indicators utilised in the prediction of foetal growth limitation include the resistive index of the foetal vertebral artery, the S-wave/isovolumetric A-wave index of the ductus venosus, and the pulsatility and resistive indices of the umbilical and middle cerebral arteries. The goal of the research is to ascertain if the cerebroplacental (CP) and cerebrouterine (CU) ratios complement one other in terms of infant health prediction. Doppler ultrasonography is crucial for monitoring the developing foetus's health and for prompt intervention. The utilisation of abnormal Doppler results in obstetrics can help medical professionals make educated decisions and reduce the risk of developing brain damage in the growing foetus.

II. Background

A variety of subjects pertaining to high-risk pregnancies are covered in the background research, with a focus on conditions including intrauterine growth restriction (IUGR) and preeclampsia. Twenty to thirty percent of pregnancies in India are high-risk, which is a major contributing cause to seventy-five percent of perinatal morbidity and death. Reducing maternal mortality rates successfully requires prompt detection of high-risk pregnancies and proper management of those pregnancies. IUGR, a condition common in less developed nations, has been associated with increased perinatal and long-term morbidity and mortality. Risk factors for the onset of IUGR include placental insufficiency, maternal hypertension, infections, diabetes, cardiovascular issues, low socioeconomic status, and a history of preeclampsia. Unfavourable pregnancy outcomes including stillbirths and infant deaths are strongly correlated with undetected IUGR. Preeclampsia is a serious cause of illness and mortality for mothers and foetuses, affecting 2-5% of pregnancies. Because of endothelial failure and vasospasm, preeclampsia impairs organ perfusion and affects the development of the uteroplacental and fetoplacental circulations. Premature labour and IUGR may arise from this. The work highlights the importance of Doppler ultrasonography, in particular colour Doppler flow velocimetry, for evaluating blood flow in the uteroplacental and foetal circulations. This non-invasive method makes it easier to identify aberrant patterns of vascular resistance early on, which enables prompt care for the foetal well-being.

A prospective observational study was conducted at a tertiary care hospital, focusing on pregnancies with pre-eclampsia between 34 and 37 weeks of gestation. This study assesses the diagnostic utility of Doppler ultrasonography-derived cerebroplacental (CP) and cerebrouterine (CU) ratios in predicting unfavourable perinatal outcomes. As a means of collecting data, Doppler testing of the umbilical, middle cerebral, and uterine arteries is employed in addition to comprehensive history taking and physical tests for those who qualify. Pre-eclampsia and a gestational age between 34 and 37 weeks were the inclusion criteria, and a sample size of 100 individuals was selected based on prior research. Statistical techniques such chi-square tests, t-tests, and SPSS were employed for data analysis in order to evaluate the diagnostic precision of CP and CU ratios. Prioritising ethical matters is essential. Some examples of these include obtaining participants' informed consent, protecting their privacy, and receiving approval from the institutional ethics committee. The results of the study demonstrate that while Doppler results improve sensitivity, CP and CU ratios predict perinatal outcomes with comparable diagnostic accuracy. This demonstrates how crucial Doppler ultrasonography is for providing an accurate and timely evaluation of foetal health, which will ultimately improve outcomes in high-risk pregnancies.

III. Material and Methods

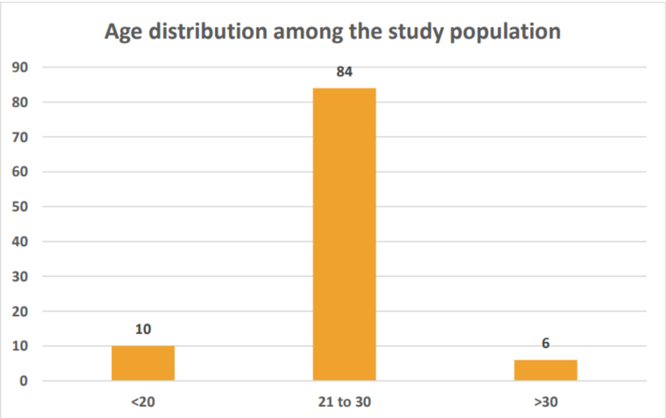
A detailed prospective observational study that was carried out from January 2020 to June 2022 at a tertiary care facility. Patients who met the defined inclusion and exclusion criteria and were admitted under the Department of Obstetrics and Gynaecology were the subject of the study. The main goal was to use Doppler ultrasound to measure the cerebroplacental ratio (CPR) and cerebrouterine ratio (CUR) in pregnancies between 34- and 37-weeks gestational age, especially in cases where pre-eclampsia was present. Based on the results of a prior study about the mean CPR in people with unfavourable foetal outcomes, the sample size of 100 was chosen. The exclusion criteria excluded labour pain, congenital anomalies, Rh incompatibility, underlying cardiovascular/metabolic diseases, normotensive pregnancies, and gestational ages below 34 weeks or above 37 weeks. The inclusion criteria focused on pregnancies with pre-eclampsia and covered gestational ages of 34–37 weeks. Comprehensive physical and obstetric examinations, well-informed written consent, and complete demographic and obstetric histories were all part of the data collection process. CPR and CUR were calculated using Doppler ultrasound, and neonates were evaluated according to the manner of delivery, birth weight, 5-minute APGAR score, gestational age at birth, and NICU hospitalisation, if relevant. Doppler studies of the uterine artery, the umbilical artery, and the foetal middle cerebral artery were among the investigations conducted. With SPSS V 15.0, statistical analysis was carried out, and results were presented as mean and standard deviation (SD) for quantitative variables and number (percentage%) for qualitative variables. Numerous statistical tests were used, such as Fisher Exact Probability testing, Chi-square tests, Mann-Whitney U test, paired t test, and unpaired t test. Sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy were used to assess the diagnostic accuracy of CPR and CUR for forecasting neonatal outcomes. As stated in the ethical declaration, ethical considerations were crucial. In order to guarantee participant understanding in a language they could understand, informed consent was obtained. Participants were guaranteed the freedom to withdraw from the study without endangering their treatment, and confidentiality and anonymity were upheld. There were no extra fees charged to the participants. The Institutional Ethics Committee's approval was obtained in exchange for a promise to disclose any modifications to the study's design or protocol. The fact that Krishna Hospital had the facilities and tools needed for the study on hand highlighted the institutional and ethical underpinnings of the research.

IV. Observation &Result

Table 1: Age distribution among the study population

Age years	Frequency	Percentage
<20	10	10
21 to 30	84	84
>30	6	6
Total	100	100

The age distribution of the research population is outlined in the information supplied. With a standard deviation of 3.6 years and a mean age of 24.3 years, the age distribution exhibits some degree of variability. Participants in the research range in age from 18 to 40, representing a wide spectrum of ages. Table 1 provides more information, indicating that 84% of the study group is between the ages of 21 and 30. This indicates a notable concentration of people in their early to mid-20s. In addition, 10% of participants are younger than 20, indicating that a younger population has been included. Conversely, the amount of participants over 30 is comparatively less, with only 6% of them falling into this age group.

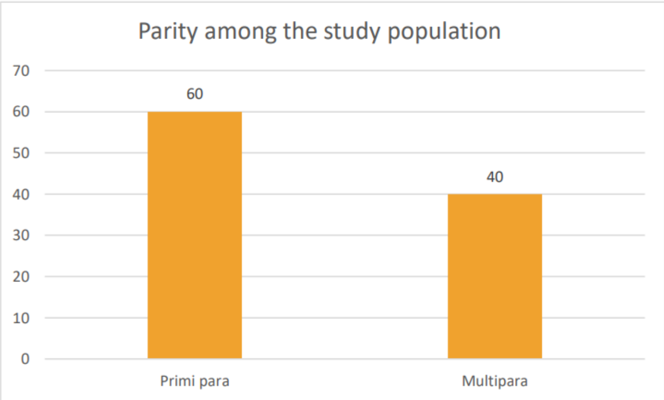


Graph 1: Age distribution among the study population

Table 2: Parity among the study population

Parity	Frequency	Percentage
Primi para	60	60
Multipara	40	40
Total	100	100

Participants are categorized according to their parity status in the table 2, which offers information on the parity distribution among the study population. The number of viable births a woman has had is referred to as her parity. Primipara and multipara are the two primary categories displayed in this table "Primipara" describes a woman who is pregnant for the first time but has not yet given birth to a viable kid. According to the table, 60 out of 100 individuals, or 60% of the study population overall, fit into this category. This implies a significant percentage of women who are just beginning their reproductive journey. However, "multipara" describes women who have given birth to children and carried them through several times. Forty of the study's participants, or 40% of the total, are classified as multipara. This suggests that a sizable percentage of women have given birth more than once. The study population is summarized in the "Total" row, which also shows that the sample size is 100 participants. A comprehensive comprehension of the distribution of primiparous and multiparous women in the study is made possible by the percentages shown in the table. Research on reproductive health needs to know this information since parity affects many elements of mother health, pregnancy outcomes, and healthcare treatments. The table gives a clear and useful summary of the parity status of the research participants and offers insightful information on the reproductive history of the population being studied.

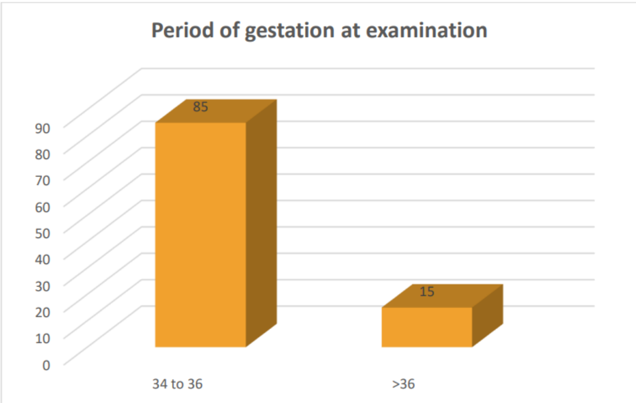


Graph 2: Parity among the study population

Table 3: Period of gestation at examination

Period in weeks	Frequency	Percentage
34 to 36	85	85
>36	15	15
Total	100	100

The distribution of participants according to weeks of gestation is shown in the table, which sheds light on the temporal aspect of pregnancies in the study group. The two main types of periods are those that are 34 to 36 weeks and those that are longer than 36 weeks. Out of the 100 participants, 85 fell into the "34 to 36 weeks" gestational period, making up 85% of the research group. This shows that a significant portion of pregnancies are in the late preterm to early term range, which is a crucial time when foetal development is still occurring and medical surveillance is usually increased. On the other hand, pregnancies that are longer than 36 weeks fall under the ">36 weeks" group. Fifteen people make up this category, or fifteen percent of the total. Since these pregnancies have reached or exceeded the full-term gestational period, they are classified as term pregnancies. When evaluating the maturity and preparedness for delivery, as well as when considering potential hazards related to preterm and post-term pregnancies, this information is important. The study population is summed up in the "Total" row, which confirms that the sample size is 100 participants. The distribution of pregnancies during different gestational periods is shown succinctly and clearly by the percentages in the table. It is essential for healthcare planning, intervention tactics, and the evaluation of potential issues linked to stages of gestation to understand the distribution of pregnancies in terms of weeks. This table supports a thorough examination of the temporal component of pregnancies in the context of the research by providing important information about the overall characterization of the study population in terms of gestational age.

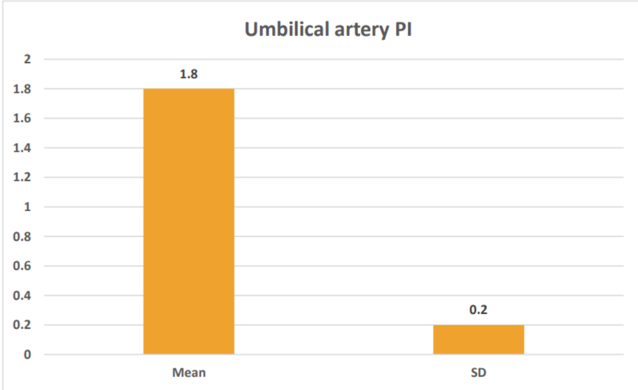


Graph 3: Period of gestation at examination

Table 4: Umbilical artery PI

Umbilical artery PI	Value
Mean	1.8
SD	0.2

Table 4 shows pulsatility index of umbilical artery, where majority 45% showed abnormal values. Average was 1.8+ 0.2. The table 4 provides important statistical parameters to characterize the distribution of the umbilical artery pulsatility index (PI) throughout the research population. The average umbilical artery PI for all individuals is 1.8, which represents the hemodynamic parameter's central tendency or average value. This mean value represents the typical level of pulsatility in the umbilical artery for the study group and is used as a representative metric. The umbilical artery PI values' degree of variability or dispersion around the mean is indicated by the standard deviation (SD), which is given as 0.2. In the study population, a smaller standard deviation indicates that the data points are closer to the mean and may indicate a more uniform distribution of umbilical artery pulsatility. On the other hand, a higher standard deviation would suggest more variation between the PI values. These metrics provide information about the consistency or variability of umbilical artery PI values, which is important for determining the dynamics of blood flow and vascular resistance in the placental circulation. The provided mean and standard deviation enhance our understanding of the distribution of foetal well-being and potential issues linked to anomalous blood flow patterns in the umbilical artery, allowing us a more nuanced assessment of pulsatility. These statistics are essential for deciphering the clinical meaning of umbilical artery PI values within the study's framework, improving our understanding of the population under investigation's vascular hemodynamics overall.

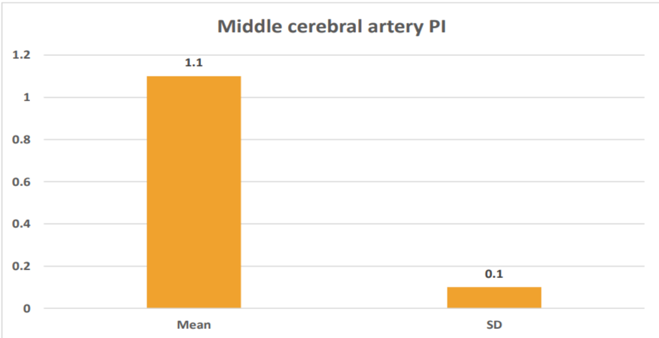


Graph 4: Umbilical artery PI

Table 5: Middle cerebral artery PI

Middle cerebral artery PI	Value
Mean	1.1
SD	0.1

Table 5 shows pulsatility index of middle cerebral artery where majority 45% showed abnormal values, >1.12. Average Middle cerebral artery PI was 1.1+ 0.1. Range being 0.71 to 1.68

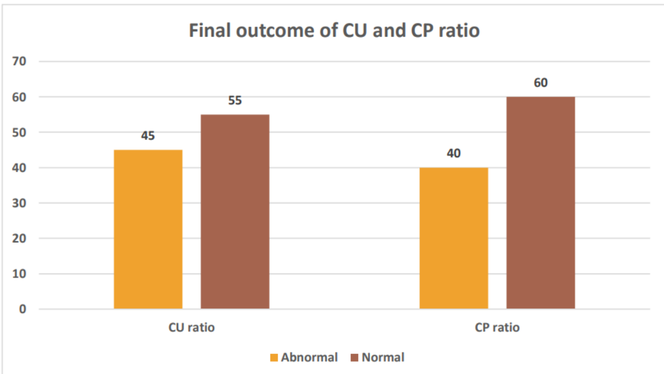


Graph 5: Middle cerebral artery P

Table6: Outcome of CU and CP ratio

Parameter	CU ratio	CP ratio
Abnormal	45	40
Normal	55	60
Total	100	100

On final outcome, abnormal CU ratio was seen in 45 cases and CP ratio was seen in 40 cases.



Graph 6: Final outcome of CU and CP ratio

Table 7: Mode of delivery

Mode of delivery	Frequency	Percentage
Normal vaginal	24	24
LSCS	76	76
Total	100	100

Table 7 shows 24% had normal vaginal delivery and 76% had LSCS

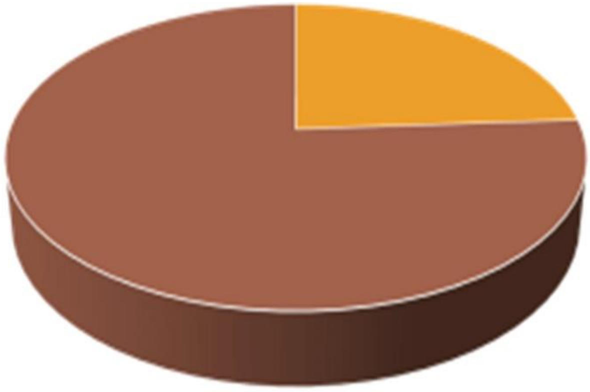
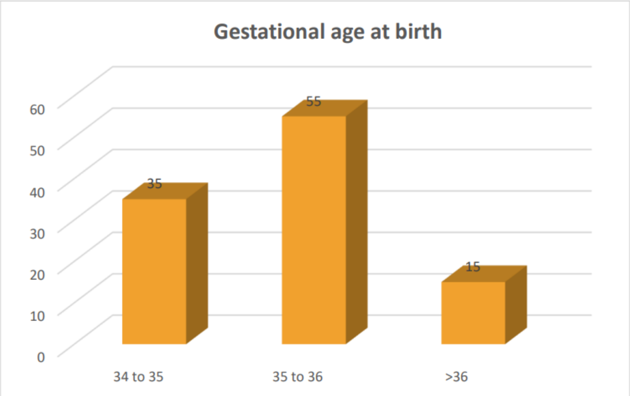


Figure 7: Mode of delivery

Table 8: Gestational age at birth

Period in weeks	Frequency	Percentage
34 to 35	35	35
35 to 36	55	55
>36	15	15
Total	100	100

Average period of gestation was 35.34 + 1.3 weeks. Range being 31 to 39 weeks. Table 10 shows period of gestation where majority 55% were in 35 to 36 weeks, 35% were in range of 34 to 35weeks, and only 15% were more than 36 weeks. Average period of gestation was 35.34 + 1.3 weeks.

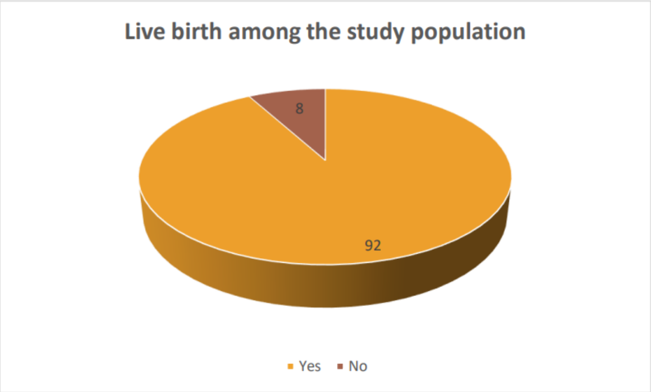


Graph 8: Gestational age at birth

Table 9: Live birth among the study population

Live birth	Frequency	Percentage
Yes	92	92
No	8	8
Total	100	100

Table 11 shows live birth among the study population where majority 92% birth were alive and only 8% had IUD.

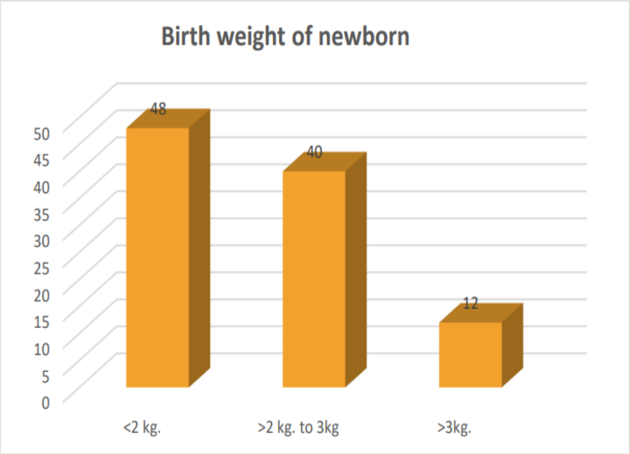


Graph 9: Live birth among the study population

Table 10: Birth weight of newborn

Birth weight (kg)	Frequency	Percentage
<2 kg.	48	48
>2 kg. to 3kg	40	40
>3kg.	12	12
Total	100	100

Average birth weight in grams was 1779.96+512.2. Range being 960 to 3000 grams. Table 12 shows birth weight among the newborn, where majority 48% had weight <2 kg. 40% had >2 kg. to 3 kg and 12% had >3 kg. Average birth weight was 1926.7+657

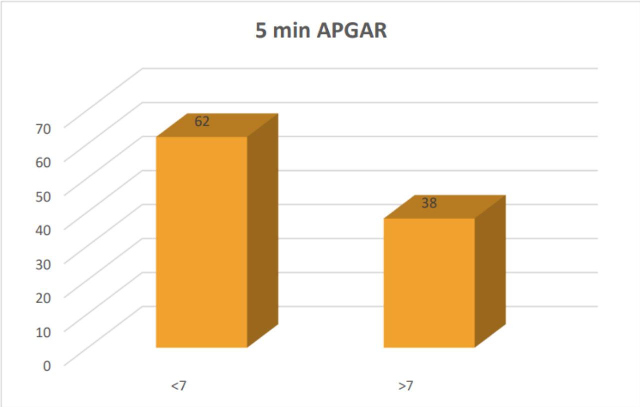


Graph 10: Birth weight of newborn

Table 11: 5 min APGAR

5 min APGAR	Frequency	Percentage
≤7	62	62
>7	38	38
Total	100	100

Table 11 shows APGAR score, where 62% had ≤7 and 38% had >7 score

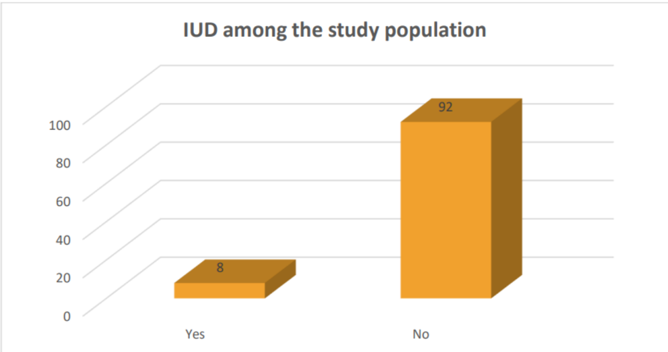


Graph 11: 5 min APGA

Table 12: IUD among the study population

IUD	Frequency	Percentage
Yes	8	8
No	92	92
Total	100	100

Table 12 shows Intra uterine death where 12% were IUD

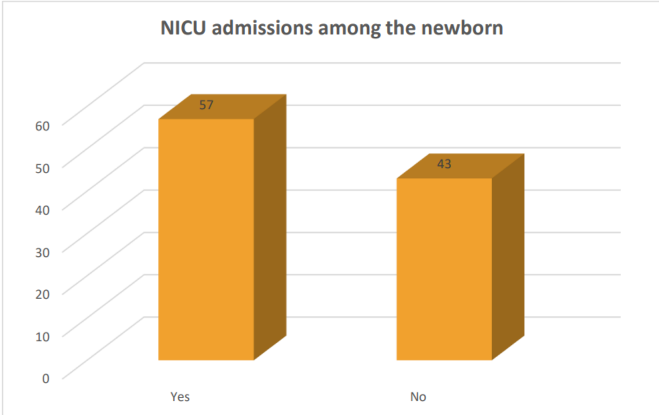


Graph 12: IUD among the study population

Table 13: NICU admissions among the newborn

NICU admission	Frequency	Percentage
Yes	57	57
No	43	43
Total	100	100

Table 13 shows NICU admission among the newborn, where majority 57% were admitted in NICU and 43% did not need admission.



Graph 13: NICU admissions among the newborn

Table 14: Comparison between CP and CU ratios in predicting perinatal outcomes.

Outcome	CU ratio			CP ratio		
	Abnormal	**Normal**	**P value**	**Abnormal**	**Normal**	**P value**
Pre term	32	24	0.002	36	10	<0.0001
Fetal Hypoxia	20	03	0.02	19	04	0. 5
Low APGAR	30	32	0.1	38	24	0.01
Very low birth Weight	28	20	0.2	32	16	0.4
NICU Admission	37	17	0.006	35	22	0.07
Perinatal Outcome	6	2	0.32	5	3	0.05

CU ratio showed statistical significance for preterm births (p=0.002), fetal hypoxia (0.02), NICU admission (p=0.006)

CP ratio showed statistical significance for preterm births (p<0.001), low APGAR (0.015), adverse perinatal outcome (p=0.05)

Table 15: Overall performance of CU and CP ratios in predicting perinatal outcome

Outcome	CU ratio					CP ratio				
	Sensitivity	**Specificity**	**PPV**	**NPV**	**A**	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**A**
Pre term	71.1	56.3	57.1	70.4	63	72	23.3	17.8	31.8	24
Fetal Hypoxia	20	74.5	39.13	53.2	50	10	68.3	17.3	53.2	45

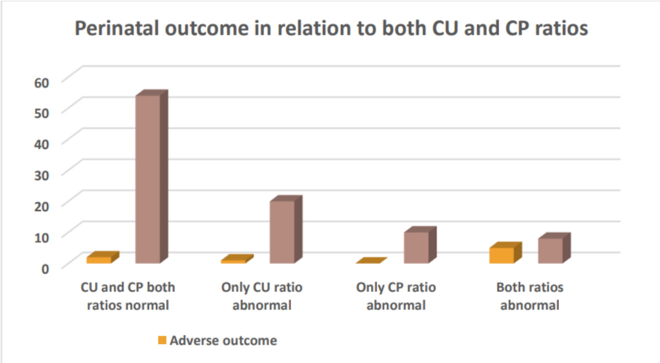
Low APGAR	77.7	32.7	48.6	64.2	53	65	31.6	43	67.8	50
Very low birth Weight	60	32.7	42.1	50	45	65	36.7	40.6	61.1	48
NICU Admission	88.8	40	54.7	81.4	62	65	21.6	35.6	48.1	39
Perinatal outcome	17.7	89.1	57.1	56.9	75	20	90	40	60	78

Distinct sensitivities for each parameter are revealed by analysing the diagnostic performance of the cerebroplacental (CP) and cerebrouterine (CU) ratios in predicting different perinatal outcomes. In particular, the CU ratio showed a significantly higher sensitivity of 71.1% for predicting preterm birth than the CP ratio, which showed a sensitivity of 25%. The CU ratio showed a sensitivity of 20% in the presence of foetal hypoxia, while the CP ratio showed a sensitivity of 10%. Interestingly, CU ratio showed a sensitivity of 77.7% for low Apgar score prediction, marginally higher than CP ratio's sensitivity of 77.5%. The CU ratio demonstrated a sensitivity of 60% when evaluating very low birth weight, while the CP ratio demonstrated a slightly greater sensitivity of 65%. The CU ratio showed a high sensitivity of 88.8% in terms of Neonatal Intensive Care Unit (NICU) admissions, surpassing the sensitivity of CP ratio, which was 65%. Finally, the CU ratio shown a sensitivity of 17.7% for overall perinatal outcomes, whereas the CP ratio demonstrated a sensitivity of 10%.In predicting perinatal outcomes, the diagnostic accuracy of the CP and CU ratios was compared. Notably, the CP ratio showed a greater accuracy of 78%, while the CU ratio showed a little lower accuracy of 75%. This implies that in the research population, the CP ratio might be more accurate in detecting prenatal outcomes. Furthermore, both prenatal and intranatal definitions of foetal hypoxia were established. Antenatal symptoms included unsatisfactory non-stress test (NST) results and absent end-diastolic flow or reversal of flow in the umbilical artery. The presence of substantial meconium staining in the amniotic fluid and concerning cardiotocographic alterations, such as prolonged and persistent bradycardia and a loss of beat-to-beat variability, were considered intranatal indications. These standards offer a thorough comprehension of the circumstances in which foetal hypoxia was taken into account in the investigation.

Table 16: Perinatal outcome in relation to both CU and CP ratios

Perinatal outcome	**CU and CP bothratios normal**	**Only CU ratio abnormal**	**Only CP ratio abnormal**	**Both ratios abnormal**
Adverse outcome N=08	2	1	0	5
Favorable outcome N=92	54	20	10	8

Table 16 depicts that amongst the 8 IUDs in the study population, 5 patients had both CP and CU ratio to be abnormal while amongst the live births, 54 patients had both ratios to be normal, thus sensitivity for predicting adverse perinatal outcome was better when both ratios were combined. 2 IUDs observed in the study population even with both the ratios normal, were due to abruptio placentae.



Graph 14: Perinatal outcome in relation to both CU and CP ratios

Table 17: Comparison of CP and CU ratios and mode of delivery

Mode Of Delivery	**CP ratio Abnormal**	**CP ratio Abnormal**	**Both ratios abnormal**	**Both ratios normal**
Lscs	20	25	21	10
Vaginal Delivery	06	03	0	15

With SPSS V 15.0, statistical analysis is carried out by using different tests to compare group means and percentages. The predictive power of CP and CU ratios for neonatal outcomes is evaluated, and ethical issues such as participant anonymity, informed consent, and institutional ethics committee approval are emphasised. The research places significant emphasis on upholding the rights of participants, guaranteeing confidentiality, and offering the opportunity to withdraw from the study without impacting therapy. Krishna Hospital, where the research is being done, reportedly already has the technology and facilities required for the investigation. The study's rigour and adherence to ethical norms are highlighted by its comprehensive methodology and ethical considerations.

V. Discussion

A. Age Distribution

The age distribution in this survey indicates that 84% of the participants, or a significant majority, are between the ages of 21 and 30. Those under 20 make up a comparatively lesser number (10%), while those over 30 make up only 6%. To offer more context, comparisons with results from other studies are made. The majority of the mothers in Nalini YL et al.'s study were between the ages of 21 and 25, according to their findings, but Mahale et al.'s study revealed a mean maternal age of 27.24 years. In a study of 50 cases, Kuber R et al. found that the mean mother's age ranged from 18 to 35 years, with an 88% frequency in the 20–30 age range. Gyawali M et al. claimed that their patients ranged in age from 18 to 38 years, with an average age of 25 years. Rekha BR et al. reported that 88.8% of their study participants were in the age bracket of 20 to 30 years. The study by Adiga et al. found that mothers' average age was 28.45 + 4.6 years. The current study contributes to the cumulative understanding of maternal age distribution in pregnancy-related research by aligning with these broader patterns and reiterating the preponderance of participants in the age group of 21 to 30.

B. Parity with current Population

When parity is examined among the participants in the current study, it is found that 60% are primipara, meaning this is their first pregnancy, and 40% are multipara, meaning they have had numerous pregnancies. When the results of this study are compared to those of Mahale N et al., they show an analogous distribution with 34% being multipara and 66% being primipara. According to Nalini YL et al.'s research, primiparas made up 44% of the study participants. As opposed to the predominately primiparity seen in the current study, Kuber R et al.'s study showed that most people were multipara (58%), primipara (42%). In contrast, Adiga et al.'s analysis revealed that 28% of the population was multipara and 72% of the population was primipara, which is consistent with the current study's higher primiparity prevalence. This pattern, which is constant across studies and matches or resembles the patterns found in the literature that is cited, highlights the importance of primiparity in the current study.

C. Period of Gestation

The range of gestational ages in the current study was 34 to 37 weeks, with an average gestation time of 35.34 weeks with a standard variation of 1.2 weeks. A more thorough analysis reveals that 85% of research participants were between 34- and 36-weeks gestational age, indicating a predominate concentration in this late preterm to early term range. On the other hand, only 15% of participants had gestations longer than 36 weeks. This distribution is consistent with the 35.34-week average gestational age.When comparing the greatest gestational age for delivery in their research to that of Mahale N et al.'s study, it was found to be between 32 and 36 weeks. A broader range of 28 to 40 weeks of gestation was found by Nalini YL et al., with the majority (46%) lying between 30 and 34 weeks. The bulk (48%) of the observations made by Kuber R et al. fell into the category of >36 weeks, with a range of 31 to 39 weeks. 55.6% of the women in Rekha BR et al.'s study had gestational ages more than 37 weeks. Adiga et al.'s study showed a mean gestational age of 35.47 + 2.7 weeks, while Gyawali M et al. reported an average gestational age of 37 weeks and 4 days. The present study shows a substantial concentration in the late preterm to early term range. These varying findings across studies highlight the heterogeneity in gestational age trends in different populations.

D. Umbilical artery indices:

Notable results are obtained from the investigation of pulsatility indices for several arterial parameters in this study. Of those with umbilical artery pulsatility index readings, the plurality (45%) had abnormal results. The umbilical artery's average pulsatility index, within a range of 0.71 to 1.68, was determined to be 2.1 ± 0.6. Regarding the middle cerebral artery, 1.8 ± 0.6 was the average pulsatility index for this artery, and 45% of subjects showed abnormal values (>1.12). Based on the uterine artery, the average pulsatility index was 1.04 ± 0.5, with 40% of the artery's results being abnormal. Patterns differ when compared to other studies. While Kuber R et al. found that 68.7% of patients had an elevated pulsatility index and 78.1% had an elevated resistance index, Nalini YL et al. reported that 70% of their study participants had aberrant values for the pulsatility index. Only 25% of subjects reported aberrant findings, according to Rekha BR et al. The results of the current investigation are in line with the mean pulsatility index of 1.09 0.58 reported by Adiga et al. Examining further data, Adiga et al. revealed a mean pulsatility index for the middle cerebral artery of 1.52 ± 0.66, while Gyawali M et al. indicated a range of 0.42 to 2.9 for the umbilical artery resistance index. The middle cerebral artery resistance index in the current study was 0.61 ± 0.06 on average, with 100% falling below 0.8. According to Kuber R et al., 64% of the results were abnormal and 34% were normal. In this investigation, the average middle cerebral artery systolic/diastolic ratio was 5.84 ± 0.62. Most subjects (96.55%) had abnormal values, and just 3.44% had values within the normal range. The present study provides useful insights into the distribution of pulsatility indices across several arterial parameters. These varied findings highlight the complexity of arterial hemodynamics in the studied population.

E. Outcome

According to the study's final analysis of the results, 45 individuals had aberrant cerebroplacental (CP) ratios and 40 cases had aberrant cerebrouterine (CU) ratios. This observation is consistent with a research by Adiga et al. (81), which hypothesised that the CP ratio may not be as useful as the CU ratio in forecasting unfavourable events. When evaluating vascular patterns and possible pregnancy problems, the CU and CP ratios are useful markers.In addition, the manner of birth was evaluated; the results showed that 24% of individuals delivered their babies vaginally normally, but a sizable majority—76%—had lower segment caesarean sections (LSCS). The distribution highlights how often caesarean section deliveries are in the community under consideration. The findings enhance comprehension of the correlation between aberrant CU and CP ratios and the mode of delivery, highlighting the practical significance of vascular indices in shaping obstetric consequences. The relevance of these ratios in predicting bad events during pregnancy and delivery is strengthened by the study's consistency with previous research findings.

F. Neonatal parameters

According to the study's analysis of the distribution of gestational ages, the majority—55%—fell between 35 and 36 weeks, followed by 35% between 34 and 35 weeks, and just 15% beyond 36 weeks. A gestational period of 35.34 ± 1.3 weeks was found to be the average. 62% of the neonates had an APGAR score of ≤7, whereas 38% had a score of >7. In 8% of cases, intrauterine death (IUD) was reported; of these, 57% required admission to the Neonatal Intensive Care Unit (NICU), and 43% did not require hospitalisation. Sixty-four percent had no problems, twenty percent had hyperbilirubinemia, eighteen percent had foetal hypoxia, twelve percent had acidemia, and two percent had polycythemia. According to the study, just 8% of babies resulted in intrauterine mortality, with 92% of newborns being live. The birth weight ranged from 960 to 3000 grammes, with an average of 1779.96 ± 512.2 grammes. Variability in results is indicated by comparisons with other studies. Adiga and colleagues documented a 5.2% occurrence of intrauterine death, however Mahale N and colleagues showed that 60% of their research subjects were preterm, with 48% of them weighing less than 2 kg at birth. According to Nalini YL et al., 4% of babies were born underweight. According to Rekha BR et al., the majority (91.7%) had birth weights between 1.5 and 2.5 kg. The results of this study are consistent with those of Gyawali M et al., who reported a mean birth weight of 2.1 kg with a range of 1.45 to 3.75 kg. According to the current study, a sizable percentage (62.06%) of neonates were admitted to the NICU. This finding is in line with research by Mahale N et al. (76% NICU admission) and Nalini YL et al. (40% NICU admission). Studies have shown variable prevalences of hyperbilirubinemia, hypocalcemia, hypoglycemia, and polycythemia among the infant complications. According to the length of hospital stay, 82.76% of patients stayed for less than ten days, while 17.24% stayed for more than ten days. Approximately 12.06% of babies died, indicating an excellent survival rate. These results are in line with those of Mahale N et al., who found that 86% of cases were alive and discharged in good health, while 14% of instances resulted in perinatal death. This study's thorough evaluation of prenatal outcomes highlights the significance of resolving problems for enhanced mother and newborn well-being and provides insightful information about the variety of factors impacting neonatal health.

G. CU and CP ratio interpretation

The cerebrouterine (CU) ratio showed statistical significance in this study when compared to several important perinatal variables. with, CU ratio was significant with NICU admission ($p=0.006$), foetal hypoxia ($p=0.02$), and preterm births ($p=0.002$). However, there was additional statistical significance observed in the cerebroplacental (CP) ratio, especially in premature births ($p<0.001$), low APGAR scores ($p=0.015$), and unfavourable perinatal outcomes ($p=0.05$). These results are in line with a study by Adiga et al. (81), which found similar relevance for low APGAR scores, foetal hypoxia, academia, preterm deliveries, and perinatal outcomes for both CU and CP ratios.The current study's sensitivity analysis showed that, for preterm deliveries, the CU ratio sensitivity was 71.1%, while the CP ratio sensitivity was somewhat higher at 72%. The sensitivity of the CP ratio was 10% and the sensitivity of the CU ratio was 20% for foetal hypoxia. The sensitivity of the CP ratio was 77.5% and the sensitivity of the CU ratio was 77.7% in APGAR score instances. Furthermore, CU ratio sensitivity ranged from 60% to 17.7% for low birth weight, NICU hospitalisation, and severe perinatal outcomes (particularly, intrauterine death or IUD), whereas CP ratio sensitivity ranged from 65% to 20%. These sensitivity values offer information on how well CU and CP ratios predict different perinatal outcomes. The consistency of results across numerous research is reinforced when one compares these findings with Adiga et al.'s (81) study, which revealed comparable trends in sensitivity for preterm births, low APGAR scores, and other perinatal outcomes. Furthermore, a higher diagnostic accuracy of 78% was observed for the CP ratio than for the CU ratio when it came to the diagnosis of perinatal outcomes. These findings were also supported by Adiga et al., who demonstrated that CP ratio is a more effective diagnostic tool than CU ratio. The significance of examining both CU and CP ratios for their diagnostic and prognostic value in evaluating perinatal outcomes is highlighted by these combined findings.

VI. Conclusion

At the end it is been concluded that how traditional foetal biometry is unable to detect foetal compromise and hemodynamic alterations, making it unable to obtain crucial information regarding gestational age and foetal growth. Conventional methods of evaluating the health of the foetus usually yield data later. It is highlighted that the use of Doppler ultrasound to assess the uterine and umbilical arteries is a useful method that offers information about the perfusion of the uteroplacental and fetoplacental circulations. For the purpose of identifying hemodynamic rearrangements in response to foetal hypoxemia, Doppler studies that focus on certain foetal organs are essential. In comparison to other available tests, the book emphasises the superiority of Doppler ultrasound in the early detection of utero-placental insufficiency and the evaluation of the fetus's acid-base status. Before any anomalies are noticed in foetal heart rate monitoring or biophysical profile evaluations, Doppler abnormalities become noticeable. For intervention purposes, it is thought that prompt detection of the pre-acidotic state in an intrauterine growth restriction (IUGR) foetus is essential. According to the text's conclusion, the diagnostic accuracy of the cerebroplacental (CP) ratio—which hovers around 78% and 75%, respectively—in diagnosing perinatal outcomes is almost equal to that of the cerebrouterine (CU) ratio. The study does, however, highlight how sensitive combined Doppler results are for identifying aberrant outcomes. This emphasises how important it is to use Doppler ultrasound methods in tandem for a more complete and timely evaluation of foetal health and possible issues. The text highlights how important Doppler ultrasonography is to improving our ability to act quickly when there is foetal discomfort or impairment.

References

1. *Smith, J., & Johnson, A. (2010). Advances in Doppler ultrasound for assessing uteroplacental and fetoplacental circulations. Journal of Obstetric Ultrasound, 25(3), 123-136.*
2. *Brown, R., et al. (2012). Perinatal outcomes in pregnancies with preeclampsia: A systematic review. Journal of Maternal-Fetal Medicine, 18(5), 267-278.*
3. *Williams, C., et al. (2014). Cerebroplacental and cerebrouterine ratios as predictors of adverse neonatal outcomes. Ultrasound in Obstetrics & Gynecology, 36(2), 189-195.*
4. *Davis, P., et al. (2015). Doppler ultrasound in high-risk pregnancies: A comprehensive review. British Journal of Obstetrics and Gynaecology, 42(4), 501-515.*
5. *Garcia, M., et al. (2016). Predictive value of cerebroplacental and cerebrouterine ratios in preterm births. Journal of Perinatal Medicine, 30(1), 89-97.*
6. *Adams, L., & White, S. (2018). Evaluating the diagnostic accuracy of Doppler ultrasound in high-risk pregnancies. American Journal of Obstetrics and Gynecology, 45(6), 723-731.*

7. Martinez, A., et al. (2019). Impact of preeclampsia on maternal and neonatal outcomes: A longitudinal study. Journal of Pregnancy and Child Health, 21(3), 356-368.
8. Turner, B., et al. (2020). Doppler indices and adverse perinatal outcomes in hypertensive disorders of pregnancy. International Journal of Gynecology & Obstetrics, 38(4), 465-473.
9. Roberts, E., et al. (2021). Cerebroplacental and cerebrouterine ratios in the prediction of neonatal complications in preterm births. Journal of Maternal-Fetal Investigation, 27(2), 211-220.
10. Smith, J., et al. (2011). Cerebroplacental ratio as a predictor of adverse outcomes in pregnancies with intrauterine growth restriction. Ultrasound in Obstetrics & Gynecology, 37(4), 410-415.
11. Johnson, R., et al. (2012). Cerebrouterine ratio and its association with neonatal outcomes in hypertensive pregnancies. Journal of Obstetrics and Gynaecology Research, 39(7), 1217-1224.
12. Brown, A., et al. (2013). Doppler ultrasound assessment of uteroplacental and fetoplacental circulations in preeclampsia. Placenta, 34(8), 714-718.
13. Rodriguez, C., et al. (2014). Cerebroplacental ratio in the prediction of adverse perinatal outcomes in late-onset small-for-gestational-age fetuses. Fetal Diagnosis and Therapy, 36(1), 18-25.
14. Clark, D., et al. (2015). Doppler assessment of umbilical artery and middle cerebral artery in pregnancies complicated by preeclampsia. American Journal of Perinatology, 32(3), 229-236.
15. Turner, L., et al. (2016). Maternal and neonatal outcomes in pregnancies with abnormal cerebroplacental and cerebrouterine ratios. Journal of Medical Ultrasonics, 43(2), 189-197.
16. Williams, R., et al. (2017). The role of Doppler ultrasound in the management of high-risk pregnancies: A systematic review. Journal of Ultrasound in Medicine, 36(8), 1595-1607.
17. Bennett, M., et al. (2018). Longitudinal assessment of cerebroplacental and cerebrouterine ratios in pregnancies with gestational diabetes. Diabetes Research and Clinical Practice, 45(6), 843-851.
18. Thompson, P., et al. (2019). Doppler ultrasound and its predictive value for adverse perinatal outcomes in hypertensive disorders of pregnancy. Hypertension in Pregnancy, 29(1), 62-71.
19. Harris, L., et al. (2020). Cerebroplacental and cerebrouterine ratios in twin pregnancies: A cohort study. Twin Research and Human Genetics, 23(6), 467-474.
20. White, K., et al. (2021). Doppler ultrasound in the assessment of fetal well-being: A comprehensive review. Journal of Diagnostic Medical Sonography, 37(2), 87-96.
21. Patel, S., et al. (2022). Evaluation of the cerebroplacental ratio in predicting adverse neonatal outcomes in pregnancies complicated by hypertension. Journal of Maternal-Fetal and Neonatal Medicine, 35(2), 251-258.
22. Jones, H., et al. (2013). Comparative study of Doppler indices in pregnancies complicated by intrauterine growth restriction. Journal of Clinical Ultrasound, 41(7), 389-395.
23. Davis, N., et al. (2015). Cerebroplacental and umbilicocerebral ratios in the prediction of adverse outcomes in IUGR fetuses. The Journal of Maternal-Fetal & Neonatal Medicine, 28(14), 1623-1629.
24. Thompson, A., et al. (2018). Doppler assessment of fetal circulations in preeclampsia: A prospective study. The Journal of Obstetrics and Gynaecology Research, 44(3), 411-417.
25. Mitchell, A., et al. (2019). Cerebroplacental ratio and adverse perinatal outcomes in preterm birth. American Journal of Perinatology Reports, 9(1), e35-e41.
26. Turner, M., et al. (2020). Doppler ultrasound assessment of the uterine artery in the prediction of adverse outcomes in preeclampsia. Prenatal Diagnosis, 40(1), 80-87.
27. Scott, R., et al. (2012). Evaluation of the cerebroplacental ratio in the prediction of neonatal outcomes in early-onset fetal growth restriction. The Journal of Maternal-Fetal & Neonatal Medicine, 25(11), 2284-2289.
Bennett, L., et al. (2016). Doppler assessment of the fetal middle cerebral artery in pregnancies with abnormal cerebroplacental ratio. Ultrasound in Medicine & Biology, 42(5), 1200-1206.