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CORRELATION OF PLACENTAL LOCATION WITH DEVELOPMENT OF PREECLAMPSIA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Preeclampsia is a multisystem hypertensive disorder arising after 20 weeks of gestation and remains a major contributor to maternal and perinatal morbidity and mortality. Abnormal placental implantation and impaired uteroplacental perfusion are central to its pathogenesis. Placental laterality detected by mid-trimester ultrasonography has emerged as a simple, non-invasive, and cost-effective screening marker for early identification of women at risk. This study was conducted to evaluate the correlation between placental location and the development of preeclampsia.

Methods: A cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, RIMS, Imphal, from May 2023 to October 2024. A total of 362 pregnant women with singleton gestations beyond 20 weeks were enrolled using convenience sampling. Women with chronic hypertension, renal disease, diabetes, cardiovascular disorders, epilepsy, vascular disease, or coagulopathies were excluded. Placental location at 18–24 weeks was retrieved from ultrasound reports and classified as central or lateral. Maternal blood pressure, laboratory parameters, and obstetric outcomes were recorded. Data were analyzed using SPSS v26, applying descriptive statistics and Chi-square tests, with $p < 0.05$ considered significant.

Results: Among 362 participants, the placenta was centrally located in 57.7% and laterally in 42.3%. Overall, 25.1% developed preeclampsia. The incidence of preeclampsia was significantly higher in women with a lateral placenta (31.4%) compared to a central placenta (20.6%) ($p = 0.019$). Lateral placentation was also associated with adverse maternal and fetal outcomes: increased rates of cesarean delivery (48%), low birth weight (28.8%), IUGR (32%), NICU admission (23.6%), and stillbirth (4.6%). These outcomes were significantly higher compared to centrally located placenta ($p < 0.05$ across parameters).

Conclusion: Placental laterality at 18–24 weeks is significantly associated with the development of preeclampsia and poorer perinatal outcomes. Early identification of lateral placenta can aid in risk stratification, closer surveillance, and timely interventions to reduce morbidity.

Keywords: Preeclampsia, Placental Laterality, Central Placenta, Lateral Placenta, Ultrasonography, Maternal Outcome, Fetal Outcome.

INTRODUCTION

Preeclampsia is a multisystem hypertensive disorder of pregnancy, characterized by new-onset hypertension after 20 weeks of gestation accompanied by proteinuria or evidence of end-organ dysfunction involving renal, hepatic, hematological, or neurological systems.[1] It affects 5–7% of first pregnancies and 2–10% of all pregnancies, making it one of the most significant complications of gestation.[2] Although its exact pathogenesis remains unclear, preeclampsia is considered multifactorial, involving maternal immunological intolerance, abnormal placental implantation, genetic influences, nutritional and environmental factors, and maternal cardiovascular health.[3] Pregnancy itself induces notable anatomical, metabolic, and inflammatory changes, which may contribute to disease development.[3]

Preeclampsia is fundamentally a disorder of trophoblastic tissue,[4] with placental abnormalities recognized as one of the earliest events in pregnancies that later develop pregnancy-induced hypertension.[5] Globally, preeclampsia is a major contributor to maternal and perinatal morbidity and mortality, and many associated deaths are preventable with timely and effective care.[6] Approximately 76,000 women die each year from preeclampsia and its related complications worldwide.[7]

Various clinical, biochemical, and biophysical tests have been explored for early prediction of preeclampsia, including assessments of placental perfusion and vascular resistance, fetoplacental endocrine markers, renal function, endothelial dysfunction, and circulating angiogenic factors.[8] However, many of these predictive tests are cumbersome, expensive, and lack sufficient accuracy for routine clinical use.

Among the available predictors, placental location assessed by ultrasonography at 18–24 weeks has emerged as a simple, cost-effective, and non-invasive tool with promising predictive value.[9] Kakkar et al.[10] demonstrated that women with laterally located placentas have a fivefold increased risk of developing preeclampsia.

AIMS AND OBJECTIVES

The study aimed to evaluate the correlation between placental location identified on ultrasound between 18–24 weeks of gestation and the subsequent development of preeclampsia. By assessing whether laterally located placentas are associated with a higher risk of the disorder, the study seeks to determine the potential utility of placental location as a simple, early, and cost-effective predictive marker for preeclampsia.

MATERIALS AND METHODS

Study Design

This cross-sectional study was conducted over a period of one and a half years, from May 2023 to October 2024, at the Department of Obstetrics and Gynaecology, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur. It was a tertiary care hospital–based study involving pregnant women with singleton pregnancies who attended the antenatal clinic or presented to the labor room during the study period. The study aimed to assess placental location and its correlation with the development of preeclampsia.

Inclusion and Exclusion Criteria

The study included pregnant women with singleton gestations from 20 weeks of pregnancy until delivery. Women with a history of chronic hypertension, diabetes mellitus, renal or cardiovascular disease, hemorrhagic disorders, previous thromboembolic events, epilepsy, or other vascular diseases were excluded to minimize confounding factors and ensure the assessment focused on the relationship between placental location and the development of preeclampsia.

Sample Size Calculation
$N = 4PQ/L^2$
Based on a study by A Gupta et al.[11]
P = 65.5% (Prevalence)
Q = 100-P=34.5
L = Allowable error = 5%
$N = 4 \times 65.5 \times 34.5/5^2 = 362$
Total sample size calculated was 362.

Data Collection Procedure
Data were collected using a predesigned proforma after obtaining ethical approval from the Institutional Ethical Committee, RIMS, Imphal, and written informed consent from all participants. Eligible pregnant women were screened according to the inclusion and exclusion criteria. A detailed history was taken, followed by comprehensive general, systemic, and obstetrical examinations during antenatal visits or at the labor room. Routine antenatal investigations were performed for all participants, while women who developed preeclampsia underwent additional tests including platelet count, liver and renal function tests, fundus examination, and 24-hour urine analysis for volume, protein, and creatinine. Placental location was determined from ultrasound reports between 18–24 weeks, classifying placentas as central if evenly distributed across the uterine midline or lateral if more than 75% of the placental mass was on one side. Maternal blood pressure and other relevant clinical and investigation findings were systematically recorded in the proforma at appropriate time points.

Statistical Analysis
Data were entered and analyzed using SPSS Statistics version 26 (IBM SPSS Inc., Chicago, IL, USA). Descriptive statistics, including mean, standard deviation, median, frequency, and percentage, were used to summarize the data. Inferential analysis was performed using the chi-square test to assess associations between categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

Variable	Category	Frequency (%)
Age Group	<25 years	145 (40.0)
	25–34 years	178 (49.2)
	≥35 years	39 (10.8)
Religion	Hindu (Meetei)	227 (62.7)
	Islam	79 (21.8)
	Christianity	56 (15.5)
Education	Up to Class V	11 (3.0)
	Up to Class X	112 (31.0)
	Graduate	171 (47.2)
	Above Graduate	68 (18.8)

*Table **1: Sociodemographic Profile of Study Subjects (N = 362)***

Table 1 shows the sociodemographic distribution of study participants, demonstrating that majority of the study subjects fell between the age group of 25-34 yrs. and were from Hindu religion.

Variable	Category	Frequency (%)
Parity	P0	172 (47.5)
	P1	136 (37.5)
	P2	41 (11.3)
	P3	13 (3.6)
Bad Obstetric History	Present	29 (8.0)
History of Abortion	Present	120 (33.1)
Oral Contraceptive Use	Present	81 (22.3)
Period of Gestation at Delivery	≤37 weeks	14 (3.8)
	38 weeks	58 (16.0)
	39 weeks	205 (56.6)
	≥40 weeks	59 (16.3)
Vital Parameters	Mean SBP	131.14 ± 13.82
	Mean DBP	83.81 ± 14.29
	BMI	26.35 ± 2.06
Table 2: Obstetric & Maternal Characteristics (N = 362)		

Table 2 illustrates maternal and obstetric characteristics, showing that the majority were primigravida or para 1, with high prevalence of obesity and normal-term gestation.

Category	Frequency (%)
Placental Location	Central – 209 (57.7%)
	Lateral – 153 (42.3%)
Preeclampsia	Developed – 91 (25.1%)
	Not Developed – 271 (74.9%)
Table 3: Distribution of Placental Location and Occurrence of Preeclampsia (N = 362)	

Overview

Table 3 shows the proportion of central and lateral placentas and the overall incidence of preeclampsia (25.1%).

Placental Location	Developed PE n (%)	Not Developed PE n (%)	p-value
Central	43 (20.6%)	166 (79.4%)	**0.019**
Lateral	48 (31.4%)	105 (68.6%)	
Table 4: Association between Placental Location and Development of Preeclampsia			

Table 4 illustrates that preeclampsia was significantly more common in pregnancies with a lateral placenta (31.4%), with statistical significance (p = 0.019).

Mode of Delivery	Central Placenta (%)	Lateral Placenta (%)	p-value
Normal delivery	67.0	31.0	**0.037**
Cesarean section	26.0	48.0	
Instrumental delivery	7.0	13.0	
Table ***5: Maternal Outcomes in Relation to Placental Location (Mode of Delivery)***			

Table 5 shows that cesarean and instrumental deliveries occurred more frequently in women with lateral placenta, while normal delivery was more common in central placentation.

Fetal Outcome	Frequency (%)
Low Birth Weight	74 (20.4%)
IUGR	66 (18.2%)

Stillbirth	9 (2.5%)
Congenital Anomaly	4 (1.1%)
Low APGAR (<7 at 5 min)	13 (4.0%)
NICU Admission	59 (16.3%)

Table 6: Fetal Outcomes – Overall Distribution (N = 362)

Table 6 illustrates the distribution of adverse fetal outcomes, with low birth weight and IUGR being the most common.

Placental Location	**Normal Weight (%)**	**LBW (%)**	**p-value**
Central	179 (85.6%)	30 (14.4%)	**0.001**
Lateral	109 (71.2%)	44 (28.8%)	
A.Birth Weight			
Placental Location	**No IUGR (%)**	**IUGR (%)**	**p-value**
Central	192 (91.8%)	17 (8.2%)	**0.002**
Lateral	104 (68.0%)	49 (32.0%)	
B.IUGR			
Placental Location	**No NICU (%)**	**NICU (%)**	**p-value**
Central	196 (93.7%)	13 (6.3%)	**0.001**
Lateral	117 (76.4%)	36 (23.6%)	
C.NICU Admission			
Placental Location	**No (%)**	**Yes (%)**	**p-value**
Central	207 (99.0%)	2 (0.1%)	**0.028**
Lateral	146 (95.4%)	7 (4.6%)	
D.Stillbirth			

Table 7: Association between Placental Location and Fetal Outcomes

Table 7 demonstrates that lateral placental location is strongly associated with worse fetal outcomes-double the rate of LBW, fourfold higher IUGR, significantly increased NICU admissions, and higher stillbirth rates.

DISCUSSION

Placental implantation plays a central role in determining uteroplacental blood flow, and therefore placental location has important implications for maternal and fetal outcomes. In normal physiology, a centrally located placenta receives relatively uniform blood flow from both uterine arteries, whereas in lateral placentation, the uterine artery on the placental side provides most of the perfusion. Because collateral circulation varies among women, reduced trophoblastic invasion and higher vascular resistance may occur in pregnancies with lateral placenta.[11,12] This altered hemodynamic environment contributes to impaired uteroplacental perfusion, predisposing affected women to PE (Preeclampsia) and fetal growth restriction.[10] Consistent with this mechanism, several studies have demonstrated increased uterine artery resistance and higher PE risk in the presence of lateral placenta.[12-14]

In the present study, 42.3% of women had a lateral placenta and 25.1% developed preeclampsia. The incidence of PE was significantly higher among women with a lateral placenta (31.4%) compared to those with a central placenta (20.6%). These findings align with a wide body of literature demonstrating that placental laterality is associated with increased PE risk. For example, Alikhani et al.[15] reported a 3–4-fold increase in PE among women with lateral placenta, while Gonser et al.[16] documented a similar association. Studies from different regions of India-including Kore et al.[17] Kaku et al.[18] Chandra and Maheshwari[19] and Muralidhar and Jyothi[9] have consistently shown that lateral placentation is a strong predictor of PE. Conversely, Salama Bello et al.[20] reported no significant difference between placenta groups, indicating that ethnic, population-based, and

environmental factors may influence these associations. The relatively lower incidence of PE in the present study compared with some earlier studies may also reflect population differences or improved antenatal care.

The current study also demonstrated a significantly higher rate of cesarean section and instrumental deliveries among women with a lateral placenta (48% and 13%, respectively). This is consistent with findings reported by Yadav et al.[21] and Vaillant et al.[22] who observed increased operative delivery rates in lateral placenta due to fetal distress and poor placental perfusion.

Fetal outcomes in this study were notably poorer in cases with lateral placenta. A significantly higher incidence of low birth weight (28.8%), IUGR (32%), NICU admission (23.6%), and stillbirth (4.6%) was observed in the lateral placenta group. These results corroborate prior research showing an increased risk of fetal growth restriction due to compromised uteroplacental blood flow in laterally implanted placentas. Kalanithi et al.[23] reported a fourfold increased likelihood of IUGR in lateral placentation. Additionally, Nair et al.[24]Seckin et al.[25] and Gosh et al.[26] all demonstrated higher rates of IUGR and fetal complications in pregnancies with lateral placenta. Similar patterns were identified by Ambastha et al.[27] and Kore et al.[18] Studies by Gupta et al.[28]and Bhalerao et al.[29] also confirmed a higher prevalence of low birth weight in the lateral placenta group, further supporting the findings of the present study. Likewise, Magann et al.[30] noted significantly reduced APGAR scores among neonates of women with lateral placentas. The increased NICU admission in such pregnancies has been consistently reported in multiple studies.[23,26]

Overall, the findings of the present study reinforce the growing evidence that placental laterality is a simple, low-cost, non-invasive marker that can aid in early identification of women at higher risk for preeclampsia and adverse maternal and neonatal outcomes. Early recognition of placental laterality during routine mid-trimester ultrasonography may therefore contribute substantially to improving pregnancy surveillance, timely intervention, and ultimately maternal–fetal health.

CONCLUSION

This study demonstrates that a laterally located placenta on ultrasound at 18–24 weeks is significantly associated with an increased risk of preeclampsia. Women with lateral placentation also experience higher rates of adverse maternal and fetal outcomes, including cesarean delivery, intrauterine growth restriction, low birth weight, NICU admissions, and stillbirth. Early identification of placental laterality during antenatal care can help recognize high-risk pregnancies and facilitate timely interventions to improve maternal and perinatal outcomes.

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