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Original Research Article

Placental location and development of preeclampsia: a longitudinal study

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ABSTRACT

Background: Preeclampsia is one of the leading causes of morbidity and mortality worldwide. A number of pregnant women suffer from it after 20 weeks of their pregnancy. The study was designed to know the association between location of placenta and the development of preeclampsia in pregnant women. the purpose of the study is to determine the incidence of lateral location of placenta and to study the relation between placental location and development of preeclampsia.
Methods: A prospective study conducted on pregnant women who attended the antenatal clinic of SRHU Hospital over period of 12 months. The study was hospital based longitudinal study with a sample size of 100 cases presenting over a period of 12 months in Obstetrics and Gynecology Department. Simple Random Sampling was used for random selection of antenatal case at 18 to 24 weeks gestation with singleton pregnancy, after taking written consent and agreeing for follow-up till delivery.
Results: Out of the total 100 cases taken for the study, there were 68 cases of lateral placenta and 32 cases of central placenta. Most of the cases belonged to middle class living in urban areas. The development of preeclampsia is mainly due to mineral deficiency and high systolic BP.
Conclusions: In present study, 48.5% patients with lateral placenta and 46.9% with central placenta developed pre-eclampsia. There was a significant association that was found between laterality of placenta and development of PIH. The laterally located placenta is associated with increased risk of developing preeclampsia. Therefore, looking for placental laterality at the time of a mandatory antenatal ultrasound scanning (level II) may serve as a non-invasive test to predict pre-eclampsia.

Keywords: Location of placenta, Morbidity, Mortality, Preeclampsia

INTRODUCTION

Preeclampsia was formerly called toxemia of pregnancy because it was thought that there were toxins in the blood. Now again it is found that there are subcellular soluble factors in the blood which contribute to the development of preeclampsia. Hence preeclampsia can be called as toxemia of pregnancy.[1] Preeclampsia is a "pregnancy specific syndrome" that affects every organ system virtually. It is a multi-system disorder with high blood pressure and significant proteinuria.[2] Preeclampsia is defined as increase in Blood pressure ≥140/90 mm of Hg recorded on two different occasions 4 hours apart with proteinuria (0.3 grams protein in twenty-four hours collected urine after gestational age of twenty weeks in previously normotensive and non proteinuric women.[3] Twelve percent of all maternal deaths in developing nations are due to pre-eclampsia according to WHO.[4]

The pathogenesis is of multi-factorial origin. It can be explained by faulty conversion of maternal uterine spiral arteries to wide sinusoids, which is due to imbalance among the circulating amount of angiogenic and the anti-angiogenic growth factors causing widespread endothelial cell dysfunction. Increased lipoprotein oxidation and bad placentation cause hypoxia initiating the release of inflammatory stimuli in the maternal circulation and genetic factors.[5] It has been depicted that in woman, branches of two uterine arteries are appropriate in number and each of them supply the respective part of the uterus. Anastomosis is there in both arteries but whether they are functional is questionable due to lack of proof.[6] Laterally located placenta has uterine artery which has less resistance than the opposite one. While centrally located placenta have same resistance observed in uterine arteries and the utero-placental flow of blood and both uterine arteries participate to meet the needs.[7]

In lateral placenta, the uterine artery close to the placenta, along with a little contribution from collaterals of the uterine artery of the opposite side meets the blood flow requirement. All women may not have same degree of collateral circulation. Deficient contribution leads to the development of preeclampsia or IUGR and in some cases both.[6] Spiral arterioles undergo a series of transformation in a normal pregnancy in order to provide blood supply to the intervillous space. This mechanism relies on trophoblast. Maternal vessels are invaded by trophoblastic tissue which then incorporates into vessel wall. The endothelial and muscular layers of the uterine arteries are replaced by the new layer formed by trophoblastic tissue, which abolishes the ability of vessel to contract. It is by this mechanism spiral arteries changes from low flow, high resistance vessels into high flow, low resistance vessels. In some circumstances, trophoblastic invasion of myometrial segment of spiral arteries is impaired.[7] So the spiral arteries remain narrow with restricted blood supply to the fetus. This predisposes the pregnancy for development of preeclampsia and intrauterine growth restriction in later gestation.

Early screening helps in identifying patients who are at risk of developing preeclampsia, to give them special obstetric care so that maternal and perinatal morbidity and mortality associated with pregnancy induced hypertension are reduced.[8] Many tests have been suggested to identify women who are at the risk of developing preeclampsia. Examples are cold pressor tests, roll over test and isometric hand grip exercise.[9] But these tests depend on pathophysiological changes occurring in preeclampsia. Biochemical alterations associated with preeclampsia are measured by urinary calcium or plasma fibronectin.

METHODS

A prospective study was conducted on pregnant women who attended the antenatal clinic of SRHU Hospital over period of 12 months after taking written informed consent and they were followed up till delivery.

The study was hospital based longitudinal study with a sample size of 100 cases presenting over a period of 12 months in Obstetrics and Gynecology Department. Simple Random Sampling was used for random selection of antenatal case at 18 to 24 weeks gestation with singleton pregnancy, after taking written consent and agreeing for follow-up till delivery.

Exclusion criteria

- Patients with chronic hypertension, multifetal gestation, uterine anomalies, previous caesarean section, twin pregnancy, thyrotoxicosis, previous history of hypertensive disorder in pregnancy, pregestational and gestational diabetes, renal disease, bleeding and coagulation disorder, history of smoking and the ones not willing for follow-up were excluded from the study.

Statistical analysis

Statistical analysis was done using descriptive statistics, chi square test and t test. P value <0.05 was considered statistically significant.

Study tools

Case reporting form, consent form, ultrasonography, color Doppler, haematological investigations, urine analysis and biochemical investigations.

RESULTS

Considering the demographic profile of the study population, most of the patients (54%) were the residents of urban area, belonging to the middle class (81%).

Table 1: Clinical-demographic profile.

Variable		Frequency	Percent
Area of residence	Rural	46	46.0
	Urban	54	54.0
Socio Economic Status	Lower	18	18.0
	Middle	81	81.0
	Upper	1	1.0
Gravida	G1	67	67.0
	G2	14	14.0
	G3	10	10.0
	G4	6	6.0
	G5	1	1.0
	G6	2	2.0
Variable		**Mean**	**SD**
Age		24	3.2
Weight		59.7	10.1
Height		2.00	0.0

Maximum of the cases (67%) were of primigravida i.e. having G1 gravidity. The mean age of 100 patients was 24 years (±3.2 years), the mean weight was 59.7kg (±10.1kg) while the mean height was 2.0 (±0.0). Systolic BP (18-24) had a mean of 118.7 (±12.4), on the other hand, the mean of diastolic BP (18-24) was 74.9 (±4.2). In the 3rd trimester the reported systolic BP had a mean of 135.3 (±17.1) while the reported diastolic BP had a mean of 85.1 (±11.9) as mentioned in Table 1.

Following tables show comparison between two groups: patients with lateral placenta and those with central placenta.

The location of the placenta plays a major role in the incidences. Out of 100 cases, there were 32 cases in which the placenta was centrally located and in 68 cases the placenta was laterally located. That is ratio of lateral: central placenta was 2.1:1 (Table 2).

Table 2: Location of placenta.

Placenta location	Frequency	Percent
Central placenta	32	32.0
Lateral placenta	68	68.0
Total	100	100.0

The pregnancy induced hypertension (PIH) was present in 33 cases of lateral placenta and 15 cases of central placenta with a p-value of 0.023 having significant difference. As per the severity of PIH, in lateral placenta 75.70% of PIH cases were mild and 24.30% were severe while in central placenta 93.30% cases were mild and 6.70% severe. There was no significant difference in the severity with placental location (Table 3).

Table 3: Cases of PIH among lateral and central placenta.

PIH	Lateral placenta	Central placenta	P Value
PIH	33 (48.50%)	15 (46.90%)	0.023
No PIH	35 (51.50%)	17 (53.10%)	
PIH	**Lateral placenta**	**Central placenta**	**P value**
Mild	25 (75.70%)	14 (93.30%)	0.295
Severe	8 (24.30%)	1 (6.70%)	

Out of 68 cases with lateral placenta only 1(1.50%) patient developed eclampsia. None of the patients with central placenta developed eclampsia. There was no significant association between development of eclampsia and lateral placenta (Table 4).

There was significant association observed between urine albumin and laterality of placenta. 8.80% cases with lateral placenta had 3+ urine albumin and none of the cases with central placenta had 3+ urine albumin (Table 5).

Table 4: Distribution of cases according to development of eclampsia.

Eclampsia	Lateral placenta	Central placenta	P value
	Number (%)	Number (%)	
Eclampsia	1 (1.50)	0 (0.00)	0.491
No eclampsia	67 (98.50)	32 (100.00)	
Total	68 (100)	32 (100)	

Table 5: Distribution of cases according to urine albumin (by dipstick).

Urine albumin (dipstick)	Lateral placenta	Central placenta	P value
	Number (%)	Number (%)	
Nil (less than 10mg/dl)	30 (44.10)	17 (53.10)	0.017
Traces (15-30mg/dl)	4 (5.90)	0 (0.00)	
1+(30mg/dl)	14 (20.60)	10 (31.20)	
2+(100mg/dl)	14 (20.60)	5 (15.60)	
3+(300mg/dl)	6 (8.80)	0 (0.00)	
Total	68 (100)	32 (100)	

Abnormal waveforms were mostly seen in 11 cases of PIH with (33.4%) lateral placenta cases, as compared to central placenta cases 3 (20%) (Table 6).

Table 6: Distribution of cases according to color Doppler in PIH cases.

Color Doppler	Lateral placenta	Central placenta	P Value
	Number	Number	
Abnormal waveforms	11 (33.4%)	3 (20%)	0.34
Normal waveforms	22 (66.6%)	12 (80%)	
Total (PIH cases)	33 (100%)	15 (100%)	

DISCUSSION

In a study, 56 % of patients had lateral placenta of which 66.6% developed PIH.[10] 44% of patients had central placenta of which 36.6% had PIH.[11] So the risk of developing preeclampsia was greater for women in laterally located placenta as compared to those with central placenta. The difference was statistically significant.

In present study 48 patients developed preeclampsia out of which 33(68.75%) had lateral placenta and 15 (31%) had centrally located placenta. present findings are

comparable to results of a study by Pai et al who found 16.6% women developing preeclampsia, 52(73.2 %) had lateral placenta and 19(26.76%) had centrally located placenta.[12]

This study had a sensitivity of 60.41% in predicting pre-eclampsia with placental laterality, and specificity of 44.2%. The positive predictive value of this screening test is 50%. And negative predictive value is equal to 54.7%. Another study had sensitivity of 73%, specificity of 86%, positive predictive value of 51% and negative predictive value of 94%. And one study found sensitivity, specificity, positive predictive value and negative predictive value of this screening test to be 72%, 80%, 52% and 94% respectively. 78 present positive predictive value of 50% correlated with positive predictive value of both the studies.[13,14]

In present study 33 patients with lateral placenta developed preeclampsia out of which 8 patients (24.3%) had severe PIH. 15 patients with central placenta developed PIH out of which only 1(6.7%) had severe PIH. Out of 48 patients with preeclampsia 11(33.4%) patients with lateral placenta had abnormal waveforms and 3(20%) patients with central placenta had abnormal waveforms. But the difference was not statistically significant.[15] Pregnancy induced hypertension (PIH) is a major obstetric problem in present day health care practice. It not only affects the maternal health but also has increased fetal risk. It accounts for 12 % of maternal mortality worldwide.[16]

This study was conducted to evaluate relation of the lateral location of placenta (diagnosed by ultrasound at eighteen to twenty-four weeks of gestation) as a predictor for the development of preeclampsia. In this study, out of 100 women 68% of patients had lateral placenta and 32 % had centrally located placenta. One study found that out of 463 study subjects, 342 (73.9%) had lateral placenta and 121(26.1%) had centrally located placenta, 33 (48.5 %) out of 68 women with laterally located placenta, developed PIH whereas 15 (46.8 %) with central placenta had PIH. The difference was found to be statistically significant.[17]

Both uterine arteries contribute equally to the uteroplacental needs in centrally located placenta. However, collateral circulation of one of the uterine arteries meets the blood flow needs in most patients of laterally located placenta. Women may show varying degree of collateral circulation. The development of preeclampsia, intrauterine growth retardation or both may be due to deficient contribution.[18] Reduced trophoblastic invasion in laterally located placenta may be responsible for development of preeclampsia.

CONCLUSION

In present study, 48.5% patients with lateral placenta and 46.9% with central placenta developed pre-eclampsia. Ultrasonography is a simple, non-invasive, easy to perform and cost effective test for placental localization. There was a significant association that was found between laterality of placenta and development of PIH. The laterally located placenta is associated with increased risk of developing preeclampsia. Therefore, looking for placental laterality at the time of a mandatory antenatal ultrasound scanning (level II) may serve as a non-invasive test to predict pre-eclampsia.

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