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EFFECT OF PLACENTAL LOCATION ON INTRA-UTERINE GROWTH RESTRICTION AND GESTATIONAL HYPERTENSION

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ABSTRACT

OBJECTIVES: To evaluate the relationship between uterine placental location and fetal growth restriction and gestational hypertension.
MATERIALS AND METHOD: A prospective cross-sectional study done in the Department of Radiology of the University of Calabar Teaching Hospital (UCTH), Calabar, within a 4-month period. The study involved a total of 100 singleton pregnant women between 20 to 40 weeks of gestation who were aged 20 to 39 years. Analysis of the data was done using the statistical package for social science (SPSS) version 20 Inc. Chicago, IL.
RESULTS: The frequency distribution of the placental locations were: anterior – 35%, postero-fundal – 36%, antero-fundal – 18% and posterior – 11%. The highest mean head circumference to abdominal circumference ratio (HC/AC) was seen in subjects with posterior placental location (1.03 ± 0.09), lowest mean estimated fetal weight (EFW) was seen in subjects with antero-fundal placental location (1.87 ± 0.92 kg) while the highest mean systolic and diastolic blood pressure were seen in subjects with postero-fundal placental location (113.89 ± 10.50 mmHg and 66.61 ± 7.07 mmHg) respectively. The lowest mean HC/AC was noted in subjects with anterior placental location (1.01 ± 0.08), the highest EFW was noted in subjects with postero-fundal placental location (2.26 ± 1.03 kg) while the lowest mean systolic and diastolic blood pressure were noted in subjects with posterior placental location (109.09 ± 5.39 mmHg and 61.82 ± 4.05 mmHg) respectively. There was no significant correlation between placental location and HC/AC, EFW, systolic blood pressure and diastolic blood pressure ($p = 0.744$, $p = 0.567$, $p = 0.671$, $p = 0.936$) respectively.
CONCLUSION: Placental location in the uterus has no relationship with intrauterine growth restriction and the development of gestational hypertension in the second half of singleton pregnancies.

KEYWORDS: Placental location, Gestational hypertension, Intra-uterine growth restriction, Ultrasonography.

INTRODUCTION

The placenta is an indispensable organ during pregnancy that permits fetal uptake of nutrient, temperature regulation and waste removal which are required for optimal development and survival of the fetus. The uterus derives its blood supply from the uterine and ovarian arteries. Each side of the uterus is supplied by the uterine artery that lies close to it and their branches anastomose with the contralateral artery which ultimately results to an unevenly distributed blood supply to the uterus (Amer, 2021; Zia, 2013). Consequently, certain locations of placental attachment might not be favourable for proper growth of the developing fetus. Therefore, the determination

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of placental location in the uterus is pertinent to detect complications early and commence appropriate management (Amer, 2021; Zia, 2013; Behzadmehr et al., 2020).

Studies have described the numerous effects of placental location on the developing fetus such as preterm birth, intra-uterine growth restriction (IUGR), fetal malposition, mal-representation and the development of hypertension (Amer, 2021; Zia, 2013). Also, placental location has been demonstrated to be significantly related to fetal weight in singleton pregnancies which have placentas that are mainly attached to the lateral and fundal aspects of the uterus. In this scenario, a high likelihood of small for gestational age (SGA) fetus is expected (Lin et al., 2019). On the other hand, posterior placentas are believed to be responsible for preterm labour, fetal distress and intra-uterine fetal death (Nair et al., 2019).

Ultrasonography is a safe, easy and accurate method of evaluating the fetus in-utero and to ascertain the location of the placenta (Roy et al., 2022; Singh et al., 2016). Ultrasonography of the placenta is focused on the examination of the placenta to detect its location, size, shape and to identify any abnormalities (Singh et al., 2016). It is mandatory for this information to be obtained during an obstetric ultrasonography (Seadati et al., 2013). To the best of our knowledge, no studies on ultrasonographic determination of placental location and its effects on the fetus in the locality of this study. Moreover, there is a paucity of data on this study in low-risk pregnancies (Kahyaoğlu et al., 2012). The present study was therefore aimed to assess the relationship between uterine placental location and intra-uterine growth restriction and gestational hypertension.

MATERIALS AND METHOD

The research was an Institution-based, prospective, cross-sectional study which was conducted in the Department of Radiology of the University of Calabar Teaching Hospital (UCTH), Calabar, Nigeria from March 2021 to June 2021. The study population was obtained from the pregnant women who attended the antenatal clinic of the Obstetrics and Gynecology Department of the University of Calabar Teaching Hospital, Calabar, Nigeria, during the period of the study. Approval for this study was obtained from the Health Research Ethics Committee of the University of Calabar Teaching Hospital. A purposive sampling technique was employed for the research.

The participants were 100 consenting singleton pregnant women between 20 and 40 weeks of gestation. Every woman filled the written informed consent form before data collection commenced. Confidentiality and other ethical principles were strictly adhered to. Women with placenta praevia, multiple gestation, hypertension in pregnancy, pre- and gestational diabetes, congenital anomaly, placental anomalies, human immunodeficiency virus (HIV) and sickle cell disease were excluded from the study.

History was obtained from the consenting women while information on socio-demographics, obstetric and medical history were collected and recorded. General physical examination (including measurement of the participant’s height and weight) and blood pressure assessment were conducted on all the participants of the present study. The body mass index (BMI) was calculated by dividing the maternal weight by the square of the maternal height (kg/m^2).

Routine obstetric ultrasound scan was done on the pregnant women using standardized procedures to obtain the estimated gestational age (EGA), estimated fetal weight (EFW), head circumference to abdominal circumference ratio (HC/AC ratio), fetal heart rate (FHR) and the placental location. HC/AC > 1.2 was regarded as asymmetrical intra-uterine growth restriction (IUGR) (Peleg et al., 1998). The placental locations recorded in the present study were; anterior, antero-fundal, posterior and postero-fundal. The ultrasound machine utilized for the procedure was an Aloka prosound SSD-3500sx (2-Dimensional with Doppler facility) that has a curvilinear probe with a frequency range of 3.5 – 5 MHz manufactured in 2008 by the Aloka company limited located in Meerbusch, Germany. The obstetric ultrasound scan for all the women was done by an experienced Radiologist with work experience of > 20 years.

Analysis was done using the statistical package for social science (SPSS) version 20.0 Inc., Chicago, IL. Appropriate tables and charts were used to illustrate the results where continuous variables were summarized using means, standard deviation, median and range. The relationship of placental location with other variables was determined by the Pearson correlation while the one-way analysis of variance (ANOVA) was used to determine differences among the means of the variables and p-value < 0.05 was considered statistically significant in both instances.

RESULTS

The age of the subjects in the present study was from 20 to 39 years with a median value of 30 years. The BMI of the subjects ranged from 20.50 to 39.70 kg/m2 with a mean value (29.15 ± 4.21 kg/m^2) which shows that most of them were over-weight. The maximum value of the HC/AC ratio in the study was high (1.22) but the mean was 1.02 ± 0.08. The maximum FHR in the present study was 160 beats per minutes and the mean value was 141.25 ± 8.33 beats per minutes. The EFW ranged from 0.41 to 4.00 kg with a mean value of 2.13 ± 1.02 kg (Table 1).

Most of the subjects had postero-fundal placental location (n = 36) while the placental location that was fewest in the study was posterior (n = 11). Anterior placental location (n = 35) was the next most common (Figure 1).

Subjects with postero-fundal placental location had the highest mean EGA (33.21 ± 5.86 weeks), mean EFW (2.26 ± 1.03 kg), mean systolic blood pressure

(113.89 ± 10.50 mmHg), mean diastolic blood pressure (66.61 ± 7.07 mmHg) and the mean FHR (141.83 ± 9.23 beats per minutes). Subjects with posterior placental location had the highest mean BMI (29.66 ± 4.40 kg/m^2), those with antero-fundal placental location had the highest mean age (30.78 ± 4.25 years) while those with posterior placental location had the highest mean HC/AC ratio (1.03 ± 0.09). On the other end of the spectrum, subjects with antero-fundal placental location had the least mean EGA (31.49 ± 4.86 weeks), mean EFW (1.87 ± 0.92 kg) and mean BMI (27.43 ± 4.27 kg/m^2). Subjects with postero-fundal placental location had the least mean systolic blood pressure (109.09 ± 5.39 mmHg), mean diastolic blood pressure (61.82 ± 4.05 mmHg), those with posterior placental location had the least mean age (28.36 ± 3.33 years) while those with anterior placental location had the least mean HC/AC (1.01 ± 0.08) and those with antero-fundal placental location had the least mean FHR (138.50 ± 7.77 beats per minutes). Utilizing one way analysis of variance, the difference in the mean values of the variables for each placental location was not significant ($p > 0.05$) (Table 2).

Only the subjects' age was shown to have a positive correlation coefficient with placental location ($r = 0.119$) but other variables had negative correlation coefficients with placental location. However, no significant correlation was shown between placental location and all the variables (Table 3).

Table 1: Characteristics of maternal and fetal variables (n=100).

VARIABLES	MINIMUM	MAXIMUM	MEAN+SD	MEDIAN
EGA (week)	20.00	40.29	32.64±5.52	34.57
EFW (kg)	0.41	4.00	2.13±1.02	2.31
BMI (kg/m^2)	20.50	39.70	29.15±4.21	29.05
AGE (year)	20.00	39.00	29.86±4.32	30.00
HC/AC	0.90	1.22	1.02±0.08	1.00
FHR (beat per min)	125.00	160.00	141.25±8.33	141.50
SYS BP (mmHg)	90.00	130.00	112.40±8.78	110.00
DIA BP (mmHg)	60.00	80.00	65.08±6.55	60.00

BMI – Body mass index, DIA BP – Diastolic blood pressure, EFW – Estimated fetal weight, EGA – Estimated gestational age, FHR – Fetal heart rate, HC/AC – Head circumference to abdominal circumference ratio, SYS BP – Systolic blood pressure.

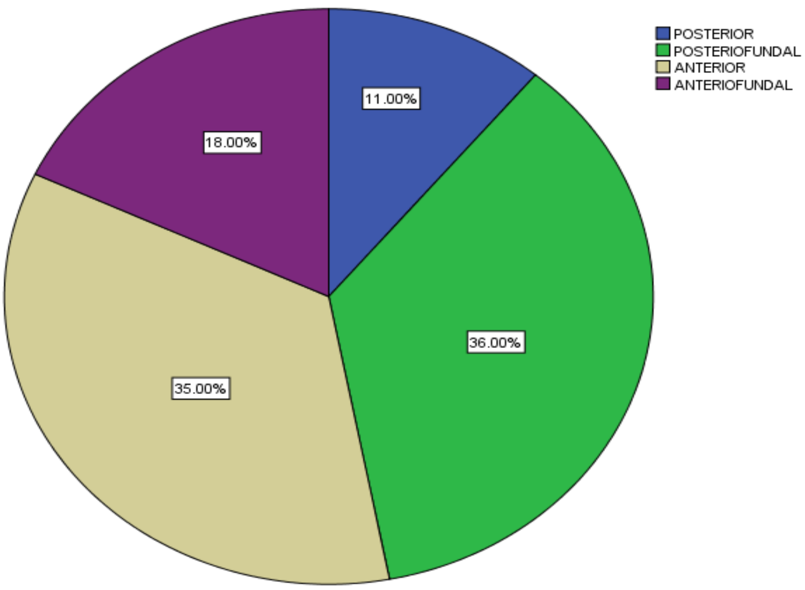

Figure 1: Frequency distribution of placental location

Table 2: Mean values of maternal and fetal variables in the placental locations (n=100).

PLACENTAL LOCATION		EGA (wk)	EFW (kg)	BMI (kg/m^2)	SYS (mm Hg)	DIA (mm Hg)	AGE (yr)	HC/AC	FHR (beat/min)
POSTE-RIOR	Mean	31.77	1.94	29.66	109.09	61.82	28.36	1.03	140.82
	n	11	11	11	11	11	11	11	11
	SD	5.76	1.04	4.40	5.39	4.05	3.33	0.09	6.78
POSTERO-FUNDAL	Mean	33.21	2.26	29.45	113.89	66.61	29.94	1.02	141.83
	n	36	36	36	36	36	36	36	36
	SD	5.86	1.03	3.95	10.50	7.07	5.20	0.07	9.23
ANTE-RIOR	Mean	32.93	2.18	29.57	113.43	65.14	29.77	1.01	141.69
	n	35	35	35	35	35	35	35	35
	SD	5.52	1.06	4.35	8.38	7.02	3.60	0.08	8.28
ANTERO-FUNDAL	Mean	31.49	1.87	27.43	109.44	63.89	30.78	1.02	138.50
	n	18	18	18	18	18	18	18	18
	SD	4.86	0.92	4.27	6.39	5.02	4.25	0.07	7.77
p VALUE		0.681	0.533	0.298	0.163	0.151	0.546	0.968	0.783

$p < 0.05$ is significant, p value – Anova P value, BMI – Body mass index, DIA – Diastolic blood pressure, EFW – Estimated fetal weight, EGA – Estimated gestational age, FHR – Fetal heart rate, HC/AC – Head circumference to abdominal circumference ratio, SD – Standard deviation, SYS – Systolic blood pressure.

Table 3: Correlation of placental location with maternal and fetal variables (n=100).

	PLACENTAL LOCATION	
	R	p VALUE
EGA (week)	-0.044	0.663
EFW (kg)	-0.058	0.567
BMI (kg/m^2)	-0.140	0.165
SYS BP (mmHg)	-0.043	0.671
DIA BP (mmHg)	-0.008	0.936
AGE (year)	+0.119	0.237
HC/AC	-0.033	0.744
FHR (beat per min)	-0.057	0.571

p value < 0.05 is significant, BMI – Body mass index, DIA BP – Diastolic blood pressure, EFW – Estimated fetal weight, EGA – Estimated gestational age, FHR – Fetal heart rate, HC/AC – Head circumference to abdominal circumference ratio, SYS BP – Systolic blood pressure.

DISCUSSION

In this study, the highest mean estimated fetal weight (2.26 ± 1.03 kg) was observed in postero-fundal location but the difference of this value compared to other placental locations was not significant (p = 0.533) and moreover, placental location was not significantly related with estimated fetal weight (p = 0.567). In contrast, Cheema et al. (2018) discovered that the difference in the mean fetal weight among the various placental location was significant (p = 0.037) and fetal weight was highest in the posterior placenta (2.60 ± 0.56 kg). Still at variance, Adekanmi et al. (2022) in their longitudinal study design, noticed that placental location was significantly associated with fetal weight (p = 0.002) and posterior placenta was noted to produce one of the highest fetal weights (3.00 ± 0.65 kg). In another longitudinal study, Dhingra et al. (2019) observed that posterior placental location was significantly associated with low fetal weight (p < 0.001) including Soleimani et al. (2021) who also recorded a significant correlation between placental location and fetal weight (p < 0.001) and that fundal placental location was seen more in fetuses with lower weights than anterior and posterior placentas. Concurring with findings of the present study, Behzadmehr et al. (2020) affirmed that there was no relationship between placental location and fetal weight (p = 0.555) even though fetal weight was higher in anterior placental location. In addition, Gunduz et al. (2022) noticed no significant relationship between placental location and fetal weight (p = 0.308).

In evaluating the relationship that exists between intrauterine growth restriction (IUGR) in the present study, we realized that the highest HC/AC value was noted in the posterior placental location but below 1.2 (HC/AC > 1.2 is regarded as asymmetric growth restriction) (Peleg et al. 1998). Besides, we observed no significant relationship between placental location and asymmetrical IUGR (p = 0.744). Deviating from our findings, Zia et al. (2013) noted that anterior placental location was significantly associated with intrauterine growth restriction (p < 0.05). This might be probably due to the significantly reduced perfusion by the uterine vascular supply to some of the regions adjacent the placental attachment (Zia et al. 2013). Also, a study by Amer et al. (2021) found that the anterior placental location was significantly associated with IUGR ($p = 0.002$) while the lateral placental location (4.88%) and the anterior placental location (1.14%) were significantly associated with IUGR ($p = 0.023$) in a similar study conducted by Soleimani et al. (2021). Similar to the present study, Seadati et al. (2013) observed that the incidence of IUGR was 1.6% but not significantly associated with placental location ($p = 0.690$). Provided the blood supply to the placenta is adequate, placental location has no paramount role in preventing or promoting the restriction of fetal growth from the first trimester to birth (Ergin and Yayla, 2010).

It was observed in this study that while the highest mean fetal heart rate in the subjects was noted in postero-fundal location, the lowest was seen in antero-fundal location. However, the difference in the mean fetal heart rate among the placental locations in the present study was not significant ($p = 0.783$). Also, no significant relationship between placental location and FHR ($p = 0.571$). In congruity, Roy et al. (2022) inferred from their study that no significant difference between the mean FHR noted in placental locations. They further stated that placental location (other than placenta previa) had no role to play in fetal distress. In variance, Chhabra et al. (2013) found out that fetal distress occurred more often in pregnant women with posterior or fundal placental location than in the anterior placenta ($p < 0.001$).

We observed in the present study that the highest mean systolic and diastolic blood pressure were found in postero-fundal placental location while the lowest were noted in posterior placental location with no significant relationship between placental location and both systolic blood pressure ($p = 0.671$) and diastolic blood pressure ($p = 0.936$). In support of our findings, Adekanmi et al. (2022) and Seadati et al. (2013) observed that placental location was neither significantly associated with gestational hypertension ($p = 0.080$) nor with pre-eclampsia ($p = 0.840$). In contradiction, while Zia et al. (2013) realized that anterior placental location was significantly associated with pregnancy induced hypertension ($p < 0.001$), Gizzo et al. (2015) found out that posterior placental location was associated with gestational hypertension/pre-eclampsia ($p < 0.05$) while Chhabra et al. (2013) inferred that pregnancy induced hypertension occurred more in pregnancies with fundal placental location (20.5%). Also, Granfors et al. (2019) opined that lateral placental location was found to be significantly associated with an increased risk of pre-eclampsia (OR: 1.41, 95% CI: 1.14 – 1.74).

CONCLUSION

Placental location in the uterus has no relationship with intrauterine growth restriction and the development of gestational hypertension in the second half of singleton pregnancies. Thus, further studies are recommended that will employ longitudinal design to make provisions for the explanations of causalities of identified relationships between variables at diverse placental locations.

STUDY LIMITATIONS

The sample size for the present study was small so future research with a large sample size should be embarked upon which might demonstrate significant statistical relationships between placental location and materno-fetal pathologies during pregnancy. In addition, this study did not evaluate the incidence and potential complications of lateral placental location in the study locality.

CONFLICTS OF INTEREST

None declared

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