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Sonographic evaluation of the impact of umbilical cord insertion site on fetal weight

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Abstract

Background: Abnormal insertion of the umbilical cord (UC) into the placenta may initiate fetal growth restriction and potentially complicates labor with intrapartum hemorrhage. The aim of this study was to sonographically determine the relationship between umbilical cord insertion types and estimated fetal weight (EFW).
Methods: This prospective cross-sectional study was done in a 7-month period and recruited 220 pregnant women with 27 to 37 weeks gestation attending the antenatal clinic of the Hospital. Ultrasound scan was done on the women to determine UC insertion and EFW. Data was analyzed using SPSS 23.0.
Results: Peripheral UC had significantly higher EFW, age and BMI (P=0.000), (P=0.009) and (P=0.003). The difference in EFW between peripheral UC and central UC in BMI $\geq$ 30 kg/m^2 was significant within the 31st – 32nd week of gestation (P=0.001) and 33rd – 34th week of gestation (P=0.034). EFW was least in velamentous UC subtype (1.385±0.12 kg) compared to central UC type (1.95±0.65 kg), eccentric UC subtype (2.29±0.77 kg) and marginal UC subtype (2.47±0.83 kg). Peripheral UC was significantly associated with BMI (P=0.000), employment status (P=0.048), past history of CS (P=0.000) and placental location (P=0.001).
Conclusion: Fetal weight, in the third trimester, is greater in obese pregnant women with peripheral umbilical cord insertion, except with velamentous cord insertion, and this is significant between 31st and 34th weeks of gestation. Peripheral umbilical cord insertion is significantly associated with high maternal BMI, posterior placental location, past history of cesarean section and being employed.

Keywords: Fetal weight, Placenta, Umbilical cord insertion, Ultrasonography, Singleton pregnancy

Introduction
The growth of a fetus is primarily determined by its genetic growth potential but other influences might promote or deter this latent growth capacity such as the state of development of the umbilical cord (UC). Umbilical cord is a structure that connects the growing embryo to the placenta from the 3rd week of gestation. Nutrients and oxygen are conveyed to the developing fetus it.[1] Embryologically it is formed by the mother and the fetus and usually has two arteries and one vein which are all embedded in the wharton's jelly and completely surrounded by a layer of amnion.[2]

UC insertion site has an indispensable place in Obstetrics as many researches have shown that anomalous insertion is associated with growth restriction, intrapartum hemorrhage, fetal bradycardia, stillbirth, preterm delivery, congenital anomalies and low APGAR score.[1,3-5] The circumstances that affect optimal growth of a fetus

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during pregnancy, such as anomalous UC insertion, is a major public health concern throughout the world, especially in developing countries with unusually large population who are bedeviled by a profound dearth of functional and affordable health care infrastructure.[5]

UC insertion is broadly categorized into 4 which are; Central, eccentric, marginal and velamentous/membranous.[1,3,6,7] It has been postulated that the variation in UC insertion site is due to the process termed trophotropism where the early placenta migrates as the pregnancy advances so that the blood flow to the fetus will be from a more vascularized region of the placenta while the previous insertion site undergoes atrophy.[3,7] Central UC insertion has been credited with the capacity to ensure equal distribution and exchange of blood which is of utmost benefit to the growing fetus.[1]

It is essential to determine UC insertion early in pregnancy because of the plethora of potential risks that some anomalous UC insertion type poses.[8] Vasa praevia is a common finding in velamentous UC insertion and is a potentially devastating cause of intrapartum hemorrhage which places the lives of both the fetus and mother in peril of fatality.[7,9,10] Moreover, anomalous UC insertion site usually leads to low-birth-weight fetuses.[11]

The aim of this study was to sonographically determine the relationship between umbilical cord insertion type and estimated fetal weight, and the factors associated with abnormal umbilical cord insertion.

Methods

Study design and setting

This was a prospective cross-sectional study that was conducted in the Radiology Department of the university of Calabar teaching hospital, from August 2022 to February 2023 in the Radiology Department of the hospital. The Hospital is a tertiary health institution located in Calabar, the capital city of Cross River state, in the south-south region of Nigeria. It is approximately an 800-bed hospital with facilities for emergency, in-patient, out-patient and community health services, training of undergraduate medical students, post graduate medical students and para-medical students.

Sample population, selection and size

The sample population consisted of pregnant women who attended the antenatal clinic of the hospital. They were recruited on week days (Mondays to Fridays) between 8.00 am and 12 pm during the duration of the study. The subjects enrolled in this study were singleton pregnant women that met the eligibility criteria and written informed consent was obtained before they participated in the study. The subjects were thereafter, administered questionnaires. Purposive sampling method was applied and the sample size for this study was 220 pregnant women.

Eligibility Criteria

All singleton pregnant women who did not have any of the following conditions (hypertension in pregnancy, diabetes in pregnancy, sickle-cell disease, human immunodeficiency virus, oligohydramnios, polyhydramnios, leiomyoma uteri > 5 cm, congenital anomaly, nuchal cord and hydrops fetalis) were deemed eligible for this study.

Ethical consideration

In strict compliance with the Helsinki declaration, the researchers of this study ensured that, prior to the commencement of the study, an approval was obtained from the health research ethics committee of the hospital. The assigned protocol number for the study is UCTH/HREC/33/VOL.III/049.

Operational definition

Umbilical cord insertion types – This consist of central umbilical cord insertion type and peripheral umbilical cord insertion type.

Central umbilical cord insertion type (Central UC) – The attachment of the umbilical cord less than 3 cm from the center of the placenta.[1,2]

Eccentric umbilical cord insertion subtype (Eccentric UC) – The attachment of the umbilical cord into the placenta at a point that is more than 2 cm away from the placental margin but more than 3 cm from the center of the placenta.[1,2]

Marginal umbilical cord insertion subtype (Marginal UC) – The attachment of the umbilical cord into the placenta at a point that is less than 2 cm away from the placental margin.[2]

Velamentous umbilical cord insertion subtype (Velamentous UC) – The attachment of the umbilical cord into the chorion leavea at a point away from the placental edge, and the vessels pass to the placenta across the surface of the membranes between the amnion and the chorion.[2]

Peripheral umbilical cord insertion type – This is a broad term that encompasses eccentric UC, marginal UC and velamentous UC.[1]

Data collection tools and procedure

Ultrasonography was done on all the subjects in a supine position between the 27th and 37th weeks of gestation using Toshiba Xario 100 (TUS-X100S), a 4-Dimensional machine with Doppler facility, manufactured in 2015 by Toshiba Medical Systems corporation, in Japan. It has attached to it a curvilinear probe with a frequency range of 3.5 – 5 MHz. The examinations were conducted by 2 experienced Radiologists. Intra-uterine fetal biometric indices (femur length, bi-parietal diameter, abdominal circumference and head circumference) were obtained by measuring the appropriate fetal regions to determine estimated fetal weight and estimated gestational age.

The search for the umbilical cord commenced by checking the fetal surface of the placenta with grey scale ultrasound until the umbilical cord was identified. Care was taken not to mistake coils of umbilical cord that lie beside the placental surface as the true point of entry of the umbilical cord into the placenta. Color flow imaging was of much assistance in this instance as it aided the demonstration of the entry of the main branches of the umbilical vessels into the chorionic plate. Immediately the point of insertion of the umbilical cord into the placenta was determined, the probe was manipulated to obtain the longitudinal span of the placenta. The distance of the umbilical cord insertion points to the nearest placental margin or the placental center were measured. These were determined in the longitudinal plane, with the umbilical cord insertion and the entire length of the placenta in view. The placental center was obtained by dividing the placental length by two. Subjects were also requested to lie in a lateral position which produced an acoustic window to enhance the visualization of the umbilical cord insertion point.[12] The total time for the entire ultrasonography procedure was about 10 minutes. Afterwards the body mass index of the subjects was determined by a nurse in the Radiology Department.

Data analysis

The data obtained was analyzed using the Statistical package for social sciences (SPSS) for windows (SPSS Inc., USA) version 23. Appropriate descriptive (including simple proportions and percentages) and inferential statistical methods were used to analyze the data. Tables, bar charts and pie charts were the means of displaying the result where applicable. Continuous variables were reported as means and standard deviation (mean ± SD). T-test and analysis of variance (ANOVA) were utilized to determine the significance of the means for categorical and continuous data. Chi-square test was used to determine the association of categorical data with umbilical cord insertion types. Statistical significance was defined at a P value that is less than 0.05.

Results

A total of 277 women were recruited for this study, however, 57 women were excluded based on the presence of leiomyoma uteri (≥5 cm in size), multiple gestation, hypertension in pregnancy, diabetes in pregnancy and congenital anomalies. The age of the 220 subjects that participated in this study ranged from 15 to 44 years with a mean of 31.78±5.25 years. Most of the subjects were married (n=191), aged between 25 to 34 years (n=130), had tertiary education (n=157) and were employed (n=183), while majority were either nulliparous (n=82) or of single parity (70) (Table 1).

Peripheral umbilical cord insertion type (60.45%) was the preponderance of the two basic categories in the study and consisted of eccentric subtype (49.55%), marginal subtype (10.00%) and velamentous subtype (0.91%). Central umbilical cord insertion type was seen in 39.55% of the subjects (Figure 1).

In the Chi-square analysis, BMI (P=0.000), employment status (P=0.048), past history of cesarean section procedures (P=0.000) and placental location (P=0.001) all showed statistically significant association with peripheral umbilical cord insertion type. Peripheral umbilical cord insertion type was commoner than central in almost all the subgroups of the variables except those with BMI < 30 kg/m^2 (n=39), the unemployed (n=20), those without previous history of CS (n=76), and antero-fundal (n=27).

and postero-fundal placental (n=23) locations. Peripheral umbilical cord insertion type was more in the subjects whose BMI were ≥30 kg/m^2 group (68.80%), the employed (63.40%), those who had a past history of having done CS procedures (84.70%) with a posterior placenta (78.12%) and those with female fetuses (63.92%). In the rest, peripheral umbilical cord insertion type was more in the subjects who were single (69.00%), multiparous (63.24%), had no history of terminating a pregnancy (61.50%), with type 2 placental previa (83.30%) and those with male fetuses (57.72%) compared with central UC insertion type (Table 2).

In T-test analysis, mean maternal age (32.53±5.37 years) of the subjects who had peripheral umbilical cord insertion type was more than those with central umbilical cord insertion type and this was statistically significant (P=0.009). The overall mean BMI (33.58±5.19 kg/m^2) and EFW (2.31±0.782 kg) of the subjects with peripheral umbilical cord insertion type were also greater and statistically

Table 1: Descriptive statistics of socio-demographic characteristics of the subjects

	n	%
Maternal age (years)		
15 - 24	18	8.18
25 - 34	130	59.09
35 - 44	72	32.73
Parity		
0	82	37.27
1	70	31.82
2	52	23.64
3	13	5.91
4	2	0.91
5	1	0.45
Marital status		
Married	191	86.82
Unmarried	29	13.18
Education level		
Primary	5	2.20
Secondary	58	26.40
Tertiary	157	71.40
Employment status		
Employed	183	83.18
Unemployed	37	16.82

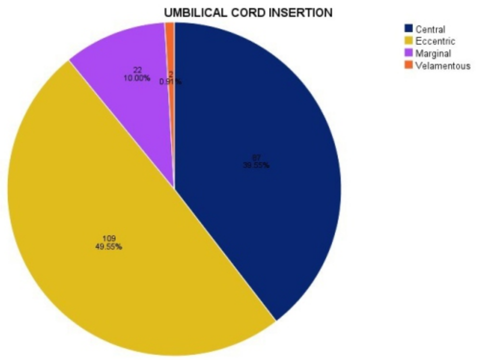

Figure 1: Frequency of umbilical cord insertion types

Table 3: Overall mean values of maternal and fetal variables within the umbilical cord insertion types (n=220)

	Mean value+SD Central UC insertion	Mean value+SD Peripheral UC insertion	T test	P value
MATERNAL AGE (years)	30.63±4.89	32.53±5.37	-2.65	0.009*
PARITY	0.95±1.06	1.08±0.96	-0.88	0.382
EGA (weeks)	31.57±2.50	32.21±2.88	-1.67	0.096
BMI (kg/m^2)	31.50±4.92	33.58±5.19	-2.97	0.003*
EFW (kg)	1.95±0.65	2.31±0.782	-3.56	0.000*

(*) – P value < 0.05 is significant; BMI – Body mass index; EFW – Estimated fetal weight; EGA – Estimated gestational age; P value – T test P value.

Table 4: Overall mean estimated fetal weight in all the umbilical cord insertion sites (n=220)

	Mean EFW (Kg)	95% Confidence interval for mean Lower bound	Upper bound	Mini-mum (Kg)	Maxi-mum (Kg)	P value
Central	1.95±0.65	1.81	2.09	1.03	3.39	0.001*
Eccentric	2.29±0.77	2.15	2.44	0.91	3.62	
Marginal	2.47±0.83	2.10	2.84	1.05	3.51	
Velamentous	1.385±0.12	0.31	2.47	1.30	1.47	

(*) – P value < 0.05 is significant; EFW – Estimated fetal weight; P value – ANOVA P value.

Table 2: Distribution and association of maternal and fetal variables with umbilical cord insertion types (n=220)

Variables		Central uc insertion n (%)	Peripheral UC insertion n (%)	Total n (%)	P value
Parity	0	38 (46.30%)	44 (53.70%)	82 (100%)	0.306
	1	24 (34.30%)	46 (65.70%)	70 (100%)	
	≥2	25 (36.76%)	43 (63.24%)	68 (100%)	
BMI (kg/m^2)	< 30	39 (54.05%)	27 (45.95%)	19 (100%)	0.000*
	≥ 30	48 (31.20%)	106 (68.80%)	154 (100%)	
Employment status	Employed	67 (36.60%)	116 (63.40%)	183 (100%)	0.048*
	Unemployed	20 (54.10%)	17 (45.90%)	37 (100%)	
Marital status	Married	78 (40.80%)	113 (59.20%)	191 (100%)	0.314
	Unmarried	9 (31.00%)	20 (69.00%)	29 (100%)	
Past history of CS	Present	11 (15.30%)	61 (84.70%)	72 (100%)	0.000*
	Absent	76 (51.40%)	72 (48.60%)	148 (100%)	
Termination of pregnancy	Present	12 (48.00%)	13 (52.00%)	25 (100%)	0.358
	Absent	75 (38.50%)	120 (61.50%)	195 (100%)	
Placenta previa	0	85 (40.50%)	125 (59.50%)	210 (100%)	0.418
	2	1 (16.70%)	5 (83.30%)	6 (100%)	
	3	1 (25.00%)	3 (75.00%)	4 (100%)	
Placental location	Anterior	22 (31.88%)	47 (68.12%)	69 (100%)	0.001*
	Anterio-fundal	27 (58.70%)	19 (41.30%)	46 (100%)	
	Fundal	8 (26.67%)	22 (73.33%)	30 (100%)	
	Posterio-fundal	23 (58.49%)	20 (46.51%)	43 (100%)	
	Posterior	7 (21.88%)	25 (78.12%)	32 (100%)	
Fetal gender	Female	35 (36.08%)	62 (63.92%)	97 (100%)	0.351
	Male	52 (42.28%)	71 (57.72%)	123 (100%)	

(*) – P value < 0.05 is significant; BMI – Body mass index; CS – Cesarean section; P value – Pearson Chi-square P value.

Table 5: Parity-matched mean estimated fetal weight within the umbilical cord insertion types in each estimated gestational age group (n=220)

Parity in EGA		Mean EFW (Kg)		T-test	P value
		Central UC insertion	Peripheral UC insertion		
27-28 weeks					
Parity	0	1.24±0.57	1.29±0.11	-0.427	0.790
	1	1.15±0.32	1.27±0.56	-1.337	0.211
	≥2	1.33±0.11	1.19±0.72	0.532	0.638
29-30 weeks					
Parity	0	1.47±0.36	1.59±0.51	-0.686	0.513
	1	1.54±0.60	1.76±0.45	-1.786	0.104
	≥2	1.59±0.33	1.81±0.48	-0.855	0.414
31-32 weeks					
Parity	0	1.83±0.32	2.72±0.61	-3.091	0.027*
	1	1.88±0.42	2.52±0.27	-1.977	0.067
	≥2	2.11±0.22	2.26±0.81	-0.611	0.568
33-34 weeks					
Parity	0	2.47±0.71	2.55±0.22	-0.367	0.720
	1	2.31±0.40	2.50±0.41	-1.102	0.289
	≥2	2.61±0.45	2.92±0.28	-2.070	0.058
≥ 35 weeks					
Parity	0	2.82±0.05	3.17±0.28	-1.972	0.074
	1	3.15±0.81	3.21±0.11	-0.387	0.706
	≥2	3.26±0.23	3.06±0.19	1.214	0.319

(*) – P value < 0.05 is significant; EFW – Estimated fetal weight; EGA – Estimated gestational age; P value – T test P value.

Table 6: BMI-matched mean estimated fetal weight within the umbilical cord insertion types in each estimated gestational age group (n=220)

BMI IN EGA	Mean EFW (Kg)		T-test	P value
	Central UC insertion	Peripheral UC insertion		
27-28 weeks BMI (Kg/m²)				
< 30	1.22±0.12	1.21±0.72	0.214	0.842
≥ 30	1.25±0.33	1.26±0.09	-0.800	0.937
29-30 weeks BMI (Kg/m²)				
< 30	1.52±0.11	1.89±0.48	-1.220	0.288
≥ 30	1.53±0.41	1.66±0.25	-1.107	0.297
31-32 weeks BMI (Kg/m²)				
< 30	1.82±0.29	2.00±0.77	-1.279	0.220
≥ 30	2.10±0.10	2.56±0.36	-2.757	0.001*
33-34 weeks BMI (Kg/m²)				
< 30	2.35±0.48	2.34±0.37	0.043	0.967
≥ 30	2.51±0.71	2.78±0.92	-2.236	0.034*
≥ 35 weeks BMI (Kg/m²)				
< 30	2.80±0.42	2.96±0.55	-1.310	0.233
≥ 30	3.10±0.75	3.19±0.34	-0.832	0.419

(*) – P value < 0.05 is significant; BMI – Body mass index; EFW – Estimated fetal weight; EGA – Estimated gestational age; P value – T test P value

significant (P=0.003 and P=0.000, respectively) in the study (Table 3).

When the mean EFW in the central UC type was compared with the peripheral UC subtypes, marginal UC subtype was shown to have the highest (2.47±0.83 kg) while the least was noted when the site was the velamentous UC subtype (1.385±0.12 kg). The difference in the values of the overall mean EFW of central UC type, eccentric UC subtype, marginal UC subtype and velamentous UC subtype insertion sites was statistically significant (P=0.001) when one-way analysis of variance test was done on the data (Table 4).

In T-test analysis, when parity was matched in the EGA groups, the difference in the mean EFW of the subjects with central umbilical cord insertion type and peripheral umbilical cord insertion type was significant at the 31^{st} to the 32^{nd} EGA group (P=0.027) among the nulliparous. The difference in the mean EFW of the two umbilical cord insertion types within the 33^{rd} to 34^{th} EGA group was nearly significant among the multiparous subjects (P=0.058). Mean EFW of subjects with peripheral umbilical cord insertion type were higher in all the parity within the EGA groups except amongst the multiparous within 27 to 28 weeks and ≥ 35 weeks EGA groups, but the differences were not significant (P=0.638 and P=0.319, respectively) (Table 5).

In T-test analysis, when the BMI was matched in the EGA groups, the difference in the mean EFW of the subjects with central umbilical cord insertion type and peripheral umbilical cord insertion type were significant at the 31^{st} to the 32^{nd} EGA group (P=0.001) and at the 33^{rd} to the 34^{th} EGA group (P=0.034), and in both cases the BMI was ≥ 30 kg/m². In the rest, subjects with peripheral umbilical cord insertion type with BMI ≥ 30 kg/m² in all the EGAs had higher mean EFW except in the 27^{th} to 28^{th} week and the 33^{rd} to 34^{th} week EGA groups where the mean EFW of the subjects with central umbilical cord insertion type was greater, albeit, marginal (Table 6).

Discussion

In this study it was demonstrated that the mean estimated fetal weight was greater in the subjects with peripheral UC type than those with central UC type, and this was found to be significant (2.31±0.782 kg vs 1.95±0.65 kg, P=0.000). This finding was in variance with the trend of several research reports such as Brouillet *et al.*,[1] in a study that involved 343 subjects with central UC insertion and 185 subjects with peripheral UC insertion, who observed that the mean fetal weight in the group with central UC in their study was 3433.7±376.7 gm while in the group with peripheral UC it was 3195±460.5 gm and the difference in these mean values was found to be significant (P<0.001) in favor of central UC. Their postulation was that a placenta with central UC ensures an effective distribution and exchange of blood between the different parts of the placenta which directly benefits the growing fetus.[1] Still in deviation from our findings, Mullapudi Venkata *et al*.[13] whose research had 36 subjects with marginal UC insertion and 121 subjects with central UC insertion, observed that mean fetal weight in marginal UC was 2.73±0.38 kg while in central UC it was 2.90±0.47 kg and the difference was significant (P=0.030) which supports the notion that peripheral UC has adverse effects on fetal weight. Tian *et al*.[6] and Yang *et al*.[14] also held same views as they observed that mean fetal weight in pregnancies complicated with velamentous UC and marginal UC were significantly lower than in those with central UC (3244.7±365.48 gm vs 3346.8±387.49 gm, P<0.05) and (3278.0±755.4 gm vs 3496.4±593.1 gm, P<0.001), respectively.

While Korantema *et al*.[15] observed that the weights of fetuses with central UC, eccentric UC and marginal UC in their study nearly declined in a linear fashion from 3294.55 gm to 3112.65 gm and then 3180.83 gm respectively, we discovered that the mean fetal weights rather significantly increased in a progressive pattern from central UC (1.95±0.65 kg), eccentric UC subtype (2.29±0.77 kg) to marginal UC subtype (2.47±0.83 kg). Aragie et al.[3] had also inferred that pregnancies complicated with marginal UC were at a higher risk of developing low fetal weight (AOR: 2.89, 95% CI: 1.23 – 6.80) which, was not the case in the index study. Yampolsky *et al*.[16] stated that placentas with peripheral UC, especially marginal and velamentous, usually grow heavier than normal such that the fetal weight will not be significantly impacted. They speculated that this unexpected placental growth in fetuses with peripheral UC is probably a compensatory mechanism that occurs as a consequence of reduced placental efficiency. This probably explains the incongruity between the findings of this study and other literatures. Further research is suggested for an in-depth evaluation of the basis behind a higher fetal weight in women with peripheral UC compared to central UC.

It was observed in this study that the disparity in mean estimated fetal weight of the obese subjects between the two UC insertion types was substantial enough to be significant between the 31st to and 34th weeks of gestational ages (31st to 32nd weeks of gestation, P=0.001 and 33rd to 34th weeks of gestation, P=0.034) in favor of peripheral UC. This suggests that the appropriate time to assess the fetus for the determination of UC insertion type and the occurrence of growth restriction in the event of anomalous UC insertion is between the 31st and 32nd week of gestation. Incongruous with our finding, Sawant *et al*.[5] inferred that the restriction of fetal growth commonly occurs at the 35th week of gestation. In support of our postulation, Di Salvo *et al*.[4] suggested that the determination of the definitive site of UC insertion is probably more reliable when evaluated between the 29th and 30th week of gestation using color Doppler. They realized that the UC insertion site from a previous placenta examination at 23 weeks of gestation which had been identified as marginal UC was later found to be velamentous UC at 30 weeks of gestation.[4] Such events are due to placental remodeling which results in the migration of UC insertion site as pregnancy progresses leading to a different UC insertion site later on. However, it was not certain if UC insertion site is permanent at the 29th or 30th week of gestation.[1,4] Brouillet *et al*.[1] lucidly stated that since visualization of the UC insertion site becomes progressively difficult as pregnancy advances, it is advisable to evaluate it at the end of the second trimester. They further stated that because the odds of having a growth restricted fetus was greater in peripheral UC insertion (OR:4.49, 95% CI: 2.26 - 8.89, P<0.05), strict monitoring of such pregnancies should be ensured.[1]

The BMI of the subjects with peripheral UC was significantly higher (P=0.003) than those with central UC. Brouillet *et al*.[1] also discovered that the BMI of the subjects with peripheral UC was higher than that of the subjects with central UC, but the difference was insignificant (P>0.05) and it did not impact the fetal weight like it did in this study. Yang *et al*.[14] found out that BMI >35 kg/m^2 increased the risk of having a pregnancy complicated with velamentous UC (OR: 1.84, 95% CI: 1.32 – 2.58, P=0.001). In consonance with this study and Yang *et al*.'s[14] finding, Mullapudi Venkata *et al*.,[13] also observed that maternal BMI ≥ 23 kg/m^2 was significantly associated with marginal UC (P=0.03). It was proffered that maternal obesity probably leads to negative modifications in placental development and UC insertion site. Moreover, obesity has negative effects on fertility which subsequently encourage the employment of fertility treatment that is ultimately responsible for a higher incidence of peripheral UC in pregnant obese women.[14] Nevertheless, Yampolsky *et al*.[16] found no association between high BMI and UC centrality or displacement from the central region during the course of pregnancy.

Maternal age of the subjects was observed to be significantly higher in those with peripheral UC type (P=0.009). In consonance with our findings, Aragie *et al*.[3] observed that maternal age increased the risk of marginal UC (AOR:2.24, 95% CI:1.35-11.08). They opined that peripheral UC insertion is common in pregnant women with advanced age (>35 years) probably due to uterine hypoxia which induces trophotrophism.[3] Also, in tandem with this study, Ebbing *et al*.[17] inferred that maternal age increased the risk of having a pregnancy complicated with peripheral UC (AOR; 2.24, 95% CI: 1.9 – 2.4). Yampolsky *et al*.[16] also observed that maternal age had a significant effect on UC insertion site displacement from the placental center (P=0.007). They explained that the magnitude of UC insertion site deviation from the central region is amplified and imposed on the placenta by an aging maternal intrauterine environment. Brouillet *et al*.[1] however, found no significant difference between maternal age of the subjects and UC insertion type in their study.

It was observed in this study that placental location was significantly associated with UC insertion type (P=0.001) and peripheral UC insertion type into placentas that are attached to the posterior myometrium was noted the most (78.12%). Similarly, Padula *et al*.[11] observed that peripheral UC insertion was more in posterior placentation (20.7%). On the other hand, central UC insertion site in the index study had a preponderant inclination for antero-fundal placental location (58.70%). Amer[18] and Zia[19] reported that there was a significant association between anterior placental location and intra-uterine growth restriction, (P=0.002) and (P<0.001) respectively, due to a reduced blood supply to the entire anterior myometrium which significantly restricts fetal growth. This could probably be responsible for the lower mean EFW in fetuses with central UC insertion in this study.

A considerable number of subjects in this study with peripheral UC insertion type were employed (63.40%) and more importantly, we observed that being employed was found to be significantly associated with this UC insertion type (P=0.037). However, Mullapudi Venkata *et al*.[13] demonstrated that there was no significant association between employment status and peripheral UC (P=0.940).

We noticed the existence of a significant association between past history of cesarean section (CS) procedures and UC insertion type (P=0.000) and most of the subjects with peripheral UC indicated that they have had CS (84.70%) prior to conceiving the index pregnancy. In agreement with our findings, Aragie *et al*.[3] and Ebbing *et al*.[17] both observed that previous CS delivery was a risk factor for peripheral UC insertion site in subsequent pregnancies (AOR: 2.51, 95% CI: 1.43-10.21) and (OR: 1.10, 95% CI: 1.01-1.19). Aragie *et al*.[3] concisely stated that uterine scar formation following previous CS results in abnormal placental attachment and peripheral UC insertion in subsequent pregnancies.

Limitations

The limitations of this study include the fact that it was conducted in a single health facility within the city. Secondly, the sample size of the velamentous UC insertion subtype was extremely low. Thirdly, there was no provision for perinatal and postnatal follow-up protocol in this study to further evaluate the impact of umbilical cord insertion type on fetal birth weight, APGAR score and neonatal growth and development. Fourthly, placental calcification grading and its impact on estimated fetal weight with respect to the umbilical cord insertion types was not a variable in this study.

Conclusion

Fetal weight, in the third trimester, is greater in obese pregnant women with peripheral umbilical cord insertion and this is most significant between the 31st and 34th weeks of gestation. However, fetal weight is least in pregnancies with velamentous umbilical cord insertion in the third trimester. High maternal body mass index (BMI), posterior placental location, having a positive history of a previous cesarean section procedure and being employed were all associated with peripheral umbilical cord insertion.

References

1. Brouillet S, Dufour A, Prot F, et al: Influence of the umbilical cord insertion site on the optimal individual birth weight achievement. *Biomed Res Int*. 2014;2014(1):341251.

doi:org/10.1155/2014/341251

2. Khan AZ, Paiker M, Srivastava G, Qadeer F, Haque M: A study of umbilical cord attachments in placentas from anaemic mothers. *International Journal of Contemporary Medical Research*. 2020;7(10):1-4. doi: org/10.21276/ijcmr.2020.7.10.8
3. Aragie H, Oumer M: Marginal cord insertion among singleton births at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia. *BMC Pregnancy Childbirth*. 2021;21(1):211. doi: 10.1186/s12884-021-03703-x
4. Di Salvo DN, Benson CB, Laing FC, Brown DL, Frates MC, Doubilet PM: Sonographic evaluation of the placental cord insertion site. *AJR Am J Roentgenol*. 1998;170(5):1295-1298. doi: 10.2214/ajr.170.5.9574605
5. Sawant LD, Venkat S: Comparative analysis of normal versus fetal growth restriction in pregnancy: The significance of maternal body mass index, nutritional status, anemia, and ultrasonography screening. *Int J Reprod Med*. 2013;2013(1):671954. doi: 10.1155/2013/671954
6. Tian Y, Luo H, He M: Effects of marginal umbilical cord insertion on the prognosis of fetus. *Clin. Exp. Obstet. Gynecol*. 2020;47(2):234–237. doi: 10.31083/j.ceog.2020.02.5103
7. Ismail KI, Hannigan A, O'Donoghue K, Cotter A: Abnormal placental cord insertion and adverse pregnancy outcomes: a systematic review and meta-analysis. *Syst Rev*. 2017;6(1):242.
8. Curtin WM, Hill JM, Millington KA, Hamidi OP, Rasiah SS, Ural SH: Accuracy of fetal anatomy survey in the diagnosis of velamentous cord insertion: a case-control study. *Int J Women's Health*. 2019;11(1):169-176. doi: 10.1186/s13643-017-0641-1
9. Paiva SPC, Parola AR, Rezende LGP, Sa Filho NJ: Velamentous insertion of the umbilical cord: intrapartum diagnosis. *Rev Med Minas Gerais*. 2013;23(3):384-386. doi: 10.2147/IJWH.S189718
10. Broady AJ, Bartholomew ML: Structural umbilical cord and placental abnormalities. *Donald School J Ultrasound Obstet Gynecol*. 2016;10(1):23-36. doi:10.5005/jp-journals-10009-1439
11. Padula F, Laganà AS, Vitale SG, et al: Ultrasonographic evaluation of placental cord insertion at different gestational ages in low-risk singleton pregnancies: a predictive algorithm. *Facts Views Vis Obgyn*. 2016;8(1):3-7. PMCID: PMC5096422
12. Sepulveda W, Rojas I, Robert JA, Schnapp C, Alcalde JL: Prenatal detection of velamentous insertion of the umbilical cord: a prospective color Doppler ultrasound study. *Ultrasound Obstet Gynecol*. 2003;21(6):564-569. doi: 10.1002/uog.132.
13. Mullapudi Venkata S, Suneetha N, Balakrishna N, Satyanarayana K, Babu Geddam JJ, Uday Kumar P: Anomalous marginal insertion of umbilical cord in placentas of COVID-19-affected pregnant mothers: A cross-sectional study. *Cureus*. 2023;15(1):e33243. doi: 10.7759/cureus.33243
14. Yang M, Zheng Y, Li M, et al: Clinical features of velamentous umbilical cord insertion and vasa previa: a retrospective analysis based on 501 cases. *Medicine (Baltimore)*. 2020;99(51):(e23166). doi: 10.1097/MD.0000000000023166.
15. Korantema TM, DuBois A: Mode of umbilical cord insertion and neonatal weight and some placental factors. *Int J Anat Res*. 2018;6(3.1):5471-5476. doi: 10.16965/ijar.2018.248
16. Yampolsky M, Salafia CM, Shlakhter O, Haas D, Eucker B, Thorp J: Centrality of the umbilical cord insertion in a human placenta influences the placental efficiency. *Placenta*. 2009;30(12):1058-1064. doi: 10.1016/j.placenta.2009.10.001.
17. Ebbing C, Kiserud T, Johnsen SL, Albrechtsen S, Rasmussen S: Prevalence, risk factors and outcomes of velamentous and marginal cord insertions: a population-based study of 634,741 pregnancies. *PLoS One*. 2013;8(7):e70380. doi: 10.1371/journal.pone.0070380
18. Amer MB: Placental location in the uterus and its roles in fetus, maternal outcome and mode of delivery. *Archivos Venezolanos de Farmacologia y Terapeutica*. 2021;4(5):487-491. doi.org/10.5281/zenodo.5449660
19. Zia S: Placental location and pregnancy outcome. *J Turk Ger Gynecol Assoc*. 2013;14(4):190-193. doi: 10.5152/jtgga.2013.92609.