Assessing Placental Thickness Using Ultrasonic Technology To Predict Placenta Accreta Invasion

Original Article

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ABSTRACT

Objectives: The purpose of the work had been to assess the correlation of ultrasonic assessed placental thickness and degree of invasion in cases of abnormal invasion of low-lying placenta.

Patients and Methods: This prospective cohort observational work had been conducted on 50 pregnant women with gestational age between 20 - 40 weeks and maternal age of 20–30 years. Low-lying placenta, history of one or more cesarean births, and body mass index (BMI) of less than 30 were the inclusion criteria. Participants were categorized into two groups: the first group had been low lying placenta (n= 18), and second group was placenta previa (n= 32).

Results: There was a highly positive statistically significant correlation between lower uterine segment thicknesses and maximum placental thickness, abnormal placenta (previa or accreta) by the US, Blood loss, blood transfusion, caesarian hysterectomy, abnormal placenta (previa or accreta) throughout surgery and myometrial fibres located in the placenta' basal plate (p<0.001). a statistically significant positive association had been existed among maximum placental thickness and lower uterine segment thickness, abnormal placenta (previa or accreta) by US, Blood loss, blood transfusion, caesarian hysterectomy, atypical placenta (previa or accreta) during Surgery and Myometrial fibers in basal plate of placenta (p<0.05).

Conclusions: A significant correlation existed between ultrasonic assessed placental thickness and degree of abnormal invasion of low-lying placenta.

Key Words: Invasion, placenta accreta spectrum, placenta previa, thickness, ultrasonic.

Received: 19 August 2024, **Accepted:** 27 November 2024

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ISSN: 2090-7265, 2025, Vol. 15

INTRODUCTION

Placenta previa is characterized by the placenta being positioned over the endocervical os. The prevalence of placenta previa is approximately 0.5% in pregnancies. The rise in rates in recent years is likely associated with a high prevalence of caesarean births, In *vitro* fertilization (IVF), prior spontaneous and intentional pregnancy terminations, and prior uterine surgeries. Placenta previa is linked to numerous negative effects on both the mother and the fetus, with many of these being caused by maternal bleeding and the resulting premature birth. Performing transabdominal ultrasonography as a regular procedure is the accepted standard for determining the position of the placental edge in reference to the internal os. In circumstances when transabdominal observations are insufficient, transvaginal ultrasonography might be used to further investigate suspected cases of placenta previa[1,2].

Placenta Accreta spectrum (PAS) is characterized by the attachment of trophoblastic tissue directly to the myometrium, without any decidua in between. PAS can be classified according to the depth of trophoblastic attachment. Placenta accreta occurs when villi adhere to the myometrium instead of the decidua. Placenta increta occurs when villi invade the myometrium. Placenta per Creta occurs when villi invade the full thickness of the myometrium and can extend outside the uterine serosa. The prevalence of placenta accreta spectrum has risen in recent years. Major risk factors include previous numerous caesarean births, uterine instrumentation such as curettage, myomectomy, pelvic radiotherapy, and endometrial ablation. PAS is linked to substantial maternal and fetal morbidity and mortality, primarily due to severe maternal bleeding and premature labor. Obstetric ultrasound is the primary method used for antenatal diagnosis of PAS. During the second and third trimesters, the presence of

DOI:10.21608/EBWHJ.2024.313708.1350

PAS is correlated with placenta previa, the absence of the normal hypoechoic retroplacental myometrial zone (clear zone), significant thinning of the underneath myometrium, and vascular alterations of the placenta (such as abnormal intraplacental vascularity and high sub placental vascularity)[3,4].

The PAS illnesses are linked to placenta previa, and there are notable similarities in the imaging characteristics of both conditions. It is of clinical significance to distinguish between placenta previa with or without PAS disorders. Furthermore, PAS disorders are linked to substantial maternal and fetal mortality and morbidity. Therefore, it is crucial to detect individuals who are at risk for PAS disorders during regular monitoring or specialized obstetric ultrasonography conducted during pregnancy. The current prenatal diagnosis of PAS is based on the subjective individual interpretation of visual sonographic findings using grey scale and color Doppler imaging[5,6].

The aim of the study was to evaluate the correlation of ultrasonic assessed placental thickness and degree of invasion in cases of abnormal invasion of low-lying placenta.

PATIENTS AND METHODS

This prospective cohort observational work had been conducted on 50 pregnant women with gestational age between 20 - 40 weeks and maternal age of 20–30 years. Low-lying placenta, history of one or more cesarean births, and body mass index (BMI) of less than 30 were the inclusion criteria.

This work had been conducted from April 2022 to October 2023 following approval from Ethics Committee, Faculty of Medicine, Tanta University, Tanta, Egypt. (Approval code:). Each participant had been provided with well-informed written consent. Patients had been divided into two groups: the first group was low lying placenta (n= 18) and second group was placenta previa (n= 32).

Exclusion criteria were smoking, abortion, hemorrhage, past scarring instead of a cesarean section, medications (low dosage aspirin and anticoagulants), and chronic diseases (cardiac, diabetes, anemia) present during pregnancy. The following procedures were performed on every patient: routine laboratory investigation, full blood picture (CBC), liver function tests, kidney function tests, and coagulation profile tests; complete clinical history (parity, prior cesarean delivery, mode of conception as spontaneous and IVF); sociodemographic characteristics (weight, age, height, and BMI) were gathered.

Ultrasonography

According to AIUM norms, ultrasonography was carried out using a conventional curved transducer (2–6 MHz). Placenta previa was assessed using both color Doppler and grayscale imaging of the internal OS area. When it was required to confirm the placenta previa diagnosis, endovaginally imaging was carried out. A midline sagittal section of the lower uterine region containing the cervical canal and implanted placenta with the intervening urine bladder is necessary for an image to be appropriate for analysis[7]. To see the lower anterior wall of the uterus, the bladder must be filled.

In addition to the history of cesarean section being documented, the following factors were observed: placental location, thickness retroplacental myometrium, thickness of placenta, the existence or lack of the retroplacental space, interruptions of the bladder line, retroplacental myometrial blood flow, existence or lack of placental lacunae, existence or lack of a cervical sinus, and cervical morphology. The probe was placed in such a way that the beam was at a right angle to the wall of the uterus to evaluate the thickness of the placenta and the retroplacental myometrial thickness. At the thickest point, the placental thickness was measured. To measure the hypoechoic muscle layer behind the placenta and determine the minimum thickness of the myometrium in the sagittal plane, the image was expanded when measuring the retroplacental myometrium. Utilising colour Doppler ultrasound while maintaining a full bladder and measuring velocity of the blood flow of at least 20 cm/s, the definition of elevated blood flow of retroplacental myometrium had been established. Normal blood flow occurred in the sagittal plane as a regular, thin, straight strip of uniform color, depicting a blood artery running along the wall of the uterus, or as a dispersed, discontinuous distribution in the wall of the uterus below the placenta.

Thickened and twisted blood vessels, that show up as overlapping, multicolored vasculature that crisscross or as turbulent blood flow along the uterine wall, are the cause of increased blood flow. The presence of the placental vascular lacunae, the bulging uterine mass, the absence of the vesical uterine interface, the retroplacental echo lucent zone, and enhanced blood vessel formation observed in the area between the outer layer of the uterus and the wall of the bladder on color Doppler imaging are all positive indicators of placenta accreta. The measurements of the maximum placental thickness (cm), aberrant placenta, myometrial fibers in the placenta's basal plate, and lower uterine segment thickness (mm) were noted.

Ultrasonography can detect many characteristics of placenta accreta which include

Loss of the normal hyperechoic line dividing the uterus from the bladder wall, multiple placental lacunae, thinning of the myometrium to less than 1 mm, the placenta protrudes into nearby organs adjacent to the uterus, causing a mass-like lesion that extends from the wall of the uterus. Placenta accreta on the lateral or posterior borders of the uterus can

pose challenges in detecting it with ultrasonography[8]. To find all the women who were established to have full placenta previa or anterior low-lying placenta in the 3rd trimester, we searched a computerized database of obstetric ultrasounds. If the leading placental border is within 20 mm of the internal os, the placenta is considered low-lying. The area of the uterus between the top of the bladder and the cervix was named the lower uterine segment. A midline sagittal section of the cervical canal with the intervening urinary bladder and the lower uterine region with the implanted placenta is needed for the image to be appropriate. Using digital photographs that had been saved, the greatest thickness of the placenta in the lower uterine section was measured. If many digital images were stored, the largest measurement was included. During the delivery of histological examination of materials for patients who underwent cesarean hysterectomy, the diagnosis of placenta accrete was verified.

Primary outcome was to determine whether ultrasonic indications suggesting the presence of placenta accreta invasion were present in second trimester, while the secondary objective was to assess the correlation strength and prognostic accuracy of these indicators in the third trimester, either throughout delivery or when undergoing pathological examination for those undergoing hysterectomy.

Sample size

A minimum sample size of 50 women is required to provide at least 80% statistical power, with a margin of equivalence ranging from -5% to 5%, and a significance level of < 0.05.

Statistical analysis

The statistical analysis was conducted using SPSS v26 software (IBM Inc., Chicago, IL, USA). The normality of the data distribution was assessed using the Shapiro-Wilks test and histograms. The mean and standard deviation (SD) of the quantitative parametric parameters have been provided and contrasted between both groups using an unpaired Student's t-test. The quantitative non-parametric variables were reported using the median and interquartile range (IQR) and were analysed using the Mann Whitney-test. The qualitative parameters were expressed as frequencies and percentages (%) and have been analysed using the Chi-square test or Fisher's exact test, as appropriate. A two-tailed *P value* less than 0.05 was deemed to be statistically significant. The correlation between different variables was assessed utilising the Pearson moment correlation equation for linear relationships between normally distributed parameters, and the Spearman rank correlation equation for non-normal parameters or non-linear monotonic relationships.

RESULTS

The maternal age was 24.34 ± 3.166 years, weight was 69.13 ± 10.606 kg, height was 1.65 ± 0.057 m, BMI was 25.37 ± 3.086 kg/m2, parity was 3.20 ± 1.229, previous cesarian birth was 2.04 ± 1.087, gestational age at examination was 32.98 ± 2.245 weeks, lower uterine segment thickness was 5.42 ± 1.000 mm and maximum placental thickness was 4.64 ± 1.835 cm. Prevalence of spontaneous mode conception was 86%, IVF was 14%, low-lying placenta was 36% and placenta previa was 64% (Table 1).

Table 1: Maternal demographic characteristics, parity, previous cesarian birth, mode of conception, gestational age at examination, lower uterine segment thickness, maximum placental thickness and abnormal placenta diagnosis by US of the studied sample

All patients (n= 50)		
Maternal age (years)		24.34 ± 3.166
sWeight (kg)		69.13 ± 10.606
Height (m)		1.65 ± 0.057
BMI (kg/m2)		25.37 ± 3.086
Parity		3.20 ± 1.229
Previous cesarian birth		2.04 ± 1.087
Mode of conception	Spontaneous	43 (86%)
	IVF	7 (14%)
Gestational age at examination (weeks)		32.98 ± 2.245
Lower uterine segment thickness (mm)		5.42 ± 1.000
Maximum placental thickness (cm)		4.64 ± 1.835
Low lying placenta		18 (36%)
Placenta previa		32 (64%)

Data are presented as Mean ± SD and number (%). IVF: In *vitro* fertilization. BMI: body mass index. US: ultrasonic

Gestational age at delivery was 38.06 ± 1.504 weeks, fetal birth weight was 3185.0 ± 122.57 gm, blood loss was 1303.0 ± 629.01 ml, blood transfusion was 1.84 ± 1.434 units and postoperative hemoglobin was 9.39 ± 1.459 gm/dl. Prevalence of need for cesarean hysterectomy was 14.0% and myometrial fibers in placental basal plate was 20% (Table 2).

Table 2: Operative, post-operative details, need for cesarean hysterectomy and existence of myometrial fibers in basal plate of placenta of the studied sample

All patients (n= 50)	
Gestational age at delivery (weeks)	38.06 ± 1.504
Fetal birth weight (gm)	3185.0 ± 122.57
Blood loss (ml)	1303.0 ± 629.01
blood transfusion (units)	1.84 ± 1.434
Postoperative hemoglobin (gm/dl)	9.39 ± 1.459
Need for cesarean hysterectomy	7 (14%)
Myometrial fibers in basal plate of placenta	10 (20%)

Data are presented as Mean ± SD and number (%).

There was a highly positive statistically significant correlation between lower uterine segment thicknesses and maximum placental thickness, abnormal placenta (previa or accreta) by the US, Blood loss, blood transfusion, caesarian hysterectomy, abnormal placenta (previa or accreta) throughout surgery and myometrial fibers in the placental basal plate (p<0.001) (Table 3).

Table 3: Correlation between lower uterine segment thickness and other considered variables of the studied sample

Lower uterine segment thickness (mm)	Correlation coefficient	*P*
Maximum placental thickness	0.785	< 0.001
Abnormal placenta (previa or accreta) by US	0.852	< 0.001
Blood loss	0.819	< 0.001
blood transfusion	0.796	< 0.001
Cesarean hysterectomy	0.464	0.001
Abnormal placenta (previa or accreta) during Surgery	0.795	< 0.001
Myometrial fibers in basal plate of placenta	0.632	< 0.001

US: ultrasonic. *P* is significant when < 0.05.

A statistically significant positive association had been existed between maximum thickness of the placenta and lower uterine segment thickness, abnormal placenta (previa or accreta) by US, Blood loss, blood transfusion, caesarian hysterectomy, atypical placenta (previa or accreta) during Surgery and Myometrial fibers in basal plate of placenta (p<0.05) (Table 4).

Table 4: Correlation between maximum thickness of the placenta and other studied variables of the studied sample

Lower uterine segment thickness (mm)	Correlation coefficient	*P*
Lower uterine segment thickness (mm)	0.785	< 0.001
Abnormal placenta (previa or accreta) by US	0.354	0.012
Blood loss	0.391	0.005
blood transfusion	0.831	< 0.001
Cesarean hysterectomy	0.793	< 0.001
Abnormal placenta (previa or accreta) during Surgery	0.416	0.003
Myometrial fibers in basal plate of placenta	0.302	0.033

US: ultrasonic. *P* is significant when < 0.05.

A highly statistically significant variation had been existed among placenta previa, low-lying placenta, and placenta accreta (p<0.001) regarding Lower uterine segment thickness. a highly statistically significant variation had been existed among low-lying vs. placenta vs. placenta previa as well as low-lying placenta vs. placenta accreta regarding maximum placental thickness (p<0.001) (Table 5).

There was a highly statistically significant difference regarding Lower uterine segment thickness (mm) (p=0.001). a statistically significant variation had been existed as regard maximum placental thickness (p=0.007) (Table 5).

Table 5: Comparison for lower uterine segment thickness and maximum placental thickness as predictors of placenta accreta in the studied sample and diagnosis by US of the studied sample

	R2	B	Odds ratio (Exp B)	95% CI of odds ratio	*P*
Lower uterine segment thickness (mm)	80.2%	1.6	6.07	4.22, 8.74	0.001
Maximum placental thickness	35.8%	0.95	2.58	1.3, 5.12	0.007

according to diagnosis by US of the studied sample

	Low lying placenta (n= 18)	Placenta previa (n= 32)	*P value*
Lower uterine segment thickness (mm)	4.23 ± 0.537	5.60 ± 0.552	< 0.001
Maximum placental thickness	2.52 ± 0.946	5.23 ± 1.413	< 0.001

Data are presented as Mean ± SD. *P* is significant when < 0.05.

DISCUSSION

Placenta accreta is a condition where the placenta improperly attaches itself to the underlying myometrium, typically in areas where there's a lack of decidua basalis. Abnormal attachment of placenta is categorized as placenta increta, accreta, and percreta based on the extent of villous invasion[9]. Placenta accreta spectrum (PAS) is a highly hazardous disorder linked to pregnancy, since it can lead to severe bleeding that can result in failure of many organ systems, disseminated intravascular coagulation, the requirement for an intensive-care unit admission, hysterectomy, and potentially fatal outcomes. Anticipatory diagnosis and comprehensive care provided by a multidisciplinary team specializing in the specific condition typically lead to enhanced outcomes[10].

Our results showed that 20% of the studied sample had Myometrial fibers in basal plate of placenta with 10 frequencies.

Our study disagreed with Miller *et al*.[11] who reported that Out of the 25 instances with morbidly adhering placenta, 19 (76%) had placental basal plate (BPMYO) on their prior

placenta, while only 41 (41%) of the control group had it (odds ratio 4.8, 95% CI 1.8–13.0). Furthermore, Jauniaux *et al*.[12] discovered that thick fibrinoid deposits, measuring 0.5 to 2 mm, were present at the junction between the uterus and placenta in 119 out of 160 samples (74.4%). These deposits were observed in the areas affected by accreta as well as surrounding all deeply implanted villi.

Regarding the relationship between thickness of Lower uterine segment and other studied variables of the studied sample. We observed that a highly statistically significant correlation had been existed between Lower uterine segment thicknesses and Maximum placental thickness, abnormal placenta (previa or accreta) by US, Blood loss, blood transfusion, caesarian hysterectomy, abnormal placenta (previa or accreta) during Surgery and Myometrial fibers in basal plate of placenta (p<0.001).

In our study regarding Correlation among Maximum placental thickness and other studied variables of the studied sample. There was a statistically significant correlation between Maximum placental thickness and Lower uterine segment thickness, abnormal placenta (previa or accreta) by US, Blood loss, blood transfusion, caesarian hysterectomy, Abnormal placenta (previa or accreta) during Surgery and Myometrial fibers in basal plate of placenta (p<0.05).

As regards Comparison of Lower uterine segment thickness (mm) and Maximum placental thickness according to diagnosis by US of the studied sample. There was a highly statistically significant difference between low lying placenta, placenta previa and placenta accreta (p<0.001) regarding Lower uterine segment thickness. There was a highly statistically significant difference between Low lying placenta VS Placenta previa as well as Low lying placenta VS Placenta accreta regarding Maximum placental thickness (p<0.001).

Concerning univariate logistic regression for Lower uterine segment thickness (mm) and Maximum placental thickness as predictors of placenta accreta in the studied sample. A highly statistically significant variation had existed regarding Lower uterine segment thickness (mm) (p=0.001). a statistically significant variation had existed regarding Maximum placental thickness (p=0.007).

Our study was consistent with Bhide *et al*.[13] who reported that the logistic regression analysis yielded statistically significant findings for the link with abnormally invasive placenta regarding Placental thickness (mm) as Adjusted odds ratio (95% CI) was 1.051 (1.018- 1.085) and significance was 0.003. Consistent with the findings of Lu *et al*.[14], our study observed a substantial increase in thickness of the placenta among individuals who had PAS disorders (3.45 cm) compared to those without PAS problems (2.90 cm) (p<0.05). The multivariate logistic regression analysis of risk factors for individuals with PAS problems revealed that placental thickness was significant (p=0.009) OR (95% CI) was 3.12 (1.35–7.22).

Our study recommended that measuring the thickness of the placenta was straightforward and easily executed, making it a potential screening test for women with placenta accreta, especially those with a previous caesarean section. However, future studies ought to be performed utilising well-designed randomised controlled trials or large, comparative observational studies. Additionally, additional studies ought to involve multicentred studies that can verify our results.

CONCLUSIONS

A significant correlation had been existed among ultrasonic assessed thickness of the placenta and degree of abnormal invasion of low-lying placenta.

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