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Correlation between Early and Late Ultrasound Scan for Diagnosis of Placenta Accreta Spectrum in Pregnant Females with History of Previous Caesarean Section

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ABSTRACT

Background: The placenta attaching improperly to or invading the myometrium can cause placenta accreta spectrum (PAS), a potentially lethal obstetric disease.

Aim: This study aimed to test the diagnostic accuracy of 2D ultrasound in the diagnosis of placenta accreta during weeks 14–18 of pregnancy.

Subjects and methods: From May to September 2024, this prospective cohort study in which one hundred and five pregnant women with a history of previous Cesarean birth between weeks 14 and 18 and who were suspected of having placenta accreta, which is characterized by the placenta occupying the bottom part of the uterus, came to the Outpatient Clinic for standard prenatal care.

Results: For early diagnosis, diagnostic performance for transvaginal ultrasound performance to detect placenta accreta spectrum for any suspicion in early diagnosis and demonstrated an accuracy of 66.5%, with a P value < 0.05. The sensitivity was 66% and the specificity 67%. And to detect placenta accreta spectrum for high suspicion in early diagnosis and demonstrated an accuracy of 62% with a P value < 0.05. The sensitivity was 64.3% and the specificity 59.7%. For late diagnosis, diagnostic performance for transvaginal ultrasound performance to detect placenta accreta spectrum for any suspicion in late diagnosis and demonstrated an accuracy of 88.3%, with a P value < 0.001. The sensitivity was 85.6% and the specificity 91.0%. And to detect placenta accreta spectrum for high suspicion in late diagnosis and demonstrated an accuracy of 90.4% with a P value < 0.001. The sensitivity was 87.1% and the specificity 93.8%.

Conclusion: When ultrasound is used for late diagnosis (between 30 and 32 weeks) as opposed to early diagnosis (between 14 and 18 weeks), it demonstrated greater accuracy, sensitivity, and specificity for detecting placenta accreta spectrum. In both early and late diagnosis, the diagnostic performance improved as the degree of suspicion rises.

Keywords: Early diagnosis, Placenta accrete, Ultrasound, Late diagnosis.

INTRODUCTION

The placenta attaching improperly to or invading the myometrium might cause placenta accreta spectrum (PAS), a potentially lethal obstetric disease. Up to 1 in 300 pregnancies are now complicated with PAS, which was once uncommon [(1)].

The number of Cesarean births, a known risk element for the onset of PAS, has been significantly correlated with the probability of placental penetration. While, the precise origin of PAS remains unclear, recent studies indicate that uterine dehiscence rather than placental invasion is the most likely mechanism [(2)].

The nomenclature may not be contradictory, reflecting the intricate interaction between the rapidly growing trophoblastic tissue and uterine scar tissue [(3)]. Antenatal diagnosis lowers mother morbidity by decreasing blood loss and the requirement for transfusions following birth and in the early postpartum period [(4)].

The recommended imaging modalities to screen for and diagnose PAS in the later stages of the second and third trimesters are color Doppler ultrasonography (US) and two-dimensional grayscale ultrasonography [(1)]. Volume contrast and other more sophisticated US modalities, such 3-dimensional (3D) power Doppler, have showed some promise in detecting placental topography [(6)].

A meta-analysis of the use of specific sonographic criteria showed that the prenatal diagnosis of PAS in the United States had a 91% sensitivity and a 97% specificity. The Placenta Accreta Index (PAI) was created in an effort to uniformly define the diagnosis of PAS in the US [(7)].

By using this method, we showed that the forecasting of histologically verified PAS was significantly better than if we had only used the history of CDs and the anterior placentation. Some studies have included staging criteria to address the long-standing debate of whether to depend on the histology or clinical diagnosis of penetration [(7, 8)]. Therefore, the goal of this investigation was to test the diagnostic efficacy of two-dimensional ultrasound in the diagnosis of placenta accreta between weeks 14 and 18 of pregnancy.

METHODOLOGY

This prospective cohort study was performed at Obstetrics and Gynecology Department, Faculty of Medicine, Cairo University Hospitals from May till September 2024. The study included a total of 105 women were enrolled.

Inclusion criteria

Pregnant women with age from 20 35 years age who were singleton viable, had a placenta placed low in the uterus, had a history of prior Cesarean sections, and had a gestational age of ≥ 14 to 18 weeks based on their most recent menstrual cycle or a recorded first trimester ultrasound.

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Exclusion criteria

Women who had been diagnosed with placenta accreta in previous deliveries, had evidence of fetal co-morbidities related to IUGR or structural abnormalities on the ultrasound exam of normal neonatal anatomy, and those who had diabetes mellitus (DM) and hepatic, renal, or autoimmune conditions.

Ethical considerations: Before being enrolled into the study, the patient made their consent to participate in this study. The protocol and all related documentation were approved for ethical and research purposes by the OB/GYN Department Council at Cairo University prior to the start of the study. Declarations of Helsinki were followed. After approval of study protocol, women were enrolled into the study according to inclusion and exclusion criteria. The demographic, maternal characteristics were extracted during their antenatal health care visit. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

All women were subjected to:

Full history taking: Menstrual history, obstetric history & past history of medical disorders or surgical operation.

Complete clinical examination: General examination and abdominal "obstetric" examination (With special emphasis on previous scar).

Ultrasonography: All patients with placenta appearing in the lower part of the uterus with previous history of Cesarean section were subjected to detailed trans-abdominal 2nd level ultrasound and Doppler for patients with full bladder in our Feto-maternal Unit at Kasr Al-Ainy Hospital between 14-18 weeks.

On US scanning using Doppler at 14-18 weeks, **we looked for at least one of these findings to specify PA :** lack of the retro-placental sonolucent area, thinning or disturbed serosal– bladder boundary, focal exophytic masses entangling the urinary bladder, anomalous placenta spaces and myometrial thickness less than 1 mm [(8)].

● ***As such, the PA diagnosis was made if one of these color Doppler criteria was noted:***

Diffuse or focal lacunar flow patterns, sonolucent vascular ponds with high-speed (PSV >150 mm/sec) & high vascularity of the uterine–bladder interfaces bridging vessels to bladder [(8)].

Ultrasound results were prospectively investigated and matched with ultrasound findings at 30-32 weeks.

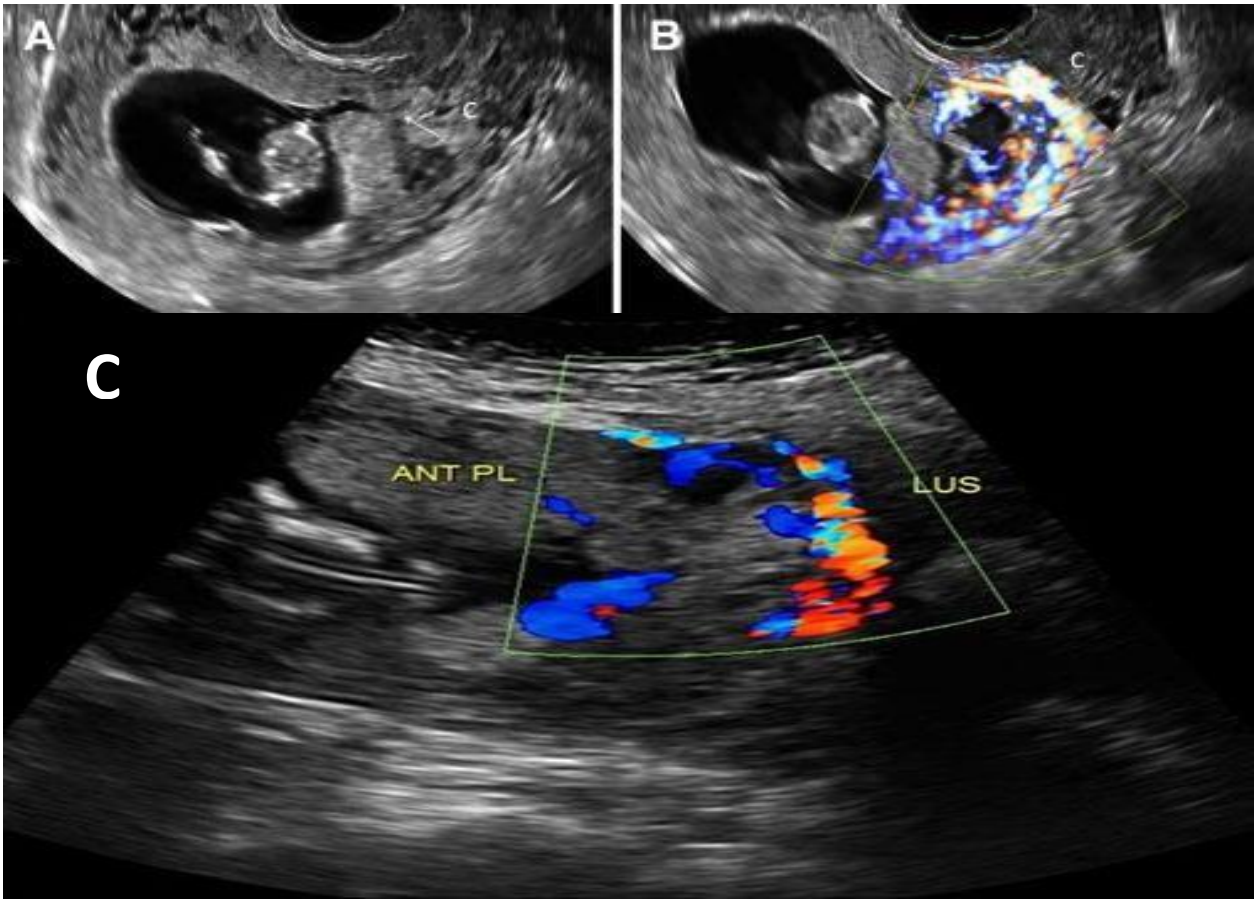

Figure (1): Early US scan between 14-18 weeks (A & B), and late US scan between 30-32 weeks for the same patient (C).

Statistical analysis

The statistical software for social sciences, version 26.0 (SPSS Inc., Chicago, Illinois, USA), was utilized to test the data. Quantitative data were displayed as mean ± standard deviation and ranges, whereas qualitative variables were displayed as percentages and numbers. The Chi-square test was used to contrast groups with qualitative data. Sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy were used to describe accuracy. Thus, a p-value ≤ 0.05 was deemed significant, a p-value ≤ 0.001 was deemed highly significant.

RESULTS

We aimed by our study to evaluate specificity, sensitivity, and diagnostic accuracy of two-dimensional (2D) ultrasound in placenta accreta diagnosis between 14-18 weeks of pregnancy and ultrasound results were prospectively investigated and matched with ultrasound findings at 30-32 weeks and we applied our study on 105 patients who were recruited, with the same inclusion and exclusion criteria. Most of the cases were previous 3, with 46 women (43.8%), followed by 33 women (31.4%) were previous 4 (Table 1).

Table (1): Patient characteristics among study group (n=105)

Patient Characteristics	**Total (n=105)**
Age (years)	
Range	20-35
Mean ± SD	27.52±3.19
BMI (kg/m^2)	
Range	24-33
Mean ± SD	29.01±3.74
Gestational age at Ultrasound (weeks),	
Early diagnosis; Median (IQR)	16 (15-17)
Late diagnosis; Median (IQR)	31 (30-32)
Parity	
Range	1-5
Median (IQR)	3 (2-4)
Gravidity	
Range	1-7
Median (IQR)	3 (2-5)
Previous abortions	
Range	0-3
Median (IQR)	1 (0-2)
Antepartum bleeding	17 (16.2%)
Previous CS	
Previous 1	6 (5.7%)
Previous 2	10 (9.5%)
Previous 3	46 (43.8)
Previous 4	33 (31.4%)
Previous 5	10 (9.5%)
Total	105 (100%)

This table showed a highly statistically significant increase in grade 2 and grade 3 in late diagnosis for US 30-32 weeks compared to early diagnosis for US 14-18 weeks., with a p-value <0.001 (Table 2).

Table (2): Placenta accreta spectrum in early diagnosis by US between 14-18 weeks and late diagnosis by US between 30-32 weeks. (n=105)

Placenta accreta spectrum	**Early diagnosis for US 14-18 weeks**		**Late 4 diagnosis for US 30-32 weeks**		**Test value**	**p-value**
	No.	**%**	**No.**	**%**		
Grade 1	96	91.4%	63	60.0%	28.294	<0.001 **
Grade 2	6	5.7%	25	23.8%		
Grade 3	3	2.9%	17	16.2%		
Total	105	100.0%	105	100.0%		

Early diagnosis for US: Diagnostic performance for transvaginal ultrasound performance to detect placenta accreta spectrum for any suspicion in early diagnosis demonstrated an accuracy of 66.5%, with a P value <0.05. The sensitivity was 66% and the specificity was 67%. Detection of placenta accreta spectrum for high suspicion in early diagnosis demonstrated an accuracy of 62% with a P value <0.05. The sensitivity was 64.3% and the specificity was 59.7%.

Late diagnosis for US: Diagnostic performance for transvaginal ultrasound performance to detect placenta accreta spectrum for any suspicion in late diagnosis demonstrated an accuracy of 88.3%, with a P value <0.001. The sensitivity was 85.6% and the specificity was 91.0%. Detection of placenta accreta spectrum for high suspicion in late diagnosis demonstrated an accuracy of 90.4% with a P value <0.001. The sensitivity was 87.1% and the specificity was 93.8%.

Table (3): Early and late diagnosis by transvaginal ultrasound performance to detect placenta accreta spectrum

Placenta accreta spectrum	**Sens. %**	**Spec. %**	**PPV %**	**NPV %**	**Accuracy %**
Early diagnosis for US					
Any suspicion (Grade 1-2)	66.0%	67.0%	59.1 %	68.0 %	66.5%
High suspicion (Grade 3)	64.3%	59.7%	61.5 %	60.8 %	62.0%
Late diagnosis for US					
Any suspicion (Grade 1-2)	85.6%	91.0%	85.7 %	90.1 %	88.3%
High suspicion (Grade 3)	87.1%	93.8%	88.2%	92.9 %	90.4%

DISCUSSION

The disorder known as Placenta Accreta Spectrum, or PAS, is characterized by aberrant placentation. It contributes significantly to maternal morbidity and mortality as one of the primary reasons of peripartum hemorrhage [10].

Over the past few years, the prevalence of "PAS" has increased dramatically. It is estimated to be one per 533 to one in 2510 deliveries [11].

One significant risk factor for "PAS" is placenta previa, particularly if you have had a previous Cesarean delivery. The antenatal care team should be made aware of the increased risk of placenta accrete spectrum if there has been a previous Cesarean birth and if the placenta has anterior low-lying, or placenta previa. This makes a diverse pre-labor strategy possible. Additionally, a delivery plan was carried out, while taking the woman's informed consent into account and preventing potentially fatal vaginal bleeding [8].

One important diagnostic technique for identifying aberrant placentation in utero is ultrasound. When carried out by a skilled sonographer, the ultrasound evaluation, which uses grayscale and color Doppler imaging, is quite accurate in detecting PAS. Clear space in the myometrial or retroplacental interface, decreased myometrial thickness, and the presence of intraplacental lacunae are grayscale ultrasonography indicators that are suggestive of PAS [12]. Along with color Doppler imaging, which shows enhanced vasculature, uneven intraplacental vascularization, turbulent placental lacunae with high velocity flow, and bridging from placental mass to the uterine-bladder or myometrial interface & occasionally beyond [12].

In current study, regarding patients' age it ranged from 20 to 35 with a mean of 27.52 ± 3.19 years, mean BMI (kg/m^2) was 29.01 ± 3.74, median gestational age at ultrasound at early diagnosis was 16 (15-17) weeks and in late diagnosis, it was 31 (30-32) weeks and median of number of prior Cesarean births was 3 (2-4). Regarding the obstetric history, the median parity was 3 (2-4), gravidity was 3 (2-5), previous abortions were 1 (0-2), and 17 cases (16.2%) had antepartum bleeding. In their study, **Jain *et al.*** [13] discovered that the patients' ages ranged from 23 to 38 years old, with a mean age of 31.24 ± 3.86 years. Their parity ranged from 1-4, with a mean of 1.96 ± 0.789, and their gravidity ranged from 2-11, with a mean of 4.0 ± 2.06 [13]. Seventy pregnant women with a documented history of a prior C/S were included in the study of **Golshan *et al.*** [14]. Participants ranged in age from 20 to 42, with a mean age of 31.4 ± 4.86 years. Gravidity ranged from 2 to 6, with a mean of 2.93 ± 1.01. Between 1 and 4, the mean parity was 1.63 ± 0.73. Every subject had a low-lying placenta diagnosis.

According to **Elgamel *et al.*** [10], intraoperative placental invasion was strongly correlated with the number of prior Cesarean sections and gestational age at Caesarean delivery. In numerous investigations, the number of prior Cesarean births was a reliable indicator of placenta invasion of the myometrium. The primary risk factor for PAS is a history of Cesarean delivery, and as the prevalence of Caesarean deliveries has significantly increased, PAS is becoming increasing. Although, the expelled placenta is typically used to make the final diagnosis of PAS, prenatal US diagnosis is growing more widespread and clinically significant, enabling precise delivery planning and lowering the risk of adverse outcomes. However, in a range of circumstances, PAS is still not identified during pregnancy. Furthermore, the specificity and sensitivity of US signals vary greatly across studies [15].

According to this new study, 96 cases (91.4%) had grade 1 placenta accreta spectrum in early diagnosis by US between 14 and 18 weeks, 6 cases (5.7%) had grade 2, and 3 cases (2.9%) had grade 3. In contrast, 63 cases (60.0%) had grade 1 placenta accreta spectrum in late diagnosis by the US between 30-32 weeks, 25 cases (23.8%) had grade 2, and 17 cases (16.2%) had grade 3.

When comparing late diagnosis by the US between 30-32 weeks to early diagnosis by the US between 14-18 weeks, there was a significant increase in grade 2 and grade 3 cases. With a significant increase in grade 2 and grade 3 in late diagnosis by US between 30-32 weeks compared to early diagnosis by US between 14-18 weeks, with a p-value of <0.001. **Doulaveris *et al.*** [16] reported that at least three out of four cases of placenta accreta spectrum can be detected by transvaginal ultrasonography between weeks 11 and 14 of pregnancy in women who had a previous Cesarean births. For placenta accreta spectrum, a detection of placental implantation within the scar niche has a strong positive predictive value. Eight (1.7%) of the 467 participants in their research had placenta accreta spectrum at birth. 442 patients (94.6%) were classified as grade 1, 2 (4.3%) as grade 2, and 5 (1.1%) as grade 3 according to the original report. 456 patients (97.6%) had grade 1, 5 (1.1%) had grade 2, and 6 (1.3%) had grade 3 according to the updated grading system.

In their retrospective investigation, **Baumann *et al.*** [17] assessed 5219 patients with singleton pregnancies who underwent a standardized ultrasonography (US) examination is consistent with our findings. In the first trimester, one patient (6.7%) was diagnosed with placenta increta/percreta, while seven (46.7%) and seven (46.7%) were found in the second and third trimesters respectively.

Regarding, diagnostic performance for transvaginal ultrasound performance we found that detection of placenta accreta spectrum for any suspicion in early diagnosis demonstrated an accuracy of 66.5%, sensitivity of 66% and specificity of 67% (P value < 0.05). Detection of placenta accreta spectrum for high suspicion in early diagnosis demonstrated an accuracy of 62%, sensitivity of 64.3% and specificity of 59.7% (P < 0.05). While, detection of placenta accreta spectrum for any suspicion in late diagnosis demonstrated an accuracy

of 88.3%, sensitivity of 81.9% and specificity of 91% (P < 0.001). Detection of placenta accreta spectrum for high suspicion in late diagnosis demonstrated an accuracy of 90.4%, sensitivity of 87.1% and specificity of 93.8% (P < 0.05). In line with our findings, **Movahedi *et al.* [18]** found that ultrasound examination for placenta accreta in 18–22 weeks of GA has 79.17% specificity, 51.61% sensitivity, 61.54% PPV, and 71.70% NPV. According to another study, the placenta accreta was detected by ultrasound imaging at 32–34 weeks of GA with 60.8% specificity, 90% sensitivity, 62.52% PPV, and 90.33% NPV. One significant finding was that whereas ultrasound examinations during weeks 18–22 of pregnancy had high PPVs and high specificity, those conducted during the 3rd trimester had greater NPVs and sensitivity**.**

The placenta accreta index by ultrasound may be helpful for determining the likelihood of placenta accreta from patient to patient, according to a study that was conducted by **Rac and colleagues [7].**

Additionally, a meta-analysis on the use of ultrasound in PAS diagnosis was conducted in 2017 by **Jauniaux and colleagues [19].**

They demonstrated that when carried out by a qualified practitioner, ultrasonography can be regarded as a very sensitive and specific technique in the diagnosis of accreta placentation. To further improve the results of this issue, the prenatal screening protocol needs to be improved. According to this study, the ultrasonic imaging specificity and sensitivity were 77.41% and 30.22%, respectively**. Rahimi-Sharbaf *et al.* [20]** used abdominal and vaginal ultrasonography to assess a 14-week pregnant woman in the 2nd and 3rd trimesters. In the second trimester, the US had the same sensitivity and specificity as our study at 60% and 83.5% respectively. In contrast to our study, the US had a third-trimester sensitivity and specificity of 71.4% and 88.5%, respectively. They come to the conclusion that PAS can be accurately detected by the US in both the 2nd and 3rd trimesters**.**

In 2004, **Comstock *et al.* [21]** conducted 163,855 obstetric examinations throughout a 12-year study period. According to the study's findings, the US's sensitivity and PPV in the second trimester were 86% and 63% respectively. In the third trimester, the US's sensitivity and PPV were 100% and 48% respectively. According to the study's findings, many cases of accreta can be predicted by a single sonographic signal as early as 15 to 20 weeks of pregnancy. This suggests that in high-risk instances, gynecologists should think about doing the second US evaluation of PAS in 32–34 weeks**.**

Abdominal US diagnosis of placenta accreta during the 1st trimester is compared by **Xia and Chang [22].** They recommend that the US check of pregnant women who are at high risk for placenta accreta at around 20 weeks, abdominal US's sensitivity, specificity, PPV, and NPV for the second trimester of pregnancy were 95.65%, 91.78%, 88%, and 97% respectively. Compared to the second trimester, the sensitivity and NPV of abdominal US were considerably improved in the 3rd trimester of pregnancy. In this investigation, we also found the same thing. It could be the cause of the significantly denser blood vessels in pregnant women's placentas during the last trimester**.**

Hamda *et al.* [9] assessed the US's sensitivity and specificity in 100 instances and found that the US sensitivity, specificity, NPV, and PPV were all 100%, 85%, and 90.9% respectively**.**

Additionally, **Baumann *et al.* [17]** discovered that the US method of identifying severe types of PAS had a high sensitivity and specificity of 100%**.** Similar findings were reported by **D'Antonio *et al.* [23]** in a comprehensive review and meta-analysis of 3707 pregnancies at risk for PAS. With a sensitivity of 90.7% and specificity of 96.9%, they concluded that the US performed exceptionally well overall**.** However, because these studies are according to a choice of cases in a high-risk category, they might exaggerate the accuracy of US.

LIMITATION

Because it is a single center study, the results can differ from those obtained elsewhere. Also, the comparatively tiny sample size, which could yield negligible findings. To get meaningful results, we advise more research in other locations with a bigger sample size.

CONCLUSION

When ultrasound is used for late diagnosis (between 30 and 32 weeks) as opposed to early diagnosis (between 14 and 18 weeks), it demonstrated greater accuracy, sensitivity, and specificity for detecting placenta accreta spectrum. In both early and late diagnosis, the diagnostic performance increases as the degree of suspicion rises. Second-trimester ultrasonography had not yet proven to be very helpful in diagnosing PAS, although it does raise the possibility that additional testing will be necessary for verifying the diagnosis.

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