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Research Article

Can uterine artery Doppler Be used to Predict Placenta accreta Spectrum disorders (PAS-disorders) in patients with placenta Previa?

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Abstract

Background: Placenta accreta is a disorder in which there is adhesion of a portion or the entire placenta to the uterine wall. Massive bleeding after placental separation, which can result in shock, renal failure, adult respiratory distress syndrome, and even death. The aim of the study is to evaluate the value of uterine artery Doppler velocimetry in Suspecting placenta accreta spectrum in patients with placenta previa. **Methods:** Between January 2023 and December 2023, a cross-sectional observational study was conducted at Minia Maternity University Hospital's Department of Obstetrics and Gynecology. 50 pregnant women with placenta previa were included . Patients underwent a thorough history taking, an ultrasound examination, and a color Doppler. **Results:** The mean age of cases was 31.6 ± 4.3, ranging from 22:41 years and 78% had average BMI. The mean PI of uterine artery Doppler in PAS cases was 0.73±0.16, and the mean RI was 0.52±0.14. The mean PI of the non-morbidly adherent placenta was 0.87 ±0.40, and the mean RI was 0.62±0.30. **Conclusion:** color Doppler and grayscale ultrasonography are useful tools for diagnosing placenta accreta. The uterine artery Doppler may be able to predict placenta accreta.

Keywords: Doppler; Placenta Accreta; Uterine artery; Pulsatility index, Resistance index

Introduction

Placenta accreta is the result of placental adhesion of either a portion or the whole placenta to the uterine wall, with partial or whole lack of the decidua basalis. The placenta may grow to invade other tissues, such as the bladder or uterine serosa, or it may cling inappropriately to the myometrium [(2,3)].

Chintamani, A. reported that the incidence of placenta accreta is 1:198 pregnancies[(4)]. Because placenta accreta cannot be avoided, the prevalence is increasing due to patient preference for elective CS and a decline in vaginal births following caesarean delivery (VBAC) trials. Prenatal diagnosis is crucial for efficient planning to reduce maternal/ fetal morbidity and mortality[(5)]. Placenta accreta was observed in three out of every 1000 deliveries, and its incidence has increased over the previous few decades [(6,7)].

A variety of techniques, including MRI, color Doppler, and ultrasound grayscale, can be used to diagnose placenta accreta. Typically, the major method utilized to diagnose invasive placentation in uterus is ultrasound[(8)]. Placental lacunae, lack of the retroplacental hypoechoic clear zone, the existence of hypervascularity of the interphase between the uterine serosa and bladder wall, and placental lacunae are specific sonographic findings of placenta accreta [(9)].

An elevated uterine artery PI may be an indirect indication of compromised placentation, according to prior uterine artery Doppler research [(10)].

This study looked into the use of uterine artery Doppler in patients with placenta previa to predict placenta accreta.

Patients and methods

An observational cross-sectional study was carried out at the Department of Obstetrics and Gynecology, Minia Maternity University Hospital. The study included 50 pregnant women with placenta previa attending antenatal care or emergency department.

Inclusion criteria: All pregnant women attending the antenatal clinic and feto-maternal unit in the study setting during the study period were diagnosed with placenta previa on ultrasonography in the third trimester and suspected to be placenta accreta. First-trimester ultrasound or the first day of the previous menstrual cycle can confirm a gestational age of more than 28 weeks, single living baby, history of one or more cesarian section or hysterotomy.
Exclusion criteria: Exclusion criteria for women were included (refused to participate, IUGR, pregnancy-induced hypertension, multiple pregnancies, fetal anomalies and Fundal placenta.

All women were assessed, including general, abdominal, and local examination, and investigation. The study was explained to them, and informed consent was obtained before the ultrasound examination. The same experienced operator performed the ultrasound assessment.

Using an ultrasound machine Voluson S.8 from GE Healthcare, USA, all patients underwent a 2D grayscale and color Doppler examination via trans-abdominal and trans-vaginal appro-aches. The examination encompassed fetal biometry, confirmation of placenta previa, evaluation of the potential of concurrent placenta accreta in the form of multiple vascular lacunae, blood vessels crossing uterine serosa, myometrial thickness of less than 1mm, and interruption of the bladder wall.

Finding the right and left uterine arteries at the apparent crossing with the external iliac arteries allows for assessment of uterine artery Doppler in various situations of placenta previa trans-abdominally. With the narrowest possible angle of insonation, measurements were obtained 1 cm distal to the crossing site, with the sample gate set at 2 mm. The waveforms were obtained using pulsed wave Doppler following the color Doppler identification of the arteries. PI was measured after at least three consecutive waveforms that were identical were recorded.
Hysterectomy specimens underwent histopatho-logical analysis to determine the extent of myometrial invasion.

Ethical Approval

Each participant signed a written informed consent form after learning about the study's objectives. The Department of Obstetrics & Gynecology at Minia Faculty of Medicine's local and institutional ethical committee was consulted in order to obtain ethical permission.

Statistical analysis

Using Microsoft Excel software, data from history collections, basic clinical examinations, laboratory studies, and outcome measures were coded, input, and examined. The Statistical Package for the Social Sciences (SPSS version 20.0) program was then utilized to import and analyze the data. Contingent on the type of data, mean±SD was used to represent the quantitative group and numbers and percentages were used to represent the qualitative data. The signifi-cance of the differences was assessed using the Chi-square test (X2) and the difference and correlation of the qualitative variable. Logistic regression predictors, The P value of less than 0.05 was deemed significant.

Results

36 patients in this study had placenta accreta verified at the time of CS. Out of 50 cases, 14 had a clear diagnosis of placenta previa without invasion.

Table (1) demonstrates the demographic data of the studied group

Demographic data	***Descriptive statistics*** *(n=50)*
Age *(years)*	
Mean ± SD	31.6 ± 4.3
Median (Range)	31.5(22:41)
Residence	
Urban	20(40%)
Rural	30(60%)
BMI	
Low weight	0
Average	39(78%)
Overweight	5(10%)
Obese	6(12%)
Morbid obese	0
Education level	
Illiterate	11(22%)
Primary education	6(12%)
Secondary education	25(50%)
High education	8(16%)
Gestational age	
Mean ± SD	37.4±*0.5*
Median (Range)	*37(37:38)*
Gravidity	
Mean ± SD	4.8± 1.5
Median (Range)	5(1:8)
Clinical presentation	
Asymptomatic	17(34%)
Antepartum Hemorrhage	33(66%)

As shown the mean age of studied cases was 31.6 ± 4.3, ranging from 22:41 years with 60% rural residents and 78% had average BMI. Regarding the education level of cases, about one-half of the studied cases had secondary education, and only 16% had a high level of education. The gestational age mean was 37.4±0.5, which also means gravidity was 4.8.

Table (2): 2D grayscale ultrasound findings

2D US sign	***Descriptive statistics*** *(n=50)*
Placenta previa in the US	
Anterior <2 cm from Internal OS	31(62%)
Centralis	19(38%)
Placenta thickness at the level of IO	
Mean ± SD	6.9 ± 1.8
Median (Range)	7(3:11)
Cervical lacunae By TVS	
No	17(34%)
Yes	33(66%)
Placental lacunae grade	
Grade 0	9(18%)
Grade 1	26(52%)
Grade 2	15(30%)
Loss of clear zone	
no loss	6(12%)
focal	34(68%)
total	10(20%)
Myometrial thickness behind the placenta	
less than 1 mm	46(92%)
more than 1 mm	4(8%)
Bladder wall interruption	
no	40(80%)
yes	10(20%)
Placental bulge	
no	20(40%)
yes	30(60%)
Focal exophytic mass	
no	26(52%)
yes	24(48%)

Regarding grayscale US signs in PAS, it was estimated that sensitivity of total loss of clear zone in PAS diagnosis was 97%, specificity was 32%. the sensitivity and specificity for myometrial thickness behind the placenta <1mm were 97% and 19%, respectively, while sensitivity and specificity for bladder wall interruption were 29% and 100%, respectively.

Table (3): Doppler signs in PAS

Doppler sign	***Descriptive statistics*** *(n=50)*
Uterovesical hypervascularity	
no	8(16%)
yes	42(84%)
Sub-placental hypervascularity	
no	9(18%)
yes	41(82%)
Bridging vessels	
no	14(28%)
yes	36(72%)
Placental lacunae feeding vessels	
no	9(18%)
yes	41(82%)

Regarding Doppler signs in the diagnosis of PAS, it was estimated that the sensitivity of utero-vesical hypervascularity in PAS diagnosis was 88% and specificity was 24%. the sensitivity and specificity for sub-placental hypervascularity were 91% and 38%, while sensitivity and specificity for bridging vessels were 88% and 63%, respectively.

Table (4): the uterine artery Doppler of the studied cases.

	Non-morbidly adherent placenta	**Placenta Accreta Spectrum (PAS)**	**P-value**
PI			
Mean ± SD	0.87 ±0.40	0.73±0.16	0.05*
Median (Range)	0.86(0.27:1.6)	0.71(0.33:1.6)	
RI			0.14
Mean ± SD	0.62±0.30	0.52±0.14	
Median (Range)	0.63(0.18:1.52)	0.49(0.18: 0.80)	

Concerning uterine artery Doppler, the mean pulsatility index of PAS cases was 0.73±0.16, and the mean resistance index was 0.52±0.14. The mean pulsatility index of Non-MAP was 0.87 ±0.40, and the mean resistance index was 0.62±*0.30.*

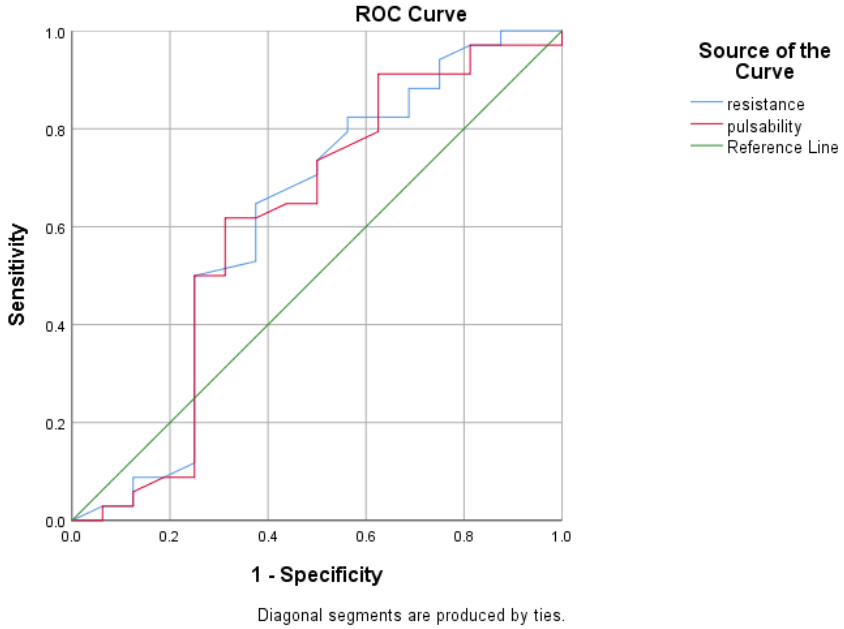

Fig. (1:) ROC curve analysis for uterine Doppler artery in PAS diagnosis

Table (5): demonstrates Doppler indices of the uterine artery in tested groups.

	Pulsatility index	***Resistance index***
Cut off value	<0.87	*<0.66*
AUC	0.63	*0.61*
95%CI	(0.42:0.80)	*(0.42:0.80)*
P value	0.21	*0.10*
Sensitivity	78.5%	*73%*
Specificity	50%	*50%*
PPV	78.5%	*73.5%*
NPV	44%	*50%*

Regarding uterine Doppler artery in the diagnosis of PAS, it was estimated that the sensitivity of the PI in PAS diagnosis when cut off value less than 0.87 was 78.5%, while specificity was 50%. The sensitivity and specificity for the RI when cut off with a value less than 0.66 were 73% and 50%, respectively.

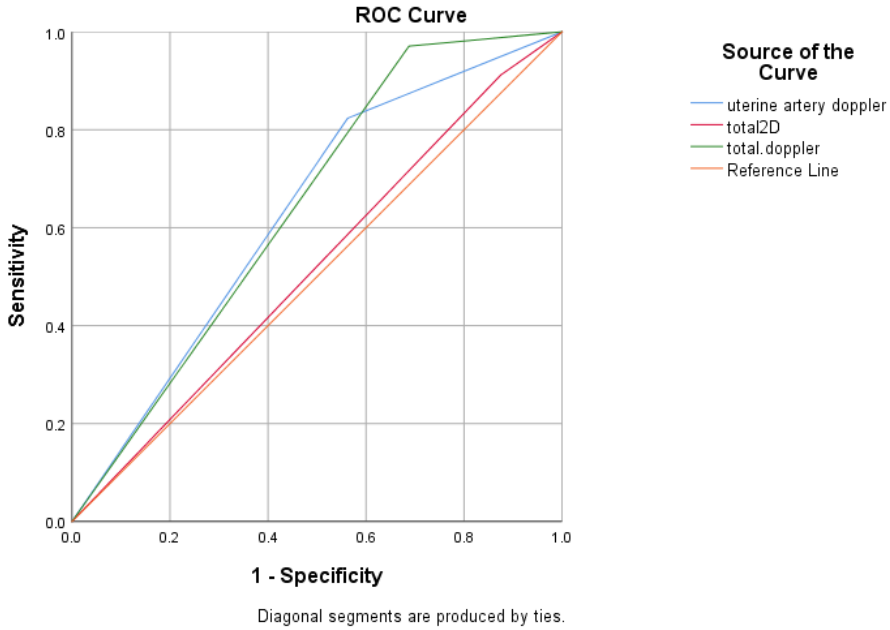

Fig. (2): ROC curve analysis for 2D grayscale US, 2D Doppler and Uterine artery Doppler signs in PAS diagnosis

Discussion

Placenta accreta is the result of placental adhesion of either a portion or the whole placenta to the uterine wall, with partial or whole lack of the decidua basalis[11]. The classification of placental attachment is based on the extent of penetration into the myometrium. Placenta accreta refers to the invasion of placental tissue into the decidual surface of the myometrium. Placenta increta occurs when placental villi invade more deeply within the myometrium. Placenta percreta where chorionic villi penetrate through the uterine serosa and may invade nearby organs[3].

Placenta accreta can be diagnosed using various imaging techniques, including ultrasound grayscale, color Doppler, and MRI[1]. This study aimed to examine screening tools that could effectively predict PAS. Currently uterine artery Doppler is performed in cases of pregnancy complications. Previous studies have explored the relationship between uterine artery Doppler velocimetric measurements and the occurrence of various pregnancy complications Such as women at high risk for pre-eclampsia, IUGR, placental abruption, and intrauterine fetal death**.** This work aimed to reduce maternal morbidity and mortality due to PAS disorders through proper diagnosis via the use of uterine artery Doppler measurements and subsequently proper preparation with avoidance of the overestimation and wasting of resources.

In the current thesis, demographic data of 50 studied cases showed that the mean age was 31.6 ± 4.3, ranging from 22:41 years with 60% rural residents and 78% had average BMI. The gestational age mean was 37.4±0.5, and the mean gravidity was 4.8± 1.5. In the same line, there was a recent Egyptian study by Jadalla in 2022 [11] aimed to examine the uterine artery Doppler's role in the PA diagnosis in cases with placenta previa. Ultrasound assessment and color Doppler were conducted for 36 pregnant women with placenta previa. The mean age of the studied cases was 31.73 ±5.49 years, Gestational age from 28 weeks till complete term.

Regarding risk factors of PAS among studied cases, 50% had a previous history of abortion

with the mean number of CS was 2.7 ranging from 1:5 and meantime of last delivery was 3.3 years. While no case had a previous history of PAS disorder, and 80% had no scar pregnancy suspected in 1st Trimester. These results were similar to the findings of Gebreil et al.,[12], who noted that the average number of CS was 2.59.

Additionally, a substantial positive association was discovered by Maged et al., [13] between the occurrence of PAS and the quantity of prior CS and abortion history. According to Clarke et al. [14], in the presence of a PP, the risk of PAS is 24% in people who have had one prior CS and rises to 67% in those who have had three or more prior CS. According to Silver et al.,[15], women with PP have a corresponding PA risk of 3%, 11%, 40%, 61%, and 67% for one, two, three, four, and five prior CS. Regarding complications, it is estimated that about 25% of cases had massive blood transfusions≥ 6 units, 32% had organ injury (bladder injury), and 80% needed HDU admission. On the other hand, no case reported DIC, cardiac arrest, and maternal and neonatal mortality.

Histopathology showed that about 68% of the cases studied had placenta accreta and 32% of cases had non-morbidly adherent placenta. Regarding 2D US signs in PAS, it was estimated that the sensitivity of total loss of clear zone in PAS diagnosis was 97%, specificity was 32%. the sensitivity and specificity for myometrial thickness behind the placenta <1mm were 97% and 19%, while sensitivity and specificity for bladder wall interruption were 29% and 100%, respectively. Retro-placental clear zone loss was estimated by Maged et al.,[13] which revealed 87.3% sensitivity, 89.1% specificity, 93% PPV, 80% NPV, and 88% accuracy.

According to a recent study by Fahmy et al.,[16], there was a 94% sensitivity, 91% specificity, 94% PPV, 91% NPV, and 93% accuracy regarding the disappearance of the retro-placental clear zone. This study demonstrated a sensitivity of 66%, specificity of 95%, PPV of 95%, NPV of 66%, and accuracy of 78% in the presence of myometrial thinning. Regarding the Doppler sign, 84% had utero-vesical hyper-vascularity, 82% had sub-placental hyper-vascularity, 72% had bridging vessels, and 82% had placental lacunae feeding vessels.

As regards uterine artery Doppler, the mean PI of PAS cases was 0.73±0.16, and the mean RI was 0.52±0.14. The mean PI of the non-morbidly adherent placenta was 0.87 ±0.40, and the mean RI was 0.62±0.30.

This is consistent with the findings of Cho et al. [10] study, which showed that in placenta accreta patients, uterine artery Doppler RI is lower than in placenta previa or normal pregnancy. Therefore, uterine artery Doppler velocimetry may be a helpful diagnostic technique for placenta accreta. It was estimated that the sensitivity of the PI in PAS diagnosis with a cut-off value less than 0.87 was 78.5%, while specificity was 50%. Also, the sensitivity and specificity for the resistance index with a cut-off value less than 0.66 were 73% and 50%, respectively.

Strength points:

It is the first study in our locality to assess the role of uterine artery Doppler in the diagnosis of Placenta Acreta. An important issue related to maternal morbidity and mortality rate.

limitations of the study:

Both the small sample size and single study setting are expected limitations that can create the challenge of generalizability. Future research will include a large sample size.

Conclusion

The application of grayscale ultrasonography and color Doppler ultrasound is a useful diagnostic technique for placenta previa accreta. Uterine artery Doppler velocimetry addition In order to decrease maternal morbidity and death from PAS disorders, Doppler indices could predict placenta accreta in placenta previa cases. This would be achieved through accurate diagnosis, precise prediction of the degree of invasion, and appropriate preparation that avoids overestimating and wasting resources.

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Conflict of Interest: None.

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