Clinical and ultrasonographic predictors of maternal morbidities in patients with placenta accreta spectrum

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Abstract

Background : The incidence of placenta accreta has been markedly increased. Patients with this condition are exposed to many complications, including massive blood loss, hysterectomy and postpartum haemorrhage.

Aim : To predict maternal morbidities related to placenta accreta spectrum (PAS) using clinical and ultrasonographic criteria so proper preoperative preparation and counselling can be done.

Patients and methods: This study analysed 106 patients diagnosed by ultrasonography as having PAS and confirmed intraoperatively according to FIGO criteria. Planned caesarean sections were done, and the amount of blood loss was calculated. Patients were considered to have massive bleeding if the estimated blood loss was 2500 cc or more.The patients with hysterectomy, bladder injury, and postpartum haemorrhage were identified, and the association with clinical and sonographic signs were analyzed.

Results: In our study, some ultrasonographic signs such as placenta previa complete centralis, lacunae grading and bridging vessels were associated with massive intraoperative bleeding with Odds ratio 1.47 95% CI (1.35-1.75) (p=0.014) for lacunae grade 2 and 1.26 95% CI (1.07-1.61) (p=0.048) for bridging vessels. However, none of them was an independent predictor for massive intraoperative blood loss in regression analysis. The risk of hysterectomy was increased in patients with lacunae grade 3 (p <0.001), while the risk for bladder injury was significantly increased with bridging vessels

(p=0.048). None of the clinical characteristics have a relation to maternal morbidities.

Conclusion: None of the patient,s clinical characteristics statistically linked to maternal morbidities. The ultrasonographic signs of PAS could allow the prediction of maternal complications.

Key words: placenta accreta, intraoperative bleeding, hysterectomy, ultrasound color Doppler.

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Introduction

Placenta accreta spectrum syndrome (PAS) represents a significant health problem; the complications include massive maternal bleeding, shock, hysterectomy and even maternal death [1,2].

The increased incidence could be attributed to the markedly increased caesarean section rate in addition to previous uterine surgery, IVF pregnancy, and advanced maternal age [3,4].

Accurate preoperative evaluation is essential to predict and manage the expected complications. Ultrasound is the most widely used tool for prenatal diagnosis .it depends on typical sonographic findings with two-dimensional (2D) and colour Doppler imaging [5,6].

The ultrasonographic signs suggesting PAS include loss of retroplacental hypoechoic space, placental lacunae, myometrial thinning, bladder wall interruption, and placental bulge (6); when colour Doppler imaging is added to the 2D greyscale, the sensitivity and the negative predictive values were increased to 90% and 95%, respectively. The colour Doppler findings include ureterovesical hypervascularity, sub-placental hypervascularity and bridging vessels [7,8].

It was reported that ultrasonographic signs could predict placental adhesion [9]; however, studies that linked ultrasonographic findings to maternal morbidity are limited. Precise antenatal diagnosis could help in planning a proper management [10], thus decreasing maternal morbidity related to that significant health problem. The aim of this study is to evaluate the role of the patient's clinical criteria and ultrasonographic markers of PAS in predicting maternal morbidity.

Patient and method

This prospective study study was conducted at Mansoura University Hospital in the period from October 2021 to October 2023 after approval from the ethical committee of the Mansoura Faculty of Medicine (code number MS.21.06.1556).

The study initially included 122 patients with palacenta accreta spectrum (PAS). Sixteen of them were excluded as they have other risk factors for bleeding; 12 had emergency caesarean sections for severe antepartum haemorrhage, 3 were twin pregnancies, and 1 had immune thrombocytopenic purpura (ITP). The remaining 106 were confirmed to have PAS by the ultrasonography according to Cali et al.[6] and all were confirmed intraoperatively according to FIGO [11]. The ultrasonography was done by the same experienced sonographer team. All participants had a history of one or more caesarean sections.

All patients were counselled, the management plan and the possible risks were explained, and informed consent was obtained.

Ultrasonographic examination at 34-36 weeks was done with a semi-full bladder to delineate the bladder–serosa interface. We used a 4.0–6.0-MHz curved transabdominal and 5.0–7.0-MHz transvaginal transducer if needed (Toshiba/Canon Aplio 500 Platinum Ultrasound Machine, Toshiba medical ultrasound, Otawara, Tochigi, Japan). The pulsed rate frequency of the colour Doppler ultrasound was initially set at 1.3 kHz, but it was then lowered to 0.9 kHz to identify the presence of placental lacunar flow. The diagnosis of PAS disorders was based on detecting at least two of the following criteria [6].

- Loss of the retro placental sonolucent zone.
- Interruption of the uterine serosa-bladder wall interface.
- Turbulent placental lacunae with the high-velocity flow.
- The myometrial thickness is less than 1 mm.
- Increased vascularity of the uterine serosa–bladder wall interface.

- Increased vascularity in the parametrial region.

A planned caesarean section was performed for all cases by the same surgical team. The uterine incision was done at a level higher than the expected upper border of the placenta to avoid disturbing the placenta. All patients were intravenously given 100 micrograms of Carbetocin (papal 100 microgram Ferring pharmaceutical) after delivery of the fetus. Delayed cord clamping was done. Bilateral uterine artery ligation , and meticulous dissection of the bladder from the lower uterine segment was done. A Hypogastric artery is ligated when severe haemorrhage occurs. Once the baby was delivered, the suction container and gauze were replaced to avoid parietal blood loss counting and amniotic fluid contamination.

The equation used when calculating blood loss of a blood soaked item is wet weight of the item (in grams) - dry weight of the item (in grams) =milliliters of blood within the item [12] .

The volume in the suction apparatus was added to the gauze weight to calculate the total amount of blood loss. Patients were considered to have massive blood loss if the estimated blood loss exceeded 2500 cc [13].

The secondary outcomes were hysterectomy, bladder injury, postpartum haemorrhage and the need for ICU admission.

Univariable and multivariable logestic regression was done to detect the association between the ultrasonographic criteria, patient's clinical characteristics and maternal complications.

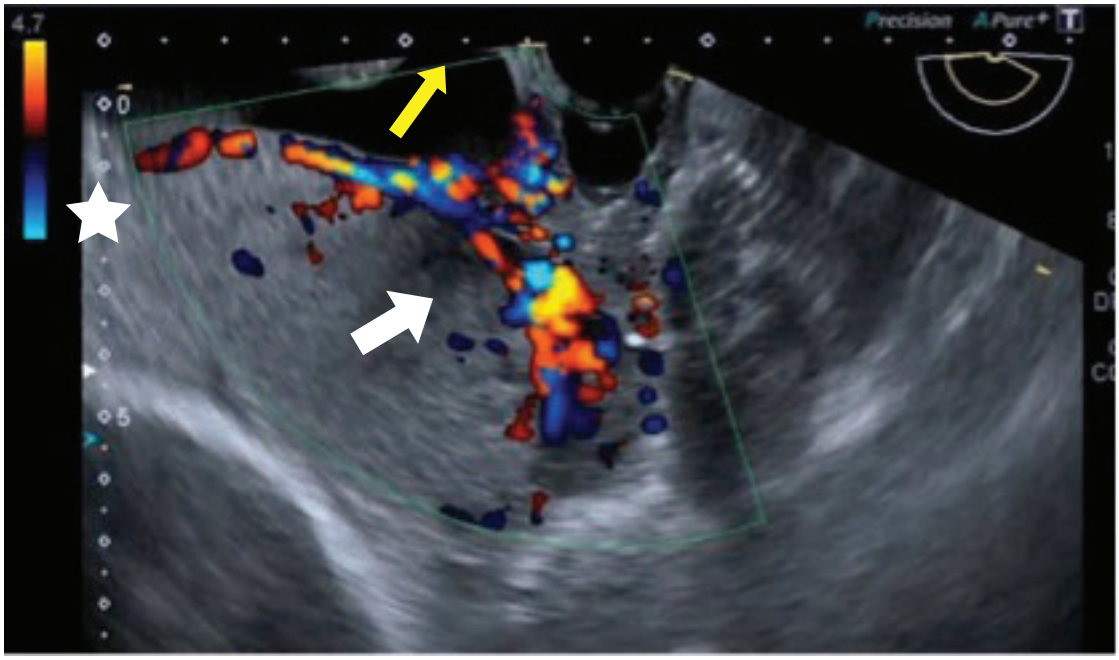

Figure (1): Transabdominal ultrasonographic examination showed retroplacental space hypervascularity (White arrow), placenta is homogenous, low lying (star), bladder (yellow arrow).

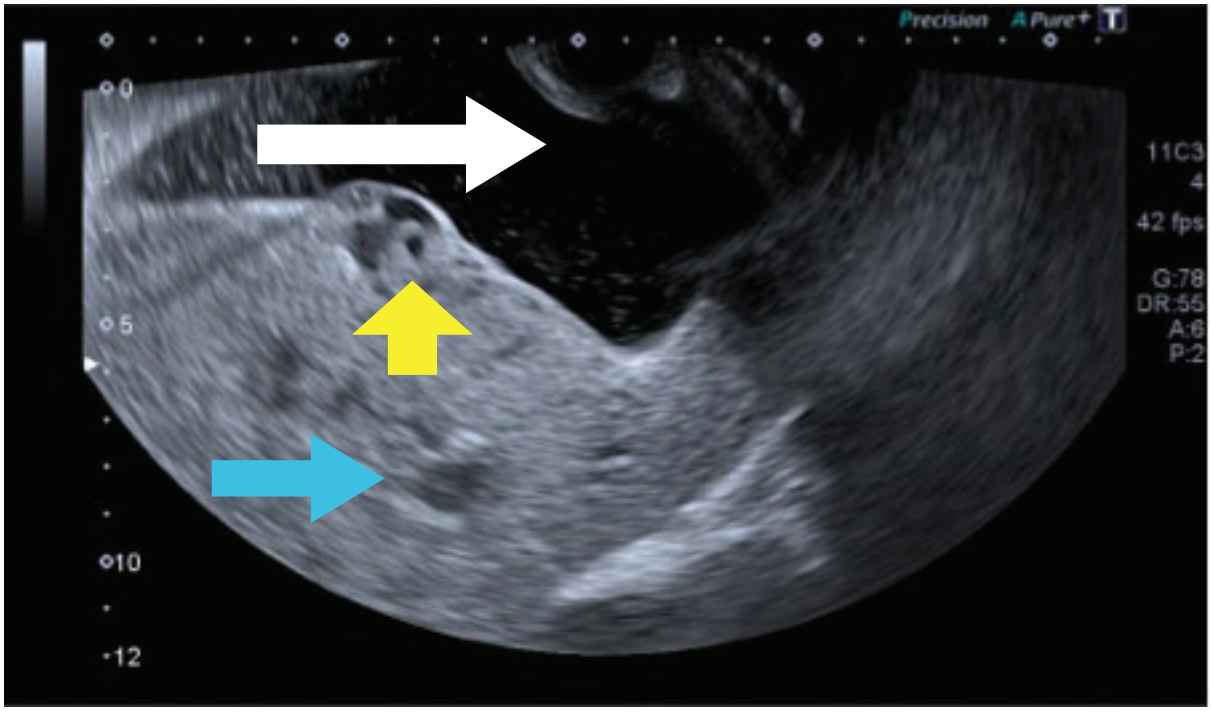

Figure (2): Transabdominal ultrasonographic examination showed focal percreta (yellow arrow), placenta is heterogenous, low lying (blue arrow), bladder (white arrow).

Statistical analysis and data interpretation

Collected data was revised, coded, tabulated and introduced to a P.C. using Statistical Package for Social Science **(IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.)**. Data were presented, and suitable analysis was done according to the type of data obtained for each parameter.

Normality of data

The Kolmogorov-Smirnov test was used to test normality. If the significance level is greater than 0.05, then normality is assumed.

Descriptive statistics

- Mean ± standard deviation (S.D.) were used for parametric numerical data, while median and range were used for non-parametric numerical data.
- Frequency and percentage were used for non-numerical data.

Results

The patient's clinical data including age, BMI, gravidity, parity and Number of cesarean sections, are shown in table (1).

The primary outcome was intraoperative blood loss, while the secondary outcomes were hysterectomy, postpartum haemorrhage, bladder injury and admission to intensive care unit (ICU).

There was no increased risk of intraoperative massive bleeding and other maternal morbidities based on maternal clinical data as shown in Table (2).

The study outcome was 65 / 106 (61.3%) patients had massive blood loss (2500 ml or more), 14 had cesarean hysterectomy, 8 had bladder injury, and 10 cases were admitted to the Intensive care unit (ICU). There are no reported cases of bowel injury or maternal mortality.

Regarding the intraoperative massive blood loss, 70% (46/65) of cases had placenta previa complete centralis, 46% (30/65) had

lacuna grade 3, and 75% (49/65) had bridging vessels. Hysterectomy, ICU admission and bladder injury were more common in complete centralis(92%,80%,75%), respectively, as shown in Table (3).

The presence of bladder invasion was significantly associated with Hysterectomy (p = 0.041), ICU admission (p = 0.015) and bladder injury (p= 0.02). Other variables didn't show significant association, as shown in Table (3)

There is a significant association between post partum haemorrhage and the placenta site (p= 0.008), as well as between hysterectomy and the grades of lacunae (p < 0.001). At the same time, bridging vessels were statistically significant with bladder injury (p = 0.048), as shown in Table (3).

The Odds ratio (OR) for clinical criteria and ultrasonographic signs was calculated by using univariate regression analysis. For massive blood loss; lacunae grade 2 OR 1.47, 95% CI (1.35-1.75) (P= 0.01), and bridging vessel OR 1.26 95% CI (1.07-1.61) (p= 0.04). However, by multivariate regression analysis, none were shown as independent risk factors for massive blood loss, as shown in Table (4)

Table (1): Demographic data of the cases of the study.

Variables	Mean ± SD
Age (years)	32.15 ± 5.36
BMI	27.35± 2.8
Gravidity	4.42 ± 1.45
Parity	2.69 ± 0.95
Previous C.S.	2.55 ± 1.03
Blood transfusion units	5.47 ± 2.88

Continuous data expressed as mean±SD and median (range)

Categorical data expressed as Number (%)

Table (2): Maternal outcome in relation t o clinical data

	Maternal outcome				
Clinical data	**Massive blood loss (N= 65)**	**Hysterecto-my (N= 14)**	**ICU admission (N= 10)**	**Bladder injury (N= 8)**	**PPH (N= 8)**
Age/years	32.23 ± 5.21	31.71 ± 3.97	32.70 ± 6.73	30.75 ± 4.86	35.38 ± 6.32
Test of significance	t= - 0.192 p = 0.870	t= 0.326 p=0.745	t= - 0.339 p = 0.735	t= 0.768 p= 0.444	t= - 1.789 p= 0.076
Gravidity	4 (2-9)	4 (2-9)	4 (2-6)	3 (2-6)	4 (2-6)
Test of significance	z= - 0.164 p=0.936	z= - 0.380 p= 0.704	z= - 1.965 p= 0.49	z= - 1.410 p= 0.158	z= - 0.148 p= 0.882
Parity	3 (1-5)	3 (1-4)	2 (1-3)	2 (1-4)	3 (1-4)
Test of significance	z= - 0.225 p = 0.822	z= - 0.32 p = 0.895	z= - 1.214 p= 0.225	z= - 1.004 p= 0.315	z= - 0.282 p= 0.778
Test of significance	z= - 0.548 p = 0.584	z = - 0.601 p = 0.548	z= - 1.555 p= 0.120	z= - 1.083 p= 0.279	z= - 0.492 p= 0.623
Previous C.S.	3 (1 – 5)	3 (0 - 4)	2 (1-3)	2 (1-4)	3 (1-4)
Test of significance	z= - 1.202 p = 0.229	z= - 0.127 p= 0.899	z= - 1.109 p= 0.267	z= - 1.465 p= 0.143	z= - 0.651 p= 0.515

Data are presented as mean ± S.D. or median (Range)

t: Independent samples t-test z: Mann Whitney U-test

*: Statistically significant ($p \leq 0.05$)

Table (3): Maternal outcomes to sonographic criteria.

	Maternal outcome				
Sonographic criteria	Massive blood loss (N= 65)	Hysterectomy (N= 14)	ICU admission (N= 10)	Bladder injury (N= 8)	PPH (N= 8)
Site of placenta					
PPCC	46 (70.8%)	13 (92.9%)	8 (80%)	6 (75%)	3 (37.5%)
PPMDA	16(24.6%)	0 (0%)	0 (0%)	0 (0%)	3(37.5%)
PPMDP	2 (3.1%)	1 (7.1%)	2 (20%)	2 (25%)	1 (12.5%)
PPM	1 (1.5%)	0 (0%)	0 (0%)	0 (0%)	1 (12.5%)
Test of significance	MC = 3.865 P=0.569	MC = 7.112 P= 0.242	MC=1.695 P= 0.890	MC=1.210 P= 0.944	**MC= 15.644 P=0.008***
Grades of lacunae					
Grade 0	0	0	0	0	0
Grade 1	12 (18.5%)	1 (7.1%)	0 (0%)	1 (12.5%)	0 (0%)
Grade 2	23 (35.4%)	1 (7.1%)	4 (40%)	2 (25%)	4 (50%)
Grade 3	30 (46.2%)	12 (85.7%)	6 (60%)	5 (62.5%)	4 (50%)
Test of significance	$\chi2$ = 4.636 P=0.098	**MC = 13.694 P<0.001***	MC=3.959 P= 0.138	MC=1.802 P= 0.406	MC= 3.049 P = 0.218
Bridging vessels	49 (75.4%)	12 (85.7%)	8 (80%)	8 (100 %)	6 (75%)
Test of significance	$\chi2$ = 3.329 P=0.068	FET = 2.135 P = 0.144	FET=0.638 P = 0.424	**FET = 3.912 P= 0.048***	FET = 0.152 P = 0.697
Bladder invasion	20 (30.8 %)	7 (50%)	6 (60%)	5 (62.5%)	3 (37.5%)
Test of significance	$\chi2$ = 0.984 P=0.321	**$\chi2$ = 4.161 P = 0.041***	**FET= 5.920 P = 0.015***	**FET= 5.377 P = 0.020***	FET = 0.448 P= 0.503

Data are presented as Numbers and per cent within groups

$\chi2$: Chi-square test MC: Monte-Carlo test FET: Fischer's exact test*: Statistically significant ($p \leq 0.05$)

PPCC: placenta praevia complete centralis

PPMDA: placenta praevia major degree anterior.

PPMDP: placenta praevia major degree posterior.

PPM: placenta praevia marginalis.

Table (4): Univariate and multivariate regression analysis for prediction of massive blood loss (n= 65)

Predictors	Univariate regression			Multivariate regression			
	P value	Odds ratio	95% C.I. for odds ratio		P value	Odds ratio	95% C.I. for odds ratio	
			Lower	Upper			Lower	Upper
Age	**0.846**	1.240	0.823	1.636				
Gravidity	**0.892**	0.320	0.032	3.184				
Parity	0.749	1.174	0.622	1.572				
Abortion	0.746	0.609	0.274	1.357				
Previous CS	0.150	0.329	0.095	1.135				
Lacunae grade 2	**0.014***	1.472	1.355	1.755	0.214	1.23	0.71	1.46
Lacunae grade 2	0.882	0.716	0.128	1.487				
Bridging vessels	**0.048***	1.267	1.073	1.614	0.348	1.245	0.60	1.52
Bladder invasion	0.532	1.254	0.630	1.245				

CI: Confidence interval OR: Odd's ratio

Discussion

Accurate preoperative evaluation of patients with PAS is mandatory to prevent the complications associated with that condition. In this study, we tried to predict the maternal complications related to PAS based on clinical and ultrasonographic findings. We hoped to optimize the delivery environment and explain the risks to the patients during preoperative counselling.

Although the relation between different sonographic sings and placenta accreta are well established, the link between these signs and maternal complications are lacking. Various ultrasonographic signs such as placental lacunae, loss of retroplacental clear zone, myometrial thining, and interruption of bladder myometrial interface were associated with placenta accreta. The lacunae were the most predictive sign of placenta accreta [14,15].

In our study it was found that ultrasonographic signs such as placenta previa complete centralis, increased lacunae grading and bridging vessels were associated with massive intraoperative bleeding with an Odds ratio of 1.47 for lacunae grade 2 and 1.26 for bridging vessels. However, none of them was an independent predictor for massive intraoperative blood loss in regression analysis.Hysterectomy was significantly related to lacunae grading and bladder invasion, while bladder injury was related to bridging vessels and bladder invasion.

We used 2 D ultrasonogrphy in combination with color Doppler. Adding colour Doppler to two D ultrasonography increases the diagnostic accuracy of placenta accreta [7,8]. and adds a great benefit. It can identify the areas with the highest vascularity, which may be taken in consideration when planning appropriate surgery, such as postponing dissection of these highly vascular areas and early stepwise devascularisation of the uterus, thus reducing intraoperative blood loss.

The clinical findings, including age, parity and Number of previous caesarean sections, although they can increase the grade of PAS, were not statistically significantly associated with maternal morbidities.

A scoring system developed by Chong et al. based on various ultrasonographic signs such as lacunae, retro-placental vascularity and loss of the retroplacental clear zone

among other criteria [16]. They discovered that higher scores were associated with massive blood loss and hysterectomy, but the method of calculation of blood loss was not straightforward and the definition of PAS was ambigious.

Hussein et al found that adding added 3D power Doppler to 2D ultrasound and colour Doppler can increase the diagnostic performance and predict the severity of blood loss during planned caesarean hysterectomy for patients with PAS. Numerous coherent vessels involving the serosa– bladder interface" are independent predictors of major blood loss [17]

Our study have some strength points. First, the ultrasonographic examination was done by the same expert team, and the surgical interference was performed by the same surgical team.This could reduce the possibility of bias. second, The diagnosis of placenta accreta was confirmed surgically according to well defined terminology of FIGO classification.

The relatively small sample size is one of the limitations in our study as it was done in a single tertiary centre. The findings were not confirmed by pathological examination but this could be explained by conservative management of most cases. The surgeon was not blind to the result of ultrasound scanning. Still, we believe that being aware of ultrasonographic scanning is better as it allows the surgeon to preoperatively plan the surgical steps, such as delayed dissection of the areas with high vascularity and decreasing intraoperative bleeding.

Conclusion

The combined use of ultrosography and colour Doppler can predict some maternal morbidities during caesarean section for PAS. So, precise preoperative ultrasonographic evaluation of patients with PAS can help the surgeon for proper planning of the surgery and optimizing the circumstances, thus decreasing the maternal complications related to that catastrophic condition.

Conflict of intrest: we declare that we have no conflict of interest

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