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ORIGINAL ARTICLE

Placental and Sub-placental Vascularity and Their Role in Prediction of Intraoperative Hemorrhage in Cases of Placenta Accreta Spectrum Disorders: An Ultrasonographic Study

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ABSTRACT

Background: Intra-operative bleeding during CS due to placenta accreta spectrum (PAS) disorders is a major cause of maternal mortality and morbidity. Moreover, a well-planned cesarean section (CS), presence of expert team and preoperative preparation of blood and blood elements decreases blood loss and, consequently, maternal morbidity and mortality. So, we found it important to predict blood loss during CS for PAS using ultrasound that has high accuracy in visualization of placental and sub-placental vascularity. So we aimed to evaluate the benefit of ultrasound in predicting intraoperative blood loss during planned cesarian sections in cases of PAS.

Methods: This prospective observational study was carried out on 98 pregnant women with placenta previa who had a history of one or repeated CSs and were suspected of having an abnormally invasive placenta in the Obstetrics and Gynecology Department at the Emergency Unit in Zagazig University Hospital. A sonogram was performed, and the amount of blood loss was calculated.

Results: Regarding prediction of major hemorrhage, sub-placental hypervascularity and intra-placental hypervascularity showed the highest sensitivity (91.7%) and negative predictive value (93.8% and 90.9%, respectively). Lacunae at the placental-serosal interface showed the highest specificity (91.9%), positive predictive value (40%), and accuracy (73.5%). On multivariate regression analysis, the presence of more than 4 placental lacunae independently increased the risk of major hemorrhage by 3.7 times, while sub-placental hypervascularity independently increased the risk by 5.3 times.

Conclusions: Color Doppler ultrasound study of placental and sub-placental vascularity can predict major intraoperative hemorrhage in cases of placenta accreta spectrum.

Keywords: Placental vascularity; Intraoperative hemorrhage; Placenta accreta spectrum; Ultrasonographic

INTRODUCTION

The illnesses collectively referred to as "abnormally invasive placenta" (AIP) include placenta accreta, increta, and percreta[1]. "Placenta accreta spectrum" (PAS) diseases were approved by the FIGO consensus guidelines in 2018 to refer to aberrant placental invasion. Placenta increta occurs when the chorionic Placenta percreta happens when it invades the uterine serosa or other structures; adherent placenta accreta (adherenta) happens when it sticks straight to the myometrium, and villi penetrate into the myometrium, such as the bladder. These aberrant placentation abnormalities can cause considerable maternal and neonatal morbidity and death [2].

Placenta accreta has a significant risk of serious vaginal bleeding following birth. In addition to lung failure (adult respiratory distress syndrome) and renal failure, the bleeding may result in disseminated intravascular coagulopathy, a potentially fatal illness that impairs blood clotting [3].

Placenta previa, repeated cesarean births, and other uterine therapies such as endometrial curettage are risk factors for placenta accreta spectrum. A highly skilled multidisciplinary team approach is the cornerstone to confirm antepartum diagnosis and decrease morbidity and death for both the mother and the fetus [4].

Prenatal diagnosis of PAS is important because it can reduce maternal morbidity, according to a joint consensus recommendation from the Society for Maternal-Fetal Medicine (SMFM) and the American College of Obstetricians and Gynecologists (ACOG). Additionally, choosing the right course of treatment depends on the diagnosis of PAS severity [5].

Greyscale and color Doppler are the first-line imaging techniques for detecting abnormally invasive placenta. A highly specialized maternal-fetal medical facility should be consulted for screening when women exhibit worrying sonographic characteristics. 3D capability Research has indicated that Doppler adds value to the detecting process of placenta accreta spectrum illnesses. [6].

Therefore, our goal was to assess the usefulness of ultrasound in anticipating intraoperative blood loss in PAS patients undergoing scheduled cesarean sections. Therefore, our goal was to assess the usefulness of ultrasound in anticipating intraoperative blood loss in PAS patients undergoing scheduled cesarean sections.

METHODS

This prospective observational study was carried out at Zagazig University Hospital's emergency department of obstetrics and gynecology from December 2022 to February 2024.The institutional review board (IRB number 10125-22-11-2022) of Zagazig University's faculty of medicine authorized this study.

Patients were selected from those attending the obstetrics and gynecology department at Zagazig University and fulfilled the criteria for inclusion and exclusion.

The inclusion criteria include singleton pregnancy, history of one or more C.S., suspicion of an abnormally invasive placenta, and gestational age ranging from 28 weeks to term, while the exclusion criteria include the presence of any risk factor for intrapartum hemorrhage, such as multiple gestations, polyhydramnios, hypertensive disorders, major illness history, either current or past, including cardiac disease, chronic hypertension, hepatic, renal, or known coagulopathy, was eliminated from the study, and local uterine causes (e.g., fibroid).

Every patient included in the research was admitted to the hospital and underwent written informed consent, taking a complete medical history and looking over it. In addition to transabdominal and transvaginal ultrasound that were performed for all included patients within one week before delivery using MindrayNuewa I9 using a curved transabdominal transducer (SC6-1s up to 6 MHZ) and a transvaginal transducer (V11-3Hs). Routine obstetrical ultrasound was used to access fetal biometry, amniotic fluid assessment, and placental location.

The ultrasonographic criteria that were used to predict adherence of the placenta to the uterus and its degree (accreta, increta, percreta) and severe intrapartum hemorrhage include retro-placental myometrial thinning (less than 1 mm), deficiency of the retroplacental-sonolucent zone, the presence of more than four placental lacunae (Fig. 1), and the presence of surface lacunae at the placental-serosal interface. (Fig. 2), uterovesical hypervascularization. (Fig. 3), sub-placental hypervascularity. (Fig. 1S), intra-placental hypervascularity. (Fig. 2S), the presence of "chaotic branching" and convoluted vascularity. (Fig. 3S), bridging vessels between bladder serosa and placenta (Fig. 3S), and cervical hypervascularity. (Fig.4S) [7].

Moreover, the investigations include blood group and Rh type, whole blood count, coagulation profile, and testing for kidney and liver function.

The management of each patient includes *counseling* regarding the case's seriousness and the available management options up to the gestational age at which a pregnancy can be terminated. and the potential for entry to an incubator, *preoperative planning* involves keeping enough blood and plasma from the same ABO group in reserve according to patient hemoglobin and severity of the case (2-unit RBCs + 1 FFP in mild cases and 4-unit RBCs + 2 FFP in severe cases), *Surgical technique* in which the senior obstetricians performed all procedures with a senior anesthesiologist and general anesthesia present. Prophylactic antibiotics were given to all patients before midline skin uterine incision at the high upper portion, followed by infant birth, and then we give time for the placenta to detach.

If the placenta detached with slight traction or separated on its own, the doctor performed a cesarean birth.If placenta did not detach. The doctor decided to perform a hysterectomy; cutting the remnant part of cord short, After the hysterotomy incision was closed, the placenta was left in place.

The ureters were seen and identified, the utero-ovarian ligaments were divided while protecting the ovaries, the vesicouterine peritoneum was then gently opened, the bladder was separated from the uterus, and the uterine arteries were then ligated. The round ligament was then divided and ligatured, opening the retroperitoneum widely. Following the division of the major arterial channels, the uterus was further dissected, the cervix and lower uterine segment were gently raised, and the uterus containing the placental mass was severed by suturing the vaginal stump. To confirm hemostasis, the entire pelvis was then examined again. The amount of transfused backed RBCs, fresh frozen plasma (FFP), cryoprecipitate (ml), and duration of surgery (min) were recorded, and *finally, postoperative observation* recording the vital signs (Bl.Pr., pulse, RR, and temperature), urine output (color and volume), filling of drains, bleeding, discomfort following surgery, and general conditions were also monitored in the patients. A complete blood count was done 2 hours postoperatively, and packed RBCs were transfused if needed.

The modified Gross formula was used to determine the actual blood loss (ABL) (ml): According to Gross JB (1983), ABL is equal to BV [Hct (i)) - Hct (f)] / Hct (m); BV is the blood volume determined by body weight (Blood Volume(ml)=Body Weight in Kg x 70). The initial, final, and mean hematocrit values were denoted by the letters Hct (i), Hct (f), and Hct (m), respectively. Two hours after surgery, the final Hct is calculated by subtracting 3% from each infused l unit of packed RBCS.

All participants were then divided into two groups based on the amount of blood lost: one group had minor bleeding (< 2500 ml), and another had major hemorrhage (≥ 2500 ml). [7]

perioperative hemoglobin change (g/dl), The duration of the ICU admission and the length of hospital stay (d) were also noted.

Statistical analysis:

Version 27 of the SPSS (2020) (Statistical Package for the Social Sciences) program was used to analyze the data. When comparing categorical variables, the chi square test and, when necessary, the Fisher exact test was used to characterize the variables according to their absolute frequencies. A chi square for trend test was used to compare ordinal data between two groups. In order to validate assumptions for use in parametric testing, the Kolmogorov-Smirnov test was employed. Depending on the type of data, the means and standard deviations or the median and interquartile range were used to characterize quantitative variables. For normally distributed data, the independent sample t test was employed to compare quantitative data between two groups. The utilization of binary logistic regression facilitated the identification of independent risk variables linked to specific health issues. $P<0.05$ was chosen as the level of statistical significance. There was a highly significant difference if $p\leq0.001$.

RESULTS

This study included 98 patients with a mean age of 30 years (ranged from 21 to 39 years). The mean gestational age at delivery was 36 weeks + 4 days (ranged from 33 to 39 weeks + 4 days). The median parity was 2 (ranged from 0 to 6), and the median number of previous CS was 2 (ranged from 0 to 5). The most frequent ultrasonographic findings in the studied patients were intra-placental hypervascularity, sub-placental hypervascularity, and bridging vessels between the placenta and bladder. The least frequent ultrasonographic finding was lacunae at the placental-serosal interface. (table 1)

Mean initial hemoglobin was 10.51 g/dl, which decreased to 9.33 g/dl after management. The mean initial hematocrit was 32.07%, which decreased to 28% after management. Blood loss ranged from 600 to 6000 ml with a median 1800 ml, and 24.5% of patients had severe bleeding. Ninety-six patients received packed RBC transfusions with a range from 1 to 8 units with a median 3 units. Eighty patients received fresh frozen plasma with a range from 1 to 7 units with a median 2 units. Eighteen patients received Cryo with a range from 2 to 6 units with a median 3 units (table 2).

According to blood loss, 74 patients (75.5%) had minor hemorrhage, and 24 patients (24.5%) had major hemorrhage (Figure 5S). Sixty-eight patients (69.4%) were managed conservatively, while 30 patients (30.6%) underwent hysterectomy (Figure 6S).

As regards maternal outcome, 81.6% of the studied patients had a good outcome, and 38.8% of patients had bladder injury. As regards neonatal outcome, 69.4% of neonates had a good outcome. About 39% of patients had bladder injuries. (Table 1S). The amount of blood loss and the patients' age, gestational age, parity, and number of prior CS have a statistically non-significant relationship (Table 2S). A statistically significant correlation exists between the volume of blood lost and the presence of more than 4 lacunae and sub-placental hypervascularity. (table 3). There is a statistically significant relation between the amount of blood loss and management techniques (major hemorrhage is significantly associated with hysterectomy). (table 3S)

There is a statistically significant relation between amount of blood loss and maternal outcome regarding bladder injury (27% versus 75% of patients with minor and major hemorrhage, respectively, had bladder injury) and ICU admission (10.8% versus 41.7% of patients with minor and major hemorrhage, respectively, needed ICU admission). There is a statistically significant relation between the amount of blood loss and neonatal outcome regarding NICU admission (21.6% versus 50% of neonates of patients with minor and major hemorrhage, respectively, needed NICU admission) (Table 4S).

Sub-placental hypervascularity and intra-placental hypervascularity showed the highest sensitivity (91.7%) and negative predictive value (93.8% and 90.9%, respectively). Lacunae at the placental-serosal interface showed the highest specificity (91.9%), positive predictive value (40%), and accuracy (73.5%). (Table 4). The presence of >4 placental lacunae and sub-placental hypervascularity can significantly independently increase the risk of severe bleeding by about 3.7 and 5.3 folds, respectively. (table 5S)

Table (1): Distribution of the studied patients according to ultrasonographic findings

	No.	%
More than 4 placental lacunae	46	46.9%
Lacunae at placental-serosal interface	10	11.1%
Sub-placental hypervascularity	66	67.3%
Intra-placental hypervascularity	76	77.6%
Uterovesical hypervascularity	26	26.5%
Bridging vessels between placenta and bladder	60	61.2%
Tortious vascularity with ‘chaotic branching.	50	51%
Cervical hypervascularity	24	24.5%

Table (2): Distribution of the studied patients according to the perioperative data

	Mean ± SD	Range
Initial hemoglobin (g/dl)	10.51 ± 1.1	8.2 – 13
Final hemoglobin (g/dl)	9.33 ± 1.36	5.8 – 11.5
Initial hematocrit (%)	32.07 ± 3.46	22.7 – 37.7%
Final hematocrit (%)	28.0 ± 4.02	17.8 – 35.4%
Packed RBCs transfusion (n=96)	3(2 – 4)	1 – 8
FFP transfusion (n=80)	2(1.5 – 4)	1 – 7
Cryoprecipitate transfusion (n=18)	3(2 – 6)	2 – 6
Calculated blood loss (ml)	1800 (1200 – 1500)	600 – 6000

Table (3): Relation between amount of blood loss and ultrasonographic findings in studied patients:

	Minor hemorrhage N=74	Major hemorrhage N=24	χ^2	p
More than 4 placental lacunae				
Absent	46 (62.2%)	6 (25%)	10.049	0.002*
Present	28 (37.8%)	18 (75%)		
Lacunae at placental-serosal interface				
Absent	68 (91.9%)	20 (83.3%)	Fisher	0.254
Present	6 (8.1%)	4 (16.7%)		
Sub-placental hypervascularity				
Absent	30 (40.5%)	2 (8.3%)	8.548	0.003*
Present	44 (59.5%)	22 (91.7%)		
Intra-placental hypervascularity				
Absent	20 (27%)	2 (8.3%)	3.638	0.056
Present	54 (73%)	22 (91.7%)		
Uterovesical hypervascularity				
Absent	58 (78.4%)	14 (58.3%)	3.736	0.053
Present	16 (21.6%)	10 (41.7%)		
Bridging vessels between placenta and bladder				
Absent	32 (43.2%)	6 (25%)	2.541	0.111
Present	42 (56.8%)	18 (75%)		
Tortious vascularity with 'chaotic branching				
Absent	38 (51.4%)	10 (41.7%)	3.638	0.056
Present	36 (48.6%)	14 (58.3%)		
Cervical hypervascularity				
Absent	54 (73%)	18 (75%)	0.038	0.845
Present	20 (27%)	6 (25%)		

χ^2Chi square test *$p<0.05$ is statistically significant **$p\leq0.001$ is statistically highly significant

Table (4): Performance of ultrasonographic findings in prediction of major hemorrhage

	Sensitivity	Specificity	PPV	NPV	Accuracy
More than 4 placental lacunae	75%	62.2%	39.1%	88.5%	65.3%
Lacunae at placental-serosal interface	16.7%	91.9%	40%	77.3%	73.5%
Sub-placental hypervascularity	91.7%	40.5%	33.3%	93.8%	53.1%
Intra-placental hypervascularity	91.7%	27%	28.9%	90.9%	42.9%
Uterovesical hypervascularity	41.7%	78.4%	38.5%	80.6%	69.4%
Bridging vessels between placenta and bladder	75%	43.2%	30%	84.2%	51%
Tortious vascularity with 'chaotic branching	58.3%	51.4%	28%	79.2%	53.1%
Cervical hypervascularity	25%	73%	23.1%	75%	61.2%

PPV positive predictive value NPV negative predictive value

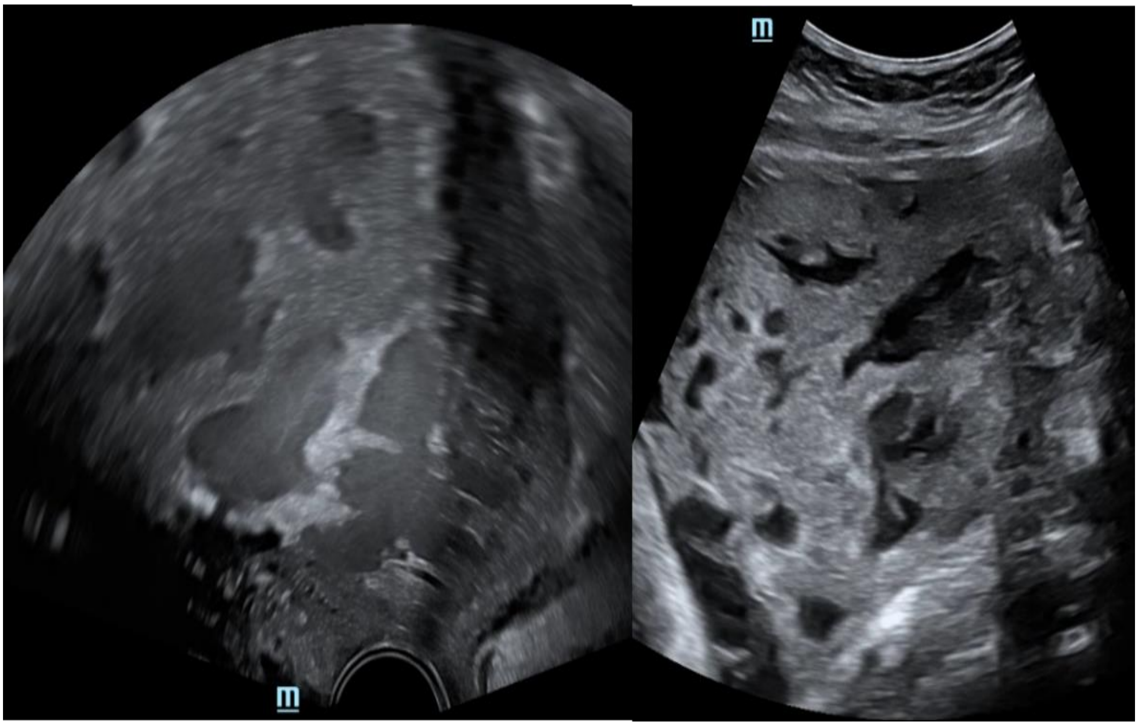

Figure (1): Presence of more than four placental lacunae.

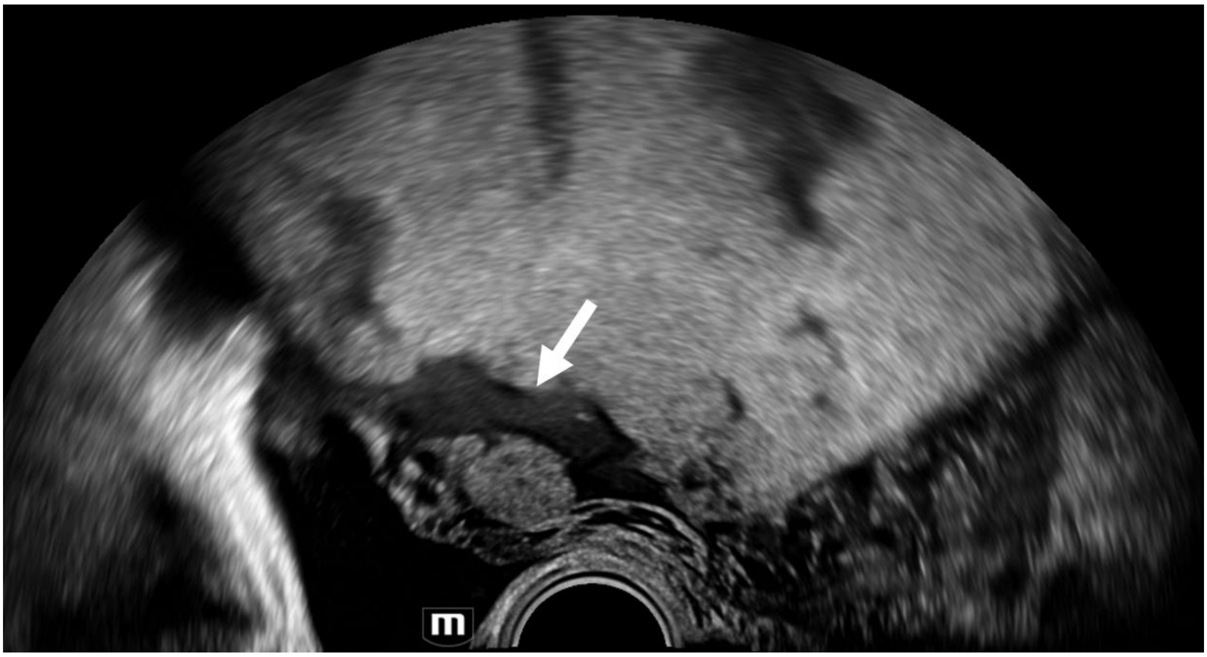

Figure (2): Presence of Surface lacunae at placental-serosal interface

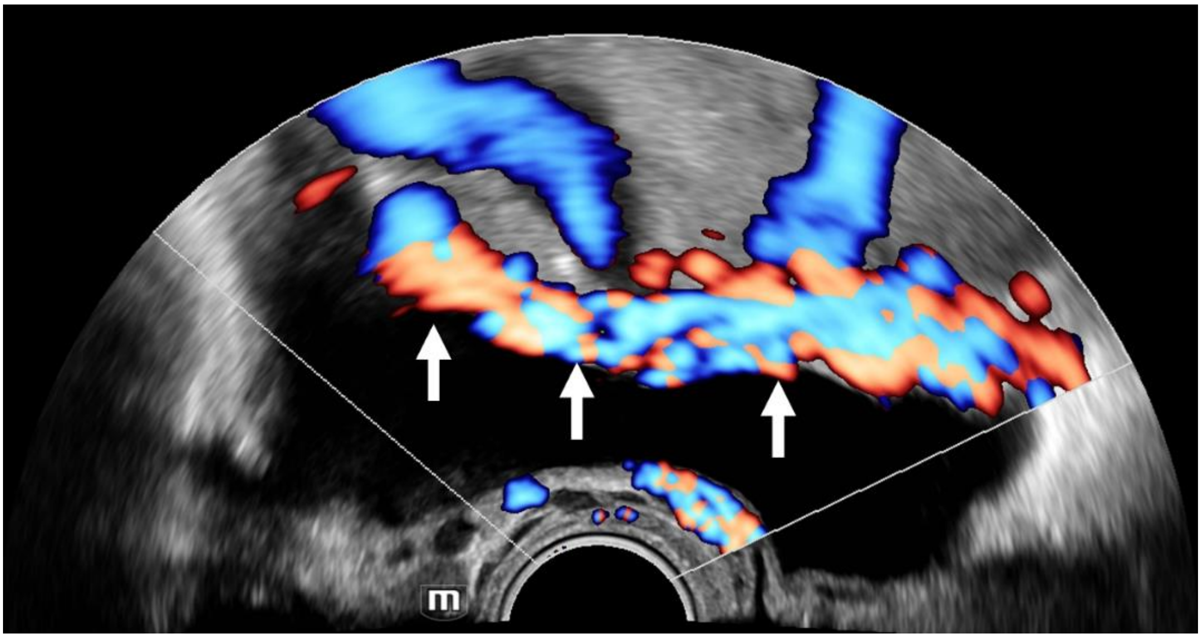

Figure (3): Uterovesical hypervascularization.

DISCUSSION

In our study, the most frequent ultrasonographic findings were intra-placental hypervascularity (77.6%), sub-placental hypervascularity (67.3%), and bridging vessels between placenta and bladder (61.2%).

These outcomes correspond with those of Del Negro et al. [9], who evaluated a novel ultrasonographic grading system for the prediction of PAS and the diagnosis of outcomes for mothers and newborns. They reported that sub-placental hypervascularity was present in a significant proportion of cases across the accreta (57.9%), increta (42.1%), and percreta (100%) groups. Vascularity at the uterus-bladder interface was observed in 50% of increta cases and 100% of percreta cases. On the other hand, the presence of placental lacunae was observed in 100% of all PAS cases. This is due to the inclusion of any number of lacunae, not only those containing more than four in each placenta, as we did in our study.

Of special note, visualization of lacunae at the placental-serosal interface was infrequent (11.1%) in our study.

The median blood loss in our study was 1800 mL and ranged from 600 to 6000 mL. Similar patterns were noted by Rebonato et al. [11] and Schwickert et al. [10]. Someone revealed a blood loss during surgery of 3340 ± 1264 mL and a mean blood loss of 2000 ml in PAS patients, respectively. Furthermore, Sumigama et al. [12] observed that up to 8600 mL of blood can be lost on average during emergency surgery in patients with placenta increta/percreta. According to Hawthorn et al. [13] and Schwickert et al. [10], PAS can cause a hemorrhage that is potentially deadly, resulting in significant blood loss ranging from 2000 to 7800 mL recorded as the median blood loss. This constancy emphasizes how important it is for PAS operations to use careful blood management techniques. There have been instances of documented blood loss after cesarean hysterectomy with values as high as 10 L, yet the typical reported blood loss for such cases is between 2000 and 5000 ml. [14].

Although placenta accreta is a significant risk factor for significant bleeding during surgery and hysterectomy, minor intraoperative hemorrhage (75.5%) and conservative management (69.4%) were the cases in the majority of patients included in our study..

However, Hussein et al. [2] reported a higher percentage of major hemorrhage (44.1%) despite using the same cutoff for amount of intraoperative blood loss (bleeding volume ≥2500 ml). Similarly, Wang et al. [15] discovered that severe bleeding was present in 40.7% of patients. However, they used a lower cutoff for major hemorrhage (bleeding volume ≥ 2000 mL).

Moreover, regarding maternal outcomes in our study, 38.8% experienced bladder injury during the cesarean delivery. The majority of our cases (81.6%) had an otherwise sound postoperative course, and only 18.4% required admission to the intensive care unit.

Wang et al. [15] revealed that bladder damage accounted for 15.2% of all intraoperative complications in PAS cases, Eller et al. [16] described an overall maternal morbidity of 59% after hysterectomy. These results in our study are mostly due to the long-standing strict protocols and experienced surgeons available in our tertiary hospital that allow best management of patients with PAS disorders.

In the current study, there was a statistically significant relation between major hemorrhage and the presence of more than 4 placental lacunae (p=0.002) and sub-placental hypervascularity (p=0.003) on ultrasound examination (Table 5). Moreover, on multivariate regression analysis, the presence of more than 4 placental lacunae independently increased the risk of major hemorrhage by 3.7 times, while sub-placental hypervascularity independently increased the risk by 5.3 times.

Of special note, although it didn't reach the level of statistical significance, intraplacentalhypervascularity (p = 0.056), uterovesical hypervascularity (p = 0.053), and tortious vascularity with 'chaotic branching (0.056) was very close to the level of significance regarding the relation to the amount of intraoperative blood loss.

In line with our findings, Hussein et al. [2]

proved that severe blood loss was associated with "number of lacunae > 4′," "sub-placental hypervascularity," "tortuous vascularity with chaotic branching," and "presence of bridging vessels." The odds of catastrophic obstetric hemorrhage were significantly higher, ranging from 2.9 to up to 10 times the risk.

Furthermore, El-Sayed et al. [17] found that the presence of placental lacunae differed significantly (p-value=0.001) between the two groups, vessels bridging, and flow in lacunae.

Wang et al. [15] discovered that there was a strong association (P < 0.05) between hemorrhage in PAS and the bridging vessels located in the sub-placental vascularity zone. Additionally, they discovered that a cervical sinus and the bridging arteries in the sub-placental vascular area were separate risk factors for significant bleeding in PAS.

In the current study, regarding prediction of major hemorrhage, Sub-placental hypervascularity and Intra-placental hypervascularity showed the highest sensitivity (91.7%) and negative predictive value (93.8% and 90.9% respectively). Lacunae at placental-serosal interface showed the highest specificity (91.9%), positive predictive value (40%) and accuracy (73.5%).

The majority of ultrasonography investigations conducted today focus primarily on PAS diagnosis. Studies on the prognostic value of several ultrasonography rating scales for hysterectomy and intraoperative blood loss are scarce. Greyscale and colored Doppler indications indicating PAS are used as scoring scales. The likelihood of intraoperative bleeding and hysterectomy increases with increasing score. However, clinical practice has also shown that, even when intraoperative blood loss may not be appreciably more even though the degree of PAS in the imaging assessment is higher; in fact, there may occasionally be greater intraoperative blood loss variances amongst various PAS instances with the same overall score [15].

A statistically significant relationship (p<0.001) was found in our study between the amount of blood loss and management strategies. Significantly more major bleeding occurred in hysterectomy instances. Additionally, a statistically significant correlation (P<0.00) was found between the mother's bladder damage and the amount of blood spilled. (Tables 6 and 7)

Accordingly, Wang et al. [15] demonstrated that patients in the massive hemorrhage group (MHG) had a hysterectomy rate of 44.1%, which was noticeably greater compared to the 2.0% hysterectomy rate in the non-massive hemorrhage group (NMHG) group.

The fundamental issue faced by obstetricians is reducing intraoperative bleeding while maintaining the uterus. One of the primary surgical procedures for PAS, particularly for percreta, is hysterectomy. In most cases, it is indicated in severe uncontrollable intraoperative bleeding, as it can control hemorrhage and reduce complications. This may explain the association between major intraoperative hemorrhage and hysterectomy.

On the other hand, bladder injury mostly occurs during dissection of the bladder from the uterus due to excess adhesions. This dissection is almost always associated with bleeding. This may explain the association between major intraoperative hemorrhage and bladder injury.

According to our research, there was no statistically significant relationship observed between the age, gestational age, and parity of the patients, or the number of prior CS procedures and the volume of blood loss.

Zhou et al. [18] did not find a significant difference regarding parities. However, some previous studies have found an association between blood loss and high parity and prior cesareans [15, 19, 20].

Moreover, El-Sayed et al. [17] found a significant difference between major and minor groups regarding the mean patient's age (p= 0.005), the median number of parities (p= 0.007) with the quantity of prior CS (p= 0.001). Nonetheless, there was no discernible difference in the mean gestational age between the two groups (p-value= 0.6).

Conclusions:

Color Doppler ultrasound study of placental and sub-placental vascularity can predict major intraoperative hemorrhage in cases of placenta accreta spectrum. This allows for good CS planning by the presence of expert team and preoperative preparation of blood and blood elements to decreases blood loss and, consequently, maternal morbidity and mortality.

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Conflict of interest: None.

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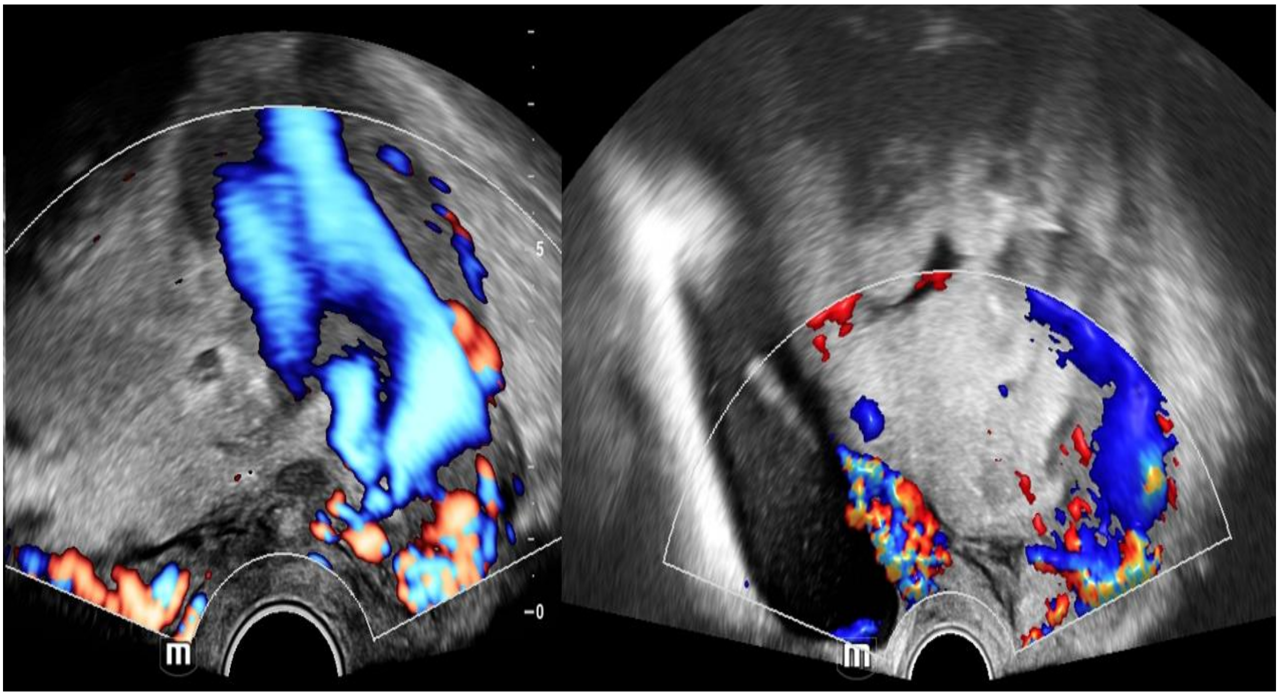

Figure (1 S): Sub-placental Hypervascularity

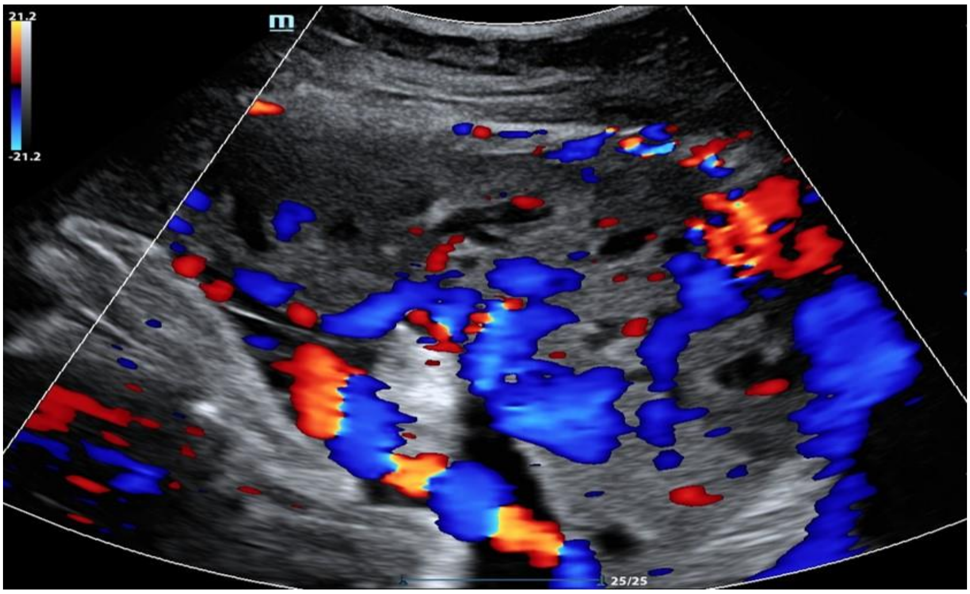

Figure (2S): Intra-placental hypervascularity.

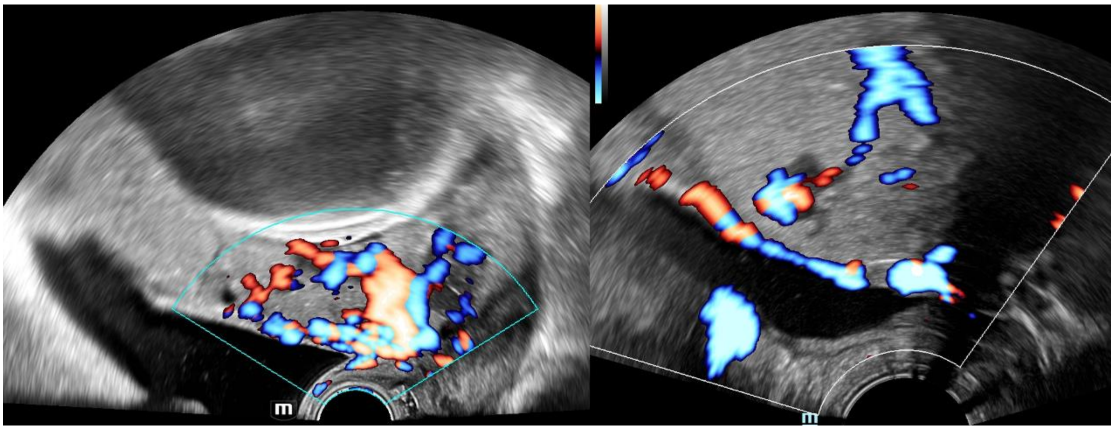

Figure (3S): Presence of tortuous vascularity with 'chaotic branching and bridging vessels between placenta and bladder serosa.

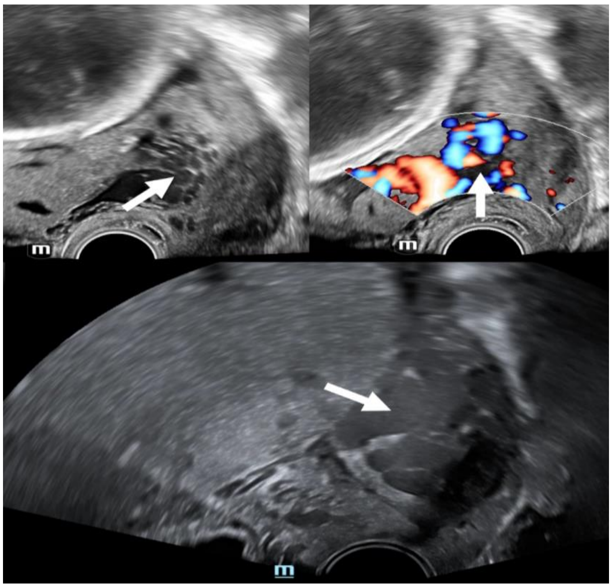

Figure (4S): Cervical hypervascularity.

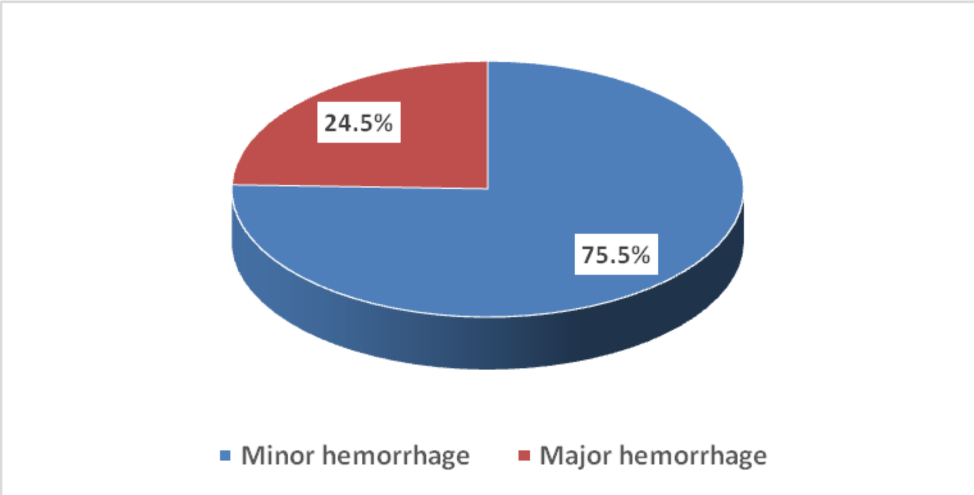

Figure (5S): Pie chart showing distribution of the studied patients according to blood loss

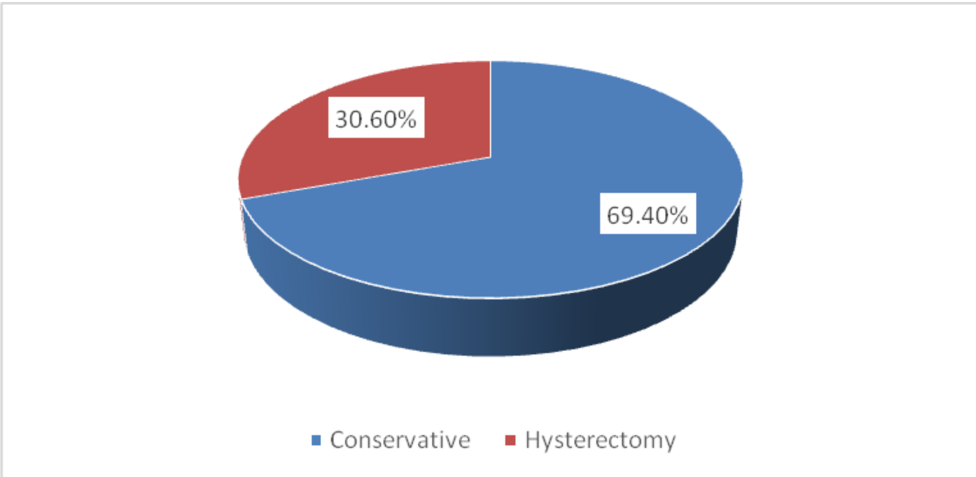

Figure (6S): Pie chart showing distribution of patients according to management techniques.

Table (1S): Distribution of the studied patients according to outcome

	No. (98)	%
Maternal outcome		
Bladder injury	38	38.8%
Sound postoperative course	80	81.6%
ICU admission	18	18.4%
Neonatal outcome		
Neonatal Death	2	2%
NICU admission	28	28.6%
Good	68	69.4%

Table (2S): Relation between amount of blood loss and baseline data of studied patients

	Minor hemorrhage N=74	Major hemorrhage N=24	t	p
	Mean ± SD	Mean ± SD		
Age (year)	29.81 ± 4.56	29.92 ± 4.38	-0.1	0.921
Gestational age (week)	36.63 ± 1.16	36.16 ± 1.31	1.67	0.098
Parity	2(1 – 3)	3(2 – 3)	1.231	0.218
Number of previous CS	2(1 – 3)	2.5(2 – 3)	1.631	0.103

Z Mann Whitney test t independent sample t test IQR interquartile range

Table (3S): Relation between amount of blood loss and management of studied patients

	Minor hemorrhage N=74	Major hemorrhage N=24	χ^2	p
Management **Conservative** **Hysterectomy**	 58 (78.4%) 16 (21.6%)	 10 (41.7%) 14 (58.3%)	11.499	0.001**

**p≤0.001 is statistically highly significant, χ^2 Chi square test

Table (4S): Relation between amount of blood loss and maternal and fetal outcome of studied patients

	Minor hemorrhage N=74	Major hemorrhage N=24	χ^2	p
Maternal outcome				
Bladder injury **Absent** **Present**	 54 (73%) 20 (27%)	 6 (25%) 18 (75%)	17.568	<0.001**
Sound postoperative course **ICU admission**	66 (89.2%) 8 (10.8%)	14 (58.3%) 10 (41.7%)	11.508	0.001**
Neonatal outcome				
Neonatal death **NICU admission** **Good**	0 (0%) 16 (21.6%) 58 (78.4%)	2 (8.3%) 12 (50%) 10 (41.7%)	21.032	<0.001**

**p≤0.001 is statistically highly significant, χ^2 Chi square test

Table (5S): Multivariate regression analysis to detect ultrasonographic findings to predict major hemorrhage.

	β	p	AOR	95% C.I.	
				Lower	Upper
More than 4 placental lacunae	1.298	0.018*	3.660	1.250	10.717
Sub-placental hypervascularity	1.674	0.035*	5.334	1.121	25.378

AOR adjusted odds ratio, CI Confidence interval, *p<0.05 is statistically significant

Citation:

Elmaasrawy, A., Elsayed, N., Ahmad, R., Nabil, R., Ibrahim, S., Sadek, S. Placental and sub placental vascularities and their role in prediction of intra-operative haemorrhage in cases of placenta accreta spectrum disorders: An ultrasonographic study.. *Zagazig University Medical Journal*, 2024; (4407-4422): -. doi: 10.21608/zumj.2024.310425.3506