Print ISSN 1110-208X.
Online ISSN 2357-0016

The Role of 2D Ultrasound & Colour Doppler in Prediction of Intra-Operative Blood Loss in Placenta Accreta Spectrum Disorders

Ahmed K. Abbas, Ahmed W. Murad, Tamer M. Assar,
Hadeel M. El-Gabrouny, Ehab E. Marzouk

Obstetrics and Gynecology Department, Faculty of Medicine Benha University, Egypt.

Corresponding to:
Dr. Hadeel M. El-Gabrouny.
Obstetrics and Gynecology Department, Faculty of Medicine Benha University, Egypt.
Email: dr.hadeel.90@gmail.com

Received:
Accepted:

Abstract:

Background: Placenta accreta spectrum (PAS) is a serious life-threatening obstetric disorder that refers to an abnormal placental attachment caused by the invasion of placental villi into the myometrium. This study aimed to evaluate the role of two-dimensional (2D) ultrasound signs and Doppler in the prediction of major intraoperative blood loss during cesarean section for cases diagnosed with PAS. **Methods:** This prospective cohort study included 50 patients diagnosed with PAS. All studied cases were subjected to detailed history taking, clinical examination, abdominal examination, and ultrasound examination. **Results:** Intraoperative blood loss was significantly higher in participants with surface lacunae, bridging vessels, sub placental hyper vasculature, and intra placental hyper vasculature compared to participants without. The number of placental lacunae, presence of surface lacunae, absence of clear zone, length of utero vesical vasculature, presence of bridging vessels, presence of sub placental hyper vasculature, and retro placental myometrial thickness are significant predictors of intraoperative bleeding. **Conclusion:** our study has underscored the significant role of two-dimensional ultrasound and Doppler imaging in predicting intraoperative blood loss in patients with Placenta Accreta Spectrum (PAS) disorders during cesarean sections. It highlights specific ultrasound markers such as surface lacunae, bridging vessels, subplacental hypervascularity, and the number of placental lacunae as crucial predictors of increased blood loss.
Keywords: 2D Ultrasound; Col our Doppler; Placenta Accreta Spectrum.

Introduction

Placenta accreta spectrum (PAS) is a serious life-threatening obstetric disorder that refers to an abnormal placental attachment caused by the invasion of placental villi into the myometrium [(1)].

The term 'placenta accreta' has been used to describe a single pathologic entity, as well as a generic term for the disease spectrum. Used singly, a placenta accreta (vera) occurs if the placenta attaches to, but does not invade into, myometrium. If the placenta invades into the myometrium, but not beyond, the placenta is described as a placenta increta. When the placenta invades through the serosal layer and potentially beyond, the term placenta percreta is employed [(2)].

The incidence of placenta accreta spectrum has increased in recent years, driven by increasing rates of cesarean delivery. Prenatal detection of placenta accreta spectrum is primarily made by ultrasound and is important to reduce maternal morbidity associated with the condition [(3)].

Placenta accreta spectrum (PAS) is a leading contributor to major obstetric hemorrhage and severe maternal morbidity in the developed world. In the United States, PAS has become the most common cause of peripartum hysterectomy. Over the last 40 years, clinicians have also witnessed a dramatic increase in the incidence of PAS. In the 1950s, the incidence of PAS was reported to be 0.03 per 1000 pregnancies. Recently the PAS incidence is 3.11 in 1000 pregnancies [(4)].

Irving and Hertig are credited for having published, in 1937, the first cohort study of placenta accreta in international literature. Their article included comprehensive clinical and histopathologic descriptions of 20 cases, and a literature review of 86 cases published before 1935. All these cases were described as "adherent", which the authors characterized clinically as a placenta adherent to the uterine wall without easy separation and/or bleeding from the placental bed, and histologically as absence of decidual layer/Nitabuch layer between the placenta and myometrium [(5)].

Sonography with grayscale and color Doppler imaging is the recommended first-line modality for diagnosing morbidly adherent placenta [(6)].

PAS is associated with high maternal morbidity resulting from severe life-threatening hemorrhage, which requires blood transfusion and additional surgical interventions including hysterectomy at the time of delivery or during the postpartum period. PAS is associated with prolonged hospital stay and more ICU admissions [(7)].

The average blood loss of those patients with placenta increta/percreta >3500 ml was less common in patients undergoing successful conservative management (placenta left in situ) [(8)].

While reported blood loss during cesarean hysterectomy for such cases has an average between 2000 and 5000 ml [(9)].

The purpose of this study was to evaluate the role of two-dimensional (2D) ultrasound signs and Doppler in the prediction of major intraoperative blood loss during cesarean section for cases diagnosed with PAS.

Patients and methods

This prospective cohort study included 50 patients diagnosed with PAS and was conducted in the Obstetrics and Gynecology Department of Benha University Hospitals from January 2023 to December 2023.

Informed consent was obtained from the study participants before participation in the research. Approval of Obstetrics and Gynecology Department and Ethics Committee in the Faculty of Medicine, Benha University was taken before preceding the study (MS 31_1_2023).

Inclusion criteria were patients ≥18 years old, confirmed diagnosis of PAS, based on ultrasound markers, presented with Placenta previa major degree anterior, and with previous one or more cesarean section.

Exclusion criteria were women with moderate to severe anemia, medical disorders, such as coagulopathies and spontaneous placental separation.

All studied cases were subjected to the following: Detailed history taking, including Age, gravidity, parity, gestational age, the nature of previous cesarean sections or uterine surgeries and history of hematuria or vaginal bleeding.

Clinical examination: General examination including Vital signs, Blood pressure, Temperature, pulse rate and BMI. **Abdominal Examination** including Leopold's maneuvers, presence of previous scars and any abdominal tenderness.

Ultrasound examination: Placental ultrasound and Doppler was done at 32-36 weeks of gestation by volson P8 ultrasound machine at Benha University Hospital. Abdominal ultrasound with partially filled bladder, then empty bladder was conducted for detection of placental site. Then transvaginal ultrasound and Doppler were done after counseling the patient and setting her approval.

All findings during abdominal ultrasound, vaginal ultrasound and Doppler were recorded in special files. Some enrolled participants were operated upon in a scheduled elective setting no later than 36+6 weeks of gestation after receiving a course of antenatal corticosteroids, others had urgent caesarian section due to active vaginal bleeding or fetal distress.

Outcomes:

The primary outcome was correlation between the amount of intraoperative blood loss during Cesarean section and recorded ultrasound and Doppler finding of the patient during antenatal care follow up.

Secondary outcomes were :Operative time in minutes was measured from skin incision to skin closure in relation to ultrasound and Doppler findings, number of units of packed RBC and fresh blood transfused in relation to ultrasound and Doppler findings, and intra-operative complications, such as bladder, ureteric, bowel injury, or hysterectomy during surgery.

Statistical analysis

The collected data underwent revision, coding, and tabulation using the IBM SPSS Statistics software (Version 2٧.0, IBM Corp., Released 2019@Chicago). Categorical data were presented as number and percentage and analyzed by qui-square test or Fischer's test accordingly. Continuous variables were assessed for normality by Kolmograv Smirov test and were analyzed by suitable statistical test of significance. P value <0.05 will be considered significant.

Results

Table 1 shows baseline characteristics and obstetric data of the study participants.

Table 2 shows that gravidity in the study participants ranged from 2 to 7 with a median value of 4 (3 – 4), the parity ranged from 1 to 6 with a median value of 3 (2 – 3). The number of previous CS ranged from 1 to 5 with a mean value of 2.3 ± 1.1.

Intraoperative blood loss was significantly higher in participants with surface lacunae, bridging vessels, sub placental hyper vasculature, and intra placental hyper vasculature compared to participants without. Intraoperative blood loss was significantly lower in participants with clear zone compared to participants without. There was no significant difference in intraoperative blood loss between participants with tortuous vascularity and those without. **Table 3**

The number of placental lacunae, presence of surface lacunae, absence of clear zone, length of utero vesical vasculature, presence of bridging vessels, presence of sub placental hyper vasculature, and retro placental myometrial thickness are significant predictors of intraoperative bleeding.

With every unit increase in the number of placental lacunae, there would be a 179 cc increase in intraoperative bleeding,

presence of surface lacunae is associated with a 589 cc increase in intraoperative bleeding, absence of clear zone is associated with a 489 cc increase in intraoperative bleeding, every 1 cm increase in the length of utero vesical vasculature is associated with a 125 cc increase in intraoperative bleeding, presence of bridging vessels is associated with a 504 cc increase in intraoperative bleeding, presence of sub placental hyper vasculature is associated with a 561 cc increase in intraoperative bleeding, and every 1 mm increase in retro placental myometrial thickness is associated with a 133 decrease in intraoperative bleeding. **Table 4**

Table 1: Baseline characteristics and obstetric data of the study participants

	Study participants (n =50)
Age (year)	31.2 ± 4.7
Weight (kg)	81.2 ± 9.4
Obstetric data	
Gravidity	3.5 ± 1.1
Parity	2.6 ± 1.2
Number of previous CS	2.3 ± 1.1

Data are represented as Mean ± SD, CS: Cesarean section.

Table 2: Obstetric data of the study participants

		Study participants (n =50)
Gravidity	**Median (IQR)**	4 (3 – 4)
	Range	2 – 7
Parity	**Median (IQR)**	3 (2 – 3)
	Range	1 - 6
Number of previous CS	**Mean ± SD**	2.3 ± 1.1
	Range	1 - 5

IQR: Interquartile range, SD: Standard deviation, CS: Cesarean section.

Table 3: Relationship between ultrasound findings and intraoperative blood loss in the study participants

		Intraoperative blood loss (cc)	**P value**
Surface lacunae	**Yes**	1325 ± 640.2	**<0.001***
	No	735.4 ± 216.4	
Clear zone	**Yes**	787.5 ± 269.6	**0.001***
	No	1276.9 ± 663.4	
Tortuous vascularity	**Yes**	1139.6 ± 598.5	0.136
	No	951.9 ± 528.5	
Bridging vessels	**Yes**	1294 ± 664.2	**0.002***
	No	790 ± 281.4	
Sub placental hyper vasculature	**Yes**	1277.6 ± 616.5	**<0.001***
	No	716.7 ± 243.6	
Intraplacental hyper vasculature	**Yes**	1147.8 ± 501.5	**0.031***
	No	951.9 ± 609.3	

*Statistically significant as p value <0.05.

Table 4: Linear regression analysis of the ability of ultrasound findings to predict intraoperative bleeding.

	Unstandardized Coefficients B (95% CI)	P value
Number of placental lacunae	179.7 (101 – 258)	**<0.001***
Surface lacunae	589 (313 - 866)	**<0.001***
Without clear zone	489 (197 - 782)	**0.001***
Tortuous vascularity	187 (-133 – 508)	0.245
Length of utero vesical vasculature	125 (71 – 180)	**<0.001***
Bridging vessels	504 (214 – 794)	**0.001***
Sub placental hyper vasculature	561 (275 – 847)	**<0.001***
Intraplacental hyper vasculature	196 (-125 – 517)	0.226
Cervical length	-194 (-473 – 85)	0.168
Retro placental myometrial thickness	-133 (-208 - -58)	**<0.001***

*Statistically significant as p value <0.05.

Discussion

In the present study, age of the study participants ranged from 23 to 41 years with a mean value of 31.2 ± 4.7 years. The weight of the study participants ranged from 64 to 102 kg with a mean value of 81.2 ± 9.4 kg.

Similar to our study results, Hussein et al. performed a study to assess the value of various grey-scale ultrasound, 2D color Doppler, and 3D power Doppler sonographic markers in predicting major intraoperative blood loss during planned cesarean hysterectomy for cases diagnosed with placenta accreta spectrum (PAS) disorders and included 50 women who were diagnosed with PAS were scanned the day before planned delivery and hysterectomy for various sonographic markers indicative of placental invasion and revealed that mean age of the studied patients was 32.15 ± 3.84 [(9)].

In a very close proximity to our results, included 59 patients with PAS in his study and found that mean age of the participated groups was 32.3±4.2 years and the mean gestational age was 34.9±1.9 weeks [(10)].

In the present study, gravidity in the study participants ranged from 2 to 7 with a mean value of 3.5 ± 1.1, the parity ranged from 1 to 6 with a mean value of 2.6 ± 1.2. The number of previous CS ranged from 1 to 5 with a mean value of 2.3 ± 1.1.

Parallel to our study results, El-Sayed et al. found that the mean gravity and number of CS of the studied participants were 5.07±1.8 and 3.3±1.1, respectively [(10)].

The increasing number of CS deliveries across the world is highly incriminated against by the progressively increasing incidence of placental adherence. Women with three or more uterine CS scar were more than 10 times at higher risk of PAS than women with single uterine scar, which indicates the increased risk of PAS as the number of CS scar increases [(11)].

In the present study, the operation time ranged from 30 to 153 mins with a mean value of 72.6 ± 32.6 mins. Intra operative blood loss ranged from 500 to 2800 cc with a mean value of 1042 ± 565.4 cc. Regarding the operation complications, 10 (20%) participants had bladder injury, 10 (20%) participants had hysterectomy, and 13 (26%) participants had focal myometrial resection. None of the study participants had bowel injuries. Twenty-two (44%) participants needed blood transfusion. The number of units of blood received ranged from 1 to 6 units with a median value of 2 (1 – 3) units.

In the study by Cali et al. that aimed to develop a prenatal ultrasound staging system for placenta accreta spectrum (PAS) disorders in women and included 259 patients found that the mean operative time was 104.6 ± 60.5 min [(12)].

Similarly, El-Sayed et al. found that mean procedure time, blood loss and blood transfusion were 60.9±23.7, 1321.2±501.1 and 1260.6±647.4, respectively [10].

This also comes in agreement with Hussien et al. where the mean amount of blood transfusion was 2.68 ± 1.88 [9]. This similarity in the findings may be attributed that both studies have been conducted in Egypt, making it more applicable to have a similar population and available facilities. This similarity in the findings may be explained by the fact that placenta accrete patients tend to have an urgent need for blood transfusion due to massive blood loss.

There was a significant positive correlation between intra operative blood loss and number of placental lacunae (r=0.540, p <0.001) and length of utero vesical vasculature (r =0.513, p<0.001). There was a significant negative correlation between intra operative blood loss and retro placental myometrial thickness (r =-0.444, p =0.001). In contrast with Hussein et al., 2020, He did not find significant correlation between myometrial thickness and amount of blood loss. There was insignificant negative correlation between intra operative blood loss and cervical length [9].

The correlation observed with retroplacental myometrial thickness indicates that thinner myometrial layers are associated with greater blood loss, due to less tissue resistance against invasive placental growth, leading to deeper placental embedding and challenging surgical management. Cervical length, although studied, does not show a significant correlation with intraoperative blood loss, suggesting it may not be a direct indicator of placental invasion depth or vascular complexity in PAS [13].

Conclusion

Our study has underscored the significant role of two-dimensional ultrasound and Doppler imaging in predicting intraoperative blood loss in patients with Placenta Accreta Spectrum (PAS) disorders during cesarean sections. It highlights specific ultrasound markers such as surface lacunae, bridging vessels, subplacental hypervascularity, and the number of placental lacunae as crucial predictors of increased blood loss. Additionally, the inverse relationship between retroplacental myometrial thickness and blood loss suggests its potential as a protective marker. These findings advocate for the incorporation of these ultrasound features into routine preoperative assessments to enhance the management and outcome of PAS cases, emphasizing the need for detailed and targeted ultrasound evaluations in the clinical setting.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Author contribution

Authors contributed equally to the study**.**

Conflicts of interest

No conflicts of interest

References

1. Wang P, Zhou Y, Zhao Y, Zhao W, Wang H, Li J, et al. Prenatal fine particulate matter exposure associated with placental small extracellular vesicle derived microRNA and child neurodevelopmental delays. Science of The Total Environment. 2022;841:156747.

2. Silver RM, Barbour KD. Placenta accreta spectrum: accreta, increta, and percreta. Obstet Gynecol Clin North Am. 2015;42:381-402.

3. Shainker SA, Coleman B, Timor-Tritsch IE, Bhide A, Bromley B, Cahill AG, et al. Special Report of the Society for Maternal-Fetal Medicine Placenta Accreta Spectrum Ultrasound Marker Task Force: Consensus on definition of markers and approach to the ultrasound examination in pregnancies at risk for placenta accreta spectrum. Am J Obstet Gynecol. 2021;224:B2-b14.

4. Einerson BD, Weiniger CF. Placenta accreta spectrum disorder: updates on anesthetic and surgical management strategies. Int J Obstet Anesth. 2021;46:102975.

5. Jauniaux E, Hussein AM, Fox KA, Collins SL. New evidence-based diagnostic and management strategies for placenta accreta spectrum disorders. Best Pract Res Clin Obstet Gynaecol. 2019;61:75-88.

6. Rac MW, Dashe JS, Wells CE, Moschos E, McIntire DD, Twickler DM. Ultrasound predictors of placental invasion: the Placenta Accreta Index. Am J Obstet Gynecol. 2015;212:343.e1-7.
7. Maged AM, El-Mazny A, Kamal N, Mahmoud SI, Fouad M, El-Nassery N, et al. Diagnostic accuracy of ultrasound in the diagnosis of Placenta accreta spectrum: systematic review and meta-analysis. BMC Pregnancy Childbirth. 2023;23:354.
8. Schwickert A, van Beekhuizen HJ, Bertholdt C, Fox KA, Kayem G, Morel O, et al. Association of peripartum management and high maternal blood loss at cesarean delivery for placenta accreta spectrum (PAS): A multinational database study. Acta Obstet Gynecol Scand. 2021;100 Suppl 1:29-40.
9. Hussein AM, Momtaz M, Elsheikhah A, Abdelbar A, Kamel A. The role of ultrasound in prediction of intra-operative blood loss in cases of placenta accreta spectrum disorders. Arch Gynecol Obstet. 2020;302:1143-50.
10. El-Sayed M, Midan MF, Elrehim A, Ibrahim E. The Role of Ultrasound in Prediction of Intraoperative Blood Loss in Cases of Placenta Accreta Spectrum Disorders. International Journal of Medical Arts. 2023;5:3039-44.
11. Eshkoli T, Weintraub AY, Sergienko R, Sheiner E. Placenta accreta: risk factors, perinatal outcomes, and consequences for subsequent births. Am J Obstet Gynecol. 2013;208:219.e1-7.
12. Cali G, Forlani F, Lees C, Timor-Tritsch I, Palacios-Jaraquemada J, Dall'Asta A, et al. Prenatal ultrasound staging system for placenta accreta spectrum disorders. Ultrasound Obstet Gynecol. 2019;53:752-60.
13. Chen X, Ming Y, Xu H, Xin Y, Yang L, Liu Z, et al. Assessment of postpartum haemorrhage for placenta accreta: Is measurement of myometrium thickness and dark intraplacental bands using MRI helpful? BMC Med Imaging. 2022;22:179.

To cite this article: Ahmed K. Abbas , Ahmed W. Murad, Tamer M. Assar, Hadeel M. El-Gabrouny, Ehab E. Marzouk. The Role of 2D Ultrasound & Colour Doppler in Prediction of Intra-Operative Blood Loss in Placenta Accreta Spectrum Disorders. BMFJ XXX, DOI: 10.21608/bmfj.2025.289080.2079.