



Diagnostic Value of Doppler Ultrasonography in the Diagnosis of Morbidly Adherent Placenta

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ABSTRACT

Aims Morbidly adherent placenta/Placenta accreta syndrome refers to morbid implantation, invasion, and/or adhesion of a placenta, whose incidence rate has increased due to the growing trend of cesarean section. Diagnosing placenta accreta before delivery plays a crucial role in reducing morbidity and mortality of the mother and fetus. This study aimed at evaluating the diagnostic value of the Doppler ultrasonography in diagnosis of morbidly adherent placenta.

Instruments and Methods In this descriptive-analytical study, 150 singleton pregnant women with gestational age of ≥ 24 weeks with a history of uterine incision (C/S, myomectomy, or metroplasty), underwent a Doppler ultrasonography to detect the position of placenta and evidence for adherent placenta. The data were analyzed by SPSS 21 software.

Findings Twelve patients underwent the cesarean-hysterectomy during their cesarean sections due to severe bleeding and morbidly adherent placenta. In terms of pathologic findings, placenta accreta, placenta increta, and placenta percreta were reported in 7 cases, 3 cases, and 1 case, respectively. The Doppler ultrasonography had a sensitivity of 91.67%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 99.28% in the diagnosis of morbidly adherent placenta.

Conclusion The thinning or absence of the retroplacental myometrial thickness and the large retroplacental lacunae are the most powerful ultrasonographic markers in the diagnosis of the placenta accreta such that the negativity of these markers can be interpreted as the absence of placenta accreta and the positivity of them can be interpreted as the presence of the placenta accreta.

Keywords Placenta Adherent; Caesarian Section; Postpartum Hemorrhage; Maternal Mortality; Doppler Ultrasonography

CITATION LINKS

[1] Williams obstetrics 24/e [2] Morbidly adherent placenta (MAP): Lessons learnt [3] Evaluation of sonographic diagnostic criteria for placenta accreta [4] Placenta accrete [5] The value of ultrasound and magnetic resonance imaging in diagnostics and prediction of morbidity in cases of placenta previa with abnormal placentation [6] Placenta accreta: Risk factors, perinatal outcomes, and consequences for subsequent births [7] Color flow mapping for myometrial invasion in women with a prior cesarean delivery [8] Morbidly adherent placenta: Evaluation of ultrasound diagnostic criteria and differentiation of placenta accreta from percreta [9] The value of specific MRI features in the evaluation of suspected placental invasion [10] Prenatal diagnosis of placenta accrete: Sonography or magnetic resonance imaging? [11] Accuracy of three-dimensional multislice view Doppler in diagnosis of morbid adherent placenta [12] 108: 3D ultrasound: The best view of placenta accreta [13] Accuracy of ultrasonography and magnetic resonance imaging in the diagnosis of placenta accreta [14] The importance of a late first trimester placental sonogram in patients at risk of abnormal placentation [15] Placenta accreta: Spectrum of US and MR imaging findings [16] The sonographic appearance and obstetric management of placenta accreta [17] Placenta previa, placenta accreta, and vasa previa [18] Sonographic diagnosis of placenta accrete, presentation of six cases [19] Ultrasonographic findings of placenta lacunae and a lack of a clear zone in cases with placenta previa and normal placenta [20] The morbidly adherent placenta: An overview of management options [21] Ultrasound detection of placenta accreta in the first trimester of pregnancy [22] Placenta accreta: Pathogenesis of a 20th century iatrogenic uterine disease

Introduction

Morbidly adherent placenta/Placenta accreta syndrome refers to morbid implantation, invasion, or adhesion of a placenta and includes any implantations of a placenta accompanied by adherence of the placenta to the myometrium caused by a partial or complete absence of decidua basalis and disruptions in the development of the fibrinoid layer (Nitabuch layer). When the spongy layer of decidua does not completely or partially exist, the physiological separation line that separates the placenta from the decidua does not exist and some or all cotyledons are densely anchored [1].

The placenta accrete syndrome is classified based on the depth of invasion to the myometrium: 1) Placenta accreta vera, in which the placenta adheres to the myometrium, 2) Placenta increta, in which the placenta invades the myometrium, and 3) Placenta percreta, in which villi penetrate the full thickness myometrium, serosa, and even adjacent organs such as the bladder, ureters, and intestines [1, 2]. These three types of the adherent placenta are observed in 80%, 15%, and 5% of cases, respectively [3]. The increase in the prevalence of the placenta accreta syndrome is due to the growing trend of cesarean section [4].

Risk factors for morbidly adherent placenta include surgical history (e.g. cesarean section, dilatation and curettage, myomectomy, and metroplasty), Asherman's syndrome, submucous myomas, maternal age, multiparity, and smoking [2].

In pregnant women who have a history of cesarean section, 2 items including Placenta previa and placenta accreta should be evaluated. Because of the implantation of the placenta on the previous cesarean section scar, the presence of a placenta previa increases the risk of morbid adherence of the placenta. In pregnant women with an anterior placenta and/or a placenta previa, who have a history of cesarean section, the likelihood of placenta accreta should be taken into consideration [5].

Accrete syndrome is among the most serious problems in the field of obstetrics and is considered the main reason for postpartum hemorrhage, emergency prepartum hysterectomy, and maternal mortality.

In a review carried out on nearly 10,000 maternal deaths, 8% of these deaths occurred due to hemorrhage caused by the morbidly adherent placenta. Other complications include creating damage to the urinary tract, being hospitalized in the intensive care unit, and performing a secondary surgery. Furthermore, the risk of recurrence of uterine rupture, the likelihood of the need for hysterectomy, and the possibility of

having a placenta previa in the subsequent pregnancy will be increased [6].

Ultrasonography is the first diagnostic method to examine the position of the placenta and morbidly adherent placenta. American College of Obstetrics and Gynecology indicated that the sensitivity of transvaginal ultrasonography in the detection of the adherent placenta was 77% to 87% and its specificity was 96% to 98%. Moreover, Positive Predictive Values (PPV) and Negative Predictive Values (NPV) in diagnosing morbidly adherent placenta were 65% to 93% and 98%, respectively [4].

Adding color Doppler ultrasonography for diagnosing the invasion to the myometrium has a high predictive power. When the distance between the uterine serosal bladder interface and retroplacental arteries is less than 1mm and large retroplacental lacunae can be seen, these indicate a myometrial invasion [7].

Calì *et al.* reported that the vascularization of the uterine serosa/bladder wall has the highest negative and positive predictive values for the presence of a placenta percreta [8]. Magnetic resonance imaging (MRI) can be used as a complimentary ultrasonography for the diagnosis of anatomy, the degree of invasion, and the possible involvement of the ureter or bladder [9].

Some researchers recommended performing an MRI in cases, where ultrasonography showed ambiguous results or a posterior placenta previa exists [4]. In several studies, the accuracies of the Doppler ultrasonography and MRI in the diagnosis of morbidly adherent placenta were alike [10].

The other tool for diagnosing placenta accreta is 3D multislice view Doppler, which is more sensitive, compared to the 3D power Doppler [11].

In a study conducted at the University of Oklahoma, 3D ultrasonography, in comparison with MRI, had more sensitivity to screen the placenta accreta. Due to its high cost and low specificity, MRI is not recommended for screening. However, ultrasonography is suggested as the best method for screening morbidly adherent placenta [12]. Since diagnosing morbidly adherent placenta before delivery is essential for optimal management of morbidly adherent placenta and reduction of morbidity and mortality of the mother, fetus, and infant, it is ideal to diagnose the placenta accreta syndrome before delivery. This provides the grounds for choosing the best time for delivery, presenting surgical facilities, anesthesia, blood bank, a women's surgeon or oncologist, as well as providing surgical consultations and interventional radiology and urology [4]. Both ultrasonography and MRI are used for the diagnosis; however, their accuracies are not known and are dependent on the skills of

sonographers and radiologists [13].

This study aimed at evaluating the diagnostic value of the Doppler ultrasonography in the diagnosis of the morbidly adherent placenta to reduce the morbidity and mortality rates in mothers and infants.

Instruments and Methods

The present prospective descriptive-analytical study was conducted on 150 pregnant women, who were cesarean section candidates, referring to Kousar Unit of Motahari Hospital in Urmia with the aim of determining the diagnostic value of the Doppler ultrasonography in the diagnosis of morbidly adherent placenta. The samples were selected in succession among singleton pregnant women with the gestational age of ≥ 24 weeks, who had a history previous uterine incision (Caesarean section, myomectomy, or metroplasty) from April to December, 2016.

In calculation of the sample size, based on a study carried out by Dwyer *et al.* [10], considering a 93% sensitivity ratio, a 5% error level, and an accuracy of 4%, a sample size of 150 was regarded.

Color Doppler sonographies were performed by the radiologist of the unit to examine the position of the placenta and evidence for the adherent placenta. Since in patients admitted in an emergency manner and because of their severe hemorrhage, there might be no time to evaluate their conditions by sonography; therefore, these patients were excluded from the study. The cases who underwent a hysterectomy during their cesarean sections due to morbidly adherent placenta and were histopathologically confirmed, were considered to determine the diagnostic value of ultrasonography.

Criteria used in the Doppler ultrasonography were the presence of large retroplacental lacunae, the absence of the transparent retroplacental hypoechoic zone, absence and/or thinning of the retroplacental myometrial thickness less than 1mm, the increased vascularization of the uterine serosa/bladder wall, and the reduction of the distance between the uterine serosa and the bladder as well as retroplacental arteries.

With regard to ethical considerations, the Doppler ultrasonography is regarded as a non-invasive method for evaluating adherent placenta. Hence, no extra costs and additional interventions were imposed on these patients. In addition, the subjects' participation in the study was subject to their consents and results obtained from the study were all presented without mentioning their names and other personal information.

In calculating the diagnostic value of the Doppler ultrasonography, standard indices of sensitivity, specificity, positive predictive value, and negative predictive value were evaluated for clinical and

pathological findings. UGEO WS80A sonography machine with L3-12A linear probe (Samsung; South Korea) was used. Demographic information, parity, obstetrics and surgical history, sonography results, findings during the surgery, and pathologic results in case of hysterectomy were recorded in the provided form and were analyzed by SPSS 21 software.

Findings

The mean age of the participants was 32.28 ± 5.33 years. The youngest patient was 20 years old and the oldest patient was 45 years old. The mean of gravidity was 2.98 ± 1.18 and it ranged from 2 to 8. The mean of parity was 1.64 ± 0.89 and it varied from 1 to 4. The mean of pregnancy age was 37.82 ± 1.81 weeks and it ranged from 27 to 41 weeks.

In terms of sonographic findings, in 139 cases (92.7%), no positive sonographic evidence for adherent placenta was found. However, in 11 cases (7.3%), at least one positive sonographic finding was found in favor of adherent placenta. In 138 cases, the placenta was completely and spontaneously removed. Twelve cases of these patients underwent a hysterectomy due to morbidly adherent placenta and severe hemorrhage, and the samples taken from their uteri, together with the placentas, were sent for a histopathologic examination.

All the patients, who underwent the hysterectomy, had a history of a cesarean section. Six cases had a history of 1 cesarean section, 4 cases had a history of 2 cesarean sections, and 2 cases had a history of 3 cesarean sections. One of the cases had a placenta accreta and another patient had a placenta previa in their previous cesarean section. Considering other surgeries, 2 cases had curettage and 1 case underwent an ovarian and incisional endometrioma surgery. In terms of their medical conditions, 1 case had asthma and 2 cases suffered from chronic hypertension; one case underwent a nephrectomy. Six cases underwent an elective cesarean section and 6 cases underwent an emergency cesarean section. In 5 cases, a total hysterectomy was done and in 7 cases, a supracervical hysterectomy was performed. Based on the histopathologic examination, 7 cases had the placenta accreta and 3 cases had the placenta increta. One case had the placenta percreta and in 1 case, pregnancy changes were reported. Due to the placenta previa and severe hemorrhage, the recent case underwent a hysterectomy after removing the placenta. In all cases, the ovaries were preserved.

In 4 cases, due to the adherence of bladder to the uterine, the bladder was injured. This injury was restored during the surgery. One case of ureteral injury was restored by conducting anastomosis.

The duration of hospitalization varied from 4 to 12 days. Except for 1 case, all other patients had blood transfusions and received blood products. The maximum receptivity of compact red blood cell, fresh frozen plasma, and platelet was 15, 20, and 10 units, respectively. Except for 1 infant, who was born in the 27th week, all infants survived.

The Doppler ultrasonography was used in the diagnosis of the adherent placenta and had a

sensitivity of 91.2%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 99.2%.

The diagnostic value of various ultrasonographic findings in the diagnosis of morbidly adherent placenta was presented (Table 1). Thinning or absence of the retroplacental myometrial thickness, as the most frequent finding, was observed in 10 cases (83.3%) of these patients.

Table 1) The frequency distribution and diagnostic value of ultrasonography findings in the diagnosis of morbidly adherent placenta

Ultrasonography findings	Frequency	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Absence and/or thinning of the retroplacental myometrial thickness less than 1mm	10	90.9%	100%	100%	99.3%
Large retroplacental lacunae with turbulent flow	7	63.6%	100%	100%	93.3%
Increased vascularization of the uterine serosa/bladder wall	4	36.3%	100%	100%	95.2%
The absence of the surface of the uterine/bladder wall	3	27.3%	100%	100%	94.5%
The absence of the transparent retroplacental hypoechoic zone	1	9.1%	100%	100%	93.3%

Discussion

The present study examined the diagnostic value of different ultrasonographic parameters presented in various studies as markers for placenta accreta. In the current study, different sensitivity, specificity, positive predictive value, and negative predictive value were obtained for each of the ultrasonographic parameters of diagnosing placenta accreta.

The increased rate of the cesarean section over the past decades has led to an increase in the number of cases of placenta previa and placenta accrete [14]. Hemorrhage and surgical complications in cases of morbidly adherent placenta are directly associated with the depth of the invasion and the involvement of adjacent organs. Prenatal diagnosis is the basis of managing and controlling the complications including severe hemorrhage.

Cesarean section and placenta previa are two risk factors for morbidly adherent placenta and the likelihood of the placenta accreta syndrome increases with the number of cesarean sections [2]. Using a transvaginal or abdominal method, ultrasonography is the basis of examining the position of the placenta and screening the morbidly adherent placenta [5].

In various studies, the sensitivity of ultrasonography in the diagnosis of placenta accreta ranged from 33% to 100% and its specificity ranged from 50% to 96%. Among other methods used for examining the placenta accreta syndrome, 3D and 4D ultrasonography and MRI can be mentioned, but they are not available in all

health care centers due to their high costs and high technologies. Therefore, it is not possible to use them at most healthcare centers and they cannot be considered as alternatives to the routine ultrasonography [2].

In case of thinning or absence of the myometrial thickness, this study obtained a sensitivity of 90.9%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 99.3%. In similar studies, the sensitivity of this method was close to 100% with a specificity of 72% to 79% and a positive predictive value of 73% [11, 15]. Accordingly, this finding is one of the strongest ultrasonographic markers in the diagnosis of placenta accrete, which can positively be interpreted as the high likelihood of the presence of placenta accreta. The progressive thinning of the retroplacental myometrial thickness indicates the proximity of the placental tissue to the peritoneal serosal tissue and its surrounding viscose, especially the bladder. Segmental thinning of the myometrial thickness less than 1mm can indicate the presence of adherent placenta [16].

In this study, the large retroplacental lacunae had a sensitivity of 63.6%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 93.3%. In several studies, the sensitivity of this finding in the diagnosis of placenta accreta in the second and third trimester was nearly 79% and its positive predictive value was approximately 92% [15, 17]. The results of the current study confirmed the high diagnostic power

of this finding in the detection of placenta accreta. Several venous structures that occur within the myometrium and placenta during accreta were first introduced by Kerr de Mendoca in 1988 [18]. The subsequent observations were described as large and irregular ponds (with the appearance of Swiss cheese). These lacunae are not necessarily invasive areas. The presence of this ultrasonographic marker in various studies was associated with the highest positive predictive value for placenta accreta. Moreover, the presence of this ultrasonographic finding was significantly accompanied by the risk of diffuse intravascular coagulopathy, massive transfusion, and severe care. However, this ultrasonographic finding was not pathognomonic and it should be applied in clinical conditions with caution [19].

In this study, the increased vascularization of the uterine serosa/bladder wall had a sensitivity of 36.3% and a negative predictive value of 95.2%. Similar studies indicated that this marker had a sensitivity of 79.6% and a negative predictive value of 82.2% [11, 20]. The reason for the low sensitivity of this finding can be explained by considering the differences in devices used in this study, in operators, and in the volume of samples in various studies. In this regard, the findings of this study cannot be interpreted as a sign of the absence of placenta accreta.

Considering the absence of the surface of the bladder-uterus wall (or other anomalies), this study reported a sensitivity of 27.3%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 94.5%. This is while similar studies reported that this marker's sensitivity ranged from 87% to 95%, its specificity ranged from 76% to 98%, and its positive predictive value ranged from 82% to 93% [11, 16]. The low number of positive cases in this study can be considered again as the main reason of the difference in the sensitivity obtained in this study and those obtained in other studies. Hence, the negativity of this finding cannot be regarded as a marker for placenta accreta.

In this study, the absence of the transparent retroplacental hypoechoic zone had a specificity of 100%, a sensitivity of 9.1%, a positive predictive value of 100%, and a negative predictive value of 93.3%. The diagnostic value of this finding was similar to other studies, which demonstrated that its specificity was 82.2% and its positive predictive value was 79.7% [11]. Given the low number of positive cases in the current study, which included only 1 patient, it cannot be regarded as a reliable finding and, in fact, this marker cannot be applied in clinical conditions.

Although other markers studied in this study had high specificities and their positivity can be interpreted as a high probability of the presence of

the placenta accreta, the number of positive cases of these markers in this study should be considered as one of the limitations of the current study. More studies with more positive cases diagnosed by these markers can help determine the diagnostic accuracy of these methods. Additionally, examining these markers in the first and second trimester, which can provide more readiness for the medical staff to deal with this problem, should be considered in future studies [21, 22].

Conclusion

The thinning or absence of the retroplacental myometrial thickness and the large retroplacental lacunae are the most powerful ultrasonographic markers in the diagnosis of the placenta accreta such that the negativity of these markers can be interpreted as the absence of placenta accreta and the positivity of them can be interpreted as the presence of the placenta accreta.

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