Evaluation of the sensitivity and specificity of 2D and color Doppler sonography in the detection of placenta accreta in pregnant women

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ABSTRACT

Introduction: Placenta accreta is the most common cause of bleeding leading to peripartum hysterectomy, and therefore, due to the importance of accreta in the mortality and morbidity of pregnant women, the correct diagnosis of the patient's final outcome is important. Therefore, this study aimed to evaluate the sensitivity, specificity, and accuracy of sonography diagnosis in the evaluation of placenta accreta by examining the two-dimensional (2D) and color Doppler sonography findings. **Materials and Methods:** Sonography was done for detection of accreta from pregnant women who were suspicious of placenta accreta in the third trimester of pregnancy. They were evaluated to confirm placenta histology for accreta and clinical examination after cesarean surgery at Maternity Ward, Ahvaz Imam Khomeini Hospital. Then they were evaluated as an overview and for the lack of accreta sonography findings. The data collected were analyzed by SPSS V 24. **Results:** About 58 patients (55.8%) of 103 pregnant mothers suspected of accreta with anterior placenta with an average age of 32.9 years after cesarean section were clinically extraordinarily positive and 45 patients (43.3%) were negative. The overall sensitivity and specificity of sonography for the detection of accreta placenta were 97.7% and 86.2%, respectively, which were most sensitive to diffuse and focal lacunar flow (100%) and the least sensitivity (33.3%) was observed for bladder wall interruption. Accuracy, positive predictive value, and negative predictive value of sonography for the diagnosis of accreta placenta with at least one diagnostic criteria were 91.2%, 84.6%, and 98.3%, respectively. **Conclusion:** Sonography, as an affordable and inexpensive diagnostic method, can be worthy by examining placenta for the detection of accreta, which can increase the diagnostic accuracy when combining 2D criteria with color Doppler.

Keywords: Accreta placenta, color Doppler, sonography

Introduction

Placenta sonography is used in pregnant women for a variety of applications such as intrauterine growth restriction, preeclampsia, accreta, and vasa previa. Correct identification of some placenta problems such as placenta previa, accreta, and vasa previa, which can lead to fatal maternal problems, thus detecting these disorders, can improve the management of pregnancy and childbirth. Precision sonography of the placenta is, in extreme cases, directly related to increasing the care of pregnant mother in improving birth results.

In sonographic evaluation of pregnancy, the attention to placenta is neglected, and this leads to a lack of recognition of many of its abnormal findings that are effective in maternal and fetal motility and morbidity.[1] When placenta accreta occurs, the placenta chorionic villi penetrate into the myometrium, and placenta percreta occurs when the chorionic villus penetrates the uterus serosa layer.[2]

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Placenta previa, previous cesarean surgery, and increased age are among the most common risk factors for placental adhesions. There is a basic risk of 0.26% for placenta accreta without a placenta previa and previous history of cesarean surgery. This amount increases linearly with the number of previous cesareans by four or more to 10%.

Women with placenta previa and uterus without a scar have a risk of 5% for accreta. With placenta previa and one previous cesarean, the risk for placenta accreta is 24%, and this risk when the number of cesarean sections reaches four or more is accompanied by a placenta previa, and it reaches 67%.

The exact pathogenesis of placenta accreta has not yet been determined, but the suggested hypothesis of incomplete development of decidua or overinvasion of trophoblastic or both is the cause of the adhesion of the placenta. On the other hand, abnormal separating of maternal vascular is also a factor in the penetration of trophoblastic and, consequently, placenta accreta.

Accrete/percreta placenta is one of the serious consequences of pregnancy, which involves the loss of maternal blood, the need for hysterectomy, and the remainder of pregnancy. With sonography, accrete placenta can be detected before delivery, and therefore it can predict the risks of cesarean surgery, so it can improve the outcome for both the mother and baby.

A large number of sonographic findings have been associated with placenta accreta. The presence of a placenta previa in most cases leads to the adhesion of the lower uterus in the previous cesarean surgery. These findings include loss of clear zone, myometrial thinning, focal exophitic mass, bladder wall interruption, lacunar flow, diffuse lacunar flow, focal lacunar flow, subplacental vascularity, and uterovesical hypervascularity. The gray scale and color Doppler findings used to detect placenta accreta are described and used with the same intensity and more percreta/increta placenta.

Color Doppler, Doppler power, and three-dimensional (3D) sonography are useful in showing the extent of twisted veins in these placentas. A significant increase in vascular lacunae with screw and whirlwind current increases the likelihood of percreta/increta.

Early diagnosis is preferable in many aspects of childbirth sonography. When findings are nonspecific, magnetic resonance imaging (MRI) may be useful, especially when the placenta is in the posterior part of the previous uterine scarring, such as myomectomy.

Information about placenta accreta and its various types is essential for the management of delivery. Proper birth control helps maintain the uterus and prevent large bleeding during labor. The strategies include preoperative balloon work in the internal iliac artery and fundal classical cesarean is above the upper limit of the placenta under sonography guidance.

Considering the importance of the issue of diagnosis of accreta prior to cesarean surgery, this study aimed to investigate the sensitivity and specificity of these sonographic findings in the diagnosis of accreta.

Materials and Methods

This cross-sectional study was conducted at Ahvaz Imam Khomeini Hospital and Ahvaz Jundishapur University from October 2015 to October 2018.

The study was approval by Ahvaz Jundishapur University's ethical committee (ID: IR.AJUMS.REC.1398.686) and performed on 103 pregnant women in the third trimester of pregnancy with a history of cesarean surgery who were suspected of having placenta accreta. Two-dimensional (2D) and color Doppler sonography of placenta were carried out for the presence or absence of accreta evidence. After sonography, patients were sent to a pathologist for histological confirmation by a female surgeon under the clinical evaluation for presence or absence of accreta.

Although placenta accreta is most common in the area of previous uterine scarring due to cesarean surgery or myomectomy in the anterior wall, it may also occur in posterior placenta, but posterior placenta evaluation is less accurate with sonography due to fetal bone artifact. Therefore, pregnant women who had posterior placenta were excluded.

Sonography examination

The sonography of the placenta was performed using the GE vuluson E6 sonography device and the transducer 3.5–5 MHZ. The placenta was examined using the criteria of gray scale and color Doppler, and after cesarean surgery, and clinical and histological confirmation of the placenta for lack of placenta accreta was evaluated.

Statistical analysis

The collected data were analyzed by SPSS V 24, and the sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) of each gray scale and color Doppler sonography were measured for detection of placenta accreta.

Results

A total of 103 pregnant women between the ages of 18 and 45 years with a mean of 32.95 years and a standard deviation of 5.24 were evaluated in the third trimester. About 58 patients were more than 30 years (29.1%) of age and 73 patients were older than 30 years (70.9%). Of these, there were significant differences in the number of patients suspected of having placenta accreta in gray scale and color Doppler sonographic findings, as shown in Table 1.

Table 1 shows that all 2D and color Doppler findings have a significant difference ($P < 0.001$) with accreta.

In Figure 1, the true positive, negative, false positive, and false positive values of the sonographic diagnosis of accreta after clinical and histologic confirmation of the placenta are presented.

In Table 2, the sensitivity, specificity, accuracy, PPV, and NPV of sonography in the case of at least one sonographic finding of 2D or color Doppler criteria in detecting placenta accreta were 97.7%, 86.2%, 91.2%, and 98.3%, respectively.

The most sensitive was diffuse and focal lacunar flow (100%), and for bladder wall interruption, the least sensitivity was observed (33.3%) but the most characteristic (100%) was shown. The highest accuracy was observed for placental lacunar (95.1%). The highest PPV was for focal exophytic mass and bladder wall interruption (100%), and the highest negative predictive value for diffuse and focal lacunar flow (100%) was for detection of placenta accreta.

Discussion

Different studies on the diagnostic use of any of the gray scale, color Doppler, 3D, or every three cases, most of which are used to detect the adhesion of the anterior placenta,
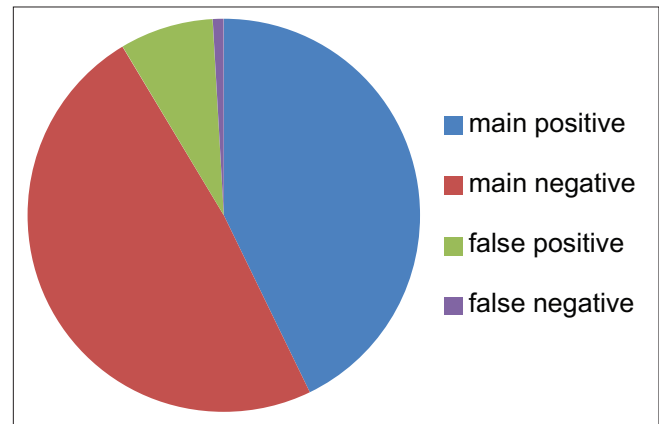
Figure 1: The results of cesarean surgery of suspect patients (*percentage in the form, 42.7, 48.5, 7.7% and 0.9% respectively)

Table 1: Pearson's correlation of placenta accreta sonographic criteria					
Sonographic finding		**Number**	**Percentage**	**Coefficient of determination**	***P***
Placenta lacunae	Accreta	45	43.6	**0.811**	**<0.001**
	Not accreta	58	56.3		
Myometrial thinning	Accreta	49	47.5	**0.687**	**<0.001**
	Not accreta	54	52.4		
Loss of clear zone	Accreta	49	47.5	**0.715**	**<0.001**
	Not accreta	54	52.4		
Focal exophitic mass	Accreta	16	15.5	**0.237**	**<0.001**
	Not accreta	87	84.4		
Bladder wall interruption	Accreta	15	14.5	**0.237**	**<0.001**
	Not accreta	88	85.4		
Diffuse lacunar flow	Accreta	45	43.6	**0.580**	**<0.001**
	Not accreta	58	56.3		
Focal lacunar flow	Accreta	45	43.6	**0.635**	**<0.001**
	Not accreta	58	56.3		
Subplacental vascularity	Accreta	44	42.7	0.544	**<0.001**
	Not accreta	59	57.2		
Uterovesical hypervascularity	Accreta	44	42.7	0.458	**<0.001**
	Not accreta	59	57.2		

Table 2: Sensitivity, specificity, accuracy, positive, and negative predictive values of sonographic criteria are presented in the diagnosis of placenta accreta					
Sonographic findings	**Sensitivity%**	**Specificity %**	**Accuracy %**	**Positive predictive value %**	**Negative predictive value %**
Placenta lacunae	97.6	93.4	95.1	91.1	98.2
Loss of clear zone	93.4	89.4	91.2	87.7	94.4
Myometrial thinning	93.6	91.1	92.2	89.7	94.4
Focal exophitic mass	34	100	70.8	100	65.5
Bladder wall interruption	33.3	100	70.8	100	65.9
Diffuse lacunar flow	100	81.6	32.5	71.1	100
Focal lacunar flow	100	84.1	89.3	75.5	100
Subplacental vascularity	90.4	90.1	90.2	86.3	93.2
Uterovesical hypervascularity	96.4	68.2	82.5	61.3	98.3
All US findings	97.7	86.2	91.2	84.6	98.03

US: ultrasound

are based on the presence of more than two sonographic findings.[1-6]

However, even having only one sonography criterion, which in some other studies has been evaluated, increases the sensitivity of sonographic diagnosis, but, on the other hand, the specificity of the diagnosis has decreased.[7]

The results of this study showed that the sensitivity of sonography and diagnostic characteristics was 97.7% and 86.2%, respectively, to detect placenta accreta.

Pillone *et al.* examined that the sonographic diagnostic sensitivity in detecting the placenta accreta was 81.1%, specificity was 98.8%, PPV was 90.9%, and NPV was 97.5% using at least two out of the six criteria for diagnosis of accreta sonography.[8]

The study by Shih *et al.*[9] on 39 cases as well as the study by Cali *et al.*[6] on 41 cases were about anterior placenta; both studies used 2D sonography imaging and color Doppler compared with 3D imaging and power Doppler and found that a 3D study of the 2D and power Doppler versus color Doppler was more valuable for the examination of hypervascularity of uterine serous with bladder wall to detect placenta accreta.

In A study by Rahimi *et al.*, which was performed on 28 patients to detect accreta in the first trimester of diagnosis, the findings of ultrasonography diagnosis were 41% and 88%, respectively.[10]

A study by Riteau *et al.*, which compared sonography and MRI in accreta diagnosis, showed that the diagnostic sensitivity was 100% with sonography and 76.9% with MRI and the specificity with sonography and MRI was 37.5% and 50%, respectively. Therefore, sonographic examination was more appropriate than MRI for screening of placenta accrete.[11]

Antonio *et al.* in their study showed that the sensitivity and specificity of sonography to detect placenta accreta were 90.7% and 96.9%, respectively, and specificity versus sensitivity was 94.4%, and it showed 84% specificity for MRI.[2] In a similar study by Meng *et al.*, the sensitivity and specificity for detecting placenta accreta by sonography were 83% and 95%, respectively, and by MRI, the sensitivity and specificity were 82% and 88%, respectively.[12]

In the study by Hesham *et al.*, the sensitivity of color Doppler sonography was 100%, 93.7% for 2D sonography, and 75% for MRI, but for MRI and Doppler, 2D and MRI it was 66.6%, 77.7%, and 55.5%, respectively.[12]

The results of our study showed that the use of a combination of gray scale and color Doppler sonographic findings in detecting placenta accreta in anterior placenta improves the diagnosis. Therefore, due to the importance of accreta in the mortality and morbidity of pregnant women, the correct diagnosis of the patient's final outcome is important. Although in other studies there is a discrepancy between the sensitivity and specificity of sonography and MRI, noninvasiveness, availability, and, on the other hand, the cheapness of the 2D and color Doppler sonography can be a good modality for the detection of placenta accreta, especially the anterior placenta.

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Conflicts of interest

There are no conflicts of interest.

References

1. Allahdin S, Voigt S, Htwe TT. Management of placenta praevia and accreta. J Obstet Gynaecol 2011;31:1-6.

2. D'antonio F, Iacovella C, Bhide A. Prenatal identification of invasive placentation using ultrasound: Systematic review and meta-analysis. Ultrasound Obstet Gynecol 2013;42:509-17.

3. Hussein M, Ramadan MF, Abu-Elhassan AM, Abbas AM, Youssef AEA. Evaluation of different ultrasonographic modalities in the diagnosis of morbidly adherent placenta: A cross-sectional study. Open J Obstet Gynecol 2019;9:405-16.

4. Wong HS, Cheung YK, Zucollo J, Tait J, Pringle KC. Evaluation of sonographic diagnostic criteria for placenta accreta. J Clin Ultrasound 2008;36:551-9.

5. Elhawary TM, Dabees NL, Youssef MA. Diagnostic value of ultrasonography and magnetic resonance imaging in pregnant women at risk for placenta accreta. J Matern Fetal Neonatal Med 2013;26:1443-9.

6. Cali G, Giambanco L, Puccio G, Forlani F. Morbidly adherent placenta: Evaluation of ultrasound diagnostic criteria and differentiation of placenta accreta from percreta. Ultrasound Obstet Gynecol 2013;41:406-12.

7. Dwyer BK, Belogolovkin V, Tran L, Rao A, Carroll I, Barth R, *et al.* Prenatal diagnosis of placenta accreta: Sonography or magnetic resonance imaging? J Ultrasound Med 2008;27:1275-81.

8. Pilloni E, Alemanno MG, Gaglioti P, Sciarrone A, Garofalo A, Biolcati M, *et al.* Accuracy of ultrasound in antenatal diagnosis of placental attachment disorders. Ultrasound Obstet Gynecol 2016;47:302-7.

9. Shih JC, Palacios Jaraquemada JM, Su YN, Shyu MK, Lin CH, Lin SY, *et al.* Role of three-dimensional power Doppler in the antenatal diagnosis of placenta accreta: Comparison with gray-scale and color Doppler techniques. Ultrasound Obstet Gynecol 2009;33:193-203.

10. Rahimi-Sharbaf F, Jamal A, Mesdaghinia E, Abedzadeh-Kalahroudi M, Niroomanesh S, Atoof F. Ultrasound detection of placenta accreta in the first trimester of pregnancy. Iran J Reprod Med 2014;12:421-6.

11. Riteau AS, Tassin M, Chambon G, Le Vaillant C, de Laveaucoupet J, Quéré MP, *et al.* Accuracy of ultrasonography and magnetic resonance imaging in the diagnosis of placenta accreta. PLoS One 2014;9:e94866.

12. Borg H, Ossman A, Salem H, El-Hemedi M, El-Shafie K, Alarabawya R. Color Doppler ultrasound in diagnosis of placenta accreta. Evidence Based Women's Health Journal 2018;8:215-22.