Doppler Ultrasound in the diagnosis of placenta percreta: our experience


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Abstract

Purpose: To demonstrate the usefulness of Doppler ultrasound in the detection of bladder invasion in cases of placenta percreta.

Materials and methods: Twenty-one patients, aged 20-44 years old, with surgical and histopathological diagnosis of placenta accreta were evaluated by ultrasound between November 2011 and May 2013. The presence of increased vascularity on the bladder wall on Doppler ultrasound was classified as bladder invasion, while the presence of other sonographic findings on grayscale imaging with negative Doppler signal was classified as probable invasion.

Results: Of the 21 patients included in the study with placenta accreta, 7 had bladder invasion on histopathological examination. Out of these 7, 5 had a diagnosis and ultrasound report of bladder invasion (due to the identification of vascular structures on color Doppler examination) and the remaining two were considered to have probable invasion. Of the 14 patients with no bladder invasion detected on histopathological examination, 7 had normal ultrasound reports and 7 were reported as probable invasion.

Conclusion: Doppler ultrasound is a very reliable method for the detection of bladder invasion in placenta percreta, seen as increased vascularity of the uterine-bladder interface on color Doppler examination.

Keywords: Placenta accreta; placenta percreta; ultrasound

Introduction

Placenta accreta (PA) results from abnormal placentation characterized by the invasion of trophoblastic villi beyond the decidua1. In placenta accreta vera, chorionic villi are attached to the surface of the myometrium; placenta increta occurs when there is a deep invasion of the villi into the myometrium and in placenta percreta the entire myometrium, including the serosa, is penetrated by chorionic villi. The latter is the least common, but it carries the highest maternal and perinatal morbidity and mortality because of its difficult diagnosis2. The main risk factors include placenta previa and Cesarean section. Owing to the increasing rate of Cesarean section in recent years, there has been a rise in the prevalence and incidence of this condition1.

Prenatal diagnosis of placenta percreta is extremely difficult. Diagnosis relies on ultrasound and color Doppler, but may be supplemented with magnetic resonance imaging (MRI), cystoscopy and biochemical markers2. If the condition is not detected before the time of delivery, it may be a devastating obstetric condition that can be life-threatening for both mother and fetus. Therefore, prenatal diagnosis is essential for adequate planning and multidisciplinary management1,3. The aim of our study is to demonstrate the usefulness of Doppler ultrasound in the detection of bladder invasion in cases of placenta percreta.

Materials and methods

Between November 2011 and May 2013, 21 patients aged 20-44 years with a surgical and histopathological diagnosis of placenta accreta were evaluated by ultrasound. All patients were examined in the third trimester of pregnancy (weeks 32 through 40 of pregnancy) and in 100% of cases bladder ultrasound was performed by the suprapubic approach with a sufficient bladder repletion, considered to be adequate when it allowed correct visualization of the entire bladder wall. Different ultrasound systems were used for this study (Toshiba Nemio, Philips HD7 and Sonosite Micromax) equipped with a convex transducer of 3.5 MHz and a lineal transducer of 7.5 MHz.
Findings were assessed using grayscale ultrasound (loss of the echogenic line between the bladder wall and the uterus, irregularity and/or bulging of the bladder wall and exophytic masses within the bladder) as well as color Doppler (irregularity of the bladder wall because of serpiginous structures with positive flow on Doppler evaluation).

Sagittal imaging was used to assess the depth of placental tissue, its vascularity and its relationship to the bladder wall, while coronal imaging was used to assess the extent of invasion. The presence of vascular structures on the bladder wall on Doppler ultrasound was classified as bladder invasion and the presence of other sonographic findings on grayscale imaging with negative Doppler was classified as probable bladder invasion.

All patients included in our study underwent scheduled Cesarean section.

Final diagnosis of bladder invasion was performed post-surgery with a histopathologic examination.

Results

Of our 21 patients with PA, 7 (30%) showed bladder invasion on histopathologic examination: 5 (71.5%) had a diagnosis and ultrasound report of bladder invasion owing to the presence of vascular structures on the bladder wall on color Doppler ultrasound (figs. 1-4); the remaining 2 (28.5%) showed probable invasion because there was no positive Doppler signal despite the loss of the echogenic border between the bladder wall and the uterus in one patient and the bulging of the bladder wall on the other (figs. 5 and 6).
Figure 5 Case 2: grayscale ultrasound, sagittal view showing loss of echogenic line (arrow).

Figure 6 Case 2: Color Doppler ultrasound, sagittal view not showing increased vascularity of the bladder wall (negative Doppler) (arrow). Histological confirmation of placenta accreta without bladder involvement.

Figure 7 Case 16: grayscale ultrasound, sagittal view showing regular and intact echogenic line of the bladder wall (arrow).

Figure 8 Case 16: Color Doppler ultrasound showing standard vascularity of the placental base, with no interface vascularity (arrow). Histological confirmation of placenta accreta without bladder involvement.

Figure 9 Case 12: grayscale ultrasound, sagittal view showing apparent loss of echogenic line at the upper region of the bladder wall (arrow).

Figure 10 Case 12: Color Doppler ultrasound, sagittal view showing no increased vascularity of the bladder wall (negative Doppler) (arrow). Histological confirmation of placenta accreta without bladder involvement.
Table 1: Sonographic findings in 21 cases of placenta accreta

<table>
<thead>
<tr>
<th>Case/Age</th>
<th>P: pregnancies; M: miscarriages; D: deliveries; CS: Cesarean sections</th>
<th>GA</th>
<th>Placental location</th>
<th>Sonographic findings of bladder invasion (positive Doppler)</th>
<th>Sonographic findings of probable bladder invasion (negative Doppler)</th>
<th>Histopathological findings</th>
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<td>37</td>
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<td>P4 M1 CS2</td>
<td>38</td>
<td>Total occlusive</td>
<td>-</td>
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<td>PA with no bladder invasion</td>
</tr>
</tbody>
</table>

P: pregnancies; M: miscarriages; D: deliveries; CS: Cesarean sections; PA: placenta accreta; GA: gestational age
Of the 14 patients (70%) with no bladder invasion on histopathological examination, 7 had normal ultrasound reports, with an intact bladder wall (figs. 7 and 8), and 7 cases were classified as probable bladder invasion based on the presence of findings on grayscale ultrasound only (figs. 9 and 10). Sonographic findings for each case are detailed in Table 1, while results obtained with and without color Doppler are reported in Figure 11.

As regards risk factors for PA, there were 16 cases of placenta previa with total occlusion, 4 cases of placenta previa with partial occlusion and one case of marginal placenta. Of the 7 patients with bladder invasion, 6 had total occlusive placenta and 1 had partial occlusive placenta.

With the number of previous cesarean deliveries, 19 patients had undergone one or more Cesarean sections, 1 reported two curettage procedures and 1 had no history of surgery. All 7 patients with bladder invasion had undergone Cesarean section.

All patients were multiparous women, with 3 or more pregnancies. For patients with bladder invasion, the number of pregnancies is summarized in Figure 12.

**Discussion**

Placenta accreta (PA) results from abnormal placentation characterized by the invasion of trophoblastic villi beyond the deciduas. The deciduas basalis is fully or partially absent due to a defect in the development of the fibrinoid layer of Nitabuch, separating the deciduas basalis from the villous portion of the placenta4.

The current incidence of placenta accreta ranges between 1/540 and 1/93000 births2. Risk factors for the development of this condition include uterine instrumentation, intrauterine scarring and prior Cesarean delivery, all of which may be associated with damage to or absence of the decidua basalis, as well as placenta previa, smoking, endometritis, maternal age over 35, grand multiparity and recurrent miscarriage5. The combination of prior Cesarean section and placenta previa represents the highest contribution to risk.

Our findings were consistent with the literature as regards the aforementioned factors. From this perspective, it is worth mentioning that over the last 50 years, the frequency of abnormal placentation has increased 10-fold and that, according to the World Health Organization (WHO) statistics, in our setting over one-third of all deliveries occur by Cesarean section (with higher rates associated with prepaid healthcare systems)4.

Depending on the depth of penetration, there are three forms of abnormal placentation:

- **Accreta**: the placenta is attached to, but does not penetrate, the myometrium (78% of cases).
- **Increta**: the placental penetrates through the myometrium (17% of cases)
- **Percreta**: the placenta penetrates the full thickness of the myometrium to the uterine serosa, and may invade adjacent organs (5% of cases).

Depending on the extension, abnormal placentation may be classified into6:

- **Focal**: when only small placental areas are involved.
- **Partial**: when one or more cotyledons are involved.
- **Total**: when the entire surface of the placenta is abnormally attached.

Our study revealed the presence of placenta percreta with bladder invasion in 30% of cases evaluated, in contrast with current statistics reported in the literature. Nevertheless, this finding may probably be related to the nature of our service, which belongs to a hospital that is a referral center for placenta accreta in the province of Buenos Aires.

As regards the forms of presentation, there is no specific clinical syndrome for placenta accreta. A large number of cases are asymptomatic; therefore, PA should be suspected whenever risk factors are present. Symptoms depend mainly on the features of the placenta previa and the invasion to other organs and the resulting complications. The main manifestation is hemorrhage, which may occur before, during or after delivery.

In cases of bladder invasion, placenta percreta may manifest with gross hematuria (20% of cases) or with microscopic hematuria. The latter is the most common sign and should raise suspicion and alert the urologist2. In our series, none of the 7 patients with bladder invasion exhibited this finding. Furthermore, placenta percreta may become evident with retained placenta at delivery or as complications (such as shock and disseminated intravascular coagulation).

The importance of making the diagnosis of PA before delivery is that it allows for multidisciplinary planning with the aim of minimizing potential maternal or neonatal morbidity and mortality.

For placenta percreta with bladder invasion, the rate of maternal mortality has been reported to be 20% and the rate of perinatal mortality has been reported to be 30%, as it is difficult to diagnose this condition prior to delivery7. In our 7 patients with bladder invasion, no deaths occurred.

The diagnosis is usually established by ultrasound and occasionally supplemented by MRI8. Some authors have detected elevated serum concentrations of alpha-fetoprotein (AFP) in patients with placenta accreta, which suggests that placental-uterine interface abnormalities might result in leakage of AFP into the maternal circulation. For this reason, in pregnant women the presence of elevated AFP concentrations and risk
factors should raise suspicion for placenta accreta. In order to establish diagnosis, more than one sonographic criterion should be met. Sonographic diagnostic criteria include: 1,10

- Placenta previa
- Placental vascular lacunae
- Abnormal color Doppler patterns
- Loss of the retroplacental clear space
- Thinning or loss of the myometrial layer
- Disruption or irregularity of the uterine-bladder cleavage plane
- Placental tissue with mass effect (bulging)
- Bladder wall irregularity

The uterus is separated from the bladder wall by the uterine-bladder cleavage plane, also known as uterine-bladder complex. This complex appears as a smooth hyperechoic linear band representing the uterine serosa, the fat tissue and the posterior bladder wall. On grayscale ultrasound examination, the bladder wall appears thin, smooth and regular, while on color Doppler ultrasound no vascular structures are detected.

Special care should be taken when examining the bladder wall since in order to make a correct and clear assessment and minimize potential errors, adequate repletion is required and the transducer should be positioned at different Doppler angles. It is much easier to diagnose placenta accreta than to make the subsequent step of determining if trophoblast has grown through the uterine wall into other structures. Although it would be ideal to identify percreta with certainty, no one has yet been able to do that reliably. Unfortunately, disruption of the echogenic line between the bladder and the uterus and bulging are non-specific signs for placenta percreta involving the bladder, and do not always predict this condition. Comstock 11 reported that in the three cases in his series in which these signs were present, two had a placenta percreta and one had a simple accreta. Kirkinen et al 12, in turn, have demonstrated similar findings, in agreement with our study.

Bladder involvement should be suspected in the event of bladder wall irregularity caused not only by placental tissue invasion but also by the existence of a large number of associated vascular structures.

Comstock 11 reports a problem in patients who had a previous Cesarean section: these women usually develop increased vascularity in the space between the myometrium and the bladder, probably because the bladder flap is retracted before the incision is made into the uterus and because this area is exposed to blood products. Therefore, it is important to differentiate between bulging due to increased number of preexisting vessels and actual neovascularization from the placenta through the myometrium.

In cases of placenta percreta, Doppler examination for assessment of vascularization of the uterine serosa-bladder interface shows an extensive hypervascular appearance with densely confluent anarchic vessels that occasionally protrude into the bladder lumen. In our experience, of the 7 patients with a histopathological diagnosis of placenta percreta with bladder invasion, 5 (71.5%) had positive color Doppler findings. The sensitivity and specificity of grayscale ultrasound for diagnosing placenta accreta vary according to different authors, but sensitivity is estimated to be approximately 77-87% and specificity approximately 96-98%. The use of Doppler increases diagnostic sensitivity, reaching --according to Lerner et al14-- 100% sensitivity and 94% specificity. Levine15, in turn, has reported a sensitivity of 86% and a specificity of 92% for Doppler imaging, while the American College of Obstetricians and Gynecologists8 has not seen significant changes in these percentages with the use of color Doppler. In our case, with color Doppler we obtained 77% sensitivity and 100% Specificity.

The diagnostic efficacy of ultrasound allows limitation of the use of MRI (whose diagnostic value is still a subject of debate) as well as of the administration of gadolinium in the prenatal stage. In addition, ultrasound is a simple, low-cost, reproducible, noninvasive and accessible method, thus being ideal for patients with suspected placenta accreta.

Our data, which agree with those of other authors, suggest the possibility of diagnosing bladder invasion using a combination of grayscale and color Doppler ultrasound findings. However, based on the results obtained, color Doppler examination became more relevant, as it enabled confirmation of 5 out of 7 cases with bladder involvement and allowed us to rule out bladder invasion in 14 patients.

**Conclusion**

Placenta accreta/percreta is an obstetric complication that is potentially ominous for the mother and that is currently developing the characteristics of an epidemic. This condition is one of the main causes of peripartum hysterectomy and maternal and perinatal morbidity and mortality. Diagnosis of this condition is based on two essential pillars: a high suspicion for disease based on the presence of risk factors, and both grayscale and color Doppler ultrasound findings (because they have a high specificity).

Doppler ultrasound allows for diagnosis of bladder invasion in placenta percreta, seen as positive vascularization of the bladder wall on color Doppler.
Conflicts of interest
The authors declare no conflicts of interest, except for Dr. Mariano who declares a possible conflict of interest as junior reviewer of the Argentine Journal of Radiology.

References