Placenta accreta spectrum: Clinical features, diagnosis, and potential consequences

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INTRODUCTION

Placenta accreta spectrum (PAS) is a general term used to describe abnormal trophoblast invasion into the myometrium of the uterine wall. It is clinically important because the placenta does not spontaneously separate at delivery and attempts at manual removal result in hemorrhage, which can be life-threatening and usually necessitates hysterectomy. The pathogenesis of most cases of PAS is thought to be placental implantation at an area of defective decidualization caused by preexisting damage to the endometrial-myometrial interface. The most important risk factor for PAS is a placenta previa after a prior cesarean delivery.

This topic will discuss the clinical features, diagnosis, and potential consequences of PAS. Management of patients with a PAS is reviewed separately. (See "Placenta accreta spectrum: Management".)

DEFINITIONS

PAS (formerly called morbidly adherent placenta) is a broad term that includes:

- **Placenta accreta** – Anchoring placental villi attach to the myometrium (rather than decidua).
- **Placenta increta** – Anchoring placental villi penetrate into the myometrium.
- **Placenta percreta** – Anchoring placental villi penetrate through the myometrium to the uterine serosa or adjacent organs.

PREVALENCE

In a 2019 systematic review that included 7001 cases of PAS among nearly 5.8 million births, the overall pooled prevalence was 0.17 percent (range 0.01 to 1.1 percent) [1]. This is markedly higher than the 0.003 percent prevalence in the United States in the 1950s [2,3]. The marked increase in PAS, which began in the 1980s and 1990s and has been observed worldwide, is attributed to the increasing prevalence of cesarean delivery in recent decades [4]. (See 'Risk factors' below.)

Placenta accreta is much more common than placenta increta and percreta. In the same systematic review, the types and frequencies of abnormal placentation were [1]:

- **Placenta accreta** – 63 percent
- **Placenta increta** – 15 percent
- **Placenta percreta** – 22 percent

PATHOGENESIS

The pathogenesis of PAS is not known with certainty. The most common theory is that defective decidualization (thin, poorly formed, partial, absent, or dysfunctional decidua) in an area of scarring caused by previous uterine surgery involving the endometrial-myometrial interface allows the anchoring villi of the placenta to attach directly to or invade the myometrium [5,6]. This theory is supported by the observation that 80 percent of patients with PAS have a history of previous cesarean delivery, curettage, and/or myomectomy [5]. Other theories, which may account for a proportion of cases, attribute PAS to excessive extravillous trophoblastic invasion or defective maternal vascular remodeling in an area of scarring [7]. In rare cases, uterine pathology, such as bicornuate uterus, adenomyosis, or submucous fibroids, may be associated with microscopic endometrial defects that interfere with normal biological endometrial functions and thereby allow abnormal placental attachment [8]. This may explain the rare occurrence of PAS in primigravid women with no history of uterine surgery.

The factors that regulate the extent of pathologic invasion (eg, accreta versus percreta) are not well defined (see "Placental development and physiology"). A placenta may have both adherent and invasive villi, and the depth of invasion may evolve with advancing gestation [8]. However, there are confirmed cases of placenta percreta as early as 16 weeks of pregnancy, which suggest that, at least in some cases, the "die is cast" at implantation as to whether an accreta, increta, or percreta will develop and that increasing depth of invasion is not related to increasing duration of gestation.

In some cases, the occurrence of placenta increta and percreta may be due to partial or complete dehiscence of a uterine scar, which allows extravillous trophoblast direct access to the deeper myometrium, serosa, and beyond [5]. In fact, emerging data support the concept of PAS as being entirely due to defects in the decidua and/or uterus [9]. Large and deep myometrial defects are often associated with absence of normal reepithelialization of the scar [10].

CLINICAL FEATURES

Risk factors — The most important risk factor for development of a PAS is placenta previa after a prior cesarean delivery. In a prospective study including 723 women with placenta previa undergoing cesarean delivery, the frequency of PAS increased with an increasing number of cesarean deliveries as follows [11]:

- First (primary) cesarean birth, 3 percent
- Second cesarean birth, 11 percent
- Third cesarean birth, 40 percent
- Fourth cesarean birth, 61 percent
- Fifth or greater cesarean birth, 67 percent

In the absence of placenta previa, the frequency of a PAS in women undergoing cesarean delivery was much lower [11]:

- First (primary) cesarean birth, 0.03 percent
- Second cesarean birth, 0.2 percent
- Third cesarean birth, 0.1 percent
- Fourth or fifth cesarean birth, 0.8 percent
- Sixth or greater cesarean birth, 4.7 percent

Other risk factors include a history of uterine surgery (eg, myomectomy entering the uterine cavity, hysteroscopic removal of intrauterine adhesions, cornual resection of ectopic pregnancy, dilation and curettage, endometrial ablation), cesarean scar pregnancy, maternal age greater than 35 years, multiparity, history of pelvic irradiation, manual removal of the placenta, postpartum endometritis, infertility and/or infertility procedures (eg, especially transfer of cryopreserved embryos), and possibly multiple gestations [12-21]. Basal plate myometrial fibers (BPMF) in

the delivered placenta may be reported by the pathologist and appear to be a risk factor for retained placenta or PAS in the index and subsequent pregnancies, especially when BPMF are prominent [22,23].

Consideration of risk factors other than previous cesarean is particularly important in women in their first ongoing pregnancy. In a retrospective study limited to primiparous women with invasive placentation, the relative risk [RR] of invasive placentation for those with a history of one or two previous gynecologic procedures (including suction curettage for pregnancy termination) was RR 1.5 (95% CI 1.1-1.9) and RR 2.7 (95% CI 1.7-4.4), respectively [19].

It is important to note that, in a multivariate analysis, placenta previa appeared to be an independent risk factor for PAS (odds ratio [OR] 54, 95% CI 18-166), while prior uterine surgery was not (OR 1.5, 95% CI 0.4-5.1) [24].

Interestingly, the sex ratio associated with PAS favors females, which is opposite to the normal sex ratio in the general population, which favors males [25,26].

Clinical presentation — Ideally, PAS is first suspected because of findings on obstetric ultrasound examination while the patient is asymptomatic. It is often diagnosed during prenatal sonographic screening of women with a placenta previa or a low anterior placenta and prior uterine surgery. In women with less prominent risk factors for abnormal placental attachment, it may be an incidental finding during routine ultrasound examination, and sometimes the diagnosis is not made until delivery of the placenta [27]. (See 'Prenatal screening and diagnosis' below.)

The first clinical manifestation of PAS is usually profuse, life-threatening hemorrhage that occurs at the time of attempted manual placental separation. In contrast to a simple retained placenta, part or all of the placenta remains firmly attached to the uterine cavity, and no plane of separation can be developed. However, it also may present as antenatal bleeding in the setting of placenta previa.

Possible laboratory findings

- **Elevated maternal serum alpha-fetoprotein (MSAFP)** – Several series and case reports have reported an association between PAS and otherwise unexplained elevations in second-trimester MSAFP concentration (>2 or 2.5 multiples of the median) [24,28,29]. Although an elevated MSAFP level supports an ultrasound-based diagnosis of abnormal placental implantation, it is an inconsistent finding and is not useful by itself for diagnosis. Moreover, a normal MSAFP does not exclude the diagnosis.

  Other placental analytes (eg, pregnancy-associated plasma protein A, free beta-human chorionic gonadotropin) have also been associated with PAS and are also not useful clinically because of their very low positive predictive value. Proteomic markers in maternal blood show promise for the diagnosis of PAS [30]. However, the test needs extensive validation before it can be recommended for clinical use.

- **Hematuria** – Placenta percreta with bladder invasion can cause hematuria during pregnancy. A literature review including 54 cases of placenta percreta invading the bladder reported that 17 (31 percent) were associated with hematuria [31]. Cystoscopy was performed in 12 patients but was not useful for making a preoperative diagnosis. This may be due to microscopic invasion of the bladder that is not visible on cystoscopy but can lead to hematuria.

Consequences — When removal of the placenta is attempted after delivery, the lack of a normal plane of cleavage between the placental basal plate and the uterine wall results in major hemorrhage. The hemorrhage is especially severe with more invasive placentation because of greater hypervascularity of the placental bed (ie, local neovascularization and vasodilatation) [32-34]. Potential sequelae of massive hemorrhage include disseminated intravascular coagulopathy, adult respiratory distress syndrome, renal failure, unplanned surgery, and death, as well as potential complications from transfusion.

- **Peripartum hysterectomy and other morbidity** – PAS is a common indication for peripartum hysterectomy, either to prevent or to control postpartum hemorrhage. Transfusion is the most common associated morbidity,

followed by complications related to surgery.

- In a systematic review including 7001 PAS cases, peripartum hysterectomy was performed in 52.2 percent (95% CI 38.3-66.4), and blood transfusion was required in 46.9 percent (95% CI 34.0-59.9) [1]. Of note, PAS was not histologically confirmed in cases without hysterectomy. Outcomes may vary among populations and may be worse for histologically confirmed cases.

- In a series of 356 patients with PAS, the most common morbidity other than transfusion was bladder injury, which occurred in 5 percent of cases [35]. The following complications occurred in ≤2 percent of cases: urinary tract damage, genitourinary fistula, bowel damage, thrombotic event, wound infection, hemorrhagic shock, cardiac arrest, and renal failure.

- **Increased maternal morbidity with more invasive placentation** – Composite maternal morbidity is especially high with placenta percreta (86 versus 27 percent with accreta [36]). Before delivery, the percreta may compromise the integrity of the previous hysterotomy scar, predisposing to uterine rupture. Delivery and hysterectomy are often complicated because extrauterine anatomic structures, including blood vessels in the pelvis, may be invaded by the placenta. If an accreta rather than a percreta is suspected before delivery, preoperative preparation for delivery may be inadequate; however, severe maternal morbidity can occur despite multidisciplinary planning, management in a referral center, and antenatal suspicion of percreta.

- **Neonatal morbidity** – Preterm birth and small for gestational age infants appear to be more common in pregnancies complicated by PAS [37]. Neonatal outcome is strongly related to gestational age at delivery but does not appear to be significantly affected by depth of placental invasion (accreta versus percreta) [38].

- **Mortality** – Maternal and perinatal death are uncommon in case series from tertiary care centers where multispecialty expertise is usually available; however, these reports are prone to selection bias [39-41]. In a series of 442 patients with suspected PAS in the International Society of PAS database (2008 to 2019), there were no maternal deaths despite blood loss as high as 20,000 mL and 88 patients with placental invasion into the bladder or beyond (eg, pelvic side wall) [42]. Nonetheless, the authors are aware of maternal deaths that occur each year in high-income countries, most of which are unreported.

Postpartum placental histology — Postpartum histologic findings show placental villi anchored directly on, or invading into or through the myometrium, without an intervening decidual plate. The placenta is characterized as an accreta (picture 1), increta (picture 2), or percreta, depending on the greatest depth of myometrial invasion (superficial, deep, or penetrating the entire uterine wall), as the degree of villous adhesion or invasion is not always uniform [8]. The diagnosis of focal accreta may be confirmed in the absence of hysterectomy by identification of these findings in uterine curettings or in fragments of myometrium adherent to the placenta.

One group has developed a protocol for gross and microscopic pathologic examination of cases of suspected PAS, including correlation with clinical and radiologic findings [43]. The standard, detailed examination can be helpful for postpartum discussions with patients and for research.

PRENATAL SCREENING AND DIAGNOSIS

Prenatal screening and diagnosis are important so that the patient can be counseled about the suspected placental abnormality and an appropriate site and plan for delivery can be developed. Preoperative preparation, including availability of surgical and radiological expertise, blood components for transfusion, and appropriate equipment, improves outcome. In a meta-analysis (11 studies, 700 pregnancies), women with a predelivery diagnosis of PAS had significantly less blood loss (mean difference 0.9 L) and fewer red cell transfusions (mean difference 1.5 units) than women in whom the condition was diagnosed at delivery [44]. (See "Placenta accreta spectrum: Management".)

Candidates and procedure for screening — Women with a placenta previa or a low anterior placenta and prior uterine surgery should have thorough transabdominal and transvaginal sonographic evaluation of the interface

between the placenta and myometrium between approximately 18 and 24 weeks of gestation. At this gestational age, the prenatal diagnosis of PAS can be made or ruled out with close to 90 percent accuracy, although in population-based studies, prenatal diagnosis was not made in one-half to two-thirds of cases [45-47]. Consistent use of a targeted screening protocol may be helpful [48].

Ultrasound follow-up of patients with placenta previa or low anterior placenta is reviewed separately. (See "Placenta previa: Management", section on 'Monitoring placental position'.)

Prenatal diagnosis — PAS is highly likely in patients with placenta previa or a low lying placenta after one or more previous cesarean deliveries plus imaging studies suggestive of abnormal implantation, as described below (see 'Ultrasound findings' below). The diagnosis can be reasonably excluded when imaging studies suggest normal placental implantation.

Based on our experience with the management of hundreds of cases, we have found that placental lacunae (which appear as intraplacental sonolucent spaces) and disruption of the interface between the bladder wall-uterine serosa (ie, bladder line) are the most reliable diagnostic sonographic findings. Color flow Doppler demonstrating turbulent ("chaotic") lacunar flow and/or bridging vessels is a valuable confirmatory finding. If the ultrasound studies are inconclusive or ambiguous (eg, when the region of concern is not the anterior lower uterine segment, such as after myomectomy [49]), magnetic resonance imaging (MRI) may be performed to clarify the diagnosis if this will affect patient management; however, the utility of the additional information gained by MRI is uncertain. (See 'Ultrasound findings' below and 'Color Doppler' below and 'Magnetic resonance imaging (MRI)' below.)

Ultrasound findings — In the second and third trimesters, the following transabdominal and transvaginal sonographic findings have been associated with PAS; all of the findings need not be present [50-52]. Many of the findings can be obscured with posterior placental location.

- **Multiple placental lacunae** – Multiple large, irregular intraplacental sonolucent spaces (ie, placental lacunae) in the center of a lobule or cotyledon adjacent to the involved myometrium replace normal placental homogeneity that give the placenta a "moth-eaten" appearance. In a meta-analysis, sensitivity of lacunae for identifying placenta accreta, increta, and percreta was approximately 75, 89, and 76 percent, respectively, and specificities were approximately 97, 98, and 99 percent, respectively [53].

  A normal placenta can have vascular lakes, typically a few small, sonolucent spaces with a regular shape and normal underlying myometrial thickness (image 1). In contrast, the placental lacunae in PAS are more numerous and irregular in shape, and the underlying myometrium may be thinned (image 2). Although a partial hydatidiform mole has a "Swiss-cheese" appearance (image 3), the sonolucent spaces are small, distributed throughout the placenta, and have no blood flow.

- **Disruption of the bladder line** – Loss or disruption of the normally continuous white line representing the bladder wall-uterine serosa interface (termed the "bladder line") can be caused by placenta percreta or neovascularity related to placenta accreta or increta.

●**Loss of the clear zone** – The normal hypoechoic area behind the placenta (termed the "clear space" or "clear zone") (image 4) may be missing or irregular. This sign can be obscured by direct pressure from the ultrasound probe and bladder filling [8]. It can also be obscured with advancing gestational age.

  In a meta-analysis, sensitivity of loss of the clear zone in identifying placenta accreta, increta, and percreta was approximately 75, 92, and 88 percent, respectively; specificity was approximately 92, 77, and 71 percent, respectively [53].

- **Myometrial thinning** – The retroplacental myometrium can be thin due to either a prior hysterotomy scar or placental invasion. When the placenta overlies the region of thinning, then it is important to look for other signs of PAS (image 5A). For example, if the placenta is seen extending through the myometrium (ie, percreta), then

it is clearly an invasive placenta. However, it can be difficult (or even impossible) to sonographically distinguish placenta accreta from increta as the thin myometrium impedes assessment of the depth of invasion.

- **Abnormal vascularity** – Vessels that extend from the placenta through the myometrium either into the bladder or through the serosa elsewhere are a clear sign of placenta percreta.
- **Placental bulge** – A portion of the uterus attached to the abnormally adherent placenta can balloon into the bladder due to weakness of the underlying thin myometrium.
- **Exophytic mass** – A focal mass that breaks through the uterine serosa, usually extending into the bladder, is a sign of placenta percreta.

In a meta-analysis of 20 studies of prenatal sonographic identification of placenta accreta, increta, and percreta, the sensitivity for depth of placental invasion was approximately 91, 93, and 81 percent, respectively, and specificity was approximately 97, 98, and 99 percent, respectively [53]. Foreknowledge of the clinical setting may have contributed to these high figures as performance was much lower (sensitivity 53 percent) in a study in which a diverse group of ultrasound providers was blinded to the patient's clinical status (eg, clinical suspicion for accreta, prior knowledge of risk factors) [54]. Other limitations of the studies are that histopathologic correlation was not always performed or adequately described. In addition, it is difficult to compare results of studies since nomenclature is not standardized and sonographic assessment of the depth of villous invasiveness in the uterine wall is subjective, without established ultrasound criteria for distinguishing between different grades of adherent and invasive placentation [55]. Standardized terminology and criteria have been proposed by expert groups but are not widely used in the United States [56-59].

Color Doppler — Color Doppler is useful for confirming the diagnosis of PAS when used in conjunction with the other ultrasound findings described above. Specific findings on color Doppler ultrasonography that suggest this diagnosis include (image 5A-B) [60-64]:

- Turbulent lacunar blood flow
- Bridging vessels
- Diffuse or focal intraparenchymal flow
- Hypervascularity of serosa-bladder interface
- Prominent subplacental venous complex

Bridging vessels are placental vessels that extend through the myometrium and beyond the serosa into the bladder (or other organs). They should not be mistaken for bladder varices, which are enlarged maternal bladder veins and often seen in normal pregnancy.

In the meta-analysis described above, lacunar flow had sensitivities of approximately 81, 84, and 45 percent for the detection of placenta accreta, increta, and percreta, respectively; specificity was approximately 84, 80, and 75 percent, respectively [53]. Uterovesical hypervascularity for the detection of placenta accreta had low sensitivity (12 percent), but higher sensitivity for placenta increta (94 percent) and percreta (86 percent); specificity was 91, 88, and 88 percent, respectively. However, assessment of the performance of any individual sign is not clinically relevant since observation of one sign is likely to increase the chance of detecting others, and the signs are not evaluated in isolation.

Utility of additional imaging techniques — The role of the following imaging techniques in diagnosis of PAS has not been clearly determined.

Magnetic resonance imaging (MRI) — MRI may be more useful than ultrasound in three clinical scenarios: (1) evaluation of a possible posterior PAS because the bladder cannot be used to help clarify the placental-myometrial interface; (2) assessment of the depth of myometrial and parametrial involvement and, if the placenta is anterior, bladder involvement; and (3) evaluation of the myometrium and placenta at the most lateral portions of the hysterotomy as this area is not well visualized by transvaginal ultrasound, which images the central portion of the

myometrium and placenta [65,66]. However, increased accuracy beyond that noted with ultrasound is unproven, and one study noted that MRI was just as likely to change a correct ultrasound-based PAS diagnosis to an incorrect MRI diagnosis as it was to correctly revise an incorrect ultrasound-based PAS diagnosis [67]. Key factors for high diagnostic performance are ensuring that MRIs are interpreted in conjunction with the ultrasound findings and both are interpreted by physicians with expertise in this area.

If performed, one group considers 24 to 30 weeks the ideal gestational age for imaging invasive placentation with MRI as false positives and negatives are more likely earlier and later in gestation [68]. MRI is safe for the fetus, although the use of gadolinium, which may improve diagnostic performance [69], is generally avoided in pregnancy due to neurologic, inflammatory, and dermatologic complications to the fetus [70], as well as unknown effects of the small amount of gadolinium deposition in the fetus [71]. (See "Diagnostic imaging in pregnant and nursing patients", section on 'Use of gadolinium'.)

A panel of experts concluded that the following MRI findings are the most accurate predictors of placenta accreta (image 6A-C) [72]:

- Uterine bulging into the bladder ("placental/uterine bulge")
- Interruption of the bladder wall
- Loss of retroplacental hypointense line on T2W images
- Abnormal vascularization of the placental bed
- Dark intraplacental bands on T2W imaging ("T2-dark bands")
- Myometrial thinning
- Focal exophytic mass

An increased number of positive findings is predictive of a worse prognosis. In a study of 100 women with placenta previa who underwent MRI, presence of ≥3 of 15 MRI features considered suggestive of PAS was associated with an odds ratio (OR) >19 for a complicated delivery, and presence of ≥6 was associated with an OR >90 for massive bleeding at delivery [73].

In a 2018 systematic review and meta-analysis of 20 studies totaling 1080 pregnancies with ultrasound suspicion or presence of clinical risk factors for PAS, MRI had high diagnostic accuracy: for detection of placenta accreta, increta, and percreta, sensitivity was approximately 94, 100, and 87 percent, respectively; the corresponding values for specificity were approximately 99, 97, and 97 percent, respectively [74]. The accuracy of diagnosis with MRI is highly dependent on the expertise and experience of the radiologist interpreting the imaging study.

Three-dimensional power Doppler ultrasound — Three-dimensional ultrasound has been used successfully for evaluation of PAS [62,75]. Diagnostic criteria include:

- Irregular intraplacental vascularization with tortuous confluent vessels crossing placental width.
- Hypervascularity of uterine serosa-bladder wall interface.

In a study of 187 patients with placenta previa and a history of uterine surgery, 97 of 146 patients without confirmed PAS had none of the five two- or three-dimensional ultrasound findings associated with PAS and the remaining 49 patients had only one finding [75]. By comparison, none of the 41 patients with PAS (placenta accreta or worse) had zero or one of these findings; five had two findings and the remainder had three to five findings.

Another cohort study of 89 women noted 100 percent sensitivity with 92 percent specificity for three-dimensional power Doppler in the detection of PAS [76]. These findings are promising and should be assessed in larger populations to evaluate consistency and generalizability.

First-trimester ultrasound examination — PAS should be suspected if first-trimester ultrasound examination reveals implantation of the gestational sac in the lower anterior segment of the uterus, particularly in the niche of the prior cesarean delivery scar [77-82]. A retrospective cohort study of 467 women with a previous cesarean reported that transvaginal ultrasound between 11 and 14 weeks of gestation showing the placenta next to, on, or

inside the hysterotomy scar could potentially identify most of the eight cases of PAS [82]. Prospective and larger studies are needed to determine sensitivity and specificity and elucidate how this finding might influence patient counseling and follow-up in the future.

The characteristic second-trimester findings of placental lacunae (which appear as intraplacental sonolucent spaces) and disruption of the interface between the bladder wall-uterine serosa (ie, bladder line) also may be observed in the first trimester [83].

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Obstetric hemorrhage".)

SUMMARY AND RECOMMENDATIONS

- Placenta accreta spectrum (PAS) is a general term comprising placenta accreta, increta, and percreta. Women with PAS are at high risk of life-threatening hemorrhage at delivery. (See 'Introduction' above and 'Consequences' above.)
- In placenta accreta, the anchoring villi attach to the myometrium; in placenta increta, the villi invade into the myometrium; and in placenta percreta, the villi penetrate to or through the uterine serosa and may invade surrounding organs. (See 'Definitions' above.)
- PAS is generally a consequence of defective decidualization in an area of scarring caused by previous uterine surgery. Because of the defective decidua, the placenta can attach directly to, and sometimes into or through, the myometrium. (See 'Pathogenesis' above.)
- The most important risk factor for PAS is placenta previa after a prior cesarean delivery. PAS occurs in 11 percent of women with a placenta previa and one previous cesarean delivery. The risk increases substantially with increasing numbers of prior cesareans. Previous gynecologic uterine surgery is also a risk factor that should be considered, particularly among primigravidas. (See 'Risk factors' above.)
- Women with a placenta previa or a low anterior placenta and prior uterine surgery should have thorough transabdominal and transvaginal sonographic evaluation of the interface between the placenta and myometrium between approximately 18 and 24 weeks of gestation. At this gestational age, the prenatal diagnosis of PAS can be made or ruled out with close to 90 percent accuracy. The diagnosis can be reasonably excluded when imaging studies suggest normal placental implantation. (See 'Candidates and procedure for screening' above.)
- Ideally, PAS is first suspected because of findings on obstetric ultrasound examination while the patient is asymptomatic. The first clinical manifestation of PAS is either antenatal bleeding or profuse, life-threatening hemorrhage that occurs at the time of attempted manual placental separation. Part or all of the placenta remains strongly adherent to the uterine cavity, and no plane of separation can be developed. Accordingly, it is important to recognize the risk factors for PAS and attempt to make a prenatal diagnosis. (See 'Clinical presentation' above and 'Consequences' above.)
- Prenatal diagnosis of PAS is based upon the presence of characteristic findings on ultrasound examination, particularly in patients with placenta previa or a low-lying placenta after one or more previous cesarean deliveries. We have found that placental lacunae (which appear as intraplacental sonolucent spaces (image 5B)) and disruption of the interface between the bladder wall-uterine serosa (ie, "bladder line") are the most reliable sonographic diagnostic findings. In addition, the normal hypoechoic area behind the placenta

(termed the "clear space" or "clear zone") (image 4) may be missing or irregular, and the retroplacental myometrium may be thin.

Color flow Doppler demonstrating turbulent ("chaotic") flow and/or bridging vessels is a valuable confirmatory finding of PAS. (See 'Prenatal diagnosis' above.)

- Placenta percreta is suggested by ballooning of the retroplacental myometrium into the bladder, a retroplacental focal mass that breaks through the uterine serosa (especially if into the bladder), and vessels that extend from the placenta through the myometrium either into the bladder or through the serosa. Placenta percreta with bladder invasion can cause hematuria. (See 'Prenatal diagnosis' above and 'Possible laboratory findings' above.)

- Magnetic resonance imaging (MRI) is an adjunctive diagnostic tool when the diagnosis is uncertain, the placenta is posterior, or to gauge the extent of placental invasion if this will affect patient management. (See 'Magnetic resonance imaging (MRI)' above and 'Prenatal screening and diagnosis' above.)

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REFERENCES

1. Jauniaux E, Bunce C, Grønbeck L, Langhoff-Roos J. Prevalence and main outcomes of placenta accreta spectrum: a systematic review and meta-analysis. Am J Obstet Gynecol 2019; 221:208.
2. Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa-placenta accreta. Am J Obstet Gynecol 1997; 177:210.
3. Read JA, Cotton DB, Miller FC. Placenta accreta: changing clinical aspects and outcome. Obstet Gynecol 1980; 56:31.
4. Jauniaux E, Chantraine F, Silver RM, et al. FIGO consensus guidelines on placenta accreta spectrum disorders: Epidemiology. Int J Gynaecol Obstet 2018; 140:265.
5. Tantbirojn P, Crum CP, Parast MM. Pathophysiology of placenta creta: the role of decidua and extravillous trophoblast. Placenta 2008; 29:639.
6. Khong TY. The pathology of placenta accreta, a worldwide epidemic. J Clin Pathol 2008; 61:1243.
7. Jauniaux E, Jurkovic D. Placenta accreta: pathogenesis of a 20th century iatrogenic uterine disease. Placenta 2012; 33:244.
8. Jauniaux E, Collins S, Burton GJ. Placenta accreta spectrum: pathophysiology and evidence-based anatomy for prenatal ultrasound imaging. Am J Obstet Gynecol 2018; 218:75.
9. Einerson BD, Comstock J, Silver RM, et al. Placenta Accreta Spectrum Disorder: Uterine Dehiscence, Not Placental Invasion. Obstet Gynecol 2020; 135:1104.
10. Ben-Nagi J, Walker A, Jurkovic D, et al. Effect of cesarean delivery on the endometrium. Int J Gynaecol Obstet 2009; 106:30.
11. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. Obstet Gynecol 2006; 107:1226.
12. Nageotte MP. Always be vigilant for placenta accreta. Am J Obstet Gynecol 2014; 211:87.

13. Timor-Tritsch IE, Monteagudo A, Cali G, et al. Cesarean scar pregnancy is a precursor of morbidly adherent placenta. Ultrasound Obstet Gynecol 2014; 44:346.
14. Silver RM, Fox KA, Barton JR, et al. Center of excellence for placenta accreta. Am J Obstet Gynecol 2015; 212:561.
15. Kaser DJ, Melamed A, Bormann CL, et al. Cryopreserved embryo transfer is an independent risk factor for placenta accreta. Fertil Steril 2015; 103:1176.
16. Fitzpatrick KE, Sellers S, Spark P, et al. Incidence and risk factors for placenta accreta/increta/percreta in the UK: a national case-control study. PLoS One 2012; 7:e52893.
17. Hayashi M, Nakai A, Satoh S, Matsuda Y. Adverse obstetric and perinatal outcomes of singleton pregnancies may be related to maternal factors associated with infertility rather than the type of assisted reproductive technology procedure used. Fertil Steril 2012; 98:922.
18. Esh-Broder E, Ariel I, Abas-Bashir N, et al. Placenta accreta is associated with IVF pregnancies: a retrospective chart review. BJOG 2011; 118:1084.
19. Baldwin HJ, Patterson JA, Nippita TA, et al. Antecedents of Abnormally Invasive Placenta in Primiparous Women: Risk Associated With Gynecologic Procedures. Obstet Gynecol 2018; 131:227.
20. Salmanian B, Fox KA, Arian SE, et al. In vitro fertilization as an independent risk factor for placenta accreta spectrum. Am J Obstet Gynecol 2020; 223:568.e1.
21. Miller HE, Leonard SA, Fox KA, et al. Placenta Accreta Spectrum Among Women With Twin Gestations. Obstet Gynecol 2021; 137:132.
22. Linn RL, Miller ES, Lim G, Ernst LM. Adherent basal plate myometrial fibers in the delivered placenta as a risk factor for development of subsequent placenta accreta. Placenta 2015; 36:1419.
23. Heller DS, Wyand R, Cramer S. Recurrence of Basal Plate Myofibers, with Further Consideration of Pathogenesis. Fetal Pediatr Pathol 2019; 38:30.
24. Hung TH, Shau WY, Hsieh CC, et al. Risk factors for placenta accreta. Obstet Gynecol 1999; 93:545.
25. Khong TY, Healy DL, McCloud PI. Pregnancies complicated by abnormally adherent placenta and sex ratio at birth. BMJ 1991; 302:625.
26. James WH. Sex ratios of offspring and the causes of placental pathology. Hum Reprod 1995; 10:1403.
27. Carusi DA, Fox KA, Lyell DJ, et al. Placenta Accreta Spectrum Without Placenta Previa. Obstet Gynecol 2020; 136:458.
28. Kupferminc MJ, Tamura RK, Wigton TR, et al. Placenta accreta is associated with elevated maternal serum alpha-fetoprotein. Obstet Gynecol 1993; 82:266.
29. Zelop C, Nadel A, Frigoletto FD Jr, et al. Placenta accreta/percreta/increta: a cause of elevated maternal serum alpha-fetoprotein. Obstet Gynecol 1992; 80:693.
30. Shainker SA, Silver RM, Modest AM, et al. Placenta accreta spectrum: biomarker discovery using plasma proteomics. Am J Obstet Gynecol 2020; 223:433.e1.
31. Washecka R, Behling A. Urologic complications of placenta percreta invading the urinary bladder: a case report and review of the literature. Hawaii Med J 2002; 61:66.
32. Mehrabadi A, Hutcheon JA, Liu S, et al. Contribution of placenta accreta to the incidence of postpartum hemorrhage and severe postpartum hemorrhage. Obstet Gynecol 2015; 125:814.
33. Zelop CM, Harlow BL, Frigoletto FD Jr, et al. Emergency peripartum hysterectomy. Am J Obstet Gynecol 1993; 168:1443.
34. Glaze S, Ekwalanga P, Roberts G, et al. Peripartum hysterectomy: 1999 to 2006. Obstet Gynecol 2008; 111:732.
35. Morlando M, Schwickert A, Stefanovic V, et al. Maternal and neonatal outcomes in planned versus emergency cesarean delivery for placenta accreta spectrum: A multinational database study. Acta Obstet Gynecol Scand 2021; 100 Suppl 1:41.

36. Marcellin L, Delorme P, Bonnet MP, et al. Placenta percreta is associated with more frequent severe maternal morbidity than placenta accreta. Am J Obstet Gynecol 2018; 219:193.e1.
37. Gielchinsky Y, Mankuta D, Rojansky N, et al. Perinatal outcome of pregnancies complicated by placenta accreta. Obstet Gynecol 2004; 104:527.
38. Seet EL, Kay HH, Wu S, Terplan M. Placenta accreta: depth of invasion and neonatal outcomes. J Matern Fetal Neonatal Med 2012; 25:2042.
39. Warshak CR, Ramos GA, Eskander R, et al. Effect of predelivery diagnosis in 99 consecutive cases of placenta accreta. Obstet Gynecol 2010; 115:65.
40. Shamshirsaz AA, Fox KA, Salmanian B, et al. Maternal morbidity in patients with morbidly adherent placenta treated with and without a standardized multidisciplinary approach. Am J Obstet Gynecol 2015; 212:218.e1.
41. Grosvenor A, Silver R, Porter TF, Zempolich K. Optimal management of placenta accreta. Am J Obstet Gynecol 2007; 195:S82.
42. van Beekhuizen HJ, Stefanovic V, Schwickert A, et al. A multicenter observational survey of management strategies in 442 pregnancies with suspected placenta accreta spectrum. Acta Obstet Gynecol Scand 2021; 100 Suppl 1:12.
43. Dannheim K, Shainker SA, Hecht JL. Hysterectomy for placenta accreta; methods for gross and microscopic pathology examination. Arch Gynecol Obstet 2016; 293:951.
44. Buca D, Liberati M, Calì G, et al. Influence of prenatal diagnosis of abnormally invasive placenta on maternal outcome: systematic review and meta-analysis. Ultrasound Obstet Gynecol 2018; 52:304.
45. Fitzpatrick KE, Sellers S, Spark P, et al. The management and outcomes of placenta accreta, increta, and percreta in the UK: a population-based descriptive study. BJOG 2014; 121:62.
46. Bailit JL, Grobman WA, Rice MM, et al. Morbidly adherent placenta treatments and outcomes. Obstet Gynecol 2015; 125:683.
47. Thurn L, Lindqvist PG, Jakobsson M, et al. Abnormally invasive placenta-prevalence, risk factors and antenatal suspicion: results from a large population-based pregnancy cohort study in the Nordic countries. BJOG 2016; 123:1348.
48. Melcer Y, Jauniaux E, Maymon S, et al. Impact of targeted scanning protocols on perinatal outcomes in pregnancies at risk of placenta accreta spectrum or vasa previa. Am J Obstet Gynecol 2018; 218:443.e1.
49. Levine D, Hulka CA, Ludmir J, et al. Placenta accreta: evaluation with color Doppler US, power Doppler US, and MR imaging. Radiology 1997; 205:773.
50. Comstock CH. Antenatal diagnosis of placenta accreta: a review. Ultrasound Obstet Gynecol 2005; 26:89.
51. Finberg HJ, Williams JW. Placenta accreta: prospective sonographic diagnosis in patients with placenta previa and prior cesarean section. J Ultrasound Med 1992; 11:333.
52. Guy GP, Peisner DB, Timor-Tritsch IE. Ultrasonographic evaluation of uteroplacental blood flow patterns of abnormally located and adherent placentas. Am J Obstet Gynecol 1990; 163:723.
53. Pagani G, Cali G, Acharya G, et al. Diagnostic accuracy of ultrasound in detecting the severity of abnormally invasive placentation: a systematic review and meta-analysis. Acta Obstet Gynecol Scand 2018; 97:25.
54. Bowman ZS, Eller AG, Kennedy AM, et al. Accuracy of ultrasound for the prediction of placenta accreta. Am J Obstet Gynecol 2014; 211:177.e1.
55. Jauniaux E, Collins SL, Jurkovic D, Burton GJ. Accreta placentation: a systematic review of prenatal ultrasound imaging and grading of villous invasiveness. Am J Obstet Gynecol 2016; 215:712.
56. Bhide A, Sebire N, Abuhamad A, et al. Morbidly adherent placenta: the need for standardization. Ultrasound Obstet Gynecol 2017; 49:559.
57. Collins SL, Ashcroft A, Braun T, et al. Proposal for standardized ultrasound descriptors of abnormally invasive placenta (AIP). Ultrasound Obstet Gynecol 2016; 47:271.

58. Jauniaux E, Ayres-de-Campos D, Langhoff-Roos J, et al. FIGO classification for the clinical diagnosis of placenta accreta spectrum disorders. Int J Gynaecol Obstet 2019; 146:20.
59. Braun T, van Beekhuizen HJ, Morlando M, et al. Developing a database for multicenter evaluation of placenta accreta spectrum. Acta Obstet Gynecol Scand 2021; 100 Suppl 1:7.
60. Chou MM, Ho ES, Lee YH. Prenatal diagnosis of placenta previa accreta by transabdominal color Doppler ultrasound. Ultrasound Obstet Gynecol 2000; 15:28.
61. Twickler DM, Lucas MJ, Balis AB, et al. Color flow mapping for myometrial invasion in women with a prior cesarean delivery. J Matern Fetal Med 2000; 9:330.
62. Shih JC, Palacios Jaraquemada JM, Su YN, 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.
63. Berkley EM, Abuhamad AZ. Prenatal diagnosis of placenta accreta: is sonography all we need? J Ultrasound Med 2013; 32:1345.
64. Comstock CH, Bronsteen RA. The antenatal diagnosis of placenta accreta. BJOG 2014; 121:171.
65. Maldjian C, Adam R, Pelosi M, et al. MRI appearance of placenta percreta and placenta accreta. Magn Reson Imaging 1999; 17:965.
66. Kirkinen P, Helin-Martikainen HL, Vanninen R, Partanen K. Placenta accreta: imaging by gray-scale and contrast-enhanced color Doppler sonography and magnetic resonance imaging. J Clin Ultrasound 1998; 26:90.
67. Einerson BD, Rodriguez CE, Kennedy AM, et al. Magnetic resonance imaging is often misleading when used as an adjunct to ultrasound in the management of placenta accreta spectrum disorders. Am J Obstet Gynecol 2018; 218:618.e1.
68. Kilcoyne A, Shenoy-Bhangle AS, Roberts DJ, et al. MRI of Placenta Accreta, Placenta Increta, and Placenta Percreta: Pearls and Pitfalls. AJR Am J Roentgenol 2017; 208:214.
69. Millischer AE, Salomon LJ, Porcher R, et al. Magnetic resonance imaging for abnormally invasive placenta: the added value of intravenous gadolinium injection. BJOG 2017; 124:88.
70. Ray JG, Vermeulen MJ, Bharatha A, et al. Association Between MRI Exposure During Pregnancy and Fetal and Childhood Outcomes. JAMA 2016; 316:952.
71. McDonald RJ, Levine D, Weinreb J, et al. Gadolinium Retention: A Research Roadmap from the 2018 NIH/ACR/RSNA Workshop on Gadolinium Chelates. Radiology 2018; 289:517.
72. Jha P, Põder L, Bourgioti C, et al. Society of Abdominal Radiology (SAR) and European Society of Urogenital Radiology (ESUR) joint consensus statement for MR imaging of placenta accreta spectrum disorders. Eur Radiol 2020; 30:2604.
73. Bourgioti C, Zafeiropoulou K, Fotopoulos S, et al. MRI prognosticators for adverse maternal and neonatal clinical outcome in patients at high risk for placenta accreta spectrum (PAS) disorders. J Magn Reson Imaging 2019; 50:602.
74. Familiari A, Liberati M, Lim P, et al. Diagnostic accuracy of magnetic resonance imaging in detecting the severity of abnormal invasive placenta: a systematic review and meta-analysis. Acta Obstet Gynecol Scand 2018; 97:507.
75. Calì 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.
76. Collins SL, Stevenson GN, Al-Khan A, et al. Three-Dimensional Power Doppler Ultrasonography for Diagnosing Abnormally Invasive Placenta and Quantifying the Risk. Obstet Gynecol 2015; 126:645.
77. Comstock CH, Lee W, Vettraino IM, Bronsteen RA. The early sonographic appearance of placenta accreta. J Ultrasound Med 2003; 22:19.
78. Stirnemann JJ, Mousty E, Chalouhi G, et al. Screening for placenta accreta at 11-14 weeks of gestation. Am J Obstet Gynecol 2011; 205:547.e1.

79. Calí G, Timor-Tritsch IE, Forlani F, et al. Value of first-trimester ultrasound in prediction of third-trimester sonographic stage of placenta accreta spectrum disorder and surgical outcome. Ultrasound Obstet Gynecol 2020; 55:450.

80. Happe SK, Rac MWF, Moschos E, et al. Prospective First-Trimester Ultrasound Imaging of Low Implantation and Placenta Accreta Spectrum. J Ultrasound Med 2020; 39:1907.

81. Rac MW, Moschos E, Wells CE, et al. Sonographic Findings of Morbidly Adherent Placenta in the First Trimester. J Ultrasound Med 2016; 35:263.

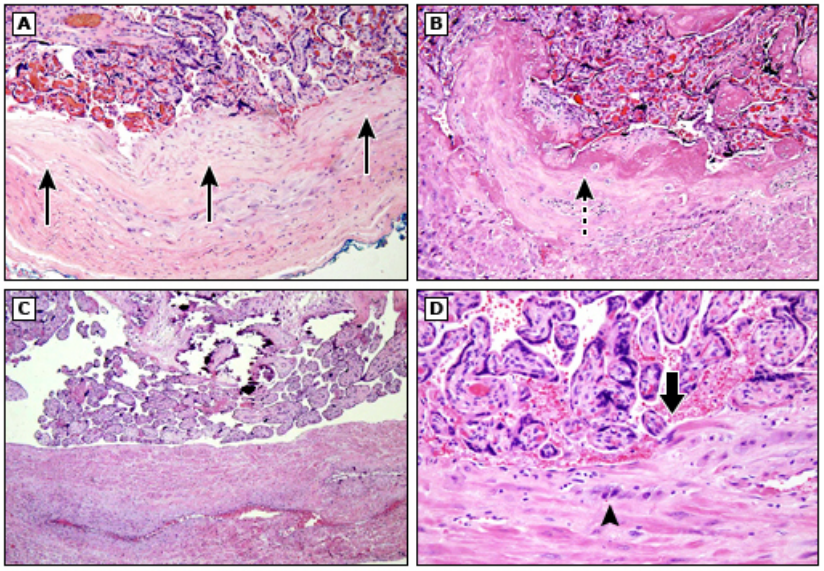
82. Doulaveris G, Ryken K, Papathomas D, et al. Early prediction of placenta accreta spectrum in women with prior cesarean delivery using transvaginal ultrasound at 11 to 14 weeks. Am J Obstet Gynecol MFM 2020; 2:100183.

83. Ballas J, Pretorius D, Hull AD, et al. Identifying sonographic markers for placenta accreta in the first trimester. J Ultrasound Med 2012; 31:1835.

Topic 6759 Version 63.0

GRAPHICS

Placenta accreta

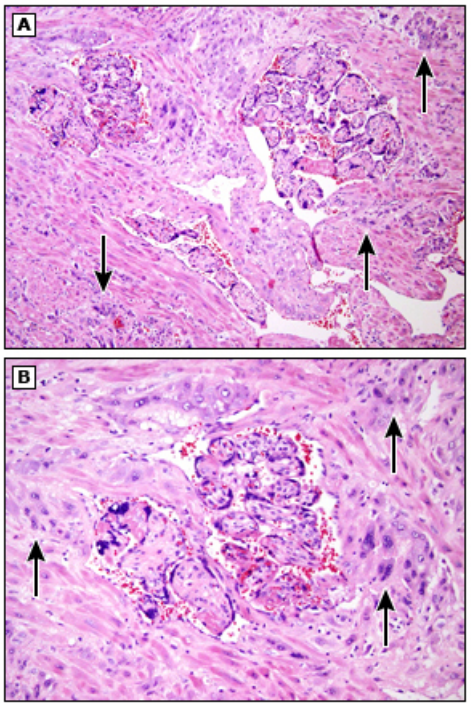


(A) Villi have implanted in scar tissue (arrows), which replaced the endometrium in an area of thinned myometrium. Placenta accretas often occur at the site of prior cesarian sections.
(B) Note the layer of dense pink fibrinoid covering the scar (dashed arrow). The presence of fibrinoid material between villi and myometrial tissue does not exclude a diagnosis of placenta accreta.
(C) Villi are immediately adjacent to underlying myometrium without any intervening decidua.
(D) Villi in direct contact with myometrium (thick arrow). Note the implantation site trophoblast (arrowhead), which can be mistaken for decidua.

Courtesy of Miriam D Post, MD.

Graphic 60800 Version 3.0

Placenta increta

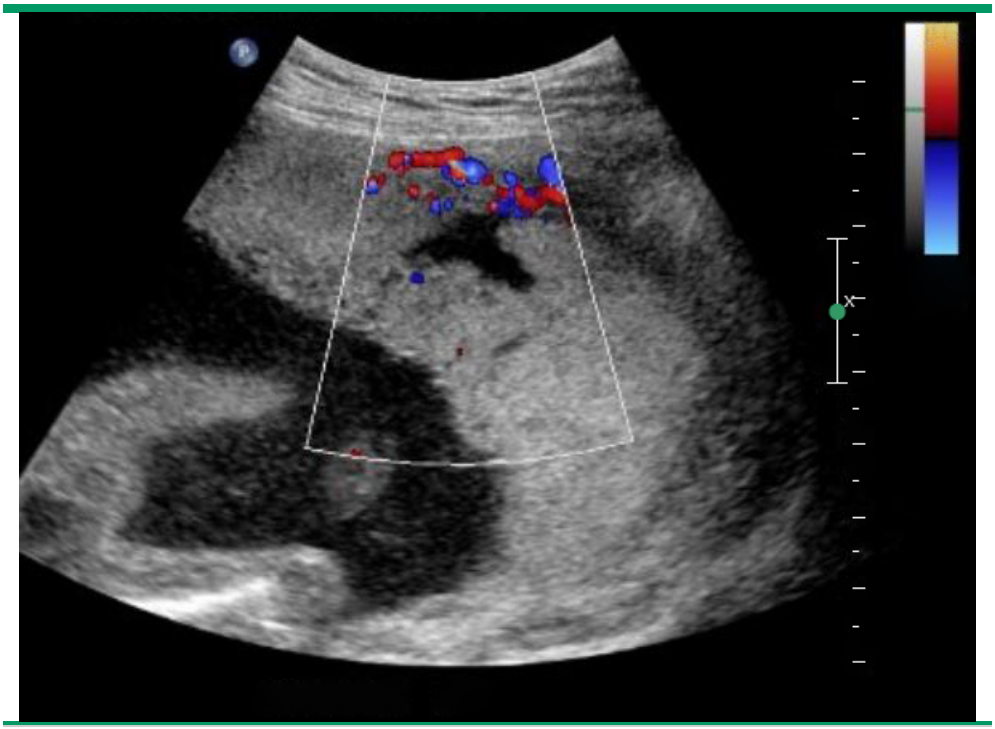


(A) Clusters of villi are entirely surrounded by myometrium without intervening decidua. Implantation site trophoblast can be seen scattered throughout the myometrium (arrows).
(B) Higher power of panel A.

Courtesy of Miriam D Post, MD.

Graphic 73597 Version 2.0

Single venous lake in a normal placenta

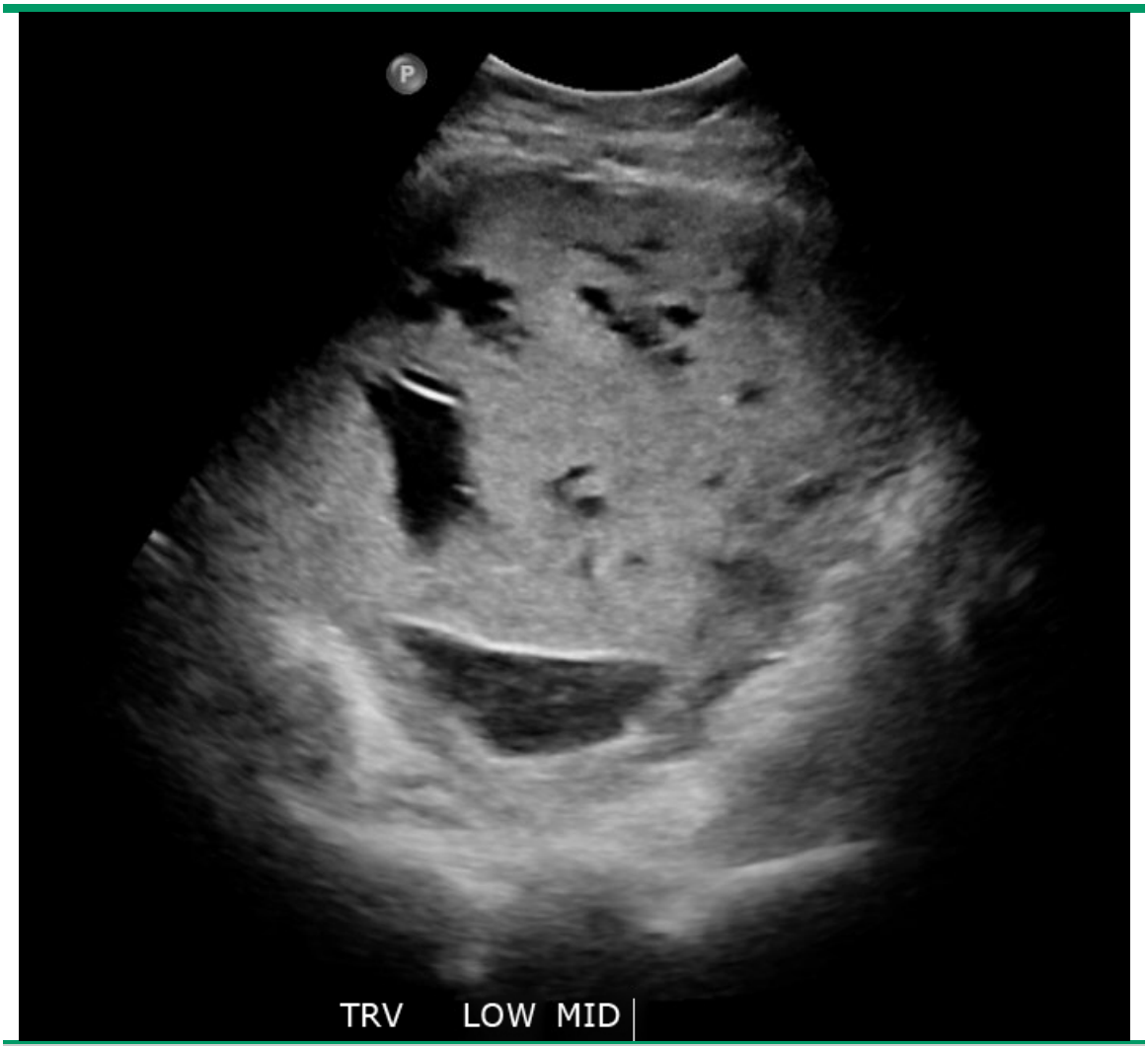


A normal placenta can have vascular lakes, typically a few small, sonolucent spaces with a regular shape and normal underlying myometrial thickness.

Courtesy of Deborah Levine, MD.

Graphic 117180 Version 1.0

Multiple, irregular placental lacunae in placenta accreta

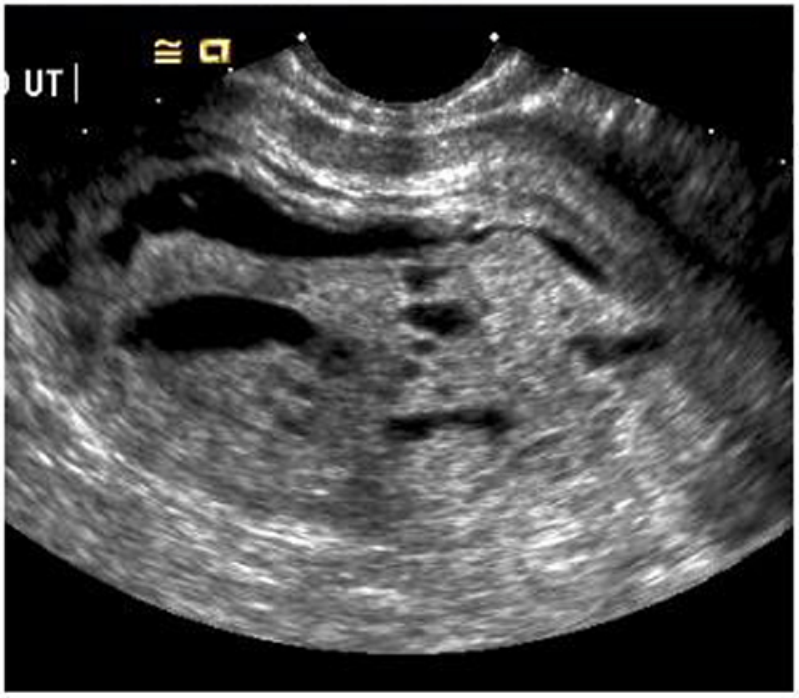


The placental lacunae in placenta accreta are numerous, irregular in shape, and the underlying myometrium may be thinned.

Courtesy of Deborah Levine, MD.

Graphic 117181 Version 1.0

Ultrasound image of partial hydatidiform mole

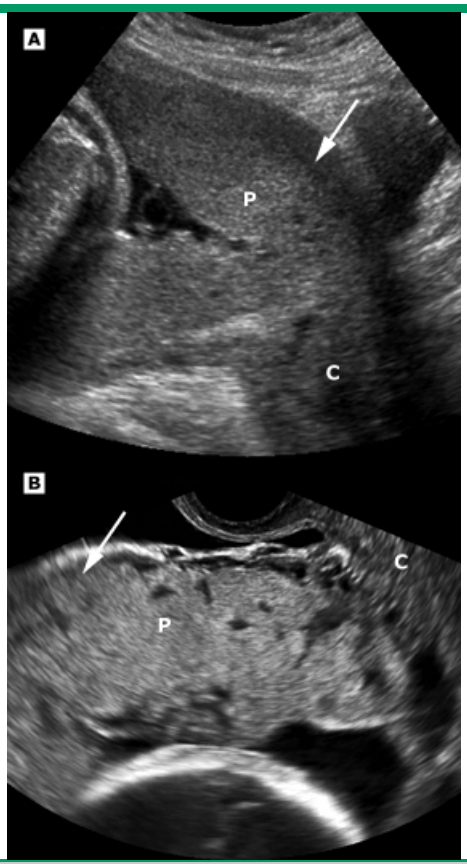


Partial hydatidiform mole: Ultrasound shows endometrial cavity filled with a partially solid and partially multicystic mass measuring 7.5 x 5.5 x 4.4 cm. Focal anechoic spaces can be seen.

Courtesy of Department of Radiology, Santa Clara Valley Medical Center.

Graphic 79947 Version 4.0

Sonogram of placenta previa and placenta previa accreta

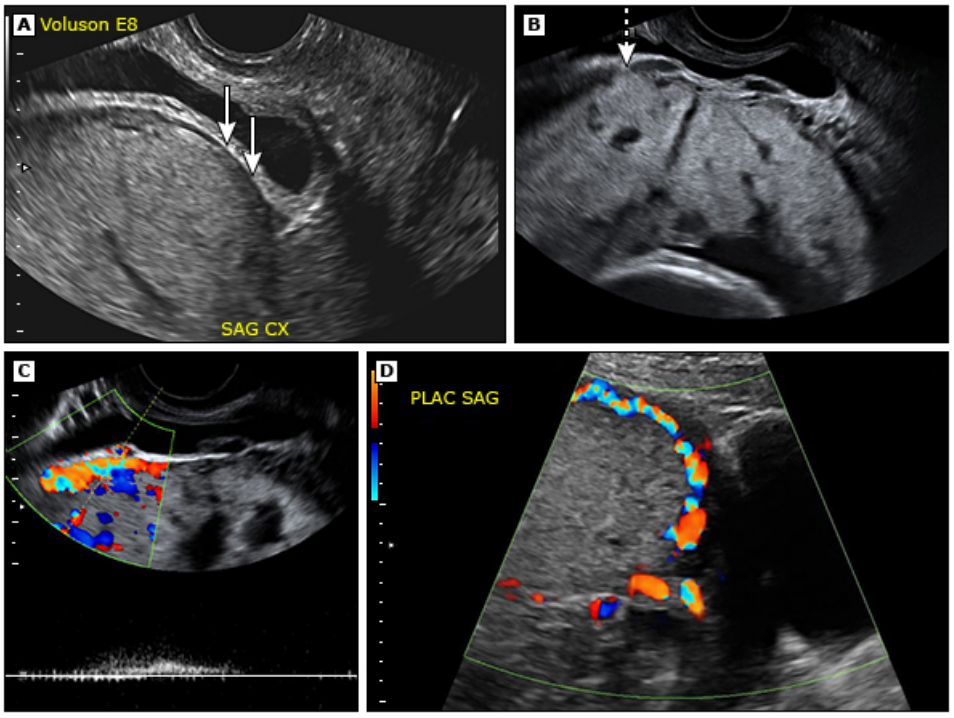


(A) Placenta previa. Sagittal transabdominal scan shows the placenta (P) centered over the cervix (C). There is a normal hypoechoic area between the placenta and the bladder.
(B) Placenta previa accreta in a different patient from (A). Oblique sagittal transvaginal scan shows the placenta (P) centered over the cervix (C). Note how the placenta invades the myometrium, with loss of the hypoechoic layer of myometrium (arrow), which can be seen in the above panel where the previa is not complicated by accreta.

Courtesy of Deborah Levine, MD.

Graphic 63825 Version 5.0

Ultrasound and Doppler images of placenta accreta

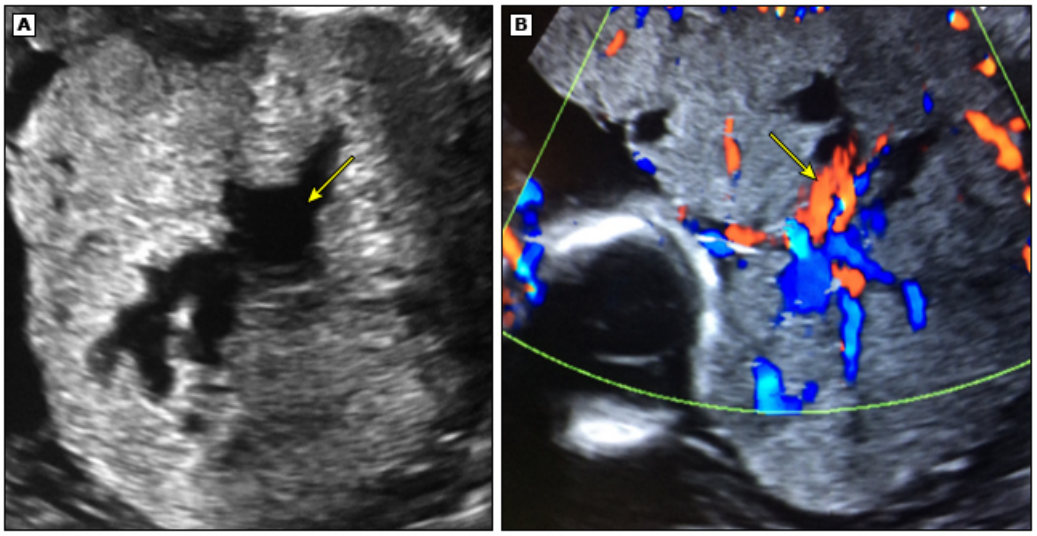


Placenta previa with accreta (A) Transvaginal image of the lower uterine segment in a patient with placenta previa shows a thin myometrium (arrows) in the region of prior cesarean delivery scar. This is either due to thinning in the region of prior cesarean scar or due to placenta accreta. In women with findings of a thinned myometrium we recommend measuring the extent of the thin myometrium in sagittal and transverse planes. (B) and (C) Transvaginal grey scale and color Doppler images of the lower uterine segment in a patient with placenta previa and prior cesarean delivery show enlarged vascular spaces within the placenta and a focal mass invading the myometrium (dashed arrow) compatible with placenta accreta. Note the hypervascularity at the serosa-bladder interface.

Placenta previa without accreta (D) For comparison, color Doppler of the lower uterine segment in a patient with placenta previa and no accreta. Note the vascular structures between the placenta and the bladder wall. The flow appears normal, without turbulence, and there is no crossing of vessels into the placental tissue. Also, note there are no placental sonolucencies and no evidence of a "bulge" into the bladder wall.

Graphic 83270 Version 4.0

Placental lacunae in placenta increta

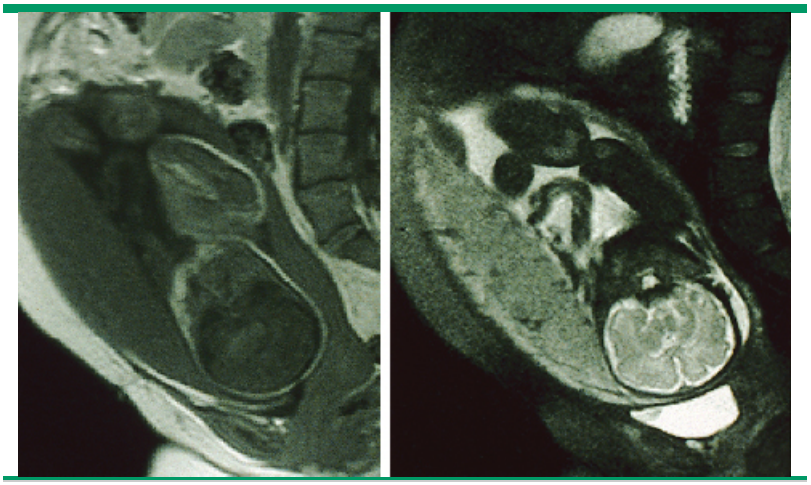


A transverse transabdominal ultrasound (A) demonstrates tortuous placental lacunae (arrow) confirmed on the color flow Doppler study (B, arrow).

Courtesy of Ronak Patel, MD.

Graphic 97402 Version 3.0

Magnetic resonance image of normal placental attachment (no accreta)

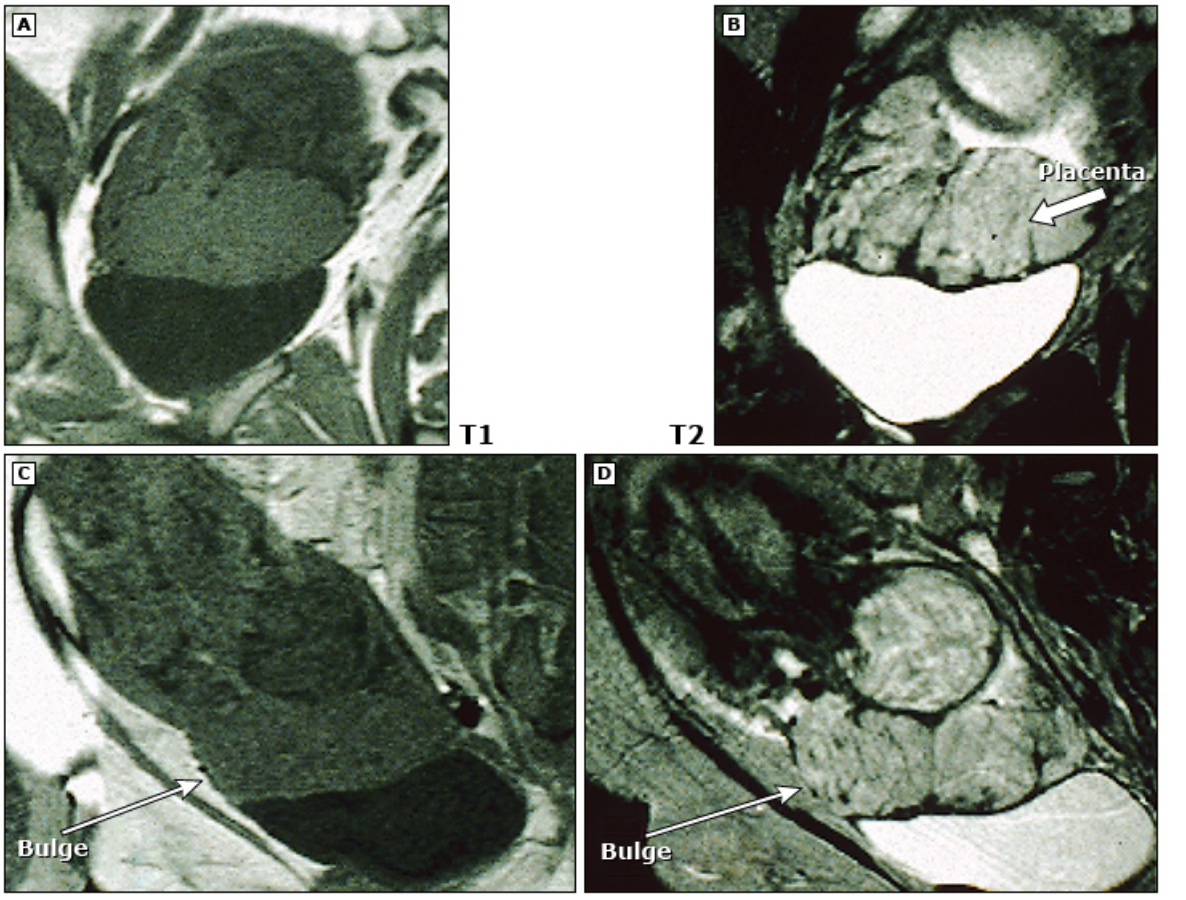


Note homogeneity of the placental mass, no "bulging" of the placenta toward the bladder, and the well delineated uterine wall.

Courtesy of Robert Resnik, MD.

Graphic 81005 Version 2.0

Magnetic resonance image suggestive of placenta accreta

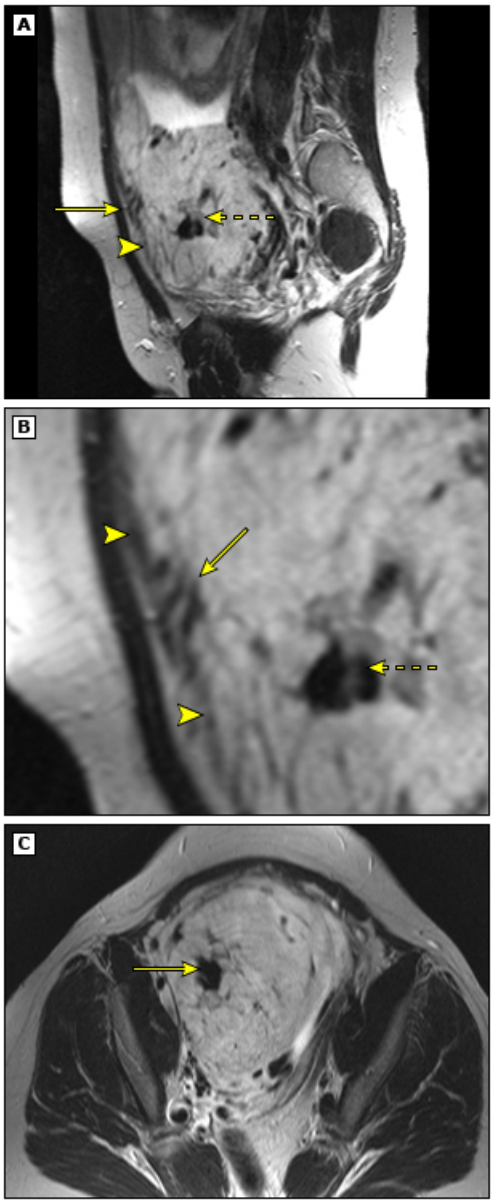


Note the placental "bulge," loss of the continuity of the uterine wall, and the dark intraplacental bands.

Courtesy of Robert Resnik, MD.

Graphic 61154 Version 4.0

Placenta increta on MRI



Sagittal T2-weighted images through the placenta (A) show an abnormal uterine contour (arrow) with discontinuity of the hypointense inner myometrial layer (arrowhead). T2 low-signal placental bands are also noted (arrowhead). Image B is a magnified view of image A and shows the normal hypointense myometrium (arrowhead) with discontinuity of the muscle layer and an abnormal uterine contour (arrow). The outer layer of the myometrium is intact. There are thick and irregular placental bands (dashed arrow). Placenta increta was documented at delivery. Axial T2 images through the placenta demonstrate T2 low-signal placental bands, which are irregular and thicker than normal placental septae.

MRI: magnetic resonance imaging.

Courtesy of Ronak Patel, MD.

Graphic 97403 Version 3.0

Contributor Disclosures

Robert M Silver, MD Nothing to disclose **Deborah Levine, MD** Nothing to disclose **Lynn L Simpson, MD** Nothing to disclose **Vanessa A Barss, MD, FACOG** Nothing to disclose

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

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