Using ultrasound in the clinical management of placental implantation abnormalities

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Placental implantation abnormalities, including placenta previa, placenta accreta, vasa previa, and velamentous cord insertion, can have catastrophic consequences for both mother and fetus, especially as pregnancy progresses to term. In these situations, current recommendations for management usually call for an indicated preterm delivery even in asymptomatic patients. However, the recommended gestational age(s) for delivery in asymptomatic patients are empirically determined without consideration of the recent literature regarding the usefulness of specific ultrasound findings to help individualize management. The purpose of this article is to propose literature-supported guidelines to the current opinion-based management of asymptomatic patients with placental implantation abnormalities based on relevant and specific ultrasound findings such as cervical length, distance between the internal cervical os and placenta, and placental edge thickness.

Key words: bleeding, hemorrhage, imaging, marginal or low-lying previa, placenta accreta, placenta previa, pregnancy, sonography, vasa previa, velamentous umbilical cord insertion

The most common placental implantation abnormalities (PIAs) are placenta previa (complete or incomplete), marginal/low-lying placenta, placenta accreta, vasa previa, and velamentous cord insertion.[1-4] After ischemic placental disease (preeclampsia, intrauterine growth restriction, and placental abruption), PIAs are the second most common cause for indicated preterm delivery. Importantly, PIAs account for 5.6-8.7% of indicated preterm deliveries at <35 weeks' gestation.[5] In symptomatic patients the timing and severity of symptomatology (ie, bleeding, labor, rupture of membranes) determines the gestational age at delivery. Even in asymptomatic patients, preterm delivery is recommended in virtually every case to avoid maternal and/or fetal complications.[6-8] However, the risk(s) for prolonging pregnancy in asymptomatic patients may not be the same for all patients according to recent literature.

Therefore, we undertook a PubMed search (Nov. 10, 2014) using combinations of key words of "placenta previa," "low-lying/marginal placenta" and "vasa previa" as related to "sonography," "cervical length," "internal os to placenta distance," and "placental thickness." The initial search provided 123 articles in the English language; 15 of these[9-23] correlated pregnancy outcome with sonographically determined cervical length, distance between internal cervical os and placenta, and/or placental edge thickness. These articles were used, along with the authors' experience, to formulate a proposed guideline for managing asymptomatic patients with PIAs.

PIA identification

The ultrasound identification of a PIA usually starts with the second-trimester fetal anatomic scan, which is most optimally performed at 18-22 weeks. One exception is a cesarean scar pregnancy, which can be detected in first-trimester ultrasound examinations.[24-26] If at any time during gestation there is suspicion for placenta previa, low-lying placenta, or difficulty in transabdominal visualization of the entire placenta, a transvaginal examination may be considered for an accurate diagnosis. Transvaginal ultrasound can also assist in evaluating suspected invasive placental implantations when the invasive area is at or near the lower uterine segment and cervix. If a PIA is confirmed by transvaginal ultrasound and/or color Doppler, follow-up examinations will help to determine the evolving relationship between placental or umbilical vessel location and internal cervical os, placental edge thickness and architecture, and cervical length. The characteristics of these ultrasound features may differentiate between the patients who are at the highest risk for developing symptoms and need closer monitoring vs those asymptomatic patients who can safely continue their pregnancies as close to term as possible. Suggested guidelines for individualized management of asymptomatic patients diagnosed with PIAs, based on the published literature, are described below.

Placenta previa with or without placenta accreta

The most common risk factor for placenta previa is when at the second-trimester ultrasound screening examination the internal cervical os is found to be covered completely or partially by

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Received Jan. 7, 2015; revised April 2, 2015; accepted May 26, 2015.

The authors report no conflict of interest.

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0002-9378/$36.00

http://dx.doi.org/10.1016/j.ajog.2015.05.059

placenta. Another risk factor for placenta previa is a history of ≥1 cesarean deliveries.[1,27,28] Ananth et al[27] reported relative risks for placenta previa of 4.5, 7.4, 6.5, and 44.9 for 1, 2, 3, and ≥4 previous cesarean deliveries. This translates to an exponential increase in the risk of placenta previa from a baseline of 0.26% with no prior uterine incision, to 0.65%, 1.8%, 3.0%, and 10% with 1, 2, 3, and ≥4 prior cesarean deliveries, respectively.[28]

In the presence of both prior cesarean delivery and placenta previa there is a strong likelihood of having an invasive placenta such as a placenta accreta, increta, or percreta. When there is a placenta previa, the risk of an invasive placenta also increases with increasing number of cesarean deliveries from a baseline of 4.5-5% (no prior cesarean delivery) to 3-24%, 11-47%, 40%, and 61-67% with 1, 2, 3, and ≥4 prior cesarean deliveries, respectively.[28,29] Another risk factor for placenta accreta is the cesarean scar pregnancy, which is most commonly diagnosed by first-trimester transvaginal sonography.[24-26] Cesarean scar pregnancies, if managed expectantly, result in an indicated preterm birth and hysterectomy in nearly all cases due to placenta accreta.[26] A detailed description of the ultrasound diagnostic criteria of placenta accreta is beyond the scope of this article. Briefly, the most specific diagnostic criterion/characteristic is the presence of placenta previa (or low-lying placenta) associated with prominent intraplacental vascular lesions close to the basal plate; additional findings may include absence of the hypoechoic area between myometrium and placenta; absence of the hyperechoic uterine serosa-bladder interface; and demonstration of blood vessels crossing from the myometrium to the posterior bladder wall.[30,31]

There is considerable overlap among placenta previa, invasive placentas, and cesarean scar pregnancies. However, we have chosen not to address all issues related to invasive placentas, but have elected to include them in this article in the context of a co-existent placenta previa.

Regardless of the presence or absence of accreta at the second-trimester ultrasound screening examination, in all cases of placenta previa, consideration should be given for an early third-trimester ultrasound examination (at 28-32 weeks) to confirm or rule out the diagnosis. If there is no placenta previa, an attempt may be made at 28-32 weeks to rule out marginal/low-lying placenta and vasa previa since placenta previa at midtrimester has been shown to be one of the precursors of vasa previa.[7,8]

After the 28- to 32-week ultrasound examination, the management of asymptomatic patients with placenta previa (with or without suspected accreta) may be based on weekly or biweekly ultrasound cervical length and placental edge thickness measurements. These 2 ultrasound parameters may be used as predictors of antepartum hemorrhage and need for preterm cesarean delivery.

Ghi et al[15] were the first to report that in patients with placenta previa, cervical length measurements at the third trimester can be used to predict antepartum bleeding and need for emergency preterm cesarean delivery. In that study, the best cervical length cutoff was ≤31 mm based on a receiver operating characteristic curve. The sensitivity, specificity, and positive and negative predictive values were 83%, 77%, 48%, and 95%, respectively, for predicting emergency cesarean delivery <34 weeks' gestation. Using a very similar cervical length cutoff, Stafford et al[16] found that women with cervical length ≤30 mm had higher rate of antepartum bleeding requiring delivery (79% vs 28%; $P < .001$), preterm birth (69% vs 21%; $P < .001$), and cesarean hysterectomy due to placenta accreta (31% vs 8%; $P = .016$). Approximately 80% of the patients with cervical length >30 mm went to term (≥37 weeks) as compared to only 31% of those with cervical lengths ≤30 mm ($P < .001$), the probability of bleeding necessitating delivery ranging from as low as 10-20% for cervical lengths of 50-60 mm and as high as 60-100% for cervical lengths <10-15 mm.[16] Sekiguchi et al,[19] who followed patients with placenta previa with serial cervical length measurements until 37-38 weeks' gestation, reported similar findings. They chose a cervical length cutoff of ≤35 mm to differentiate between those who required preterm cesarean delivery vs those who went to term. However, they also analyze their data according to various cervical length cutoffs; 72% (33/46) of patients with cervical length >30 mm went to term as compared to only 28% (13/46) when the cervix was ≤30 mm (odds ratio, 3.81; 95% confidence interval, 1.37−10.62; $P = .018$).[19] Zaitoun et al[17] reported similar findings regarding the value of cervical length as predictor of bleeding. They found that patients with placenta previa and cervical length >30 mm had fewer emergency cesarean deliveries <36 weeks (10% vs 46%, $P = .002$) and higher mean birthweights (2.8 vs 1.9 kg, $P = .003$) as compared to those with cervical lengths ≤30 mm.[17] Similar findings were reported by Fukushima et al[18] where 77% of patients with placenta previa and cervical length >30 mm delivered >37 weeks as compared to only 50% of those with cervical length ≤30 mm who required emergency cesarean delivery due to bleeding <37 weeks' gestation ($P = .04$); an additional finding was that a short cervix (≤30 mm) was associated with morbidly adherent placenta requiring cesarean hysterectomy in 35% of the cases as compared to only 6% in those with cervical length >30 mm ($P = .004$).

In addition to cervical length, placental edge thickness has been evaluated as a predictor of antepartum bleeding and preterm delivery.[17,20] Studies have shown that patients with placenta previa with "thick" placental edges over the internal os (>1 cm thickness), as compared to those with thin placental edges over the internal os (≤1 cm) have a significantly higher frequency of antepartum hemorrhage episodes (3.8 ± 1.6 vs 1.6 ± 0.7), require more emergency cesarean deliveries <36 weeks (53% vs 26%; $P = .002$), require more blood transfusions (2.4 ± 2.6 vs 1.03 ± 1.3 U; $P = .004$), and have lower mean birthweight (1.93 ± 0.47 vs 2.72 ± 0.86 kg; $P = .006$).[17,20] If an echo-free or spongelike space is identified