Abnormal Placentation as a Cause for Vaginal Bleeding in Pregnancy

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Case Presentation

A 36-year-old G3P2002 woman at 26 weeks and 6 days’ gestational age (GA) with a history of two prior cesarean sections, presented to a labor and delivery department with vaginal bleeding. Due to an abnormal prenatal ultrasound, the patient recently underwent fetal MRI for further evaluation of ultrasound findings (Figures A-D). Upon presentation, fetal and maternal vital signs were stable. During the observation period, the patient developed persistent contractions despite magnesium sulfate administration. She subsequently was taken to the operating room at 28 weeks’ GA for a third cesarean section.

FIGURE 1. Unenhanced MRI of the pelvis with attention to the gravid uterus obtained at 26+1 weeks’ gestational age. (A, B) Sagittal T2 half-Fourier acquisition single-shot turbo spin-echo (HASTE), (C) coronal T2 HASTE and (D) coronal T1 fat-saturated volumetric interpolated breath-hold examination (VIBE). (A) A focal bulge is identified in the anterior lower uterine segment at the level of placental implantation with focal areas of disruption of the normal outer myometrium (white bracket) and focal tenting of the urinary bladder at the dome (yellow arrow). (B, C) The uterus has an hourglass configuration (white arrows) and thick low T2 signal intraplacental bands (red arrows in B). (C, D) Heterogeneous T2 hypointense and T1 hyperintense collection in the lower uterine segment represents a hematoma (black asterisks).
Differential Diagnosis

Placenta previa
Morbidly adherent placenta
( accreta vera/increta/percreta)
Vasa previa
Placental abruption

Discussion

A normal placenta is discoid in shape, 2-4 cm thick and is embedded within the anterior, posterior, or fundal uterine wall at least 2 cm from the internal cervical os. On MRI, the placenta has a homogenous, intermediate T2 signal with clear distinction from the adjacent myometrium and smooth linear regions of hypointensity throughout. The myometrium is characterized by 3 distinct layers on T2-weighted sequences: thin hypointense inner and outer layers with a thicker intermediate signal middle layer. These layers become more difficult to differentiate as the myometrium thins with progression of pregnancy. The gravid uterus is normally smooth in contour with the uterine fundus greater in diameter in relation to the lower uterine segment.

Placenta previa and morbidly adherent placenta (MAP), previously known as placenta accreta spectrum, are key differential diagnoses of abnormal placenta- tion. Prevalence of these conditions has been increasing in the United States alongside increasing numbers of cesarean sections. Intact decidua basalis tissue is necessary for normal placenta- tion; therefore, any prior trauma predisposes a pregnant woman to placental abnormalities. The risk factors for both placenta previa and MAP are prior cesarean sections or other uterine surgery including myomectomy, dilatation and curettage, in addition to congenital uterine anomalies and advanced maternal age. Initial ultrasound diagnosis is usually made at 18 to 20 weeks gestation with further MR imaging indicated in challenging or equivocal cases, such as if the placenta is difficult to visualize secondary to a poor acoustic window, overlying bowel gas and/or placental positioning. Additionally, MRI offers superior soft-tissue contrast that is helpful in surgical planning of confirmed cases of MAP.

Placenta Previa

Implantation of the placenta within the lower uterine segment near the internal cervical os results in a low-lying marginal placenta or placenta previa. The two conditions are within the same spectrum with distinction made by the proximity of the placental edge to the internal os. A low-lying placenta is within 2 cm of the os while full extension over the os defines previa. Ultrasound is di- agnostic, although an increased rate of false positives is seen during the second trimester of pregnancy as the placenta shifts during the third trimester with increased uterine distention.

Morbidly Adherent Placenta

MAP encompasses a spectrum of abnormal chorionic villi invasion into the myometrium. The spectrum consists of accreta vera, the mildest and most common, with limited superficial invasion of the myometrium; increta, defined by further extension into the myome- trium; and percreta, the most severe form, with penetration of both the myometrium and serosa, and potential extension into adjacent structures. Clinical diagnosis is usually made at delivery, at which time placental detachment fails, resulting in bleeding and potential need for a hysterectomy. Other severe complications include disseminated intravascular coag- ulopathy, acute respiratory distress syn- drome (ARDS), renal failure and even death. MR imaging is highly sensitive and specific for the diagnosis of MAP, providing pertinent anatomic detail that can optimize patient management by planning the ideal timing and location of delivery, need for interdiscipli- nary involvement and/or availability of blood products. Additionally, intrapartum di- agnostics can prepare the patients and their families for potential complications with significant future implications.

The imaging findings associated with the spectrum of MAP utilize the knowledge of normal appearance of the placenta to identify the different aspects of abnormal placentation. As stated, the myometrium has distinct layers and signal intensities; MAP causes interruption of the smooth utero-placental interface with focal defects and thinning of the layers, particularly the outermost layer. This finding unfortunately can be diffi- cult to detect if the myometrium is diffusely thinned secondary to pregnancy progression; it is also nonspecific in regions of prior cesarean section scar tissue. In contrast, thick T2 hypointense intraplacental bands are highly sensitive for MAP. Although the pathophysiology of the finding is not completely known, it is thought to relate to fibrin deposition secondary to hemorrhage, with increased band volume and heterogeneity corresponding to the increasing degree of invasion. The placenta can also be abnormally thickened with increased vascularity; this results in increased flow voids on T2 imaging. The abnormal vessels measure at least 6 mm in diameter and have corresponding hypointensity on balanced steady-state free precession (SSFP) sequences, secondary to vessel hypertrophy.

An irregular uterine contour with focal bulging and deviation from the normal pear-like shape, is highly indicative of placental invasion. This abnormal uterine configuration consists of widening of the lower uterine segment, creating an “hourglass” uterus. Additionally, loss of definite tissue planes adjacent to the myometrium indicates placenta percreta. As the placenta infiltrates through the uterine serosa, the bladder becomes the most frequent target for further invasion. The key imaging feature for this diagnosis is urinary bladder wall tenting.

Vasa Previa

Vasa previa is associated with high fetal mortality rates (approximately 60%) and is defined by abnormal fetal vessels overlying the internal cervical os. The vessels are unsupported by the umbilical cord or the placenta and are vulnerable to tearing, especially upon rupture of membranes. Painless vaginal bleeding is the presenting symptom,
with an incidence rate of 1:2,500 and an alarmingly high fetal mortality rate secondary to massive fetal hemorrhage; prenatal diagnosis of the condition is key for appropriate management and surgical planning.\textsuperscript{7,8} It is divided into 2 types: type I in which there is a single placental lobe with a velamentous umbilical cord (cord insertion into the chorioamniotic membrane instead of the placenta), and type II, with multiple placental lobes with connecting vessels that cross the internal os.\textsuperscript{7}

The presence of tubular or round anechoic structures with corresponding flow on color Doppler overlying the cervix on transvaginal ultrasound examination is diagnostic; however, further evaluation with MRI may be indicated in equivocal cases.\textsuperscript{9} MRI can additionally assess for placental variations, such as the number of lobes and their locations to aid in surgical planning of confirmed cases. Specifically, time-of-flight magnetic resonance angiography (MRA) performed without intravenous contrast can provide more detailed information as to the type of vasa previa and the vascular distribution.\textsuperscript{7,9}

Placental Abruption

Placental abruption is the premature detachment of the placenta from the myometrium resulting in hemorrhage and possibly fetal death. Associated risk factors include maternal trauma, vascular disease, chorioamnionitis and cocaine use. Hemorrhage may occur within the placental parenchyma or be adjacent. If hemorrhage is adjacent to the placenta it is further characterized as being retroplacental (on the maternal side) or subchorionic (on the fetal side). Imaging is necessary for accurate diagnosis. Although ultrasound may be able to diagnose abruption, it has low sensitivity and cannot visualize the full extent of hemorrhage, particularly if massive. In the setting of maternal trauma, CT of the abdomen and pelvis is the study of choice due to the life-threatening nature of the diagnosis. On CT, there may be areas of full-thickness placental hypoenhancement and/or an adjacent hyperattenuating hematoma. MRI is less frequently performed in nonemergent cases due to duration of the study; findings are those of hemorrhage with variable signal characteristics depending on the acuity of the abruption.\textsuperscript{1}

Diagnosis

MAP/placenta percreta

Summary

Formation of a normal utero-placental interface is a critical component of a successful pregnancy and delivery. Abnormal location or extent of implantation leads to significantly increased rates of maternal and fetal morbidity and mortality.\textsuperscript{2,4} Placenta previa, morbidly adherent placenta (formerly placenta accreta spectrum), vasa previa and placental abruption are direct consequences of abnormailities within the utero-placental interface and result in significant fetal/neonatal and maternal morbidity and mortality due to peripartum and postpartum hemorrhage and possible emergent hysterectomy.\textsuperscript{3} Early identification of abnormally adherent placenta is necessary as multispecialty management is often necessary. Ultrasound remains the primary means of diagnosis. MR imaging serves as a complementary exam to ultrasound in cases of potential abnormally adherent placenta, and is useful if sonographic findings are equivocal or if the placenta is posteriorly located.\textsuperscript{2,5} An accurate imaging diagnosis with ultrasound and fetal MRI can greatly improve fetal and maternal outcomes.

References