Imaging of the placenta

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Aims and objectives

Identify anomalies of placental implantation, including the various forms of placenta previa and placenta accreta.

Discuss the added value of crosssectional imaging in the evaluation of invasive placental processes, including placenta accreta and gestational trophoblastic disease.

Methods and materials

Clinical series descriptive study with a retrospective examination of women with placental abnormality. US were performed in all patients and Magnetic resonance imaging (MRI) in 5 cases. Of our 20 women, placenta previa was found in 6 cases, placenta accreta in 5 cases, gestational trophoblastic disease in 6 cases (4 cases of Hydatidiform Mole, 1 case of invasive mole, 1 case of choriocarcinoma), vasa previa in one case of and chorioangioma in 2 cases.

Results

Imaging modality of the placenta

Sonography remains the imaging modality of choice for evaluation of the placenta, but MRI is more beneficial in advanced gestational age, obese women, and posterior placental location (1). MRI is advantageous due to the larger field of view and its multiplanar capabilities. MRI can be of added diagnostic value when further characterization is required, particularly in the setting of invasive placental processes such as placenta accreta and gestational trophoblastic disease (1, 5). Placental MRI has become an important complementary method for evaluation of placental anatomy and pathologies contributing to fetal problems such as intrauterine growth restriction.

Normal imaging appearance and variants

Typically, the placenta is located along the anterior or posterior uterine wall, extending on to the lateral walls (figure 1) (5). Although usually discoid, the placenta can be variable in morphology. Variant placental shapes include bilobed (figure 2), succenturiate,
circumvallate, and placenta membranacea (5). The umbilical cord typically inserts centrally, but eccentric and velamentous (outside the placental margin) insertions also occur.

**Placental pathology**

**Placental thickness**

Placental thickness tends to gradually increase with gestational age in a linear fashion (1). Sonographically, this can be seen to be approximately 1 mm per week and the thickness of the placenta can be used to approximate gestational age (approximate gestational age (in weeks) = placental thickness +/- 10 mm).

An abnormally increased placental thickness falls under the spectrum of placentomegaly (figure 3). This can happen with number of conditions and is associated with increased risk of placental insufficiency. Causes include: upper limit of normal variation, fetal macrosomia, fetal hydrops, maternal medical conditions (maternal anaemia, maternal diabetes) and Beckwith-Wiedemann syndrome (1). An isoechoic abruption can mimic a large placenta on ultrasound.

An abnormally decreased placental thickness can be seen with placenta membranacea or chromosomal anomalies (trisomy 18 : reduced volume, digynic triploidy)

**Placental grading:**

Placental grading refers to an ultrasound grading system of the placenta dependant on maturity (1). This primarily affects the extent of calcifications. In some countries the use of placental grading has fallen out of obstetric practice.

**Placental calcification:**

Placental calcification has long been considered a manifestation of staging" of the placenta (1) It commonly increases with gestational age. Increased calcium is seen with increased placental grading (figure 4).

**Placental venous lakes**

It refers to a phenomenon of formation of sonolucent cystic spaces centrally within the placenta. Finding placental lakes during a second trimester ultrasound scan is not
associated with any utero-placental complication or with an adverse pregnancy outcome. They can however be abnormal if very diffuse or if seen very early in pregnancy.

They are a common occurrence, reported to occur in approximately 20% of pregnancies that usually result from peri-villous fibrin deposition with cystic change within areas of subchorionic fibrin. Their presence tends to be associated with increased placental thickness, with placenta accreta spectrum, abnormal placental villous adherence and placental insufficiency, especially if seen early in pregnancy.

They are typically seen at ultrasonography as relatively well defined hypo-echoic regions within the placenta. Colour Doppler imaging may show low-velocity laminar flow within

**Placental developmental abnormalities**

**Placenta previa:**

The prevalence has been estimated to be approximately 0.5% of all pregnancies and it refers to abnormal implantation of the placenta in the lower uterine segment, overlying or near the internal cervical os (6). It is a major cause of antepartum and intrapartum hemorrhage; maternal morbidity and mortality; preterm delivery and neonatal mortality (1, 5). Placenta previa is associated with a number of risk factors, including: previous placenta previa, previous caesarean section, old maternal age, multiparity, large placentas, and erythroblastosis (6, 7).

It is divided into 4 grades depending on the relationship and distance to the internal os.

- **grade I** - low lying placenta - placenta lies in lower uterine segment but its lower edge does not reach up-to internal cervical os (lower edge 0.5-5 cm from internal os).

- **grade II** - marginal previa - placental tissue reaches the margin of the internal cervical os, but does not cover it (figure 5a).

- **grade III** - partial previa - placenta partially covers the internal cervical os (figure 5b).

- **grade IV** - complete previa - placenta completely covers the internal cervical os (figure 5c, d).

Sometimes types I and II are termed a minor or partial placenta previa and types III and IV termed a major placenta previa.

The diagnosis of a placenta previa is not usually made before 20 weeks. During the routine 18 week morphology scan, the distance between lower edge of the placenta and the internal os should be measured. If it lies within a few centimeters of the os then a
repeat ultrasound at 32 weeks should be performed to ensure that the edge has migrated further away.

MRI is the gold standard to imaging the placenta and its relationship to the cervix, although in most instances it is not required. Sagittal images best demonstrate the relationship of the placenta to the internal cervical os

**Vasa Previa**

It represents the presence of abnormal fetal vessels within the amniotic membranes that close too or crossing the inner cervical os and which are at risk of rupture when the supporting membranes rupture or during labor. This occurs normally in 1:2500-5000 pregnancies and can leads to a catastrophic fetal hemorrhage (2). It exist two types:

- **type 1**: associated with velamentous cord insertion
- **type 2**: associated with the vessels wich connect the placental lobes traversing the internal os (**figure 6**).

Risk factors usually include multiple pregnancies, abnormal positioning of the placenta, and placental anatomic variants (bilobed, succenturiate, etc). Management consists of cesarean section (2).

Spectrum of abnormal placental villous adherence

**Placenta accreta**

The abnormal placental villous adherence describes the degree to which there is invasion of chorionic villi into the myometrium because of a defect in the decidua basalis (2). Approximately 0.9% of pregnancies are complicated by this condition, with prior uterine surgery, cesarean sections, and placenta previa being the main risk factors (2, 7).

The diagnosis of placental invasion of the myometrium usually can be made by ultrasound (1, 2, 6, 7). Normal attachment is characterized by a homogeneous appearance of the placenta and a hypoechoic boundary between the placenta and the bladder that represents the myometrium and the normal retroplacental myometrial vasculature. The bladder wall is intact throughout. In contrast, placental accreta is associated with loss of the normal hypoechoic boundary, and there are usually intraplacental sonolucent spaces adjacent to the involved uterine wall (**Figure 7a**) (6, 7).

Color-flow and power Doppler sonography have also been reported to facilitate the diagnosis (**Figure 7b**). MRI has also been used to confirm the diagnosis of the presence or extent of accrete (1, 6, 7). MRI is also useful in the presence of a posterior placenta
and in the assessment of deep myometrial, parametrial, and bladder involvement (Figure 7c). The placental protrusion sign is a useful novel MRI finding for predicting invasive placenta (3).

Vascular pathologies of placenta

Placental Abruption

It is refers to a premature separation of the normally implanted placenta after the 20’ week of gestation and before the 3rd stage of labour. It is a potentially fatal complication of pregnancy and is a significant cause of third-trimester bleeding / antepartum haemorrhage (1, 2, 4). The estimated incidence is at 1% of all pregnancies (2). The rate of placental abruption is thought to have dramatically increased in the past few years. Patients with a placental abruption typically present with antepartum bleeding, uterine contractions, and fetal distress.

Placental infarction

A placental infarction refers to a localised area of ischaemic villous necrosis. It is a significant cause of placental insufficiency. A localized infarction can occurs in up to 12.5% (range 5-20%) of all gestations. It usually results from an interrupted maternal blood supply. Placental infarcts are more common at periphery of placenta. Most placental infarcts are difficult to diagnose on ultrasound. They may on occasion be seen as a hypoechoic region with thick hyperechoic rim.

Placental Hematoma

Placental hematomas are a frequent complication of pregnancy, which can predispose to premature delivery and spontaneous abortion. The incidence of placental hematoma in the first trimester ranges from 4% to 22%. (1, 2, 4) There are 3 types of placental hematoma, including retroplacental, subchorionic, and subamniotic.

Hematoma will be seen as a crescent-shaped fluid collection that is hyperechoic to isoechoic in the first week after hemorrhage, hypoechoic at 1-2 weeks, and finally, anechoic at 2 weeks and thereafter. No vascular flow will be demonstrated on Doppler hematoma will be seen as a crescent-shaped fluid collection that is hyperechoic to isoechoic in the first week after hemorrhage, hypoechoic at 1-2 weeks, and finally,
anechoic at 2 weeks and thereafter. No vascular flow will be demonstrated on Doppler
(2, 4).

Retroplacental hematomas (figure 8) are defined as being posterior to the placenta,
representing 43% of hematomas. Subchorionic hematoma will involve the chorion
beyond the margins of the placenta (figure 9).

**Gestational Trophoblastic Disease**

Gestational trophoblastic disease is the uncontrolled growth of trophoblastic tissue, which
occurs in about 1 in 1200 pregnancies (1, 2). Risk factors include a prior history of
gestational trophoblastic disease, Asian ethnicity, and advanced maternal age. Common
clinical symptoms will include a large uterine size for gestational age, elevated beta-
human chorionic gonadotropin, hyperemesis gravidum, preeclampsia, and first trimester
bleeding (2, 4, 5).

**Complete and Partial Moles:**

The complete hydatidiform mole is the most common form of gestational trophoblastic
disease (1, 2-5). Complete moles result from fertilization of an empty ovum with
subsequent duplication of the paternal chromosomes. Thus, most complete moles
(approximately 90%) have a 46,XX karyotype with a minority having a 46,XY karyotype.
This chromosomal anomaly causes early loss of the embryo and proliferation of the
trophoblastic tissue. Partial hydatidiform moles are much less common and result from
fertilization of a normal ovum by two sperm. At pathologic analysis, the trophoblastic tissue
appears as a complex multicystic mass, classically described as a "cluster of grapes".

At sonography, partial moles appear similar to complete moles but are differentiated by
the presence of fetal tissue (figure 10).

**Invasive Mole and Choriocarcinoma**

Invasive moles represent deep growth of the abnormal tissue into and beyond the
myometrium, sometimes with penetration into the peritoneum and parametrium (2, 5).
Owing to their aggressive growth characteristics, invasive moles are considered locally
invasive nonmetastasizing neoplasms. Choriocarcinomas are similar to invasive moles
but are capable of metastasizing, frequently manifesting with lung and pelvic metastases
(figure 11).

**Nontrophoblastic Placental Tumors**
**Chorioangiomas:**

Chorioangiomas are essentially hemangiomas of the fetal portion of the placenta, supplied by the fetal circulation.

**Cystic Lesions**

The vast majority of hypoechoic foci in the placenta represent intervillous space thrombi or decidual septal cysts, commonly referred to as placental lakes (**figure 12**). The term placental lakes may also refer to intervillous vascular spaces that appear hypoechoic and demonstrate low-velocity laminar flow on color Doppler images (1, 2, 4).

**Images for this section:**

![Fig. 1:](image)

**Fig. 1:** Figure 1: (a): Normal placenta at 26 weeks’ gestation. coronal single-shot fast spin-echo image demonstrates relatively homogeneous signal of the placenta (arrowhead). (b): Normal placenta at 36 weeks’ gestation. Axial single-shot fast spin-echo image shows that the placenta appears more heterogeneous and lobulated than at 26 weeks’ gestation (arrowhead). (c): Normal myometrium at 32 Weeks’ gestation. Sagittal single-shot fast spin-echo image demonstrates the heterogeneous, hyperintense middle layer with thin, hypointense layers on either side (arrows).
**Fig. 2:** Figure 2: Bilobed placenta. Coronal single-shot fast spin-echo image in a 40-year-old woman demonstrates the succenturiate lobe (S), clearly separate from the main placenta.
Fig. 3: Figure 3: Abnormally increased placental thickness
**Fig. 4:** Figure 4: Extensive calcification of the basal plate of the placenta. There is also calcification along the placental septa and chorionic plate.
Fig. 5: Figure 5: Spectrum of placenta previa. Transvaginal US image shows in (a): a low-lying placenta, (b): The placental margin comes to the internal cervical os but does not cover it, (c): The placenta entirely covers the internal cervical os, (d): The posterior placenta entirely covers the internal cervical os.
**Fig. 6:** Figure 6: (a): Ultrasonography at 17 W and (b): Sagittal Contrast-enhanced T2-weighted MR image reveals vasa previa with succenturiate lobe. Note the umbilical cord possibly overlying the cervix (arrows). P: Placenta, S: succinate lobe

**Fig. 7:** Figure 7: Placenta accreta: (a): Ultrasonography at 15 W: loss of the hypoechoic retroplacental myometrial zone opposite to the bladder wall. (b): Doppler examination shows abnormally dilated vasculature (c): Sagittal T2 MR image shows obliteration of the normal dark myometrium posteriorly, with placental tissue of heterogeneous signal intensity penetrating the full thickness of the uterine wall
**Fig. 8:** Figure 8: Retroplacental hematoma. Hypoechoic collections (arrows) posterior to the placenta
**Fig. 9:** Figure 9: Subchorionic hematoma. Hypoechoic collection (arrow) representing a subchorionic hemorrhage adjacent to the margin of the placenta.

**Fig. 10:** Figure 10: Ultrasonography at 17 W reveals tripled gestation with partial mole and two normal fetus.
Fig. 11: Figure 11: (a) Sagittal T2-weighted MR (b) Sagittal Contrast-enhanced T1-weighted MR image: shows a mass of heterogeneous signal intensity in the uterine fundus; the mass invades into the posterior uterine wall. Image shows avid enhancement of the mass. The mass has central low signal intensity, which represents necrosis. The mass was a pathologically proved choriocarcinoma
Fig. 12: Figure 12: Placental cyst. Doppler US image shows an anechoic spherical structure (arrowhead) on the fetal surface of the placenta.
Conclusion

The placenta is often overlooked in the routine evaluation of a normal gestation, receiving attention only when an abnormality is detected. Sonography remains the imaging modality of choice for evaluation of the placenta. MRI can be of added diagnostic value when further characterization is required.

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References

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