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THREE DIMENSIONAL SONOGRAPHIC IMAGING OF PLACENTAL MESENCHYMAL DYSPLASIA AND ITS DIFFERENTIAL DIAGNOSES

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Abstract

Objective—Placental mesenchymal dysplasia (PMD) is an uncommon vascular anomaly of the placenta characterized by mesenchymal stem villous hyperplasia. Its main sonographic features is a thickened placenta with hypoechoic areas, and an accurate sonographic diagnosis is challenging. The aim of this study was to report two cases of PMD, and discuss the differential diagnosis of its sonographic features.

Methods—Cases of placental masses studied by two-dimensional (2D), three-dimensional (3D) and Color Doppler imaging.

Results—Case 1 - a thick placenta with multiple hypoechoic areas was noted at 13 weeks of gestation. At 19 weeks, the multi-cystic area, clearly demarcated from a normal looking placenta, measured 6.5×8.5cm and enlarged gradually. The patient delivered a 625 gram female after a spontaneous labor at almost 26 weeks' gestation. Case 2 - a first sonographic examination at 25 weeks' gestation revealed a thickened placenta with hypoechoic areas and a fetus with a single umbilical artery and a ventricular septal defect. At 27 weeks, the abnormal area of the placenta measured 14.5×7.5cm. At 32 weeks' gestation, a caesarean section was performed due to non-reassuring fetal heart tracing and a 1415 gram female infant was delivered. Both cases were evaluated by 2D, 3D and Color Doppler imaging and the pathologic features of both placentas were consistent with PMD.

Conclusions—Placental mesenchymal dysplasia should be considered in the differential diagnosis of every placental mass, especially in cases of multi-cystic placental lesion with lack of high velocity signals inside the lesion, and a normal karyotype.

Keywords

Pseudo-partial mole; mesenchymal hyperplasia; ultrasound; Doppler; chorioangioma; complete hydatidiform mole and coexistent fetus

Introduction

Placental mesenchymal dysplasia (PMD) was first described by Moscoso et al¹ in 1991, as a placental vascular anomaly characterized by mesenchymal stem villous hyperplasia. Various terms to describe the same clinico-pathological features of the placenta have been used such as mesenchymal hyperplasia,^{2,3} mesenchymal stem villous hyperplasia,⁴ and pseudo-partial mole.⁵ The gross features of PMD include placentomegaly, dilatation of chorionic vessels and large areas of cystic villous changes along with areas of normal placenta.⁶ The histologic findings consists of enlarged stem villi with loose connective tissue and cistern-like formations, and absence of trophoblastic proliferation.^{1,6}

An accurate sonographic diagnosis of PMD is challenging, as its main sonographic feature is a thickened placenta with hypoechoic areas.¹ The differential diagnosis includes molar pregnancy, chorioangioma, subchorionic hematoma, placental cyst, placental infarcts and a spontaneous abortion with hydropic changes.^{7–9} Three-dimensional (3D) and Color Doppler ultrasound may add essential information about origin, location, size and blood supply of placental lesions.^{8,10–13} The purpose of this communication is to report two cases of PMD, which were studied by 2D, 3D and Color Power Doppler imaging, and to discuss the differential diagnoses of its sonographic features.

Case 1

A 27 year-old African-American woman, G7P0423, had a sonographic finding of a thick placenta with multiple hypoechoic areas on a routine ultrasound examination at 13 weeks of gestation. The nuchal translucency measurement was 1.2 mm and the patient declined at that time a karyotype examination to rule out triploidy. Frequent follow-up ultrasound examinations revealed normal amniotic fluid index, fetal anatomy and middle cerebral artery peak systolic velocity (MCA-PSV). At 19 weeks of gestation, the multi-cystic area, clearly demarcated from a normal looking placenta, measured 6.5×8.5 cm (Figure 1A) and it enlarged gradually to 15.8×8.5 cm at 25 weeks of gestation (Figures 1B). At 23 weeks of gestation, the patient complained of with mild vaginal bleeding without contractions; speculum examination revealed a cervical dilation of 4 cm with bulging membranes. Two- and three-dimensional ultrasound examinations (Voluson E8™, GE Healthcare, Kretztechnik, Zipf, Austria; IU-22™, Philips Medical Systems, Bothell, Washington, USA) demonstrated an estimated fetal weight between the 10th and 15th percentiles, normal amniotic fluid index. A large echogenic mass resembling a “honeycomb” with multiple hypoechogenic cysts of variable size (maximal cyst diameter - 20.7 mm) was adjacent to an anterior normal-appearing placenta. Color Doppler interrogation of the placenta could not identify any high velocity blood flow signal within the lesion; however, weak low velocity signals were noticed (Figure 2). The 3D reconstruction image revealed a multi-cystic placental mass clearly separated from, but adjacent to a normal appearing placenta (Figure 3), and multiple fluid filled cysts that did not seem to communicate with each other were demonstrated using “inversion mode”¹⁴ rendering of the 3D image (Figure 4).

Because of advanced cervical dilatation and the patient’s desire to continue the pregnancy, intra-amniotic infection and an abnormal karyotype were ruled out by amniocentesis, and a McDonald rescue cerclage was placed. Ten days later, the cerclage was removed because of

moderate vaginal bleeding and tension on the cervical suture. After a spontaneous prelabor rupture of membranes at 25 weeks and 6 days of gestation, the patient vaginally delivered a 625 gram female infant with Apgar scores of 7 and 8 at 1 and 5 minutes, respectively. A retained placenta and postpartum hemorrhage necessitated a manual removal of the placenta. The pathologic examination of the placenta revealed thick, dilated and tortuous chorionic vessels on the fetal surface of the placenta and enlarged stem villi with prominent cystic changes, consistent with the pathologic features of placental mesenchymal dysplasia (Figure 5).

Case 2

A 28 year-old African-American woman, G6P1132, with a history of three first trimester induced abortions, two cesarean sections, chronic hypertension and gestational diabetes in the index pregnancy, had her first prenatal care visit and ultrasonographic examination at 25 weeks of gestation. Two- and three-dimensional transabdominal ultrasound (Voluson 730 Expert™, GE Healthcare, Kretztechnik, Zipf, Austria; IU-22™, Philips Medical Systems, Bothell, Washington, USA) revealed a thickened placenta (71 mm) with hypoechoic areas and a fetus with an estimated weight between 11th–25th percentile, with a single umbilical artery and a ventricular septal defect. At 27 weeks of gestation, the abnormal area of the placenta, clearly demarcated from an adjacent normal placenta, measured 14.5×7.5 cm (Figure 6A), the MCA-PSV was elevated (>1.55 MOM¹⁵) and the fetal heart was enlarged (circumference greater than 50% of thorax area). Color Doppler interrogation could not identify blood flow signals within the mass (Figure 6B). Due to suspected fetal anemia and chorioangioma, fetal blood sampling was performed and revealed a fetal hemoglobin of 13.5 mg/dl and a normal karyotype (46XX). At 32 weeks of gestation, the estimated fetal weight was below the 10th percentile; the MCA-PSV was elevated (>1.55 MOM¹⁵), and the fetal heart tracing was non-reassuring; thus, a cesarean delivery was performed. A 1415 gram female infant was delivered with Apgar scores of 4 and 8 at 1 and 5 minutes, respectively. A single umbilical artery and a ventricular septal defect were confirmed after delivery. Pathologic examination of the placenta revealed macroscopically prominent thick and dilated vessels throughout the placenta, and microscopically markedly enlarged stem villi with abnormal thickening of the vessels and cystic changes, all of which were consistent with the pathologic features of placental mesenchymal dysplasia (Figure 7).

Discussion

We report herein two cases of placental mesenchymal dysplasia that were initially suspected to be chorioangiomas due to their sonographic features. However, in the first case, the large placental mass without a demonstrable feeding vessel or fetal compromise (as the classic appearance of a large chorioangioma¹⁶) raised the possibility of PMD. The second case was managed as a chorioangioma due to a large placental mass, fetal growth restriction (FGR) and suspected fetal anemia, and the pathologic features turned out to be PMD.

These cases were studied by 2D, 3D and color Doppler imaging of the placenta, and we present for the first time 3D images of PMD. The 3D reconstruction image (Figure 3) demonstrates a multi-cystic placental mass with cysts of various diameters clearly separated but adjacent to a normal appearing placenta. Rendering the 3D image with ‘inversion mode’¹⁴ revealed multiple fluid filled cysts that seemed not to communicate with each other (Figure 4).

What is placental mesenchymal dysplasia?

Placental mesenchymal dysplasia is a placental anomaly with a prevalence of 0.02% (seven cases among 30,758 placentas over a period of 21 years).¹⁷ Over a period of 25 years, Paradinas et al⁵ identified 15 cases of PMD among 7,560 placentas (0.2%) with an initial referral diagnosis of partial hydatidiform mole. Indeed, the definitive diagnosis of PMD can only be

made by pathologic examination of the placenta; however, due to lack of awareness⁵ to this relatively new entity, it is likely that PMD will be occasionally misdiagnosed,^{5,6,18} under-recognized and under-reported,⁹ especially in cases with a good perinatal outcome. Thus, the true incidence of this condition is probably underestimated.

The clinical presentation of PMD is diverse and non-specific, and has been reported in conjunction with: 1) an uneventful pregnancy with postnatal pathologic findings of PMD;⁵ 2) incidental ultrasonographic abnormalities of the placenta;^{19,20} 3) an elevated maternal serum alpha-feto protein concentrations;²¹ 4) fetal growth restriction;²² 5) fetal demise;²³ 6) vaginal bleeding;^{18,24} 7) preterm delivery;²⁵ 8) fetal anomalies (i.e. fetal liver cysts or vascular malformations);²⁵ and 9) fetal overgrowth with Beckwith-Wiedemann syndrome (BWS) features (placentomegaly, omphalocele, macroglossia and visceromegaly).^{26,27} Placental mesenchymal dysplasia was found to be more frequent in female fetuses (as in our two cases) with a female to male ratio of 3.6:1.²⁶

Recently, Pham et al²⁷ reported a series of 11 cases of PMD identified over a period of 34 years (some identified retrospectively) and summarized it together with 71 cases previously reported in the literature. Nearly one fifth of the cases (15/82) were associated with BWS (in some cases its features can become apparent after the delivery of a normal appearing newborn). After excluding these cases, the authors found a risk of 50% for FGR, 36% for fetal demise, and 7% for neonatal death.²⁷ Of note, many of the fetal and neonatal deaths were not associated with FGR. Furthermore, there was a high incidence (4 of the 8 cases in the available data) of umbilical cord anomalies, such as single umbilical artery (as in case 2), excessively long cord and marked twisting²⁷ and velamentous insertion

The sonographic characteristics of placental mesenchymal dysplasia and other placental masses

The sonographic appearance of PMD is a thickened placenta with hypoechoic areas¹ (Figure 1 and Figure 6). The differential diagnoses of these features include placental mesenchymal dysplasia, molar pregnancy,^{8,11} either a partial hydatidiform mole or a complete mole with coexistent fetus (CMCF),²⁸ chorioangioma, subchorionic hematoma, placental infarcts and spontaneous abortion with hydropic changes.⁹

In partial hydatidiform mole, the placenta is characterized by 2D sonography as heterogeneous, partially solid with cystic areas, representing hydropic villous degeneration of the molar tissue,²⁸ resembling the sonographic appearance of PMD⁶. Similar features can be found in CMCF when a normal fetus in one gestational sac coexists with a complete mole in the other sac.²⁹ Color Doppler studies of a partial mole placenta can demonstrate the presence of high-velocity, low impedance flow with low resistance indices in the molar mass.²⁸

A chorioangioma, the most common of the placental tumors,^{30,31} is characterized sonographically by a well-circumscribed lesion with different echogenicity than the rest of the placenta,¹³ and can be located on the fetal placental surface or protruding into the amniotic cavity.¹² The sonographic diagnosis of chorioangioma is based upon an increased vascularity or a large feeding vessel inside the tumor with the same pulsation rate as in the umbilical cord¹² (see Figure 8), a finding that is absent in PMD.

Placental hematomas can mimic the 2D sonographic appearance of a chorioangioma as a partly solid or partly cystic mass; however, no blood flow within the mass would be demonstrated using color Doppler.^{8,11} Thus, a placental hematoma may have a similar sonographic appearance to PMD.

Jauniaux et al,⁶ using serial ultrasound and color Doppler examinations in four pregnancies with PMD, did not identify blood flow within the placental lesion during the first five months of pregnancy. However, in the third trimester, large vascular areas with turbulent blood flow were observed, either in arterial or venous patterns, located mainly under and at the level of the chorionic plate. These changes have been proposed to be due to progressive dilatation of chorionic arteries and veins that becomes aneurysmal.⁶ The absence of blood flow in the placental mass has also been reported in pregnancies with PMD delivered before 32 weeks of gestation.^{32,33} However, Furuhashi et al³⁴ observed blood flow by color Doppler in a case of PMD at 23 weeks' gestation. High velocity or pulsating blood flow vessels were not identified in either of our cases, though, at 23 weeks of gestation, low venous Doppler signals inside the pathologic placental tissue were identified in the first case (Figure 2) probably due to the pathologically enlarged fetal blood vessels as shown on gross examination postpartum (Figure 5 and Figure 7). Thus, although PMD may be associated with different patterns of blood flow with advancing gestation, the absent or low venous signals inside the placental lesion (at least during the first two trimesters) may be of value in differentiating PMD from chorioangioma or a molar pregnancy that are characterized by high velocity blood flow, as well as from placental hematoma in which there is no blood flow inside the lesion.

Further differentiation from partial hydatidiform mole is done by excluding a triploid fetus by amniocentesis although diploid partial moles have been previously reported.^{35,36}

Differentiation of PMD from a twin pregnancy with CMCF can be difficult. Documentation of two gestational sacs on first trimester ultrasound scan, tumor that comprises the whole thickness of the placenta, and the lack of blood flow signals, can suggest the diagnosis of CMCF (Figure 9). However, all of those features can be found in PMD, and the final diagnosis of PMD is made on histologic examination by exclusion of trophoblastic hyperplasia.

Is there a correlation between the sonographic features and pregnancy outcome of placental mesenchymal dysplasia?

Placental mesenchymal dysplasia is associated with adverse pregnancy outcome, including FGR, fetal demise and BWS;²⁷ however, it can be diagnosed by pathologic examination of the placenta after an uneventful pregnancy.⁹ The mechanism of fetal compromise in PMD is not clear and is unpredictable; Indeed, Jauniaux et al⁶ analyzed 21 cases of PMD delivered during the second half of pregnancy and could not find any relationship between the placental weight and fetal or maternal complications. In addition, there are case reports of PMD with a good outcome despite large placentas, and others with relatively low weight placenta and a poor outcome.²⁷ This is in contrast to the pathophysiology of chorioangioma, where the fetal circulation supplies the tumor, leading in large lesions to increase load on the fetal heart and congestive heart failure.¹²

One possible explanation is that in some cases of PMD, a relatively small functional normal placenta is left, and the remaining normal chorionic villi are not sufficient to support a normal fetal growth.²⁷ The fetal outcome in PMD cases with inadequate fetal growth may be determined by the relative size and growth of the remaining functional normal placenta and not necessarily by the extent of the PMD. It is possible that close follow-up of the normal placental growth using 3D ultrasound and volume calculation, may allow a better prognosis assessment to predict fetal outcome than just following the development of the "sick" part of the placenta. This remains to be proven in prospective follow-up of suspected cases. Moreover, given the association between PMD and BWS, failure to demonstrate FGR is not necessarily a good prognostic sign.

In summary, PMD should be considered in the differential diagnosis of every placental mass, especially when a multi-cystic placental lesion is demonstrated, there is lack of high velocity signals inside the lesion, and a normal karyotype is present. Although in our two cases 3D

sonography did not add much information over that obtained from 2D sonography, given the widespread use of ultrasound in early pregnancy, it should be emphasized that a detailed placental “anatomy” scan including 2D, 3D and Doppler studies is recommended for a more accurate prenatal diagnosis, as some diagnosis are associated with more significant fetal or maternal complications than others.

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Figure 1.

Case 1 - Transabdominal two-dimensional ultrasound of the placenta: A) at 19 weeks of gestation, a multi-cystic area measuring 6.5×8.5 cm clearly demarcated from an adjacent normal placenta is demonstrated. B) At 25 weeks of gestation, the lesion enlarged and measured 15.8×8.5 cm.

Figure 2.
Case 1 - Transabdominal Color Doppler imaging of the placenta at 23 weeks of gestation shows a multi-cystic placental lesion (left). No high velocity signal could be detected inside the placental lesion; however, low velocity signal were noted (right).

Figure 3.

Case 1 - Transabdominal three-dimensional ultrasound of the placenta at 23 weeks of gestation demonstrating a multi-cystic placenta arising from the chorionic plate and not from the basal plate. (NP: normal placenta, PMD: placental mesenchymal dysplasia)

Figure 4.

Case 1 - Transabdominal three-dimensional image of the placenta at 23 weeks of gestation rendered with “inversion mode”. Multiple fluid filled structures, variable in size (some pointed with white arrow) and not communicating with each other can be seen.

Figure 5.

Case 1 - placenta with placental mesenchymal dysplasia: A) gross specimen - chorionic vessels are thick, dilated, and tortuous on the fetal surface of the placenta (white arrows), and multiple cystic vesicles are found in the placental parenchyma (white arrowheads). B) Histologic section - thick-walled vessels are conglomerated in the subchorionic area (black arrows), and stem villi are enlarged with prominent cystic change (black arrowheads).

Figure 6.

Case 2 - Transabdominal ultrasound examination of a case of placental mesenchymal dysplasia: A) at 27 weeks of gestation, a heterogenic mass with cystic areas measuring 14.5×7.5 cm clearly demarcated from an adjacent normal placenta is demonstrated. B) Color Doppler imaging at 30 weeks of gestation showing lack of signals within the placental lesion.

Figure 7.
Case 2 - placenta with placental mesenchymal dysplasia: A) gross specimen - prominent meshwork of thick and dilated vessels in the placenta with focal subchorionic hemorrhage. B) Histologic section - the enlarged stem villi have abnormally thickened vessels (black arrow) and cystic changes (black arrowhead) as well.

Figure 8.

Transabdominal ultrasound examination of a placental mass: A) a three-dimensional (3D) imaging at 34 weeks of gestation, demonstrating a solid placental tumor was seen on the chorionic plate with a large calcified feeding blood vessel (white arrow). B) 3D Power Doppler angiography of the tumor demonstrated significant vascularity within the mass with a large feeding vessel. This placental tumor was proved to be a chorioangioma.

Figure 9.

Transabdominal three-dimensional (3D) ultrasound of the placenta at 19 weeks of gestation demonstrating a multi-cystic placenta (MP) along a normal placenta (NP). 3D Power Doppler angiography did not reveal blood flow signals inside the multi-cystic placenta (P in the colored panel). This placental tumor was proved to be a complete mole with a coexistent fetus (CMCF)