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Placental lakes, absent umbilical artery diastolic flow and poor fetal growth in early pregnancy

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ABSTRACT

Uteroplacental insufficiency is a common cause of intrauterine growth retardation in the third trimester of pregnancy. We report a case in which placental vascular lesions, absent end-diastolic frequencies in the umbilical artery and high maternal serum levels of α-fetoprotein and human chorionic gonadotropin were observed from the beginning of the second trimester in a patient with a history of recurrent first- and second-trimester miscarriages. Fetal growth started to slow down from 14 weeks of gestation and no end-diastolic phase was found in the umbilical artery until 18 weeks of gestation, when the pregnancy was terminated. In apparently healthy women with or without a history of fetal death during the first half of pregnancy, the discovery of placental vascular lesions together with a high resistance to blood flow in the umbilical circulation should prompt early antepartum surveillance.

INTRODUCTION

Intrauterine growth retardation (IUGR) is a common obstetric complication, occurring with an incidence of 5–10% of all deliveries in developed countries[1]. The majority of these cases are simply small for their gestational age and otherwise healthy, achieving a genetically programmed growth potential. Fetal growth can be impaired very early during pregnancy as a result of chromosomal defects, congenital infections, irradiation and drug exposure or chronic maternal illness. In fetuses with chromosomal abnormalities such as trisomy 18 and triploidy, fetal growth can be found to slow down from the end of the first trimester[2]. However, the great majority of IUGR cases are diagnosed during the second half of pregnancy and are secondary to abnormal placental development and function. The precise mechanism of growth retardation in most of these situations frequently remains unclear. In developed countries, impairment in the development of the uteroplacental circulation seems to be pre-eminently the cause of hypoxic IUGR[1].

Placenta-related ultrasound features associated with hypoxic IUGR include abnormal flow velocity waveforms in the umbilical and/or uterine circulations, a jelly-like placental appearance and the presence of vascular lesions[3–5]. These features have been mainly described after 20 weeks of gestation. We report here a case presenting with these features during the first half of pregnancy.

CASE REPORT

A 26-year-old woman, gravida 8, para 1, was referred for obstetric ultrasound at 12 weeks of gestation, because of a previous history of recurrent miscarriages in early pregnancy. Her medical history was unremarkable and there was no familial history of miscarriage. The patient's first pregnancy was uncomplicated and resulted in a normal spontaneous delivery of a healthy female baby. She then changed partner and experienced six consecutive miscarriages between 6 and 16 weeks of gestation. Both she and her new partner underwent cytogenetic and blood investigations, which did not reveal any abnormality. During her last pregnancy, immunoglobulin therapy was started, but the pregnancy ended with the spontaneous death of an anatomically and chromosomally normal male fetus at 16 weeks of gestation.

In the current pregnancy, she presented for a dating scan at 12 weeks' menstrual age. The crown–rump length was 48 mm, confirming the gestational age. The ultrasound scan also showed multiple echo-poor spaces within the placental tissue (Figure 1a). Triploidy was suspected. A transvaginal scan was performed which did not reveal any fetal abnormalities and the patient opted against

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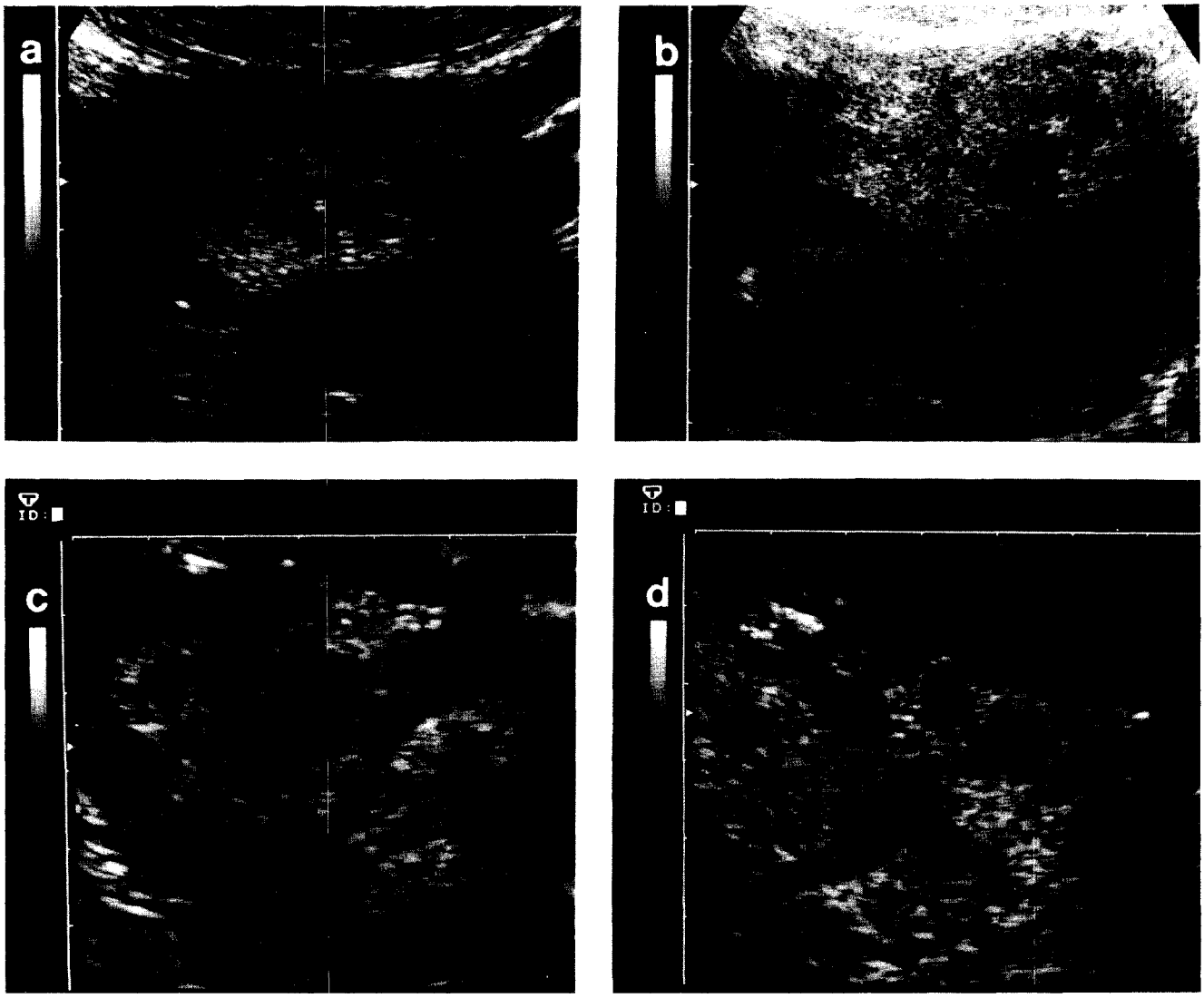

Figure 1 Transabdominal sonograms of the placenta at 12 (a), 14 (b) and 16 (c and d) weeks, showing large echo-poor spaces disseminated in the whole placental mass. Note the change in shape of the lesions with maternal position from supine (c) to lateral (d)

undergoing an invasive procedure. Color Doppler imaging of the placental mass showed continuous non-pulsatile waveforms in all the echo-poor spaces (maternal lakes) identified on gray-scale imaging (Figure 2). At 14 weeks and 3 days, the fetal crown–rump length and biparietal diameter were those of a fetus of 12 weeks and 6 days. The placental features were similar (Figure 1b) and flow velocity waveforms from the umbilical artery showed no end-diastolic phase. Maternal serum human chorionic gonadotropin (hCG) and α-fetoprotein levels were respectively 5.6 and 3.4 multiples of the normal median (MoM) for the corresponding gestational age.

At 16 weeks and 6 days, all fetal ultrasound measurements were below the 5th centile for gestational age according to our charts[6]. The placental lesions were comparable, the shape of the lakes changed only with maternal position on the table (Figure 1c and d). No end-diastolic phase was found in the umbilical arteries along the cord and uterine artery flow velocity waveforms demonstrated notches on the left side, next to the placental implantation site. Umbilical artery pulsatility index (PI) measurements were above the 95th centile of our chart, whereas uterine artery PIs were within our normal range. At 18 weeks and 1 day, ultrasound examination showed no fetal growth, reduced amniotic fluid and fetal activity and similar Doppler features (Figure 3). Because of the poor fetal prognosis, the patient opted for a medical termination of the pregnancy. The fetus was male, weighed 95 g and had a normal karyotype. Histopathological examination of the placenta showed several recent intervillous thromboses and areas of fibrin deposition, with villous necrosis involving about half of the placental tissue.

DISCUSSION

Abnormalities of placentation may explain not only late pregnancy complications such as pregnancy-induced hypertension[7] but also first-trimester miscarriages[8,9] and early second-trimester fetal death, as demonstrated by the

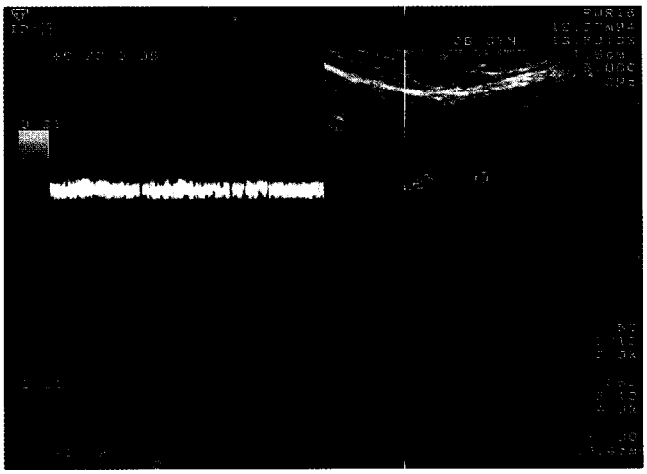

Figure 2 Color flow imaging and spectral analysis of the placental lesions at 12 weeks of gestation, showing a continuous non-pulsatile (venous-like) flow

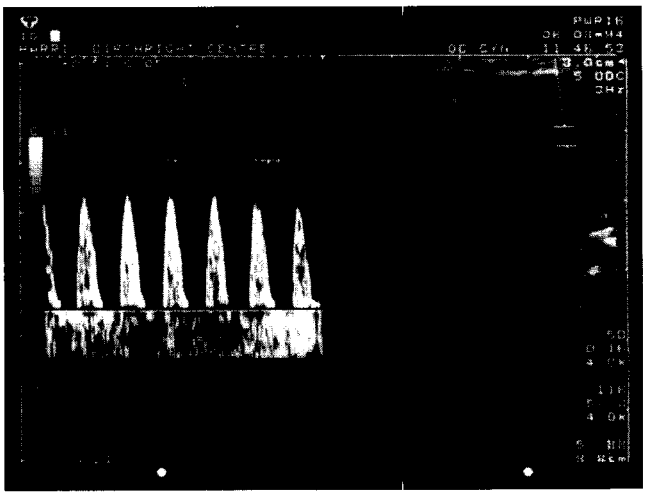

Figure 3 Umbilical artery flow velocity waveforms near the placental insertion of the cord at 18 weeks of gestation, showing no end-diastolic phase

present case. Failure of the placenta to implant may, therefore, result in a wide spectrum of clinical and pathological features that may all be observed during the reproductive life of a single couple.

Normal placentation requires a progressive transformation of the spiral arteries and infiltration of the placental bed by trophoblastic cells[7]. These physiological changes normally extend into the inner third of the myometrium and in normal pregnancies all the spiral arteries are transformed into uteroplacental arteries before 20 weeks of gestation. In most cases of early pregnancy failure, as in pregnancy-induced hypertension, there is inadequate placentation and, in particular, a defective transformation of the spiral arteries[9,10]. Reduced trophoblastic penetration into the decidua and into the spiral arteries together with a thinner and discontinuous trophoblastic shell have also been shown in spontaneous abortions, whereas in normal first-trimester pregnancies the physiological changes are always present. The extent of the placentation deficit does not seem to be linked to a specific etiology, but is probably related to the onset of secondary complications such as pre-eclampsia. Recurrent early and late spontaneous abortions as experienced by our patient could represent the most severe form of this phenomenon.

Sonolucent areas within the placental tissue vary from small hypoechoic spaces to large sonolucent spaces, also called 'maternal lakes'. Small hypoechoic spaces are found in the center of the cotyledons in normal third-trimester mature placentas[11]. These centrocotyledonary cavities are secondary to the dispersion of the terminal villi by maternal arterial jets of blood, entering the intervillous space with an increased pressure as pregnancy advances[12,13]. Larger sonolucent spaces within the placental tissue have been observed by ultrasound from the second trimester until the end of pregnancy[14]. Single large lakes under the chorionic plate, between two cotyledons or at the placental margin correspond to a non-pathological variant of the normal placental anatomy and are not associated with an increase in perinatal complications[13–15]. Multiple large maternal lakes, distorting the placental architecture, as in the present case, are probably due to abnormal hemodynamic flow in the intervillous space. Incomplete transformation of the spiral arteries will produce disturbed and possibly turbulent flow[16]. This may result in focal overpressure within the above cotyledon and secondary alterations of the surrounding villous tissue with maternofetal hemorrhage, as demonstrated by increased maternal serum α-fetoprotein and hCG[4,14]. Maternal blood will eventually coagulate within the lakes, permanently obliterating the intervillous circulation in the corresponding placental area.

During the first 3 months of gestation, umbilical arteries show a high degree of vascular resistance to blood flow, expressed by narrow systolic waveforms, absence of the end-diastolic phase and high PI values[17]. Between 12 and 14 weeks, the end-diastolic phase develops and diastolic frequencies throughout the entire cardiac cycle are recorded in the umbilical artery of the normally developing fetus from 14 weeks onward. There have been three recent reports of a fatal fetal outcome between 11 and 18 weeks of gestation, following the discovery of absent or reverse end-diastolic phase in the umbilical artery[18–20]. In the first and second cases, the fetus died 24 h[18] and 10 days[20], respectively, after the ultrasound examination, whereas in the third case the pregnancy was terminated at 18 weeks, because of maternal pre-eclampsia[19]. These findings indicate that an abnormal end-diastolic phase in early pregnancy can also be an ominous sign of adverse fetal outcome before mid-gestation, as it is during the second half of pregnancy. In the present case, the end-diastolic phase in the umbilical arteries never appeared, suggesting that the formation of the villous vascular bed was impaired from at least 12 weeks of gestation. Within this context, uterine Doppler parameters have little predictive value for detecting an abnormal placental implantation before 20 weeks of gestation[10].

In conclusion, it appears that the ultrasound and Doppler features suggestive of uteroplacental insufficiency can be found from the beginning of the second trimester. With the introduction of early scans (11–14 weeks) in routine

antenatal management, more cases may be detected before the fetal growth starts to slow down, the uterine Doppler waveforms become abnormal and certainly long before the mother develops secondary symptoms such as pre-eclampsia. In an apparently healthy woman with a history of fetal death during the fourth or fifth month of pregnancy, antepartum surveillance could start at around 12 weeks. Even in primigravida patients, the demonstration of placental vascular lesions and high resistance to blood flow in the fetoplacental circulation at this stage are suggestive of an impaired transformation of the spiral arteries. Aspirin or other medical therapies could be offered in these cases.

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