Prenatal diagnosis of placenta and umbilical cord pathologies by three-dimensional ultrasound: pictorial essay.

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Abstract

The authors present their experience in prenatal diagnosis of placental and umbilical cord pathologies, using three-dimensional ultrasound (3DUS) in the rendering and tomography ultrasound imaging (TUI) modes, associated with color Doppler in some cases. Cases of placenta accreta/placenta previa, circumvallate placenta, succenturiate lobe, true knot of the umbilical cord, nuchal cord, and marginal/velamentous umbilical cord insertion are presented. 3DUS can contribute to improve the accuracy of prenatal diagnosis of placenta and umbilical cord pathologies.

Keywords: prenatal diagnosis, placenta, umbilical cord, Doppler ultrasonography, 3D ultrasound.

Introduction

Ultrasound professionals often underestimate the value of ultrasonographic evaluations of the placenta and umbilical cord. Placenta and umbilical cord abnormalities may have important prognostic implications for perinatal morbidity and mortality. In recent years, with the advancement of high-resolution ultrasound, the three-dimensional ultrasound (3DUS), associated in some cases with color and/or power Doppler, has become an important prenatal diagnostic tool [1-3].

This pictorial essay presents the authors’ experience while using 3DUS (associated in some cases with color and/or power Doppler) in the diagnosis of placenta and umbilical cord pathologies.

Placenta accreta

Placenta accreta (defined as an abnormal adherence of the placenta to the uterus, rendering the separation from the uterus difficult or impossible) is a rare complication, with an estimated prevalence of 1 in 2,500 pregnancies. Nonetheless, it has become an important etiology of maternal morbidity and mortality, as it is the leading cause of emergency peripartum hysterectomy [1,4]. Clinically, the main feature of placenta accreta is abundant uteroplacental neovascularization, which can cause severe and difficult-to-treat bleeding [1,5]. The prevalence of placenta accreta has been increasing, and the most common predisposing conditions are prior cesarean section and placenta previa [1,6].

A prenatal diagnosis of placenta accreta is essential for proper delivery preparation and, usually, for the performance of a cesarean hysterectomy [1,6]. The ultrasound diagnosis is based on gray-scale findings, which can be associated with color Doppler and 3DUS. Among these findings, irregularly shaped placental lacunae, thinning of the myometrium, in which the placenta is implanted, and loss of retroplacental hypoechoic area are notable [1,5]. In figure 1 are shown some examples of this pathology.
Circumvallate placenta

Circumvallate placenta is an abnormality in the shape of the placenta in which the membranes are inserted from the inside towards the edge and through the center of the placenta. It is characterized by cylindrical, peripherally thickened chorioamniotic membranes [2,7]. The incidence of circumvallate placenta varies from 0.5% to 18% in postpartum placental examinations [2]. This placental form is associated with an increased risk of several perinatal complications, particularly amniotic rupture, intrauterine growth restriction, abruptio placentae, fetal malformation, and perinatal death [2].

Fig 1. a) Longitudinal plane of the three-dimensional (3D) image with HD flow of the cervix and anterior lower uterine segment, using tomography ultrasound imaging (TUI) software, evidencing loss of placental hypoechoic area (white arrows) in a case of placenta accrete in the third-trimester of pregnancy; b) cervix and anterior lower uterine segment using TUI software, showing loss of placental hypoechoic area; c) cervix and anterior lower uterine segment using TUI software, evidencing loss of placental hypoechoic area; d) photograph of the same uterus after a cesarean hysterectomy and after longitudinal incision, showing placental invasion into the myometrium at the segment region (black arrows); e) longitudinal and transverse planes of the 3D image of the cervix and anterior lower uterine segment using TUI software, showing the placenta bypassing the internal opening of the cervix, and the presence of placental hypoechoic area (white arrows), placenta previa. BEX: bladder; PLAC: placenta; COLO: cervix.

Fig 2. a) Two-dimensional image of a transverse plane of the placenta, showing thick peripheral edges and corners, circumvallate placenta (white arrows), in a third-trimester pregnancy; b) Three-dimensional image with the HD live software of a circumvallate placenta, showing thick peripheral edges and curves (white arrow) in a pregnancy in the third trimester, with light incidence at 1 o’clock; c) Three-dimensional image with HD live software of a circumvallate placenta, evidencing thick peripheral edges and curves (white arrow), appearance of a tire mounted on a wheel, with light incidence at 1 o’clock, in a third-trimester pregnancy.
Two-dimensional ultrasonographic findings are described as a placental band or placental shelf, specifically the thick, cylindrical placental edge [2] (fig 2). Nonetheless, the prenatal diagnosis of circumvallate placenta is rare [2]. Figures 2B and 2C illustrate, through 3DUS with HD live software, a finding described as the “tire” sign, in which a circular depression with a thick peripheral ring on the chorionic plate is observed, resembling a tire mounted on a wheel [2].

**Succenturiate lobe**

Succenturiate lobe or accessory lobe is recognized by ultrasonography as a mass of placental tissue separated from the main lobe, occurring in approximately 5% of pregnancies [7] (fig 3). This finding is correlated with a higher incidence of velamentous umbilical cord insertion, vasa previa, and placental infarction [8].

**Marginal/velamentous umbilical cord insertion**

The insertion of the umbilical cord at the edge of the placenta, known as battledore placenta, occurs in 7% of pregnancies [7]. In 1% of all pregnancies, the umbilical cord falls beyond the placental edge, allowing a variable portion of the umbilical cord to remain between the two
membranes without the protection of the Wharton’s jelly [7,9]. This condition is associated with fetal growth restriction, congenital anomalies, retained placenta, and prematurity, in addition to rupture, thrombosis of the umbilical vessels, and fetal death [7,9]. The ultrasound diagnosis is possible; placental cord insertion should be routinely tracked at obstetric ultrasound [7,9] (fig 4).

**True knot of the umbilical cord**

A true knot of the umbilical cord is observed in approximately 0.3%–2.1% of births [10]. Although it is a rare event, this finding is associated with serious consequences. Fetal mortality rate can be four to ten times higher when compared with that of the general obstetric population [3]. It can also be associated with a non-reassuring fetal heart rate pattern during labor and higher incidence of cesarean section [10]. Some obstetric factors are described to be correlated with true knot of the umbilical cord: polyhydramnios, gestational diabetes, fetuses that are small for gestational age, long umbilical cord, male fetus, and genetic amniocentesis [10]. Prenatal diagnosis of true knot of the umbilical cord became possible with the modernization of ultrasound equipment; however, it is still an uncommon diagnosis [3,10]. Ultrasound with gray scale, color Doppler, two- and three-dimensional power Doppler, and 3DUS with HD flow software are used in the diagnosis of this condition, which is suspected by the visualization of a “loop” (fig 5).

**Nuchal cord**

Nuchal cord is defined as a 360° turn of the umbilical cord around the fetal neck [11]. The prevalence of nuchal cord at delivery has been reported to be between 6% and 37% [11]. The prevalence of single, double, triple, and quadruple nuchal cord was described by Shui et al to be of 10.6%, 2.5%, 0.5%, and 0.1%, respectively [12]. There is a linear increase in the prevalence of single or multiple nuchal cords with advancing gestational age [11,12]. Prenatal diagnosis of nuchal cord is not routinely done, but there is a correlation between this event and abnormal fetal heart rate pattern during labor [11]. The sagittal and transverse planes at the fetal neck level allow for a precise diagnosis [12], and the sensitivity of diagnosis usually improves with the use of color Doppler and 3DUS [11,12] (fig 6).

**Conclusions**

With technological advancement, new possibilities in diagnostic imaging are made available for the antenatal period [13]. 3DUS has been used as a complementary technique for prenatal diagnosis of placenta and umbilical cord pathologies [1-3]. Some of these conditions, which are associated with high perinatal morbidity and mortality, have a low antenatal detection rate as they are often diagnosed at birth or postpartum [1,3,6]. Prenatal diagnosis of these pathologies allows for the quantification of risks, prenatal and delivery programming, and guidance to families, having a significant impact on the follow-up of these patients. 3DUS also allows for data storage, which can be forwarded for review to tertiary centers.

**Conflict of interest:** none

**References**

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