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Case Report

Vasa previa evaluated by noncontrast time-of-flight magnetic resonance angiography

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ABSTRACT

Objective: Vasa previa is a rare complication, and rupture of vasa previa during pregnancy may lead to significant perinatal mortality. Here, we report a case of vasa previa evaluated prenatally using noncontrast time-of-flight magnetic resonance angiography (TOF MRA).
Case Report: A 22-year-old primiparous woman was referred to our hospital due to suspicion of vasa previa. Transvaginal ultrasonography showed two vessels running over the internal os. To obtain further information, magnetic resonance imaging (MRI) and TOF MRA were performed. Caesarean section was carried out, and macroscopic findings of the vascular distribution on the fetal membrane were consistent with those identified by TOF MRA.
Conclusion: TOF MRA in addition to MRI may be an option for prenatal identification of the precise three-dimensional vascular distribution in patients with vasa previa.

Introduction

Vasa previa is a rare complication which occurs in one in 2500 pregnancies. Blood vessels unsupported by the placental tissues or the umbilical cord run through the fetal membrane over the internal cervical os [1]. Vasa previa is classified into two types: Type I, in which there is a single placental lobe with velamentous cord insertion, and Type II, in which the vessels over the cervix connect between the lobes of a placenta with multiple lobes [1]. Rupture of vasa previa during pregnancy may lead to a massive blood loss in the fetus and significant perinatal mortality of approximately 60% in the absence of prenatal diagnosis, whereas 97% of fetuses survive when the diagnosis is made prenatally [2]. Ultrasound imaging (US), including the developments of color and power Doppler, pulsed Doppler, and three-dimensional (3D) Doppler technology, affords the possibility of prediction of vasa previa before the onset of labor [1,2]. Recently, magnetic resonance imaging (MRI) is increasingly utilized to evaluate fetal and placental abnormalities without any adverse fetal effects. A MEDLINE search from 1966 to 2013 revealed only three case reports of vasa previa diagnosed using MRI [3–5]. These were Type II vasa previa, and there have not been any reports of Type I vasa previa diagnosed by MRI. In addition, there have been no reports mentioning the usefulness of noncontrast time-of-flight magnetic resonance angiography (TOF MRA) for diagnosis of vasa previa. In this report, we used TOF MRA to elucidate more information regarding Type I vasa previa in addition to the usefulness of MRI in such cases. This is the first report to identify fetal vessels using TOF MRA *in utero*.

Case Report

A 22-year-old primiparous woman was referred to our hospital at 29 weeks of gestation due to suspicion of vasa previa. Transvaginal US with color Doppler, pulsed Doppler, and 3D Doppler revealed two vessels running over the internal os (Figure 1A). By abdominal ultrasonography, the placenta was located on the posterior wall of the uterus, and we did not find any accessory placenta. The patient was hospitalized at 31 weeks of gestation. To obtain further information, MRI and TOF MRA were performed at 33 weeks of gestation. From MRI, we detected two vessels running over the internal os, but we could not identify the vascular distribution and insertion of the umbilical cord clearly (Figure 1B). TOF MRA with 3D reconstruction showed velamentous cord insertion located at the posterior wall,

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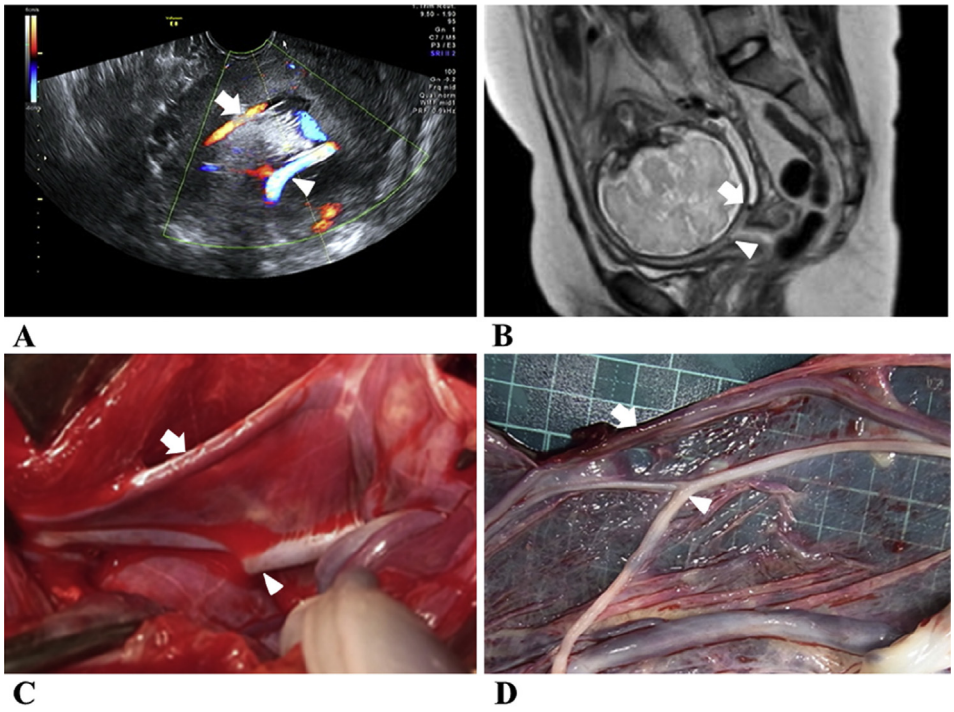

Figure 1. Preoperative and postoperative findings of vasa previa; umbilical vein (arrow) and artery (arrow head) were detected in each image. (A) Transvaginal ultrasonography; two vessels were detected above the internal os in axial view of the uterine cervix; (B) T2-weighted sagittal image of magnetic resonance imaging; (C) operation view; (D) macroscopic finding of placenta.

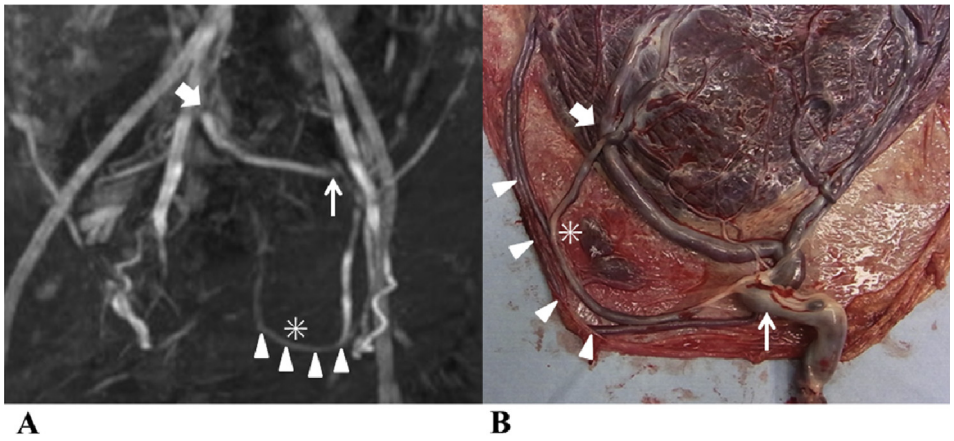

Figure 2. The vascular distribution of vasa previa; we were able to find the vessel (arrow head) running over the internal os (asterisk), velamentous cord insertion (small arrow), and insertion to placenta (big arrow). (A) Noncontrast time-of-flight magnetic resonance angiography with three-dimensional reconstruction; (B) macroscopic finding of placenta.

which is the area caudal of the placenta (Figure 2A). There were no vessels on the anterior lower segment of the uterus, and we were able to visualize the vascular distribution, determining the optimum site for hysterotomy at delivery. At 35 weeks of gestation, elective caesarean section was performed with consideration of the vascular distribution. A 2617-g female baby was delivered with an Apgar score of 9/9 at 1 minute and 5 minutes, respectively. Before delivery of the placenta, we confirmed the two vessels over the internal os, corresponding to the prenatal transvaginal US, MRI, and TOF MRA (Figure 1C and D). Furthermore, macroscopic findings of the vascular distribution on the fetal membrane were consistent with those identified by prenatal TOF MRA (Figure 2). The placenta was normal and without accessory placenta, and large vessels spanned the extraplacental membrane without rupture. TOF MRA was useful in the present case to understand the vascular distribution of the uterine lower segment.

Discussion

This report highlighted the important clinical suggestion that TOF MRA may be a useful tool for obtaining precise information on the 3D vascular distribution in prenatal evaluation of vasa previa.

The incidence of vasa previa has been estimated to be one in 2500 pregnancies. Women with painless bleeding during pregnancy, with a low-lying placenta, who had undergone *in vitro* fertilization, with bilobed placenta, or with multiple pregnancies are also potentially in the high risk group for vasa previa [2]. Prenatal diagnosis of vasa previa is based on the identification of fetal

vessels with no Wharton's jelly passing across the internal os by transvaginal US [1,2]. Color or power Doppler can demonstrate the blood flow through these vessels and pulsed Doppler can demonstrate fetal vessel waveforms near the internal os. Three-dimensional US also maps out the fetal vessels on the cervical os. In cases of diagnostic uncertainty or the need for additional required information, MRI has an increasing role in the diagnosis of vasa previa, in particular, velamentous cord insertion located at the posterior uterine wall [3,6]. MRI has not been shown to have any adverse fetal effects, and has been proven to be a powerful tool in the evaluation of several fetal and placental abnormalities, providing in several circumstances information superior to that obtained using US alone [6]. In the previous three reports, vessels running over the cervix and the existence of accessory placenta had been demonstrated by MRI [3–5]. However it is difficult to know about the vascular distribution of the 3D structure of fetal vessels on the membrane using MRI. TOF-MRA may become an option in the identification of fetal vessel distribution.

TOF MRA is a noncontrast MRA technique that has become a standard technique for the visualization of the peripheral, intracranial, and carotid vessels, but not in pregnancy. In the present case, macroscopic findings of the vascular distribution on the fetal membrane were consistent with those identified by prenatal TOF MRA (Figure 2). TOF MRA may contribute to the correct diagnosis of Type I vasa previa, which is associated with a velamentous cord.

In addition, prenatal evaluation of the 3D vascular distribution in patients with vasa previa using TOF MRA may contribute to the avoidance of massive bleeding and fetal blood loss during caesarean section. Clear 3D visualization of the velamentous cord distribution and insertion may ensure the safety of operation by determining the optimum site for hysterotomy at delivery. In the present case, we were able to image the detailed 3D vascular distribution, including the site of the velamentous cord, which resulted in a successful cesarean delivery without rupture of the fetal vessels or any neonatal complications.

There may be some limitations for the use of TOF MRA in pregnancy. In the present case, using TOF MRA we were able to only locate the umbilical vein, but not the umbilical artery on the internal os. The signal loss may have been due to the saturation effect of in-plain flow, intravoxel dephasing of complex or turbulent flow, or artifacts because of the nature of the gradient-echo sequence [7]. Moreover, MRI and TOF MRA cannot be used for patients with active hemorrhage or uterine contraction, because of the need for a long acquisition time.

In conclusion, we demonstrated the usefulness of TOF MRA for the prenatal diagnosis and 3D vascular evaluation of vasa previa. Further studies with a large number of patients with vasa previa are needed to determine the indication of TOF MRA and its significance for perinatal outcome.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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