CASE REPORT

Fetal Intra-abdominal Umbilical Vein Varix Assessed by the Novel Doppler Ultrasound

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ABSTRACT

We present two cases of fetal intra-abdominal umbilical vein varix (FIUVV) assessed using RadiantFlow, HDlive Flow, and SlowflowHD. In the first case, FIUVV may have been caused by a persistent right umbilical vein, and it may have been due to umbilical ring contracture in the second case. These causes were suspected by the novel Doppler ultrasound. These novel Doppler techniques may provide useful information on the prenatal diagnosis and understanding of the pathophysiology of FIUVV.

Keywords: Fetal intra-abdominal umbilical vein varix, HDlive Flow, Pathophysiology, Prenatal diagnosis, RadiantFlow, SlowflowHD.

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INTRODUCTION

The incidence of fetal intra-abdominal umbilical vein varix (FIUVV) is 0.1 to 2.8 per 1,000 pregnancies.^{1,2} Isolated FIUVV can be easily diagnosed using color/power Doppler ultrasound and is associated with a favorable prognosis.^{3,4} There have been several studies on three-dimensional (3D) power Doppler ultrasound assessment of FIUVV during pregnancy.⁵⁻⁷ Using this technique, we can clearly recognize the spatial relationships between FIUVV and surrounding vasculatures. HDlive Flow is one form of 3D color/power Doppler that facilitates the spatial reconstruction of the fetal heart and blood vessels with an adjustable light source to realize lighting and shadowing effects.⁸⁻¹⁴

RadiantFlow is a unique form of Doppler ultrasound, which shows 3D color/power Doppler information on a two-dimensional (2D) grayscale image by shading based on the amplitude of the color/power Doppler signal.¹⁵⁻¹⁷

SlowflowHD is a novel power Doppler technique that can depict slow blood flow in fetal peripheral circulations.^{18,19} In this study, we present two cases of FIUVV assessed using RadiantFlow, HDlive Flow, and SlowflowHD.

CASE DESCRIPTION

Case 1

A 40-year-old pregnant Japanese woman, gravida 1, para 0, received a routine third-trimester fetal anomaly scan at 29 weeks and 3 days of gestation, and round FIUVV (13.6 mm) was noted by color Doppler ultrasound (Fig. 1). Swirling flow in the varix was identified using a power Doppler ultrasound (Fig. 2). SlowflowHD showed a persistent right umbilical vein making a right-angled turn from FIUVV (Fig. 3). HDlive Flow clearly demonstrated spatial relationships among vortex FIUVV flow and surrounding blood vessels (Fig. 4). The size of FIUVV did not change during pregnancy, and we could not find the clot in FIUVV.

At 38 weeks and 1 day of gestation, the elective cesarean section was performed due to previous uterine surgery, resulting in a viable, single male newborn weighing 2,804 g, with a height of

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48 cm. The Apgar scores were 9 (1 minute) and 10 (5 minutes), and the umbilical artery blood pH was 7.39. The mother and neonate followed a favorable course after the delivery.

Case 2

A 36-year-old pregnant Japanese woman, gravida 1, para 0, received a routine third-trimester fetal anomaly scan at 30 weeks of gestation, and tubular FIUVV was noted by 2D sonography (Fig. 5). RadiantFlow showed two-stream flows in the tubular FIUVV (Fig. 6), and a high-peak velocity was noted (Fig. 7). SlowflowHD depicted precise intrahepatic small vessels (Fig. 8). HDlive Flow clearly demonstrated umbilical ring contracture (Fig. 9). The size of FIUVV did not change during pregnancy, and we could not find the clot in FIUVV.

One male newborn was vaginally delivered at 40 weeks and 5 days of gestation with a body weight of 2,952 g and a

Fig. 1: Color Doppler ultrasound image of fetal intra-abdominal umbilical vein varix (arrow) at 29 weeks and 3 days of gestation. GB, gallbladder; St, stomach

Fig. 2: Power Doppler ultrasound image of fetal intra-abdominal umbilical vein varix (arrow) at 35 weeks and 3 days of gestation. Swirling flow in the varix is noted. UC, umbilical cord

Fig. 3: SlowflowHD image of fetal intra-abdominal umbilical vein varix (arrow) at 36 weeks and 3 days of gestation. PRUV, persistent right umbilical vein

Fig. 4: HDlive Flow image of fetal intra-abdominal umbilical vein varix (arrow) at 35 weeks and 3 days of gestation. Swirling flow in the varix is spatially evident. PRUV, persistent right umbilical vein; UA, umbilical artery; UC, umbilical cord

Fig. 5: Two-dimensional sonographic image of fetal intra-abdominal umbilical vein varix (arrow) at 30 weeks of gestation. H, heart

Fig. 6: RadiantFlow image of fetal intra-abdominal umbilical vein varix (arrow) at 32 weeks and 6 days of gestation. DV, ductus venosus; GB, gallbladder

Fig. 7: Pulsed Doppler ultrasound image of fetal intra-abdominal umbilical vein varix at 34 weeks and 6 days of gestation. High-peak velocity (60 cm/s) is evident

Fig. 9: HDlive Flow image of fetal intra-abdominal umbilical vein varix (arrow) at 32 weeks and 6 days of gestation. Umbilical ring contracture (UR) is clearly identified. UA, umbilical artery; UC, umbilical cord

length of 50 cm. The umbilical artery pH was 7.27. He had an Apgar score of 9/10 at 1 and 5 minutes, respectively. The mother and neonate followed a favorable course after the delivery.

DISCUSSION

There have been numerous studies on the clinical characteristics of FIUVV.^{1–4,20,21} However, the etiology and pathophysiologic causes of FIUVV were not described in these previous studies. In our first case, straight umbilical venous flow through the umbilical ring may hit the intra-abdominal venous wall, which bends at a right angle due to the persistent right umbilical vein. Moreover, swirling flow in varix may widen FIUVV. Therefore, FIUVV may adopt a round shape in this case. In the second case, high-speed umbilical venous flow through the contracted umbilical ring may widen the intra-abdominal umbilical vein. So, FIUVV may adopt a tubular shape in the second case. These pathophysiologic causes of FIUVV were suspected by novel Doppler ultrasound involving RadiantFlow, HDlive Flow, and SlowflowHD. This allows us to clearly recognize spatial relationships among FIUVV and surrounding blood vessels. These novel Doppler techniques may provide useful information on

Fig. 8: SlowflowHD image of fetal intra-abdominal umbilical vein varix (arrow) at 32 weeks and 6 days of gestation. DV, ductus venosus

the prenatal diagnosis and understanding of the pathophysiology of FIUVV.

With respect to the perinatal management of FIUVV, fetal ultrasound follow-up is mandatory, focusing on an increase in the size of varix and appearance of a clot.² In our cases, the sizes of varix did not change until delivery. Moreover, we could not detect any clots in varix. Consequently, the newborn babies followed a favorable after delivery. Novel Doppler ultrasound might also be useful for monitoring fetal well-being, especially for detecting a clot in varix.

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