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Original Article

Prenatal sonographic diagnosis of single umbilical artery: Emphasis on the absent side and its relation to associated anomalies

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ABSTRACT

Objective: To determine the absent side of a single umbilical artery (SUA) and to evaluate whether associated anomalies are related to the side of the missing artery in a Taiwanese population.
Materials and methods: We retrospectively studied SUA fetuses from our computer database of fetal ultrasound in a tertiary medical center in Southern Taiwan. All cases were diagnosed as SUA prenatally using conventional scanners of two- and three-dimensional (2D and 3D, respectively) ultrasound, as well as color, power, and high-definition Doppler. The absent side of UA and associated anomalies were analyzed.
Results: From September 2006 to November 2011, 31 fetuses with SUA were diagnosed prenatally by ultrasound and all were enrolled for this series. The incidence was estimated to be 1:556 (0.18% = 31/17,086). The mean maternal age was 29.2 years (range, 15–36 years) and the mean fetal age was 30.0 weeks of gestation (range 18–36 weeks). Notably, the left-absent UA was detected in 16/31 (52%) fetuses, compared with the right-absent UA in 15/31 (48%) cases. In addition, congenital anomalies were noted prenatally in 2/16 (13%) fetuses with left-absent UA and in 3/15 (20%) fetuses with right-absent UA.
Conclusion: In SUA fetuses, the absence of UA appears to occur equally at each side. Moreover, this study showed no significant difference between either side of missing UA and associated anomalies after statistical examination.

Introduction

Single umbilical artery (SUA) is one of the most common congenital malformations. Prenatal diagnosis of SUA is mandatory. According to previous reports, the incidence of SUA was in the range from 1:500 (0.2%) to 1:50 (2.0%) [1–11]. Twins are affected three to four times more frequently than singletons [8]. With the recent advent of color, power, and high-definition (HD) Doppler ultrasound, the umbilical cord blood flow imaging makes the identification of which side of UA is missing much easier than ever before. Previous studies showed that left UA was absent more frequently than right UA [9–11]. However, no reports investigated which side of the UA is absent more frequently in Taiwanese fetuses.

Of interest, increased risk of congenital anomalies in SUA was postulated previously [9,11]. To date, most literature surveyed the associated structural defects and aneuploidy in fetuses with SUA [8,11,12]. Nevertheless, only a few studies discussed the side of missing UA and its relation to associated abnormalities [9–13]. In this series, we attempted to investigate two areas in this regard: First, we evaluated the incidence of right/left side of the missing UA in Taiwanese fetuses and tested which side is predominant. Second, we tried to determine whether associated anomalies diagnosed prenatally are related to the side of missing UA.

Materials and methods

Participants

In this series, we retrospectively reviewed the cases of SUA between September 1, 2006, and November 30, 2011, in our computer database of fetal ultrasound. All SUA cases were diagnosed *in utero* using conventional scanners of two- and three-dimensional (2D and 3D, respectively), high-resolution, real-time ultrasound, as well as color, power, and HD Doppler (GE Voluson 730-Expert,

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Milwaukee, WI, USA; Medison, Accuvix V20, Seoul, Korea; AlokaSSD-680, Tokyo, Japan, respectively). The study was approved by the Institutional Review Board (IRB), National Cheng Kung University Hospital, Tainan, Taiwan (IRB number: ER-99-011). The flowchart of this SUA series is summarized in Fig. 1.

Ultrasound examination

First, the SUA was determined by visualizing only two vessels (1 artery and 1 vein) within the umbilical cord at the cross-sectional and longitudinal views of 2D and/or 3D ultrasound (Fig. 2). Second, color, power, and HD Doppler ultrasound scanners were used to confirm SUA (Fig. 3). Third, to determine which side of UA is missing, color, power, and HD Doppler ultrasound scanners were further used to depict UA at either side of the fetal bladder (perivesical view) and in continuity with cord insertion to fetal abdomen (Fig. 4). Besides, HD Doppler is a bidirectional power Doppler technique that delivers HD axial resolution and has increased sensitivity for imaging small vessels. In addition, HD Doppler reduces spatial overlap of tissue signals by application of small sample volumes and provides optimal clutter elimination with adaptive wall filtering. In other words, the missing side of UA can be clearly visualized and determined by perivesical view using color Doppler (Fig. 4) as well as power and HD Doppler. In addition, all fetuses with SUA underwent a detailed examination by systemic level II ultrasound to identify any associated anomalies.

Statistics

We used Mann–Whitney test (nonparametric independent two-group comparisons) to examine which missing side of UA is predominant and whether associated anomalies diagnosed prenatally are related to the side of missing UA. A p value < 0.05 was considered statistically significant.

Results

As listed in Table 1 and Fig. 1, 31 fetuses with SUA were recruited for analysis. At the same period, 17,086 cases with 17,848 examinations were recorded in our computer database. Hence, the incidence of SUA was estimated to be 1:556 (0.18% = 31/17,086). In addition, the mean maternal age was 29.2 years, ranging from 15 to 38 years. Among them, 29 cases were singletons (93.5%) and two cases were twins (6.5%). Both pairs of twins had only one SUA fetus, and the other twin was normal. On average, the mean fetal age was 30.0 weeks of gestation (range, 18–36 weeks). The earliest diagnosis of SUA was made at 18 weeks' gestation. Four cases (13%) were diagnosed at or before 20 weeks' gestation, 10 cases (32%) at 21–24 weeks' gestation, 12 cases (39%) at 25–28 weeks, and the remaining five cases (16%) after 28 weeks' gestation (Table 1).

The left UA was absent in 16 of 33 (52%) fetuses and the right artery was absent in 15 of 33 (48%) fetuses. In this series, the absence of UA appears to occur equally at each side when statistically examined. In other words, no significant difference can be observed in the incidence of either side in Taiwanese SUA fetuses.

In total, congenital associated anomalies were discovered in 5/31 (16%) fetuses during the prenatal examination. In cases with left-absent UA, two of 16 (13%) cases had structural abnormalities. Intrauterine growth restriction (IUGR) and ventricular septal defect

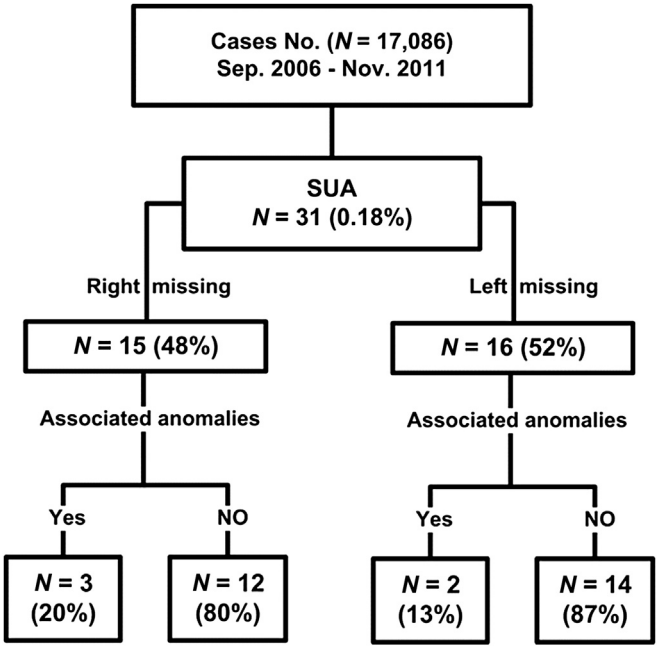

Fig. 1. Flowchart of this single umbilical artery (SUA) study.

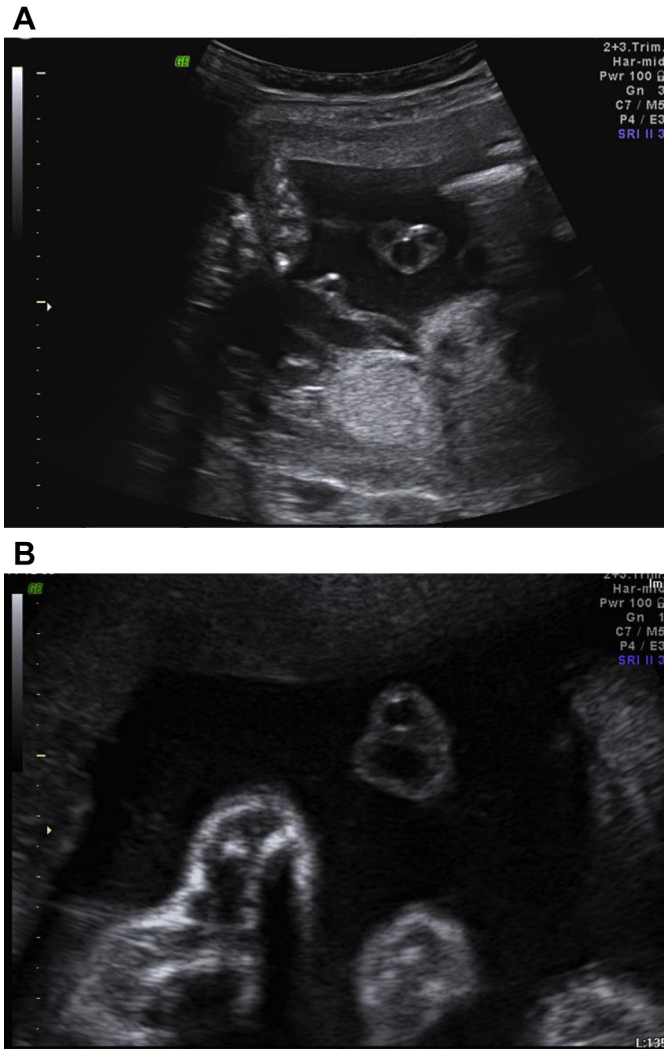

Fig. 2. (A) Cross-sectional view of a normal, three-vessel umbilical cord demonstrates the umbilical vein and two smaller umbilical arteries in normal pregnancy. (B) Cross-sectional view of an umbilical cord with single umbilical artery (SUA) demonstrates two vessels in the umbilical cord. The larger one is the umbilical vein and the smaller one is the SUA. Notably, it is impossible to determine which side of the UA is missing from this view.