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Four-vessel umbilical cord with three arteries and one vein: a case report and literature review

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ABSTRACT

Background. Four-vessel umbilical cord (FVUC) is a rare embryonic anomaly, characterized by the presence of an umbilical cord with 4 vessels, usually 2 arteries and 2 veins. In early embryonic life, at 4th week, three pairs of major veins (vitellins veins drain the yolk sac, cardinal veins drain foetal body, and umbilical veins from the placenta) are connected to the primitive foetal heart at the sinus venosus. A multivessel cord has been associated with congenital anomalies, especially cardiac abnormalities, but also intrauterine growth restriction (IUGR). A more uncommon anomaly is when a FVUC is made by three arteries and one vein, with only two cases described in the literatures.

Case presentation. Here we report a rare case of FVUC with three arteries and one vein.

Conclusions. FVUC is an uncommon condition associated with major malformations and high risk of IUGR. Cases with three arteries and one vein seem to be associated with better outcomes.

INTRODUCTION

Four-vessel umbilical cord (FVUC) is a rare embryonic anomaly, characterized by the presence of an umbilical cord with 4 vessels, usually 2 arteries and 2 veins. In early embryonic life, at 4th week, three pairs of major veins (vitellins veins drain the yolk sac, cardinal veins drain foetal body, and umbilical veins from the

placenta) are connected to the primitive foetal heart at the sinus venosus. By the 6th week, a "critical anastomosis" between left umbilical vein and the hepatic sinusoid are formed and resulting in the normal drainage pattern of placenta through will be the ductus venosus [1, 2]. Failure of this normal process results in an uncommon anomaly of a persistent right umbilical vein (PRUV), and in rarer situation persistence

of both umbilical veins, defined as FVUC [3, 4]. A multivessel cord has been associated with congenital anomalies, especially cardiac abnormalities [4], but also intrauterine growth restriction (IUGR). A more uncommon anomaly is when a FVUC is made by three arteries and one vein, with only two cases described in the literatures [5, 6].

CASE PRESENTATION

A 38 years old pregnant woman was referred to our Gynecology and Obstetrics outclinic of San Giovanni Di Dio e Ruggi D'Aragona Hospital for a routine foetal scan at 20 weeks and 2 days of gestation. She had a history of two previous caesarean deliveries, reported uncomplicated preg-

nancies and absence of genetic anomalies. The indications for caesarean sections were respectively post-term pregnancy and foetal macrosomia. During first trimester screening no congenital anomalies were detected.

The second trimester anatomy scan showed a male foetus with normal biometry. The evaluation of the umbilical cord showed a FVUC (**Figure 1**), with three arteries and one vein at Doppler. No other congenital abnormalities were identified.

Follow-up ultrasound scan at 30 weeks confirmed the FVUC and also revealed a large cyst of the umbilical cord (77 × 74 mm), with corpuscular content. Second follow-up was planned at 35 weeks of gestation and showed regular growth and normal Doppler of the umbilical cord (**Figure 2**).

The woman received emergent caesarean delivery at 36 weeks of gestation due to onset of preterm labour contractions. A male foetus of 3,200 grams was born with APGAR score at 1 and 5 minutes of 8 and 9, respectively. The placenta, sent to histological examination, revealed a 15 cm umbilical cord with paracentral insertion, and presence of blood clots. The FVUC was confirmed, with three arteries and one vein.



Figure 1. The evaluation of the umbilical cord showed a FVUC with three arteries and one vein at Doppler.



Figure 2. Second follow-up was planned at 35 weeks of gestations.

DISCUSSION

A systematic review of the literature was performed including all studies reporting cases of FVUC. Searches were performed independently by authors (S.M., G.S.) in Medline, OVID, Scopus, and Web of Science, with the use of a combination of keywords: “Four-vessel umbilical cord”, “fetal vein”, “vein varix” and “fetal” from inception of each database to December 2021. Only studies published in English were analysed. References from relevant research articles and reviews were also reviewed.

The systematic review identified and included 15 relevant studies [5-15] for a total of 16 cases (**Table 1**). Study period ranged from 1966 to 2019. Out of the 16 cases, only 7 were diagnosed prenatally with ultrasound, while most were diagnosed postnatally following umbilical cord catheterization. Gestational age at prenatal diagnosis of FVUC ranged from 22 to 36 weeks. No cases of first trimester diagnosis were identified. Only two cases were FVUC with three arteries and one vein, while 14/16 were FVUC with two

Table 1. Characteristics of the included studies.

	Maternal age (years)	Risk factors	Associated malformations	Diagnosis of FVUC	Type of FVUC	Foetal karyo	Baby sex	Intrauterine growth restriction	Mode of delivery
Murdoch 1966 [7]	16	N/R	None	Postpartum	Two arteries Two veins	Not performed	Male	Yes	Vaginal
Painter 1977 [8]	32	N/R	Ectopic cordis, cleft lip and palate, bifid liver, pulmunar stenosis	Postpartum	Two arteries Two veins	Not performed	Male	Yes	Vaginal
Rodriguez 1984 [9]	30	N/R	None	Postpartum	Two arteries Two veins	Not performed	Female	No	Caesarean section
Aoki 1997 #1 [10]	N/R	N/R	None	29 weeks	Two arteries Two veins	Not performed	Female	No	Vaginal
Aoki 1997 #2 [10]	N/R	N/R	None	23 weeks	Two arteries Two veins	Not performed	Female	No	Vaginal
Schimmel 1998 [11]	N/R	<i>In vitro</i> fertilisation	None	Postpartum	Two arteries Two veins	Not performed	Male	Yes	NR
Paize 2006 [12]	N/R	N/R	None	Postpartum	Two arteries Two veins	Not performed	Male	No	Vaginal
Perez-Cosio 2008 [13]	37	SLE	None	33 weeks	Two arteries Two veins	Not performed	Male	No	Caesarean section
Avnet 2011 [14]	33	N/R	None	22 weeks	Two arteries Two veins	Regular, XX	Female	No	Caesarean section
Karatza 2011 [15]	16	N/R	Hydropic neonate with hypertrophic cardiomyopathy	Postpartum	Two arteries Two veins	Regular, XX	Female	No	Caesarean section
Puvabanditsin 2011 [16]	20	N/R	Heterotaxy syndrome, interrupted IVC, common atrium, CAVC, HLV, malrotation of the small bowel	Postpartum	Two arteries Two veins	Regular, XX	Female	Yes	Caesarean section
Degirmencioglu 2012 [17]	22	N/R	Oesophageal atresia	Postpartum	Two arteries Two veins	Trisomy 18	N/R	Yes	Caesarean section
Du 2015 [5]	28	N/R	None	Postpartum	Three umbilical arteries and one vein	Not performed	N/R	No	NR
Hoh 2015 [6]	N/R	N/R	None	22 weeks	Three umbilical arteries and one vein	Not performed	Male	NR	NR
Lei 2017 [18]	31	N/R	None	35 weeks	Two arteries Two veins	Regular, XY	Male	Yes	Vaginal
Kurakazu 2019 [19]	37	N/R	None	36 weeks	Two arteries Two veins	Not performed	Female	No	Vaginal

FVUC: four vessels umbilical cord; NR: not reported; SLE: Systemic Lupus Erythematosus; CAVC: complete atrioventricular canal; HLV: hypoplastic left ventricle; IVC: inferior ven cava.

arteries and two veins (Table 1). Amniocenteses were performed in 5 cases, and there were one trisomy 18 and four normal karyo. Mode of deliveries reported were 7 vaginal deliveries, 6 caesarean deliveries, while in three cases mode of delivery was not reported. Four cases (4/16, 25%) had associated malformations, and there were 6/16 (37.5%) cases of IUGR.

CONCLUSIONS

In this study we reported a case of a FVUC with no associated malformations, no IUGR, and favourable outcome of the baby. We also reported a literature review of 16 cases. The rate of associated malformations was 25%, and the rate of IUGR was 37.5%. The literature review confirmed that the cases with no associated complications have a favourable outcome. Notably, the two prior cases with three arteries and one vein had a normal outcome raises the question of the better outcome of this subtype of FVUC compared to the subtype of three veins and one artery.

In summary, FVUC is an uncommon condition associated with major malformations and high risk of IUGR. In case of prenatal diagnosis of FVUC we recommend detail examination of the foetus, including foetal echocardiography, and growth scan. Cases with three arteries and one vein seem to be associated with better outcomes.

COMPLIANCE WITH ETHICAL STANDARDS

Authors' contribution

All authors contributed equally to this work.

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Study registration

N/A.

Disclosure of interests

The authors declare that they have no conflict of interests.

Ethical approval

N/A.

Informed consent

Subject gave informed consent and patient anonymity was preserved.

Data sharing

Data are available under reasonable request to the corresponding author.

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