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Maternal and neonatal outcomes in pregnancies with complicated single umbilical artery: A retrospective cohort study

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Abstract

This study aims to investigate maternal and neonatal outcomes in pregnancies complicated by a single umbilical artery (SUA), distinguishing between isolated SUA (iSUA) and those associated with additional anomalies. In a retrospective cohort study, 52 pregnancies were diagnosed with SUA, categorized into iSUA (n=25) and SUA with additional anomalies (n=27). Maternal demographics, prenatal findings and neonatal outcomes were analyzed. Statistical tests were used to investigate associations between SUA types and adverse outcomes. Gestational age at delivery was significantly lower in the SUA with anomalies group (31.31±8.22 weeks) than in the iSUA group (37.39±2.65 weeks, p<0.001). Although birth weight was slightly lower in the group with anomalies, the difference was not statistically significant. Congenital anomalies were predominantly cardiovascular (30%), urinary (25%) and digestive (17.5%) anomalies in the anomaly group. The live birth rate was higher in the iSUA group (92%) than in the SUA group with anomalies (55%, p<0.001). Postnatal mortality was also higher in the group with anomalies (11%). SUA is associated with significant adverse outcomes, especially when additional anomalies are present. Enhanced prenatal surveillance and multidisciplinary care are recommended for the management of these pregnancies.

Keywords: Single umbilical artery, congenital anomalies, pregnancy outcomes, neonatal complications

Introduction

The umbilical cord, which usually consists of two arteries and one vein, is a critical structure for fetal development and nourishment. A single umbilical artery (SUA), characterized by the presence of only one umbilical artery, is one of the most common umbilical cord anomalies, occurring in between 0.5% and 5% of all pregnancies [1]. SUA can be classified into isolated SUA (iSUA), where no other anomalies are present, and complex SUA, which is associated with structural malformations or chromosomal abnormalities [2,3]. The exact etiology of SUA remains unclear, but it is hypothesized to result from primary agenesis, secondary atrophy or persistence of the allantoic artery [1].

SUA is linked to various perinatal complications, including intrauterine growth restriction (IUGR), preterm birth, and increased perinatal mortality [4,5]. While iSUA is often considered a benign condition, distinguishing it from SUA with additional anomalies remains a clinical challenge. The presence of iSUA may occasionally be associated with undiagnosed congenital or chromosomal abnormalities, necessitating a more nuanced approach to prenatal evaluation [6,7]. Although iSUA is not always a predictor of adverse outcomes, its presence must be closely monitored to ensure appropriate management [5].

This retrospective study aims to investigate the maternal and fetal outcomes of pregnancies complicated by SUA. By comparing isolated SUA cases with complex SUA and pregnancies with normal umbilical cord, this study seeks to elucidate the maternal characteristics, chromosomal and structural anomalies, and perinatal outcomes associated with SUA.

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Material and Methods

Study Design and Population

This retrospective cohort study included pregnant women aged 18 to 45 years who were examined in the perinatology clinic between October 1, 2022 and January 1, 2024. Eligible participants were identified based on ultrasound findings that indicated the presence of SUA. Patients with incomplete medical records or with pregnancies complicated by multiple gestations were excluded.

Data Collection

Data were collected from the hospital's electronic medical records. Key variables included maternal demographics, prenatal ultrasound findings, and pregnancy outcome. SUA cases were categorized into isolated iSUA and complex SUA based on the presence of additional structural or chromosomal abnormalities. Neonatal outcomes, including birth weight, Apgar scores and need for neonatal intensive care, were recorded.

Definitions

- **SUA diagnosis:** SUA was diagnosed by prenatal ultrasonography, identifying a single artery around the fetal bladder by color Doppler imaging [1].
- **Isolated SUA:** Defined as SUA cases in which no other abnormalities were identified on ultrasound or postpartum examination [1].
- **SUA with additional anomalies:** Defined as SUA cases associated with one or more structural or chromosomal abnormalities [2].
- **Fetal growth restriction (FGR):** The term FGR describes fetuses with an estimated fetal weight below the 10th percentile for gestational age (GA), while the term small for gestational age (SGA) is used exclusively to describe newborns whose birth weight is less than the 10th percentile for GA [8].

Instruments and Methods

Fetal biometric measurements were conducted using the E8 ultrasound systems (GE Healthcare, Chicago, IL, USA). The frequency of abdominal probe was adjusted to 3.0–5.0 MHz. All ultrasound images were processed under standard routine protocols. Doppler energy levels were maintained below 100 mW/cm². SUA was identified during the second or third trimester. The ultrasound results were reviewed by experienced sonographers specializing in this field.

Outcome Measures

The primary outcomes were the incidence of fetal growth restriction, preterm birth (<37 weeks) and perinatal mortality. Secondary outcomes included the rate of congenital anomalies and admission to the neonatal intensive care unit (NICU).

Statistical Analysis

The data were summarized using descriptive statistical methods. For continuous variables, comparisons were made with either the Student's t-test or the Mann–Whitney U-test, depending on data distribution. Categorical variables were evaluated using the chi-square test or Fisher's exact test as appropriate. Logistic regression analysis was employed to investigate the relationship between SUA types and adverse outcomes, with adjustments made for confounding factors such as maternal age, parity, and pre-existing medical conditions.

Ethical Considerations

All procedures involving human participants were carried out in compliance with the ethical principles outlined by the institutional research committee (Ankara Etlik City Hospital Clinical Research Ethics Committee No. 1; Decision No.: AEŞH-BADEK-2024-055, dated 15/05/2024). The study adhered to the guidelines of the 2013 Declaration of Helsinki, including its subsequent revisions or equivalent ethical standards.

Results

Maternal and Neonatal Characteristics

A total of 52 patients diagnosed with SUA were included in the study, divided into two groups: isolated SUA (n=25) and SUA accompanied by additional anomalies (n=27). Maternal characteristics, including age, weight, height, and body mass index, were comparable between the groups. The GA at delivery was notably earlier in the group with SUA and anomalies (31.31±8.22 weeks) compared to the isolated SUA group (37.39±2.65 weeks, $p<0.001$). Although the birth weight was lower in the anomalies group, the difference was not significant (2573.63±779.0 g vs. 2759.6±705.2 g, $p=0.211$). Apgar scores at 1 and 5 minutes were consistent across both groups (Table 1).

Congenital Anomalies

Among the 27 cases of SUA with additional anomalies, cardiovascular anomalies were the most common (n=12, 30%), followed by abnormalities of the urinary tract (n=10, 25%) and digestive system (n=7, 17.5%). Other affected systems were the nervous system (n=4, 10%), the skeletal system (n=3, 7.5%) and the facial/body structures (n=3, 7.5%). One patient had anomalies in an unspecified category (Table 2). Among the 27 cases of SUA with additional anomalies, invasive prenatal testing was performed in 12 cases. Chromosomal abnormalities were detected in three cases, including two with trisomy 21 and one with trisomy 18. Invasive prenatal testing was not used in any of the iSUA cases. 8 of the 27 cases with SUA and additional anomalies and 6 of the 25 cases with iSUA underwent non-invasive prenatal testing. No chromosomal abnormality was detected in these cases.

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Neonatal Outcomes

Neonatal outcomes differed significantly between the groups. The isolated SUA group had a higher live birth rate (23 vs. 15, p<0.001), while intrauterine deaths, terminations, FGR and NICU admission were exclusively observed in the SUA group with anomalies (2 intrauterine deaths, 7 terminations, 7 FGR, 8 NICU admission). Postnatal mortality was higher in the SUA group with anomalies (3 vs. 2) (Table 3).

Delivery Type

Of the 52 deliveries, 28 were vaginal, 17 by cesarean section and 7 pregnancies were terminated. All terminations were in the SUA group with additional anomalies.

Table 1. Maternal and neonatal characteristics by SUA group

	Groups		p-values
	Isolated SUA (n=25)	SUA with additional anomalies (n=27)	
Age (year)	31.56±5.95	27.2±4.87	0.574
Weight (g)	72.84±14.74	76.11±11.5	0.730
Length (cm)	162.72±5.27	163.29±5.64	0.963
Body mass index (kg/m²)	27.6±5.36	28.5±4.32	0.637
Gravida	3.08±2.9	2.44±1.57	0.286
Parity	1.08±1.2	.85±1.1	0.589
Living child	1.04±1.2	.81±1.1	0.870
Misccariage	1.0±2.5	.59±1.2	0.499
Gestational age at diagnosis	21.9±4.01	21.62±3.81	0.811
Gestational age at delivery	37.39±2.65	31.31±8.22	**<0.001**
Birthweight (g)	2759.6±705.2	2573.63±779.0	0.211
Apgar score at 1 minute	7.04±1.64	7.0±1.78	0.573
Apgar score at 5 minute	8.92±1.1	8.81±1.25	0.375

Data are presented as mean±standard deviation; statistical significance was set at p<0.05; significant differences in body mass index and gestational age at delivery highlight the disparities between groups; SUA: single umbilical artery

Table 2. Distribution of congenital anomalies by affected organ system

	One abnormal organ system (n=17)	Two abnormal organ system (n=8)	Three abnormal organ system (n=2)	Total (n=27)
Cardiovascular	6	4	2	12 (30%)
Urinary	4	5	1	10 (25%)
Digestive	4	2	1	7 (17.5%)
Nervous	1	2	1	4 (10%)
Skeletal	1	2	-	3 (7.5%)
Face and body	1	1	1	3 (7.5%)
Other	1	-	-	1 (2.5%)
Total	18	16	6	40

Table 3. Neonatal outcomes in SUA group

Neonatal outcome	Groups		p-values
	Isolated SUA	SUA with additional anomalies	
Live birth	23	15	<0.001
Intrauterine death	-	2	
Death after birth	2	3	
Termination	-	7	
Intrauterine growth restriction	2	7	
NICU admission	2	8	

NICU: neonatal intensive care unit, SUA: single umbilical artery

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Discussion

This study underscores the critical differences in maternal and neonatal outcomes between pregnancies affected by iSUA and those with SUA accompanied by additional anomalies. Consistent with prior research, the presence of additional anomalies significantly increased the risks of adverse outcomes such as preterm delivery, reduced GA at delivery, and neonatal complications [1,9].

The GA at delivery was notably lower in the group with SUA and additional anomalies, which aligns with findings from other studies that highlight the association of complex SUA cases with preterm labor and delivery [7]. This observation highlights the necessity of early and enhanced prenatal monitoring in such cases. The higher rate of pregnancy terminations in the SUA with anomalies group further emphasizes the challenges posed by complex SUA, where the decision for termination is often driven by the severity of associated malformations [3,5].

Interestingly, although the difference in birth weight between the two groups was not statistically significant, the observed trend suggests that SUA with additional anomalies may still contribute to fetal growth restriction. Given the relatively small sample size, this study may not have been sufficiently powered to detect subtle differences in birth weight [2,3]. The slightly lower Apgar scores in the SUA with anomalies group, despite not reaching statistical significance, might suggest that immediate neonatal adaptation could be subtly affected in these cases.

The higher prevalence of cardiovascular and urinary anomalies in the SUA with anomalies group is consistent with existing literature, which identifies these systems as commonly affected in complex SUA cases [6,10]. This finding underscores the importance of detailed anomaly scanning and systematic organ evaluation during prenatal care. Early detection of such anomalies enables targeted interventions and the involvement of specialized care teams to optimize both prenatal and postnatal outcomes.

Additionally, the observed postnatal mortality differences between the groups suggest that the long-term prognosis of neonates affected by SUA with anomalies is significantly compromised. This observation reinforces the need for a multidisciplinary approach that includes neonatologists, pediatric cardiologists, and other specialists to manage these pregnancies effectively [4,6].

From a clinical perspective, the lack of chromosomal abnormalities in iSUA cases, despite the use of both invasive and non-invasive prenatal testing, provides reassurance regarding the relatively benign nature of iSUA when no other anomalies are present. This finding is in line with previous research emphasizing that iSUA cases generally carry a favorable prognosis [7].

However, this study has certain limitations that should be acknowledged. First, the retrospective design inherently limits the ability to establish causal relationships and is subject to selection bias. Data were extracted from electronic medical records, which may introduce inaccuracies or missing information, potentially affecting the robustness of the findings. Additionally, our study lacks long-term follow-up data on neonatal development, which is critical for understanding the potential neurodevelopmental consequences of SUA, particularly in cases with additional anomalies. Future research should focus on longitudinal studies that assess neurodevelopmental outcomes and refine prenatal screening techniques to improve early detection and risk stratification.

Conclusion

In conclusion, this study highlights the necessity of distinguishing between isolated and complex SUA during prenatal assessments. The adverse outcomes associated with complex SUA call for intensified surveillance, comprehensive anomaly scanning, and individualized management plans to mitigate risks and improve outcomes. Future studies should aim to investigate the long-term developmental outcomes of neonates with SUA, particularly in cases with additional anomalies, to better understand their impact on growth and neurological development.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
All procedures involving human participants were carried out in compliance with the ethical principles outlined by the institutional research committee (Ankara Etlik City Hospital Clinical Research Ethics Committee No. 1; Decision No.: AEŞH-BADEK-2024-055, dated 15/05/2024). The study adhered to the guidelines of the 2013 Declaration of Helsinki, including its subsequent revisions or equivalent ethical standards.

References

1. Voskamp BJ, Fleurke-Rozema H, Oude-Rengerink K, et al. Relationship of isolated single umbilical artery to fetal growth, aneuploidy and perinatal mortality: systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2013;42:622-8.
2. Ebbing C, Kessler J, Moster D, Rasmussen S. Isolated single umbilical artery and the risk of adverse perinatal outcome and third stage of labor complications: a population-based study. Acta Obstet Gynecol Scand. 2020;99:374-80.
3. Beharier O, Sheiner E, Sergienko R, et al. Isolated single umbilical artery poses neonates at increased risk of long-term respiratory morbidity. Arch Gynecol Obstet. 2017;296:1103-7.
4. Rechnagel AA, Jørgensen FS, Ekelund CK, et al. Risk of adverse pregnancy outcome in isolated single umbilical artery diagnosed at the mid-trimester anomaly scan: a large Danish retrospective cohort study. J Matern Fetal Neonatal Med. 2023;36:2239982.
5. Blum M, Weintraub AY, Baumfeld Y, et al. Perinatal outcomes of small for gestational age neonates born with an isolated single umbilical artery. Front Pediatr. 2019;7:79.
6. Siargkas A, Giouleka S, Tsakiridis I, et al. Prenatal diagnosis of isolated single umbilical artery: incidence, risk factors and impact on pregnancy outcomes. Medicina (Kaunas). 2023;59:1080.

DOI: 10.5455/medscience.2025.01.01

7. Xu Y, Ren L, Zhai S, et al. Association between isolated single umbilical artery and perinatal outcomes: a meta-analysis. Med Sci Monit. 2016;22:1451-9.

8. American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—obstetrics and the society for maternal-fetal medicin. ACOG Practice Bulletin No. 204: Fetal Growth Restriction. Obstet Gynecol. 2019;133:e97-109.

9. Friebe-Hoffmann U, Hiltmann A, Friedl TWP, et al. Prenatally diagnosed single umbilical artery (SUA) - retrospective analysis of 1169 fetuses. Ultraschall Med. 2019;40:221-9.

10. Gutvirtz G, Walfisch A, Beharier O, Sheiner E. Isolated single umbilical artery is an independent risk factor for perinatal mortality and adverse outcomes in term neonates. Arch Gynecol Obstet. 2016;294:931-5.