Journal of Vessels and Circulation
Qom University of Medical Sciences
Autumn 2022. Volume 3. Number 4

Research Paper

The Frequency of Single Umbilical Artery in Fetal Ultrasound Among Neonates With Congenital Heart Disease Compared to Neonates Without Congenital Heart Disease

Mohammad Hossein Arjmandnia[1], Neda Minaei[1], Mostafa Vahedian[2], Javad Tafaroji[1], Maryam Yousefi[3], Hamideh Sadat Mirmohammadi[1*], Mohammad Hassan Tavazo[1], Milad Siamaki[1]

1. Department of Pediatrics, School of Medicine, Hazrat-e Fatemeh Masoumeh Hospital, Qom University of Medical Sciences, Qom, Iran.
2. Department of Family and Community Medicine, School of Medicine, Qom University of Medical Sciences, Qom, Iran.
3. Department of Obstetrics and Gynecology, School of Medicine, Qom University of Medical Sciences, Qom, Iran.

Use your device to scan and read the article online

Please cite this article as Arjmandnia MH, Minaei N, Vahedian M, Tafaroji J, Yousefi M, Mirmohammadi HS, Tavazo MH, Siamaki M. The Frequency of Single Umbilical Artery in Fetal Ultrasound Among Neonates With Congenital Heart Disease Compared to Neonates Without Congenital Heart Disease. J Vessel Circ. 2022; 3(4):159-164. http://dx.doi.org/10.32598/JVC.3.4.31.20

DOI: http://dx.doi.org/10.32598/JVC.3.4.31.20

Article info:
Received: 2023/01/16
Accepted: 2023/03/18
Publish: 31 May2023

Keywords:
Single umbilical artery (SUA), Heart defects, Congenital, Echocardiography

ABSTRACT

Background and Aim: The need for more fetal echocardiography by a specialist in isolated single umbilical artery (SUA) pregnancies is controversial. Therefore, this study aimed to investigate the frequency of SUA in fetal ultrasound in neonates with congenital heart disease (CHD) compared to neonates without CHD referred to Hazrat Masoumeh Hospital in 2019.

Materials and Methods: The files of all the neonates who underwent fetal ultrasound and echocardiography in 2019 were reviewed. Based on the results of the fetal echocardiography, these neonates were divided into two groups with/without cardiac abnormalities. Then, the results of fetal ultrasound performed in terms of the frequency of SUA were examined in the groups, and variables, such as birth, weight, gestational age, and gender were entered into the checklist. Finally, the frequency of SUA in fetuses with/without cardiac abnormalities was compared between the two groups.

Results: The mean age of mothers in the SUA group was 32.47±8.7 years and in the normal group was 32.07±11.5 years. A total of 135 boys (54%) and 115 girls (46%) were examined in this study. No statistically significant relationship was found between maternal age (P=0.72), fetal gender (P=0.92), gestational age (P=0.42), and parity (P=0.92) despite the finding of a SUA. In the group of patients with CHD, 12 out of 125 patients (4.8%), and in the group without CHD, five out of 125 patients (2%) had an SUA. Although this number was highest in the group who had CHD, no statistically significant difference was found between the two groups (0.07).

Conclusion: The relationship between SUA in a fetus with normal ultrasound and CHD varies significantly with population selection criteria. The risk of CHD after diagnosing SUA in a normal fetus from an unselected population appears to be low and may not warrant specialized fetal echocardiography.

*** Corresponding Author:**
Hamideh Sadat Mirmohammadi, MD.
Address: *Department of Pediatrics, School of Medicine, Hazrat-e Fatemeh Masoumeh Hospital, Qom University of Medical Sciences, Qom, Iran.*
Phone: *+98 (912) 7516670*
E-mail: *dr.hs.mirmohammadi@gmail.com*

Journal of Vessels and Circulation
Qom University of Medical Sciences

1. Introduction

Single umbilical artery (SUA) is the most common umbilical cord anomaly with an incidence of 0.55-4.85% [1]. During the screening of fetal abnormalities, it is considered a conventional structural abnormality indicator, chromosomal defect, fetal growth restriction, premature birth, and low birth weight [2]. In the previous studies conducted on 1038 SUA cases diagnosed prematurely, the prevalence of fetal abnormalities was 33.6 [3]. Therefore, a very high risk of structural abnormalities exists in all major systems, including abnormalities in the reproductive system, musculoskeletal system, digestive system, cardiovascular system, and central nervous system [4]. Accordingly, to diagnose the SUA, ultrasound should be used to perform a regular and accurate examination of the fetal anatomy to detect congenital defects [5].

Currently, a detailed ultrasound study in the second trimester is the most effective method for prenatal screening of congenital anomalies and ultrasound studies successfully demonstrate SUA in most pregnancies. The success of ultrasound is influenced by the gestational age, the thickness of the mother's abdominal wall, a lower abdominal ulcer, the condition of the fetus, the volume of amniotic fluid, the scanning experience, and the skill and lateral resolution of the equipment [6, 7]. Studies on SUA have reported a prevalence of 11.4% for heart defects; however, it has not been stated whether these defects were isolated or accompanied by multiple abnormalities [8]. According to previous reports on the relationship between SUA and cardiovascular abnormalities, SUA was previously considered an indication for fetal echocardiography, and SUA pregnancies still assign 5-6% of all referrals for fetal echocardiography in some centers [9]. Some previous studies have shown that the prevalence of CHD in SUA fetuses has increased to 5% regardless of chromosomal abnormalities or extracardiac abnormalities [10]. However, several studies have argued that isolated SUA in fetuses with no additional risk factors for CHD cannot increase the risk of CHD [3]. Therefore, the need for more fetal echocardiography by a specialist in isolated SUA pregnancies is controversial. This study was conducted to compare the frequency of SUA in fetal ultrasound in neonates with/without congenital heart disease (CHD) referred to Hazrat Masoumeh Hospital in 2019.

2. Materials and Methods

This study was conducted as a retrospective cohort. The research population included neonates referred to the heart clinic of Hazrat Masoumeh Hospital. Convenience sampling was used. The sample size was calculated considering the type 1 error of 5%, the power of 0.8, and the rate of SUA in the group with CHD and without CHD (27% and 16%, respectively). Based on the results of similar studies [11], the minimum required samples was calculated to be 120 people in each group and 5% was added to the sample volume due to possible dropouts, 125 people in each group and a total of 250 people were examined. The inclusion criteria included the diagnosis of the umbilical cord artery using ultrasound by an imaging specialist, echocardiography of the baby in the echocardiography unit at Hazrat Masoumeh Medical Center, the availability of these neonates, confirmation of the SUA by clinical and histopathological examination after delivery, and the data related to live births. The exclusion criteria included cases of fetal death and termination of pregnancy due to aneuploidy or abnormal embryos. In this study, the files of all neonates who underwent fetal ultrasound and echocardiography during 2019 were examined, and the neonates were divided into two groups with/without cardiac abnormalities, and then, based on the ultrasound results, the groups were compared considering the frequency of SUA. Variables, such as birth, weight, gestational age, and gender were included in the checklist. All information was entered into SPSS software, version 22 and the independent t-test was used to analyze quantitative data and the chi-square test was used to analyze qualitative data. A significance level of <0.05 was considered. All ultrasounds were performed by a radiologist and all echocardiographs were performed by a pediatric cardiologist.

3. Results

The mean age of mothers in the SUA group was 32.47±8.7 years and in the normal group, it was 32.07±11.5 years. A total of 135 boys (54%) and 115 girls (46%) were examined in this study. No statistically significant relationship was observed between maternal age (P=0.72), fetal gender (P=0.92), gestational age (P=0.42), and parity (P=0.92) and the presence of an SUA (Table 1). In the group of patients with CHD, 12 out of 125 patients (4.8%), and in the group without CHD, five out of 125 patients (2%) had an SUA; although this number was higher in the CHD group, no statistically significant difference was found between the two groups (Figure 1).

Table 1. Studied variables in groups with and without a SUA

Variables		Mean±SD/No. (%)		P
		Ultrasound Findings		
		SUA	No SUD	
Mother's age (y)		32.47±8.77	11.5±32.07	0.723*
Gestational age (w)		1.92±39.7	1.84±39.3	0.424**
Parity		0.99±2.1	1.16±2.09	0.926**
Gender	Male	8(47.1)	107(45.9)	0.921
	Female	9(52.9)	126(54.1)	

SUA: Single umbilical artery.

*Chi-square test, **T-test

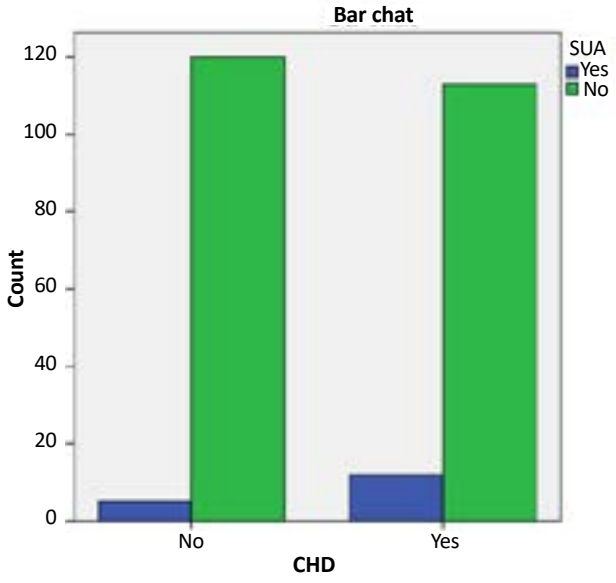

Figure 1. Relationship between cardiac abnormalities in neonates and the frequency of single umbilical artery (SUA)

4. Discussion

SUA was observed in 12(4.8%) out of 125 patients in the CHD group and five (2%) out of 125 patients in the group without CHD; although this number was higher in the CHD group, no statistically significant difference was found between the two groups. DeFigueiredo et al. [3] investigated the relationship between SUA and heart defects and assessed whether SUA patients need specialized fetal echocardiography. In this study, the incidence and type of heart defects in fetuses with SUA observed in the second-trimester ultrasound examination were determined. A routine second-trimester scan was performed in 46 272 singleton pregnancies at a median gestation of 22 weeks (range: 18–25), 246 cases (0.5%) had an SUA. Heart defects were diagnosed in 16 cases (6.5%), including ten cases (4.4%) in the subgroup of 233 patients with other defects and in six (46.2%) out of 13 cases with multiple defects. In 11 cases (68.8%) of 16 cases with heart defects, this disease was easily diagnosed by evaluating the standard four-chamber view and observing great arteries. The result of this study determined that although SUA is associated with an increased incidence of heart defects, these patients do not need to refer to a specialist for fetal echocardiography because these defects can be detected by evaluating standard heart views that should be part of the routine scan in the second trimester [3]. Fetuses with SUA along and extracardiac abnormalities and maternal risk factors show a higher risk of

CHD, and referral for fetal echocardiography is highly recommended. In contrast, fetuses with SUA without the mentioned conditions may only require routine gynecological follow-up. Wang et al. conducted a retrospective study to investigate the possible risk factors associated with CHD in fetuses with SUA and whether all fetuses with SUA should be referred for partial fetal echocardiography. In this study, all pregnancies were divided into CHD and non-CHD groups according to fetal echocardiography results. The result of this study indicated that the incidence of CHD was higher in cases with SUA, and fetal CHD can be effectively screened by abnormal heart screening during screening ultrasound of childbirth [11].

Another study evaluated the relationship between SUA and CHD in two selected and defined populations. In this retrospective review, all cases with SUA who were prematurely diagnosed in a tertiary referral center between 1997 and 2003 were analyzed. The umbilical cord arteries were usually identified around the fetal bladder by color Doppler ultrasound. The unselected population consisted of pregnancies from a well-defined geographical area, at the same hospital. The selected group was referred from other hospitals due to suspected abnormalities or other risk factors. Major CHD was defined as CHD requiring treatment after birth or long-term follow-up. The result of this study revealed that the relationship between SUA and CHD was significantly different from the selection criteria of the population. The risk of CHD after the diagnosis of SUA in a normal fetus in an unselected population seems to be small and may not warrant fetal echocardiography [12]. It is suggested that an interventional prospective study be conducted in the future considering more clinical follow-ups to access more comprehensive information.

5. Conclusion

The relationship between SUA and CHD varied significantly by population selection criteria. The risk of CHD after diagnosis of SUA in a normal fetus from an unselected population appears to be low and may not warrant advanced fetal echocardiography.

Ethical Considerations

Compliance with ethical guidelines

The Ethics Committee of Qom University of Medical Sciences approved this study (Code: IR.MUQ.REC.1399.203). Written informed consent was obtained from all patients to access their medical file records.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors would like to thank the Research and Technology Deputy of Qom University of Medical Sciences and all participants cooperating in this study.

References

[1] Thummala MR, Raju TN, Langenberg P. Isolated single umbilical artery anomaly and the risk for congenital malformations: A meta-analysis. J Pediatr Surg. 1998; 33(4):580-5. [DOI:10.1016/S0022-3468(98)90320-7] [PMID]

[2] Sun HY. Prenatal diagnosis of congenital heart defects: Echocardiography. Transl Pediatr. 2021; 10(8):2210-24. [Link]

[3] DeFigueiredo D, Dagklis T, Zidere V, Allan L, Nicolaides KH. Isolated single umbilical artery: Need for specialist fetal echocardiography? Ultrasound Obstet Gynecol. 2010; 36(5):553-5. [DOI:10.1002/uog.7711] [PMID]

[4] Kim HJ, Kim JH, Chay DB, Park JH, Kim MA. Association of isolated single umbilical artery with perinatal outcomes: Systemic review and meta-analysis. Obstet Gynecol Sci. 2017; 60(3):266-73. [DOI:10.5468/ogs.2017.60.3.266] [PMID] [PMCID]

[5] Lubusky M, Dhaifalah I, Prochazka M, Hyjanek J, Mickova I, Vomackova K, et al. Single umbilical artery and its siding in the second trimester of pregnancy: Relation to chromosomal defects. Prenat Diagn. 2007; 27(4):327-31. [PMID] [DOI:10.1002/pd.1672]

[6] Herrmann Jr UJ, Sidiropoulos D. Single umbilical artery: Prenatal findings. Prenat Diagn. 1988; 8(4):275-80. [DOI:10.1002/pd.1970080405] [PMID]

[7] Hill LM, Wibner D, Gonzales P, Chenevey P. Validity of transabdominal sonography in the detection of a two-vessel umbilical cord. Obstet Gynecol. 2001; 98(5 Pt 1):837-42. [DOI:10.1016/S0029-7844(01)01572-1] [PMID]

[8] Granese R, Coco C, Jeanty P. The value of single umbilical artery in the prediction of fetal aneuploidy: Findings in 12,672 pregnant women. Ultrasound Q. 2007; 23(2):117-21. [DOI:10.1097/01.ruq.0000263848.07808.02] [PMID]

[9] Friedberg MK, Silverman NH. Changing indications for fetal echocardiography in a university center population. Prenat Diagn. 2004; 24(10):781-6. [DOI:10.1002/pd.981] [PMID]

[10] Araujo Júnior E, Palma-Dias R, Martins WP, Reidy K, da Silva Costa F. Congenital heart disease and adverse perinatal outcome in fetuses with confirmed isolated single functioning umbilical artery. J Obstet Gynaecol. 2015; 35(1):85-7. [DOI:10.3109/01443615.2014.935720] [PMID]

[11] Wang J, Ye Y, Xin T, Zhang X, Chen S, Wu Y, et al. Is echocardiography necessary for all single umbilical artery fetuses? A retrospective study in a selected Chinese population. J Obstet Gynaecol Res. 2019; 45(4):803-9. [DOI:10.1111/jog.13912] [PMID]

[12] Prefumo F, Güven MA, Carvalho JS. Single umbilical artery and congenital heart disease in selected and unselected populations. Ultrasound Obstet Gynecol. 2010; 35(5):552-5. [DOI:10.1002/uog.7642] [PMID]

This Page Intentionally Left Blank