

The Role of Second and Third Trimester Umbilical Artery Doppler Ultrasonography in Determining Chorionicity of Twin Pregnancies

Fatemeh Ghatreh Samani ¹, Alieh Ghasemzadeh ², Hassan Mousavi ^{1,*}

¹ Department of Radiology, Imam Reza Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

² Department of Obstetrics and Gynecology, Alzahra Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

* Corresponding author: Hassan Mousavi, Department of Radiology, Imam Reza Hospital, Tabriz University of Medical Sciences, Tabriz, Iran. E-mail: lily_rasouli2005@yahoo.com

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Abstract

Introduction: Determining the chorionicity in monozygotic twins is of pivotal importance, because it has been shown that monochorionic fetuses compared to dichorionic counterparts bear a higher risk of morbidity and mortality. Using conventional ultrasonography in this regard is along with accurate results provided that it is conducted before 14 weeks' gestation. It has been suggested that differences between color Doppler ultrasonographic indices obtained from the umbilical arteries of twins may result in the prediction of chorionicity. Nevertheless, relevant available data are very scarce. This study aimed to examine the role of umbilical artery Doppler ultrasound in the second and third trimesters in determining chorionicity in twin pregnancies

Methods: A total 20 monochorionic monozygotic pregnancies and 30 dichorionic monozygotic pregnancies between 28 and 39 weeks' gestation were examined by color Doppler study of the umbilical arteries. The pulsatility index (PI), resistive index (RI) and the S to D ratio (S/D) of the umbilical arteries and their differences in each group independently were compared between twins.

Results: The mean PI difference between the two umbilical arteries did not differ significantly between the two groups; however, the mean differences of RI and S/D were significantly higher in the dichorionic group (0.006 ± 0.01 vs. 0.04 ± 0.01 , $P = 0.02$, and 0.54 ± 0.09 vs. 0.33 ± 0.05 , $P = 0.04$, respectively). When the difference between the two fetuses in terms of the umbilical artery RI difference exceeded 0.05 and over, the probability of dichorionic pregnancy was present (sensitivity, 60% and specificity, 65%). The difference of S/D was not acceptable as to the diagnostic accuracy in this regard.

Conclusions: On the basis of our findings, the results of umbilical artery color Doppler study in twin pregnancies aged 28-39 weeks' gestation could be used for determining chorionicity. To reach more solid conclusions, further studies with larger sample sizes are recommended to be carried out.

INTRODUCTION

The Incidence of multiple pregnancies is increasing constantly because of aging mothers and using assisted reproductive techniques (ART). Twine pregnancies, in comparison with single ones, are along with higher rate of complication from the first trimester until the time of delivery of the second baby [1]. Chorionicity determined placental status. On this basis, placentas could be categorized as monochorionic and dichorionic [2]. Dizygotic twines are always dichorionic and monochorionic twines are always monozygotic [3]. Dichorionic diamniotic monozygotic twines are the result of zygot-

ic division in bicellular and morula stages (less than 4 days after conception) and constitute 26-28 percent of monozygotic twines. The division of cellular mass between days 4-8 post-conception leads to development of monozygotic diamniotic monochorionic twines, this is the most frequent type (70%). Monochorionic monoamniotic twines are developed when the cell division occurs after the day 8 and comprise 2-8 percent of monozygotic twines. Incomplete embryonic disc division after the day 13 produces conjoined twines [3]. Chorionicity determination can be helpful in risk assessment

in twine pregnancies and following up pregnant women. The rate of pregnancy related complications are associated with zygosity and chorionicity. It has been shown that the perinatal morbidity and mortality rate, particularly neurologic problems, is higher in monochorionic than in dichorionic fetuses [4, 5].

With advancing pregnancy age beyond second and third trimesters the possibility of evaluating chorionicity with conventional ultrasound decreases dramatically. In a recent study by Ingec et al. [6], using Doppler ultrasound parameters such as pulsatility index (PI), resistive index (RI), and S/D ratio has been suggested in such cases. In this study on 50 twine pregnancies, mothers were categorized into two groups of dichorionic and monochorionic on the basis of ultrasound findings in the first trimester. Finally it was shown that the mean PI, RI and S/D of the umbilical artery differed significantly between the fetuses in dichorionic cases, whereas such differences were insignificant between the fetuses in the monochorionic group.

To the best of the authors' knowledge, there is no other study in this regard in the English literature. So, the present work aims to examine the usefulness of Doppler ultrasonography in determining chorionicity in pregnancies beyond first trimester.

METHODS

A total of 50 twine pregnancies were recruited from Tabriz Alzahra Teaching Center within 21 months (2014-2016). Written informed consents were obtained from the participants, and the ethics committee of Tabriz University of Medical Sciences approved the study.

The inclusion criteria were ultrasonographically confirmed twine pregnancies, who were possible to be followed up by the end up the second trimester. Cases with umbilical arterial or fetal anomalies were not included.

According to the result of conventional ultrasonography within the first trimesters, subjects were categorized as dichorionic and monochorionic following the criteria suggested in previous studies [7, 8].

Color Doppler ultrasonography of the umbilical artery was conducted within the weeks 24-34, and related PI, RI and S/D values were reported by an experienced sonologist. The ultrasound machine was ALOKA model 3500 (Tokyo, Japan), equipped with a 3.5 MHz probe.

Statistical Analysis

The SPSS software Ver. 16 (SPSS Company, USA) was used. The independent samples t test or the Mann-Whitney U-test was used to compare quantitative data. The chi-square test or the Exact Fisher test was used for analyzing qualitative data. Receiver Operator Characteristics (ROC) curve was plotted to determine the optimal cut-off point. A P-value < 0.05 was considered statistically significant.

RESULTS

According to post-delivery findings, there were 20 monochorionic (40%) and 30 dichorionic (60%) cases in this study. The monochorionic and dichorionic groups were comparable for the mean age (27.45 ± 6.48 years vs. 28.93 ± 5.63 years, respectively; $P = 0.67$), gravidity (1.95 ± 0.26 vs. 1.93 ± 0.19 , respectively; $P = 0.88$), and pregnancy age (23.60 ± 3.17 weeks vs. 33.57 ± 2.88 years, respectively; $P = 0.78$).

In the monochorionic group conventional ultrasonography yielded a wrong result in 1 case (5%). In the dichorionic group, however, all ultrasonographic findings were true.

The mean difference of color Doppler ultrasonographic parameters between the fetuses are set out in Table 1 and compared between monochorionic and dichorionic groups. Accordingly, the mean difference of RI and S/D was significantly higher in the dichorionic group. ROC curves of these two parameters are shown in Fig 1. The area under the curve for Δ RI and Δ S/D were 0.70 (95% confidence interval, 0.56-0.85) and 0.63 (95% confidence interval, 0.47-0.78). Only the first parameter was statistically significant in this regard ($P = 0.02$ and 0.14, respectively). The optimal cut-off value for Δ RI was calculated at 0.05 (sensitivity, 60%, specificity, 65%).

Parameter	Monochorionic (n = 20)	Dichorionic (n = 30)	P-Value
Δ PI	0.11 ± 0.01	0.14 ± 0.02	0.14
Δ RI	0.04 ± 0.01	0.06 ± 0.01	0.02
Δ S/D	0.33 ± 0.05	0.54 ± 0.09	0.04 c

Data are presented as mean \pm standard deviation.

Abbreviations: PI, pulsatility index; RI, resistive index; S/D, S to D ratio.

P-value < 0.05 is statistically significant.

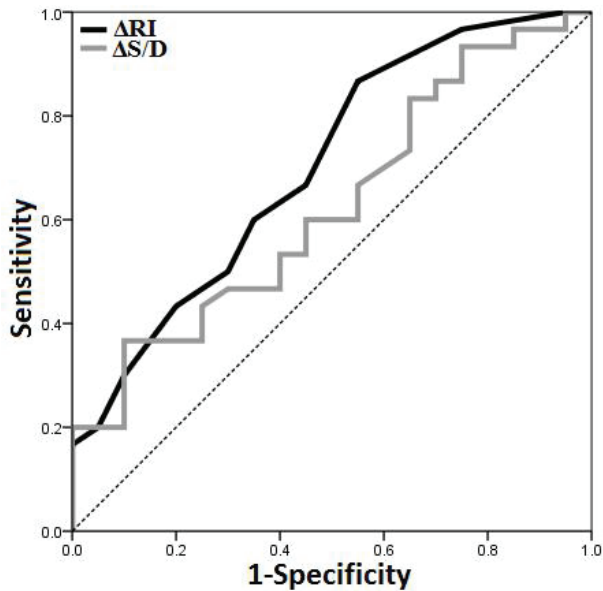


Figure 1: Receiver Operator Characteristics Curves of the Difference in RI and S/D Between Fetuses in Predicting Dichorionicity

Pregnancy was terminated by cesarean section in all 20 cases in the monochorionic group, and by cesarean section in 28 cases (93.3%) in the dichorionic group ($P = 0.51$). No significant maternal/neonatal complications were documented.

DISCUSSION

In this study, color Doppler ultrasonographic parameters (including PI, RI and S/D) were documented in monochorionic and dichorionic twine pregnancies. Accordingly, the mean difference of RI and S/D between the fetuses was significantly higher in dichorionic pregnancies, but only the RI was appropriate for defining a predictive optimal cut-off value, which was set at 0.05 with a sensitivity and specificity of 60% and 65%, respectively.

By now, only a similar study has been carried out in this regard. In this series by Ingec et al. [6] including 50 pregnancies, the mean differences of PI, RI and S/D of the umbilical arteries between the two fetuses were significant in dichorionic cases, but not in monochorionic ones.

In conformity with the results of this study, we showed similar findings in the difference of PI and S/D between the two groups, suggesting a more heterogeneous blood flow in the umbilical arteries in twine pregnancies with dichorionicity. The determination of chorionicity is important for predicting the prognosis of pregnancy, because it has been shown that in monochorionic cases, vascular anastomoses or imbalanced placental vascular distribution in the two placentas may lead into the twin insufficiency syndrome. In addition, hemodynamic imbalances may jeopardize the health of both fetuses and cause significant consequences [4, 9, 10].

A worse prognosis in monochorionic pregnancies is possibly due to the twin to twin transfusion syndrome, growth restriction, and the twin reverse arterial perfusion syndrome in such cases. It should be borne in mind that a fetal demise in twin pregnancies may have unfavorable effects on the other one. Owing to vascular anastomoses in such pregnancies, factors contributing to hypoxic lesions in the neural system may

also affect the other healthy fetus. On the other hand, invasive prenatal diagnostic procedures may also be influenced by chorionicity. In fetal reduction procedures in one fetus, the other fetus may also be involved. Therefore, early diagnosis of chorionicity is vital in twine or multiple pregnancies [6]. So, procedures have been suggested in precise monitoring of fetuses in monochorionic twin pregnancies to prevent morbidity and mortality [4, 9, 11-13].

It should be noted, however, none of these pathologic entities were present, neither in the study by Ingec et al, nor in the present study. Various ultrasonographic parameters have been suggested in determining chorionicity in twin pregnancies such as the number of placental mass, fetus gender, and lambda/T signs [8, 14-16]. These variables, however, are accurate only in studies performed during the first or early second trimesters (before week 14). Missing this period, will decrease the accuracy of conventional ultrasonographic findings in determining the chorionicity [14, 17].

Doppler flow velocimetry has been found a good method in examining the status and path of blood flow in fetal circulation [18]. Previously, color Doppler ultrasonography has been used with success in examining the fetal circulation in terms of pathologic conditions such as intrauterine growth abnormalities, fetal anemia, and twin-to-twin transfusion syndrome [19-22]. However, its use, as a modality to determine the prognosis of twin or multiple pregnancies on the basis of chorionicity has been rarely studies [23, 24]. For example, in a study by Fichera et al. [25], the sensitivity and specificity of this method were 75% and 100%, respectively. Comparing our results with the reported values, although the sensitivity documented in our series (60%) was near the reported figure, the specificity is much lower. This shortcoming is possibly due to a rather small sample size for calculating a cut-off point. In addition, classification of pregnant cases by the age of gestation is also essential in this regard and should be considered in future studies. Furthermore, unlike in the study by Ingec et al. [14], we used the difference of values between the fetuses. Limitations of color Doppler for evaluating umbilical arteries are as follows: being time-consuming, operator-dependency, needing complex utilities, and scarce available information in this regard.

Using a difference of values instead of a direct measurement could reliably cover the second limitation, because only one operator is involved in the assessment of patients, leading to the lowest possibly of inter-observer variation. In another study by Mulcahy et al. [26], the normal ranges of color Doppler Ultrasonographic values were reported between 24-38 weeks gestation in 618 pregnancies. They showed that the mean value of RI and PI is significantly higher in twin than in singleton pregnancies. In addition, they were significantly higher in monochorionic than in dichorionic pregnancies. In a study by Hack et al. [4], it was shown that in monochorionic pregnancies, abnormalities in color Doppler findings of the umbilical arteries could reflect pregnancies at risk for preterm delivery, low birth weight and morbidity. Zuckerman et al. [27] also concluded that in monochorionic twin pregnancies with fetal growth retardation, color Doppler ultrasonographic findings might be abnormal.

On the other hand, it has been shown that in uncomplicated monochorionic pregnancies before the week 28, color Doppler ultrasonographic findings might be abnormal [28] and single abnormal findings may indicate the presence of certain

placental anastomosis and not essentially a hazardous, unfavorable condition [4, 10, 23]. So, it is important to include abnormal twin pregnancies in terms of neonatal-fetal abnormalities in future studies.

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CONFLICTS OF INTEREST

There is no conflict of interest.

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