The Effect of Trans-Abdominal Chorionic Villus Sampling on Fetal Heart Rate and Placental Vascular Resistance Index: A Color Doppler Ultrasound Study

Nazanin Farshchian[1], Farhad Naleini[1], Negin Farshchian[2], Parisa Bahrami Kamangar[1]

[1] *Department of Radiology, Clinical Research Development Center, Imam Reza Hospital, Kermanshah University of Medical Sciences, Kermanshah, Iran*

[2] *Department of Radiation Oncology, Clinical Research Development Center, Imam Reza Hospital, Kermanshah University of Medical Sciences, Kermanshah, Iran*

Received: 16 Aug. 2020; Accepted: 11 Jan. 2021

Abstract- Fetal hemodynamic changes can occur immediately following invasive chorionic villus sampling (CVS). We decided to study the possible effect of CVS on fetal heart rate (FHR), and uteroplacental resistance index (RI) changes using color Doppler ultrasound. Thirty-five pregnant patients with a gestational age of more than 12 weeks were included. Trans-abdominal CVS was done to assess the possibility of thalassemia. Before and after the CVS, color Doppler ultrasound was done to measure FHR and uteroplacental RI. Mean (SD) values for FHR before and after the CVS were 175.22 (±9) and 173.62 (±9.94) beats per minute, respectively; *P*=0.18. Mean (SD) uteroplacental RI before the CVS was 0.79 (0.07) which significantly increased to 0.82 (0.08); *P*=0.03. We observed a significant increase in resistance of blood flow in placental circulation after CVS. However, no significant change was observed regarding FHR after CVS.

Acta Med Iran 2021;59(3):169-172.

Keywords: Chorionic villus sampling; Fetal heart rate; Resistance index; Doppler

Introduction

Chorionic villus sampling (CVS) is used for prenatal genetic diagnosis. This invasive procedure is usually performed after ten weeks of gestation. Using CVS, we are able to diagnose conditions where tests such as diagnostic cytogenetic or molecular methods are useful. This procedure is considered an alternative to amniocentesis. But, there is evidence that CVS is associated with higher diagnostic uncertainty than amniocentesis. Additionally, there is concern that CVS, as an invasive procedure, may be associated with some adverse effects like fetal distress (1,2). These include fetal loss, infection, bleeding, limb defects, congenital anomalies, fetal growth impairment, *etc.* (3-5). However, in general, when indicated, CVS is considered a safe method and, in fact, the procedure of choice for diagnosis of certain conditions (6).

One of the issues that have gained attention by the researchers is the effect of CVS on fetal heart rate (FHR) and placenta vascular flow. It has been shown that variations in FHR can occur when CVS, either via trans-abdominal or trans-vaginal approach, is done. However, this is a controversial issue (7). FHR variations have been suggested as a good predictor of fetal distress (8). The most important adverse effect that warrants attention is bradycardia which can cause hypoxia and fetal distress. In a previous study, it was reported that CVS had no significant effect on FHR, and no significant decrease in FHR occurred. But, the umbilical artery pulsatility index (PI) increased significantly immediately following CVS (9). Also, FHR decelerations were reported to occur more frequently than accelerations. But this change was not prognostic for fetal loss (10).

Color Doppler ultrasound is a non-invasive useful method in pregnancy. This technique allows measurement of uterine and umbilical blood flow and resistance index (RI). It has been shown that in high-risk

Corresponding Author: N. Farshchian
Department of Radiology, Clinical Research Development Center, Imam Reza Hospital, Kermanshah University of Medical Sciences, Kermanshah, Iran
Tel: +98 9123757729, Fax: +98 8334276355, E-mail address: N_Farshchian2000@yahoo.com

pregnancies such as preeclampsia and intrauterine growth retardation (IUGR), uteroplacental blood flow decreases. This change can be detected by the Doppler technique and hence help in better management of pregnant patients (11,12). In addition to FHR, changes in uteroplacental blood flow can reflect hemodynamic changes that can occur following CVS (9).

This study was performed to determine changes in FHR and umbilical blood flow following trans-abdominal CVS in pregnancies where the prenatal diagnosis of thalassemia was suspected. We think that the results of this study will be of utmost usefulness for clinicians when considering invasive CVS in the first trimester.

Materials and Methods

Study population and research design

The study population consisted of pregnant patients (singleton pregnancy) with minor thalassemia who either their husbands had minor thalassemia or had a history of giving birth to a neonate diagnosed with major thalassemia. These patients were referred to our university hospital imaging center for CVS. The gestational age was more than 12 weeks. Exclusion criteria were gestational age of fewer than 12 weeks, spotting or vaginal bleeding, systemic diseases, illegal drug abuse by mother, and multiple pregnancies. CVS was done via a trans-abdominal approach. Color Doppler ultrasound was done by a G40 Siemens machine using a 5 MHz Convex probe. FHR and RI measurements were done two times: once before CVS and for the second time after performing the CVS.

Sample size

The sampling method was of convenience method. With the confidence of 95% and power of 90% and considering mean (SD) PI values of 2.72 (0.02) and 2.75 (0.02) (5), the estimated sample size was calculated as 22 subjects.

Variables

Maternal factors including age, parity, gravidity, gestational age, placenta position were recorded. CVS duration was also recorded. The variables that were collected by color Doppler ultrasound were FHR and RI.

Statistical analyses

In order to express descriptive statistics, frequency, percentage, mean and standard deviation were used. In order to compare FHR and RI values before and after CVS, the paired *t*-test or Wilcoxon test was used. The analyses were done using the SPSS software (ver. 20.0). The significance level was set at 0.05.

Ethics

The study protocol was approved by the Ethics Committee of our medical university. The study objectives were explained to the patients prior to participation, and if agreed, written informed consent was obtained from them.

Results

Thirty-five pregnant patients were studied. The mean (±SD) maternal age was 26.27 (±4.97) years (range, 18 to 40 years). The mean (±SD) gestational age was 12.7 (±1.12) weeks (range, 12 to 17 weeks). Eighteen patients (51.4$) were gravida 1, 12 (34.3%) were gravida 2, four (11.4%) were gravida 3, and one patient (2.9%) was gravida 7. Seven patients (20%) had previous abortion history. The position of the placenta was posterior in 19 subjects (54.3%) and anterior in 16 subjects (45.7%). The number of needle passes was once in 30 subjects (85.7%), two times in 4 subjects (11.4%), and four times in one patient (2.9%).

Table 1 summarizes FHR and RI values before and after the CVS. As observed, no significant change was detected in the mean value of FHR. But, RI significantly increased after the CVS.

Table 1. Comparison of fetal heart rate (FHR) and uteroplacental resistance index (RI) before and after chorionic villus sampling (CVS) in pregnant patients

	Before CVS	After CVS	*P*
Fetal heart rate, beat/min	175.22 (±9)	173.62 (±9.94)	0.18
Resistance index	0.79 (±0.07)	0.82 (±0.08)	0.03

Data are presented as mean (±standard deviation)

Discussion

According to the findings, FHR decreased after the CVS, but this was not statistically significant. However, CVS caused a significant increase in placental circulation RI. CVS is a well-established procedure usually done

after 12 weeks of gestation. As in this invasive procedure, placental villi are disrupted, injury to feto-maternal circulation is possible (13). This consequently can affect fetal hemodynamic, and fetal distress or hypoxia can occur.

There is controversy in the literature regarding the hemodynamic effects after CVS. Several causes have been addressed as the reasons for variable results regarding CVS-induced FHR fluctuations. Some important factors include gestational age, amount of villi sampled, and the procedure of CVS (13). Studies frequently have focused on FHR, as the measurement of FHR is a reproducible method and a good predictor for fetal distress, and less attention has been made regarding uteroplacental circulation flow. Our results are compatible with some former studies which reported no significant change in FHR after CVS. In a previous study (7) on 165 pregnant women who underwent first-trimester (between 9 and 13 weeks of gestation) CVS for diagnosis of beta-thalassemia, the mean FHR before CVS in the 12th week of gestation was 159.17, which changed to 160.14, which was not statistically significant. When the authors performed analyses in different gestational ages, none of the changes were significant. In another study (13), gestational age was reported as an important contributor to FHR changes. FHR change increased with increasing gestational age. The authors performed logistic regression on several variables (gestational age, maternal age, length of the procedure, number of procedures) and showed that only maternal age and gestational age were significant predictors of FHR change after CVS. Another study, including 279 singleton pregnancies, reported that a mixed pattern was observed in terms of FHR change following FHR at different gestational ages. For instance, in the 12th week of gestation, the mean FHR was 161.9 before CVS, which changed to 161.2 with no statistically significant difference. However, some studies contradict the role of gestational age. For example, in a report (14), including 42 patients between 9.5 and 12 weeks' gestation, it was revealed that by regression analysis, FHR change after CVS was not affected by either gestational age or placental vascular resistance.

It seems that several issues should be considered in terms of interpretation of FHR change after CVS. Firstly, we expect to observe some degree of changes in FHR after CVS (7). Secondly, changes in FHR should be interpreted in each week of gestational age and compared with the normal range of FHR in the particular week. By this method, any pathologic deceleration or acceleration can be defined more precisely.

In contrast to FHR, placental vascular resistance increased significantly after CVS. Former studies have suggested that changes in FHR and vascular resistance are distinct entities (9). As CVS is an invasive procedure, insult caused by the needle on the placental vascular can result in vasoconstriction and a rise in resistance. This increased resistance can adversely affect the blood flow through these vessels. A previous study (15), including two groups of patients who underwent CVS and a control group, showed that maternal arcuate artery RI did not change immediately after CVS. In agreement with what we observed here, no significant change in placental resistance was reported after CVS in pregnant patients with a gestational age of fewer than 12 weeks (14).

We think that further studies are required to elucidate several important unanswered questions. First, by longer follow-ups, it should be determined what the clinical significance of any changes seen in FHR and placental vascular resistance is. Second, to enable clinicians to better management of the patients, what degree of changes is important and needs further attention. Also, by conducting a systematic review incorporating all studied variables, the most important ones that need particular attention by the clinicians who perform CVS should be recognized.

We observed a significant increase in resistance of blood flow in placental circulation after CVS. However, no significant change was observed regarding FHR after CVS.

Acknowledgments

This study was extracted from a thesis under the code of 94553. The authors would like to thank the Clinical Research Development Center of Imam Reza Hospital for consulting services.

References

1. Mujezinovic F, Alfirevic Z. Procedure-related complications of amniocentesis and chorionic villous sampling: a systematic review. Obstet Gynecol 2007;110:687-94.
2. Farshchian N, Hajsafarali M, Farshchian N, Bahrami Kamangar P. Correlation Between Transabdominal Chorionic Villus Sampling and Fetal Distress With Color Doppler Sonography. Acta Med Iran 2019;57:720-4.
3. Tabor A, Vestergaard CH, Lidegaard O. Fetal loss rate after chorionic villus sampling and amniocentesis: an 11-year national registry study. Ultrasound Obstet Gynecol 2009;34:19-24.
4. Sotiriadis A, Eleftheriades M, Chatzinikolaou F,

Chatzistamatiou K, Assimakopoulos E, Chasiakos D. Fetal growth impairment after first-trimester chorionic villus sampling: a case-control study. J Matern Fetal Neonatal Med 2016;29:1731-5.

5. Akolekar R, Bower S, Flack N, Bilardo CM, Nicolaides KH. Prediction of miscarriage and stillbirth at 11-13 weeks and the contribution of chorionic villus sampling. Prenat Diagn 2011;31:38-45.
6. Wax JR, Cartin A, Chard R, Carpenter M, Pinette MG. First trimester transabdominal chorionic villus sampling--does the needle matter? J Clin Ultrasound 2012;40:385-8.
7. Akhlaghpoor S, Hosseinipoor T. The effect of chorionic villus sampling on fetal heart rate. Fetal Diagn Ther 2005;20:116-20.
8. Chung DY, Sim YB, Park KT, Yi SH, Shin JC, Kim SP. Spectral analysis of fetal heart rate variability as a predictor of intrapartum fetal distress. Int J Gynaecol Obstet 2001;73:109-16.
9. Martinez JM, Comas C, Ojuel J, Borrell A, Puerto B, Fortuny A. Immediate changes in umbilical blood flow after transcervical chorionic villus sampling performed by biopsy forceps. Prenat Diagn 1996;16:223-9.
10. Wilson RD, Gibson W, Bebbington M, Walker M, Shaw D. First trimester fetal heart rate: response to chorionic villus sampling in the chromosomally normal fetus. Fetal Diagn Ther 1997;12:236-40.
11. Nagar T, Sharma D, Choudhary M, Khoiwal S, Nagar RP, Pandita A. The Role of Uterine and Umbilical Arterial Doppler in High-risk Pregnancy: A Prospective Observational Study from India. Clin Med Insights Reprod Health 2015;9:1-5.
12. Ebrashy A, Azmy O, Ibrahim M, Waly M, Edris A. Middle cerebral/umbilical artery resistance index ratio as sensitive parameter for fetal well-being and neonatal outcome in patients with preeclampsia: case-control study. Croat Med J 2005;46:821-5.
13. Radunovic N, Kuczynski E, Kontic O, Kanjuh V, Lockwood CJ. Chorionic villus sampling significantly affects fetal cardiovascular function. J Matern Fetal Neonatal Med 2007;20:285-8.
14. Kofinas AD, D'Amico K, McGuiness T, Clay D, King K. Transabdominal chorionic villus sampling at 9.5-12 weeks' gestation. Placental vascular resistance and fetal cardiovascular responses. J Reprod Med 1995;40:453-7.
15. Zoppini C, Ludomirsky A, Godmilow L, Weiner S, Maislin G, Donnenfeld AE. Acute hemodynamic effects induced by chorionic villus sampling: a preliminary investigation. Am J Obstet Gynecol 1993;169:902-7.