

Predictive Value of Uterine Artery Blood Flow Value for Preeclampsia

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ABSTRACT

Objective: To investigate the predictive value of uterine artery blood flow value for preeclampsia.

Methods: A total of 70 pregnant women with preeclampsia (observation group) and another 70 healthy pregnant women (control group) who were admitted to our hospital from January 2016 to March 2019 were enrolled. The uterine artery hemodynamic parameters of the pregnant women were detected by color Doppler ultrasonography, the uterine artery blood flow value was calculated according to the color Doppler flow spectrum, and they were compared between observation group and control group. Besides, the uterine artery hemodynamic parameters and uterine artery blood flow value were compared among pregnant women with different degrees of preeclampsia, and the associations of uterine artery hemodynamic parameters and uterine artery blood flow value with the severity of preeclampsia were analyzed. In addition, the pregnant women were followed up and pregnancy outcome was compared among pregnant women with different uterine artery blood flow values.

Results: The uterine artery pulsatility index, resistance index, peak systolic to end diastolic velocity ratio (S/D value) and uterine artery blood flow value in observation group were higher than those in control group ($P < 0.05$). The peak systolic velocity and the minimum diastolic velocity of uterine artery in observation group were lower than those in control group ($P < 0.05$). The uterine artery pulsatility index, resistance index, S/D value and uterine artery blood flow value in severe preeclampsia group were higher than those in mild and moderate preeclampsia group ($P < 0.05$). The peak systolic velocity and minimum diastolic velocity of uterine artery in severe preeclampsia group were lower than those in mild and moderate preeclampsia group ($P < 0.05$). The results of correlation analysis revealed that the pulsatility index, resistance index, S/D value and uterine artery blood flow value were positively correlated with the severity of preeclampsia, while the peak systolic velocity and minimum diastolic velocity were negatively correlated with the severity of preeclampsia. In addition, there were statistically significant differences in the gestational age, neonatal weight and neonatal Apgar score among pregnant women with different uterine arterial blood flow values ($P < 0.05$). With the increase of uterine arterial blood flow value, the gestational age, neonatal weight and neonatal Apgar score decreased.

Conclusion: Uterine artery blood flow value and uterine artery hemodynamic parameters are closely associated with the occurrence and development of preeclampsia, and they are valuable for predicting the pregnancy outcome in the case of preeclampsia.

KEYWORDS: preeclampsia; color Doppler ultrasonography; uterine artery blood flow value; hemodynamics

INTRODUCTION

Preeclampsia is an idiopathic disease of

pregnancy, which is an important contributor to maternal and fetal death [1,2]. The clinical pathogenesis of preeclampsia is not clear yet, which needs to be further studied. It has been reported in some studies that pregnant women with preeclampsia are affected by their disease status, and their uterine artery blood flow value often

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exhibits abnormal changes [3,4]. To explore the role of uterine artery blood flow value in preeclampsia, 70 pregnant women with preeclampsia and another 70 healthy pregnant women were enrolled for this comparative study.

MATERIALS AND METHODS

General information

A total of 70% of pregnant women who were enrolled in our hospital from January 2016 to March 2019 were pre-eclampsia (observatory group) as well as a further 70 healthy pregnant women (control group). The group of observations consisted of 59 primipares and 11 multiparas aged 21-35 years, with an average age (29.32 ± 4.62) years, with an average of (27.35 ± 2.46) weeks of gestational age of 23-31 weeks. In the checks group, the average age (average of 29.18 ± 4.70) and the gestations of gestations were 23-31 weekly with a mean week (average age of 27.29 ± 2.48), was 57 primipares and 13 multiparas aged between 20 and 35 years. There were no statistically significant differences between both groups at a comparable age, gestational age, and past fertility status ($P > 0.05$). The study was approved by the Medical Ethics Committee and the informed consent was signed by all subjects.

Methods

The color Doppler ultrasonic diagnostic apparatus, Voluson™ E8 ultrasound system (GE, USA) equipped with 3.5-5.0 MHz ultrasound probes, was adopted for the detection for the pregnant women. The subjects were instructed to hold back their urine before examination and to maintain the filling state of the bladder. During the examination, they were instructed to take a supine position. Then the ultrasound probe was placed on the abdomen of the pregnant women for scanning, and the uterine artery images were obtained. Subsequently, the uterine artery hemodynamic parameters of the pregnant women were detected according to the uterine artery images. The detection indices included pulsatility index, resistance index, peak systolic to end diastolic velocity ratio (S/D value), peak systolic velocity and the minimum diastolic velocity. The uterine artery blood flow value was calculated according to the color Doppler flow spectrum, and scaled 0-4 points (0 points = normal bilateral uterine artery blood flow, 1 point = 1 abnormal blood flow parameter, 2 points = 2 abnormal blood flow parameters, 3 points = 3 abnormal blood flow parameters, and 4 points = 4 abnormal blood flow parameters). The higher the score is, the severer the abnormality of

the uterine artery blood flow will be [5].

Observation indices

The hemodynamic parameters of the uterine artery were compared with the blood stream of the uterine artery. Pregnant females were divided into slight and moderate (24-h urinary protein 0.3 g, systolic blood pressure ~ 140 mmHg, diastolic blood pressure ~ 90 mmHg) pre-eclampsia and severe (24-hour urinary protein: 22.0 g, systolic $+160$ mmHg and diastolic < 110 mmHg $>$). The uterine blood hemodynamics and blood flow values of uterine arteries were then compared among the pregnant women with different levels of preeclampsia and hemodynamics of the uterine artery.

Pregnancy results have been monitored for pregnant women with preeclampsia. A comparison between pre-eclampsic pregnant women and the different uterine flow values was made with the gestational age, neonatal weight and neonatal score of APCAR (rated at 1 min after birth, 0-10 points by skin color, breathing, pulse, muscle tension and stimulant response of the newborn).

Statistical analysis

SPSS 22.0 software was utilized, and χ^2 test and t test were performed for the numerical data (n) and quantitative data ($\bar{x} \pm s$), respectively. $P < 0.05$ suggested that the differences were statistically significant. The Pearson's correlation coefficient analysis was employed. $P < 0.05$ indicated there was a correlation, $r > 0$ suggested a positive correlation, and $r < 0$ indicated a negative correlation.

RESULTS

Uterine artery hemodynamic parameters and blood flow values of observation and control groups

In the observation group higher than the control group ($P < 0.05$), uterine artery pulsation index, resistance index, S / D value, and blood uterine artery flow value were observed. The uterine artery's peak systolic speed and minimum diastolic speed was in the observation group less than in the control group ($P < 0.05$) (Table 1).

Uterine artery hemodynamic parameters and blood flow values of pregnant women with different degrees of preeclampsia

41 cases of moderate to mild preeclampsia and 29 cases of severe preeclampsia were reported among 70 pre-eclampsia pregnant women. The pulse index, resistance index, value S / D and flow of the blood uterine artery were higher in the severe preeclampsia group than in the mild and

moderate group preeclampsia ($P < 0.05$). The uterine artery was lower in the severe preeclampsian group than the mild and moderate preeclampsia ($P < 0.05$) group (Table 2), with the maximum systolic rate and minimum diastolic speeds.

Correlation analysis results

The result of a correlation analysis shows a positive correlation between pulsation, resistance indication, the value of S / D and the blood flow rate of the uterine cell and severity preeclampsia and the peak systoly velocity and minimum diastolic velocity (Table 3).

Pregnancy outcomes of pregnant women with preeclampsia and different uterine artery blood flow values

70 pregnant females with preeclampsia received 0 (n=27), 1 (n=11), 2 (n=13), 3 (n=10) and 4 (n=9.) Uterin flux was uterine. In pregnant women with preeclampsia and different uterine blood flow values statistically significant differences in the gestational age, the neonatal weight and the neonatal Apgar score were found the uterine flow rate decreased gestational age, neonatal and Apgar's neonatal weight (table 4).

DISCUSSION

In recent years, the incidence rate of eclampsia in pregnancy has increased, which has become one of the major factors leading to maternal mortality. Preeclampsia refers to the pre stage of eclampsia, which is a common type of hypertensive disorder during pregnancy. Patients with preeclampsia are accompanied by abnormally increased blood pressure and albuminuria [6,7]. According the severity, preeclampsia can be divided into mild to moderate preeclampsia and severe preeclampsia. In general, the disease status of pregnant women with severe preeclampsia is more serious, and the risk of adverse pregnancy outcome is increased, which easily triggers intrauterine fetal hypoxia-ischemia response, and even leads to perinatal death, seriously endangering maternal and infant safety [8,9].

Since the pathogenesis of preeclampsia remains unclear, the clinical diagnosis and treatment of preeclampsia should be further studied. Color Doppler Ultrasound Diagnostic Apparatus is a type of instrument commonly used in ultrasound examinations. Color Doppler ultrasound has the advantages of non-invasive and easy operation, so that it can be performed and popularised on a large scale. By scanning the abdomen of pregnant

women with ultrasonic probes, the conditions of pregnant women and intrauterine fetuses can be clearly demonstrated and it is convenient for the timely detection of abnormal conditions of pregnant women and intrauterine fetuses. The application of this test in obstetrics is mostly associated with foetal prenatal screening and is the main method of prenatal screening [10]. However, there is little clinical evidence of Doppler ultrasound detection of the uterine blood flow parameters. Doppler colour ultrasonography of hemodynamic uterine artery parameters showed whether pregnant women have complications such as preeclampsia [11]. This view was verified by comparing pregnant women with pre-eclampsia with healthy pregnant women in this study. The uterinity pulsation index, resistance index, value S / D, value of the uterine blood flow, peak systolic velocity and low diastolic velocity between observing group or control group were found to be obvious differences. Differences in pulse rate of the uterine artery, resistance index, S / D value, blood flow value in the uterine artery, systemic speed and low diastolic velocity between severe preeclampsia and mild-to - moderate preeclampsia were also found. In addition, there are positive correlation of the index of pulse, resistance indice, value of S / D and blood flow value of the artery to the severity of preeclampsia. Furthermore, there had a negative pre-eclampsia-severity relationship to peak systoly speed and minimum diastolic velocity. These results suggest that hemodynamic uterine artery components are associated with the pathogenesis and development of a pre-eclampsia, with a possible monitoring of hemodynamic mother's uterine artery parameters by means of Doppler colouration ultrasound.

Statistically significant differences were identified in gestational age, neonatal weight and neonatal Apgar score for pre-eclampsia and different blood flow values in the uterine artery. Store age, neonatal weight, and neonatal Apgar were reduced by increasing the uterine artery blood flow value, indicating that the foetal growth and development can result in abnormal maternal hemodynamic hemodynamics. Under normal circumstances, nutrients required for placental growth and the removal of metabolites from the utero of healthy pregnant women depend primarily on the infusion of the placental space that is derived from the motherly perfusion of the uterine artery. If the mother's uterine artery is hemodynamic, placental blood infusion, which can be harmful to the intrauterine growth of the foetus, is affected [12,14]. This indicated that abnormal placental

blood infusion among women who were pregnant can be observed in time by monitoring the parameters of the maternal uterine artery, which can be used as important indicators for the prediction of the pregnancy.

In short, the flow of uterine arteries and hemodynamic parameters in the uterine artery are closely related to preeclampsia incidence and development and are useful for predictions of preeclampsia in patients.

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Table 1. Uterine artery hemodynamic parameters and blood flow values of observation and control groups ($\bar{x} \pm s$)

Group	n	Pulsatility index	Resistance index	S/D value	Peak systolic velocity (cm/s)	Minimum diastolic velocity (cm/s)	Uterine artery blood flow value (point)
Control	70	0.47±0.15	0.97±0.32	2.13±0.71	50.29±6.48	9.58±2.30	0.89±0.28
Observation	70	0.65±0.20	1.38±0.41	3.45±1.12	43.51±5.27	7.32±1.94	1.67±0.52
t		6.024	6.596	8.328	6.791	6.284	11.050
P		0.000	0.000	0.000	0.000	0.000	0.000

Table 2. Uterine artery hemodynamic parameters and blood flow values of pregnant women with different degrees of preeclampsia ($\bar{x} \pm s$)

Group	n	Pulsatility index	Resistance index	S/D value	Peak systolic velocity (cm/s)	Minimum diastolic velocity (cm/s)	Uterine artery blood flow value (point)
Mild to moderate preeclampsia	41	0.61±0.08	1.27±0.19	3.28±0.34	44.10±1.35	7.82±0.94	1.45±0.31
Severe preeclampsia	29	0.70±0.09	1.49±0.21	3.64±0.35	42.91±1.09	6.85±0.91	1.80±0.34
t		4.402	4.568	4.311	3.925	4.309	4.470
P		0.000	0.000	0.000	0.000	0.000	0.000

Table 3. Correlation analysis results

Indices	r	P
Pulsatility index	0.826	0.007
Resistance index	0.837	0.006
S/D value	0.845	0.004
Peak systolic velocity	-0.821	0.007
Minimum diastolic velocity	-0.819	0.007
Uterine artery blood flow value	0.850	0.003

Table 4. Pregnancy outcomes of pregnant women with preeclampsia and different uterine artery blood flow values ($\bar{x} \pm s$)

Blood flow score	n	Gestational age (week)	Neonatal weight (g)	Neonatal Apgar score (point)
0 point	27	38.24±0.73	3629±125	8.96±0.71
1 point	11	37.50±0.70	3548±131	8.25±0.69
2 points	13	36.91±0.62	3467±119	7.57±0.68
3 points	10	36.23±0.64	3382±127	6.89±0.63
4 points	9	35.49±0.61	3305±108	6.27±0.60
F		4.259	4.318	4.527
P		0.000	0.000	0.000