

Evaluation of Cardiac Reserve Function in Gestational Hypertension

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Abstract

Objective: Explore the cardiac reserve function in gestational hypertension, in order to provide a basis for the prevention and early treatment of pregnancy with hypertension disease and reduce the maternal and infant complications.

Methods: We collected the related information of 112 pregnant women with gestational hypertension and 224 normal pregnant women who do perinatal care in Department of Women's Health Care Division of Third Affiliated Hospital of Zhengzhou University from January 2009 to December 2012. We acquired the phonocardiogram with resting state and take the ratio of S1/S2 (first heart sound maximum amplitude ratio of the second heart sound maximum amplitude of S1 and S2)/D/S (diastolic to systolic duration) HR (heart rate) as the indicators of cardiac reserve function.

Results: The comparison of the indicators between pregnant women with gestational hypertension and normal pregnant women show that S1/S2 between two groups have no significant difference while D/S and HR are significantly different; D/S values at 12~27⁺⁶ weeks \geq 28 weeks in the two groups are significantly different ($p < 0.05$), while D/S values have no significant difference when the gestational age \leq 11⁺⁶ weeks.

Conclusion: The cardiac reserve function of gestational hypertension pregnant women are significantly lower than the normal pregnant women. The cardiac reserve function of gestational hypertension pregnant women reduces with gestational age.

Keywords: Hypertension; Pregnant women; Cardiac reserve function

Materials and Methods

Hypertensive disorders complicating pregnancy (HDCP) is a pregnancy-specific disease. It often occurs after 20 weeks and the incidence was 9.4% in our country while 7% -12% [1] in the foreign reports. Hypertensive disorders in pregnancy is a great harm for maternals which can seriously damage the heart, brain, kidney and other organs of pregnant woman [2,3] and the incidence of premature children, fetal growth restriction, fetal distress are significantly higher. So it is the main cause of maternal and perinatal morbidity and mortality, ranking in the first 5 reasons of maternal death [4,5]. From the study of cardiac reserve function, we can reduce maternal mortality and improve the quality of perinatal care.

General information

This is a prospective study. Under the inclusion criteria, 112 pregnant women with gestational hypertension who do perinatal care in Department of Women's Health Care Division of Third Affiliated Hospital of Zhengzhou University from January 2009 to December 2012 were selected at random. They aged from 22 to 42 years whose mean age is 28.7 ± 3.8 years old and the gestational age ranged from 20⁺¹ to 39 weeks. On the other hand, we selected 224 normal pregnant women in the corresponding period who aged from 20 to 39 years (the mean age is 27.3 ± 3.8 years old) and the gestational age from 18⁺² to 40 weeks. All the pregnant women selected in the study had no other pregnancy complications.

This study was approved by the Ethic Committee of Third Affiliated Hospital of Zhengzhou University, and informed consent was obtained from all participants.

Criteria

The diagnostic criteria of hypertensive disorders in pregnancy refer to the sixth edition of Obstetrics and Gynecology in 2004. Gestational

hypertension refers to blood pressure elevated during pregnancy for the first time (blood pressure \geq 140/90 mmHg, measuring 2 times interval of at least 4 hours) and the urine protein was negative, no other pregnancy-related complications (such as intrahepatic, cholestasis of pregnancy, gestational diabetes); no previous significant medical history (heart problems, hypertension or diabetes), and not taking any medication, known to affect heart function. Normal pregnant women refers to at least two blood pressure readings $<$ 130/80 mmHg, no pregnancy-related complications, no significant medical history and not taking any medication known to affect heart function.

Methods

Collect the heart sound signals of the pregnant women with Cardiac Contractility Monitor (CCM, Bojing Medical Informatics Institute of Chongqing University model, patent number 01256971.2). This was the same device and specificity as used in the study by Xie et al and Shao et al. Then measure the amplitude and time of ingredients about heart sound and calculate S1/S2, D/S and HR.

Statistical analysis

Using SPSS 17.0 statistical software for statistical analysis. The index can be represented by $\bar{x} \pm s$, using group design. Statistical comparisons between groups were performed with a t-test, $\alpha = 0.05$ is the standard of the test.

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Result

There were significant differences in cardiac reserve function between pregnant women with gestational hypertension and normal pregnant women. As shown in Table 1: S1/S2 has no obvious difference ($t = -1.63, P = 0.103$), D/S is significantly different ($t = 6.89, P = 0.000$), HR is significantly different ($t = -4.664, P = 0.000$).

Comparison of D/S in different gestational age between women with gestational hypertension and the normal pregnant women is shown in Table 2. D/S has no obvious difference for the pregnant women whose gestational age is less than 12 weeks. While D/S are statistically significant in 12~27⁶ weeks and more than 28 weeks.

Discussion

Hypertensive disorders complicating pregnancy (HDCP) is a common and frequently occurring disease during pregnancy. The basic pathophysiology is the spasm of small vessel. Because of the spasm of small vessel, peripheral resistance increased and so as the myocardial contractility and afterload [6,7]. So because of the increase of blood pressure, cardiac output reduced significantly and the blood supply of organs were insufficient. The ischemia and hypoxia of coronary make the ventricular diastolic dysfunction. When it comes to diastolic, the blood supply for heart is insufficient which will decrease the cardiac reserve function of maternal. If the burden on the heart sustained on high level or continue to increase, the ability of ventricular contraction will reduce and cardiac function can be decompensation [8-10], even heart failure. It may be a serious threat for maternal and child health and the leading cause of maternal and perinatal death.

Cardiac reserve function represents the ability to increase by the metabolic needs of the body [11]. It is the earliest indicator for the decrease of cardiac function [12]. The most important aspect of cardiac dysfunction is not the inhibitory of the heart properties in the resting state, but the loss of cardiac reserve [13]. Pregnant women cannot afford pregnancy, childbirth and surgery without certain cardiac reserve function. For example, Xie et al. [13] reported the S1/S2 of pregnant women abruptly increased during delivery, suggesting that cardiac reserve (contractility reserve) is mobilized to adapt to the increased stress. Shao et al. indicated that cardiac reserve function declines with the increasing severity of hypertension during pregnancy [14]. The cardiac reserve function decreased gradually with gestational age [15-17]. For example, in the study by Xiong et al., with the increase in the number of weeks of pregnancy and progress of pre-eclampsia,

Groups	n	S1/S2	D/S	HR
Gestational hypertension group	112	2.33 ± 0.82*	1.11 ± 0.13**	104 ± 14**
Normal pregnant group	224	2.10 ± 0.79	1.35 ± 0.16	91 ± 10

* $P > 0.05$: gestational hypertension group vs normal pregnant group

** $P < 0.01$: gestational hypertension group vs normal pregnant group

Table 1: Comparison of index the cardiac reserve function between gestational hypertension group and the normal pregnant women ($\bar{x} \pm s$).

	n	≤11 ⁶	12~27 ⁶	≥28
gestational hypertension group	112	1.40 ± 0.16	1.35 ± 0.22	1.28 ± 0.17
Normal pregnant group	224	1.42 ± 0.13	1.39 ± 0.09	1.35 ± 0.10
t		1.354	3.158	6.872
p		0.112	0.027	0.00

Table 2: Comparison of D/S in different gestational age between gestational hypertension group and the normal pregnant women ($\bar{x} \pm s$).

the number of subjects with D/S ratio ≥ 1.5 was decreased and the number of subjects with D/S ratio < 1.2 was increased [21]. Moreover it also can be relevant with a variety of factors such as age, pregnancy complications, prematurity, low weight at birth and so on [18-20]. Therefore, assess the cardiac reserve function of pregnant women and realize the changes of cardiac function under stress conditions or complications are conducive to the safety of pregnant women and the fetus.

Heart sound signal is the direct manifestation of cardiac mechanical activity, which can safely, easily, and accurately provide the information on cardiac cycle and the durations of its components [21,22]. In this study we examined the indicators of cardiac reserve function for the women with gestational hypertension, the results show that the cardiac reserve function of gestational hypertension women is lower than normal pregnant women and it reduced with the increase of gestational age.

Therefore, the related indicators of cardiac reserve function should be closely monitored throughout pregnancy, childbirth and postpartum for women with gestational hypertension and so that we can detect the damage of cardiac function in pregnant women as soon as possible. Combined with clinical symptoms and fetal conditions, we can give some treatment and drug intervention and even termination the pregnancy at the appropriate time and manner if necessary [23]. We should try our best to reduce maternal mortality, improve the adverse pregnancy outcomes of hypertensive disorders in pregnancy and improve the quality of perinatal care.

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