Original Research Article

A comparative study of autonomic function tests in different trimesters of pregnancy in Cuddalore district

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Abstract

Background: Pregnancy is associated with substantial changes in the cardiovascular system. The action of the autonomic nervous system is essential for the circulatory adaptations in pregnancy and the nourishing growing fetus. All types of behavioral and hormonal changes occur in women, especially during reproductive life. Most of the behavioral and emotional patterns are exhibited through the autonomic nervous system. Testing of autonomic functions will also help to interpret the test results such as whether these changes are within physiological limit or pathological. **Aim of the study:** The present study was done to evaluate the autonomic (sympathetic and parasympathetic) nervous system sequentially during the three trimesters of pregnancy. **Methods:** This cross-sectional study included 90 pregnant women who are attending the outpatient department of Sri Rajah Mutaiah Medical College and Hospital Chidambaram. I-Trimester (30) Women's, II-Trimester (30)Women's, II-Trimester (30)Women's All subjects were explained of the procedure to be undertaken and written consent was obtained. All 50 pregnant women attending antenatal (ANC) clinic were assessed for autonomic function tests during first trimester of pregnancy. Physical parameters noted in each participant were age in years and weight in Kgs. All subjects were evaluated by CAN WIN–Cardiac Autonomic Neuropathy Analyser. **Results:** Women in group I show normal parasympathetic function plus mild parasympathetic (PNS) dysfunction; and moderate sympathetic (SNS) dysfunction. Women in group II shows mild PNS dysfunction with moderate SNS dysfunction. Women in group III shows moderate parasympathetic and sympathetic dysfunction. In the present study, for sympathetic activity, it was observed that orthostatic variation in arterial blood pressure and cold pressor test were statistically significant (p0.05) in All 3 Trimester of Pregnant women .**Conclusions:** The observations of the present study serve to corroborate that the cardiovascular indices in pregnant women are significantly altered in comparison to non-pregnant women. This finding may be useful in highlighting the importance of cardiovascular monitoring during pregnancy in order to detect abnormalities at an early stage

Keywords: Pregnancy, sympathetic activity, parasympathetic activity, cardiovascular Stability

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INTRODUCTION

Pregnancy is associated with substantial changes in the cardiovascular system. [1]The action of the autonomic nervous system is essential for the circulatory adaptations in pregnancy and a nourishing growing fetus. The autonomic nervous system is anatomically and functionally divided into two distinct interacting divisions i.e. the sympathetic and parasympathetic. Cardiac output, stroke volume, and heart rate are increased in pregnancy. In the first half of pregnancy, systemic vascular resistance and blood pressure decrease. During the last trimester, systemic vascular resistance increases. [2] Pregnancy is

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associated with higher baroreceptor sensitivity. As pregnancy advances, there is higher sympathetic and lower vagal modulation. [3] A well-controlled interaction between the sympathetic and the parasympathetic system is necessary for adapting the cardiovascular system to various hemodynamic needs not only under pathophysiological circumstances, such as hemorrhage and shock but also in physiological states such as pregnancy. [4] Pregnancy is associated with profound adaptive changes in the maternal hemodynamics. The autonomic nervous system plays a major role in the regulation of cardiovascular function but its role in pregnancy is less ill-defined. [5] Determination of the cyclical changes of heart rate over time does not only allow an assessment of sympathovagal control of the sinuatrial node under resting conditions but also enables researchers to non-invasively explore baroreflex mechanisms especially when spectral analysis of blood pressure variability is obtained simultaneously. Compared with the classical pharmacological method of arterial baroreflex testing, this newer technique, due to its non-invasive nature, represents a real advantage for studying pregnant women as itis safe and can be performed easily and repeatedly. [6] Hence this study was conducted with objectives that to study the physiological responses to noninvasive cardiovascular autonomic function tests in first-trimester pregnant women and also to compare autonomic functions in first-trimester pregnant women with nonpregnant women

METHODS

This cross-sectional study included 90 pregnant women who are attending the outpatient Department of sri rajah mutaiah medical college and hospital Chidambaram. I-Trimester (30)Women's, II-Trimester (30)Women's, II-Trimester (30)Women's All subjects were explained of the procedure to be undertaken and written consent was obtained. All 50 pregnant women attending the antenatal (ANC) clinic were assessed for autonomic function tests during the first trimester of pregnancy. Physical parameters noted in each participant were the age in years and weight in Kgs. All subjects were evaluated by CAN WIN–Cardiac Autonomic Neuropathy Analyser. Pregnancy was confirmed by urinary human chorionic gonadotrophin determination test. Informed written consent was taken from the study participants after having to explain them the study protocol. Subjects having any illness in the present or past, hypertension, diabetes, cardiovascular abnormality, bad obstetric history, history of previous abortion, previous cesarean section were excluded from the study.

Subjects were grouped as follows; GROUP I: 30 subjects of the First Trimester, GROUP II: 30 subjects of second Trimester, GROUP III: 30 subjects of Third Trimester

Following cardiovascular sympathetic and parasympathetic tests were carried out with analyzer CAN WIN, it is a window-based cardiac autonomic neuropathy analyzer with interpretation.

Sympathetic tests

1. Blood pressure response to standing /Orthostatic postural hypotension
2. Blood pressure response to sustained handgrip

Parasympathetic tests

1. Resting heart rate /minute
2. Heart rate response to deep breathing (Expiratory/ Inspiratory ratio)
3. Heart rate response to Valsalva maneuver
4. Heart rate response to standing (30:15 ratio)

Precautions during measurements

1. The test was carried out only after the subjects were relaxed
2. Subjects were advised to have light breakfast and empty their bladder before commencing the tests

STATISTICAL ANALYSIS: The data collected were statistically analyzed. One way ANOVA and Multiple comparison analyses were performed to compare the cardiovascular indices between the three study groups and controls to calculate whether any significant difference existed between these groups. Further, each subject was assigned a Cardiovascular Autonomic Score (CAS)

RESULTS

Table 1: Demographic characteristics of the groups

Parameters	Group I (n = 30)	Group II (n = 30)	Group III (n = 30)
	Mean ± SD	Mean ± SD	Mean ± SD
Age (Years)	22.06 ± 2.78	21 ± 1.66	21.94 ± 2.39
Height (Cm)	155 ± 4.99	155.79 ± 5.38	154.73 ± 4.81
Weight (Kg)	48.14 ± 0.074	47.68 ± 7.14	50.45 ± 8.03
BMI	20.01 ± 2.47	19.62 ± 2.18	21.08 ± 3.18

Table I shows the mean value of age, height, and weight (anthropometric data) in the four groups (n=90). It revealed statistically insignificant results for the mean value of age and height between the I-Trimester (30) Women's, II-Trimester (30) Women's, II-Trimester (30) Women's. ($p>0.05$). However, the mean value for weight showed statistically significant results between group IIIrd trimester and Non –pregnant and between-group IIIrd trimester and IInd trimester

Table 2: Parasympathetic tests in the three groups

Para-sympathetic tests	Group I (n=30)	Group II (n=30)	Group III (n=30)
	Mean ± SD	Mean ± SD	Mean ± SD
RHR /min	80.48 ± 10.22	89.82 ± 12.94	94.18 ± 16.74
E : I Ratio	1.26 ± 0.142	1.19 ± 0.107	1.17 ± 0.12
30 : 15 Ratio	1.12 ± 0.160	1.10 ± 0.15	1.08 ± 0.133
Valsalva Ratio	1.56 ± 0.258	1.51 ± 0.25	1.39 ± 0.35

*Statistically significant difference at 5 % level. Abbreviations: HR: Heart Rate, E:I: Expiratory: Inspiratory Ratio and VR: Valsalva Ratio

Table 3: Sympathetic tests in the three groups

SYMPATHETIC TESTS	GROUP I	GROUP II	GROUP III
	Mean ± SD	Mean ± SD	Mean ± SD
OHT	2.91 ± 2.92	4.09 ± 3.38	5.38 ± 3.47
HGT	7.91 ± 7.14	4.54 ± 5.3	10.97 ± 4.2

Table 3 shows the group-wise distribution of mean and standard deviation of sympathetic tests in the three groups. As can be seen, women in the three groups showed moderate sympathetic dysfunction.

Table 4: Group wise distribution of ANS interpretation

	Group I (n = 30)	Group II (n = 30)	Group III (n = 30)
Parasympathetic tests	Normal/Mild	Mild	Mild/Moderate
Sympathetic tests	Moderate	Moderate	*Moderate*
ANS dysfunction	Mild + Moderate	Moderate	Moderate

Table: 4 shows the group-wise distribution of ANS test interpretation. Thus, it shows that women in the group I had normal parasympathetic function plus mild to moderate parasympathetic dysfunction and moderate sympathetic dysfunction. Women in group II showed mild parasympathetic dysfunction and moderate sympathetic dysfunction. Women in group III showed moderate parasympathetic and sympathetic dysfunction. So, in group II, both the sympathetic and parasympathetic functions are more affected as seen by sta- statically significant results in resting heart rate and expiratory to inspiratory ratio.

DISCUSSION

In present study, the heart rate response to deep breathing expressed as DBD, a measure of cardiac parasympathetic function was observed to be significantly lower in pregnant subjects when compared to control group and generally followed a decreasing trend with increase in gestation This finding was in conformity with observation of Ekholm EMK, *et al* who have suggested a multifactorial basis for it with involvement at multiple levels of neuraxis including peripheral and central mechanisms.[7] A diminished parasympathetic input to the heart during pregnancy has been attributed to, among others, reduced baroreceptor sensitivity, impaired vagal afferents to the brain and altered efferent signals to the heart. A reduction in the oscillation of right atrial distension arising from diminished pulsatility of venous return from the growing uterus has been described in pregnant subjects, which may account for the lowering of DBD in pregnancy. autonomic changes separately in different trimesters of pregnancy, it was observed that women in group-I, had mild autonomic nervous system dysfunction. Women in group-II showed moderate autonomic nervous system dysfunction, whereas women in group-III demonstrated moderate autonomic nervous system dysfunction with mild parasympathetic dysfunction plus moderate sympathetic dysfunction.[8]On comparison among the three groups, in group II the parasympathetic dysfunction is more in comparison to the group I as evident by statistically highly significant ($p < 0.01$) and significant ($p < 0.05$) results in resting heart rate and expiratory to inspiratory ratio, respectively. In group II the sympathetic dysfunction was also more as compared to group I with statistically significant result in - sustained handgrip test ($p < 0.05$). On comparison of parasympathetic tests and sympathetic tests in groups II and III, it was found that in-group III the parasympathetic dysfunction is more in comparison to group II when compared with the mean values, however statistically nonsignificant results were found in the parasympathetic tests among group II and group III. The sympathetic dysfunction was found to be more in group II when compared to group III and statistically highly significant ($p < 0.01$) results in-sustained handgrip test were obtained. The results indicate that sympathetic activity was decreased more in the second trimester, less in first trimester and least in last trimester of pregnancy i.e. towards pre-pregnant level.[9] In the early pregnancy an overall decrease in vascular tone leads to systemic vasodilatation and rise in arterial compliance, there is a possible role of release of vasopressin.which causes hemodilution and with a reduction in viscosity, which

potentiates fall in vascular resistance and contributing to falling in afterload. [10]Also, there is evidence that increased nitric oxide (NO) activity plays a major role in the pregnancy-associated drop in systemic resistance, as depicted in study done by Morris *et al.*[10] Another important contribution is by circulating estrogens progressively during pregnancy which may stimulate vascular function directly or indirectly via increased NO availability. [11]Other factors contributing are increased concentrations of circulating prostaglandins. increased heat production by the developing fetus and development of a low-resistance circulation in the pregnant uterus. With further increase in the gestational age, aortocaval compression caused by the enlarging gravid uterus further compromises venous return and cardiac output leading to a shift in sympathetic nervous activity towards an even higher sympathetic and lower vagal modulation the third trimester of pregnancy.[12] Silver HM *et al* demonstrated decreased parasympathetic responsiveness during pregnancy which returns to normal after delivery.[13]Thus this kind of study with use of noninvasive methods is an area of keen interest, with least risk to maternal as well as fetal well being.[14,15]

CONCLUSION

Thus, the present study has shown the ample amount of physiological changes the body has to adapt to nurturing the baby in the fetus. Such studies are therefore important in early diagnosis of any cardiovascular monitoring in pregnancy, detecting abnormalities at an early stage and thereby improving the outcome of pregnancy.

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