

Original article:

A comparative study of sympathetic function tests during different trimesters of pregnancy in rural area

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ABSTRACT:

Background and Objectives: Several important changes in maternal hemodynamics take place during pregnancy and the action of autonomic nervous system is essential for these changes. The present study was designed with the objectives to study the physiological responses to sympathetic function tests in normal pregnancy and to compare sympathetic function tests with non-pregnant women.

Material and methods: The present study group comprised of pregnant women attending Rural Hospital, Loni in Maharashtra for antenatal care. Depending on different trimester of pregnancy, they were divided into three sub-groups of 50 each (1st, 2nd and 3rd trimester). The control group comprised of 50 age-matched, non-pregnant normal women. The following Sympathetic Function Tests were done using “CANWIN”.

Results: Blood pressure response to standing shows a significant difference in 1st and 3rd trimester as compared to control, but 2nd trimester showed no-significant changes.

Conclusion: From present study, we may conclude that , blunted BP responses may reflect impaired adaptive capacity of maternal cardiovascular system during pregnancy. According to the findings of the present study the fall in BP in response to orthostatic hypotension test in 2nd trimester imply that the cardiovascular system was incompletely adapted during the first half of pregnancy.

Keywords: Maternal hemodynamics, sympathetic function test, Blood pressure.

INTRODUCTION:

Systemic vascular resistance is decreased in response to hemodynamic changes.^{1, 2, 3, 4} Arterial blood pressure shows a progressive fall in the first and middle trimesters, whereas cardiac output and heart rate gradually increase to a plateau by the end of the second trimester.^{5,6} As pregnancy advances, aortocaval compression from the gravid uterus gradually becomes evident, which may cause supine hypotensive syndrome in late pregnancy. It has been noted that cardiovascular autonomic nervous activity tends to lower vagal and increases sympathetic modulation in late

pregnancy.⁷ Aortocaval compression was suggested to be the main factor responsible for this change. This theory was supported by observations that moving to an upright position could lead to lessening of sympathetic activation⁸ and that delivery of the fetus leads to return of normal cardiovascular autonomic nervous activity within the three months.⁹

During the early stages of pregnancy, cardiovascular autonomic nervous activity may be expected to vary little from that of the non-pregnant woman because aortocaval compression is absent. All these adaptations are associated with autonomic nervous system changes that produce alteration in cardiac autonomic modulation. Failure of these adaptations may result in pregnancy related complications such as pregnancy induced hypertension, pre-eclampsia and eclampsia.¹¹ As the cardiovascular autonomic nervous system plays an important role in adaptation of the maternal body to nurturing fetus, it is important to understand the sequential changes in cardiovascular autonomic nervous activity at various stages of pregnancy.^{10,11} The events in pregnancy elicit one of the best examples of selective anatomical, physiological and biochemical adaptations that occur in the body.

Aim of study: Assessment of changes in the sympathetic function test during different trimesters of pregnancy and to compare with non-pregnant women

MATERIALS & METHODS

The study was approved by the Board of Research Institutional Ethics Committee of Pravara Institute of Medical Sciences (DU) , Loni. The study was performed as per the Ethical Guidelines for Biomedical Research on Human participants (ICMR October 2006) This was a case control observational study was carried out department of Physiology, Rural Hospital, Loni in Maharashtra. Total study duration was three years as a part of postdoctoral work.

Non-probability purposive sampling was used for present study. The study Participants were taken from rural areas of Loni. A total of 200 women aged from 20 to 35 years without any recent history of cardiac diseases were selected 150 were in the Pregnant and 50 were in the non-pregnant. 150 pregnant women were equally divided in 1st, 2nd, and 3rd trimester of pregnancy. 50 healthy non-pregnant women were taken as control.

Sympathetic function tests were , Blood pressure response to standing orthostatic hypotension test (OHT) and blood pressure response to sustained handgrip test (SHGT) measured in normal pregnant and normal non-pregnant women.

Inclusion & Exclusion Criteria:

Healthy Non-pregnant Women & Pregnant Women 1st, 2nd & 3rd Trimester:

Inclusion Criteria:

1. Age group between 20 to 35 years
2. Pregnant women visiting the Rural Hospital, Loni hospital for routine ANC checkup.
3. Free from any systemic illness which can affect sympathetic function test.

Exclusion Criteria:

1. H/O cardiovascular disorders
2. Healthy females with history of addiction to tobacco, mishri, alcohol

Data collection method:

Parameters: Data comprising of Anthropometric data (name, age, height, and weight), Hb, were obtained and recorded from all pregnant and non-pregnant women. Estimation of Hemoglobin was done by Sahli’s Method (Acid Haematin Method). Canwin (cardiac autonomic neuropathy (CAN) analysis system) was used for the following sympathetic function tests.

1: Blood pressure response to standing orthostatic hypotension test (O HT):

Procedure: The participant was relaxed, lying down comfortably. B.P. was recorded in supine position. The participant was asked to stand up quickly and the B.P. recorded immediately after standing. Then the BP was recorded again at the end of one minute after standing. The test ends automatically and the result was displayed immediately.¹¹

2: Blood pressure response to sustained handgrip test (SHGT):

Procedure: The B.P. was recorded in sitting position. Then the participant was asked to hold the spring of dynamometer in the dominant hand, and instructed to compress the spring of dynamometer with the full efforts for the period of 5 minutes. The BP was recorded thrice during these 5 minutes automatically and the alteration in the B.P. just before the release of hand grip test.¹²

RESULTS AND ANALYSIS:

Indices of cardiovascular autonomic activity in four study groups had been shown in the master charts included in the Annexure section. The individual tests were given Mean± SD of each individual. The name, age, height, weight and Hb of subjects with result of each individual test and autonomic values were tabulated in master charts.

Table: 1- Comparison of anthropometric parameters between non-pregnant women and different trimester of pregnancy.				
Parameters	Non-pregnant	1 st trimester	2 nd trimester	3 rd trimester
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age (year)	21.81 ± 3.37	22.01 ± 3.65	21.78 ± 2.33	21.10 ± 2.69
Height (cm)	152.90 ± 3.81	152.79 ± 5.02	152.49 ± 6.05	151.99 ± 3.95
Weight (Kg)	50.06 ± 4.66	49.67 ± 5.80	52.42±7.74*	58.76 ±4.72*
Hb (gm/dl)	12.07 ± 0.68	11.89 ± 0.45	12.10 ± 0.41	11.84 ± 0.4
Statistically significant difference at P< 0.05* vs non-Pregnant				

Table no.1 Shows comparison of anthropometric parameters results between non-pregnant (controls) and 1st 2nd and 3rd trimesters of pregnancy. There was statistical no-significant (P>0.05) difference in the parameters age, height and Hb, but weight was statistically significant (P < 0.05*) during 2nd and 3rd trimester when compared with non-pregnant women by One Way ANOVA Test.

Table :2- Comparison of Mean \pm SD values of sympathetic tests in non-pregnant & different trimester of pregnancy:				
Sympathetic function tests:	Non-pregnant	1 st trimester	2 nd trimester	3 rd trimester
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
B. P. response to standing orthostatic hypotension test	5.6 \pm 3.386	7.4 \pm 3.074	5.62 \pm 4.13	6.12 \pm 3.314
B. P. Response to sustained handgrip test	7.8 \pm 5.388	10.72 \pm 3.939	8.033 \pm 4.81	9.188 \pm 5.796
OHT and SHGT shows a statistically significant difference in 1 st and 3 rd trimester as compared to non-pregnant, but 2 nd trimester showed no-significant difference compared to non-pregnant.				

DISCUSSION:

The cardiovascular autonomic activity has an important role in overall cardiovascular homeostasis. Sympathetic function tests like B.P. response to OHT and BP response to SHGT have been widely used for studying the autonomic nervous control of heart and circulation. In our study all the above variable were assessed to find out changes in cardiovascular autonomic activity during different trimester of pregnancy.

Blood pressure response to standing was evaluated in all the pregnant and non-pregnant women. Mean and SD of fall in SBP in control, 1st, 2nd and 3rd trimesters were 5.6 \pm 3.38, 7.3 \pm 3.0, 5.62 \pm 4.13 and 6.12 \pm 3.31 respectively (table no 2). Systolic Blood pressure response to standing shows a statistically significant difference in 1st and 3rd trimester as compared to non-pregnant, but 2nd trimester showed no-significant difference compared to non-pregnant. The hemodynamic response may be due to a decrease in the baroreceptor sensitivity, which may develop in early pregnancy. The fall in SBP to orthostatic stress occurring in the 1st trimester imply that the cardiovascular system is incompletely adapted to pregnancy. The increased blood volume seems to improve hemodynamic stability, especially during the second half of pregnancy.^{7,15} The present study corroborates the findings of several earlier studies. Thomas R E and Barbara C studied the hemodynamic effect of orthostatic stress during pregnancy in 15 non-pregnant women and 14 pregnant women in 1st trimester and 16 pregnant women in 2nd and 3rd trimester each. In the 1st trimester, there was significant fall in SBP in response to postural change when compared to non-pregnant women. However, result in 2nd and 3rd trimester were not significant.¹⁵ Del Bene R, Barletta G studied effects of posture on cardiovascular function in pregnancy. They concluded that cardiac output increased during pregnancy in supine posture also in active orthostatic position. However, the decrease in cardiac output associated with early standing attenuated significantly at the early 2nd trimester and was absent at mid-3rd trimester.¹⁷ Pyorola T evaluated cardiovascular response to upright position during pregnancy. He found that head up tilt caused a similar fall in SBP at 5 to 8 months of pregnancy as in non-pregnant women.¹⁸

Avery et al. found in the orthostatic test, the sustenance of tachycardia is by virtue of sympathetic stimulation. The duration of pregnancy seems to influence the heart rate difference between supine and standing posture. There was no difference in systolic blood pressure response between the pregnant and non-pregnant groups.

In the non-pregnant women there was a fall in the central venous filling pressure, stroke volume and cardiac output caused by the pooling of blood from the thorax into the veins in the legs on standing up from supine position.²⁰

Jayawardana (2001), observed that decreased stimulation of the high pressure baroreceptors as the arterial pressure falls and decreased stimulation of cardiopulmonary receptors because of diminished right ventricular filling pressure leads to reflex vasoconstriction and recovery of the diastolic blood pressure. Reloading of the arterial baroreceptors causes an increase in blood pressure.²² Ewing et al. found that when cardiopulmonary receptors are unloaded by orthostatic stress, sympathetic outflow rises. This leads to increase in total peripheral resistance, and in the orthostatic test there is immediate vagal withdrawal on standing from the lying down position which reflexively increases the heart rate, therefore, the shortest R-R interval is observed at the 15th beat, thereafter, there is a gradual lengthening of the R-R interval exhibiting the minimum heart rate at the 30th beat due to spontaneous vagal reactivation.²¹

150 pregnant and 50 non-pregnant women were evaluated for blood pressure response to sustained handgrip test. Mean and SD of increase in DBP in control, 1st, 2nd and 3rd trimesters are 7.8 ± 5.38 , 10.72 ± 3.93 , 8.03 ± 4.81 , 9.18 ± 5.79 respectively (table no 2). Blood pressure response to sustained handgrip test shows a significant increase in DBP in 1st, 2nd and 3rd trimester as compared to non-pregnant. Heart rate responses in all pregnant and non-pregnant were similar but BP response was slightly weaker in the second trimester group. The presser response caused by sustained handgrip test is achieved by an increase in cardiac output and a change in the total systemic resistance. The increase in vascular resistance caused by sustained handgrip test is smaller in 2nd trimester women than in non-pregnant ones. This could depend on a lesser concentration of norepinephrine (NE), a diminished contractile response of the vascular smooth muscle or an antagonistic effect of progesterone.^{1,7}

The present study has similar findings from earlier studies of Heiskanen H, which concluded that decreased sympathetic tone prevails during the second half of pregnancy which may be responsible for failure of increase in DBP in response to sustained handgrip test.¹⁴ Whittaker et al and Robinovici observed blunted plasma NE responses after sustained handgrip test during second half of gestation compared to non-pregnant women.^{13,23} Van Hook JW has shown that the heart rate and presser response to maximal sustained handgrip test of short duration is affected by pregnancy. They have concluded that presser changes to sustained handgrip test were different in both pregnant and control group.¹⁹ Ekholm EMK & Antila KJ et al, found that that cardiovascular response to isometric handgrip exercise, primarily mediated by sympathetic stimulation was observed to be weaker during 2nd and 3rd trimester of pregnancy as evidenced by a significantly reduced alteration in DBP in these two groups.^{11,16}

It may be inferred that a smaller increase in vascular resistance in response to isometric exercise may be existent during the second half of pregnancy consequent to a generalized reduction in sympathetic tone during 2nd and 3rd trimester as postulated by Assali, corroborating the result of the present study.¹¹ it's always beneficial to be informed earlier to patients.²⁴ To avoid further complications its always advisable regular ANC check of patient from her first trimester.^{25,26}

CONCLUSION:

From present study, we may conclude that , blunted BP responses may reflect impaired adaptive capacity of maternal cardiovascular system during pregnancy. According to the findings of the present study the fall in BP in response to orthostatic hypotension test in 2nd trimester imply that the cardiovascular system was incompletely adapted during the first half of pregnancy. As the reproducibility of BP response in the sustained handgrip test was poor and the studies have shown contradictory result, the sustained handgrip test may not be recommended for research on cardiovascular reactivity in pregnancy.

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