



ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2019; 5(7): 94-96
www.allresearchjournal.com
Received: 13-05-2019
Accepted: 15-06-2019

Dr. Bhakti R. Kharate
Associate Professor
Department of Physiology
Dr. RN Cooper Hospital and
HBT Medical College Vile
Parle, Mumbai, Maharashtra,
India

Dr. Laxmichhaya A Gunjal
Assistant Medical Officer
Centenary Hospital, Kandivali,
Mumbai, Maharashtra, India

Comparison of autonomic function tests among pregnant and non-pregnant females for sympathetic activity

Dr. Bhakti R. Kharate and Dr. Laxmichhaya A Gunjal

Abstract

Introduction: Autonomic nervous system is thought to be essential for the circulatory adaptation seen in pregnancy, alteration of it has been implicated to play an important etiologic role in pregnancy induced hypertension.

Amis and objectives: To study physiological responses to non-invasive cardiovascular autonomic sympathetic test in normal pregnancy and follow these females till term to see for changes if any and development of PIH.

Materials and method: Standard autonomic function tests for sympathetic activity such as blood pressure changes during isometric hand grip exercise, orthostatic test and cold pressor test were performed in 50 pregnant and 50 non pregnant subjects. Data was analysed using unpaired t-test. P-value < 0.05 was considered as statistically significant.

Results: In the present study there was a significant difference in response to handgrip test and cold pressor test among the two groups. The increase in diastolic pressure was significant in pregnant females who developed PIH.

Conclusion: Autonomic function is found to be altered in pregnancy from that of non-pregnant state.

Keywords: Sympathetic activity, pregnancy, PIH

Introduction

A rearrangement of autonomic tone takes place in pregnancy. During pregnancy, hemodynamic mechanisms are altered significantly. A well-controlled interaction between sympathetic and parasympathetic system is necessary for adapting to cardiovascular hemodynamic changes during normal pregnancy failure of which may lead to pregnancy complications. Development of hypertension in pregnancy has been associated with loss of autonomic control. Autonomic functions for parasympathetic activity are published elsewhere. Blood pressure response to sustained handgrip, cold pressure response are well established as non-invasive measures of sympathetic autonomic control. The present study aims at studying and comparing these parameters among pregnant and non-pregnant females.

Aim and objective

To study physiological responses to non-invasive cardiovascular autonomic function test (sympathetic tests) in normal pregnancy and compare these indices with healthy non-pregnant women.

Materials and method

Study was conducted in the department of Physiology at tertiary hospital in Mumbai. Ethical approval was taken from Institutional ethical committee. Written informed consent of all the participants was taken. Study population included 100 subjects comprising 50 pregnant and 50 non-pregnant women; aged 20-40 years. Multipara, females with gestational diabetes, h/o pre-eclampsia, cardiovascular/lung diseases, smokers and anaemia were excluded from the study. Pregnant females in their first trimester were included in the study. All the subjects

Correspondence

Dr. Bhakti R. Kharate
Associate Professor
Department of Physiology
Dr. RN Cooper Hospital and
HBT Medical College Vile
Parle, Mumbai, Maharashtra,
India

Were called in morning hours between 10 am to 12pm to avoid diurnal variations in autonomic functions.¹

The participants were monitored for the heart rate by an electrocardiographic tracing and blood pressure was monitored in the right upper extremity by sphygmomanometer. Blood pressure and heart rate were recorded in the beginning and then, after continuous rest in supine position. These data has been published in the earlier paper.

Cold Pressor Test:

Blood Pressure Response to Cold: The subject was made to immerse one hand in ice water at 4⁰ c for one minute. The blood pressure response was measured in the opposite arm [2].

Hand grip test

Blood Pressure Response to Sustained Hand Grip Procedure: A hand grip dynamometer was used for this test. The subject was asked to use the maximum voluntary effort (maximum voluntary - MVC) and press the hand grip

dynamometer. The reading of the handgrip dynamometer was noted. Then the subject was asked to maintain the handgrip at level of 30% of maximum effort for 5 minutes. The rise in blood pressure was measured.³ Reference values of Ewing & Clark were used to interpret the results of the tests.

Statistical analysis

Statistical analysis was done by using SPSS software version 20. Descriptive statistics i.e. mean and standard deviation was used for numerical data. Comparison of numerical variables among groups was done by using unpaired t-test.

P-value< 0.05 was considered as statistically significant. All pregnant women are followed till term. 4 out of 50 pregnant women developed PIH. Wilcoxon signed rank test was used for comparison of normal and abnormal autonomic function tests in pregnant group.

Results

Table 1: Comparison of autonomic function tests among study population for sympathetic activity

Variable	N	Group	Mean	± sd	P value	Significance
OT (orthostatic fall in SBP in mmHg)	50	Pregnant	6.64	4.30	0.091	Non significant
	50	Non – pregnant	5.26	3.75		
CPT (rise in DBP in mmHg)	50	Pregnant	11.24	4.23	0.000	Significant
	50	Non – pregnant	14.60	1.66		
HGD (rise in DBP in mmHg)	50	Pregnant	7.08	5.96	0.000	Significant
	50	Non – pregnant	21.58	3.47		

Table 2: Comparison of autonomic function tests among study population for sympathetic activity

Variable	N	Group	Mean	± SD	P value	Significance
OT (orthostatic fall in SBP in mmHg)	4	PIH	6.00	4.89	0.091	Non significant
	46	Non – PIH	6.70	4.30		
CPT(rise in DBP in mmHg)	4	PIH	23.00	1.15	0.000	Significant
	46	Non – PIH	10.22	2.46		
HGD (rise in DBP in mmHg)	4	PIH	24.50	1.91	0.000	Significant
	46	Non-PIH	5.57	3.03		

Discussion:

In the present study there was a significant difference in response to handgrip test and cold pressor test among the pregnant and non pregnant groups. The increase in diastolic pressure was significantly less in pregnant females as compared to control group. (Table 1) The increase in blood pressure (DBP) during both the test i.e. CPT & HGD was found to be more in pregnant women who subsequently developed PIH as compared to women with normal pregnancy outcome and was statistically significant (0.001) on applying Wilcoxon signed rank test. (Table 2)

Cardiovascular responses to sustained handgrip test and cold pressor test are mediated by sympathetic stimulation. Pregnancy does not seem to affect basal postganglionic sympathetic nerve activity in skeletal blood vessel nor is there increased activity in response to cold pressor test in the first trimester. Local mechanisms within the arterial tree itself may account for the relaxation observed during pregnancy, perhaps due to humeral signals deriving from ovary, placenta possibly from pituitary [4]. The rise in DBP response to cold pressor test is less in pregnant group than that of non-pregnant group, which may be because of blunted systemic response to norepinephrine.

The pressor response caused by Isometric handgrip is achieved by an increase in cardiac output and a change in the total systemic resistance. The increase in vascular resistance caused by Isometric handgrip is smaller in pregnant women than in non-pregnant ones. This could depend on a smaller concentration of norepinephrine (NE) in sympathetic nerve endings, a diminished contractile response in the blood vessels to NE during pregnancy or an antagonist effect of the products of the utero-placental unit, such as progesterone [5]. In the present study rise in diastolic blood pressure response to hand grip dynamometer test is less than that of non-pregnant control group and this may be because of decreased sympathetic activity which is due to smaller concentration of NE in sympathetic nerve endings.

In the present study all pregnant women are followed till term. 4 out of 50 pregnant women developed PIH. In the study group of 50 pregnant women, 4 women developed PIH whereas rest 46 remained normal during the course of pregnancy. Rise in DBP to cold pressor test and hand grip dynamometer in PIH subject was more than that of normal pregnant group and was statistically significant.

Sympathetic vasoconstrictor discharge to skeletal muscle is markedly elevated in patients with PIH but normal in normotensive pregnant subjects. The increase in peripheral

vascular resistance seen in PIH is mediated at least partly by a substantial increase in sympathetic vasoconstrictor activity. It was suggested that a defect in central conflict-processing systems may mediate an increase in catecholamine levels, which not only provokes somatic and affective symptoms of anxiety and hostility, but also leads to an increase in peripheral vascular resistance and blood pressure. The fundamental hemodynamic characteristic of pre-eclampsia is a marked increase in peripheral vascular resistance. Augmented sympathetic vasoconstrictor activity is one important mechanism producing this increase in vascular resistance [6].

Our data confirms the presence of hemodynamic changes shortly after the beginning of pregnancy. Second, these changes are different in women whose pregnancies are eventually complicated by PIH.

Conclusion

In our study cold pressor and sustained handgrip tests showed significant changes in the pregnant women which could be due to blunted sympathetic response in the first trimester. However pregnant females who eventually developed PIH had significantly higher sympathetic response compared to normal pregnant females. Thus these tests can be used as early indicators of PIH, they being non-invasive and cost effective. Early detection of high risk patients is essential for prophylactic interventions to reduce morbidity & mortality.

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