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PHYSIOLOGY

COMPARISON OF AUTONOMIC FUNCTION TESTS AMONG PREGNANT AND NON-PREGNANT FEMALES FOR PARASYMPATHETIC ACTIVITY.

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ABSTRACT

Introduction: The autonomic nervous system plays a fundamental role in adaption of the heart and circulation to the increased demands of mother during pregnancy. Cardiovascular reflex tests are well established as non- invasive measures of parasympathetic autonomic control.

Amis and objectives: To study physiological responses to non-invasive cardiovascular autonomic function test (parasympathetic tests) in normal pregnancy.

Materials and method: Standard autonomic function tests for parasympathetic activity such as Deep breathing test, Valsalva manoeuvre, and orthostatic 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: There was significant decrease in heart rate variation during Deep breathing.

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

KEYWORDS : autonomic function tests, pregnancy

Introduction:

Pregnancy is the process during which many physiological changes occur to meet up the metabolic needs of the mother and the growing foetus. The autonomic nervous system plays a fundamental role in adaption of the heart and circulation to the increased demands. 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. Cardiovascular reflex tests such as the Valsalva manoeuvre, the deep breathing test and the orthostatic test are well established as non- invasive measures of parasympathetic 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 (parasympathetic 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 were called in morning hours between 10 am to 12pm to avoid diurnal variations in autonomic functions.

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.

In the deep breathing test the subject lay supine, breathing as deeply as possible at the rate of 6 breaths per minute. A continuous ECG tracing was obtained. Maximum and minimum R-R intervals during each breathing cycle was measured. The deep breathing difference (DBD) was calculated as the mean of differences of maximum and minimum instantaneous heart rate.

In the Valsalva manoeuver the subject was asked to blow into the tubing of mercury sphygmomanometer and raise the column of mercury to 40 mm Hg. and maintain it at that level for at least 10 seconds at least .Care was taken that the pressure rose sharply at onset and fell abruptly at the termination of the strain period. Following a training period each subject performs two Valsalva manoeuvres separated by a rest period. During each manoeuvre, heart rate was monitored continuously throughout the strain period and for 15 seconds following release of strain by means of an electrocardiograph.

In the Orthostatic test immediate Heart Rate Response to Standing was studied. Only the limb leads of the ECG machine were attached to the subject. The blood pressure cuff was tied to the arm and kept inflated and the sphygmomanometer was held at heart level. With this arrangement, the subject was asked to stand up from the supine position and was instructed to remain motionless for two minutes. The ECG was recorded from about 15 beats before to about 40 beats after standing. The maximum R-R interval around 30th beat and minimum R-R interval around 15th beat were measured with ruler. The subject's blood pressure was recorded when lying down quietly and again when subject stands on.

Reference values of Ewing & Clark were used to interpret the results of the tests

STATISTICALANALYSIS

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.

Results:

Table 1:

Comparison of mean values of Basal parameters among pregnant and non-pregnant

VARIABLE	n	GROUP	MEAN	± SD	PVALUE	SIGNIFICANCE
RHR (per minute)	50	PREGNANT	85.96	10.30	0.000	SIGNIFICANT
	50	NON – PREGNANT	74.88	9.055		
SBP (mmHg)	50	PREGNANT	109.16	8.85	0.000	SIGNIFICANT

	50	NON – PREGNANT	115.84	6.67		
DBP (mmHg)	50	PREGNANT	66.72	3.74	0.000	SIGNIFICANT
	50	NON – PREGNANT	78.04	5.9		

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

VARIABLE	n	GROUP	MEAN	±SD	P VALUE	SIGNIFICANCE
DBD	50	PREGNANT	6.30	3.84	0.000	SIGNIFICANT
	50	NON – PREGNANT	22.34	8.57		
Valsalva Ratio	50	PREGNANT	1.39	0.21	0.350	NON-SIGNIFICANT
	50	NON – PREGNANT	1.34	0.28		
Orthostatic test (30:15ratio)	50	PREGNANT	1.13	0.25	0.823	NON-SIGNIFICANT
	50	NON – PREGNANT	1.13	0.10		

Discussion:

Normal pregnancy is associated with marked changes in cardiovascular hemodynamics, which in part may be due to changes in autonomic control mechanism. The action of the autonomic nervous system is thought to be essential for the circulatory adaptations seen in pregnancy. The physiological changes during pregnancy facilitate the adaptation of the cardiovascular system to the increased metabolic needs of the mother enabling adequate delivery of oxygenated blood to the peripheral tissues and to the fetus. [2]

Heart rate increase steadily throughout pregnancy. Increased heart rate during early pregnancy is thought to be a compensatory attempt to maintain cardiac output in a state of relative hypovolemia resulting from initial vasorelaxation. The basal parasympathetic nerve activity to the heart is the major determinant of baseline heart rate. It can be concluded that the increase in heart rate was due to a decrease parasympathetic tone.[2]

In spite of the large increase in CO, the maternal BP is decreased until later in pregnancy as a result of a decrease in SVR that nadirs mid pregnancy and is followed by a gradual rise until term. The most obvious cause for the decreased SVR is progesterone-mediated smooth muscle relaxation; Increased NO also contributes to decreased vascular resistance by direct actions and by blunting the vascular responsiveness to vasoconstrictors such as Angiotensin II and norepinephrine. During normal conception, the expression and activity of NO synthase is elevated and the plasma level of cyclic guanosine monophosphate, a second messenger of NO and a mediator of vascular smooth muscle relaxation is also increased. As a result, despite the overall increase in the RAAS in pregnancy, the normal gravid woman is refractory to the vasoconstrictive effects of angiotensin II.

Heart rate variation during deep breathing test was significantly lowered in pregnant women. The finding of the present study is in conformity with earlier studies by Ekholm et al. A diminished parasympathetic input to the heart during pregnancy has been attributed to, among others, reduced baroreceptor sensitivity, impaired vagal afferents to brain and altered efferent signals to the heart.

Panja et al found no difference for Valsalva ratio between pregnant and control group.15 The different results between studies could depend on the position of subject tested. In semi recumbent position the growing uterus may decrease venous return & CO. which may attenuate the refectory bradycardia and decrease the Valsalva ratio in pregnant women.6 As in the present study subjects are in first trimester of gestation and also in sitting position, so there is no effect of gravid uterus on venous return and cardiac output to attenuate refectory bradycardia and decrease the Valsalva ratio in pregnancy.

The heart rate response to standing in pregnant groups did not differ significantly from that of the non-pregnant control. Panja S et al assessed HR response to standing expressed as PTI, observed to remain unaltered during early stages of pregnancy.[15]

Orthostatic stress generated by changing from recumbent to standing position is associated with acute hemodynamic changes. Standing up from supine position causes, blood to pool from thorax into veins of leg, this causes a fall in central venous return, a decline in Stroke volume and cardiac output. The fall in BP by standing up unloads systemic baroreceptors and therefore raises the heart rate 10. It seems that heart rate to standing depend upon duration of pregnancy6.

Summary:

The parasympathetic division of ANS function was found to be altered during pregnancy from that of the non-pregnant state. Resting heart rate is higher in pregnant group as compared to non-pregnant group. Resting systolic and diastolic blood pressure was lower in pregnant group than non-pregnant control group. There was significant decrease in heart rate variation during Deep breathing. These observed changes possibly reflect decreased vagal control of the heart. These study confirms the importance of monitoring cardiovascular functions in pregnancy to detect early abnormalities at an early stage. Autonomic test can be used as early indicators of PIH, they being non-invasive and cost effective. These study will be continued to monitor the pregnant females and look for any abnormality in the autonomic function test that could predict PIH at an early stage.

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