Comparative study of Parasympathetic activity of pregnant women of 2nd & 3rd trimesters and Non Pregnant Women

Vikhe Balasaheb B*, Latti R G**

Abstract

Introduction: *The present study was designed to evaluate the physiological responses to noninvasive cardiovascular autonomic function tests in normal pregnancy and compare them with non- pregnant controls. All types of behavioral and hormonal changes occur in women especially during reproductive life. Therefore, it is worth, while to assess autonomic functions during various phases of woman's reproductive life. These would also help to predict any existing autonomic dysfunction during various phases of woman's life. The present study was designed to the physiological responses of parasympathetic activity tests of pregnant women 2nd &3rd trimester and non pregnant women in rural area.*

Materials and Methods: *Variations in parasympathetic activity study was carried out in the Department of Physiology in Rural Medical College, Loni, Maharashtra during the period of Feb2012 to may 2015. Study population was 390 pregnant and non-pregnant women, pregnant and non-pregnant women are equally divided in to three groups during study period.*

Hence the total 390 women were interviewed and examined. Data were analysed statistically using ANOVA and Multiple Comparison analysis

Results: *In the present study, For parasympathetic activity, it was observed that heart rate response, E:I ratio and valsalva ratio were significant ($p < 0.05$) in both pregnant and non-pregnant women.*

Conclusion: *The study showed significant increase in heart rate response, E:I ratio and valsalva ratio in the 2nd &3rd trimester of pregnancy, reflecting parasympathetic activity as compared to non pregnant group.*

Key words: *Autonomic function tests, pregnant women.*

Introduction

The present study was designed to evaluate the physiological responses to noninvasive cardiovascular autonomic function tests in normal pregnancy and compare them with non- pregnant controls. All types of behavioral and hormonal changes occur in women especially during reproductive life. Therefore, it is worth, while to assess autonomic functions during various phases of woman's reproductive life. These would also help to predict any existing autonomic dysfunction during various phases of woman's life.

* Assistant Professor, **Professor and HOD

Corresponding author:
Vikhe Balasaheb B
Department of Physiology, RMC,
Pravara Institute of Medical Sciences,(DU)
Loni, Maharastra

Materials and Methods

A total 390 healthy normotensive 2nd &3rd trimester of pregnant& non-pregnant women ranging in age group between 18 to 35 years attending regular Antenatal Clinic of Pravara Rural Hospital were considered for the study as soon as pregnancy was established. Pregnancy was confirmed by urinary human chorionic gonadotropin determination test.

The study design was approved by ethical committee of the institute. Subjects were divided into three groups.

Group I: Control group (non-pregnant women).

Group II: women during second trimester of pregnancy.

Group III: women during third trimester of pregnancy.

Study protocol was explained to the subjects and written informed consent was obtained. Subjects with any major illness in the past or at present such as hypertension, diabetes, any cardiovascular abnormality; with any addiction, history of caesarean section, or previous

abortions were not included in this study. Canwin is the-state-of-the-art window based computer having cardiac autonomic neuropathy (CAN) analysis system with interpretation. It has an extensive data base to keep track of subject's history and for archive test retrieval and comparisons. Being fully automatic, the need of manual recordings, readings and calculation is eliminated. Inbuilt time domain waveform analysis and Blood pressure measurements make the task of conducting all the Autonomic Nervous System tests very easy.

Tests performed to assess parasympathetic functions:

1. Heart rate response: Procedure: The subject was asked to lie down comfortably and the heart rate was recorded. Then the subject was asked to stand up and immediately the heart rate was recorded. The heart rate was calculated with the help of R-R interval. Response was taken as a difference between the heart rate in supine and standing positions.

Result: Normally heart rate should increase at least by 10 beats per minute in standing position. The absence of increase in heart rate during standing position has been interpreted as an impairment of autonomic function of heart.

2. Expiratory: Inspiratory ratio (E: I ratio): Procedure: The subject was asked to lie down

comfortably and was asked to take deep breaths slowly in and out, approximately at 6 breaths per minute i.e. 5 seconds inspiration and 5 seconds expiration. The maximum and minimum R-R intervals during each phase of respiration were recorded. The heart rate was calculated and the variation during respiration was observed.

Result: E:I ratio is taken as the ratio of longest R-R interval during expiration to the shortest R-R interval during inspiration. E:I <1.2 is abnormal.

3. Valsalva ratio: Procedure: The subject was asked to take deep breaths with closed nostrils and puff the cheeks simultaneously for 15 seconds and then was asked to release the strain by doing forceful expiration. The heart rate was recorded and calculated during the strain and after release of strain.

Result : Normally heart rate is increased during the strain and this raised heart rate is due to baroreflex stimulation to the fall in the blood pressure seen as a result of increased intrathoracic pressure (decreased venous return). On release of strain the cardiac output is restored and there is anincrease in blood pressure. Valsalva ratio is taken as the ratio of longest R-R interval after release of strain to the shortest R-R interval during strain. It is used as an index of cardiac vagal function. A ratio of < 1.2 is abnormal.

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) after classification of each of their test results as normal, borderline and abnormal following the criteria laid down in Table 1 and an overall CAS between 0 and 10 was calculated for each subject.

The mean and standard deviation of cardiovascular autonomic test results were calculated. One way ANOVA to compare mean between the different groups of study population and controls was performed, Table I shows the mean value of age, height and weight (anthropometric data) in the four groups (n=390). It revealed statistically insignificant results for the mean value of age and height between the four groups Non –pregnant, IInd trimester, and IIIrd trimester and ($p>0.05$). 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 ($p<0.05$). and Table II shows p value calculated.

Table No-1 : Anthropometric value measures of pregnant women in 2nd &3rd trimesters & in non- pregnant women.

Anthropometric parameter	Non-pregnant(n=130)	2nd Trimester(n = 130)	3rd Trimester(n = 130)
	Mean ± SD	Mean ± SD	Mean ± SD
Age (Years)	22.01 ± 1.78	21.06 ± 1.80	21.80 ± 2.36
Height (Cm)	155 ± 4.55	155 ± 4.40	155 ± 4.78
Weight (Kg)	45.25 ± 0.05	47.98 ± 7.14	51.40 ± 8.03*

*: statistically significant as compared to group Non-pregnant & 3rd Trimester ($p<0.05$)

Table No. 2 : Variation of parasympathetic activity of pregnant women of 2nd trimesters & non- pregnant women

Parameters reflectingpara sympathetic activity	Non-pregnant (n=130) Mean ± SD	2nd Trimester (n = 130) Mean ± SD	p-value
H R Response to standing (mmHg)	77.15±6.26	89.70±9.62	P> 0.05
Expiratory:InspiratoryRatio	1.46±0.25	1.19±0.10	P < 0.05*
Valsalva Ratio	1.51±0.280	1.409±0.229	P> 0.05

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

Table No. 3 : Variation of parasympathetic activity of pregnant women of 3rd trimesters & non- pregnant women

Parameters reflectingparasympathetic activity	Non-pregnant (n=130)	3rd Trimester (n = 130)	p-value
	Mean ± SD	Mean ± SD	
Heart Rate Response to standing (mmHg)	77.15±6.26	94.73±17.07	p < 0.05*
Expiratory:Inspiratory Ratio	1.46±0.25	1.17±0.11	p < 0.05*
Valsalva Ratio	1.51±0.280	1.319±0.211	p < 0.05*

* Statistically significant difference at 5 % level. Abbreviations: HR: Heart Rate, E:I:

Expiratory:Inspiratory Ratio & VR: Valsalva 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 (Tables 2&3). 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[6]. 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[7]. A reduction in 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. A significant difference in VR was observed between the control and third trimester group, between 2nd and 3rd trimester group and finally between 2nd and 3rd trimester groups (table 2). From table 2, it was concluded that VR in pregnancy followed a downward trend through to the end of pregnancy, probably as a consequence of physiologic adaptation to chronic volume overload. These findings corroborated well with those of Souma ML, et al who have reported a higher VR for controls than the mean for every gestational group and a definite downward trend in the VR during later stages[8]. However, a few earlier studies, including one by Eneroth- Grimfors et al have reported unaltered VR during 2nd and 3rd trimester registering a significant decrease[9]. The apparent non conformity of these finding with those of present study may be due to the affection of cardiac responses with body position of the subject.

While the present study was carried out with the subjects in sitting posture, these studies had been carried out with subjects in semi recumbent position. In contrast to VR showing a generally decreasing trend with advancing gestation, Steven LC et al, in their study have noted such blunted heart rate response in primiparous women between 36 to 38 weeks of pregnancy and have suggested

that the altered hemodynamic profile brought about by pregnancy may be more profoundly affected in late pregnancy by the effect of gravid uterus on venacaval and aortic blood flow when the subject is supine[10]. In the Orthostatic Test, the fall in SBP on standing was found to be significantly increased during 3rd trimester of pregnancy when compared to the controls. A decrease in barorecepteor sensitivity, especially observed in early pregnancy may be attributed to this observed result perhaps signifying an incomplete adaptation of the cardiovascular system to the pregnant state. It has been noted that during second half of pregnancy, the increase in blood volume seemed to improve hemodynamic stability[11]. This has been adequately highlighted in the present study where no significant difference in fall in SBP on standing was observed between controls and 2nd and 3rd trimester groups. Similar findings have been reported by work of other of other researchers. For example, Thomas

RE et al, have observed a significant fall in SBP in response to postural changes during 1st trimester but not during 2nd and 3rd trimester when compared to controls[12].

Conclusion

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. This is especially important in the context of a developing country like India where early detection of cardiovascular abnormality in pregnancy during routine antenatal visits may prove to be immensely helpful in preventing complications, which, in addition to endangering the lives of mother and baby, prove to be a heavy burden on the health care delivery system.

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