Original article:

Study of Valsalva maneuver Ratio and Deep Expiration Inspiration Ratio in pregnant and non-pregnant women

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ABSTRACT

Background: Many behavioral and hormonal changes occur during normal pregnancy. Most of the behavioral patterns are exhibited through cardiovascular autonomic nervous system Assessment of parasympathetic functions during pregnancy help to predict any existing autonomic dysfunction during pregnancy. Many studies done to assess these parasympathetic functions. But little data is available for woman from rural area so we decided to study Valsalva Maneuver Ratio (VMR) and herart rate response to deep breathing (E:I ratio) in pregnant woman from rural area of Loni Maharashtra.

Aim & Objectives: The present study was designed to investigate the changes in cardiovascular autonomic functions in pregnancy and compare it with non-pregnant woman.

This study was conducted to assess the parasympathetic function tests among different trimester of pregnancy and non-pregnant women in rural area.

Materials and Methods: A comparative study was carried out in the Department of Physiology of Rural Medical College, Loni. A consecutive 320 women, divided 80 non-pregnant and 240 numbers of pregnant women in equal number in each trimester of pregnancy during study period. Hence the total 320 women were interviewed and examined. All pregnant and non-pregnant women were evaluated by "CANWIN- Cardiac Autonomic Neuropathy Analyzer", Valsalva Maneuver Ratio (VMR) and herart rate response to deep breathing (E:I ratio) was studied on it. Data was analyzed using ANOVA test and Multiple Comparison analysis.

Results: In the present study significant decrease in both E:I ratio and VMR ($p < 0.05$) observed in pregnant women as compares to non-pregnant women.

The significant increase in overall parasympathetic function tests and within all groups were also observed.

Conclusion: The study showed significant decrease in E:I ratio and VMR in the during pregnancy, reflecting parasympathetic functions test as compared to non- pregnant group.

Key words: Parasympathetic function tests, Pregnant Women, VMR, E:I ratio.

INTRODUCTION

Many significant physiologic adaptations take place during pregnancy in multiple systems in pregnant woman long before they are functionally necessary. The significant changes were observed in body compositions and cardiopulmonary functions. The decrease in systemic vascular resistance is most probably caused due to gestational hormones, increased levels of circulating prostaglandins, and increased heat production due to developing fetus and development of a low-resistance circulation in the uterus.[1]

As gestational age increases aortocaval compression caused due to enlarging gravid uterus further compromises the venous return. The important maternal adaptation to pregnancy take place due to change in cardiovascular sympathetic activity for better prenatal and post- natal outcomes. [2] The different changes occur during pregnancy may be due to changes in autonomic control mechanisms resulting in altered heart rate response to deep breathing activity (E:I ratio) and Valsalva maneuver (VMR) in pregnant woman. [3,4]

The tendency in pregnant women to have an altered Valsalva ratio and E:I ratio appeared to be related to period of gestation. A reduction in venous return due to growing uterus has been observed in pregnant subjects, which may account for the lower Valsalva ratio & E:I ratio in pregnancy. These changes are due to different physiological adaptations to chronic volume overload during pregnancy. [5] Even in primipara i.e. women with first pregnancy during as getational period advances Valsalva ratio goes on decreasing . [6]

The first half of pregnancy is associated with sympathetic reactivity, whereas the latter half of pregnancy is characterized by increased hemodynamic stability during the Valsalva maneuver was blunted in mid pregnancy. [7]

The heart rate response to the Valsalva maneuver is blunted during mid-pregnancy, it is possibly due to changes that take place in baroreflex activity and increased maternal blood volume.[8] Circulating estrogens increase early and progressively during pregnancy and may stimulate vascular function directly or indirectly by various means including increased Nitrous Oxide availability. Estrogen has acute vasodilator effect by directly relaxing vascular smooth muscles possibly due to blocking voltage-dependent Ca^{2+} channels in cell membrane.[9] So the present study was planned to investigate the sequential changes in heart rate response to deep breathing activity (E:I ratio) and Valsalva maneuver (VMR) during the three trimesters of pregnancy and compare it with non-pregnant women in rural area of western Maharashtra.

MATERIALS & METHODS

This case control study was carried out in department of Physiology in collaboration with the department of Obstetrics and Gynecology, Rural Hospital, in Loni. Sample size was calculated using two independent samples. The study was approved by the Institutional Ethics Committee

The study participants were taken from rural areas. A total of 320 women aged from 18 to 25 years without any recent history of cardiac diseases were selected 240 were in the Pregnant (Cases group) and 80 were in the non-pregnant (control group). Cases group included 80 1st Trimester (Up to 12 weeks), 80 2nd Trimester (13 to 28 weeks), and 80 3rd Trimester (29 to 40 weeks) pregnant women. 80 healthy non-pregnant women were taken as control.

Parasympathetic function tests heart rate response to deep breathing (E:I ratio), and heart rate response to Valsalva maneuver ratio (VMR) were measured in normal pregnant and healthy non-pregnant women.

Inclusion & Exclusion Criteria:

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

Inclusion Criteria:

1. Age group between 18 to 25 years
2. Pregnant women visiting the Rural Hospital for routine checkup.

3. Free from any systemic illness which can affect cardiovascular Function test.

Exclusion Criteria:

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

Data collection method:

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: It was done by Acid Haematin Method.

Cardiac autonomic neuropathy (CAN) analysis system used for Parasympathetic Function Tests

Parasympathetic Function Tests:

1. **Heart Rate Response to deep breathing.**

E:I ratio is the ratio of HR during expiration & inspiration

Procedure: The participant was relaxed, lying down comfortably and was asked to take deep breaths slowly in and out approximately at 6 breaths per minute i.e. 5 second inspiration and 5 seconds expiration for one minute while the ECG recording continued.[10]

2. **Heart Rate Response to Valsalva Maneuver.**

Procedure: The participant was in sitting position. When the ECG wave forms appear on the computer screen and the GREEN light turns on, the participant was asked to blow air into the mouthpiece till the meter reading reaches 40 mm Hg and hold it in the same position for 15 seconds and when the RED light turned on, the pressure was released.[10]

RESULTS AND ANALYSIS

Statistical Treatment of the Data:

The data was suitably arranged into tables for discussion under different headings.

One way ANOVA (Kruskal –Wallis Test) and multiple comparisons were done to compare the parasympathetic activity indices between the four study groups. The mean difference was significant if $P<0.05$. Conclusions were drawn based on outcome of statistical treatment.

Table No.1. Comparison of anthropometric parameters between non-pregnant and pregnant women				
Parameters	Non-pregnant	1st trimester	2nd trimester	3rd trimester
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age (year)	21.81 ± 3.37	21.37 ± 3.65	20.78 ± 2.33	21.10 ± 2.69
Height (cm)	153.99 ±4.81	153.99 ± 4.82	154.41 ± 5.05	154.26 ± 4.95
Weight (Kg)	48.06 ± 5.66	47.32 ± 5.60	**50.32±6.64***	**56.06 ± 5.62***
Hb (gm/dl)	12.07 ± 0.68	11.89 ± 0.45	11.84 ± 0.41	11.84 ± 0.44
Statistically significant difference (P< 0.05)*.				

Table no.1. Shows comparison of anthropometric parameters. There was no-significant difference (P>0.05) difference in age, height and Hb. But weight was statistically significant (P < 0.05*) during 2nd and 3rd trimester when compared with non-pregnant (control).

Table No.2 : Group wise distribution of Mean and SD values for Parasympathetic tests				
Parasympathetic tests:	Non-pregnant	1st trimester	2nd trimester	3rd trimester
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
E:I ratio	1.42±0.22	1.27±0.14*	1.21±0.09*	1.17±0.11*
VMR	1.51±0.26	1.46±0.24*	1.40±0.20*	1.31±0.19*
Statistically significant difference (P<0.05)*.				

Table no.2. Shows mean values for E:I ratio and VMR. E:I ratio shows a statistically significant difference (P < 0.05*) during 1st 2nd and 3rd trimester when compared with non-pregnant (control). VMR shows a statistically significant difference (P < 0.05*) during 2nd and 3rd trimester when compared with non-pregnant (control).

Table No.3. Multiple Comparison analysis for individual VMR & E:I ratio. Results between different groups of Study participants and Controls						
	HR Response to Deep Breathing (E:I ratio)			HR Response to Valsalva Maneuver Ratio		
	Control	1st trimester	2nd trimester	Control	1st trimester	2nd trimester
1st trimester	(P<0.05)*			P >0.05		
2nd trimester	(P<0.05)*	(P<0.05)*		(P<0.05)*	(P<0.05)*	
3rd trimester	(P<0.05)*	(P<0.05)*	P >0.05	(P<0.05)*	(P<0.05)*	P<0.05*
Statistically significant difference (P<0.05)*						

Table no.3. Shows comparison of E:I ratio and VMR in pregnant and non-pregnant women along with comparison in different trimester among pregnant women.

DISCUSSION

This case control study was carried out in department of Physiology at Rural Medical College Loni. Sample size was calculated using two independent samples. A total of 320 women aged from 18 to 25 years were selected. 240 were in the pregnant (Cases group) and 80 were in the non-pregnant (control group). Cases group included 80 in each 1st Trimester (Up to 12 weeks), 2nd Trimester (13 to 28 weeks), and 3rd Trimester (29 to 40 weeks). Parasympathetic function tests heart rate response to deep breathing (E:I ratio), and heart rate response to valsalva maneuver ratio (VMR) were measured in normal pregnant and healthy non-pregnant women. The nervous system has an important role in overall parasympathetic function tests like E:I ratio, and 30:15 ratio, VMR, In our study all the above variable were assessed to find out changes in cardiovascular autonomic activity with pregnancy.

The response of heart rate to deep breathing was recorded in all the pregnant and non-pregnant (control). Mean and SD of control, 1st, 2nd and 3rd trimesters are 1.42 ±0.22, 1.27 ± 0.14, 1.21±.09 and 1.17±0.11 respectively (table no-2). E:I ratio showed a significant decline in 1st, 2nd and 3rd trimester when compared to non-pregnant (control). But there was no-significant difference between the E:I ratio of 2nd trimester and 3rd trimester (P>0.05). The finding of the present study is in conformity with earlier studies of Atkins AF showed that there is decrease in heart rate response during deep breathing with advancement of gestational age.[4] Ekholm EMK evaluated heart rate response to deep breathing in 60 pregnant and 62 non-pregnant women at 22- 29 week of gestation. Heart rate response was significantly reduced ($p<0.001$) in the pregnant group than in controls.[7] Avery N D evaluated autonomic function by deep breathing test in 90 healthy pregnant women and 90 non-pregnant women. The E/I ratio was significantly lower ($P<0.05$) in pregnant women.[2]

The reasons for this finding may be due to different changes at multiple levels of neuraxis. The response is primarily due to fluctuation in parasympathetic output to heart which is observed to be decreased in pregnancy.[1] Again reduced baroreceptor sensitivity, impaired vagal afferents to the brain, and impaired ability of the brain stem to properly response the different signal of body result in altered heart response to deep breathing.[11,12]

All pregnant and non-pregnant (control) were evaluated for heart rate response to Valsalva maneuver ratio. The mean and SD of VR in control, 1st, 2nd and 3rd trimesters were 1.51 ± 0.26, 1.46 ± 0.24, 1.40 ± 0.20 and 1.31 ± 0.21 respectively (table no-2). Valsalva maneuver ratio (VMR) showed a significant difference in 1st, 2nd and 3rd trimester when compared to non-pregnant women. The findings of the present study are similar to the results of earlier studies by Capeless EL in his study of 282 pregnant subjects and 37 non-pregnant female controls found progressive decrease in VMR in pregnant woman as compare to non-pregnant woman. Our present studies are consistent with some other studies like Brooks VL & Souma ML found that VMR decreased until the 32nd week of pregnancy. Furthermore, he found that VMR was lower during the entire period of pregnancy than during non-pregnant state.[16] The mean VMR in non-pregnant women was higher than the mean for every gestation group and that there was a definite downward trend in the VMR for 3rd trimester group.[1] It may be concluded that VMR in

pregnant subjects follow a downward trend towards the end of pregnancy. The falling VMR with advancing pregnancy may be a consequence of various physiologic adaptations take place in pregnant woman handle condition of chronic volume overload along with this increased left ventricular dimension and peripheral vaso-dilation also contribute to altered parasympathetic functions in pregnancy.[5] In present study the parasympathetic functions were found to be altered during pregnancy as compare to non-pregnant woman. Parasympathetic cardiovascular responses were attenuated significantly. Decreased E:I ratio and VMR may be reflect impaired adaptive capacity of maternal cardiovascular system during pregnancy.

CONCLUSION

The parasympathetic function test in the study groups were statistically significant compared with non-pregnant (control). The Heart rate response to Valsalva maneuver ratio was significantly decreased during in 1st, 2nd and 3rd trimester of pregnancy.

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