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RESEARCH ARTICLE

Effect Of Diet On Autonomic Modulation Of Heart In Menstrual Cycle

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Abstract

Introduction: Menstrual cycle is a cyclical occurrence in women. It is associated with changes in metabolism and endocrine changes. Among other changes, cardiac autonomic changes have also been seen. In the present study, we investigated the autonomic control of heart, and its association with diet.

Material and methods: Forty seven women whose cycles were charted were recruited from a group of 80 subjects who reported for this study voluntarily. Lead II ECG was recorded. Time domain and frequency domain analysis of Heart rate Variability (HRV) was done after which a comparison of these variables were done associated with vegetarian and non-vegetarian diet in the luteal phase of the menstrual cycle.

Results: The results of this study were analysed by applying Wilcoxon's signed rank sum test. In Timedomain analysis RMSSD (36.91 ± 2.73, $p<0.05$) showed significant decrease during ovulation, while other parameters did not show significant variation among the three phases. Frequency domain analysis yielded results to suggest that there is increased variability during ovulatory and luteal phase ($p<0.05$). Comparison of vegetarians with non-vegetarians in the luteal phase showed a higher parasympathetic activity in the vegetarian group.

Conclusions: The results of our study strengthened the findings of previous reports on heart rate variability implying that the HRV was more during ovulatory and luteal phase. This gives an idea of the role of progesterone on the HRV. Further parasympathetic activity being higher in the vegetarian group suggests that vagal regulation is facilitated by the same. This might prove to be of some value to postmenopausal women in whom baroreflex sensitivity is altered.

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Introduction

Reproductive system in women manifests regular cyclical changes that may be regarded as periodic preparation for fertilization and pregnancy. Hormonal variations are seen during menstrual cycle which affects various organ systems of the body including the heart. There are conflicting reports regarding the effect of menstrual cycle on cardiac autonomic control. Some studies have reported a sympathetic predominance in the luteal phase (Sato et al.1995) whereas others have showed vagal predominance (Princi T et al. 2005). A recent study showed no difference in autonomic activity in all three phases of the menstrual cycle (Leicht AS et al. 2003).The status of

autonomic control of the heart can be assessed by a technique called heart rate variability. The same is recognized as a powerful, non-invasive assessment that reflects sympathetic and parasympathetic nervous control of myocardium at rest (Perini R et al. 1990). It is also popular in order to study the physiological mechanisms responsible for control of heart rate fluctuations, autonomic neuropathy, heart transplantations, M.I and other cardiac and non-cardiac diseases (Stys A et al. 1998). Food has influence on the autonomic functions. There is evidence showing that postmenopausal women eating vegetarian diet had an increase in cardiac vagal functions and baroreflex sensitivity determined by heart rate variability (Task force 1996). The aim of the present study was to compare the heart rate variability in three phases of the menstrual cycle and to determine if vegetarian diet had any role in modulating the cardiac autonomic control.

Changes in the autonomic nervous system activity have been observed in the menstrual cycle. Although reports have been documented about the autonomic changes on the heart seen during menstrual cycle, results have been inconsistent. Also very few studies have been done to find out the effect of diet on autonomic modulation of the heart in menstrual cycle. Therefore the present study has been undertaken to observe the effect of vegetarian diet on autonomic functioning of the heart.

Material and Methods

Sample size: 47 women with normal menstrual cycle having had their cycles charted over two months were chosen for the study. Early follicular phase was calculated as fourth day of the present cycle, the ovulatory phase as 14 days prior to the onset of next cycle and midluteal phase as 7^{th} day from the day of ovulation.

Inclusion criteria

Healthy women in the age group of 20- 30 years having normal regular menstrual cycles were chosen for the study after an informed consent.

Exclusion criteria

- Lactating women
- Subjects on oral contraceptives/ medication for cardiovascular (CVS) and central nervous system (CNS) disorders.
- Subjects with past/ present history of CVS disorders, diabetes
- Subjects with history of smoking

Brief Procedure

80 young females in the age group of 20- 30 years opted for the study voluntarily. Their menstrual cycles were charted over two months and healthy women having regular menstrual cycles were chosen for the study. Out of 80 volunteers, 20 had irregular cycles. Out of the 60 in whom heart rate variability was performed thirteen were dropouts. Few of them were unable to attend on all three days. Therefore the results from 47 volunteers are presented.

Measurement of HRV-

Computerized ambulatory ECG system was used in this study.ECG recording was taken under standardized conditions in order to minimize artefacts. Time domain and frequency domain methods were used for analysis.

ECG was recorded in the supine position for 5 minutes after 10 minutes of supine rest. Lead two was used for ECG signal. Subjects were instructed to close the eyes and to avoid talking, moving of hands, legs and body, coughing and sleeping during the test. The ECG signal was continuously amplified, digitized and stored in the computer for offline analysis. The data obtained was analyzed and subjected to Fast Fourier Transformation.

The participants were informed when they were to come next. In a similar way HRV recording and analysis was performed in the next two phases of the menstrual cycle. Since sympathetic predominance was observed in the luteal phase a comparison was made between vegetarians and non-vegetarians in the luteal phase.

Results

Table 1: HRV analysis in three phases of menstrual cycle (* $p<0.05$; Phase 1 Vs Phase 2&3)

Phases of observation	High frequency in normalized units (nu) Mean ± S.E	Low frequency in normalized units (nu) Mean ± S.E	Standard deviation of all NN intervals (ms) Mean ± S.E	LF/HF Mean ± S.E	RMSSD (ms) Mean ±S.E
Early follicular	69.02±2.70	30.98±2.70	71.68±2.78	0.57±0.07	41.17±3.21
Ovulatory	64.80±2.41	35.20±2.41*	75.53±3.70	0.68±0.08*	36.91±2.73
Midluteal	64.59±2.62	35.41±2.62*	73.65±2.40	0.70±0.08*	40.47±3.45

Table 2: Comparison of frequency domain analysis parameters among vegetarians and non-vegetarians in the luteal phase of menstrual cycle

	Vegetarians (n-25)	Non-vegetarians (n-22)
Lf (nu)Mean ± S.E	38.8±1.54	31.9±2.15
Hf (nu)Mean ± S.E	79.12±1.54*	48.07±2.15
S.D Mean ± S.E	80.65±3.6*	65.7±2.08
Lf/Hf	0.2756±0.02	1.18±0.109*

Discussion

The level of gonadal hormones varies during different phases of the menstrual cycle, thus varying their effect on homeostatic mechanisms which regulate the CVS (Coroner EB et al. 1991). In this study the co-relation between autonomic regulation of the heart and various phases of the menstrual cycle was undertaken. The influence of diet on the autonomic regulation of the heart was then observed. In this study sympathetic predominance was found in the luteal phase of the menstrual cycle. This is in accordance with other studies where sympathetic predominance in the luteal phase of the menstrual cycle was found as indicated by a higher LF and LF/ HF ratio in the luteal phase (Bernardi F et al.1999, Sato N et al.1995). Studies comparing heart rate variability among pre and postmenopausal women have shown increased heart rate and lower heart rate variability in post menopausal women (Princi T et al. 2005). This decrease was also found following combined estrogen progesterone hormone replacement therapy which provides a support to the vagal inhibitory nature of progesterone. Progesterone in physiological doses, acts as an adrenergic agonist by inducing an increase in non epinephrine level. On the other hand estrogen may influence the ANS function by upregulating parasympathetic activity and down regulating the sympathetic nervous system activity (Bernardi F et al. 1999).However estrogen on the cardiovascular responses to stress have produced mixed results, with some showing a protective effect,(Du XJ et al.1995, Komesaroff et al. 1999), and others showing no effect (Mathews KA et al. 2001). High frequency power (HF) is parasympathetically mediated. The LF component corresponds to 0.04-0.15 Hz, and is jointly modulated by the sympathetic and parasympathetic nervous systems. The mean LF/HF ratio is indicative of sympathovagal balance. The mean LF component in normalized units (nu) showed a difference which was not statistically significant between early follicular phase and midluteal phase. A statistically significant increase ($p < 0.05$) was found between early follicular and the ovulatory phase.

Concerning diet there are studies indicating that long-term vegetarian diets might facilitate vagal regulation of the heart and increase baroreflex sensitivity in healthy postmenopausal women (Fu CH et al. 2006).HF value indicating parasympathetic activity was significantly higher ($p< 0.05$) in vegetarians when compared to non vegetarians. The mean LF/HF ratio which is indicative of sympathovagal balance, showed a significant increase ($p<0.05$) in non vegetarians as compared to vegetarians. This might be of some value in patients suffering from psychosomatic symptoms premenstrually in whom parasymapathetic activity was found to be decreased in the symptomatic late luteal phase (Yergani et al. 2000). Although estrogens and progesterone cannot be excluded as etiological factors of PMS further studies can be carried out too see if long term vegetarian diet by increasing parasympathetic activity can decrease the occurrence of premenstrual symptoms.

Conclusion

From the present study it can be concluded that HF component in HRV was higher in follicular phase and LF component higher in the ovulatory and luteal phases. This suggests a parasympathetic predominance in the follicular phase and sympathetic in the luteal phase. Parasympathetic activity is higher in the vegetarians when compared to non vegetarians in the luteal phase.

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