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RESEARCH ARTICLE

Evaluation of visual reaction time during pre- and post- menstrual phase

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ABSTRACT

Background: Females suffer from a cluster of symptoms during premenstrual phase. Those subside on the onset of menstruation. Varied symptoms are confusion, headache, decrease in alertness, forgetfulness, and mood fluctuations. Cyclical variation in ovarian hormones is responsible for these symptoms. These hormones affect reaction time (RT) of an individual to a particular stimulus. RT gives us information about sensorimotor association and processing capability of central nervous system. **Aims and Objectives:** To study the influence of phases of menstrual cycle on visual RT (VRT). **Materials and Methods:** Seventy females in the age group of 18–21 years were selected for the study. VRT was assessed in pre- and post-menstrual phase with portable instrument. Results were analyzed using Student's paired *t* test. **Results:** The study shows highly statistically significant prolongation of VRT in premenstrual phase as compared to postmenstrual phase. **Conclusion:** Prolongation of VRT in premenstrual phase is predominantly due to high levels of progesterone. It exerts its action centrally through inhibitory neurotransmitter gamma-aminobutyric acid. It delays neuronal conduction time. Effects of progesterone locally acting on the ocular tissue and the intraocular fluid also contribute to prolonging VRT in premenstrual phase.

KEY WORDS: Visual Reaction Time; Progesterone; Ovarian Hormones; Premenstrual Phase; Postmenstrual Phase

INTRODUCTION

Menstrual cycle is caused due to cyclical secretion of gonadotropins from pituitary glands which further causes cyclicity of estrogen and progesterone secretion from the ovaries. During this cycle, ovarian and uterine changes are also taking place simultaneously.[1] The average duration of menstrual cycle is around 28 days, but normally it varies between 20 and 45 days. As a result of this cycle, normally fertilized ovum is expected to be received by well-prepared uterus. If this fertilization does not occur, the preparation of the uterus gets undone and uterine endometrium breaks down, resulting in bleeding which manifests in menstruation. Menstrual cycle has three phases: Proliferative, secretory, and menstrual phase. Proliferative phase which corresponds to follicular or preovulatory phase of ovarian cycle shows higher levels of estrogen. Secretory phase corresponds to luteal or postovulatory phase of ovarian cycle.[2] It shows higher level of progesterone in comparison to estrogen. Of all women of reproductive age, 80% experience physical and or psychological changes during their pre-menstrual phase. The most common amongst these changes are "cognitive alterations."[3] Etiology of which is yet unknown. Probable cause can be fluctuations in steroid hormones during the course of the menstrual cycle.[4] Neuroactive effects of ovarian hormones can be assessed by a non-invasive method. It estimates reaction time (RT) in various phases of menstrual cycle. The ability in processing information and the ability to concentrate and coordinate is judged by this method.[5] RT is defined as the time interval between onset of stimulus and the initiation of response under the given conditions by the respondent as instructed.

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It gives an idea about time taken for processing in central nervous system. It measures sensorimotor association and performance of the individual being studied.[6] Few studies in literature put forward the hypothesis that prolongation of RT in premenstrual phase is due to fluctuating levels of ovarian steroids. They modulate neurotransmitter and prolong neuronal conduction time. Various studies do not specify which ovarian hormone has a predominant role in prolongation of RT. In our study, we attempt to find out is there prolongation of RT in premenstrual phase. In this study visual RT was evaluated in the premenstrual and post menstrual phase.

MATERIALS AND METHODS

Prior approval of the Medical Ethics Committee was obtained for conducting this study in the Department of Physiology of Dr. D. Y. Patil Medical college in Pimpri, Pune (India).

A total of 70 female subjects studying in 1st year MBBS and B.PTh courses were selected for this study on the basis of their clinical history. Before the onset of the study, informed consent was obtained from these subjects. The subjects' age group ranged between 18 and 21 years. Some with regular menstrual cycle and normal visual acuity and others with refractive error correction were selected. During selection process, subjects with irregular menstrual cycle, heavy or scanty menstrual loss, history of having severe premenstrual distressing symptoms, undertaking hormonal treatment, history of any addictions, color blindness, and eye surgery were excluded from the study. Subjects were oriented about the calculation of pre- and post-menstrual phase. 1st day of bleeding per vaginum is considered as 1st day of cycle. Postmenstrual phase was considered as 7th–10th day of menstrual cycle. Premenstrual phase was considered as 21st–25th day of menstrual cycle. It coincides with secretory or luteal phase of menstrual cycle. VRT was recorded with "RT Measuring Instrument (RTMI)" manufactured by Unitech Instruments Company, Nigdi, Pune (India). RTMI has a range of 1 s to 1/10th ms and accuracy of ± 1/10th ms. RT was measured in a quiet, closed, well-illuminated room between 10.00 am and 12.00 noon. A subject was instructed to release microswitch as soon as there was red glow in signal unit. The time interval between appearance of red glow and releasing of microswitch by subject is measured in milliseconds and displayed in display unit. This reading was considered as VRT for red colour. Adequate trials were given to the subject on instrument. Minimum seven readings were taken and final reading was selected by taking median of obtained values. Median is the better indicator of central value when the lowest and highest value is not so evenly distributed.

Data Analysis

Student's paired *t*-test was performed for statistical analysis of data. Observation was expressed in terms of mean and its standard deviation. The level of significance is expressed here in terms of "*P*" value where $P < 0.05$ is considered as statistically significant.

RESULTS

The findings of the present study are depicted in Table 1 and Figure 1.

DISCUSSION

The results in the Table 1 shows that VRT in milliseconds in premenstrual phase is 241.83 ± 38.71 and in postmenstrual phase is 212.87 ± 29.02. Prolongation of VRT in premenstrual phase is highly statistically significant ($P < 0.001$). Our result is in agreement with the results of previous studies.[7-13] A study by Das *et al*. attributed these changes to fluctuating levels of estrogens and progesterone across menstrual cycle. These hormones may be modulating neurotransmitter which is mainly affecting central processing in central nervous system and sensorimotor association.[7]

Dabir and Kalwale study contributed this effect due to increased levels of progesterone metabolite in premenstrual phase. It has an anesthetic effect. This metabolite through gamma-aminobutyric acid (GABA) neurotransmitter delays neuronal conduction time and affects sensorimotor association.[8] It has been observed that RT is longer in females in comparison to males.[13] With onset of menstrual cycle, there is a change in excitability of cortical network. Compared to follicular phase, a study of trancranial magnetic stimulation shows more inhibition in luteal phase.[14] Visual-evoked potential study by Yousuf and Jha shows that,

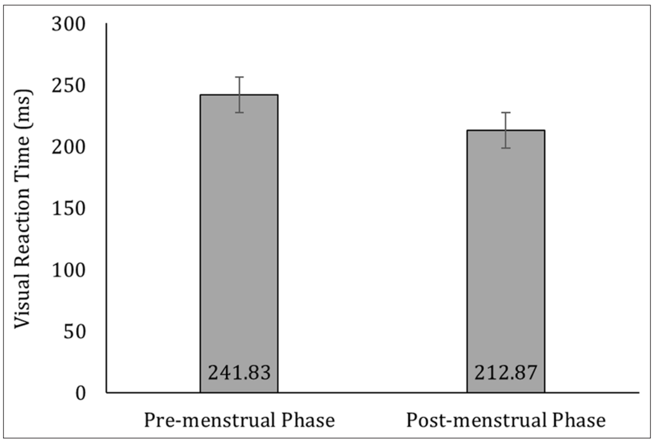

Figure 1: Bar chart: Visual reaction time in premenstrual and postmenstrual phase. The findings of the present study are depicted in Table 1 and Figure 1

Table 1: VRT in pre- and post-menstrual phase

Parameter	Number of subjects	Average age (mean±SD)	Premenstrual phase (mean±SD)	Postmenstrual phase (mean±SD)	*P*	Remarks
VRT(ms)	70	19±0.8	241.83±38.71	212.87±29.02	<0.001	Highly significant

VRT: Visual reaction time, SD: Standard deviation

in luteal phase, there is a prolongation of latency P100 waves as compared to follicular phase.[15] There are ocular changes during premenstrual phase. Corneal thickness varies during menstrual cycle. It is thinnest at the beginning of cycle and thickest at the end.[16] Intraocular pressure varies with pre- and post-menstrual phase of menstrual cycle. Intraocular pressure was found to increase during the luteal phase of menstrual cycle. It could relate to mildly impaired vision.[17,18] Estrogen augments glutamate receptor activity through reduction of GABA production. Progesterone enhances GABA neurotransmission and inhibits neural excitement. Kinetics of estrogen and progesterone continue changing throughout menstrual cycle. Fluctuation in ovarian hormones across menstrual cycle alters neural activity.[19] Thus, varying levels of ovarian hormones increase neuronal conduction time. These hormones also impair visual acuity. Correlating our results with those of hormonal assays would have authenticated this study further. However, paucity of time limited this further study.

CONCLUSION

Thus, we concluded that visual RT is prolonged in premenstrual phase as compared to postmenstrual phase. This indicates delay in central processing and sensorimotor association. It is due to higher levels of progesterone than estrogens during premenstrual phase (luteal or secretory phase). It predominantly affects neuronal excitability and delays its conduction. It affects visual processing by enhancing the inhibitory effect of neurotransmitter GABA. Furthermore, the effects of ovarian hormones on ocular tissue and intraocular fluid negatively affect visual processing and contribute toward prolongation of visual RT in premenstrual phase.

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