e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(4); 479-483

Original Research Article

Study of Auditory and Visual Reaction Time in Premenstrual and Post Menstrual Phase

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Received: 08-01-2023 / Revised: 05-02-2023 / Accepted: 19-03-2023
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Conflict of interest: Nil

Abstract

Background: 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.

Materials and Methods: VRTwas assessed in pre- and post-menstrual phase with portable instrument. Results were analyzed using Student's paired*t* test. Prior approval of the Medical Ethics Committee was obtained for conducting this study in the Department ofPhysiology of DMCH, Darbhanga. Study duration of Two years.

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 neuronalconduction time. Effects of progesterone locally acting on the ocular tissue and the intraocular fluid also contribute to prolonging VRT in premenstrual phase.

Keywords: Visual Reaction Time, Progesterone, 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] This is followed by proliferative or postmenstrual phase which is under influence of estrogen and then the secretory or premenstrual phase under the influence of estrogen and progesterone**.** These are food cravings nervousness depression, irritability, anger, mood swings, confusion, forgetfulness, dizziness and headache. Other symptoms are abdominal bloating, breast tenderness, nausea, diarrhea and constipation. Exact etiology of these premenstrual symptoms not known. This could be due to fluctuation in steroid hormones during menstrual cycle . The general state of arousal of the nervous system might also vary with the different phases of the menstrual cycle. [4] The balance between the stimulatory/ inhibitory modalities of the existing neural networks may be altered due to variations in the synthesis and catabolism of various CNS neurotransmitters, due to the effects of sex steroids on the corresponding enzymes.[3] Sex hormones are known to affect a whole gamut of CNS modalities such as neurite outgrowth, synaptogenesis, dendritic

branching, myelination which ultimately affects the neural plasticity.[5] On one hand, a significant reduction in the response time indicates an improved sensorimotor performance and/or enhanced processing ability of the CNS,[8] whereas a prolonged response time indicates a deterioration of processing capability of the CNS or poor sensorimotor performance or a combination of both.[9] It is a measure of sensorimotor association and performance of an individual [2] Therefore, we envisaged this study to find out how and to what extent the sensory motor performances are. being affected during different phases of menstrual cycle, by measuring the reaction time to visual (VRT)/auditory (ART) stimuli as a surrogate Subjects were instructed to press a response micro switch (thumb switch) as quickly as possible, after the presentation of appropriate stimuli (light/sound), but not prematurely, with thumb of the dominant hand.

Objectives

To study the influence of phases of menstrual cycle on visual RT (VRT).

Material and Methods

The study was conducted in the Department of Physiology at Darbhanga Medical College and Hospital Darbhanga Laheriasarai, Bihar. Study duration of two years. A total of seventy female subjects were selected from first MBBS batch on the basis of clinical history. Female student of age group 18—21 years with regular menstrual cycle and normal auditory acuity checked by Rinnes and Weber test were selected. Subjects with irregular menstrual cycle, heavy or scanty menstrual loss, history of having premenstrual distressing symptoms, undertaking hormonal treatment, history of any addictions, ear surgery were excluded . Premenstrual phase was taken as 1 to 7 days prior to onset of next menstruation and postmenstrual phase as 5 th to 10th day of menstrual cycle. All subjects were asked to have adequate sleep at night and to refrain from any medications throughout the period of study. Subjects with history of irregular menstrual cycle, pregnancy, lactation or use of contraceptive in past 1 year were excluded from the study. Subjects with history of audiovisual disturbances, psychiatric illness or sleep disorders, any trauma or addictions were also excluded from the study. The study protocol was explained and informed consent was obtained from all the volunteers. After taking consent personal, medical and menstrual history of subjects was noted and audiovisual reaction time was measured during the premenstrual period (i.e.1 to7 days prior to onset of next menstruation) and postmenstrual period (5th to 10th day of menstrual cycle). ART and the VRT were measured in a quiet separate room with the subject sitting comfortably on a chair. The ART and VRT were measured by using a reaction time instrument which was supplied by Medicaid Systems RTM-604. The data was analyzed by paired t test and p value <0.05 was taken as significant.

Results

Table 1: ART and VRT during different phases of menstrual cycle (in milliseconds)

Phase	(Mean±SD)	
	ART	VRT
Menstrual	177.23±19.20	180.37±8.83
Proliferative	183.58±14.63	187.79±10.70
Secretory	175.23±13.14	178.53±15.11

ART: Auditory reaction time, VRT: Visual reaction time, SD: Standard deviation

Discussion

The present study shows the prolongation of both ART and VRT during premenstrual phase as compared to those during postmenstrual phase. Retention of water

and sodium due to variation in sex steroid levels during menstrual cycle might influence the process of axonal conduction time and availability of neurotransmitter at synapses in auditory pathways The sex hormones, especially estrogen and progesterone secreted from the ovaries, vary in their level during different phases of menstrual cycle. The menstrual phase is characterized by low levels of both these hormones and as we progress through the follicular phase, estrogen level rises rapidly to reach the peak just before ovulation, with progesterone levels continuing to remain low.

Whereas during the luteal phase, the levels of both estrogen and progesterone rises, thus in the mid luteal phase, both the hormones are high. Hence during the normal menstrual cycle, there are two peaks of estrogen secretion, an "ovulation peak," which occurs near the end of the follicular phase and a "luteal peak." Progesterone reaches a peak about 4-7 days before menstruation.4 A study by Smith et al. showed for the first time that the activities of a specific neural network composed of excitatory afferents and inhibitory interneurons, that ultimately determines the excitability of corticospinal neurons, is not constant through the various phases of a normal menstrual cycle.[10] Study of auditory evoked responses by Yadav A et al showed trend of increase in peak latencies of auditory brainstem response waves in estrogen peak midcycle. While decrease in latencies in progesterone peak in midluteal phase. Smallest latencies of all waves occurred during menstruation. 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] IA study by A fshan et al. has found that the shortest VRT occur during the luteal phase.[18] The most likely cause for this is that estrogen causes delay in conduction by influencing gamma amino butyric acid release at the various polysensory association areas of brain, which is blunted by the presence of progesterone.[19 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 Studies of weight changes and balances of sodium, water and potassium across normal menstrual cycle have shown occurrence of sodium and water retention in premenstrual phase (12). It is reported that there is estrogen induced up regulation of GABA receptors in nervous tissues of rodents. [18] Bovine adrenochromaffin cell study by Callachan et al stated that progesterone metabolite potentiate action of GABA and directly activate GABA-A receptors. [17]. It was concluded by Cox J that middle ear pressure was significantly higher during premenstrual phase which was of sufficient magnitude to alter Eustachian tube function [11]. Various auditory function tests carried by Al mana D revealed that there was alteration in auditory function during normal menstrual cycle [12]. This imply withdrawal of sex hormones improves hearing threshold [9]. Sandeep kaur et al also reported increased peak latencies of brain stem responses during proliferative phase which is estrogen dominant and decrease latencies of waves in secretory phase which is progesterone dominant. The strength of this study lies in the usage of

reaction times as a surrogate for measuring sensorimotor performance, as they are objective measurements and easily reproducible. The limitations of the present study are that the subjects in this study belonged to a restricted age group (20-25 years) and the classification of different phases of the menstrual cycle (i.e., menstrual, proliferative, and secretory) were based on basal body temperature measurements and not on the measurement of relevant sex hormones 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. [20] However, paucity of time limited this further study. Limitations of study include the small sample size and study design. Further research with larger sample size and with robust study design needs to be done to further understand the difference in reaction time during various phases of menstrual cycle.

Conclusion

While studying the ART and VRT to appropriate sensory stimuli in healthy women, with normal menstrual cycles, we observed significantly shorter reaction times during the secretory phase, which is probably attributable to the higher levels of progesterone seen in this phase. The menstrual phase is characterized by longer reaction times, which could be due to a generalized slowing of neural conduction times, because of fluid and salt retention

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