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Cognitive Function and Menstrual Cycle

Medical Science

KEYWORDS : Cognition,Premenstrual Phase,Postmenstrual Phase,MMSE, Ovarian Hormones

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ABSTRACT

Cognition is an intellectual process involved in gaining knowledge and comprehension. The process include thinking ,knowing,remembering,judging and problem solving.In the present study seventy young females were assessed for cognitive function during pre and postmenstrual phase by MiniMental State examination(MMSE). The score obtained during two phases did not show any cognitive impairment. But study group showed better cognitive performance during postmenstrual phase as compared to premenstrual phase. This result may be due to fluctuating levels of ovarian hormones during menstrual cycle. High levels of estrogens in postmenstrual phase might be having positive role in cognition. Thus neuroactive ovarian hormones modulate cognitive function.

INTRODUCTION

Menstruation is a physiological process in which there is cyclical bleeding per vaginum in females during reproductive age .This is due to cyclical production of estrogens and progesterone by ovaries with associated changes in endometrium of uterus. In proliferative phase of menstrual cycle estrogen levels are high and in secretory phase, progesterone level is high as compared to estrogens. Proliferative phase of endometrial cycle corresponds to follicular phase of ovarian cycle and secretory phase corresponds to luteal phase of ovarian cycle. 75% of women suffer from mild to moderate physical and psychological disturbances 7 to 10 days before menstruation. 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 ovarian hormones during menstrual cycle [1]. Cognitive complaints, including difficulty in concentrating, memory impairment, distractibility, lack of self-confidence when making decisions, lead us to assess cognitive function in premenstrual and postmenstrual phase.This was done with the help of MiniMentalState examination(MMSE).

This is simple noninvasive, bedside test. It is developed by Dr.Marshall Folestein in 1975.It is 30 point questionnaire test that is used to screen for cognitive impairment. Commonly used in medicine to screen for dementia.This test covers variety of cognitive domains,such as orientation to time,place,short and long term memory, registration, recall, construction ability,language and ability to understand and follow commands.Specific points are given for assessment of each domain. Score below 21 is considered as cognitive impairment.[2-3]

MATERIAL AND METHODS

The study was conducted in the Department of Physiology ,DR.D.Y.Patil medical college in Pimpri Pune. A total of seventy female subjects were selected from first MBBS and BPTh batch on the basis of clinical history. The approval of medical ethics committee and informed consent from subject was obtained to conduct the study. Female student of age group 18-21 years with regular menstrual cycle were selected.

Subjects with irregular menstrual cycle, heavy or scanty menstrual loss, history of having premenstrual distressing symptoms, undertaking hormonal or psychiatric treatment, history of any addictions,were excluded .Subjects were oriented about calculation of pre and post menstrual phase. First day of bleeding per vaginum is considered as first day of cycle. Postmenstrual phase was considered as 7 th to 10 th day of menstrual cycle .Premenstrual phase was considered as 21 st to 25 th day of menstrual cycle.MMSE was done in both the phases.

DATA ANALYSIS

Score was assessed in both phases for any cognitive impairment. The score below 21 signifies cognitive impairment.

Statistical analysis of data was done by Students paired ' t 'test. Observations were expressed in terms of mean and its standard deviation. The level of significance is expressed in terms of p value .The p value < 0.05 is considered as significant

RESULTS

TABLE-1 MMSE SCORE

MMSE Score	Number of subjects	
(MAX=30)	PREMENSE	POSTMENSE
Below 21	None	None
21-24	None	None
25	02	None
26	04	None
27	08	04
28	20	13
29	24	29
30	12	24

Significance of test-If score below 21, then cognitive impairment

Result shows no cognitive impairment in study group. Better score is observed in postmenstrual phase.

TABLE-2 MMSE SCORE in Premenstrual phase And Postmenstrual phase

PARA METER	n	AGE Mean ±SD	PREMENSE MEAN± SD	POSTMENSE MEAN± SD	P	REMARK
MMSE Score	70	19±0.8	28.37±1.22	29.04±0.87	<0.001	HS

n= no .of subjects HS=Highly Significant

DISCUSSION

In the present study none of the participants scored below 21 in pre or postmenstrual phase, thus excluding possibility of cognitive impairment. But study group showed statistically significant better score during postmenstrual phase as compared to premenstrual phase. This may be due to higher level of estrogens and lower level of progesterone in postmenstrual or follicular phase.

The previous studies also showed there is variation in cognitive performance across menstrual cycle. Spatial performance is sensitive to hormonal fluctuations over the menstrual cycle. A significant cycle difference in spatial ability as tested by the Mental Rotation Test was found with high scores during the menstrual phase and low scores during the midluteal phase[4]. Most studies suggested that healthy women show small fluctuations in cognitive performance across the menstrual cycle, with

low performance scores in the luteal phase for visuospatial and motor skills, attention and concentration, verbal memory, visual memory.

Study by Maki showed that conceptual implicit memory was better at the midluteal than the follicular phase. In contrast, performance on a test of explicit memory, category-cued recall, did not vary across the menstrual cycle. Women in the follicular phase performed better on the fragmented object identification task than did those in the midluteal phase[5].Study by Philips et al observed lower visual memory (delayed recall) scores during the menstrual phase compared to the luteal phase. No phase differences were found on mood measures or on other memory measures including digit span, paired-associate learning, immediate recall of visual material, and immediate or delayed paragraph recall. The visual memory decrease was most prominent and was significantly correlated with plasma progesterone in the luteal phase. Paired-associate learning was positively correlated with estradiol levels in the luteal phase. These results suggest that changes in memory test performance may be associated with ovarian hormonal levels.[6] Study by Jana et al observed that women are more successful in the parallel processing of emotional and cognitive information in the follicular cycle phase compared to the luteal cycle phase[7]. The Immediate and delayed recall task showed no differences across the phases of menstrual cycle. Speed of verbal reasoning was found to be slower on more complex sentences during ovulation. Recall of semantically similar word lists was impaired in ovulation, while recall of acoustically similar lists tended to be impaired in premenstrum. On the Menstrual Distress questionnaire, self-reported arousal was higher in ovulation, whereas distress was higher in the premenstrual phase[8]. Sex-related hormone modulation selectively affects cognitive functions depending on the type of task and low level secretion of estradiol appears to contribute to reducing the level of attention that relates to the prefrontal cortex[9].

Electrical activity of the brain changes in a parallel with changed hormone levels. Slower alpha waves during follicular phase and faster alpha waves during luteal phase were noted [10].Visual evoked EEG potential study revealed longer interhemispheric transfer time during luteal phase[11]. Interhemispheric correlation between frontals was higher during ovulation and between occipitals was higher during premenstrual phase. Higher activation of centro-parietal regions during menstruation and lower activation of frontal regions during premenstrual phase[12]. Neuroimaging study showed functional cerebral asymmetries changes during menstrual cycle.This is due to interhemispheric inhibition of dominant on nondominant hemispher[13]. The menstrual cycle modulates the integration of emotional and cognitive processing on a behavioral level and this change in behavior can be associated with functional, molecular and structural changes in the brain during a specific menstrual cycle phase. The growing evidence for menstrual cycle-specific differences suggests a modulating role for sex hormones on the neural networks supporting the integration of emotional and cognitive information.[14] The female brain under estrogen showed a marked increase in perfusion in cortical areas involved in cognitive tasks [15]. MRI study reported that the inhibitory influence of left-hemispheric language areas on homotopic areas of the right hemisphere is strongest during the menses, resulting in a pronounced lateralization. During the follicular phase, due to rising estradiol levels, inhibition and thus functional cerebral asymmetries are reduced. Beta estradiol enhances hippocampal memory consolidation via rapid activation of multiple intracellular signaling cascade[13].Women showed an improved score on memory scale after six months of HRT in study group. Only estrogen users benefited more[16]. These results reveal a powerful neuromodulatory action of estradiol on the dynamics of functional brain organization in the female brain.

Progesterone, or rather its neuroactive metabolite allopregnanolone, modulates, amygdala activity and thereby influences anxiety, cognition and memory. It impairs memory by reducing the response of amygdala,hippocampus, during memory formation and retrieval[17].

Higher levels of progesterone in luteal phase were associated with lower interhemispheric correlations for alerting and orienting. It was also associated with longer interhemispheric transfer time, lower congruence between implicit motives and explicit goal commitments.These results suggest that Progesterone is associated with the degree to which attentional functions are correlated between hemispheres [18]. Progesterone binding to GABA-A receptors on GABAergic interneurons in the hippocampus may directly interfere with the ability of estradiol to increase dendritic spine density. Progesterone thereby promoting GABAergic activity may reduce arousal levels which may lead to progesterone induced impairments in memory[19]. Thus we can state that cognitive function get varied during menstrual phases and fluctuating levels of ovarian hormones may be responsible for it.

Conclusion

We concluded that MMSE score in study group did not show any cognitive impairment .But cognitive performance was better in postmenstrual phase. Thus fluctuating levels of ovarian hormones modulate cognitive function. Estrogen correlate positively and progesterone negatively to it.

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