STUDY OF VISUAL ONLINE REACTION TIME IN DIFFERENT PHASES OF MENSTRUAL CYCLE IN HEALTHY FEMALES

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ABSTRACT

Aims and objectives: The present study was designed to study the influence of various phases of menstrual cycle on visual online reaction time.

Material and Methods: Fifty females in the age group of 18-25 years were recruited for the study. Visual reaction time test was taken online. Statistical Analysis: Results were analysed by ANOVA with SPSS version 17.0 using paired 't' test.

Results: showed that there was significant prolongation of reaction time (p<0.05) in luteal phase as compared to follicular and menstrual phase.

Conclusions: Variation in visual reaction time could be due to the fluctuating levels the female sex hormones across the menstrual cycle.

Key Words: Follicular phase, Luteal phase, Online reaction time

INTRODUCTION

The biological activity of the menstrual cycle is created by the coordination among hypothalamic, hypophysal and ovarian hormones.\(^1\)

The established hypothalamic, hypophysal and ovarian axis and its cyclical hormonal changes during the three phases of normal menstrual cycle are as follows.\(^2\)

Follicular phase: is mainly a phase of oestrogen, influenced by follicular stimulating hormone.

Luteal phase: primarily a phase of progesterone influenced both by follicular stimulating hormone and luteinizing hormone.

Menstrual cycle: the cervical bleeding phase, due to the withdrawal of hormonal effect on endometrium. The fluctuations in hormonal levels affect not only the female reproductive tract but also many other tissues of the body.

Various studies have shown that female sex hormones modulate auditory, visual and taste threshold, latency and amplitude.\(^3\) Behavioural and neurological symptoms like decreased concentration, nervous, irritability, emotional instability, poor judgement, tension and depression are seen in women during premenstrual phase.\(^4\) This may be due to due to effect of gonadal hormones on neural functions.\(^5\)

Reaction time is the measure of how fast a person responds to a particular type of stimuli. It can be defined as the time interval between the application of a stimulus and an appropriate voluntary response from the subject. It measures the ability to process information and judges the ability to concentrate and coordinate.\(^6\)

Flow of information in an organism can be depicted in this way: \(^{7,8,9}\)

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Receptors</th>
<th>Integrators</th>
<th>Effectors</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus</td>
<td>Sensory neuron</td>
<td>Spinal cord or Brain</td>
<td>Motor neuron</td>
<td>Response</td>
</tr>
</tbody>
</table>

Various studies have shown that ovarian steroids influence dopamine release in the nigrostriatal pathway.\(^10,11\) Estradiol has widespread effects throughout the brain regions involved in affective state as well as cognition.\(^12,13\)
Online visual reaction times during various phases of menstrual cycle studies have not been studied in other researchers. As menstrual cycle is associated with fluctuating levels of ovarian hormones, this study was designed to study the visual online reaction time across different phases of menstrual cycle.

**MATERIAL & METHODS**

The present study was a cross-sectional study, conducted in Department of Physiology, Santosh Medical College, Ghaziabad. Ethical approval was taken from the research committee of the Institution before starting the study.

One hundred apparently healthy female volunteers in the age group of 18-25 years with history of regular menstrual cycle were studied in follicular, luteal and menstrual phases of menstrual cycle. Menstrual history including age of menarche, regularity of cycles, history of dysmenorrhea, history of premenstrual symptoms like irritability, headache were collected. Female subjects with age > above 25 years, history of irregular menstrual cycles, use of contraceptive pills, use of psychotropic drugs (sedatives, hypnotics and tranquilizers), antihistaminics, antiepileptics, and smokers or consuming alcohol were excluded from the study. Females with history of psychiatric illness or recent psychological trauma or sleep disorders were also excluded from the study. Informed consent was taken from all the subjects.

**Height** was measured using a standard stadiometer with the subject standing in erect posture. The readings were taken to the nearest 0.1 cm.

**Weight** was recorded in kgs using a calibrated weighing machine (Avery) scale with a capacity of 120 kg and a sensitivity of 0.05 kg.

**BMI** (body mass index) was calculated as the weight in kilograms divided by the square of the height in meters [weight(kg)/height(m)$^2$)]\(^{[14]}\).

**Online Reaction Time Test:** Visual reaction time test was taken online.\(^{[15]}\). It consists of a traffic light signal of red, yellow, and green. The subject is instructed to click on a button to begin when ready, to wait for the stoplight to turn green, and click the button when it turns green quickly! The average of five responses in seconds is taken as a reading.

**Statistical Analysis:** Results were analysed by ANOVA with SPSS version 17.0 using paired ‘t’ test and expressed as Mean ± SD. P value < 0.05 was considered as significant.

**RESULTS**

**Table 1: Mean ± SD of the anthropometric variables**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(yrs)</td>
<td>20.72±1.20</td>
</tr>
<tr>
<td>BMI(kg/m$^2$)</td>
<td>21.67±0.97</td>
</tr>
</tbody>
</table>

**Table 2: Statistical analysis of online visual reaction test during different phases of the menstrual cycle.**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Menstrual phase(MP)</th>
<th>Follicular phase(FP)</th>
<th>Luteal phase(LP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Reaction Time (sec)</td>
<td>0.42±0.12</td>
<td>0.53±0.11</td>
<td>0.65±0.14</td>
</tr>
<tr>
<td>p value</td>
<td>MP vs FP &lt;0.05</td>
<td>FP vs LP &lt;0.05</td>
<td>LP vs MP &lt;0.05</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Our study results have shown that there is prolongation of online visual reaction time in luteal phase [mainly progesterone] as compared to the follicular phase [mainly oestrogen]. Delayed reaction time in the luteal phase may be due to female sex hormones [mainly progesterone] that cause salt and water retention thus affecting the axonal conduction. Altered axonal conduction influences the availability of neurotransmitter at synapses in signal processing pathway that causes slow conduction of the impulse and hence prolonged reaction time\(^{[16]}\).

Kaneda et al. have also showed that increased latency of visual evoked potentials may be due to high progesterone levels during the luteal phase\(^{[17]}\).

Various studies have showed that effects of estrogen on brain are antagonistic to that of progesterone therefore explaining less reaction time in follicular phase as compared to luteal phase\(^{[18,19,20,21]}\). Progesterone may also decrease the sensitivity of neurons and blunts the estrogen potentiated GABA (Gamma-Amino Butyric Acid) release\(^{[22,23]}\). Moreover, estrogen has been shown to be neuroprotective\(^{[24]}\).
It has been shown by many authors that female sex hormones act at the receptor level on the hippocampus and hypothalamus that alters the excitability of the neurons across different phases of the menstrual cycle\(^{25,26}\). Limitation of our study is that we have not measured hormonal levels of estrogen and progesterone in the serum during various phases of menstrual phases. These also have not been statistically correlated with reaction times.

**CONCLUSIONS**

Variation in visual reaction time could be due to the fluctuating levels the female sex hormones across the menstrual cycle. The prolongation of reaction time in menstrual phase correlates well with the mood swings associated with premenstrual syndrome. Tasks requiring short reaction times like emergencies situations in speeding while driving, air force postings on the war front may be avoided in this phase, as these are prolonged during the phase.

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