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ORIGINAL ARTICLE

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Effect of pregnancy on visual reaction time

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OBJECTIVE(S) : To assess the alteration in visual reaction time, a reliable index of central nervous system processing, in pregnancy.

METHOD(S) : Sixteen nonpregnant women as controls and 37 age matched newly diagnosed healthy women in their first trimester of pregnant were included in the study. They were tested for simple visual reaction time (VRT) task in each trimester of pregnancy. Results were expressed as Mean ± SEM and statistically analyzed using students paired t test and single factor ANOVA.

RESULT(S) : The pregnant women in their first trimester had significantly longer simple VRT as compared to age matched controls. In the second and third trimesters VRT decreased as compared to the first trimester.

CONCLUSION(S) : A physiological stress like pregnancy tends to alter the VRT and thus inflicts an alteration in the central nervous system processing.

Key words : pregnancy, visual reaction time

Introduction

Reaction time is the time interval between the application of a stimulus and the appearance of appropriate voluntary response by a subject. It acts as a reliable indicator of rate of processing of sensory stimuli by central nervous system and its execution in the form of motor response. Reaction time is found to be altered by a number of factors both physiological and pharmacological [1]. Pregnancy is a physiological process, which alters the function of most endocrine glands and is associated with alteration of the levels of sex steroids. Ovarian steroids have widespread effects throughout the brain regions involved in spatial and declarative memory. Thus ovarian steroids have measureable effects on affective state as well as cognition [2,3]. Findings from basic neuroscience have elucidated mechanisms of actions of estrogen on cognitive functions. Processing speed and motor speed appear to be dependent on cerebral dopaminergic systems, in particular the nigrostriatal system. Neurophysiological studies have shown that estrogen stimulates dopamine release in the nigrostriatal pathway. This provides a possible physiological explanation for estrogen acting as an activator of the motor system [4]. Studies on reaction time in regularly menstruating healthy females showed that changes in ovarian hormonal level across the menstrual cycle influence the processing capability of the central nervous system [5]. Since sex steroids have been found to modify cortical function through hippocampal synaptogenesis [6] and pregnancy is associated with alteration of sex steroids it was hypothesized that reaction time in pregnant females could be altered during pregnancy. So it is expected that this might have effect on visual reaction time (VRT). The present study was aimed to elucidate the effect of pregnancy on VRT. Reaction times of pregnant women were studied in the three trimesters of pregnancy and compared with those of the nonpregnant control group.

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Methods

Thirty-seven healthy pregnant women of age group 20-35 years were randomly selected. They were examined to rule out hypertension, diabetes mellitus, and tuberculosis.

Simple VRT were measured with the help of an audiovisual reaction time apparatus (RTM-608, supplied by Medicaid system, Chandigarh). This instrument can measure upto 1/ 10^{th} of a msec with an accuracy of ± 1 digit. For simple VRT red light of 570 nm wavelength was used. The test was carried out in properly illuminated room. This was ensured by taking the data during morning hours to coincide with the outpatient timing. The room in which data was collected had a closed door where only the subject and the experimenter were present. Each subject was made familiar with the apparatus. The subject was taught to perform simple VRT. The practice was given for 15 to 20 minutes to each subject before taking the final reading in the following manner. The subjects were told to immediately react to the stimuli by pressing the respective button as soon as respective stimuli appeared. For VRT, as the red light glowed, the subject had to immediately press the button after viewing it. This process was done 6 to 7 times. Finally simple VRT for red light was measured after giving this practice.

Readings were taken during the first trimester (3^{rd} month of pregnancy), followed up during the second trimester (6^{th} month of pregnancy) and the third (8^{th} month of pregnancy) trimester. Sixteen age matched healthy women were studied as control using similar protocol.

The results were expressed as Mean ± SEM (standard error of mean) and were statistically analyzed using student's paired t test. For a better statistical analysis single factor ANOVA was carried out. The statistical analysis was done by using statistical package of MS Excel.

Table 1. Visual reaction time. (Mean ± SEM).

Control (n=16) (msec) (c)	1^{st} Trimester (n=37) (msec) (T_1)	2^{nd} Trimester (n=37) (msec) (T_2)	3^{rd} Trimester (n=37) (msec) (T_3)
318 ± 32.1	393 ± 15.2	360 ± 13.4	336 ± 14.6

T1 vs C, P=0.045 T2 vs T1, P=0.013 T3 vs T1 P=0.002

Results

Table 1 shows that there was a significant increase (P=0.045) in simple reaction time for visual stimuli during first trimester in pregnant women as compared to the control group. As pregnancy advanced, VRT decreased significantly during second (P=0.013) and third (P=0.002) trimesters as compared to the first trimester VRT.

Discussion

In the initial stages of pregnancy, the human chorionic gonadotropin (hCG) is synthesized and detected in blood or urine of pregnant women as early as 7 days after fertilization. At the same time the level of estrogen and progesterone also increases [7]. But the increase in the level of hCG, a glycoprotein, is more than that in estrogen and progesterone in first trimester of pregnancy.

The reaction time is affected by many factors like mood, memory, psychological state, stress, and first time performance etc [1]. In pregnancy besides hormonal changes a number of psychological changes also occur [8]. Though measurement of hormones was not done in this study, from existing knowledge it can be expected that hormonal changes, mainly rise in hCG, and psychological changes might affect the reaction time and this may be the cause of increased VRT in first trimester of pregnancy as compared to that in the controls.

As pregnancy advances to second and third trimester the levels of estrogen and progesterone, the sex steroids, are more than hCG level. Earlier studies have shown that reaction to visual stimuli is better with high level of estrogen [9]. Also, the brain is a target for the sex steroid hormones. Study by Hampson [10] showed that high level of gonadal steroids might facilitate congnitive and motor skills in females. Estrogen exerts a variety of actions on many regions of the nervous system that influence higher cognitive functions, pain mechanisms, fine motor skills, mood, and susceptibility to seizures [11]. Though both progresterone and estrogen are reproductive hormones the actions of estrogen on the cognitive functions are more apparent. Estrogen acts as an activator of the motor system and hence the faster nonverbal processing speed observe in estrogen treated subjects [4]. There are reports of an interaction between estrogen and acetylcholine for improvement of sensory transmission [12]. As pregnancy is associated with alteration in estrogen level it is expected that this may be one of the probable reasons of improvement in VRT in second and third trimester of pregnancy as compared to first trimester. However, contradictory studies are there which show perceived impairments in cognition during pregnancy, but these may be mild and can be overcome by conscious effort in short periods of testing [13].

Thus, the increased VRT in the first trimester compared to that in the nonpregnant might be due to high level hCG while decreased VRT in second and third trimester as compared to that in the first trimester of pregnancy might be due to high level of sex steroids, estrogen and progesterone.

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