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P_3 EVENT RELATED EVOKED POTENTIALS IN PREGNANCY

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Abstract : Cognitive function using P_3 auditory event related evoked response was examined in 18 pregnant women of age group 18–25 years (Mean 21.78±2.1). P_3 was obtained from scalp electrodes at CZ, PZ referenced to ear lobules during a task in which the subjects concentrated and pressed the button on hearing high pitched rare clicks in a train of low–pitched frequent and high pitched rare clicks. Latency and amplitude of P_3 was compared with age matched twelve non–pregnant women. There was a significant increase in P_3 latency and amplitude in the pregnant group suggesting that changed milieu of pregnancy does affect generators of P_3 component of event related potential and cognitive functions of the brain.

Key words : P_3 event related evoked potential
cognition pregnancy

INTRODUCTION

Pregnancy, a normal stress, maintains homeostasis by bringing about adjustments in the functioning of various systems including central nervous system. Sensory and cognitive functions do show changes as revealed by subjective as well as objective studies. Changes in taste sensitivity, hedonics, mood and cravings for odd food articles have been reported during normal pregnancy (1, 2, 3). Auditory and visual evoked potential studies during pregnancy reveal significant changes in peak and interpeak latencies, reflecting alterations in excitation and neural conduction processes (4, 5, 6). These studies indicate involvement of sex steroids in sensory perception and their interaction with neurotransmitters (7, 8). Psychological and behavioural tests done during peripartal period point towards temporary impairment in cognitive performance especially memory and attention (7, 8). No study seems to have been done to evaluate electrophysiologically the cognitive functions during gestation. As P_3 component of event related potentials appears to be a reliable indicator of cognitive functions, the present study was planned to assess cognition in normal pregnant women.

METHODS

Thirty healthy female volunteers of which eighteen were pregnant and twelve nonpregnant of 18–25 years age were the subjects of this study. The pregnant women were chosen from antenatal clinic after screening and those having history of (a) Hearing impaired, (b) Diabetes mellitus, (c) Hypertension, (d) Having given birth to malformed babies or small for date babies and (e) Frequent abortions were excluded. Written consent about the study was taken and so also the clearance from the local Ethics Committee. The healthy controls were the employees of the UCMS and GTB Hospital. Pregnant women were given antenatal check up. Their Hb BP and routine urine tests were done.

Cognitive function was examined using P_3 auditory evoked response to the odd ball

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paradym'. The details of the method used are given in our earlier reports (9, 10). P_3 potential which is a reliable indicator of cognitive function and basically relates to incoming sensory information to memory updating processes. Its latency i.e. the interval from the stimulus to the peak of the evoked potential remains stable within individuals and is unaffected by sex (11). P_3 evoked potentials were obtained from scalp electrodes (Ag/Agcl) placed on the vertex (CZ, PZ) referenced to linked ear lobes (A1–A2) during a task in which subject presses button on hearing rare high pitched clicks in a train of frequent low pitched and infrequent high pitched clicks. Thirtytwo such responses were averaged by the computer in each subjects. Student 't' test was done to find out statistical significance of changes in P_3 latency and amplitude in pregnant women as compared to nonpregnant controls. ANOVA test was also performed to find correlation between different parameters.

RESULTS

These pregnant women were multiparous (parity 1–4), having similar socio–economic and educational background with period of gestation 16–34 weeks (average 23.6 wks). The values of P_3 latency and amplitude were significantly higher in pregnant women as compared to nonpregnant controls (Table I). Representative

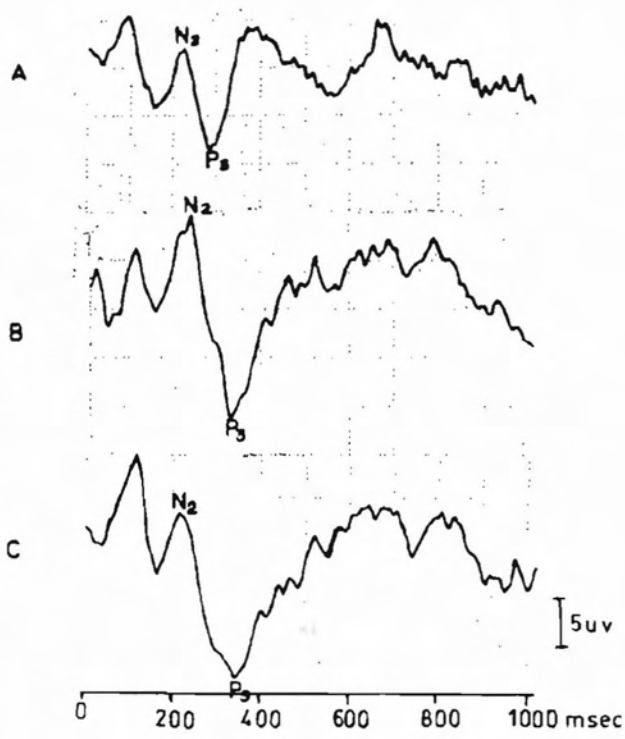

Fig. 1. : Representative records of the P_3 –event related evoked potentials in
A) Nonpregnant,
B) Pregnant woman with gestation 20 wks,
C) Pregnant woman with gestation 30 wks.
However, period of gestation did not have any significant correlation with increase in P_3 latency.

TABLE I : Showing P_3 latency (msec) and amplitude (uv) in control and pregnant women. Values are mean ± S.D. and range.

Group	*Period of gestation(wks)*	*Age (yrs)*	*B.P. Systolic (mm Hg)*	*B.P. Diastolic (mm Hg)*	*Event related evoked potentials*		
					N_2 latency	*P_3 latency*	*P_3 amplitude*
Control n = 12	–	22.58 ± 2.5 (20-26)	114.17 ± 10.8 (90–130)	75.0 ± 6.3 (60–80)	224.9 ± 16.2 (200–250)	301.58 ± 17.9 (280–335)	14.79 ± 2.4 (10.9–18.6)
Pregnant n = 18	23.6 (16–34)	21.78 ± 2.1 (18–25)	116.78 ± 9.6 (100–134)	74.4 ± 7.5 (60–86)	218.0 ± 21.2 (176–252)	355.78 ± 19.8 (328–384)	7.22 ± 2.2 (13.9–21.5)
P value (t–test)		0.18	0.496	0.835	0.348	0.001*	0.009*

*Highly Significant

tracings of P_3 in control and pregnant women are depicted in Fig. 1. Multiple regression equations and correlation coefficients between P_3 and HB, BP are given in Table II. Level of Hb in pregnant women is negatively correlated with P_3 latency (Fig. 2).

TABLE II : Values of correlation coefficients of P with haemoglobin concentration. Systolic and diastolic blood pressure in pregnant women.

	Haemoglobin	*Systolic blood pressure*	*Diastolic blood pressure*
Latency			
N_2	−0.3361	−0.3509	−0.2791
P_3	−0.5147*	−0.0353	−0.1318
Amplitude			
P_3	0.2819	0.0204	0.0824

$P < 0.05$

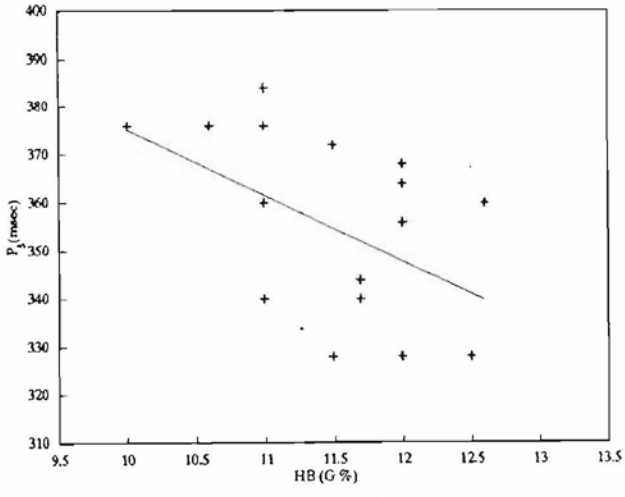

Fig. 2. : Scatter diagram showing negative correlation of Hb with P_3 latency in pregnant women.

DISCUSSION

The neuroendocrinal interactions during pregnancy bring about changes so as to meet the necessary demands of the ingrowing foetus and its well being. The enhanced levels of hormones modulate feedback to CNS in order to have harmonious interaction and relationship between foetus and mother which culminates in the classical maternal behaviour. The increased level of estrogen. Progesterone and other placental hormones during pregnancy might play important role in controlling higher functions including cognition.

The significant increase in P_3 latency and amplitude in the pregnant group (Table I) as compared to nonpregnant control, is an important finding. As P_3 latency reflects time required for processing of sensory information, attention, discrimination and memory updating, it implies that these processes particularly the selective attention are delayed during normal pregnancy. Such inhibitory influence of pregnancy on cognitive function could be due to increased level of sex steroids and their interaction with generators of P_3 in the brain. During pregnancy levels of these hormones, both in serum and CSF, may be enhanced by eight fold or more, than levels in nonpregnant state (12, 13). Estrogen and progesterone are known to interact with neurotransmitters and their enzymes and voltage dependent calcium channels (8, 14). This sex steroid neurotransmitter interaction is known to affect the morphology and latency of various evoked potential responses (15). Some of the diverse effects of estrogen on the CNS may be mediated by estrogen receptors, which are widely distributed in the brain (16, 17). It is also reported that progesterone antagonises the estrogen mediated CNS responses (8, 18). Hence, the increase in P_3 latency and amplitude in pregnancy might be due to changes in the ratio of estrogen, progesterone and their interaction with the P_3 generators. Our earlier studies have shown that latencies of stimulus related evoked potentials are affected during pregnancy, those of brainstem auditory are delayed and P_1 latency of visual evoked potential is decreased

(4, 5). Since P_3 component of auditory event related evoked potential is a late component of auditory evoked response, it implies that delayed P_3 in pregnancy might not only be due to depression of P_3 generators in the cortical region alone but also delay in conduction in auditory pathways at brainstem level. As such the location of P_3 generator is debated. Most of the reports say that P_3 generators lie in hippocampus and meditation is cholinergic and is linked with memory mechanism (19, 20). Hence the present study suggests that normal pregnancy affects the cognitive functions by delaying either the conductive processes in sensory pathways or information processing at the cortical regions. The other important finding of the present study is the negative correlation of Hb with P_3 latency. However, deficiency states (protein–calorie, vitamins) do affect latencies of brainstem auditory and visual evoked potentials (21–23) but no authentic report of anaemia due to haemodilution affecting long latency responses (like P_3) is available. Whether this physiological anaemia due to haemodilution, is a causative factor for increasing P_3 latency, remains to be seen. Anaemia in men or in nonpregnant women does not seem to have any effect on evoked potentials. Hence the increase in P_3 latency might be anaemia related in pregnancy. However, elaborate and systematic studies need to be done to prove or disapprove this.

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