Indian J Physiol Pharmacol 2003; 47 (4) : 423–428

MID LATENCY AND SLOW VERTEX RESPONSES DURING PREGNANCY

ASHA YADAV*, O. P. TANDON AND NEELAM VANEY

Department of Physiology,
University College of Medical Sciences & GTB Hospital,
Dilshad Garden, Delhi – 110 095

(Received on January 7, 2003)

Abstract : Central auditory pathways picked up electro-physiologically as mid latency responses (MLRs) and slow vertex responses (SVRs) have been studied least in women during their critical periods of life although auditory brainstem responses (ABRs) have been studied by many researchers. In the present study MLRs and SVRs were recorded in 20 pregnant women of age group 18–28 years. Their period of gestation ranged between 26–40 weeks and pregnancy had been uneventful and normal. MLRs and SVRs were recorded from Cz-A1 and Cz-A2 positions with alternating 90 dB sound pressure click stimuli delivered at 5 Hz and 0.5 Hz respectively. 256 stimuli for mid-latency and 64 stimuli for slow vertex responses were averaged and analyzed. Different waves of these auditory evoked responses were compared with 20 age matched non-pregnant females. The data obtained was analyzed for each variable by using unpaired student's T test.

Present study did not reveal any difference in MLR waves during pregnancy when compared with the non-pregnant females whereas all the SVR waves were found to be significantly delayed in pregnant females. As SVR generators are found in different cortical areas, it can be said that auditory information processing at the higher centers is slow during pregnancy which in turn could be due to elevated levels of sex hormones specially estrogen and progesterone during pregnancy.

Key words : pregnancy auditory brainstem responses (ABR) mid latency responses (MLR) slow vertex responses (SVR)

INTRODUCTION

Female hormones undergo quantitative changes during critical periods of their life i.e., menstrual cycle, pregnancy and menopause. Various physiological changes occur in the body during these critical periods due to alteration in the levels of estrogen and progesterone. Baker and Weiler suggested that circulating levels of female sex hormones influence the sensory nervous system (1). Changes in taste, sensitivity, hedonics, mood and craving for odd food articles have already been reported during normal pregnancy (2, 3). Hearing being one of the sensory modality also gets

*Corresponding Author

influenced. The effects of sex steroids on electro-physiological responses have also been reported (4).

There are contradictory findings concerning the impact of the menstrual cycle on hearing levels. Hormonal influence on auditory brainstem responses (ABR) has been elaborated by different researchers differently during menstrual cycle. Fagan and Church, Howard et al and Resende et al reported no change in ABRs throughout the menstrual cycle (5–7) while Zani, Elkind-Hirsch et al and Tasman et al reported increasing latencies of wave III and V in midcycle and decreasing latencies in midluteal phase of menstrual cycle (8–10). Elkind-Hirsch and co-workers postulated that central auditory pathways are modulated by the changing levels of hormones during menstrual cycle on the basis of the quantitative analysis of various hormones during different phases of menstrual cycle (11). Bhatia et al found increasing latencies in pre-menstrual phase (2). All of them reported shortest latencies during menstrual phase when hormonal levels are lowest in the body.

Very few reports are available to indicate the effect of pregnancy on the hearing levels. Only two controversial reports are available to demonstrate electro-physiologically the impact of pregnancy on auditory brainstem pathway. Tandon et al reported increase in inter-peak latency I–V of ABR in pregnant females suggesting thereby a delay in conduction at the brainstem level (13). However, a recent study by Sennaroglu and Belgin did not reveal any change in ABR throughout the pregnancy (14). They postulated that hormonal changes are occuring slowly over a long period of time which leads to adaptation and sensitization of brain.

Central auditory conduction was found to be affected in different studies during menstrual cycle (8–10). As MLRs and SVRs are better tool to represent the central auditory conduction electro-physiologically and hormonal levels changes markedly during third trimester of pregnancy, so we planned to record these responses during pregnancy. Our previous study in different phases of menstrual cycle suggested that SVR waves do get affected by the changing levels of estrogen and progesterone (15). As pregnancy involves a number of neuro-endocrine interactions, so in the present study we tried to see the effect of pregnancy on central level of auditory pathways by recording MLRs and SVRs.

METHODS

Subjects :

A total of 40 subjects of age group 18–28 years (mean 23) participated in this study. They formed two groups of 20 each. First group consisted of pregnant females in their third trimester (gestation between 26–40 weeks). Second group consisted of non-pregnant females having regular menstrual cycle who served as control. The subjects were selected according to the following criteria : 1. No systemic disease; 2. No ear complaint before pregnancy; 3. No history of frequent abortions or small for date babies; 4. No toxaemia during pregnancy; 5. No use of medication during pregnancy; 6. Normal blood pressure and electrolytes.

Non-pregnant females were also checked for any ear problem or systemic disease. Female subjects having regular (28–30 days) menstrual cycles were selected in control group. All records were obtained during menstruation phase when hormonal levels are believed to be lowest in the body. The subjects were included in the study after excluding any ear pathology and were having hearing threshold of 0–20 dBHL at octave interval frequencies from 250–8000 Hz.

During the recording session, the subject was asked to lie in supine position on a reclined bed. The study was conducted in an air conditioned (22°C ± 2°C) and sound-proof laboratory room. Ag/Agcl scalp electrodes were affixed with collodion at Cz-A1 and Cz-A2 positions of 10/20 electrodes placement system and ground electrode was placed on the forehead. Skin on electrode impedance was kept below 5 Kohms. MLRs and SVRs were picked, averaged, filtered and displayed on the screen of Neuropack-II Plus Evoked Potential Recorder (Nihon Kohden Japan).

MLR: Alternating rarefaction and condensation clicks were generated by passing 0.1 msec square pulses through shielded headphones having an inter-stimulus interval of 75 msec. With the stimulus rate 5 Hz, 256 stimuli were filtered, amplified and averaged for each ear separately for recording mid-latency responses. The contra-lateral ear was masked with a white noise of –40 dBHL. Peak latencies of each positive and negative wave, No, Po, Na, Pa, Nb, and Pb in the latency range 10–50 msec were recorded.

SVR: In the same subjects, 64 acoustic responses were amplified and averaged at stimulus rate 0.5 Hz for slow vertex responses. Peak latencies of different positive and negative waves, P1, N1, P2 and N2 were recorded in the latency range 50–300 msec.

Records from both the ears were averaged and a mean of them was taken into consideration. The data obtained from both the pregnant and non-pregnant groups was compared for each variable by using unpaired student's T test for statistical analyses.

RESULTS

Mid latency waves are not found to be altered significantly when pregnant and non pregnant groups were compared. Table I depicts the absolute peak latencies of

TABLE I: Showing the peak latencies of waves of MLR in pregnant and non-pregnant females.

Groups	*n*	*No*	*Po*	*Na*	*Pa*	*Nb*	*Pb*
		Latency (ms) (Mean ± 2SD)					
Pregnant	20	9.15±1.71	11.99±2.11	16.34±3.32	28.73±3.75	40.13±3.85	46.37±3.09
Non-pregnant (controls)	20	9.62±1.99	11.86±1.66	15.52±2.77	27.12±6.36	40.06±4.05	46.25±3.01

TABLE II: Showing the peak latencies of waves of SVR in pregnant and non-pregnant females.

Groups	*n*	*P1*	*N1*	*P2*	*N2*
		Latency (ms) (Mean ± 2SD)			
Pregnant	20	87.06±22.76*	118.85±34.57*	195.00±32.44*	319.59±50.20*
Non-pregnant (controls)	20	71.50±8.86	100.5±19.58	169.40±16.91	255.35±43.51

*P<.05

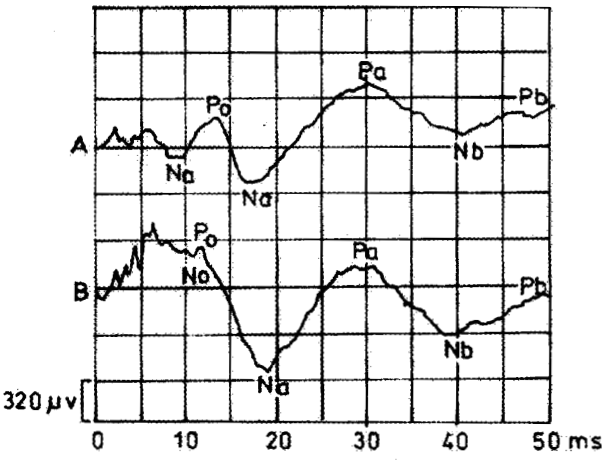

Fig. 1: Representative tracings of MLR in non-pregnant (A) and pregnant (B) females.

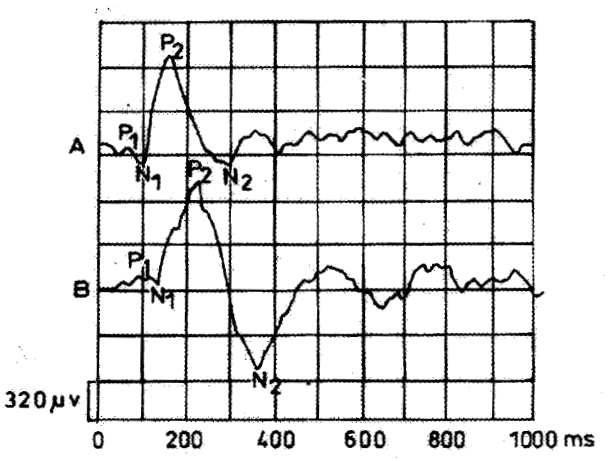

Fig. 2: Representative tracings of SVR in non-pregnant (A) and pregnant (B) females.

different variables of MLRs in both the groups. SVR variables P1, N1, P2 and N2 are significantly affected during pregnancy when compared to the non-pregnant females. Mean and standard deviation of different waves in both the groups is being compared in Table II. Absolute peak latency of all the SVR waves increases during pregnancy in the present study. The figures 1 and 2 show the actual recordings of MLRs and SVRs when compared in pregnant and non-pregnant females.

DISCUSSION

The increased levels of estrogen, progestrone and other placental hormones during pregnancy might play an important role in controlling the higher functions. Pregnancy has been found to have an inhibitory influence on cognitive functions which could be due to increased levels of sex steroids and their interaction with the central nervous system (16). During pregnancy levels of these hormones increases 10–12 fold than the non-pregnant state which may interact with various neurotransmitters in the brain. This sex steroid neurotransmitter interaction is known to affect the morphology and latencies of various evoked potential responses.

Earlier studies from our lab have revealed that latencies of visual evoked potentials (VEP) decreases (17) while those of auditory brainstem responses (ABR) increases during pregnancy (13). They suggested that increased inter-peak latency I–V of ABRs during third trimester of pregnancy could be because of elevated levels of estrogen and progesterone or could be due to retention of water. Another study by Sennaroglu & Belgin did not find any change in the waves of ABR in pregnancy (14). They suggested that hormonal changes are occurring over a long period of time which result in adaptation and sensitization of the brain. However they found that hearing level to low tone sounds decreases which could be because of excessive retention of sodium and water.

Such contradictory statements are also there regarding the influence of these hormonal changes across the menstrual cycle on ABRs. Some reported no change across the menstrual cycle (5–7) while others reported rise in latencies of wave III and V during mid-cycle and fall in these latencies during mid-luteal phase (8–10). Elkind-Hirsch and co-workers stated that estrogen by increasing the synthesis of GABA in auditory pathways has an inhibitory role on auditory conduction whereas progesterone has antagonistic and nullifying effect (11).

No report is available till now showing the effect of pregnancy on mid-latency responses (MLRs) and slow vertex responses (SVRs) which are the indicators of auditory information processing at the thalamo-cortical and cortical association areas respectively. In the present study MLR waves are not showing any significant change in pregnant group as compared to the non pregnant group. We can interpret that primary thalamo-cortical auditory pathway, supposed to be the generators for MLR might not get affected by the changing levels of estrogen and progesterone during pregnancy. All the waves of SVRs are getting significantly delayed during pregnancy in our study which could be because of the interaction between estrogen and progesterone with the generators of SVRs.

Generators of P2 and N2 components of SVR are found to be located in various poly-sensory association areas- peri-cruciate gyrus, antero-lateral gyrus and medial supra-sylvian gyrus (18, 19). N1 wave arises from sub-cortical sources receiving projections from inferior parietal lobule and P1 reflect an additional auditory processing system in parallel with the primary thalamo-cortical pathway. All these generators lie in various cortical areas, it can be said that auditory information at the central level is getting delayed. This could be because of the elevated levels of various hormones and their interaction with various neurotransmitters in the generator regions. P3 event related potential which is a late component of auditory evoked response has already been found to be prolonged in pregnancy whose generators lie in hippocampus (16). Retention of sodium and water during pregnancy is not likely to affect the SVRs because that is most likely to affect the

peripheral auditory conduction rather than central.

This study further provides an electrophysiological evidence of slowing of information processing and perception at the cortical and association areas during third trimester of normal pregnancy.

REFERENCES

1. Baker MA, Weiler EM. Sex of listener and hormonal correlates of auditory thresholds. *Br J Audiol* 1977; (II): 65–68.
2. Walker ARP, Walker BF, Jones J. Nausea, vomiting and dietary cravings and aversions during pregnancy in South African women. *Br Obst Gynaecol* 1985; 92: 484–489.
3. Bhatia S, Puri RI. Taste sensitivity in pregnancy. *Indian J Physiol Pharmacol* 1991; 35: 121–124.
4. Silber M. Hormonal influences in women, as reflected on cognitive function, libido, sexual behavior and premenstrual symptoms. *Obstet Gynaecol Scand* 1991; 70: 393–394.
5. Fagan PI, Church GT. Effect of menstrual cycle on the auditory brain stem response. *Audiology* 1986; 25: 321–328.
6. Howard R, Mason P, Taghavi E, Spears G. Brainstem auditory evoked responses during the menstrual cycle in women with and without premenstrual syndrome. *Biol Psychiatry* 1992; 32: 682–690.
7. Resende LA, Silva MD, Impemba F, Achoa NB, Schelp AO. Multimodal evoked potentials and the ovarian cycle in young ovulating women. *Arq Neuropsiquiatr* 2000; 58(2B): 418–423.
8. Zani A. Brainstem evoked responses reflect information processing changes with the menstrual cycle in young female athletes. *J Sports Med Phys Fitness* 1989; 29(1): 113–121.
9. Elkind-Hirsch KE, Stoner WR, Stach BA, Jerger JF. Estrogen influences auditory brainstem responses during the normal menstrual cycle. *Hear Res* 1992; 60: 143–148.
10. Tasman A, Hahn T, Maiste A. Menstrual cycle synchronized changes in brainstem auditory evoked potentials and visual evoked potentials. *Biol Psychiatry* 1999; 45(11): 1516–1519.
11. Elkind-Hirsch KE, Wallace E, Malinak LR, Jerger JJ. Sex hormones regulate ABR latency. *Otolaryngol Head & Neck Surg* 1994; 110: 46–52.
12. Bhatia S, Tandon OP, Sharma KN. Brainstem auditory and visual evoked potentials in menstrual cycle. *Ann Natl Acad Med Sci (India)* 1991; 2: 177–182.
13. Tandon OP, Mishra R, Tandon I. Brainstem auditory evoked potentials in pregnant women. *Indian J Physiol Pharmacol* 1990; 34: 42–44.
14. Sennaroglu G, Belgin E. Audiological findings in pregnancy. *J Laryngol Otol* 2001; 115: 617–621.
15. Yadav A, Tandon OP, Vaney N. Auditory evoked responses during different phases of menstrual cycle. *Indian J Physiol Pharmacol* 2002; 46(4): 449–456.
16. Tandon OP, Bhatia R, Goel N. P3 event related evoked potentials in pregnancy. *Indian J Physiol Pharmacol* 1996; 40(4): 345–349.
17. Tandon OP, Bhatia S. Visual evoked potential responses in pregnant women. *Indian J Physiol Pharmacol* 1991; 35(4): 263–265.
18. Dickerson LW, Buchwald JS. Long latency auditory evoked potentials : role of polysensory association cortex in the cat. *Experimental Neurology* 1992; 117: 313–324.
19. Woods DL, Clayworth CC, Simpson GV, Naeser MA. Generators of middle and long latency auditory evoked potentials : implications from studies of patients with bi-temporal lesions. *Electroenceph Clin Neurophysiol* 1987; 68: 132–148.