

P₃ EVENT-RELATED EVOKED POTENTIAL IN YOUNG ADULTS

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Abstract : P₃ component of event related potential reflects memory and decision making processes. It has been applied as an index of information processing in a wide variety of normal and cognitive impaired subjects. Scalp P₃ was elicited in 24 male neurologically and audiotically normal young subjects of 17-20 years (Av. 17.7) of age. Standard auditory 'Oddball' paradigm involving simple discrimination task of concentrating on infrequent (target) stimulus and ignoring frequent (non target) stimulus was employed. Evoked response trials of discriminating 32 target stimuli out of 160 total presented (20% target and 80% non target randomly) were replicated and analysed by computer. Latency of P₃ as 305±18.4 msec and amplitude 6.5±2.1 uv are being reported which are comparable with age and sex matched subjects of western world.

Key words : event related evoked potential

P₃ latency amplitude

INTRODUCTION

Event related potential (ERP) is the generic name given to the response evoked due to various mental work loads while, a certain stimulus input and the problem related with that input, are being applied. The ERP is said to be a manifestation of cerebral activity corresponding to various psychological processes such as expectancy, attention, cognition, search, discrimination, decision making and memorisation. In recent years, there has been a growing interest in finding out neurophysiological correlates of the cerebral mechanisms of information processing in humans. One such correlate of selective attention is a late positive, scalp-recorded, event related potential that has a latency of approximately 300 msec. This potential called as P₃ or P₃₀₀ is generated when a subject detects an unexpected but relevant stimulus in the auditory, visual or somatic modalities (1). P₃ therefore is a very useful clinical tool and has been applied as an index of information processing in a wide variety of normal and cognitive impaired subject population (2-5). As P₃ data is lacking in Indians, the present study reports latency of P₃ in neurologically and audiotically normal young adults with age of 17-20 years.

METHODS

Twenty four male medical students 17-20 years of age, with no previous history of neurological or psychiatric impairment consented to participate in this study. The subjects were apparently healthy, non-smokers and were not on any medication. They were given a thorough ENT check up and had normal hearing. The subjects were briefed about the ERP test procedure. They were asked to lie down on a bed in a standard audiometric, sound proof and air conditioned room, so that they were relaxed at the time of recording. SMP-4100, Auditory/Visual Stimulator and MEB-5200 Evoked Potential Recorder (Nihon Kohden Japan) were used for this study. P₃ was measured from the vertex (CZ & PZ) in response to random application of two types of sound stimuli presented binaurally through head phones applied to the subject's ears. Standard auditory 'oddball' paradigm (6) was used in application of more frequent (non target) and the other less frequent (target) stimuli and asking the subject to respond by pressing a button whenever a target, infrequent stimulus was presented. A total of 32 event responses so obtained were analysed by the evoked potential averaging method. Ag/AgCl disc elec-

trodes, anchored with collodion were used for recording P_{300} . Active electrodes (-ve) were placed at CZ and PZ with reference electrodes at ear lobules (A1+A2). The ground electrode was placed at Fz. The input impedance was kept below 5 k ohms. Alternating tone bursts, with a starting condensation phase, of 10 msec rise/fall time, 100 msec duration (plateau time), intensity 70 dB nHL and rate one every 2sec were used as target stimuli. 80% of total (160) tones were 1KHz (frequent) and 20% were 2KHz (rare). Stimulus sequence was random. The signals were in phase at two ears. The MEB-5200 settings were properly selected and evoked responses to the frequent and rare stimuli were filtered with a band pass 5-30 Hz (filter slope = 12dB/octave) and averaged simultaneously for 32 responses. Data from two trials were obtained consequently and stored, analysed and averaged by the computer. The latency and amplitude of P_{300} for target stimulus (rare) was calculated (Fig. 1, Left panel). During the P_{300} recording session subject was instructed to fixate his eyes on a particular spot on the ceiling in

order to avoid artifacts due to eye movements and improve his concentration and attention to target stimulus. If the target stimulus was ignored, configuration of P_3 was vague, peak not distinct and much delayed (Fig. 1 right panel).

RESULTS

The task performance of all the subjects was virtually perfect: with fewer than 0.5% of the target trials misperceived. Upto 3% misperception of the target stimulus has been observed for calculating normative values for P_3 (1). P_3 was defined as the first target blocks between 250 to 380 msec occurring after the N1-P2-N2 complex, as has been done by other workers (1-7). Table I shows the values obtained for P_3 latency and amplitude in the twenty four young subjects. The average value of 305.6 ± 18.4 msec of P_3 for target stimuli is being reported. The normal morphology of P_3 is shown in Fig. 1, Lt panel. However it did show variation across subjects and it was

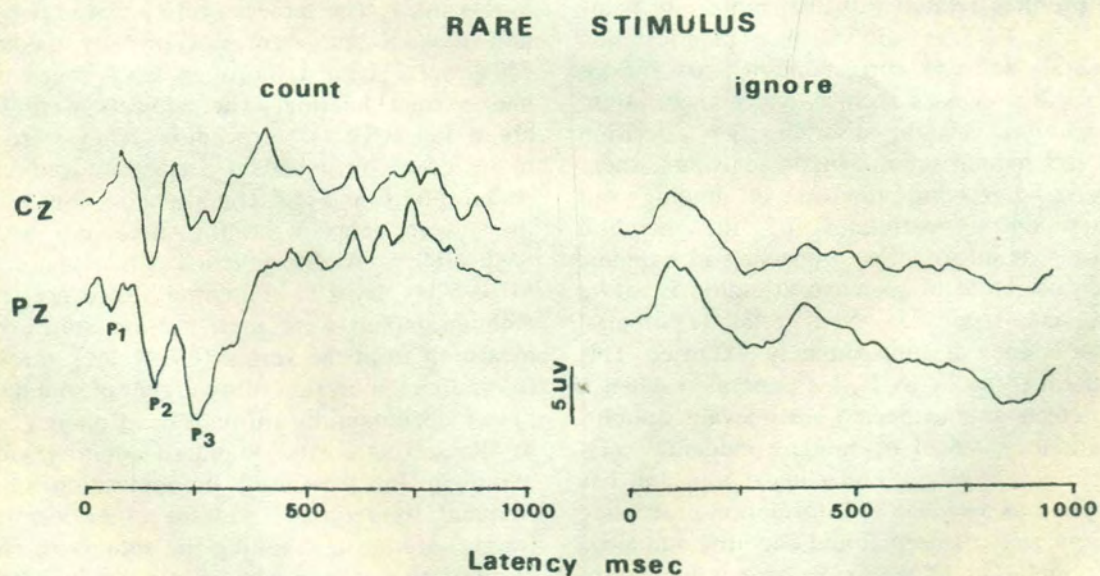


Fig. 1: Showing actual tracing of the Event Related Evoked Potential using auditory 'oddball paradigm' in a normal subject. Left panel shows that the subject is attentive to the rare (target) stimulus and his count is 100% and right panel shows that the rare stimulus is ignored and is not counted (gross misperception). It is seen that in the latter case morphology of P_3 is not distinct, and it is delayed.

TABLE I: Showing values of latency and amplitude of P₃ (Mean ± SD) in male young adults.

Age (yrs) Mean	Sex	No. of subjects	P ₃₀₀ latency (msec) Mean±SD	P ₃₀₀ Amp. (uv) Mean±SD
17.7	Male	24	305±18.4	6.5±2.1
Range (17-20)			(288-348)	(4.1-10.3)

categorised as (i) single peaked (ii) bifid or (iii) multi-peaked. In the latter two categories average of peak latency was taken into consideration for determining the P₃ latency. All mean latencies across subjects (N=24) fell within 2 SD of overall mean.

DISCUSSION

The subjects of the present study were medical students, with comparable socio-economic and educational background. They understood the procedure, were co-operative and relaxed at the time of recording. That may be the reason that error in pressing the button on random presentation of target stimulus was minimum to the tune of 0.5%. This is quite low as compared to the 3% reported by other workers (1). This could also be due to the fact that auditory 'oddball' paradigm in the present study was modified, the subject had to press the button as and when target stimulus was presented instead of mental counting of frequency of these randomly presented stimuli. The button press counting (monitored on screen) was compared with actual count of target stimuli presented (indicated by the stimulator). In all cases the reported total (button press) was correct and subject were instructed to relax, avoid movements and confine their gaze to a circular marking on the ceiling.

The visual fixation task has been shown to effectively eliminate electro-oculographic artifacts in ERP recordings of cooperative subjects (8-9). This visual fixation procedure has also been effectively utilised during conventional long latency auditory evoked potential recordings (10). Therefore its use in present study was fully justified in absence of actual monitoring of eye movement potentials.

The mean latency of P₃ recorded in the present study is similar to the ones reported by other workers in age and sex matched healthy subjects of the western world (1, 11-14). This observation suggests that there is no ethnic variation of P₃ latency. We have also reported absence of ethnic variations in visual evoked potentials (15). As regards morphology of P₃, in most of the cases, it was single peaked. However, bifid and multi-peak configuration was also seen in a few cases. This variation in P₃ waveform morphology has been interpreted as the manifestation of two distinct P₃ subcomponents P_{3a} and P_{3b}, which have different latency, scalp topography and psychological correlates (16). Variability in P₃ wave form morphology may therefore reflect the degree to which P₃ subcomponents fuse or separate. As only a central recording site was utilised in the present study, separation of P₃ subcomponents was not possible. However, it is envisaged that clinical conditions where P₃ complex is often poorly defined, multiple recording sites may improve identification of P₃ and thus enhance the clinical utility of P₃ studies.

The present study only deals with male subjects, the other on females is in progress, to find out latency of P₃ in different phases of menstrual cycle and during normol pregnancy. The values of P₃ latency reported here should reflect normal cognitive process in young male adults of 17-25 yrs age.

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