Physiology

REVISUALISING EVENT RELATED POTENTIAL P300 THROUGH PRISM OF TOTAL NUMBER OF STIMULATIONS

Manjeet Singh	Associate Professor, Physiology, BPSGMCW, Khanpur Kalan, Sonepat
Shalini Sharma*	Associate Professor, Physiology, BPSGMCW, Khanpur Kalan, Sonepat, *Corresponding Author
Jyoti Kumar	Professor & Head, Physiology, BPSGMCW, Khanpur Kalan, Sonepat
Mukesh Kumar	Professor, Physiology, BPSGMCW, Khanpur Kalan, Sonepat

ABSTRACT

Background: Event Related Potential (ERP) P300 is a neurophysiological response that reflects the status of cognition and memory related functions. P300 latency increases with cognitive decline. Sometimes disturbances appear in the lag phase of recording due to movements of head or loosening of electrodes over scalp. So it was decided to investigate that if effect of less number of stimuli is not significantly different from total number of stimuli, we can report the result of earlier one in case of any error appearing later during the procedure.

Aim & Objective: To study the effect of total number of stimulations on ERP P300.

Material & Methods: This cross sectional study included 30 subjects of age > 18 years of either sex. ERP P300 latency was recorded as per standard procedure at four levels categorized as groups A,B,C and D on the basis of total number of stimulations i.e. during 140-160 stimulation [A], 190-210 stimulation [B], 240-260 stimulation [C] and automatic at the end i.e. 300 stimulations [D]. All the data so obtained of same individual at four levels were compared and analyzed statistically.

Results: There were no significant differences among groups in relation to P300 latency.

Conclusion: Minimally exposure of 150 tones in total or 30 rare tones is required to get stabilized ERP P300 latency so the recording beyond this at any range of stimulations can be considered as final recording if any error occurs later on during the process.

KEYWORDS : ERP P300 latency, number of stimulations

INTRODUCTION

Event related potentials (ERPs) are the electrical activity generated in brain in response to a specific external stimulus in the form of a sensory, motor or cognitive event and can be recorded by electrodes placed over the scalp. P300 wave is an ERP component arises due to mental processes undergoing while taking a decision. ERP P300 is a neurophysiological response that reflects the status of cognition & memory related functions. It is a positive wave with a latency of 250-500 ms and have an amplitude of 5-20μv. If two peaks are observed in P3 wave, the second (P3b) should be used to score latencies. P300 latency is inversely related to cognitive capability; higher the latency more will be the cognitive loss. P300 amplitude may indicate the alertness of a subject and it is proportional to the attention allocated during the test procedure. Thus Event related potential (ERP) P300 help us in assessing cognitive functions.[1-4] For eliciting P300 recording, electrodes are placed over scalp using electrolyte paste and verbal click stimulations up to 85 dB are applied via headphone and test may last minimally for 10 minutes. Various studies used different number of total stimulation e.g. 160, 200 or 300.[3,5-7] Due to irritation caused by verbal click stimuli and difficulty in keeping body & head in a steady position during the procedure, sometimes subject tends to move his scalp or body during the test. It may result in loosening of electrodes and sometimes their detachment from scalp can lead to some disturbances and thus errors may creep in the recording. Many a time these disturbances appear in the lag phase of test and ultimately abnormal waves are formed leading to recording of wrong latency and amplitude of P300. In such cases we have to repeat the test procedure which is very disturbing or unwelcomed by children, uncooperative, elder, drug addicted, pregnant, psychologically ill or cardio-pulmonary compromised subjects.

Considering these entire procedural problems arising during test, we wanted to compare the effect of four different ranges of total number of stimuli and indirectly rare tone on ERP P300 in four ranges i.e. during 140-160, 190-210, 240-260 stimulations and at the end i.e. 300 stimulations. If effect of less number of stimuli were not significantly different from total number of stimuli, we can report the result of earlier one in case of any disturbance or error appearing later during the procedure. So our study was an effort to investigate the effect of total number of stimulations on ERP P300 latency.

AIM AND OBJECTIVE

To study the effect of total number of stimulations on ERP P300 latency

MATERIALS AND METHODOLOGY

This cross sectional study was performed in the department of Physiology, BPSGMCW, Khanpur Kalan, Sonepat and included 30 subjects of either sex aged more than 18 years. The four recordings of same individual were compared, so there was no need of control group.

Inclusion Criteria

Subjects were selected from patients coming to the departmental neurophysiology laboratory and their bystanders as well as institutional staff after taking their informed written consent.

Exclusion Criteria

1. Patients who don't cooperate during the study.
2. Patients having deafness, altered sensorium, any psychiatric or neurological disease.
3. Any history or symptoms of cognitive dysfunctions.

Institutional ethical clearance was obtained for this cross sectional study. ERP P300 was recorded with SCORPIO-4P, EMG EP NCS system (Allengers) instrument.

Procedure for P300

Subjects were explained in detail about the procedure. Four electrodes were placed as per 10–20 International system of placement on scalp with the help of electrolyte paste. One electrode was placed on vertex on Cz position as active electrode, one as ground electrode on forehead at Fpz and two reference electrodes on mastoids referred as A1 & A2 respectively. All electrodes were connected to preamplifier which was connected to the junction box. Skin to electrode impedance was monitored and kept below 5 K ohms. Band pass filter was 0.2 -100 Hz. Then subjects were asked to lie supine comfortably on a bed in a quiet, air conditioned room keeping eyes closed to eliminate artifacts caused by ocular movements. Patient was asked to remain alert and avoid sleep. Subject was instructed to carefully listen click stimuli of 1000 Hz (frequent tone) and 2000 Hz (rare tone) of 85 dB using head-phone in 80% and 20% in frequency in random. Total numbers of stimuli given was 300 at the rate of 1.0 /s. Artifacts were rejected by the machine automatically. Subjects were instructed to raise their index finger on hearing the rare tone. Brain generated the evoked potentials in

response which were picked up by Ag/AgCl electrodes attached to scalp. A waveform was formed due to rare tone having positive and negative waves termed as negative N1- positive P2 – negative N2 – positive P3 complex. The recordings of these waves were averaged along the procedure. ERP P300 can be recorded manually by clicking the 'capture icon' on the screen at any time during procedure and automatically gets recorded at the end of procedure.[2,8-15]

This P300 test is mainly performed to assess the cognitive status of an individual therefore ERP P300 latency was recorded at four levels on the basis of total number of stimulation and categorized as groups A, B, C and D recordings as below:

1. During 140-160 stimulations (A group recording)
2. During 190-210 stimulations (B group recording)
3. During 240-260 stimulations (C group recording)
4. At the end i.e. 300 stimulations. (D group recording)

All the data so obtained at four levels were compared and analyzed statistically using ANOVA Post Hoc Tukey test by SPSS 16 software with p value < 0.05 taken as statistically significant.

RESULTS
Subjects were in age group of 18-60 years of either sex. All 4 readings of same individual were compared so there was no need of control group. P300 latency of group A, B, C and D were not significantly different from each other (Table 1).

Table 1: ERP P300 latency as per total number of stimulations

Groups as per total numbers of stimulations	ERP P300 LATENCY	
	Mean	SD
A (140-160)*	300.28	33.67
B (190-210) *	300.17	33.87
C (240-260) *	300.87	34.81
D (300) *	301.85	35.48

* p> 0.05 (non significant in relation to all other groups)

DISCUSSION
There is enough literature explaining effect of factors e.g. alertness, age, target to target interval and randomness of stimulation on P300 but a very limited number of studies had enlightened the effect of total number of tones on P300 latency.[6,16-18] Total 300 stimulations i.e. around 60 rare stimulations were used in present study and it was observed that P300 latency of all 4 groups i.e. A, B, C & D were non-significantly different from each other (table 1). It means that latency had been stabilized at about 150 stimulations (average of 140-160) altogether or at 30 rare stimuli. Later on latency did not change significantly. So these recordings i.e. 150 stimulations can be taken as final if later on any error or disturbances appear during the procedure. There are few studies which supports our results. Picton TW observed that averaging of 30-100 trials produced reliable P300 recordings.[16] Polich J[17] in 1986 and later on in 1997 Cohen J & Polich J[18] suggested that P300 amplitude stabilized with 20 rare tones and latency stabilized with equal or more than 30 rare tone trials. There was decrease in amplitude and very little increase in latency when trials or auditory tones were further averaged which indicated towards property of habituation in P300. Tandon et al[6] and Sahai et al[7] used 32 rare tones with 0.2 probability i.e. total 160 stimulations minimally to get the reliable ERP P300 recording. Whereas minimum 36 artifact free rare tone were needed to get stabilized recording as per Duncan et al which accounts to 180 stimulations in total.[19] In the meta-analysis of 32 different P300 normative aging studies, it was found that characteristic features of study sample, types of task and stimulus factors affects the P300 latency value. As there are so many factors affecting ERP outcome result, so each ERP laboratory should have its own normative data.[20] Therefore it is further suggested that ERP P300 procedure should stop at average recording of 30-40 rare tones as per their normative data.

CONCLUSION
Minimally exposure of 150 tones in total or 30 rare tones is required to get stabilized ERP P300 latency so the recording beyond this at any range of stimulations can be considered as final recording if any error occurs later on during the process.

CLINICAL IMPLICATIONS

Our study sets an indicator for improvement in evoked potential machines to establish the automatic recording at every 10-15 rare tones. It can help professionals to save their time as well as increases the acceptability of test to patients while keeping results of test consistent and reliable.

LIMITATIONS
1. Number of participants is low in our study.
2. The study did not include recording at less than 30 rare tones.

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