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MEDIAN NERVE SOMATOSENSORY EVOKED POTENTIALS CORRELATION WITH PHYSICAL PARAMETERS

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Abstract : Somatosensory evoked potentials (SEPs) following median nerve stimulation of 25 medical students were recorded along with their height, age and upper limb length. Three major positive and negative peaks were recorded. P1 (16 msec), N1 (20 msec), P2 (28 msec), N2 (33 msec), P3 (43 msec), N3 (50 msec). Significant correlation (P value < 0.05) of N1 and P1 with height and limb length was observed. It is therefore suggested that studies involving SEPs must include physical parameters like age, height and limb length. Our future studies will indicate the accurate correction factor for these physical parameters.

Key words : somatosensory evoked potential height median nerve upper limb length

INTRODUCTION

Somatosensory Evoked Potentials (SEPs) are the electrical manifestations of the neural response to an external stimulus. These serve as non-invasive clinical tools used in characterizing the electrophysiological phenomenon of neural excitation, conduction and transmission across the sensory pathways. It is generally accepted that the complexity of the potentials characterizes the impulse transmission and its generators. The different peaks and components predominantly reflect the sequential activation of neural generators excited by the ascending volley (1).

Reliable identification of any abnormalities in the SEPs, requires their statistical evaluation in neurologically normal subjects in relation to various physical variables like age, sex, height, limb length etc. As sufficient data on SEPs in normal young Indian adults is not available, it was of interest to record SEPs, and compare them with the already available western data to see whether there were any ethnic variations. Further this data can also serve as a reference for future studies.

METHODS

The study was conducted on 25 medical students aged 18-21 years, in a sound proof, air conditioned room. They were breifed about the technical procedure and physical parameters like height, age, and upper limb length (2) were measured. The SEPs were recorded by the methods used in the previous studies (3, 4). The right median nerve was stimulated at the wrist, using an electronic stimulator delivering a constant square wave current of 0.1 msec duration at a frequency of 2 Hz. The intensity of stimulation was enough to produce a detectable twitch of the right thumb. The evoked responses were recorded by using silver-silver chloride disc electrodes on the contralateral parietal scalp 2 cm posterior to the C3 position

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(according to the International 10-20 placement system) (5). The ear electrode A1 was taken as the reference as the ear lobes are relatively free from cortical electrical activities. A filter setting of 2 Hz-1kHz and an electrode impedence of < 5000 ohm were used. 256 evoked responses were averaged by the inbuilt computer in the Evoked Potential Recorder (MEB 5200 series, Nihon-Kohden, Japan).

The absolute peak latencies and amplitudes of positive potentials (P) and negative potentials (N) between 15-60 msecs of the stimulus (middle latency potentials), were analyzed. These latencies and amplitudes were then correlated with physical parameters like height, limb length and age. Linear regression analysis of the significant correlation (P values <0.05) was done.

RESULTS

The mean age of the subjects of this study was 19.8±1.7 years, height was 169.4±6.1 cms, and limb length was 57.24±2.91 cms. The representative tracing of median nerve Somatosensory Evoked Potentials is given in Fig. 1. Three major positive and negative peaks were observed. These are P1 (16 msec), N1 (20 msec), P2 (28 msec), N2 (33 msec), P3 (43 msec), N3 (50 msec). Their latencies and amplitude are given in Table I.

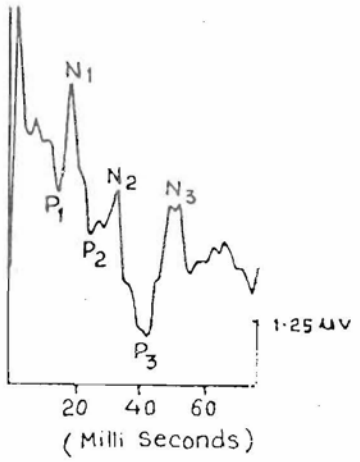

Fig. 1 : MEDIAN NERVE SEP's

Correlation coefficients of the latencies and amplitudes with height, limb length and age are shown in Table II. The significant correlation (P values < 0.05) were of N1 and P1 with height and limb length. Their regression lines and scatter diagrams are given in Fig.2.

TABLE I : Peak latencies and amplitudes.

Peaks	*Latencies (ms) Mean ± S.D.*	*Amplitudes (μv) Mean ± S.D.*
P1	16.03 ± 1.02	2.077 ± 1.342
N1	19.84 ± 1.08	2.511 ± 1.131
P2	28.26 ± 2.92	5.674 ± 3.051
N2	33.12 ± 4.29	1.636 ± 0.887
P3	43.55 ± 3.12	3.405 ± 1.633
N3	50.29 ± 3.72	2.203 ± 0.960

TABLE II : Correlation coefficients of the absolute peak latencies and amplitudes with age, height, and limb length.

	Age	*Height*	*Limb length*
Latencies			
P1	0.0428	0.4515*	0.5089**
N1	–0.2200	0.5793*	0.5353**
P2	0.0159	0.3636	0.3870
N2	0.0687	0.1129	0.1664
P3	0.2312	–0.1522	0.1591
N3	–0.0927	–0.0801	0.0661
Amplitude			
P1	–0.1908	0.3391	–0.0139
N1	–0.2018	0.1151	–0.0096
P2	0.1081	0.1789	0.0840
N2	0.0488	0.1382	0.1237
P3	0.3738	0.0290	0.0211
N3	–0.4190	0.1658	0.0197

*P value < 0.03; **P value < 0.01

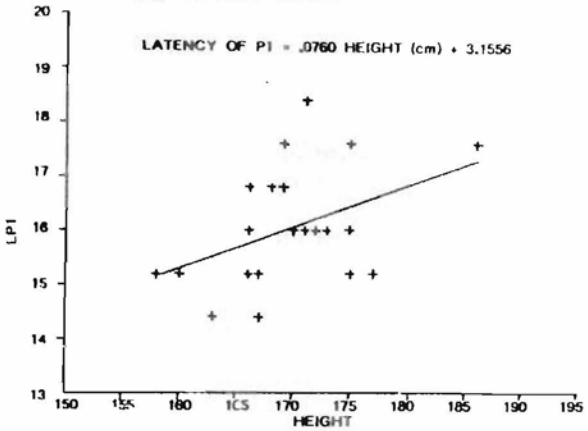

Fig. 2a - SCATTER DIAGRAM AND REGRESSION LINE FOR LATENCY OF P1 ON HEIGHT

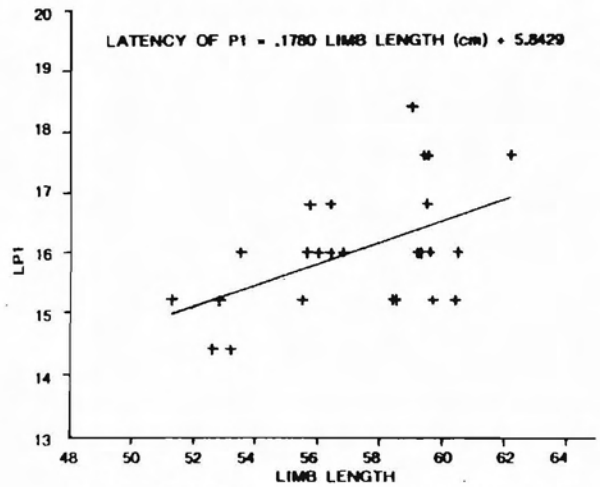

Fig. 2b - SCATTER DIAGRAM AND REGRESSION LINE FOR LATENCY OF P1 ON UPPER LIMB LENGTH

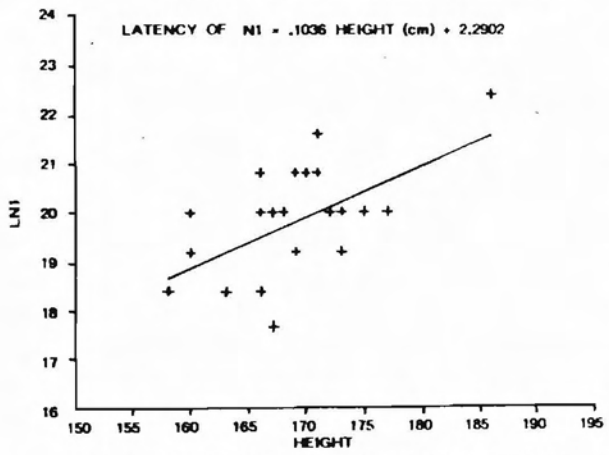

Fig. 2c - SCATTER DIAGRAM AND REGRESSION LINE FOR LATENCY OF N1 ON HEIGHT

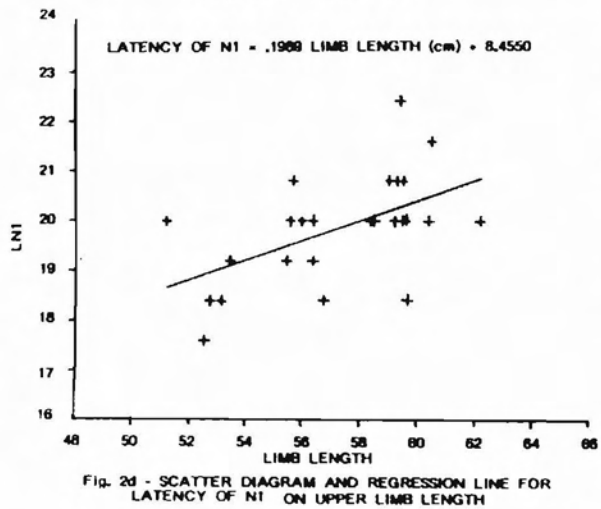

Fig. 2d - SCATTER DIAGRAM AND REGRESSION LINE FOR LATENCY OF N1 ON UPPER LIMB LENGTH

DISCUSSION

The data on SEPs vary from lab to lab depending upon the various techniques used. Hence each lab should spell out various technical factors for recording normative data on SEPs. In light of this our data can serve as a reference for normative data on SEPs.

When the median nerve is stimulated, two types of fibres are excited, Motor and Ia and type II sensory fibres. The impulses from type II afferent fibres ascends through the following pathway : Median nerve – Brachial plexus – Dorsal ganglia of Spinal nerves – Dorsal Columns – Cuneate nucleus – Medial leminiscus – Contralateral Thalamus – Thalamo-cortical projections – Cortex.

The SEPs are divided into short latency (< 15 msecs), middle latency (15-60 msecs), and long latency (> 60 msecs). In our study the middle latency SEPs were recorded. These SEPs showed mainly three positive and negative waves.

P1 (16 msec) : A peak similar to our P1 has been recorded in many studies at 13 msec (6), 15 msec (4, 7) and 16 msec (8, 9). However, this peak is most widely accepted as P_{14} and has been so recorded by many authors (10, 11, 12).

This peak is suggested to be generated in the dorsal column nuclei or medical leminiscus (7, 11, 13). This is supported by the fact that patients with thalamic lesions show the presence of P_{14} (12) while it is abolished in patients with spinal lesions at the cervical level.

N1 (20 msec) - P2 (28 msec) - N2 (33 msec) complex : This complex is reported as a whole in many studies because all the components are due to the activation of the parietal somatosensory cortex. Latencies of this complex in our study are comparable with others (4, 8, 9, 11, 12).

The N1 peak is the first cortical response to the external stimulus (1, 4, 12, 14) and is usually the largest negative peak of the Somatosensory Evoked Potentials. The later peaks of this

complex are also generated by the activation of the somatosensory cortex (4). This complex is found absent in cases of brain death and thalamic lesions (12).

P3 (44 msec) - N3 (50 msec) complex : This complex is generally recorded as a P_{40}-N_{60} (1, 9, 12) complex. The P3-N3 complex is a generalized complex, and is due to the activation of nuclei other than the primary sensory nuclei (15).

Comparison of our data with the previous studies is given in Table III. It shows only minor variations most of which can be accounted for by the differences in our stimulating and recording techniques, and/or by the variations in physical parameters of the subjects.

In our study quite an early N3 is reported compared to the other studies. This difference could be due to ethnic variations.

The significant correlations found in our study were between P1 and N1 with Height and Limb length. The significance was more with limb length than that with the height. Since limb length and height are significantly correlated (r value = 0.6162, P value < .001) the correlation to height may be secondary to the correlation with limb length. Regression analysis showed that N1 is more dependent on the physical parameters than P1.

Thus our study has provided normative data in Indian males, and could serve as a base for future studies. We suggest that the height and limb length should also be taken into consideration while recording Somatosensory Evoked Potentials, and if need be, correction factors can be worked out and applied. More number of subjects have to be used to find out the exact correction factors.

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TABLE III : Comparison of our results with the results of previous studies.

Author	*Year*	*Latencies (msecs)*					
		P1	*N1*	*P2*	*N2*	*P3*	*N3*
Giblin D.R.	1964	16	19	28	36		
Abbruzzese M.	1978	15					
Yamada T.	1980	14					
Kimura J.	1982	14	19	27	32		
Allison T.	1983	15	20	26			
Yamada T.	1984	14	20	26	34	44	64
Kakigi R.	1989	13					
Goff P.S.	1990	16	20	25		48	65
Our study	1995	16	20	28	33	44	50

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