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Comparison of Somatosensory Evoked Potentials Between Genders in Healthy South Indian Population

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Abstract

Evoked potential recordings (EPR) are designed to test the three most important of the five senses, touch, hearing and sight. Together, these three senses account for most of the incoming information absorbed by the brain. Evoked potentials (EPs) are important tools to study nerve impulse conduction in central nervous system. SEPs are one of the commonly used EPs which measure the transmission in somatosensory pathways. Aim of study was comparison of somatosensory evoked potentials between genders in healthy south indian population**.** Study was conducted in 120 healthy volunteers of both male & female in the age group of 15 to 60 years. Recording of SEPs was done in subjects. Informed written consent was obtained after explaining the procedures and answering all their queries. Normative data for Somatosensory Evoked Potential (SEP) for upper limb and lower limb in terms of both latency and amplitude were collected. statistical analysis was done using **SPSS** 20.0. In the present study, no significant correlation was found between gender and latencies of the waves both in upper and lower limbs. Amplitudes of the waves also could not be correlated with gender.

Keywords: *Somatosensory evoked potential, Gender.*

Introduction

The five human senses of sight, hearing, smell, taste and touch are imperative to life. Impairment or nonfunctioning of any one of these incapacitates a human being to such a degree that the sufferer can only be considered as disabled. Evoked potential recordings (EPR) are designed to test the three most important of the five senses, touch, hearing and sight. Together, these three senses account for most of the incoming information absorbed by the brain. They are also the most easily monitored parameters. Studies have shown that sight accounts for as much as 70% of the huge and varied volume of information absorbed by a human being. Touch sense is responsible for another 15% and hearing sense for 10%. Evoked potentials (EPs) are important tools to study nerve impulse conduction in central nervous system. SEPs are one of the commonly used EPs which measure the transmission in somatosensory pathways by any mode of stimulation whether it is electrical or mechanical. Evoked potentials are usually summated surface electrical potentials generated and recorded on the scalp overlying primary receptive areas of the brain corresponding to somatosensory system in parietal cortex [1]. The SEPs assess the intactness of the sensory pathway and the long course makes it easy to evaluate. The stimulation of median nerve generate a number of wave forms, negative waves are designated by N and positive waves are designated by P. Usually the significant negative wave N20 and Positive wave P24 are recorded. The N20 is generated by Ventro-postero lateral (VPL) nucleus of thalamus and the primary sensory cortex. Tibial SEPs are recorded by stimulating the posterior tibial nerve. The important waves are P45 and N55. SEPs have a good correlation with impairment of joint position and vibration position[2]. For an abnormality in SEP to occur, a significant degree of sensory impairment should take place[3].

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Materials & Method

Study was conducted in 120 healthy volunteers of both male & female in the age group of 15 to 60 years.

They were subjected to a basic neurological examination and only those without neurological deficit and those who satisfied the inclusion & exclusion criteria were included in the study (n=120; Male=79, Female=41). Subjects were instructed to wash their hair with shampoo (oil free scalp) on the day of recording, to reduce skin impedance, for better recording of SEPs. Informed written consent was obtained after explaining the procedures and answering all their queries. Participants were made to lie down supine in a couch comfortably with head pillow to avoid muscle artifacts. Standard silver chloride electrodes of 1cm diameter were used for recording. International 10-20 system nomenclature was used for naming electrode position. The electrodes were applied to the scalp using conduction jelly after thoroughly cleaning the area. American Clinical Neurophysiology Society (**ACNS)** guidelines were followed to record SEP [4]. Recording electrode was placed at **C3'** position for Upper limb, and **Cz** position in the midline for lower limb recordings. The reference electrode was placed at **Fz** for both upper limb & lower limb recordings[5]. The ground disc type electrode was placed over forearm after thoroughly cleaning with spirit.

Data Recording

Upper Limb SEP Recording: The median nerve was stimulated near wrist with square pulse for duration of 0.2 milli seconds, and at the rate of 5 Hz. The strength was decided by the threshold of the patient. 1000 averaging was taken for analysis. N20 & P24 wave latencies and amplitudes were measured and compared.

Lower Limb Recording: The tibial nerve was stimulated at ankle with a square pulse of 0.2 milli seconds duration and at the rate of 5 Hz. Like upper limb SEPs the stimulus intensity was decided by the patient threshold and 1000 averaging was taken for analysis. P45 & N55 wave latencies and amplitudes were measured and analyzed. Brain electrical activity was amplified 50, 000 times through an inbuilt amplifier and recorded with a sampling rate of 1000 Hz and filtered through a band pass filter of 1-100 Hz. The negative wave around 20ms was designated as N20 and the positive wave that succeeds it around 24ms was designated as P24 in case of upper limb recording, whereas in case of lower limb recordings the waves were designated as P45 & N55. The peak latencies of all the waveforms were marked.

Data Analysis: The detailed data was entered into the Microsoft Excel sheet and subsequently statistical analysis was done using **SPSS (Statistical Package for Social Sciences)** software version 20.0. Normative data for Somatosensory Evoked Potential (SEP) for upper limb and lower limb in terms of both latency and amplitude were collected.

Results

On analyzing the influence of gender over the SEP waveforms, significant difference was seen between genders for cortical wave latency for Lower Limb for P45 and N55 waves (P values were 0.001 and 0.002 respectively).

Table 1: Comparison of latency and amplitude of N20 and P24 and cortical waves in Upper limb with respect to Gender

Parameters	Male Mean ± SD	Female Mean ± SD	t-test for Equality of Means			
			P value	Mean Difference	95% Confidence Interval of Difference	
					Lower	Upper
Latency N 20 Right Arm (ms)	17.93 ± 3.17	17.63 ± 2.96	0.615	0.2991	-. 8762	1.4743
Latency N 20 Left Arm (ms)	18.03 ± 3.03	17.66 ± 3.27	0.527	0.3789	-. 8044	1.5623
Latency P 24 Right Arm (ms)	24.28 ± 3.53	23.80 ± 2.83	0.451	0.4786	-. 7755	1.7327
Latency P24 Left Arm (ms)	24.28 ± 3.33	23.79 ± 2.52	0.409	0.4883	-. 6781	1.6546
Amplitude from N 20 to P 24 Right Arm (μV)	0.66 ± 0.67	0.541 ± 0.49	0.312	0.1199	-. 1138	. 3537
Amplitude from N 20 to P 24 Left Arm (μ V)	0.60 ± 0.67	0.77 ± 1.22	0.333	-0.1689	-. 5127	. 1749
Cortical Wave Latency Right Arm (ms)	64.38 ± 9.67	62.27 ± 7.59	0.223	2.1106	-1.3031	5.5244
Cortical Wave Latency Left Arm (ms)	64.48 ± 10.62	62.32 ± 8.58	0.259	2.1632	-1.6123	5.9387

Analysis was done using Student's unpaired t test

Table 2: Comparison of latency and amplitude of P45 and N55 and cortical waves in Lower limb with respect to Gender

Parameters	Male Mean±SD	Female Mean±SD	t-test for Equality of Means				
			P value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Latency P 45 Right Leg (ms)	40.43 ±4.10	39.92 ±5.33	0.560	0.5110	. 8752	-1.2222	2.2442
Latency P 45 Left Leg (ms)	40.33 ±3.87	40.18±5.75	0.866	0.1498	. 8838	-1.6004	1.9000
Latency N 55 Right Leg (ms)	51.31 ±6.14	51.71 ±7.35	0.758	-0.3903	1.2616	-2.8885	2.1079
Latency N 55 Left Leg (ms)	51.26 ±6.02	51.83 ±7.58	0.654	-0.5690	1.2654	-3.0749	1.9368
Amplitude from P 45 to N55 Right Leg (μV)	0.437 ±0.38	0.532 ±0.45	0.225	-0.0950	.0778	-. 2491	.0592
Amplitude from P 45 to N55 Left Leg (μV)	0.46 ±0.40	0.56 ±0.43	0.196	-0.1031	.0792	-. 2599	.0537
Cortical Wave Latency Right Leg (ms)	83.94 ±6.49	80.07 ±4.77	0.001***	3.8676	1.1397	1.6107	6.1245
Cortical Wave Latency Left Leg (ms)	84.49 ±6.46	80.85 ±4.50	0.002**	3.6386	1.1217	1.4174	5.8599

Analysis was done using Student's unpaired t test * = P <0.05, ** = P<0.01, *** = P<0.001

Discussion

Somatosensory evoked potentials (SEP) are the type of evoked potentials originating in the somatosensory and other neighboring areas of the cerebral cortex and other relay pools of neurons of the somatosensory pathways in response to sensory stimuli. The stimuli are usually mild electric impulses. SEPs can represent the location, relay centre and chronology of the electrical events that follow the sensory stimuli. SEPs are totally non invasive surface bioelectric recordings which provide an excellent alternative to the invasive techniques to appreciate the sensory neurophysiology.

Green et al discovered shorter central conduction time in females as compared to males [6]. In their study, absolute peak SEP Latencies correlated with height. They did a study in a group of 31 normal subjects with 21 females and they found shorter central conduction times in females compared to males by about 1 msec, but they could not find the reason for this difference. Mervaala et al found correlation between gender and latencies of the SEP waves. They conducted the study among 120 normal subjects and discovered the higher value of latency for males when compared to females. Further, they attributed the head circumference and brain size could be responsible for this gender difference. But, no gender based difference could be established while considering central conduction time [7]. Allison et al discovered a statistically significant correlation between gender and latencies. They explained the gender based difference with help of arm and shoulder dimension which are more for males as compared to females that could cause increase in latency of waves in males [8, 9, 10]. This study was conducted among 286 normal subjects covering a wide range of age between 4 to 95 years; they could not find any gender based difference among children, which further supported this explanation for this difference among adults.

Conclusion:

In the present study, no significant correlation was found between gender and latencies of the waves both in upper and lower limbs. Amplitudes of the waves also could not be correlated with gender **(Table 1, 2)**. This prompted us to confirmation that gender based difference in the arm and shoulder dimensions might have a role in this aspect.

Ethical Cleareance: Taken from ethical committee

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Conflicts of Interest: Nil

References

1. Chiappa KH: Evoked potentials in clinical medicine 3rd edi. Raven press, New York. 1997
2. Ronald G Emersion. Comprehensive clinical neurophysiology: W B Saunders. 2000; 38, 543-564

3. Kenry H Levin, Hans O Luders. Comprehensive clinical neurophysiology: WB Saunders. 2000; 36: 507-564
4. Ray Cooper, colin D Binnie, Richard Billings. Techniques in Clinical Neurophysiology-A Practical Manaua. Amsterdam: Elsevier Churchill Livingstone, Elsevier Ltd; 2005. P 58
5. U K Misra. Clinical Neurophysiology: J Kalita, editors:B. I Churchill Livingstone Pvt Ltd, New Delhi Publishers; 1999:293-295
6. Green JB, Walcoff MR, Lucke JF Comparison of phenytoin and phenobarbital effects on far-field auditory and somatosensory evoked potential interpeak latencies. Epilepsia. 1982; 23 (4):417-21
7. Mervaala E, Paakkonen A, Partanen JV, The influence of age, gender, height on the interpretation of median nerve SEPS. Electroencephalogr Clin Neurophysiol 1988; 71 (2):109-13
8. Allison T, Wood CC, Goff WR Brain stem auditory, pattern-reversal visual, and short-latency somatosensory evoked potentials: latencies in relation to age, sex, and brain and body size Electroencephalogr Clin Neurophysiol. 1983; 55 (6):619-36
9. Eric S. Rosenthal The Utility of EEG, SSEP, and other Neurophysiologic Tools to Guide Neurocritical Care Neurotherapeutics (2012); 9:24-36
10. Liberson WT; Contributions to the history of the discovery of brain stem somato-sensory potentials Electromyogr Clin Neurophysiol. 1994; 34 (1):49-51