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Comparison of H reflex in abductor digiti minimi between dominant and non- dominant hand of healthy adult male volunteers in Puducherry- Observational Study

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ABSTRACT:

A nerve conduction study is a commonly used medical diagnostic test to evaluate the function of the motor and sensory nerves in the human body and to diagnose some of the common disorders like Peripheral neuropathy, ulnar neuropathy, Guillain Barrie syndrome [1].They can be used to localize the site or level of lesion and it can also determine if the pathology involves the neuromuscular junction, nerve root, anterior horn cells or the peripheral nerves[2, 3]. Nerve conduction studies are motor nerve conduction tests, sensory nerve conduction tests, F response and H reflex tests.

H reflex is the electrical analogue of the routinely used stretch reflex. The H reflex is a non invasive technique used to study the reflex pathways and associated activities in the spinal circuitry[4]. H reflex is used as an effective tool in research and clinical neurophysiology because of its monosynaptic nature[5]. The H reflex is used to assess the nerve conduction in the proximal segment of the nerves. It is used to detect lesion in more proximal nerve lesions which might be missed in peripheral conduction studies[6].

H reflex is found to be useful in detecting conditions like radiculopathies, Parkinson's disease, neuropathies and clinically proven C6, C7 or C8 radiculopathies and plexopathies. H reflex is found to be an attractive tool in diagnosing diabetic peripheral neuropathy[7]. The present study was undertaken to determine latency and amplitude of H reflex of abductor digiti minimi of the dominant and non dominant hand, and to find if there is any side-side difference, as very few Indian studies are available on H reflex.

Methodology :Fifty healthy male subjects in the age group of 25-35 years were studied by stimulating ulnar nerve while the subject is maintaining 10-20% of maximum voluntary contraction of the abductor digiti minimi. The stimulus intensity was 5-10mA (submaximal) of 1 ms duration, delivered from a constant current stimulator through bipolar stimulating electrodes. The latency of the first deflection from the baseline and the peak to peak amplitude of the evoked H reflex responses were measured digitally using a digitalized nerve conduction / EMG / EP machine (Aleron, Recorders Medicare systems, Chandigarh, India) .

Statistical analysis showed that the H reflex latency of ADM of dominant hand(27.42±2.0ms, Mean± SD) was equal to the corresponding value of non dominant hand(27.37±1.7ms). H reflex amplitude of ADM of dominant hand(0.62±0.3µV,Mean± SD) was also equal to the corresponding value of non dominant hand(0.59±0.2 µV). Wilcoxon signed rank test was used to compare the corresponding values of latency and amplitude of the H reflex of dominant and non dominant hands as the data was not normally distributed.

RESULTS AND CONCLUSION

The study was conducted with the objective to compare the H reflex latency and amplitute of upper limb muscle, abductor digiti minimi (ADM) in the dominant and non dominant hands in healthy adult male volunteers. We observed that the differences in the side- side mean latencies and the mean amplitude were not statistically significant. There was no difference between dominant and non-dominant hand in the mean amplitude and latency of H reflex (abductor digiti minimi muscle-Ulnar nerve) in healthy young adult males.

Keywords: H reflex (Hoffmann's reflex), ADM (Abductor digiti minimi),EMG (Electromyography)

1. Introduction

A nerve conduction study is a commonly used medical diagnostic test to evaluate the function of the motor and sensory nerves in the human body and to diagnose some of the common disorders like Peripheral neuropathy, ulnar neuropathy, Guillain Barrie syndrome [1].They can be used to localize the site or level of lesion and it can also determine if the pathology involves the neuromuscular junction, nerve root, anterior horn cells or the peripheral nerves[2, 3]. Nerve conduction studies are motor nerve conduction tests, sensory nerve conduction tests, F response and H reflex tests.

H reflex is the electrical analogue of the routinely used stretch reflex. The H reflex is a non invasive technique used to study the reflex pathways and associated activities in the spinal circuitry[4]. H reflex is used as an effective tool in research and clinical neurophysiology because of its monosynaptic nature[5]. The H reflex is used to assess the nerve conduction in the proximal segment of the nerves. It is used to detect lesion in more proximal nerve lesions which might be missed in peripheral conduction studies[6].

H reflex is found to be useful in detecting conditions like radiculopathies, Parkinson's disease, neuropathies and clinically proven C6, C7 or C8 radiculopathies and plexopathies. H reflex is found to be an attractive tool in diagnosing diabetic peripheral neuropathy[7].

Tapping the tendon stretches the muscle and activates the muscle spindle receptors to fire action potentials, and this evokes Ia afferent activity. In the spinal cord, the Ia afferents end on homonymous motoneurons generating an action potential in these motoneurons. The resulting muscle contraction is the effect of this reflex. The Ia afferent fibers can be electrically stimulated by a mild electrical impulse in the laboratory to obtain the H reflex.

Normally, H reflex can be obtained in both upper and lower limb muscles in infants under 1 yr of age[8]. In adults, H reflex can be obtained in the relaxed gastronemius - soleus muscles with posterior tibial nerve stimulation[9]. Elsewhere in the body this reflex is not readily elicitable. Due to strong central suppression of motor neurons to the hand muscles, H reflex is difficult to elicit in normal condition[10]. Only when this central supression is overcome by voluntary contraction the H reflex can be elicited in the upper limb. The difficulty of recording the H reflex from the upper limb muscles with a single stimulus can be overcome by averaging 100 - 200 responses in a contracted muscle.

There are not many Indian studies on the upper limb H reflex. Few studies that are available have been performed on newborns. It is also well established that nerve conduction parameters show right to left asymmetry.

The presence of such side to side differences in the upper limb H reflex is not established. So, this study was done to determine the H reflex in the abductor digiti minimi(ADM) muscle of either side by ulnar nerve stimulation and to determine the normal latency and amplitude values and to find if there is any side-side difference.

2. Materials and methods

FIGURE1: Electrodes Placement for recording H reflex in abductor digiti minimi

Figure :1

This cross sectional study was conducted in the department of Physiology, PIMS Pondicherry. Ethical clearance was obtained from the Institutional Ethical Committee. Clinically normal male subjects in the age group of 25 to 35 years from PIMS staff volunteers were considered for the study. The subjects chosen for the study have undergone a complete clinical examination in the institute's neurological department. Subjects with diabetes mellitus, neuromuscular injury/disorder, carpal tunnel syndrome or any other medical conditions likely to produce nerurologic involvement were excluded. We also excluded smokers, alcoholics, subjects with present or past history of fracture of upper limb bones, subjects on any medication which might alter nerve conduction or on implanted pacemakers. The participants were informed about the study and written consent was obtained from them before including them in the study.

H reflex recording: Subjects then reported to the electrophysiology lab, physiology department at 10 AM in the morning after a light breakfast. Subject's arm length, height, oral temperature and body weight were recorded. The dominant hand of the subject was identified by asking the subject about the hand used to write, draw, or eat. The experimental procedure was explained to them again and they were oriented them to the electrophysiology lab and the equipments. The recording was done with minimal light and sound and the lab temperature was maintained at 24 ±2 ^{o}C.

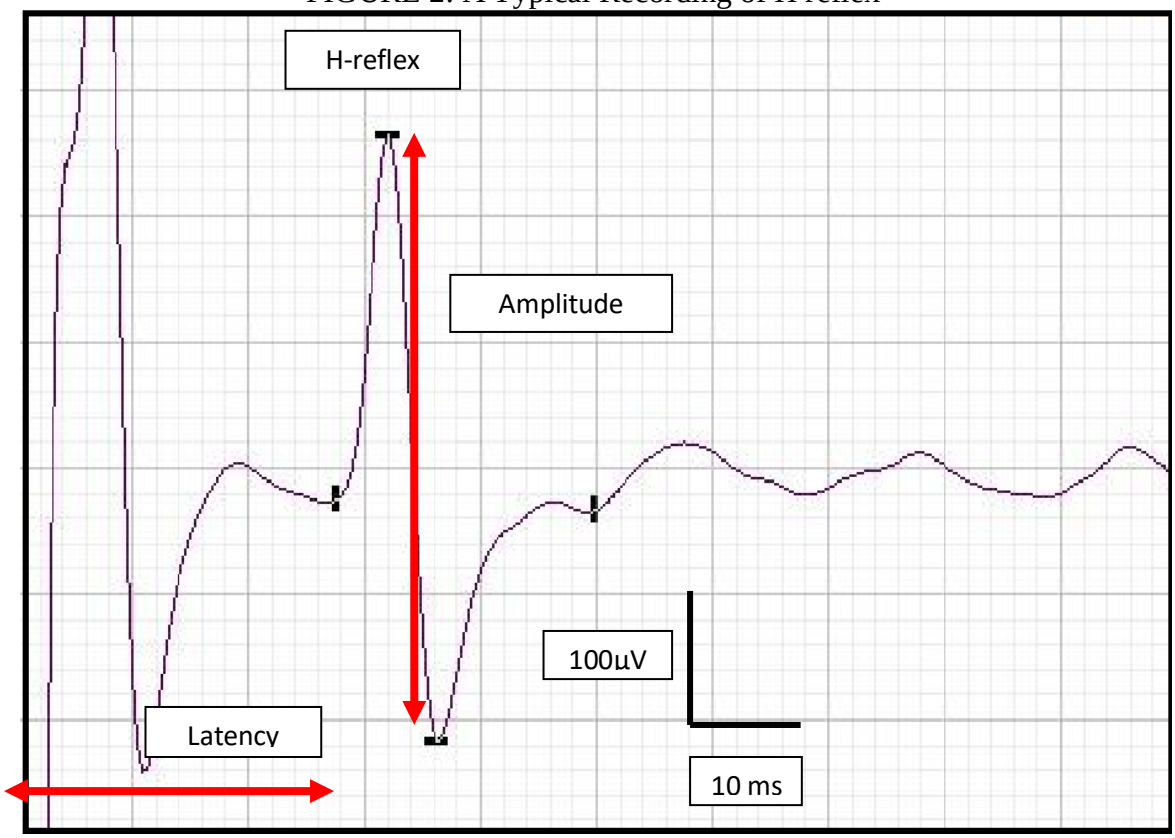
The subject was asked to lie down comfortably in the supine position. The skin over the dorsum of the forearm and palm was thoroughly cleaned with spirit to decrease impedance. The subject's arm was placed in an extended position with support and the subject was asked to maintain 10-20% of maximum voluntary contraction of the abductor digiti minimi by abducting the little finger.

The Silver – silver chloride surface electrode electrodes were fixed at the midpoint of ADM muscle belly (Active electrode) and on the volar surface of the little finger (Reference electrode). Bipolar metal electrodes were used to stimulate ulnar nerve near the wrist 8 cm

proximal to the active recording electrode with cathode placed proximal. Ground electrode (disc electrode) was fixed at the wrist between the active electrode and the stimulating electrode (Figure 1).

The stimulus intensity was 5-10mA (submaximal) of 1 ms duration, delivered from the constant current stimulator through bipolar stimulating electrodes. Stimulus repetition rate was 1 Hz. The H reflex was recorded using a digitalized nerve conduction / EMG / EP machine (Aleron, Recorders Medicare systems, Chandigarh, India). 200 responses were averaged and the H reflex was recorded. The latency of the first deflection from the baseline and the peak to peak amplitude of the evoked H responses were measured digitally (fig.2). The recording was done on both the dominant and the non-dominant hand.

FIGURE 2: A Typical Recording of H reflex



STATISTICAL ANALYSIS: Wilcoxon signed rank test was used to compare the corresponding values of latency and amplitude of the H reflex of dominant and non dominant hands as the data was not normally distributed.

3. Results And Discussion

Table 1: Comparison of H reflex latency (ms) and amplitude in dominant and non dominant hand.

	Mean Latency (ms)	**SD**
Dominant Hand (Right)	27.42	2.0
Non-Dominant Hand (Left)	27.37	1.7

The mean amplitude in the dominant hand (right) was 0.62 mV and the mean amplitude in the non dominant hand (left) was 0.59mV (table 2)

Table: 2 Comparison of H reflex amplitude (mV) in dominant and non dominant hand. The values are given as Mean +/- SD (n=50).The results are as follows:

	Mean Amplitude (mV)	**SD**
Dominant Hand (Right)	0.62	0.3
Non-Dominant Hand (Left)	0.59	0.2

Since the distribution of differences between the latencies and the amplitude is skewed, Wilcoxon signed rank test is used (table 3)
The differences in the side - side mean latencies and the mean amplitude were not statistically significant.

Table: 3 Differences in variables between dominant and non-dominant Hands of Healthy young adult males.

	Differences in variables between dominant and non-dominant Hands of Healthy young adult males.			
VARIABLES	**MEDIAN**	**PERCENTILE**		**'p' VALUE**
		25th	**75th**	
LATENCY(ms)	0.11	-0.61	0.86	0.415*
AMPLITUDE(mV)	0	-0.13	0.13	0.844*

*Wilcoxon Signed Rank test

The study was conducted with the objective to compare the H reflex latency and amplitute of upper limb muscle, abductor digiti minimi (ADM) in the dominant and non dominant hands in healthy adult male volunteers. We observed that the differences in the side- side mean latencies and the mean amplitude were not statistically significant.
In our study the mean latency in the dominant hand (right) was 27.4 ms and the mean latency in the non dominant hand (left) was 27.3 ms. Similar results were found in the literature. In a study conducted by Estanol B[35], ADM was tested with ulnar nerve stimulation, the mean H reflex latency was found to be 25.0 ±1.6 ms. It was concluded that H reflex was elicitable only when the muscle was under contraction. In a study conducted by OKU Y[54] in 1973, the mean H reflex latency was 25.4 ms with the range between 24.2 ms to 26.7 ms. This too was elicited from a contracted muscle. Aminoff[51] observed that ADM H reflex was evoked by ulnar nerve stimulation at the wrist with slight abduction of the little finger. In studies done by E.F Stanley[21] (1978), the mean reflex latency was found to be 28 ms in human thenar muscles during voluntary contraction. An average H reflex latency of 27 ms has been reported with an upper limit of 30 ms [28] by Bodofsky, who also had reported on the normative values for contraction induced upper extremity H reflex. In a study by Burke et al.[29] on the effects of voluntary contraction on the H reflex of human hand muscles, the mean H reflex latency of APB was 28.1 ms.
In the present study, the mean amplitude in the dominant hand (right) was 0.62 mV and the mean amplitude in the non dominant hand (left) was 0.59mV. In our study the side –side differences in the mean amplitude were not statistically significant. This was comparable to other studies reported in literature. In a study by De Meulenmeeter et al.,[52] on Abductor pollicis brevis, the mean amplitude of H reflex was reported as 1.17 mV. It was also concluded that their findings were also not statistically significant. Duchateau and K. Hainaut[53] in 1993 reported a mean H reflex amplitude on APB as 229 ± 48 μV. The pathway for H reflex involves activation of Ia afferent nerve fibres from the muscle, obtained by stimulating the nerve. These Ia afferents enters the dorsal horn of spinal cord and synapse with the alpha motor neurons. In the spinal cord, the Ia afferents end on homonymous motor neurons generating an action potential in these motor neurons.

The efferents are via alpha motor neurons to the muscle and the response was recorded as the H reflex. Muscle contraction increases the alpha motor neuron excitability due to excitatory descending facilitatory influences bringing it closer to the threshold. Thus it is said that contraction would potentiate H reflex activity of the upper extremity muscles.

4. Conclusion

There was no difference between dominant and non-dominant hand in the mean amplitude and latency of H reflex (abductor digiti minimi muscle-Ulnar nerve) in healthy young adult males.

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