Original Article

Effects of various head postures on flexor carpi radialis H reflex in healthy subjects

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Abstract

Background and Aim: The H reflex is a useful measure of the nerve conduction through the entire length of the afferent and efferent pathways, especially at the proximal segment of the peripheral nerve, which is inaccessible by routine surface stimulating and recording techniques. Therefore, the objective of the present study is to determine the effect of head postural modification on flexor carpi radialis H reflex in healthy subjects.

Methods: This study was done on 40 healthy individuals with a mean age of 22.37 ± 1.23. The H reflex was then recorded by the use of the electromyography machine with the subject in a sitting position. The subjects were asked to maintain 30-s hold into the end range of flexion, extension, rotation (to the right and then to the left), lateral bending (to the right and then to the left), retraction, and protraction of neck. The H reflex amplitude, latency and H/M ratio were measured.

Results: Repeated multivariate analysis of variance was used to evaluate the significance of the difference among the H reflex, amplitude, and latency, in various head positions. Head postural modification does not significantly influences amplitude, latency and H/M ratio in normal healthy subjects.

Conclusion: The H reflex latencies, amplitudes and H/M ratios did not show any significant difference between various head positions when compared with neutral head position.

Key words: Cervical radiculopathy, flexor carpi radialis H reflex, H reflex, head posture

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INTRODUCTION

Diagnostic imaging (electromyography [EMG]) and electrophysiologic studies are most commonly used to establish a diagnosis and degree of nerve impairment. Although not perfect, these tests are considered to be most accurate means of diagnosis available.[1,2] Neurophysiologic testing and H reflex, in particular, provides an objective assessment of nerve root compression or entrapment. It has been found to be a clinically useful method in the diagnosis of radiculopathies and assessing of the McKenzie neck retraction exercise in patients with cervical radiculopathy.[3] It is also reported to be an objective tool in measuring the degree of compression and decompression on the compromised nerve root in patients with radiculopathy.[4] The technique used to evoke the H reflex involves electrical stimulation of a mixed (i.e., containing both motor and sensory axons) peripheral nerve. Stimulation to evoke the H reflex involves both afferent sensory (from the point of stimulation to the spinal cord) and efferent motor (from the alpha motor neurons (MN) in the spinal cord to the neuromuscular junction) arcs as well as a direct (from the point of stimulation to the neuromuscular junction) efferent motor response (M wave).[5] When percutaneous stimulation of increasing intensity is applied, the Ia afferents that innervate muscle spindle sensory receptors, because of their larger diameter, will be recruited before the smaller diameter motor axons.[6] Therefore, the H reflex can be observed with or without an M wave. Measurement of the M wave is often used to monitor stimulus constancy [Figure 1].[7]

Increasing the level of electrical stimulation recruits additional Ia afferent and motor axons, thus yielding a

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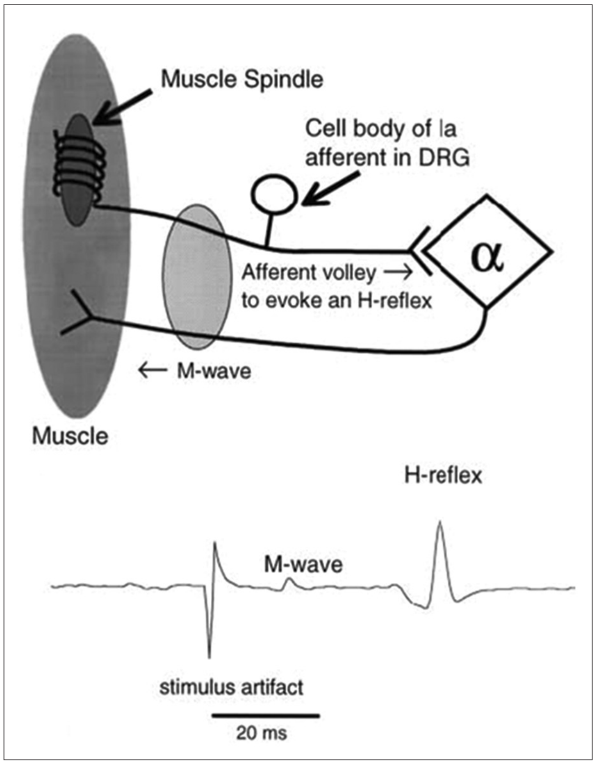

Figure 1: Simplistic schematic of the spinal processing of the monosynaptic component of the H reflex

larger reflex response and a larger M wave. Because of this, measurement of the M wave is often used to monitor stimulus constancy. The amplitude is used to monitor spinal activity whereas, latency usually assess the sensory and motor conductivity.[7] H/M ratio reflects the proportion of alpha MN pool recruited by Ia afferents and is used as a functional index of alpha MN pool excitability.[8] H reflex is used to assess the neuropathological changes in nerve root and spinal excitability at lumbosacral and cervical level 10. H reflex is affected by factors such as eye closure, head position, joint position and angle, remote muscle contractions, and muscle length.[9] There are several other factors affecting the normal value of H reflex amplitude and latencies. Latencies are affected by body height, extremity length, and age.[10] Amplitude is affected by muscle contraction, intensity of the stimulus, vestibular stimulation, movement of head and neck, temperature, type and training level of skeletal muscle and also maximum inspiration and tendon pressure.[11] Mechanical stimulation of cervical regions influences gain of H reflex pathway.[12] H reflex modulation during various head postures could be influenced by neural or mechanical factors. Neural factor may include vestibular, or tonic neck reflexes, and mechanical factor include compressive and decompressive mechanism of spinal nerve root.[13] The idea behind postural modification during H reflex recording is that it can cause further H reflex inhibition, indicating more compression of impinged nerve root or H reflex facilitation indicating decompression of nerve root. Such assumption cannot be supported unless the influence of normal head postural modification on H reflex in a healthy subject is studied.[14]

Hence, the purpose of the study is to find out the effect of various head postures on H reflex in healthy subjects.

MATERIALS AND METHODS

Healthy subjects were selected in the age group between 20 and 35 years. The subjects were selected from Srinivas college of Physiotherapy, Mangalore. The mean age of the subjects was 22.37 ± 1.23. Healthy subjects between age group of 20 and 35 years were included in studies. The patients with cervical disc prolapse, with a positive history of constant neck or radiating arm pain or radicular symptoms in past 6 months, any metabolic or systemic disorder was excluded from the study.

Written consent was taken from subjects who fulfilled the criteria. The procedure was explained to them. Baseline parameters such as age, gender, height (cm) and arm length (cm) was taken of each subject. Arm length was measured from the top of digit 3 to C6 spine with the arm pronated and abducted to a right angle.

The H reflex of the flexor carpi radialis (FCR) muscle was recorded using the methods of Sabbahi and Khalil.[15,16] The subject was seated upright with forearm resting on a pillow in the lap, and the elbow slightly flexed. The skin was abraded with fine-grade sand-paper and cleaned with spirit.

Then, the surface electrode was positioned with the active electrode on the motor point of the FCR and the reference electrode 2 cm lateral to it. To identify the belly of the FCR muscle, the subject was asked to flex and radially deviate the wrist, and mild resistance was provided to the flexed wrist over the thenar muscles. This causes contraction of the FCR, and the muscle belly was bulge at the middle point of the upper third of the forearm.

A surface bar electrode with coupling gel was placed on the medial surface of the lower third of the arm above the median nerve proximal to the cubital fossa. It was positioned with a negative electrode proximal to the positive electrode and in line with a median nerve. A ground surface metal electrode was positioned on the cubital fossa between the stimulation and recording sites. Electrode gel was used with all electrodes for good coupling.

The stimulation parameter was 0.5 ms pulses at a frequency of 0.2 pulses per second and intensity of H-maximum. The H reflex was monitored by the M-response to avoid any changes in the stimulation recording condition.

The H reflex was then recorded by the use of EP-EMG machine (NIHON KOHDEN-NEUROPACK MACHINE) with the subject in a sitting position. The subjects were asked to maintain 30 s hold at the end range of flexion, extension, rotation (to the right and then to the left), lateral bending (to the right and then to the left), retraction, and protraction of neck. These recordings were compared with H reflex recording in comfortable neutral head position.

Data were collected after subjects maintained 30 s sustained head position so that the effect of dynamic postural modification on H reflex was eliminated. Four readings of the H reflex will be recorded, and the mean was calculated for each head position.

Statistical analysis of data

Data were expressed as mean ± standard deviation. The repeated multivariate analysis of variance was used to evaluate the significance between the variables and a $P < 0.05$ was considered statistically significant [Figures 2 and 3].

RESULTS

Mean and S.D of age, sex, height, arm length of the study group is depicted in Table 1.

Table 2 shows means amplitude, mean latency of FCR H reflex in various head positions in normal subjects. The H reflex amplitude does not show any significant changes in various head position (*P* - 1.000) as depicted in Table 3. The lowest H reflex amplitude was 0.79 ± 0.5 mV in the neutral head position. The

Table 1: Demographic data of study group

Parameters	Mean±SD
Age (years)	22.37±1.23
Sex	21.18±1.2
Height (of what)	20.98±1.37
Arm length	21.48±2.2

Data are expressed as mean±SD. SD: Standard deviation

Table 2: Mean latency, the amplitude value of H reflex and H/M ratio values in various head position

Head position	Latency (ms)	Amplitude (mV)	H maximum/ M maximum (%)
Neutral	19.10±1.6	0.7±0.51	13.39±7.52
Flexion	19.13±1.6	0.8±0.54	14.29±7.56
Extension	19.25±1.7	0.8±0.49	14.43±8.02
right side flexion	19.18±1.6	0.8±0.52	13.53±8.09
left side flexion	19.17±1.6	0.8±0.54	14.36±8.45
right rotation	19.21±1.6	0.8±0.56	14.85±9.08
left rotation	19.20±1.6	0.8±0.53	15.16±8.77
Protraction	19.19±1.6	0.8±0.52	13.61±7.62
Retraction	19.24±1.6	0.8±0.60	13.95±7.85
P	0.18	0.56	0.33

Data are expressed as mean±SD. The repeated multivariate analysis of variance was used to evaluate the significance between the variables and a $P<0.05$ was considered statistically significant. SD: Standard deviation

Table 3: Comparison of neutral H reflex latency with other head position

Head position	Mean difference (I-J)	SE	*P*
Neutral			
Flexion	−0.035	0.045	1.000
Extension	−0.150	0.067	1.000
right side flexion	−0.080	0.047	1.000
Left side flexion	−0.070	0.062	1.000
right rotation	−0.113	0.053	1.000
Left rotation	−0.105	0.045	0.896
Protraction	−0.093	0.050	1.000
Retraction	−0.138	0.061	1.000

$P<0.05$ was considered statistically significant. SE: Standard error

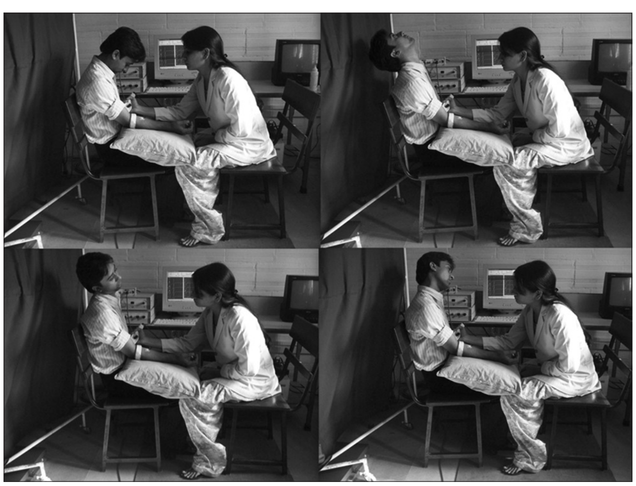

Figure 2: Head positions: Flexion, extension, Rt side flexion, Lt side flexion

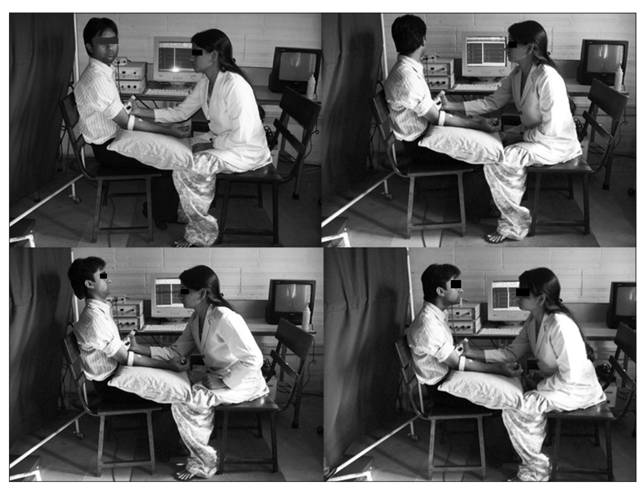

Figure 3: Head positions: Rt rotation, Lt rotation, protraction and retraction

highest was 0.87 ± 0.6 mV in retraction. The H reflex latency does not show any significant changes in various head position (*P* - 1.000) as shown in Table 4. The lowest H reflex latency was 19.1 ± 1.6 ms in the neutral position. The highest was 19.25 ± 1.7 ms in extension.

The H/M ratio does not show any significant changes in various head position (*P* - 1.000) as shown in Table 5. The lowest H/M ratio was 13.39 ± 7.5 in the neutral position. The highest was 15.16 ± 8.7 in left rotation position. In our study, we found that there were no significant differences in amplitudes, latencies and H/M ratios in various head positions.

DISCUSSION

The H reflex is a useful measure of the nerve conduction through the entire length of the afferent and efferent pathways, especially at the proximal segment of the peripheral nerve, which is inaccessible by routine surface stimulating and recording techniques. The H reflex is particularly useful in evaluating C6, C7, L5, and S1 radiculopathies.[17-19] The amplitude is used to monitor spinal activity whereas, latency usually assess the sensory and motor conductivity. This study was done on 40 healthy individuals (19 males and 21 females) with a mean age of 22.37 ± 1.23. The H reflex was then recorded by the use of EMG machine with the subject in a sitting position, 30 s sustained head movement into the end range of flexion, extension, rotation (to the right and then to the left), lateral bending (to the right and then to the left), retraction, and protraction. The H reflex amplitude, latency and H/M ratio was measured. These recordings were compared with comfortable neutral head position.[12] The obtained values of latency with various head positions in our study can be attributed to (1) an absence of the sensitivity needed to detect changes in neural conduction that occurs temporarily. This was expected because demyelination or axonal loss must occur before any changes in reflex latency could be recorded. The fact that the study was done on healthy subjects and for changes in latency there should be disordered conduction such as demyelination or significant damage of large diameter nerve axons.[20] The above studies suggest that for significant change in H reflex latency there should be demyelination or axonal loss change but as study was done of healthy subjects, so there were no such changes hence finding obtained in our study supports these results. Hence, in our study mean H reflex latency falls within the normal range. Our results suggest that the amplitude and not the latency parameter would appear to be more useful for detecting physiological processes and changes related to human postural control in contrast with previous reports.[21] The H reflex is thought to be affected by vestibular, visual, and somatosensory interactions. In this study, we did not find that the amplitudes of H reflex and M response and H/M ratio were significantly influenced by any neck and vestibular inputs that might be evoked by various head positions. Previous studies have indicated that very slow movement, e.g. 90° head rotation can compromise or cancel the tonic neck and labyrinthine reflexes. In our study, each subject was asked to maintain various head postures for 30 s. Hence, this static head postures canceled the effect of neck and vestibular afferents inputs.

Another possibility, which would also contribute to the nonsignificant differences in the responses during different head positions and strength, is the adaptation of reticular neurons. During the remote contraction of muscle, the excited impulses will transmit upward and centrally, which might ultimately facilitate the reticular neurons. However, the reticular response would soon adapt to repetitive stimuli as the maneuver sustained >2 or 6 s in duration. The duration of the maneuver was 30 s in our study. This would exhaust or reduce the augmented effect from the reticular formation. This may also explain the nonsignificant differences in H/M ratio among different neck positions. Because H/M ratio is theorized to reflect the proportion of alpha-MN participating in H reflex generation and may be influenced by the attenuated descending impulses from supraspinal relays, it is therefore possible that alpha MN were not strongly reinforced. It is the duration of the maneuver rather than neck positions change that modulates the

Table 4: Comparison between neutral H reflex amplitude and other head position

Head position	Mean difference (I-J)	SE	*P*
Neutral			
Flexion	−0.060	0.044	1.000
Extension	−0.054	0.039	1.000
right side flexion	−0.005	0.050	1.000
Left side flexion	−0.042	0.041	1.000
right rotation	−0.067	0.042	1.000
Left rotation	−0.055	0.046	1.000
Protraction	−0.005	0.046	1.000
Retraction	−0.077	0.065	1.000

$P<0.05$ was considered statistically significant. SE: Standard error

Table 5: Comparison between neutral H/M ratio and other head position

Head position	Mean difference (I-J)	SE	*P*
Neutral			
Flexion	−0.905	0.779	1.000
Extension	−1.041	0.665	1.000
right side flexion	−0.141	0.855	1.000
Left side flexion	−0.975	0.713	1.000
right rotation	−1.469	0.730	1.000
Left rotation	−1.775	0.915	1.000
Protraction	−0.221	0.796	1.000
Retraction	−0.563	0.912	1.000

$P<0.05$ was considered statistically significant. SE: Standard error excitability of MN.[22,23] Hence, the possible causes for nonsignificant changes in amplitude with various head positions can be attributed to one fact that nerve root impingement in younger population ("up to 50 years"), may have resulted from disc herniation but as subjects in present study are healthy subjects without any cervical problems, it is not possible to find any significance between various head positions.

Limitations of the study

Nonsignificant changes in amplitude with various head positions observed in the present study could be due to the small sample size consisting of normal healthy subjects aged between 20 and 35 years old. Future studies on a larger population with and without cervical problem in different age groups are warranted.

CONCLUSION

From the present study, we conclude that the H reflex latencies, amplitudes and H/M ratios did not show any significant difference between various head positions when compared with neutral head position. Therefore, it can be taken into consideration that a different head position does not affect H reflex parameters.

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