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Original Article

Effect of Menstrual Cycle in H-reflex of Abductor Pollicis Brevis of Healthy Adult Female Volunteers

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Abstract

Hoffmann reflex (H-reflex) is an electrical analogue of the stretch reflex and it is one of the late responses seen in a nerve conduction study. H-reflex is absent in proximal nerve lesions and are advocated in patients with lumbosacral and cervical nerve root lesions, particularly involving S1 radiculopathy. It is a known fact that there is a change in body temperature during menstrual cycle and the change in body temperature affects conduction velocity. However, no studies are available to indicate the latency and amplitude changes in Abductor Pollicis Brevis (APB) H-reflex during menstrual cycle. The present study was carried out on 50 healthy adult female volunteers between age group of 20-30 years. H-reflex recording was done using digital nerve conduction/EMG/EP machine (Recorders Medicare System, India). During early follicular and mid-luteal phase of the participants, H-reflex recordings were done between 9.00a.m to 11.00 a.m, in the electrophysiology laboratory,temperature maintained at 22±3ºC. H-reflex was obtained during stimulation of median nerve while abducting the thumb. Latency and amplitude of APB H-reflex obtained during two phases of menstrual cycle were compared.The median value of latency (25.17 ms) of APB H-reflex in the mid luteal phase was significantly ($p<0.001$) shorter as compared to early follicular phase (25.83 ms). The median value of amplitude (1177.50 µV) of APB H-reflex in the mid luteal phase was significantly ($p<0.001$) higher as compared to early follicular phase (910 µV). This was possible due to the significant ($p<0.01$) higher body temperature in the mid luteal phase. Hence, phases of the menstrual cycle should be considered while performing and interpreting the H-reflex in females.

Introduction

H-reflex or Hoffmann's reflex is the electrical analogue of stretch reflex. The H-reflex is equivalent to the stretch reflex which is elicited by a mechanical tap to the tendon. The group Ia sensory fibers and alpha motor neurons form the afferent and efferent arcs of the H-reflex. The primary difference between the H-reflex and the spinal stretch reflex is that the H-reflex bypasses the muscle spindle and is therefore a valuable tool for assessment of monosynaptic reflex activity in the spinal cord. H-reflex is used to assess the nerve conduction in the proximal segment of nerves. Hence, H-reflex testing helps in detection of more proximal segment nerve lesions like Guillain-

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Barre syndrome, plexopathies and radiculopathies that might be missed in routine peripheral conduction studies (1).

Conduction of nerve impulse is known to be affected by various factors like age, myelination, diameter of the neuron and body temperature. An increase in nerve conduction velocity (NCV) by 5%, per degree centigrade increase in the body temperature is well established (2).

It is known that during the mid-luteal phase of the menstrual cycle, the body temperature increases by 0.5 to 1°C. This rise in temperature during the menstrual cycle may affect nerve conduction velocity (3). During routine nerve conduction studies in females, changes in conduction velocity during the phases of the menstrual cycle might not be noticed as the velocity is measured in shorter segments of the peripheral nerve. However, the change in conduction velocity might be apparent in studies using longer segments of the nerve as in H-reflex.

The present study was designed to determine the effect of the menstrual cycle on the latency and amplitude of the H-reflex. The findings of this study will be helpful while interpreting the results of the carried out H-reflex in female patients in different phases of the menstrual cycle.

Materials and Methods

The present study was conducted in the department of Physiology, Pondicherry Institute of Medical Sciences (PIMS). Ethical clearance was obtained from institutional ethics Committee. Informed written consent was obtained from each participating subject before including them in the study. This was an observational study on a single group of 50 clinically normal females in the age group of 20 to 30 years in and around PIMS. Subjects with history of diabetes mellitus, carpal tunnel syndrome, thyroid dysfunction, myopathy, oral contraceptive pills intake were excluded from the study.

Procedure

Menstrual cycle charting was done for 2 months to confirm regularity. During early follicular phase, subjects were tested at the same time each day in the electrophysiology lab, at Pondicherry Institute of medical Sciences, Puducherry, with reduced sound and light at 22±3°C. The subject was asked to lie down comfortably in the supine position. The skin over the palm and dorsum of the forearm was thoroughly cleaned with spirit to decrease the impedance. The subject's dominant hand was placed in an extended position with support. The subject was asked to contract the abductor pollicis brevis (APB) and to maintain 10% maximal isometric contraction of APB. In normal adults, the APB H-reflex cannot be recorded under resting condition due to inhibition of APB H-reflex by higher centre (4). Collision mechanism due to antidromic impulses in the motor axons simultaneously created by the electrical stimulus while recording H-reflex may also be responsible for the absence of H-reflex at rest. However, during isometric contraction, the inhibition from the higher centre is abolished. Thus, during voluntary contraction, H-reflex from APB was elicited by electrical stimulation of the median nerve. Stimulus intensity was 2-5mA and duration of 1 ms delivered from a constant current stimulator through bipolar stimulating electrodes. Stimulus repetition rate was once in every 2 seconds. APB H-reflex was recorded using a digitalized nerve conduction/ EMG/EP machine (Aleron, Recorders Medicare systems, Chandigarh, India). 100 responses were averaged. H-reflex latency and amplitude of the abductor pollicis Brevis (APB) were obtained. H-reflex latency was measured from the stimulus artefact to the first deflection from the baseline and the peak to peak amplitude of the evoked H responses were measured digitally (Fig. 1). Similar procedure was repeated for the same subject in the mid-luteal phase.

The mean values of latency and amplitude of the H-reflex obtained in early follicular phase and mid-luteal phase were compared.

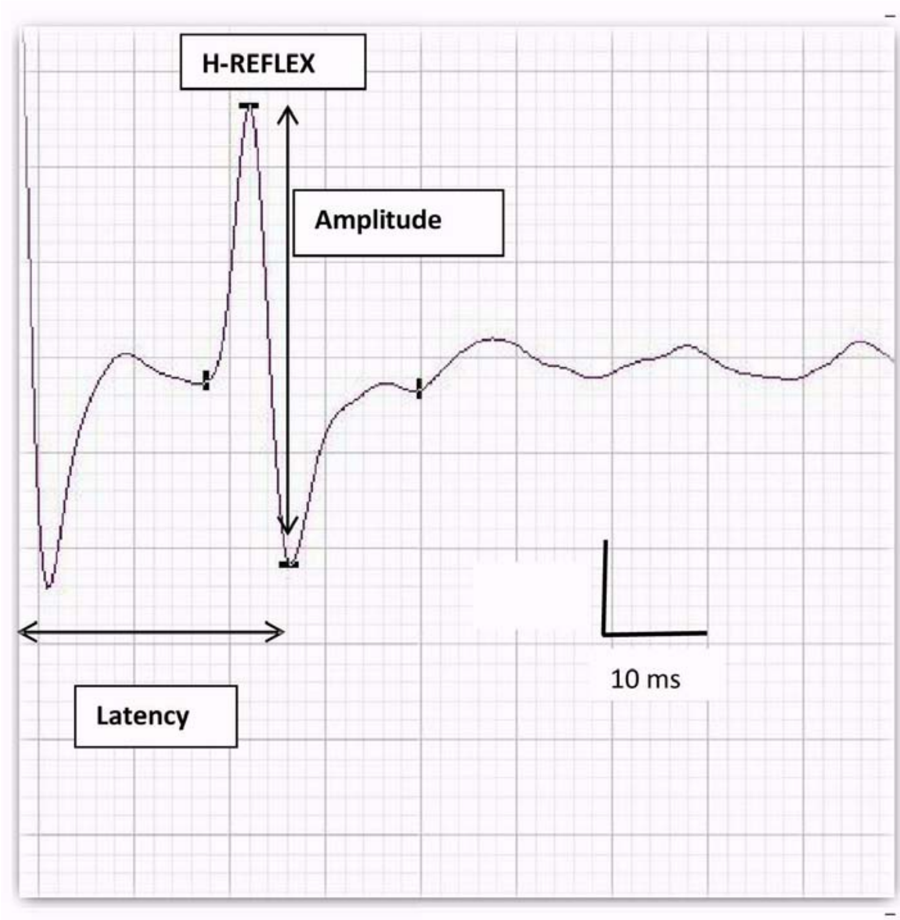

Fig. 1 : A Typical Recording of APB H-Reflex.

Statistical Analysis

- Results were tabulated and analysed. The Mean±SD values of H-reflex latency and amplitude of APB during early follicular phase and mid-luteal phase were obtained.

- Paired Student's – t – test could not be used as the data of difference in latency, amplitude and temperature between early follicular phase and mid-luteal phase were not normally distributed. Hence, Wilcoxon signed rank test was used.

- Wilcoxon signed rank test was used to compare the corresponding values of latency, amplitude and temperature of the H-reflex of the early follicular phase and mid-luteal phase.

Results

APB H-reflex was studied in 50 apparently healthy females. Electrically stimulated and contraction facilitated APB H-reflex in the dominant hand was recorded in all subjects during early follicular phase and mid luteal phase.

H-reflex Latency:

- The median value of APB H-reflex latency was shorter (25.17 ms) during mid-luteal phase compared to early follicular phase (25.83 ms)

- Wilcoxon signed rank test was used for testing the significance. APB H-reflex latency was significantly shorter in mid-luteal phase compared to early follicular phase with p value less than 0.001 (Table I).

H-reflex Amplitude:

- The median value of APB H-reflex amplitude was greater (1177.50 µV) during mid-luteal phase compared to early follicular phase (910.00 µV).
- The difference in amplitude during both the phases of menstrual cycle was statistically significant (Table II).

Body Temperature During Menstrual Cycle:

- The median value of body temperature (36.7°C) during mid-luteal phase was higher compared to early follicular phase (36.2°C).
- The difference in temperature during both the phases of menstrual cycle was statistically significant ($p<0.001$) (Table III).

Discussion

The result of our study showed that the median value of latency of APB H-reflex was significantly shorter (median value = 25.17 ms) in the mid-luteal phase as compared to the early follicular phase (median value=25.83 ms). APB H-reflex amplitude was higher during the mid-luteal phase (median value = 1177.50 µV) as compared to the early follicular phase (median value = 910.00 µV).

The oral temperature recorded from the subjects, also was found to be significantly higher during the mid-luteal phase as compared to the early follicular phase ($p<0.001$).

As the laboratory temperature was maintained constant, this variation in body temperature could be due to cyclical changes in the secretion of female sex hormones in the various phases of the menstrual

TABLE I: Shows the mean latency, standard deviation and median values in both the early follicular phase and mid-luteal phase.

Variable		*Mean*	*SD*	*Median*	*Percentile*		*'p' value*
					25th	*75th*	
Latency (ms)	Early follicular	25.87	1.74	25.83	24.41	27.17	<0.001*
	Mid-luteal	25.31	1.46	25.17	24.25	26.36	

*Wilcoxon Signed Rank Test

TABLE II: Shows the mean amplitude, standard deviation and median values in both early follicular phase and mid luteal phase.

Variable		*Mean*	*SD*	*Median*	*Percentile*		*'p' value*
					25th	*75th*	
Amplitude (µV)	Early follicular	960.70	410.56	910.00	695.83	1100.00	<0.001*
	Mid-luteal	1277.43	471.89	1177.50	882.50	1497.50	

*Wilcoxon Signed Rank Test

TABLE III: Shows the Mean±SD values of body temperature in both early follicular phase and mid luteal phase.

Variable		*Mean*	*SD*	*Median*	*Percentile*		*'p' value*
					25th	*75th*	
Temperature (°C)	Early follicular	36.12	0.67	36.20	35.90	36.50	<0.001*
	Mid-luteal	36.67	0.31	36.70	36.40	36.90	

*Wilcoxon Signed Rank Test

cycle. It is well established that the plasma level of estrogen is higher during the early follicular phase and that of progesterone is higher during the mid-luteal phase (5).

Increase in temperature during mid-luteal phase was probably due to thermogenic effect of progesterone as proved by the following studies:

Animal study was done by Marrone BL et al., to know the effect of gonadal hormones and body temperature in rats during estrous cycle. He found that rise in body temperature was directly related to progesterone and inversely proportional to estrogen (6).

Strott JR et al., did a study in 18-35 year old females and found there is an increase in body temperature during mid-luteal phase. Thermogenic action of progesterone was confirmed by hormonal assay (7).

Studies were done by Lee et al., and Kattapong et al., by monitoring core body temperature and plasma level of estrogen and progesterone during menstrual cycle. He found a positive correlation between plasma progesterone level and body temperature during the mid-luteal phase (8, 9).

Temperature is known to have a major influence on nerve conduction velocity (NCV). This is because temperature variation in the tissues surrounding the nerve alters the opening time of voltage gated calcium channel and also alters the resistance of the skin surface there by affecting NCV and latency.

Lowering of the temperature prolongs the open time of the voltage gated sodium channel, thereby generating a larger and longer action potential with reduction in the nerve conduction velocity and increasing the latency (10). However, study done by Tiwari S et al concluded that the latency, amplitude and conduction velocity of median motor nerve is not affected by temperature variation in different phase of menstrual cycle of female (11). This may be due to short segmental nerve studied and minimal change in body temperature like 0.5°C. But in H reflex study, longer nerve segment is involved and thus H-reflex is likely to be influenced by the small change in body temperature during menstrual cycle.

Dewhurst et al carried out a study to determine the effect of temperature on soleus H-reflex among 10 young and 10 older women at three different muscle temperatures. He found that cooling increased and warming decreased the H-reflex latency. This is because cold temperature will decrease the facilitation in reflex output along with a delayed reflex response (12).

Chen et al., measured the soleus H-reflex in rat and found out H-reflex amplitude was largest in the late morning and smallest around midnight and showed a marked diurnal variation which are basically due to the influence of temperature on conduction velocity and excitability of the tibial nerve, soleus muscle and the motor neuron pool (13).

H-reflex latency increased in lower limb muscles on cooling because it increases the excitability of motor neuron pool and suppression of muscle spindle activity (14).

Conclusion

In the present study, the median value of APB H-reflex latency of the dominant hand during the mid-luteal phase was significantly shorter as compared to the early follicular phase. The median value of APB H-reflex amplitude of the dominant hand during the mid-luteal phase was significantly greater than obtained during the early follicular phase. Body temperature was found to be significantly higher in the mid-luteal phase as compared to the early follicular phase.

Hence, the shorter latency and higher amplitude of APB H-reflex in the mid-luteal phase observed in our study may be explained by increased nerve conduction velocity in median nerve which would have occurred either due to an increase in body temperature or due to the thermogenic effect of progesterone during the mid-luteal phase of menstrual cycle.

From this study we conclude that menstrual cycle affects H-reflex. Hence, it is suggested that the phases of the menstrual cycle should be considered while performing and interpreting the H-reflex in female patients in the age group of 20-30 years having normal regular menstrual cycle.

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Conflict of Interest:

None

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Nil

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Obtained

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