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THE EFFECT OF THE TRANSCENDENTAL MEDITATION AND TM-SIDHI PROGRAM ON THE PAIRED HOFFMAN REFLEX

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Subjects practising the TM-Sidhi programme demonstrated faster recovery of the paired H reflex than a control group practising only Transcendental Meditation.—EDITORS

The paired H reflex was investigated in an experimental group (N = 6) practicing the Transcendental Meditation (TM) and TM-Sidhi program and in a control group (N = 6) practicing only the TM program. At each delay interval studied (50 msec – 1000msec) the experimental group demonstrated significantly faster recovery of the paired H reflex than the control group. These results indicate that the TM-Sidhi program produces neurophysiological changes distinct from the TM program and that the paired H reflex may be a useful tool for further delineating the benefits of this program.

INTRODUCTION

In 1918 Hoffman (6) discovered that submaximal stimulation of the tibial nerve produced a delayed response in calf muscles. He surmised that this delayed response was the result of a monosynaptic reflex similar to the tendon reflex.

In 1950 Magladery (9) designated this delayed response the Hoffman, or H wave, and further studies with McDougal supported Hoffman's view that the H reflex was a monosynaptic (two neuron) reflex. Continued investigation found that not only was an H wave generated from tibial stimulation but also an M wave which characteristically appeared before the H wave; approximately 15 msec after stimulus onset. This first potential results from direct stimulation of motor nerve fibers whereas the H wave results from direct activation of the Ia fibers.

As an electrophysiological measure, the H reflex has been widely used in the study of both normal (1, 8, 15, 17) and abnormal (1, 10, 11, 12, 14) human physiology. In a review and classification article by Braddum and Johnson (3), the four most practical and diagnostically helpful of the suggested clinical uses of the H reflex are outlined.

The fourth suggested clinical use listed in this review represents a second method for utilizing this monosynaptic reflex. In this "paired H reflex", not one, but two stimuli to the tibial nerve are used. Consequently two H waves are elicited rather than one; the first from direct stimulation of the tibial and the second from both tibial stimulation and input from higher cortical centers. In this method the magnitude of the second H wave is compared to that of the first under various paired-stimuli delay intervals. The difference in application between the paired H reflex and the single H reflex is as follows: since no internuncial neurons are involved in the single H reflex, the size of the H wave provides a measure of motoneuron excitability under a variety of experimental and pathological conditions (4), whereas in the paired H response, internuncial neurons are involved and the result is a measure of the quality of supraspinal influences on the reflex, and the degree of cortical activation (16).

Researchers at Maharishi European Research

University (5) have used the paired H reflex, along with measurements of EEG coherence and creativity, on individuals participating in an advanced Transcendental Meditation (TM) program. Results indicated significant correlations between EEG alpha coherence, creativity, clarity of experience of transcendental consciousness, and H-reflex recovery. Compared to population norms, participants' recovery time of the H reflex was significantly faster even at short stimulus intervals.

The present study is concerned with further determining the value of the paired H reflex as a measure for understanding the neurophysiological effects of the TM and TM-Sidhi program.

METHODS

SUBJECTS—The subjects were 12 male volunteers, attending either undergraduate or graduate programs at Maharishi International University. The experimental group consisted of 6 individuals practicing the TM-Sidhi program (age range 20 – 29, mean 25 years; length of practice of the TM program 5 – 8 1/2 years, mean 7 years; length of practice of the TM-Sidhi program 6 months – 2 1/2 years, mean 1 1/2 years); the control group consisted of 6 individuals practicing the TM program (age range 18 – 26, mean 23 years; length of practice of the TM program 4 – 7 years, mean 6 years).

APPARATUS AND PROCEDURE—Reflexes were elicited by percutaneous electrical stimulation (square wave pulses of 1 msec duration) applied to the posterior tibial nerve in the region of the popliteal fossa. The stimulating electrode was fixed securely over the tibial nerve, with stimulus intensity set to produce the maximum H/M ratio. Electromyographic signals were recorded from bipolar surface electrodes (2 cm apart) located longitudinally over the soleus muscle approximately 6 cm below the gastrocnemius. The EMG was amplified by a Data Inc. differential amplifier prior to an oscilloscope display.

Reflexes were elicited with subject seated, eyes open, left leg extended, knee slightly flexed and leg propped to maintain a neutral position. Stimuli delay intervals were 50, 70, 100, 150, 200, 250, 333, 500, and 1000 msec, with each interval tested three times and the results averaged. The experimenter and the equipment—a Grass Model 509 square wave stimulator and a Tektronix T 912 oscilloscope—were located in the adjacent room.

Since H-wave magnitude was the variable being tested we had to ensure that any change in the H wave was a result of alteration of motoneuron excitability or supraspinal influence, and not displacement of the stimulating electrode or the underlying nerve. The M wave was the very convenient control for monitoring the H wave since the M wave is directly under the influence of electrode placement: any change in the H wave due to shifting of the nerve or electrode is immediately apparent via the changes in M-wave magnitude. With any subject, changes in the M wave were the grounds for repeating the test. If the H wave changed and the M wave remained constant, we took this to be from alteration of motoneuron excitability.

RESULTS

The results are summarized in table 1 and figure 1. A *t*-test for independent means was run for each delay interval between the two groups. Significance was obtained at each interval.

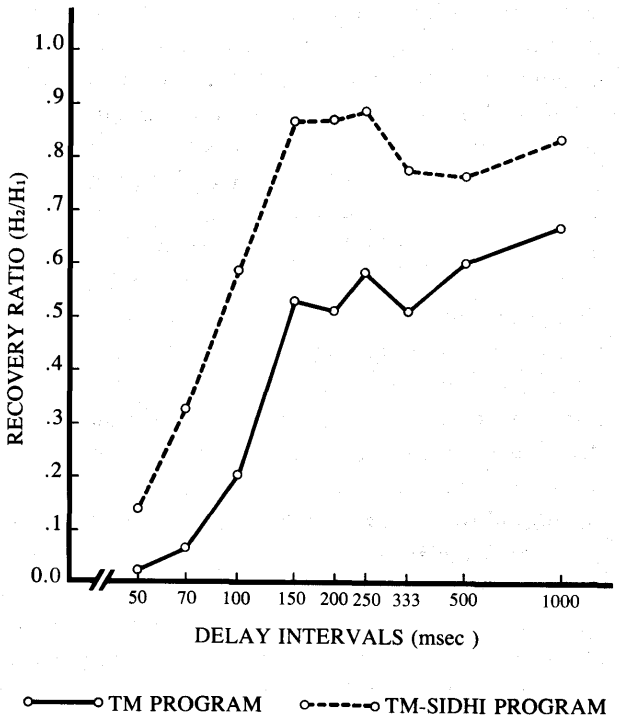

FIG. 1. PAIRED H-REFLEX RECOVERY CURVES FOR BOTH THE TM AND TM-SIDHI GROUPS. The TM-Sidhi subjects had significantly faster recovery at each delay interval.

TABLE 1

PAIRED H-REFLEX RECOVERY RATIOS FOR DIFFERENT DELAY INTERVALS

	TM SUBJECTS		TM-SIDHI SUBJECTS			
Delay Interval (msec)	Mean (H_2/H_1)	S.D.	Mean (H_2/H_1)	S.D.	t	p*
50	.014	(.016)	.142	(.099)	3.1	.011
70	.061	(.053)	.328	(.234)	2.7	.021
100	.208	(.108)	.588	(.171)	4.5	.001
150	.530	(.262)	.869	(.131)	2.8	.017
200	.513	(.237)	.876	(.092)	3.5	.005
250	.584	(.232)	.888	(.128)	2.7	.019
333	.510	(.227)	.777	(.063)	2.7	.019
500	.603	(.139)	.766	(.043)	2.7	.020
1000	.672	(.107)	.835	(.047)	3.3	.007

* $df = 10$, two-tailed t-test.

DISCUSSION

The results indicate that the TM-Sidhi program produces neurophysiological changes distinct from the TM program, and that practice of the TM-Sidhi program results in a faster recovery of the paired H reflex at intervals 70 – 1000 msec. The results also indicate that the paired H reflex may be a useful tool for further delineating the benefits of this program.

The physiological explanations of the H reflex after paired stimuli has been the source of considerable controversy. The decrement in reflexes which normally results with successive trials, according to some authors, may be called habituation and should be considered to be of supraspinal origin, whereas other authors consider it a strictly spinal phenomenon. An argument against reflex decrement as a spinal process could be provided if the reflex amplitude were to co-vary with changes in activation at the supraspinal level. To test this Van Boxtel (16) selected EEG alpha activity as an indication of changes in supraspinal activation, and hypothesized that reflex decrement would not be observed if the alpha parameters remained constant. On the other hand, a change of alpha parameters indicating a decrease of cortical activation, would correlate with an increase in reflex amplitude. Van Boxtel's results supported the notion that changes in reflex response are accompanied by changes in cortical activation. A decreasing alpha index was accompanied by decreasing reflex amplitudes; under conditions of stable alpha index and amplitude, reflex amplitudes did not change significantly.

Research on the Transcendental Meditation technique has found that individuals practicing the technique markedly increase the amount of alpha activity in the EEG. Banquet (2) and Kras (7) reported a spreading of large amplitude alpha activity to anterior regions of the brain and further noted that practitioners of the technique spontaneously maintain alpha activity after the meditation sessions while sitting with eyes open, indicating stabilization of the effects of meditation in activity.

The high incidence of frontal, as well as central and occipital alpha during the technique suggests that all areas of the cortex are simultaneously in a de-excited state. Other physiological changes associated with the TM technique also suggest such a generalized quieting of central nervous system functioning.

Practice of the TM-Sidhi program has been found to produce even greater alpha activity and coherence than the TM program (13). It is possible that by stabilizing the increased alpha activity and coherence in normal routines (outside of meditation), the mind can more effectively process information and consequently respond most appropriately and with greater discrimination to sensory input. This may be the underlying phenomenon of the decreased inhibition and faster recovery of the paired H reflex in participants of the TM-Sidhi program.

In conclusion, the results of this study indicate that the paired H reflex may be a useful method for evaluating and understanding the effects of the advanced TM-Sidhi program. Further longitudinal research, including measurements of EEG activity, will be necessary to substantiate this effect.

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