The Transcendental Meditation Technique and Acute Experimental Pain

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The Transcendental Meditation (TM) technique decreases the distress associated with the experience of acute experimental pain. Fifteen advanced mediators and 15 controls were administered the cold pressor test before and after a 20 minute period of meditation (TM group) or relaxation (control group). Verbal reports of the intensity of pain sensation and pain distress were obtained at intervals during the cold pressor trials. Skin resistance and heart rate were measured throughout. The mean distress level for the TM group was significantly lower than controls during both trials; the mean pain sensation level for the TM group did not differ significantly from controls during either trial. Heart rate and skin resistance changed for both groups in the expected manner, with no significant differences between groups. The validity, implications, and possible causes of these results are discussed.

The Transcendental Meditation technique has previously been found to relieve anxiety and improve the individual's reaction to stress in a variety of ways. We now report that TM also decreases the distress associated with the experience of acute experimental pain.

The Transcendental Meditation (TM) technique, as taught by Maharishi Mahesh Yogi, has been described (1) as a simple, natural, effortless means to establish inner quietness, uniquely deep rest, and expanded mental awareness. During practice of the technique an individual sits comfortably with eyes closed. Using a technique learned during precise and individualized personal instruction, the meditator allows the mind to perceive a thought at progressively earlier and more satisfying steps in its development, until the mind transcends the subtlest level of mental activity and experiences the "least excited" state of consciousness, "pure" or "transcendental" consciousness, a state of complete mental quiesence with maintained awareness (1). This experience is described as extremely peaceful, yet full with lively potentiality. The purpose of the technique is to prepare body and mind to return to activity with reduced stress, and with greater mental orderlines, clarity, and creativity. TM is typically practiced for 15–20 min twice daily and requires no concentration, mental or physical control, beliefs, moral tenets, or changes in diet or lifestyle (1). TM has apparently been taught in a uniform and systematic manner to over one million people.

The TM technique has been readily available for scientific study and has been examined more extensively than any other meditation procedure (2). The range of reported effects attributed to the practice of TM includes decreased anxiety (3), increased self-actualization (4), and increased creativity (5). Among the physiological effects are increased au-

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Received for publication February 12, 1980; final revision received November 4, 1980.

0033-3174/81/02015708$02.50

tonomic stability (6), decreased plasma cortisol (7), decreased blood pressure in hypertensives (8), and improvements in asthmatic conditions (9). Various control conditions have been used in these studies. Some investigators chose to measure meditation and control groups shortly before and again several weeks after the meditation subjects received instruction in the TM technique. In these studies the control subjects received approximately the same intellectual knowledge but were not instructed in the TM technique (4, 5) or were taught a different technique, a method of passive relaxation (3). In expanded versions of this design the controls subsequently learned TM and were then remeasured (6, 7, 9). Two studies combined these approaches (3, 9). Random assignment of subjects to groups is difficult to arrange in this type of research and was employed in only one of the cited studies (3). In several instances the experimenters were blind to the experimental design.

A meditation technique with such a broad range of physiological and psychological effects, including relaxation and reduction of anxiety, might alter the experience of pain. Indeed Mitchell and White cite recent successful application of TM and a combination of TM and muscle relaxation techniques in the treatment of migraine (10). Buckler also found TM effective in relieving muscle tension pain (11). In related studies, Grzesiak stated that simple relaxation techniques are effective with chronic pain (12) and French and Tupin reported that a mantra type of meditation proved a useful adjunct in management of anxiety states and pain of moderate severity (13).

The experience of pain, being private, would not appear to be readily quantifiable. However, verbal report scales on the experience of pain, combined with a posttest questionnaire and interview, have proven reliable over extended use (14–16). Hilgard distinguishes two separable components of the pain experience, a sensory component (the perception of pain) and a distress component (the emotional reaction to a painful stimulus) (17). This distinction is illustrated by morphine's considerable influence on the distress caused by pain and its minimal influence on the perception of pain (17, p. 30). In this study we have employed this distinction and the verbal report scales developed by Hilgard, and have also measured two physiological responses to pain, skin resistance and heart rate.

METHODS

The experimental group consisted of 15 advanced practitioners of the program (11 men, 4 women). They were solicited from the San Diego center for the Transcendental Meditation program. They had practiced TM for a mean of 9 years, ranging from 3.5 to 12 years. Each was a qualified teacher of TM and a graduate of the TM-Sidhi program, an advanced meditation program. The mean age was 28 years with a range of 20 to 41 years, and the mean education level was 16 years. The control group consisted of 15 nonmeditating volunteers (11 men, 4 women). Several were Veterans Hospital employees involved in pain research. The group's mean age was 27 years with a range of 18 to 40 years. The mean education level was 17 years. The Taylor Anxiety Trait Questionnaire was administered to all subjects to control for possible differences in trait anxiety. This anxiety scale consists of 50 questions from the Minnesota Multiphasic Personality Inventory. The two-tailed *t*-test for independent samples did not show a significant difference in mean anxiety scores between the two groups. Thus, the groups were matched on size, sex, age, education, and anxiety level.

Pain was induced by means of the cold pressor test. The subject inserted his arm in a 30 × 45 × 60 cm ice bath with circulating water maintained at 10°C. The subject's arm was separated from the ice in the bath by a wire mesh. Preliminary experiments

indicated that if the water was maintained at 0°C instead of 10°C the subjects withdrew their arms within 15–30 sec, which did not provide sufficient time for a series of verbal reports. Cold pressor pain changes in an orderly and linear fashion with temperature (17, pp. 339–340).

Heart rate and skin resistance were measured on a Grass model 7 polygraph. For heart rate an electrocardiogram was obtained from gold-plated electrodes on the left wrist and left ankle. Skin resistance was measured from silver-silver chloride electrodes placed on the left thenar eminence and mid-palm.

The subject sat in a comfortable chair throughout the session. After the electrodes were applied the experimenter read standard instructions to the subject regarding the pain induction technique, the protocol, the distinction between pain sensation and distress, and the verbal response scales used for reporting the levels of pain and distress. The instructions emphasized that pain and distress are not necessarily equivalent. For the pain state scale 0 represented no pain sensation and 10 indicated "so much pain that you want to remove your hand from the water." For the distress scale 0 meant no distress and 10 represented "the maximum amount of distress you can withstand." Subjects were instructed to use the same scales in both test periods.

Heart rate and skin resistance were measured throughout the experiment. After the instructions were read the pre-TM/relaxation cold-pressor test (trial 1) was administered, lasting from 45 to 300 sec depending on the subject's tolerance. Pain state reports were obtained at 5 sec intervals throughout the cold pressor test, and distress state reports every 15 sec. Some subjects had not reached their maximum tolerable pain level after 300 sec but the test was terminated at this point because numbing of the hand probably prevented any further rise in pain sensation.

During a 5 min recovery period the subject's hand was wrapped in a towel and thus warmed up to some extent. Control subjects were then instructed to "relax as easily as possible" with eyes closed and experimental subjects were instructed to practice the TM technique. The experimental subjects had previously been instructed to use only the TM technique and not TM-Sidhi techniques during this period. After 20 min each subject was given 3 min to open his eyes. After an additional 3 min, a second cold-pressor test was administered (trial 2), identical to the first. After the recovery period for the second test a brief interview was conducted to evaluate the subject's experience and assess the validity of the subject's pain and distress reports.

Various aspects of the experimental procedure were designed to reduce experimenter influence on the subjects to a minimum. For example, instructions to the subjects were standardized, and other discussion was minimized. The subject was positioned such that he could not observe the experimenter. In addition to these precautions, the treatment itself greatly reduced the significance of potential experimenter influence; the intense pain induced during the cold-pressor test probably becomes the dominant influence during the experiment.

Many subjects withdrew their arms from the ice bath before the end of the trial period, which precludes the use of analysis of variance for the data in Figure 1. Instead, we pooled all the subjects (TM and control groups at trials 1 and 2) to determine the "half-life" of the experiment, i.e., the time at which half of the subjects had either reached their maximum pain level and withdrew their arms from the ice bath or had come to a plateau in their pain reports such that their pain level did not increase during the subsequent 30 sec. Of 60 pooled subjects, 30 had arrived at this point within 60 sec after the start of the experiment. Therefore 60 sec was used as the sampling time for the data in Table 1.

With the protocol described above we can expect a ceiling effect in the Figure 1 data at around 10, and hence a skewed sample distribution. For this reason we employed nonparametric statistics in Table 1. For both pain scales and both groups, we evaluated the change from trial 1 to trial 2 using the sign test. For both pain scales and both trials, we compared the TM and control groups by means of the Mann-Whitney U-test.

Heart rate and skin resistance were determined by visual inspection of the polygraph record. For each subject the mean value of each parameter was estimated for the period starting 50 sec and ending 70 sec after the onset of each cold pressor test (i.e., 60± 10 sec). Group means of these values were statistically compared as described above.

RESULTS

The reports of the TM group on the intensity of perceived pain were not significantly different from those of the control group, but the TM group's reports indicated significantly less distress associated with the experience of acute experimental pain than the control group.

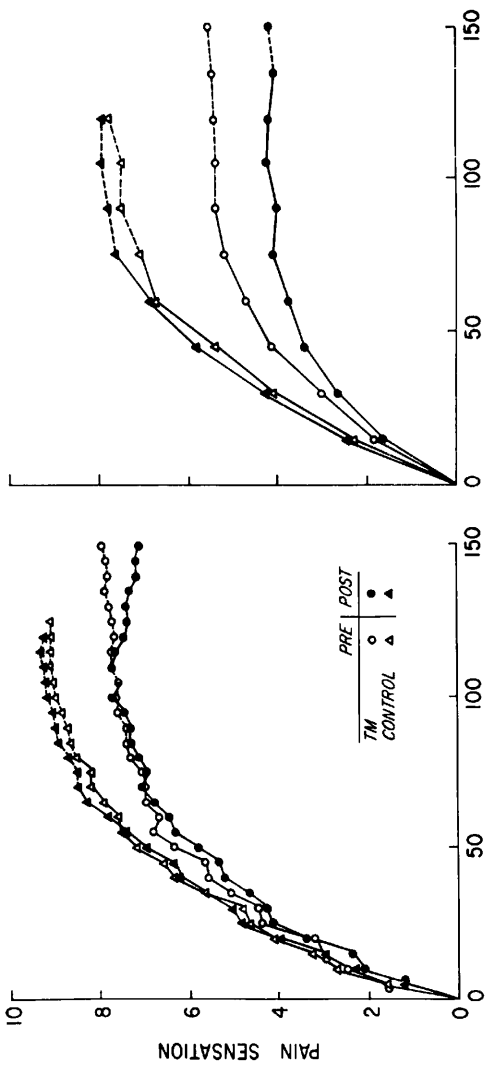

Fig. 1. Pain sensation and distress. Graph shows verbal reports, over time, of two components of the experience of acute experimental pain, sensation (left) and distress (right). Many subjects reached their maximum level of tolerable pain before the end of the trial period and withdrew their arms from the ice bath. In this circumstance the subject's final report before withdrawing was used to calculate the mean group value for all subsequent sample times; each point is thus the mean of 15 individual scores. Of the 15 subjects in each group at each trial, 11 remained at the point where the solid line changes to a broken line, and 7 or less remain if the line stops before the end of the trial period.

TABLE 1. Mean Pain Sensation and Distress Reports[a] and Mean Time of Arm Withdrawal (sec)

	Trial 1 (pre-TM/relax)	Trial 2 (post-TM/relax)
Pain Sensation		
TM	6.7	6.6
Controls	7.6	7.7
Distress		
TM	4.8	3.8
Controls	6.5	6.4
Withdrawal		
TM	123	135
Controls	115	113
Trial 1 × Trial 2[b]	*TM*	*Controls*
Pain Sensation		
p	NS	NS
Distress		
p	0.02	NS
Withdrawal		
p	0.03	NS
TM × Controls[c]	Trial 1	Trial 2
Pain Sensation		
U	95.5	88.5
p	NS	NS
Distress		
U	73.5	57
p	0 05	0.01
Withdrawal		
U	67.5	74
p	0.03	0.05

[a] Mean values on a 0–10 scale at 60 sec, as described under Methods.
[b] Sign test (one-tailed); NS = not significant, i.e., >0.05.
[c] Mann Whitney U-test (one-tailed).

Both groups experienced approximately the same rate of increase in perceived pain through both trials (Fig. 1), as others have found (14, 16, 18). There was no significant difference in perceived pain between the groups at either trial and no significant change from the first trial to the second for either group (Table 1).

The results on the distress component are in marked contrast to those on the sensory component (Fig. 1). The meditators reported significantly less distress in the second trial as compared to the first trial, whereas there was no significant change for the controls (Table 1). Furthermore, the intensity of distress reported by the TM group was significantly less than controls in both trials (Table 1). The lower mean distress level for the meditators at trial 1 (5.4 units), as compared to controls (7.8 units), indicates a long-term effect of TM on the distress component of the pain experience.

The time at which the subject withdraws his/her arm from the ice bath can be taken as a secondary indicator of intensity of distress (Fig. 1 and Table 1). For the meditators the mean time of withdrawal was significantly longer in the second trial than in the first, and significantly longer than controls in both trials.

The two physiological measures of the response to pain, heart rate and skin resistance, changed for both groups during both trials in the expected manner; heart rate increased 4–7 beats per minute over the pretrial period and skin resistance decreased by 40–50%. The two groups were not significantly different on either parameter.

DISCUSSION

The salient feature of these results, the effect of TM on the distress component of the experience of acute experimental pain, is based on verbal reports. How reliable is the subjective evaluation of pain? Hilgard and Hilgard (17) found that verbal pain state reports are "more capable of discriminating fine differences in

stimulus conditions, more reliable upon repetition, and more lawfully related to changed conditions than any physiological measures of pain." Both verbal responses and physiological indicators are influenced by numerous factors, but a subject can attend selectively to one or another factor and give reports for each (e.g., sensory and distress components), whereas a similar separation of influences causing physiological changes is very difficult, if not impossible, to achieve (17, p. 43).

One could argue, however, that the verbal reports in this experiment were unreliable because the meditators were consciously or unconsciously motivated to bias the responses in favor of TM. Direct questioning during the interview after each session regarding the honesty of reports did not reveal any intentional bias in the TM group. Furthermore, the pattern of results argues against a bias. Any bias would most likely have influenced both the sensory scale and the distress scale, but the verbal reports on the sensory component were insignificantly different from those of the control group, whereas the distress reports were markedly and significantly different. All of these reasons suggest that the results are probably valid.

The meditators appear to experience less pain sensation than controls (Fig. 1). One might argue that this difference, even though it is not statistically significant (Table 1), could be the cause for the difference between meditators and controls in reported distress; less perceived pain presumably produces less distress. This factor might conceivably explain distress differences between the groups, but does not account for the marked and significant decrease in the meditators' distress at trial 2 as compared to trial 1. For the controls, pain sensation did not change from trial 1 to trial 2, and neither did distress, which is consistent with this reasoning; similar perceived pain leads to similar distress. For the meditators as well, pain sensation did not change from trial 1 to trial 2, but distress did decrease. This result is not consistent with this alternative explanation; similar pain perception did not correspond to similar distress level. Therefore this argument does not account for the TM effect on distress at trial 2. And because the difference between groups in pain sensation is not statistically significant the argument probably does not account for the significant group differences in distress either.

The physiological response to pain has adaptive value in preparing the individual to react to the painful stimulus. Previous research on TM (6) has shown that the skin resistance response exhibited by meditators after a 100 dB auditory stimulus is the same as that of nonmeditating controls, but that the meditators adapt more quickly than controls to repetitions of the stimulus. This finding, extended to the present study, could account for the similar autonomic responses of the two groups during the first two presentations of the painful stimulus. The intensity of the response to pain is considerably influenced by the level of anxiety. Because the two groups were matched for trait anxiety level (see Methods) one might expect the magnitude of their initial physiological responses to pain to be similar, as was found.

TM's capacity for reducing the distress component of the pain experience may have significant clinical applications. The distress, anxiety and, in the case of chronic pain, depression associated with pain can intensify the original pain, thereby establishing a positive feedback cycle in which the initial cause can even

become obscured (19). This situation is aggravated in a neurotic personality. In many cases, treatment of distress is therefore the primary goal of pain therapy. Because TM reduces the distress component of pain over both short and long periods of time, and also reduces anxiety, depression, and neuroticism (3, 20), TM could prove to be a useful adjunct in the clinical treatment of pain. Other meditation techniques, none of which have been evaluated as extensively as TM (2–9, 11), might also prove useful in this regard.

One final implication of this study concerns a phenomenon often referred to by TM proponents as "witnessing," a quality of awareness that they regard as a characteristic outcome of TM. Several TM group subjects reported in the posttest interview that in trial 2 they were as much aware of pain as in trial 1, but that the pain concerned them less. For example,

> After meditation I felt in better equilibrium. I could almost laugh at the pain. I guess my interpretation of pain was different in that the pain seemed very small in contrast to my expanded awareness. Mud in a small pond can greatly disturb the color of the water, but when one's awareness is as big as the ocean a little mud goes practically unnoticed.

And,

> I retained a deep feeling of inner quietness though I could feel myself reacting on the outside with my heart rate increasing and my physiology speeding up in general.

And again,

> It was easier to tolerate the second time. I was not overshadowed by the experience. It was as if I was just witnessing myself go through the test. It was almost laughable.

The emotional equilibrium and lack of attachment to pain conveyed in these informal statements could account for the observed results. These qualities deserve further study both for their inherent interest and because they could be the basis for a more general clinical application of TM.

The authors gratefully acknowledge the support and expert guidance of Gretchen Timmermans, and wish to thank Bill Grassell for statistical analyses.

REFERENCES

1. Bloomfield HH, Cain MP, Jaffe DT: TM: Discovering Inner Energy and Overcoming Stress. New York, Delacorte, 1975, pp. 11–19
2. Orme-Johnson DW, Farrow JT, eds. Scientific Research on the Transcendental Meditation Program, vol. 1. Livingston Manor, NY, MIU Press, 1977
3. Dillbeck MC: The effect of the Transcendental Meditation technique on anxiety level. J Clin Psychol 33:1076–1078, 1977
4. Nidich S, Seeman W, Dreskin T: Influence of Transcendental Meditation: a replication. J Counsel Psychol 20:565–566, 1973
5. Schecter H, The Transcendental Meditation program in the classroom: a psychological evaluation, in Scientific Research on the Transcendental Meditation Program, vol. 1. Edited by DW Orme-Johnson, JT Farrow. Livingston Manor, NY, MIU Press, 1977, pp. 403–409
6. Orme-Johnson DW: Autonomic stability and Transcendental Meditation. Psychosom Med 35:341–349, 1973
7. Jevning R, Wilson A, VanderLaan E, Levine S: Plasma prolactin and cortisol during Transcendental Meditation. Endocrine Soc Program, 57th Annual Meeting, June 18–20, 1975, p. 257

8. Benson H, Wallace RK: Decreased blood pressure in hypertensive patients who practice meditation. Circulation (suppl) 45–46:516, 1972
9. Wilson AF, Honsberger R, Chiu JT, Novey HS: Transcendental Meditation and asthma. Respiration 32:74–80, 1975
10. Mitchell K, White R: Control of migraine headache by behavioral self-management: a controlled case study. Headache 16:178–184, 1976
11. Buckler, W: Transcendental Meditation. Can Med Assoc J 115:607, 1976
12. Grzesiak, R: Relaxation techniques in treatment of chronic pain. Arch Phys Med Rehabil 58:270–272, 1977
13. French A, Tupin J: Therapeutic application of a simple relaxation method. Am J Psychother 28:282–287, 1974
14. Hilgard E: Pain: its reduction and production under hypnosis. Proc Am Phil Soc 115:470–476, 1971
15. Bowers K: The effect of demands for honesty on reports of visual and auditory hallucinations. Int J Clin Exp Hypn 15:31–35, 1967
16. Sachs L: Comparison of hypnotic analgesia and hypnotic relaxation during stimulation by a continuous pain source. J Abnorm Psychol 76:206–210, 1970
17. Hilgard E, Hilgard J: Hypnosis in the Relief of Pain. Los Altos, CA, William Kaufmann, 1975
18. Barber T: The effects of hypnosis on pain. Psychosom Med 25:303–333, 1963
19. Kocher R: Use of psycho-tropic drugs for the treatment of chronic severe pain. Adv Pain Res Ther 1:579–582, 1976
20. Tjoa A: Meditation, neuroticism and intelligence. Gedrag: Tijdschrift voor Psychologie (Behav: J Psychol) 3:167–182, 1975