

## PAPERS AND ORIGINALS

**Acupuncture analgesia: an experimental investigation**

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*British Medical Journal*, 1977, 1, 67-70**Summary**

**A study was designed to establish whether acupuncture has any analgesic properties beyond those of suggestion. In three one-hour experimental sessions the increases in detection thresholds and tolerances for thermal pain at six body locations on 12 subjects were compared. A control session (without needles) was followed by one session in which electrically stimulated needles were inserted in accord with Chinese practice, and another in which the needles were inserted to avoid all recognised acupuncture "points." Acupuncture was significantly more effective than suggestion in raising overall body pain thresholds but just below significance for tolerances. A significant disproportionate effect on the epigastrium, predicted by the choice of acupuncture points, was found for tolerances but not thresholds.**

**Introduction**

Anecdotal reports and neurophysiological speculation about Chinese acupuncture analgesia are widespread, yet an explanation in terms of suggestion remains inadequately assessed despite supportive evidence. The traditional use of acupuncture in China, its support by Maoist doctrine, and the careful selection and psychological preparation of patients would tend to ensure maximum belief in the efficacy of the "analgesic" technique.<sup>1-3</sup> Furthermore, until recently, probably at most 2% of Chinese surgical operations were carried out under general anaesthesia, with regional anaesthesia, mainly epidural blockade, extended to perhaps another 18% of cases.<sup>1</sup> Consequently consciousness during operations may elicit less anxiety in Chinese patients than in Western patients.

Narcotic analgesics, local anaesthetics, and sedatives are often given in conjunction with acupuncture needles, and acupuncture is little used when there is much traction of abdominal viscera, pleura, or peritoneum.<sup>1-3</sup> Reports indicate that acupuncture analgesia is usually incomplete, with both physiological and behavioural evidence of discomfort.<sup>1-3</sup> In about 10% of cases this is severe enough to require the operation to be finished under chemical anaesthesia.<sup>1-3</sup>

It is, of course, well known that Western patients may become insensitive to pain after inactive drugs,<sup>4</sup> suggestion with or without hypnotic induction,<sup>5</sup> simple attentional manipulation,<sup>6</sup> or counterirritation.<sup>7</sup> The effect may indicate that patients are less prepared to label a sensation as painful (increased tolerance) rather than that they have a diminished sensory experience (increased threshold).<sup>8</sup> One study suggests that a similar process may underlie acupuncture analgesia,<sup>9</sup> while another found close correlation between the hypnotic suggestibility of patients and pain relief from acupuncture.<sup>10</sup>

Acupuncturists certainly seem to use suggestion, if not hypnosis, while the discomfort from needling and electrical stimulation through the needles must produce distraction with counterirritation.<sup>1-3</sup>

We therefore conducted an experiment to determine whether acupuncture, in the presence of controls for suggestion, could produce analgesia and whether Chinese claims of a specific relation between the position of the needle and the site of the effect would be supported.

**Subjects and methods**

Twelve paid volunteers (six men) aged 18-32 years, in normal health and knowing little about acupuncture, took part in a balanced experiment which compared both their detection thresholds and tolerances for pain induced by heat stimuli under three different conditions. All procedures were approved by the Royal Edinburgh Hospital ethics committee and were demonstrated to the written satisfaction of all volunteers in an initial adaptation session.

The first experimental treatment for all subjects was a control session without acupuncture. Two days later six subjects (three men) took part in a session during which needles were inserted according to current Chinese practice (genuine acupuncture session) followed, two days later, by one of simulated acupuncture (pseudoacupuncture session). The order of the acupuncture sessions was reversed for the

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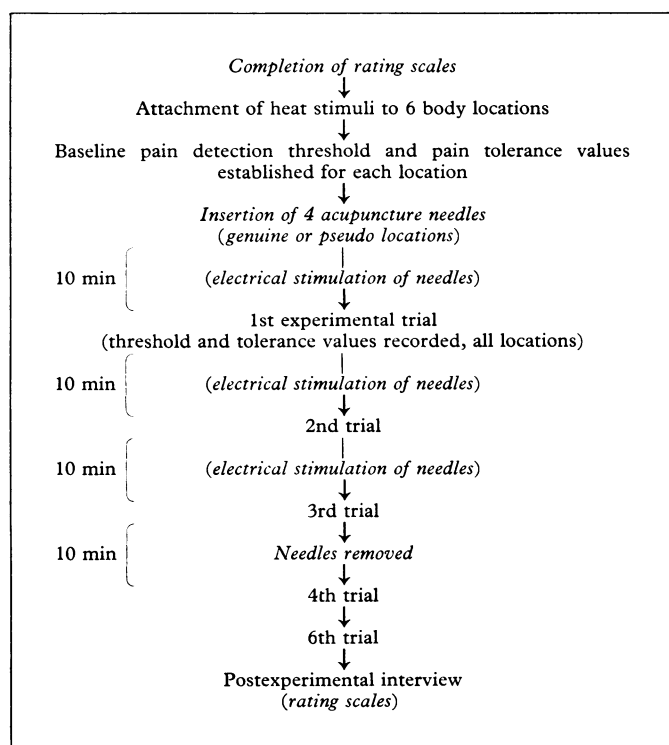


FIG 1—One-hour experimental procedure for all sessions. Items in italics were not included in control session.

other six subjects. The procedural sequence common to all sessions is outlined in fig 1.

Thermal pain stimuli were produced by 12-V light units (6-mm diameter), which delivered a heat output rising linearly over time to an automatic safety cut-off point. One unit was attached to each of the following sites on the supine subjects: the central epigastrium, the mid-sternum, the lateral surface of the left upper arm, the antero-medial surface of the left lower leg, the dorsal right forearm, and the anterior right thigh.

#### BASELINE VALUES

A baseline pain-detection threshold and a pain-tolerance value were then established sequentially for each of the six stimulus sites. The measure used was the time (in seconds) from onset of a heat stimulus to the subject's indication, by pushing a button, that his pain detection threshold had been reached and shortly afterwards, by pushing another button (which also cancelled the stimulus), that his pain tolerance duration had been exceeded. A 15-second interval followed before the onset of the next stimulus at another body site.

The pain detection threshold was defined as "the moment when the experience of heat suddenly coalesces to a point accompanied by a sharp pricking sensation."<sup>4 11</sup> Subjects identified this sensory point with ease. Instructions on pain tolerance countermanded heroics and emphasised consistency.

The length of stimulus taken as the baseline for each body location was the second of two readings obtained after a 3-minute interval, since a pilot study had indicated that this response would closely approximate to the mean of several such closely consecutive responses.

After these session baselines had been established the remainder of a session consisted of the sequential presentation, in random order, of one heat stimulus to each of the six cutaneous locations, with automated recording of threshold and tolerance values at those sites, once every 10 minutes for the next hour.

#### ACUPUNCTURE SESSIONS

**Genuine acupuncture**—Needles were inserted in both the genuine and pseudoacupuncture sessions immediately after the baseline values had been established. Two acupuncture points were selected, on the basis of current Chinese practice, for bilateral insertion. The point "Ho-

Ku," is located in the skin web between the thumb and index finger about midway between the junction of the first and second metacarpals and the fold. It is said to induce diffuse analgesia.<sup>1 12</sup> Insertion was perpendicular to the dorsal cutaneous surface to a depth of 2.0 to 2.5 cm. The second point, "Tsu-San-Li," is located about 3-cm distal and lateral to the tibial tuberosity and is specified for most abdominal operations since this is expected to be the principal locus of its effect.<sup>1 12</sup> Insertion was perpendicular and to a depth of 3.0 to 3.5 cm. With the selection of these two points we expected (a) a general increase of all threshold or tolerance values, or both, with (b) a disproportionately greater increase in the epigastrium. The predicted local effect was unknown to the physician inserting the needles.

**Pseudoacupuncture**—Two needles were also inserted bilaterally in the pseudoacupuncture session. One was inserted about 9 cm distal from the acromioclavicular joint, insertion being perpendicular and to a depth of 2.0 to 2.5 cm. The second position was about 6 cm distal from the greater trochanter along a line from the greater trochanter to the lateral border of the patella. Insertion was at 45° to the skin surface, penetrating posteriorly to a depth of 2.0 to 2.5 cm. These locations were selected to avoid recognised acupuncture points, while providing a source of suggestion and distraction comparable to genuine acupuncture.<sup>13</sup>

Electrical stimulation was applied to needle pairs in both sessions from a 6-V battery stimulator, of Chinese design, delivering an AC output at 2.5 Hz at a maximum comfortable intensity sufficient to induce local fasciculation. Current was passed only during the 10-minute intervals between the first three heat stimulus trials. Thereafter all needles were removed, since a period of about 35 minutes is said to be adequate for analgesia.<sup>14</sup>

The sessions ended with a structured interview in which subjects reported their experiences. They also made a 10-cm line rating of the degree, and sites, of any analgesic effects, ranging from "No effect at all" to "A very considerable effect." Before the session they had each indicated in a similar manner the degree of analgesia they expected as a result of acupuncture. This had followed a standardised description of the experiment as an investigation of the claimed, but still unproved analgesic properties of acupuncture.

## Results

Owing to variation in the baseline time values that each subject recorded at the outset of his three sessions, a proportional arithmetic correction was applied to all data from the needle sessions. This standardised the baselines of the genuine and pseudoacupuncture sessions so that they equalled the corresponding baseline values for each body location in the control session, and thus allowed direct comparison of subsequent trial values at corresponding stages during the three sessions.

#### CHANGES WITHIN SESSIONS

A measure of change of threshold within each session was then obtained for each stimulus site in each subject by subtracting his session baseline value from the mean of his six subsequent trial values obtained at the same location later during the session. Measures of tolerance change within each session were similarly obtained. An increase of both thresholds and tolerances occurred during all three sessions.

A mean representing the magnitude of within-session change in threshold shown by the body as a whole was then obtained for each subject, for each session, from his six threshold "change values" (described above). Mean tolerance change values were similarly calculated.

Group means (table I) derived from these mean change values for all

TABLE I—Group mean increases in pain thresholds and tolerances (pain stimulus duration in seconds) for whole body during each session. Standard errors are shown (n=12)

	Control session	Pseudoacupuncture session	Genuine acupuncture session
Threshold increase	1.6 ± 0.5	2.3 ± 0.5	3.4 ± 0.8
Threshold increase (%)	16.4 ± 4.6	23.2 ± 4.4	35.3 ± 7.6
Tolerance increase	2.5 ± 0.6	3.7 ± 0.9	4.6 ± 0.9
Tolerance increase (%)	19.3 ± 3.2	28.3 ± 5.5	36.6 ± 5.3

12 subjects indicated that the largest increases in both thresholds and tolerances occurred in the genuine acupuncture session followed by the pseudoacupuncture session.

CHANGES BETWEEN SESSIONS

A Friedman two-way analysis of variance by ranks applied to the same data indicated that there were significant differences among the three experimental conditions for thresholds ( $\chi^2_r=6.43$ ;  $P<0.05$ ;  $DF=2$ ;  $n=12$ ) and for tolerances ( $\chi^2_r=8.73$ ;  $P<0.02$ ;  $DF=2$ ;  $n=12$ ).<sup>15</sup> A Wilcoxon matched-pairs, signed-ranks test was applied to determine the significance of these intersession differences (table II).<sup>15</sup> The results indicated that increases in tolerance during both the pseudoacupuncture and genuine acupuncture sessions were significantly greater than increases during the control session. Increases in thresholds were significantly better than control levels during only the genuine acupuncture session. Genuine acupuncture was significantly better than pseudoacupuncture for thresholds but not for tolerances.

TABLE II—Significance levels for observed intersession differences in increase of pain thresholds and tolerances. (Wilcoxon matched-pairs, signed-ranks test).<sup>15</sup> Probability (P) of observed differences between sessions and mean of differences between two sessions are shown

	Thresholds		Tolerances	
	Mean	P	Mean	P
<i>Overall body data (all subjects)</i>				
Control v pseudoacupuncture	+0.8	0.080*	+1.2	0.007
Control v genuine acupuncture	+2.0	0.012	+2.1	0.005
Pseudoacupuncture v genuine acupuncture	+1.2	0.035	+0.9	0.065*
<i>Epigastrium data (all subjects)</i>				
Control v pseudoacupuncture	+1.8	0.726*	+1.0	0.025
Control v genuine acupuncture	+3.2	0.087*	+4.1	0.010
Pseudoacupuncture v genuine acupuncture	+1.5	0.119*	+3.1	0.019

\*Not significant.

**Epigastrium**—Analysis of increases in tolerance at the different body sites confirmed that, as had been predicted, a disproportionate increase on the epigastrium had occurred during the genuine acupuncture session. The Friedman test applied to the data of table III indicated significant differences across the three sessions at this location ( $\chi^2_r=10.60$ ;  $P<0.01$ ;  $DF=2$ ;  $n=12$ ), in contrast to the failure to reach individual significance in the case of the other five locations. The Wilcoxon test indicated that the increases in tolerance on the epigastrium were significantly better during the genuine acupuncture session than during either the control or pseudoacupuncture sessions (table II and fig 2).

No significant intersession differences of threshold increase were found for any single body location.

**Subjects' ratings**—The subjects' 10-cm line pre-session predictions and postsession estimates of the analgesic effect of acupuncture were examined for correlation (Spearman rank correlation) with the actual

TABLE III—Mean increases in pain tolerance (pain stimulus duration in seconds) on epigastrium during each session. Values expressed as percentage increases above baseline tolerance value appear in parentheses

Subject No	Control session	Pseudoacupuncture session	Genuine acupuncture session
<i>Men</i>			
1	3.7 (28.7%)	2.2 (16.3%)	6.3 (48.8%)
2	0.9 (5.4%)	5.3 (36.0%)	9.9 (66.7%)
3	-0.3 (-2.1%)	2.9 (20.1%)	1.6 (11.1%)
4	1.1 (6.0%)	2.2 (12.1%)	17.3 (95.0%)
5	1.9 (14.6%)	2.7 (20.8%)	2.9 (22.3%)
6	-0.9 (-7.6%)	0.1 (0.8%)	10.8 (90.8%)
<i>Women</i>			
1	3.3 (23.7%)	5.8 (41.0%)	6.9 (48.9%)
2	3.9 (28.1%)	4.2 (30.4%)	-0.1 (-1.5%)
3	1.6 (13.2%)	1.8 (14.9%)	4.8 (39.7%)
4	2.0 (21.7%)	2.5 (27.2%)	4.5 (48.9%)
5	3.1 (25.4%)	2.3 (18.8%)	2.7 (22.1%)
6	5.3 (33.3%)	5.6 (35.2%)	7.7 (48.4%)
Group mean	2.1 (15.9%)	3.1 (22.8%)	6.3 (45.1%)

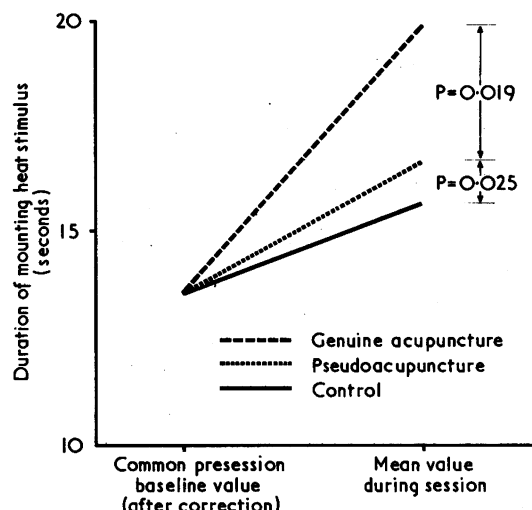


FIG 2—Increase of tolerances on epigastrium (mean values from 12 subjects).

percentage increases over baselines in thresholds and tolerances that they showed in the same session.<sup>15</sup> Significant correlations with postsession estimates of analgesia were found for thresholds in both the pseudoacupuncture session ( $r_s=0.91$ ;  $P<0.01$ ;  $n=12$ ) and the genuine acupuncture session ( $r_s=0.65$ ;  $P<0.05$ ;  $n=12$ ) but this was not the case with pre-session predictions. No significant correlation was found between the subjective ratings and tolerance increases. Both the pseudoacupuncture and genuine acupuncture sessions showed similar declines in the degree of efficacy that subjects attributed to acupuncture analgesia at the end of the session compared with the beginning. This similarity occurred despite indications of more intense needle sensations in the genuine acupuncture session. Ratings showed no bias towards greater analgesia under either of the experimental conditions, nor at any particular body location.

Discussion

We conclude from the overall body data that acupuncture is significantly more effective than suggestion in raising pain thresholds. A similar interpretation is indicated with regard to tolerance, although the superiority of genuine acupuncture over pseudoacupuncture just failed to reach significance (table II).

Substantial support for the superiority of acupuncture is provided by the disproportionate increases of tolerance on the epigastrium during the genuine acupuncture session, as had been predicted. Counterirritation or anything short of the most highly specific suggestion are difficult explanations to apply to such a localised effect. Furthermore, both the lack of reference to the epigastrium in subjects' rating scales and the ignorance of the experimental significance of the epigastrium on the part of the physician inserting the needles render specific cueing unlikely. Chinese claims of a highly localised analgesic effect remote from one acupuncture point are supported. Since this effect did not apply to thresholds, however, the mode of action may be similar to that of morphine, which, when applied to experimental pain, is really effective only at suprathreshold levels.<sup>16</sup>

The significantly greater increase in tolerances on the epigastrium during the pseudoacupuncture session compared with that which occurred in the control session could not have resulted from specific suggestion since this effect had not been predicted. A possible explanation comes from the fact that, as we now realise, both genuine and pseudoacupuncture needle locations were situated in the same dermatomes.<sup>17</sup> This might imply a similar segmental afferent input in both cases, although, perhaps, as acupuncturists would claim, there was a more intense stimulation from genuine acupuncture points.<sup>18</sup>

Since the control session always came first, any significant differences between it and either the pseudoacupuncture or

genuine acupuncture sessions may have been the result of an order effect. This explanation, however, cannot be used to explain any of the demonstrated superiority of genuine acupuncture over pseudoacupuncture since these sessions were in balanced order of presentation.

The conclusion must be that acupuncture may have analgesic effects. This is consistent with the results of other research on Western populations which has controlled for suggestion<sup>19</sup> and with several recent studies on man and animals which implicate neurophysiological mechanisms.<sup>1 20 21</sup> The practical value of acupuncture, however, still remains to be established.

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# Dreaming, fenfluramine, and vitamin C

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## Summary

**The effect of increasing doses of fenfluramine on dream patterns was studied in 20 patients receiving a reducing diet with or without a controlled dietary intake of vitamin C daily. The dream pattern was unchanged in six patients and dreams disappeared in another who normally dreamed often. In 13 patients dreams increased in frequency and intensity, and in five the dreams assumed frightening proportions. There was a significant straight-line relation between response and the size of the dose. When placebo tablets were given to four patients their dreams disappeared or assumed their pretreatment normal pattern. Absence of vitamin C from the diet did not significantly affect the dream pattern. That fenfluramine has dose-related cerebral effects should be remembered in patients with a history of mental illness.**

## Introduction

Fenfluramine hydrochloride has an antiobesity and anorectic action and has been successfully used to treat obesity.<sup>1 2</sup> It is chemically similar to amphetamine but lacks its central stimulant effects.<sup>3</sup> Several studies have shown that the cate-

cholamines are intimately concerned in the sleep mechanism<sup>4-6</sup> and that the anorectic action of fenfluramine depends on a direct or indirect serotonin mechanism.<sup>7</sup> Moreover, the anti-obesity action of fenfluramine may be related to its specific ascorbic acid releasing action,<sup>8 9</sup> while dietary desaturation of ascorbic acid potentiates the antiobesity action of fenfluramine in man.<sup>10</sup> Administration of vitamin C 2000 mg/day produces better nocturnal sleep and less sleeplessness in young adults than placebo treatment.<sup>11</sup> We investigated the effect of fenfluramine on the dream pattern of 20 patients who were receiving a weight-reducing diet and either fenfluramine or placebo tablets.

## Subjects and methods

Eighteen women and two men participated. The investigation was part of a larger trial in which the effect of ascorbic acid was examined on the antiobesity action of fenfluramine.<sup>10</sup> The patients were aged 14-63 years (mean 43 years). Each patient received a 4.18-MJ (1000 kcal) reducing diet. Alternate patients received either a controlled intake of 40 mg vitamin C daily, or a diet free of vitamin C. All received fenfluramine in daily doses ranging from 20 to 80 mg/day. The patients completed a daily chart of their weight, sleep and dream pattern, and mood. They were asked to record the number and nature of their dreams each morning on waking.

Placebo tablets were administered double blind to four of the patients for four weeks from the 10th week of the investigation. Some patients received tablets for as long as 17 weeks (see table).

## Results

Of the 20 patients, five received other forms of drug treatment consisting of ketoprofen, indomethacin, amitriptyline, or reserpine. None of these patients experienced any change in the nature or increase in the frequency of their dreams while receiving fenfluramine.

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