

ORIGINAL PAPER

THE EFFECTS OF THERAPEUTIC FORMS OF HEAT
AND ICE ON THE PAIN THRESHOLD
OF THE NORMAL SHOULDER

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SUMMARY

An investigation designed to assess and compare the effects of therapeutic forms of heat and cold on the pain threshold of the normal shoulder is described. Heat and cold were both found to raise the normal pain threshold significantly, the maximum effect occurring immediately following treatment. Ice therapy was more effective than heat, but following both forms of treatment the effect rapidly declined and after thirty minutes there was no significant effect on the pain threshold.

THE use of heat and cold for their analgesic properties is part of everyday practice in physiotherapy departments. Although these treatments are simple in application, they are time-consuming for patients and staff, they need expensive apparatus, and they result in increased demands for hospital transport. The continued use of such therapy is largely empirically based. In this study the effects of heat and cold on the pain threshold of both shoulders of physiotherapy students were measured and compared.

METHOD

The pain threshold was quantitatively assessed by means of an algometer similar to that originally used by Hardy *et al.* (1952) (Fig. 1). This apparatus consists of a plunger surrounded by a metal sleeve within which is mounted a steel spring. The force in kg. exerted on the tissues by a rounded plastic tip plunger 1 cm. in diameter is read from the scale, which indicates the degree of compression of the steel spring. The pain threshold was taken as the minimum pressure required to produce a sensation of pain. The pressure

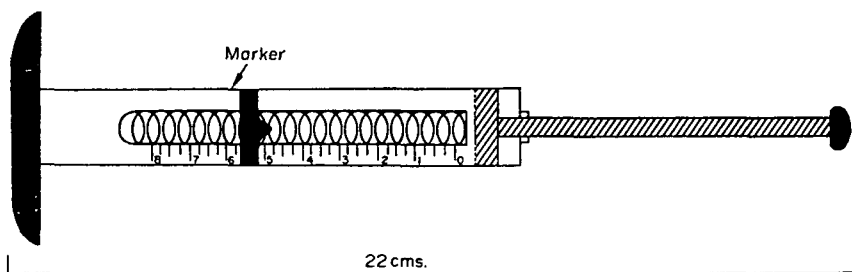


FIG. 1.—Algometer.

Accepted for publication October 1973.

TABLE I
LEVEL OF PAIN THRESHOLD BEFORE AND AFTER THERAPEUTIC HEAT AND ICE IN GROUPS EXAMINED

Treatment Groups	Before Treatment	Heat Therapy			Before Treatment	Ice Therapy		
		0 min.	15 min.	30 min.		0 min.	15 min.	30 min.
1st Group L shoulder	2·33	3·38	2·94	2·37	2·37	3·13	2·50	3·12
1st Group R shoulder	2·71	3·19	2·37	2·19	2·96	3·88	3·81	2·75
2nd Group L shoulder	3·31	3·56	3·37	3·37	2·23	2·87	2·69	2·62
2nd Group R shoulder	3·12	3·56	3·56	3·37	2·67	4·19	3·81	2·50
3rd Group L shoulder	3·43	3·94	3·56	3·62	3·22	5·25	5·00	3·81
3rd Group R shoulder	3·48	4·19	4·00	3·37	2·79	4·44	4·06	2·50
Average all Groups: Both shoulders ..	3·06	3·64	3·30	3·05	2·71	4·12	3·64	2·88

was applied with uniformly increasing intensity within a maximum period of three seconds and expressed in kg. per sq. cm.

No expression or indication of the result was made by the observer during or immediately after taking the readings, to avoid creating a conditioned response.

The subjects used for this trial were twelve physiotherapy students at the beginning of their studies, and consequently without any clinical experience or preconceived ideas regarding the use or value of heat and ice therapy.

The ice therapy consisted of towelling packs, 24 cm. and 18 cm., containing wet crushed ice applied over the anterior and posterior aspects of the shoulder for a period of 15 minutes.

The therapeutic heat consisted of 20 minutes of short-wave diathermy, the electrodes used being one 7 inch \times 4 inch flexible electrode and one 5 inch diameter rigid electrode. The flexible electrode was placed over the posterior aspect of the joint with five felts for spacing ($1\frac{1}{2}$ inches); the rigid electrode was placed over the anterior aspect of the shoulder. The treatment was given for 20 minutes at thermal intensity.

PROCEDURE

The students were divided into three groups of four. This was a manageable number to investigate at one time taking into account available equipment and the timing of the readings. One group and one form of therapy was examined at a time. On each occasion before applying therapeutic heat or ice, the normal pain threshold was estimated over the anterior aspect of each shoulder at a point on the middle of a line joining the coracoid process and lesser tuberosity of the humerus. A skin marker was used to fix this point. An average of three readings taken at five-minute intervals was taken as the final estimate of the pain threshold. Following this the shoulders of each pupil in the group were treated with short-wave diathermy for 20 minutes. Measurements of the pain threshold were then recorded immediately afterwards and after an interval of 15 and 30 minutes. When this investigation had been completed on the three groups the process was repeated on another occasion substituting ice therapy for short-wave diathermy.

RESULTS

The effects of heat and of ice therapy on the pain threshold are shown in Table I. These were subjected to statistical analysis using the technique of the analysis of variance. An additive model was assumed taking into account differences between individuals and differences between left and right shoulders.

The standard error for the mean increase in pressure after the treatments was 0.123 kg. The average increase of pressure required after heat and after ice therapy to reach pain threshold is shown in Table II.

TABLE II
DIFFERENCE IN PAIN THRESHOLD BEFORE AND AFTER
TREATMENT MEASURED IN KILOGRAMMES PRESSURE

Treatment	Time after Treatment		
	0 min.	15 min.	30 min.
Short-wave diathermy	+0.58	+0.24	-0.01
Ice	+1.41	+0.93	+0.17

A comparison of the effects of heat and ice therapy on the normal pain threshold is shown in Fig. 2.

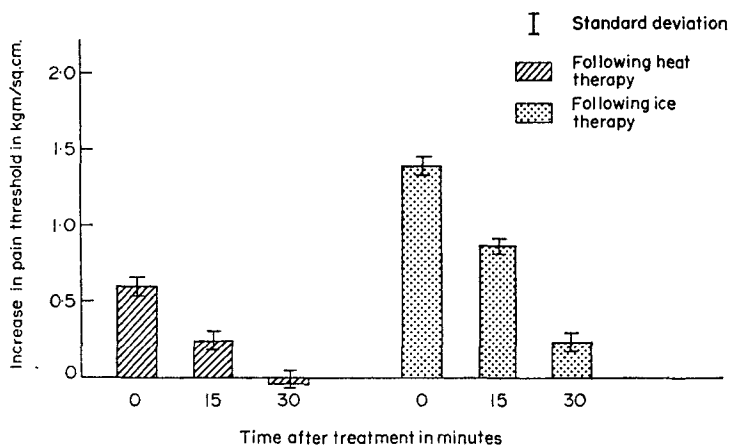


FIG. 2.—Histogram showing effects of therapeutic heat and ice on pain threshold.

DISCUSSION

The results of this investigation have shown that ice is significantly more effective than short-wave diathermy in elevating the pain threshold to pressure for a period of up to 30 minutes following treatment.

Both ice and short-wave diathermy had their maximum effect immediately after treatment, following which the effect declined rapidly, and after 30 minutes the effect was not significantly different from zero. In particular, for short-wave diathermy even after 15 minutes the effect of raising the pain threshold is only just significantly different from zero.

Whilst acknowledging that pain in the shoulder arising from injury or disease may respond differently, these findings suggest that ice therapy is superior to short-wave diathermy as a form of treatment to reduce joint pain.

The short duration of their effect would support the generally held view that the principal value of such treatment is as a preliminary to active movements or mobilizing exercises.

ACKNOWLEDGMENTS

We are grateful to Mr. A. Gibbs, Department of Community Medicine, for the statistical analysis, and to the staff and students of the Physiotherapy Department, Manchester Royal Infirmary.

REFERENCE

HARDY, J. D. *et al.* (1952) *Pain Sensations and Reactions*. Williams and Wilkins, Baltimore.