Topical Cryotherapy

Use for Relief of Pain and Spasticity

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■ *Cold applications are sometimes of pronounced symptomatic benefit in some rheumatic disorders such as acute myalgia; in the temporary relief of spasticity; in helping to release tight structures in poliomyelitis and allied diseases; and in temporary recovery of energy in multiple sclerosis.*

EVER SINCE the beginning of the scientific revolution in medicine, physicians have fallen into the easy assumption that every kind of treatment they habitually order is based on building stones as solid as the Koch postulates. Even when some hallowed notion gets jostled—like prolonged bed rest after surgical operation, or the necessity of operations like circumcision and tonsillectomy—they tend to be uncritically accepting of many other procedures that they continue to do.

One of these entrenched routines is the use of some form of heat in preparation for other physical measures. The purpose of this article is to indicate an alternate procedure—removal rather than addition of heat to the body. The extreme individualist might even decide to use neither heat nor cold.

Since 1952 in our clinic applications of ice rather than heat have constituted the usual mode of preparation of the patient for further physical treatment. This has been true of both short-term, localized disorders suitable for outpatient care and of long-term, severely involved (rehabilitation) conditions. In contrast to the very little heat that can be conveyed to patients by one diathermy unit and a single whirlpool, we use the principle of heat exchange in the other direction provided by the latent heat entailed in the fusion of about one ton of ice per day.

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Theoretical Background

While the literature on thermotherapy is nearly endless (and pretty sterile), that on its counterpart, cryotherapy, is sparse indeed. A group of scholarly studies from Canada and Britain are reported in Volume 17 of *British Medical Bulletin,* January 1961.[1] The entire issue is devoted to the physiologic aspects of cold and the technique of induced hypothermia. The articles on local cooling, vascular effects and the effects on nerve transmission are of particular interest, but the emphasis is on profound change—hypothermia as used in operations on the central nervous system and the heart—and not on the kind of brief chilling used in physical medicine. In the latter technique even the employment of ice baths rarely lowers the core body temperature more than 1°F.[5] In 1951, Wakim, Porter and Krusen[7] plotted the time-temperature curves of skin, muscle and joints when the limb was packed in ice for one hour. The temperature of the internal tissues declined 6°C within 10 minutes of application and fell only 2° to 3°C more by the end of an hour of chilling. After one hour of recovery these tissues still lacked 1° to 2°C of

returning to control temperature. Zaimis, Cannard and Price[9] found that lowering of muscle temperature increases the magnitude and duration of effects of neuromuscular blocking agents. Kelly and Fry[4] found in the excised muscles of the frog that twitch tension increases in both directions from a minimum at 20°C, as the muscle is either warmed or cooled.[4] Brooks, Koizumi and Malcolm[2] found that, in cats, warming depressed reflex activity of the exposed spinal cord. Cold produced a remarkable augmentation of all responses. When chilling reached 20°C, cold block occurred. Intramedullary conduction of impulses was slowed by cooling; synaptic impulses were, however, augmented in amplitude.

Effect on Spasticity

Heat has been used for many years to relax spastic limbs (spasticity is here defined solely as resulting from disease of the pyramidal-extrapyramidal systems so that stretch reflexes are abnormally increased). Heat is not very efficacious for this purpose. By contrast, cold applications are decidedly effective. Decrease in resistance to passive stretch lasts from a few minutes up to 24 hours. Unmasking of spasticity permits strengthening of voluntary mechanisms normally snowed under by undesired reflexes.

The explanation of the mechanism of relief of spasticity must be at present purely speculative. It is possible that cold anesthesia of peripheral sensory end-organs changes the balance of the algebraic sum of facilitatory-inhibitory influences playing on the anterior horn cell in favor of inhibition. Wearing off of the cold anesthesia would then permit return to the previous conditions of spasticity. One observed paradox is that patients with spasticity say they are often worse on cold days.

Joint Restriction in the Rheumatic Affections

The only mechanism suggested for the present is cold anesthesia. Again a seeming paradox may be observed: Patients who have decreased joint mobility on cold, damp days may, nevertheless, be benefited by ice applications. There is, however, a vast difference between cold, damp climate and severe local chilling of the skin and underlying tissues.

It is necessary to separate increase in joint mobility secondary to relief of pain from increase in joint mobility from other mechanisms. In nonpainful restricted joints sometimes observed in the evolution of periarthritis of the shoulder, one must also be sure that adhesions (histological contracture) have not occurred. This can be decided only by gentle passive testing under curarization and general anesthesia. Cold has no effect on histological contracture. One can often demonstrate increase in muscle extensibility, especially of tight hamstring muscles, after cold application in a normal subject.

Relief of Certain Types of Pain

That surface anesthesia—induced either by cold or by drugs—can produce pain relief in certain types of deep-seated pain is incontestably established.[3] Travell and Rinzler[6] used surface block in coronary pain. We once noted striking relief of pain by chilling the anterior thigh with ethyl chloride spray in a young woman who later proved to have metastasis to the femur from carcinoma of the thyroid gland.

Cold anesthesia is quite limited by severe discomfort which develops at the transitional zone between warm and cold tissues and ordinarily is not suitable for chronic intractable or diffuse pain syndromes.

Techniques of Application

For relaxation of hands and feet, immersion in a mixture of ice and water is suitable. Following immersion there will nearly always be an increase in spasticity of the flexors. To relax these further, we suggest that towels dipped in ice water, which is at approximately 15°C, be put directly over the groups which are tight or limited in range. For best results it is advisable to move the part through the range you wish to obtain while the cold towel is on the part. If there is tightness or spasticity of both flexors and extensors, it is possible to wrap the whole extremity with the towel and move passively in ranges desired as the part relaxes. Many persons in applying cryotherapy yield to the temptation merely to wrap a joint, such as the elbow joint, with a cold application. This will not work very well with a two-joint muscle such as the biceps brachii or the biceps femoris. The entire muscle belly must be chilled.

Another effective way of getting good results from the use of cold is to have the patient contract against manual resistance in the direction of the tightness or spasticity of both flexors and extensors. Or one may have the patient contract against manual resistance in the direction of the tightness or spasticity and follow the contraction by voluntary relaxation. This should be done while cold appli-

cations are in place. It is possible to wrap the whole extremity with the towel and move passively in ranges desired as the part relaxes. It is essential also that the contraction and the relaxation be done in the range in which the limitation occurs.

Uses of Cryotherapy

Syndromes in which cryotherapy has been especially successful include the following:

Spasticity Disorders. These include, of course, multiple sclerosis as well as cerebrovascular syndromes, postoperative states and certain spinal cord syndromes. Watson[8] noted specific improvement in eight patients with multiple sclerosis who were treated by chilling. The improvements included improved vision and reduction in central scotomas; improvement in gaze paresis; improved swallowing, phonation and articulation; improved willed movement; and improvement in spastic resistance to passive movement of joints. Deep reflexes were increased rather than subdued by cold. Most astonishing was improvement in position sense. All effects were transient.

We have repeatedly observed, in multiple sclerosis patients, augmented strength and endurance from chilling. Conversely we have noted a history of severe increase in symptoms in hot, humid climates, which is almost diagnostic in this disease.

Resistance to passive stretch may melt away under the effects of ice packs but this effect is gone in a few hours or a day. The important point is that persons with craniocerebral injuries or encephalitis who may lie comatose for days or weeks in flexion postures may be preserved from irreversible contracture by brief ice packing and a little stretching just once a day. (We do no stretching in conscious patients.) Obviously if joints and related structures are moved through their entire range even once daily, histological contractures will not have time to occur. But since contracture occurs with stunning suddenness, it is important to start treatment early.

Arthritis and Periarthritis. In dealing with patients with these diseases, selections have to be made. Some patients respond better to heat than to cold. Certain ones respond well to both. In hemiplegic patients, spasticity coexists with periarthritis of the shoulder, as described by Charcot over a hundred years ago. Increased capillary permeability with transudation and swelling of the hand is certainly limited by cold applications, whereas heat tends to increase interstitial edema.

In some instances of acute myalgia of the neck, shoulder or back, we have had good symptomatic relief from cold treatment combined with conventional methods such as traction, massage and relaxation techniques.

General Comment

Other than producing anesthesia of superficial nerves, mechanisms by which the benefits of local applications of cold are brought about are quite unknown. Treatment by local or general chilling has the following advantages:

It is more sedative than heat and at the same time is without its enervating effects.

It is usually more pain-relieving than heat, by the mechanism of transient peripheral nerve block.

It has far more relaxing effect on spasticity and rigidity than heat.

It is, of course, specifically indicated and heat is specifically contraindicated in acute trauma.

While heat has many contraindications cold has only two: cold allergy and Raynaud's disease.

It is without medicolegal risk, whereas burns from hot applications have been the subject of innumerable malpractice suits.

Heat equipment costs vary from modest to highly expensive. Cold is available for the price of ice.

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