

Simultaneous Use of Heat and Cold in Treatment of Muscle Spasm

Richard L. DonTigny, R.P.T.
Missoula, Mont.

and
Keith W. Sheldon, M.D.
Colorado Springs, Colo.

● Local application of heat acts to relax muscles generally throughout the skeletal system, at the same time lowering the threshold of muscle spindles locally. The hyperactive muscle spindles may become electromyographically silent during application of heat, but a minimal amount of either voluntary motion or passive exercise will cause these muscles to return to their spastic state. Local application of cold raises the threshold of muscle spindles, and prolongs relaxation even when exercise follows. If the patient becomes chilled during cold packing, he may shiver and increase existing spasm. The application of cold packs directly to the involved muscles simultaneously with heat to an uninvolved section of the body, to maintain core temperature and prevent shivering, has proved to be an effective method of relaxing muscle spasm.

Human beings have enjoyed heat in a multitude of forms for thousands of years. The cave man enjoyed the warmth from his fire and the sun as men do today. The newborn of nearly all animals enjoy the security and the comfort afforded them in the warmth from the mother. The feeling of well-being received from an external source of heat probably has been the basis for its use as a panacea for all varieties of aches and pains for hundreds of years.

Seldom is a treatment prescribed for a symptom unless there is a good physiologic basis for it. Both heat and cold have been prescribed for the treatment of muscle spasm, and the results of both have been varied. The physiologic mechanisms of the local and general effects of heat and cold on muscle spasm are different, and both must be taken into consideration for a comprehensive evaluation of their therapeutic effect.

Electromyographic study¹ has shown conclusively the complete relaxation of normal human striated muscle at rest. Neuromuscular activity in a spastic muscle can be abolished also by simple relaxation or rest. However, the slightest

stimuli acting through hyperactive reflexes cause immediate and excessive activity.²

Matthews³ stated that hypertonus is produced by an excessive discharge of the motor neurons supplying the main muscle fibers and the gamma motor neurons supplying the specialized muscle fibers within the muscle spindles. The activity of the gamma motor neurons does not directly produce tension in the muscle, but increases the proprioceptor discharge of the muscle spindles, and this may cause contraction of the muscle by reflex excitation of the alpha motor neurons. The level of activity of the gamma motor neurons is important in determination of the degree of hypertonus, and overactivity of the gamma motor neurons is a major factor in the development of the hypertonus, although not its sole cause. Paralysis of the gamma fibers causes the stretch reflex to diminish or disappear. Activity of the gamma neurons affects the "threshold" rather than the stiffness of hypertonus. It would appear, then, that decreasing the frequency of impulses along the gamma motor neurons would do a good deal toward raising the threshold of the spindle cells and thus relaxing the hypertonus. Raising the over-all body temperature does decrease the excitability of gamma fibers, and results in decreased excitability of spindles. A decrease in body temperature increases gamma nerve activity, resulting in increased excitability of spindles.⁴ As soon as the core temperature really falls about a degree, involuntary reflex shivering occurs to increase heat production.⁵ If hypertonus is already present, shivering will then tend to increase it. If cooling is continued, shivering ceases at about 94 F. (34.4 C.), as the

patient goes into hypothermia and all neural activities decrease. Both shivering and general hypothermia are to be avoided in the treatment of muscle spasm.

Local application of cold decreases neural activity locally. Eldred and associates⁶ reported that annulospiral flower-spray (muscle spindles) and tendon organ endings under tension all fired slowly when cooled, with greater absolute decreases at the higher tensions. In effect, then, cold raises the threshold stimulus of the muscle spindles, and heat lowers it. Vasoconstriction also is brought about through application of cold, and the resulting reduction in blood flow tends to bring about an impairment of the strength of contraction.

Relaxation of muscle spasm through the application of heat is brought about by the resultant decrease in the frequency of impulses along the gamma motor neurons with a general rise in body temperature, but the heat should be applied to an uninvolved part of the body to avoid increasing the local excitability of spindles. A cold pack applied to the region of muscle spasm at the same time the heat is applied elsewhere decreases local excitability of spindles and greatly enhances the relaxation of the spasm. This is true not only of skeletal muscles, but of smooth muscle in the intestine. The motor activity of isolated gut will increase when the temperature is increased and decrease when the temperature is lowered. The indirect effect of heat or cold on the intact intestinal tract is just the opposite.⁷

Local application of cold packs tends to be more effective than heat treatment, because cold penetrates more deeply than do most forms of heat.⁸ Moreover, cold relaxes hypertonus directly,⁸ so that the muscles warm slowly because of the decreased circulation. This prolongs relaxation, and pain is lessened by the anesthetic properties of cold. Exercise is easier after cold than after hot packs, because of the decreased resistance to stretch.

Method

In this study, cold packs were made by arranging ice cubes in a rectangle about 6 by 14 inches (15 by 36 cm.) lengthwise on a bath towel and then folding the sides and ends to keep the ice in place. A warm damp towel was first placed on the area to be treated, and the cold packs were placed on top of it, so that the initial shock of the cold was minimized and the muscle could cool slowly. The packs were then left in place for twenty or thirty minutes, and the resultant cold was effective from three to four hours.

Generally it is not necessary to heat the body when cold packs are applied to less than 10 per cent of the body area. However, if massive cold packs are necessary, short wave diathermy is effective in preventing shivering, which increases tone and existing spasm.

Report of Cases

One of us (R. L. D.) had occasion to use cold packs on 3 patients with acute poliomyelitis recently. Heat was used first, but increased the pain and spasm of all 3 patients, a 6-year-old girl, a 2½-year-old girl and a 4-year-old boy. All 3 obtained excellent relief from cold packs. The legs of the 6-year-old girl were drawn up tightly under her buttocks at first, but after cold packs were applied to her hamstrings and gastrocnemius muscles regularly for two days, she was able to lie with her legs fully extended for several hours and tolerated stretching much better. The 4-year-old boy would look forward to his afternoon cold packs so he could nap as the spasms relaxed. After the acute stage passed, it was possible to exercise these patients in a warm Hubbard tank.

A 40-year-old woman with multiple sclerosis was admitted with spasms in both quadriceps and a sustained bilateral clonus. Cold packs were applied to both quadriceps and gastrocnemius muscles, and short wave diathermy was applied over the abdomen. After the first session, the clonus was relaxed almost completely. After treatments twice daily for a week, there was no trace of clonus after treatment, although sustained clonus was present before each treatment. After cold packs, the patient was able to participate in resistive exercises to her lower extremities in all ranges of motion.

Comment

With almost any injury to the head, neck and shoulders, and with the painful shoulder common in the hemiplegic patient, bilateral local muscle spasms usually occur in the teres major, the rhomboid muscles, the infraspinatus, the supraspinatus or the sternocleidomastoideus or a combination of these, and care must be taken to locate and

cold pack all the affected muscles for effective relief. In the lower part of the back there is a tendency to spasm in the quadratus lumborum and the lumbar extensors. Cold packs give good relief in the presence of preoperative disc syndromes and good to fair relaxation of spastic flexor groups when cerebral palsy or hemiplegia is present.

In cold packing for the common spasms of the teres major, the packs are laid from the scapulas up over the shoulders. If there are accompanying spasms in the rhomboid muscles, a third cold pack may be placed up and down the spine. If no spasms are present in the rhomboid muscles, a narrow hot pack may be applied on the spine between the cold packs. A narrow cold pack, about 3 inches (7.6 cm.) wide, wrapped around the neck is effective for relaxation of spasms in the scalenus and the sternocleidomastoideus muscles.

When cold packing is followed with massage, superficial effleurage seems to be more relaxing than deep massage, as the deep massage has a tendency to disturb the muscle spindles and increase spasm.

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