CHAPTER 51

POSTOPERATIVE CRYOTHERAPY

Robert P. Taylor, D.P.M.

Cryotherapy can be defined as the use of a modality to lower an area of body temperature to attain therapeutic effects.[1] The first reported use of cold was by Hippocrates, who used snow and ice following soft tissue injury.[2] Today the application of cold is an integral part of the treatment for an acute injury, or postoperatively.

While the use of cryotherapy has proven to be an essential treatment modality in the acute injury setting, its postoperative use is still limited. Studies have shown that patients who receive postoperative cryotherapy have a reduced incidence of hematoma, less pain and swelling, and convert from parenteral pain medications to oral pain medications sooner. Overall, these patients require less pain medication, and thus are more alert and able to ambulate and rehabilitate sooner.[1-9] In this paper, the physiologic effects, benefits, potential complications, and contraindications of cryotherapy will be discussed, as well as guidelines for application and the anticipated effects.

PHYSIOLOGICAL EFFECTS AND BENEFITS

The primary effect of cryotherapy is a reduction in blood flow. Vasoconstriction is the initial response of the surface vessels. This is caused through an axon reflex arc that is a projection of the peripheral autonomic system. Vasoconstriction also occurs through reflexive action via the spinal reflexes. As cooled venous blood returns to the general circulation, it activates the posterior hypothalamus to further increase vasoconstriction.[1] This vasoconstriction limits the amount of hemorrhage and edema in the area. Cold also decreases vascular permeability and reduces the amount of fluid that leaks into the extracellular spaces.[6] This reduced vessel permeability preserves lymph drainage because of the decrease in the pressure of the extravascular fluid.[6] All of this aids in the prevention of wound dehiscence, infection, and decreases pain. Control of excessive swelling, hemorrhage, and exudate formation help ensure satisfactory healing.[1]

Cryotherapy limits tissue hypoxia. Following an injury, tissue disruption reduces available oxygen supply, and therefore, the metabolic needs of uninjured tissue might not be met. Secondary tissue hypoxia may develop. Cold temperatures decrease the metabolic demands of the area and subsequently reduce the need for oxygen.[1] Studies have shown that with a 10°C reduction in temperature, venous blood from a cooled area demonstrates 80% oxygen saturation, versus 70% saturation in the normal return. The reduced oxygen utilization is indicative of the fact that chemical reactions are decreased by one-half with a 10°C reduction in temperature. Obviously, with the production of fewer metabolites, the amount of debris and tissue damage is limited, and so is the required repair.[6]

Several reasons have been postulated for the reduced pain levels noted with cryotherapy. Some suggest that a local anesthetic effect is produced secondary to decreased nerve conduction velocity. Another idea is that the cold sensation overwhelms and blocks the inflow of pain stimuli to the cortex. Probably the most significant contribution to analgesia comes from the ability of cryotherapy to inhibit muscle spasm. Pain caused by spasm, which occurs when the body attempts to immobilize an injured area, produces ischemia. There are not many pharmacological treatments the physician can employ to help relieve the pain of an ischemic episode.

Ice also reduces the release of enzymes, histamines, and other vasoactive substances that stimulate nerve endings and cause spasm.[6] Schaubel's study evaluated 519 patients, of which 207 received postoperative ice. Only 5.3% of the patients that were treated with ice required bivalving of the cast for swelling and pain, as compared to 42.3% of the patients who did not receive postoperative ice. Of the 519 cases, 66 involved the foot. The results of the foot cases were also impressive. Only 10% of those who received ice needed a cast modification, while 63.9% of the patients without ice required a split cast. The patients who received postoperative cryotherapy also had temperatures, pulse rates,

respirations and white blood cell counts that ranged closer to normal than those who did not receive cryotherapy.[6] Patients who receive postoperative cryotherapy have a quicker recovery period, fewer postoperative complications, and are able to return to higher levels of function earlier.[1,4-11]

Another benefit of cryotherapy is its effect on collagen. Cooler temperatures increase the stiffness of collagen, therefore a more stable wound site is produced as motion is be reduced.[6]

CONTRAINDICATIONS

McDonald and Guthrie divided the contraindications to cryotherapy into two categories, absolute and relative. Their absolute contraindications to cryotherapy include Raynaud's phenomenon and hypersensitivity to cold.[6] Juhlin and Shelley presented three classifications of cold hypersensitivity. Type I is the result of histamine and histamine-like substances which present as cold urticaria. Type II is when cold homolysins and agglutinins are present, and produce general symptoms such as malaise, chills, and fever with a concomitant anemia. Type III is caused by the presence of cryoglobulins which produce fever and chills, and can affect vision and hearing, possibly to the point of blindness and deafness.[1,6]

These hypersensitivities are most commonly found in patients with associated diseases such as lupus, atypical pneumonia, rheumatoid disease, multiple myeloma, and progressive symptomatic sclerosis.[1] Most of these individuals may only experience wheals and flushing of the face. Hypersensitivity to cold is uncommon, but the clinician should be aware of its existence and the associated disease states.

Relative contraindications to cryotherapy include patients diagnosed with paroxysmal cold hemoglobinuria, pheochromocytoma, rheumatoid disease, and antipathy to cold.[1,6,12] Patients with paroxysmal cold hemoglobinuria may produce a free flow of hemoglobin that could cause renal dysfunction and hypertension. Patients with Pheochromocytoma may have an increased blood pressure, while patients with rheumatoid disease can precipitate cryoglobulinemia or simply have an increase in joint pain and stiffness. The emotional distress caused by cold in patients with antipathy to cold outweighs the benefits of cryotherapy.[1] All of the relative and absolute contraindications can be avoided with the preoperative history.

An additional contraindication is a postsurgical foot where vascular status to the digits is in question. Although in the majority of these cases, the digits return to normal vascular status and non-eventful healing, the author recommends avoiding cryotherapy initially until the toes' appearance improves.

POTENTIAL COMPLICATIONS

There are few potential complications to cryotherapy, most of which can be avoided. These complications include nerve injury, frostbite, and maceration of the wound site.[1,3] Peripheral nerve injury can result from the use of cryotherapy. Although the injury usually spontaneously resolves, it can be avoided by giving consideration to the location of major peripheral nerves, the thickness of the overlying subcutaneous tissue and dressing, and the length of application time.[1,3] Direct contact of ice with the skin should be avoided. The chance of frostbite can be eliminated with careful attention in the patient with questionable vascular supply.

Wound maceration may occur as a result of condensation from an ice bag or gel pack leaking into the dressing, or from a faulty seal of a broken bag. This can be avoided by proper placement of the ice, and by checking the ice bag for defects.

APPLICATION GUIDELINES

When using cryotherapy, clear guidelines should be established and communicated to both the patient and the nursing staff. Patients may experience a number of different sensations during cryotherapy. Four stages have been described by Hocutt et al. In stage 1, the initial feeling is the sensation of cold, lasting from 1 to 3 minutes. Stage 2 begins when the patient experiences a burning or aching sensation, and lasts for the next 2 to 7 minutes. Stage 3 is the level at which the local anesthesia starts to take effect. On average, stage 3 is reached after 5 to 12 minutes.

Hocutt et al. described a stage 4 in which there was a deep vasodilation without an increase in metabolism. However, a recent study has shown that this deep dilation does not occur.[13] Ho et al. compared various icing times and the effect on bone metabolism and blood flow. They found that a small increase in arterial flow was seen an average of ten minutes after application, but this

was followed by continued vasoconstriction with reduced blood flow and metabolism. This effect may represent a reflex vasodilation, but if the cold therapy is continued, reduction in blood flow and metabolism is maintained.[12,14,15] The maximum effect of icing was achieved at twenty-five minutes.[14]

The use of cold, as with many time-honored remedies, has developed empirically.[16] Application times and effects have been detailed. However, there are no consistent recommendations as to how often cryotherapy should be used in the postoperative setting. The benefits of cryotherapy have been seen with application frequencies ranging from every 1 to 3 hours with a soft dressing, and continuously for the first 48 to 72 hours when a cast was involved. The author recommends continuous ice for the first 48 to 72 hours when a cast or Jones compressive dressing is used, and 25-minute applications every 2 to 3 hours of waking time for 24 to 48 hours when a soft dressing is used. Ice is best applied as soon as the patient arrives in the recovery room. Cryotherapy should be continued at home if the surgery is performed in the outpatient setting. Often, the only time postoperative out-patients receive cryotherapy is for the short period they are in the recovery room. The author also recommends that with soft dressings, that the 25-minute application time be used every hour for the first two postoperative hours then continue every 2-3 hours. The ice bag or gel pack should be placed just proximal to the surgical site.

CONCLUSION

Postoperative cryotherapy can reduce pain, edema, and hematoma. This will increase the patient's ability to ambulate and rehabilitate sooner. With avoidable complications, and few contraindications, cryotherapy is a safe, effective adjunctive modality for postoperative treatment. Continuous cryotherapy is recommended for the first 48 to 72 hours when a cast or Jones compressive dressing is used, and twenty-five minutes every 2 to 3 hours when a soft dressing is used.

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