Cryotherapy after cruciate knee surgery

Skin, subcutaneous and articular temperatures in 8 patients

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We recorded temperature changes on the skin surface, subcutaneously and intraarticularly during cryotherapy after knee surgery by using Cryo-cuff compression dressings. Subcutaneous recordings on the contralateral knee were used as reference. 8 patients were examined. There was a reproducible decrease in skin temperature and subcutaneous temperature. Skin temperature had to be lowered to about 20 °C to obtain demonstrable intraarticular temperature changes.

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Cryotherapy to reduce tissue edema, inflammatory reaction, hematoma formation and subsequent pain, has been known for many years (Schaubel 1946). Topical application of cold has been used in the treatment of arthritic joints (Oosterveld and Rasker 1994). Some authors have reported reduced blood loss, and diminished pain in patients undergoing knee surgery (Cohn et al. 1989, Levy and Marmar 1993). Intraarticular probes for measurements of temperature changes after application of ice during 30 minutes have been used by Bocobo et al. (1991) on dog's knees, and on patients with inflammatory arthritis of the knee (Oostervald and Rasker 1994). In these studies, the intraarticular temperature was lowered by 5°–6° C.

We assessed temperature reduction on the skin surface, subcutaneously and intraarticularly following the application of cold compression for 24 hours after cruciate ligament surgery of the knee.

Patients and methods

5 men and 3 women, median age 25 (17–41) years, were studied. Preoperatively, they were carefully informed about the study. They all had a sports-related anterior cruciate ligament injury and were operated on with a bone-tendon-bone graft harvested from the patellar tendon. We used a single-incision technique, with a straight short anterior midline incision and mini-arthrotomy in a bloodless field. The operating time was 60–70 minutes.

At the end of the operation, 3 thermosensors (NiCr-Ni(K)) were applied to the operated knee on the skin, subcutaneously and intraarticularly, respectively (Figure 1). On the contralateral side, one subcutaneous thermosensor was used as reference. After wound closure, dressings and a Tubigrip stocking, the tourniquet was released and cold compression was applied with the Aircast Cryo-cuff, which was immediately inflated with ice-cold water from the cooler.

The thermosensors were connected to a programmable data acquisition instrument (Therm 2281-8, Ahlborn, Mess und Regelungstechnik. PF 1260, D-8150 Holzkirchen, Germany). The instrument was programmed to record the temperature at each measuring point at 10-minute intervals.

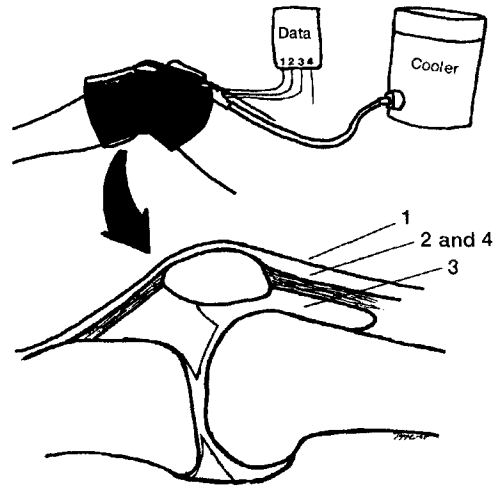

Figure 1. Placement of thermosensors: on the skin surface (1), subcutaneously (2), intraarticular in the operated on knee inside suprapatellar pouch (3), and as control, on the contralateral knee subcutaneously above suprapatellar pouch (4).

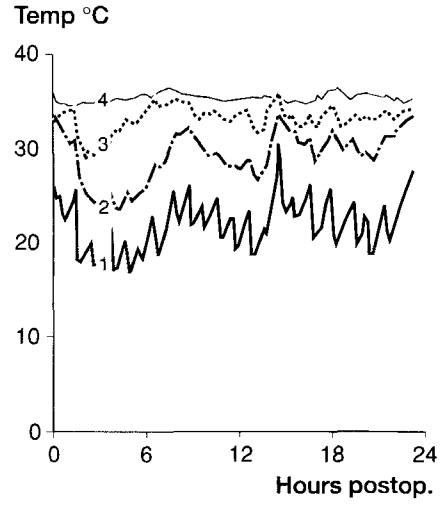

Figure 2. Good manually nursing and ice-changes gives lowering of temperature. Curve numbered as in Figure 1.

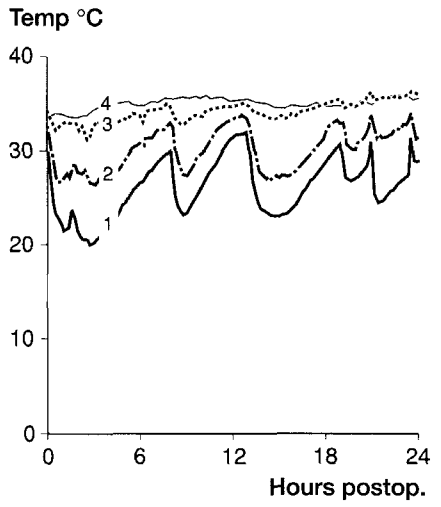

Figure 3. Automatic pump and ice-changes every 5–6 hour. Curve numbered as in Figure 1.

The nursing staff changed the water in the Cryo-cuff every hour and refilled the ice in the cooler every 4th hour. In patients Nos. 7 and 8 we tested a pump-device which refills and evacuates the Cryo-cuff automatically by cyclic increase and lowering of the pressure (15–35 mmHg) in the cooler every 30th second. When the automatic pump was used, the cooler was placed at the same level as the treated knee.

No complications caused by cryotherapy or negative effects due to the recording devices were seen.

Data were transmitted via RS-232 interface to a computer program.

Results

On the operated knee, skin surface recordings during the first 6 postoperative hours showed a median temperature of 24 (20–28) °C. During the same period, the subcutaneous and intraarticular temperatures were 32 (27–34) °C and 35° (32–36) °C, respectively. On the nonoperated reference side, the median subcutaneous temperature was 35 (34–36) °C.

Skin temperature had to be 20 °C to give any demonstrable intraarticular temperature decrease (Figure 2). The automatic pump produced a more continuous lowering of the skin surface and subcutaneous temperatures (Figure 3).

Discussion

Bocobo et al. (1991) recorded intraarticular temperature changes during 5–30 minutes on anesthetized dogs' knees after applying ice compression. They found that when ice had been applied for 30 minutes, the temperature fell by a mean of 6.5 °C and the intraarticular temperature fell an average of 0.2 °C per minute. In arthritic patients, Oosterveld and Rasker 1994 refuted an old hypothesis that intraarticular temperature was increased by superficial cold. They showed that the intraarticular temperature was lowered from 35° to 29 °C after the application of ice chips and nitrogen cold air during 30 minutes.

In our study, we regularly recorded reduction in temperatures on the skin surface and in the subcutaneous tissue. However, it seems difficult to obtain a persistent decrease in intraarticular temperature for 24 hours. Many factors—for example, room temperature, the thickness of the subcutaneous fat layer and the thickness of the postoperative dressings—may influence the effect of postoperative cryotherapy. The automatic compressor pump seemed to facilitate postoperative care and result in a steadier decline in temperature.

The Cryo-cuff device is easy to handle and we have seen no complications such as frostbite or nerve palsy which have been reported (Drez et al. 1981). The Cryo-cuff is supposed to act both by cooling and by compression for longer periods. Further studies are needed to evaluate the separate effects of compression and cooling.

In conclusion, it seems that skin temperature needs to be lowered to about 20 °C before any intraarticular temperature decrease can be recorded. It also seems difficult to achieve a continuous lowering of intraarticular temperature for longer periods. However, it is not known whether a reduction in intraarticular temperature is needed to reduce negative side-effects and pain after surgery.

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