

## PAPERS AND SHORT REPORTS

## Cryoanalgesia for relief of pain after thoracotomy

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### Abstract

One hundred patients undergoing thoracotomy had their intercostal nerves blocked by cryoanalgesia before closure and the effect of this on their postoperative pain was evaluated.

Of the 100 patients, 79 were free of pain, 12 had some discomfort, and nine reported severe pain necessitating narcotic analgesia (mean 1.5 injections per patient). Only five patients needed assisted removal of sputum, though eight showed retention of sputum or subsegmental collapse of lung radiographically. Overall, lack of pain and greater alertness much enhanced the value of physiotherapy, which resulted in a low incidence of complications and a smooth recovery.

The technique of cryoanalgesia is simple, extremely effective, and apparently offers benefits not conferred by other methods of preventing pain after thoracotomy.

### Introduction

Thoracotomy leaves a very painful surgical wound<sup>1</sup> and large quantities of analgesics may be required.<sup>2</sup> Thoracotomy is also associated with a high incidence of pulmonary complications.

Usually narcotic analgesics are used to control pain after operation, but these may not be completely effective and may lead to respiratory depression in patients with limited pulmonary reserve.<sup>3,4</sup> Local anaesthetic injections into the intercostal nerves produce only temporary relief, and further injections are often not practicable.<sup>5</sup>

For hundreds of years low temperatures have been used to relieve cancer pain and provide local analgesia. Only since the work of Cooper<sup>6</sup> and Amoils,<sup>7</sup> however, has technology allowed the practical application of cryogenic temperatures to tissue. In 1976 Lloyd *et al*<sup>8</sup> described the specific application of extreme cold to nerves to achieve pain relief by a long-term reversible nerve block and called the technique cryoanalgesia.

Cryoanalgesia appeared to offer a practical technique for controlling pain after thoracotomy. The cryoprobes used employ the Joule Thompson principle, whereby high-pressure gas (nitrous oxide) is allowed to expand within the probe tip and hence cause rapid cooling to some  $-60^{\circ}\text{C}$ . When applied to the nerve this cooling causes local degeneration through the nerve bundle but spares nerve sheaths and connective tissue. Axonal regeneration of the nerve occurs with the return of normal nerve function after a period of time.<sup>9</sup>

### Patients and methods

One hundred consecutive patients (16 female, 84 male) were treated with cryoanalgesia. Their mean age was 55.4 years and the range 6-86 years. Eleven had operations for oesophageal disease, six for mediastinal disease, and four for pulmonary decortication; the remaining 79 had various lung resections. Two surgeons used the same technique, the same nursing staff, and the same management before and after operation. Five different consultant anaesthetists participated but their techniques were not significantly different.

Before closure of the thorax a Spembly cryoprobe operating from a BMS40 control unit (fig 1) was applied to the intercostal nerves. The parietal pleura was peeled back locally to enable the probe to be placed



FIG 1—BMS40 console and probe for cryoanalgesia after thoracotomy (Spembly Ltd, Andover, England).

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under direct vision on to the relevant intercostal nerve, close to the intervertebral foramen proximal to the collateral branch (fig 2).

The intercostal nerve at the thoracotomy space and two intercostal nerves above and two below the space were frozen for 30 seconds. The probe was allowed to defrost in situ to facilitate its removal. Each nerve was refrozen at the same site for a further 30 seconds in a similar manner. Chest drains were placed within the anaesthetised area.

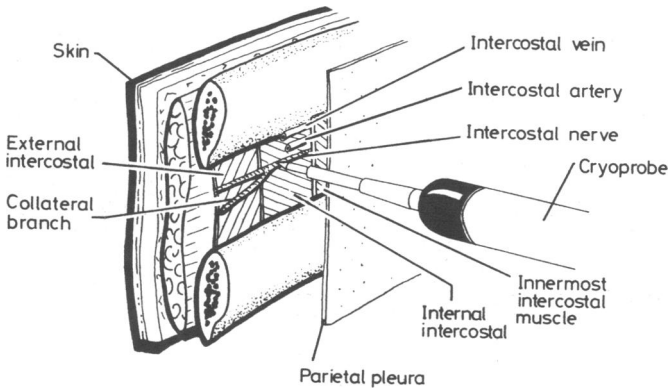


FIG 2—Cryoprobe applied to intercostal nerve.

The postoperative regimen and analgesia were ordered by the anaesthetist and were identical for all patients. The administration of analgesia was decided solely on the basis of need, and no attempt was made to withhold analgesia.

The amount of postoperative narcotics (pethidine hydrochloride or papaveretum) and other analgesics required were studied. The early postoperative recovery and incidence of complications were assessed clinically and radiologically.

## Results

There was excellent control of pain at the operation site. Of the 100 patients, 79 claimed to be free of pain, 12 experienced some discomfort, and 9 had severe pain requiring narcotics. This group received an average of 1.53 narcotic injections per patient. Almost all patients were given a narcotic injection on the first postoperative night to facilitate nursing and were converted to oral analgesia at the earliest opportunity.

Early postoperative recovery was noticeably smooth, only five patients needing catheter suction for removal of sputum. Postoperative bronchoscopy was not required by any patient in this group. Early postoperative radiographs showed sputum retention or subsegmental collapse of the lung in eight patients.

The patients were easily able to comply with rigorous physiotherapy because of the relative absence of pain and their alertness. Compliance with physiotherapy is a major contributor to smooth recovery and low incidence of complications. Patients could sit, walk, and exercise soon after operation and for long periods, and were easy to nurse. Measurement of drainage postoperatively showed no excess bleeding.

Normal sensation returned after three to six months. Cryoanalgesia of the lower intercostal nerves (7-12) could theoretically result in weakness of the related part of the anterior abdominal wall. Slight bulging was noted in three cases but was recovering as the cutaneous sensation returned to normal.

Wound healing was delayed in four cases.

## Discussion

Freezing intercostal nerves gives a reversible nerve block with no undesirable sequelae. The simplicity of the technique and the ease of operating the equipment, especially with a newly designed probe, has resulted in extremely effective control of pain after thoracotomy.

Comparison between patients given cryoanalgesia and others in the unit whose postoperative pain was controlled either by narcotics or by intercostal nerve blocks with local anaesthetic

before closure showed a greatly reduced demand for narcotic and oral analgesia and increased willingness to comply with physiotherapy. Enhanced application of effective physiotherapy results in a reduced incidence of postoperative complications and a smooth recovery.

The longer time required for the return to normal cutaneous sensation in our 100 patients when compared with that reported<sup>10</sup> (up to four weeks) indicates that the lesion produced is axonotmesis and not neurapraxia. Though a similar freeze cycle was employed, the difference may have been due to the improved technique using pleural retraction to ensure that the probe was accurately located on the nerve proximal to the collateral branch. This is essential for an effective and predictable nerve block. Although this long duration of anaesthesia poses no problem to the patient, further study is being undertaken to assess how much the freezing time may be shortened and yet provide adequate analgesia. It is also important that the drainage tubes should be sited in the anaesthetised area, as they may cause intense discomfort.

Since this was an initial trial no observations were made about length of hospital stay.

Using cryoanalgesia adds 10-15 minutes to the total operating time. We consider this to be time well spent. Cryoanalgesia appears to be the method of choice for controlling pain after thoracotomy, offering advantages not achieved by any other available technique.

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CRAB'S CLAWS. Called also Water Sengreen, Knight's Pond Water, Water House-leek, Pond Weed, and Fresh-water Soldier.

It has sundry long narrow leaves, with sharp prickles on the edges of them, also very sharp pointed; the stalks which bear flowers, seldom grow so high as the leaves, bearing a forked head, like a Crab's Claw, out of which comes a white flower, consisting of three leaves, with divers yellowish hairy threads in the middle; it takes root in the mud at the bottom of the water. It grows plentifully in the fens in Lincolnshire. It flowers in June, and usually from thence till August.

It is a plant under the dominion of Venus, and therefore a great strengthener of the reins; it is excellently good for inflammation which is commonly called St Anthony's Fire; it assuages inflammations, and swellings in wounds: and an ointment made of it is excellently good to heal them; there is scarcely a better remedy growing than this is, for such as have bruised their kidneys, and upon that account discharge blood; a dram of the powder of the herb taken every morning, is a very good remedy to stop the terms. (Nicholas Culpeper (1616-54) *The Complete Herbal*, 1850.)