CRYOSURGERY IN VASOMOTORIC RHINITIS

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Cold was used in medical therapy as early as 3500 B.C. (Torre, 1967). Egyptian physicians applied cold, among other things, to heal head wounds and inflammation of the breast. Modern cryosurgery, however, was developed during the 1960s, in New York, by Cooper (1961) who designed a cryoprobe with a tip where freezing was produced by liquid nitrogen. In Paris, Mazers (1966) constructed a similar probe and carried out his first cryohypophysectomy in 1960. In the same year, Lemarley & Muler published their findings concerning the use of liquid nitrogen for treating laryngeal papillomatosis in children. The first report on the use of cryotherapy in Scandinavia was published by Palva & Meurman in 1962.

Biological action

From a biological point of view, freezing means that the fluid in tissues is crystallized, in other words, dehydrated. Consequently, as the biologic medium freezes and ice separates as a pure substance, the solutes are concentrated in the spaces remaining between ice crystals. The increase of electrolyte concentration raises the ionic strength of the suspending medium, often producing a toxic concentration of electrolytes. The pH of the medium may change (Marchall et all., 1941). The initial destructive effect of freezing upon biologic tissue results from the toxic concentration of electrolytes due to dehydration. Rapid freezing used in cryosurgery produces rates of cooling sufficiently high to cause intracellular crystal growth resulting in the rupture of cell membrane (Meryman, 1956, 1957). Thawing of the tissues after freezing also has a destructive effect, which must be added to the effect of crystallization and the toxic concentration of electrolytes. As the temperature is raised, the exposure of tissue to a high concentration of electrolytes at a higher temperature results in a particularly high rate of injury. Moreover, slow thawing permits the growth of ice crystals by re-crystallization prior to actual melting. The development of larger crystals by this process causes further damage to the cell membrane. It is also known (Lovelock, 1957) that there are three further mechanisms of cellular damage due to freezing: denaturation of lipid-protein complexes, thermal shock and vascular stasis. Lovelock pointed out that lipid-protein complexes, such as exist in cell membranes, are held together by weak association forces which are inherently unstable. Freezing causes profound changes in the physical environment and is sufficient to denature these sensitive cellular lipid-protein complexes thus damaging or destroying the cellular membrane. The loss of phospholipid as a result of

freezing renders the cell membrane so permeable to ions that it slowly swells and bursts.
The lysis of the cell membrane may occur during the freezing or the thawing stage. Lovelock (1957) demonstrated that not only the principal cell membrane but also the membranes of the nucleus, mitochondria and microsomes may suffer irreversible damage during freezing because of the denaturation of lipid-protein complexes. Thermal shock refers to cell injury due to the rapid change in temperature rather than to the direct effect of freezing (Walton, 1957). The mechanism of cold shock may involve the varying coefficients of expansion in membranes, resulting from cold changes in various components of the cell, and account for the increased lethal effect on the cell.
During freezing and subsequent thawing there is a specific effect not only on cells and their immediate environment but also on the local organized tissue in situ (Kreyberg, 1957). Kreyberg stated that the critical temperature for the constant production of tissue damage is somewhere between -10°C and -20°C. He found that the development of vascular stasis is a factor of special significance in tissue damage following freezing: this damage should be added to the list of physical factors directly causing cellular damage and death, as a result of biologic freezing.
It is evident that repeated freezing and thawing must be more lethal for the cells than a single exposure to freezing temperatures. Lesions produced by more intense cold are generally larger and more severe than those produced by lesser degrees of cold.
Cryosurgery has in recent years been more widely used especially in oto-rhinolaryngology (Leden, 1967, Letscher, 1969). Laffolé (1967) has applied cryotherapy to allergic rhinitis. The Department of Otorhinolaryngology, University Central Hospital, in Helsinki has used cryosurgery e.g. for the treatment of patients with vasomotoric rhinitis.

Material and method

We treated 38 patients, of ages ranging from 18 to 65 years. 28 of the patients were women and 10 were men. All these patients had a typical vasomotoric rhinitis, as well as other vasospastic symptoms (cold, clammy hands and feet, etc.). No patient had nasal polyposis. They had previously received symptomatic therapy for vasomotoric rhinitis with various antihistaminic drugs etc. The patients' main symptoms were:

1. Obstruction of the nasal cavities, involving markedly obstructed respiration through the nose
2. Watery discharge from the nose
3. Attacks of sneezing
4. Many patients had additional symptoms, such as anosmia or hyposmia, and vasospastic headache.

Anterior rhinoscopy showed a thick, livid mucous membrane with large turbinates. The nasal cavities were blocked.
Cryotherapy was carried out using a probe (ACU_2 Cryo Surgical Unit) manufactured by Keeler. Freezing was effected by nitrous oxygen (N_2O) gas. The probe works on the Joule-Thomson principle, in which the sudden expansion of gas under pressure produces a rapid drop in temperature. The advantage

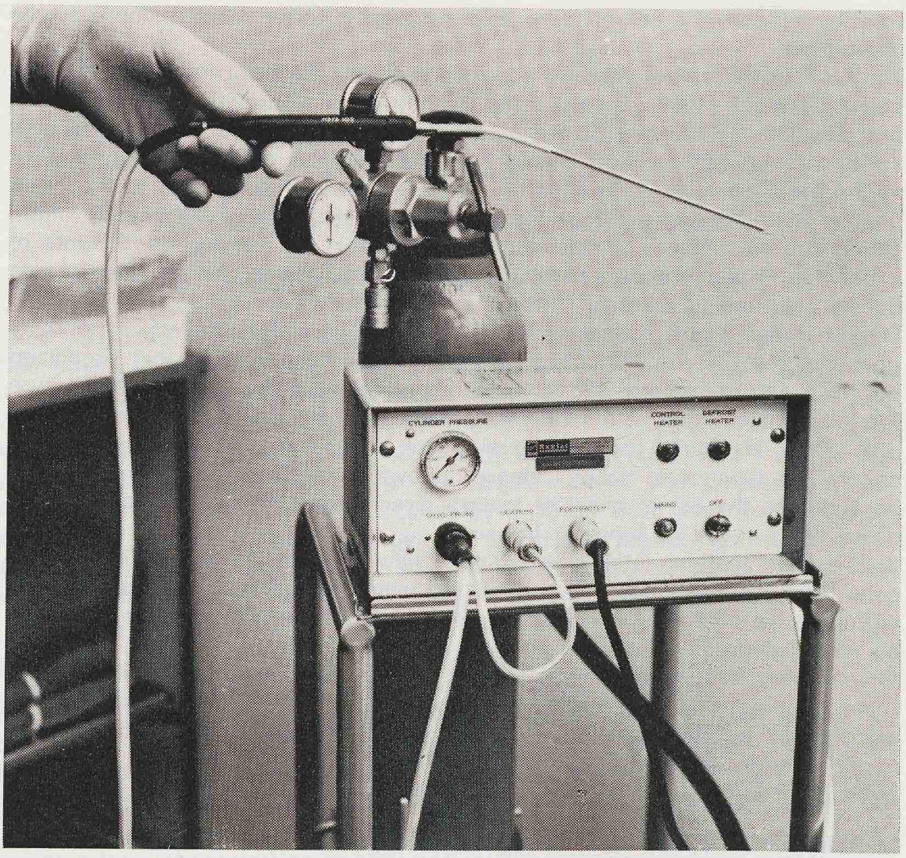

Figure 1. The E.N.T. cryosurgical unit with the nasal probe. Gas flow is controlled by a footswitch-operated solenoid valve.

of using this principle for obtaining low temperatures enables the construction of sturdy yet simple probes which have remarkable rates of cooling, even in contact with tissue. A micro-heater within the tip of the cryoprobe ensures defrosting of the tip in about 10 seconds.

The technique we used was as follows. After treating the mucous membrane with a topical application of Xylocain spray(R) the probe was placed as far posteriorly as possible against the medial side of the inferior turbinate. Cold was switched on for one minute. After thawing the procedure was repeated on the contralateral side. The inferior turbinate was treated bilaterally at about three sites during one session. The anterior parts of the middle turbinates were also often treated, once on each side. After the treatment the patient's nose was more blocked than preoperatively for 1—2 days.

Most patients were treated in a sitting position. Treatment took place in the outpatient clinic, and patients went straight back to work after the treatment, which involves no pain whatsoever.

RESULTS

In the assessment of the results it should be borne in mind that all earlier attempts to treat this group of patients had either failed completely or only provided slight relief.

The results of the treatment were:

1. Completely symptom-free: 10 patients
2. Free nasal respiration but slight residual watery discharge: 21 patients
3. Distinct improvement of the obstruction but watery discharge just as before the treatment: 6 patients
4. No improvement: 1 patient

The follow up time was from 6 months to 2 years.

In most cases the patients reported that their sense of smell had improved markedly. Anterior rhinoscopy after the treatment revealed increased opening of the nasal cavities, and a nasal mucosa thinner and closer to the normal colour. The mucous membrane showed scattered small scars.

DISCUSSION

Owing to the nature of the disease, the assessment of the results must be based largely on the patients' subjective views. By and large, the patients found the results very positive, and in any case it was the most effective form of treatment they had experienced.

This form of treatment is associated with several marked advantages.

1. There is no minimum or maximum age. Children from 7 years upwards can stand the operation without anaesthesia. The treatment can be given at an outpatient clinic without premedication and operative anaesthesia.
2. The treatment takes 10 minutes at a time.
3. The patients can go straight back to work.
4. The treatment is painless. Cold is anaesthetic.
5. The treatment is harmless and without complications.
6. No haemorrhage occurs during or after the treatment.
7. No suppurative infection occurs postoperatively.

SUMMARY

The biologic effect of rapid freezing is discussed. The mechanism of cellular and tissue destruction is considered to depend on dehydration, thermal shock, crystallization and re-crystallization with physical rupture of the cell membrane, denaturation of lipid-protein molecules in the cell membranes, and vascular stasis. Cryosurgery has been used in 38 cases of vasomotoric rhinitis where symptomatic treatment had not given any noticeable relief. Both the inferior and middle turbinates were treated (2—4 times) by cryoprobe. The advantages of the method are discussed. The results seem to be promising considering the difficulty of curing the symptoms of this disease.

RÉSUMÉ

L'effet biologique de la réfrigération rapide est traité. On est d'avis que le mécanisme de la destruction des cellules et des tissus dépend de la déhydration, du thermochoc, de la cristallisation et la récristallisation avec rupture

physique de la membrane cellulaire, dénaturation des molécules protéines lipoïdes dans les membranes cellulaires, et de la stase vasculaire. La cryothérapie a été appliquée dans 38 cas de rhinite vasomotorique où le traitement des symptômes n'avait pas résulté dans un soulagement sensible. Les cornets inférieurs et moyens ont été traités (2—4 fois) avec une cryosonde. On discute les avantages de la méthode. Les résultats semblent être favorables en considération des difficultés rencontrées dans la cure des symptômes de cette maladie.

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