CRYOEXTRACTOR AND CRYOPEXOR*†

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FEW new developments in ophthalmology have so gripped the imagination of ophthalmologists as cryosurgery. In a relatively short space of time very many instruments of varying complexity have been designed for this purpose. Some of the more complex ones are unfortunately rather erratic in function.

It is the purpose of this paper to present another instrument in this field, one that has interchangeable extractor and pexor tips, with the advantages of simple and robust construction, ease of use, and consistently reliable action.

New instruments for cryosurgery have been described by many authors, including Krwawicz (1961), Rosengren (1964), Bellows (1964), Kelman (1965), Cibis (1965), Rubinstein (1965), Fison (1965), and Amoils (1965). The technique and results of use of the various instruments for cataract extraction and retinopexy have been described by Krwawicz (1961) and Bellows (1965a). Other indications, such as the treatment of herpetic keratitis, episcleritis, pterygium, glaucoma, corneal vessels, intra-ocular tumours, etc., have been discussed by Bietti (1950), McLean and Lincoff (1964), Polack and de Roeth (1964), Krwawicz (1965), Bellows (1965), Lincoff and McLean (1965), and de Roeth (1966).

Matthäus (1965) reported on the temperature changes in the vitreous during cryo-extraction. Kirkconnell and Rubin (1965) reported on the absence of vitreous changes after cryopexy in contradistinction to the quite marked changes after photo-coagulation and diathermy.

The instruments (Fig. 1) were designed to require a minimum of fuss in operation and to bring cryogenic techniques within the scope of all ophthalmologists.

FIG. 1.—Cryoextractor and cryopexor tips for use with the same handle.

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The cryoextractor is a pencil-shaped instrument, consisting of a special white plastic handle with a metal probe tapering to the ball-shaped extractor tip. The handle has the property of very low temperature conduction, and can therefore be grasped within a few millimetres of the metal probe when the latter is at its working temperature, without causing any discomfort to the surgeon.

The metal probe screws into the handle. The main body is of the same diameter as the handle, tapers to a short neck and swells out to the ball tip that is applied to the cataractous lens. Some surgeons prefer to twist a short length of supramid or silk round the neck for protection of the cornea, should it accidentally be allowed to drop while the instrument is in the anterior chamber. The sphericity of the tip appears to obviate any tendency to rupture the capsule, which may be encountered with instruments with a flat applicator surface and a sharpish edge. If too much pull is exerted during an extraction by means of this instrument, the ball tip will separate from the icicle without rupturing the capsule. After waiting for a few seconds to allow the capsule to become unfrozen, the extractor can be re-applied.

The cryopexy probe screws into the same handle; the main body is of the same diameter as the handle and tapers off to a tip with three different sizes of applicator surface, according to requirements (Fig. 2).

FIG. 2.—Cryopexor tip.

Freezing Media

The design of the instruments necessitates immersion of the probe into the freezing medium to allow it to cool to a suitable working temperature. The two most universally available and hence the most useful media for this purpose are carbon dioxide snow and liquid nitrogen.

Carbon dioxide snow with acetone added to give it a suitable mushy consistency as well as to provide sterility (Drews and Edelmann, 1956) yields a temperature of -79°C . if the probe is immersed for some 15 to 20 seconds. If the probe is incompletely immersed it will need a longer period to reach this temperature.

Liquid nitrogen can be poured into a stainless steel, thermos, pyrex, or plastics container. Complete immersion of the metal probe for about 40 seconds gives a temperature of -196°C ., whereas 15 to 20 seconds gives a temperature adequate for cryoextraction. The drop in temperature is a virtually linear function of time, as is shown by thermographic studies, using copper Constantan thermocouples. The temperature decay occurs in a curvilinear fashion (Fig. 3, opposite), and varies with a number of factors.

The likelihood of introducing harmful organisms into the eye as a direct result of immersing the metal probe in the coolant must be regarded as virtually nil; the instrument is frozen, freezes the lens to itself, and removes it. The essence of the technique is not to touch other tissues. Nevertheless, bacteria and spores may survive these low temperatures, provided that the cooling occurs rapidly. The possibility of contamination by spores was investigated as follows:

Approximately 2 to 3 ml. liquid nitrogen were poured straight from the container as supplied to the hospital, into six meat-broth culture bottles, and the bottles were then cultured in the usual way. Subcultures were done from each daily for a week but yielded no growth.

FIG. 3.—Rise in temperature of cryopexor probe tip from -196°C. after immersion in liquid nitrogen measured by copper Constantan thermocouple, with one junction in ice.

- E Probe tip at room temperature of 23°C. , probe position vertical, tip down and stationary.
 D Probe tip in permanent contact with eye, position constant (eye bath temperature 30°C.).
 C Probe tip moved constantly over surface of the eye (eye bath temperature 36 to 32°C.).
 A Probe tip exposed to blast of air from hair drier (room temperature).
 B Probe tip applied intermittently: 15 sec. on, 5 off (Low peaks: application to cornea. High peaks: application to conjunctiva and sclera).

Bellows (1965b) used purified filtered liquid nitrogen and a hood over the tip during immersion. The same can be used with these instruments or alternatively they may be immersed in alcohol, contained in a sterile test tube standing up in the container into which the liquid nitrogen will be poured (*cf.* the Krwawicz instrument).

Sterilization can be done in any of many ways, *e.g.* by ethylene oxide, a variety of chemicals, irradiation, boiling, or autoclaving at temperatures below 250°F.

Method of Use

This has been adequately described by many authors. It will suffice to emphasize a few points of technique: The best solution to the very real danger of touching the iris is to use an adequate iris retractor such as that described by du Toit (1967). Alternatively this complication can be dealt with by dripping saline onto the tip of the instrument, causing it to unfreeze and release the iris within 3 to 8 seconds, ready for a fresh start. This represents a speedier defrosting process than is possible with some of the more complex instruments.

Applying the tip as near as possible to the upper pole of the lens, the author waits for 5 to 8 seconds to allow firm adhesion to the lens before beginning to dislocate it. Counter pressure below has been found to be unnecessary.

The use of chemical zonulolysis has not been found to be of real additional help.

Occasionally it is found that, on first application of the tip to the lens, adhesion is inadequate. Immersion of the tip into the freezing medium for a further few seconds or touching the ball tip only to the surface of sterile water before reapplying the tip to the lens, solves this problem.

Summary

A new instrument for cryosurgery with interchangeable extractor and pexor tips is described. Its advantages over existing instruments of more complex design are pointed out.

Two freezing media, viz. liquid nitrogen and carbon dioxide mush, are recommended as the most suitable for use with this instrument.

Methods of sterilization and some points of technique are discussed.

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