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Use of the Perkins hand-held applanation tonometer in retinal detachment surgery

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The applanation method is generally accepted as being the most accurate for measuring intraocular pressure. Perkins (1965) described a hand-held portable applanation tonometer. Whitty (1969) reported his results using this tonometer: he found that readings with the hand applanator were slightly (1–1·5 mm.Hg) lower than those taken with the Haag-Streit tonometer, and he felt that this may have been caused by a slight defect in technique. There was no difference between the readings taken with the hand applanator when the patients were sitting and lying.

In a list of uses to which the instrument may be put, Whitty mentioned the operating theatre. The purpose of this communication is to describe the indications and technique for its use in retinal detachment surgery. In this study, the battery-powered model (Fig. 1, opposite) was used, and pressures were recorded in over fifty cases.

Indications

(1) AT THE END OF RETINAL DETACHMENT PROCEDURES DURING WHICH SUBRETINAL FLUID HAS BEEN DRAINED

The main danger in this procedure is hypotony. Hawkins and Schepens (1966) stressed the significance of hypotony in the production of choroidal detachments. They also felt that choroidal haemorrhage was more likely to occur if the globe was left hypotonic after drainage of subretinal fluid, particularly in myopic eyes. Schepens (1968) suggested a final pressure of 10–15 mm.Hg.

(2) DURING PROCEDURES IN WHICH SUBRETINAL FLUID IS NOT DRAINED

This technique has been advocated by Lincoff, Bavas, and McLean (1965), who modified the original procedure of Custodis (1953). During the operation there is always a rise in intraocular pressure as the scleral buckle is produced. The main danger of this procedure is occlusion of the central retinal artery. In many cases it is possible to observe the behaviour of the central artery with indirect ophthalmoscopy; sometimes the view of the artery at the disc may be partially or totally obscured by opacities in the media or even by a ballooned detachment of the retina itself. Recordings of the intraocular pressure would be particularly valuable in these cases.

Bailliart (1917), using ophthalmodynamometry, found the average diastolic pressure in the ophthalmic artery to be 47 mm.Hg, and the systolic pressure 78 mm.Hg. Mikuni and Yoneyama (1960) found pressures of 38·7 and 77·1 mm.Hg. Galin, Baras, and Cavero (1969), using a suction-cup technique, found higher values: in their series of 67 cases the lowest pressures were an ophthalmic diastolic pressure of 60 mm.Hg and a systolic pressure of 109 mm.Hg. This patient had a brachial artery pressure of 120/70 mm.Hg.

Smith and Cogan (1959) considered the relationship between brachial artery and ophthalmic artery pressure. In a series of normal subjects, they found the average systolic

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pressure in the ophthalmic artery to be 81·1 per cent. of that in the brachial artery, and the average diastolic pressure to be 72·4 per cent. In patients with frank cerebrovascular disease, the corresponding figures were 73·7 and 64·3 per cent.

These findings suggest that, provided that the systemic diastolic blood pressure does not fall below 75–80 mm. Hg, it is quite safe to raise the intraocular pressure to 30–35 mm. Hg (*i.e.* less than 50 per cent.) even though the central retinal artery cannot be seen. There would seem to be little risk of totally occluding the central retinal artery at this pressure. Exceptions may be cases of retinal detachment in which there is ipsilateral ocular ischaemia (*e.g.* carotid artery stenosis, retinal artery disease, carotico-cavernous fistula), which may result in abnormally low pressures in the ophthalmic artery.

Technique

A small amount of 2 per cent. fluorescein from a freshly opened bottle is placed on the cornea with a glass rod and diluted by a stream of saline. The surgeon then puts on a loose-fitting sterile linen glove and the tonometer is handed to him by an attendant. An applanation prism which has been sterilized in ethylene oxide is inserted into the tonometer by the surgeon. The operating theatre lights are dimmed. It has been found to be most convenient to measure the pressure from the side (Fig. 2). Two separate readings are taken. No part of the instrument other than the sterile applan-

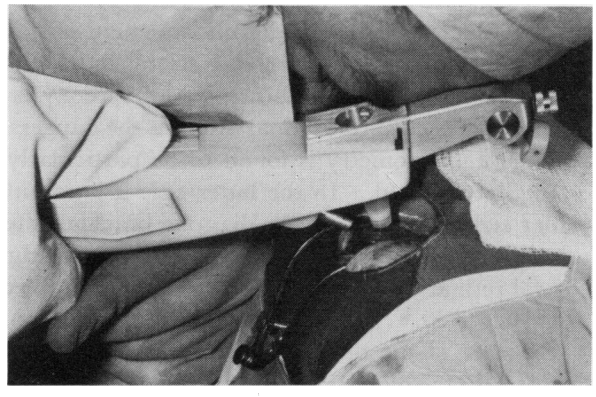

FIG. 2 *Applanator in use during an operation. A sterile linen glove is worn and the eye is approached from the side*

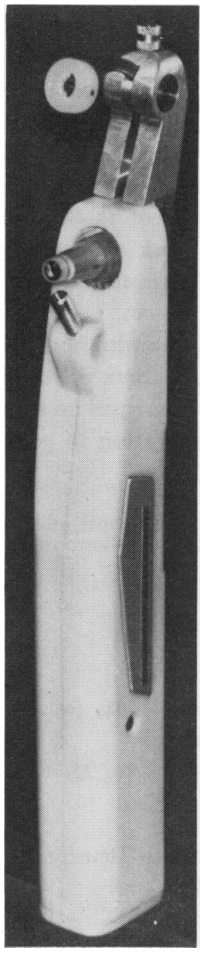

FIG. 1 *Battery-powered Perkins hand-held applanation tonometer*

ation prism touches the operation field. When the readings have been made the attendant takes the instrument and removes the linen glove from the surgeon's hand. With practice the whole procedure can be completed in about 1 minute, and there is little inconvenience.

When subretinal fluid is not drained, pressures are recorded at the beginning of operation, in between and after the tying of the scleral sutures to raise the indent, and at the end of the operation. Pressures are also recorded in the other eye for control purposes. The blood pressure is recorded by the anaesthetist each time the intraocular pressure is measured

DIFFICULTIES ENCOUNTERED

(1) Great care must be taken during the operation to see that the cornea remains moist. If it is allowed to dry, the applanation rings become indistinct and accurate readings are difficult to obtain.

(2) On one occasion a small unsuspected corneal abrasion was present before tonometry was performed; fluorescein was applied and this resulted in rapid and marked taking up of the stain by the corneal stroma. This slightly impaired the view of the fundus obtained with the indirect ophthalmoscope.

These problems were the only ones encountered in over fifty cases.

Summary

It is considered that accurate measurement of intraocular pressure is essential in retinal detachment procedures involving scleral indentation, either with or without drainage of subretinal fluid. In the former case hypotony is to be avoided and in the latter total occlusion of the central retinal artery is the danger. When subretinal fluid is not drained, applanation tonometry is found to be particularly useful when disc details are partially or totally obscured. In the latter case it is considered that, in the absence of ipsilateral ocular ischaemia and with a diastolic brachial artery pressure of 75–80 mm.Hg, it is safe to raise the intraocular pressure to 30–35 mm.Hg without risk of total occlusion of the central retinal artery. If subretinal fluid is drained, a final pressure of 10–15 mm.Hg has been suggested.

The ease of use of the hand applanator is stressed. Contamination of the operative field is easily avoided. Because of the speed of the procedure there is little inconvenience or unnecessary lengthening of the operation time. In over fifty cases no serious difficulties have been encountered. Care of the cornea during the operation to prevent drying or abrasion is essential.

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Notes