Pneumohydrostatic device for goniotomy

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Barkan's goniotomy is agreed to be the safest and most effective procedure for the management of eyes with congenital glaucoma. Technical difficulties arise in the maintenance of the anterior chamber throughout the procedure. Conical shaft knives, as designed by Barkan (1948, 1950), Shaffer (1959), and Swan (1965), do not prevent early loss of aqueous and "tend to dimple the cornea, which is another cause of aspiration of air under the goniotomy lens" (Worst, 1965). The hydrostatic instrument proposed by Wells (1961) proved, in our hands, to be unsatisfactory (Radian, Radian, and Lupu, 1968). The improved hydrostatic device of Worst (1965) is suited for a longer maintenance of the anterior chamber; however, as in Wells's technique, the assistant plays too great a part in the procedure because the surgeon has to wait for the manipulation of the saline-filled reservoir by a person who cannot watch carefully the position of the iris-lens diaphragm. With both devices, the goniotomy needle must be large enough to allow the necessary flow of saline under low pressure.

Our pneumohydrostatic apparatus is designed not only to prevent the loss of the anterior chamber during goniotomy, but also to give the surgeon freedom to adjust its depth rapidly, whenever needed.

Construction

The pneumohydrostatic device (Fig. 1, overleaf) consists of:

- (1) A bottle (A) of the type commonly used for perfusions, three-quarters filled with sterile saline; it can be attached to a floor stand (B).
- (2) Two 20-cm.-long cone-needles plus a shorter one (about 8 cm.)—all taken from an intravenous drip system.
- (3) A manometer (C).
- (4) A rubber bulb (D).
- (5) Rubber cannulae, one 5 m. long and two 40 cm. long.
- (6) A hollow shaft (E), much like that used by Worst, on which a fine 24 hypodermic needle can be fastened with a slotted slip-over nut.
- (7) A foot-switch (F) with a spring, strong enough to flatten the rubber cannula.

The metal parts (the shaft, the needles, and the foot-switch) are sterilized by dry heat. Rubber cannulae should be sterilized by boiling. The manometer and the rubber bulb need no sterilization.

Preparation for use

The 24 hypodermic needle is inserted into the shaft and the slotted nut is tightened. The 5-m. rubber cannula is slipped over the rear of the shaft with one end; the other end is passed through the body of the foot-switch (while this is depressed with the hand) until the switch is located 2.5 m. distant from the hollow shaft. The second end of the long rubber cannula is slipped over the short cone-needle which is introduced by the nurse into the saline bottle. Each of the two 40-cm. rubber

FIG. 1 *Diagram of apparatus*

- A Bottle
- B Floor stand
- C Manometer
- D Rubber pear-shaped bulb
- E Hollow shaft
- F Foot-switch

cannulae is slipped over the end of a cone-needle (20 cm. long) and both of them are introduced through the rubber cork of the bottle, till their tips reach the air. The nurse connects the first cannula to the manometer and the second one to the rubber bulb. The foot-switch is then handed over to the nurse, who puts it on the floor. The complete apparatus is shown in Figs 2 and 3 (opposite).

Method of use

Now the nurse begins to pump air into the bottle, while the surgeon presses the foot-switch, thus washing the system with saline and expelling air bubbles. When only saline reaches the hypodermic needle (held tip-upwards), the surgeon cuts the saline stream by lifting his foot from the foot-switch. The pressure in the infusion bottle is adjusted, at the beginning, at 40–50 mm. Hg. The nurse has to watch the manometer during the procedure in order to maintain the due pressure by repeatedly pumping air into the bottle, but the adjustment of the saline flow in the anterior chamber is made by the surgeon himself.

Commentary

Barkan (1950) stated that one-third to one-quarter of the chamber angle must be stripped to normalize the intraocular pressure in eyes with congenital glaucoma. It is true that goniotomy can be repeated, but one looks for an extensive one, in order to avoid re-operation with its possible drawbacks (hazards of general anaesthesia, multiple corneal scars, hyphaemata, possible damage to the lens). Of utmost importance for an extensive goniotomy is the maintenance of the anterior chamber throughout the procedure. With the pneumohydrostatic device, even at the end of an extensive goniotomy, when the

FIG. 2 *Components assembled* FIG. 3 *Footswitch*

corneal aperture is enlarged by the rotation of the hypodermic needle, the chamber can rapidly be filled and even deepened, by adjustment of the pressure in the infusion bottle.

This device provides the surgeon with the following advantages:

- (a) A thinner needle can be used on the metallic shaft with no reduction of the saline flow (the pressure in the bottle is higher than with the known hydrostatic devices). This largely facilitates observation of the angle during goniotomy. Distortion of the cornea when crossing Descemet's membrane is also reduced.
- (b) The position of the iris-lens diaphragm can be properly adjusted by the surgeon himself. Using the foot-switch, it can be pushed and maintained slightly behind the normal plane.
- (c) When bleeding occurs, haemostasis can be obtained instantly, without wasting time for the raising of the infusion bottle or pumping saline with the syringe.

In twelve out of the sixteen eyes on which goniotomy has been performed with the pneumohydrostatic apparatus, we have been able to open more than one-third of the angle. Only in four eyes was it necessary to repeat the procedure. With the simpler hydrostatic devices we have been using in previous years, only a few eyes were cured by a single goniotomy.

Finally, there is no need to emphasize the ease with which the components can be obtained. For example, the manometer and rubber bulb can be taken from a Vaquez blood pressure apparatus. Except for the foot-switch, which has to be manufactured, everything is ready to hand in any surgical department.

Summary

A pneumohydrostatic apparatus designed for goniotomy is described. The pressure in the feed-pipe can be controlled manometrically and the flow of saline stopped by the surgeon himself. The goniotomy needle is thinner, providing easy penetration through the cornea

and facilitating gonioscopic observation during surgery. The anterior chamber can be preserved for a longer time during the operation, thus enabling the surgeon to perform an extensive goniotomy without risk.

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