Recent advances in the surgical treatment of glaucoma

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Contributed by request and dedicated to Sir Stewart Duke-Elder

The period since the founding of the Institute of Ophthalmology seems to be an appropriate span of time to consider; changes in technique and attitudes to surgery which have materially benefited sufferers from the disease are worthy of consideration as “advances”.

Acute congestive glaucoma

The modern concept of angle block, consequent very high intraocular pressure, consecutive iris ischaemia with sphincter failure, and inflammation resulting therefrom was almost completely unknown in the 1940s. Furthermore, Diamox and the osmotic agents were not available. The ophthalmologist was faced therefore with a painful inflamed eye with raging hypertension over which he had little control and the cause of which was imperfectly known. The remedy was somewhat dangerous and time was pressing. The emergency broad iridectomy often through a hazardous Graefe section, the knife being threaded across the shallow anterior chamber the point dimly seen through a steamy cornea, was hurriedly performed, often late at night or on an exhausted patient and an often imperfectly anaesthetized eye.

The first real advance during our period in the management of acute glaucoma was not, however, surgical but medical, the introduction of Diamox by Becker (1954). This drug and its successors, the parenteral and later oral osmotic agents, completely altered the surgical management of the disease.

Iridectomy no longer had to be carried out while the pressure in the eye was raised, and time was available for a more leisurely and complete assessment of the situation. The chief object of such an assessment was to discover whether a fistulizing operation was required or whether an iridectomy would suffice.

Three principal methods were available; tonography, gonioscopy, and later gonioscopy combined with Chandler’s manoeuvre.

Unfortunately the first of these, tonography, proved to be somewhat disappointing and has gradually been abandoned by most workers in the assessment of acute glaucoma.

Gonioscopy also posed great difficulties in this type of case, first because of the state of the cornea and secondly because in all eyes with narrow angles it is notoriously difficult to be exactly certain whether an angle is just open or just shut. Chandler and Simmons (1965) attempted to get round this problem in an ingenious fashion. They advocated emptying the anterior chamber by a paracentesis and then immediately refilling it. The
method was known as anterior chamber deepening, a slightly inaccurate name. What actually happened if the manoeuvre was correctly executed was not deepening of the chamber but restoration of its original depth, but with reversal of the normal physiological iris bombé because fluid was being introduced into the eye anterior to the iris. This produced a concavity of the peripheral face of the iris so that it became easy to see whether peripheral anterior synechiae were present.

A variant of Chandler's manoeuvre is carried out by some skilled gonioscopists. Using a small lens, such as the Zeiss four-mirror goniolens, some workers find it possible to expose various sectors of the angle to view by judicious movements of the lens which indent the limbus somewhat in the manner of an indirect ophthalmoscopist (Forbes, 1966).

The fellow eye in acute glaucoma

Surgical treatment of the fellow eye in acute angle-closure glaucoma has been one of the outstanding advances in management which has taken place during this era and since it was introduced has probably saved many thousands of eyes from blindness or severe damage.

Bain (1957) found that 53 per cent. of fellow eyes became involved if treated only with miotics, while Luntz (1960) reported that peripheral iridectomy failed in only 7 per cent. of cases. He pointed out that Curran (1920) had originally described the mechanism of the attack and its treatment and that Chandler (1952) had given precise details of the ab externo approach to peripheral iridectomy.

The position of peripheral iridectomy in prophylaxis has been finally and convincingly established by Lowe (1973) in a 5-year follow-up of 52 patients.

The next step in this field may well be iridectomy with the laser. This method has not yet been fully developed but encouraging results are reported by Perkins and Brown (1973).

Glaucoma simplex

Surgical "advances" in the sense of surgical innovations in this disease have been extraordinary in their profusion, but whether real benefits have accrued is more open to question. A glance at the index of a few numbers of Ophthalmic Literature will serve to indicate the masses of operations described; in 1948 we find angiodiathermy, anterior flap sclerotony with basal iridencleisis, cyclodiathermy, iridotasis, iridencleisis; in 1958 cycloelectrolysis, iridectomy with scleral cautery, iridosclerectomy, sclerecto-iridencleisis, trephano-cyclodialysis; in 1968 external carotid ligation, cryotherapy, modified Scheie's operation, gonipuncture, goniotrabeculotomy, sinusotomy, trabeculectomy, and valve diathermo-sclerecto-iridectomy. These examples selected at random from three particular years constitute a far from complete list of methods available to the surgeon, trabeculectomy and Strampelli's operation for example being two obvious omissions.

Operations involving diathermy, electrolysis, and later cryotherapy to the area of the ciliary body enjoyed some popularity during the period of study but have not been universally accepted. The reason seems to lie in the difficulty of estimating how much treatment to give—too little having no permanent effect and too much causing hypotension and eventually phthisis bulbi.

De Roetth (1969, 1971), one of the principal workers in cryotherapy for glaucoma, has pointed out that temperatures as low as -80°C. are required for effective results.

Laser therapy for glaucoma simplex is as yet in its infancy. There are at present two chief forms, cyclocoagulation through intact conjunctiva and sclera (Beckman and Sugar,
1973) and trabecular puncture (laseropuncture) through a gonioscope (Krasnov, 1973). One awaits with the greatest interest further reports on these important developments: it seems possible, for example, that trabecular laseropuncture may prove to be a treatment which has to be regularly repeated, rather than an "operation" with a permanent effect. Although this would be inconvenient it would certainly not be an insuperable obstacle.

Several types of plastic implants have been described, but one feels that their place is very limited except perhaps where unduly brisk healing of conventional fistulizing procedures is to be expected. An example is that of Molteno (1969).

Apart from surgical innovations it is probably true to say that a more realistic view of the mechanisms involved in fistulizing procedures has been gained during the period.

Galin (1968) was able to demonstrate external fistulization of thin blebs by means of fluorescein studies and actually obtained aqueous humour from the surface of a bleb by means of a suction cup.

Sourdille (1968) pointed out that between 48 and 71 per cent. of blebs showed true external fistulae according to the type of operation. Thus subconjunctival drainage of blebs is by no means the exclusive mechanism, a concept which gives us more insight into the reasons for late infection.

Reactivation of a failing filtration bleb by means of suction cup decompression was attempted by Mittl and Galin (1967). Since it is almost certainly true that the development of a satisfactory bleb during the first few weeks after surgery is a far from straightforward process, it seems that this technique, which may give some degree of control over the process, has received less attention than it deserves.

**Buphthalmos**

Goniotomy has remained the standby for congenital glaucoma. Progress has been made in matters of technique in particular in the design of contact lenses by Worst (1964), Lister (1965), Swan (1965), and many others. Maintenance of the anterior chamber for an unlimited period during goniotony by means of an irrigating gonioscope seems an obvious advance which curiously enough has not received as much attention as one would expect, although such instruments have been described for example by Tagawa, Aizawa, Noraka, Ono, and Fukui (1971). The reviewer has used a normal disposable hypodermic needle on a syringe with very satisfactory results.

Harms and Dannheim (1969) have, however, claimed a very high success rate in congenital glaucoma by trabeculotomy.

**Secondary glaucomas**

Certain specific types of secondary glaucoma have become better understood during the last decade and surgical methods have been devised to overcome them. One very interesting example, which is almost iatrogenic, is pupil-block aphakic glaucoma occurring early after an intracapsular lens extraction with an imperforate or incarcerated iridectomy. In former times such a case would simply have produced an iris prolapse but because of adequate suturing pupil-block glaucoma occurs instead. Remedies such as very prompt iridectomy, with or without deliberate incision of the vitreous face, have been suggested.

Malignant glaucoma, a somewhat similar condition, although occurring after fistulizing procedures instead of lens extraction, has received a good deal of attention. The surest way to cure the condition is to remove the lens early, but few surgeons care to do this especially as in some cases the lens can be pulled back by maximal cycloplegia.
Chandler, after previously describing a somewhat frightening procedure consisting of passing a needle posteriorly around the side of the lens to evacuate trapped aqueous, later abandoned this and described a more acceptable method of vitreous aspiration and anterior chamber reconstitution (Chandler, Simmons, and Grant, 1968)

Post-detachment surgery glaucoma is a relatively new entity which has come about as the result of plomb and encirclement procedures. A complicated sequence of events, involving slight forward movement of the lens iris diaphragm as a direct mechanical result of the procedure, often combined with further shallowing of the anterior chamber by an active uveal effusion associated with venous obstruction, and ischaemia of the iris from the same cause, gives rise to a complicated clinical picture including severe ischaemic inflammation with or without true acute angle-closure glaucoma.

Surgical management of this type of secondary glaucoma requires extremely careful assessment of the situation and modification of the encircling band may be required.

**Microsurgery**

The period under study has seen the rise of microsurgery and the development of operations, the performance of which would be hazardous and difficult without microsurgical aid.

**Trabeculotomy**

Smith (1960), Burian (1960), Harms and Dannheim (1969), Mackensen (1970), and many others have described various devices whereby the trabecular meshwork may be selectively ruptured after an approach to Schlemm's canal via an *ab externo* incision.

Although the usual claims of freedom from complications and excellence of surgical control of tension have been made, nevertheless it is still open to question whether these types of operation are superior to more conventional procedures. Gonioscopic observations after trabeculotomy are surprisingly disappointing, very little evidence of a trabecular cleft often being seen, but it is probable that some trabeculotomies do function by removal of part of the trabecular element of obstruction although equally others without doubt drain through a bleb. Harms and Dannheim (1969) published figures of 300 cases operated upon by their method with the 'hairpin' probe, and in the successful cases (approximately 80 per cent. overall) found draining blebs in only 13 per cent. They concluded that, in the majority of successful cases, the operation functioned by removal of trabecular resistance. They felt that, in cases which failed in spite of a gonioscopically visible cleft with blood reflux, pathological resistance external to the canal might be implicated.

**Trabeculectomy**

The excision of a small block of tissue which included the canal of Schlemm was first described by Sugar (1961), but these operations were not a success. Nakajima, Kanski, and Takayama (1961) described a full-thickness trabeculo-sclerectomy in which a piece of tissue 2 x 5 mm. was removed. A diffuse bleb was said to result. Cairns (1968) described trabeculectomy by making a limbus-based conjunctival flap under which was made a fornix based 2/3 thickness corneoscleral flap 5 mm. square. From the floor of this a block of tissue which included Schlemm's canal was removed. A modification by Watson (1970) consisted of forming the lamellar scleral flap in a limbal-based fashion and removing a larger area of the deep tissue so that not only the canal but the scleral spur and part of the deep sclera over the ciliary body were included.
Sinusotomy

Krasnov (1964, 1968) described sinusotomy which consists of excision of a portion of the sclera external to Schlemm’s canal, thus removing the scleral element of resistance to aqueous outflow. Krasnov felt that many cases of glaucoma simplex have their pathological resistance in the sclera although not everyone would agree with him.

Conclusion

The modern surgeon dealing with a case of glaucoma thus has an enormous number of surgical options available. The days are gone when all that was required was the observation of a cupped disc and a “full” tension to justify a routine trephine.

Most surgeons are now somewhat more reluctant to operate than in former times, which gives one the slightly worrying feeling that our “advances” are not as convincing as we should like.

But, as always in Medicine, we must follow the example of our illustrious predecessors and, although the prospect seems unpromising and the means at our disposal inadequate, we must keep on trying to advance.

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