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THE FUTURE OF IRIS-INCLUSION IN GLAUCOMA

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IN this paper is given the basis of a firm faith, strengthened by recent experience, in iris-inclusion as inevitably the future treatment for many chronic primary glaucomas. But the paper would not have been written had it not been necessary to introduce a new and much needed item in operative technique that alters the outlook materially.

The Need for Iris-inclusion

No one can maintain that there is not much room for improvement in many of the final results of the various iris-free operations now performed, or can show much reason to doubt that the limit of achievement in this direction has probably been reached.

The main defect of all iris-free drainage, apart from early operative risks, is now fairly obvious. It can be summed up in the statement that there is no assured happy mean in this form of relief. Despite all efforts, frequent disappointment is met with in attempts to steer a safe course between excessive localized drainage, as shown by conjunctival blebbing, with or without hypotony, on the one hand, and the liability to early or late return of glaucomatous tension on the other hand.

From the earliest days of iridectomy the frequently observed time-limit to the relief afforded has been a great drawback of the operation. By small flap sclerotomy a few surgeons have obtained a large proportion of possibly permanent successes, with

perfectly diffused drainage. I recently saw two such eyes in a patient operated upon by myself 17—18 years before, and the brother of this patient, similarly operated upon about the same time has equally good results.

But unfortunately there is no known way of ensuring such enduring results from this operation always, and some surgeons have been very unsuccessful with the method, probably, as Mr. Reginald Bickerton has suggested, through fear of touching the iris—not going deeply enough in making the scleral puncture.

My own very limited experience of late results of trephining, performed by various surgeons, suggests that in eyes that have been thus operated upon, and in which there is no conjunctival vesiculation, there is a greater liability to recurrence of tension than in eyes with linear filtering scars secured by either of the above-mentioned operations. It would be interesting to know whether others with larger experience of trephining results, are able to confirm the above impression that limitation of the area of moderate drainage—drainage unaccompanied by conjunctival blebbing—tends greatly to limit the period of effective relief obtained.

I did not realize till recently how much the gravity of a late return of glaucomatous tension may be enhanced by insidiousness of onset, particularly when there are no available records of the visual field.

A patient came nearly seven years after a trephine operation, thinking she did not see quite so well as formerly. With slight astigmatic correction her visual acuity was nearly 5/6. The local condition seemed surgically perfect, in that there was no trace of conjunctival vesiculation. The trephine hole could not be seen, and there was some definite cicatricial tissue in part of the area of reflexion of conjunctival flap. I was quite certain that there was no glaucomatous tension at the time. But there had been some early history of slight transient congestive attacks before her operation, and the corneae were slightly small. Later history suggests that possibly there were transient elevations of tension at that time, at night, at least. The fellow eye was blind and hard from absolute glaucoma.

Fourteen months later she went again to the well-known surgeon who had trephined her eye. I believe her vision had then definitely deteriorated. But he evidently found no plus tension. He must have taken the case to be one of progressive optic atrophy, in spite of full relief of glaucomatous tension, since his verdict was that there was nothing more to be done. Greatly disappointed, she resigned herself to the oncoming blindness. Finally, in despair, she was brought to me again nearly blind, more than three years after I had first seen her.

The tension was + 1, and the vision was reduced to the counting of one or two fingers at 2—3 feet distance in a small portion of the outer field.

I performed an iridencleisis operation immediately to the inner side of the area of adherent conjunctival flap, up and in. The result has been unsatisfactory from my point of view, in that the early promise of fibrosis over the prolapsed iris, in the form of dilated conjunctival blood-vessels, failed to materialize. There is a conjunctival bleb, due, I believe, to restriction of sub-conjunctival diffusion of aqueous above the cornea by the firmly adherent conjunctival flap of the trephine operation. (Diffusion beneath the neighbouring conjunctiva to the inner side of the cornea is also limited, since the conjunctiva exposed in the palpebral aperture is normally somewhat adherent).

The patient, however, has been most grateful for the steady improvement in vision that progressed up to the time when I last saw her, nine months after the operation. She then saw one or two letters of 5/20.

The Promise of the Future: A Technical Detail

Hitherto I have shrunk from the responsibility of recommending expressly the fairly general adoption of iris-inclusion, (1) because of failure to get rid entirely of the conjunctival bleb, with its presumptive risk of late infection, and (2) because of the need for insistence upon measures to be taken to eliminate the risk of sympathetic ophthalmitis.

Now I believe it can at last be claimed that the needful control over conjunctival changes has been secured—not through any elaborate deduction from preconceived ideas or from basic principles—but simply from observation of the effects of rare instances of unintentional irido-dialysis, produced during glaucoma operations.

Latterly in most of my operations for chronic primary glaucoma the iris has been purposely detached from its base locally by the downward pull of iris forceps, before being drawn up to be cut meridionally with scissors beneath the conjunctiva. The number of cases so treated has been small, but in every case a perfect result has followed. There is reason to hope, therefore, that this small and apparently insignificant addition to ordinary technique marks the final development of the principle of iris-inclusion, the fruit of years of effort.

The Perfect Result

Some of those who have practised deliberate iris-inclusion have been far too content with very inferior results, including apparently all grades of conjunctival vesiculation and rarefaction.

Iridencleisis cannot justify itself unless it brings with it a reasonable hope of securing always a near approach to the perfect result—assuredly permanent and full relief of tension, together with complete protection against late infection, as provided by localized conjunctival fibrosis. It seems strange that little notice has been taken of this most desirable development of new fibrous tissue in the conjunctiva covering an iris-prolapse, extending down into, and practically replacing the iris tissue, yet not interfering in the least with efficient drainage of aqueous into the surrounding subconjunctival tissue. (See photo-micrographs by Verhoeff, *Arch. of Ophthal.* XLV, 1916, p. 5, and by Holth, *Brit. Jl. of Ophthal.* IV, 1922, p. 13; both reproduced in my small book on the Operative Treatment of Glaucoma, 1923).

This fibrosis—apparently a result of friction and pressure of the upper lid upon the locally elevated conjunctiva—is always preceded by a quite early appearance of dilated and tortuous conjunctival blood-vessels, that evidently have much to do with the new formation of tissue. The enlarged blood-vessels are very noticeable within a week, over the whole field of operation, and though they mostly disappear later, a few generally remain larger than normal.

It is not perhaps entirely clear why irido-dialysis should be so effective in ensuring this localized fibrosis, this protective fibrous shield. The explanation is probably to be found chiefly in the fact that the dilatator muscle of the iris is put out of action locally. Having no basal attachment, it cannot draw the prolapsed iris back into the eye. The sphincter of the pupil has also been put out of action temporarily in my operations, by the combined use of cocaine, adrenalin and atropine. And owing to the basal detachment, the iris lying under the conjunctiva forms a tongue of tissue, apparently of the right size, that can be floated forwards by aqueous, while yet allowing free escape of the fluid on both sides.

My first attempt to utilize deliberate irido-dialysis to ensure conjunctival fibrosis was a great failure, and most discouraging. Having detached the iris, I simply drew out the bridge of tissue and left it under the conjunctiva. But the extent of iris tissue was too great for the whole of it to be elevated by outflowing aqueous. In consequence, the aqueous found a way through the iris, and produced a conjunctival bleb. The result compared very badly with the perfect fibrosis that had been secured earlier in the fellow eye by older technique.

Security in Operating

When it is fully realized that the desired result, as given above, is uniformly obtainable in the average primary glaucoma by any

really careful operator of quite moderate experience, I believe that nothing can stop the rapid advance of the practice of iris-inclusion.

There is nothing difficult in the operation. It is, in fact, one of the simplest imaginable. And it becomes, apparently, one of the safest of all glaucoma operations if the available safeguards are fully used.

The shortness of the necessary straight sclero-corneal incision—varying a little with the thickness of the iris forceps that are to be introduced, but in any case not longer than about 3·5 mm. at the deep surface of the cornea—prevents any long delay in refilling of the anterior chamber, with its possible evil consequences.

Among preparatory measures is the omission of miotics after 4 or 5 p.m. of the day preceding operation. If this rule is not observed, it may be difficult to dilate the pupil sufficiently at the time of operation, the dilatation being needed to prevent the pupillary sphincter drawing the prolapsed iris partly back into the eye after operation.

In place of the miotic a saline purgative is given, varying with circumstances, to lower the intra-ocular tension. This, together with adrenalin instillation before operation, appears to guard sufficiently against the possible complication of retinal or choroidal haemorrhage.

Even in hard eyes, in congestive glaucoma, such preparation freely used, together with limitation of the incision to the absolute minimum, appears at least to exclude the risk of expulsive haemorrhage.

Conjunctival antisepsis of proved efficacy is essential to remove the reproach of possible sympathetic ophthalmitis (see below). One must act upon the admission that one failure in this respect, one instance of the disease among a hundred good results, would be enough to condemn the whole undertaking.

The final safeguard of a strictly sub-conjunctival operation completes the list of precautions.

Past History

It is necessary to add that the provisional claim of securing absolute and unvarying permanency of relief of tension is based on my experience.

I have never known nor heard of a late return of tension following satisfactory intentional or unintentional iris impaction in primary glaucoma. There have been cases of imperfect drainage from the beginning. This is a different matter. I remember a Bombay case with fibroid inelastic iris and rigidity of pupil, in which iris-inclusion gave incomplete relief. And imperfect drainage has been seen where only a tag of stretched and torn iris has been fixed in the sclero-corneal wound.

I began operating by iris-inclusion methods in the year 1900 with insufficient safeguards. The incision at first was considerably larger than necessary. In consequence, there were some protracted delays in refilling of the anterior chamber (*Trans. Ophthalm. Soc., U.K., XXIII, 1903, p. 329*) leading to trouble in a few instances, including early recurrence of plus tension, cataract formation, and contraction of visual field. There may have been rupture of the zonule rarely.

At first there was no measured perchloride irrigation of the conjunctiva. Hence, a case of sympathetic ophthalmitis and one of ordinary iritis.

Priestley Smith's equatorial puncture was practised as an aid in some hard eyes until an instance of infection of the vitreous occurred.

In recent years, the only slight complication requiring mention has been an occasional superficial injury to the lens, by iris forceps or blunt iris hook. These slight flaws, seen as surface markings, have not extended far enough to affect vision appreciably. The longest of them was in a case in which the blunt hook had to be used, owing to the corneal incision (made in this instance with a 1 mm. Graefe knife) being too small at the deep surface of the cornea.

I can remember no trouble from haemorrhage since the early days of my 1903 report (*Trans. Ophthalm. Soc. U.K.*) But in India one did not examine the fundi after operation, except for some special reason.

In this respect quite the last of my operations may be mentioned. The vision of the fellow eye, which was only slightly glaucomatous, was much reduced by numerous retinal haemorrhages, and at a recent operation for appendicitis on this patient, it had been noted that the arteries concerned were hard and "brittle." The glaucoma in the eye upon which I operated was advanced, with considerably contracted field, and tension not fully reducible by eserine. The only chance of saving useful sight for a long period evidently lay in operation. This was performed quite satisfactorily after due preparation of the patient (aged 67 years).

Rationale

It is quite time that it was generally recognised that iris tissue lying in a sclero-corneal wound accomplishes something in the matter of drainage, that nothing else can ever do. It does almost exactly what is wanted, no more and no less. Apparently it is not too much to suggest that the results probably represent the highest possible limit of attainment in glaucoma treatment.

I used to think that the lining of pigment epithelium was the only thing that mattered in the sclero-corneal track. Now I feel sure that much of the permanency of quite moderate drainage that is secured, is closely related to the observation (emphasized, if not made originally, by Thomson Henderson) that a cut iris may remain permanently unhealed. Evidently none of the cells forming the stroma of the iris is capable of forming new fibrous tissue, granulation tissue. One may suppose that the filter formed by spongy iris tissue in a sclero-corneal wound, helps to avoid the two extremes—excess and defect in drainage. The filter probably from the first restrains the flow of aqueous, preventing marked hypotony, and at the same time effectively resists closure of the track, and so ensures permanent relief of the glaucoma.

Glaucomatous tension associated with past or present iritis or irido-cyclitis is in general quite unsuited for treatment by iridencleisis.

Elsewhere I have mentioned the complete disappearance of prolapsed iris by contraction of new fibrous tissue in the prolapse that was seen after iris-inclusion operations upon eyes that had formerly suffered from irido-cyclitis.

Of more importance is recognition of the fact that the displacement and nipping of iris in a sclero-corneal wound—that is, an iris-inclusion operation—evidently places the iris at a disadvantage in dealing with infective bacteria. This was the lesson inculcated by the recurrence in aggravated degree of a previous intermittent bilateral rheumatic iritis, that followed an iris-inclusion operation, as reported in the *Brit. Jl. of Ophthal.*, X, 1926, 380—4.

The same inference is to be drawn from a recent case of plus tension in both eyes, associated with a tendency to slight iritis, and with a good deal of vitreous opacity, mainly coarse, and stringy, in a patient with swollen and deformed finger joints. I performed a small flap sclerotomy with a small iridectomy on one eye. But as the effect on the plus tension seemed not quite sufficiently prolonged, in performing a similar operation later on the fellow eye, I added a very limited inclusion of iris, drawing the iris into one of the lateral incisions of the small flap. The object was mainly to prop the scleral flap a little forwards. Whereas the eye first operated upon remained quite quiet, the second eye, in which the iris was displaced, flared up sharply for rather more than a week. There was considerable swelling of the lids and pain, and perhaps a trace of muddiness of the iris, that gave way slowly to atropine.

The Elimination of Ectogenous Infection, including Sympathetic Ophthalmitis

The crux of the whole question of deliberate iris-inclusion lies, of course, in the possibility of total exclusion of the risk of sympathetic disease. Treatment by iris-incarceration has been condemned so whole-heartedly on account of this risk "as a matter of principle" by surgeons in authority in this country, that the hands of a younger generation are thereby largely tied.

At present the less experienced will naturally hesitate in face of a prohibition that will in time, I hope, be justly regarded as an unwarranted confession of helplessness, and a bar to progress.

The Problem

In dealing with an unknown infective agent, the question of its exclusion must be essentially a clinical one. Clinical experience must outweigh inferences to be drawn from laboratory findings with regard to recognised bacteria. One can only hope to extend to the utmost such defensive measures as seem to have been successful hitherto in preventing sympathetic ophthalmitis, while also excluding ordinary septic invasions.

The only collective evidences large enough to be convincing, of which I am aware, are comprised (1) in the history of the war, and (2) in large Indian operative experience, particularly in cataract work.

Sir John Parsons in his manual, "Diseases of the Eye," 6th Edition, 1930, p. 440, says that sympathetic ophthalmitis "was very rare during the Great War. This gratifying fact is due to increased skill in the treatment of penetrating wounds, particularly in the application of antiseptic principles."

Such observations can only mean that by such measures as the cleansing of wounds, so far as possible, the excision of prolapsed or incarcerated uveal tissue, and the removal of foreign bodies, the unknown infective agent was generally excluded or removed, or its effects overcome. It seems perfectly plain dealing with an outside organism, that had occasionally got beyond the reach of early preventive or of curative measures.

The issue is more clearly defined and narrowed down to preventive conjunctival treatment by operative experience in India. Though the incidence of the disease is admittedly lower in India than in Europe, yet the danger has always to be reckoned with there.

The available evidence is very strong that sympathetic disease can always be excluded in glaucoma work, if sufficiently strong, yet harmless, preventive measures are invariably adopted.

The empirical use of measured perchloride irrigation of the

conjunctiva, that enabled Colonel Elliot (*Trans. Ophthalm. Soc. U.K.*, XXIV, 1914, pp. 280—1) and myself to eliminate suppurations and greatly to reduce the number of lower grade septic invasions in our cataract work, served also nearly to exclude sympathetic disease. (See my "Cataract Extraction," 1907, pp. 287—8). It is particularly noticeable that neither type of infection was entirely excluded—the septic or the sympathetic. Both types of disease were alike in showing that the routine preventive treatment had not been quite effective enough. Accordingly more of the solution was used later, and more time was given for it to act (see below).

Can it be merely an extraordinary coincidence that the only instance of the disease known to have followed an operation of any kind performed by me in England—a case of cataract extraction described in Appendix No. 2—occurred in the only eye in which the usual measured irrigation, before the cocaine instillation period, had been forgotten?

Further, the only case of the disease known ever to have followed a glaucoma operation of mine, during thirty-five years' ophthalmic practice, was the one mentioned above, that occurred quite at the beginning of the century, before regular conjunctival irrigation had been started in my work.

In support of all such individual experiences, the general feeling among experienced eye surgeons that the disease must represent an outside infection cannot be disregarded.

Two additional inferences must be drawn from clinical experience.

(1) If the disease is due to invasion by an unknown conjunctival organism, this organism obviously cannot be pathogenic to the conjunctiva. It must be present in some perfectly normal membranes, since the disease seems quite as prone to occur in eyes with normal conjunctivae as in others. Children are held to be particularly liable to the affection, including those with the thinnest, palest and smoothest membranes imaginable. Therefore, any preventive measures utilized in operating must be applied indiscriminately to all eyes alike.

This conclusion is strictly in accord with a suggestion that has been put forward to explain the spread of the disease from the exciting to the sympathising eye. The suggestion is that the spread is through the blood stream, by means of a virus that is pathogenic to uveal tissue only.

(2) The infective agent, though a non-pathogenic inhabitant of the conjunctiva, must yet be a parasitic one, not living wholly on the surface, but penetrating into the epithelial layers sufficiently deeply to be partly beyond the reach of the most powerful antiseptics that can be ordinarily used, preparatory to

operations. This conclusion follows from the experience that no amount of antiseptic conjunctival treatment can be relied upon surely to prevent the onset of the disease, if an uncovered prolapse of iris is allowed to remain.

It is important, therefore, in deliberate iris-impaction operations to act always on the assumption that the protection against sympathetic ophthalmitis afforded by antiseptic applications before operation is definitely time-limited, and possibly quite brief. An essentially transient influence upon the conjunctiva, however, is all that is needed in a purely sub-conjunctival glaucoma operation.

Practical Application

I feel strongly that no one should ever perform an iris-inclusion operation without having used one of the proved means of clearing away conjunctival bacteria. But no reliance can be placed upon laboratory findings on the germicidal power of various unirritating solutions, as measured by effects upon common bacteria. And the same possibly applies to reports of purely surface cleansing of the conjunctiva obtained by various applications, such as mercurio-chrome in two per cent solution (Friedenwald, J. S. and H., *Trans. Ophthal. Soc. U.K.*, XLV, 1924), and two per cent. yellow oxide of mercury ointment (Stanka, R., *Klin. Monats. f. Augenheilk.*, LXII, 1924, 432.)

Substances should be chosen that have a definitely "fixative" action on the superficial epithelium, such as silver nitrate or corrosive sublimate. One cannot expect to act directly upon organisms lying in the superficial epithelial layers, but one can fix them together with the epithelial cells, and one can remove them afterwards, together with the fixed cells, when the latter are shed, and the whole can be washed away in the mucus that is secreted. Preliminary treatment with unirritating applications cannot be objected to, provided it is regarded as auxiliary only.

Efforts with caustic or corrosive solutions should be concentrated on one single measured "maximal" application, on account of the variable slight inflammatory reaction that is to be expected afterwards. By the term "maximal" should be understood the strongest application—measured by the period of irrigation or by the strength of solution—that any particular conjunctiva can be expected to bear without unpleasant reaction. And time should be given always—roughly twenty minutes or more—for the full fixative effect to be attained before the operation.

The silver salt may be more suitable than the mercury salt. A few drops of one per cent. silver nitrate solution instilled an hour

before operation may be ample. (See Bell, G. H., *Arch. of Ophthalm.* III, 2, 1930, p. 196 and earlier references there quoted.) But I do not know of any sufficiently extensive operative experience under this treatment to carry conviction with regard to its use in iris-prolapse operations. It is mainly a question of the strength of the solution, the amount of it used, and the time when it is used.

The instillation of a few drops of solution is certainly much less troublesome than measured irrigation.

I personally have naturally preferred the 1 in 3,000 sublimate solution that has been well tested by the large figures available in cataract work in India. It may be noted that the period of irrigation that sufficed to give the Indian results, above referred to, varied usually from $1\frac{1}{4}$ to $1\frac{3}{4}$ minutes, according to the clinical condition of the conjunctiva. This amount of irrigation was shown, by means of cultures on Löffler's serum—taken before the irrigation and again just before operating—invariably to remove all the purely surface organisms, xerosis bacilli and Morax-Axenfeld diplo-bacilli. But various cocci were certainly not always fully removed (See report in *The Ophthalmoscope*, IV, 1906, p. 674). Thus these bacteriological results were in conformity with the clinical evidence mentioned above, indicating the need for somewhat stronger measures. The results, both clinical and bacteriological, would probably have been more complete if the interval between irrigation and operation had been longer. It was often ten minutes only.

In this country in spite of the much more normal average condition of the conjunctiva, the minimum period of irrigation, both in cataract and glaucoma work, has been almost invariably two minutes. And the period has frequently been extended a little; occasionally, for particular reasons, up to two and a half minutes. And the time that has elapsed between irrigation and operation has rarely been less than twenty minutes. More often it has been longer, up to forty minutes. The exact time has depended upon quite another consideration—the influence of the cocaine and adrenalin on the pupil.

In guarding against such a deadly disease as sympathetic ophthalmitis, the surgeon must be personally responsible for the thoroughness of the preparation of the eye. A *visible* and *tangible* result of the irrigation is obtainable in the mucus that is secreted, to serve as a practical index of the total effect.

As judged in this way after an interval of 20–30 minutes the effect of a routine irrigation for two minutes varies considerably in conjunctivae of practically normal appearance. Usually there is a moderate but variable quantity of mucus that can be detached by movements of the everted lids upon one another, and washed

away with sterile water. Occasionally there is little or no mucus, and in this case additional irrigation for $\frac{1}{2}$ — $\frac{3}{4}$ minute has been practised. Used thus, just before operating, one can still hope to obtain some of the immediate fixative coagulative action, that may be seen occasionally clinically in some rather delicate membranes during the first prolonged (two minutes') irrigation, in the form of a faint superficial cloudiness of the palpebral conjunctiva.

This variability in action of the antiseptic lotion is not very satisfactory in an operation that involves deliberate impaction of the iris in such a way as to handicap the iris in its ability to deal with infective organisms, as above indicated. On this account one must be prepared always to overdo the defensive irrigation at the cost of some transient subsequent pain, injection, and conjunctival discharge, rather than to run the slightest risk of undoing the precautionary measures.

And the use of all available *overlapping* minor precautions in operative procedure is indicated.

Among the latter may be mentioned: Expression of Meibomian secretion, swabbing of lid margins, the use of a Lang or Lawford lid speculum to cover the lashes, placing the conjunctival puncture 6—7 mm. from the corneal margin, rapid rinsing of points of iris-forceps or scissors in the boiling water of a sterilizer, if by any chance they have to be introduced into the wound a second time. If prolapsed iris possibly extends rather near the conjunctival puncture, through the latter being misplaced, or through stretching of the iris, a little of the latter should perhaps be excised. And the edges of the conjunctival puncture may be temporarily pinched together by the fixation forceps.

Objections to Perchloride Douching

Maximal irrigation has been commonly rejected in cataract extraction as unnecessarily harsh. This cannot apply in iris-inclusion work, for the reasons given.

The usual standing order in my work, as regards after-treatment, is that all patients who wish for it shall have $\frac{1}{12}$ gr. of heroin or $\frac{1}{8}$ gr. of morphia hypodermically soon after operation, and that the dose shall be repeated, if wanted. The assurance thus given has generally sufficed. Few patients have cared to have the injection, and many of them seem to experience no pain at all.

Moderate conjunctival injection and a varying quantity of mucous discharge—chiefly sticking the lids together in the mornings—is the rule for a week or more. But this reaction does no harm whatever. It cannot weigh for a moment against the overwhelming combination of benefits claimed for iris-inclusion.

The reaction is not necessarily associated with a development of pathogenic properties in any cocci that may be present in the conjunctiva. This was shown in old Indian days by one or two cases of impaction of firm vitreous in the wound after cataract extraction. The vitreous in such cases did not necessarily become infected. I have seen it gradually covered in by new-formed fibrous tissue, the eye remaining quiet.

Conclusion

The theoretical side of the above argument may be disregarded; it is merely explanatory and unessential. The facts appear to me overwhelming. The essential permanency of iris-produced drainage required for its demonstration the lapse of years, and safeguarding by means of conjunctival fibrosis has taken years to develop, and there has always been the fear of sympathetic trouble to be exorcised by no uncertain means. So far as can be judged now the defence, fully applied, seems infallible. There has been no need in the above discussion to raise the question of septic risks, the consideration of this lesser evil being merged in that of the greater sympathetic menace.

On the evidence now available, is it any longer right to reject absolutely the only measure, iris incarceration, that gives the slightest promise of ever reaching near to 100% of permanent successes in glaucoma treatment? If further experience should give reason for doubt with regard to present means of securing temporary practical sterilization of the field of operation, surely we cannot have exhausted possibilities in this direction.

My chief fear is lest indiscriminate practice of iris-inclusion without the indicated safeguards should, by courting disaster, succeed merely in "putting the clock back."

Operation in Acute Glaucoma

The above does not apply without some qualification to painful congestive glaucoma of more or less sudden onset, generally with shallow anterior chamber and dilated pupil. But the treatment is not radically different.

In place of the old and well tried wide iridectomy I believe that by far the safest and best operation is the smallest sub-conjunctival iridectomy that can be made, leaving the iris incarcerated.

After purging and conjunctival irrigation or silver nitrate drops (?) and the use of adrenalin locally, whether under a general anaesthetic or novocaine sub-conjunctivally, the conjunctiva is slid on the point of a keratome for a moderate distance—5 mm. only. The keratome puncture is quite the smallest that will allow of the introduction of ordinary iris forceps and the pulling out of a small loop of iris. The end of the loop is snipped away, leaving the iris impacted on each side.

The pupil being more or less dilated from the glaucoma and the adrenalin used, a very obvious iris prolapse is found in practice to be unnecessary to secure permanent drainage. Atropine is used rather freely in the after-treatment, the fellow eye being guarded by eserine drops.

It is surprising how little artificial drainage is needed to keep the tension permanently down in these eyes. There is no conjunctival vesiculation, and often little or no oedema even. And it cannot be that the unhealed margins of the iris coloboma absorb much aqueous, impacted as they are in the wound.

Appendices

1. *Technique.*—To busy surgeons it may be a valuable saving of time to have the half hour's preparation of the eye done by a thoroughly reliable theatre sister, with an assistant. For this detailed instructions are needed.

In perchloride irrigation the solution can be dropped on the everted lids from a bowl with an ordinary eye-dropper, the lids being kept moving vertically, *i.e.*, towards the patient's brow and feet. In order that the upper tarsal conjunctiva shall be fully exposed, the eversion of the lid is maintained by pressure of the retaining finger on the eyelashes or lid border only. The period is two minutes exactly, unless a longer time, *e.g.*, two and a half minutes, has been ordered. Cocaine instillation, five grains in two drachms, is begun immediately afterwards, and an ophthalmic disc of adrenalin (? 1/110 grain) introduced after the first instillation. The instillations are repeated every two or three minutes, and a disc of atropine (? 1/200 grain) used generally after the second one. If the eye is not blanched at the time of the third instillation, a second adrenalin tabloid is used then, since it will be found to be useless later on. (I don't know the reason of this).

No eserine having been used after tea-time of the day before (for a morning or mid-day operation), the pupil should be rather well dilated in 20—25 minutes, exceptionally a little earlier; and it may be found that further instillations fail to enlarge the pupil more.

The surgeon has to move the everted lids upon one another to detach conjunctival mucus, to be washed away with sterile water. If there is little or no mucus, perchloride is substituted for the water and used for $\frac{1}{2}$ — $\frac{3}{4}$ minute.

He may wish to squeeze the lids together in order to express Meibomian secretion, and swab the lid borders.

The site of the incision is often to one or other side, either to avoid the larger blood-vessels, or possibly because the patient does not look sufficiently downwards. The edge of the ordinary pattern bent keratome (small blade preferred) pushes the conjunctiva from a point 6—7 mm. from the corneal margin down nearly to the corneal margin, the exact point depending on the varying degree of overlapping of the cornea by the conjunctival limbus.

The knife point is pushed on into the anterior chamber, at first inclined somewhat towards the iris, very slowly and preferably with side-to-side movements, till the exact size wanted at the deep surface of the cornea is judged to have been produced.

The ordinary pattern of bent iris forceps is easily introduced through the subconjunctival pathway and so into the chamber. The points of very fine forceps are apt to be caught repeatedly in the conjunctival tissue.

The iris is well gripped and pulled slowly towards the centre of the pupil, till it is seen to have been torn from its base locally. There is no bleeding from the torn iris. It is then drawn up through the sclero-corneal wound, to be cut radially under the conjunctiva. Straight iris scissors are the more convenient for this. If de Wecker's scissors are used, short-bladed ones are best. Repeated snips are made because the effect cannot be seen sufficiently, often being hidden by blood or uveal pigment under the conjunctiva. It is not quite essential that the cut should reach the pupillary border, though this is aimed at. The iris is not released from the grip of the forceps until the cutting is completed.

2. *The origin of the sympathetic case* referred to on p. 441, following a cataract extraction, needs consideration.

The patient was in the care of another ophthalmic surgeon, though I performed the operation and was fully responsible for it. The nursing home was situated at a distance; it was new to me and to eye-work generally, I believe. I was so pre-occupied in re-arranging lighting, etc., that I quite forgot to wash out the conjunctiva

with perchloride at the usual time, and failed to notice the omission till the cocaine instillation period was ended. To make up for this extraordinary lapse I irrigated for three minutes, instead of the usual two minutes, though the conjunctiva appeared quite normal. I doubt if I have ever irrigated for so long a period continuously, even in dealing with unhealthy conjunctivae in India. As an additional precaution I made the sclero-corneal incision purely sub-conjunctival, by sliding the conjunctiva slightly on the point of the knife before making the puncture, and I made a rather longer conjunctival flap than usual.

The operation otherwise was uneventful. Next day the cornea was adherent to the upper lid, from the excessive irrigation practised. I left it so, and did not see the case again for some weeks, when there were large pale corneal precipitates found. Eventually, the fellow eye softened and shrank, in spite of "N. A. B." treatment, begun rather late. Vision in the operated eye was lost mainly, I believe, through plus tension due to an impermeable diaphragm formed of iris and pupillary membrane, pressed so closely against the cornea that repeated attempts to divide the membrane failed, till too late to save vision.

The chief point of interest is: how did the disease arise? Was the infection introduced at the operation through the irrigation being too late to be of use? Another explanation seems more likely. Owing probably to the pull of the adherent upper lid, the sub-conjunctival sclero-corneal incision gaped so widely, that there was a strong suggestion that even the conjunctival incision might have been pulled open at times by lid movements. The suggestion was that conjunctival organisms might have been sucked into the eye thus by the pull of the lid, after the transient protective effect of the perchloride had passed off. This explanation might appear far-fetched, were it not that this was my only post-operative case of sympathetic ophthalmitis in England, as already mentioned. For this unique result an exceptional explanation is not out of place. There was no iris prolapse nor visible incarceration, and the pupil was not displaced.

3. A friend wrote asking if I could explain "*recurrence of tension in spite of a 'cushion scar'*," i.e., filtration oedema. The following case throws a good deal of light on the subject, which does not come under the title of this paper, but which I should like to mention here.

No less than four small flap scleromies were performed on one eye of a most considerate and most helpful patient, beginning in 1920. I am sure that the last two of the four operations had no permanent effect, and probably the second operation had very little effect. Yet there was conjunctival oedema, and the outlines of the various flaps remained clearly visible.

The tension, periodically measured, still showed the need for pilocarpine and massage, until finally the treatment came to an end by a satisfactory iris-inclusion operation in February, 1929. The latter was performed to the inner side of the former operations, where the conjunctiva was not sufficiently mobile to be freely "slid." Accordingly, as the first step in the operation, the conjunctiva was elevated by injecting air beneath it, with a hypodermic syringe. Air was chosen in preference to normal saline, partly because the latter differs in composition from aqueous humour. It was most unexpected to find that much of the air injected passed at once into the anterior chamber, filling the chamber with air bubbles. Since the air found its way so readily into the chamber, obviously the aqueous could have no difficulty in passing out beneath the conjunctiva through the sclerotomy wounds. Yet why should it not have become absorbed in the usual way? Why had it remained locked in sufficiently to keep the tension above normal?

Looking back, I am sure the explanation was supplied during the after-treatment of the fourth sclerotomy operation. Twice the use of atropine drops was pushed to the limit, eight or nine times daily, for a couple of days. This was done to try to dilate the pupil to some extent, the pupil being small, due to synechiae left by former operations. Unfortunately after the first operation atropine had not been used quickly enough to prevent one or two synechiae forming, and these had been added to at later operations. Finally on each of the two occasions just mentioned the free use of atropine, instead of quietening the eye, had the opposite effect. The eye flared up unmistakably, becoming painful and injected. I am sure that this inflammatory reaction, from excessive pull on the old posterior synechiae, must have led to inflammatory deposit of some kind in or beneath the conjunctiva, passing out from the blood-vessels of the iris through the recent sclerotomy wound.

And the same thing, less marked, must have taken place unnoticed, after the

earlier operations, to have accounted for permanent restriction of absorption of aqueous from the sub-conjunctival wounds.

It would be interesting to hear whether in other cases of this kind, unusual or prolonged post-operative reaction has been noticeable.

There was no trouble of any kind after the final iris-inclusion operation, and the posterior synechiae were not noticed at all at the operation. They were evidently very fine, and broke down at once. The prolapsed iris has become fibrosed, but the elevation is much more sharply defined and higher than usual, owing to restricted lateral diffusion of aqueous.

A CASE OF RING SARCOMA OF THE IRIS

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History.—The patient, A. B., a mason's labourer, aged 44 years, was first seen on February 2, 1930, at the Central London Ophthalmic Hospital. He gave a history of a sudden attack of pain and inflammation in the left eye which began three weeks previously. The inflammation had subsided to some extent as the result of treatment, but the eye was still painful. Vision in that eye had been decreasing gradually for the past nine months, and was now lost almost entirely. There had been no previous attacks of inflammation.

Clinical examination.—The left eye had bare perception of light. It was much inflamed and showed both ciliary and conjunctival injection. The tension was + 2, and the cornea was hazy and oedematous. The anterior chamber was deep, while the pupil was dilated and eccentric, being drawn downwards and outwards towards 5 o'clock. The iris was grey, and its normal pattern was somewhat obscured. In addition there was a striking irregular dark brown pigmentation forming two bands at 11 o'clock and extending round the iris to a larger patch at 5 o'clock. (When the pigmentation was remarked upon, the patient said that he had noticed the development of a brown spot on the nasal side of the iris during the last 12 months). With the loupe, a deposit of fine pigment could be seen on the posterior surface of the cornea. The fundus was barely visible, but the disc appeared cupped. The right eye was normal in all respects, with a full field and vision 6/6. The iris was grey and had no extraneous deposits of pigment. A ring sarcoma of the uveal tract was diagnosed and the left eye was excised on February 25, 1930.

Macroscopic appearance.—On vertical section of the eyeball, a fine ring of dark pigment could be seen surrounding the anterior chamber in the region of the angle and coming forward on to the