COMMUNICATIONS

SURGERY OF TUMOURS OF THE CILIARY BODY AND BASE OF THE IRIS*†

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UNTIL recently enucleation was the only method of treating tumours originating in the ciliary body, or originating in the iris and invading the ciliary body. Early reports on the possibility of removing such tumours without sacrificing the globe (Lindner, 1937, 1942; Kolen, 1942, 1952; Stallard, 1951; Friede, 1953, 1956; Kopp and Ozhigar, 1959, 1961) were largely ignored by ophthalmic surgeons, probably because of the general opinion that the ciliary body should never be touched. Müller, Niessen, Niesel, and Lund (1960), at a meeting of the German Society of Ophthalmologists, showed a film which illustrated in detail all stages of surgery of tumours of the ciliary body in sixteen cases, and this series of case reports was followed by the publication of several articles (Flieringa, 1961; Stallard, 1961, 1964; Diamond, Borley, and Miller, 1964; Borley and Miller, 1965; Linnic, 1966a, b), showing that excision of one-quarter of the ciliary body may be tolerated by the eye without much difficulty. A histological check is essential to establish that the zone of surgical interference is surrounded by perfectly healthy tissue—complete recovery is possible only under this condition.

Present Investigations

The effect of iridocyclectomy on the viability of the eye was studied in 63 experiments on 63 rabbits. Iridocyclectomy with excision of one-quarter, one-third, and one half of the iris and ciliary body had different effects on the eyes of the experimental animals. Examinations carried out after a long interval (12 months and more after the operation) have demonstrated that the resection of one-quarter and one-third was tolerated by the eye satisfactorily; postoperative hypotony generally disappeared by the end of the third week and the intra-ocular pressure returned to normal. If one half is resected hypotony lasts longer and atrophy of the globe sometimes occurs, though as a rule the function of the eye is preserved.

Clinical Studies

These experimental data have permitted us to estimate the range of surgical treatment of neoplasms which may be possible in clinical practice. If a unilateral tumour is judged to be benign but is causing disturbance of the intra-ocular pressure, partial iridocyclectomy may be indicated.

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Partial iridocyclectomy for neoplasms has been performed at our clinic on thirty patients: sixteen male and fourteen female, aged from 3 to 80 years. The diagnosis was as follows:

Malignant melanoma of the iris with invasion of the ciliary body—five.

Malignant melanoma of the iris and ciliary body with invasion of the corneo-scleral region—six.

Malignant melanoma of the ciliary body with invasion of the iris—five.

Naevus pigmentosus of the iris and ciliary body with signs of malignancy—four.

Vascular tumour of the iris and ciliary body—four.

Cyst of the iris and ciliary body cyst—six.

In six cases tumour of the iris and ciliary body was associated with total cataract.

Method

The extent of the swelling and the corresponding boundaries of surgical interference were determined with the help of the biomicroscope, gonioscope, cycloscope, and diaphanoscope. The approach was made through a trephination after the method of Friede, through combined limbo-scleral incisions after the method of Stallard, and also by the combined method of Friede-Müller. In some cases a new technique developed in our clinic was used.

Tumours invading the Corneo-scleral Region.—In six cases we used Friede's technique with corneo-scleral trephination.

The method of reaching the base of an iris tumour by trephination should be called the method of Mursin-Friede, because Mursin (1930a, b) described how he operated on a case of iris tumour approaching the cornea and involving the structures of the angle, using the Hippel 4 mm. trephine. Much later Friede (1953) devised variants in different locations with tumours of different sizes.

For excising the corneo-scleral area affected by a neoplasm, we used trephines of 5 to 14 mm. diameter. In four cases, to ensure a more radical excision of the tumour, trephination was complemented with limbo-scleral incisions by the method of Müller. The defective section of the external coat of the globe was replaced by identical homoplastic tissues from cadaver eyes preserved by the method of Filatov.

Histological examination of the excised tissue confirmed the diagnosis of malignant melanoma in all six cases; in five the excision was complete, but in one case histological examination showed that the incision had passed through the tumour tissue, and enucleation was performed immediately.

For complete excision of the tumour a successful outcome is assured by the removal of 3 to 4 mm. of macroscopically intact tissue around the circumference of the neoplasm.

Of utmost importance in the correct interpretation of histological data is the suggestion of Stallard (1961) that the excised tissues should be spread out on a flat cork and the edges fixed with pins. Only by such fixation of the tissue is it possible to obtain "step-like" sections which enable one to determine whether the excision is complete.

In one case we used a trephine of 14 mm. diameter; this case is described below, because we have found no reference to any case in which such a great amount of the external coat of the globe was removed.

Case 1. A 33-year-old male fitter had a melanoma of the iris and ciliary body with invasion of the corneo-scleral area in the left eye (Fig. 1, opposite). There were recurrent haemorrhages into the anterior chamber. The visual acuity was 0.3 and there was secondary glaucoma.

Operation.—The patient refused enucleation and it was decided to excise the whole affected area. The use of the 14 mm. diameter trephine assured that the excision was complete. After trephination of the corneo-scleral region together with the conjunctiva outlined by the trephine (preliminary scleral thermocauterization had been carried out along the trephination line), the iris, ciliary body, and choroid within the macroscopically healthy tissue were completely excised. The vitreous body bulged through into the trephination opening but there was no vitreous loss. A corneo-scleral disc of the same diameter taken from the same region of a cadaver eye was inserted into the opening, fixed with 24 capron sutures, and covered with a conjunctival flap.

Result.—Histological examination showed a malignant melanoma of the iris and ciliary body with invasion of sclera and cornea, which was completely excised. The postoperative period was quiet. The transplant "took", and its corneo-scleral part was semitransparent. To date (18 months postoperatively) the eye is quiet; visual acuity with correction is 0.3; intra-ocular pressure is normal; tonography reveals some diminution of aqueous humour formation ($F = 0.15$ compared with 0.44 in the opposite eye). There are no signs of local recurrence (Fig. 2).

FIG. 1.—Case 1. Left eye. Melanoma of the iris and ciliary body with invasion of the limbus and sclera. Visual acuity 0.3, not correctable.

FIG. 2.—Case 1. Left eye 18 months after excision of the tumour by iridocyclectomy with a 14 mm. diameter trephine, followed by keratoplasty. The excision was complete. Visual acuity 0.3, with correction.

The technique of Mursin-Friede will certainly be the operation of choice in the future in cases of invasion of the corneo-scleral region by tumours of the iris and ciliary body. If the invaded area is not extensive, smaller trephines should be used and the operation completed by the method of Müller (1964).

Tumours not requiring Resection of the External Coat of the Eye.—In fourteen cases surgery was performed with limbo-scleral incisions by the method of Friede and Stallard, and the tumour was completely excised. In some cases the neoplasm was found to be more extensive than was at first indicated; this necessitated further scleral incisions, after which the tumour was completely removed as in the following case.

Case 2. A 12-year-old schoolgirl had a cyst of the iris and ciliary body in the cyclitic stage in the right eye (Fig. 3, overleaf). The visual acuity was 0.3 and could not be improved by glasses.

Operation.—On October 1, 1965, the cyst was excised by partial iridocyclectomy under intravenous thiopentone anaesthesia. After preparation and exposure of the sclera, a half-depth limbal groove was made from 2.30 to 9.30 o'clock in the lower segment. Two additional 6 mm. scleral grooves perpendicular to the limbal incision were made at 4.30 and 7.30 o'clock. Corneo-scleral and scleral sutures were pre-placed. The limbus was cut through along the grooves, and the resulting scleral flap laid back to the equator. Excision of a neoplasm with 3–4 mm. of intact tissue in the inferior temporal quadrant when the tumour extends below the sclera makes an excision under visual control impossible. An additional incision concentric to the limbus was therefore made from the end of the first incision, perpendicular to the limbus at 7.30 o'clock. The scleral flap was then laid back outwards, enabling the boundaries of the neoplasm to be seen, and total excision was performed.

Result.—Histological examination showed that the intra-epithelial cyst was completely excised. The postoperative course was uneventful, and the patient was discharged with a visual acuity of 1.0 (with diaphragm); 7 months later the eye was quiet, the intra-ocular pressure normal, and the visual acuity 0.9 (without diaphragm) (Fig. 4, overleaf).

FIG. 3.—Case 2. Right eye. Cyst of the iris and ciliary body in cyclitic stage. Visual acuity 0·3, not correctable.

FIG. 4.—Case 2. Right eye 7 months after removal of the tumour by partial iridocyclectomy. The excision was complete. Visual acuity 0·9.

Tumours in the Iridociliary Region.—Clinical observation and experimental investigation (23 experiments on rabbit eyes; 32 experiments on cadaver eyes) have enabled us to modify the surgical approach to neoplasms in the iridociliary region. Ten tumours have been excised by my new method.

After the conjunctiva has been incised at the limbus along two-thirds of the circumference and the flap laid back to the equator, one or two of the adjoining rectus muscles are sutured with catgut and cut off at the sclera. A groove two-thirds the depth of the limbus is made with the scalpel about halfway round the circumference, and a second scleral groove concentric to the first is made about 6 to 10 mm. away. Along the projection of the centre of the tumour a third connecting groove is made perpendicular to the limbus (Fig. 5). Two pre-placed corneo-scleral and scleral sutures are inserted where the grooves cross. The loops are drawn apart and the limbus cut through with scalpel and scissors.

FIG. 5.—Author's method of making limbal incisions in iridocyclectomy.

Two scleral flaps provide easy access to the iridociliary region when the lips of the scleral incisions are separated, and the ciliary body is freed from the sclera with a spatula (Fig. 6, opposite). The affected zone is examined, one of the flaps is replaced, and the tumour together with 3–4 mm. of surrounding intact tissue is removed in the area exposed by the second flap. To prevent vitreous loss only one flap is kept open at a time. When removal of the tumour is complete the pre-placed mattress-sutures are drawn up and tied, thus providing hermetic closure of the incisions. At this

stage it is important to apply no pressure to the eye as the least pressure may cause vitreous loss. Four to eight additional biosutures may be placed as required without difficulty.

All the operations performed by this technique were without complications; there was no loss of vitreous and the tumour was totally excised.

FIG. 6.—Author's method of exposing the iridociliary region by drawing apart the two scleral flaps.

Case 3. A 65-year-old housewife had a pigmented tumour of the iris invading the ciliary body and total cataract in the right eye. The visual acuity was perception of light (Fig. 7).

Operation.—On June 28, 1965, the tumour was excised by partial iridocyclectomy with simultaneous cryoextraction of the cataract. The operation and postoperative period were uneventful. The tumour (a melanoma) was completely removed.

Result.—The visual acuity on discharge was 0.6 (with aphakic correction) (Fig. 8).

FIG. 7.—Case 3. Right eye. Melanoma of the iris base and ciliary body with total cataract. Visual acuity perception of light.

FIG. 8.—Case 3. Right eye 12 months after excision of the tumour by the author's method of partial iridocyclectomy with simultaneous cryoextraction of the cataract. The excision was complete.

Case 4. A 26-year-old student had a neoplasm of the iris and ciliary body, with advanced glaucoma. The visual acuity was 0.3, not correctable (Fig. 9, overleaf).

Operation.—On March 2, 1966, the tumour was excised by iridocyclectomy. The operation and postoperative period were uneventful. Histological examination showed that the tumour (an angioma) was completely removed.

Result.—The intra-ocular pressure returned to normal and the visual acuity on discharge was 0.4, not correctable (Fig. 10, overleaf).

FIG. 9.—Case 4. Left eye. Haemangioma of the iris and ciliary body with secondary glaucoma. Visual acuity 0.3, not correctable.

FIG. 10.—Case 4. Left eye after removal of tumour by the author's method of partial iridocyclectomy. The excision was complete. Visual acuity 0.4, not correctable. Intra-ocular pressure normal.

Discussion

The advantage of the above technique is that a sufficiently large area of the iridociliary zone (half or even more) is exposed in two steps. The gradual opening and closure of the exposed area simplifies the operation and reduces the risk of vitreous loss. The matching of the lips of the wound is not spoilt as the incisions are lengthened along the line of the original section. The technique of drawing the scleral flaps apart concentrically to the limbus is made easier by the concentric orientation of the scleral fibres in this zone (Salzmann, 1912; Vogelsang, 1960).

Complications.—In thirty operations vitreous loss occurred in only six; in five the loss was insignificant, but in one case in which a 12 mm. diameter trephine was used the loss was considerable.

In spite of the seemingly traumatizing nature of the operation the postoperative period was comparatively quiet. Postoperative cyclitis was not unusual but disappeared by the end of a month.

The corneo-scleral grafts took well, although they were rather large (5–14 mm.); there was no tissue reaction in five cases out of six. The one case which showed allergic reaction was the one referred to above in which there was significant loss of vitreous.

Haemorrhages into the anterior chamber and vitreous occurred in three cases, but further treatment eliminated the haemorrhages and the visual acuity was not affected.

Pre-operative Preparation and Anaesthesia.—These are of great importance in preventing complications. A very soft eye is desirable. General anaesthesia was used only for children.

In the early cases scleral diathermocoagulation was used during the operation to prevent retinal detachment; more recently photocoagulation of the extreme periphery of the fundus in the appropriate quadrant was done 2 weeks before the operation (Müller and others, 1960).

Visual Acuity.—This not infrequently reached the preoperative level; it was very good not only in seven cases in which the sphincter iridis was spared but also in those in which large iris colobomata resulted postoperatively. Stallard (1961) recommended the use of

contact lenses with a screened and painted periphery and a transparent centre, which serve as a diaphragm for improving visual acuity after iridocyclectomy as well as for cosmetic reasons. In our cases, however, the eye adapted itself to new conditions after the formation of the iris coloboma and the visual acuity was often scarcely affected.

The pre- and post-operative visual acuity in our patients is shown in the Table, which demonstrates a tendency to postoperative improvement. At first glance an improvement in visual acuity after iridocyclectomy seems illogical, but in six cases iridocyclectomy was combined with cataract extraction and in one case the improvement was due to the reduction to normal of the intra-ocular pressure.

TABLE
VISUAL ACUITY BEFORE AND AFTER OPERATION

Visual Acuity	Number of Patients	
	Before Operation	After Operation
Perception of light to 0·1	10	5
0·2 to 0·5	7	10
0·6 to 1·0	13	14
Total	30	29*

* One eye had to be enucleated in the postoperative period.

Cycloscopy.—This was used postoperatively to see if the tumour was completely removed and to check local recurrence. We used van Beuningen's gonioscope as well as a goniolens of our own design. The incision concentric to the limbus appeared as a whitish winding line, and no incarceration of the iris and ciliary body tissue in the incision was noted. In one case synechiae formed between the limbal incision and a part of the equatorial line of the lens. Incisions perpendicular to the limbus appear as whitish bands following the curve of the inner surface of the sclera. The exposed region of the sclera corresponding to the resected part of the ciliary body is covered up to a month post-operatively with a whitish-yellow cotton-like film with an uneven surface; this may be a precipitation of fibrin and transudate. This film later becomes consolidated and by the end of about the third month the scleral area not covered by the ciliary body and choroid takes on a bright whitish-yellow colour, its surface remaining slightly uneven. The line demarcating the intact part of the ciliary body and choroid is always distinct. In the early period the precipitate on the sclera is a little raised above the level of pars plana, but later becomes flat (Fig. 11, overleaf).

Tonography.—This was performed in eighteen cases before and after the operation by the method of Nesterov-Sacharov to check the effect on aqueous formation. In cases in which glaucoma was present before the operation, fluid exchange in the eye became normal postoperatively, partly through a reduction in aqueous formation and to a lesser degree through an increase in aqueous outflow. The same tendencies were noted in eyes which were normal preoperatively.

FIG. 11.—Case 3.

Goniocycloscopic picture of right eye after iridocyclectomy with simultaneous cryoextraction of the cataract:

- A. Line of limbal incision;
- B. Line of scleral incision perpendicular to the limbus;
- C. Exposed area of sclera corresponding to resected zone of ciliary body;
- D. Ciliary body;
- E. Ciliary processes;
- F. Beginning of choroid;
- G. Iris base.

Summary

Partial iridocyclectomy has been performed in thirty cases of neoplasm of the base of the iris and ciliary body. In most cases a fairly high degree of visual acuity was preserved.

Our patients have now been under observation for from 3 months to 2 years, and our clinical experience leads us to consider iridocyclectomy as a useful surgical procedure which makes it possible to salvage eyes which would formerly have been enucleated.

The complete excision of the tumour confirmed histologically guarantees to a certain extent against local recurrence, but such patients should be checked monthly and later every 2 to 3 months, by goniocycloscopy as well as by routine examination.

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