ASSESSMENT OF THE INTRA-SCLERAL SILICONE-RUBBER IMPLANT WITH ENCIRCLING BAND IN RETINAL DETACHMENT SURGERY*

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THE ROLE of the intra-scleral silicone-rubber implant with encircling silicone-rubber band, in the surgical treatment of retinal detachment, was first described by Regan, Schepens, Okamura, Brockhurst, and McMeel in 1962. Uncertainty and speculation regarding the state and future of an eye encircled by an elastic band are probably the main reasons for the relatively slow adoption of the procedure in this country.

It is the intended purpose of this paper to allay some of this uncertainty by presenting the results of a review of 40 consecutive cases of retinal detachment cured by this operation.

Material and Method

The series consisted of 25 males and 15 females and their average age was 42 years. Twenty-one were myopic, two were aphakic, and the remainder either emmetropic or mildly hypermetropic. No case which had had previous surgery for retinal detachment has been included in this series, and all patients were cured by a single operation conforming to the technique previously described (Dalglish, 1964).

The cases were reviewed after a mean post-operative follow-up period of twelve months. The minimum follow-up was five months, and the maximum just over two years. At the time of the review the clinical examination of both eyes included: a full refraction, charting of the peripheral visual fields (3/330 mm.), applanation and indentation tonometry, tonography, gonioscopy, and ophthalmoscopic examination of the fundi. The results of this investigation are listed below.

Visual Acuity and Induced Change in Refraction

The distribution of the corrected visual acuity of the affected eyes is shown in Fig. 1. Three eyes which were known to be densely amblyopic pre-operatively have been excluded from this assessment.

It can be seen from Fig. 1 that more than one-third of the eyes had a final visual acuity of 6/9 or better, less than one-third had 6/12 or 6/18, and the remaining third had 6/24 or less.

* Received for publication March 26, 1965.

FIG. 1.—Distribution of corrected visual acuity of affected eyes after intra-scleral silicone-rubber implant.

In 10 eyes with a post-operative visual acuity of 6/12 or better, acceptable information was available concerning their refraction before the onset of the retinal detachments. This has been compared with the refraction at the time of the review, and the precise induced spherocylindrical change has been calculated in each case. Because of the small number of cases, the subjective element, and the variable factors relating to the operation, no finite correlation is possible. However, in each case the induced change in refraction, expressed as the equivalent sphere (the spherical power plus one-half the cylindrical power), has been on the minus side; the mean value for the ten cases is $-1D$ and the lower limit is $-2.25D$.

Peripheral Visual Fields

In the operation used in these cases, diathermy is generally confined to the area of the intra-scleral silicone-rubber implant (i.e., the site of the retinal tear) and to a small adjacent area where the sub-retinal fluid is evacuated. This, and the extent and duration of the retinal detachment, produces a varying degree of absolute or relative visual field defect.

Examination of the peripheral visual fields (3/330 mm.) of the eyes which maintained good central visual acuity indicates quite clearly that unless otherwise affected, the retina peripheral to the encircling silicone-rubber band remains functionally viable. This was found to be the case even in those eyes which on ophthalmoscopic examination were seen to have a deep encircling ridge. This finding is supported by the fact that retinal pigmentation has not occurred on the encircling ridge unless diathermy has been applied under the band.

Applanation and Indentation Tonometry

These investigations were carried out by independent observers on the affected eyes and on the fellow eyes (if apparently normal), and the applanation tonometry preceded the indentation tonometry by a short interval.

Fig. 2 shows the range of the intra-ocular pressure as assessed by applanation tonometry and indentation tonometry (Schwarzer electro-tonometer) in the operated

FIG. 2.—Range of intra-ocular pressure assessed by applanation and indentation tonometry in operated eyes (solid lines) and in fellow eyes (dotted lines).

eyes and in the fellow eyes. The paired eyes of individual patients are not related in this figure.

By either method of assessment the range of the intra-ocular pressure in the operated eyes was lower than that of the fellow eyes.

If the two halves of Fig. 2 are compared, it is seen that there is a greater separation between the range of the intra-ocular pressure, as assessed by applanation tonometry and indentation tonometry, in the operated eyes compared with the fellow eyes (a greater vertical separation between the solid lines compared with the dotted lines). This indicates a relative reduction of the coefficient of scleral rigidity in the operated eyes.

Because of the low range of the indentation pressures (Fig. 2, solid line, right side) and the reduced scleral rigidity, the estimation of the coefficient of aqueous outflow from the tonographic tracings in the operated eyes has been abandoned.

Gonioscopic Findings

This investigation was carried out on 30 patients in whom, apart from the retinal detachment surgery, the fellow eyes were apparently similar to the operated eyes (i.e., bilateral myopia, bilateral aphakia), and the findings are presented as a comparison between the two sides:

(1) In 21 cases (70 per cent.) the filtration angles were completely open and equal in depth on the two sides. This includes 3 cases in which the anterior chamber underwent paracentesis at operation in order to soften the globe to allow a scleral indentation.

(2) In 3 cases the filtration angles were narrower on the operated side. This includes one case in which peripheral anterior synechiae occluded 10 per cent. of the filtration angle in the operated eye.

(3) In 6 cases there was a backward shift of the lens-iris diaphragm affecting one or both eyes. In these cases the iris curved at a near right-angle so that a portion of its periphery contributed to the "side-wall" of the deepened anterior chamber. This affected the operated eye in 4 cases, the fellow eye in one case, and both eyes in one case.

Miscellaneous Data

In a previous communication (Dalgleish, 1964) it was reported that the success rate in cases of retinal detachment treated by the operation under consideration was over 90 per cent., and that this was achieved against a background of an overall cure rate of over 80 per cent. in all patients with simple retinal detachment who were willing and fit to undergo operation; this state of affairs has been maintained. Up to the present, retinal detachment has recurred in only one case of those considered to be cured by the silicone-rubber implant and band procedure at the time of discharge from hospital.

In a series of over 50 cases it has been observed that the silicone-rubber implant and encircling band are tolerated with a minimal degree of tissue reaction and no persistent post-operative pain. This has been in marked contrast to the state of affairs so often observed in this clinic and elsewhere (Manson, 1964) when the encircling Mersilene suture has been used.

There has been no case of intrusion or extrusion of the silicone-rubber implant or band, and no case of overt deep infection.

Discussion

In the absence of any standardized form of presentation few valid comparisons can be drawn between the findings of this review and the published results of other retinal detachment operations. However, it is felt that the implications of certain findings require amplification.

The mean coefficient of scleral rigidity of the operated eyes was 0.008 and of the fellow eyes 0.014 (Friedenwald nomogram, 1955 calibration (Friedenwald, 1957)). It is therefore obvious that an isolated reading with an indentation tonometer is of little value in eyes which have undergone this operation. In view of the very low intra-ocular pressure readings in the majority of cases, as assessed by indentation tonometry (Fig. 2), it is suggested that where possible, this should be completely abandoned in these eyes in favour of applanation tonometry.

This presents certain difficulties at operation. The original authors advise that following the evacuation of the sub-retinal fluid, the encircling band should be tightened until the intra-ocular pressure is raised to within normal limits and that this should be controlled by tonometry. Under operating conditions a sterile indentation tonometer is the most practical method available. From a comparison with a limited number of cases cured by an encircling Mersilene suture, it would appear that the greatly reduced coefficient of scleral rigidity relates largely to the elasticity of the encircling silicone-rubber band and an attempt must be made to compensate for this when assessing the intra-ocular pressure at operation. By applying the mean coefficient of scleral rigidity of 0.008 which we have found in the operated eyes, a Schiötz (5.5 G.) indentation tonometer reading of between 12 and 17 mm. Hg will be equivalent to an applanation reading between 20 and 25 mm. Hg (i.e., the true intra-ocular pressure is likely to be about 8 mm. Hg higher than the pressure indicated by a Schiötz-type tonometer). It must be emphasized that this is an approximation and that indentation tonometry is inherently inaccurate in these cases.

The mean intra-ocular pressure in the operated eyes was 14.5 mm. Hg (applanation) compared with 17.5 mm. Hg in the fellow eyes. In the vast majority of cases the relative hypotony has not produced overt complications. The single exception was a post-operative soft eye in an 18-year-old male; massive unilateral papilloedema developed in the immediate post-operative phase and although the retina has remained flat, all useful vision has been lost in that eye. Following a thorough investigation it was decided that the hypotony was the cause of the papilloedema. In the absence of any valid basis for comparison it is not possible to decide whether or not this degree of relative hypotony is a complication peculiar to the operation under consideration. From the examination of a relatively small number of cases cured by other "encircling" operations it seems unlikely that this is, in fact, the case. The mean intra-ocular pressure of the operated eyes in those followed up for less than twelve months was 14.4 mm. Hg (applanation), and the mean pressure of the eyes with a follow-up of more than twelve months was 14.6 mm. Hg. This strongly suggests that the hypotony of the operated eyes is not progressive.

The main revelation of the gonioscopic investigation is the fact that the compression of the posterior segment by the silicone-rubber band and implant produces little, if any, long-term narrowing of the anterior chamber. The backward shift of the lens-iris diaphragm which was observed in 5 of the operated eyes is a phenomenon which has been reported in cases of simple retinal detachment (Graham, 1958). It is of interest that this change affected the fellow eye in two cases.

Summary

Information is presented concerning the state of 40 eyes in which simple retinal detachments were cured by an intra-scleral silicone-rubber implant with encircling silicone-rubber band. The mean post-operative follow-up in these cases was twelve months.

The final visual acuities are presented as a possible basis for future comparison. It is shown that, on average, the operation tends to induce a degree of myopia equivalent to one dioptre on subjective testing.

Examination of the visual fields indicates that unless otherwise affected, the retina peripheral to the encircling silicone-rubber band remains functionally viable.

Attention is drawn to the relative hypotony and reduced coefficient of scleral rigidity of the operated eyes and the implications of these findings are discussed in some detail.

The gonioscopic investigation indicates that there is little if any tendency for the operation to induce any long-term narrowing of the anterior chamber.

It is confirmed that the cure rate previously reported (Dalgleish, 1964) has been maintained. Attention is drawn to the conspicuous absence of post-operative complications relating to the implant material.

The satisfaction previously expressed regarding the clinical results obtained with the operation under consideration has been consolidated by the findings of this review. It is hoped that this report will stimulate a more widespread adoption of the procedure.

I am grateful to Mr. M. J. A. Britten, Dr. E. J. Naylor, and to Mrs. R. Coffman, our glaucoma technician, for their assistance with the assessment of these cases.

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