Choroidopathy produced by pressure on the sclera by synthetic buckling material

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The pressure of the synthetic buckling material used in retinal detachment surgery may produce uveal vascular engorgement followed by mild uveopathy, and the choroidopathy so formed aids in sealing the retinal tear.

The effect of scleral buckling by synthetic material on the uveal tract has been studied by the observation of human eyes and by experiments on rabbit eyes.

(A) Human eyes

(1) A silastic encircling 3-mm. band tightened at the equator of the globe (Schepens, Okamura, and Brockhurst, 1957) will indent the sclera (without affecting the retinal circulation or causing glaucoma) and produce a grey circle of chorio-retinal reaction which in time becomes a white circle surrounded by pigmentation.

(2) A localized silicone rod 5 mm. in diameter and 2 to 3 cm. long may be pressed on to the sclera (Custodis, 1952) to push the choroid against the edges of the retinal tear and relieve vitreous traction; this seals the retinal tear even if some of the diathermy or cryotherapy applications are not visible in the fundus during the operation or postoperatively. Fine mottling and pigmentation are seen all over the area under pressure about 20 days after the operation. In about 10 per cent. of cases excessive dense yellow retino-choroidopathy of the buckled area, unrelated in degree to the intensity of the treatment usually applied, may be seen from 7 to 24 days after the operation. The dense retino-choroidopathy resolves in a month leaving a retino-choroidal scar. In 5 per cent. of cases, however, severe exudative choroidopathy of the buckled area occurs, and this re-opens the retinal tear with recurrence of the detachment.

(3) If a very sensitive choroid is treated with either a band or a rod, the pressure of the synthetic implant may produce very severe choroidopathy with increased subretinal fluid, retinal or choroidal punctate haemorrhages, macular lesions, or vitreous haze that may obscure the view of the fundus.

(4) When either the band or the rod is used, the ocular tension immediately after the operation rises to about 20 to 30 mm. Hg (Schiötz) above the normal preoperative level (usually 5 to 10 mm. Hg), but this does not affect the retinal circulation (arterial or venous), press on the two long posterior ciliary arteries, produce glaucoma, or cause severe pressure on the vitreous or loss of corneal transparency. At the first dressing, 24 hours after the operation, the ocular tension will be found to have returned to the preoperative level. In subsequent days, because of the mild uveopathy induced by the scleral indentation, the ocular tension will fall to 5 mm. Hg (Schiötz) or below. After 1 or 2 months, with resolution of the uveal vascular engorgement, the ocular tension gradually rises to the normal level.

(5) A few minutes after the sclera is compressed by the band or rod, the compressed area becomes bluish-red because of the dilation of the underlying choroidal vessels.

(B) Experimental studies on rabbit eyes

Fig. 1 shows the cornea and iris, Fig. 2 the sclera and choroid, and Fig. 3 the retina of a normal rabbit eye. This may be compared with these structures in eyes enucleated 15 days after the following operations:

FIG. 1 *Normal cornea and iris of rabbit, showing thickness and iris vessels.*
× 120

FIG. 2 *Normal choroid and sclera of rabbit, showing thickness of choroid. Pigment epithelial cells of retina adherent to choroid. Choroidal vessels not clearly seen.* × 120

(1) Four diathermy applications (60 m.amps for 6 sec. each) to the bed of a simple scleral infold 1 cm. long at the upper equator (using Supramid mattress sutures without pressure on the sclera by a synthetic implant).

FIG. 3 *Normal retina of rabbit. Artificial separation showing no pigment epithelial cells of retina adherent to rods and cones layer. $\times 120$*

FIG. 4 *Experimental scleral infolding and four diathermy 60 m.amp. 6-sec. applications to infolded area in rabbit eye enucleated 15 days after operation. Changes are seen only at the site of diathermy application. Left to right: (1) Sclera with mononuclear infiltration. (2) Degenerated sclera. (3) Engorged choroidal vessels. (4) Chorio-retinal adhesions, and retina infiltrated by mononuclears and pigment epithelial cells. $\times 120$*

FIGS 5 to 9 *Experimental 5-mm. silicone rod 1 cm. pressed onto upper equatorial sclera of rabbit eye by two Supramid mattress sutures without diathermy or cryocautery applications. Eye enucleated 15 days after operation.*

FIG. 5 *Diffuse corneal oedema. Cornea is three times thicker than normal (cf. Fig. 1). Slight mononuclear infiltration $\times 120$*

Only the diathermized sclera, choroid, and retina are affected (Fig. 4). The cauterized choroid and retina are adherent. The affected retina shows infiltration with mononuclear and pigment epithelial cells. The sclera, choroid, retina, and other ocular structures not touched by the diathermy are normal.

(2) A silicone rod 5-mm. in diameter and 1 cm. long pressed onto the upper equatorial sclera.

The cornea (Fig. 5) and iris (Fig. 6) are three times thicker than normal. The iris and ciliary body show severe generalized vascular engorgement.

FIG. 6 *Iris three times thicker than normal. Mononuclear infiltration and extreme vascular engorgement (cf. Fig. 1). $\times 120$*

The choroid becomes six times thicker because of severe generalized vascular engorgement (Fig. 7).

FIG. 7 *Choroid as thick as sclera, and six times or more thicker than normal. Severe choroidal vascular engorgement is evident (cf. Fig. 2). $\times 120$*

At the indented area the choroid and retina are adherent and show mononuclear infiltration (Fig. 8, overleaf). The retina away from the indented area shows, in some aspects, adhesion of pigment epithelial cells to the rods and cones, denoting a tendency for adhesions to develop between the choroid and the retina (Fig. 9, overleaf).

(3) A 3-mm. silastic encircling band applied to the sclera at the equator.

FIG. 8 Choroid, retina and vitreous below scleral area pressed by silicone rod, showing adhesion to retina, and mononuclear infiltration of choroid, retina, and periphery of vitreous. $\times 120$

FIG. 9 Retina away from scleral area pressed by silicone rod, showing in some areas pigment epithelial cells adherent to the rods and cones, and tendency to adhesions between retina and choroid. $\times 120$.

FIG. 10 Experimental 3-mm. encircling silastic band pressed on to sclera at equator of rabbit eye and held by Supramid mattress sutures at each eye quadrant, without application of diathermy or cryocautery. Eye enucleated 15 days after operation. Cornea and iris show changes similar to those in Figs 5 and 6 after pressure of segmental silicone rod on sclera). Sclera, choroid, retina, and vitreous, showing generalized severe engorgement of choroidal vessels. The retina is adherent to the choroid and infiltrated by pigment epithelial cells: there is also mononuclear infiltration of the choroid, retina, and periphery of the vitreous. $\times 120$

The cornea, iris, and choroid show changes similar to those seen in Figs 5, 6, and 7. The iris, ciliary body, and choroid show severe generalized vascular engorgement. The choroid and retina are completely adherent all round and are infiltrated by mononuclear cells. Pigment epithelial cells infiltrate the retina (Fig. 10).

When the sclera was indented by segmental or encircling synthetic material, the eyelids of the operated eyes showed dermatitis with alopecia.

To show that the pressure of a synthetic implant on the sclera is the cause of the uveal vascular engorgement and to establish the time when this engorgement is produced, the operations were repeated, and the synthetic material was removed 24 hours after the operation. The eyes were enucleated 15 days later. Histological examination revealed uveal vascular engorgement and exudation just like those seen in the first experiments, proving that the engorgement is produced soon after the operation while the pressure on the sclera is heavy. In both cases the eyelids of the operated eyes showed dermatitis with alopecia.

Discussion

Uveal vascular engorgement and exudations of plasma from permeable capillaries, especially in the buckled area, produce an aseptic inflammation of the choroid and retina, which helps to seal the edges of the retinal tear. In segmental buckling of human eyes, exudations from the permeable choroidal capillaries at the indented area assist in sealing the tear as the pigment epithelial layer adherent to the choroid also adheres to the retina. In 10 per cent. of cases the choroidal exudations are very severe, and in 5 per cent. they may be so severe that the retinal tear re-opens with recurrence of the detachment.

The uveal vascular engorgement occurring after the operation while the sclera is indented by the synthetic implant before the reduction of ocular tension may be due to the following causes:

- (1) An axon reflex initiated by pressure stimulation of scleral sensory nerve endings (Duke-Elder and Gloster, 1968).
- (2) Direct contusion damage to the uveal capillary endothelium (Duke-Elder and Jay, 1969), especially of the indented area.
- (3) Partial constriction of the two long ciliary arteries supplying the ciliary body, iris, and anterior part of the choroid, giving a period of ischaemia with liberation of a histamine-like substance.

On the other hand, pressure on the sclera by the synthetic implant tends to force some of the intraocular fluid out of the eye, so that ocular tension falls with subsequent uveal vascular dilatation.

As the retinal artery and vein are not affected by the moderately raised ocular tension induced by the pressure of the synthetic implant immediately after the operation, so also the two long ciliary arteries are most probably unaffected.

The most likely cause for this uveal vascular engorgement and hypotony is the axon reflex mechanism. Compression of the globe sets in motion dilatatory vascular reactions (Perkins, 1957). Mechanical stimulation of the sensory nerve endings in the indented sclera liberates a histamine-like substance in the uvea and eyelids supplied by the same nerve. Simple scleral infolding without pressure on the sclera by a synthetic implant is not sufficient to produce choroidopathy.

One must not be afraid of the moderately raised ocular tension which occurs immediately after the operation. Okun (1969) stated:

"If, in the process of performing a scleral buckling procedure without drainage of subretinal fluid, the intraocular pressure is temporarily raised to 50 mm. Hg, what I propose is that we simply relax a little bit and wait for it to come down. As long as the central retinal artery remains open I have seen no harm come from this. We have followed the tension in these patients after they have gone back to their rooms and found that it returns to normal or subnormal and remains that way provided the angle is adequate".

There is a difference between uveal vascular engorgement in normal rabbit eyes and human eyes affected by retinal detachment. In rabbit eyes the ocular tension before the operation is normal, and vitreous, choroid, and retina are healthy; the uveal vascular engorgement tends to be generalized and severe, especially when an encircling silastic band is used. In human eyes with retinal detachment the ocular tension before operation is low, and the choroid, retina, vitreous, and fundus vessels are usually diseased because of myopia or senility. Fundus examination after a buckling operation shows that the choroidal vascular engorgement tends to be confined to the buckled area. Clinically there is no iris, ciliary body, or corneal lesion as in the case of rabbit eyes.

The higher percentage of success in retinal detachment surgery which is achieved by indenting the sclera opposite the tear edges with a silicone rod or an encircling silastic band without reducing the ocular tension (as by an attempt to evacuate the subretinal fluid) is due not only to the contact of the edges of the tear with the treated choroid but also to the choroidopathy so produced which assists in closing the retinal tear. Choroidopathy produced by a silastic encircling band gives quicker and firmer adhesions between retina and choroid than those effected by a segmental silicone rod.

Summary

After scleral buckling operations using a silicone rod or an encircling silastic band indenting the sclera at the equator, observations on human eyes operated on without evacuation of subretinal fluid, and examination of sections of rabbits eyes removed 15 days after the operation without perforation of the globe, showed the following results:

- (1) The pressure of the synthetic implant on the sclera not only brings the edges of the retinal tear into contact with the choroid but also produces uveal vascular engorgement and mild uveopathy, which helps to seal the tear.
- (2) The uveal vascular engorgement starts immediately after the operation.
- (3) The uveal vascular engorgement is probably due to an axon reflex initiated by pressure on scleral sensory nerves or to changes in the uveal vessels caused by the pressure of the synthetic implant on the globe while ocular tension is high soon after the operation.

References

- CUSTODIS, E. (1952) *Ber. dtsh. ophthal. Ges.*, 1951, **57**, 227
- DUKE-ELDER, S., and GLOSTER, J. (1968) In "System of Ophthalmology", ed. S. Duke-Elder, vol. 4, p. 78. Kimpton, London
- and JAY, B. (1969) In "System of Ophthalmology", ed. S. Duke-Elder, vol. 11, p. 734. Kimpton, London
- OKUN, E. (1969) In "Symposium on Retina and Retinal Surgery: Transactions of New Orleans Academy of Ophthalmology", p. 373. Mosby, Saint Louis
- PERKINS, E. S. (1957) *Brit. J. Ophthal.*, **41**, 257
- SCHEPENS, C. L., OKAMURA, I. D., and BROCKHURST, R. J. (1957) *A.M.A. Arch. Ophthal.*, **58**, 797