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A POSSIBLE AETIOLOGY FOR GLAUCOMA IN NEGROES*

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CHRONIC simple glaucoma is a syndrome well established in ophthalmic practice, but its aetiology is still unknown. Fundamentally this must be related to the question of how the intra-ocular pressure is maintained at a constant level. The many theories which have been advanced to explain the cause of this disease fall into two groups postulating either a hypersecretion of aqueous humour or an obstruction to its drainage. The latter concept has assumed pride of place ever since Leber (1873) discovered the preferential channel of drainage of the aqueous humour at the angle of the anterior chamber. This was confirmed by Priestley Smith (1891), who stressed that obstruction at the angle of the anterior chamber was primarily responsible for raised tension.

This simple mechanical concept was challenged by Duke-Elder (1926), who felt that the obstruction was only an adjuvant factor and that the essential disease process was a vascular disturbance resulting in a state of congestion and stasis of the uveal circulation.

Recently a large volume of work has accumulated on the anatomy and physiology of the drainage of aqueous humour from the angle of the anterior chamber, and various sites of obstruction have been suggested, so that the mechanical hypothesis is slowly gaining ground. Sugar (1957) summarized the immediate cause of ocular hypertension as being either vasoconstriction or sclerosis at the outlets of Schlemm's canal, or increased resistance within the trabecular meshwork itself. In considering the importance of the episcleral and aqueous veins in the drainage mechanism, Thomassen (1948) showed that changes in the pressure of episcleral blood veins anticipated changes in the intra-ocular pressure in glaucomatous eyes, and that this was a constant finding. He further concluded that, because the pressure in the aqueous veins is proportional to the intra-ocular pressure, the same relationship must exist between these veins and the episcleral blood veins; therefore, when the intra-ocular pressure is in an increasing phase, the pressure in the blood veins will be high in proportion to the aqueous veins, and the outflow through the latter will accordingly be hampered. This idea was confirmed

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by Bain (1954) who used a more refined technique to measure changes in the pressure of the episcleral blood veins. In studying a case with a normal and a glaucomatous eye, however, he found that the changes in venous pressure in both eyes were the same. He concluded that changes in the venous pressure do not of themselves cause pathological rises in ocular tension, but may play an important role in eyes with an already defective drainage. Thus, while confirming Thomassen's results, he disagreed with his hypothesis.

The work of Dobree (1953) is also of interest. He studied the changes in calibre of the episcleral arteries, veins, and capillaries during the diurnal fluctuations in tension and recorded them photographically. He found in both normal and glaucomatous eyes that, where the rise in ocular tension was moderate in degree, there was an association between the vascular tone in the episcleral vessels (mainly the venous side) and the ocular tension. Thus, when the latter was raised, the former were in a phase of relative vasoconstriction, while the period of most marked vascularity coincided with the lowest pressure found. He suggested that these changes facilitated the outflow of aqueous by causing a reduction in pressure in the venous outflow from the canal of Schlemm.

Turning finally to clinical observation, Fuchs (1923) stated that corrosive injuries, especially those affecting the limbus, quite frequently caused a rise in ocular tension which developed several days after the injury and might last a week or more. He also pointed out that in scleritis glaucoma might supervene through ectasia of the sclera.

The paper records our observations on four Negro patients, two with chronic simple glaucoma and two in whom the exact diagnosis was in doubt, who were found at operation to have a pathological degree of episcleral fibrosis. It has always been difficult to achieve satisfactory drainage in this race and no good reason for this has yet been suggested, although Friedenwald (1950), in discussing reasons for the failure of glaucoma operations, remarked that post-operative histological studies showed more episcleral scarring in Negroes than in white patients. It is our surmise that in Negroes glaucoma may be caused by a diffuse fibrosis of the episclera, which would also explain the unsatisfactory results of many drainage operations.

Case Reports

The four cases to be described were all seen at outpatient clinics at this hospital, from which they were referred to the hospital's glaucoma clinic for investigation and advice as to treatment.

Case 1, a female kitchen-hand aged 34, was an immigrant from Jamaica. She was referred to hospital by an optician who discovered on routine examination that she had lost the vision of the left eye. The family history was negative.

Examination.—The visual acuity in the right eye was 6/9, and in the left there was no perception of light. The pupillary responses in the right eye were normal, but in the left the direct response to light was absent, the consensual reflex being retained. Both discs were pathologically cupped. The ocular tension was 59 mm. Hg Schiötz in the right eye and 42 mm. Hg Schiötz in the left. The right peripheral field showed an almost complete loss of the nasal sector. Gonioscopy showed open angles.

Diagnosis.—Bilateral chronic simple glaucoma.

Treatment.—She was admitted to hospital for phasing on gutt. pilocarpine 2 per cent. three times a day and Diamox 250 mg. twice a day. As this did not control the ocular tension, surgery was advised.

A cyclodialysis was done 8 mm. from the limbus in the lower outer quadrant of the right eye. At operation a diffuse fibrosis of the episclera was encountered; this extended to at least 8 mm. around the limbus, and may have extended further but this was not confirmed. The overlying conjunctiva was freely mobile.

Case 2, a male Negro labourer aged 49, also came from Jamaica. He had consulted his general practitioner complaining of poor vision in the right eye for the past year and was referred to hospital for investigation. The family history was negative.

Examination.—The visual acuity in the right eye was counting fingers, and in the left 6/12 corrected. Both pupils were constricted (he had been using gutt. pilocarpine 1 per cent. three times a day) and both discs were pathologically cupped. The ocular tension was 45 mm. Hg Schiötz in each eye. There was field loss in both eyes. Gonioscopy showed that both angles were of moderate width, exhibiting golden pigmentation of the whole trabecular zone.

Diagnosis.—Bilateral chronic simple glaucoma.

Treatment.—He was admitted to hospital for phasing on gutt. pilocarpine 2 per cent. three times a day. As this did not control the ocular tension, surgery was advised.

A cyclodialysis was done in the lower outer quadrant of the right eye, and this was followed 2 weeks later by an infero-temporal cyclodialysis in the left eye. At both operations the same fibrosis in the episclera was encountered as in Case 1. The overlying conjunctiva was mobile.

Case 3, a male Nigerian student aged 31, had come to England 18 months previously. He complained of poor visual acuity in the left eye for the past 9 months and an indefinite history of haloes. There was no family history of glaucoma.

Examination.—The visual acuity was 6/9 in each eye with correction. The corneae were rather small and the anterior chambers shallow. The pupils were miotic (due to treatment with gutt. pilocarpine 1 per cent. twice daily). The disc in the right eye was probably cupped in the upper temporal quadrant, and that in the left eye was definitely cupped in the same quadrant. The ocular tension was 22 mm. Hg Schiötz in both eyes. Both central fields had a large inferior scotoma of the arcuate type and gonioscopy showed that both angles were narrow but open. No definite peripheral anterior synechiae were found. A dark-room test performed while he was off treatment was indefinite in both eyes.

Diagnosis.—The classification of this case was in some doubt but a tentative diagnosis was made of closed-angle glaucoma.

Treatment.—He was admitted to hospital for phasing on gutt. pilocarpine 2 per cent. three times a day and gutt. eserine 0·25 per cent. three times a day, but the tension was not controlled.

An iris inclusion was done in the right eye, and this was followed a week later by a cyclodialysis in the lower temporal quadrant of the left eye. Once again the same degree of episcleral fibrosis was seen. Interestingly enough, so intense was the tissue reaction in this man, that the iris inclusion fibrosed up within a week of the operation.

Case 4, a Nigerian male in the service of his Government, aged 48 years, had been seen at this hospital in 1957 when bilateral chronic closed-angle glaucoma was tentatively diagnosed (there was some doubt as to the correct classification) and he was treated with gutt. eserine 0·5 per cent. twice daily to both eyes. He returned in November, 1958, for a reassessment.

Examination.—The corrected visual acuity in the right eye was 6/9, but in the left it was down to 4/60 by reason of an area of old choroiditis at the left macula. The right disc had a suspicious-looking cup; the left disc showed definite pathological cupping. The pupillary reactions were normal. The ocular tension in both eyes was 40 mm. Hg Schiötz. The right visual field was normal but there was an upper arcuate scotoma in the left field. Gonioscopy showed narrow angles which were partially closed in both eyes. On pupillary dilatation the left angle became almost completely shut. A mydriatic test (using homatropine 2 per cent. and cocaine 2 per cent.) gave an indefinite result in the left eye (25–30 mm. Hg Schiötz).

Diagnosis.—This could not be made with any more certainty than before.

Treatment.—He was admitted to hospital for phasing on gutt. pilocarpine 2 per cent. with gutt. eserine 0·5 per cent. four times a day. In spite of this intensive treatment the ocular tension could not be controlled.

A cyclodialysis was done in the upper temporal quadrant of the right eye and a week later in the left eye. Here again, the same degree of episcleral fibrosis was encountered.

Comment

The feature of interest in these four cases is the significance of the episcleral fibrosis, which was common to them all. This was so definite and required such vigorous dissection that we considered it to be pathological, the more so in the light of our experience with a series of ten pterygium operations on Negroes where we found no evidence of fibrosis in the episclera. Reference to the literature has failed to reveal reports of a similar finding at operation, although, as mentioned earlier, Friedenwald commented on episcleral fibrosis in glaucomatous eyes excised post-operatively from Negroes.

Discussion

We have observed that in four Negro patients with primary glaucoma a pathological degree of episcleral fibrosis was present, which has led to the surmise that this might be of aetiological significance in glaucoma in this race.

The aqueous humour from Schlemm's canal is drained into the episcleral venous plexus by a series of intercommunicating plexuses in the sclera and

episclera, so that it eventually reaches the superficial vessels of the episclera. The aqueous humour leaves from Schlemm's canal by approximately thirty external collector channels. These are irregularly distributed and vary in size and shape. Most of them anastomose with the deep scleral plexus near the external wall of the canal of Schlemm, with the intrascleral plexus, and finally with the episcleral plexus (Maggiore, 1917); some communicate directly with the surface.

Ascher (1942) discovered that some vessels in the episclera, when examined biomicroscopically, appeared to contain clear fluid; he named them aqueous veins (Ascher, 1951, 1952). The same observation was made independently by Goldmann (1946), who conclusively proved their aqueous content.

The early studies of the minute anatomy of this peri-limbal circulation were made upon specimens injected with dyes or Indian ink, reconstructed serial sections, or combinations of these two methods. This early work has been reviewed by Dvorak-Theobald (1934). An advance came with the development of the Neoprene cast technique by Ashton (1951, 1952); Schlemm's canal and the intrascleral and episcleral venous plexuses were filled with Neoprene, the ocular tissues being later digested with pepsin and trypsin so that a Neoprene cast of the peri-limbal circulation remained. Aqueous veins previously identified and tied with a tantalum wire loop by Mr. Arthur Lister were followed to their origin. This work showed that striated or pure aqueous-containing veins may arise either from Schlemm's canal directly or in a more indirect fashion *via* the deep scleral venous plexus. Aqueous veins can be seen biomicroscopically in the episcleral tissue where they join the episcleral venous plexus.

Under these anatomical conditions, it is clear that a relative obstruction to the outflow of aqueous humour could occur as a result of severe fibrosis in the episclera with accompanying strangulation or obliteration of the veins.

There is also experimental evidence for this hypothesis; thus Huggert (1951) produced a rise in intra-ocular pressure in 25 out of 33 normal and glaucomatous eyes by means of contact lenses with a narrow haptic. The contact lens was designed to produce compression of the episcleral veins. Ascher (1951) reported that aqueous outflow may be blocked or at least retarded by contact lenses, even if they rested gently on the conjunctival surface.

Sugar (1957) named obstruction of venous drainage in the eye as one of the causes of both primary and secondary adult glaucoma. Sondermann (1934) considered that constriction of the vortex veins at their exits, by condensation or sclerosis of the surrounding sclera, could be responsible for raised tension, and Sugar, reviewing the literature on glaucoma caused by obstruction of venous drainage, pointed out that an increase in intra-ocular pressure under these conditions occurred both clinically and experimentally. He contended, however, that though this had been implicated experimentally as a cause of primary glaucoma it had not been proved clinically.

Our case reports suggest that in Negroes a possible cause for obstruction to the venous and aqueous efferents from the anterior segment of the eye may be a diffuse fibrosis in the episclera. There is no indication at present as to the aetiology of this fibrosis, and indeed its existence is based only upon a clinical impression obtained at operation. It would be interesting to know if other surgeons have also encountered this apparent abnormality of the episclera in Negroes.

Summary

The cases of four Negro patients with glaucoma are reported, in whom an abnormal degree of fibrosis in the episcleral tissue around the limbus was encountered at operation. It is suggested that obliteration of the episcleral veins by this fibrosis may constitute a specific type of glaucoma in this race. This could also be correlated with the poor results obtained after filtration operations for glaucoma in Negroes.

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