Zembrano (1946) that neither were the parents related, nor—which is more important—did the condition appear to be hereditary or associated with other developmental anomalies. This is not inconsistent with the hereditary character of the disease. It may be that the parents cannot give exact information about their family history; moreover, the child afflicted with anophthalmos may become the founder of a family suffering from this or some other developmental anomaly.

By clinical examination I could not detect rudiments of the eye on either side. But it has been shown in the literature that when the child dies and *post-mortem* or histological examination can take place, rudiments of the eye are usually found in the soft parts of the orbit. From the X-ray examination we may deduce that the optic nerves or perhaps the chiasm and tracts were defectively developed but positive radiological proof of this is lacking.

REFERENCES

- VAN CANNEYT & VANDERMEULENBROECKE, (1937)—*Bull. Soc. belge Ophtal.*, 73, 17.
 CECCHETTO, E. (1920)—*Arch. Ottalmol.*, 27, 114.
 GALLEMAERTS, E. (1924)—*Ann. Oculist., Paris*, 161, 490.
 HANKE, V. (1904)—*Graefes Arch. Ophthal.*, 57, 28.
 HIPPEL, E. (1899)—*Graefes Arch. Ophthal.*, 47, 227.
 LANDESBERG, M. (1877)—*Klin. Monatsbl. Augenheilk.*, 15, 141.
 MANZ, (1876) in GRAEFE, A. & SAEMISCH, T.—*Handbuch der gesamten Augenheilkunde*, Leipzig, 2, 119.
 OUGAUD, M. (1922)—*Arch. Ophtal., Paris*, 39, 74.
 PAPOLCZY, F. (1948)—*Brit. Jl. Ophthal.*, 32, 439.
 SORSBY, A. (1934)—*Brit. Jl. of Ophthal.*, 18, 469.
 TRIEPEL, H. (1920)—*Arch. Entw. Mech. Org.*, 47, 25.
 VENTOLA, A. and ZEMBRANO, J. C. (1946)—*Rev. Med. Cienc. affin.*, 8-9, 685.
 WICKERKIEWICZ, B. (1878)—*Klin. Monatsbl. Augenheilk.*, 16, 162.
 WIRTH, F. (1937)—*Dissertation*, Erlangen.

ACUTE A THERAPEUTIC STEP IN CHRONIC GLAUCOMA*

BY

G. DE L. FENWICK

A MEASURE that is sometimes very useful in treating an attack of acute glaucoma is the retrobulbar injection of novocain (procain), administered not pre-operatively, but as an isolated therapeutic incident (S. Gifford, M. J. Icaza). It does not of course have a permanent effect, so that an operation becomes necessary sooner or later; but the object of the injection is to avoid the performance of

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a Graefe iridectomy on a haemorrhagic painful eye, in a sick exhausted patient; for the results of these operations, whether done with local or general anaesthesia, are inferior to those of the "quiet" glaucoma operations, leisurely performed. Retrobulbar injections have certain risks, of which the chief is retrobulbar haemorrhage, but it is believed that this danger can be eliminated by the use of a specially designed needle. These matters will be discussed later in this paper.

The following histories demonstrate the possibility of success with this treatment; others could be quoted in which it was entirely without effect; why it succeeded in some cases and not in others is not known. Accurate statistics are not yet available, but it appears that the injection will produce the desired result in about one quarter of the cases in which it is tried; the desired result being the establishment not necessarily of normal tension, but of a comfortable white eye which can be trephined in due course.

CASE HISTORIES

1. I., female, aged 64 years, came to Moorfields August 5, 1947, with pain in R. eye of 2 weeks duration; typical acute glaucoma, VA=4/60; treated with 1 per cent. oily eserine and heat every 15 minutes, but after several hours of this there was no improvement whatever. Was then given a retrobulbar injection of 1 c.c. of 4 per cent. novocaine containing 0.1 c.c. of 1/1000 adrenalin and eserine was resumed; his pupil soon contracted, his pain subsided and his tension fell, though it was not normal until next day. The eye was trephined in March, 1948, with a satisfactory result.

2. J.G., male, aged 60 years, attended January 6, 1949, with a pain in R. eye which had lasted 8 days; congestion, corneal oedema, shallow A.C.; tension (digital)="+" (35 to 50 Schiötz); VA=counting fingers; L. eye blind; was treated with eserine and heat, as in Case 1, but without any improvement, was then given a retrobulbar injection as above, which reduced the tension to normal in an hour. Eserine was continued, but next day the tension began to rise again. On the third day the injection was repeated (this time without adrenalin), the tension again fell to normal, the eye whitened and was trephined an hour later; VA=6/6.

3. A.P., aged 56 years. Onset of acute glaucoma in L. eye October 22, 1948; intensive eserine and heat treatment instituted the same day but without effect; next day was taken to theatre and given 1.5 grm. sodium pentothal intravenously, as this anaesthetic, when previously used for glaucoma iridectomy, had been observed to reduce the tension; it fell very slightly and then became stable; half-an-hour later, retrobulbar novocaine and adrenalin were given and considerable improvement was almost immediately evident in cornea, pupil and tension. He returned to bed and the improvement was maintained. November 2, L. trephine, December 11, VA=6/9.

DISCUSSION OF CASES

In Case 2 the tension fell after the first injection, only to rise later, presumably because of absorption of the novocaine. A second injection reduced it again, and the operation was performed without delay lest it should rise a third time. Perhaps in this case, after the first injection had reduced it, it could have been kept down by the use of miotics other than eserine; for Scheie and Ojers believe

that retrobulbar novocaine, by paralysing the ciliary ganglion, inhibits the formation of acetyl-choline in the pupillary nerve-endings, and so renders eserine (but not pilocarpine) ineffective. However, in the present writer's brief experience, eserine has been observed to maintain pupillary constriction after cataract extraction, even though a complete extra-ocular paralysis had been pre-operatively induced.

In Case 3, one cannot say with certainty how much the fall in tension was attributable to the retrobulbar injection and how much to the pentothal, but it seemed to be largely due to the former.

Dangers of Retrobulbar Injections

1. The chief danger is *retrobulbar haemorrhage*. See below.
2. *Transient blindness*. This has been described by Ida Mann, occurring in an otherwise healthy woman aged 35 years, after retrobulbar novocaine-adrenalin for repair of a retinal detachment. A few weeks later the same injection was given (for a second operation), but this time without harmful effect; the operation was successful, the visual acuity being 6/6. The temporary blindness was thought to be caused by the needle-tip piercing the sheath of the optic nerve and allowing the solution to infiltrate its fibres. Bidault saw a similar occurrence in a patient with senile macular lesions. He attributed it to constriction either of the central retinal artery or of other vessels entering the optic nerve from the ophthalmic artery.
3. The injection is usually said to cause pupillary dilation. This would be a disadvantage in glaucoma, but appears to be only a theoretical one.
4. The optic nerve might be damaged in clumsy hands.
5. Orbital infection. This is, or should be, unthinkable.

Retrobulbar Haemorrhage

In the Moorfields theatres some six haemorrhages are seen every year—i.e., one haemorrhage in about 160 injections. The majority of these injections are given for cataract or detachment operations, but even for these non-urgent procedures a haemorrhage (and the necessity to defer the operation) may have unsatisfactory results; as in the case of a nervous patient who, after such a postponement, could never be persuaded to enter the theatre again. If the postponed operation is urgent, as in acute glaucoma, the situation can be more serious; two cases are known to the writer: in the first, the haemorrhage necessitated a postponement of an urgent glaucoma iridectomy for five days; as a result, this patient left hospital with extremely poor vision. In the second, likewise, iridectomy had to be deferred, but happily the glaucomatous attack subsided and the

patient went home with an efficient (though black) eye; such good fortune would be exceptional.

Traquair believed that haemorrhages could always be avoided by slow careful injection, and many surgeons hold the view that if the solution is being constantly forced out of the advancing needle, it is impossible to enter a vessel. However, haemorrhages have occurred even when these criteria were fulfilled. One would expect them to occur more often if the needle point is passed to the very apex of the orbit (as recommended by H. Gifford), for here the vessels are larger and more fixed; one would also expect them more often in inflammatory conditions because of orbital congestion. Goulden considered that the incidence could be reduced by using a needle with a slightly blunt point.

To reduce the risk of haemorrhages, a blunt needle with a sharp stylet has been designed.

Length of needle	...	...	50 mm.
External diameter	...	...	0.7 mm.
Base	...	ordinary Record syringe fitting.	

Technique of Retrobulbar Injection

The needle with the stylet in it is passed through the skin in the usual infero-temporal position just inside the orbital margin. This takes more pressure than with an ordinary retrobulbar needle because of the shoulder and the greater diameter; in a hypersensitive patient, therefore, a few minims of novocaine could be injected into the skin first; but this is not usually necessary if the stylet is really

sharp. The needle and stylet are now advanced until one feels the orbital septum being pierced. As soon as this is passed, the stylet is withdrawn, and the blunt-ended needle can now be moved on safely. Often the needle-tip is felt meeting another fascial layer—the sheet that extends between the lateral and inferior recti. If pain is experienced here one can fit the syringe to the needle and inject 0.5 c.c. of novocaine before proceeding. After this sheet has been passed, the end of the needle lies within the muscle cone (the ideal position for it is 2 mm. below and behind the posterior pole of the eye) the ciliary ganglion lies some 7 mm. behind the posterior pole, so if the needle-tip is in this situation, the solution flows into this 7 mm. space and infiltrates the ciliary nerves and ganglion. 1.5 c.c. of 4 per cent. novocain are used. It usually contains 1/1000 adrenalin, 1 minim to the c.c., but in case 2 described above the second injection was successful without adrenalin. It seems doubtful whether adrenalin is essential to its success, and occasionally it has produced alarming anginal reactions. It is not suggested that this needle should be used for every retrobulbar injection, but only where it is particularly important to avoid a haemorrhage.

Rationale

We do not know how retrobulbar novocaine relieves an attack of acute glaucoma. Its effect could be due to:

(a) Extra-ocular muscle paralysis. The fall in tension that occurs after ordinary pre-operative retrobulbar injections (as for cataract extractions) is attributed to this, but it cannot be important in acute glaucoma.

(b) Inhibition of parasympathetic activity. This explanation is not easily supported anatomically; for the only para-sympathetic fibres that are known to pass to the eye are those that terminate in the sphincter pupillae and ciliary muscle, and inhibition of these would be expected to aggravate narrow-angle glaucoma, not relieve it. There is no evidence that any vasodilatator fibres supply the eye (Duke-Elder).

(c) Inhibition of sympathetic activity. Thiel found that the tension in glaucomatous eyes was reduced by ergotamine. This drug, though vasoconstrictive, is in general antagonistic to adrenalin and sympathetic activity, and he concluded that glaucoma may be due to an increase in sympathetic tonus. If this were so, the success of retrobulbar injections would be a fairly logical consequence.

(d) Interruption of Reflexes. It seems possible that the injection reduces the tension by breaking two reflex arcs. One of these is a conscious cycle—the increasing pain of acute glaucoma induces a mental state which aggravates the tension. The other one is autonomic, but its exact pathways are not known (*b* or *c*, above). Probably an important part in the aetiology of acute glaucoma is played by axon reflexes (*i.e.*, local reactions in the eye, liberating histamine); but these reflexes occur whether the main sensory trunks are intact or not, so they do not explain the beneficial effect of the injection. However, the mechanism may be similar to that of causalgia. In this disorder there is, in the affected limb, pain and

congestion which may be relieved by the injection of anaesthetic solutions into the trunk of the sensory nerve concerned. Lewis suggests that the symptoms of causalgia are due to release of histamine-like substances in the skin as a result of abnormal impulses passing in a centrifugal direction along the affected sensory nerve.

Conclusion

It is suggested that a retrobulbar injection of novocaine should be tried in all cases of acute glaucoma which are not improving after 24 hours of the usual intensive treatment—miotics, counter-irritants and sedatives. The chief danger of this measure, *viz.*, retrobulbar haemorrhage, has, it is hoped, been eliminated by using a needle on the trocar-and-cannula principle.

Summary

1. Some cases of acute glaucoma can be terminated by a retrobulbar injection of novocaine; three such are described.
2. The risk of an orbital haemorrhage is important.
3. This can be avoided by using a special needle.
4. The rationale of the procedure is discussed.

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REFERENCES

- BIDAULT (1947).—*Ann. d'Ocul.*, **180**, 59.
 DUKE-ELDER, STEWART (1942).—Text-book of Ophthalmology. Kimpton, London, 417.
 GIFFORD, S (1934).—*J. Amer. Med. Assoc.*, **103**, 1537.
 GIFFORD, H. (1949).—*Arch. Ophthalm.*, **41**, 5.
 GOULDEN, C. B. (1943).—*Proc. Roy. Soc. Med.*, **36**, 408.
 ICAZA, M. J. (1946).—*Arch. Ophthalm.*, **35**, 361.
 LEWIS, THOMAS (1946).—*Vascular Disorders of the Limbs*. Macmillan. London, 110.
 MANN, IDA (1949).—Personal communication.
 SCHEIE and OJERS (1949).—Quoted by Scheie, *Trans. Amer. Acad. Ophthalm. Otol.*, **53**, 208 (Jan.-Feb., 1949).
 THIEL, R. (1926).—*Klin. Monatsbl. Augenheilk.*, **77**, 753.
 TRAQUAIR, H. M. (1938).—*Trans. Ophthalm. Soc. U.K.*, **58**, 697.