STELLATE GANGLION BLOCK IN GLAUCOMA*

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THE influence of emotional tone in congestive glaucoma suggests that the sympathetic nervous system may be the mediator whereby attacks of raised intra-ocular pressure are precipitated. The idea is not a new one and has suggested itself to many (Lagrange, 1922). Jonnesco (1899) made wide claims for the effectivity of resection of the sympathetic in the neck in the management of glaucoma, but Linksz (1931) found that the intra-ocular pressure was more labile after cervical sympathectomy. Further research has not been devoted to the subject, but the recent discovery by Nickerson and Goodman (1945) of the sympatholytic drug, dibenamine, and of its hypotensive effect in glaucoma (Christiansen, Swan, and Gould, 1948) has led to a renewal of interest in the possible role of neurogenic factors in the aetiology of this disease.

This paper records the responses of thirty glaucomatous eyes to local block of the stellate ganglion with procaine. The anterior approach to the ganglion is fully described by Leriche and Fontaine (1934), Gilbert and Takats (1948), and Moll (1951). I am indebted to the late Mr. E. R. Garnett-Passe for personally demonstrating his method to me (Passe, 1951).

Method

The patient lies in the supine position with the head turned to the opposite side through an angle of 45°. A pillow is placed under the scapula on the side of injection. A point is chosen 1 in. above the clavicle just internal to the external jugular vein, about 0.5 to 1 in. behind the medial border of the sternocleidomastoid muscle. A bleb is raised in the skin with procaine hydrochloride 1 per cent. solution. The needle is inserted through the bleb directed backwards, medially and horizontally, lateral to the great vessels. The transverse process of C7 is felt by the needle after it has penetrated about 2 in. The point of the needle is then made to travel along the upper border of the process until it strikes the body of this vertebra; the needle is then withdrawn slightly and, after it has been ascertained that the point is neither in a blood vessel nor in the spinal cord, 5 to 10 ml. procaine are slowly injected.

Criteria of an Effective Block.—A Horner's syndrome begins to appear on the side of the injection before the needle is withdrawn. Contraction of the pupil is the more sensitive index of a successful block, but narrowing of the palpebral fissure also becomes well marked. The two signs reach their maximum in 10 to 20 min., and gradually wear off during the ensuing hour. Flushing and warming of the skin with absence of sweating appear over the head and neck on the same side, and extend along the upper extremity to the hand. The vessels of the conjunctiva and the tympanic membrane are dilated and form an accurate indication of success or failure.

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Results

A study of the results of stellate ganglion block shows the following changes affecting the ocular tension and the behaviour of the aqueous veins.

(A) PRESSURE CHANGES

(1) IN SIMPLE GLAUCOMA.—There is an immediate rise in intra-ocular pressure, which lasts for approximately 10 mins, and is followed by a fall to the original pressure and somewhat below it (Fig. 1).

FIG. 1.—Intra-ocular pressure (mm. Hg Schiötz) in six cases of simple glaucoma charted before and after unilateral block of stellate ganglion.

(2) IN CONGESTIVE GLAUCOMA

(a) *With a structurally open angle.*—The intra-ocular pressure falls at once to levels below that found before injection (Fig. 2).

FIG. 2.—Intra-ocular pressure (mm. Hg Schiötz) in five cases of congestive glaucoma charted before and after unilateral procaine block of stellate ganglion.

(b) *With a partially closed angle.*—The intra-ocular pressure behaves as in simple glaucoma: an initial rise is followed by a fall. Fig. 3 (opposite) shows the curve of the intra-ocular pressure following stellate ganglion block in a

patient aged 31 years who had complained of attacks of halos, blurred vision, and ocular pain for 2 years. His fields of vision were full and his disks not cupped. Gonioscopy revealed persistent mesoderm in both chamber angles.

(c) *With a completely closed angle.*—The intra-ocular pressure rises at once and there is no subsequent fall; in effect, an acute attack of glaucoma is precipitated. Fig. 4 depicts the rise in intra-ocular pressure in a patient who had long-standing congestive glaucoma with the formation of total peripheral anterior synechiae.

FIG. 3.—Intra-ocular pressure (mm. Hg Schiötz) in a case of congestive glaucoma with persistent mesoderm in the angle of the anterior chamber charted before and after unilateral procaine block of stellate ganglion.

(B) BEHAVIOUR OF AQUEOUS VEINS

(1) *IN SIMPLE GLAUCOMA.*—The recipient laminated veins at first fill with blood and regain their laminated appearance when the intra-ocular pressure begins to fall.

(2) *IN CONGESTIVE GLAUCOMA.*—The aqueous veins remain clear throughout the period of observation if the angle is structurally open.

FIG. 4.—Intra-ocular pressure (mm. Hg Schiötz) in a case of congestive glaucoma with peripheral anterior synechiae charted before and after unilateral procaine block of stellate ganglion.

Analysis of Results

The results of novocaine block of the stellate ganglion may be discussed under four headings:

(1) *Pupillary Effect.*—The pupil contracts on the side of the injection even in the dark. In simple glaucoma, it is to be remembered that the size of the pupil has little effect on intra-ocular pressure, for dilatation has no influence on the height of the intra-ocular pressure provided the angle of the anterior chamber is broad and open. In congestive

glaucoma, on the other hand, pupillary constriction facilitates the outflow of aqueous by opening up the angle of the anterior chamber (Fig. 5).

FIG. 5.—Intra-ocular pressure (mm. Hg Schiötz) in a case of congestive glaucoma charted before and after unilateral block of stellate ganglion carried out in the dark.

(2) *Dilatation of Intra-Ocular Capillaries.*—In simple glaucoma, dilatation of the intra-ocular capillary bed cannot be rapidly compensated by displacement of intra-ocular fluid because the rate of drainage of aqueous is below normal (Thomassen, 1946; Grant, 1951), so that a sudden and early rise of intra-ocular pressure occurs. In congestive glaucoma it seems probable that, so long as the angle is open, a dilatation of the intra-ocular capillary bed immediately displaces aqueous from the eye, and that the increased intra-ocular capillary volume is so rapidly and effectively compensated that the height of the intra-ocular pressure remains unaffected.

(3) *Dilatation of Veins.*—It is claimed that throughout the body generally the sympathetic system exerts a tonic influence on veins and that section of the sympathetic leads to their dilatation in man (Wright, 1952). In the eye, Wagener (1931) has watched the retinal veins dilate after interruption of the sympathetic nerve supply. It would therefore be expected that a sudden sympathetic block of the stellate ganglion would produce a relaxation of the veins and a fall in the lateral pressure of their contents. This effect

would be reinforced as a result of the dilatation of the intra-ocular capillary bed which becomes a temporary reservoir. It is well known that in histamine poisoning the venous return is greatly reduced because the blood stagnates in the capillaries, and it is possible that a similar effect is produced in the exit veins of the eye after sympathetic block.

Thomassen (1945) has shown that, in the phasic variations of glaucoma, a fall in venous pressure precedes the fall in intra-ocular pressure in the descending phase. The exact mechanism linking the venous and intra-ocular pressures has yet to be elucidated. If the venous fall is causative, as suggested by Duke-Elder (1952), then the fall in intra-ocular pressure following sympathetic block may be regarded as a secondary result of its effect on venous pressure.

(4) *Formation of Intra-Ocular Fluid.*—It is probable that the formation of the intra-ocular fluid is equally affected by sympathetic block in both types of glaucoma, and that this factor does not contribute to the difference in the reactions of their intra-ocular pressures.

These factors may be summarized as follows:

Effects of Sympathetic Block	Effect on Intra-ocular Pressure	
	Congestive	Simple
Pupillary constriction 	Fall facilitated	No effect
Dilatation of intra-ocular capillaries ...	No effect	Rise
Lowering of venous pressure 	Fall	Fall

Discussion

In simple glaucoma, the events following stellate ganglion block are probably determined by a dilatation of the intra-ocular capillaries causing an increase in the volume of the intra-ocular capillary bed. A corresponding volumetric displacement of aqueous through the drainage channels is not immediately possible because of the reduced capacity for drainage characteristic of this disease (Thomassen, 1946; Grant, 1951) and the net effect is therefore a temporary rise in intra-ocular pressure. However, the resumption of drainage made possible by the lowered venous pressure in the exit veins, and possibly facilitated by the temporary increase in the intra-ocular pressure, quickly neutralizes this rise so that the same circulatory changes, effective at once in congestive glaucoma, eventually induce a fall in tension in simple glaucoma.

This explanation implies that the rise in intra-ocular pressure found in simple glaucoma is due to the suddenness of the sympathetic block and to the speed with which the capillary volume tends to increase. Were it possible to effect a gradual relaxation of sympathetic tone, it is probable that this preliminary rise in tension would not occur so that the intra-ocular pressure would fall slowly from the beginning.

After stellate ganglion block in congestive glaucoma the intra-ocular capillaries dilate in the same way as in simple glaucoma. There is a similar increase in the volume of the intra-ocular capillary bed which is compensated at once in the presence of a structurally open angle by a corresponding volumetric displacement of aqueous through the drainage channels, particularly the canal of Schlemm, this outflow being facilitated by a constriction of the pupil and by the lowered venous pressure in the exit veins.

In congestive glaucoma associated with an impediment to drainage, the effect on the intra-ocular pressure following sympathetic block depends upon the degree of obstruction. If the latter is incomplete, there is a preliminary rise (as in simple glaucoma) followed by a fall; but, where the obstruction is such that the fall in venous pressure is no longer effective in facilitating a rapid outflow of aqueous, the added capillary dilatation induces a rise of intra-ocular pressure which cannot be compensated.

It is to be borne in mind that the effect of blockage of the sympathetic

supply is only temporary since the circulation rapidly accommodates itself; procaine block of the stellate ganglion is therefore useless as a therapeutic measure even when the angle of the anterior chamber is open, and, as has been shown, when the angle is closed in congestive glaucoma it may be dangerous.

Summary

(1) The responses of the intra-ocular pressure in glaucomatous eyes to local procaine block of the stellate ganglion are recorded.

(2) In simple glaucoma there is at first a rise followed by a fall in intra-ocular pressure.

(3) In congestive glaucoma there is an immediate fall of intra-ocular pressure unless there is an organic obstruction to the outflow of aqueous. If the obstruction is partial, there is a preliminary and temporary rise followed by a fall; if it is complete there is a sustained rise of intra-ocular pressure.

(4) The findings are discussed and an attempt is made to account for them.

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