Observations

ON

INJURIES OF THE OPTIC NERVE.*

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As a cause of blindness, optic atrophy ranks second to ophthalmia neonatorum. In the reports of the Birmingham Institute for the Blind, optic atrophy is given as the cause of blindness in 14 per cent. of the cases, and in over a fourth of this number there was a history of traumatism. During the last year 42 cases of primary optic atrophy were treated at the Birmingham Eye Hospital, and of these 10 were ascribed to injury; 25 per cent. seems, therefore, to represent the average percentage of traumatic cases, but, owing to the accelerated methods of locomotion, this percentage is likely to be increased in the future.

For the purposes of this paper it will be convenient to discuss injuries of the optic nerve under the headings "Direct" and "Indirect."

I. DIRECT INJURIES OF THE OPTIC NERVE.

In civil practice these injuries are comparatively rare, but in military practice they are more common. During the Boer war several cases of bullet wounds of the optic nerve were recorded, but it is more than likely that most of the cases of bilateral blindness ascribed to bullet wounds of the optic nerve were due to indirect rather than direct injury of the nerve. Apart from immediate and permanent loss of vision, wounds or rupture of the optic nerve are generally associated with haemorrhage into the orbit, ptosis and impairment of ocular movements either from injury to the oculo-motor nerves or from the mechanical interference of the effused blood. In many instances there is impairment of the sense of smell from injury to the olfactory nerves. It is possible, however, for these associated symptoms to be absent almost entirely. I remember a butcher who came to the Eye Hospital some years ago complaining of having suddenly lost the sight of one eye as the result of his knife having accidentally penetrated into the inner angle of the orbit. Beyond some haemorrhage into the conjunctiva in that region there was little to note, and though the fundus looked normal at the time, he was absolutely blind in that eye, and he developed signs of atrophy of the optic disc in the course of a few weeks. We therefore concluded that the nerve had been divided by the knife.

As a contrast to this is the case of a boy, once shown before this society, who fell on an open pocket knife, which penetrated the lower lid and entered the orbit, and apparently seriously damaged every nerve in the orbit, producing complete ophthalmoplegia and loss of vision, followed by enophthalmos, permanent minus tension and keratitis neuroparalytica. In this case there was an extensive haemorrhage into the orbit, and some in the eye itself, at the time of the accident.

In most cases the injured part of the nerve lies behind the point of entry of the central retinal vessels, and consequently there is no disturbance of the intraocular circulation. If the nerve has been divided in front of the point of entrance of the central retinal vessels, the ophthalmoscopic picture will be like that of embolism of the central artery—namely, marked retinal oedema at the posterior pole, without, however, any very definite cherry-red spot at the macula. The retina to a great extent regains its vascularity by degrees, but, of course, this is not accompanied by restoration of retinal function.

In obstetric practice the eye has, in rare instances, been scooped out by the blade of the forceps getting between the eye and the roof of the orbit, the optic nerve being torn in its orbital course or at the optic foramen. The most remarkable obstetric accident recorded is that in which the obstetrician mistook an orbit in a face presentation for the anus in a breech presentation, and gouged out the eyeball with his finger! It is interesting to note and important to remember that, short of avulsion, the eye may be extruded between the lids, during labour, without doing any serious harm to the optic nerve. Cases of this

kind, in which the eye has been replaced and the sight retained, have been recorded by Beaumont, Baldwin, and others. It is, therefore, absolutely unjustifiable to excise an extruded eye without making an attempt to reduce it. The optic nerve may be directly injured during operations on the orbital contents or on the nose. In optico-ciliary neurectomy a piece of the optic nerve is excised. It appears that simple section of the optic nerve and central vessels does not cause retinal oedema, but this latter effect follows section of the ciliary arteries only.

Formerly the optic nerve sheath used to be tapped in cases of optic neuritis. I have no experience of the operation, but though it apparently did not arrest the progress of the neuritis, it presumably did not aggravate the disease. I have, however, seen a cyst of the optic nerve sheath removed after resection of the orbital wall by Krönlein's method, and the patient has retained practically full vision and field.

Intranasal operations on the ethmoidal and sphenoidal sinuses must be apt to cause injury to the optic nerve, either by direct action of the instruments or by splintering of the thin bony partitions which bound the optic foramen and sulcus. Whether such operative interference is often followed by interference with visual function I do not know; but were this at all common I think we should become aware of it, as in Birmingham, at any rate, ophthalmologists and rhinologists are often associated in the treatment of diseases of the accessory sinuses.

II. INDIRECT INJURIES OF THE OPTIC NERVE.

Indirect are, in my experience, much more common than direct injuries.

The injury may result from the application of force to the eye itself, from blows on the orbital margins, from damage to the orbital contents by projectiles, or they may result from falls or blows on the head, compression of the skull, or falls on the lower end of the spinal column.

(a) Blows on the Eye.

Blows by blunt instruments—that is, by the point of an umbrella, garden stake, stone, etc.—are sometimes followed by atrophy of the optic nerve owing to partial or complete rupture of the nerve at the scleral foramen. In these cases it is usual to find haemorrhage in Cloquet's canal and in the retina and choroid. Cases of this kind have been recorded by Lang, Caspar, and Aschmann. The last-named was able to verify the diagnosis, histologically. Lang's case retained vision of $\frac{3}{10}$ and the greater part of the lower half of the visual field.

I saw a case of this kind with Dr. Rowlands, of Bromsgrove, some three years ago. A boy aged 9 years had been struck by a stone which had bruised the left eyebrow at the junction of outer and middle third, and there was an abrasion of the cornea and sclerotic in the upper and outer segment of the globe. The anterior chamber was full of blood. When the latter became absorbed it was found that there was still haemorrhage in the vitreous, and that the iris was ruptured and the lens dislocated. The optic papilla was hazy and surrounded by a halo of retinal infiltration. The field was defective, chiefly in the upper and inner quadrants. Vision was reduced to $\frac{3}{10}$. When I examined him again, three years later, I found the disc was horizontally oval, with a crescentic atrophic area, having a collection of pigment at one horn, below and out. The vision was $\frac{3}{10}$ with correction, but the field had contracted considerably.

(b) Blows on the Orbital Margins.

Blows on the orbital margin are a prolific source of indirect injuries of the optic nerve. Cyclists are particularly liable to such injuries. A cyclist when thrown from his machine, through skidding or otherwise, is very liable to strike some part of the orbital margins. If he falls over the handlebars the part injured will probably be the superior border, but if he falls laterally he generally strikes the external angular process against the kerbstone or some such object. According to the pace of the rider and the force of the fall, this may or may not be followed by loss of consciousness and other signs of concussion of the brain, and it may or may not be associated with haemorrhage from the nostril or nostrils, sickness, and vomiting. In many cases momentary dizziness and a black eye are the only symptoms beyond an immediate failure of sight on the injured side. This failure of vision may amount to complete blindness in the affected eye, but in many cases it is a partial though permanent blindness—that is, loss of part of the field of vision, with reduction of

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central vision. The part of the visual field lost seems to me to bear a relation to the direction of the force applied to the orbital margins. In the case of a fall on the external angular process the force is applied laterally to the lateral half of the field, and almost always the temporal half becomes lost. When the force is applied vertically, the vertical half of the field is lost—the upper half when force is applied from above downwards, and the lower half when the force is applied from below upwards—though this is not so constant as the loss of the temporal field in falls on the external angular process.

Whether vision be partially or completely lost in these cases, ophthalmoscopic changes are conspicuous by their absence at the time of the injury. In the course of three or four weeks, however, atrophic changes become visible in the nerve head, and after some considerable time a slight, though appreciable, diminution in the size of the retinal vessels becomes apparent.

Central vision often improves considerably during the first few months after the accident, but the restriction of the visual field undergoes no appreciable change. Colour vision is often somewhat impaired, and central scotoma for colours has been noted.

As to the pathogenesis of this form of nerve injury, a good deal has been written. I am, however, inclined to doubt Oettingen's statement that "there are few cases in which permanent blindness should, with our present knowledge, be attributed to concussion of the retina or the optic nerve." Various authorities have ascribed the injury of the nerve in these cases to:

1. Fracture of the skull extending through the optic foramen.
2. Laceration of the nerve by a detached and displaced anterior clinoid process or other spicule of bone.
3. Haemorrhage into the sheath or substance of the optic nerve.

It is hardly conceivable that anything more than a fissure fracture of the orbital roof can occur in the less severe cycling accidents, and fracture without considerable displacement is not likely to produce immediate, complete, or partial destruction of the optic nerve.

Laceration by detached bone would appear equally unlikely to give rise to such definite results as follow falls on the orbital margins. Haemorrhage into the sheath or nerve substance would probably involve the whole nerve, or, at any rate, would not be at all likely to be confined in its effects to one-half of the nerve, as it would have to be to produce hemianopia. One is therefore forced to regard the lesion as one of contusion of the optic nerve, at the foramen, by *contrecoup*—that is, the nerve is damaged by being driven against the inner boundary of the foramen in falls on the external angular process and against the lower and upper boundaries in blows or falls from above downwards and from below upwards respectively. In the case of falls on the external angular process, the external part of the nerve is also largely protected from the severity of the force by the ophthalmic artery, which lies on its outer side.

(c) *Gunshot Wounds of the Orbit and Indirect Injuries of the Optic Nerve.*

In civil practice one's experience of these cases is confined to a few accidental and suicidal injuries. Cohn's studies of such injuries in the Franco-German war, and Nettleship's paper on blindness from gunshot injuries—chiefly in the last Boer war—have thrown a good deal of light on the subject. In the case of blindness caused by projectiles of high velocity it is usual to find that there is free bleeding into the vitreous, with choroido-retinal inflammatory exudation, without, however, any softening or shrinking of the globe, or any sign of rupture of the sclerotic.

In cases due to projectiles of lower velocity—for example, revolver and air-gun projectiles—these intra-ocular changes are either absent altogether or are present to a limited extent only when the projectile has passed rather close to the globe.

In cases of injuries from rifle bullets and shells the blindness and intra-ocular lesions occur without the projectile having touched the eye or optic nerve, and even without its traversing the orbit.

In these cases Nettleship remarks:

The almost total blindness is not explained by the choroido-retinal changes, and we must assume that the optic nerve is

destroyed either by immediate haemorrhage into its substance, by vibration injury, or by subsequent inflammation, extending from the damaged region of the choroid. As no examination of sight was made until several weeks after the injury, the point cannot be decided.

I think, however, that we are justified in ascribing the nerve and intra-ocular lesions to vibration effects, which Nettleship describes as follows:

The indirect lesions are, it seems, to be explained by assuming that—at any rate, in the case of soft tissues, which during life are almost fluid—the force of the projectile is partly changed into vibrations of the tissue particles, which vibrations radiate in lines from the long axis of the bullet track so forcibly that they act as secondary missiles.

These vibrations may pass harmlessly through a somewhat dense and resisting tissue, such as the sclerotic, and even through bone, and yet cause destructive changes in the soft, delicate structures of the retina, optic nerve, and choroid.

(d) *Falls or Blows on the Head.*

Optic atrophy may follow compression of the skull and distortion of the orbit of a child by the forceps in instrumental delivery. In these cases the nerve becomes compressed by displaced bone, or the atrophy follows upon haemorrhage into the optic nerve sheath or substance. Possibly a similar result may follow pressure of the head against the sacral promontory during natural but prolonged and difficult labour. Falls on the head (vertex) may be followed by atrophy of the optic nerve for the same reasons that were put forward to explain optic atrophy following blows on the orbital margins. It is evident that it is not essential to assume a fracture of the optic foramen or foramina in these cases, though such is more likely than in cases of blows on the orbital margins. It should be noted, too, that most extensive fractures of the skull and facial bones may occur without affecting the optic nerves and eyes in the least degree.

Antero-posterior blows, falls, or compression of the skull may likewise be followed by atrophy of the optic nerve. In many cases of skull injuries the atrophy is post-neuritic, and in some cases we find a persistent optic neuritis, or at any rate an apparent optic neuritis, which does not progress to atrophy.

It is evident that we have much to learn with regard to these injuries of the optic nerve, and our knowledge can only be advanced by co-operation between general and ophthalmic surgeons and more careful and frequent *post-mortem* examinations of skull injuries. By these means and careful clinical observations, we may hope some day to establish a theory adequate to explain the varied and somewhat contradictory conditions frequently observed.

ON THE VALUE OF SURFACE SIGNS IN THE DIAGNOSIS OF DEEP-SEATED DISEASE.

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EXAMINATION of several typical cases of gastric ulcer elicited the well-recognized tenderness over the epigastrium. Various methods were used, such as pressure, pinching the skin, etc., but the most satisfactory results were obtained by gently drawing a pencil over the area examined, when a definite localized hyperaesthetic spot was found without unduly exciting the patients; when hyperaesthesia is found on the abdomen, a spot also exists over the spinal column in the region of the dorsal branch of the cutaneous nerve affected (Sahli). All the cases examined exhibited the abdominal tenderness, and the more recent ones were confirmed by the dorsal reaction.

Similar observations were made in young men of the gastro-neurasthenic type, and, while tapping and pinching would at times elicit a response, gentle stroking of the epigastrium, controlled by stroking the spine, never gave evidence of hyperalgesia. During these observations a young man about 24 years of age presented himself for treatment with dyspeptic symptoms. He had had many gastric sedatives without relief, but his gastric symptoms were relieved by bromides, in spite of the irritating effect of the salt on the gastric mucosa.

The two following cases suggest this sign to be of value in the diagnosis of duodenal ulcers. A typical case of