CONCUSSION CATARACT: ITS MEDICO-LEGAL ASPECT; WITH NOTES OF AN UNUSUAL CASE.

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CONCUSSION of the eyeball as a cause of cataract is well recognised. Hence "concussion" cataract is a term applied to opacity of the lens which has followed contusion of the eyeball in which no penetration of the contusing body or rupture of the ocular coats has occurred. The contusion may be caused either directly or indirectly. Directly, when the eyeball has been suddenly compressed anteriorly by some force by which an increase in its transverse diameter has followed. Indirectly, when the body generally has been subjected to a sudden jar, in the effects of which the eyeball partakes. Nearly 50 years ago—in 1866—Dyer pointed out that cataract ensued as the result of judicial hanging. Similarly blows upon the head, jumping or falling from a height and alighting upon the feet have also been cited as among the causes of concussion cataract. Whatever may be the nature of the contusion to which the eye is subjected, the resulting opacity of the lens is due to a rupture of the capsule. Most commonly this takes place equatorially, but both anteriorly and posteriorly the same may occur. It may be stated that some hold to the opinion that a rupture of the capsule is not necessary to the development of cataract in these cases—that a cataract can, and at times does, follow concussion of the eyeball without any lesion of the capsule. The evidence, however, in support of this view is not satisfactory or conclusive. It depends mostly upon personal impressions. No post-mortem opportunities have ever arisen to determine the point. Cases which have been quoted in proof of the non-rupture capsular theory have been those in which the lental changes have been delayed for some time after the eye has been injured. But reasonably enough it may be assumed that in these cases an incomplete rupture was present at first which afterwards became complete. Moreover, to determine an equatorial rupture by examination is not possible. Norris sums up the matter by saying: "Quite a large number of cases of cataract are on record where, after blows on the eye or in its vicinity, the lens becomes opaque without any visible rupture of the capsule, but so long as no such case has come to autopsy, and we are familiar with ruptures of the posterior capsule, they are always open to the suspicion that there has been a rupture at some point not accessible to examination."

A fact which seems to bear upon the incidence of these cases of concussion cataract is the inconsistency in the nature of the force causing the lesion. A severe blow upon the eye may be followed by rupture of the choroid without the lens or its capsule being injured. A blow may even cause rupture of the eyeball, but again the lens may escape injury. And yet, as will be gathered from the notes recorded below, a most trivial injury to the eye was followed by cataract, to which the term "concussion" was applicable. The explanation of this inconsistency and of its effects, so far as the lens is concerned, may lie in the hypothesis that the lens capsule is not structurally perfect: that rupture of the capsule ensues as the result of concussion because of this structural defect. It is

certain that concussion cataract would be of very frequent occurrence in ophthalmic surgery were the capsule to rupture upon all occasions upon which the eye was subjected, directly or indirectly, to contusion. Fortunately, however, it is only rarely that such an untoward result occurs.

Subjoined are the notes of a case which has recently been under my care.

A man came to the West London Hospital on Nov. 18th, 1912. He gave the history of an accident to his right eye, which occurred on August 24th previously. While engaged in his occupation—that of working a milling machine—a chip of steel, described as of about the size of 1/16th of an inch, suddenly became detached and struck his right eye. The foreman of the shop having examined the eye, stated that there was no trace of the piece of metal, but only an abrasion of the cornea. The pain having subsided, the man was able to resume his work after an interval of half an hour. On the following day, owing to discomfort in the eye, he attended the Royal Free Hospital. He was told by the house surgeon that two small foreign bodies were present on the cornea. These were removed, and he was informed that the eye would be well again in a few days. The sight was then quite unaffected. About seven days later he first noticed slight blurring of the vision in the right eye. This blurring continued and increased, and it was on account of this that he sought advice.

On examination the right eye was quiet; there was a small, superficial, irregularly shaped opacity upon the inner quadrant of the cornea, below the pupillary area. The iris was intact and its movements free and natural. The lens was cataractous. Projection good; fingers at 4 inches. Tension normal. There was no evidence of penetration by a foreign body; nevertheless, a skiagram was taken, which proved negative. The man continued his occupation until the end of January of the present year, the condition of the injured eye not causing him any inconvenience. About this time proceedings were begun for the recovery of compensation, and on legal advice, in consequence, he ceased his occupation. On August 28th I extracted the lens; subsequently with + 2 cyl. axis 85° N.E. $\bar{c}$ + 10 sph. the vision was 6/6 and with + 2 cyl. axis 85° N.E. + 14 sph. J. 1 at 7 inches.

On Nov. 10th, after several postponements, the case was heard in the High Court before Mr. Justice Channell, and after two days' trial with a special jury the plaintiff was awarded £273 and costs. The machine which had been provided him to work with was proved to have been defective, hence the cataract was held to have been caused through the culpable negligence of his employers. In giving evidence, it was essential to point out that although the plaintiff had recovered the vision in the injured eye, binocular vision had been abolished and that the sight so regained would only be of limited use as long as the other eye remained sound. Presumably in awarding the damages the jury were influenced more by the fact that the injury had necessitated an operation than by the result of the latter.

One or two further points remain for comment. The accident which occurred is one of the commonest in ophthalmic surgery. Workmen in metal employment are exposed to it almost daily, so much so that fragments of metal impacted upon the surface of the cornea are often removed by a particular workman, by whom has been acquired in the shop some skill in doing so, with the aid usually of the dirty blade of a pocket knife. In other cases the injured workman places himself before a

powerful magnet when this is available. And yet in the above case, despite the trivial degree of concussion which a fragment of steel, stated to be only 1/16th of an inch in size, could have caused, a traumatic cataract followed. The damages awarded seem to be rather excessive; the amount almost equals that which insurance companies offer for permanent and total loss of vision in an eye. Stress also was laid by the plaintiff's counsel, as well as by the judge in his summing up, upon the fact that the medical evidence was unchallenged. But the solicitors for the defendants, after hearing from me in regard to the case before the trial, were satisfied that further medical evidence was unnecessary.

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THE RELATION OF THE THYROID TO ANTITOXIN.

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In a preliminary paper¹ thyroid hyperplasia was described as occurring in many diseases, and it was shown, among other conditions, that it was produced by the action of diphtheria toxin in horses and guinea-pigs. It was suggested that the hyperplasia was associated with increased secretion which could be traced into the blood, for it was found in four estimations that diphtheria antitoxin contained more iodine than normal serum, and that when fed to a normal rabbit it caused death in a manner similar to thyroid feeding, while it had no such effect on a thyroidectomised rabbit. Normal horse serum produced no ill-effect when fed to a rabbit. The thyroids from four horses were found to be in a condition of hyperplasia following repeated injections of diphtheria toxin, the extent of the hyperplasia being in inverse proportion to the antitoxic value of the serum. It was suggested that thyroid hyperplasia with the increased secretion in the blood was associated with the formation of antitoxin, and that the thyroid had an antitoxic function. This appeared to be borne out by experiments on guinea-pigs, as 10 out of 13 pairs survived longer if thyroid feeding was combined with the administration of diphtheria toxin, and 4 out of 5 survived when given the serum of a thyroid-fed rabbit with the toxin. I have continued to work on this subject, and while I am able to confirm my results in many points, some of the deductions require modification.

The production of thyroid hyperplasia in disease will be more fully described in my next paper; it was found to occur in a number of diseases (toxæmias) in man, and was produced in some 50 guinea-pigs by the injection of diphtheria toxin, and was also obtained by the injection of abrin and ricin. So it can definitely be said that thyroid hyperplasia is caused by some toxæmias.

The Detection of Thyroid Secretion in the Blood.

1. The estimation of iodine.—It was thought that the production of thyroid hyperplasia would lead to the presence of an increased secretion in the blood, and that this would be detected by an estimation of the iodine contained in the serum. Any increase in the amount of iodine in an antitoxic serum would suggest that the toxin used for its preparation had produced a thyroid hyperplasia. The different brands of the various sera were obtained, and the iodine estimated with the following results:—

Normal horse serum.—Contained faint traces.

Dysentery (two brands).—(1) Contained 1·83 parts of iodine per 1,000,000 of serum; (2) contained 2·04 parts.

Antimeningococcic serum (4 brands).—(1) Nil; (2) Nil; (3) contained 1·41 parts of iodine per 1,000,000 of serum; (4) contained 1·66 parts.

Antiplague serum (4 brands).—(1) Nil; (2) 1·82 parts of iodine per 1,000,000 of serum; (3) 1·98 parts; (4) 2·04 parts.

Antiscorpion serum (1 brand).—Contained Nil.

Antitetanic serum (4 brands).—All four contained Nil.

These estimations were made before it was realised that the horses had been rendered immune to more than one toxin. The third and fourth samples of antimeningococcic serum were obtained from horses that had previously been used for the preparation of diphtheria antitoxin, so the amount of iodine in the serum cannot be ascribed to the sole action of meningococcic toxin on the thyroid, especially as practically no thyroid change is found in meningococcic meningitis in man. The estimation of the iodine is open to another fallacy—the apparatus used for drawing off the horse's blood may perhaps have been contaminated with iodine from the use of potassium mercuric iodide as an antiseptic; this applies equally to the normal horse serum. These fallacies are sufficient to render the estimations valueless.

2. The effect of feeding rabbits on commercial diphtheria antitoxin.—Three rabbits were fed on commercial diphtheria antitoxin (see table); they were given 2000 units a day mixed with their food. The serum was obtained from several different horses, which precluded the estimation of the total amount of iodine given to any one rabbit. Three samples contained 2·25, 2·3, and 3·1 parts of iodine per 1,000,000 of serum. The rabbits developed the same symptoms as those produced by thyroid feeding—loss of weight, tachycardia, and fur changes; and the post-mortem changes were similar to those found in rabbits dead from thyroid feeding—i.e., absence of fat, muscular wasting &c.

Amount of antitoxin.	Feeding days.	Original weight.	Final.	Per cent. lost.
(a) 46,000 units	23	840 g.	535	40·0
(b) 63,000 „	33	1,880 g.	1,260	33·0
(c) 66,000 „	34	1,510 g.	1,120	25·8

These experiments agree with those of the original paper, and the conclusion drawn is that diphtheria antitoxin (commercial) contains an iodine-containing substance with a similar action to thyroid secretion.

The Estimation of Iodine in Diphtheria Antitoxin.

A series of iodine estimations were made on samples of diphtheria antitoxin which had been collected free from any possible source of extraneous iodine.

Horse.	Antitoxic value.	Iodine content.
Baby	2 units	Nil.
Sarah	200 „	Very faint traces.
Lincoln	300 „	2·7 parts per 1,000,000.
Fleck	300 „	Nil.
Liverpool	500 „	Faint traces.
Durham	500 „	Very faint traces.
Matilda	600 „	Faint traces.
Alfred	600 „	„
—	700 „	Very faint traces.
Three others contained ntl.		

Further estimations were made on unlabelled duplicated samples to determine the value of the faint traces with the following results:—

Normal serum.—(1) Nil; (2) faint traces.

70 units.—(1) Nil; (2) faint traces.

300 units.—Nil.

350 units.—Nil.

400 units.—1·81 parts per 1,000,000 of serum.

These estimations were made by Oswald's modification of Baumann's method; the smallest amount

¹ Transactions of the Royal Society of Medicine, November, 1912.