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ELECTRICAL CATARACT*

Notes on a Case and a Review of the Literature

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Case Report

ON August 18, 1941, H. Ch., a man, aged 51 years, had an accident at an electric power station when he came into contact with live apparatus. He was wearing metal rimmed glasses and earpieces. Second and third degree burns were present around the orbits, along the temples and the bridge of the nose. Other burns of second degree were present on the shoulder, neck and face. There were also third degree burns over the right shoulder, over the thyroid cartilage and the left hand. A discharge at 11,000 volts passed by sparking contact with the rim of the spectacles. He was admitted to St. Leonard's Hospital, and was discharged after 26 days.

Visual symptoms developed six months after the accident, when sight began to deteriorate. He sought advice at the Central London Ophthalmic Hospital on July 16, 1943, nearly two years after the accident.

On examination.—R.V. 6/18 c. +1.25 D.sph.=6/12; L.V. 6/18 c. +1.0 D.sph. +0.5 D.cyl. 110°=6/12 c. readers J.4. Right and

From the Central London Ophthalmic Hospital.

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left cornea, iris and pupil: no pathological changes present. Both lenses show changes as seen in the colour plate. The opacities are mostly vacuoles in the anterior capsule, and sub-capsular greyish dots, in some places confluent. On the left anterior capsule there was a scale-like grey opacity. Vitreous and fundi were normal.

General examination.—Mild hyperpiesia (B.P. 180/100). Electrocardiographic examination showed no evidence that the electric shock had affected his heart (Dr. Jenner Hoskin).

The patient was kept under observation at the C.L.O.H. for 16 months during which time the eye condition remained stationary.

Review

The occurrence of cataract due to electric shock is well established.

(a) *Morphology.*—A survey of reports of 50 cases of electrical cataract reveals that in the majority of cases the first changes are on the anterior capsule and in the anterior cortex, generally in the nature of punctate opacities with vacuoles in the anterior capsule. In a few cases the lens opacities were predominantly in the posterior cortex (Djacos, Licskó, Koeppe), and on the posterior capsule (Djacos), or at the equator (Desbrière and Bargy).

(b) *Histology.*—The only available report is that of Komoto (1910). He found that the capsule showed patches where there was no, or only faint, staining of the cell nuclei. Small vacuoles were present in the cortex, some of them empty, others filled with a pale eosin staining mass. The lens nucleus was normal.

(c) *Development of the cataract.*—In a number of cases the lens changes were observed within a few days after the accident (Godtfredsen, 1942, Becker, 1920), in others a delayed onset was reported (Holloway, 1930, Davies, 1916). It must, however, be pointed out that only exceptionally was the eye examined by an ophthalmologist immediately or soon after the accident (Ellett, 1906, Horton, 1926, Godtfredsen, 1942).

The lens changes may be unilateral or bilateral, they may be stationary, and in such cases vision may be much better than one would expect judging by the lens changes. Sometimes the apparently stationary lens changes may become progressive some months, or even as long as three years, after the accident (Le Roux, 1909, Holloway, 1930). In other cases the cataract became complete in a few weeks. In rare instances the lens opacities which were present after the accident have disappeared completely (Godtfredsen, 1942).

(d) *Prognosis and complications.*—The prognosis of the operation is complicated by the fact that electric shock may cause choroiditis or cyclitis, and changes of the fundus and optic nerve (Spir, 1922). A relatively rare observation is the dislocation of the lens after the accident (Freysz, 1909, case No. 1).

Hamblin

Experimental.—Early experiments were performed by discharge of static electricity and in this way the cataract due to lightning was imitated (Hess). In these experiments there was inevitably a flash which introduced the complicating elements of heat and ultra-violet light. Later it was shown that cataract can be produced by alternating as well as by direct current—and without a flash. (Hess and Kiribuchi, 1900; Comberg, 1936).

The lens changes may appear within a few hours after the experiment. In many experiments the electrical discharges were followed by violent reaction of the iris and ciliary body, and Hess suggested that the cataract was due to changes in the capsule epithelium, and also to changes in the ciliary body.

An experiment was reported by Comberg (1936), where the electrodes were placed respectively at the centre of the cornea and at the back of the rabbit's eye, thus ensuring that the flow of the current was mainly through the lens, and that only a fraction of the current was flowing through the iris and ciliary body. According to Comberg's calculations the current density of the discharge through the lens was three times that of the discharge through the iris, and eight times that through the ciliary body, whereas with the older experiments the current density in all these tissues was the same. In spite of these precautions, however, there was a fibrinous exudate in the anterior chamber in 67 per cent. of the experiments. Lens opacities developed in 15 out of 16 experiments without any noticeable difference between eyes with severe uveitis and those in which the irritation was slight. Observation for 12 months has shown that in seven cases the lens opacities were progressive, in six they were stationary, and in two the opacities disappeared.

Experiments with isolated lenses by Kuwabara (1909), and on isolated eyes by Bellows and Chinn (1941), have shown that electric shocks produce injury to the lens which can be demonstrated by measuring the loss of protein when immersed in saline solution (Kuwabara) and by the decrease of swelling when placed in distilled water (Bellows and Chinn).

Histology of experimental electrical cataracts.—Large areas of degeneration of the anterior capsule and at the equator were seen followed later by degenerative changes of the lens fibres, especially near the capsule. Regenerative changes were also observed (Hess, 1888; Hess and Kiribuchi, 1900).

Significance of electrical cataract as an industrial accident.—The number of publications of electrical cataract shows a steady increase which reflects the more widespread use of electricity in industry. The significance of electrical cataract as an industrial accident is best viewed in relation to other industrial eye injuries, and in relation to the total number of electrical accidents of all kinds.

1. The number of reported electrical accidents :—*

1934	1935	1936	1937	1938	1939	1940	1941	1942
81	87	112	106	127	120	150	170	181

shows a steady increase in the eight years between 1934-42.

2. The following figures taken from the Quarterly Returns of the Registrar General, Scotland, are in line with the increase in the number of deaths due to electric shock (lightning excepted) :—

1934	1935	1936	1937	1938	1939	1940	1941	1942
5	8	10	9	8	15	15	14	17

3. The number of industrial accidents in relation to electrical accidents :—†

Year	Total of all accidents in factories (fatal and non-fatal)	Number of eye injuries other than F.B.	Total of electrical accidents	Number of eye injuries due to electr.
1938	180,000	3,751	560 (30 fatal)	Data not available
1942	315,000	6,501	1,042 (51 fatal)	

These figures reveal that electrical accidents in relation to the number of other industrial accidents are not frequent, and that eye injuries due to electricity are not common.

It should, however, be emphasized that though relatively rare, in every case of electrical accident the patient should be examined by an eye specialist, and kept under observation for at least one year after the accident, as electrical cataracts are of delayed onset and are usually compensation cases.

Discussion

Electrical cataract has puzzled ophthalmologists for the past 60 years. This problem, however, is extremely complicated because

* Electrical Accidents and Their Causes, 1938, London, His Majesty's Stationery Office.

† Annual Report of the Chief Inspector of Factories for the Year 1942, London, His Majesty's Stationery Office.

the only information available regarding the damage to tissues caused by electricity is that it is a specific damage to the cells, which cannot be explained by the heat, or by the chemical changes due to the passage of the current, alone. Another difficulty is that the problem of cataract formation is not yet solved, although researches during the past decades have yielded much valuable material.

Experiments carried out in such circumstances could not be expected to solve the principal problem, nevertheless they gave valuable results in showing that electric shock can produce cataract. But the process by which electrical cataract is produced is not clear. As regards the lens fibres there is experimental evidence of damage caused by the current. As regards the capsule Bellows and Chinn found that its permeability for ascorbic acid and for glutathione is not different from that of the controls. This, however, does not exclude the possibility that the capsule is damaged. Jellinek thinks that the changes of the tissues after an electric shock are comparable to changes in the pattern of metallic particles in an electromagnetic field.

There are certain points of interest. The pressure in the reported cases varied from 200 to over 40,000 volts. The points of contact shown by the location of burns was in most cases near the eye, usually on the head or neck, and the eye nearer to the contact point generally shows the more marked changes. A case was reported by Koeppé (1921), where only the contralateral eye developed electrical cataract after electrical shock and the eye nearer the burn remained healthy. In one case cataract developed where head and neck burns were absent, and the points of contact were at the two hands (Gabrielides, 1935).

The duration of contact, the dryness or moisture of the skin, and the path taken by the current possibly have an influence on the development and type of the cataract.

In almost every case reviewed, severe burns were present arising from an electrical discharge to the body by sparking. The clinical material shows a certain similarity to that group of experiments in which the electrical shock was accompanied by a flash. Exceptionally, however, cases are reported where cataract developed from flash only (Freysz, 1909, Case No. 2 and 3, Hackel, 1932) and the patient did not feel an electric shock. In these cases the cataract is strictly speaking not electrical in origin, but as an industrial accident it comes under this heading.

In the case described in this paper there was sparking flash, and the passage of electricity through the body.*

* As a practical suggestion it is advisable that persons employed in electric power stations should not wear spectacle rims containing metal (A. H. Levy).

Summary

A case of electrical cataract is described.

A review of the literature shows that the number of electrical cataract cases has increased recently, and this corresponds to the increase in the number of electrical accidents of all kinds.

In electrical cataracts the onset of the patient's symptom is usually delayed, and only a few cases have been thoroughly investigated immediately after the accident. The burns of the face and other parts of the body are usually so severe that a thorough eye examination is very difficult; the patients are usually admitted to general wards in a severe condition, and only after general recovery is attention directed to the eyes.

The evidence hitherto collected is not sufficient to enable us to state the cause of electrical cataract or the process by which it develops. Much useful information could be obtained if all cases of electrical accidents were examined immediately or as soon as practicable after the shock, possibly with a slit-lamp, and were kept under observation for about a year.

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THE EFFECT OF ASCORBIC ACID ON THE OCCURRENCE OF HYPHAEMA AFTER CATARACT EXTRACTION*

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CONTROVERSY over the causes and possible prevention of post-operative hyphaema after cataract extraction has continued from 1867 (the publication of the first series of 100 extractions performed by Von Graefe's method) until the present day. In 1942, de Voe, in a very complete clinical and experimental paper on the question, gave, as his list of possible causes to be investigated, the age of the patient, the season of the operation, the social status of the patient, the blood pressure, the presence of diabetes or syphilis, the intra-ocular pressure, the type of operation performed, including use or otherwise of sutures and of iridectomy, the skill of the surgeon, the use of retro-ocular injection, post-operative trauma, plasma vitamin C level, capillary fragility and prothrombin level of the blood. In a study of 453 cases of operation for cataract he found that variations in these factors were not related to the incidence of post-operative haemorrhage which throughout the series occurred in approximately 20 per cent. of the cases.

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