Bilateral electric cataracts: Clinicopathologic report

Hassan Hashemi, MD, Mahmood Jabbarvand, MD, Mehrdad Mohammadpour, MD

We report a case with bilateral intumescent electric cataracts, outcomes of cataract surgery with a new technique, and a histopathologic study of the anterior capsule followed by a review of the literature on electric cataracts. The patient had bilateral cataract extraction and posterior chamber intraocular lens implantation, achieving a visual acuity of 20/20. Hematoxylin and eosin staining of the anterior capsule revealed significant scar tissue formation consisting of fibroblast proliferation and hyaloid production over the basement membrane of the anterior capsule. Electric injuries can cause bilateral intumescent cataracts; the outcomes after cataract surgery are excellent provided the fundus and optic nerve examinations are normal. Scar formation over the anterior capsule may disturb lens nutrition, leading to cataract formation.

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The first description of electric cataract caused by lightning was reported by Saint Yves,[1] and a cataract produced by an artificially generated electrical current was reported by Desbrieres and Bargy.[2] Subsequently, cataract formation after electrical injury has been reported from various parts of the world.[3–26]

During an electric shock, the current flows through the body between 2 contact points. The clinical picture of electrical injury is influenced by numerous factors including voltage, tissue sensitivity, type of current (direct or alternating), length of contact, place and area of contact, and route traveled in the body.[11] We report a rare case of bilateral mature cataracts caused by high-voltage electrocution in a young man who regained normal vision after surgery in both eyes. A histopathologic study of the anterior capsule prepared after a 4-incision capsulorhexis[27] and a review of the literature on the clinical features and pathogenesis of this condition are also presented.

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From the Ophthalmology Department and Eye Research Center, Cornea Consultant, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran.

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Corresponding author: Mehrdad Mohammadpour, MD, Eye Research Center, Farabi Eye Hospital, Medical Sciences–University of Tehran, Tehran, Iran. E-mail: mahammadpour@yahoo.com.

CASE REPORT

A 21-year-old man with a history of electrical shock was referred because of loss of vision. Approximately 3 years earlier, he sustained a shock from a high-voltage (10 000 volts) alternating current power line cable that led to loss of consciousness for approximately half an hour. On presentation, the visual acuity was light perception in both eyes. The slitlamp examination showed white cataracts (Figure 1). There was a large scar on the patieint's scalp (Figure 2) and a scar on the left foot following amputation of 2 toes (Figure 3). In both eyes, the anterior chambers became shallow the day before cataract surgery; however, the intraocular pressure (IOP) was 18 mm Hg.

Because of impending angle-closure glaucoma secondary to intumescent cataracts, simultaneous bilateral cataract extraction (sutureless clear corneal phacoemulsification) and intraocular lens (IOL) implantation under general anesthesia were performed. The procedure was the same in both eyes: Clear corneal incisions were made at 10 o'clock and 2 o'clock. Diluted adrenalin and atropine (1:10 000) were injected into the anterior chamber, but the pupil was sluggish and pupil dilation was no larger than 6.0 mm. The anterior capsule was stained with trypan blue. A 4-incision capsulorhexis as done in pediatric cataract surgery was performed because the anterior capsule was completely fibrosed and thickened. The anterior capsule was stained with trypan blue and the anterior chamber filled with a cohesive ophthalmic viscosurgical device (sodium hualuronate 1% [Healon]). Four arcuate incisions (each 1.0 to 2.0 mm in length) were made in the anterior capsule using a bent 27-gauge needle. The distance between 2 opposite arcuate incisions was the same as the intended capsulorhexis diameter (5.0 mm). The center of each incision was grasped by a capsular forceps and pulled to the center of the capsulorhexis. The flaps were joined by the capsular forceps to form a 5.0 mm continuous curvilinear capsulorhexis. The operating surgical set and gloves were changed before the procedure was performed in the second eye.

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Figure 1. Bilateral intumescent white electrical cataracts.

After phacoemulsification and IOL implantation in the capsular bag, the incision was sealed with stromal hydration. Subconjunctival betamethasone 4 mg and gentamicin 20 mg were injected, and the eye was patched.

In both eyes, on the first postoperative day, the uncorrected visual acuity was 20/30. The cornea was clear, the anterior chamber was deep, and good red reflexes were seen. The retinal examination was unremarkable, and the IOP was 12 mm Hg. The best corrected visual acuity was 20/20 with −0.50 sphere in the right eye and +0.50 −1.00 × 90 in the left eye.

Histopathologic Examination

Hematoxylin and eosin (H&E) staining of the anterior capsules revealed significant scar tissue formation that consisted of fibroblast proliferation and hyaloid production over the basement membrane of the anterior capsule (Figures 4 and 5).

DISCUSSION

The incidence of cataract reported in patients with electrical injuries varies from 0.7% to 8.0%.[3–24] This is probably due to differences in the voltage and duration of action of the current, the distance of the area

Figure 3. Amputation of the toes on the left foot.

Figure 2. Large scar on the the patient's scalp.

of contact from the eye, the extent of the surface contact, and the direction taken by the current in the body. The strength of electrical current causing cataract formation varies from 220[4] to 80 000 volts.[19] For unknown reasons, electroconvulsive therapy does not cause cataract.[20]

The cataract may develop immediately after injury or be delayed a few days; the latency varies from 1 to 18 months,[3] although a latent period of 11 years has also been reported.[8] If the point of contact is on one side and the lens changes are bilateral, the cataract initially forms in the eye on the affected side (closest to the contact point) and later in the contralateral eye.[3] The interval between cataracts occurring in the 2 eyes can vary from 3 weeks to 2 years.[22]

Our patient remembered decreased vision in the left eye and then in the right eye. As the foot injury was on the left side, the lens might have become cataractous immediately after the electrical injury in the left eye (the side of contact), resulting in gross loss of vision that the patient noted after recovering from the electric shock.

In most cases, the current passes through the head in the vicinity of the eye and a contact electrical burn

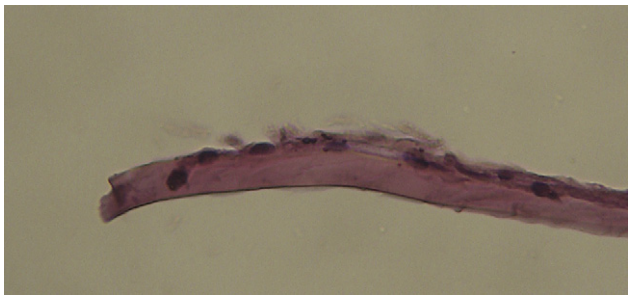

Figure 4. Histologic examination of the normal anterior capsule in the peripheral part of the capsulorhexis (H&E staining).

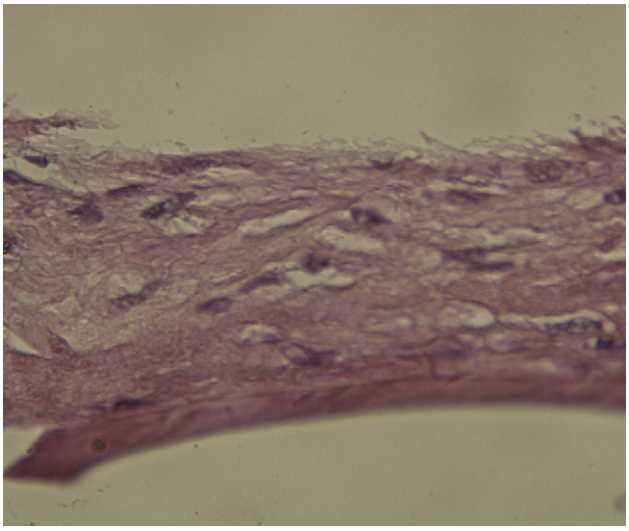

Figure 5. Hemotoxylin and eosin staining of the central part of the anterior capsule shows scar tissue formation consisting of fibroblast proliferation and hyaloid production over the basement membrane of the anterior capsule.

develops.[3] In our case, the current passed through the head and the patient developed electrical burns on his scalp. Such findings have been reported in 2% of cases of burns due to electricity.[12]

The earliest changes seen in the lens after electrical injury are a collection of multiple fine vacuoles beneath the anterior capsule, usually in the midperiphery of the lens, requiring dilation of the pupil for visualization. These collections are always present in the anterior subcapsular area and show no apparent relationship to lens fiber configuration. Over intervals varying from weeks to months, these vacuoles are replaced with flake-like opacities that coalesce and migrate into the line of vision.[9,23] Electrical burn can cause scar formation in the anterior capsule, leading to impairment of lens nutrition and, eventually, cataract formation.

Industrial electrical accidents generally affect the anterior subcapsular cortex, while lightning injuries affect anterior and posterior subcapsular areas.[6] However, Saffle et al.[13] report a 40% incidence of posterior subcapsular cataracts in their review of industrial electrical accidents. Clinically, there is a general tendency toward progression but occasionally the cataract remains stationary for as long as 2 years.[3] In 77%[13] to 82%[9] of cases, the cataract progressed to maturity and surgery was required. In our case, the cataracts in both eyes progressed to maturity 5 months after the electrical injury. Rarely, the cataract may become complicated by secondary glaucoma in the intumescent stage.[24]

The exact pathogenesis of electric cataract is controversial, and several theories have been put forward.[3] Decreased permeability of the lens capsule, a direct coagulative effect on the proteins of the lens cells, powerful contraction of the ciliary muscle causing a concussion type of cataract due to mechanical damage, nutritional disturbance of the lens due to iritis and impaired circulation, or ultraviolet and infrared irradiation could be causative factors in electric cataract. However, the H&E staining of the anterior capsule in our case, which revealed significant scar tissue formation consisting of fibroblast proliferation and hyaloid production over the basement membrane of the anterior capsule, can better explain the pathophysiology of electric cataracts.

A histopathologic study of eyes obtained postmortem shows a decreased corneal endothelial cell population, mild focal atrophy of iris structures, mild lymphocytic infiltration, vitreous liquefaction, and epiretinal membrane formation.[26] We believe that our report is the first histopathologic examination of the anterior capsule after curvilinear capsulorhexis in patients with electric cataracts that provides a better understanding of the pathophysiology of electrical injury in a case with bilateral white intumescent cataracts.

In conclusion, electrical injuries can cause bilateral intumescent cataracts. Outcomes after cataract surgery are excellent if fundus and optic nerve examinations are normal. It seems that the scar formation over the anterior capsule may disturb lens nutrition, leading to cataract formation.

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First author:
Hassan Hashemi, MD

Cornea Consultant, Farabi Eye Hospital, Tehran University Medical Sciences, Tehran, Iran

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