

Case report of unilateral electric cataract with transmission electron microscopy image

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Dear Sir,

We hereby report a case of unilateral electric cataract with transmission electron microscopy (TEM) image. Ocular injuries induced by electricity can occur simultaneously or sequentially with the electric event, and occasionally occur later than the initial event. There are many ocular manifestations, with the most common one being cataract formation [1]. To provide a better understanding of electric cataract, we present this case of unilateral electric cataract with the outcome of TEM examination. To our knowledge, this is the first report about ultrastructural changes after curvilinear capsulorhexis.

An 18-year-old male presented with painless progressive decreased visual acuity in left eye for one year. He sustained an electric shock when accidentally touched a high-voltage electric transmission wire with 10000 V alternating current by left hand two and a half years ago. The patient remained unconscious for 1h after the injury with skin burns in left scalp and left hand. He was admitted to a local hospital for management. There was no sign of visual loss and other eye irritation and no ocular examination was performed then. One year ago, patient noticed decreased visual acuity with a white spot in left pupil area. Patient had no family history or other secondary causes of cataract such as previous ocular trauma, ocular disease or systemic disease.

General physical examination showed obvious scars on left scalp, left hand and left eyelid (Figure 1). The scar on left scalp was clear edge, narrow with alopecia, measuring 5 cm without hair growth. There were two small round scars on the back of left hand (Figure 1C). Ophthalmologic examination revealed best corrected visual acuity (BCVA) of 20/20 in right eye and counting figures at 50 cm in left eye. There

were also 15° exotropia with mild lower-eyelid entropion in left eye. Slit-lamp examination of anterior segment of left eye was unremarkable besides a milky-white cataract with flat, irregular, snowflake-like anterior subcapsular opacities in left lens. Both direct and indirect pupillary light reflexes were normal. The view of left fundus was occluded by cataract. There was no abnormality identified in right eye. Intraocular pressures (IOP) were 18.5 mm Hg in right eye and 19.0 mm Hg in left eye. Ultrasound examination of left eye showed an intact globe with clear vitreous and flat retina.

Based on the history of electric shock with a high voltage wire, skin burns, typical appearance and location of lens opacities and no previous systemic disease or ocular trauma, electric cataract was then diagnosed. Phacoemulsification surgery was performed and a piece of intraocular lens (IOL) was implanted into posterior chamber (+21.5 diopters; Bausch&Lomb Adapt-AO, Rochester, New York, USA). During the surgery, we got a better view of the anterior subcapsular opacities and anterior capsular was collected after continuous curvilinear capsulorhexis. Interestingly, we found that the cataract was loose, agglomerated-milk like, without solid nuclear, which could be removed easily by aspiration.

The BCVA of left eye improved to 20/20 after surgery. Ultrasound biomicroscopy revealed that the IOL was stable and well centered in the bag. The fundus photograph found no abnormality. Optical coherence tomography (OCT) examination revealed a normal retina and macular structure. Anterior lens capsule with attached lens epithelial cells (LECs) were obtained by continuous curvilinear. Tissue was further fixed as described previously [2] and examined under TEM (Model H-7650, Hitachi, Baraki Prefecture, Japan). Ultrastructure of LECs was compared between the electric cataract and an age-related cataract (Figure 2). Both anterior capsule were of normal thickness and homogenous in structure. In age-related cataract, LECs maintain single-layer structure with signs of nuclear condensation, cytoplasmic degeneration and significant intracellular vacuolization (Figure 2B, 2D). In electric cataract, the cell membrane was continuous with extracellular space between cells (Figure 2A). The size of nucleus was similar to age-related cataract but elongated in shape. Cytoplasm of LECs was less and contained mitochondria, rough endoplasmic reticulum and other organelles. Unlike age-related cataract, there were individual cells containing plenty of collagenous fibrils with the presence of lipid particles, lipofusin (Figure 2C).



Figure 1 An 18-year-old male presented with progressive decreased visual acuity A: The left eye shows cataract with subcapsular opacities; B: Left scalp shows clear boundary, narrow scar; C: Left hand with 2 small round scars (white arrow).

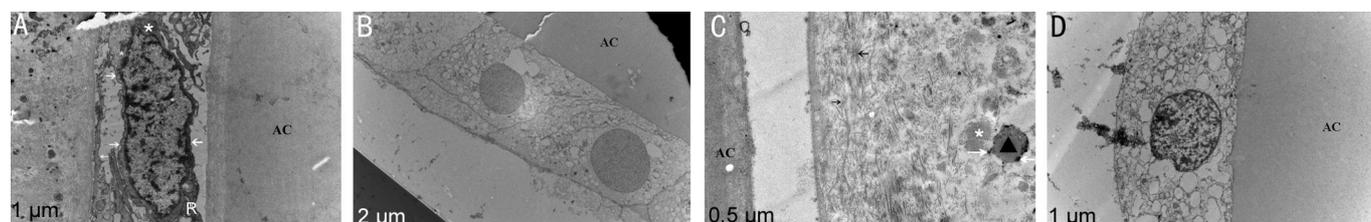


Figure 2 TEM result of anterior capsular obtained from electric cataract and age-related cataract A: LECs with elongated nucleus and less cytoplasm were found in electric cataract with enlargement extracellular gap between cells and continuous cell membrane (white arrow), mitochondria (asterisk) and rough endoplasmic reticulum (R) in cytoplasm (12000 \times); B: LECs maintain single layer structure with cytoplasmic vacuoles in age-related cataract (4000 \times); C: Individual cells containing plenty of collagenous fibrils (black arrow) with the presence of lipid particles (black triangle), lipofusin (white arrow) and significant edema of mitochondria (asterisk) in electric cataract (20000 \times); D: LECs with nuclear condensation and multiple cytoplasmic vacuoles in age-related cataract (8000 \times).

The high water content and its surroundings of the crystalline lens make it a good conductor of electric current. Anterior subcapsular opacities are common change in recently reported cases [1,3], which is considered to be caused by metaplasia of the epithelium, producing capsular wrinkling and a fibrous plaque over the visual axis[4]. Our report aims to provide further understanding of the mechanism of electric cataract by comparing the ultrastructure with age-related cataract. In age-related cataract, LECs cells present typical apoptosis with nuclear condensation, cytoplasmic degeneration and intracellular vacuolization, which were similar as previous studies [2]. TEM examination of AC opacity collected from this patient revealed elongated LECs with distinguishable intracellular organelles. Individual cells with collagenous fibrils were also observed beneath the central AC [5]. The ultrastructure changes of LECs from electric cataract suggested elongation of LECs and scar tissue formation [3]. The ultrastructure difference between electric and age-related cataract might be due to different pathological process. In age-related cataract, LECs went through apoptosis with years of exposure to risk factors. However, electric current cause the damage to LECs in a comparatively short term. Electricity can directly cause pore formation in the lipid bilayers that form cell membranes[6]. When the strength of voltage or the number of pulses reaches a threshold, the membrane is broken down permanently thereby inducing cell death and thereafter, cellular and tissue debris triggers local or systemic inflammation and immunoreaction. Secondary injury processes may be disruptive or even fatal to the cell[7]. Cataractogenesis following electrical trauma usually occur with a latency period varying from immediately after injury

to years [3,5]. Detailed ocular examinations with careful follow-up are required to patients with electrical injuries near head, neck or shoulder. Additional longitudinal studies are needed to determine the progression of electrical injuries and the mechanism of electric cataract over time.

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