Case Report

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Bilateral maculopathy and cataracts secondary to an accidental high-voltage electrical discharge

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Abstract:

The aim of the study was to describe the ocular findings following an accidental high-voltage electrical discharge. A 32-year-old male suffered an accidental electric discharge of 10,000 volts of direct current. He developed cortical, nuclear, and posterior subcapsular opacities in both the eyes. The retinal examination showed bilateral macular cysts. Four months after the event, the macular cyst in the OD spontaneously regressed without visual improvement. The macular cyst in the OS remained unchanged. High-voltage electrical discharge can lead to bilateral maculopathy and cataracts. The visual prognosis is reserved. The visual acuity may not improve despite macular cyst regression.

Keywords:

Burns, electric shock, electric shock maculopathy, lightning maculopathy, macular hole

Introduction

Up to 20% of burns are caused by electric injuries.[1] The severity of tissue damage will depend on several factors including the type of current, duration of current, amount of current, voltage, tissue resistance, area of contact, and the proximity of the route traveled by the electrical current. Up to 15% of these injuries may be life threatening. Electric shocks have been categorized as low voltage (lower than 1000 volts) or high voltage (>1000 volts).[1]

Ocular changes secondary to electrical burn injuries were first reported in 1772 by St Yves, who described the development of cataracts in a patient who suffered a lightning strike.[2] Since then, eyelid skin burns, cataract, recurrent uveitis, optic neuropathy, macular cyst, macular hole, vascular occlusions, retinal pigment epithelium (RPE) changes, and nerve injuries have all been described.[3] We hereby present a case of a young man who suffered an accidental high-voltage electrical discharge.

Case Report

A 32-year-old healthy man was electrocuted with 10 kV DC current while fixing a high-voltage transmission line tower. He lost consciousness and was taken to the emergency room. The electrical discharge was noted to enter the occipital region of the scalp and exit at the superior left limb [Figure 1]. Neuroimaging showed an epidural hemorrhage in the occipital lobe that was treated surgically with a craniotomy procedure. He had third-grade burns in the scalp and superior limb [Figure 2]. After recovering from his neurosurgical procedure, the patient complained of bilateral visual loss and a central scotoma. Ophthalmological evaluation of the patient revealed a visual acuity of counting fingers in the right eye and 20/100 in the left eye. Intraocular pressure was normal. Anterior segment evaluation revealed cortical, nuclear, and posterior subcapsular opacities in both the eyes. Funduscopic

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examination revealed bilateral macular cysts. An optical coherence tomography (OCT) confirmed the presence of bilateral macular cysts [Figure 3]. A postcraniotomy brain computed tomography was read as showing no abnormalities in the occipital cortex [Figure 4]. Four months after the event, the patient's best-corrected visual acuity remained counting fingers and 20/400 in the OD and OS respectively. The opacities in the crystalline lens remained unchanged [Figure 5]. The OCT revealed that the macular cyst in the OD underwent spontaneous regression, whereas the macular cyst in the OS remained unchanged [Figure 6].

Discussion

The macula is particularly sensitive to electrocution-related damage for several reasons. The macula contains the greatest concentration of melanin granules in the retina which greatly resists electrical conductance.[4,5] Due to its high resistance, the melanin granules in the RPE absorb the electrical energy causing a rise in temperature which results in thermal damage and protein denaturation in the adjacent tissues including the overlying retina.[6] The foveal avascularity increases the risk of ischemic insult. Electrical injuries can lead to vascular changes that cause choroidal ischemia which, in turn, may lead to involutional macular thinning and eventual hole formation.[3] Thermal shrinkage of the vitreous leading to an acute posterior vitreous detachment with subsequent vitreous traction has been postulated as a mechanism of macular hole formation.[7]

The spectrum of clinical findings in electric shock maculopathy will vary according to the degree of insult that the macula sustains at the time of electrocution. Very mild cases are characterized by RPE and photoreceptor layer disruption.[8] More commonly, there is an absence of the RPE and the outer retina forming an outer lamellar

Figure 1: Entry site of the accidental electrical discharge in the occipital region of the scalp after craniotomy

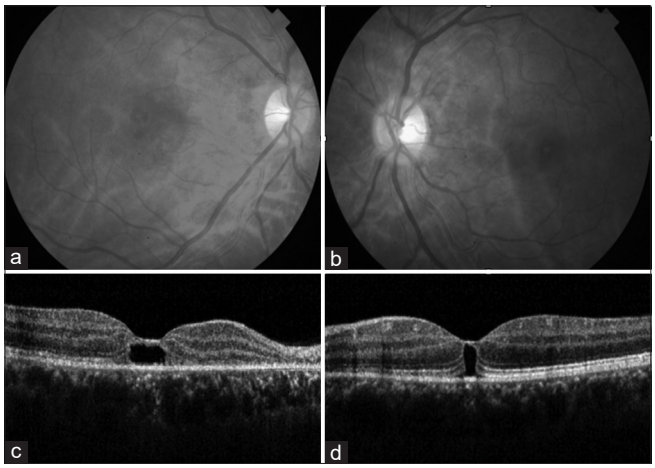

Figure 3: (a) Fundus photograph of the OD showing a macular cyst, (b) Fundus photograph of the OS showing a macular cyst. (c) Optical coherence tomography of the right macula confirming the presence of a macular cyst with an outer retina defect and a slim bridge of internal limiting membrane, (d) optical coherence tomography of the left macula showing a macular cyst bridged by the slender internal limiting membrane

Figure 2: Exit site showing third-degree burns of the left hand

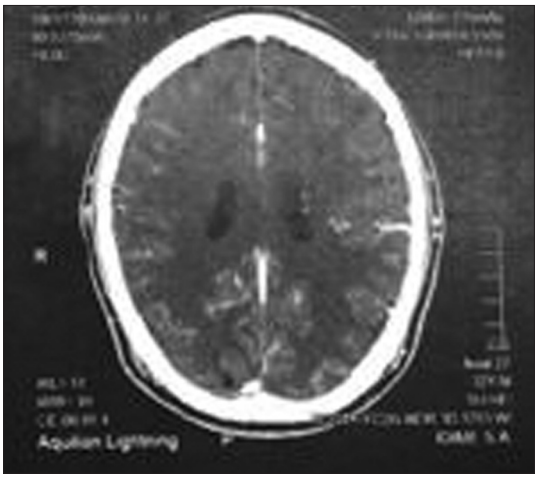

Figure 4: Post craniotomy computed tomography demonstrating no injuries to the occipital cortex

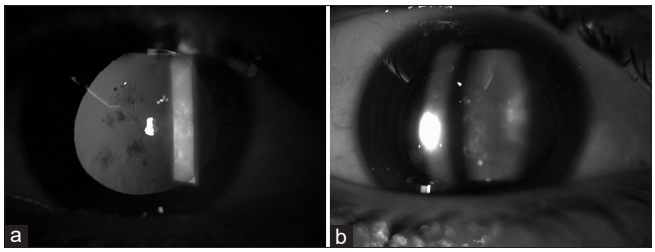

Figure 5: (a) Slit-lamp examination of the crystalline lens under retroillumination mode showing lens opacities, (b) Slit-lamp examination of the crystalline lens showing opacities

macular hole with an intact internal limiting membrane overlying the defect. These have been described as intraretinal macular cysts.[5,9-12] Rarely, patients may present with a full-thickness macular hole or submacular hemorrhage.[8,13,14]

Since there are only a handful of cases of electric shock maculopathy reported, the natural history of the condition is poorly understood.[8] Some cases have undergone spontaneous resolution with an improvement of visual acuity.[8] In some cases, the outer lamellar hole undergoes gliosis and scar formation without any functional improvement as exemplified by the right eye of the current case.[8] Other cases have progressed from an outer lamellar macular hole to a full-thickness macular hole and rhegmatogenous retinal detachment.[15] Ouyang *et al*.[5] reported a single case that failed to gain vision despite surgical intervention. It remains unclear when to consider vitrectomy in these patients. The functional outcomes of macular holes secondary to electric shock maculopathy following an electric discharge may not be as good as idiopathic macular holes despite the closure.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil

Conflicts of interest

The authors declare that there are no conflicts of interests of this paper.

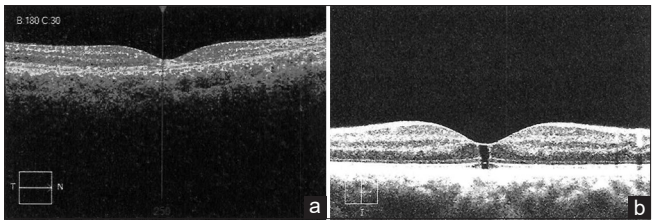

Figure 6: Four month follow-up, optical coherence tomography of the OD (a) showing resolution of the macular cyst and optical coherence tomography of the OS (b) showing that the macular cyst remains unchanged from baseline

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