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## Case report

# A case series: Bilateral ischemic optic neuropathy secondary to large volume fluid resuscitation in critically ill burn patients



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## ABSTRACT

Ischemic optic neuropathy (ION) in the trauma setting is a rare and devastating condition associated with systemic hypotension, massive volume resuscitation, and sepsis. The objective of this case series is to highlight a potential correlation between severe burn and ischemic optic neuropathy. We present three patients with total body surface area (TBSA) thermal injury burns ranging from 57 to 68% treated at the North Carolina Jaycee Burn Center that developed bilateral ischemic optic neuropathy during their hospital stay. Each patient required greater than 25 L of crystalloid fluid within 24 h after admission, suffered multiple bouts of sepsis, and required extended pressor support. We postulate that ischemic optic neuropathy develops as a result of the interplay between the patient's systemic pathophysiology, i.e. shock, sepsis and the continued need for large volume fluid resuscitation. Current treatments of ION have not proven to be effective, except for possibly limiting fluid resuscitation. In the few cases of refractory burn shock, the incidence of this condition is unlikely to be readily improved. However, it is important for clinicians to be aware of this devastating complication and consider early ophthalmology involvement in the care of severely burned patients.

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## 1. Introduction

Vision loss secondary to ischemic optic neuropathy is a rare and devastating complication seen in major non-ophthalmological surgical procedures such as head and neck, cardiac, spinal and general surgery [1–3]. Ischemic optic neuropathy (ION) has also been proposed to be a complication of major traumas requiring resuscitation and also a result of systemic hypotension secondary to dialysis, and sepsis [4–7]. However, ischemic neuropathy associated with major burns has not been well described [8–10]. We discuss three patients admitted to University of North Carolina at Chapel Hill Burn Intensive Care Unit (UNC-CH BICU) with subsequent bilateral blindness, after sustaining severe partial and full thickness burns (>55% total body surface area, TBSA) that required initial large volume fluid resuscitation. All cases had normal globes and fundoscopic anatomy on ophthalmologic exams on admission.

## 2. Case report

### 2.1. Patient 1

A 40-year-old male was admitted to the UNC-CH BICU following an industrial plant fire. The patient was evacuated via air from the scene and arrived intubated with 62% TBSA thermal injury burns to his hands, back, abdomen, lower legs and feet, and with inhalation injury. A right upper extremity bedside escharotomy was performed on admission because of absent distal pulses and elevated compartment pressures in the right arm. On admission vital signs were: blood pressure 100/50 mmHg, heart rate 140 bpm, mean arterial pressure (MAP) 65 mmHg, and temperature was 35.5 °C. Admission central venous pressure (CVP) was 6 mmHg, and bladder pressure was 16 mmHg. Arterial blood gas (ABG) on admission showed pH of 7.22, with a base deficit of –7.3 and lactate of 2.1. On physical exam, pupils were 3 mm in size and reactive to light. The patient was resuscitated in the first 24 h with a total of 28.8 L of crystalloids, and pressor support was added to maintain hemodynamic instability. The patient's initial ventilator settings included a PEEP of 10 cmH<sub>2</sub>O for his inhalation injury.

Over the following 24 h, hemodynamic instability continued, systemic blood pressure ranged from 65/35 to 110/65 mmHg with MAP ranging from 56 to 70 mmHg, heart rate ranging from 120 to 170 bpm, CVP ranged from 5 to 15 mmHg, and cardiac output ranged from 6.23 to 9.96 L/min. An additional 20 L of crystalloid fluid was administered over the next 24-h period; bladder pressure remained 16 mmHg during this time. Pressor support and invasive cardiac monitoring was continued for a total of 26 days in order to maintain blood pressure.

At 32 days post burn, the patient's mental status improved and the loss of vision was discovered. Physical exam noted pupils were 3 mm in size but minimally reactive to light. CT scan of head was negative for acute cerebral hemorrhage or infarction. MRI of the brain with and without gadolinium contrast also noted no intracranial pathology. Neuro-ophthalmology service performed a dilated fundoscopic exam and

found severe bilateral optic nerve pallor with sparing of the remaining peripheral retina. These findings along with negative imaging studies were consistent with ION. The patient was discharged from the hospital with complete bilateral vision loss and has had no recovery to date.

### 2.2. Patient 2

A 51-year-old male who was transferred from an outside hospital after sustaining severe burns in a camper fire. Patient 2 had 57% TBSA that consisted of 3rd and 4th degree burns to the neck, face, trunk, upper extremity bilaterally and second degree burns to the forearms, hands, right knee and left foot with a concurrent inhalation injury. He was intubated at the scene and had escharotomies performed on his chest, neck, and right upper extremity at the outside hospital. His temperature on arrival to the outside hospital was 32.9 °C. On arrival to UNC-CH BICU, fluid resuscitation was initiated and escharotomies were deepened and extended to the shoulders, lower right arm, and hand. His vital signs on arrival to UNC-CH BICU were: blood pressure 100/40 mmHg, heart rate 80 bpm, MAP 53 mmHg, and temperature of 33.0 °C. The patient received invasive cardiac monitoring on arrival and vasopressor support. Invasive monitoring showed a cardiac output range of 4.27–7.4 L/min and CVP ranged from 9 to 11 mmHg. Admission ABG showed acidosis with pH of 7.17 with a base deficit of –13.7 and a lactate of 5.2. Thirty eight liters of fluid was administered in first 24 h for maintenance of systemic pressure and urine output. Additionally, a PEEP of 15 cmH<sub>2</sub>O was required for adequate oxygenation because of his inhalation injury.

In the following 24 h, 7 L of fluid were given and his blood pressure ranged from 80/35 to 160/70 mmHg, heart rate ranged from 110 to 150 bpm, MAP 53 to 110 mmHg, and cardiac output from 4.26 to 8.30 L/min. Arterial blood gases showed an improved pH range of 7.33–7.38 with base deficits of –4.4 to +1.1. Within 48 h of admission, the patient became septic and blood cultures were positive for oxacillin resistant *Staph aureus* (ORSA). He was subsequently started on vancomycin.

The patient required pressor support for 45 days during hospitalization and was not successfully extubated until 52 days post burn. The patient's bilateral blindness was first noted at 64 days post burn. On admission, ophthalmologic exam showed normal pupils size and equal pupillary response to light. The patient had initial consultation with ophthalmology service upon admission because of facial burns and corneal burns. Early fundoscopic exam showed normal retinas with no optic disk pathology. On re-examination once visual loss noted, there was an absent pupillary response to light and optic disks showed severe atrophy with pallor. CT scan of the head showed no acute hemorrhage or infarction. An MRI of the brain with and without gadolinium contrast showed no lesions. These findings were suggestive of ION. Unfortunately, the patient also did not regain visual loss on discharge.

### 2.3. Patient 3

A 52-year-old male was admitted following a gas grill explosion sustaining 68% TBSA 2nd and 3rd degree burns to the head, neck, trunk, bilateral upper extremities and bilateral

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