Case Report

Ocular manifestations of TASER-induced trauma

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\textbf{ABSTRACT}

A young adult male experienced penetrating globe injury due to a Thomas A. Swift Electric Rifle (TASER). Despite successful repair of the globe, the damage was profound. This case report explores the complex ways in which mechanical and electrical forces from a TASER may impact the structural integrity and the neurosensory structures of the eye.

\section*{Introduction}

The Thomas A. Swift Electric Rifle, or the TASER (Taser International, Scottsdale, AZ), is a tool employed by law enforcement officials for self-defence and to subdue violent criminals without resorting to lethal means. The TASER is capable of delivering up to 50,000 Volts (V) of electrical charge on contact for up to 5 s\textsuperscript{[1]}, resulting in striated muscle contraction and tetany while avoiding involvement of non-striated muscle\textsuperscript{[2]}. Although serious injuries occurring in less than 1.4% of cases\textsuperscript{[1]}, TASER injuries can be devastating when they involve the eye. In this case report, we will explore the complex mechanisms of ophthalmic injury associated with TASERS.

\section*{Case report}

A young adult male without known prior medical history was brought emergently to a level one trauma center following penetrating trauma to the right eye (Fig. 1). The patient had been struck twice with a TASER, once in the back and once in the right eye (OD). The patient was heavily sedated and poorly cooperative on initial evaluation. Visual acuity OD was no light perception (NLP). A TASER probe emerged from the limbus, and the patient was found to have a hyphema, significant chemosis, and periorbital edema.

Pupillary response was intact in the left eye (OS) with a right relative afferent pupillary defect (RAPD). Extraocular motility was full OS but difficult to assess OD due to extensive periorbital edema.

Computed tomography (CT) confirmed penetration of a metallic foreign body into the right globe with hyperdense vitreous and free air within the globe. The lens was not visualised. (Fig. 2). The patient had several episodes of bradycardia while in the emergency department, likely due to a vagal response to the trauma. He was stabilised and then taken emergently to the operating room for globe repair OD.

The probe had entered the globe medial to the limbus at 3 o'clock. Vitreous was found over the right lower lid and extending inferiorly. The patient was found to have a 15 mm laceration of the limbus between 2 and 4 o’clock with a scleral laceration extending

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12 mm posteriorly. The uvea had prolapsed with extensive loss of tissue and vitreous. No additional tissue was lost during the removal of the probe. The portions of the eye that had been in contact with the TASER probe were charred and coagulated. This material was debrided along with removal of prolapsed uvea. The scleral laceration was repaired with 8-0 polyglactin sutures in an interrupted fashion, and the limbal laceration was repaired with 10-0 nylon interrupted sutures. The anterior chamber (AC) remained formed during the procedure. AC washout was performed subsequently, during which time blood, vitreous, and lens material were found. No iris was identified during the washout, and significant tissue loss was suspected. The paracentesis wound was closed and basic saline solution was injected to reform the anterior chamber. The wound was Seidel negative at closure.

Due to the extent of the injury and tissue loss, the initial postoperative prognosis was grim. On the first post-operative day, the globe was found to be well formed with AC pressure maintained. The patient remained NLP with right RAPD. A lengthy discussion was had at this time with patient and family regarding the mechanism of injury, the extent of the tissue damage, the patient’s poor visual prognosis, and the possibility of sympathetic ophthalmia. The patient and family decided to proceed with enucleation, which was performed the second day after the initial injury. The patient tolerated the procedure and placement of an orbital implant. Per the pathology report, the globe was found to be filled with haemorrhage, and the retinal surface could not be identified.

Discussion

TASER injuries to the globe are particularly complicated in that damage may occur via multiple mechanisms simultaneously. A TASER fires two metal darts at a distance of up to 35 ft at speeds ranging from 160 to 180 ft/s [1,3]. The darts are barbed, enabling them to grip onto clothing or tissue while the TASER delivers electrical impulses. The probe itself may cause significant injury to the eye on impact, and the barbs make removal of the dart a potential source for further damage to the globe [4–5].

When the TASER strikes its target, it forms a closed circuit that allows a high-voltage, low current shock to be delivered [1–2]. This electrical current may cause thermal damage, ischemia due to vascular constriction, and disruption of endogenous electrical signalling pathways [1,4]. The optic nerve and retina provide a low resistance pathway for electrical currents, making them susceptible to compromised retinal vascular supply and resultant ischemia [4].

Estimates suggest that TASER probes strike and penetrate the face in approximately 1% of cases [3], with an even smaller percentage striking the eye and orbit. Cases of penetrating injuries have been associated with a broad spectrum of mechanical injuries ranging from corneal and scleral lacerations [3–4,6], injury to or loss of iris and uveal prolapse [3,6], dislocation of or injury to the lens [2–4,6], retinal tears [2,4] and vitreous haemorrhage [2,4–6]. The case detailed in this report demonstrated all of these physical findings. It also demonstrated thermal damage and coagulative necrosis suggestive of anterior segment electrical injury. The retina itself could not be identified by the pathologist and may have suffered extensive mechanical damage, thermal injury, and ischemia with potential optic nerve injury or axonal transport disruption. These injuries resulted in NLP vision on presentation that persisted after repair of the ruptured globe.

Vision after penetrating TASER injury varies from irreversible, total vision loss [6–7] to patients attaining a visual acuity of 20/60 or better after treatment [1–2,4–5]. An extensive evaluation of long-term consequences of TASER injury is limited by frequent loss to follow-up [1,3–4] and enucleation of the globe [6–7]. However, long-term sequelae of TASER injuries include the subsequent development of cataracts, which has also been noted in the setting of other electrical injuries and non-penetrating TASER injuries [6,8]. Additionally, retinal ischemia, likely due to microvascular damage from the electrical injury, has been observed to result in proliferative vitreoretinopathy with consequent retinal detachment after TASER injury [2].
Significant injuries of the globe and orbit due to TASER use are rare [1,3]. However, these injuries may be particularly complex, resulting in mechanical damage, electrical and thermal injury to the eye and optic nerve, and iatrogenic injury during subsequent stabilisation and management of the patient [1–3]. As such, it remains important for emergency physicians, trauma surgeons, and ophthalmologists to be aware of these mechanisms and to work closely together for prompt and effective management of these patients.

Conflict of interest

The authors certify that they have no financial disclosures or proprietary interests regarding the subject matter or materials discussed in this case.

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