

Ophthalmic injuries from a TASER

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ABSTRACT

The TASER (TASER International) is an energy-conducting weapon, that is becoming more frequently used by law enforcement officials to subdue combative individuals. Though generally regarded as a safe alternative, the use of such weapons has been reported to cause serious injuries. We describe a case in which ocular injuries were sustained by impalement with a TASER dart. Emergency physicians should be aware of the potential for serious ophthalmic injuries from TASERs and how such injuries should be managed.

Keywords: TASER injury, ophthalmic trauma, penetrating eye trauma, globe rupture, traumatic mydriasis, electrical ophthalmic injury

RÉSUMÉ

Le pistolet TASER (TASER International) est une arme à impulsions électriques que les responsables de l'application de la loi utilisent de plus en plus fréquemment pour neutraliser les individus combattifs. Bien que l'emploi de cette arme soit généralement considéré comme une méthode d'immobilisation sûre, son déploiement a causé des traumatismes graves. Nous décrivons un cas de blessure oculaire par empalement du dard d'un pistolet paralysant. Les médecins d'urgence doivent être conscients de la possibilité de blessures oculaires graves que les pistolets TASER peuvent causer et savoir quelle est la prise en charge dans de tels cas.

Introduction

The use of TASERs (TASER International) by law enforcement officials is increasing because of the demand for less lethal weapons to subdue combative individuals. According to the US Government Accountability Office, in 2005 TASERs were “used by over 7000 of the 18 000 law enforcement agencies in the United States, with more than 140 000 TASERs in use by police officers in the field and an additional 100 000 TASERs owned by civilians worldwide.”¹ Studies examining the safety of TASER use in healthy volunteers have suggested that the electrical current produced by such devices does not result in any sustained clinically significant cardiac, respi-

ratory or physiologic stress.²⁻⁴ Nevertheless, injuries^{5,6} and deaths^{7,8} have been reported with the use of TASERs. We report the case of a traumatic globe rupture and associated vitreous hemorrhage, retinal laceration and lid injury resulting from the use of a TASER by law enforcement officials.

Case report

A 25-year-old previously healthy man was brought to the emergency department (ED) by paramedics after being subdued with a TASER by law enforcement officials. Pre-hospital treatment by paramedics consisted of cardiac monitoring and securing the TASER dart that was impaled

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in the right orbital region. On arrival at the ED, the patient denied any loss of consciousness, denied neurologic or cardiorespiratory symptoms, and his immunizations were up to date. He admitted to consuming a moderate amount of alcohol. Physical examination revealed a Glasgow Coma Scale score of 15, blood pressure of 125/83 mm Hg, pulse rate of 100 beats/min, respiratory rate of 16 breaths/min and oxygen saturation of 100% on room air. Cardiovascular and respiratory exams were normal. A neurologic exam did not reveal any abnormalities with the exception of findings related to a right eye injury. Examination of the right eye revealed an angulated 3-cm metal TASER dart partially embedded through the right eyelid just below the eyebrow, accompanied by slight bruising in the surrounding tissues (Fig. 1). Extraocular movements of the right eye were normal.

A pupillary examination revealed anisocoria (Fig. 2). The right pupil was 7 mm in diameter and its reactivity to light was very sluggish. In comparison, the left pupil had a diameter of 3 mm and normal reactivity. Visual acuity testing of the right eye revealed an ability to finger count at a distance of about 30 cm; however, this rapidly deteriorated and approximately 1 hour later the vision in the right eye was limited to light perception only. Fundoscopic assess-

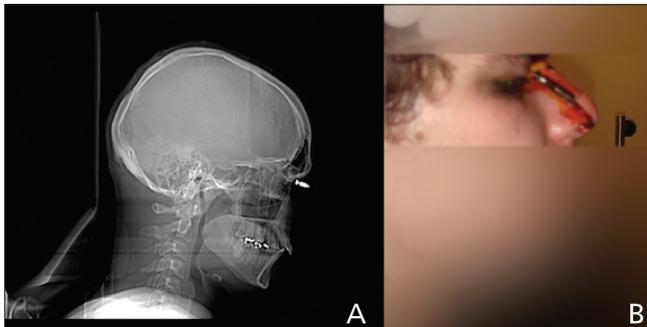


Fig. 1. Sagittal computed tomography scout view of the head. Note that the TASER dart is embedded just below the brow ridge (A). Photo of the patient (B).



Fig. 2. Traumatic mydriasis. Note the dilated pupil in the right eye compared with the left.

ment was challenging in the presence of the embedded TASER dart and inconclusive.

Intraocular pressure (IOP) in both eyes was measured using a TONO-PEN AVIA (Reichert, Inc.). The IOP in the right eye was 8 mm Hg (reference range 11–21 mm Hg). The IOP in the left eye was 11 mm Hg. Examination under the upper lid revealed a focal lesion on the surface of the superior aspect of the right globe. This was surrounded by a darkened ring. The focal lesion, which appeared to be an entrance wound from the dart with surrounding thermal injury from the electrical current delivered by the TASER, extended 2 mm radially and was located approximately 3 mm superior to the limbus. Seidel sign was inconclusive.

Because of a high suspicion of a right globe rupture, an emergent computed tomography (CT) scan of the head and facial bones was obtained. The CT scan showed the dart embedded preseptally in the soft tissues and appearing to contact the right globe. Definite dart penetration into the globe could not be confirmed because of artifact from the dart itself (Fig. 3). A hyperdensity was also noted within the right vitreous humour, which measured about 0.5×0.4 mm, and was suspected to be a vitreous hemorrhage (Fig. 3). The right lens also appeared slightly displaced posteriorly, raising the possibility of a lens dislocation. The extraocular muscles were intact and there was no evidence of facial fractures or intracranial injury (Fig. 3).

Intravenous (IV) cefazolin was administered to prevent

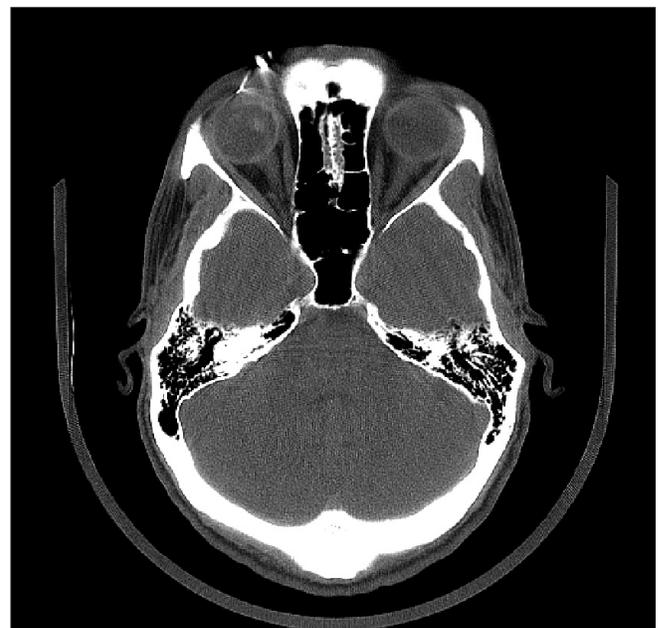


Fig. 3. Axial computed tomography scan of the head and facial bones showing the presence of a hyperdensity in the right ophthalmic globe and artifact created by the presence of the metal dart.

endophthalmitis, and an ophthalmologist was consulted. Examination by the ophthalmologist confirmed the presence of a globe rupture with the focal lesion comprising a laceration that spanned the sclera, retina and choroid. This was further complicated by a retinal tear and vitreous hemorrhage. The patient was admitted to the hospital and taken to the operating room. Under general anesthesia, the TASER dart was removed and the eyelid repaired by an oculoplastic surgeon. The right globe was then repaired by the ophthalmologist. Intravenous ciprofloxacin was administered postoperatively. The patient subsequently underwent a right vitrectomy and laser photocoagulation to reduce the likelihood of future retinal detachment.

One week after surgery, the patient had a visual acuity of 20/40 in the injured right eye. No other complications had occurred and the patient was expected to make a full recovery. Unfortunately, the patient was lost to follow-up and his ultimate outcome could not be confirmed.

Discussion

TASERs (an acronym for Thomas A. Swift's electric rifle) are conducted energy weapons, designed to incapacitate individuals by delivering an electrical shock for a duration of approximately 5 seconds. Upon firing, the TASER launches 2 metal barbed darts at the target individual. The darts, which remain embedded in the individual, are connected to the device by insulated wires. A series of pulses, each measuring at 0.36 J and up to 50 000 V, are delivered through these wires, resulting in tonic-clonic contractions of the skeletal muscle and incapacitation.⁸

Injuries arising from the use of TASERs can occur either physically, from dart impalement, or electrically, from the current delivered by the device. The tips of the metal darts are barbed in configuration and are about 4 mm long. Though not considered to be life- or limb-threatening when projected into an individual, the potential of injuring vulnerable areas such as the eyes, genitalia and large blood vessels in the neck exists and has been previously described.^{9,10}

Tissue damage can also arise from the electrical current delivered by the TASER. The damage likely occurs through the transmission of electrical current directly through tissues, and the conversion of electrical energy to thermal energy, which is absorbed by the tissue and results in end-organ ischemia caused either by generalized vascular constriction or cardiac arrhythmias.¹¹ The degree of damage sustained by tissues is dependent on the intensity of the current delivered, the duration of tissue exposure and the internal resistance of the tissue involved.¹² Resis-

tance of each body tissue varies: it is greatest in bone, followed by fat, tendon, skin, muscle, blood vessels and nerves.¹³ Ocular tissues, such as the optic nerve and retina, have a particularly low resistance to electric current and thus are more prone to ischemia resulting from coagulation and necrosis of the vascular supply tissues.¹²

A literature search revealed 3 previously published case reports documenting ocular injuries from use of a TASER. In 2 cases, the TASER damage was caused by penetrating trauma and resulted in intraoperative removal of the barbed dart and repair of the globe under general anesthesia with satisfactory visual outcomes.^{14,15} The third case involved a TASER deployment in the facial area and the subsequent development of a monocular cataract, thought to be related to the electrical effects of the device.¹⁶ Cataract formation is a known complication of severe electric shock.¹⁷

The assessment and management of patients with ocular trauma from use of a TASER should include investigation for arrhythmias, bleeding control and pain control. The priority should then shift to ruling out a ruptured globe through a detailed ocular exam and imaging. If a ruptured globe is identified, the patient should be referred to an ophthalmologist without delay for surgical repair. Though intraocular pressure measurements were obtained in the case we present, both by the emergency physician and the ophthalmologist, this is generally felt to be contraindicated in cases of suspected or known globe rupture.

The imaging modality of choice in ocular trauma is a CT scan of the head and facial bones. Current generation CT scanners are able to image and localize metallic foreign bodies less than 1 mm in size, while simultaneously identifying associated ocular injuries such as intraorbital and intraocular emphysema or hemorrhage, lens dislocation or subluxation, globe rupture associated with corneal or scleral lacerations, retinal or choroidal detachment, optic nerve injuries and extraocular muscle injuries.¹⁸ However, in our patient, the CT findings were inconclusive. Although the CT scan in our case was useful to localize the dart and identify a suspected vitreous hemorrhage, the presence of the metallic barbed dart created artifact in the CT images that made it difficult to delineate the extent of ocular injury.

Infectious endophthalmitis can complicate open globe injuries. The incidence of endophthalmitis varies, though its development after weapon-related globe rupture is associated with an extremely poor visual prognosis.¹⁹ Both the delayed timing of primary repair²⁰ and delayed administration of systemic antibiotics beyond 24 hours²¹ has been shown to be associated with a higher risk of developing posttraumatic endophthalmitis. Our patient received IV cefazolin in the ED, rapid surgical intervention by an

ophthalmologist and postoperative administration of IV ciprofloxacin. All interventions were carried out within 12 hours after the initial injury. Preoperatively, urgent medical conditions and associated TASER-related or -unrelated injuries should be identified and treated.

The removal of barbed TASER darts from most soft tissues is safe and within the scope of practice of emergency physicians. To remove a TASER dart, quick traction is placed on the dart, perpendicular to the site and angle of penetration. This process can be aided by the infiltration of local anesthetic if necessary. However, in situations where the TASER dart has penetrated vulnerable areas, such as the eyes, emergency physicians should not attempt to remove the dart, as iatrogenic injury may result. In our patient, initial examination revealed that the dart had clearly penetrated the eyelid and may have contacted the globe. In addition, the patient had a dilated pupil suggestive of traumatic mydriasis. Because of this, no attempt was made to remove the dart in the ED and consultation was obtained.

Conclusion

The increasingly widespread view that TASERs are a safer alternative to conventional law enforcement weapons and the resulting increasing distribution of these devices will likely result in an increased use of conducted energy weapons. As a consequence, the incidence of eye injuries related to TASER use can be expected to rise. Emergency physicians should therefore be aware of the ocular injuries that may arise from use of TASERs.

Competing interests: None declared.

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