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Received 18th April 2023
Revised 16th September 2023
Accepted 10th November 2023
Published Online 18 Nov 2023

A Case of Orbitocranial Penetrating Injury

***Abstract* – Objective**: To report a case of right orbitocranial penetrating injury by a metal rod. **Case report:** A 10-year-old boy presented with alleged right orbitocranial injury with a metal rod penetrating from the right superior orbital edge. The right globe was displaced inferiorly with mechanical restriction of extraocular muscle movement (EOM). Right eye visual acuity (VA) was limited to perception of light with negative reverse relative afferent pupillary defect (RAPD). Computed tomography of the orbit and brain revealed a metal rod penetrating the supero-temporal aspect of the right orbit with right orbital roof fracture. A multidisciplinary team performed the operation. Upon metal rod removal, there was right orbital roof defect with pulsation of the right globe. However, exploratory craniotomy revealed intact dura matter with no subdural haemorrhage. Postoperatively, there was mild right eye proptosis with EOM restriction. The right VA was improved from 6/60 at 1-week post operation to 6/6 at 2-month follow-up with resolution of proptosis. EOM restriction over upper and lower gazes was noted due to the presence of symblepharon, which then was subsequently resolved after symblepharon release. **Conclusion:** Orbital penetrating injuries necessitate multidisciplinary involvement and with globe preservation leads to a better visual outcome.

***Keywords* –** *Orbitocranial penetrating injury, metal rod*

1 INTRODUCTION

Ocular injuries can range from minor form to severe cases resulting in significant ocular morbidity, blindness and even life threatening events leading to mortality. These injuries can involve both the upper and lower eyelids, the lacrimal drainage system, the bones of orbital wall, and the eyeball itself. The penetration of a foreign body into the orbit and breaching the cranium is known as orbitocranial penetrating injury [1-3].

In young children, severe and catastrophic injuries can lead to permanent visual deprivation which can affect their life in the long run. A lot of domestic and school activities may predispose them to ocular injury especially if no proper eye protections such as safety sealed glasses and goggles are applied. We report a case of orbitocranial penetrating injury in a young boy that occurred at home during COVID pandemic.

2. CASE REPORT

A 10-year-old boy presented to the emergency department with an alleged domestic injury to his right eye. The incident occurred while he and his elder brother were changing a tyre of their father's car. The patient was lying under the car while his elder brother attempted to loosen the nuts on the tyre, which was attached to a hook-shaped metal rod. Upon completion of loosening all the nuts on the tyre, suddenly the tyre gave way and fell onto the patient's head. Simultaneously, the metal rod that attached to the tyre was also fell onto the patient's head. Unfortunately, the short end of the metal rod entered his right globe. Subsequently, he had right eye pain, reduced vision, and bleeding from the site of injury. With the help of firefighters, the long end of the metal rod was cut into half. Following this, he was promptly taken to the emergency department.

Upon arrival at the hospital, the patient was fully alert and conscious with stable vital signs. There was penetration of the metal rod from superior orbital edge of the right eye (Figure 1A) with no active bleeding. The right visual acuity (VA) was limited to light perception and no relative afferent pupillary defect. The right globe was displaced inferiorly with mechanical restriction of extraocular movement (EOM) in all directions. The upper

eyelid was inverted into the orbital cavity at the site of the metal rod insertion, with no visualisation of upper lid margin. The conjunctiva was injected and chemosis was present. The anterior chamber was formed with no hyphema. The pupil was round and reactive. The left eye VA was 6/6 with normal anterior segment examination.

Computed tomography of the orbit and brain revealed a metal rod penetrating the supero-temporal aspect of the orbit with right orbital roof fracture (Figure 1B and 1C). Due to artifacts from other part of the metal rod, there was poor visualisation of intracranial extension, and it was not possible to visualise any intracranial bleeding surrounding the site of injury. The patient was co-managed together with neurosurgical team and oral-maxillofacial team.

He underwent an emergency operation performed by multidisciplinary teams under general anesthesia. Intraoperatively, there was full thickness laceration wound on the right upper lid with an intact right orbital rim. Upon the removal of the metal rod (Figure 1D), there was profuse bleeding from the site of the metal rod insertion associated with pulsation of the right globe.

All extraocular muscles were intact with no obvious injury. In view of pulsation of the globe, a right frontal exploratory craniotomy was performed by the neurosurgical team to assess any associated brain injury or intracranial bleeding. There was a right orbital roof fracture with an orbital roof defect measuring 2x2 cm with intact dura matter and no subdural haemorrhage. Reconstruction of the right orbital roof defect with autogenous cranial bone was performed by the oral-maxillofacial team. Closure of the right upper lid laceration wound was performed by the ophthalmology team.

Figure 1. Right eye showed penetration of the metal rod from superior orbital edge (A). Computed tomography of the orbit and brain revealed a metal rod penetrating the supero-temporal aspect of the right orbit (B and C). The metal rod upon the removal with the tip (red arrow) that penetrate the right orbit (D)

Postoperatively, the patient was treated with intravenous metronidazole for 5 days, and intravenous ceftriaxone for 1 week, along with moxifloxacin eye drops, and chloramphenicol

ointment to the right eye. In addition to systemic and topical antibiotics, he was also given artificial tears eye drops and hydrating eye gel to provide ocular lubrication. The use of all topical medications gradually tapered down over 2 months period.

On day 6 postoperatively, the right eye VA improved to 6/60 with mild proptosis and restriction of EOM in all gazes. There was no globe pulsation seen, and fundus examination was unremarkable. At 2 months follow-up, his right eye VA improved to 6/6 with resolved proptosis. However, there was a limitation of the right eye upper gaze and lower gaze secondary to the development of symblepharon from the right upper palpebral conjunctival towards the limbal conjunctival (Figure 2A). Release of the right eye symblepharon was performed, demonstrating full movement of the right upper and lower gaze in the subsequent follow-up. Nevertheless, there was right traumatic ptosis related to the injury (Figure 2B).

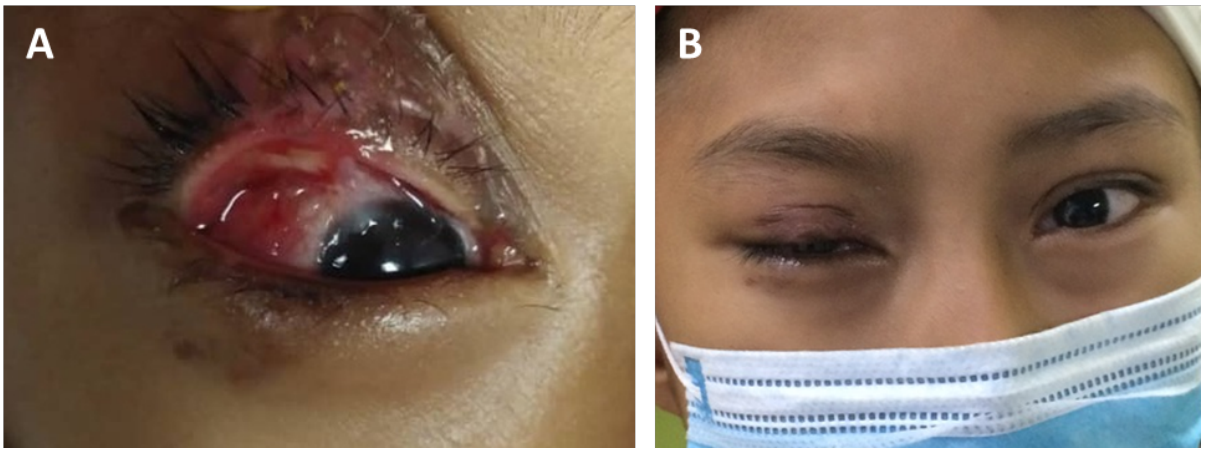

Figure 2. Symblepharon from the upper palpebral conjunctival towards the limbal conjunctival of the right eye (A). Right traumatic ptosis related to the injury at follow-up (B)

3. DISCUSSION

During the COVID-19 pandemic, many people spend a significant amount of time at home, with workers are encouraged to work from home, and educational institutions transition to e-learning using available platforms. Consequently, domestic injuries are expected to be on the rise due to most activities or tasks becoming a do-it-yourself (DIY) project as presented in our case.

Studies in Malaysia show that the place of ocular injuries occurs depending on the region [4]. In our region (Kelantan), the most common place of ocular injury occurrence was at home (51.8%), followed by the workplace (23.4%) [5]. In Kuching (a city in East Malaysia), most ocular injuries took place at home among children (75.2%) [6]. A study on paediatric ocular trauma in West Malaysia showed that domestic tools play a role in ocular injury [7].

The orbital roof is one of the least common facial fractures encountered [8]. Jordyn et al reported that penetrating injury is the least common cause of orbital roof fracture whereas motor vehicle-accidents, falls and assaults are the most common cause of trauma. If it occurred, it usually accompanied by multiple facial and neurological injuries [8]. The orbital roof is relatively thin and composed of orbital plate of the frontal bone and the lesser wing of the sphenoid bone [1,2,9]. Therefore, the orbital roof has a relatively higher risk of injury especially in children [10].

Orbital roof fracture associated with orbitocranial penetrating injury are rare. Orbitocranial penetrating injury accounts for 0.04% of traumatic brain injuries [11], and can lead to devastating and fatal complications. Foreign bodies, for example metal and glass may cause slight inflammation of the periorbital fat [8]. However, contaminated material especially vegetative in origin can cause severe infection [8]. Timely and proper management can prevent the occurrence of ocular complications (ocular motility alterations, optic nerve damage, endophthalmitis, panophthalmitis) and intracranial complications (meningitis, cerebrospinal fluid leakage or brain abscess) [2,8]. In our case, there was an orbital

roof fracture with intact dura matter and no subdural haemorrhage. The globe was displaced inferiorly as it is relatively mobile within the orbital cavity.

Currently, there is no exact management or guideline for the orbital roof fracture [2,8]. Generally, surgical intervention is required in cases of dural tears, refractory oculorrhea, displaced fracture that penetrate the brain parenchyma and fractures of other neighboring structures (ethmoid, frontal, maxillary, and zygomatic bone) [1,8]. Imaging modalities, for example, radiographs, computed tomography and magnetic resonance imaging can aid in the diagnosis and assessment of the extent of the injury [1,2]. In our case, the orbital roof defect was closed with autogenous cranial bone.

Prognosis in cases of orbitocranial penetrating injuries is guarded and it depends on structures involved, the extent of the injuries and the complications [1,2,8]. In our case, the patient was fortunate, as the metal rod bypassed the ocular globe, and the tip of the metal rod did not breach the dura layer. His vision was preserved, and no neurological complications occurred.

One of the complications of orbitocranial injury is symblepharon especially when the foreign body penetrates to the orbit through the eyelid as what presented in our case. Symblepharon is easier to prevent than to treat. It can be prevented by keeping the raw surfaces separated for one to two weeks until re-epithelialization takes place, using soft contact lens and a conjunctival or scleral ring postoperatively [12].

Symblepharon can be treated by various methods. The autologous conjunctival graft from the fellow eye can be used to restore destroyed conjunctiva [13]. Nasal mucosa also can be used as a suitable substitute for the conjunctiva to treat symblepharon, but this method cannot provide the eye with limbal stem cells, and the likelihood of recurrence is significant [14].

In our case, symblepharon formed due to the absence of a contact lens or conjunctival/scleral ring after the operation. We recommend that in cases of orbital injury with lid involvement, contact lens or conjunctival/scleral ring should be applied postoperatively until re-epithelization occur to prevent symblepharon.

4. CONCLUSION

A multidisciplinary approach is necessary in the case of orbitocranial penetrating injury, as thorough evaluation and proper management can save lives and preserve the globe and vision. Proper eye protection, safety gears, and parental caution can help prevent unnecessary injuries and complications.

ACKNOWLEDGEMENT

We would like to express our gratitude to the Neurosurgical and Oral-Maxillofacial teams for their contributions in managing this case intraoperatively.

REFERENCES

[1] Tewari VK, Dubey RS, Dubey GC. Trans-orbital orbitocranial penetrating injury by pointed iron rod. J Neurosci Rural Pract. 2015;6(2):231.
[2] Agrawal A, Reddy VU, Kumar SS, Hedge KV, Rao GM. Transorbital orbitocranial penetrating injury with an iron rod. Craniomaxillofac Trauma Reconstr. 2016;9(2):145–8.
[3] Mzimbiri JM, Li J, Bajawi MA, Lan S, Chen F, Liu J. Orbitocranial low-velocity penetrating injury: a personal experience, case series, review of the literature, and proposed management plan. World Neurosurg. 2016; 87:26-34.
[4] Thevi T, Reddy SC. Review of ocular injuries in Malaysia. Malaysian J Public Heal Med. 2017;17(1):69-77.
[5] Madhusudhan AP, Evelyn-Tai LM, Zamri N, Adil H, Wan-Hazabbah WH. Open globe injury in Hospital Universiti Sains Malaysia - A 10-year review. Int J Ophthalmol. 2014;7(3):486-490.
[6] Mallika P, Tan A, Asok T, Faisal H, Aziz S, Intan G. Pattern of ocular trauma in Kuching, Malaysia. Malaysian Fam Physician. 2008;3(3):140–145.
[7] Chew FLM, Qamaruddin F. A West Malaysian study of pediatric ocular trauma. Int Eye Sci. 2016;16(7):1212-1215.
[8] Lucas JP, Allen M, Nguyen BK, Svider PF, Folbe AJ, Carron M. Orbital roof fractures: an evidence-based approach. Facial Plast Surg Aesthet Med. 2020;22(6):471-480.
[9] John PA, Patrick S, Ibrahim M, Hussein A. Traumatic globe displacement into anterior cranial fossa. Mal J Med Health Sci. 2020;16(3):325-327.
[10] Sarkar S, Modi S, Seth AK, Panja S. An unusual transorbital penetrating injury by house-key (lock): A case report with a small review of literature. J Clin Diagn Res. 2015;9(9):PD08-9.
[11] Presetyo E, Oley MC, Samual V, Faruk M. Transorbital-penetrating intracranial injury due to a homemade metal arrow: A case report. Ann Med Surg. 2020;57:183-189.
[12] Kaufman HE, Thomas EL. Prevention and treatment of symblepharon. Am J Ophthalmol. 1979;88:419-423.
[13] Shi W, Wang T, Gao H, Xie L. Management of severe ocular burns with symblepharon. Graefes Arch Clin Exp Ophthalmol. 2009;247:101-106.
[14] Wenkel H, Rummelt V, Naumann GO. Long term results after autologous nasal mucosal transplantation in severe mucus deficiency syndromes. Br J Ophthalmol. 2000;84(3):279-284.