Case Report

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Unusual Transorbital-Penetrating Intracranial Injury by A Metal Bar: A Case Report

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Abstract

The orbit has a fine bony structure and represents the most vulnerable structure in the cranium. Therefore, penetrating orbital injuries are often associated with traumatic brain injury. Although transorbital-penetrating intracranial injury is not commonly encountered in emergency medicine practice, this occurrence has the potential to cause severe and fatal brain injury. In this study, we report the case of a 21-year-old male patient presented with an injury to his left orbit, caused by falling while holding a metal bar. A local examination revealed a perforating injury at the entry location of a metallic bar (S-shaped) that penetrated his left orbit. CT imaging showed the appearance of a metallic foreign body that entered anterior superior to the left orbit, passed into the left half of the frontal sinus, and extended into the intracranial area. The metallic bar was removed by craniotomy. The patient fully recovered and was discharged on postoperative 9th day. The penetration of foreign bodies through the orbitofrontal region is rare but potentially life-threatening. An emergent surgical initiative is necessary to save the life of the patient. When managed in a timely and efficient manner, the associated mortality and morbidity can be reduced.

Key Words: foreign body, penetration, transorbital, intracranial injury

Introduction

Transorbital-penetrating intracranial injury (TOPI) is rare and considered to represent a severe traumatic head injury. Although TOPI is rarely encountered in general emergency department (ED) practice, and cases that present are predominantly accidental injuries. The morbidity and mortality associated with TOPI remain high, and TOPI can result in severe structural and functional damage. TOPI accounts for 0.04% of all traumatic head injuries[1]. TOPI can be the result of either intentional or unintentional events, including gunshot wounds, stab wounds, and motor vehicle or occupational accidents involving nails, screwdrivers, metal poles, ice picks, keys, pencils, chopsticks, and power drills. TOPI is typically the result of a high-speed injury but can also be caused by comparatively insignificant trauma. The orbit is thinner in children than in adults and consists of bony walls that can be easily fractured even by low-velocity penetrating foreign bodies. Because the frontal bone section of the orbital roof is very thin, foreign bodies will most commonly be observed in this area with a certain penetration angle. This condition often results in frontal lobe damage[2].

Neurological disorders such as intracranial bleeding, central nervous system infections, cerebrospinal fluid leakage, cerebrospinal fluid fistulas, pneumocephalus, orbital cellulitis, carotid-cavernous sinus fistula and vascular complications may develop in patients as a result of penetrating head trauma[3]. The prevalence of vascular complications following TOPI has been reported as high as 50%, and this complication can be life-threatening[4]. Surgical treatment is the primary strategy for this type of injury. The mortality rate for TOPI is 33% when timely surgical treatments are applied but increases to 53% in cases where surgery is delayed[5].

In this article, we present a case report of a penetrating, metal, orbitocranial foreign body in a young male patient. Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Case Report

A 21-year-old male patient presented with an injury to his left orbit, caused by falling while holding a metal bar. Local examination revealed a perforating injury at the entry location of a metallic bar (S-shaped) that penetrated his left orbit (Figure 1). Neurological examination revealed a Glasgow Coma Scale of 15/15, and the patient had normal bilateral vision. His left pupil was miotic, reactive to light, anterior segment of cornea intact, and eye movement was normal. Also, no lacerations were found in the sclera and conjunctiva. The examination of the cranial nerves was normal. No other motor or sensory deficits were observed, and the patient's vital signs were within normal ranges.

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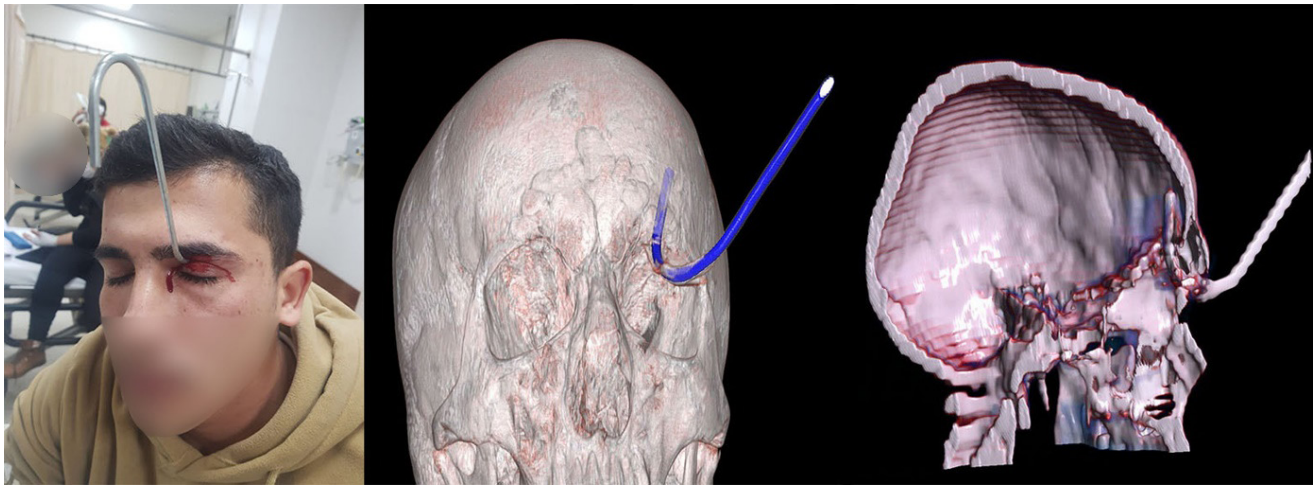

Figure-1: Photograph and a 3-dimensional CT images of the patient who has a perforating injury at the entry location of a metallic bar (S-shaped) that penetrated his left orbit.

Non-contrast computed tomography (CT) and a 3-dimensional (3D) CT scan were performed on the patient because the foreign body extended toward the cranial cavity. CT images revealed a metallic foreign body in the left parietal region (Figure 2). CT and 3D CT imaging showed the appearance of a metallic foreign body that entered anterior superior to the left orbit, passed into the left half of the frontal sinus, and extended into the intracranial area (Figure 1-2). Although the evaluation provided by this imaging sequence was suboptimal due to artifacts introduced by the foreign body, the integrity of the globe and optic nerve appeared to be preserved. The tip of the foreign body extended into the frontal lobe parenchyma, and pneumocephalus was observed near the tip (Figure 2).

In this case, the first approach involved the maintenance of airway, breathing, and circulation, with local hemostasis.

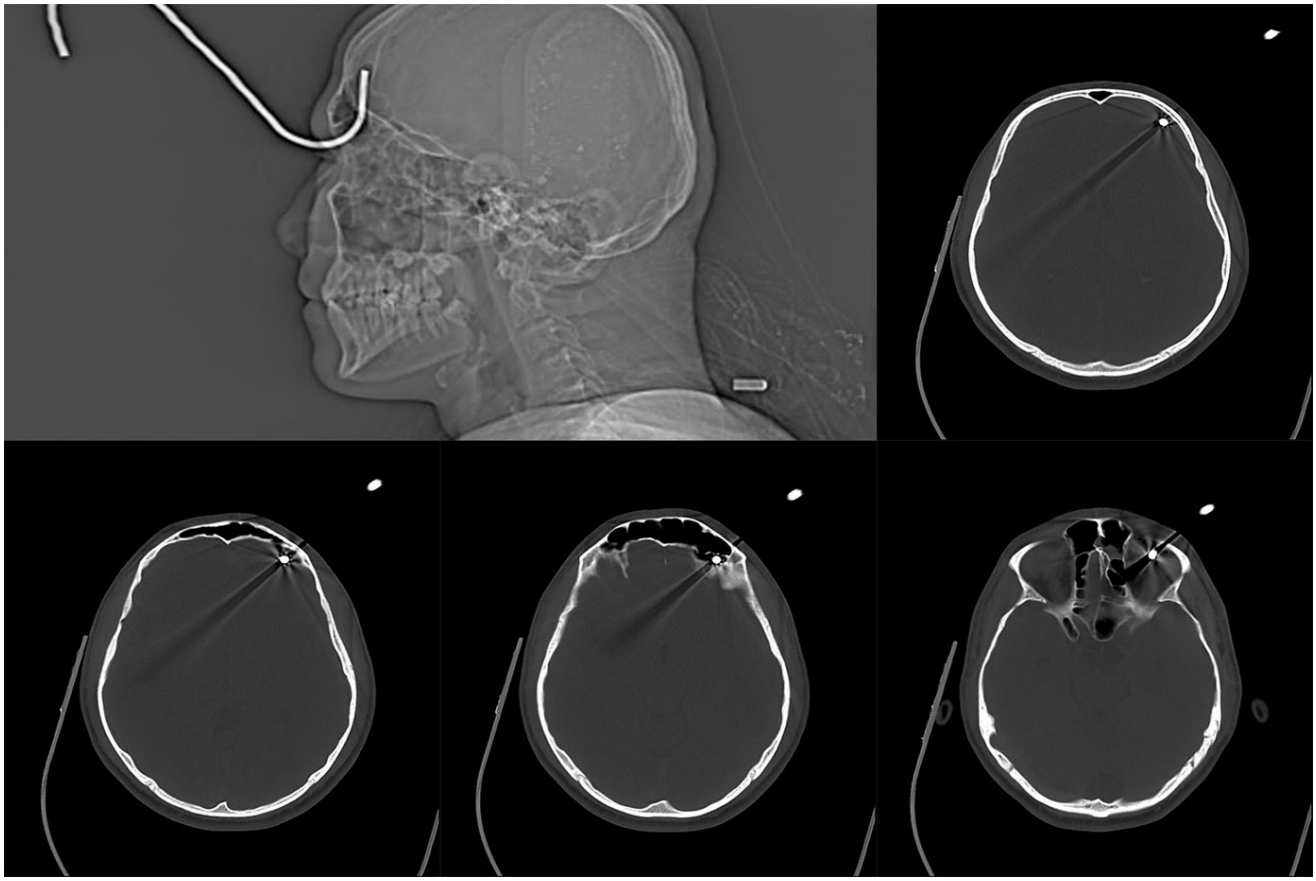

Figure-2: Non-contrast CT scan of head in axial plane showing pneumocephalus and the foreign body.

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Broad-spectrum antibiotic prophylaxis and tetanus vaccination were administered immediately. A consult with neurosurgeons and ophthalmologists was performed, as a result of the evaluations made, the metallic bar was removed by craniotomy by neurosurgeons. The patient fully recovered and was discharged on postoperative 9th day.

Discussion

Although TOPIs are not common, they can cause severe brain damage and significant ophthalmic and neurological disabilities. Therefore, the management of such cases needs a multidisciplinary approach involving both neurosurgeries as well as ophthalmology departments[5]. Previous reports have been published describing intracranial penetration via the orbit with various types of foreign bodies. Penetrating orbitofrontal foreign bodies is more common in males than in females and in younger people than in older people. The management and prognosis of TOPI depend on the composition and localization of the foreign body and the presence of secondary infections.

In TOPI cases, pathophysiology depends on tracing the trajectory of the foreign body through the skull. In these injuries, intracerebral hematoma, cerebral contusion, intraventricular hemorrhage, pneumocephalus, and brain stem damage can be considered immediate complications. Some of these injuries can extend through the cerebellum and brain stem. Penetrating injuries through the superior orbital fissure may affect the III, IV, V, and VI cranial nerves, the arteries of Willis circle, and the carotid artery[6]. The orbit, which is shaped like a quadrangular pyramid, is directed to certain anatomical regions of the intracranial cavity with penetrating foreign bodies. The degree of neurological damage that occurs is associated with the orbital bone anatomy, in addition to the size, shape, and trajectory of the foreign body. Foreign bodies can access the cranial cavity via various routes. Foreign bodies typically penetrate the orbit from the medial canthus, passing through the optic canal and superior orbital fissure before lodging in the ipsilateral or contralateral side of the cranium[7]. Intracranial penetration can occur through the orbital roof due to the fragile structure of the superior orbital fissure of the frontal bone, often resulting in frontal lobe damage[2].

In our case, the metal bar entered anterior superior of the left orbit and passed through the left half of the frontal sinus, extending intracranially. Therefore, our case is an example of injuries in which penetration occurs through the superior orbital fissure. Diagnostic methods that can be used to assess the detection and localization of penetrating orbitofrontal foreign bodies include plain radiographs, ultrasonography (USG), CT, and magnetic resonance imaging (MRI). CT is excellent for identifying high-density impurities such as metal or glass but is not suitable for similarly sized organic objects. MRI allows for accurate localization and provides a better separation of organic foreign bodies from soft tissue but is contraindicated in the presence of a ferromagnetic foreign body[8]. USG has shown promising results, especially in the detection of radiolucent foreign bodies, and its sensitivity of 95% for detecting foreign bodies. However, the biggest disadvantage of USG is the imaging of the air[9]. CT scan is useful and can readily be applied to determine the extent of intraparenchymal injury, identify bony defects in the skull, and locate the foreign body, allowing for the location, position, size, and shape of the foreign body to be accurately reproduced[10]. CT and 3D CT were performed on our patient to provide a detailed analysis of the bone pathology and determine the position and trajectory of the foreign body involved. In this case, CT revealed that the metal bar passed through the roof of the left orbital toward the ipsilateral frontal lobe. In our case, parenchymal damage extending into the frontal lobe and pneumocephalus was observed due to the transorbital penetration of the foreign body.

The most appropriate management of transorbital penetration cases that present to the ED is the retention of the transorbital object *in situ* and the careful transfer of the patient to the surgical department. Metal bars with extracranial components should be carefully surgically removed, and broad-spectrum antibiotic treatment should be initiated. If not treated promptly, these injuries can result in serious neurological damage or even death. Treatment aims to minimize brain damage and prevent mortality by controlling bleeding through early surgical intervention. In our case, because the neurological and radiological investigations showed no vascular injuries, the foreign body was surgically removed. An intensive antibiotic treatment regimen is recommended during both the perioperative and postoperative periods to prevent late infections, which were also applied in our case. Antiepileptic drugs are also recommended during the early stages after injury to prevent seizures and were applied in our case. In our case, during the acute period and in the follow-up evaluations performed one month later, no complications, neurological deficits, or mortality were observed.

In conclusion, the penetration of foreign bodies through the orbitofrontal region is rare but potentially life-threatening. If not treated immediately, TOPIs can result in critical neurological damage or even death. An emergent surgical initiative is necessary to save the life of the patient. We would like to emphasize that radiological imaging is important for both diagnosis and planning appropriate surgical intervention, and patient disability and mortality rates will decrease when a multidisciplinary approach is used.

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