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Case Report

Transbasal penetrating traumatic brain injury caused by a rifle rod: A case report

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ABSTRACT

Background: Penetrating traumatic brain injury (TBI) caused by a low-velocity object is a rare entity with a potential range of critical complications.

Case Description: We report a unique case of a 30-year-old male presenting with penetrating TBI caused by a rifle's cleaning rod. The rod passes through the left nostril to reach the frontal lobe after transgressing the sella turcica. A cranial computed tomography scan shows the extension of brain damage and the trajectory of the rod with no evidence of an associated vascular injury. Surgical removal of the rifle rod was performed using a transnasal approach by a multidisciplinary with the postoperative course went uneventfully.

Conclusion: Transbasal penetrating TBI through the nose is an extremely rare entity. This type of head injury carries its own peculiarities that deviate from the classic treatment algorithms.

Keywords: Skull base, Penetrating head injury, Rifle rod, Traumatic brain injury

INTRODUCTION

Penetrating traumatic brain injury (TBI) through the nose is a rare entity with various potential culprits.[1] The causative object may include metallic rods, pencils, paintbrushes, wooden sticks, chopsticks, wire, nails, umbrellas, scissors, and even tree branches.[2] This type of TBI is clinically significant due to the wide range of complications and the imposed surgical challenges.[3,4] In this paper, we report a case of TBI caused by a rifle cleaning rod, which entered through the left nostril while the patient was doing the weapon maintenance along with its challenging management scenario.

CASE DESCRIPTION

A 30-year-old male was admitted to the surgical department of Al-Anbar Hospital in Iraq due to a complaint of behavioral changes a few days after firing his rifle. The patient had no history

of bleeding, loss of consciousness (Glasgow Coma Scale [GCS] of 15), weakness, or headache. Moreover, there was no clear entry wound. On physical examination, he was vitally stable and conscious but disoriented. Neurological examination was unremarkable in that there was no loss of sensory, motor, or cerebellar function; besides, he had normal reflexes.

Imaging assessment was initially performed using a plain X-ray, which demonstrated the presence of an intracranial foreign body [Figure 1]. Noncontrast head computed tomography (CT) was ordered to confirm the location of the foreign body and to estimate the potential complications of the injury, including intracranial bleeding, air or displaced ossific fragments. It demonstrated a radiopaque foreign body that was the rifle's cleaning rod that entered through the left nasal cavity [Figure 2]. There was soft-tissue edema but no significant intracranial hemorrhage (ICH). The location of the cleaning rod was confirmed to be in the left frontal lobe. A CT angiography would have been a more precise tool to assess vascular lesions, but it could not be performed due to limited resources.

The patient was admitted to the neurosurgery ward. The extraction was done through the same site through a transnasal approach with the assistance of a maxillofacial surgeon and otolaryngologists. The closure was performed through layers using a septal flap and fat. Postoperative imaging showed no ICH with a GCS of 15. Further management included prophylactic antibiotics and antiepileptic medications throughout the follow-up period, which was uneventful.

DISCUSSION

Although transnasal TBI represents one of the most severe traumatic brain injuries,[1,4] the outcome was very fortunate for the mentioned patient. TBIs can affect people of all age groups and are a major cause of morbidity and mortality, with an incidence of approximately 10 million people worldwide. Intracranial injuries caused by penetrating foreign bodies are relatively rare. Although injuries caused by guns, hunting rifles, and other "high-velocity" weapons have been well-illustrated in the literature, incidents caused by "low-velocity" objects are considered uncommon.[5,6] About 70–90% of the penetrating TBI victims die before reaching the hospital, and 50% of those who survive to die during resuscitation in the emergency department.[7-9]

In this patient, the rifle cleaning rod accidentally sprang out and penetrated his left nostril during his gun maintenance. Additional examples of unintentional firearm accidents could result from poor weapon handling, inadequate weapon safety measures, and incidental child handling of a firearm.[8,10] There is a significant variation in the documented penetrating brain injuries due to unusual equipment, including; nails, stones, screws, wooden sticks, metallic rods, chopsticks, hooks, pencils, crochet hooks, and arrows. Since different injury patterns can result from such different case scenarios, there is no standardized management for penetrating brain injuries. Each case is unique, and treatment should be individualized in addition to the general management principles.[6]

However, in first aid response, foreign bodies should be left *in situ* until proper diagnostic tools are available. The foreign

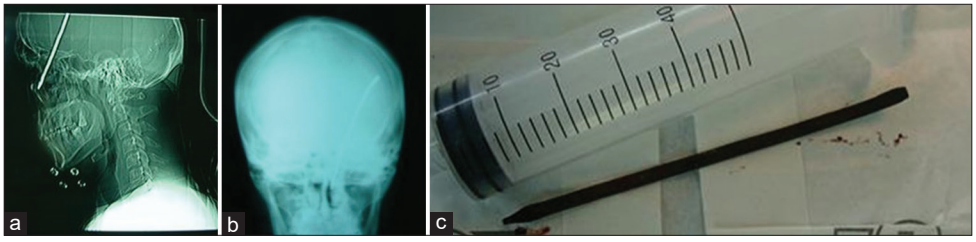

Figure 1: (a) A skull X-ray (lateral view) reveals the presence of a rifle rod. (b) A skull X-ray (posteroanterior view) shows the penetrating rifle rod. (c) The extracted object (rifle rod).

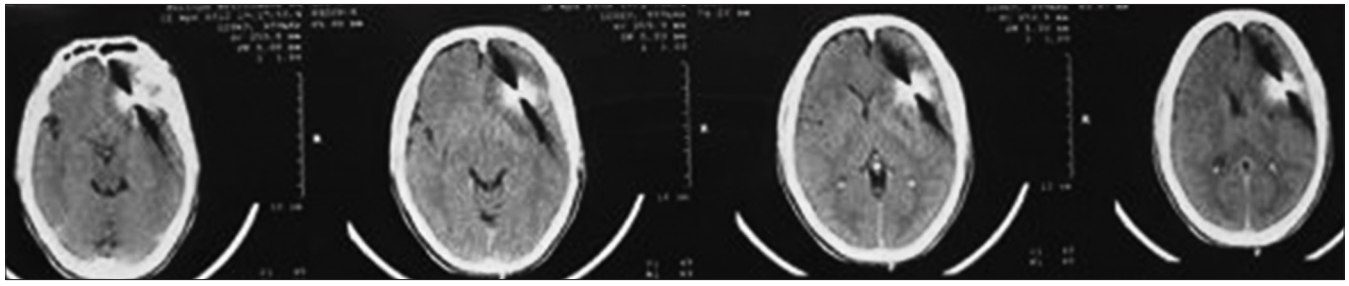

Figure 2: Head axial CT images in parenchyma window showing the rifle rod penetrating from inferior to superior through the skull base to the left frontal lobe with a metallic artifact.

bodies might prevent significant bleeding by acting as a tamponade.[11,12] Nevertheless, after adequate resuscitation following the advanced trauma life support (ATLS) protocol, intracranial foreign bodies opt to be removed to avoid morbid immune response complications and acute or chronic infection. In this report, the patient received the first aid response according to the ATLS protocol; despite the limited resources of diagnostic equipment.

The uneventful history of the patient and the absence of wound entry made the diagnosis more difficult. However, the behavioral changes and social history of firearm acquisition led to a more focused differential diagnosis. Radiological imaging was ordered for the confirmation of diagnosis. Notably, a CT scan can localize different intracranial lesions, estimate the depth of injury, and reveal ossific fractures and the extent of parenchymal damage; therefore, it is considered the gold standard diagnostic tool for evaluating penetrating TBIs.[1] Because of the risk of metallic foreign body migration, magnetic resonance imaging is not usually recommended unless the ferromagnetic nature of the artifact has been excluded.[3] Moreover, for optimum estimation of vascular lesions, a CT angiography should be requested. However, in our case, there were no valid resources in the town, and the referral system would take days to arrive at a well-equipped center. Therefore, careful surgical removal of the foreign body has been made.

The management of the patient started in the emergency room with advanced trauma care according to ATLS guidelines. The patient was then taken to the operating room and started broad-spectrum antibiotic coverage with the third generation of cephalosporins and metronidazole. Craniotomy has the advantages of early visualization with the protection of neurovascular structures, controlled object removal, accessible debridement of the devitalized brain tissue, associated hematoma emptying, and adequate dural reparation. The optimum approach would be a combined transnasal and transcranial approach according to the vascular injury extension. Thus, if there was an injury to the anterior cerebral artery, the combined approach would be transnasal and transfrontal.

In contrast, if the middle cerebral artery is injured, the pterional approach combined with the transnasal approach would be effective. To avoid infection complications and further tissue damage, urgent surgery was performed with the transnasal approach without a vascular study. To overcome this obstacle, surgical step modification was planned after collaborating with the attending neurosurgeon, maxillofacial surgeon, and otolaryngologist. These modifications include drilling 0.5 cm bone on the periphery of the metallic nail, followed by the intact frontobasal dura opening at the rod's periphery for proper visualization of the surgical field. A careful extraction was performed with the aid of a pressure monitor for rapid detection of any vascular impairment of the internal carotid artery and circle of Willis. The nail was successfully extracted with no intraoperative bleeding. Hemostasis and field washing were done. After that, the frontobasal dura was repaired layer by layer, followed by an autogenous bone graft.

The postoperative course was uneventful; after 2 days of close observation, his GCS was 15. However, the patient was scheduled for a follow-up every 6 months for a thorough neurological assessment.

Severe complications of intracranial foreign bodies include abscess formation, cerebrospinal fluid fistulas, posttraumatic seizure foci, ICH, vascular injuries, and infection.[13,14] The most devastating complication is related to vascular injury. For instance, cerebral artery vasospasm is due to subarachnoid hemorrhage and traumatic intracranial aneurysm formation.[15] Regarding infection, *Staphylococcus aureus* is considered the most frequent pathogenic agent in intracranial infections after a penetrating brain injury.[16] Usually, the development of infection will occur within 6 weeks after a penetrating brain injury. Approximately 55% of infections occur during the first 3 weeks and 90% within 6 weeks.[16] Prophylactic antibiotic use should be determined individually, considering the patient's overall risk of infection, and collaboration with the infectious disease department is strongly advised.[15] The recommended course duration of antibiotics is 10–14 days, while for anticonvulsant drugs is at least 6–12 months.[17] Moreover, tetanus vaccination should also be administered as a routine prophylactic measure in traumatic head injuries.[18]

In summary, managing cases of penetrating TBI caused by unusual low-velocity penetrating tools do not follow a typical plan. Therefore, treatment should be individualized according to the severity of the injury and the specific type of insult.

CONCLUSION

Penetrating brain injury caused by unusual tools has characteristics that are different from high-velocity penetrating TBI. In this study, removing the rifle cleaning rod was challenging and required a multidisciplinary team, including neurosurgeons, otolaryngologists, and maxillofacial surgeons, to plan the treatment and accomplish a good outcome.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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