




Unusual Case of Low-Velocity Large Object Penetrating the Frontal Bone with Favorable Outcome: A Case Report in Pediatric Patient

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Abstract

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BACKGROUND: Penetrating head injury is one of the deadliest forms of head trauma; the outcome is usually low, and patients who survive long enough require complex medical treatment. Immediate imaging assessment with appropriate management can improve patient recovery.

CASE REPORT: We reported a case of head penetration trauma on a 12-year-old child with embedded cylindrical iron that enters the skull without any signs of neurological deficit.

CONCLUSIONS: This case shows that aggressive diagnostic imaging and emergency care followed by proper immediate head surgery management and postoperative intensive care to monitor and intervene in possible surgical and medical complications could significantly improve patient outcomes.

Introduction

Penetrating head injury or penetrating traumatic brain injury (TBI) is a type of injury in which a missile breaches the skull but does not exit it [1]. Penetrating TBI cases are rare which about 0.4% of all of head injuries and have high morbidity and mortality [2]. Most of the literature regarding penetrating TBI were rare in accordance with the number of occurrences [3]. In low and middle-income countries, TBI is the leading cause of trauma-related death and disability [4].

Penetrating TBI can be divided into low-velocity and high-velocity injuries. A speed of 300 m/s is considered the cut-off between low- and high-velocity injuries [5]. In this case report, we present low-velocity injury of penetrating TBI. Cases of penetrating TBI caused by nonmissile, low-velocity objects frequently occur accidentally. Low-velocity penetrating TBI depicts a unique pathology with a more favorable outcome due to the localized primary injury [6], [7].

Immediate radiological examination is mandatory to determine the extent of head penetration, the penetrating foreign body's location, and the necessity for surgery. Skull plain X-ray, although of less importance, can indicate the location of the foreign body and shows the nature of the depressed skull fragments.

In this situation, the essential radiological diagnostic tool is the brain computed tomography (CT) scan for both the soft tissue and bone windows. It can show any associated hematomas, brain contusions, and the extent of skull injury, thus aiding the management plan [8], [9], [10].

Case Report

A 12-year-old girl, about 9 h before admission, was practicing the marching band routine. During the exercise, the trainer threw the majorette stick up, but the stick hit the ceiling and broke, then one of the broken parts fell into and stuck in the patient's forehead. The strike was strong enough to be embedded about 1 cm deep into the frontal bone. There was minimal bleeding at the time of the incident. The patient remains alert in a panic condition (Figure 1). Since the incident, there was no altered mental state, neither seizure, and bleeding from the nose or ears (Figure 2). The patient vomited 3 times and nonprojectile. The patient was then referred to our hospital.

The head CT scan revealed fractures in the frontal bone with a minimal impression; no brain



Figure 1: State of the patient during the computed tomography scan. The patient is cooperative and calm. The majorette stick is held manually during the examination to maintain its position

pathology was found (Figures 3 and 4). After the CT scan was conducted, the neurosurgeon could efficiently plan the surgery to extract the stick. After surgical extraction, the patient was observed and treated for



Figure 2: Patient' position while waiting for the examination process

5 days without any symptoms of neurological deficits, and the patient was finally allowed to go home.

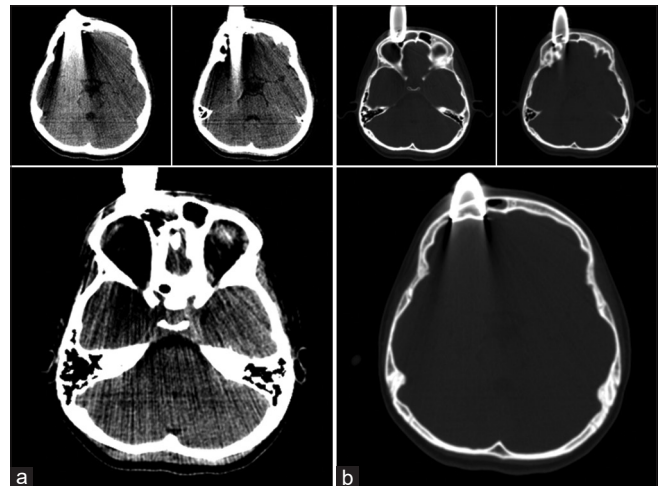


Figure 3: Non-contrast head computed tomography axial plane (a) brain and a (b) bone window showed the extent of the object and the brain structure involved

One of the problems we faced when performing the CT scan is the foreign object stuck in the head was long enough so that it is difficult to position the patient to fit in the CT scan gantry.

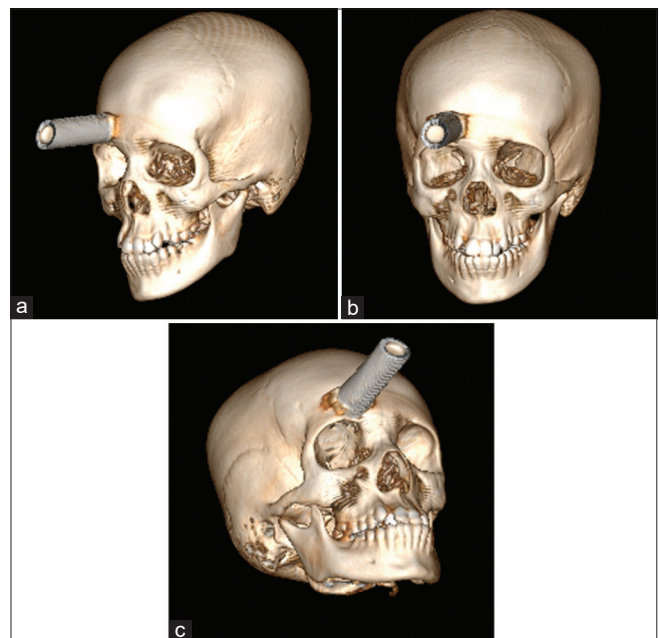


Figure 4: (a-c) Three-dimensional reconstruction of the head computed tomography showed the shape and exact location of the object

Discussion

Mass and velocity determine the severity of the injury [11]. Most missile objects other than bullets provide less and more localized damage to the skull and brain because of their lower velocity [12]. In our case, the object penetrates using the kinetic energy

generated from its mass, considering its low-velocity setting, which is quite rare.

Penetrating TBI injuries can be classified into tangential wounds, penetrating wounds, perforating wounds, ricochet, and careening (Figure 5) [12]. Assessing the types of penetrating TBI can help with surgery planning, especially to anticipate complications and stratify prognosis [13]. Judging by its morphology, the penetrating TBI that occurred in our patient was a penetrating wound, although there was no clinical nor radiological brain involvement. In our case, the object was a majorette stick, fell with enough velocity to penetrate the frontal bone but leave the brain parenchyma intact.

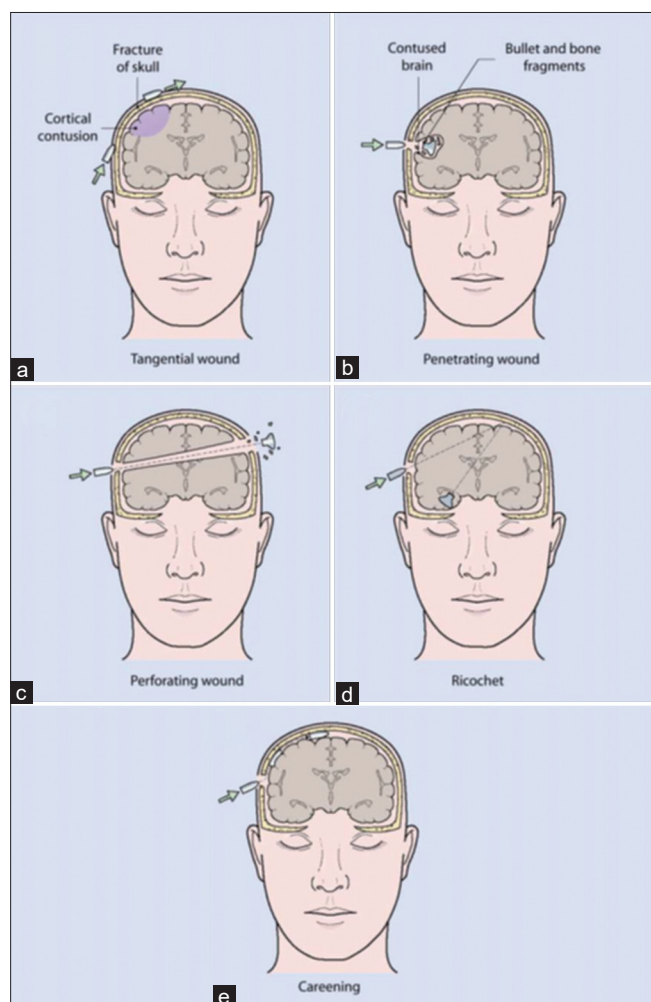


Figure 5: (a-e) Classification of penetrating traumatic brain injury (AbdulAzeez et al.)

TBI clinical features include prolonged coma, headache, nausea, aphasia, seizures, amnesia, and behavioral abnormalities such as aggression and anxiety, which occur within seconds to minutes after TBI; however, some of these manifestations can persist up to a more extended period [14].

CT scan had been reviewed and accepted as the modality of choice for imaging evaluation of the acute TBI [15]. It is non-invasive and widely accessible instrument and has few contraindications. CT

advantages for TBI assessment include its sensitivity for confirming acute hemorrhage, mass effect, ventricle size, and fractures. Disadvantages include its low sensitivity for detecting small non-hemorrhagic lesions such as contusions and diffuse axonal injuries and early ischemic encephalopathy [16]. CT with three-dimensional reconstruction can fully show the shape, size, length, direction, and position of the object in three dimensions, which is beneficial for effective surgery planning [7].

The incidence of any neurosurgery intervention in the general pediatric trauma population is small, ranging roughly from 0% to 8% [17]. In accordance with our case, several studies have tried to predict which imaging or clinical findings in children with GCS scores ≥ 14 would require neurosurgical involvement. Mackel *et al.* showed that intracranial findings or decrease of consciousness might be predictive for future intervention [18]. Addiouli *et al.* reported that only 4.4% of 180 patients required neurosurgical intervention [19]. These studies suggest that the typical fracture requiring neurosurgical intervention results from a severe injury mechanism, neurological deficits, and obvious skull fracture. In our case, we could identify the frontal fracture and severe mechanism of injury, despite no neurological deficit nor altered mental status. Even with a seemingly severe kind of penetrating injury, the CT revealed no critical findings other than the frontal bone fracture. All of that emphasizes the importance of cross-sectional imaging in emergency TBI.

Conclusions

The patient was discharged in good condition without any neurological deficits or disabilities. It took more than 8 h, beginning at the initial complex evaluation process, to foreign body extraction surgery. Ours is a unique case where a foreign object that penetrates the head could cause far more critical injury to the brain tissue, resulting in most cases. Radiological examination is one of the main workups that play an essential role in supporting planning complex surgery.

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