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Case Report

Removal Technique of Penetrating Nail in Head: A Case Report

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Abstract

Objective: To present a unique case involving a 44-year-old man who sustained a penetrating head injury after nailing his head with a hammer. Despite the severity of his injury, the patient underwent successful surgical treatment and experienced a good recovery.

Methods: Clinical and imagery review was performed on a cranial puncture trauma caused by a metal nail, which penetrated the cranium, dura mater, right parietal cerebral parenchyma, and right ventricle. The nail was lodging next to midline without damaging the superior sagittal sinus. The patient underwent craniotomy nail removal and debridement with normal saline and metronidazole antibiotics.

Results: Craniotomy, careful nail extraction, wound debridement, and duraplasty remain the treatment standard for penetrating nail injury in the head. Patient in this case study did not exhibit any signs of neurologic deficit or infection.

Conclusion: Proper diagnosis and treatment are required in patients with penetrating brain trauma, with head x-rays and CT scans help in evaluating vascular depth and damage. Craniotomy and debridement are the main treatments for this type of trauma.

Keywords: Nails, head injury, surgery

Introduction

Since the 1980s, the utilization of nail guns has been widespread due to their efficiency in increasing the productivity. However, their usage has also been associated with a rise in injury incidents. According to reports, there are approximately 5,000 cases of injuries caused by pneumatic nail guns per year in the United States between 1991 and 1993. This number then significantly increases to as high as 15,000 cases per year from 2001 to 2003. Penetrated brain injury is a challenge in the case of brain surgery because this trauma can cause damage to the blood vessels of the brain. Complications arising from this condition may involve bleeding and thrombosis, both of which can cause additional neurological deficits, such as paresis or seizures. Furthermore, in cases where the bleeding or infarct is extensive, there may be an increase in intracranial pressure leading to further complications. Cases of nail injuries have a better prognosis than cases of penetrated brain injury by a knife or bullet. The surgical procedure to remove the nail not only addresses the physical trauma but also serves as a means to prevent potential infections, such as meningitis or encephalitis, which can have severe consequences. Ideally, surgery for penetrating brain injuries should be conducted within 12 hours, especially in cases where there are no signs of mass effect or active bleeding. Therefore, comprehensive treatment and follow-up care are essential for ensuring the best possible outcomes.[1,2]

Generally, surgical interventions applied for penetrating brain injury primarily focuses on treating mass effect and decreasing the risk of infectious complications. Small entrance wounds to the scalp and skull can be managed with local wound care; however, larger or more complex injuries may require extensive debridement with subsequent primary closure or grafting to achieve a watertight closure.

Routine removal of small bone and missile fragments is not recommended due to the associated high morbidity. Delayed removal of contaminated foreign bodies like wood has been linked to higher rates of complications compared to immediate surgical intervention. People with psychiatric disorders such as schizophrenia and major depressive disorder have been associated with previous cases of intracranial nail gun injuries. It is therefore recommended that psychiatric services be involved in the diagnosis and management of any suicide attempt survivors during and after their injury treatment. This underscores the importance of ongoing mental health maintenance and follow-up.[33]

Case

A 44-year-old man was brought by his family to the ER with a penetrating nail his head due to accident with a hammer. The patient was conscious but complained of headaches and hallucinations. A head CT-scan was performed, resulting an image of an elongated metallic foreign body with a defect in the right parietal bone penetrating through the right parietal lobe and right ventricle (Fig. 1). On blood examination, there was leukocytosis (19.18 thousand/uL) with predominant neutrophils (76.9%).

The patient had a history of trauma from falling two years ago during a flood that caused the patient to suffer brain contusion. At that time, the patient complained of headache, without neurological deficit. He was treated at the stroke center for 3 days and then moved to the inpatient room for one week. The patient continued working after returning. In the following month after the incident, the patient's family complained of changes in the patient's attitude, mood, and memories, which often happened repeatedly. The patient also had hand an attempt to kill himself by slashing his hand because he heard whispers. The patient routinely visited a psychiatrist with diagnosis

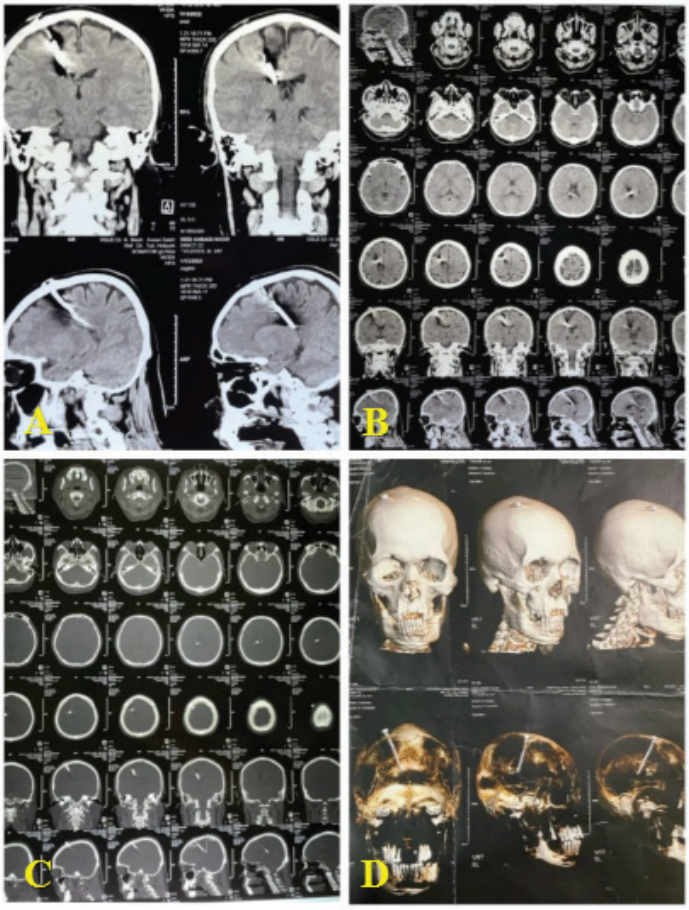

Fig. 1 Patient Head CT Scan Pre-Operation (A-D)

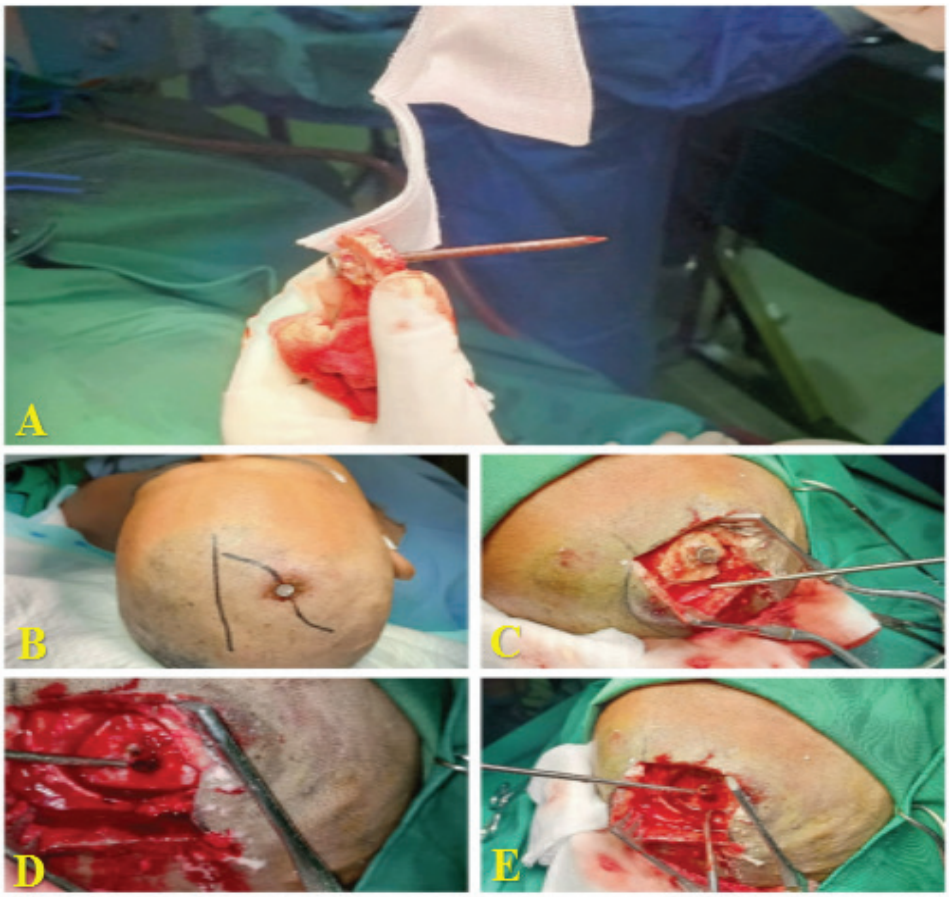

Fig. 2 Durante Operation Pictures (A-E). The nail and bone has been extracted (A). Design of the incision with lazy s incision and play close attention to superior sagittal sinus (B). Craniotomy around the nail perimeter (C). The nail track was debrided and control bleeding (D-E).

organic mental disorder. His total score for the mini mental status examination (MMSE) was 23 with the impression of moderate cognitive-dementia impairment. The patient also did a clock drawing test (CDT) and could only draw a closed circle.

The surgery was performed 12 hours after the patient was pierced by the nail. Prior the surgery, the patient received broad-spectrum antibiotics, Ceftriaxone IV 2x1 gr; anticonvulsants, phenytoin IV 3x100 mg; tetanus immunoglobulin IM 250 IU; as well as tetanus toxoid IM 0.5 ml.

The patient was placed in supine position under general anesthesia with endotracheal intubation. His hair was shaved and then treated for antisepsis with povidone-iodine, and the operating field was narrowed with a sterile dressing. Marking was done in the operating area followed by a lazy S incision up to the cranium. After that, a retractor was placed on the skin and a 2 cm en block craniotomy was performed around the nail perimeter by avoiding the superior sagittal sinus. Cranium was lifted along with the nail (Fig. 2).

The nail track was evaluated, debrided, washed with normal saline around the nail track, and flushed with metronidazole into the track. Bleeding was evaluated and controlled using a hemostatic sponge. Duraplasty was the performed and the operation was completed. A post-operative head CT scan was then done (Fig. 3).

After the surgery, the patient immediately regained consciousness. He was then treated in the intensive care unit (ICU) for two days. The post-operative head CT scan showed a post-puncture intracranial wound with intracerebral hemorrhage and perifocal

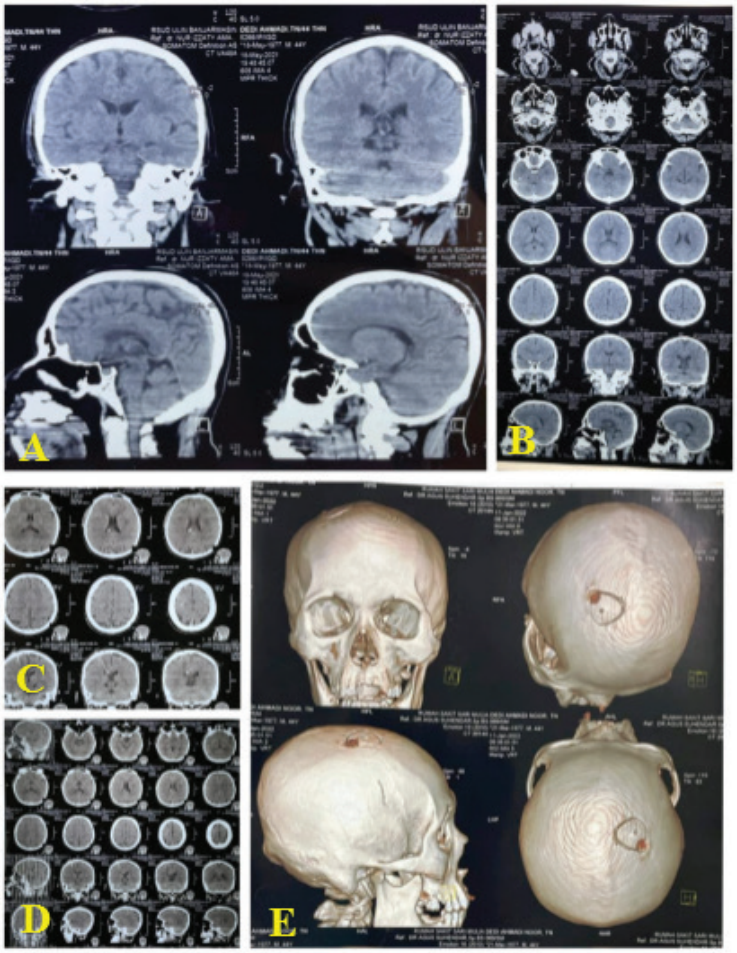

Fig. 3 Patient Head CT Scan Post Operation (A-E)

vasogenic edema (Fig. 3). The patient went home after 11 days of treatment at the hospital with no complaints of seizure, tetanus, or meningitis. He took a sick leave 3 months and continued treatment at the psychiatric department.

Discussion

Head trauma due to foreign body penetration is less common than closed head trauma but has a worse prognosis.[1] Penetrating head trauma can be classified as a missile or non-missile injury. The difference between a missile and a non-missile is, missile trauma has velocities of more than 100 m/s causing damage by heat and kinetic trauma. Missile trauma has worse morbidity and mortality. Non-missile trauma has a lower velocity and usually causes tissue laceration and maceration. Although non-missile trauma is less common this trauma has a better prognosis and effect on treatment.[3] Non-missile trauma is usually caused by accidents, crimes, and attempted suicides. In this case, the patient had non-missile trauma caused by attempted suicide. According to the literature in developing countries, it is reported that there are many nail penetration traumas with the intention of suicide.[4]

Diagnosing brain trauma requires detailed history taking, physical examination, and investigations. X-ray photos are useful for diagnosing trauma caused by metal materials. Investigations with head CT scans are useful for evaluating foreign bodies and predicting the depth of foreign bodies, besides that, a head CT scans can be useful for monitoring postoperative complications. MRI examination is very limited for diagnosing metallic foreign bodies because of the ferrous content of the metallic material. CT angiography is usually performed in cases of penetrating trauma to

look for vascular complications.[5,6] In this case, CT angiography was not performed due to limited facilities at our center.

Craniotomy remains the preferred method of neurosurgical treatment for penetrating foreign body injuries, as it is associated with fewer complications compared to blind removal. Reports indicate that blind removal of foreign bodies can result in subdural hematoma and intraparenchymal hemorrhages. To ensure safe removal, the craniotomy should be performed around the area where the foreign body entered. Bone fragments should also be removed with the aid of brain navigation if required, and the area should be thoroughly cleaned to prevent brain abscess formation.[7]

The operations performed are aimed at removing the foreign body as soon as possible, removing bone fragments, focal debridement of nail track, decompression of neovascular structures, hemostasis, and duramater repair.[8] In this case, nails were taken and debridement was performed using normal saline and metronidazole antibiotics. After confirming that there was no bleeding, a duraplasty was performed to prevent cerebral fistula.

No specific antibiotics for treatment of penetrating trauma caused by nail has been identified. The treatment for this patient was immediate and identical to the approaches in several similar case reports. Broad spectrum antibiotic therapy, vaccination, craniotomy, careful nail extraction, wound debridement, and duraplasty was performed. Complications such as meningitis and cerebral abscess increase in patients with penetrating brain trauma due to contaminations with foreign bodies, skin, and bone fragments carried by the brain parenchyma along the wound track.[9,10] *Staphylococcus aureus* and gram-negative bacteria have been reported to be associated with secondary infections.[3] Recent guidelines recommend the use of ceftriaxone, metronidazole, or vancomycin for 7-14 days in cases like our patient. However, some sources argue that antibiotics should not be used as a preventative measure unless there is a known bacterial source or a specific clinical need. At present, there is limited high-quality evidence from randomized controlled trials to guide treatment, indicating the need for further research in this area. In our case, we used ceftriaxone and metronidazole as therapeutic. Antibiotics were continued for up to 2 weeks postoperatively.[11]

The prognosis for patients with penetrating brain trauma is usually good if the cerebral vessels and brainstem are not involved. In this case, a good outcome is obtained in the patient because the injury did not involve blood vessels and brainstem.[2] Whether antiepileptic drugs should be used to prevent seizures after penetrating traumatic brain injury remains a controversial issue. Early seizures (within 1 week of injury) occur in 6 to 10% of cases, and this percentage can increase to 53% in those with penetrating head injury. The surgical critical care guidelines committee issued a set of recommendations in 2017 that suggest ant seizure prophylaxis should only be given to patients with severe TBI, such as those with a brain contusion, intracranial hematoma, loss of consciousness, posttraumatic amnesia for more than 24 hours, or a GCS score of 3 to 8.[12] The patient did not complain of headaches or seizures when he was discharged. Late seizure cannot be evaluated because the patient died due to kidney and heart failure 9 months after the surgery. No study has reported the rate of tetanus incidence in penetrating brain injury yet, and the tetanus prophylaxis administered to this patient was for preventive measures.

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