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Self-Ambulating Patient with a Penetrating Cranial Injury: A Case of Left Parietal Transcalvarial Stab Wound

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Abstract

An 18-year-old male presented to the emergency department with a stab injury to the left parietal region, sustained from a knife still lodged in the skull. He was fully conscious (GCS 15/15), hemodynamically stable, and without neurological deficits. CT imaging revealed a metallic foreign body penetrating the parietal lobe with minimal hemorrhage, likely due to a tamponade effect. The patient underwent urgent craniectomy under general anesthesia, allowing controlled extraction of the knife while minimizing secondary injury and sudden decompression bleeding.

Intraoperative inspection confirmed no major vascular injury, and meticulous hemostasis was achieved. Postoperative recovery was uneventful, with no new deficits or intracranial infection. Broad-spectrum antibiotics, seizure prophylaxis, and analgesia were administered, and follow-up imaging demonstrated resolving edema without hemorrhage. This case highlights the importance of careful preoperative planning, maintenance of the penetrating object until surgery, and meticulous operative technique in managing penetrating brain injuries.

Keywords: Penetrating brain injury; Stab wound; Craniectomy; Tamponade effect; Neurosurgical management; Head trauma

Abbreviations: PBIs: Penetrating Brain Injuries; PSBIs: Penetrating Stab Brain Injuries; GCS: Glasgow Coma Scale; ABC: Airway, Breathing, and Circulation; CT: Computed tomography

Introduction

Penetrating brain injuries (PBIs) are uncommon, constituting 0.4% of head injury [1]. Several foreign bodies such as wooden chopsticks, forks, knives, and umbrella tips have been documented in such injuries [1]. Some are due to accidents, but most are due to violence, particularly those that are caused by thrusting injuries such as knives [2]. Young males are predominantly affected, most of whom get such injuries due to assaults or road traffic accidents [3]. Penetrating stab brain injuries (PSBIs), typically caused by high-velocity instruments, have very high mortality rates [4]. Stab wounds are responsible for 7.3% of all cases of assault, with 3.2% being the rate of mortality. Although head wounds occur most commonly, chest injuries have the highest chance of death [5].

This case report outlines an unusual case of a self-ambulating patient with a penetrating cranial injury resulting from a left parietal transcalvarial stab wound. The patient was neurologically intact on arrival, despite the severity of the trauma, illustrating the

unpredictable nature of such injuries. This report covers clinical presentation, imaging characteristics, surgical intervention, and post-operative course, with special emphasis on the need for early assessment and multidisciplinary management of penetrating brain injuries.

Case Presentation

Case History & Examination

An 18-year-old male came to the emergency room with a stab injury to the left parietal area with a knife. The patient came alone to the hospital and was alert, and the Glasgow Coma Scale (GCS) was 15/15. The patient did not have a history of loss of consciousness, nausea, vomiting, seizures, or focal neurological deficit. The patient had no retrograde or anterograde amnesia, and walked into the hospital unaided, even with a penetrating brain injury. This preservation of consciousness and memory suggests that critical cortical and subcortical structures responsible for awareness and cognition were intact.

His primary complaint was continued bleeding from the wound site. Airway, breathing, and circulation (ABC) were assessed upon arrival and were normal. The patient was hemodynamically stable and had no respiratory distress or shock. Intravenous access was obtained, and the patient was started on IV fluids, broad-spectrum antibiotics (ceftriaxone and metronidazole), and tetanus prophylaxis. On physical examination, a metallic object (knife) was seen penetrating the left parietal bone, with a linear wound at the entry point.

Differential Diagnosis

Given the nature of the injury, the primary concern was penetrating brain injury with potential complications, including: Intracranial hemorrhage (epidural, subdural, intraparenchymal, or subarachnoid), traumatic brain injury (concussion or contusion), Vascular injury (arterial or venous damage leading to stroke or hemorrhage), Skull fracture with or without depressed bone fragments and Infection risk (meningitis, brain abscess, or osteomyelitis).

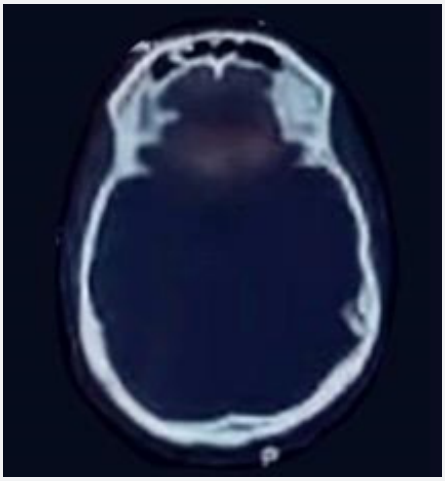

Figure 1(A): Left parietal bone penetration.

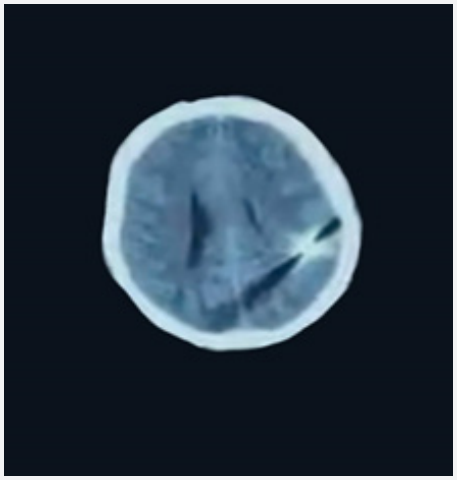

Figure 1(B): Minimal hemorrhage, likely due to the tamponade effect.

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Investigations

A preoperative CT scan confirmed a metallic foreign body (sharp knife) extending into the parietal lobe of the brain (Figure 1A). Characteristically, there was very little hemorrhage, most probably a result of the tamponade effect of the retained knife. Tamponade effect is that effect of the penetrating object that compresses the surrounding vessels and tissue, temporarily preventing profuse bleeding. No extensive vascular injury, midline shift, or mass effect was noted (Figure 1B and 1C).

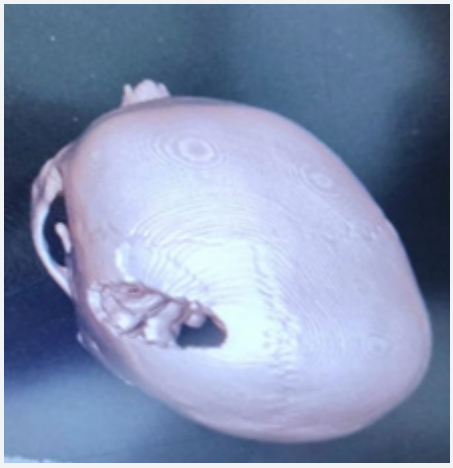

Figure 1(C): 3D reconstruction showing the penetration site.

Treatment

Given the risk of exacerbating hemorrhage, the knife was left in place until surgical removal could be performed under control conditions. The patient was transferred to the operating room, and under general anesthesia, a linear skin incision was made along the wound tract. A careful craniectomy was performed, avoiding excessive manipulation of the knife to prevent secondary brain injury or sudden decompression bleeding. A linear scalp incision was extended along the initial wound to provide adequate exposure (Figure 2A). The scalp and periosteum were carefully retracted using multiple hemostatic forceps to expose the underlying bone and the embedded knife.

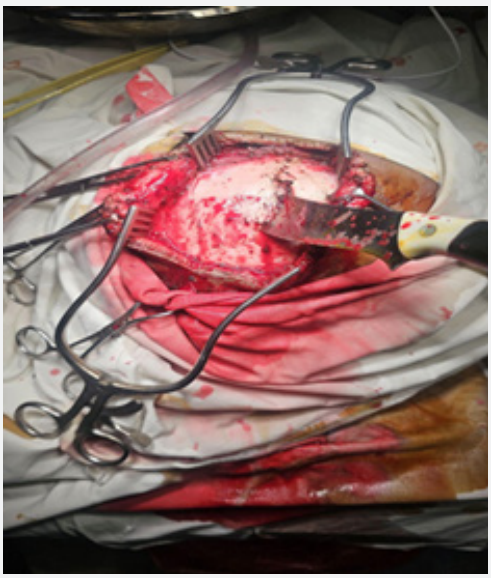

Figure 2(A): Craniectomy procedural images showing knife penetration in the left parietal region.

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Figure 2(B): Application of bipolar electrocautery for hemostasis.

With a high-speed drill and Kerrison rongeurs, the craniectomy involved the removal of the involved bone segment to create a bony window to provide a safe path for knife removal with alleviation of any intracranial pressure. The knife blade was clamped with surgical clamps to allow stable removal. Bipolar electrocautery was applied for hemostasis to avoid excessive bleeding (Figure 2B). The tissue around it was dissected gently to avoid further trauma before the controlled removal. The knife was then slowly withdrawn along its path of entry to avoid further injury to the brain parenchyma. Once removed, the dura was checked for laceration or active bleeding, and the brain parenchyma was checked for vascular damage (Figure 2C).

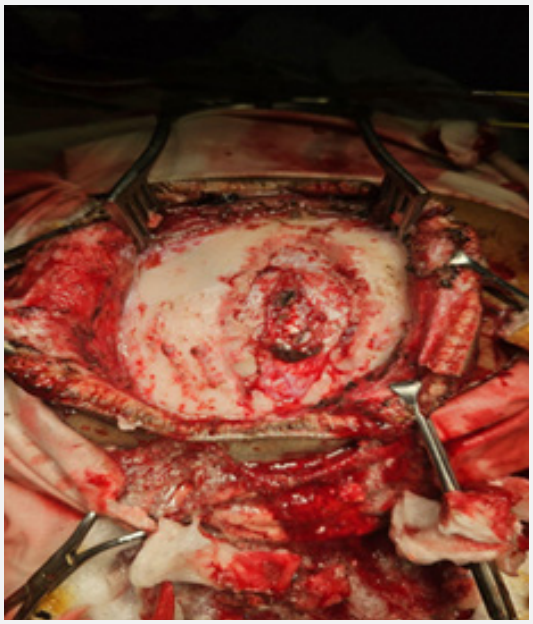

Figure 2(C): Penetrating site after knife removal.

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Hemostasis was secured and the wound irrigated prior to closure, with no retained bone fragments or foreign material Hemostatic agents and bipolar coagulation were applied as necessary for control of minor oozing. The wound was irrigated with sterile saline to minimize the chance of infection. The incision was closed in layers, maintaining proper wound closure with drainage as needed. This was done to ensure safe extraction of the intruding object with minimal secondary trauma to the brain and surrounding tissues. After the operation, the patient was very closely observed in the neurosurgical ward for neurological deterioration.

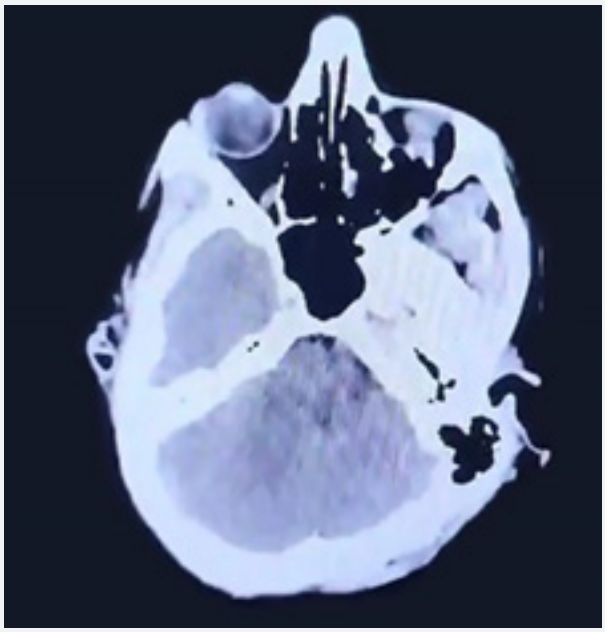

Figure 3(A): Postoperative CT scan image showing penetrating site after removal of the foreign body.

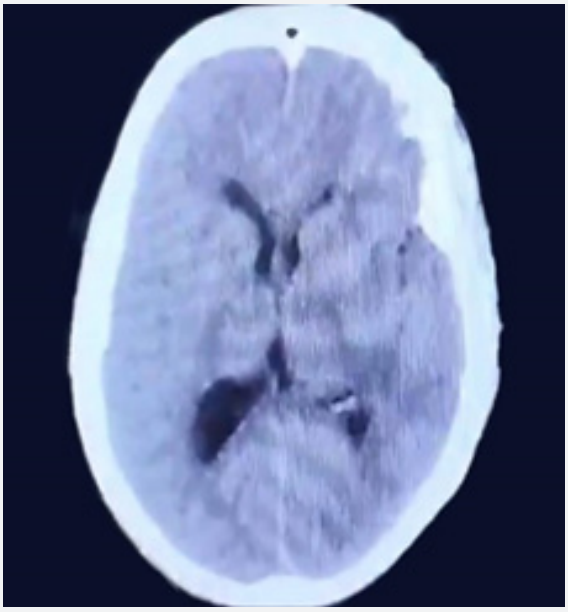

Figure 3(B): Resolving edema with no hemorrhage or mass effect.

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Outcome & Follow-Up

Glasgow Coma Scale (GCS) was evaluated on a regular basis, and serial neurological examinations were done to find out any developing deficits. Postoperative CT scan was done, which showed resolving edema with no sign of new hemorrhage, vascular damage, or mass effect (Figure 3A, 3B). Since the injury was penetrating, intravenous broad-spectrum antibiotics (ceftriaxone and metronidazole) for 5-7 days were started to avoid intracranial infections such as meningitis and brain abscess. Levetiracetam seizure prophylaxis was given because of the risk of post-traumatic epilepsy from penetrating brain injury. Intravenous analgesics were used to manage pain without excessive sedation.

The patient was kept hemodynamically stable, and head elevation at 30 degrees was continued to ensure optimal venous drainage and intracranial pressure reduction. The preoperative CT scan revealed minimal hemorrhage at the site of injury, presumably because of the tamponade effect of the lodged knife, which occluded active bleeding by applying local pressure on the injured vessels. Nevertheless, intraoperative careful hemostasis was achieved to avoid secondary hemorrhage upon removal. The wound was maintained clean with aseptic dressing changes, and tetanus prophylaxis was administered postoperatively. No evidence of surgical site infection or intracranial pressure rise was noted during hospitalization. With the lack of neurological deficits, the patient was mobilized and remained to improve. He was discharged home with wound care instructions, seizure precautions, and follow-up in the neurosurgery clinic for reassessment and reimaging.

Discussion

Penetrating brain injuries are rare but severe forms of head trauma that require precise clinical and surgical management to mitigate complications and improve outcomes [6]. Although severe injuries have been associated with high rates of mortality and morbidity, this case showed an atypical presentation in which the patient's nervous system was intact. Penetrating items typically trigger extensive deficits by damaging important brain regions, which is why incidents like these are rarely observed [7]. This patient's preservation of cognitive and motor function indicates that the knife's trajectory avoided significant cortical and vascular structures, which is consistent with previous findings that demonstrated minimal neurological damage from retained foreign bodies [8].

The tamponade effect is one of the most significant elements affecting the outcome of penetrating injuries. By compressing adjacent blood vessels, the retained knife reduced hemorrhage at the injured site [9]. According to studies, this hemostatic effect can be disrupted by removing piercing objects promptly, which can result in secondary hemorrhage and elevated intracranial pressure [10]. Minimal preoperative bleeding was observed in this scenario, highlighting the significance of well-managed surgical extraction. In research studies, this tendency has been extensively reported, especially in cases with retained metallic foreign materials [11]. Preoperative imaging is essential for evaluating penetrating brain injuries.

Computed tomography (CT) confirmed that the knife pierced the parietal lobe without inducing a midline shift or mass effect [6]. CT angiography is necessary when vascular involvement is suspected, since it aids in the identification of pseudoaneurysms or arteriovenous fistulas [12]. Studies indicate that keeping the foreign object in situ until a controlled surgical removal minimizes subsequent vascular injury and reduces the incidence of rapid decompensation [13]. Surgical intervention aimed at reducing subsequent brain injury while facilitating safe evacuation. A craniectomy was executed to facilitate regulated excision, hence diminishing the danger of abrupt decompression hemorrhage [14].

Neurosurgical guidelines recommend this method to ensure adequate exposure as well as minimize brain tissue damage during extraction [15]. The administration of bipolar coagulation and hemostatic drugs during surgery significantly contributed to hemostasis, which has been consistently identified as a key factor in minimizing postoperative consequences in penetrating brain injuries [16]. Preventing postoperative infections is a burning issue in PBIs due to the introduction of foreign materials into the cerebral region. Prophylactic antibiotics, specifically Ceftriaxone and Metronidazole, were used to prevent complications such as meningitis and brain abscesses [6].

The study suggests that immediate antibiotic treatment markedly reduces the chances of septic complications in penetrating brain trauma [12]. Moreover, seizure prophylaxis with Levetiracetam was initiated due to the increased risk of post-traumatic epilepsy, a widely found complication of PBIs [13]. Despite the magnitude of the injury, the patient demonstrated neurological integrity postoperatively, sustaining a Glasgow Coma Scale (GCS) score of 15/15. The absence of focal deficits implies that substantial subcortical pathways were not affected, aligning with previous findings in similar cases where penetrating wounds preserved eloquent regions of the brain [6]. To achieve the best outcomes of such injuries, early mobilization and organized rehabilitation are essential because extended bed rest might result in further complications [7].

A comparative review of similar cases suggests that transorbital penetrating brain injuries generally exhibit worse prognosis due to the potential for vascular damage, while transcervical injuries that bypass major vessels frequently yield favorable outcomes [8]. Evidence confirms the notion that meticulously coordinated surgical excision, along with infection management and systematic rehabilitation, enhances successful results in such situations [9]. Prolonged follow-up is a vital element for monitoring the sequelae, including post-traumatic epilepsy, cognitive impairments, and neurovascular anomalies.

Repeated imaging is inevitable to diagnose delayed vascular injuries, such as pseudoaneurysm formation, which can develop weeks to months after the initial injury [10]. Additionally,

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psychiatric evaluation was advised, as post-traumatic stress disorder (PTSD) and anxiety problems have been observed in patients with penetrating injuries, even after complete neurological recovery has been accomplished [11]. Forensic and medico legal factors have significance for cases of penetrating cranial trauma. In incidents where assault or self-harm is suspected, comprehensive medical documentation is mandatory for judicial procedures [6].

The mechanism of injury is clarified, and proper medico-legal reporting is ensured using imaging and surgical results as forensic evidence [12]. This case calls attention to the irregular characteristics of penetrating brain injuries and the significance of a comprehensive treatment approach. Considering the wound's severity, a successful neurological outcome was achieved via comprehensive imaging, skillful surgical removal, infection prophylaxis, and persistent postoperative management. This case demonstrates that, when appropriately treated, penetrating cranial injuries do not inevitably lead to substantial neurological deficits or poor prognosis.

Conclusion

This case describes the unpredictable nature of penetrating brain injury and the advantage of a multidisciplinary team. Despite a severe cranial stab wound, the patient was neurologically intact, illustrating the possible protective effect of tamponade. Early surgical intervention with controlled removal and hemostasis avoided secondary complications. Prophylactic antibiotics and seizure prophylaxis were essential in preventing infection risk and post-traumatic epilepsy. Close postoperative observation facilitated the early diagnosis of complications, and there was a good outcome. The case highlights the importance of individualized management and forensic documentation in penetrating brain injuries.

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