

# **Journal of Trauma & Treatment**

**Case Report** 



# Traumatic Penetrating Injury to Left Temporal Lobe, Cavernous Sinus, and Internal Carotid Artery: Case Report

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# Introduction

Penetrating transcranial stab wounds, although an uncommon presentation of traumatic brain injury, carry with them a high risk of significant neurological deficits and mortality. Classification of such wounds remains vital for prognosis and therapeutic management. Temporal penetrating stab wounds are often fatal; however, anterior temporal injuries feature a lower mortality than posterior injuries. This case report describes a patient who presented with a penetrating injury to the left calvarium in which successful management hinged on early cerebral angiography and definitive treatment.

### **Case Report**

The patient, a 27-year-old African American male, presented with a penetrating knife injury to the left temple subsequent to an altercation at work. He was emergently flown from the US Virgin Islands to Ryder Trauma Center in Miami; there was no reported loss of consciousness or altered mental status en route. Upon arrival, the knife appeared to be securely fixed in the calvarium, extending approximately 8 to 9 inches into the cerebrum (Figures 1 and 2). The patient was assessed to have a Glasgow Coma Scale (GCS) score of 15.

Remarkably, his neurological deficits were limited to trigeminal sensory loss inferior to the left orbit (V2) and just anterior to the angle of the mandible (V3). Motor neuropathies for the oculomotor (CN III)



Figure 1: 27-year-old African American male, presented with a penetrating knife injury to the left temple.



Figure 2: Initial x-ray demonstrating knife securely fixed in the calvarium, extending approximately 8 to 9 inches into the cerebrum.c



Figure 3: CT scan demonstrated the knife entering the calvaria through left temporal bone, extending through the left anterior temporal lobe, and traveling inferiorly through the lateral wall of the left sphenoid sinus with the distal tip resting within the right sphenoid sinus.

and trochlear (CN IV) nerves were observed on the left side secondary to cavernous sinus penetration, resulting in left ophthalmoplegia and ptosis. The left pupil was fixed and dilated; however his vision was intact bilaterally. The patient was alert and oriented to name and place. No motor weakness or sensory losses were evident. A computerized tomography (CT) scan showed the knife entering the calvaria through left temporal bone, extending through the left anterior temporal lobe, and traveling inferiorly through the lateral wall of the left sphenoid sinus with the distal tip resting within the right sphenoid sinus (Figure 3). The point of the knife appeared 3mm anterior to the pituitary gland. The scan also revealed evidence of subarachnoid hemorrhage and hemosinus.

On August 11<sup>th</sup>, a preoperative CT angiogram (CTA) demonstrated minimal filling of the left internal carotid artery (ICA) with possible transection and occlusion of the vessel. Due to the high-risk formation of a traumatic pseudoaneurysm and re-hemorrhage, a permanent vessel sacrifice of the ipsilateral ICA was performed. An occlusion of ICA proximal to the knife bleed was conducted with coils, followed by a distal occlusion of the ICA via a transcirculation approach across the posterior communicating artery and into the supraclinoid ICA. His angiogram indicated adequate collateral flow across the anterior communicating and vertebral arteries. The patient was immediately taken to surgery. The procedure began with a frontotemporal craniotomy just anterior to the knife-edge. A corticectomy in the left middle frontal gyrus near

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Figure 4: MRI scan showed an extensive infarct in the left middle cerebral artery (MCA) distribution, foci of restricted diffusion in the right cerebellum and right middle cerebellar peduncle, and effacement of the left lateral ventricle with mild right hydrocephalous.

the coronal suture was completed and a ventriculostomy catheter was inserted to aspirate cerebrospinal fluid (CSF) with the goal of relaxing the brain. A temporal lobectomy was then performed from the blade of the knife to 4cm anteriorly. The oculomotor nerve, optic nerve, and ICA were isolated and preserved. After temporarily clamping the ICA just proximal to the proximal communicating artery, the blade was gently removed from the cavernous sinus; modest bleeding occurred from the site that was controlled using packing from the temporalis muscle and Surgicel. The cavernous sinus was packed with additional muscle and DuraSeal sealant to prevent CSF leak into the sphenoid sinus. A subgaleal drain was placed. Postoperatively, the patient was able to obey commands and displayed no motor weakness. There was no evidence of cerebral edema.

On August 16<sup>th</sup> (post-operative day five), the patient's hospital course was complicated by a cerebral infarction in the left-sided cerebral watershed area. A magnetic resonance imaging (MRI) scan showed an extensive infarct in the left middle cerebral artery (MCA) distribution, foci of restricted diffusion in the right cerebellum and right middle cerebellar peduncle, and effacement of the left lateral ventricle with mild right hydrocephalous (Figure 4). The patient developed aphasia and altered mental status with a reduction in his GCS score to 11-12. No motor weakness was evident. One month later at the time of discharge, the patient's verbal and mental statuses were much improved; although an expressive and receptive aphasia still persisted, he was able to count numbers and name objects with cues. There have been no additional neurological sequelae, and the patient has returned to the US Virgin Islands.

## Discussion

In individuals between the ages of 1 to 45, traumatic brain injury remains a significant cause of death in the United States and developed countries worldwide [1]. Of these cases, penetrating craniocerebal knife injuries are relatively uncommon; however, they have the potential to carry significant morbidity and mortality. A review of 13 cases of intracranial stab wounds at the University of Werzburg, Germany between 1971-2000 revealed lethal injury in approximately 30% of cases [2]. The prognosis associated penetrating transcranial stab wounds is dependent upon its location. Frontal stab wounds are less likely to be associated with a high morbidity and mortality, whereas temporal wounds are more likely to be fatal owing to the thinness of the regional calvarium and the relatively short distance to deep brain structures [3]. Temporal stab wounds can be further classified into two groups based upon the penetrating object's angulation, either anteriorly or posteriorly. Anterior-angled temporal wounds tend to feature cavernous sinus injury including cranial nerves III to VI, ICA, and pituitary gland; posterior-angled wounds involve the basilar artery and brain stem, and are associated with a higher mortality [4]. In this case, the knife's course through the patient's left anterior temporal lobe contributed to the relatively limited sensory and motor deficit findings.

Patients who have sustained a transcranial stab wound may not uncommonly present with an intact neurological exam. In a study of 330 patients with penetrating stab wounds to the head in Durban, South Africa, patients were found to have a mean GCS score of 11 with nearly one-third presenting fully conscious; however despite their primary exam, an intracerebral hematoma was visualized on CT scan in 50% of the patients [5]. In absence of a knife in situ, "small but insignificant" scalp lacerations to the temporal region may be the only clue suggestive of the diagnosis, thus highlighting the imperative for acute imaging at the time of initial presentation [4]. Neuroimaging remains a vital tool for initial surgical and clinical decision making. CT scanning is the neuroradiological test of choice to assess penetrating brain injury largely due to its improved ability to identify: the extent of cerebral injury, the penetrating object's trajectory, in driven bone and metal fragments, and hematomas [6,7]. MRI has a limited role owing to the effect of magnetic torque upon the imbedded metal object [8]. CT angiography is often obtained after the initial CT scan of the head has been reviewed and concern remains for injury to major vascular structures; penetrating trajectories of particular concern include those that cross the sylvian fissure and subfalcine areas (involving the anterior- and middle-cerebral arteries, respectively) [9]. Approximately one third of patients with transcranial stab wounds will have vascular lesions identified by angiography and include intracranial aneurysms (15%), arteriovenous fistulas (11%), occlusion (4%), transection (3%), and vasospasm (3%) [10]. Of all penetrating head injury complications, traumatic aneurysms remain a catastrophic sequela that may form within hours of the initial insult. Up to half will rupture within the first few weeks, carrying a mortality rate of approximately 34% - 54% [11]. Pseudoaneurysms are of particular concern because of their friable mucosa and secondary hemorrhage due to rupture [12].

Endovascular coil embolization of the internal carotid artery remains an established technique for the management of acute bleeding in the head and neck [13]. Carotid artery sacrifice with coil devices achieves successful hemostasis, but may result in complications including stroke, delayed carotid thrombosis, rebleeding, and brain abscess formation [14]. Mortality rates of endovascular treatment of acutely rupture aneurysms have been demonstrated to be approximately 8% with initial hemorrhage (9%) and delayed ischemia (6.7%) the two most common complications [15]. After cerebral angiography has evaluated for vascular injury with appropriate endovascular treatment, the object should be maintained in position until the surgeon is ready to perform a craniotomy and manage hemorrhage [16].

In summary, despite a near normal GCS score upon initial presentation, successful treatment involves early cerebral angiography coupled with immediate and directed surgical care. Overall once diagnosed and treated, the outcome for patients with anteriorly angled temporal penetrating knife wounds is generally fair [17].

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