Article published online: 2024-02-28

Anesthesia Management of a Patient with Penetrating Brain Injury with a Knife into the Occipital Region

Shruti S. Patil[1] Kavin K Devani[2] Swapnil D Lemle[1]

[1] Department of Anaesthesiology, Lokmanya Tilak Municipal Medical College and Lokmanya Tilak Municipal General Hospital, Sion, Mumbai, Maharashtra, India
[2] Department of Neurosurgery, Lokmanya Tilak Municipal Medical College and Lokmanya Tilak Municipal General Hospital, Sion, Mumbai, Maharashtra, India

Address for correspondence Shruti S. Patil, MD, DNB Anaesthesia, Department of Anaesthesia, Lokmanya Tilak Municipal Medical College and Lokmanya Tilak Municipal General Hospital, 4th Floor College Building, Sion, Mumbai, Maharashtra 400022, India (e-mail: dr.shrutipatil@gmail.com).

J Neuroanaesthesiol Crit Care

Abstract

Penetrating brain injuries are rare events in modern times. In this article we present the case of an adolescent with a knife, lodged in the occipital region needing surgical care. The patient was conscious, cooperative, and vitally stable with a Glasgow coma scale (GCS) of 15/15 with no lateralizing signs. Computed tomography (CT) scan of the brain demonstrated the knife blade in the suboccipital bone with suspicious injury to the right transverse sinus. General anesthesia was provided and airway secured in a lateral position using a video laryngoscope. Surgery was performed in the prone position using the Mayfield head holder. All measures to prevent secondary brain injury were taken. The patient remained vitally stable during surgery and could be extubated after surgery. Planning and preparation are vital for the smooth conduct of the case.

Keywords
- brain injury
- penetrating
- video laryngoscope
- Glasgow coma scale
- knife

Introduction

Penetrating brain injuries (PBIs) are rare events in modern times. These are caused by violence, suicide, road traffic, and work accidents.[1] Patients who survive such injuries require foreign body removal. Further neurological deterioration, life-threatening hemorrhage, or death can occur while providing anesthesia, positioning, and foreign body removal.[2,3] There are few case reports describing anesthesia management of PBI, and none describing intubation challenges in abnormal positions due to foreign body in situ. So, here we present the case of an adolescent with a knife lodged in the occipital region needing surgical care.

Case Report

A previously well, 13-year-old adolescent boy, presented with an alleged history of assault with a knife. There was a small puncture wound over the right occipital bone with the knife in situ. The external length of the knife was 14 cm and the intracranial length was 1.8 cm. There was no history of headache, nausea, vomiting, convulsion, or decreased vision. The patient was vitally stable. The Glasgow coma scale (GCS) on arrival was 15/15 with no lateralizing signs. Systemic examination was also within normal limits. Airway examination performed in the lateral position showed a Mallampati score of 2, inter-incisor gap of 3.5 cm, and thyromental distance of 6.5 cm. Computed tomography (CT) scan of the brain demonstrated the distal part of the knife in the suboccipital bone penetrating beyond the inner table with the corresponding metal streak artifact. CT venogram revealed suspicious injury to the right transverse sinus. The rest of the brain parenchyma appeared normal (►**Fig. 1**).

Removal of the foreign body was mandatory as it jeopardized the patency of right transverse sinus. After

DOI https://doi.org/10.1055/s-0043-1774302.
ISSN 2348-0548.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

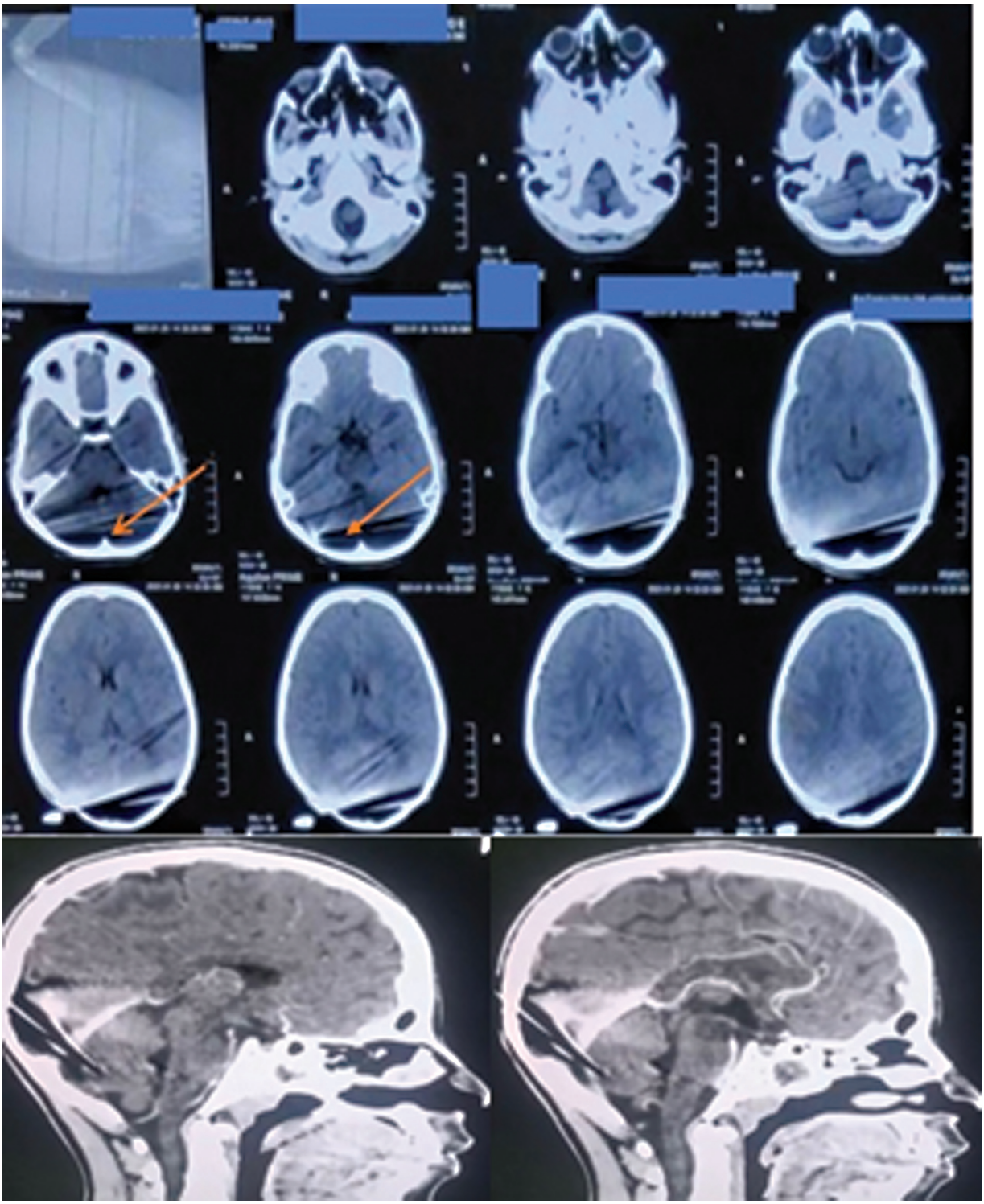

Fig. 1 Computed tomography (CT) of the brain showing knife blade in the occipital bone with the corresponding metal streak artifact with CT venogram sagittal view.

administration of antiepileptics, tetanus toxoid, antibiotic prophylaxis, and confirming nil by mouth (NBM), the patient was moved into the operation theater for retrieval of the foreign body. Standard American Society of Anesthesia (ASA) monitors were attached. An 18-gauge intravenous (IV) cannula was secured in the right arm and IV fluid Ringer lactate was administered. Difficult airway cart as per ASA guidelines was kept ready for intubation in the lateral position.

The patient was premedicated with glycopyrrolate (0.004 mg/kg), midazolam (0.03 mg/kg), and fentanyl (2 mcg/kg). After preoxygenation with 100% oxygen for 3 minutes, anesthesia was induced with graded doses of propofol till loss of consciousness. Injection rocuronium bromide 1 mg/kg was administered only after confirming adequate ventilation. Intubation was performed in the lateral position with the help of video laryngoscope (HugeMed, Shenzhen, China) and

MAC no. 3 blade by a senior anesthetist with an assistant performing external laryngeal manipulation (ELM). The trachea was intubated with a cuffed endotracheal tube no. 7. Another assistant was asked to support the patient's right shoulder during intubation to minimize the movement (►**Fig. 2**). The Modified Cormack–Lehane grade was 2B, which improved to 1 with ELM. The lungs were ventilated with volume-controlled ventilation with an oxygen-to-air ratio of 1:1, a tidal volume of 7 mL/kg, and a respiratory rate of 14 breaths per minute. General anesthesia was maintained with inhaled isoflurane and intermittent divided doses of rocuronium. Invasive BP monitoring was initiated in the left radial artery.

After local infiltration, Mayfield clamps were applied and the prone position was given meticulously (►**Fig. 2**).

Tranexamic acid 500 mg was administered prior to craniotomy. A linear incision was made in continuity with the puncture wound. After drilling a single burr hole around the entry site, bone around the knife was removed in pieces. Thereafter, the foreign body was carefully removed. A small 3×2 mm rent was found in the right transverse sinus, bleeding from which was controlled with dural hitch sutures (►**Fig. 2**). There was a transient fall in mean arterial pressure (MAP) to 55 mm Hg following retrieval of the knife. This was treated with IV fluids and 12 mg of ephedrine. Thereafter, one bag of packed red blood cells was transfused. The patient remained vitally stable with an MAP between 70 and 80 mm Hg for the rest of the procedure. A thorough antibiotic wash was given after achieving hemostasis. The patient was kept normothermic using forced air warmer. The patient was euglycemic and normocapnic (32–35 mm Hg) during the procedure. Analgesia was provided with fentanyl (total 4 mcg/kg) and paracetamol 1 gm infusion.

The neuromuscular blockade was reversed and the patient was extubated taking care that the patient does not cough on the tube.

Injection phenytoin and injection amoxicillin and clavulanic acid were administered for 7 days. The convalescence was uneventful (►**Fig. 3**).

Discussion

Blind removal of the penetrating foreign body carries the risk of subdural hematoma and intraparenchymal hemorrhages

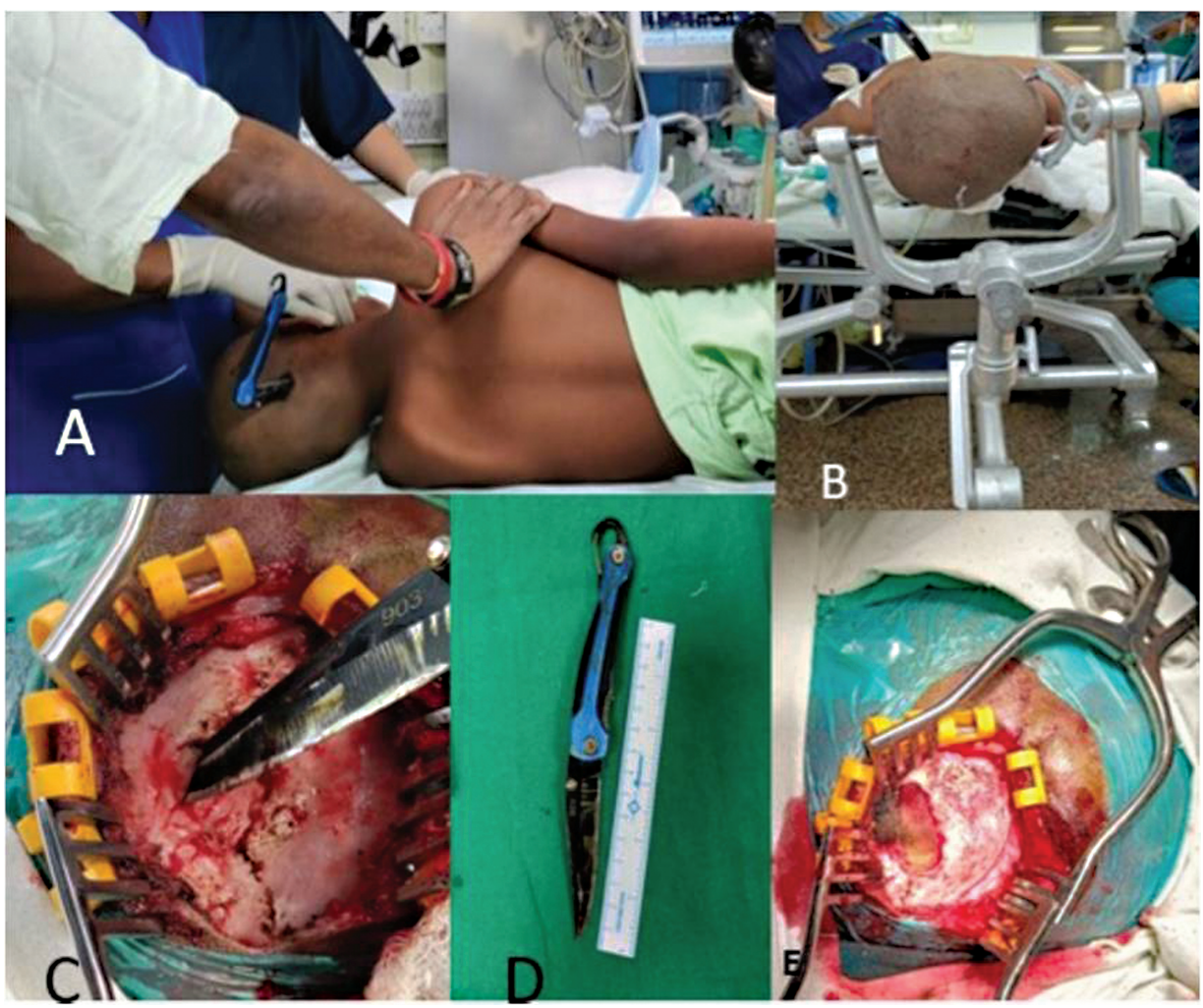

Fig. 2 (**A**) Position for intubation. (**B**) Position for surgery on Mayfield clamps. (**C**) Before craniotomy. (**D**) Foreign body after retrieval. (**E**) After closure.

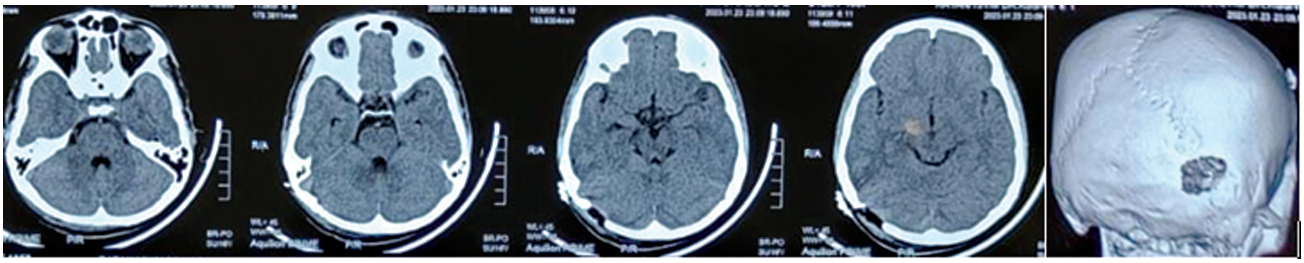

Fig. 3 Postoperative computed tomography (CT) scan with 3D reconstruction.

along with injury to major neurovascular structures; hence, craniotomy is recommended.[3]

It is paramount that cerebral vasculature near the path of the penetrating object be evaluated to rule out a traumatic aneurysm or vascular dissection. In our case, it was suspected to have penetrated the transverse sinus and hence CT venography was performed.[4]

The first challenge was intubating in the lateral position. McCaul et al stated that the left lateral position deteriorated laryngoscopic views in 35% of their patients when compared to the supine position.[5] Nathanson et al demonstrated that intubation took longer and was more difficult in the left lateral position than in the supine position, but intubation success improved with practice, indicating a learning curve.[6] Goh et al mentioned that the lateral position is ergonomically challenging for the laryngoscopist and intubating in the left lateral position is easier than in the right lateral position as the tongue falls to the left, making glottic view superior.[7]

The ASA 2022 difficult airway guidelines recommend performing an awake intubation if there is possibility of difficult intubation and one or more of the following apply: (1) difficult ventilation (face mask/supraglottic airway), (2) increased risk of aspiration, (3) the patient is incapable of tolerating a brief apneic episode, or (4) there is expected difficulty with emergency invasive airway rescue. An uncooperative or pediatric patient also restrict the options for awake intubation.[8] Hence, intubation after general anesthesia was chosen.

The guidelines also state that if a noninvasive approach to airway management is selected, identify a preferred sequence of noninvasive devices.[8] If difficulty is encountered with individual techniques, combination techniques may be used. As per these guidelines, success rate of video-assisted laryngoscopy was similar to awake fiberoptic intubation.

Hence, the use of video laryngoscope combined with ELM helped us perform intubation in first attempt with minimal neck extension.[9] Use of video laryngoscopy with bougie was our second choice, followed by laryngeal mask airway-guided fiberoptic intubation. In our case, any amount of movement or extension of the neck could cause the foreign body to impinge onto the cerebellum or shear the transverse sinus; hence, we had to be mindful of this.

Penetrating objects have a tamponade effect and hemorrhage may occur during the extraction of the sharp.[2] Retrieval of the sharp object in our patient was followed by blood loss and hypotension, which was managed with crystalloids and blood. Use of invasive blood pressure monitoring aided us in beat-to-beat monitoring.

The goals of anesthesia, that is, optimization of cerebral perfusion pressure (CPP) and prevention of secondary brain injury, were achieved. Anesthesia management was similar to that described by Parua et al,[2] Dalal and Vijayan,[3] Awori et al,[4] Khandelwal et al,[10] and Mbengono et al,[11] at par with the latest brain trauma foundation guidelines.

Antibiotics were continued to prevent infection and sepsis for 7 days. Although the brain parenchyma was not injured, the child could have developed seizures due to concussion or cerebral venous sinus thrombosis. Hence, antiepileptics were also administered for 7 days.[2,10,12]

Conclusion

In cases of PBI with weapon in situ, one must be prepared for a difficult airway as intubation may have to be performed in positions other than supine. In our patient, intubation and positioning were an additional challenge due to the possibility of impingement of the cerebellum or shearing of the transverse sinus by the weapon. Other goals are to maintain CPP and avoid secondary brain injury. But long-term follow-up will be required to identify delayed complications.

Conflict of Interest
None declared.

Acknowledgments
We thank the Department of Anaesthesiology and Department of Neurosurgery, Lokmanya Tilak Municipal Medical College and Lokmanya Tilak Municipal General Hospital, Sion, for their support.

References

1 Tabibkhooei A, Taheri M, Rohani S, Chanideh I, Rahatlou H. Penetrating brain injury with a metal bar and a knife: report of two interesting cases. Neuroradiol J 2018;31(02):203–206
2 Parua S, Hazarika R, Choudhury D, Baishya B. Anesthetic management of penetrating nail injury brain: a case report. J Anesth Crit Care 2016;5:14–12
3 Dalal N, Vijayan NK. Anaesthetic management of penetrating brain injury caused by a foreign body. J. Evid. Based Med. Healthc. 2018;5:1218–1220
4 Awori J, Wilkinson DA, Gemmete JJ, Thompson BG, Chaudhary N, Pandey AS. Penetrating head injury by a nail gun: case report, review of the literature, and management considerations. J Stroke Cerebrovasc Dis 2017;26(08):e143–e149

5 McCaul CL, Harney D, Ryan M, Moran C, Kavanagh BP, Boylan JF. Airway management in the lateral position: a randomized controlled trial. Anesth Analg 2005;101(04):1221–1225
6 Nathanson MH, Gajraj NM, Newson CD. Tracheal intubation in a manikin: comparison of supine and left lateral positions. Br J Anaesth 1994;73(05):690–691
7 Goh SY, Thong SY, Chen Y, Kong AS. Efficacy of intubation performed by trainees on patients in the lateral position. Singapore Med J 2016;57(09):503–506
8 Apfelbaum JL, Hagberg CA, Connis RT, et al. 2022 American Society of Anesthesiologists Practice Guidelines for management of the difficult airway. Anesthesiology 2022;136(01):31–81
9 Pascarella G, Caruso S, Antinolfi V, Costa F, Sarubbi D, Agrò FE. The VL3 videolaryngoscope for tracheal intubation in adults: a prospective pilot study. Saudi J Anaesth 2020;14(03):318–322
10 Khandelwal A, Bithal PK, Rath GP. Anesthetic considerations for extracranial injuries in patients with associated brain trauma. J Anaesthesiol Clin Pharmacol 2019;35(03):302–311
11 Mbengono J, Ntock F, Tochie J, et al. Anesthetic management of a rare penetrating traumatic brain injury caused by a pickaxe: a case report. Open J Anesthesiol 2009;9:155–165
12 Dash HH, Chavali S. Management of traumatic brain injury patients. Korean J Anesthesiol 2018;71(01):12–21

