CASE REPORT

ANAESTHETIC CHALLENGES IN A CASE OF TRANS-ORBITAL PENETRATING BRAIN INJURY BY A TREE TWIG

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ABSTRACT: Penetrating injury of the skull and brain are relatively uncommon wounds, representing about 0.4% of all head injuries. The orbit forms an easy path for low-velocity foreign bodies into the intracranial space. Often the severity of the injury is masked by unobtrusive superficial wounds and lack of primary neurological deficits. Appropriate management can lead to optimal outcomes and limit secondary brain injury. We present an unusual and interesting case of trans-orbital penetrating brain injury by a tree twig which was successfully managed with no neurological or visual deficits.

KEYWORDS: Anaesthetic management, trans-orbital penetrating brain injury, intra-cranial pressure, Tree Twig.

INTRODUCTION: Penetrating brain injury (PBI), includes all traumatic brain injuries which are not the result of a blunt mechanism. Although less prevalent than closed head trauma, PBI carries a worse prognosis. We report here an unusual and interesting case of a 22yrs old male with history of fall from a tree, presented to the emergency department with a tree twig of 5cm in diameter, penetrating the brain through the left orbit which was successfully managed with no neurological or visual deficits.

CASE REPORT: A 22yrs old male with history of fall from a tree, presented to the emergency department with a tree twig of 5cm in diameter, penetrating the brain through the left orbit. On examination there was oedema, ecchymosis, bleeding from left orbit and bleeding from left nasal cavity. Pulse Rate was 120/min, Blood Pressure was 90/60 mm Hg and GCS was 12/15. No other major injuries were detected. There were no neurological deficits. Systemic examination revealed no abnormalities. All laboratory investigations were within normal limits. Computed Tomography (CT) scan revealed a tree twig of 5cm diameter penetrating the orbit and entering the frontal lobe on left side with pneumocephalus. A 3D reconstruction was performed which clearly demarcated the trajectory. Chest X-ray was normal. The patient was shifted to the operating room within 2 hours post trauma for removal of the foreign body by a fronto-orbital craniectomy.

General anaesthesia was planned. An 18G IV cannula was secured. Monitors like non-invasive blood pressure (NIBP), heart rate (HR), electrocardiography (ECG), pulse oximetry (SpO₂) were connected and baseline readings were noted. Pre-oxygenation was started with nasal prongs with 3L/min and Premedication was given with Inj. Glycopyrrolate 0.2mg IV, Inj. Fentanyl 2µg/kg IV. The twig was cut a few centimeters away from the skin by the surgeon with a small saw taking care not to injure the nearby vital structures. Then rapid sequence induction was done using Inj. Thiopentone sodium 5 mg/kg and Inj. Rocuronium 1.2mg/kg IV, intubated with 8.5mm ET tube and secured after confirming bilateral equal air entry. Care was taken not to move or disturb the tree twig. Right subclavian vein was cannulated with a triple lumen central venous catheter. Right radial artery was

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cannulated for IBP monitoring. Anaesthesia was maintained with Isoflurane, oxygen and Vecuronium with controlled ventilation. Nitrous Oxide was avoided as the CT scan revealed pneumocephalus. Intraoperative analgesia was provided with intravenous Fentanyl and Paracetamol. Invasive blood pressure, heart rate, ECG, SpO₂, EtCO₂, temperature and urine output were monitored throughout the intra-operative period. Foreign body was successfully removed. After completion of surgery reversal of neuromuscular blockade was done satisfactorily with Inj. Neostigmine 0.05mg/kg and Inj. Glycopyrrolate 0.01mg/kg intravenously. Patient was extubated after regaining complete consciousness. Post-operative period was uneventful and patient was discharged after 10 days. He was followed up regularly. There were no neurological deficits and vision was intact.

DISCUSSION: Penetrating brain injury (PBI) includes all traumatic brain injuries which are not the result of a blunt mechanism.⁽¹⁾ Although less prevalent than closed head trauma, PBI carries a worse prognosis.⁽²⁾ PBI caused by non-missile, low-velocity objects represents a rare pathology among civilians, with better outcome because of more localized primary injury,⁽²⁾ and is usually caused by violence, accidents, or even suicide attempts.⁽³⁾ For this purpose, the current literature on various parameters related to PBI was reviewed. This case was managed in accordance with the Guidelines for the Management of Penetrating Brain Injury.

In 1995, the American Association of Neurological Surgeons and the Brain Trauma Foundation collaborated to formulate evidence-based Guidelines for the Management of Severe Head Injury⁽⁴⁾ which were periodically revised and last updated as third edition in 2007.⁽⁵⁾

In the emergency department, a primary survey and stabilization of the patient with regard to the airway, breathing, circulation and cervical spine, including external haemorrhage should be achieved.⁽⁶⁾ After resuscitation, an inspection of the superficial wounds should be done. Any CSF, bleeding, or brain parenchyma oozing from the wound should be noted. After careful examination of the wound, a detailed neurological examination should be performed, and the post-resuscitative Glasgow coma scale (GCS) of the patients should be documented.⁽¹⁾ Clinical features suggestive of raised intracranial pressure (ICP) must be documented carefully. A complete examination of other organ systems is recommended as PBI patients may have multiple organ injuries.⁽⁶⁾ A detailed medical history from family or friends and a chronology of the incidence from a witness is warranted. Initial laboratory evaluation must include a complete blood count, electrolytes, coagulation profile, type and cross match, arterial blood gas, and an alcohol and drug screen.⁽⁷⁾ Once the initial evaluation is done, the patient should be transferred to radiology for a neuroimaging study.

Trans-orbital penetrating injuries include both ocular and cerebral complications in which blindness, haemorrhage and various kinds of infections such as meningitis, abscess may be seen. Secondary injuries may occur due to hypoxia, hypercapnia, hypotension, ischemia, raised ICP or biochemical derangements. These may develop within minutes, hours, or days of the initial injury and cause further damage to nervous tissue. Trans-orbital foreign body poses a challenge of securing airway because of inability of proper positioning and difficulty in proper mask holding. Precautions have to be taken to prevent rise in intraocular pressure on one hand and complications of full stomach on the other hand.

The major goals of anaesthetic management are:

- a. Optimize cerebral perfusion and oxygenation,
- b. Avoid secondary neurological damage,

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- c. Provide adequate surgical conditions for the neurosurgeons,
- d. Maintain normal ICP by the following measures:
 1. Hyperventilation to maintain $Paco_2$ of ≤ 30 mm Hg.
 2. Diuretic therapy: Inj. Mannitol 1g/kg IV infused over 10 minutes.
 3. Posture: a head-up tilt of 10° to 30° facilitates cerebral venous and CSF drainage.
 4. Barbiturates are known to exert cerebral protective and ICP lowering effects.

General guidelines for ICP management in non-penetrating TBI have been applied to PBI patients as well i.e., hyperventilation, mannitol, CSF drainage, high-dose barbiturates, and more recently, decompressive craniectomy.⁽¹⁾⁽⁸⁾

Vascular complications after PBI range from under 5%–40% in various reports. The common vascular complications after PBI include traumatic intracranial aneurysms (TICAs) or arterio-venous fistulas (AVFs), SAH, and vasospasm.⁽⁹⁾

Cerebrospinal fluid leakage is a common complication of PBI. Arendall and Meirowsky reported a 28% instance of CSF leaks.⁽¹⁰⁾ Cerebrospinal fluid leaks after PBI have been documented to be highly predictive of infectious complications.⁽¹¹⁾

Infectious complications are common after PBI, and they are also associated with higher morbidity and mortality rates.⁽¹²⁾ The risk of local wound infections, meningitis, ventriculitis, or cerebral abscess are particularly high among PBI patients because of the presence of contaminated foreign objects, skin, hair, and bone fragments driven into the brain tissue along the projectile track.⁽¹⁾

The risk of posttraumatic epilepsy after PBI is high probably due to direct traumatic injury to the cerebral cortex with subsequent cerebral scarring. It is reported that the more severe the injury to the brain according to the Glasgow outcome scale (GOS) grade, the higher the risk for the development of posttraumatic epilepsy.⁽¹⁾⁽¹³⁾⁽¹⁴⁾ About 30%–50% of patients suffering a PBI will develop seizures.⁽¹⁴⁾

Advanced age, suicide attempts, associated coagulopathy, Glasgow coma scale score of 3 with bilaterally fixed and dilated pupils, and high initial intracranial pressure have been correlated with worse outcomes in PBI patients.

CONCLUSION: This case posed challenges on anaesthetic management faced in cases of penetrating brain injuries such as difficulties in intubation, patient positioning, maintaining hemodynamic stability, normal ICP and cerebral blood flow. It also presented challenges in prevention of secondary cerebral injury from hypoxia, hypercapnia, hypo tension and raised ICP. With a multidisciplinary approach and proper anaesthetic management, we were able to obtain a successful and good outcome.

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Figure 1: Front view showing tree twing entering the left orbit

Figure 2: Tree twig cut just outside the orbit to facilitate intubation

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Figure 3: 3D reconstruction of CT Scan tracing the trajectory of Tree Twig in the fronto-orbital region

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