ANAESTHETIC MANAGEMENT OF PENETRATING BRAIN INJURY CAUSED BY A FOREIGN BODY

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PRESENTATION OF CASE

A 23-year-old male patient referred to tertiary care centre presented in the emergency department with a history of road traffic accident with traumatic metallic foreign body injury brain. The patient had post traumatic loss of consciousness, 2 episodes of vomiting.

CLINICAL DIAGNOSIS

A 23 year old male presented in the emergency department with a history of road traffic accident with traumatic metallic foreign body injury brain. The patient had post traumatic loss of consciousness, 2 episodes of vomiting with GCS E₁V₁M₂, no other external injuries were noted. On examination Pulse- 110/min, B.P.- 96/58 mmHg, SpO₂- 94% room air. Systemic Examination- CVS -S₁S₂, RS-Air entry equal, basal crepts ++, Routine blood investigations, coagulation profile were normal.

Skull X-ray showed a vertically oriented radio-opaque nail penetrating the skull and into the brain parenchyma.

CT Brain: - Foreign body with metallic artifact in right parietal region with entry through bone with right ventricular haemorrhage.

Images Related to the Case

Figure 1. X-Ray Skull

Figure 2. CT Scan Film of Brain

Figure 3. Right Temporal Parietal Bone and Nail Exposure after the Skin and Subcutaneous Incision

Figure 4. Curvilinear 7 Cm Nail was Removed
MANAGEMENT
An informed consent was obtained from the patient for the operative procedure & general anaesthesia. Patient had received Tetanus Immunoglobulin 250 IU and Inj. Tetanus Toxoid I.M. in the emergency department.

After taking informed written consent, patient was shifted to the neurosurgical operating room. Standard American Society of Anaesthesiologists (ASA) monitors were attached and baseline vitals were recorded. 18G IV cannulas were secured on each forearm and warm normal saline was started slowly. Patient received broad spectrum antibiotics as per hospital protocol. Inj. Levetiracetam 1000 mg IV and Inj. Fentanyl citrate 120 micro grams IV were also administered. Patient was preoxygenated for 3 minutes with 100 % oxygen.

Rapid sequence induction (RSI) was done with 120 mg Propofol and muscle relaxation was achieved with 60 mg of Inj. Rocuronium Bromide. Airway was secured with a 8 millimeter internal diameter reinforced endotracheal tube which was fixed at 22cms after bilateral air entry was checked and found to be equal and adequate. Anaesthesia was maintained with oxygen: air in 1:2 ratio (flow 2 L/minute) with 0.4 to 0.8% Isoflurane. Patient was ventilated with a tidal volume of 6-8 ml/kg, with a respiratory rate of 12 to 14 breaths per minute. Divided doses of Inj. Paracetamol 1000mg slow IV intraoperatively. Intraoperatively patient was normocapnic and no episodes of hypoxaemia (SaO₂<92%) were noticed. Throughout the procedure we maintained a mean arterial pressure equal to or greater than 60 mm Hg. At the end of the procedure, neuromuscular blockade was reversed adequately and later shifted to neuro surgical intensive care unit. The operative procedure was completed in 60 minutes. Patient received 2000 ml of isotonic saline intraoperatively; blood transfusion-1000ml, with an estimated blood loss of 1500ml. Intraoperative urine output was 200 ml. CVP 8 cm H₂O. Postoperatively, the patient was put on mechanical ventilation. Vitals deteriorated over next 2 days on high inotropic support with decrease in urine output, patient had a cardiac arrest on the 3rd postoperative day and could not be revived.

Penetrating nail injury brain is an emergency situation which requires prompt neurosurgical intervention. Following penetrating injury to the brain, pre-hospital care involves patient stabilization & securing the penetrated object to prevent further brain injury. Usually penetrating objects do not cause intracranial bleed at the time of impalement, but the high velocity of impact may have a tamponade effect. But they may bleed once that tamponade effect ceases to act i.e. during their extraction.

Goals of anaesthesia are optimization of cerebral perfusion pressure (CPP) and prevention of intracranial hypertension; adequate anaesthesia and analgesia; prevention of secondary insults by adequate oxygenation, normocapnia, and avoidance of hyper or hypoglycaemia and hyperthermia. Anaesthesia and analgesia are essential, as surgical stimuli can increase cerebral blood flow (CBF), CMRO₂, and ICP.

Correction of hypoxia and hypotension prevents secondary brain injury & is the chief priority during the perioperative management of patients with penetrating brain injury. A single episode of associated hypotension increases morbidity and doubles mortality. Both invasive and noninvasive monitoring are important and should include electrocardiogram, pulse oximetry, capnography, temperature, urine output, invasive arterial pressure monitoring, arterial blood gas analysis and perioperative blood glucose monitoring. Central venous access may be useful for administration of vasoactive drugs and central

DISCUSSION OF MANAGEMENT
"Penetrating Brain Injuries (PBIs) usually result in devastating problems and therapeutic challenges. These injuries may occur due to motor vehicle accidents, gunshot wounds or sharp objects such as knife."

"Surgical extraction of such projectiles can be successfully done, when they are partly impacted to the skull bone, but their blind removal carries the risk of secondary brain injury."

"Neurosurgical treatment performed by craniotomy still seems to be the safest one; there are reports of complications such as subdural hematoma and intraparenchymal haemorrhages following the blind removal of foreign bodies leading to suggestions that all penetrating foreign bodies should be removed under direct vision."

"Prognosis of patients with penetrating injuries to the brain generated by objects with low kinetic energy is good and they have a better outcome."

DISCUSSION
"Since the patient had history of road traffic accident followed by loss of consciousness, differential diagnosis included extradural and subdural haematoma."

"PATHOLOGICAL DISCUSSION"
Penetrating Brain Injuries (PBIs) usually result in devastating problems and therapeutic challenges. These injuries may occur due to motor vehicle accidents, gunshot wounds or sharp objects such as knife. Surgical extraction of such projectiles can be successfully done, when they are partly impacted to the skull bone, but their blind removal carries the risk of secondary brain injury. Neurosurgical treatment performed by craniotomy still seems to be the safest one; there are reports of complications such as subdural hematoma and intraparenchymal haemorrhages following the blind removal of foreign bodies leading to suggestions that all penetrating foreign bodies should be removed under direct vision. Prognosis of patients with penetrating injuries to the brain generated by objects with low kinetic energy is good and they have a better outcome.

"Differential Diagnosis"
Since the patient had history of road traffic accident followed by loss of consciousness, differential diagnosis included extradural and subdural haematoma.
venous pressure monitoring during resuscitation. Intracranial pressure (ICP) monitoring is highly recommended in patients presenting with traumatic brain injury.

Propofol infusion in these patients causes significant hypotension which may further reduce cerebral perfusion pressure (CPP). Intravenous induction agents on the other hand reduce CMRO2, CBF, and ICP. Neuromuscular blocking drugs allow controlled ventilation & prevent coughing or straining reflexes in the operated patient. Rocuronium has minimal cardiovascular effects with no histamine releasing property & is the muscle relaxant of choice in neuroanaesthesia. All volatile agents up to 1 minimum alveolar concentration (MAC), usually reduce CMRO2, cause cerebral vasodilation, increase cerebral blood flow (CBF) further increasing ICP. Sevoflurane below 1 MAC is best suited for neurosurgical interventions. Use of inhalational nitrous oxide is obsolete in neurosurgical cases. Patient positioning with extremes of flexion or rotation of the head impedes venous drainage from brain, further raising the ICP.

Controlled ventilation aims at maintaining normocapnia, while preventing hypoxia. A reduction in PaCO2 reduces cerebral blood volume and ICP due to cerebral vasoconstriction. But hyperventilation may cause cerebral hyperperfusion, further causing ischaemia. Maintenance of perioperative euglycaemic state is essential. 20% Mannitol may be used perioperatively for control of acute increase in ICP, but may cause intravascular volume depletion, hypotension, renal complications, and hyperkalaemia and rebound intracranial hypertension.

Neurosurgical treatment performed by craniotomy still seems to be the safest one; there are reports of complications such as subdural haematoma and intraparenchymal haemorrhages following the blind removal of foreign bodies leading to suggestions that all penetrating foreign bodies should be removed under direct vision. Rapid treatment is crucial. Our patient presented 24 hours post injury thereby leading to poor prognosis and outcome.

FINAL DIAGNOSIS
This was a case of traumatic metallic foreign body injury in right parietal region with entry through bone with right ventricular haemorrhage. Neurosurgical treatment performed by craniotomy still seems to be the safest one; there are reports of complications such as subdural haematoma and intraparenchymal haemorrhages following the blind removal of foreign bodies leading to suggestions that all penetrating foreign bodies should be removed under direct vision. Acute subdural haematomas in patients with a severe TBI have 90% mortality if surgical evacuation occurs 4 hours after injury compared with 30% for those evacuated earlier. Therefore, active rapid treatment is crucial in post-traumatic brain injury patients.

REFERENCES