ANAESTHETIC MANAGEMENT OF PENETRATING BRAIN INJURY CAUSED BY A FOREIGN BODY

Niti Dalal[1], Naveen Kundilmadom Vijayan[2]

[1]Senior Resident, Department of Anaesthesia and Intensive Care, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi.
[2]Senior Resident, Department of Anaesthesia and Intensive Care, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi.

HOW TO CITE THIS ARTICLE: Dalal N, Vijayan NK. Anaesthetic management of penetrating brain injury caused by a foreign body. J. Evid. Based Med. Healthc. 2018; 5(13), 1218-1220. DOI: 10.18410/jebmh/2018/252

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 $E_1V_1M_2$, no other external injuries were noted. On examination Pulse- 110/min, B.P.- 96/58 mmHg, SpO_2-94% room air. Systemic Examination- CVS -S_1 S_2, 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

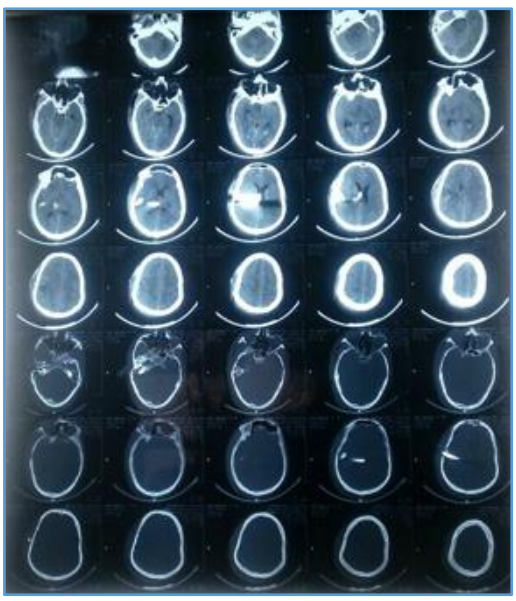

Figure 2. CT Scan Film of Brain

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

Figure 4. Curvilinear 7 Cm Nail was Removed

Financial or Other, Competing Interest: None.
Submission 07-03-2018, Peer Review 09-03-2018,
Acceptance 24-03-2018, Published 26-03-2018.
Corresponding Author:
Dr. Niti Dalal,
#A104, Sector 19,
Dwarka, New Delhi.
E-mail: dalal.niti@gmail.com
DOI: 10.18410/jebmh/2018/252

DIFFERENTIAL DIAGNOSIS

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.[1]

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.[2]

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.[3]

Prognosis of patients with penetrating injuries to the brain generated by objects with low kinetic energy is good and they have a better outcome.[4,5]

DISCUSSION OF 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. Rocuronium Bromide were used intraoperatively. After local infiltration of the surgical site with 20ml of 1% lignocaine, a 10cm curved incision was made across the head to raise a scalp flap (Figure 3).

A craniotomy trephine was created adjoining the nail to widen the interphase between it and the skull. Under direct vision using plain forceps, the metallic rod was stabilised and gradually pulled out of the brain parenchyma. The nail measured 7 centimeters. The surgical site was irrigated copiously & gently with warm normal saline from a 20 ml syringe.

The opening in the skull was covered by the trephined piece of bone & the wound was closed in layers.

Patient received Inj. Paracetamol 1000mg slow IV intraoperatively. Intraoperatively patient was normocapnic and no episodes of hypoxaemia ($Sa0_2$<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-8cm H_20. 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.[6]

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.[7] 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

venous pressure monitoring during resuscitation. Intracranial pressure (ICP) monitoring is highly recommended in patients presenting with traumatic brain injury.

Propofol induction 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 $PaCO_2$ reduces cerebral blood volume and ICP due to cerebral vasoconstriction. But hyperventilation may cause cerebral hypoperfusion, further causing ischaemia.[8] Maintainance 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.[9] 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.[4,10,11] 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 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. 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

[1] Aghazade J, Salehpoor F, Nader N, et al. Unusual self-inflicted penetrating brain injury: a case report and review of literature. Advances in Bioscience & Clinical Medicine 2014;2(2):91-95.

[2] Sweeney JM, Lebovitz JJ, Eller JL, et al. Management of non-missile penetrating brain injuries: a description of three cases and review of the literature. Skull Base Rep 2011;1(1):39-46.

[3] Ferraz VR, Aguiar GB, Vitorino-Araujo JL, et al. Management of a low-energy penetrating brain injury caused by a nail. Case Rep Neurol Med 2016;2016:1-4.

[4] Agu CT, Orjiaku ME. Management of a nail impalement injury to the brain in a non-neurosurgical centre: a case report and review of the literature. Int J Surg Case Rep 2016;19:115-118.

[5] Chen PC, Tsai SH, Chen YL, et al. Post-traumatic cerebral infarction following low-energy penetrating craniocerebral injury caused by a nail. J Korean Neurosurg Soc 2014;55(5):293-295.

[6] Parua S, Hazarika R, Choudhury D, et al. Anesthetic management of penetrating nail injury brain: a case report. J Anesth Crit 2016;5(1):00176.

[7] Chesnut RM, Marshall LF, Klauber MR. The role of secondary brain injury in determining outcome from severe head injury. J Trauma 1993;34(2):216-222.

[8] Coles JP, Fryer TD, Coleman MR, et al. Hyperventilation following head injury effect on ischaemic burden and cerebral oxidative metabolism. Crit Care Med 2007;35(2):568-578.

[9] Helmy A, Vizcaychipi M, Gupta AK. Traumatic brain injury: intensive care management. Br J Anaesth 2007;99(1):32-42.

[10] Lee CS, Park KH. Six nails in the head: multiple pneumatic nail gun head injury. British Journal of Neurosurgery 2010;24(4):493-494.

[11] Litvack ZN, Hunt MA, Weinstein JS, et al. Self-inflicted nail-gun injury with 12 cranial penetrations and associated cerebral trauma: case report and review of the literature. Journal of Neurosurgery 2006;104(5):828-834.