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Case report

Brain impalement by an angle metal bar

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ABSTRACT

The author reports the case of a 37-year-old right-handed man who was impaled in the head by an angle metal bar at a construction work site. Impalement injuries of the brain are rare, and their management is complex. The surgical treatment of the injury and the medical management of complications are described in detail. The patient made a good recovery although he has functional deficits related to the injury to his frontal lobes.

1. Introduction

Impalement injuries to the brain are rare, complex, and present formidable management problems for the multidisciplinary team of care providers. More damage may be caused by well-meaning associates or eye witnesses who may be tempted to remove the object out at the scene. Emergency personnel must exercise extreme caution to stabilize the object during rescue and transportation. Extrication tends to be long, and blood loss can be considerable. A case of a patient who was impaled in the brain by an angle metal bar, at a construction site in July 2000 is presented. The bar was a cross brace which is designed to provide diagonal stability to a scaffold.

2. Case report

A 37-year-old right-handed construction worker became impaled in the head in July 2000 while wearing a protective hat, by a seven-foot (2.13 m) long angle metal bar that fell from a height. The rescue squad cut off 3 feet (0.9 m) from each end of the bar in order to extricate him from the ditch where he had been working. He was initially alert at the scene, but he soon became somnolent and he developed agonal respirations, necessitating endotracheal intubation prior to transfer to the hospital.

Upon arrival to the emergency department, his blood pressure was 116/82 mmHg, heart rate 137 beats per minute, temperature of 37 °C. He was somnolent and did not follow verbal commands. He withdrew the left arm and blinked his eyes to painful stimulation (Glasgow Coma Scale of 7). His head was impaled by a metal bar that was 12 inches (30.5 cm) long and passed across the anterior frontal lobe on the right and the posterior frontal lobe on the left. The portion of the bar on the right had a 90° angle (Fig. 1) while it was flat on the left side (Fig. 2). A copious amount of bright red blood and blood clots along with white matter of the brain were noted to be oozing out from wounds on both sides of the head on to the stretcher. There was a stellate laceration in the face that extended from the bridge of the nose to the right forehead.

No other injuries were noted on secondary survey. Intravenous lines were placed and an indwelling catheter was inserted into his bladder. Intravenous mannitol was started, but was discontinued by the neurosurgeon. A head CT scan was not obtained because the impaling bar would be an obstacle to positioning. A portable Skull X-ray consisting of a single anterior-posterior view showed that the entire portion of the bar in the brain was angled. A linear skull fracture was also evident. While still in the trauma room, he became hypotensive with a systolic blood pressure (BP) of 50 mmHg. He responded to blood transfusion and the BP rose to 110 mmHg. Cefazolin and gentamicin were given for prophylaxis, and he was transferred to the operating room.

The scalp was shaved, and the surgical field was prepped first with alcohol and then with Prevail antimicrobial gel (Allegiance

Abbreviations: CSF, cerebrospinal fluid; CT, computed tomography; MRI, magnetic resonance imaging.

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Fig. 1. The brain is impaled by metal bar which has a 90° on the right side. (Reprinted with permission by © Joe Ordia, M.D.).

Healthcare Corporation, IL, USA) which contains 0.5% iodine and 62% ethanol. The metal bar was similarly prepped with alcohol and Prevail in order to reduce the contamination of the brain when eventually removing it. A bicoronal skin incision that extended from ear to ear was made behind the position of the bar. The incision was extended anteriorly on either side to connect to the lacerations produced by the metal bar. This made it possible to raise a wide scalp flap that exposed all the margins of the compound communited skull fractures. Bone fragments and hair were removed from the brain around the margins of the bar.

The metal bar was then carefully removed from the right side of the head to avoid further damage that could occur if the angled portion of the impaling object were to traverse the brain. As the bar was slowly pulled, hair, bone fragments, and intracerebral blood clots along the path of the object were removed, and bleeding was controlled with bipolar coagulation. Fairly brisk bleeding was observed from a medium size artery in the right frontal lobe and was coagulated. Devitalized brain tissue was debrided while preserving all brain substance that was contused but potentially viable. The brain was then gently irrigated first with saline and then an antiseptic solution consisting of neomycin and polymyxin. Following debridement the skull defect in the right frontal region measured 4 cm × 3 cm, and in the left frontal temporal region 6 cm × 6.5 cm. The dural lacerations were repaired with grafts taken from pericranium. Due to the heavy wound contamination and the risk of infection, the fracture fragments were not replaced.

Fig. 2. The metal bar has a flat surface on the left side where it exits the head in the posterior frontal region. (Reprinted with permission by © Joe Ordia, M.D.).

The patient would be allowed to recover from his injury and wait several months before performing cranioplasty. A hemovac drain was placed in the subgaleal space before the scalp wound and lacerations were closed. The stellate laceration in the forehead was cleaned with betadine solution and closed with a skin adhesive. The estimated blood loss during surgery was 500 ml, but he received a total of 13 units of blood transfusion perioperatively, most of it to replace the earlier blood loss.

He remained on a respirator after surgery. Phenytoin was given for seizure prophylaxis. On postoperative day one he was drowsy, but he moved his left limbs strongly and purposefully, and the right limbs weakly. Range of motion exercises were provided by the physical and occupational therapists. Adequate blood levels of phenytoin could not be achieved; therefore it was changed to carbamazepine 400 mg bid. Postoperative computed tomography (CT) scan showed bilateral frontal hemorrhagic contusions, more so on the left than on the right and also along the track of the metal bar (Fig. 3). No foreign bodies or retained bone fragments were evident. There was a slight midline shift to the right.

Within one week he was fully alert and was following simple verbal commands. Cultures of indriven material and devitalized tissue from the brain taken at surgery grew propionibacterium acnes and rare soil and skin flora, and he was treated for 14 days with penicillin. A tracheostomy was done on postoperative day 12, followed by a percutaneous endoscopic gastrostomy 5 days later. He spiked a fever to 40 °C, and the tip of the central line grew *Candida parapsilosis* for which he was treated with amphotericin B for two weeks. Cultures of the cerebrospinal fluid and aspirations of subgaleal fluid did not grow any organisms, but his airway was colonized by enterobacter, and he was treated with levofloxacin.

On neuropsychological testing 3 weeks after the injury, he was alert, but mute, and he followed simple commands but not consistently. He tracked with his eyes, and he could grasp and hold objects. He was scored as Rancho Level III of cognitive function.

Follow-up head CT scans showed progressive hydrocephalus with CSF extending into the subdural spaces. The right frontal horn was slightly more dilated than the left and he had bilateral frontal encephalomalacia. Lumbar punctures were done, and opening pressures were between 210 and 240 mm of water. MRI (Fig. 4) revealed ventriculomegaly as well as extensive bilateral frontal lobe encephalomalacia.

After completing his course of antibiotics and remaining afebrile for several days, he was taken to the operating room 7 weeks after the injury for placement of ventriculoperitoneal shunt with a Codman-Hakim programmable valve. The initial opening pressure of the valve was set at 120 mm of water. On the first postoperative day, head CT showed that the ventricles were still markedly dilated. He also had nausea and vomiting. The opening pressure of the valve was then set to 100 mm of water. The cranial defects became soft at this point and the vomiting stopped.

He was weaned from mechanical ventilation but the tracheostomy remained in place. He was discharged to an acute rehabilitation hospital 60 days after his accident. At the time of discharge, he was fully awake and alert and he followed simple commands, but he was non-verbal. In spite of a right hemiparesis, he could stand with assistance but could not ambulate.

His neurological and functional status improved during the 6 weeks of inpatient rehabilitation. The tracheostomy and gastrostomy tubes were removed uneventfully. He began to speak coherently with only an occasional word-finding difficulty. He could count 9 of 10 numbers, accurately recite all 7 days of the week, and 7 of 12 months. He was disoriented to year and place. His memory was impaired especially for recent events. He had a flat affect, and he was easily emotional, at times crying at the sight of care givers, and some family members. He could feed himself and