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Research Article

Management and Outcomes of a Penetrating Traumatic Brain Injury in the North Region of Burkina Faso: A Pediatric Case Report

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Abstract

Introduction: Penetrating traumatic brain injury are often the result of accidents, especially in children. These injuries can lead to morbidity depending on the anatomical area affected. We report management and outcomes of a pediatric case of penetrating traumatic brain injury.Methods: We describe a case of penetrating traumatic brain injury in a child following a farm shed fall managed in January 2022 at the neurosurgery department of the Regional University Hospital Center of Ouahigouya.

Observation: The patient was a nine-year-old female child, admitted at the eighth hour following a penetrating traumatic brain injury without initial loss of consciousness, resulting from a farm shed fall. Local examination revealed a piece of wood embedded in the cranial box at the left frontal region. The initial neurological examination and laboratory values were normal. Cranioencephalic computed tomography revealed embedded bone fragments with a biconvex hyperdensity corresponding to an acute epidural hematoma, and an extra-cranial hypodensity with corresponding intracranial extension indicative of a piece of wood in the left frontal region.

She received antibiotic therapy, underwent a craniotomy to circumscribe the foreign body with extraction, evacuation of an acute epidural hematoma, and repair of the dural breach. The postoperative course was uneventful.

Conclusion: Penetrating traumatic brain injury caused by a wooden foreign body such as a piece of wood requires a precise assessment of the injuries before any extraction attempt.

INTRODUCTION

Penetrating traumatic brain injury is a catastrophic primary wounding mechanism encoun-tered in military and civilian settings and is characterized by the violation of the skull and brain by a foreign body [1]. In civilian populations, penetrating traumatic brain injuries are mostly caused by high velocity objects, which result in more complex injuries and high mortality [2]. Penetrating brain injuries caused by non-missile, low-velocity objects represents a rare pathology among civilians, with better outcome because of more localized primary injury [3,4], and is usually caused by violence, accidents, or even suicide attempts [3].

These injuries are the result of accidents, especially in children. Clinical manifestations depend on the intracranial trajectory and determine the management approach. Here, we report management and outcomes of a pediatric case of a penetrating traumatic brain caused by a farm shed fall.

METHODS

We describe a case of penetrating traumatic brain injury in a child following a farm shed fall managed in january 2022 at the neurosurgery department of the Regional University Hospital Center of Ouahigouya.

Observation

The patient was a nine-year-old female child, admitted in January 2022 at the eighth hour following a penetrating traumatic brain injury without initial loss of consciousness, resulting from a farm shed fall. During a strong wind, the shed under which she had taken shelter collapsed on top of her. Upon noticing bleeding from the head, she was transported by her parents to a first-level healthcare facility and then transferred to the surgical emergency department for better care. There is no medical or surgical history.

Local examination revealed a piece of wood embedded in the cranial vault at the left frontal region (Figure1). The initial physical examination revealed: A normal temperature of 37.4°C and a body weight of 23 kg. A Glasgow coma scale of 15, pupils of normal size and reactive, and no neurological deficit. The blood test carried out showed a moderate normochromic normocytic anemia with a hemoglobin of 11.2 g/dl, leukocytosis 16,500 leucocytes per millimeter-cube predominantly neutrophils (71%), prothrombin was normal (89%), uremia was 4,2 millimol per liter and creatininemia was 105 micromol per liter.

Figure 1 Image showing the piece of wood embedded in the cranial vault.

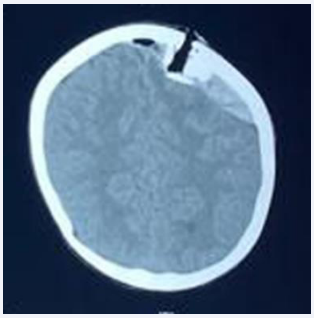

Figure 2 Cranioencephalic CT scan showing the embedded piece of wood, intra-cranial bone fragments, and a pneumocephalus bubble in the left frontal region.

The cranioencephalic computed tomography revealed embedded bone fragments with a biconvex hyperdensity corresponding to an acute extradural hematoma, an extracranial hypodensity with intra-cranial extension of approximately 20mm corresponding to a piece of wood in the left frontal region, and a hypodensity corresponding to a pneumocephalus bubble (Figure 2). She received medical and surgical treatment. Medically, she received analgesics and antibiotics based on ceftriaxone and parenteral metronidazole for 07 days (ceftriaxone 1g q 12 hours, Metronidazole 200mg q 8hours). On the neurosurgical front, she was urgently taken to the operating room. Under general anesthesia and in the supine position, she underwent a horseshoe-shaped anterior hinged skin incision circumscribing the wood (Figure 3), as well as a craniotomy centered on the penetrating object.

Figure 3 Image showing the piece of wood embedded in the cranial vault after detachment of the scalp.

The removal of the penetrating object and bone flap (Figure 4) was performed cautiously and gradually, allowing the identification of an acute epidural hematoma. Evacuation of the acute epidural hematoma revealed a dural breach approximately 2cm in size with jagged edges and bone fragments embedded in the minimally hemorrhagic brain parenchyma. We performed careful bone fragment removal, achieved satisfactory hemostasis with bipolar cautery, and applied absorbable hemostatic compresses. Dural closure was tension-free due to a plastic repair using epicranium. The bone flap was repositioned after suspending the dura mater and then the skin was closed. Post-operative antibiotic treatment continued for 6 days at the same dosage. The immediate post-operative course was straightforward and the child was discharged home after 7 days in hospital with a Glasgow coma scale of 15, a normal temperature of 37.1°C and no neurological complications. After 12 months, no complications were noted.

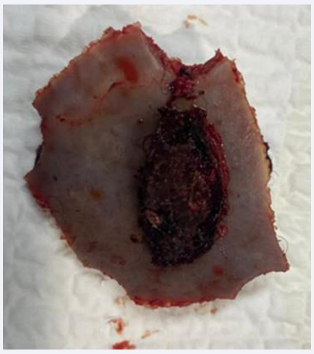

Figure 4 Image of the cranial flap centered on the piece of wood.

DISCUSSION

The prevalence of penetrating traumatic brain injury in Africa, and specifically in Burkina Faso, remains unknown. They generally occur in accidental or homicide contexts and are most often associated with a poor prognosis [5]. The occurrence circumstance in our patient was accidental. According to Zeeshan [6], The Glasgow coma scale at presentation, injury to brainstem and presence of vascular injury at presentation are the most important predictors of outcome in such cases. The patient's prognosis is influenced by the clinical state on admission and the extent to which the penetrating object has affected the noble structures of the brain.

In the vast majority of cases, most penetrating traumatic brain injury are rarely associated with major neurological symptoms regardless of the size of the penetrating objects, except in cases of high-velocity injuries [7,8]. Primary injury to the brain is determined by the ballistic properties (kinetic energy, mass, velocity, shape, etc.) of the projectile and any secondary projectiles, such as bone or metallic fragments [9]. The kinetic energy (E) is defined by the relationship: $E = 1/2mv^2$, which implies that the velocity (V) of the projectile has a greater influence than the mass (m) of the projectile alone [10]. CT imaging is essential for comprehensive lesion assessment in penetrating head injuries [11,12]. In our case, we performed a cranioencephalic CT scan, allowing for a precise description of cranioencephalic lisions. Some authors [13,14] advised against the removal of the material without prior cerebral angiography due to the risk of fatal vascular injury leading to exsanguination. Cerebral angiography was not performed in our case before the surgical procedure.

Removal of the blunt object remains the solution, although there is a risk of cataclysmic haemorrhage. According to Hubschmann [15], patients with active intracranial bleeding should be treated urgently. In our case, there was no active external bleeding, which allowed us to better explore and plan the operation without losing time. In the literature, some authors [16-18] have opted for a craniotomy with the vulnating object removed, allowing better exposure, while others[18,19] perform blind removal. In our case, we opted for craniotomy because it allows better exposure and control of the underlying lesions.

The presence of contaminated foreign objects, skin, hair and bone fragments introduced into the brain tissue along the trajectory of the projectile explains Why the risk of local wound infection, meningitis, ventriculitis or brain abscess is particularly high in patients with penetrating brain injury [10,20]. Early and appropriate treatment can limit the onset of infection. Our patient was treated after the first 12 hours following the trauma, but we did not note any infectious complications. There is currently no consensus regarding antibiotic therapy for penetrating traumatic brain injury. Some recommendations have suggested the use of ceftriaxone, metronidazole, and vancomycin for 7-14 days [15].

As for the "Infection in Neurosurgery" Working Party of British Society for Antimicrobial Therapy recommended starting antibiotic therapy as soon as possible after the injury and continuing for 5 days after the operation with the following regimen for penetrating brain injury : intravenous co-amoxiclav 1.2g q 8h, or intravenous cefuroxime 1.5g, then 750mg q 8 h with intravenous metronidazole 500mg q 8 h (or 1g q 12h per rectum or 400mg q 8h by mouth) [21-23]. In our case, the patient received early broad-spectrum antibiotic therapy, which was supplemented at 7 days with intravenous ceftriaxone and metronidazole. According to William [16], cortical lesions may lead to gliosis or glial scarring, which could predispose to seizures. More recent studies recommend the prophylactic use of anticonvulsants (e.g. phenytoin, carbamazepine, valproate or phenobarbital) during the first week following an penetrating brain injury [22,23]. Although we did not administer anticonvulsants to our patient, she did not develop any posttraumatic epilepsy after 12 months of follow-up.

CONCLUSION

Penetrating traumatic brain injury represent a special entity in neurotraumatology. There is a lack of consensus in management, and the approach for each patient is specific. Prognosis depends on the speed of management and the anatomical structures traversed by the offending object.

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