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Management of Penetrating Cranioencephalic Trauma Caused by Sharp Metal Objects—Therapeutic and Evolutionary Aspects: 12 Cases at the Renaissance University Hospital in N'Djamena

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Abstract

Introduction: Cranioencephalic trauma caused by bladed weapons is rare, and that caused by sharp objects is exceptional. The aim of our study was to describe the clinical, therapeutic and evolutionary aspects. **Materials and method:** This was a descriptive and analytical study over a 48-month period at CHU la Renaissance from January 1, 2018 to December 31, 2021, concerning patients admitted for penetrating cranioencephalic trauma by pointed object. **Results:** Twelve cases, all male, of penetrating cranioencephalic sharp-force trauma were identified. The mean age was 34 ± 7 years, with extremes of 11 and 60 years. Farmers and herders accounted for 31% and 25% of cases respectively. The average admission time was 47 hours. Brawls were the circumstances of occurrence in 81.2% of cases. Knives (33%), arrows (25%) and iron bars (16.6%) were the objects used. Altered consciousness was present in 43.8% of cases, and focal deficit in 50%. Scannographic lesions were fracture and/or embarrhment (12 cases), intra-parenchymal haematomas (6 cases) and presence of object in place (4 cases). Surgery was performed in 11 patients. Postoperative outcome was favorable in 9 patients. After 12 months, 2 patients were declared unfit. **Conclusion:** Penetrating head injuries caused by sharp objects are common in Chad. Urgent surgery can prevent disabling after-effects.

Keywords

Penetrating Trauma, Skull, Encephalon, Sharp Object, Surgery, Patient

Outcome

1. Introduction

Cranioencephalic trauma (CET) refers to any direct or indirect mechanical attack on the skull, immediately or subsequently responsible for disorders of consciousness reflecting diffuse or localized encephalic suffering ranging from obnubilation to coma. This is a major public health problem, in terms of mortality, morbidity and economic and social repercussions. Indeed, CET is the leading cause of death and disability in young adults [1] [2] [3].

Cranioencephalic trauma caused by bladed weapons is a relatively rare form of head injury, and penetrating trauma caused by sharp objects is exceptional [1]. Our aim is to study the epidemiological, clinico-radiological, therapeutic and evolutionary aspects of penetrating cranioencephalic trauma caused by sharp-edged knives at the Renaissance University Hospital in N'Djaména.

2. Materials and Methods

We had conducted a descriptive and analytical study over a 48-month period at the neurosurgery unit of CHU-R from January 1, 2018 to December 31, 2021. Our study focused on all penetrating cranioencephalic trauma caused by a sharp bladed weapon at the CHU-R of N'Djamena during the period of our study. The Glasgow Coma Scale (GCS) was used to classify patients according to their state of consciousness.

All patients admitted with penetrating cranioencephalic sharp-force trauma were included in the study. Excluded from the study were: non-consenting patients; patients discharged against medical advice.

Sharp objects included: knives, arrows, sharp-tipped iron bars, nails and any sharp-tipped object capable of causing penetrating cranioencephalic injury.

Data was collected using the previously drawn up data sheets. The outcome of the victims was based on clinical assessment after a 6-month and 12-month follow-up, to assess their neurological condition and occupational outcome. The data were processed using IBM SPSS version 21 software, and entered into Office World and Excel 2010.

3. Results

We recorded 12 cases of cranioencephalic sharp-edged trauma out of a total of 649 cases of CET, *i.e.* a frequency of 1.85%. All patients were male.

The age range 21 - 40 (**Table 1**) was represented by 7 patients, *i.e.* 58.3% of cases, with an average age of 31.22 ± 8 years, ranging from 11 to 70 years.

Concerning the occupation (**Table 2**) of the patients, the majority were farmers in 33.3% (n = 4) of cases, followed by stockbreeders in 25% (n = 3) of cases.

Table 1. Distribution of patients by age group.

Age	n	%
Under 20	2	16.7
21 to 40	7	58.3
41 to 60	2	16.7
Over 61	1	8.3
Total	**12**	**100.0**

Table 2. Distribution of patients by profession.

Function	n	%
Farmer	**4**	**33.3**
Breeder	**3**	**25.0**
Pupil/student	2	16.7
Trader	1	8.3
Defence and security force	2	33.3
Total	**12**	**100.0**

Patients came from rural areas in 9 cases (75%) and from urban areas in 3 cases (25%).

Patients were transported by non-medical ambulance in 7 cases (58.3%), by medical ambulance in 16.7% (n = 2) and by private vehicle in 25% (n = 3).

Fighting was the circumstance of occurrence in 10 patients (83.3%), including 7 cases of intercommunity conflict and 3 cases of conflict between two individuals.

The knife (**Figure 1(a)**) was the pointed white weapon responsible for penetrating cranioencephalic trauma in 5 patients, followed by pointed iron bars in 4 patients, the arrow (**Figure 1(b)**) in 2 patients and the pointed end of a pickaxe in one patient.

The mean admission time was 47 ± 8 hours, with extremes ranging from 8 hours to 128 hours. Half the patients (n = 6) were admitted within 48 hours. No patient was admitted before the first 6 hours.

Symptoms on admission included disturbed consciousness in 9 patients, nausea and vomiting in 4, seizures in 2 and motor disorders in 7.

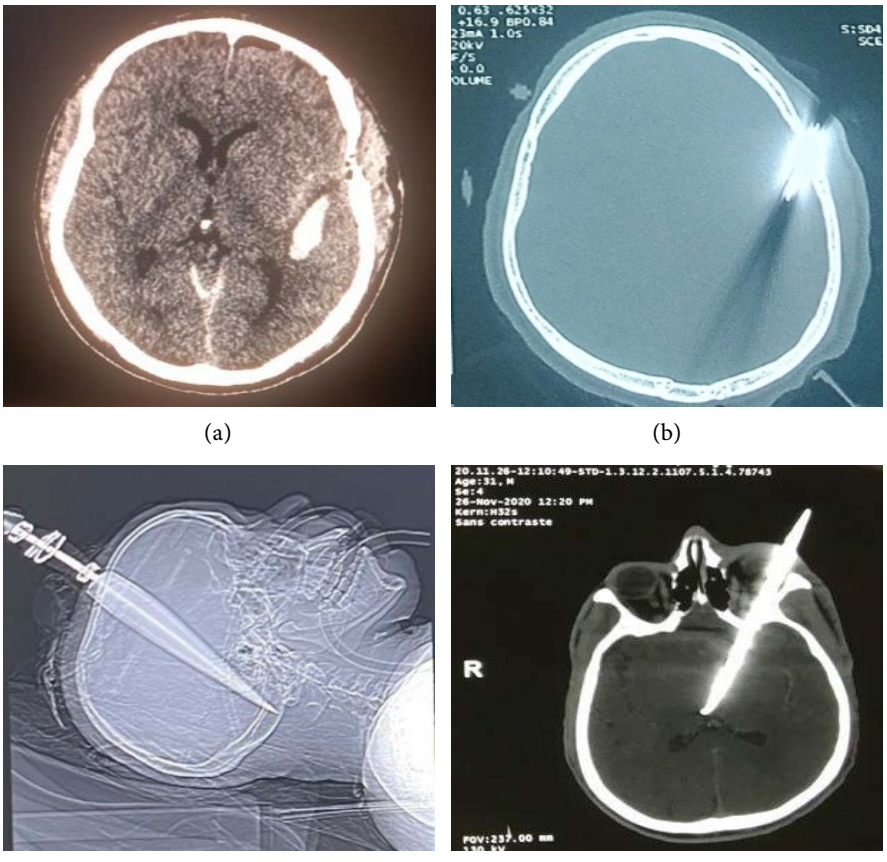
Evaluation of the state of consciousness identified 3 patients as severe TCE with a GCS of 3 - 8, 4 as moderate CET (GCS = 9 - 12) and 5 as mild TCE with a GCS of 13 - 15. Unilateral mydriasis was found in three patients (25%). Pupils were isochoric in 9 patients. Neurological deficit was noted in 7 patients, including 3 cases of hemiparesis and 4 cases of hemiplegia.

All 12 patients had undergone CT brain scans when their condition allowed, and some had done so intubated and in good hemodynamic condition. Various craniocerebral lesions were identified (**Figure 2**). Fracture of the skull was the

most common CT lesion in all 12 patients, with 7 cases of compound fracture and 5 cases of simple fracture. Intracranial lesions included 6 cases of intra-parenchymal haematomas, 3 cases of oedemato-haemorrhagic contusions, 2 cases of sub-dural haematomas and 1 case of extradural haematomas.

(a) (b)

Figure 1. Preoperative images of patients; (a): cephalic image with penetration of a knife to the guard; (b): image of a pointed object of the kind with lateral penetration of the left orbit.



(a) (b)

(c) (d)

Figure 2. Cerebral CT scan: (a): Parenchymal window in axial section showing an intra-parenchymal hematoma; (b): Bone window in axial section showing a fracture with a penetrating object embedded in the skull; (c): Bone window in sagittal reconstruction showing a knife penetrating to the occiput; (d): Parenchymal window in axial section showing an arrow-like penetrating object in the right orbit.

On admission, all patients received tetanus serum combined with tetanus vaccine, and double antibiotic therapy (ceftriaxone 4 g/day and metronidazole 1.5 g/day) for a minimum of 10 days and a maximum of 21 days. A total of 9 patients, or 75% of cases, were admitted to intensive care, including 3 patients admitted intubated in poor hemodynamic condition.

Of the 12 patients registered, 11 had undergone surgery. The only non-operated patient arrived with a sutured puncture wound. The CT scan showed a small contusion opposite the wound, and he was given medical treatment and monitored for 48 hours. Surgery was performed in 8 patients within the first 6 hours after admission, *i.e.* 72.7% (8/11) of cases. All patients underwent surgery within 48 hours of admission. The surgical indications were many and varied (see **Table 3**).

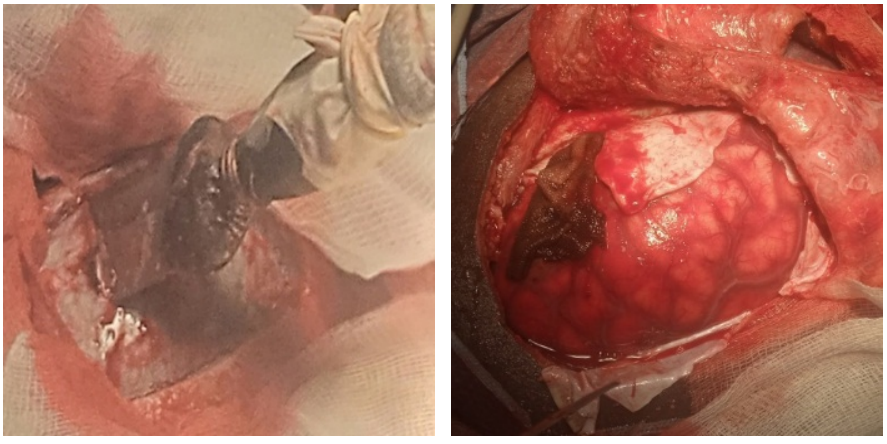
Of the 11 patients operated on, 10 had undergone a craniotomy and only one a trepanation. Removal of the pointed object was performed in all cases after craniotomy (**Figure 3(b)**). Extraction was performed in the axis of entry of the object. Two craniotomy enlargements were performed for a finding of cerebral swelling (**Figure 3(b)**) after removal of the pointed object.

The mean length of stay was 11 ± 6 days, with extremes of 2 days and 21 days.

Post-operative evolution was marked by:

- 9 cases with a favorable outcome (81.8%).
- One case complicated by an infection of the surgical site, which necessitated a repeat and prolongation of hospitalization for up to 21 days.
- 2 deaths, representing a mortality rate of 18.1%.

Both deaths were due to major haemorrhage on admission, which could not be controlled during the operation. In both cases, the object was removed immediately after the trauma. After 12 months' follow-up, 8 patients had resumed their normal professional activities, while two patients were left with sequelae incompatible with their profession (**Table 4**).



(a) (b)

Figure 3. Intraoperative images: (a): Craniotomy all around the vulnating object (knife); (b): Cerebral swelling after removal of the vulnating object.

Table 3. Distribution of patients by surgical indication.

Surgical indication	n	%
Craniocerebral wound trimming	5	45.4
Removal embarrure	1	9.1
Foreign body removal	4	36.4
Hematoma evacuation	1	9.1
Total	11	100.0

Table 4. Distribution of patients according to sequelae.

After-effects	n	
	After 6 months	After 12 months
Minor residual headache	3	2
Comitiality	1	1
Hemiparsis	3	2
Decreased visual acuity	1	1
Hypoacusis	1	1
No after-effects	7	8

4. Discussion

During the study period, we recorded 12 cases of penetrating cranioencephalic trauma caused by a sharp object, out of a total of 749 cases of cranioencephalic trauma, *i.e.* a frequency of 1.6%. Penetrating cranial trauma involving sharp foreign bodies is rare, unlike closed cranial trauma. This finding has been noted by most authors [3] [4] [5]. Our result is much higher than that of S Feknous *et al.* [1], who obtained 0.4%. This difference could be explained by the upsurge in inter-community conflicts in our country.

The mean age was 31.22 ± 8 years, with extremes of 14 and 70 years. All our patients were male. This could be explained by the fact that young people are more exposed to cranioencephalic trauma by stabbing, as they are always at the front line of conflicts or brawls [6].

The association of farmers in 33.3% (n = 4) and stockbreeders in 25% (n = 3) of cases constitutes the majority of trauma victims, *i.e.* 58.8%. We also noted that 75% of patients came from rural areas (n = 9) and 25% from urban areas. These two observations could be explained by the resurgence of inter-community conflicts, especially the farmer-breeder conflict in our context. Cohabitation between these two groups is always subject to conflict for a variety of reasons, ranging from the mistreatment of livestock by herders to the destruction of farmers' fields.

We found that brawling was the main cause of penetrating cranioencephalic trauma, with a rate of 81.2%. According to C Gökçek *et al.*, most of these penetrating injuries are the result of industrial accidents or criminal assaults [7]. Most authors report cases of penetrating trauma linked to assaults [4] [5] [7], which is not the case here, where fights predominate.

The clinical presentation is variable, depending above all on which part of the brain is injured. When a pointed object penetrates the skull, it successively injures the scalp, the skull and the brain along its path to the boundary. during its path, the vulnating object may damage parenchymal and vascular structures in contact [2] [8]. If the object is removed after penetration, it may cause further lesions if the path is not the same as the initial one. Clinical presentation ranges from altered consciousness to focal deficits correlating with parenchymal lesions caused by the vulnating object. Exceptionally, patients were admitted conscious—5 cases in our series. This has been reported by various authors in the literature [9] [10] [11] [12].

Cerebral CT scans performed as an emergency procedure help to identify the extent of lesions, but should only be carried out on a well-stabilized patient. Skull fractures and/or embayments, intra- or extra-parenchymal hemorrhages, cerebral ischemia, cerebral edema and depth of penetration even if the object is removed are generally the lesions detected by cerebral CT. Assessment of vascular structures is also mandatory, especially if the path of the pointed object crosses that of the vessels [13] [14] [15] [16].

In our series, 11 patients had undergone emergency surgical treatment, with satisfactory results (81.8% favorable postoperative outcome). S Zyck *et al.* reported good results after surgical treatment [2]. Surgery should be performed urgently, as there is 53% morbidity in cases of late surgery and 62% morbidity in non-operated cases [7].

Complications leading to mortality in the early stage are intracerebral haemorrhage, major vascular lesions and meningitis [7] [9] [14]. In our series, both deaths were due to hemorrhagic complications.

Survival is higher in patients with penetrating intracranial stab wounds than in those with penetrating intracranial firearm wounds.

A more contemporary study reported an even lower mortality (11%), in a series of 66 patients with transcranial stab wounds [16]. However, stab wounds penetrating the orbit are associated with a mortality of up to 30% [17]. In contrast, overall mortality from firearms to the head can be as high as 91% [18] [19].

Residual headache in 2 patients after 12 months was the type of neurological sequelae, as well as sequellar hemiparesis in 2 patients. The two patients with motor sequelae were unable to return to their usual work.

5. Conclusion

Penetrating cranioencephalic trauma is a frequent occurrence in Chad, and is mainly suffered by young males. Neurosurgical management is highly successful,

despite the existing vascular and infectious risks. The non-negligible after-effects can be disabling for patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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