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Fatal Cranio-Encephalic Trauma in Bujumbura: Epidemiological, Clinical and Computed Tomography Aspects

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Abstract

Background: Traumatic brain injuries are a major cause of death and mortality in young adults. Computed tomography allows for a lesion assessment to establish the prognosis in case of good management. This study aims to elucidate the epidemiological, clinical, and computed tomographic characteristics of patients who succumbed to traumatic brain injuries. **Patients and method:** This retrospective descriptive study was conducted over a 16-month period from August 2021 to December 2022 at the Teaching Hospital of Kamenge, Kamenge Military Hospital, Kira Hospital and Tanganyika Care Polyclinic. We included patients who died because of cranioencephalic trauma, regardless of whether they underwent a CT scan. A total of 58 patients met our inclusion criteria. The parameters analyzed included epidemiological data, clinical characteristics, and cranioencephalic CT findings. **Results:** During the study period, 266 patients were admitted to intensive care with traumatic brain injuries. Among these, 63 patients (27.87%) died. The mean age of the patients was 37.36 years (± 16.33), with men comprising 89.66% of the cases. Road traffic accidents accounted for 46 cases (79.31%). Upon admission to intensive care, 39 patients (67.24%) exhibited impaired consciousness, unilateral mydriasis was observed in 26 patients (44.83%), and intracranial hypertension was noted in 20 patients (34.48%). The Glasgow Coma Scale score was recorded for 40 patients (68.9%), of whom 37 (92.5%) had a score of 8 or lower, with a mean score of 6.15 (± 2.14). CT scans were prescribed for 57 patients (98.28%), with 33 patients (57.89%) undergoing the procedure. Skull fractures were identified in 20 patients (60.61%), while brain lesions were present in all

33 patients, predominantly located in the left hemisphere (51.51%) and primarily affecting the frontal lobe (51.51%). Hemorrhagic contusions were noted in 26 patients (78.78%). Notably, 70.69% of deaths occurred within three days of hospitalization. **Conclusion:** Cranioencephalic trauma primarily affects young males. CT scans provide a comprehensive assessment of these injuries. Most fatalities occur within the first 72 hours of hospitalization.

Keywords

Computed Tomography, Head Trauma, Mortality

1. Introduction

Traumatic brain injuries are a leading cause of death and morbidity among young adults [1]. In low- and middle-income countries, these injuries frequently result from road accidents, and their incidence continues to rise annually due to the increasing number of motor vehicles and inadequate adherence to road safety measures [2]-[4]. Traumatic brain injuries are associated with a high mortality rate, with fatalities occurring either immediately following the injury or several hours or days later [1]. In developing nations, healthcare resources remain limited, particularly regarding specialist physicians and essential equipment such as CT and MRI scanners. Consequently, the mortality rate associated with cranioencephalic trauma is significantly higher than that observed in high-income countries [5].

With appropriate technical resources and effective coordination of patient care—from the site of the injury to hospitalization through emergency services—mortality rates can potentially be reduced. Many deaths result from severe traumatic brain lesions that, under optimal conditions, should receive timely medical and surgical intervention, including effective resuscitation [6]. In Burundi, the management of severe cranioencephalic trauma is suboptimal, characterized by a shortage of specialist physicians and necessary equipment to provide quality care. Not all patients with severe head injuries have access to essential imaging studies, including CT scans and MRIs, due to financial constraints or geographical barriers. These imaging modalities are crucial for a comprehensive assessment of injuries and for informing appropriate therapeutic decisions [5]. This study aims to elucidate the epidemiological, clinical, and computed tomographic aspects of patients who succumbed to head trauma.

2. Patients and Methods

This retrospective and descriptive study was conducted over a 16-month period from August 2021 to December 2022 at the Teaching Hospital of Kamenge, Kamenge Military Hospital, Kira Hospital, and Tanganyika Care Polyclinic. We included patients of all ages and genders who died because of cranioencephalic trauma, regardless of whether they had undergone a CT scan during their

hospitalization in intensive care. Data were collected from medical records using a pre-established survey form. A total of 58 patients met our inclusion criteria for this study. The parameters analyzed included epidemiological data, clinical characteristics, and cranioencephalic CT findings. Data entry was performed using Word and Excel software, while data analysis was conducted using SPSS software.

3. Results

During the 16-month study period, out of a total of 2,704 patients admitted to intensive care, 266 were diagnosed with cranioencephalic trauma, representing 9.8% of cases. Among these, there were 63 fatalities, accounting for 27.87% of the cases. The Kamenge Military Hospital and the Teaching Hospital of Kamenge reported the highest numbers of deaths related to cranioencephalic trauma, with 32 cases (50.79%) and 24 cases (38.10%), respectively. Our study ultimately included 58 patients who met the inclusion criteria.

A predominance of young adults aged 31 to 40 was observed, comprising 29.31% of cases. The mean age of our patients was 37.36 years (±16.33), with ages ranging from 4 to 71 years. The male population was significantly larger, representing 89.66% of the cases, yielding a sex ratio of 8.67. Road traffic accidents were the primary cause of head trauma, affecting 46 patients (79.31%). Among these, vehicles with four or more wheels were involved in 24 cases (52.17%), while motorcycles accounted for 32.61% of road incidents. Fatal head trauma predominantly affected farmers and students, who constituted 18.97% and 15.52% of cases, respectively; additionally, 25.86% of patients did not have a declared profession in their records.

Of the 50 patients for whom the time of the accident was documented, 30 patients (60%) were admitted to intensive care within 24 hours, and 45 patients (90%) within 72 hours post-trauma. Upon admission, consciousness was impaired in 39 patients (67.24%), unilateral mydriasis was observed in 26 patients (44.83%), and intracranial hypertension was noted in 20 patients (34.48%). Scalp lacerations were present in 19 patients (32.76%), and hemiplegia was noted in 17 patients (29.31%). The Glasgow Coma Scale (GCS) score was recorded in 40 patients (68.9%), with 37 patients (92.5%) having a GCS score of 8 or lower, yielding a mean score of 6.15 (±2.14) with extremes of 3 and 14.

CT scans were prescribed for 57 patients (98.28%), of which 33 patients (57.89%) underwent the procedure. The scan was not performed in 15 patients (26.31%) due to financial constraints. A general practitioner prescribed CT scans for 73.68% of these patients (42 patients). All CT scans were completed within 72 hours of prescription, with 15 patients (45.46%) receiving their scans within 24 hours. Skull fractures were identified in 20 patients (60.61%) (**Figure 1(a)**), with multiple fractures present in 12 patients (60%) and the temporal bone involved in 60% of cases.

All 33 patients who underwent CT scans exhibited brain lesions of varying locations and types (see **Table 1**). Most brain lesions were located on the left side

(17 patients, 51.51%), with similar proportions found in the frontal lobe (51.51%).

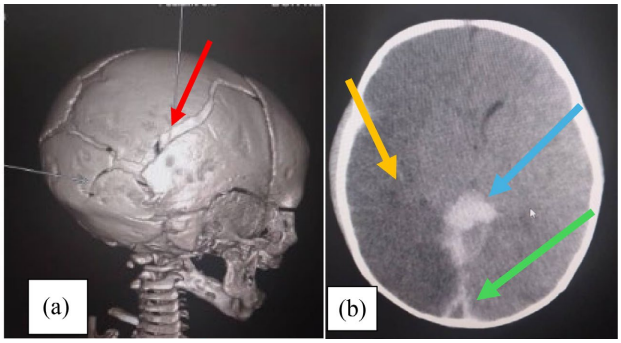

Figure 1. Kira hospital: 3-year-old patient: Victim of a road accident. On CT scan: Right hemispheric cerebral oedema (orange arrow) with mass effect on the medial structures. Haemorrhagic flooding of the 3rd ventricle (blue arrow) and subarachnoid haemorrhage (green arrow) (a). Multiple fracture of the right parietal and occipital bones (red arrow) (b).

Table 1. Distribution of patients according to brain lesions on CT scan.

Brain injuries		Effective	Percentage (%)
Affected side	Left	17	51.51
	Right	8	24.24
	Bilateral	8	24.24
Affected lobe	Frontal lobe	17	51.51
	Temporal lobe	12	36.36
	Parietal lobe	9	27.27
	Occipital lobe	3	9.09
Type of injury	Hemorrhagic contusion	26	78.78
	Diffuse parenchymal edema	17	51.51
	Brain engagement	10	30.03
	Pneumocephalus	10	30.30
	Subdural hematoma	8	24.24
	Extradural hematoma	8	24.24
	Ventricular flooding	4	12.12
	Mass Effect without commitment	4	12.12
	Subarchnoid hematoma	1	3.03

All patients in our study (33 patients) who underwent CT scans had lesions in the brain.

Hemorrhagic contusion was noted in 78.78% of patients (26 cases). Diffuse parenchymal edema was observed in 17 patients or 51.51% of cases (**Figure 1(b)**). Cerebral engagement concerned 30.30% of patients (10 cases) (**Figure 2**). Pneumencephalus was also observed in 10 patients. A subdural hematoma and an

extradural hematoma were each observed in 8 patients (24.24% of cases).

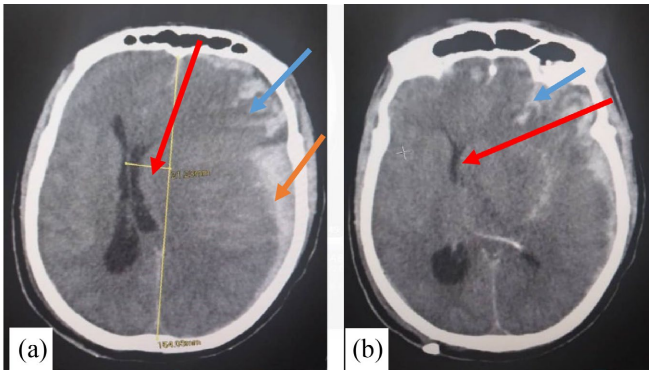

Figure 2. (a) and (b): Kira hospital: 71-year-old patient: Victim of a road accident. On CT scan: Left subdural hematoma (orange arrow) with sub-falcorial engagement (red arrow). Left frontal and temporal hemorrhagic contusion (blue arrow).

During hospitalization, 32.76% of deaths (19 patients) occurred on the first day, with 50% (29 patients) dying within the first two days and 70.69% (41 patients) within three days of admission (see **Figure 3**).

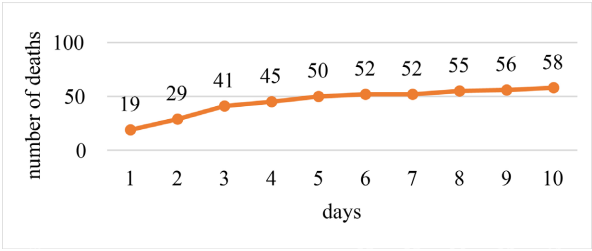

Figure 3. Cumulative number of deaths versus length of hospitalization.

The mean duration of hospitalization was 3.14 days (±2.41), ranging from 30 minutes to 11 days. Death times were documented for 15 patients (25.86%), with fatalities occurring between 6 p.m. and 6 a.m. in 53.33% of cases.

4. Discussion

Head trauma accounted for 9.83% of cases admitted to the multipurpose intensive care unit during our study, a rate slightly higher than the 7.39% reported by Irié Bi *et al*. in Ivory Coast [7]. The overall mortality rate among our patients was 27.87%, which aligns closely with other studies, such as that by García ARP *et al*. in Cuba, which reported a mortality rate of 29.3% [8], and Mengistu Z *et al*. in Ethiopia, which noted a rate of 30.2% [9]. Some studies have reported significantly higher mortality rates, with figures reaching 66% in research by Irie G *et al*. in Bouaké, Ivory Coast [7], and 67% in a study by Mangat HS *et al*. in Tanzania [10]. These elevated rates are typically observed in patients who have suffered severe

head trauma [5].

The majority of patients in our study were admitted to the intensive care units of Kamenge Military Hospital (50.79%) and the Teaching Hospital of Kamenge (38.10%). These public hospitals have access to neurosurgeons and intensive care specialists, as well as a substantial patient intake capacity, while offering relatively affordable care compared to private institutions. However, they currently lack CT scanners, necessitating that CT imaging be performed at private facilities such as Kira Hospital and Tanganyika Care Polyclinic.

The average age of our patients was 37.36 years (±16.33), with the most affected age group being 31 to 40 years, which constituted 29.31% of cases. This trend is consistent with findings from various studies [11]-[14], indicating that cranioencephalic trauma primarily affects young adults, who are typically the most economically productive demographic. Similar observations were made by Anakwue AM *et al*. in Nigeria, where the average age was 32.6 years [11], and Onwuchekwa CR *et al*. noted that the most affected group was aged 21 to 30 years (23.87%) [15].

The predominance of male subjects (89.66%) among those who died from traumatic brain injuries is consistent with findings from other studies [10] [14] [15], suggesting that males are more frequently involved in activities that lead to such injuries. Road traffic accidents were the leading cause of head trauma in our study, accounting for 79.31% of cases. This aligns with existing literature indicating that road accidents are a primary source of traumatic injuries [8] [13] [15] [16]. In our cases, both four-wheeled vehicles and motorcycles contributed significantly to these incidents, with cars involved in 52.17% of the accidents. However, other studies have reported a higher involvement of two-wheeled vehicles [7] [13].

Farmers and students constituted most patients with fatal head injuries, reflecting the demographic characteristics of Burundi, which has a predominantly agricultural economy and a young population [17]. Early medical and surgical intervention for cranioencephalic injuries is crucial for improving patient outcomes [18]. In our study, 51.72% of patients were admitted within 24 hours of the trauma. Upon admission, consciousness was impaired in 39 patients (67.24%), with 37 patients (92.5%) scoring less than or equal to 8 on the Glasgow Coma Scale, averaging 6.15 (±2.14). The Glasgow score is a critical indicator of injury severity and is associated with high mortality rates, as confirmed by McIntyre A *et al*. [19].

Neurological signs, such as unilateral mydriasis (44.83%) and intracranial hypertension (34.48%), further highlighted the severity of the injuries. Intracranial hypertension significantly increases the risk of mortality, necessitating prompt and effective management [20] [21]. CT scans are the preferred imaging modality for assessing cranioencephalic injuries, guiding both urgent and elective therapeutic interventions [22]. In our study, CT scans were prescribed for nearly all patients (98.28%), yet only 57.89% underwent the examination, primarily due to financial constraints.

In our context, most patients are initially evaluated by general practitioners,

who are responsible for managing emergency cases despite limited expertise in neurosurgical emergencies. The scarcity of neurosurgeons—only two during our study period-exemplifies a broader issue faced by healthcare systems in many sub-Saharan African countries [23].

While all CT scans were conducted within 72 hours, only 45.46% were performed within 24 hours post-trauma. This delay can be attributed to financial challenges faced by victims' families and the limited availability of CT scanning facilities in the capital, Bujumbura. The sensitivity and specificity of CT for detecting traumatic craniocephalic injuries are well established [24]. In our study, skull fractures were observed in 60.61% of patients, often accompanied by significant vascular injuries.

All patients who underwent CT scans displayed brain lesions, predominantly on the left side and mainly in the frontal lobe. Hemorrhagic contusions were recorded in 78.78% of cases, with associated parenchymal edema in 51.51%. Such findings correlate with high mortality rates, as noted in previous studies [9] [14] [18] [20]. During hospitalization, 32.76% of deaths occurred on the first day, with 70.69% within three days. The average duration of hospitalization was 3.14 days (±2.41). The timing and rapidity of deaths are indicative of the severity of traumatic cranioencephalic injuries and highlight potential inadequacies in therapeutic management.

5. Conclusion

Cranioencephalic trauma predominantly affected young males, many of whom were engaged in agricultural activities. Road accidents were the leading cause of these fatal injuries, with four-wheeled vehicles being the most involved. Clinical presentations were characterized by altered consciousness, with a significant proportion of patients scoring ≤8 on the Glasgow Coma Scale. Although nearly all patients were prescribed CT scans, not all received them, and those who did exhibited skull fractures and brain lesions. Most deaths occurred within the first three days of hospitalization, particularly during nighttime hours, underscoring the need for increased vigilance among medical staff during these critical periods.

Limitations of the Study

The limitations of this study are related to its retrospective nature. Some patients had incomplete records because death occurred before filling in all the data that should be in the record.

This study made it possible to identify the clinical and CT aspects which can help to establish a prognosis in any case of serious trauma.

Data Availability

The data from this study are available in the intensive care unit. Upon request, the corresponding author can make them available to anyone who needs them.

Ethical Approval

This study was approved by the ethics committee of the Faculty of Medicine at the University of Burundi.

Consent

Written consent was obtained from the patients' family. The parents were informed of the purpose of the article.

Authors' Contributions

All authors have read and agreed to the final manuscript.

Conflicts of Interest

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

References

[1] Adeloye, D., Thompson, J.Y., Akanbi, M.A., Azuh, D., Samuel, V., Omoregbe, N., *et al*. (2016) The Burden of Road Traffic Crashes, Injuries and Deaths in Africa: A Systematic Review and Meta-Analysis. *Bulletin of the World Health Organization*, **94**, 510A-521A. https://doi.org/10.2471/blt.15.163121

[2] Ciza, M. and Szpytko, J. (2018) Transport System Telematics, Burundi Case Study. *Archives of Transport System Telematics*, **11**, 3-10.

[3] Djibo, I., Yanogo, P.K., Kabore, J., Antara, S., Sawadogo, B. and Meda, N. (2021) Profil Epidémiologique des accidents de la route survenus à Niamey, Niger du 1er février au 31 mars 2017. *Science et Technique*, *Sciences de la Santé*, **44**, 51-59.

[4] Tung, T., Tseng, W., Chen, C., Lai, J. and Chen, Y. (2000) Acute Life-Threatening Injuries in Facial Fracture Patients: A Review of 1,025 Patients. *The Journal of Trauma*: *Injury*, *Infection*, *and Critical Care*, **49**, 420-424. https://doi.org/10.1097/00005373-200009000-00006

[5] Abio, A., Bovet, P., Valentin, B., Bärnighausen, T., Shaikh, M.A., Posti, J.P., *et al*. (2021) Changes in Mortality Related to Traumatic Brain Injuries in the Seychelles from 1989 to 2018. *Frontiers in Neurology*, **12**, Article 720434. https://doi.org/10.3389/fneur.2021.720434

[6] Koome, G., Thuita, F., Egondi, T., Atela, M. (2022) Association between Traumatic Brain Injury (TBI) Patterns and Mortality: A Retrospective Case-Control Study. *F1000Research*, **10**, 795. https://doi.org/10.12688/f1000research.54658.2

[7] Irie, G., Pete, Y., Koffi, N., Nda-Koffi, C., Ogondon, C., Kouadio, S., Able, E. and Brouh, Y. (2017) Profil épidémiologique des traumatismes crânio-encéphaliques au centre hospitalier et universitaire de Bouaké. *Médecine d'Afrique Noire*, **64**, 607-612.

[8] García, A.R.P., Hernández, A.P., García, A.R.P. and Borges, W.R. (2015) Prognostic Factors of Death in Patients with Cranioencephalic Trauma. *Revista Cubana de Medicina Intensiva y Emer-gencias*, **14**, 61-69.

[9] Mengistu, Z., Ali, A. and Abegaz, T. (2021) Predictive Factors for Fatality after Traumatic Brain Injury Among Road Traffic Crash Victims in Addis Ababa City, Ethiopia. *Translational Medicine*, **14**, Article 1000315.

[10] Mangat, H.S., Wu, X., Gerber, L.M., Shabani, H.K., Lazaro, A., Leidinger, A., *et al*. (2021) Severe Traumatic Brain Injury Management in Tanzania: Analysis of a

Prospective Cohort. *Journal of Neurosurgery*, **135**, 1190-1202. https://doi.org/10.3171/2020.8.jns201243

[11] Anakwue, A., Idigo, F.U., Nwogu, U.B., Ogbu, S.O., Nnamani, A., Joseph, K. and Ugwoke, C.C. (2018) Intracranial CT Findings in Traumatic Brain Injury: A Retrospective, Cross-Sectional Study among Igbo Population in Nigeria. *Journal of Health and Social Sciences*, **3**, 273-280.

[12] Al-Qazzaz, M.A. and Jabor, M.A. (2014) Medico-Legal Study of Intracranial Causes of Death. *Egyptian Journal of Forensic Sciences*, **4**, 116-123. https://doi.org/10.1016/j.ejfs.2014.07.007

[13] Shisoka, J.M., Omondi, L.A. and Kimani, S.T. (2019) Determinants of the Outcome on Traumatic Brain Injury Patients at Kenyatta National Hospital. *African Journal of Health Sciences*, **32**, 35-47.

[14] Boniface, R., Lugazia, E., Musa, A. and Kiloloma, O. (2017) Management and Outcome of Traumatic Brain Injury Patients at Muhimbili Orthopaedic Institute Dar Es Salaam, Tanzania. *Pan African Medical Journal*, **26**, Article 140. https://doi.org/10.11604/pamj.2017.26.140.10345

[15] Onwuchekwa, C. and Alazigha, N. (2017) Computed Tomography Pattern of Traumatic Head Injury in Niger Delta, Nigeria: A Multicenter Evaluation. *International Journal of Critical Illness and Injury Science*, **7**, 150-155. https://doi.org/10.4103/ijciis.ijciis_6_17

[16] Bonkoungou, P., Traoré, I., Bako, Y.P., Sanou, J. and Ouédraogo, N. (2014) La mortalité en réanimation polyvalente du centre hospitalier universitaire Yalgado Ouédraogo de Ouagadougou au Burkina-Faso. *Annales Françaises d'Anesthésie et de Réanimation*, **33**, A310. https://doi.org/10.1016/j.annfar.2014.07.523

[17] Théogène, A.N., Manirakiza, D. and Nimubona, F. (2018) Déterminants de l'offre des crédits agricoles: Cas des micro-finances au Burundi. Finances, Agriculture et Assainissement. *Cahiers du CURDES*, No. 17, 10-42.

[18] Bélanger, M. (2000) La réanimation cérébrale des victimes d'un traumatisme crânien grave. *Le médecin du Québec*, **35**, 91-99.

[19] McIntyre, A., Mehta, S., Aubut, J., Dijkers, M. and Teasell, R.W. (2012) Mortality among Older Adults after a Traumatic Brain Injury: A Meta-Analysis. *Brain Injury*, **27**, 31-40. https://doi.org/10.3109/02699052.2012.700086

[20] Mrozek, S., Srairi, M. and Geeraerts, T. (2017) Traumatisme crânien grave à la phase aiguë. *Journal Européen des Urgences et de Réanimation*, **29**, 241-254. https://doi.org/10.1016/j.jeurea.2017.08.005

[21] Abouhashem, S., Albakry, A., El-Atawy, S., Fawzy, F., Elgammal, S. and Khattab, O. (2021) Prediction of Early Mortality after Primary Decompressive Craniectomy in Patients with Severe Traumatic Brain Injury. *Egyptian Journal of Neurosurgery*, **36**, Article No. 1. https://doi.org/10.1186/s41984-020-00096-5

[22] Mutch, C.A., Talbott, J.F. and Gean, A. (2016) Imaging Evaluation of Acute Traumatic Brain Injury. *Neurosurgery Clinics of North America*, **27**, 409-439. https://doi.org/10.1016/j.nec.2016.05.011

[23] Beer-Furlan, A., Neto, S.G., Teixeira, M.J. and Figueiredo, E.G. (2019) Fulfilling Need for Neurosurgical Services in Sub-Saharan Africa: Initial Angola-Brazil Training Experience. *World Neurosurgery*, **122**, 29-32. https://doi.org/10.1016/j.wneu.2018.10.081

[24] Wintermark, M., Sanelli, P.C., Anzai, Y., Tsiouris, A.J., Whitlow, C.T., Druzgal, T.J., *et al*. (2015) Imaging Evidence and Recommendations for Traumatic Brain Injury: Conventional Neuroimaging Techniques. *Journal of the American College of Radiology*, **12**, e1-e14. https://doi.org/10.1016/j.jacr.2014.10.014