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Contribution of Computed Tomography in the Diagnosis of Cranioencephalic Trauma

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Abstract

Background: cranioencephalic trauma is an important cause of mortality and morbidity in young subjects. CT scan is the first-line examination in it exploration. In Central African Republic (CAR), CT scan examination profile is poorly known in current practice, reason why we chose this subject. **Objective**: list traumatic cranioencephalic lesions and describe their CT appearance. **Patients and methods:** This was a cross-sectional study carried out in the Bangui radiology and medical imaging department from March 1 to December 31, 2021. We included patients of two sexes regardless of age, having performed brain CT for cranioencephalic trauma during the study period. Data analysis was done using Epi info software. **Results:** During the study period, 593 cerebral CT scans were performed, of which 84 patients met our inclusion criteria, *i.e.*, a hospital frequency of 14.2%. There was a male predominance with a sex ratio of 2.8. The average age was 26 years with extremes of 1 to 84 years. The most represented age group was that of 20 to 30 years old. The clinical signs were dominated by Master's group 1 with Glasgow between 15 and 9 (52.4%). Road accidents were the predominant cause with 81% of cases. In 61.9% of cases, the CT examination is performed within more than 24 hours after the trauma. The main CT lesions were dominated by skull vault and facial bone fractures (42.8%). Subdural hematoma, oedemato-hemorrhagic contusions and extra dural hematoma were the main pericerebral and intracerebral lesions with 38.5% respectively; 24%; and 9.5%. In 42.8% of cases the CT scan was normal. **Conclusion:** CT is a first-line examination for lesional assessment in the event of cranioencephalic trauma. These lesions are dominated by fractures of the vault of the skull and the facial bone. Subdural hematoma, oedemato-hemorrhagic contusions and extra dural hematoma are the main pericerebral and intracerebral lesions observed.

Keywords

Cranioencephalic Trauma, Computed Tomography, Bangui

1. Introduction

Cranio-encephalic trauma (CTE) is an attack on the integrity of the skull and/or the brain following a direct or indirect mechanical attack by an external agent [1]. This is a medical-surgical emergency. It is a serious condition that can be life-threatening or a source of disability. TCE constitutes a significant cause of mortality and morbidity in young subjects. Public road accidents (PVA) are responsible for 1.3 million deaths per year, 93% of which occur in low- or middle-income countries [2]. In Central African Republic (CAR), studies were carried out on the epidemiological aspects of CTE highlighting the involvement of motorcycles and young subjects aged 16 to 20 as the main victims [3]. However, no study has been carried out on the CT aspects of the lesions observed due to a lack of modern imaging; the acquisition of the scanner in 2020 motivated the choice of this subject. The National Imaging Medical Center in Bangui where the study is carried out is the only center with a CT scan in CAR. Among the methods of exploring TCE, computed tomography (CT) occupies a special place. It therefore seemed important for us to choose this subject in order to highlight the experience of Bangui. This work aimed to list the traumatic lesions observed and to describe their CT aspects.

2. Patients and Methods

This was a descriptive cross-sectional study carried out at the radiology and medical imaging department of Bangui from March 1 to December 31, 2021, *i.e.*, a duration of 10 months. Our study population was patient who suffered from craniocerebral trauma and had a brain scan performed the medical imaging center at Bangui. Inclusion criteria were all patients who have a complete file (socio-demographic variables, CT scan results and iconography). Non-inclusion criteria were results outside the study period, CT difficult to interpret due to poor image quality (hardening or movement artifacts).

Variables studied were age, sex, origin, CT performance time after trauma, CT scan results.

The data from the interview of the patient and those close to him, the clinical examination and the result of the brain CT were noted on an individual investigation form. All examinations were carried out using a Hitachi Supra 16 multislice scanner, carried out without injection of contrast product. Statistical analyses were carried out using Epi info software.

3. Results

We collected 84 patients out of 593 brain CT examinations carried out during the

study period, representing a hospital frequency of 14.2%. The average age of the patients was 26 years, with extremes ranging from 1 to 84 years. Male patients predominated with (73.8%, n = 62). The most represented age group was 20 to 30 years old as illustrated in Table 1.

Table 1. Distribution of patients according to age and sex.

	n	%
Age		
<20	22	26.2
20 - 30	32	38.1
31 - 40	22	26.1
41 - 50	04	4.8
>50	04	4.8
Total	84	100
Sex		
Male	62	73.8
Female	22	26.2

The different causes of trauma are shown in Table 2.

Table 2. Distribution of patients according to the causes of cranioencephalic trauma.

Cause of CTE	n	%
Public road accident	68	81
Domestic accident	12	14.2
Blow and injury	3	3.6
Work accident	1	1.2
Total	**84**	**100**

Public road accidents dominated the different causes of cranioencephalic trauma.

The causes of cranioencephalic trauma by sex are presented in Table 3.

Table 3. Causes of Cranioencephalic Trauma by Sex

	Cause of cranioencephalic trauma			
	Public road accident, n (%)	Other cause, n (%)	OR [95% IC]	p-value
Male	56 (90.3)	6 (9.7)	7.7 [2.4 - 25.5)	0.0007
Female	12 (54.5)	10 (45.5)	Ref.	

Males have a significantly higher risk of having a road accident compared to females.

Distribution of trauma by sex is shown in Table 4.

Table 4. Distribution of cranioencephalic trauma by sex.

	Cause of cranioencephalic trauma			
	Public road accident, n (%)	Other cause, n (%)	OR [95% IC]	p-value
<30 ans	47 (87.3))	7 (12.7)	2.9 [0.9 - 8.8]	0.06
≥30 ans	21 (70.0)	9 (30.0)	Ref	

This risk is observed more in relatively young people, age less than 30 to years, although we didn't observe in this study a statistically significant difference compared to older people (p = 0.06).

The predominant clinical signs were group 1 of Master with 52.4% and the CT examination was most often performed beyond 24 hours in 61.9%, as shown in Table 5.

Table 5. Distribution of patients according to clinical signs and time to performing the scan.

	n	%
Clinical signs		
- Groupe 1 Master (headache, Glasgow: 15-13)	44	52.4
- Groupe 2 Master (Obsession, Glasgow: 13 - 9)	28	33.3
- Groupe 3 Master (Focus signs, Glasgow < 9)	12	14.3
Examination completion time		
1 - 6 h	12	14.3
6 - 24 h	20	23.8
>24 h	52	61.9

Table 6 and Table 7 shows the CT scan results.

Table 6. Distribution of patients according to primary lesion.

Primary lesions	n	%
Pericerebral lesions		
Sub dural hematoma (SDH)	**19**	**38.1**
Extra dural hematoma (EDH)	**05**	**9.5**
Sub arachnoid hemorrhage	**02**	**4.8**
Intracerebral lesions		
Intra cranial hematoma	**07**	**14.3**
Brain contusions	**05**	**9.5**
Bone lesions		
Vault/base fracture of the skull and or facial bone	**21**	**42.8**
Association of fracture and hemosinus	**11**	**23.8**

Bone lesions predominated (42.8% n = 21) consisting of jolts and facial fractures (Figure 1).

Figure 1. Brain CT without contrast product injection, axial section in bone window: left frontal fracture with the presence of air in the frontal horns of the lateral ventricles and the right frontal cerebral parenchyma.

Table 7. Distribution of patients according to secondary lesion.

Secondary lésions	n	%
Edema with mass effect + cerebral herniation	**12**	**14.3**
Sequelae lesions		
Porencephalic cavities	**2**	**2.4**
Cerebral atrophy	**1**	**1.2**

Table 8. Distribution of brain lesions by age.

	Primary lesion			
	Brain lesions, n (%)	**Other lesions, n (%)**	**OR [95% IC]**	**p-value**
<30 ans	26 (62)	8 (38)	**3.5 [1.2 - 10.7]**	**0.03**
≥30 ans	12 (48)	13 (52)		

Table 8 shows brain lesions by age.

Furthermore, brain lesions are more common in these young people compared to those who are advanced in age.

Bone lesions were followed by peri-cerebral lesions consisting of chronic subdural hematoma (38.1% n=19) and extradural hematoma (9.5% n = 5) (Figure 2 and Figure 3). Oedematous-hemorrhagic contusions were also found (Figure 4).

Figure 2. Brain CT without injection of contrast product, axial section in parenchymal window: Chronic subdural hematoma left fronto Parieto-occipital.

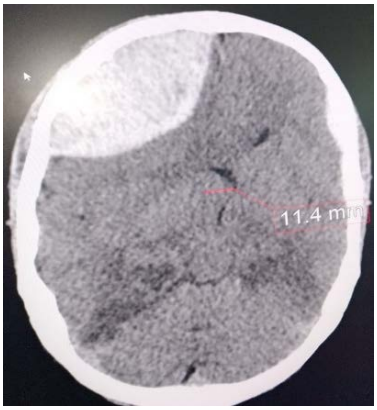

Figure 3. Brain CT without contrast product injection, axial section in parenchymal window: right frontal extradural hematoma.

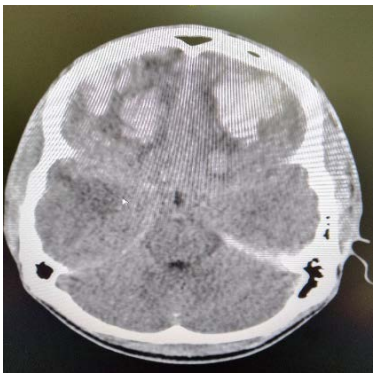

Figure 4. Brain CT without injection of contrast product, axial section in parenchymal window intracerebral lesions represented (23.8% n = 12) consisting of oedematous-hemorrhagic contusions.

4. Discussion

This study is the first of its kind to be carried out in the CAR. It has some limitations, in particular missing data (risk factor) due to retrospective nature of study. It is performed in a single-center hospital study, what constitutes bias. Problem of financial accessibility to the examen was also observed.

This study should open up to other prospective research work over a long period, involving a large number of people, taking into account not only the CT aspects of lesions but also the risk factors, the future of the patients. However, this study provides information on contribution of CT scan in the diagnosis of cranioencephalic trauma in Bangui.

During the study period, we recorded 84 cases of craniocerebral trauma out of 593 brain CT scans performed, representing a hospital frequency of 14.2%. Other African authors [4] [5] reported 21.77% and 10.36% respectively. This difference could be explained by their methodology taking into account in the study population all the cases of CT scans carried out during the study period. Our series established a male predominance (sex ratio = 2.8) which is almost identical to the results of other authors [1] [2] [4] [6] [7]. The most represented age group was

that of 20 to 30 years old most often following a public road accident (PRA) consistent with the results of other authors [1] [2] [4] [6] [7]. According to the World Health Organization (WHO), young men are three times more likely to be victims of PRA than young women [3]. This could be explained by the exercise of an activity which is more exposed to cranio-encephalic trauma, such as the use of motorcycles without a helmet [2] [8]. Likewise, most authors also agree on the fact that age is a factor in the major risks of exposure to the occurrence of head trauma [2]. When the patients arrived at the imaging center, the clinical signs were dominated by group 1 of Master and the CT examination was most often performed after 24 hours in 61.9% of cases. According to Amadou Diarra in Bamako, in 50.9% of cases, the CT examination is carried out between the second and sixth hours.

Concerning the CT lesions found, it is important to note, as also noted by Djeutcheu *et al*. in Mali [9] as well as Onana and Dongmo in Cameroon [2] [10], that several patients presented simultaneously with intracerebral and peri-cerebral bone lesions consistent with the results of several authors [1] [2]. In our series, fractures were the most frequent damage (42.8%), often consisting of impingement and fractures of the facial mass thus constituting a sign of seriousness. Subdural hematomas were the most frequent peri-cerebral lesions (38.1%) as in other series [9] [10]. Extradural hematomas (9.5%) come second after subdural hematomas. On the other hand, our observations contrast with those reported by the teams from Mali [9] [10] and the team of Cameroon [2], who noted more cases of extradural hematoma in peri-cerebral lesions. Sidibé *et al*. in Mali noted a tendency towards equality between extradural and subdural hematomas [2] [3] [6]. This data is not standard in the literature [2] [3] [8] [11]-[14]. As for intracerebral lesions, they were dominated by edema-hemorrhagic contusions (13.7%), similar to the results of Dabo Moussa and Onana [1] [2]. Other significant abnormalities were found, such as diffuse cerebral oedema with or without involvement (14.3%, n = 12). The brain scan was normal in 42.8% of cases. This corroborates the results of Onana *et al*. [2], who reported 32.6% of normal brain scans. In the study by Konan *et al*. [11] in Ivory Coast, they noted that 52.6% of pediatric brain CT scans were also normal.

5. Conclusion

Cranio-encephalic trauma frequently affects young male subjects, often following a public road accident involving a motorcycle. Computed tomography remains a first-line examination in the assessment of cranioencephalic lesions, thus allowing better management. Bone lesions predominated, followed by peri-cerebral lesions (chronic subdural hematoma and extra dural hematoma) and intracerebral lesions consisting mainly of oedematous-hemorrhagic contusions.

Conflicts of Interest

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

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