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Contribution of CT Scanning in the Investigation of Cranioencephalic Lesions in Bangui

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Abstract

Introduction: Cranioencephalic exploration has always played a major role in CT scans. In the Central Africa Republic (CAR), the lack of cross-sectional imaging before the year 2020 meant that no study had focused on cranioencephalic lesions. The aim of this study was to contribute to improving the management of cranioencephalic pathologies in CAR. **Patients and Method:** The study took place at the Bangui National Medical Imaging Centre (CNIMB). It was a retrospective study over a two-year period (March 1, 2021 to February 30, 2023). All patients referred for cranioencephalic CT scans were included, regardless of age or sex. **Results**: 1745 CT scans were performed, 575 of which were cranioencephalic CT scans. The majority of patients were male (53%). Most lived in the capital Bangui (90.9%). Patients aged 61 and over were the most representative. The distribution of patients by requesting department showed that the reception and emergency department was one of the least requesting departments. The main abnormalities observed were strokes, 82.1% of which were ischaemic strokes and 17.9% haemorrhagic strokes. Strokes were followed by degenerative lesions. Post-traumatic injuries included haemorrhagic contusions (38.3%), subdural haematomas in 20.5% of cases, and extradural haematomas (9.3%). Craniofacial lesions (fractures) were observed in 45.8% of cases. **Conclusion**: Cranioencephalic scans accounted for 1/3 of CT examinations performed during the study period. It revealed pathologies that could not be detected by conventional means. All in all, CT scans contributed to the diagnosis of cerebral pathologies.

Keywords

Cranioencephalic Scan, National Medical Imaging Centre, Bangui

1. Introduction

Cranioencephalic computed tomography (CT) is a medical imaging examination that produces images of the anatomical structures of the cranium and its contents in the form of axial slices in 2 or 3 dimensions to facilitate analysis [1]. Created in 1971 by an English engineer, Newbold Hounsfield, with the help of an American mathematician working on reconstruction algorithms, Allan Mc Leod Cormack, CT has become an important tool in medical diagnosis [2]. In the 1980s, CT first became established in neurological pathologies, and then progressively throughout the body. Both in everyday practice and in emergencies [3].

Thanks to continuous improvement in its technical performance, CT has seen considerable growth in recent years, justified by its diagnostic value [4]. With the advent of multi-slice and twin-tube helical CT scanners offering better spatial resolution, the number of indications for CT scans has increased in all areas. Whole-body helical CT scans can be used to carry out a precise and complete lesion assessment in a short space of time, with a minimum of manipulation [5].

CT scans are in great demand, so much so that the number of examinations carried out each year continues to rise [6]. CT now accounts for the majority of diagnostic exposure to X-rays, and more than a third of medical exposure [7]. According to a number of studies [8] [9], brain exploration has always played a predominant role in CT scans. Cerebral CT is very easy to access. It is still frequently performed as a first-line investigation of a recent-onset neurological disorder with a central appearance [10]. It is a rapid, atraumatic and reliable means of investigation [11].

Cerebral lesions are complex, varied and not always visible; they are very common, but often poorly understood [12]. Cranioencephalic lesions are frequent, progressive and potentially serious in both the short term (life-threatening) and long term (disabling), threatening vital prognosis [13]-[15]. Lesions of the brain stem are serious and rapidly fatal [16].

In the CAR, the lack of cross-sectional imaging before 2020 meant that no study had focused on brain lesions per se, and CT and MRI scanners were not among the radiological facilities available in the Central African Republic [17]. This motivated us to carry out this study, the general objective of which was to contribute to improving the management of cranioencephalic pathologies in CAR. Specifically, the aim was to determine the socio-demographic profile of patients, to identify the requesting services, to describe the profile of examinations performed, and to determine the different pathologies diagnosed on cerebral CT.

2. Patients and Method

The study took place at the Centre National d'Imagerie Médicale de Bangui (CNIMB). It was a retrospective study over a two-year period (March 1, 2021 to February 30, 2023). It involved all patients referred to the medical imaging centre for cranioencephalic scans, regardless of age or sex, who presented during the study period. All complete records of patients who had undergone a cranioencephalic CT scan were included in this study. were excluded from this study, all files not including one or more parameters studied (age, sex, profession, Departments requesting, indication for the examination, results of the examination).

This was an exhaustive sample of all brain scans recorded during the study period. The sample size was determined by the number of patient records meeting the inclusion criteria. The materials used for this study consisted of a patient information sheet containing the patient's identity and address, the requesting department, the indication for the examination, the reports of the results of the cranioencephalic scans and the results of the brain scans. The CT scans were analysed and interpreted by a radiologist. A 16-slice HITACHI scanner was used.

The data collected was entered into Word 2016 software, and analyzed with Epi-info 2008 3.5.1 software. The Pearson chi-square test was used to compare proportions and the chosen significance level was set at $p = 0.05$.

3. Ethical Considerations

As this was a retrospective study, we did not obtain informed consent from the patients. However, all the files retained were used anonymously and with the authorisation of the head of the National Medical Imaging Centre department.

4. Results

Of the 1745 CT scans performed, 575 were cranioencephalic CT scans, representing a frequency of 32.95%. The majority of patients were male (53%). Most lived in the capital, Bangui (90.9%). The breakdown by age group is shown in Figure 1.

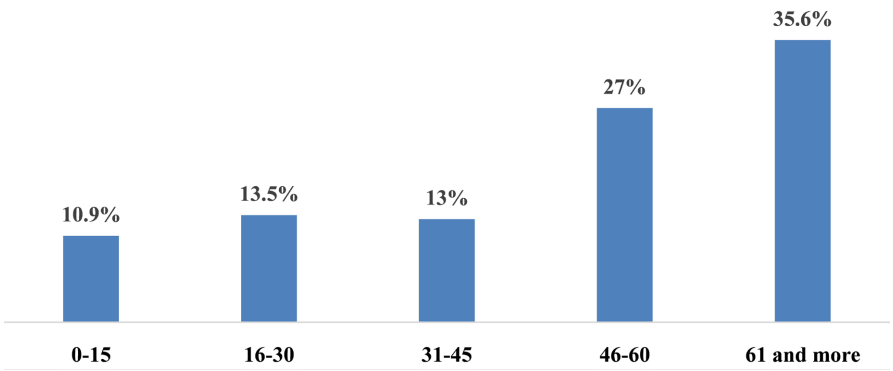

Figure 1. Age groups.

Cranioencephalic lesions are observed at all ages, however subjects aged 61 and over were the most representative.

5. Profession

Civil servants, pensioners and pupils/students were the most represented socio-professional categories, Table 1.

Table 1. Breakdown of patients by professional activity.

Profession	Number (n = 575)	Percentage
Civil servants	220	38.3%
Retirees	98	17%
Pupils/Students	92	16%
Households	68	11.8%
Workers	55	9.6%
Retailers	35	6.1%
Cultivators	7	1.2%
Total	**575**	**100%**

The distribution of patients by requesting department shows that the reception and emergency departments were among the departments with the lowest demand for cranioencephalic scans, while the neurology department and private doctors' surgeries were the main providers of examinations (Table 2).

Table 2. Departments requesting cranioencephalic scans.

Applicant departments	Number (n = 575)	Percentage
Neurology	207	36%
Private medical practice	190	33%
Internal medicine	90	15.7%
Traumatology	35	6.1%
Pediatrics	33	5.7%
Emergency department	15	2.6%
ENT department	5	0.9%
Total	**575**	**100%**

The indications for craniocerebral scans are shown in Figure 2, the main indication being motor deficits.

Depending on the technique used, 75.5% of CT scans were performed without injection of contrast medium. As regards the results of the examinations, of the 575 cranioencephalic CT scans performed, 445 (77.4%) were pathological. The various lesions observed are shown in Figure 3.

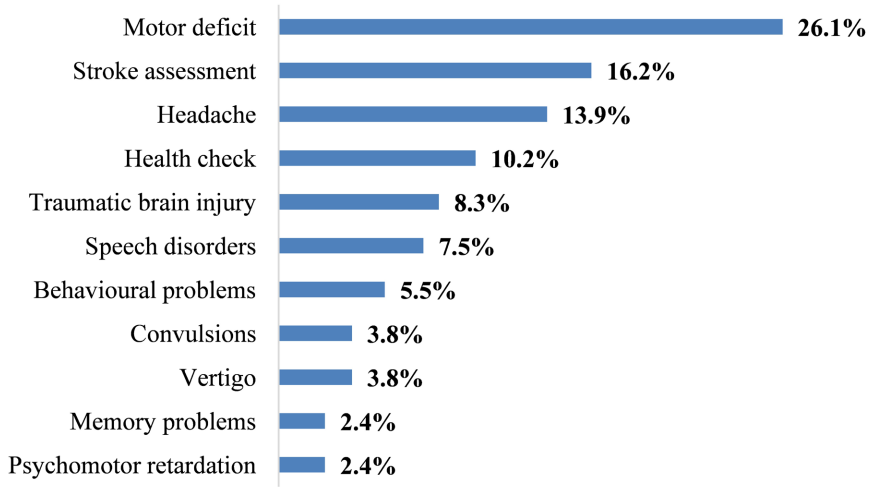

Figure 2. Indications for cranioencephalic scans.

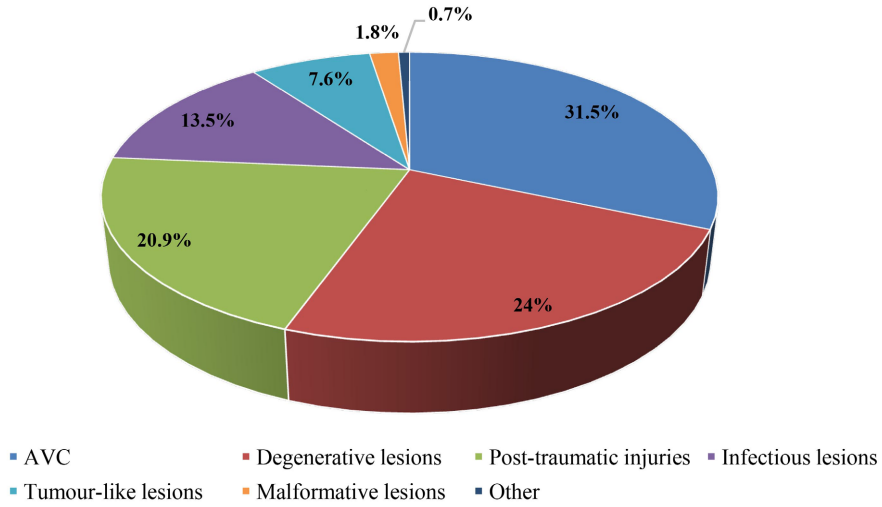

Figure 3. Lesions observed.

Figure 4. Cerebral CT scan, axial section: law attenuation changes in left temporal lobe consistent with acute infact in left middle cerebral artery distribution.

The main abnormalities observed were strokes, represented mainly by ischaemic strokes (82.1% of cases) and haemorrhagic strokes (17.9%). These is-

chaemic lesions took the form of areas of hypodensity (Figure 4) or lacunar infarcts. Strokes were followed by degenerative lesions. Post-traumatic lesions included haemorrhagic contusions (38.3%), sub-dural haematomas in 20.5% of cases (Figure 5), and extra-dural haematomas (9.3%). Craniofacial lesions (fractures) were observed in 45.8% of cases (Figure 6).

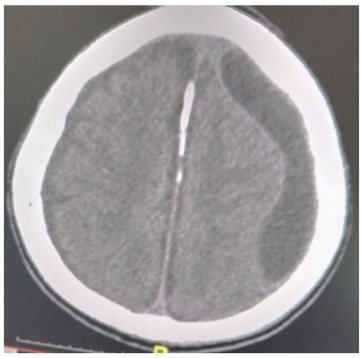

Figure 5. Cerebral CT scan, axial section. Hypodensity along the left hemisphere in favour of a chronic subdural haematoma.

Figure 6. CT scan of the skull, bone window, fracture of the temporal bone and left zygomatic arch, bilateral maxillary sinushemoid, right tympanic hemoid and hematic filling of the right mastoid cells.

Figure 7. CT scan of the skull, coronal reconstruction, bone window, inflammatory filling of the maxillary sinuses, increased on the left, associated with a nasal filling on the right.

Infectious lesions were dominated by inflammatory fillings of sinus cavities

(70%) (Figure 7). As for malformative lesions, apart from 5 cases of unruptured aneurysms discovered incidentally in adults, 2 cases of Dandy Walker malformation and a left unilateral megaencephalin were observed in children.

6. Discussion

This study, the first of its kind in the Central African Republic, would contribute to increasing knowledge about the contribution of cranioencephalic CT and thus considerably improve the performance of this examination. However, during the course of the work, several difficulties were encountered, in particular the retrospective nature of the study, the lack of certain data in the patient identification forms, and the lack of individual forms in the files of certain patients. However, the results were satisfactory in the vast majority of cases.

As soon as it became operational in 2021, the CNIMB performed 1.745 CT scans in two years, representing a monthly proportion of 72.7 scans. This proportion is almost identical to the 70 monthly scans reported by Nikiema *et al.* in 2013 in Burkina Faso [8]. Of the 1745 CT scans performed, 575 were cranioencephalic, representing a proportion of 32.95%. Konaté Abidjan in 2020 [18] reported a cranioencephalic CT rate of 11.5%. Their study focused solely on cranioencephalic trauma.

The majority of patients were male (53%). These results are superimposed on those of certain authors [8] [9] [11], but there is no explanation for them.

The age group 61 and over was the most represented. This shows that the majority of patients who underwent cranioencephalic scanning were elderly.

As far as the requesting departments are concerned, the majority of patients were referred by the neurology department, followed by private doctors' surgeries. This finding reflects a malfunction in the medical pathway for patients in Bangui's hospitals, and at the same time a gap in access to scanners for social strata with low purchasing power. The reception and emergency departments are supposed to carry out an initial medical assessment, provide first aid and refer patients to the various sectors appropriate to the reason for consultation, according to the sorting scale. Thus, all patients whose condition required a cranioencephalic scan should in principle have been referred by this department. The fact that the majority of patients came from the neurology department reflects a delay in patient management. In the series by Cissé in Bamako [11] in 2013, 90.4% of patients came from the reception and emergency departments. The same is true of the Ahile series in Cocody, Côte d'Ivoire [19], where 31.71% of patients came from emergency departments. Awareness campaigns should also be carried out in the reception and emergency departments in Bangui to optimise use of the scanner.

What's more, the patients who are treated in doctors' surgeries are those who have the financial means to pay for the CT scan. Although the Central African Republic now has a CT scanner, more needs to be done to make it accessible to all sections of society. As for the indications for cranioencephalic CT, motor deficit was the main indication. Our results agree with those of some African

authors, but to varying degrees. Damourou in 2008 in Mali [20] reported hemi-corporeal deficits in 79.12% of cases, while Amadou in Togo in 2016 [21] highlighted 46% of hemi-corporeal sensory-motor disorders as the main clinical signs. In this series, CT scans were pathological in 77.4% of cases. This shows that the majority of cranioencephalic CT examinations requested were justified. The main lesions found were strokes and degenerative brain lesions, accounting for 31.5% and 24% respectively. The same results were obtained by Amadou *et al.*, although the order differed from ours: 40% degenerative lesions versus 38% strokes. Like the results of the other authors, strokes were dominated by ischaemic strokes, with proportions varying from one author to another. In this series, ischaemic stroke accounted for 82.1% of cases compared with 17.9% of haemorrhagic stroke. Chiasseu Mbeumi *et al.* [22] reported 60% ischaemic stroke versus 40% haemorrhagic stroke in Cameroon in 2011. Feigin *et al.* [23] found that 80% of strokes were ischaemic compared with 20% haemorrhagic.

Cerebral degenerative lesions, the second most common craniocerebral lesion after strokes, appeared on the CT scan as widening of the cortical sulci and ventricular system, or marked hypodensity of the periventricular white matter known as leukoaraiosis. Strokes and degenerative lesions are found in elderly people with several co-morbidity factors [24] [25]. Strokes in young people are characterised above all by their diverse aetiologies [26]. Post-traumatic injuries were represented by haemorrhagic contusions (38.3%), sub-dural haematomas (20.5%) and extra-dural haematomas (9.3%). Craniofacial lesions (fractures) were observed in 45.8% of cases. In some cases, these different lesions were associated with each other. Our results are similar to those of Konate *et al.* [18], who highlighted haemorrhagic contusions as the main post-traumatic lesions and suggested that these lesions were related to violent trauma. In Bangui, cranioencephalic lesions are most often linked to road accidents involving motorbike taxis, the main mode of locomotion [26].

7. Conclusion

This study highlighted the under-utilisation of CT scans at the National Medical Imaging Centre, given the number of patients using the centre, the low level of participation from certain requesting departments and the limited access of certain social groups who cannot afford the cost of CT scans. Cranioencephalic scans accounted for 1/3 of CT examinations carried out during the study period. It revealed pathologies that could not be detected by conventional means. All in all, CT scans contributed to the diagnosis of cerebral pathologies.

Conflicts of Interest

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

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