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The Limits of Etiological Diagnosis of Convulsions in Children at the Bangui Pediatric Hospital

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Abstract

Introduction: Convulsions are a frequent cause of admission to paediatric wards in countries with limited resources, and a major cause of neurological and cognitive sequelae. In sub-Saharan Africa, the aetiology of febrile convulsions is dominated by infections of the central nervous system. A detailed clinical examination and laboratory and imaging tests are carried out to identify the cause of the disease. Computed tomography is reserved for emergency situations or as a second line of defence, after Magnetic Resonance Imaging (MRI) to look for calcifications. Imaging thus helps to establish the nature of the epileptogenic lesion, specify its extent and guide its therapeutic management. The aim of this study is to clarify the contribution of MRI in the etiological investigation of convulsions in children at the paediatric university hospital, in addition to the usual means of exploration. **Patient and Method:** This was a cross-sectional, descriptive study from January 2022 to December 2023. We carried out an exhaustive sampling of all children aged between 1 and 59 months admitted for convulsion with fever or not who had undergone complementary examinations for aetiological purposes in relation to our technical platform during the study period. **Results:** Thirty patients were recruited. Children aged 12 to 59 months were the most represented (69.7%). The sex ratio was 1.30. The mean age was 36 months (range 30 days to 59 months). Of the 30 patients, 21.8% had a history of febrile convulsions. Most of our patients were from Bangui (73.3%). On admission, the majority of patients presented with an elevated temperature ranging from 38.5 degrees Celsius to 39.4 degrees Celsius in 33.1% of cases. The dominant clinical manifestations were tonic-clonic convulsions (53.2%), tonic convulsions (35.3%) and clonic

convulsions (11.5%). According to their characteristics, convulsions were complex in 53.7% of cases and simple in 46.3%. Examinations for infectious diseases, tumors or malformation has been ruled out. The anticonvulsants most commonly used were diazepam, phenobarbital and phenytoin. We recorded a 73.3% cure rate and 4 (13.3%) cases of death. **Conclusion:** The investigation of seizures in search of aetiology outside the usual means in our context still presents difficulties. MRI is the examination of choice for exploring the posterior fossa and midline lesions. Combined with CT, it is better for exploring hemispheric tumours.

Keywords

Limitations, Aetiological Diagnosis, Convulsions, Children, Central African Republic

1. Introduction

Convulsions are brief episodes of involuntary shaking affecting part of the body (partial seizures) or the whole body (generalised seizures), according to the World Health Organisation (WHO) [1]. Convulsions can occur with or without fever. They are called febrile convulsions when they are associated with a fever, and may be caused by an acute infection of the central nervous system or simply be the consequence of the presence of fever. In the latter case, morphological examinations cannot reveal a lesion [2]. Seizures are a frequent cause of admission to paediatric wards in countries with limited resources, and a source of neurological and cognitive sequelae [3]. The incidence of seizures is highest in children under 5 years of age, with a decreasing frequency in older children [4]. In tropical countries, convulsions are frequent and their prevalence is higher than in Western countries [5] [6]. Febrile seizures are usually classified into two categories: simple febrile seizures and complex febrile seizures. Clinically, most simple febrile seizures are brief, clonic, bilateral and symmetrical, and most often generalised. They are not followed by a post-critical deficit [7]. When faced with a simple febrile convulsion, it is necessary to look for the cause of the fever, most often severe malaria or meningitis, or in some cases acute upper respiratory infections, which are very common in children of this age [8] [9]. They have a variety of aetiologies, dominated in sub-Saharan Africa by CNS infections (80% of cases) [3]. The prognosis depends on the causative pathology and the severity of the seizures. Acute febrile convulsions are more common in children under 5 years of age [3] [6] [7] [10] [11]. A detailed clinical examination and laboratory and imaging tests are carried out to investigate the aetiology [5] [7]. Computed tomography coupled with MRI enables a detailed study of bone structures, particularly in the posterior cerebral fossa, the base of the skull and the spinal canal, as well as their contents. EEG, is a test which records the electrical activity produced by the brain's neurons, and is used in the diagnosis and

monitoring of epilepsy. Apart from infectious aetiologies, the persistence of convulsions poses a diagnostic problem. Brain tumours may be evoked. They account for about a quarter of all solid tumours observed in paediatric age [12]. The most common are subtentorial tumours, which are seen mainly between the ages of 4 and 11. This is where our diagnostic limitations lie. Cerebral imaging must be used extensively, as the circumstances in which it is discovered can be misleading [12].

2. Patients and Methods

This was a cross-sectional, descriptive study from January 2022 to December 2023. We performed an exhaustive sampling of all children aged 1 to 59 months admitted for febrile or non-febrile convulsion to the paediatric university hospital of Bangui. Various investigations were carried out in search of infectious, metabolic, tumour or malformative aetiologies in our context during the study period. These included lumbar puncture with cerebrospinal fluid analysis to detect meningitis or encephalitis, blood tests to measure glycaemia, blood ionograms to look for metabolic disorders, blood and urine cultures to look for infections, brain imaging by means of computed tomography (CT), electroencephalogram to look for abnormal electrical activity, etc. The results of these tests were then analysed in order to determine whether there was any evidence of malformation. The patients were all initially examined in emergency room by an intern or senior paediatrician, and then transferred to different departments depending on their clinical course. They were treated for certain diagnosed pathologies, including malaria, meningitis, upper respiratory infection, correction of hypoglycaemia and anaemia related to severe malaria. Despite this treatment, convulsions persisted in some of our patients. Data were collected on a survey form from the medical files and registers of the department. The variables studied were sociodemographic, clinical and paraclinical, diagnostic and evolutionary data. This study was authorised by the Scientific Committee. We used Epi-Info software to analyse the data. Standard descriptive statistics were used. Differences between proportions were analysed using the Chi-2 test. Values of $p < 0.05$ were considered statistically significant.

3. Results

Thirty patients were recruited. Children aged 12 to 59 months were the most represented (69.7%). The sex ratio was 1.30. Mean age was 36 months (extremes 1 and 59 months). Of the 30 patients, 21.8% had a history of febrile convulsions. Most of our patients came from Bangui (73.3%), as shown in **Table 1**.

On admission, the majority of patients had elevated temperatures ranging from 38.5 degrees Celsius to 39.4 degrees Celsius in 17 (56.7%) cases, as shown in **Figure 1**.

Table 1. Patient distribution by sex, age and origin.

Characteristics	Number	Percentage
Gender		
Male	17	56.7
Femal	13	43.3
Age range (months)		
0 - 11	9	30.3
12 - 59	21	69.7
Place of residence		
Urban	22	73.3
Rural	8	26.7

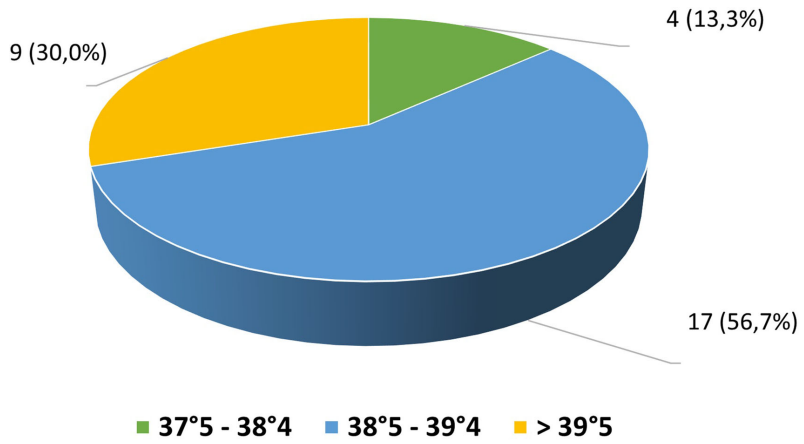

Figure 1. Distribution of patients by temperature on admission.

Tonic-clonic convulsions (53.3%) predominated, followed by tonic (33.3%) and clonic (13.4%) types. According to their characteristics, convulsions were complex in 63.3% of cases and simple in 36.6%, as shown in Table 2.

Table 2. Distribution of patients according to type and nature of convulsions.

Characteristics of convulsion	Number	Percentage
Type		
Tonic-clonic	16	53.3
Clonic	4	13.4
Tonic	10	33.3
Nature		
Simple	11	36.6
Complex	19	63.3

The most commonly used anticonvulsants were diazepam, phenobarbital and phenytoin. We recorded 73.3% recoveries and 4 (13.3%) deaths.

4. Discussion

The frequency of febrile convulsive seizures is assessed differently in the literature. Most authors put it at between 2 and 5% before the age of 5 [13] [14]. Strict

selection of the files led us to reject incomplete files and those for which a proven disease of the central nervous system could be suspected on admission. The sample was slightly male-dominated, with 17 males and 13 females, giving a sex ratio of 1.30.Our results are in line with those of some authors [15] [16].The mean age was 36 months (extremes 1 month and 59 months).

Our results were similar to those reported in the literature [17]. The authors believe that the high incidence in young children is due to the immaturity of the neurovegetative system [18]. It is clear that age-related brain immaturity plays a major role in the onset of febrile seizures, in response to the various aggressions that occur during infectious disease.

The role of body temperature has been proven, but the occurrence of seizures is not strictly correlated with temperature levels. Disturbances in cerebral homeostasis linked to the infection in progress play an important role in the onset of a febrile seizure. Indeed, despite the blood-brain barrier, the inflammation generated in the periphery by the infection reaches cerebral targets, notably via certain cytokines such as IL1-β, IL-8 and interferon γ.

These cytokines can have a direct effect on the central nervous system or activate the glutamatergic system, which increases neuronal excitability, favouring the onset of epileptic seizures. Some infectious agents are known to be pro-convulsant, even in the absence of viral replication in the central nervous system.

These include the influenza A virus [19] and the HHV6 and HHV 7 viruses [20]. It should be noted that the vast majority of children in the age group in question do not develop febrile seizures when they encounter an infection, even when their body temperature is high, the inflammatory reaction is significant and the virus is pro-convulsive. Other factors are therefore probably at work in the genesis of febrile seizures [21].

Two risk factors have been identified: one is the presence of a genetic predisposition to trigger seizures in an infectious context [22]. In addition to the single-gene disorders responsible for fever-sensitive epilepsy mentioned in the differential diagnoses, there are genetic polymorphisms that make people vulnerable to febrile seizures during infectious episodes. This is illustrated by the high prevalence of a family history of febrile seizures in a child with febrile seizures [23]. Of the 30 patients, 21.8% had a history of febrile convulsions.

Familial epilepsy syndrome characterised by the presence of epilepsy belonging to the spectrum of generalised epilepsy with febrile seizures-plus (GEFS+) in family members, ranging from simple febrile convulsions to the more severe phenotype of myoclono-astatic epilepsy or Dravet syndrome. Causative mutations in the SCN1A (2q24.3) (most commonly) and SCN1B (19q13.12) genes have been identified in several families with GEFS+. These genes code for two subunits of the neuronal sodium channel. Other causative mutations include those in the GABRG2 gene, which codes for the gamma 2 subunit of GABAA receptors. The SCN2A (2q24.3), SCN9A (2q24) and GABRD (1p36.3) genes are possible susceptibility genes for GEFS+ [24]. Some genes have been identified in a small proportion of cases, for

example mutations in human chromosome 2, known to harbour the SCN1A sodium channel gene, have been associated with the occurrence of febrile convulsions [25].

In some families, the disorder is inherited as an autosomal dominant trait related to mutations in the SCN9A sodium channel, and new missense mutations in the same sodium channel have been reported in patients with unrelated febrile seizures. Febrile convulsions in particular are a specific pathological entity linked to age. Pathophysiological explanations remain diverse, referring to an age-dependent cerebral hyperexcitability linked to fever [24]. From a pathophysiological point of view, it is assumed that the release of high levels of cytokines such as interleukin-1 and tumour necrosis factor (TNF) can alter normal brain physiology, particularly that of temperature-sensitive ion channels, triggering convulsions. Similarly, inflammatory mediators and cytokines released during fever can contribute to the genesis of convulsive seizures. On the other hand, a developing brain before the age of 3 has an inherent increased vulnerability to low-threshold neuronal excitation [26]. Based on their clinical characteristics, a distinction is made between simple and severe febrile convulsions. A duration of more than 10-15 minutes, repetition during the febrile episode or over the course of 24 hours, and focal nature are the factors of severity that differentiate severe from simple seizures. Occurrence before the age of 18 months is thought to be a risk factor for recurrence [26] [27]. This is in line with the data in the literature. On admission, the majority of patients presented with a high temperature ranging from 38.5 degrees Celsius to 39.4 degrees Celsius in 17 (56.7%) of cases. The dominant clinical manifestations were tonic-clonic convulsions (53.2%), tonic convulsions (35.3%) and clonic convulsions (11.5%). According to their characteristics, convulsions were complex in 63.7% of cases and simple in 36.3%. SALL in Senegal [28] recorded similar results with 43.3% of temperatures between 38.5˚ and 39.4˚ and 36.3% of temperatures above 39.5˚. In this study, various investigations were carried out in search of infectious, metabolic, tumour or malformative aetiologies, and in most cases the results were negative.

Our results are similar to those reported in the literature. The electroencephalogram does not seem to help distinguish between simple and severe febrile convulsions. It should therefore be carried out on the basis of more relevant clinical data than the mere occurrence of convulsions [29] [30]. The same attitude should also be adopted when determining the indication for neuroradiological exploration [31]. Brain scans revealed no abnormalities in our series. This diagnostic method is used to search for brain tumours and malformations. However, CT scans have their limitations. The classification proposed by the International League Against Epilepsy (ILAE) in 2001 reduces the dichotomy between partial and generalised seizures and incorporates recent genetic data [32]. It follows from the above that simple febrile convulsions are not an indication for imaging, and that the indication for imaging a first epileptic seizure, outside a specific context and if the neurological examination is normal, should be discussed [33] [34]. In view of these diagnostic difficulties, MRI was not available in the country to contribute to the aetiological diagnosis of these convulsions. According to the literature, MRI reveals a

morphological abnormality in over 80% of cases. In fact, MRI has become the reference examination for exploring epilepsy. The anatomical definition of this examination, which is far superior to that of CT scans, has made it possible in recent years to identify a large number of lesions which had not previously been revealed by other examinations [35]. The anticonvulsants most commonly used were diazepam, phenobarbital and phenytoin. According to a protocol established in the department, the first drug used in our patients was intrarectal diazepam at a dose of 0.5 mg per kg of body weight, not exceeding 10 mg. If the seizure did not stop or reappeared after 5 minutes, diazepam was re-administered slowly intravenously. If the convulsions still persist, they are considered to be status epilepticus and should either be transferred to a medical intensive care unit or a critical care unit, or else treated with second-line anticonvulsants (phenobarbital) or even third-line anticonvulsants (phenytoin). This has been described in the literature. Diazepam by slow infusion was used in 5 patients (16.66%), in the absence of clonazepam, in cases of convulsive malaise resistant to 2nd and 3rd line treatment.

The duration of hospitalisation ranged from 3 to 14 days (82%) with an average of 6.5 days. We recorded 73.3% recoveries and 4 (13.3%) cases of death after a 2-week follow-up. In the majority of cases, and particularly in cases of simple febrile convulsions, the prognosis was good. Prognosis remains a major concern for parents, especially those with some familiarity with epilepsy.

5. Conclusion

In our countries, febrile convulsions are still a frequent reason for emergency consultations, causing stress and anxiety among parents. However, this study has demonstrated our limitations in terms of in-depth investigation of convulsions. MRI is a tool that can be used to establish the nature and extent of cerebral lesions, as well as the repercussions of prolonged convulsive seizures on the cerebral parenchyma, and to help establish a prognosis.

Authors' contributions

All authors have contributed to the drafting of this manuscript and have read and approved the final version.

Conflicts of Interest

The authors declare no conflicts of interest.

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