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Epidemiological, Diagnostic, and Prognosis Aspects of Seizures in Children Aged 1 to 60 Months at the Dakar University Hospital Center (Senegal)

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Abstract

Introduction: Convulsions and epileptic seizures refer to the same phenomenon, characterized by a hypersynchronous, abnormal, and excessive discharge of a population of neurons propagating within the cortex. The main objective of this study was to describe the epidemiological, diagnostic, and prognostic aspects of seizures in children at the University Hospital Center of Dakar (Senegal). Methodology: This was a two-center, retrospective, descriptive, and analytical study conducted over a two-year period, from January 1, 2022, to December 31, 2023, in the pediatric departments of the Abass NDAO Hospital Center (CHAN) and the Albert Royer National Children's Hospital Center of Dakar (CHNEAR). All children aged one to 60 months who presented with at least one seizure upon admission were included. The data was entered into Excel 2021 and analyzed with RStudio-2024.09.1-394 software. **Results:** During the study, 2185 children were hospitalized, including 182 for seizures, representing a hospital prevalence of 8.4%. The median age was 25.3 months, and the male-to-female ratio was 1.6. Psychomotor developmental delay was noted in 20 children (10.9%). A family history of epilepsy was found in 10 children (5.49%). The reasons for hospitalization were predominantly generalized seizures (n = 80, or 43.9%). Fever was noted in 31.87% of the children. 9.34% of the children were obtunded, 18.13% were in a coma, and 72.53% were conscious. The most common cause of illness was febrile seizures (31.87%), followed by epilepsy (22.53%) and metabolic disorders (19.7%). Central nervous

system infections accounted for 12.08% of cases, including meningitis (9.34%) and cerebral malaria (2.74%). Diazepam was used in 53.85% of cases, followed by midazolam (24.18%) and phenobarbital (17.58%). The outcome was favorable in 89.01% of cases. Complications were predominantly neurological (7.69%). Fifteen children died (8.24%). The unfavorable evolution of seizures in children was statistically associated with the time of seizures before hospitalization ≥ 5 days ($p = 0.01$), the presence of generalized seizures ($p < 0.01$), hyponatremia ($p = 0.04$) and C-reactive protein (CRP) > 50 mg/l ($p = 0.04$). **Conclusion:** Seizures are a particularly frequent medical emergency in pediatrics, primarily affecting children under five years of age. Due to their potential to be life-threatening, rapid and appropriate management is essential to prevent long-term consequences and death.

Keywords

Seizures, Child, Epileptic Seizure, Meningitis, Cerebral Malaria

1. Introduction

Convulsions and epileptic seizures are two terms referring to the same phenomenon: hypersynchronous, abnormal, and excessive discharge of a large population of neurons propagating within the cortex [1] [2]. The term "seizure" is used to refer to the motor manifestations of an epileptic seizure. Epileptic seizure remains the term currently used because it includes convulsions and seizures without motor manifestations [1]. Seizures are the most common neurological disorder in pediatrics. They occur in about 4% to 10% of children and account for 1% of all emergency room visits. The incidence is higher in those under 3 years, with a decreasing frequency in older children [3] [4]. The etiologies of seizures are diverse. In sub-Saharan Africa, the etiologies are essentially dominated by central nervous system infections (80% of cases) [1] [5]. A thorough understanding of the etiology of seizures can have relevant implications for management and prognosis [6]. Numerous studies have been conducted on hyperpyretic seizures and epilepsy in Senegal [7] [8], however few of them have questioned seizures in children under five (5) years of age in general. It is in this context that we conducted this work whose objective was to describe the epidemiological, diagnostic and prognostic aspects of seizures in children aged one to 60 months at the university hospital center in Dakar (Senegal).

2. Materials and Methods

The present study took place in two university hospital departments, namely the pediatric department of the Abass Ndao Hospital Center (CHAN) and the pediatrics department of the Albert Royer National Children's Hospital Center (CHNEAR) in Dakar. This is a retrospective, descriptive and analytical study that took place from January 1, 2022, to December 31, 2023. Was included any

child aged from one to 60 months, having presented during the study at least one convulsive seizure upon arrival at the SAU of CHNEAR or CHAN. Incomplete or lost records were not included in our study (n = 3). Children older than 5 years or younger than 1 month at the time of the seizure were excluded from the study, as were all children with a known history of epilepsy or recurrent non-febrile seizures, or with permanent neurological deficits or a previously diagnosed brain malformation. The studied parameters were sociodemographic (prevalence, age, sex, address and socio-economic level of the parents), clinical (family history of seizures or familial epilepsy, inbreeding of the parents, vaccination, psychomotor development), paraclinical (blood ionogram, thick drop, lumbar puncture, imaging results including brain scan and electroencephalogram), therapeutic (anticonvulsant treatment, etiological treatment) and progressive (favorable or unfavorable). The defined operational variables were:

- The socio-economic level has been classified as follows: Low level (unemployed), middle level (informal sector) and high level (civil servant).
- Psychomotor developmental delay was defined by the non-acquisition of developmental norms at programmed Middle Ages.
- Hypoglycemia was defined as blood glucose below 0.5 g/l;
- Hyperthermia is defined is defined by a temperature above 38 degrees Celsius
- The state of consciousness has been defined according to current international recommendations.
- The evolution was considered favorable, in case of improvement of seizures during hospitalization; or unfavorable, in case of onset of complications, sequelae or death.

The data were collected using an investigation sheet established for this purpose and filled out form the children's medical records in the hospital archives. The data was entered on Excel 2021 and analyzed with RStudio-2024.09.1-394 software. For the descriptive results, quantitative variables were presented as means or medians with their ranges. The qualitative variables were expressed in percentages. For the analytical results, we used the Fisher test and p-value (p) for statistical comparisons, with calculation of the 95% confidence interval (CI) according to the application conditions. A value of $p < 0.05$ was considered significant.

3. Results

3.1. Descriptive Results

Epidemiological and sociodemographic aspects: During the study, 2,185 children aged one to 60 months were hospitalized in both hospitals, including 182 children for seizures. Hence, an estimated hospital prevalence of 8.4% and calculated at 8.3%. The sex ratio was 1.6. The median age at diagnosis was 25.3 months [1 - 60 months]. The distribution of children by age group was recorded in the following figure (**Figure 1**).

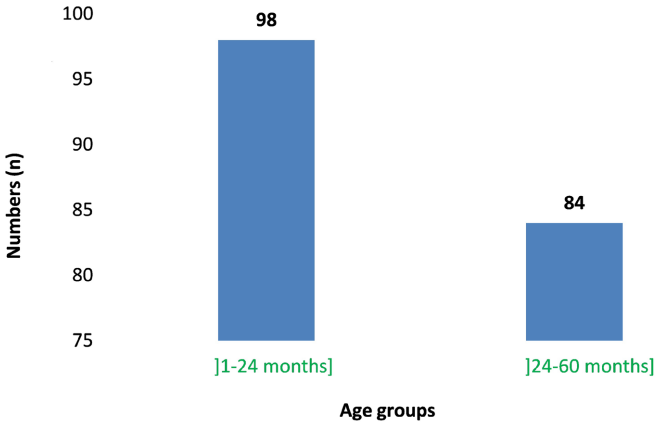

Figure 1. Distribution of children by age group.

3.2. Diagnostic Aspects

3.2.1. Personal History

Regarding vaccines in the expanded immunization program, children living in Senegal were up to date in 81.87% of cases. Psychomotor development was normal in 162 children (89.01%) and delayed in 20 children (10.9%).

3.2.2. Family History

A family history of epilepsy was found in 10 children (5.49%).

3.3. Reasons for Hospitalization

Generalized seizures accounted for 43.9% (n = 80) and tonic-clonic seizures for 32.9% (n = 60) (Figure 2). The average duration of seizures was specified in 32 children and was 11.9 minutes [1 - 60 minutes].

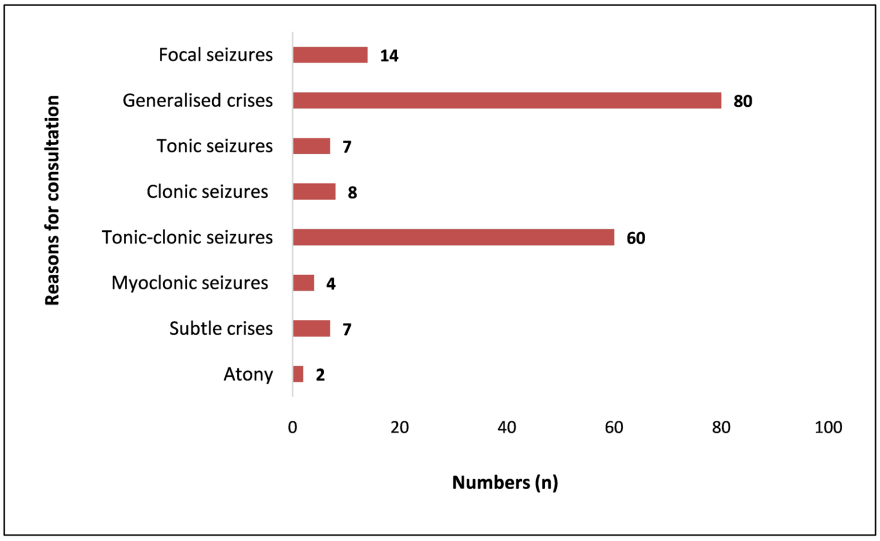

Figure 2. Distribution of children according to reasons for hospitalization.

3.3.1. Nutritional Status

The nutritional status was good in 164 children (90.1%) and poor in the others

(9.89%).

3.3.2. Level of Consciousness

In terms of consciousness, the children were delirious (9.34%), comatose (18.13%) or had preserved consciousness (72.53%).

3.3.3. Biology

Thick drop was positive in 5 children (2.75%), and lumbar puncture revealed meningitis in 17 children (9.34%). The other biological results are summarized in the table below **(**Table 1**)**.

Table 1. Summary of biological assessments.

Assessments	Averages (min - max)	Interpretation (%)
Leukocytes	15246/mm^3 (2080 - 37470/mm^3)	Hyperleukocytossis (25.27%)
CRP	27.16 mg/l (1 - 166 mg/l)	Positive (30.77%)
Sodium	138.20 mEq/l (115 - 180 mEq/l)	Hyponatremia (10.99%)
Calcium	95.65 mg/l (64 - 111.2 mg/l)	Hypocalcemia (0.55%)
Magnesium	21.07 mg/l (16.7 - 26.6 mg/l)	Hypomagnesemia (1.10%)
Glucose	1.34 g/l (0.2 - 4.03 g/l)	Hypoglycemia (2.75%)

3.4. Imaging

Transfontanellar ultrasound was performed in 3 children (1.65%) and revealed one case of cortical atrophy (0.55%), one case of subarachnoid hemorrhage (0.55%), and one case of agenesis of the corpus callosum (0.55%).

Brain CT scans were performed in 21 children (11.54%) and revealed hydrocephalus in 4 children (2.20%) and cortico-subcortical atrophy in one child (0.55%).

One child (0.55%) underwent magnetic resonance imaging (MRI) of the brain, which revealed bilateral maxillary sinusitis.

Electroencephalograms (EEGs) were performed on 54 children (29.67%) and revealed 41 cases of epilepsy (22.53%).

3.5. Causes

Hyperpyretic convulsions and epilepsy were found in 31.87% and 22.53% of cases, respectively. The etiologies of convulsions in children are listed in the table below **(**Table 2**)**.

Table 2. Distribution of children according to causes of seizures.

Causes of seizures	Numbers (n)	Percentage (%)
Hyperthermia	**58**	**31.87**
Epilepsy	**41**	**22.53**
Metabolic	**36**	**19.78**
Hyponatremia	20	10.99

Continued

Hypernatremia	8	4.39
Hypoglycemia	5	2.75
Hypomagnesemia	2	1.09
Hypocalcemia	1	0.54
Infections	**22**	**12.09**
Meningitis	17	9.34
Malaria	5	2.75
Undetermined	**10**	**5.49**
Traumatic brain injury	**7**	**3.85**
Brain malformation	**5**	**2.75**
Subarachnoid hemorrhage	**1**	**0.55**
Stroke	**1**	**0.55**
Neuroblastoma	**1**	**0.55**

3.5.1. Therapeutic Aspects

The anticonvulsant drugs used in this study are shown in the table below (Table 3).

Table 3. Distribution of children according to anticonvulsants used.

Anticonvulsants	Numbers (n)	Percentage (%)
Diazepam	98	53.85
Midazolam	44	24.18
Phenobarbital	32	17.58
Valproate de sodium	23	12.64
Thiopental de sodium	1	0.55
Fentanyl	1	0.55

3.5.2. Progressive Aspects

The average length of hospital stay was 4.1 days [0 - 39 days].

The children progressed favorably in 89.01% of cases and unfavorably in 10.99% of cases. Unfavorable progression led to complications or death. The complications were predominantly neurological (7.69%), such as confusion or coma, status epilepticus, or brain death. Death was observed in 15 children (8.24%). Of these 15 deaths, 6 were recorded at CHNEAR, *i.e.*, 4.8% (n = 124), and the other 9 at CHAN, *i.e.*, 15.5% (n = 58).

3.5.3. Analytical Results

The unfavorable outcome of seizures in children was statistically associated with the delay in seizures before hospitalization ≥ 5 days ($p = 0.01$), the presence of generalized seizures ($p < 0.01$), hyponatremia ($p = 0.04$), and CRP > 50 mg/L ($p = 0.04$) (Table 4).

Table 4. Factors associated with bad prognosis of seizures in children aged one month to 5 years.

Factors	Evolution		P-value (OR) [CI 95%]
	Favourable (%)	Unfavourable (%)	
Age			
<2 years	85 (86.7)	13 (13.3)	0.35 (1.68) [0.59 - 0.35]
≥2 years	77 (91.7)	7 (8.3)	
Sex			
Male	95 (85.6)	16 (14.4)	0.09 (2.80) [0.85 - 12.06]
Female	67 (94.3)	4 (5.7)	
Geographic origin			
Dakar	145 (90)	16 (10)	0.28 (0.44) [0.08 - 4.65]
Out of Dakar	8 (80)	2 (20)	
Delay of convulsions before hospitalisation			
<5 jours	103 (92)	9 (8)	**0.01 (0.28) [0.09 - 0.85]**
≥5 jours	10 (23.8)	32 (76.2)	
Seizures			
Generalised	78 (97.5)	2 (2.5)	**<0.01 (0.14) [0.01 - 0.77]**
Others	7 (15.9)	37 (84.1)	
Familial epilepsy			
Yes	9 (90)	1 (10)	1 (0.89) [0.02 - 7.12]
No	153 (89)	19 (11)	
Psychomotor development			
Normal	18 (50)	18 (50)	1 (1.12) [0.23 - 10.79]
Delay	144 (98.6)	2 (1.4)	
Natremia			
<135 mEq/l	5 (25)	15 (75)	**0.04 (3.24) [0.81 - 11.21]**
≥135 mEq/l	147 (90.7)	15 (9.3)	
C-reactive protein (CRP)			
≤50 mg/l	143 (91)	14 (9)	**0.04 (3.20) [0.90 - 10.26]**
>50 mg/l	6 (24)	19 (76)	
White blood cells			
<12000/mm^3	32 (65.3)	17 (34.7)	0.77 (0.72) [0.13 - 2.71]
≥12000/mm^3	130 (97.7)	3 (2.3)	

4. Discussion

4.1. Limitations of Our Study

The limitations of the study lie in the fact that it was a retrospective study, some-

times resulting in the loss of information and sometimes incompletely filled-out records.

4.2. Epidemiological and Sociodemographic Aspects

Seizures are a relatively common reason for admission to pediatric emergency departments, accounting for 8.4% of cases in our series. This is consistent with data from the African literature, notably Doumbia *et al*. and Doussoh *et al*., who found hospital admission rates of 11% in Mali and 11.3% in Benin, respectively [2] [9]. Data from the Asian literature confirmed these results: Adhikari *et al*. [10] found a hospital admission rate of 12.7% in Nepal, while Nishiyama *et al*. [11] found a rate of 12.1% in Japan. This frequency can be explained by the multiplicity of etiologies in our contexts, particularly infections of the central nervous system such as malaria and meningitis, which are very common in our tropics, but also ENT and respiratory infections, which are often accompanied by fever and can cause febrile seizures.

In our series, the median age at diagnosis was 25.3 months, with extremes ranging from one to 60 months. This is comparable to the results of Doumbia *et al*. [9], where the average age of patients was 29 months.

The age group [1 - 24 months] was the most represented, with 98 out of 182 patients, or 53.8%. Our results corroborate those of several African studies in which children under two years of age were the most represented, notably Diawara *et al*. [12]. The authors believe that the high incidence during young age is linked to the immaturity of the autonomic nervous system [9].

We noted a male predominance with a sex ratio of 1.6. This has been observed in most series; in their study, Diawara *et al*. [12] reported a sex ratio of 1.4, while Adhikari *et al*. [10] found a sex ratio of 1.58. Indeed, some studies have found that there is a neurobiological difference between the neurons of male and female subjects, leading to a difference in response when brain damage occurs [13].

4.3. Diagnostic Aspects

4.3.1. Reasons for Consultation

Generalized seizures were predominant in our series, accounting for 43.9% of cases. Tonic-clonic seizures were found in 32.9% of cases. These results are consistent with those of most African studies, which found a predominance of generalized tonic-clonic seizures; in particular, Diawara *et al*. [12] and Adhikari *et al*. [10] found a proportion of 58.3% and 69.9%, respectively. In most studies, generalized seizures are more common than localized seizures, although the explanation for this is not clear.

4.3.2. State of Consciousness

In terms of consciousness, most children remained conscious (72.53%). Coma was observed in 18.13% of cases. In children, seizures often end in a post-critical coma lasting from a few minutes to several hours.

4.3.3. Biology

In our series, thick smear tests were positive in only 5 children (2.75%), contrary to the findings of most African studies, which reported a high rate of positive thick smear tests [7] [9] [14]. This seems to be explained by the fact that the present study was conducted in Dakar, given that in the interior of the country, particularly in the southeast, the incidence of malaria is too high.

4.3.4. Imaging

CT scans are indicated in certain situations, such as status epilepticus with no identified cause, persistent abnormalities on neurological examination, and non-febrile seizures in infants [15]. It was performed in 21 children (11.54%) and showed hydrocephalus in 4 children (2.20%) and cortico-subcortical atrophy in one child (0.55%). In the series by Doumbia A. [9], CT scans were performed in 9 patients, or 3.2% of cases, and 6 out of 9 cases were abnormal, or 67% of cases. In our series, one child (0.55%) underwent magnetic resonance imaging (MRI). Electroencephalograms (EEGs) were performed in 54 children (29.67%), revealing 41 cases of epilepsy (22.53%). According to the literature, apart from simple febrile seizures, any first seizure should be followed by an EEG.

4.3.5. Causes

In our series, the etiologies were dominated by hyperpyretic convulsions (31.87%), followed by epilepsy (22.53%) and metabolic disorders (19.7%), with hyponatremia being predominant (10.9%). Central nervous system infections accounted for 22 of the 182 cases, or 12.08%; meningitis (9.34%) and neuropaludism (2.74%) were the only causes found. Hyperpyretic convulsions were identified as the main cause in several African studies, notably Mwipopo *et al.* [16] (87.5%), Diawara *et al.* [12] (34.25%), and Adhikari [10] (30.5%). The pathophysiological explanations for CF remain diverse, referring to age-dependent cerebral hyperexcitability linked to fever. However, other African studies have shown a predominance of central nervous system infections, mainly malaria followed by meningitis. Indeed, Dembélé *et al.* [14] found 69.9% of neuromalaria and 14.7% of meningitis in their series; Doumbia *et al.* [9] found 70% of neuromalaria and 20% of meningitis; Alao *et al.* [7] had the same results, with 85.5% of cases involving neuropaludism. In our series, epilepsy was the second most common etiology after hyperpyretic convulsions, accounting for 22.53% of cases. These results are like those of Malu *et al.* [17], who found a rate of 21%.

4.4. Therapeutic Aspects

We noted that diazepam was the most used first-line anticonvulsant (53.85%), followed by midazolam (24.18%). For second-line drugs, phenobarbital was used more (17.58%), followed by valproic acid (12.64%). This is consistent with the results of Dembélé A [14], which showed that diazepam was used in 45.6% of cases and phenobarbital in 34%. Diazepam is the most readily available first-line drug in our emergency departments, as is phenobarbital.

4.5. Progression

Most children hospitalized for seizures had a favorable outcome (89.01%). An unfavorable outcome was noted in 10.99% of cases. The unfavorable outcome was due to complications or death. The complications found were predominantly neurological (7.69%). Death was observed in 15 children, or 8.24% of cases. These results are comparable to those of Alao *et al.* [7], where death was observed in 13% of cases.

This high death rate may be linked to delays in consultation and, consequently, in treatment, as we observed in our study, but also to our limited resources, given that medical transport between home and hospital is virtually unavailable, as are our treatment facilities, which are generally modest.

4.6. Factors Associated with Poor Prognosis for Seizures in Children Aged 1 to 60 Months

4.6.1. Types of Seizures

In our study, generalized seizures were associated with a poor prognosis. These results differ from those of Malu *et al.* [17], who found that children who had experienced a generalized seizure were twice as likely to have a favorable outcome within 24 hours than those who had experienced a focal seizure. This can be explained by the fact that children with generalized seizures who also had a poor prognosis were being monitored for kidney disease, which was the underlying cause of the metabolic disturbances responsible for the seizures. Apart from these cases, having a generalized seizure in the absence of any underlying pathology does not constitute a poor prognostic indicator [17].

4.6.2. Hyponatremia

In our study, we observed a significant association between hyponatremia and poor outcome. The fact that hyponatremia is a factor in poor prognosis can be explained by the fact that it constitutes a secondary brain injury and contributes to the worsening of the clinical picture. Indeed, in cases of hyponatremia, the prognosis is worsened by the simultaneous presence of hypoxia, which is explained by the resulting cerebral edema and ICH [18].

5. Conclusion

Seizures are a diagnostic and therapeutic emergency in children and are a common reason for hospitalization. Their morbidity and mortality rates remain relatively high. The main causes in our regions are febrile seizures, epilepsy, and central nervous system infections, hence the importance of a rigorous diagnostic approach. Prevention mainly involves combating all febrile conditions and central nervous system infections, particularly bacterial meningitis and malaria.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki. To ensure confidentiality, each patient was assigned an identification code. This study

was a hospital-based research study conducted under routine conditions.

Conflicts of Interest

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

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