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Early Post-Stroke Epileptic Seizures in Ouagadougou, Burkina Faso: Frequency and Associated Factors

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ABSTRACT

Introduction: *The aim of this study was to assess the incidence and identify the main risk factors associated with early post-stroke epileptic seizures.*

Patients and Methods: *This was a descriptive and analytical cross-sectional study, with prospective, multicentre hospital collection, that involved patients hospitalised for stroke in the university hospitals of Ouagadougou, Burkina Faso, from 1st /03/ 2021 to 30/09/2021. Consenting patients, aged ≤ 18 years, hospitalised for a first episode of stroke confirmed by CT and/ or brain MRI, less than 72 hours old, were included in the study. The diagnosis of early post-stroke epileptic seizure (EPSES) was based on direct observation of at least one epileptic seizure episode symptomatic of an acute cerebral insult directly and exclusively related to the acute stroke, occurring during the 7 days following the stroke. Socio-demographic, clinical (stroke and any epileptic seizures), paraclinical (brain CT, EEG and biological) variables were studied. A bivariate and then multivariate analysis using a logistic regression model with the calculation of ROs and 95% confidence intervals (95% CI) was used to identify the risk factors for the occurrence of EPSES (p≤ 0.05).*

Results: *A total of 347 patients were hospitalised for stroke, with an average age of 59.6 years, including 232 cases of cerebral infarction (66.9%), 113 cases of intracerebral haemorrhage (32.6%) and 2 cases of cerebral venous thrombosis (0.5%). The predominant location of stroke lesions was supratentorial cortical with or without subcortical extension in 139 patients (40.1%), with large strokes accounting for 8.2% of cases.*

The frequency of EPSES was 10.1% (35 patients), with an average onset time of 26.1 hours. Seizures were more frequently repetitive (82.8%) and focal (48.6%). Phenobarbital and carbamazepine, used in 19 patients (54.3%) and 11 patients (31.4%) respectively, were the most frequently prescribed anti-epileptic drugs. After multivariate analysis with logistic regression, the cortical lobar location of the stroke (OR 5.29; 95% CI [1.56-20], p=0.008) and the large size of the stroke (OR 2.22; 95% CI [1.43-6.56], p=0.001) were identified as independent risk factors for the occurrence of EPSES.

Conclusion: *In our context, EPSESs are fairly frequent, occurring predominantly within 24 hours of the stroke and favoured by the cortical location and large size of the stroke. Improved stroke management would help to reduce this frequency.*

Keywords

Early post-stroke epileptic seizures, Frequency, Cortical stroke, Large stroke, Ouagadougou.

Introduction

Stroke is one of the main epileptogenic conditions and the main cause of epileptic seizures (ES) in the elderly; ES is one of the most common neurological sequelae of stroke [1].

Post-stroke ESs are classified as early post-stroke ESs (EPSESs) and late post-stroke ESs, depending on when they occur after cerebrovascular injury. There are different temporal definitions of stroke-associated ESs, but the most widely used is that which defines early ESs as those occurring within 7 days of the onset of stroke (ILAE). After stroke, the reported incidence of acute (early) symptomatic attacks of brain damage secondary to stroke varies considerably between studies, with an average frequency of 10% [2-7]. According to the literature, the incidence of EPSES is higher in intracerebral haemorrhage (ICH) (10-16%) than in cerebral infarction (CI) (2-4%) [2]. EPSESs are mostly focal or have a focal onset that is later generalised [8].

A number of factors predictive of EPSES have been identified, including e subtype, size, location and severity of stroke. However, the results of previous studies are inconsistent and sometimes contradictory. These differences are largely due to different recruitment criteria, such as stroke type, length of follow-up, uncontrolled use of antiepileptic drugs and different time windows to distinguish early and late seizures [8].

In Africa, an incidence of EPSES ranging from 9 to 15% has been reported in studies [9-12]. Some studies have reported an association between EPSES and high rates of disability, mortality and hospital morbidity in stroke patients [2,13-16]. These observations, in a context of high stroke frequency, justify the conduct of the present study, the aim of which was to assess the incidence of EPSES and identify the main risk factors associated with EPSES, in order to help improve the prognosis and quality of life of stroke patients.

Patients and Methods

This was a multicentre hospital-based cross-sectional study, with prospective, descriptive and analytical data collection, involving patients hospitalised for stroke in the university hospitals of Ouagadougou (Yalgado Ouédraogo, Tengandogo, Bogodogo) in Burkina Faso, from 1st /03/ 2021 to 30/09/2021. The size of the patient population was not pre-established.

Patients were consecutively included in the present study: of both sexes, aged at least 18 years, admitted to the said university hospital for a first episode of stroke confirmed by neuroimaging (CT and/ or brain MRI), less than 72 hours old, during the study period, and who had given their consent for the study. The diagnosis of early post-stroke epileptic seizure (EPSES) was based on direct observation by senior neurologists of at least one epileptic seizure symptomatic of an acute cerebral insult directly and exclusively related to the acute stroke, occurring within 7 days of stroke onset. In cases where the patient's consent could not be obtained (altered consciousness, confusional syndrome, aphasia, language barrier) we used a family member or a third person.

Patients with a personal history of epilepsy or stroke, those with epileptic seizures symptomatic of an acute cerebral event other than an acute stroke, and those with a time to onset of ES of more than 7 days were not diagnosed as EPSES.

Patients whose stroke was more than 72 hours old at the time of admission and patients who did not consent to the study were not included in the study. Data collection was based on questioning, physical examination and paraclinical examinations, supplemented by a face-to-face interview, except for aphasic or uncooperative patients, for whom the interview was conducted with the carers. On admission, neurological signs were documented and progressively expanded. Stroke study variables were socio-demographic (age, sex, occupation, socio-economic level, residence, education level), clinical stroke characteristics (history; comorbidities; Glasgow Scale, NIHSS score, general signs; in-hospital complications, clinical outcome at the end of hospitalisation according to the modified Rankin score (mRS), neuroradiological characteristics of the stroke (stroke subtypes, size of the cerebral lesion (large, medium, small or lacunar), topography (cortical or subcortical), associated neuroradiological signs (old cicatricial lesions, cerebral oedema, mass effect, cerebral involvement, hydrocephalus, etc.), biological abnormalities on admission. The EPSES study variables were socio-demographic, clinical (types of epileptic seizures (ES) according to the ILAE 2017 classification, onset times, durations, frequencies in case of recurrence.

In a bivariate analysis, the socio-demographic, clinical and paraclinical characteristics of patients with EPSES were compared with those of patients without seizures during the first 7 days post-stroke. Statistical significance was verified using Student's test or the X^2 test as appropriate. Finally, a multiple logistic regression analysis was used to identify the independent factors associated with the occurrence of EPSES. Only variables with a p-value <0.05 in the bivariate analysis were included in the multivariate analysis. Measures of association were OR with 95% confidence intervals (95% CI).

The data were analysed using Epi info version 7.5.1 and IBM Statistic SPSS 25. For the purposes of this article, we have defined early post-stroke seizure as "any single or multiple episode of seizure occurring within 7 days of stroke and considered to be directly and exclusively related to reversible or irreversible brain damage due to stroke" (ILAE 1993). The clinical severity of the stroke was assessed using the NIHSS score (NIHSS ≤ 7: mild neurological deficit, NIHSS 7-16: moderate neurological deficit, NIHSS ≥ 17: severe neurological deficit); functional disability was assessed using the modified Rankin scale (mRS): autonomy or independence (mRS ≤ 2), moderate dependence (mRS=3), severe to very severe dependence (mRS = 4-5) and death (mRS = 6).

Any ischaemic lesion occupying at least 2/3 of the territory of the MCA or the entire territory of the ACA or PCA or the entire brainstem or cerebellar hemisphere was classified as a large infarct. ICHs were classified as small, medium- and large-volume ICHs when the volume was ≤ 30 cc, between 30 and 60 cc and ≥60 cc according to Khotari's formula for calculating ICH volume on brain CT [13]. The location of the lesion was classified as cortical lobar with or without subcortical extension or subcortical lobar and/or subtentorial. Ethical and deontological considerations: The study was carried out with the authorisation of the administration of the 3 university hospitals concerned, anonymity was guaranteed and the patients's consent was obtained beforehand.

Results

Descriptive study

We consecutively collated 347 patients hospitalised for stroke. The mean age of the patients was 59.6 years ± 15.57 years (extremes18 years and 98 years). The majority of patients were male, aged > 60 years and not attending school (201 patients (57.9%), 187 patients (53.9%) and 263 patients (75.8%) respectively). On admission, hypertension, fever, impaired alertness and severe neurological deficit (NIHSS ≥ 17) were present in 224 patients (64.6%), 27 patients (7.8%), 52 patients (15%) and 119 patients (34.3%) respectively. Table 1 summarises the socio-demographic and clinical characteristics of patients admitted for stroke.

Table 1: Distribution of 347 patients admitted for stroke according to socio-demographic and clinical characteristics.

Variables	Numbers (n=347)	Percentages (%)
Type		
Male	201	57,9
Female	146	42,1
Age		
≤ 50 years	86	24,8
50-64 years old	119	34,3
65-79 years	103	29,6
≥ 80 years	39	11,2
Level of education		
Out of school	263	75,9
Primary level	16	4,6
Secondary level	51	14,7
Top level	17	4,9
Initial Glasgow score		
≤ 12	52	15%
≥ 13	295	85%
Initial NIHSS score		
NIHSS ≤ 5	39	11,4
NIHSS 6-16	189	54,3
NIHSS ≥ 17	119	34,3
HTA	224	64,6
Fever	27	7,8

There were 232 cases of cerebral infarction (66.9%), 113 cases of intracerebral haemorrhage (32.6%) and 2 cases of cerebral venous thrombosis (0.5%). The location of stroke lesions was supratentorial in 321 patients: cortical with or without subcortical extension in 139 patients (40.1%), deep subcortical in 182 patients (52.5%); and subtentorial in 26 patients (7.5%). With regard to supratentorial cortico-subcortical lesions, frontal and temporal locations were the most frequently reported, with 64 cases (46.1%) and 57 cases (41%). CI in the MCA territory, with 161 cases (69.4%), was the most common; deep ICH, with 98 cases (86.7%), was the most frequent. In terms of size, medium-sized CIs were the most common, with 171 cases (74%); medium-sized ICHs were the most common, with 60 cases (53.1%). Cerebral oedema, with 27 cases (7.8%), was the most frequent neuroradiological anomaly. Table 2 shows the distribution of patients admitted for stroke according to neuroradiological data.

Table 2: Breakdown of patients admitted for stroke according to neuroradiological data.

Neuroradiological data	Numbers (n=347)	Percentage (%)
CI	232	66,9
ICH	113	32,6
CVT	2	0,5
Location of the stroke		
Sus tentorial cortical +/- sub cortical extension	139	40,1
Sus tentorial sub cortical or deep	182	52,4
Sub tentorial	26	7,5
Cortico-subcortical lobar location		
Frontal lobar	64	46,1
Temporal lobar	57	41
Parietal lobar	46	33,1
Occipital lobar	30	21,6
Brain stem and cerebellum	16	6,9
Neuroradiological abnormalities associated with stroke		
Diffuse cerebral oedema	27	7,8
Mass effect	14	4
Brain engagement	3	0,9
Acute hydrocephalus	2	0,6
Characteristics of CI	n=232	100
Arterial territories in CI		
Middle cerebral artery	161	69,4
Anterior cerebral artery	17	7,3
Posterior cerebral artery	32	13,8
Anterior choroidal artery	6	2,6
CI size		
Small CI	51	21,9
Medium-sized CI	171	74
Large CI	10	4,1
Characteristics of ICH	n=113	100
ICH topography		
Lobar	15	13,2
Deep	98	86,7
Brain stem and cerebellum	6	5,1
Volume of ICH		
Small volume (≤ 30 CC)	48	42,9
Medium volume (30-60 cc)	60	53,1
Large volume (> 60 cc)	9	8

The sites of CVTs were: the superior sagittal sinus in 2 cases and the transverse sinus in 1 case.

At the end of hospitalisation, 66 patients had died (19%) and 41 patients remained severely or very severely disabled (12%). Figure 1 shows the distribution of patients admitted for stroke according to

clinical outcome at the end of hospitalisation. At least one EPSES was observed in 35 patients, representing a frequency of 10.1% for all strokes. The incidence of EPSES was 2 cases/2 for CVTs, 12.4% for ICHs (14 cases) and 8.2% for cerebral infarctions (19 cases), but did not differ significantly between CIs and ICHs (p=0.310). The mean time to onset of the initial EPSES was 26.14 hours ± 58.12 hours (concomitant with stroke onset and 12 days); the majority of EPSESs, i.e. 45.7% (16 patients), occurred within 24 hours of the stroke (Table 3).

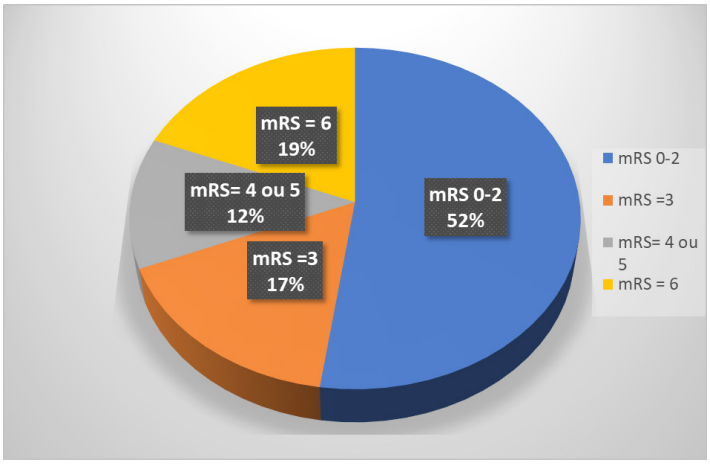

Figure 1: Distribution of patients according to clinical outcome (mRS) at the end of hospitalisation (n=347).

Table 3: Distribution of patients with EPSES according to the time of onset of the epileptic seizure (n=35).

Time to onset	Numbers (n=35)	Percentage (%)
≤ 24h	16	45,7
Between 24 and 72 hours	15	42,8
Between 72 hours and 7 days	4	11,4
Classification of epileptic seizures		
Generalised seizures (GC)	**16**	**45,7**
CG Tonic-clonic initially or secondarily	12	34,3
CG Tonics	4	11,4
Focal seizures	**17**	**48,6**
Focal seizures without alteration of consciousness with motor phenomena	11	31,4
Focal seizures with altered consciousness and/or confusional symptoms	6	17,1
Unclassifiable crises	**2**	**5,7**

The incidence of EPSES varied from 3.6% within 24 hours, 4.3% between 24 and 72 hours and 1.1% after D3. Seizures were recurrent in 29 patients (82.8%), but unique in 6 patients (17.2%). Focal status epilepticus, with 17 cases (48.7%), was the most frequent. Focal status epilepticus with secondary generalised convulsions was observed in 3 patients (8.6%).

Anti-epileptic treatment was instituted in 29 patients (82.9%) because of recurrent epileptic seizures: phenobarbital, carbamazepine and valproate, respectively in 19 patients (54.3%), 11 patients (31.4%) and 9 patients (25.7%). At discharge from hospital, 7 patients (20%) still had recurrences of epileptic seizures, despite antiepileptic treatment.

Analytical study

In bivariate and multivariate analysis with logistic regression using the Cox proportional hazards method, the occurrence of EPSES (yes/no) as the dependent variable and sociodemographic, clinical and paraclinical data as the independent variables: the cortical lobar location of the stroke (OR 5.29; 95% CI [1.56-20], p=0.008) and the large size of the stroke (OR 2.22; 95% CI [1.43-6.56], p=0.001) were identified as independent risk factors for the occurrence of EPSES (Table 4).

Table 4: Univariate and multivariate analysis with logistic regression between sociodemographic, clinical and neuroradiological variables and the occurrence of EPSES.

Independent variables	EPSES- Yes	EPSES- No	P	OR 95% CI	p adjusted
≥60 years	19 (11,4%)	147 (88,6%)	0,42	0,963 [0,42-2,21]	**0,93**
Male gender	24 (11,9%)	177 (88,1%)	0,21		
Diabetes II	6 (15,4%)	33 (84,6%)	0,24		
Hypercholesterol-emia	9 (39,1%)	14 (60,9%)	10^{-6}		
HTA	20 (9,4%)	192 (90,6%)	0,61		
Smoking	28 (9,1%)	281 (90,9%)	0,07		
Alcoholism	10 (11,9%)	74 (88,1%)	0,52		
Obesity	4 (13,3%)	26 (86,7%)	0,53		
Embologenic heart disease	11 (23,4%)	36 (76,6%)	10^{-3}	2,34 [0,74-7,14]	0,146
Sedentary lifestyle	28 (9,4%)	269 (90,6%)	0,32		
Hormonal contraception	2 (28,6%)	5 (71,4%)	0,10		
Carotid atherosclerosis	7 (19,0%)	14 (81%)	0,12		
NIHSS ≤17	23 (8,1%)	262 (91,9%)	0,017		
NIHSS ≥ 17	12 (19,4%)	50 (80,6%)			
Glasgow≤ 12	11 (21,1%)	41 (78,9%)	0,010		
Glasgow between 13 and 15	24 (8,1%)	271 (91,9%)			
Cerebral infarction	19 (8,2%)	213 (91,8%)	0,310		
ICH	14 (12,4%)	99 (87,6%)			
Large stroke	4 (21%)	15 (79%)	0,0001	2,22 [1,43-6,56]	0,001
Cortical lobar location with or without subcortical extension	29 (20,6%)	110 (79,1%)	10^{-4}	5,29 [1,56-20]	0,008
ACA territory	1 (5,9%)	16 (94,1%)	0,55		
MCA territory	15 (7,2%)	192 (92,7%)	0,87		
PCA territory	3 (25%)	9 (75%)	0,08		

Discussion

Our study found an incidence of CEPPA of 10.1% in patients admitted for a first episode of acute stroke at the Ouagadougou University Hospital in Burkina Faso.

Incidence rates similar to ours have been reported recently throughout the world: between 9 and 11% in Egypt [9] and Nigeria [12]. However, higher incidence rates are generally reported in Africa: 13% in Morocco [11] 14.9% in Ghana and Nigeria [10] and up to 17.9% in India [14]. In contrast, most series from developed

countries have reported lower incidences, below 8%. [5,15-17]. This variability in incidence rates could be explained, among other things, by different genetic susceptibility to epileptic seizures in different population groups, by differences in study methodologies, particularly differences in the time windows used to define EPSES (1 to 30 days), by differences in stroke subtypes, by differences in whether or not non-convulsive seizures are included, and by differences in whether or not video-EEG monitoring is used [18,19]. For CIs, the incidence of EPSES is generally 3 to 6% [5,20,21], but can reach 15% in certain cohorts [19,20,22] whereas for ICH, the risk of EPSES is slightly higher [18,23] with early seizures occurring in 10-16% of patients according to [5,24,25].

The incidence of EPSES differs according to stroke subtype and region. In developed countries, the reported data converge towards a significantly higher incidence of EPSES for ICH compared with CI; however, in sub-Saharan Africa, the data seem to diverge. In the series by Aiwansoba et al. [12] EPSES were up to 4 times more frequent in patients with CI compared with ICH (p=0.030). However, in our series, the difference in the frequency of EPSES between ICH and CI was not significant (p=0.135); whereas in the series by Sarfo et al. [10] in a multicentre study in Ghana and Nigeria, the incidence of EPSES was significantly higher in CI (p=0.01). The relatively low incidence of EPSES within ICH in certain series in sub-Saharan Africa compared with the West could be explained by the predominance of deep ICH (capsulo-thalamo-lenticular) linked to cerebral micro angiopathy secondary to chronic hypertension, which is very frequent but insufficiently managed in this part of the world according to Aiwansoba et al. [12]. We also believe that the early management of patients in neurovascular units (NVU) with privileged access to fibrinolysis and/or mechanical thrombectomy, in developed countries, could also explain the low incidence rates of EPSES.

In this study, 45.7% of EPSESs occurred within the first 24 hours after stroke. This observation was also made by the other studies, confirming that the risk of developing early seizures after a stroke was highest in the first 24 hours and tended to decrease thereafter [5,9,26]. The triggering of EPSES during ICH is linked to blood extravasation into the cerebral parenchyma with the release of blood metabolites such as haemosiderin, which is known to be epileptogenic during the formation of ICH according to Beghi et al. [5]. In the case of cerebral infarctions, EPSESs appear to be the result of transient cellular biochemical dysfunction, including ionic imbalance, degradation of membrane phospholipids, release of free fatty acids, membrane instability and a drop in the depolarisation threshold of damaged cells; transient release of excitoxic neurotransmitters such as glutamate, secondary to hypoxia; free radical damage, transient depolarisation of neurons within the ischaemic penumbra zone [18,27,28]. Usually 2/3 of EPSESs are typically focal seizures related to the location of the stroke, whereas about 1/3 of patients present with tonic-clonic generalised seizures according to Myint et al. [27]. In our study, we found the same tendency for focal seizures to predominate, but with a fairly high proportion of generalised convulsive seizures. Among these generalised convulsive seizures, however, there could be a significant proportion of focal seizures that are secondarily generalised with an unrecognised focal onset according to Aiwansoba et al. [12].

Using multivariate logistic regression analysis, we identified the presence of a stroke of cortical location and a large stroke as independent risk factors for the development of EPSES; this is consistent with the results of many previous studies. Indeed, these previous studies have identified the presence of cortical lesions as an independent risk factor for the development of EPSES [5,15,29,30]. Our results showed that stroke of cortical location increased the risk of EPSES by 5.9 times (p=0.008). It should be remembered that in animal models, the development of seizures was associated with hyperexcitability caused by cortical lesions according to Kharatishvili et al. [31].

Our series also demonstrated a significant and independent positive association between large stroke size and the development of EPSES, in agreement with the data in the literature [15,29,32]. A large stroke often reflects a clinically severe stroke. Admission of strokes to the VNU, recanalisation therapies for IC and prevention of volume expansion in ICH could therefore help to reduce the incidence of EPSES.

Limitations of our study

Some EPSESs were difficult to diagnose, particularly those with non-convulsive symptoms, and may have gone undetected; the very small number of CVTs did not allow statistical analyses to be carried out; the absence of certain neuroradiological data meant that it was not possible to search for certain EPSES risk factors.

Conclusion

EPSES affects around 1 in 10 patients hospitalised in Ouagadougou. They occur most frequently during the first 24 hours after the stroke, manifesting more frequently in the form of focal seizures with or without secondary generalisation. They are favoured by the cortical location and large size of the stroke. Early admission of strokes to the NICU and access to therapies for recanalisation and prevention of stroke volemic expansion will help to reduce the incidence of EPSES.

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