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Research Article

Continuous Spike and Waves During Slow Sleep in the Neurological Department of Fann National University Hospital of Dakar: Topographic Aspects and Age

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Abstracts

Introduction: Continuous spikes and waves during slow sleep (CSWS), are characterized by marked activation of epileptic activity on electroencephalographic (EEG) recording during slow sleep. Their topographic distribution is not homogeneous, and this could be not random. The aim of our study is to describe topographic aspects of CSWS and look for correlation with patients age.

Patients and methods: We conducted a descriptive retrospective study in the neurophysiological department of the neurological service of Fan national university hospital in Dakar (Senegal), over a 2 years period. We studied topographical aspects of EEG anomalies of children whose recordings presented CSWS, then looked for correlation between the predominant diffusion region of these and the age of patients.

Results: The CSWS were found on 1.02% of the global sample EEG and 2.60% of the children EEG. The sex-ratio was 1.42. The age varied from 3 to 14 years at the time of the first recording with a mean age of 6.65 +/- 2.63 years. The predominant age group was 3 to 8 years (81%). The main indications were generalized tonico-clonic seizures, focal seizures and benign epilepsy with centro-temporal spikes. CSWS were predominant on the left hemisphere on awake as well as sleep EEG. During waking state, the basal activity was normal on 96.97% of the recordings, anomalies were found on 96.97%, and the major diffusion location were the peri-sylvian regions. Sleep architecture was altered for 63.49% of patients. Topographically, CSWS diffused predominantly in the temporal, central and frontal regions. Children with anterior predominant diffusion of CSWS were older than those with posterior predominant diffusion and the difference was statistically significant (p = 0,031).

Conclusion: CSWS topographic distribution is variable and likely age-related. Given that brain areas have functionnal specificities, this could orient neuropsychological tests in cognitive deficits.

Keywords: Fann; Continuous; Spikes; Waves; Sleep; Topographic; Age

Abbreviations: CSWS: Continuous Spikes and Waves During Slow Sleep; EEG: Electroencephalographic, Electroencephalogram; Or: Odds Ratio; CI: Confidence Interval

Introduction

Continuous spikes and waves during slow sleep (CSWS), are characterized by marked activation of epileptic activity on electroencephalographic (EEG) recording during slow sleep [1], acompanied by the occurrence of or increase of pre-existing spikes and waves, these becoming bilateral and continuous/subcontinuous [2]. The anomalies can occur during awakness, realizing isolated spikes and waves or bursts of spikes and waves [1-3]. They can

be due to epileptic encephalopathy [4,5], but sometimes to some focal epilepsies, wether structural or not [6,7]. Thus, the syndrom (epileptic encephalopathy with CSWS) must be differentiated from the EEG pattern that can be seen in different clinical contexts [8]. Many aspects have been described regarding this EEG pattern. Indeed, considering topographic feature, many studies reported a non-homogeneous topographic distribution of the anomalies on EEG, with an either anterior or posterior predominant diffusion [9-14]. This distribution is not random.

The aim of our study is to describe topographic aspects of EEG of patients presenting CSWS on their EEG recordings and to look for correlation between the topographic distribution and the age of patients.

Patients and Methods

We conducted a descriptive and retrospective study in the neurological department of the Fann national university hospital in Dakar, from June 1st, 2017 to May 31th 2019. The study population was all patients admitted at the neurophysiological department to undergo an EEG recording. We reviewed the recordings of all the children (age from 3 to 16 years) during this period. We included in the study, all EEG on which CSWS were identified, based on quantitative criteria consistent with spikes and waves index showing occupation by the anomalies of at least 50% of the period. We collected the personal data of patients, the EEG indications, the data related to EEG recording during waking state when it was done (basal activity aspects, other anomalies), then sleep EEG recording (sleep architecture aspects, other anomalies). Regarding anomalies, we precised their type, the spikes and waves index during sleep, their topographic characteristics (major diffusion : anterior if the predominant topography was fronto-central, fronto-temporal, centro-temporal or fronto-centro-temporal; posterior if the predominant topography was temporal posterior, pariéto-temporal, temporo-occipital or temporo-pariéto-occipital). Then we looked for correlation between the location of predominant diffusion and the age of the patients, using chi2 test. Data were analyzed with Microsoft Excel and described anonymously with respect for confidentiality for all patients.

Results

Epidemiological aspects

Six thousand sixty-eight patients have had an EEG recording between June 1st 2017 and May 31th 2019, of whom 2424 were 3 to 16 years old. During this period, 97 EEG showed CSWS, corresponding to 63 patients of whom 18 benefited from control EEG. The CSWS were found on 1.02% of the global sample and 2.60% of the children EEG. They were 37 (58,73%) male and 26 females (41,27%), with a sex-ratio of 1.42. The patients' age at the time of the first recording varied from 3 to 14 years (Table 1), with a mean age of 6.65 +/- 2.63 years and a median of 6 years. On the whole sample including the 18 control EEG, the mean age was 7,39 +/- 1.41 years. The predominant age group was 3 to 8 years (81% of the total group) with a peak frequency at >4 to 6 years (34.92%) (Table 1).

Table 1: Patients distribution according to age.

Age groups (years)	Number	Frequency (%)
3 – 4	12	19.05
>4 – 6	22	34.92
>6 – 8	17	26.99
>8 – 10	7	11.11
>10 – 12	2	3.17
>12 - 14	3	4.76
Total	63	100

Clinical characteristics

EEG indications were as follows : 33,33% of patients suffered from generalized tonico-clonic seizures (with one having psychomotor retardation, another one behavioral disorder); 25.39% had focal seizures (of whom one had global cognitive deficit and another one alternating seizures and psychomotor retardation); 14.28% suffered from benign epilepsy with centrotemporal spikes (of whom one had learning disabilities); 12.70% had already diagnosed CSWS; 7.93% had unprecised seizures (one of them with cognitive deficit). For the remaining 6.36% (4 patients) indications were respectively: myoclonic epilepsy, encephalopathy, psychomotor retardation, no diagnosis for the last. Thus, 8 patients (12.70%) had cognitive disorder on their EEG indication.

Electroencephalographic characteristics

Thirty-three patients (52.40%) benefited from awake EEG recording.

Awake EEG aspects

Table 2: Paroxysmal anomalies dominant diffusion on awake electroencephalogram.

Cerebral Regions	Number	Frequency (%)
Central	27	84.37
Temporal	26	81.25
Frontal	22	68.75
Pariétal	8	25
Occipital	0	0

On awake EEGs, the basal activity was normal in 96.97% of cases, not well modulated in one patient (3.03%). Anomalies were found on 96.97% of the recordings (Figure 1): it was diphasic spikes or spikes and waves, occuring on a paroxysmal way. They were predominant on the left hemisphere in half of the sample, on the right one for 34.37%, were symmetrical for 12.5% and maximal on the midline for 3.13%. The major diffusion region was fronto-cen-

tro-temporal for 37.5% of children, centro-temporal for 15.15%, fronto-central and fronto-centro-parieto-temporal for 9.37% each, then centro-parieto-temporal and fronto-temporal for 6.25% each, fronto-centro-parietal, frontal, temporal, centro-parietal and temporo-parietal for 3.16% each. Thus the frequency in which brain lobes were involved in the major diffusion of paroxysmal anomalies was higher for peri-sylvian regions, respectively: central, temporal, frontal (Figure 1 and Table 2).

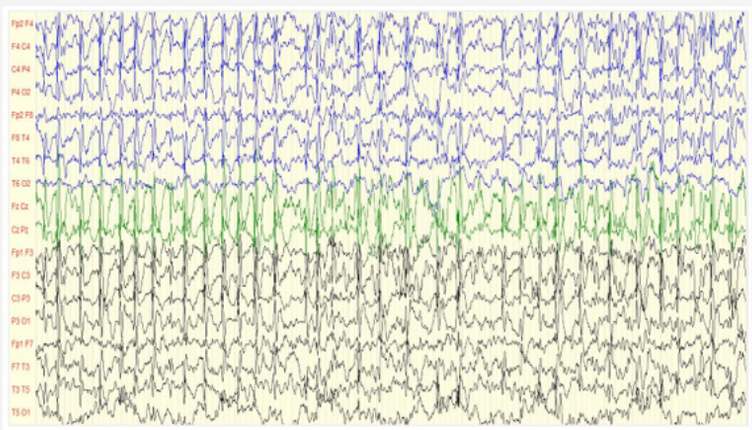

Figure 1: Electroencephalographic recording (longitudinal derivations) in stage 2 of sleep, showing generalized continuous spikes and waves.

Sleep EEG aspects

a) Sleep architecture

For thirty-six point fifty-one per cent of the sleep EEG recordings, sleep micro-architecture was normally organized, while it was altered for 63.49%. On the whole sample (including the 18 control recordings) these rates were respectively 45.36% and 54.64%.

The continuous spikes and waves during slow sleep

Topographically, CSWS predominated in the left hemisphere in 49.20% of patients, in the right one for 41.27%, sometimes on the left sometimes on the right on the same recording for 7.94%, on the midline for 1.59%. The predominating diffusion region was variously distributed : fronto-centro-temporal (23.81%) centro-parieto-temporal (14.30%) fronto-temporal (12.70%), fronto-central (11.11%), centro-temporal (9.52%), frontal (7.94%) parieto-temporal (4.76%), fronto-centro-parietal / parieto-temporo-occipital / centro-parietal (3.17% for each) then temporal / fronto-parito-temporal / fronto-centro-parieto-temporal /fronto-parieto-temporo-occipital (1.59% for each). So, the frequency in which brain lobes were involved in major diffusion of the paroxysmal anomalies was 74.60% for temporal regions, 66.67% for central regions, 63.50% for frontal regions, 33.33% for parietal regions, 4.76% for occipital regions (Table 3 & Figure 2).

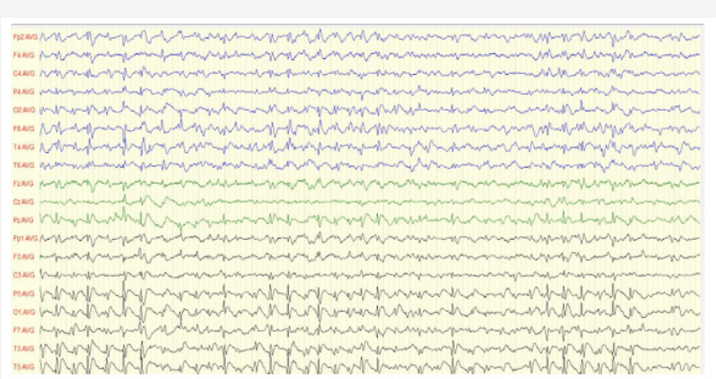

Figure 2: Electroencephalographic recording (referential derivations) with sleep getting lighter, showing diffuse and sub-continuous spikes and waves, with diffusion predominating on left hemisphere and in posterior regions (parietal, occipital and posterior temporal)

Thus it appears that most of the patients (90.47%) had anterior major diffusion of the CSWS, while it was posterior for 7.94%. For one patient (1.59%) it was bipolar: antero-posterior.

b) Correlation between CSWS and age

Children with an anterior predominant diffusion of the CSWS were 3 to 14 years old with a mean age of 6,9 ± 2,6 years; those with

a posterior predominant diffusion were 3 to 8 years old (respectively 3 years for 3 of them, 5 years, 8 years) with a mean age of 4,4 ± 2,2 years. The difference was statistically significant (p =0,031). After distribution into 2 age groups, we notice that for children 5 or more years old, anterior predominant diffusion was found in 96,1% against 72,7% for the second group. The difference was statistically significant, as children of the first group were 9,2 times more likely to have anterior predominant diffusion of the CSWS (Table 4 & Figure 3).

Table 3: Continuous spikes and waves dominant diffusion on sleep electroencephalogram.

Cerebral Regions	Number	Frequency (%)
Temporal	47	74.6
Central	42	66.67
Frontal	40	63.5
Pariétal	21	33.33
Occipital	3	4.76

Table 4: Continuous spikes and waves during slow sleep dominant diffusion according to age.

Age Groups	CSWS Dominant Diffusion						
	Anterior		Posterior				
	Number	%	Number	%	Total	P value	Or [CI = 95%]
<5 ans	8	72,7	3	27,3	11	0,009	
≥5 ans	49	96,1	2	3,9	51		9,2[1,3 – 63,8]

Or: odds ratio – CI: confidence interval – CSWS: continuous spikes and waves during slow sleep

Figure 3: Electroencephalographic recording (longitudinal derivations) in stage 2 of sleep, showing generalized continuous spikes and waves, with symmetrical diffusion predominating in anterior regions (frontal).

Discussion

Epidemiological aspects

We collected over a period of 2 years, data of 63 patients EEG recording having CSWS, corresponding to 1.02% of all the patients that have benefit from EEG during this period and 2.60% of the children. Demographic characteristics of the sample, as we describe them in a former study [14], are consistent with most of the littérature data. This is the case for the sex-ratio in favour of male gender [15-18,8], the mean age of 7,39 years +/- 1.41, the predominant age groups from 3 to 8 years (81% of the population) with a frequency peak at >4-6 years (34.92%) [19,20,8], even if some authors have found higher mean age [17] or higher age frequency peak [21].

Electroencephalographic aspects

a. Electroencephalographic aspects of awake EEG

Regarding paroxysmal anomalies, their topography was similar to what is classically reported in the litterature, particularly by Giorgis et al. [6] and Tassinari et al. [22,23]. The same applies to the asymmetrical distribution of the anomalies [6,20,12].

b. Electroencephalographic aspects of sleep EEG

We analyzed topographically, the first EEG recording of the 63 patients. The CSWS predominated on the left hemisphere for 49.20% of patients, the right one for 41.27%. This left predominance, although slight in our series, has been reported by Saltik et al. [20] and Aeby et al. [21], with higher frequency rates, respectively 62,5% and 66,6% of their cases.

In our series, predominant diffusion of anomalies included more often temporal (74.60%), central (66.67%) and frontal regions (63.50%), which probably explains that most of the subjects (90.47%) had anterior major diffusion of CSWS, as defined by some authors [24,22]. Thus, rolandic and peri-rolandic regions were the most frequently involved in the major diffusion zone of the CSWS. This also support our idea that most of the patients, mainly those with tonico-clonic generalized seizures might have had a focal component in their clinical manifestations, particularly compatible with benign epilepsy with centro-temporal spikes. Indeed, focal anomalies have been described in CSWS with clinical correlations, frontal predominance on EEG being correlated to global or specific nonlinguistic deficits [9,12,13], and temporal predominance to linguistic deficits [10,11]. Some patients of ours ample presented cognitive deficit but didn't benefit from neuropsychological tests in order to discriminate specifically the nature of the disorder.

c. Correlation between CSWS predominant diffusion

The mean age of children with major anterior diffusion was higher than that of those with posterior major diffusion: respectively 6,9 ± 2,6 years and 4,4 ± 2,2 years; with a statistically significant difference (p = 0,031). Many authors [25], described a relationship between age and the preponderant location of epileptic foci in childhood epilepsies. In general, it has been shown that the younger the patients are (preschool age), the more posterior the anomalies foci are (occipital); by contrast, the older they are, the more anterior the epileptic foci are (frontal, temporal) [25-28].

This dichotomous aspect is confirmed when we divide the sample into 2 groups: under 5 years of age on one hand, and five years old or more on the other hand, major posterior diffusion being more frequent in the first group. The opposite is true when we consider major anterior diffusion, with a statistically significant difference.

According to some authors, epileptic foci in focal seizures, particularly in idiopathic ones, might have an anterio-posterior migration [26,27]. The process might be related to brain cortical maturation [25], the occipital regions developing first and frontal areas last [27]. But other studies did not demonstrate it [26]. As the pathology in CSWS is linked to slow wave activity during sleep, this later being more pronounced at the age of onset of CSWS, it explains the risk for hyper synchronization and then evolution into spikes and waves [25].

Conclusion

CSWS are a rare EEG pattern which seriousness is due to their neuropsychological impact if undiagnosed. Their topographic distribution is variable. They likely predominate in the dominant cerebral hemisphere, more frequently in the peri-sylvian regions, leading to linguistic or not cognitive deficits, that have adverse effects on the neurobehavioral development of the child. The dominant location of the anomalies is topographically variable but seems to be age-related. Posterior dominant location is more willingly seen in preschool age, while the anterior dominant location in seen in older children. This topographic distinction is interesting, as it can be a guidance for neuropsychological assessment and allow more specific tests according to the dominant location. Thus, latent cognitive deficits could be diagnosed in apparently asymptomatic subjects.

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Conflict of Interest

No financial interest or conflict of interest.

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