

CONVULSIONS IN CHILDHOOD: ELECTROENCEPHALOGRAPHIC ASPECTS

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Convulsions in childhood as the only sign or symptom of disease constitute an important chapter within the field of the pathology of convulsive disorders. For better understanding of the pathological conditions involved and to provide better basis for correct diagnosis and treatment, the study of large and homogeneous groups of patients is necessary.

In a previous paper¹⁹ we discussed the concepts of *febrile* and *non febrile* convulsions in childhood. The role played by predisposing factors such as birth trauma and heredity was also discussed. In the present paper we study the EEG records of 700 children with convulsions, in order to determine the presence or absence of cerebral lesions.

Many papers are found in the literature dealing with convulsions in childhood. However, children presenting convulsions as the only sign or symptom of disease are still poorly studied. About the same incidence of abnormal EEG records in patients suffering from febrile convulsions was reported by Lennox (20%)¹¹, Gibbs (33%)⁵, Millichap et al. (24%)¹⁶, Aass and Kaada (25%)¹. In children with convulsions as a whole group the incidence of abnormal EEG records was considerably higher (51%). Underwood et al.^{13, 14} pointed out that abnormal EEG patterns are more frequent in those patients who respond poorly to proper treatment. Other authors reported different figures^{2, 3, 7, 17}. Many other reports are found in the literature on the subject^{3, 6, 8, 9, 10, 12, 15, 20, 21, 22}.

MATERIAL AND METHODS

We have studied 700 patients from 1960 to 1963. The patients were selected in order to include only children up to 6 years of age with isolated convulsions, without any other neurological or mental manifestation of cerebral disease. The history of convulsions was the only objective sign of the disease when these patients came to seek medical care. The children had been previously healthy and

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the history was taken by ourselves or by one of our collaborators* from the child and its family, in most cases its parents.

Electroencephalographic examination was made in all patients, once or repeatedly, using an 8 channel, model III, Grass Electroencephalograph. The electrode positions used were those recommended by the International Federation (bipolar sets being used always, and also sets with ear and vertex as common reference).

EEG records were taken from 362 patients being awake and repeated in the same patients under barbiturate-induced sleep. In 338 patients electroencephalographic recordings were taken only under barbiturate-induced sleep owing to the lack of cooperation of the child (table 1).

It should be pointed out that the EEG was used here as a technique for diagnosis of the existence of a cerebral lesion, since it is now widely admitted that a paroxysmic abnormal electrical disturbance of the EEG, which appears consistently in one and same area, indicates that some neurons in such area are originating potentials triggered by the lesion. Thus, the EEG results both in the text and in the tables, are considered according to a clinical rather than a purely electroencephalographic point of view. Whenever more than one record has been taken from one patient, the final and definitive diagnosis was considered for analytical purposes.

The 700 patients were divided into two main groups: 1) *febrile convulsions* (319 patients that had presented their first convulsion during a febrile episode, even if subsequent convulsions appeared outside of a febrile state); 2) *non febrile convulsions* (381 patients in which as for group 1, only the first convulsive episode was taken into consideration).

Age was considered in both groups: a) patients up to two years; b) patients from 2 to 6 years old.

The electroencephalographic results are summarized in table 1. The cases were separated in two groups, the first with signs of cerebral lesions (focal abnormalities with sharp waves, diffuse abnormalities with sharp waves or diffuse disorganization of the basic pattern) and the second with bilateral synchronous discharges, which may also be due to deep lesions, as known from literature and also observed in our own material¹⁸. In the evaluation of the borderline patterns or normal pattern, we obviously considered the patient's age. All records taken near a convulsive seizure, specially those showing signs of an acute affection of the nervous parenchyma (delta waves) were excluded.

In table 2 we divide the electroencephalographic results in two groups, the first including all pathological results (focal and diffuse), the second including the normal and borderline results. In each of these groups *febrile* or *non febrile* convulsions are analysed separately. Each of these subgroups are analysed according to the ages of the patients (0-2 and 3-6 years).

A statistical analysis of the figures of table 2 was made according to the method described in Fischer's book**.

RESULTS

Frequencies indicated by the figures of table 2 are plotted in graph 1. From our results the following analysis can be performed:

- 1) In 700 children presenting one or more convulsions as only sign or symptom of disease, we found 39.1% abnormal EEG patterns (28.5%

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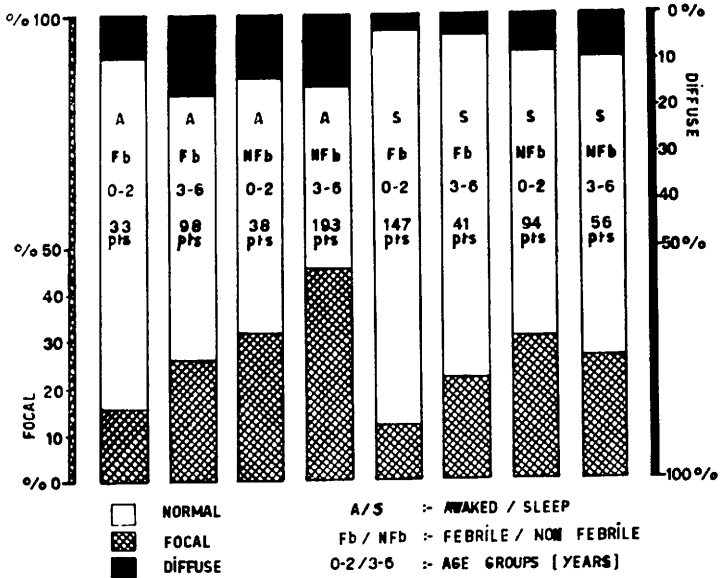
** Fischer, R. A. — Statistical Methods for Research Workers. Oliver Dan Boyd, London, 1958, page 79.

<i>EEG results</i>		<i>Awake</i>		<i>Asleep</i>		<i>Total</i>	
		<i>Febrile</i>	<i>Non febrile</i>	<i>Febrile</i>	<i>Non febrile</i>	<i>Awake</i>	<i>Asleep</i>
Focal	Anterior	13	38	16	19	51	35
	Posterior	6	32	7	19	38	26
	Deep	11	30	3	5	41	8
Diffuse sharp	Bilateral	8	6	4	4	14	8
	Unilateral	4	6	2	6	10	8
Diffuse	Disorganized	3	17	—	2	20	2
	Waves/spikes	5	6	1	—	11	1
Borderline	3 c/sec. waves	22	21	—	—	43	—
	Slow pattern	3	8	—	—	11	—
Normal		56	67	155	95	123	250
Total		131	231	188	150		
		362		338		700	

Table 1 — EEG results in 700 patients according to the type and localization of the abnormalities: anterior = frontal or anterior-temporal foci; posterior = parietal or temporo-occipital foci; deep = subcortical foci; unilateral = diffuse sharp unilateral or sharp patterns predominantly in one hemisphere; disorganized = diffuse disorganized bursts of disorganization of the background activity; waves/spikes = bilateral synchronous bursts of rhythmic waves and spikes; febrile = febrile convulsions. For details, see text.

Technical conditions	Clinical conditions	EEG					Total		
		Abnormal		Borderline	Normal				
		Focal	Diffuse						
Awake	Febrile	0-2	5	3	3	22	33	131	
		3-6	25	17	22	34	98	362	
	Non febrile	0-2	12	5	—	21	38	231	
		3-6	88	30	29	46	193		
Asleep	Febrile	0-2	17	5	—	125	147	188	
		3-6	9	2	—	30	41	338	
	Non febrile	0-2	29	7	—	58	94	150	
		3-6	15	5	—	36	56		
	Awake		130	55	54	123	362	700	
	Asleep		70	19	—	249	338		

Table 2 — EEG results in 700 patients grouped by clinical conditions: 0-2/3-6 = age (years); febrile = febrile convulsions. For details, see text.



Graph 1 — EEG results in 700 patients up to 6 years of age presenting convulsions.

focal and 10.5% diffuse). This fact points to the high frequency of cerebral lesions in such patients.

- 2) The frequency of abnormal EEG patterns was significantly higher in patients being awake (50.8% awake and 26.3% sleeping), showing the influence of the waking or sleeping state on the EEG results.
- 3) In patients suffering from *febrile* convulsions the frequency of abnormal focal EEG patterns was 17.5%, while in *non febrile* convulsions this frequency was 37.7%.
- 4) The frequency of abnormal focal EEG patterns differed significantly for the two age groups (0-2 yrs 20.2%; 3-6 years 35.3%). However, this fact can not be taken into account because EEG records of children up to two years were taken frequently only under barbiturate induced sleep. If waking patients and sleeping patients are compared, we found 20.6% abnormal focal EEG patterns for sleeping patients, and 35.0% for waking patients, which confirms the fact that the significant difference between age groups may be only apparent.
- 5) The frequency of abnormal diffuse EEG patterns in *febrile* convulsions (8.4%) differed significantly from the frequency of abnormal diffuse EEG patterns in *non febrile* convulsions (12.3%).

- 6) The frequency of abnormal diffuse EEG patterns in age group 0-2 years was 6.4% while in age group 3-6 years it was 13.9%. Such figures are significantly different. However, if one takes into consideration whether the EEG was recorded in the waking or the sleeping state the difference diminishes considerably. As we have in our material only few cases of diffuse abnormalities in the EEG, no conclusion can be drawn.

SUMMARY AND CONCLUSIONS

The electroencephalographic records of 700 children, up to 6 years old, with a history of only convulsions without other clinical manifestations are analysed. The EEG findings in patients with *febrile* and *non febrile convulsions*, in waking and sleeping state and according to their age (0-2 and 3-6 years old), were compared statistically.

From this study three main conclusions can be drawn: 1) there is a significant percentage of cerebral abnormalities among the children with isolated convulsions; 2) there is a significantly higher incidence of focal abnormalities in patients with *non febrile convulsions* than in those with *febrile convulsions*, suggesting that convulsions in each group may correspond to different cerebral conditions; 3) in the electroencephalographic study of these children with convulsions one must take into account the state of the patient during the recording (awake or asleep). It would be an error to consider results as they were of a homogeneous group.

RESUMO E CONCLUSÕES

Convulsões na infância. Aspectos eletrencefalográficos

São analisados os resultados eletrencefalográficos de 700 crianças, com idade de 0 a 6 anos, que apresentaram convulsões isoladas, sem história ou manifestações clínicas de qualquer outra moléstia.

Os resultados nos subgrupos de pacientes com *convulsões febris* e *não febris* são analisados separadamente sob o ponto de vista estatístico, assim como nos subgrupos de 0-2 e 3-6 anos de idade. Análise similar foi feita nos subgrupos de pacientes examinados somente durante o sono ou em sono e em vigília, com finalidade de testar o fator técnico do exame.

Dêste estudo podem ser tiradas três conclusões principais: 1) nas crianças com convulsões isoladas aparecem sinais eletrencefalográficos que permitem diagnóstico da existência de lesão cerebral em uma incidência estatisticamente significante; 2) a incidência de lesões cerebrais focais nos casos de *convulsões não febris* é também significativamente maior que nos casos de *convulsões febris*, o que sugere que as convulsões nesses grupos de pacientes dependem de condições cerebrais diferentes; 3) no estudo eletrencefalográfico das crianças com convulsões, deve ser tomado em consi-

deração se o exame foi feito somente durante o sono ou se também em vigília, pois tais resultados não podem ser considerados em conjunto, sob pena de se incorrer em erro grosseiro.

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