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NEUROPHYSIOLOGICAL FEATURES OF FEBRILE SEIZURES IN CHILDREN

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Summary: *The article presents the clinical and neurophysiological features of febrile seizures in children and the results of a comparative study of children with febrile and afebrile seizures. It has been established that febrile seizures develop during hyperthermia due to a somatic disease and are accompanied by diffuse microorganic symptoms that do not affect the cognitive development of the child.*

Key words: *children, seizure, febrile seizures, afebrile seizures, epilepsy.*

Relevance: Febrile seizures (FS) are currently a common variant of paroxysmal conditions in children [1-5]. Febrile convulsions (seizures, FS) are currently a common variant of paroxysmal conditions in pediatric practice. These are episodes of epileptic seizures that occur in preschool children with hyperthermia not associated with neuroinfection. FS is a benign, age-dependent, genetically determined condition in which the brain is susceptible to epileptic seizures that occur in response to high temperature. [4,6]. According to literature sources, the prevalence of febrile seizures in children from 6 months to 5 years is about 2-5%. Boys get sick more often than girls in a ratio of 1.5-2:1. The peak incidence is observed at the age of 18 months [8].

It has now been revealed that the majority of children who have suffered FS are in normal health, and the condition after a seizure has a benign course. Recently, evidence has emerged that a small number of children after FS may develop a neurological defect, relapses of FS or epilepsy, learning problems, movement disorders and behavioral changes, nonspecific sensory symptoms and memory disorders [11], which requires the provision of timely emergency assistance to children with FS with timely correction of violations [7, 10].

The prevalence of febrile seizures in children from 6 months to 6 years is about 2-5%. Boys get sick more often than girls in a ratio of 1.5-2:1. The peak incidence occurs at the age of 18 months. 80% of patients have a family history of episodes of convulsive seizures of various etiologies. In 25% of children, parents also suffered from similar manifestations in childhood. In most cases, the outcome of the disease is favorable and depends on the correct tactics of the doctor.

Febrile seizures in children are a heterogeneous pathological condition. The exact etiology and pathogenesis have not been established. One of the possible factors in the development of pathology is the immaturity of the central nervous system in children under 6 years of age, which manifests itself in a tendency to generalize processes and weakness of inhibitory activity.

Purpose of the study: to study the clinical, neurological, neurophysiological features of febrile seizures in children with the determination of prognostic criteria.

Research methods included medical history, clinical neurological examination, electroencephalography of the brain (EEG) and magnetic resonance imaging (MRI of the brain).

To achieve this goal, 120 children with febrile seizures aged from 6 months to 5 years were selected. The average age of the children was 3.2±0.12. Among children with febrile convulsions, children aged 2-3 years predominated: 2-year-old children accounted for 36.7%, 3-year-olds 26.7%. There was a decrease in the number of patients with age: children 4 years old accounted

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for 23.3%, and children 5 years old - 10%. Among the examined children with febrile convulsions, there were more boys in the gender ratio - 63.3%, girls accounted for 36.7% of cases.

The first stage of the study consisted of collecting anamnesis, clinical neurological examination and testing to determine speech development delay (SDD) or psycho-speech development (PSRD).

To ensure completeness of registration, the author of this study developed a questionnaire. It included perinatal history data, hereditary factors (presence of febrile seizures, epilepsy in relatives); conditions for the occurrence of seizures (temperature, degree of its rise, type of underlying disease, frequency of diseases), information about the nature, frequency, duration of febrile seizures, data on neurological status, data from additional research methods (EEG, EEG-video monitoring, MRI).

EEG doimiy vakti 0.3 sonia bulgan, “MBN” (2003-yil ishlab chikarilgan) ilmiy-tibby firmasining spectral kartirlanishi bilan “Neurocartograph-1-MBN” 16 channels of electroencephalography yerdamida amalga ruykhatga olindi. “Kogoz harakatining” tezligi – 30 mm/sonia. Yukori frequency filterlarining kyimati 30 Hz, electrodlar karshiligi kўpi bilan 10 kOhm. Kanallarning ta'sirchanligiga 1 µV/mm ni tashkil etdi. Signal caliber 50 µV ha, amplitude 50 mW ha tenge baldi. Barcha tadqiqotlar korongilashtirilgan, shovqindan himoyalangan honada, bola makhsus chairda yoki onasining qўlida ўtirgan ҳolatda ўkazildi. QEEG ertalabki vakt, asosan physiologist uyku holatida, kamdan-kam holatlarda uygok holatda olindi. Mudrok ҳolatining sodir bўlishini ҳatti-ҳarakat mezonlari (kўzlar uzoq muddat yumish) va vegetative kўrsatkichlar (yurak qiskarishlari frequency sining kamayishi wa mushaklar tonusining pasayishi) bilan nazorat qilindi. “Neuro” dasturidan foidalanib monopolar yozuv amalga oshirildi.

Electrodlar қўyish zharayoni, ularni bolaning boshida zhoylashtirish usuli “10-20%” halkaro standard schemaga mos boldi. QEEG yozuvi unipolar, kobiқning sakkiz symmetric nuktasidan olib borildi: pešana (FsFd), marcasium (CsCd), bosh suyagining tepa qismi (PsPd) wa ensa (OsOd). Indifferent sifatida bola kulogiga takilgan makhsus kuloq elektrodidan foidalanildi. Elektrodlar boshga yumshok rubber helmet erdamida maqamlandi. QEEG bipolar chikishlarda rўyhatga olindi. QEEG taҳlilida bolalar miyashida bioelectric faollikning yoshga boglik ўziga hos hususiyatlari etiborga olindi. QEEG rhythmic faolliging tarifi rhythmni identificationlashning uch mesoni asosida amalga oshirildi: frequency oraligi, faollic focusing tomographic zhoylashuvi, rhythmik tebranishlarning haraqatlar bilan bogliqligi (functional reactive). QEEG malumotlarining interpretationsi ёshning ўziga hos hususiyatlarini etiborga olib, umum etirof ethylgan mezonlar bўyicha ўkazildi. Electroencephalogrammar tekshirilgan bemorlarda bosh mia bioelectric faolliging holatini lens baghosini olish imkonini birdie.

The obtained data were subjected to statistical processing on a Pentium-4 personal computer using programs developed in the EXCEL package using a library of statistical functions. Differences in mean values were considered significant at a significance level of $P < 0.05$. To assess the influence of potential risk factors and construct a prediction equation, regression analysis was used, the quality of the 11 model was checked using ROC analysis, and the area under the curve (AUC) was interpreted. When deciding whether groups were equal (in the absence of differences), $p = 0.05$ was determined as the threshold value. Differences were considered statistically significant at $p < 0.05$.

Research results: Temperature is one of the main conditions for the occurrence of febrile seizures. We analyzed individual temperature characteristics associated with the onset of febrile

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seizures: the level of temperature during the onset of seizures, the presence of temperature before the onset of seizures, the rate of increase in temperature with the onset of seizures.

The temperature at which febrile convulsions occurred in children was most often above 38.5°C (56.7%), only 6.7% of children had a body temperature less than 38°C. An attack of convulsions was the initial symptom of a febrile illness in 10% of patients; in 90% of cases, the children were already sick and had a fever. Seizures occurred more often with a rapid increase in temperature (50%), and only in 3.3% of cases did seizures occur with a sharp decrease in temperature.

A marker of an increased likelihood of febrile seizures is considered to be perinatal pathology, which may have an impact on the clinical manifestation of febrile seizures and their outcome. When studying the perinatal history, the most significant pathology was taken into account: acute, chronic fetal hypoxia, a combination of chronic hypoxia and acute asphyxia during childbirth, premature birth, birth weight, and mechanical ventilation.

Pregnancy pathology in children with febrile convulsions was more common in the main group - 59.7% than in the comparison group, with a predominance of chronic fetal hypoxia in both groups (Table 1).

Table 1

Perinatal history of children with febrile seizures (%)

Indicators	Group				Assessing the significance of differences
	main (n=72)		comparisons (n=48)		
	abs.	%	abs.	%	
Course of pregnancy	12	16,7	29	60,4	P<0,05
Without pathology	60	83,3	19	39,6	P<0,05
With pathology, including:	54	75,0	10	20,8	P<0,01
- chronic hypoxia (CH) of the fetus	6	8,3	8	16,7	P<0,05
- acute fetal hypoxia	5	6,9	2	4,2	P>0,05
- CHG + acute asphyxia					
Childbirth	55	76,4	31	64,6	P>0,05
Timely	5	6,9	7	14,6	P<0,05
Premature	4	5,6	8	16,7	P<0,05
Caesarean section planned	8	11,1	2	4,2	P<0,01
Emergency caesarean section					
Birth weight, g	1	1,4	0	0	
1000 – 1500	8	11,1	2	4,3	P<0,01
1600 – 2500	63	87,5	46	95,8	P>0,05
More than 2500					
Performing mechanical ventilation after birth	66	91,7	46	95,8	P>0,05
Not carried out	6	8,3	2	4,2	P<0,01

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Statistically significant differences were established in the course of labor, birth weight, and mechanical ventilation after birth between groups of children with febrile seizures with and without disorders of psycho-speech development.

The temperature at which febrile attacks occur is most often caused by acute respiratory diseases, otitis media, pneumonia, intestinal infections, and inflammation of the urinary tract. These infections are the cause of most febrile disorders in childhood. In our study, in the vast majority of cases, the underlying disease in children was acute respiratory infection (86.7%). It is also known that fever as a result of immunization can also provoke febrile attacks. In our case, children who had seizures after immunization accounted for 10%.

It was noted that febrile convulsions were observed in frequently ill children. Thus, according to the study, 70% of children were considered to be frequently ill, since the frequency of respiratory infections was 4-5 or more times a year.

The average duration of attacks was 4.03±2.18 minutes, simple AF was recorded in 77.5% of cases (93 people), complex AF - 22.5% (27 people). Moreover, depending on the development of ZPRD in children with FS of the main group, simple seizures were recorded in 70.8% (51 children), and complex ones in 29.2% (21 children), while in the comparison group in 87.5% (42 children) and 12.5% (6 children), respectively, which was significant (P<0.05).

The majority of children (86.7%; 104/120) had generalized seizures. Of these, 63.3% (76/120) of children had generalized tonic-clonic seizures and 13.3% (16/120) clonic ones; in 10% (12/120) of patients the attack began with limpness. Moreover, in children from the comparison group, clonic seizures were observed in 6.3% of cases (3/48), while in the main group in 18.1% (13/72), which is almost 2.9 times more often (P<0. 05).

What was common to all attacks was a sudden and complete loss of consciousness. A generalized tonic-clonic attack was characterized by a tonic spasm with upward movement of the eyeballs, followed by clonic twitching in the limbs and facial muscles, breath holding, and cyanosis of the nasolabial triangle. After the attack, general weakness and drowsiness were noted.

In 13.3% of children, the attacks occurred in the form of clonic convulsions of the limbs and torso with respiratory failure; in 10% of children, at the beginning of the attack, limpness was noted with the eyeballs moving upward, after which clonic twitching in the limbs and torso and breathing disturbance occurred. Regardless of the nature of febrile seizures, all children had post-attack sleep.

Changes in neurological status occurred in both groups with a significant predominance in children of the main group (Table 2).

Table 2

Neurological examination results

Indicators	Groups				Assessing the significance of differences
	main (n=72)		comparisons (n=48)		
	Абс.	%	Абс.	%	
	22	30,6	22	45,8	P>0,05
Without changes	50	69,4	26	54,2	P>0,05
With changes, including:	21	29,2	2	4,2	P<0,01
- cranial nerves	12	16,7	5	10,4	P>0,05

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We conducted an EEG study of the brain, which was usually carried out at least 10 days after the seizure event. In children with febrile seizures, the waking EEG was without pathology in 76.7%; in 23.3%, EEG changes were recorded, which were predominantly nonspecific: a slight slowdown in the background EEG activity (20.4%), as well as short diffuse theta discharges. and delta waves with an amplitude of up to 100 μV in the background (3.3%). In the comparison group, pathological changes on the EEG were recorded in 12.5% (6/48), and in the main group in 30.6% (22/72).

Neuroradiological examination of patients with febrile seizures revealed structural changes in the brain only in 1 case (cyst of the septum pellucidum).

The relative risk of developing PVRD (RR) in children with FS with complex attacks is 3.6 (95% CI 1.6 - 8.4; p = 0.003), and with simple ones it is 0.5 (95% CI 0.3 - 0.8; p = 0.004)

The relative risk of developing PVRD (RR) in children with FS with clonic seizures is 15.4 (95% CI 1.0 – 243.6; p = 0.05), and with generalized seizures it is 0.4 (95% CI 0, 3 - 0.6; p < 0.0001).

The relative risk of developing PVD (RR) in children with FS in the presence of focal neurological symptoms in the neurological status is 4.0 (95% CI 1.3 - 12.1; p = 0.01), and in the absence of abnormalities in the neurological status - 0.5 (95% CI 0.3 – 0.9; p = 0.009).

The relative risk of developing PVD (RR) in children with FS in the presence of pathological changes on the EEG is 1.6 (95% CI 1.0 – 2.4; p = 0.03).

The relative risk of developing PVD (RR) in children with FS in the presence of an unfavorable course of pregnancy and childbirth is 1.9 (95% CI 1.1 - 3.1; p = 0.01), and in the absence of a normal course - 0.6 (95% CI 0.4 - 0.8; p = 0.001).

Based on the identified statistically significant differences in the anamnesis, clinical manifestations, data from instrumental research methods (electroencephalography) of children with FS, an equation for predicting the development of PVD was compiled by creating a mathematical formula using the regression analysis method, calculating logistic regression logit (p) using the following formula:

logit (p) = -1,58 + (1,54×x1) + (1,06×x2) + (0,53×x3) + (0,87×x4)

где:

x1 – complex FS (RR = 3,6; 95% ДИ 1,6 - 8,4; p = 0,003),

x2 – clonic seizures (RR = 15,4; 95% ДИ 1,0 – 243,6; p = 0,05),

x3 - disturbances in neurological status in the form of focal neurological symptoms (RR = 4,0; 95% ДИ 1,3 - 12,1; p = 0,01),

x4 – pathological changes on the electroencephalogram (RR = 1,6; 95% ДИ 1,0 – 2,4; p = 0,03).

The optimal cutoff value for diagnosing the disease was determined: with $p > 0.74$ – a high risk of developing PVRD, with $p \leq 0.74$ – a low risk of developing PVRD.

The specificity of the proposed formula is 95.6%, and the sensitivity is 93.2%.

Conclusions: EEG nor febrile seizures cannot be definitively accepted as a risk factor for the transition of febrile seizures to epilepsy, taking into account the age of the patients, as well as the time of onset of seizures. In our study, 76.7% of children with epilepsy were diagnosed with EEG pathology, while this indicator was equal to 3.3% in the group of patients with epilepsy.

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