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NON-EPILEPTIC PAROXYSMAL EVENTS IN CHILDREN: STRUCTURE AND PHENOMENOLOGY. I. JITTERINESS

Abstract. Parents, pedagogues and doctors often face ambivalent conditions of children difficult to be diagnosed as normal, adaptive or pathological. Non-Epileptic Paroxysmal Events (NEPE) occupy a special place among them. The given research focuses on the description of the main non-epileptic paroxysmal events in children which are often observed in everyday professional activity of pedagogues, psychologists and pediatricians and may be difficult to interpret. The authors have undertaken an analysis of diagnosability of NEPE at the specialized neurological department of the city children's hospital in 2016. Four out of 78 children with the admission diagnosis of NEPE arrived from children's preschool institutions where their paroxysmal disorders caused special anxiety and worry. The NEPE was diagnosed in 53,8 % of cases; in 46,2 % of cases the disorders failed to be differentiated. The article considers jitteriness as a most widespread kind of NEPE in babies in more detail. It shows that this phenomenon is present in about a half of the typically developing babies; nevertheless, jitteriness may be a consequence of impaired metabolism, somatic diseases, withdrawal syndrome and the baby's nervous system lesions, which needs in-depth diagnostics and delicate treatment. In the overwhelming majority of cases, the prognosis for this condition is favorable.

Keywords: children; pediatrics; non-epileptic paroxysmal events; non-epileptic paroxysmal disorders.

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From the very first days of their practical activity, the pedagogue, psychologist and pediatrician may come across various peculiarities of the child's behavior which puzzle both the parents and the specialists. These phenomena may include, specifically, trembling, stereotypical habitual movements in the state of wakefulness, and puzzling phenomena taking place during sleep. Standard education cannot answer the question about the origin of such states. Thus, "classical" medicine considering all phenomena through the dichotomy "normal – pathological" or "normal – abnormal", and in the case of "pathology" or "abnormality" – via the scheme "etiology – pathogenesis – pathomorphology – clinic – diagnostics – treatment – prognosis" turns out to be helpless in this case.

It would be worthwhile remembering the phrase of the outstanding Russian pediatrician I. M. Vorontsov that pediatrics as a medical science is radically different from the medicine of the adults because it represents a combination of medicine of development and medicine of disease.

A considerable number of ambivalent conditions of children are difficult to be diagnosed as normal, adaptive or pathological, and the solution of this problem has a directive rather than arguable nature. The decision about the abnormality of such state is often taken because of the inability to explain its origin and character.

The founder of developmental neurology H. F. R. Prechtl suggested using the dichotomy *optimal/suboptimal* instead of the typical for medicine in general and for neurology in particular approach to a clinical phenomenon through the dichotomy of *normal/pathological* or *normal/abnormal* [18].

In order to rank the phenomenon as optimal or suboptimal, special scales (sheets) of optimality are worked out, and the suboptimal indicators are evaluated from the

point of view cumulative risk, while the total evaluation should have numeric expression. Optimality is a narrower notion than normality. This approach will allow us to regard some ambivalent states in babies from a different angle.

The phenomena under investigation in this article have been recently called in the world literature non-epileptic paroxysmal events (NEPE).

In Europe, the incidence of epilepsy in children is 4-5%; in 39% of children with suspected epilepsy the primary diagnosis is not confirmed, and in 47% of these cases the disorder is diagnosed as a NEPE [21; 22].

The NEPEs in children can be classified according to the behavioral state during which they manifest themselves (sleep, wakefulness) [3], or in accordance with the age at which they mostly occur (babyhood, childhood or adolescence) [21] (Tables 1, 2).

It is necessary to add that a number of paroxysmal phenomena are observed in the fetus in the course of its typical prenatal development. They include *startles* and *hiccups* from the 8th week of gestation, *urges* to urinate – from the 9th week of gestation, *stretching* – from the 12th week, *tongue protrusion* – from the 13th week, *blink reflex* – from the 22nd week of gestation [2; 9; 10].

The aim of the given research is to describe the main non-epileptic paroxysmal events in children which are encountered in everyday professional activity of pedagogues, psychologists and pediatricians and, as a rule, are difficult to interpret.

Table 1. Systematization of NEPE according to the behavioral state (A. B. Pal'chik et al. [3])

Wakefulness	Sleep
Jitteriness	Sleep-dependent rhythmic movement disorders — RMD
Startle-syndrome and hyperekplexia	Benign neonatal sleep myoclonus
Benign myoclonus of early infancy (Fejerman syndrome)	Masturbation
Gastro-esophageal reflux disease (Sandifer syndrome)	
Paroxisms of “jerking”, “trembling” and “shuddering” attacks	
Children’s transient syndromes	
Breath-holding spells	

Table 2. Most widespread age-related NEPE (B.Tatl et al. [21])

Babyhood	Childhood	Adolescence
Jitteriness	Breath-holding spells	Syncope
Hyperekplexia	Shuddering attacks	Sleep disorders
Benign neonatal sleep myoclonus	Stereotipies	Psychogenic crises
	Benign paroxysmal torticollis	Tics
	Benign paroxysmal tonic upward gaze syndrome	Migraine
	Benign paroxysmal positional vertigo	
	Sleep disorders	
	Masturbation	
	Spasmus nutans	
	Sandifer syndrome	

Materials and methods

Over the period from January 1 till December 31 2016, 78 children aged up to 4 years with paroxysmal consciousness disorders were admitted to the neurological department of the St Olga Children's Hospital of Saint Petersburg. Four of them were taken to hospital from preschool institutions accompanied by medical personnel or parents because of paroxysms at the crèche or children's home.

General characteristics of the children under observation are shown in table 3.

Each child's state was evaluated with the help of universal schemes of somatic, neurological and ultrasonographic observation. Electroencephalography (EEG) was carried out with "Mitsar-EEG-201" by standard methods during wakefulness using functional tests in accordance with the age of the children under observation.

Video EEG was taken in the functional diagnostics laboratory with "Mitsar-EEG-201", as well as on the base of the Diagnostic and Treatment Center of the International Institute of Biological Systems.

Statistical analysis was made with the help of the program *Statistica for Windows 10.0* using the Spearman's rank correlation.

Results

As a result of our investigation we found out that 22 children (28.9 %) out of those with paroxysmal disorders identified as NEPE had no neurological deviations; other babies demonstrated various deviations of causative nature in their neurological status; 12 children (15.9 %) had multiple deviations. The ultrasonographic observation showed normal structural brain picture in the majority of children (55.3 %); mild brain ventricular expansion (22.4 %) was predominant among the deviations observed.

Table 3. Characteristics of children under observation

Indicator		M ($X_{min.}$ — $X_{max.}$)
Sex	boys	39
	girls	39
Gestational age (months)		35.5 (29—42)
Postnatal age (months)		25.5 (1—50)
Optimality of the course of pregnancy, %		83.5 (70—97)
Optimality of the course of birth, %		80.5 (61—100)
Evaluation according to the Apgar scale	1'	5 (1—9)
	5'	6.5 (4—9)

Table 4. Character of consciousness and movement disorders in children under observation

Character of paroxysmal disorders	n	%
NEPE differentiated into:	42	53.8
– breath-holding spells	9	11.5
– benign paroxysmal eye phenomena	6	7.7
– Fejerman syndrome	11	14.1
– benign paroxysmal torticollis (retrocollis)	4	5.1
– benign nocturnal alternating hemiplegia	2	2.6
– mild hyperekplexia	2	2.6
– masturbation	2	2.6
– benign sleep myoclonus	1	1.3
– spasmus nutans	1	1.3
– sleep apnea	1	1.3
– paroxysmal dystonia attacks	1	1.3
– jitteriness	1	1.3
– startle response	1	1.3
undifferentiated NEPE	36	46.2

EEG corresponded to the age norm in 73 children (96 %); three children (4 %) demonstrated delay in formation of bioelectrical activity, which was one more argument in favor of referring these paroxysms to the NEPE.

The structure of the NEPE discovered by our study is presented in table 4.

In spite of the fact that the phenomenon under study was diagnosed in one child only, it refers to the most commonly found NEPEs.

Jitteriness means "nervousness, tremor, and ease of startle".

Jitteriness is a stable tremor of constant amplitude around a fixed axel associated with high muscle tone and deep reflexes, stable newborn reflexes, low threshold of the startle response and the Moro reflex which becomes less marked or dis-

appears in a calm condition and/or during passive flexion of the limbs.

In a more extensive research of the same problem which included 936 healthy full term babies, jitteriness was diagnosed in 44% of newborns [16].

Hypernoradrenalinemia serves as the basic mechanism of development of jitteriness in healthy newborns or low risk group babies. Among adaptive borderline states of the nervous system of newborns, N. P. Shabalov [5] mentions the "simpatico-adrenal crisis of a newborn" or the "newly born child's syndrome" which, in fact, is analogous to jitteriness and discloses the mechanisms of its emergence.

It is necessary to note that jitteriness is a significant syndrome of those metabolism disorders of the baby that influence on the balance of the processes of excitation and inhibition of neuron and neural ensembles.

This particularly applies to hypoglycemia. As far as hypoglycemia is quite frequent in newborns (38% of all newly born babies), this state may be one of the main causes of jitteriness. According to the data of the joint research of such authors as M. Cornblath and R. Schwartz [7], 81 % of newborns with delay of prenatal development and hypoglycemia demonstrate jitteriness.

Alongside frequent metabolism disorders, the formation of jitteriness may be caused by magnesium and sodium deficiency and dehydration [14; 26].

Neonatal sepsis is singled out among other somatic causes of jitteriness [12; 23].

The mechanisms of development of jitteriness caused by sepsis may be varied: from numerous secondary metabolism disorders mentioned above to hypernoradrenalinemia emerging as a result of tension of the hypothalamic-pituitary-adrenal axis.

Jitteriness was the leading neurological deviation among 156 newborns in the South African Republic during the outbreak of rotavirus infection [8].

Moreover, it is necessary to mention polycythemia as a possible cause of jitteriness among other somatic diseases of the newborn. With polycythemia, jitteriness is diagnosed in 7.3—25.9 % of cases [20; 25].

The withdrawal syndrome serves as one more cause of jitteriness. What is more, jitteriness might be the main characteristic feature of the abstinence syndrome. The narcotic drugs taken by women during pregnancy and causing the withdrawal syndrome are reported to include morphine, buprenorphine, heroine and its surrogates, methadone, tramadol and cocaine [4; 11; 13; 15]. The first five drugs are opioids and have a common mechanism of the withdrawal syndrome development.

The medications that bring about the withdrawal syndrome marked by jitteriness include antidepressants, neuroleptics, tranquilizers (benzodiazepines) and anticonvulsants.

Lesions of the nervous system of newborn babies are significant but not leading factors in the causal structure of jitteriness. Jitteriness may appear as the manifestation of the first stage of the hypoxic-ischemic encephalopathy of the newborn (H. B. Sarnat, M. S. Sarnat [19]). According to such scholars as U. Kramer, Y. Nevo, S. Harel [12] and J. J. Volpe [24], in addition to hypoxic-ischemic lesion, jitteriness may be caused by intracranial hemorrhage.

Jitteriness is manifested in the child's constraint and tremor, which, if marked, impresses the parents and the pedagogical and medical staff. The research by A. B. Pal'chik and A. E. Ponyatishin [3] presents a detailed objectification of the main manifestations of jitteriness with the help of standard scales. Calming the baby down while taking it in the arms, and passively bending its limbs serve as important differential-diagnostic techniques aimed to discern between jitteriness and spasm. Taking into account that the phenomenon under description has a favorable prognosis, the simple diagnostic techniques mentioned above are utterly important for understanding this state and for organizing the support for such babies.

Due to the fact that in many foreign countries jitteriness is not subject to medical treatment, the hopes for the early resolution of this state are connected with natural processes not needing medicamentous intervention. According to R. Pe Benito et al. [17], jitteriness vanishes during the first year of life and sometimes may be observed during the second year. In cases when other neurological signs are present, the outcomes may be associated with some neurological disorders and developmental deviations (first of all, with muscle hypertonia) [6; 17]. It is only the children in whom jitteriness is based on the pathological states described above that need special therapy.

It has been mentioned that the leading disorder among those forming jitteriness is the neonatal abstinence syndrome. This explains the reason why the staff of the specialized children's homes complain of the presence of the given disorder in 75% of children [1].

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