

Main Factors of a Decrease in Stress Resistance in Six- to Eight-Year-Old Children with Long-Term Consequences of Perinatal CNS Pathology during Transition to School Period of Their Activity

V. A. Ilyukhina*, N. Yu. Kozhushko*, Yu. K. Matveev*, and V. M. Shaitor**

**Institute of the Human Brain, Russian Academy of Sciences, ul. Akad. Pavlova 9, St. Petersburg, 197022 Russia*

***Medical Academy of Postgraduate Education, Russian Ministry of Public Health, St. Petersburg, Russia*

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Abstract—Central disorders that determine a decrease in stress resistance and compensatory-adaptive possibilities of six- to eight-year-old children with remote consequences of a perinatal hypoxic-ischemic CNS injury were comprehensively characterized on the basis of literature data and results of the complex psychophysiological and neurophysiological examination using complementary integral indices. The main factors responsible for constraints of adaptive possibilities of such children at a preschool age and aggravation of the central regulatory disorders during the transition to school period of their life were revealed.

Impairment of health, especially in technologically developed regions of the world, is a problem of high priority. According to the information of WHO, decrease in the level of health in children and young people, the main productive force of the XXI century, is of especial urgency. In this connection, when discussing problems of training and education of the rising generation it is practically impossible to ignore the general growth of the numbers of children with subclinical forms of pre- and perinatal CNS pathology.

Investigation of physiological backgrounds of poor tolerance of current mental and physical loads by children and young people resulted in a substantiated concept of the basic significance of pre- and perinatal disorders in the control of oxygen-dependent systems of energy supply in a decrease in stress resistance of an organism and restriction of compensatory-adaptive CNS possibilities [1, 2]. The literature data for exact perinatal injuries, which can be responsible for the development of oxygen-dependent hypoergy, bear witness to the advanced and developed concept. Among such injuries are late gestosis, intrauterine fetal hypoxia, intrauterine microinjuries of the brain that affect the development of brainstem structures and respiratory center, and subclinical forms of perinatal injuries of brain and cervical part of the vertebral column. The latter injuries subsequently lead to chronic cerebrovascular inferiority, including the gradual development of chronic insufficiency of cerebral and spinal circulation with respective disorders of adaptive behavior of the children [3, 4]. In cooperation with neonatologists, in our study of infants after intrauterine hypoxia or birth asphyxia, we demonstrated the role of these factors in disorders, first of all, of the brainstem control

of wakefulness and impairment of adaptive reactions in the early postnatal period closely associated with disorders of the central regulation of the oxygen-dependent of energy supply of organs and tissues [5, 6]. A.Yu. Ratner [3, 4] discovered the mechanisms of remote consequences of birth microinjuries of the cervical part of the vertebral column resulting in early development of chronic cerebrovascular insufficiency.

Analysis of the literature shows that the major part of examinations of children with perinatal hypoxic-ischemic CNS injuries was carried out at the early stages of ontogeny [3–10]. However, even at the minimal perinatal cerebral dysfunctions in newborns, early formation of the astheno-circulatory and astheno-neurotic symptom groups, light diffuse neurologic symptoms, moderate sensorimotor and speech disorders, perception disorders, increased distractibility, behavioral problems, immaturity of cognitive skills, and learning difficulties were observed at subsequent developmental stages (especially in the critical periods) [11–15].

Thus, the long-term studies proved that pre- and perinatal CNS disorders produce a decrease in compensatory-adaptive possibilities of children from the moment of birth and determine their poor tolerance of sociobiological information loads and any other stress stimuli in the following developmental periods [3–5, 15–20]. An increase in numbers of children with such kinds of disorders, especially, during transition from preschool to school periods, brings the threat of dysadaptation at early stages of social development of a child.

In the absence of manifest delays in motor and speech development, children with minimal brain dysfunction, as a rule, become a problem for teachers and parents only at their entering school. In this connection,

there are a lot of psychological–pedagogical studies of children's adaptation to school loads including formation of school skills [21–26].

It is known that the common procedure of determination of child's preparedness to school is basically restricted by the frames of psychological-pedagogical criteria (motivational, intellectual, and cognitive functions of a child), with the exception of cases of manifests developmental delays. However, the requirements of modern education make these criteria insufficient for neurobiological justification of school adaptation with the maintenance of mental and physical health under new conditions of vital activity, especially, in practice of early teaching of junior children.

In recent years, the number of clinical-psychological and neurophysiological investigations of minimal brain dysfunction in children with remote consequences of perinatal CNS pathology substantially increased [8, 9, 27–33]. The active search for neurophysiological and neuropsychological criteria of school dysadaptation in the first years of education is on [30–32, 34]. Age-related features of brain mechanisms of organization of cognitive processes and influence of functional maturity of the cortex on the cognitive activity of a child are studied with application of EEG and evoked potentials' techniques [33, 35–37].

Current clinical and neurobiological studies of children (including the junior ones) both in our country and abroad are largely focused on the attention deficit and hyperactivity phenomenon. The contribution of studies of other widely distributed manifestations of the minimal brain dysfunction (MBD), which are responsible for restrictions of compensatory-adaptive possibilities of children to everyday mental and physical loads (determined by psychological characteristics of tolerance and stability). Among such MBD manifestations are hypertensive-hydrocephalic and cerebral-asthenic syndromes, muscular dystonia etc. [29, 31, 38–43].

The present order of priorities in studying the minimal brain dysfunction and the role of this factor in the sociobiological dysadaptation of children may be considered as a stage of data accumulation, and the current views of early development of psychosomatic disorders in the remote period of perinatal lesions of the central nervous system in children (including those with mild CNS injuries more frequently of hypoxic-ischemic origin) are conflicting.

Thus, at the variety of modern medical, psychological, and psychophysiological methods of assessment of the state of health of children of different age groups, investigation of physiological backgrounds of a decrease in stress resistance in children with remote consequences of perinatal CNS pathology is among the burning and virtually undeveloped aspects of dysadaptation and early development of nervous and mental diseases.

The aim of this work was the study of physiological backgrounds of a decrease in sensory stability and con-

straints of compensatory-adaptive possibilities of six- to seven- and seven- to eight-year-old children with remote consequences of perinatal CNS pathology during transition from the preschool to school periods of vital activity.

METHODS

Results of complex psychophysiological and neurophysiological examination of 61 six- to eight-year-old children are presented in the work. Of them, 29 children (13 girls and 16 boys) aged six to seven were preschoolers and 32 children (14 girls and 18 boys) were pupils of the first form at the age of seven to eight years.

All the children were examined because of their parents' complaints of hyperactivity, restlessness, emotional lability, undue fatigability, sleep disorders (problems with falling asleep, interrupted sleep), and periodic headaches. Some children suffered from motor disorders (obsessive movements, tics) and speech and writing problems (dysarthria and dysgraphia). Half of the examined children in early ontogeny had a diagnosis of perinatal encephalopathy of hypoxic or mixed origin. In the remaining children, in the absence of this diagnosis, the following risk factors of pre- and perinatal cerebral insufficiency were present: the absence of the vagitus, cord entanglement round the neck, long duration of the dry labor stage, incomplete pregnancy, stimulation of delivery due to uterine inertia, cesarean section etc.

The children were examined in the daytime (from 13 to 16 hours). The first graders were examined in different periods of the academic year as complaints appeared or general state impaired. According to the aims of the study, it was important to specify the psychophysiological background of changes in the child's state in correlation with widening the scope of sociobiological loads in subjects whose the baseline state of health was decreased due to pre- or perinatal CNS lesion. Psychophysiological and neurophysiological examination was performed under comfortable conditions in daylight after the child's adaptation to situation and personnel. A child was sitting in a comfortable armchair.

To attain the aims of the study, we used a complex psychophysiological approach. Developing such an approach we were guided by the principles of complementarity and commensurability in the choice of the integral psychological and physiological indices, which would most comprehensively determine the informational and control functions of the CNS in regulation of wakefulness, stress resistance, and organization of adaptive behavior of children of different age groups [44].

With consideration for age-related features of the examined children, we used the index of anxiety and psychoautonomic index in Luscher's test as the integral psychological indicators of emotional state and set to active activity.

Superslow physiological processes (SPP) were used as a basic integral physiological index of the wakefulness level and psychoemotional stability. The SPP were recorded using a DC amplifier (Krasnodar, Russia) with input resistance of 100 M Ω . EVL-1-MZ liquid nonpolarizing Ag/AgCl electrodes [45] were used for SPP recording from the head and body surface (vertex—thenar). In the state of rest, a sign and value of a kind of SPP, millivolt-range steady potential (ω -potential (OP)) were measured after reaching the plateau. The presence and degree of psychoemotional instability and capability for spontaneous relaxation of children in psychoemotional tension, or, on the contrary, development of psychoemotional tension were judged from the difference between the initial and end values of the ω -potential ($\omega_i - \omega_e$) before reaching the plateau, time of reaching the plateau, and the character of dynamic changes in initial values of the ω -potential [46]. The amplitude, regularity, and stability of superslow potential oscillations (SPO) with the period $T = 2-4$ min recorded in the same lead were used as an indicator of spontaneous fluctuations of realized and unconscious mental processes. For analysis of spontaneous SPP dynamics in the resting state we used the technique developed by V.A. Ilyukhina *et al.* [46, 47] (classification of type features of changes in this index during ten-minute observation).

Stange's test in the form of a single deep breath with individually maximal voluntary breath holding was used for estimation of the state of regulation of oxygen-dependent systems of energy supply as a leading component of stress-reaction body systems. In accordance with the present views, the resistance to endogenous transitory hypoxia assessed by the duration of the voluntary threshold apnea (VTA) is an integral physiological index of regulation of central and peripheral links of oxygen-dependent systems of energy supply. I.B. Zabolotskikh [48] summarized the literature data and the results of his own studies of the latency, direction, and intensity of changes in the indices of central hemodynamics and gas homeostasis during Stange's test in healthy subjects and patients with different VTA durations. In cases of short (less than 34 s), moderately decreased (less than 55 s), long (60–90 s), and extremely long (more than 91–95 s) VTA, the regular differences were revealed in reactivity of the central and peripheral chemoreceptors, reactivity of baroreceptors of systemic and pulmonary circulation, hemodynamic shifts resulted from the level of reactivity of baroreceptors and peripheral chemoreceptors, and oxygenation of peripheral tissues.

The results of these studies justified the use of different VTA durations as the integral physiological markers of low, moderately decreased, high, and extremely high resistance to transitory hypoxia. Comparisons of VTA durations during Stange's tests with the indices of autonomic tone, physicochemical and energy homeostasis, peripheral oxygenation, external and tissue respiration, system hemodynamics, and

superslow physiological processes in the vertex—thenar lead determined physiological markers of different types of hypoergy in healthy subjects and patients characteristic of the state of fatigue at baseline normosthenia (instability of decreased VTA values), metabolic substrate-enzymatic hypoergy (VTA less than 34 s), hypoergy due to congenital or acquired hypokinetic type of circulation (VTA from 35 to 55 s), and hypermetabolic hypoergy (VTA longer than 91 s) [2, 18, 48, 49].

Commonly accepted indices of the autonomic tone (Kerdo's autonomic index (KAI)), central hemodynamics (systolic blood pressure and cardiac output), external respiration (respiration rate), and autonomic control of coordination between the cardiovascular and respiratory systems (Hildebrandt coefficient (HC)) were used for investigation of autonomic and hemodynamic mechanisms of the maintenance of wakefulness and mental activation in children with remote consequences of perinatal CNS pathology during their transition from the preschool to school periods of education.

The state of central hemodynamics was assessed by the integral rheoencephalographic (REG) indices of pulse volume (PV) and vascular reactivity of vertebralbasilar and carotid beds (head rotation tests and single deep breath). REG was recorded by means of a 4RG-2A impedance plethysmograph in symmetrical frontal-mastoidal and occipital-mastoidal leads.

For general estimation of the functional state of the CNS of the examined subjects, dysfunction of their median nonspecific brainstem structures, reactivity of their nervous processes, and signs of irritation and seizure readiness of the CNS, we used the standard multichannel bipolar EEG recording with the help of a Medico encephalograph. The functional state of the CNS and reactivity of the nervous processes were assessed by the common baseline EEG characteristics in the state of rest and during hyperventilation.

Results of the complex psychological, physiological, and neurophysiological investigations were compared with the data of anamnesis and clinical neurological examination. A software package ANBS-2 [50] for spectral analysis of biopotential dynamics realized at IBM AT-486 was used for analysis of neurophysiological processes of the brain in the ranges of EEG and SPO. A summary-statistics method with subsequent testing of between-group differences by Student's test (a Two-Sample Analysis program of STATGRAPHICS package, vers. 2.6, Microsoft Excel (vers. 7.0a) Windows 95, 1996 realized at Intel Pentium 166) was used for statistical analysis of the results.

RESULTS AND DISCUSSION

A strong decrease in resistance to transitory hypoxia was revealed in all examined preschoolers and schoolchildren with remote consequences of perinatal pathology, which was reflected in a sharp decrease in duration of voluntary threshold apnea (VTA) in Stange's test

Table 1. Characteristics of the wakefulness level and autonomic and hemodynamic mechanisms of its maintenance in preschoolers (the first group) and first graders (the second group) with remote consequences of perinatal CNS pathology and low resistance to transitory hypoxia

Characteristics of the functional state	The first group (<i>n</i> = 29)			The second group (<i>n</i> = 32)		
	<i>M</i> ± <i>m</i>	absolute number	%	<i>M</i> ± <i>m</i>	absolute number	%
I. Level of wakefulness (ω plateau, mV)						
low	-17.8 ± 2.3	2	7.1	-16.7 ± 0.1	2	6.3
moderately decreased	-23.8 ± 0.7	5	17.8	-24.0 ± 0.6	8	25.0
optimal	-33.4 ± 1.2	16	57.1	-32.0 ± 2.8	8	25.0
high	-47.1 ± 4.9	5	17.9	-47.1 ± 1.9	14	43.7
II. Psychoemotional instability ($\omega_1 - \omega_e$, mV)						
absent	3.5 ± 0.8	6	21.4	2.7 ± 2.5	12	37.5
moderately expressed						
a) relaxation	-13.1 ± 0.8	11	39.3	-13.3 ± 2.2	6	18.8
b) tension	–	–	–	11.0 ± 0.1	2	6.1
expressed						
a) relaxation	-26.0 ± 2.1	10	35.7	-24.5 ± 2.9	12	37.5
b) tension	30.0 ± 0.0	1	3.6	–	–	–
III. Autonomic Kerdo's index	10.2 ± 3.1	4	13.8	10.8 ± 4.8	10	31.2
	28.6 ± 3.4	25	86.2	31.0 ± 3.6	22	68.8
IV. Hildebrandt coefficient						
within normal range (2.8–4.9)	4.4 ± 0.2	5	17.3	4.3 ± 0.3	6	8.8
high	5.58 ± 0.4	24	88.7	5.64 ± 0.3	26	81.2
V. Minute volume of circulation, l/min						
low	2.31 ± 0.2	18	62.0	2.33 ± 0.6	12	37.5
within normal limits (3.2–4.4)	3.49 ± 0.21	9	31.0	3.67 ± 0.23	14	43.8
high	6.42 ± 0.58	2	7.0	6.7 ± 0.4	6	18.7

(18.7 ± 1.3 s). In accordance with the data of such kind, the decrease in VTA pointed to disorders of regulation of central and peripheral links of oxygen-dependent systems of energy supply, predominantly due to disorders of regulation of the respiration system, including tissue respiration (substrate-enzymatic hypoergy). A sharp decrease in resistance to transitory hypoxia in the examined children was revealed in behavioral manifestations of asthenic disorders (rapid physical and mental fatigability and a decrease in productivity and attention stability).

Table 1 summarizes the results of the complex psychophysiological studies of the wakefulness level and psychoemotional lability (characterized by ω potential (OP)), autonomic and hemodynamic mechanisms of maintenance of the wakefulness level in the examined preschoolers (six to seven years old, the first group) and first graders (seven to eight years old, the second group) with strongly decreased resistance to transitory hypoxia. In preschoolers with remote consequences of perinatal CNS pathology and low resistance to transi-

tory hypoxia, the optimal wakefulness level (OP equal to -33.4 ± 1.2 mV) was observed in 57.1% of cases. In 24.9% of the cases, the level of wakefulness was moderately (OP equal to -23.8 ± 0.7 mV) or sharply decreased (OP equal to -17.8 ± 2.3 mV). In five children of this group (17.9%), psychoemotional tension was revealed in the state of rest, which was reflected in a sharp increase in negativity of the ω potential (-47.1 ± 4.9 mV) (Table 1, I).

As seen from Table 1, the overwhelming majority (86.2%) of children of the first group had an impairment of suprasegmental autonomic regulation of functions with autonomic disorders by the sympathoadrenal type (KAI 28.6 ± 3.4), which is characteristic of sympathotonic asthenics with low resistance to transitory hypoxia [51]. The presence of autonomic dysfunction was confirmed by the imbalance of autonomic control of interaction between the cardiovascular and respiration systems (HC equal to 5.58 ± 0.4) revealed in 88.7% of children, whereas a decreased CO (to 2.31 ± 0.2 l/min) was observed in 62% of the examined preschoolers.

Moderately and strong expressed psychoemotional instability in the majority of children of this group (78.6%) as shown by SPP dynamics ($\omega_i - \omega_e$ was equal to -13.1 ± 0.8 and -26.0 ± 2.1 mV, respectively) objectively supplemented the evidence for psychoemotional disorders characteristic of neurosis-like state.

Thus, the optimal wakefulness level in 57.1% of examined preschoolers was maintained due to activation of ergotropic systems in the state of rest under conditions of impairment of its suprasedgmental autonomic regulation and dysfunction of the limbic-reticular structures.

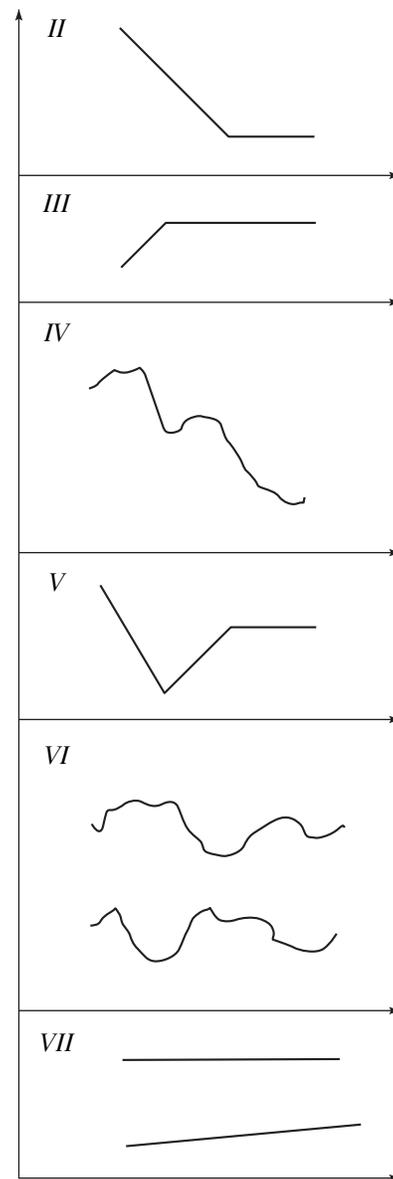
During transition to the school period of vital activity (the second group of children), there was a sharp (twofold) decrease in the number of children with the optimal level of wakefulness and the number of children with psychoemotional tension increased (43.7% of cases versus 17.9% of preschoolers). The number of children with decreased wakefulness level somewhat increased (31.3% of cases versus 24.9% of preschoolers). The earlier revealed autonomic vascular disorders retained in schoolchildren (Table 1, II).

Study of the type features of spontaneous dynamics of superslow physiological processes at rest allowed us to objectively describe the character of psychoemotional disorders in preschoolers and first graders with remote consequences of perinatal CNS pathology (see figure and Table 2). As seen from the table, the IV and VI types of spontaneous SPP dynamics prevailed in the group of preschoolers (in 50.0 and 21.4% of cases, respectively). In accordance with present knowledge, such spontaneous SPP dynamics at rest characterizes instability of the level of wakefulness and psychoemotional lability with manifest fluctuations of conscious and unconscious mental process [46, 52].

A clear-cut tendency for increase in the number of children with the VI type of spontaneous SPP dynamics in the state of rest (from 21.4 to 50.0%) characteristic of neuroses and neurosis-like disorders [46, 52–54] was observed during transition to the school period of vital activity.

Among the examined children of the first and second groups with remote consequences of perinatal CNS pathology of hypoxic-ischemic origin, a small subgroup of five subjects was revealed with the VII type of spontaneous SPP dynamics, which characterized a stable decrease or increase in the wakefulness level at the lack of response of stress-reactive systems under conditions of functional or stress load [47]. This type of SPP at rest and during loading has been found by us earlier in newborn children with chronic impairment of brain circulation [3]. It should be noted that the VII type of SPP revealed in preschoolers also persisted in them during transition to the school period of vital activity. The clinical manifestations of chronic cerebrovascular insufficiency in such cases could be poorly expressed.

The application of rheoencephalography and electroencephalography allowed us to obtain supplement-



Types (II–VII) of spontaneous dynamics of superslow physiological processes in the state of rest.

tary evidence about the extent of interplay of disorders of regulation of cerebral blood flow and changes in the CNS functional state in children of the first and second groups with remote consequences of hypoxic-ischemic perinatal pathology during transition from the preschool to school periods of vital activity [55, 56].

REG examinations showed that in the overwhelming majority of preschoolers (90.6%), the pulse volume ($A\Omega$) in the carotid bed was at the upper boundary of the normal range with the tendency to increase (0.26 ± 0.006). In these children, the precapillary vessel tone was moderately (83.5 ± 0.44 , 49.0% of cases) and sharply increased (97.1 ± 0.85 , 21.8% of cases).

Table 2. Features of distribution of the types of spontaneous dynamics of superslow physiological processes (SPP) in the state of rest in preschoolers (the first group) and first graders (the second group) with remote consequences of perinatal CNS pathology

SPP type (see figure)	Physiological significance, reference	The first group		The second group	
		<i>(n = 28)</i>		<i>(n = 32)</i>	
		absolute number	%	absolute number	%
II	Psychoemotional instability, delayed spontaneous relaxation at the low wakefulness level [46, 47, 54]	2	7.1	1	3.1
III	Psychoemotional instability with development of emotional tension [46, 47, 54]	1	3.6	–	–
IV	Decrease and instability of the wakefulness level, psychoemotional lability with fluctuations of conscious and unconscious mental processes [46, 47, 52, 54]	14	50.0	8	25.0
V	Phasic character of the dynamics of the wakefulness level with development of psychoemotional tension [54]	–	–	2	6.2
VI	Manifest fluctuations of conscious and unconscious mental processes at the low and high wakefulness levels characteristic of neuroses and neurosis-like states [46, 47, 52, 54]	6	21.4	16	50.0
VII	Steadily decreased or increased wakefulness level at the absence of reaction to stress load [3, 47]	5	17.9	5	15.7

A moderate decrease (0.15 ± 0.04) in the pulse volume in the vertebrobasilar bed (VBB) was found in half of the preschoolers. In individual cases, this index of cerebral blood flow in the VBB was sharply decreased (0.10 ± 0.006). Increase in the tone of precapillary vessels of the VBB was revealed in the majority of children of this group. A moderate increase in the tone (83.0 ± 0.45) was observed in 52.1% of these children. Moderately expressed vertebrogenic influences of a compressive character were observed in half of the examined preschoolers, which was reflected in a decrease in the VBB pulse volume in response to head rotation to the point of 40% of the initial values.

Thus, the REG examinations revealed a deficiency of cerebral hemodynamics due to a decrease in pulse volume in the VBB and compressive vertebrogenic influences in half of the examined preschoolers with remote consequences of perinatal CNS pathology. At tendency to an increase in pulse volume in the carotid bed, increase in the precapillary vessel tone was observed in the overwhelming majority of these children. The above listed changes in cerebral hemodynamics and metabolic hypoergy persisted in the first graders. Among them, additionally, the number of children with a weak reaction (if any) of precapillary vessels of the carotid bed to a functional load increased (from 16 to 25%).

Features of disorders of cerebral circulation in the VBB correlated with the changes in the brain functional state demonstrated by the EEG examination (Table 3). As seen from the table, deviations in the dynamics of resting bioelectric activity from its normal age-related characteristics were found in a half of the examined preschoolers. Different manifestations of instability of

the CNS functional state with a pronounced dysfunction of the median nonspecific brainstem structures were observed in 32.6% of cases. The functional state of the CNS was decreased in 19.6% of the examined preschoolers. In virtually all examined children of this age the reactivity of the nervous processes during hyperventilation was changed. This was manifested by appearance or enhancement of long-latency polymorphous paroxysmal bioelectric activity in 65.2% of the preschoolers. Under the same conditions, short-latency generalized or focal paroxysms of epileptiform activity appeared in 34.8% of cases. The observed changes in brain bioelectric activity during the functional load with hypercapnic and hypoxic components, on the one hand, unraveled the nature of a dysfunction of the brainstem structures and cortical-subcortical disorders of hypoxic origin. On the other hand, the features of changes in brain electrical activity during hyperventilation and respiration delay in this children contingent served an additional confirmation of disorders of regulation of oxygen-dependent systems of energy supply reflected in a sharp decrease in resistance to transitory hypoxia (VTA equal to 18.7 ± 1.3 s) pointing to the presence of substrate-enzymatic hypoergy [57].

In half of the examined preschoolers such kind of disorders of regulation of oxygen-dependent energy supply systems at the level of tissue respiration were combined with deficiency of cerebral hemodynamics, predominantly, in the vertebrobasilar bed (with the presence of compressive vertebrogenic influences). Disorders in regulation of the oxygen-dependent energy supply systems determined pathological changes in reactivity of the nervous processes reflected in signs of increased seizure readiness during the func-

Table 3. Features of changes in the functional state of the brain and reactivity of the nervous processes in preschoolers (the first group) and first graders (the second group) with remote consequences of perinatal CNS pathology by the results of EEG study

Functional state of the CNS and reactivity of the nervous processes	The first group (n = 46)		The second group (n = 34)	
	absolute number	%	absolute number	%
I. The state of rest (eyes closed)				
decrease in the functional state (a variant of low-amplitude EEG)	9	19.6	9	26.5
normal age variant with correct spatial distribution of the basic rhythm	22	47.8	19	55.9
instability of the functional state with a dysfunction of median brainstem structures of different severities	15	32.6	6	17.6
II. Reaction to hyperventilation				
appearance or enhancement of long-latency polymorphous paroxysmal bioelectric activity	30	65.2	30	88.2
appearance of short-latency generalized and/or focal paroxysms of epileptiform activity	16	34.8	4	11.8

Table 4. Characteristics of psychological set to activity in preschoolers (the first group) and first graders (the second group) with remote consequences of perinatal CNS pathology

Psychological set to activity	Psychoautonomic index (score)	The first group (n = 27)		The second group (n = 28)	
		absolute number	%	absolute number	%
Overexcitation	>1.5	6	22.3	2	7.1
Set to efficient activity	1.0–1.5	10	37.0	4	14.3
Set to minimization of efforts (self-preservation)	<1.0	11	40.7	22	78.6

tional load with hypercapnic and hypoxic components (hyperventilation test).

Impairment of compensatory-adaptive mechanisms and decrease in stress resistance in preschoolers with pre- and perinatal disorders of regulation of the oxygen-dependent energy supply systems were manifested at the behavioral level by the features of psychological set to activity (Table 4).

Psychoautonomic index in Luscher's test pointed to the set to minimization of efforts in 40.7% of the examined preschoolers. Overexcitation with increased anxiety was revealed in the same contingent of children in 22.3% in cases. A set for efficient activity was revealed only in 37% of examined preschoolers.

During transition to the school period, in the same contingent of examined first graders with remote consequences of perinatal CNS pathology the number of children with the set to minimization of efforts almost doubled (78.6% versus 40.7% in preschoolers), the number of children with the set to minimization of efforts increased (Table 4).

As follows from the obtained evidence, such changes in psychological set can be underlain by the following group of factors.

(1) Deepening of oxygen-dependent hypoergy due to increase in the number of children (from 16.0 to 25.0%) with disorders of cerebral blood flow in the form of a reduction or disappearance of reactions of precapillary vessels of the carotid bed during functional load against the background of persisting metabolic hypoergy.

(2) Substantial growth of the number of children with disorders of the central mechanisms of wakefulness and emotion control. Psychoemotional tension was revealed in 43.7% of first graders (versus 17.9% of preschoolers). Decrease in the wakefulness level was observed in 31.3% of the first graders (versus 24.9% in the preschoolers).

(3) Substantial increase (twofold) in the number of children with disorders of the central mechanisms of emotional control with development of emotional disorders at the neurotic level (the VI type of the SPP was found in 50% of the first graders as compared to 21.4% in the preschoolers).

CONCLUSION

Summarizing the results of the complex psychophysiological and neurophysiological examination made it possible to determine supplementary integral

psychological and physiological characteristics, which most comprehensively show the disorders in the informational and control CNS functions in regulation of the level of wakefulness and emotional behavior as well as in decrease in stress resistance and compensatory-adaptive possibilities in six- to seven-year-old and seven- to eight-year-old children with remote consequences of perinatal CNS pathology of the hypoxic-ischemic origin. The main factors were revealed that determine the limitations of adaptive possibilities of this contingent of children at the preschool age and deepen the central regulatory disorders during transition to school period of vital activity.

The main factors responsible for a decrease in stress resistance in six- to seven-year-old children with remote consequences of perinatal CNS lesion were shown to be the following.

(1) Disorders in regulation of central and peripheral links of oxygen-dependent energy supply systems with predominant involvement of the respiratory system into the pathological process, including tissue respiration (substrate-enzymatic hypoergy). This was reflected in a sharp decrease in the VTA in Stange's test (18.7 ± 1.3 s) in all the examined children.

(2) Deficiency of the central mechanisms of circulation control. This was reflected in a decrease in the minute circulation volume (in 62.0% of cases) and deficiency of cerebral circulation, predominantly in the vertebrobasilar bed (in 50.0% of cases).

(3) Inferiority or disorder of suprasedgmental compensatory mechanisms of autonomic regulation of functions. In the overwhelming majority of children (88.7%) this was manifested in circulatory dystonia of sympathoadrenal type with a disturbed balance of autonomic regulation of interaction between the respiratory and cardiovascular systems (Hildebrandt coefficient higher than 5.0).

(4) Dysfunction of the median nonspecific brainstem and limbicorecticular structures as a basis of instability of the wakefulness level with a change in reactivity of nervous processes and psychoemotional lability in 75.0% of the examined preschoolers.

During transition from the preschool to school periods of vital activity (the first form), results of psychological testing of the examined contingent and study of superslow physiological processes revealed a substantial increase in the number of children with psychoemotional tension (43.7% versus 17.9% in preschoolers) as well as with disorders of reactivity of the nervous processes during the functional load of hyperventilation (from 65.2% in the preschoolers to 88.2% of cases in the first graders) (Table 3).

At the behavioral level, among the first graders there was a substantial increase (twofold) in the number of children with the set to minimization of efforts and refusal from activity under conditions of increased sociobiological requirements due to the transition to the school period of vital activity.

The results of the study are of great scientific and practical importance and can be implemented in physiological justification of the optimization of educational programs and preparation for the critical periods of child's development (transition from the preschool and school periods) in children with remote consequences of perinatal CNS pathology, in development of approaches to increasing the efficiency of performance of learning programs with account for the individual topological features of a decrease in the health level and stress resistance in children with remote consequences of perinatal CNS pathology, for detection of groups of risk of early development of nervous and mental diseases and its appropriate prophylaxis, thus decreasing expenses for keeping invalids and patients with chronic diseases of the nervous system.

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