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The Issue of Mental and Motor Disturbances and Correction thereof in Children with Infantile Cerebral Paralysis and Moderate Mental Retardation

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Abstract

Correction of the condition of children with infantile cerebral paralysis and moderately expressed mental retardation is a serious problem of modern recreation therapy. The goal of this article is to analyze the available information on the most important aspects of mental and motor disturbances in children with infantile cerebral paralysis and moderate mental retardation and to summarize the information on the most effective approaches for the compensation of such disturbances. The work contains information on primary mental and physical problems of mentally challenged children with infantile cerebral paralysis who require active compensation for the arrangement of conditions for the maximum possible health improvement and introduction of such children into the society. The articles deals with main approaches to the correction of psychomotor defects in case of infantile cerebral paralysis which proved to be effective in practice and which can be taken in case of moderate mental retardation. After the analysis of the available information on the problem, it becomes clear that there is still a need for additional development of options for the complex correction of existing disturbances in this category of children. Further development of new methods and the refinement of existing ones can result in the improvement of their health which should ensure the greater degree of their integration into society.

Keywords: Children; Infantile Cerebral Paralysis; Mental Retardation; Mental Disorders; Motor Disturbances; Physical Rehabilitation

Abbreviation: ICP: infantile cerebral paralysis

Introduction

Despite the serious progress of medicine, infantile cerebral paralysis (ICP) still remains a very common disease that occurs as a result of brain damage in prenatal, intra natal, and early postnatal periods [1,2]. In Russia, the prevalence of the ICP is still rather high: 1,6-6,0 cases per 1,000 full term infants, 9-24 per 1,000 premature infants with a body weight of 1,000-2,500 g and 18-40 per 1,000 infants with a body weight less than

1,000 g. Spastic diplegia is the most common form of the ICP [3]. In case of spastic diplegia, lower limbs are significantly affected, and the degree of damage to arms may vary from evident palsy to slight in-coordination of movements. Spastic hemiplegia, hyperkinetic form and atonic/astatic form of infantile cerebral paralysis are also rather common. Mixed forms which are characterized by the combination of two and more aforementioned forms are less common. The dynamics of neurological Manuscript Click here to download Manuscript 1.docx 2 syndromes in this case is explained by the fact that with age, the earlier defect becomes more apparent [4]. A rather serious form of the ICP is its combination with mental retardation in various degrees which is connected with the morphological damage of the cortex cerebri and basal nuclei. This combination of pathologies begins to manifest itself at a rather early age [5,6].

Such children go to specialized kindergartens for kids with mental disorders at pre-school age and at specialized (correctional) schools the age of 7-8 years. Children who have such pathology are able to learn communication skills, reading and writing, social skills, and counting. They can process some information about the world around [7]. On leaving school, such boys and girls can live in a family, are able to perform service work and work that does not require special skills. They are good at the agricultural labor [8,9]. Modern recreation therapy treats children with the ICP who have moderate signs of mental retardation with great attention [10]. In case brain damage is unexpressed, elaborate rehabilitation options sometimes make it possible to achieve significant improvement of their condition and provide wider opportunities for their socialization and employment in the future [11,12]. In view of the timeliness of this problem, our goal is to analyze the available information on the most important aspects of mental and motor disturbances in children with the ICP and moderate mental retardation and summarize the insights into the most effective approaches to the compensation of such conditions.

Psychophysical Development Children with Infantile Cerebral Paralysis and Mental Retardation

The following is characteristic of children with the ICP and mental retardation: persistent impairment of cognitive activity which is expressed in the absence of interest in studies, sluggishness, poor concentration, defective memory, low intellectual work capacity and concentration of attention and thinking [13]. Besides, the speed and scope of perceived information is also decreased which dramatically increases the terms during which they learn new motor actions. Difficulties with the perception of time and space bar them from feeling confident in the world around. The underdevelopment of the speech activity causes a pronounced delay in understanding speech that is addressed to them. The reason for these manifestations is the dissociation between the first and the second signaling systems. The memory of such children is poorly developed. They are distinguished by the low level of memorizing, keeping, and reproduction of information [14]. Attention of such children is very unstable. It is hard for them to divide and shift it. Weakening of volitional processes is characteristic of children with the ICP.

They are quite wanting in initiative and cannot control their activities. The underdevelopment of the emotional sphere is expressed in them as the lack of emotional undertones, mood swings, weakness of intentions, and constriction. Such children demonstrate the expressed emotional instability and immaturity, difficulties in understanding facial expressions and expressive movements. The quick change of the expressed emotional torpor and hyper excitability are observable [15]. The physical development, moving abilities, educability, and adaptability to exercise stress in case of the ICP depend, to a large extent, on the severity of an intellectual defect, secondary diseases, and secondary disorders, peculiarities of mental and emotional-volitional sphere of children [13]. Motor deficiency in children with moderate mental retardation with the ICP is found in 90-100% of cases. In adolescence, it is challenging for them to take and hold certain postures, distribute their efforts, and shift to other types of physical activities [16]. In case of the ICP, disturbances of physical development are almost always observed. They are manifested by the insufficient mass and length of body, postural abnormalities, development of chest and feet, paresis of limbs, skull deformities, and facial skeleton anomalies. The intensity of the physical developmental delay in mentally challenged children with the ICP and the degree of adaptation to physical exercise depend not only on the injury of the central nervous system but also are the result of forced hypokinesia. The restriction of motor activity hampers the natural development of a child, causing a chain of negative reactions in the system: the resistance to cold-related and virulent 3 diseases becomes weakened, the weak, untrained heart is formed, and obesity reduces the physical activity even further [17].

In the case of children with moderate mental retardation and ICP, rapid nervous breakdown, especially in the course of executing monotonous work, increasing fatigue, decreased performance, and less endurance are noticed. In many cases, there are disorders in cardiovascular, respiratory, endocrine systems, internal organs, eyes, ears, congenital structural abnormalities of teeth and occlusion, congenital dislocation of hips, as well as multiple comorbidities [18]. With the increase of years, the existing brain disorders in children with the ICP and mental retardation may be imposed on age-related changes and increase dramatically. Without relevant correction, it may lead to a complete social alienation [19]. Therefore, a number of mental and physical issues are observed in mentally challenged children with the ICP. They require active compensation for the arrangement of conditions for the maximum possible health improvement and integration of such children into the society.

Motor Disturbances in Case of Infantile Cerebral Paralysis

Motor disturbances in case of the ICP manifest themselves in children as palsy, paralysis, and compulsory movements. Complex disorders of tonus regulation that are classified by the type of spasticity, stiffness, dystonia, and hypotension are often found. The hypertonicity of certain muscles caused the forming of wrong postures in cases of the ICP. Frequent bringing together of shoulders is caused by the hypersthenia of the greater pectoral muscle; lifting of shoulder girdles is formed due to the hypersthenia of the trapezius muscle. The propensity for over flexion in shoulder and elbow joints is caused by the excessive stress of the biceps muscle of arm, and the hypersthenia of round and quadrate pronator muscles results in the pronation fixation of the antebrachium. The flexion fixation of the body and femora in children with the ICP is possible owing to the chronic tension of the iliopsoas muscle, and the excessive strain of the gastrocnemius and soleus muscles forms the flexion fixation of the shank.

The restriction of the shoulder retraction and extension is related to the weakening of the middle and rear parts of the deltoid muscle. Postural disorder provides for the weakness of back extensors in the thoracic spine, most frequently forming kyphoscoliosis and kyphosis. Protrusion of stomach, epigastric hernia, and umbilical and groin hernia can be caused by the weakening of abdominal muscles [13]. The weakening of lower shoulder blade stabilizers has an adverse effect on the development of motions in upper extremities. At the same time, shoulder blades are shifted laterally upward and become “pterygoid.” The ventral gluteal muscle and gluteus minimus muscle get weaker, which results in the normal gait disturbance and makes the pelvis excessively motional [20]. Longitudinal and transverse platypodia, as well as planovalgus deformity which are characteristic of the ICP is caused by the weakening of muscles of longitudinal and transverse arches of foot. Because of this, resting on the fore part of the foot clearly disturbs the stability of gait. Under such circumstances, there is no front push, and the rear one is weakened, and the ligamentous apparatus of foot arches becomes stretched [4]. As early as at the age of two-three years, a child with ICP develops a consistent pathological synergism and wrong postures. Hyperkinesis, namely, involuntary compulsory movements appear in case of the hyperkinetic form of the ICP.

They are made at rest and in one’s sleep, but they gain momentum in case of emotional or physical tension, fatigue, and attempt to make a movement. Hyperkinesis may manifest itself in the muscles of limbs, body, neck, tongue, and face. In case of the atonic/astatic form of the ICP, shivering is also possible, especially finger and tongue tremor. Ataxia is rather frequent, i.e. the disturbance of equilibrium and coordination under static and dynamic conditions. All forms of the ICP are characterized by the abnormality of proprioceptive regulation which often complicates the generation of conditioned reflex connections. Children with cerebral paralysis have abnormal posture sense, and their perception of direction gets distorted. Movements are often repetitious and stereotypical. The delay in forming of finely coordinated movements is distinctive. 4 Because of this, such children’s space orientation is impaired. It is hard for a child to perceive and memorize such notions as “to the right,” “to the left,” “above,” “below,” “far,” “close,” etc. [21].

The appearance of secondary disturbances is related to the inability of a child with the ICP to move, maintain a stable posture, and change the posture during the day [22]. In the development of secondary disorders, the decompensation mechanism plays a large role: up to a certain point, the tissues resist the inadequate external influence, but then the possibilities of compensation become exhausted, and complications arise. The appearance of secondary disturbances significantly deteriorates the child’s quality of life and nursing process [8,23]. Therefore, the development of motor disturbances in case of the ICP is rather versatile and mandatory

manifestation of this condition which forms the basis for the clinical implications of this pathology.

Approaches to Physical Rehabilitation in Case of Infantile Cerebral Paralysis

The expressiveness of the ICP manifestations and their detrimental effect on the adaptation of a child in the society necessitates the continuing research, improvement, and active application of various methods of correction of this condition [24]. At present, different methods of the ICP correction are developed, inter alia, in case of mental retardation, which proved their effectiveness under various conditions of this pathology [25, 26]. Let us consider some of them.

Method of Bertha and Karl Bobaths: This method became a frequent practice in Europe from 1940-1950-s. It provides for the correction of functions of various body systems. The basic essentials of the method are as follows:

1. Ontogenetic approach to the treatment on the basis of the main stages of the motor development of a child.
2. Reflex-prohibiting postures: the use of such postures and positions of various parts of the body which inhibit the pathological tonic reflexes.
3. Focus on the quality of movement.
4. Techniques of suppression of involuntary movements and facilitation of motion performance are used to stimulate the neurophysiological service of the motorial sphere.
5. Teamwork with a child.
6. Rehabilitation must be functional for the adaptation of a child to life. Within the framework of Bobath-therapy, it is necessary to choose key points to learn functional movement.

At the same time, mechanical fixation of various body parts is used, but the appliances must not restrict the child's movements. It is important to fix the proximal areas and ensure larger scope of movements in distal parts of limbs [27].

Vojta Therapy Method: It was developed by Czech neurologist Václav Vojta in the 1950-1970-s. This method is based on reflex locomotion [28]. This means that the reflexes that cause motion in various parts of the child's body create elementary patterns of locomotion, which are used for health improvement. In different positions, targeted pressure is applied to certain areas, which results in patient's involuntary reflex actions. In the same way the automatic control of equilibrium, strengthening of the body against the force of gravity, and purposeful prehensile and step movements of limbs are achieved. In Vojta therapy, movements are mostly made in the diagonal direction with the right leg and the left hand or vice versa. This method focuses on the activation of the natural innate abilities of a child, not the training of various skills.

PNF Method (proprioceptive neuromuscular facilitation): It was developed by Herman Kabat in 1940-1950-s. It is related to neurodevelopment physical rehabilitation methods [29]. The author of the method considers that movements which result in muscle extension are the most efficient for children with the ICP. With this purpose, he uses the spiral and diagonal techniques. His method focuses on exercises which cause active muscular contraction and excites the maximum number of motor units with involvement thereof into will activity for the afferent recovery of functions and muscle power. This method can be defined as the method of strengthening the volitional muscular contraption by 5 means of stimulating proprioceptive sensory endings. The application of this method creates repeated excitement through the neural pathway, gradually easing neuromuscular conductivity.

Method of dynamic proprioceptive correction: It was developed in the 1970-s. At first, it was considered as a tool for preventing the adverse effect of weightlessness on astronauts [15].

This method activated the antagonistic muscles in body and limbs which did work against gravity. Later, after the adaptation of astronaut's spacesuits to children with the ICP, Adeli and Gravistat overalls were developed. Their effectiveness is based on the proven interrelation between the reactions of vegetative systems and the nature of actively supported and passive postures of humans in space (motor visceral reflexes). In this method of rehabilitation of children with the ICP, the appropriateness of the load is of considerable importance, which is produced by force by the overalls system if the distribution of the power load vector with due regard to the formed pathological movement pattern is correct. It is well established that the use of this method causes the increase of metabolism, increases the cardiac rate, intensifies the lung ventilation and increases the bone density. Besides, Adeli and Gravistat overalls correct the proprioceptive inflow and stimulate the disturbed structures which control movements.

Method of N.A. Gross: It was proposed in the 1920-s and involves the use of a special simulator which allows children with the ICP single-handedly remain upright, move, and do various physical exercises. The simulator can be installed in any room. It consists of a tensioned cable with a movable block, a lever and carbine mechanism, elastic retainers, safety belt and hand rings. The exercises are done in different initial positions (seated, upright, in lying position), which makes it possible to make movements and jumps, as well as use various exercise machines.

The method of Gross is highly emotional, original and efficient. The simulator can be used in rehabilitation centers, specialized institutions, and at home [29].

Method for the rehabilitation of spastic forms of the ICP "ball-trampoline-expansion": It was developed in the early 2000-s. The method is based on the relaxation of spastic muscles for the normal muscular tone, forming of vertical orientation, and training of balance. Rocking in the fetal position or on fit balls, trampoline or swinging platform in the course of local relaxation of muscles due to special massage techniques aids the general relaxation of muscles of a child with the ICP [30]. The essence of the method is that an incompletely inflated ball with the diameter of 120 cm has the trampoline effect. In the course of rocking on such ball up and down, a child develops responses which exercise a training effect on the vestibular apparatus and cause relaxation. The trampoline effect is increased by stretching exercises performed to restore reciprocal relations in body and limb joints.

Hippo therapy method: It was developed at the beginning of the 1950-s in Germany and Scandinavian countries and then improved in Great Britain, Canada, Poland, Switzerland, and France. The basics of the therapeutic action of riding are in the natural movements of horses which allow a rider to organize and systematize his movements [31]. On horseback, almost all groups of muscles kick into gear, and the muscular tone becomes regulated. If a rider sits properly, the most spastic muscles of femora and shanks relax. The net thermal effect of the horseback also promotes the relaxation of muscles of femora and buttocks. Riding decreases the amplitude and number of hyperkineses and improves the coordination of movements. Movements of the back of a horse that walks form rider's normal sensomotor stereotypes of standard bipedal locomotion. Besides, riding develops orientation and body feeling in space, naturally influencing both hemispheres.

It is proved that none of the sports equipment gives such a strong motivation for training as hippo therapy. Children with the ICP gain confidence and get an opportunity to master complicated precise movements. Thus, the scheme of their bodies is clearly formed.

Hydro-Rehabilitation method: The hydro-rehabilitation method centers around swimming for medicinal purposes [32,33]. The effectiveness of the method is based on children's strong interest in swimming and the relevant bright emotional coloring. This method is widely used for the correction of motor disturbances in cases of 6 ICP. Such training is advisable to patients with all forms of ICP of varying severity. The temperature of the air in the pool should be at least 23-25°C, and the temperature of water should be 30-32°C. It is recommendable to provide training activities within 30-40 minutes. One course should consist of 15- 20 procedures. Breaks should be taken between courses. Positive effects are achieved if the method is used for a long time. Therefore, there are many various methods for the correction of condition of children with the ICP, including those with mental retardation.

Conclusion

At the same time, the need to achieve the complete correction of psychomotor defects in cases of ICP and moderate mental retardation dictates the need for continuing scientific research in this direction. At present, such research is being conducted, and one can safely say that its results will enrich the rehabilitation practice in the nearest future. Infantile cerebral paralysis is still one of the most complicated medicinal problems in the whole world. Its prevalence in the structure of children's chronic diseases is still rather high. In this regard, the issue of the rehabilitation of children with the cerebral paralysis remains to be topical for the modern recreation therapy. At the same time, particular attention should be given to the category of children with the ICP and mental retardation. At present, the scientific and methodological support of the rehabilitation of such children is still insufficient. At the same time, it is clear that their rehabilitation must be of complex nature. New tools and methods of the correction of motor disturbances must be developed. In this regard, various types of physical activities are rather promising, inter alia, with the use of special simulators. Further development of new methods and improvement of the existing ones are required for more complete correction of motor disturbances.

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