NUTRITIONAL SUPPORT OF PALLIATIVE CHILDREN WITH SERIOUS NUTRITION DEFICIT

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Children with severe injury of nervous system compose high risk group on nutrition deficit. The purpose of the study is to assess the degree of nutrition deficit, calculate its actual requirement in enteric substrate and organization of adequate feeding. Indices of Broke 2, Pine, Z-score were used for determination of nutrition insufficiency degree. Physiological and actual requirements were defined by Schofield (WÍ) equation. Broke 2 index accounted for 40 %, BWI – 9.18, Z-score for BW on age – "-"6, for height on age – "-"12, for BW on height – "-3.5", which attested about extreme degree of nutritive insufficient (cachexia) and significant delay in physical development. High requirements in energy and low tolerance for necessary volume of feeding determine the administration of specialized isocaloric clinical product. **Conclusion.** Employment of simple standardized indices allows to determine the degree of nutrition deficit in palliative children. The definition of actual, instead physiological, requirements and administration of special clinical products permits to provide adequate nutrition in spite of low tolerance for high volume of feeding.

Keywords: children, palliative care, nutrition's deficit, clinical feeding, polymeric enteral products.

Introduction. The development of medical technologies and an increase in survival rate of children with critical anomalies or illnesses during recent years have led to an increase in the proportion of children who are in need of a complete palliative care system, including a range of nutritional support. It is this category of children where a high incidence of nutritional deficiency is observed, whereas malnutrition of alimentary origin among other children's population, changes its structure and decreases its frequency [1].

Due to the presence of severe chronic diseases that contribute to the inappropriate delivery of substratum substances, and cause an increase in the needs of certain constituents of the enteric substrate depending on the type of pathological condition in the child, significant quantitative and qualitative deficiencies of nutrients in such children can be expected. Insufficiency of feeding and its imbalance in children of the palliative group leads to changes in body composition, which is determined by the total content of fat and lean mass (muscle, visceral structures, bone tissue) [2, 3]. Determination of the body composition component is a complex and expensive method for assessing nutrition that requires certain equipment and staff and is not usually performed in clinical practice.

Close attention to the insufficiency of feeding and nutritional deficiency is due to the development of stress in each functional system of the organism, triggering an increase in cortisol production and augmentation in the correlation of cortisol/insulin [4]. The intensification of catabolism under these conditions is deepened by a decrease in synthesis of growth factors and hormones of the thyroid gland. The main priority of the body is the provision of a substrate (glucose) into the brain tissue which causes starvation of other tissues, impaired insulin-dependent tissue growth, weight loss and deceleration of linear growth, deep disorders of the function of organs and systems, immunity. Severe malnutrition leads to a decrease in the rate of physical development, physiometric disorders, thus much more

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complicating the intake of the disease and affecting functional systems of the body [2, 4, 5].

A separate problem is the provision of necessary nutrients to orphans at child welfare institutions. Lack of nutritionists, adequate financing of the costs on the corresponding food substrates, insufficiency of staff of the facilities of orphanages causes a high frequency of severe forms of nutritional deficiency in children not only of the palliative group, but also of those with uncritical chronic somatic morbidity.

Particular group is assembled of children with pathology, which leads to severe damage of nervous system. Disturbances in nutrition in mentioned above children are combined, both due to the nutritional factor, and as a result of violation of the assimilation of macro- and micronutrients and the increased need for them [6, 7]. The term malnutrition is used to characterize the nutritional status of such children, which is wider than protein-energy deficiency.

The assessment of the child's nutrition and calculation of his needs, taking into account the lack of growth, is the key to the organization of nutrition for palliative children [8, 9]. Most common methods of diet calculation or a simple "empirical" approach (will eat or not, will tolerate or not) cannot be the basis for the organization of catering for children with diseases of the nervous system, although, unfortunately, is the reality of most orphanages.

The aim of the study is the evaluation of the degree of nutritive deficiency in palliative group children, calculation of necessary enteric substrates and organization of catering.

The study was approved by the human research ethics committees of the participating hospitals, and informed consent was obtained for infants. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Materials and methods. The study involved the employment of anthropometric method of diagnosing the degree of protein-energy insufficiency with the definition of the percentage of body weight deficiency, indices of physical development in children with severe congenital pathology.

Several indices recommended by the WHO for physical growth were used to determine the degree of nutritional deficiency [3, 4]. Brock 2 index is the determination of the degree of hypotrophy or obesity as a percentage relative to the average values in the population according to the formula 100 x MT (kg) / M (kg), where MT is the child's body weight, M is the average body weight of children of the corresponding sex and age. The Piney Index is an index of proportionality between the indices, which is determined by the formula P – (O + M), where P is height, M is the body weight, O is the circumference of the chest, the fluctuations around 20 are normal values. The assessment of the physical development indices for the Z-score, which is accepted as the most accurate by using the median of the reference population, and is calculated by the following formula: individual value – median value / value of the average reference population, is the most commonly used. Recent years working groups of the WHO nutrition experts recommended using the body mass index (BMI) or Kettle index, which is determined by the formula: body weight (kg) / height (m) in the square. The standard value of the BMI is 19.5 – 22.9 kg/m2).

Apart from calculation of indices of physical development we evaluated clinical signs of nutritional deficiency.

The second phase of the child's examination was to determine the actual energy and protein consumption, and calculate the energy requirements of the WHO, Schofield (W) and Schofield (WN) equations [4,10]. We also calculated the child's physiological needs and actual needs according to additional correction coefficients: factor of activity, thermal factor, body weight deficit, factor of damage. The calculation of basal metabolism was adjusted according to the introduced coefficients [5].

The next step was to identify food and to develop a plan for administering the enteric substrate to monitor food tolerance, clinical signs and anthropometric indices, as well as working out recommendations for the child after discharge from the hospital.

Results and its discussion.

A boy I., at the age of 1 year 2 months weighs 4 kg, height 66 cm, entered the hospital from an orphanage due to acute lower respiratory tract disease secondary to chronic aspiration syndrome. A child was born preterm at 36 weeks, with body weight of 1920 g, height of 46 cm, with asymmetric form of the 3^{rd} degree intrauterine growth retardation syndrome with multiple congenital malformations of the bone and muscular system. At present, the main diagnosis of the child is microcephaly, spastic tetraparesis, Larsen syndrome, neurotrophic syndrome. At the age of 4.5 months he entered the orphanage. From the 5^{th} month of life up to the present condition he had six cases of acute respiratory infection (ARI) with complicated intake. He is fed every two hours through a catheter, a semi-customized milk formula with conventional feed additives appropriate for his age. He tolerates small capacity of food, up to 60–80 ml. Between feedings the child is not calm, periodically cries. The sleep is not deep, with the changed formula, difficulty in falling asleep. An increase in body weight over the last six months is 250 g.

Establishment of the degree of body weight and height deficiency. The assessment of the child's physical development was difficult due to the extremely small body weight (more than 4 δ) and large deformations of the joints and bones that influenced the accuracy of the measurement of growth and required segment measurement, taking into account combined muscle contractions and spasticity [11].

Brock 2 index was 40 %, BMI 9.18. The Z-score for body weight for the age representing acute nutritional deficiency was "-" 6, a Z-score for the growth for the age that indicated long-term growth retardation secondary to chronic nutritional deficiency, was "-" 12. The Z-score for body weight on body length, evaluating the harmony of the child's development, and proving acute fasting, was "-3.5". The obtained data confirmed extreme degree of nutritional insufficiency (cachexia) and a significant retardation in physical development.

Despite the apparent nutritional deficiency, the Piney index was 19, thus indicating proportionality between the growth rates, the body weight and the circumference of his chest. That is, with a symmetric delay in all indices of physical development, the assessment may be normotrophy, while the child has a severe form of malnutrition.

That is why the child had criteria for the diagnosis of severe chronic protein-energy deficiency (ICD-10 – E43) in the form of extreme expression of the main syndromes: trophic disorders, edema disorders, dysfunction of the nervous system and a decrease in immunological reactivity.

Calculation of real energy and protein intake. The child received 60 ml every two hours with a break at night during the day10 times a day, which is 600 ml per day. Composition of the enteral substrate: 20 ml of anti-reflux formula and 40 ml of the usual milk formula, during the illness the addition of vegetables and cereals was not provided due to a marked decrease in tolerance. The actual intake of energy at a dose of 600 ml/day was 100.5 kcal/kg, protein – 2.2 g/kg/day.

Calculation of physiological and actual needs of the child in energy and protein according to the degree of nutritional deficiency 4,12 . It should be noted that calculation of physiological needs should be based on the weight loss and certain states that increase energy costs and it is necessary to apply basic coefficients of the amendments.

The basic energy requirement in all age groups increases because of inflammation, fever, chronic cardio-pulmonary disease 4,5 . For children with severe nutritional deficiencies, the calculation of the initial needs is based on the ideal body weight and height that corresponds to 50 ‰ per child's actual age [2, 3, 8, 12]. This approach is recommended by leading nutrition committees to achieve catch-up growth.

Different equations are used to determine basic needs in energy of infants, such as the WHO, Schofield (W) and Schofield (WN) equations. Calculation of the physiological energy requirement according to the WHO recommendations for the examined child is 189.6 kcal/day, Schofield (W) – 207.59 kcal/day, Schofield (WN) – 384.55 kcal/day. This difference is due to different approaches to data computation, taking into account the presence of additional factors that increase the outgoes of energy and protein. That is why it is considered that the Schofield (WN) equation is most appropriate in determining the energy needs of infants with the presence of pathological conditions.

The evaluation of energy expenditure of this patient revealed that the actual needs, taking into account all coefficients, were 460.92 kcal/day (115.23 kcal/kg/day), and were based on the actual body weight, and not on the ideal one. Calculating energy needs for an ideal body weight gives much higher index – up to 140-150 kcal/kg. However, considering the impossibility of a sharp load and an increase in feed volume, the energy demand was estimated at 115 kcal/kg during the adaptation period.

According to ESPHGAN recommendations, protein needs for children with neurological pathology are similar to healthy children [2] . Exclusions are children with bedsores. The additional administration of protein due to high protein metabolism in enteric nutrition can be reviewed in case of reduced level of albumin in serum and urea, combined with high levels of cognitive impairment.

High protein intake in children with severe nutritional deficiencies can have a negative effect on the function of kidneys and organs of the digestive tract. As a result, the needs in protein for children are set at 1.2–1.5 g/kg per day. The actual intake of high quantity of protein is due to the extremely low body weight of the baby and does not require additional correction. For the examined patient, the protein requirement is 6 g per day, in recount on the real body weight and 12–15 g per day for the ideal body weight.

After determining the real energy loss, the main issue for children with severe diseases of the nervous system, especially in combination with another congenital somatic pathology, is to determine the way to increase the energy supply capacity. Most of these children have major problems with the feeding process itself (decreased capacity of the gastrointestinal tract, intolerance to large volumes of food, lack of oromotoric skills, etc.). For one-year-old children the only solution is the enrichment of breast milk or the use of special formulas. In the world's practice it is common to administer one-year-old patients special products of clinical nutrition with a low risk of overloading fluid, electrolytes, having the ability to accurately calculate caloric intake and dosage 13 .

Since ESPGHAN recommendations for high nutritional deficit and reduced tolerance to high levels of food recommended the introduction of a high-calorie polymer substrate (1,0 kcal/ml) [2], it was decided to add the product of clinical nutrition Infatrini (composition on 100 ml: proteins – 2.6 g, fats – 5.4 g, carbohydrates – 10.3 g), which corresponded to these requirements.

The calculation of needs in relation to the real child's weight is carried out at the beginning of the adjustment of feeding during a certain period of adaptation 4,14 . When the positive effect and evaluation of the product's tolerance are received, the recount of needs is performed according to the ideal body weight. Abrupt initial hyperalimentation may worsen the state of a child 14 .

Regular assessment of the needs of the child depending on the time course of the body weight and the correction of the enteric substrate composition depending on the period of the outlet from the state of nutritional deficiency (adaptation, reparation, enhanced nutrition) is an extremely important stage in the organization of nutrition. Except taking into account the results of the assessment and calculation of data on the physical development of a child, clinical examination should be conducted in children with implementation of nutritional adequacy and specific signs of insufficiency of the individual components of food.

Children with a severe degree of protein-energy deficiency have the greatest risk during the first week since the start of the adaptation period in feeding. Initial enteric feeding for infants with severe nutritional deficiencies (BMI less than 16 kg/m^2, body weight loss more than 15%) begin with 75% of the needs in the nutrients 4,14 . In case of good tolerance the initial adaptation period can be reduced to 5–7 days. Small volumes of enteric isocaloric nutrition help avoiding fluid loading.

During five days of life, the gradual replacement of the enteric substrate with a product of clinical nutrition was provided. At the end of the week, the child assimilated 70 ml of food, of which: 20 ml of anti-reflux formula, 50 ml Infatrini. The reception mode was left as the previous one, namely 10 times a day. Thus, 480 kcal/day (120 kcal/kg/day), 16.2 g per day protein was hold in the volume of the enteric substrate, which the child tolerated well. Checking the residual stomach contents in the child indicated lack of residual volume. The child less vomited which suggested the possibility of a progressive increase in volumes of bolus nutrition.

During 10 days of specialized nutrition administration the child increased body weight by 100 g. After 5 days of receiving an adjusted nutrition, the child became calmer, for a long time he could observe the staff or toys, showed interest in environment, sleep duration increased after feeding. The child was discharged from the hospital and returned to the orphanage with further recommendations in accordance with the rates of increase in volume and changes in the composition of the enteric nutrition.

Recommendations for the organization of further nutritional support included the maintenance of a high level of energy supply during the reparation period (120 kcal/kg/day) with the progressive transfer of energy needs for the ideal body weight. In future, the child will have to undergo a long period of intense feeding with a possible increase in energy intake to 130-145 kcal/kg/day, introduction of other food products (vegetables, cereals and fruits), an increase in the single volume of food.

The way and methods of administration of the enteric substrate are also crucial aspect of the organization of feeding for the examined child. Dangerous swallowing with constant aspiration pneumonia requires adjustment of gastrostoma, administration of proton pump inhibitors and active speech therapy with sensomotor therapy for the improvement of the function of the orofacial zone.

Conclusions. Children of the palliative group have a high risk of nutritional deficiency, both of alimentary nature and due to insufficient digestive problems. Deep protein-energy insufficiency in children with combined neurosomatic pathology can be corrected by carefully calculating the actual energy and protein needs and the appointment of specialized clinical nutrition (1 kcal/ ml). Infants of the palliative group, deprived of parental care and who are in orphanage, have the greatest risk of developing nutritional deficits.

Lack of a standardized approach to feeding such children, lack of qualified staff and insufficient financial support have extremely negative effects on the course of the disease, leading to even greater delay in the development and progression of pathology.

Employment of standardized indices of physical development to determine the degree of protein-energy deficiency and formulas for establishing energy needs in the practice of nutritional support for children of the palliative group can contribute to adequate nutrition.

Specialized products for clinical nutrition (isocaloric or high-caloric) can maintain nutritional needs of the child and help overcome such problem as reduced tolerance to the required amounts of food.

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