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Research Article

Use of Bioimpedansometry at the Rehabilitation Stage of Obese Children and Adolescents

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Abstract

Objective: To individualise recommendations on reduction of body mass based on assessment of the findings of analysis of morphological specificities of obese children.

Patients and Methods: We examined 43 obese patients aged 8 - 17y (27 boys, 62.7%, 16 girls, 37.3%). Analysis of morphological specificities of body composition was performed with the use of bioelectrical impedance method. Parameters of lipid and carbohydrate metabolism were assessed by the findings of blood biochemistry.

Results: In 58.1% of the examined children the percentage of active cell mass was decreased, which is indicative of true hypodynamic. Decreased skeletal-muscle mass against the background of significant elevation of its total level (in kg) are indicative of a low functional potential of myofibrils in male adolescents (62.7% of examined individuals). The basal metabolic rate, reflecting the intensity of metabolic processes in the body, was decreased in all subjects, in 35 (81.4%) by more than 20%. These 35 patients had a compromised family history of obesity: in boys this parameter was lower than in girls (72 vs. 78%, respectively). In 17 examined children with a hypersthenic body type (39.5%), marked hydrophilia of tissues was found: the amounts of extracellular fluid exceeded normal values by 3.2 [1.5; 3.4] kg ($p = 0.04$).

Conclusion: Based on revealed morphological specificities patients received Personalized recommendations on weight loss. This permitted to reduce body mass in all patients within the first month of follow-up by 5 - 7% from the initial level. During subsequent 5 months of follow-up body weight decreased in the overwhelming majority of patients (95%).

Keywords: *Bioimpedance Analysis; Children; Obesity; Adolescents*

Introduction

The prevalence of obesity in the world's infant population has reached pandemic levels. Over the past four decades, the total number of obese children and adolescents between the ages of 5 and 19 has increased more than 10 times, from 11 million in 1975. The number of obese boys increased from 6 million to 74 million in 2016, and from 5 million to 50 million (6 and 8% of the population respectively). WHO experts predict that the number of obese children and adolescents in the world by 2022 will exceed the number of their peers with moderate or significantly reduced body weight, which in 2016 approached the mark of 185 million people. The urgency of the problem of childhood obesity is also due to the progressive growth of various metabolic disorders arising against the background of obesity, leading to the development in adolescents of cardiovascular pathology, type 2 diabetes, reproductive dysfunction. Given that obesity is a morbid

disease, the individual approach to each patient is an essential condition for successful treatment and long-term preservation of the achieved result. Body Mass Index (BMI), which is the difference between a calculated, or true, patient BMI is an average arithmetic BMI for a given gender and age indicate deviations. However, this criterion is not objective enough, as it does not reflect the true amount of fat tissue in the patient's body.

One way to individually assess the component composition of the body is bioimpedansometry (BIM), a method of studying body composition based on the measurement of electrical resistance of tissues (impedance) when passing through them low-frequency electric current. This method allows you to estimate not only the true amount of fat tissue in the body or its excess, but also to get an idea of a number of other parameters, such as specific basic metabolism (UO), skeletal-muscle mass (SCM), the amount of extracellular fluid, etc [1-6].

Purpose of the Study

The purpose of the study was to individualize the recommendation to reduce body weight based on the evaluation of the results of the analysis of morphological features of obese children.

Materials and Methods

The study group consisted of 43 obese patients between the ages of 5 and 17, of whom 27 were boys. (62.7%), girls - 16 people. (37,3%). The study included the study of complaints, a history of life and disease, hereditary predisposition, According to the data of biochemical blood analysis, the indicators of fat metabolism were studied: total cholesterol (OH), triglycerides (TH), high lipoproteins (HDL) and low density (LDL); carbohydrate metabolism: thus-water glucosemia (G), immunoreactive insulin(IRI) NOMA-index calculated according to the formula: HOMA (IRI0-G0)/22.5, where IRI - insulin concentration in the serum on an empty stomach, MKED/ml, G0 - fasting plasma glucose, mmol/l.

At the end of the standardized examination, all patients were evaluated the structural and functional features of the body composition by bioimpedance analysis using a domestically produced analyzer connected to a personal computer. The study was conducted no earlier than 2 hours after eating, in the patient's position lying on the back to the right of the bioimpedance analyzer with fixation on the rear surfaces of the right hand and right foot of disposable bio adhesive electrodes for 20 - 40 seconds. The study was preceded by measurement of height, body weight, waist circumferences (OT) and hips (OB), BMI calculation.

Statistical processing of the data obtained was carried out using the XL Statistic version 4.0 packages. the parameters studied were found to be reliable at the statistical level of strafe; 0.05. Correlation analysis was used to assess the relationship between individual indicators, calculating the Pearson correlation ratio.

Results and Discussion

The people included in the procedure complained of overweight. Almost all children (94%) had a rhythm disturbance with the preemptive evening meal. 13 patients (30%) complained of headaches.

According to the history, the majority of those surveyed (60%) overweight appeared in the older preschool age and progressed to puberty, 40% (17 people) 11 - 14 years old, i.e. at the beginning of puberty.

The BMI of all patients exceeded 95% for a given sex and age and reached 28 kg/m^2. SDS BMI in the group as a whole - 3.5... 2,7; 4,3. 60.5% of the surveyed (26 adolescents) were diagnosed with stria syndrome, of which 13 people were diagnosed with acanthosis nigricans.

The study of fat metabolism found that the level of OH as a whole in the group was 6.75 (5,5; 8,1) mmol/L, hypercholesterolemia was detected in 80% of children. Triglycerides level - 2.2 (0.5; 3,9) mmol/L, hypertriglyceridemia - in 45% of patients. High-density lipopro-

tein levels were 0.65 (0.1; 1.2) mmol/L, and 30% of the surveyed showed a decrease in HDL levels. The LDL level is 2,2, 3,5 mmol/L and 15% of children have an increase in LDL.

In the group as a whole, the level of shupaic glycemia was 5.4 (2,5; 7,5) mmol/l. Five surveyed (2%) a violation of carbohydrate metabolism - fasting hyperglycemia was detected. The level of IRI in the group as a whole was 21 (7,4; 35,7) mkED/l (Thyroid Functional Autonomy), in 40% of patients were detected hyperinsulinemia. The level of the NOM index as a whole for the group was 3.5, 1,5; 5,5, which is within reference values, but in 55.8% of the individual, showed that the absolute majority of patients examined (24 people), this figure exceeds the upper limit of the norm, which indicates the formation of insulin resistance.

The following results were obtained in the course of working with BIM indicators. Analysis of skinny (fat-free) body weight, as an indicator of the constitutional characteristics of the individual, showed that the absolute majority of patients in the study group (60.4%) have a normalized physique. The number of children of asthenic and hypersthenic physique is about the same: 18.6% and 20.1% respectively.

The relationship between the type of physique and the dynamics of body weight is noteworthy. Comparing the history data and the results of BIM, it was found that in the group of patients of asthenic physique for 6 months, In the group of patients of the normothermic physique, the same rate was 5.5, 4,7; 6,1 kg and among hypersthenic patients 6.4; 5.8; 7.8 kg. therefore, patients of this constitutional type are prone to more severe forms of obesity.

The vast majority of those surveyed (62.7%) had a survey of active cell mass (AKM, kg) the mentioned percentage corresponds to normal values, which indicates an adequate intake of protein with food. Only 16.3% of those surveyed reduced this figure, indicating the pre-pre-nutrition in their carbohydrate-containing foods. increased skeletal-muscle mass (SMM, kg) inpatient data (Table 1). At the same time, half of them showed low levels of skeletal-muscle mass (% SMM), which indicates a low functional potential of myofibril. The revealed set of data allows us to say that the hypertrophy of skeletal musculature is false: the increase in the volume of muscle mass is caused by the growth in the organ of adipocytes, which leads to a decrease in the volume and functional reserve of parenchyma. Low SMM rates were found mainly in adolescent patients (exclusively young men). In addition, two of them had low levels of SMM, along with a low proportion of SMM (rq0.79), which can be regarded as the beginning of their sarcopenic syndrome.

In patients of preschool and elementary school age (5 - 11 years) the proportion of SMM, on the contrary, was increased.

The rate of specific main exchange (USO, kcal/m^2/day), reflecting the intensity of metabolic processes in the body, in all patients examined decreased, and in 35 people. (81,4%) more than 20% (Table 2). It is these patients who have hereditary obesity, and boys have a lower rate than girls (72% vs. 78% respectively).

At 17 people of the total number surveyed (39.5%) a pronounced hydrophilic ness of tissues has been revealed, as evidenced by the positive correlation between AKM and HKY. Thus, the high values of AKM, which, as mentioned above, are typical of the hypersthenic constitution, corresponded to a surplus of HWC by 3.2 (1.5; 3,4) kg compared to the norm (p-0.04). At low AKM values (in patients of asthenic physique), the rate of HKY did not exceed the normal range of values (p-0.02). In patients with a norm-crystal constitution, the increase in the rate of H.W.C.A. was detected only in 1/3 of the cases (p-0.1).

Analysis of the waist-thigh index (OT/OB), which characterizes the type of fat-deposition, found in 21 people (48.8%) Android type of distribution of subcutaneous fat. Moreover, the number of young men with this type of fat-free deposit exceeded the number of girls almost three times: 17 people and 6 people respectively (p-0.04). Android type of fat deposition is the most unfavorable compared to gynoids and intermediate types due to association with a high risk of metabolic syndrome: increased mass of visceral fat, hypertension, hyperinsulinemia, etc.

Test date, time	02.12.2016 13:29:08	Impedance (resist. on 5 and 50 kHZ, react. on 50 kHz)	601/536/34
Age, gender	14 M	Phase angle (50 kHz), degrees	5.71
Height, cm/weight, kg	169/103	Intracellular water/mineral mass, kg	25.4/3.35
Waist /hip, cm	111/119	Basal metabolic rate, kcal	1600

Compartments	Characteristic	Normal range
Body mass index, kg/m^2	36.1	16.9 - 21.7
Body fat mass, kg	43.4	6.8 - 13.5
Fat free mass, kg	59.6	40.6 - 61.9
Body cellular mass, kg	31.1	22.4 - 34.0
Body cellular mass, %	52.3	53.0 - 59.0
Skeletal muscle mass, kg	28.5	20.3 - 29.0
Skeletal muscle mass, %	47.9	53.4 - 58.6
Basal metabolic rate, kcal	754.6	828.0 - 963.4
Total body water, kg	43.6	29.8 - 45.1
Extracellular water, kg	18.2	13.2 - 16.1
Waist-hip ratio	0.93	0.75 - 0.81
Body fat mass, %	42.2	14.5 - 20.1

Table 1: *Body composition analysis (a patient B., 12 y.o.).*

Test date, time	06.07.2017 14:31:13	Impedance (resist. on 5 and 50 kHZ, react. on 50 kHz)	622/557/55
Age, gender	12 M	Phase angle (50 kHz), degrees	5.66
Height, cm/weight, kg	164/89	Intracellular water/mineral mass, kg	22.4/3.04
Waist /hip, cm	106/112	Basal metabolic rate, kcal	1487

Compartments	Characteristic	Normal range
Body mass index, kg/m^2	33.1	15.8 - 20.0
Body fat mass, kg	36.0	6.6 - 13.1
Fat free mass, kg	53.0	37.7 - 57.8
Body cellular mass, kg	27.6	20.8 - 31.8
Body cellular mass, %	52.0	53.0 - 59.0
Skeletal muscle mass, kg	26.3	14.6 - 21.8
Skeletal muscle mass, %	49.6	49.1 - 56.5
Basal metabolic rate, kcal	770.5	850.8 - 998.4
Total body water, kg	38.8	27.6 - 42.2
Extracellular water, kg	16.5	12.4 - 15.0
Waist-hip ratio	0.95	0.76 - 0.88
Body fat mass, %	40.4	14.0 - 19.6

Table 2: *Body composition analysis (a patient Yu., 14 y.o.).*

Based on the morphofunctional features identified, patients were individualized recommendations to reduce body weight. Thus, patients with reduced AKM score, in addition to general recommendations for nutrition optimization, were advised to reduce the amount of carbohydrates consumed (limited to breakfast cereal intake) and to increase the consumption of protein-containing foods.

With a combination of a reduction in AKM and % of AKM indicating hypodynamia, the rehabilitation plan included limiting pastime with any electronic medium. Parents of patients refused wireless access to the Internet at home, work on fixed computers took place at a strictly fixed time within 30 minutes. Subject to a set of exercises (in cardio-training mode) lasting at least 45 minutes, compiled individually, the patient received an additional 10 minutes.

In case of excess HKY in people with elevated ACM levels, patients were advised to adhere to salt-free food for a month.

When the low USO is combined against the background of a reduced % of SCM, daily walks at a fast pace (5 - 6 km/h) with parents or friends under the control of the pulse became a prerequisite for reducing mass. With a high level of tolerance to physical activity, walking was replaced by running and swimming.

Taking into account the true excess fat mass in the surveyed, which ranged from 6 kg to 36.8 kg, each patient was calculated real terms of rehabilitation: from 3 months - 1.5 years, respectively.

Conclusion

The study identified constitutional, sexual and age-related morphofunctional features of obese children. body weight was declining.

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