

RESULTS OF BIOIMPEDANCE ANALYSIS IN CHILDREN WITH EMERGENCY PATHOLOGY OF THE URINARY SYSTEM

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Abstract

Introduction. *The number of studies on the application of bioimpedance analysis in pediatric surgery is disproportionately low, and in domestic literature, there are practically few sources available, which necessitates the investigation of the potential of bioimpedance as an objective method for studying the course of pathological processes.*

Aim. *To explore the possibilities of bioimpedance analysis in the comprehensive diagnosis of children with emergency pathology of the urinary system.*

Materials and Methods. *Bioimpedance analysis using the "InBody 230" human body composition analyzer was performed on 45 boys aged 7 to 18 years, who were urgently hospitalized with urolithiasis.*

Results. *Bioimpedance analysis of the body composition in boys with emergency pathology of the urinary system revealed a decrease in muscle mass and total body fluid, which remained unnoticed during the examination.*

Conclusions. *Bioimpedance analysis appears to be the simplest, safest, and most informative method for evaluating water balance and the development of physical status in routine clinical practice.*

Keywords

bioimpedance analysis, children, urolithiasis, water balance.

Introduction. The development of any disease encountered in pediatric urological practice is associated with the involvement of two closely related pathological processes: disturbance of the body's water balance and structural disorganization of cell membranes. It should be noted that in pediatric surgical practice, there is an increasing occurrence of a combination of a pathological process requiring surgical intervention and accompanying chronic diseases of the urinary system, in the pathogenesis of which water homeostasis disturbances already exist. In such cases, the addition of a surgical disease on the background of

existing water balance disorders and membrane functions is likely to have more serious consequences for the growing child's body.

Studying disturbances in the body's water balance and the structural organization of cell membranes, in our view, will help understand the intricate mechanisms of disease pathogenesis, which may improve treatment outcomes for patients. One of the "life-defining conditions" for the existence of an organism is the dynamic equilibrium of water balance. Any changes in balance parameters that deviate from the evolutionarily established norm initially cause functional and then morphological cell disorders. To study these two interconnected pathological processes, the use of bioimpedance analysis (BIA) appears promising, as it is based on the physical principle of the dependence of the electrical conductivity of the investigated object on the electrical conducting characteristics of its constituent tissues.

Aim. To explore the possibilities of bioimpedance analysis in the comprehensive diagnosis of children with emergency pathology of the urinary system.

Materials and Methods. The study included 45 boys with urolithiasis who were urgently hospitalized in the Surgery and Combined Trauma Department of the Samarkand Branch of the Republican Scientific Center for Emergency Medical Care from 2020 to 2023. The obtained results were analyzed for 15 children aged 7 to 10 years, 15 boys aged 12 to 15 years, and 15 patients aged 15 to 18 years.

Bioimpedance analysis (BIA) using the InBody 230 human body composition analyzer was included in the comprehensive examination of these patients. The following BIA parameters were investigated: height, weight, total muscle mass (TMM), body fat mass (BFM), total body fluid (TBF), free fat mass (FFM), body mass index (BMI), percentage of body fat (PBF), and basal metabolic rate (BMR) (Figure 1).

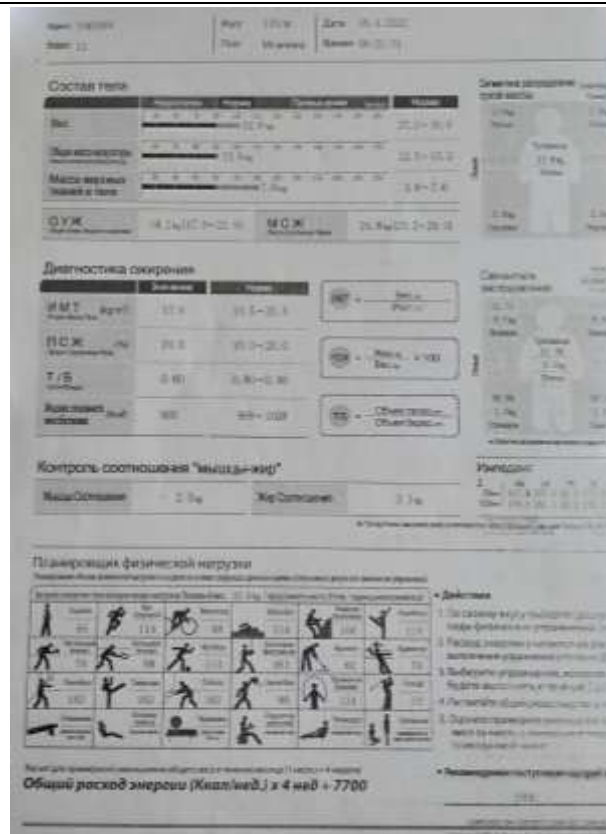


Figure 1. Table of Results of Bioimpedance Analysis of Human Body Composition.

Methodology. Taking into account that perspiration and evaporation also influence the results, causing temporary changes in body composition, data control was performed under the same conditions: at room temperature of 22-24°C and with the patients in a vertical position. Bioimpedance analysis of human body composition was conducted on an empty stomach, after urination and bowel movement. All measurements were taken at the same time of day, between 8:00 and 9:00 AM (24-hour time format).

The analysis of parameters was conducted in absolute units (cm, kg), relative units (%), and calculated indices (kg/m^2). The obtained data are presented as mean values ($M \pm m$). The significance of differences in mean values was determined using the Student's t-test. A significance level of $p < 0.05$ was considered statistically significant. The obtained body composition parameters of the patients were automatically compared with reference values of practically healthy children.

Results. Bioimpedance analysis of body composition in boys hospitalized with urolithiasis in the emergency department revealed the following findings (Table 1): for children aged 7 to 10 years, the mean height was 121.6 ± 6.3 cm, and the weight was 25.8 ± 4.2 kg. In the age group of 12-15 years, the patients had a mean height of

134.4±3.7 cm and a weight of 32.8±4.2 kg. For the older age group, the mean height and weight were 159.7±6.3 cm and 55.6±4.2 kg, respectively.

Table 1.

Bioimpedance analysis results in children with urolithiasis

Analyzer parameters	Age					
	7-10years		12-15years		15-18years	
	values	reference	values	reference	values	reference
Height (cm)	121,6 ±6,3	131,7±9,3	134,4 ±3,7	145,6±5,3	159,7 ±6,3	168,1 ± 9,5
Weight (kg)	25,8 ±4,2	33,7±6,1	32,8 ±4,2	44,8±7,2	55,6 ±4,2	63,7±6,1
LBM (kg)	9,3 ±2,1	13,6±5,2	14,3 ±2,1	17,7±3,2	19,3 ±2,1	24,6±5,2
FM (kg)	4,6 ±1,7	7,9±2,3	6,7 ±2,3	8,6±2,4	4,6 ±1,7	7,9±2,3
TBW (kg)	15,4 ±2,6	19,2±2,4	17,4 ±2,1	24,7±3,4	23,4 ±2,6	29,2±2,4
BMI (kg/m ²)	13,3 ±2,4	17,4±3,2	16,3 ±2,4	20,4±2,2	19,3 ±2,1	22,4±2,2
BF% (%)	12,3 ±2,5	16,6±5,1	15,3 ±2,5	18,6±4,1	21,3 ±2,2	26,3±3,1
BMR (kcal)	767,4 ±32,3	812,3±38,2	940,4±32,3	1000,3±28, 2	767,4 ±32,3	812,3±38,2

In relation to the body weight to height ratio, BMI was determined using the formula $BMI = \text{Weight (kg)} / (\text{Height m})^2$. The BMI values varied according to the patients' age, with the following corresponding values: for children aged 7-12 years - 13.3±2.4 kg/m², 12-15 years - 16.3±2.4 kg/m², and 15-18 years - 19.3±2.1 kg/m².

As shown in the above-presented Table 1, the total body water (TBW) varied in relation to the age of the boys, with different obtained and reference data. In children with urolithiasis urgently hospitalized in the surgical ward, the TBW for the age group of 7-10 years was 15.4±2.6 kg, for boys aged 12-15 years - 17.4±2.1 kg, and for the older age group - 23.4±2.6 kg.

Discussion. The mathematical analysis of the bioimpedance measurements of body composition parameters in comparison with reference data allowed us to identify the following findings. Boys with acute pathologies of the urinary system exhibited a decrease in muscle mass and total body water, which remained

unnoticed during the examination (Figure 1). The state of dehydration in the examined children, in our opinion, is associated with the development of complications of urolithiasis. This manifests as nausea, vomiting, the development of pain syndrome, and overall reduction in the quality of life for these patients.

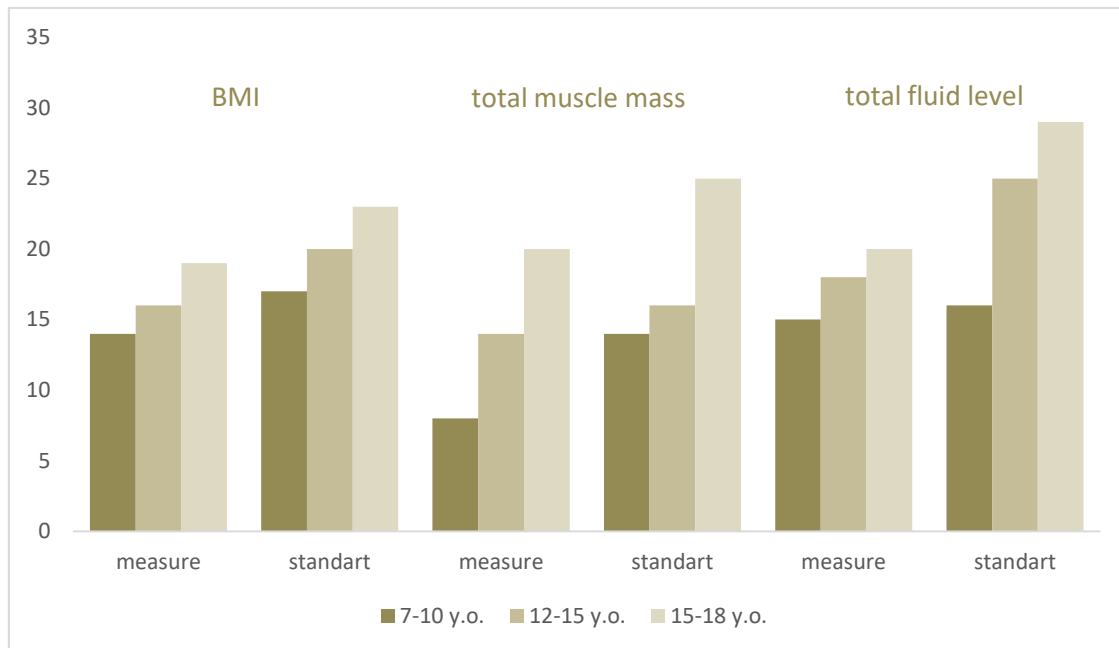


Figure 1. Mathematical analysis of bioimpedance measurement results (p<0.05).

The study of the influence of acute ureteral obstruction on water balance in children with urolithiasis revealed patterns of systemic changes in bioimpedance analysis (BIA). Significant differences in body composition parameters of the patients were observed during the comparison (Figure 1, p<0.05). As evident, the BIA measurements were significantly lower than the normative values. Commenting on the obtained data, it is important to note that sudden obstruction of urine outflow through the urinary system increases tissue pressure, leading to the development of ischemic processes. The earliest manifestation of this is the presence of pain symptoms that may not be proportional to the degree of ureteral obstruction.

Conclusion. The analysis of bioimpedance analysis (BIA) dynamics indicates that in children with urgent pathology of the urinary system, acute disturbances in urodynamics, combined with inflammatory complications, lead to systemic impairments in the body composition of the affected children. Assessing the role and diagnostic value of bioimpedance analysis in the conducted study, it is necessary to highlight that BIA provides objective data on the initial disturbances in

the body's water balance. The BIA method appears to be the simplest, safest, and most informative approach for assessing water balance and monitoring the development of physical status in routine clinical practice.

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