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DIAGNOSTIC VALUE OF BIOIMPEDANCEMETRY IN THE DIAGNOSTIC COMPLEX OF THE URINARY SYSTEM'S EMERGENCY PATHOLOGY IN CHILDREN

Firdavs Mukhiddinovich Tukhtaev

Samarkand State Medical University, Samarkand, 140100, Uzbekistan

Farhod Shavkatovich Mavlyanov

Samarkand State Medical University, Samarkand, 140100, Uzbekistan

Shavkat Khuzhamkulovich Mavlyanov

Samarkand State Medical University, Samarkand, 140100, Uzbekistan

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ABSTRACT

Background: The number of studies on applying bioimpedance analysis in pediatric surgery is disproportionately low. In domestic literature, few sources are available, which necessitates the investigation of the potential of bioimpedance as an objective method for studying the course of pathological processes. To explore the possibilities of bioimpedance analysis in the comprehensive diagnosis of children with emergency urinary system pathology.

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

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

Conclusion: Bioimpedance analysis appears to be the most straightforward, 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, adding a surgical condition on the background of existing water balance disorders and membrane functions will likely have more severe consequences for the growing child's body.

In our view, studying disturbances in the body's water balance and the structural organization of cell membranes will help us understand the intricate mechanisms of disease pathogenesis, which may improve patient treatment outcomes. One of the "life-defining conditions" for the existence of an organism is the dynamic equilibrium of water balance. Any changes in balance parameters deviating from the evolutionarily established norm initially cause functional and morphological cell disorders. To study these two interconnected pathological processes, 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.

This study aims to investigate the potential applications of bioimpedance analysis for the comprehensive diagnosis of pediatric patients presenting with acute urinary system pathologies.

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.

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), full body fluid (TBF), free fat mass (FFM), body mass index (BMI), percentage of body fat (PBF), and basal metabolic rate (BMR) (Figure 1).

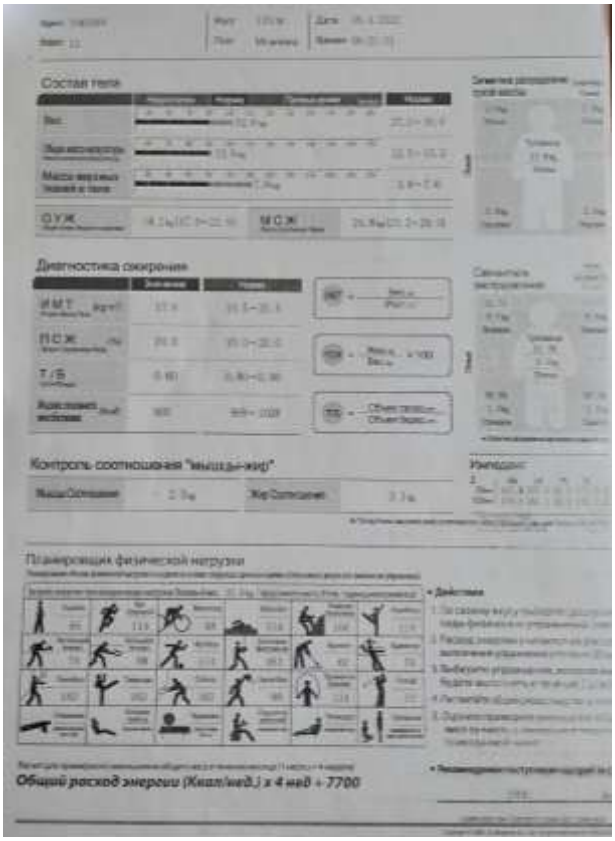

Figure 1. Table of Results of Bioimpedance Analysis of Human Body Composition.

Methodology

Considering 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 simultaneously, 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±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 elevation of 134.4±3.7 cm and a weight of 32.8±4.2 kg. The mean height and

weight for the older age group were 159.7±6.3 cm and 55.6±4.2 kilograms, 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

Concerning the body weight to height ratio, BMI was determined using the formula BMI = Weight (kg)/(Height m)2. The BMI values varied according to the patient's 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 concerning the boys' age, 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 kilograms, and for the older age group - 23.4±2.6 kg.

DISCUSSION

The mathematical analysis of body composition parameters' bioimpedance measurements compared with reference data allowed us to identify the following findings. Boys with acute urinary system pathologies exhibited decreased muscle mass and total body water, which remained unnoticed during the examination

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

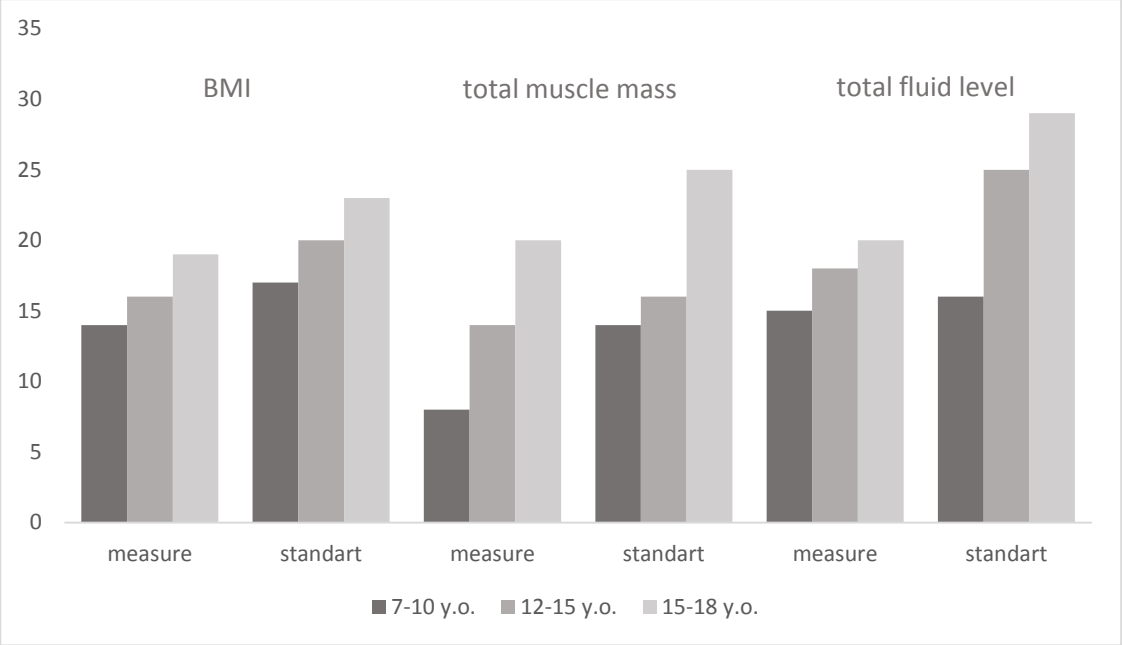

Figure 1. Mathematical analysis of bioimpedance measurement results ($p<0.05$).

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 the 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 essential 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 bioimpedance analysis (BIA) dynamics analysis 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 most straightforward, safest, and most

informative approach for assessing water balance and monitoring the development of physical status in routine clinical practice**.**

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