ANTROPOMETRIC AND BIOIMPEDANCE DATA IN A GROUP OF PEDIATRIC PATIENTS WITH LEUKEMIA

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ABSTRACT

Introduction. Poor nutritional status is a common problem among children with malignant disease. In order to detect changes in nutritional status and body composition this study investigates anthropometrical parameters and body composition among pediatric patients with leukemia.
Material and methods. The prospective study included 33 patients hospitalized in Pediatric Clinic No I Tg-Mures who were divided in two groups: group I-study group, patients with leukemia (15 patients) and group II-the control group consisting of 18 patients with different pediatric diseases. The anthropometric parameters [weight-W, height-H, body mass index (BMI), middle upper arm circumference (MUAC), tricipital skinfold thickness (TST)] were comparatively evaluated. Fat mass (FM, kg and %), fat free mass (FFM, kg), muscle mass (MM, kg) and total body water (TBW, %) were measured in the both group using Tanita BC 420 S MA Analyzer.
Results. Anthropometric parameters in Group I were significantly different from those in Group II for MUAC and TST ($p < 0.05$). In the study group, FM was much lower (14.79 ± 7.14%) compared with controls (21.56 ± 9.06%) ($p = 0.01$) and TBW was much higher (61.84 ± 4.93% versus 57.45 ± 6.64%) ($p = 0.02$). FFM and MM were not statistically different in the two groups.
Conclusion. Bioelectrical impedance analysis in conjunction with arm anthropometry is a sensitive method to detect alteration of body composition in children with malignancy. Compared with the control group, children with leukemia had higher alterations of nutritional status.

Keywords: electrical bioimpedance, anthropometry, children, leukemia

Abbreviations
BIA: Bioelectrical impedance
BMI: Body mass index
FFM: Fat free mass
FM: Fat mass
H: Height
MM: Muscle mass
MUAC: Middle upper arm circumference
SD: Standard deviation
TBW: Total body water
TST: Tricipital skinfold thickness
W: Weight

INTRODUCTION

Both malnutrition and obesity represent increasing risk factors with children suffering of malignant diseases. Malnutrition is related to the reduction of tolerance to chemotherapy, the increase of sensitivity to infections as well as the inferior response to treatment. Even though the precarious nutritional status can affect the prognosis and tolerance to treatment negatively, its evaluation is often neglected with cancer patients. It is important to assess nutritional status at early stages of cancer in order to detect nutritional risk and be able to start nutritional interventions in time to improve nutritional status and outcome, as well as quality of life.

Body composition measurement in children is important for assessing nutritional status for both health and disease. Currently, there are many methods available for obtaining body composition measures such as summation of skinfolds , bioelectrical impedance analysis (BIA) (1), bioelectrical impedance spectroscopy (2), air displacement plethysmography (3), hydrostatic weighing (HW)

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(4), magnetic resonance imaging (5) and dual energy x-ray absorptiometry (DXA) (6). HW and DXA are not always practical and can be expensive, limiting their use. Compared to these methods, BIA is a noninvasive, painless, practical and cheap method (7), making it highly suitable for survey and clinic use, particularly in school-age children. Bioimpedance analysis (BIA) measures the percentage of the various compartments having in view the different tissue conductivity. The difference between the resistance by non-fat tissue (conductor) and fat tissue (resistant to the passage of microcurrent) on electric current (bio-impedance) and the difference density between the two compartments allow a reliable estimate of total adiposity and total lean tissue (8).

AIM

Analyze of nutritional status in pediatric patients with leukemias compared with pediatric patients with nononcologic diseases.

MATERIAL AND METHOD

A prospective study was performed in 47 pediatric patients aged between 5 and 18 years, hospitalized in Pediatric Clinic I from Tîrgu Mures from October 2013 to March 2014. Patients were divided into two groups. Group I was made of 17 pediatric patients diagnosed with leukemias and Group II comprised 30 age- and sex-matched controls, were pediatric patients with different non-malignant diseases. Exclusion criteria for both groups of patients were chronic disease (malabsorption syndromes, inflammatory bowel disease, liver disease) because they could influence nutritional status.

Weight, height, BMI, MUAC, and TST were measured using standard techniques (9). Weight was measured with electronic scales, after fasting overnight (with an error 0.1 kg). Height was measured with stadiometer, with an error margin of 0.1 cm. Body mass index was calculated using the ratio of weight in kilograms and the square of height expressed in meters (kg/m^2). MUAC (cm) was measured with the forearm relaxed and supported on the trunk, at the midway between the olecranon process of the ulna and the acromial process of scapula. TST (mm) was measured using a digital caliper, and is daily calibrated at the midpoint of the back of the arm, between the olecranon and the acromial process ends. These anthropometric measurements have been made by a single examiner and, for accuracy, the measurements were performed in duplicate and the averages were calculated. The values of these five parameters were converted in standard deviation (SD) for age and sex using the growth curves Switzerland Growth Chart 1989 (10); the physiological reference range values were between -2.5 and +2.5 SD. We considered malnutrition for patients who had MUAC and TST < -2.5 SD.

Body composition was measured using the Tanita BC-420 MA body composition analyzer (Tanita Corp., Tokyo, Japan). BIA measurements were done according to the manufacturer's guidelines at a frequency of 50 kHz. Participants were asked to void their bladder prior to measurement. Height, sex, and age were entered manually; weight was recorded automatically with 0.5 kg as an adjustment for weight of clothes. The measurement procedure required the subject to stand barefooted on the analyzer. BIA assesses the difference in impedance caused by the fact that fat and lean tissues have different electrical properties. Tanita Analyzer estimate fat mass (FM), fat-free mass (FFM), muscle mass (MM) and total body water (TBW).

The database was prepared using Microsoft Excel and statistical analysis by Graph PadPrisma and GraphPad InStat Demo version.

This study has been authorized by the Local Ethics Committee at the University of Medicine and Pharmacy. The legal caregivers of each patient have signed an informed consent at the moment of hospitalization in our clinic in compliance with the principles of the Declaration of Helsinki.

RESULTS

Group I (the study group) consisted of 17 patients hospitalized in the Hemato-oncology Department of Pediatric Clinic I and diagnosed with leukemias (acute lymphoblastic leukemias and chronic granulocytic leukemias). The control group (Group II) consisted of 30 children who were hospitalized in the Pediatric Clinic No I Tg-Mures with different diseases: respiratory, digestive, osteoarticular and hematological diseases.

The two groups showed symmetrical age and sex distribution. Basic features of the groups appear in Table 1.

TABLE 1. *Demographical aspects of patients*

Parameter	Leukemia patients (N = 17)	Control (N=30)	p
Age (years) mean ± SD (range)	11 ± 5.07 (5-18)	10.70 ± 3.91 (5-17)	0.82
Male (%)	10 (58%)	15 (50%)	-

We studied by comparison the anthropometric parameters of the two groups and we found that among patients with leukemias, this parameters are lower than patients with nononcological disease. We identify a statistically significant differences among the anthropometric parameters of the arms ($p < 0.05$) (Table 2).

TABLE 2. *Anthropometric parameters in the two groups*

Parameter (SD)	Leukemia patients (N = 17)	Control (N = 30)	p
Weight	-0.43	0.09	0.25
Height	-0.54	-0.7	0.71
BMI	-0.51	0.2	0.07
MUAC	-0.1	1.31	**0.01**
TST	-0.01	1.35	**0.01**

Electrical bioimpedance data shows a lower percent of fat mass in leukemia patients than in control group (14.79 ± 7.14 % vs 21.56 ± 9.06 %; p=0.01). It has been found that the percent of total body water was significantly higher in leukemia patients compared with controls (61.84 ± 4.93 % vs 57.45 ± 6.64 %; p = 0.02). The fat free mass and the muscle mass were not significantly different in the two groups (Table 3).

TABLE 3. *Body composition in the two groups assessed by electrical bioimpedance method*

Parameter	Leukemia patients (N = 17)	Control (N = 30)	p
Fat mass (%) mean ± SD	14.79 ± 7.14	21.56 ± 9.06	**0.01**
Fat mass (kg) mean ± SD	5.5 ± 4.63	8.9 ± 6.55	0.07
Fat free mass (%) mean ± SD	33.09 ± 17.80	29.72 ± 13.02	0.46
Muscle mass (%) mean ± SD	31.36 ± 16.96	28.15 ± 12.40	0.46
Total body water (kg) mean ± SD	23.9 ± 12.61	21.75 ± 9.52	0.51
Total body water (%) mean ± SD	61.84 ± 4.93	57.45 ± 6.64	**0.02**

DISCUSSION

Malnutrition has a negative impact on the evolution of malignant disease, being an unfavorable prognostic factor that is associated with higher morbidity and mortality in children with cancer (11,12). Assessment of nutritional status is difficult because there is no "gold standard". Recent studies have identified that nutrition assessment measures should not be limited to anthropometric methods and that body composition analysis provides details on the procent of the various compartments (fat mass, fat free mass, extracellular water). Weight is potentially misleading in pediatric patients with cancer, especially in patients with oedema, abdominal tumours that can weight more than 10% of their total body weight. Arm anthropometry is valuable in these patients because it is independent of tumour mass. Tricipital skinfold thickness and middle upper arm circumference are good indicators of nutritional status in the pediatric population with malignancy. TST reflects body fat and MUAC reflects muscle mass (13). In our study, patients with leukemia had lower values of weight and BMI compared with the control group and significantly lower values of anthropometric parameters of the arms (MUAC and TST) compared with the control group (Table 2), reflecting the nutritional damage. Arm anthropometry can be a useful tool for the measurement of nutritional status in children with cancer (14,15), as evidenced also in our data.

Recent studies have shown that nutritional assessment should not be limited to anthropometric measurements; body composition analysis by BIA provides details regarding the percent of the various compartments (fat mass, fat free mass, extracellular water) on the basis of their different conductance and impedance characteristics (16,17). In our study, anthropometric measurements were followed by electrical bioimpedance analysis. We found that not only TST was decreased in patients with leukemia, but the percent of FM was significantly lower compared with controls. These results express a poor nutritional status at the onset of malignant disease in the context of malnutrition. Fat free mass and muscle mass were not affected in patients with leukemia; so we have not identified differences compared to the controls.

In the literature there are few studies which investigate the bioimpedance analysis of body composition in children with cancer; recent articles reported an increase in the percent of FM in pediatric patients with oncologic pathology, but during the chemotherapy (18) or after cytostatic and steroid therapy which can cause accumulation of fatty tissue (19,20).

Because of known association of malnutrition with the reduced tolerance to chemotherapy, unfavorable outcomes, it is practical to use bioimpedance analysis, as a safe method for monitoring of nutritional state in pediatric oncology patients (18,21).

Although our research was carefully prepared, we are still aware of its limitations. First of all, the subject population omitted the large proportion of

younger children under the 5 years of age, who tend to be more vulnerable to malnutrition; thus the future studies should focus on this group. Secondly, this research had a relatively small number of patients, which decreases the statistical power of this group.

This research evaluates the nutritional state of pediatric patients with leukemia, which is very important, because an adequate correction of malnutrition to these patients improves the evolution and abates the progress of the disease. Thus, the correct and complex study of malnutrition in malignant disease is recommended.

CONCLUSIONS

This research showed that the pediatric patients diagnosed with leukemia has a poor nutritional status than the control group. Arm anthropometry, in conjunction with bioelectrical impedance analysis, accurately characterizes the nutritional disorders at the diagnosis of malignant disease.

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