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ORIGINAL RESEARCH PAPER

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IS BODY PROTEIN INDEX BASED ON BIOELECTRICAL IMPEDANCE ANALYSIS A RELIABLE MARKER FOR NUTRITIONAL STATUS ASSESSMENT?

KEY WORDS: bioelectrical impedance analysis, hemodialysis, nutrition

Dr. Nitoi Luciana Carmen*

MD, Clinical Medical Department "Dunarea de Jos" University, Faculty of Medicine and Pharmacy, Al. I. Cuza Str., 800010, Galati, Romania. *Correspondign Author

Dr. Maria Cristina Vladeanu

Departament of Physio-pathology, University of Medicine and Pharmacy "Gr. T.Popa", 16 University Str., 700115, Iasi, Romania.

ABSTRACT

Bioelectrical impedance analysis (BIA) is a method extensively used in studies assessing body composition, as a non-invasive method for generating information through portable, easy to use and relatively inexpensive equipment that estimates the body components. Signs of protein-energy malnutrition are common in maintenance hemodialyis (HD) patients and are associated with increased morbidity and mortality. To evaluate the nutritional status and relationship between various parameters used for assessing malnutrition, we performed a cross-sectional study in 69 HD patients treated with thrice weekly sessions for at least three months. The aim of our study was to assess the prevalence and degree of malnutrition in a population of HD patients, using mSGA (modified Subjective Global assessment) and BIA, and analyze the usefulness of a new nutritional marker Body Protein Index (BPI) based on bioimpedance analysis. The majority of our study patients was found to suffer of a variable degree of malnutrition. Strong correlations were found between BPI and anthropometric measurements, laboratory data and BIA nutritional markers. In conclusion, BPI could evaluate whole body somatic protein stores, and is a potentially useful new marker assessing nutritional status in HD patients.

Introduction

Patients on dialysis have important changes in body composition because of decreased protein and/or energy intake, chronic inflammation, physical inactivity, concurrent acute or chronic conditions, illness, and catabolism induced by the dialysis process. Previous studies have shown that changes in body composition occur after dialysis treatment, with a significant decrease in lean body mass (LBM) and body muscular mass (BMM) an increase in body weight and fat mass (FM), where as other studies state that FM and body weight decrease over time. , , In haemodialysis patients (HD), it is important to perform an early diagnosis of malnutrition, using the best clinically available tools to create specific nutritional strategies that can predict outcomes, evaluate therapeutic responses, and avoid severe nutritional deterioration. , There was not found a single measurement that provides complete and unambiguous assessment of nutritional status of HD patients. Ideally, a nutritional marker/ evaluation test, should not only predict outcome, but also be inexpensive, reproducible and easily performed test, that is not affected by factors such as inflammation, gender, age and systemic disease. There are various methods for estimating body composition in patients on dialysis, one of which is bioelectrical impedance analysis (BIA). BIA measures impedance and resistance with a small electrical current as it travels through the body's water pool. Body protein index based on bioelectrical impedance analysis can be a useful new marker assessing nutritional status applied to patients with chronic renal failure on maintenance dialysis. Anyway, use of a panel of anthropometric and biochemical markers that correlate with nutritional status is required to assess protein-energy malnutrition in a given individual.

Aim:

1) to assess the prevalence and degree of malnutrition in HD patients in Romania.
2) to analyze the usefulness of a new nutritional marker Body Protein Index (BPI) based on bioimpedance analysis.

MATERIAL AND METHOD

This was a prospective cross-sectional observational study conducted in a single dialysis unit, BBraun Avitum Botosani, Romania in october 2015, that included 69 hemodynamic stable patients (divided into two: 36 patients are CLD-free and 33 patients with CLD) on regular HD three-times a week for at least three months. Study group were selected from 270 HD patients according to the following exclusion criteria: 1) age <18 years old; 2) hospitalization or acute illness in the preceding 3 months; 3) psychiatric disorders (like mental retard or dementia); 4) who declined to participate to the study. Informed consent was obtained from all the study participants.

Bioelectrical Impedance Analysis of body composition

Bioelectric impedance analysis is a very common method, used to estimate the body composition, particularly the body fat, muscle mass and lean body mass. It determines the electrical impedance, upon flow of a low-intensity alternating electric current, through body tissues. Total body water (TBW), extra- and intracellular water (ECW, ICW), body cell mass (BCM), total fat mass (TFM), fat free mass (FFM), protein mass and body muscle mass (BMM) were directly measure in the first 30 minutes of the HD session by the Body Composition Analyzer (Maltron Bio Scan 920-2, Medical Device Class IIA, UK) using four pairs of skin electrodes: one pair on the hand, second above the cubital fossa and near to clavicle, the third one on foot, and the last one above the knee and the iliac crest, all of them placed in a supine position of the patient). An alternating electrical current of 800 μA intensity at a frequency of 50 kHz was sent through the body.

Nutritional assessment

Nutritional status was evaluated by using standard methods like mSGA (modified Subjective Global Assessment) test, biochemical markers and anthropometric measurements (AM). Biochemical parameters included serum albumin, creatinine and CRP. AM included body mass index (BMI), subcutaneous fat - tricipital skinfold (TSF- a skinfold calipter measurement), mid-arm circumference (MAC), and mid-arm muscle circumference (MAMC, an indicator of skeletal muscle mass and it is calculated by a specific formula MAMC= MAC- (3.14 x TSF)). All were measured in pre-dialysis. mSGA (modified Subjective Global Assessment) relied on seven components—weight change, dietary intake, gastrointestinal symptoms, functional capacity, comorbidity, subcutaneous fat, and signs of muscle wasting. Each component was given a score from 1 (normal) to 5 (severe). Thus, the MS (malnutrition score), sum of all components, ranged from 7 (normal) to 35 (severely malnourished). Patients with mSGA score from 7-21 are considered with mild degree of malnutrition and from 21 to 34 with moderate malnourished.

Body Protein Index

To assess whole body somatic protein stores, we devised the body protein index (BPI). The volume of body protein mass was measured by multifrequency bioelectrical impedance analysis and then BPI was calculated as body protein mass (kg) divided by height in meters (m2).

Statistical analysis

The analysis was made with SPSS 16.0 and a P value<0.05 was considered statistically signi cant. Baseline characteristics of the study sample, assessed by descriptive statistics, are presented as mean ± standard deviation (SD) as appropriate. Pearson's correlation is used to assess the magnitude and direction of association between biological nutritional markers and BIA parameters. ANOVA and t-student test are used to compare cantitative nutritional BIA parameters and biohemical nutritional indicators between the groups.

RESULTS

Table 1. Comparative bioelectrical impedance analysis parameters between the groups

Bioelectrical impedance analysis parameters (t student test)	Lot HD-CLD-vs. HD-CLD+	
	HD-CLD- (n=36)	HD-CLD+ (n=33)
BCM - Body Cell Mass (kg)	32.27±7.15	32.13±5.18
	t = 0.090. p = 0.929	
TBW - Total Body Water (l)	42.47±9.40	43.60±7.63
	t = -0.549, p = 0.585	
TBW Total Body Water %	55.59±8.52	57.84±7.94
	t = -1.131 , p = 0.262	
Malnutrition index	0.67±0.04	0.78±0.06
	t = -8.035 , p = 0.000	
ECW - extra cellular water (%)	46.38±1.83	46.6±1.92
	t = -0.542, p = 0.590	
ECW - extra cellular water (l)	19.78±4.89	19.78±3.47
	t = -0.081, p = 0.936	
ICW -Intracelular Water (l)	23.37±7.02	22.74±3.56
	t = 0.475, p = 0.637	
BMM -Muscular mass (kg)	28.70±6.07	28.0±4.94
	t = 0.516 , p = 0.608	
TBF - Total Body Fat (kg)	20.70±9.81	19.50±10.99
	t = 0.479, p = 0.634	
TBF - Total Body Fat (%)	25.91±8.16	24.34±8.94
	t = 0.759 , p = 0.451	
LFFM - Lean Fat Free Mass (%)	76.17±7.76	73.06±9.17
	t = 1.526, p = 0.132	
LFFM - Lean Fat Free Mass (kg)	55.96±12.31	55.88±8.93
	t = 0.029, p = 0.977	
Protein Reserve of the body (kg)	12.32±2.72	12.39±1.95
	t = -0.118, p = 0.907	

HD CLD- hemodialysed patients without chronic liver disease; HD CLD+ hemodialysed patients with chronic liver disease.

Table 2. mSGA- Comparative malnutrition score between the groups

Pearson Chi-pătrat = 2.236, p = 0.135		mSGA		Total
		Mild Malnutrition (7<21)	Moderate Malnutrition (≥21<34)	
HD CLD-	n	35	1	36
	%	97.2%	2.8%	100.0%
HD CLD+	n	29	4	33
	%	87.9%	12.1%	100.0%
Total	n	64	5	69
	%	92.8%	7.2%	100.0%

HD CLD- hemodialysed patients without chronic liver disease; HD CLD+ hemodialysed patients with chronic liver disease; mSGA-modified Subjective Global Assessment score.

Table 3. Antropometric parameters (MAC, MAMC, TSF) – Comparative data between both groups

AM (test t Student)	Groups	N	Mean±SD
MAC	HD CLD-	36	26.33±4.6
t = 0.863, p = 0.391	HD CLD +	33	25.33±4.9
TSF	HD CLD -	36	1.72±0.6
t = 0.978, p = 0.331	HD CLD +	33	1.56±0.6
MAMC	HD CLD -	36	22.88±1.9
t = 1.333, p = 0.187	HD CLD +	33	22.23±2.0

AM-antropometric measurements; MAC-mid-arm circumference;TSF-tricipital skin fold);

MAMC- mid-arm muscle circumference; SD-standard deviation.

Table 4. Correlation between mSGA and AM in both study samples

Clinical nutritional markers	Mild Malnutrition (7<21)		Moderate Malnutrition(≤21<34)	
	HD CLD-	HD CLD+	HD CLD-	HD CLD +
	Mean±SD		Mean±SD	
BMI (kg/m2)	25.59±6.4	24.68±6.7	23.70	23.22±2.0
MAC	28.35±2.8	27.42±2.9	26.00	25.22±3.6
MAMC	22.92±1.9	22.42±2.0	21.60	20.82±1.7
TSF	1.73±0.6	1.59±0.68	1.40	1.40±0.8

BMI-body mass index; AM-antropometric measurements; MAC-mid-arm circumference; TSF-tricipital skin fold); MAMC- mid-arm muscle circumference; SD-standard deviation.

Table 5. Correlation between BPI and clinical, laboratory and BIA nutritional parameters

Clinical, Laboratory and BIA nutritional markers	HD CLD-		HD CLD +	
	Body Protein Index			
	r	p	r	p
MAC	.546**	.001	.421*	.015
MAMC	.496**	.002	.696**	.000
TSF	.293	.083	-.074	.681
Serum Albumin	.164	.338	.003	.985
Serum Creatinin	.438**	.008	.363	.038
BMM (kg)	.718**	.000	.938**	.000
LFFM %	-.178	.299	-.072	.691
LFFM (kg)	.702**	.000	.942**	.000
Protein Reserve (kg)	.940**	.000	.965**	.000
mSGA (malnutrition score)	-.196	.252	-.461**	.007

HD CLD- hemodialysed patients without chronic liver disease; HD CLD+ hemodialysed patients with chronic liver disease; BPI- body protein index;BMI- body mass index; MAC-mid-arm circumference; TSF-tricipital skin fold); MAMC- mid-arm muscle circumference; BMM- body muscular mass; LFFM- lean fat free mass; SD-standard deviation.

DISCUSIONS

Evaluation and monitoring of nutritional status is a fundamental concept in providing nutritional care to patients with end-stage renal failure. Until now there have been, however, few practically available indices assessing whole body protein stores of patients. The measurement of bioelectrical impedance is an important clinical-diagnostic tool for each physician to assess the nutrition and hydration of the patients. It represents an affordable and non-invasive method that provides useful information on changes in body composition. Bioelectrical impedance analysis estimates the electric impedance of an electric current passing through the body allowing the determination of various BIA parameters.

The majority of our study patients was found to suffer of a variable degree of malnutrition; 92.8% had a mild degree of malnutrition and only 7.2% moderate malnutrition. No patients reported severe malnutrition (mSGA score = 35) and none with adequate nutritional status (mSGA score<7)(table 2). In the HD CLD+ group, the percentage of those with a moderate malnutrition was 12.1%, higher compared to the other group (2.8%) but statistically not significant (table 2). If we do a quick literature review of the malnutrition prevalence among HD patients worldwide, we can easily observe that Iraq is joining us to the top of the list. The study results conducted by Khadum et al. in 2012 , indicates that the majority of the subjects suffer from moderate malnutrition according to several indicators including anthropometric measurements, laboratory investigations and (type and quality) of food. Most of study sample was illiterate and despite that they were nutritionally instructed did not reflected the desired compliance. A second study from Iraq on HD patients indicated that malnutrition was present in 63.5% of patients with no significant gender differences. A cross-sectional study in Jordan used SGA to assess nutritional status among HD patients found that 50% of female patients were malnourished and 75% of male patients were malnourished. Studies from Saudi Arabia showed that malnutrition in HD patients was generally lower than that reported in Jordanian and Iraqi studies.

Assessing nutritional status among the maintenance hemodialysed patients by bioelectrical composition analysis revealed differences with no statistical differences between both groups (HD-CLD-/HD-CLD+). Exception from the rule did it Malnutrition Index which recorded indeed a better score in HD subjects free of liver disease. Mean BPI in HD CLD+ patients was not significantly lower than those of HD CLD- subjects (7.94 ± 1.14 vs 7.22 ± 0.93, p= 0.04). But on the other hand, strong correlations were found between BPI and anthropometric measurements, serum albumin and creatinine concentrations and also with BIA nutritional markers. A inversely moderate correlation with mSGA was found in both HD groups. In a similar study of Nakao et al., in 2007, BPI in both HD and PD (peritoneal dialysed) patients was significantly lower than those of control group, but no significant differences in BPI values was found between diabetic and non-diabetic subjects. The clinical characteristics, laboratory data and analysis by bioimpedance of all patients are summarized in tables 1-5.

CONCLUSIONS

BPI calculated from measurement of multifrequency bioelectrical impedance analysis could evaluate whole body somatic protein stores, and is a potentially useful new marker assessing nutritional status in patients with chronic renal failure. A relatively limitation of this study was the number of patients who participated. Increasing the number of patients would possibly strengthen our observations.

REFERENCES

1. Broers NJH, Cuijpers ACM, Van Der Sande FM, et al. The first year on haemodialysis: A critical transition. Clin Kidney J 2015;8(3):271-7.
2. Marcelli D, Brand K, Ponce P, et al. Longitudinal Changes in Body Composition in Patients After Initiation of Hemodialysis Therapy: Results From an International Cohort. J Ren Nutr 2016;26(2):72-80.
3. Keane D, Gardiner C, Lindley E, et al. Changes in Body Composition in the Two Years after Initiation of Haemodialysis: A Retrospective Cohort Study. Nutrients 2016;8(11):702.
4. Dekker MJ, Marcelli D, Canaud B, et al. Unraveling the relationship between mortality, hyponatremia, inflammation and malnutrition in hemodialysis patients: results from the international MONDO initiative. Eur J Clin Nutr. 2016; 70(7):7 79–784.
5. Dekker MJE, Konings C, Canaud B, et al. Interactions between malnutrition, inflammation, and fluid overload and their associations with survival in prevalent hemodialysis patients. J Ren Nutr. 2018;28(6):435–444.
6. Fouque D, Vennegoor M, Ter Wee P, et al. EBPG Guideline on Nutrition, Nephrology Dialysis Transplantation 2007;22(2):ii45–ii87.
7. Kalantar-Zadeh K, Kleiner M, Dunne E, et al. A modified quantitative subjective global assessment of nutrition for dialysis patients. Nephrol Dial Transplant, 1999, 14 (7), 1732-1738.
8. Kyle UG, Bosaeus I, De Lorenzo AD, et al. Biolectrical impedance analysis – Part I: Review of the principles and methods. Clin Nutr. 2004; 23: 1226–1243.
9. Kadhum IA, Mohammed WK. Nutritional status of adult hemodialysis patients in Al-Najaf Al-Ashraf governorate. Iraqi Natl Nurs Spec 2012; 25: 64-78.
10. Al-Saedy AJ, Al-Kahichy HR. The current status of hemodialysis in Baghdad. Saudi J Kidney Dis Transpl 2011; 22: 362-367.
11. Tayyem RF, Mrayyan MT. Malnutrition, and anthropometric and biochemical abnormalities in end-stage renal disease patients. Saudi Med J 2007; 28: 1575-1581.
12. Al-Saran KA, Elsayed SA, Molhem AJ, et al. Nutritional assessment of patients in a large Saudi dialysis center. Saudi Med J 2009; 30: 1054-1059.
13. Suzuki H, Kimmel PL (eds): Nutrition and Kidney Disease: A New Era. Contrib Nephrol. Basel, Karger, 2007, vol 155, pp 18-28. doi: 10.1159/000100993.