Nutrition Characteristics of the Patients on Continuous Ambulatory Peritoneal Dialysis
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Introduction
During the last years, the number of patients affected by end-stage renal failure on chronic renal replacement therapy is increasing. A high incidence of morbidity and mortality is present in spite of the significant scientific and technological improvements in the field of therapy by chronic dialysis (1). The results of treatment are strongly associated with the prescribed dose of dialysis and the nutritional status of the patients (2). Chronic renal failure is characterized by plenty of metabolic and endocrine disorders, which contribute to protein-energy malnutrition and to protein depletion. These disorders persist, and they get even worse in patients on hemodialysis (HD) or peritoneal dialysis (PD) (1,2).

A lot of positive effects by continuous ambulatory peritoneal dialysis (CAPD) treatment are emphasized:
- good regulation of serum biochemistry and correction of anemia;
- improvement of acid-base balance and volume;
- effective clearance of middle molecules;
- continuous energy supplementation.

Patients on CAPD quickly recover, body-weight and hematocrit increase, acid-base and volume balance is even better than in patients on other depuration modalities. These phenomenon, which pointed to anabolic condition, were explained by continuous dialysis process and higher clearance of middle-mass molecules (1,2).

On the other side, many harmful effects are recognized:
- continuous supplementation of calorie is a superfluos energy load and it can aggravate hyperglycemia; hyperinsulinemia and hypertriglyceridemia, and eventually cause obesity;
- shortage of appetite, because of glucose absorption and the sensation of fullness in the abdomen, often causing that patients on CAPD take insufficient amounts of food;
- continuous loss of protein, aminoaicids, vitamins and other nutritive factors in dialysate.

These occurrences have long term metabolic and nutritional consequences which might limit the application of CAPD (1, 2). Causes of malnutrition in patients on PD are numerous: nutritional status at the beginning of chronic dialysis treatment, metabolic and hormonal disorders, dialysis dose and dietary protein intake, protein losses, the state of chronic inflammatory syndrome, comorbidity and social and economic conditions (3).

Nutritional status in PD patients is assessed by:
Biochemical parameters (albumin, prealbumin, IG-1, essential aminoaicids, hemoglobin, cholesterol, creatinine kinetics); immunological indices (number of lymphocytes, C3, skin tests); anthropometric measures; bioelectrical impedance analysis (BIA); dual-energy X-ray absorptiometry (DEXA); muscle biopsy; prompt neutron activation analysis (PNAA); dilution with isothops; assessment of protein intake (dietary recall, protein cathabolic rate calculation); subjective global assessment score (SGA).

Multiple markers, in various combination, are used in assessment of the nutritional status in patients on PD (4).

The use of BIA measurement in body-composition assessment has been receiving recent investigative attention. This approach in searching an optimal method of assessing human body composition has been suggested for evaluation because it is safe, non-invasive, convenient, easy and unexpensive (5, 6).

BIA is a method to measure the resistance (R, the opposition to the flow of an alternating electrical current) and the reactance (Xc, the capacity of cell membranes to store electrical charge). The principle of this method is based upon the different electrical conductivities of different tissues: high for water and lean tissue, and low for skin, bone and fat (1). Impedance to the electrical flow of a localized injected current is related to the volume of a conductor (the human body) and the square of the height of the conductor (approximated by body height). Resistance R is defined as the pure opposition of a biological conductor to flow of an alternating current, whereas reactance Xc is the resistive effect due to capacitance produced by tissue interfaces and cell membranes. Capacitance, or the storage of electric charge by a capacitor, causes the current to lag behind the voltage when projected on a time scale, creating a phase shift. This shift is quantified geometrically as the angular transformation of the ratio of reactance to resistance, or phase angle. High values of reactance and phase angle suggest intact cell-membrane structures and high body cell mass. As cell-membrane integrity is destroyed and fluid shift associated with increases in total body water are observed, both reactance and phase angle decline to nearly zero (7).

Many studies have demonstrated strong correlation between BIA and fat-free mass (determined by hydrodensitometry) and total body water measured by isotope dilution (8, 9). Distribution of body water between the intracellular water (ICW) and the extracellular water (ECW) phases is of clinical concern in obese, critically ill, malnourished patients and in other patients with abnormal hydration (10,11). BIA techniques are widely used to assess body composition in surgical intensive-care units after operations, in patients affected by liver insufficiency, in severe dehydration due to infective deseases, in anorexlic
and other malnourished patients, and – during the last years, in dialysis patients (12, 13, 14, 15, 16).
Small portable BIA-measurement devices are now available to make use of a tetrapolar electrode configuration to measure the resistance in the body flow of the injected current and yield a measure of total body resistivity.

Aim of the study
The aim of the study was to analyze hydration and nutritional status in a group of patients on peritoneal dialysis on the basis of common biochemical markers and BIA analysis.

Material and methods
Standard tetrapolar impedance measurements were obtained in a group of patients on chronic peritoneal dialysis treatment (PD). We examined 50 patients, 26 male and 24 female, middle-age 55±13 years (range 28 to 78 years), affected by end-stage renal disease of different leading cause, on chronic PD treatment during 3 to 60 months. Only 2 of the patients were on automated peritoneal dialysis program, while the others were on continuous ambulatory peritoneal dialysis (CAPD), performing 4 to 5 2-l exchanges daily. BIA measurements were performed with a tetra-polar analyser at 50 kHz frequency. Two pairs of electrodes were attached on the right hand the right foot with patients supine on a bed, the legs not touching at the thighs and the arms not touching the torso. Kt/V, total weekly creatinine clearance (Ccr) and weekly residual renal function (RRF) were assessed according the internationally advised methods. We assessed serum creatinine, total serum protein, serum albumin, cholesterol and tryglicerides, hemoglobin and hematocrit levels, C-reactive protein.

Statistical analysis was performed by the Pearson’s correlation test, the Student’s t test and the Wilcoxon test.

Results
In the examined group there were 20 (40%) diabetic patients; 12 (24%) of the patients were older than 65 years; 44 (88%) patients were hypertensive; one patient was obese (2%) and only 2 (4%) were malnourished according to their body-mass index (BMI); 3% of the patients were anuric. Kt/V was 2.27±0.36, total weekly Ccr was 67.5±27.8 l and weekly RRF was 37.8±20.8 l. Common biochemical markers of nutrition and body composition of our patients on CAPD are reported on Table 1. and Table 2.

Table 1. Biochemical markers of nutrition in CAPD patients

<table>
<thead>
<tr>
<th></th>
<th>Creatinine (µmol/l)</th>
<th>Total serum protein (g/l)</th>
<th>Albumin (g/l)</th>
<th>Cholesterol (mmol/l)</th>
<th>Tryglicerides (mmol/l)</th>
<th>C-reactive protein (mg/l)</th>
<th>Hematocrit</th>
<th>Hemoglobin (g/l)</th>
</tr>
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<tbody>
<tr>
<td>Mean ±std</td>
<td>724±210</td>
<td>62±5.4</td>
<td>34.7±5</td>
<td>5.79±1.4</td>
<td>2.2±1.3</td>
<td>2.1±1.2</td>
<td>0.28±0.4</td>
<td>92±14.6</td>
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</tbody>
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Table 2. Body composition of patients on CAPD treatment

<table>
<thead>
<tr>
<th></th>
<th>Body-weight (kg)</th>
<th>Body-mass index</th>
<th>%Fat</th>
<th>Fat weight (kg)</th>
<th>%Muscle mass</th>
<th>Muscle mass (kg)</th>
<th>%Water</th>
<th>BIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ±std</td>
<td>70.5±14</td>
<td>24.4±4.5</td>
<td>22.4±11.32</td>
<td>16.1±10</td>
<td>77.6±11.3</td>
<td>54.4±11.9</td>
<td>61.14±10.1</td>
<td>482.5±180.2</td>
</tr>
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We found correlations between bioelectrical impedance vector (BIVA) and the common biochemical markers of nutrition: serum albumin, total serum protein, lipids, creatinine. Body weight and body composition parameters paralleled the changes in biochemical nutrition markers. Statistical analysis with parametric and non-parametric tests showed that gender, age, diabetes mellitus didn’t influence biochemical status nor body composition in our patients.

Discussion
Most of our PD patients performed adequate dialysis according to international criteria and they had residual renal function. The incidence of diabetic and hypertonic patients was high, but at levels elsewhere reported (1). We found a very low prevalence of malnutrition and obesity in our patients, being moderate to significant malnutrition diagnosed in about 40% and obesity in an increasing number of CAPD patients (1, 4, 18, 19).

Fourteen 14 (28%) patients were hypoalbuminemic (≥32 g/l), being hypoalbuminemia considered a strong comorbidity and mortality predictor (4). BIA measurements are a simple, non-invasive and fast method to assess body composition and to complement the biochemical assessment of nutritional status in PD patients.

References