Body Composition, Nutritional Status and Mortality in Peritoneal Dialysis Patients

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Abstract

**Background:** Protein energy malnutrition is highly prevalent and a risk factor for mortality in peritoneal dialysis (PD) patients. In this study we have investigated the association of body composition parameters with nutritional status and outcomes in PD patients.

**Methods:** We enrolled 63 PD patients between November 2000 to May 2008. On enrollment, demographic, clinical and biochemical data were recorded. Patients were followed to May 2011. Body composition was determined by bioelectrical impedance analysis (BIA).

**Results:** Mean age was 54 years. At enrollment, the mean (± SD) serum albumin, creatinine and nPCR were 3.71 ± 0.59 g/dL, 11.38 ± 4.2 mg/dL and 0.94 ± 0.27 g/kg/day respectively. Mean (± SD) body mass index (BMI), phase angle (PA) and extracellular mass/body cell mass (ECM/BCM) ratio were 25.37 ± 5.46 Lbs/inch², 8.06 ± 1.6 degrees and 1.21 ± 0.59 respectively. Albumin, and creatinine directly correlated with BMI (p=0.027 for albumin; p<0.0001 for creatinine) and PA (p<0.0001 for albumin; p=0.031 for creatinine) and inversely correlated with ECM/BCM ratio (p=0.001 for albumin; p=0.07 for creatinine). During the study period 26 patients expired. Patients who survived had higher BMI (p=0.05), PA (p=0.017) and lower ECM/BCM ratio (p=0.04) compared to those who expired. In Cox's multivariate analysis, adjusting for confounding variables, higher levels of PA (Relative risk: 0.52, p=0.009) and lower levels of ECM/BCM ratio (Relative risk: 1.039, p=0.035) were significantly and independently associated with increased survival in PD patients followed up to 11 years.

**Conclusions:** Estimates of BMI, PA and ECM/BCM ratio reflect nutritional status and are important predictors of long term survival in PD patients. It may be useful to incorporate these parameters in the management of malnutrition and overall health in these patients.

Keywords: Peritoneal dialysis; Bioimpedance analysis; Nutrition; Body composition; Nutritional markers; Mortality

Abbreviations: PD: Peritoneal Dialysis; BIA: Bioimpedance Analysis; BMI: Body Mass Index; ECM: Extracellular Mass; BCM: Body Cell Mass; nPCR: normal Protein Catabolic Rate; PA: Phase Angle

Introduction

Although the survival rate of end-stage renal disease (ESRD) patients continues to improve, it remains markedly reduced compared to the general population. Adjusted rates for all-cause mortality are seven times greater for dialysis patients than for individuals in the general population [1]. Despite the increasing knowledge and improvement in dialysis treatment, mortality of PD patients remains high. Identification of various risk factors and aggressive risk factor modification are important strategies to improve outcomes in these patients.

Malnutrition is highly prevalent and is an important factor contributing to high morbidity and mortality in PD patients [2-4]. Lower levels of serum nutritional markers are associated with higher mortality in PD patients [5-8]. Low dietary protein intake and protein energy wasting have been reported to be associated with increased mortality in PD patients [9,10].

BIA has been recognized as a simple, fast and noninvasive method for assessing the body composition and fluid status in PD patients [11]. We and others have investigated the relationship of BIA derived body composition parameters with nutritional markers, morbidity and mortality in PD patients [12,13]. We have reported that BIA derived ECM/BCM ratio, a marker of malnutrition, is an independent predictor of survival in PD patients followed to 8 years [14]. In this study we have extended the follow-up period to 10 years and in addition to ECM/BCM ratio, we have investigated the relationships of two other important body composition parameters such as BMI and PA with nutritional markers and survival in PD patients. In the present study, we have analyzed the data in a different way to add new information to the literature.

Materials and Methods

We enrolled 63 PD patients between November 2000 to May 2008. On enrollment, demographic, clinical and biochemical data were recorded. BIA measurements were conducted using an impedance plethysmograph (800 mA and 50 kHz). Patients’ electrical impedance values, resistance and reactance were used for computerized calculation of the body composition parameters using Cypress version 1.0 (BIA-101; RJL/Akern Systems). Patients were followed until September, 2011. Long Island College Hospital Institutional Review Board approved this study protocol and informed consent was obtained from each patient.

Statistical analysis

Continuous variables are expressed as mean ± SD. For selected
comparisons between group means, parametric (t-test) or non-parametric (Mann-Whitney test) tests were used. Correlations were reported as either the Pearson correlation coefficient or the Spearman rank correlation coefficient. Observed survival was computed by the Kaplan-Meier method [15]. Independent predictors of survival were determined by Cox regression analysis. Calculations were performed using SPSS for Windows 12.0.1 (IBM Corporation, Armonk, New York).

Results

Demographics and biochemical characteristics

Mean age was 54 ± 16 (SD) years. Fifty-five percent were women, sixty-three percent were of African descent and twenty-five percent were diabetic. At enrollment, the mean (± SD) serum albumin, creatinine and nPCR were 3.71 ± 0.59 g/dL, 11.38 ± 4.2 mg/dL and 0.944 ± 0.27g/kg/day respectively. Mean (± SD) body mass index (BMI), phase angle (PA) and extracellular mass/body cell mass (ECM/BCM) ratio were 25.37 ± 5.46 Lbs/inch², 6.06 ± 1.6 degrees and 1.21 ± 0.2 respectively.

Correlation of body composition parameters with serum nutritional markers

Albumin, and creatinine directly correlated with BMI (r=0.28, p=0.027 for albumin; r=0.48, p=0.001 for creatinine) and PA (r=0.49, p<0.0001 for albumin; r=0.28, p=0.031 for creatinine) and inversely correlated with ECM/BCM ratio (r=−0.42, p=0.001 for albumin; r=−0.24, p=0.07 for creatinine). nPCR directly correlated with BMI (r=0.24, p=0.08) and PA (r=0.26, p=0.049).

Patients were divided into 2 groups based on combined median values of BMI, ECM/BCM ratio and PA. Group 1: patients with BMI ≤ 24.72 & PA ≤ 6.0 & ECM/BCM ratio ≥ 1.18. Group 2: patients with BMI>24.72 & PA>6.0 & ECM/BCM ratio<1.18. As reflected by BIA indexes, group 2 patients had better nutritional status and were healthier than group 1 patients. Levels of nutritional markers such as albumin, creatinine and nPCR were significantly higher in Group 2 patients compared to those in Group 1 patients (Table 1).

Body composition parameters and survival

Patients were followed maximum up to 11 years. Three patients were followed up to 11 years. Fourteen patients were followed between 4 to 8 years. Twenty patients were followed between 2 to 4 years and number of patients followed less than 2 years was 26. Mean and median follow-up were 2.98 and 2.31 years respectively. During the study period, 26 patients (42%) expired. Patients who survived had higher follow-up were 2.98 and 2.31 years respectively. During the study period, 26 patients (42%) expired. Patients who survived had higher

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 patients</th>
<th>Group 2 patients</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin (g/dL)</td>
<td>3.34 ± 0.47</td>
<td>3.49 ± 0.56</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>9.41 ± 3.21</td>
<td>14.60 ± 4.33</td>
<td>0.001</td>
</tr>
<tr>
<td>nPCR (g/kg/day)</td>
<td>0.805 ± 0.23</td>
<td>1.00 ± 0.25</td>
<td>0.034</td>
</tr>
</tbody>
</table>

nPCR: normal protein catabolic rate

Group 1: Patients with BMI ≤ 24.72, PA ≤ 6.0 & ECM/BCM ratio ≥ 1.18
Group 2: Patients with BMI>24.72, PA>6.0 & ECM/BCM ratio<1.18

Table 1: Biochemical nutritional markers by body composition in peritoneal dialysis patients.
by deMutsert et al that PD patients with a low BMI during dialysis have a twofold increased mortality risk [19]. However in Cox’s multivariate model when we adjusted for the confounding variables, the association between BMI and survival did not reach statistical significance (p=0.09). The association between BMI and outcome of PD had significant survival advantage in their patient population [21]. However, McDonald et al. reported that obesity at the commencement of PD therapy is a significant risk factor for death and technique failure [22].

PA reflects cellular health and nutritional status in PD patients. In this study, PA was inversely associated with mortality risk and independently predicted 11 year’s survival in PD patients. This confirms the previously published reports concerning the prognostic ability of PA in PD patients followed up to more than 5 years [16,23].

Our study has several limitations. Although BIA measurements correlate well with gold standard methodology and BIA has been validated for dialysis patients, this method has some limitations including variability of BIA technique. The results of the BIA analysis may be influenced by hydration status, body position during procedure, recent physical activity and food consumption etc. Accuracy of the method can be improved by following the guidelines such as the use of same machine by the same operator, reducing the disturbances in fluid distribution, restricting food and alcohol consumption and exercise prior to the testing.

In summary, our study showed that enrollment BMI, PA and ECM/BCM ratio which reflect nutritional status and are important predictors of survival in PD patients followed up to 11 years. However, the dietary and therapeutic intervention studies are needed to demonstrate if improvement in BIA parameters and nutritional status are associated with greater survival in PD patients.

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Disclosures

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References


