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Diet Patterns, Nutrition Status and Physical Activity in Patients on Peritoneal Dialysis

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Abstract

Background: End-stage renal disease (ESRD) and renal replacement therapy options are associated with malnutrition, which occurs in 30-50% of patients. Suboptimal nutritional status and physical inactivity are common in peritoneal dialysis patients also and are consequences of the restrictive diet, appetite loss, and poor physical fitness.

Materials and methods: This single-center observational study aimed to analyze the dietary intake, body composition, and physical activity of 19 peritoneal dialysis (PD) patients. Dietary assessment was performed with a three-day 24-hour dietary recall, while nutritional status was assessed with body composition measurements. Patients' physical performance was assessed with a handgrip test and a sit-stand test. Each value was expressed as a percentage or mean ± SD. Continuous variables between normal values and of study values were compared using paired t-tests and Wilcoxon signed ranks test. A two-tailed P value <0.05 was considered statistically significant.

Results: The mean caloric intake of the 19 patients was 1545 ± 295 kcal/day (21.4 kcal/kg BW/day), and the mean protein intake was 0.8 g/kg BW/day. The mean value of body mass index was 24.4 ± 2.9 kg/m^2, phase angle was 5.2 ± 0.9, lean tissue index was 14.5 ± 2.8 kg/m^2 and adipose tissue index was 9.3 ± 3.6 kg/m^2. The results of the handgrip test and the sit-to-stand test showed muscular weakness associated with low caloric intake.

Conclusion: In our PD patients, average energy and protein intakes were inadequate according to dietary recommendations, which are related to reduce muscle strength among observed patients and a poor physical activity profile. The overall approach of nutritional counseling is necessary to improve the nutritional status of patients.

Keywords: Peritoneal dialysis; Nutrition; Diet recall; Body composition; Physical activity

Introduction

End-stage renal disease (ESRD) and renal replacement therapy options, i.e., peritoneal dialysis (PD) and hemodialysis, are associated with malnutrition, which occurs in 30-50% of patients. It is currently unclear whether malnutrition and sarcopenic obesity are simply secondary to poor nutrition or are related to other complex associated conditions such as chronic systemic inflammation, fluid overload, underlying comorbidities and physical inactivity [1].

Globally, it has already been estimated that PD patients have protein and energy intakes below the National Kidney Foundation Kidney Dialysis Outcome Quality Improvement (NKF-K/DOQI) guidelines [2] and approximately 40% of dialysis patients are classified as clinically malnourished [3,4]. Several factors such as inadequate dialysis, loss of residual renal function, volume overload, intestinal dysbiosis, chronic fatigue, older age and concomitant diseases are known to contribute to lower nutrient intake in PD patients [5]. Lower amounts of ingested dietary protein may also be partly a consequence of the comparatively higher concentration of uremic toxins in PD, which are known appetite suppressants [6]. Reduced nutrient intake due to specific (additional) dietary restrictions associated with a fear of hyperkalemia and hyperphosphatemia, which begins in patients with chronic kidney disease (CKD) stage 3-4, and may also result in protein-energy wasting (PEW) [4]. In addition, the PD technique involves solute and fluid exchange across peritoneal membranes, which is associated with a daily loss of about 7 g of protein and a gain of about 100 g of sugar with the dialysate [6-8].

Dietary recommendations for ESRD patients are not universal and are influenced by numerous individual factors [9]. The current standard recommends 1.2-1.3 g/kg protein per day and 35 kcal energy/kg body weight/day, which is not easy to comply with in practice [2]. On the other hand, adequate energy intake is more important than daily protein intake itself to maintain lean body mass and prevent uremic sarcopenia [10,11]. In parallel, we are becoming increasingly aware of plant-based diets and their more positive influence on health in general, but also in PD patients, as this type of diet has an alkaline influence on the acid balance of the body [11,12]. Increased consumption of foods containing proteins with low biological value, such as plant proteins, could be a good alternative to the intake of proteins with high biological value, which are associated with a higher acid load. In addition, phosphate intake from plant proteins is lower than from proteins with high biological value (dairy products and meat) [13,14].

Nowadays, various methods are available to assess nutritional status, including clinical symptom assessment, subjective global assessment (SGA) and the malnutrition inflammation (MIA) score questionnaires, various serum laboratory measurements (serum albumin levels), 24-hour dietary recalls, and other novel techniques such as dual-energy X-ray absorptiometry. Meanwhile, bedside bioimpedance spectroscopy (BIS) has gained popularity as a noninvasive, rapid, and relatively inexpensive method for quantitative assessment of patient volume and nutritional status. In particular, phase angle (PhA) and lean tissue index (LTI) of BIS are most commonly used to determine a patient's nutritional status [3,15].

Nutritional guidelines in PD recommend regular and thorough assessment of appetite, body weight measurements, clinical status, and food intake, as well as analysis of laboratory markers of nutrition (albumin, potassium, bicarbonate and phosphate) [2]. To follow these recommendations and optimize the rehabilitation program of PD patients, a multidisciplinary team with nutrition and exercise counseling is crucial [16-18].

The aim of this study is to evaluate the dietary habits and nutritional status of our PD patients and to investigate their relationship with body mass composition and physical performance.

Methods

This study was an observational, cross-sectional study that included patients treated with maintenance PD for at least 3 months in a hospital PD unit at University Medical Center Ljubljana. Patients were enrolled in the study from April to October 2018. Patients with inadequate dialysis, active congestive heart failure, advanced liver disease, active malignancy, recent peritonitis or hospitalization within 3 months, and active inflammation were excluded. All subjects signed an informed consent form before enrollment in the study. The study protocol was approved by the Medical Ethics Committee of Slovenia.

Anthropometric measurements (body weight, height, and body mass index (BMI)) were performed according to standard protocols. Blood samples were taken in the morning and plasma concentrations of glucose, hemoglobin, creatinine, blood urea nitrogen (BUN), calcium, phosphorus, albumin, magnesium and protein were measured.

A 24-h dietary recall in three days was repeated with the open platform for food evaluation (OPKP) food database program performed three times during the observation period [16,19]. Nutritional status was compared with body mass composition using the principle of bioimpedance spectroscopy (BIS) to calculate lean tissue index (LTI), fat tissue index (FTI), overhydration (OH), and Ph A as a prognostic index [15]. The PhA was calculated *via* bio-impedance spectroscopy using the following formula: Ph A (°)=arctangent (X c/R) * (180/π). Physical performance was assessed with a five-second standing and sitting test (five seconds stand to sit test; SS5) and a handgrip test.

Each value was expressed as a percentage or mean ± SD. Continuous variables between baseline and study values were compared using paired t-tests and Wilcoxon signed ranks test. A two-tailed P value <0.05 was considered statistically significant. Statistical analysis was performed using SPSS for Windows, version 16.0 (SPSS, Chicago, IL, USA).

Results

A total of 19 patients (7 women and 12 men) treated with PD were recruited. The mean age of the patients was 52 ± 13.7 years, body weight 72.4 ± 13.4 kg and BMI 24.4 ± 2.9 kg/m^2. Baseline biochemical data (presented as mean values ± SD) are shown in table 1.

Intake of energy, protein, fat, carbohydrate, potassium, sodium, phosphate (using 24-hour recall), body mass composition with BIS (LTI, FTI, OH, PhA), and handgrip and SS5 test results compared with recommended or normal values for all parameters are shown in table 2. Frequency of consumption of various protein foods in patients on PD is shown in table 3.

According to the body composition measurements, our study patient cohort has a comparable LTI but a significantly lower PhA, a higher FTI and is over-hydrated compared to normal population values [20]. Both physical fitness tests (SS5 and handgrip test) show significantly lower regular physical activity with low upper extremity strength and low repetitive leg strength compared to the normal population.

Table 1: The basic biochemical data of patients on peritoneal dialysis (presented as mean ± SD).

Biochemical parameter	Mean ± SD
Albumin (g/l)	37,7 ± 3,4
Protein (g/l)	62 ± 4,9
Phosphate (mmol/l)	1,6 ± 0,4
Creatinine (µmol/l)	776 ± 258
Magnesium (mmol/l)	0,9 ± 0,1
Urea (mmol/l)	23 ± 6,4
Hemoglobin (g/l)	114 ± 11
Potassium (mmol/l)	4,6 ± 0,7
Calcium (mmol/l)	2,3 ± 0,1
Cholesterol (mmol/l)	4,3 ± 0,9
HDL (mmol/l)	1 ± 0,3
LDL (mmol/l)	2,4 ± 0,6
CRP (mg/l)	<5

Table 2: 24-hour diet recall, body mass composition and physical activity test in patients on peritoneal dialysis.

	Patients data	SD	Recommended values	SD	P-value
Kcal	1544	295	2450	371	<0.001
Protein (g)	58	16	88	16	<0.001
Protein kg/W	0.8	1.6	1.2	1.0	<0.001
Fat (g)	56	18	55	8	0.69
Carbohydrates (g)	199	39	210	32	0.19
Na (g)	2.2	0.9	2.0	1.0	0.39
K (g)	1.6	0.5	2.0	0.5	0.002
Phosphate (g)	0.8	0.2	1.0	0.2	<0.001
Ph A (^{0})	5.2	0.9	6.0	1.0	<0.001
LTI (kg/m^2)	14.5	2.8	14.6	3.2	0.14
FTI (kg/m^2)	9.3	3.6	7.0	2.2	0.01
OH (kg)	2.2	1.8	1.0	1.0	0.006
SS5 (s)	9.4	3.6	5.0	3.0	<0.001
HG (kg)	23.8	6.1	40	10	<0.001

Ph A: phase angle; LTI: lean tissue index; FTI: fat tissue index; OH: overhydration; SS5: 5 seconds stand sit test; HG: hand grip test.

Table 3: Frequency of consumption of various protein foods in patients on peritoneal dialysis.

Food	% of patients
Milk	74
Chicken meat	68
Cheese	58
Beaf meat	57
Cheese spread	47
Butter	42
Eggs	37
Cottage cheese	21
Joghurt	21
Pork meat	10
Fish	10

Daily calories (1544 ± 295 *vs* 2450 ± 371; p <0.001) and especially protein (58 ± 16 g/day *vs* 88 ± 16 g/day, p <0.001) intake is significantly lower compared to the normal population. Intake of fat, carbohydrates and sodium is comparable; however intake of potassium and phosphate is much lower in comparison with the normal population.

Higher caloric intake is positively correlated with better results in the SS5 test (correlation coef. +0.50, p=0.03), but not with hand grip test (correlation coef. +0.05, p=0.84) (Figure 1).

Intake of proteins is not associated with hand grip (correlation coef. -0.20, p=0.41), nor with SS5 test (correlation coef. -0.20, p=0.40). Phosphate intake (according to the dietary recall report) is positively correlated with an adequate protein intake (correlation coef. +0.86, p <0.001).

There was no association between Ph A and caloric intake (correlation coef. +0.38, p=0.10), as well as Ph A and protein intake (correlation coef. +0.38, p=0.10).

Discussion

The results presented here show that our group of patients treated with PD consumes a suboptimal amount of protein and energy. However, this low energy and protein intake is not consistent with their nutritional status, which shows sarcopenic obesity, with body mass indices in the range of normal values, but with lower muscle mass and increased fat mass [21]. Based on simple physical fitness tests (i.e., SS5 and the handgrip test) [17], low physical fitness values were found, including very low upper extremity strength and low repetitive leg strength [22]. As expected and reported also by others [23,24], these values were related to the suboptimal nutritional status of our patients, especially caloric and protein intake.

Patients treated with PD are more susceptible to PEW due to the undesirable effects of the PD technique itself, associated with the absorption of sugars from the dialysate and protein loss from the peritoneal fluid [7,8]. The additional reasons for inadequate food intake and sarcopenia in our patients were comparable to other studies and related to loss of appetite, social, emotional and economic problems and a sedentary lifestyle [17,25,26].

The 24-hour dietary recall is a subjective method of assessing nutrient intake, and the sub-record of food intake is very often [27]. However, sub-analysis of the 24-hour dietary recall revealed that our patient's diet consisted of a high intake of carbohydrates and fat, with a much higher intake of animal proteins than vegetable proteins, and a lower intake of fish, vegetables and fiber. Although our patients do not have hyperkalemia and hyperphosphatemia, their potassium and phosphate intakes are too low. Thus, they still have many reserves to improve in their nutritional status by consuming enough protein to avoid a negative nitrogen balance and choosing a healthier diet with more vegetable protein. This is consistent with other studies in ESRD patients, which found that PD patients barely followed recommendations to eat 1.2 g protein per kg body weight [27,28].

The beneficial influence of a plant-based diet, resulting from its protective and therapeutic influence on uremic toxins, is increasingly recognized in CKD patients [29]. Plant-based proteins are very suitable for dialysis patients because phosphate uptake from plant proteins is lower than from proteins with high biological value [30]. In addition, a plant-based diet is also important for improving acid-base balance because potential renal acid load (PRAL) is lower on a diet with more plant foods [13,14]. Recommendations now include a diet with 50% or more plant-based protein in conjunction with potassium control and regular physical activity to prevent frailty [2,3,17,29].

Conclusion

In our PD patients, average energy and protein intakes are inadequate according to dietary recommendations, which are related to reduce muscle strength among observed patients and poor physical activity profile. The overall approach of nutritional counseling is necessary to improve and nutritional status of patients. More intensive efforts, including a multidisciplinary approach with dietitians, nephrologists, and kinesiologists, are needed to continuously educate and encourage people on PD to consume optimal amounts of high-quality food and follow exercise schedules.

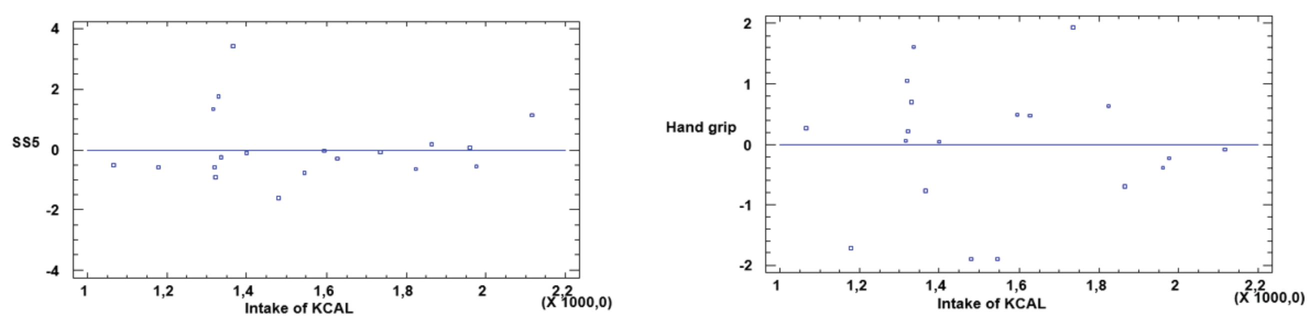

Figure 1: Correlations between 5 seconds stand-seat test and hand grip test and caloric intake from 24 h diet recall.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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