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Original Article

The Evaluation of the Association Between Serum Cholesterol Levels with Nutritional Parameters and Anthropometric Measures in Non-Diabetic Continuous Ambulatory Peritoneal Dialysis Patients

Diyabetik Olmayan Sürekli Ayaktan Periton Diyalizi Hastalarında Serum Kolesterol Seviyeleri ile Beslenme Parametreleri ve Antropometrik Ölçümler Arasındaki İlişkinin Değerlendirilmesi

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ABSTRACT

We evaluated the association of serum cholesterol levels with nutritional parameters and anthropometric measurements in non-diabetic patients undergoing continuous ambulatory peritoneal dialysis (CAPD) treatment. Thirty-nine (21 males, 18 females) patients were enrolled into the study. The patients were divided into two groups as group 1 (n=20, serum cholesterol ≥ 200 mg/dl), and group 2 (n=19, serum cholesterol < 200 mg/dl.) according to serum cholesterol levels. A positive correlation was found between serum levels of cholesterol and prealbumin (r=0.428, p=0.007), transferrin (r=0.322, p=0.046), triglyceride (r=0.537, p=0.001), LDL-C (r=0.739, p<0.001), and HDL-C (r=0.454, p=0.004), and between BMI and FM (r=0.851, p<0.001), FFM (r=0.503, p=0.001), TBW (r=0.522, p=0.001) and MAMC (r=0.849, p<0.001). BIA in group 1 was higher than group 2 (p = 0.007). No statistical relation was found between serum cholesterol, and the anthropometric measurements.

In conclusion, we found a positive correlation between serum cholesterol levels and prealbumin and transferrin but not in anthropometric measurements in CAPD patients. Further, large scale studies are needed to conclude an absolute judgement.

KEY WORDS: Cholesterol, Nutrition, Anthropometric measurements, CAPD.

ÖZ

Bu çalışmada diyabetik olmayan Sürekli Ayaktan Periton Diyaliz (SAPD) tedavisi alan hastalarda serum kolesterol seviyeleri ile beslenme parametreleri ve antropometrik ölçümler arasındaki ilişkiyi değerlendirdik. 39 hasta (21 kadın, 18 erkek) çalışmaya alındı. Hastalar serum kolesterol seviyelerine göre grup 1 (n = 20, serum kolesterol ≥ 200 mg/dl) ve grup 2 (n = 19, serum kolesterol < 200 mg/dl) olarak ikiye ayrıldı. Serum kolesterol ile prealbumin (r=0,428, p=0,007), transferin (r=0,322, p=0,046), trigliserid (r=0,537, p=0,001), LDL-K (r=0,739, p<0,001) ve HDL-K (r=0,454, p=0,004) arasında pozitif korelasyon ve vücut kitle indeksi (VKİ) ile yağ kitlesi(YK) (r=0,851, p<0,001), serbest yağ kitlesi (SYK) (r=0,503, p=0,001), total vücut suyu (TVS) (r=0,522, p=0,001) ve orta kol kas çevresi (OKKÇ) (r=0,849, p<0,001) arasında da pozitif korelasyon saptandı. Bioelektrik impedans analiz (BIA) grup 1'de grup 2'ye göre daha yüksek idi (p=0.007). Serum kolesterol düzeyi ile antropometrik ölçümler arasında istatistiksel bir ilişki saptanmadı.

Sonuç olarak, SAPD hastalarında serum kolesterol düzeyi ile prealbumin ve transferrin arasında pozitif korelasyon saptandı ancak antropometrik ölçümlerle korelasyon saptanmadı. Bu konuda daha kesin yargıya varmak için daha geniş kapsamlı ileri araştırmalara gereksinim vardır.

ANAHTAR SÖZCÜKLER: Kolesterol, Beslenme, Antropometrik ölçümler, SAPD

INTRODUCTION

It has been well recognized that nutrition has great importance and is associated with morbidity and mortality among patients with end stage renal disease (ESRD) undergoing either hemodialysis (HD) or continuous ambulatory peritoneal dialysis (CAPD) therapy (1). Maintaining the nutritional status of patients is accepted to be an important aspect of CAPD therapy. The serum cholesterol level is an important marker of nutritional status among dialysis patients. The serum cholesterol level is also an independent risk factor of mortality in patients undergoing HD or CAPD therapy. The relation between serum cholesterol and mortality has been described as either "U shaped" or "J shaped" with an increasing risk for mortality as the serum cholesterol rises above the 200 to 300 mg/dl range or falls below approximately 200 mg/dl (2,3). In contrast, the relation between low levels of serum cholesterol and increased mortality is not observed in CAPD patients probably due to confounding by greater energy (glucose intake) and /or hypertriglyceridemia or smaller sample size of the patients in the studies (4). Moreover, nutritional parameters such as serum albumin, creatinine, prealbumin, transferrin and anthropometric measurements are also important methods in the assessment of the nutritional status. On the other hand, reports on the relationship between serum cholesterol and other markers of nutritional status such as serum albumin, creatinine, prealbumin, and also with inflammation markers (e.g. C-reactive protein) and anthropometric data are somewhat contradictory.

Our aim in this study was to evaluate the relationship between serum levels of cholesterol and nutritional parameters and anthropometric measurements in non-diabetic CAPD patients.

MATERIALS and METHOD

Thirty-nine non-diabetic patients (21 females, 18 males) who were undergone CAPD therapy in the dialysis center of Dicle University Medical Faculty hospital for at least six months were enrolled into the study. Obese (n=3) and diabetic (n=3) patients were excluded. The study was designed as a descriptive and analytic clinical trial. The demographic features, dialysis adequacy (weekly Kt/Vurea), and educational and economic status of the patients were obtained from the registries of each patient at the dialysis center. Blood biochemistry values were measured in the morning at the dialysis center after a 12-hour fasting period. The hematocrit (hct) and hemoglobin (hb) levels of the patients were also measured at the beginning of the study. The anthropometric measurements [waist/hip ratio (W/H), body mass index (BMI), fat mass (FM), free fat mass (FFM), total body water (TBW), bioelectric impedance analysis (BIA), mid-arm muscle circumference (MAMC)] were obtained on the same morning.

The patients were divided into two groups as group 1 ($n = 20$, serum cholesterol ≥ 200 mg/dl) and group 2 ($n = 19$, serum cholesterol < 200 mg/dl) according to the serum cholesterol level.

The educational and economic status, dialysis adequacy, anthropometric measurements, nutritional parameters, hct and hb levels, and also CRP levels of the two groups were compared.

The data were analysed using Student's t-test, one-way ANOVA and Pearson's correlation test. The data were shown as mean ± SD. A p value < 0.05 was accepted as statistically significant.

RESULTS

Demographic and nutritional parameters and anthropometric measurements of both groups were shown in table I and table II. BIA was higher in group 1 than in group 2 ($p < 0.007$). Triglyceride, LDL-C, and HDL-C were lower in group 2 than in group 1 ($p=0.045$, $p<0.001$, and $p=0.021$ respectively). Comparison of cholesterol with serum albumin, CRP levels and BMI were demonstrated in figure 1, 2, and 3 respectively.

There was no statistically significant difference between the educational status and economic status of the groups ($p>0,05$). The level of serum cholesterol was not associated with the educational and economic status of the groups.

The serum levels of cholesterol were higher in group 1 than in group 2 ($p <0.001$). A statistically significant correlation was not established between the serum levels of cholesterol and anthropometric measurements. There was a positive correlation between the serum levels of cholesterol and prealbumin ($r=0.428$, $p=0.007$), transferrin ($r = 0.322$, $p = 0.046$), triglyceride ($r = 0.537$, $p = 0.001$), LDL-C ($r = 0.739$, $p<0.001$), and HDL-C ($r = 0.454$, $p = 0.004$). While there was positive correlation between BMI and FM ($r = 0.851$, $p<0.001$), FFM ($r = 0.503$, $p = 0.001$), TBW ($r = 0.522$, $p = 0.001$) and MAMC ($r = 0.849$, $p<0.001$), there was a negative correlation between BMI and BIA ($r = 0.377$, $p = 0.018$). A positive correlation was seen between MAMC and BMI ($r = 0.849$, $p<0.001$), FFM ($r = 0.738$, $p<0.001$), FFM ($r = 0.568$, $p<0.001$) and TBW ($r = 0.539$, $p<0.001$). A positive correlation was found between albumin and hct levels ($r = 0.563$, $p<0.001$). A negative association was established between CRP and albumin levels ($r = - 0.423$, $p = 0.007$)

Table I. The demografic features and anthropometric measurements of the groups

Parameters	Group 1 n = 20	Group 2 n = 19	p
Gender (F / M)	1 2/9	1 1/9	0.886
Age (years)	39.0 ± 10.7	38.8 ± 12.4	0.967
PD Duration (months)	49.8 ± 27.2	51.3 ± 26.8	0.862
Weekly Kt/V$_{urea}$	2.02 ± 0.54	1.88 ± 0.44	0.415
Education (0/1)*	**3/17**	**6/13**	**0.230**
Income (0/1)**	**1/4**	**6/13**	**0.421**
Waist / hip (cm)	0.88 ± 0.84	0.88 ± 0.82	0.962
BMI (kg/cm^2)	20.65 ± 3.37	23.07 ± 4.27	0.057
FFM (%)	45.65 ± 8.73	49.14 ± 8.67	0.218
TBW (%)	33.7 ± 6.1	35.8 ± 6.5	0.293
BIA	524.2 ± 121.7	432.8 ± 71.4	**0.007**
MAMC (cm)	21.7 ± 2.6	23.7 ± 4.3	0.090

(*); 0 not graduated, 1 graduated
(**); 0 bad economic status, 1 normal/good economic status

Table II. Comparison of the nutritional status, hematocrit, hemoglobin, and serum levels of CRP in both groups

Parameters	Group 1 n = 20	Group 2 n = 19	P
Cholesterol (mg/dl)	223.8 ± 33.4	156.9 ± 13.2	**<0,001**
Albumin (gr/dl)	3.0 ± 0.5	2.9 ± 0.4	0.369
Creatinin (mg/dl)	10.7 ± 2.7	10.3 ± 3.1	0.634
Prealbumin (mg/dl)	44.8 ± 14.7	36.8 ± 13.0	0.082
Transferrin (mg/dl)	212.0 ± 49.2	191.9 ± 55.9	0.240
Triglyceride (mg/dl)	165.5 ± 103.5	112.3 ± 42.5	**0.045**
LDL – C (mg/dl)	144.7 ± 40.4	103.7 ± 14.8	**<0.001**
HDL– C (mg/dl)	38.6 ± 13.5	29.8 ± 8.4	**0.021**
Hematocrit (%)	30.9 ± 6.7	29.2 ± 4.3	0.377
Hemoglobin (g/l)	10.3 ± 2.2	9.7 ± 1.4	0.351
CRP (mg/dl)	13.09 ± 17.2	13.0 ± 13.9	0.997

DISCUSSION

It has been reported that CAPD therapy has a nutritional advantage over HD therapy. This advantage may be due to a number of factors including control of acidosis, reduced protein turnover, maintenance of residual renal function, the absence of the catabolic effects of a bioincompatible membrane and a stable blood urea concentration (5). However, both cross-sectional and longitudinal studies have suggested that up to two thirds of the patients on HD or CAPD therapy are malnourished (6). It is increasingly recognized that malnutrition underlies many of the manifestations of uremic syndrome such as increased susceptibility to infection, impaired wound healing, poor rehabilitation, vascular disease, and anemia. Some factors contributing to malnutrition are insulin resistance due to both post-receptor defects and hormonal factors (7), substantial losses of protein (5-15gr/24h) from the peritoneal cavity (8), metabolic acidosis (9), inadequacy of dialysis (10), high peritoneal permeability (11) and comorbid illnesses (12).

In addition to these parameters, the serum level of cholesterol (SLC) may be a useful screening factor for detecting malnutrition in patients on CAPD therapy. Indeed, it was interestingly found that the serum level of cholesterol is associated with the prognosis. Both high SLC (>250 mg/dl) and low SLC (<150mg/dl) were established as poor prognostic factors. The inverse association of total cholesterol levels with mortality in dialysis patients is probably due to the cholesterol lowering effect of systemic inflammation and malnutrition, and not to a protective effect of high cholesterol concentrations (13). The mean SLC range of our patients was between 157 to 224 mg/dl in both groups. It has been reported that SLC commonly exhibits a high degree of collinearity with other nutritional markers such as serum albumin, creatinine, prealbumin, as well as age (14,15). Nevertheless, the serum level of albumin is a negative acute phase reactant and it is both an inflammatory and nutritional marker in HD and CAPD patients. The association of hypoalbuminemia with cholesterol and inflammation in chronic dialysis patients has not been demonstrated yet (16). In addition, SLC may be influenced by the same comorbid conditions, such as inflammation, that affect other nutritional parameters (eg; serum albumin). Han et al (17) suggested that there was no difference in serum cholesterol in CAPD patients whose serum level of albumin was less than 3.5 gr/dl as compared with those with levels ≥ 3.5 gr/dl. No significant differences were observed in serum albumin concentrations between group 1 (3.0 ± 0.5 g/dL) and group 2 (2.9 ± 0.45 g/dL) (p = 0.369). The serum level of albumin was not associated with SLC (r = -0.019, p = 0.910). The association of SLC with serum albumin was shown in figure 1. Our finding was the same as those of Santos et al (16). However, we found a positive correlation between serum cholesterol levels, prealbumin (r = 0.428, p = 0.007), and transferrin levels (r = 0.322, p = 0.046). There was also no statistically significant difference in serum levels of CRP between group 1 and 2 (p = 0.997). In addition, no significant correlation was observed in serum levels of CRP between the groups (r = 0.132, p = 0.422). The association between SLC and the serum levels of CRP was shown in figure 2. These findings suggest that SLC may be influenced by some factors besides serum albumin and serum CRP levels and the matter needs further investigation. On the other hand we can say that there was a negative correlation between serum levels of CRP and albumin that does not affect the SLC as a negative correlation was established between levels of CRP and albumin (r = - 0.423, p = 0,007).

The overweight CAPD patients who have higher anthropometric parameters have a lower urea kinetic

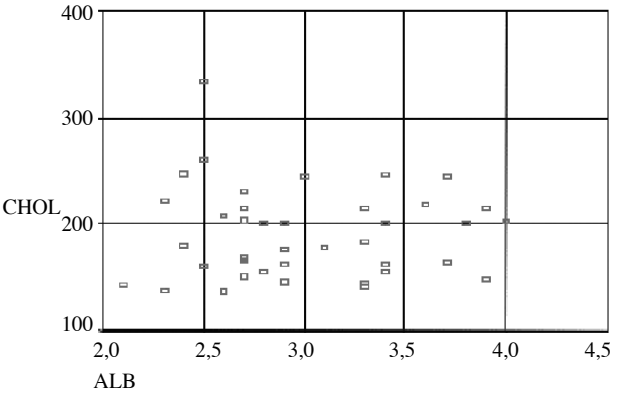

Figure 1. *The relationship between cholesterol and serum level of albumin.*

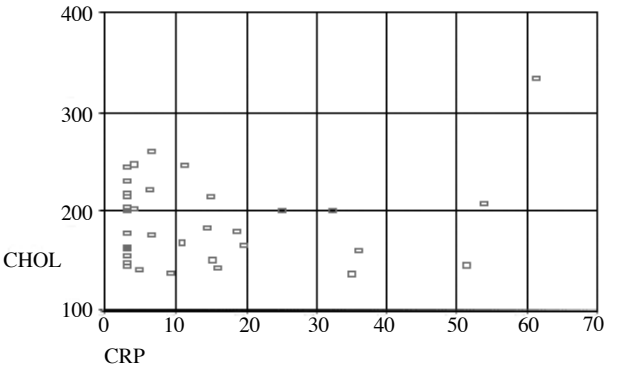

Figure 2. *The relationship between cholesterol and serum level of CRP.*

model owing to a higher urea distribution volume (18). The patients were in normal range of BMI. Therefore, no statistically significant difference was found in BMI between group 1 (20,65 ± 3,37) and group 2 (23,07 ± 4,27) (p = 0,057). A significant difference was also not observed between SLC and the other anthropometric measurements. We found a significant difference in BIA

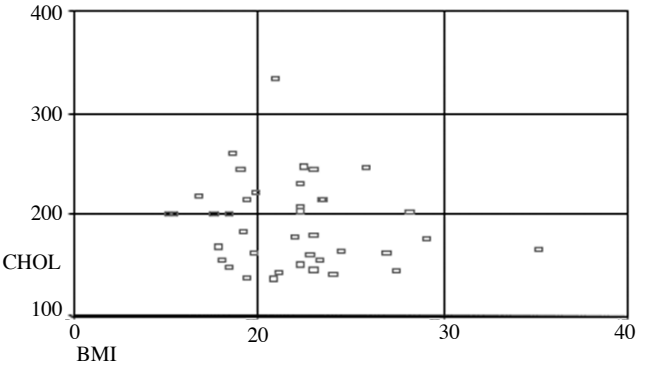

Figure 3. *The relationship between Cholesterol and BMI.*

between the two groups (p = 0.007) but we did not find any association between SLC and BIA (r = 0.287, p = 0.076). Although the BMI of group 1 was lower than group 2, the SLC was higher in group 1. The relationship between SLC and BMI was shown in figure 3.

In conclusion, we found a positive correlation between serum levels of cholesterol, prealbumin and transferrin, but not with anthropometric measurements in CAPD patients. Further studies with large scales are needed since low numbers of the patients limited the value of this study.

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