ISSN: 2005-4238

International Journal of Advanced Science and Technology

IJAST

Science & Engineering
Research Support soCiety

International Journal of Advanced Science and Technology
Vol. 29, No. 11s, (2020), pp. 3224-3229

Influence Of 12 Week Workouts On Physical Activity In Patients With Chronic Kidney Disease

Daminov Botir, Saipova Durdona, Egamberdieva Dano, Ruzmetova Iroda, Raimkulova Narina
Tashkent Pediatric Medical Institute

ABSTRACT

The article describes the definition of the physical activity of patients with chronic kidney disease, as well as the effect of 12-week physical training on physical activity in patients with chronic disease of stage 3-4 who are on a low-protein diet.

KEY WORDS*: chronic kidney disease, physical activity, low protein diet*

INTRODUCTION

It is well known that patients with chronic kidney disease (CKD) exhibit limited physical function. Limiting the tolerance of physical activity not only reduces the quality of life, but also leads to an increase in morbidity and mortality.

Symptoms of CKD include symptoms such as fatigue, muscle weakness, and decreased daily physical activity. Various types of physical activity, such as exercise, improve the physical condition of patients with CKD and increase their tolerance to physical activity [1-2].

At the same time, patients with a number of chronic diseases other than CKD also suffer from poor physical performance and muscle atrophy, but more evidence has been accumulated of the positive effect of exercise in such patients [3].

Increased physical activity is associated with improved ability to perform everyday activities, professional tasks. Therefore, regular exercise is recommended for such patients. In the DOPPS study, patients who performed regular physical activity had a higher quality of life associated with health, good physical fitness and sleep quality indicators, with fewer patients with limited physical activity and lack of appetite [4].

The nutritional status of patients is one of the fundamental conditions affecting mortality and the degree of rehabilitation of patients with CKD, including those undergoing renal replacement therapy [5-7].

Insufficient intake of protein and energy leads to a violation of nutritional status: this leads to a decrease in muscle mass and a decrease in the amount of adipose tissue. Approximately 20-50% of patients with pre-dialysis stages of CKD show nutritional disorders [8].

Increased protein breakdown and slower elimination of nitrogenous toxins leads to uremia. Elevated creatinine also has a toxic effect on internal organs and tissues, where sarcosine is converted to methylguanidine. In addition, changes in protein metabolism in uremia are closely associated with impaired amino acid metabolism [9, 10].

With a low-protein diet, which is recommended at stages 3-4 of CKD, a decrease in the plasma concentration of essential amino acids is due to both insufficient intake of amino acids from food, low calorie intake and a violation of their endogenous synthesis, as well as acidosis. [10]

The aim of our study was to study the effect of 12-week training on physical activity in patients with 3-4 stages of CKD on a low-protein diet.

MATERIALS AND METHODS

The study included 119 patients with CKD C3 and C4 stages. Clinical data included anthropometric data: height, weight, body mass index (BMI), measurement of the circumference of the mid-thigh and circumference of the middle shoulder, laboratory data: urea, creatinine, electrolytes, albumin, total protein, hemoglobin. Glomerular filtration rate (rSCF) was estimated using the formula CKD-EPI (2011) [11]. All patients underwent instrumental research methods: ECG, echocardiography, cardiopulmonary stress test.

The patients included in the study were offered three nutrition options - with a low and limited protein content, as well as a low protein content with correction by keto-analogues (Ketosteril,

manufacturer FRESENIUS, Germany, in an average dose of 1 tab. / 5 kg of weight). Table 1 shows the nutritional types of patients participating in the study.

To assess physical activity, we used tests: a six-minute walk test, an equilibrium test (the ability to stand together with legs). The assessment was carried out on a scale of 0 to 4 points for each task. Patients received 0 points for each task that they could not complete. Summing up the points, a final performance score was created for each participant (range from 0 to 12), with higher scores indicating better physical activity. Depending on the total score, patients were divided into 3 groups with scores of 0–4, 5–8, and 9–12.

Within 12 weeks, all patients performed exercise programs that were selected individually for each patient. The program of physical exercises was compiled for independent homework and included cardiovascular exercises (primarily walking, morning exercises) and strength training exercises with dumbbells of 1, 3 kg. The frequency of training was at least 3 times a week and had a duration of at least 20-30 minutes. Patients kept training diaries, which were studied by the doctor at each subsequent dose. The training exercise was adjusted depending on the patients' self-awareness; if necessary, the training time was increased to 60 minutes.

Table 1. Characterization of the nutritional status of patients included in the study

	Type of diet	Protein Intake (g / kg / day)	Main characteristics	Notes
1 group n = 38	Low protein diet	0.6 g / kg / day;	Mixed proteins, bread, and other carbohydrate-rich foods. Carbohydrates are the basis of diet	protein intake up to 0.6 g / kg / body weight
2 group n = 42	Low protein diet	0.6 g / kg / day + keto analogs (ketosteril 1 tab. 5 / kg weight)	Mixed proteins, bread, and other carbohydrate-rich foods. Carbohydrates are the basis of diet	Protein intake up to 0.6 g / kg / body weight
3 group n = 39	Low protein diet	0.6–0.8 g / kg / day;	Mixed proteins (animal and vegetable origin) is corrected by quantity: ordinary food, based on traditional dishes.	Often consistent with what patients already eat.

Statistical data processing was carried out according to standard methods using a software package.

RESULTS

The general clinical characteristics of patients are presented in Table 2. The first group of patients (24% of patients) received a diet with a low protein content, the second group comprised 40% of patients, the third group comprised 37% of patients receiving a diet with a low protein content. The ratio of men and women, the average glomerular filtration rate, daily proteinuria and BMI did not differ significantly between the groups.

Table 2. General clinical characteristics of patients with CKD

Parameters	Low protein diet 0.6 g / kg / day	Low protein diet 0.6 g / kg / day + keto analogs	Low protein diet 0.6 –0.8 g / kg / day	p
n (%)	38 (31.9)	42 (35.3)	39 (32.8)	
Men, n (%)	23 (60.5)	25 (59.5)	22(58)	
Women n (%)	15 (39,5)	17 (40.5)	17(42)	
Age (years)	49±2,2	47±2.3	46±1.4	<0,01
BMI (кг/м2)	26.6 ±2.32	27.0 ± 2.6.	25.8±0,66	0,207
Serum Creatinine (μmol \ L)	218,74±16	221,74±19.3	215,7±11,1	<0,01
GFR (ml / min)	30±2,5	29±3.6	31 ± 2,84	<0,01
Proteinuria (g / day)	0.67±0,13	0.69±0,26	0.68± 0,12	0,140
Glomerulonephritis, n (%)	19 (50)	20 (47.6)	19 (48.7)	
Nephroangiosclerosis, n (%)	10 (26.4)	12 (28.5)	13 (33.3)	
Hypertension n (%)	9 (23.6)	10(23.8)	7(18)	

The physical activity data of patients, which were determined before the start of physical training in the dynamics of 12 weekly training.

Table 3. Physical activity of patients before the start of physical training and in the dynamics of 12 weekly training

	1 group n = 38	2 group n = 42	3 group n = 39	p

	initially	12 week change	Initially	12 week change	initially	12 week change	
mid-thigh circumference (cm)	46.5±6.0	+0.3-1.2	47.3±5.9	+0.6-1.1	47.8±5.9	+0.7-1.1	0.0385
circumference of the middle of the shoulder (cm)	29.1±3.0	+0.4-0.9	29.8±2.0	+0.4-1.1	30.1±3.0	+0.6-0.9	0.0 03
VO2 peak (ml / kg / min)	22.56±1.84	+1.4-1.56	23.68±0.98	3.37-3.58	24,36±0.95	+2.66-2.98	<0.0001
Patients with 9-12 n points (%)	4 (11%)	7 (18,2%)	6(15%)	10 (23.9%)	8 (20.5%)	10 (25.6%)	0.001
Patients with 5-8 n points (%)	19 (50%)	21 (55.4%)	21(50%)	24(57.1%)	22 (56.4%)	25 (64.2%)	0.001
Patients with 0-4 n points (%)	15 (39%)	10 (26.4%)	15(35%)	8 (19%)	9 (23.1%)	4(10.2%)	0.001

In all examined patients, an increase in the circumference of the middle of the thigh and shoulder was recorded in the dynamics of 12-week training sessions.

The indicator of maximum oxygen consumption (MIC) increased in all groups (by 1.4, 3.37 and 2.66 ml / min * kg, respectively). Patients from the group with a low performance score were redistributed and partially transferred to the groups with high performance indicators.

A study of the physical activity of patients with different types of diets showed that in patients of the 1st group, even with a low nutritional status in the dynamics of 12 weekly training, there was an improvement in such physical indicators as the circumference of the middle of the thigh and shoulder, as well as a slightly improved BMD. When comparing groups of patients who received and did not receive ketosteryl (group 2 and 3, respectively), physical training for 12 weeks led to a significant improvement in indicators such as the circumference of the middle of the shoulder and BMD. However, in the group receiving ketosteryl, an indicator such as BMD significantly improved.

DISCUSSION

Our study shows that a decrease in renal function is associated with a deterioration in physical performance.

In a meta-analysis of Gaiqin Pei, et al. the authors, when studying the effects of physical training in 1305 patients with CKD of the pre-dialysis stages, there was a significant improvement in cardiorespiratory function (peak VO2) [12].

In a study by Guralnik JM, Ferrucci L et al. (2000) found that physical activity test scores correlate with renal function in patients with CKD. Available data indicate that the use of objective indicators of physical performance can help identify early signs of disability [13].

The inverse relationship between the indicator of tests of physical activity and the decrease in physical activity observed in previous studies suggests that the tests for assessing physical activity reflect a measurement of physical performance, which may be useful for determining the risk of a further decrease in physical performance in patients with CKD [13,14] . Our study suggests that a similar conclusion applies to physical disorders associated with CKD, but further prospective study is needed.

Eating disorders can underlie the relationship between renal function and impaired physical activity.

The relationship between kidney function and muscle strength probably reflects sarcopenia associated with renal failure. Results of physical activity tests for muscle strength were associated with lower serum albumin, and low levels of serum albumin, even within the normal range, were independently associated with weaker muscle strength [15]. Similarly, anemia has been described as another factor associated with lower levels of muscle activity physical activity tests in patients with CKD [16].

With CKD, patients with a low-protein diet have muscular depletion. A muscle is tissue that is affected by diet, exercise, and hormones that can affect protein metabolism. According to the results of studies, keto analogs, in particular, ketoleucine, reduce the degradation of muscle protein [17]. A study of the effects of ketoleucine showed that adaptation to protein restriction in the diet includes a decrease in leucine oxidation, which leads to more efficient use of dietary amino acids and postprandial inhibition of protein breakdown with a decrease in ureagenesis. These results were similar in patients with CKD on a low-protein diet [18]. Moreover, the decrease in amino acid oxidation during the low-protein diet with the addition of keto-analogs was maintained during the 16-month observation [19].

CONCLUSION

Regular dosed physical training has a positive effect on the physical condition of patients with CKD on a low-protein diet. Correction of keto-analogue nutrition improves the cardiorespiratory status of patients.

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