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ORIGINAL ARTICLE

Effect of calisthenic exercise program on inflammatory markers, quality of life and exercise capacity after renal transplantation: a randomized controlled study

Ayça AYTAR TIĞLI[1], Yavuz YAKUT[2]

Purpose: The aim of this study was to investigate the effects of calisthenic exercise training on inflammatory markers, biochemical values, quality of life and exercise capacity after renal transplantation.
Methods: This study involved 29 patients who underwent renal transplantation. Patients were randomly divided into 2 groups, calisthenic exercise and control groups. All patients' complete blood counts, serum creatinine, total protein, albumin, glucose, cholesterol, triglyceride, low- and high-density lipoprotein, C reactive protein and interleukin 6 levels were determined by appropriate biochemical methods. General quality of life was assessed with the Short Form 36 (SF-36), disease-specific quality of life was assessed with the Kidney Disease Quality of Life Questionnaire (KDQOL-SF) and exercise capacity was measured by the 6-Minute Walk Test (6-MWT). Supervised and home exercises were given to exercise group individually. Participants in the control group just received the education session and continued their current medical therapies.
Results: The social function subparameter of quality of life measurement was better in the Exercise Group ($p<0.05$). Level of patient satisfaction also was better in the Exercise Group ($p<0.05$). Serum biochemical levels, KDQOL-SF and 6-MWT evaluations were not statistically different between the groups ($p>0.05$). There was an increase in hemoglobin values and 18-meter improvement in 6-MWT in the exercise group ($p<0.05$).
Conclusion: This study showed that calisthenic exercise training increased exercise capacity, hemoglobin levels, satisfaction levels and some parameters of quality of life in renal transplantation patients and these results positively affect the outcomes of renal transplantation.
Keywords: Renal transplantation, Calisthenic exercise, Quality of life.

Renal transplantasyon sonrası kalistenik egzersiz programının inflamatuar belirleyiciler, yaşam kalitesi ve egzersiz kapasitesi üzerine etkisi: randomize kontrollü bir çalışma

Amaç: Bu çalışmanın amacı, kalistenik egzersiz eğitiminin böbrek nakli sonrası inflamatuar belirleyiciler, biyokimyasal değerler, yaşam kalitesi ve egzersiz kapasitesi üzerindeki etkilerini araştırmaktır.
Yöntem: Bu çalışmaya renal transplantasyon yapılan 29 hasta dahil edildi. Hastalar rastgele olarak kalistenik egzersiz ve kontrol grupları olmak üzere 2 gruba ayrıldı. Tüm hastaların tam kan sayımı, serum kreatinin, toplam protein, albümin, glikoz, kolesterol, trigliserit, düşük ve yüksek yoğunluklu lipoprotein, C reaktif protein ve interlökin 6 düzeyleri uygun biyokimyasal yöntemlerle belirlendi. Genel yaşam kalitesi Kısa Form 36 (SF-36), hastalığa özgü yaşam kalitesi Böbrek Hastalığı Yaşam Kalitesi Anketi (KDQOL-SF) ile değerlendirildi ve egzersiz kapasitesi 6 Dakika Yürüme Testi (6-DYT) ile ölçüldü. Egzersiz grubundaki kişilere bireysel olarak gözetimli egzersiz ve ev egzersizleri verildi. Kontrol grubundaki katılımcılara sadece eğitim seansı verildi ve mevcut tıbbi tedavilerine devam ettiler.
Bulgular: Yaşam kalitesi ölçümünde sosyal fonksiyon alt parametresinde egzersiz grubu daha iyiydi ($p<0,05$). Hasta memnuniyeti düzeyi de benzer şekilde egzersiz grubunda daha iyiydi ($p<0,05$). Serum biyokimyasal düzeyleri, KDQOL-SF ve 6-DYT değerlendirmeleri gruplar arasında istatistiksel olarak farklı değildi ($p>0,05$). Egzersiz grubunda hemoglobin değerlerinde artış ve 6-DYT'de 18 m iyileşme gözlendi ($p<0,05$).
Sonuç: Bu çalışma, kalistenik egzersiz eğitiminin böbrek nakli olan hastaların egzersiz kapasitesini, hemoglobin düzeylerini, memnuniyet düzeylerini ve bazı yaşam kalitesi parametrelerini arttırdığını ve bu sonuçların böbrek nakli sonuçlarını da olumlu yönde etkilediğini göstermiştir.
Anahtar kelimeler: Böbrek nakli, Kalistenik egzersiz, Yaşam kalitesi.

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1: Baskent University, Vocational School of Health Sciences, Department of Therapy and Rehabilitation, Ankara, Turkey.
2: Hasan Kalyoncu University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey.
Corresponding Author: Ayça Aytar Tığlı: aycatigli@baskent.edu.tr
ORCID IDs (order of authors): 0000-0002-4089-5406; 0000-0001-9363-0869
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Chronic renal failure affects not only medical but also social, economic and psychological conditions of the patients. Clinical signs and symptoms of patients are closely related to the grade and progression rate of renal failure. Glomerular filtration value of 5-10 ml/min refers to end-stage renal failure and requires renal replacement therapies such as dialysis or renal transplantation.[1]

Even after a successful renal transplantation, some medical problems may continue to affect these patients. Physical capacity, quality of life may not fully improve as expected in spite of medication. Decrease in physical capacity and fatigue may cause other diseases due to inactivity. Moreover, post-transplantation treatments can cause other problems such as adverse effects of drugs. Especially in this patient group, the incidence of cardiovascular diseases, hypertension and diabetes is high. It is stated that there is a relationship between the risk and/or severity of chronic diseases and high levels of inflammatory mediators.[2] Systemic inflammation has several measurable biomarkers, such as interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP).[3] Circulating inflammatory biomarkers originate from many sources, particularly visceral adipose tissue. Excess fat promotes macrophage uptake and both adipocytes and macrophages secrete a large number of cytokines (IL-6, TNF-α and leptin). ß-adrenergic receptor activation may be a mechanism that mediates exercise-dependent replacement of inflammatory mediators. B-adrenergic receptor activation of adipocytes increases pro-inflammatory cytokine secretion, and ß-adrenergic receptor density and activity may vary with exercise. Major depressive disorder, stress and anxiety are associated with increased inflammatory cytokines, and exercise has been shown to reduce clinical depression and anxiety. Skeletal muscle is another source of cytokines called myokines, which are thought to play a dual role of IL-6 as anti-inflammatory and pro-inflammatory. Long-term high-intensity exercise can significantly affect myokine production, thereby enhancing the anti-inflammatory effect of the exercise. Thus, multiple mechanisms (psychosocial and physiological) may mediate exercise-induced reduction of inflammatory factors. It is very important to know the effects of exercise type, duration and severity on systemic inflammation and to investigate the effect of exercise on which stage of exercise.[4]

Generally resistant and aerobic exercises training after transplantation has been investigated[5,6] but it should be noted that; It is often difficult for transplantation patients to perform high intensity exercise because of their degree of functional capacity.[5,6] Calisthenic exercises are motivating exercises and should be rhythmic[7] it has also been shown that low to moderate calisthenic exercise training requires little equipment and could be sustained for a long time as home exercise.[8]

Although the beneficial effects of exercise are mentioned in renal transplantation patients there are no studies on the relationship between calisthenic exercise training and inflammatory markers. Thus, the aim of this study was to investigate the effects of calisthenic exercise training on inflammatory markers, biochemical values, quality of life and exercise capacity after renal transplantation.

METHODS

Patients

This study was carried out at Başkent University Ankara Hospital nephrology outpatient clinic between October 2015 and February 2017 on patients who had renal transplantation surgery. This study was approved by Baskent University Ethics Committee (Approval number: KA15/276, date: 14/10/2015) and carried out according to the institutional guidelines and principles of the Declaration of Helsinki.

A total of 119 patients were screened for this study and at the end 29 patients were included in the study (Figure 1).

Study patients were referred from a physician who met the following inclusion criteria:

1) Patients between the ages of 18-60,

2) Patients with normal cognitive functions (Mini mental test score>24),[9]

3) Patients at least 6 months after renal transplantation,

4) Patients who had no regular exercise habits.

Patients were excluded from this study if they demonstrated any of the following;

1) Patients with neurological symptoms (Guillain–Barré syndrome, etc.),

2) Patients with a musculoskeletal system problem that would prevent from exercising,

3) Patients with heart failure,

4) Patients with unstable angina pectoris,

5) Patients with renal transplant rejections,

6) Patients with chronic liver failure,

7) Patients with a history of cerebrovascular accident (within the past 12 months),

8) Patients 24 months after renal transplantation surgery.

All participants provided written informed consent.

The sample size required to detect significant differences on mean difference (Δ) and common standard deviation (σ) of Kidney Disease Quality of Life Questionnaire scores. The sample size was determined as 12 patients in case of dropout in each group with the alpha level set at .05 and beta level set at .20 to achieve 80% power.

Before the study began, randomization procedure was performed using an online random-allocation software program.[10] Patients were randomized into two groups: exercise (n=14) and control (n=15) group.[11]

A complete medical history was obtained for each patient. Serum biochemical values and quality of life scores were used as initial; exercise capacity and patient satisfaction were used as second outcome assessments. Assessments repeated for all patients at the beginning and at the 8th week of the study. Patient satisfaction was assessed by visual analogue scale at the 8th week.

Primary Outcome Measures

a) Serum Biochemical Values

Biochemically, total blood, serum creatinine, total protein, albumin, glucose, cholesterol, triglyceride, low density lipoprotein (LDL), high density lipoprotein (HDL) and CRP measurements were determined by appropriate auto analyzers and IL-6 was measured by ELISA method.

b) Quality of Life

Health-related quality of life

The Turkish version of the Medical Outcomes 36-Item Short Form Health Survey (SF-36) was used to assess quality of life. SF-36, is a 36-item self-assessment scale consisting of eight subscales. This scale consists of physical function, physical role, emotional role, pain, vitality, general health and mental health subscales. Each subscale is scored between 0-100, with "0" being the lowest and "100" being the best quality of life. The Questionnaire is also valid and reliable in Turkish.[12,13]

Disease-specific quality of life

Kidney Disease Quality of Life Questionnaire (KDQOL-SF) was used to assess the level of quality of life specific to the disease. This scale is a measure for monitoring patients with end stage renal disease and evaluating various treatment effects and patients' well-being by self-report. The questionnaire contains 36 items and divided into 5 subscales. Scores in each subscale range from 0 to 100, with higher scores reflecting better disease-related quality of life. The questionnaire is valid and reliable in Turkish.[14-16]

c) Exercise capacity

The exercise capacity of the patients was assessed by 6 Minute Walk Test (6-MWT).[17] 6-MWT was applied twice, on the same day with an interval of half an hour. Patients were asked to walk as fast as possible at their own walking speed for 6 minutes on a 30-meter straight corridor. Oxygen saturation, heart rate, blood pressure values, fatigue and dyspnea perceptions were recorded before and after the test. Fatigue and dyspnea perception were assessed with Modified Borg Scale.[18] Every minute during the test, standard expressions were used to encourage the patient. At the end of the test, 6-minute walk distance was recorded and used for analysis.[17,18]

d) Patient satisfaction

Patients' satisfaction with physiotherapy was evaluated by visual analogue scale.

Five questions were asked for the level of satisfaction of the patients. The questions were as follows:

1. How satisfied are you with your pain after your treatment?

2. How satisfied are you with your functionality after your treatment?

3. How satisfied are you with all of your treatment?

4. How satisfied are you with your physiotherapist?

5. How satisfied are you with your quality of life after your treatment?

For the visual analogue scale, it is desirable that individuals express their satisfaction with a (x) mark on a scale of 100 mm. According to this, "0" means that the patients are not satisfied at all and "100" means that they are completely satisfied.[19]

Exercise Group

A calisthenic exercise program consisting of major muscle group exercises was instructed to the exercise group. Patients performed ten repetitive warm up exercises including upper and lower limb distal joint movements and breathing exercises before the calisthenic exercise program. The severity level of the training was set at 4-6 according to the Borg Scale and it was adjusted weekly with rests between exercises according to patients' tolerance. The severity of the training was at levels 4-6 according to the Borg scale. Calisthenic exercises were repeated 10-15 times in the first and second weeks; 15-20 repetitions in the third and fourth week; 25-30 repetitions in the 5th to 8th weeks. Patients were instructed to perform the exercises with rhythmic and rapid movement accompanied by music. For some exercises it was allowed to be supported by chairs or walls in case of difficulty.[20]

We gave exercises brochures to the patients and we explained to do these exercises at home 3 days a week and keep daily. Patients were asked to write an exercise diary and follow-ups were weekly by phone calls. In addition, they continued their calisthenic exercises not only as home exercise but also under the supervision of a physiotherapist at the clinic every 15 days. Exercises were performed in the exercise room in the hospital's physical therapy unit for an average of 60 minutes. When they arrived at 15 days, the exercise diaries were reviewed. The duration of treatment was a total of 8 weeks. Exercises were explained and applied individually.

Control Group

Patients in the control group were not included in any exercise training program. We have given nothing like brochures to the control group. Participants in the control group just received the education session and continued their current medical therapies. Education session includes the importance of exercise and the movements that need attention for transplantation patients. We suggested them to continue normal daily work and do regular walking. Although they did not receive a supervised exercise program, they gave a half-hour training session to explain the importance of exercise in terms of ethics, the movements needed to be paid attention after the transplantation and the importance of gait, and they contacted the physiotherapist. Therefore, satisfaction was also evaluated at the second assessment in this group.

Statistical analysis

All statistical analyses were conducted using the Statistical Package for the Social Sciences 18.0 (Statistical Package for the Social Sciences Inc, Chicago, IL, USA). Normal distribution characteristics of the data were tested with Mann Whitney U and Chi-Square Tests. Non-parametric Mann-Whitney U test was used to analyze differences between groups. The Wilcoxon test was used to analyze differences between dependent groups. The results were evaluated at a $p<0.05$ significance level of 95% confidence interval.

RESULTS

Patients were randomized into two groups: 4 females to 10 males in total 14 patients in the Exercise Group (mean±SD_{age} = 38.86±13.84, mean±$SD_{body\ mass\ index}$ = 25.67±5.61) and 5 females to 10 males in total 15 patients in the Control Group (mean±SD_{age} = 40.80±9.56, mean±$SD_{body\ mass\ index}$ = 26.42±4.80). The clinical characteristics of the patients were determined in Table 1. There was no statistically significant difference between the groups in terms of age, gender, body mass index, mini mental test score, duration and cause of renal failure, dialysis and organ donor status ($p>0.05$). The clinical characteristics of the patients are shown in Table 1.

Inter-group comparisons:

There was no statistically significant difference between the patient's initial and second assessment serum biochemical values ($p>0.05$), 6-MWT parameters showed no significant difference between the two groups whereas total distance significantly increased in exercise group compared to the control group

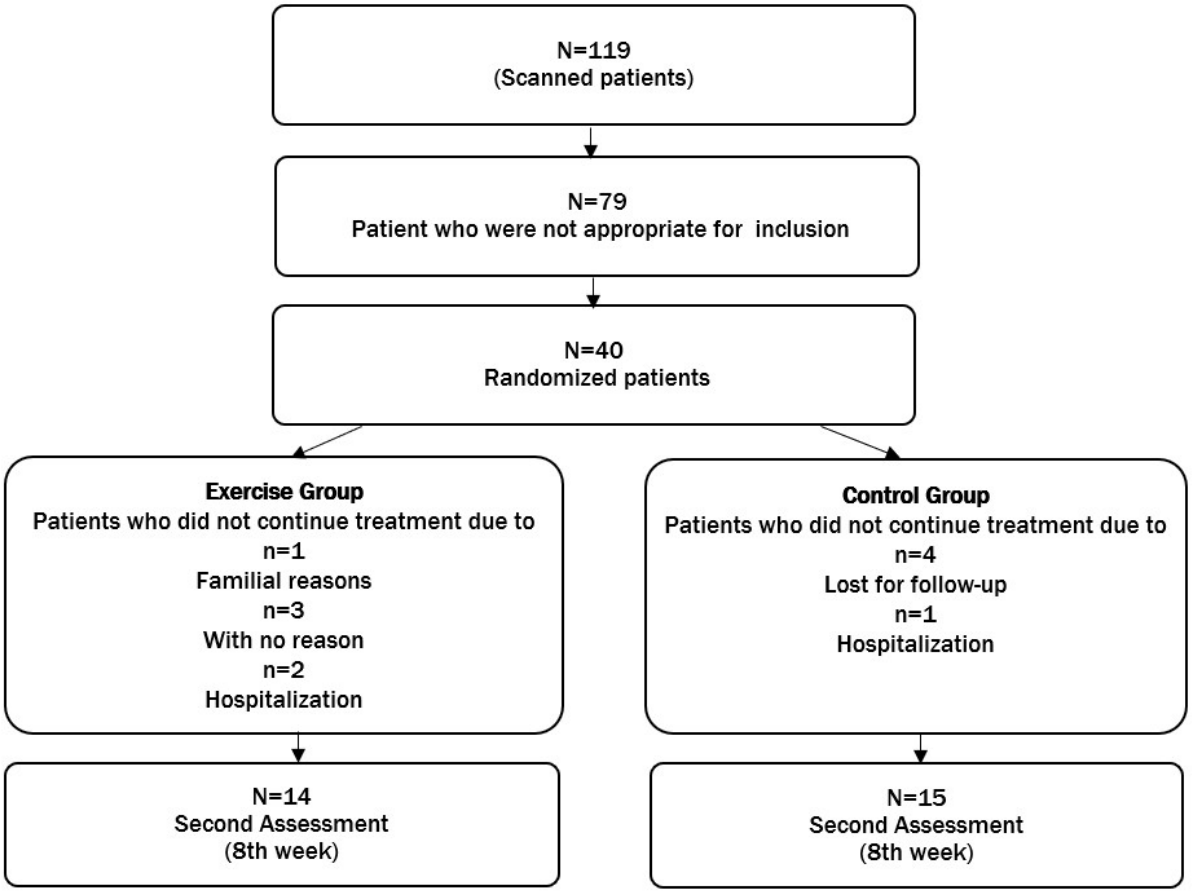

Figure 1. Flow up diagram.

($p<0.05$). Serum biochemical values and 6-MWT scores of the groups are shown in Table 2. There was no significant difference in terms of SF-36 scores between initial and second assessments within the groups ($p>0.05$) whereas social function sub parameter of SF-36 significantly increased in exercise groups ($p=0.02$). There was no statistically significant difference between the KDQOL-SF scores between the groups ($p>0.05$) SF-36 and KDQOL-SF scores of the groups are shown in Table 3.

Intra-group comparisons:

Hemoglobin ($p=0.01$), CRP ($p=0.03$), glucose level ($p=0.02$) and 6-MWT total distance of walking ($p<0.001$) showed an increase in favor of the exercise group in the intra-group comparison (Table 2). According to intra-group comparisons 'kidney disease effect' subparameter of KDQOL-SF significantly increased in exercise group after 8 weeks. (Table 3).

In our study, decrease in pain, increase in functionality, total treatment and satisfaction with physiotherapist were questioned. There was no significant difference between the groups in terms of patient satisfaction at 8th week except satisfaction regarding quality of life after treatment. Patients in exercise group were significantly more satisfied with their quality of life at 8th week in comparison to the patients in the control group (Table 4).

DISCUSSION

Literature shows that IL-6 is a powerful mediator that elicits the anti-inflammatory effect of exercise. It has been shown that exercise induced IL-6 is not released as part of the inflammatory triad (IL-6, TNF-alpha, and IL-1). Contrary, this increase in IL-6 stimulated

Table 1. Clinical characteristics of the patients.

	Exercise Group (n=14)	Control Group (n=15)
	X±SD	X±SD
Duration of renal impairment (month)* [a]	91.92±80.78	89.46±80.91
	n (%)	n (%)
Etiology of renal impairment* [b]		
Nephrotic Syndrome	1 (7.1)	- (0)
Amyloidosis	1 (7.1)	- (0)
Protein-losing disease	1 (7.1)	- (0)
Nephritis	2 (14.3)	- (0)
Hypertension	4 (28.6)	4 (26.7)
Vascular	2 (14.3)	1 (6.7)
Pregnancy poisoning	- (0)	1 (6.7)
IgA Nephropathy	- (0)	1 (6.7)
Focal Segmental Glomerulosclerosis	- (0)	1 (6.7)
Familial Mediterranean Fever	- (0)	1 (6.7)
Drugs	- (0)	1 (6.7)
Unknown etiology	3 (21.4)	5 (33.3)
Dialysis before transplantation (Yes/No) * [b]	6 (42.9) / 8 (57.1)	9 (60) / 6 (40)
Organ donor status* [b]		
Mother	1 (7.1)	2 (13.3)
Dad	2 (14.3)	3 (20)
Sibling	3 (21.4)	2 (13.3)
Kid	- (0)	1 (6.7)
Spouse	4 (28.6)	3 (20)
Cadaver	4 (28.6)	4 (26.7)

*p>0.05. a: Mann-Whitney U Test. b: Chi-Square Test.

Table 2. Serum biochemical values and 6-minute walk test scores of patients.

	Exercise Group			Control Group			
	Initial	Second		Initial	Second		
	X±SD	X±SD	p^a	X±SD	X±SD	p^a	p^b
Hemoglobin	12.4±3.0	13.9±2.0	**	12.5±1.9	12.7±2.4	*	*
Serum creatinine	1.3±0.5	1.4±0.8	*	1.5±0.4	2.0±1.9	*	*
Total protein	6.5±0.9	5.9±2.2	*	6.3±0.5	6.7±0.1	*	*
Albumin	4.3±0.5	4.3±0.4	*	4.0±0.6	4.4±0.2	*	*
Glucose	105.0±29.4	117.8±41.8	**	114.4±44.4	93.2±19.9	*	*
Cholesterol	194.0±53.4	225.8±59.6	*	189.8±62.1	195.2±49.1	*	*
Triglyceride	155.6±57.8	191.7±66.9	*	177.1±83.1	172.2±108.5	*	*
Low density lipoprotein	118.1±46.5	134.9±56.2	*	120.2±50.0	116.6±39.9	*	*
High density lipoprotein	47.4±14.9	49.3±13.9	*	40.4±12.5	48.9±8.5	*	*
Interleukin 6	12.0±12.0	16.0±15.6	*	50.7±94.8	47.9±94.1	*	*
C-Reactive Protein	3.9±4.7	9.0±13.0	**	11.0±12.7	12.5±13.0	*	*
6-Minute walk test, total distance (m)	421.4±76.4	439.2±83.2	**	415.8±44.6	408.5±65.8	*	*

*p>0.05. **p<0.05. a: Wilcoxon Test, b: Mann-Whitney U Test.

Table 3. Quality of life scores of the patients.

	Exercise Group			Control Group			
	Initial X±SD	Second X±SD	p[a]	Initial X±SD	Second X±SD	p[a]	p[b]
Short Form-36 (SF-36) subscales							
Physical function	76.0±25.1	73.1±28.4	*	63.6±33.3	72.0±32.0	*	*
Role limitations due to physical problems	85.7±36.3	86.3±32.3	*	80.0±41.4	77.7±44.1	*	*
Pain	86.2±25.0	86.8±23.9	*	86.4±21.5	80.3±21.3	*	*
General health	61.0±28.6	59.0±24.8	*	44.0±27.4	41.7±24.8	*	*
Vitality	67.8±20.2	68.1±17.7	*	67.6±15.8	65.5±19.2	*	*
Social function	84.3±21.4	85.2±21.5	*	75.7±21.3	78.3±12.7	*	**
Role limitations due to emotional problems	90.4±27.5	90.9±30.1	*	87.4±35.3	77.7±44.1	*	*
Mental health	69.1±14.8	68.0±16.9	*	64.5±15.2	66.6±18.5	*	*
KDQOL-36 subscales							
SF-12	82.0±22.6	81.2±23.7	*	72.2±20.2	70.6±25.6	*	*
Burden of kidney disease	70.9±40.7	68.8±36.7	*	65.0±34.1	54.6±37.6	*	*
Symptom	91.5±13.3	91.1±12.5	*	91.5±9.0	92.4±8.7	*	*
Kidney disease effect	90.1±15.6	90.6±15.4	**	85.4±13.0	88.5±13.1	*	*
Total	84.6±16.4	85.1±17.3	*	80.9±13.0	79.4±13.2	*	*

KDQOL-36: Kidney Disease Quality of Life Questionnaire-36. *p>0.05. ** p<0.05. a: Mann-Whitney U Test. b: Wilcoxon test.

Table 4: Satisfaction evaluations of patients after second assessment.

	Exercise Group X±SD	Control Group X±SD	p[a]
Questions Regarding Patients' satisfaction level (VAS, cm)			
How satisfied are you with your pain after your treatment?	8.6±1.4	9.11±1.6	*
How satisfied are you with your functionality after your treatment?	8.5±1.6	8.41±2.0	*
How satisfied are you with all of your treatment?	9.5±0.6	8.78±1.3	*
How satisfied are you with your physiotherapist?	9.8±0.4	9.11±1.0	*
How satisfied are you with your quality of life after your treatment?	9.5±0.6	8.11±1.6	**

VAS: Visual Analog Scale. cm: centimeter, *p>0.05. **p<0.05. a: Mann-Whitney U Test.

by exercise suppresses the production of TNF-α. Together with exercise, the brain behaves like a molecule that helps increase physiological, metabolic and immunological changes caused by increased IL-6 exercise. Fischer et al.[21] reported that the magnitude of the exercise induced IL-6 response is dependent on intensity and especially duration of the exercise. Romano et al.[6] and also suggests that there may be a link between exercise intensity and IL-6 levels in aerobic training in kidney transplant patients and that well-balanced exercise severity may reduce this value while increasing compulsive exercise induced IL-6 levels. Similarly, Surgit et al.[5] have shown that the immune response was enhanced following the exercise program to a degree that reached statistical significance for peripheral T-helper cell count; CD4 to CD8 ratio; natural killer cell activity; and IgG and IgM levels. There was no difference in IL-6 and CRP levels between the exercise group and the control group in our study but there was an

increase in IL-6 and CRP in our exercise group. The cause of elevation may be due to different factors such as serum creatinine level or endothelial dysfunction other than exercise affecting the patients in the study. In addition, there was an increase in cholesterol, LDL and triglyceride levels of the exercise group. However, decreased after 8 weeks in the control group. This suggests that many factors other than exercise may affect inflammatory conditions such as endothelial dysfunction.[22]

The leading causes of death in kidney transplant patients are cardiovascular diseases. The death rate in the total population is 17%. In addition, the incidence of metabolic syndrome is also higher in these individuals. Pre-existing comorbidities such as hypertension, diabetes and hyperlipidemia increase the risk of cardiovascular disease in renal transplant patients. Further, the usage of immunosuppressive also effects the cardiovascular diseases risk factors: corticosteroids tend to promote metabolic syndrome due to their antimetabolic effects; cyclosporine is associated with hypertension and hyperlipidemia while tacrolimus is related with insulin resistance and posttransplant diabetes. Therefore, exercise is a good choice for decreasing all these side effects for kidney transplant patients. Although in some disease such as chronic obstructive pulmonary disease,[24] coronary artery disease[20] shows the positive effects of calisthenic exercises there are studies found that the relationship between calisthenic exercise training on inflammatory markers and biochemical values together. Although there was no statistically significant difference in hemoglobin values between the groups in our study, we speculated that the increase of hemoglobin values in the exercise training group is an important factor that should not be ignored. There are many studies indicating the importance of anemia after renal transplantation mostly due to a slow increase in newly graft-produced-erythropoietin. Moreover, post-transplant hemoglobin levels were found to be associated with long term graft outcomes and even patient survival.[25,26]

Increased hemoglobin levels in individuals will increase the amount of oxygen recirculation to the muscles, which will positively affect the exercise capacity. Thus, there was no statistically significant in exercise capacity between the exercise group and the control group in our study, in exercise group distance of total walking of patients increase 18-meter. It is an important result that will affect the quality of life of renal patients with low exercise capacity. Similar to our study, Wang et al.[27] had 567 to 581 meters walking distance before and after the pilot study of active video game with aerobic exercise in kidney transplant patients and observed an average improvement of 14 meters. Carvalho et al.[28] showed that walking time was positively correlated with calcium levels and time post transplantation and they found that the transplantation patients had a longer 6-MWT interval than the dialysis patients. Cury et al.[29] reported that dialysis and transplant patients had lower functional capacities, lower performance and less distance walking at 6-MWT than healthy controls.

In addition, hemoglobin levels in these patients have a significant effect on fatigue and this decreases their quality of life. In our study, the increase in these values in the calisthenic exercise group is a good result that significantly affects the quality of life. Increasing the quality of life of people after surgery is a very important indicator in the success of surgery. Our results are also very important in this sense.

The person with kidney transplant is confronted with many other problems, such as the risk of continuous rejection, the ability to adjust to drug treatment with significant side effects, and the necessity of regular control. Fighting these stressors and trying to cope with it significantly affects the quality of life of the patients.[30,31]

There was a significant difference both in the control group and the exercise group in the general quality of life SF-36 social function subparameters. We also found that the exercise group also had an increase in the subparameters of KDQOL-SF renal disease effect after treatment.

Oskay et al.[32] found statistically significant improvements in pain and emotional scores of the quality of life assessed by KDQOL-SF at 3 months in peritoneal dialysis patients. Although the evaluation of satisfaction, which may affect all the results of treatment is important, most of the studies in the literature evaluates only satisfaction from medication in transplant patients. In our study, decrease in pain, increase in functionality, total treatment and satisfaction

with physiotherapist were questioned and patients in exercise group were significantly more satisfied with their quality of life at 8th week in comparison to the patients in the control group. This is; another important result that underlines the importance of exercise and physiotherapist in improving quality of life in renal transplant patients.

We believe that unnecessity of an additional cost for exercising is an important point for this patient population as treatment costs are already very high. In our study, we used a home-based exercise program which did not require any special equipment. We also aimed to indirectly prevent the occurrence of other diseases and to decrease the number of medications for these by providing regular exercise habit to patients which would further lower the health care costs. Home-based and supervised exercise programs lead to similar improvements in clinical and patient outcomes in dialysis patients. However, home-based exercises were suggested to be more sustainable.[33] In our study 94.16% participation rate in the number of sessions in exercise group highlights the importance of regular daily follow-ups in home-based exercise regimens. Although various types of exercise programs have been described in renal transplant patient[34-36] there is no calisthenic exercise treatment has been prescribed for them in the literature.

Limitations

There were some limitations of our study. Endothelial functions of the patients could be evaluated. Moreover, body mass index is another important issue in renal transplant patients. Inflammation is also might be affected by this value. This value should be recorded not only at the beginning but also at the second assessment.

Conclusion

As a conclusion, calisthenic exercise could be a good alternative for renal transplant patients to improve hemoglobin level, walking distance and quality of life but it should not be forgotten that inflammatory values in transplant patients may vary depending on many factors. Therefore, it is important to determine the factors that can affect these values correctly. All these should be considered in the future and studies should be conducted in larger samples.

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