International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.4, pp 573-581, 2017

Resisted Exercises versus Aerobic Exercises in Patients with Chronic Kidney Disease

Samah H. Naguib and Haidy N. Ashem

Physical Therapy Department for surgery-Faculty of physical therapy-Cairo University, Egypt.

Abstract : The purpose of this study was to determine which type of exercises out from resisted exercises versus aerobic exercises obtains the best improvement in the patients with chronic kidney diseases. Thirty male patients with chronic kidney diseases participated in this study, Their ages ranged from 35 to 50 years, All patients had chronic renal impairment with median glomerular filtration rate (GFR) of 27.5ml /min /1.73m2)these patients were randomly divided into two equal groups:-Group A: (resistance training), this group was composed of 15 patients that followed a low protein diet (0.6/kg body weight/day) for 2 to 8 weeks before randomization and they continued on the low protein diet plus resistance exercise training 3 times /week for 12 weeks additionally. Group B: (aerobic exercises), this group was composed of 15 patients that followed a low protein diet (0.6/kg body weight/day) for 2 to 8 weeks before randomization and they continued on the low protein diet plus aerobic exercise training 3 times /week for 12 weeks additionally. Measurements were conducted before starting the treatment as a first record and at the end of treatment after three months as a second record for Serum C-reactive protein(CRP),serum albumin ,creatinine concentrations, BMI,Sit-to-stand-to sit test and six minutes' walk test (6MWT). The finding of the present study showed a significant decrease in the level of CRP (mg/L) and creatinine level (mg/dL),increase in the albumin (g/dL) and a significant improvement in the results of Sit-to-stand-to sit test and 6MWT between pre-treatment and post-treatment in both groups of the study ($p < 0.05$).While there was a non-significant difference post-treatment between group A and group B ($p > 0.05$).There was a non-significant difference in BMI (kg/m2) between pre-treatment and post-treatment in both groups of the study ($p < 0.05$).And also there was a non-significant difference post-treatment between group A and group B ($p > 0.05$). There were no differences between the effects of resisted exercises oraerobic exercises in patients with chronic kidney disease.

Key words : Chronic kidney disease, resisted exercises, aerobic exercises.

Introduction

Chronic kidney disease (CKD) is defined as occurring where an individual has either kidney damage for >3 months, as denoted by structural or functional abnormalities, or has a glomerular filtration rate (GFR) of <60 ml/min per 1.73m2 or a urinary albumin-to-creatinine ratio >30mg/g for >3 months [1].

Chronic kidney disease (CKD) is an important epidemic and public health problem which occurs in many countries with an increasing prevalence [2].

Patients withchronic kidney disease (CKD) have a mild chronic inflammation which is attributed to decreased cytokine excretion, uremia, acidosis, and oxidative stress, bio-incompatibility of dialyzer membrane and frequent episodes of infections [3].

Studies show that inflammation also causes muscle wasting, and it interferes with the body's ability to make new proteins. When a person has inflammation, chemicals called cytokines are released. Normally cytokines are good – they help fight infection. However, cytokines also decrease the appetite and slow down stomach emptying. If chronic inflammation is not treated, muscle wasting and cytokines contribute to chronic low albumin levels. Low albumin is used as a marker of malnutrition and inflammation in kidney disease patients [4].

Low-grade chronic inflammation characterized by increased levels of serum C-reactive protein (CRP), a proinflammatory cytokine, may be a mediator of protein-energy malnutrition and survival in patients with kidney failure. Inflammatory cytokine–mediated catabolism is associated with hypoalbuminemia, hypermetabolism, and loss of body cell mass [5].

Patients with chronic Kidney diseases have diminished physical activity, which is associated with increased risk of cardiovascular diseases. Exercise improves hypertension, endothelial dysfunction, insulin resistance, dyslipidemia, inflammation and oxidative stress in this population [6].

Exercise is one of the possible preventive maneuvers to reduce muscle protein loss and maintain muscle function. Recently, many studies have shown the importance of exercise or regular physical activity to prevent muscle wasting in CKD patients [7].

Physical exercise has beneficial effects on functional capacity, quality of life, cardiovascular risk factors, anemia, serum lipid levels, endothelial function, inflammation, type 2 diabetes mellitus and psychosocial problems in CKD patients [8].

The aim of this study was to determine the effect of resisted exercises versus aerobic exercises in patients with chronic kidney disease

Patients & Methods:

Thirty male patientswith chronic kidney diseases participated in this study, Their ages ranged from 35 to 50 years, selected from National Institute of Urology and Nephrology,Cairo , Egypt., All patients had chronic renal impairment with median glomerular filtration rate (GFR) of 27.5ml /min /1.73m2). All patients were not on dialysis therapy. All patients had serum creatinine concentrations from 1.5 to 5.mg/dl, confirmation of the diagnosis of renal disease, and physician approval for prescription of a low protein diet. All patients were conscious and ambulant. All patients were assessed by physician carefully before starting and had blood hematologic test, urine analysis, and a treadmill stress test.All patients were following a low protein diet of (0.6g /kg body weight / day).

The exclusion criteria were:smokers, alcohols drinkers or any substance abuse, uncompensated congestive heart failure, recent myocardial infarction, cerebrovascular accidents within prior 6 months, active infection or inflammation, presence of severe muscle weakness or interfering skeletal deformity, history of repeated episodes of hypoglycemia, decrease in hemoglobin level or white blood cell count less than base line, the patients who had malignant disorders and the patients who missed two successive sessions.

All patients consented to measurements and availability for re-assessments. They were however, informed of their freedom to withdraw from the study at any point in time. They were randomized (by odd number selection method) into two equal groups of equal number; these patients were randomly divided into two equal groups:-

Group A: (resistance training), this group was composed of 15 patients that followed a low protein diet (0.6/kg body weight/day) for 2 to 8 weeks before randomization and they continued on the low protein diet plus resistance exercise training 3 times /week for 12 weeks additionally.

Group B: (aerobic exercises), this group was composed of 15 patients that followed a low protein diet (0.6/kg body weight/day) for 2 to 8 weeks before randomization and they continued on the low protein diet plus aerobic exercise training 3 times /week for 12 weeks additionally.

1. Therapeutic equipment:

1) Kettlermultigym for resistance exercise training:-

The Kettlermultigym (Fig-1) is one of the newest multigyms. It is the middle of the range machine, and caters for every muscle building training technique, features include a butterfly, seated bench press, seated crunches, Latissimus rope frame, lower pulley for arm and leg exercises, rowing and leg curl. The weight stack ranges from 5-80 kg, it has an adjustable bench press unit and butterfly arms. The maximum user weight is 130 kg. The dimensions when set up are 181x109x200 cm.

Fig (1): KettlerMultigym equipment.

- Butterfly, Bench press seated, Crunches seated, Latissimus rope frame, Lower pulley for leg and arm exercises, Rowing, Leg extension, Leg curl are all available
- Weight stack 5 – 80 KG (16 x 5 KG)
- Adjustable bench press unit
- Adjustable butterfly arms
- Easy change from bench press to butterfly without the need to adjust
- Padded seat, adjustable in height
- Plastic coated steel ropes
- Maximum weight 80KG
- Max user weight 130 KG
- Dimension when set up (L x W x H cms) 181 /109 /200
- 3 yrs part and labour warranty

2) Stationary bicycle for resistance aerobic training:

Magnetic bicyce, China ,Automatic display of the following functions (time, speed, distance, pulse and calories).

2. Measurement procedures

1-Measurement of inflammatory markers and biochemical markers:

- Using a commercially available kit (CRP SPQ Test System; DiaSorinInc, Stillwater, MN) for measuring of Serum C-reactive protein(CRP).
- The Dialab automated centrifugal analyzer for estimation of serum albumin and creatinine concentrations.

2- Measurement of body mass index:

Weight and height (without shoes) was measured on a TZ weight and height scale then Body mass index was calculated by dividing weight over height square as kg/m2.

3- Examination of muscle strength of the lower extremities, using (Sit-to-stand-to sit test)

The patient rises from a chair to the standing position without additional support of his arms and then sits down again. The number of such cycle repetitions per one minute constitutes the result of the test. The patient performs the test at his own rate; in case of marked fatigue, he may stop the test and have a rest, however, without prolonging duration of the test. The participants were encouraged to perform the test at highest possible rate. **(McIntyre et al., 2006)**

4- Evaluation of functional performance using 6-minute walk test (6MWT)

The six minutes' walk test (6MWT) performed indoors, along a long, flat, straight, enclosed corridor with a hard surface that is seldom traveled. The length of the corridor marked at starting line and end line marked on the floor using brightly colored tape. Ask the patient to walk as far as possible without jogging or running, the patient performs the test at his own rate **(Holub et al., 2002 and Headley et al., 2002)**

3. Treatment procedures

1-The procedures of resistance-exercise training program application(fig-2a,b).

By using Kettlermultigym Subjects did the exercise 3 times/wk under supervision in the out clinic of Faculty of Physical Therapy, Cairo University, Each session lasted approximately 45 minutes and included a 5-minutewarm-up, 35-minute resistance training (knee extension/flexion and Latissimus pull down), and a 5-minute cool down. Subjects performed 3 sets of 8 repetitions for each exercise per training session. Each repetition consisted of a 2-countconcentric (lifting) phase, a slight pause, and a 4-counteccentric (lowering) phase. There was a 1- to 2-count pause between repetitions and a 1- to 2-minute rest period between sets. Proper breathing technique was emphasized at all times to avoid an increase in thoracic pressure with fluid intake in between to avoid dehydration. Training intensity was at an intensity of 15-17 out of 20 at the RPE scale. Starting weights were determined from a three-repetition maximum (3RM) using weights that could be adjusted in 0.5–1 kg/week increments. A 3RM is the maximum weight that can be lifted three times with a proper technique. Training started at approximately 60% of3RM for two sets of eight repetitions and was increased to three sets as tolerated or (60% of MHR). When patients could perform three sets successfully, the weight would be increased. Blood pressure and heart rate of the participants were monitored each 5 min during exercise. Training intensity was increased progressively as needed to ensure that target intensity was maintained as subjects got stronger and setting of workloads would become easier, assessed by subjects' self-perceived levels of exertion using a Rating of Perceived Exertion Scale. Cool-down exercises included 5 to 8 stretching and flexibility exercises for the upper and lower body.

(A) **(B)**

Fig ($2_{A,B}$): The procedures of resistance-exercise training program application.

2-The procedures of aerobic -exercise training program application:

The aims of treatment were explained to each patient, the physical training by using stationary bicycle (magnetic ,China) conducted during a period of 3months, three times per week, each time during the hemodialysis procedure, for the first two hours figure (4).

The program of treatment consisted of three parts:

First part: warm-up (approximately 5 minutes) in form of free active exercises for lower extremities in the supine position.

Second part: the main part (10 to 30 minutes) exercise on a stationary bicycle.

Third part: cool-down (approximately 5 minutes) in form of free active exercises for lower extremities in the supine position and breathing exercises (Chojak et al., 2006).

The patients were taught to stop the exercise and to notify if they felt any dizziness, headache, palpitations, nausea, anxiety, exhaustion or any other adverse effects. The patients' vital signs were examined at least once during exercise.

Statistical procedures:

- In this study, the mean, the standard deviation and the standard error will be calculated for each group in the study.
- The mean, the standard deviation and range will be used as primary source of connecting facts about each parameter to measure central tendency.
- Paired T-test will be used to compare within each group and to detect significance level between 2 groups (comparison).
- The statistical package for social science (SPSS) will be utilized for data analysis and the level of significance will be set at the 0.05 level.

Results:

1- **General characteristics of patients in both groups (A&B).**

Table (2): General characteristics of patients in both groups (A&B).

General characteristics	Group A		Group B		Comparison		S
	Mean	±SD	Mean	±SD	t-value	P-value	
Age (year)	42.93	±5.836	42.53	±6.412	.221	.828	**NS**
Weight (Kg)	77.20	±3.802	77.86	±5.501	.372	.715	NS

***SD: standard deviation, P: probability, S: significance, NS: non-significant.**

2-Measurement of BMI:

In table (2); The results of study showeda non-significant significant difference of BMI pre & post treatment in Group A and Group B as p value >0.05**.** In comparing both groupspost treatment, the results of study showed a non-significant differences p value >0.05

Table 2: Measurement of BMI

	Group A	Group B	P value between both groups post treatment
BMI test Pre	25.45 ±2.273	25.25 ±2.733	.625*
BMI testPost	25.53 ±2.261	25.03 ±2.955	
P value	0.443*	0.736*	

*** No significant difference * * Significant difference**

3-Measurement of Serum C-reactive protein (CRP):

In table (3); The results of study showed significant difference of CRP pre& post treatment in Group A and Group B as p value <0.05**.** In comparing both groupspost treatment, the results of study showed a non-significant differences p value >0.05

Table 3: Measurement of Serum C-reactive protein (CRP).

	Group A	Group B	P value between both groups post treatment
CRP Pre	6.91±.877	6.51±.691	.748*****
CRP Post	5.21±.934	5.30±1.23	
P value	0.000**	0.000**	

*** No significant difference * * Significant difference**

4-Measurement of Serum albumin:

In table (4); The results of study showed significant difference of Serum albumin pre & post treatment in Group A and Group B as p value <0.05**.** In comparing both groupspost treatment, the results of study showed a non-significant differences p value >0.05

Table 4: Measurement of serum albumin :

	Group A	Group B	P value between both groups post treatment
Albumin Pre	3.43 ±.260	3.39 ± .257	.670*****
Albumin Post	3.57 ±.237	3.66±.257	
P value	0.000**	0.000**	

*** No significant difference * * Significant difference**

5-Measurement of Serum creatinine concentration:

In table (5); The results of study showed significant difference of Serum creatinine concentration pre & post treatment in Group A and Group B as p value <0.05**.** In comparing both groupspost treatment, the results of study showed a non-significant differences p value >0.05

Table 5: Measurement of Serum creatinine concentration

	Group A	**Group B**	**P value between both groups post treatment**
Creatinine Pre	3.18 ±.871	3.12 ±.913	.495*****
Creatinine Post	2.93 ±.880	2.65 ±.913	
P value	0.000**	0.000**	

*** No significant difference * * Significant difference**

6-Measurement of (Sit-to-stand-to sit test):

In table (6);The results of study showed significant difference of **(Sit-to-stand-to sit test):** pre & post treatment in Group A and Group B as p value <0.05**.** In comparing both groupspost treatment, the results of study showed a non-significant differences p value >0.05

Table 6: Measurement of (Sit-to-stand-to sit test):

	Group A	**Group B**	**P value between both groups post treatment**
Sit to stand test Pre	14.21 ±1.928	14.78 ±2.154	.852*
Sit to stand testPost	20.28 ±2.840	20.50 ±2.345	
P value	0.000**	0.000**	

*** No significant difference * * Significant difference**

7-Measurement of (6MWTtest):

In table (7);The results of study showed significant difference of (6MWT test): pre & post treatment in Group A and Group B as p value <0.05**.** In comparing both groupspost treatment, the results of study showed a non-significant differences p value >0.05

Table 7: Measurement of (6MWT test):

	Group A	**Group B**	**P value between both groups post treatment**
6MWTtest Pre	182.5±9.517	182.5±10.639	**.**893*****
6MWTtestPost	211.5±7.303	212.2±16.296	
P value	**0.000****	**0.000****	

*** No significant difference * * Significant difference**

Discussion

There is much interest in the effects of aerobic exercise and resistance (strength) training in chronic disease states. These measures may decrease morbidity and mortality by reducing inflammation, oxidative stress, and endothelial dysfunction.

The finding of the present study showed a significant decrease in the level of CRP (mg/L) and creatinine level (mg/dL)between pre-treatment and post-treatment in both groups of the study ($p < 0.05$).While there was a non-significant difference post-treatment between group A and group B ($p > 0.05$).

The finding of the present study showed a significant increase in the albumin (g/dL) between pre-treatment and post-treatment in both groups of the study ($p < 0.05$).While there was a non-significant difference post-treatment between group A and group B ($p > 0.05$).

There was a non-significant difference in both and BMI (kg/m2) between pre-treatment and post-treatment in both groups of the study ($p < 0.05$).And also there was a non-significant difference post-treatment between group A and group B ($p > 0.05$).

The finding of the present study showeda significant improvement in the results of Sit-to-stand-to sit test and 6MWTbetween pre-treatment and post-treatment in both groups of the study ($p < 0.05$).While there was a non-significant difference post-treatment between group A and group B ($p > 0.05$).

These results proved that both resisted exercises and aerobic exercises are effective in patient with chronic kidney disease.

Aerobic Exercise and Non-Dialysis CKD Aerobic exercise in nondialysis patients improves symptom scores, sickness impact profiles, and health-related quality of life **[9].** Exercise training, via stationary cycling, increases peak oxygen consumption and peak power output and improves maximum aerobic capacity. Four months of exercise training in **[10],** nondialysis CKD subjects resulted in the following findings: (1) unchanged hemoglobin, lipids, and left ventricular mass and function; (2) decreased blood pressure (systolic and diastolic); (3) increased peak oxygen consumption; and (4) no effect on declining glomerular filtration rate (GFR) [11].

Clyne and coworkers **[12],** reported that aerobic exercise in nondialysis CKD patients was associated with increased maximum exercise capacity and decreased heart rate but was not associated withimproved hemoglobin, GFR, blood pressure, or echographic findings.

Eidemak and colleagues **[13],** studied patients with moderate CKD (GFR range, 10-43 mL/min) and found that aerobic exercise increased maximum work capacity but had no effect on declining GFR.

Heiwe and colleagues **[14],** studied the elderly population (average age, 76 years; average GFR, 18) and showed that aerobic exercise increased muscle strength and functional capacity.

Pechter and coworkers **[15],** found that aquatic exercise in mild to moderate CKD decreased blood pressure, decreased proteinuria, decreased products of lipid peroxidation, and increased glutathione; mean GFR increased from 62.9 to 67.1 mL/min. Physical activity correlated with elevated GFR in an analysis of The Third National Health and Nutrition Examination Survey **[16].**

The effect of resistance Training and Non-Dialysis CKD The nutritional status, protein utilization, and functional capacity in CKD patients is responsive to resistance training **[17],** showed increased total body potassium and type I and II muscle fiber crosssectional areas, improved leucine oxidation and serum prealbumin, maintenance of body weight, and improved muscle strength in patients with serum creatinine between 1.5 and 5.0 mg/dL.

Cheema and colleagues reported an improvement in inflammatory status due to a reduction in CRP concentrations after 12 weeks of progressive resistance training. The Progressive Exercise for Anabolism in Kidney Disease (PEAK) study, were randomly assigned 49 patients to progressive resistance exercise training plus usual care (n=24) or usual care alone (n= 25) for 12 weeks **[18]. [19]** reported that CRP levels have been reduced with progressive resistance exercise training in a randomized trial in 34 hemodialysis patients. The resistance training group performed two sets of 10 exercises with free weights, targeting all major muscle groups, 3 times per week.

Briefly we can concluded thatbased on these studies and reviews, aerobic exercise is certainly beneficial for improving blood pressure, muscular strength, aerobic capacity, physical function and quality of life in patients with chronic kidney disease. It may also be beneficial for reducing symptoms and for improving glomerular filtration rate.

Based on these studies and reviews, resistance training is certainly effective for improving muscular strength and physical function and for increasing muscle mass in the face of a catabolic, low-protein diet in patients with chronic kidney disease who would otherwise suffer marked muscular atrophy.

Finally,there were no differences between the effects ofresisted exercises oraerobic exercises in patients with chronic kidney disease

References:

1. Levey AS, Atkins R, Coresh J, Cohen EP, Collins AJ, Eckardt KU, Nahas ME, Jaber BL, Jadoul M, Levin A, Powe NR, Rossert J, Wheeler DC, Lameire N and Eknoyan G. Chronic kidney disease as a global public health problem: approaches and initiatives - a position statement from Kidney Disease Improving Global Outcomes. Kidney Int. 2007,Aug;72(3):247-59.
2. Abed W, Al Rasadi K and Al-Riyami D: Estimated Glomerular Filtration Rate (eGFR): A Serum Creatinine-Based Test for the Detection of Chronic Kidney Disease and its Impact on Clinical Practice. Oman Med J 2012.Mar; 27(2):108-113**.**
3. Kamimura MA, Draibe SA and Dalboni MA: Serum and cellular interlukine-6 in hemodialysis patients: relationship with energy expenditure. Nephrol Dial Transplant. 2007; 22:839-44.
4. Stenvinkel P, Heimburger O and Lindholm B.: Wasting, but not malnutrition, predicts cardiovascular mortality in end-stage renal disease. Nephrol Dial Transplant; 2004,19: 2181–2183.
5. Zhang L, Kao WH, Berthier-Schaad Y, et al.: C-Reactive protein haplotype predicts serum C-reactive protein levels but not cardiovascular disease risk in a dialysis cohort. Am. J. Kidney Dis. 2007;49:118-126.
6. Bai Y, Sigala W, Adams GR and Vaziri ND: Effect of exercise on cardiac tissue oxidative and inflammatory mediators in chronic kidney disease. Am J Nephrol. 2009; 2:213-21.
7. Jung TD and Park : Exercise Programs for Hemodialysis Patients Chonnam Med J. 2011 August; 47(2): 61–65.
8. Daul AE, Schafers RF, Daul K and Philipp T: Exercise during hemodialysis. ClinNephrol. 2004;61Suppl 1:S26-30.
9. Boyce ML, Robergs RA, Avasthi PS, et al: Exercise training by individuals with predialysis renal failure: Cardiorespiratory endurance, hypertension, and renal function. Am J Kidney Dis 30:180-192, 1997
10. Poehlman ET, Gardner AW, Ades PA, et al: Resting energy metabolism and cardiovascular disease risk in resistance-trained and aerobically trained males. Metabolism 41:1351-1360, 1992
11. Boyce ML, Robergs RA, Avasthi PS, et al: Exercise training by individuals with predialysis renal failure: Cardiorespiratory endurance, hypertension, and renal function. Am J Kidney Dis 30:180-192, 1997
12. Clyne N, Ekholm J, Jogestrand T, et al: Effects of exercise training in predialytic uremic patients. Nephron 59:84-89, 1991
13. Eidemak I, Haaber AB, Feldt-Rasmussen B, et al: Exercise training and the progression of chronic renal failure. Nephron 75:36-40, 1997
14. Heiwe S, Tollback A, Clyne N: Twelve weeks of exercise training increases muscle function and walking capacity in elderly predialysis patients and healthy subjects. Nephron 1:48-56, 2001
15. Pechter U, Ots M, Mesikepp S, et al: Beneficial effects of water-based exercise in patients with chronic kidney disease. Int J Rehabil Res 26:153-156, 2003
16. Finkelstein J, Joshi A, Hise MK: Association of physical activity and renal function in subjects with and without metabolic syndrome: A review of the Third National Health and Nutriton Examination Survery (NHANES III). Am J Kidney Dis 48:372-382, 2006
17. Castaneda and colleagues Castaneda C, Gordon PL, Uhlin KL, et al: Resistance training to counteract the catabolism of a low-protein diet in patients with chronic renal insufficiency A randomized, controlled trial. Ann Intern Med 135: 965-976, 2001
18. Cheema BSB, Abas H, Smith BC, et al. (2011): Effect of resistance training during hemodialysis on circulating cytokines: A randomized controlled trial, European Journal of Applied Physiology, vol. 111, no. 7, pp. 1437–1445.
19. Smith BC, Cheema BS and O'Sullivan AJ. (2005): Resistance training during hemodialysis reduces C-reactive protein: results from a randomized controlled trial of progressive exercise for anabolism in kidney disease (The PEAK Study) [abstract]. J Am Geriatr Soc.

*****