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RESEARCH ARTICLE

IMPACT OF AEROBIC VERSUS RESISTED EXERCISES ON LIPID PROFILES IN PATIENTS UNDERGOING HEMODIALYSIS

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ABSTRACT

Background: Chronic kidney disease(CKD)is an important risk factor for cardiovascular diseases and mortality. Physical inactivity is a modifiable risk factor that may affect the development and course of CKD. It is well established that exercise improves a number of metabolic factors, blood pressure and insulin resistance, which would be expected to preserve renal function and lower cardiovascular risks. **Purpose**: The purpose of the study was to compare the impact of both aerobic and resistance exercises on lipid profiles among patients undergoing hemodialysis. **Subject and Methods**: Forty patients who diagnosed as chronic renal failure with age ranged from 45 to 60years were selected randomly from Hemodialysis Unit of Ain Shams General Hospital .Only who agreed to be volunteers participated in this study and were randomized into two groups of equal number, twenty patients for each group, Group (A) received moderate intensity aerobic exercise program during dialysis using cycle ergometer for 30mintes,3times/week for 12 successive weeks plus their medical care.Group (B)received moderate intensity resistance exercises during dialysis for lower limbs using ankle free weights at 60% of 1 repetition maximum(RM)for 30 minutes, 3times/week for 12successive weeks plus their medical care, **Parameters**: Laboratory assessment (lipid profile)before the initiation of the training program and after the completion of the study (after 12 weeks). **Results**: The results showed that there was significant increase in high-density lipoprotein (HDL) and decrease in triglyceride (TG), cholesterol and low-density lipoprotein(LDL) in both group's while the results obtained from group A were superior to that of group B when comparing the results of both groups together **Conclusion**: It can be concluded that both moderate aerobic and resisted exercise improve lipid profile and can lower cardiovascular risks in patients with chronic renal failure undergoing haemodyalisis.

INTRODUCTION

CKD is the progressive deficiency of renal function for months and years. When renal function decreases, the disease reaches life threatening (ESRD) stage which requires urgency replacement, in other words, dialysis or transplantation (Takhreem, 2008). CKDlimits functional capacity, leading to cardio-vascular complications, and endocrine-metabolic, musculoskeletal problems(Reboredo, 2006).About one-third of hem dialysis (HD) patients are unable to perform the normal daily activities without assistance. On the other hand, physical functioning has been shown to be a major determinant of the quality of life (Capitanini et al., 2008). Dyslipidemia including increased total cholesterol, triglycerides (TG), and low-density lipoprotein cholesterol (LDL-C) concentrations and decreased high-density lipoprotein cholesterol (HDL-C) is oneof the risk factors implicated in increased cardiovascular risk associated with CKD and also in the progression of renal damage.

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Therefore, early identification and proper management not only of CKD but also of dyslipidemia can prevent the progression of ESRD and the development of associated morbidities, including cardiovascular disease(Kim, 2009).In ESRD patients, exercise has beneficial effects on functional capacity, anemia, cardiovascular risks factors, dyslipidemia, and psychosocial problems(Daul, 2004). Regular exercise is an important part of rehabilitation of patients on renal replacement therapy. The influence of it on physical exercise capacity, endurance, muscle strength, and social and emotional status is very high. The diminishing of cardiovascular risk factor is expected. Side effects of exercise are very rare. Also exercise in first hour of hemodialysis can be an option for better rehabilitation. Aerobic and resistance exercise are also important for the anabolic effect and malnutrition in patient with ESRD (Knap, 2005). Protective effects of regular physical activity or exercise have been determined in previous studies. Secondary gains of exercise include cardiovascular protection and improvement of some sudden cardiac death indicators in randomized controlled studies (Kouidi et al., 2009).

The purpose of this study was to compare the impact of both aerobic and resistance exercises on lipid profiles among patients with chronic renal failure undergoing hemodialysis.

MATERIALS AND METHODS

Subjects

- Forty patients with chronic renal failure undergoing hem dialysis participated in this study.
- Participants were of age between 45 to 60 years old.
- Patients were selected and referred from Dialysis unit of A in Shams general hospital The subject selection was according to the following criteria:
  - ❖ Age ranged between 45 to 60 years.
  - ❖ All patients diagnosed as chronic renal failure (CRF).
  - ❖ All patients were stable on dialysis for a minimum of three months.
  - ❖ All patients enrolled to the study had signed the informed consent form.
  - ❖ Both genders participated in the study.
  - ❖ All the patients examined medically by nephrologists

Exclusive criteria

- Patient who did not want to participate in study.
- Cardiac problems.
- Chronic chest disease.
- Uncontrolled hypertension and diabetes
- Chronic inflammatory orthopedic disorders and rheumatoid arthritis
- Severe obesity (BMI≥38)
- Patients with cognitive and psychiatric disorders.
- Patients were receiving medications to control ,decrease cholesterol levels or triglycrides level

Evaluation procedures

- All patients were evaluated pre-treatment and post-treatment for: Laboratory investigation measuring serum lipid profile(cholesterol, TG, LDL and HDL)carried out before the initiation of the training program and after the completion of the study(i.e after 12 weeks)

Treatment procedure

Group A: (Aerobic exercise group)

- This group of patients composed of twenty patients who received moderate intensity aerobic exercise program during dialysis using cycle ergometer for 30mintes, 3 times/week for 12 successive weeks in addition to their medical care.
- The program of treatment consists of three phases:

First phase: Warm-up (approximately 5 minutes) in form of free active exercises for lower extremities in supine position (Chojak, 2006).

Second phase: The main part of exercises approximately 20 minutes of cycling exercise at low to moderate intensity (Chojak, 2006).

Third phase: Cool-down (approximately 5 minutes) in form of free active exercises of lower extremities in supine position (Chojak, 2006).

Group B: (Resistance exercise group)

- This group of patients composed of twenty patients who received moderate intensity resistance exercises during dialysis for lower limbs using ankle free weights at 60% of 1RM for 30 minutes, 3times/week for 12 successive weeks in addition to their medical care.
- The program of treatment consists of three parts:

First phase: warming-up (approximately 5 minutes) was in form of free passive stretching for lower extremities (Ufuk, 2003).

Second phase: The main part (20 minutes) in form of moderate resistance exercise of lower extremities using ankle weights for knee extention and flexion and hip abduction and flexion with intensity 60% of 1RM, 2-3sets with two to three minutes of rest between sets to allow recovery, 8-15 repetitions. Starting weights were determined from a three repetition(3RM) maximum using ankle weights, A 3RM is the maximum weight that can be lifted three times with a proper technique. Training started at approximately 60% of 3RM and excluded if the participants were unable the 3 sets were tolerated the weight increased by 0.5/1k. Blood pressure and heart rate were monitored frequently during the session (Ufuk, 2003).

Third phase: Cooling-down (approximately 5 minutes) were free passive stretching exercises of lower limbs and breathing exercises (Ufuk, 2003).

Statistical procedure: Descriptive statistics and Unpaired t-test were conducted for comparison of subject characteristics between both groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to ensure the homogeneity between groups. Unpaired t-test was conducted to compare the mean values of total cholesterol (TC), triglycerides (TG),high-density lipoprotein(HDL) and low-density lipoprotein (LDL) between the group A and the group B. Paired t-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (Jack, 2003).

RESULTS

Subject characteristics: Table 1 showed the mean ± SD of subjects age of group A and B. There was statistically no significant difference between both groups in the mean age ($p < 0.05$). Also, there was statistically no significant difference in the distribution of sex and affected sides between both groups ($p < 0.05$).

Effect of treatment on TC, TG, LDL and HDL

Within group comparison: There was a statistically significant decrease in TC, TG and LDL post treatment in the group A and B compared with that pre -treatment ($p < 0.001$). The percent of decrease in TC, TG and LDL in the group A was 5.96, 11.06 and 18.56% respectively; and that in group B

Table 1. Basic characteristics of participants:

	Group A	Group B	
	x̄±SD	x̄±SD	p-value
Age (years)	52.8 ± 4.43	51.75 ± 4.84	0.47
Sex			
Male			
Female	4 (20%)	4 (20%)	
	16 (80%)	16 (80%)	

Table 2. Mean TC, TG, LDL and HDL pre and post treatment of group A and B:

	Group A	Group B			
	x̄±SD	x̄±SD	MD	t- value	p value
Cholesterol					
Pre treatment	245 ± 8.7	248 ± 7.9	-3	-1.14	0.26
Post treatment	230.4 ± 8.04	236.2 ± 6.93	-5.8	-2.44	0.01**
MD	14.6	11.8			
Percentage of change	5.96%	4.76%			
t- value	19.6	17.37			
	p = 0.001**	p = 0.001**			
Triglyceride (mg/dl)					
Pre treatment	233.75 ± 7.42	236.3 ± 7.18	-2.55	-1.1	0.27
Post treatment	207.9 ± 9.72	224.9 ± 5.86	-17	-6.69	0.001**
MD	25.85	11.4			
Percentage of change	11.06%	4.82%			
t- value	11.62	10.49			
Low-density lipoprotein	p = 0.001**	p = 0.001**			
Pre treatment	**174**.3 ± 8.43	173.55 ± 8.56	0.75	0.27	0.78
Post treatment	141.95 ± 8.24	149.35 ± 7.88	-7.4	-2.9	0.006**
MD	32.35	24.2			
Percentage of change	18.56%	13.94%			
t- value	27.07	9.54			
	p = 0.001**	p = 0.001**			
High-density lipoprotein					
Pre treatment	28.85 ± 2.18	28.65 ± 1.75	0.2	0.31	0.75
Post treatment	50.75 ± 4.56	46.1 ± 3.3	4.65	3.69	0.001**
MD	-21.9	-17.45			
Percentage of change	75.91%	60.91%			
t- value	-20.64	-24.36			
	p = 0.001**	p = 0.001**			

x̄, Mean; SD, Standard deviation; p value, Probability value; **, Significant

were 4.76, 4.82 and 13.94 % respectively. Also, there was a significant increase in HDL post treatment in the group A and B compared with that pre -treatment ($p < 0.001$). The percent of increase in HDL in the group A and B was 75.91 and 60.91% respectively (table 2, figure 1).

Between groups comparison: There was no significant difference in TC, TG, LDL and HDL between both groups pre-treatment ($p > 0.05$). Comparison between the group A and B post treatment revealed a significant decrease in TC, TG and LDL of the group A compared with that of the group B ($p < 0.01$) and a significant increase in HDL of the group A compared with that of the group B ($p < 0.001$) (table 2).

DISCUSSION

This study was designed to evaluate the impact of aerobic exercise versus resisted exercise on lipid profile of patients undergoing hemodialysis and it was conducted on forty patients undergoing hemodialysis in Ain Shams general hospital dialysis unit, their ages ranged between 45 and 60 years. Patients were randomly assigned into two equal groups: group A (Aerobic training group) composed of 15 patients received exercise training during hemodialysis treatment using cycling ergometer for 30mins during first two hours of hemodialysis while group B(resisted training group) using ankle free weights for lower limb muscles for 30mins, the treatment of both was 3 times per week for 12 successive weeks. Lipid profiles was measured to both groups prior to treatment and after 3 months of treatment for both groups. Dyslipidemia including increased total cholesterol, triglycerides, and low-density lipoprotein cholesterol concentrations and decreased high-density lipoprotein cholesterol is one of the risk factors implicated in increased cardiovascular risk associated with CKD and also in the progression of renal damage. Therefore, early identification and proper management not only of CKD but also of dyslipidemia can prevent the progression of ESRD and the development of associated morbidities, including cardiovascular disease (Kim, 2009). Cheema *et al.* (2005) reported that in dialysis patients, both aerobic and resistance exercises have observable effects. A broad classification of such studies, including the type of exercise, the timing in relation to the dialysis session and the end result on physiological function, has been published. Aucella *et al.* (2015) reported that exercise is beneficial in ameliorating cardiovascular risk factors such as hypertension, dyslipidemia, hyperglycemia, obesity, inflammation, and oxidative stress. Moreover, it has been reported that inactivity is associated with the development of major CKD precursors, including albuminuria, reduced glomerular filtration rate and initiates diabetes. Awney *et al.* (2016) investigate the effect of moderate aerobic exerciseon kidney function tests and lipid profile in patients with CKD stages 3 and 4 and concluded that there were no significant differences between pretreatment and

post-treatment values of creatinine, blood urea, or glomerular filtration rate but there was a significant decrease in TG, cholesterol, and LDL, and a significant increase in HDL after 3 months. Vatani *et al.* (2011) examined the effects of various intensities of resistance training on the lipid profile over 6 weeks. Healthy male participants (n = 30) were randomized to either a moderate-intensity resistance training programme (45–55 % 1 RM) or a high-intensity resistance training programme (80–90 % 1 RM). Both groups were supervised during training sessions and attended three sessions weekly. Significant (p\0.05) reductions in LDL cholesterol (moderate-intensity -13.5 mg/dL vs highintensity-12.1 mg/dL), total cholesterol (moderateintensity-12.2 mg/dL vs high-intensity -11.3 mg/dL) and the total: HDL cholesterol ratio (moderate-intensity-0.38 vs high-intensity -0.47) were found in both groups, with no significant differences between the two groups. Significant increases in HDL cholesterol, however, were observed only in the high-intensity group (+5.5 mg/dL). Ronaldo *et al.* (2013) stated that patients with CKD when subjected to resistance exercise show substantial improvements in many functions, especially those related to the cardiovascular system, respiratory, muscular and quality of life (QOL). The results of Leehey *et al.* (2013), Afshar *et al.* (2009) and Ronaldo *et al.* (2011) studies contradict with the effect of this study on lipid profile:

Leehey *et al.* (2009) who reported that aerobic exercise training did not significantly alter blood urea nitrogen (BUN), creatinine, glomerular filtration rate (GFR),hemoglobin, serum lipid, or C-reactive protein (CRP) values, but power was limited because only seven patients in the exercise group and four patients in the control group finished the study. Afshar *et al.* (2010) found that aerobic exercise and resistance exercises that conducted to hemodialysis patient were significantly correlated with a reduction of serum creatinine and C-reactive protein levels, thus aerobic exercise induced more reduction, however the exercise had no influence on weight, serum urea, albumin, hemoglobin or lipid levels. Ronaldo *et al.* (2013)found that the protocol of 8 weeks of resistance exercise during haemodyalisis resulted in significant, although slight, alterations inbiochemical parameters. However, they showed no clinically important impact on dialysis. Results of this study revealed a statistically significant increase in the high dense cholesterol level (HDL) and decrease in low density cholesterol level (LDL), triglycerides (TG) and cholesterol (CHO) in both groups but improvement in aerobic training group was better than resisted training. The study was limited to physical and psychological conditions of the patients that might affect the evaluation and treatment also, inability to perform knee flexion from prone against gravity due to shortness of arterio-venous fistula of dialysis machine.

Conclusion

It was concluded that both aerobic and resisted exercise improve lipid profile of chronic renal failure patients undergoing haemodialysis with superior results for the aerobic exercise.

Future studies and Recommendations

The results of this study have indicated a need to consider the following recommendations:

- Further researchers are needed to compare between aerobic and resisted exercise effects on exercise tolerance, marker of inflammation in CKD and ESRD patients.
- Further researchers are needed to compare between aerobic and resisted exercise effects on quality of life in CKD and ESRD patients
- Further researchers are needed to compare between aerobic and resisted exercise effects on psychological condition in CKD and ESRD patients
- Further researchers are needed to compare between aerobic and resisted exercise effects in CKD and ESRD patients at different age group.

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