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Effect of Isotonic Exercise on the Frequency of Muscle Cramps in Hemodialysis Patients: A Clinical Trial

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Abstract

Background: The long-term complications of hemodialysis deteriorate patients' quality of life and lead to physical and mental discomfort. Physiologically, sports activities can play an important role in reducing these side effects including muscle cramps.
Objectives: The aim of this study was, to determine the impact of isotonic exercise on the frequency of muscle cramps.
Methods: This clinical trial was carried out on 60 hemodialysis patients admitted to the dialysis units of Shahrekord and Borujen hospitals in 2014. The intervention included an isotonic exercise program that was implemented during 10 sessions of constant cycling (each lasting 10 minutes) immediately before dialysis. The outcome variable was the number of muscle cramps in patients during the hemodialysis session. The data were analyzed in SPSS-16 using descriptive statistics (frequency, percentage, mean, and standard deviation) and inferential tests (independent and paired *t*-tests).
Results: The mean frequency of leg cramps before the intervention was not significantly different between the two groups (P = 0.10). However, it was significantly different between the groups after the intervention (P = 0.001). Moreover, the number of muscle cramps in the experimental group was significantly lower after the intervention than before implementing the program (P = 0.03).
Conclusions: The isotonic exercise of constant cycling has a considerable effect on decreasing the number of muscle cramps in hemodialysis patients. Hence, it is suggested that dialysis units provide facilities for constant walking and cycling to accelerate patients' treatment.

Keywords: Isotonic Exercise, Muscle Cramp, Hemodialysis, Chronic Renal Failure

1. Background

Chronic renal failure (CRF) as a life-threatening event is currently on the rise. The global incidence of end-stage renal disease (ESRD) is annually 260 per million, and it is growing by approximately 6% each year (1). According to the Kidney Foundation of Iran, more than 1,500 out of 40,000 kidney patients die annually in Iran, (2).

Chronic kidney disease (CKD) is a condition that affects not only physical health but also other aspects of health. In the absence of successful kidney transplant, these patients escape premature death thanks to new therapies like hemodialysis; meanwhile, they are still caught up with a wide range of physical, psychological, economic, and social problems that negatively affect their quality of life (3).

When more than 95% of the kidney tissue is destroyed due to various diseases, toxins are accumulated so much in the body that the patient cannot survive without dialysis or kidney transplantation (4, 5). On average, each patient undergoes dialysis three times a week for three to four hours each session. Hemodialysis treatment, in addition to complications during dialysis, entails a long-term side effect called uremia syndrome that is associated with motor neuropathy, myopathy of cardiac skeletal muscle, peripheral vascular changes (increased vascular resistance), anemia (loss of erythropoietin products), depression, and anxiety (6). During dialysis, the body discharges a large amount of fluid. To compensate for the removal of this amount of fluid, muscle vessels, especially those of the arms and the legs, contract. Consequently, blood flow to these areas reduces during dialysis. As a result, these muscles develop problems related to nutrition and blood supply. In addi-

tion, immobility for three to four hours gradually emaciates the muscles, and lack of blood supply and lower blood flow give rise to muscles' fatigue and cramp. Muscle cramps are severe and painful contractions that occur in one or a group of muscles in people with no myopathy or neuropathy. These cramps are typically limited to the muscles of the leg but can involve other skeletal muscles, as well. Many factors contribute to the development of muscle pain, yet, most of them are idiopathic (7, 8).

Pain relief is the basis of nursing care (9). Using physical and mechanical factors and applying special techniques and medical exercises, one can alleviate muscle pain and spasm (10). Doing regular exercises is one of the mechanisms to compensate for the decrease in blood flow and the resulting muscle cramps and pain. When a dialysis patient exercises, the muscles of the leg send a message to the brain that they require having more blood to provide the necessary force for activity. Thus, blood flow increases in the muscles of either hands or legs as necessary (11). Studies have shown that exercise can relieve pain and fatigue by decreasing muscle sensitivity and stiffness and improving blood flow (12, 13). Exercise lowers edema and reduces pain by blocking impulses into the brain and secreting endorphins (14). Furthermore, exercise enhances fluid transfer and reduces blood pressure, chills, muscle cramp, and post-dialysis bruising (15). Besides, sports activities lead to the reduction of stress hormones (16). In general, exercise can affect blood circulation, lymph flow, muscle spasm, and secretion of endogenous endorphins (5, 17).

In their study in Liverpool, Takhreem found that exercise could promote health, physical efficiency, and quality of life of patients (18). Henrique et al. confirmed the role of aerobic exercise in reducing blood pressure and laboratory variables (19). Riahi et al. also concluded that exercise could significantly improve the mean of muscle atrophy and physical function and reduce muscle pain in hemodialysis patients (20). Zamanzade observed a significant improvement in sleep and sexual relationships, as well as other aspects of life, following an exercise program (21).

The abovementioned studies corroborate the effective role of exercise and physical activity in uplifting the physical and mental status of hemodialysis patients. In these studies, the effects of sports programs and various sports activities have been explored on different indices, but there has been no research on the effect of exercise on the frequency of muscle cramps. In addition, the exercise program in the present study was implemented before patients underwent dialysis, which distinguishes it from previous investigations.

2. Objectives

The present study was designed to assess the impact of isotonic exercise before dialysis on the frequency of muscle cramps.

3. Methods

This is a two-group clinical trial performed in the dialysis units of Shahrekord and Borujen hospitals, Chaharmahal and Bakhtiari province, in 2014. The authors obtained approval from the Ethics Committee (Ir.bums.REC.1394.93). The study population consisted of all hemodialysis patients referring to the dialysis units of the mentioned hospitals. Given the power of 95%, the significance level of 0.05, the dropout of 10%, and considering previous studies (7, 9, 12), the authors chose 30 individuals for each of the two groups. Qualified participants were those who underwent hemodialysis (with the same duration in the two groups) and had no history of neurological-skeletal and genetic disorders (19-21). On the other hand, urgent hemodialysis, low level of consciousness, and inability to cooperate in performing the exercises –including patients with cardiac problems, musculoskeletal disorders, and motor restrictions- were the exclusion criteria (20, 21). After obtaining the necessary permits from the Ethics Committee and the Vice-presidency for Research of Shahrekord University of Medical Sciences, the authors referred to the dialysis units to determine the number of patients. If the patients consented to cooperate, they would enter the study after being given enough explanation about the project. Convenience sampling continued daily until reaching the final sample size (n = 60). The subjects were randomly assigned to the intervention and control groups using six-element permutation blocks.

After random assignment, written informed consent was obtained. The instrument used in the study was a checklist that included demographic information (age, sex, weight, and frequency of dialysis per week) and a form for recording the frequency of muscle cramps, which was immediately checked after each dialysis session. The intervention included a sports program that was designed based on the advice of a specialist in sports physiology. Patients performed isotonic exercises, which included 10 minutes of fixed cycling before hemodialysis. Since the effect of exercise remains for at least 10 sessions (22), the sports intervention was presented to the patients before 10 dialysis sessions. Patients in the intervention group, prior to dialysis, used bicycles that were installed on the patient's bed. First, the patients slowly cycled for two minutes to warm up. Afterward, they continued cycling at a

moderate speed for eight minutes, during which symptoms such as frequency of cramps, blood pressure, pulse rate, and respiratory rate were recorded. If any problem occurred, further cycling would be prevented. The intervention was conducted such that the two groups were blinded to each other. Before the intervention, the number of muscle cramps was individually asked from the participants and recorded in the data collection forms. The number of cramps at the end of dialysis was assessed and recorded. The results were analyzed by SPSS-16 using descriptive statistics (frequency, percentage, mean, and standard deviation) and inferential statistical tests (independent and paired *t*-tests). The significance level was considered at 0.05.

4. Results

Of the total 60 patients under study, 65% were male and 35% were female. Patients' age ranged from 20 to 73 years. Based on the independent *t*-test, the two groups were matched in terms of demographic variables (Table 1).

The mean frequency of leg muscle cramps before the intervention was not significantly different between the control and experimental groups (P = 0.10). However, it differed significantly between the groups after the isotonic exercise program (P < 0.001). Similarly, the frequency of muscle cramps in the experimental group was significantly lower after the intervention than before deploying the program (P = 0.03) (Table 2).

5. Discussion

The results established that the isotonic exercise program positively influenced the frequency of muscle cramps in patients and significantly decreased the number of muscle cramps in the intervention group compared to the control group.

These findings are consistent with the results of a study by Yaghobi et al. and confirm that administering the isotonic exercise program for hemodialysis patients can help prevent and decrease the number of muscle cramps and the severity of pain associated with this condition (23). In line with the present study, Hadian Jazi and Aliasgharpour stated that sports activities help cut down the cramp frequency of patients (24). Moreover, Ozdemir et al. reported that doing exercise significantly mitigates fatigue and the number of muscle cramps in hemodialysis patients (25). Abe et al. reported that metabolic abnormalities dwindle skeletal muscles and bring about weakness, fatigue, muscle cramp, loss of strength, and inability to perform daily activities. Generally, muscle catabolism in hemodialysis patients heightens the risk of death and significantly diminishes the quality of life (26). In a 12-month study, Mustata et al. revealed that doing regular exercises raises one's sports capacity, decreases mortality rates, and improves the quality of life. They attributed these effects to cardiovascular and metabolic benefits of exercise (27). Giannaki et al. found that training exercise and administering low doses of dopamine agonist are conducive to reducing the symptoms of restless legs syndrome by 46% and 56%, respectively (28). Parsons et al. concluded that a low-intensity exercise program is an adjunct therapy for promoting physical functioning and efficiency of patients undergoing hemodialysis (29). The study by Bennett et al. demonstrated that the falling risk of hemodialysis patients decreased after doing strength-balance exercise (30). Another study by Bennett et al. showed that exercise entails positive effects such as the reduction of cardiovascular risks, depression, muscle cramps, muscle diseases, and mortality and the improvement of the quality of life and physical functioning of hemodialysis patients (31). The results of a systematic review by Smart and Steele on 15 studies displayed the effects of exercise on maintaining fat-free body mass and quadriceps, preventing knee deformity, and increasing the strength of knee and hip joints in patients undergoing hemodialysis (32). Finally, Mortazavi et al. reported the positive effect of aerobic exercise on alleviating the symptoms of restless legs syndrome in hemodialysis patients (33). Therefore, the results of these studies are compatible with those of the current survey, indicating that exercise is effective in reducing hemodialysis-associated complications such as muscle cramps.

5.1. Conclusions

The results of this study illustrated that performing isotonic exercises through fixed cycling for 10 sessions (each lasting 10 min) significantly diminishes the number of leg muscle cramps after dialysis sessions. Hence, regular sports exercises in dialysis centers can be considered a care intervention assisting dialysis patients to avoid an inactive life and get closer to the status before their illness. It is important to note that many patients may not have the possibility of doing exercise and physical activity at home. In this regard, providing necessary facilities at treatment centers will enable these individuals to take advantage of this adjuvant therapy prior to undergoing hemodialysis.

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Table 1. Demographic Characteristics of Study Subjects[a,b]

Variable	Control Group	Intervention Group	P Value
Age	50 ± 5.2	46 ± 28.7	0.07
Gender			0.19
Male	19	20	
Female	10	11	
Dry weight	57.5 ± 11.22	64.40 ± 14.71	0.1
Systolic blood pressure	14.13 ± 3.75	14.35 ± 3.52	0.09
Ultrafiltration	3.68 ± 1.25	3.45 ± 1.12	0.08

[a]Values are expressed as mean ± SD.
[b]Independent *t*-test.

Table 2. Comparison of the Mean Frequency of Leg Muscle Cramps in Study Groups Before and After Intervention[a]

Variable	Intervention Group	Control Group	P Value
Before intervention	3.10 ± 0.95	2.73 ± 0.73	0.10
After intervention	1.16 ± 0.40	2.60 ± 0.46	0.001[b]
P value	0.03[c]	0.1[c]	

[a]Values are expressed as mean ± SD.
[b]Independent *t*-test.
[c]Dependent *t*-test.

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Footnotes

Authors' Contribution: Mahdi Poornzaari and Sara Parsa: Sampling; Mostafa Roshanzadeh: Statistical analysis; Somayeh Mohammadi: Proposal writing; Ali Tajabadi: Manuscript drafting and submission; Khadijeh Dehghani: Proposal writing.

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