National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Effectiveness of physical activity on selected biochemical parameters of patients on hemodialysis

Amirtha Santhi S[1], Rebecca Samson[2], Srikanth[3], Pethuru D[4]

[1]Research Scholar, Saveetha University, Chennai, Tamil Nadu, India, [2]Dean, College of Nursing, Pondicherry Institute of Medical Sciences. Pondicherry, India, [3]Incharge, PMR, Pondicherry Institute of Medical Sciences. Pondicherry, India, [4]Department of General Practice, Al Nahil International Clinic, Kuwait.

Correspondence to: Amirtha Santhi S, E-mail: Samirthasanthi@gmail.com

Received: April 03, 2018; **Accepted:** April 28, 2018

ABSTRACT

Background: Lack of physical activity is considered as a major risk factor for global mortality, especially for cardiovascular diseases. Regular assessment of physical functioning is recommended for patients on hemodialysis. **Aims and Objectives:** This study aimed to observe the effectiveness of physical activity on selected biochemical parameters of patients on hemodialysis. **Materials and Methods:** The present experimental study was conducted at dialysis unit at Pondicherry Institute of Medical Sciences, Pondicherry. A total of 14 patients including males and females who were undergoing hemodialysis at selected hospital and who fulfill the selection criteria were included in the present study. **Results:** Results showed that physical activity of the extremities for 15 min duration leads to positive changes in the selected biochemical parameters and also increased hemoglobin levels significantly. **Conclusion**: The exercise program could also increase the hemoglobin. Further detailed studies with higher sample size are recommended to support the use of exercise programs during a hemodialysis.

KEY WORDS: Physical Activity; Biochemical Parameters; Hemodialysis

INTRODUCTION

Lack of physical activity is considered as a major risk factor for global mortality, especially for cardiovascular diseases.[1] It was reported that nearly 31% of the world's population do not have minimum required physical activity.[2] The physical activities of patients on hemodialysis were still worse due to the presence of different comorbidities such as anemia, uremia, neuropathy, myopathy, disorders of bone, cardiovascular abnormalities, and depression.[3,4] Further, it was reported that during the dialysis days, the physical activity lower that non-dialysis days.[5] This decreased physical activity in the patients with chronic renal diseases, increases the risk of heart diseases due to abnormal lipid metabolism.[6] According to the World Health Organization, regular physical activity was recommended to improve health and quality of life.[7] Regular physical activity decreases the risk of mortality and prevents most of the chronic diseases.[8] Regular assessment of physical functioning is recommended for patients on hemodialysis. Hence, the current study was undertaken to assess the changes from pre-test to post-test level of biochemical parameters of patients on hemodialysis.

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2018.8.0415528042018	

MATERIALS AND METHODS

Study Design

Experimental design was used.

Participants

A total of 14 patients including males and females who were undergoing hemodialysis at selected hospital and who fulfill the selection criteria were included in the present study. The participants were stratified according to the time of hemodialysis and selected using simple random sampling. The participants who receive hemodialysis on morning hours were allotted to the experimental group (n = 7), and participants who receive hemodialysis on afternoon hours were allotted for control group (n = 7).

Inclusion Criteria

Male and female patients within the age group of 40–65 years, receiving regular hemodialysis for >2 times a week and can understand Tamil or English languages, were included in the study.

Exclusion Criteria

Patients diagnosed with hepatitis B, hepatitis C, and HIV, those receiving emergency dialysis, with a history of uncontrolled hypertension, heart failure, heart block, cardiac arrhythmias, third-degree atrioventricular heart block, suspected aneurysm, and recent significant change in resting electrocardiogram and any orthopedic or musculoskeletal limitations were excluded from the study.

Study Setting

The present experimental study was conducted at dialysis unit at Pondicherry Institute of Medical Sciences, Pondicherry.

Intervention

After 30 min of starting hemodialysis, the participants were instructed to do the physical activity of the extremities for 15 min duration in sitting or lying down position. The physical activity includes elbow flexion/extension, forearm supination/pronation, wrist circumduction, and fingers flexion/extension for 5 min in the upper extremity which is not connected to the hemodialysis machine and ankle rotation, toes flexion, extension, and hyperextension for 5 min in each lower extremity. The participants were instructed not to do any activity in the extremity that is connected to the hemodialysis machine. Each time of admission for hemodialysis the physical activity was performed by the participants for 15 min for 2 months. The physical activity done by the participants was supervised by the staff nurse or the physiotherapist. Vital signs of the participants were monitored during exercise.

Instruments

Semi-structured interview schedule

Demographic variables

It included age, sex, education, occupation, monthly family income, treatment cost per month, treatment cost paid by whom, marital status, religion, primary caregiver, number of overnight hospital admissions in the past 6 months, dietary habit, adherence to dietary prescriptions, habit of regular exercise, and body mass index.

Clinical variables

It includes reason for chronic kidney disease, how long the patient is in hemodialysis, frequency of dialysis per week, number of dialysis in the past 2 months, duration of dialysis (h/2 months), vascular access, hemoglobin, number of medications and frequency, adherence to medication prescriptions, and comorbidities. This is collected from the patient records.

Blood Investigation for Biochemical Values

Before starting the dialysis, serum values of sodium, potassium, urea, creatinine, albumin, calcium, and phosphate and after the dialysis serum value of urea were analyzed by laboratory standards. These are the routine investigations done every month for the participants who are undergoing hemodialysis. The biochemical values before starting the intervention and after 1 month and 2 months of intervention were collected from the patient records.

Data Collection Process

The baseline biochemical values of the participants were collected from the participants' health record and semi-structured interview guide, the experimental group was involved in 15 min of physical activity during hemodialysis for 2 months. Control group received the routine care practiced in the hospital. The routine practice in the hospital is, after starting the hemodialysis the patients were allowed to take rest and no specific physical activity was practiced. The biochemical values of the participants were collected from the participants' health record at the end of 1st and 2nd months in both experimental and control group.

Statistical Analysis

The paired t-test is used to compare the pre-test and post-test level of biochemical values of experimental group.

Ethical Consideration

The present study was approved by Institutional Human Ethical Committee of Saveetha University, Chennai (020/08/2016/IEC/SU Dated 11th August 2016) and Institutional Review Board at Pondicherry Institute of Medical Sciences, Pondicherry.

RESULTS

Table 1 summarizes the demographic data of the participants. Table 2 summarizes clinical variables of the study

Table 1: Distribution of demographic variables of study participants (***n***=14)

Background variables	f (%)		*P*
	Experimental group *n*=7	Control group *n*=7	
Age in years			0.76
41-50	2 (28.6)	3 (42.8)	
51-60	3 (42.8)	3 (42.8)	
61-65	2 (28.6)	1 (14.4)	
Sex			0.12
Male	5 (71.4)	7 (100)	
Female	2 (28.6)	0 (0.0)	
Education			0.44
No formal education	1 (14.2)	1 (14.3)	
Primary education	2 (28.6)	4 (57.1)	
High school	2 (28.6)	2 (28.6)	
Diploma/degree	2 (28.6)	0 (0.0)	
Occupation			0.19
Unemployed	3 (42.8)	6 (85.7)	
Employed	2 (28.6)	1 (14.3)	
Retired	2 (28.6)	0 (0.0)	
Monthly family income			0.57
Up to Rs. 10,000	4 (57.1)	5 (71.4)	
Rs. 10,001–20,000	2 (28.6)	2 (28.6)	
Above Rs. 20,000	1 (14.3)	0 (0.0) 0.0	
Treatment cost per month			1.00
Rs. 10,001–20,000	6 (85.7)	6 (85.7)	
Above Rs. 20,000	1 (14.3)	1 (14.3)	
Marital status			0.31
Single	1 (14.3)	0 (0.0)	
Married	5 (71.4)	7 (100)	
Widow	1 (14.3)	0 (0.0)	
Religion			0.14
Hindu	5 (71.4)	5 (71.4)	
Christian	2 (28.6)	0 (0.0)	
Muslim	0 (0.0)	2 (28.6)	
Primary caregiver			0.22
Self	4 (57.1)	6 (85.7)	
Spouse	2 (28.6)	0 (0.0)	
Son	0 (0.0)	1 (14.3)	
Daughter-in-law	1 (14.3)	0 (0.0)	
Dietary habit			
Non-vegetarian	7 (100.0)	7 (100.0)	
Habit of regular exercise			0.280
Yes	2 (28.6)	4 (57.1)	
No	5 (71.4)	3 (42.9)	
BMI			0.58
Underweight (>18.5 kg/m2)	1 (14.3)	0 (0.0)	
Normal (18.5–24.9 kg/m2)	5 (71.4)	7 (100)	
Overweight (25–29.9 kg/m2)	1 (14.3)	0 (0.0)	

BMI: Body mass index

participants. The comparison of clinical variables of both the groups shows that both the groups are comparable and no significant difference between the experimental and control group. Table 3 summarizes the pre-test biochemical values in experimental and control group. Both the groups are comparable as there is no significant difference in *P* values. Table 4 summarizes the comparison of pre-test and post-test level of biochemical values in experimental group. There is a significant difference between the pre-test and post-test hemoglobin ($P = 0.04$) and sodium ($P = 0.05$) in the experimental group. However, there is no significant difference in potassium, urea, creatinine, albumin, calcium, phosphate, and post-dialysis blood urea levels. Table 5 summarizes the comparison of pre-test and post-test level of biochemical values in control group. There is a significant difference between the pre-test and post-test sodium ($P = 0.006$) in the control group. However, there is no significant difference in hemoglobin, potassium, urea, creatinine, albumin, calcium, phosphate, and post-dialysis blood urea levels.

DISCUSSION

Chronic renal disease is a major public health problem and epidemic in both developing and developed countries. Currently, about 50 million people are having chronic renal disease worldwide, and the prevalence of this epidemic was reported to increase each year.[9] Alteration in the electrolytes and hemoglobin is commonly observed in patients undergoing hemodialysis. This may be due to the physical stress caused by the procedure. Metabolic changes were observed in patients undergoing dialysis due to altered concentration of the electrolytes and changes in the blood volume. This study aimed to observe the effectiveness of physical activity on selected biochemical parameters of patients on hemodialysis. Results showed that physical activity of the extremities for 15 min duration leads to positive changes in the selected biochemical parameters. Physical exercise was reported to improve blood pressure, heart rate, rate of respiration, strength of the muscles, and improvement in overall quality of life.[10] It was reported that the baseline blood level of phosphate, calcium, urea, creatinine, and potassium, as well as hemoglobin, was

Table 2: Distribution of clinical variables of study participants (*n*=14)

Clinical variables	f (%)		*P*
	Experimental group (*n*=7)	Control group (*n*=7)	
Presence of comorbidities			0.29
Hypertension	6 (85.7)	7 (100)	
Hypertension and diabetes mellitus	1 (14.3)	0 (0.0)	
Reason for chronic kidney disease			0.29
Hypertension	6 (85.7)	7 (100)	
Hypertension and diabetes mellitus	1 (14.3)	0 (0.0)	
Number of inpatient admissions in the past 6 months			0.09
Nil	2 (28.6)	5 (71.4)	
1 time	4 (57.1)	2 (28.6)	
2 times	1 (14.3)	0 (0.0)	
How long the participant is in dialysis (year)			0.29
<1	0 (0.0)	2 (28.6)	
1–5	5 (71.4)	4 (57.1)	
More than 5	2 (28.6)	1 (14.3)	
Frequency of dialysis per week (times)			0.29
2	6 (85.7)	7 (100)	
3	1 (14.3)	0 (0.0)	
Number of dialysis in the past 2 months			0.29
16	6 (85.7)	7 (100.0)	
25	1 (14.3)	0 (0.0)	
Duration of dialysis (h/2 months)			0.29
64	6 (85.7)	7 (100)	
100	1 (14.3)	0 (0.0)	
Vascular access			0.29
Arteriovenous fistula	6 (85.7)	7 (100)	
Arteriovenous graft	1 (14.3)	0 (0.0)	

Table 3: Distribution of pre-test biochemical values in experimental and control group (***n***=14)

Biochemical values	Experimental group (*n*=7)	Control group (*n*=7)	*P*
Pre-dialysis blood serum chemical values			
Hemoglobin	8.56±1.70	8.25±1.69	0.75
Sodium	136.86±2.97	136.43±3.16	0.79
Potassium	5.42±1.07	4.80±0.99	0.28
Urea	111.57±29.72	108.86±30.13	0.87
Creatinine	8.62±4.38	9.90±2.27	0.51
Albumin	4.07±0.45	3.84±0.38	0.33
Calcium	9.04±0.60	8.97±0.41	0.79
Phosphate	4.30±1.54	4.86±1.70	0.50
Post-dialysis blood serum chemical values			
Urea	34.71±12.75	32.14±8.36	0.66

Table 4: Comparison of pre-test and post-test level of biochemical values in experimental group (***n***=7)

Biochemical values	Pre-test	Post-test	Mean difference	SD	t value	*P*
Pre-dialysis blood serum chemical values						
Hemoglobin	8.55	9.49	0.93	0.95	2.57	0.04*
Sodium	136.86	139.29	2.43	2.69	2.38	0.05*
Potassium	5.43	5.09	0.34	0.86	1.05	0.33
Urea	111.57	101.14	10.43	41.80	0.66	0.53
Creatinine	8.63	9.06	0.43	1.63	0.69	0.51
Albumin	4.071	4.03	0.04	0.29	0.39	0.70
Calcium	9.04	9.44	0.40	0.59	1.80	0.12
Phosphate	4.41	4.30	0.11	0.95	0.32	0.76
Post-dialysis blood serum chemical values						
Urea	34.71	37.71	3.00	7.57	1.048	0.33

*Statistically significant, SD: Standard deviation

Table 5: Comparison of pre-test and post-test level of biochemical values in control group (***n***=7)

Biochemical values	Pre-test	Post-test	Mean Difference	SD	*t* value	*P*
Pre-dialysis blood serum chemical values						
Hemoglobin	8.2	8.7	0.47	0.55	2.26	0.06
Sodium	136.4	139.4	3.00	1.92	4.15	0.006*
Potassium	4.8	5.3	0.50	0.74	1.79	0.12
Urea	108.9	99.1	9.71	26.56	0.97	0.37
Creatinine	9.9	10.1	0.200	0.73	0.73	0.49
Albumin	3.8	4.0	0.19	0.38	1.28	0.24
Calcium	9.0	8.7	0.31	1.08	0.77	0.47
Phosphate	4.9	4.7	0.20	0.54	0.99	0.36
Post-dialysis blood serum chemical values						
Urea	32.1	30.9	1.29	3.95	0.86	0.42

*Statistically significant, SD: Standard deviation

compared between the exercise and control groups.[11] Further, improvement in the calcium levels followed by physical exercise program also reported by earlier studies.[12-15] Earlier studies reported that physical exercise plays a key role in improving the daily life activities and decreases the mortality in patients undergoing hemodialysis.[16] Mild exercise during dialysis should be performed during the first 2 h of dialysis.[17] Physical exercise increases blood flow to the skeletal muscles and helps to remove urea and other toxic substances.[18] Further, exercise helps to improve the efficiency of the dialysis.[19,20] Our

results are consistent with earlier studies by Henrique *et al*.,[21] McMurray *et al*.,[22] and Fallahi *et al*.[23] who conducted studies on the effects of exercise in patients under chronic hemodialysis. Increase in the hemoglobin levels was reported followed by the exercise.[24] In contrast, Parsons *et al*. reported decrease in the levels of hemoglobin after exercise during dialysis. This may be due to strengthening the effects of erythropoietin in patients with lower hemoglobin levels followed by exercise.[18] Results of the present study indicated a significant increase in the hemoglobin levels followed by the intervention.

Limitations

This study was conducted in one center and in a small sample size, so generalization of the findings may not be possible.

CONCLUSION

The present study showed that the physical activity of the extremities for 15 min duration during dialysis had positive effects on selected biochemical parameters. The exercise program could also increase the hemoglobin. Further detailed studies with higher sample size are recommended to support the use of exercise programs during a hemodialysis.

REFERENCES

1. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, *et al*. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation 2007;116:1081-93.
2. Kohl HW 3rd, Craig CL, Lambert EV, Inoue S, Alkandari JR, Leetongin G, *et al.* The pandemic of physical inactivity: Global action for public health. Lancet 2012;380:294-305.
3. Kosmadakis GC, Bevington A, Smith AC, Clapp EL, Viana JL, Bishop NC, *et al.* Physical exercise in patients with severe kidney disease. Nephron Clin Pract 2010;115:c7-c16.
4. O'Hare AM, Tawney K, Bacchetti P, Johansen KL. Decreased survival among sedentary patients undergoing dialysis: Results from the dialysis morbidity and mortality study wave 2. Am J Kidney Dis 2003;41:447-54.
5. Majchrzak KM, Pupim LB, Chen K, Martin CJ, Gaffney S, Greene JH, *et al.* Physical activity patterns in chronic hemodialysis patients: Comparison of dialysis and nondialysis days. J Ren Nutr 2005;15:217-24.
6. Prichard SS. Impact of dyslipidaemia in end-stage renal disease. J Am Soc Nephrol 2003;14:S315-20.
7. World Health Organization. World Health Report. Reducing Risks, Promoting Healthy Lifestyle. Geneva: World Health Organization; 2002. p. 61, 218-9, 226-7. [Last retrieved on 2017 Mar].
8. Stewart AL, Hays RD, Wells KB, Rogers WH, Spritzer KL, Greenfield S, *et al.* Long-term functioning and well-being outcomes associated with physical activity and exercise in patients with chronic conditions in the medical outcomes study. J Clin Epidemiol 1994;47:719-30.
9. Mula-Abed WA, Al Rasadi K, 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;27:108-13.
10. Koh KP, Fassett RG, Sharman JE, Coombes JS, Williams AD. Intradialytic versus home-based exercise training in hemodialysis patients: A randomised controlled trial. BMC Nephrol 2009;10:2.
11. Noghabi AA, Bassampour SH, Zolfaghari M. Critical Care Nursing ICU, CCU, Dialysis. 2th ed. Tehran: Salemi Publication; 2007. p. 448-53.
12. Cappy CS, Jablonka J, Schroeder ET. The effects of exercise during hemodialysis on physical performance and nutrition assessment. J Ren Nutr 1999;9:63-70.
13. Vaithilingam I, Polkinghorne KR, Atkins RC, Kerr PG. Time and exercise improve phosphate removal in hemodialysis patients. Am J Kidney Dis 2004;43:85-9.
14. Borzou R, Galyaf M, Amin R. Assessment of effect of increasedblood flow on blood levels of potassium and phosphorus in hemodialysispatients. Ardebil Univ Med Sci 2008;8:235-40.
15. Man NK, Chauveau P, Kuno T, Poignet JL, Yanai M. Phosphate removal during hemodialysis, hemodiafiltration, and hemofiltration. A reappraisal. ASAIO Trans 1991;37:M463-5.
16. Jha V, Garcia-Garcia G, Iseki K, Li Z, Naicker S, Plattner B, *et al.* Chronic kidney disease: Global dimension and perspectives. Lancet 2013;382:260-72.
17. Smart N, Steele M. Exercise training in haemodialysis patients: A systematic review and meta-analysis. Nephrology (Carlton) 2011;16:626-32.
18. Parsons TL, Toffelmire EB, King-VanVlack CE. Exercise training during hemodialysis improves dialysis efficacy and physical performance. Arch Phys Med Rehabil 2006;87:680-7.
19. Kong CH, Tattersall JE, Greenwood RN, Farrington K. The effect of exercise during haemodialysis on solute removal. Nephrol Dial Transplant 1991;14:2927-31.
20. Sun Y, Chen B, Jia Q, Wang J. The effect of exercise during hemodialysis on adequacy of dialysis, [Chinese]. Zhonghua Nei Ke Za Z 2002;41:79-81.
21. Henrique DM, Reboredo Mde M, Chaoubah A, Paula RB. Aerobic exercise improves physical capacity in patients under chronic hemodialysis. Arq Bras Cardiol 2010;94:823-8.
22. McMurray A, Blazey L, Fetherston C. The effect of intradialytic foot pedal exercise on blood pressure phosphate removal efficiency and health related quality of life in haemodialysis patients. Ren Soc Aust J 2008;4:38-44.
23. Fallahi M, Shahidi S, Farajzadegan Z. The effect of intradialytic exercise on dialysis efficacy, serum phosphate, hemoglobin and blood pressure control and comparison between two exercise programs in hemodialysis patients. J Isfahan Med School 2008;26:152-61.
24. Musavian AS, Soleimani A, Masoudi Alavi N, Baseri A, Savari F. Comparing the effects of active and passive intradialytic pedaling exercises on dialysis efficacy, electrolytes, hemoglobin, hematocrit, blood pressure and health-related quality of life. Nurs Midwifery Stud 2015;4:e25922.

How to cite this article: Santhi SA, Samson R, Srikanth, Pethuru D. Effectiveness of physical activity on selected biochemical parameters of patients on hemodialysis. Natl J Physiol Pharm Pharmacol 2018;8(8):1194-1199.

Source of Support: Nil, **Conflict of Interest:** None declared.