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Research Article

An Experimental Study to Assess the Effectiveness of Aerobic Exercise on Blood Urea in Hemodialysis Patients in Selected Hospitals, Chennai

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Abstract

Aim: This study was aimed to determine the effect of intradialytic aerobic exercise on blood urea in hemodialysis (HD) patients.

Introduction: HD is one way to treat advanced kidney failure and can help to carry on an active life despite failing kidneys. Intradialytic exercise (IDE) is the exercise training performed during the HD session to increase the patient's strength and endurance.

Materials and Methods: A quasi-experimental study was carried out among 60 adult patients on HD (30 each in control and experimental groups), selected by consecutive sampling technique, at selected tertiary care centers in Chennai. The baseline characteristics and pretest blood urea were collected from both the groups and the intradialytic aerobic exercise was administered for 8 weeks (3 times/week) among the experimental group of patients. Then Post-test I and II blood urea were assessed in both the groups at end of 4th and 8th week. The data were analyzed in SPSS 22.

Results: IDE showed a significant effect in reducing blood urea (mg/dl) among experimental group of participants than control group in post-test I (76.73 ± 17.58, 93.20 ±19.24) and in post-test II (62.23 ± 13.28, 90.20 ±19.60) at $P = 0.001$. There was no significance difference in baseline data/pre-test between experimental and control group pre-test (103.53 ± 30.03, 103.70 ± 30.46).

Conclusion: This study reveals that intra dialytic aerobic exercises is beneficial in terms of reducing blood urea, as a supplementary therapy for HD patients.

Key words: Blood urea, chronic kidney Disease, intradialytic aerobic exercise, hemodialysis

Introduction

Chronic kidney disease (CKD) is a global threat to health in general and for developing countries in particular, with a high economic cost to health systems. The global estimated prevalence of CKD is 13.4% (11.7–15.1%), and patients with end-stage kidney disease (ESKD) needing renal replacement therapy are estimated between 4.902 and 7.083 million.[1] The number of people receiving renal replacement therapy exceeds 2.5 million and is projected to double to 5.4 million by 2030.[2] The prevalence of CKD in general population is 16% (95% CI 12–21%) in India,[3] End-stage renal disease (ESRD) is the point in kidney failure when almost 90% of renal function has been lost, rendering the body unable to maintain proper fluid and electrolyte balance, adequate waste removal, and normal hormonal function.

People with ESRD must undergo some form of renal replacement therapy, namely, a peritoneal dialysis, or

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hemodialysis (HD), or kidney transplantation for survival.[4] Among these options, dialysis is considered the treatment of choice. The majority of patients receive HD, as patients on HD account for approximately 98.7% of patients receiving dialysis and 1.3% who received peritoneal dialysis.[5] Worldwide, HD is a physically stressful procedure.

These patients suffer from weakness, fatigue, nausea, vomiting, tremors, abnormal mental function, and increase of blood pressure (BP) measurements due to increased level of urea in the blood. Furthermore, they are liable to develop uremia and hypertension.[6] Physical activity ameliorates cardiovascular risk factors such as BP and lipid profiles as well as dialysis efficacy.[7] Blood urea level is increased in most of the CKD patients in which hemodialysis (HD) is recommended as treatment of choice. Along with dialysis there are other measures which will help in reducing the blood urea level such as aerobic exercise, ergometric cycle exercise, and pedal exercise. Aerobic exercise is one of the effective, feasible, and cost-effective intervention that helps in reducing the blood urea.

Motedayen *et al.*[8] in their study they have reported that aerobic exercise is effective in reducing the blood urea level in patients undergoing HD. Researches have proven that exercise during HD is easy and safe showing significant changes in physical and psychological conditions, which positively influence their social life.

Intradialytic exercise (IDE) is defined as exercise training program during the HD session aiming to increase strength and endurance of HD patients and hence targeting various physiological and psychosocial parameters. The nature of the IDE includes resistance, aerobic and stretching, using different technique. IDE has shown to have a positive effect on the overall health and hospitalization rate of HD patients.[9] An exercise protocol can lead to improvement in many functions, such as BP, heart function (especially ventricular function in HD patients), muscle strength, and respiratory capacity, and reduce muscle atrophy, with excellent results for the quality of life. Range of motion exercises (ROM) can be considered as a routine care while delivering HD as it is performed for 15 min/day, 3 times a week during dialysis sessions.[10] The nurses in HD unit play an important role in alleviating their sufferings during dialysis. However, in India limited researches were done on IDE s for HD patients. Therefore, this study is conducted to determine the effect of IDE s on blood urea among patients undergoing HD.

Material And Methods

This study was conducted using two groups quasi-experimental time series design at two tertiary care centers in Chennai, among 60 adult patients undergoing conventional maintenance HD (30 each in control and experimental groups), after obtaining setting permission and ethical clearance. Settings were allotted to control and experimental group randomly. Samples were selected using consecutive sampling technique (Setting I - control group and Setting II - Experimental group) The inclusion criteria were as follows: Patients undergoing HD for more than 3 months, aged between 20 and 59 years, receiving HD 3 times per week, for 3 or 4 h (180 min or 240 min) per treatment, having no problems in arteriovenous fistulas (based on the physician's diagnosis) willing to participate in the study, The exclusion criteria included were: Patients having blood coagulation on dialysis filter (during HD), having instability in hemodynamic parameters before and during the exercises, having a history of angina pectoris in the past 3 months, and having any contraindication to exercise (based on the physician's diagnosis).

The data were collected after obtaining consent using the pretested, predetermined, and validated tools such as demographic variables and clinical variables pro forma by structured interview and blood urea was assessed in pre-test. The IDE program was given for the experimental group. The protocol for exercise is as follows: After connecting the patient to the HD machine, aerobic ROM was performed for 15 min during the first 2 h of the dialysis session and no exercise was prescribed during the second half of the session. The prescribed exercises included rotating the wrist as follows: 20 rounds/min (RPM) clockwise and anticlockwise, 20 times full flexion and extension of the wrist, 20 times full flexion and extension of the elbow joint, 20 RPM of rotating the ankles clockwise and anti-clockwise, and 20 times full flexion and extension of the ankles.[9] The control group participants were given routine care. The post-tests I and II were done at the end of 4th and 8th week for both the groups.

Statistical analysis

The data were analyzed using IBM SPSS version 22. The data were presented in tables and Figures using appropriate descriptive (frequency, percentage, mean, and standard deviation) and inferential (Chi-square test, independent t test, and repeated measures ANOVA) statistics.

Results

The study findings on demographic variables revealed that 70% and 66.67% were aged between 41 and 60 years, males (60%, 53.33%), urban residents (60%, 53.33%), Hindus (63.33%, 56.67%), non-vegetarians (63.33%, 73.33%), married (70%, 60%), graduates (56.67%, 46.67%), and unskilled workers (33.33%, 40%) with the monthly income of more than Rs. 15000 (50%, 43.33%) not following any exercise regimen regularly (56.67%, 63.33%) and with spouse as their primary care giver (50%, 46.67%).

Clinical variables revealed that, the presence of co-morbidities such as diabetes mellitus or hypertension (50%, 46.66%) with the family history of ESRD (63.33%, 53.33%), unknown cause of CKD (26.67% and 23.33%), was on HD for more than 3 years of duration (36.67%, 33.33%) regularly thrice in a week (83.33%, 83.33%) with >60kg dry weight (36.67%, 30%) in control and experimental group, respectively. Both the groups were homogenous with respect to all selected demographic and clinical variables [Tables 1 and 2].

Table 1: Frequency and percentage distribution of demographic variables of patients undergoing hemodialysis

Variables	Group				χ^2 and *P*-value
	Experimental (*n*=30)		Control (*n*=30)		
	n	%	*n*	%	
Age in years					
21–30 years	3	10.00	4	13.33	χ^2=0.37
31–40 years	6	20.00	6	20.00	*P*=0.95
41–50 years	8	26.67	9	30.00	(NS)
51–60 years	13	43.33	11	36.67	
Gender					
Male	18	60.00	16	53.33	χ^2=0.27
Female	12	40.00	14	46.67	*P*=0.60
					(NS)
Residence					
Rural	4	13.33	5	16.67	χ^2=0.28
Semi urban	8	26.67	9	30.00	*P*=0.87
Urban	18	60.00	16	53.33	(NS)
Religion					
Hindu	19	63.33	17	56.67	χ^2=0.36
Christian	7	23.33	9	30.00	*P*=0.84
Muslim	4	13.33	4	13.33	(NS)
Dietary habit					
Vegetarian	11	36.67	8	26.67	χ^2=0.69
Non-Vegetarian	19	63.33	22	73.33	*P*=0.41
					(NS)
Education					
Illiterate	0	0.00	0	0.00	χ^2=0.60
Primary/middle	5	16.67	6	20.00	*P*=0.74
High school/HSC	8	26.67	10	33.33	(NS)
Graduate and above	17	56.67	14	46.67	
Occupation					
Home maker	6	20.00	7	23.33	χ^2=1.29
Unskilled	4	13.33	5	16.67	*P*=0.94
Semi-professional	10	33.33	7	23.33	(NS)
Professional	3	10.00	4	13.33	
Unemployed	1	3.33	2	6.67	
Retired	6	20.00	5	16.67	
Income in rupees					
<Rs. 5000	0	0.00	0	0.00	χ^2=0.27
Rs. 5001–10,000	6	20.00	7	23.33	*P*=0.87
Rs. 10,001–15,000	9	30.00	10	33.33	(NS)
>Rs. 15,000	15	50.00	13	43.33	
Marital status					
Married	21	70.00	18	60.00	χ^2=0.98
Unmarried	2	6.67	4	13.33	*P*=0.80
Widowed	5	16.67	6	20.00	(NS)
Divorced	2	6.67	2	6.67	
Habit of regular exercise					
Yes	13	43.33	11	36.67	χ^2=0.27
No	17	56.67	19	63.33	*P*=0.60
					(NS)
Primary caregiver					
Self	10	33.33	8	26.67	χ^2=1.26
Spouse	15	50.00	14	46.67	*P*=0.75
Son	3	10.00	6	20.00	(NS)
Daughter in law	2	6.67	2	6.67	

NS=Not significant

Table 2: Frequency and percentage distribution of clinical variables of patients undergoing hemodialysis

Variables	Groups				χ^2 and *P*-value
	Experimental (*n*=30)		Control (*n*=30)		
	n	%	*n*	%	
Comorbidities					
Diabetes mellitus	6	20.00	5	16.67	χ^2=0.52
Hypertension	4	13.33	6	20.00	*P*=0.91
Both	15	50.00	14	46.66	(NS)
Other renal	5	16.67	5	16.67	
Family history of ESRD					
Yes	19	63.33	16	53.33	χ^2=0.61
No	11	36.67	14	46.67	*P*=0.43
					(NS)
Cause For Kidney Disease					
Diabetes mellitus	4	13.33	5	16.67	χ^2=0.31
Hypertension	7	23.33	8	26.67	*P*=0.99
polycystic kidney disease	3	10.00	3	10.00	(NS)
Unknown etiology	8	26.67	7	23.33	
Any other cause	8	26.67	7	23.33	
Duration of ESRD					
<1 year	6	20.00	6	20.00	χ^2=0.12
1–3 years	7	23.33	7	23.33	*P*=0.99
3–5 years	6	20.00	7	23.33	(NS)
>5 years	11	36.67	10	33.33	
Duration of HD					
<6 months	0	0.00	0	0.00	χ^2=0.42
6 months–1 year	6	20.00	8	26.67	*P*=0.93
1–2 years	6	20.00	5	16.67	(NS)
2–3 years	7	23.33	7	23.33	
>3 years	11	36.67	10	33.33	
Dry weight					
31–40 kg	3	10.00	5	16.67	χ^2=0.83
41–50 kg	6	20.00	7	23.33	*P*=0.84
51–60 kg	10	33.33	9	30.00	(NS)
>60 kg	11	36.67	9	30.00	
HD treatment per week					
Thrice in a week	25	83.33	25	83.33	χ^2=0.00
Twice in a week	5	16.67	5	16.67	*P*=1.00
					(NS)

NS=Not significant

The repeated measures ANOVA *F*-test analysis revealed that, there was statistically significant difference in mean blood urea score between pre-test, post-test I, and post-test II in experimental group ($F = 44.70$, $P \leq 0.001$) and control group ($F = 4.32$, $P < 0.05$) as shown in Table 3. However, the independent t test revealed a significant reduction in urea scores among experimental group in post-test I and post-test II ($P = 0.001$) compared to control group [Table 4]. Therefore, we can conclude that an intradialytic aerobic exercise reduces significantly blood urea level among HD patients.

There was a significant association between blood urea of HD patients in experimental group and their education, occupation, and duration of HD ($P = 0.05$). However, there was no significant association between blood urea and other background variables such as age, gender, residence, religion, dietary habit, income in rupees, marital status, habit of regular exercise, primary care giver, presence of comorbidities, family history of ESRD, cause for kidney diseases, duration of ESRD, dry weight, and HD treatment per week.

Discussion

CKD is a serious and common disease, and it eventuates in multiple complications, including premature mortality and

Table 3: Comparison of Blood Urea Level Between Pre-Test, Post-Test-I, and Post-Test-II in Control and Experimental Group of Patients Undergoing Hemodialysis (RM ANOVA with *post hoc* Analysis) (*n*=60)

Groups	Assessment	Mean	SD	F value	*P*-value	*Post hoc* Analysis		
						Comparison	MD	*P*-value
Experimental (*n*=30)	Pre-test	103.53	30.03	*F*=44.70	*P*=0.001***	Pre-test versus Post- test I	26.80	0.001
	Post-test-I	76.73	17.58			Pre-test versus Post- test II	41.30	0.001
	Post-test-II	62.23	13.28			Post-test-1 Versus Post-test-II	14.50	0.001
Control (*n*=30)	Pre-test	103.70	30.46	*F*=4.32	*P*=0.05*	Pre-test versus Post- test I	10.50	0.01
	Post-test-I	93.20	19.24			Pre-test versus Post- test II	13.50	0.01
	Post-test-II	90.20	19.60			Post-test-1 versus Post-test-II	3.00	0.05

Table 4: Comparison of mean blood urea level between control and experimental group of patients undergoing hemodialysis

Blood urea level	Group				Mean Difference	Student independent *t*=test
	Experimental (*n*=30)		Control (*n*=30)			
	Mean	SD	Mean	SD		
Pre-test	103.53	30.03	103.70	30.46	−0.17	*t*=0.02 *P*=0.98 DF=58 (NS)
Post-test-I	76.73	17.58	93.20	19.24	16.47	*t*=3.46 *P*=0.001*** DF=58 (S)
Post-test-II	62.23	13.28	90.20	19.60	27.97	*t*=6.47 *P*=0.001*** DF=58 (S)

NS=Not significant *P*>0.05 is not significant S=Significant

ESKD.[11] HD is the most common form of treatment modalities for renal replacement therapy. This study was conducted to determine the effect of IDE on urea reduction score the study demonstrates that there was a statistically significant decrease in urea level in post intervention I and II among experimental group compared to control group. It can be attributed to the effectiveness of aerobic exercise on blood urea among patients undergoing HD.

The current study findings were in agreement with that of Mohseni *et al*. The effect of 8-weeks IDE program (consisting of 15 min low-intensity exercise during the first 2 h of dialysis) on dialysis efficacy was evaluated, in an open randomized controlled trial. A total of 50 clinically stable HD patients were enrolled into the study and randomly allocated into two groups: The aerobic exercise group (n = 25) and the control group (n = 25). Aerobic exercises were done in the intervention group for 15 min/day, 3 times a week for 2 months. The dialysis efficacy was assessed before and at the end of each month of the program results of this study revealed that the efficacy of dialysis increased at the end of the 1st month and remained elevated for the duration of the program in the exercise program has increased the efficacy of dialysis and may be considered as a safe, complementary, and effective modality for HD patients.[12] It had been suggested that exercises improved removal of uremic toxins into vascular compartments during dialysis. Muscular blood flow increased the efflux of urea and cellular permeability to water soluble molecules. Correspondingly, Paluchamy and Vaidyanathan and Paluchamy (2018) reported that exercises during HD session (intradialtic) increased the muscle blood flow. Thereby, there was more removal of waste products and as a result there was an improvement in dialysis efficacy and improvement in BP measurements.[13] A recent meta-analysis showed improvements in dialysis adequacy following exercise training in HD patients.[14]

A single intradialytic cycling session of 60 min at submaximal exertion improved Kt/V by 14%, which is comparable to the effect of 20 min prolongation of HD treatment time.[15] Hence, it could be inferred from the above findings that IDE resulted in benefits in terms of improving HD adequacy. The present study results show a significant association between urea score of HD patients in experimental group with their background characteristics such as education, occupation, and duration of HD (P = 0.05). The graduate and home maker HD patients undergoing the treatment for >3 years of duration had high urea reduction score. This study findings were coherent with the findings of Liangos *et al*. He reported in his study on factors associated with urea reduction ratio in acute renal failure, that among the dialysis-related variables, treatment time (P < 0.01), dialyzer surface area (P < 0.01), dialyzer K (UF) (P = 0.04), blood flow rate (P < 0.01), and the use of a femoral venous catheter (P < 0.01) were also independently associated with URR.[16]

Conclusion

Over all the study findings revealed that intradialytic aerobic exercise was effective in reducing the blood urea in HD patients. Intradialytic aerobic exercise could be safely practiced in the HD units to a wide range of the dialysis population. Despite the beneficial effects of aerobic exercise training in the HD population, there is a lack of the widespread adoption of such program. Therefore, it is essential to organize and execute orientation and awareness programs for health-care professionals in the dialysis unit to incorporate intradialytic aerobic exercise as standard and routine clinical practice in dialysis unit. Furthermore, additional studies are required with longer duration, larger sample sizes, and different exercises in HD patients. Health-care professionals especially nurses play vital role in caring the HD patients by effective interventions to reduce blood urea level and improve their well-being and quality of life.

Conflict of Interest

The authors declare no conflicts of interest.

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