Effect of Different Types of Deep Breathing Training on Functional Capacity and Fatigue Level in Hemodialysis Patients

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ABSTRACT

Background: Functional capacity (defined as the ability of individuals to do their daily living activities) in hemodialysis patients is affected due to peripheral muscles and pulmonary function impairment.

Objective: This study aimed to evaluate the effect of different types of deep breathing training on functional capacity and fatigue level in hemodialysis patients. **Patients and methods**: A total of 111 hemodialysis patients of both sexes with end stage renal disease (ESRD) participated in the study with age ranged from 55 to 65 years old. They were randomly recruited from Quesna Central Hospital from Dialysis Unit. They were assigned randomly into three groups (A, B & C). Group (A) consisted of 37 patients who received Diaphragmatic Breathing Exercise 3 sessions per week, 20 minutes for each session with 6 sets per each session, for 8 successive weeks. Group (B) consisted of 37 patients who received breathing training by incentive Spirometer Device 3 sessions per week, 20 minutes for each session with 6 sets per each session, for 8 successive weeks. Group (C) consisted of 37 patients who received their medical treatment and hemodialysis only. **Results:** A significant change in six-minute walk test (6MWT) and fatigue assessment scale (FAS) in the 3 groups post-training compared with that pre-training was observed. There was no discernible difference existed between the 3e post-training groups in terms of 6MWT. However, there was significant decrease in FAS of the group A and B post training compared with that of the group C. **Conclusion:** Different types of deep breathing training improve the functional capacity and the fatigue level in hemodialysis patients.

Keywords: Diaphragmatic Breathing Exercise, Incentive Spirometer, Functional Capacity, Hemodialysis, Chronic kidney disease.

INTRODUCTION

Permanent urine abnormalities, structural changes, or reduced kidney excretory function that may indicate the loss of functional nephrons is all signs of chronic kidney disease (CKD). Most CKD patients are more vulnerable to cardiovascular illnesses and death **[1]**. Inspiratory muscle impairments in hemodialysis patients lead to loss in their functional abilities. Inspiratory muscle weakness (IMW) leads to decrease of the functional capacity in some populations that suffer from muscle wasting. In end stage renal disease (ESRD), uremic myopathy may influence the strength and endurance loss in inspiratory muscles, and also muscles of the locomotor system **[2]**.

Muscle wasting leads to high rates of mortality and morbidity, among patients with CKD particularly those receiving hemodialysis (HD). However, little is understood about diaphragm dysfunction in HD patients. The high incidence of dyspnea and the fatigue scores in HD patients were related to diaphragmatic dysfunction **[3]**.

CKD consists of renal damage and progressive and irreversible loss of kidney function (glomerular, tubular and endocrine). This is a worldwide problem, with an estimated prevalence of 8- 16%, which incurs high costs for the health system. It is believed that these numbers will increase disproportionately in the coming years, especially in developing countries **[4]**.

In CKD patients, the decrease in exercise tolerance and levels of physical activity in daily life, and high mortality rate may be due to reduction in functional capacity **[5]**.

In adults with respiratory and heart illness, assess functional capability and therapy impact, six-minute walk test (6MWT) is the most common submaximal, valid and reproducible test used [6].

Fatigue Assessment Scale (FAS) initial's version was created in 2003 and consisted of 10 questions about perceived patient's physical and level of mental tiredness. The replies are scored using a 7-point Likert scale (1= never to 5= always). As a result, the score ranges from 10 to 50. A total of 10 questions are answered by the patients to calculate the total score. The scale is divided into 3 categories: exhausted, not exhausted, and very exhausted. Patients are classified as "non-exhausted" if their FAS score is less than 22; "fatigued" if it is between 22 and 35, and "very fatigued" if it is greater than 35 **[7]**.

Incentive spirometer is amedical device used for achieving and maintaining maximal to serve as motivation and to support maintaining optimal lung health to improve respiratory function. For patients, it is a device that is simple to use. This device's visual input on airflow and volume is a key benefit. Effective inspiration, better controlled flow, and higher practice motivation are brought about by prolonged use. It improved pulmonary function (FVC, FEV1) in hemodialysis patients **[8]**.

Received: 25/5/2022
Accepted: 2/8/2022

During hemodialysis session Patients with ESRD can benefit greatly from respiratory muscle exercise in terms of increased strength and functionality [9].

Diaphragmatic breathing is a relaxation procedure that makes individuals breath deeper in slow rhythms. At each breath, the individual uses the diaphragm muscle to put in the oxygen into the lungs. Anxiety or autonomic arousal usually makes breathing fast and short. This diaphragmatic breathing reduces anxiety by changing breathing patterns to a more relaxed pattern [10].

This study aimed to evaluate the effect of different types of deep breathing training on functional capacity and fatigue level in hemodialysis patients.

PATIENTS AND METHODS

A total of 111 hemodialysis patients of both sexes with ESRD participated in the study. They were between the ages of 55 and 65 years. They were assigned randomly into three groups (A, B & C). Group (A) included 37 patients who received 3 sessions per week for 8 successive weeks of diaphragmatic breathing exercise; Group (B) that included 37 patients who received breathing training by incentive spirometer, and Group (C) included 37 patients who underwent hemodialysis sessions and medical treatment only. All patients within the 3 groups were assessed 6 minute walk test and fatigue assessment scale.

Sample Size:

Using G.Power 3.1.9.7, the sample size was determined. A prior type of power analysis was used with Power (1-error probability) = 0.95 and α error probability 0.05. A total of 111 patients were discovered to be the minimal sample size.

Inclusion criteria:

All patient's age between 55-65years from both gender, the patients have been on hemodialysis for at least 1 year with 2 to 3 sessions per week for 3-4 hours per session, the patients were diagnosed with end stage renal failure (stage 5 CKD) on maintenance regular HD (3 sessions/week, on alternate days, for 4 hours/session, for more than 3 months. Receiving HD through uncomplicated arm arteriovenous (A-V) fistula, in a stable medical, clinical and hemodynamic, Body math index range from 25-34.9 kg/m² and dyspnea score more than 2.

Exclusion criteria:

Resting systolic blood pressure of more than 200 mmHg and/or a diastolic blood pressure of more than 120 mmHg, neurological issues (such as a stroke or head injury), musculoskeletal issues (such as severe osteoarthritis or mobility issues), and uncontrolled pulmonary disease. (e.g., exaggerated acute asthma, exaggerated chronic obstructive lung illness), and mental health issues and cognitive impairment due to inability to teach them how to make respiratory training, any patient who missed more than two weeks of the program or want to terminate the program, Severe obesity (BMI >35), presence of malignant disease, Acute pericarditis, myocarditis, uncontrolled cardiac arrhythmia, unstable angina, decompensated heart failure ,hearing impairment or mental disorders, underlying respiratory illness that makes performing respiratory exercises and participating in the study difficult.

Evaluating Procedure:

All data and information of each participant who participated in this study including name, address, age, weight, height, BMI are recorded in recording data sheet. Detailed history was obtained to detect other pathological conditions that may affect the study. Fatigue assessment scale was used to assess fatigue level. All patients were required to complete the scale in Arabic by personal interview and then the therapist calculated the total score for each patient. Six-minute walk test was conducted to evaluate the patients' functional abilities. The individuals were instructed to walk similar to their habitual walking from end to end that marked by cones at their own space to cover as much distance as possible within 6 minutes. A 30 meters' straight course was marked by cones. The patient was instructed to walk "laps" at comfortable pace (one lap is 60 meters).

Training procedure:

The training was during hemodialysis session and full explanation of treatment procedures was given to the patients. Dialysis session lasts for four hours and the training was begun during the third hour, in this investigation, the patients were divided into three groups at random.

Patients in group A:

The patient sit or lie down comfortably, the therapist place one hand on the chest and the other hand on the abdomen, then ask the patient to take deep breath from the nose and exhale from the mouth. Patients received diaphragmatic breathing exercise, for 8 weeks. There were 3 sessions of 20 minutes each, plus maintaining medical treatment and hemodialysis.

Patients in group B:

Each patient was instructed to sit upright with placing incentive spirometer at the same level of his mouth to promote optimal lung expansion while using the spirometer.

- The patient was instructed to exhale letting all the breath out.
- Ask the patient to close the lips around the mouth-piece of the spirometer.
- Instruct the patient to inhale slowly, breathing in until unable to do any more, this would raise the balls to the top of the column.
- Ask the patient to hold the breath as long as possible (at least five seconds) then exhale slowly.

Incentive spirometer group received respiratory training by triflow incentive spirometer device for 8 weeks. There were 3 sessions of 20 minutes each, plus maintaining medical treatment and hemodialysis.

Patients in group C:

Control group: Patients in this group were maintained on medical treatment and hemodialysis.

Ethical consent:

The Research Ethics Committee at Cairo University gave its approval to this work (P.T.REC/012/003653). It was optional to participate. Before being included in the study, each participant completed a written statement of informed permission. The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans, was followed in the conduct of this work.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 18 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) and Fisher's exact test to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean and standard deviation (SD). ANOVA test was used to compare the subject characteristics between groups and the effect of the intervention (between groups) on mean values of 6MWT. Kruskal-Wallis test was conducted for comparing the effect of the intervention (between groups) on mean values of FAS. Paired T-test was used to detect the effect of intervention within group and compare between the mean values 6MWT, pre and post treatment. Wilcoxon Signed-Ranked test was used to detect the effect of intervention within group and compare between the mean values of FAS pre and post training. P value $\leq$ 0.05 was considered significant.

RESULTS

Demographic Data:

Table1 compared the general characteristics of the patients in the 3 groups. There was no statistically significant difference in the mean age, weight, height, and BMI between the 3 groups.

Table (1): Comparison of age, weight, height and BMI of group A, B, and C:

Variable	Group A	Group B	Group C	F-value	P-value	Sig
	$\bar{X}$ ± SD	$\bar{X}$ ± SD	$\bar{X}$ ± SD			
Age (years)	60.49 ± 4.62	60.35 ± 4.3	58.92 ± 3.52	1.59	0.207	**NS**
Weight (kg)	75.22 ± 11.93	77.92 ± 8.62	73.97 ± 16.76	0.91	0.406	**NS**
Height (cm)	165.32 ± 7.92	168.32 ± 7.05	164.16± 7.69	2.98	0.055	**NS**
BMI (kg/m²)	27.3 ± 2.73	27.43 ± 1.74	27.06 ± 4.5	0.13	0.879	**NS**

Effect of the training on 6MWT:

Group A was significantly higher after training compared with before training (P <0.05). In group B, there was a significant increase in 6MWTpost training compared with that pre training (P <0.05). In group C, there was no significant change in 6MWTpost training compared with that pre trainingin (P =0.019).

Comparison between groups:

Comparison between the 3 groups prior to treatment showed no significant change on the 6MWT (P =0.823) and no significant difference in the 6MWT between the 3 groups post-training (P =0.251).

Table (2): Mean 6MWT pre and post training of groups A, B and C.

6MWT				
Groups		**(A)**	**(B)**	**(C)**
Pretraining		235.14 ± 18.08	250.54 ± 18.48	238.92 ± 18.03
Post training		272.97 ± 21.45	291.89 ± 21.77	243.3 ± 18.8
MD		37.8	41.4	4.3
% of change		16.1 %	16.5%	1.8%
P-value		P<0.05	P<0.05	P=0.019
Sig.		**S**	**S**	**S**
ANOVA test results (comparing between groups)				
		F value		**P-value**
Pretraining		**0.195**		**0.823**
Post training		**1.401**		0.251
Post Hoc tests (Multiple comparison between groups)				
Post training		**MD**	**P-value**	**Sig**
	Group A vs Group B	**-18.9**	**0.525**	**NS**
	Group A vs Group C	**29.73**	0.313	**NS**
	Group B vs Group C	**48.64**	**0.1**	**NS**

Effect of the training on FAS:

In group A, there was a significant decrease in FAS post training compared with that pre training ($P < 0.05$). In group B, there was a significant decrease in FAS post training compared with that pre training ($P < 0.05$). In group C, there was no significant change in FAS post training compared with that pre training ($P = 0.87$).

Comparison between groups:

There was no significant difference in the FAS between the 3 groups pre training ($P = 0.405$) and there was a significant difference in the FAS between the 3 groups pre training ($P < 0.05$).

Table (3): Mean FAS pre and post training of groups A, B and C.

FAS			
Groups	**(A)**	**(B)**	**(C)**
Pretraining	38.9 ± 4.9	38.4 ± 4.7	39.4 ± 6.2
Post training	35 ± 6.3	33.8 ± 6.3	40 ± 5.8
MD	3.9	4.6	0.6
% of change	10%	11.9%	1.5%
P value	P <0.05	P <0.05	P =0.87
Sig.	**S**	**S**	**NS**
Kruskal Wallis ANOVA test results (comparing between groups)			
	P value		**Sig**
Pre training	**0.405**		**NS**
Post training	P <0.05		S

DISCUSSION

This study was conducted to show the impact of different types of breathing training on functional capacity and fatigue level on hemodialysis patients. The training was done by diaphragmatic breathing exercise and incentive spirometerdevice.

The result of the study in Group (A) showed that when compared to pre-training, the 6MWT significantly increased, and the percent difference was 16.1%. Additionally, the tiredness evaluation scale significantly decreased after training compared to before training and the percent of change was 10%. This agrees with **Simões *et al.*** [11] who conducted a protocol consisted of several physiotherapy techniques as associated with progressive resistive workouts include breathing exercises, cardio exercises, and electrical stimulation. These strategies were tested for lung function, palmar grip strength, knee extensor strength, respiratory muscle strength, and functional capability. The study findings indicate that there was a considerable increase in functional capacity ($P = 0.009$).

The result of the current study was not consistent with **Arazi *et al.*** [12] who showed that after 2 months of breathing exercises with hemodialysis patients in the 6-minute walk test, no significant differences were found.

The results of the current study agreed with **Hamed and Abdel Aziz** [13] who concluded in their study that performing deep breathing exercises for twenty minutes, twice per day for full month can reduce patient's fatigue level. The total mean percent score of fatigue pre-intervention was 66.30 (SD 12.19), and after performing the exercise the mean score was 26.25 (SD 5.47).

The results of the this study come in support with the result stated by **Sutinah and Azhari** [14] who concluded that deep breathing exercise can reduce fatigue level in hemodialysis patient and the score pretreatment 50.18 and post treatment 46.45 with p value of 0.043.

In Group (B) comparisons showed that there was a considerable increase in 6MWT and FAS post training ($P < 0.05$).

This agrees with **Aboelmagd and Ismail** [15] who concluded that training by incentive spirometer is suggested to be a part of every day life of hemodialysis patients to increase functional capacity by 12.52% as measured by 6MWT.

CONCLUSION

Diaphragmatic breathing exercise and training by incentive spirometer during dialysis sessions improve functional capacity and decrease fatigue level in hemodialysis patients.

Conflict of interest: The authors declare no conflict of interest.

Sources of funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contribution: Authors contributed equally in the study.

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