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Effect of Pulmonary Rehabilitation Program on Quality of Life and Pulmonary Functions in Mild Alzheimer's

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Abstract: By 2050, the incidence of Alzheimer's disease is expected to approach nearly a million people per year, with a total estimated prevalence of 11 to 16 million persons. Lower respiratory function predicted poorer performance on cognitive function tests as low respiratory function was related to prevalent dementia. This study was designed to determine changes in quality of Life and pulmonary functions in mild Alzheimer's after a designed pulmonary rehabilitation program. Forty patients with mild Alzheimer, their age ranged between 65 to 70 years and were included into 2 equal groups; group (A) received aerobic walking exercise training and incentive spirometry breathing exercises at a frequency of 3 sessions per week for two months. The second group (B) received no exercise training. Measurements of pulmonary functions (VC, FEV_1, MVV and SaO_2) and questionnaire of the quality of life (QOL) were obtained for both groups before and after the exercise program. There was a significant increase in VC, FEV_1, MVV, SaO_2 and questionnaire of QOL of group (A), while the results of group (B) were not significant. There was a significant difference between both groups. It is recommended to apply this pulmonary rehabilitation program for patients with Alzheimer's to improve their pulmonary functions and quality of life.

Key words: Pulmonary Rehabilitation · Quality of Life · Pulmonary Functions · Mild Alzheimer's

INTRODUCTION

Alzheimer's disease is the seventh leading cause of all deaths in the United States and the fifth leading cause of death in Americans older than the age of 65 years. Significant cost implications related to Alzheimer's disease and other dementias include an estimated $148 billion annually in direct (Medicare/Medicaid) and indirect (e.g., caregiver lost wages and out-of-pocket expenses, decreased business productivity) costs [1].

Pulmonary function has been associated with some measures of cognitive performance, mostly in late adulthood. FEV_1 has a small but reliable positive association with cognitive test performance throughout adulthood, possibly reflecting a common physiological factor [2].

Quality of life (QOL) is a widely used concept in social science and relates to various aspects of life. It can be measured in four dimensions (physical functioning, emotional distress, social health and perceived health) in their definition of quality of life. Physical functioning included the concepts of vigor, activities of daily living (ADL) and health that interfered with activities. Emotional distress included anxiety and depression. Social health included social function, social life satisfaction and intimacy. Finally, perceived health included general health[3].

Older adults with AD can successfully participate in moderate intensity aerobic exercise. Engaging older adults with AD in aerobic exercise is important, because aerobic exercise training improves physical functioning and has the potential to alleviate AD symptoms and could significantly improve their health and quality of life[4].

Incentive spirometry is widely used clinically as an adjunct to chest physiotherapy that provides the patient with visual feedback of the volume of air inspired during a deep breath. It provides low-level resistive training while minimizing the potential of fatigue to the diaphragm. It has been used to enhance lung expansion and inspiratory muscle strength [5].

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The aim of this study was to determine quality of life and pulmonary functions response to pulmonary rehabilitation program in mild Alzheimer's.

MATERIALS AND METHODS

Subjects: Forty mild Alzheimer elderly subject their age ranged between 65 to 70 years, free from respiratory, cardiac, kidney, liver, metabolic and neurological disorders. Subjects were not smokers and included into 2 equal groups; group (A) received aerobic walking exercise training and incentive spirometry breathing exercises at a frequency of 3 sessions per week for two months. The second group (B) received no physical therapy intervention and asked to maintain their ordinary life style. Informed consent was obtained from all participants. All participants were free to withdraw from the study at any time. If any adverse effects had occurred, the experiment would have been stopped, with this being announced to the Human Subjects Review Board. However, no adverse effects occurred and so the data of all the participants were available for analysis.

Evaluated Parameters

Pulmonary Function Test: Vital capacity (VC) and maximum voluntary ventilation (MVV), forced expiratory volume in the first second (FEV_1) and arterial oxygen saturation (SaO_2) were measured using spirometer (Schiller-Spirovit Sp-10, Swizerland) with a special sensor to measure arterial oxygen saturation (SaO_2).

The LEIPAD: (an acronym deriving from the first two of the three most involved universities: LEIden (the Netherlands), PADua (Italy) and Helsinki (Finland)) assessment questionnaire was used to evaluate the quality of life of elderly subjects. The LEIPAD is an assessment questionnaire specifically designed to appraise quality of life in the elderly. The project has been conducted under the auspices of World Health Organization (WHO). It meets the specific requirements of this age group and was not only valid and reliable, but was also very practical, that has been adopted internationally because it is sufficiently discriminatory to be applied to highly varied cultural settings, despite its standard, basic structure[6].

LEIPAD questionnaire has been designed to measure main QOL dimensions or domains which are physical functions, self-care, depression and anxiety, cognitive functions, social functions, life satisfaction, the perceived personality disorder, the anger sensation, self-esteem and the trust in god. This instrument has also been designed to be sensitive enough to pick up changes in patients' QOL resulting from any kind of intervention, be it medical, surgical, or psychosocial with a level of reliability. So LEIPAD scales adequately cover the range of quality of life domains and with a stability between the various countries seems acceptable [7].

The Aerobic Treadmill Exercise Training: The aerobic treadmill-based training (Enraf Nonium, Model display panel Standard, NR 1475.801, Holand) was developed in accordance with aerobic exercise guidelines for older adults from the American College of Sports Medicine and the National Institute on Aging[8] and [9].The protocol include 5 minutes of warm-up activities (lower body stretches and marching in place at a casual pace), 10-30 minutes of moderate-intensity cycling on a recumbent stationary cycle (with moderate intensity defined as 60-65% of maximal heart rate, MHR = 220-age) and 10 minutes of cool-down activities (slowing cycling and stretches). Participants are expected to complete this protocol 3 times a week for 2 months under the guidance and supervision of a trainer. Over the 24 sessions, trainers work to gradually increase a participant' cardio-respiratory capacity to reach the target intensity and duration.

Breathing Exercise Training with Incentive Spirometer: Incentive spirometer (volydyne volumetric manufactured by Sherwood medical company U.S.A) is a respiratory therapy device that provides visual feedback in term of volumetric success as a patient performs a deep breath. It is considered as a mechanical aid to lung expansion and was applied for five minutes, five times a day for two months.

Statistical Analysis: The mean values of VC, MVV, FEV_1, SaO_2 and QOL obtained before and after two months in both groups were compared using paired "t" test. Independent "t" test was used for the comparison between the two groups ($P<0.05$).

RESULTS

Forty patients with mild Alzheimer, their age ranged between 65 to 70 years and were included into 2 equal groups; group (A) received aerobic walking exercise training and incentive spirometry breathing exercises at a frequency of 3 sessions per week for two months. The second group (B) received no exercise training.

Measurements of VC, MVV, FEV_1, SaO_2 and QOL obtained before and after two months in both groups were compared using paired "t" test. The mean VC, MVV, FEV_1, SaO_2 and QOL values were significantly higher statistically in group (A), while the results of group (B)

Table 1: Comparison of mean value, standard deviation and p-value of VC, FEV_1, MVV, SaO_2 and QOL in group (A) before and after treatment

	Mean±SD			
	Before	After	T-value	P-value
VC (L.)	3.15±0.48	4. 16±0.63	2.86	<0.05
FEV_1 (L. /Sec.)	1.89±0.56	2.76±0.46	2.79	<0.05
MVV (L. /min.)	44.67±3.04	48.73±3.13	3.59	<0.05
SaO_2 (%)	92.60±3.27	97.41±3.13	3.12	<0.05
QOL	40.23±4.45	45.88±4.16	4.15	<0.05

VC= vital capacity FEV_1 = Forced expiratory volume in the first second
MVV= maximum voluntary ventilation QOL= quality of life
SaO_2 = arterial oxygen saturation

Table 2: Comparison of mean value, standard deviation and p-value of VC, FEV_1, MVV, SaO_2 and QOL in group (B) before and after treatment

	Mean±SD			
	Before	After	T-value	P-value
VC (L.)	3.06±0.344	3.12±0.39	0.53	>0.05
FEV1 (L. /Sec.)	1.82±0.46	1.86±0.45	0.01	>0.05
MVV (L. /min.)	43.53±3.50	44.26±3.21	0.45	>0.05
SaO_2 (%)	92.16±3.15	92.55±3.01	0.34	>0.05
QOL	40.86±4.34	40.11±4.23	-0.63	>0.05

VC= vital capacity FEV_1 = Forced expiratory volume in the first second
MVV= maximum voluntary ventilation QOL= quality of life
SaO_2 = arterial oxygen saturation

Table 3: Comparison of mean value, standard deviation and p-value of VC, FEV_1, MVV, SaO_2 and QOL in group (A) and group (B) after treatment

	Mean±SD			
	Group (A)	Group (B)	T-value	P-value
VC (L.)	4. 16±0.63	3.12±0.39	4.48	<0.05
FEV1 (L. /Sec.)	2.76±0.46	1.86±0.45	4.36	<0.05
MVV (L. /min.)	48.734±3.13	44.26±3.21	3.14	<0.05
SaO_2 (%)	97.41±3.13	92.55±3.01	3.53	<0.05
QOL	45.88±4.16	40.11±4.23	3.08	<0.05

VC= vital capacity FEV_1 = Forced expiratory volume in the first second
MVV= maximum voluntary ventilation QOL= quality of life
SaO_2 = arterial oxygen saturation

were not significant (Table 1 and 2). There was a significant difference between both groups after treatment using independent "t" test (Table 3). So, pulmonary rehabilitation program is recommended for elderly Alzheimer's.

DISCUSSION

This study was designed to determine quality of life and pulmonary functions response to pulmonary rehabilitation program in mild Alzheimer's. Measurements of VC, MVV, FEV_1, SaO_2 and QOL questionnaire were done before the beginning of the study and repeated at the end of the study after two months for group (A) and group(B).

The measures of the QOL in this study were obtained by the total score of the QOL questionnaire (equal to the sum of scores of the physical function scale, the self-care scale, the depression and anxiety scale, the cognitive functioning scale, the social functioning scale, the life satisfaction scale, self-perceived personality disorders, a scale for assessing anger, resentment and irritability, social desirability, faith in God and the self-esteem).

The results of this study indicated a significant increase in VC, FEV_1, MVV, SaO_2 and questionnaire of QOL of group (A), while the results of group (B) were not significant. There was a significant difference between both groups. These results agreed with the previous studies in this area.

The increase in V.C observed in subjects received breathing exercises using incentive spirometer might be related to the enhanced strength of the respiratory muscles and reduction of air trapping [10]. The possible explanation of the improvement in maximum voluntary ventilation (MVV) following breathing exercise is increase in respiratory muscle efficiency [11].Incentive spirometry increases production of surfactant which leads to reducing surface tension, increasing lung compliance, decreasing the work of breathing and opening of collapsed alveoli to prevent atelectasis that contributed to increase arterial oxygen saturation (SaO_2) [12].

Inspiratory muscles training makes recruitment of the diaphragm, delays onset of ventilatory muscles fatigue, decreases dyspnea and improves vital capacity in lungs with efficient gaseous exchange which helps in mental activity [13]. A direct correlation was found between total cognitive score and vital capacity [14].Good respiratory capacity may protect the brain from chronic hypoxic and ischemic damage. Chronic hypoxia may cause defective ATP production, abnormal synthesis of neurotransmitters (such as acetylcholine), oxidative stress and blood-brain barrier dysfunction, all of which may be involved in the etiology of AD [15].

Application of treadmill walking exercise three times weekly for 8 weeks resulted in increased exercise endurance, less dyspnea, improved V.C, MVV and twelve minute walking test. Improvements may be due to one or more of the following factors: improved aerobic capacity, or muscle strength or both, increased motivation and improved ventilatory muscle function [16].

This is surprising, as regular physical activity is recommended for patients with dementia not only to support physical health, but also to improve quality of life and behavioral and psychological symptoms [17]. Physical activity amongst patients with Alzheimer's disease is inversely correlated with cerebral blood flow to the temporal and parietal lobes. This was interpreted as being an indication that physical active patients have a higher brain reserve [18].

Older women can take part in high-frequency, high-intensity training programs with no risk to their health while experiencing improvements to their quality of life, cognitive function, degree of independence and physical fitness [19]. Ventilatory muscle training in addition to lower extremity exercise training resulted in reduction in dyspnea, improved respiratory muscle strength and endurance, increased exercise ability and improved health related quality of life [20].

CONCLUSION

Pulmonary rehabilitation program can improve QOL for mild Alzheimer elderly subject.

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