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Rehabilitation in obstructive sleep apnea: an ignored treatment adjunct

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Abstract

Patients with obstructive sleep apnea (OSA) remain physically inactive during the day, are deconditioned, and have an impaired health-related quality of life (HRQoL). The role of rehabilitation is not yet defined in OSA, despite proven effective modalities for chronic illnesses like chronic obstructive pulmonary disease. In this prospective study, over a period of one year, 30 individuals with sleep-disordered breathing were included. Before recruitment, every patient was receiving continuous positive airway pressure treatment for at least 4 weeks. A statistically significant negative correlation was seen between the apnea hypopnea index and reductions in 6-minute walk distance, energy, and general health, which signified that patients with greater levels of daytime sleepiness have poor quality of life and are more deconditioned. Enrolled patients in the study underwent a 20-session rehabilitation program (with a minimum of 2 sessions per week). The patient received resistance and endurance exercises, dietary guidance, and counseling at each session. Before and after rehabilitation, target parameters such as 6MWD, HRQoL domains, Epworth sleepiness scale (ESS), and body mass index (BMI) were recorded. All 8 HRQoL domains showed improvement post-rehabilitation. Along with improvements in ESS and BMI, the 6MWD was also improved. No adverse event such as cardio-respiratory distress occurred in individuals undergoing rehabilitation. To conclude, rehabilitation is a safe and efficacious modality as an adjunct to positive airway pressure therapy in OSA patients.

Key words: OSA, CPAP, rehabilitation, quality of life.

Introduction

Sleep-disordered breathing (SDB) includes several conditions that cause a partial or complete cessation of breathing during sleep, resulting in daytime sleepiness and fatigue that lowers a person's quality of life and interferes with their capacity to perform. SDB most commonly manifests as obstructive sleep apnoea (OSA), which is linked to several additional detrimental health effects, such as an elevated mortality risk [1]. For treating OSA, positive airway pressure (PAP) therapy is considered the gold standard. Adherence to the device is necessary for therapy to be effective. Adherence barriers include mask discomfort, nasal congestion, local irritation, and claustrophobia. These obstacles make it difficult to maintain efficacy over the long term, which results in poor performance and repeated symptoms during the day [2].

Deconditioning is defined as loss of physical fitness due to the inability to maintain a required level of activity or training. Patients with SDB are prone to deconditioning due to engaging in less physical activity during the daytime due to a combination of factors such as obesity, excessive daytime sleepiness, and weariness. Co-morbidities like depression, cognitive impairment, and mood changes further contribute to deconditioning by reducing activity levels.[2] The symptoms and co-morbidities of obstructive sleep apnoea, such as diabetes, affect a person's physical, mental, and social well-being. These patients are more likely to experience reduced quality of life (QOL) [3].

Due to their obesity, excessive daytime sleepiness, and sedentary lifestyles, which further decondition them, patients with OSA have restricted functional capacity, impaired health-related quality of life, and limited daytime activity. This results in a vicious cycle that exacerbates OSA by depressing the patient further and causing gradual weight gain, muscular dysfunction, and negative psychosocial effects [4].

Engaging in physical activity has a substantial positive impact on vigor and certain aspects of quality of life by reducing depressed symptoms and weariness. Increased physical activity during rehabilitation will break the vicious cycle of deconditioning in people with OSA and serve as a crucial supplement to PAP therapy [5].

A rehabilitation program consists of education, exercise, and support to assist patients learn how to breathe and operate as best they can. It entails following an organized curriculum under expert supervision. Patients receive nutritional guidance and counselling in addition to engaging in resistance and endurance exercises. It has been successful in restoring deconditioning and raising the quality of life in COPD and heart failure patients [6]. There is a paucity of literature on HRQoL in patients with OSA. Besides, there are no consensus guidelines on rehabilitation in OSA.

Materials and Methods

A pre- and post-interventional study was conducted on patients with OSA who were attending the Department of Pulmonary, Critical Care, and Sleep Medicine's sleep clinic. Deconditioning or impaired HRQoL was screened for all patients (18–65 years old) with polysomnography-diagnosed OSA who were on positive airway pressure therapy for four weeks and willing to engage in a rehabilitation program. A patient was considered deconditioned if their 6 Minute Walk Distance (6MWD) was less than 80% of what was expected to be normal. The SF 36 questionnaire was used to calculate the HRQoL in eight domains: physical function, bodily pain, role limitation due to physical problems, general health perceptions, social function, emotional well-being, role limitation due to emotional problems, and energy/fatigue. The study included patients with deconditioning and/or reduced HRQOL. Patients with uncontrolled congestive heart failure, uncontrolled hypertension, angina, critical aortic stenosis, cognitive impairment, and refusal to engage in the trial were excluded from the study.

Alice 6 LDX (Philips Respironics, USA) polysomnography machine was used to diagnose OSA. Spirometry was done using medisoft spiroair system. The En motion treadmill, Motomed Viva 2 cycle ergometer, and Biodex arm ergometer were used for endurance training.

Consecutive OSA patients who visited the sleep clinic were assessed for deconditioning and reduced HRQoL. In addition to PAP treatment, patients had 20 sessions of thorough rehabilitation spaced out over a minimum of 8 weeks.

The three primary components of the rehabilitation program were diet, exercise (both resistance and endurance training), and counseling with education [7]. Aerobic activities for the upper and lower limbs were used in endurance training. For the Upper Limb arm, an ergometer was used initially with minimum resistance at 50 rpm for about 4-6 min. Exercise duration and intensity were gradually raised to a total of 15 minutes per session based on the patient's tolerance. Based on the preferences of the patients, either a cycle ergometer or a treadmill was used for lower limb training. For the first twenty minutes of the activity, the pace was set at 2 km/h. To a maximum of 60 minutes each session (since the effect peaks after this time), the duration and intensity of exercise were increased based on the patient's tolerance. For the major group of muscles such as the biceps and triceps in the upper limb, quadriceps, and calf muscles for the lower limb, resistance training was performed. Using weights, 2-4 sets of 10-15 repetitions were performed to develop the biceps and triceps in the upper limb. Each set of weights was customized, and they were increased as soon as tolerance allowed. There was at least a 48-hour break between each session. Resistance training for the lower limbs included utilizing weights to strengthen the quadriceps and calves, with each set consisting of ten to fifteen repetitions. Individual weights were used, and when each set was finished with tolerance, the weights were increased. There was a minimum of 48 hours between each session.

Using a pulse oximeter, heart rate, and SpO2 were recorded during exercise. Patients achieved a target heart rate, which is equivalent to 80% of their maximum heart rate, where their maximum heart rate is (220-age). Before each exercise session, there was a five-minute warm-up and a five-minute cool-down. Every exercise session included counselling on lifestyle adjustment, quitting smoking, maintaining good sleep hygiene, and adhering to PAP treatment. Seminars were utilized to impart knowledge about the OSA. For a detailed food plan, each patient was referred to our college's diet department.

Statistical analysis

At baseline and after 20 rehabilitation sessions, the following data were recorded: 6MWD, HRQOL (SF36), AHI, ESS, BMI, and pulmonary functions (FEVI and FVC). Thirty patients who completed a structured rehabilitation program were included in the analysis. Numbers and percentages (%) were used to represent categorical data, whereas mean ± SD and median were used to represent continuous variables. The paired t-test/Wilcoxon rank sum test was used to compare the two points of view. AHI was correlated with several characteristics using the Spearman rank correlation coefficient. P values less than 0.05 were regarded as statistically significant.

Results

Patients included in the study belonged to age groups ranging from 27 to 69 years. The mean age was 52.63 ± 8.97 years. Twelve male and eighteen female patients were included in the study. The patients' mean body mass index (BMI) was 35.62 ± 4.73 kg/m2, irrespective of sex, indicating an obese population. The study's mean AHI score was 34.6 ± 13.47, irrespective of sex, indicating severe OSA. In terms of co-morbid conditions, 11 people had diabetes mellitus and 12 had hypertension. Patients' mean Epworth sleepiness score ranged from 12 to 11.77 ± 2.57.

In all 30 patients, the 6MWD was reduced when compared to their calculated expected values. A decrease of 46.22 ± 32.63% and a median value of 44.36% were observed.

All eight parameters of HRQoL showed a significant reduction in their mean values. In the results, there was a trend towards a higher percentage reduction in 6MWD in patients with severe OSA when compared to moderate OSA. Among all eight health-related quality of life parameters, the scores were lower in the severe OSA group when compared to the moderate OSA group and the p-value was statically significant in the domains of Energy, General Health, and Role Limitation Physical Health ($p<0.05$). Low scores in eight domains also indicated a poor HRQoL. Table 1 shows the eight HRQoL parameters in 30 patients.

A significant p-value was found for the positive correlation between the percentage reduction in 6MWD and the AHI (correlation coefficient 0.441, p-value 0.0147). Among HRQoL parameters there was a negative correlation for General health, Energy, Emotional well-being, Role Limitation Emotional health, Role Limitation Physical Health, and Social Functioning but this was statistically significant for domains of energy and general health only ($p<0.05$). Table 2 represents the correlation of AHI with 6MWD and HRQoL.

Following rehabilitation, 6MWD, HRQoL parameters, and ESS showed statistically significant improvements (p value<0.005). No significant reduction was seen in heart rate, blood pressure, FEV1, and FVC were significantly decrease. Table 3 represents the effect of rehabilitation on 6MWD, HRQoL, and ESS.

A statistically significant positive correlation (correlation coefficient: 0.338, p-value 0.0341) was seen between AHI and the improvement in 6MWD. Among improvements in HRQoL parameters, all showed a positive correlation with AHI and it was statically significant for general health (correlation coefficient: 0.436, p-value<0.05) and role limitation physical health (correlation coefficient: 0.455, p-value<0.05). Table 4 represents the correlation between improvement in 6MWD and HRQoL parameters with AHI.

Discussion

Dyspnoea, obesity, excessive daytime drowsiness, sadness, and anxiety are common in patients with sleep-disordered breathing. As a result, they experience fatigue, which makes them less active, which degrades their quality of life and deconditions them. A vicious cycle of increasing weight gain, muscular dysfunction, and worsening OSA and deconditioning results from all of this, further impairing quality-of-life areas.

According to our study, 6MWD and HRQOL domains were decreased with values that were below anticipated for every patient who was recruited. This implies that OSA patients are deconditioned and have an impaired quality of life across all domain. In a similar previous study, when 6MWD was measured in 151 obese patients with severe OSA, Pływaczewski et al. showed that it was considerably lower in these individuals when compared to comparable healthy control participants [8].

Our study found that patient with severe disease have more EDS, dyspnoea and hence are more deconditioned and have poorer health related quality of life. This finding was similar to a study by Lopez C et al. [9]. Lopez C et al found that excessive sleepiness and lack of physical activity affected the quality of life of apneic patients; this effect was worse among sleepy non-physically active subjects and worsened with increasing severity in the group with severe sleep-disordered breathing.

A statistically significant weak positive correlation was seen between AHI and 6MWD ($p<0.05$). This shows that higher the AHI higher is the level of deconditioning in these patients. There was a weak negative correlation between all HRQoL parameters and AHI, which was statistically significant for the energy and general health domains. According to this, individuals with higher AHI scores also may have more comorbid conditions such as anxiety and depression, pain, drowsiness, dyspnea, and cognitive issues. As a result, individuals experience more fatigue and a poorer perception of their quality of life.

The positive impact of rehabilitation on deconditioning and health-related quality of life has been assessed in several chronic illnesses, such as COPD and CHF when employed as an adjunct to standard therapy [10,11]. In our study, effect of rehabilitation on 6MWD and HRQoL domains was evaluated in OSA patients. We found a statistically significant increase ($p<0.005$) in 6MWD for all individuals along with a decrease in ESS and BMI. This result showed that patients who got both positive airway pressure therapy and rehabilitation as part of their OSA treatment saw an improvement in their degree of deconditioning. These results were similar to the study conducted by the Sengul et al. [12], which demonstrated the beneficial effects of rehabilitation on excessive daytime sleepiness and BMI in individuals with OSA.

Muscle training, decreased obesity, decreased daytime sleepiness, and greater motivation for these individuals may have contributed to the enhanced 6MWD, decreased deconditioning, and higher exercise capacity. These findings were significant because higher 6MWD in these individuals will enhance their level of physical activity and aid in the continued reduction of their deconditioning.

In our study, each domain of HRQoL (physical function, role limitation due to physical problems, bodily pain, general health perceptions, social function, emotional well-being, role limitation due to emotional problems, and energy/fatigue), measured with SF-36 questionnaire showed a statistically significant improvement ($p<0.005$). This finding was consistent with study conducted by Norman et al. that evaluated the effect of exercise training on the physical and subjective aspects of patients with OSA [13]. The study demonstrated a significant improvement in HRQoL during the post-exercise interval. In a similar study, Kline CE et al. used standardized questionnaires to examine the efficacy of exercise training on quality of life (QOL), mood, functional impairment from sleepiness, and daytime functioning [14]. This study found that physical function, vitality, and mental health were significantly improved with exercise training and all SF-36 subscales showed small to moderate gains after exercise training as compared to the control.

Exercise's proven antidepressant benefits are widely known. The two most common mental health conditions seen in individuals with OSA are anxiety and depression. Numerous research has indicated that exercise therapy might be an effective non-pharmacologic treatment for OSA patients' anxiety and depressive symptoms. This leads to the improvement in the HRQoL domains of role restriction and emotional well-being due to emotional health, as seen in our study [14-16]. A patient's social functioning and overall health perception both increase as his physical and mental well-being do, which results in improvement in these domains. A statistically significant positive ($p<0.005$) correlation was found between AHI and improvement in 6MWD. This suggests that patients with higher AHI and sleepiness during the day showed more improvement. Among improvements in HRQoL domains, all showed a positive correlation which was statistically significant ($p<0.005$) for general health and role limitation physical health. This suggested that post-rehabilitation patients with higher AHI had a better perception of their general health.

Rehabilitating a patient with OSA is safe. During their rehabilitation, none of our patients had any severe cardio-respiratory discomfort, such as chest pain or exercise-induced hypertension. Following rehabilitation, all eight parameters of health-related quality of life have shown a significant improvement. By lowering their BMI, improving their muscle strength, and decreasing their level of daytime sleepiness, rehabilitation also lowers the degree of deconditioning. Our study suggests that, when used as an adjunct to positive airway pressure therapy, rehabilitation can be a useful and safe technique. Nonetheless, more research with a larger sample size is necessary to determine its function and establish it as a standard procedure.

Conclusions

According to the study's findings, even with CPAP treatment, individuals with OSA are deconditioned and have poor health-related quality of life. Rehabilitation is a safe modality and well tolerated by most patients with sleep disordered breathing. Rehabilitation can act as an adjunct to standard positive airway pressure therapy to improve quality of life, deconditioning, and daytime sleepiness in patients with sleep-disordered breathing. However, further studies using a larger sample size and a longer time frame are necessary to assess its role further and establish it as a standard of practice.

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Table 1. Eight parameters of Health-related quality of life.

Parameter	Mean ± SD	Range
Physical function	40.67 ± 9.17	25-65
Role limitation physical health	28.33 ± 21.51	0-75
Role limitation emotional health	23.1 ± 23.17	0-66
Energy/Fatigue	34.83 ± 14.23	15-80
Emotional well being	46.8 ± 12.78	20-72
Social functioning	43.5 ± 16.81	13-75
Bodily pain	39.53 ± 12.84	13-68
General Health	35.6 ± 13.99	20-70

SD, standard deviation.

Table 2. Correlation of AHI with HRQoL and 6MWD.

		AHI
Percentage reduction 6MWD	Correlation Coefficient	0.441
	P value	**0.0147**
Emotional Well being	Correlation Coefficient	-0.286
	P value	0.125
Energy	Correlation Coefficient	-0.604
	P value	**0.0004**
General Health	Correlation Coefficient	-0.372
	P value	**0.0429**
Pain	Correlation Coefficient	0.046
	P value	0.8084
Physical Function	Correlation Coefficient	0.016
	P value	0.9317
Role Limitation Emotional health	Correlation Coefficient	-0.262
	P value	0.1627
Role Limitation Physical Health	Correlation Coefficient	-0.338
	P value	0.0675
Social Functioning	Correlation Coefficient	-0.151
	P value	0.4269

AHI, apnea hypopnea index; HRQoL, health related quality of life; 6MWD, 6-minute walk distance.

Table 3. Pre- and post-rehabilitation comparison for 6MWD, HRQoL, ESS, and BMI.

Parameter	Pre-Rehabilitation (Mean±Std)	Post-Rehabilitation (Mean±Std)	p-value
Epworth Sleepiness Score	11.77 ± 2.57	7.47 ± 1.81	**<0.001**
6MWD	724.2 ± 152.64	819 ± 127.03	**<0.001**
Physical Function	40.67 ± 9.17	64.5 ± 10.7	**<0.001**
Role Limitation Physical Health	28.33 ± 21.51	55 ± 19.03	**<0.001**
Role Limitation Emotional Health	23.1 ± 23.17	46.4 ± 27.09	**<0.001**
Energy	34.83 ± 14.23	55.87 ± 11.78	**<0.001**
Emotional Well Being	46.8 ± 12.78	64.07 ± 16.24	**<0.001**
Social Function	43.5 ± 16.81	63.53 ± 15.58	**<0.001**
Pain	39.53 ± 12.84	66.3 ± 10.8	**<0.001**
General Health	35.6 ± 13.99	57.67±9.44	**<0.001**
Body Mass Index	35.62 ± 4.73	33.65 ± 4.42	**<0.001**

ESS, Epworth sleepiness score; 6MWD, 6-minute walk distance; HRQoL, health-related quality of life; BMI, body mass index.

Table 4. Correlation between improvement in 6MWD and HRQoL with AHI.

Parameter		AHI
Percentage improvement 6MWD	Correlation Coefficient	0.388
	P value	**0.0341**
Emotional Well being	Correlation Coefficient	0.348
	P value	0.0598
Energy	Correlation Coefficient	0.339
	P value	0.0668
General Health	Correlation Coefficient	0.436
	P value	**0.0161**
Pain	Correlation Coefficient	-0.322
	P value	0.0827
Physical Function	Correlation Coefficient	0.131
	P value	0.8693
Role Limitation Emotional health	Correlation Coefficient	0.131
	P value	0.4892
Role Limitation Physical Health	Correlation Coefficient	0.455
	P value	**0.0114**
Social Functioning	Correlation Coefficient	0.093
	P value	0.625

6MWD, 6-minute walk distance; HRQoL, health-related quality of life; AHI, apnea-hypopnea index.