Original Article

Effect of breathing retraining on functional capacity in Pickwickian syndrome patients

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ABSTRACT

Background: Pickwickian syndrome is a condition in which severe obese patients fail to breathe quickly or deeply enough, leading to low oxygen levels and high blood carbon dioxide (CO_2) levels. **Purpose:** To investigate the effect of breathing retraining using breathslim device on functional capacity in Pickwickian syndrome patients. **Subjects and methods:** Sixty patients of both sexes with BMI more than 35kg/m^2 were recruited from the outpatient clinic of Tanta Police Hospital; they were randomly and equally allocated into 2 different groups using select the card method into 2 groups. Group A (study group) consisted of 13 men and 17 women who received breathing retraining plus controlled diet (1200kcal) and physician advises and Group B (control group) consisted of 15 men and 15 women received controlled diet (1200 kcal) and physician advice only. Arterial blood gases were analyzed using an analyzer; FEV1 and FVC were assessed using spirometry besides recording the score of 6MWT. **Results:** All variables exhibited statistically significant improvement (P>0.000) in the study group with a significant difference regarding post values when contrasted to the control group (P>0.000). The results showed that the percent of change for PO_2, PCO_2, HCO_3, FEV1, FVC and 6MWT for the group A were increased by9.54%, 80.33%, 94.54%, and 12.69% and decreased by14.93% and 15.38% respectively, and for the group B also increased by 0.37%, 0.75%, 2.48%, 2.31%, 0.7% and decreased by 2.2%, respectively. **Conclusion**: It was concluded that breathing retraining using breath slim device have a modulating effect on functional capacity in Pickwickian syndrome patients.

Keywords: Pickwickian; Breath slim; breathing retraining.

Introduction

Pickwickian syndrome patients are at a greater risk for comorbidities due to arrhythmia, asthma, chronic kidney disease, chronic obstructive pulmonary disease, diabetes, gastroesophageal reflux disease, hyperlipidemia, hypertension, hypothyroidism, and trans-ischemic attack or stroke [1]. Besides, it was established that "colon, endometrium, postmenopausal breast, kidney, esophagus, pancreas, gallbladder, liver, and hematological malignancy" are common cancers often related to obesity [2]. Obesity represents a state of excess storage of body fat [3-5].

Most research related to obesity and respiratory disorders focuses on Obstructive Sleep Apnea (OSA), with its associated risk of cardiovascular disease, stroke, and death. OSA is the most frequently diagnosed respiratory complication of obesity [6]. Presently, OSA is diagnosed in 70-95% of obese patients [7].

With the prevalence of OSA and increasing obesity rates, a lesser-known illness, Obesity Hypoventilation Syndrome (OHS), is extensively misunderstood and often misdiagnosed as OSA [8]. Nevertheless, the diagnosis of OHS is regularly missed because of the low number of case investigations; more importantly, diagnosis is delayed because of unfamiliarity with the disease procedure and diagnostic criteria [8]. While

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inappropriate diagnosis precludes a precise count of patients who suffer from OHS, the prevalence of the disease is expected to be 10-20% in the obese patient population and 0.15-0.3% in the general population [9].

Pickwickian syndrome impairs respiratory mechanics resulting in decreased lung volumes, reduced chest wall compliance, improved respiratory resistance, and enhanced work of breathing. These parameters are further weakened in OHS patients. Spirometry values from patients with OHS usually exhibit a restrictive pattern with a decrease in FEV1and FVC but normal FEV1/FVC. Total lung capacity, functional residual capacity, and expiratory reserve volume are also decreased in OHS [10].

Materials and Methods

Subjects

Ethical Consideration: The approval of the ethical committee of the Faculty of Physical Therapy, Cairo University was obtained on the protocol of the research (No: P.T.REC/012/001303). Thepatient acceptance on the enrollment in this study was approved and they signed as the consent form.

Randomization: The Selection of the patient to be submitted in each group was done by the card randomization method.

Groups: Sixty patients of both sexes (13 men and 17 women in group A and 15 men and 15 women in group B) were recruited from the outpatient clinic of Tanta Police Hospital, before beginning. Group A (study group) received breathing retraining by breathslimplus controlled diet (1200Kcal) and physician advice (eat more servings of vegetables and fruits, have less processed and sugary foods, engage in regular aerobic activity). Group B (control group) had a controlled diet (1200Kcal), medications (Medroxyprogestroneand acetazolamide), and physician advice.

Inclusion criteria

The age of the patients ranged from 50 to 70 years, Body Mass Index ranged from 36 up to 50 kg/m^2, $PaO_2 < 85$ mmHg, $PaCO_2 > 45$ mmHg, and $HCO_3 > 26$.

Exclusion criteria

A neurological disorder, musculoskeletal disorders that interfere with an exercise program, leg or foot ulcers, contraindication to the use of breath slim: intracranial pressure >20 mmHg, hemodynamic instability, recent surgery or trauma of "facial, oral, or skull", acute sinusitis, epistaxis, esophageal surgery, active hemoptysis, and diaphragmatic hernia.

Materials

a) Evaluation materials

1) Weight and height scale

Weight and height were measured for each patient to ensure that he/she fulfilled the criteria of being included in the study according to the calculation of BMI [11].

2) Waist circumference using measurement Tape

The patient was in a standing position and the therapist adjusted the tape at the level of the umbilicus and then took the round measurement.

3) Arterial blood gases analyzer

PHOX PLUS C 402103020, America was used for ABG analysis (PaO_2, PH, $PaCO_2$, and HCO_3).

4) Spirometry

Contec spirometer SP10 Digital spirometer was used in this study as the changes in FEV1 and FVC were the primary outcome measure [12].

5) Six-minute walk test

Blood pressure, heart rate, and oxygen saturation were recorded [13] before and after the test [14].

Patient preparation

The patient always utilized comfortable clothing with suitable shoes for walking with walking aids (cane, walker) without exercising vigorously within 2 hours of the beginning of the test [15].

Location

The walk tests were conducted in an air-conditioned, measured, and marked corridor. The turnaround points were marked with two cones apart from each other. The distance covered between the two cones was 4.67m [16].

Reasons for immediately stopping a 6-MWD include the followings: If the oxygen saturation decreased<90% or symptoms of significant desaturation were present (i.e. confusion, stupor), marked dyspnea, dizziness, chest pain, uncontrolled angina, severe musculoskeletal pain or vascular insufficiencies such as leg claudication, leg cramps, and anemia (pale appearance) [17].

During walking rests, patients were monitored with a continuous pulse oximeter to record the oxygen saturation [18].

Modified Borg Scale of Dyspnea

The Borg scale of Dyspnea (11 point scale) was used in this study to measure the degree of breathlessness during walking [19].

B) Treatment procedures

1) Breathslim device

The Breathslim method is intended for exercising the respiratory system to improve ventilation of the lungs, gas exchange, and the metabolism of people who are carrying excess weight. The Breathslim method of exercising is on the basis of utilizing the resistance of water to exhalation [20]. The device was cleaned with soap and water, then 70% alcohol before and after the use and between patients. Its reservoir contained 35% water to apply moderate resistance to breathing.

Users were instructed to use the device as instructed for 20 minutes a day. At the start of exercise, the patient was asked to hold the device tightly, exhale normally, then use the device and put the mouth over the device opening breathing in through the nose for 5 seconds, holding the breath for 5 seconds, and exhaling through the device for 10 seconds. Finally, they were asked to repeat this for 20 minutes. The patient could not use the mouthpiece for longer than 24 hours [20]. Termination of the exercise was done in case of chest pain or shortness of breath or the patient felt dizziness. The treatment procedures were applied for 3 sessions per week for 12 weeks [21].

Results

This study was conducted to investigate the effect of breathing retraining using a breath slim device on functional capacity in Pickwickian syndrome patients. The results were presented under the following headings:

- Demographics: age, weight, height, BMI, and gender
- Measurement variables: PO_2, PCO_2, HCO_3, FEV1, FVC, and 6MWT.

Table 1: Patients' demographics distribution among groups

	Group A	Group B	t	P	Sig
Age (years)	58.37±3.41	59.73±4.55	-1.317	0.193	NS
Weight (KG)	111.93±11.75	115.03±7.73	-1.207	0.233	NS
Height (m)	1.64±0.06	1.63±0.05	0.413	0.681	NS
BMI (KG/m^2)	41.73±3.71	43.32±4.01	-1.599	0.115	NS
WC (cm)	100.97±9.45	104.47±7.69	-1.57	0.12	NS

Table 2: Gender distribution among groups

Gender	Group A	Group B	Chi value	P	Sig.
Male	13	15	0.268	0.605	NS
Female	17	15			

Table 3: O_2 concentration distribution among groups

	Group A	Group B	t	P	Sig.
$PreO_2$	73.4±1.65	73.43±1.68	-0.078	0.938	NS
$PostO_2$	80.4±1.3	73.7±1.82	16.383	0.000	S
Change	↓9.54%	↑0.37%			
T	-17.576	-0.656			
P	0.000	0.517			
Sig	S	NS			

Table 4: CO_2 concentration distribution among groups

	Group A	Group B	t	P	Sig.
Change	↓-14.93%	↑0.75%			
P	0.000	0.632			
$PostCO_2$	41.43±1.89	48.33±2.63	-11.672	0.000	S
$PreCO_2$	48.7±3.09	47.97±2.77	0.968	0.337	NS
Sig	S	NS			
T	13.347	-0.484			

Table 5: HCO_3 concentration distribution among groups

	Group A	Group B	t	P	Sig.
$PreHCO_3$	32.89±2.17	32.27±1.78	1.211	0.231	NS
$PostHCO_3$	27.83±0.99	33.07±2.56	-10.454	0.000	S
Change	↓-15.38%	↑2.48%			

T	13.495	-1.365
P	0.000	0.183
Sig.	S	NS

Table 6: FEV1 concentration distribution among groups

	Group A	Group B	t	P	Sig.
Pre FEV1	1.83±0.41	1.82±0.37	0.023	0.982	NS
Post FEV1	3.3±0.54	1.78±0.43	12.081	0.000	S
Change	↑80.33%	↓-2.2%			
T	-10.488	0.432			
P	0.000	0.669			
Sig	S	NS			

Table 7: FVC concentration distribution among groups

	Group A	Group B	t	P	Sig.
Pre FVC	1.83±0.39	1.73±0.39	0.973	0.335	NS
Post FVC	3.56±0.33	1.77±0.38	19.499	0.000	S
Change	↑94.54%	↑2.31%			
T	-16.850	-0.321			
P	0.000	0.750			
Sig	S	NS			

Table 8: 6MWT concentration distribution among groups

	Group A	Group B	t	P	Sig.
Pre 6MWT	354.4±30.11	350.4±32.64	0.493	0.624	NS
Post 6MWT	399.37±43.62	352.87±27.91	4.919	0.000	S
Change	↑12.69%	↑0.7%			
t	-14.526	-0.270			
P	0.000	0.789			
Sig	S	NS			

Discussion

This study was conducted to investigate the effect of breathing retraining using the Breathslim device on functional capacity in Pickwickian syndrome patients with BMI ranged from 36 up to 50 Kg/m^2. Sixty patients of both sexes (28 men & 32 women) were recruited from the outpatient clinic of Tanta Police Hospital; they were randomly and equally allocated into 2 different groups. Group A (study group) received breathing retraining by breathslim, and Group B (control group) received physician advice. Both groups had a controlled diet of 1200 Kilo Calories.

Arterial blood gases were analyzed using an analyzer; FEV1 and FVC were assessed using spirometry besides recording the score of 6MWT pre-study and re-assessed after 12 weeks of training.

All variables showed statistically significant improvement ($P<0.000$) in the study group with a significant difference regarding post values when compared to the control group ($P<0.000$). The results showed that the percent of change for PO_2, PCO_2, HCO_3, FEV1, FVC, and 6MWT for the group A were increased by 9.54%, 80.33%, 94.54%, and 12.69% and decreased by 14.93%, and 15.38% respectively, and for the group B also increased by 0.37%, 0.75%, 2.48%, 2.31%, 0.7% and decreased by 2.2%, respectively.

Varied mechanisms can result in hypoventilation related to several medical disorders, namely derangements in central ventilatory control, mechanical impediments to breathing, and abnormalities in gas exchange resulting in enhanced dead space ventilation. The pathogenesis of hypercapnia in obesity hypoventilation syndrome remains rather ambiguous, although in many patients comorbid obstructive sleep apnea seems to play a noteworthy role. Hypoventilation in neurologic or neuromuscular disorders is principally described by the weakness of respiratory muscles, although some central nervous system diseases may influence control of breathing. In other chest wall disorders, obstructive airway disease, and cystic fibrosis, much of the pathogenesis is defined by mechanical impediments to breathing, but an element of enhanced dead space ventilation also often happens. Central alveolar hypoventilation syndrome includes a genetically determined weakness in central respiratory control. Treatment in all of these disorders includes coordinated management of the primary disorder (when possible) and, increasingly, the utilization of noninvasive positive pressure ventilation [22].

This work is considered from the first trials to show the effect of breathing retraining on Pickwickian syndrome patients or obesity hypoventilation syndromes (OHS) that is considered a complex multiorgan system ailment procedure that seems like driven by adaptive modifications in respiratory physiology and compensatory alterations in metabolic processes, both of which are eventually counter-productive. The diurnal hypercapnia and hypoxia encourage pathologic influences that further worsen sleep-related breathing, leading to a slowly progressive worsening of the disease. Besides, leptin resistance in obesity and OHS likely involves the blunting of ventilatory drive and insufficient chemoreceptor response to hypercapnia and hypoxemia [23].

A study that in the same line with the current study was conducted to describe patients with dysfunction of breathing (DB), five years after a breathing retraining intervention. Out of initially twenty five patients with DB and twenty five age and sex-matched patients with asthma, twenty two patients with DB and twenty three patients with asthma (ages 25–78 years) were followed up after five years. Data were collected from posted self-report questionnaires. Only patients with DB had received breathing retraining, consisting of information, advice, and diaphragmatic breathing. Patients were assessed regarding quality of life (SF-36), anxiety, depression, sense of coherence, hyperventilation, impact on daily life, emergency room (ER) visits, and symptoms linked to DB. Quality of life (SF-36) and physical component summary scale (PCS), had increased in patients with DB from 43 to 47 ($p = 0.03$). The number of ER visits had reduced from 18 to two in patients with DB ($p = 0.02$). Symptoms related to DB had reduced widely, from a mean score of 6.9 to 2.7, on a DB criterion list ($p < 0.001$). Patients with DB were less weakened by their breathing complications both in daily life and when exercising ($p < 0.001$). The only difference was found over time in the asthma group concerning the quality of health, bodily pain, which had declined from 77 to 68 ($p = 0.049$). This five-year follow-up study pointed out that patients with dysfunctional breathing advantage from breathing retraining [24].

Breathing retraining procedures necessitate greater attention to and acceptance of sensations related to breathing skills which are core components of mindfulness which propose that the quality of life and subjective symptom enhancements from breathing retraining are the outcomes of unintended but beneficial increases in mindfulness, leading to reductions in the secondary stress response to hypoventilation syndromes [25].

The results of this study coincided with the finding of a study done by Korim et al. in 2016 [26] who indicated that hypoventilation syndrome arises from the interaction between sleep-disordered breathing, diminished respiratory drive, and obesity-related respiratory issues which have an influence on arterial blood gases. The study was applied to forty patients of both sexes as 20 men and 20 women; their age ranged from 55-65 years with hypoventilation syndrome. The parameters measured from patients were body weight, body mass index (BMA), waist circumference, hip circumference, waist/hip ratio (WHR), the atrial partial pressure of oxygen (PaO_2), the atrial partial pressure of carbon dioxide ($PaCO_2$), and level of bicarbonate (HCO_3^-). Also, apnea hypo apnea index (AH') was used to evaluate the number of times the patient had obstructive sleep apnea during sleeping hours. 20 patients (11 women and 9 men) used Breathslim training and a balanced diet (group A), and the other 20 patients (9 women and 11 men) used traditional diaphragmatic breathing with a balanced diet (group B) for 12 weeks. The results showed that the percent of improvement of body weight, body mass index, PaO_2, PCO_2, and HCO_3 for the group A was 10.59%, 10.61%, 54.04%, 22%, and 12A4% and for the group B was 4.13%, 4.17, 15.36%, 6A8%, and 3.28%, respectively. Thus, they concluded that using Breathslim for hypoventilation patients modulates blood gas parameters as well as restores sleep quality [26].

Conclusion

It was concluded that breathing retraining using breath slim device have a modulating effect on functional capacity in Pickwickian syndrome patients.

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