Effects of Ujjayi Pranayama Training on Selected Ventilatory Function Test in Patients with Mild Bronchial Asthma

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Abstract

Background: Bronchial asthma is a common disease and an important cause of morbidity among both children and adults. Ujjayi Pranayama Training (UPT) is a technique of controlling and modulating breath, a process through which one attains a state of deep rest, yet active state of mind.

Objectives: To investigate the effectiveness of 2-months Ujjayi Pranayama Training (UPT) program on Forced Vital Capacity (FVC) and Forced Expiratory Volume in first second (FEV₁) as well as the ratio FEV₁/FVC in patients with mild asthma.

Participants: Forty patients (25 men and 15 women) who suffered from mild bronchial asthma for at least 8 years participated in this study. Patients were randomly assigned into; experimental group (Group A) that included 20 asthmatic patients (12 men and 8 women), age (35.85±2.99) and control group (Group B) that included 20 asthmatic patients (13 men and 7 women), age (34.80±3.44).

Methods: In both groups patients received Diaphragmatic Breathing (DB) exercise and asthmatic medications. Experimental group received UPT in addition to other interventions. Exercises in both groups were done for 3 sessions weekly over 8 weeks. The two groups were evaluated pre-training and after 2 months of training by using computerized spirometer for measuring Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV₁) and their ratio FEV₁/FVC.

Results: The experimental group showed that there is significant increase in both forced vital capacity and forced expiratory volume in first second than the control group (p>0.05). Both groups significantly improved in all parameters after 2 months.

Conclusions: This study showed that UPT, combined with medical treatment and diaphragmatic breathing exercise improve FVC, FEV₁ and FEV₁/FVC% in patients with mild bronchial asthma.

Key Words: Bronchial asthma – Ujjayi pranayama training – Forced vital capacity – Forced expiratory volume in first second – Diaphragmatic breathing exercise.

Introduction

BRONCHIAL asthma is one of the most frequent chronic inflammatory disorders of airways and constitutes a major social problem, since it increases healthcare cost and limits patients’ quality of life [1]. It is associated with airway hyper responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing particularly at night or in the early morning [2]. Onset of asthma can occur at any age, but children and young adults are commonly affected. Although asthma can be cured, clinical episode can be prevented and controlled by proper management [3].

Ventilatory functions including forced vital capacity and forced expiratory volume in first second using spirometry, are particularly effective in diagnosing the type and the severity of bronchial asthma particularly the demonstration of reversibility of bronchial obstruction, these measurement help to determine whether there is airflow obstruction, its severity and whether it is reversible over short term [4].

Breathing techniques are among the most popular complementary medicine modalities used by people with asthma [5]. It was concluded that breathing exercises for asthma, such as Buteyko, pranayama and diaphragmatic breathing, led to decreased use of short acting b2 agonists and a trend towards improvement in quality of life, but no consistent evidence of improved disease control such as reduced requirement for anti-inflammatory medication, reduced airway hyper responsiveness, or improved lung function [6,7].
Diaphragmatic breathing has been shown strengthening the abdominal muscles [8], correct abdominal chest wall motion, improve chest expansion [9,10], excursion of the diaphragm, airway dilation and expulsion of excess mucus, re-educate the diaphragmatic movements and relax spasmodic muscle contractions and reduce thoracic-type breathing [10]. These improvements can then decrease the work of breathing and dyspnea, increase thoracic volume [11] and improve spirometry variables improve spirometry variables such as vital capacity, forced expiratory volume in one second (FEV$_1$), maximum breathing capacity, tidal volume which results an increased minute ventilation, airway reserve while decreasing breathing frequency and residual volume [12].

Pranayama" (the practice of voluntary breath control, consisting of conscious inhalation, retention and exhalation) is often practiced in conjunction with meditation, and physical posture [13]. Pranayama involves slow deep breathing, breathing through one nostril at a time, slow expiration, breath holding, and usage of abdominal muscles for expiration [14]. Meditation is a technique of extending ordinary consciousness to reach higher states of consciousness and there by discovering more about ourselves. Also meditation is often looked upon as a relaxation technique to be used for treating stress and stress related illnesses [15].

Several studies reported improvement of the various disease parameters in asthmatics with the use of pranayama and controlled ventilation exercises [16-20].

On the other hand, other studies have shown no additional benefit of pranayama breathing [21-23]. Singh et al., [19] and Thomas [24] have concluded that the usefulness of controlled ventilation exercises in asthmatics should further be investigated. Thus the results of various studies on the efficacy of pranayama and other breathing techniques in asthmatics have been variable.

In the light of these variable findings, the present study was conducted to assess the outcome of Ujjayi pranayama training on selected ventilatory function in patients with mild bronchial asthma.

**Material and Methods**

**Study design:**

The present study included forty patients, of sex, (25 men and 15 women) diagnosed with mild bronchial asthma duration at least eight years. The patients were recruited from chest outpatient clinic of El-Matareya Teaching Hospital during 2015. Patient's demographic data, clinical characteristic and all medical history were collected from medical sheets to ensure that all the patients were clinically and medically stable. Their body mass index ranged from 25 to 29.9Kg/m$^2$. Patients were randomized into the following two groups: Group (A) (diaphragmatic breathing exercise and Ujjai pranayama training group) age (35.85±2.99) and Group (B) (diaphragmatic breathing exercise group), age (34.80±3.44). All patients remained on their medical prescribed treatment during the study.

The study protocol was approved by institutional ethical committee of scientific research prior to conduction of the procedure and patients who were illegible for inclusion had complete explanation of the objectives of the study and the procedures, they signed an informed consent form prior to participation in the study.

**Exclusion criteria:**

Patients with a history of tuberculosis, diabetes, renal failure, coronary artery disease and musculoskeletal chest deformities, respiratory tract infections within the previous 6 weeks and engagement in any regular exercise/training were excluded, BMI more than 29.9Kg/m$^2$, pregnant patient, severely breathless patient, patient with acute exacerbation of asthma attacks, patients having other associated respiratory disease with asthma, mental or cognitive disorders, smoker, hepatic, any thoracic surgery and cardiac surgery were also be excluded from the study.

**Experimental measurements:**

- Assessment data sheet: Designed, in order to record Forced Vital Capacity-FVC, Forced Expiratory Volume in first second-FEV$_1$ and Ratio of FEV$_1$/FVC (%) expressed in percentage of the concerned patients also height and body weight for all patients. Body Mass Index (BMI) was calculated as body weight (kg) divided by the square of the height (m$^2$).
- Pulmonary Function Tests (PFT): Were performed on patients of both the groups before training and after 8 weeks. The tests were done on a computerized instrument (Spiro meter Neurosoft Spiro Spectrum USB 5v DC Iv). Adequate demonstration was given till subject has comprehended the instructions. Patients were then subjected to pulmonary function tests including Forced Vital Capacity-FVC, Forced Expiratory Volume in first second-FEV$_1$ and ratio of FEV$_1$/FVC (%) expressed in percentage.
Training program:
Patients in both groups performed diaphragmatic breathing for three sets of 5 repetitions each using 1 s of inspiration and 2 s of expiration (1:2 inspiration-to-expiration ratio) with rest after each set [25], duration of session 30 minutes 3 times weekly as it contains teaching the use of the abdomen (rather than upper chest) and the importance of nasal breathing. Patient should be comfortably positioned sitting with their hips and knees bent and their shoulders, head, and neck supported and relaxed. Patients were asked to breathe in slowly through their nose so that their stomach moves out against their hand. One hand placed on their upper chest and the other just below their rib cage. This allows them to feel their diaphragm move as they breathe, tighten their abdominal muscles, and letting them fall inward as they exhale through nose. The hand on their upper chest must remain as still as possible [26].

Patients in the Ujjayi Pranayama (UPT) performed by group sat in any comfortable position. Patients closed the eyes and relax the whole body. The awareness to the breath in the nostrils was taken and allows the breathing to become calm and rhythmic. After some time, when they got the awareness to their breath they instructed to transfer the awareness to the throat. Feel or imagine that the breath is being drawn in and out through the throat and not through the nostrils, as if it is taking place through a small hole in the throat. The sound of the breath should be audible, practiced 15 repetition per session with rest in between, 3 times per week [27].

Results
There was no statistical significant differences ($p>0.05$) of mean value of patients weight, height and BMI between both groups at entry of the study as showed in (Table 1) and Fig. (1).

<table>
<thead>
<tr>
<th>Items</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>35.85±2.99</td>
<td>34.80±3.44</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>81.80±5.83</td>
<td>82.35±5.82</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>169.60±0.05</td>
<td>170.7±0.05</td>
</tr>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>28.49±0.88</td>
<td>28.04±0.83</td>
</tr>
</tbody>
</table>

Table (1): Comparative analysis of the mean values of patients demographic data between Group A and Group B.

<table>
<thead>
<tr>
<th></th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>0.310</td>
<td>0.767</td>
</tr>
<tr>
<td>Group B</td>
<td>0.767</td>
<td>0.545</td>
</tr>
</tbody>
</table>

Fig. (1): The mean values of patients' demographic data between Groups A and B.

Analysis of mean values of FVC between and within Groups A and B are shown in (Table 2) and Fig. (1A,B). There is no significant difference between groups at pre-treatment assessment, while we reported significant post-treatment assessment in favor of Group A. Means of pre vs. post experimental examinations of showed significant improvement in FVC in both groups.

Table (2): Comparative analysis of FVC means values between and within Groups A and B at pre and post examinations.

<table>
<thead>
<tr>
<th>Items</th>
<th>Pre-</th>
<th>Post-</th>
<th>t-value</th>
<th>Level of sig. p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>2.23±0.11</td>
<td>2.41±0.19</td>
<td>7.654</td>
<td>0.000*</td>
</tr>
<tr>
<td>Group B</td>
<td>2.25±0.10</td>
<td>2.29±0.11</td>
<td>4.556</td>
<td>0.032*</td>
</tr>
<tr>
<td>t-value</td>
<td>0.577</td>
<td>2.672</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of sig. p-value</td>
<td>0.568</td>
<td>0.011*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: Significant at $p<0.05$. 
Concerning mean FEV$_1$, no significant differences between means of both groups at pre-treatment assessment, while significant difference between means of both groups was detected post-treatment showing significantly higher mean in Group A. The comparison between pre and post-treatment assessments showed significantly higher FEV$_1$ means post-treatment in both groups as shown in (Table 3) and Fig. (3A,B).

Table (3): Comparative analysis of FEV$_1$ means values between and within Groups A and B at pre and post examinations.

<table>
<thead>
<tr>
<th>Items</th>
<th>FEV$_1$ Pre-</th>
<th>FEV$_1$ Post-</th>
<th>$t$-value</th>
<th>Level of sig. ($p$-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>1.56±0.16</td>
<td>1.79±0.19</td>
<td>13.998</td>
<td>0.000*</td>
</tr>
<tr>
<td>Group B</td>
<td>1.59±0.14</td>
<td>1.64±0.14</td>
<td>4.899</td>
<td>0.026*</td>
</tr>
<tr>
<td>$t$-value</td>
<td>0.844</td>
<td>2.702</td>
<td></td>
<td></td>
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<tr>
<td>Level of sig. ($p$-value)</td>
<td>0.404</td>
<td>0.010*</td>
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<td></td>
</tr>
</tbody>
</table>

*: Significant at $p<0.05$.

Mean values of FEV$_1$/FVC between and within Groups A and B are shown in (Table 4) and Fig. (4A,B). There is no significant difference between groups at pre-treatment or post-treatment assessments. Means of pre vs. post experimental examinations of showed significant improvement in FEV$_1$/FVC in both groups.
Table (4): Comparative analysis of FEV₁/FVC means values between and within Groups A and B at pre and post examinations.

<table>
<thead>
<tr>
<th>Items</th>
<th>Pre-</th>
<th>Post-</th>
<th>t-value</th>
<th>Level of sig. (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>68.35±5.75</td>
<td>73.25±4.89</td>
<td>9.116</td>
<td>0.000*</td>
</tr>
<tr>
<td>Group B</td>
<td>70.48±5.52</td>
<td>71.06±5.34</td>
<td>3.856</td>
<td>0.001*</td>
</tr>
<tr>
<td>t-value</td>
<td>1.212</td>
<td>1.353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of sig. (p-value)</td>
<td>0.233</td>
<td>0.184</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: Significant at p<0.05.

Discussion

The results of the study clearly showed improvements in Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV₁), ratio of FEV₁/FVC (%) expressed in percentage in both Groups (A) and (B), but Ujjayi pranayama training with diaphragmatic breathing in Group A has more significant effect on selected pulmonary functions compared to diaphragmatic breathing in Group (B). This indicates that Ujjayi pranayama training when combined with diaphragmatic breathing is the optimal exercise strategy for mild asthmatic patient.

The results of the present study agrees with patil that study the effect of pranayama on pulmonary function, sixty randomly selected volunteers participated in this study these volunteers were subjected to 12 weeks pranayama training program that includes Bhashrika Pranayama, the pulmonary function significantly improved after 12 weeks of study comparing with base line values. Finally they concluded that pranayama exercises are beneficial for better pulmonary functions even in normal healthy [28].

In agreement with the results of the current study, preliminary controlled clinical trial study on 24 volunteer asthmatic patients, they were grouped in yoga and control groups. The yoga group was supervised for four weeks taking yoga exercise daily for 50 minutes. Peak expiratory flow rate was taken using peak flow meter and vital signs were measured in both groups. There was statistically significant reduction in day and night asthma attacks in yoga group, also it showed significant improvement in the peak expiratory flow rate [2].

The results of this study are coincided with result that was conducted on two asthmatic children groups aged 6-17 years to assess beneficial effects of yoga in exercise-induced bronchoconstriction, the research team observed a significant improvement in maximum Forced Expiratory Volume (FEV₁ %) following the exercise challenge after yoga training. All exercise-response-positive asthmatics became exercise-response-negative asthmatics after yoga training, so training children in the practice of yoga had beneficial effects on exercise induced bronchospasm [29]. Significant improvement reported in Peak Expiratory Flow Rate (PEFR), FEV₁ could be due to pranayama breathing responsible for strengthening of the respiratory muscles as well as a major physiological stimulus for the release of lung surfactant and thereby increasing the lung compliance [30].

Fig. (4): Mean values of patient’s FEV₁/FVC: (A) Pre-post treatment comparison within Groups A and B. (B) Between groups comparisons of pre-treatment and post-treatment assessments.
On the other hand the results of the two controlled studies from Australia in 39 and 36 subjects are more modest [31,32]. In first, which focused on patients taking high doses of short acting b2 agonists (median >800mg salbutamol daily), Buteyko training resulted in a large reduction in b2 agonist use which correlated with a reduction in minute ventilation compared with the control group. There was a non-significant trend to reduced inhaled steroid use and better quality of life, but no change in lung function or end tidal CO₂ pressure. In the second study subjects taught Buteyko breathing exercises by video had a reduction in bronchodilator use and improvement in quality of life but no change in peak flow rate [32]. But in cooper et al., study was larger and longer than the previous studies, and looked for the first time at bronchial responsiveness and asthma exacerbations, although only averaging two puffs of b2 agonist a day on entering the study, subjects in the Buteyko group were able to reduce their b2 agonist use. Despite this, symptoms were reduced and there was no increase in exacerbations or use of inhaled corticosteroids.

The changes in asthma quality of life and reduction in inhaled corticosteroids favored Buteyko, but the differences were small and non-significant. There was no change in bronchial responsiveness or FEV₁ despite clear potential for improvement [23].

Practice of ujjayi pranayama in combination with diaphragmatic breathing exercise seems to be beneficial for respiratory efficiency as breathing is not a conscious event and is regulated automatically by the nervous system through the respiratory centers located in the medulla oblongata and pons. These are the dorsal and ventral group of neurons located in the medulla, the pneumotaxic center and the apneustic center located in the pons. Thus it can be concluded that pranayama is a useful adjunct therapy with diaphragmatic breathing exercise in treating mild bronchial asthma.

**References**


الملخص العربي

المقدمة: الربو الشعبي هو مرض شائع وحيد أسباب الإصابة بالمرض بين كل من الأطفال والبالغين. تدريبات الليجي برانايا ها هي تقنية للسيطرة على التنفس، وهي عملية تبلغ من خلالها الشخص حالة الراحة العميقة، مع حالة ذهنية نشطة.

الأهداف: لتحقيق فعالية تدريبات الليجي برانايا ها لمدة شهرين على السعة الحيوية القصيرة (FVC) وحجم الزفير القسري في مرضى الرئا الشعبي المنخفض الشدة. في الثانية الأولى (FEV₁/FVC) وكذلك نسبة FEV₁ في مرضى الرئا الشعبي المنخفض الشدة، نسبة المنخفض الشدة لمدة 8 سنوات على الأقل شاركوا في هذه الدراسة. وقسمنا مرضى عشوائيا إلى المجموعة التجريبية (المجموعة الأولى) التي شملت 20 مريضا (12 رجلا و 8 نساء)، العمر (40-64). المجموعات الضابطة (المجموعة الثانية) التي شملت 20 مريضا بالربو (12 رجلا و 8 نساء)، العمر (40-64).

الطريقة: في كل المجموعتين، تم تدريب الأشخاص على تنفس الحجاب الحاجز لفترات تدريبية الليجي برانايا ها بالإضافة إلى التدريبات الأخرى. وأجريت التدريبات في كل المجموعتين لمدة 3 جلسات أسبوعية على مدى 8 أسابيع. ثم تقييم المجموعتين قبل التدريب وبعد شهرين من التدريب باستخدام مقياس التنفس المحسوب لقياس السعة الحيوية القصيرة (FVC) وحجم الزفير القسري في الثانية الأولى (FEV₁/FVC) ونسبة حجم الزفير القسري في الثانية (FVC).

النتائج: أظهرت المجموعة التجريبية أن هناك زيادة كبيرة في كل من السعة الحيوية القصيرة (FEV₁) في المجموعة المحصنة (0.05 ≤)، دون أن تظهر في المجموعة الضابطة (0.05 ≤). المجموعتين تحسن بشكل ملحوظ في كافة المؤشرات بعد الشهرين مقترن بإصابتهاما عند بداية الدراسة.

الاستنتاجات: أظهرت هذه الدراسة أن تدريبات الليجي برانايا ها، جنبًا إلى جنب مع العلاج الطبي ومارس تدريبات الحجاب الحاجز للتنفس تحسن FEV₁/FVC في المرضى الذين يعانون من الرئة الشعبي المنخفض الشدة.