IMPACT OF ACTIVE CYCLE OF BREATHING TECHNIQUE ON FUNCTIONAL CAPACITY IN PATIENT WITH BRONCHIECTASIS

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Abstract

Background and Purpose: Bronchiectasis is associated with impairment of the mucociliary escalator and retention of secretions within the bronchial tree, making airway clearance a primary concern in the management of bronchiectasis.

Patients and methodology:
Objective: The objective of this study was to determine the effect of active cycle of breathing as an airway clearance technique on functional capacity in adults with productive bronchiectasis by using six minute walk test and dyspnea index.

Design: The study was cohort design carried out on 45 patients (mean age 54.93±3.82 years) of both genders with stable productive bronchiectasis receiving multiple sessions (3 times/week for two months) of active cycle of breathing.

Measurements: Pre and post treatment measures were recorded for functional capacity in form of six minute walk test and dyspnea index.

Results: All 45 patients were stable during the study period. The functional capacity and level of dyspnea were significantly improved post treatment sessions with mean difference 48.06 for six minute walk test and 29.2 for dyspnea index.

Conclusion: The active cycle of breathing technique is an effective method for airway clearance and improving functional capacity in patients with bronchiectasis.

Key words: (Bronchiectasis, Active cycle of breathing, Functional Capacity, 6 Minute Walk Test, Dyspnea Index).

Introduction

Bronchiectasis is a disease with the potential to cause devastating illness, including repaired respiratory infections requiring antibiotics, disabling productive cough, shortness of breath and occasional Hemoptysis [1].

Bronchiectasis is allied with the impairment of the mucociliary escalator and retention of secretions within the bronchial tree, causing airway clearance is a physical defense mechanism, which protects the lungs from damage caused by inhaled or endogenous pitless within the airway. Bronchiectasis, in concert with damage to cilia, leads to deterioration of the uncoiling explorer and retention of secretions [2].

Until the late 1970s, physiotherapy for airway clearance was mainly a passive treatment, with the therapist prodding manual techniques of percussion, vibration and shaking with the patient...
appropriately positioned. However, the findings related to hazards such as transmission hypoxia and hemoptysis due to case techniques, resultant poor compliance and chronic cause of the disease, necessitating its need for self-management and lead to the development of alternative methods [3].

Various airway clearance techniques have been used in the physiotherapy management of patients with bronchiectasis. A recent summary showed that the active cycle of breathing technique in the UK, however, no studies have demonstrated that this technique is more effective than any other [4, 5].

Airway clearance techniques are considered as an integral component of management. Active cycle of breathing technique is widely interceded composing breathing control, thoracic expansion exercise and forced expiratory technique [6].

The active cycles of breathing technique consists of a cycle of huffs from mid to low lung volume dispersed with deep breathing and replaced abdominal breathing. The components include breathing control for 10-15 sec., thoracic expansion exercises (deep breathing exercises with emphasis inspiratory hold for 3 sec before expiration) and forced expiration (three huffs) in a set cycle [7].

COPD and bronchiectasis can lead to severe disability as the disease advances. The six minute walk test is commonly used to measure functional capacity in these patients and has three potential outcomes; walking distance, oxygen destruction and perceived exertion assessed by the Borg scale, all reflecting different aspects of these diseases [8].

The six minute walk test is widely used to assess change in functional exercise capacity following a pulmonary rehabilitation with the primary outcome reported being the distance walked [9].

It's also a reliable and safe tool to assess the functional status of patients suffering from chronic cardiac and pulmonary diseases. It's also useful in detecting the effectiveness of different forms of treatment for these patients [10].

Typically this test is administered in an enclosed indoor corridor, free of distractions, and patients are asked to cover as much distance as they can in 6 minutes. This environment is somewhat artificial and many not reflect activities that individual usually do on a daily basis [11]. Dyspnea is the term generally applied to sensations experience of by individuals who complain of unpleasant or uncomfortable, respiratory sensations many definitions of dyspnea have been offered, including difficult, labored Uncomfortable breathing an ownerless of repository distress and as uncomfortable sensation of breathing. These definitions have sometimes mixed the true symptom with physical signs [12].

**Purpose of the Study:**

The aim of this study is to determine the effect of active cycle of breathing as an airway clearance technique on functional capacity in patients with productive bronchiectasis.

**Subjects and Methodology:**

**Subjects:** Forty five volunteer patients of both genders who suffered from productive bronchiectasis with age ranged from 50-60 years had participated in this study. Patients suffering from musculoskeletal and cardiac problems were excluded from this study. All patients were enrolled in multiple active cycle of breathing technique (3 times/week for 2 months) as an airway clearance technique then we started to compare the pre- and post- results of this technique on the functional capacity of these patients by using the 6 minute walk test and the dyspnea index questionnaire.

**Methods**

A) **Evaluation procedures:**

1- **Six minute walk test:**

The 6 minute walk test was conducted in a temperature-controlled measured and marked corridor (30 meters). The turnaround points were marked with a come. A starting line, which marked the beginning and end of each 30m, was marked on the floor using bright by colored tape [13].

Reasons for immediately stopping a 6 MWT include chest pain, intolerable dyspnea, leg cramps and role appearance. If the test was stopped for any of these reasons, the patient should sit or lie supine as appropriate depending on the severity or the event and the oxygen should be administrated as apposite [14].

The patients sit on a chair at least 10 minutes before starting. During this time measure oxy-hemoglobin saturation and heart rate by pulse oxymeter. Patients was instructed to walk similar to their maximal habitual walking form and to end at their own place, attempting to cover as much distance as possible within 6 min. During walking the examiner recorded the time, distance walked,
contribution of tests and also monitored oxyhemoglobin saturation continuously by using the pulse oxymeter. The test was stopped for safety purposes if the rational oxygen saturation dropped less than 86% \cite{15}.

**2- Dyspnea Index Questionnaire:**

The Patients were asked to do the activities according the questionnaire before treatment and offer it. The prognosis detected by increasing the activity and the quality of doing for every patient.

The severity of shortness of breath experienced during 21 different activities of daily living associated with various levels of exertion and to rote 3 questions about limitation in his daily life. The patient was asked to estimate the degree of shortness of breath anticipated for activities he did not perform. The questionnaire is scored by summing the responses across all 24 items to obtain overall score. Scores ranged from 0 to 120.

**B) Training:**

**Active cycle of breathing technique (ACBT)**

Eaton et al., 2010\cite{16} stated that active cycle of breathing technique is used to mobilize and clear excess pulmonary secretions from the lung peripheries without increasing airflow obstruction. It’s a combination of thoracic expansion exercises interspersed with breathing control followed by expiratory technique with an open glottis combined with periods of breathing control.

1- **Chest expansions:**
- Breath gently at normal rate and depth using the lower chest (breathing control).
- Breath in slowly and deeply using the lower chest then pause.
- Breath out fully but not forcefully.
- Repeat for a further two breaths.
- Return to breathing control.
- Take three further slow deep breaths.
- Return to breathing control.

2- **Forced expiratory technique:**
- Take a slightly bigger than normal breath in.
- Open your mouth and keep it O shaped.
- Breathe out more for cheerfully using your abdominal muscles to assist. This should sound like a forced sigh. This is described abseiling.
- Repeat for a further two breaths.
- Return to breathing control.
- Cough to clear sputum if necessary.
- Return to breathing control until you are ready to begin another cycle.

**Statistical Analysis:**

The data were collected from patients pre- and post-treatment. Descriptive statistics was done in the form of mean and standard deviation. Inferential statistics assessed changes using dependent t-test to assess changes within group, analysis was done using SPSS version 17 and Relatives changes percentage was calculated according to:

\[
\text{Relative changes percentage} = \frac{\text{post} - \text{pre}}{\text{pre}} \times 100
\]

**Results**

(1) Six minute walk test distance:

Table and figure (1) demonstrated the 6 minute walk test distance pre and post treatment procedures. There was a significant difference in the dependent t-test between pre and post treatment 6 minute walk test as the mean value of pre-treatment was (82.26 ± 27.32) and for post-treatment was (130.33 ± 43.85) where the t-value was (7.54) and P-value was (0.0001). The percentage of improvement was 58.42%.

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<thead>
<tr>
<th>Group</th>
<th>6 min walk test distance</th>
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<tbody>
<tr>
<td></td>
<td>Pre treatment</td>
</tr>
<tr>
<td>Mean</td>
<td>82.26</td>
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<tr>
<td>± SD</td>
<td>± 27.32</td>
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<td>Mean difference</td>
<td>48.06</td>
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<td>Percentage of improvement</td>
<td>58.42%</td>
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<td>t-value</td>
<td>7.54</td>
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<td>P-value</td>
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Fig. (1): Mean and ±SD, t and p-values of 6 min walk test distance pre and post treatment.

(2) Dyspnea index:
Table and figure (2) demonstrated the Dyspnea index pre and post treatment. There was a significant difference in the dependent t-test between pre- and post- treatment procedures. The mean value of pre-treatment was (100.73± 14.91) and for post-treatment was (71.53± 15.58) where the t-value was (10.25) and p-value was (0.0001). The percentage of improvement was 28.98%

Table (2): Mean and ±SD, t and p-values of Dyspnea index pre- and post- treatment.

<table>
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<tr>
<td></td>
<td>Pre treatment</td>
<td>Post treatment</td>
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<tr>
<td>Mean</td>
<td>100.73</td>
<td>71.53</td>
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<td>± SD</td>
<td>± 14.91</td>
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<td>Mean difference</td>
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<td>29.2</td>
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<td>Percentage of improvement</td>
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<td>28.98%</td>
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<td>t-value</td>
<td>10.25</td>
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<td>P-value</td>
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Fig. (2): Mean and ±SD, t and p-values of Dyspnea index pre and post treatment.

Discussion
Chronic obstructive pulmonary diseases and bronchiectasis are becoming an increasingly important cause of morbidity and mortality worldwide in those ever age of 45 years. The sociologic impact of these diseases burden to tremendous. There is strong evidence that occupational exposures and another key preventable risk factor [17].

The present study was designed to investigate the effect of active cycle of breathing technique on functional capacity in patients with bronchiectasis. This study assessed by applying 6 minute walk test and shortness of breath questionnaire. Assessment ways measured pre- and post-treatment to direct progress.

Forty five patients received treatment with active cycle of breathing technique. They have been taught 3 times / week for 2 successive months.
Analysis of the results showed that there was a significant improvement in 6 minute walk test and with scoping in shortness of breath questionnaire.

Several studies agreed with results of the current study. Kulkorni, 2012\(^{[18]}\) compared the effect of autogenic drainage and pursed lip breathing versus active cycle of breathing in hospitalized bronchiectasis patients. Pulmonary functions (FEV\(_1\), FEV\(_1\)/FVC) were assessed and discussed using Medical Research council scale before and after treatment sessions. The results concluded that ACBT is better used Iran autogenic Drainage and pursed lip breathing in bronchiectasis patients and is easy adaptable by patients\(^{[18]}\).

Paneeth et al., 2012\(^{[19]}\) conducted a randomized study for 30 patients with bronchiectasis, is patients treated with active cycle of breathing technique and the other is treated with postural drainage. Pre and post evaluation were done by FVC, FEV\(_1\), PEFR and SPO\(_2\) by using pulmonary function test and pulse oxymeter. The study concluded that both of postural drainage and ACBT have significant effect in clearance of airways and improving the pulmonary function in bronchiectasis but ACBT has the better effect than postural drainage in airway clearance, FVC, FEV\(_1\) and SPO\(_2\)\(^{[18]}\).

Nafeez, et al., 2009\(^{[7]}\) compared the efficacy of commonly used conventional treatment with ACBT in bronchiectasis patients with varied etiology. The techniques used are widely practiced in pulmonary care of the patients and care proven safe and effective. Isotonic has been well documented as the most important risk factor in the development of COPD and bronchiectasis. Prolonged smoking causes the mucus hyper-secretion associated with enlargement of the mucus-secreting tissue and mucosal inflammation of the airways. The results of result of this study are not in accordance to those of Pryor & wetter, wherein ACBT has been shown to be more effective than conventional cheers physical therapy for the amount of sputum expectorated in bronchiectasis patients\(^{[7]}\).

In agreement with the present study, the findings of Patterson et al., 2004\(^{[20]}\) which demonstrated that ACBT was a more effective airway clearance technique than incremental respiratory endurance. ACBT is an important factor and component of the care package effaced to patient with bronchiectasis. In this study more than half of the patients perceived that ACBT was a more effective method of airway clearance\(^{[20]}\).

Eaton et al., 2007\(^{[21]}\) stated the first study to systematically evaluate the acute acceptability and tolerability as well as acute efficacy of airway clearance techniques (Flutter and ACBT with and without PD) in bronchiectasis. ACBT with PD was superior to ACBT alone as measured by sputum production. But ACBT was significantly more comfort than ACBT with PD which causing greater interference with daily life\(^{[22]}\).

In contrast Janet et al., 2005\(^{[22]}\) demonstrated that A capella device is as effective method of airway clearance as ACBT in patients with bronchiectasis. Evidence for the use of ACBT in bronchiectasis is limited and focuses on four randomized controlled trials. A randomized controlled trial compared the efficacy of mineral controlled trial compared the efficacy of ACBT with flutter in 17 patients for 4 weeks of each technique in a crossover design. No significant differences were found in daily significant differences were found in daily sputum weight produced between treatments\(^{[22]}\).

However, in the study of Jamal et al., 2007\(^{[23]}\) subjects were demonstrated a significant in provident in oxygen saturation in treatment with autogenic drainage (AD) and active cycle of breathing. The tendency towards Righter oxygen saturation in treatment with autogenic drainage and active cycle of breathing. The tendency towards righter oxygen saturation was with AD than ACBT and therefore, the difference found statistically significant\(^{[23]}\).

This was very much in accordance to finding of Savci et al., 2000\(^{[24]}\) who found that in AD treatment. Increase in oxygen saturation might have been the results of removal of remitted mucus plugs from the airways, lead to improved alveolar ventilation from the airways, lead to improved alveolar ventilation optimized ventilation-perfusion mismatch, and finally improved oxygen transport to the tissue\(^{[25]}\).

Robinson et al., 2012\(^{[26]}\) compared the clinical effectiveness of ACBT with other airway clearance therapies including studies composed ACBT to autogenic drainage, airway oscillating devices, high frequency compression devices, and conventional chest physiotherapy. There is insufficient evidence to support or reject the use of
ACBT over any other airway clearance therapy. Four studies, with four different comparators, found that ACBT was comparable to other therapies in outcomes such as patient preference, lung function, sputum weight, oxygen saturating and member of pulmonary exacerbations[26].

**Conclusion:**
Active cycle of breathing technique produce significant and remarkable benefits on exercise tolerance and functional capacity via 6 minute walk test and scoring with shortness of breath questionnaire in patients with bronchiectasis. It was a very simple way to the patient and not expensive in cost. It assisted in mobilizing secretions. The cycle of breathing technique was liable and adapted to needs of individual and helps in re-expansion of lung tissue. Finally it was a way of relaxation due to the effect of breathing exercises.

**Conflict of Interests**
Authors of this work declared that there is no conflict of interests regarding the publication of this paper.

**References:-**
20. Patterson, J.E., Bradely, J.M., Elborn, J.S.; Airway clearance in bronchiectasis: a randomized crossover trial of active cycle of breathing techniques versus test of incremental


