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Effect of buteyko breathing on modulation of acid base balance among asthmatic patients

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The aim of this study was to determine the effect of Buteyko breathing technique (BBT) as an adjunctive treatment on blood gases among asthmatic patients. Thirty asthmatic patients (18 females and 12 males), suffering from bronchial asthma for 3 years or more were enrolled in the study. Their ages ranged from 25-35 years. They were chosen from out-patient clinic at Abasseya Chest Diseases Hospital. They were randomly assigned into two equal groups each included 15 patients; Group (A) (8 females -7males) received BBT and their medications, while Group (B) (10 females -5 males) received their medications with the standard relaxed positions and diaphragmatic breathing exercises. Patients were assessed by analysis of arterial blood gases (ABG), control pause test and asthma questionnaire at the beginning of the study and after 8 weeks. Results revealed significant changes in ABG values in-group (A): (pH 1.32%- HCO_3 12.39%- $PaCO_2$ 12.82%- PaO_2 8.85%) and for control pause (65.68%). While Group (B) showed non-significant changes in correspondence (pH 0.53%- HCO_3 3.07%- $PaCO_2$ 3.6%- PaO_2 0.67%) and for control pause (7.25%). Regarding to asthma questionnaire, significant change was achieved in group A where the percentage of improvement was 29.45 % while it was 2.29 % in group B. Results also revealed significant difference between groups post treatment as the p value was 0.03.BBT has a modulated effect on ABG and beneficial impact in reducing the recurrence of asthma attacks and the severity of its symptoms specially when it is added to traditional chest physical therapy program.

Keywords: Buteyko Breathing Technique, Bronchial Asthma, Asthma Control Questionnaire.

INTRODUCTION

Asthma is a disease characterized by long-term airway inflammation with respiratory symptoms such as dyspnea, wheezes, shortness of breath and episodes of coughing of variable severity. This chronic inflammation is characterized by airway hypersensitivity with reversible airway obstruction and bronchospasm especially at night or in the early morning (Vincent et al., 2006), (Reddel et al., 2014), and (Narwal et

al., 2012).It has been estimated to affect as many as 300 million people worldwide and this number could increase to become100 million by 2025(Ulrik et al., 1994).

It has been observed that the most common manifestation of bronchial asthma is hypocapnia-induced bronchospasm caused by hyperventilation in order to decrease further loss of CO_2**.** This transient airway obstruction results in hypoxemia and consequent V/Q mismatch, which triggers further hyperventilation and further loss of CO_2. This in turn increases respiratory muscle burden and work of breathing, while the continuous reduction in $PaCO_2$ leads to respiratory alkalosis which is the most prevalent acid base imbalance among asthmatics. (Bruton and Lewith., 2005),(Hassan et al., 2012),(Johnsen et al., 2013) and(Mousavi et al.,2014).

Knowing for a fact that asthma is a chronic pathology, a regular breathing training such as Buteyko method is found to be the most effective complementary technique that should be performed to regularize breathing patterns by lowering respiratory rate and increasing the duration of exhalation (Narwal et al., 2012). Having acknowledged that, it paved the way to develop the Buteyko method which both reduces asthma symptoms and other hyperventilation-associated pathologies. Furthermore, nitric oxide (NO) is secreted as a result of Buteyko breathing application inducing bronchodilation while only depending on nasal breathing (Bruton and Lewith., 2005). It also reduced the dependence and consumption of short acting β2-agonists, as a bronchodilator, eventually leading to overall improvement in the quality of life**. (**Slader et al., 2006),(Courtney and Cohen., 2008),and (Thomas and Bruton., 2014).

MATERIALS AND METHODS

Participants and Procedures:

Participants:

Thirty patients of both genders (18females and 12 males) with age ranged from 25-35 years, suffering from bronchial asthma for 3 years or more were enrolled in this study**.** The participated patients were selected based on peak expiratory flow (PEF) variation (Twice daily –morning and afternoon – readings over two weeks, as a variation >20% over the observation period was considered significant (Jain et al., 2006). All patients were chosen from outpatient chest clinic of Abasseya Chest Diseases Hospital where thoroughly examined and diagnosed by the chest physician. They were randomly assigned into two equal groups each included 15 patients. Randomization was determined by opening of sequentially numbered sealed envelopes. Group (A) composed of (8 females -7 males) who received their traditional medical treatment such as bronchodilator (B2 agonist), anti-inflammatory as inhaled corticosteroids and mucolytic (with or without antibiotics) in addition to the designed Buteyko program with a rate of 2 sessions per week for 8 weeks. While Group (B) composed of (10 females -5 males) who received the same medical treatment and performed diaphragmatic breathing exercise and relaxation positions during the attack. Patients were assigned according to GINA guidelines severity classification pretreatment (Bateman et al., 2008) into (2 sever-3moderate-6 mild-4 intermittent in group A while (3sever-3moderate-5 mild-4 intermittent) in group B. They were chosen according to inclusion criteria such as: non-smokers or ex-smokers in the last 3 years taking in consideration that patients with cardiovascular, renal diseases or mental disabilities were excluded from the program. All patients signed an informed consent before participation into the study while all study procedures were explained carefully. The study was approved by the ethical committee of the faculty of physical therapy with approval NO:P.T.REC/012/002097, Cairo University, Egypt.

Evaluation procedures:

Arterial blood gases were measured by using (PHOX PLUS C 402103020, America) in the form of PaO_2, Pa CO_2, HCO_3 in addition to pH level before and at the end of the study after 8 weeks of training.

Measurement of control pause breathing test:

By using a stop watch; the patient assumed a relaxed sitting position. No change in breathing pattern or its rate was allowed before taking control pause. Patient was asked to inhale in two seconds and exhale in three seconds. Then, close the nose and start counting the number of seconds every patient could hold their breath with ease before they feel the urge to take another breath. Depending on the duration in which the patient could sufficiently hold his\her breathing, the degree of severity of asthma could be determined accordingly (Hassan et al., 2012).

Assessment of asthma control questionnaire:

Five symptoms included in the questionnaire and considered most important for assessing asthma control. Additionally, there is a question on short-acting β2-agonist use and another on FEV_1% predicted which being provided by clinic staff. Patients were asked to recall their symptoms and short –acting β2-agonist use during previous week. All seven questions were scored on a7-point scale (0=good control, 6=poor control), and the mean of the seven responses was recorded (Jia et al., 2013).

All measurements were performed once at the beginning of the study and another at the end of 8 weeks.

Treatment procedures:

The patients in group (A) received Buteyko Breathing Technique BBT in addition to their medical treatment. Each patient was trained about 20 minutes per session for two sessions per week. Timing of the session was (9 -11am) at least two hours after meals. The BBT steps as demonstrated and performed by the patients were: 1) Close the mouth while only breathing through the nose. 2) Breath into the diaphragm (stomach) and the chest should be still. 3) Ensure that it is only shallow breathing. 4) Sit uprightly and shallow breath for 2-3 minutes and after this period while in the exhaling part pinch the nose closed and hold the breath until the need to breathe again. 5) After sufficient time of holding breath, un-pinch the nose without taking a deep breath, instead continue with the shallow breathing technique **(**Prasana et al.,2015).Each patient performed the technique as a home program along the duration of the study. For Group (B), patients received their medical treatment in addition to relaxation positions and diaphragmatic breathing exercise.

Statistical Analysis:

The collected data were analyzed by using SPSS program version 17 to show: Demographic data of patients in both groups represented as mean and standard deviation. Paired t test to analyze parameters changes within group for ABG results while unpaired t test to analyze the same parameters changes between groups. Median (Wilcoxon matched pairs test) and inter Quartile range to analyze parameters changes within the group for control pause and asthma questionnaire while Mann-Whitney test used to analyze changes between both groups for the same variables. $p<0.05$

RESULTS

For Group (A), the mean values of age were (33.46±4.9) years and BMI (29.25±2.05) kg/m^2. While for Group (B), the mean values of age were (33.2±5.2) years and BMI (28.73±2.2) kg/m^2. There was no significant difference between both groups regarding ages and BMI. The p-values were (0.14, 0.88) and (0.67, 0.5) respectively as shown in (Table1). The results of ABG showed significant improvement in-group A as regard to all measured values (pH 1.32%- HCO_3 12.39%- $PaCO_2$ 12.82%- PaO_2 8.85%) while Group (B) showed non-significant changes (pH 0.53%- HCO_3 3.07%- $PaCO_2$ 3.6%- PaO_2 0.67%) as shown in table (2).

Statistical Analysis of control pause test for group A revealed 65.68% as a percentage of improvement as the median was 30 seconds pretreatment and become 53 seconds post treatment while for group B was 7.25% where the median was 33 seconds reduced to be 32 seconds post treatment. Regarding Asthma questionnaire, significant change was achieved in-group A where the p value was 0.001 while it was 0.18 in-group B. The percentage of improvement was 29.45 % in-group A while it was 2.29 % in-group B. Results of all measured variables also revealed significant difference between both groups post treatments.

Table (1): Demographic characteristics of patients in both groups (A&B).

	Group A	Group B	Comparison		
	Mean ±SD	Mean ±SD	t-value	p-value	S
Age (yrs)	33.46±4.9	33.2±5.2	**0.14**	**0.88**	**NS**
Weight (kg)	77.1±3.1	75.66±7.3	**0.69**	**0.49**	**NS**
Height (cm)	162.53±5.5	162.2±5.1	**0.17**	**0.86**	**NS**
BMI (kg/m^2)	29.25±2.05	28.73±2.2	**0.67**	**0.5**	**NS**

*SD: standard deviation, P: probability, S: significant, NS: non-significant.

Table (2): Statistical Analysis for Arterial blood Gases in Both Groups: -

Items	Group A		Group B				
	Pre	Post	Pre	Post	t-value	p-value	S
pH	7.55±0.04	7.45±0.02	7.50±0.03	7.46±0.03	2.56	0.01*	S
t-value	6.54		1.04				
p-value	0.0001*		0.31 (NS)				
%	1.32		0.53				
HCO_3 Bic(mEq/L)	19.37±2.1	21.78±1.4	19.52± 1.8	20.12±1.8	2.79	0.001	S
t-value	6.93		2.33				
p-value	0.0001*		0.03(NS)				
%	12.39 %		3.07 %.				
$PaCO_2$ (mmHg)	46.64± 4.1	40.66±3.5	47.88±5.1	46.12±4.8	2.31	0.02*	S
t-value	10.81		1.03				
P-value	0.0001*		0.31(NS)				
%	12.82 %.		3.6 %.				
PaO_2(mmHg)	72.37±6.2	78.79±5.8	72.5±7.5	73.0±6.7	2.51	0.01*	S
t-value	6.21		1.54				
P-value	0.0001*		0.14 (NS)				
%	8.85 %.		0.67 %.				

SD: standard deviation, P: probability, *S: significant, NS: non-significant.

DISCUSSION

It was believed that evaluation of pulmonary functions, as by measuring FEV_1, which necessitates forced expiration, has a risk of inducing further bronchospasm. (Bruton and Lewith., 2005).Furthermore, (Raimondi et al., 2014)confirmed the relationship between airway obstruction and acid base disturbances in asthmatics. For the above-mentioned reason, this study has opted for measuring arterial blood gases, since it is a more accurate measurement to determine the blood pH as well as the type of the acid-base imbalance, whether respiratory or metabolic. Our study is one of the very few that measured arterial blood gases as a good indicator for the effectiveness of butekyo breathing technique on asthmatic patients.

It was proven that changes in breathing pattern directly influences the pH balance of the blood, (Parvathy et al., 2014) confirmed the remarkable effect of modulating respiratory rate or depth on blood pH by adjusting blood carbon dioxide level. On one hand, shallow breathing causes an increase of carbon dioxide blood level and consequent respiratory acidosis. On the other one, rapid deep breathing washes out carbon dioxide from the blood increasing blood pH. On that account, respiratory adjustments play a major role in the acid-base balance of the blood.

As was proven in this study, the results related to ABG showed significant improvement in the butekyo group via decreasing pH level and $PaCO_2$ values by 1.32% and 12.82% respectively, while increasing HCO_3 and PaO_2 values by 12.39% and 8.85% respectively. These results coincided with (Mousavi et al., 2014), who reported that elevation of HCO_3 as a result of elevation of alveolar carbon dioxide is a form of body compensation to modulate hypoxia and to deal with the problem of inadequate alveolar ventilation in cases of bronchial asthma. Furthermore, enhancing diaphragmatic muscle breathing through relaxation of accessory muscles of respiration and abdominal muscles contractions will decrease the retention of air inside the alveoli. (Afle and Grover. 2014).

In the current study, the percentage of improvement of control pause test was 65.68% in Group A; the median was 30 seconds pretreatment and become 53 seconds post treatment while it was 7.25% in Group B. The median was 33 seconds reduced to be 32 seconds post treatment. This came in agreement with (Hassan et al., 2012)who stated that the average breath holding time increased from about 3–6 s to over 30 s. Their average control pause increased from 4 to 30 s. Results of this study also were consistently with reports stated by Buteyko practitioners who showed that a longer control pause is associated with decreased

symptoms and severity of the disease for asthmatic patients(Ma et al., 2015).

The results of BBT showed improvement in asthma control questionnaire with 29.45% in group A and 2.29% in group B. The p value was 0.45 pretreatment and becomes 0.03 post-treatment between both groups. The results of this study were supported by findings achieved by (Cowie et al, 2008) who revealed better results of asthma control questionnaire on 129 asthmatic patients who showed an initial level of asthma control of 40% in the Buteyko group, and 44% in the control group. After a follow-up of 6 months period, the percentage of improvement with asthma control increased to 79% in the Buteyko group and to 72% in the control group, so he concluded that the Buteyko technique is highly beneficial in asthmatic patients.

Additionally, BBT has shown to improve the overall quality of life of asthmatic patients, as was demonstrated by a study done by (Opat et al., 2000), on 36 patients with mild to moderate asthma, where asthma-related quality of life, symptoms and asthma medication intake were monitored before and after training. Those patients performed BBT for 2 sessions per day for 4 weeks, their results revealed dramatic enhancement of the quality of life in comparison with placebo. That was supported by a study performed by (McHugh et al., 2006) where there was an 85% reduction in beta2-agonists and a 50% reduction in steroid use amongst people who had used the Buteyko method compared to a 1% increase in steroid use and 37% decrease in β2 -agonist use in the control group.

Results of the present study showed that group A who trained by BBT adjunct to traditional chest physical therapy program showed reduction on the asthma severity scale than happened in group B who trained by traditional chest physical therapy program only. Hyperventilation and depth of breathing were treated better by the Buteyko therapy as compared to conventional physiotherapy group in 6 weeks of training (Narwal et al., 2014).

CONCLUSION

It has been validated that adding regular application of BBT to traditional chest physical therapy program represents a safe and cheap method. This integrated program comprises a much greater benefit for asthmatic patients. It improves patient's self-satisfaction and self-esteem by drastically reducing the intake of medical treatments. Also, it significantly decreases the recurrence and severity of bronchial asthma symptoms such as dyspnea, wheezes, nocturnal waking, morning symptoms, activity limitation and chest tightness.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

All authors contributed equally in all parts of this study.

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