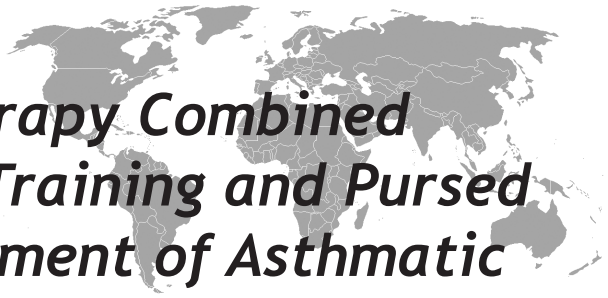

Laser Acupuncture Therapy Combined with Aerobic Exercise Training and Pursed Lips Breathing in Treatment of Asthmatic Children

A Comparison of Two Treatment Protocols.

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ABSTRACT

***Aim:** About 11-15% of children less than 18 years of age suffer from bronchial asthma that impairs their overall physical ability and reduces heath related quality of life. Therefore, the development of non-pharmacological interventions to prevent asthma, reduce its severity and improve its prognosis is essential. This study compares two types of treatment protocols to determine the efficiency laser acupuncture therapy added to aerobic exercise training and pursed lips breathing in treatment of asthmatic children.*

***Method:** Forty asthmatic children, their age ranged between 8 -15 years participated in the study and divided into two groups, group (A) received laser acupuncture therapy, aerobic exercise training plus pursed lips breathing and group (B) received aerobic exercise training plus pursed lips breathing . The program consisted of three sessions per week for two months. Measurements of forced vital capacity (FVC), the forced expiratory volume in the first second (FEV1), the average of forced expiratory flow at 75-85% of forced vital capacity (FEF 75-85%) and maximum expiratory flow at 50% of forced vital capacity (MEF 50%) and number of asthmatic attacks per week were taken before and after treatment.*

***Result:** There was a significant reduction in number of asthmatic attacks per week and improvements in FVC, FEV¬1, FEF 75-85% and MEF 50% in both groups after treatment. However, there was a significant difference between mean levels of the investigated parameters in both groups after treatment.*

***Conclusion:** Laser acupuncture therapy added to aerobic exercise training and pursed lips breathing improves treatment of asthmatic children.*

***Key words:** Laser acupuncture therapy, aerobic exercise training, pursed lips breathing, bronchial asthma.*

Astımlı Çocukların Tedavisinde Aerobik Egzersizle Kombine Akapunktur Tedavisi Ve Büzük Dudaklı Solunum İki tedavi protokolünün karşılaştırılması

Amaç: *18 yaşın altındaki çocukların yaklaşık %11-15'i genel fiziksel yeterliliklerini bozan ve yaşam kalitesini düşüren bronşiyal astmadan muzdariptirler. Bu nedenle, astmayı önleyecek, şiddetini azaltacak ve prognozunu iyileştirecek nonfarmakolojik girişimler önemlidir. Bu çalışma astmalı çocukların tedavisinde iki protokolünün, aerobik egzersize eklenmiş lazerli akapunktura karşı büzük dudak solunumu, etkinliğini karşılaştırmaktadır.*

Metod: *Yaşları 15 ila 18 arasında değişen 40 astımlı çocuk çalışmada iki gruba ayrıldı; grup (A) lazerli akapunktur, aerobik egzersize ek olarak büzük dudak solunumu ve grup (B) aerobik egzersize ek olarak büzük dudak solunumu tedavisi aldı. Program 2 ay süresince haftada 3 seanstan oluşuyordu. Ölçümler tedaviden önce ve sonra alınan forced vital kapasite (FVC), ilk saniyedeki zorlu expiratuar hacim (FEV1), zorlu vital kapasitenin (FEF %75-85) %75-85'inde iken alınan zorlu expiratuar akımın ortalaması ve zorlu vital kapasitenin (MEF %50) %50'sinde maksimum expiratuvar akım ve haftalık astım atakları sıklığı olarak kaydedildi.*

Bulgular: *Tedaviden sonra her iki grupta da haftalık astım atakları sıklığında azalma ve FVC, FEV1, FEF %75-85 ve MEF %50 değerlerinde iyileşme olduğu saptandı. Bununla birlikte tedaviden sonra çalışılan parametrelerim ortalama değerleri açısından her iki grup arasında anlamlı farklılık mevcuttu.*

Sonuç: *Aerobik egzersize ilave lazerli akapunktur tedavisi ve büzük dudaklı solunum, astımlı çocukların tedavisinde iyileşme sağlamaktadır.*

Anahtar kelimeler: *Lazerli akapunktur tedavisi, aerobik egzersiz, büzük dudaklı solunum, bronşiyal astım*

INTRODUCTION

Asthma is a major public health problem. It is the most common chronic chest illness of childhood, it affects about 18% of children less than 12years of age (1-2). Most asthma begins in childhood (3). There is presently some concern that childhood asthma may persist and/or deteriorate later in life (4).Asthma is defined as a disease that is characterized by airway inflammation and manifested by pulmonary symptoms, reversible airway obstruction and bronchial hyperactivity. Patients with asthma are exposed to airway obstruction and hyperinflation which interfere with the ability of the respiratory muscles to generate subatmospheric pressure and increase the load on the respiratory muscles. Airway resistance is increased three folds or higher than normal in patients with chronic persistent asthma (5).

Asthmatic attacks are characterized by dyspnea and wheezes. In states of chronic symptomatic asthma, exacerbations and remissions are also common, but airflow obstruction to some degree is always present (6).Bronchial asthma develops bronchial inflammation and increased smooth muscle contractility. This inflammation remains poorly controlled despite of big corticosteroids doses and their side effects as suppression of growth, more evident in prepubertal age. This phenomena increase the need of an alternative effective anti- inflammatory treatment (7). Physical activity is essential for young children to develop adequately and for quality of life. It can be lower in children with asthma, and therefore methods to reveal reduction in physical activity in young children are warranted as asthmatic symptoms have been identified as a barrier to exercise by children (8).

Physical activity is important in children with asthma such as running and bicycling are associated with improved fitness and decreased severity of asthma symptoms (9). Pursed-lip breathing (PLB) performed as nasal inspiration followed by expiratory blowing against partially closed lips is a breathing retraining strategy employed by patients with chronic obstructive pulmonary disease(10). Pursed lips breathing exercise results in improvement of arterial oxygen and carbon dioxide tensions as a result of decreased airway collapse decreased respiratory rate and increased tidal volume (11). Application of laser acupuncture therapy in asthmatic patients produced a good immunocorrection, marked broncholytic effects and improved to potency of bronchi due to its anti-inflammatory effect (12- 13).

The aim of this study was to compare two types of treatment protocols to determine the efficiency laser acupuncture therapy added to aerobic exercise training and pursed lips breathing in treatment of asthmatic children.

MATERIALS AND METHODS

Subjects

Forty asthmatic children of both sexes (21 girls and 19 boys), their age ranged between 8 and 15 years, received bronchodilators, antibiotics and received no supplemental oxygen. Children with congenital heart disease, vertebral fractures, kyphosis or scoliosis, pleural

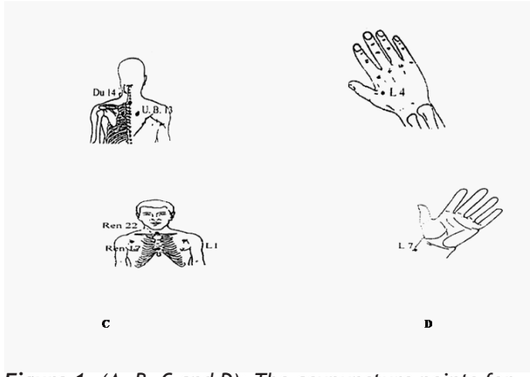

Figure 1*. (A, B, C and D): The acupuncture points for the respiratory system disorders (15).*

disease, neurological, mental and metabolic disorders were excluded from the study. The children were examined by specialized physician to exclude subjects with any disorders. participants in the study were divided into two equal groups, The first group (A) received laser acupuncture therapy , aerobic exercise training plus pursed lips breathing in addition to the current medical treatment and the second group (B) received aerobic exercise training plus pursed lips breathing in addition to the current medical treatment . The program consisted of three sessions per week for two months. Informed consent was obtained from all participant parents. This study was approved by the ethics committee and that the patients gave their informed consent. Also, this study was undertaken in compliance with the Helsinki Declaration and the International Principles governing research on animals. All participant parents were free to withdraw their children from the study at any time. If any adverse effects had occurred, the experiment would have been stopped, with this being announced to the Human Subjects Review Board. However, no adverse effects occurred, and so the data of all the participants were available for analysis.

Materials

Evaluated parameters

The forced vital capacity (FVC), the forced expiratory volume in the first second (FEV_1), the average of forced expiratory flow at 75-85% of forced vital capacity ($FEF_{75-85\%}$) and maximum expiratory flow at 50% of forced vital capacity ($MEF_{50\%}$) were measured using spirometer (Schiller-Spirovit Sp-10, Swizerland) and the number of asthmatic attacks per week (No. of asthmatic attacks) for all participants before the study and repeated after two months at the end of the study.

Aerobic exercise training

The aerobic treadmill-based training programme (PRECOR 9.1/ 9.2, China) was set to 60%-70% of the maximum heart rate (HRmax) performed according to a modified Bruce protocol. This rate was defined as the training heart rate (THR).After an initial, 5-minute warm-up phase performed on the treadmill at a low load, each endurance training session lasted 20 minutes and ended with 5-minute recovery and relaxation phase. All patients performed three weekly sessions (14).

Laser acupuncture therapy

Gallium-Arsenide Laser (Model: LTU-904 H, Maximum peak power: 5W, Wave length: 904±10 nm, Pulse length: 200 ns, Class I laser product manufactured by Laser ex Technologies PTY LTD, Australia) was used to apply laser acupuncture therapy for the respiratory system, while the patient was in the sitting position bare skin of the site of laser application, back was supported hips and knees were 90° flexion and feet rest on the floor. Each acupuncture point of the respiratory system disorders received laser for 90 seconds, three sessions per week for 2 months. The acupuncture (L.1), shamzhong (Ren 17), Tiantu (Ren 22), feishu (U.B.B), Dazhui (Du 14), lieque (L.7) and Heagu (L.I.4) (15).Figure 1 (A,B,C and D).

Pursed lips breathing

The child assumed a comfortable sitting position with back supported, shoulders and neck relaxed and instructed that expiration must be passive as abdominal muscles contraction must be avoided. The therapist hand was applied over the abdomen of the child to detect any contraction of the abdominal muscles the child was instructed to inhale slowly through the nose them to purse his/her lips and exhale slowly and try to prolong exhalation as long as he/she can (16). It was applied for three times then rest for thirty seconds .This maneuver was repeated for 10 minutes /session, three sessions per week for two months.

Table 1. *Mean value and significance of FVC, FEV_1, $FEF_{75-85\%}$ and $MEF_{50\%}$ and the number of asthmatic attacks per week in group (A) before and after treatment.*

	Pre	Post	t-value	p value
FVC, L	1.97±0.41	2.57±0.43	4.66	< 0.05
FEV_1, L/sec	1.26±0.32	1.85±0.31	4.51	< 0.05
$FEF_{75-85\%}$, L/sec	0.65±0.22	0.96±0.25	3.94	< 0.05
$MEF_{50\%}$, L/sec	0.94±0.24	1.41±0.26	3.78	< 0.05
Asthmatic attacks, n	9.37±2.28	5.21±1.82	5.65	< 0.05

FVC = Forced Vital Capacity. FEV1 = Forced expiratory volume in the first second. FEF75-85% = Average of Forced expiratory flow at 75-85% of forced vital capacity. MEF50% = Average of Maximum expiratory flow at 50% of forced vital capacity.

Statistical analysis

The mean values of ventilatory function test (FVC, FEV_1, $FEF_{75-85\%}$ and $MEF_{50\%}$.) and the number of asthmatic attacks per week (No. of asthmatic attacks) obtained before and after two months in both groups were compared using paired "t" test. Independent "t" test was used for the comparison between the two groups ($p<0.05$).

RESULTS

Forty asthmatic children were participated in the study and divided into two equal groups, The first group (A) received laser acupuncture therapy, aerobic exercise training plus pursed lips breathing in addition to the current medical treatment and the second group (B) received aerobic exercise training plus pursed lips breathing in addition to the current medical treatment for two months . The mean values of FVC, FEV_1, $FEF_{75-85\%}$ and $MEF_{50\%}$ were significantly higher, where the mean values of the number of asthmatic attacks per week were significantly lower in both groups after treatments (Table 1, 2). There were significant differences between mean levels of the investigated parameters in group (A) and group (B) after treatment (Table 3).

DISCUSSION

Asthma has become an epidemic world-wide and the soaring costs of treatment combined with the rising morbidity and mortality rates necessitate alternative cost-effective treatment options since many asthmatics continue to go untreated due to the inaccessibility and high costs of medical care , therefore, the development of non-pharmacological interventions to prevent asthma, reduce its severity and improve its prognosis is essential. This study was designed to compare two types of treatment protocols to determine the efficiency of laser acupuncture therapy added to aerobic exercise training and pursed lips breathing in treatment of asthmatic children. Results of this study showed that addition of laser acupuncture therapy to aerobic exercise training and pursed lips breathing led to a more significant improvement in ventilatory functions and reduction number of asthmatic attacks per week in asthmatic children. Disappearance of inflammatory changes in bronchial mucosa, improved potency of airways and increase in respiratory muscles strength are the possible cause of these results.

Sixteen asthmatic subjects were enrolled in this 2-way crossover study. At first patients had been treated with

Table 2. *Mean value and significance of FVC, FEV¬1, $FEF_{75-85\%}$ and $MEF_{50\%}$ and the number of asthmatic attacks per week in group (B) before and after treatment*

	Pre	Post	t-value	p value
FVC, L	1.90±0.43	2.04±0.42	3.26	0.05
FEV1, L/sec	1.17±0.31	1.41±0.29	3.14	< 0.05
$FEF_{75-85\%}$, L/sec	0.54±0.25	0.75±0.21	3.02	< 0.05
$MEF_{50\%}$, L/sec	0.87±0.26	1.08±0.24	3.25	< 0.05
Asthmatic attacks, n	9.41±2.74	7.56±1.76	3.68	< 0.05

FVC = Forced Vital Capacity. FEV1 = Forced expiratory volume in the first second. FEF75-85% = Average of Forced expiratory flow at 75-85% of forced vital capacity. MEF50% = Average of Maximum expiratory flow at 50% of forced vital capacity.

Table 3. *Mean value and significance of FVC, FEV¬1, FEF 75-85% and MEF 50% and the number of asthmatic attacks per week in group (A) and group (B) after treatment.*

	Pre	Post	t-value	p value
FVC, L	2.57±0.43	2.04±0.42	3.15	< 0.05
FEV1, L/sec	1.85±0.31	1.41±0.29	3.61	< 0.05
$FEF_{75-85\%}$, L/sec	0.96±0.25	0.75±0.21	3.44	< 0.05
$MEF_{50\%}$, L/sec	1.41±0.26	1.08±0.24	3.25	< 0.05
Asthmatic attacks, n	5.21±1.82	7.56±1.76	4.16	< 0.05

FVC = Forced Vital Capacity. FEV1 = Forced expiratory volume in the first second. FEF75-85% = Average of Forced expiratory flow at 75-85% of forced vital capacity. MEF50% = Average of Maximum expiratory flow at 50% of forced vital capacity.

symphatomimetics and corticosteroids for at least 4 weeks (the control stage), after that they were evaluated by symptoms, physical examination and PFT. At second stage (interventional stage) laser acupuncture therapy with 100 mW, 980 nm in direct contact exposure on 8 points of lung with 5 J/cm^2, 2-3 times in a week for 8-12 sessions. A noticeable improvement of the clinical and functional characteristics was remarked in patients. Symptoms and signs like; night dyspnea, cough, effort dyspnea, morning symptoms, discharge, and lung exams, wheezing, work absence showed a statistically significant difference ($p< 0.05$) after adding laser acupuncture therapy as it's anti-inflammatory effects is the suitable and effective complement modality for the treatment of pul¬monary diseases. So, the combination of laser acupuncture therapy with standard drug therapy is more effective than conventional drug therapy alone (17). Eight patients with intermittent or mild persistent asthma received laser acupuncture for 10 weeks and probiotic treatment for 7 weeks confirmed that a beneficial clinical effect on bronchial hyperreactivity in school age children with intermittent or mild persistent asthma and might be helpful in the prevention of acute respiratory exacerbations (18).

Low intensity laser therapy might cause improvement of general condition, normalization of body temperature, reduction of cough, disappearance of inflammatory changes in bronchial mucosa, activation of proliferative processes and normalization of bronchial secretion which indicated increase of tissue metabolism and improvement of epithelial cover. Also laser therapy displayed a good immunocorrection effect (12). The improvement of ventilatory functions in asthmatic children after low intensity laser therapy was due to its anti-inflammatory effect and improved patency of the small airways (13). Pulmonary rehabilitation program regularly include pursed lips breathing retraining as a standard part of patient education program .Pursed lips breathing ,by creating an obstruction at the lips, increase the pressure in the mouth which is reflected backwards into the tracheobronchial tree. It is assumed that this increase in intraluminal pressure diminishes airway collapse (19).It has been reported that the relief from dyspnea provided by PLB is related to its ability to promote a slower and deeper breathing (10).

Mueller et al evaluated the effect of PLB on PaO_2, $PaCO_2$ and oxygen saturation (SaO_2) in COPD patients at rest and during exercise (20).The impact of PLB on the breathing pattern seems to be positive, both at rest and during exercise, because it promotes prolonged expiration with a decrease in end-expiratory lung volume (EELV), leading to lower breathing frequency and higher tidal volume; the end result is an improvement in ventilatory efficiency (21). PLB can be said to cause a change in the pattern of respiratory muscle recruitment, increasing recruitment of the accessory muscles of the chest wall and increasing abdominal muscle activity throughout the entire respiratory cycle while, at the same time, decreasing diaphragmatic muscle recruitment. All these changes lead COPD patients to breathe more efficiently and consume less oxygen; as a result, the propensity of the diaphragm to become fatigued during crises or physical exercise decreases (22-23).

Jones et al studied oxygen consumption and the clinical implications of having COPD patients perform breathing exercises (including PLB). Compared to spontaneous breathing, oxygen consumption was significantly reduced in all of the breathing patterns studied: diaphragmatic breathing (DB), PLB, and a combination of DB and PLB. PLB resulted in the lowest oxygen consumption, followed by DB and then the combination of PLB and DB. Based on their results, the authors suggested that

COPD patients be taught to use breathing patterns that consume less oxygen in order to minimize the metabolic demand of respiration (22).

Pulmonary rehabilitation programs involve upper and lower limbs exercise, usually treadmill or bicycle ergometer can increase walking distance and health related quality of life in people with asthma (24). Participation in physical activity is an important part of a child's normal psychosocial development and self image. Physical activity is especially important in children with asthma, activities such as running and bicycling are associated with improved fitness and decreased severity of asthma symptoms (9). Exercise rehabilitation improves aerobic fitness in both asthmatics and normal participants. Additional benefits of improved ventilatory capacity and decreased hypercapnea of exercise occurred in patients with mild asthma (6). Exercise training may reduce the perception of breathlessness through a number of mechanisms includes strengthening of respiratory muscles (25).Supervised aerobic training program for two months, three sessions every week for thirty minutes per session in children with moderate to severe stable asthma improved their cardiorespiratory fitness .Also; exercise training reduced the daily use of both inhaled and oral steroids (26).

Laser acupuncture therapy added to aerobic exercise training and pursed lips breathing is of value in clinical management of asthmatic children.

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