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Original Research Article

LASER PUNCTURE THERAPY VERSUS INTERFERENTIAL THERAPY AS A COMBINED TREATMENT IN ASTHMATIC EGYPTIAN CHILDREN: COMPARISON OF TREATMENT APPROACHES

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ABSTRACT

Background: Asthma is a complex and multifaceted condition causing significant impairment of physical and psychosocial well-being in the affected individual. This study aimed to compare laser puncture therapy or interferential therapy added to diaphragmatic breathing exercise in the treatment of asthmatic children.

Materials and Methods: Thirty Egyptian children suffering from asthma participated in this study. Their age ranged from 9-15 years. They had normal body mass index ranged from 18.5 to 24.9 kilogram/ meter^2. They were divided randomly into three groups. Group (I) received diaphragmatic breathing exercise. Group (II) received Laser puncture therapy combined with diaphragmatic breathing exercise. Group (III) received Interferential therapy combined with diaphragmatic breathing exercise. Pulmonary functions were measured before and after interventions for all children in the three groups.

Results: Comparing the pre and post treatment mean values of the measurable variables revealed significant improvements in pulmonary functions after the treatment in the three groups with favor to laser puncture therapy group.

Conclusion: It may be concluded that the laser puncture therapy has a highly significant impact as compared with interferential therapy in the asthmatic children.

KEY WORDS: Asthma, Pulmonary, Laser, Interferential, diaphragmatic breathing, exercise.

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INTRODUCTION

Asthma is a chronic inflammation in respiratory organs. Subjects suffering from asthma had airway hyper responsiveness and reversible airflow obstruction. They were manifested by recurrent episodes of wheezing, breathlessness, chest tightness and coughing, particularly at night or in the early morning [1,2].

The prevalence of bronchial asthma is 6% in adults and 10% in children [3]. In Egypt, its prevalence was 7.7% [4]. Asthma has three characteristic features namely intermittent reversible inflammation, obstruction and hyper responsiveness for airways [5]. The airway inflammation is a complex process that can involve a progression from acute events such as allergen-induced activation of mast cells to release pro-inflammatory cytokines and mediators, leading to acute bronchoconstriction and airway obstruction, to chronic inflammation in which the

changes in the airway cause not only airway obstruction but also an increase in airway responsiveness [6]. Asthmatic airway obstruction can be caused by a variety of changes including acute bronchoconstriction, airway edema, and chronic mucous plug formation as well as structural changes including the hypertrophy and hyperplasia of the airway smooth muscle [7-9]. Bronchial hyper reactivity in asthma results in airway narrowing which leads to variable airflow limitation and intermittent symptoms. Different mechanisms were mentioned to interpret the exaggerated bronchoconstriction in asthmatic patients. One of them is the direct stimulation of airway smooth muscle. Also, there was indirect stimulation by pharmacologically active substances from mediator- secreting cells such as mast cells or not myelinated sensory neurons that may be sensitized by inflammation [10].

The long standing chronic and allergic airways inflammation leading to mucus gland and goblet cell hyperplasia, airway smooth muscle cells hypertrophy and hyperplasia, vascular hyperplasia, sub epithelial fibrosis and collagen deposition in the airway [5,11]. Furthermore, small airway obstruction leads to ventilation-perfusion mismatch, potential hypoxemia and pulmonary atelectasis, hyperinflation of lung and thorax, increased work of breathing, changes of elastic recoil alteration of respiratory muscle function, ventilation/ perfusion inequality with altered arterial blood gases, decreased expiratory airflow, increased lung volume and airway resistance that lead to the decrease of forced expiratory volume at first second (FEV1), increased lung volumes, residual (RV), functional residual capacity (FRC) and total lung capacity (TLC) [12-14]. Also, there were persistent inspiratory intercostals, accessory muscle activity during expiration, abdominal muscle recruitment leading to chest wall configuration that tends to optimize diaphragmatic function [15].

Inhaled steroids are an effective treatment that yields reduced asthma symptoms, better lung function, reduced bronchial response, fewer asthma attacks, improved health related quality of life, and a reduced risk of death from asthma [16]. Also, pre-medicating with beta-2 agonists and/or sodium cromoglycate (Lomudal) before the physical exercise can reduce or prevent exercise-induced breathing difficulties [17, 18]. Physical therapy has an effective role in the rehabilitation of asthmatic patients. The rehabilitation techniques include self- drainage, ventilation patterns and recommending therapeutic exercises [1]. Laser puncture therapy was added to approaches used in management for asthmatic children. It has a significant impact in improving pulmonary functions in these children [19]. Also, it was found that the interferential therapy promotes most of the pulmonary functions [20]. This study aimed to compare two types of therapy added to diaphragmatic breathing exercise in the treatment of asthmatic children.

SUBJECTS, INSTRUMENTATIONS AND PROCEDURES

Subjects: Thirty children (23 boys and 7 girls) conducted to this study. They selected from the Abu El Reish pediatric hospital according to the following criteria:

1. They were diagnosed with mild to moderate persistent asthma according to the severity of classification of GINA guidelines 2010 [22].
2. Their age ranged from 9 to 15 years.
3. They had no history of other disorders (pulmonary, cardiovascular or skin) or associated musculoskeletal deformities.
4. They had normal body mass index (BMI): range from 18.5 to 24.9 kilogram/ meter^2 (kg/m^2) [21].
5. The children had abnormal ventilatory functions above 60% of normal predicted values that were based on age, sex and height for each child.
6. All children were controlled and on long term medical treatment of asthma and following up in the Allergy Clinic.

They were divided randomly into three groups that are equal in number. They were matched regarding age, sex, age and the degree of asthma severity. Group I: control group: included 10 children (7 boys and 3 girls) with mean age ranged from 10.91 ± 2.29 years and BMI ranged from 18.57 ± 1.18 kg/m2. Group II: Laser puncture group: included 10 children (8 boys and 2girls) with mean age ranged from 10.26 ± 1.32 years and BMI ranged from 18.41 ± 2.42 kg/m2. Group III: Interferential therapy group: included

10 children (8 boys and 2 girls) with mean age ranged from 9.67 ± 2.45 years and BMI ranged from 20.08 ± 2.30 kg/m2.

The study was approved by an Ethics Committee of the Cairo University. Written approval and Volunteer Information Sheet were authorized to Child's parents. All information about the aim of the study, its benefits and risks and their committee with regard to time and money were mentioned in these forms.

Instrumentations:

For evaluation:

Spirometer: Spirometer (Master Screen Paed) device made in Germany (serial number 51567-1715000) was used to measure several lung volumes e.g. FVC, FEV1, and FEV1/FVC.

Tape measurement: It was used to determine the height of the child in centimeters (cm).

Weight scale: It was used to determine the weight for every child in kilograms.

For treatment

The endolaser 467 apparatus (Enraf Noius CO.): It was used to provide laser puncture therapy (type: Gallium-aluminum arsenide, penetration: 6-8 mm, power: 10-90 mw, wave length: 632.8, 820, 830 or 904 nm and wave form: continuous, pulsed: 1- 4000 Hz).

Interferential Uniphy guidance apparatus (S.N.65244): It was used to provide interferential therapy.

Procedures

For evaluation

The body mass index (BMI): The tape measurement was installed on the wall by using pins. The stature was determined as the vertical distance between the floor and the top of the head and measured with the subject standing erect against the wall and looking straight ahead [22]. After the stature of the child's had been measured, the child was asked to stand on a weight scale to determine his weight in kilograms. The BMI was calculated as the ratio of the subject's height (in meter) and weight (in kilogram) i.e. weight/ height2. The normal child's BMI value should range from 18.5 to 24.9 kg/ m^2 [21].

Ventilatory function parameters: All children included in the study were conducted to ventilatory function testing before receiving chest physical therapy programs and then after successive three months for the three groups. Ventilatory function testing was carried out by using spirometer device. Before starting, it was clearly illustrated to each child that all tests were done in sitting position; each child was relaxed, wearing loose- fitting clothes with no belt that may make it harder to him/ her to breath. The patient should not have eaten heavily within three hours of the test. The physical therapist should explain and demonstrate the breathing maneuvers to the patient. A nose clip was applied and the patient closed his lips around the mouth piece. The patient was instructed on how breath during the procedure. Three breathing maneuvers were practiced before recording the procedure and the highest of three trails was used for evaluation of breathing. This procedure measure air flow by electronic or mechanical displacement principles and use a microprocessor and record to calculate airflow.

The spirometery system fed up with the child data including name, age, sex, height in meter and weight in kilogram then automatically calculated the predicted normal values for the ventilatory function parameters from the regression equation. The patient should practice breathing into the mouthpiece until he or she was able to duplicate the maneuvers successfully on two consecutive attempts. Each test was repeated three times the best result was chosen for the following parameters:

i- Forced Vital Capacity (FVC): after breathing out normally to full expiration, the child was instructed to breathe in with a maximal effort and then exhale as forcefully and rapidly as possible.

ii- Forced Expiratory Volume in the First Second (FEV1)

iii- Forced Expiratory Volume in the First Second (FEV1)/ Forced Vital Capacity (FVC).

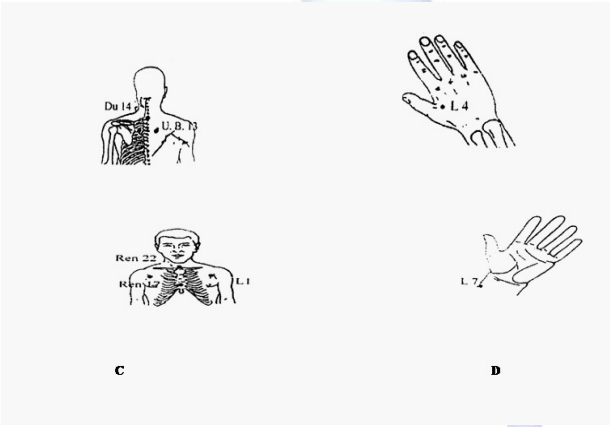
For treatment:

Diaphragmatic breathing exercise for group I: Each child in group I was received diaphragmatic breathing exercise as the following procedures: The child assumed comfortable and relaxed neck and shoulder muscles (half lying,

sitting or standing position to practice this type breathing). The therapist was placed one hand on upper chest and the other hand at the bottom of ribs, just above waistline (hands were used to feel the movement as breath). A breath in was taken through nose and felt hand on stomach moved outward (did not let shoulders moved up). He/she was expired S-L-O-W-L-Y and gently through mouth pursed lips as if he/she was going to whistle or blow out a candle. The hand on stomach moved in as breath out. The child may need to pull in stomach muscles at first to help diaphragm to move up. He/she exhaled or breathed out at least twice as long as inhale or breathe in. He/she was practiced diaphragmatic breathing for at least 10 to 15 minutes, three times per week and for three months. Rest was needed between breaths.

Laser puncture therapy for group II: Each child in group II was received diaphragmatic breathing exercise and laser puncture therapy. The puncture points for respiratory system disorders were Zhongfu (L.1), Shanzhong (Ren 17), Tiantu (Ren 22), Feishu (U.B. B), Dazhui (Du 14), Lieque (L.7) and Heagu (L.I.4) as illustrated in fig (1), [19& 23]. The child assumed comfortable and relaxed position. Each puncture point of the respiratory system disorders received laser for 90 seconds, three sessions per week for 3 months.

Fig. 1: The puncture points for the respiratory system disorders.



Interferential therapy for group III: Each child in group III was received diaphragmatic breathing exercise and interferential therapy. They were placed in a half lying position. Two electrodes were positioned over the upper limits of the trapezius bilaterally on the upper back, and the other two electrodes were placed anteriorly over the lower ribs. Using a 4,000 Hz base current, the interferential current range was set from 10 to 150 Hz and participants received the therapy for 20 minutes per session, three times a week for three months [24,25].

Statistical analysis: The mean value and standard deviation were calculated for each variable measured during the study for both groups. Comparing mean values of each parameter in each group were be done by paired t-test. It was considered significant as $p < 0.05$. Analysis of variance (ANOVA) was used to compare the results post treatment among the three groups of the study. It was considered significant as $p < 0.001$.

RESULTS

Comparing the pre-treatment and post treatment mean values of the each variable (FVC, FEV1 and FEV1/FVC) in each group revealed significant differences as ($p < 0.05$), table (1).

Table 1: Pre and post treatment mean values of FVC, FEV1 and FEV1/FVC for all groups.

Item			$\bar{X}$ ±SD	MD	Percentage of improvement	t value	P Value
Group I (control)	FVC	Pre treatment	2.07 ± 0.31	0.38	18.36%	16.73	0.000*
		Post treatment	2.45 ± 0.29				
	FEV1	Pre treatment	1.72 ±0.43	0.5	29.07%	14.91	0.000*
		Post treatment	2.22 ±0.42				
	FEV1/FVC	Pre treatment	82.32 ±4.36	5.63	6.84%	21.69	0.000*
		Post treatment	87.95 ±3.83				
Group II (Laser puncture)	FVC	Pre treatment	2.05 ± 0.31	1.14	55.61%	16.4	0.000*
		Post treatment	3.18 ± 0.30				
	FEV1	Pre treatment	1.67 ±0.21	1.19	71.26%	22.26	0.000*
		Post treatment	2.86 ± 0.25				
	FEV1/FVC	Pre treatment	81.56 ±4.89	14.02	17.19%	13.88	0.000*
		Post treatment	95.57 ±2.51				
Group III (interferential therapy)	FVC	Pre treatment	1.98 ± 0.49	0.83	41.92%	10.91	0.000*
		Post treatment	2.80 ± 0.45				
	FEV1	Pre treatment	1.67 ±0.35	0.86	51.50%	10.46	0.000*
		Post treatment	2.53 ±0.29				
	FEV1/FVC	Pre treatment	82.53 ±4.34	8.96	10.85%	15.96	0.000*
		Post treatment	91.50 ±3.31				

$\bar{x}$: Mean. SD: Standard Deviation.
MD: Mean difference ,t value: Paired t-value.
P value: Probability value. *: Significant.

Analysis of variance revealed that there was no significant difference among the three groups for pre treatment values while there were significant differences among the three groups for post treatment values, table (2). Post-hoc test was performed to determine the difference between the three groups in the post treatment mean values of the measured variables, table (3). The result was represented at 0.05 levels. There were significant differences for FVC, FEV1 and FEV1/FVC between groups I and II, between groups I and III and between groups II and III.

DISCUSSION

Table 2: ANOVA among the three groups for FVC, FEV1 and FEV1/FVC.

Item			SS	MS	F	P value
Pre treatment	FVC	Between groups	0.05	0.025	0.178	0.838
		Within groups	3.833	0.142		
		Total	3.883			
	FEV1	Between groups	0.017	0.009	0.072	0.93
		Within groups	3.167	0.117		
		Total	3.184			
	FEV1/FVC	Between groups	5.293	2.647	0.129	0.88
		Within groups	555.82	20.586		
		Total	561.116			
Post treatment	FVC	Between groups	2.666	1.333	10.607	0.000*
		Within groups	3.393	0.126		
		Total	6.059			
	FEV1	Between groups	2.004	1.002	9.26	0.001*
		Within groups	2.922	0.108		
		Total	4.926			
	FEV1/FVC	Between groups	290.865	145.432	13.675	0.000*
		Within groups	287.152	10.635		
		Total	578.016			

SS: Sum of square MS: Mean square.
P: probability. *: Significant.

Table 3: Post hoc test among the three groups for FVC, FEV1 and FEV1/FVC.

Item			MD	P value
Post treatment	FVC	Group I vs group II	0.73	0.000*
		Group I vs group III	0.35	0.036*
		Group II vs group III	0.38	0.024*
	FEV1	Group I vs group II	0.633	0.000*
		Group I vs group III	0.305	0.048*
		Group II vs group III	0.328	0.034*
	FEV1/FVC	Group I vs group II	7.621	0.000*
		Group I vs group III	3.546	0.022*
		Group II vs group III	4.075	0.009*

MD: Mean difference P value: Probability value.
*: Significant.

The aim of this study was to compare two treatment protocols in the management of asthmatic children. It was compared the pulmonary functions in asthmatic children received Laser puncture therapy combined with diaphragmatic breathing exercises to those who received interferential therapy combined with diaphragmatic breathing exercises. The children's age ranged from 9 to 15 years which was confirmed by Hossny et al., 2009 who stated that the incidence of asthma in Egyptian children aged 3-15 years was estimated to 8.2% [25].

The results demonstrated that there were significant post treatment improvements in pulmonary functions (FVC, FEV1, and FEV1/FVC) for the control group (received diaphragmatic breathing exercises only), group II (Laser puncture combined with diaphragmatic breathing exercises) and group III (interferential therapy combined with diaphragmatic breathing exercises).

The results also showed there were significant improvements in pulmonary functions (FVC, FEV1, and FEV1/FVC) for children received Laser puncture therapy combined with diaphragmatic breathing exercises than those who received interferential therapy combined with diaphragmatic breathing exercises. Also, it showed that there were significant improvements in pulmonary functions (FVC, FEV1, and FEV1/FVC) for children received interferential therapy combined with diaphragmatic breathing exercise than those who received diaphragmatic breathing exercise only.

Asthmatic children often develop a shallow rapid respiratory pattern as they are using accessory muscles of inspiration rather than diaphragmatic deep respiratory effort. Expiratory obstruction may cause expiration which is passive; to be active through using abdominal muscles, this eventually leads to decreased regional ventilation with many small areas of atelectasis of lower lobes of the lung [26]. The results of this study showed that there were post treatment improvements in diaphragmatic breathing group. It came in agreement with Tecklin [26], who showed that deep breathing retraining is essential to asthmatic children, since breathing in an asthmatic patient is of the thoracic type and since dyspnea can cause the asthmatic patient to increase inspiration further, leading to more overextension of the already over inflated lungs. This is then worsened by the increased dead space ventilation, metabolic requirements and a tendency to maintain a low arterial partial pressure of oxygen.

Respiratory training promotes asthma specific health status and other patient centered measures. It helped patients whose quality of life was impaired by asthma and reduce the need for anti-inflammatory medications [19,27]. The results obtained in this study showed that there were post treatment improvements in the laser puncture therapy group. It came in agreement with Mahmoud [19], who concluded that

a combination of laser puncture therapy with standard asthma was effective than drug therapy alone. It was due to its anti-inflammatory effect and improved patency of the small airways. Also, positive effects of laser treatment in patients with bronchial asthma are achieved in a short time and tend to have a prolonged effect (several weeks, even months) in both lung functions and gas exchange parameters. Successive laser stimulation in asthmatics prolonged periods of remission and decreased the severity of asthmatic attacks [28]. Laser puncture therapy had an effective action on bronchial patency, displayed an immune-correcting action and it is recommended in attack free periods in children [29].

The results of this study also showed that there was post treatment improvement in the interferential therapy group. It was confirmed by Shuto et al., [30] who reported that there was a significant effect of interferential therapy on the pulmonary functions for the asthmatic patients. Also, the improvements in pulmonary functions in asthmatic patients received interferential therapy had significant increases in their asthma control test and the quality of life [20].

CONCLUSION

It was concluded that both laser puncture therapy and interferential therapy were effective interventions for asthmatic children when they were combined with diaphragmatic breathing exercises. These treatment protocols promote the pulmonary functions in these children. Also, it was concluded that the laser puncture therapy has a highly significant impact as compared with interferential therapy in the asthmatic children.

Conflicts of interest: **None**

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