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Effect of Laser Acupuncture on Inflammatory Markers and Chest Expansion in Children with Parapneumonic Effusion

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ABSTRACT

Background: Parapneumonic effusion and pleural empyema are the most common complications of community acquired pneumonia in children. Recently an increase in the incidence and severity of parapneumonic pleural effusion in paediatric populations has been observed. **Objective:** To detect the effect of laser acupuncture as a non-invasive anti-inflammatory treatment procedure on controlling the inflammatory markers and improving chest expansion in children complaining from parapneumonic effusion following acquired pneumonia.

Patients and methods: Thirty children with parapneumonic effusion as a complication of acquired pneumonia, ranging in age from 6 to 12 years were selected from El-Abbasia chest diseases hospital. They were randomly assigned into two groups of equal number (control and study groups 15 patient in each group) Patients in both groups were treated by selected chest physical therapy program while patients in the study group received an additional laser acupuncture intervention that was conducted 3 times per week for 2 successive months. Chest expansion and inflammatory markers were measured before and after the suggested treatment period.

Results: The results showed a statistically significant reduction of C-reactive protein (CRP) a significant increase in the mean values of chest expansion, while insignificant difference in the mean values of WBCs and Neutrophilia was recorded. **Conclusion**: Laser acupuncture therapy is an effective non-invasive physical therapy modality in treating children with parapneumonic effusion following the acquired pneumonia where it is added to conventional chest physiotherapy program alone

Keyword: Laser acupuncture, inflammatory markers, chest expansion, parapneumonic effusion.

INTRODUCTION

Pediatric community-acquired pneumonia (PCAP) is defined as the presence of signs and symptoms of pneumonia in a previously healthy child due to an infection, which has been acquired outside hospital, it is a leading cause of morbidity and mortality in children worldwide, with streptococcus pneumonia and mortality rate are significantly higher in developing countries than in the industrialized world **(1).**

Community-acquired pneumonia (CAP), the most common serious bacterial infection in childhood, it may be complicated by parapneumonic effusion empyema, necrotizing pneumonia, and lung abscess. Children with complicated pneumonia require prolonged hospitalization and frequently undergo multiple pleural fluid drainage procedures. Additionally, para-pneumonic pleural effusion and empyema are considered different stages of the same pathophysiological process in which pleural inflammation causes fluid to accumulate in the pleural cavity **(2)**.

Treatment failure in CAP may be due to antibiotic resistance as CAP is the first presentation of an underlying condition such as cystic fibrosis, immune-deficiency or congenital thoracic malformation (CTM). However, it is more usually because pulmonary complications to the initial infection have developed. These may be due to the accumulation of fluid, accumulation of air or Atelectasis, leading to pus formation (empyema) **(3)**.

Parapneumonic effusion is defined as fluid in the pleural space in the presence of pneumonia. It is a well-known complication of CAP, and it is a common clinical problem that frequently causes dyspnea and abnormal arterial oxygenation. Infections with Streptococcus pneumonia are the most common cause of this complication. The high frequency of pneumonia in children worldwide makes this local complication an important problem. Moreover, an increasing incidence of Parapneumonic effusion and Pleural effusion PPE/PE has been reported since 1990s **(4)**.

Pleural effusion causes reduction of chest expansion and leads to lung atelectasis, because the capacity of the thorax is limited and excess fluid causes the lungs to collapse so it is important to emphasize expansion of problems areas of the lungs and chest wall **(5)**.

Physical Therapy management of pleural effusion may include breathing exercises, localized chest expansion exercises, positioning, chest mobility

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exercises, which are effective in improving the mobility of the chest wall, trunk and incentive spirometer improves lung expansion and capacity [6].

A growing number of clinical studies are demonstrating the efficacy and safety of Low Level Laser Therapy (LLLT) as a non-invasive modality for different pulmonary diseases, as asthma and chronic obstructive pulmonary diseases (COPD). In addition, some studies have demonstrated that the application of LLLT for the treatment of patients with chronic obstructive bronchitis accelerates the elimination of clinical symptoms, promotes drainage function of the bronchi, facilitates standardization of the immune status of the patient, and contributes to the optimization of lipid [7]. Blood inflammatory markers (total white blood cells and neutrophils count, C-reactive protein) can be used as indicators of disease activity and as a signal of the severity of an exacerbation [8]. In pneumonia, the close proximity of infection and tissue damage in the lung parenchyma to the pulmonary circulation produces an immunological stimulus for systemic CRP synthesis. The CRP response that is mediated by cytokines would be expected to be greater in pneumonia cases where there is more tissue damage [9]. C- reactive protein (CRP), which is increased in the serum/plasma of patients with pneumonia is among the leading infection markers and plays a valuable role in the diagnosis of pneumonia. An increasing number of studies have reported that both serum and pleural CRP can play a role in diagnosis of parapneumonic effusion and differentiating between uncomplicated and complicated parapneumonic effusion in addition to Leukocyte count [10].

Ethical approval: approval of the Ethical Committee of the Faculty of Physical Therapy, Cairo University with number of 012/002112 was obtained. Every patient signed an informed written consent for acceptance of the study.

PATIENTS AND METHODS

Randomized control trail study that was conducted at Abbasia Chest Disease Hospital. Thirty children suffering from parapneumonic effusion and medically controlled, with age ranged from six to twelve years old of both sexes participated in the current study. They were divided randomly into 2 groups of equal number (15 patient in each) representing control and study groups respectively.

Control group subjected to a conventional chest physical therapy program CCPT, **and Study group that** received the same (CCPT) given to those in the control group in addition to laser acupuncture therapy.

Patients in both groups were treated at a frequency of 3 sessions per week for 2 successive months. Each child was evaluated before and after the suggested treatment duration to detect the inflammatory markers (C-reactive protein, total white blood cells count, and absolute neutrophils). In addition, chest expansion that was detected by using tape measurement.

Treatment procedures:

Conventional chest program given to patients in both groups: Program consisted of breathing exercises (Diaphragmatic breathing, segmental breathing using beltand incentive spirometer), chest mobilization exercises (mobilization of one side of the chest, mobilization of upper chest and stretch pectoralis muscles, and mobilization of upper chest and shoulders.

Laser acupuncture given to study group (B): Laser acupuncture device was applied on the lung acupuncture points that were determined according to the anatomical landmark shown as in (Fig. 1) for 90 sec for each point.

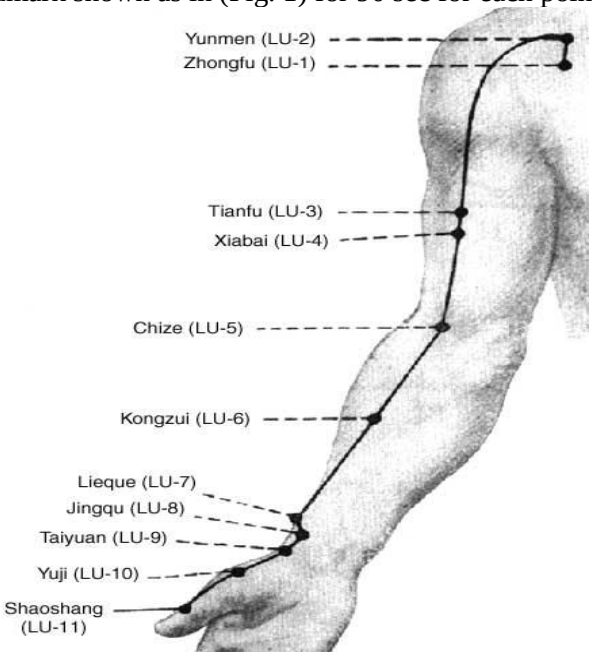

Figure (1): Laser acupuncture points.

Statistical analysis

Independent t-test was used to compare the post-treatment values of the two groups, and unpaired t-test for comparison between two groups. Paired t test was used to compare within group (pre- vs post-treatment) differences. Results were expressed as mean ± standard deviation or median (minimum and maximum). Statistical Package for Social Sciences (SPSS) computer program (version 23 windows) was used for data analysis. P value ≤ 0.05 was considered significant.

RESULTS

As shown in table (1), there was a statistically insignificant difference between both control and study groups regarding age, sex, weight and height of the subjects where P-values were > 0.05.

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

	Group A (n= 15)	Group B (n= 15)	Test Statistic	P value
Gender			**Chi-Square = 3.88**	**0.135 (NS)**
Male	**11**	**9**		
Female	**4**	**6**		
Age (yrs.)	**8.6 ± 2.4**	**8.23 ± 1.98**	**t-value = 0.941**	**0.353 (NS)**
Weight (kg.)	**27.53 ± 8.4**	**25.2 ± 7.9**	**t-value = -0.308**	**0.760 (NS)**
Height (m)	**130.24 ± 12.14**	**127.23 ± 11**	**t-value = -0.777**	**0.442 (NS)**

Data are expressed as mean ± SD. NS= p> 0.05= not significant.

Inflammatory markers including CRP showed a significant reduction in both control and study groups with percentage of 67% and 83% respectively in favour to the study group. The **Total WBCs**, in both groups was reduced with a percentage of 40.76% decrease in the control group and 56% in the study group. While the **Absolute Neutrophils Count (ANC)** decreased with percentage of 42.1% and 58% respectively in favour to the study group. **Chest expansion** improved in both groups with 49% increase in the control group and 63% increase in the study group (Table 2).

Table (2): Comparison between mean values of the selected measures of control and study group pre-treatment, and post-treatment

Measurements	Mean ± SD		Independent T-test	P-value
Group	**Control Group**	**Study Group**		
CRP Pre-treatment	**31.24 ± 6.328**	**36.433 ± 8.431**	**1.771**	**0.087 (NS)**
CRP Post-treatment	**10.2 ± 2.538**	**5.94 ± 1.706**	**3.122***	**0.004 (S)**
Percentage of improvement	**67.3%↓↓**	**83.7%↓↓**		
Mean Difference	**21.04**	**30.493**		
T-test	**3.021***	**3.239***		
p value	**0.001 (S)**	**0.001 (S)**		
Total WBC Pre-treatment	**11.625 ± 2.702**	**14 ± 3.829**	**1.666**	**0.107 (NS)**
Total WBC Post-treatment	**6.887 ± 1.589**	**6.153 ± 1.688**	**1.225**	**0.231 (NS)**
Percentage of improvement	**40.76%↓↓**	**56%↓↓**		
Mean Difference	**4.738**	**7.847**		
T-test	**2.549***	**3.283***		
p value	**0.001 (S)**	**0.001 (S)**		
ANC Pre-treatment	**6.7 ± 1.487**	**8.393 ± 1.958**	**1.551**	**0.132 (NS)**
ANC Post-treatment	**3.873 ± 0.102**	**3.487 ± 0.539**	**0.791**	**0.436 (NS)**
Percentage of improvement	**42.1%↓↓**	**58.45%↓↓**		
Mean Difference	**2.827**	**4.906**		
T-test	**2.15***	**2.589***		
p value	**0.001 (S)**	**0.001 (S)**		
Chest Expansion				
Pre-treatment	**1.56 ± 0.148**	**1.92 ± 0.15**	**1.352**	**0.187 (NS)**
Post-treatment	**2.327 ± 0.532**	**3.13 ± 0.305**	**8.849***	**0.006 (S)**
Percentage of improvement	**49%↑↑**	**63% ↑↑**		
Mean Difference	**0.767**	**1.21**		
T-test	**10.048***	**13.36***		
p value	**0.001 (S)**	**0.001 (S)**		

DISCUSSION

Children with parapneumonic effusion were selected in the current study because parapneumonic effusion occurs in 40% of children hospitalized with bacterial pneumonia and the rate of parapneumonic effusion (PPE) were noticed to increase in children [(11)].

Significant difference between control and study groups regarding CRP and increase in chest expansion in favour to the study group may be attributed to effect of laser acupuncture therapy that helped in controlling inflammation and improving of inflammatory markers. This is supported by **Rindge [(12)],** who reported that laser therapy has biostimulative and tissue regenerative properties as well as antimicrobial, anti-inflammatory and analgesic effects. Studies on its effects in respiratory diseases have shown improvement in both gas exchange and pulmonary function, as well as enhanced immunity and other health benefits. The results of the current study agree with **Levon [(13)]** who reported reduction of CRP after application of laser therapy and concluded that it was due to activation of nonspecific mechanisms of infectious immunity, intensifying antibacterial activity of serum and activation of phagocytosis diseases.

In the current study, there was a statistically significant difference in systemic inflammatory markers of study group B (laser acupuncture group) as C-reactive protein (CRP) was more than in the control group. This agrees with **Amany and Marwa [(14)]** who stated that the medical use of laser acupuncture has been occurring for decades, primarily in the area of tissue healing and inflammatory conditions. Mainly focusing on the concept of a non-invasive, non-thermal intervention of laser acupuncture. They found that there was efficacy of laser acupuncture as a non-pharmacological intervention that provide a valuable adjunctive or alternative treatment for chronic respiratory.

Improvement in chest expansion in both groups may be due to the effect of conventional physical therapy program. This is supported by the work of **Wing [(15)]** who concluded that physiotherapy has been proposed as a part of the treatment of pleural effusion regardless of the etiology. Various studies have suggested that patients with pleural effusion should be included in a respiratory physiotherapy program as early as possible.

Improvement of chest expansion in favour to the study group may be explained as laser acupuncture helped in reducing inflammation in lung, which help in re-absorption of effusion in lung leading to improvement in lung gas exchange, chest expansion and lung capacity and volumes. This agrees with **Milojevic *et al.* [(16)]** who concluded that patient with pleurisy undergoing laser stimulation presented with faster resorption of effusion and remission of the subjective symptoms. In addition, there was significant decrease of biochemical acute inflammation parameters in the peripheral blood and therefore faster recovery. In patients with pleurisy, laser treatment increases regenerative mechanisms of the pleural surface, thus decreasing the quantity of formed adhesions and resulting in better mobility of the diaphragm.

CONCLUSION

Adding laser acupuncture therapy to conventional chest physiotherapy program is recommended in treatment of parapneumonic effusion following community acquired pneumonia in children.

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