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Aerobic Exercises versus Laser Puncture Therapy on Immune Response Following Neck Lymph Node Dissection

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Abstract
Background: The treatment of head and neck cancers is still difficult and calls for a multidisciplinary strategy that includes surgery, radiation, chemotherapy, and systemic therapy.
Purpose: In the current academic work, the effects of aerobic exercise and laser puncture on immunological responses following neck lymph node removal were assessed and compared.
Subjects and Methods: After dissection of the neck lymph nodes, forty male cases with decreased total leukocyte counts and differential lymphocyte counts. They were sub-categorized into two equal groups randomly. Group (A) had two months treatment plan of 15 minutes per day, every other day, of aerobic exercise. Group (B) had a two-month treatment plan of 15 minutes per day, every other day, of laser puncture in the depression beneath the spinous process of C7 at Governor Vessel (GV - 14 Dazhui). Leukocyte total count and a differential lymphocyte count were utilized in the current work as evaluation techniques.
Results: The results demonstrated the effectiveness of both aerobic exercise training and laser puncture in the depression beneath the spinous process of C7 at Governor Vessel (GV - 14 Dazhui). However, aerobic exercise training was more successful and helpful in boosting the decreased immune response than the laser puncture.
Conclusion: The outcomes of the current academic work highlighted the fact that aerobic exercise is preferable, and low-level laser puncture is also crucial in boosting the immune response.
Keywords: Aerobic exercises; Laser puncture; Leukocytes; Differential count of lymphocytes; Immune response.

INTRODUCTION

This study aimed to trace and shed light on the influence of aerobic exercise and laser puncture on the immune response after neck lymph node dissection. The incidence of neck cancer is substantially higher in several regions of the world. 90% of cases with a history of smoking report that smoking, alcohol, nicotine, viruses, and heredity were major contributing factors to the development of their neck cancer [(1)].

Squamous cell carcinoma accounts for about 90% of neck cancer cases. Cancer suppressor genes are rendered inactive and proto-oncogenes are overexpressed in epithelial cells, which lead to the growth of tumor cells and distant metastasis. Cases with head and neck squamous cell carcinoma (HNSCC) have decreased dendritic cell (DC) and natural killer (NK) cell functions, elevated levels of immune-suppressive molecules, a loss of regulatory T cells, co-stimulatory molecules, and major histocompatibility complex (MHC) class I molecules, fewer lymphocyte subsets, and suboptimal response to antigen-presenting cells (1).

A deeper comprehension of the interplay between the immune system and HNSCC is needed in order to create successful immunotherapies, and innovative therapeutic alternatives should be developed in particular. An individual's white blood cell count can be impacted by certain cancer treatments, which can cause leukopenia. Chemotherapy and radiation therapy are two treatment plans that might have this impact [(2)].

The medication plan for individuals with squamous cell carcinoma (SCC) of the neck encompasses the treatment of the local lymph nodes. Often, medical treatment consists of several different interventions [(3)].

Neck dissection, or the excision of the neck's lymph nodes, was the surgical procedure followed to treat neck cancer. There are three main categories of neck dissection procedures: radical neck dissection, modified radical neck dissection, and selective neck dissection [(4)].

A spectrum of academic research papers has demonstrated that host cellular immunity is both qualitatively and quantitatively compromised when malignancies advance. According to recent research, immune deficiencies are linked to both cancer and its therapy, and blood immune function is positively correlated with cancer progression

Exercise is increasingly popular as an intervention for symptoms brought on by cancer treatment. Preliminary evidence suggests that exercise can enhance cancer survivors' blood immunological function, according to a new systematic review. Increased monocyte function, circulating granulocyte percentage, and natural killer (NK) cell cytotoxic activity are a few of the improvements that have been observed i.e., neutrophils, eosinophils, and basophils [(5)].

There has been a lot of attention lately on the connection between exercise and the immune system. By hemodynamic changes, exercise is thought to affect innate immunity, T and B cell activities, and cytokine responses. Exercises that are aerobic or "with oxygen" improve cardiovascular fitness [(6)].

The results of current randomized controlled trials on the benefits of moderate-intensity exercise are,

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however, ambiguous; in certain cross-sectional investigations contrasting exercisers with non-exercisers, variations in innate immune system components were found [(7)].

Light amplification through stimulated emission of radiation is referred to as laser. Studies have shown that laser therapy can speed up the inflammatory process, lessen discomfort, and encourage tissue healing. Laser therapy has also been shown to stimulate fibroblast proliferation, type I and type III procollagen mRNA synthesis, and wound revascularization [(8)].

A therapeutic laser was implanted to modify biochemical pathways and has been demonstrated to have a variety of intriguing impacts on immune function [(9)].

To trace the influence of low-level laser treatment (LLLT), numerous experimental and theoretical investigations have been carried out in the following domains: medicine, dentistry, dermatology, rheumatology, physiotherapy, and traumatology. It provides statistics on procedures performed with 200-ns pulsed GaAs diode lasers operating at a wavelength of 904 nm in various Italian health departments. These findings demonstrated that the laser pulse repetition rate is a crucial factor in determining whether a treatment is effective [(10)].

The study's objective is to evaluate and compare the effects of aerobic exercise and laser puncture on immunological responses following neck lymph node removal .

PATIENTS AND METHODS

The participants in this trial were 40 cases with post-neck lymph node dissection who also had blood-immune function deficiencies and were between the ages of 40 and 60. The chosen cases were sub-categorized into two equal experimental groups by random selection: groups 1 and 2. Each group encompassed 20 cases. The National Institute of Cancer provided the study's sample of outpatients, and every patient received the same level of postoperative care and medications.

Study design:

Group (1): Twenty cases with decreased white blood cell counts after neck lymph nodes and deficient in blood immunological functions made up this group. They underwent aerobic exercise training on a cycle ergometer. The cases received one 15-minute session, three sessions per week, for two months, with follow-up after the course of treatment.

Group (2): Twenty cases with underdeveloped blood immune systems; decreased white blood cell counts after having their neck lymph nodes removed, a low-level laser puncture was performed on the Governing Vessel 14 acupuncture point. They received a 15-minute session, three sessions per week, for two months, with follow-up after the course of treatment. Leukocyte total count and differential lymphocyte count measurements were completed before the intervention began as a first record and at the end of the second month of intervention as a final record.

Inclusion criteria:

All cases were checked carefully by a physician before the study procedures. All cases were approximately the same age. All cases were conscious. All cases in both groups obtained the same medications and they received three sessions per week for 2 months. All patients enrolled in the study had a deficiency in blood immune functions post neck lymph node dissection and received chemotherapy.

Exclusion criteria:

Patients with associated disease (other pathological conditions), patients suffering from metastases, patients taking medications that alter leukocytes count and pregnancy or epilepsy.

Measurement procedures:

The total number of circulating leukocytes (white blood cells) and the differential lymphocyte count were adopted in the current academic work to measure the immunological response in both groups. These were carried out two months after the start of treatment and before the first session: pre-treatment application and post-treatment after two months. The measurement steps were as follows:

Measurement of immune response:

The cases were seated when immune response was measured. Morning peripheral blood sample aspiration was followed by venous blood collection into sterile glass containers with the necessary anticoagulants and preservatives. A Coulter hematology analyzer **(Coulter Electronics, USA)** was used to perform differential counts of lymphocytes and the total leukocyte count.

Treatment procedures: The following steps were adopted to complete the treatment procedures: When a patient comes in for treatment, they were given a thorough explanation of the procedures' goals as well as their physiological and therapeutic advantages.

Cycle ergometer treatment protocol (Group 1):

The case was lying back in a comfortable position on the stationary bike ergometer when the exercise test was conducted. The exercise test began with a 3-minute warm-up session of unloaded cycling on a cycle ergometer, and then progressed at a rate of 10 W per minute up to the subject's threshold. After cycling for 30 W to warm up, the intensity was raised by 15 W every 60 seconds until fatigue, after which the individuals cycled for 30 W to cool down. This treatment protocol was administered to each patient 3 times/week for a total of 15 minutes of treatment, broken into intervals of two to three minutes each.

Low-level laser treatment protocol (Group 2):

The laser probe was administered using the contact approach on the dorsal midline, in the depression below the spinous process of C7 at Governor Vessel, with the patient seated in a chair with back support (GV – 14 Dazhui). The primary power switch was activated. The following settings were used for applying laser puncture: 5 mW, the maximum average power. Type of laser: gallium arsenide (Ga-As), 904 nm wavelength, 5 kHz maximum repetition rate - Program: Maintaining programs for people who had their neck lymph nodes removed and have a low leukocyte count, up to 30 J/cm^2 of energy, a 2 J/cm^2 energy density, and protective glasses were required to prevent irreversible eye injury from either direct or indirect laser exposure. The treatment took place for 15 minutes.

Ethical Approval:

The Physical Therapy Research Ethical Committee at Cairo University in Egypt approved the study with No. (P.T. REC/012/004069) and the patients were given all the information they need about the trial. After being fully informed, each study participant gave his(her) signed consent. The conduct of this study was governed by the Declaration of Helsinki, the World Medical Association's rule of ethics for human research.

Data analysis

Data were entered into a computer for statistical analysis *that* was performed using the Statistical Package for the Social Sciences (SPSS) version 25 for Windows (IBM SPSS, Chicago, IL, USA). An unpaired t-test was applied to compare age, duration of diabetes, and the results between the 2 groups. Pre- and post-treatment data were compared in each group using a paired t-test. The significance level for all statistical tests was set at $p < 0.05$

RESULTS

As recorded in the result the range value of the second record of LTC in aerobic group was 500.0 mm^3. while in laser therapy group was 400.0 mm^3..

The range value of the second record of LDC in aerobic group was 750.0 mm^3. while in the laser therapy group was 300.0 mm^3.

As highlighted in table (1), the mean value of the LTC before intervention in each of the first and second study groups was highly significantly increased after treatment.

Table (1): Comparison of the mean values of the leukocyte total count (LTC)/mm^3 before and after treatment in the 2 study groups

	Before treatment		After treatment		Mean difference	T-value	P-value
	Mean	SD	Mean	SD			
First study Group Aerobic exercises application(N=20)	3600.0	161.5	4780.0	132.6	-1180.00	-25.25	0.0001
Second study Group (Laser puncture application)(N=20)	3604.0	124.6	4630.0	155.2	-1026.00	-23.05	0.0001

As depicted in both table (2) , the mean value of the lymphocytes differential count (LDC)/mm^3 before treatment, in each of the first study group (Aerobic exercises) and the second study group (Laser puncture group), was highly significantly increased after treatment.

Table (2): Comparison of the mean values of the LDC in mm^3 before and after treatment in the 2 study groups

	Before treatment		After treatment		Mean difference	T-value	P-value
	Mean	SD	Mean	SD			
First study Group (Aerobic exercises)(N=20)	1330.0	95.15	2400.0	169.36	1070.00	29.74	0.0001
Second study Group (Laser puncture)(N=20)	1325.0	98.0	2105.0	105.0	295.000	6.62	0.0001

DISCUSSION

The current academic work found that aerobic exercise and low-level laser puncture effectively increased the decreased immune response in cases following neck lymph node dissection, but aerobic exercises are crucial. The outcomes of the current study depicted the idea that there was a crystal-clear increase in the scores of the 2nd record of both of LTC/mm^3 and LDC (after 2 months of treatment) compared to the 1st record (before treatment) in each of the studied groups.

Comparison between means of the first pre-treatment records of LTC and LDC in the 2 groups revealed that there was a non-significant disparity in the first pretreatment records of LTC and LDC, between the first and second study groups ($P > 0.05$).

While comparing the means of the second records of LTC in the 2 groups showed a noticeable increase in the second records of LTC, between the second study and the first study groups ($P < 0.002$).

A comparison between the means of the second records of LDC in the two study domains revealed a marked increase in the second records of LDC, between the first experimental and the second experimental groups ($P< 0.0001$). The outcomes of this study support the expectation that adopting both aerobic exercises and laser puncture had a valuable impact and equivalent in increasing the LTC and LDC in cases of the decreased immune response following neck lymph node dissection.

Noticed disparities, between the first experimental (Aerobic exercise training) and the second experimental (Laser puncture application), go in line with those explored and recorded by **Chan *et al.* [11]; Chubak *et al.* [12]; Balducci *et al.* [13]; Barrett *et al.* [14]; Broman-Fulks and Storey, [15]; Chon *et al.* [16]; Jang *et al.* [17]; and Whittaker, [18]**.

On one level, the results of this study corroborated those of **Chan *et al.* [11]**, who discovered that even without dietary restriction, aerobic exercise increases work capacity, improves cardiorespiratory fitness, improves ventilatory muscle endurance, boosts immune function, and results in favorable changes in body mass and composition. Many modalities were used during the aerobic conditioning part of the exercise sessions, including treadmills, lower-extremity ergometers, arm ergometers, and combined upper and lower ergometers. Aerobic exercise treatments include walking on a treadmill or track, cycling in an upright or recumbent position, rowing, stair climbing, using an elliptical trainer, and using an arm ergometer.

On another level, the outcomes of this study supported those of **Chubak *et al.* [12]**, who showed that the impact of aerobic exercise on the immune response after neck lymph node dissection has been discussed in the medical literature for years. Cancer patients also develop functional deficits as a result of their treatment. Also, individuals experience serious issues with their physical health and activities of daily living (ADL), which negatively affect their quality of life.

Exercise-induced increases in immune function (such as neutrophils, monocytes, eosinophils, and lymphocytes) are followed by a decrease below pre-exercise levels that can last anywhere between one and three hours, according to research by **Balducci *et al.* [13]**. It has been proposed that physical activity level and immune function have an inverted J-shaped dose-response relationship. While vigorous exercise, overtraining, or high-intensity activity might suppress the immune system and make people more susceptible to upper respiratory infections, moderate physical activity strengthens the immune system.

Similar to this, **Barrett *et al.* [14]** discovered that the available evidence regarding the benefits of moderate-intensity physical activity from randomized controlled studies is inconclusive; however, differences in innate immune system components were observed in some cross-sectional studies comparing exercisers with non-exercisers. The results of this study supported those of **Broman-Fulks and Storey's [15]** research, which demonstrated that increasing physical activity is associated with good epidemiological evidence for a decreased risk of various malignancies. With potential connections for prostate, endometrial, and lung cancer, colorectal and postmenopausal breast cancer has the strongest supporting data.

Low-intensity laser radiation is now the cornerstone for the conservative treatment of a range of musculoskeletal, neurological, and soft tissue diseases all around the world, according to **Chon *et al.* [16]**. The anti-inflammatory, analgesic, and anti-oedematous effects of LLLT on tissues are its bio-stimulating impact. The microcirculation has increased significantly, and this has led to faster rates of ATP, RNA, and DNA production as well as better tissue feeding and oxygenation.

According to **Jang *et al.* [17]**, the GV (Governor Vessel) and the Ren (Conception Vessel) Channels, which make up the majority of the acupoints, are dispersed along the 12 regular channels as well as the 14 acupoints, also known as the "regular points," of the 14 channels. The points with regular names and regular positions but not part of the aforementioned 14 channels is considered extraordinary.

According to **Whittaker *et al.* [18]**, maintaining optimum health necessitates that the predetermind subterranean pathways of body's energy is in equilibrium. A disruption in this flow, on the other hand, causes an energy imbalance, either an excess or a deficiency, which in turn leads to illness. By stimulating particular sites along the pathways, acupuncture aims to control and restore energy balance and so treat the condition. Adopting both aerobic exercise training and laser puncture had prominent effects on the immune response following neck lymph nodes dissection, as evidenced by the highly marked increases in LTC and LDC, it can be claimed after the discussion of the results and in accordance with reports of the previous researchers in fields related to this study. The laser

puncture was effective, but aerobic exercise training was more effective.

=Significance of the study: The need for the current academic work is linked to complication of neck lymph nodes dissection surgery, which is a major procedure followed by chemotherapy that impairs immune cell function. Subsequently, the advantages of this study are directed at solving this issue and will help in determining the best physical therapy approach. There is disagreement about the facts regarding physical therapy's ability to enhance immune cell activity. In order to better understand how aerobic exercise and laser puncture therapy affect immune cell activity after neck lymph node dissection, this study was done.

CONCLUSION

When there is a reduced immune response after neck lymph node dissection, both aerobic exercise and laser puncture have a crystal-clear impact and increase the LTC and LDC in a manner that is virtually similar.

DECLARATIONS

- **Consent for publication:** I attest that all authors have agreed to submit the work.
- **Availability of data and material:** Available
- **Funding:** No fund
- **Conflicts of interest:** no conflicts of interest.

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