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Effect of Low-Intensity Laser on Blood Pressure, Serotonin and Cortisol

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ABSTRACT: *Low-intensity laser therapy (LLLT) is characterized by its ability to induce athermic, nondestructive photobiological processes. In recent decades, LLLT has been used for the treatment of various disorders. The aim of this study was to examine the effectiveness of LLLT on blood lipid fractions and serotonin and cortisol levels. A laser, 100 mW, wavelength 660 nm, was used to irradiate the right radial artery in the pulse region in 10 patients for 10 consecutive days. Samples of blood were collected before and after treatment. Blood pressure was measured for 10 consecutive days before and after laser therapy. The results showed significant differences in the levels of serotonin, triglycerides, LDL and VLDL after LLLT. There was a reduction of blood pressure, cholesterol and increase of HDL after laser therapy, however, the differences were not significant. Cortisol levels remained stable after treatment. Low-intensity laser byincreasingtheamountofserotoninmaybepromising in the treatment of depression and pain relief, as well as canbeused in cases of hypercholesterolemia by reducing lipid fractions.*

KEYWORDS*: Low-intensity laser, Triglycerides, Cholesterol, Serotonin****.***

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I. INTRODUCTION

Low-intensity laser therapy (LLLT) hasbeen used for over 40 yearstotreatinjuriedtissues, inducethecellproliferationandlessenthepain[1]. Animportantarea for verifying the feasibility of using low-intensity laser isthe cardiovascular system, which several diseases can betreated. The use of this device may cause hemodynamicseffects, verifying vascular modifications and changes in end othelialcells[2].

Previous studies have shown that LLLT promoted improvement in diseases of the cardiovascular system such as changes numbers of erythrocytes in elderly patients with coronary heart disease [3], decrease in blood viscosity and platelet aggregation [4], reduction in total infarct size, decrease in inflammation and increase in tissue repair in animals [5], increased oxygen content and stimulates microcirculation in blood and decreased arterial pressure of patients with pre-hypertension[6] and Spontaneously Hypertensive Rats[7], elimination and prevent atherosclerotic alterations in the vessels [8]. It also stimulates the increase of serotonin production and the reduction of cortisol, which decrease the pain [9-11].

The Intravascular Laser Irradiation of Blood (ILIB) laserapplied transcutaneously, with wavelength 660 nm and red light, reaches sufficient depth to irradiate the arteries, so that all blood stream receives this photon energy and its beneficial effects. Based on what has been exposed and considering that studies with ILIB in humans are limited, this study aims to evaluate the effects of modified LLLT on blood pressure, lipid fractions and serotonin and cortisol levels.

II. METHOD

Three men and seven women, aged from 18 to 60 years, participated in this study. All subjects provided written informed consent and agreed to participate in the study. Participants had none of the following exclusive conditions: diabetes dependent on insulin or oral hypoglycemic medication; known cardiovascular disease such as cardiac arrhythmias and congestive heart failure; cardiac surgeries such as cardiac bypass, heart

transplant surgery, or pacemakers; excessive alcohol consumption (more than 21 alcoholic drinks per week); prior surgical intervention for body sculpting/weight loss, such as liposuction, abdominoplasty, stomach stapling, lap band surgery; pregnant; serious mental health illness such as dementia or schizophrenia; depression; chronic pain; developmental disability or cognitive impairment that would preclude adequate comprehension of the informed consent form and/or ability to record the necessary study measurements.

Procedure

The research site, including blood collection, application of questionnaires and laser therapy session was the Laboratory of Welfare of the Federal University of MatoGrosso do Sul, in the city of TrêsLagoas, state of MatoGrosso do Sul, Brazil.

For blood collection for serotonin dosing, volunteers will remain forty-eight hours prior to the day of collection without eating: avocado, banana, eggplant, nuts, pickles, tomatoes, pineapples, plums, mussels, chocolate, dried fruits, goji berry, kiwi, coffee, tea, mate, soda, flavored foods with vanilla and alcoholic beverages. They also will not be able to practice any type of physical activity, including sexual activity for at least twenty four hours before the day of the collection, since these factors interfere in the serotonin release.

The blood sample was taken for the measurement of plasma cortisol, serotonin and lipid fractions from 7 a.m. to 8 a.m. Each patient was fasted for eight hours and was drawn two blood samples from cubital vein two times. The first sample was obtained before the first day's treatment and the second sample was obtained after treatment on the eleventh day.

Participants had blood pressure checked daily before and after the laser therapy. The ILIB laser (model Omnia, brand EccoFibras, Brazil) was applied in the region of the right radial artery of each patient for 30 minutes on 10 consecutive days. A bracelet was placed on the participant's wrist with a small aperture, where the 660 nm (100 mW) laser pointer tip was attached.

Participants also responded to a questionnaire at the end of the closed-question survey to find out how they felt after 10 days of ILIB treatment.

The parameters such as levels of total cholesterol, triglycerides (TG), very low density lipoprotein (VLDL), low density lipoprotein (LDL) and high density lipoprotein (HDL), serotonin and cortisol levels, systolic blood pressure and diastolic blood pressure before and after treatment with laser therapy were statistically evaluated using Student's t-test, with significance level $p < 0.05$.

III. RESULTS

A total of 60% of the participants reported improved sleep, decreased stress and felt more physically vigorous and 70% reported feeling less restlessness. Other effects reported by the participants were decreased edema, vasodilation of the superficial veins of the forearm and increased urine output.

There was a decrease in pressure levels before and after treatment, however, there was no statistical difference. Serotonin levels increased significantly at the end of treatment, however, there was no significant difference for the cortisol levels (Table 1).

Table 1. Data of blood pressures, serotonin and cortisol levels of participants before (day 0) and after laser therapy (day 11).

Day	Systolic pressure (mmHg)	Diastolic pressure (mmHg)	Serotonin (ng/mL)	Cortisol (mcg/dL)
0	122.61± 2.65	76.44± 1,69	87.19± 17.49	13.10± 1.84
11	118.34± 2.91	75.16± 1,80	182.80± 36.68*	13.00± 1.34

*p< 0.05 meant the significant difference before and after treatment session.

Analysis of lipid fractions showed a non-significant difference cholesterol and HDL levels, but occurred significant reduction of triglycerides, VLDL and LDL before and after ILIB application (Table 2).

Table 2. Mean and Standard Error of total cholesterol, triglycerides, VLDL, LDL and HDL for participants at baseline and study end.

Day	CHO (mg/dL)	TG (mg/dL)	VLDL (mg/dL)	LDL (mg/dL)	HDL (mg/dL)
0	170.80±17.88	137.30±37.08	58.70±38.13	122.70±33.42	47.80± 3.47
11	169.20±17.00	129.20±32.81*	25.40± 6.55*	92.80± 11.23*	50.20± 2.93

* p< 0.05 meant the significant difference before and after treatment session.

IV. DISCUSSION

In this study, there was a decrease in systolic and diastolic blood pressure and this was possibly due to increased nitric oxide (NO) production by the vascular endothelial cells of patients treated with ILIB.

In some studies, the increase of the production of NO is related when the low intensity laser acts on the endothelium. This substance is synthesized at the cells by nitric oxide synthase (NOS), which contains groups of flavin and heme that absorb light [12]. Thus, when there is laser irradiation, it causes the endothelial cells to secrete NO, which is responsible for causing vasodilatation. Moreover, the NO is responsible for the maintenance of the blood flow and the hemostasis. The laser therapy increases the functional activity of the endothelial cells and its NO-producing capacity [13].

A study carried out with 19 adults treated with laser diode laser device emitting 635 nm (red) laser light revealed a reduction of the cholesterol (191.11±43,34 *vs* 178.79±36.46 (mg/dL), LDL (103.68±31.53 *vs*96.53±25.69 mg/dL) and triglyceride (80.37±45.96 *vs* 68.68± 26.88 mg/dL) levels before and after the LLLT [14].

A research performed with hypercholesterolemic rabbits, which were treated with auricule laser (650 nm) for 30 minutes twice daily for twenty weeks, showed a decrease in cholesterol, triglycerides and LDL at the 16th week of treatment [15].

Our study evaluated the effects of low intensity laser on lipid fractions in humans and the findings corroborate the others researches. It has been proposed that LLLT may be able to serve as a subtle, noninvasive instrument in the reduction of serum cholesterol levels. It is proposed that laser therapy may suppress cholesterologenesis by altering the transcription factors responsible for the expression of essential genes involved in the biosynthetic process [14].

In this study, it was found that HDL increase in the participants after use of LLLTfor 10 days, however, was not significant. HDL plays an important role in the transport of cholesterol from the peripheral blood to the liver via a reverse cholesterol transport pathway. Therefore, increased HDL is associated with a decreased risk of heart disease [16].

Given the great importance of serotonin as a neurotransmitter and its relevance to a variety of physiological actions, some studies have proven the release of serotonin by LLLT [17]. Serotonin functions include the stimulation of the heart rate and the onset of sleep, is related to behavior, mood, anxiety, aggression, depression and suppression of appetite [9], [10].

The increase in serotonin found in the study was striking, therefore, an increase of more than 50% throughout the study. This increase in serotonin may be associated with improved sleep, decreased stress, and less restlessness reported by the study participants.

Studies have revealed that LLLT lowers cortisol levels by improving pain [11]. The cortisol enables the body to combat the stress associated with trauma or the disease process. In this study, we did not detect a significant difference in cortisol levels before and after treatment.

A study of 243 patients with various types of pain (headaches and facial pain, myogenic neck pain, shoulder and arm pain, epicondylitishumery, tenosynovitis, low back and root pain, Achilles tendinitis) and treated with LLLT revealed that the rigidity decreases, the mobility is restored (functional recovery), and the spontaneous or induced pain decreases or even disappears. Results demonstrated to diminished more than 70% in acute pain and more than 60% in chronic pain [18].

V. CONCLUSION

The low-intensity laser was able to reduce systolic blood pressure, increase blood circulation, increase diuresis, decrease edema, and promote a sense of well-being and increased vitality. Within the scope of our study, we conclude that LLLT has a significant effect in reducing the levels of triglycerides, LDL, VLDL and increased serotonin.

Thesefindings point to LLLT as a promising tool for thetreatmentofanxiety, depression, andpain as it increasesserotoninlevelsandcan even be used to assist uncontrolled hypertension and prehypertension in addition to hypercholesterolemia.

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