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Effect of Laser Diode 820Nm on the Levels of Lactate Dehydrogenase, Creatin Phosphokinase, and Lactic Acid in Muscles of Students

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ABSTRACT

Background: Lactic acid is the end product of glycogenolysis. Glycogen is converted to pyruvic acid in the deficiency of oxygen. The creatin phosphokinase enzyme activity is important to change AMP to ATP in glycogenolysis. However, in the deficiency of CPK, the pyruvic acid is changed to lactic acid with the lactate dehydrogenase (LDH) enhancement. Low level laser treatment (LLLT) is one of the most important research aspects targeting the cellular level. The output laser should be low and do not make thermal changes inside tissues. The aim of this study was to see the effect of laser diode 820nm on the levels of lactic acid and body enzymes, lactate dehydrogenase (LDH) and creatin phosphokinase (CPK), in the after physical activity of facial muscles which are considered important for various activities. Methods: The sample was taken from the 1st-year dentistry students, College of Dentistry/Kufa University in 2014-2015 in collaboration with Al-Saddar Teaching Hospital, Kufa City, Iraq. This study was based on retrospective studies that are related to our research. The protocol of this research was based on clinical studies on three groups of students. Each group contained 30 patients. All the samples were based on same biological qualification of age, weight, and length. The first two groups were submitted into pre and post evaluation of the lactic acid, LDH, and CPK except the control group. From all the groups, each subject was asked to chew a gum of frankincense continuously for a half hour. The weight of the gum was 1.5gm. Results: The result of this study was positive toward the laser group. After mouth muscle activity, lactic acid and enzymes accumulated in the muscle cells. The laser effect reduces muscle fatigue and pain due to reorientation the chemical levels to normal values.

Keywords: *Creatin phosphokinase, facial muscles, lactate dehydrogenase, laser diode 820nm, lactic acid.*

Introduction

Lactic acid is the end product of glycogenolysis (GCS?????). Glycogen is converted to pyruvic acid in the deficiency of oxygen. The creatin phosphokinase (CPK) enzyme activity is important to change AMP to ATP in the GCS. However, in the deficiency of CPK, the pyruvic acid is changed to lactic acid with the lactate dehydrogenase (LDH) enhancement [1,2].The anaerobic GCS increases lactic acid, LDH, and CPK in the body especially in muscles affected by intense exercise [3-5].

$$CH3–C–COOH^{*} + NADH + H \leftrightarrow CH3–C–COOH^{**} + NAD$$

Without O2

*pyruvic acid

**Lactic acid

Equation Glycogenolysis without Oxygen [3].

The concentration of lactic acid in normal people at rest position equals 10mg/100ml of blood. The maximum concentration after intense exercise, within 1-3 minutes, in arterial blood stream for normal men and ladies is 10-15mg/100ml of blood. The normal persons can't tolerate more than 112mg/100ml in blood while the concentration in rest position is 10-12 mg/100ml [3].

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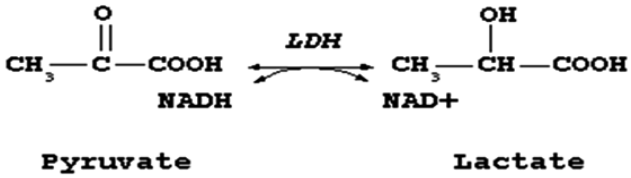
The CPK is considered as one of the transport enzymes. This enzyme is found in the skeletal muscles, smooth muscles, and cardiac muscles. This enzyme is found in blood stream when the body has an accident or muscle spasm [6,7]. The LDH is an enzyme that can stimulate the reverse reaction between lactic acid and pyruvic acid according to the equation shown below



This enzyme is found in all body cells of liver, heart, skeletal muscles, kidneys, and red blood cells in high concentrations [8,10].

Low level laser treatment (LLLT) is one of the most important research aspects targeting the cellular level [11]. The output laser should be low and do not make thermal changes inside tissues. For laser output to be as LLL, the output should be between 300-9000mj/cm². The laser–tissue interaction explains how the electromagnetic field can change electrolyte elements like sodium and potassium in and out of the cell [12]. Rather than who activates Crip's cycle to increase ATP production from ADP, the cytochrome alpha is the last chain in Crip's cycle of the electron transport chain. Laser, especially in red and near infrared is absorbed by this cytochrome. This cytochrome lets the O_2 electrons to potentially be attracted to this magnetic component of the Crip's chain [13]. The end result is a lot of O_2 electrons with end result of much ATP [14,15]. Finally, the cells will be enriched with energy that is necessary for their activities. Figure 1 summarizes the LLLT-tissue interaction [16].

The aim of this study was to see the effect of laser diode 820nm on the levels of lactic acid and body enzymes, lactate dehydrogenase (LDH) and creatin phosphokinase (CPK), after physical activity of facial muscles which are considered important for various activities.

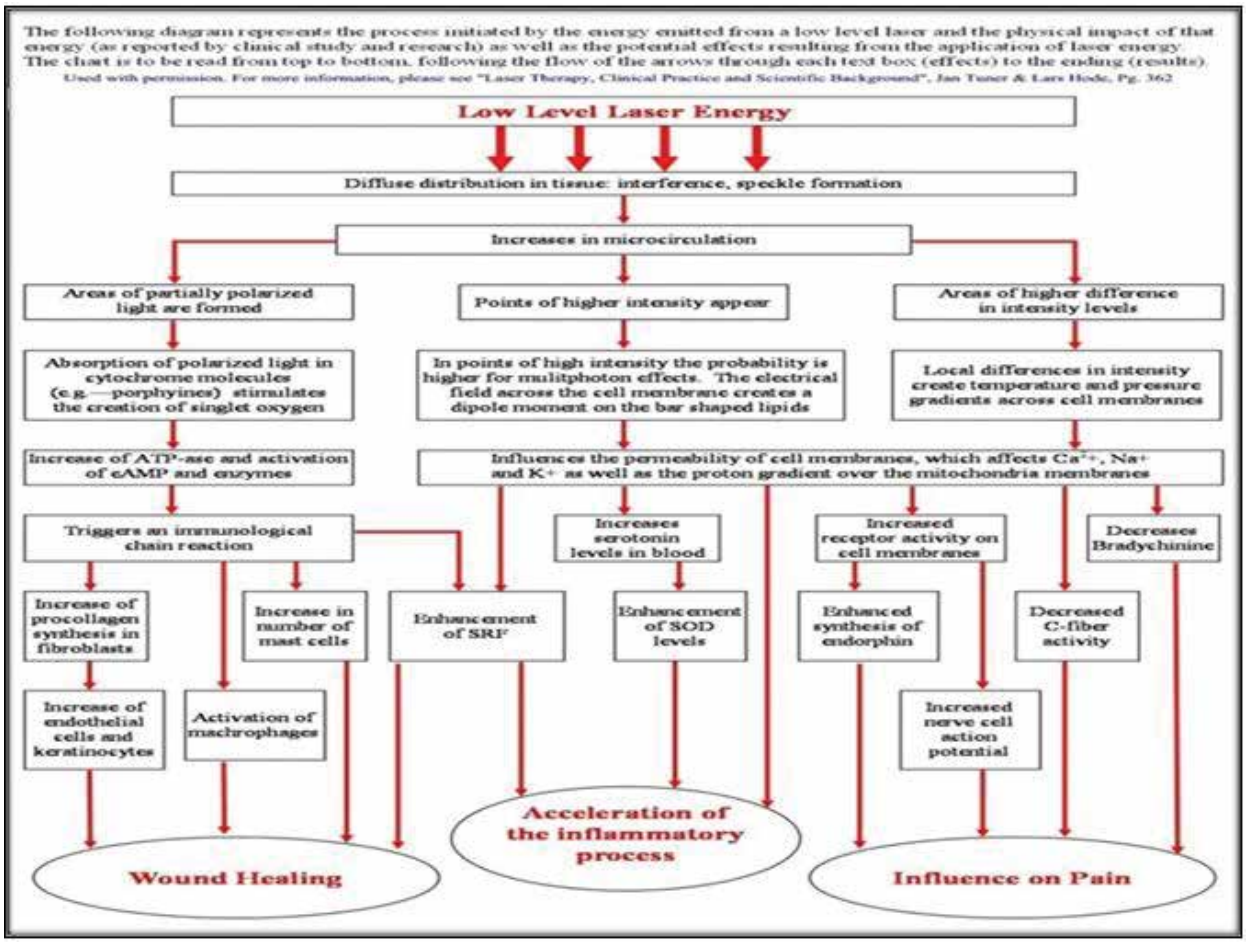


Figure 1: Flow chart of the LLLT-tissue interactions[16].

Materials and Method

Diode laser 820nm: It's a semiconductor laser 820nm (OMEGA Co., UK). It consists of two parts; control part (time, frequency and output) and laser delivery part. These two parts are connected by cable to allow the operator reach different areas on the patient face.

The gum: For all students, the gum (frankincense) was chewed continuously for a half hour. The weight of the gum was 1.5gm.

Sampling: In the College of Dentistry, 1st-year dentistry students, 90 healthy students with an average age of 28 years old, were divided into three groups; laser treatment, no laser treatment and control groups.

Measurement of lactic acid: Blood samples, obtained via fingers, were taken from each student pre and post experiment to measure lactic acid concentration (Lactic acid measurement device, mmol/100ml, Figure 2), LDH and CPK enzymes [17].

Figure 2: Lactic acid measurement device

Stimulation program by laser 820nm: The laser group was exposed to a laser session applied on the facial muscles bilaterally. The laser parameter was 100mJ output. The laser delivery system had 100 laser apertures. Each laser spot area was at 2.07mm². When it was divided to change it to cm² and multiply to sum all areas of laser apertures, it became the same area but in cm² to calculate the power density divided by the output over area, that was 500mJ/cm² irradiance. To reach the maximum therapeutic dose, the time was 2 minutes, the total session time. The final dose was between 9000-1000mJ flounce. After the laser session was done, blood samples from all groups were taken for laboratory tests.

Results and Discussion

According to the Tables 1 and 2, shown below, laser exposure showed significant differences between the control group and the laser-treated group. That can be explained due to the laser effect on biology of the cells. However, it restored back the normal activities of the cells getting rid of the fatigue and made much difference on the muscles. The laser was very effective in improving and changing the CPK levels by regeneration of ATPs. The ATPs normally produced by cells are few and can be consumed quickly. However, when the cells are affected by laser, they can produce more ATP energy in a period of two sessions per week according to the response of the cells. When a living being is exposed to a low power laser in organized sessions, the laser supports to rebounce the activities of the LDH, CPK, and lactic acid [18]. Moreover, the activity of muscles is subscribed with enzymes as co-enzymes, so it raises the activity of the coenzymes. The unexposed samples to laser showed no changes. Lactic acid is accumulated inside the cells. Normally, lactic acid already exists in muscles and elevates during muscle activity. Though, lactic acid is the final image of the anaerobic metabolism. In conclusion, the reaction of laser at low power with living tissue is very energetic and ends with clinical results such as healing of injuries, pain relief, biological stimulation, and many others. Laser light has special physical properties that do not exist in the ordinary light (mono chromatic, coherence, brightness and/or one direction).

Table 1: Explains the groups of lactic acid, CPK, and LDH with and without laser stimulation

No.	Group		Unit	Before		After	
				Mean	SD	Mean	SD
1.	Lactic Acid	Without laser	Millimol	26.5	2	25.5	1.5
2.		With laser		26.5	2	23.5	1.5
3.	CPK	Without laser	MI/IU	69.56	12.5	69.57	12.5
4.		Laser		69.54	11.5	70.52	12.5
5.	LDH	Without laser	I/U	158.52	36.5	158.56	36.5
6.		Laser		158.49	37.5	159.5	37.5
Welcokson value is (0) in temperature 5C under level (0.05)							

Table 2: Comparison between laser and no-laser groups

Test groups	No laser group		Laser group		Mann–Whitney
	Mean	SD	Mean	SD	
Lactic acid	25.5	1.5	23.5	1.5	0
CPK	69.57	12.5	70.25	12.5	0
LDH	158.56	36.5	159.5	37.5	0

Ethical Clearance: Obtained from the Research Ethics Committee at College of Dentistry/Kufa University in collaboration with Al-Saddar Teaching Hospital, Kufa City, Iraq.

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Conflict of Interest: Nil.

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