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Short Communication

The interaction between photonic technology and physical exercise: The action of low-level laser therapy

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ABSTRACT

Introduction: Obesity is a global-level epidemic. Together with this disease, called chronic subclinical inflammatory disease, many other diseases, known as comorbidities, arise.

Objective: To show that the association between low-level laser therapy and physical exercise is supported, by experimental and clinical studies, being an instrument that maximizes the treatment of obesity as well as its comorbidities.

Conclusion: This manuscript brings a compendium of accomplished work by our group that allows understand the mechanism base of interaction between the photonic technology and the physical exercise, allowing to potentiate the treatment of the obesity.

INTRODUCTION

Obesity, defined as a chronic subclinical inflammatory disease is a worldwide epidemic, present in developed and developing countries [1]. It is estimated that 95% of obesity cases are directly related to two factors: irregular feeding and sedentary lifestyle. These factors name this type of obesity as exogenous [2].

Thus, the main means of non-pharmacological and non-invasive treatment is lifestyle change, through dietary reeducation and physical exercise. However, the use of technologies has increasingly emerged as a new advent for the treatment of this disease. The objective of this work was to show a synthesis of papers that allow us to understand the use of photonic technology as a potentiator mechanism in the treatment of obesity.

The action of photonic technology in association of physical exercise

Photonic technology, here represented by low-level laser therapy and Light Emitting Diode (LED), is a widely used technology in the field of health, such as skin cancer [3], orofacial lesions [4], dermatological treatments [5], physiotherapeutic rehabilitation [6], healing of venous ulcers [7], among others.

In the last 7 years, our group has performed experimental [8-10] and clinical research [11-13], obtaining expressive results regarding the treatment of obesity and metabolism control. The oxidative metabolic pathway can be controlled through the combination of low-level laser therapy and physical exercise [14,15]. This conjugated therapy allows to modulate the metabolism, altering the oxidative capacity [9]. The

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great importance of the metabolic modulation, intervening in the metabolic pathways, is due to the necessity of a new methodology for the treatment of obesity and its comorbidities. In this context, several studies in our group have shown the relationship between the use of low-level laser therapy in sedentary and active conditions [8-10,14].

Thus, it became possible the development of the theory of the systemic action of low-level laser therapy associated with physical exercise as a new methodology for the treatment of obesity. The action proposition of low-level laser therapy on tissues and enzymes is known [9,16-18].

One of the denominations to this action is called Photobiomodulation [19,20]. This phenomenon, initially imagined to occur punctually, is increasingly taking on systemic proportions. It is known that the various wavelengths have the capacity to reach a determined tissue profundity [21] and thus, to interact in a specific way with each tissue, increasing the amount of available energy. According to KARU (2010), even small changes in the level of available ATP may alter cellular metabolism, a significant increase in energy can improve the metabolism of the cell under conditions of suppression or disease [19].

Currently, the change in the concept of adenosine triphosphate (ATP) is merely an energy unit is under discussion. Findings indicate that ATP is also an important signaling molecule that allows the communication of cells and tissues throughout the body. Thus, neurons are responsible for the release of ATP in muscle, intestinal and tissue, in addition to other important organs [19,22-24].

Evidently, in experimental [8-10,14] and clinical studies [11-13,15], it has been observed that point or local applications of lasers or LEDs provide enzymatic modulation and changes in parameters in areas other than those in which applications were performed. Thus, a systemic action can be activated. This activation, in several levels and in cascade, may be responsible for the potentiation of low-level laser therapy action when associated with physical training in the treatment of obesity.

The application of the low-level laser therapy in the infrared length range (780nm to 850nm), when applied to the muscle, has a profundity of about 4.5 mm, reaching a reasonable muscular layer [21]. Thus, the effect of light action on muscle tissue is initiated both by increased mitochondrial structure and your function [9,18]. Structurally, it is postulated that mitochondrial hypertrophy and fusion occur, which would explain the increase in its size. As for function, the enzyme Citrate Synthase, key enzyme in the Krebs cycle, may be increased up to 2.5-fold in relation to normality, when realized the association between light and physical exercise [9,14].

The altered action in the electron transport chain is a key point in the mitochondrial process [25]. In the internal membrane of the mitochondria, there are 5 units of metalloproteins bound to the internal membrane of this organelle: Complex I (Nicotinamide Adenine Dinucleotide Dehydrogenase), Complex II (Succinate Dehydrogenase), Complex III (Cytochrome C Reductase), Complex IV (Cytochrome C Oxidase) and Complex V (ATP Synthase). In addition, two molecules move freely and carry electrons from an anterior complex to a posterior complex (Ubiquinone and Cytochrome c). The activity of light in the electron transport chain complex occurs by generating the excitation of the photoreceptor molecule (cytochrome c oxidase), which moves the cell metabolism through cascades of reactions called cell signaling or retrograde mitochondrial signaling. Studies have monitored the cell signaling reactions after light action on the molecule of cytochrome C oxidase (transient enzyme of the IV complex of the electron transport chain in mitochondria) [19,22,25,26]. One of the important points is the dissociation of nitric oxide from the catalytic center of cytochrome c oxidase [13]. An enzyme, nitric oxide synthase (NOS), from amino acids and using cofactors such as oxygen and nicotinamide adenine dinucleotide phosphate

(NADPH), synthesizes the nitric oxide. Through cell irradiation, the charge transfer channels as well as the transition channels in the chromophores, in the state oxidized or reduced, are reorganized in a manner dependent on the presence or absence of nitric oxide [19,20,23]. Thus, it is believed that in the presence of nitric oxide, which is a physiological regulator of cytochrome C oxidase, sequential reorganization of the effects of signaling occurs, optimizing the physiological process [23].

When we associate physical exercise of moderate intensity, the metabolic action found results in increased energy expenditure (physical exercise and phototherapy), through the so-called energy demand [9,12,14,15]. Physical exercise when combined with phototherapy allows a more intense modulation of the lipase enzymes, lipase sensitive hormone and lipoprotein lipase, hydrolyzing the triglycerides in fatty acid and glycerol in greater quantity [8,9]. The molecular units of fatty acid are then used in the route of beta-oxidation, through an increased oxidative capacity (energy demand), then the consumption of this energy substrate (fatty acid), which over time allows the reduction of body weight, total adipose tissue and several anthropometric and biochemical variables [5,11-13,15]. Hydrolyzed glycerol is consumed in the gluconeogenesis pathway, providing the generation of glycogen stores in the liver and muscle [9]. Thus, in our group studies, the reduction of obesity levels can be obtained in 16-week protocols [11-13,15].

CONCLUSION

In summary, the association of photonic technology and physical exercise like a non-pharmacological and non-invasive treatment for obesity is a sustainable model, which brings significant results not only for obesity treatment, but also for the associated comorbidities.

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