

IRRADIAÇÃO LASER TRANSCUTÂNEA DO SANGUE EM MODO SIMULTÂNEO (S-ILIB) PARA RECUPERAÇÃO DE FADIGA: UMA SÉRIE DE CASOS

TRANSCUTANEOUS LASER IRRADIATION OF BLOOD IN SIMULTANEOUS MODE (S-ILIB) FOR FATIGUE RECOVERY: A CASE SERIES

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Resumo: A irradiação transcutânea do sangue com laser (ILIB), modalidade sistêmica de terapia de fotobiomodulação (PBMT), consiste na aplicação de laser na artéria radial ou outra artéria, para melhorar as funções sistêmicas e a dinâmica fisiológica do corpo. As estratégias terapêuticas disponíveis para o manejo da fadiga devido ao estresse da vida diária concentram-se principalmente em mudanças no estilo de vida associadas à nutrição e ao exercício. Assim, o presente estudo tem como objetivo relatar uma série de casos em que a terapia ILIB transcutânea, com a técnica modificada e simultânea (S-ILIB), foi utilizada para tratar sintomas de fadiga. Quatro pacientes saudáveis, sem qualquer tipo de comorbidade significativa, relataram fadiga relacionada ao estresse. Foram tratados pelo novo protocolo de PBMT com a técnica S-ILIB modificada. A intensidade ou percepção da fadiga foi avaliada por meio de uma escala visual analógica (EVA). A "técnica simultânea" utilizada no presente estudo consistiu na irradiação do laser em quatro locais do corpo: 1- região da artéria radial do braço direito; 2- região da artéria radial do braço esquerdo; 3- artéria pediosa direita; e 4- artéria pediosa esquerda. Para a PBMT foram utilizados dois aparelhos laser de 660 nm, em modo contato, com potência de 100 mW. Os pacientes relataram uma clara recuperação da sensação energética após a sessão de S-ILIB. O protocolo de PBMT parece ser uma terapia promissora para gerenciar a recuperação energética em rotinas diárias relacionadas ao estresse e fadiga; entretanto, são necessários estudos complementares para estabelecer o protocolo mais seguro e eficiente.

Palavras-chave: fadiga; dor; ativação muscular.

Abstract: The modified transcutaneous laser irradiation on blood (ILIB), a systemic modality of photobiomodulation therapy (PBMT), consists of a laser application on the radial artery or other artery in the body, to improve systemic functions and physiological dynamics of the body. The available therapeutic strategies for the management of fatigue due to daily life stress are mainly focused on lifestyle changes associated with nutrition and exercise. Thus, the present study aims to report a series of cases in which transcutaneous modified ILIB therapy in simultaneous mode (S-ILIB), was used to treat fatigue symptoms. Four healthy patients, without any type of significant comorbidity, reported fatigue related to stress. They were treated by the new PBMT protocol with the modified ILIB technique. The intensity or perception of fatigue was rated using a visual analogue scale (VAS). The "simultaneous technique" used in the present study consisted of laser irradiation in four sites of the body: 1- the radial artery region of the right arm; 2- the radial artery region of the left arm; 3- the right dorsal pedis artery; and 4- the left dorsal pedis artery. For PBMT, two laser device were used at 660 nm, on contact mode, with 100 mW of power. The patients reported a clear recovery in the energy sensation after the S-ILIB session. The PBMT protocol seems to be a promising

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therapy for managing energy recovery in fatigue-stress-related daily routines; however, complementary studies are required to establish the safest and most efficient protocol.

Key words: fatigue; pain; muscle activation.

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1 INTRODUCTION

Fatigue is a common non-specific symptom experienced by many people and is associated with many health conditions. Often defined as an overwhelming sense of tiredness, lack of energy, and feeling of exhaustion, fatigue relates to the difficulty in performing voluntary tasks (Ewais et al., 2023; Wan et al., 2017).

Muscle pain and fatigue are conditions that can significantly reduce muscle performance during exercise or daily life activities (Lin et al., 2023; Mastaglia, 2012). The available therapeutic strategies for the management of fatigue due to daily life stress are mainly focused on lifestyle changes associated with nutrition and exercise.

The non-invasive treatment of fatigue and muscle pain includes photobiomodulation (PBM). PBM therapy (PBMT) uses sources of nonionizing light, such as light-emitting diodes (LEDs) and lasers. The use of PBM triggers reactions photophysically and photochemically in human body tissues by interacting with cell components that absorb light (chromophores) (Avci et al., 2013; Ferraresi et al., 2016; González-Muñoz et al., 2023).

The photoreceptors in the mitochondria are stimulated by light, which can trigger a stimulation or, contrarily, inhibit the cellular metabolism. The PBM action mechanism involves bioenergy, photochemistry, and photobiology (González-Muñoz et al., 2023).

To perform a continuous laser PBMT, the modified intravascular laser irradiation of blood (ILIB) technique was developed and is an option of a modality that can deliver energy to the organism.

The benefits of ILIB were previously reported as improvement of the oxygen-carrying capacity and rheological properties of red blood cells, improvement of mitochondrial functionalities within white blood cells (Zhong et al., 2017), immune response modulation (Wasik et al., 2007), platelet aggregation inhibition and reduction of blood viscosity (Chuang & Cheng, 2023; VA, 2015).

In light of these facts, the present study aims to report a series of cases in which transdermic laser photobiomodulation therapy with the modified ILIB technique, was used to treat fatigue symptoms in healthy patients.

2 METHODS

The study was approved by the Ethics and Research Committee (ERC) of the Universidade do Vale do Paraíba (UNIVAP – 6.507.243) and carried out following the Declaration of Helsinki. A Free and Informed Consent Form was obtained from participating patients. Four patients, two female (49-year-old) and two male patients

(47 and 54-year-old) reported fatigue related to stress. They received treatment using the new PBM protocol with the modified simultaneous ILIB technique proposed in this case report. Patients who received this experimental protocol were healthy, without any significant comorbidity.

The intensity or perception of fatigue was rated using a visual analog scale (VAS) from a scale of 0 (full fatigue sensation) to 10 (full fatigue-recovery feeling). Before the PBMT, the subjects were asked to rate their sense of fatigue according to the proposed VAS scale.

The "simultaneous technique" used in the present study consisted of laser irradiation in four sites of the body: 1- the radial artery region of the right arm; 2- the radial artery region of the left arm; 3- the right dorsal pedis artery; and 4- the left dorsal pedis artery (Figure 1).

Patients were placed in a comfortable position in a chair. Before PBMT, the palpation of the pulses of the radial artery of both arms and the dorsal pedal artery was performed to identify the proper location to perform therapy. Next, local asepsis with 70% alcohol and gauze was performed and a specific ILIB bracelet was placed in the site proposed to apply the PBMT.

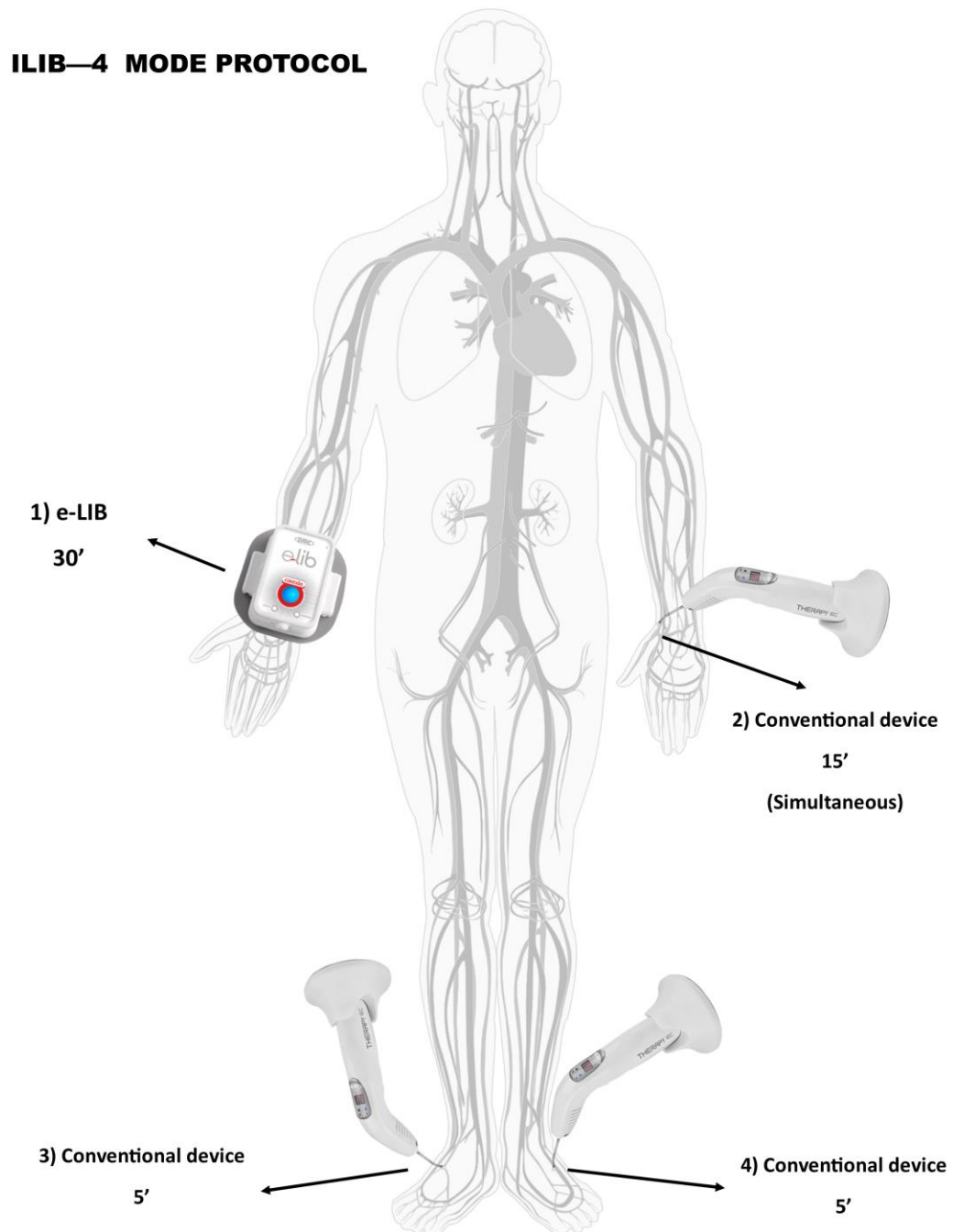
The proposed new ILIB protocol consisted of four steps (Figures 1 and 2). For PBMT, a laser device Therapy EC® (DMC, São Carlos, SP, Brazil) or e-LIB® (DMC), were used at 660 nm, on contact mode, with 100 mW of power. The PBMT was conducted on four sites (radial and dorsal pedal arteries of both sides, Figures 1 and 2).

The protocol started in the radial artery region of the right arm, using a laser device in the form of a clock (e-LIB, Figures 1 and 2a). This device is controlled by Bluetooth and an application on a smartphone and was programmed for 30 min of irradiation with 100 mW of power.

Second, in the radial artery region of the left arm, a bracelet was positioned when the first laser device reached 15 min of irradiation; this second device began the PBMT and was programmed for an additional 15 min of irradiation with 100 mW of power (Figures 1 and 2b).

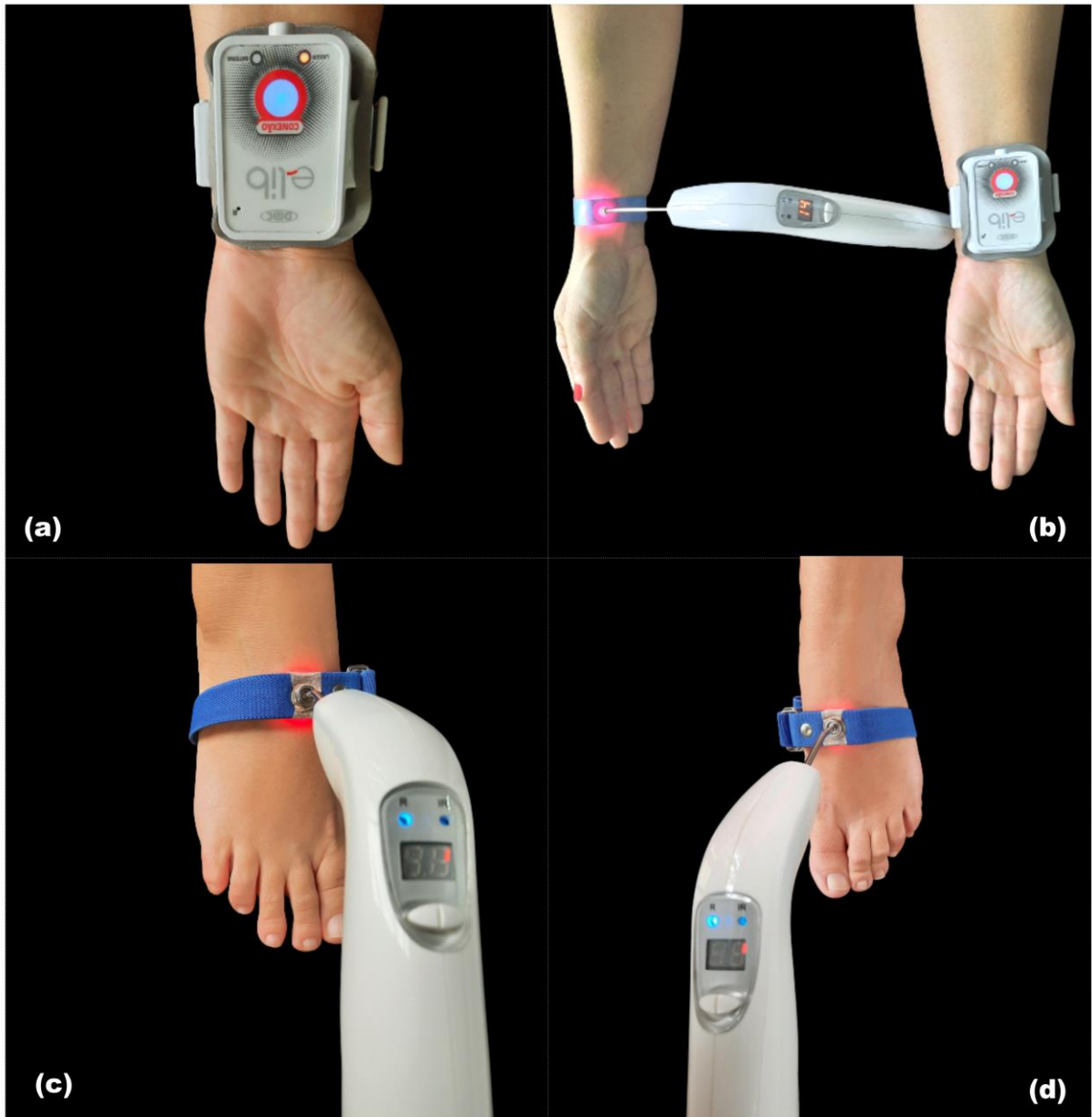
After 30 min of PBMT on both arms, the bracelet was positioned in the right dorsal pedis artery and 5 min of irradiation was performed (Figures 1 and 2c). The same procedure was done in the left dorsal pedis artery. The total irradiation time was 40 min per patient with a single application mode (Figures 1 and 2d).

Figure 1 - Schematic illustration to indicate the ILIB four mode protocol sequence – steps 1 and 2 were performed simultaneously after 15 min of e-LIB treatment; steps 3 and 4 were performed separately after step 2 was completed.



Source: Created by the author (2024).

Figure 2 - Simultaneous Modified Laser Transcutaneous Irradiation of blood (S-ILIB) therapy for fatigue and muscle pain recovery with the four-mode protocol sequence: – radial artery region of the right arm (laser device in the form of a clock) (a); radial artery region of the left arm (b); right dorsal pedis artery (c); left dorsal pedis artery (d).

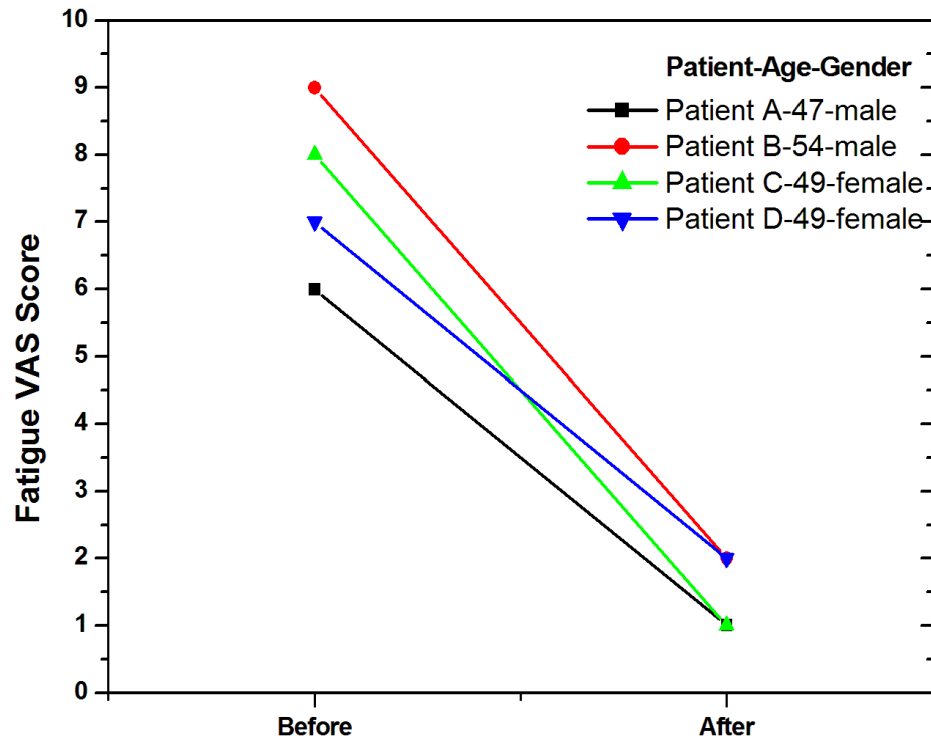


Source: Created by the author (2024).

3 RESULTS AND DISCUSSION

Before the PBMT session, participants classified the feeling of fatigue according to the VAS scale and the values were between 6 and 9 (Figure 3). At the end of the systemic PBMT session, the four patients reported a score below three on the VAS scale (Figure 3).

Figure 3 – VAS scale report according to patients' age and gender.



Source: Created by the author (2024).

One patient (Patient D) reported side effects such as transitory nausea and moderate headache. These symptoms disappeared after approximately 1 h. The other three patients reported only the benefits of enhancement of the energy sensation and motivation to do exercises or home activities. The patient who reported these symptoms (Patient D) had never previously undergone an ILIB session and the other three patients had already undergone a conventional ILIB session. We believe that the high dose of energy may have been excessive at first, but that later the body itself metabolized and came into balance. Therefore, it would be interesting to recommend conventional ILIB sessions before a simultaneous ILIB session. It is also interesting at the end of the simultaneous ILIB session to follow and observe the patient for at least 30 minutes to 1 hour.

In the present study, a placebo group was not applied because it was a case report with information on a new technique or application modality. Using two different laser devices was necessary to create and apply the simultaneous energy delivery

technique. This technique is clinically viable because some professionals have two or more laser equipment, which can often be underused in their offices.

To the best of the authors' knowledge, there are no previous studies on the use of transdermic photobiomodulation therapy, with the modified ILIB technique adapted to deliver more energy simultaneously and considering different body sites. In the present study, the technique was applied to the radial and dorsal pedis arteries of both the upper and lower limbs, respectively.

In the cases presented, there was a symptomatic improvement of the fatigue sense in all the patients treated. The PBM performed by the two ILIB devices positioned in four sites of the body promoted light absorption by the radial and pedial arteries. This transdermal irradiation of arteries may stimulate the production of nitric oxide (NO), a potent vasodilator that can increase blood flow and improve tissue oxygenation (Luo et al., 2013; Mitchell & Mack, 2013). ILIB therapy also has a direct effect on the mitochondria within cells, leading to improved energy production and metabolism (Ferraresi et al., 2015; Lin et al., 2023), which can result in a sense of fatigue relief observed in the present study. The recovery of energy sensation reported by the patients after simultaneous ILIB therapy was probably due to the known ILIB mechanisms as a reduction in blood viscosity, enhancement in red blood cell oxygen capacity (Fu et al., 2022). Considering these effects on the circulatory system, the use of the simultaneous technique was proposed in the present study to improve blood circulation in upper and lower limbs.

The noninvasive systemic irradiation form is an effective therapy to support athletes before or after competitions. This recovery in the well-being sense reported by the patients after IPBMT is clinically relevant for the quality of life and could be used for muscle recovery after exhausting activities.

The presented protocol of the ILIB technique (Powered ILIB) was demonstrated as a recovery therapy that could be performed in a hospital setting or a home care condition and is neither time-consuming nor expensive. The laser protocol tested in the present study can be considered simple, relatively low-cost, and non-invasive (Soares et al., 2021).

However, this study has some limitations that must be considered, such as the absence of a placebo or control group and the use of only one ILIB session. Furthermore, there has been no long-term follow-up of the effects of an ILIB session on patient-reported fatigue. Finally, further studies are necessary to understand better the impact of simultaneous ILIB on patients' quality of life and find the best dosimetry for use.

4 CONCLUSION

After analyzing the data obtained from the current case series report, it is clear that there is a lack of information on the protocols of simultaneous high-energy delivery by ILIB therapy. The PBMT protocol seems to be a promising therapy for managing fatigue-related symptoms, but further complementary studies are required to establish the safest and most effective protocol.

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