CASE STUDY

REVISTA ENFERMAGEM ATUAL IN DERME

USE OF LOW POWER LASER AS ADJUVANT IN TREATMENT OF VENOUS ULCER: CASE STUDY

USO DEL LÁSER DE BAJA POTENCIA COMO COADYUVANTE EN EL TRATAMIENTO DE LA HERIDA VENOSA: ESTUDIO DE CASO

USO DO LASER DE BAIXA POTÊNCIA COMO COADJUVANTE NO TRATAMENTO DE FERIDA VENOSA: ESTUDO DE CASO

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ABSTRACTS
Objective: To demonstrate the effects of low-power laser therapy as an adjunct to nursing care in the treatment of patients with vascular wounds. **Method:** This is a case study of qualitative approach, developed at the Stomal Therapy Nursing Outpatient Clinic of URCA. Data collection occurred in the months of September and October 2021 through the medical record, nursing records and report/opinion of generalist and specialist nurses in stomal therapy. After the data collected, it was transparently described through patient history, images of wound evolution and chart containing information from the records. **Results:** Patient J.B.M. 66 years old, hypertensive, diabetic, weighing 56 kg, with height of 1.69 m, BMI: 19.67, with history of stroke, vascular problems, has amputation of the right lower limb, and venous injury in the left lower limb in tibial region. She received nursing care for wound healing and improvement of her health condition, and as an adjunct to treatment, the low power laser was used. **Final considerations:** The use of low power laser as an adjuvant in the treatment of vascular wound proved to be efficient and brought good results throughout the treatment. This study also shows the importance of nurses in the use of new technologies for wound care.
Keywords: Nursing Care; Wound Closure Techniques; Healing; Stomal Therapy.

RESUMEN
Objetivo: Demostrar los efectos de la terapia láser de baja potencia como complemento de los cuidados de enfermería en el tratamiento de pacientes con heridas vasculares. **Método:** Se trata de un estudio de caso de enfoque cualitativo, desarrollado en la Consulta Externa de Enfermería de Terapia Estomal de la URCA. La recopilación de datos se produjo en los meses de septiembre y octubre de 2021 a través del prontuario, los registros de enfermería y el relato/opinión de los enfermeros generales y especialistas en estomaterapia. Después de los datos recopilados, se describen de forma transparente a través del historial del paciente, imágenes de la evolución de la herida y el cuadro que contiene la información de los registros. **Resultados:** Paciente J.B.M. 66 años, hipertenso, diabético, con un peso de 56 kg, con estatura de 1,69 m, IMC: 19,67, con antecedentes de ictus, problemas vasculares, tiene amputación del miembro inferior derecho, y lesión venosa en el miembro inferior izquierdo en región tibial. Recibió cuidados de enfermería para la curación de la herida y la mejora del estado de salud, y como complemento al tratamiento se utilizó el láser de baja potencia. **Consideraciones finales:** El uso del láser de baja potencia como complemento al tratamiento de la herida vascular demostró ser eficaz y aportó buenos resultados a lo largo del tratamiento. Este estudio también muestra la importancia de las enfermeras en el uso de las nuevas tecnologías para el cuidado de las heridas.
Palabras clave: Cuidados de Enfermería; Técnicas de Cierre de Heridas; Cicatrización; Terapia Estomal

RESUMO
Objetivo: Demonstrar os efeitos da lesarterapia de baixa potência como coadjuvante na assistência de enfermagem no tratamento de paciente com ferida vascular. **Método:** Trata-se de um estudo de caso de abordagem qualitativa, desenvolvido no Ambulatório de Enfermagem em Estomaterapia da URCA. A coleta de dados ocorreu nos meses de setembro e outubro de 2021 através do prontuário, registros de enfermeiros especialistas em estomaterapia com vasta experiência. Após os dados coletados, forma descritos de forma transparente através do histórico de paciente, imagens da evolução da ferida e quadro contendo informações dos registros. **Resultados:** Paciente J.B.M. 66 anos, hipertenso, diabético, pesando 56 kg, com estatura de 1,69 m, IMC: 19,67, com histórico de AVC, problemas vasculares, tem amputação de membro inferior direito, e lesão de cunho venoso em membro inferior esquerdo em região tibial. Recebeu cuidados de enfermagem para cicatrização da ferida e melhora do estado de saúde, e como coadjuvante ao tratamento, utilizou-se o laser de baixa potência. **Considerações finais**: O uso do laser de baixa potência como coadjuvante no tratamento da ferida vascular se mostrou eficiente e trouxe bons resultados durante todo o tratamento. Este estudo também mostra a importância do enfermeiro no uso de novas tecnologias para o tratamento de ferida.
Palavras-chave: Cuidados de Enfermagem; Técnicas de Fechamento de Ferida; Cicatrização; Estomaterapia.

REVISTA ENFERMAGEM ATUAL IN DERME

INTRODUCTION

Varicose ulcers, also known as venous ulcers, are mostly wounds caused by problems with blood flow. This type of ulcer is prevalent in the lower limbs as legs and feet and it arises through increased intravenous blood pressure and blood stagnation until tissue disruption.[1]

Due to this blood stagnation in a given region, a small trauma can open an injury and evolve to an ulcer, this abnormally elevated and localized pressure, weakens the skin and mainly affects patients with varicose veins of years who did not seek treatment.[2]

Affected groups usually are sedentary, obese, smokers and people with reduced mobility or who work with activities that require a lot of time standing or sitting. Symptoms presented are: swelling, itching, varicose veins, skin darkening and tired legs.[3]

As they are painful and hard-to-heal wounds, it is necessary to have qualified professional guidance, in order to influence the quality of life of the affected patient. This problem requires multidisciplinary work to identify vascular disorder and to monitor evolution during treatment, to perform practices for regular blood circulation and good care for venous ulcer.[4]

Nursing interventions during treatment are fundamental for evolution of the patient's condition. This professional should always seek quality care, based on the nursing process, emphasizing this practice in care of individuals with venous wound.[5]

Among nursing techniques used, low level laser therapy has shown efficiency and innovation. This therapeutic modality has been used for treatment of injured tissues such as photobiomodulation therapy, photodynamic therapy and Intravascular Laser Irradiation of Blood (ILIB) in the reduction of free radicals in blood.[6]

Photobiomodulation is based on interaction of light with tissues on the human body being the low-intensity laser or LED light-emitting diode, stimulating at mitochondrial level photophysical, photochemical and photobiological processes increasing cell metabolism, generating healing, relieving pain and draining inflammations.[7]

Photodynamic therapy is an adjuvant therapy aims to eliminate microbes in skin lesions, promoting healing, through combination of electromagnetic radiation, photosensitizer and tissue oxygen, such action promotes high local cytotoxic effect, which leads pathogenic microorganisms to death.[8] Thus, photodynamic therapy in wound healing occurs initially by a light source transfers energy to the photosensitizing agent, and reacts with intracellular substrates, forming free radicals, which interact with molecular oxygen to form reactive oxygen species, producing antimicrobial effect.[5]

ILIB is continuous irradiation of red and/or infrared therapeutic laser in the radial artery region. From a bracelet fixed on the patient's wrist, the laser is absorbed and then

REVISTA ENFERMAGEM ATUAL IN DERME

runs through the bloodstream. This mechanism causes a series of immediate and chained effects, but which have prolonged duration in metabolism. Initially, there is an increase in the synthesis of main physiological protein regulating body oxidative system, superoxide dismutase (SOD), this enzyme inactivates reactive oxygen species (ROS), protecting cells against mutations and aging.[9]

In addition, laser irradiation contributes to improvement in hemorheological capacity of red blood cells, interfering with the arachidonic acid cascade (which have an inflammatory effect) and inducing production of prostacyclins, which provide a fluid character to blood reducing problems.[9]

Therefore, to integrate this technology in nursing care to patients with wounds is important. Few studies indicate use of lasers in nursing practice, even though this technique is recognized by the Federal Nursing Council (Conselho Federal de Enfermagem, COFEN)[10] and should be supported by the class. This study aims to demonstrate effects of low-power laser therapy as an adjuvant to nursing care in treatment of patients with vascular wounds.

METHODS

Study was approved by the Research Ethics Committee in accordance with the National Council of Health, Resolution No. 466, of December 12, 2012. Research participant was informed about risks and agreed to participate in the study and allowed his data and photos to be disclosed through signing of the informed consent agreement.

Single case study with a qualitative approach that allowed full investigation about a particular phenomenon of care.[11] Study was developed at the Nursing Outpatient Clinic in Stomal Therapy of the Regional University of Cariri (URCA), which is a school clinic for undergraduate and graduate students of the Regional University of Cariri located in the city of Crato, Ceará. Case Report Guidelines[12] criteria were adopted to guide this study.

Data collection occurred in september and october 2021 through medical records and nursing records, focusing on the main aspects related to history, nursing examination, therapeutic conduct, wound dressing and relevant observations present in records. To evolve the case specialist stomatherapists and generalist nurses with extensive experience in skin care have participated in patient's clinical follow-up.

After data collection, characteristics were identified on use of low-power therapy as an adjuvant in wound treatment, and data were exposed through patient history, images of wound evolution and a table containing information from the records.

RESULTS

Case report

Patient J.B.M. is 66 years old, married, retired, hypertensive, diabetic, weights 56kg

REVISTA ENFERMAGEM ATUAL IN DERME

(123.45lbs), height 1.69 m (5.54ft), BMI: 19.67, with medical history of cerebrovascular accident (CVA), vascular disorders, has right lower extremity amputation. He uses medicines: metformin, xarelto, hydrochlorothiazide, losartan and metoprolol. He attends the Stomatherapy Outpatient Clinic and in his first visit his main complaint is pain in the tibial region lesion in left lower limb on October 3, 2019.

Patient reports a history of injury, claims to have experienced a mechanical trauma in the region about three months ago and the site was hot and painful, wound was growing until a rigid crust formation. The patient reports use of crystal sugar as a primary cover and suspension of secondary coverage by another professional class conduct. Regrets the loss of the right lower limb and reports it all happened due to neglect over care and intends to change his lifestyle.

Physical examination has identified on the left limb a lesion with venous etiology, with necrotic tissue covering lesion, presence of dorsalis pedis and posterior tibial pulses, presence of phlogistic signals and lower limb edema.

At the beginning of treatment, at the first consultation, conservative sharp wound debridement was performed and necrotic tissue was removed, a deep and infected lesion was identified, with presence of purulent drainage, detached edge, slough on wound bed, points of infection and pain related to manipulation (Figure 2).

A service scale and reassessment of wound was performed, in which, laser therapy was an adjuvant associated with other conducts, such as debridement, use of primary and secondary coverage, changes in life habits; due to these techniques the lesion showed improvements. Treatment associated the use of photobiomodulation therapy, photodynamics and ILIB which started in the sixth consultation and ended in the 18th.

REVISTA ENFERMAGEM ATUAL IN DERME

Figure 1- Necrotic wound, Crato, Brazil, 2021.

Source: Personal archive

Figure 2 - Infected wound, Crato, Ceará, 2021.

Source: Personal archive

Specialized treatment for wound care by general nurses and stomatherapists was initiated, through conducts and techniques aimed at care for better healing, associated with low-power laser.

The follow-up lasted four months, with 20 nursing consultations.

REVISTA ENFERMAGEM ATUAL IN DERME

Table 1 - Records of nursing progress notes of medical records in each care of J.B.M., divided by consultation, examination, conduct, dressings and remarks. Crato, Brazil, 2021.

CONSULTATION	EXAMINATION	CONDUCT	DRESSING	REMARKS
1st	Necrotic tissue with coagulation; slough; exudate; pedal pulse present and filiform.	2% Chlorhexidine cleansing; Mechanical debridement with gauze and PHMB; Conservative sharp wound debridement.	Collagenase + Chloramphenicol; ointment; gauze and bandage.	There is no record.
2nd	Slough covering wound's surface; foul-smelling; sensitive to touch; purulent drainage.	Physiological saline solution 0.9% cleansing; Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement.	There is no record.	Patient referred to a physician for treatment with antimicrobial and analgesic.
3rd	Slough; Biofilm; exudate; wound edges macerated and eroded; sensitive to touch.	Physiological saline solution 0.9% cleansing; 2% Chlorhexidine cleansing; Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement.	Silver sulfadiazine; gauze and bandage.	There is no record.
4th	BP: 120/80 mmHg; glucose: 416 mg/dL; purulent exudate with wound undermining; maceration; slough; biofilm; sensitive to touch;	Physiological saline solution 0.9% cleansing; 2% Chlorhexidine cleansing; Cleansing with 10% hydrogen peroxide; Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement.	Silver sulfadiazine; gauze and bandage.	Patient oriented to seek for endocrinologist evaluation; To improve eating habits.
5th	BP: 120/80 mmHg; glucose: 266 mg/dL; Clinical improvement in lesion that produces low exudation and purulent drainage; slough; sensitive to touch.	Cleansing with 10% hydrogen peroxide; Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement;	10% papain ointment; gauze and bandage.	There is no record.
6th	BP: 140/80 mmHg; pulse: 100 bpm; Clinical improvement; slough, biofilm; soft wound edge by misuse of papain at home.	Physiological saline solution 0.9% cleansing; Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	There is no record.
7th	Clinical improvement related to low infection and presence of biofilm.	Polyhexanide (PHMB) cleansing; Mechanical debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	Patient oriented on correct use of papain ointment at home.
8th	Clinical improvement; presence of	Polyhexanide (PHMB) cleansing;	10% papain ointment; gauze and	There is no record.

REVISTA ENFERMAGEM ATUAL IN DERME

	granulation tissue; wound edge epithelialization, underdeveloped biofilm.	Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	bandage.	
9th	Clinical improvement; presence of granulation tissue; wound edge epithelialization; underdeveloped biofilm.	Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	Lesion size: 2.5 cm width and 4.5 cm length.
10th	Wound contraction; presence of biofilm; granulation tissue.	Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	Lesion size: 2.3 cm width and 4 cm length.
11th	Better clinical improvement than in other days; granulation tissue and biofilm; macerated edges.	Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	Lesion size: 1.8 cm width and 3.5 cm length.
12th	Wound contraction; granulation tissue; presence of biofilm.	Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	There is no record.
13th	Wound contraction; granulation tissue; presence of biofilm.	Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	10% papain ointment; gauze and bandage.	Lesion size: 1.5 cm width and 3.5 cm length.
14th	Granulation tissue with underdeveloped biofilm.	Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	There is no record.	There is no record.
15th	Granulation tissue with underdeveloped biofilm.	Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	Polyhexanide 0.2%; gauze and bandage.	There is no record.
16th	Granulation tissue with underdeveloped biofilm.	Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	Polyhexanide 0.2%; gauze and bandage.	There is no record.

REVISTA ENFERMAGEM ATUAL IN DERME

17th	Granulation tissue with underdeveloped biofilm.	Polyhexanide (PHMB) cleansing; Conservative sharp wound debridement; ILIB - systemic laser therapy; Photobiomodulation and photodynamic therapy.	Polyhexanide 0.2%; gauze and bandage.	There is no record.
18th	Granulation tissue with underdeveloped biofilm.	Conservative sharp wound debridement; ILIB - systemic laser therapy. Photobiomodulation and photodynamic therapy.	Polyhexanide 0.2%; gauze and bandage.	There is no record.
19th	Granulation tissue.	Polyhexanide (PHMB) cleansing.	Polyhexanide 0.2%; gauze and bandage.	There is no record.
20th	Wound closure; Patient is discharged.			

Source: Authors.

Parameters of low level laser therapy were based on the laser use guideline in vascular lesions[13,14]: 30 minutes ILIB therapy with light on the right radial pulse, photobiomodulation therapy at 4 Joules per minute on peri-lesion skin, red light plus infrared, photo-dynamic therapy in 20 Joules per cm² associated with use of Methylene Blue 0.1%. Laser model used for conducting the case was: DMC Therapy EC.

REVISTA ENFERMAGEM ATUAL IN DERME

Figure 3 - Wound evolution according to treatment, Crato, Brazil, 2022.

Source: Personal archive

DISCUSSION

Low level laser therapy, ILIB, phototherapy and photodynamics were initiated at the sixth consultation. Indication occurred through an evaluation of the patient's general condition analyzing inflammatory aspects of the lower limb, resistant wound infection and difficulty in healing response.

Table 1 describes all information extracted from the patient's evolution, in which it was divided into examination, conduct, dressing and remarks. In the gaps in which there is the information "there is no record", it means in nursing progress notes, referring to consultation, no information was observed that fit classification.

Regarding physical examination, information is related to the patient's signs and symptoms, lesion characteristics and alterations observed by the professional. Concerning conduct, there are techniques performed during service, which is frequently observed cleaning, conservative sharp wound debridement and application of laser therapy. Relating to observations, those referring to orientations are present, referral to other professionals and lesion size.

In order to reduce local infection impaired wound evolution, use of photodynamic therapy proved effective since its first application. After use of this therapy associated with Methylene Blue 0.1%, at the seventh consultation (Table 1), an improvement in the patient's clinical picture related to infection was identified through the nursing physical exam. Conduct of photodynamics with use of Methylene Blue 0.1% for Moura, Brandão and Barcessat[8], in their research, shows a good penetration of relative light into the skin proving an antibacterial action with low toxicity.

Inflammatory process associated to a infected wound has a direct effect on pain and

REVISTA ENFERMAGEM ATUAL IN DERME

local sensitivity[15], in which, in the results, examination (Table 1) shows in the third, fourth and fifth consultation, sensitivity to wound manipulation and after beginning of the use of laser therapy, it is not evident in evolutions and examinations, information regarding pain in manipulation.

Biofilm was mentioned in examination (Table 1), from first to eighteenth consultation, as a factor present in wound bed. This set of microorganisms attached to the wound forming an intricate of exopolysaccharide matrix, often presents itself clearly, developing wound bed whitish, opaque and with shiny film, in some cases is only visible through a microscope.[16]

These intricate organic polymers make wound healing difficult and often cannot be eliminated with use of oral antibiotics. Low-power photodynamic therapy mediated by Methylene Blue, applied directly in biofilm, according to Da-Silva[17] reduce significant microbial load, in different concentrations, however, in his study, it was not possible to observe complete biofilm elimination, these conditions are directly linked to irradiation time and consequently a higher dose of deposited energy.

With infectious wound control, photobiomodulation applied peri-lesion showed good results in its healing process and cellular stimulus. It was observed throughout the care process closure of the edges that were detached and appearance of granulation tissue, which resulted in lesion healing. Figure 3 shows the healing process, as it proceeded. Brandão et al.[18], explains photobiomodulation as a therapy of great action in the wound, and this technology has benefits, such as increased perfusion of diseased tissue, cell proliferation, stimulation of neovascularization compared to treatment of individuals who do not use this technology. Thus, it was possible to identify laser as an adjuvant therapy, providing relief in pain status and local discomfort of the patient.

Regarding dosage used during laser therapy sessions, photobiomodulation was performed in (4J/min) for each cm² peri-lesion, red light plus infrared. Use of these parameters proved its efficiency during treatment and accelerated healing process. Mathur et al.[3] applied in diabetic ulcer dosimetry of 3 to 6J/cm² in the area of impaired tissue and author asserts these parameters are within standards for intensification of wound closure, reducing inflammatory action, increasing collagen deposition and greater myofibroblasts proliferation.

Associated with other therapies mentioned above, ILIB was applied for 30 minutes in the right radial pulse from sixth consultation to eighteenth (Table 1). This therapy is understudied in literature, relating to treatment of wounds, but, proven, its function is associated with systemic anti-inflammatory actions, improving blood perfusion, aiding the immune system, promoting oxygenation and cellular nutrition. Widely used in aesthetics field, as a strong combatant to cellular premature aging.[9]

REVISTA ENFERMAGEM ATUAL IN DERME

Diabetes mellitus is a disease considered complex that delays wound healing and changes leukocytes functions, altering inflammatory processes. It is observed in clinical case the patient has decompensated diabetes, which characterizes another challenge for wound healing. Based on results analysis of the study by Brandão et al.[18], there is a consensus that use of low-intensity laser is beneficial for progress of tissue repair in diabetic patients with injury. Therefore, this effectiveness is observed in the process of wound care through laser in the study of this case.

As described in (Table 1), during consultations an improvement and wound contraction were identified, as well as a decrease in inflammatory process, reported in the nursing examination. Salvi et al.[19], declares laser recruits cytokines and growth factors, promoting an increase in neovascularization and fibroblast proliferation and improves inflammation in lesions, which consequently contributes to modulation of tissue repair with an organized and rapid healing, reaffirming what brings the study of Brandão el al.[18]

A randomized clinical trial conducted at Hospital das Clínicas de Porto Alegre, which compared conventional treatment to adjuvant treatment with low level laser therapy in venous ulcers of 40 patients, demonstrated patients who received adjuvant treatment with low level laser therapy had notable improvement in healing scores compared to those receiving conventional treatment, with statistically significant differences related to aspects as wound size and scar formation.[20]

Study by the authors[20], explains the reason for rapid wound healing, when compared to other studies that do not bring use of the same therapy associated with treatment. Patient attended twenty consultations and his treatment lasted four months. Due to its complexity, healing time with use of therapy was fast and brought results.

To emphase care for individuals with wounds Persilva[13] asserts it is a work mainly directed for the nurse. Among techniques recognized by the Federal Nursing Council (Conselho Federal de Enfermagem, COFEN), according to the Advisory Opinion of the Technical Chamber No. 13/2018/CTLN/COFEN, this one deliberates the use of low level laser for treatment of wounds and other associated problems by the nurse.[10]

Thus, it is necessary to train nursing professionals in laser therapy and they need to seek for update this knowledge, because efficacy of this therapy is related to correct application of doses, which will depend on the type of lesion and the patient.[10]

CONCLUSION

Use of low-power laser as an adjuvant in treatment of vascular wounds proved to be efficient and brought good results throughout the treatment. Despite complexity of the case and local infection resistance, the three therapies, ILIB, photobiomodulation and photodynamics

REVISTA ENFERMAGEM ATUAL IN DERME

were able to solve these problems, aiming at healthy healing.

This study shows the importance of nurses in the use of new technologies for wound treatment. This professional, based on their academic background, must have practical and scientific knowledge for wound care, thus associating improvement in new technologies for this practice, such as use of low-power laser.

There are still few studies in literature that bring the effects of laser therapy in practice. Clinical cases are important for professionals' knowledge of these management and implementation of good practice in care. Further studies aimed at laser therapy are needed, as this technique has proved effective in practice and needs to be scientifically significant.

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