RIASE
REVISTA IBERO-AMERICANA DE SAÚDE E ENVELHECIMENTO
REVISTA IBERO-AMERICANA DE SALUD Y ENVEJECIMIENTO

COLD ATMOSPHERIC PLASMA IN THE HEALING OF LEG ULCER IN A PATIENT WITH BEHÇET SYNDROME: CASE REPORT

PLASMA ATMOSFÉRICO FRIO NA CICATRIZAÇÃO DA ÚLCERA DE PERNA NUM UTENTE COM SÍNDROME DE BEHÇET: RELATO DE CASO

PLASMA ATMOSFÉRICO FRÍO EN LA CURACIÓN DE UNA ÚLCERA DE PIERNA EN UN PACIENTE CON SÍNDROME DE BEHÇET: INFORME DE CASO

Adélia Carinhas Gonçalves Pereira[1]; Katia Furtado[2,3];
Isaura Serra[4,3]; Maria do Céu Marques[4,3].

[1]Évora Hospital, Central Alentejo Local Health Unit of Évora, Évora, Portugal.
[2]Portalegre Hospital, Alto Alentejano Local Health Unit of Portalegre, Portugal.
[3]Comprehensive Health Research Centre (CHRC), University of Évora, Évora, Portugal.
[4]Nursing Department, University of Évora, Évora, Portugal.

Received/Recebido: 2025-03-21 Accepted/Aceite: 2025-03-27 Published/Publicado: 2025-03-31

DOI: http://dx.doi.org/10.60468/r.riase.2024.10(3).732.151-172

ABSTRACT

Introduction: Recent studies have shown that the use of cold atmospheric plasma in wound treatment is promising. Although compression therapy is essential for healing leg ulcers, cold atmospheric plasma increases vascularization and angiogenesis, accelerating healing.

Objective: To describe the healing process of leg ulcers in a patient with Behçet's Syndrome after the application of Cold Atmospheric Plasma and the Impact on Quality of Life.

Methodology: A case report was prepared according to the CARE CASE REPORT guideline regarding a patient with Behçet's Syndrome, with leg ulcers, followed at a Complex Wound Center. Data collection was carried out using a semi-structured interview guide, based on the Nancy Roper Theoretical Model; Cardiff Scale and RESVECH 2.0 Scale. The ICNP, NIC and NOC taxonomy were used for the Nursing Care Plan.

Results: The diagnostic evaluation allowed the identification of nursing diagnoses and the definition of an individualized intervention plan. The application of Cold Atmospheric Plasma resulted in good results for the evolution of the healing of leg ulcers, despite the aggravating factor of having Behçet's Syndrome.

Conclusion: The healing evolution of leg ulcers after the application of the new treatment was quite positive, reflecting an improvement in the patient's quality of life. However, in parallel with the intervention described, it is important to manage comorbidities and optimize rest and nutrition.

Keywords: Case Report; Cold Atmospheric Plasma; Leg Ulcer; Nursing Care; Quality of Life.

RESUMO

Introdução: Estudos recentes demonstram que o uso de plasma atomosférico frio no tratamento de feridas é promissor. Embora a terapia compressiva seja essencial na cicatrização das úlceras de perna, o plasma atomosférico frio aumenta a vascularização e a amgiogenese, acelerando a cicatrização.

Objetivo: Descrever o processo de evolução da cicatrização das úlceras de perna num utente com Síndrome de Behçet após aplicação de Plasma Atmosférico Frio e o Impacto na Qualidade de Vida.

Metodologia: Foi elaborado um relato de caso segundo a *guideline* CARE CASE REPORT referente a um utente com Síndrome de Behçet, com úlceras de perna, acompanhado num Centro de Feridas Complexas. Recolha de dados com recurso a guião de entrevista semi-estruturada, com base no Modelo Teórico de Nancy Roper; Escala de Cardiff e Escala RESVECH 2.O. Para o Plano de Cuidados de Enfermagem foi utilizada a taxonomia CIPE, NIC e NOC.

Resultados: A avaliação diagnóstica permitiu a identificação de diagnósticos de enfermagem e a definição de um plano de intervenção individualizado. A aplicação do Plasma Atmosférico Frio refletiu bons resultado para a evolução da cicatrização das úlceras de perna, apesar da agravante de ser portador de Síndrome de Behçet. Conclusão: A evolução cicatricial das úlceras de perna após a aplicação do novo tratamento foi bastante positiva, refletindo numa melhoria da qualidade de vida do utente. Não obstante, paralelemente á intervenção descrita é importante gerir as comorbilidades e otimizar o repouso e nutrição.

Palavras-chave: Cuidados de Enfermagem; Plasma Atmosférico Frio; Qualidade de Vida; Relato de Caso; Úlcera de Perna.

RESUMEN

Introducción: Estudios recientes demuestran que el uso de plasma atmosférico frío en el tratamiento de heridas es prometedor. Aunque la terapia de compresión es esencial en la curación de las úlceras en las piernas, el plasma atmosférico frío aumenta la vascularización y la angiogénesis, acelerando la curación.

Objetivo: Describir el proceso de cicatrización de úlceras de pierna en un paciente con Síndrome de Behçet después de la aplicación de Plasma Atmosférico Frío y el Impacto en la Calidad de Vida.

Metodología: Se elaboró un informe de caso según la guía CARE CASE REPORT de un paciente con síndrome de Behçet, con úlceras en las piernas, seguido en un centro de heridas complejas. Recolección de datos mediante guía de entrevista semiestructurada, basada en el Modelo Teórico de Nancy Roper; Escala de Cardiff y escala RESVECH 2.O. Para el Plan de Atención de Enfermería se utilizó la taxonomía CIPE, NIC y NOC.

Resultados: La evaluación diagnóstica permitió la identificación de diagnósticos de enfermería y la definición de un plan de intervención individualizado. La aplicación de Plasma Atmosférico Frío reflejó buenos resultados para la evolución de la cicatrización de las úlceras de pierna, a pesar del factor agravante de padecer Síndrome de Behçet.

Conclusión: La evolución de la curación de las úlceras de pierna tras la aplicación del nuevo tratamiento fue bastante positiva, reflejando una mejora en la calidad de vida del usuario. Sin embargo, paralelamente a la intervención descrita, es importante manejar las comorbilidades y optimizar el descanso y la nutrición.

Descriptores: Atención de Enfermería; Calidad de Vida; Informe de Caso; Plasma Atmosférico Frío; Úlcera de Pierna.

INTRODUCTION

Leg ulcers represent a major health problem, as they increase health costs and morbidity for people with leg ulcers. Although venous leg ulcers are the most common, identifying the presence of concomitant obstructive arterial disease is important to determine the most appropriate therapeutic approach. The combination of venous and arterial disease is called arteriovenous disease, and leg ulcers are defined as arterial and venous etiology[1].

These ulcers present as wounds that are difficult to heal due to venous and arterial factors that hinder the normal healing process. Thus, they last over time and cause changes in self-esteem, pain, changes in sleep quality, inability to work and reduced quality of life[2].

Several factors can contribute to the appearance of leg ulcers, such as Behçet's Syndrome (BS). BS is a chronic disease that affects several systems of the body and is characterized by a pattern of vascular changes that cause systemic vasculitis and thrombosis. During the course of the disease there are remissions and exacerbations; however, the increase in inflammatory mediators results in acute tissue damage and lesions[3].

Compression therapy stands out for its ability to reduce edema, improve venous reflux and arterial perfusion, and reduce local inflammatory effects. It can be used for ulcers of venous and arterial aetiology (with moderate involvement). This therapy is the basis of treatment for leg ulcers and for preventing recurrences, improving the patient's quality of life[1].

A non-invasive and cost-effective therapeutic innovation in the treatment of difficult-to-heal wounds is the application of Cold Atmospheric Plasma (CAP), which has the ability to enhance local microcirculation and improve wound healing[4].

This Case Report studies the clinical case of a patient with Behçet's Syndrome, who lives with leg ulcers of venous aetiology in the left lower limb (LLL) and of arterial and venous aetiology in the right lower limb (RLL), with a history of recurrences. This patient received nursing care that included, among other things, the treatment of leg ulcers with compression therapy and CAP and the assessment of the impact of the healing of these wounds on his quality of life. This study is relevant because it corroborates the effectiveness of this technique in wound healing and demonstrates positive results in terms of improving quality of life.

This study was developed at a Complex Wounds Center. The CARE guidelines for Case Reports from the Equator-network were used to prepare it, as a simplified structure for organizing the case report, and the Vancouver standards[5].

METHODOLOGY

It is a case report, based on a descriptive and observational study, with the purpose of presenting in a narrative way the diagnostic evaluation of the clinical case, the identified nursing diagnoses, interventions and results related to a user, allowing scientific and educational development. This report aims to evaluate the evolution of the healing of leg ulcers in a user with Behçet Syndrome after the application of CAP and the Impact on the Quality of Life of this individual. Data collection was carried out through a semi-structured interview, during nursing consultations, using direct observation and assessment. Informed consent was obtained from the user for the processing and disclosure of data for academic purposes and, if possible, scientific dissemination and/or publication in scientific journals, in accordance with Standard No. 015/2013 of the DGS[6], complying with the principles in force in the Declaration of Helsinki for studies involving human beings and with the explicit recommendations in the Oviedo Convention to guarantee human dignity. The collaboration of the nurses who regularly monitor the patient and the information available in the SClinico computer system were also taken into account.

This Case Report was prepared in accordance with the Care guidelines for Case Reports, which are the guidelines used in clinical case reports, in the form of an organized and structured narrative, which includes clinical questions, diagnoses, interventions, results, adverse events and the monitoring of the patient under study. It includes the discussion and justification of the conclusions and the main messages of the case report[7].

The study carried out was based on the clinical situation of a 50-year-old male patient, followed in the nursing consultation at a Complex Wounds Center. This patient had bilateral leg ulcers, and was referred by the reference USF, due to difficult healing of the ulcers, with a history of multiple recurrences. He began to be monitored at the Complex Wounds Center at the beginning of 2023. For a systematic presentation of the clinical case under study, a flowchart was prepared, according to the CARE guidelines. (Figure 1↗).

The patient has the following personal history: multisystemic Behçet's syndrome, high blood pressure, active smoking (4 cigarettes/day), asthmatic bronchitis, AMI in 2018, pacemaker since November 2023, hyperuricemia, grade II obesity, unspecified CHF, varicose vein surgery at the LLL 15 years ago and amputation of the distal phalanx of the third finger of the left hand, due to ischemia, 2 years ago. Polymedicated user, with a history of impaired adherence to the prescribed therapy. No known allergies. He has no family history of BS. He had previous hospitalizations for infection of lower limb ulcers, in the context of BS, peripheral arterial disease, ischemic heart disease and decompensated heart failure. The most recent hospitalization, for bacterial pneumonia, occurred in February 2024.

The taxonomy of the International Classification for Nursing Practice (ICNP, 2019)[8] was used to implement the Nursing Care Plan and construct the diagnoses, the nursing interventions were identified through the Nursing Intervention Classification (NIC, 2010)[9], and the results and their evaluation were carried out based on the Nursing Outcome Classification (NOC, 2010)[10]. It should be noted that the interventions and monitoring of the results were carried out in a personalized manner and adapted according to the patient's clinical situation.

The diagnostic evaluation allowed the identification of five Nursing Diagnoses. Roper, Logan and Tierney's Nursing Model Theory aims to help nurses plan personalized interventions in order to empower, alleviate or resolve needs that arise in any of the users' Activities of Daily Living (ADLs), and prevent their reappearance[11]. This model allowed the identification of nursing focuses, based on the ICNP language (2019), and respective diagnoses (Table 1↗).

RESULTS

All these aspects influence the patient's quality of life, which was assessed according to the Cardiff Wound Impact Scheme (2007)[13], which revealed that the patient feels confident that his/her wounds will heal, but is concerned that they may recur, and feels discomfort due to the exudate, odor and applied bandages. In addition, the difficulty in taking a bath is something that greatly disturbs him/her. He/she was ranked 6th in "How is your quality of life?" and 5th in "To what extent are you satisfied with your quality of life in general?".

An individualized care plan was drawn up for each diagnosis, as well as the expected results, the indicators assessed and the monitoring of the results (Tables 2-7↗).

Regarding the patient's quality of life, after reassessment using the Cardiff Scale (2007)[13] on 03/07/24, the patient remains confident that his wounds will heal, is afraid of getting hurt by the lesions, and has less discomfort in relation to the wound and the odor. Despite maintaining his position at 6 regarding "How is your quality of life?", on a scale of 0 to 10, his position improved to 7 regarding "To what extent are you satisfied with your quality of life in general?".

The patient showed receptiveness to the nursing care provided to him and to the advice of health professionals. He states that "he has been well treated and is very expectant with the new treatment" (sic). Despite this, he shows concern about the possibility of the wounds recurring. He plans to improve his eating habits, ingest more protein, and adopt measures to prevent recurrence. Furthermore, he is pleased to be able to return to work and to see the symptomatic improvement associated with the healing process.

DISCUSSION

The presence of Behçet's syndrome, which corresponds to chronic inflammation of blood vessels and skin lesions[17] and causes an increase in inflammatory mediators, leading to multisystemic inflammation and tissue damage[3], contributes to the difficulty in healing leg ulcers. Vascular inflammation may involve large, medium or small vessels, with vasculitis of small vessels frequently observed during the course of the disease[3]. Treatment of the disease is symptomatic, to control inflammation and functional changes.

Since these are leg ulcers, it is important to determine their etiology before therapy in order to adapt the ideal treatment. Treatment involves wound care, application of compression therapy and prevention of recurrences[18]. Preparation of the wound bed is essential for healing and is performed by cleaning the wound with water at 37°C and neutral soap, and with cleaning products with bactericidal action, such as hypochlorous acid, and debridement with a curette, to help the wound overcome the inflammatory phase; hydration of the peri-injury skin, to prevent further injury; and application of a dressing to manage moisture (in this case, a foam). As an increase in wound odor and yellow exudate (signs of infection) was observed, an antimicrobial dressing, Dialkylcarbamyl Chloride[19], was applied. Compression therapy was used to treat these ulcers and allowed for a reduction in edema of the lower limbs and improvement in venous and arterial insufficiency. The selection of a multilayer compression is more effective in this treatment and is intended to provide compression during muscle contraction[18]. In this case, it was possible to apply compression therapy to the RLL, with arterial compromise, since when the IPTB is between 0.5 and 0.8, it benefits from modified compression therapy, that is, between 20 and 30 mmHg, which was well tolerated by the patient. The intervention in the wound with the application of CAP allowed progression in the healing of the ulcers and, consequently, in the Quality of Life of the patient. CAP significantly improves microcirculation in chronic wounds and, when applied more than once, increases blood flow and local oxygen. It stimulates angiogenesis and has bactericidal action[4]. The results of the effectiveness of this treatment are visible through the figures below, which depict a timeline, from the first session (Figures 1A and 1B)↗ to the tenth (Figures 3A and 3B)↗. The assessment on 03/07/24 corresponds to the resumption of CAP treatments, after having been interrupted for two weeks, due to hospital admission of the patient due to Bacterial Pneumonia. In these last figures it was possible to observe the regression in the characteristics and size of the wounds, due to the non-application of compression therapy and CAP.

According to Alves *et al* (2021), chronic inflammation in complex wounds leads to malnutrition of the extracellular matrix and protein loss. Malnutrition prolongs the healing process because it reduces the proliferation of fibroblasts and the formation of collagen, and increases the risk of infection, as it reduces phagocytic activity, T-cell function, and the production of antibodies and complement factor[20]. Therefore, a higher quality food intake is important: proteins (meat, fish, eggs, legumes), which help in the synthesis of enzymes essential for healing, collagen synthesis and cell proliferation; arginine supplementation (source of protein); carbohydrates (pasta, rice, bread, potatoes), which are a source of energy for cells and promote healing; fats (nuts, flaxseed, salmon, sardines), which are an energy reserve for cells and help in the synthesis of the cell membrane/matrix; Vitamins A, C and E also help in wound healing and are found in vegetables, yogurts, cheese, fruits, and the mineral zinc (clams, beef, beans, chicken)[20].

Maintaining quality sleep is also an important factor for wound healing, since anabolic processes (cell renewal) occur during sleep. Sleep also has an impact on homeostasis and skin restoration after injury[21].

It is possible to conclude, when analyzing the results obtained with the Care Plan, that more time in contact with the patient would be necessary to work on the intervention "Nutrition Control", as well as "Circulatory Care: Venous/Arterial Insufficiency", with regard to wound assessment and care and prevention of recurrence. The patient's follow-up was positive, however, the limited hours for implementation and evaluation of all the interventions performed compromised the achievement of better results. The patient continues to be monitored by nurses working at the Complex Wounds Centre, with a view to achieving the best results. Regarding the work carried out with the patient, his improved perspective regarding the clinical situation was noticeable, as he noted improvements in the size of the lesion, exudate, pain and itching.

The application of this new CAP technology has resulted in good results for the evolution of the healing of the leg ulcers of this patient, who has the added problem of having Behçet's Syndrome, a factor that compromises circulation due to chronic vasculitis. These treatments performed on the leg ulcers, together with careful cleaning of the wound and application of compression therapy, have reduced the size of the wounds. In addition, the importance of a good nutritional intake and quality of sleep for successful healing is highlighted.

CONCLUSION

Complex wound healing is often compromised by comorbidities, and new technologies are sometimes needed to accelerate the healing process. In this case, CAP has proven to be a good choice for healing difficult-to-heal leg ulcers. The existence of a wound has an impact on the individual's Quality of Life, so nursing care must be person-centered and based on scientific studies. The person's adherence to treatments is essential and it is the nurse's responsibility to involve the patient in the provision of care, benefiting and managing their expectations. Systematic reviews indicate that CAP has the potential to be a promising technology in the wound healing process, although further studies are needed to standardize protocols and confirm its effectiveness in clinical applications.

REFERENCES

1. Lim SL, Chung RE, Holloway S, Harding KG. Modified compression therapy in mixed arterial-venous leg ulcers: An integrative review. Int Wound J [Internet]. 2021 Dec [cited 2024 Mar 1];18(6):822-42. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=153791377&lang=pt-pt&site=ehost-livedoi:10.1111/iwj.13585

2. Ribeiro GS, Cavalcante TB, Santos KC, Feitosa AH, Silva BR, Santos GL. Pacientes internados com feridas crônicas: um enfoque na qualidade de vida. Enferm Foco [Internet]. 2019 Jun [cited 2024 Feb 20]; 10(2):70-5. Available from: https://eds.p.ebscohost.com/eds/pdfviewer/pdfviewer?vid=28&sid=e42be1ed-b9ad-4465-a803-bc08708cf405%40redis

3. Adisen E, Temel B. Behçet's Disease. Gazi Med J [Internet]. 2019 Mar [cited 2024 Feb 20];30(2): 221-6. Available from: https://medicaljournal.gazi.edu.tr/index.php/GMJ/article/view/1758/1411doi:10.12996/gmj.2019.58

4. Schleusse S, Schulz L, Song J, Deichmann H, Griesmann A, Stang FH, et al. A single application of cold atmospheric plasma (CAP) improves blood flow parameters in chronic wounds. Microcirculation Wiley [Internet]. 2022 Feb [cited 2024 Jan 30]; 29(3):1-8. Available from: https://onlinelibrary.wiley.com/doi/epdf/10.1111/micc.12754 doi:10.1111/micc.12754

5. Pontifícia Universidade Católica de Minas Gerais, Sistema Integrado de Bibliotecas. Orientações para formatação de artigos científicos: conforme o estilo Vancouver [Internet]. Belo Horizonte: Sistema Integrado de Bibliotecas. 2021 [cited 2024 Jan 30]. Available from: https://portal.pucminas.br/biblioteca/documentos/VANCOUVER-2022-NV.pdf

6. Direção-Geral da Saúde. Consentimento Informado Esclarecido e Livre Dado por Escrito. Norma n.º 015/2013[Internet]. 2015 [cited 2024 Mar 10]; p.16. Available from: https://www.dgs.pt/normas-orientacoes-e-informacoes/normas-e-circulares-normativas/norma-n-0152013-de-03102013-pdf.aspx

7. Riley DS, Barber MS, Kienle GS, Aronson JK, Schoen-Angerer TV, Tugwell P, et al. CARE guidelines for case reports: explanation and elaboration document. J Clin Epidemiol [Internet]. 2017 Sep [cited 2024 Feb 19];89:218-35. Available from: http://dx.doi.org/10.1016/j.jclinepi.2017.04.026

8. International Council of Nurses. Browser CIPE [Internet]. 2019 [cited 2024 Mar 20]. Available from: https://www.icn.ch/icnp-browser

9. Bulechek GM, Butcher HK, Mccloskey Dochterman J. Classificação das Intervenções de Enfermagem (NIC). 5.ª ed. Rio de Janeiro: Elsevier; 2010.

10. Moorhead S, Johnson M, Maas M, Swanson E. NOC_4ed. 4ª ed. Rio de Janeiro: Elsevier; 2010.

11. Fonseca C, Coroado R, Pissarro M. A importância do Modelo das Atividades de Vida de Nancy Roper, Winifred Logan e Alison Tierney na formação de estudantes do curso de licenciatura em Enfermagem. J Aging Innov[Internet]. 2017 Dec [cited 2024 Mar 10];6(3):96-102. Available from: http://www.journalofagingandinnovation.org/wp-content/uploads/10-Nancy-Roper.pdf

12. Todorovic V, Russel C, Elia M. O folheto explicativo da "MUST": um guia para a "Malnutrition Universal Screening Tool" [Internet]. 2011 Nov [cited 2023 Dez 12]. Available from: https://www.bapen.org.uk/images/pdfs/must/portuguese/must-exp-bk.pdf

13. Ferreira PL, Miguéns C, Gouveia J, Furtado K. Medição da qualidade de vida de doentes com feridas crônicas: a Escala de Cicatrização da Úlcera de Pressão e o Esquema Cardiff de Impacto da Ferida. Nursing [Internet]. 2007 Mai [cited 2024 Mar 10];32-41. Available from: https://www.researchgate.net/publication/289546976

14. Marques JM. Adaptação Cultural e Validação para a População Portuguesa de um Instrumento de Monitorização de Feridas Crônicas: Escala Resvech 2.0. [Dissertação de Mestrado]. Porto: Universidade Católica Portuguesa. 2017 Sep [cited 2024 Mar 15]. Available from: https://repositorio.ucp.pt/bitstream/10400.14/28142/1/REVISAO%20RESVECH%20-%20José%20Miguel%20Nunes%20Duarte%20Marques.pdf

15. Júnior NF, Bezerra SM, Branco NF, Carvalho MR, Júnior KR, Ferreira LF, et al. Ferramenta TIME para avaliação de feridas: concordância interobservador. Estima Braz J Enterostomal Ther [Internet]. 2020 Jul [cited 2024 Mar 3];18:1720. Available from: https://www.revistaestima.com.br/estima/article/view/875/321 doi:10.30886/estima.v18.875_PT

16. Direção-Geral da Saúde. A Dor como 5.º sinal vital. Registo sistemático da intensidade da Dor [Internet]. Circular Normativa n.º 09/DGCG. 2003 [cited 2024 Mar 15]; p.1-4. Available from: https://www.aped-dor.org/documentos/DGS-dor_como_5_sinal_vital_-_2003.pdf

17. Sato M, Chen KR, Yamamoto T. Coexistence of superficial thrombophlebitis and cutaneous venulitis in Behçet's disease: Report of 5 cases. Indian J Dermatol [Internet]. 2022 Nov-Dec [cited 2024 Mar 14];67(6):721-4. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10043681/ doi:10.4103/ijd.ijd_229_22

18. DeBacker SE, Bulman JC, Weinstein JL. Wound care of venous ulceration. Semin Intervent Radiol [Internet]. 2021 Jun [cited 2024 Mar 14];38(2):194-201. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8175111/pdf/10-1055-s-0041-1727161.pdf doi:10.1055/s-0041-1727161

19. Mosti G, Magliaro A, Mattaliano V, Picerni P, Angelotti N. Comparative study of two antimicrobial dressings in infected leg ulcers: a pilot study. Wound Healing South Afr [Internet]. 2020 [cited 2024 Feb 20]; 13(2):46-50. Available from: https://journals.co.za/doi/pdf/10.10520/ejc-mp_whsa-v13-n2-a3

20. Alves P, Teixeira A, Albuquerque L, Borges C, Magalhães B, Mendes D, et al. O Papel da Nutrição na Prevenção e Tratamento de Feridas. Associação Portuguesa de Tratamento de Feridas [Internet]. 2021 [cited 2024 Mar 14]. Available from: https://www.nestlehealthscience.pt/sites/default/files/2021-11/WhitePaper_Nutri%C3%A7%C3%A3o%20e%20Feridas.pdf

21. Gethin G, Touriany E, van Netten JJ, Sobotka L, Probst S. The impact of patient health and lifestyle factors on wound healing, Part 1: Stress, sleep, smoking, alcohol, common medications and illicit drug use. J Wound Manag[Internet]. 2022 [cited 2024 Mar 10];(1 Suppl 1, pt 1):S1-41. Available from: https://www.researchgate.net/publication/361052351_The_impact_of_patient_health_and_lifestyle_factors_on_wound_healing_Part_1_Stress_sleep_smoking_alcohol_common_medications_and_illicit_drug_use doi:10.35279/jowm2022.23.01.sup01.01

Authors
Adélia Carinhas Gonçalves Pereira
https://orcid.org/00009-0008-4929-5854
Katia Furtado
https://orcid.org/0000-0002-1130-3678
Isaura Serra
https://orcid.org/0000-0002-1225-6631
Maria do Céu Marques
https://orcid.org/0000-0003-2658-3550

Corresponding Author/Autora Correspondente
Adélia Pereira – Hospital do Espírito Santo Évora, Portugal.
adeliapereira01@gmail.com

Authors' contributions/Contributos dos autores
AP: Study coordination, study design, collection, storage, and analysis of data, review and discussion of results.
KF: Study design, data analysis, review and discussion of results.
IS: Study design, data analysis, review and discussion of results.
MM: Study design, data analysis, review and discussion of results.
All authors have read and agreed with the published version of the manuscript.

Ethical Disclosures
Conflicts of Interest: The authors have no conflicts of interest to declare.
Financial Support: This work has not received any contribution, grant or scholarship.
Provenance and Peer Review: Not commissioned; externally peer reviewed.

Responsabilidades Éticas
Conflitos de Interesse: Os autores declararam não possuir conflitos de interesse.
Suporte Financeiro: O presente trabalho não foi suportado por nenhum subsídio ou bolsa.
Proveniência e Revisão por Pares: Não comissionado; revisão externa por pares.

Figure 1 – CARE guidelines flowchart.

Table 1 – Roper, Logan and Tierney's life activities.

Daily Life Activities	Focus	Diagnosis
Maintaining a Safe Environment The patient lives with his parents and brother in his own home, with safe and adequate conditions. He has attended his nursing and medical appointments. His vaccination plan is up to date. He has two bilateral leg ulcers, in the region of the internal malleolus, due to his BS and venous and arterial insufficiency of the lower limbs, which he has been dealing with since he was 20 years old. He has edema and pruritus related to the wounds, which are included in this diagnosis.	Leg ulcer	Leg ulcer present
Communication No changes in communication pattern. Reports pain when undergoing treatments, mainly in the LLL (venous ulcer), and when walking for long periods. Feels anxious when undergoing treatment due to the possibility of pain and the possibility of ulcers recurring.	Pain Anxiety	Pain present Anxiety present
Breathing No respiratory changes. Vital signs assessed: 141/86 mmHg, 77 bpm, 96%SpO2, 36.6°C. At the time of assessment, no pain. Apneic on room air, 22 crm. Full and rhythmic pulse (Pacemaker). Asthmatic bronchitis, under Budesonide 160 mcg + Formoterol 4.5 mcg.		
Eating and drinking The patient only has a full meal at lunch. For breakfast, he eats cereal with milk and for a snack, a cheese sandwich. For dinner, he eats soup and fruit. He does not take protein supplements. He drinks 1.5 L of water/day. The MUST Nutritional Assessment Scale (Appendix IV)[12] was applied, according to which the patient is overweight with an estimated BMI of 27.5 kg/m^2, with an involuntary loss of approximately 5 kg in the last 3-6 months, and is at high risk of malnutrition.	Nutritional intake	Nutritional intake compromised
Elimination No changes in the elimination pattern.		
Personal Hygiene and Clothing The patient reports difficulty in bathing due to wounds on the lower limbs. He overcomes this difficulty independently, with some strategies: he uses a basin to wash his thighs; he washes his head, torso and upper limbs separately. His skin and mucous membranes are flushed. The skin on his lower limbs is dry, which is treated when the wound is cared for. He has dystrophic nails due to hypoperfusion.		
Control of body temperature Apyretic. He knows the sensations of cold and heat. He usually has cold extremities, but warms himself with clothes, blankets or heaters, with caution.		
Mobility No changes in mobility. He says he has had numbness in his legs, but that it has not happened recently. When he walks for a long time or stands for a long time, he feels pain, which relieves with rest.		
Work and leisure The patient works as a waiter in a bakery. He spends his free time with friends and family. He enjoys watching films and football on television.		
Sexuality expression The patient is divorced. He feels uncomfortable with his body image due to his wounds. He is bothered when the exudate from the wounds gets on his clothes and releases an odor, so he chooses to avoid other people and often prefers to walk and avoid the bus due to the odor from the wound. He says that, nowadays, since the wounds have less exudate, this no longer happens as often. He is concerned about his clothes and tries to be comfortable. He occasionally takes care of his toenails.		

Table 1 – Roper, Logan and Tierney's life activities.

Sleep	Focus	Diagnosis
Refers that he has difficulty falling asleep and that he sometimes wakes up during the night with pain. Sleeps about 5-6h/day. Death	Self-image	Self-image compromised
This ADL was not addressed in the interview.	Sleep	Sleep compromised

Table 2 – Diagnosis "Leg ulcer present".

CIPE Diagnosis: "Leg Ulcer Present"

Expected Outcome (NOC): "Wound Healing: Second Intention" (1103)

Interventions (NIC)

"Circulatory Care: Venous Insufficiency" (4066)

- To assess peripheral pulses, edema, skin color and temperature;
- To determine IPTB, as appropriate;
- To evaluate the wound;
- To implement wound care as appropriate (including application of Cold Atmospheric Plasma);
- To monitor the degree of pain or discomfort;
- To encourage passive and active exercises of the extremities, especially the lower limbs when at rest;
- To explain to the patient the importance of applying compression therapy;
- To apply compression therapy as necessary;
- To elevate the affected limb 20 degrees or above the heart;
- To maintain adequate hydration (reduces blood viscosity);
- To inform about the importance of complying with antiplatelet therapy.

"Circulatory Care: Arterial Insufficiency" (4062)

- To assess peripheral pulses, edema, skin color and temperature;
- To determine the IPTB, as appropriate;
- To monitor the degree of pain/discomfort with exercise at night or at rest;
- To teach the patient to stay warm and be careful with heat in the extremities;
- To place the extremity in a hanging position, as appropriate;
- To provide guidance on factors that interfere with circulation, such as smoking, tight clothing, exposure to cold environments, crossing feet and legs;
- To assess the wound;
- To perform wound care as appropriate (including application of Cold Atmospheric Plasma);
- To maintain adequate hydration (reduces blood viscosity);
- To inform about the importance of complying with antiplatelet therapy..

Monitoring and Results

The patient was found to have a palpable pedal pulse in both lower limbs (LL), more superficial in the RLL, and edema, more pronounced in the LLL, which has been improving with the application of compression therapy. The skin of both limbs was flushed and the extremities were cold. The IPTB assessed by Doppler (Appendix VI) was 1.1 in the LLL and 0.5 in the RLL. Both leg ulcers were located in the internal malleolar region and were assessed using the RESVECH 2.0 Scale[14] (Appendix VII).

13/12/23: The LLL ulcer had a dressing slightly covered in yellowish-serous exudate, with a unique odor. The lesion size was assessed as 3 cm^2. It presented 30% devitalized tissue and 70% granulation tissue, distinct and red edges. The ulcer in the left lower limb presented a moderate amount of yellow exudate with a foul odor. The lesion was assessed as measuring 21 cm^2, with 30% devitalized tissue and 70% granulation tissue, diffuse edges and redness. The affected tissue in both ulcers is the dermis-epidermis. The TIME approach[15] (Appendix VIII) was used to care for the wound bed, which allowed the most appropriate care to be determined through a visual assessment. Both wounds were cleaned with water at 37°C and mild soap. Hypochlorous acid was also applied to clean the wound (bactericidal action). Sharp debridement was performed with a curette and dissection forceps of devitalized tissue and hyperkeratosis in both wounds. Lidocaine 2% spray was applied to the ulcer in the left lower limb prior to debridement due to complaints of local pain. After cleaning and debridement of the wounds, CAP was applied locally. Due to redness, pain and perilesional pruritus, Betamethasone was applied. The skin of the MIs was moisturized with a cream containing lanolin and petroleum jelly on the hyperkeratosis of the feet, which was difficult to remove. Antimicrobial dressings with exudate absorption action, Dialkylcarbamyl Chloride (Sorbact), absorbent foam with a silicone base, for wound moisture management and better removal, and sterile compresses were applied to both ulcers. A tubular bandage, a cotton bandage and a short-traction bandage with 20 mmHg compression were applied to the MID, and adhesive to fix the bandage.

A tubular bandage, a cotton bandage, two short-traction bandages with 40 mmHg compression and a cohesive bandage for fixation and compression were applied to the LLL. These wounds had been treated once a week, but with the start of the new CAP therapy, they were treated 3 times in the first week of application, twice in the second week and once in the remaining weeks.

15/12/23: On this day, the same treatment was performed on the leg ulcers. The one in the LLL, measuring 2.21 cm^2, was less exudative and the one in the LLL, measuring 16.5 cm^2, had more distinct edges. Both had slight perilesional redness, improvement in edema and pruritus.

30/01/24: The same treatment was maintained. The patient was applying CAP once a week. The ulcer in the left lower limb was 1 cm^2 in size, with distinct edges and already showing the presence of epithelial tissue, the wound bed was moist and without perilesional erythema. The ulcer in the left lower limb was 10 cm^2 in size, with distinct edges and also showing the presence of epithelial tissue, with the presence of a moderate amount of exudate and a singular odor. There was still erythema in the perilesional area.

07/03/24: After being admitted to the hospital, during which time he was not given compression therapy or CAP, there was a regression in the growth of epithelial tissue, an increase in edema, perilesional erythema and wound exudate. Regarding the dimensions of the lesions: left lower limb – 1 cm^2; left upper limb – 18 cm^2. The plasma test was performed again in the initial sequence.

Assessment indicators (NOC):	Results Assessment							
	23/12/13		23/12/15		24/02/30		24/03/07	
	LLL	RLL	LLL	RLL	LLL	RLL	LLL	RLL
(110301) Granulation	4	4	4	4	3	3	4	4
(110320) Reduced wound size	2	2	3	3	4	4	3	4
(110321) Erythema in the tissue surrounding the wound	2	2	3	3	4	4	3	3

Table 3 – Diagnosis "Present Pain".

CIPE Diagnosis: "Present Pain"
Expected results (NOC): "Pain control" (1605)
Interventions (NIC): "Pain control" (1400)

- To assess pain using the Numerical Pain Scale[16] (Appendix IX);
- To evaluate the cause of pain and how it can be relieved;
- To teach non-pharmacological pain relief techniques (e.g. resting with legs elevated at 20 degrees, taking breaks during work to rest);
- To reduce/eliminate factors that increase pain experiences such as fear, anxiety and lack of information;
- To implement pain relief measures during wound treatments, such as explaining the procedure to the patient, irrigating the dressing before removing it, choosing dressings with less adhesion, negotiating with the patient to perform sharp debridement with prior application of anesthesia, involving the patient in the dressing application;
- To instruct the user on how to administer SOS pain relief therapy, in this case Tramadol;
- 100mg prescribed by the doctor, in SOS.

Monitoring and Results

Patient who positions himself in a 4 position when dressing his left leg. With the application of Lidocaine 0.2%, the pain decreased to 1. He reported the presence of grade 3 pain due to edema, prior to the evaluation on 12/13/23, positioning himself in a 3-4 position when walking, with improvement at rest. Currently, with improvement in edema and pain, positioning himself in a 1-2 position, but when walking for long periods he classifies the pain as 2-3, which improves at rest. He says he takes rest periods at work, as he is allowed. He manages the pain therapy and takes SOS when he feels grade 2-3 pain and prior to performing the treatments.

Assessment Indicators (NOC):	Results Assessment			
	23/12/13	23/12/15	24/02/30	24/03/07
(160504) Use of non-analgesic relief measures	3	3	4	4
(160505) Use of analgesics as recommended	4	4	4	4
(160511) Report of controlled pain	3	3	4	4

Table 4 – Diagnosis "Impaired Nutritional Intake".

CIPE Diagnosis: "Impaired Nutritional Intake"
Expected Outcome (NOC): "Nutritional Status: Food Intake" (1009)
Interventions (NIC): "Nutrition Management" (1100)

- To explain the importance of a healthy diet for wound healing;
- To encourage greater intake of carbohydrates, proteins, fats, vitamin A, vitamin C and vitamin E, and protein supplements, such as arginine.

Monitoring and Results

The patient understood the importance of a good nutritional intake in wound healing. He said that he started eating more protein-rich yogurts and is considering including protein supplements in his diet. Despite being encouraged to include fish or meat, pasta, rice or potatoes and vegetables, he continues to eat only soup and fruit for dinner. He does not like nuts, only chestnuts, but he rarely eats them.

Assessment Indicators (NOC):	Results Assessment			
	23/12/13	23/12/15	24/02/30	24/03/07
(100902) Protein intake	1	1	2	2
(100904) Carbohydrate intake	2	2	3	3
(100903) Fat intake	2	2	3	3
(100905) Vitamin intake	3	3	3	3

Table 5 – Diagnosis "Present Anxiety".

CIPE Diagnosis: "Present Anxiety"
Expected Outcome (NOC): "Self-Control of Anxiety" (1402)
Interventions (NIC): "Reduction of Anxiety" (5820)

- To use a calm, relaxed approach and actively listen to the patient;
- To establish a relationship of empathy and trust;
- To clarify expectations according to the patient's behavior;
- To explain the procedures to the patient in advance;
- To support/enable the patient to use coping mechanisms (reinforce their positive outlook on treatments and their good adherence, show the results of treatments in wound healing, encourage them to maintain a relationship of dialogue and sharing with health professionals);
- To praise and reinforce positive behaviors and small achievements.

Monitoring and Results

After establishing an empathetic relationship with the patient, we set objectives in accordance with their expectations, particularly in relation to the possibility of ulcer recurrence. It was explained to the patient that if they adopt preventive behaviour, this probability would decrease, and they were receptive and confident in using compression stockings after healing and maintaining good eating and hydration habits. Anxiety also improved at the time of dressing application, as the entire procedure and pain prevention measures were explained.

Assessment Indicators (NOC):	Results Assessment			
	23/12/13	23/12/15	24/02/30	24/03/07
(140204) To look for information to reduce anxiety	3	3	4	4
(140205) To plan strategies to deal with stressful situations	3	3	4	4

Table 6 – Diagnosis "Impaired Sleep".

CIPE Diagnosis: "Compromised Sleep"
Expected Outcome (NOC): "Sleep" (0004)
Interventions (NIC): "Improved Sleep" (1850)

- To determine the patient's sleep/wake pattern;
- To explain the importance of good quality/quantity of sleep for wound healing (the skin regenerates during sleep);
- To teach the patient to prepare the environment and reduce stimuli before going to sleep (light, television, cell phone, video games);
- To instruct the patient to increase the number of hours of sleep on days when they do not have to wake up early to go to work;
- To teach about non-pharmacological techniques (relaxation, meditation, relaxing bath) and pharmacological techniques (therapy indicated by the doctor).

Monitoring and Results

Although he still has difficulty falling asleep, the patient says he has been able to rest better, as he has less pain in his lower limbs. He also sleeps more hours when he is not working, a maximum of 8 hours. Sometimes he takes a nap.

Assessment indicators (NOC):	Results Assessment			
	23/12/13	23/12/15	24/02/30	24/03/07
(000421)Difficulty in falling asleep	3	3	3	3
(000401) Sleep hours	2	2	3	3
(000404) Sleep quality	3	3	4	4

Table 7 – Diagnosis "Compromised Self-Image".

CIPE Diagnosis: "Compromised Self-Image"				
Expected Outcome (NOC): "Body Image" (1200)				
Interventions (NIC): "Body Image Improvement" (5220)				
• To determine expectations regarding self-image based on current development and help to identify causes that affect self-image; • To help the user identify positive situations that are happening; • To identify ways to reduce the impact, through clothing, for example; • To instruct the user to clean/moisturize the skin to reduce the risk of new injuries, as well as nail care (dystrophic nails); • To determine whether the change in self-image contributes to social isolation.				
Monitoring and Results				
The patient understands that leg ulcers are due to venous and arterial complications, with a contribution from BS. He expects the wounds to heal with the new treatment applied. Ways to improve self-image were identified: wearing clothes that do not show the bandage, looser trousers to avoid injuries, as well as comfortable shoes that are the right size for the use of the compression bandage. He was instructed to take care of his toenails (short, round and cleaned with cider vinegar to prevent fungus), as dystrophic nails grow in different directions and can cause injury to the toes. The patient reports that the change in self-image does not prevent him from being with friends, work colleagues and taking part in family lunches.				
Assessment Indicators (NOC):	Results Assessment			
	23/12/13	23/12/15	24/02/30	24/03/07
(120017) Attitude towards using strategies to improve appearance	3	3	4	4
(120005) Satisfaction with body appearance	2	2	3	3

Figure 1A Internal malleolar ulcer RLL, 23/12/13.↖

Figure 2A Internal malleolar ulcer RLL, 23/12/15.↖

Figure 3A Internal malleolar ulcer RLL, 24/01/30.↖

Figure 4A Internal malleolar ulcer RLL, 24/03/07.↖

Figure 1B Internal malleolar ulcer LLL, 23/12/13.↖

Figure 2B Internal malleolar ulcer LLL, 23/12/15.↖

Figure 3B Internal malleolar ulcer LLL, 24/01/30.↖

Figure 4B Internal malleolar ulcer LLL, 24/03/07.↖