Case Reports

Use of Melaleuca Essential Oil in Healing Pressure Injuries (LP): Case Series

Andrieli Taís Kila [1], Mari Ângela Gaedke [1], Chana de Medeiros da Silva [1], Naiele da Costa Fagundes [1], Adriane dos Santos Nunes Anacker [1,*]

[1] Universidade de Santa Cruz do Sul – UNISC, Santa Cruz do Sul, RS, Brazil.

* Correspondence: adriane.anacker6@gmail.com.

Abstract: To monitor and describe the healing process of pressure injuries (PI) grades I, II, III, and IV using tea tree essential oil (TTEO). A descriptive-exploratory study, using a multiple case study approach, was developed by monitoring patients with PI at different stages in a teaching hospital in the interior of Rio Grande do Sul, Brazil, from July to October 2021. The Bates-Jensen Wound Assessment Tool (BWAT) was used to assess wound characteristics. The study included 11 male patients hospitalized in the Intensive Care Unit (ICU) and the COVID-19 and clinical-surgical inpatient unit, with eleven PIs predominantly grade III in the sacral region. Regarding the characteristics evaluated by BWAT, a favorable progression in the lesions was observed in the following items when comparing the first and third days of TTEO use: peripheral skin color, exudate type, granulation tissue, wound edges, exudate amount, and epithelialization. However, an increase in scores was noted for necrotic tissue amount, undermining, necrotic tissue type, size, and depth, indicating regression in these aspects. The pharmaceutical formulations used in this study not only highlighted the benefits of TTEO in the healing process but also reinforced its advantages for being natural and more cost-effective compared to existing commercial formulations on the market.

Keywords: Healing; Melaleuca; Phytotherapy; Pressure Injury.

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1. Introduction

Pressure injuries (PI) are understood as localized damage to the skin and/or underlying soft tissues, usually manifested over a bony prominence or related to the use of a medical device or another artifact [1]. Its occurrence is the third most frequently reported event by Patient Safety Centers (PSC) in health services [2]. The development of PI has negative repercussions, thus constituting a problem in the healthcare process by causing physical and emotional harm to patients, in addition to increasing expenses for healthcare institutions due to the cost of treatment [3].

After their onset, PIs are classified into six categories based on the depth of the injury and the type of tissue involved: Grade I, II, III, IV, the unstageable category, and the suspected deep tissue injury category [4]. Recognizing the stages is a crucial aspect in determining the best therapeutic option, which over the years has shown advances in understanding the processes and phenomena involved in tissue repair. The use of appropriate dressings is essential to provide benefits for the treatment of the injury and thus achieve skin healing [5].

Among the wide range of essential oils (EO) used in the treatment of skin injuries, tea tree essential oil (TTEO) (Melaleuca alternifolia), also known as Tea Tree, stands out. In addition to its healing properties, it also stimulates the immune system and is used in treating various pathologies, including wound treatment. TTEO has bactericidal, expectorant, fungicidal, anti-infective, antioxidant, balsamic, antiseptic, antiviral, febrifuge,

insecticidal, immunostimulant, diaphoretic, parasiticide, vulnerary activities, and excellent healing properties, reducing skin irritation, comedone formation, and the onset of the inflammatory cascade [6]. The present study aimed to monitor and describe the healing process of PI grades I, II, III, and IV using two formulations containing TTEO according to the PI grade of these patients.

2. Methods

2.1 Study Design

This is a descriptive-exploratory study, specifically a multiple case study (case series), developed by monitoring patients who presented with PIs at stages I, II, III, or IV in a teaching hospital in the interior of Rio Grande do Sul, Brazil, from July to October 2021. Being a multiple case study, the sample was of consecutive convenience type.

2.2 Selection of Participants

Participants were recruited from the Intensive Care Unit (ICU) and the COVID-19 and clinical-surgical inpatient unit of the aforementioned hospital. The study included individuals over 18 years old who presented with PI at stages I, II, III, or IV during hospitalization. Patients were excluded if they had previously known hypersensitivity to tea tree essential oil (TTEO) (1), wounds with mechanical debridement (3), or if they were already undergoing other types of treatment for PI with good results (4).

2.3 Data Collection

Once subjects meeting the inclusion criteria were identified, the researcher contacted the attending physician for authorization to use TTEO as a therapeutic option in PI dressing. During the initial approach to the patient, the research objective, risks, and benefits were explained, and an invitation to participate in the study was extended. The Informed Consent Form (ICF) was then made available. In cases where the patient was not conscious and oriented, an evaluation was conducted using the Glasgow Coma Scale, and the legal guardian was approached to sign the consent form.

Data collection proceeded through the application of a questionnaire structured by the researcher, containing sociodemographic information, previous and current health history, and the reason for hospitalization. The Bates-Jensen Wound Assessment Tool (BWAT) was used to measure the injuries. BWAT contains 13 items that assess size, depth, edges, undermining, type and amount of necrotic tissue, type and amount of exudate, edema and hardening of peripheral tissue, skin color around the wound, granulation tissue, and epithelialization. The total score can range from 13 to 65 points, with higher scores indicating worse wound conditions. PI was assessed before and after intervention using BWAT after six dressings, with two dressings performed daily.

2.4 Acquisition of Tea Tree Essential Oil and Preparation of Formulations

TTEO used in this study was donated by an engineer who produces tea tree essential oil on a farm in the city of Ibiúna, São Paulo. The extraction was performed from the leaves using steam distillation. The TTEO at a concentration of 6% was incorporated into pharmaceutical formulations, including a lipid solution and a hydrogel. The lipid solution was prepared using sunflower oil as a vehicle, with 6% TTEO added, along with an antioxidant. The hydrogel was prepared using a carbopol (1%) gel base, with 6% TTEO added, along with antioxidants and preservatives. These formulations were produced in the pharmaceutics and cosmetology laboratory of a university located in the same municipality and affiliated with the hospital institution, following good manufacturing practices.

2.5 Intervention Process

Dressings were performed by the researcher and the nursing teams of the previously described units. A prior training session was conducted with the teams, explaining the study's objectives, the two available pharmaceutical preparations, the frequency of dressings, and the ideal quantity to be used.

For grade I or II PIs, dressings were performed by cleaning with 0.9% saline solution and sterile gauze. After cleaning, a thin layer of the lipid solution containing 6% TTEO was applied, and the dressing was finished with gauze covered with micropore tape. For grade III or IV PIs, the same cleaning method was used, but the wound bed was treated with the hydrogel containing 6% TTEO. In these cases, due to the more cavitary nature of the PIs, the entire bed and edges were filled with the hydrogel, and then covered with gauze fixed with micropore tape.

3. Results

The results can be seen in the table below. Based on the screenings conducted, there were 11 patients who had a total of 11 pressure injuries (PI). The participants were predominantly male (n=10), over 60 years of age (n=5), and with white skin color (n=8). All were hospitalized in the ICU. Regarding the reason for hospitalization, three patients were diagnosed with COVID-19, two with polytrauma, two with associated sepsis, and the others had diagnoses such as valvulopathy, endocarditis, iliac and femoral vessel stenosis, appendicitis, upper gastrointestinal hemorrhage, Wernicke's encephalopathy, severe pneumonia/acute kidney injury (Table 1).

Regarding previous pathologies, two patients were previously healthy, four participants had at least two previous pathologies, such as systemic arterial hypertension (SAH) (n=6), diabetes mellitus (DM) (n=2), chronic obstructive pulmonary disease (COPD) (n=2), among other pathologies. Regarding habits, five were smokers and two were alcoholics (Table 1). All research participants had hemoglobin (Hb) and hematocrit (Ht) levels below the normal reference value at the time of inclusion in the study. The lowest Hb and Ht values were observed in patient case 10 (Hb 7 g/dL and Ht 21.1%). The highest values found were 13.3 g/dL and Ht 40.1% in case 3 (Table 1).

As for the anatomical region of the lesions, the sacral region had the highest occurrence, manifesting in five patients, followed by four lesions on the buttocks, one on the back, and one on the heel. Regarding the classification of the lesions, one PI was stage I, four were stage II, five were stage III, and one was unstageable. Notably, the lesion progressed from grade I to grade II in case 11 after the intervention, while no changes in classification were observed in the others.

Table 1. Characterization of the Sample Concerning Demographic and Clinical Characteristics.

Case	Sociodemographic Characteristics	Reason for Hospitalization	Previous Diseases and Habits	Hemoglobin and Hematocrit on 1st Day of Monitoring	PI Location	Grade
Case 1	51 years, male, white	COVID-19	SAH	Hb 8g/dL, Ht 24.8%	Sacral	Grade III
Case 2	55 years, male, white	COVID-19	Epilepsy	Hb 7.8g/dL, Ht 23.2%	Sacral	Grade III

Case 3	27 years, male, white	COVID-19	Previously healthy	Hb 13.3g/dL, Ht 40.1%	Gluteal	Grade II
Case 4	30 years, male, white	Polytrauma	Previously healthy	Hb 10.5g/dL, Ht 32%	Sacral	Grade II
Case 5	19 years, male, white	Polytrauma	Smoker	Hb 8.2g/dL, Ht 25%	Gluteal	Grade III
Case 6	60 years, female, black	Valvulopathy	SAH, DM, COPD, Asthma, smoker, aortic stenosis	Hb 7.2g/dL, Ht 22%	Gluteal	Grade II
Case 7	52 years, male, white	Endocarditis - sepsis	SAH, smoker, previous endocarditis, valve replacement	Hb 8.2g/dL, Ht 26%	Heel	Unstageable
Case 8	63 years, male, white	Critical ischemia associated with lower limb infection	SAH, DM, CHF, smoker, right lower limb amputation	Hb 7.3g/dL, Ht 21.2%	Sacral	Grade III
Case 9	73 years, male, white	Appendicitis and upper gastrointestinal hemorrhage	SAH, polio at 5 years	Hb 9.1g/dL, Ht 26.6%	Back	Grade II
Case 10	68 years, male, black	Severe community-acquired pneumonia	SAH, COPD, smoker and alcoholic	Hb 7g/dL, Ht 21.1%	Gluteal	Grade III
Case 11	75 years, male, white	Wernicke's encephalopathy / sepsis	Alcoholic	Hb 8.5g/dL, Ht 25.7%	Sacral	Grade I

Regarding the characteristics evaluated by the BWAT scale, comparing the first day of the intervention with the third day, a favorable progression was observed in the following items: skin color around the wound (cases 1 and 5); exudate type (cases 2, 4, 6); granulation tissue (cases 2, 3, 4, 6, 10); and edges (cases 4 and 8). It is noteworthy that these items did not show any regression in any of the monitored lesions (Table 2).

Regarding the amount of exudate, a reduction was observed in six lesions (cases 2, 3, 4, 5, 6, 8), although an increase was noted in case 11. Concerning the item of epithelialization, among the four cases where changes in scores were observed, three showed positive changes (cases 3, 4, and 6), with regression occurring only in case 11. An increase in scores was noted for the items: amount of necrotic tissue, undermining, type of necrotic tissue, and size, causing regression in these aspects. However, in the item of depth, there was regression in two lesions (cases 2 and 11), contributing only to the lesion in case 6 (Table 2).

It was found that in case 7, there were no changes in the BWAT scale scores after the implemented therapy, meaning it neither contributed to nor worsened the condition of the lesion. It is emphasized that for the items present on the BWAT scale not described,

there were no changes in scores from the first day and after the dressings on the third day (Table 2).

Table 2. Description of the Healing Process of Pressure Injuries (PI) Using 6% TTEO Formulations for 3 Days.

Case	BWAT Scale Score on 1st Day	BWAT Scale Score on 3rd Day	BWAT Scale Items with Score Changes
Case 1	39 points	38 points	Amount of necrotic tissue: 4 points (1st day) - 5 points (3rd day). Skin color around the wound: 4 points (1st day) - 2 points
Case 2	37 points	40 points	Depth: 3 points (1st day) - 5 points (3rd day). Undermining: 2 points (1st day) - 3 points (3rd day). Type of necrotic tissue: 2 points (1st day) - 4 points (3rd day).
Case 3	28 points	24 points	Amount of necrotic tissue: 2 points (1st day) - 3 points (3rd day). Exudate type: 2 points (1st day) - 1 point (3rd day). Amount of exudate: 4 points (1st day) - 3 points (3rd day). Granulation tissue: 4 points (1st day) - 3 points (3rd day). Size: 2 points (1st day) - 1 point (3rd day). Amount of exudate: 4 points (1st day) - 3 points (3rd day). Granulation tissue: 3 points (1st day) - 2 points (3rd day).
Case 4	28 points	17 points	Epithelialization: 4 points (1st day) - 3 points (3rd day). Edges: 2 points (1st day) - 1 point (3rd day). Exudate type: 3 points (1st day) - 1 point (3rd day). Amount of exudate: 3 points (1st day) - 1 point (3rd day).
Case 5	34 points	32 points	Granulation tissue: 5 points (1st day) - 2 points (3rd day). Epithelialization: 5 points (1st day) - 2 points (3rd day). Amount of exudate: 4 points (1st day) - 3 points (3rd day). Skin color around the wound: 4 points (1st day) - 2 points
Case 6	20 points	14 points	Depth: 2 points (1st day) - 1 point (3rd day). Exudate type: 2 points (1st day) - 1 point (3rd day). Amount of exudate: 2 points (1st day) - 1 point (3rd day).
Case 7	35 points	35 points	Granulation tissue: 2 points (1st day) - 1 point (3rd day). Epithelialization: 4 points (1st day) - 2 points (3rd day). There were no changes in the scores after the implemented therapy.
Case 8	39 points	37 points	Edges: 4 points (1st day) - 3 points (3rd day). Amount of exudate: 5 points (1st day) - 4 points (3rd day).
Case 9	26 points	32 points	Depth: 2 points (1st day) - 3 points (3rd day). Type of necrotic tissue: 1 point (1st day) - 4 points (3rd day). Amount of necrotic tissue: 1 point (1st day) - 3 points (3rd day).
Case 10	24 points	23 points	Granulation tissue: 4 points (1st day) - 3 points (3rd day).

Case 11	13 points	16 points	Depth: 1 point (1st day) - 2 points (3rd day). Amount of exudate: 1 point (1st day) - 2 points (3rd day). Epithelialization: 1 point (1st day) - 2 points (3rd day).

4. Discussion

The participants included in the study were those in the Intensive Care Unit (ICU) and COVID-19 and the clinical-surgical inpatient unit. It is noteworthy that patients in ICUs are more susceptible to developing pressure injuries (PI), often requiring vasoactive drugs, sedation, and mechanical ventilation, with restricted mobility to the bed and compromised skin integrity [7]. It is important to emphasize that the participants were in a critical hemodynamic condition, which sometimes made it impossible to implement pressure relief measures, directly influencing the wound healing process. Repositioning individuals at risk or with PI should be performed to redistribute pressure, especially in areas of bony prominences [8].

The fact that the highest number of PIs was identified in the sacral and gluteal regions is consistent with another research [9]. These regions are the points of greatest pressure in patients in the supine position, highlighting the association between the position the patient remains in for extended periods and PI. These factors indicate the need for evaluation, recording patients' clinical conditions, and planning care according to the critical patient's hemodynamic condition [10].

Most patients' hemoglobin and hematocrit levels were below the reference values for their gender and age group. It is important to note that biochemical parameters should be considered in wound healing assessment, as hemoglobin and hematocrit values represent the volume of red blood cells in the blood, which serves as the vehicle that transports oxygen, influencing cell proliferation and life [11].

Although beneficial effects were observed in only a few lesions, it was evident that tea tree essential oil (TTEO) incorporated into the formulations contributed to healing by reducing exudation in the wound area and promoting the proliferation and advancement of granulation tissue and epithelialization. These findings align with an experimental study that investigated the wound healing potential of three topical chitosan-based preparations incorporating TTEO, rosemary, or a mixture of both oils, where all groups using TTEO in the tested formulations showed excellent results in the complete re-epithelialization of the lesions [12].

Since none of the lesions included in the study were infected and remained so during the TTEO use period, it is emphasized that due to its antimicrobial properties, TTEO may have contributed to preventing microorganism proliferation in the wound bed. A study evaluating the efficacy of low-frequency ultrasound combined with a gel of copaiba and melaleuca oils in skin wound healing conducted in a public hospital in Ceará found that TTEO inhibited the growth of fungi and bacteria in the lesions [13].

It was found that the hydrogel formulation containing TTEO used in grade III and IV lesions facilitated application and contributed to improving maceration and exudate control in the wound and its edges. This same finding was observed in research aimed at evaluating the efficacy of low-frequency ultrasound combined with a gel containing copaiba and melaleuca oils in skin wound healing in patients from a stomatherapy outpatient clinic and medical and surgical inpatient clinics of a hospital [13]. Furthermore, the availability of TTEO in hydrogel stands out as a low-cost formulation in scenarios where established commercial formulas are unavailable and have higher costs. The use of hydrogel in cavitary wounds has demonstrated advantages in hydrating the wound bed and edges, stimulating the healing and epithelialization phases of tissue. Its use is recommended in wounds with little exudate, acting in the autolytic debridement of tissue, promoting angiogenesis, and influencing the selectivity of granulation tissue [14].

The study's limitations include the small sample size, the short application period, and the follow-up of dressings, considering the predominance of grade III lesions, which are considered cavitary and more complex, making it impossible to identify the effects of TTEO in the tested formulations more broadly. Moreover, the patients' clinical severity and anemia may have negatively influenced the tissue regeneration process, hindering any additional benefits from using TTEO.

Therefore, further research on TTEO therapies that can contribute to PI treatment, especially in critical patients prone to complications, is encouraged. The lesions have negative repercussions, posing a severe problem in patient care due to the physical and emotional damage they cause and increasing healthcare institutions' costs due to treatment expenses.

5. Conclusion

The use of appropriate dressings is essential to ensure the best possible outcome in the tissue repair process. The pharmaceutical formulations used in this study not only provided evidence of the benefits of tea tree essential oil (TTEO) in the healing process—such as improvements in skin color around the wound, exudate type, granulation tissue, wound edges, exudate amount, and epithelialization—but also highlighted their advantages of being natural and lower in cost compared to existing commercial formulations on the market.

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