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RESEARCH LETTER

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Advanced wound management approaches in Hidradenitis Suppurativa postsurgical lesions

1 | INTRODUCTION

Hidradenitis suppurativa (HS), is a chronic inflammatory disease of the follicular pilosebaceous unit. It commonly involves axillary, inguinal, submammary, perineal, and perianal areas, with the occurrence of recurrent, painful, and inflamed nodules, abscesses, sinus tracts, and scarring, thus affecting patient's quality of life. The pathogenesis of the disease seems to be related to an obstruction of the hair follicle due to a hyperproliferation of ductal keratinocytes, that results in follicular rupture and activation of inflammatory response.[1]

The diagnosis of HS is mainly based on clinical features and biopsy is not necessary, except in cases of diagnostic uncertainty. Among imaging exams, ultrasound (US) is useful for an objective assessment and monitoring of the disease severity.[2]

To date, HS management is a combination of medical and surgical therapy. In patients with recalcitrant moderate to severe forms of HS, wide surgical excision may allow definitive resolution of the active inflammatory process and removal of scarring tissue. Many factors must be considered before surgery, such as the affected areas and the presence of an acute or chronic phase of the disease. After surgery, wounds can heal by first intention, second intention, or through the use of flaps or grafts.[3]

However, surgery should be combined with proper postsurgical management and lifestyle changes to reduce the risk of recurrence. The gold standard management of HS postsurgical wounds healing by second intention has not yet been identified. The objective of postoperative wound care is to maintain a moist and clean microenvironment, through wound dressing changes, physical therapy, or hydrotherapy. Moreover, to prevent wound infection, dressings with antiseptic function should be used.[4]

To improve and simplify the management of postsurgical wounds, the TIME acronym was introduced to summarize the four main parameters of wound bed preparation (WBP): devitalized tissue removal (T), infection and inflammation control (I), moisture imbalance (M), and advancement of the epithelial edge of the wound (E). This acronym has been modified and renamed as HS-TIME to assist both clinicians and vulnologists, in the complex management of HS postsurgical wounds.[5,6]

The aim of our study was to evaluate the postsurgical results obtained on HS wounds treated with a slow-releasing reactive oxygen species (ROS) oleic matrix and to compare them with the results obtained with the medications suggested by HS-TIME and the use of an ultraportable negative pressure wound therapy (NPWT).

2 | MATERIALS AND METHODS

A clinical prospective study was conducted by the Department of Dermatology, University of Pisa. The study was approved by IRB and written consents were obtained from all the patients. We enrolled 25 patients affected by moderate to severe HS resistant to standard therapy. Our population consisted of 25 patients, seven males, and 18 females, with a mean age of 43.63, a mean disease duration of 10 years and a mean body mass index of 26.39 kg/m^2. Fourteen patients presented HS lesions of the groin and five patients on axilla, pubis region was affected in four patients and the gluteal region in two patients.

Patients were treated with wide excision of the entire affected area, after a presurgical US mapping of lesions' margins. US examination of HS lesions was performed in B-MODE and C-MODE, with a 70 MHz probe, using an appropriate amount of gel to maintain a proper distance of the probe from the skin.

Subsequently, patients were single-blind randomized and divided into three groups. Group 1 consisted of 10 patients treated twice a week with silver hydrofiber and polyurethane foam as a secondary dressing, according to the principles of HS-TIME.[6] Group 2 included 10 patients treated twice a week with oxygen-enriched olive oil in the form of an oily gel in a prefilled syringe. Oxygen-enriched oil-based dressings used in the second group are a class IIb medical device obtained through a chemical reaction between ozone and unsaturated fatty acids of vegetable oils. The oily gel was applied in a 2–3 mm layer on the bottom of the lesion and was covered with nonadherent gauze. Group 3 consisted of five patients treated with ultraportable NPWT changed every week.

At baseline (V0), after 2 weeks (V1) and after 4 weeks (V2), a comprehensive wound assessment was provided. Wound size was evaluated by a 3D imaging system (Star™); wound bed and

surrounding skin features were evaluated with the Wound Bed Score (WBS); pain experienced by the patient before dressing changes was assessed through Numerical Rating Scale (NRS).

Categorical data were described by absolute and relative (%) frequency, continuous data by mean and standard deviation. To evaluate differences between measurements (Area, WBS, and NRS) taken at the subsequent timepoints (V0, V1, and V2) analysis of variance (ANOVA) for repeated measures was performed. Moreover, differences between groups in terms of mean variables (Area, WBS, and NRS) deltas (Δ) were calculated and analyzed by one-way ANOVA. Significance was fixed at $p \leq 0.05$ and all analyses were carried out with SPSS v.28 technology.

3 | RESULTS

After 2 weeks (V1), a reduction in mean area was detected (Group 1: 51.17%; Group 2: 54.51%; Group 3: 55.07%), as well as an improvement in mean WBS (Group 1: 15.25%, Group 2: 16.94%; Group 3: 17.24%) and a decrease in mean pain NRS (Group 1: 54.24%, Group 2: 55%; Group 3: 50%). After 4 weeks (V2) a significant reduction in terms of wound area, an improvement of WBS, and a decrease in pain NRS were detected in all groups (p-value < 0.001). In particular, the reduction in mean area was of 79.91% for Group 1, 81.74% for Group 2, and 74.75% for Group 3. The improvement in mean WBS was of 22.88%, 19.49%, and 25.86%, respectively. Mean pain NRS showed a decrease of 71.19% (Group 1), 75% (Group 2), and 73.33% (Group 3) (Table 1). No statistically significant differences were found in terms of reduction in mean area, mean WBS, and mean pain NRS between the three groups analyzed neither at V1 nor at V2 (Figure 1).

4 | DISCUSSION

The patients enrolled in this study suffered from a moderate to severe form of the disease, refractory to previous medical and surgical therapy. The choice of wide excision and secondary intention healing was based on the data obtained from a systematic review and meta-analysis, that demonstrated a lower recurrence rate (13%), compared to deroofing technique (27%).[7]

Key messages

- The most appropriate management of recurrent Hidradenitis Suppurativa (HS) lesions consists of wide surgical removal of the lesions with subsequent healing by second intention. Successful wound healing depends on the choice of an adequate wound dressing, targeted to the features of the wound.
- We enrolled 25 patients randomized into three groups according to the advanced dressing used in second intention healing of postsurgical wounds (standard therapy, an oxygen-enriched oil-based medical device with prolonged release of reactive oxygen species [ROS], ultra-portable negative pressure therapy). Data on wound size, clinical appearance of the wound bed, and pain experienced by the patient were collected twice a week for 4 weeks
- No statistically significant differences were observed between the different groups evaluated. Oxygen-enriched oil-based medical device with prolonged release of ROS can be included in the principle of HS—tissue, inflammation, moisture, and epithelium (TIME).

In our study, presurgical mapping of the lesions was performed to detect any subclinical lesion, which could potentially lead to disease recurrence if not properly removed. Different data in literature confirmed the usefulness of US imaging in diagnosis, monitoring, and preoperative evaluation of HS.[8,9]

After surgery we opted for secondary intention healing. The modality of wound healing following radical excision depends on the site and size of the lesions and influences disease recurrence rate.[10] Wide excision with secondary closure or skin grafting are considered the best surgical approaches with a recurrence rate of 11% and 2%, respectively. However, skin grafts present a more complicated intraoperative and postoperative management, while secondary intention healing is easier to manage at home, even if it requires a postsurgical period of dressing changes.[11]

No guidelines or therapeutic recommendations are available in literature about optimal postsurgical wound healing.[12–14]

TABLE 1 Clinical outcomes in the different groups in terms of mean area, Wound Bed Score (WBS), and pain Numerical Rating Scale (NRS) were evaluated at baseline (V0) and after 4 weeks (V2) (Statistics: mean [sd]).

	Group 1		Group 2		Group 3	
	V0	V2	V0	V2	V0	V2
Area	20.56 (14.68)	4.13 (4.21)	18.51 (12.47)	3.38 (6.39)	40.80 (47.93)	10.30 (13.74)
WBS	11.80 (0.63)	14.50 (0.71)	11.80 (0.79)	14.10 (3.35)	11.60 (1.34)	14.60 (1.34)
NRS	5.90 (1.29)	1.70 (1.16)	6.00 (1.15)	0.90 (1.20)	6.00 (0.71)	1.60 (1.52)

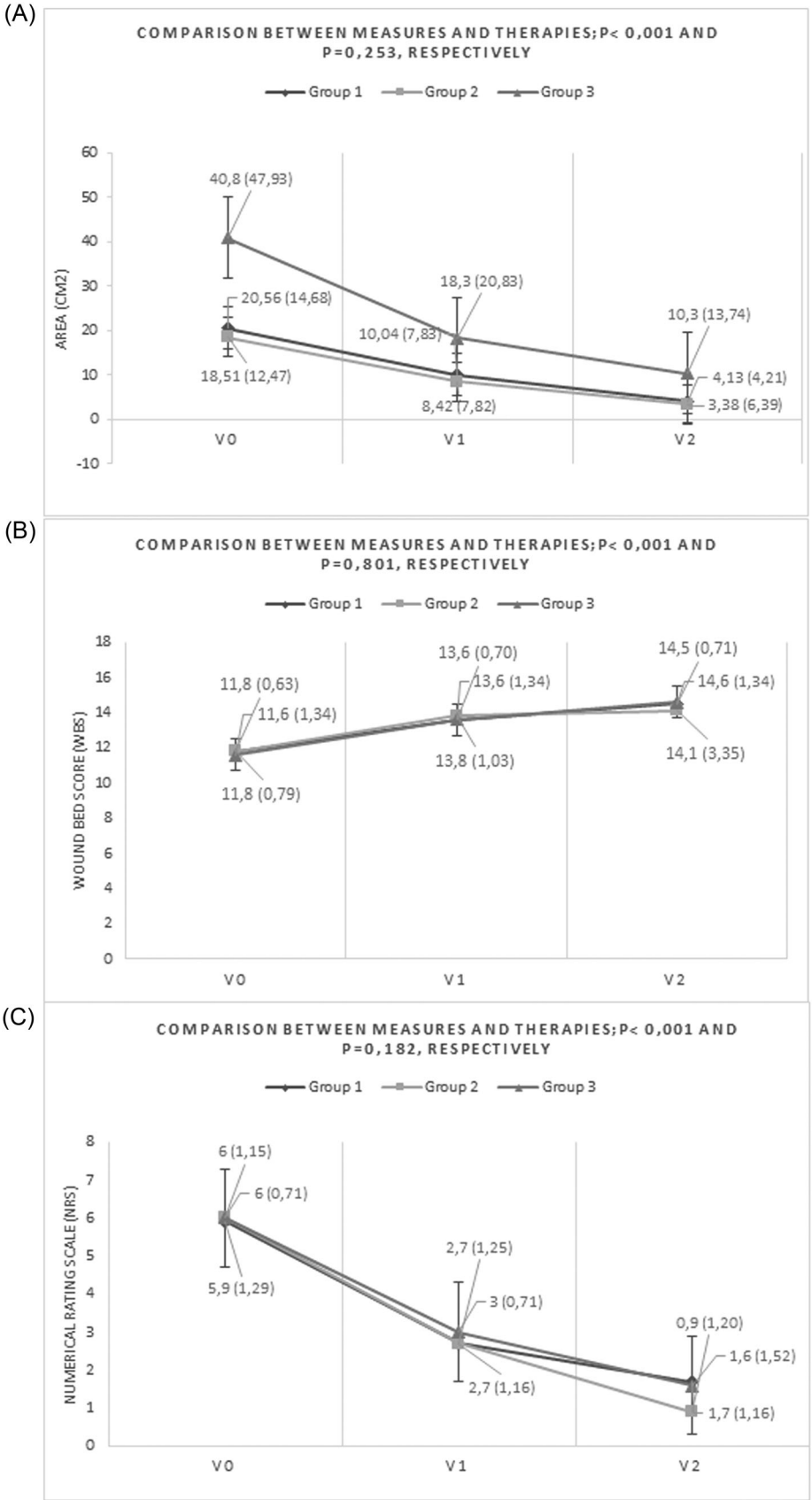

FIGURE 1 Comparison between mean area (A), mean Wound Bed Score (WBS) (B) and main pain Numeric Rating Scale (NRS) (C) at baseline, 2 weeks (V1), and 4 weeks (V2) follow-up in the three treatment groups. Statistics: mean (sd).

The aim of our study was to compare different modalities of postsurgical treatment. The three postoperative managements demonstrated to be effective in ensuring the appropriate micro-environment for the healing process, keeping the exudate in balance, controlling the bacterial load and promoting granulation tissue. The shorter healing time, evaluated in terms of wound size reduction and WBS improvement, as well as the decrease of pain, had a great impact on both psychological aspect and socioeconomic one.

Dressings in the first group were applied using the principles of HS-TIME: silver hydrofiber was able to contol bacterial load, while a secondary foam provided adequate moisture balance.[6,15] Our study revealed a reduction in area (ΔV1-V0 = 51.17%, ΔV2-V0 = 79.91%), WBS (ΔV1-V0 = 15.25%, ΔV2-V0 = 22.88%) and pain NRS (ΔV1-V0 = 54.24%, ΔV2-V0 = 71.19%), confirming the effectiveness of a postsurgical management by advanced local dressings tailored to the features presented by the wound at each visit.

Oxygen plays a key role during the inflammatory and proliferative phases of wound healing, stimulating angiogenesis and reducing bacterial load.[16] The constant and prolonged release of ROS seems to be able to inhibit bacterial and fungal proliferation. The oleic form of the gel used in Group 2 provided a moist microenvironment, while the sustained-release of ROS encouraged the process of angiogenesis, cell proliferation and collagen synthesis.[17] The results obtained from our study identified a reduction in area (ΔV1-V0 = 54.51%, ΔV2-V0 = 81.74%), WBS (ΔV1-V0 = 16.94%, ΔV2-V0 = 19.49%) and pain NRS (ΔV1-V0 = 55%, ΔV2-V0 = 75%), confirming data presented in literature about the effectiveness of oxygen-enriched olive oil in different kinds of wounds.[18]

Finally, the experience of Group 3 showed a decrease in wound area (ΔV1-V0 = 55.07%, ΔV2-V0 = 74.75%), WBS (ΔV1-V0 = 17.24%, ΔV2-V0 = 25.86%) and pain NRS (ΔV1-V0 = 50%, ΔV2-V0 = 73.33%), demonstrated that NPWT, and in particular ultraportable NPWT, can be successfully used for the management of HS postsurgical wounds, as widely evidenced in the literature.[19]

The oxygen-enriched oil-based device, due to different formulations (gel, pad, roll, and cup), is adaptable to different body regions (including the groin and axillary regions). In addition, an advanced dressing allows easier home monitoring by nurses and territorial wound care units, reducing the number of outpatient visits. It also presents several other significant advantages that enhance patient care and overall treatment outcomes. The proper moist environment, provided by the oleic formulation, reduces trauma related to dressing changes as well as pain thus increasing patient comfort. Traditional wound dressings often adhere to the wound bed, leading to discomfort and pain during removal. However, the advanced dressing's oleic formulation gently adheres to the wound without causing additional trauma. This feature not only reduces patient discomfort during dressing changes but also supports the delicate wound healing process. In addition, its antiseptic function enables to reduce the use of antibacterial dressings in cases of silver intolerance. In such cases, the use of typical antibacterial dressings might not be feasible due to potential adverse reactions. However, the antiseptic properties of the advanced dressing offer an alternative solution, providing effective wound protection and minimizing the risk of infection without relying on silver-based additives. On the other hand, NPWT was able to provide the correct microenvironment to promote wound healing, stimulating granulation tissue, increasing blood flow, removing interstitial fluids, and controlling bacterial growth.[20] NPWT is already introduced into HS-TIME for moisture control, preventing maceration, and supporting a favorable wound healing environment. It is preferred for larger substance losses, although it is not easily applicable to all body sites and it cannot be used in case of infected tissue on the wound bed. The need for continuous monitoring by wound healing specialists both in the hospital and at home and the device space requirement could result in a lower patient's compliance. However, the use of an ultraportable NPWT can be maintained in place for up to 7 days, reducing the number of outpatient visits. Additionally, the small size and portability of the ultraportable NPWT device contribute to enhanced patient comfort. The compact design allows patients to move freely without feeling burdened by bulky dressings or equipment. The increased comfort provided by the ultraportable NPWT system encourages patients to adhere to the prescribed treatment regimen, promoting better wound healing outcomes.

The absence of statistically significant differences at V1 and V2 among the three groups demonstrates equal effectiveness of the three treatments in terms of wound size reduction, WBS improvement, and pain decrease. Therefore, the choice of postsurgical treatment should be based on the site, size and features of the wound, as well as patient compliance and comfort. The main limitations of this study are the small number of enrolled patients and the variability among the analyzed groups in terms of initial wound area. Non-inferiority studies with enlarged samples will allow these preliminary data to be further confirmed, but at the moment we can suggest that the oxygen-enriched oil-based device with constant ROS release could be successfully included within the HS-TIME. On the other hand, the integration of an ultraportable NPWT system into HS-TIME exemplifies a patient-centered approach that optimizes wound healing outcomes and improves the overall quality of care for individuals with HS.

KEYWORDS

dressings, hidradenitis suppurativa, postsurgical wound, ulcers, wound healing

AUTHOR CONTRIBUTIONS

Alessandra Michelucci: Conceptualization; investigation; supervision; validation; writing—original draft. **Agata Janowska**: Conceptualization; investigation; supervision; validation; writing—original draft. **Giammarco Granieri**: Conceptualization; investigation; supervision; validation; writing—original draft. **Flavia M. Margiotta**: Conceptualization; investigation; supervision; validation; writing—original draft. **Riccardo Morganti**: Conceptualization; investigation; supervision; validation; writing—original draft. **Marco Romanelli**: Conceptualization; investigation; supervision; validation; writing—original draft. **Valentina Dini**: Conceptualization; investigation; supervision; validation; writing—original draft.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available on request from the authors. The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

All patients in this manuscript have given written informed consent for participation in the study and the use of their deidentified, anonymized, aggregated data and their case details (including photographs) for publication.

TRANSPARENCY STATEMENT

The lead author Valentina Dini affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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