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Comparative Efficacy of Silver Sulfadiazine and Aquacel Ag in Superficial Partial Thickness Burn Treatment: A Retrospective Analysis

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Abstract: ***Background: Aquacel is a moisture-retentive topical dressing containing 1.2% w/w silver, referred to as Aquacel Ag, which has demonstrated safety and efficacy in the management of superficial partial-thickness burns. This dressing delivers silver over a continuous duration of up to two weeks, setting it apart from other silver delivery treatments being used for treatment of burns. Methods: This study included 50 patients with superficial partial-thickness burns who reported to the Department of Burns and Plastic Surgery at SMS Hospital, Jaipur, from September 2023 to January 2024. This retrospective study compares the healing outcomes of Aquacel Ag and silver sulfadiazine SSD dressings in 50 patients with superficial partialthickness burns. Patients were randomly assigned to either the SSD or Aquacel Ag group. Results: The Aquacel Ag group demonstrated faster reepithelialization, reduced pain, and fewer dressing changes compared to the SSD group. The study highlights the benefits of Aquacel Ag in improving patient comfort and overall healing outcomes. Conclusion: This study is significant as it offers insights into optimizing burn care by comparing two widely used dressings, potentially improving patient outcomes and reducing treatment complexities. Aquacel Ag reconciles multiple advantageous qualities for the treatment of partial-thickness burns, rendering it an efficacious choice for addressing superficial partial-thickness burn injuries. The dressing's prolonged silver release and moisture-retentive properties enhance its effectiveness in improving patient outcomes in burn treatment.***

Keywords: Aquacel, burns, dressing, reepithelialisation, silver sulfadiazine

1. Introduction

Superficial second-degree burns are prevalent injuries in the outpatient department. The treatment protocol for severe burns is contentious, while deep second-degree and third-degree burns are optimally addressed with early excision and grafting.[1]

The treatment methods for first-degree and third-degree (full-thickness) burns are well-defined; however, the treatment strategy for mixed partial-thickness burns poses considerable clinical difficulties.[2]

Superficial burn injuries may heal independently after around two weeks, generally treated with combination of topical antimicrobials along with various forms of dressings.

In contrast, the deeper structures, which are unlikely to mend autonomously in a timely fashion, require surgical procedures such as excision and grafting, typically within the initial days following the injury. [3]

No matter how helpful the method of early aggressive excision is, it is complicated by the fact that it is hard to tell which areas will heal on their own and which ones need surgical intervention. This lack of certainty could lead to an original underestimation of the need for surgery, with some areas getting worse on their own (a condition called "spontaneous conversion") because of circumstances like infection or dessication. Consequently, these regions may necessitate further surgical intervention to rectify the delayed acknowledgment of their severity.[4]

Furthermore, this is not unusual for areas initially deemed necessitating surgical intervention to later exhibit more superficial injuries and then recover without surgical intervention, illustrating the dynamic nature of burn wound healing.[5]

In light of these challenges, we can utilize moisture-retentive or occlusive dressings throughout the entirety of mixed partial-thickness burns for durations of 10 to 17 days. These dressings are designed to forestall wound desiccation and facilitate an optimal healing environment. [6]

Although introduced in 1968, 1% silver sulfadiazine (SSD) remains the benchmark in burn care protocols. Nonetheless, numerous studies have underscored possible disadvantages, including protracted wound healing and the requirement for daily dressing changes, which are often painful and mislead the evaluation of burn progression due to the development of a pseudo-eschar. [7]

Recent improvements in dressing technology have resulted in an emergence of novel silver-impregnated dressings aimed at overcoming the limits of SSD. Aquacel Ag is a notable innovation, consisting of a hydrofiber dressing formulated from sodium carboxymethylcellulose. This compound is

recognized for its capacity to create a gel upon interaction with wound exudate, thus preserving a moist healing environment. The dressing gets absorbed and vertically wicks exudates, encapsulating microorganisms within its fibers, thereby drastically decreasing bioburden and minimizing infection risks. Aquacel Ag uniquely incorporates 1.2% w/w ionic silver throughout the hydrofiber matrix, facilitating a regulated release of silver to the wound and thereby augmenting its antibacterial efficacy over an extended duration.[8].

Comprehensive literature have recognized staphylococcus aureus and pseudomonas aeruginosa as common pathogens in burn injuries. An in vitro investigation evaluating the antimicrobial efficacy of Aquacel Ag against these pathogens revealed a fast plunge in microbial activity within the initial 48 hours, with persistent efficacy that diminished bacterial populations to undetectable concentrations by 72 hours, continuing subsequently. The dressing has demonstrated efficacy against other significant infections, including methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus.[9]

Given the ongoing use of silver sulfadiazine and Aquacel Ag in healthcare settings for burn treatment, it is essential to consistently assess and compare their efficacy so as to ensure optimal care and outcomes for burn patients.[10]

Aim

This study aims to evaluate and compare the healing efficacy of Aquacel Ag and silver sulfadiazine dressings in the management of superficial partial thickness burns.

2. Methodology

Study Design and Participants

This is a retrospective, randomized controlled study that was conducted at the Department of Burns and Plastic Surgery, SMS Hospital, Jaipur, from September 2023 to January 2024. Fifty patients with superficial partial-thickness burns were recruited Simple randomization was done to assign patients into two groups, one group received SSD dressings and another group rrceived Aquacel Ag dressings.

Inclusion Criteria

1) Patients who had superficial partial-thickness burns encompassing a total body surface area (TBSA) of 40% or less.
2) Patients who voluntarily gave informed consent
3) Ability to follow the complete treatment schedule until wound healing.

Exclusion Criteria

1) Existence of full-thickness burns or partial-thickness burns with total body surface area exceeding 40%.
2) Inability to adhere to the entire treatment regimen.
3) Pre-existing conditions that may hinder research participation.
4) Participation in an alternative clinical trial using experimental medications within the preceding 30 days.
5) Existence of medical illnesses like diabetes, renal, hepatic, hematologic, neurologic, or immunological disorders that may impede wound healing.
6) Requirement for surgical intervention owing to atypical conditions.
7) Contraindications for the application of silver sulfadiazine-impregnated dressings include neonatal patients, pregnancy, and hypersensitivity to sulphonamides.
8) Burns caused by electrical or chemical injuries, frostbite, or associated injuries including inhalation injury, neurological impairment, or fractures.
9) Burns involving critically important areas such as the face, scalp, hands, and feet.

3. Data Collection

Patient's gender, age, cause of burn, total body surface area (TBSA) that was burned in %, location of burn over body, TBSA represented by the target wound in % and the day that SSD or silver dressing therapy was started were noted. To determine the extent of the injury, TBSA appropriate for the subject's age was calculated using the Lund and Browder chart. Clinical judgment of the investigators was employed to ascertain the depth of the injury. Photographs were taken and a wound swab was collected for semi-qualitative and microbiological analysis.

4. Evaluation of Treatment

1) **Wound Assessment**: Wound assessments for re-epithelization was done during every dressing changed and photographs were obtained. Wound swabs were collected for semi-quantitative and microbiological evaluation. Swabs were obtained before the initial dressing application and, if feasible, on a weekly basis thereafter. The procedure entailed utilizing sterile cotton-tipped swabs dampened with saline, put to the wound in a zig-zag pattern, and conveyed to the microbiology laboratory within four hours.
2) **Pain and Comfort**: Pain and itching were evaluated using a numerical scale ranging from 1 (none) to 5 (severe). Comfort during the application and removal of the dressing was assessed using a 5-point Likert scale (1 = very uncomfortable to 5 = very comfortable). Silver staining was evaluated in a similar manner.
3) **Physical Performance**: The physical performance of patients was assessed at each treatment session utilizing the performance Scale, which ranges from 0 (totally active, no restrictions) to 4 (completely incapacitated).
4) **Clinical Infection**: Characterized by cellulitis, visible purulence, lymphangitis, and symptoms such as localized discomfort, erythema, edema, or malodor. Infection severity was assessed on a scale from 0 (none) to 3 (severe).

Statistical Analysis

The primary outcomes evaluated to determine the efficacy of the treatments included the percentage and rate of reepithelialisation, pain alleviation, user-friendliness, and the total number of treatments needed. The parameters were statistically examined to identify significant differences between the two treatment groups.

5. Results

Part A: Mean Scores for Silver Sulfadiazine and AQUACEL AG (N=50)

Metric	Silver Sulfadiazine (GroupA)	Aquacel Ag (Group B)
Pain	4.82 ± 2.35	2.76 ± 1.02
Comfort while dressing in place	6.45 ± 1.65	7.54 ± 1.56
Comfort during dressing removal/application	6.78 ± 1.54	7.74 ± 1.68
Performance Scale	1.81 ± 2.05	0.84 ± 0.72
No. of treatments for 100% re-epithelialization	10.34 ± 7.52	4.23 ± 1.53

Part B: Observational Insights

1) Wound Healing Dynamics:

- Accelerated healing observed in the age group of 10 to 40 years.
- Prolonged healing noted in pediatric and geriatric populations.
- No notable disparity in wound healing between male and female populations.

2) Causes of Burns:

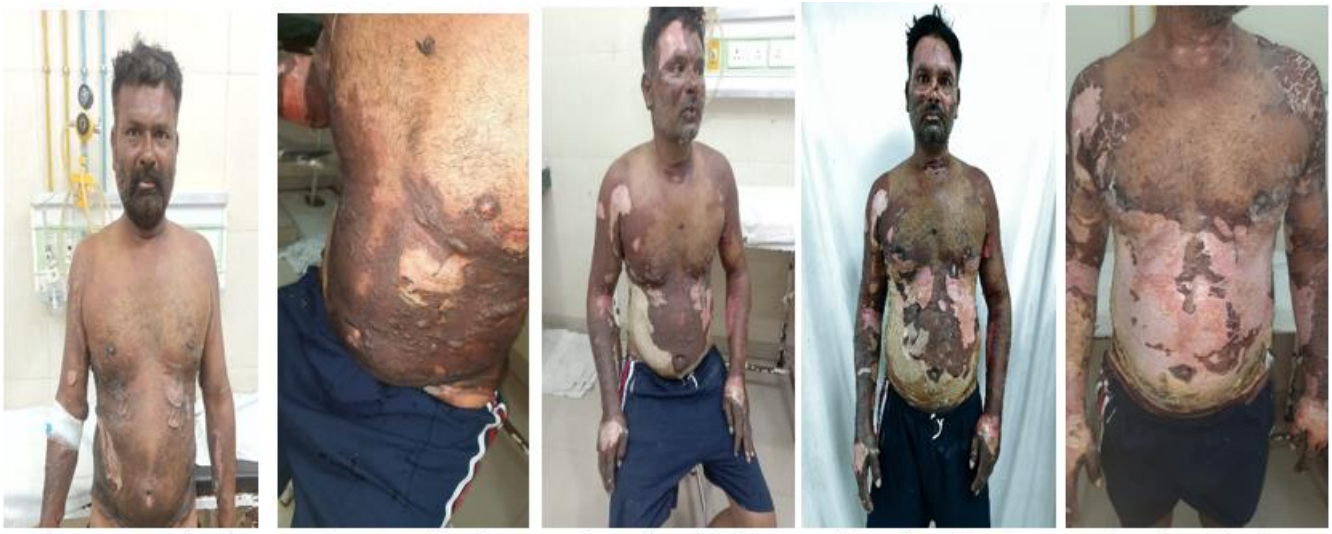
- The majority of patients had either flame or scald burns.

3) Mechanism of Burns:

- There is no variation in wound healing with regard to the mechanism of burns in superficial partial thickness burns.
- Clinical pictures have been shown in figure 1.

Figure 1

a) SSD Dressing



Before SSD application at the time of admission | After 1st application | After 2nd application | After 3rd application | After 4th application

B. Aquacel ag dressing

Before aquacel ag dressing at the time of admission | After 1st application | After 2nd application

6. Discussion

This study's results reveal notable disparities in the healing properties of silver sulfadiazine (SSD) and Aquacel Ag in the treatment of superficial partial-thickness burns. The principal outcomes evaluated were reepithelialization rate, pain control, usability, and the frequency of required treatments, with Aquacel Ag exhibiting higher efficacy in all these areas.

Repithelialization rate: The reepithelialization rate was enhanced with Aquacel Ag relative to SSD, due to its moisture-retentive characteristics and sustained release of silver ions. These qualities likely enhance wound healing by reducing skin exposure and risk of contamination. [11]

Pain Management: Patients in the Aquacel Ag cohort reported markedly reduced pain scores during the therapy duration. The alleviation of pain may be attributed to the dressing's gel-forming properties, which create a protective barrier that does not adhere to the healing wound, hence reducing discomfort during dressing changes and daily activities. [12]

Ease of use: The study outcomes reveal that Aquacel Ag was more user-friendly and simpler to administer than SSD. This is especially crucial in burn care, as the simplicity of dressing application can alleviate pressure on hospital resources and enhance adherence to treatment protocols. [13]

Treatment Frequency: The necessity for fewer dressing changes with Aquacel Ag indicates not only a reduction in material and labor expenses but also a diminished disturbance to newly developing epithelial tissues, a crucial element in preventing wound regression and infection. [14]

Mechanisms of Action: Aquacel Ag's ionic silver delivers a comprehensive antibacterial action that remains effective for the duration of the dressing's application. Conversely, SSD, while efficacious as an antibacterial, creates a pseudo-eschar that may obscure the wound bed, confounding evaluations and potentially postponing the detection and management of infections or other problems. [7]

Clinical Consequences: The therapeutic implications of these findings are significant, indicating that Aquacel Ag may enhance the management of superficial partial-thickness burns by facilitating expedited healing, alleviating pain, and diminishing the overall care load.

These advantages may result in better patient outcomes, increased patient comfort, and perhaps decreased healthcare expenses due to diminished treatment complexity and frequency. [10]

7. Limitations

This study offers significant insights, however it has some limitations. Small sample size affects the generalizability of results.
Expanded multi-center trials would be advantageous to validate these findings across diverse patient demographics and therapeutic environments. Exact size and depth of the burn, which significantly affect healing, were not taken into account. This requires measurement of each burn wound size or laser doppler imaging respectively. In Aquacel Ag group, there was lesser frequency of direct wound evaluation and microbiological bioburden assessment as the wound swabs could only be harvested in case of wound exposure or when, at silver dressing removal.

8. Conclusion

In summary, this study demonstrates that Aquacel Ag is a superior dressing compared to silver sulfadiazine for treating superficial partial thickness burns. It offers enhanced reepithelialization, improved patient comfort, and a reduced need for dressing changes, making it an efficient option for burn care.

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Conflicts Oof Interest
There are no conflicts of interest.

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