Original Article

Comparative study of silver-sulfadiazine-impregnated collagen dressing versus conventional burn dressings in second-degree burns

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Abstract

Background: The advantages of biological skin dressings like collagen are well-known. It makes wound impermeable to bacteria and creates the most physiological interface between the wound surface and the environment. Silver-sulfadiazine-impregnated collagen (SIC) is a type 1 collagen impregnated with silver sulfadiazine (SSD)-loaded alginate microspheres to deliver SSD in a controlled fashion to manage infected burn wounds for an extended period of time with lesser dressing changes. **Materials and Methods:** In this study, we used SIC for the treatment of second-degree burn wounds in 25 patients and compared with similar burn wounds in 25 patients treated with conventional dressings. **Results:** For SIC-treated group, we observed improved wound healing in all the patients after 7 days except two patients who required skin grafting, and none of them had any serious complications. For conventionally treated group, improved wound healing was seen in 14 patients, whereas the rest of the patients required prolong dressing or skin grafting. All the patients who were treated with SIC were satisfied with healing of wound and pain relief. **Conclusion:** Second-degree burn wounds are well-treated with SIC in the form of good healing, control of infection, and reducing pain without any serious complications when compared with conventional dressing.

Keywords: Second-degree burn, silver-sulfadiazine-impregnated collagen, wound healing

Introduction

Most superficial burns are managed as outpatient cases, but the scenario changes for the partial-thickness burns. Traditionally, the superficial burns are treated by referral to burns and plastic surgery specialist where management comprises alternate-day dressing of wound with or without anesthesia. The conventional dressing of burn includes wound cleaning followed by application of 1% silver sulfadiazine (SSD) cream with occlusive dressing with roller gauze. The dressing is opened on the second day and thereafter every alternate day. The SSD has become a drug of choice in burn dressings[1] due to its broad-spectrum action against Gram-positive and Gram-negative bacteria as well as against fungi.[2-4] However, there are two concerns associated with SSD dressing: the first problem is the systemic absorption of silver which remains in the body even after dissociation.[5] This absorption becomes significant in burns involving larger burn surface area (BSA).[6] Another problem with conventional dressing is of repeated daily or alternate-day painful dressings, especially in pediatric population where frequently anesthetic services are needed for dressing change.

The other method of management includes biological dressing which creates a barrier between wound surfaces and

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environmental bacteria. The collagen dressings have other advantages over conventional dressings in terms of ease of application and being natural, nonimmunogenic, nonpyrogenic, hypoallergenic, and pain-free. It acts by providing a wound bed for migration of fibroblasts, promotion of angiogenesis, and enhancing the metabolic activity of granulation tissue.[7,8] Many researchers in the past have compared the outcome of wound healing by collagen dressing versus conventional dressings.[9,10] The collagen dressings have demonstrated variable results when compared with conventional results in terms of wound healing and pain perception. It was superior in terms of completeness of wound healing, need of SSG, and need of repeated dressing which is of more concern in pediatric age group. Although collagen dressings seem to be ideal for second-degree burns, there usually are certain disadvantages associated with them. The collagen dressings may provide excellent environment for the growth of bacterial colonies which leads to exudation and delayed wound healing.[11,12] Collagen dressing may get infected in 19% of partial-thickness burn wounds leading to removal and redressing.[13] This infection may promote scarring by increasing local release of inflammatory mediators such as prostaglandins and tumor necrosis factor-alpha. This delayed wound healing infection leads to wound dehiscence, low oxygen tension, and destruction of existing cellular matrix.[14,15] The silver-impregnated collagen dressings are designed to provide the functions of both collagen dressings and conventional dressing. Also, they appear to be more comfortable to patients and are easier to use for care givers.[16]

Keeping all the above-mentioned points in mind, a study was conducted to know the benefits of silver-impregnated collagen dressing over SSD dressings in partial-thickness burns as primary treatment modality as outpatient or day-care services.

Aims and objectives

This study was conducted to evaluate the role of SIC dressings when compared with conventional dressings in the management of second-degree burns. This study also compared both groups for pain, wound infection, and associated complications.

Materials and Methods

It is a prospective, randomized case–control study conducted over a period of 6 months in burns and plastic surgery department in a tertiary healthcare setup in urban western India. Patients with less than 20% second-degree burns who presented within 48 h of were included in the study. The cases were then randomized into two groups based on surgical dressing they received, that is, group 1 silver-sulfadiazine-impregnated collagen (SIC) dressing group and group 2 conventional dressing with SSD cream group.

Sample size

A total of 50 cases with less than 20% BSA of second-degree burns were included in the study.

Randomization

Cases were randomized into two groups. In the first group, the dressing was done by SSD-impregnated collagen. In the second group, routine dressing with 1% SSD was done.

Inclusion criteria

All the clinically and hemodynamically stable patients with less than 20% second-degree burns presented within 48 h and patients who are willing for and giving consent for this procedure were included in this study.

Exclusion criteria

Cases with full-thickness burns, cases involving >20% BSA, patients presented after 48 h of burn, hemodynamically unstable patients, and patients with debilitating chronic medical disorders were excluded from the study.

Methodology

Group 1: Under all aseptic precautions, we cleaned the wound with normal saline, and some patients required anesthesia for this procedure. Then we applied SIC which was covered by paraffin gauze and dressing. We gave antibiotics for 7 days according to their swab for culture and sensitivity which was taken before applying SIC. We monitored the patients according to clinical parameters (wound discharge, soakage, pain, and fever) and hematological parameters (complete blood counts on alternate days). In all the patients of group 1, we opened the dressing on the seventh day and compared the wound with that of group 2 in the form of signs of healing, size, discharge, epithelisation, slough, and granulation tissue.

Group 2: In this group, the patients were treated with conventional method of dressing. We applied 1% SSD cream over the cleaned wound followed by occlusive dressing with gauze pad and roller bandage. The patients were asked to take bath with soap once in every 2 days and the dressings were changed along with application of ointment. The first dressing was changed after 48 h and the subsequent dressing was done on the alternate day.

Antibiotics were given according to swab culture, and follow-up was done in the both groups.

Outcome criteria

1. Patients were assessed for pain with Visual Analog Scale (VAS) on days 2, 7, and 14
2. Healing was assessed on day 7 in both the groups, and complete healing (evidenced by appearance of epithelization in 90% of wound) was compared in both the groups
3. Any complication such as infection, scarring, and incomplete healing was documented.

Statistical analysis

An analysis was performed using SPSS software for Windows (version 11.0, 2001; SPSS Inc., Chicago, IL, USA). All

the variables were tested for normality by Kolmogorov–Smirnov test before statistical comparisons. Chi-square test and logistic regression were used for analyses.

Results

A total of 50 cases with second-degree burns of <20% body surface area were included for study in our hospital during a period of 6 months. The cases were randomized into two groups. Both the groups were comparable in terms of age groups and mean ages. The male-to-female ratio in the both groups was 0.66:1 and 0.78:1, respectively, showing more number of females presenting with second-degree burns. Two age peaks were noted, that is, <5 years age and 15–60 years age. It shows that toddlers and young females who frequently work around fire are at greater risk [Table 1].

Of 25 cases in SIC group, 22 cases were completely healed on day 7, whereas only 14 cases were completely healed during that interval in conventional dressing group ($P = 0.027$). Furthermore, a reduction in wound size was noticed in SIC-treated group [Table 2]. The mean complete healing time in SIC group was 7.476 ± 3.134 days which was significantly lower ($P < 0.0001$) than control group which was 12.88 ± 4.912 days [Table 3].

The day 2 and day 7 pain scores on VAS were compared in both the groups. The cases in SIC groups experience much lesser degree of pain than the SSD group. Most of the cases had pain scores below 4 in SIC group, whereas in SSD group the mean pain score was around 4.194 ± 1.7 which was significantly higher ($P < 0.0001$) [Table 4].

Similarly, on the seventh day most of the cases in SIC group were pain-free. But in SSD group, the average pain score was 2.846 ± 1.002. This pain was more attributed to repeated removal and reapplication of dressings [Table 5].

Table 1: Age and sex distribution

Age in years	Group 1		Total	Group 2		Total	*P*
	Female	Male		Female	Male		
<5	4	3	7 (28%)	5	3	8 (32%)	0.6681
5-15	2	2	4 (16%)	2	1	3 (12%)	0.5383
15-60	7	4	11 (44%)	7	5	12 (48%)	0.6889
>60	2	1	3 (12%)	0	2	2 (8%)	0.46
Mean age	23.112±20.668 years			22.947±20.185 years			0.9773

Table 2: Healing at seventh day

Type of dressing	Healed	Not healed	Total
SIC	22	3	25
SSD	14	11	25
Total	36	14	50

SIC: Silver-sulfadiazine-impregnated collagen; SSD: Silver sulfadiazine Yates Chi-square=4.861; *P*=0.027 (<0.05)

Table 3: Mean complete healing time

Group	*n*	Mean	Std. dev.	*T*	df	*P*	
SIC	25	7.476	3.134	8.622	24	<0.0001	95% CI for mean
SSD	25	12.88	4.912				6.18-8.76

SIC: Silver-sulfadiazine-impregnated collagen; SSD: Silver sulfadiazine; CI: Confidence interval

Table 4: Day 2 pain score

Group	*n*	Mean	Std. dev.	*T*	df	*P*	
SIC	25	2.154	1.33	7.669	24	<0.0001	95% CI for mean
SSD	25	4.194	1.727				1.6050-2.7030

SIC: Silver-sulfadiazine-impregnated collagen; SSD: Silver sulfadiazine; CI: Confidence interval

Table 5: Day 7 pain score

Group	*n*	Mean	Std. dev.	*T*	df	*P*	
SIC	25	0.746	0.822	12.774	24	<0.0001	
SSD	25	2.846	1.002				95% CI for mean 0.4067-1.0853

SIC: Silver-sulfadiazine-impregnated collagen; SSD: Silver sulfadiazine; CI: Confidence interval

Complication

Two patients of the 25 cases in SIC showed discharge on the second day for which the dressing was removed and redressing was done. This value was significantly lesser (Chi-square statistic = 4.5 and $P = 0.033895$) than SSD dressing group in which eight cases showed soakage of wound on day 2.

Discussion

In India, the annual burn incidence is around 6–7 million which is based on the data from major hospitals of the country.[17] The burn incidences tend to be more common in children, females, and people from low socioeconomic status.[18] This can be attributed to the practices of open burning flame for cooking in rural India and synthetic flowing garments (sari).[18] The higher incidence in children is due to their impulsiveness, lack of awareness, higher activity levels because of natural curiosity, and total dependency on caregivers.[19] Although there are well-equipped burn centers throughout India, they are overwhelmed by the burden of cases over them. The majority of cases are still treated in the centers that do not have established burn unit.[20] There is a need in the current scenario to develop an effective treatment methodology for partial-thickness buns of lesser BSA involvement so that they can be dealt with at primary health centers or at district hospitals. This will not only reduce the burden on burn units but also save the inconvenience of travel and prolonged admission on patients themselves.

This study has clearly demonstrated the superiority of SIC dressing over conventional dressings. They were not only associated with better healing and decreased infection rated but also pain suffered by patients was significantly lowered. Barret *et al.*[21] described the pain of conventional dressing significant in pediatric age group. They compared dressing of 1% SSD with Biobrane in pediatric population for the management of partial-thickness burns. They concluded that the treatment of partial-thickness burns with Biobrane is superior to topical therapy with 1% SSD. Pain, pain medication requirements, wound healing time, and length of hospital stay were significantly reduced.

Shanmugasundaram *et al.*[22] developed a reconstituted collagen scaffold impregnated with SSD-loaded alginate microspheres, capable of delivering the drug in a controlled manner. They concluded that the collagen-based scaffold impregnated with SSD-loaded alginate microspheres can deliver SSD in a controlled fashion with control of infection for an extended time period with lesser dressing frequencies, and it would enable easier assessment of wound.

Sheckter *et al.*[23] evaluated the cost-effectiveness of enclosed silver dressings and 1% SSD dressings. According to their study, enclosed silver dressings are a cost-effective means of treating partial-thickness burns. In a large multicenter randomized study, Silverstein *et al.*[24] evaluated the cost-effectiveness, performance, tolerance, and safety of a silver-containing soft silicone foam dressing versus SSD cream (control) in the treatment of partial-thickness thermal burns. Both treatments were well tolerated; however, the total incidence of adverse events was higher in the control group. The silver-containing soft silicone foam dressing was as effective in the treatment of patients as the standard care (SSD). In addition, the group of patients treated with the soft silicone foam dressing demonstrated decreased pain and lower costs associated with treatment. In a randomized controlled trial (RCT) by Muangman *et al.*[25] in 70 outpatient cases with partial-thickness burns of less than 15% BSA, they showed that silver-impregnated hydrofiber dressing increased time to healing, decreased pain symptoms, and increased patient convenience because of limiting the frequency of replacement of the dressing at lower total cost when compared with 1% SSD dressing. This study confirms the efficacy of silver-impregnated hydrofiber dressing for the treatment of partial-thickness burns at an outpatient clinic.

A large systematic review conducted by Heyneman *et al.*[16] concluded that the use of SSD in the conservative treatment of burn wounds can no longer be supported. Their review clearly demonstrated that a faster wound healing, optimal function, and good aesthetic outcome are obtained with the newly developed burn dressings. They also concluded that these new dressings tend to be more comfortable for patients and are easier to use for care givers. The minor differences in antibacterial activity between SSD and the new products did not seem to have any influence on the rate of wound healing. In another systematic database review by Wasiak *et al.*[26] which included 30 RCTs, it was concluded that conventional SSD dressings were associated with poorer outcome when compared with biosynthetic (skin substitute) dressings, silver-containing dressings, and silicon-coated dressings for the treatment of superficial and partial-thickness burns.

Conclusion

Our study clearly demonstrated that SIC dressing is a better alternative than the conventional dressing. The pain, infection, and early complications were significantly lesser in SIC group, and the advantage of lesser dressings was also desirable in high-volume burn centers as well as to patients' comfort. However, to opine SIC dressing as first-line management for superficial burns in primary care centers, multicenter parallel larger randomized studies will be needed for better conclusion.

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Conflicts of interest

There are no conflicts of interest.

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