

Original Research Article

A comparative study of efficacy of silver stream versus povidone iodine in healing the diabetic ulcers

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ABSTRACT

Background: Diabetic ulcers affect morbidity, mortality and QOL of patients. Wound debridement and dressing using antiseptics are part of standard treatment. Silver stream solution containing silver ions, menthol, glycerol and surfactant has shown promising results in chronic DFU. But no clinical trials have been conducted yet. The aim of the study was to compare effectiveness of silver stream solution with traditionally used povidone iodine in healing diabetic ulcers.

Methods: 100 diabetic ulcer patients randomly divided into 2 groups A and B of 50 each, received ulcer dressing with silver stream solution or povidone iodine respectively every 48 hourly. Ulcer size and healing was evaluated at 2 weeks intervals for 8 weeks or till ulcer healed.

Results: Patients of both groups were comparable in their age/sex distribution, duration, control of diabetes and pre-treatment mean ulcer size. At end of 8 weeks, percentage reduction in mean ulcer size was much more in group A (89.51%) than in group B (33%). All patients treated with silver stream responded, though response was partial in (10%). Patients having poor glycaemic control. In contrast only 46% showed complete response to povidone iodine, 42% had partial response and 12% did not responded.

Conclusions: Response rate with silver stream dressing is significantly higher and reduction in mean ulcer size at end of 8 weeks treatment is significantly more than with povidone iodine.

Keywords: Diabetic ulcer, Povidone-iodine, Silver stream

INTRODUCTION

Diabetic foot ulcers constitute a devastating part of course of illness and influence morbidity, mortality and quality of life.¹ Diabetic foot ulcers affect approximately 15% of diabetic people worldwide.² Important factors contributing to causation of diabetic ulcers include loss of glycaemic control, peripheral neuropathy, peripheral vascular disease and immunosuppression.²

Ulcers usually get colonized by microbes. The overall impact of bacterial colonization of ulcer is determined by

complex interaction of numerous microbial, host and environmental factors.^{1,3}

Inflammation is body's natural response to any injury and plays crucial role in healing process. Bacterial infection leads to excessively prolonged inflammation, biofilm formation, abnormal remodelling, and delayed healing. So acute injuries become chronic wounds because of infection. Presence of biofilm enables pathogens to survive attack of host defensive mechanism. Their responsiveness to antimicrobials also decreases. Topical application of antiseptics promotes faster healing by decreasing

inflammation as well as biofilm formation induced by microbes.⁴

So, wound dressings are an important aspect of diabetic foot ulcer treatment. Dressings should, relieve symptoms, protect wounds, and promote healing. There is no single dressing that can meet all the needs of a diabetic patient with an infected foot ulcer. Various germicides have been tried from time to time for wound dressing in diabetic ulcers. These include povidone-iodine, silver ions, hydrogen peroxide, benzalkonium chloride, pilohexanide etc.⁵ Povidone-iodine is a widely used antiseptic in patients with foot ulcers. Silver ions, silver nanoparticles, silver zeolite all have been reported to possess good antimicrobial effect.⁶⁻⁸ Silver stream is a patent wound management solution that contains silver ions, menthol, glycerol and surfactant. Silver stream applied daily is reported to reduce size, fibrotic tissue, exudates and pain associated with venous ulcers or DFU and increase granulation tissue in a case series of 4 patients, but there is absence of controlled trials comparing its efficacy with other frequently used antiseptics in healing of diabetic ulcers.⁹

The aim of the study was to compare the effectiveness of silver stream versus povidone-iodine on healing of diabetic ulcers.

METHODS

It was a prospective, randomized, parallel group, open label study. After approval by IEC of Punjab institute of Medical Sciences, Jalandhar, 100 diabetic ulcer patients visiting surgery department of SBLs, Civil hospital Jalandhar from January 2020 to March 2021 were included. Patients between 18-60 years of age with chronic ulcers of grade 2-3 and atleast one palpable pedal pulse, who gave informed consent were enrolled in study. However patients with diabetic ulcers grade 1, 4 and 5 of Wagners classification, established gangrene, blackening of skin, absence of pedal pulses and allergy to povidone iodine or silver stream were excluded from study. Participants were randomly divided into two groups of 50 each, using computer generated random numbers.

A detailed history, including family history, duration of diabetes, dietary history and history of anti-diabetic medications was recorded. General physical examination and relevant investigations were performed for all patients. Measurement of ulcer size and area was done by putting a transparent plastic cover over the ulcer and markings were made along the margins and then the cover was placed on the graph paper and assessed periodically. Surgical debridement of the wounds was done initially and also during subsequent dressings as needed. After debridement, In Group A patients, silver stream solution was poured on wound with a syringe with 19-22 gauge needle. Then a gauze soaked in silver stream was applied for wound dressing. Dressing was changed every 48 hrs. Ulcer was evaluated for signs of healing like decrease in size,

decrease in inflammation, formation of granulation tissue and degree of epithelisation after an interval of 14 days. Similarly in group B patients ulcer dressing was done at 48 hours interval with povidone-iodine and ulcer was evaluated as in group A. Standard antibiotic treatment, wound debridement, antidiabetic drugs as per need of particular patient were continued. Ulcers were treated until the wound closed spontaneously, or surgically by skin grafting or till completion of the 8-week period, whichever was earlier. Outcome measures for study included decrease in ulcer size at end of 2 weeks, 4 weeks, 6 weeks, 8 weeks of treatment or till complete healing (whichever is earlier), number of ulcers showing complete or partial responsiveness, number of patients in both group in which ulcer persisted till 8 weeks. Data was analysed statistically using SPSS version 21.0. Association between qualitative variables was assessed by chi square test and Fishers exact test for all 2x2 tables. Quantitative data was presented as mean±SD and compared using unpaired t test. P value<0.05 was considered significant.

RESULTS

Patients in both groups were comparable in terms of age and gender distribution.

In both the groups, number of participants are higher in 51-60 years age groups and lowest in 20-30 years age group as shown in Table 1. Difference in mean age of group A (53.8±12.8) and group B (55.9±10.7) was not significant (p=0.18). The number of male participants is higher in group A (66 percent) while females are more in number in group B (52%) as shown in Figure 1. The gender differences between two groups are however not statistically significant (p=0.46).

Figure 2 shows that mostly patients have normal skin condition (62% in silver stream treated and 52% in povidone-iodine group). While 38% patients in group A and 48% in group B have macerated skin before starting treatment. These differences between two groups in skin condition were not significant (p=0.19).

42 (84%) patients in group A and 44 (88%) in group B had diabetes for >10 years. Mean duration of diabetes in years between group A (21.5±9.4) and group B (23.4±9.6) were not significantly different (p=0.13). The differences in mean HbA1C levels and FBS levels between two groups were also not significant (p=0.45 and 0.98 respectively).

Table 2 shows that majority of patients (more than 70%) got infected spontaneously while only a quarter of patients had onset due to trauma in both the groups. The differences in two groups were not statistically significant (p=0.81).

Table 3 shows progressive reduction in mean size of ulcer in both groups at 2, 4, 6 and 8 weeks of treatment. The differences in pre-treatment mean ulcer size between two groups were not significant (p=0.34), but mean ulcer size in silver stream group was significantly lesser than in

povidone iodine group at 2, 4, 6 and 8 weeks of treatment. Figure 3 shows percentage reduction in ulcer size at end of 8 weeks to be significantly more in group A (89.5%) than in group B (33.0%) (p=0.01). All the patients in silver stream group responded to treatment. Response was complete in 90% and partial in 10% patients (N=5).

Table 4 shows reduction in size in cm² in these partial responders in group A and their HbA1c was ≥9.3 indicating poorly controlled diabetic status. In contrast in povidone iodine group only 46% patients showed complete response, 40% had partial response and 14% were non responsive to treatment. The differences in response rate between two groups were statistically significant (p=0.010). Mean HbA1c of partial respondents in group A was 11.1, whereas in group

B mean HbA1c was 8.6 for non-responders and 9.4 for partial responders.

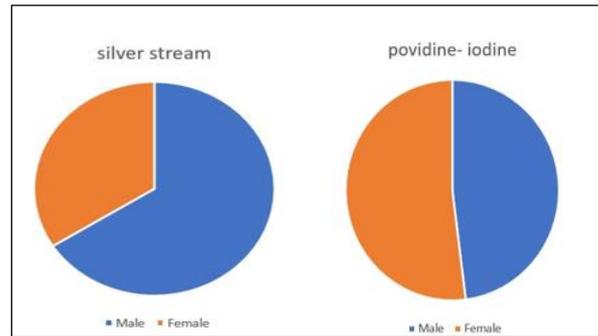


Figure 2: Showing pre-treatment skin condition in both groups.

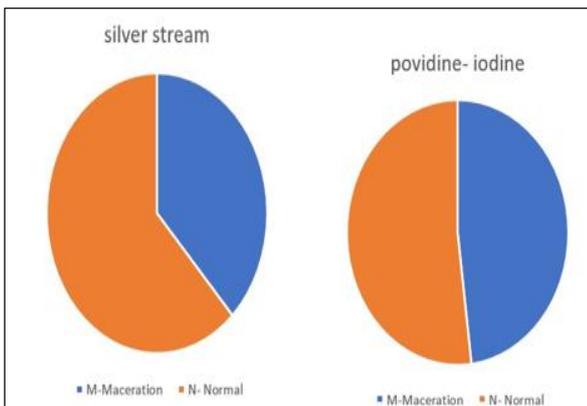


Figure 1: Showing gender wise distribution of patients.

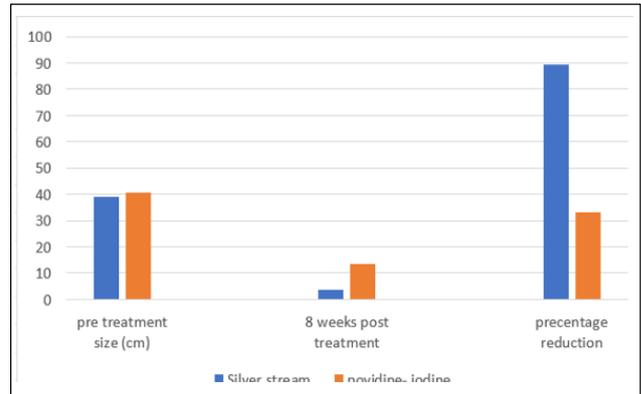


Figure 3: Showing pre-treatment skin condition in both groups.

Table 1: Age-wise distribution of patients.

Age group (years)	Silver stream (N=50); group A		Povidine-iodine (N=50); group B		P value (t test)
	N	%	N	%	
20-30	01	02	03	06	
30-40	13	26	17	34	
41-50	15	30	10	20	
51-60	21	42	20	40	
Total	50	100	50	100	
Mean±SD	53.8±12.8		55.9±10.7		0.18

Table 2: Onset of diabetic ulcer.

Onset	Group A		Group B		P value
	N	%	N	%	
Spontaneous	37	74	36	72	0.813
Trauma	13	26	14	28	

Table 3: Size of diabetic foot ulcer.

Size (cm ²)	Silver stream (N=50); group A		Povidine-iodine (N=50); group B		P value (t test)
	N	%	N	%	
Pre-treatment	39.1	7.9	40.6	7.9	0.34
2 weeks post-treatment	30.8	8.6	35.4	8	0.007

Continued.

Size (cm ²)	Silver stream (N=50); group A		Povidine-iodine (N=50); group B		P value (t test)
	N	%	N	%	
4 weeks post-treatment	23.3	9.4	31.1	8.7	0
6 weeks post-treatment	14.6	10.5	27	9.4	0
8 weeks post-treatment	3.5	10.9	13.4	14.8	0

Table 4: Size of diabetic foot ulcer.

Ulcer size before treatment	Ulcer size at 8 weeks (cm ²)	Reduction in size (cm ²)	HBA1c
54	41	13	9.3
49	39	10	12
51	42	09	11.9
35	27	08	9.6
34	29	05	12.6

DISCUSSION

Treatment of diabetic ulcer should be early, aggressive and systematic to ensure optimum outcome. The choice of wound dressing is important component of diabetic wound care management. In present study silver stream solution containing silver ion, menthol, glycerol and surfactant was compared with povidone iodine, a frequently used antiseptic in a prospective, randomized, open label, parallel group trial, in 100 patients with diabetic ulcers grade 2 and 3.

42% patients in group A and 40% in group B were in age group 51-60 years. Data from the past literature shows that the risk of foot ulceration and limb amputation increases with age and the duration of diabetes. Studies by O'Brien et al, Callam et al, Cornwall et al reported an increase in prevalence with each decade of life.¹⁰⁻¹²

Out of total 100 participants with diabetic foot ulcers, 57 were males and rest females. In a study by Rao H et al, 73.68 percent of the study population was males.¹³ Dinh et al also showed that women have a lower risk than men for diabetic foot ulceration.¹⁴ This could be explained by the fact that men have more outside activity than women, which may lead to more exposure to different risks and more plantar pressure on their feet. A study by Yazdanpanah et al also reported males to be more commonly suffering from DFU in a univariate analysis, though it was not found to be significant in a multivariate analysis.¹⁵

In majority of patients (more than 70%) ulceration occurred spontaneously while only a quarter of patients had onset due to trauma in both the groups. Mean duration of diabetes among the patients of silver stream group and povidine-iodine group was 21.5 years and 23.4 years respectively. 84 percent of the patients of the silver stream group and 88 percent of the patients of the povidine-iodine group were diabetic for more than 10 years. Our results are

in agreement with previous studies by Gwak et al.¹⁶ Gwak et al have reported mean duration of diabetes to be approximately five to six years in patients with diabetic foot ulcers.¹⁶ Sharma et al also reported higher incidence of diabetic foot ulcer in patients who were diabetic for 6-15 years.¹⁷

A progressive significant reduction in the mean size of diabetic ulcer at different post-treatment follow-ups was observed in both groups. At final follow-up the percentage reduction in size of diabetic foot ulcer in silver stream group was 89.5 percent as compared to 33% in povidone iodine group. Our results are in concordance with a study by Gupta et al which reported 83.42% reduction in mean wound area with silver dressing at end of 8 weeks.¹⁸ Sharma et al also reported 85.65% reduction in ulcer size after 12 weeks treatment with silver colloid.¹⁷ All the patients in the silver stream group responded to treatment. Response was complete in 90 percent and partial in 10 percent patients. All partial responders had poor glycemic control as shown by their HBA_{1c}. The percentage of partial responders with silver dressing was reported to be 15.38% by Sharma et al and 20% by Gupta et al.^{17,18} In our study, in group B receiving povidone-iodine, complete healing occurred only in 46% patients. Similar results were obtained by Gwak et al in their study on diabetic foot ulcers treated with povidone-iodine.¹⁶ Complete healing occurred only in 44.4 percent of the patients within 8 weeks.

Strength of this study was prospective, randomized design which ensured similar baseline characteristics in both treatment groups. Moreover ulcer size and healing was assessed at two weeks interval. The differences in mean reduction in size between two groups were found to be significant during each follow up at 2, 4, 6 and 8 weeks. An important limitations of study is that partial responders of both groups and non-responders in povidone iodine group at 8 weeks were not followed further to see final outcome or time to complete healing.

Our study found silver stream to be more effective than povidone iodine in healing of diabetic ulcers with alternate day dressing. Further trials can follow up the patients till complete healing to see whether time to healing is shortened by silver stream as compared to other antiseptics.

CONCLUSION

Both the dressings were effective in diabetic foot ulcer patients. However; the silver-stream dressing had far better results in comparison to povidone-iodine dressing in the management of diabetic foot in terms of mean reduction in ulcer size and response rate.

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