

Original Research Article

Management of Diabetic Foot Ulcer using Silver Nitrate in Liquid Form - A Prospective Interventional Study

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Abstract

Background: Diabetic foot ulcer is very common nowadays. It ranges from 15% to 25%. Various methods and dressing agents have been tried for dressing.

Objective: To access silver nitrate in solution form as a dressing agent for diabetic foot ulcer.

Materials and methods: A prospective study was conducted at tertiary care institute. Here, a total of 100 patients having diabetic foot ulcer were studied and consent for various procedures were obtained from them. Data regarding granulation tissue formation, pus culture and sensitivity report, skin graft acceptance and hospital stay were analyzed in tabular manner.

Results: Among 100 study subjects, 50 were taken as control group and 50 as study group. The granulation tissue formation on 15th day was 95% in study group and 80% in control group. Successful skin graft uptake was 96% in study group and 80% in control group. Hospital stay in study group was 24.6 ± 3.2 days and 34.3 ± 7.4 days.

Conclusion: Various modalities of dressing methods and materials are available, but in this study silver nitrate in the form of solution form is a better option as compared to others for diabetic foot ulcer.

Key words

Diabetic foot ulcer, Diabetes, Silver nitrate, Culture sensitivity, Skin graft, Granulation test.

Introduction

The period incidence of foot ulcer within the diabetic community is around 15%. Diabetic foot ulcers precede almost 85% of amputations in India [1]. Chronic leg ulcers are generally related with reduced quality of life, high morbidity and financial loss to the patient [2, 3, 4, 5]. The dressing of wound is an old art varying from herbal dressing to modern dressing material like creams, ointments and solutions. The classes of wound dressing are occlusive dressing, non-occlusive dressing, absorptive dressing, skin substitutes and negative suction vacuum dressing. Despite many modes of wound dressing, treating diabetic wound is a challenging task and this has led in search of better option for wound healing agent [6, 7]. Liquid Silver nitrate, a newer agent may be tried in treating of diabetic foot ulcer, as it has been claimed for faster granulation tissue formation in the wound. Hence, improves quality of graft bed and results in better graft uptake: a better wound management. The present study was conducted to assess the efficacy and effect of topical spray of silver nitrate solution in the diabetic wound versus conventional dressing material.

Materials and methods

It was a prospective Interventional study among 100 study participants who visited surgical department admitted in Tertiary care institute from July 2018 to June 2019.

Inclusion criteria

- Grade I and II-foot ulcers as per Meggitt-Wagner classification.
- Patients on oral hypoglycemic agent or insulin for Diabetes mellitus.

Exclusion criteria

- Chronic ulcers due to other etiology.
- Grade III, IV, V foot ulcers as per Meggitt-Wagner classification.

- Immunocompromized state like HIV.
- Age less than 15 years.
- Patients with varicose vein and decreased vascularity (ischemia) of lower limb.
- Patients with allergy to silver nitrate.

Methodology

The selective patients were randomly assigned to study group and control group. Each patient participating in the clinical trial signed on informed consent form, though one had the right to withdraw without any prejudice at any point of time. In all cases, detailed history was taken. History of IHD (Ischemic Heart Disease), other chronic systemic ailments, smoking and alcohol drinking was asked and recorded. The site, depth and duration of ulcer were recorded. In all patients, hemoglobin, DC (Differential Count), TLC (Total Leucocyte Count), FBS (Fasting Blood Glucose), PPBS (Postprandial blood glucose), blood urea and creatinine were routinely done. Urine routine and microscopic examination was done. After slough removal the surface were measured, tracing the outline on transparent paper. This outline was transferred to graph paper and size was measured in both control and study group. In study group, 2 mL of silver nitrate solution was taken in a syringe after cleaning the wound with distilled water, drying it with sterile gauze and then the silver nitrate solution was sprinkled over the wound surface. After this the wound was covered with gauze soaked with silver nitrate solution, whereas in control group dressing was done by 50% w/v povidone-iodine solution. Dressings were done and followed every alternate day for 14 days. Size of ulcers was measured weekly. Wound culture was done on day 1 and on day 14, observed side effect (local and systemic) were documented.

Informed Consent - Written informed consent was taken before the start of the study.

Ethical Approval - The study was approved by Institutional Ethics Committee (IEC).

Statistical analysis

All statistical analyses were performed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Means or medians and frequency/percentage were computed for quantitative and qualitative observations, respectively. Chi-Square test was used for analysis. P value \leq 0.05 was considered significant.

Results

The rate of granulation tissue formation was assessed on 15th day and mean granulation tissue was 95% in study group and 82% in control group. The result was analyzed using chi-square test and was found to be significant (p = 0.001) as per **Table - 1**.

The patients in both groups were subjected to split thickness skin grafting and graft uptake was again measured on the 7th post-operative day as the % of ulcer surface area mentioned. In study group, 96% successful graft taken was observed and in control group it was found to be 80% which showed to be highly significant (p= 0.001) as per **Table - 2**.

Hospital stay for study group was 24.6 ± 3.2 days and in control group was 34.30 ± 7.3 days. The results were obtained using Independent sample t-test, which was found to be highly significant (p= 0.001). Difference in mean duration of hospital stay between the control and study group is 10.30 days (95% CI 8.54 -10.82) as per **Table - 3**. As per **Table - 4**, after 14 days culture and sensitivity was done and significant result was obtained in study group who were subjected to silver nitrate solution (p=0.001).

Table - 1: Granulation Tissue formation on 15th day.

Granulation tissue	Control group (N=50)	Study group (N=50)	p-value
71-80%	20	6	0.001*
81-90%	25	14	
91-100%	5	30	

*p<0.05 was statistically significant

Table - 2: Graft Uptake in the both groups.

Graft uptake	Control group (N=50)	Study group (N=50)	p-value
<70%	10	5	0.001*
71-80%	8	8	
81-90%	25	9	
91-100%	7	28	

*p<0.05 was statistically significant

Table - 3: Hospital Stay as per study participants.

Hospital stay	Control group (N=50)	Study group (N=50)	p-value
Mean \pm SD	34.3 \pm 7.3	24.6 \pm 3.2	0.001*

*p<0.05 was statistically significant

Table - 4: Bacterial Culture Report on Day 14.

Result	Control group (N=50)	Study group (N=50)	p-value
Positive	10	8	0.001*
Negative	40	42	

*p<0.05 was statistically significant

Discussion

Management of diabetic foot ulcer is a challenge to every treating surgeon. As newer dressing materials have come, it is necessary to identify the cheapest and effective one for dressing the diabetic ulcer. In this study the dressing material is silver nitrate in liquid form, though in ointment base form its efficacy has already been proved. But it is better in liquid form and its response has been tried in the present study. This study is like Muthu Kumar Swamy MG, et al. [8] who tried with phenytoin studied with newer dressing material (oxum, opsite, collagen, oxoferin). In this study, mean age group in study group were 48 and 50 years in control group. Graft uptake was 93% and 76% respectively. Hospital stay was 25 days and 35 days respectively. My study was also compared with other studies like Pendse, et al. and Bansal, et al. [9, 10].

The microbiological findings showed 60% polymicrobial bacterial isolates with *Staphylococcus aureus* and *Escherichia coli* predominating. Similarly reported by other studies [11, 12]. The bacterial isolates in the present study showed multi- drug resistance, except carbapenems group drug showed 100% sensitive to all isolates. Present findings were comparable with another study done by Vishwanathan, et al. [13]. The multi-drug resistance bacterial isolates from DFUs required immediate surgical intervention. The duration of hospital stay in the present study was between 15-116 days. Another study showed duration of hospital stay was 36.24 ± 12.62 days. The variations of hospital stay due to the availability of facilities in hospital and severity of illness. The rate of mortality in the present study was 9.4% [13]. Another study showed mortality rate 13.2% due DFUs mainly in patients with severe sepsis. The mortality rate can be reduced by proper health care with control sugar level, early presentation in hospital by patients and appropriate antibiotic therapy [14].

Conclusion

Silver nitrate in liquid form is newer concept in management of wound healing. It enhances granulation tissue formation and reduces bacterial load in the wound. Hence, better management after skin grafting, which also shortens the hospital stay for diabetic foot ulcer patients.

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