



Nanocrystalline Silver Dressings in Wound Management: A Prospective Study

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Abstract

Background: The incidence of diabetes and its complications is rising as a result of the lifestyle changes. The foot is most frequent site for complication in patients with diabetes. Dressings have a vital part to play in the management of wounds. Nanotechnology makes it possible to expand the surface area of silver particles markedly to nanoscale. They expand the surface area of silver particles increasing their contact with bacteria.

In the proposed study, over a period of 3 months, 60 cases (30-30 in 2 groups) of chronic wounds were studied with respect to response (healing) to nano silver dressing and sulfadiazine dressing after dividing them randomly. Assessment was based on various parameters like size reduction, healthy granulation tissue, etc.

It was seen that percentage reduction in size, was more in nano silver group as compared to sulfadiazine group. Wounds were managed successfully, early in nano silver group and wound healing was better in nano silver group as compared to sulfadiazine group. Also, nano silver was better antimicrobial.

Conclusions: The prospective study showed nano silver gel is safe and effective in wound management and gives better efficacy and faster response as compared to traditional sulfadiazine dressing

Keywords: Diabetic foot ulcers, Nano silver gel, Wound management

INTRODUCTION

The ultimate goal for wound healing is a fast recovery with negligible scarring and best function. Wounds expose patient to various hazards like infection, tissue necrosis, disfigurement and scars. It is the surgeons' task is to minimize the adverse effects of injuries, remove or repair the damage structure and hasten the process of wound healing to restore the function. Poor glycemic control results in lessened inflammatory response, neo-vascularization and collagen synthesis therefore delaying healing. It is interaction of contributory causes which leads to the breakdown of the foot at risk.

Silver has antiseptic, antimicrobial, anti-inflammatory properties and is a broad spectrum

antibiotic effect [1, 2] Silver sulfadiazine, or other ionic silver compounds. Ag⁰ is the uncharged form of metallic silver present in nanocrystalline silver[3]. Free silver cations have a potent antimicrobial effect which destroys micro-organisms immediately by blocking the cellular respiration and disrupting the function of bacterial cell membranes. This occurs when silver cations bind to tissue proteins, causing structural changes in the bacterial cell membranes which in turn cause cell death. Silver cations also bind and denature the bacterial DNA and RNA, thus inhibiting cell replication. [2, 4]

METHODS

This study was conducted in a tertiary care hospital after the approval of Hospital Ethics Committee. Prospective study was done from June 2020 to June 2021. Informed written consent was taken from all the patients after explaining to them, the procedure and purpose of this study. Total of 60 cases were enrolled in study. Patients were divided into two groups of 30 each. In first group, after cleaning

wound with normal saline, nano silver crystalline gel was applied over the wound covered with paraffin mesh, while in the second group, sulfadiazine soaked gauze was Maximum follow up period of 8 weeks was undertaken and ulcer status was noted using visual assessment, thus analysing the response of ulcers to both dressings.

Table 1: Age Distribution.

Age group	Group A		Group B	
	N	%	N	
40-50	14	46.6	7	23.33%
51-60	8	26.67	11	36.67
>60	8	26.67	12	40.00
Total	30	100.00	30	100.00

As depicted in Table 1, patients of different age groups were studied. Maximum number of patients being in age group of 40-50 overall (in group A) and second being the age group of more than 60 years (in group B). Mean age in group A was 53.80±9.81 years. Mean age in group B was 58.20±10.70 years.

Table 2: Wound size.

Wound size in cms at different time period	Group A		Group B		P VAUE
	Mean	SD	Mean	SD	
Initial	7.01	4.40	8.24	5.13	0.324
1 week	5.29	3.93	6.93	4.79	0.152
2 nd week	2.76	2.05	4.01	2.32	0.044
4 th week	1.12	1.04	2.84	4.16	0.032
8 th week	-	-	0.32	-	-
Difference (intial- 4 th week)	5.89+0.92		5.4+0.98		0.042

Table 2, showed that in group A, initial wound size was 7.01±4.40 cms and in group B, initial wound size was 8.24±5.13 cms (p<0.324). During the study at 4 weeks, in group A, final wound size at 4 weeks was 1.12±1.04 cms and in group B, final wound size was 2.84±4.16 cms (p=0.042). Wound size is comparably less in group A than in group B at 4 weeks follow-up (p<0.05).

Table 3: Wound healing status at fourth week.

Status of wound at 4 th week				
Amputate	1	3.33	1	3.33
Grafting	2	6.67	10	33.33
Healed	18	60.00	10	33.33
Flap	1	3.33	0	0.00
Primary suturing	1	3.33	0	0.00
Not healed	7	23.3	9	30.0
Total		100.00	30	100.0

As shown in Table 3, we observed that most of the ulcers healed completely with nano silver gel and Sulfadiazine dressings only. Till 4th week, in group A, 18 out of total 30 patients healed entirely by applying nano silver gel, while in group B, 10 wounds were healed by sulfadiazine dressing. 2 patients in group A underwent grafting, while in group B, 10 patients had to undergo grafting. One patient with flap. Wounds in 7 patients in group A and 9 patients in group B were not healed by dressings by the time of 4 weeks.

Table 4: Floor status at fourth week

Floor 4 (granulation tissue)	Group		Group	
	N	%	N	%
Pink	8	26.67	4	13.33
Pale	0	0.00	5	16.66
Healed /grafting/fla/amputate primary suturing	22	73.33	21	70.00
Total	30	100.00	30	100.00

As shown in Table 4, after 4 weeks' time, no patient in group A had pale granulation. In group B, 16.66% patients had pale granulation. 26.67% patients in group A had pink granulation while in group B, 13.33% patients had pink granulation ($p=0.042$). Granulation tissue was comparably better in group A than in group B ($p<0.05$).

Table 5: Swab positive cases with type of organism.

ORGANISM	GROUP A		GROUP B	
	%		N	%
Acinetobacter	0	0.00	1	3.33

Citrobacter	3	10.00	2	6.67
E.coli	6	20.00	3	10.00
klebsiella	3	10.00	4	13.33
No growth	6	20.00	8	26.67
Proteus mirabilis	0	0.00	4	13.33
pseudomonas	3	10.00	1	13.33
Pus culture c/s	5	16.67	4	3.33
Staphylococcus aureus	4	13.33	3	13.33
Total	30	100.00	30	100.00

TABLE 6 Percentage reductions in wound size

Variable	Group A MEAN+SD	GROUP B	P Value
Difference (initial -4thweek)	5.89+0.92	5.4=0.98	0.042
% Reduction	84.2	65.5	

Table 7: Discharge from wound status at fourth week.

Wound status	Group A N	%	Group B N	%
Absent	8	26.67	4	13.33
Present	0	0.00	5	16.66
Total	30	100.00	30	100.00

DISCUSSION

Nanocrystalline silver dressings are used selectively for infected wounds, particularly in chronic wounds.

The effectiveness of a nanocrystalline dressing should be evaluated in weeks. Extension of use beyond this time period should be based on expert clinical knowledge. Wounds with high amount of exudate requires secondary absorbent dressing, which should be changed on a regular basis as required.

Various studies have found that silver dressings is beneficial in terms of cost effectiveness, e.g. reduced time to wound healing, shorter hospital stay, reduced dressing change frequency, reduced need for pain.[5, 6]

Mendoza et al studied a direct co-relation between old age and poor wound healing outcomes such as dehiscence.[7] Holt et al studied that, in comparison to healthy human volunteers, there was a significant

delay of 1.9 days in the epithelisation of superficial skin defects in those older than 70 years of age. 8

A study conducted by Kautzky-Willer et al, it was the male gender that was suffering more from diabetic foot. Sex distribution did not carry much of inference in our study, as sex distribution was comparable in both the groups, comprising of 60% male patients and 40% female patients in group A and 66.6% male patients and 33.33% female patients in group B.

The study conducted by Heughan et al, concluded that patients having anaemia had slower wound healing rate as compared to healthy individuals [9] In our study, though majority of patients had anaemia, as a co-morbidity, the co-morbid condition was equally distributed in both the groups and no bias in study was there due to this condition, effecting wound healing.

Lee et al investigated the effect of silver nanoparticles in dermal contraction and epidermal re-epithelialization during wound healing and suggested that silver nanoparticles could increase the rate of wound closure with nano silver gel showed early granulation with less eschar formation when compared to conventional dressing, .sulfadiazine

Conclusion

Nano silver gel is safe and effective in wound management and gives better efficacy and faster response as compared to sulfadiazine and other topical antiseptics. It is less painful during cleaning and debridement procedures. The result of this study therefore appears to show more favourable results for nano silver gel group than for conventional dressing. Hence nano crystalline silver dressing is preferred over sulfadiazine in chronic wounds.

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