



NANO CRYSTALLINE SILVER DRESSING VS BETADIENE DRESSING IN CASES OF DIABETIC FOOT ULCER - A COMPARITIVE STUDY

General Surgery

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ABSTRACT

Introduction :- The incidence of diabetes and its complication is rising as a result of lifestyle changes. In patients with diabetes, foot is the most common site for complication. Dressing have a vital part to play in management of wounds. The ideal antiseptic is one that is lethal to all forms of bacteria has no deleterious effect on healing tissues, delineate operative areas, easily applied and has wide spectrum of activity and absence of required bacterial resistance. 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, whereas providing-iodine (betadiene) is an antiseptic medicine composed of polyvinylpyrrolidone with water, iodide and 1% iodine. It has bactericidal properties against a large number of pathogen. **Methods:-** In this study over a period of 10 months, 60 cases (30 each) were divided in 2 group, Group A in which dressing was done by nano silver and Group B by betadiene and patients were divided equally in both groups through chit system. **Result:-** It was seen that percentage reduction in size was more in Group A as compare to Group B. Wounds were managed successfully, early in the Group A and wound healing was also better in Group A as compare to Group B.

KEYWORDS

diabetic foot ulcer, nano silver gel, betadiene, dressing, wound management.

INTRODUCTION:-

The primary objective of wound healing is to achieve a quick recovery with minimal scarring and optimal functionality. Wounds present several risks to patients, including infection, tissue death, disfigurement, and scarring. Surgeons play a crucial role in mitigating the negative impacts of injuries, repairing or removing damaged tissue, and accelerating the healing process to restore function. Additionally, inadequate glycemic control can impair the inflammatory response, neovascularization, and collagen production, leading to delayed healing.

There are four main causes for development of diabetic foot ulcers :-

- 1-Neuropathy
- 2-Peripheral vascular disease
- 3-Charcoal foot
- 4-Infection

Irrigating wounds with antibiotic or antiseptic solutions has significantly decreased the risk of infection, especially in contaminated or clean-contaminated procedures. While antiseptic agents can help manage bacterial levels and prevent infections, they may also be harmful to fibroblasts and other healthy cells (1). In contrast, silver exhibits minimal toxicity and rarely leads to microbial resistance. Research has shown that silver-based dressings are effective against harmful bacteria(2). Therefore, using silver-releasing dressings in conjunction with debridement on wounds prone to infection is advantageous(3). Additionally, nanotechnology has enabled the creation of very small silver particles with larger surface area-to-volume ratios, enhancing their antimicrobial properties while reducing toxicity to human cells.(4)

The use of silver for infection prevention and treatment dates back to around 1000 BC, when ancient Greeks and Romans utilized it as a disinfectant. Silver foil was applied to surgical wounds to enhance healing and reduce postoperative infections, while silver pencils were used for wart removal and ulcer debridement.(5-6)

Silver possesses antiseptic, antimicrobial, and anti-inflammatory properties, functioning as a broad-spectrum antibiotic.(7) Its biologically active forms include soluble silver ions (Ag^+) and clusters of metallic silver (Ag_0). Ag^+ is found in compounds like silver nitrate and silver sulfadiazine, whereas Ag_0 is present in nanocrystalline silver. Silver cations exert a strong antimicrobial effect by disrupting cellular respiration and damaging bacterial cell membranes. This occurs when silver binds to tissue proteins, leading to structural changes in the membranes and ultimately causing cell death. Additionally, silver cations can bind to and denature bacterial DNA and RNA, inhibiting replication.

Research by Wright et al. investigated the early healing processes and effectiveness of nanocrystalline silver on matrix metalloproteinase levels, cell apoptosis, and healing in a porcine model of contaminated wounds. They found that nanocrystalline silver plays a significant role in modifying inflammatory responses and facilitating the initial stages of wound healing.(8)

METHODS:-

This study focused on patients with diabetic foot ulcers admitted to Mahatma Gandhi Medical College in Jaipur. A prospective comparative study was conducted from December 2023 to September 2024, with informed written consent obtained from all participants after explaining the study's purpose and procedures. A total of 60 patients were enrolled and randomly assigned to two groups of 30 using a chit system. In the first group, after cleaning the wound with normal saline, a nano silver crystalline gel was applied and covered with paraffin mesh. The second group received betadine-soaked gauze. Patients were monitored for 8 weeks, and ulcer progression was assessed visually to compare the efficacy of the two dressing types.

Inclusion Criteria

- Patients over 18 years old
- Both sexes
- Admitted to the departments of general surgery, medicine, or orthopedics
- Diagnosed with diabetic foot ulcers
- Ulcer size up to 10×10 cm

Exclusion Criteria

- Patients under 18 years old
- Those with significant comorbidities (e.g., liver cirrhosis)
- Patients positive for HBsAg, HCV, or HIV
- Individuals on steroids, immunosuppressive agents, radiation, or chemotherapy

Procedure

Patients were divided into two groups of 30 each. Group A received nano silver crystalline gel after wound cleansing with normal saline, while Group B had conventional betadine-soaked gauze applied. Both groups were followed for 8 weeks, during which ulcer status was assessed visually.

Each patient in Group A was treated with the nano silver dressing after cleaning, while Group B received standard dressing(betadiene) without nano silver. Necessary debridement was performed, and adequate antiseptic solutions were used to ensure the wound bed was clean. Dressings were secured with bandages as needed.

Wound assessments were conducted on admission and at weeks 1, 2, 4, and 8 during dressing changes. Cultures for pus were collected on the first day of admission and at the end of 4th week. Each follow-up included a complete physical examination, wound examination, and monitoring for any adverse effects. Laboratory tests, including hemoglobin, CBC, HbA1c, blood sugar, and renal function tests, were also performed.

RESULTS

The study involved 60 patients who were prospectively randomized into two groups, with 30 patients in each (Group A and Group B).

Efforts were made to ensure that patients in both groups had similar types of wounds. Wound healing was assessed using various parameters, including size reduction, discharge levels, the condition of edges and margins, and the presence of granulation tissue.

As shown in Table 1, patients from different age groups were included. The largest number of participants was in the 40-50 age range in Group A, while the second largest group was those over 60 years in Group B. The mean age for Group A was 53.80 ± 9.81 years, and for Group B, it was 58.20 ± 10.70 years.

Table 1: Age Distribution.

AGE GROUP	GROUP A	GROUP B
40-50	14	7
51-60	8	11
>60	8	12

Table 2 indicates that the initial wound size in Group A was 7.0 ± 4.0 cm, while Group B had an initial size of 8.0 ± 5.0 cm. By the 4-week, the final wound size in Group A reduced to 1.1 ± 1.0 cm, whereas Group B had a final size of 2.8 ± 2.0 cm. Thus, Group A demonstrated a significantly smaller wound size compared to Group B at the 4-week follow-up.

Wound size (in cm)	Group A	Group B
	MEAN	MEAN
Initial	7.04.0	8.05.0
1 st week	5.24.0	6.94.0
2 nd week	2.73.0	4.02.0
4 th week	1.11.0	2.82.0
8 th week	-	1.31.0

Table 3 shows the pus culture on admission and one at the end of 4th week in both groups.

On admission:-

Pus culture	Group A	Group B
Positive	18	22
Negative	12	8

At the end of 4th week:-

Pus culture	Group A	Group B
Positive	5	8
Negative	25	22

The above table shows that on admission in group A out of 30 patients 18 patients pus culture organism were found and 12 patients had negative culture report. In group B 22 patients had positive culture reports and 8 have negative culture report.

On comparing at the end of 4th week in group A only 5 had positive culture out of 30 and in group B only 8 had positive culture report.

Thus in group A 83.3% reduction in bacteria as compared to group B where it was 73.3% reduction.

Common organism /bacteria isolated were E.coli, pseudomonas, klebsiella, staph aureus, etc.

DISCUSSION

Nanocrystalline silver dressings should be selectively applied to infected wounds, especially in diabetic patients or those with peripheral arterial occlusive disease, as systemic antibiotics often fail to reach these infections effectively. The performance of nanocrystalline dressings should be monitored over several weeks, and any extension of use beyond this period should be based on clinical judgment. For wounds with moderate to high exudate, a secondary

absorbent dressing may be necessary, which should be changed regularly.

Several studies indicate that silver dressings can enhance cost-effectiveness by reducing healing time, shortening hospital stays, decreasing the frequency of dressing changes, minimizing the need for pain relief during changes, and lowering the incidence of MRSA bacteremia from infected wounds.(9)

Research by Mendoza et al. found a correlation between age and poor wound healing outcomes, such as dehiscence, while Holt et al. noted a significant delay in the epithelialization of superficial skin defects in individuals over 70. In this study, age distribution was comparable between the two groups, with mean ages of 53.80 ± 9.81 years in Group A and 58.20 ± 10.70 years in Group B, indicating that age did not significantly influence the results.

Kautzky-Willer et al. reported that men develop diabetic foot syndrome at an earlier age than women, with male sex being a positive predictor for a higher risk of foot ulceration. In this study, there was a higher prevalence of diabetic foot in males; however, the sex distribution was similar across both groups, with 60% male and 40% female in Group A, and 66.6% male and 33.3% female in Group B.

Heughan et al. found that patients with anemia experienced slower wound healing compared to healthy individuals.(10) Although many patients in our study had anemia, this co-morbidity was evenly distributed between the groups, minimizing bias in wound healing outcomes.

Research by Versloot et al. demonstrated that nanocrystalline silver dressings achieved superior healing rates (89%) compared to silver sulfadiazine (68%).(11) In our study, Group A showed a percentage reduction in wound size of 84.2% at four weeks, compared to 65.5% in Group B ($p = 0.042$), indicating that nano silver gel was more effective than betadine.

Fong et al. found that nanocrystalline silver delivered silver cations more rapidly and effectively reduced bacterial presence compared to other dressings.(12)

In another study by Ansari et al., wounds treated with silver nanoparticles healed in an average of 25.2 ± 0.72 days, while those treated with common antibiotics took 28.6 ± 1.02 days ($p < 0.01$). This suggests that silver particles are more potent antibacterial agents. In our study, by the end of the four-week follow-up, no patients in Group A had pus discharge, while 16.67% of patients in Group B still exhibited pale discharge, further confirming the greater reduction in wound discharge in Group A.

CONCLUSION:

Nano silver gel is safe and effective in wound management and gives better efficacy and faster response as compared to traditional iodine 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 betadine in diabetic foot ulcers.

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