

Topical Silver Dressing versus Conventional Saline Dressing in the Management of Non-Healing Ulcers: A Prospective Randomized Interventional Study

Kanneedi Naresh Kumar¹, G. Sashikalyan²

¹Assistant Professor, Department of General Surgery, MNR Medical College and Hospital, Sangareddy, Telangana, India

²Assistant Professor, Department of General Surgery, MNR Medical College and Hospital, Sangareddy, Telangana, India

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Corresponding author: Dr G. Sashikalyan

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Abstract

Introduction: Understanding and addressing obstacles in the management of non-healing ulcers steer to favorable outcome, which can reduce economic burden and improve quality of life of the patient. Topical silver dressings are effective in the management of non-healing ulcers. However, their safety and efficacy is always debatable. This study was designed to assess the efficacy topical silver preparations versus conventional saline dressing in the management of non-healing ulcers.

Material and Methods: This prospective randomized interventional study consist of a source of 124 cases with non-healing ulcers of different etiological background approached Department of General Surgery at MNR Medical College and Hospital was recruited. Participants were randomly allotted to group 1 (topical silver dressing) and group 2 (conventional saline dressing). The recovery of wound size and rate of granulation tissue were recorded at the end of first, second and third week of treatment.

Results: At the end of 3rd week, cases managed with topical silver dressing (82.81%) had effective recovery of granulation tissue than conventional saline dressing (32.37%). There was a decreased incidence of microbial flora from first week to third week of treatment in silver dressing. The overall ulcer size was significantly reduced in group 1 than group 2. The mean difference between both study groups was statistically significant ($p < 0.05$).

Conclusion: Topical silver dressing has superior efficacy in terms of wound discharge reduction, early recovery of granulation tissue, diminishing the microbial isolates and reduction of ulcer size than conventional saline dressing.

Keywords: Efficacy, Silver nanocrystalline gel, Lower limb ulcers, Wagner ulcer grade classification.

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Introduction

The advancement of novel and effective interventions in the management of ulcers remains a research scope [1]. Chronic lower limb ulcers often do not cope with wound recovery and become a challenging task for the health facilitators [2]. These ulcers were

common in people with vascular diseases or diabetes, prolonged pressure, arterial diseases and chronic venous insufficiency [3]. These ulcers remain for months, which can impact quality of life and become significant cause of morbidity [4]. Topical

antimicrobial therapy is an effective modality in the management of chronic ulcers. Since several decades, silver and its various forms gained importance in wound management due to its antimicrobial abilities. Silver products in the form of nanocrystalline, silver nitrate and other dressings have anti-inflammatory effect and stimulate neovascularization [5-7]. Silver products are easy to smear, reduce frequent dressing changes, effective in uncurbed discharge management, and facilitates moist wound environment [8]. Literature suggested that topical silver dressings are preferable choice for the treatment of infected wounds [9]. However, there are considerable queries emerged in regard to its safety, efficacy and cost effectiveness [10,11], which lead to complete or partial withdrawal of silver preparations in the wound management [12]. With above reference this study was designed to assess the efficacy topical silver preparations versus conventional saline dressing in the management of non-healing ulcers.

Material and Methods

A source of 128 cases with non-healing ulcers of different etiological background was recruited for this prospective interventional study Conducted in the Department of General Surgery, MNR Medical college and Hospital, Sangareddy during September 2020 to February 2022.

Inclusion criteria: Cases with grade 2 and grade 3 Wagner ulcers, cases with ulcers \geq 4 weeks and cases willing to participate were included.

Exclusion criteria: cases with grade 1, grade 4 & grade 5 Wagner ulcers, diabetes mellitus, cardiovascular complications, renal diseases, under radiation therapy, under steroid and not willing to participate were excluded.

Written informed consent was obtained from all the participants and study protocol was approved by institutional ethics committee. The patients were evaluated according to Wagner's ulcer grading (Tab/Fig 1).

Table 1: Wagner ulcer grade classification (13)

Wagner ulcer grade classification	
Grade 0	No open lesion or a preulcerative lesion - may have a deformity or cellulitis
Grade 1	Partial- or full-thickness ulcer (superficial)
Grade 2	Deep ulcer extended to ligament, tendon, joint capsule, bone, or deep fascia without abscess or osteomyelitis (OM)
Grade 3	Deep abscess, osteomyelitis
Grade 4	Partial foot gangrene
Grade 5	Whole gangrene

Study procedure

All study participants underwent complete clinical examinations, and routine laboratory investigations. Wound debridement and dampened tissue were removed from the consented participants. Standard wound management procedure was followed to stabilize ulcers. Antibiotic course was started based on isolated microbial flora by microbiological investigations.

Study participants were randomly divided in to two groups. Group 1 (n=64) cases were managed with silver nanocrystalline gel composed with 32ppm of colloidal silver and group 2 (n=64) cases with conventional dressing with normal saline. The parameters like recovery of healthy granulation tissue, culture analysis of wound discharge, slough and recovery wound size was monitored at the end of first, second and third week of treatment. Wound size at the beginning and final level

was measured in mm², which was represented in the form of percentage.

Statistical Analysis

The data was extracted to Microsoft Excel worksheet and analysed by using SPSS version 23.0. Categorical variables were presented in the form of frequency and percentages. and analysed by chi-square test. Continuous variables were analysed by using an independent student 't' test. The p value <0.05 was considered statistically significant.

Results

A total of 64 patients between aged 21-70 years were randomly allotted to two study groups. In both study groups, majority cases belonged to > 50 years (71.8% in group 1 & 62.5% in group 2) of age with mean age of 41.28±2.56. Male participants were common than female participants in both study groups. The mean difference between of age and gender was statistically not significant (p=0.762) (Tab/Fig 1).

Table 2: Age and gender wise distribution of study participants

Age group	Group 1 (n=64)		Group 2 (n=64)	
	Male	Female	Male	Female
21-30	03 (4.68%)	01 (1.56%)	04 (6.25%)	02 (3.12%)
31-40	06 (9.38%)	02 (3.12%)	06 (9.38%)	02 (3.12%)
41-50	07 (10.94%)	04 (6.25%)	06 (9.38%)	04 (6.25%)
51-60	12 (18.75%)	10 (15.62%)	10 (15.62%)	09 (14.06%)
61-70	12 (18.75%)	07 (10.94%)	12 (18.75%)	09 (14.06%)
Chi-square value	0.762			

Table 3: Distribution of cases according to Wagner ulcer grade

	Group 1	Group 2
Grade 2	40.62%	3.50%
Grade 3	59.38%	62.50%

Grade 3 ulcers were common (59.38%-group 1 & 62.50%-group 2) in both study groups than grade 2 ulcers (40.62%-group 1 & 37.50%-group 2) (Tab/Fig 3). Ulcers over plantar aspect (35.93% in group 1 & 45.31% in group 2) of limb were common than the dorsal aspect and common over medial malleoli (20.31%-group 1 & 18.75%-group 2) than over lateral malleoli (Tab/Fig 4). Diabetes was leading etiological factor causing ulcers in 62.50% in group 1 and 56.25% in group 2, followed by pressure related (15.62% each) causes and traumatic related causes (7.81% I group 1 & 14.06 in group 2) (Tab/Fig 5).

Table 4: Frequency of ulcer duration and ulcer site between study groups

Ulcer details	Group 1	Group 2
	Number (%)	Number (%)
Duration of ulcers (In weeks)		
5-8	4 (6.25%)	9 (14.02%)
9-12	11 (17.18%)	20 (31.25%)
13-16	21 (32.81%)	18 (28.12%)
17-20	18 (28.12%)	10 (15.62%)
21-24	10 (15.62%)	7 (10.93%)
Ulcer site		
Over medial malleoli	13 (20.31%)	12 (18.75%)
Over lateral malleoli	08 (12.5%)	07 (10.93%)
Over plantar aspect	23 (35.93%)	29 (45.31%)
Over dorsal aspect	18 (28.12%)	13 (20.31%)
Over sacrum	02 (3.12%)	03 (4.68%)

Table 5: Etiological distribution of ulcers.

Various etiology	Group 1	Group 2
Diabetes related	62.50%	56.25%
Pressure related	15.62%	15.62%
Burns related	6.25%	7.81%
Venous related	4.68%	4.68%
Infection continued	3.12%	1.56%
Traumatic related	7.81%	14.06%

Table 6: Recovery of healthy granulation tissue at the end of 3rd week

Granulation tissue	Group 1	Group 2
Recovered	82.81%	34.37%
Not recovered	17.18%	65.62%

Cases managed with topical silver dressing (82.81%) had effective recovery of granulation tissue at ulcer site than cases had conventional saline dressing (32.37%) (Tab/Fig 6). Microbial culture analysis showed less microbial incidence in silver nanocrystalline gel group at the end of first (25%), second (9.38%) and third weeks (1.56%) of treatment. The reduction rate of microbial isolates was high in silver nanocrystalline gel group than conventional treatment group (Tab/Fig 7).

Table 7: Percentage of culture positivity among study groups

Duration	Group 1	Group 2
Week 1	16 (25%)	37 (57.82%)
Week 2	6 (9.38%)	20 (31.25%)
Week 3	1 (1.56%)	11 (17.18%)

Table 8: Slough and discharge (end of 3rd week) details among study groups

Slough & discharge	Group 1	Group 2
Present	14.06%	48.44%
Absent	85.94%	51.56%

Cases treated with topical silver dressing showed better overall recovery rate than the conventional saline dressing group. The mean difference of recovery rate between study groups was statistically significant ($p < 0.05$) (Tab/Fig 9).

Table 9: Mean difference of overall reduction of ulcer size between study groups.

Reduction area	Group 1	Group 2	P value
	Mean±SD	Mean±SD	
Over medial malleoli	38.98±5.36	14.69±7.56	0.0348
Over lateral malleoli	39.20±5.01	14.52±8.81	0.0316
Over plantar aspect	38.44±2.68	13.67±7.85	0.0183
Over dorsal aspect	38.56±5.43	13.08±6.64	0.0225
Over sacral aspect	32.15±2.23	18.37±3.88	0.001

*Independent 't' test assessed p value < 0.05 considered as statistically significant

Discussion

Management of wound ulcers with available silver products have claimed diversified outcomes [14]. Silver products have antimicrobial, antiseptic and anti-inflammatory properties which diminish

inflammation of wounds and stimulate healing [15,16]. Silver foam dressing has rapid healing ability for wounds showing delayed healing [17]. The present study was aimed to assess the efficacy topical silver

preparations versus conventional saline dressing in the management of non-healing ulcers. Chronic leg ulcers are more prevalent in elderly people and severity advances with age and disrupts the quality life of patient [18,19]. In current study, majority participants were >50 years of age in both treatment groups.

Silver compounds in the form of ionic, nanocrystalline and metallic have gained great importance as topical antiseptics in the management of various wounds. Their antibacterial abilities like destructing cell membranes, ribonucleoproteins and respiratory enzymes can kill the microorganisms [20,21]. Thus, the microbial burden is reduced at ulcer site by adsorption of metal ions on the microbial surface. Mahadev V reported negative culture report in 48 cases of silver dressings and 42 cases if normal saline group at third week of treatment ($p=0.046$) [22]. In current study, cases treated with silver nanocrystalline gel showed decreased incidence of microbial flora from first week to third week of treatment than conventional dressing with normal saline treatment group.

A study by Sharma MK *et al.*, reported that 86% of cases treated with silver colloid and 16% of cases treated with conventional dressing showed 91-99% of ulcer size recovery and also reported a significant reduction of ulcer size from time of admission (36.8 cm²/group 1 and 20.46 cm²/group 2) to end of the 12th week by 31.52 cm² and 14.04 cm² in group 1 and group 2 respectively [23]. Mahadev V reported a significant reduction in slough and discharge and formation of healthy granulation tissue at the end of third week ($p<0.001$) [22]. Somanath *et al.*, found better slough and discharge in silver dressing group cases than conventional betadine dressing group [24].

Jorgensen B *et al.*, reported that sustained silver releasing dressing is effective than the traditional absorbent moist wound healing dressing in the management of

vascular leg ulcers [25]. Beam JW commented that silver foam dressings have greater ability to reduce the wound size and more efficient in wound leakage control and odour [26]. Silver nanocrystalline particles release bunch of highly reactive silver particles that are able to occupy maximum surface area of wound, thus enhancing bioactivity and silver solubility [27,28]. In current study, the overall ulcer size was significantly reduced in cases treated with silver nanocrystalline gel than conventional treatment group. The mean difference between both study groups was statistically significant ($p<0.05$).

The present prospective randomized interventional study has limitation with less sample size and limited treatment follow-up duration. Further long term follow-up studies with large sample size are required to determine the effective dressing method for the management of non-healing ulcers. However, there is lack of in vivo reports of the toxicity of silver nanocrystalline on keratinocytes. Thus, clinicians should consider necessary parameters while using silver nanocrystalline in the management of ulcers and proliferating wounds.

Conclusion

Topical silver dressing has superior efficacy in terms of wound discharge reduction, early recovery of granulation tissue, diminishing the microbial isolates and reduction of ulcer size than conventional saline dressing. The overall ulcer size was significantly reduced in cases treated with silver nanocrystalline gel than conventional treatment group. The mean difference between both study groups was statistically significant ($p<0.05$).

References

1. Armstrong, D.G.; Boulton, A.J.M.; Bus, S.A. Diabetic Foot Ulcers and Their Recurrence. *N. Engl. J. Med.* 2017; 376:2367–2375.
2. Frykberg RG, Banks J. Challenges in the Treatment of Chronic Wounds. *Adv*

- Wound Care (New Rochelle). 2015; 4(9):560-582.
3. Richmond NA, Maderal AD, Vivas AC. Evidence-based management of common chronic lower extremity ulcers. *Dermatol Ther*. 2013;26: 187–196.
 4. Canadian Agency for Drugs and Technologies in Health. Optimal Care of Chronic, Non-Healing, Lower Extremity Wounds: A Review of Clinical Evidence and Guidelines. Ottawa, ON, Canada, 2013.
 5. Carter MJ, Tingley Kelley K, Warriner RA. Silver treatments and silver impregnated dressings for the healing of leg wounds and ulcers: A systematic review and meta-analysis. *J Am Acad Dermatol*. 2010; 63:668-79.
 6. Wilkinson LJ, White RJ, Chipman JK. Silver and nanoparticles of silver in wound dressings: a review of efficacy and safety. *J Wound Care*. 2011; 20(11): 543-49.
 7. Walker M, Bowler PG, Cochrane CA. In vitro studies to show sequestration of matrix metalloproteinases by silver-containing wound care products. *Ostomy Wound Manage*. 2007; 53(9): 18-25.
 8. White R, Kingsley A. Silver dressings the light of recent clinical research: what can be concluded? *Wounds UK*. 2010; 6(2): 157-58.
 9. Vermeulen H, van Hattem JM, Storm-Versloot MN, Ubbink DT. Topical silver for treating infected wounds. *Cochrane Database Syst Rev*. 2007 Jan 24;(1):CD005486.
 10. Storm-Versloot MN, Vos CG, Ubbink DT, Vermeulen H. Topical silver for preventing wound infection. *Cochrane Database Syst Rev*. 2010; 17(3): CD006478.
 11. Controlled trial and economic modelling of antimicrobial silver dressings versus non-adherent control dressings for venous leg ulcers: the VULCAN trial. *Health Technol Assess*. 2009; 13(56): 1-114, iii.
 12. White R. Silver-containing dressings: availability concerns. *Ostomy Wound Manage*. 2010; 56: 6-7.
 13. Huang Y, Xie T, Cao Y, Wu M, Yu L, Lu S, Xu G, Hu J, Ruan H. Comparison of two classification systems in predicting the outcome of diabetic foot ulcers: the Wagner grade and the Saint Elian Wound score systems. *Wound Repair Regen*. 2015;23(3):379-85.
 14. Sood A, Granick MS, Tomaselli NL. Wound Dressings and Comparative Effectiveness Data. *Adv Wound Care (New Rochelle)*. 2014;3(8):511-529.
 15. Tomaselli N. The role of topical silver preparations in wound healing. *J Wound Ostomy Continence Nurs*. 2006;33(4):367-78.
 16. Fong J, Wood F, Fowler B. A silver coated dressing reduces the incidence of early burn wound cellulitis and associated costs of inpatient treatment: Comparative patient care audits. *Burns*, 2005;31:562–7
 17. Munter KC, Beele H, Russell L, Crespi A, Gröchenig E, Basse P, Alikadic N, Fraulin F, Dahl C, Jemma AP. Effect of a sustained silver-releasing dressing on ulcers with delayed healing: the CONTOP study. *J Wound Care*. 2006 May;15(5):199-206.
 18. Karlsmark T, Agerslev RH, Bendz SH, Larsen JR, Roed-Petersen J, Andersen KE. Clinical performance of a new silver dressing, Contreet Foam, for chronic exuding venous leg ulcers. *J Wound Care*. 2003;12(9):351-4.
 19. Andersen KE, Franken CPM, Gad P, Larsen AM, Larsen JR, van Neer P, Vuerstaek J, Wuite J, Neumann H. A randomized, controlled study to compare the effectiveness of two foam dressings in the management of lower leg ulcers. *Ostomy Wound Manage*. 2002;48(8):34-41.
 20. Fonder MA, Lazarus GS, Cowan DA, Aronson-Cook B, Kohli AR, Mamelak AJ. Treating the chronic wound: a practical approach to the care of non-healing wounds and wound care

- dressings. *J Am Acad Dermatol.* 2008; 58:185-206.
21. Castellano JJ, Shafii SM, Ko F, *et al.* Comparative evaluation of silver containing antimicrobial dressings and drugs. *Int Wound J.* 2007; 4:114-22.
 22. Mahadev V. A randomized comparison study of conventional normal saline and silver nanocrystalline gel as topical wound dressings in non-healing wounds. *Int Surg J.* 2021; 8:3050-4.
 23. Sharma MK, Brajendra S, Kedarnath A, Rajesh KB. A comparative analysis of topical silver preparation versus conventional dressing in non-healing ulcer. *International Journal of Health and Clinical Research.* 2020;3(12):269-271.
 24. Somanath, Ashwini BG. Efficacy of topical silver preparations for treating non-healing ulcers versus conventional dressing. *International Journal of Surgery Science.* 2020; 4(4): 231-233
 25. Jorgensen B, Price P, Andersen KE, Gottrup F, Bech-Thomsen N, Scanlon E, *et al.* The silver-releasing foam dressing, Contreet Foam, promotes faster healing of critically colonised venous leg ulcers: a randomised, controlled trial. *Int Wound J.* 2005; 2:64-73.
 26. Beam JW. Topical silver for infected wounds. *J Athl Train.* 2009;44(5):531-3.
 27. Pangli H, Vatanpour S, Hortamani S, Jalili R, Ghahary A. Incorporation of Silver Nanoparticles in Hydrogel Matrices for Controlling Wound Infection. *J Burn Care Res.* 2021 Aug 4;42(4):785-793. Ovington LG: Bacterial toxins and wound healing. *Ostomy Wound Manage.* 2003; 49 (7A): 8.