

Role of Silver Nitrate Solution Dressings Over Conventional Dressings in Chronic Lower Limb Ulcers – A Prospective Study.

Chanda Sukanya¹, Adeppa Penugonda², Venkataprakash Gandikota³, Chinni Anupama⁴, G. Harsha vardhan reddy⁵

1. Junior Resident, Department of General Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh

2. Associate Professor, Department of General Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh.

3. Professor and HOD, Department of General Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh.

4. Junior Resident, Department of General Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh.

5. Junior Resident, Department of General Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh.

Abstract

OBJECTIVE: To study the effect of silver nitrate solution over conventional dressings in management of chronic lower limb ulcers.

BACKGROUND : Chronic leg ulcers are a significant cause of morbidity in developing countries like India, leading to excessive health care expenses and loss of effective work hours. Various novel methods are available, like vacuum assisted closure, offloading technique, nanosilver dressings etc, in order to facilitate earlier recovery with a varied response among the patients. In spite of availability of various novel modalities in the management, foot ulcers have become a major cause of morbidity and hence this study aims to compare the effectiveness of silver nitrate solution dressings and total conventional dressings in outcome of healing in chronic lower limb ulcers in order to standardize a procedure with maximum benefits.

METHODS : A comparative prospective study was conducted on a total of 160 individuals presenting with chronic lower limb ulcers, divided into two groups, Group A (patients treated with silver nitrate solution dressings) and Group B (patients treated with conventional dressings) who were treated until wound healing, either spontaneous or surgical. The study was conducted from September 2018 to September 2019 in patients admitted with plantar foot ulcers in Department of General Surgery, in tertiary care hospital.

RESULT: In this study male sex distribution is 80% and female distribution is 20%. Most common aetiology was diabetes, which is 53.12% followed by trauma which is 21.87%. Most common location of ulcer was leg which belongs to 63.12%. Initial wound size mean with Group A and Group B was 8.06 ± 1.76 cm² and 7.79 ± 1.75 cm². Final wound size was 1.94 cm² in Group A and 3.84 cm² in Group B. Mean number of dressings in Group A and Group B was 22.65 and 27.30 respectively. Percentage negative culture and sensitivity at 14th day in Group A and Group B was 75 and 34 patients respectively. Mean hospital stay with Group A and Group B was 25.35 and 35.91 days respectively.

CONCLUSION : Silver nitrate solution dressings appear more effective when compared with conventional dressings in the treatment of chronic lower limb ulcers, with effectively lower duration of hospital stay and earlier return to work.

Keywords: Chronic lower limb ulcers, silver nitrate solution dressings, conventional dressings.

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I. Introduction:

Chronic wounds are a major health challenge, among those non-healing ones are the most common surgical condition a surgeon encounters in his daily practice. The habit of a chronic wound is that, in spite of regular daily dressing even with expensive local preparations and thorough debridement, the healing process usually does not accentuate a lot.

This problem is generally seen in diabetic ulcers, venous ulcers, pressure ulcers. Hence the goal of wound care in patients suffering with chronic ulcers is to facilitate wound healing as much as possible by using standardized protocols, which forms a constant challenge for a treating surgeon.

Chronic wounds are defined as a slow or non-healing wounds resulting from the breakdown of epidermal and dermal tissue, which usually lasts for a period of more than 6 weeks. A practical definition of a non-healing wound is the one that fails to heal spontaneously within a period of 3 months¹ and the tissue lesion many a times lands up in a fibrous scar.²

The potency of silver as an antimicrobial was found to be related to the amount and rate of free silver released onto the wound bed. Silver is biologically active when it is in soluble form ie, as Ag⁺ or Ag⁰ clusters. Free silver cations have a potent antimicrobial effect which destroys microorganisms immediately by blocking the cellular respiration and disrupting the function of bacterial cell membranes.³ Silver cations also bind and denature the bacterial DNA and RNA, thus inhibiting cell replication. Controlling micro-organisms within a wound environment promotes wound healing.

Because of the presence of a negative charge on the surface, they are highly reactive, which helps to modify the surface of silver nano-particles with several bio molecules, which aids various drug delivery applications because of the strong interaction between the silver surface and thiol-containing or amine-containing molecules (organic molecules, DNA, proteins, enzymes, etc).^{4,5}

Table 1: The University of Texas (grade and stage) wound classification system-mostly used to grade diabetic foot ulcers.⁶

Stage	Grade			
	0	1	2	3
A	Pre or post ulcerative lesion completely epithelized	Superficial wound not involving tendon capsule or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone or joint
B	Infection	Infection	infection	Infection
C	Ischemia	Ischemia	ischemia	Ischemia
D	Infection and ischemia	Infection and ischemia	Infection and ischemia	Infection and ischemia

II. Materials and Methods

A hospital based comparative prospective clinical study was conducted in the Department of General Surgery, in our Hospital, from August 2017 to March 2019. The eligible 160 subjects fulfilling the inclusion and exclusion criteria, were randomized into two groups, Group A, wherein the patients were treated by silver nitrate dressings and Group B, wherein the patients were treated by conventional dressings.

INCLUSION CRITERIA:

1. Patients aged more than 18 years with chronic ulcers. Like diabetic ulcers, non-diabetic ulcers [Traumatic ulcers and pressure ulcers]
2. Ulcer of size less than 10x10 cm

EXCLUSION CRITERIA

1. Patients with x-ray showing Osteomyelitis.
2. Patients with severe Malnutrition.
3. Patients receiving corticosteroids, immunosuppressive agents, radiation, or chemotherapy prior to entry into the study were also excluded.
4. Patients who are allergic to silver

Procedure methodology:

All patients underwent general physical and clinical examination for peripheral vascular status and peripheral neuropathic changes in lower extremities.

Routine hematological, biochemical, radiological investigations done for each patient. The wounds were thoroughly debrided when necessary. After slough removal, the surface area was measured by taking imprint with gauze piece then gauze piece was measured with tape. On each occasion areas were measured twice. When identical, the reading was recorded.

Silver solution (Silver Stream) with 0.01% (w/v) was used for dressing. One ml solution for 1 cm² solution should be taken and it should be soaked in the solution and placed over wound. Conventional dressing done with normal saline soaked gauze piece. Regular dressings done for every day or whenever is required. Patients were followed up to 14 days. Wound culture was obtained at 14th day of treatment. Treatment outcome was assessed in terms of time taken for appearance of granulation tissue and effect of silver on granulation tissue, measurement of wound depth and area at subsequent follow up.



Fig: chronic traumatic ulcer over leg; healed ulcer after silver dressings

Statistical analysis:

All the Quantitative data was compared using student’s t test. Qualitative data was presented as frequency and percentage and analyzed using chi-square test. All analyses were carried out by using SPSS software.

III. Results:

Table (2): Distribution of study population based on gender

Sex	No of patients	Percentage
Male	128	82
Female	32	20

In the total study population of 160 patients 80% are male population and 20% are female population. Highest number of population belongs to male sex.

Table (3): Distribution of study population based on age:

Dressings	Number	Mean age in years
Silver	80	53.72
Conventional	80	53.43

Mean age distribution of the population was 53.72 years in silver group and 53.43 years in conventional group. There was no significant difference in the mean age group distribution between silver and conventional group

Table (4): Distribution of patients based on etiology of ulcer:

ETIOLOGY	GROUP A	GROUP B	TOTAL	PERCENTAGE
TRAUMATIC	19	16	35	21.87%
DIABETIC	43	42	85	53.12%
TROPHIC	7	3	10	6.25%
VENOUS	10	20	30	18.75%
TOTAL	79	81	160	100%

The etiology wise distribution of the ulcers in both groups is shown in the graph below. The main etiology in both groups was diabetes with 53.12%. The second etiology in Both Groups was trauma with 21.87% followed by venous ulcers with 6.25 % and Trophic ulcers with 18.75%.

Table (5): various location of ulcers.

LOCATION	GROUPS		TOTAL	
	GROUP A	GROUP B	NUMBER	PERCENTAGE
THIGH	10	7	17	10.62%
LEG	49	52	101	63.12%
DORSUM OF FOOT	7	14	21	13.12%
PLANTAR ASPECT	13	8	21	13.12%
TOTAL	79	81	160	100%

The most common location of chronic non healing ulcer is leg with 63.12 % followed by dorsum of the foot and plantar aspect with 13.12% and least common site for lower limb ulcer was thigh with 10.62%.

Table(6):Comparative analysis of wound size by treatment methods.

Wound size in cm ²	Group A	Group B	P value
Initial wound size	8.06 ± 1.76	7.79 ± 1.75	0.33
Final wound size	1.94 ± 0.68	3.84 ± 1.07	<0.0001

In Group A mean initial wound size of was 8.67cm² and in Group B mean initial wound size value is 7.78 cm² respectively. In Group A P value is <0.0001 which is significant. Wound size final mean value in Group A and Group B is 1.93 and 3.8 cm² respectively. In Group B, P value obtained is 0.33 which is insignificant.

Table (7): distribution based on no of dressings required.

No of dressings for complete healing	Groups		P value
	Group A	Group B	
Mean no of dressings	22.65	27.3	<0.0001
SD	3.01	4.70	

In our study the mean number of dressings required for complete healing of wound in Group A was 22.65 days and in Group B 27.30 days with p value of <0.0001 which is statistically significant.

Table(8) :Distribution of study population based on hospital stay.

	Group A	Group B	P value
Mean duration of hospital stay	25.35	35.91	<0.0001

The mean duration of healing in Group A was 25.35 days, mean duration of healing for Group B was 35.91 days. The probability value was 0.0001 which is statistically significant.

IV. Discussion:

In our study total numbers of males are 55(55%) and females are 45(45%). In the study conducted by Rao Harish et al, 2012 males (75%) had increased incidence of chronic wounds on leg as compared to female (25%).⁷ The NHDS (National Hospital Discharge Survey) a well-known govt. source, documented higher hospital rates of chronic wounds such as diabetic foot and admissions in males.⁸ Sex distribution in the present study is similar to that of Moffat et al i.e., Males have increased incidence of chronic wound -diabetic wound compared to that of females.⁹

In the present study the majority patients shows negative culture and sensitivity report with silver nitrate solution dressings when compare to conventional dressings. Which shows that silver has antibiotic effect on wound and make it ready for grafting. Wright et al in 1998 compared 3 types of topical silver applications: silver nitrate solution, silver sulfadiazine cream and acticoatTM against a control dressing to determine their bactericidal isolates of antibiotic resistant organisms. The organisms were inoculated onto each of dressing, incubated for 30 minutes and then washed using a recovery solution which was then subjected to culture for organism survival rate. All the trials of dressing demonstrated an ability to reduce the number of viable bacteria. The nanocrystalline dressing was found to be the most efficacious against bacteria. The researchers concluded that silver was efficacious for killing even the antibiotic resistant bacteria strains that were tested. Wright et al¹⁰ study concurring with my study showed that silver has antibacterial effect on wound surface.

Smith and nephew 2003¹¹ study shows that Acticoat has a two fold benefit, as it unleashes the antimicrobial property of nanocrystalline silver and assisted in maintaining a moist environment to promote granulation wound healing. In our study we use silver nitrate solution which will be providing moist environment to promote wound healing.

In a study conducted by Miller et al, the mean wound healing rates were similar for both the silver and iodine groups with silver recording a marginally higher healing rate (average 52.10; SD 51.89) compared with iodine (average 51.69; SD 52.46).¹² In our study Healing rate was high with silver dressings when compared to the conventional dressings. In our study, Group A mean initial wound size was 8.06±1.76 and final wound size was 1.94 ± 0.68 cm² in group B initial wound size was 7.79±1.75 and final wound size was 3.84±1.07 cm². It shows that there is marked reduction of wound size in patients treated with silver dressings.

Ramanaiah et al¹³ shows duration of hospital stay with nanosilver dressings was 20.54 days and duration of hospital stay with conventional dressings was 36.19 days. In our study duration of hospital stay with silver dressings and conventional dressings were 25.35 and 35.91 days respectively, which shows that duration of hospital stay was decreased in both the studies patients who were treated with silver dressings.

Nacharaiah et al study¹⁴ shows number of dressings required for wound healing with nanosilver and conventional dressings were 7.39 and 20.46 respectively. In our study Number of dressings required for complete healing with silver and conventional dressings were 11.51 and 27.30 respectively. The dressings required were decreased with nanosilver dressings in both the groups.

In another RCT conducted by Munter, Beele, the number of dressings for chronic wounds with silver dressings were on an average of 18.¹⁵ The main objective of the study was to evaluate the time required for healing which was less in Nanosilver dressing and also the number of dressings required are also less when compared with conventional dressings. In our study mean number of dressings required in group A and group B were 11.51 ± 3.01 and 27.30 ± 4.70 respectively and $p < 0.0001$, which is a significant result. Which shows that number of dressings required for wound healing with silver dressings were less when compare to the conventional dressings.

V. Conclusion

In this study we observed that the silver group showed marked reduction in wound size and surface area with shorter hospital stay compared to the conventional group. The time duration taken for formation of healthy granulation tissue was less in silver compared to conventional. And the granulation tissue formed was healthy and uniform in silver than conventional.

Hereby we conclude that the silver method of wound dressing is more effective and superior to the conventional technique in healing of the ulcers.

Limitations: In our study sample size was only 150, which limits the scope of research.

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References :

- [1]. Saltmarche AE. Low level laser therapy for healing acute and chronic wounds the extendicare experience. *Int Wound J.* 2008 Jun;5(2):351-60.
- [2]. Crovetti G, Martinelli G, Issi M, Barone M, Guizzardi M, Campanati Bet al. Platelet gel for healing cutaneous chronic wounds. *Transfus Apheres Sci* 2004 Apr; 30(2):145-151.
- [3]. Armstrong DG, Lavery LA, Harkless LB. Validation of diabetic wound classification system. The contribution of depth, infection and ischemia to risk of amputation. *Diabetes Care.* 1998;21(5):855-9.
- [4]. Lansdown AB, Williams A. How safe is silver in wound care? *J Wound Care* 2004; 13(4): 131-36.
- [5]. Munteanu A, Florescu IP, Nitescu C. A modern method of treatment: The role of silver dressings in promoting healing and preventing pathological scarring in patients with burn wounds. *J Med Life.* 2016; 9(3):306-15.
- [6]. Kirshner R, Orsted HL, Wright JB. Matrix metalloproteinases in normal and impaired wound healing: A potential role of nanocrystalline silver. *Wounds: A Compendium Clinical Research and Practice.* 2002; 13:4-14.
- [7]. Rao H, Pai A, Hussein I, Arun A, Ram HS, Pai A, A comparative study between collagen dressings and conventional dressings in wound healing, *Int J Collab Res Internal Med Publ Health.* 2012; 4(5):611-23.
- [8]. Franks PJ, Moffat CJ. Who suffers most from leg ulceration? *J Wound Care.* 1998; 7:383-5.
- [9]. Edmonds ME, Blundell MP, Morris ME, et al, Improved survival of diabetic foot. The role of specialized foot clinic. *QJ med.* 1986; 60:763-71.
- [10]. Wright J, Lam K, Burrell R. Wound management in an era of increasing bacterial antibiotic resistance: a role for topical silver treatment. *Am J Infect Control.* 1998; 26:572-7.
- [11]. Smith, Nephew. Dynamic silver release rapid destruction, sustained protection, Acticoat with silvercryst. Smith and Nephew Pty.Ltd. Product information; 2003.
- [12]. Miller C, Royal District Nursing Service. Treating bacterial burden in chronic lower leg ulcers: a randomised controlled trial comparing two antimicrobial dressings - cadexomer iodine and nanocrystalline silver: executive summary. Royal District Nursing Service, Melbourne, Melbourne, Vic, 2009.56
- [13]. N.V.Ramanaiah, Saikrishna, Chandrasekhar, Vamshidhar, G.V.Ramanaiah, K.Lokesh. "A Clinical Study on Efficacy of Nanocrystalline Silver Dressing in Diabetic Foot Ulcers". *Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 45, November 05, 2015; Page: 8160-8170, DOI:10.18410/jebmh/2015/1097.*
- [14]. P.Nacharaiah, S Zwalitha, V Jeevankumar. "A Comparative Study Between Conventional And Nanosilver Dressings In Patients With Diabetic Ulcer" *IOSR Journal of Dental and Medical Sciences; (IOSR-JDMS), Vol.17, no.1, 2018, pp. 39-32.*
- [15]. Munter KC, Beele H, Crespi A, Gronchenig E, Basse P, Alikadic N, et al. Effect of a sustained silver-releasing dressing on ulcers with delayed healing: the CONTOP study. *J Wound Care.* 2006; 15:199-206.

Chanda Sukanya, et. al. "Role Of silver Nitrate Solution Dressings Overconventional Dressings In Chronic Lower Limb Ulcers –A Prospective Study.". *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(7), 2020, pp. 10-14.