International Surgery Journal
Suhas K et al. Int Surg J. 2018 Dec;5(12):3995-3999
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20185033

Original Research Article

Efficacy of nano silver dressings over conventional dressings in chronic wounds

K. Suhas*, P. Naga Manvi

Department of General Surgery, Alluri Sita Rama Raju Academy of Medical Sciences, Eluru, Andhra Pradesh, India

Received: 04 October 2018
Accepted: 30 October 2018

***Correspondence:**
Dr. K. Suhas,
E-mail: nagamanvi.paruchuri@gmail.com

ABSTRACT

Background: Chronic wounds give rise to serious health problems, accompanied by a decrease in quality of life. Silver has been an effective agent with documented efficacy against wide spectrum of bacterial, viral, and fungal infections. Recently, many silver-based preparations are available for effective management of wounds. Among them silver nano particles, exhibit significantly novel and distinct physical, chemical, and biological properties. Due to their nano scale size, they have been elicited much interest in wound management. This study aims to compare the efficacy of nano silver dressing in Chronic wounds with that of conventional dressings.
Methods: This was a prospective study conducted in the Department of General Surgery, Alluri Sita Rama Raju Academy of Medical Sciences from August 2017 to August 2018. A total of 100 patients with chronic wounds were included in the study and were equally divided into – Study group and Control group randomly. Swab cultures were sent in all the patients. The study group received nano silver dressings while the controls received daily dressings with normal saline soaked gauges, betadine and hydrogen peroxide. Data regarding the time required for healing, number of days required for healing and percentage of healing are noted.
Results: Nano silver dressings in the treatment of chronic wounds are found to be safe, effective, promoter of wound healing, promotes epithelization, accelerates healing, eliminates anaerobes and breaks microbial synergy more effectively than conventional dressing. Hence Nano silver spray prove to be more effective in the management of chronic wounds. In study group, 50% of patients stay for 3-4 weeks whereas in control group, 70% of patients stay for 5-6 weeks. 91-99% reduction in size of ulcer is seen in 43 out of 50 patients in study group whereas in control group only 8 out of 50 shows 91-99% reduction in size.
Conclusions: Nano silver dressings is a cost effective option in ulcer management. It decreases the period of hospitalization and reduces the burden on the health care system.

Keywords: Nano silver, Swab cultures, Wound

INTRODUCTION

Wounds are either acute or chronic and can result from venous or arterial insufficiency, diabetes, burns, trauma, chronic pressure or surgery.[1,2] The focus on chronic wounds in the past few years has improved because of many problems that occur with them and their occurrence and prevalence. Chronic wounds are defined as a slow or non-healing breakdown of epidermal and dermal tissue on the foot that last more than 6 weeks. Wound healing is a complicated procedure involving a combination of activities of different tissues and cell lineages and has been the subject of concentrated research for a long time.[3] When skin is injured, bleeding occurs, which activates hemostasis, initiated by exudates with components such as clotting factors. Eventually hemostasis results in the formation of a clot in the wound, and the bleeding stops.[4] During this process, the wound

passes through 4 phases, homeostasis, inflammation, granulation tissue formation, and remodeling, which overlap in time.[3,5]

The process is affected by various factors that are specific to the individual, such as nutritional status, age, systemic disease, medication, and behavior, along with the size, depth, causation, and the etiology of the wound.[6] Signs of chronic wounds are: presence of necrotic or non-viable tissue, lack of healthy granulations, recurrent wound breakdown, increasing wound size, and a stasis in wound improvement. The chronic wound environment has molecular and biochemical imbalance. One of the major factors to delayed wound healing is prolonged inflammatory response within the wound environment which results in tissue destruction. The vital goal for wound healing is rapid recovery with little scarring and maximal function.

The selection of wound dressings plays a pivotal role in wound care management. An ideal dressing should be cheap, easy to use, non adherent, non allergic, maintain a moist wound environment, absorb excessive exudates, allow gaseous exchange, control wound odor, provide thermal insulation and mechanical protection, prevent wound contamination and lower the risk of infections.[7] Many types of dressings are available.

Silver dressings are one among them.

Silver-containing dressings are used worldwide for the local management of colonized or infected wounds. Silver has antiseptic, antimicrobial, anti-inflammatory properties and is a broad spectrum antibiotic. Silver is biologically active when it is in soluble form i.e., as Ag^+ or Ag^0 clusters. Ag^+ is the ionic form present in silver nitrate, silver sulfadiazine, or other ionic silver compounds. Ag^0 is the uncharged form of metallic silver present in nano silver.

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.

Nanotechnology has facilitated the production of very small size silver particles with increasingly large surface area to volume ratios which imparts greater antimicrobial efficacy and most importantly lowers their toxicity to human tissue cell[8]. Silver nano particles are easy to synthesize by several simple, economical, safe, and reliable methods, such as wet chemical, physical, and biological. They can be easily synthesized in different shapes (spheres, rods, tubes, wires, ribbons, plates, cubes, hexagons, triangles) and various sizes (2-100 nm) using templates and changing reaction conditions. 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).

To achieve a broad spectrum bactericidal effect, silver ions concentration must be at least 30-40 mg/l. Nano silver ion dressings provides concentration of silver at 70-100 mg/l which is bactericidal and kills over 150 types of pathogens. It releases as much as 30 times silver ions which allows dressing changes to be reduced from once or twice daily to every second or third day.[9] A continuous equilibrium of aqueous silver is maintained for over 48 hours and silver is released at good concentration levels even when water volume is doubled at 24 hours. Nano crystalline silver ion dressings have been in use for burns and chronic wounds.[10,11]

Unique features of nano silver

- Moisturizes wound bed.
- Disrupts the bio film produced by bacteria.
- Improves oxygenation, angiogenesis and granulation on wounds.
- Aids in removal of debris and dirt.
- Does not disturb normal flora
- Reduces odor.
- It kills common pathogens like *E. coli*, *Pseudomonas*, *Staphylococcus* etc. in 1 hour after application.
- It is highly potent against MRSA and kills 99.98% in 1hour.

Aims and objectives

- To study the efficacy of Nano silver dressings in chronic wounds.
- To compare the time required for healing.
- To compare number of dressings required.

METHODS

This was a prospective study conducted in the Department of General Surgery, Alluri Sita Rama Raju Academy of Medical Sciences from August 2017 to August 2018. A total of 100 patients with chronic wounds were included in the study and were equally divided into study group and Control group. Swab cultures were sent in all groups. Nano silver spray dressings were done in study group daily. In control group dressings were done with normal saline or hydrogen peroxide or betadine dressings. The wounds were measured with planimetry on OPD basis.

Inclusion criteria

Inclusion criteria were patients with age group more than 20years with chronic wounds were selected; chronic

wounds due to Burns, Diabetes (Grade 1 and 2 Wagner), pressure sores, venous ulcer, were selected.

Exclusion criteria

Exclusion criteria were malnourished and uncontrolled Diabetic patients; clinical signs of infection, cellulitis, x ray showing osteomyelitis, underlying malignancy; other medical conditions that would impair wound healing like renal, hepatic, heamotological, neurological and immunological diseases; patients receiving corticosteroids, immune suppressives, radiation or chemotherapy one month prior to this study; patient`s refusal.

Collection of data

A detailed history was taken about mode of onset, duration, progression of ulcer. If patient is diabetic then its duration and medication.

All patients were subjected to following investigations:

Hemoglobin, blood sugars, HbA1C in Diabetics, serum creatinine, x-ray foot, swab culture.

RESULTS

Table 1: Age distribution.

Age in years	Study group		Control group	
	No.	%	No.	%
21-30	1	2	2	4
31-40	5	10	2	4
41-50	16	32	14	28
51-60	19	38	17	34
61-70	8	16	8	16
71-80	1	2	7	14
>80	0	0	0	0
Total	50	100	50	100
Mean±SD	51.24±10.49112		55.3000±12.69300	

In our study the mean age in study group is 51 and in control is 55 (Table 1).

Table 2: Sex distribution.

Sex distribution	Study group		Control group	
	No.	%	No.	%
Male	29	58	26	52
Female	21	42	24	48
Total	50	100	50	100

Total number of males in the study was 55(55%) and females were 45%). The male and female ratio of the study group is 58%: 42% and the control group is 52%:48% (Table 2).

Table 3: Commonly encountered organism in swab culture.

	Study group	Control group
Klebsiella	15	17
Pseudomonas	24	22
Staphylococcus aureus	5	4
E. coli	5	4
others	1	3

In one study the most common pathogen isolated in both groups is pseudomonas 24 out of 50 and 22 out of 50 followed by *Klebsiella* in 15 out of 50 in study group and 17 out of 50 in control group followed by *Staphylococcus aureus* and *E. coli* (Table 3).

Table 4: Average duration of hospital stay.

Period of stay (weeks)	Nano silver dressings		Conventional dressings	
	No.	%	No.	%
1 to 2	10	20	0	0
2 to 3	15	30	0	0
3 to 4	25	50	0	0
4 to 5	0	0	15	30
>5 weeks	0	0	35	70
Total	50	100	50	100

Mean±SD is 19.8200±6.43869 days for study group and for control group. Mean±SD is 36.19±7.246 days and $p<0.001$ and is highly significant. In study group, 50% of patients stay for 3-4 weeks whereas in control group, 70% of patients stay for 5-6 weeks (Table 4).

Table 5: Percentage reduction of ulcer size.

Percentage reduction of ulcer size	Study group		Control group	
	No.	%	No.	%
61-70	0	0	3	6
71-80	0	0	17	34
81-90	7	14	22	44
91-99	43	86	8	16
Total	50	100	50	100

Mean±SD of study group and control group are 93.96±3.81169 and 80.9200±9.24461 and $p<0.001$ and is highly significant. 91-99% reduction in size of ulcer is seen in 43 out of 50 patients in study group whereas in control group only 8 out of 50 shows 91-99% reduction in size (Table 5).

Mean±SD of study group and control group are 10.6200±6200 and 17.54±3.87583 and $p<0.001$ (Table 6).

Table 6: No. of dressings required.

No. of dressings	Study group		Control group	
	No.	%	No.	%
1-5	2	4	0	0
6-10	25	50	0	0
11-15	20	40	1	2
16-20	3	6	18	36
21-25	0	0	22	44
26-30	0	0	9	18
Total	50	100	50	100

DISCUSSION

In our study the Mean±SD for study group is 51.24±10.49112 and control group is 55.3000±12.69300. Thus, the prevalence of chronic wounds progressively increases with increasing age.

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%).[12] 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.[13] 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.[14]

In the present study, duration of hospital stay is 19.8200±6.43869 days in study group and 36.0600±4.06784 days in control group.

In a study conducted by Miller et al, the mean wound healing rates were similar for 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).[15] Although there was no significant difference in the time taken for wound healing when compared.

In the present study percentage reduction of ulcer with Nano silver spray dressing is 93.96% and with conventional dressing is 80.9200 % which is significant ($p<0.001$).

In the study by Miller et al, a comparison of the number of wounds that healed within each treatment group was explored for the wound duration and wound size segmentations. In similar findings, there was no difference between the treatment groups in the number of wounds healed overall for young [$w2(1)$ 50.07, $p>0.05$] and old wounds [$w2(1)50.17$, $p>0.05$] as well as for small [$w2(1)50.10$, $p>0.05$] and big wounds [$w2(1)50.02$, $p>0.05$]. In our study, percentage reduction of ulcer is more than that of the study conducted by Miller et al.

Under circumstances provided silver dressings were more effective in comparison with the routine conventional dressings in healing the chronic wounds,

In our study number of nano silver spray dressings required per patient is significantly less compared to conventional dressing group.

In the study by Miller et al, it was concluded by the results that the time taken and number of dressings taken for healing of ulcers in both cases with silver and betadine were similar.

In another RCT conducted by Munter, Beele, the number of dressings for chronic wounds with silver dressings were on an average 18.[16] The main objective of the study was to evaluate the time required for healing which was less in Nano silver dressing and also the number of dressings required are also less when compared with conventional dressings. Mean±SD of study group and control group are 10.6200±3.63501 and 21.7200±3.87583 and $p<0.001$, which is a significant result. Thus, our study is in accordance with the results of study by Miller CN et al.

CONCLUSION

Nano silver dressings are safe, effective, with a slight beneficial edge to the conventional dressing with solutions like betadine in terms of promoting wound healing and are more patient compliant in view of.

- Less pain while changing the dressing.
- Less number of dressings required.
- Less duration of hospital stay.

The above results indicate that nano silver dressings may be used as an adjunct in management of chronic wounds and seems to be more efficient than conventional dressings in this regard.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. O'Meara SM, Cullum NA, Majid M, Sheldon TA. Systematic review of antimicrobial agents used for chronic wounds. Br J Surg. 2001;88(1):4-21.
2. O'Meara S, Al-Kurdi D, Ologun Y, Ovington LG. Antibiotics and antiseptics for venous leg ulcers. Cochrane Database Syst Rev. 2010;(1):CD003557.
3. Martin P. Wound healing-aiming for perfect skin regeneration. Science. 1997;276:75-81.
4. Boateng JS, Matthews KH, Stevens HNE, Eccleston GM. Wound healing dressings and drug delivery systems: a review. J Pharm Sci. 2007;97:2892-923.

5. Singer AJ, Clark RA. Cutaneous wound healing. New Engl J Med. 1999;341:738-46.
6. Purna Sai K., Babu M. Collagen based dressing-a review. Burns. 2000;26:54-62.
7. Foster AV, Greenhill MT, Edmonds ME. Comparing two dressings in the treatment of diabetic foot ulcers. J Wound Care. 1994;3:224-8.
8. Nair LS, Laurencin CT. Silver nanoparticles: Synthesis and therapeutic application. J Biomed Nanotech. 2007;3:301-16.
9. Muangman P, Chuntrasakul C, Silthram S, Suvanchote S, Benjathanung R, Kittidacha S, et al. Comparison of efficacy of 1% silver sulfadiazine and Acticoat for treatment of partial-thickness burn wounds. Med Assoc Thai. 2006;89(7):953-8.
10. 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.
11. 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.
12. 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.
13. Franks PJ, Moffat CJ. Who suffers most from leg ulceration? J Wound Care. 1998;7:383-5.
14. 14.. 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.
15. Miller C, Royal District Nursing Service. Treating bacterial burden in chronic lower leg ulcers: a randomised controlled trial comparing two antimicrobial dressings - cadexomer lodine and nanocrystalline silver: executive summary. Royal District Nursing Service, Melbourne, Melbourne, Vic, 2009.
16. 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.

Cite this article as: Suhas K, Manvi PN. Efficacy of nano silver dressings over conventional dressings in chronic wounds. Int Surg J 2018;5:3995-9.