

A Clinical Study of Use of Silver Nitrate in Chronic Wound Management

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How to cite this article:

Vishal G Sonkamble, Meghraj J Chawada, PT Jamdade. A Clinical Study of Use of Silver Nitrate in Chronic Wound Management. *New Indian J Surg.* 2020;11(2):237-243.

Abstract

Context: More and more silver based products are becoming available and therefore it is necessary to prove beyond doubt the effectiveness of these products by research

Aims: To study effects of use of Silver Nitrate in healing of chronic wound

Settings and design: Longitudinal observational study was carried out in a tertiary care academic hospital.

Methods: 100 Patients were recruited as cases using inclusion and exclusion criteria. Age, Gender, Occupation and Detailed history pertaining to Pain associated with wound, discharge from wound, site of wound, and duration of wound. Clinical examination was done. Local examination and Investigations were carried out.

Statistical Analysis: Data was coded and analyzed in statistical software, STATA version 10.1, 2011. Descriptive statistics like mean and standard deviation were calculated to summarize continuous variables. Frequency and percentages were used to summarize categorical variables. p -value < 0.05 was considered statistically significant.

Results: Most common etiology was trauma (61%) followed by infections. 33 had diabetes out of which 16 were above 60 years. 64 patients healed completely on Silver Nitrate dressing only with varied time of

duration and 36 patients have required Split Thickness Skin grafting. 9 patients had wound of size 1-3 cm, 27 patients had 4-5 cm, 28 patients had 6-7 cm, 30 patients had 8-10 cm and 06 patients had 11-12 cm. 8-10 cm was most common wound size. Patients with wound size ≤ 7 cm has successfully healed with Silver Nitrate dressings only but patients with wound size >7cm required STSG. Wound with size >7 cm when managed with Silver Nitrate dressings it is found to have increased duration of hospital stay.

Conclusion: It is concluded that Silver Nitrate is found to be very effective in early healing of chronic wound.

Keywords: Clinical study; Silver nitrate; Chronic; Wound, Management.

Introduction

It is the time since 18th century that silver has been used in the management of the wounds. Silver nitrate use has since been documented for the wound treatment successfully.¹

The mechanism of action of silver ions that they kill the microbial was recognized in the 19th century. US Food and Drug Administration (FDA) accepted the colloidal silver as a method of choice in the treatment of the wounds. US Food and Drug Administration (FDA) found that silver nitrate was very useful in the treatment of the wounds in 1920.²

But in 1940 with the introduction of penicillin as an effective antibiotic, use of silver nitrate diminished. As penicillin was very effective and gave results very fast use of silver nitrate reduced overall. It took another 20 years to start the use of silver nitrate in 1960 when it was being used in the

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Received on 27.12.2019, Accepted on 14.02.2020

management of wounds due to burns. This time it was being used as 0.5% of silver nitrate solution.³

In 1968, silver sulfadiazine cream was being used which was a combination of silver nitrate with sulphonamide antibiotic. This gave rise to the use of broad spectrum antibacterial activity in the management of the wounds. This cream was commonly used for the management of wounds which were occurred due to the burns.⁴

Now a day due to increasing resistance of the bacteria to the drugs, wound dressings has been done with different proportions of silver nitrate by the clinicians. This action is very natural as the bacteria have been acquiring the resistance to the antibiotics.⁵ Now a days there are a variety of options available related to the proportions of the silver nitrate like for example, acticoat and actisorb to mention a few. They offer a greater range of treatment options and give flexibility to the treating clinicians in the management of the infections. They are used to stimulate the healing in wound that is indolent. They can also be used as protective use for those at risk of acquiring the wound infections and also can be used in managing the wounds that have been critically colonized.⁶

Catheters used in urinary as well as vascular structures are also now silver based. Thus more and more silver based products are becoming available and therefore it is necessary to prove beyond doubt the effectiveness of these products by research.⁷

Hence present study was carried out to study effects of use of Silver Nitrate in healing of chronic wound, to study the advantages and disadvantages of using Silver Nitrate on chronic wounds and to study the impact of silver nitrate on duration of hospital stay.

Materials and Methods

The present study was carried out in a tertiary care academic hospital from September 2017 to August 2019 over a period of 2 years as an obligation for MS degree in General Surgery.

Study Design

The present study was a tertiary care hospital based longitudinal observational study on a sample size of 100 patients.

Study Population

The study population was all patients with chronic wounds admitted in the hospital.

Study Subject

Patients were recruited as cases using the below mentioned inclusion and exclusion criteria

Inclusion Criteria

1. Patients above age of 18 yrs.
2. Patients of all healing and non healing wound.
3. Patients of all diabetic wounds, neuropathic wounds, bed sores and burn wounds.
4. Patients of post-operative chronic wound.

Exclusion Criteria

1. Patients less than 18 yrs of age.
2. Patients not willing for study.

Sample Size

Sample size 100 Patients are to be studied based on medical record statistics of last 3 years before starting the study. Final sample turned out to be 100 based on the inclusion and exclusion criteria of total patients during the study period.

Ethical Clearance

The study was granted by the institutional ethical committee of the tertiary care institute and the concerned university authorities.

Study Factors

Using a proforma the following study factors were studied and data recorded was entered into an excel sheet and analyzed using statistical software STATA version 10.1, 2011.

Demographic factors

Age: (in years at the time of presentation of disease was recorded as a continuous variable).

Occupation: involving prolonged standing has an important role in causation of chronic leg wound (present occupation of the patient noted)

Detailed history

1. Pain associated with wound, discharge from wound, site of wound, and duration of wound.
2. Cause of wound: Traumatic, Infective, Vascular insufficiency, Malignant Ulcer, Chronic Burn Wounds.

3. Associated conditions: Anemia, diabetes, hypertension, rheumatoid arthritis and sickle cell disease.

Clinical examination

Following parameters were recorded at the time of presentation of Chronic wound to tertiary care centre.

1. Pulse rate per minute
2. Blood pressure in millimetre of mercury (right brachial artery),
3. Body temperature in Fahrenheit (F0) at the time of presentation

Local examination

The Patients were examined in an examination room in day light, after completely exposing the part of body involving wound.

Following points were noted in proforma.

1. Exact site of wound
2. Number of wound/s
3. Size of wound
4. Edges of wound
5. Floor of wound

On palpation of wound following parameters were noted:

1. Tenderness at the site of wound
2. Induration of base and surrounding area of wound

Investigations

Biochemical Studies

The patients were subjected to appropriate investigations like complete blood counts (Hb gm%, total leucocyte count and platelets), blood sugar (fasting and post meal).

Microbiological Assessment

Pus/Discharges from wounds were sent for culture and sensitivity and gram staining at the time of presentation to the tertiary care institute.

Colour Doppler study of lower limb vessels was done in patients with suspected Vascular Disease of lower extremity.

X-ray of affected leg to rule out any bone involvement in clinically suspicious cases. Wound with duration of more than 6 months and not responding to conservative treatment and wounds

which were clinically suspicious of malignancy were biopsied from the edge of the wound.

Liver function test, kidney function test and seropositive status (HIV/HBsAg) as a part of routine pre Anesthetic work up. Electrocardiograph (ECG), X ray chest and echocardiography (if required) was done to assess the cardiorespiratory status of selected old age patients with history of cardio respiratory diseases. Appropriate advice was taken from physician for cardiorespiratory diseases and diabetes whenever indicated.

Patients with chronic wound were treated depending on the cause of wound and they were followed up for healing of the wound, reduction in size of wound, or flaring up of the wound. Silver nitrate solution was sprayed with the help syringe in a dose of 1 ml/cm³ daily once.

Outcome factors of the study

1. Complete healing of wound in terms of management
2. Reduction in size of wound
3. Infection or recurrence of wound

Statistical Analyzis

Data was coded and analyzed in statistical software, STATA version 10.1, 2011. Descriptive statistics like mean and standard deviation were calculated to summarize continuous variables. Frequency and percentages were used to summarize categorical variables.

p -value < 0.05 was considered statistically significant.

Implication of the study

1. Identification of different aetiological factors for chronic wound, different types of chronic wound.
2. Identification of different associated co morbid condition existing with chronic wound.
3. Different plans of treatment based on aetiological factors.

Results

Table 1 shows number of patients according to age. Total 100 patients were studied in this study out of which most common age group is above 60 years of age. Mean age for study is 54.

Table 1: Number of patients according to age

Age group (years)	No. of patients
<30	10
31-40	16
41-50	15
51-60	15
>60	44
Total	100

Table 2 shows sex Incidence. Total 100 patients were followed with Silver Nitrate dressing out of which 79 were male patients and 21 were female patients.

Table 2: Sex Incidence

Sex	No. of patients
Male	79
Female	21
Total	100

Table 3 shows number of patients according to Etiology. Most common etiology among study group is of Traumatic origin and second most common etiology is of Infectious origin. Out of 100 patients 61 patients are of Traumatic origin, 32 patients are of Infectious origin, 1 patient is of vascular insufficiency, 1 patient of malignant ulcer and 5 patients are of Burn.

Table 3: Showing number of patients according to Etiology

Etiology	No. of patients
Traumatic	61
Infectious	32
Vascular insufficiency	01
Malignant	01
Burns	05
Total	100

Table 4 shows number of Diabetic patients according to Age. Diabetes is an essential factor affecting healing of wound and hence affects the duration of hospital stay of patients managing with Silver Nitrate dressings. Among the sample size of 100 patients, 33 were having diabetes mellitus with 16 patients having age above 16.

Table 4: Showing number of Diabetic patients according to Age

Age	No. of patients
<30	2
31-40	5
41-50	6
51-60	4
>60	16
Total	33

Table 5 shows number of Traumatic patients according to Age. Among sample size of 100 patients, 61 patients have developed wound due to traumatic cause. 23 patients out of 61 are found to be above 60 years of age.

Table 5: Number of Traumatic patients according to Age

Age distribution	No. of patients
<30	5
31-40	12
41-50	9
51-60	12
>60	23
Total Patients	61

Table 6 shows number of Traumatic patients according to Age. Out of 100 patients treated with Silver Nitrate dressing 64 patients have healed completely on Silver Nitrate dressing only with varied time of duration and 36 patients have required split thickness skin grafting.

Table 6: Number of Traumatic patients according to Age

Age distribution	No. of patients
<30	5
31-40	12
41-50	9
51-60	12
>60	23
Total Patients	61

Table 7 shows number of patients and treatment underwent. Out of 100 patients treated with Silver Nitrate dressing 64 patients have healed completely on Silver Nitrate dressing only with varied time of duration and 36 patients have required split thickness skin grafting.

Table 7: Showing number of patients and treatment underwent

Treatment modality	No. of patients
Silver Nitrate	64
STSG	36

Table 8 shows average duration of hospital stay according to size of wound. Duration of hospital stay have been observed among sample size of 100 patients according to the size of wound as following: Average duration of hospital stay for wound size of 1-3 cm was 13.9 days, for wound size of 4-5 cm was 20 days, for wound size of 6-7cm was 28.75 days, for the wound size of 8-10 cm was 32.67 days and for the wound size of 11-12 cm was 35.83 days.

Table 8: Showing average duration of hospital stay according to size of wound

Size of wound (in cm)	Average Duration of hospital stay in Days
1-3	13.9
4-5	20.00
6-7	28.75
8-10	32.67
11-12	35.83

Table 9 shows duration of healing in days with number of patients. Average duration of wound healing with Silver Nitrate dressings is found to be 10-15 days for 15 patients, 16-20 days for 14 patients, 21-25 days for 16 patients, 26-30 days for 32 patients, 31-35 days for 17 patients, 36-40 days 2 days, 41-45 days for 4 patients.

Table 9: Showing-duration of healing in days with number of patients

Duration of wound healing in days	No. of patients
10-15	15
16-20	14
21-25	16
26-30	32
31-35	17
36-40	2
41-45	4

Table 10 shows patients distribution according to size of wound. Out of total sample size of 100 patients 09 patients were found to have wound of size 1-3 cm, 27 patients were found to have wound of size 4-5 cm, 28 patients were found to have wound of size 6-7 cm, 30 patients were found to have wound to have size of 8-10 cm and 06 patients were found to have wound of size 11-12 cm. 8-10 cm were most common wound size group of study.

Table 10: Showing patients distribution according to size of wound

Size of wound	No. of patients
1-3 cm	09
4-5 cm	27
6-7 cm	28
8-10 cm	30
11-12 cm	06
Total	100

Table 11 shows duration required for wound healing according to size of wound. Duration of wound healing has been observed among sample size of 100 patients according to the size of wound.

Duration of wound healing was found to be 14.1 days for wound size of 1-3 cm, 20.18 days for wound size of 4-5 cm, 29.17 days for wound size of 6-7 cm, 33.17 days for the wound size of 8-10 cm, 35.83 for the wound size of 11-12 cm.

Table 12 shows formation of Pink Granulation Tissue on Day 10 according to size of wound. Out of 100 patients of study sample, 97 patients formed pink granulation tissue on Day 10 of Silver Nitrate dressing. Out of these 97 patients, 8 patients of size 1-3 cm, 27 patients of size 4-5 cm, 26 patients of size 6-7 cm, 31 patients of size 8-10 cm and 5 patients of size 11-12 cm formed pink granulation tissue respectively on Day 10 of Silver Nitrate dressing.

Table 12: Formation of Pink Granulation Tissue on Day 10 according to size of wound

Size in cm	Day 10			Total
	0	2	3	
1-3	1	0	8	9
4-5	0	0	27	27
6-7	0	1	26	27
8-10	0	0	31	31
11-12	0	1	5	6
Total	1	2	97	100

Discussion

Majority of the study subjects were in the age ranging above 60 years followed by 30 to 40 years and 50 to 60 years.

Total 100 patients were followed with Silver Nitrate dressing out of which 79 were male patients and 21 were female patients. In present study percentage of male population (79%) was higher than that of female population (21%) in each age group.

Most common etiology among study group is of traumatic origin (61%) and second most common etiology is of infectious origin (32%).

Out of 100 patients 61 patients are of traumatic origine, 32 patients are of infectious origin, 1 patient is of vascular insufficiency, 1 patient of malignant ulcer and 5 patients are of burn

Diabetes is an essential factor affecting healing of wound and hence affects the duration of hospital stay of patients managing with Silver Nitrate dressings. Among the sample size of 100 patients, 33 were having diabetes mellitus with 16 patients having age above 16.

With the use of Silver Nitrate dressings diabetic wound has shown good response as much as like

non diabetic patients.

With the use of Silver Nitrate dressing there is delay of 4–5 days in healing of diabetic wound is found than healing of non diabetic wound within each age group.

Use of Silver Nitrate dressings has healed 64 patients wound out of 100 sample sizes and only 36 patients' required secondary management with STSG.

Patients with wound size less than or equal to 7 cm has successfully healed with Silver Nitrate dressings only but patients with wound >7 cm required STSG accordingly.

Wound with size >7cm when managed with Silver Nitrate dressings it is found to have increased duration of hospital stay.

Average duration of wound healing with Silver Nitrate dressings is found to be 10–15 days for 15 patients, 16–20 days for 14 patients, 21–25 days for 16 patients, 26–30 days for 32 patients, 31–35 days for 17 patients, 36–40 days 2 days, 41–45 days for 4 patients.

Average duration of hospital stay for wound size of 1–3 cm was 13.9 days, for wound size of 4–5 cm was 20 days, for wound size of 6–7cm was 28.75 days, for the wound size of 8–10 cm was 32.67 days and for the wound size of 11–12 cm was 35.83 days

Duration of wound healing has been observed among sample size of 100 patients according to the size of wound.

Duration of wound healing was found to be 14.1 days for wound size of 1–3 cm, 20.18 days for wound size of 4–5 cm, 29.17 days for wound size of 6–7 cm, 33.17 days for the wound size of 8–10 cm, 35.83 for the wound size of 11–12 cm.

Out of 100 patients of study sample, 97 patients formed pink granulation tissue on Day 10 of Silver Nitrate dressing.

Out of these 97 patients, 8 patients of size 1–3 cm, 27 patients of size 4–5 cm, 26 patients of size 6–7 cm, 31 patients of size 8–10 cm and 5 patients of size 11–12 cm formed pink granulation tissue respectively on Day 10 of Silver Nitrate dressing.

Tredget EE et al.⁷ observed from their study that removal of dressing with acticoat was having less pain compared to the removal of the dressing with silver nitrate. But the application pain was comparable. Ease of use comparison between the silver nitrate and the acticoat was also comparable. But the acticoat dressing provided better protection from bacterial infections compared to the silver

nitrate dressing of the wounds. Secondary bacterial infections rate was also low with the acticoat dressing compared to the silver nitrate dressing of the wounds. Thus the authors concluded that acticoat was better than silver nitrate.

Muangman P et al.⁸ compared to groups which were similar for age and TBSA. Both the groups were found to be comparable in terms of infection of the wounds and also the LOS as the *p*-value was more than 0.05. Topical as well as systemic treatment using antibiotics was found to be very successful. Split thickness skin graft was better in 1% AgSD group in comparison to patients in the acticoat group but there was no statistical difference. Acticoat group patients have shown statistically significant low pain scores compared to the other group.

Brown M et al.⁹ compared two groups of patients i.e. acticoat and aquacel and found that both the groups were comparable in terms of epithelisation on 10th day. Both the groups did not show significant adverse effects. Number of changes in the dressings was less in aquacel group patients. Author found that both types of dressing were effective. But concluded that aquacel Ag dressing was superior to acticoat.

Caruso DM et al.¹⁰ also found that Aquacel Age dressing group patients experienced less pain as well as anxiety, required changes of dressings less, less time for nursing, burning was less. There was more flexibility with the silver sulfadiazine and also the movement ease was less. It was also cost effective.

Huang SH et al.¹¹ studied 20 patients. They found that Aquacel Ag with Vaseline gauze the patients in their group had less score of the visual analog scale when compared to the patients with SSD group. This difference was found out to be statistically significant. Labor cost was also significantly lesser in aquacel Ag group.

Conclusion

It is concluded that Silver Nitrate is found to be very effective in early healing of chronic wound. Advantage of using Silver Nitrate as dressing solution is that Small wounds of size less than or equal to 7 cm healed completely with use of Silver Nitrate dressings without the need of skin grafting. Use of Silver Nitrate dressings for large wounds greater than 7 cm size helped in early formation of healthy granulation tissue for grafting purpose.

We also found that overall healing rate, graft survival and patient compliance were better with the use of Silver Nitrate dressings. Disadvantage of using Silver Nitrate as dressing solution is that it is expensive solution as compared to other dressing solutions. When not used appropriately and judiciously silver nitrate solution causes hypergranulation in some patients it also caused burning sensations. Silver Nitrate showed faster healing of chronic wound, therefore overall hospital stay of chronic wound patient was reduced when Silver Nitrate was used for wound dressings.

Key messages:

Silver nitrate can be used in the management of the wounds

References

1. Klasen HJ. Historical review of the use of Silver in the treatment of burns. I. Early uses. *Burns* 2000;26(2):117-30.
2. Hugo WB, Russell AD. Types of antimicrobial agents. In: Russell AD, Hugo WB, Ayliffe GAJ eds. *Principles and Practice of Disinfection, Preservation and Sterilisation*. Oxford, UK:Blackwell Scientific Publications 1982. pp.8-106.
3. Price WR, Wood M. Silver Nitrate burn dressing. Treatment of seventy burned persons. *Am J Surg* 1966;112(5):674-80.
4. Fox CL, Jr. Silver sulfadiazine-a new topical therapy for Pseudomonas in burns. Therapy of Pseudomonas infection in burns. *Arch Surg* 1968;96(2):184-8.
5. Gemmell CG, Edwards DI, Fraise AP et al. Guidelines for the prophylaxis and treatment of methicillin-resistant Staphylococcus aureus (M RSA) infections in the UK. *J Antimicrob Chemother* 2006;57:589-608.
6. Sibbald RG, Orsted H, Schultz GS et al. Preparing the wound bed 2003: focus on infection and inflammation. *Ostomy Wound Manage* 2003;49(11):23-51.
7. Tredget EE, Shankowsky HA, Groeneveld A, et al. A matched-pair, randomized study evaluating the efficacy and safety of Acticoat silver-coated dressing for the treatment of burn wounds. *J Burn Care Rehabil* 1998 Nov-Dec;19(6):531-7.
8. Muangman P, Chuntrasakul C, Silthram S, et al. Comparison of efficacy of 1% silver sulfadiazine and Acticoat for treatment of partial-thickness burn wounds. *J Med Assoc Thai* 2006 Jul;89(7):953-8.
9. Brown M, Dalziel SR, Herd E, et al. A Randomized Controlled Study of Silver-Based Burns Dressing in a Pediatric Emergency Department. *J Burn Care Res* 2016 Jul-Aug;37(4):e340-7.
10. Caruso DM, Foster KN, Blome-Eberwein SA, et al. Randomized clinical study of Hydrofiber dressing with silver or silver sulfadiazine in the management of partial-thickness burns. *J Burn Care Res* 2006 May-Jun;27(3):298-309.
11. Huang SH, Lin CH, Chang KP, et al. Clinical evaluation comparing the efficacy of aquacel Ag with Vaseline gauze versus 1% silver sulfadiazine cream in toxic epidermal necrolysis. *Adv Skin Wound Care* 2014 May;27(5):210-5.