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# Cost-Effectiveness of Nano Silver Compounds as a Single Dressing in Wound Healing

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## Abstract

**Introduction:** Needless to say, the silver ion-containing antimicrobial products are the new era in wound healing as they are the cornerstone in promoting wound healing, resisting infection, obtaining suitable pH, and reducing medical expenses. Despite the difference in silver concentration, mode of silver release, quantity, and duration of silver availability in the wound dressing, and pH optimization; yet we still need to Northampton study their wound-healing power as granulation tissue formation, the biocompatibility of cell vitality and growth, and antibacterial effect as infection eradication. **Objective:** Comparing the effectiveness of two different Nano – Silver compounds on wound healing in a randomized prospective study. **Patients & Methods:** 40 patients presented to Royal Vascular Center from Jan.1st, 2020-Dec.30th, 2020. with lower limb chronic wounds and randomly divided into two groups Group A) 20 patients treated with tetra oxide nano silver (silver sol) spray and jell dressing. Group B) 20 patients treated with Colloidal nano silver (Farmactive) spray. All patients were subjected to:

- Careful history taking and General examination

- ABI & Duplex examination of arterial and venous systems of both extremities

- Plain X-ray of the affected lower limb

- wound examination and classification

**Results:** Mean age was (29.6+1.02 &41.3+0.95 years) .M/F was (12/8 & 14/6) in both groups. Right lower limb was affected in 11 (55%) & 13 (65%) patients, left 3 (15%) &2 (10%) patients and bilateral in 7(35%) & 4 (20%) patients. Revisualization was performed in 4 & 5 patients 20 % &25 % while venous ablation and improving venous pathology was reported in 3 (15%) & 2 (10%). Wound duration was 6.8+9 &7.1+0.4 months in both groups with a mean diameter 9.5X 5.7 & 8.6X 4.9 CM. Wounds were healed spontaneously in19 patients (95%) in group A). On the other hand, Wounds were healed spontaneously in 14 patients (70%) Duration of healing was in the range of 4-16&3-18 weeks in patients of both groups. **Conclusion:** Nano Silver is very effective as a single dressing for wound healing and significant results were achieved for good wound healing regarding the duration of healing, the nature of scar tissue, and cost-effectiveness with Tetra oxide Nano silver compounds.

**Keywords:** Chronic Wound; Dressing; Nano Silver compounds/healing

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## Introduction

Wounds that have not progressed through the normal process of healing and are open for more than a month are classified as chronic wounds [1]. (Nonhealing wounds, left untreated and improperly managed, can result in significant medical issues, including infection, sepsis, the need for limb amputation, and even death. Importantly, the lack of regular wound care visits to a wound clinic could increase hospitalization rates by 20 time [2]. To accurately assess the prevalence of chronic wounds is problematic because of disparities in study design and how health conditions are defined and measured [3]. Factors that limit comparability of prevalence studies are heterogeneous study design and lack of clear definitions [4]. These obstacles hamper accurate comparability and calculations of pooled estimates for chronic wounds. Because of the importance of the inflammatory phase in wound healing, silver nanoparticles (AgNPs) have mostly been tested with regard to their inflammatory properties [5]. Wound dressings that contain AgNPs have been suggested to enhance wound healing by decreasing inflammation through the modulation of cytokines [6]. Several wound dressings with AgNPs are used because of their antibacterial properties [7], but the influence of AgNPs on the complete mechanism of wound healing has not been extensively investigated [6]. The effectiveness of silver nano particle containing dressings has been widely tested in vitro. Recently, research has been published demonstrating that these dressings have a fast and broad-spectrum antibacterial activity against both Gram-positive and Gram-negative bacteria [7].

**Objective:** Comparing the effectiveness of two different Nano – Silver compounds on wound healing in a randomized prospective study, which were selected 1- tetra oxide Nano silver spray and jell dressing. 2- Colloidal Nano silver spray.

**Patients & Methods:** 40 patients presented to Royal Vascular Center from Jan.1st, 2020-Dec.30th, 2020. with lower limb chronic wounds and randomly divided into two groups Group A) 20 patients treated with tetra oxide nano silver (silver sol) spray and jell dressing. Group B) 20 patients treated with Colloidal nano silver (Farmactive) spray. All patients were subjected to:

- Informed Consent

- Careful history taking and General examination

- ABI & Duplex examination of arterial and venous systems of both extremities

- Plain X-ray of the affected lower limb

- Wound examination and classification according to Texas classification (Figure 1) [8].

| | GRADE | | | |
|---|---|---|---|---|
| STAGE | 0 | 1 | 2 | 3 |
| A | Pre-ulcerative lesions No skin break | Superficial wound No penetration | Wound penetrating tendon or capsule | Wound penetrating bone or joint |
| B | With infection | With infection | With infection | With infection |
| C | With ischemia | With ischemia | With ischemia | With ischemia |
| D | With infection and ischemia | With infection and ischemia | With infection ad ischemia | With infection and ischemia |

**Figure 1:** Texas wound classification.

## Results

In the present study we compared 2 different nano silver compounds in daily dressing for chronic wounds. Age of group (A) patients ranged from 24:51 years and mean age was (29.6+1.02 ), and Age of group (B) patients ranged from 40:56 years and mean age( 41.3+0.95 years) .Male/female was (12/8 & 14/6) in both groups. The wound was located on right lower limb in 11 (55%) & 13 (65%) patients, and on left lower limb in 3 (15%) &2 (10%) patients while bilateral leg wound was noticed in 7(35%) & 4 (20%) patients (Table 1).

| | A | B |
|---|---|---|
| Right lower limb | 11 (55%) | 13 (65%) |
| Left lower limb | 3 (15%) | 2 (10%) |
| Bilateral | 7(35%) | 4 (20%). |

Table 1: Side affected.

According to Texas wound classification, 9 Patients in both groups 45% were in grade (a), 6&7 patients in grade b in both groups,4&one patient in grade c, while 1&3 patients in grade d. Table -2a Staging of the wound revealed that 8&11 patients were in stage 1,8&4 patients in stage 2, while 4&5 patients were in stage 3 Figure 2b.

| Grade | A | B |
|---|---|---|
| A | 9 patients | 9 patients |
| B | 6 patients | 7 patients |
| C | 4 patients | one patient |
| D | one patient | 3 patients |

**Table 2a:** Wound grades.

| Stage | A | B |
|---|---|---|
| 1- | 8 patients | 11 patients |
| 2- | 8 patients | 4 patients |
| 3- | 4 patients | 5 patients |

**Table 2:** Wound stages.

Infection was noticed in 11 patients 55%, but the toxic manifestations and toxemia was shown in 3 patients 15% in group A, and 2 patients 10% in group B isolation of the organisms and organism frequency was shown in Table 3 a&b. We had used antibiotics (Tavacin+Targocin) only in 3 patients with toxemia in group A, but we used antibiotics (Tavacin+Targocin) in 2 patients with toxic manifestations in group B in addition to 5 patients more severe infection in group B Table 3 a&b.

| Organism | Patients | Toxic manifestations |
|---|---|---|
| Staph aureus | 4 patients | no |
| Citrobacter freundii | One patient | no |
| Klebsiella | 2 patients | no |
| Pseudomonas | One patients | no |
| MRSA + E.coli | 3 patients | yes |

**Table 3a:** Organisms Frequency in group (A).

| Organism | Patients | Toxic manifestations |
|---|---|---|
| Staph aureus | 3 patients | no |
| Staph aureus + coliform species | 2 patients | yes |
| Proteus mirabilis | One patient | no |
| Pseudomonas | 2 patients | no |
| MRSA | 3 patients | no |

**Table 3b:** Organisms Frequency in group (B).

The duration of the wound duration varied from 4-11 & 5- 10 weeks and mean duration of 6.8+9 &7.1+0.4 months in both groups. Wound measurements in all patties were done; the mean length was 8&7.6+0.9&1.02 CM in group A&B width was 6.2&5.8 +0.8&0.76 CM in group A&B patient. Figure 2a, the depth of the wound was 1.9 & 1.7 + 0.4 &0.6 CM in group A &B patients Figure 2b.

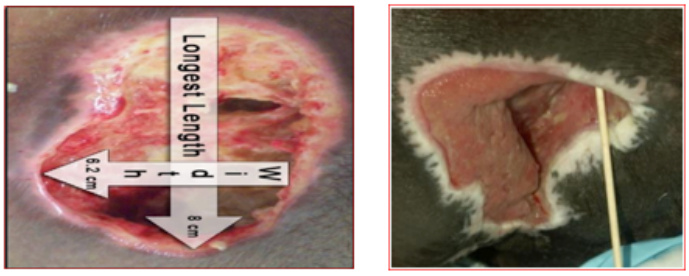


**Figure 2a&b:** Wound measurements.

Arterial assessment of all patients was done and ABI was 0.9 &0.87 in group A & B patients, ischemic manifestations were detected in 4 & 5 patients 20 % &25 % in both group and revisualization was performed before wound care management ,while venous duplex showed significant reflux in the great saphenous vein in 3&2 patients 15 &10% that was treated by ablation of the GSV and improving venous pathology, while post thrombotic changes were detected in further 2& 3 patients 10 & 15% that was counteracted by wearing elastic compression type III (40 mm Hg). Duration of the wound healing was ranged from 4 -16 & 3-18 weeks in patients of both groups and wounds were healed spontaneously in 19 patients (95%) in group A) and only one patient applied thin skin graft. On the other hand, Wounds were healed spontaneously in 14 patients (70%) in group B patients and skin graft was successfully taken in 4 patients 20% Figure 3.

**Figure 3:** Post thrombotic ulcer healed using skin graft.

## Discussion

This study, applying a clear definition for chronicity, provides a comparison of the effectives of two different Nano silver compounds( tetra oxide nano silver (silver sol) spray and jell & Colloidal nano silver (Farmactive) spray ) in the healing process of chronic wounds. Age of the patients was ( & ) in both groups which was the in agreement with Salomoni et al [7] in his study for diabetic foot ulcer, and much younger than those patients in Lipsky B, et study for chronic wound management using Nano silver colloid

[9]. Initially, the wound starts unintentionally, therefore wounds are colonized with microorganisms causing a serious diabetic foot infection once the wound becomes infected with purulent exudate and inflammation may lead to DFU and ends by leg amputation [9]. Practically, selecting a suitable type of advanced antimicrobial dressing to play a key part of DFU treatment as Honey-impregnated dressings, Iodine-Impregnated dressing, and silver-impregnated dressing [10]. About 45% of the patients in both groups in this study had clinical manifestations of infection and the frequency of organisms was done with systemic antibiotic therapy in 10% of cases in group A patients while it was used in 15% of patients in group B without toxic signs . Recently, the integration of silver with nanoparticles displays a significant novel and distinguish of physical, chemical, and biological characteristics, meanwhile, the magic nanoscale size provides a unique tool in tissue repair and overall wound management [11]. Duration of the wound healing was ranged from 4 -16 & 3-18 weeks in patients of both groups and wounds were healed spontaneously in 19 patients (95%) in group A) and only one patient applied thin skin graft. On the other hand, Wounds were healed spontaneously in 14 patients (70%) in group B patients and skin graft was successfully taken in 4 patients 20%. Essa reported that: After the implementation of the hydrogel/ nano silver-based dressing on patients with chronic leg ulcer of the present study, the findings illustrated that use of hydrogel\nano silver wound dressing compared to the traditional dressing showed a more significant reduction in the area when the initial wound area is compared to the subsequent area measurements expressed as the initial percentage and their findings proved that the healing rate was statistically significant and the healing rate per week and the complete recovery was achieved with Sliver STAT group, around one-fifth of the study sample by six weeks where the rest of the patients were healed from week eight to week twelve, whereas the conventional group the wound healing started from week eight to week twelve [12].

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