ORIGINAL ARTICLE

COMPARATIVE STUDY OF SILVER FOAM DRESSING OVER POVIDONE IODINE DRESSING IN INFECTED WOUNDS

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ABSTRACT: OBJECTIVE: To compare the healing of wounds with silver foam and povidone dressing materials. **MATERIAL & METHOD:** This was a prospective comparative clinical trial. Seventy patients with infected wounds were evaluated. Silver foam and povidone iodine dressings were applied in thirty five each patients, and the patients were followed as per post-application treatment protocol until wound healed or preparing for graft. Wound assessed every 4th day. Assessment included clinical examination, bacteriological analysis, histopathological findings. **RESULTS:** Total duration of treatment in silver foam dressing and povidone iodine dressing in 1-50cm² are 34.67 days and 40.81 days and in 51-100cm² are 48.22 days and 57.20 days. On assessment of reduction of surface area and slough every 4th day in both group, it was found that silver foam was significantly better than control group. In 1-50cm² mean percentage of reduction in size on 28th day in silver foam is 76.45% as compared to povidone iodine is 57.29% (P< 0.001). In 51-100cm² mean percentage of reduction in size on 28th day, in silver foam is 53.06% as compared to povidone iodine is 28.63% (P<0.001). Mean time taken for reduction of exudate in silver foam dressing and povidone iodine was respectively 11.6 days and 18.91 days (P<0.0001) and mean time taken to resolution of odor in silver foam dressing and povidone iodine dressing was respectively 4.80 days 6.54 days (P=0.0924). **CONCLUSION:** This study provides evidence that use of silver foam in infected wounds in which healing process is impaired due to bacterial colonization is more efficacious than povidone iodine dressing. It suggests that antibacterial activity of silver foam is very efficient and that it has excellent exudate management, both of which lead to rapid initiation, maintenance and completion of healing process.

KEYWORDS: Infected wound, silver foam dressing, povidone iodine dressing

INTRODUCTION: A person with an infected wound often suffers from physical disability, pain, social and mental disturbances. It may cause extensive necrotizing fasciitis and other soft tissue and bone infections which can be life threatening. Addressing these multiple issues requires prompt management of precipitating factors and efficient wound care. Silver has proven antimicrobial activity that includes antibiotic-resistant bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE).¹ Fong 2005 Since ancient times silver was used for disinfecting stored water and liquids. The ancient Greeks and early Americans used silver coins for this purpose.² Demling and DeSanti 2001; Dunn and Edwards-Jones 2004; Fong 2005 Prior to the 1800s, silver was used for treating epilepsy, venereal infections, acne, and leg ulcers. Silver foil applied to surgical wounds was known to improve wound healing and reduce post-operative infections, and silver pencils were used to remove warts and to debride ulcer.³ The sustained release of silver from this dressing has been demonstrated for up to seven days.¹ Silver foam is a sustained silver release dressing that combines antibacterial activity with effective exudates

ORIGINAL ARTICLE

handling. This study compares the clinical performance of silver foam and povidone iodine dressing in infected wounds.

KEYWORDS: Infected wound, silver foam dressing, povidone iodine dressing.

MATERIAL AND METHOD: The present study comparative study of silver foam dressing over povidone iodine dressing in infected wound was carried out in Department of surgery, People College of Medical Sciences and associate People Hospital, Bhopal in year 2011-2013. Total of 70 patients with different kinds of wounds were studied over a period of one and half year. The patients underwent dressings after obtaining informed consent. The Seventy patients were randomized to be divided in two different (A) silver foam and (B) povidone iodine group. Along with the dressings the patients also received broad spectrum antibiotics in both groups. The antibiotics were changed as per pus culture sensitivity. The antibiotics were continued for longer duration as required by circumstances. Daily dressing once and twice (if required) was done in povidone iodine group.

PVP-I (Povidone iodine) is 2-pyrrolidinone, 1- ethenyl-, homopolymer, compound with iodine. Free iodine, slowly liberated from the povidone-iodine (PVP-I) complex in solution, kills eukaryotic or prokaryotic cells through iodination of lipids and oxidation of cytoplasmic and membrane compounds. This agent exhibits a broad range of microbicidal activity against bacteria, fungi, protozoa, and viruses. Silver foam comprises a soft hydrophilic polyurethane foam containing silver as an integral part of matrix. It is recommended for use on moderately to highly exuding chronic wounds with a high bacterial burden. The silver is evenly distributed in the foam. When the dressing is applied, silver is released continuously, depending on the amount of exudate from the wound.

Inclusion criteria –

- Age: 5 to 60 years
- Infected wound secondary to trauma and skin infection.
- Wound area (1cmsq.-100cmsq.)

Exclusion criteria –

- Age < 5 yr. and >60 yr.
- Diabetic, Arterial, Venous, Pressure, Tubercular ulcer
- Wound size (>100cmsq)

Ulcer classified on the basis of area was 1-50 cm² and 51-100cmsq. Clinical assessment of wounds was performed at the beginning of treatment and each dressing change for each group. Wounds were examined for the presence of any inflammation, necrosis, exudates, sloughing and growth of healthy granulation tissue and reduction in surface dimensions. The simplest and cheapest method is to calculate the wound surface area by measuring its linear dimensions with a tape measure or ruler. Two-dimensional wound measurement tool is wound tracing, which a pen is used to trace the outline of the wound directly onto sterile transparent film. Wound tracing can be performed at the bedside using a minimum of equipment and requires no special skills or training on the part of the clinician. Each tracing in a sequence is easy to compare with the others. However, this two-dimensional method assumes that the wound has a geometric surface shape, for example a rectangle (length x width), a circle (diameter x diameter) or an oval (maximum diameter x maximum

ORIGINAL ARTICLE

diameter perpendicular to the first measurement). On 1st day multiplying the longest vertical and horizontal dimensions of irregular shape wound made measurement of area of ulcer. The presence and absence of pain was ascertained initially and each dressing change during therapy. Every 4th, 8th, 12th, 16th, 20th, 24th, 28th, day wound was assessed clinically for size, surrounding skin, presence of slough or discharge, appearance of healthy granulation tissue, and reduction of wound area. Pus culture sensitivity was carried out every 4th day with aseptic precaution. All samples are examined by microbiologist for bacterial analysis and sensitivity for antibiotics. Histopathological examination was carried out on first day and seventh day a biopsy was performed from the margin of ulcer. Inflammation assessed by the presence of inflammatory cells, vascularization, necrosis and bacteria. Healing as assessed by the presence of healthy granulation tissue, fibroblast proliferation, collagenisation and epithelisation.

Treatment continued until the complete healing of ulcer or ulcer bed was ready for skin grafting full of granulation tissue, without evidence of residual exudates or inflammation. Statistical comparison of data from silver foam and control groups was performed using appropriate tests.

Ethical Consideration: The study protocol was approved by the Ethics Committee. All patients gave written consent to participate after having received full written information about the study objectives and conduct.

Informed written consent was taken from the patient. Investigations were done using aseptic precautions. Treatment was given as per protocol. They had the right to withdraw from the study. Protection was given from any kind of harm. Full confidentiality of data was maintained. No religious issues involved. All religions and customs were respected. Study was conducted under supervision.

Statistical analysis: Continuous data were described by sample size, mean, standard deviation, and range. For statistical analysis, student's unpaired t-test was applied for continuous variables.

RESULTS:

Status of wound surface area every 4th day: In our present study mean reduction of size of ulcer in silver foam dressing and povidone iodine dressing in 1-50cm² on 8th day was 12.10% and 7.82% respectively (P=0.0243), on 12th day 25.76% and 17.68% respectively (P=0.0029), on 16th day 38.55% and 26.39% respectively (P=0.003), on 20th day 53.01% and 36.20% respectively (P<0.0001), on 24th day 65.0% and 47.89% respectively (P<0.0001%) and on 28th day 76.45% and 57.29% respectively (P<0.0001). Mean reduction of size of ulcer in silver foam dressing and povidone iodine dressing in 51-100cm² on 8th day was 2.40% and 1.72% respectively (P=0.4932), on 12th day 8.35% and 5.68% respectively (P=0.0455), on 16th day 16.55% and 10.22% respectively (P=0.0130), on 20th day 35.14% and 16.86% respectively (P=0.0382), on 24th day 43.44% and 22.16% respectively (P=0.0096) and on 28th day 53.06% and 28.63% respectively (P<0.0001).

ORIGINAL ARTICLE

Mean duration for healing of ulcer: In the course of treatment of ulcer mean duration of time of healing of ulcer in silver foam in 1-50cm² was 34.67 days and mean duration of time of healing of ulcer in povidone iodine in 1-50cm² was 40.81 days and mean duration of time of healing of ulcer in silver foam in 51-100cm² was 48.22 days and mean duration of time of healing of ulcer in povidone iodine in 51-100cm² was 57.20 days (P=0.0058) and mean duration of prepare for grafting in silver foam dressing was 48.22 days and mean duration of prepare for grafting in silver foam was 57.20 days (P=0.1667).

Exudate and odor assessment: In this study mean time was taken to reduction of exudate was in silver foam dressing was 11.6 days and mean time was taken to povidone iodine was 18.91 days ($P < 0.0001$) and about the odor in silver foam dressing patients only 13 patients had odor and in povidone iodine patients, 12 patients had odor and mean time taken to resolution of odor in silver foam dressing and povidone iodine dressing was respectively 4.80 days 6.54 days ($P = 0.0924$).

Mean no. of days to reduction of exudate:

Histopathology of ulcer margin: Histopathological biopsy taken from wounds on 1st day and 7th day and compared histological features in different days in both group. We found that mean fibroblast proliferation on 1st day in povidone iodine and silver foam is 10/HPF and 7.75/HPF respectively ($P = 0.5114$) and on 7th day in povidone iodine and silver foam is 13.25/HPF and 22/HPF respectively ($P =$

ORIGINAL ARTICLE

0.264). Collagen formation on 1st day in povidone iodine and silver foam is 4.50/HPF and 6/HPF respectively ($P=0.5847$) and on 7th day in povidone iodine and silver foam is 18/HPF and 33.50/HPF respectively ($P= 0.472$). Inflammatory cells on 1st day in povidone iodine and silver foam is 38.50/HPF and 52/HPF respectively ($P=0.7749$) and on 7th day in povidone iodine and silver foam is 42.85/HPF and 13.25/HPF respectively ($P= 0.2591$). Capillaries formation on 1st day in povidone iodine and silver foam is 1.875/HPF and 1.62/HPF respectively ($P=0.8716$) and on 7th day in povidone iodine and silver foam is 11.25/HPF and 22.50/HPF respectively ($P= 0.0457$).

Pus culture: In our study staphylococci was present in 36 (51.4%) patients, streptococci was present in 28 (40%) patients, E.Coli was present 15 (21.4%) patients, Pseudomonas was present in 14 (20%) patients, Klebsiella was present in 8 (8.4%) patients, Proteus sp. was in 2 (2.8%) patients and acetinobacter was found in 1(1.4%) patients. Mean number of days taken to achieving no growth in culture of wound in silver foam group is 9.60 days and mean number of days taken to sterile wound in povidone iodine group is 14.63 days ($P<0.001$).

DISCUSSION: The number of patients examined and studied was 70. All these patients were divided in two groups. In group A all 35 patients treated by application of silver foam. In group B all 35 patients treated by application of povidone iodine. The age ranges from 5-60 years with mean age of 39.43 years for group silver foam. The age ranges from 5-60 years with mean age of 39.66 years for group povidone iodine. Maximum no. of patients belonged to age group 41-60 years. Male/Female ratio was 3.1:1. The commonest symptoms associated with wound were pain and swelling. Most common etiology of wounds was post cellulitis. The commonest signs were slough and edema. Most common site was lower limbs. Regional lymph node was involved in 19 cases (27.18%). Total duration of treatment in silver foam dressing and povidone iodine dressing in 1-50cm² are 34.67 days and 40.81 days and in 51-100cm² are 48.22 days and 57.20 days. On assessment of reduction of surface area and slough every 4th day in both group, it was found that silver foam was significantly better than control group. In 1-50cm² mean percentage of reduction in size on 28th day in silver foam is 76.45% as compared to povidone iodine is 57.29% ($P< 0.001$). In 51-100cm² mean percentage of reduction in size on 28th day, in silver foam is 53.06% as compared to povidone iodine is 28.63%.

ORIGINAL ARTICLE

($P < 0.001$). T. Karlsmark in clinical performance new silver dressing, Contreet foam for chronic exuding venous ulcer founded that a mean 56% reduction in ulcer area recorded in four week in (3-58.1 cm² of ulcer size) and there was mean 25% reduction in granulation tissue from dull to healthy after one week. Wound odor reduced significantly after one week. Mean dressing wear time was 3.1 days⁴. Rayman, M. Lohmann, B. Jorgensen, T. Karlsmark in clinical evidence for the use of a sustained silver-releasing foam dressing, Contreet Foam, in the treatment of diabetic foot ulcers and venous leg ulcers In the non-comparative study where 27 patients with diabetic foot ulcers of Wagner's grade I or II were treated with Contreet Foam for 4 weeks, the median reduction in relative ulcer area was 81% (mean: 56%) and 4 ulcers healed during the treatment In the comparative, randomized, study with 109 patients with delayed healing leg ulcers the median relative reduction in ulcer area was 45% in the Contreet Foam group compared with 25% in the control group at 4 weeks ($p < 0.05$, Wilcoxon two-sample test⁵. K. C. Munter et al 2006 compared the effect of sustained silver release foam dressing with local best practice (CONTOP STUDY). 619 patients with ulcers of varying aetiologies for 4 weeks were studied. Silver foam reduced wound area by 50% while local best practice reduced wound area by 34%. In addition less time, less slough, more progressive wound healing was achieved with silver foam dressing. They concluded that silver foam dressing supports faster healing of delayed healing wounds⁶. Jorgensen et al 2005, compared the effect of a sustained silver-release foam dressing (Contreet Foam) with a foam dressing (Allevyn Hydro cellular) without added silver in critically colonized venous leg ulcers with delayed healing. After 4 weeks, there was a significantly greater reduction in ulcer area in the Contreet Foam group (45%) than in the Allevyn Hydro cellular group (25%)⁷. Lezareth I et al, 2007 evaluation of new silver foam dressing in patients with critically colonized venous leg ulcers compared with baseline, the mean reduction in ulcer area was 35.0 $\pm$ 58.0% (median 33%, $p < 0.001$) after the four weeks treatment in (2.5- 48 cm² of ulcer size). Finally concluded results suggest that the test dressing had a favorable influence on the wound prognosis, and was well tolerated and accepted in the treatment of venous leg ulcers with clinical signs of critical colonisation⁸. In this study mean time taken for reduction of exudate in silver foam dressing was 11.6 days and mean time taken for reduction of exudate in povidone iodine was 18.91 days ($P < 0.0001$) and In this study odor was present in 13 patients of silver foam dressing group and 12 patients of povidone iodine dressing group and mean time taken to resolution of odor in silver foam dressing and povidone iodine dressing was respectively 4.80 days 6.54 days ($P = 0.0924$). There is better elimination of bacterial strains in GROUP A treated with Silver foam as compared to GROUP B treated with povidone iodine solution. Mean number of days taken to achieving no growth in culture of wound in silver foam group is 9.60 days and mean number of days taken to achieving no growth in culture of wound in povidone iodine group is 14.63 days ($P < 0.001$). The most common strains of bacteria isolated in the study was coagulase positive staphylococci 36(51.4%). Histopathologically biopsy taken from the silver foam treated wounds showed marked feature of wound healing. On comparison in amount of collagen fibers and capillary proliferation are statistically significantly increase in silver foam dressing as compared to povidone iodine dressing ($p < 0.05$) Fibroblast proliferation and low inflammatory cells are more marked in silver foam dressing but statistical difference in both group are not significant. Silver foam did not appear to have allergic or systemic side effect. Thus in our observation Silver foam dressing was found to be superior compared to dressing with povidone iodine.

ORIGINAL ARTICLE

CONCLUSION: This study provides evidence that use of silver foam in infected wounds in which healing process is impaired due to bacterial colonization is more efficacious than povidone iodine dressing. It suggests that antibacterial activity of silver foam is very efficient and that it has excellent exudate management, both of which lead to rapid initiation, maintenance and completion of healing process.

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Before silver foam dressing 1st day

**After silver foam dressing
skin grafting 20th day**

ORIGINAL ARTICLE

Before povidone iodine dressing 1st day

After povidone iodine dressing 40th day

Before application of silver foam 1st day

After application of silver foam 36th day

Before application of silver foam 1st day

After application of silver foam 28th day

ORIGINAL ARTICLE

Before silver foam dressing 1st day

After silver foam dressing 30th day

**Before application of
povidone iodine 1st day**

**After application of
povidone iodine 34th day**

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