

Comparison of Results of Silver-Impregnated Dressing with Povidone Iodine Based-Dressing in Patients with Diabetic Foot

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Abstract

Aim-Background: The use of silver in the management of burn wounds is well known. This prospective study was undertaken to evaluate the efficacy of silver-impregnated dressing in patients with diabetic foot.

Materials and methods: This study was conducted in the Department of Surgery at a tertiary care hospital in North India. It was a randomized case control study to compare the effectiveness of silver-impregnated dressings with conventional povidone iodine-based dressings in the healing of diabetic foot ulcers.

Results: At the end of our study, we found that 19 (70.37%) patients whose wounds were dressed with silver-impregnated dressing had 100% granulation tissue while only 10 (34.48%) patients whose wounds had been dressed with povidone iodine-based dressing had 100% granulation tissue.

Conclusion: Dressing diabetic foot ulcers with silver-based dressing is effective in controlling the microbiological burden of the wound and increasing the rate of granulation tissue formation.

Key Words: Silver; diabetic foot; povidone iodine; dressing

Introduction

Diabetic foot is defined by the World Health Organization (WHO) as “The foot of a diabetic patient that has the potential risk of pathologic consequences, including infection, ulceration, and/or destruction of deep tissues associated with neurologic abnormalities, various degrees of peripheral vascular disease, and/or metabolic complications of diabetes in the lower limb” [1]. According to the International Diabetes Federation, the prevalence of patients with diabetes is estimated to be 387 million worldwide and is expected to rise by 205 million by 2035 [2]. The expected cost of treating diabetic foot amounts

to around 12 billion \$ in the USA alone [3]. The peculiarity of diabetic ulcers is that they refuse to heal owing to their multifactorial origin (vasculopathy and neuropathy). According to Boulton et al., the most common cause of non-traumatic limb amputation is diabetic foot [4]. Thus, diabetic foot represents a major physical and economical problem for society.

Extensive research has been conducted in the pathophysiology and management of diabetic foot. Earlier concepts advocated keeping the wound dry for healing. This concept changed with time, nowadays supporting moist healing. Despite much progress being made in the understanding of diabetic foot pathophysiology, the search for the ideal dressing material continues. The use of silver in the management of burn wounds is well known. Silver possesses antimicrobial properties that inhibit cytochromes in the respiratory chain. Silver has been found to be effective in treating aerobic, anaerobic bacteria, yeast, filamentous fungi and viruses [5]. In silver-impregnated dressings, silver comes in contact with the bacteria and is absorbed by exudates. These dressings also have the advantage of less frequent need for dressing change [6]. Very little of the silver contained in the dressing is systemically absorbed. Most of the silver remains within the dressing or binds to proteins in the wound or wound debris [7]. Even if absorbed systemically, silver is excreted mainly via the biliary route in the faeces or in the urine [8]. This prospective study was

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undertaken to evaluate the efficacy of silver-impregnated dressing in patients with diabetic foot.

Methods and materials

This study was conducted in the department of general surgery at a tertiary care hospital in North India after receiving clearance from the Ethical Committee of the institution. It was a randomised case control study aimed to compare the effectiveness of silver-impregnated dressings with conventional povidone iodine-based dressings in the healing of diabetic foot ulcers. The study population included patients with diabetes mellitus aged over 18 years, with stage 2 or 3 diabetic foot ulcers (as defined by Wagner's classification [9]). All patients were included in the study after providing written informed consent. The patients were further randomised into either Group A (patients treated with povidone iodine-based dressing) or Group B (patients treated with silver-impregnated dressings). Each group comprised an equal number of patients in ($n=30$). Patients aged under 18 years, pregnant or nursing mothers, patients with foot ulcers other than diabetes, osteomyelitis of the underlying bone, allergy to silver or patients with established gangrene were not included in the study. Similarly, people receiving medication, such as corticosteroids, immunosuppressive agents or chemotherapy, were not included. A detailed history, clinical examination and relevant investigations were performed for all patients. The wounds of all the patients included in the study underwent surgical debridement initially and during subsequent dressing change to remove necrotic tissue and slough. After debridement, the wounds of group A patients were dressed with povidone iodine-based dressing daily while silver-impregnated dressings were used for group B and changed every 72 hrs. Every 14 days, cultures were taken from wound and the size of wound and granulation tissue area was assessed with the help of butter paper. Antibiotic therapy was guided by culture sensitivity reports.

Ulcers were treated until the wound closed spontaneously, surgically or until completion of the 8-week period, whichever was earlier. All patients were kept on insulin for control of their diabetes mellitus as per the advice given by the endocrinologist of this hospital. Patients were assessed every two weeks for healing rate and granulation tissue formation and culture of the wound.

Results

A total of 60 patients were distributed into two groups of 30 patients. One patient in group A and three in Group B were lost to follow-up. Patients were matched for age and gender. Ages ranged from 30 to 85 years with mean age of

53.03 years in Group A and 52.95 years in Group B ($p=0.48$). Group A comprised 17 male patients and 13 female while in Group B the male and female ratio was equal ($p=0.6$).

At the end of the study, i.e. at the end of eight weeks, we found that 19 (70.37%) patients whose wounds were dressed with silver-impregnated dressing had 100% granulation tissue while only 10 (34.48%) patients who had povidone iodine-based dressings displayed 100% granulation tissue (Table 1). At the end of four weeks, 96.3% of cases in group B had negative culture sensitivity as compared against 51.7% in control group A, denoting a statistically significant difference (p value 0.005) (Table 2).

Discussion

Diabetic foot is affecting a growing population. It is unclear which type of dressing material should be used for early healing of wounds. Even the recent guidelines given by the International National Federation [10] fail to provide a definite solution to this problem and suggest: "In the absence of strong evidence of clinical or cost effectiveness, healthcare professionals should use wound dressings that best match the clinical appearance and site of the wound, as well as patient preferences"

In 2007, the COCHRANE group undertook an analysis of different research papers, analyzed individually by Bergin and Wraight [11]. They came to the conclusion that at that time, no clinical trials had evaluated the clinical effectiveness of dressings and topical agents containing silver. In 2011, the Cochrane collaboration again declared the same concerning the status of silver-based dressing on diabetic foot ulcers.

At the end of our study i.e. at the end of eight weeks, we found that 19 (70.37%) patients whose wounds were dressed with silver-impregnated dressing had 100% granulation tissue while only 10 (34.48%) patients who had their wounds dressed with povidone iodine-based dressing had 100% granulation tissue. At the end of four weeks, 96.3% of cases in group B had negative culture sensitivity as compared against 51.7% in control group A, denoting a statistically significant difference (p value 0.005).

TABLE 1. Appearance of granulation tissue

No. of patients with 100% granulation	Group A	Group B	p value
Week 2	0	0	
Week 4	0	0	
Week 6	6 (21.4%)	8 (29.%)	0.147
Week 8	10 (34.48%)	19 (70.37%)	0.03
Wounds with complete contraction	2 (7%)	5(18.5%)	0.20

TABLE 2. Culture reports for the two groups.

Negative Culture	Group A	Group B	p value
Week 2	8 (27.5%)	16 (66.66%)	0.016
Week 4	15 (51.7%)	26 (96.3%)	0.0001
Week 6	24 (85.7%)	27 (100%)	0.041
Week 8	27 (96.42%)	27 (100%)	0.32
Need for amputation	1 (3.4%)	0 (0%)	

One patient required amputation in control Group A due to sepsis while none had to undergo amputation in the case group. One patient in the control group and three in the case group were lost to follow-up.

Silver has been shown to be a highly effective antimicrobial agent even against organisms like MRSA and VRE. Our study has also shown the same effect with a significant difference between cases and controls in reaching negative culture sensitivity starting from as early as the second week, with 96.3% of the patients in silver dressing group reaching the negative culture target by the end of 4th week with a p value of 0.0001.

An article published by Tong JW in 2007 described four patients who were treated with soft silicone dressing, all of whom showed positive wound contraction and reduction with a healthy red granulating base [12]. In 2007, Jude et al. conducted a study using hydrofiber dressing containing ionic silver or calcium alginate dressings on non-ischaemic diabetic foot ulcers. They found that in 21/67 patients, ulcers had healed by the end of study as compared with 15/67 of those in the control group [13]. A study conducted by Belcaro et al. in 2010 found that after four weeks, silver treatment achieved more effective results in the case group than the control group, with significantly improved healing rates and wound contraction [14]. Recently, after searching CINAHL, ProQuest, MEDLINE and Cochrane Database of systematic reviews, Moore and Young concluded that silver dressings and topical agents were promising, safe and effective for wound care [15]. However, the search for the ideal dressing material for treating diabetic foot ulcers continues. More research is required in this direction as well as towards finding other alternatives for faster healing of diabetic foot ulcers.

Conclusion

Dressing of diabetic foot ulcers with silver-based dressing is effective in controlling the microbiological burden of wounds and increasing the rate of granulation tissue formation. However, more studies with a larger number of patients are required before use of silver-impregnated dressings can be added to diabetic wound care.

Ethical Approval

The study has obtained ethical approval from our institutional review board.

Conflict of Interest

The Authors declare that there is no conflict of interest.

References

- *International Working Group on the Diabetic Foot. International Consensus on the Diabetic Foot and Practical Guidelines on the Management and the Prevention of the Diabetic Foot. Amsterdam, Netherlands; 2011.
- *International Diabetes Federation. IDF Diabetes Atlas update poster, 6th ed. Brussels, Belgium: International Diabetes Federation, 2014.
- Rice J, Desai U, Cummings A, Birnbaum H, Skornicki M, Parsons N. Burden of Diabetic Foot Ulcers for Medicare and Private Insurers. *Diabetes Care* 2014;37:651–658. *Diabetes Care* 2014;37:2660–2660.
- Boulton AJM. The pathogenesis of diabetic foot problems: An overview. *Diabet Med* 1996; 13(Suppl):S12–6
- Lansdown A, Silver I. Its antibacterial properties and mechanism of action. *Journal of wound care* 2002;11:125–31.
- Caruso D, Foster K, Blome-Eberwein S, Twomey J, Herndon D, Luterman A et al. Randomized clinical study of Hydrofiber dressing with silver or silver sulfadiazine in the management of partial-thickness burns. *Journal of burn care & research* 2006;27:298–309.
- Thorn R, Austin A, Greenman J, Wilkins J, Davis P. In vitro comparison of antimicrobial activity of iodine and silver dressings against biofilms. *J Wound Care* 2009;18:343–6.
- Kostenko V, Lyczak J, Turner K, Martinuzzi R. Impact of silver-containing wound dressings on bacterial biofilm viability and susceptibility to antibiotics during prolonged treatment. *Antimicrobial agents and chemotherapy* 2010;54:5120–31.
- Wagner FW. The dysvascular foot: a system of diagnosis and treatment. *Foot Ankle* 1981; 2:64–122.
- Tan T, Shaw E, Siddiqui FK, Aswamy P, Barry P et al. Inpatient management of diabetic foot problems: summary of NICE guidance. *British Medical Journal* 2011;342:1280.
- Bergin S, Wraight P. Silver based wound dressings and topical agents containing silver for treating diabetic foot ulcers. John Wiley and Sons, Ltd for The Cochrane Collaboration. 2011.
- Tong J. Case reports on the use of antimicrobial (silver impregnated) soft silicone foam dressing on infected diabetic foot ulcers. *International wound journal* 2009;6:275–84.
- Jude E, Apelqvist J, Spraul M, Martini J. Prospective randomized controlled study of Hydrofiber® dressing containing ionic silver or calcium alginate dressings in non-ischaemic diabetic foot ulcers. *Diabetic Medicine* 2007;24(3):280–8.
- Belcaro G, Cesarone M, Errichi B, Ricci A, Dugall M, Pellegrini L et al. Venous and diabetic ulcerations: management with topical multivalent silver oxide ointment. *Panminerva medica* 2010;52(2 Suppl 1):37–42.
- Young J. Effectiveness of silver in wound care treatment. *Physical Therapy Reviews* 2011;16:201–9.