

Case Report

Nano crystalline silver: a breakthrough in treating diabetic foot ulcers

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ABSTRACT

India harbours world's largest population of diabetic patients thus earning an infamous designation of 'diabetic capital of the world'. Apart from various metabolic aberrations that are bound to happen in a patient with uncontrolled hyperglycemia, foot ulcers are one of the serious complications that may become limb and life threatening, if not addressed properly. Surgical debridement along with appropriate antibiotics, remain as the mainstay of management of such wounds. Conventional dressing methods involving povidone-iodine and other antiseptic agents have offered limited scope of effective wound healing owing to their inherent toxicity towards fibroblasts. In the present scenario where a large chunk of population crosses over to the list of newly diagnosed diabetics every year, nano crystalline silver has come as a breakthrough in effective management and early healing of diabetic foot ulcers through its effective antimicrobial action and limited toxicity for the host tissue.

Keywords: Nano crystalline silver, Diabetic foot, Non-healing ulcers, Peripheral arterial disease, HbA1C

INTRODUCTION

India has earned the dubious distinction of becoming the *world's diabetes capital*. A term, 'Asian Indian Phenotype' has been coined to describe the susceptible Indian population which has propensity of having increased insulin resistance, increased abdominal adiposity i.e. having increased abdominal girth despite having lower body mass index, lower adiponectin levels and a higher sensitive C- reactive protein levels.¹ Most disturbing trend all this while has been a shift in the age of onset of disease. A large number of young Indians are falling prey to this ailment every year. According to an estimate there will be more than 69.9 million diabetics by 2025 in India.² With such a high burden of the disease, complications associated with type II diabetes mellitus are going to corner a large share of already scant public health resources available in the country. A diabetic patient who has not been diagnosed in time or has been undertreated owing to various reasons is invariably going to develop micro as well as macrovascular complications.

This may result into a myriad of clinical illnesses including retinopathy, nephropathy, cardiovascular complications, peripheral arterial disease, etc.³ Surgeons worldwide face an uphill task in managing foot ulcers that occur in diabetics as these are invariably infected with polymicrobial flora that thrives in immunocompromised hyperglycemics. Various studies have led to the conclusion that more than 2% of community based diabetic patients develop new foot ulcers every year.⁴ Whereas lifetime risk of a person with diabetes developing a foot ulcer may be as high as 25%.⁵ Upto 50% of older patients with type II diabetes have one or more risk factors for foot ulceration.^{6,7} Treatment of foot ulcers requires active surgical debridement of the wound along with its regular dressing with an appropriate agent. Use of silver for treatment of infection dates back to 1000 B.C. when the ancient Greeks and Romans used it as disinfectant.^{8,9} Availability of nano crystalline silver in modern era has afforded a well-meaning chance for surgeons to manage even Wagner grade-III and grade-IV diabetic ulcers¹⁰ with satisfactory outcomes.

CASE REPORT

The patient was a 33 years old male, who was not a known case of type II diabetes mellitus, presented in the outpatient department of our institution with complaints of pain and swelling in the outer aspect of right leg for 10 days. There was history of high grade fever along with black discoloration of the affected region for last 3 days. The discoloured skin sloughed off spontaneously leading to development of a raw area from which prulent discharge mixed with blood occurred. He was treated at a private clinic but wasn't afforded any relief. On general physical examination the patient was febrile with fever documented upto 100 degree Fahrenheit. His pulse rate was 106/minute and blood pressure was 132/76 mm Hg. His random blood sugar was 213 mg/dl.

On local examination there was an ulcer measuring 39x16cm in longest dimensions. There was presence of abundant slough and whole of the ulcer was covered with pale granulation tissue. Surrounding skin was edematous with peri-lesional erythema. No musculoskeletal deformities were noticed. On neurological assessment, touch sensation, assessed with 10-g monofilament, was found to be impaired in right lower limb. Whereas vibration sensation assessed with 128-Hz tuning fork, pinprick sensation and ankle reflexes were found to be normal in bilateral lower limbs. Peripheral pulses were also found to be normal bilaterally.



Figure 1: Wound after first debridement and application of magnesium sulphate in surrounding skin.

A clinical diagnosis of infected diabetic foot ulcer was made and the patient was subjected to surgical debridement of the wound along with irrigation of the ulcer with betadine solution 5% and normal saline. He

was prescribed oral co-amoxyclav along with oral hypoglycemics in form of glimiperide and metformin in appropriate dosage. His pus culture was sent and he was advised to follow up on daily basis in surgery out-patient department for daily debridement and dressing. Magnesium sulphate 58% was also applied on the surrounding skin to counter the regional cellulitis (Figure 1).

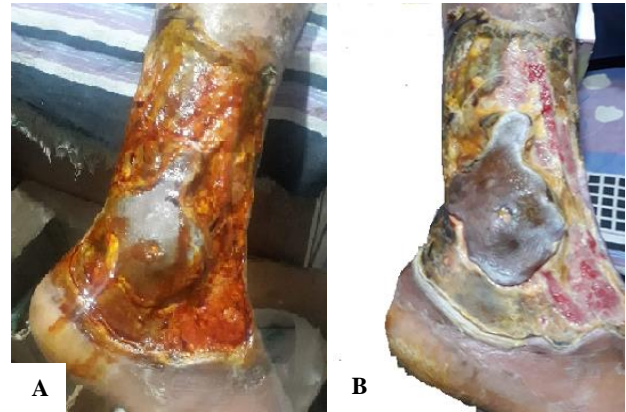


Figure 2: (A) Daily dressing with povidone-iodine; (B) wound after one week of treatment.

The wound was subjected to serial daily debridement along with aseptic dressing with povidone-iodine on out-patient basis. The patient was rendered afebrile within two days and adequate glycemia control was achieved with in first five days of treatment. Pus culture report was suggestive of heavy growth of *Staphylococcus Aureus* sensitive to Co-Amoxyclav. Despite repeated debridements and daily dressings, little improvement was seen in the wound condition (Figure 2A and B).



Figure 3: (A) After 1 week of treatment with NCS*, (B) After 2 weeks of treatment with NCS*.

*NCS: Nano crystalline silver

At the end of first week *nano crystalline silver* dressings were employed along with serial debridement of devitalised tissue. There was a visible improvement in the

wound from day 3 of using *nano crystalline silver* and by the end of another week the wound started to develop pink granulation tissue. Pus culture was repeated which came out to be sterile. It took another one week for wound to develop healthy pink granulation tissue with sloping edges. The size of the ulcer contracted to half of its original at the end of two weeks of treatment with *nano crystalline silver*.

DISCUSSION

Type II diabetes mellitus has assumed an epidemic proportion in matter of prevalence in India and most of the nations worldwide. There has been a rampant increase in the number of individuals affected every year thus paving way for other complications associated with the disease. Diabetic foot management has been a nightmare for surgeons owing to its slow pace of recovery and inherent risks of limb amputations. In unfavourable circumstances the disease can assume proportions that may be imminently life threatening. Though most of the management depends on an adequate glycemia control and nutritional correction, much needs to be explored in terms of choice of agent for local application. Conventional dressings like povidone-iodine have stood the test of time for long but the patients usually end up with skin grafting at the end of a usually prolonged treatment. Use of nano crystalline silver has opened up a new dimension in treating the diabetic foot ulcers in various trials wherein chances of quicker recovery without requiring subsequent skin grafting is a possibility.¹¹ Such novel methods of treatment may prove to be a boon in reducing the burden of disease along with debilitating morbidity that one suffers while undergoing recuperation. Making use of nano silver colloid dressings is especially important in the secondary care institutions where the resources and manpower are usually limited.



Figure 4: After 6 week of treatment with NCS.

CONCLUSION

Use of nano crystalline silver in treating diabetic foot ulcer has advantage of faster healing and lesser morbidity. The role of this newer congener requires further investigation and trials to establish its clear cut superiority over the conventional agents.

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REFERENCES

1. Mohan V, Sandeep S, Deepa R, Shah B, Vargheese C. Epidemiology of type II diabetes mellitus: Indian scenario. *Indian J Med Res.* 2007;125(3):217-30.
2. Sicree R, Shaw J, Zimmet P, Tapp R. The global burden of diabetes. *Diabetes Atlas.* 2003;3:15-73.
3. Parving H, Hommel E, Mathiesen E, Skott P, Edsberg B, Bahnsen M, et al. Prevalance of microalbuminuria, arterial hypertension, retinopathy and neuropathy in patients with insulin dependent diabetes mellitus. *BMJ.* 1988;296(1):156-60.
4. Abbot CA, Carrington AL, Ashe H, Bath S, Every LC, Griffiths J, et al. The North West diabetes foot care study: incidence of, and risk factors for, new diabetic foot ulceration in a community-based patient cohort. *Diabetes UK. Diabetic Med.* 2002;19:377-84.
5. Boulton AJM, Armstrong DG, Albert SF, Fryberg RG, Hellman R, Kirkman MS, et al. Comprehensive foot examination and risk assessment. *Diabetes Care.* 2008;31(11):1679-85.
6. Singh N, Armstrong DG, Lipsky BA. Preventing foot ulcers in patients with diabetes. *JAMA.* 2005;293:217-28.
7. Boulton AJ, Kirsner RS, Vileikyte L. Clinical practice: neuropathic diabetic ulcers. *N Engl J Med.* 2004;351:40-55.
8. Dowsett C. The use of silver-based dressings in wound care. *Nursing Standard.* 2004;19(7):56-60.
9. Russell AD, Hugo WB. Antimicrobial activity and action of silver. *Progress in Medical Chemistry* 1994;31:351-71.
10. Calhoun JH, Eng M, Cantrell J, Cobose J, Lacy J, Valdez RR, et al. Treatment of diabetic foot infections: wagner classification, therapy, and outcome. *Foot and Ankle.* 1988;9(3):101-6.
11. Sharma R, Gupta N, Kumar V, Pal S, Sharma R, Kaundal V, et al. Silver colloid dressings score over conventional dressings in diabetic foot ulcer: a randomized clinical trial. *Int Surg J.* 2017;4(8):2627-31.

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