

Chemical Debridement in the Treatment of Multidrug-resistant *Pseudomonas* Biofilm in Diabetic Foot Ulcers

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Received : March 18, 2026

Published : June 19, 2026

INTRODUCTION

One of the most challenging bacterial pathogens to manage in diabetic foot ulcers is multidrug-resistant *Pseudomonas aeruginosa* [1-4]. This observational study aimed to assess the efficacy of chemical debridement using methanesulfonic acid, a less invasive, more cost-effective, and more easily applicable alternative to other treatment modalities that require hospital based care, with outcomes evaluated over medium- and long-term follow-up periods.

MATERIALS AND METHODS

Between October 1, 2022 and October 15, 2024, 20 patients (8 men and 12 women) with a mean age of 75 ± 10.2 years were evaluated. All subjects had complicated diabetes and lower-limb ulcerative lesions colonized by multidrug-resistant *Pseudomonas*. The mean ulcer diameter was 9.6 ± 7.5 cm. The cohort included:

- 1.2 kidney transplant recipients
2. 16 patients with peripheral arterial occlusive disease of the lower limbs who had previously undergone revascularization
3. All patients were receiving anticoagulant or antiplatelet therapy

Three patients had experienced acute myocardial infarction within 12 months prior to treatment, five were on dialysis, and six were obese according to BMI indices.

Inclusion criteria were as follows:

- Patients with complicated diabetes mellitus and ulcerative lesions of the lower extremities;
- Colonization by multidrug-resistant *Pseudomonas* spp.;
- Impaired renal function parameters;
- Use of advanced wound dressings for more than 30 days;
- Adequate distal tissue perfusion.

Exclusion criteria included poor patient compliance and/or refusal to undergo treatment. The mechanism of action of the product is based on the dehydration of wound-bed components and devitalized tissue while preserving the surrounding healthy skin, whose outermost layer is characterized by a relatively low water content. Following standard sterile preparation of the surgical field, patients with severe peripheral neuropathy underwent the procedure without analgesia, whereas all other patients received local anesthesia according to standard outpatient practice. The procedure consisted of cleansing the wound with sterile saline solution and gauze, followed by careful drying of the ulcer surface. Methanesulfonic acid was subsequently applied to the entire ulcer bed and allowed to remain in contact for up to 60 seconds. The product was then removed by thorough irrigation with copious amounts of saline solution. Following treatment, the ulcer bed was gently debrided using sterile gauze to remove as much dehydrated and devitalized tissue as possible. Patients were discharged with confirmation of the previously prescribed dressing regimen, consisting of highly absorbent dressings (including foams, alginates, and hydrofibers, generally containing >100 ppm silver) in combination with non-adherent materials (such as Phytostimoline®, silicone dressings, or paraffin gauze). The study protocol included a baseline visit (T0) with microbiological assessment of the bacterial flora. Advanced wound dressings were documented, followed by treatment with methanesulfonic acid. Clinical follow up assessments were performed at 7, 14, 30, 90, 180, and 360 days. Outcomes were categorized as ulcer healing, improvement, stability, or worsening.

RESULTS

The mean follow-up duration was 352 ± 8 days. Additional debridement was required in 6 patients (30%), while ulcer sterilization was achieved in 14 cases (70%). Bacterial recolonization occurred in 6 patients (30%), of whom only one experienced recurrence of *Pseudomonas*. Healing within 180 days was achieved in 6 patients (30%), while 11 patients (55%) showed a reduction in ulcer diameter and overall improvement in ulcer characteristics. Two cases (10%) showed no significant change, whereas one patient (5%) experienced worsening, also related to poor treatment adherence. Final analysis demonstrated complete healing in 17 patients (85%), stability in 2 cases (10%), and worsening in 1 case (5%).

DISCUSSION

The treatment of multidrug-resistant *Pseudomonas aeruginosa* in diabetic foot ulcers represents an increasingly complex challenge, particularly due to limited systemic therapeutic options in patients with diabetic nephropathy [5-7]. Therefore, there is a need for alternative methods that are easy to apply and manage, capable of eradicating both the pathogen and its biofilm without further compromising renal function or promoting additional resistant strains [8,9]. Methanesulfonic acid addresses these challenges by selectively dehydrating wound-bed materials without damaging the surrounding healthy skin, whose outermost layer is characterized by a low water content. The present clinical experience provides an evaluation of medium- to long-term outcomes and establishes the basis for a future multicenter study involving a statistically significant patient cohort.

CONCLUSION

In our experience, methanesulfonic acid appears to be effective for the local treatment of *Pseudomonas* infection in patients with diabetic foot ulcerations, demonstrating a high long-term healing rate and a potential protective effect against medium to long-term reinfection by *Pseudomonas*.

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