



(CASE REPORT)



Hard-to-heal wounds: A new biofilm treatment with a novel desiccant

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Abstract

Biofilms are slow-growing communities of multiple strains of bacteria that resist both innate immunemechanisms as well as antibiotics [1] [16] [17]. They also contain extracellular DNA (bacterial or host origin), polysaccharides, and proteins that form dense matrix is resistant to the host's innate immune response [18] [19].

Keywords: Dissecant; Biofilm; Chronic Wound; Wound Bed Preparation (WBP)

1. Introduction

Biofilms are believed to occur in 60-100% of chronic wounds [2] [5]. The World Union of Wound Healing Societies released a position statement that they believe clinicians should assume that all chronic wounds that have failed to heal under standard of care contain a biofilm [3] [20].

Biofilms are a self-feeding barrier:

- With resistance to host's innate immune response
- With resistance to antibiotics due to slow growth rate
 - The mechanism for antibiotic function happens during replication, therefore low replication, low antibiotic activity.
- Secrete glycolipids that disrupt signaling as well as proteolytic enzymes that attack ECM proteins

Chronic skin wounds represent a major health problem and financial burden [21].

2. Biofilm

There are many factors in biofilms that contribute to inhibition of wound healing. Data suggest that chronic wounds are trapped in the acute inflammatory phase of healing, which amplifies over time [8]. Dynamic Reciprocity (DR) is out of balance [9] [28]. DR is an ongoing, bidirectional interaction between cells and their surrounding microenvironment (including ECM), it plays a critical role in biochemical, biophysical and cellular responses that regulate tissue regenerative responses. DR between cells and Extracellular matrix (ECM) [10].

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Cells synthesize ECM components, and degrade and remodel ECM, the latter events occurring through the production and regulation of matrix metalloproteases (MMPs) and other enzymes.

The ECM regulates cellular tension and polarity, differentiation, migration, proliferation, and survival.

The ECM consists of collagen, elastin, multidomain glycoproteins (i.e., fibronectin), and proteoglycans and glycosaminoglycans.

The composition of the ECM varies by tissue and by state of the tissue (i.e., intact adult tissue, healing wound, etc.)

Due to their continued persistence, biofilm infections cause more damage and greater inflammatory responses than the corresponding infections caused by planktonic bacteria [6] [7] [22] [23].

The biofilm matrix, composed of proteins, DNA and sugars, is called Extracellular Polymer Substance, or EPS1-3 The biofilm is difficult to eradicate because it is resistant to antimicrobial therapies [24] [25]. and to the host's immune system [2] [3].

To effectively eradicate the biofilm and promote healing, an antimicrobial must be able to penetrate the EPS and attack the bacteria inside with a prolonged action that prevents the biofilm from reforming [26] [27].

p-toluensulfonic acid is used for the topical/local treatment of skin areas at high risk of bacterial development thanks to its ability to remove bacterial biofilm with a physical mechanism of action dependent on the dehydrating nature of the product and independent of the bacterial species present.

Wound Bed Preparation was performed solely as surgical debridement [4].

Dessicating agent was applied and distributed with a gloved finger on the wound bed and approximately 1 cm margin of surrounding healthy skin and had remained on the wound bed for 10-15 seconds. The wound has been rinsed with wet (saline) sterile gauze and medicated as usual.

This procedure has been repeated at 1 week interval until the wound bed had progressed up to 100% granulation, wound healing to spontaneous reepithelization or skin graft or ADM.

3. Clinic

#1 – Man, 56 years old

Chronic ulcer in type 2 diabetic patient with kidney transplant

Healing after 4 p-toluensulfonic acid applications



#2 – Man, 47 years old
Necrosis in type 2 diabetes wounds
1 p-toluensulfonic acid applications after surgical debridment



#3 – Woman, 86 years old
Chronic ulcer in type 2 diabetes
Healing after 1 p-toluensulfonic acid



#4 – Woman, 62 years old
Type 2 diabetes – Neuropathy – Infection
Healing after 5 p-toluensulfonic acid applications and ADM grafted



#5 – Woman, 86 years old
Type 2 diabetes – Neuropathy e Vasculopathy (macro e micro)
Healing after 4 p-toluensulfonic acid applications and Split Skin Graft



4. Conclusion

Overall, p-toluensulfonic acid reports a remarkable anti-biofilm effect and promote healing. Dissecting agent treatment appears to restart the healing process of chronic ulcers.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The Authors have no actual or potential conflict of interest in relation to this paper.

Statement of informed consent

Informed consent was obtained from all individual included in cases study.

References

- [1] Attinger and Wolcott. Biofilm-based Healthcare-associated infections” Donelli (ed); Position Document from World Union of Wound Healing Societies. 2016.
- [2] Biofilms Made Easy. Phillips Pl. et al. Wounds International 2010; The prevalence of biofilms in chronic wounds: a systematic review and meta-analysis of published data.
- [3] Percival SL, Int Wound J. Consensus guidelines for the diagnosis and treatment of biofilm in chronic non-healing wounds. 2019.
- [4] RD Wolcott, JP Kennedy, SE Dowd. Journal of Wound Care, Vol. 1 B, No. 3, February 2009; Regular debridement is the main tool for maintaining a healthy wound bed in most chronic.
- [5] A Omar, JB Wright, G Schultz, R Burrell, P Nadworny. Microbial Biofilms and Chronic Wounds.
- [6] C Attinger, R Wolcott. Clinically addressing biofilm in chronic wounds, Adv Wound Care (New Rochelle). 2012 Jun; 1(3): 127–132.
- [7] Biofilm-based healthcare-associated infections. Vol. II; Spinger.
- [8] The biofilm in chronic wounds: World Union of WUWHS – Congress in Florence, Italy. Position document. Wound International. 2016.
- [9] GS Schults, JM Davidson, RS Kisner, P Bornstein, IM Herman. Dynamic reciprocity in the wound micromovement; Wound Repair Regen. Mar 2011; 19(2): 134-148.
- [10] Khan Academy. The extracellular matrix and cell walls, AP.BIO: ENE-2 (EU); ENE-2 (LO); ENE-2.D.1 (EK).
- [11] De La Fuente-Nunez C, Reffuveille F, Fernández L, Hancock RE. Bacterial biofilm development as a multicellular adaptation: antibiotic resistance and new therapeutic strategies. Curr. Opin. Microbiol. 2013; 16: 580–589.
- [12] Kostakioti M, Hadjifrangiskou M, Hultgren SJ. Bacterial biofilms: development, dispersal, and therapeutic strategies in the dawn of the postantibiotic era. Cold Spring Harbor Perspect. Med. 2013; 3: a010306.
- [13] Lynch AS, Robertson GT. Bacterial and fungal biofilm infections. Annu. Rev. Med. 2018; 59: 415–428.
- [14] Flemming HC, Wingender J. The biofilm matrix. Nat. Rev. microbiol. 2010; 8: 623–633.
- [15] Gregory et al. Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds. 2016.
- [16] De La Fuente-Nunez C, Reffuveille F, Fernández L, Hancock RE. Bacterial biofilm development as a multicellular adaptation: antibiotic resistance and new therapeutic strategies. Curr. Opin. Microbiol. 2013; 16: 580–589.
- [17] Kostakioti M, Hadjifrangiskou M, Hultgren SJ. Bacterial biofilms: development, dispersal, and therapeutic strategies in the dawn of the postantibiotic era. Cold Spring Harbor Perspect. Med. 2013; 3: a010306.
- [18] Lynch AS, Robertson GT. Bacterial and fungal biofilm infections. Annu. Rev. Med. 2018; 59: 415–428.
- [19] Flemming HC, Wingender J. The biofilm matrix. Nat. Rev. microbiol. 2010; 8: 623–633.
- [20] Gregory et al. Consensus guidelines for the identification and treatment of biofilms in chronic nonhealing wounds. 2016.
- [21] Batoni G, Maisetta G, Esin S. Antimicrobial peptides and their interaction with biofilms of medically relevant bacteria. Biochimica. Biophys. Acta (BBA) Biomembranes. 2016; 1858: 1044–1060.
- [22] Lebeaux D, Ghigo JM, Beloin C. Biofilm-related infections: bridging the gap between clinical management and fundamental aspects of recalcitrance toward antibiotics. Microbiol. Mol. Biol. Rev. 2014; 78: 510–543.

- [23] Donlan RM, Costerton JW. Biofilms: survival mechanisms of clinically relevant microorganisms. *Clin. Microbiol. Rev.* 2002; 15: 167–193.
- [24] Bridier A, Briandet R, Thomas V, Dubois-Brissonnet F. Resistance of bacterial biofilms to disinfectants: a review. *Biofouling*. 2011; 27: 1017–1032.
- Biofilms Made Easy. Phillips Pl. et al. *Wounds International* 2010 The prevalence of biofilms in chronic wounds: a systematic review and meta-analysis of published data.
- [25] Percival SL et al. *Int Wound J* 2019 Consensus guidelines for the diagnosis and treatment of biofilms in chronic non healing wounds.
- [26] Romling U, Balsalobre C. Biofilm infections, their resilience to therapy and innovative treatment strategies. *J.Int. Med.* 2012; 272: 541–561.
- [27] WUWHS Position document, *Advances in wound care: the triangle of wound assessment.*