BIOFILM AND OUR CLINICAL EXPERIENCE

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Bacteria organized in biofilms are insensitive to the usual treatment with dressings or antibiotics. Most successful is surgical debridement to remove their colonies, but this option may not be possible in all environments. Dressings with silver and other antiseptics are often the only tools available to nurses at patient homes or to dermatologists at outpatient clinics. In our clinical studies conducted several years ago, we demonstrated that dressings with antiseptics were an effective tool in daily clinical practice to remove bacteria/biofilms from chronic wounds.

Key words: biofilm, clinical practice, chronic wounds, hydrofiber, silver dressings, antiseptics, polyhexamethylene biguanide (PHMB)

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INTRODUCTION

Biofilm is a community of microorganisms surrounded by an extracellular polymeric, polysaccharide matrix at the surface (1). Biofilms were discovered in the 1650s by van Leeuwenhoek, but it was only in 1978 that Costerton wrote about the 'Bacteria Stick'. In 1978, research on biofilm bacteria has exploded (2).

Biofilms play a significant role in a large number of infections, in particular in chronic wounds (1). Some of the frequent microorganism that make a biofilm on the wounds are *Staphylococcus (S.) epidermidis, S. aureus* and *Pseudomonas (P.) aeruginosa* (3,4). It was a big problem to prove the biofilm formation in wounds. Now we can identify biofilm formation by light microscopy, electron microscopy and confocal laser scanning microscopy (5). We can demonstrate extracellular polymeric, polysaccharide matrix surrounding the bacteria in biofilm by staining with ruthenium red, carbohydrate stains and concanavalin A (6). James *et al.* evaluated 16 acute and 50 chronic wounds. They found biofilms in 6% of acute and 60% of chronic wounds (7).

Antiseptics are preferred to antibiotics for removal of biofilms. Silver and polyhexamethylene biguanide (PHMB) are very effective against planktonic bacteria and immature biofilms. When applied on mature biofilms, they can only inhibit further growth and prevent bacteria from spreading beyond the biofilm but not resolve the infection (8,9). The antimicrobial efficacy of silver dressings against bacterial biofilms was investigated on *in vitro* and *in vivo* models. Hegger *et al.* showed that dressings with silver reduced biofilm less than 90% in one-week treatment in an animal model (10). However, *in vitro* studies produced better results. Percival *et al.* report that hydrofiber dressings with silver acting against bacterial biofilms proved efficient after 24-h treatment and killed total bacterial biofilm within 48 h (11).

OUR CLINICAL EXPERIENCE

Study 1. In this case study we evaluated the effects of two alginate dressings on healing during the treatment of 20 venous leg ulcers. Results: Ulcers treated with alginate with silver (Silvercel®) were smaller by 15.4% and ulcers treated with calcium-alginate without silver were larger by 0.7% (12,13) .

Study 2. In a large-scale, comparative, randomized study we compared the effects on healing of foam dressing with silver (Contreet-H®) *versus* 'local-best-practice' in the treatment of 619 ulcers with delayed healing. Results: Wound-area decreased faster in patients

treated with foam dressing with silver (50% *vs*. 34.3% reduction). The foam dressing with silver significantly promoted positive wound progress in 67% compared to 51% using 'local-best-practice' (12,14).

Study 3. In a comparative clinical trial we compared hydrofiber dressing and ointments in changing microbial colonization and healing of 24 venous ulcers in 7 weeks. Results: The most frequently isolated bacterium in the group with hydrofiber dressing (Aquacel®) was *P. aeruginosa* (in the beginning: 44.4%; at the end: 20%), as well as in the group with ointment (in the beginning: 53.3%; at the end: 60%). The mean wound size in patients treated with hydrofiber dressing was 9.6 cm^2 at the beginning and 8.8 cm^2 at the end. The mean wound size in patients treated with ointment was 16.4 cm^2 at the beginning and 19.5 cm^2 at the end (12,15).

Study 4. This small study included five patients with no progress in venous leg ulcer healing over a mean of 5.2 years. At the beginning, their wound beds were in stage C3 and mean size 24.44 cm^2. Foam AMD with PHMB® were changed every 3-4 days. Treatment lasted for a mean of 44.7 days or until the wound healed. Results: One wound healed, while the rest were smaller, mean 17.69 cm^2 at the end. Wound beds were in stage A2 in all patients (12,16).

Study 5. In a randomized clinical study, we evaluated the effects on healing and pain in 14 venous leg ulcers with wound beds C2-3 treated with honey (Vivamel®, group 1) and 16 venous leg ulcers with wound bed C3 treated with antiseptic (AMD with PHMB®, group 2). Results: In group 1, healing results were achieved faster (after one week), but in group 2 there was no pain which persisted in group 1. After two weeks, all ulcers from both groups were in B2 stage according to Falanga's classification of wound bed (12,17).

All the above studies measured only wound size and isolated bacteria, but did not search for biofilm because at that time we did not have possibilities to do it. All the wounds had been persisting for a long time and their wound bed was slough, so the presence of biofilm was quite likely.

CONCLUSION

In our study, we demonstrated that wounds with critical colonization and probably biofilms healed faster when we used dressings with antiseptics.

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SAŽETAK

NAŠA KLINIČKA ISKUSTVA S BIOFILMOM

T. PLANINŠEK RUČIGAJ

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Bakterije koje su organizirane u biofilmu nisu osjetljive na uobičajeno liječenje oblogama ili antibioticima. Najuspješnije uklanjamo njihove kolonije kirurškim debridmanom, ali nemamo takve mogućnosti na svakom mjestu. Obloge sa srebrom i drugim antisepticima često su jedino raspoloživo sredstvo medicinskim sestrama u bolesnikovu domu ili dermatologu u ambulanti. U našim kliničkim studijama prije nekoliko godina pokazali smo da su obloge s antisepticima bile učinkovite u svakodnevnoj kliničkoj praksi za uklanjanje bakterija/biofilmova iz kroničnih rana.

Ključne riječi: **rana, biofilm, infekcija, antimikrobna obloga, anti-biofilm**