Electric Field Based Dressing Disrupts Mixed-Species Bacterial Biofilm Infection and Restores Functional Wound Healing

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Purpose

As many as 80% of all wound infections are believed to be caused by bacteria with biofilm.[1,2] Biofilms shelter bacteria within a protective barrier that affords antibiotic tolerance and impedes immune system clearance. In managing biofilm infection, antibiotic treatment strategies have fallen short of expectations.

The authors previously reported on an FDA-cleared and commercially available disposable, wireless electroceutical dressing (WED) that generates a weak electric field in a moist wound environment. These electrical fields were shown to disrupt bacterial biofilms in vitro.[3]

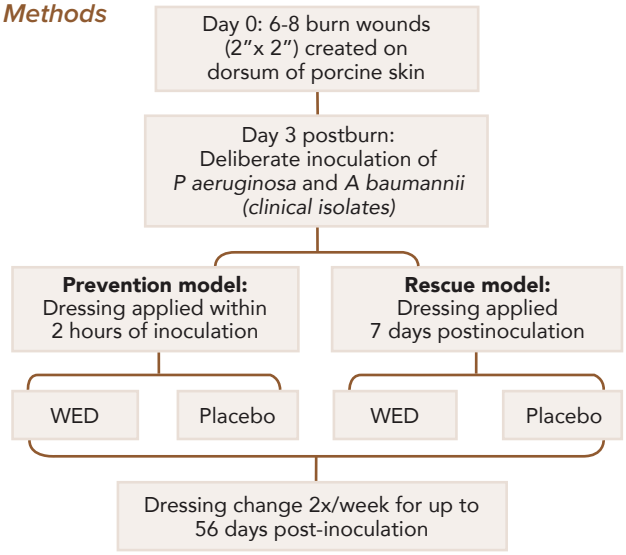
Objective

Test the ability of the WED (ie, Vomaris's bioelectric technology) to manage bacterial biofilm infection in vivo, in an established porcine chronic wound biofilm infection model inoculated with clinical wound isolates *Pseudomonas aeruginosa* (PAO1) and *Acinetobacter baumannii* (19606).

Conclusions

- When used preventively within 2 hours of an acute wound infection, WED was effective in circumventing biofilm formation.
- Even after a pathogenic biofilm infection was allowed to establish over 7 days of infection, application of WED twice a week was effective in disrupting biofilm infection and related pathological complications.

Methods



WED utilizes electrophysical forces that are unlikely to be susceptible to conventional drug-resistant mechanisms often employed by bacteria to overcome antibiotic interventions.

Results

1. Disrupted biofilm infection on the wound surface.

WED	Placebo		
☑	☐	In the biofilm prevention model, only the placebo group went on to form biofilm; the WED group did not progress to form biofilm. *Figure 2 in publication.*	

2. Repressed genes responsible for QS, disrupting bacterial communication.

WED	Placebo		
☑	☐	In the biofilm prevention model, QS gene induction was significantly repressed with WED application. *Figure 2 in publication.*	Bacteria use quorum sensing (QS) to communicate electrically with each other and form biofilm.

3. Rescued biofilm-induced loss of E-cadherin.

WED	Placebo		
☑	☐	E-cadherin, a protein necessary for maintenance of skin barrier function, is present in skin normally. Biofilm infection induces a gene called miR-9 which silences E-cadherin. In the biofilm prevention model, presence of E-cadherin is restored in wounds treated with WED. *Figure 4 in publication.*	Strong skin barrier function protects the skin from water loss and entrance of harmful microorganisms.

4. Achieved functional closure of wounds compromised by biofilm infection.

WED	Placebo		
☑	☐	In the biofilm prevention and rescue models, both placebo and WED-treated wounds appear to be healing visually. However, upon deeper examination, only wounds treated with WED demonstrated significant restoration of barrier function compared to placebo, as measured by TEWL. *Figure 3 in publication.*	Transepidermal water loss (TEWL), water passing from inside a body through the epidermis to the surrounding atmosphere via diffusion and evaporation, increases in proportion to the level of skin damage and decreases to signify functional wound closure.

WED brings the bioelectric technology platform for wound biofilm management to a clinically applicable format.

References

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