New dispersion method to effectively kill biofilm bacteria could improve wound care

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Researchers at Binghamton University, State University of New York have developed a method to treat bacterial infections which could result

in better wound care.

Biofilms are a structured community of bacterial cells that are adherent to inert or living surfaces. What makes these structures special is that living within these biofilm communities makes its resident bacteria resistant to antibiotics. A research team led by Karin Sauer, professor of biological sciences at Binghamton University, demonstrated that two important human pathogens, P. aeruginosa and S. aureus, need pyruvate to form these structured biofilm communities that are inherently resistant to antibiotics. In turn, the research team demonstrated that removal of pyruvate induces a physiological change in biofilm bacteria that has two consequences: 1) it causes them to disassemble the biofilm structure in a process referred to as biofilm dispersion; and 2) it renders biofilm bacteria more susceptible to antibiotics.

"Our in vitro laboratory findings translated to animals and chronic wound infections, as exposing infected burn wounds to pyruvate depleting conditions not only reduced the bacterial burden present in these wounds, but also enabled the effective killing of biofilm cells by the antibiotic tobramycin," Sauer said.

Biofilm infections are almost impossible to treat by conventional antibiotic therapy. In that regard, these findings are noteworthy, Sauer said. Inducing biofilm dispersion by depleting pyruvate is an add-on therapy that maximizes the effectiveness of conventional antibiotics in killing biofilms. That this novel therapeutic strategy works was apparent as the combination treatment (inducing biofilm dispersion in addition to conventional antibiotic therapy) was significantly more effective than treatment with antibiotics alone or even with the antimicrobial cream silver sulfadiazine, which is considered the gold standard in wound care.

"What this means for wound care is that pyruvate depletion can improve the anti-biofilm activity of conventional antibiotic therapy (which by itself is not working so well), to better treat infected wounds and, ultimately, improve wound healing," Sauer said. "Given that pyruvate depletion not only disperses already established biofilms, but also prevents the formation of antibiotic-resistant biofilms by the two principal pathogens associated with wound infections, pyruvate depletion can also be used to prevent biofilm-related wound infections."

Sauer said that her lab and collaborator Amber Doiron, assistant professor of biomedical engineering at the University of Vermont, are planning on developing therapies based on pyruvate-depleting conditions.

The paper, "Pyruvate-depleting conditions induce biofilm dispersion and enhance the efficacy of antibiotics in killing biofilms in vitro and in vivo," was published in Nature's *Scientific Reports*.

More information: James Goodwine et al, Pyruvate-depleting conditions induce biofilm dispersion and enhance the efficacy of antibiotics in killing biofilms in vitro and in vivo, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-40378-z

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