

Protecting titanium implants from infection

Certain microorganisms are capable of growing in layers, forming biofilms on medical surfaces, like implants, heart valves, etc... Biofilm-associated infections on implants are responsible for 15-25 % of implant failures as biofilms are resistant to most of the conventional anti-microbial agents. To improve integration of bone implants novel porous materials have been used as scaffolds that ironically serve as an ideal niche for microbial growth.

So far, implant coatings with biocidal properties have been generated, which release silver ions or conventional antibiotics to inhibit biofilm formation. The EU-funded project COATIM (<http://www.coatim.eu>, Development of antibiofilm coatings for implants) initiative aims to develop the next generation of implant coatings containing antimicrobial agents like vancomycin (VAN) or caspofungin (CAS) without releasing them. These agents were grafted on small titanium implant substrates and their anti-microbial activity was evaluated alongside their osseointegration capacity, i.e. the capacity of the implant to sustain growth of bone cells on the implant. The latter is important for fixating the implant. Researchers found that vancomycin- or caspofungin-containing titanium implant substrates were better protected against growth of various micro-organisms, while their osseointegration potential was preserved.

More specifically, VAN and CAS were covalently bound on titanium (Ti) substrates using an improved processing technique adapted to large-scale coating of implants. Resistance of the VAN-coated Ti (VAN-Ti) and CAS-coated Ti (CAS-Ti) substrates against biofilm formation of the bacterium *Staphylococcus aureus* and the fungal pathogen *Candida albicans* was determined *in vitro* and *in vivo* using a biomaterial-associated murine infection model. The osseointegration potential of VAN-Ti and CAS-Ti was examined *in vitro* using bone marrow derived stromal cells, and for VAN-Ti also in a rat osseointegration model. Researchers found that biofilm formation of *S. aureus* and *C. albicans* on VAN-Ti and CAS-Ti substrates, respectively, was significantly reduced *in vitro* as compared to biofilm formation on control-Ti. *In vivo*, they observed over 99.9 % reduction in biofilm formation of *S. aureus* on VAN-Ti substrates and 89 % reduction in biofilm formation of *C. albicans* on CAS-Ti substrates, as compared to control-Ti substrates. Moreover, they observed that the coated substrates supported osseointegration *in vitro* and *in vivo*.

In conclusion, the need to resolve biofilm-associated infections is urgent to reduce the necessity for revision surgery. Besides higher medical costs, such infections lead to significant pain and distress in patients. Study outcomes are expected to help avoid or reduce this unnecessary suffering. These data demonstrate the clinical potential of covalently bound vancomycin and caspofungin on titanium to withstand microbial biofilm formation without jeopardizing osseointegration.

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Publication

[Covalent immobilization of antimicrobial agents on titanium prevents *Staphylococcus aureus* and *Candida albicans* colonization and biofilm formation.](#)

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