Antimicrobial coatings for orthopaedic applications

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A significant advance in modern medicine is the introduction of artificial medical devices, including dental and orthopaedic implants and prostheses. This has led to significant improvements in patient well-being and functionality. However, these 'foreign' devices can cause significant complications, of which bacterial infections remain the most common problem. AMR is the broader term for the loss of sensitivity in different microorganisms or viruses towards antibacterial, antiviral, antiparasitic and antifungal substances. It occurs when microorganisms such as bacteria, viruses, fungi, and parasites change in ways that render the treatment schemes used to cure the infections they cause ineffective [1]. The increase in infections by multi-antibiotic-resistant bacteria has become of great concern, especially in hospitals, after orthopaedic surgical procedures. The extra costs due to antibiotic resistance have been estimated at USD 1000 per infected patient [2]. The risk of reinfection during revision surgery is far greater than that of primary infection, which is estimated to fall around 2 %, depending on the type of the prosthetic implant, patient condition, clinical setting, and surgical procedure [2]. The overall infection rates associated with such surgery are approximately 5% for fracture-fixation devices, 2 % for primary joint replacements and 14 % for total hip and knee revisions [3]. Because of the risks (including fatalities) and costs associated with antibiotic-resistant bacterial infections, it is imperative to develop antimicrobial materials to be incorporated into implants that will not result in new types of bacterial resistance. Antimicrobial peptides (AMPs) are important components of the innate immune system of multicellular organisms and act as the first line of defense against exogenous pathogens, resulting in their death. They have shown broad-spectrum activity against a wide variety of pathogens (bacteria, fungi, protozoa, and viruses) with high potency, ability to modulate host immunity, low propensity to induce resistance and low toxicity to host cells. These properties make them emerging agents for the treatment of infections. Disadvantages in the production, properties, and efficacy of AMPs together with high manufacturing costs have contributed to slow the transfer from research to clinical practice and development of commercial products [4].

Acknowledgements: In this presentation, we will report recent advances on the use of antimicrobial peptides [5] developed in the MSCA Horizon 2020 ITN AIMed (grant agreement 861138) for the formation of antimicrobial coatings for titanium implants. We will report how we can achieve a stable immobilization of these antimicrobial peptides, and their antimicrobial effectiveness *in vitro* against orthopaedic pathogens. The work presented here is a contribution from the efforts of two research groups at the University of Birmingham and the University of Trieste and shows how an interdisciplinary team can advance research within the framework of a training network such as AIMed.

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