ABSTRACT

Total hip and knee arthroplasty surgeries form an integral part of orthopaedic practice. With an increase of the primary arthroplasty surgeries performed, comes also an increase in the number of complications. The most common complications of these otherwise very successful procedures is periprosthetic joint infections which are also one of the most difficult to treat.

In the first part of the study, we evaluated the primary bacterial resistance of the 14 most commonly used materials in the construction of joint prostheses. More specifically, we concentrated on how their surface treatment resists colonisation by specific bacterial species (*Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Enterococcus faecalis and Escherichia coli*). The studied materials included metal alloys that are commonly used in the weight bearing parts of implants - CoCrNo, FeNiCr and Ti6A14V - but also polymeric and ceramic materials used in the bearing materials, represented by ultra-high-molecular-weight polyethylene (UHMWPE) and aluminium oxide (Al_2O_3). Our aim was to assess the relationship between material surface roughness and the sensitivity to colonisation by specific bacterial strains and to evaluate their affinity to different materials. Previous studies have proven that the roughness of a material surface is a key factor in biofilm formation by *E. coli, Enterococcus and P. Aeruginosa* species without any differences in the type of material. Meanwhile, *S. epidermis* but mainly *S. aureus* have been shown to adhere well to all materials without any relation to their surface roughness. It has been proven that S. aureus has the highest affinity to metallic materials followed by Al_2O_3 and then UHMWPE. Another treatment strategy that is gaining increasing scientific interest is the covering of implants with bioactive materials which increases biocompatibility and osseointegration while also having an antibacterial function by incorporating or binding antibiotics inside them. Therefore, the second part of this presented study concerned the biological evaluation of nanostructured collagen-hydroxyapatite layers containing vancomycin and gentamycin antibiotics and finding possible correlations between their biological and physical properties. These materials with controlled antibiotic release (elution) showed minimal sensitivity to colonisation by bacterial species. Furthermore, their composition and structure mimics the composition of real bone and they are not toxic to the organism.

Keywords: Aloplastic materials, periprosthetic joint infections, biomaterials, bakterial strains, surface roughness, orthopaedic surgery