Joint Event
11th International Conference on
OSTEOPOROSIS, ARTHRITIS & MUSCULOSKELETAL DISORDERS
&
10th INTERNATIONAL CONFERENCE ON ARTHROPLASTY
December 04-05, 2017 | Madrid, Spain

Evaluation of the response of primary human peripheral blood mononuclear phagocytes to silicon nitride nanoparticles

Saurabh Lal, Richard M Hall and **Joanne L Tipper**
University of Leeds, UK

Introduction: Silicon nitride is a new generation orthopaedic bearing material that has shown potential in its monolithic form and as a coating material. Previous studies have shown that silicon nitride has low friction, and wear rates. However, there is limited evidence to support its biocompatibility. This study aimed to evaluate the biological impact of silicon nitride nanoparticles by measuring cytotoxicity, DNA damage and oxidative stress in peripheral blood mononuclear cells (PBMNCs). CoCr and titanium wear debris were used as reference controls.

Materials and Methods: Sterile CoCr and titanium wear debris were generated using a pin-on-plate reciprocator. Amorphous silicon nitride particles (<50 nm, Sigma) were heat-treated at 180°C for 4 h to remove endotoxin. All particles were dispersed by sonication and overnight incubation in serum proteins (10% fetal bovine serum) at 37°C prior to their use in cell culture experiments. PBMNCs were cultured with particles for 24 h in 5% (v/v) CO2 at 37°C in 96-well plates. Cytotoxicity was measured after 24 h by ATPLite assay (PerkinElmer). DNA damage in the cells was measured by using alkaline comet assay (Trevigen). Oxidative stress was measured using 2',7'-dichlorodihydro-fluorescein diacetate (DCFDA) based reactive oxygen species detection assay (Abcam). Hydrogen peroxide was used as a positive control for DNA damage. The results were expressed as mean ±95% confidence limits and the data were analyzed using one-way analysis of variance (ANOVA) and Tukey-Kramer post-hoc analysis.

Results and Discussion: Silicon nitride nanoparticles and titanium wear debris did not reduce cell viability at both low doses (0.5 μm3 per cell) and high doses (50 μm3 per cell). However, CoCr wear debris significantly reduced the cell viability at high doses. The alkaline comet assay detected no DNA damage in the cells cultured with titanium and silicon nitride particles, whereas CoCr wear debris caused noticeable damage to the DNA. Similarly, no significant increase in the oxidative stress was observed for silicon nitride and titanium particles, while CoCr caused significant increase in the oxidative stress in comparison to the cells only control.

Biography

Saurabh Lal is a Research Fellow at the University of Leeds working in a large collaborative EU project (LifeLongJoints). He has over seven years of experience in the development and testing of orthopaedic medical devices, with expertise in several areas such as biocompatibility testing, biotribology, nanomaterial characterization and image analysis. Recently he is also involved in the development of standards for risk-based evaluation of novel orthopaedic implants. He has won national and international awards for his work on isolation, characterization and biological evaluation of orthopaedic bearing materials. He has completed his PhD in Medical Engineering and Computer Science from Durham University and completed his BTech from Indian Institute of Technology, Delhi. Prior to his PhD, he worked in the Tissue Engineering Labs at Harvard Medical School, USA and in the Biomedical Image Analysis group at KAIST, South Korea.

s.lal@leeds.ac.uk