Nanoparticle genotoxicity screening models using lab-on-a-chip technology

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Project outline:
The use of nanomaterials, and in particular nanoparticles, is predicated on the substantial benefits of nanotechnology. Nanoparticles have significant and growing economic and scientific impacts and have applications in many areas ranging from electronics to environmental remediation to medical healthcare and diagnostics. Nanoparticles are also at the forefront of medical research, owing to the enhanced optical, chemical, and physical properties exhibited at the nanoscale. At the same time, industrial production for non-medical applications including catalysts, sensors, coatings and cosmetics is increasing at a staggering rate. However, there is mounting concern over the safety of nanoparticles in the context of occupational, consumer and environmental exposures. A comprehensive understanding of the health effects of nanoparticles in common use is currently lacking but urgently needed.

The proposed study aims to screen for cancer hazard, by investigating the genotoxicity of Organization for Economic Co-operation and Development (OECD) priority-listed nanoparticle formulations with the use of high-throughput lab-on-a-chip technology. This involves a lymphocyte-sorting microarray platform. The key hypothesis is that cytotoxicity and genetic damage caused by nanoparticles occurs in specific subsets of lymphocytes and is not uniformly distributed across all subsets. Determining the exact location and extent of genetic damage will provide new insight into the mechanisms of nanotoxicity and elucidate the cellular responses, indicating potential long-term effects caused by exposure.

Cells are then incubated on the microarrays yielding in situ cell sorting into subsets allowing subset-specific analysis of genetic damage (Figure 1).

Figure 1: Cell microarray fabrication. Capture antibodies are micro-printed onto GMA and PEGMA coated glass slides generating a covalent antibody linkage to the substrate.

Methods & Equipment:
microarray printing and scanning, surface modification of glass slides, lymphocyte culture, immunohistochemistry, cell culture assays, automated cytometry, nanoparticle preparations.
References:

About Adelaide:
Adelaide is the capital of South Australia and offers a very high standard of living (top 5 most liveable city in the world according to a survey by "The Economist"), with great climate, food, wine, beautiful unspoiled nature and beach environments, in an inexpensive setting. Adelaide was also recently voted into the Lonely Planet top 10 cities in the world.
The Mawson Institute (MI) has recently been established at the University of South Australia, with strong support from the South Australian Government to research new manufacturing technologies. Manufacturing is an important and substantial part of South Australia's economic base. The MI promotes a strategy based upon strong basic and applied research that encourages scientific and technological innovation within the manufacturing sector. Fundamental to this is the Institute's multidisciplinary approach, building research teams in concentrations that encompass a diverse range of disciplines, and collaboration with partners from both academia and industry.

The institute is based in two new state-of-the-art buildings with outstanding research facilities (see photo of the MM building).

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