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In vitro evaluation of gold nanoparticles toxicity towards human endothelial cells and comparison between static and flow conditions

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In the last years metal nanoparticles has seen an escalation as new multi-functional platform for diagnostic and drug delivery, but, at the same time, awareness towards their impact on human and environmental health requires studies that characterize their potential cytotoxic effects (Dykman and Khlebtsov, 2012).

In this work we investigate uptake and toxicity of gold nanoparticles (Au NPs) towards cells of the human vascular system (Human Umbilical Vein Endothelial Cells, HUVEC), because these are the first one to get in contact with NPs intravenously administered. The characterization of Au NPs is done by standard methods and by Two-Photon Fluorescence Correlation Spectroscopy. Au NPs uptake is investigated through transmission electron microscopy, fluorescence microscopy and ICP-AES, and NPs toxicity is measured through standard bio-analytical tests. We have explored the cytotoxicity of Au NPs by evaluation of gene expression of inflammatory markers and by the cell production of reactive oxygen species (ROS) after incubation with Au NPs.

In parallel, we propose and study a new *in vitro* model system, which consists in a linear microfluidic device (MFD) in polydimethylsiloxane. In this model we add shear stress associated with a flowing medium and a continuous infusion of Au NPs solution, since these phenomena are present when NPs are intravenously administrated (Mahto et al., 2010). The comparison between static and flow conditions shows that administration of equal concentrations of Au NPs under flow results in reduced sedimentation and uptake of NPs on the cells and in 20% lower cytotoxicity, providing new useful information to evaluate the therapeutic efficacy of nanoparticle-based formulations.

References

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Keywords

Gold nanoparticles, HUVEC, cellular uptake, toxicity, ROS production, PDMS microfluidic devices.