In Vitro Dosimetry of Silver Nanoparticles

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An important issue for interpreting in vitro nanomaterial testing is quantifying the dose absorbed by target cells. Considerations include the concentration added to the culture and the proportion of the applied dose that is absorbed by the target cells. Rapid and efficient techniques are needed to model and measure delivered doses. Previously, we showed that silver nanoparticles (AgNP) are absorbed by cells in a dose dependent manner between 1ug/ml and 30ug/ml and can be detected by light scatter using a flow cytometer (1). Here, we compare AgNPs dose to cells measured by inductively-coupled plasma mass spectrometry (ICP-MS), flow cytometry side scatter and modeled with an In vitro sedimentation, diffusion and dosimetry model (ISDD) (2). A retinal pigment epithelial cell line (APRE-19) (25cm^2 flasks, 37°C, DMEM/F12, 10% FBS, pen/strep, pH 7.4) was exposed to 20 nm or 75 nm citrate-coated AgNP for 24 hr. The ISDD model predicted 26 and 34 % of the applied dose (10 µg/ml) would be delivered to the cells by 24 hr, compared with Ag measured in the cell pellet by ICP-MS of 12 and 30% for the 20 and 75 nm AgNP, respectively. Flow cytometry side scatter was linearly related to Ag mass measured by ICP-MS, and to calculations of internalized particle number and surface area. The relationships between particle sizes varied according to the dose metric, with a greater mass of silver incorporated into the cells after exposure to 75 nm than to 20 nm AgNP. However, the reverse was true, that more 20 nm AgNP than 75 nm AgNP, incorporated into the cells when expressed as the number or surface area of internalized particles. The results indicated that the ISDD model worked better for 75 nm AgNP than for 20 nm AgNP, perhaps reflecting silver dissolution which was not accounted for. In addition, the results suggest that flow cytometry side scatter could be used as a rapid and inexpensive measure of cellular dose if pre-calibrated for particle size and composition. *This abstract does not reflect EPA policy.*

1 Zucker, et al. Cytometry A 83 962-972 2013
2 Hinderliter et al. Particle and Fibre Toxicology 2010, 7:36