TRANSLOCATION AND ACCUMULATION OF INHALED GOLD NANOPARTICLES IN ATHEROSCLEROTIC PLAQUE

Poster Contributions
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Background: Although millions of deaths are caused each year by combustion-derived nanoparticulate (CDNP) air pollution, little is known about the health consequences of airborne-engineered nanoparticles. Whether inhaled nanoparticles can translocate into the circulation remains of crucial importance in understanding the potential for adverse health effects. Using complementary clinical and experimental studies we address the possibility of particle translocation, and the fate of inhaled nanoparticles.

Methods: Clinical Studies. 14 male volunteers were exposed to gold nanoparticles (particle size 3.8 nm; 5.8±0.3x10^6 particles/cm^3) by inhalation for 2 hours. Blood and urine samples were analyzed for the presence of gold using high-resolution inductively-coupled mass spectroscopy (HR-ICPMS). Animal Studies. Male ApoE-/- mice fed a "Western diet" received twice-weekly intra-tracheal instillations of 5 nm gold nanoparticles or vehicle for 5 weeks (total particle mass of ~1 mg). The aortic arch, thoracic aorta, liver biopsies and blood were analyzed for gold using HR-ICPMS. Tissue samples were visualized using histology and Raman microspectroscopy.

Results: Clinical Studies. Following exposure, gold was detectable in blood as early as 15 min and was present in 86% of subjects by 24 hours. Gold was detected in the urine of all subjects within 24 hours of exposure. Animal Studies. Gold concentration in blood was higher in gold-treated compared with vehicle-treated mice (9.4±1.2 vs 0.41±0.21 ng/ml; P<0.0001). The aortic arch developed complex atherosclerotic plaques rich in lipids and foam cells. Gold concentrations in the aortic arch were higher in gold-treated compared with vehicle-treated mice (60±24 vs 6±1 ng of gold/g of tissue; P=0.023), and exceeded concentrations in the descending thoracic aorta. The presence of particulate gold within atherosclerotic plaques was confirmed using Raman spectroscopy.

Conclusions: Inhaled nanoparticles enter the circulation and localize within atherosclerotic tissue. These findings may help explain the adverse effect of CDNPs on the cardiovascular system and have immediate relevance for the nanotechnology industry.