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Comparative study of cytotoxic and genotoxic effects of uncoated and poly-ethylene glycol-coated gold nanoparticles on human kidney cells

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Gold nanoparticles (AuNPs) have generated a substantial amount of scientific and technological interest due to their ease of synthesis, chemical stability, and unique optical properties. Numerous empirical studies demonstrate their biomedical applications in chemical sensing, biological imaging, drug delivery, and cancer treatment. In considering these applications, biocompatibility and the absence of cytotoxicity of AuNPs are essential. Comparative studies were conducted to investigate whether 25-35 nm poly (ethylene glycol) (PEG) coated and uncoated AuNPs are more or less cytotoxic and genotoxic to human kidney(HK-2) cells. Cytotoxicity, oxidative stress, and genotoxicity were evaluated by the MTT assay, dichlorofluorescein (H_2DCF) assay, and single cell gel electrophoresis, respectively. Results showed that uncoated Au particles significantly reduced cell viability and were cytotoxic with an IC50 concentration of 100µM whereas, the PEG coated AuNPs displayed low toxicity even at a high dose of 200µM after 24-hour exposure. Uncoated AuNPs increased reactive oxygen species concentration (ROS), decrease GSH production, and depolarize the mitochondrial membrane potential in a concentration-dependent manner. PEG AuNPs produced no notable increase in ROS or deceased in GSH along with negligible polarization of the mitochondrial membrane potential. PEG AuNPs showed insignificant genotoxic effect of DNA damage represented by 1.07% in comparison to 37.4% exerted by uncoated AuNPs. Overall these findings show that uncoated AuNP appear to be more cytotoxic and more genotoixis than PEG coated AuNPs. of cytotoxicity and genotoxicity of PEG coated AuNP compared to uncoated AuNP will have beneficial clinical implications for application in nanobiotechnology and nanomedicine.

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