Effect of Size and Concentration of Gold and Silver Nanoparticles on Skin Cancer Chemoprevention

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Abstract

Skin cancer is the most commonly diagnosed malignancy in America. The traditional approach to protect against the harmful effects of ultraviolet (UV) radiation has been to use sunscreen lotion as a direct barrier on the skin. However, recent studies have shown that zinc oxide (ZnO) nanoparticles and titanium dioxide (TiO_2) nanoparticles, which are used as UV filters in sunscreens, can have inflammatory/toxic effects on normal skin cells. For this reason, it is necessary to look for novel nanoparticles that are effective for skin cancer chemoprevention with minimal side-effects on normal skin cells. In this research, the effect of size and concentration of gold nanoparticles (AuNPs) and silver nanoparticles (AgNPs) were tested for skin cancer chemoprevention against UV-induced cell damage. Cell viability analysis indicated that AuNPs and AgNPs in the size range 10-100 nm and concentration range 1-10 mg/L are not toxic to nontumerigenic HaCaT cells. Dot-blot assay results indicate that UV-B radiation causes considerable DNA damage to HaCaT cells and this damage is significantly reduced in the presence of AgNPs in the size range 10-40 nm. FACS results indicate that cells without AgNPs undergo significant early apoptosis in the presence of UV radiation. However, AgNPs of size 10-40 nm provide significant protection (4-5 fold reduction in apoptosis), thereby proving the chemopreventive effect of AgNPs. On the other hand, AuNPs do not provide any chemoprevention to UVB-induced DNA damage. Cell cycle studies show that treatment with AgNPs in the size range 10-40 nm prior to UVB exposure caused significant accumulation of HaCaT cells in the G1/S phase (~ 9.0 fold higher as compared to AgNPs-untreated UVB-exposed cells).