Zinc Oxide Nanoparticles Demonstrating Directed Cytotoxicity to Leukemia and Other Cancers
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Abstract

Even as knowledge of cancer at the molecular and nanometer level has improved, advances in more targeted treatments have been slow. The indiscriminate action of cytotoxic agents used for cancer therapy lead to systemic toxicity and adverse effects, such as bone marrow suppression, neurotoxicity, and cardiomyopathy. In an attempt to reduce side effects of cancer therapeutics, Boise State presents uniquely designed Zinc Oxide Nanoparticles (ZnO-NPs). These nanoparticles have demonstrated an increased cytotoxicity toward cancerous cell lines with relatively low effect on healthy tissues. The cytotoxicity is due to reactive oxide formation and subsequent cell death. ZnO-NPs elicit their cytotoxic effects 28-35 times higher on mammalian T-cell Leukemia cell lines in comparison to healthy body tissues. The preferential targeting of ZnO-NPs to cancerous cells is of substantial magnitude, especially in comparison to ex vivo indices reported for other commonly used chemotherapeutic agents using similar cell viability assays. For example, therapeutic indices of ≤10 have been reported for both doxorubicin and carboplatin.

Advantages

- ZnO-NPs exhibit a strong preferential ability to kill cancerous cells compared to healthy tissues.
- Key research findings show that ZnO-NPs induce toxicity in a cell-specific and proliferation-dependent manner, with rapidly dividing cells being the most susceptible and quiescent cells being the least sensitive.
- ZnO-NPs have the potential to be delivered directly to cancerous cells through the coupling to targeting ligands specific for cancer cell markers.

Stage of Development

This technology is in early stage development. The nanoparticles cytotoxicity characteristics have been tested in vitro on multiple cell lines. Further development of this technology at Boise State is proceeding through testing of ZnO-NPs cytotoxic characteristics on other cancers cell lines. Attempts at improving their selective cytotoxicity are being made through modifications effecting reactive oxide formation and coupling with tumor-targeting ligands (monoclonal antibodies, peptides, and small molecules). Also, in vivo efficacy and safety studies are planned for the near future.

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