Roadmap to clinical translation of gold mediated therapeutics

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Recent developments in nanotechnology has provided new tools for cancer therapy and diagnosis. Among other nanomaterial systems, gold nanoparticles are being used as radiation dose enhancers and anticancer drug carriers. Our studies show that size, shape and surface properties of NPs can play a major role in their interaction with tumor cells. We have a developed a comprehensive research platform which includes monolayer cell models, multilayer cell models (tissue like models), and *in vivo* animal models to test the therapeutic efficacy of gold mediated sensitization. It is important to test NP formulations at all three above mentioned levels to optimize their use in future clinical applications. For example, our previous work at monolayer level showed that NPs of diameter 50 nm had the highest cell uptake among the size range 10-100 nm. However, at tissue-level NPs of diameter lower than 50 nm showed the highest tissue penetration. Once these NPs leave the tumor blood vessels, it important that they should be able to penetrate tumor tissue deeper. Hence, we used smaller NPs for our *in vivo* studies. We were able to achieve more than 12% of the NP formulation within the tumor. We have also shown for the first time that cancer drug loaded gold nanoparticles can reach the nucleus (or the brain) of cancer cells enhancing the therapeutic effect dramatically. Nucleus of the cancer cells are the most desirable target in cancer therapy. In chemotherapy, smart delivery of highly toxic anticancer drugs through packaging using nanoparticles will reduce the side effects and improve the quality and care of cancer patients. In radiation therapy, use of gold nanoparticles as radiation dose enhancer is very promising due to enhanced localized dose within the cancer tissue.

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