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Green Nanotechnology in Nuclear Medicine—Tumor Specific Radioactive Gold Nanoparticles for New Approaches in Cancer Therapy

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We report herein, for the first time, on the application of Mangiferin—a glucose functionalized xanthanoid found in abundance in mangoes peel—as a tumor targeting agent for the selective delivery of inherently therapeutic radioactive gold nanoparticles (Au-198) into prostate tumors in mice. Mangiferin functionalized radioactive gold nanoparticles (MGF-198AuNPs) have been synthesized and fully characterized for their potential applications in tumor therapy. The highly innovative feature of this green nanotechnology focused work is the ability of Mangiferin to serve dual roles of chemical reduction, to produce gold nanoparticles, with subsequent encapsulation to afford in vivo stability and tumor specificity. Laminin receptor specificity of Mangiferin affords site specific accumulation of optimum therapeutic payloads of this new therapeutic agent within prostate tumor cells (PC-3) of human prostate tumor origin. Over expression of laminin receptors in human prostate tumors and the selective affinity of Mangiferin toward such receptor subtype has allowed effective treatment of prostate tumors in mice using the new MGF-198AuNPs—thus demonstrating that small sized phytochemicals will play important roles in achieving tumor specificity in drug design. The dual beta and the gamma emissions of Au-198 provides unique advantages for tumor therapy, through the beta energy while gamma rays are used for the quantitative estimation of gold within the tumors and various organs through radio scintigraphy. Detailed in vivo therapeutic efficacy studies, through the intratumoral delivery of MGF-198AuNPs, revealed that over 80% of the injected dose (ID) of MGF-198AuNPs was retained in prostate tumors up to 24 h. There was minimal/no leakage of MGF-198AuNPs to non-target organs including liver, blood and stomach. This unprecedented retention of MGF-198AuNPs within prostate tumors translated into excellent ability of this nanoceutical to reduce tumor volumes in comparison to saline control groups. By three weeks post treatment, tumor volume of control group (saline) was significantly lower than the tumor volume of the two different groups of prostate tumor bearing mice injected with radioactive nanoparticles (1.31±0.00cm3 for control versus 0.18± 0.17cm3 for MGF-198AuNPs for group 1, and 0.22±0.02 cm3 for MGF-198AuNPs for group 2). Observation of normal blood parameters, body weights and the overall systemic tolerance of MGF-198AuNPs, in both the experimental and control groups, suggested new opportunities in oncology for the application of this agent for the treatment prostate and various other tumors.

Country/Organization invited to participate

United States of America

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