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Initial in Vitro and in Vivo Assessment of Au@DTDTPA-RGD Nanoparticles for Gd-MRI and 68Ga-PET Dual Modality Imaging

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Aim
Gadolinium chelate coated gold nanoparticles (Au@DTDTPA) can be applied as contrast agents for both in vivo X-ray and magnetic resonance imaging. In this work, our aim was to radiolabel and evaluate this gold nanoparticle with Ga-68, in order to produce a dual modality PET/MRI imaging probe.

Materials and Methods
For a typical preparation of 68Ga-labeled nanoparticles, the Au@DTDTPA nanoparticles (Au@DTDTPA/Au@DTDTPA-RGD) were mixed with ammonium acetate buffer, pH 5 and 40 MBq of 68Ga eluate. The mixture was then incubated for 45 min at 65 ℃. Radiochemical purity was determined by ITLC. In vitro stability of both radiolabeled species was assessed in saline and serum. In vitro cell binding experiments were performed on integrin αvβ3 receptor-positive U87MG cancer cells. Non-specific Au@DTDTPA was used for comparison. Ex vivo biodistribution studies and in vivo PET and MRI imaging studies in U87MG tumor-bearing SCID mice followed.

Results
The Au@DTDTPA nanoparticles were labeled with Gallium-68 at high radiochemical yield (>95%) and were stable at RT, and in the presence of serum, for up to 3 h. The cell binding assay on U87MG glioma cells proved that 68Ga-cRGD-Au@DTDTPA had specific recognition for these cells. Biodistribution studies in U87MG tumor-bearing SCID mice showed that the tumor to muscle ratio increased from 1 to 2 h p.i. (3,71 ± 0.22 and 4,69 ± 0.09 respectively), showing a clear differentiation between the affected and the non-affected tissue. The acquired PET and MRI images were in accordance to the ex vivo biodistribution results.

Conclusion
The preliminary results of this study warrant the need for further development of Au@DTDTPA nanoparticles radiolabeled with Ga-68, as possible dual-modality PET/MRI imaging agents.

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