Gold nanoparticles

AuNPs

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Chemical name:	Gold nanoparticles	
Abbreviated name:	AuNPs	
Synonym:		
Agent category:	Metal	
Target:	Non-targeted	
Target category:	Non-targeted	
Method of detection:	X-ray, CT	
Source of signal:	Au	
Activation:	No	
Studies:	• *In vitro* • Rodents	Structure is not available in PubChem.

Background

[PubMed]

X-Ray imaging (computed tomography, CT) visualizes tissue density differences that provide the image contrast produced by X-ray attenuation between electron-dense bone and soft tissues (1). Contrast enhancement with use of X-ray contrast (radiopaque) agents are needed to increase the degree of contrast between diseased tissues from normal tissues. Water-soluble X-ray contrast agents are generally based on small tri-iodobenzene compounds as monomers or dimmers (2), which can be ionic (high osmolality) or nonionic (low osmolality). When injected intravenously (intra-arterial catheterization is commonly used), they exhibit highly non-specific vascular permeation and rapid renal excretion limiting their targeting performance.

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Gold has not been used as an X-ray contrast agent *in vivo*. Gold has a higher atomic number and a higher absorption coefficient than iodine, providing 2.7-fold greater contrast/weight than iodine (3). Furthermore, imaging gold at 80-100 keV reduces interference from bone absorption and provides lower soft tissue absorption, which would reduce radiation to patient. Hainfeld et al. (3) have performed experiments in mice using gold nanoparticles (AuNPs, 1.9 nm in diameter, ~50 kDa) as a CT contrast agent. This preparation exhibit excellent stability, high X-ray absorption, good safety profile, long blood half-life, and enhanced CT contrast of the vasculature, kidneys and tumor in mice.

Related Resource Links:

- Chapters in MICAD (Gold imaging)
- Clinical trials (Gold nanoparticles)
- Drug information in FDA (Gold nanoparticles)

Synthesis

[PubMed]

AuNPs (1.9 ± 0.1 nm as determined by electron microscopy) were obtained commercially from Nanoprobes (Yaphank, NY).

In Vitro Studies: Testing in Cells and Tissues

[PubMed]

Chithrani et al. (4) showed that AuNPs of sizes between 14 and 100 nm entered cultured HeLa cells in medium containing 10% serum and trapped in vesicles in the cytoplasm as determined by transmission electron microscopy. The cellular uptake of the AuNPs increased for the first 2 h and gradually reached a plateau at 4-7 h. The uptake half life was 2.10, 1.90, and 2.24 h at a rate of 622, 1294, and 417 nanoparticles/h for the 14, 50, and 74 nm nanoparticles.

Animal Studies

Rodents

[PubMed]

In mice bearing EMT-6 syngeneic mammary tumors, AuNPs (1.9 nm, 2.7 g/kg) had a half-life of <10 min in blood after intravenous injection, followed by a slower decrease of another 50% between 15 min and 84 min (3). No AuNPs were detected in the blood by 24 h. The tissue with the highest gold accumulation was the kidneys (10.62%ID/g) at 15 min, followed by tumor (4.2%ID/g), liver (3.6%ID/g) and muscle (1.2%ID/g). The tumor/muscle ratio was 3.4 at 15 min and 9.6 at 24 h. CT imaging at 2 and 10 min showed clear delineation of blood vessels as fine as 100 μm. Imaging at later time points showed that AuNPs did not continue to concentrate in the liver but cleared through the kidneys,

indicating renal excretion. Planar X-ray scan of the kidneys at 60 min revealed a detailed anatomical and functional image.

Histological examination of 24 organs and tissues from each of 15 mice injecting with 0, 7, 70 or 700 Au mg/kg showed no evidence of toxicity of in any mice (3). All mice showed normal haematology and blood chemistry at 11-30 days after injection. Mice injected with 2.7 g Au/kg survived over 1 year without any signs of sickness.

Other Non-Primate Mammals

[PubMed]

No publication is currently available.

Non-Human Primates

[PubMed]

No publication is currently available.

Human Studies

[PubMed]

No publication is currently available.

References

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2. Wallingford V.H. *The development of organic iodine compounds as x-ray contrast media.* J Am Pharm Assoc Am Pharm Assoc (Baltim). 1953;42(12):721–8. PubMed PMID: 13108780.
3. Hainfeld J.F., Slatkin D.N., Focella T.M., Smilowitz H.M. *Gold nanoparticles: a new X-ray contrast agent.* Br J Radiol. 2006;79(939):248–53. PubMed PMID: 16498039.
4. Chithrani B.D., Ghazani A.A., Chan W.C. *Determining the size and shape dependence of gold nanoparticle uptake into mammalian cells.* Nano Lett. 2006;6(4):662–8. PubMed PMID: 16608261.