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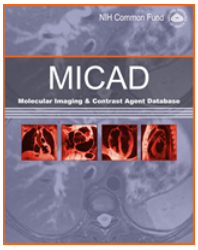

^{111}In-Diethylenetriamine pentaacetic acid-single-walled nanotubes

^{111}In-DTPA-SWNTs

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Chemical name:	^{111}In-Diethylenetriaminepentaacetic acid-single-walled nanotubes	
Abbreviated name:	^{111}In-DTPA-SWNTs	
Synonym:		
Agent category:	Nanoparticle	
Target:	Non-targeted	
Target category:	Other	
Method of detection:	SPECT, gamma planar	
Source of signal\contrast:	^{111}In	
Activation:	No	
Studies:	• *In vitro* • Rodents	No structure is currently available in PubChem.

Background

[PubMed]

Optical fluorescence imaging is increasingly used to visualize biological functions of specific targets (1, 2). However, the intrinsic fluorescence of biomolecules poses a problem when fluorophores that absorb visible light (350–700 nm) are used. Near-infrared (NIR) fluorescence (700–1,000 nm) detection avoids the background fluorescence interference of natural biomolecules, providing a high contrast between target and background tissues. NIR fluorophores have wider dynamic range and minimal background as a result of reduced scattering compared with visible fluorescence detection. They also have high sensitivity, resulting from low infrared background, and high extinction coefficients, which provide high quantum yields. The NIR region is also compatible with solid-state optical components, such as diode lasers and silicon detectors. NIR fluorescence imaging is becoming a non-invasive alternative to radionuclide imaging in small animals.

Carbon nanotubes are made of fullerene carbon units, which respond to local dielectric changes without photo-bleaching (3, 4). They can be tuned to a range of wavelengths for NIR absorption, thus providing broad

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excitation profiles and high absorption coefficients. They can be coated and capped with hydrophilic materials for additional conjugation with biomolecules, such as peptides, antibodies, nucleic acids, and small organic compounds for *in vitro* and *in vivo* studies (5). Single-walled carbon nanotubes (SWNTs) have a diameter of 1–5 nm and a length of 300–1,000 nm. They have been shown to be nontoxic to cells *in vitro* (6). However, there have been limited studies of their *in vivo* toxicological and pharmacological profiles in small animals. SWNTs have been conjugated with diethylenetriamine pentaacetic acid (DTPA) and radiolabeled with ^{111}In to form ^{111}In-DTPA-SWNTs for quantitative biodistribution studies in small animals (7).

Synthesis

[PubMed]

Singh et al. (7) introduced DTPA groups to NH_2-SWNTs (0.5 mmol NH_2/g) by incubation of NH_2-SWNTs (1.4 nm in diameter and 300–1,000 nm in length) with diisopropylethylamine and DTPA dianhydride for 3 h at room temperature. DTPA-SWNTs were diluted with water and lyophilized twice. DTPA-SWNTs were complexed with ^{111}In-citrate for 60 min at room temperature. ^{111}In-DTPA-SWNTs were used without further purification. ^{111}In-DTPA-SWNTs-3 contained 0.5 mmol/g DTPA with one ^{111}In ion per ~70,000 DTPA, whereas ^{111}In-DTPA-SWNTs-5 contained 0.3 mmol/g DTPA groups with one ^{111}In ion per ~42,000 DTPA. The specific activity of both tracers was ~12.3 MBq/mg (~0.33 mCi/mg)

In Vitro Studies: Testing in Cells and Tissues

[PubMed]

Yehia et al. (8) performed transmission electron microscopy (TEM) and confocal Raman spectroscopy using human HeLa cells after incubation with SWNTs for up to 60 h at 37°C. SWNTs were taken up by HeLa cells in a time-dependent manner as determined with confocal Raman spectroscopy. TEM revealed that SWNTs were found in intracellular vacuoles but not in the nucleus. SWNTs did not affect the growth rates of HeLa cells.

Animal Studies

Rodents

[PubMed]

Singh et al. (7) studied short-term biodistribution in normal mice (n = 3 mice/group) up to 24 h after intravenous injection of 60 μg ^{111}In-DTPA-SWNTs-3 or ^{111}In-DTPA-SWNTs-5 with a total radioactivity of 0.74 MBq (20 μCi). Both nanotubes (-3 *versus* -5) accumulated quickly in the kidney (10.5 *versus* 20.7% injected dose (ID)/g), skin (1.9 *versus* 9.1% ID/g), muscle (6.2 *versus* 8.6% ID/g), blood (2.7 *versus* 3.2% ID/g), and lung (0.47 *versus* 1.35% ID/g) at 30 min after injection. Lower levels were observed in the heart (0.22 *versus* 0.52% ID/g), liver (0.19 *versus* 0.20% ID/g), and spleen (0.42 *versus* 0.23% ID/g). The nanotubes were cleared from all tissues in 3–24 h. ^{111}In-DTPA-SWNTs-3 had a half-life of 3.5 h in blood, and ^{111}In-DTPA-SWNTs-5 had a half-life of 3.0 h. TEM analysis of urine indicated that the nanotubes were excreted into urine intact.

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.

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