Bismuth sulphide polyvinylpyrrolidone nanoparticles

BPNPs

Kam Leung, PhD[1]

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Chemical name:	Bismuth sulphide polyvinylpyrrolidone nanoparticles	
Abbreviated name:	BPNPs	
Synonym:	Bi_2S_3 PVP nanoparticles	
Agent Category:	Metal	
Target:	Phagocytes	
Target Category:	Phagocytosis, endocytosis	
Method of detection:	X-ray, CT	
Source of signal:	Bi	
Activation:	No	
Studies:	• *In vitro* • Rodents	No structure is currently available in PubChem.

Background

[PubMed]

X-ray imaging, or computed tomography (CT), visualizes tissue density differences that provide the image contrast produced by X-ray attenuation between soft tissues and electron-dense bone (1). Contrast enhancement with the use of X-ray contrast (radiopaque) agents are needed to increase the degree of contrast between diseased tissues and normal tissues. Water-soluble X-ray contrast agents are generally based on small tri-iodobenzene compounds such as monomers or dimers (2), which can be ionic (high osmolality) or nonionic (low osmolality). When injected intravenously, commonly via

[1] National Center for Biotechnology Information, NLM, NIH, Bethesda, MD; Email: micad@ncbi.nlm.nih.gov.

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intra-arterial catheterization, these agents exhibit highly nonspecific vascular permeation and rapid renal excretion, which limits their targeting performance.

Bismuth salts were used as X-ray contrast agents in the gastrointestinal tract as early as 1897 (1). However, their use did not continue because high doses of bismuth salts are toxic. Rabin et al. (3) have performed experiments using polyvinylpyrrolidone (PVP)-coated Bi_2S_3 nanoparticles (BPNPs) as a CT contrast agent. This preparation exhibited excellent stability, high X-ray absorption (5-fold better than iodine provided as iopromide), a good efficacy/safety profile, long blood half-life, and enhanced CT contrast of the vasculature, liver, and lymph nodes in mice.

Synthesis

[PubMed]

Rabin et al. (3) reported that Bi_2S_3 nanocrystals were grown by precipitation of bismuth citrate and sodium sulphide in the presence of 3-mercaptopropionic acid. The reaction mixture was then filtered and lyophilized. The nanocrystals were resuspended in aqueous PVP and dialyzed against aqueous polyethylene oxide. The mean hydrodynamic diameter of the BPNPs as measured by laser-light scattering was 30 ± 10 nm.

In Vitro Studies: Testing in Cells and Tissues

[PubMed]

X-ray fluoroscopic study showed that a 0.55 M in bismuth concentration of BPNPs solution was equivalent in X-ray absorption to a 2.36-M iodine solution of iopromide (3). Cytotoxicity studies of BPNPs and bismuth subsalicylate using U937 human macrophages and HepG2 hepatocytes showed that bismuth subsalicylate had lethal dose (LD_{50}) values of 8 and 5 mM, respectively. On the other hand, bismuth from BPNPs had LD_{50} values of 100 and 114 mM, respectively. Therefore, bismuth provided via BPNPs was >10-fold less toxic to cells than bismuth provided via bismuth subsalicylate. BPNPs also exhibited a better efficacy/toxicity ratio than iopromide in hepatocytes.

Animal Studies

Rodents

[PubMed]

In mice, BPNPs (57 μmol bismuth-equivalent/mouse) had a half-life of 140 ± 15 min in blood after intravenous injection as compared to <10 min for commercial iodinated preparations (3). CT imaging up to 48 h showed clear delineation of the cardiac ventricles, all major blood vessels, and the liver at 24 h. Weak contrast was visualized in the kidneys and urinary tract at 24–48 h. No residual bismuth was detected in any organ in the mice 2 months after the injection of BPNPs. Regional lymph nodes were clearly delineated up to

140 h after subcutaneous injection of BPNPs (11.4 μmol bismuth-equivalent). The authors suggested that further biodistribution and histological studies are required to fully assess the safety and usefulness of BPNPs as a CT agent *in vivo*.

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.

NIH Support

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References

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