Ferumoxsil

Large SPIO

Kam Leung, PhD[1]

Created: November 1, 2004; Updated: December 12, 2007.

Chemical name:	Ferumoxsil	
Abbreviated name:	Large SPIO	
Synonym:	Siloxane-coated SPIO, AMI-121	
Agent Category:	Superparamagnetic Iron Oxide	
Target:	Reticuloendothelial system	
Target Category:	Internalized by phagocytes	
Method of detection:	Magnetic Resonance imaging (MRI)	
Source of signal/contrast:	Iron oxide	
Activation:	No	
Studies:	• *In vitro* • Rodents • Humans	No structure is available in PubChem.

Background

[PubMed]

Magnetic resonance imaging (MRI) maps information about tissues spatially and functionally. Protons (hydrogen nuclei) are widely used to create images because of their abundance in water molecules. Water comprises about 80% of most soft tissues. The contrast of proton MRI depends mainly on the density of nuclear (proton spins), the relaxation times of the nuclear magnetization (T1, longitudinal and T2, transverse), the magnetic environment of the tissues, and the blood flow to the tissues. However, insufficient contrast between normal and diseased tissues requires development of contrast agents. Most of the contrast agents affect the T1 and T2 relaxation of the

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

NLM Citation: Leung K. Ferumoxsil. 2004 Nov 1 [Updated 2007 Dec 12]. In: Molecular Imaging and Contrast Agent Database (MICAD) [Internet]. Bethesda (MD): National Center for Biotechnology Information (US); 2004-2013.

surrounding nuclei, mainly the protons of water. T-2* is the spin-spin relaxation time composed of variations from molecular interactions and intrinsic magnetic heterogeneities of tissues in the magnetic field [1].

Superparamagnetic iron oxide (SPIO) structure is composed of ferric iron (Fe^{3+}) and ferrous iron (Fe^{2+}) in the general formula of $Fe_2{}^{3+}OFe^{2+}O$. The iron oxides particles are coated with a layer of dextran or other polysaccharide. These particles have a large combined magnetic moments or spins which are randomly rotated in the absence of an applied magnetic field. SPIO is used mainly as a T2 contrast agent in MRI though it can shorten both T1 and T2/T2* relaxation processes. SPIO particle uptake into reticuloendothelial system is by endocytosis or phagocytosis. SPIO particles are taken up by phagocytic cells such as monocytes, macrophages, and oligodendroglial cells. A variety of cells can also be labeled with these particles for cell trafficking and tumor-specific imaging studies. SPIO agents are classified by their sizes with coating material (about 20 nm to 3,500 nm in diameters) as large SPIO agents (Ferumoxsil or AMI-121, Ferucarbotran, OMP), standard SPIO (SSPIO) agents (Ferumoxides or AMI-25, SHU 555A), ultrasmall SPIO (USPIO) agents (Ferumoxtran or AMI-227, NC100150) and monocrystalline iron oxide nanoparticles (MION) agents [1].

Ferumoxsil is composed of iron particles of about 10 nm and the hydrodynamic diameter is about 300 nm. The iron particles are coated with a non-biodegradable and insoluble matrix (siloxane) and suspended in viscosity-increasing agents such as starch and cellulose [2]. They are used in oral large SPIO preparations. Ferumoxsil has been tested in clinical trials as negative contrast agent that decreases signal on T2 images. Ferumoxsil is used in bowel MR imaging.

Synthesis

[PubMed]

SPIO agents are produced by controlling the precipitation of iron oxide in an aqueous solution of ferric salt, ferrous salt, and coating material by addition of an alkaline solution while active stirring or sonication is applied. The desired SPIO size of the agent is isolated and purified by differential centrifugation, column chromatography, and dialysis. Electron microscopy, X-ray diffraction and laser light scattering are used to measure median diameter of the nanoparticles. Relaxivities are measured by NMR spectroscopy [1].

In Vitro Studies: Testing in Cells and Tissues

[PubMed]

No publication is currently available.

Animal Studies

Rodents

[PubMed]

Ferumoxsil preparations were well tolerated in rats without adverse effects as studied by hematological evaluations and histopathological examinations of organs and tissues. Most of ferumoxsil was eliminated in the feces by 72 hours. MRI of the rats showed that signal-intensity loss was detected without distortion artifacts [2].

Other Non-Primate Mammals

[PubMed]

No publication is currently available.

Non-Human Primates

[PubMed]

No publication is currently available.

Human Studies

[PubMed]

MRI with AMI-121 was performed in 15 volunteers. Loss of T2-weighted enhancement signal intensity was observed in the proximal and distal small bowel. Enhanced images showed improved marking of the head and tail of the pancreas, anterior regions of the kidneys, and para-arotic region [2]. AMI-121 MRI was helpful in discriminating normal bowel from solid lesions and in detecting subtle gastrointestinal tract mass change. In 30 consecutively studied patients suspected of having gastrointestinal pathology, oral contrast-enhanced computed tomography was more sensitive than AMI-121 MRI in detecting abdominal pathology. Conversely, AMI-121 MRI was more specific than computed tomography [3]. Oral ferumoxsil contrast agent is effective in gastrointestinal MR imaging and in delineation of normal and pathologic structures in the bowel [PubMed].

References

1. Wang Y. X., Hussain S. M., Krestin G. P. Superparamagnetic iron oxide contrast agents: physicochemical characteristics and applications in MR imaging. *Eur Radiol*. 2001;**11**(11):2319–31. PubMed PMID: 11702180.
2. Hahn P. F., Stark D. D., Lewis J. M., Saini S., Elizondo G., Weissleder R., Fretz C. J., Ferrucci J. T. First clinical trial of a new superparamagnetic iron oxide for use as an

oral gastrointestinal contrast agent in MR imaging. *Radiology*. 1990;**175**(3):695–700. PubMed PMID: 2343116.

3. Johnson W. K., Stoupis C., Torres G. M., Rosenberg E. B., Ros P. R. Superparamagnetic iron oxide (SPIO) as an oral contrast agent in gastrointestinal (GI) magnetic resonance imaging (MRI): comparison with state-of-the-art computed tomography (CT). *Magn Reson Imaging*. 1996;**14**(1):43–9. PubMed PMID: 8656989.