

# SPIO 가 MR

MR, SPIO가, MR, SPIO가

SPIO 112  $\mu\text{gFe/mL}$   $2.384 \times 10^{-7}$   $\mu\text{gFe/mL}$  T2\*

SPIO가  $112 \mu\text{gFe/mL}$  SPIO 24

SPIO가  $1 \times 10^6$  1/4

MR T2\*

SPIO가 28  $\mu\text{gFe/mL}$  T2\* 가 가 ,

0.219  $\mu\text{gFe/mL}$  가 (plateau)

SPIO가 가 , SPIO가

가 122 MR T2\*

SPIO가 가 T2\* 가 , SPIO

가 488 T2\* 가

(molecular Imaging) (cellular imaging) SPIO 가 , SPIO가 (susceptibility effect)

(magnetic resonance, MR) (1). MR (3).

(iron oxide) (3),

MR MR SPIO 가

(1). (superparamagnetic iron oxide, 가 MR MR 가

(macrophage) (2). MR Philips 1.5 - T Gyroscan Intera (Philips, Best, the Netherlands)

(phagocytic cell) T2\* (T2\* - weighted gradient echo)

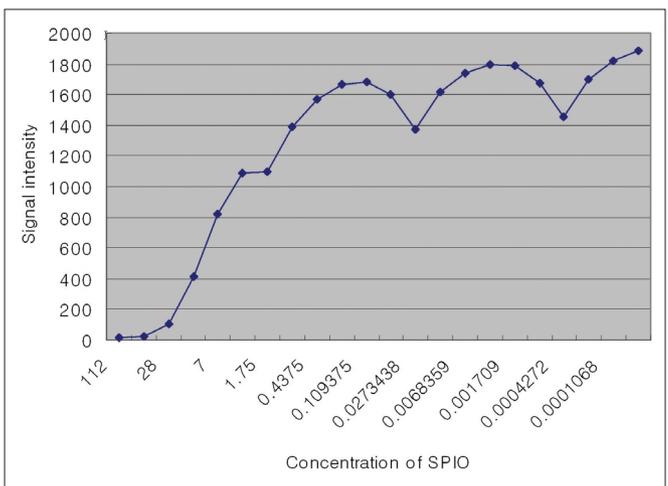
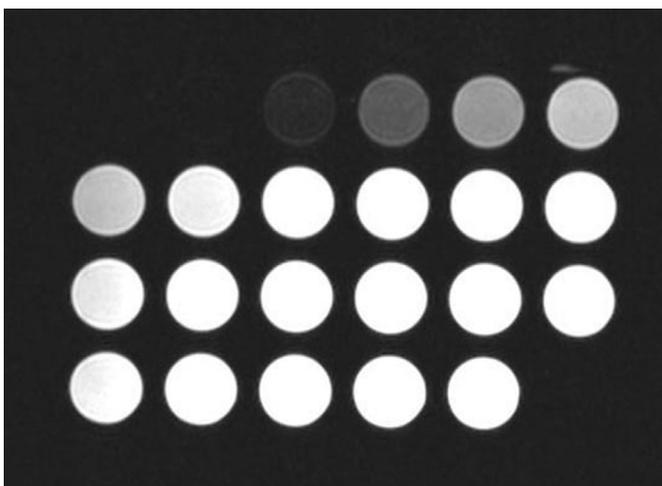
(Repetition time/Echo time = 313 msec/14 msec, 18 ° flip angle, 512 x 512 matrix, 1.5 - mm section thickness)

<sup>1</sup> 2005 (05-384)

<sup>2</sup> 2005 12 30 2006 8 11

SPIO MR T2\* 1.5T MR  
 가 , 24  
 (well plate) 112  $\mu\text{gFe/mL}$  1/2  
 22  $2.384 \times 10^{-7} \mu\text{gFe/mL}$   
 T2\* Region of Interest (ROI) 1  $\text{cm}^2$   
 3% aged Brewer's thioglycollate 1 mL  
 saline, 5 (Phosphate buffered  
 PBS) (peritoneal washing)  
 가 (4). 60 10 mL  
 0.2N , 10 mL 1.8 N  
 fetal calf serum RPMI - 1640  
 10% heat - inactivated  
 (tissue culture flask)  
 37 2 가  
 가 PBS 가  
 SPIO 가 112  $\mu\text{gFe/mL}$   
 SPIO 25  $\mu\text{gFe/mL}$ , Feridex, Berlex Laboratories)  
 24

: SPIO 가 MR  
 SPIO , 37 10 mmol/L  
 EDTA (ethylenediaminetetraacetic acid) 가 PBS  
 10 - 15 .  
 PBS  
 EDTA SPIO  
 (Prussian -  
 blue staining) .  
 SPIO 가 MR  
 Neubauer hemocytometer (Neubauer, Marienfeld,  
 Germany) Trypan blue SPIO  
 SPIO  
 MR T2\* (detectabi -  
 ility) ,  $1 \times 10^6$  가  
 1 10 tube 1/4  
 8000 rpm 10  
 SPIO  
 MR  
 SPIO 112  $\mu\text{gFe/mL}$   $2.384 \times 10^{-7} \mu\text{gFe/mL}$   
 T2\* , SPIO  
 가 112  $\mu\text{gFe/mL}$ ,  $\mu\text{gFe/mL}$  SPIO  
 T2\* MR 가  
 . SPIO 가 28  $\mu\text{gFe/mL}$   
 가 가 , 0.219  $\mu\text{gFe/mL}$   
 가 (plateau) (Fig. 1).  
 $1 \times 10^6$   
 24 SPIO



**A** T2-weighted MR image of variable concentration of iron oxide. According to the decreased concentration of iron oxide, signal intensity of MR image was increased gradually.  
**B** Plotting of the relation between the concentration of iron oxide and signal intensity.

SPIO 가 (Fig. 2).  
 SPIO가 T2\* SPIO (1).  
 1 (1 × 10<sup>6</sup> cells)  
 6 (488 cells)  
 7 (122 cells)  
 가 MR (Fig. 3).  
 (targeted macromolecules) (biological

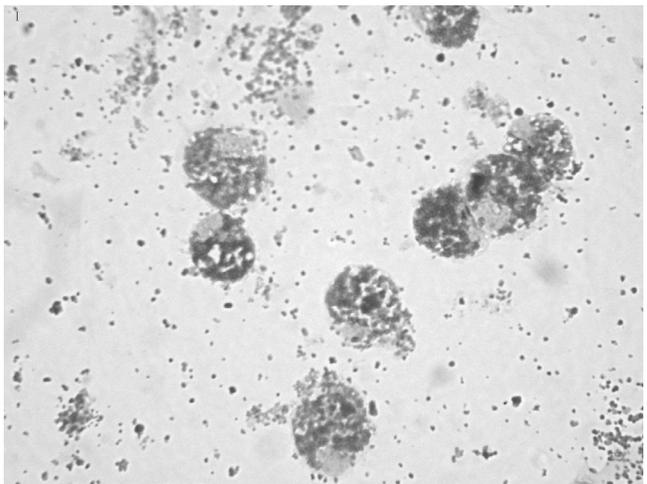


Fig. 2. Prussian blue staining of macrophages after incubation with 112 (µgFe/mL tissue culture flask for 24 hours. Compact upkake of SPIO was detected in the cytoplasm of the macrophages. (Prussian blue staining; × 200)

processes)  
 (1).  
 (cellular level)  
 (molecular level)  
 MR (ultra - small super - paramagnetic iron oxide, USPIO)  
 가 USPIO 가 (5 - 15). Kooi (8) (prospective patient trial) (stable plaque) (rupture)  
 가 (acute tubulopathy), (cyclosporine) (12). (13) (14), (experimental allergic encephalomyelitis) (15)  
 MR USPIO

, FDA SPIO, Feridex (ferumoxides injectable solution, Berlex Laboratories, Montville, NJ, U.S.A.) 가 , USPIO product Combidex (Ferumoxtran - 10, Advanced

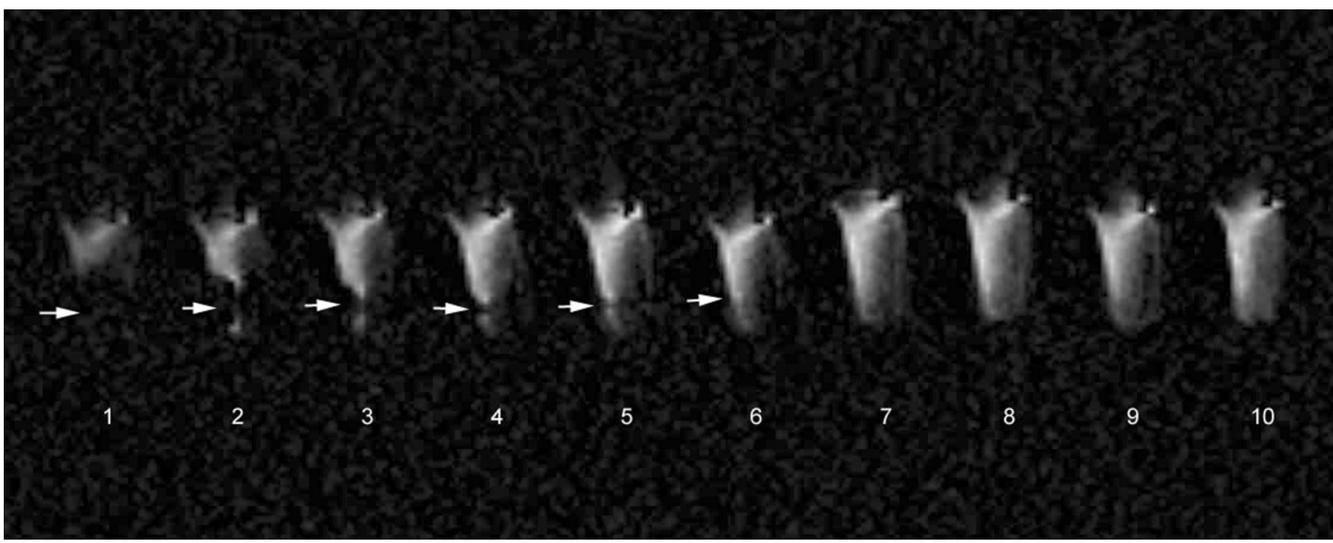


Fig. 3. T2\*-weighted GRE MR image (313/14, 18 °flip angle) of micro tubes with variable number of macrophages labelled with superparamagnetic iron-oxide. There was very strong susceptibility artifact (arrows) in #1 tube with 1 × 10<sup>6</sup> macrophages. The susceptibility effect could not be detected in the tubes with macrophages no more than 122 macrophages (#7 - 10 tubes).

Magnetics, Cambridge, MA, U.S.A.) Sinerem (AMI - 227, Guerbet, Paris, France) (1).  
 USPIO 가 MR , USPIO 가 MR (biodegradation) , USPIO 가 (USPIO 가 T2\* 가 SPIO가 SPIO 가 micron - sized iron oxide particles (MPIOs)가 (16).  
 Foster - Gareau (22) 1.5 T MR SPIO MRI . Fleige (20) neutral carboxydextran - coated 가  $1 \times 10^6$  , acidic citrate - coated 가  $0.09 \times 10^6$  , MR .  
 1.5 T MR SPIO 가 488 . Fleige (20) 3 mmol/L USPIO 120 112  $\mu\text{gFe/mL}$  SPIO 24 USPIO SPIO (dephaging) T2\* 가 (19). SPIO T2\* 가 MR 가 .  
 Fleige (20) USPIO 0  $\mu\text{mol/L}$  1,000  $\mu\text{mol/L}$  MR , USPIO 가 0 100% , USPIO (Non - phagocytic cell) SPIO (cell migra - tion) (trafficking) (monitor) 가 (19, 23 - 25).  
 100% , SPIO 가 1.75  $\mu\text{gFe/ mL}$  50 - 60%가 , SPIO 가 (target cell) (migration) 28  $\mu\text{gFe/mL}$  , T2\* 가 (target organ) 가 (26, 27). SPIO , SPIO (foreign material) 가 , SPIO (28, 29).  
 27가 (phagocytosis) , SPIO (pinocytosis) SPIO 가 62.5, 125, 250  $\mu\text{gFe/mL}$  2 (Unpublished data). MR SPIO (21). Raynal (3) SPIO 가 62.5, 125, 250  $\mu\text{gFe/mL}$  SPIO , SPIO가 5 pg Fe , 250  $\mu\text{gFe/mL}$  7.7 pg Fe , SPIO가 100  $\mu\text{gFe/mL}$  24, 48, 72 , 가 2.5, 2.9. 6.2 pg Fe SPIO SPIO 가 SPIO 가 .

가 가

	SPIO	112 $\mu\text{gFe/mL}$	2.384
$\times 10^{-7}$ $\mu\text{gFe/mL}$		T2*	
SPIO		T2*	
	112 $\mu\text{gFe/mL}$	SPIO	24
		SPIO	
SPIO가		MR T2*	
	SPIO	가 488	
	T2*	가	

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## Relationship between the Number of SPIO-labeled Macrophage and MR Signal Intensity<sup>1</sup>

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**Purpose:** For the in vivo imaging of macrophages using MRI, the feasibility of labeling macrophages with iron oxide and the number of SPIO-labeled macrophage detected in 1.5 T MR, were assessed.

**Materials and Methods:** The MR signal intensity was measured with variable concentrations of iron oxide, ranging from 112 to  $2.384 \times 10^{-7}$   $\mu\text{gFe/mL}$ . The macrophages were incubated in SPIO solution (112  $\mu\text{gFe/mL}$ ) for 24 hours. The MR signal intensity was measured in variable numbers of SPIO-labeled macrophages.

**Results:** The MR image signal intensity gradually increased with decreasing SPIO concentration, and reached a plateau at a concentration of 0.219  $\mu\text{gFe/mL}$ . After incubation with iron oxide, the compact uptake of SPIO was detected in the cytoplasm of the macrophages using Prussian blue staining. No susceptibility effect was detected in the tubes of more than 122 macrophages.

**Conclusion:** The MR signal intensity was dependent on the number of macrophages. No susceptibility effect due to a cluster of SPIO-labeled macrophages was detected in more than 488 cells.

**Index words :** Phantoms

Magnetic resonance (MR), experimental studies

Magnetic resonance (MR), contrast enhancement

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