

Cellular and molecular imaging with MRI in Cardiovascular system

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Current Imaging Technology for Molecular Imaging

	Anatomy	Physiology	Metabolism	Molecular
CT	++++	+	-	-
US	+++	++	-	-
MRI	+++	+++	++	++
Nuclear	+++	++	++	++
Optical	+	+	+	+

	Sensitivity	Spatial	Temporal	Contrast
CT	+	++	+	++
US	++	+++	++	++
MRI	+++	++	++	+++
Nuclear	+++	+	+	++
Optical	+++	+	++	+++

Acad Radiol 2001

Single Cell Imaging using MRI

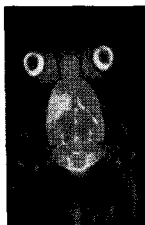


KSBI

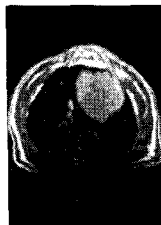


Bruker 4.7TMR

MR Imaging of Small Animals

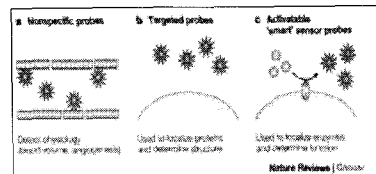


Rat Brain, T2WI



Liver, T2WI with SPIO Feridex

Three Types of the Probes in Molecular Imaging



	Nonspecific NIR2 probes (TKD)	Targeted NIR2-Folate Conjugate (1.4 KD)	Activatable Cathepsin B (600KD)
Signal Intensity	+++	++++	+++
Noise	++	++	-
SNR	+	++	+++

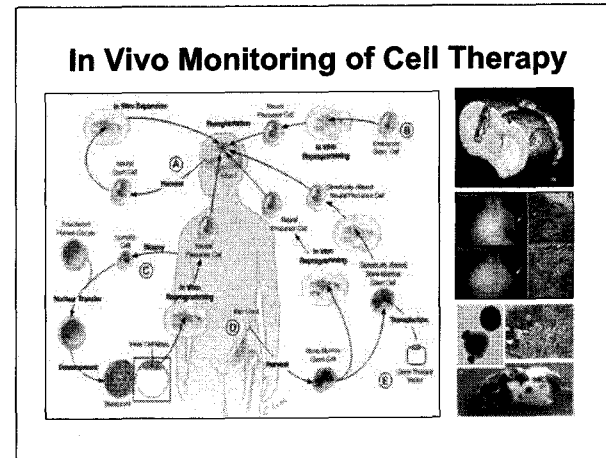
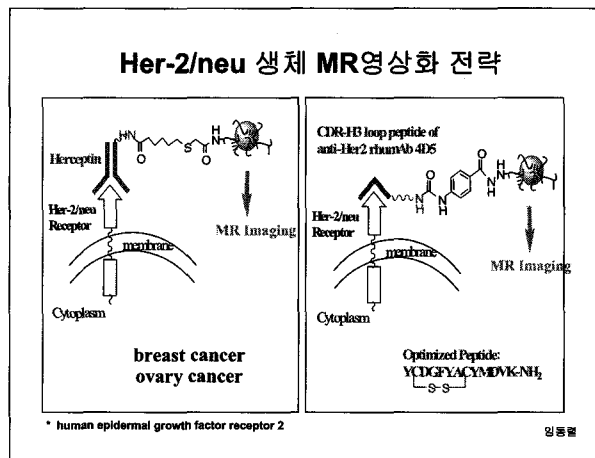
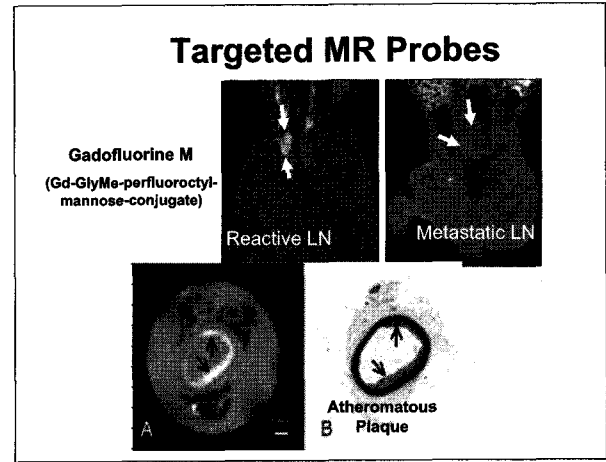
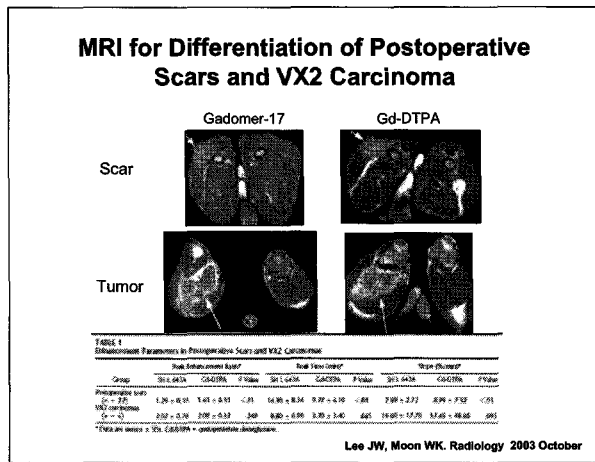
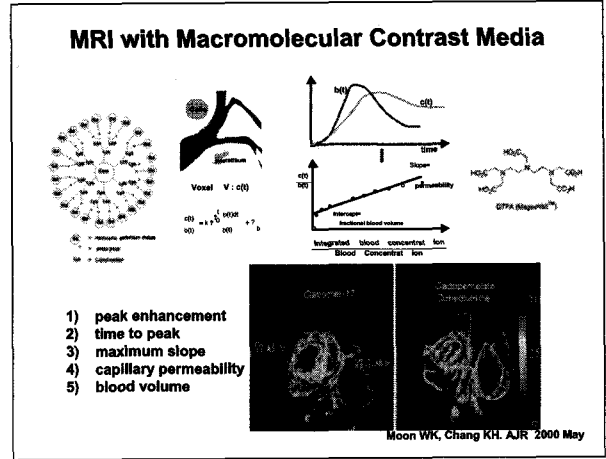
Molecular MR Probes

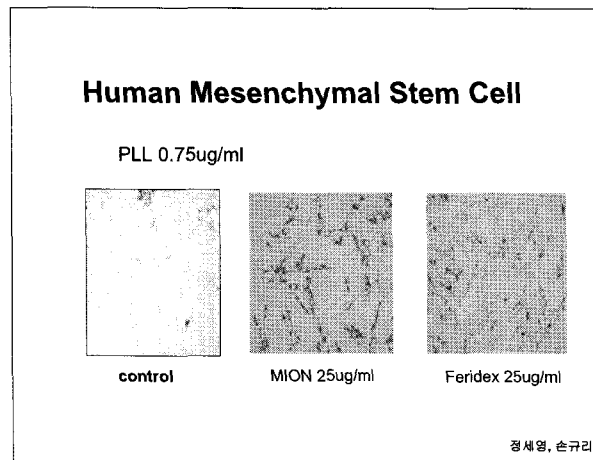
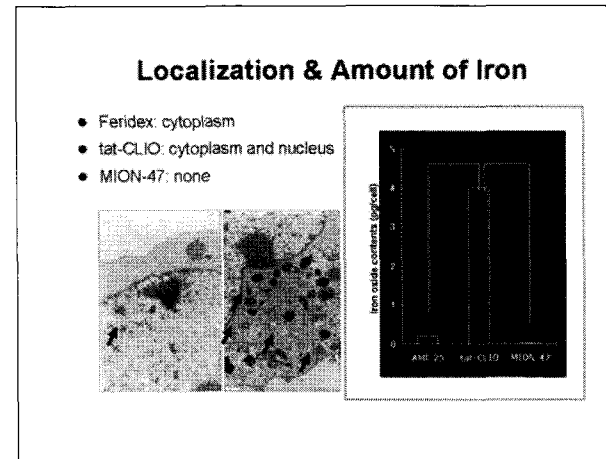
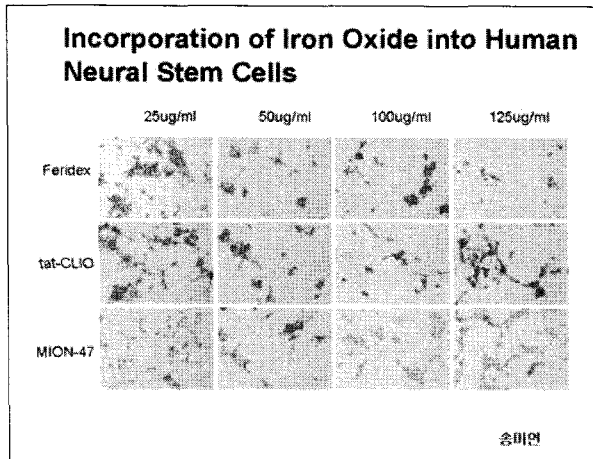
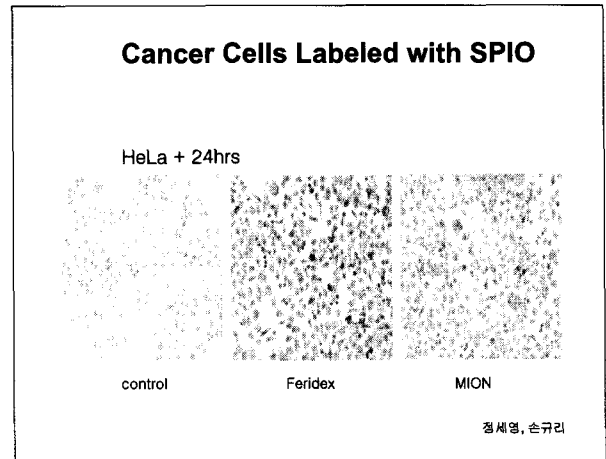
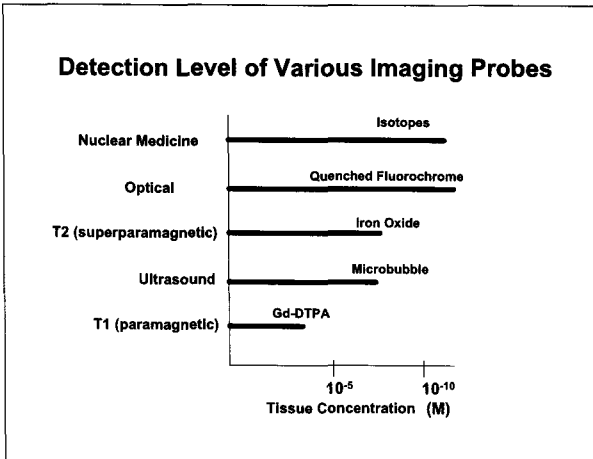
표 1. 분자 MR 영상용 조영제 개발에 관련된 주요 물질들

종류	대표적 물질	분자량 (kDa)	분자당 (Da)
계면활성 조영제	Gd-DTPA Magnevist*	-	743
단백질 수송체	Albumin	8	60,000
	Poly-L-Lysine	-	52,000
수용체	PANAM (dextrane)	6-8	60,000
	Gadomer-17	5-6	37,500
인쇄질 나노입자	MECN-45	34	75,000
	OLEO	37	800,000
	SPIO Feridex*	70-140	Megadaton
다공성	Gd-particle-carbon	200	Megadaton

* monocrySTALLINE Iron oxide Combidex (ferumoxtran-10)

문우경, 대한의학회지 2004



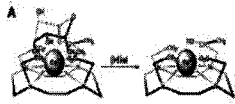


Activatable ("Smart") MR Probe

- Enzyme activated
- Calcium activated
- pH activated
- pO₂ activated
- Protein binding

Meade T. 2003

"Smart" MR Probe for In vivo Imaging of β -galactosidase mRNA Expression



Upon β -galactosidase,
 β -galactose terminal removed from (Egad- Gd-HPDO3A) and Gd has one coordination site, to which water molecule can be accessed



Biochemical switch !

Meade T. Nature Biotechnology 2000

Plaque imaging

- Expected role of plaque imaging
 - Detection of plaque itself
 - ❖ Not only stenosis of vessel lumen
 - Characterization of plaque
 - ❖ Fibrous plaque vs soft plaque
 - Final goal: differentiate plaques that are more likely to cause ACS

MR coronary angiography



- Contrast enhanced coronary MR angiography
- Blood pool agent
- Not suitable for vessel wall imaging

Black blood MRI technique



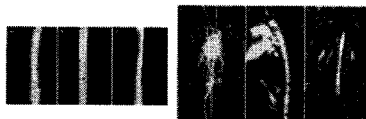
- Double inversion recovery preparation pulse
- Blood signal is suppressed and vessel wall is clearly demonstrated
- Limited resolution
 - > - high CNR (contrast media for atheroma) is needed

MR contrast media for plaque

- Fibrin specific nanoparticles



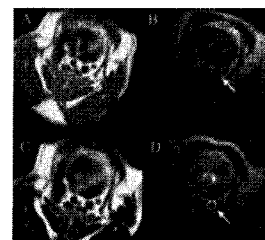
- USPIO



- Gadofluorine

Gadofluorine

Pre



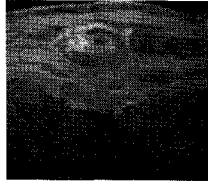
48H delay

Haste T1

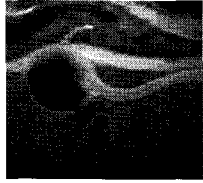
IR Turbo Flash

Barkhausen et al. Circulation.2003; 108: 605-609

In vivo MR of rabbit aorta with atherosclerosis

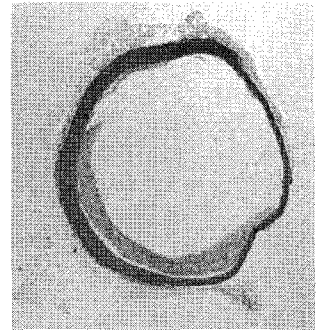
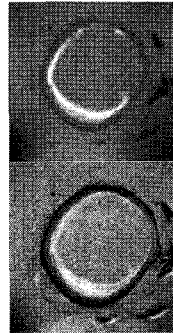


Pre contrast
fat sat T1



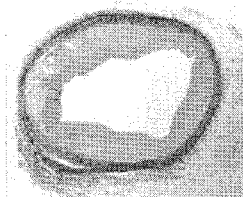
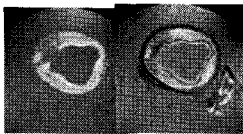
Gadofluorine post contrast
fat sat T1

DM & Diet 0.05 mmol GDM



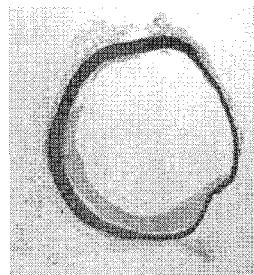
GDM 2002 M

DM & Diet 0.05 mmol GDM

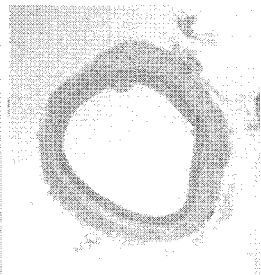


2003-Upper

**Intimal injury 3 days
- active inflammation**



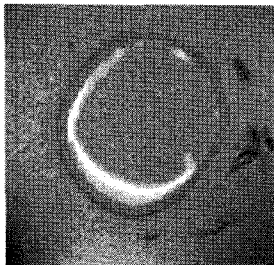
DM & Diet 4 month



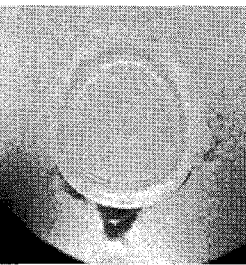
Intimal injury 3 days

GDM 4002 M

**Intimal injury 3 days
- active inflammation**



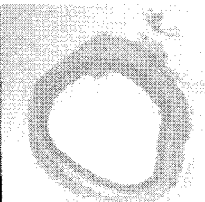
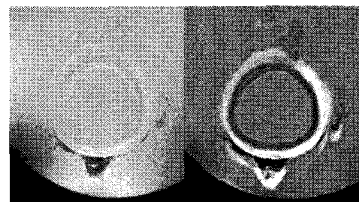
DM & Diet 4 month



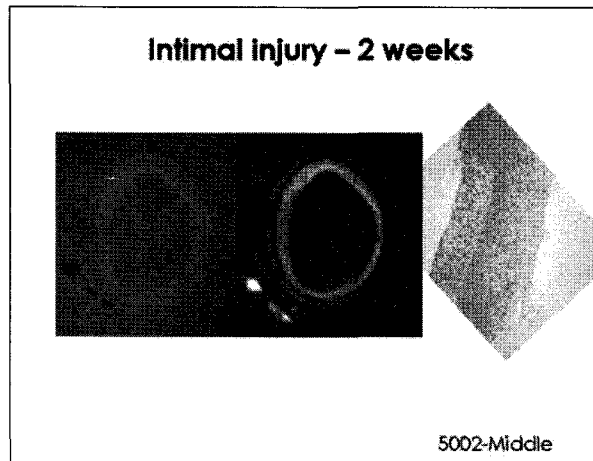
Intimal injury 3 days

GDM 4002 M

**Intimal injury 3 days
- active inflammation**



4002-Middle



MEMO

MEMO