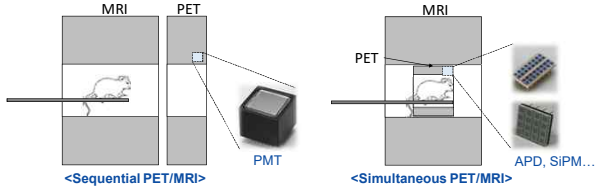
Initial *in vivo* imaging studies using a multi-parametric simultaneous PET/MR imager

Guen Bae Ko, Kyeong Yun Kim, Min Sun Lee, Ji Yong Park, Yun-Sang Lee, Keon Wook Kang, Jae Sung Lee

Department of Nuclear Medicine, Seoul National University, Seoul, Korea

Introduction

Advantage of simultaneous PET/MRI



✓ Simultaneously operated PET/MRI **reduces acquisition time and anesthesia dose** and attains **perfect spatial and temporal correlation** between the information provided by two imaging modalities.

New multi-parametric simultaneous PET/MR imager

Permanent magnet MRI

- ✓ No cryogens
- ✓ Compact & safe (no stray field)
- ✓ Low maintenance
- ✓ Small installation area

SiPM-based PET insert

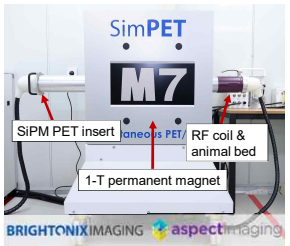
- ✓ High image quality (vs. APD)
- ✓ Stable PET performance (Real time temperature compensation)

To demonstrate the feasibility of the combined PET/MRI system, we performed various rodent imaging studies.

Simultaneous PET/MR Scanner

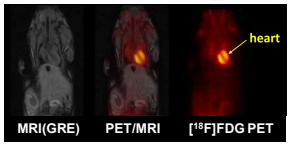
Aspect SimPET™ PET/MRI[1,2]

- ✓ 1-T permanent magnet based MRI system
- ✓ SiPM PET technology
- ✓ Fully simultaneous operation or standalone operation



<PET Specifications>

Characteristics	Value
Detector ring diameter (mm)	64
Scintillator materials	LYSO
Crystal size (mm³)	1.2 × 1.2 × 10.0
Number of crystal rings	36
Number of crystals/ring	144
Total number of crystals	5184
Axial FOV (mm)	55
Insert inner diameter (mm)	60



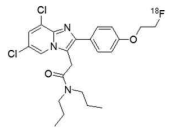
<PET Performance[3,4]>

Characteristics	Value
Scatter fraction for mouse	17%
Peak sensitivity	3.4%
Spatial resolution w/ 3D OSEM	0.8 mm
Spatial resolution w/ FBP	1.3 mm
Energy resolution	15%

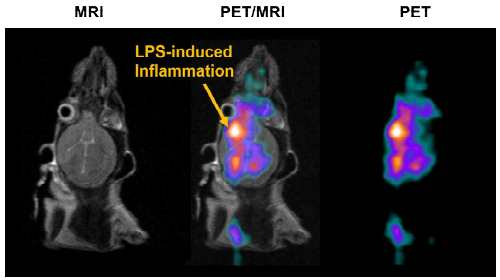
In vivo Imaging Studies

Neuroinflammation imaging

- TSPO imaging tracer: [18F]CB251



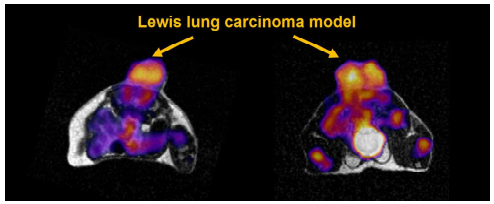
- Promising TSPO PET imaging agent for neuroinflammation [Perrone *et al.*, Sci Rep, 2016]
- C57BL/C mouse, 20.1g
- 200 μCi [18F]CB251, 20 min uptake
- T2w FSE (TR = 3000 ms, TE = 63.5 ms)



Collaboration with Prof. Yoon H & Lee BC (Seoul National University Hospital)

LLC tumor model imaging

- C57BL/C Lewis lung carcinoma model
- 200 μCi [18F]FDG, 60 min uptake
- T2w FSE (TR = 3070 ms, TE = 63.8 ms)



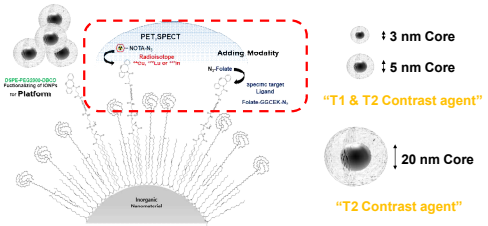
Collaboration with Prof. Ahn G & Cheon GJ (POSTECH & SNUH)

Iron oxide nanoparticle (IONP) imaging

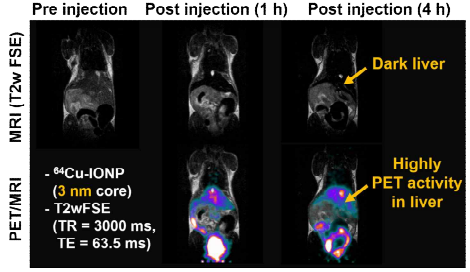
Collaboration with Prof. Lee Y-S (Seoul National University Hospital)

- ✓ Surface modification:

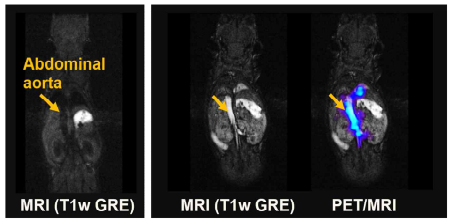
Specific amphiphile encapsulation [Lee *et al.*, J. Nucl. Med., 2012]



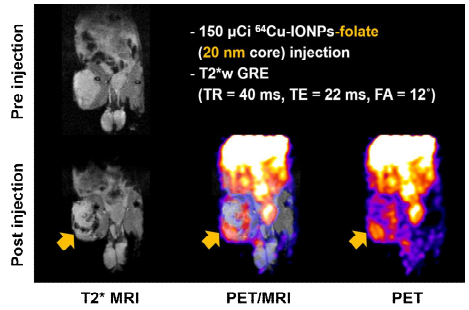
- ✓ T2 Contrast change by IONP uptake

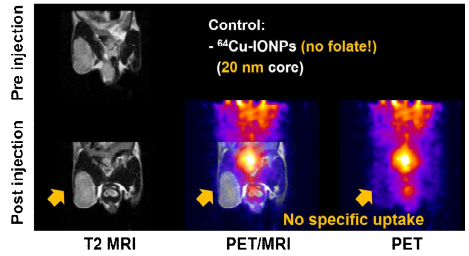


- ✓ Blood pool imaging using 5 nm IONP
  - 325 μCi 64Cu-IONPs (5 nm core) injection
  - T1w GRE (TR = 9 ms, TE = 2.8 ms, FA = 45°)



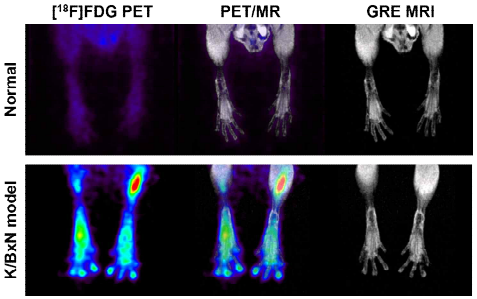
- ✓ Tumor imaging using 20 nm IONP and folate





Mouse arthritis imaging

- K/BxN arthritis mouse model
- 300 μCi [18F]FDG, 60 min uptake



Collaboration with Prof. Paeng JC (Seoul National University Hospital)

Conclusion

Our initial in vivo imaging studies using the new multi-parametric imager demonstrated its feasibility for small-animal experiments, suggesting its usefulness for investigating rodent models of diseases and for cross-validation studies of bi-modal imaging probes for PET and MRI.

References

[1] http://www.brightoniximaging.com [2] http://www.aspectimaging.com

[3] Ko *et al.* Evaluation of a silicon photomultiplier PET insert for simultaneous PET and MR imaging. Med Phys. Jan 2016:43(1):72-83.

[4] Ko *et al.* Simultaneous multi-parametric PET/MRI with silicon photomultiplier PET and ultra-high field MRI for small animal imaging. J Nucl Med. Aug 2016;57(8):1309-1315.

guenbko@gmail.com (Guen Bae Ko) & jaes@snu.ac.kr (Jae Sung Lee)