^{44m}Sc-DOTA-TATE imaging with a cancer disease mouse model for multiple-isotope PET imaging

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Positron emission tomography (PET) is a powerful tool for the visualization of radiotracer distribution used for imaging diagnosis in medical and fundamental life sciences. However, standard PET is only useful for single-tracer imaging because of the energy constancy of annihilation photons, which are utilized for PET imaging. To enhance the usefulness of PET, we developed a new PET system that can be used for simultaneous multi-tracer PET imaging, named multiple-isotope PET (MI-PET).[1,2)]

A positron emitter ^{44m}Sc is one of the MI-PET nuclides. MI-PET utilizes a prompt γ-ray to identify the tracer nuclide in addition to coincidence measurement of positron-electron annihilation photons, which is used for conventional PET systems. ^{44m}Sc is a beta-plus decay nuclide with a half-life of 58.6 h and emits 1157 keV prompt γ-ray successively after positron emission. As a preliminary study for future multi-tracer imaging, we conducted single-tracer PET imaging experiment using a cancer mouse model with ^{44m}Sc labelled drug.

For future multi-tracer imaging, we synthesized a tracer labelled by an MI-PET nuclide ^{44m}Sc (positron prompt γ-ray emitter) and tested for accumulation on cancer cells. For the experiment, we synthesized a ^{44m}Sc labelled DOTA-TATE (DOTA-[Tyr^3]-octreotide), which is a compound containing tyrosine^3-octreotate and somatostatin receptor for numerous malignancies. The labelling protocol was based on a method developed by Huclier-Markai *et al.*[3,4)] DOTA-TATE was purchased from BACHEM (Switzerland). ^{44m}Sc was produced *via* the reaction of ^{44}Ca$(d, 2n)^{44m}$Sc with a 24-MeV deuteron beam at the RIKEN AVF cyclotron and purified by ion-exchanges. The produced ^{44m}Sc was transported to the RIKEN Kobe campus for the drug synthesis. A total of 0.2 nmol of DOTA-TATE and 5 MBq of ^{44m}Sc were added into NaOH 95°C for 30 min with shaking. After incubation, 1.1 MBq of 95°C for 30 min with shaking. After incubation, 1.1 MBq of ^{44m}Sc labelled DOTA-TATE was purified using a C18 solidphase extraction column. The labelling ratio for ^{44m}Sc-DOTA-TATE was approximately 30%.

We prepared an 8-week-old immunodeficient male mouse transplanting pancreatic tumoral cell (AR42J)[5)] as a cancer disease animal model. For the imaging experiment, 1.1 MBq of ^{44m}Sc-DOTA-TATE was administered *via* the tail vein. After 1 min from administration, a 90-min scan of the mouse abdomen was performed under anaesthesia using the MI-PET system.[1)] The experimental setting for the mouse imaging is shown in Fig. 1. All animal experiments in this study received ethical approval by the institutional review board of RIKEN and were performed in accordance with the guidelines for care and use of laboratory animals.

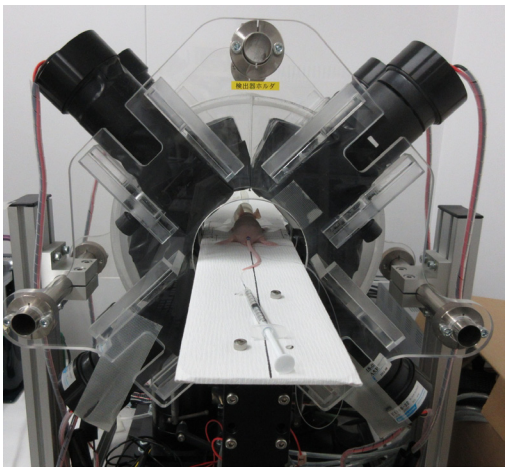

Fig. 1. Experimental setting for the mouse imaging using MI-PET system.

Figure 2 shows a photograph and reconstructed image of a mouse. In this reconstructed image, we

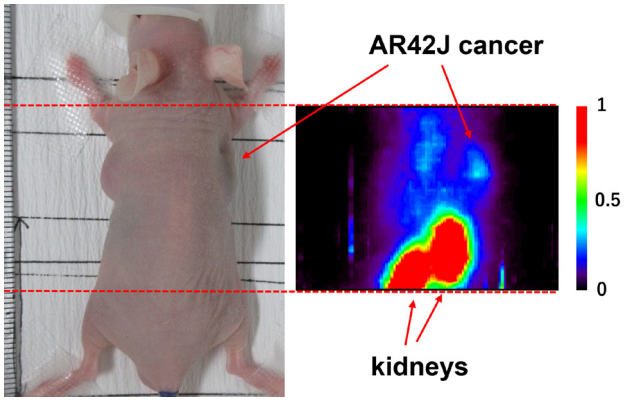

Fig. 2. A photograph (left) and reconstructed image (right) of a mouse administrated with ^{44m}Sc-DOTA-TATE. Image is reconstructed by conventional PET events, namely coincidence measurement of the annihilation photons without prompt γ-ray detection.

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can clearly observe the accumulation of ^{44m}Sc-DOTA-TATE in AR42J cancer. In the future, we will perform imaging experiments for multi-drug comparison on animal disease models using ^{44m}Sc-DOTA-TATE and other PET tracers, such as ^{18}F-FDG.

References

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