Department of Patho-Functional Bioanalysis

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Research Projects:

A wide range of biological functions are established via the interactions of many biomolecules; therefore, the clarification of such molecular interactions is necessary for the elucidation of biological functions. Our department is developing analytical methods that visualize the interactions among molecules occurring in living and functioning bodies (*in vivo*) as real-time spatial and temporal images using photon technology (molecular imaging), studying biological functions and etiology using this method, and developing clinical diagnostic methods and therapeutic agents based on the characterization of pathological conditions. Our current research projects are outlined below.

1) Development of molecular probes for the *in vivo* analysis of biological function, etiological mechanisms, and action mechanisms of drugs

We are currently conducting research on development of radiolabeled and optical molecular probes, which are reagents for molecular imaging, on the basis of analysis of the relationships among the structure, activity, and distribution. For example, we have succeeded in development of radiolabeled molecular imaging probes, imaging and the quantitative evaluation of β-amyloid plaques and neurofibrillary tangles in the brain in Alzheimer's disease patients (Figure 1). Furthermore, we also develop radiolabeled molecular probes effective for molecular imaging of receptors of endocrine peptides and transporters of pharmaceuticals. Moreover, we have developed a self-quenching activatable fluorescence probe for *in vivo* near-infrared optical imaging, which is activated by the interaction with specific molecule or under cellular microenvironment *in vivo* and emits fluorescence. In addition, with the molecular design concept of bifunctional compounds having both a moiety related to physiologic activities and a moiety that emits detection signals of radiation and fluorescence, within the same molecule, we are conducting research for the development of molecular probes derived from physiologically active peptides or proteins.

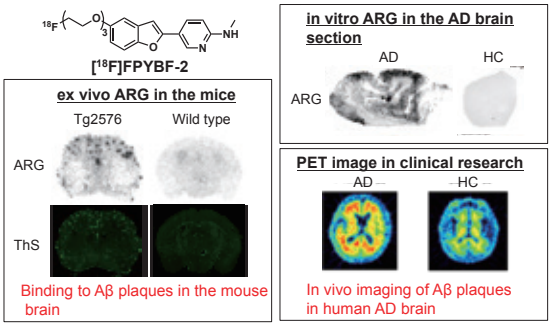

Figure 1. In vivo imaging of Aβ plaques in the brain from Alzheimer's disease (AD) patients

2) Development of radiopharmaceuticals for functional diagnosis and internal radionuclide therapy

The nuclear medicine techniques, in which a radioactive compound (radiopharmaceutical) is administered to patients, and radioactivity from the radioactive compound is detected and processed into images, are used as a clinical imaging method excellent for functional diagnosis. We are conducting research into the development and clinical use of radiopharmaceuticals based on the characterization of physiological conditions and diseases. We are simultaneously conducting research for the development of ^{99m}Tc-labeled radiopharmaceuticals for nuclear medicine diagnosis; that is, we are systematically investigating the formation of complexes of Tc, a transition metal, and developing functional radiopharmaceuticals labeled with ^{99m}Tc. We are also developing cancer radiotheranostics that includes nuclear medical imaging and internal radionuclide therapy targeting carbonic anhydride IX (CA-IX) (Figure 2).

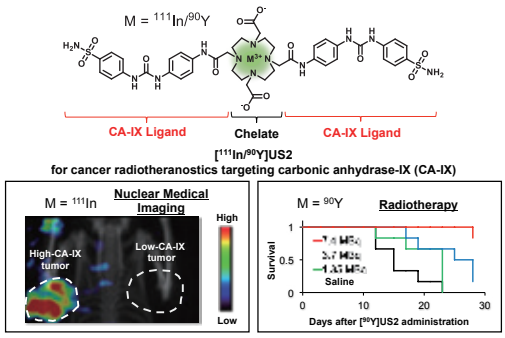

Figure 2. Development of cancer radiotheranostics agents targeting CA-IX

Recent publications

- Iikuni S, et al., Cancer radiotheranostics targeting carbonic anhydrase-IX with ^{111}In- and ^{90}Y-labeled ureidosulfonamide scaffold for SPECT imaging and radionuclide-based therapy. *Theranostics*, **8** (11), 2992-3006 (2018).
- Watanabe H, et al., Novel benzothiazole derivatives as fluorescent probes for detection of β-amyloid and α-synuclein aggregates. *ACS Chem. Neurosci.*, **8** (8), 1656-1662 (2017).
- Ono M, et al., Radioiodination of BODIPY and Its Application to a Nuclear and Optical Dual Functional Labeling Agent for Proteins and Peptides. *Sci. Rep.*, **7**, 3337 (2017).