·Editorial·

Neuro-molecular imaging

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Neuroscience is the scientific study of how the nervous system develops, its structure, and what it does. With the development of different sciences and technologies, neuroscience has become an interdisciplinary science that collaborates with other fields, and the research approach of neuroscience has also changed greatly. Molecular imaging is a powerful tool for neuroscience that can be used for understanding disease, identifying biomarkers, and developing novel therapeutics. Molecular imaging plays an important role in neuroimaging, especially for investigations of the living brain. While CT and MRI provide important structural and anatomical information on the brain, neuro-molecular imaging allows the *in vivo* visualization and measurement of cellular/molecular processes in the living brain.

The topics covered in this special issue include advances in PET/CT and CT imaging in neurological disease, tracer development for neuroreceptors, brain function evaluation, stroke therapy, and the translational imaging approach in dementia. For instance, changes in cerebral blood flow (CBF) and cerebral glucose metabolism have often been associated with regional neuronal activity in brain function. Advances in biomarkers in PET imaging for parkinsonism and middle cerebral arterial disease such as the ratio of CBF to cerebral blood volume as a marker of regional cerebral perfusion pressure[1,2], and brain network makers of cerebral glucose metabolism and blood flow[3] are reported and discussed. These biomarkers can serve as clinically useful markers of disease severity and therapeutic response, as well as aid in the differential diagnosis of parkinsonism. Along this line, Heiss[4] reviews PET applications to pathophysiological changes caused by cerebrovascular diseases, which have broadened our understanding of flow and metabolic thresholds critical for the maintenance of brain function and morphology.

Imaging tracers provide possibilities for molecular imaging in neuroscience. PET uses biomolecules as tracers that are labeled with radionuclides with short half-lives, synthesized prior to imaging studies. The administration of such radiotracers to the brain provides images of transport, metabolic, and neurotransmission processes on the molecular level. The contribution by Peter *et al.*[5] reviews the strategy of radiotracer development bridging from basic science to biomedical application; this allows molecular neuroreceptor imaging studies in various small-animal models of disease including genetically-engineered animals, and can be used for *in vivo* pharmacology during the process of pre-clinical drug development to identify new drug targets, to investigate pathophysiology, to discover potential drug candidates, and to evaluate the pharmacokinetics and pharmacodynamics of drugs *in vivo*.

Tracer kinetic modeling in dynamic PET has been widely used to investigate the characteristic distribution patterns or dysfunction of neuroreceptors in brain diseases. Seo and co-workers[6] review graphical analysis (GA) which is a major parametric mapping technique that is independent of any compartmental model configuration, robust to noise, and computationally efficient. They describe recent advances in the parametric mapping of neuroreceptor binding based on GA methods. Hou and co-workers[7] discuss the value of PET in drug addiction and review the major findings of PET imaging studies on the involvement of dopamine (DA) in drug addiction, including presynaptic DA synthesis, vesicular monoamine transporter

2, the DA transporter, and postsynaptic DA receptors. Imabayashi *et al.* [8] review the superiority of neurostatistical imaging for diagnosing dementia using PET, MRI, and CT. Dong and co-workers[9] report a study on the effect and safety margin of bevacizumab on the infarction area of cerebral ischemia using PET. They demonstrate an inhibitory effect on metabolic recovery after bevacizumab therapy in a rat model of cerebral ischemia. Cui *et al*.[10] review the role of cortical spreading depression in the pathophysiology of migraine.

In summary, neuro-molecular imaging can integrate metabolomics and neurobiology and provides novel insights into pathophysiology in the brain. This special issue provides a platform on neuroscience research from molecular imaging technology which may have a high impact on brain science from basic to translational medicine.

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