[SY04] Preclinical Bioimaging for Drug Development

SY04-01

Preclinical MRI for new drug development

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The principal strengths of MR techniques are non-invasiveness, high spatial resolution and excellent soft tissue contrasting capabilities. Particularly, MRI can provide an exceptional range of information - anatomical/metabolic/physio-pathological/functional information. Many MR techniques – basic imaging techniques (T1w/T2w/PD), diffusion, perfusion, MR spectroscopy, functional-MRI and angiography – have been applied in both preclinical and clinical stage of new drug development. This talk is going to introduce the examples (with cases of C-BiND) of MRI/MRS applications on preclinical stage for new drug development.

Keywords : Preclinical MRI, New drug development, Mouse, Rat, CBiND

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SY04-02

Optical imaging & multiplex immunohistochemistry

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Molecular imaging has gained popularity in recent years, which provides an effective information acquisition, analysis and processing methodology at cellular and molecular levels for biomedical study. As an important molecular imaging technique, optical imaging, especially fluorescence and bioluminescence imaging, has attracted remarkable attention in gene expression regulation and activity detection, biological development and cytological detection, drug research and development, pathogenesis research, pharmaceutical effect evaluation and therapeutic effect evaluation for its excellent performance, non-radioactivity and high cost-effectiveness in comparison with traditional imaging modalities (such as MRI, CT, and radionuclide-based methods). Optical imaging is regarded as the combination of traditional medical imaging technology and modern molecular biology, in which the advanced optics, biology, information, medicine, and other techniques are being married to non-invasively obtain in vivo physiological and pathological information sensitively, quantitatively, and specifically.

Fluorescence imaging in biomedical research aims to evaluate cellular perturbations rather than morphological changes. Disease-specific biomarkers are used as optical molecular probes in these approaches. It is important to consider several aspects for appropriately selecting exogenous probes, such as target specificity, rapid binding kinetics, deep tissue penetration, low immunogenicity, and the ease at which labeling with fluorescent agents can be performed. Recent molecular imaging studies have used fluorescence-labeled exogenous molecular probes such as antibodies, aptamers, peptides, affibodies, nanoparticles, and activatable probes. Bioluminescence imaging has emerged as a powerful tool for the validation of cell culture findings in animal models of cancer. Bioluminescence imaging is a non-invasive imaging modality widely used in the field of pre-clinical oncology research. Imaging of small animal tumor models using bioluminescence imaging involves the generation of light by luciferase-expressing cells in the animal following administration of substrate. This light may be imaged using an external detector. The technique allows for repetitive and exceptionally sensitive real-time monitoring of a disease course, as well as of tumor response to therapeutic interventions in an individual animal.

Here, we will introduce the latest researches and application progresses of commonly used optical molecular imaging techniques such as bioluminescence imaging, fluorescence molecular imaging and multiplex IHC.

Keywords : Optical imaging, Multiplex IHC, Drug, Live cell imaging, FRET

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SY04-03

Uncovering molecular function and particle's behavior in live cells based on confocal microscope-based fluorescence methods

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Confocal microscope based fluorescence correlation method (FCS) is now one of the most reliable techniques that can determine absolute concentration, mobilities (translational and rotational diffusion), interaction, and photo-chemical kinetics of fluorescent molecules and particles. In addition, dual-color fluorescence cross-correlation spectroscopy (FCCS), an extension of single-color FCS, directly provides equilibrium and rate constants of interactions between specific two molecules. By virtue of its single-molecule level sensitivity, high spatial resolution, easy quantification, broad dynamic range, FCS has been applied to various fields of researches such as physical chemistry, nanoparticle science, and life science for detecting hidden properties of molecules (particles) and systems consisted of them. Since protein function is expressed by its interaction with target molecules and cellular organelles, detecting spatio-temporal mobility and molecular interaction give us information for finding and uncovering protein functions. In contrast, non-functional protein and particles give us information about cellular microenvironment such as local viscosity. Therefore, FCS and FCCS have been applied for uncovering/finding protein functions directly in living cells in addition to the characterization of cellular microenvironment by using standard proteins and nanoparticles. The study will provide insight into a general strategy to understand the molecular function and particle’s behavior in live cells through its hydrodynamic and interactional properties.

Keywords : Molecular function, Protein interaction, Mobility, Confocal laser scanning microscopy, Fluorescence correlation spectroscopy

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SY04-04

Small animal PET imaging in Asan Medical Center

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As new chemotherapeutic drugs are continuously being developed, there is an increasing need for non-invasive tools to guide therapy selection and to evaluate response. Molecular imaging technology can be an alternative. Molecular imaging is a technology that enables visualization, characterization, and measurement of biological process at the molecular and cellular levels in living systems. It is an important part of translational studies because it can be repeatedly imaged without damaging the living tissues. Positron Emission Tomography (PET), a type of molecular imaging, is a nuclear medicine functional imaging technique that is used to observe metabolic processes within the body as a functional surrogate response imaging biomarker. In this session, I'd like to introduce our PET imaging core in ASAN medical center and share my experiences.

Keywords : Molecular Imaging, Positron Emission Tomography (PET)