Functional Imaging Division

Introduction

The Functional Imaging Division was opened in June 2006. Our mission is to establish imaging strategies that provide optimal treatment in the fields of surgery, medicine and radiotherapy, using various kinds of imaging modalities. Although there are many kinds of imaging modalities for evaluating the functional aspects of diseases, those most commonly used are nuclear medicine examinations and magnetic resonance imaging (MRI) tests. Our division focuses its attention on these two tests.

Nuclear Medicine

In the clinical field, the usefulness of FDG PET/CT scanning was investigated. PET/CT is an imaging tool that can fuse functional and morphological information. Since our experience in cases of metastatic liver tumors from colorectal cancer has revealed the clinical usefulness of this imaging modality (105), the optimal imaging conditions were actively investigated. The usefulness of 2D imaging in the detection of small lymph node metastases was demonstrated when compared to 3D imaging. Statistical analyses of images also proved promising in detecting these small lesions.

In the laboratory for radionuclide experiments, a SPECT/CT scanner for small animals such as mice and rats, called nanoSPECT/CT, was used. Sentinel nodes of the feet of mice were successfully depicted using this device, demonstrating excellent spatial resolution and sensitivity. This imaging modality could clearly visualize I-125 sources that emit gamma rays with energies as low as 28 keV. It is advantageous in multi-radionuclide imaging that gamma rays with a wide range of energies can be imaged.

Magnetic Resonance Imaging

Due to its high contrast resolution, magnetic resonance imaging (MRI) can provide detailed morphological information. It can also reveal information on the contents of objects by use of magnetic resonance spectroscopy (MRS), contributing to the detection and differentiation of various lesions.

The recent availability of higher magnetic fields is improving the sensitivity of MR signals, resulting in accurate evaluations of metabolite profiles in various organs *in vivo*. When a 4.7-T MR unit was used, the seminiferous tubules in rat testis could be clearly visualized, showing excellent spatial resolution. ^{1}H MRS using this device could also successfully detect and assign several metabolites, including creatine, choline, glutamate, glycine, and lactate in the rat testis by using a short-echo-time stimulated acquisition mode (STEAM) sequence combined with short TI inversion recovery (STIR) (106). This result suggests that MRS at a high magnetic field is valuable for monitoring the metabolic activity of tissues composed of highly proliferative cells, including germ cells and cancer cells.

Future Perspectives

Good methods for accurately evaluating therapeutic effects need to be established for FDG PET/CT. Experimental studies using nanoSPECT/CT will contribute to the development of new methods of evaluating therapeutic effects.

Whole-body MR systems with 3.0-T fields will be soon installed at our division. MR spectra in cancer-bearing hosts will be investigated to find surrogate markers of proliferative activity of cancer lesions.

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