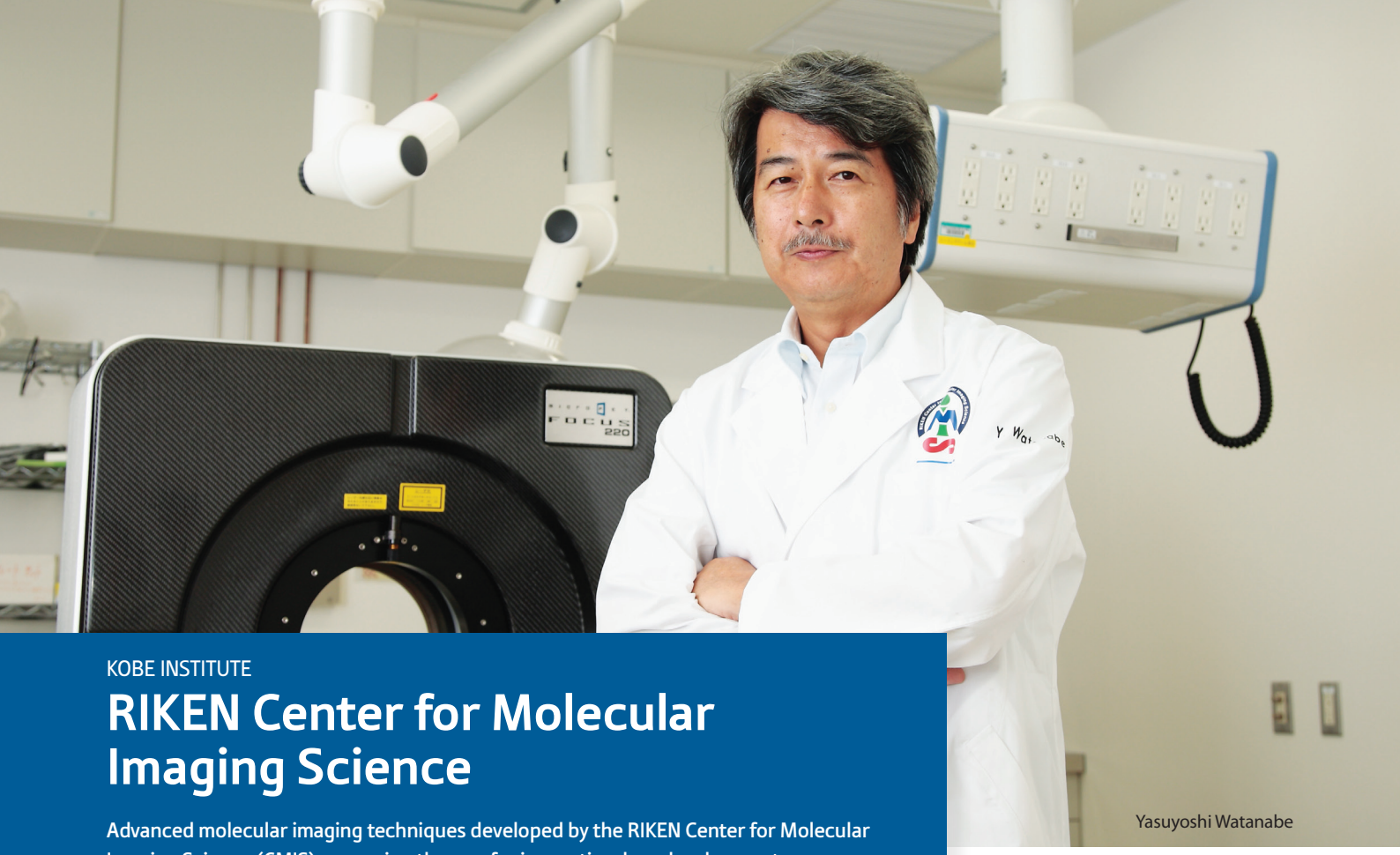

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Advanced molecular imaging techniques developed by the RIKEN Center for Molecular Imaging Science (CMIS) are paving the way for innovative drug development processes.

The rapid advance in molecular and genomic studies has opened a new realm of scientific research on humans, but the difficulty in observing samples in natural conditions remains a major obstacle. "We want to look into how they behave in the body. That is molecular imaging. Our objective is to elevate 'life science' to 'live science' in humans," says Yasuyoshi Watanabe, director of the RIKEN Center for Molecular Imaging Science (CMIS).

Molecular imaging refers to methods to visualize and track the dynamic behavior of genes, proteins and other biological molecules in the body using sophisticated technologies such as positron emission tomography (PET). Currently, less than 10% of compounds pass clinical trials due partly to the differences in targeted deliverability and pharmacokinetics of drug molecules between humans and small laboratory animals. PET allows such pharmacokinetics to be observed directly in humans noninvasively, providing an extra level of certainty prior to making the decision to take a drug to clinical trials. Thes are called 'micro-dose' clinical trials, in which pharmacokinetics can be observed using less than 1% of the normal dosage, well below the threshold of side-effect occurrence. "One thing we are aiming at is to conduct micro-dose trials and drop unpromising compounds before entering actual clinical phase trials. Another is to build an interface between animals and humans," Watanabe says.

Molecular imaging can also be used to diagnose illnesses such as dementia, cancer, diabetes and even fatigue. CMIS researchers are seeking to comprehend the onset of such symptoms in our body by imaging disease-related biomarker molecules, and pursuing technological innovation for predictive and preemptive medicine.

RIKEN researchers have for many years been at the forefront of molecular imaging research, and their efforts accelerated in 2005 with the launch of the national Molecular Imaging Research Program. The base for the program in Kobe was reorganized as the CMIS in 2008. Since April 2010, the CMIS has been playing a central role in the government's new initiative, the Japan Advanced Molecular Imaging Program (J-AMP).

In 2010, the CMIS took a place on the board of the third World Molecular Imaging Congress in Kyoto. In terms of research, the CMIS has continued to unveil impressive achievements in drug discovery, diagnostics and therapeutic biomarkers. For example, thanks to a site-selective reaction developed by a team led by Hiroshi Mizuma and Hirotaka Onoe from the CMIS, molecular imaging of the brain in living conscious animals is now possible with minimal impact on their physiological condition (*J. Nucl. Med.* **51**, 1068–1075, 2010). In a separate study led by the CMIS's Tadayuki Takashima, CMIS researchers teamed up with colleagues from the University of Tokyo to develop a PET probe to observe in living mice the functions of multidrug resistance-associated protein 2—one of the most important proteins associated with hepatobiliary transport (*J. Pharmacol. Exp. Ther.* **335**, 314–323, 2010).

Watanabe sees a challenging but rewarding future for the CMIS, which he believes is well positioned to become the global leader in molecular imaging. More extensive collaboration with the corporate sector will be an important driver of the CMIS's growth, and already the center has seen a rise in the number of joint projects with the healthcare sector to 45 in 2010 from 30 the previous year. "We want to create a center where we can test molecules or compounds in humans quickly and safely," Watanabe says. "Clinical institutions cannot afford such tasks. This has become another role of a basic research center like the CMIS."