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Hybrid scanner combines five molecular imaging technologies

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Scientists are taking medical imaging research and drug discovery to a new level by developing a molecular imaging system that combines several advanced technologies for all-in-one imaging of both tissue models and live subjects, say presenters at the 2015 annual meeting of the Society of Nuclear Medicine and Molecular Imaging (SNMMI).

The preclinical and intra-vital molecular imaging system houses a window for tissue observation in addition to a larger imaging chamber. Together they are being used to peer into the microenvironment of tumors and other tissues while learning about the co-registration of multiple lines of imaging data.

'This technology allows us to obtain in-depth knowledge of molecular imaging techniques, how to optimize them, and how to leverage data with statistical analysis while advancing new radiotracers and contrast agents for the imaging and treatment of a range of diseases,' said Zhen Liu, Ph.D. candidate and lead author of the study from the department of nuclear medicine at Technical University Munich, in Munich, Germany.

Each technology has its own strengths. Direct positron imaging is a nuclear medicine technique that allows researchers to gain physiological information from radiolabeled imaging agents that bind to targets in the body, which are then imaged with a specialized detector. The hybrid system applies both conventional and hyperpolarized MRI. The former is ideal for soft-tissue contrast, and the latter has extremely fine imaging

resolution due to a revolution in the technology called dynamic nuclear spin polarization, which is used to track minute biochemistry in the body—such as the transition of the naturally occurring chemical pyruvate to lactate. This exchange, which takes place throughout the body, has been found to be an excellent biomarker for disease. Finally, luminescence, fluorescence and optical imaging are all state-of-the-art imaging techniques that can be used to paint targets as small as a strand of DNA with glowing substances to make them stand out when scanned or observed under a very powerful microscope.

'Understanding the physiology behind multimodal imaging is very challenging due to discrepancies between macroscopic and microscopic images and between images of extracted or transplanted tissues versus images of a live subject,' said Liu. 'This establishment of high-resolution multimodal intra-vital imaging can bridge these discrepancies and offer a tool for the long-term observation of underlying physiology.'

For this study, a tumor cell line was transplanted into a rat and imaged with each of the following: conventional MRI, the radiotracer carbon-13 (C-13) pyruvate and hyperpolarized MRI at a resolution of 2.5 mm, Medipix positron detector, luminescence sensor and a fluorescence microscope.

Results of the study showed that increased lactate production was found by hyperpolarized MRI in areas of hypoxia, or low-oxygenation, and higher levels of FDG binding represented areas of hypermetabolic activity surrounding the hypoxic areas. These are indications that areas of diseased tissue could be dying, while other parts of a tumor could be rapidly growing or becoming more aggressive. These details tell researchers about the heterogeneity of tumors, which is essential for developing appropriate research and drug protocols that can navigate all the inherent complexity of not just the anatomy and physiology being imaged but also how imaging technologies intersect to capture as much

information as possible.

More information: Scientific Paper 59: "A multimodal intravital molecular imaging system based on dorsal skin window chamber tumor model"

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