UKE Paper of the Month November 2017

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Magnetic Particle Imaging for Real-Time Perfusion Imaging in Acute Stroke.

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ABSTRACT: The fast and accurate assessment of cerebral perfusion is fundamental for the diagnosis and successful treatment of stroke patients. Magnetic particle imaging (MPI) is a new radiation-free tomographic imaging method with a superior temporal resolution, compared to other conventional imaging methods. In addition, MPI scanners can be built as prehospital mobile devices, which require less complex infrastructure than computed tomography (CT) and magnetic resonance imaging (MRI). With these advantages, MPI could accelerate the stroke diagnosis and treatment, thereby improving outcomes. Our objective was to investigate the capabilities of MPI to detect perfusion deficits in a murine model of ischemic stroke. Cerebral ischemia was induced by inserting of a microfilament in the internal carotid artery in C57BL/6 mice, thereby blocking the blood flow into the medial cerebral artery. After the injection of a contrast agent (superparamagnetic iron oxide nanoparticles) specifically tailored for MPI, cerebral perfusion and vascular anatomy were assessed by the MPI scanner within seconds. To validate and compare our MPI data, we performed perfusion imaging with a small animal MRI scanner. MPI detected the perfusion deficits in the ischemic brain, which were comparable to those with MRI but in real-time. For the first time, we showed that MPI could be used as a diagnostic tool for relevant diseases in vivo, such as an ischemic stroke. Due to its shorter image acquisition times and increased temporal resolution compared to that of MRI or CT, we expect that MPI offers the potential to improve stroke imaging and treatment.

STATEMENT: *Magnetic Particle Imaging is a new promising tomographic imaging method. For the first time, we show that MPI might be a useful imaging method for the assessment of cerebral perfusion in an acute stroke model and potentially a new clinical imaging modality. At the moment, there is no technique for continuous cerebral perfusion monitoring, just clinical examinations every three hours, so a deterioration in the patient's health between these examinations can be missed.MPI scanners can be built quite small and used for continuous monitoring of cerebral perfusion in patients with stroke, bleeding and subarachnoid haemorrhage, which could substantially improve stroke therapy.*

BACKGROUND: This study was an interdisciplinary teamwork between the Department of Neurology and the Institute for Biomedical Imaging/ Radiology at the UKE. Together we are one of the world leading groups in MPI research. This work was supported by the “Forschungszentrums Medizintechnik Hamburg” (FMTHH, granted to P.L. and N.G.), the “Werner Otto Stiftung” (P.L.), the “Schilling Professur” (T.M.), the ERANET Grant “NeuroSurv” (T.M.), and “Geräteeinzelförderung Großgeräteinitiative Projektnummer 228148563” of the DFG (G.A).