No. 10 March 6, 2017 (AM)

DKTK Freiburg: Physicists simplify production of hypersensitive contrast agent for cancer diagnostics

To make even the smallest tumor clusters and other pathological metabolic processes visible with the help of magnetic resonance imaging (MRI): Physicists from the German Cancer Consortium (DKTK) at the University Hospital of Freiburg have come one step closer to this goal. The scientists used the highly sensitive hyperpolarization MRI, which uses magnetic contrast agents to be several times more sensitive than classic MRIs. The Freiburg researchers managed to radically simplify the production of such contrast agents, which had previously been both very complicated and expensive. This will allow the production of contrast agents that can be used to observe pathological metabolic processes in cancer in real time. The production procedure of these contrast agents has been published in the journal "Nature Communications."

The DKTK is made up of the German Cancer Research Center (DKFZ) in Heidelberg as the core location, along with renowned oncology departments of universities in various partner locations across Germany.

"With this process we have named SAMBADENA we are able to make the contrast agent for hyperpolarization MRIs much cheaper, simpler and faster than previously possible," said the project leader Dr. Jan-Bernd Hövener, Emmy Noether research group leader in the Radiology-Medical Physics clinic of the University Hospital Freiburg. Along with his doctorate students Andreas Schmidt and Stephan Berner, he has achieved an important step in the production of hyperpolarized contrast agents. "For the first time it is possible to produce the injection solution with the contrast agent right where it is needed, in the MRI scanner, within a matter of seconds," says principal author Andreas Schmidt.

With the hyperpolarization MRI, a magnetically marked contrast agent is injected into the body, from where it sends out signals which are significantly stronger than would be possible in a classic MRI. This can greatly increase the sensitivity of the MRI, and thus help gather information crucial for diagnosis and therapy. Previously, liquid hyperpolarized contrast agents were chiefly produced with dynamic nuclear polarization (DNP). For this method, already used on patients, scientists require a complex device that costs up to 2.5 million Euros. The new method opens up the opportunity to drastically decrease these costs. "We hope that this will help further develop the use of hyperpolarization MRI," says Jan-Bernd Hövener, who researches in the radiotherapy and imaging department of the German Cancer Consortium, and is part of the EU sponsored research network EUROPOL-ITN.

By creating the contrast agent directly in the MRI device, researchers will soon presumably be able to use molecules as contrast agents, whose marking would otherwise have disintegrated during transportation to the MRI device. "We are now intensively working on using SAMBADENA on bio molecules which naturally occur in the body. Their deconstruction or reconstruction could then be observed in real time," says Jan-Bernd Hövener. Early unpublished results point in this direction. Since cancer cells often exhibit a different metabolism, an increased or decreased deconstruction of the contrast agent could point to cancer tissue. This would allow for early identification of metastases and the ability to characterize tumors more accurately. It also seems possible to use the change in cancer metabolism to detect earlier whether a therapy is working or not. "A further advantage is that endogenous substances do not cause allergic reactions, which is sometimes the case with

previous MRI contrast agents," says Jan-Bernd Hövener. A series of suitable contrast agents are to be developed in subsequent studies.

Schmidt, A.B. et. al.: Liquid-state carbon-13 hyperpolarization generated in an MRI system for fast imaging. In: Nature Communications
doi:10.1038/ncomms14535 (http://www.nature.com/articles/ncomms14535)

A video for the press release is available at:
https://www.youtube.com/watch?v=N2Ekdk09fI4
How does the hyperpolarization MRI work and how can patients benefit from it? A video of the Hövener research group explains the imaging method with magnetic contrast agents.

* The German Cancer Consortium (DKTK) is a joint long-term initiative involving the German Federal Ministry of Education and Research (BMBF), participating German states and the German Cancer Research Center (DKFZ) and was established as one of six German Health Research Centres (DZGs). As DKTK's core center the DKFZ works together with research institutions and hospitals in Berlin, Dresden, Essen/Düsseldorf, Frankfurt/Mainz, Freiburg, Munich, Heidelberg and Tübingen to create the best possible conditions for clinically oriented cancer research. The consortium promotes interdisciplinary research at the interface between basic research and clinical research, as well as clinical trials for innovative treatments and diagnostic methods. Another key focus of the consortium's work is on developing research platforms to speed up the application of personalized cancer treatments and to improve the diagnosis and prevention of cancer.

More information is available at www.dktk.org

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