Metabolic activity of brown adipose tissue easier to verify with new method

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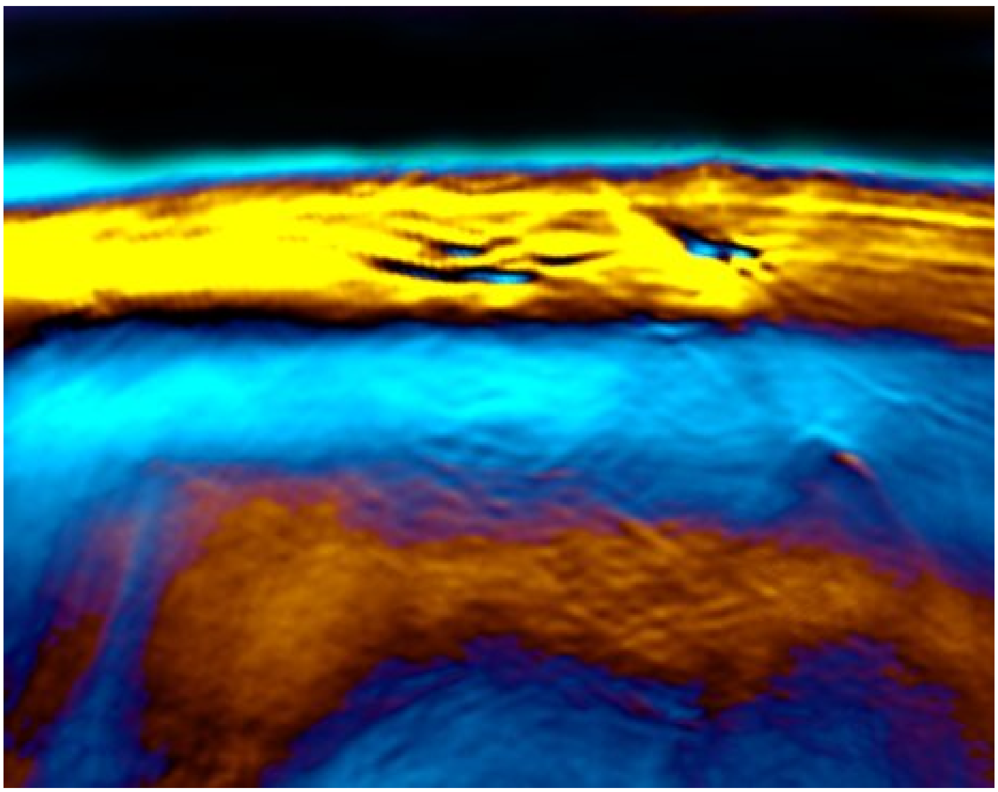

The new laser method MSOT represents brown fat. Credit: Reber/ TUM

Brown adipose tissue has played a key role in prevention research since its presence was first documented in adults. However, there was no non-invasive method of measuring its heat generation. A team at the Technical University Munich (TUM) and the Helmholtz Zentrum München has now visualized the activity of brown adipose tissue without injecting substances.

In the cold, brown adipose tissue acts like a heat generator, and its activity has a positive effect on energy balance. The heat output of brown adipose tissue in humans decreases with increasing age. It is also less active in diabetics and obese persons. Therefore, scientists are researching the factors keeping brown adipose tissue active. Because it is able to burn energy from carbohydrates and fat, it is of great interest for interventions against obesity and diabetes.

Until now, it has only been possible to measure the heat output of brown adipose tissue by means of invasive methods. This approach involves the injection of radioactive substances called "tracers" that participate in the metabolism, making it possible to observe the heat conversion in the tissue. However, a team from Helmholtz and the TUM has developed a new, non-invasive method. After establishing its viability in mice, the initial measurements in humans have also been successful without the need to inject imaging agents.

The team of researchers demonstrated a relationship between the metabolic activation of the tissue and changes in oxygenated and deoxygenated hemoglobin (red blood pigment), measured by means of multispectral optoacoustic tomography (MSOT). Professor Vasilis Ntziachristos at Helmholtz Zentrum München explains the new investigative method as follows: "A laser beam sends light pulses approximately two to three centimeters deep into the tissue. This light is absorbed by tissues containing hemoglobin, causing them to minimally warm up and transiently expand. This expansion creates sound waves that can be measured."

The study demonstrated a direct relationship between the metabolic activation of the brown adipose tissue measured using hemoglobin gradients as an intrinsic biomarker of tissue metabolism and its calorie consumption after stimulation. "Overall we expect MSOT to become a key tool in measuring metabolic parameters in tissue, using portable and safe MSOT technology," says Prof. Ntziachristos. "This ability can revolutionize understanding of metabolic processes not only in patients but also in healthy individuals."

Co-author Professor Martin Klingenspor from the Chair for Molecular Nutritional Medicine says, "The higher metabolic demand of the brown adipose tissue is supplied by increased blood circulation and oxygen utilization, which can be made visible in the tissue and the venous outflow by MSOT. This means that blood flow and changes in oxygen saturation in blood are markers for metabolic output."

MSOT can enable the investigation of an increased number of functional tissue parameters beyond metabolism, including inflammation or angiogenesis. The combination of safe non-ionizing radiation and a portable format could enable novel applications of the technology in point-of-care and outpatient settings. A next step for the investigating team is to examine the accuracy of the technology in quantifying the effect of various medications in the active fat content of the human body.

More information: Josefine Reber et al, Non-invasive Measurement of Brown Fat Metabolism Based on Optoacoustic Imaging of Hemoglobin Gradients, *Cell Metabolism* (2018). DOI: 10.1016/j.cmet.2018.02.002

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