Predicting Weight Loss And Fat Metabolism Using Optical Signal Changes In Fat

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BRIEF DESCRIPTION

Researchers at UCI have developed a novel use of an emerging functional imaging technology, Diffuse Optical Spectroscopic Imaging (DOSI), for monitoring changes in subcutaneous adipose tissue (“AT” also known as “fat” tissue), structure and metabolism during weight loss. Changes in subcutaneous adipose tissue structure and metabolism have been shown to correlate with the development of obesity and related metabolic disorders.

The invention is a diagnostic tool that assesses the structure and function of fat tissue in vivo.

FULL DESCRIPTION

Recent investigations have established a clear role for changes in the amount and size of fat tissue and oxygen metabolism as having an impact on the early stages of pathologies such as insulin resistance, which can lead to diabetes, and vascular dysfunction. However, there are no diagnostic tools available to assess tissue structure or function in fat tissue in vivo.

Existing technologies are sensitive only to changes in the macro-structure of adipose tissue layers, such as thickness. Ultrasound and optical techniques exist to monitor the macro-structure of adipose tissue during interventions. Ultrasound techniques provide tomographic imaging of biological tissue, which allows the thickness of various layers of tissue to be quantified. Optical techniques also exist which can quantify fat layer thickness. However, these previous devices and techniques are not capable of measuring changes reflective of cell size, metabolism, or extracellular milieu.

Researchers at UCI are introducing the use of a quantitative, non-invasive spectroscopic technique (DOSI) for measuring dynamic changes in AT metabolism in vivo. UCI researchers have applied the technology to study the response of AT to calorie restriction (CR), an intervention known to produce significant improvements in weight and in health. Results generated from these studies have demonstrated that DOSI-detected changes in optical and physiological properties are consistent with existing hypotheses on the response of AT to CR and weight loss.

DOSI combines frequency-dependent photon migration (“FDPM”) with broadband near-infrared spectroscopy (NIRS). FDPM by itself can only be done at discrete wavelengths (e.g., 790nm. 830nm) and is therefore limited in spectral resolution. Broadband NIRS, on the other hand, offers good spectral resolution, but is by itself not quantitative, because it ignores the contribution of tissue scattering. When the two modalities are combined, broadband absorption and scattering features can be determined, which allow for calculation of concentrations of chromophores (e.g. oxy- and deoxy-hemoglobin, water, lipid) in a variety of human tissues.

The system is capable of calculating the concentrations of oxyhemoglobin, deoxyhemoglobin, total hemoglobin, and fractions of water and lipid. Using these values, the oxygen saturation and tissue optical index can be calculated which serves as an index of metabolic activity. Various measurements sites can be used to obtain these values and they can be averaged for analysis.

SUGGESTED USES

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OTHER INFORMATION

KEYWORDS

NIRS, DOSI, Subcutaneous Fat, Metabolism

CATEGORIZED AS

- **Biotechnology**
  - Other
- **Medical**
  - Devices
  - Diagnostics
  - Disease: Cardiovascular and Circulatory System
  - Disease: Metabolic/Endocrinology
  - Research Tools

DOSI and similar technologies could be used to guide therapeutic interventions such as diet, exercise, and medication by assessing their impact on fat tissue physiology quantitatively and longitudinally.

DOSI may contribute to a fuller understanding of fat tissue biology in various metabolic states, and could constitute a new bedside tool for monitoring AT metabolism and composition generally.

RELATED CASES

2015-869-0

ADVANTAGES

DOSI for monitoring of subcutaneous fat is advantageous because:

(1) DOSI provides both structural and functional information about tissue;

(2) DOSI is non-invasive and requires no ionizing radiation;

(3) The technology is portable;

(4) Measurements can be done repeatedly with no additional discomfort;

(5) Near-Infrared light is well suited to the assessment of superficial low absorbing tissues such as subcutaneous fat.

While DOSI is not capable of the spatial resolution of MRI, it offers advantages in quantitation, spectral information content, ease of application, and cost.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,827,974	11/10/2020	2015-869

STATE OF DEVELOPMENT

The invention is well into the experimental stage, with data collection ongoing, and with preliminary findings submitted for publication.

TESTING

The invention has been tested on 10 overweight adults during a three-month calorie-restricted diet. Test results suggested that DOSI measurements of NIR optical properties could be used to enhance understanding of the role of AT in disease progression, and to advance diagnostics and monitoring of metabolic disorders.

Future studies will further assess the ability for the invention to predict the effectiveness of loss regimens.

RELATED MATERIALS

» Goutham Ganesan, Ylenia Santoro, Robert V Warren, Anaïs Leproux, Enrico Gratton, Shaista Malik, Pietro R Galassetti, and Bruce J Tromberg.“Spectral changes in subcutaneous fat with weight loss measured by diffuse optical spectroscopy.” BIOS 2015. Part of SPIE Photonics West. San Francisco, California, February 7-12, 2015. Proc SPIE. 2015:9319,9319-2 - 02/07/2015

» Anaïs Leproux, Amanda Durkin, Montana Compton, Albert E Cerussi, Enrico Gratton and Bruce J Tromberg “Assessing tumor contrast in radiographically dense breast tissue using Diffuse Optical Spectroscopic Imaging (DOSI)” Leproux et al. Breast Cancer Research 2013,15:R89 - 09/26/2013

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