WEARABLE HIGH-THROUGHPUT PHOTOACOUSTIC SCREENING AND PHOTOTHERMAL KILLING OF CIRCULARING MELANOMA CELLS

Lead Inventor

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Research Interests

- Micro sensors
- Micro actuators and microsystems
- Micro optical and acoustic devices and systems for non-destructive sensing and imaging
- 3D micro and nanofabrication technologies

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Overview

As the most fatal type of skin cancers, melanoma is a major public health problem in U.S. A considerable patient population with advanced metastatic melanoma does not respond to the FDA-approved drugs and thus still suffer high mortality. Because most deaths of melanoma are caused by bloodstream spread of circulating melanoma cells (CMCs) into distant organs and their subsequent growth into overt metastases, noninvasive detection and clearing of CMCs represents a highly promising diagnosis and treatment strategy.

Technology

Combining high-sensitivity and high-throughput photoacoustic detection and high-efficiency photothermal elimination, this invention represents a novel wearable technology, which is capable of simultaneous fast screening and killing of CMCs in vivo, approaching the treatment of melanoma metastasis entirely from a physical perspective. The photoacoustic detection can screen CMCs in the entire human blood volume within a few hours. This high-throughput screening is enabled by a fast MEMS (microelectromechanical systems) scanning on deeper blood vessels with higher blood flows. By using short laser pulses of suitable wavelength to heat melanosomes inside CMCs to evaporation temperature, CMCs can be mechanically ruptured without damaging surround cells or tissues, thereby causing no side effects of the treatment.

Advantages

- Non-invasive label-free screening of most types of CMCs in the bloodstream in vivo at single-cell level
- On-demand highly-selective killing of CMCs with minimal or no side effects, which may reduce CMC extravasation and self-seeding, and thus help prevent cancer metastasis and recurrence
- Compact system footprint and wearable capability are convenient for either in-office or bed-side use, which will accelerate the translation of the developed technology

Applications

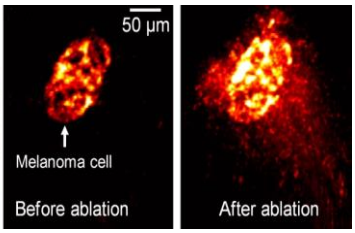
- Fundamental research on melanoma progression and metastasis
- CMC counting for melanoma prognosis
- Clinical evaluation of melanoma therapies
- Physical treatment of late-stage patients not responsive to conventional drugs

Stage of Development

Concept verified and prototype under development

Patent Status

Pending



Publications

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- Yao, J., et al., Wide-field fast-scanning photoacoustic microscopy based on a water-immersible MEMS scanning mirror, Journal of biomedical optics, 2012. 17(8): p. 0805051-0805053.
- Yao, J., et al., High-speed label-free functional photoacoustic microscopy of mouse brain in action, Nature methods, 2015. 12(5): p. 407-410.
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