Method of fast spectral analysis of cancerous tissues

SUMMARY

The present technology allows to rapidly determine if the tissue under investigation is healthy or cancerous. No special preparation of samples is needed. Analysis can be done directly in the operating room during a surgical intervention (*in vivo*).

BACKGROUND

During a surgery, while performing resection of an organ or a tissue, which was affected by tumor, *a priori* information is needed on the exact boundary between tumor and healthy tissue. This knowledge is crucial, in order to remove precise amount of affected tissue to stop tumor from spreading, while doing the least harm to the healthy tissue. Visually this boundary is often difficult to identify. Often used biopsy or histological method of frozen cuts takes time, requires special preparation of samples, depends on a subjective assessment of a physician-pathologist.

The differences in infrared absorption spectra enable to distinguish cancerous and healthy tissues of different organs. However, for more reliable results, application of complex statistical data processing techniques is needed. Therefore, this method is not suitable for fast identification of cancerous tissue areas during surgeries.

TECHNOLOGY

The present technology is based on the spectral analysis of extracellular fluid. Due to different cell growth speed, chemical composition and infrared absorption spectra of extracellular fluid of normal and tumor tissues is very different. Therefore, relative intensities of spectral bands are reliable markers of tumor tissues.

A fiber optic probe is used to record the spectrum. The probe has an attenuated total reflection (ATR) prism on its tip and is connected to radiation-generating optics by at least one incoming signal and one outgoing signal optical fiber, and is also connected to standard infrared absorption spectrometer. At first, a background spectrum without a sample is recorded. Then a sample is applied on ATR prism and is dried by dry air. After that the absorption spectrum in the spectral region of 4000-600 cm^{-1} is recorded. Spectral analysis is performed in a specifically narrow spectral region of 1200-100 cm^{-1}. Then a sample can be assessed by visually comparing spectra of extracellular fluid of healthy tissue and tissue under investigation, or by using software for comparative analysis.

TECHNOLOGY READINESS LEVEL

TRL 7 – prototype demonstration.

INTELLECTUAL PROPERTY

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PUBLICATIONS

M. Pučetaitė, M. Velička, V. Urbonienė, et al. Rapid intra-operative diagnosis of kidney cancer by attenuated total reflection infrared spectroscopy of tissue smears. *J. Biophotonics*. 2018, 11:e201700260. https://doi.org/10.1002/jbio.201700260

M. Velička, M. Pučetaitė, V. Urbonienė, et al. Detection of cancerous kidney tissue by means of SERS spectroscopy of extracellular fluid. *J Raman Spectrosc*. 2017, 48:1744–1754. https://doi.org/10.1002/jrs.5232

BENEFITS

- → No special preparation of samples is needed.
- → Analysis can be done directly during a surgical intervention (*in vivo*).
- → Fast results: from 20 seconds to a few minutes.
- → The device operator does not need any special knowledge to perform analysis.

APPLICATION

The present method of fast spectral analysis of cancerous tissues can be used in various applications:

- → Surgeries;
- → Pathology research;
- → Clinical research;
- → Scientific research.

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