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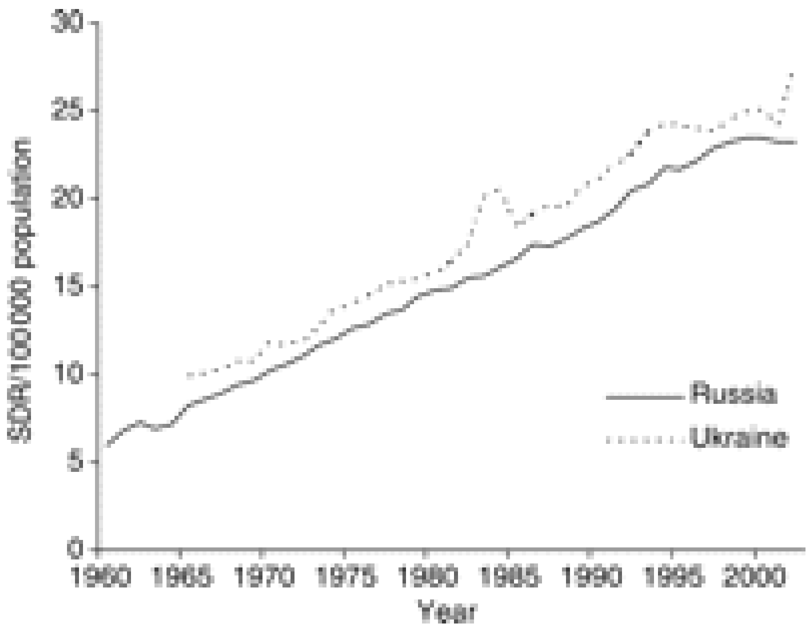
# DIAGNOSING BREAST CANCER BY MEANS OF OPTICAL COHERENT TOMOGRAPHY

Breast cancer ranks as the first leading cause of death in women in the overall structure of malignant tumors in women. The vast majority of breast cancer cases occur in females. Breast cancer is the most common invasive cancer in females worldwide. Altogether, more than 650 thousand cases of breast cancer are registered globally every year. It accounts for 16% of all female cancers and 22.9% of invasive cancers in women. 18.2% of all cancer deaths worldwide, including both males and females, are from breast cancer.

In Ukraine, statistics is also not comforting: over 16 thousand women develop breast cancer annually.

This graph illustrates how breast cancer mortality at ages 30–84 years has increased steadily in Ukraine since the early 1960s.



In the Transcarpathian region about 300 women become the victims of this disease every year, and one of the two takes medical advice when it is too late - at the stages III-IV of the disease.

As a result, every third woman who develops breast cancer dies within a year after diagnosing it. This is the sad statistics.

Let us try to consider the reasons for such a high mortality rate. Of course, treatment and rehabilitation methods do matter, but, to start with, the majority of the common diagnosing methods can’t provide reliable and timely early detection which is the best protection against breast cancer. Suffice it to note that the first stage of treatment for breast cancer (tumor up to 2 cm in diameter without damage to regional lymph nodes) can recover 95% of women. However, with the growth of a tumor or spread to regional lymph nodes the percentage of recovery falls dramatically - no more than 50%.

Therefore, novel methods yielding such data on the earliest stages of the clinical course of the disease are of greatest value. One of these directions is a relatively new diagnosing method - Optical coherence tomography which has some serious benefits if compared to other traditional detection methods and which is currently being investigated by the researchers in the USA, Austria, Denmark and others.

Optical coherence tomography (OCT) is an emerging medical imaging and diagnostic technology developed in 1991. In their studies researchers investigated OCT imaging of human breast tissue and lymph nodes in order to assess the ability to identify cancer pathologies. The ability to visualize tumor margins would have applications to breast cancer surgery, while the ability to assess metastasis in lymph nodes could reduce sampling errors associated with sentinel node biopsy.

The following figure shows a schematic of how OCT images are generated. OCT can perform cross sectional and three dimensional, micron scale imaging of tissue structure. It is analogous to ultrasound, measuring the intensity of backreflected or backscattered infrared light, rather than acoustical waves.

OCT is attractive for biomedical research and clinical imaging for the following reasons.

1. Imaging can be performed in real time, allowing tissue microstructure to be visualized without the need to excise and process specimens as in conventional biopsy and histopathology.
2. Image resolutions are 1 to 15 microns, enabling visualization of tissue architectural morphology.
3. OCT can be performed with a wide range of instruments including ophthalmoscopes, small endoscopes, catheters, probes, needles, or other surgical instruments.
4. OCT has also had a dramatic impact in ophthalmology, where it has become a standard diagnostic instrument for retinal disease and glaucoma.

In addition, OCT is an emerging technology for intravascular imaging, where it can identify unstable plaques that are prone to rupture, producing myocardial infarction. OCT research combines multiple technologies including photonics, high speed electronics and signal processing, imaging processing, medical device development and biomedical engineering.

Recent advances in OCT technology have yielded dramatic increases in performance. These new techniques measure the echo time delay of light by Fourier transforming the interference spectrum of the light signal and are, therefore, known as Fourier domain OCT detection. High speed imaging enables three dimensional OCT imaging, generating volumetric data sets which contain comprehensive structural information.

High speeds also enable the rapid survey of large areas on tissue as well as increased imaging throughput. In addition, high speeds allow multi-frameaveraging or acquisition of high-pixel-density images, which can be used to improve image quality or reduce speckle. Fourier domain OCT also has the advantage of providing direct access to the interference spectrum, enabling a wide range of phase sensitive applications such as Doppler imaging of blood flow. Finally, Fourier domain OCT techniques are also well-suited for numerical dispersion compensation, supporting broad bandwidths and enabling ultrahigh axial image resolutions.

Such novel technologies still in developmental phases are expected to provide scientists with earliest possible detection of breast cancer cases as well as the range of other diseases and may be best suited for clinical studies.

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