OPTO-ACOUSTIC TECHNOLOGY

A New Medical Imaging Technology

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In 1880 Alexander G. Bell heard "a pure musical tone" from an enclosed gas that had been illuminated by a very brief flash of sunlight. This tone was a result of the opto-acoustic effect,the conversion of light into sound. This occurs when a pulse of light absorbed by a target is excited and emits a sound wave. In recent years, advances in laser technology, electronics and materials and the understanding how light and sound interact with the human body have created an opportunity to use this phenomenon in medical imaging.

Opto-acoustic imaging has emerged as a sensitive modality for visualizing and quantitatively characterizing malignant tumors. Opto-acoustic imaging combines the most compelling features of optical imaging with ultrasound imaging to provide blood maps of the body. This new imaging method provides the image contrast of optical imaging with the resolution of ultrasound imaging — a feature no other imaging technology can accomplish.

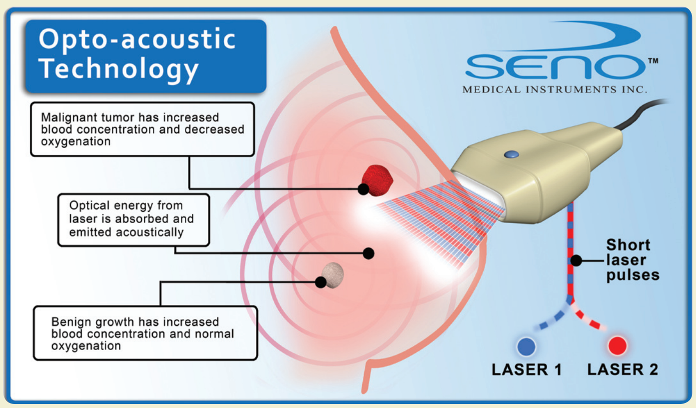
The basic principles behind opto-acoustic imaging are that very short pulses of laser light scatter through the part of the body being imaged. The colors (wavelengths) of the light pulses are chosen due to their ability to be preferentially absorbed either by oxygenated blood or by de-oxygenated blood. The acoustic waves that result from the light absorption travel effectively with minimal distortion through the body to the skin. Transducers (embedded in a probe) are in contact with the skin, receive the sound waves and transmit the information to an electronic system that converts the sound into images of the objects that absorbed the light. By using arrays of transducers it is possible to reconstruct two-dimensional and three-dimensional images. The illustration presented within this article depicts opto-acoustic imaging used for diagnostic imaging of breast cancer.

Malignant solid tumors develop an enhanced network of micro vessels to supply nutrition and oxygen to multiply cancer cells. This phenomenon is known as angiogenesis. As a result of rapid consumption of oxygen by an aggressively growing cancerous tumor and leakiness of its vessels, the blood in and around the cancerous mass becomes de-oxygenated; the blood in and around a benign tumor is more highly oxygenated. Blood strongly absorbs the two wavelengths of light selected for opto-acoustic imaging. Strong light absorbers produce correspondingly strong acoustic waves, resulting in a bright image. Therefore, blood vessels provide high opto-acoustic contrast. As a result, optical contrast between normal and cancerous tissues is substantially greater than the contrast obtained from conventional imaging methods. Furthermore, functional information about hemoglobin concentration in blood and its level of oxygen saturation in tumors can serve as a basis for noninvasive diagnostics using opto-acoustic imaging. Studies indicate that opto-acoustic imaging can provide acceptable image contrast and resolution to a depth of up to 60mm.

Opto-acoustic technology applied to medical imaging can provide high-resolution 3D maps containing functional information on blood concentration and its oxygen saturation, thereby providing valuable diagnostic information not otherwise available. Clinical applications include (1) diagnostic imaging of breast tumors and potentially other types of malignant solid tumors in soft tissues, (2) intravascular imaging and characterization of atherosclerotic plaques, (3) detection of vascular occlusions and (4) detection of brain hemorrhages. Recent studies performed in breast cancer patients demonstrated that the functional imaging capability of opto-acoustic imaging provides additional medically relevant information regarding breast tumors, which results in better sensitivity and specificity of cancer detection without the use of injected contrast agents or X-rays.

A unique opportunity for further substantial enhancement of the opto-acoustic detection sensitivity comes from merging opto-acoustic imaging with nanotechnology. An opto-acoustic contrast agent based on gold nanorods may be designed and selectively delivered to cancer cells in order to substantially increase contrast of cancerous tumors on opto-acoustic images. The same contrast agent can serve potentially as a therapeutic agent for treatment of early cancer.

Seno Medical Instruments, Inc., a San Antonio-based medical device developer is commercializing the opto-acoustic technology for the earliest detection of cancer. Seno's platform technology also addresses medical applications such as stroke, cardiovascular and inflammatory diseases.



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