Acoustically Induced Blood Stasis and in vivo Optical Spectroscopy Thereof

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Technology description

In this invention, standing wave ultrasound is used as a noninvasive localized contrast agent that will increase the spatial sensitivity of the optical spectroscopy as well as increase the dynamic changes of oxy/deoxy hemoglobin. This invention is especially sensitive to both vascularization and blood volume. Tumors have been shown to have significantly different vascularizations and oxy/deoxy hemoglobin saturations when compared with surrounding tissues, two characteristics that other modalities cannot measure. MRI techniques can perform similar measurements but the imaging requires ingestion of a contrast agent and large, expensive imaging equipment. This invention is small in size, much cheaper than MRI, and does not require ingestion of a contrast agent.

Because of this inventions sensitivity to oxyhemoglobin saturation and vascularization, it can also be used to manipulate radiation effects of oxygenation. It is well known that the cell killing effects of radiation are mediated by oxygenation, and conversely, hypozxia serves to protect normal tissue that is in the path of the radiation field.

Another issue this invention can potentially solve is the difficulty of localized drug delivery. The standing wave ultrasound causes reversible blood stasis in a localized area. When using this technique, it may be possible to potentially arrest the blood flow with photosensitive drugs present and expose them to the optical stimulation signal. Thus, the effects of the drug can be minimized to the area of the blood flow stasis. This may also be accomplished with normal, non-photosensitive drugs as well.

Technology Status

An initial prototype has been constructed and tested on mice; and preliminary data has shown enormous potential for this invention. Work is continuing to refine the optical probe construction, to construct a functioning clinical apparatus, and to test the invention on larger animals with the tests culminating in clinical human trials.

Application area

The present invention combines the effects of ultrasound-induced blood stasis and optical spectroscopy to create a new, non-invasive tissue imaging and diagnostic tool. It has applications in

non-invasive tissue diagnosis, localized drug delivery, non-invasive manipulation of vascular blood flow and oxygenation for generally enhanced therapeutic and diagnostic effects.

Advantages

Presently there are few tissue diagnosis methods approved for clinical use. For some tissue diagnosis purposes, imaging molecules is sufficient (e.g. MRI, CT, PET etc.). Breast cancer is very difficult to diagnose using presently available methods. The cancer tissue is very similar to the surrounding tissue when viewed with the present imaging modalities and thus biopsies are usually required.This invention is based on a discovery that ultrasound can be used to manipulate blood flow and oxygenation of tumor versus normal tissues differently. Thus it combines two modalities, ultrasound and optical spectroscopy, to create a new tissue diagnostic tool that will hopefully eliminate the need for at least most biopsies.

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