A painless, radiation-free approach for looking at blood vessels

Yoshiaki Matsumoto
Yasufumi Asao
Hiroyuki Sekiguchi
Aya Yoshikawa
Tomoko Ishii
Ken-ichi Nagae
Shuichi Kobayashi
Itaru Tsuge
Susumu Saito
Masahiro Takada
Yoshihiro Ishida
Masako Kataoka
Takaki Sakurai
Takayuki Yagi
Kenji Kabashima
Shigehiko Suzuki
Kaori Togashi
Tsuyoshi Shiina
Masakazu Toi

Video Abstract

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Abstract

Physicians may soon be able to get a detailed look at blood vessels surrounding breast tumors quickly, painlessly, and without radiation, thanks to the work of a team of Japanese researchers. One application of the technology is earlier and more accurate tracking of when cancer has turned deadly. The formation of new blood vessels around a tumor is a key sign that cancer is getting ready to spread. But getting a clear look at these blood vessels can be tricky. Approaches like MRI or computed tomography often come with a hefty price tag, and exposure to contrast agent or radiation may pose health risks. To sidestep these issues, the researchers optimized a way to perform photoacoustic imaging. This type of imaging utilizes the light-absorbing properties of hemoglobin to show where blood is flowing in the body. When hemoglobin is exposed to pulses of laser light, it produces small vibrations. These vibrations are picked up by scanners and used to generate a detailed map of blood vessel architecture. Although a promising approach, past attempts at photoacoustic imaging have suffered from poor image quality due to low resolution. This prompted the researchers to design a new photoacoustic imaging device. The device uses a hemispherical detector array to observe tumor-related blood vessels around breast tumors with unprecedented resolution. And it incorporates alternating light irradiation to paint a rainbow-colored picture of a patient's vasculature, with veins shaded in blue and green and arteries in red. Coupling the device to an ultrasound probe allowed the researchers to simultaneously visualize both three-dimensional tumor location and the delicate nest of blood vessels surrounding the growth. The setup gave a clear image of the tumor environment. And the images took only a few minutes to obtain. The implications of the technology extend beyond cancer. The team also showed that they could readily view blood vessels in other parts of the body, such as the hand or thigh. Such images could help surgeons plan safer and more precise procedures or provide an early warning of blood vessel damage caused by other types of disease.