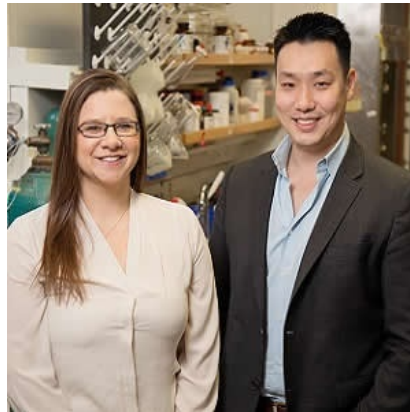




New noninvasive method for detecting hypoxia



Researchers at University of Illinois have developed a new, less invasive method for detecting hypoxia in tissue. The technique consists of a photoacoustic molecular probe that activates in tissues low in oxygen, which could lead to better diagnosis and treatment of cancer, stroke and blocked or narrowed blood vessels. In a paper published in Nature Communications, the researchers demonstrated the probe's ability to image hypoxic tumours and constricted arteries in mice.

The research team, led by chemistry professor Jefferson Chan, created an oxygen-sensitive molecular beacon that emits ultrasound signals in response to light, a process called photoacoustic imaging – a less invasive, higher resolution and less costly method than the current clinical standard, which uses radioactive molecules and positron emission tomography scans.

The photoacoustic method provides a 3-D, real-time view into the tissue that can guide surgical procedures and treatment plans. The molecular probes Chan's group developed only become active when oxygen is lacking. When excited by light, they produce an ultrasound signal, allowing direct 3-D imaging of hypoxic areas. They tested the system on cell cultures, and then in live mice with breast cancer and mice with constricted arteries in their legs.

"The system that we used in this study is a preclinical system for animals. However, in a clinical setting, you can take a regular ultrasound machine and equip it with a light source – you can buy LEDs for around \$200 that are powerful enough and safe for clinical applications," Chan said.

Physicians can administer the photoacoustic molecules to the patient, either by injecting into a vein or directly to a tumour site, then use the modified ultrasound machine to visualise the area of interest, Chan explained.

In their study, Chan's team, which included graduate student Hailey Knox and bioengineering professor Wawrzyniec Lawrence Dobrucki, demonstrated that their photoacoustic method could find hypoxia mere minutes after a mouse's artery was constricted, showing promise for quickly finding stroke sites or blood clots in deep tissue. In the mice with cancer, the probes enabled detailed, 3-D ultrasound imaging of hypoxic tumours.

According to Chan, current methods for detecting hypoxia in tissue can only identify chronic hypoxia, and thus cannot help doctors find aggressive cancers or acute conditions like a stroke that require immediate intervention. Such methods are limited to invasive procedures involving large electrode needles or indirect imaging with radioactive probes, which has the added challenges of off-target activation and interference.

The new photoacoustic method is able to detect hypoxia without the need for surgery. Another advantage is the low cost of producing the molecules and their long shelf life, the researchers said. They can stay stable for years, whereas radioactive molecules must be used soon after manufacturing and require special training for use.

Chan's team is exploring other types of photoacoustic molecules that could image other conditions. For example, they are working on probes that can detect specific cancers so they can find any places where cancer has spread or metastasised in a patient's body.

Source: [University of Illinois at Urbana-Champaign](#)

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