Tools of the trade

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Deep tissue imaging of cancer in the infrared

Despite the emergence of neoadjuvant immunotherapies, the surgical removal of a primary tumour often remains the first treatment a patient with cancer will undergo. Image-guided surgery uses real-time images to allow surgeons to see the demarcation lines between a tumour and healthy tissue and decide how much of the tissue they should remove to prevent tumour regrowth. To date, image-guided surgery has been performed using dyes that are not targeted to tumours but instead leak into tumours owing to damaged blood vessels around the tumour site. In addition, the wavelength that is used to detect these dyes also exists in the ambient light, which means that to be able to see the tumour, the surgeons must first turn off the lights, wait until the camera has acquired pictures of the tumour and then turn the lights back on to continue the surgery.

"clinical approval of this dye ... could lead to highly sensitive, real-time detection and precise removal of cancerous tissues during surgery"

To overcome this limitation, we developed an approach that uses a commercially available cyanine dye called CJ215, which can accumulate around damaged and dying cells that are abundant within various tumours. Because this is not a specific tumour-targeting mechanism, CJ215 can also accumulate around wound healing sites. With improved accumulation within tumours, this dye offers more accuracy and precision compared with existing methods while using the same surgical infrastructure. Moreover, it can also provide a signal in the short-wave infrared range, so that specialized cameras can 'see through' to deeper areas of the tissue with more sensitivity and without being affected by the ambient light. This dye can specifically label a wide range of cancer types and other damaged cells, solely by modifying the chemical properties of the dye rather than using large and complex targeting molecules. For example, altering the charge and hydrophobicity can change its capacity for tumour retention. This technique can also detect metastasis sites in highly aggressive tumour types and can be used to monitor the wound healing response in mice. Overall, CJ215 offers immense benefits to preclinical research in visualizing cancer progression, metastatic growth and treatment response in deep tissue. Our approach is readily adaptable to existing image-guided surgery methods, and clinical approval of this dye, along with the adoption of short-wave infrared cameras in clinics, could lead to highly sensitive, real-time detection and precise removal of cancerous tissues during surgery, where timeliness and accuracy are both essential.

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Competing interests
The author declares no competing interests.

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