Nanoparticles on track to distinguish tumour tissue

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Nanoparticles could be used with optical coherence tomography (OCT) tests to help surgeons distinguish the tumour from other tissue. Credit: US Department of Defence, Kristopher Radder

Gold nanoparticles could be used to help detect the margins between tumours and normal tissue, enabling surgeons to better determine which tissue to remove and which to leave.

Research by Jeremy Duczynski from the University of WA's School of Chemistry and Biochemistry investigated whether the nanoparticles would work as effective optical contrast agents to provide an estimate of the size and shape of tumour margins during surgery.

Optical coherence tomography (OCT) is a recently developed high-resolution imaging test but one of its limitations is an inability to distinguish between some types of healthy tissue and tumours.

Other imaging tests use dye administered to patients to distinguish between different tissue types—although, to date, no such dyes exist for OCT.

Mr Duczynski says OCT is analogous to ultrasound, using light instead of sound waves for detection.

"The problem is the scattering and absorbing qualities of tumour tissue can be quite similar to healthy tissue," he says.

"This is why different agents are being pursued to increase this contrast.

"Most research has been done with straight gold nanoparticles as contrast agents but the problem with them is they absorb light very strongly. This leads to negative contrast with the image appearing darker in areas with gold.

"This is a problem because empty spaces, such as the thoracic cavity, will also appear dark, possibly leading to incorrect identification of tumour margins."

Silica-gold nanoparticles provide greater contrast, visibility

To get around this, Mr Duczynski used silica nanoparticles coated with a gold shell (silica-gold core-shell nanoparticles) in his research.

"There are some theoretical and experimental papers where it was observed that by varying the dimensions of either the silica core or gold shell you could also vary the scattering ratio of the particles," he says.

"This makes them possible contrast agents for OCT because the test requires a high scattering of light at about 850 nanometres for good image contrast."

Ultra-violet spectroscopy was used on the silica-gold core-shell nanoparticles made by Mr Duczynski to better understand their optical properties, such as extinction, scattering and absorption.

The research also involved the development of iron oxide-gold core shell nanoparticles.

"This particle system was attempted because I was having difficulty with shelling the silica particles," Mr Duczynski says.

"I was able to see some scattering of the iron oxide-gold core-shell nanoparticles, meaning they could possibly be pursued as another contrast agent for OCT.

"Iron oxide is also magnetic, meaning these particles could be used as a multimodal contrast agent for imaging techniques such as MRI [magnetic resonance imaging]."

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