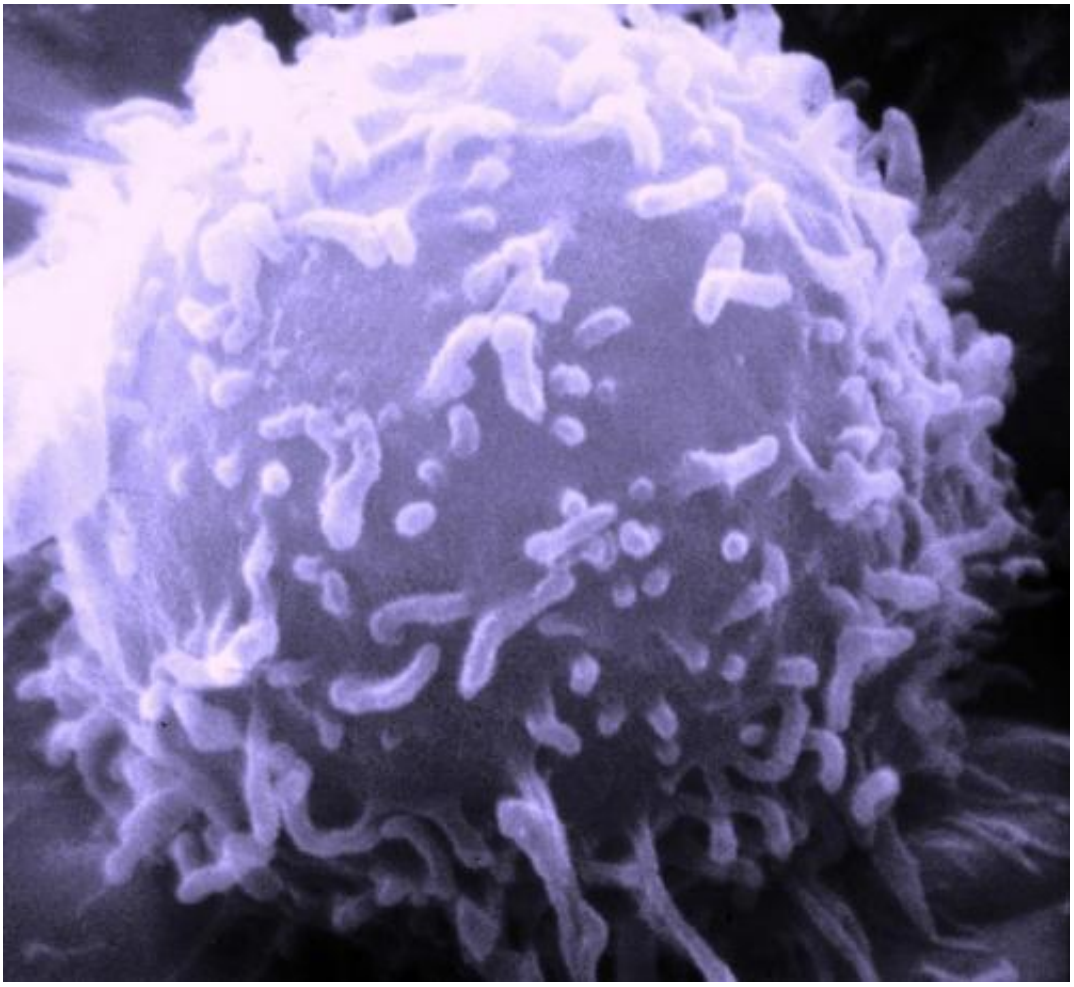
Following cancer with tiny magnets

November 24 2015, by Aidan Cousins



Electron microscopic image of a single human lymphocyte. Credit: Dr. Triche National Cancer Institute

Life-saving surgery and treatments rely on doctors being able to accurately track the spread of cancers.

A new device that uses iron particles and a magnetic probe will allow clinicians to narrow down exactly which lymph nodes tumours spread to.

Developed by Aidan Cousins with colleagues at the University of South Australia, the novel approach is more sensitive and safer than existing methods for monitoring cancer.

"Pre-clinical trials of our approach suggest it gives a very clear picture of where tumours are most likely to spread," Aidan explained.

"It will allow subsequent surgery and treatment options to be refined for better standards of care and improved prognosis."

The technique involves injecting biodegradable iron particles at the primary site of a tumour, from where – as part of their normal surveillance activities – cells of the immune system transport them to the draining lymph nodes.

"The first place primary cancers typically spread to is the lymph node that taps directly from that site," said Aidan.

"The particles accumulate in the same place, and we use the probe to detect their magnetic properties as soon as 20 minutes after injection."

The network of lymphatic vessels and nodes that drain our body's organs are notoriously difficult to map, being very fine and transparent.

Currently the only way spread of cancer from a primary site to lymph nodes can be tracked is with a radioactive tracer. The material is injected into the patient, and preferentially accumulates wherever tumour cells are multiplying. So-called 'hot spots' can then be identified using a radiation-detecting probe.

"This approach has a resolution of around 20mm, which means that sometimes a cancer-free lymph node is removed along with a 'hot' one," said Aidan.

"In addition, it requires the patient being exposed to a small dose of radioactive material."

By comparison, Aidan's magnetic technique offers 5 times better accuracy and is logistically simpler and safer for both patient and medical staff.

"The most exciting aspect of this technology is the spatial resolution," explained Aidan.

"At the moment, we can distinguish between a positive and a negative lymph node even if they're in direct contact."

This means that patients would be able to keep their healthy lymph nodes, and have cancerous ones removed to prevent further spread.

Aidan and his colleagues expect to improve this sensitivity even further in the near future, with extra refinements of the approach already in development.

"Our approach may be particularly suited to identifying the spread of cancers from the head and neck, and also from the gastrointestinal tract, where draining lymph nodes can be located very close together," Aidan said.

Dr Melissa Moore is a Medical Oncologist at St Vincent's Hospital in Melbourne, Victoria, and specialises primarily in cancers of the breast, lung and upper gastrointestinal tract. She said accurate monitoring of cancer spread is a critical factor in determining the best therapies for

patients.

"The presence of cancer cells in the draining lymph nodes is a main factor in determining risk of tumour recurrence," said Dr Moore.

"We use information about the nodal positivity to guide us in determining the best treatments for patients, including surgery but also chemotherapy and hormone therapy."

"In this way, tools that enable better tracking of cancer spread will have a clinical impact," she said.

With the design of the magnetic probe patented, Aidan and his colleagues have recently published a report on a successful preclinical trial.

The scientists are now working with collaborators to progress the technology towards clinical testing.

More information: A. Cousins et al. Novel Handheld Magnetometer Probe Based on Magnetic Tunnelling Junction Sensors for Intraoperative Sentinel Lymph Node Identification, *Scientific Reports* (2015). DOI: 10.1038/srep10842

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