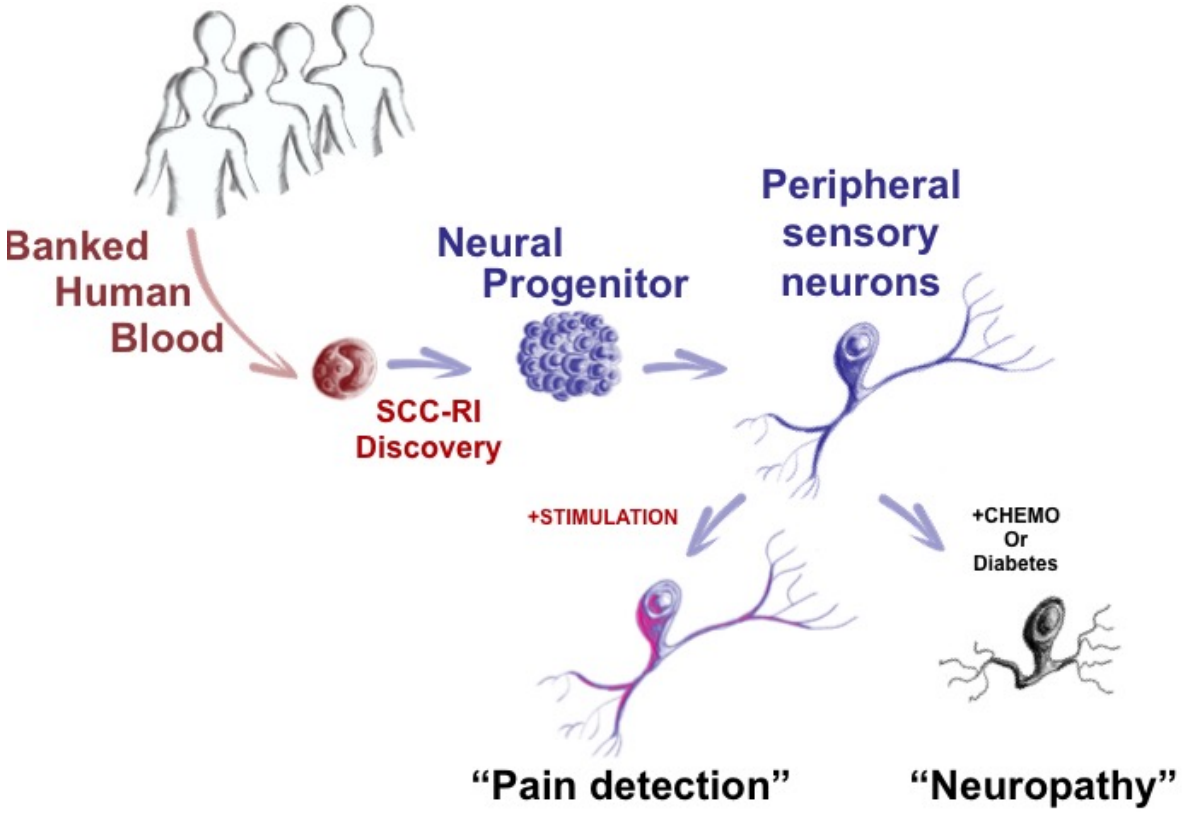
Scientists turn blood into neural cells

May 21 2015



Credit: McMaster University

Scientists at McMaster University have discovered how to make adult sensory neurons from human patients simply by having them roll up their sleeve and providing a blood sample.

Specifically, stem cell scientists at McMaster can now directly convert adult human blood cells to both central nervous system (brain and spinal cord) neurons as well as neurons in the peripheral nervous system (rest of the body) that are responsible for pain, temperature and itch perception. This means that how a person's nervous system cells react and respond to stimuli, can be determined from his blood.

The breakthrough, published online today and featured on the cover of the journal *Cell Reports*, was led by Mick Bhatia, director of the McMaster Stem Cell and Cancer Research Institute. He holds the Canada Research Chair in Human Stem Cell Biology and is a professor in the Department of Biochemistry and Biomedical Sciences of the Michael G. DeGroote School of Medicine. Also playing a key role was Karun Singh, a co-author in the study and holder of the David Braley Chair in Human Stem Cell Research.

Currently, scientists and physicians have a limited understanding of the complex issue of pain and how to treat it. The peripheral nervous system is made up of different types of nerves - some are mechanical (feel pressure) and others detect temperature (heat). In extreme conditions, pain or numbness is perceived by the brain using signals sent by these peripheral nerves.

"The problem is that unlike blood, a skin sample or even a tissue biopsy, you can't take a piece of a patient's neural system. It runs like complex wiring throughout the body and portions cannot be sampled for study," said Bhatia.

"Now we can take easy to obtain blood samples, and make the main cell types of neurological systems - the central nervous system and the peripheral nervous system - in a dish that is specialized for each patient," said Bhatia. "Nobody has ever done this with adult blood. Ever.

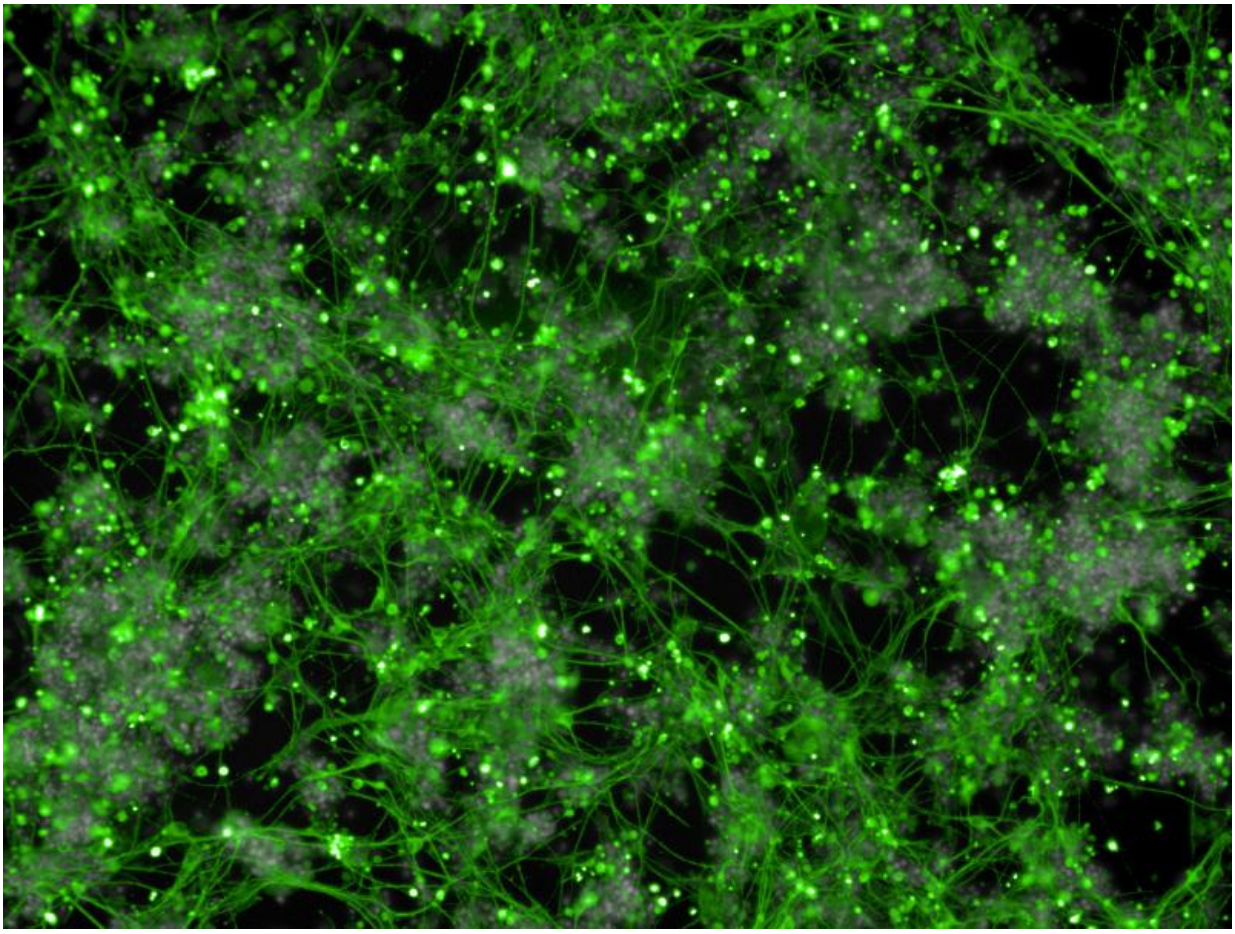


Image shows a field of neurons stained positively for beta-tubulin III derived from blood through direct conversion method.

"We can actually take a patient's blood sample, as routinely performed in a doctor's office, and with it we can produce one million sensory neurons, that make up the peripheral nerves in short order with this new approach. We can also make central nervous system cells, as the blood to neural conversion technology we developed creates neural stem cells during the process of conversion."

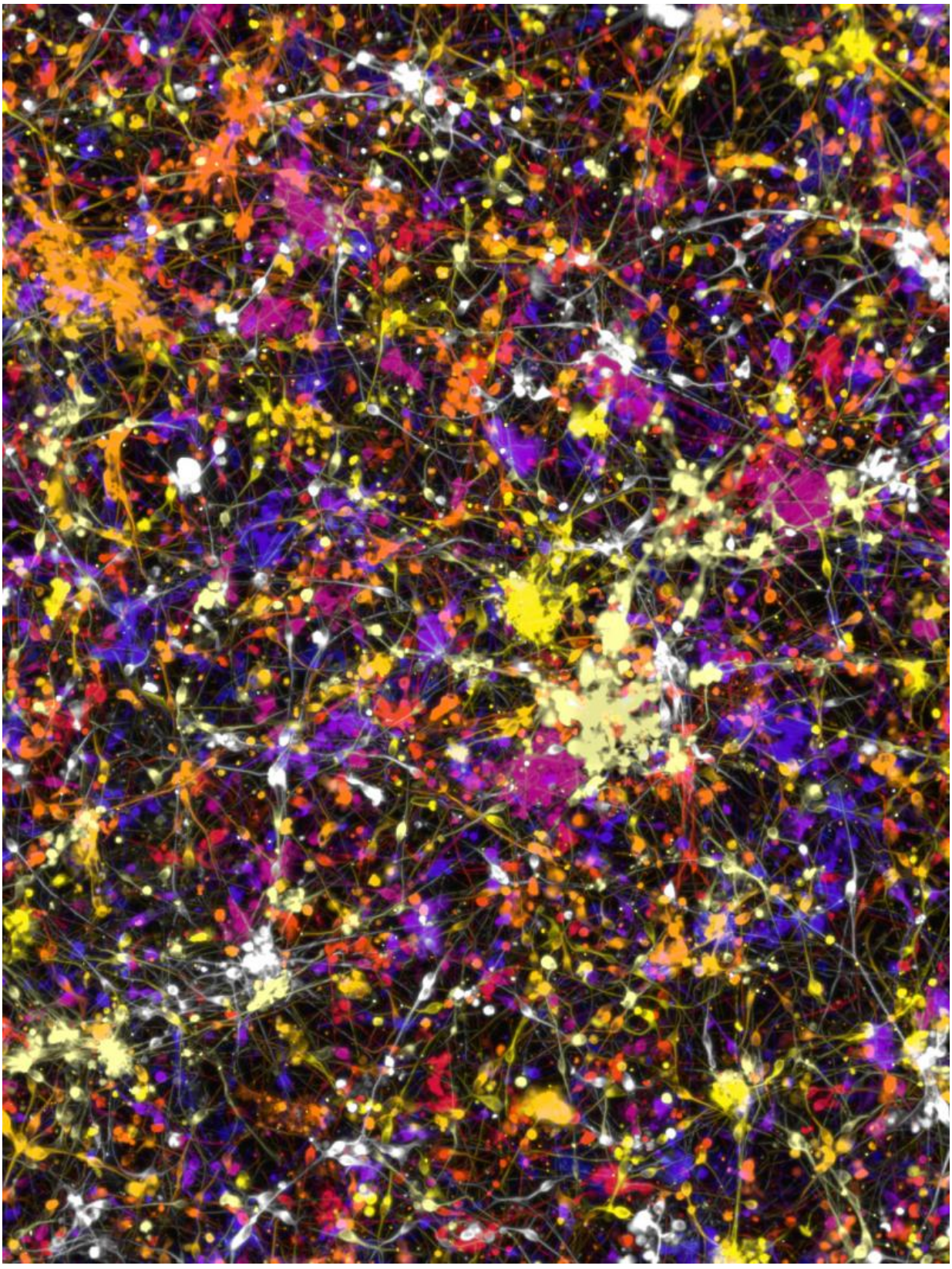
His team's revolutionary, patented direct conversion technology has

"broad and immediate applications," said Bhatia, adding that it allows researchers to start asking questions about understanding disease and improving treatments such as: Why is it that certain people feel pain versus numbness? Is this something genetic? Can the neuropathy that diabetic patients experience be mimicked in a dish?

It also paves the way for the discovery of new pain drugs that don't just numb the perception of pain. Bhatia said non-specific opioids used for decades are still being used today.

"If I was a patient and I was feeling pain or experiencing neuropathy, the prized pain drug for me would target the peripheral nervous system neurons, but do nothing to the central nervous system, thus avoiding non-addictive drug side effects," said Bhatia.

"You don't want to feel sleepy or unaware, you just want your pain to go away. But, up until now, no one's had the ability and required technology to actually test different drugs to find something that targets the peripheral nervous system and not the central nervous system in a patient specific, or personalized manner."



An overlay of individually pseudo-coloured fields from a single tissue culture dish of neurons generated under culture conditions for nociceptive sensory neurons. Credit: McMaster University

Bhatia's team successfully tested their process using fresh blood, but also cryopreserved (frozen) blood. Since blood samples are taken and frozen with many clinical trials, this allows them "almost a bit of a time machine" to go back and explore questions around pain or neuropathy to run tests on neurons created from blood samples of patients taken in past clinical trials where responses and outcomes have already been recorded".

In the future, the process may have prognostic potential, explained Bhatia, in that one might be able to look at a patient with Type 2 Diabetes and predict whether they will experience neuropathy by running tests in the lab using their own neural cells derived from their blood sample.

"This bench to bedside research is very exciting and will have a major impact on the management of neurological diseases, particularly neuropathic pain," said Akbar Panju, medical director of the Michael G. DeGroote Institute for Pain Research and Care, a clinician and professor of medicine.

"This research will help us understand the response of cells to different drugs and different stimulation responses, and allow us to provide individualized or personalized medical therapy for patients suffering with neuropathic pain."

Provided by McMaster University

Citation: Scientists turn blood into neural cells (2015, May 21) retrieved 5 May 2024 from https://medicalxpress.com/news/2015-05-scientists-blood-neural-cells.html

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