Australian Senate Approves Embryonic Stem Cell Research

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Stem cells: the new frontier

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OF ALL the advances in medical science only organ transplantation and the discovery of penicillin come close.

The narrow victory of Kay Patterson's stem cell bill in the Senate this week finally brings Australian researchers — already considered among the best in the world — to within touching distance of a similar revolution.

The Age's medical research reporter Christian Catalano looks at four diseases that Australian stem cell research is destined to impact on.

Three Australian scientists tipped to be among the first to unlock the secrets of successfully cloning human embryonic stem cells also offer their thoughts on what the opportunity to finally experiment with therapeutic cloning would mean to them.

DIABETES

Having already discovered the method for coaxing mouse embryonic stem cells to become insulin-secreting pancreas cells, Professor Alan Trounson says his team at Monash University will be among the first to apply for a new licence to try the technique in humans.

The ultimate aim is to combine a patient's DNA with a donated egg and then grow the specialised cells — known as islets — in the laboratory. Those cells could then be injected into the vein that drains into the liver, where they would carry out their normal function of secreting insulin in response to blood-sugar levels.

"In principle, two-thirds of the problems for the type 1 diabetes solution are already there," said Professor Ian Frazer. "We know how to put the islet cells in, we know how to protect them, we just don't have them."

Professor Frazer said human embryonic cloning was the only feasible way to create islet cells that wouldn't be rejected by the body. "If we go the route of trying to get islets from cadaver donors, which is what we're doing at the moment, we can only hope to transfer 20 patients a year in Australia. We've got 20,000 people who need the transplant."

BREAST CANCER

It was a stunning Australian breakthrough, but one that managed to slip by largely unnoticed. On January 5 this year, a team from Melbourne's Walter and Eliza Hall Institute confirmed it had grown a breast from a single mouse stem cell.

It was the first time a complex organ of an animal had been grown from stem cells and many scientists believe it will form the genesis of potential therapies for breast cancer and a paradigm for the study of other cancers.

"The thing that will captivate people's attention of course is that women could regrow their breasts after they've had a mastectomy," the institute's Professor Geoff Lindeman said.

Rather than stem cell regeneration, Professor Lindeman said the more exciting prospect would be to watch how stem cells grew into breast cancers.

One theory is that the same cells that are responsible for growing breast tissue may also grow into tumours. Using that concept, Professor Lindeman said methods for detecting harmful stem cells were possible within the next decade.

HEART DISEASE

A few years ago, it was believed impossible that a damaged heart could regenerate healthy tissue. Today, researchers are not only convinced there are stem cells in the heart, but believe it is possible to treat heart attack victims by injecting the body's own stem cells.
At Sydney's Victor Chang Cardiac Research Institute, patients with heart disease — and little chance of receiving a transplant — have volunteered for one such trial.

"What they wanted to do was to try and mobilise the patient's own stem cells to come in and try and start repairing defects in their heart," the institute's Professor Sally Dunwoodie said. "They're still analysing the data, but there were certainly some improvements in heart function."

During a heart attack, muscles that stop receiving blood die. A layer of thick, fibrous cells that inhibit the actual pumping of the heart grow in their place, leaving the heart permanently weaker.

"The big question is, if we know there are stem cells within the heart muscle, why don't they come in to repair the damaged tissue rather than the fibrotic tissue?"

The trials are using adult stem cells derived from a patient's own bone marrow. But Professor Dunwoodie said research in mice had shown that it was possible to create beating heart tissue from an embryonic clone.

"The next step is to tailor those cardiac progenitor cells and inject them directly into a damaged heart. Obviously we'd do that in animal models, but there's certainly scope to do it in humans one day."

MULTIPLE SCLEROSIS

At the Monash Immunology and Stem Cell Laboratories, Professor Claude Bernard has begun investigating how stem cells may help to treat multiple sclerosis.

"One of the first things that happens in MS is that cells go into the brain and create inflammation," he said. "Some stem cells actually have some immuno-suppressive activities."

Professor Bernard said it's even possible that the specialised subset of immuno-suppressive stem cells — which stop the immune system from attacking the body — could be administered simply by a jab in the arm. But on top of the inflammation, MS sufferers experience debilitating neural damage as the myelin sheath that coats the nerve begins to break down.

"It's like you were to take two electric wires and take out the plastic in between them, you would have a short-circuit."

Professor Bernard believes it will be possible to direct stem cells to create replacement neurones and myelin-producing cells in future.

THE STAYER: DR PAUL VERMA

Paul Verma could be among the first scientists in the world to successfully reprogram a human cell through embryonic cloning. The problem is that, to date, he's only been able to apply those skills to cow cells. Dr Verma feels ethically compelled to abide by Australian laws, even though that could mean sacrificing his chance to create history in a highly competitive field. When a lucrative offer from an overseas institution came earlier this year, he says he agonised about accepting. "I'm an Australian citizen now," says Dr Verma, who came to Australia from India. "I have a family now and two kids still in school. For those reasons I've chosen to make the best of what I can here and if the legislation changes that would be fantastic." Dr Verma thinks the most promising aspect of human stem cell research lies in the potential to find the genetic causes of late-onset diseases like Alzheimer's and Parkinson's. "It's not the sexiest part unfortunately, but to me that's the most powerful aspect of this research."

THE EXPATRIATE: DR ANDREW FRENCH

When Andrew French took the offer of a job as chief scientific officer at stem cell research and development company Stemagen, in San Diego, earlier this year, the Senate had just begun its review of laws restricting therapeutic cloning. The possibility of change to Australian regulations weighed heavily on his thoughts. "But science is all about opportunity and discovery," he says. "I didn't know if I would end up regretting it if I didn't take that chance." The former project leader of reproductive technology at the Monash Institute of Reproduction and Development, Dr French draws on work with animal embryo manipulation to experiment with human eggs. His team is well advanced in its efforts to pioneer a technique to harvest stem cell lines through SCNT (somatic cell nuclear transfer), a process he hopes will lead to "patient-specific, as well as disease-specific" therapies. He says this week's Senate decision may lure back Australian stem cell scientists working overseas.

THE UP-AND-COMER: LINCON STAMP

When his PhD is finished early next year, Lincon Stamp plans to find work at one of the big stem cell institutions overseas. But after nearly seven years of study, the 27-year-old scientist from the Australian Stem Cell Centre at Monash also wants a break. "It will be half-and-half — a bit of seeing the world and a bit of career advancement," he says. But Australia may not lose him for good. Should Senator Kay Patterson's stem cell bill cross the final hurdle in the House of Representatives next week, he has every intention of coming back. "Whether I'll come back will be highly affected by whether the legislation is passed," he says. Stamp has worked on trying to direct embryonic stem cells to become early liver or pancreas cells — which may ultimately unlock the mysteries of diabetes. He is confident the current generation of Australian scientists will be responsible for more than a few breakthroughs in coming years."Stem cells are the trendiest thing in science now and we've got a really good group of people here."