

Regenerative medicine: new hope for broken hearts

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Researchers at the recently established McEwen Centre for Regenerative Medicine at University Health Network (UHN) are looking for new ways to treat heart diseases using the tools of regenerative medicine.

“Regenerative medicine uses innovative approaches such as cell therapy and tissue engineering to repair or replace diseased or damaged tissues.” explains Dr. Richard Weisel, director of the Toronto General Research Institute (UHN) and a McEwen Investigator .

“According to Health Canada, cardiovascular diseases are the underlying cause of death for 1 in 3 Canadians. Unfortunately, in many cases, we can’t use heart transplantation to treat heart failure because there are simply not enough donor organs to meet the needs of our aging population. The goal of regenerative medicine is to exploit the ability of the body to heal itself. Thus, this exciting new field offers a solution for many Canadians with heart diseases for which the available treatments are inadequate” Dr. Weisel says.

Dr. Weisel and fellow McEwen Investigator Dr. Ren-Ke Li began investigating cardiac regenerative medicine in 1996 while developing new treatments for heart attacks. A heart attack occurs when the blockage of a major blood vessel impairs blood supply in the heart, leading to death and scarring of the cardiac tissues. This can in turn lead to heart failure and death, in part because the heart is unable to regenerate the dying cells.

Drs. Weisel and Li demonstrated for the first time that the implantation of heart muscle cells into the damaged heart following a heart attack dramatically improved cardiac function in experimental models.

Over the last decade, their studies have shown that transplanting various cell types into the damaged heart can improve cardiac function and prevent heart failure. This beneficial effect can be enhanced by modifying the cells in the laboratory prior to their implantation—for example, by increasing the expression of specific genes.

“Our evidence suggests that the transplanted cells act by sending signals that enhance intrinsic mechanisms of repair in the heart — for example, by recruiting stem cells that are naturally present in the patient’s bone marrow. These stem cells can migrate into the heart and actually repair the damaged organ—as opposed to conventional therapies which only slow down the progression of the disease or treat symptoms” says Dr. Weisel.

“Of course, we need to determine which cell types, gene enhancements and delivery techniques are most effective to restore function in the damaged heart. However, our preclinical studies are very encouraging and the initial clinical trials in Europe based on the principles established by researchers at the McEwen Centre are also promising.”

Tissue engineering is another innovative approach under investigation. Dr. Li and his team have developed new technologies to grow various cell types into three-dimensional

biodegradable scaffolds to create tubes or patches which can be employed to replace defective regions of the heart.

One of the constructs they have created can be used as a surgical “replacement part” for children born with a heart defect. A major advantage of this new technology is that the scaffold dissolves with time, allowing the graft to grow with the child. This approach avoids leaving any foreign synthetic material in the heart and may eliminate the need for multiple surgical procedures in these children.

“We are currently collaborating with scientists in Japan who have tested these bioengineered constructs in forty children. After three years, the results are promising. The biodegradable scaffold has dissolved and the graft grew with the children” says Dr. Weisel.

Tissue engineering may also provide a new method to treat heart attacks. Dr. Li has developed “patches” which can be employed during surgical repair to restore the normal size and shape of the heart after a heart attack. His team has also demonstrated that the bioengineered mesh seeded with heart cells beats regularly and spontaneously in the laboratory—mimicking the activity of the heart.

“There is some really exciting regenerative medicine research going on at UHN—and not only in cardiovascular diseases” Dr. Weisel says. “The McEwen Centre also has strong programs in pulmonary diseases, neurodegenerative disorders, spinal cord injury, diabetes and cancer. For many of these diseases, no effective treatment is currently available. Regenerative medicine therefore offers the promise of new treatment alternatives—it could potentially transform medical practice.”

For more information about the McEwen Centre for Regenerative Medicine, please visit: www.mcewencentre.com