Paving the way to truly mend a broken (donor) heart in the future

Anticipated breakthroughs by Peter Munk Cardiac Centre doctors and scientists could lead to more donor hearts, fewer rejections, advanced stem cell treatments and repairs to a patient's own heart

By **David Israelson**

THREE DECADES AFTER THE FIRST SUCCESSFUL HEART TRANSPLANT WAS ACHIEVED IN TORONTO, the medical mysteries keep unravelling, and the miracles keep multiplying.

"We have done more than 700 transplants, and I have been here long enough to have worked on 500," says Dr. Heather Ross, world-renowned cardiologist and Director of the Ted Rogers and Family Centre of Excellence in Heart Function and the Cardiac Transplant Program at the Peter Munk Cardiac Centre (PMCC), part of the University Health Network.

"It's still a remarkable achievement every time it happens," Dr. Ross says.

Thanks to new research and technology, it's getting more remarkable all the time. Doctors and scientists are on the verge of breakthroughs that promise to increase the success of heart transplants and which may vastly expand the number of patients who can receive the life-saving treatment.

The first successful heart transplant in Toronto took place on November 17, 1968, at St. Michael's Hospital, performed by Dr. Clare Baker on Charles Perrin Johnston, who lived until 1975. It took place after two earlier transplants in Toronto in which patients died within a week of surgery, as well as less than a year after the world's first heart-to-heart transplant was performed in South Africa by Dr. Christian Barnard.

In the next 30 years, the possibilities for innovation range from incremental improvements in technology and medication to *Star Trek*-like procedures that are so stunning they're barely imaginable.

Dr. Ross says the breakthroughs and discoveries that medical teams are working on now include:

- new medications that lower the risk of cellular rejection;
- the use of donor hearts that were previously considered too damaged to transplant, making transplants available to many more people;
- the possibility of stem cell treatment to repair damaged hearts; and
- taking a patient's own heart and putting it "on the hoist" – removing it temporarily for repairs and then reinstalling it, rather than replacing it with a donor's heart.

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01 Dr. Mitesh Badiwala and his team are working on a host of new technologies, some which will be able to repair heart damage as fast as possible.

02 Dr. Heather Ross, Director of the Ted Rogers and Family Centre of Excellence in Heart Function, has worked on 500 of the more than 700 heart transplants done to date at the Toronto General Hospital and the PMCC.

"In the first 30 years, nothing has really changed in terms of the surgery itself – until recently," says Dr. Mitesh Badiwala, a cardiac surgeon at the PMCC.

"We'd take a donor's heart, flush it and package it in a cooler full of ice." Donors are always those who have been declared brain-dead, with no hope of recovery.

Brain death is declared when it is clearly irreversible, and it is a legally accepted concept of death in virtually every country in the world.

Still, even when a donor has been declared brain-dead, doctors can't use hearts that are damaged. So, many people who need transplants are placed on waiting lists.

"We're probably taking only up to 35 per cent of the hearts from donors. The rest are turned down, sometimes because the donors are really old or have heart disease," Dr. Badiwala explains.

At the same time, "there are hearts out there that we know have only temporary damage, and even though the donor is brain-dead, the heart has the potential to recover," he says.

Understandably, grieving families want a donor's heart to be used quickly to save someone, so Dr. Badiwala and his team are working on technology that can repair temporary heart damage as fast as possible.

"We're testing the machine in the lab now. We hope that later this year, we'll be able to use human hearts that have been discarded as too damaged for transplants and see how many we can bring back," Dr. Badiwala says.

"At some point, when we're confident that the hearts are working well, we'll be able to take them off the machine and use them for transplants."

Perhaps an even more exciting aspect of this research into correcting damage is that it may make it literally possible to fix a broken heart.

"It gives us an opportunity to potentially repair hearts, with new strategies that are being used in other labs," Dr. Badiwala says. New medications can be used experimentally without putting patients at risk, as leading-edge biotechnology such as gene or stem cell therapy are developed.

This goes beyond fixing the temporary damage that sometimes shows up in donors' hearts.

"We may be able to repair hearts that right now are not useable," Dr. Badiwala says.

The team is also about to begin clinical trials with DCD – or "donation after circulatory death" – hearts. Unlike hearts that come from donors who are brain-dead, DCD hearts have been considered unreliable for transplants because they stopped beating when the donor died.

Hospitals in Britain and Australia are now using DCD hearts.

"They've done this in those two centres nearly 50 times. My team and I visited the facility in Papworth, England (near Cambridge), and we were impressed. They were able to increase their volume of transplantation by more than 50 per cent," Dr. Badiwala says.

"We hope to decrease the incidence of patients who die while they're on waiting lists."

Donors' and families' wishes must be respected, including when it is appropriate to withdraw life support for a patient who will not recover. The legal definition of a circulatory death in Canada is when a person's heart has stopped beating for five minutes, Dr. Badiwala notes.

Which leads to a dream for the future. "We can dream of the device we're working on to repair hearts becoming a device not just to repair hearts for transplant, but [also] to repair your own heart," Dr. Badiwala says. "Take it out, put it on the machine and transplant it right back into you."

This is not as far-fetched as it sounds. He points out that patients on waiting lists already survive for short periods, even months sometimes, with mechanical heart devices. Maybe they can do so while their own hearts are on the hoist.

Yet as promising as the future may be, the present at the PMCC is pretty amazing, too, Dr. Ross says.

"I've been working in this area for 23 years, and every time we do a transplant it seems like the first time, in terms of miraculous and life-saving potential."

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