Marva Lorde relied on a left ventricular assist device (LVAD) for two years before receiving a heart transplant.

Mechanical hearts are buying time for patients and groundbreaking research

Combined with stem cell technology, a patient's own heart can start pumping again

By **Bryan Borzykowski**

WHEN MARVA LORDE WENT TO BED ON THE NIGHT OF OCTOBER 25, 2007, nothing seemed out of the ordinary. The former bank employee had been enjoying a life of leisure after working for 34 years, and she was looking forward to going to her regular workout class in the morning. At some point during the night, though, a feeling of indigestion came over her, and soon after the clamminess and vomiting began.

Despite feeling ill, she drove herself to the hospital, where she learned she had experienced a massive heart attack and had to stay in the Coronary Intensive Care Unit for the next 10 days. "There was no pain, but on the inside damage was happening," she says. "I thought it was just a virus."

Over the next three years, the damage worsened to the point where, in 2010, her heart essentially stopped working on its own. Doctors had to implant a left ventricular assist device (LVAD) – a battery-powered mechanical heart that pumps blood through the body.

While Ms. Lorde had to plug it in every night, and she had to be mindful of the power cord sticking out of her chest, it helped improve her life. "I had to be careful, but I got around to do a lot of things, like my cooking and washing," she says. "I didn't feel sorry for myself."

Ms. Lorde received her mechanical heart (called a Duraheart) at the Peter Munk Cardiac Centre (PMCC), which, over the last 16 years, has developed a robust mechanical circulatory support program – it installed its 200th LVAD in late 2016.

In 2001, Dr. Vivek Rao, Division Head of Cardiovascular Surgery at PMCC and the Peter Munk Cardiac Centre Chair in Advanced Cardiac Therapeutics, launched the LVAD program in Toronto after working under Dr. Mehmet Oz at Columbia University, Department of Surgery, in New York, which has one of the world's largest mechanical heart programs.

Those first few years were challenging, as the program was exclusively funded by donors, which meant only about five to 10 devices a year were paid for. In 2012, though, the government began covering LVADs for use in patients on the heart transplant list, and the number of people receiving the device rose. Now, Dr. Rao and his team install about 30 annually.

MORE LVADS NEEDED

However, it's still not enough, says Dr. Rao. Most people with heart failure aren't candidates for heart transplants. They might have a history of cancer or lung problems that make them ineligible for a new transplant. LVADs, though, can help them live long and fulfilling lives. "Patients with heart failure who are not transplant candidates are given a death sentence," says Dr. Rao. "They have one or two years to live, and it's not a great life. But those who get these devices do live active lives. They're not restricted by heart failure anymore."

Now that funding has been extended to non-transplant patients, the number of LVADs installed should triple – from 30 to 90. That number could grow even more, as technology continues to improve. It may not be long before Dr. Rao is installing LVAD devices that charge without needing to be plugged in. "We'll get to the point where devices are completely implantable, and they charge like a watch battery," he says. "It won't impact life in any way, and you won't have to worry about your heart failing."

MAKING BAD HEARTS GOOD AGAIN

While the PMCC's mechanical heart program is mostly focused on implanting LVADs, it's also doing groundbreaking research around stem cell technology, says Dr. Terrence Yau, cardiovascular surgeon and Angelo & Lorenza DeGasperis Chair in Cardiovascular Surgery Research. He's currently trying to see if stem cells injected into the heart can help the patient's heart work on its own again.

Dr. Yau is taking patients with LVADs, putting stem cells into their heart and then turning down the LVADs to reduce their pumping function. Normally, if an LVAD is turned off or down, the patient's heart almost instantly fails. However, in the first phase of testing, Dr. Yau found that half of the patients who received stem cell injections could tolerate a reduction in the LVAD's power, compared to only 20 per cent of those patients who did not receive stem cells.

The second phase of the trials are now underway, which will see even more stem cells injected into LVAD patient hearts. The goal? To get people's hearts pumping again. "We want to be able to take the LVAD out and leave the patient with their own heart," says Dr. Yau. "There's nothing better than having your own well-functioning heart."

Ms. Lorde knows that better than most. In 2012, she received a heart transplant, which meant she no longer needed the LVAD. Now she can do everything she used to do, including going to exercise classes. "I've never felt better," says Ms. Lorde. "And that LVAD really helped me as I was waiting for a transplant."

The look and function of Left Ventricular Assist Devices (LVADs) have evolved over the years and are now being combined with other treatments, such as stem cell technology, to restore function to a patient's own heart:

2001
Heartmate I
(1,225 g)

2004
Novacore
(550 g)

2006
Heartmate II
(450 g)

2010
Duraheart
(540 g)

2010
Heartware
(160 g)

2014
Heartmate III
(200 g)