GAME-CHANGING DEVICES

A proving ground for game-changing devices

From valve replacements that are a perfect fit to the smallest possible artificial heart, the Peter Munk Cardiac Centre is where industry partners go to test trailblazing – and life-saving – medical devices

Joel Schlesinger

"We pride ourselves on being the hospital that introduces new technologies to the country's healthcare system," says Dr. Vivek Rao, head of the division of cardiovascular surgery at the Peter Munk Cardiac Centre and the Peter Munk Cardiac Centre Chair in Advanced Cardiac Therapeutics.

When it comes to bringing broken hearts back from the brink, the Peter Munk Cardiac Centre is a global leader.

The Peter Munk Cardiac Centre is a go-to proving ground for the latest devices that are rapidly changing the treatment of heart disease. It's often on the short list when industry partners seek to test new devices on patients who often have no other safe, viable therapy alternatives.

Call it the cutting-edge technology that can reduce the "cutting" involved in surgery.

"The device field is rapidly evolving as the technology improves, and every three to four years a new device is introduced into the market," says Dr. Rao.

New devices tested at the centre save lives. They also transform what were once major surgeries into much safer procedures, involving smaller incisions and less recovery time.

These game-changing devices are welcome additions to health providers' toolkits across many disciplines of acute cardiovascular care, including these three key areas:

VALVE REPLACEMENTS

Size matters when it comes to getting the latest technologies to treat valvular problems.

In the case of the Peter Munk Cardiac Centre, it helps to be big.

"Because of our size and volume – being in Toronto – we have access to a lot of technologies before they are ready for prime time and widely available," says Dr. Eric Horlick, a cardiologist, professor of medicine at the University of Toronto and the Peter Munk Chair in Structural Heart Interventions at the Peter Munk Cardiac Centre.

Further to that point, the Peter Munk Cardiac Centre has established connections with industry leaders, who recognize the centre's skilled teams and their ability to integrate new technologies into care models.

Yet size is also an important aspect of the new devices themselves. They often treat conditions involving leaky, malfunctioning valves controlling blood flow within the heart and to the rest of the body. Dr. Horlick points to a current study underway at the Peter Munk Cardiac Centre involving next generation replacement valves used to treat aortic stenosis – the narrowing of the valve of the main artery exiting the heart.

"It's a common problem we see as people get older," Dr. Horlick says. In the past, valve replacements would involve major surgery, and were often not a good option for elderly patients.

But the latest heart valve to treat this condition can fit through all but the smallest arteries using a catheterization procedure. Catheterization means inserting the device through a vessel in the neck or leg to gain access to the heart.

"When we started this 10 years ago, we were one of the first centres in the country doing catheterization procedures," he says. "At the time, it was so unthinkable to shove a rather large valve up someone's leg, so it was only done in the highest risk people with no other options."

Now, new devices can not only travel up a blood vessel into the heart, they also fit more perfectly within the heart, like a bespoke suit, resulting in less leakage and a longer lifespan.

Dr. Horlick points to new imaging technologies combining magnetic resonance imaging (MRI) and computed tomography (CT) scan modalities that create three-dimensional, highly accurate copies of a patient's heart. Using 3D printing technology in a facility at the Peter Munk Cardiac Centre, cardiac teams can construct an exact, life-sized model of a patient's heart that they can hold in their hands.

"This allows us to ensure the replacement valve is a perfect fit," he says, adding they can literally place the valve within the model. "Our team of cardiologists and surgeons have carefully and meticulously refined the process of choosing the right size and type of valve for the right patient, and that gives me confidence and piece of mind when we offer TAVI [transcatheter aortic valve implantation] to our patients."

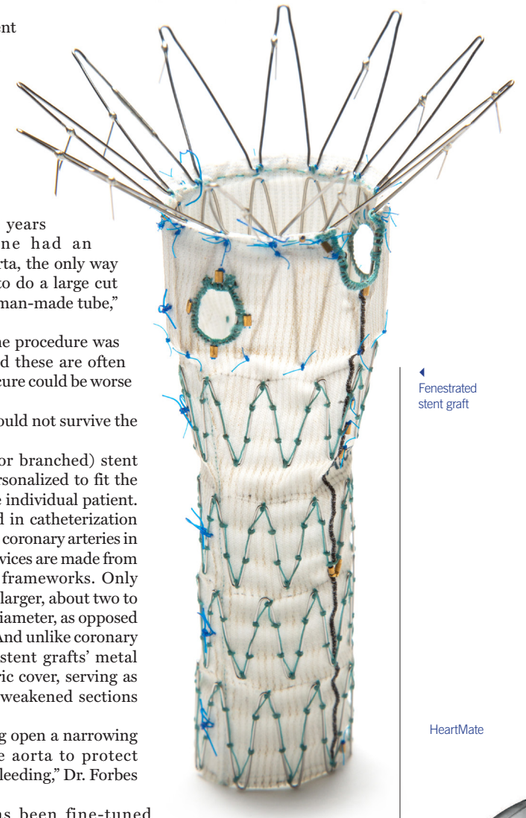
Altogether, these advances have made procedures safer and more effective, Dr. Horlick says.

What used to involve a large incision in the chest, splitting open the rib cage, five to 10 days in hospital and about six weeks of recovery can now be done in about half an hour. And the patient can often go home the next day.

"Think of it from the patient's perspective," Dr. Horlick adds. "Who would want to have surgery if this alternative is available?"

TREATING AORTIC ANEURYSMS

For more than a decade, the Peter Munk Cardiac Centre has been revolutionizing treatment for aortic aneurysms. Essentially a thinning of a section of the wall of the aorta, an aneurysm can burst without treatment leading to fatal hemorrhaging, says Dr. Thomas Forbes, division head of vascular surgery and the R. Fraser Elliott Chair in Vascular Surgery at UHN.



Fenestrated stent graft

"Up until about 15 years ago, when someone had an aneurysm of their aorta, the only way to fix that would be to do a large cut and replace it with a man-made tube," Dr. Forbes says.

"Correspondingly, the procedure was a large operation, and these are often elderly people, so the cure could be worse than the disease."

Simply put, many would not survive the procedure.

Enter fenestrated (or branched) stent grafts that can be personalized to fit the vessel structure of the individual patient. Similar to stents used in catheterization procedures to unblock coronary arteries in heart attacks, these devices are made from stainless steel mesh frameworks. Only aortic stent grafts are larger, about two to three centimetres in diameter, as opposed to a few millimetres. And unlike coronary artery stents, aortic stent grafts' metal framework has a fabric cover, serving as a new lining for the weakened sections of the aorta.

"Rather than holding open a narrowing vessel, it relines the aorta to protect against rupture and bleeding," Dr. Forbes says.

The procedure has been fine-tuned by the centre over several years, and the stents themselves have improved as a result. Today, they are more reliable, more customizable to the patient and, perhaps most importantly, smaller. Again, the move toward greater miniaturization has opened the procedure up to more patients, especially women.

"In the past, we were not able to repair aneurysms in women with this therapy, because they had smaller blood vessels," Dr. Forbes says.

Surgery still occurs to treat aneurysms today, he adds, but it is much rarer.

Of course, notes Dr. Forbes, "the least invasive procedure is prevention."

The Peter Munk Cardiac Centre is involved in groundbreaking research on this front too, carrying out basic research to understand how aneurysms form so that one day, pharmacological therapies could treat them rather than more invasive options.

"We're a ways off," Dr. Forbes says. "But we're always looking at different ways to transform the treatment paradigm."

ARTIFICIAL HEARTS

The Peter Munk Cardiac Centre is one of Canada's top centres for heart transplants – a last-line option for patients with severe heart failure. But many can wait for long periods for a donor heart. As well, others may not be suitable for the most invasive of cardiac procedures.

That's why since the early 2000s, the centre has been at the forefront of procedures involving left ventricular assist devices (LVADs) – essentially the technical term for an artificial heart.

Working with industry leaders, the centre was among the first hospitals in the world to implant the earliest version of the device in a patient with heart failure – whose organ could no longer adequately pump blood throughout the body.

After years of testing and implanting new-and-improved iterations of LVAD technology, another new device is on the horizon, called a miniaturized ventricular assisted device. The size of a AA battery, it will be the smallest artificial heart device yet.

"This will allow us to do the surgery in a much more rapid fashion, and with a less invasive procedure so that people who are elderly, frail and may not tolerate an operation to implant an [LVAD] may now have a viable option," Dr. Rao says.

Only time will tell if the next generation of devices improves outcomes and expands care options for patients who may not be good candidates for other therapies.

And that's just fine with Dr. Rao and the clinical care team at the Peter Munk Cardiac Centre. After all, they see themselves as the gatekeepers for new innovations, helping to determine whether they increase safety and efficacy of treatment. "Or are they very expensive toys you would like to have on your shelf, but they don't provide a cost-effective solution?" Dr. Rao says.

"In that respect, we're not just clinical implanters of the latest devices; we're scientists evaluating the benefits of new technology."

HeartMate

HeartMate 3 LVAD photo courtesy of Abbott Medical Devices