AN INSIDE LOOK AT THE LARGEST SURGICAL PROGRAM IN CANADA

SPROTT

DEPARTMENT OF SURGERY

DR. SHAF KESHAVJEE, Surgeon-in-Chief

13 divisions. 140 surgeons. 35,000 operations annually.

How the Sprott Department of Surgery saves lives through world-leading innovations.

UHN
Toronto General
Toronto Western
Princess Margaret
Toronto Rehab
Michener Institute

WELCOME

Saving lives with surgery

Sprott Surgery has one of the best multidisciplinary teams in the country.

In a typical year, more than 35,000 surgical procedures are performed at the Sprott Department of Surgery at University Health Network (UHN) in Toronto. Of course, 2020 has not been a typical year. Because of COVID-19, elective surgeries across the country were put on hold for months. An estimated 100,000 patients nationwide – including many in Ontario – had their surgeries delayed. Now, our dedicated surgical teams are working tirelessly to clear the backlog.

While this year looks different from years past, one thing hasn't changed: for the best leading-edge surgical treatment, Canadians can rely on the Sprott Department of Surgery. As the largest surgical program in Canada, we perform some of the most challenging operations worldwide, as you will read in this magazine.

Our surgeons are part of multidisciplinary teams – including anesthetists, intensivists, perfusionists, nurses, prosthetics experts, physical therapists, occupational therapists, speech pathologists, social workers, nutritionists and more – that strive to offer the best care and outcomes through a patient-centred approach.

Our diverse knowledge and our drive to seek innovative solutions are what make the Sprott Department of Surgery a leader in the development of new surgical technologies and techniques. Patients from around the world benefit from these groundbreaking innovations, as surgeons and surgical trainees from every continent are drawn to our operating rooms to learn first-hand from our teams.

For the second year in a row, UHN's Toronto General Hospital (TGH) was named one of the world's best hospitals in a global ranking by *Newsweek*. Ranked fourth, and the only Canadian hospital in the top 10, TGH was selected in significant part because of the Sprott Department of Surgery. We are honoured to share in this recognition with our UHN colleagues, and we're inspired to keep moving forward.

These accomplishments would not be possible without funding from our steadfast donors, particularly the Sprott Foundation, which has generously supported the vision of the Sprott Department of Surgery for close to a decade. Philanthropy is essential to our success, and we are indebted to our entire donor community for their generosity and support.

Together, we can be world leaders in surgery – and build a healthier world.

Shaf Keshavjee, O.C., O.Ont, MD, M.Sc., FRCSC, FACS
Surgeon-in-Chief, Sprott Department of Surgery
James Wallace McCutcheon Chair in Surgery
Director, Toronto Lung Transplant Program
Director, Latner Thoracic Surgery Research Laboratories
Professor of Thoracic Surgery, University of Toronto

PHOTO: COURTESY OF UHN

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ALLCAPS
UHN Sprott Department of Surgery

DISCLAIMER: All photos were taken either before the COVID-19 pandemic or following appropriate physical distancing guidelines.

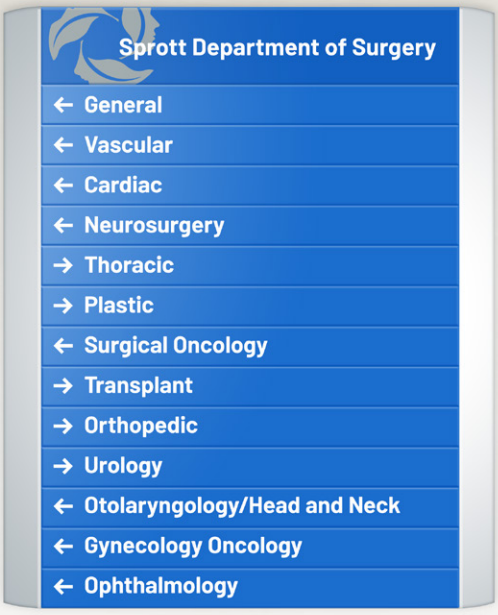
INSIDE SPROTT SURGERY

What is the Sprott Department of Surgery?

There's a good chance that if you or a loved one requires a complex operation, you'll end up at the Sprott Department of Surgery, the largest surgical program in Canada. The department spans 13 surgical divisions, from cardiovascular to neurosurgery to thoracic, across three University Health Network hospitals: Toronto General Hospital, Toronto Western Hospital and Princess Margaret Cancer Centre.

Every day, doctors, nurses, scientists and others from different disciplines work together to tackle some of the world's most complex surgeries and toughest medical problems. Sprott Surgery's teams have developed groundbreaking technologies that are now used in hospitals everywhere, and they've developed surgical techniques that save countless lives.

As Dr. Shaf Keshavjee, Surgeon-in-Chief of the Sprott Department of Surgery, puts it: "At Sprott Surgery, we strive to transform surgical innovation, conduct world-leading research and offer life-saving surgical care."



These 13 divisions make up the Sprott Department of Surgery.

Gift of a lifetime

The Sprott Foundation's ongoing support has helped transform surgery at UHN.

FROM LEFT TO RIGHT:
Larisa, Vizma, Eric and Juliana Sprott

In 1988, Eric and Vizma Sprott founded the Sprott Foundation, which focuses on food security and homelessness. In 2012, the Sprott Foundation gave one of its largest gifts – $25 million – to University Health Network's department of surgery, which was then renamed the Sprott Department of Surgery. Since their first gift, the Sprott Foundation has donated more than $25 million of additional support to surgery at UHN. "We support organizations that are leaders in their field," said Eric Sprott after his first donation. "Surgeons at UHN have, among other things, pioneered numerous heart and brain surgeries, and developed the Toronto Ex Vivo Lung Perfusion System. These innovations have gone on to save the lives of millions of patients around the world."

The gift has helped UHN hire and retain world-leading surgeons, and make new investments in best-in-class surgical technology, including robotic systems and organ repair innovations. Thanks to the Sprott Foundation's generosity, the Sprott Department of Surgery is one of the top surgical departments in the world.

Sprott Surgery by the numbers

For 70 years, UHN's surgeons have been performing life-saving operations, conducting industry-leading research and developing world-class technologies.

Surgeries performed between April 2019 and March 2020 by the Sprott Department of Surgery

23,344

- **12,370** Surgeries performed at Toronto Western Hospital
- **9,122** Surgeries performed at Toronto General Hospital
- **1,852** Surgeries performed at Princess Margaret Cancer Centre

140+
Surgeons who work at the Sprott Department of Surgery

12,333
Endoscopic procedures performed by Sprott surgeons between April 2019 and March 2020

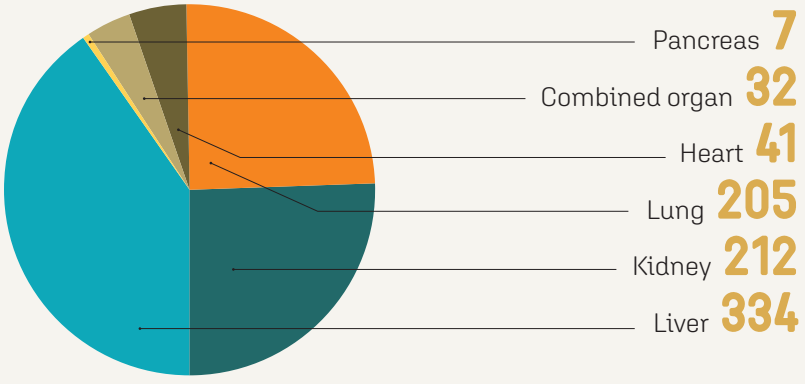
2,055
Cardiovascular and vascular surgeries performed in 2019

39
Operating rooms

376
Robotic surgeries performed by Sprott surgeons between April 2019 and March 2020

Number of transplants between April 2019 and March 2020

831



Surgical firsts at UHN

Just a few of UHN's many major surgical and surgery-related innovations.

1921 Discovery and first clinical use of insulin at Toronto General by Dr. Frederick Banting – a general surgeon at Toronto General – and Dr. Charles Best

1950 World's first external heart pacemaker used in an open-heart resuscitation

1983 World's first successful single-lung transplant

1989 World's first heart valve-sparing aortic root replacement, known as the "David Operation"

1996 World's first awake outpatient craniotomy for brain tumour removal

2003 World's first use of deep brain stimulation to treat drug-resistant depression

2008 World's first lung transplant using the Ex Vivo Lung Perfusion System

2016 Canada's first upper limb transplant (forearm and hand)

2020 Canada's first robotic-assisted nipple-sparing mastectomy

Dr. Carol-Anne Moulton (L) and Dr. Tim Jackson (R) lead UHN's safety and quality benchmarking program.

Safe space

UHN's safety and quality program ensures patients get the best care possible. **By Bryan Borzykowski**

Every day at around 7 a.m., a small group of nurses and anesthesiologists gather in front of the operating room to talk about how to make the day's surgeries go smoothly. They then regroup later to debrief on what went right – and wrong. The idea is to ensure that all the things that went well are repeated in the future, while the things that didn't go as smoothly are acknowledged and improved upon.

It's all part of the Sprott Department of Surgery's quality and patient safety benchmarking program, which University Health Network (UHN) began putting in place in 2010. Until then, there was no way of knowing whether patients received better outcomes at UHN than they did at other medical centres or whether the institution's rates of infections or deaths were too high.

That wasn't right, says Dr. Tim Jackson, Operating Room Medical Director at Toronto Western Hospital, general surgeon in the Sprott Department of Surgery, and the Medtronic Chair in Minimally Invasive Surgery. "You need to measure quality," explains Dr. Jackson, who helped create the quality improvement program that UHN now follows. "It's good for patients – it reduces complications – and it's good for surgeons, who can get data on their performance and then think about how they can do better."

MORE EFFICIENT OPERATORS

Over the past several years, Dr. Jackson and Dr. Carol-Anne Moulton, Operating Room Medical Director at Toronto General Hospital and Princess Margaret Cancer Centre, and a general surgeon in the Sprott Department of Surgery, have, along with others, measured a variety of surgical-related processes and procedures, from how many times doctors wash their hands to whether blood transfusions are done properly. As part of the program, every death or surgery-related complication gets discussed. "Everything is reviewed, and we look at whether we could have done anything differently," explains Dr. Moulton.

There are several goals: to give patients the best care possible, but also to make sure doctors are doing their jobs efficiently and cost effectively, while still putting safety first, says Dr. Moulton.

UHN wants to make sure it's keeping up with other top hospitals, too. It participates in four North America-wide programs, including the American College of Surgeons National Surgical Quality Improvement Program, in which results on more than 80 measures are entered into a database and then compared against hundreds of other institutions.

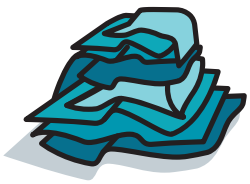
The program has helped Sprott Surgery dramatically reduced its rate of infection, for instance, and UHN is doing as expected or better than expected on a number of measures.

One reason so much progress has been made, and why Drs. Jackson and Moulton are confident they can continue raising the quality of Sprott Surgery's work even further, is because of UHN's culture: everyone wants to improve. "All of us want to know how we can better our own craft," says Dr. Jackson. "That's exciting to see – how energized people get by looking at these reports." ■

Going green

Canada's healthcare sector is responsible for nearly five per cent of the country's greenhouse gas emissions. The Sprott Department of Surgery wants to cut that down. Led by thoracic surgeon Dr. Laura Donahoe, it's taking steps to reduce waste and contribute positively to climate change. Here's how.

Glass recycling
Glass medication bottles used to be incinerated. There's now a recycling bin in every OR.



Blue wrap reuse
Sterile tray wrap used to be thrown out. It's now reused – to cover items during moving and more.

Recycling copper wires
Cautery cords, which contain copper, are sent to a scrap metal dealer, who recycles the product.

COVID-19

How Sprott Surgery is navigating the pandemic

An inside look at how UHN's surgeons are dealing with the novel coronavirus.

By Wendy Glauser

In early March, Dr. Fayez Quereshy, Clinical Vice-President at University Health Network (UHN) and a surgical oncologist in the Sprott Department of Surgery, received a flurry of texts from colleagues in Italy and Spain warning him about COVID-19. At the time, the Canadian public wasn't sure what to make of the novel coronavirus, especially with cases still in the single digits, but Dr. Quereshy's European colleagues knew what was coming. "This is very real, and it's scary," the texts read. "We don't have enough ventilators. Patients are coming to our emergency departments, and they're super sick."

Those reports from abroad motivated Dr. Quereshy to organize an emergency meeting with leaders at the Sprott Department of Surgery, including Dr. Shaf Keshavjee, Surgeon-in-Chief and the James Wallace McCutcheon Chair in Surgery; Terri Stuart-McEwan, Executive Director, Surgical Services in the Sprott Department of Surgery; Dr. Barry Rubin, Medical Director of the Peter Munk Cardiac Centre at UHN, Peter Munk Cardiac Centre Medical Director Chair and vascular surgeon in the Sprott Department of Surgery; and Dr. Tom Waddell, Head of the Division of Thoracic Surgery in the Sprott Department of Surgery, the F.G. Pearson-R.J. Ginsberg Chair in Thoracic Surgery, the Richard and Heather Thomson Chair in Thoracic Translational Research, and the pandemic lead for Sprott Surgery.

For hours, the group sat together, creating a plan to keep surgery patients safe – an Italian study found that 40 per cent of post-surgery patients who had the coronavirus didn't survive. Plus, the Sprott Surgery team realized they had to start conserving drugs and personal protective equipment (PPE). "Countries were facing shortages of masks and gloves, and the same drugs that were helping keep COVID-19 patients alive in other places were also the drugs we needed to anesthetize patients for an operation," recalls Stuart-McEwan. "We were scared."

At that meeting, the group decided to operate on only those who required emergency care or would be at a risk of significant harm if they weren't operated on in the next two weeks. "It was pretty bold to say an organization that does upwards of 2,000 surgeries per month would go down to double digits. But all of us felt that by doing this, we could save Ontarians' lives," explains Dr. Quereshy. "We knew we had to act quickly," adds Dr. Keshavjee. "If we didn't do something radical, we were facing the potential of overwhelming the entire healthcare system."

SORTING OUT STAFF

There was also immense pressure on human resources. By late March, OR nurses were being pulled into the intensive care unit (ICU) to prepare for the expected surge. Hospital projections estimated that by mid-April, 240 patients would require ICU beds,

but the ICU only had 90 beds, says Dr. Rubin. The group was also aware that, as Dr. Rubin puts it, "the sickest COVID patients from all over Ontario … they're coming here." That's because UHN is the only hospital network in Ontario that provides Extracorporeal Lung Support (ECLS), a state-of-the-art machine, reserved for life-and-death situations, which keeps people with severe lung failure alive. ECLS pumps blood with oxygen through a patient's body and can take over the work of the heart and the lungs if they both fail.

Once Sprott Surgery's leadership knew they would only operate on the most at-risk patients, they had to figure out who those patients were. Dr. Keshavjee gathered the heads of Sprott Surgery's 13 divisions to create categories of urgency for surgery cases. They also organized surgical teams to be "on" and "off" to ensure surgeons wouldn't all get sick at once if COVID-19 swept through the hospital.

DIFFICULT DECISIONS

March was one of the more challenging months – physically and emotionally – in the leadership team's careers. Everyone put in 12-plus-hour weekdays and often worked on weekends. Dr. Quereshy found himself frequently unsure what day of the week it was, while Dr. Rubin moved into his daughter's condo (and she moved in with her mom) so he wouldn't expose his family to the virus. When Stuart-McEwan developed and communicated the new protocols to teams, she'd take the time to listen to their fears – knowing her own nurse daughter was among those at work in the ICU. There were also urgent 11 p.m. meetings where many medical issues were discussed. "We'd often have to say, 'There isn't a randomized trial for this. We're just doing the best we can with the best information we have.' People understood. We were in it together," says Dr. Keshavjee.

The shutdown required close communication between surgeons and their divisions. Before the pandemic, each surgeon scheduled their patients within their individual allotted time slots. Because of COVID-19, they had to schedule surgeries in coordination with the entire Sprott Surgery team to ensure a less urgent case wasn't scheduled before a more urgent one, says Stuart-McEwan.

The decisions weren't always easy. Dr. Quereshy recalls a patient with rapidly spreading cancer. The operation to save their life would be done in two stages, by two separate surgeons. Dr. Quereshy and the other surgeon were worried about how long the patient would have to stay at the hospital afterwards, where they might be exposed to COVID-19. They knew the patient had a young family at home. "I remember standing in the hallway, feeling really conflicted about what decision we should make," he recalls. "But we went ahead, and they're now cancer-free."

The hardest part was calling patients and letting them know their scheduled surgeries wouldn't go ahead as planned. "What's amazing is no one pushed back," says Dr. Quereshy. "Certainly, our frontline care providers are heroes, but patients are amazing and heroes as well." While patients waited, doctors continued to monitor their health through tests and imaging. In some cases, they called patients multiple times a week to ensure their conditions weren't worsening.

33 Patients with COVID-19 treated with Extracorporeal Lung Support at UHN

CREATIVE SCHEDULING

Donna Williams and Rose Puopolo, Nurse Managers of Perioperative Services in the Sprott Department of Surgery, were involved in scheduling patients. Surgeons went from having operations back to back to coming in for just one or two procedures, often on short notice. As leaders, Williams and Puopolo were present for many of the surgeries, where they would make sure staff were carefully donning their protective equipment in the right order and the right way. "Everyone was nervous. The information about what kind of PPE staff should be wearing, and when, was changing frequently," says Williams.

In a fortunate coincidence, Sprott surgeons had a tool to help them prioritize and schedule patients. For the past year, Stuart-McEwan and Dr. Waddell had been collaborating with Boston's Institute of Health Care Optimization to fine-tune operating room scheduling according to urgency. With models based on previous patient volumes and a dashboard of available resources, from hospital beds to anesthesia to nurses, staff could schedule surgeries in order of urgency with little risk of cancellation. This tool turned out to be extremely helpful during the pandemic, when operating rooms went down to four from more than 30. "We could make much more calculated, granular decisions about scheduling," explains Dr. Waddell.

PREPARING FOR THE NEW NORMAL

All the measures they put in place were working, but by May the backlog began to grow to worrying levels. "We felt the pressure," says Dr. Rubin. Fortunately, some restrictions were lifted that month, and they were allowed to increase their case load. As of August, Sprott surgeons were doing about 80 per cent of the operations they had been performing before the pandemic. Doctors continue to work in close coordination to ensure the most urgent patients are operated on first.

If there's one silver lining to COVID-19, it's that Sprott Surgery's leadership team has had to reimagine patient care. In this "new normal," as Dr. Quereshy calls it, minimally invasive technologies will be used more frequently to reduce hospital stays. Virtual visits, in which doctors can walk their patient through an upcoming procedure or answer any post-surgery questions, will also become the norm. "Patients will get even better care," says Dr. Keshavjee. "Instead of someone having to travel far to see me for 15 minutes, we can talk on video. It's better for everybody." Clearly, the pandemic has tested the limits of modern-day medicine, but Sprott Surgery was ready to take on the challenge. ■

"TeamUHN has been remarkable through this pandemic. They are selflessly responding to this new and deadly disease and giving their all for every patient. The response at UHN has been an amazing team effort in service of fellow Canadians and in support of the broader health and social services system."

DR. KEVIN SMITH, PRESIDENT & CEO, UHN

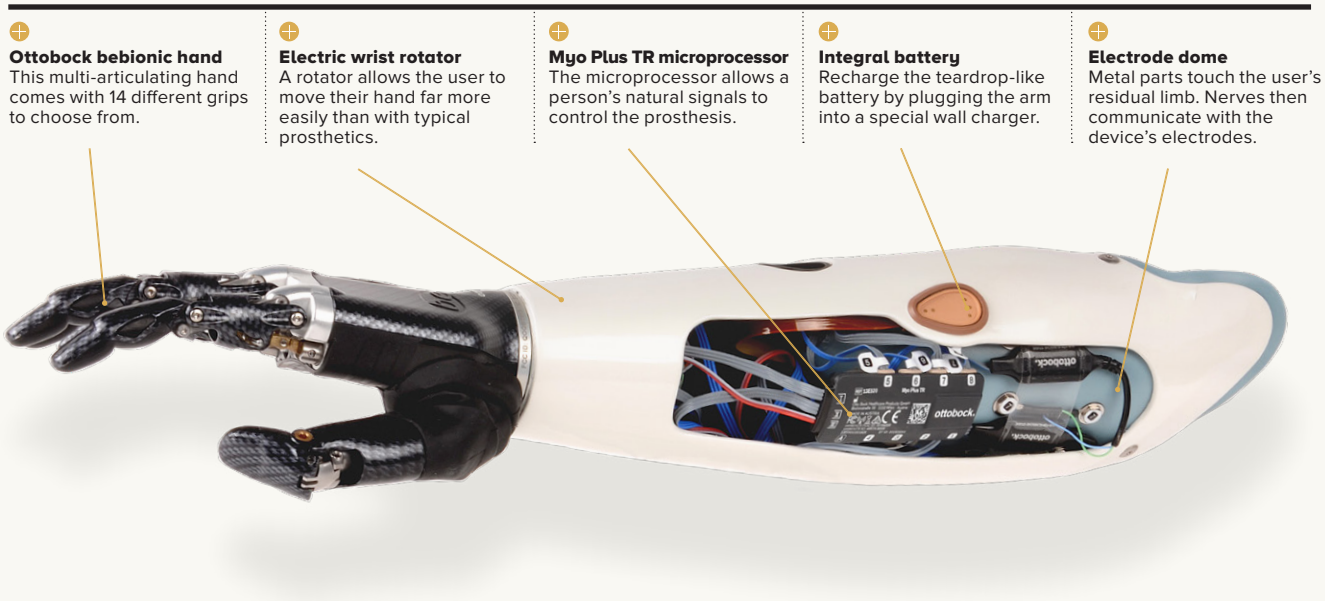


PHOTO: COURTESY OF OTTOBOCK (MYO PLUS TR PROSTHESIS)

PLASTIC SURGERY

Making hands move

A new kind of artificial hand, combined with an innovative operation, is helping amputees use their limbs again.

By Sharon Oosthoek

"Can you imagine not having a hand? How would it affect your daily life?" asks Dr. Heather Baltzer, a plastic surgeon in the Sprott Department of Surgery and Director of the Hand Program at University Health Network. As a prominent Canadian hand surgeon, she's treated many patients with a loss of digits or hands and knows just how impactful this can be on a person's life. While prosthetic hands are helpful, patients who use them still struggle to do simple tasks, such as picking up a glass of water.

While Dr. Baltzer would prefer if everyone were able to keep the limbs they were born with, that's not realistic: traumas from causes such as workplace and construction injuries continue to happen, leading to nearly 5,000 Ontarians with severe lower arm and hand injuries per year. One of her focuses now is on getting those with amputations increasingly sophisticated prosthetics.

A BETTER PROSTHETIC

Most prosthetics today are what Dr. Baltzer calls "body powered." Patients move their elbows or upper arms in a certain way to mechanically operate a cable in the prosthetic. This lets them do one thing at a time, such as open or close their fingers, but not rotate the wrist. "It's Civil War-type technology," she says. "But it's still used today."

Dr. Baltzer works in collaboration with a rehabilitation medicine specialist, Dr. Amanda Mayo, to give people something better: the myoelectric prosthetic, an artificial hand that takes signals from a person's muscles and transmits them into multiple movements at once. With this hand, people can lift a beverage to their lips or even carry a suitcase.

SPECIALIZED SURGERY

Not everyone has access to the myoelectric prosthetic. For someone to get one, they must undergo a special procedure Dr. Baltzer performs. This surgery prepares a patient's body to work with the device, because after any amputation, severed nerve endings continue to grow "like a salamander's tail," she explains. The nerve endings form painful little balls called neuromas, which make it difficult to wear any kind of prosthetic.

Limb fixer
Dr. Heather Baltzer is one of the top hand surgeons in Canada.

Dr. Baltzer surgically removes these neuromas and redirects the nerve endings to a muscle in the remaining upper arm, which boosts the muscle's electrical signal. (Muscles and nerves work together to generate electricity that allows bodies to move.) That electrical signal can be detected on the skin and is then picked up by a sensor inside the prosthetic. "So, when your brain tells your hand to flex, even if it's not the muscle that was supposed to make your fingers flex, it gives that signal," says. Dr. Baltzer.

MORE SENSORY FEEDBACK

While myoelectric hands are a step up from the older models, they're still not perfect – they can't give sensory feedback to the brain, which makes it harder to grasp something delicate, like an egg, without crushing it.

So, Dr. Baltzer is bringing together several Toronto-based experts to design inexpensive prosthetics that meet this need. "Sensory feedback will make patients feel that this is really their hand," she says. "You need to look toward the future. You need to offer hope." ■

INJURY IMPACT

227,000

Canadians living with a limb or extremity amputation

SOURCE: ACTIVE LIVING ALLIANCE

ADVANCED SURGERY

3D VISION

How a printed model of a tumour helped doctors save a man's life.

By Elizabeth Chorney-Booth

When Eduard Savchuk went to see his family doctor with complaints of an increasingly hoarse voice last year, he had no inkling there was a massive tumour inside his chest. The 56-year-old electrician from Newmarket, Ont. had no pain, felt no unusual pressure and wasn't experiencing any obvious organ failure. Like most of us, he – and, initially, his doctor – assumed his loss of voice was the result of a run-of-the-mill virus or a simple problem with his vocal cords that would pass on its own.

Not only did Savchuk's voice not repair itself, but by the summer of 2019, he couldn't speak at all and had to rely on his wife to make phone calls for him. After a return trip to his GP's office, Savchuk was sent for diagnostic scans, which revealed a four-kilogram cancerous tumour entwined around his heart and airway. The tumour compressed the nerve to his voice box – an ominous sign.

"I didn't know about the tumour at all," Savchuk says. "I couldn't understand how such a big mass could exist inside my body when I didn't feel anything. It was so strange to me, to have what I had inside of me, wrapped around my heart."

MAKING THE IMPOSSIBLE POSSIBLE

Savchuk went through a round of chemotherapy, which didn't shrink the tumour. His local oncology team decided it was too large and too close to his organs to remove safely. Thinking there was little to be done other than to keep Savchuk comfortable as the tumour slowly took his life, in a last-ditch effort, his doctors referred the case to Dr. Shaf Keshavjee, UHN's Surgeon-in-Chief and the James Wallace McCutcheon Chair in Surgery, who is known for making seemingly impossible operations possible.

Even for a surgeon with Dr. Keshavjee's vast experience, Savchuk's tumour was challenging. Shaped sort of like a Mickey Mouse head, the tumour had "ears" that wrapped behind and pressed into the heart, and interfered with both his airway and his aorta. Dr. Keshavjee knew the tumour would be fatal if it went untreated, but he also didn't want to go into surgery if he wasn't confident the procedure would work. He could see the general placement of the tumour through CT and MRI scans, but they didn't give him enough critical spatial information to determine if he could operate safely.

"It was already starting to obstruct his heart and his vena cava. So he was slowly dying," recalls Dr. Keshavjee, explaining that while the tumour was growing slowly, the pressure was becoming more than Savchuk's organs could withstand. "Even though he didn't feel sick, there was this huge thing inside of him, literally the size of his head."

A TEAM APPROACH

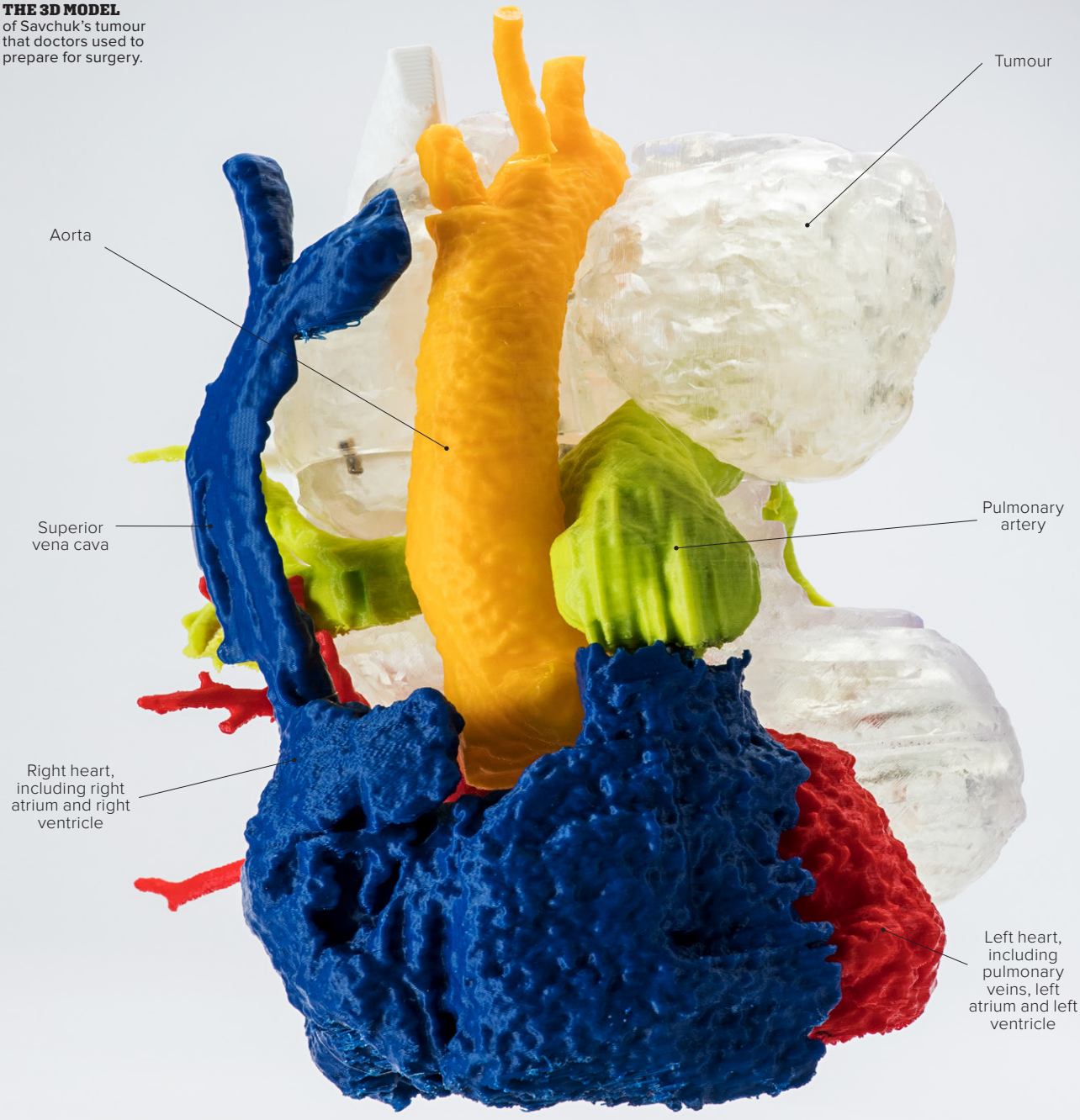
Because of his experience with similarly complicated tumours, Dr. Keshavjee thought he had a good shot of saving Savchuk, but he knew it wasn't a one-surgeon job. Thankfully, in addition to attracting some of the highest-rated surgeons in Canada, the Sprott Department of Surgery has earned a reputation for its highly collaborative approach to patient care. Surgeons with expertise in treating one organ can call in equally skilled colleagues with expertise in another. The department's multidisciplinary approach also extends to Sprott Surgery's various teams of engineers, computer scientists and other healthcare-adjacent professionals. Safely getting Savchuk's tumour out of his chest was going to take careful planning and teamwork.

Dr. Keshavjee started by reaching out to a colleague, cardiovascular surgeon Dr. RJ Cusimano. Dr. Keshavjee knew that in addition to years of experience dealing with cardiovascular tumours, Dr. Cusimano, who holds the David & Stacey Cynamon Professorship in Cardiovascular Surgery Innovation and Education, and is also part of the Peter Munk Cardiac Centre's team, was open to using technology to come up with outside-the-box surgical solutions.

Drs. Keshavjee and Cusimano next tapped into the expertise of Dr. Azad Mashari,

Continued on page 11

THE 3D MODEL
of Savchuk's tumour that doctors used to prepare for surgery.



"With the 3D model, we could figure out how to dismantle the tumour like a jigsaw puzzle before we even went into the operation."

DR. SHAF KESHAVJEE

"It's important to appreciate the spatial context of the tumour. Dr. Keshavjee wanted to visualize the data on the monitor as the surgery was happening."

JIMMY QIU

"You can see how intertwined the tumour is with his heart. The patient didn't know how complex it was until he held the model in his hands."

DR. RJ CUSIMANO

"The patient knew that if he did nothing, the tumour would kill him. Exactly how long it would take, we didn't know."

DR. AZAD MASHARI

Continued from page 9

an anesthesiologist in the Department of Anesthesia and Pain Management at Toronto General Hospital, who has the ability to create 3D printed models derived from patients' diagnostic scans. The models gave the surgeons a more accurate picture of how Savchuk's tumour was interacting with his heart so they could decide whether surgery was even a possibility. More importantly, the surgical team could then simulate where specific incisions might be made to extricate the tumour from the middle of Savchuk's chest.

HOLDING HIS HEART IN HIS HANDS

3D modelling may not seem like the natural purview of an anesthesiologist, but just as Sprott Surgery employs some of the world's best surgeons, its anesthesiologists are also world-class.

It's not uncommon for a high-level anesthesiologist like Dr. Mashari to perform transesophageal echocardiograms on patients, which involve an internal ultrasound that gives surgeons a better look at a patient's heart immediately before surgery. Dr. Mashari had already been using internal ultrasounds to create 3D ultrasound images (much like the videos expectant parents get with prenatal ultrasounds), which led to the idea to create 3D models from CT scans that surgeons could look at well before surgery.

"The aspect of making 3D models is not routinely part of anesthesia," says Dr. Mashari. "It's part of the innovative mindset that exists at UHN."

Dr. Mashari and his colleague Joshua Qua Hiansen spent more than 15 hours in the lab using information from a series of Savchuk's CT scans to develop the life-size 3D model, which took 40 hours to produce on a 3D printer. The result was a colour-coded model that not only showed Drs. Keshavjee and Cusimano exactly how the tumour was placed, but for the first time also gave Savchuk a clear visual representation of what was going on in his body. Before surgery, Savchuk got to hold the model of his tumour and heart, which somewhat quelled his fears, because he was able to understand exactly what his doctors were going to do.

"I'm a technical guy – I work with electronics," Savchuk says. "I like to understand my body like I would a computer. The model helped me understand those parts of my body and how complicated they can be. After seeing it, and hearing Drs. Keshavjee and Cusimano's explanation, it was more clear to me what would happen on the surgical table."

A SMART OR FOR SMARTER SURGERY

Dr. Mashari's model wasn't the only UHN-specific technical element that helped the Sprott surgeons successfully remove Savchuk's tumour. The 3D images of Savchuk's heart and tumour – both the physical model and the digital representation that could be manipulated on a computer screen – were important for planning before the surgery, but the surgeons also needed to see the images during surgery. While computer displays are not uncommon in operating rooms, to access them, surgeons typically have to scrub in and scrub out, wasting precious time while the patient's chest is open.

The perfect print
Eduard Savchuk is still in awe of how Sprott Surgery's team saved his life.

"I was surprised when they gave me a model of my heart and my tumour. It let me see how the procedure would go. I was absolutely astonished."

Bringing technology into the surgical process requires support so that it doesn't unintentionally impede surgeons as they concentrate on more delicate work. To address this, UHN has developed a program dubbed "*Surgility*," which incorporates the expertise of on-site engineers in operating rooms. In Savchuk's case, the surgeons worked with Jimmy Qiu, manager of engineering at the Techna Institute for the Advancement of Technology for Health at UHN, to set up displays on moveable arms adjacent to the operating table – similar to what would be used for laparoscopic surgery – so that the surgeons could quickly access the 3D imaging as they worked. Qiu says the direct relationship between his engineering team and Sprott Surgery makes it easier to come up with innovative solutions for these complex cases.

"Traditionally in an academic hospital setting, research engineers work in a lab and have a very siloed experience," Qiu explains. "We typically don't see the pain points and have that interaction with the stakeholders. When engineers are embedded in the OR, that leads to more engagement and interaction, and the surgeons are more open in their real-time communication as well. We all learn more."

All of these pieces coming together – the engineering, the 3D imaging and printing, and the collaboration between surgeons, anesthetists, perfusionists and nurses – is what got that tumour out of Savchuk's chest. The extraction surgery was performed in December 2019. Dr. Mashari was the anesthesiologist, while Drs. Keshavjee and Cusimano successfully removed the tumour within the span of four or five hours. Dr. Keshavjee estimates it could have taken up to 10 hours without the opportunity to plan in advance with the aid of the 3D model, which would have put Savchuk at additional risk. While it would be overly simplistic to say the procedure was "routine," the advance planning and ability to reference the model meant there was an efficiently pre-developed operative plan and few surprises or complications for the surgeons.

Savchuk's speaking voice is still husky, but he's now able to talk with ease and has returned to work. His doctors are confident the tumour was completely removed, and Savchuk's most recent round of tests confirm he is cancer-free.

While the outcome is what matters most to Savchuk and his loved ones, the success of the operation is also significant to Drs. Keshavjee and Cusimano, in that it illustrates what's possible when high-performance surgical teams work together and leverage the breadth of talent and expertise of all the medical professionals at UHN. It's this approach that makes Sprott Surgery capable of taking such challenging cases and giving real hope to patients who thought they'd run out of options.

"We don't say no to people here. We say, 'We'll find out,'" Dr. Cusimano says. "If [Savchuk] had come to us three years earlier, we may not have been able to help him. But every year we build a little bit more. Who knows what's going to happen next? It's a constant evolution." ■

VASCULAR

The stroke whisperer

An award-winning surgeon-scientist has a plan to stop this disease.

By Bryan Borzykowski

Dr. Kathryn Howe has one mission: to stop strokes related to carotid artery disease. For years, the vascular surgeon in the Sprott Department of Surgery and the Peter Munk Cardiac Centre has been trying to better understand what causes this devastating medical issue and how to prevent it from happening. "I've lived through strokes with family, and I would love to have a fix for this," she says. "A stroke is a terrible event."

Her research, which looks at how microRNAs – tiny packets of genetic code – influence strokes, is starting to generate attention. In May, she won the Wylie Scholar Program, a $150,000 three-year career development grant to help fund her research. This prestigious award is given out to a doctor who has demonstrated aptitude in vascular research, leadership and promise in vascular surgery. "I was shocked," says Dr. Howe, who is one of only three Canadians to receive the prize, all of whom are a part of the Peter Munk Cardiac Centre at UHN. We spoke with Dr. Howe about her research and the grant.

WHAT IS YOUR RESEARCH ABOUT?

I'm focused on strokes, which are caused by vulnerable plaques in blood vessels leading to the brain. These plaques misbehave, which can cause a stroke. We want to look at the plaque and know whether it's stable and someone may never need surgery, or if it could be a problem down the road.

To figure that out, I look at how blood vessels communicate through microRNAs, little packages of genetic code that help regulate cell function. We used to think microRNAs had no function, but we've found these packets of genetic code get released by one type of cell and can get swept up by other cells, which then cause these cells to behave differently. By understanding the different microRNAs that get delivered between cells in patients with vulnerable plaques, we hope to find new therapeutic targets to prevent this process – that is, to figure out how to make a plaque stable or prevent it from forming in the first place. Ultimately, we're trying to predict and prevent strokes caused by vulnerable plaques in the carotid arteries.

SO, WHAT'S THE PROBLEM?

Think of blood vessels as a tree. When the trunk is nice and straight, blood flows in a straight line. Wherever there are branches, you get turbulent flow, and these are the locations we typically see atherosclerotic disease. Now, the cells that line the inside of the blood vessels are exposed to currents that are constantly irritated. The cells that live nearby receive messages from the stressed-out cells to change their behaviour, which can result in a stroke. We want to understand that process.

HOW ARE YOU STUDYING THIS?

We're looking at patients who had surgery but didn't have a stroke beforehand, and then those who have had a stroke, and we compare the two plaques. In patients who haven't had a stroke, the plaques are stable. If the cells and inflammation stay under control, then the plaque and its contents don't rupture and go to the brain. By knowing how different clusters of microRNAs lead to plaque vulnerability, maybe we can stop these strokes from happening through new therapeutic targets. Detect these things in advance, and we can say, "This person is at risk of a stroke."

HOW WILL THE GRANT HELP?

It's for people in the early phases of their career, where they aren't ready to publish and need more funds for research. This grant allows us to accelerate our research, perform cutting-edge experiments and be competitive in an area where people are doing research with large grants. Being at Sprott Surgery and the Peter Munk Cardiac Centre has helped launch my career – there's nowhere in Canada I could do this kind of research and be supported clinically. ■

Most of **DR. GELAREH ZADEH'S** surgeries involve her staring into a microscope for hours.

NEUROSURGERY

Brains of the operation

Dr. Gelareh Zadeh is a surgeon-scientist who excels in the research lab and the OR.

By Diane Peters

On Christmas Day 2016, Chrissie Rejman's dizziness got so bad that she was stumbling around the house. Her son – whom she affectionately calls Mr. Worrywart – declared he'd had enough of this six-month-old worsening health issue and called an ambulance.

An emergency room doctor told Rejman, who's now 71, that he suspected she had an acoustic neuroma, which is a non-cancerous brain tumour that grows in the vestibular nerve in the inner ear, causing dizziness and also hearing loss. Indeed, hearing tests soon confirmed, to her surprise, that she'd lost a quarter of her hearing in her left ear. "You don't really realize when you're going deaf," says Rejman.

Luckily, in early 2017, Rejman got a formal diagnosis and top-notch care from one of the best doctors in the country, Dr. Gelareh Zadeh, Head of the Division of Neurosurgery and the Division of Surgical Oncology in the Sprott Department of Surgery, the Wilkins Family Chair in Neurosurgical Brain Tumour Research, and the Medical Director of the Krembil Brain Institute. "She was terrific," recalls Rejman of Dr. Zadeh.

Indeed, Dr. Zadeh is known as a rock star in neurosurgery. She specializes in some of the most complex neurosurgeries – removing skull-base tumours, of which acoustic neuromas are one – runs a busy and successful research lab, and still finds time to take leadership roles, including those at top international neurological medical organizations.

INNOVATIONS IN SURGERY

At Sprott Surgery, Dr. Zadeh is part of a powerhouse team of neurosurgeon-researchers who are both treating patients, and researching new treatments and approaches to surgery. She and her colleagues are developing innovative ways to treat brain tumours, including using lasers and less invasive procedures to help patients like Rejman avoid brain surgery. While the rise of technology in brain surgery could, in theory, limit her work in the future, "nothing can replace talking to the patients and sitting with them to hear their stories," says Dr. Zadeh.

Her research focuses on skull-base tumours, meningiomas in particular, but she's also researching ways to treat other cancers, such as glioblastoma, the most common type of adult brain cancer.

Despite her high-level expertise – Dr. Zadeh has a PhD in molecular biology and did a fellowship in radiobiology – she clearly cares about her patients. "She's very approachable and very calm, and you can talk to her – you can ask her anything. Not a lot of doctors are like that," says Rejman.

Radiation to the rescue
Chrissie Rejman, who was helped by gamma knife radiation, can smile knowing her neurosurgeon is one of the best in the country.

When Dr. Zadeh met with Rejman, she saw that surgery wasn't the best option for her growing tumour. Instead, she suggested Rejman try gamma knife radiation, a non-invasive procedure that targets a tumour with hundreds of highly accurate and powerful radiation beams. Rejman had the procedure in early 2019 and it has, so far, stopped the growth of the tumour.

MARATHON OPERATIONS

Most of Dr. Zadeh's time is spent in the operating room. While she performs a wide range of brain surgeries – on the day we spoke to her, she had to rush off to operate on an emergency room patient with a blocked brain shunt – she's an expert in tumours that are located near the base of the skull, such as acoustic neuromas.

Most skull-base tumours are benign, and the larger ones that cannot be treated by a non-invasive procedure like gamma knife radiation require careful surgical removal. Surgery is done using a microscope and can take five to 12 hours, as the surgeon has to carefully distinguish between the tumour and the surrounding tissue, which are often the same colour. It doesn't help that these tumours grow in an area of the body that contains tiny, sensitive nerves that control things like blinking and the movement of the lips.

Dr. Zadeh thrives on these marathon operations. She does about 10 skull-base surgeries a month, along with an average of 10 more brain procedures. "When we use the microscope, we have to remain focused for the entire duration of the operation," she explains. "It's very rewarding work, because with surgery you can cure the majority of the skull-base tumours."

RESEARCHING CURES

When she's not being a surgeon-scientist, she's a volunteer, working for organizations like the Acoustic Neuroma Association of Canada, where she's Medical Director, and at the Society for Neuro-Oncology, where she's President, the first woman to ever hold that prestigious position.

With 25 Canadians being diagnosed with brain tumours every day, the medical community needs leaders and innovators like Dr. Zadeh, who pushes the field forward with new treatments but also cares for her patients. Some, like Rejman, live with the effects of their brain tumours for life, which means doctor and patient will be interacting for years. "It's a long-term relationship," notes Dr. Zadeh.

While Rejman's tumour is no longer growing, it's still there. She's lost the hearing in her left ear and has to manage her dizziness on a daily basis, but she knows she's got one of the top neurosurgeons in the country monitoring her condition, offering her support and staying on top of treatment innovations. Says Rejman of Dr. Zadeh, "She's an expert in everything." ■

Minds matter
Tumours impact everyone.

120+
The number of different types of brain tumours
SOURCE: BRAIN TUMOUR FOUNDATION OF CANADA

55,000
Canadians living with a brain tumour
SOURCE: BRAIN TUMOUR FOUNDATION OF CANADA


DR. GONZALO SAPISOCHIN performs living donor liver transplants in cancer patients.
DR. IAN MCGILVRAY leads liver and pancreas surgery at Sprott Surgery.

TRANSPLANT

A life-saving transplant trial

Doctors are using living donor liver transplants to save patients with cancer.

By Tamar Satov

It's late in the evening on Mother's Day 2017, and Sandra Elhilali is sitting with a radiologist, counting the tumours on a scan of her liver. She should have been celebrating the day at the lake with her husband and kids, but the 42-year-old had been feeling unwell for several months, not eating and sleeping all hours. A trip to the ER that morning revealed the shocking cause: Stage 4 colorectal cancer with metastasis to the liver. "...16, 17, 18, 19..." The radiologist stops at 20, realizing it's pointless to continue.

Elhilali is immediately admitted to her local hospital to begin chemotherapy in a palliative setting and is told she might never return home to her family. "It was the absolute worst possible scenario," she recalls, her voice breaking.

What Elhilali didn't know at the time, however, was that at Toronto General Hospital, Dr. Gonzalo Sapisochin, a transplant surgeon with the Sprott Department of Surgery who is also part of the Soham & Shaila Ajmera Family Transplant Centre, had just launched a clinical trial to perform living donor liver transplants on patients just like her – a groundbreaking procedure that would eventually save her life.

LEADERS OF LIVING DONOR LIVER TRANSPLANTS

Sprott Surgery is home to a team of surgeons who are experts at living donor liver transplants. They perform about 70 a year, making it the largest such program in the western world. Unlike with other organs, someone can donate 70 per cent of their liver to another person, and then have it regrow to regular form in a few weeks or months. "The liver is the only organ in the body that regenerates," explains Dr. Sapisochin. "You can donate most of a liver to a person, and both livers will quickly regenerate almost to normal size."

These transplants are already routinely done on patients with inoperable primary liver cancer, but living donor liver transplants are not usually the standard of care for individuals like Elhilali, who have colorectal cancer that has spread to the liver.

It's an unfortunately large cohort of patients, often with poor prognoses. Of the more than 25,000 Canadians diagnosed with colorectal cancer each year, about half will see the disease spread to their liver because blood drains directly from the colon to the sponge-like organ, which effectively soaks up the cancer cells. For 60 to 80 per cent of these patients, surgical removal of the liver tumours is impossible, because the size and number of tumours are too great, and it's too difficult to leave an adequate amount of normal functioning liver. As a result, only five to 10 per cent of patients will be alive five years after their diagnosis.

GENEROUS DONORS

2,782

Organ transplant procedures across Canada done in 2018

SOURCE: CANADIAN INSTITUTE FOR HEALTH INFORMATION

A NEW ERA IN TRANSPLANT ONCOLOGY

Research conducted in Oslo, Norway, has shown that patients with inoperable liver metastases from colorectal cancer who receive a liver transplant have a five-year survival rate of 60 per cent. Transplantation hasn't been an option for these patients in Canada, however, due to a chronic shortfall of deceased liver donors – about 30 per cent of Canadians waiting for a liver transplant die before they can get one.

Because livers are in such short supply, Dr. Sapisochin and his team set up the clinical trial in August 2016 to see if living donor liver transplants could become an effective treatment for these patients. While still investigational, the early results of the trial are promising. "We have done two so far, and both patients are doing well," he says, noting that the first patient, who is 16 months

Sprott surgeons perform hundreds of transplants every year.

post-op, had a recurrence of cancer in their lungs, but it is treatable and the patient is enjoying a good quality of life. The second patient, who had her transplant a month later, was Elhilali.

RENEWED HOPE

About a year after her diagnosis, chemotherapy and surgery had successfully eradicated the cancer in Elhilali's colon, but her liver was still full of tumours. "It looked like a spotted Dalmatian," she recalls. "I knew I would have to look at alternative solutions."

In June 2018, she was referred to the University Health Network (UHN) clinical trial and met with Dr. Sapisochin. "We discussed the possibility of a living donor liver transplant and all it would entail," she says. "I came away from that meeting with a renewed sense of hope, knowing if I had to entrust my life to anyone's hands, I could not find a safer place."

But there was still a long road ahead. To qualify for a transplant, trial candidates must be monitored for at least six months to ensure their cancer remains stable and has not spread to other organs, and they need to find someone they know who is willing to be a living donor, is in good health and has a matching blood type.

After months of waiting to find a match, Elhilali learned in March 2019 that her first cousin got the green light. Two months later, he would give her the right lobe of his liver.

THE SURGICAL PROCESS

The transplant team began early in the morning with a five-hour operation on Elhilali's cousin, removing the designated portion of his liver. It's a complicated but safe procedure; of the nearly 1,000 living liver donors who have been through UHN, fewer than five per cent have had any complications, and mortality is zero.

Elhilali's eight-hour transplant was timed to happen immediately after her cousin's, since a donated lobe can only survive outside the body for a maximum of 12 hours. "It's a challenging operation," says Dr. Ian McGilvray, Head of Liver and Pancreas Surgery in the Division of General Surgery in the Sprott Department of Surgery and Research Director of the Soham & Shaila Ajmera Family Transplant Centre. "The liver is a large organ smack dab in the middle of the body, and our major blood vessels are attached to or run through it, carrying a phenomenal amount of blood."

To prevent blood loss, the surgeons must carefully clamp the various arteries and veins as they cut out the diseased liver, ensuring they leave enough length on the blood vessels to enable grafting of the donated lobe. Each graft involves extremely fine sutures around the front and back walls of the tiny blood vessels, viewed through microscopic goggles. Finally, the bile duct must be attached, and the clamps removed to restore blood flow.

After the surgery was done, Elhilali was observed in hospital for about two weeks to make sure none of the sutures were leaking, there were no infections and that she was responding well to the immunosuppressant drugs that would prevent her body from rejecting the new liver. "I've been doing transplants for 17 years, but I still think it's really freaking cool that we can do this at all – it blows my mind," says Dr. McGilvray. "Even 10 years ago we wouldn't have been thinking of doing anything like this. Someone with metastatic colon cancer, we'd tell them, 'Go home and get your affairs in order.' The way we treat cancer has changed so much."

"I've been doing transplants for 17 years, but I still think it's really freaking cool that we can do this at all – it blows my mind."

Dr. Ian McGilvray

A NEW LEASE ON LIFE

Elhilali will continue to be monitored for five years as part of the clinical trial, but so far, she has remained cancer-free. "I am forever grateful and blessed for this second chance at life," she says. "Every moment I get to spend with my children, sharing adventures and simple moments, or seeing the world, is a gift I will cherish forever."

Dr. Sapisochin hopes to include 20 patients in the trial by 2023, and is about to launch an international registry so doctors in other countries who may conduct similar trials can share information. "We'll be able to analyze all the cases in detail and learn from them," he explains, "so we can offer this treatment in the best way to our patients." ■

ORTHOPEDIC

New hips, shorter trips

Hip replacement procedures used to involve a week-long hospital stay. Now patients can get in and out on the day of the operation.

By Wendy Haaf

After two hip surgeries, **SHARYN SHELL** can once again walk Toronto's Beltline pain-free.

It's hard to imagine Sharyn Shell, 67, doing anything slowly. "I've always been active – I have ADHD, and I talk too fast and move too fast," explains the Toronto retiree, who spent much of her career teaching children with vision loss. But not long ago, when the severe arthritis in Shell's hips was at its worst, unrelenting pain brought her pace to a crawl, interfering with every facet of her life, including beloved pastimes like hours-long walks visiting Toronto's beaches with friends and bargain hunting. She also had to quit her consulting job. "It was hard to get onto the subway and carry my materials," she says.

Yet the prospect of a second hip replacement surgery – she needed two separate procedures – and another hospital stay made Shell anxious. "You worry about what's going to happen. Will they be able to fix it?" As it turned out, not only did Shell get her former life back thanks to the way University Health Network's (UHN's) Arthritis Program and the Sprott Department of Surgery have transformed their approach to hip replacement, but she was able to return home within hours of the operation.

THE PREVIOUS APPROACH

While hip surgery is now fairly routine, the recovery process has traditionally been long and difficult. It was normal for patients to be in hospital for a week. They would arrive two days before surgery to do blood work and an electrocardiogram, and have an anesthesia consult, and then spend five or so days post-operation recovering in bed.

Six years ago, the Ontario government asked hospitals to shrink the average length of stay after a hip replacement to four-and-a-half days. "We thought that was crazy," says Dr. Rod Davey, an orthopedic surgeon within the Sprott Department of Surgery and Head of Patient Safety and Quality in the Arthritis Program at UHN. Not only did they hit that target, but two years ago they reduced the time in hospital even further. Now, most patients are out within a day.

CONNECTED CARE FOR A FASTER TIMELINE

Making same-day hip replacement surgery possible involves a multidisciplinary effort that incorporates every available advancement in anesthesia and surgical technique, while connecting and streamlining the way care is delivered. It includes everything from the education patients receive before their operations to the availability of experienced healthcare providers who can answer any questions that arise after returning home, and integrating rehab services into the patient's journey after surgery.

"We try to achieve the same goals, which are that patients are medically stable, getting around safely enough for the home environment, and eating and drinking well, with pain well controlled," says Dr. Michael Zywiel, a Sprott Surgery orthopedic surgeon. "We're now able to get patients there much quicker. It's also abundantly clear from the science that the sooner you can get someone home, the better it is for their physical recovery and their mental health."

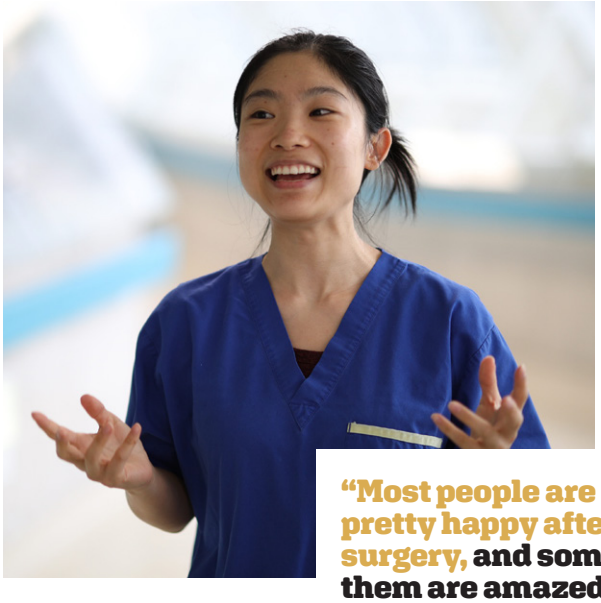
That was the case for Shell, who found even the overnight stay after her first operation, which took place in 2018, unnecessarily confining. "I said, 'What do I have to do to go home the same day?'"

ASSESSMENT AND EDUCATION

Deciding whether someone is a candidate to go home on the day of surgery – some still stay in the hospital for two or three days – begins with assessing whether they need an operation in the first place. UHN's Arthritis Program has developed a comprehensive care process that begins with an assessment at the Hip and Knee Rapid Access Clinic within two weeks of referral. A surgeon and an advanced physiotherapy practitioner consult with each individual patient to determine whether surgery or another treatment, such as joint injections or a specialized exercise program, is the best option. "Based on the data we have, and the patient's situation, we try to give them a sense of the likelihood that they will get a meaningful benefit from each of these treatments," Dr. Zywiel explains.

"We're doing the same procedure, with a much smaller incision and much less damage to the muscles that control the hip."

Dr. Rod Davey



"Most people are pretty happy after the surgery, and some of them are amazed that they can walk right away, and go up stairs."

Amanda Ma, registered nurse

JOINT OPERATIONS

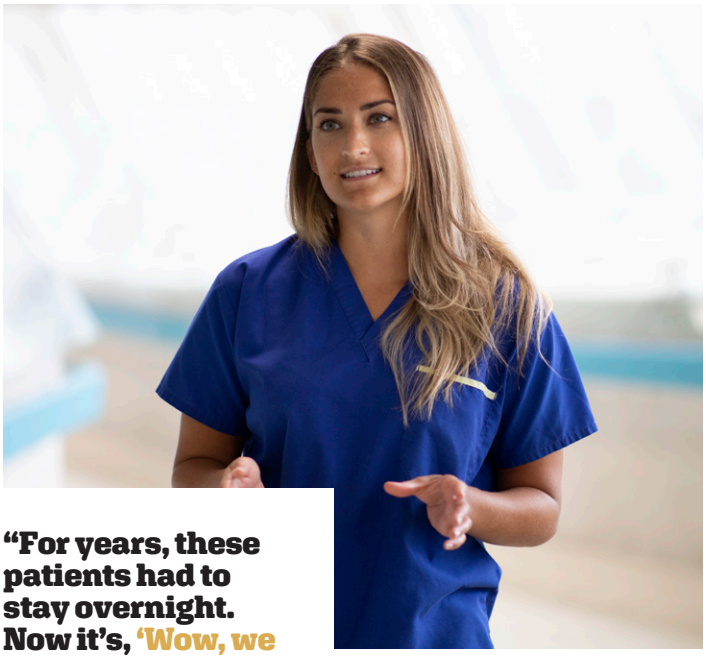
17.4%

Increase in hip replacement surgeries in Canada between 2014 and 2018

SOURCE: CANADIAN INSTITUTE FOR HEALTH INFORMATION

Once this process, which involves questions and medical tests, is complete, the patient and doctor can decide how best to proceed. Shell originally opted to enrol in GLA:D Canada, an education and exercise program created in Denmark that's been proven to reduce osteoarthritis pain in 60 per cent of patients. It helped her regain muscle strength, resulting in a speedier post-op recovery.

Those who decide to go ahead with surgery attend an education session with a nurse



"For years, these patients had to stay overnight. Now it's, 'Wow, we can do this.' They can go home, and they're excelling."

Kendra Willis, registered nurse and patient care coordinator

"We said, 'How can we do this in a way that's going to have everyone walking as quickly and safely as possible, recognizing that motion is life?'"

Dr. Michael Zywiel

practitioner and a volunteer who's been through joint replacement and who can bring up questions participants might not think of asking otherwise – such as when they can resume having sex. That last addition was made thanks to Shell, who discovered during her second round of pre-operative education that her fellow participants weren't raising such issues, but were relieved when she did. "I have no filter," she says with a chuckle.

Education is important, explains Dr. Davey, because it reassures them they don't need to stay in the hospital to recover, and helps drive home the need for post-op rehab. Pre-op tests and an anesthesia consult take place 10 to 14 days before surgery, and physiotherapists help patients organize aids they'll require while recovering at home, such as walkers and raised toilet seats.

ADVANCES IN ANESTHESIA, SURGICAL TECHNIQUE

As for the operation itself, the orthopedic surgeons at Sprott Surgery, and their colleagues in anesthesia, have used every tool at their disposal to minimize its negative impact on the body. Over the course of Dr. Davey's career, for example, the average incision size has shrunk to 3.5 inches from roughly 14.5. Dr. Davey and his colleagues also use a medication that prevents bleeding, which then eliminates the likelihood of needing a blood transfusion. As well, anesthesiologists now use spinal anesthesia that wears off quickly, rather than heavy narcotics, and the orthopedic surgeons infiltrate the area around the incision with local anesthetic to control pain, which then allows patients to regain use of their legs within hours.

Following a short stay in the recovery room, hip replacement patients go to the day surgery unit – something that didn't happen before – where nurses monitor their progress. Rehabilitation starts immediately, with physiotherapists helping patients walk up and down a portable staircase.

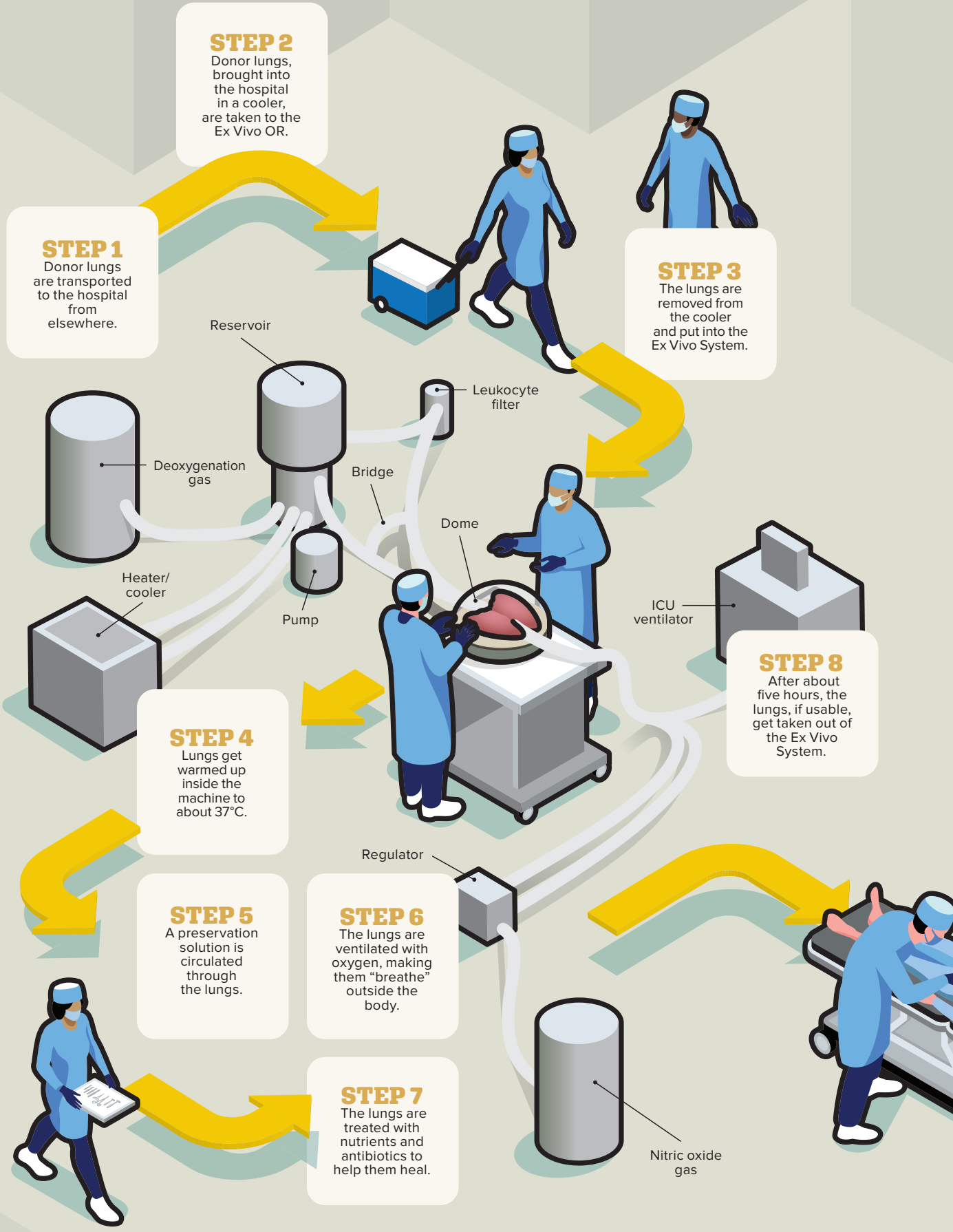
Before discharge, Amanda Ma, a registered nurse at UHN, and her colleagues teach patients how to move, dress wounds, and manage their pain and nausea. "We also have a nurse practitioner who's a pain expert coming in to explain further how to manage their pain," she explains. The day after discharge, the day surgery team will do a followup call to ensure the patient's pain is well managed. "Most often, they're feeling fine, and they're always happy to be home," adds Kendra Willis, a registered nurse and patient care coordinator at UHN.

If an unexpected situation arises at home – maybe swelling or bruising – expert help is just a phone call away. "You can talk to a person 24-7," Dr. Zywiel says. "And not just any person, but an orthopedic nurse, a physician assistant or a surgeon."

INTEGRATED REHAB CARE

The post-op rehab that patients can access once they're home, and the new referral process, also streamline their recovery. The process was designed by UHN's Altum Health, alongside the Arthritis Program, to ensure patients have a seamless transition after surgery. Before their surgery, patients are referred to a local Altum clinic – there are 12 across Ontario – where they will be seen by a variety of specialists, such as physiotherapists, chiropractors, kinesiologists and massage therapists, instead of one practitioner. "You get physiotherapy that's connected with the hospital where you had your surgery and your surgeon's office," says Dr. Rajiv Gandhi, an orthopedic surgeon at the Sprott Department of Surgery and Medical Director of Altum Health. "We know patients are getting good quality aftercare."

After Shell's second operation in August 2019, she immediately started feeling better. She's now back to her old self, regularly walking and swimming, and she can't wait to travel again, once the pandemic ends. Shell is effusive about every aspect of the care she received. "It was outstanding," she enthuses. "I tell everyone to go to UHN's Arthritis Program and the Sprott Department of Surgery because they're fantastic." ■


STEP 2
Donor lungs, brought into the hospital in a cooler, are taken to the Ex Vivo OR.
STEP 1
Donor lungs are transported to the hospital from elsewhere.
STEP 3
The lungs are removed from the cooler and put into the Ex Vivo System.
Reservoir
Leukocyte filter
Deoxygenation gas
Bridge
Dome
Heater/ cooler
Pump
ICU ventilator
STEP 8
After about five hours, the lungs, if usable, get taken out of the Ex Vivo System.
STEP 4
Lungs get warmed up inside the machine to about 37°C.
Regulator
STEP 5
A preservation solution is circulated through the lungs.
STEP 6
The lungs are ventilated with oxygen, making them "breathe" outside the body.
STEP 7
The lungs are treated with nutrients and antibiotics to help them heal.
Nitric oxide gas

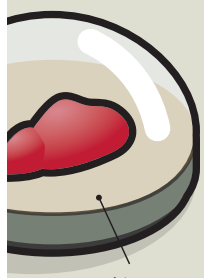
THORACIC

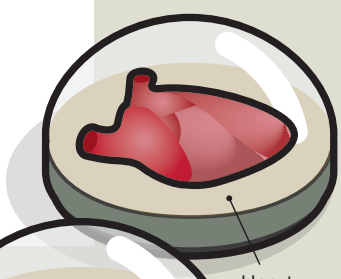
Out-of-body experience

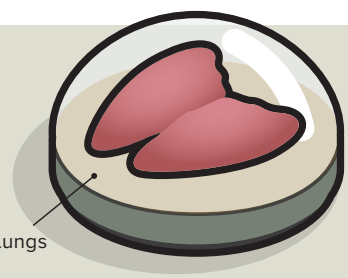
How UHN's doctors invented a revolutionary way to repair and transplant damaged donor organs.

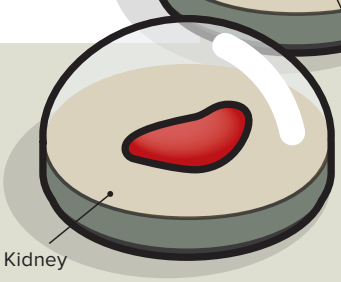
By Bryan Borzykowski

Picture this: inside Toronto General Hospital is an operating room that looks just like any other, except no patient will ever be wheeled into it for surgery. The space is filled with organs – livers, lungs, hearts, kidneys, pancreases – living in a plethora of strange-looking devices, which repair and regenerate these body parts so they can be used for transplants. Surgeons might walk into the room, grab an organ and walk out the same way they'd choose other surgical instruments or supplies.









Drs. Shaf Keshavjee and Marcelo Cypel with the Ex Vivo System, their transplant-altering invention.

While the room doesn't yet exist, there is a smaller version in OR 11 at Toronto General Hospital, where lungs are kept alive and breathing, and are treated *ex vivo* – outside one's body – before being transplanted into a patient. The key piece of equipment in this OR is a dome-like device where damaged donor lungs, ones that would be unsuitable for transplantation under normal circumstances, get treated, fixed and made usable again. While a lot of medical devices are heralded as breakthrough technologies, the Toronto Ex Vivo Lung Perfusion System, as it's called, really can make a difference as to whether someone lives or dies.

CENTURIES OF INNOVATION

The quest to build an Ex Vivo-like machine has been going on for hundreds of years – in the 15th century, Leonardo da Vinci made drawings of organs living on external support systems. In the 1930s, aviator Charles Lindbergh and surgeon Alexis Carrel tried to create a perfusion pump, a device that would keep organs functioning outside the body. But it was a team of Toronto General doctors who finally did what many thought was impossible.

In 2008, Dr. Shaf Keshavjee, now Surgeon-in-Chief of the Sprott Department of Surgery, and Dr. Marcelo Cypel, now Surgical Director of the Soham & Shaila Ajmera Family Transplant Centre at University Health Network (UHN) and head of transplant surgery within the Sprott Department of Surgery, built a device and developed a method that could keep lungs alive for up to 24 hours after they had been removed from a donor's body without needing any blood to run through the organ.

EX VIVO NEEDED

85%

Donated lungs, globally, which are not suitable for transplant

SOURCE: LUNG TRANSPLANT FOUNDATION

Dr. Keshavjee, who is also the James Wallace McCutcheon Chair in Surgery, Director of the Toronto Lung Transplant Program and Director of the Latner Thoracic Surgery Research Laboratories, had originally been trying to find a way to use gene therapy to modify donor lungs and make them more likely to be accepted by a transplant recipient. For this kind of gene therapy to work, he had to develop a way to treat donor lungs outside the body rather than in a patient. If lungs could be kept alive and healthy outside the body prior to transplantation, surgeons could apply different therapies to help heal and repair the lungs and make them almost as good as new. "We want to get to the point where we can make an organ that lasts forever," says Dr. Keshavjee.

FINDING THE RIGHT COMBINATIONS

It took this long for someone to create a working Ex Vivo System because the stakes are so high – the primary goal for the device is to support the organ. Lungs are extremely fragile, says Dr. Keshavjee, which is why the world's first-ever successful lung transplant was only done in 1983 – at Toronto General – many years after the first heart, liver and kidney transplants. Until the Ex Vivo System was developed, it was far more difficult to find suitable donor lungs to save a person's life.

To create this device, Drs. Keshavjee and Cypel had to find a way to perfuse lungs with something other than blood. (Perfusion refers to the way fluid moves through a circulatory system of an organ or tissue.) The problem with blood is that when artificially pumped through the lungs, it can cause inflammation and injury, explains Dr. Cypel, who is also Surgical Director of the Extracorporeal Lung Support Program at UHN.

They had to find a way to keep lungs at body temperature, which is not the norm. When organs are removed from a donor, they typically go onto ice. "That's how people still preserve organs – they keep them cold," explains Dr. Cypel. "But you can't give any treatment to the organ when it's cold, as there's not enough metabolism."

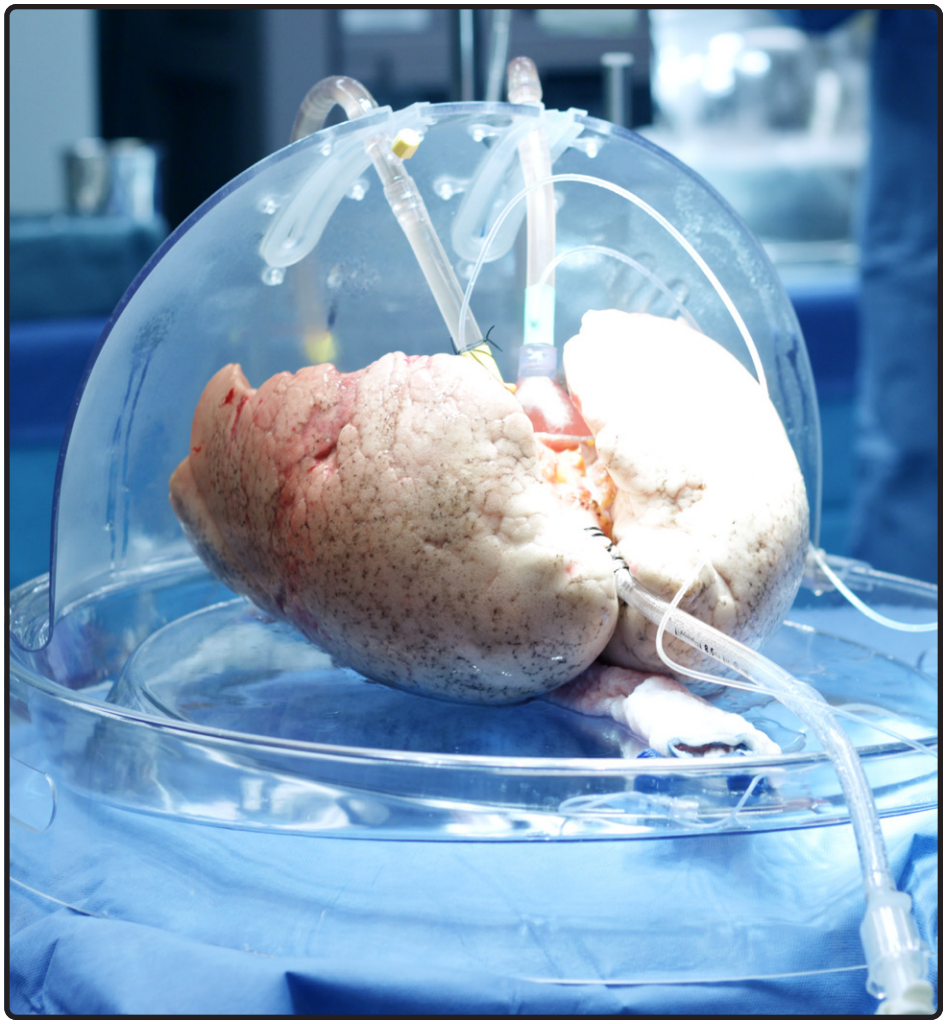
Other steps had to be taken too, such as determining the right amount of oxygen and nutrients to pump into the organ, and they had to keep the lungs ventilated. After joining Dr. Keshavjee's research team in 2005, Dr. Cypel was tasked with trying to find the right combination of fluids and nutrients, among other elements, necessary to keep lungs alive. It only took about a year before they figured it out. "We moved fast," he says. "A year later, we kept lungs on the system for 12 hours, and it looked perfect at the end. We realized that we had achieved a major milestone."

UNDERSTANDING THE TRANSPLANT PROCESS

When a donor passes away, their lungs are flushed, cooled, put on ice and brought to Toronto General – as the largest lung transplant centre in the world, lungs arrive from across the continent – where a small team of specially trained organ perfusion specialists put the lungs into the Ex Vivo System's dome. The dome is connected to a circuit, which consists of tubes, a pump, a ventilator and a filter, through which the liquids, oxygen and nutrients flow. The lungs are then warmed over about 30 minutes, at which point ventilation starts, causing the organ to breathe in and out, like it would inside a body, right there in the dome.

Over the next several hours, doctors essentially operate on the donor organ to try to make it healthy again. They might remove water from the lungs, treat them with high doses of antibiotics, take out blood clots and more. Every hour, the surgeon, such as Dr. Keshavjee, gets updated on how the lungs are doing, and usually about three hours into this process, they will know whether the lungs are usable. While lungs can now live on the Ex Vivo System for up to 24 hours, they are usually kept in there for about five. Once the process is over, surgeons transplant the donor lungs into the patient, who would have already been waiting in the hospital.

When Drs. Keshavjee and Cypel started telling people they had succeeded in creating the completely donor-funded Ex Vivo System, System, launched with a generous gift from the Latner family, some were skeptical. "They didn't believe we did it," recalls Dr. Keshavjee. Once everyone realized the doctors did indeed accomplish what so many before them couldn't, they started to clamour for this technology. Today, hospitals around the world use a version of their Ex Vivo System.



The Ex Vivo System allows lungs to live and literally breathe outside a body for up to 24 hours.

BREATHE EASY

1,868

Canadians (excluding Quebec) living with a lung transplant in 2018

SOURCE: CANADIAN INSTITUTE FOR HEALTH INFORMATION

At Toronto General, surgeons currently perform double the number of lung transplants they used to, as so many organs that would have been previously deemed unsuitable can now be used. Thousands more people are living healthy and productive lives because of this device. The technology has also been adapted for other organs – Sprott surgeons can now assess and treat livers and kidneys *ex vivo* and then transplant them into patients – and they are developing similar systems for the heart and pancreas.

In the near future, the organ repair operating rooms, where several systems will be housed to help repair different organs, will be up and running – these ORs are currently under construction. When they're built, and as the technology continues to advance, many more donor organs will be available for use. Nearly anyone who needs a transplant will get one.

Dr. Keshavjee continues to explore and develop gene therapy. Using the Ex Vivo System, he could make donor lungs closely resemble the recipient, so there's less risk of organ rejection. One day doctors might remove a person's own lungs from their body, fix them using the Ex Vivo System and then reinsert them as good as new. "The development of the Toronto Ex Vivo Lung Perfusion System is the biggest advancement since transplantation itself," says Dr. Keshavjee, who participated in the world's first successful double-lung transplant in 1986 at Toronto General and has received numerous awards worldwide for this device. "Soon we'll do this for every organ, and it will save even more lives." ■

ENDOSCOPY

The game-changer

Dr. Kazu Yasufuku has changed the way doctors around the world view endoscopy.

By Anna Sharratt

Dr. Kazuhiro Yasufuku likens joining the Sprott Department of Surgery in 2008 to the Japanese baseball players who joined Major League Baseball (MLB) in the 1990s. Back then, doctors didn't travel nearly as much as they do now to work at other institutions, and only the top medical professionals were lucky enough to join a place like Toronto General Hospital.

"In the '90s, so few professional Japanese players came to MLB," says Dr. Yasufuku, better known as Kazu among his colleagues. "As proud as they were to join the major leagues, it was an honour for me to be part of Toronto General."

It turns out, the honour belongs to the Sprott Department of Surgery, where Dr. Yasufuku quickly established himself as a medical superstar. When the mild-mannered doctor arrived in Toronto 14 years ago, he had only planned on staying for a year. A brilliant thoracic surgeon who had studied in Japan and the U.S., he joined University Health Network (UHN) as a fellow to train in lung transplant surgeries, with the intention of launching a lung transplant program in Chiba, Japan, where he's from, once his fellowship was up.

But while in Canada, Dr. Yasufuku, who is the Deputy Head of the Division of Surgical Oncology in the Sprott Department of Surgery, the William Coco Chair in Surgical Innovation for Lung Cancer and Director of Endoscopy and the Interventional Thoracic Surgery Program at UHN, pioneered an innovative way of performing lung biopsies that profoundly transformed how lung cancer is diagnosed and treated. The procedure, the endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA), was heralded around the world for its non-invasive approach and became the gold standard for sampling lymph nodes in the chest and, in some cases, even doing lung biopsies.

The EBUS-TBNA procedure involves inserting a long, flexible scope down a patient's throat, deep into the lungs. The scope is then guided to the tumour, where it grabs a part of it and pulls it out for testing. The whole process takes 30 minutes, and patients can go home hours after the procedure.

Dr. Yasufuku developed this technique because he wanted to create a better, minimally invasive way to conduct a lung tumour biopsy. Until the EBUS-TBNA, doctors used a process called a mediastinoscopy (it was also developed at Toronto General and was a revolutionary procedure at the time), which involved making an incision in the neck and inserting a rigid steel rod to sample tissue. It required general anesthetic and carried the risk of bleeding, nerve injury and infection.

Dr. Yasufuku's invention made him an endoscopic hero – in 2020 he received the prestigious Medical Research and Development Grand Prize Award from Japanese Prime Minister Shinzō Abe – and it has inspired others to incorporate minimally invasive techniques into their work. Dr. Eran Shlomovitz, a general surgeon in the Sprott Department of Surgery who works alongside Dr. Yasufuku, says the techniques he uses build on similar principles as the surgeon's pioneering work. Dr. Shlomovitz performs minimally invasive endoscopic procedures to treat esophageal conditions, as well as early stomach and colon cancers. "The risk of complications is very low, and patients can return to normal activity quickly with less pain," he says about minimally invasive endoscopic operations. "The idea is to reduce the morbidity of these interventions."

NON-INVASIVE APPROACH

650,000

Lung cancer cases diagnosed globally by the EBUS-TBNA since its introduction

SOURCE: UHN

COMBATTING CANCER

29,800

Estimated number of Canadians who will be diagnosed with lung cancer in 2020

SOURCE: CANADIAN CANCER SOCIETY

In 2010, Dr. Yasufuku created the Interventional Thoracic Surgery Program at UHN, which provides leading-edge thoracic interventional procedures, such as airway stenting, chest procedures and diagnostic bronchoscopies. That year he also opened the state-of-the-art Menkes Family Interventional Thoracic Surgery Suite, which is outfitted with high-end, world-leading endoscopic technology with the capability to provide general anesthetic that enables endoscopists to perform tests and surgical treatments in the same place. Now about 800 EBUS-TBNA procedures are performed annually at Toronto General Hospital, versus the 200 mediastinoscopies that used to be undertaken. "This really has changed the diagnostic workup of cancer patients," says Dr. Yasufuku.

TRANSFORMATIONAL APPROACH

These days, people from all over the world come to learn from Dr. Yasufuku. When Dr. Kasia Czarnecka-Kujawa, an interventional respirologist cross-appointed to the Department of Medicine and the Sprott Department of Surgery, discovered in 2011 that he was teaching at UHN, she decided to further her study in interventional pulmonology and apply to work with him. "I stood observing Kazu's endoscopies for 60 hours," she recalls. "I remember saying to him, 'I want you to teach me what you know.'"

She was also impressed with how Dr. Yasufuku's hand-picked team embraced the collaborative spirit he embodies. "The whole department, they

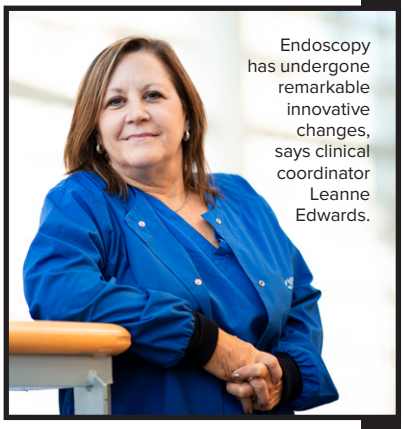
Continued on page 27

DR. KAZU YASUFUKU'S world-renowned innovations have altered endoscopy forever.

Continued from page 25

all think: 'How do we move things forward?'" she explains. A year later, he hired Dr. Czarnecka-Kujawa as his first fellow in pulmonary intervention. "He is a great mentor," she says.

Dr. Yasufuku's visionary approach to endoscopy has transformed the way the specialty is handled at Sprott Surgery. Like Dr. Czarnecka-Kujawa, who brings a unique respirology background to her role, he selects surgeons who have diverse experience and bring one-of-a-kind approaches to their practice. Dr. Shlomovitz is cross-trained in radiology and surgery. Another team member, Dr. Paul James, is an advanced endoscopist and gastroenterologist.



Endoscopy has undergone remarkable innovative changes, says clinical coordinator Leanne Edwards.

There's also a sense of partnership that permeates the endoscopic suite, says Leanne Edwards, clinical coordinator of endoscopy at Toronto General. She says she's watched Dr. Yasufuku transform the division by breaking down silos and allowing other divisions to merge and share learnings. "He is an excellent teacher," adds Edwards. "He has really improved the whole flow of the endoscopy unit," which encompasses liver, gastrointestinal, thoracic surgery and respirology.

Dr. Yasufuku isn't afraid to go to bat for patients, she says. He recently lobbied senior hospital administrators to have endoscopic retrograde cholangiography (ERCP) return to Toronto General. For almost two decades, the procedure, which helps treat gallstone disease, pancreatitis and cancers, was done off-site. Dr. Yasufuku decided that ferrying patients to appointments outside the hospital was taking too much time and impeding care. "For more than 20 years, people had this done at St. Michael's Hospital," explains Dr. James. "Now, due to Kazu's leadership, they are doing ERCP at Toronto General." The hospital now performs 350 procedures in-house annually, which has dramatically improved the quality of patient care.

DOING MORE WITH ROBOTICS

Dr. Yasufuku now focuses more of his attention on robotics – he started UHN's Thoracic Robotic Surgery Program in 2011, which, he says, will bring even more minimally invasive operations to the hospital. By using small robots to perform surgeries, procedures can be more precise and done with less risk to patients. He trains surgeons on how to robotically remove lung tumours in the operating room, and also tests new technologies for minimally invasive diagnosis and treatment of lung cancer in the Latner Thoracic Surgery Research Laboratories at UHN. "This brings us a lot of ideas," he notes. "Once we prove it works and that it is safe, we can translate that to our patients."

Dr. Yasufuku is also working toward the development of a second interventional endoscopy suite for gastrointestinal and urology-related surgeries, as the first suite is at capacity. His goal is to move as many minimally invasive endoscopic procedures as possible into one centralized space with cross-trained physicians skilled in the most up-to-the-minute endoscopic surgeries. "We continue to advance things," he says. "We're doing a great job as a hospital." ■

MINIMALLY INVASIVE

The robots are coming

"Robotic surgery is a critical part of the future of surgery. It will further enhance the capabilities of master surgeons," says Dr. Shaf Keshavjee, Surgeon-in-Chief, Sprott Surgery.

A number of sophisticated machines are increasingly being used in complex surgeries that require a high level of precision and control that can't be done by hand. Surgeons are using robots to perform minimally invasive surgeries – procedures that involve smaller incisions, less pain and better surgical outcomes – which makes a dramatic difference in patient recoveries. Surgeons in the Sprott Department of Surgery are employing a number of innovative technologies in many procedures, from nipple-sparing mastectomies to minimally invasive gastrointestinal (GI), lung, prostate, gynecological and kidney cancer surgeries. The result is a world-class surgical centre that's pioneering new robotic techniques that are revolutionizing patient care.

BREAST CANCER SURGERY

Dr. Tulin Cil

Surgical oncologist and Head, Breast Surgical Oncology, Division of General Surgery, Sprott Department of Surgery

Dr. Tulin Cil is in the midst of a North American–first clinical trial looking at how robotic procedures can help women undergoing nipple-sparing mastectomies. Traditional mastectomies – the surgical removal of the breast to remove cancer or to reduce the risk of developing it – often involve taking off the nipple and areola, but now there is a possibility to perform total skin- and nipple-sparing mastectomies. "Nipple sparing is done more and more, with immediate breast reconstruction at the same time," says Dr. Cil. In a traditional nipple-sparing mastectomy, the incision is placed on the breast and there is limited visibility. Using robotics, an incision is made in the underarm area, and the breast tissue is then removed through that incision. Because the incision is small, there's minimal scarring afterwards. Robotic instruments, explains Dr. Cil, help doctors more easily manoeuvre around tight areas, and they provide greater visibility inside the breast, which makes it easier for surgeons to see tissue more clearly. "It allows us to visualize those borders really well," says Dr. Cil, who adds that this kind of minimally invasive procedure lowers infection risks and reduces the chance of nipple and skin death.

NEXT UP Dr. Cil is planning on recruiting more patients for this groundbreaking study, which was delayed due to COVID-19. She's also looking to collaborate more with plastic surgery colleagues to continue improving the cosmetic and quality of life outcomes for breast cancer surgeries.

UROLOGY

Dr. Jason Lee

Urology and transplant surgeon, Sprott Department of Surgery

Dr. Jason Lee is passionate about using robotics to "reduce the footprint of surgery," especially in his specialty, kidney disease. With more robotic surgery platforms entering the market, and with increasing advances in minimally invasive operations, more innovative surgical techniques are available to doctors than ever before. "I'd like to ensure our patients have access to all this cutting-edge technology," he says. Dr. Lee is particularly interested in how robotics can help transform the treatment of urologic conditions, such as kidney and prostate cancers. Robotics have allowed surgeons to approach these cancers in novel ways, such as accessing tumours in hard-to-reach locations. For example, doctors can now use a robot to reach the kidneys through a patient's back rather than their front, which prevents bowel complications. These minimally invasive techniques also allow patients to leave the hospital within a day.

NEXT UP Sprott Surgery and the Soham & Shaila Ajmera Family Transplant Centre are embarking on a robotic kidney transplant program, which will be offered soon. Using minimally invasive technology will result in fewer surgical complications following kidney transplantation. "It's a really exciting time for us and our patients," says Dr. Lee.

GI/ABDOMINAL SURGERY

Dr. Allan Okrainec

Head, Division of General Surgery, Sprott Department of Surgery; Peter A. Crossgrove Chair in General Surgery and Director, Temerty Advanced Surgical Education and Simulation Centre

Surgeons need training – especially when it comes to the cutting-edge robotic procedures being used in Sprott Surgery. To help get people up to speed on the latest robotic technologies, Dr. Allan Okrainec is heading a new surgical education and simulation centre at the Michener Institute of Education at UHN. Dr. Okrainec, who specializes in minimally invasive GI and abdominal surgery, says the new simulation hub will help advance minimally invasive surgical techniques among surgeons, nursing staff and anesthetists. With a focus on robotic and image-guided surgeries, and using artificial intelligence and virtual reality training, physicians will be able to learn how to use the robots specific to their surgical subspecialty, he explains. "We can train people around the world in these surgeries," says Dr. Okrainec. Phase one, which was just completed, focused on building a simulated operating room where surgical procedures can be rehearsed as a team. This operating room will allow surgeons to train on the latest surgical robots and practise image-guided surgeries.

NEXT UP Phase two of the simulation centre will involve the construction of a facility that will house 10 mini operating room bays, which will allow more surgeons to come to the centre to learn new procedures and perform surgical simulations on-site.

BARIATRIC SURGERY

Dr. Tim Jackson

Operating Room Medical Director, Toronto Western Hospital; general surgeon, Sprott Department of Surgery and Medtronic Chair in Minimally Invasive Surgery

Dr. Tim Jackson is passionate about Toronto Western Hospital's bariatric surgery program, which treats patients who suffer from morbid obesity. The bariatric clinic performs more than 500 gastric operations a year, mostly gastric bypasses, which reduce the amount of food the stomach can hold. "All of our surgeries are done laparoscopically," says Dr. Jackson. "It's fascinating stuff." The secret to their success is a combination of technology and a patient-centred approach. Patients don't just head for surgery – all complete a comprehensive multidisciplinary assessment that includes seeing a psychiatrist, nurse, psychologist, social worker and dietitian.

NEXT UP Dr. Jackson wants to develop an endoscopic bariatric program and incorporate robotics for complex surgeries. Many exciting studies are currently underway, including one that will develop a way to conduct weight-loss surgery at the time of a liver transplant. This will treat many severely obese patients who develop liver failure, a common complication of carrying excess weight.

ILLUSTRATION: REMIE GEOFFROI

DR. HANCE CLARKE, holding a pipette of CBD, is looking at how medical cannabis products manage pain.

ANESTHESIOLOGY

Know pain, know gain

How Sprott Surgery's team is advancing the study of pain management and making the surgical experience safer.

By Ben Waldman

As innovative as surgery has become, recovery from operations can still be painful. In the not too distant past, patients might have taken opium to quell their discomfort or consumed a bottle of vodka before going under the knife. These days, anesthesia and postoperative pain management have become more advanced, with doctors administering or prescribing everything from Tylenol to morphine to medical cannabis to help make patients more comfortable.

"The neurobiology of pain is consistent," says Dr. Hance Clarke, an anesthesiologist and Director of Pain Services in the Department of Anesthesia and Pain Management and Director of the GoodHope Ehlers Danlos Clinic at Toronto General Hospital. "What has changed is the way we view it and the way we treat it."

One lesson researchers have learned over the years is that an individualized approach to pain management and anesthesiology can drastically enhance a patient's recovery. That's why, after decades of research, doctors continue to search for more innovative ways to manage postoperative pain.

FINDING OPIOID ALTERNATIVES

Dr. Clarke has long been investigating how patients can better manage pain post-surgery. For years, opioids were the main therapy clinicians prescribed for treating post-surgical pain. While they are effective for controlling pain, they come with major risks for misuse and addiction. "One of the strongest predictors of whether patients will become addicted is the dose of opioids they are prescribed when they leave the hospital," notes Dr. Clarke, who says nearly 30,000 Ontarians exit hospitals with prescriptions of more than 100 milligrams daily. "With that kind of dose, it's not going to be an easy road back to becoming opioid-free."

In 2014, Dr. Clarke launched Toronto General Hospital's Transitional Pain Service, a program that helps patients, most of whom have recently had surgery, wean themselves off excessive opioid medications. A multifaceted approach is used: patients are prescribed non-opioid therapeutics, and they also learn psychological techniques, such as mindfulness, and receive acupuncture from medical pain specialists. Doctors are also taught to prescribe fewer opioids. Many patients who enter into the program dependent on opioids as their primary mode of pain management no longer use them by the time they leave, he says.

Dr. Clarke is currently conducting a first-of-its-kind evidence-based clinical trial involving medical cannabis and its use for surgical-related pain. He's running the study, in partnership with Shoppers Drug Mart, to test whether medical cannabis can effectively manage pain and potentially replace opioids. "I want the data so we can use the right dosage, the right products and the right regimen to treat a condition," explains Dr. Clarke.

TECH FOR KEEPING TRACK

While Dr. Clarke is focused on post-op pain, others at University Health Network (UHN) are trying to make anesthesia for surgery safer. In 2011, Dr. Ludwik Fedorko, an anesthesiologist and an early innovator in pain management, introduced the Drug Reconciliation and Electronic Anesthesia Monitoring, or DREAM, machine – a computer and barcode-aided system for drug administration that he invented – to operating rooms.

Sweet dreams
"It watches over you," says Dr. Ludwik Fedorko, whose DREAM machine ensures the right drugs are delivered and accurately documented during surgery.

The DREAM system helps UHN anesthesiologists ensure they're giving the right drugs to patients at the right time. Sometimes doctors might misread a drug's label or give a drug at the wrong moment, which can lead to serious complications. "Humans are not machines," says Dr. Fedorko. "We can make mistakes."

The DREAM machine acts as a verification system. Before the anesthesiologist administers a drug, they scan the medicine's bar code in front of the machine, which then tells everyone in the room, in real time and in a human voice, which medication the patient is being given. If the incorrect medication gets flashed, someone will be alerted before it's too late. "It watches over you like a second person," explains Dr. Fedorko. Since the system was introduced, there hasn't been a critical intraoperative medication error.

Canada's largest surgical program requires a best-in-class team of anesthesiologists and assistants who strive for excellence. "Our objective is to continue on this path of making the surgical journey as safe as possible for patients," says Dr. Keyvan Karkouti, Anesthesiologist-in-Chief at UHN. "Along with our colleagues at Sprott Surgery, we must continue to advance practice through groundbreaking, innovative research and education activities." ■

PAIN PROBLEM

21,000

Opioid-related overdoses in Canada in 2019

SOURCE: GOVERNMENT OF CANADA

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