



CUTTING-EDGE INNOVATIONS IN CARDIOVASCULAR CARE

From 3-D imaging of the heart to multimodal practitioners, the Peter Munk Cardiac Centre is driving medical advances in both methods and technology

BY MARJO JOHNE

Graham Nie sat down with his doctor at the Peter Munk Cardiac Centre (PMCC) to look at a CT scan of his heart, rendered in 3-D on a computer screen, a year after he had surgery to implant a stent in a diseased artery.

“It was amazing. He could flip this image around, so I could see where the stent and its branches were put in,” recalls Mr. Nie, who was first diagnosed in 1997 with an abdominal aortic aneurysm – a balloon-like bulge that can cause parts of the body’s largest blood vessel, the aorta, to swell and, in some cases, rupture. “It was the first time in many years that I was clear of aneurysms.”

Today, Mr. Nie, a 75-year-old retired school principal, remains aneurysm-free and continues to recover. He’s active, albeit slower in his everyday tasks such as mowing the lawn around his property in Peterborough, Ont.

Mr. Nie’s successful treatment and recovery can be attributed directly to leading-edge innovations at the PMCC, particularly in advanced medical imaging. From the increased use of CT scans to diagnose and address heart and vascular disease to multimodal practitioners with combined expertise in cardiology, vascular surgery and radiology, the PMCC is driving advances in medical methods and technology to improve patient outcomes.

Located at Toronto General Hospital – one of four hospitals that make up Ontario’s University Health Network (UHN) – the PMCC has a history of innovations that goes back 75 years. It boasts many world firsts, from the first pacemaker implant in 1950 to the first installation and use of the Carto 3 heart monitor recorder system, which uses electromagnetic technology to create three-dimensional images of the heart.

“Everything we do is based around how to make things better for patients and for the health-care system,” says Dr. Narinder Paul, Division Chief, Cardiothoracic Radiology, University Health Network. The medical imaging team that also serves Toronto’s Mount Sinai and Women’s College hospitals. “This means exploring and embracing new technologies, as well as innovating through new applications of existing technology.”

In Mr. Nie’s case, the marriage of two innovations – advanced endovascular aneurysm repair (EVAR) and advanced imaging – gave him a

better-than-fighting chance when a large aneurysm caused a tear in his aorta. In February 2013, doctors at the PMCC implanted a stent (an expandable tube made with fabric and alloy materials) into the affected artery using a tube inserted through a small slit in the groin. Once the stent was in place, a balloon tip at one end of the tube inflated it to its full size, enabling it to reinforce the weakened artery and prevent further swelling.

“Advanced EVAR is one of the most significant developments in aortic surgery, developed elsewhere, but refined at UHN,” says Dr. Kong Teng Tan, Division Head, Interventional Radiology, Toronto General Hospital.

“The conventional way is open surgery, with an incision practically from the top of the chest to the groin,” adds Dr. Tan, noting that the PMCC leads the country in the number of advanced EVARs performed each year. “It’s very invasive, so not all patients can go through the operation because you have to have a certain level of health to tolerate it.”

With advanced EVAR, the PMCC can give more patients a chance to get a potentially life-saving stent – an avenue that used to be closed off to about 80 per cent of patients with aortic aneurysms, says Dr. Tan. But what sets the PMCC apart from many other hospitals that offer advanced EVAR is its use of advanced imaging during the procedure.

In the past, doctors had to keep injecting patients undergoing EVAR with X-ray dye to ensure the stent was positioned properly. This isn’t good

for the patient, says Dr. Tan, because X-ray dye can be toxic to the kidneys.

With the PMCC’s advanced imaging technology, a CT scan is used to generate a 3-D picture of the aorta, which is then fused with an X-ray of the same area. The result is a complete and detailed digital representation of the artery, allowing for precise placement of the stent without further injections of X-ray dye.

“What is unique here is our ability to offer advanced EVAR in an advanced imaging environment,” says Dr. Tan, referring to the image-guided operating rooms (OR), which feature large computer screens that give OR teams access to CT, X-ray and other images during a surgical procedure. “We are one of the few pioneering places to do it.”

The use of CT scans in cardiology is, in itself, a pioneering strategy that the PMCC continues to advance through research. Aside from minimizing X-ray dye injections, CT scans provide deeper insight into the anatomy of the heart, all the way down to the cellular level. This allows doctors to see physiological clues and diagnose disease sooner and more precisely. For example, the amount of blood flow to muscles in the heart might indicate that certain arteries are likely to continue narrowing and will eventually stop functioning.

“By looking at the physiology, we can pick up disease early and characterize the disease to help with decision making,” says Dr. Paul. “This type of insight also helps us determine later if the treatment is working.”

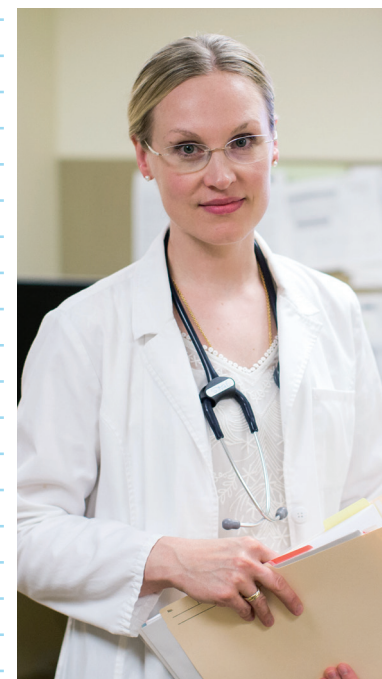
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Advanced uses and research with CT scans aren’t the only imaging innovations at the PMCC. Dr. Danna Spears, Clinical Director of the Heritable Arrhythmia Program at the PMCC, uses catheter-guiding technologies to map patients’ cardiac electrical systems by picking up

Dr. Kong Teng Tan and Dr. Elsie Nguyen are members of the innovative medical imaging team.

The work of Dr. Danna Spears (near left) focuses on patients with irregular heartbeats.

signals from an ultrasound probe or by sensing changes in electrical resistance. Electrode patches applied on the body generate a magnetic field that communicates with an electrode tip on the catheter to produce 3-D images of the heart’s electrical system. “The conventional way of imaging is



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University Health Network

by guiding catheters with an X-ray,” says Dr. Spears, whose work focuses on patients with irregular heartbeats. “For simple X-rays, we’re not talking about a huge amount of radiation exposure, but, for serious cases, a patient could easily spend an hour getting X-rays, and that means a much greater exposure to radiation.”

Imaging innovations also extend to how the centre’s health-care professionals hone and apply their expertise. The PMCC is one of the few sites in the world where cardiology, vascular surgery and radiology are practised by multimodal professionals working in fully integrated teams. The centre has two cardiologists who work in the the Joint Department of Medical Imaging (JDMI) - one reports magnetic resonance imaging (MRIs) and CT scans, while another reports MRI scans. The PMCC also has one radiologist, Dr. Elsie Nguyen, who does echocardiography reporting, which uses sound waves to create moving pictures of the heart.

“I’m the only Level III certified radiologist in Canada who does both cardiac MRI, CT and echocardiography,” says Dr. Nguyen. “Multimodality imagers are a feature that’s unique to the PMCC. We’re swapping roles and blurring boundaries, so radiology and cardiology are less separated.”

For patients, this blending of traditionally separate roles often means faster diagnosis and less additional testing. A multimodal professional can usually speed up the process, if further investigation is needed.

“I can actually arrange for an MRI based on identifying an abnormality on the echocardiogram (heart ultrasound),” says Dr. Nguyen, “so the patient doesn’t have to wait weeks or months.”

Today, the PMCC continues to lead the way with a wide range of innovations in cardiology. Through the work of Dr. Spears and Dr. Michael Gollob – who is Chair of the PMCC’s Centre of Excellence in Cardiovascular Molecular Medicine – the PMCC is using novel technologies in genetic research to determine the cause of atrial fibrillation, the most common form of arrhythmia, as well as the underlying genetic factors that predispose to sudden death in some people with irregular heartbeats.

“In the last 10 years, my group discovered some genes that cause atrial fibrillation,” says Dr. Gollob. “The benefit of identifying the genes that cause a condition is that it allows you to know the protein that can be targeted in developing drug therapy.”

In collaboration with the Joint Department of Medical Imaging: the

Retired school principal Graham Nie (left) reads to his granddaughter. His successful treatment and recovery is the result of leading-edge innovations in imaging and care at Peter Munk Cardiac Centre.

Embracing new technologies and innovating is the goal, says Dr. Narinder Paul, Division Chief, Cardiothoracic Radiology, University Health Network.



Peter Munk Cardiac Centre is now building an education centre to house its Program for Inter-Professional Competency Optimization (PICO). Plans for the centre include simulation and observation spaces where health-care professionals in Canada and from around the world can learn and practise the innovations developed at the PMCC.

“The idea is for health-care professionals to have a dedicated program for learning new skills, incorporating four essential elements: a workstation-based teaching laboratory for advanced image analysis; a simulation space where they can perform diagnostic and interventional procedures, including use of life-like phantoms; a period of clinical attachment where they can go and observe how things are done and gain knowledge at a deeper level; and a dedicated, state-of-the-art education center where they can have time for reflective learning” says Dr. Paul. “To my knowledge, when this is built, it will be the only place of its kind in the world.”



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