

Striking gold in cardiac care

How state-of-the-art twin CT scanners are revolutionizing the treatment and management of heart patients

By Marlene Habib

A world-first project involving twin state-of-the-art CT scanners has only been in gear at Toronto General Hospital (TGH) since April 2015, but this novel approach to conducting research that can be used immediately to help patients is already striking cardiac care “gold,” according to TGH’s head of cardiothoracic imaging.

This “research-to-clinical platform” using two special identical scanners – operated from a single control room – has proved to be “huge” in advancing the study and care of heart patients in the short time it has been in place at the Peter Munk Cardiac Centre (PMCC) at TGH, says Dr. Narinder Paul, Division Chief, Cardiothoracic Radiology, University Health Network (UHN), and a world-renowned, British-educated radiologist.

The centre specializes in scientific research and innovative patient care carried out by multidisciplinary teams. The joint, multiyear project was unveiled this spring within the Joint Department of Medical Imaging (JDMI) at the University Health Network (UHN).

Dr. Paul believes that, over time, what’s being done through the project – a collaboration between the Peter Munk Cardiac Centre, JDMI at the UHN and Toshiba Medical Systems, Japan – will lead to a “fundamental change in patient care and patient management.”

The project involves using two Aquilion ONE ViSION Edition CT scanners, which Toshiba of Canada Limited installed in a single setting. One suite houses a clinical CT scanner, the middle area acts as a joint control room and the research scanner is in the

adjacent suite. The JDMI carries out some 1,800 cardiac CT scans a year, Dr. Paul says.

Researchers have conventionally used CT scans to evaluate the anatomy or structure of organs such as the heart, lungs and brain. But the focus has progressed to developing techniques that demonstrate how these organs function and, more recently, to investigating how they are perfused. The aim of analyzing organ perfusion (blood flow) is “to pick up disease before it would otherwise be detected and to earlier detect the disease response to various treatments,” Dr. Paul adds.

“These CT scanners allow us to look at disease in a different way to traditional methods, and the partnership between the Peter Munk Cardiac Centre and the Joint Department of Medical Imaging has ensured that the TGH is the only place in the world that has this particular set-up,” he says.

“Having these advanced CT units side by side allows us to rapidly put cutting-edge research protocols into clinical care as soon as they are validated – boom! And that’s huge. As we research, evaluate and validate performing cardiac CT scans at very low radiation doses, the technique becomes more available for at-risk people. Imagine a person whose father and brothers died at a young age of a heart attack, and every time they get a squeeze in their heart they are wondering, ‘Am I next?’ Now we have a CT scan-based test that can tell with a very high degree of accuracy whether or not someone has coronary artery disease.”

Traditionally, research and clinical work is performed on

separate CT scanners. The CT scanners are not necessarily the same age or model, or from the same manufacturer, and they are usually located in different areas, with different imaging protocols. In this scenario, once a CT research protocol is validated, it would require further modification to be used on the clinical CT scanner. This process could take days or weeks to translate those protocols from the research scanner to the clinical scanner, Dr. Paul says.

In the case of the twin CT scanners, if the new CT protocol developed in the research scanner does not need to be peer reviewed, then it can be transferred to the clinical scanner and put to work on patients – almost instantly, he says.

Since April, when the project got underway, “we’ve reduced the

radiation dose even below the low level it had been at before, so in some patients by 20 to 30 per cent,” says Dr. Paul.

He believes research and clinical tools like the twin CT platform also help empower patients. “The old idea of the patient coming into hospital and having their treatment without any meaningful interaction with the medical team is gone. We very much embrace patients being involved in their management, so anything that we can use to help them understand their disease more fully, particularly through use of CT images, is golden.”

For patients like Amy Shannon, whose family has a history of heart disease, waiting weeks for research and diagnostic results can be stressful and, possibly, life-threatening.

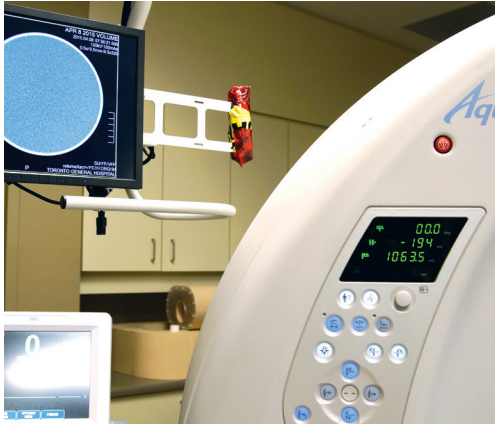
Ms. Shannon, a 51-year-old Lindsay, Ont., resident, has benefited from other forms of diagnostic and clinical care at the centre since November 2012, when it was determined she has ALCAPA, a congenital heart defect whereby the left coronary artery, which carries blood to the heart, is attached to the pulmonary artery, instead of to the aorta. Since having open heart surgery in March 2013 at TGH to repair the defect, Ms. Shannon has made frequent follow-up visits to the adult congenital heart clinic. Although she hasn’t needed to get involved in the twin CT project, she sees it as an exciting development from a patient perspective.

“I think it’s excellent,” says the former teacher. “With something like my congenital heart defect, for instance, because it is so rare, it would put the information out there more quickly and can be linked worldwide, which would be amazing because they [the researchers and clinicians] can compare their information,” she notes.

“Now they can check anybody with families with congenital heart defects, see it right away and fix it right away.”

Jens Dettmann, general manager and vice-president of Toshiba of Canada, Medical Systems Division, says the total cost of the two CT scanner project is about \$3.6-million. He says the project is a continuation of a decade-long

Twin state-of-the-art CT scanners have allowed the Peter Munk Cardiac Centre to “rapidly put cutting-edge research protocols into clinical care as soon as they are validated,” says Dr. Narinder Paul. He calls it a “huge” advancement in the study and care of patients with heart disease.



partnership with the JDMI and the centre that aims to make imaging procedures more “patient friendly.”

This is what a patient with a possible heart condition can expect to experience as part of the joint CT imaging project: The patient undergoes a CT scan, during which the dye injected into a vein will go to wherever the blood goes – if there’s a restriction to blood going into a certain area, that dye will not highlight as well as it would in areas where there is no restriction. The image data then goes to a powerful computer and a software program, where the heart can be turned in three dimensions to look at every vessel, no matter how small – both in and around the heart. This determines how blood is flowing into that area, thus seeing if there’s any disease, the extent of the disease and whether it requires any intervention.

“These new scanners are

pushing the envelope of how quickly we are able to capture an anatomic picture of the human body, and that’s of critical importance in cardiac imaging. Imagine the heart as a piece of muscle beating and moving rapidly in three dimensions, and the inherent challenges in capturing anatomic details of this complex anatomic structure in a single snapshot in time,” says Dr. Lawrence White, Radiologist-in-Chief of the Joint Department of Medical Imaging at Mount Sinai Hospital, the University Health Network and Women’s College Hospital.

“When trying to assess something as small as the coronary arteries, the vessels that supply blood to the heart muscle, to be able to see and assess these structures you need a certain amount of resolution to your images; they need to be sharp and accurate. These new machines are

able to give much greater accuracy and speed, so you can assess things now you absolutely couldn’t do five years ago,” says Dr. White.

Dr. Paul adds: “With a cardiac CT, because patients may be nervous, the heart rate can be quite fast. Therefore, we often have to temporarily slow the heart down to 60 beats per minute using medication. With these new machines, because the X-ray tube and detector spin that much faster, the heart rate can be as high as 80 beats per minute, and we can still obtain wonderful images at a fraction of the radiation dose that is used in older CT scan units.”

So where does the future lie for imaging?

Toshiba of Canada, for one, is focusing on “volume” scanners – ones that capture 3-D and even 4-D images that cover more area and in less time than conventional scanners, meaning less radiation exposure and quicker results, says

Mr. Dettmann.

But the company is also looking at preparing for future health-care needs, and that’s where important medical partnerships – such as the one with the Joint Department of Medical Imaging and the Peter Munk Cardiac Centre – come into play, he says, adding that there currently are no plans to put this research-to-clinical platform anywhere but the PMCC.

“What you need is the physicians telling you: what the headaches are you have now; what the solutions are you’re looking for; what things we need to do in five to 10 years; and what kinds of diseases are increasing,” Mr. Dettmann says. “Definitely, heart disease is one of the top two diseases in the world [along with cancer], so having a solution to the variety of heart diseases, and developing them together with clinicians, is a very important part of our business.”