



## IMAGING

# Real images in real time

### 4D TECHNOLOGY TAKES ECHOCARDIOGRAPHY TO NEW LEVEL

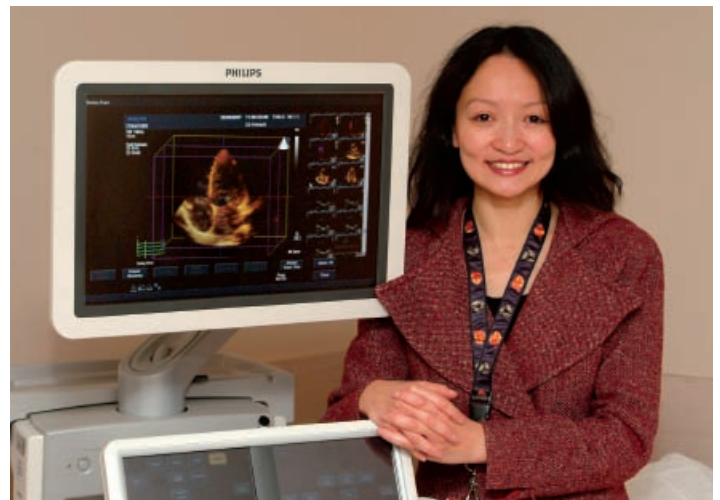
Dr. Anna Woo is helping to take cardiac imaging into a new dimension – both figuratively and literally.

As Interim Director of the Echocardiography Lab and Assistant Director of the Hypertrophic Cardiomyopathy Clinic, Dr. Woo is one of the experts at the Peter Munk Cardiac Centre (PMCC) currently involved in the ground-breaking use of four-dimensional – or 4D – echocardiography.

A Montreal native, Dr. Woo earned her medical degree at McGill University, furthering her training at Harvard University in Boston and the University of Toronto, where she was appointed an Assistant Professor in 1999. Her current role at the PMCC combines both clinical work and research. Both of these are reflected in her involvement with 4D imaging.

### A tradition of imaging advances

“To begin with, it’s worth remembering that Toronto General Hospital has been at the forefront of some of the major advances in cardiac imaging in general, and echocardiography in particular, over the past 30 years,” Dr. Woo points out. “This has included pioneering work in two-dimensional and trans-esophageal echocardiography.”



Dr. Anna Woo believes 4D technology will provide clinicians with the images they need for more complex treatments.

With this strong tradition of research, it seems only natural that the PMCC’s Echocardiography Lab is again at the forefront of advancing the use of this vital clinical diagnostic procedure.

“Since its inception, echocardiography has been a tremendously important tool for clinicians,” says Dr. Woo. “It has a number of benefits. It is easily accessible and usable in a variety of clinical situations, from general coronary care and the intensive care unit,

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## ABOUT THE PMCC: A CENTRE OF CARDIAC EXCELLENCE

The Peter Munk Cardiac Centre (PMCC) is the premier cardiac centre in Canada. Each year, approximately 17,000 patients receive innovative and compassionate care from the PMCC’s world-renowned multidisciplinary heart team. The PMCC is based at Toronto General Hospital and Toronto Western Hospital. Both hospitals, along with Princess Margaret Hospital, are part of University Health Network. All three are research hospitals affiliated with the University of Toronto.

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to the cath lab, the operating room and even the emergency room. It provides images that help in diagnosis and guide treatment decisions. Echocardiography also helps in guiding clinicians and surgeons during actual procedures.

Refinements over the years have also made the procedure portable; some machines have gone from being the size of a stove to laptop dimensions.”

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*“To top it off, echocardiology is extremely safe,” Dr. Woo says. “There are no worries about acute radiation exposure or the long-term cumulative exposure of radiation because the images are generated through ultrasound.”*

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The PMCC’s Echocardiography Lab is one of the busiest in Canada, handling nearly 20,000 cases each year and employing seven staff echocardiographers. It is against this busy background that Dr. Woo and her team are exploring the new frontier of 4D imaging.

Echocardiography plays a role in the diagnosis of patients with a variety of heart conditions, from congenital heart disease to hypertrophic cardiomyopathy, Dr. Woo’s particular area of expertise.

A steady series of advances (see sidebar) has improved the images dramatically, to the point where 3D echocardiography systems now provide unprecedented clarity and detail.

### The fourth dimension

And now, science has added that elusive fourth dimension – time. “Three-dimensional imaging was a tremendous advantage,” explains Dr. Woo. “Computer technology allowed us to view the entire structure of the heart from all perspectives and angles. It helped us to identify defects and problems and allowed surgeons and interventional cardiologists to plan

their treatment approaches. The major drawback was time. It took time – literally hours – for the computer to assemble all the data from the individual images captured by the probes and to reconstruct the 3D image. And of course, that image was static.”

Now, recent advances have allowed echocardiography to cross the time barrier. Specifically, the advances have been in two key areas: highly sensitive transesophageal probes (placed in the patient’s esophagus, as opposed to the traditional transthoracic probes placed on the chest) and powerful software that reconstructs the 3D model of the heart virtually instantaneously.

“We can see the heart as it exists in real time” says Dr. Woo. “Our specialists can observe changes with every heartbeat. Problems can be seen and traced to their source. The information it provides us is invaluable.”

### Positive results

The PMCC is one of the first installations in North America for this new 4D echocardiography system, and its use is still in the early stages. “We have only really been using it for a matter of months,” Dr. Woo notes. “And its use is currently restricted to more complex cases, where extremely precise images and data are needed. But, so far the experience has been very positive, and we can see that the potential is tremendous. For example, we recently used the 4D echocardiographic system to provide real time echocardiographic guidance to Dr. Eric Horlick, one of our interventional cardiologists, during a complicated procedure. It really helped.”

As Dr. Woo points out, the last five years have seen significant technological advances in the treatment of cardiac conditions. Doctors can now treat patients more effectively, and tackle more complex conditions than ever before.

“As treatments become more complex, surgeons and cardiologists are going to require more precise images and information to guide them,” says Dr. Woo. “With 4D echocardiography, we can give them the data they need.”

## ECHOCARDIOLOGY: A MULTI-DIMENSIONAL HISTORY

Echocardiography was one of the first medical uses of ultrasound. It was first developed in the 1950s, although its usage didn't gain wide acceptance until many years later.

Using sound waves, the first echocardiographs initially provided one-dimensional and, subsequently, two-dimensional (i.e., width and height) images of the heart. Essentially, these images were like looking at a 'slice' of the heart.

The advent of computer-based 3D imaging allowed for data from multiple two dimensional images to be

assembled to create a model of the heart with width, height and depth. This technology provided a wealth of helpful information, including the size and shape of the heart, its pumping strength, and the location and extent of any damage or defect.

Although in development for over 15 years, new 4D technology represents the latest advance in echocardiography. This technology produces accurate 3D images, but in real time, allowing for a more thorough assessment of problems and serving as a guide to treatment approaches and procedures.

## New generation CT scanner the first in Canada

One of only five currently at use in the world – and the only one in Canada – the PMCC's new Toshiba Aquilion One scanner represents the very latest advance in computed tomography, or CT.

Computed tomography's primary value as a diagnostic tool is the ability to provide images of anatomical structures at different depths within the body. It produces cross sectional images – called slices – that are reassembled to create three-dimensional pictures of internal organs.

Over the years, the CT scanners have developed from four to eight to 16 to 32 to 64-slice machines. The Aquilion One is a generation beyond – a 320-slice scanner that provides the highest level of image quality and sophistication. The image size it provides is more than large enough to cover an adult heart.

"We can get the whole heart at once," comments Dr. Narinder Paul, PMCC's Chief of Cardiothoracic Imaging. "And because it provides such a quick scan, the radiation exposure is much less."



The new 320-slice scanner at the Peter Munk Cardiac Centre will provide the highest level of image quality and sophistication.

The PMCC's clinicians are currently testing the Aquilion One on various cardiac diagnostic procedures. For example, it is being used to detect clogged coronary arteries, where it provides a much less invasive approach than cardiac catheterization, the current method in general use. So far, the results have been very impressive. "This machine has tremendous potential," notes Dr. Paul.

## DID YOU KNOW?

CT scanning has been called "one of the greatest legacies of The Beatles". The massive profits from their record sales in the late 60s and early 70s, allowed their record company, EMI, to invest in a scientific research arm. The company's first commercial product was computed tomography – originally called the EMI scan.

## INNOVATION

# I<sup>3</sup> Centre taking shape

NEW RESOURCE ON TRACK FOR 2008

The Peter Munk Cardiac Centre (PMCC) is moving steadily closer to establishing a new centre of excellence in cardiac care, as work continues on the exciting I<sup>3</sup> Centre.

With a name derived from its mandate and slogan – *Imaging, Intervention and Innovation* – the I<sup>3</sup> Centre was officially announced last November.

In the approximately 12 months that have followed, significant progress has been made towards realizing its vision of bringing medical imaging, cardiology, cardiac surgery and vascular surgery together, in what I<sup>3</sup> Development Director Dr. Harry Rakowski terms, a unique “community of practice”.

Leading-edge medical imaging technology will be a cornerstone of the Centre, and the purchasing team has been busy. “We have already purchased or committed to approximately \$17.5 million in new equipment,” Dr. Rakowski notes.

The list of this equipment is impressive, including a 1.5 and 3.0 Tesla Magnet MRI, two 320-slice CT scanners, four cath lab suites, five 3D echocardiography machines and a gamma CT camera for use in nuclear cardiology.

In addition, the I<sup>3</sup> Centre has been able to leverage a \$30 million gift from Peter and Melanie Munk to apply for \$9 million in matching funds from the Research Hospital Fund (part of the Canadian Foundation for Innovation). These funds would be

used to purchase a novel combination PET/MRI machine. “This is a new computer-based machine for multi-modality imaging,” explains Dr. Rakowski. “This is a technology that doesn’t exist anywhere at present. We would be involved in its development and defining its applications. It would also help fund a novel 3D ultrasound representation of intracardiac structures that could be used to guide cath lab interventions. This is an exciting opportunity, which we hope to confirm by the spring.”

### Second to none

These technologies, and others being investigated, will provide the I<sup>3</sup> Centre (or I-cubed, as it is commonly known) with digital cardiac imaging equipment that is second to none in North America.

And, of course, the Centre will ensure that the human component is also of the highest standard. “We will complement our excellent current imaging staff with some new recruits over the next year or two,” Dr. Rakowski notes. “This will allow us to expand the value of our services to patients, as well as foster collaborative research. We have also started a search for an Imaging Chair, who will serve as an additional catalyst for leading-edge research.”

Finally, there is the physical space. Construction is expected to begin in February, 2008. It will be a 24-month project that will redevelop much of the southern section of the first floor of the Toronto

General Hospital site, as well as the second floor cath labs. The redevelopment of the interventional medical imaging suite is also part of the I<sup>3</sup> project.

The objective is to be able to utilize state-of-the-art equipment and world-leading imaging expertise in a modern, highly functional space.



I<sup>3</sup> Development Director Dr. Harry Rakowski

Instead of one grand launch, there will be a series of implementation dates as various pieces of equipment and facilities become operational. Computed Tomography (CT) and MRI are expected to be the first online, with nuclear cardiology and the cath labs to follow.

### An integrated model of care

“As I have stated before, one of the primary goals of the I<sup>3</sup> Centre is to develop a new integrated model of care,” says Dr. Rakowski.

“So far things are progressing as expected,” he adds. “We are well on the way to establishing the I<sup>3</sup> Centre as a unique clinical resource.”

## SURGERY

# Multipurpose OR increases efficiency and patient safety

NEW FACILITY PUTS IMAGING EQUIPMENT WHERE IT IS NEEDED

The multipurpose operating room (OR) was originally the idea of the late R. Fraser Elliott, who generously donated \$2.8 million to realize his vision. Now, championed by Dr. K. Wayne Johnston, the R. Fraser Elliott Chair in Vascular Surgery, this vision is becoming reality.

The concept is a simple one: a place that offers a kind of cardiovascular “one-stop shopping”, providing advanced imaging equipment right in the OR suite, where it can assist directly in surgery.

### A multidisciplinary team

The PMCC’s new multipurpose OR will be a fully functional operating theatre that houses advanced x-ray equipment, along with the technology to do angiograms, CAT scans, regular ultrasounds and special ultrasounds that provide precise images of blood vessels. It will be used by vascular surgery, cardiology, cardiovascular surgery and medical imaging. These departments will work together within a multidisciplinary team that includes nursing, anesthesia, perfusion and respiratory therapy.

“No question that this is the direction that surgery for the circulatory systems and the heart is going,” comments Dr. Barry Rubin, Chief, Division of Vascular Surgery. “In our position as a leading cardiac centre, it is absolutely mandatory for us to have this type of capability.”

“The multipurpose OR gives us greater flexibility in the types of procedures and interventions we can do,” he adds. “It also cuts down on the number of procedures a patient needs. For example, if a vessel needs to be ballooned open, it can be done right in the OR, instead of sending the patient first to medical imaging, and then to surgery.

### Reducing risks

Dr. Rubin also feels that the multipurpose OR has tremendous potential for use in emergency situations. For example, if a patient comes to the emergency room (ER) with a ruptured blood vessel, the normal procedure is to send him or her for a CAT scan first, which can be very risky. With the multipurpose OR, a CAT scan or angiogram can be done in the OR and the surgical



The late R. Fraser Elliott (left) with Dr. K. Wayne Johnston. Mr. Elliott was a longtime supporter of vascular surgery.

repair started immediately – a much safer scenario for the patient.

From the perspective of vascular surgery – his particular area of expertise – Dr. Rubin is tremendously excited about the potential use of this OR. “You cannot attract the best vascular surgeons without this type of equipment,” he comments. “And you can’t do the type of procedures that state-of-the-art patient care demands.”

“The new facility will be ideal for minimally invasive vascular procedures,” Dr. Rubin continues. “Endovascular repair of aortic aneurysms, advanced pacemaker work, percutaneous heart valve repair, and repair of thoracic/abdominal aneurysms are just some of the procedures that we will do in the multipurpose OR.”

With most of the funding secured, work will soon begin on the facility, which will be located on the second floor of Toronto General Hospital. While a typical OR is about 700 square feet, the new PMCC facility will cover about 1,000 square feet – the extra space is needed to house the imaging equipment.

The facility is expected to be fully functional by December 2008, and will be a tribute to the foresight and generosity of one visionary – Fraser Elliott.

## FELLOWSHIPS

# Dr. Leo Ihlberg

## FINNISH SURGEON STEPS OUTSIDE HIS 'COMFORT ZONE'

*The Peter Munk Cardiac Centre's international reputation has helped to attract some of the brightest medical talents from Canada and around the world.*

*Researchers and clinicians from across the globe come to both learn from, and contribute to, the Centre's expertise in cardiac care.*

*One such individual is Dr. Leo Ihlberg, an accomplished cardiac surgeon from Finland, who is currently serving a clinical fellowship at the PMCC.*

*Dr. Ihlberg recently took a few moments to chat about his experience.*

### Q: What is your professional background?

"I am a cardiac surgeon, associated with the Helsinki University Central Hospital and the University of Helsinki. Right now, I am here on a one-year clinical fellowship in cardiac surgery."

### Q: How did you end up at PMCC?

"The work being done here is well known and highly respected in the international cardiac surgery community, and Finland is no exception. I knew fellowship opportunities might be available. So, when I met Dr. Tirone David (Head, Division of Cardiovascular Surgery) at a meeting in Europe, we started talking and he suggested the possibility of applying for one of these. From then, it was a case of emailing back and forth to check out the details, applying and being accepted."

### Q: What do you hope to achieve from a professional standpoint?

"I essentially came here to learn more about the most complex cardiac and valve surgery techniques – to study difficult procedures, such as complex re-operations and transplantations. Many of the leading-edge approaches, especially new techniques to correct or repair aortic and mitral valves, rather than replace them, were developed or refined by Dr. David. This is obviously the best place to study them."



Dr. Leo Ihlberg came to PMCC to learn about the most complex cardiac and valve surgery techniques.

### Q: How have you found the experience?

"I am now about a quarter of the way through my term here, and the experience has been very good for me. It is always good to get out of your comfort zone, and learn new ways to work and be part of a team that practices in a different way – not to mention a different language!"

While the basic principles of cardiac surgery are international, everyday you experience some small detail or see something that can make you a better surgeon."

**Q: Is there a research component to your fellowship?**

"While this is a general clinical fellowship, there is also a research component. I am part of Dr. David's team looking at long-term outcomes after surgical treatment of type A aortic dissection. Type A is the more common and dangerous type of aortic dissection. It involves a tear in the ascending portion of the aorta just where it exits the heart, but usually damages the whole aorta. While the ascending part is corrected by immediate surgery, the remainder is usually left uncorrected. We are looking at predictors of future problems in the uncorrected part."

**Q: Has your family adapted to Canada?**

"My family was very much part of the decision to come

here. I wanted to give my family, especially our three girls, who are now four, 10 and 12, a chance to spend a year in a different, English-speaking environment. My wife, Virpi, took a sabbatical and we all came together. Now that they have had time to settle in and make new friends, the girls are all doing very well and we are all enjoying it."

**Q: Where do you go from here?**

"Once the fellowship is completed, I plan to return to Finland with the additional knowledge and experience I have gained. I will take a new look at how things are done and see what is reproducible in my home environment. This especially applies to what I have learned about the more complex valve surgeries."

RESEARCH TEAM TACKLES COGNITIVE DECLINE IN BYPASS PATIENTS

A recent study at Toronto General Research Institute – the first of its kind in the world – has demonstrated a new way to improve the outcomes of bypass surgery in elderly patients.

Following coronary bypass surgery, which reroutes blood around clogged arteries to improve blood flow to the heart, some elderly patients experience a decrease in their cognitive abilities. The new study illustrates a way to remedy this by simply "cleaning" the blood removed during surgery.

The research team led by Dr. George Djaiani and including Drs. Ludwik Fedorko and Jacek Karsi, studied a new clinical tool called 'cell saver', which filters blood suctioned from the surgical site, removing debris, fats and other small particles, and allows the blood to be retransfused into the patient.

"This study was the first to show the efficacy of the cell saver technique in bypass surgery," notes Dr. Djaiani.

PETER MUNK CARDIAC CENTRE - CLINICAL & RESEARCH REPORT

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## PMCC IN THE NEWS

### 'Disappearing' implant a North American first

In a North American first, PMCC clinicians repaired a common heart defect linked to stroke with an implant, or patch. The implant encourages the heart's own health tissue to grow and heal itself, and then disappears within months.

Under the direction of lead interventional cardiologist Dr. Eric Horlick, the PMCC team used a novel 'bioresorbable' device made of collagen and an alloy frame to treat a patient with patent foramen ovale (PFO), a common congenital heart defect. PFO is a small hole in the muscular wall separating the heart into the upper right and left sides. Normally, the PFO closes at birth, but in about 30% of the population, it does not.

"This type of technology is futuristic, it helps the heart heal itself and then the majority of the device gets absorbed by the body, so there is no barrier to future therapies," explains Dr. Horlick.

The groundbreaking procedure was performed on 59-year-old Derwyn Miller, who was able to go home the same day. "I was very happy to be the first patient to have this done," said Miller, adding that he was surprised at how quickly he recovered from the procedure. Since this first, the procedure has been performed successfully a number of times.



Dr. Eric Horlick (left) shows the innovative bioresorbable implant to pioneering patient Derwyn Miller.



Dr. Vivek Rao

### Dr. Vivek Rao named one of Canada's Top 40 under 40

Dr. Vivek Rao, Surgical Director of the PMCC's Cardiac Transplant Program, has been recognized as one of Canada's *Top 40 Under 40*.

Canada's *Top 40 Under 40* is a national program founded and managed by The Caldwell Partners to celebrate our leaders of today and tomorrow, and to honour Canadians who have achieved significant success, but have not yet reached the age of 40.

Recipients are selected by a national board comprised of leaders from Canada's business, educational and scientific communities.

For more information about the Peter Munk Cardiac Centre please visit [www.petermunkcardiaccentre.ca](http://www.petermunkcardiaccentre.ca)

**For questions or comments about this newsletter or for more information on how you can help support the PMCC, contact:**

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