Volume 1, Issue 3

THE BEAT

A COMPENDIUM OF INFORMATION ABOUT THE UNIVERSITY OF OTTAWA HEART INSTITUTE

HIGHLIGHTS

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– Dr. Fraser Rubens, Cardiothoroacic surgeon, Co-Director of the Centre for the Cardiac Surgery Clinical Trials Research Unit, UOHI (from Complex, Integrated Surgical Procedure Saves High-Risk Patients from Across Canada, pages 1-4)

Elizabeth Coletta is the only registered nurse in Canada who performs micro-neurography, a precise technique that measures activity of the sympathetic nervous system (SNS).

(from "Fight or Flight" Has Coronary Consequences, page 3)

Battery backup for medical technology is a life and death technical issue. The Heart Institute operates with an inventory of 8,000 medical devices and upwards of 750 batteries are used as backup power supplies.

(from Routine Effort Prevents Life or Death Consequences, page 6)

"3-D reconstruction of coronary arteries allows for more exact placement of coronary devices."

– Dr. Marino Labinaz, Director of the Cardiac Catheterization Laboratory, UOHI (from Sophisticated, New Cath Lab Speeds Treatment, page 6)

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The Beat is published 9 times a year by the University of Ottawa Heart Institute (UOHI). Comments or questions about *The Beat* should be directed to Jacques Guerette, Vice President, Communications at (613) 761-4850 or jguerette@ottawaheart.ca. For more information about UOHI, please visit www.ottawaheart.ca

University of Ottawa Heart Institute
Institut de cardiologie de l'Université d'Ottawa

Ultra New Imaging Technology Holds Significant Diagnostic Promise

From cinematic fantasies like *Star Wars* to creative software for 3D garden landscape design, the effects of advanced imaging technology are everywhere. Employing the power of that kind of technology in cardiology holds the promise of quick efficient diagnosis for potential heart ailments.

A new $3.9 million diagnostic imaging system installed at UOHI in February is considered the first high-volume, state-of-the-art scanner in Canada dedicated to cardiac care. The multi-slice x-ray scanning technology known as computerized tomography or CT may revolutionize cardiac diagnostic medicine. The high-resolution scanner uses a computer and x-rays to create cross-sectioned 'slices' of the heart rendered in 3D images.

The thinner the slices, the higher the resolution of the images. The 64-slice dedicated cardiac CT at the Heart Institute works with sophisticated image processing tools so a physician can manipulate images for closer inspection at different vantage points. Higher resolution also means detailed mapping of the vascular system and surrounding soft tissue with a series of data sets for 3D visuals. "The way technology has expanded and developed means that cardiac CT is the new frontier of cardiology," says cardiologist Dr. Benjamin Chow, who is also co-director of Cardiac Radiology at UOHI.

Dr. Ben Chow is spearheading diagnostic research using ultra new cardiac CT imaging technology.

A series of studies is currently underway at the Heart Institute to investigate the potential use of cardiac CT diagnostic technology as a faster and effective alternative to more invasive tests such as cardiac catheterization. Cardiac catheterization involves threading a tiny catheter through a blood vessel to the heart to produce images of flow – a coronary angiogram. Although the test requires 15 to 40 minutes to perform, patients stay in hospital for four to six hours to recover.

A cardiac CT scan takes seven to 10 seconds. It is possible to visualize the entire heart and arteries with extremely high accuracy, and to the point where individual plaques

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Complex, Integrated Surgical Procedure Saves High-Risk Patients from Across Canada

A pioneering surgical program to remove life-threatening blood clots from pulmonary arteries and restore blood flow to the lungs is preparing to move to a new level of research.

The Heart Institute is a provincially-designated Centre of Excellence for Pulmonary Thromboendarterectomy (PTE), a complex procedure requiring an integrated experienced surgical team. The Institute's PTE Program, which by its nature attracts high-risk patients, has continued to excel and expand since the first procedure was successfully performed in 1995. A total of 102 patients, ranging in age from 15 to 78, have been referred from across Canada to undergo the procedure at the Heart Institute. The clinical success of the program has saved millions of dollars in health spending on patients who would have otherwise been referred to the United States for the complex procedure.

The procedure can result in a dramatic improvement in the patient's quality of life. One of the earliest patients faced a certain early death without the PTE and now is a personal fitness trainer, says cardiothoracic surgeon Dr. Fraser Rubens, who established the program in collaboration with Dr. Michael Bourke of the Division of Cardiac Anesthesia. "A lot of these patients do well, have very productive lives and can return to functional positions in society," says Dr. Rubens.

The success of PTE is dependent on a number of factors, including an experienced surgical team with specific

(continued on page 4)

(Ultra New Imaging Technology Holds Significant Diagnostic Promise, continued)

and calcification can be seen in the arteries. Coronary artery calcification is a marker for 'hardening' of the arteries and may predict future cardiac events.

Currently, referrals for cardiac CT at the Heart Institute have been patients with uncertain results from other tests. The next step would have meant cardiac catheterization, which has a much longer waiting list, says Dr. Chow. The Heart Institute conducts about 5,000 catheterizations a year for diagnostic angiography. "The whole premise here is serving our patient population with the latest technology and reducing wait lists to the shortest possible times," says Dr. Chow.

Slower, lower resolution CT scanners have been used in other areas of medicine for several years. The extremely fast rotation of the 64-slice, equivalent to a fast shutter speed on a camera, enables visualization of the heart, which until now was not possible. The heart is in constant motion, making for a tricky imaging situation. The new CT technology is so fast, it can capture 'still' images of a beating heart.

"We are using thinner slices and can image very small objects," Dr. Chow says. "The coronary arteries are very small and range between one millimetre and four millimetres in diameter. It has only been recently that we've been able to visualize these with CT scanners."

A unique feature of the Heart Institute's cardiac CT program is the collaborative approach of cardiology with radiology. Radiologist Dr. Carole Dennie is co-director with Dr. Chow of the Cardiac Radiology Unit at the Heart Institute. "This is one of the few centres, possibly the only one in Canada, where a cardiologist reads independently and radiology reads independently," says Dr. Chow. Collaboration is important because of unrelated discoveries, such as a recent showing of a normal heart but a mass on the lung consistent with lung cancer, Dr. Chow adds.

The 64-slice CT is not without controversy, largely because the technology is so new and so little literature is available yet. A report completed last year by the Ontario's Ministry of Health noted at the time that only about 20 of the 64-slice cardiac CTs were operating worldwide. Researchers agree the new CT is able to generate a tremendous amount of information about the heart and coronary arteries. How to translate the vast amount of new data into improved patient care remains the major issue at hand, they say. To address this very subject, Dr. Chow is involved in a series of at least five major research studies.

"One question," he says, "is to try to identify the patient populations where cardiac CT is appropriate. Not all tests are for everyone. CT does have limitations. For example, we cannot visualize stents as well as we would like. We are trying to identify patients who might benefit most from CT and those who should have more traditional tests."

The Ontario Health Technology Advisory Committee, following the report last year on the new technology, is currently conducting a field evaluation of 64-slice cardiac CT in four Ontario centres. Effectiveness of the fast imaging could go a long way to solving wait times for cardiac care patients, who might otherwise only be diagnosed by cardiac catheterization. Other concerns involve increased wait times for general CT use if more dedicated cardiac CTs were put into service. There are other issues such as additional radiation exposure although technology to ensure dosage limits can address this.

The $800,000 Ontario study, which involves the Heart Institute and three centres in Toronto, is evaluating the accuracy of CT in a defined population of 1,000. The test population at UOHI involves 250 people. The total group will include patients with valve disease, patients with so-called dilated cardiomyopathy (a disorder of the heart muscle) and patients with intermediate likelihood of having coronary artery disease.

Dr. Chow has other studies underway to evaluate cardiac CT as a screening tool.

- Patients with acute coronary syndrome are normally tested using cardiac catheterization before a decision is made on three possible avenues for treatment: medical therapy only, angioplasty, or coronary bypass grafting. Dr. Chow is investigating whether diagnostic cardiac CT is precise enough to be used to help select the appropriate therapy for heart patients. "Is it possible to pick out the patients who might be treated medically so they can avoid angiogram or can we identify candidates for bypass surgery and send them straight to the surgeon?" Dr. Chow asks.

- A pilot study now being completed is examining how cardiac CT compares with other non-invasive modalities. Cardiac catheterization is regarded as the gold standard diagnostic tool. Dr. Chow's study is examining accuracy of cardiac CT in detecting heart disease when compared with other non-invasive methods such as Positron Emission Tomography (PET) imaging and Magnetic Resonance Imaging (MRI). PET uses radio tracers, which are taken up by the heart and are used to gauge blood flow. The amount of blood flow is a surrogate marker for narrowing of the arteries or coronary artery disease.

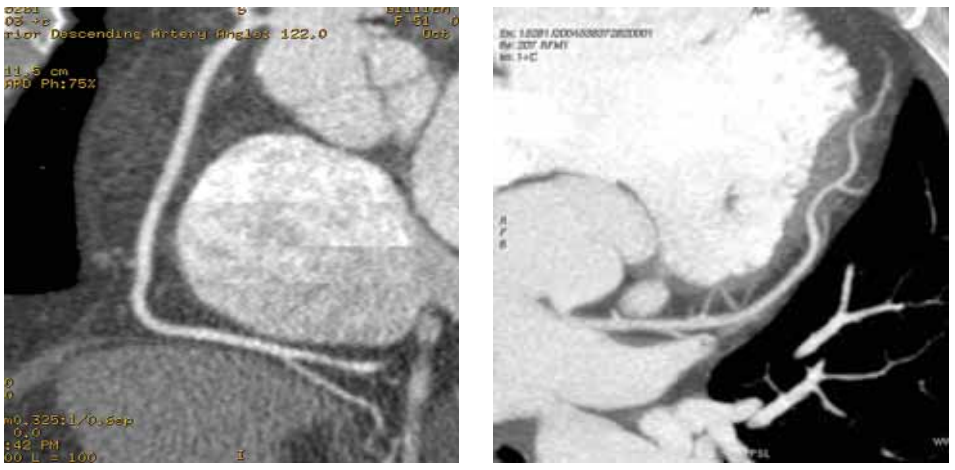
Much of the research to date, says Dr. Chow, asks whether CT can replace cardiac catheterization. "My personal belief is that we are not there yet. The images are certainly not perfect enough where I can confidently say that we can prevent an angiogram 100 percent of the time. Whether it can replace other non-invasive modalities has never been studied."

"The whole premise here is serving our patient population with the latest technology and reducing wait lists to the shortest possible times."

– Dr. Benjamin Chow

"We're trying to identify patients who might benefit most from CT and those who should have more traditional tests. The goal is to help improve patient care and shorten the waiting lists."

- Staff Cardiologist.
- Co-director of Cardiac Radiology, Ottawa Heart Institute.
- Expertise in Nuclear Cardiology and Positron Emission Tomography (PET).
- Training and experience in Cardiac CT and MRI from Harvard Medical School Massachussetts General Hospital.
- Clinical interests: Cardiac CT, Nuclear Cardiology, Positron Emission Tomography, Acute Coronary Syndrome.
- Research interests: Diagnostic imaging in Cardiology, myocardial perfusion imaging, cardiac PET and coronary angiography.



CT angiography provides detailed images of the coronary arteries. The photos show an example of a patient with a normal left anterior descending artery and right coronary artery.

CT Technologist Richard Tessier assists a patient undergoing a cardiac CT scan.

"Fight or Flight" Has Coronary Consequences

Sympathetic nerve activity has become an important factor in the study of heart failure and high blood pressure. Researchers at UOHI are taking a closer look at this activity using a complex investigative technique called microneurography, which is conducted in only a few centres in Canada.

Clinical research underway at the Heart Institute's Microneurography Laboratory is looking at ways to normalize heart functions such as blood pressure by monitoring and analyzing bursts of activity in the sympathetic nervous system (SNS). The SNS is called into action during the "Fight or Flight" response, typically during a traumatic incident. The system turns on a kind of energy reserve, triggering hormones such as adrenalin and then moves to increase blood pressure, the heart rate and pulse, and slow digestion. SNS is also stimulated during a period of illness. Studies show that prolonged SNS hyperactivity can damage the heart and blood vessels. But growing evidence indicates this system does not return to a normal state on its own after trauma or a major illness.

Sympathetic nerve or neural activity is measured by inserting an electrode directly into the peroneal nerve just behind the knee, says Research Manager Elizabeth Coletta RN, of UOHI's Hypertension Unit. The neural signal is amplified, filtered, integrated and recorded as bursts on a neurogram. Microneurography is a difficult technique to learn and can take up to a year of training. The technique, however, provides accurate, direct information about sympathetic nerve impulses travelling from the brain.

Coletta is the project manager for clinical microneurography research under two leading experts at the Heart Institute's Hypertension Unit at the Heart Institute. They are Dr. Frans Leenen, Director of the Hypertension Unit, and Dr. Marcel Ruzicka, who is a nephrologist at the Ottawa Hospital with a cross appointment to the Hypertension Unit at UOHI. Dr. Ruzicka's expertise includes kidney disease and the related links with high blood pressure and the sympathetic nervous system.

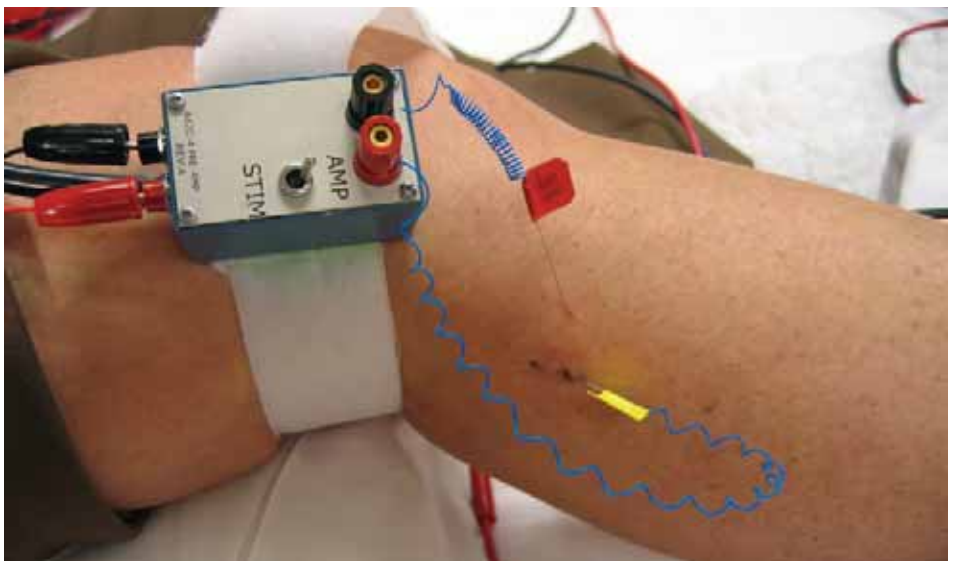
Coletta is the only RN in Canada who performs the microneurography technique after an extended training period both in Italy and in Canada under Dr. John Floras, senior scientist at the Toronto General Research Institute. Overseas, she attended the hypertension research institute in Milan – Centro di Fisiologia Clinica e Ipertensione – where she was trained under supervision of Dr. Guido Grassi, who had conducted many studies on the role of SNS and high blood pressure.

> **"You can record the brain impulses as they travel down the nerve. It is a very accurate way of testing the nerve activity."**
>
> *– Elizabeth Coletta*

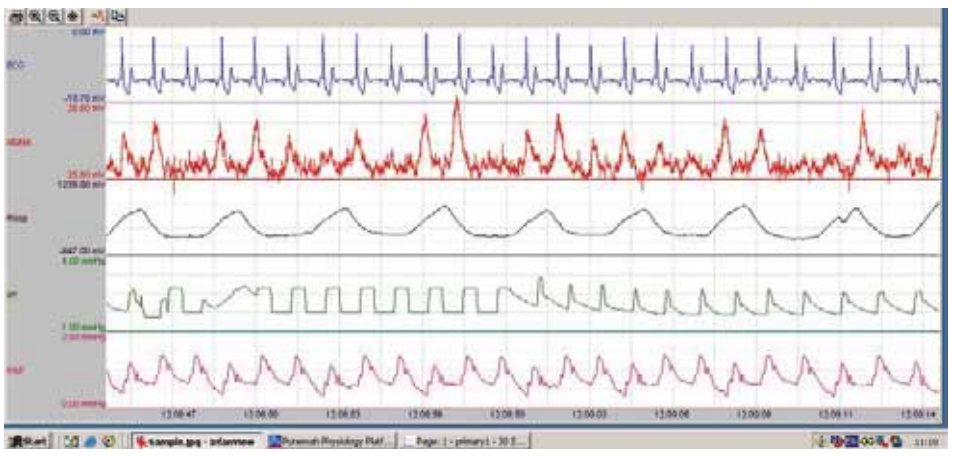
Elizabeth Coletta is the only registered nurse in Canada who performs microneurography, a precise technique that measures activity of the sympathetic nervous system (SNS).

"The peroneal nerve wraps itself right around the bone and it's a good place to insert an electrode," says Coletta. "You can record the brain impulses as they travel down the nerve. It is a very accurate way of testing the nerve activity." Research has shown that measuring sympathetic nerve activity offers a clear, consistent reflection of changes in a patient's status or disease. Microneurography is used primarily in basic research settings. Coletta always performs the technique as part of a research team with the attending physician-researcher.

The Microneurography Research Lab at the Heart Institute was retrofitted last year with in-situ shielding against electromagnetic interference (EMI). EMI has long been a problem in hospitals because of the operation of electronic equipment, especially the proliferation of wireless devices and computer activity. The Microneurography Lab at the Heart Institute is located in an area reserved for complex diagnostic imaging and the nearby electronics systems posed a dilemma for conducting high sensitivity readings of nerve activity. The new EMI-shielded lab opened in late December 2005.



An electrode smaller than the thickness of the human hair is inserted into the peroneal nerve near the kneecap.



Microneurography directly measures the electrical activity of the SNS which is displayed in a manner similar to an ECG. This picture shows normal SNS activity.

Six different research projects are either under way or volunteers are being recruited for pilot studies. One investigation is looking into the effects of blood pressure lowering medications in reducing excessive sympathetic nerve activity among heart failure patients. These patients have normal blood pressure but the research is examining how the medication is able to reduce the sympathetic hyperactivity.

"Our work is strictly research but the ultimate goal is prevention and treatment," says Coletta. "We want to test medications that are currently on the market and examine how they affect the activated state of the sympathetic nervous system and how the activity might be brought back to a normal state."

Pulmonary Thromboendarterectomy

PTE surgery removes blood clots that are blocking the pulmonary arteries to allow the right side of the heart to work properly. With the clots out of the way, blood can get to all parts of the lungs and oxygen delivery is improved. When these clots are removed from the pulmonary arteries, the heart and the lungs work together better.

The eight-hour procedure requires a strong team-based approach and an extremely high level of skill from both the cardiothoracic surgeon and the anesthetist. The open-heart surgery, performed under general anesthesia, involves bypass through a heart-lung machine. The patient's body temperature is cooled dramatically and no blood is pumped through the arteries. The arteries are carefully opened, the clots extracted very slowly. The arteries are closed, blood flows back into the body as it is warmed again and the chest is closed.

(Complex, Integrated Surgical Procedure Saves High-Risk Patients from Across Canada, continued)

expertise in thrombosis, pulmonary hypertension and knowledge of right heart physiology – areas of specialty at the Heart Institute. "The procedure itself requires very complex management of the heart-lung machine," says Dr. Rubens. "A heart surgeon needs to understand the patho-physiology of the heart-lung machine because the patient is on a bypass machine all day long." Dr. Rubens has led numerous large clinical trials relating to the nature of the heart-lung machine and its complications.

The surgery, which restores normal blood pressure in the pulmonary artery and reverses the right-heart failure, takes eight hours or longer. The chest is opened and the patient is attached to a heart-lung bypass machine. The patient's body is also cooled to about 17°C, down from the normal body temperature of 37°C, to reduce the need for oxygen. Once the patient is cooled, the surgeons open the arteries obstructed by scarring and clots. The heart-lung bypass pump is shut off, essentially leaving a bloodless surgical field to work with. While no blood is being pumped through the arteries, the surgeons extract the scar and clots using careful dissection techniques as they adhere to the thin arterial walls. The on-off process of the heart-lung bypass pump is repeated until all of the clots are extracted. The arteries are sewn closed, blood is allowed to flow into the body, which is warmed again, and the chest is closed.

The operation requires a multidisciplinary surgical team and is extremely resource intensive. "You have to be committed to be at the bedside and deal with all the unique complications that arise from this procedure, which is very different from other heart surgery. Often, the heart is swollen, the pressure may be very high at the right side of circulation. Patients may bleed more because the liver may not be functioning. They may have difficulty with oxygenation so ventilator settings have to be exquisitely monitored."

PTE also requires a dedicated approach during pre-operative and post-operative care. As part of the Heart Institute's PTE program, candidates for surgery receive a 27-page booklet published by the Heart Institute. All heart patients receive detailed information about the nature of their surgery, but this extensive booklet provides in-depth material and details about exercise routines, since nearly 40 percent of PTE patients come from outside the province and most Ontario patients are from outside Ottawa. Of the 102 patients, 66 were from Ontario and 14 were from British Columbia. Other provinces have sent only a handful of patients, owing partly to the extraordinary complexity of the medical problems, which is underscored by the length of time from onset of the disease to diagnosis – normally about two years, says Dr. Rubens.

Awareness of the program is growing across Canada, he adds. While there may be several hospitals in the country where PTE is attempted, this procedure is an example of how patient outcome is optimized by the higher volume of specialized surgery. "This is the high-volume centre in the country," Dr. Rubens adds. "We do more of these cases than anyone else. Focusing resources in one centre means we can optimize the outcome. There is overwhelming evidence that the higher the volume in a centre for this particular procedure, the lower the mortality."

Increased patient volume not only bodes well for patient outcome but it puts Canada's expertise in this area on an international footing. "Just as importantly, this also gives us the opportunity to ask research questions and the large volume enables us to conduct peer-reviewed research." Research from the beginning has led to numerous published articles by the Ottawa team. These have ranged from clinical documentation of outcomes, to anti-coagulation techniques for patients who are allergic to blood-thinners. "We would like to have a parallel research laboratory and use the momentum derived by the success of the program to facilitate recruitment of expertise at the University of Ottawa in pulmonary hypertension and right ventricular physiology research," says Dr. Rubens.

The Heart Institute's PTE program has adopted a strong multi-disciplinary team approach throughout the whole process, from pre-operative to post-operative and rehabilitation. "The partnership without a doubt requires an extremely good anesthetist," says Dr. Rubens, and now there is a team of three anesthetists who rotate for the PTE procedures with Dr. Rubens.

Dr. Bourke is also Medical Director of the Cardiac Surgical Intensive Care Unit at the Heart Institute and in that role he has developed a protocol for the anesthetic and ICU management of PTE patients specifically. Together the team of anesthetists has continued to modify the anesthetic and ICU protocol as more experience has been generated. In general, the protocols hinge on the carefully balanced administration of medication to support the heart, taking into account an exquisite knowledge and understanding of ventilation methods to optimize a patient's oxygen delivery without causing lung toxicity and damage.

The UOHI's multidisciplinary approach also incorporates paramedical assistance, allied support and a nursing care co-ordinator dedicated to the families to ensure communication and emotional support.

Immediately on returning to Ottawa after initial training, Dr. Rubens performed the surgery on his first patient. This 64-year-old man arrived at the Heart Institute extremely ill, suffering jaundice with a swollen and congested liver as a result of heart failure. The patient spent 24 days in ICU and was released after 42 days in hospital. "He continued to improve and to this day he is doing well with an excellent quality of life, no heart failure and no pulmonary hypertension," says Dr. Rubens.

"Patients who arrive with this disorder are severely ill," he adds. "They have pulmonary hypertension and various degrees of right heart failure. Their life expectancy is dependent on the state of the disease when it is diagnosed. Inevitably, if the disease is left untreated in the majority of these individuals who don't have other problems, the disease will be the cause of their death. And it's premature death."

The disease is not easily diagnosed. "Patients are often shuffled around, treated for disorders that include pneumonia, asthma, psychological problems or fibromyalgia" he says. At some point, the patient is tested and pulmonary emboli are discovered. "The Ottawa Heart Institute has a great deal of experience in many facets that are integral to these patients," Dr. Rubens says. "We are also leaders in performing high-risk surgery."

Not all candidates are eligible for the surgery because of other factors that would limit their chances for survival, he adds. The Heart Institute has assessed 180 candidates to date but only performed surgery on 102. "This is big surgery for the heart," says Dr. Rubens. "We work here with this as a team. We have the experience behind us. The more accumulated surgical experience, the better we get at deciding who will have the surgery and how to manage complications to continue to decrease the mortality rate."

Dr. Fraser Rubens

"We have the expertise in thrombosis, knowledge of right heart physiology and pulmonary hypertension. It became a natural fit that a high-risk surgery such as this should be performed here as a national centre."

- Cardiothoroacic surgeon, University of Ottawa Heart Institute; expertise includes pulmonary embolic disease, thrombosis, right heart physiology, pulmonary hypertension.
- Co-Director Centre for the Cardiac Surgery Clinical Trials Research Unit, University of Ottawa Heart Institute.
- Interests: complete arterial revascularization, off-pump surgery, optimized bypass conduits, minimally-invasive surgery, evidence-based standards for the management of cardiopulmonary bypass.
- Principal investigator of peer-reviewed grants, Canadian Institute of Health Research; internal reviewer, Heart and Stroke Foundation of Canada.

"The Ottawa Heart Institute has a great deal of experience in many facets that are integral to these patients. We are also leaders in performing high-risk surgery."

– Dr. Fraser Rubens

New Electrophysiology Lab is a Canadian First

Canada's first advanced remote control cardiac mapping and ablation centre for the treatment of cardiac arrhythmia has opened at the Heart Institute. The Fuller Electrophysiology Lab provides a revolutionary new magnetic-assisted guidance system to navigate and manipulate the catheter remotely into various locations in the heart for treatment.

The new technology provides cardiologists with precise and effective control of the catheter tip as it is threaded through the blood vessels to the heart for diagnostic, mapping and ablation in routine and more complex cardiac cases, such as atrial fibrillation, which is the most common heart rhythm disorder. The new system relies on magnets to help position and manœuvre a magnetic-tipped catheter through the patient's body. The new technology includes software that will allow the lab to integrate three-dimensional CT images, adding another level of precision to electrical signal mapping of the heart.

The Heart Institute installed a new $3.9 million diagnostic imaging system earlier this year. Considered the first high-volume, state-of-the-art 64-slice CT scan scanner in Canada dedicated to cardiac care, the multi-slice x-ray scanning technology known as computerized tomography or CT uses a computer and x-rays to create cross-sectioned 'slices' of the heart rendered in 3D images.

The new Fuller Electrophysiology Laboratory, named for donors Thomas and Jeanne Fuller of Ottawa who made the original lab possible, is among the busiest centres at the Heart Institute. The new technology allows cardiologists to negotiate tricky curves and bends throughout the body, says Dr. Anthony Tang, Director of Electrophysiology and of Clinical Cardiology Research at UOHI. "We will be able to use the magnetic navigation system to steer the catheter remotely into the heart and to various regions of the heart and be able to do more precise measurements. As well, we will be able to deliver ablation in a much more precise manner."

UOHI cardiologists are recognized internationally for the mapping of complex rhythm disturbances leading to their precise location and treatment. Work pioneered at the Heart Institute has demonstrated that complex cardiac pacing techniques are capable of providing significant improvement in cardiac function for some patients with abnormal cardiac conduction.

Dr. Tang is leading a major Canadian study into the long-term value of these techniques. An expanding area in electrophysiology is the implantation of automatic implantable cardiac defibrillators used to monitor heart rhythm and apply an electrical shock to the heart to prevent a fatal rhythm disturbance. Dr. Tang was also recently awarded a grant from Heart and Stroke Foundation of Canada to evaluate the effects of cellular telephones on defibrillators.

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– Dr. Anthony Tang

Dr. Anthony Tang (left) reacts to a comment by Ontario Premier Dalton McGuinty during a ceremony marking the completion of a number of sophisticated new facilities at UOHI, including Dr. Tang's EP Lab.

In the EP Lab's control room, Melanie McIntyre, a cardiopulmonary technologist, monitors a variety of equipment and patient parameters.

A medical team successfully completes another cardiology procedure using one of the world's most advanced EP labs. For instance, catheters inserted into the patient are manipulated magnetically instead of mechanically.

Routine Effort Prevents Life or Death Consequences

In July 2005, a severed power cable at the Heart Institute accidentally cut off electricity to the Cardiac Surgical Intensive Care Unit (CSICU) and Coronary Care Unit (CCU). But this is a good news story with a lesson in preventive maintenance that is making its way to health care institutions across North America.

Not a single piece of equipment, from the ventilators to defibrillators, at the Heart Institute's ICU failed as a result of the power loss. The battery backup power supply kicked in. "It was seamless," says Tim Zakutney, Manager of the Biomedical Engineering Service Department of the Cardiovascular Devices Division at UOHI. "It was clear that the batteries were in great condition and there is a huge amount of confidence on our part that the equipment is going to work." That part was no accident.

Zakutney and his team analyzed three years worth of data collected routinely as part of a daily regimen initiated in 2002 to log, monitor and manage the Heart Institute's battery backup power supplies. Many complex medical instruments from defibrillators to artificial hearts rely on backup power particularly for patients who are being moved. In a power blackout, backup supplies are especially critical and there is no room for error.

"Our main goal is to make sure that when patients come through the door, they are not going to be adversely affected by any technology here and that is paramount," says Zakutney. "Staff know patients will be safe, that care is going to be delivered and it is not going to be delayed by anything with respect to technology."

Zakutney along with Senior Biomedical Engineering Technologist, Mark Cleland and his background and expertise in battery management, initiated the battery program in 2001. This program became one of the missions of the department while Zakutney developed a new Biomedical Engineering Services Department. Zakutney, a Professional Engineer and graduate of Applied Science in Systems Design Engineering at the University of Waterloo, worked at the National Research Council of Canada and then obtained his Masters in Health Science in Clinical Engineering from the Institute of Biomedical Engineering at the University of Toronto. He was Assistant Manager, then Director of Biomedical Engineering at the Atlantic Health Sciences Corp., in Saint John, N.B., before coming to Ottawa.

The mandate of Biomedical Engineering does not differ from the health care professions within the Heart Institute. Patient safety and high quality of care are paramount. Maintaining and managing medical devices and technology is their vehicle to achieve this mandate. Battery backup for medical technology is a life and death technical issue. The Heart Institute, for instance, operates with an inventory of 8,000 medical devices and upwards of 750 batteries are used as backup power supplies. Virtually every medical device utilized in the Heart Institute relies on battery technology for proper operation. "Ultimately, we want to know exactly the kind of backup we are putting into our medical devices," says Zakutney. Typically, battery power is required on a patient who is being transported – whether across the city or between the operating room and ICU.

"Our main goal is to make sure that when patients come through the door, they are not going to be adversely affected by any technology here and that is paramount."

– Tim Zakutney

A regimen of preventive maintenance was set up to ensure the integrity of the battery. Batteries pass through an analysis protocol to determine power capacity of each battery. All information is logged daily. "Essentially every single battery that comes into this hospital whether it be new or whether it be with the purchase of other equipment is analyzed. We get a quantitative assessment of the condition before it is deployed."

With this approach, Zakutney discovered that some batteries weren't up to spec and that generic brand batteries performed as well or better than name brand batteries. Investigation also showed that battery life could safely be extended by 1-2 years beyond the manufacturer's recommendation to swap batteries annually, which has lead to some cost savings.

Batches of new batteries are tested; some new shipments tested have shown only 20 percent or 30 percent power capacity. "We ended up sending them back. This puts us in a much safer position from a liability perspective. The fact that we've let people know what we've done and as a result of our findings, this has raised the bar for other organizations. It has raised the level of due diligence that groups need to meet."

At onset, the testing and monitoring appear overwhelming, he says. But the protocol is integrated into a daily routine, making it an automatic procedure in the operation of the department, Zakutney adds. The Heart Institute's Biomedical Engineering Services Department of the Cardiovascular Devices Division has also been invited to share details about the protocol and the battery management program at American conferences hosted by the U.S. Food and Drug Administration and in Canada with the Canadian Medical and Biological Engineering Society (CMBES). Zakutney is also on the Executive Committee of the CMBES. "We are trying to impress that this is just a small piece of the puzzle," he says. "It doesn't add a lot of time in the day-to-day operation but it is an important task."

Sophisticated, New Cath Lab Speeds Treatment

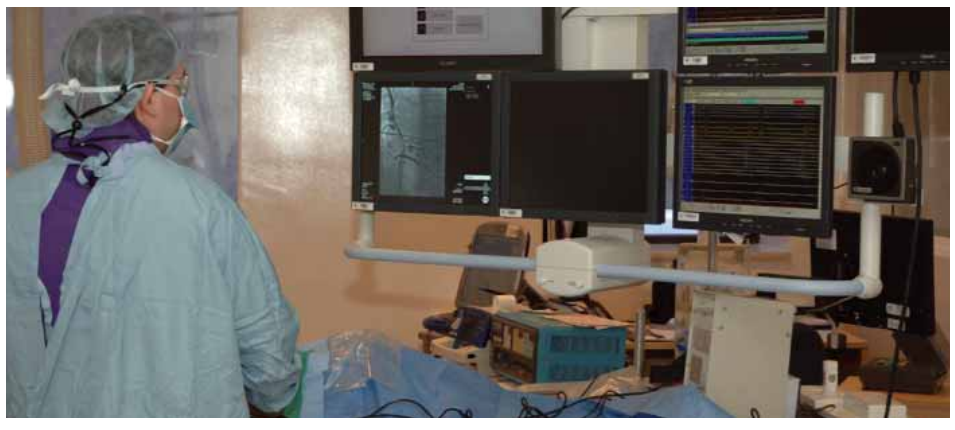
A state-of-the-art Cardiac Catheterization Laboratory, which recently opened at the Heart Institute, is already having a dramatic impact on managing wait times for Canadian heart patients.

The new laboratory is one of the most sophisticated in North America. It features technology provided by Philips Electronics, which has released an advanced software platform for 3-D reconstruction of coronary artery structures. "3-D reconstruction of coronary arteries allows for more exact placement of coronary devices," says cardiologist Dr. Marino Labinaz, Director of the Cardiac Catheterization Laboratory at UOHI.

Catheterization is an important tool in cardiac care, allowing cardiologists to reach into the heart without opening the chest to investigate and treat heart ailments. Newer techniques are already changing the way the heart can be examined and repaired. The very thin catheter tube inserted into a blood vessel is threaded through the circulatory system to the heart. Damaging blockages in vessels that reduce supplies of oxygen and blood flow are seen easily after injecting a dye visible by X-ray. Other tests measure blood pressure within the heart and oxygen in the blood to provide information about the heart's pumping ability. Catheters with a balloon on the tip are used in another procedure to widen blocked arteries, most often using a stent that works like scaffolding to ensure the opening remains intact. Catheterization is also performed to treat defects such as repairing a hole in the heart.

The 3-D technology will be especially useful for patients who cannot tolerate large amounts of dye, says Dr. Labinaz. Further, cardiologists at the Heart Institute are investigating a revolutionary technique to implant a replacement aortic valve by catheterization. The treatment has recently been pioneered in Canada for possible use on patients too frail for open-heart valve replacement surgery. "As people get older, they develop more medical problems and so some may not be eligible to have open-heart surgery to fix their valves," says Dr. Labinaz.

With the new lab, the Heart Institute expects to handle an additional 1,200 cases annually, says Dr. Labinaz. The Institute now has a total of four catheterization labs, which now provide capacity for about 200 procedures in total each week. Urgent cases are scheduled within two weeks of a patient's visit for assessment by a cardiologist at the Institute. "The real impetus to have this new lab is to shorten the wait list and treat patients in our area in a timely fashion and we are doing that," says Dr. Labinaz.



The real impetus for cath lab 4 is to shorten wait lists and treat patients quickly. With the newest lab now operational, UOHI is completing about 200 procedures each week, spread across its four cath labs.

UOHI's newest catheterization lab offers a wealth of technological advantages. For instance, it has the ability to do 3-D reconstruction of coronary arteries which allows coronary devices to be placed with extreme accuracy.