MAYO CLINIC

CARDIOVASCULAR UPDATE

CLINICAL CARDIOLOGY AND CARDIOVASCULAR SURGERY NEWS

Volume 9, Number 3, 2011

Inside This Issue

New Cardiovascular Diseases Chair at Mayo Clinic in Florida

Issam D. Moussa, MD
Mayo Clinic in Florida

Issam D. Moussa, MD, has been named chair of the Division of Cardiovascular Diseases at Mayo Clinic in Florida. Dr Moussa graduated from Damascus University Medical School in Damascus, Syria, followed by postgraduate training at Georgetown University Medical Center in Washington, DC, University of California, Irvine, and Lenox Hill Heart and Vascular Institute of New York. He is board certified by the American Board of Cardiovascular Medicine, the American Board of Interventional Cardiology, and the American Board of Endovascular Medicine.

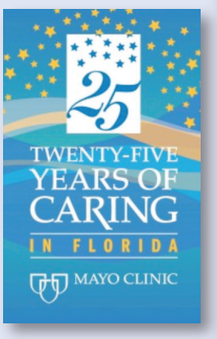
Previously Dr Moussa was affiliated with the University Hospital of Columbia and Cornell as director of the Endovascular Service at NewYork-Presbyterian Hospital of Weill Cornell Medical College and codirector of the Endovascular Service at the Columbia University campus and with Lenox Hill Heart and Vascular Institute as director of interventional cardiology research. He has been a subinvestigator on multiple clinical trials. He has coauthored more than 100 peer-reviewed journal articles and almost 200 abstracts. He is editor-in-chief of the journal *Acute Cardiac Care* and chair of the publications committee of the Society for Cardiovascular Angiography and Interventions. His interests include interventional treatment of complex coronary and peripheral vascular disease.

IN THE NEWS

Mayo Clinic Develops Partnership With the International Clinical Research Center

Mayo Clinic has signed a collaborative agreement with the International Clinical Research Center (ICRC) in Brno, Czech Republic. The initiative will be led by Virend Somers, MD, PhD, a cardiologist at Mayo Clinic in Rochester, and Tomas Kara, MD, PhD, a cardiologist in the Czech Republic who trained in Dr Somers's Mayo Clinic laboratory. Dr Kara is the ICRC director and Dr Somers is its international scientific director. Both were instrumental in establishing the ICRC, with the goal of facilitating scientific partnerships, technology development, and large clinical research studies. Planned projects include studies of cardiovascular and neurologic diseases, geriatrics and aging, cancer, and lung, gastrointestinal tract, and kidney disease, with an emphasis on preventive strategies. Investigators will train at Mayo Clinic and other institutions, then live and work at the ICRC to complete specific studies. Based on the conceptual model of the International Space Station, a continuously changing group of researchers will be working at the ICRC, and their assignment to the ICRC will depend on the type of work being conducted at any given time. The ICRC will emulate Mayo Clinic's patient-centered focus; all studies will require approval by both the Mayo Clinic Institutional Review Board and an equivalent organization in the Czech Republic.

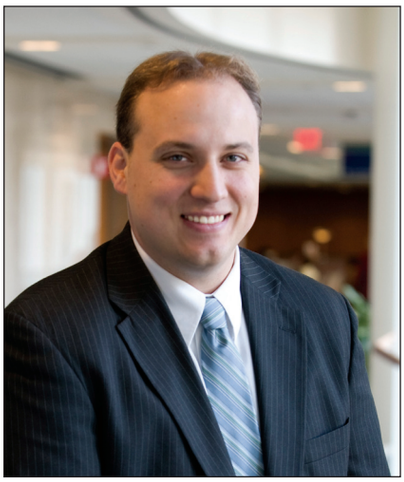
Mayo Clinic Celebrates 25 Years in Florida



In October, Mayo Clinic's campus in Jacksonville celebrated 25 years of providing care in Florida. Since the clinic opened in 1986, more than half a million patients from all 50 states and 143 countries have come to the Florida campus for Mayo's unique patient-centered approach to medical care.

"We are proud of what Mayo has accomplished in 25 years, and we know that the next 25 years will advance the medical profession even further," says William C. Rupp, MD, chief executive officer of Mayo Clinic in Florida. "These accomplishments wouldn't have been possible without the trust of our patients; the dedication of our physicians, nurses, and support staff; the philanthropy of our benefactors; and the partnership of our referring physicians."

Evolving Strategies and Technologies in Pediatric Heart Failure and Pediatric Heart Transplantation



Jonathan N. Johnson, MD
Mayo Clinic in Rochester

Remarkable progress has been made in the surgical and medical treatment of pediatric heart failure over the past 35 years. The first human heart transplant was performed in South Africa in December 1967. The first pediatric heart transplant was performed 3 days later in Brooklyn, New York, on a 2½-week-old infant with Ebstein anomaly. This patient died 6 hours later due to persistent severe acidosis. Dismal outcomes were common, and after 1967, pediatric heart transplants were placed on hold until outcomes could be improved. Finally, in 1984, the first successful pediatric heart transplants were performed at several centers around the United States. These successes were driven by the discovery of cyclosporine, an immunosuppressive medication that revolutionized the care of patients after transplant.

Before the 1980s, many diagnoses in pediatric cardiology carried a fatal prognosis, including severe dilated cardiomyopathy, severe myocarditis, restrictive cardiomyopathy, severe neonatal Ebstein anomaly, and many forms of complex congenital heart disease. "The increased availability of pediatric heart transplantation and advances in reparative and palliative surgery for neonates with complex congenital heart disease provided new options for these patients and their families," says Jonathan N. Johnson, MD, pediatric transplant cardiologist at Mayo Clinic in Rochester.

While the care for and management of pediatric heart transplant patients has improved markedly, there remains 1 large limiting factor that impacts transplantation in pediatric cardiology: donor availability. Despite the availability of more than 50 pediatric transplant centers in the United States, the number of donor hearts has plateaued in the past few years, effectively limiting the number of transplants that can be performed (Figure 1). In 2010, according to the Organ Procurement and Transplantation Network of the US Department of Health and Human Services, 359 heart transplants were performed in patients younger than 18 years. Meanwhile, it is estimated that at least 40 infants and young children die every year in the United States while awaiting a heart for transplantation. "Clearly, with this limited donor supply, it is critical that new strategies are developed to improve the length and quality of life in transplant recipients," says Dr Johnson.

New Strategies in Pediatric Heart Transplantation

Pediatric patients who have undergone or are awaiting heart transplantation can have complex medical issues, and a true multidisciplinary approach is required before, during, and after the transplant. At Mayo Clinic in Rochester, pediatric transplant patients are evaluated concurrently by cardiac surgery, pediatric cardiology, intensive care, infectious diseases, pulmonology, pharmacy, social services, and child life teams. The input of experts across the varied fields allows for optimal care for these patients.

While the initial pediatric heart transplants were often performed on patients with normal anatomy but abnormal function (eg, dilated cardiomyopathy), advances in congenital heart surgery permit transplantation in patients with extracardiac concerns, including coarctation of the aorta, pulmonary artery or vein stenosis, and abnormal systemic venous return to the heart (such as interrupted inferior vena cava and left or bilateral superior vena cava). It is now rare that a patient cannot receive a transplant simply because of abnormal arterial or venous connections.

Once a heart has been transplanted, extreme care goes into ensuring that the allograft is not rejected by the recipient's immune system. The Mayo Clinic team has developed a grading system for determining a patient's likelihood of experiencing rejection; the immunosuppressive regimen is modified depending on patient risk factors such as blood type, age, history of rejection, and presence of antibodies specific to donor antigens. Newer immunosuppressive agents, including tacrolimus, mycophenolate, and sirolimus, are regularly used and appear to have improved adverse effect profiles compared with older immunosuppressive medications.

One of the greatest long-term risks to the pediatric heart transplant patient is the development of coronary vasculopathy. This requires regular screening using both coronary angiography (Figure 2) and intravascular ultrasound (IVUS) (Figure 3). The use of sirolimus in particular is thought to reduce the appearance and progression of coronary vasculopathy.

New Strategies in Pediatric Heart Failure

With the limited availability of donor hearts, the need has arisen for therapies with which to "bridge" the patient to transplantation, allowing longer wait times. Arguably one of the greatest advancements in adult cardiology in the past 30 years has been use of the ven-

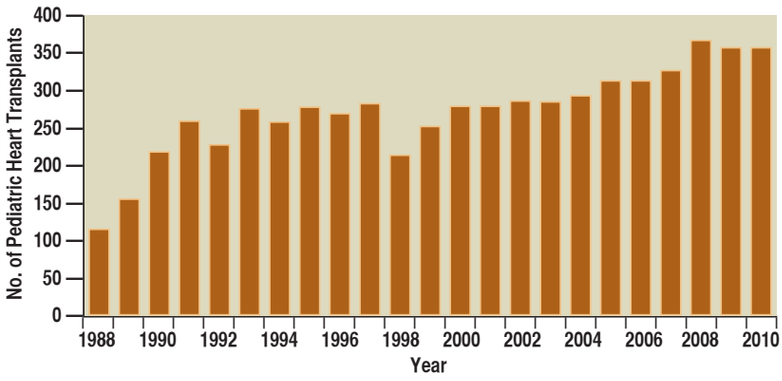


Figure 1. Number of pediatric heart transplants performed annually in the United States.

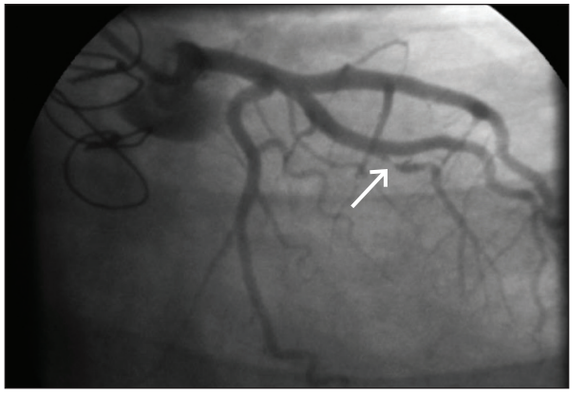


Figure 2. Left coronary angiography performed on an 18-year-old patient 5 years after heart transplant. Note the subtle diffuse narrowing (arrow) likely indicating graft vasculopathy.

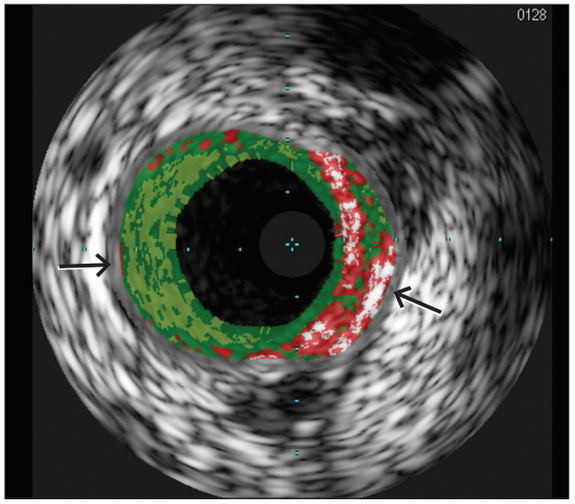


Figure 3. IVUS image taken during evaluation of a 19-year-old patient 14 years after transplant. Virtual Histology (Volcano Corporation) technology shows scattered abnormal tissue densities surrounding the vessel lumen, including fibrous and calcific changes (arrow, right side of image) and intimal thickening (arrow, left side of image), suggesting the presence of graft vasculopathy. This patient had a normal coronary angiogram, and graft vasculopathy would not have been diagnosed without the use of IVUS.

tricular assist devices (VADs) in the treatment of severe heart failure. While the use of VADs in adult patients is now routine, the lack of appropriately sized pediatric VADs has been problematic. The paucity of devices is at least partially attributable to the need for critical design features in VADs to handle smaller outputs; simple "miniaturization" of effective adult VADs has been unsuccessful. Currently, several companies are producing pediatric VADs, of which 2 types have been used in pediatric patients younger than 5 years at Mayo Clinic in Rochester. VADs designed for adults can be used in teenagers who are close to adult size. While these pediatric VADs have shown promise and have been very effective, the known risk of neurologic embolic events, particularly in infants, has prompted investigation of new devices.

In February 2010, the National Heart, Lung, and Blood Institute recognized the need for more effective pediatric-sized VADs and awarded contracts worth almost $24 million to 4 institutions for preclinical testing of different versions of pediatric VADs. It is hoped that this 4-year program, entitled the PumpKIN program (Pumps for Kids, Infants, and Neonates), will provide cardiologists with more tools in the care of critically ill children with heart failure.

Pediatric Heart Transplantation at Mayo Clinic

The first pediatric heart transplant at Mayo was performed in 1991. Since then, of the 400-plus total heart transplants performed at Mayo Clinic in Rochester, 40 have been in pediatric patients (less than 18 years old) and 25 more have been in adult patients with congenital heart disease. Multiorgan transplants in patients with congenital heart disease, including heart-kidney and heart-liver combined transplants, are also performed. Pediatric patient survival at 1 month and 1 year after transplant has been excellent. Pediatric transplant cardiologists work closely with their surgical and adult transplant colleagues to ensure optimal care is delivered to all heart transplant patients.

Failing Fontans

The Mayo Clinic Congenital Heart Disease Center has established a transplant, heart failure, and VAD program specifically directed at pediatric and adult patients who have had a Fontan procedure. The team includes pediatric cardiology, adult congenital, cardiovascular surgery, gastroenterology, radiology, and infectious disease experts. "This is a population of patients in dire need of options when their surgically created circulation fails, and collaboration among the various specialists is critical to their management," says Dr Johnson.

New Protocols Allow for MRI in Selected Pacemaker Patients

Win-Kuang Shen, MD
Mayo Clinic in Arizona

Robert E. Watson Jr, MD, PhD, Joel P. Felmlee, PhD
Mayo Clinic in Rochester

Heart Rhythm Services
Mayo Clinic in Arizona
Luis R. Scott, MD, *Director*
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Radiation Physics
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Matthew A. Bernstein, PhD
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The use of implantable pacemakers and cardioverter-defibrillators (ICDs) has increased dramatically, due in part to the aging of society and expanded indications for their use. An estimated 75% of patients who currently have an implantable cardiac electronic device will need MR imaging during their lifetimes. In the past, MR imaging was contraindicated in all patients with implantable cardiac devices because of concerns that the powerful magnetic and radiofrequency fields generated during imaging might damage device components, inhibit pacemaker function, trigger rapid pacing, or deliver inappropriate shocks.

In recent years, several centers have begun offering MR imaging to patients with cardiac pacemakers. However, the current guidelines from the American Heart Association and the US Food and Drug Administration do not support MR imaging in pacemaker patients, nor do any of the device manufacturers (except for new MRI-conditional devices). "The American College of Radiology recognizes that MRI in pacemaker patients is never routine and should be conducted only when the case is properly triaged and deemed medically necessary and when alternative radiologic methods have not been diagnostic," according to Robert E. Watson Jr, MD, PhD, a radiologist at Mayo Clinic in Rochester. "Also, it is stipulated that there is cardiology pacemaker support and careful pacemaker and physiologic monitoring during the MRI, as well as MRI physicist support during imaging."

The first MRI-conditional pacemaker received FDA approval for use in the United States in February 2011. This first-generation device has important limitations. It requires a special lead system, so the generator cannot be simply replaced and connected to in situ intracardiac leads. Cardiac MRI is excluded because of potential overheating of the new lead system (second-generation devices currently available in Europe use a lead system that is compatible with cardiac MRI). Additionally, the first-generation devices are limited to 1.5-Telsa scanners.

"While it is likely that, in the next decade, MRI-conditional pacemakers and possibly ICDs will become standard, there is a large population of patients who in the interim may require MRI scanning," says Win-Kuang Shen, MD, a cardiac electrophysiologist and chair of the Division of Cardiovascular Diseases at Mayo Clinic in Arizona. Recent studies have suggested that MRI can be done safely in many patients with standard cardiac pacemakers. Physicians from the Department of Radiology and the electrophysiology group in the Division of Cardiovascular Diseases at Mayo Clinic in Rochester and Arizona devised a pilot protocol for patients with standard pacemakers in whom MRI was the preferred imaging modality.

After device interrogation, prospective patients met

IN THE NEWS

The Unequivocal Benefit of a Smoke-Free Environment

A study by Mayo Clinic researchers has demonstrated the unequivocal benefit of a smoke-free environment. The study, presented at the recent meeting of the American Heart Association, revealed a 45% reduction in myocardial infarction and a 50% reduction in sudden cardiac death since the workplace smoking ban was instituted in Olmsted County, Minnesota, home of Mayo Clinic in Rochester. These decreases were noted despite no demonstrable change in other risk factors for myocardial infarction and sudden cardiac death such as hypertension, hyperlipidemia, diabetes mellitus, and obesity. The smoking prevalence in the community decreased by 23%, accounting for some but not all of the improvement.

The study was conducted by Richard D. Hurt, MD, director of the Nicotine Dependence Center at Mayo Clinic in Rochester, using data from the Rochester Epidemiology Project, a longitudinal collaborative project encompassing data from all health care providers in Olmsted County. The 18-month period following the passage of the law in 2002 banning smoking in restaurants was compared to like data collected for 18 months following passage of the comprehensive smoke-free ordinance in 2007. This is the most definitive study to date demonstrating the correlation between secondhand smoke and cardiac events.

with an electrophysiologist to determine whether the patient was pacemaker dependent and the relative need for pacing under baseline conditions. Only nondependent patients with mature lead systems (longer than 90 days) were considered. Patients with devices that demonstrated inadequate function (eg, high capture threshold, high pacing impedance, depleted battery voltage) were excluded. Although initially only head MRI was performed, later in the protocol body scanning was allowed.

According to the protocol, the pacemaker is programmed in an asynchronous mode at the intrinsic heart rate plus 20 beats per minute prior to scanning. Patients are supervised by a cardiologist or pacemaker nurse through the procedure. Pulse oximetry and ECG are monitored. The device is then reprogrammed to original settings after the scan is complete.

The MRI pulse sequences are determined by the radiologist and the physicist. "All the exams take place on a 1.5-Tesla magnet and the specific absorption rate is limited to 1.5 W/kg for a maximum of 30 minutes," according to Joel P. Felmlee, PhD, a radiation physicist at Mayo Clinic in Rochester. "If prescan sequences demonstrate heart rate synchronization to the transmission-receive interval of the radiofrequency coil, the scan is discontinued."

No clinically adverse events have been noted. "Power-on" resetting (POR) and magnet mode pacing have been observed in some patients and seem to be device specific. Premature ventricular contractions have been observed, but they have been clinically insignificant. Lead model has not been predictive of abnormal pacing function during MRI studies, nor has region of the body scanned. All pacing abnormalities appear to have been transient and reversible. No effects on generator voltage or lead function have been observed either immediately after scanning or at 1-month follow-up.

During POR, battery voltage declines to less than a critical preset level (the trip level) at which point operation of the device is unpredictable. After recovery of battery voltage, devices typically reset to the manufacturer's nominal settings. "Because of the potential for POR and the unpredictability of pacemaker function during MRI scanning, pacemaker-dependent patients should not undergo MR imaging," says Dr Shen.

Magnet mode pacing occurs as a result of reed-switch activation by the magnetic field generated during MRI. Theoretically, programming the device to an asynchronous mode should prevent reversion; however, magnet mode pacing has been seen during scanning despite asynchronous programming and could initiate arrhythmias.

The Centers for Medicare and Medicaid Services have approved reimbursement for MRI in patients with the new MRI-conditional pacing system. However, they continue not to reimburse for MRIs performed in patients with other pacemaker systems. The Mayo Clinic Department of Radiology has been providing this service to patients in need of MRI regardless of reimbursement issues.

- MRI in patients with non–MRI-conditional devices should be considered only if the patient is not pacemaker dependent.
- MRI should not be performed if there is evidence of generator or lead malfunction.
- MRI in selected patients with ICDs is currently under investigation.

RECOGNITION

Mayo Clinic in Rochester Department of Medicine has announced the recipients of the 2011 Education and Research Recognition Awards. The awardees are Barry A. Borlaug, MD, outstanding new investigator, and Michael J. Ackerman, MD, PhD, outstanding investigator, both from the Division of Cardiovascular Diseases.

Gerald T. Gau, MD, a cardiologist at Mayo Clinic in Rochester, has received the Department of Medicine 2011 Laureate Award.

New Technology Facilitates Treatment of Pediatric Arrhythmias

Bryan C. Cannon, MD
Mayo Clinic in Rochester

Cardiac rhythm disturbances are relatively common in the pediatric age group, occurring in about 1 of 1,000 children. Although most of these arrhythmias tend to be benign, some can be debilitating or life-threatening. In the past, the options to treat young patients with arrhythmias were few, including a limited number of medications or open heart surgery. "Technology has rapidly advanced so that now almost all children with arrhythmias can be successfully treated or completely cured with percutaneous ablation," according to Bryan C. Cannon, MD, director of pediatric electrophysiology at Mayo Clinic in Rochester.

The most common arrhythmia in children is paroxysmal supraventricular tachycardia (PSVT). Children with PSVT can achieve heart rates higher than 300 beats per minute. Although this high heart rate is not often life-threatening, children are typically symptomatic, with palpitations, dizziness, or even syncope when PSVT occurs. Some children learn techniques to terminate their tachycardia, but many children require some type of medical intervention, particularly when their symptoms occur during school or sports.

The most common mechanism of PSVT in pediatrics involves an accessory pathway. Prior to 1990, the only way to ablate these accessory pathways was via open heart surgery. However, in the early 1990s, percutaneous radiofrequency ablation (RFA) technology was developed. RFA lesions are very small (on the order of 4-6 mm), and they do not typically affect the overall structure or function of the heart. More than 20 years of follow-up has confirmed that there are no major negative long-term consequences as a result of performing this procedure in children.

The success rate for affecting a complete cure in ablation procedures is greater than 95%; the complication rate is very low (approximately 2%), the most common complication being ecchymosis at the catheter entry site. Once a child is over the age of 5 years or weighs more than 33 pounds, the risk of complications is no greater than that for adult patients undergoing the same procedure. Ablations can be performed in smaller children (even neonates) who have medically refractory or life-threatening arrhythmias. The most severe complication that can occur in younger patients is damage to the atrioventricular (AV) node; if this occurs, the patient requires lifetime pacing therapy.

Some of the original open heart surgical ablations were performed using cryoablation, but until several years ago, this technology was too large and bulky to be introduced percutaneously. Today, this technology can be delivered through a catheter that is similar in size to a traditional RFA catheter. The advantage to cryoablation is that cooling the tissue creates a temporary effect on the electrical tissues in the heart which becomes permanent only after several minutes of freezing. "Use of percutaneous cryoablation in children therefore allows

Announcements

E-Update

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Get Caught Up

Know This Number: Mayo Clinic Takes to Social Media to Spread Heart Health Awareness

If you find yourself singing "blood pressure, lipids, and BMI" to the tune of the 1982 hit song "867-5309/Jenny" after watching Mayo Clinic's "Know Your Numbers" video, the Division of Cardiovascular Diseases will have accomplished its goal.

Partnering with Mayo Clinic's Center for Social Media and the Office of Women's Health, the division created the parody to reiterate the importance of knowing your numbers to help prevent heart disease. Along with the video, the heart health campaign features a free app on Mayo Clinic's Facebook page (https://www.facebook.com/MayoClinic) that helps people calculate their risk of a heart attack and learn what they can do to prevent one. Since it launched in mid-October, the video has had more than 23,000 views.

"This is a fun way to encourage people to reduce their risk of heart disease," says Sharonne N. Hayes, MD, Mayo Clinic cardiologist and founder of the Women's Heart Clinic. "Social media offer us the opportunity to get this important health message out to people in a broad way. I guarantee that viewers of the video will be singing the refrain 'blood pressure, lipids, and BMI' to the 'Jenny' song all day long."

Watch the video at http://www.youtube.com/watch?v=kkps4XwvxK4.

monitoring of the normal cardiac conduction system during lesion formation," says Dr Cannon. "Cryoablation is especially valuable because it allows ablation of accessory pathways that are very close to critical structures such as the AV node and the His-Purkinje system." There has not been an incidence of permanent damage to normal conducting tissue when this system is used properly.

Another challenge that complicates ablation procedures in children involves the manipulation of the catheters. Since catheters are typically placed into the heart from the femoral vein, precise manipulation and location can be challenging. Stereotactic technology has been developed to direct the tip of the catheter using a strong magnetic field, eliminating the need for the physician to move the catheter manually. This magnetic field can be manipulated in any direction, allowing an almost limitless number of catheter positions. This approach is useful particularly in patients with complex congenital heart disease.

An important breakthrough in the field involves advanced computer technology that is reducing radiation exposure in pediatric patients. Until recently, manipulating the catheters for the ablation was performed exclusively using fluoroscopy. However, new technology is now making it possible to create 3-dimensional computer models of the entire heart to be used as a map to perform ablation procedures. The computer images can be rotated in any direction to allow visualization of all parts of the heart. "In some cases, ablations are performed without any radiation exposure to the patient, which is particularly important in growing children," says Dr Cannon.

The pediatric electrophysiologists at Mayo Clinic collaborate with colleagues in adult electrophysiology and cardiovascular surgery to plan the most appropriate treatment for each individual child. "New technology has made it possible to both safely and effectively eliminate most arrhythmias in the pediatric population," says Dr Cannon.

IN THE NEWS

Mayo Clinic to Partner in New Insurance Option for Canadians

Mayo Clinic has announced a new health insurance option that will allow Canadians to access Mayo Clinic expertise and care. The product, called MyCare, is provided by Assured Diagnosis Inc (ADI) and will be available nationwide in Canada, initially excluding Quebec. MyCare policyholders will have access to Mayo Clinic expertise delivered remotely via an electronic second-opinion consultation, as well as on-site care at Mayo Clinic campuses in Jacksonville, Florida, Scottsdale/Phoenix, Arizona, and Rochester, Minnesota.

"Mayo Clinic has provided hope and solutions for tens of thousands of Canadians over the past 90 years. We look forward to the opportunity to extend our expertise to Canadians through the MyCare offering," says David L. Hayes, MD, medical director of the International Office at Mayo Clinic in Rochester. "Our Canadian patients, just like those from the United States and other parts of the world, tell us that they appreciate our team approach, the breadth of our knowledge and expertise, and our efficiency. It is our honor and privilege to provide timely, high-quality care to more than half a million patients each year, in virtually every subspecialty of medicine."

The remote second opinion, or "eConsult," provides the foundation for the MyCare offering. It will allow people to access Mayo Clinic expertise remotely, in some cases perhaps precluding their need to travel to Mayo Clinic for care. For those for whom in-person care is deemed appropriate or necessary, the MyCare program also offers that option.

Mayo Clinic enjoys many long-standing relationships with patients and providers in Canada. In most cases, Mayo Clinic does not require a physician referral.

Questions for Cardiovascular Update? Send an e-mail to CVUpdate@mayo.edu.

RECOGNITION

Prediman Krishan Shah, MD, director of the division of cardiology at Cedars-Sinai Medical Center, presented the 17th annual Robert L. Frye Lecture at Mayo Clinic in Rochester in August 2011. Dr Shah (left) is pictured with Dr Frye.

David L. Hayes, MD, has been named medical director of the Mayo Clinic Affiliated Practice Network. Dr Hayes is the former chair of the Division of Cardiovascular Diseases, Mayo Clinic in Rochester.

Upcoming Courses

Continuing Medical Education, Mayo Clinic

For additional information, visit www.mayo.edu/cme/cardiovascular-diseases, e-mail cme@mayo.edu, or phone 800-323-2688, 800-283-6296, 507-266-0677, or 507-266-6703, unless noted otherwise.

CARDIOLOGY BOARD REVIEW COURSES

Echocardiography Review Course for Boards and Recertification
Jun 2-5, 2012, Rochester, MN
Course directors: Charles J. Bruce, MD, Jae K. Oh, MD

Pediatric Cardiology Board Review Course
Aug 26-31, 2012, Laguna Beach, CA
Course directors: Frank Cetta Jr, MD, Benjamin W. Eidem, MD, Anthony Chang, MD

Electrophysiology Review for Boards and Recertification
Sep 7-9, 2012, Rochester, MN
Course directors: Samuel J. Asirvatham, MD, Paul A. Friedman, MD, Thomas M. Munger, MD

Electrophysiology for Boards and Recertification (Transseptal and Epicardial Workshop)
Sep 10, 2012, Rochester, MN
Course directors: Samuel J. Asirvatham, MD, Paul A. Friedman, MD, Thomas M. Munger, MD

Mayo Clinic Cardiovascular Review Course for Cardiology Boards and Recertification
Sep 29-Oct 4, 2012, Rochester, MN
Course directors: Rick A. Nishimura, MD, Steve R. Ommen, MD

9th Annual Mayo Clinic Interventional Cardiology Board Review
Oct 12-14, 2012, Rochester, MN
Course directors: Gregory W. Barsness, MD, Malcolm R. Bell, MD, Paul Sorajja, MD

NEW Hawaii Heart 2012: Case-Based Clinical Decision Making Using Echocardiography and Multimodality Imaging Presented by Mayo Clinic
Jan 16-20, 2012, Big Island, HI
Course directors: Charles J. Bruce, MD, Heidi M. Connolly, MD, Fletcher A. Miller Jr, MD

NEW Case Studies in Structural Heart Disease
Jan 27-29, 2012, Miami, FL
Course directors: Charanjit S. Rihal, MD, Maurice E. Sarano, MD

19th Annual Arrhythmias and the Heart: A Cardiovascular Update
Jan 30-Feb 3, 2012, Kauai, HI
Course directors: Paul A. Friedman, MD, Stephen C. Hammill, MD, Douglas L. Packer, MD

37th Annual Cardiovascular Conference at Snowbird
Feb 5-8, 2012, Snowbird, UT
Course directors: Douglas L. Packer, MD, Jeffrey Anderson, MD, George Klein, MD, Christopher O'Connor, MD

Optimal Treatment Strategies for Advanced Heart Failure
Feb 24-25, 2012, Scottsdale, AZ
Course director: Robert L. Scott, MD

17th Annual Cardiology at Cancun: Topics in Clinical Cardiology: Focus on Heart Failure
Feb 27-Mar 2, 2012, Cancun, Mexico
Course directors: Steve R. Ommen, MD, Guy S. Reeder, MD

NEW Heart Failure Management for Nurse Practitioners, Physician Assistants, and Primary Care Providers
Mar 11-13, 2012, San Antonio, TX
Course directors: Barry L. Karon, MD, Jean R. Wagner, RN, CNP

19th Annual Echocardiographic Workshop on 2-D and Doppler Echocardiography at Vail
Mar 12-15, 2012, Vail, CO
Course directors: George M. Gura Jr, MD, Thomas Ryan, MD

NEW Cardiology in the Capital: Case-Based Clinical Decision Making
Apr 12-15, 2012, Washington, DC
Course directors: Heidi M. Connolly, MD, Bernard J. Gersh, MB, ChB, DPhil, Charanjit S. Rihal, MD

Echocardiography in the Nation's Capital: Focus for the Physician
Apr 16-18, 2012, Arlington, VA
Course directors: Fletcher A. Miller Jr, MD, Patricia A. Pellikka, MD, Sunil V. Mankad, MD

Echocardiography in the Nation's Capital: Focus for the Sonographer
Apr 19-21, 2012, Arlington, VA
Course directors: Barry L. Karon, MD, Fletcher A. Miller Jr, MD, Merri L. Bremer, RN, RDCS

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Echo Fiesta: An In-Depth Review of Adult Echocardiography for Sonographers and Physicians
May 10-12, 2012, San Antonio, TX
Course directors: William K. Freeman, MD, Fletcher A. Miller Jr, MD

Controversies in Cardiovascular Disease
May 19-20, 2012, Minneapolis, MN
Course directors: Kevin L. Greason, MD, Sunil V. Mankad, MD

American Society of Echocardiography Satellite Education Program
Jun 30-Jul 3, 2012, Washington, DC
Course directors: Naser M. Ammash, MD, Garvan Kane, MD

26th Annual Echocardiographic Symposium at Vail: New Technologies, Live Scanning, and Clinical Decision Making
Jul 23-26, 2012, Vail, CO
Course directors: George M. Gura Jr, MD, Fletcher A. Miller Jr, MD, Jae K. Oh, MD

Success With Heart Failure: Heart Failure for Clinical Practice
Aug 12-15, 2012, Tahoe, NV
Course directors: Barry A. Borlaug, MD, Brooks S. Edwards, MD, Barry L. Karon, MD

Other Education Opportunities

American College of Cardiology
Mar 24-27, 2012, Chicago, IL
Web site: www.accscientificsession.org

Heart Rhythm Society 33rd Annual Scientific Sessions
May 9-12, 2012, Boston, MA
Web site: www.hrsonline.org

American Heart Association
Nov 3-7, 2012, Los Angeles, CA
Web site: scientificsessions.americanheart.org