Multimodal Management of Atrial Fibrillation

The CardioVascular Thoracic Institute at Keck Medicine of USC offers a multimodal approach to treat patients with atrial fibrillation. At the CardioVascular Thoracic Institute (CVTI), teams of physicians and surgeons collaborate across specialties including electrophysiology, interventional cardiology, cardiothoracic surgery, pulmonary medicine, and cardiac radiology. We combine and stage procedures according to the needs of the patient to deliver the most effective care for their condition.

Advances in technology have yielded a broad range of tools to diagnose and monitor cardiovascular and arrhythmic conditions. The Center for Body Computing (CBC) at USC and the CardioVascular Thoracic Institute have a robust collaboration that has resulted in cardiac monitors in the form of wearable sensors, disposable monitors, implantable sensors and smartphone monitors with apps. These sensors are being used to monitor patients with atrial fibrillation who had a cryptogenic stroke. CBC is using the AliveCor smartphone sensor and a unique app developed to monitor patients with atrial fibrillation in the peri-ablation period. CBC and CVTI have also collaborated on studies for the CardioMEMS device, which measures pulmonary artery hemodynamics, and the left atrial pressure sensor (being investigated in the LAPTOP-HF trial).

CVTI is employing techniques to reduce the amount of radiation received by patients who are undergoing electrophysiologic tests and treatments, including catheter ablations for patients with atrial fibrillation, ventricular tachycardia and atrial flutter. Advanced 3-dimensional imaging technologies (cardiovascular computed tomography and cardiovascular magnetic resonance) are used at CVTI to diagnose anatomic substrates associated with electrophysiologic disease processes and guide therapeutic interventions.
MESSAGE FROM LEADERSHIP

Dear Colleague,

The field of cardiac electrophysiology involves the evaluation and treatment of cardiac arrhythmias. At USC, we have assembled an impressive group of national leaders in the treatment of arrhythmias. Most prevalent among these arrhythmias is atrial fibrillation which affects millions of Americans annually. When atrial fibrillation catheter ablation is an appropriate therapy, USC brings to bear the most talented group of ablation experts in Southern California with one of the largest volume clinical programs. The very latest in computerized mapping and ablation techniques are available at the Keck Medical Center of USC and are expertly applied.

An accompanying concern with atrial fibrillation is its propensity to increase the risk of stroke. Typically, reducing the risk for stroke requires anticoagulants but USC physicians are leaders in the application of a procedural technology obviating the need for life-long anticoagulation. In order to appropriately employ these technologies, the very best in cardiac imaging is required. USC has a robust program of cardiac imaging, including the latest CT scan and MRI hardware available.

When a patient’s cardiac condition requires a permanent pacemaker or implantable cardioverter defibrillator, USC physicians are leaders in the advancement of this technology. Conventional defibrillators and biventricular implants are performed with a high degree of expertise. USC has also been a pioneer in the clinical investigation of implantable defibrillators not requiring intracardiac leads. These can be especially useful in patients who are prone to infection. Similarly, a totally leadless intracardiac pacemaker can now be implanted inside the heart without any subcutaneous pacemaker required. These and other technological advances are only a small sample of the expertise in our electrophysiology program.

Cardiac electrophysiology perhaps best exemplifies the marriage of technology and clinical treatment of cardiovascular disease. We welcome the opportunity to partner with you in the care of your patients.

Ray V. Matthews, MD
Professor of Clinical Medicine
Chief, Cardiovascular Medicine
Keck School of Medicine of USC

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These modalities visualize cardiac and vascular structures important to cardiac electrophysiology, including the cardiac veins, coronary arteries, pulmonary veins, atrial appendage, atria and ventricles. Our comprehensive imaging creates individualized 3-D roadmaps that interventional cardiologists and cardiovascular surgeons use for virtual procedure planning as well as actual procedural facilitation. The integration of 3D imaging and mapping systems has allowed us to reduce the use of fluoroscopy at various stages of procedures and, in many instances, eliminate the use of fluoroscopy altogether. We have implanted pacemakers without the use of fluoroscopy in certain unique circumstances.

The CardioVascular Thoracic Institute has broad expertise and many approaches to treat patients with atrial fibrillation (afib). We individualize the treatment and management plan for each patient with afib using a variety of approaches. Our physicians also have expertise in treating adult patients with congenital heart disease (ACHD) who develop afib, a subgroup of patients with afib who don’t have many experienced medical centers at which to obtain treatment.

We treat patients with complex atrial fibrillation, including patients with advanced heart failure or cardiomyopathy. The range of therapies for patients with afib includes conservative management with antithyroid and antiarrhythmic pharmacotherapy. Through collaborations across multiple specialties at Keck Medicine of USC, we address the prevention and management of comorbid conditions. Keck Medicine of USC is developing a center of excellence focusing on arrhythmias and breathing disorders (particularly obstructive sleep apnea and chronic obstructive pulmonary disease).1,2 We offer state-of-the-art clinical care focused on a common cluster of diseases that are interconnected, using a multi-specialty approach that includes physicians from cardiology, pulmonology, sleep medicine and otolaryngology.

Catheter ablation has become an increasingly common procedure to treat patients with afib, with the goal of eliminating areas that initiate or maintain afib. Physicians at the CardioVascular Thoracic Institute perform 150 to 200 afib ablations each year. Catheter ablation offers superior results at eliminating afib than current pharmacotherapy.1,2 Some of the newest developments in catheter ablation for afib being employed at CVTI are 3-D electroanatomic mapping systems (see Figure 1) and contact force electrodes.

Patients with afib who have a need for cardiac pacing may be candidates for leadless pacemakers (see Technology Spotlight). Cryoballoon ablation for pulmonary vein isolation is another option to treat afib offered at CVTI.2

For patients with atrial fibrillation who are undergoing a cardiac surgical procedure for another indication, surgeons at the CVTI will surgically manage the patient’s afib at the same time. Several options exist for surgical management that include an epicardial or thoracoscopic ablation, ligation of the left atrial appendage or the Cox-Maze procedure. The Cox-Maze procedure requires a highly specialized skill set that CVTI surgeons possess.

Two devices have recently been investigated to close off the left atrial appendage (LAA), which is believed to be a source of blood clots in patients with non-valvular atrial fibrillation. The Watchman™ device is indicated in patients who are at risk for thromboembolic complications and who have a reason to seek out a non-pharmacologic solution to manage their afib. The Watchman™ device is deployed by catheter (see Figure 2). Patients receiving the Watchman™ device had fewer hemorrhagic strokes, cardiovascular/unexplained deaths and nonprocedural bleeding than patients receiving warfarin.1,2 Physicians at CVTI participated in the clinical trials for the Watchman™ device (PROTECT AF and PREVAIL). The LARIAT™ device is a suture delivery device that is used by some physicians to close off the LAA in patients with afib. Unlike other procedures or devices that close the LAA, the LARIAT device does not require anticoagulation after the procedure, so the LARIAT™ device can be used in patients who have an absolute contraindication to anticoagulation for any period of time.

USC CardioVascular Thoracic Institute: (213) 442-5849 cvti.KeckMedicine.org
The Adult Congenital Heart Disease (ACHD) program is deeply integrated with Keck Medicine’s cardiac and cardiothoracic surgical specialties that care for pediatric and adult patients, as well as other services that offer specialized and unique services to these patients including gastroenterology, hematology, nephrology and pulmonology. The program director is board certified in Adult Congenital Heart Disease Management within the American Board of Internal Medicine and works in close collaboration with The Heart Institute at Children’s Hospital Los Angeles.

The ACHD program offers novel and progressive ways to treat congenital heart disease (CHD) and associated adult-acquired cardiac conditions. Two cardiac surgeons at the CardioVascular Thoracic Institute have specialty training for surgical interventions to treat patients with CHD.

A highlight of the ACHD program at CVTI is the pediatric/adult transition program. The ACHD program director meets with young adult patients (18 to 21 years old) with CHD and their families in a monthly transition clinic at Children’s Hospital Los Angeles. The director reviews all of the patient’s medical records before an extensive clinic visit to discuss conditions, procedures, future outlook, and possible issues that require surveillance and follow-up. This transition program helps ensure that patients obtain suitable health insurance as well.

Patients with CHD require life-long individualized care with physicians who specialize in CHD and can recognize device closure of atrial septal defects, patent foramen ovale, ventricular septal defects and patent ductus arteriosus. We also offer transcatheter percutaneous pulmonary valve replacement and complex electrophysiology procedures including RF catheter ablation and implantable device therapies. Our goal is to keep radiation to a minimum and we offer reduced-radiation fluoroscopy and radiation-free procedures when possible.

Patients with CHD are a growing population of patients that require and benefit from implantable devices. However, abnormal cardiac anatomy, past surgical procedures, residual defects and uncorrected or absent vasculature may complicate or preclude standard device implantation. Novel device technology and alternative device implantation techniques can circumvent these limitations, enabling us to provide implantable device benefits to our patients.

We offer and implant the full spectrum of implantable cardiac devices in our ACHD patients. This includes devices such as the subcutaneous ICD, leadless pacemaker and cardiac resynchronization therapy devices. We also offer hybrid surgical/percutaneous implants that can combine intra- and extra-cardiac device hardware. In addition to comprehensive implantable device options, we also offer extraction services and expertise in treating patients who require removal of leads from the vasculature either due to lead malfunction, damage or infection.

Many patients with a single ventricle are now surviving into middle-aged adult life and new cardiac conditions are developing in this population that previously were not seen because of their experience across a broad range of cardiac conditions to apply new pacemakers and defibrillators for unique or unusual circumstances (see Case Study).

Recent developments in pacing and defibrillation have brought about new, all-in-one devices: leadless pacemakers and a subcutaneous implantable cardioverter-defibrillator (ICD). Leadless pacemakers are single chamber pacemakers that don’t contain wire leads as used in conventional pacemakers, which are prone to breakdown and more difficult to extract than the pacing device itself. These devices are indicated for patients with limited vascular access (possibly due to a history of multiple cardiac interventions), dialysis requirement for renal failure or a high risk of infection. A leadless pacemaker also has different implications for the patient’s level of physical activity and aesthetic needs than a traditional pacemaker.

The leadless pacemaker is placed directly into the right ventricular apex by catheter deployment (see Figure 4). Results of clinical studies show pacing capture thresholds and R-wave sensing amplitudes that were within a suitable range. Two leadless pacemakers, the Nanostim™ device and the Micra™ device, are approved for use in the European Union. The CVTI participated in clinical trials for the Nanostim™ device (St. Jude Medical) and can offer this device to patients through continued access.

The CardioVascular Thoracic Institute can tailor pacing and defibrillation therapy to the needs of the patient, including devices that can pace or monitor in one to three cardiac chambers. With the current and next-generation pacing and defibrillation devices, CVTI is changing the approach to device implantation and is expanding the population of patients who can be effectively managed with these devices. Our physicians and surgeons are using their experience across a broad range of cardiac conditions to apply new pacemakers and defibrillators for unique or unusual circumstances (see Case Study).

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CVTI is committed to providing patients leading edge procedures and devices to treat their cardiac electrophysiological conditions as appropriate.
CLINICAL TRIALS
Continued from page 1

used to characterize cardiovascular disease processes including clinical history, cardiovascular risk factors, electrocardiographic, echocardiographic, and anatomic/physiologic findings of other cardiovascular diagnostic studies in patients with electrophysiology or structural heart disease.

The STAR-VT trial is examining the role of the ReStarAB™ ablation catheter system as it compares to routine drug therapy to reduce ventricular tachycardia (NCT01107865). An NAc-sponsored clinical trial is evaluating the outcomes of catheter ablation for persistent a fibrillation with the ethanol infusion through the vein of Marshall. It is added to the standard pulmonary vein antral isolation (PVA) procedure (NCT01168821).

Multiple studies are underway in the fields of pacing and defibrillation. The ENHANCE CRT study is examining the effect of implant location for left ventricular pacing leads in patients with non-left bundle branch block heart failure who are receiving cardiac resynchronization therapy (NCT01528933). The NAVIGATE X4 study is evaluating two new pacing and defibrillation leads (NCT02701173).

Physicians at CVTI are still involved in continued access to the Nanostim leadless pacemaker that was evaluated in the LEADLESS II pacemaker study (NCT02081341). EFFORTLESS is a post-market registry examining the clinical effectiveness of the subcutaneous ICD system in patients with ventricular tachycardia (NCT01845435). Quad PACE is a post-market study examining the acute and chronic performance of a quadrapolar CRT-D device (NCT01559919).

An investigator-initiated, retrospective clinical trial is examining the minimum energy required for successful defibrillation of induced ventricular fibrillation in patients with chronic kidney disease (stage III or higher) or end-stage renal disease. The study will also examine modifications that can effectively lower the defibrillation threshold in these patients.

The Center For Body Computing used a smartphone-enabled ECG device (AliveCor) to monitor heart rhythms in the general adult public. CRC enrolled over 17,500 participants. At an interim analysis of half of the population in May 2015, atrial fibrillation was detected in 53 unique subjects (from the 86%).

For more information on any of the clinical trials or to inquire about enrolling a patient, please contact Melissa Minor, RN (323) 442-7983 or Melissa.Minor@med.usc.edu.

CASE STUDY
A 35-year-old male was referred to the CardioVascular Thoracic Institute with a challenging combination of congenital complete heart block and Hansen’s disease (leprosy). While the heart block required permanent pacemaker support, the patient experienced significant morbidity related to recurrent breakdown and infection of the pacemaker pocket site secondary to the extreme skin fragility that resulted from Hansen’s disease. These infectious complications required the complete removal of pacemaker generators, transvenous leads and epicardial pacing systems. These components were subsequently reimplanted at alternate sites, but suffered the same complications (see Figure 5). The complications dramatically affected the patient’s life, resulting in his inability to maintain consistent work, a tremendous financial burden and a substantial impact on his family life because of frequent hospitalizations and procedures.

After his last epicardial pacemaker was compromised, our team explored the option of implanting a leadless pacemaker, which theoretically had the advantage of providing permanent pacing support without the involvement of any materials implanted under the skin or within the vasculature. Given that the device is investigational and that the indication for implantation in this patient’s case differed from the conventional criteria, CVTI physicians obtained approval for compassionate use of the leadless pacemaker from the US Food and Drug Administration and the device manufacturer. The leadless pacemaker was implanted into the patient’s right ventricle without complication.

Excellent device function was noted at the time of implant as well as throughout subsequent follow-up, now extending to 18 months.

Since the leadless device was implanted, he has had no hospitalizations or urgent care visits for pacemaker infections as he repeatedly had in the past. The patient has returned to work full-time and is enjoying a full life.

References