A Year of Remarkable Growth
Nassir F. Marrouche, MD, FHRS
CARMA Center Executive Director

Four years ago, when I came to the University of Utah to direct the atrial fibrillation program, I saw great potential to build upon the excellent resources provided by the University’s interdisciplinary approach. Since then we have formed a world-class team at the CARMA Center that is leading the fight against atrial fibrillation.

This past year was a banner year for the CARMA Center. We treat patients from around the world and our labs teach us more about atrial fibrillation every day. In addition, we are participating in a variety of studies, including leading the international DECAAF study, which will help answer many questions about atrial fibrillation. We are also making our mark in Utah. We have started outreach and education efforts that will help the community better understand and prevent the disease.

With your help, and with the support of industry partners, former and current patients, and the community at large we can cure atrial fibrillation. This journey has been extraordinary, and I assure you
Joseph Albergo, Hawaii
Joseph Albergo, 65, is an avid sports fan. However, after his triple bypass surgery in 2002, he contracted atrial fibrillation and had significant trouble maintaining and slowing his heart rate. After consistently battling the disease, and being subjected to years of poor quality of life, Joseph’s cardiologist told him about the CARMA Center and the work of Dr. Nassir Marrouche.

Joseph and his cardiologist traveled to Utah together in 2007, and Joseph was treated by Dr. Marrouche the day after the Super Bowl. Since the procedure, Joseph has regained his active lifestyle. He is now going to the gym several times a week, running a couple of miles each day, and playing basketball and racquetball.

In Joseph’s own words, “Lots of the guys at the gym had ablations at our local hospital and they’ve had to go back for second and third procedures. I’m feeling great and just want to say thanks again to Dr. Marrouche and all the nice people at the University of Utah.”

“After my ablation procedure, I awoke to the most beautiful sound in the world – the rhythmic beating of my heart.”

Don Winder, Utah
At age 56, Don Winder was stunned when he was diagnosed with atrial fibrillation. He had been racing road bicycles for 18 years to maintain his health. Unfortunately for Don, like many others, he did not realize the older male athletes are five times more likely that non-athletes to develop atrial fibrillation.

After years of deteriorating quality of life, at age 61, Don attended a presentation given by Dr. Marrouche at the Salt Lake Rotary Club. After the presentation Don scheduled an appointment and Dr. Marrouche determined he was a good candidate for ablation. Since his ablation Don feels “great,” and he said, “after my ablation procedure, I awoke to the most beautiful sound in the world - the rhythmic beating of my heart.”
Mary Watkins, Utah
Mary Watkins, 62, suffered with atrial fibrillation for more than a decade. Originally, Mary’s physician diagnosed her racing heart as panic attacks. However, as her episodes increased in length and became more frequent, she was finally diagnosed correctly with atrial fibrillation. After her condition worsened, Mary elected to have an ablation. Like many, Mary’s life has improved greatly since her procedure at the University of Utah in 2009. “Since I had my ablation last April, my heart hasn’t raced one time. I have the highest respect and love for Dr. Marrouche and his team.”

Michelle Straube, Utah
Unlike most atrial fibrillation patients, Michelle Straube, 55, developed atrial fibrillation when she was very young. Michelle developed an irregular heart beat in her twenties, and for 30 years various physicians told her that she was not a good candidate for an ablation. That was until she discovered Dr. Marrouche and the CARMA Center.

Dr. Marrouche told Michelle something she’d never heard before. After examining her cell tissue and assessing her condition, he said, “I think I can fix you.” Since her procedure, Michelle’s quality of life has improved tremendously. “Now I don’t have to take the drugs I’ve been taking for more than 10 years and I can ride my bike to work for the first time in 15 years. I told my daughter that we’ll both be participating in the University’s 5K race to benefit atrial fibrillation even if we have to shuffle most of the way. The day I had my procedure (November 12, 2009) is a date I will celebrate all my life.”
Mission, Vision & Values

**Mission**
To redefine the management of atrial fibrillation through a unique interdisciplinary program of basic and clinical research focused on the understanding, diagnosis, and clinical treatment of atrial fibrillation.

**Vision**
The CARMA Center is a multifaceted and comprehensive program, in collaboration with our research partners, seeking to further develop the technology, research, and clinical management leading to the advancement of superior, world-class medical treatment of atrial arrhythmias.

**Values**
Research: The CARMA Center will lead the initiative to overcome the major obstacles in the evaluation and successful treatment and management of atrial fibrillation.

Teaching: Sharing the creation of new technology and understanding of arrhythmias with Academic partners, students, residents, fellows and physicians is the ideal mechanism to change improve current arrhythmia management techniques.

Partnership: Collaboration with other disciplines is integral to the success of our mission to combine the knowledge and expertise required to move technology forward and advance our understanding of the diagnosis and treatment of atrial fibrillation.
Atrial Fibrillation Quick Facts

Atrial Fibrillation Basics

Atrial fibrillation (AF) is a heart rhythm disorder (arrhythmia), involving a rapid heart rate, in which the upper heart chambers (atria) are stimulated to contract in a disorganized and abnormal manner. The abnormal heart rhythm increases the likelihood that blood will pool and/or clots will form -- making AF the leading cause of stroke.

Prevalence

• More than 5 million Americans have AF and its prevalence increases with age.
• In patients 80 and older, almost nine cases out of 100 have the disease.
• AF accounts for one-third of hospital admissions for cardiac rhythm disturbances, and the rate of admissions for atrial fibrillation has risen in recent years.

Risks

AF’s most serious risk occurs when blood clots form. If blood clots break off into the bloodstream, they can cause stroke. As a result, the disease:
• Increases the risk of stroke five times,
• Triples the risk of heart failure, and
• Doubles the risk of mortality.

Stress, smoking and heavy drinking, obesity and a range of illnesses also increase the risks of developing the condition and reduce treatment options.

Symptoms

Common symptoms include:
• Palpitations and heart pounding
• Lightheadedness
• Fainting
• Headaches
• Shortness of breath
• Weariness or exercise intolerance
• Chest pain
• Shortness of breath
• Some with AF, however, may not experience any symptoms.

Atrial Fibrillation Causes

In atrial fibrillation, arrhythmias (irregular heart beats) are caused by a disruption of the normal functioning of the electrical conduction system of the heart. The electrical impulses that are normally generated by the sinoatrial node are replaced by disorganized activity, leading to irregular conduction of impulses to the ventricles that generate the heartbeat. This results in ineffective and uncoordinated atria contractions, which lead to an irregular (and usually fast) pulse.

Other causes include heart and lung disorders such as coronary artery disease, rheumatic heart disease, mitral valve disorders, pericarditis, and others. Recent research suggests susceptibility to AF may be inherited in some cases. It also may be caused by factors unrelated to the heart including medications, metabolic diseases, substances in the environment, diet and stress.

Diagnosing Atrial Fibrillation

The fleeting nature of arrhythmias makes it difficult to actually capture an event during any single test. It may be necessary to monitor the heart over time. At times specialists provoke abnormal rhythms in a safe environment in order to evaluate and diagnose a problem. Electrophysiologists can also conduct special tests to determine if non-specific symptoms are related to problems in the heart’s electrical conduction system or other types of heart disease.

The most commonly used diagnostic tests include:
• Electrocardiogram (ECG/EKG)
• Electrophysiology Study
• Echocardiogram
• Holter Monitor
• Event Recorder
• Tilt Table Test
Atrial Fibrillation Treatment

Conventional Treatment Options

Until the last decade, anti-arrhythmic drugs and cardioversion have been the primary atrial fibrillation (AF) treatment options.

Anti-arrhythmic drugs control the heart rate and are often used in combination. They effectively restore a normal rhythm about 50 to 60 percent of the time and are very toxic.

Until now, Cardioversion has been the treatment of choice to stop atrial fibrillation. During cardioversion the patient undergoes a brief anesthesia-induced sleep. While the patient is asleep, an electrical discharge is administered to the their chest. In the majority of cases, the electrical discharge stops AF and resumes normal heart rhythm.

Cardioversion is safe and effective when performed by experienced physicians. However, the procedure may dislodge newly-formed blood clots from the heart and precipitate stroke. Cardioversion’s greatest drawback is its reliance on anti-arrhythmic drugs. Many patient’s AF returns if they do not take drugs regularly, and only about half of those who do will achieve good control of their AF after one year.

However, the CARMA Center is charting a new course and much of the work being done at CARMA is changing treatment options for atrial fibrillation.
Over the past 15 years, physicians cured many forms of cardiac arrhythmias using ablation, a procedure where a patient’s heart arrhythmia is mapped, localized and then destroyed (i.e., ablated). Ablation applies radiofrequency energy to the abnormal area, rendering it electrically inactive.

This technique, however, has been extremely difficult to use in AF cases in which the electrical abnormalities are much more generalized, essentially encompassing most of the left and right upper heart chambers. A newer, more complex technique involves ablating groups of cells with radiofrequency energy near the openings of the four pulmonary veins where AF is thought to originate. An energy emitting electrode is placed into the heart through a catheter inserted into veins in the groin or neck. Electrodes are also placed in the catheter that can detect electrical activity from inside the heart. An electrophysiologist uses these to “map” the heart in order to locate the abnormal electrical activity before eliminating the responsible tissue.

The risks of catheter ablation of AF are widely variable, due to differences in the electrophysiologist’s experience, techniques and technical proficiency. The American College of Cardiology, as well as four other major American and European doctors’ groups, recommend atrial ablation as standard care for patients who do not respond to drug therapy. In addition, new approaches show great promise in facilitating AF treatment before, during and after ablation procedures.

Dr. Nassir Marrouche has successfully used MRI imaging modalities as a precise, pre-procedure diagnostic tool to visually demonstrate AF’s progression and location. He also has conducted studies in animals to monitor the effects of radiofrequency ablation on heart tissue during a procedure and to assess scars and other collateral damage within 24 hours after a procedure is completed.
Financial Summary

Fiscal Year Income Totals

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2010 Revenue Allocation

- Education: $923,258.80
- Research: $1,051.12
- Development: $500,863.52
Highlights

Research
• Managed eight IRB approved research projects, which are currently active.

• Served as the primary U.S. research site for the CASTLE-AF clinical trial based in Germany.

• Acted as the primary research site for the DECAFF study, which includes multiple sites from the United States, Europe and Australia.

Publications and Presentations
• Published seven articles in peer-reviewed journals.

• Presented 42 abstracts, papers and posters at national and international conferences.

Education and Outreach
• Hosted the Western Atrial Fibrillation Symposium and the Heart Rhythm Society Satellite Symposium titled “Coming to Consensus: Defining New Treatment & Management Options for Atrial Fibrillation,” which both doubled in attendance over the previous year.

• Began community outreach events including “The Heart of the Matter” presentation and screening and “Healing the Heart” a University of Utah Health Sciences Advocates lecture.
Ongoing Studies

AAD
Primary Site: University of Utah
Description: This study compares the differences in regular early recurrence of atrial fibrillation to recurrences of atrial fibrillation in patients using antiarrhythmic drug therapy during the first eight weeks following pulmonary vein isolation.

Body Surface Mapping
Primary Site: University of Utah
Description: This study aims to determine a way to use a 32 Lead EKG to map the heart through noninvasive procedures.

CASTLE-AF
Primary US Site: University of Utah
Description: This is a prospective randomized trial of post ICD patients. Upon enrollment, patients are placed into the conventional (medication) or surgical (ablation) arms of the study. Patients are followed for at least five years and data is collected in Utah and then analyzed by the primary study site in Germany.

DECAAF: DE-MRI
Primary Site: University of Utah
Description: This international study seeks to expand and improve Delayed-Enhancement MRI (DE-MRI) image acquisition and processing for atrial fibrillation management.

FMRI: Functional Magnetic Resonance Imaging
Primary Site: University of Utah
Description: FMRI studies the nervous system and the role, and to what degree, it plays in atrial fibrillation.

LA Fibrosis: Characterization of Left Atrial Wall Tissue by Delayed Enhancement Magnetic Resonance Imaging
Primary Site: University of Utah
Description: Aims to characterize left atrial fibrosis in a normal population and in patients with atrial fibrillation. The data will be help determine whether there is an identifiable MRI phenotype that predicts atrial fibrillation development.

RADAR
Primary Site: University of Utah
Description: Strives to evaluate the impact of pre-ablation fibrosis on scar formation and progression in the left atrium of the heart as assessed by DE-MRI of patients who have undergone successful open irrigated cooled-tipped radiofrequency ablation of paroxysmal atrial fibrillation.

Real-time MRI Mapping
Primary Site: University of Utah
Description: Using animal experiments, this study, a main focus of the CARMA Center, attempts to find a way to utilize MRI in ablation procedures.
AFIS, which stands for Atrial Fibrillation Information System, is a prospective collaborative data collection trial with the goal of assessing factors related to atrial fibrillation across the nation and eventually internationally. Data will be collected in Utah using the system developed by eCardio Diagnostics.

CorView

CorView is a segmentation, analysis and quantification system that will give CARMA’s segmentation team better tools when analyzing hearts of atrial fibrillation patients. The software will allow more detailed and accurate views of the heart. The software will also bring together several tools into one system -- providing for a more streamlined and efficient approach for users.
Publications


Presentations

American College of Cardiology


Presentations

Heart Rhythm Society


3. Lori McMullan, MD, Gaston Vergara, MD, Thomas S. Haslam, No Degree, Nathan S. Burgon, BS, Eugene Kholmovski, PhD, Christopher J. McGann, MD, Gangadhar Malasana, MD and Nassir F. Marrouche, MD. Comprehensive Arrhythmia Research and Management Center, University of Utah, Salt Lake City, UT. (5/14/2010). Acute Abolition of Local Endocardial Left Atrial Electrograms Post Atrial Fibrillation Ablation Does Not Correlate with Appropriate or Transmural Lesion Formation as Detected Using Delayed-Enhancement MRI. Poster session presented at Heart Rhythm Society Scientific Sessions 2010, Denver.


European Society of Congress


American Heart Association


Third Annual Western Atrial Fibrillation

This year marked the Third Annual Western Atrial Fibrillation Symposium (WAF) in Park City, UT. The WAF was codirected by Nassir F. Marrouche, MD and Mohamed H. Hamdan, MD, and featured presentations from an impressive array of national and international leaders in the field of Atrial Fibrillation.

The WAF Symposium serves to:
1. Explain the mechanisms of atrial fibrillation
2. Recognize the relationship between atrial fibrillation and heart failure
3. Define appropriate treatment options for each atrial fibrillation patient
4. Apply new treatment options for atrial fibrillation.

Heart Rhythm Society (HRS): Satellite Symposium


The symposium strives to:
1. Review and update of the HRS Consensus Statement and how it has changed.
2. Address the knowledge gap regarding the updated Ambulatory Cardiac Monitoring Guidelines.
3. Develop a strategy of how to use the Atrial Fibrillation Information System (AFIS) to manage atrial fibrillation patients.
4. Assess acute and long term success of ablation treatment for atrial fibrillation.
Community Outreach

The Heart of the Matter

On May 19, 2010, the CARMA Center hosted its first community awareness event in conjunction with StopAfib.org, which more than 150 attended. Hosted at the Salt Lake City Public Library, the event attracted more than 150 people interested in learning more about atrial fibrillation. Dr. Nassir Marrouche and Mellanie True Hills, Founder & CEO of StopAfib.org, presented the group with information on the patient experience, research breakthroughs and new atrial fibrillation treatment options.

The Heart of the Matter was the inaugural event in what will be many awareness events in the CARMA Center’s future.

Healing the Heart

In partnership with the University of Utah Health Sciences Advocates program, the CARMA Center presented “Healing the Heart” on April 29, 2010.

The event was held at University Hospital and showed attendees how the CARMA Center pioneered the use of MRI technology for cardiac purposes. Following the presentation by Dr. Nassir Marrouche guests were treated to a tour of the University of Utah’s EP (MRI) lab -- the only one of its kind in North America.
Future Projects

**A few words from CARMA team members concerning upcoming developments in research and imaging.**

We have seen some exciting developments in basic cardiac arrhythmia research at CARMA this year. Going forward, my work will be focused on investigating the causes and treatment options for atrial fibrillation (AF) and ventricular fibrillation (VF).

AF is the most common cardiac arrhythmia. It affects millions of people directly and causes an enormous financial burden on the health care system. Despite an increase in treatment options and significant research into the causes of AF, there are many unanswered questions about the factors that lead to AF. We have initiated the Utah Collaborative Atrial-fibrillation Project (UCAP) to investigate the development of the substrate that leads to AF. CARMA, in collaboration with other institutes at the University of Utah, has partnered with Utah State University to develop a long-term model of AF. We will induce AF in test subjects and study changes in the heart structure and electrophysiology as AF progresses. This project will help us to understand the factors that lead to AF and to develop more effective treatment options for patients with AF. This unique resource will place the University of Utah at the forefront of AF research.

VF is a cardiac arrhythmia that is almost always fatal if a patient does not receive treatment within a few minutes of VF onset. Our recent work has shown that specialized cells responsible for spreading cardiac contractions throughout the heart called Purkinje fibers may play a critical role in VF onset and propagation. Soon we will map out the electrical impulses in the Purkinje fibers during VF and attempt to alter VF with drugs or pacing targeting the Purkinje fibers.
Future Projects

In the coming year, the CARMA image processing research and development team will continue to research improved methodologies for MRI-based staging of atrial fibrillation (AF). We will focus on three key areas: automatic LA segmentation, more sensitive and statistically-based classification algorithms and improved 3D image visualization. Our upcoming Spring 2011 release of CorView, clinical software for processing and analysis of 3D MRI cardiac image data, will provide a research platform through which to quickly deploy and test many of these new ideas. In January 2011, we will also begin a research collaboration with the NIH-funded National Alliance for Medical Image Computing, with support for investigation of new methodologies for automated left atrium (LA) segmentation.

Another exciting area of research that will continue in 2011 is the statistical analysis of the shape of the left atrium in AFib patients. Studies show that as AF progresses there is a significant increase in LA volume correlated with structural and electrical remodeling of LA tissue. While volume changes have been observed, there has been little analysis of LA shape, which could provide insight into the mechanisms behind AF. To investigate possible clinical applications for shape variation in the treatment of atrial fibrillation, we have constructed statistical shape models from structural MRI of left atria to quantify statistically-significant morphological differences between atrial fibrillation patient populations. Further research in this area may lead to an image based means of evaluation of the progression of AF, and allow for rapid and efficient means of monitoring patients and refining treatment options.
Acknowledgements

Thank You

We would like to express our sincerest thanks to the individuals, industry partners and academic institutions that provide both financials and administrative support that allow us to conduct vital research and help redefine the management of atrial fibrillation.

A very special thanks to our many expert colleges at UCAIR and SCI who are critical to the work at the CARMA Center and who assist with researching, publishing and teaching cutted-edge atrial fibrillation techniques and technologies.

Institutions

University of Utah, School of Medicine
University of Utah Health Sciences Center
Cardiovascular Research & Technology Institute
Utah Center for Advanced Imaging Research
Scientific Computing and Imaging Institute
Heart Rhythm Society

Industry Partners and Collaborators

Biosense Webster, Inc.
   Biotronik
Boston Scientific Corporation
   Cardionet
eCardio Diagnostics
   Medtronic
Sanofi-Aventis
   Siemens
St. Jude Medical
   StopAfib.org
Surgi-Vision
   TZ Medical
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