



Feature Article

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milestone **200<sup>TH</sup>**  
heart transplant p.10

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Advanced treatments for chronic total  
occlusions of the coronary arteries p.16



## José L. Navia, MD, FACC

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S. Donald Sussman Distinguished Chair  
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Dear Colleagues,

In December 2021, Cleveland Clinic Florida's Transplant Center team performed a lifesaving heart transplant operation for the 200th time. We are extremely proud of this milestone, which signifies that our caregivers are fulfilling a need in helping some of the most critically ill patients in South Florida, the Caribbean and Latin America. Since our heart transplant program was established in 2014, it has grown exponentially into the robust center it is today, rated among the top five centers in the country according to the Scientific Registry of Transplant Recipients. To read more about the program, see the article that starts on page 10.

Meanwhile, we are making progress and advancements in other areas of heart and vascular care as well. Our interventional cardiologists at Weston Hospital have been successfully performing revascularization procedures on patients with chronic total occlusions – an extremely difficult form of coronary artery disease to treat. Our team is one of the few that has the expertise to perform these complex procedures, which give patients a minimally invasive option for restoring blood flow – see page 16 for details. And our interventional cardiologists at Indian River Hospital have implemented an algorithm that allows for timely diagnosis and treatment of ischemic stroke in patients with patent foramen ovale (PFO). Our interventionists can close the atrial defect via an outpatient procedure in the cath lab in order to reduce the risk of a second stroke by 50 to 70%. PFO closure is the standard of care for patients with cryptogenic stroke, particularly in patients 65 years or younger. For more on this, see page 6.

The vascular medicine department at Cleveland Clinic Florida is growing as well. Now the largest department of its kind in the Southeast United States, we offer a comprehensive array of services for all vascular conditions, including rare types such as fibromuscular dysplasia. To read more about what we are doing in this specialty area, read the articles on pages 4 and 18.

We hope you enjoy this issue of *Cardiac Care*, our first of 2022. We welcome the opportunity to partner with you on specialized care for your patients.

Respectfully,

A handwritten signature in blue ink, appearing to read "José L. Navia".

José L. Navia, MD, FACC

*Cardiac Care* is produced by Cleveland Clinic Florida’s Heart, Vascular and Thoracic Institute.

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Cleveland Clinic Florida’s Weston Hospital has once again earned the top spot as the #1 hospital in the Miami-Fort Lauderdale metro area for 2021-2022, according to the annual ranking of Best Hospitals by *U.S. News & World Report*. It is the fourth consecutive year Cleveland Clinic Weston Hospital has earned the top ranking, the only hospital to be ranked #1 for four straight years in South Florida.

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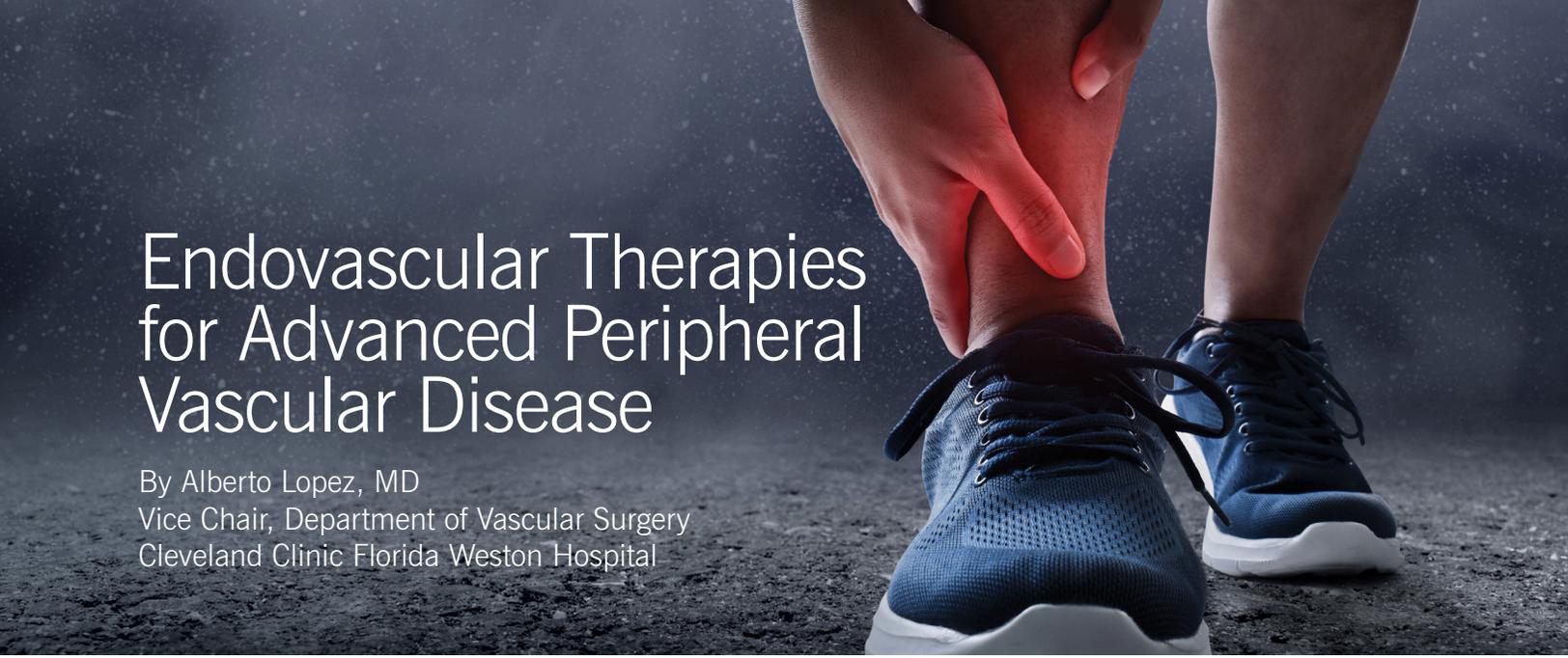
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# Endovascular Therapies for Advanced Peripheral Vascular Disease

By Alberto Lopez, MD  
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In the developed world, peripheral artery disease (PAD) affects about 5.3% of 45 to 50-year-olds and 18.6% of 85 to 90-year-olds. Severe PAD may include critical limb ischemia and gangrene. Critical limb ischemia occurs when there is severe obstruction to blood flow in the artery and it can lead to pain at rest and a feeling of cold or numbness in the affected foot and toes. After a trial of the best medical treatment, if symptoms persist, patients may be referred to a vascular or endovascular surgeon for revascularization procedures that will improve blood flow to the affected extremity.

The benefit of revascularization is thought to correspond to the severity of ischemia, and treatment may utilize open surgical methods or an endovascular approach.

A 64-year-old male patient presented at Cleveland Clinic Florida Weston Hospital with excruciating pain in the right leg. He had a long-standing history of PAD and had undergone a right femoral-popliteal bypass using autologous saphenous veins eight years prior in Berlin. This patient was very active in his younger years. Despite being a smoker, he was an avid skier, runner and cyclist. After open surgery in Germany, he quit smoking and resumed his active lifestyle for some time. One year before he was seen at Weston Hospital he noticed he was having pain with ambulation. His extensive research to find a program that would provide evidence-based medicine with the latest technology and the best quality of care led him to Cleveland Clinic Florida.

## Diagnosis

He was initially seen with symptoms of pain after walking one block, which was very limiting. Noninvasive studies demonstrated a severe PAD with an ankle-brachial index of 0.4 on his pulse volume recordings with flattened waveforms below the knee. An initial angiogram confirmed occlusion of the arterial bypass performed eight

years ago (Figure 1A), and the patient underwent a three-month trial of optimal medical management with anticoagulation, antiplatelet and statin therapy, without significant relief of symptoms.

## Intervention

An endovascular surgical intervention was performed at Weston Hospital in mid-2021 where his native arterial system that had been occluded for many years was opened using antegrade and retrograde approaches to open his vessels. Postoperative recovery was uneventful, and within one month the patient began running on the treadmill and riding his bike. We continued with optimal medical management. Within a few months he was back to the activities from his younger years, and because of his persistent exercise regimen, even improved the blood flow and symptoms of the contralateral untreated leg, with a dramatic improvement in his quality of life. He is very grateful for the specialized service he was given at Weston Hospital and will continue to be proactive in his health by leading a healthy and active lifestyle.

## National Leaders

The experts in Cleveland Clinic Florida's Department of Vascular Surgery are national leaders in treating aneurismal disease of the thoracic and abdominal aorta, occlusive disease in the cerebrovascular circulation via both open and endovascular methods, and in minimally invasive treatments for venous disease. We are highly experienced in treating a broad spectrum of vascular diseases.

Working as a team with cardiologists and radiologists in the Department of Vascular Medicine, we provide comprehensive services for all types of peripheral vascular disorders, including catheter-based intervention as well as traditional surgical treatment. Due to our extensive experience in endovascular repair of abdominal aortic aneurysms, we can treat approximately 60% of aneurysms through endovascular repair.

We serve as a major referral center for reoperative surgery and other difficult cases. Should you be looking for a partner in the care of your patients, please contact us at 954.659.5230.

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Figure 1A: Initial angiogram

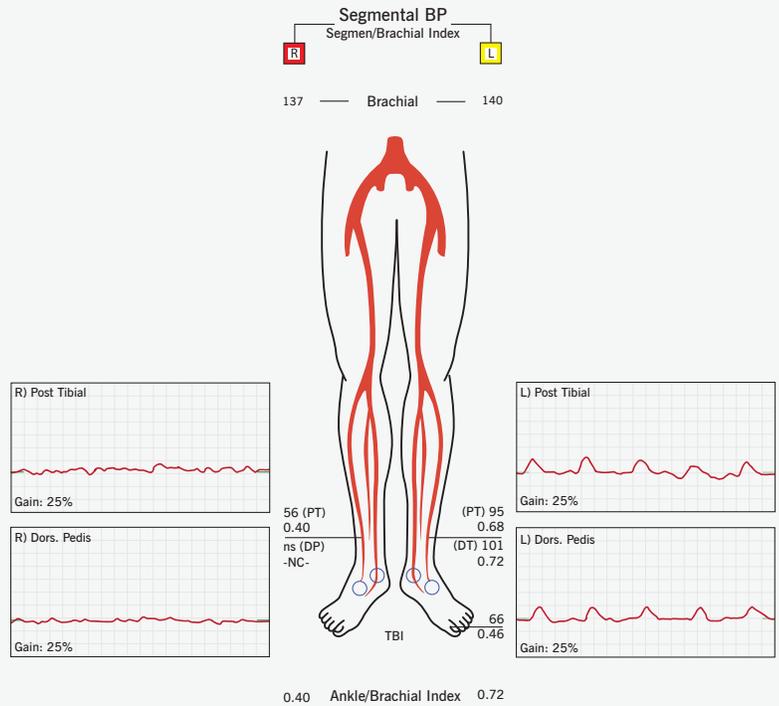
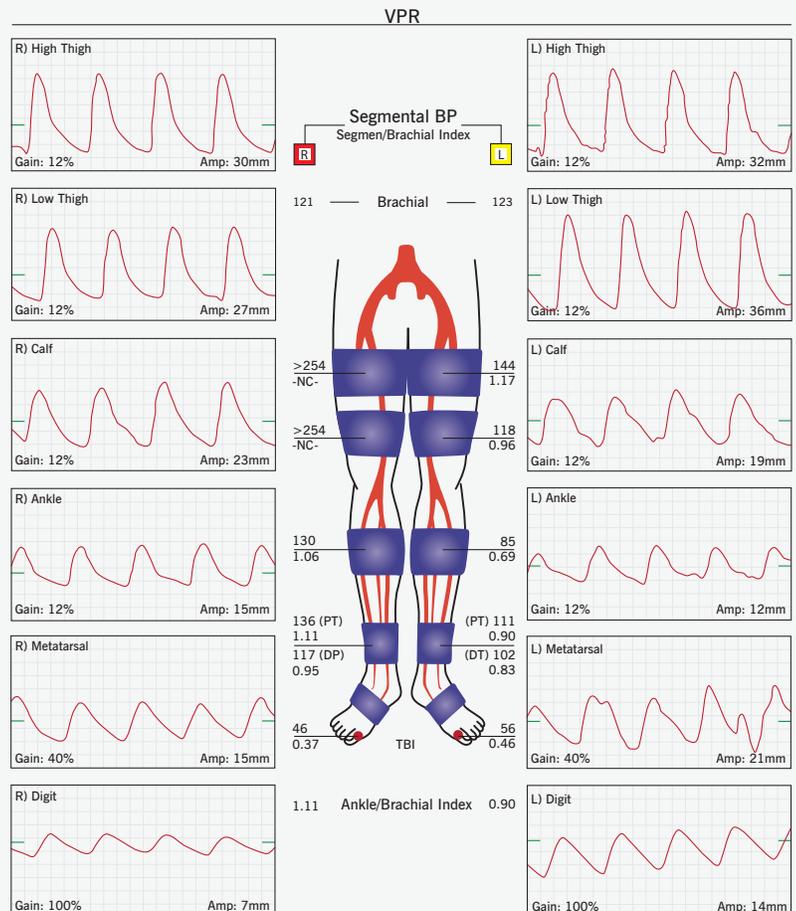


Figure 1B: Post angiogram





# Percutaneous Closure of Patent Foramen Ovale

By Carlos Gonzalez Lengua, MD  
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Patent foramen ovale (PFO) is the most common congenital lesion, found in 25-30% of the adult general population. PFO is an orifice within the septum secundum that forms a flap-like valve with the septum primum. While in utero, the foramen ovale allows the oxygenated blood to bypass the lungs, crossing from the right atrium to the left atrium. Immediately after birth, due to several changes in intracardiac pressures, the blood flow across the PFO ceases and the flap-like valve closes. At about 2 years of age, in the majority of people, a complete fuse of the interatrial septum occurs. However, in about 20-30% of the general population, the foramen ovale fails to close permanently. In general, this is considered a benign and incidental

finding when it is not associated with any symptoms, such as ischemic stroke of unclear etiology, also known as “cryptogenic stroke.”

Cryptogenic stroke is defined as an embolic stroke that fails to reveal a clear etiology after a comprehensive work-up. It accounts for one in three (35%) ischemic strokes, affecting more than 240,000 patients every year in the United States. The work-up includes a prolonged heart rhythm monitor to rule out atrial fibrillation, aortic arch, neck and brain vessels evaluation to rule out atherosclerotic plaques, lower extremity ultrasound to rule out deep venous thrombosis and hypercoagulation studies.

When cryptogenic stroke is diagnosed, current medical guidelines

recommend a close evaluation of the left atrial appendage to rule out thrombus, as well as investigation for intracardiac shunts with a transesophageal echocardiogram. In patients 65 years or younger with cryptogenic stroke and PFO there is a clear benefit to closing the atrial defect to prevent a second stroke. This is supported by high-quality clinical data from multiple randomized clinical trials that suggest a clear benefit to PFO closure along with medical therapy vs. medical therapy alone in this subset of patients.

Our dedicated multidisciplinary team at Cleveland Clinic Indian River Hospital has implemented an algorithm that allows for timely diagnosis and treatment of ischemic stroke in patients with PFO (Figure 1).

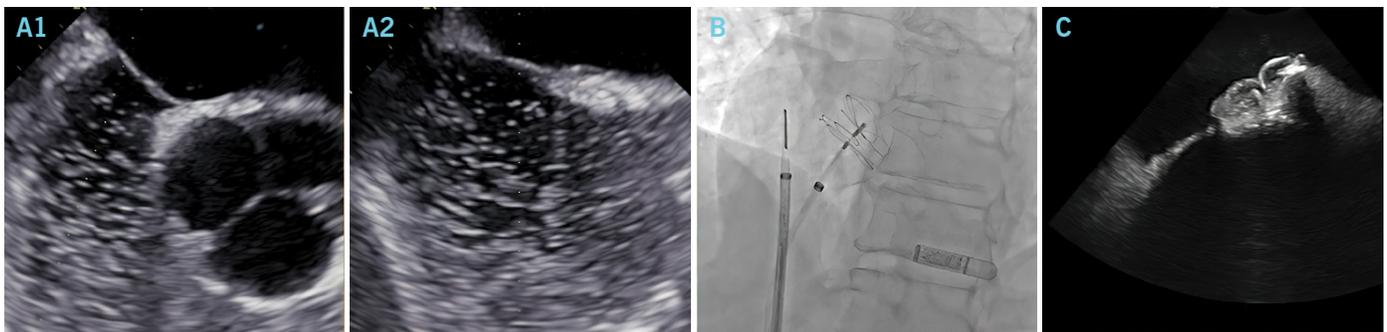


Figure 1: A1 and A2 Transesophageal echocardiogram with bubble study, showing PFO with right to left shunt. B) Fluoroscopy showing an intracardiac echocardiogram catheter and a PFO occluder device during a procedure. C) Intracardiac echocardiogram images showing the PFO closure device after deployment.

At this time there are two commercially available FDA-approved devices in the United States that offer excellent results and safety profile, **reducing the risk of stroke by 50-70%** when compared with medical therapy alone.

At Cleveland Clinic Indian River Hospital, this procedure is done in the cardiac catheterization laboratory under conscious sedation, guided by intracardiac echocardiogram and fluoroscopy (Figure 2). The procedure has an excellent safety profile. The average procedural time is 45-60 minutes, and patients are usually discharged home the same day with early outpatient follow-up. A follow-up echocardiogram is needed to ensure proper closure of the PFO. Patients remain on dual antiplatelet therapy for six months, with only a single antiplatelet after that when the device is endothelialized with a low risk of causing embolic events.

PFO closure has evolved over the past several decades and now occupies a role as a standard of care for patients with cryptogenic stroke. Recently, Cleveland Clinic Indian River Hospital was certified as a comprehensive stroke center. Having a PFO closure program further expands the services we can offer to our community.

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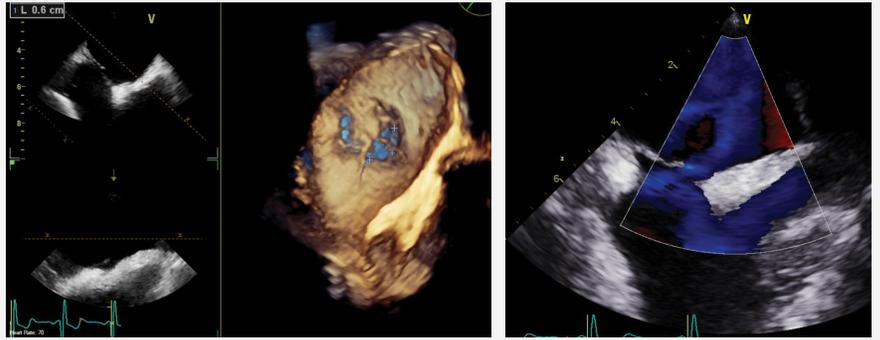


Figure 2: A) Transesophageal echocardiogram showing a 3D reconstruction of a large patent foramen ovale.

B) Transesophageal echocardiogram showing a color doppler demonstration of a left to right shunt from a large patent foramen ovale.

## Cleveland Clinic Indian River Hospital algorithm for the diagnosis and treatment of ischemic stroke in patient with patent foramen ovale

**AGE <65 YEARS, ISCHEMIC STROKE AND PFO**

**Large neck and thorax; Artery atherosclerosis  
Cardioembolic source; Brain small vessel disease; Hypercoagulable disorder**

NO

YES

**Rule out atrial fibrillation (>30 days cardiac rhythm monitor)**

**Medical Treatment**

NO

**PFO closure + medical treatment**

# Advances in the Treatment of Atrial Fibrillation

By John Bibawy, MD  
Section of Electrophysiology  
Cleveland Clinic Florida Weston Hospital

Atrial fibrillation (AF) is the most common arrhythmia in the world. As our population ages, more people are being diagnosed with it each year. It has taken a significant toll on our healthcare system and, despite advances in cardiac expertise and procedures, many clinicians still treat their patients conservatively. New ablation strategies have significantly improved quality of life, risk of stroke and cardiovascular-related mortality. Additionally, left atrial appendage closure devices have decreased the need for long-term anticoagulants in intolerant patients. These medical advancements have made it easier and safer to treat AF patients, and cardiac electrophysiologists have taken the lead in these efforts.

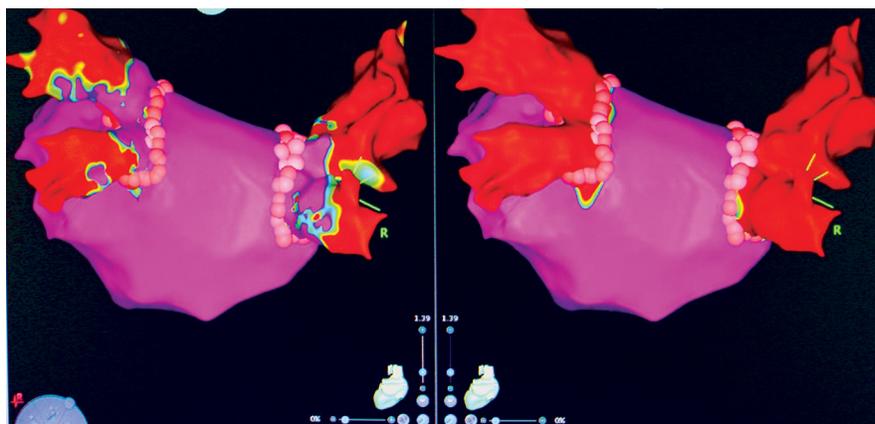
The prevalence of AF has increased three-fold in the past 50 years, with a projected 6 to 16 million individuals expected to develop AF by the year 2050. Although the causes of AF vary from long-standing hypertension to untreated sleep apnea to cardiovascular diseases, among many others, the common denominator is age. We note a significant increase in prevalence of AF after the age of

65, with an almost logarithmic rise to patients 85 years old and above.

Under-diagnosis and inadequate treatment is frequent. Emergency room and office visits for AF have increased, with some patients presenting with heart failure or stroke. There is a five-time increased risk of heart failure and strokes, and a two-time increased risk of cardiovascular mortality in untreated patients with AF. Delayed diagnosis and treatment also leads to more difficult-to-treat patients with a direct association with cardiac atrial remodeling.

## Various Treatments for AF

Treatment of AF has been debated for a number of years amongst experts. Many clinicians employ the “rate vs. rhythm” control strategy. Success rates of cardioversion and anti-arrhythmic drug therapy only show a 45-65% long-term success with high recurrence rates and compliance issues. Recent publications and advancements in ablation therapy show that the early ablation strategy with rhythm control yields better overall outcomes and improved



*Image 1: AF ablation, voltage map, posterior anatomical view: Left atrial pulmonary vein isolation using Biosense Webster Carto Prime. Red dots are ablation lesions around the pulmonary veins as they enter the left atrium. Pre- and post images are shown revealing electrical isolation of the pulmonary veins, as indicated by the transition from purple (electrical activity) to red (no electrical activity) in the electrical map.*

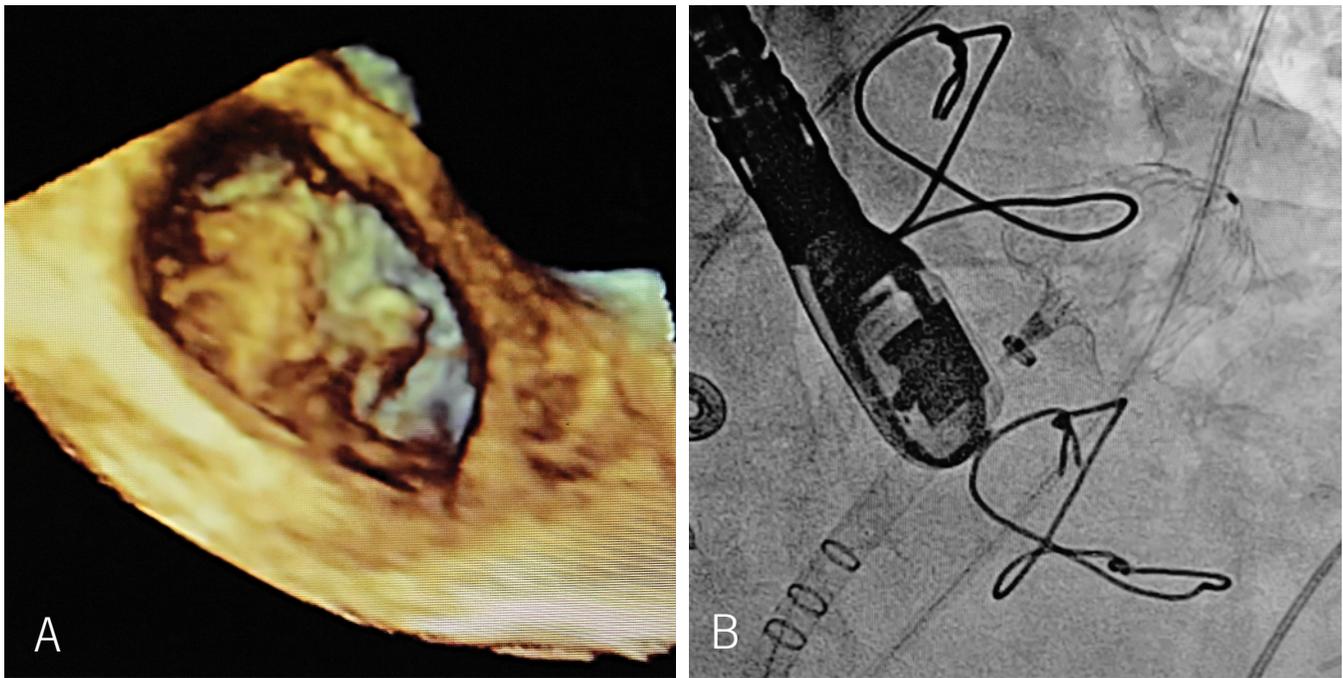


Image 2: A. Transesophageal echocardiogram in 3D view at a 45-degree angle with a view of an implanted WATCHMAN in the left atrial appendage. B. Fluoroscopic image of a deployed WATCHMAN in an RAO/Caudal view.

symptoms. Success in ablation is usually between 75-80% at a three-year assessment, with noted improvement in quality of life, reduction in cardiovascular-related mortality and significant reductions in stroke.

Flouro-less approaches with RF ablation (Image 1) are now being used at Cleveland Clinic Florida, and these cases take 45 minutes to 1 hour. With these decreased lab times,

Ablation strategies also have improved over the course of the last few years. The two mainstay ablation strategies are radiofrequency (RF) ablation and balloon cryo-ablation. These procedures have decreased lab times from 6 hours to 1-2 hours.

patients can anticipate a 6-8 hour stay with same-day discharge.

Most patients say ablation therapy has “changed their life,” with many of them being able to return to their normal routines and activities. Some patients with significantly reduced ejection fractions have experienced full recovery. A recent publication had shown mortality benefit in a subset of patients with heart failure who underwent ablation therapy. Another advantage is being able to decrease or discontinue rate-controlling medications or antiarrhythmic drugs.

Left atrial appendage (LAA) closure with a transvenous WATCHMAN™ device (Image 2) or surgical AtriClip® also has decreased the need for long-term anticoagulants in intolerant patients despite a high CHADSVASc score.

## Cardiac Electrophysiology Offers Improved Treatments

Advances in cardiac electrophysiology have played a major role in improving patient care with regards to outcomes and quality of life when treating AF. Ablation therapy has shown to be superior to conservative therapy, and with improved techniques and decreased procedural time, current medical practice should shift gears into pursuing ablation for our patients. LAA closure devices also offer an alternative to long-term anticoagulation and should be offered to patients who have an intolerance and are at risk of stroke. Consultation with an electrophysiologist early in diagnosis is preferred and ultimately leads to better patient care.

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# Two Hundred Heart Transplants at Cleveland Clinic Florida

By Cedric Sheffield, MD  
 Director, Heart Transplant Program  
 Cleveland Clinic Florida Weston Hospital

Cleveland Clinic Florida established the Heart Transplant Program in late 2014 with a goal to provide access to heart transplant services for advanced heart failure patients in South Florida. With a population of more than 6 million people and only one low-volume center in the area offering heart transplant services, there was a significant need in the region to increase access to these lifesaving procedures for a largely underserved population. The program has grown exponentially over the past 7 years, having completed our 200th heart transplant in December 2021 (Figure 1).

According to the United Network for Organ Sharing (UNOS) database, 147 heart transplants were

performed by existing South Florida centers in 2014. That number grew by 78% to a total of 263 heart transplants performed in 2021. This was accomplished in spite of the challenges presented by the COVID-19 pandemic. Our program has consistently performed around 45 heart transplants a year, ranking it among the three largest programs in the state.

Our dedicated multidisciplinary team of caregivers is committed to helping patients with advanced heart failure and collaborates on a daily basis to expedite work-up, listing and access to organ donors, resulting in one of the shortest waitlisting times in the country. Median time from listing to receiving a heart transplant in

our program is about 1.5 months, in contrast to regional and national median waiting times of 5.8 and 5.5 months, respectively. A strong focus on quality has resulted in our program being rated among the top 5 centers in the country, according to Scientific Registry of Transplant Recipients (SRTR) reports.

We have been focused on expediting patient care, including access for the initial visit in the outpatient clinic, expeditious hospital-to-hospital transfer for sicker patients, as well as thorough evaluation and support of these patients. An early adaptation of the program to the heart allocation score implemented by UNOS in October 2018 resulted in more than 50% of patients currently receiving heart transplants being admitted to the hospital and frequently requiring the assistance of a short-term mechanical circulatory support device. As reflected in the most recent report by SRTR, chances to receive an organ transplant for patients listed at Cleveland Clinic Florida are 2.5 times higher than the national average (Figure 2). Quite often our team goes the extra mile, with more than 80% of patients receiving organs imported from other donor service areas (Figure 3).

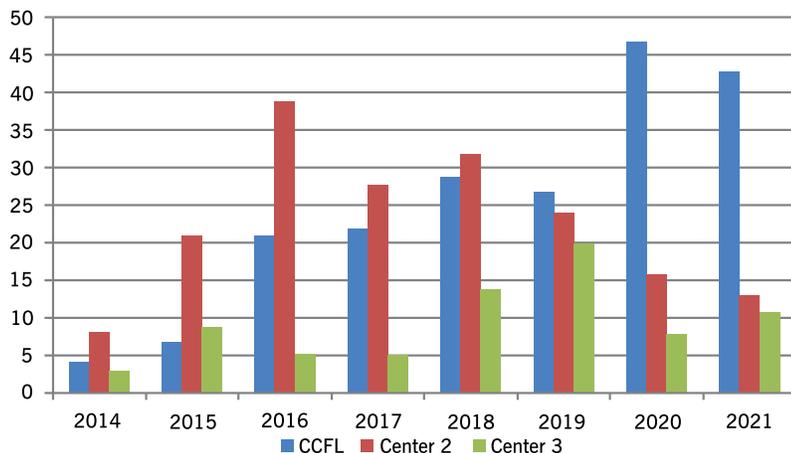


Figure 1: The bar graph shows number of heart transplants performed every year in South Florida, revealing the progressive increase in volume at Cleveland Clinic Florida (blue bars) facilitating access to local population to this lifesaving therapy.

**Offer acceptance: Donor more than 500 miles away**

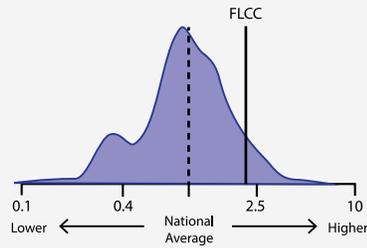


Figure 2: Our team travels over 500 miles to recover hearts for transplantation double the miles of most transplant teams in the country.

**Offer acceptance: Overall**

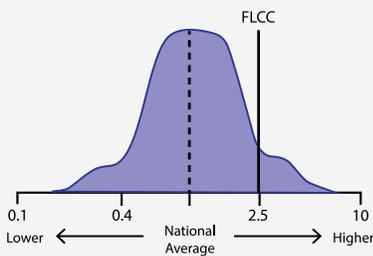


Figure 3: Patients listed at CCFL are 2.5 times more likely to receive a heart transplant than national average.

The strong collaboration of our multidisciplinary team on optimizing each patient's condition in anticipation of surgery, as well as the postoperative recovery of heart transplant patients, results in most patients being discharged on average 14 days after transplant, which is 4 days below the national average of 18 days.

## A program tailored to address the needs of South Florida region: Going the extra yard

The Heart Transplant Program at Cleveland Clinic Florida provides a lifesaving therapy to the growing population of South Florida, tailored to the particular demographics of the region. A strong collaboration across specialties supports the provision of services tailored to the needs of our patients, including heart transplantation for patients in cardiogenic shock supported with temporary mechanical circulatory support devices, elderly patients with advanced heart failure, patients with severe obesity, and patients requiring combined heart and kidney transplantation.

The population of South Florida continues to grow at a rapid pace, surpassing 21.5 million people in 2021, with more than 20% over 65 years old. The incidence of heart failure increases with age, and these patients may present multiple comorbidities, resulting in only 17% of patients listed for heart transplantation in the age group over 65 across the country. In contrast to chronologic age, we focus on age among other biologic

factors when assessing a patient for heart transplantation, and patients over 65 represent nearly 27% of patients listed for heart transplant at Cleveland Clinic Florida.

The population of patients with severe obesity (BMI > 35) and advanced heart failure are another group of patients drawing increasing attention. They have a complex situation in which one pathology prevents the surgery to treat the other pathology. We have developed innovative approaches to treat these patients, performing bariatric surgery while assisting the failing heart with mechanical circulatory support, in order to facilitate weight loss and listing patients for heart transplantation.

Finally, collaboration with the Kidney Transplant Program has resulted in an increasing number of patients receiving combined heart and kidney transplant as we have learned this strategy provides the best long-term outcome for patients with kidney failure requiring a heart transplant.

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**CELEBRATING  
HEART  
TRANSPLANT  
MILESTONE**

**Thank you to the donors and exceptional healthcare teams that help sustain life.**

# A Celebration of the Cleveland Clinic Florida Heart Transplant Program and the Cleveland Clinic Transplant Enterprise

By Charles Miller, MD  
Enterprise Director of Transplantation  
Cleveland Clinic



We are pleased to highlight a milestone achievement, the celebration of the 200th heart transplant operation at Cleveland Clinic Florida, which

took place on Dec. 17, 2021, just 6 1/2 years after the inception of the transplant program here.

The history of transplantation at Cleveland Clinic Foundation dates back to 1967 when Dr. Ralph Straffon and his colleagues performed an initial series of cadaveric donor kidney transplants on patients with end-stage kidney disease. This was followed in 1968 by the first heart transplant, which was performed by Dr. Rene Favaloro and his colleagues. Advances in the field of immunology and immunosuppressive therapies allowed for the development of transplant programs in the 1980s, and the heart transplant program was officially established in 1984,

performing more than 2,000 heart transplants in nearly 40 years. Even more remarkable is the excellent survival that has been achieved in the modern era with heart transplants. Cleveland Clinic's long-term outcomes exceed those of other programs in the country. We continue to devote efforts to further improving outcomes and support of patients who are not candidates and, instead, receive left ventricular assist devices, an operation that has also come into its own for excellent outcomes to provide support for patients with advanced heart failure. This background of medical expertise and experience was paramount to support the development of transplant service lines across the enterprise.

The Heart Transplant Program at Cleveland Clinic Florida started operations in 2014 and established an extremely high-tech, quaternary service in what was then a 125-bed hospital. Support was made available from the Cleveland Clinic Main Campus program when needed, but the lion's share of the

effort, strategy and developmental work was really home-grown. The core multidisciplinary team of surgeons, cardiologists and nurses provide high-quality outcomes and a great patient experience.

In 2017, the Transplant Enterprise was established. A first step at organization was to hold a retreat for all of the transplant stakeholders from Weston, Abu Dhabi and Cleveland; the Florida teams were all present and eager to participate. The purpose was to explore and define our Transplant Enterprise's vision and mission and how we would follow our core values of quality and safety, teamwork and innovation to help each other succeed. The core values that guide our daily operations highlight the importance of teamwork, diversity, inclusion and innovation to provide the highest quality and safest transplant services.

The retreat allowed for the initiation of a shared culture of transplantation across the Cleveland Clinic global footprint and an enhanced ability

**VISION:** To be the global leader in saving and restoring lives through transplantation

**MISSION:** To create a global approach to honor the gift of life by providing the highest quality transplant care, research and education

## CORE VALUES:

QUALITY & SAFETY

EMPATHY

TEAMWORK

INTEGRITY

INCLUSION

INNOVATION



to share ideas, policies, strategies, struggles and achievements. In addition, through enhanced cross-credentialing throughout the enterprise, staff and administrative personnel could help deliver care at the various sites when the need arose. The enterprise concept also enhanced opportunities for patients to optimize their chances to receive an organ, especially a heart, due to various supply/demand imbalances in the country. The Florida-based team has always been most gracious working with the team in Cleveland to enhance organ opportunities for patients across the hospital system.

The Cleveland Clinic Transplant Enterprise has evolved into a comprehensive, global, innovative service line, providing a full range of care for patients with end-stage organ failure and related diseases. The COVID-19 pandemic has presented many challenges to transplantation. One silver lining has been our enterprise approach to providing the safest care for our patients. Using various virtual platforms, the leaders of all the programs have met regularly to share our best practices, opportunities and struggles. This

enhanced level of communication has been a great advancement, not just related to COVID-19 practices, but to many other areas of quality and strategic approaches. We have now launched formal organ-specific alliance teams of leaders on each campus to allow for convergence of practices where appropriate or to allow for divergent practices due to local customs or practical limitations and to then analyze how these different practices may affect outcomes. The transplant programs are interconnected in a complex matrix resembling a neural network in which experience and ideas move back and forth seamlessly, supporting the application of best practices at every location. In other words, we share our best ideas and learn from each other.

The field of solid organ transplantation is ever-evolving as we strive to support our patients with increased access to lifesaving therapies, and our caregivers are at the forefront of innovation, adopting new strategies such as the use of organs from DCD donors (donation after circulatory death), employing devices for ex-vivo organ perfusion

that allow further assessment of organ function before proceeding with transplantation, performing multi-organ transplantation, and exploring the latest concepts in transplantation, such as transplant of the uterus in childbearing-age women with uterine factor infertility, and facial transplantation as an effective solution for patients with extensive facial disfigurement when autologous approaches fail in restoring optimal facial form and function.

As we celebrate 200 heart transplants at Cleveland Clinic Florida it is important to recognize the grit and determination the care team has to do the right things for patients through every phase of their transplantation journey. The team's dedication to the "intention to treat" longitudinal care paradigm has truly produced the highest quality care for all those in need and is what makes this program so special.

---

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# Reconditioning Patients on Circulatory Support Devices Awaiting Heart Transplant

By Kyle Magley, DPT  
Cleveland Clinic Florida Weston Hospital

Changes in the UNOS allocation score in late 2018 to optimize allocation of donor hearts and decrease waitlist mortality resulted in more than half of patients having to be hospitalized in an intensive care unit before getting their lifesaving operation. Many of these patients are admitted for cardiogenic shock for being refractory to medical therapy and require additional support with various short-term mechanical circulatory support devices that help stabilize them until a suitable donor heart becomes available.

The intra-aortic balloon pump (IABP) and transvalvular axial flow pumps (Impella) are the most frequently used devices, and have historically been inserted into the groin, requiring patients to remain in bed for prolonged periods of time, which leads to further physical deconditioning. The broad adoption of axillary artery approach for insertion of these devices in recent years has improved the possibilities of therapy for these patients. With this approach, they are now able to get out of bed and ambulate as they await the transplant operation.

Rehabilitation for a large portion of patients with Impellas or IABPs is only part of the therapy required. “Prehabilitation” is also crucial for patients connected to these circulatory support devices. The focus of therapy should be to optimize physical conditioning of these patients in anticipation of their transplant.

A great amount of work is done for these patients as we prepare them

for surgery and recovery. This work is methodical, the formula is tried-and-true and can be best described as a stepwise approach.

For the most deconditioned patients – those who are more or less bed-bound and are possibly obtunded or agitated – we have a focus of overall engagement and participation. Only when patients actively partake in therapy can therapy improve. Following their enhanced engagement, we can work on their extremity strength and tolerance to positional changes. Strengthening is typically carried out with active-assisted range of motion or active range of motion therapeutic exercise with the patient in a supine or reclined position. Therapy focused on positional changes and rectifying their displaced equilibrium from extended supine positioning is typically carried out by sitting edge-of-bed with assistance or following a passive lift transfer from the hospital bed to a medical grade recliner.

A crucial note here, however, is that once you begin to move the patient, the logistics of line management become paramount. These patients typically have more life-sustaining lines than the average surgical ICU patient and are supported by a machine (or two) that provides hemodynamic stability, requiring a team of caregivers to assist in mobilizing them. The typical therapist-nurse combination frequently requires a third or fourth caregiver to ensure the patient, lines and devices remain intact over the course of the therapy session.

As the patient regains strength, balance and confidence during the initial session at the bedside or within the patient’s room, the sessions will progress to hallway ambulation. For physicians and surgeons, ambulation is the most significant metric demonstrating patient improvement. It reflects an overall improvement in the patient’s condition prior to the transplant operation, which results in enhanced postoperative recovery.

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*Patient supported on temporary ventricular assist device awaiting heart transplant, participating in physical therapy session.*



# Cardiac Xenotransplantation

By Nicolas Brozzi, MD, FACC  
Surgical Director, Mechanical Circulatory Support Program  
Director, Cardiovascular Research  
Cleveland Clinic Florida Weston Hospital

Dr. Christiaan Barnard, a cardiac surgeon from South Africa, performed the first human-to-human heart transplant in 1967. Since then, advances in our understanding of transplant immunology and the development of immunosuppressive drugs has resulted in heart transplantation becoming the standard-of-care treatment for patients with advanced heart failure. However, access to this therapy continues to be limited by the scarcity of human donors.

News of a human patient receiving a heart transplant from a non-human donor shocked the press and medical community alike earlier this year. The operation, performed by Bartley P. Griffith, MD, and colleagues at the University of Maryland Medical Center (UMMC), was enabled by decades of basic and translational research in the field of immunology and transplantation.

Xenotransplantation – the transplantation of organs between different species – is a concept that dates back to 1964 when Dr. James Hardy, of the University of Mississippi Medical School, performed a heart transplant from a chimpanzee to a human patient, which eventually did not succeed due to acute rejection in the operating room. Dr. Keith Reemtsma, of Tulane University at the time, made several attempts at transplanting kidneys from chimpanzees to humans in 1963 and 1964. At that time, human organs were not available and

chronic dialysis was not yet in use. Thomas Starzl, MD, PhD, attempted the first chimpanzee-to-human liver transplantation in 1966.

Genetic engineering technologies have led to the production of pigs with various traits that prevent cross-species immune response, which has resulted in increasing xenograft survival in nonhuman primate transplant models.

Extensive research in the past decades has been focused on addressing the three major hurdles of xenotransplantation: innate and adaptive immune responses, interspecies incompatibilities and molecular interactions involving the complement and coagulation pathways, and the risk of infection. Porcine hearts present striking similarities to human hearts in terms of size, structure and function that make them suitable for xenotransplantation. A few research groups have employed CRISPR-Cas9 genome editing technology in recent years to develop swine strains with organs that are less likely to be attacked by the human immune system and to disable more than 60 pig genes encoded for porcine endogenous retrovirus in order to prevent risk of transmission to human recipients.

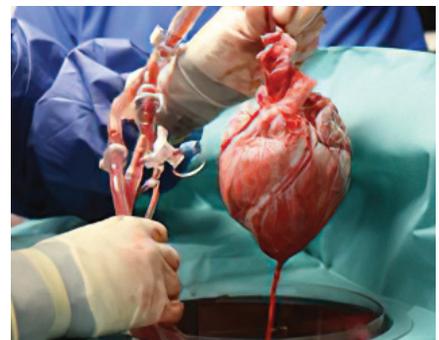
On January 7, Mr. David Bennett became the first human to receive a porcine heart. This 57-year-old man had been admitted to UMMC in refractory cardiogenic shock, requiring

ECMO support for more than two months. He presented with a very particular social background including non-compliance that precluded him from getting on a heart transplant waiting list after evaluation by multiple heart transplant programs. In this context, the FDA approved the operation that was performed at UMMC. Early xenograft function has been good, allowing for discontinuation of ECMO support within 48 hours and adequate recovery of the patient in the initial weeks after the operation.

Xenotransplantation has the promise of an unlimited supply of readily available and optimally functioning organs. The initial early success of this first cardiac xenotransplantation is an important step forward to further research in the field aimed at understanding mid- and long-term physiologic consequences of the procedure.

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*Credit: University of Maryland School of Medicine*

# Advanced Treatments for Chronic Total Occlusions of Coronary Arteries

By Kenneth Fromkin, MD, FACC, FSCAI  
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Cleveland Clinic Florida Weston Hospital



Chronic total occlusions (CTOs) represent perhaps the most difficult subset of coronary artery disease to address in the cath lab. A CTO, defined as a coronary artery which has been blocked for more than 90 days, is extremely difficult to cross and to open in the cath lab. It is only within the past decade or so that interventional cardiologists and other industry professionals have developed new techniques and equipment to allow revascularization of these difficult blockages. Due to the complexities of addressing this subset of lesions and the need for familiarity with the latest techniques and equipment to approach them, patients with CTOs generally are referred to

centers with special expertise in them. Cleveland Clinic Florida Weston Hospital is such a center.

CTOs are present in 20-45% of patients undergoing coronary angiography. While many of these CTOs represent previous infarctions, others do not. A substantial percentage of patients with CTOs are found to have significantly sized territories of myocardium that remain alive via an alternative blood supply known as collateral circulation. While this collateral circulation is sufficient to keep these heart territories alive, it is very rarely sufficient to adequately supply these territories with blood under conditions of stress or exertion. In many patients, this leads to chronic

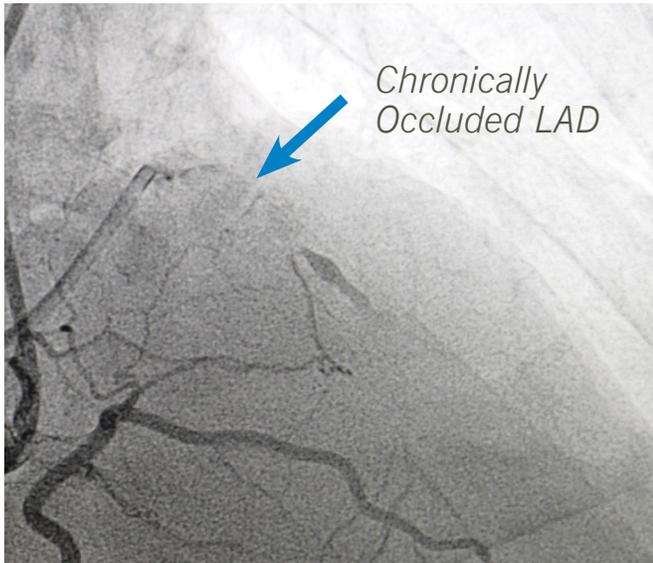
angina. In other patients, despite the lack of traditional anginal symptoms, cardiac testing often identifies significantly sized territories of heart muscle that remain alive beyond the CTO.

## Patients with Chronic Total Occlusion

Patients with CTOs who also experience chronic anginal symptoms despite medical therapy are excellent candidates for CTO interventions. Carefully selected patients who are identified to have significantly sized territories of living myocardium are also often candidates for a CTO intervention procedure on a carefully vetted case-by-case basis.

Prior to the mid 2000s, it was the general consensus in the field that CTOs were very rarely able to be successfully intervened upon in the cardiac cath lab. For a long time, such patients were relegated to medical therapy alone or perhaps to bypass surgery.

More recently, and with steady growth, techniques and equipment have been developed and refined to allow successful crossing and



*Before: Left Anterior Descending (LAD) is chronically occluded and is seen to partially fill via right to left collaterals.*



*After: LAD now widely patent and stented with brisk forward flow.*



revascularization of CTOs in specialized centers of expertise. CTO procedures are more complex than traditional percutaneous coronary intervention (PCI) procedures. They take longer, usually require dual sites for access, and have a success rate of 80-90% as compared to 99% for traditional PCIs. Nonetheless, this represents a substantial advancement over prior treatment options.

In the antegrade CTO technique, various wires and devices are slowly advanced forward to get across the area of blockage. Sometimes these devices succeed in crossing but find themselves within different layers of the coronary artery, requiring a secondary technique of re-entry to be able to restore complete forward flow to the entire artery. In the retrograde technique, wires are inserted through the collateral circulation and work their way backwards to cross the blockage from the other side of the occlusion.

With knowledge of these techniques and of the specialized equipment necessary to successfully perform these revascularization procedures, we at Cleveland Clinic Weston Hospital have had great success in addressing this most difficult subset of coronary artery disease.

With knowledge of these techniques and access to the specialized equipment necessary to successfully perform these revascularization procedures, we at Cleveland Clinic Weston Hospital have had great success in addressing this most difficult subset of coronary artery disease.

For the right patient, CTO intervention represents an excellent and minimally invasive option to restore brisk blood supply to still living areas of heart muscle, and often alleviates chronic angina in a group of patients who may have thought they could not be helped any further.

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# Fulfilling the Need for Specialists in Vascular Medicine

By Jason Wheeler, MD  
Department of Vascular Medicine  
Cleveland Clinic Florida Weston Hospital

Cleveland Clinic has been a leader in vascular medicine since establishing one of the first departments for the specialty in 1947. At that time only a few other hospitals had a dedicated vascular medicine program. Today, Cleveland Clinic in Ohio has the largest vascular medicine department in the country, and most major cardiovascular centers have or plan to start similar departments.

Cleveland Clinic Florida Weston Hospital's vascular medicine department is now the largest in the Southeast United States, filling the need in our region. Our board-certified physicians have the expertise to manage complex vascular conditions including common but poorly understood high-risk venous and arterial disorders, such as deep vein thrombosis, pulmonary embolism and peripheral arterial disease (PAD). Few physicians know that PAD patients actually have a higher risk of stroke and heart attack than any other group, including those with previous stroke or heart attack. Further, few know that pulmonary embolism is

the third most common cause of cardiovascular death.

Rare vascular conditions like fibromuscular dysplasia, and lymphatic vessel conditions like lymphedema or its mimic – lipedema – are routinely managed at Weston Hospital. Many of the world leaders in the treatment of these disorders either trained at or still practice at Cleveland Clinic. While many generalists and specialists treat these conditions, the in-depth details of risk stratification, the breadth of treatment options, hypercoagulability and genetic testing, and use of novel blood thinners are rapidly expanding with each new clinical trial, necessitating advanced training and experience to provide the best care.

Our department serves as a referral center for a wide variety of hereditary thromboembolic disease and rare pathologies related to vasospastic, aneurysmal, inflammatory and noninflammatory vascular disease.

Our noninvasive vascular laboratory provides services for inpatient and outpatient testing and has

been consistently recognized with accreditation by the Intersocietal Commission for the Accreditation of Vascular Laboratories. Our outpatient anticoagulation program provides strict monitoring of patients with complicated vascular disorders that result in recurrent thrombosis and bleeding events. We also provide an outpatient clinic with same-day access for urgent evaluations and treatment of patients with all types of vascular problems, including acute venous thrombosis diagnosed in the outpatient noninvasive vascular laboratory.

The vascular medicine department at Weston Hospital offers a team of interventional and noninterventional specialists in a single high-resource clinic, all in one location, making communication between cardiovascular caregivers much more effective.

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# New Staff

To refer a patient to one of our Heart, Vascular and Thoracic Institute specialists, please call 877.463.2010.

## Cleveland Clinic Florida Heart, Vascular and Thoracic Institute Welcomes the Following New Staff Members



### Sophia Bampoh, MD

Sophia Bampoh, MD, recently joined the staff of the Vascular Medicine Department at Cleveland Clinic Florida Weston Hospital. Dr. Bampoh completed her residency in internal medicine in 2020 and fellowship training in vascular medicine in 2021, both at Vanderbilt University Medical Center in Nashville. She earned her medical degree from the

Geisel School of Medicine at Dartmouth in New Hampshire in 2017. During her fellowship training, Dr. Bampoh gained expertise in performing and interpreting the full range of noninvasive vascular diagnostic tests including Doppler ultrasonography, Duplex ultrasonography, and ABI. She is skilled in interpretation of axial vascular imaging (MR and CT arteriography imaging).

Dr. Bampoh has participated in many volunteer community service programs, including health literacy and screening outreach programs in rural Ghana. She has several years of research experience, including 18 months spent as a research assistant in the Cardiovascular Institute at Beth Israel Deaconess Medical Center in Boston.

She is board-certified in internal medicine and board eligible in vascular medicine. Her clinical interests include fibromuscular dysplasia, aortic aneurysms, peripheral arterial disease, DVT, pulmonary embolism, venous insufficiency and lymphedema.

*To reach Dr. Bampoh, call 954.659.5230.*



### Kushal Handa, MD

Kushal Handa, MD, recently joined the Cardiovascular Medicine Department at Cleveland Clinic Florida Weston Hospital. Prior to joining Cleveland Clinic Florida, Dr. Handa practiced at the Sanger Heart and Vascular Institute, Atrium Health (formerly Carolinas HealthCare System), in Monroe, N.C.

Dr. Handa received his medical degree from Charing Cross and Westminster Medical School (now Imperial College of Medicine) in London in 1986. He completed fellowship training in cardiology at Mount Sinai Medical Center in New York in 1994. He completed fellowship training in electrophysiology at the University of Wisconsin in 1997.

Dr. Handa has held numerous leadership positions, notably as Chief of Cardiology and Director of the Intensive Care Unit at the VA Medical Center in Fargo, N.D., and Chief of Cardiology, Southern Region, at the University of North Dakota School of Medicine, where he was also a clinical associate professor of medicine. He was director of echocardiography at Meritcare Healthcare System in Fargo. Dr. Handa was Chief of Cardiology at Union Hospital in Monroe, N.C., and Director of the Southeast Region for Sanger Heart and Vascular Services.

Dr. Handa has held several teaching positions and is a prolific researcher. He is board-certified in internal medicine, cardiovascular medicine and nuclear cardiology.

*To reach Dr. Handa, call 954.659.5290.*

## Research Fellows



### Rene Aleman, MD

Rene Aleman, MD, joined Cleveland Clinic Florida's Heart Vascular and Thoracic Institute as a clinical research fellow in June 2021. Prior to this appointment, he

had worked as a clinical research fellow for the Cleveland Clinic Florida Bariatric and Metabolic Institute since 2017.

Dr. Aleman received his medical degree from Universidad Francisco Marroquin in Guatemala in 2016. His current projects include: The robotic cardiothoracic surgical experience: A systematic review of current applications; A retrospective analysis of the National Inpatient Sample database: Incidence in concomitant heart failure and morbid obesity; Robotic fluorescent guided surgery for lung sentinel lymph node mapping; and Lymph node cryotherapy harvesting.



### Sinal Patel

Sinal K. Patel, MD, began work as a clinical research fellow in the Cleveland Clinic Florida Heart Vascular and Thoracic Institute in July 2021.

Dr. Patel transitioned from clinical research fellow in the Department of General Surgery at Cleveland Clinic Florida leading research studies minimally invasive surgery. Her research is currently focused on cardio-oncology, ECMO support for patients with severe lung failure due to COVID-19, and rehabilitation of patients awaiting heart transplantation on mechanical circulatory support.

## Heart, Vascular and Thoracic Institute at Cleveland Clinic Florida

Patients from across the United States, Latin America and the Caribbean turn to Cleveland Clinic Florida's Heart, Vascular and Thoracic Institute for life-saving treatment options. Physicians are subspecialty trained in a number of areas and provide compassionate heart care that is second to none.

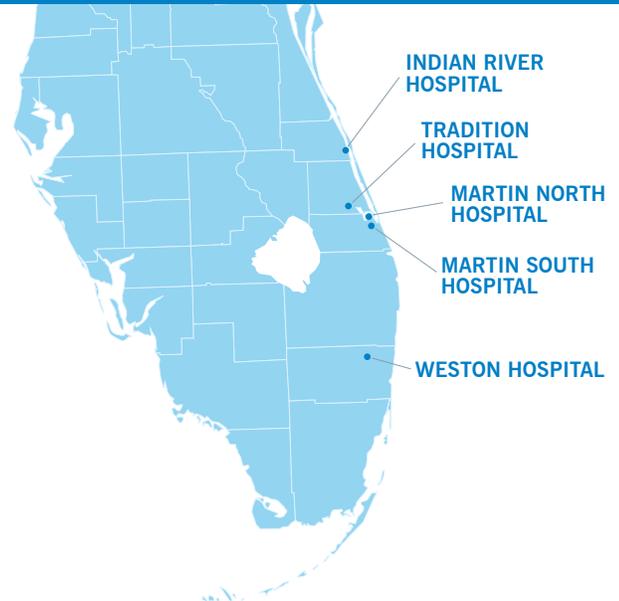
### Departments & Centers

- Cardiology
- Cardiac Amyloidosis
- Cardiac and Thoracic Surgery
- Cardiac Electrophysiology and Pacing
- Cardiac Imaging
- Cardio-Oncology
- Heart Transplant and Mechanical Circulatory Support
- Hypertrophic Cardiomyopathy
- Structural and Interventional Cardiology
- Vascular Medicine
- Vascular Surgery

### About Cleveland Clinic Florida

Cleveland Clinic Florida is a nonprofit, multi-specialty healthcare provider that integrates clinical and hospital care with research and education. The Florida region now includes Cleveland Clinic Indian River Hospital, Cleveland Clinic Martin Health, and Cleveland Clinic Weston Hospital, with five hospitals and numerous outpatient centers in Broward, Palm Beach, Martin, St. Lucie and Indian River counties. Cleveland Clinic Florida ranked #1 in the Miami-Fort Lauderdale metro area and is a top hospital in Florida, according to *U.S. News & World Report's* "2021-22 Best Hospitals" rankings. The Florida region is an integral part of Cleveland Clinic in Ohio, where providing outstanding patient care is based upon the principles of cooperation, compassion and innovation. Physicians at Cleveland Clinic are experts in the treatment of complex conditions that are difficult to diagnose.

For more information about Cleveland Clinic Florida, visit [www.clevelandclinicflorida.org](http://www.clevelandclinicflorida.org).



### For Patient Appointments

#### **Cleveland Clinic Weston Hospital**

877.463.2010

#### **Cleveland Clinic Martin Health**

844.630.4968

#### **Cleveland Clinic Indian River Hospital**

877.463.2010

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