Is your patient a candidate for a clinical trial?

**Referring your patient**
The UPMC Heart and Vascular Institute is a leader in conducting research studies and clinical trials to better understand and treat cardiovascular disease.

To refer a patient, please call 1-844-848-7425 (1-84-HVI-TRIAL) or email HVIresearch@upmc.edu.

For more information about the UPMC Heart and Vascular Institute, please call 1-855-876-2484 (1-855-UPMC-HVI) or visit UPMC.com/HVI.

**Cardiac Catheterization**

**FlowTriever® All-Comer Registry for Patient Safety and Hemodynamics (FLASH)** A prospective, single-arm, multicenter study of FlowTriever® Retrieval/Aspiration System for submassive and massive pulmonary embolism. The use of the device will be assessed in a real-world population, with eligibility criteria that closely approximate its use in clinical practice. The FlowTriever System is cleared for the treatment of PE under 510(k) number K180466.

- **Inclusion criteria:** Age ≥ 18 years, clinical signs and symptoms consistent with acute PE, CTPA or pulmonary angiographic evidence of proximal filling defect in at least one main or lobar pulmonary artery, scheduled for PE treatment with the FlowTriever System per the Investigator’s discretion

**Principal Investigator:** Catalin Toma, MD

**ILUMIEN IV: OPTIMAL PCI:** Prospective, single-blind clinical investigation randomizing subjects to OCT-guided coronary stent implantation vs. angiography-guided coronary stent implantation; The objective is to demonstrate the superiority of an OCT-guided stent implant strategy in achieving larger post-PCI lumen dimensions and improving clinical cardiovascular outcomes in patients with high-risk clinical characteristics (diabetes mellitus) and/or with high-risk angiographic lesions (defined below)

- **Inclusion Criteria:** Age > 18, evidence of myocardial ischemia (e.g., stable angina, silent ischemia, unstable angina, or NSTEMI) suitable for elective PCI, planned use of XIENCE stent implantation during a clinically indicated PCI procedure, with at least one target lesion meeting high-risk criteria (e.g. culprit NSTEMI lesion, length ≥28mm, bifurcation to be treated with 2 stents, severe calcification, etc.)

**Principal Investigator:** Catalin Toma, MD

**Sub-Investigator:** Jeffrey Fowler, DO

continued
PK Papyrus: Coronary Covered Coronary Stent System:
Approved by the FDA, under a Humanitarian Device Exemption (HDE H170004), the PK Papyrus Covered Coronary Stent System (HUD# 15-0343) is a Humanitarian Use Device for use in the treatment of acute perforations of native coronary arteries and coronary bypass grafts in vessels 2.5 to 5.0 mm in diameter.

Principal Investigator: Suresh Mulukutla, MD

The “RADIANCE II” Pivotal Study: A randomized clinical trial evaluating safety and efficacy of the ReCor Medical Paradise® System, a catheter-based system that delivers ultrasound energy to thermally ablate and disrupt the renal efferent and afferent sympathetic nerves while sparing the renal arterial wall, for patients with Stage II HTN. The objective is to achieve a reduction in sympathetic over-activity with the resultant effect of reducing systemic arterial BP and mitigating resultant end organ damage.

Inclusion Criteria: M/F ages 18-75 with documented diagnosis of stage II HTN, taking 0-2 anti-HTN medications at time of consent, average blood pressure readings of greater than or equal to 140/90 and less than or equal to 180/120, suitable renal anatomy by CTA/MRA, Sinus rhythm at time of procedure

Exclusion Criteria: No history of treatment with anti-HTN meds, Type I DM or HbA1C >9%, GFR<40 ml/min, any history of CV event (CVA, TIA, MI, CABG, CHF NYHA III-IV), AICD or CRT-D, night shift workers

Principal Investigator: John Schindler, MD
Sub-Investigators: Evan Ray, MD and Matthew Muldoon, MD

XIENCE 90: Prospective, single arm, multicenter, open label trial to evaluate safety of 3-month DAPT in subjects at high risk of bleeding (HBR) undergoing PCI with XIENCE drug-eluting stents.

Inclusion criteria: Subjects considered HBR (one or more of the following: age ≥ 75, chronic anticoagulation therapy, history of major bleed or stroke, renal insufficiency or failure, hematologic disorder, Hgb <11 g/dL); Willing to stop taking P2Y12 inhibitor at 3 months, if eligible per protocol

Angiographic Inclusion Criteria: Up to 3 target lesions with length ≤ 32 mm, RVD 2.25-4.25mm, Xience only, no STEMI, no total occlusions, no LVEF <30% no planned surgery necessitating discontinuation of P2Y12 inhibitor within 3 months following Xience placement

Principal Investigator: Catalin Toma, MD

AMPLATZER™ Post-Infarct Muscular VSD Occluder: The AMPLATZER™ Post-Infarct Muscular VSD Occluder (PIVSD) is a Humanitarian Use Device (HUD) which was granted approval for use in the United States under a Humanitarian Device Exemption (HDE) on January 10, 2017. The AMPLATZER™ PIVSD is a percutaneous transcatheter occlusion device intended for closure of post MI muscular VSDs in patients who are not satisfactory surgical candidates.

Principal Investigator: A.J. Conrad Smith, MD

HARP: NYU Women’s Heart Attack Research Program (HARP):
Multicenter, diagnostic observational study employing standardized imaging protocols in women with MI with non-obstructive CAD (MINOCA) to determine the prevalence and composition of disrupted plaque and the prevalence and location of myocardial abnormalities. Enrollment is at the time of diagnostic angiography. Questionnaires will be administered to assess psychosocial stress leading up to the event. Eligible patients will undergo 3-vessel optical coherence tomography (OCT) at the time of angio and Cardiac MR imaging within one week. Findings of OCT and CMR will be integrated to identify vascular causes (plaque disruption, dissection and coronary artery spasm), to assess plaque composition, edema and to synthesize the findings of OCT and CMR to identify the underlying etiology of MINOCA in women.

Inclusion criteria: Women age ≥ 21 years, acute ischemic symptoms with objective evidence of MI (elevated troponin or ST elevation ≥ 1mm)

Principal Investigator: Catalin Toma, MD

Progress CTO Registry: Multicenter Registry of Chronic Total Occlusion Interventions; This chart review data collection registry can have a significant impact on the care of patients with coronary CTOs by allowing better understanding and improvement of the techniques and outcomes of CTO PCI.

Principal Investigator: Catalin Toma, MD

OPTIMUM: A prospective registry of outcomes of percutaneous revascularization or Guideline Directed Medical Therapy only for management of surgically ineligible patients with multivessel or left main coronary artery disease.

Inclusion criteria: Obstructive 3VD stenosis >70% or unprotected left main disease >50%; patient considered high risk for CABG and declared ineligible for surgery by the heart team

Principal Investigator: Catalin Toma, MD

SPECT vs. FFR: Simultaneous assessment of invasive FFR and SPECT myocardial ischemia using regadenoson in the catheterization lab. The aim is to determine the correlation between FFR and the presence or extent of associated ischemia in patients with CAD.

Inclusion criteria: Age 18 or older scheduled to undergo cardiac catheterization.

Principal Investigator: Prem Soman, MD, PhD
ALIVE: Clinical Study of the BioVentrix Revivent TC™ System for Treatment of Left Ventricular Aneurysms: A prospective, multicenter, dual-arm pivotal study of 126 patients with 2:1 study (84 patients treated with the investigational device) vs. active concurrent control group (42 patients). The Revivent TC™ System is indicated for patients referred for surgical treatment of left ventricular aneurysm or anterior scar that is contiguous, and includes both anterior and septal components.

**Inclusion Criteria:** Age 18–80; CHF patients suffering from heart failure symptoms as defined by NYHA Class > 2 not responsive to medical therapy, with LVEF < 45%, LVESV ≥ 50 mL/m²; presence of LV aneurysm or anterior scar: defined by a contiguous acontractile (akinetic and/or dyskinetic) scar involving the septum and anterior, apical, or anterolateral regions of the LV as evidenced by cardiac imaging and referred for surgical management; viability of myocardium in regions remote from area of intended scar exclusion as evidenced by cardiac imaging; patient is on adequate guideline-directed medical therapy; candidates allocated to active concurrent control group must meet all inclusion criteria (including LV aneurysm scar presence), with the exception of LV aneurysm scar location.

**Principal Investigator:** Catalin Toma, MD

**Sub-Investigators:** Marc Simon, MD
Christopher Sciortino, MD

MINT (Myocardial Infarction and Transfusion): Randomized, unblinded, multicenter clinical trial randomly allocates 3,500 patients with acute myocardial infarction and a hemoglobin concentration less than 10 g/dL to be treated either according to a liberal or restrictive blood transfusion strategy; purpose of the trial is to assess RBC transfusion strategies currently used in clinical practice and important medical events. RBCs are a limited and expensive medical therapy. Physicians frequently transfuse patients to maintain specific (and often differing) hemoglobin levels, despite the lack of evidence supporting the strategy. The study results, which will determine the benefit (or risk) of a liberal transfusion strategy, will influence the allocation of red blood cells worldwide.

**Inclusion criteria:** Age ≥ 18 years, presumptive diagnosis of STEMI or NSTEMI (Type I and II), Hgb <10g/dL

**Principal Investigator:** Catalin Toma, MD

**Sub-Investigator:** Mark Schmidhofer, MD

BRICK (Biochemical and Renoprotective Effects of Remote Ischemic Preconditioning on Contrast-induced Kidney Disease): Double-blind, sham-controlled, RCT examining the effect of remote ischemic pre-conditioning (RIPC) on incidence of CI-AKI following cardiac cath and PCI in high risk patients with CAD. Patients will be randomized to RIPC or sham-RIPC, receiving the intervention prior to cardiac catheterization; RIPC involves 5 minute cycles of non-injurious ischemia using a manual BP cuff placed around the upper arm inflated to 200 mmHg for RIPC group, 10mmHg for Sham-RIPC group and interrupted three times for 5-minutes of reperfusion with the cuff deflated (total of 30 minutes).

**Inclusion Criteria:** Age ≥ 18 years with diagnosis of unstable angina or NSTEMI, planned for cardiac catheterization and at high risk for CI-AKI, determined by Mehran’s CI-AKI risk score of ≥ 11

**Principal Investigator:** Oladipupo Olafiranye, MD

Precise Rx (Pharmacogenomics-guided Care to Improve the Safety and Effectiveness of Medications): A study to measure the performance and impact of pharmacogenomics-guided drug therapy individualization following PCI. We hypothesize that: targeted genetic variants are detectable in UPMC patients, point-of-care interventions can be accomplished, clinical outcomes are improved, and patients find these processes acceptable. PreCISE-Rx establishes to create a bio-bank to enable future research use of pharmacogenomic research.

**Inclusion criteria:** Patients (>18 years of age) who have received or are planned for PCI and pharmacogenomic testing at UPMC

**Principal Investigator:** Philip Empey, PharmD, PhD
**Cardiac Imaging**

**Attribute-CM:** A Phase 3, Randomized, Double-Blind, Placebo-Controlled Study of the Efficacy and Safety of AG10 in Subjects with Symptomatic Transthyretin Amyloid Cardiomyopathy. The primary endpoint is to evaluate the change in distance walked during the 6MWT from baseline to Month 12 of treatment and to determine a hierarchical combination of All-Cause mortality and CV-related hospitalization over a 30-month period.

**Inclusion Criteria:** ages 18-90; diagnosis of ATTR-CM (wild-type TTR or variant TTR); history of HF or clinical evidence of HF; NYHA Class I-III due to ATTR-CM; (if applicable) must be on stable CV GDMT for at least two weeks; completed ≥ 150m on the 6MWT for two consecutive tests; NT-pro BNP levels ≥ 300pg/mL; LV wall thickness ≥ 13mm; WOCBP agree to use acceptable methods of contraception.

**Exclusion Criteria:** Acute MI, ACS, or coronary revascularization within 90 days; experienced stroke within 90 days; hemodynamic instability; likely to undergo OHTx within one year; history of left- or right-ventricular amyloidosis; abnormal LFTs >3x ULN; NT-pro BNP levels ≥ 7000pg/mL; eGFR <15mL/min/1.73m²; current treatment for ATTR-CM with Tafamidis or with marketed drug products lacking a labeled indication for ATTR-CM, patisiran, inotersen, green tea extract, or any investigational agent within 14 days or 90 days; hemodynamic instability; likely to undergo OHT x 90 days; hemodynamic instability; likely to undergo OHT x 90 days; experienced stroke within 90 days; diagnosed with nHCM with LV wall thickness ≥ 15mm or ≥ 13mm with positive family history of HCM

**Principal Investigator:** Prem Soman, MD

**Nuc Gene:** Study to assess the prevalence and determinants of global myocardial flow reserve abnormalities and its association with a specific gene variant in African-American women with chest pain that are referred for myocardial perfusion imaging.

**Inclusion criteria:** African-American females referred for myocardial perfusion imaging.

**Exclusion Criteria:** ages 18-90; diagnosis of ATTR-CM (wild-type TTR or variant TTR); history of HF or clinical evidence of HF; NYHA Class I-III due to ATTR-CM; (if applicable) must be on stable CV GDMT for at least two weeks; completed ≥ 150m on the 6MWT for two consecutive tests; NT-pro BNP levels ≥ 300pg/mL; LV wall thickness ≥ 13mm; WOCBP agree to use acceptable methods of contraception.

**Principal Investigator:** Prem Soman, MD, PhD

**MYK-461-006 (MAVERICK-HCM):** A randomized, double-blind, placebo-controlled, concentration-guided, trial to evaluate the safety and tolerability of a 16-week course of Mavacamten (MYK-461) in Patients with Symptomatic Non-Obstructive Hypertrophic Cardiomyopathy (nHCM) and Preserved LV EF

**Inclusion Criteria:** Diagnosed with nHCM with LV wall thickness ≥ 15mm OR LV wall thickness ≥ 13mm with a positive family history of HCM, LV EF ≥ 55%; NYHA Class II or III symptoms, has an elevated NT-proBNP at rest, LVOT peak gradient at rest AND during Valsalva AND post-exercise < 30 mmHg (determined by core echo lab)

**Principal Investigator:** Timothy Wong, MD

**EXPLORER-HCM:** A randomized, double-blind, placebo-controlled clinical study to evaluate a 30-week course of Mavacamten (MYK-461) in Adults with Symptomatic Obstructive Hypertrophic Cardiomyopathy (oHCM). Primary object is to compare the effect of MYK-461 with placebo on clinical response comprising of exercise capacity and clinical symptoms

**Inclusion Criteria:** Age 18 or older, weight is greater than 45 kg, diagnosed with oHCM, meeting both:

A.) Has unexplained LV hypertrophy with nondilated ventricular chambers in the absence of other cardiac (eg, hypertension, aortic stenosis) or systemic disease and with maximal LV wall thickness ≥ 15 mm (or ≥ 13 mm with positive family history of HCM)

B.) Has LVOT peak gradient ≥ 50 mmHg during screening as assessed by echo at rest, after Valsalva maneuver, or post-exercise (confirmed by echocardiography core lab)

**ClinicalTrials.gov Identifier:** NCT03470545

**Principal Investigator:** Timothy Wong, MD

**LIVE HCM:** Study to compare the composite risk of death, cardiac arrest, ventricular arrhythmias, or syncope in patients with hypertrophic cardiomyopathy (HCM) or the Long QT Syndrome (LQTS) who are participating in moderate or vigorous exercise with sedentary patients.

**Inclusion criteria:** Patients with HCM or LQTS, age 8 to 60, half pediatric and half >18 years old, will be enrolled. Patients with HCM with systolic or diastolic heart failure which precludes vigorous exercise will not be enrolled (NYHA Class III/IV)

**Principal Investigator:** Timothy Wong, MD

**TOPAS III:** Prospective study to develop and validate new parameters and biomarkers to improve the assessment of stenosis severity and myocardial impairment, the risk stratification, and the clinical decision making in patients with low-flow low-gradient aortic stenosis and to assess the impact of the different therapeutic strategies on outcomes.

**Inclusion criteria:** Age > 21 years, suspected severe AS defined by an AVA ≤ 1.0 cm² and indexed AVA ≤ 0.6 cm²/m², low-gradient defined by a mean gradient < 40 mmHg, low LV outflow defined by a stroke volume index ≤ 35 mL/m².

**Principal Investigator:** Erik Schelbert, MD

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**UPMC Heart and Vascular Institute**
Electrophysiology

PSR (Product Surveillance Registry): Post-market surveillance registry to obtain information on product performance assessment. The objective of the registry is to serve as an ongoing source of acute and chronic product performance, patient safety, and clinical outcomes information associated with the use of market-released products.

- **Inclusion criteria:** Patient has or intends to receive or be treated with an eligible Medtronic product.
- **Principal Investigator:** Sandeep Jain, MD

SMART MSP (Strategic Management to Improve CRT Using Multi-Site Pacing Post Approval Study): Prospective, multicenter, single arm, post approval study to evaluate the effectiveness of Boston Scientific’s Left Ventricular Multisite Pacing feature in the Resonate Family of CRT-D devices and confirm safety when used in accordance with its approved labeling.

- **Inclusion criteria:** Subjects who received de novo implantation of Boston Scientific’s Resonate family CRT-D devices with the required features for the study or device upgrade from single or dual chamber pacemaker or ICD. Subjects must have functional RA and RV leads implanted.
- **Exclusion:** Documented history of permanent Atrial Fibrillation or permanent complete AV block are excluded.
- **Principal Investigator:** Sandeep Jain, MD

Symplicity AF: Prospective, randomized, multicenter, investigational clinical study evaluating the feasibility of performing both renal artery denervation and pulmonary vein isolation on the same patient with the intent of characterizing both safety and effectiveness in a paroxysmal and persistent atrial fibrillation (AF) population with hypertension.

- **Key Inclusion Criteria:** Age 18-80, drug refractory recurrent symptomatic paroxysmal or persistent AF, systolic BP > 140mm Hg.
- **Key Exclusion Criteria:** Active systemic infection, pulmonary vein stents, Type 1 diabetes, NYHA IV, ineligible renal artery anatomy, primary pulmonary hypertension, presence of any pacemaker or ICD; significant PVD, AAA, anemia or thrombocytopenia, previous organ transplant.
- **Principal Investigator:** Samir Saba, MD

JAVA-CRT (Junctional AV Ablation in CRT-D patients with Atrial Fibrillation): Unblinded, randomized, controlled clinical trial to determine if patients with permanent Atrial Fibrillation who meet conventional criteria for CRT-D and undergo AVJ ablation have improved left ventricular remodeling as assessed by left ventricular end-systolic volume reduction ≥ 15% from baseline to 6 months.

- **Inclusion Criteria:** Age > 21 years, existing indication for de novo CRT device, ischemic or nonischemic cardiomyopathy, LVEF ≤ 35% within 12 months prior to or on consent date, NYHA class II-IV (ambulatory), QRS ≥ 120ms for LBBB and ≥ 150 ms for non-LBBB patients.
- **Exclusion Criteria:** Ventricular rate > 90 bpm at rest despite maximal medical therapy, ventricular rate < 50 bpm at rest. Heart block/symptomatic bradycardia that necessitates permanent pacing. Severe aortic or mitral valvular heart disease. Prior AVJ ablation. Renal failure requiring dialysis.
- **Principal Investigator:** Sandeep Jain, MD

SOLVE CRT (Stimulation of the Left Ventricular Endocardium for Cardiac Resynchronization Therapy in Non-Responders and Previously Untreatable Patients): Prospective, two-arm, randomized, double blind, multicenter study to demonstrate the safety and effectiveness of the WiSE CRT System. The WiSE CRT System is indicated for patients considered CRT non-responders or previously untreatable and meeting established CRT treatment criteria. The WiSE CRT System provides endocardial left ventricular stimulation, synchronized to the right ventricular pacing output pulse of a commercially-available implanted pacemaker, ICD, CRT-P, or CRT-D to achieve Cardiac Resynchronization Therapy.

- **Inclusion:** Patients with a class I or IIa indication for implantation of a CRT-D device according to current available guidelines. Non-responders are defined as patients who have a CRT system that is functional and despite optimal device programming the patients have not responded (EF has remained unchanged or worsened and the patient’s clinical status has remained unchanged or worsened). Or previously untreatable patients who are a full or partial CRT system, who are deemed as ‘previously untreatable’ (patients with failed CS lead implantation, CS lead is programmed off, high risk upgrade: relative contraindication to CS lead implant).
- **Exclusion:** Persistent or permanent atrial arrhythmias (or cardioversion for atrial fibrillation) within the past 1-month, pure RBBB, LVEED ≥ 8cm, chronic hemodialysis, mechanical aortic valves or TAVR valves, persistent or permanent atrial arrhythmias, moderate or severe aortic stenosis.
- **Principal Investigator:** Samir Saba, MD
**ECG Belt:** ECG Belt for CRT Response is a prospective, interventional, randomized, multi-center, investigational, pre-market research study. The objective is to compare ECG belt managed CRT patients and a ‘no ECG belt’ CRT group with respect to left ventricular remodeling. ECG belt will be used at implant and/or follow-up to help implanters choose an optimal LV lead position (at implant) within the recommended locations for LV lead implantation and optimize pacing vector/timing parameters (during implant and follow-up) in line with EHRA/HRS expert consensus.

**Inclusion Criteria:** Indicated for CRT implant and planned to be implanted with a Medtronic CRT device with AdaptivCRT and an Attain Performa quadripolar lead, QRS duration ≥ 120 ms, Meets at least one of the following criteria: QRS duration < 150ms, Lack of complete left bundle branch block on baseline ECG, or Ischemic cardiomyopathy.

**Key Exclusion Criteria:** Permanent/persistent AF or presenting with AF with ventricular rate ≥ 90 BPM, Pre-existing LV lead or other confounding devices e.g. LVAD, Vagal Nerve Stimulator, Currently implanted with IPG or ICD with > 10% pacing, Complete AV block.

**Principal Investigator:** Andrew Voigt, MD

**PREEMPT-HF:** PREcision Event Monitoring of PatienTs with Heart Failure using HeartLogic is a global, multi-center, post-market prospective, non-randomized study. The goal of the PREEMPT-HF study is to collect device and clinical event data to evaluate extended applications of the HeartLogic Heart Failure Diagnostic in a broad spectrum of heart failure (HF) patients with an implantable cardioverter defibrillator (ICD) or cardiac resynchronization therapy defibrillator (CRT-D).

**Key Inclusion Criteria:** Subject has a documented diagnosis of heart failure, Subject has a Boston Scientific CRT-D or ICD device implant that has HeartLogic with Heart Failure Sensors turned ON, Respiratory Sensor turned ON, and Sleep Incline Sensor turned ON, Subject has an active bipolar RV lead implant, Subject is enrolled in LATITUDE (NXT 5.0 or future version), and is willing to be remotely monitored from the baseline visit for approximately 12 months with HeartLogic disabled.

**Key Exclusion Criteria:** Atrial fibrillation or flutter, history of MI/PCI/CABG (serum markers or imaging) or evidence of coronary disease with increased likelihood of undergoing PCI or CABG, upgrade to CRT from ICD or pacemaker, secondary prevention indication after documented cardiac arrest, severe claustrophobia, renal insufficiency or known allergy to gadolinium-based contrast.

**Principal Investigator:** Samir Saba, MD

**MARVEN:** Clinical, Electrocardiographic, and Cardiac Magnetic Resonance Imaging Risk Factors Associated with Ventricular Tachyarrhythmias in Nonischemic Cardiomyopathy Current guidelines for cardiac resynchronization therapy defibrillator (CRT-D) device implantation indications are based on left ventricular ejection fraction and QRS duration and further risk stratification of arrhythmic events is needed to optimize device therapy in nonischemic cardiomyopathy (NICM) patients. The purpose of the MARVEN study is to determine what clinical, ECG, and cardiac magnetic resonance imaging (CMR) factors identify patients at risk for developing rapid irregular heartbeats requiring therapy by implantable defibrillator. The CRT-D implant procedure is not part of the study. However, information about the procedure and device will be collected for this study along with a 24-hour Holter monitor and CMR imaging prior to the CRT-D implant.

**Key Inclusion Criteria:** NICM patients, 21 years of age and older, meeting primary prevention indications for CRT-D on optimal pharmacologic therapy for at least 3 calendar months after NICM diagnosis, in sinus rhythm by most recent ECG qualifying patient for CRT-D, willingness to undergo CRT-D implant with remote interrogation enabled within two months after consent, if no CMR within six months of consent date or quality of prior CMR not sufficient, willingness to undergo CMR imaging prior to CRT-D implant.

**Key Exclusion Criteria:** Atrial fibrillation or flutter, history of MI/PCI/CABG (serum markers or imaging) or evidence of coronary disease with increased likelihood of undergoing PCI or CABG, upgrade to CRT from ICD or pacemaker, secondary prevention indication after documented cardiac arrest, severe claustrophobia, renal insufficiency or known allergy to gadolinium-based contrast.

**Principal Investigator:** Raveen Bazaz, MD