Icahn School of Medicine at Mount Sinai

Translational & Molecular Imaging Institute

tmii.mssm.edu

Summer 2015

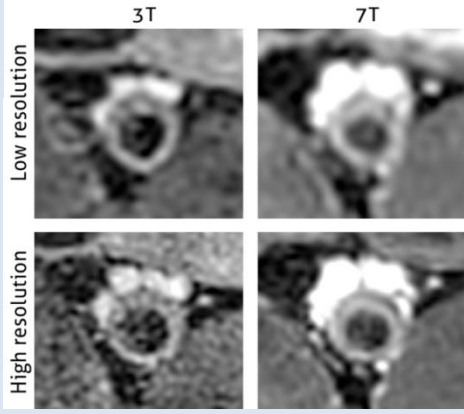
CARDIOVASCULAR IMAGING

The Imaging Research Center is the backbone of the Translational & Molecular Imaging Institute at Mount Sinai Health System. Housed on four floors of the Leon and Norma Hess Center for Science and Medicine, the Imaging Research Center enhances the use of seamless diagnostics and treatment methods for our patients. Under the directorship of **Zahi A. Fayad, PhD**, the Imaging Research Center provides physicians and scientists with previously unavailable images of patients' internal organs, necessary for noninvasive diagnostics to treat cardiovascular, brain, and cancer diseases.

The **Cardiovascular Imaging Research Program** is focused on developing and using noninvasive imaging methods that allow the early detection, prevention, and treatment of cardiovascular disease. Despite considerable therapeutic advances over the past 50 years, *cardiovascular disease is the leading cause of death worldwide,* mostly because of the widespread lack of recognition and treatment of individuals with risk factors for atherosclerosis.

Atherosclerosis is caused when cholesterol deposits, inflammation, extracellular-matrix formation, and thrombosis combine to form atherosclerotic plaque that thickens the arterial wall. This causes a decrease in blood supply that in turn leads to heart disease and strokes. Traditionally, diagnosis of atherosclerosis was possible only at advanced stages of the disease by physically examining the clogged arteries.

The Cardiovascular Imaging Research Program is developing and applying new imaging approaches that allow the assessment not only of the structure of blood vessels, but also of the composition of the vessel walls—enabling atherosclerosis-associated abnormalities in the arteries (including the coronary arteries) to be observed down to the cellular and molecular level.



Some of these approaches are now in clinical use or are being tested in clinical trials, whereas others are better suited to basic and translational research. Mount Sinai is currently leading several major multi-center clinical trials to evaluate cardiovascular therapeutics, including one for a novel anti-inflammatory drug.

The main challenge that we face today in diagnosing heart disease is to identify patients at risk before they suffer from a coronary event. Today, clinical evaluation alone might be insufficient because only a small group of patients experiencing an event would have been identified as high-risk by the available clinical tools we have before the event.

STATE-OF-THE-ART EQUIPMENT

3T Skyra

PET/MR

7T

Force CT

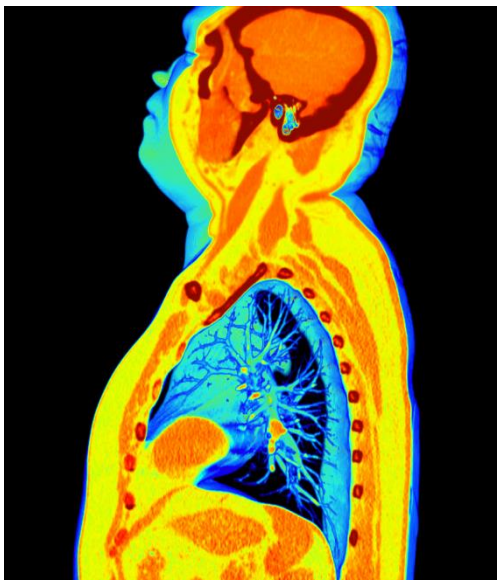
MR Simulator

The Translational and Molecular Imaging Institute (TMII) is responsible for providing support for all in vivo imaging research at The Mount Sinai Medical Center. TMII Imaging Core is the backbone of the Translational and Molecular Imaging Institute and is responsible for coordinating, supporting and executing imaging research at Mount Sinai including, neuroimaging, cardiovascular imaging, cancer imaging, nanomedicine (molecular imaging and drug delivery), and image processing in the preclinical and clinical settings.

CLINICAL IMAGING CORE

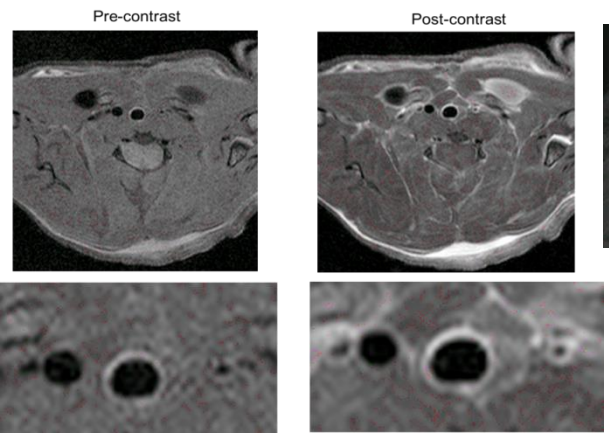
Whole Body MRI

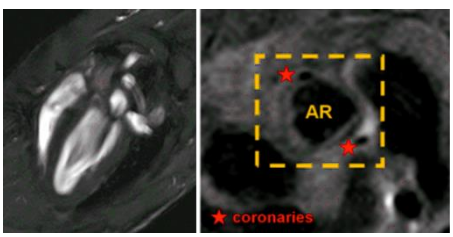
Dr. Fayad and the Siemens 7 Tesla

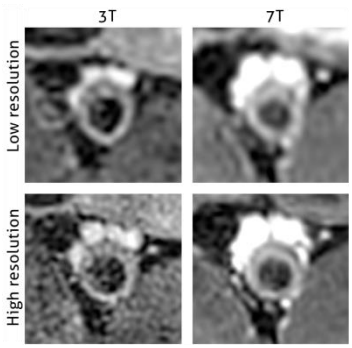


Low-dose CT

PRE-CLINICAL IMAGING CORE







RESEARCH HIGHLIGHT: IMAGING PLAQUES TO PREDICT AND BETTER MANAGE PATIENTS WITH ACUTE CORONARY EVENTS

"Finally Going After The Holy Grail"

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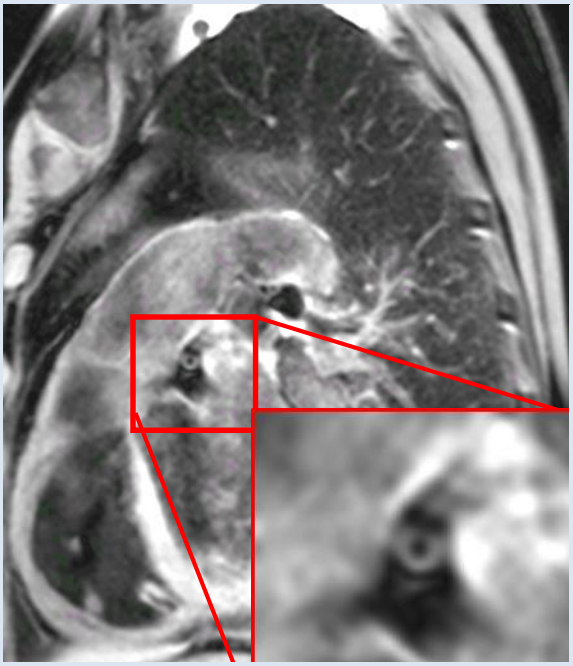


FDG PET/MRI in a slice through the Left Main Coronary Artery

At the Translational and Molecular Imaging Institute (TMII), the Cardiovascular Imaging Group led by **Dr. Zahi Fayad is developing improvements in imaging techniques** for a novel, combined Positron Emission Tomography (PET) imaging and Magnetic Resonance Imaging (MRI) system.

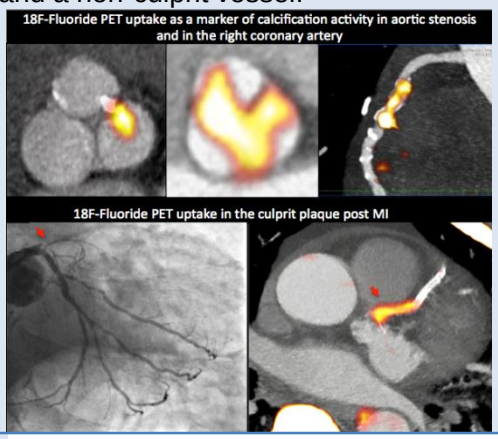
We believe such advances will significantly impact our understanding and diagnosis of atherosclerosis in the coronary arteries, which is the major cause of sudden heart attacks. Vascular inflammation and active calcification are hallmarks of vulnerable atherosclerotic plaques, at high-risk for causing acute clinical events.

Recently, the PET metabolic tracers such as 18F-fluorodeoxyglucose (FDG) and 18F-sodium fluoride (18F-NaF) have been used to target important biological processes in atherosclerosis such as inflammation and active micro-calcification. Use of PET alone to quantify metabolic activity in coronary arteries is challenging due to respiratory and cardiac motions, and the limited spatial resolution of PET.

Systems like the Siemens (Biograph mMR) at TMII that combine PET and MRI have become available that allow for simultaneous, co-registered PET and MRI acquisitions. MRI requires no ionizing radiation and produces high spatial and temporal resolution images with excellent soft tissue contrast.

These characteristics are ideally suited to repeated, tomographic imaging for motion correction, repeated scans in longitudinal studies, improving partial volume error (PVE) correction of the PET data, and in providing complementary information about coronary plaque morphology. Studies are currently underway to evaluate in vivo, combined PET/MR imaging of ^{18}F-labeled fluorodeoxyglucose (FDG) and NaF uptake in the coronary arteries of individuals following an acute myocardial infarction to determine the ability of these techniques to discriminate between the culprit lesions responsible for the clinical event and a non-culprit vessel.

This builds on our earlier work, using different imaging modalities, attempting to image plaque based on vulnerability to rupture. If we are successful, then this technique might alter the way we detect coronary disease, moving us away from the current limited clinical techniques based on lesion severity and ischemia to one based on plaque metabolism and vulnerability.



SCIENTISTS

Fayad Lab

Zahi A. Fayad, PhD
Professor of Radiology and Medicine (Cardiology)
Director, Translational and Molecular Imaging Institute
Director, Cardiovascular Imaging

Dr. Fayad's laboratory is dedicated to the detection and prevention of cardiovascular disease and conducts interdisciplinary and discipline bridging research, from engineering to biology, which includes pre-clinical and clinical investigations. The focus of this lab is to develop and use innovative multimodality cardiovascular imaging including to study, prevent and treat cardiovascular disease, including: Magnetic Resonance Imaging (MRI), computed tomography (CT), and positron emission tomography (PET), as well as molecular imaging and nanomedicine. Dr. Fayad's focus at Mount Sinai is on the noninvasive assessment and understanding of atherosclerosis.

Claudia Calcagno, MD, PhD
Fayad Lab

Dr. Calcagno is an Instructor at the Translational and Molecular Imaging Institute at Mount Sinai. She holds an MD from the University of Genova, Italy (2004) and a PhD in Computational Biology from New York University/Mount Sinai. Her research is focused on the development and validation of non-invasive, quantitative imaging techniques in animal models (mice, rabbits, pigs) of cardiovascular disease. More specifically, her expertise is in dynamic contrast enhanced (DCE) MRI to measure microvasculature/permeability, and PET imaging to measure inflammation, two of the hallmarks of high-risk atherosclerotic plaques.

Her current projects are focused on the development of 3 dimensional (3D) imaging combined with cutting edge fast image acquisition and reconstruction methods for the accurate, extensive quantification of these parameters in large vascular territories.

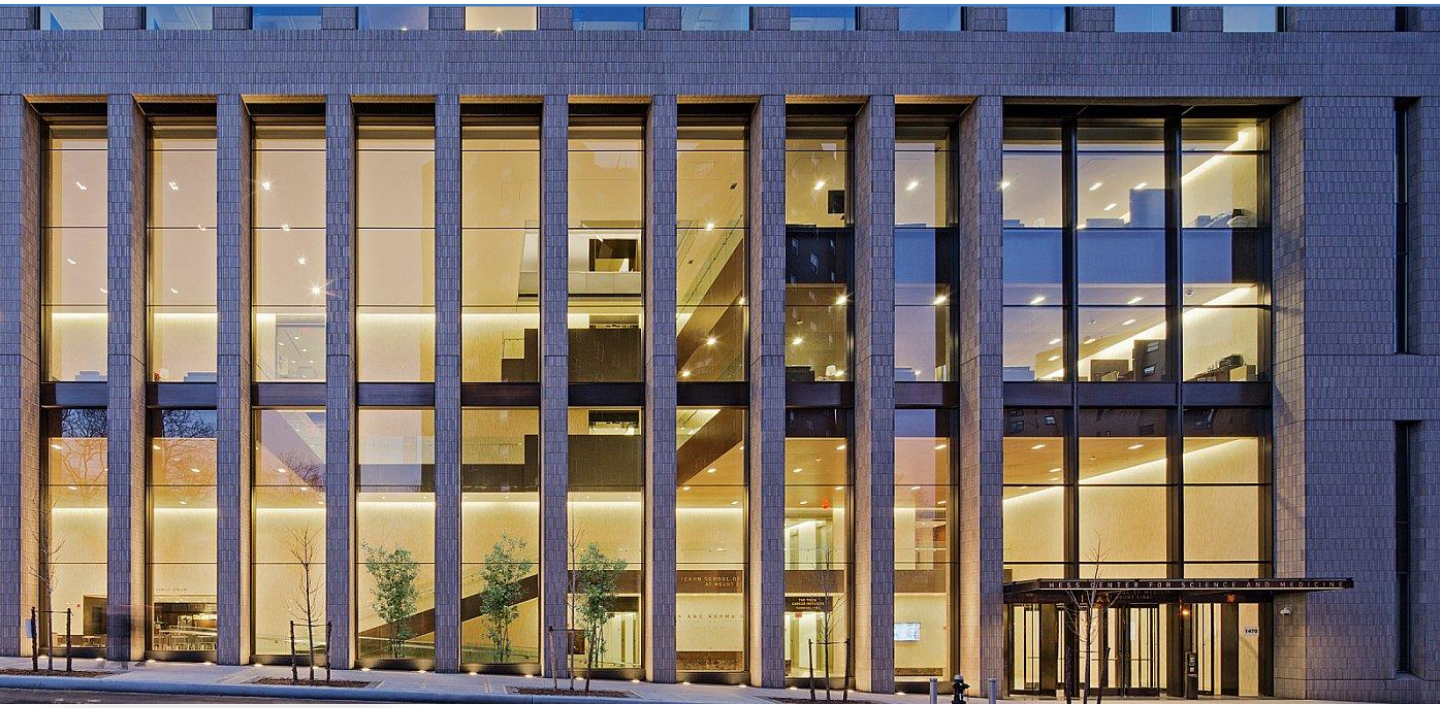
Mani Lab

Venkatesh Mani, PhD
Assistant Professor of Radiology
Director, Cardiovascular Imaging Clinical Trials Units (CICTU)

As a TMII faculty member and CICTU Director, Dr. Mani works to translate novel multi-modality imaging techniques for use in multicenter clinical trials. His main interests are in imaging of cardiovascular diseases, specifically focusing on atherosclerosis, thrombosis and their complications using FDG-PET, CT and MRI.

The CICTU is composed of clinicians, image processing and programming experts, image analysts, data managers, IT personnel and research coordinators. It is a modern hybrid between a contract research organization and an imaging core lab. They undertake and manage all aspects of clinical trials, ranging from scientific conduct to administrative management. CICTU's tasks span from industry or federally sponsored multicenter clinical trials to the support of individual investigators interested in using imaging endpoints for their work.

LEADERSHIP



Dr. Zahi Fayad is Director of the Imaging Research Center and the Translational and Molecular Imaging Institute, Director and Founder of the Eva Morris Feld Imaging Science Laboratories, and Director of Cardiovascular Molecular Imaging Research at the Icahn School of Medicine at Mount Sinai. He is a world leader in the development and use of multimodality cardiovascular imaging including: cardiovascular magnetic resonance (CMR), computed tomography (CT), positron emission tomography (PET). He holds twelve U.S. and worldwide patents and/or patent applications.

Dr. Fayad is the recipient of multiple prestigious awards and was recently honored with the John Paul II Medal from the City of Krakow, Poland, in recognition of the potential positive impact of his work on humankind and he holds the title of Honorary Professor in Nanomedicine at Aarhus University in Denmark.

In 2013, he was elected Fellow of the International Society of Magnetic Resonance In Medicine, Magnetic Resonance Imaging, received a Distinguished Reviewer from Magnetic Resonance in Medicine, and was selected as an Academy of Radiology Research, Distinguished Investigator. In 2014 his alma mater, Bradley University, awarded him its highest honor, the Centurion Society Award, for bringing national and international credit to his university.

Dr. Fayad has authored more than 300 peer-reviewed publications, 50 book chapters, and more than 400 meeting presentations. He is currently the principal investigator of four federal grants/contracts funded by the National Institutes of Health's National Heart, Lung and Blood Institute and the National Institute of Biomedical Imaging and Bioengineering, with a recent large award from NHLBI to support the Program of Excellence in Nanotechnology. In addition, he serves as principal investigator of the Imaging Core of the Mount Sinai National Institute of Health (NIH)/Clinical and Translational Science Awards (CTSA).

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If you wish to make a donation to support the Translational & Molecular Imaging Institute, please contact:
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