

## Cardiovascular Imaging: Current Developments in Research and Clinical Practice

### ■ Amgad N. Makaryus

Chairman of Cardiology at Nassau University Medical Center, East Meadow, NY, USA, Associate Professor of Cardiology at the Hofstra North Shore-LIJ School of Medicine, NY, USA.

### ■ Roman Zeltser

Director of Cardiac Clinical Services at Nassau University Medical Center, East Meadow, NY, USA, Assistant Professor of Cardiology at the Hofstra North Shore-LIJ School of Medicine, NY, USA.

### ■ Daniel Chikvashvili

Cardiologist at Nassau University Medical Center, East Meadow, NY, USA, Assistant Professor of Medicine SUNY Stony Brook University, NY, USA.

### ■ Dali Fan

Associate Professor of Medicine at the University of California, Davis, CA, USA.

### ■ Lawrence Boxt

Consultant, Department of Radiology at Albany Medical Center, Albany, NY, USA.

### ■ John N. Makaryus

Director of Nuclear Cardiology, North Shore University Hospital, Manhasset, NY, USA, Assistant Professor of Cardiology at the Hofstra North Shore-LIJ School of Medicine, NY, USA.

## Supplement Aims and Scope

### Cardiovascular Imaging: Current Developments in Research and Clinical Practice

This supplement aims to provide readers with a comprehensive overview of current developments in this important area. Topics addressed span non-invasive and invasive cardiovascular imaging and include but are not limited to advances in applied (translational) research in:

- Echocardiography
- Cardiac computer tomography
- Cardiac MRI and spectroscopy
- Magnetic resonance angiography
- Cardiac positron emission tomography

- Non-invasive vascular imaging
- Non-invasive assessment of vascular and endothelial function
- Radionuclide Imaging
- Molecular imaging
- Intravascular ultrasound
- Optical coherence tomography

Article types include original clinical and basic research articles, case reports, commentaries, meeting reports, methodology, perspective, research proposal, reviews, software/database reviews, and technical advance.

The field of cardiovascular imaging has experienced exponential growth over the past 25 years in terms of new modalities, improvements in the accuracy of these modalities, volume of imaging procedures, technological advancements, and new applications for cardiovascular imaging. As a result, related quality improvement and clinical awareness in this expanding field is essential for researchers and practicing clinicians alike. Technological developments in cardiovascular imaging have affected every aspect of practice leading to noticeable improvements in diagnosis and impact on patient management. Our supplement highlights the major advances in many of the current areas of cardiovascular

imaging and the expanding clinical applications of these imaging modalities including echocardiography, cardiac CT imaging, perfusion imaging and others.

Our supplement addresses many of the facets of cardiovascular imaging and examines new applications in clinical practice. We examine multi-detector coronary CT (MDCT) imaging for the identification of coronary artery stenoses in a “Real-World” population and highlight the fact that coronary CTA has become an essential and central tool in the assessment for coronary artery disease (CAD). We further document that MDCT is an accurate imaging tool that allows a non-invasive assessment of significant CAD with a high



diagnostic accuracy in a “real-world” population of patients. The sensitivity and specificity that we noted are not as high as those in prior reports of idealized selected patients, but are more indicative of an “unselected” real world population.<sup>1</sup> The paper by Catanzaro and colleagues<sup>2</sup> goes on to further document the usefulness of MDCT in the planning and guidance of cardiac resynchronization therapy-lead implantation by evaluating the coronary venous anatomy with MDCT. This study demonstrates the capacity of MDCT to delineate large venous structures as well as the ability to characterize the environment through which the LV lead must be advanced to achieve optimal LV pacing. Furthermore, it shows that MDCT can be used to reconstruct coronary venous structures with accurate fidelity compared to intracoronary venograms. This ability to predict availability of appropriate target vessels is an additional utility of MDCT scanning prior to CRT implantation.<sup>2</sup>

Cardiovascular imaging improvements have allowed us to better understand the pathophysiology underlying heart disease. This is documented in the article in the supplement assessing gender difference in coronary calcification as assessed by MDCT. Documentation of clear differences between males and females regarding total vessel calcium scores and therefore risk of future adverse coronary events is noted in this work. Males tended to have higher average calcium scores in each coronary artery than females with a greater tendency to have multiple vessel involvement. Using this information, more large-scale, randomized controlled studies should be performed to correlate differences in the extent of coronary calcification with the observed variance in clinical presentation during coronary events between males and females as a means to potentially establish gender-specific therapeutic regimens. These noted differences may point to the answer and cause for observed presentation variations with respect to cardiac disease in men versus women.<sup>3</sup>

The supplement also highlights the essential nature of one of the cardiology field’s most accessible and commonly used imaging modalities: echocardiography. Echocardiographic indices have been used as predictors of prognosis and outcomes. For example, the determination of echocardiographic parameters that can be used to reliably assess the risk of the development of life-threatening ventricular arrhythmias (VA) can theoretically improve outcomes by guiding alterations in either pharmacologic or electrophysiologic therapy and in risk stratification prior to consideration for ICD implantation. The study in our supplement that demonstrates the main echocardiographic predictors associated with the first occurrence of VA may provide the impetus for more large-scale studies

evaluating the utility of readily available echocardiographic parameters as predictors of ventricular arrhythmias.<sup>4</sup> Another report<sup>5</sup> highlights the importance of echocardiography in the identification and evaluation of anatomical findings noted on imaging studies.

In a recent commentary,<sup>6,7</sup> the future of cardiovascular imaging is summarized by citing the following eight opportunities and challenges: “1) Imaging is crucial in cardiovascular health care delivery. 2) Multimodality imaging ranges from high-end, molecular imaging to hand-held devices. 3) [Cardiovascular imaging] allows detection of early disease, identification of the cardiovascular phenotype. 4) Possible use [of cardiovascular imaging] for novel drug development and as surrogate to patient outcome. 5) Multimodality imaging: adding complexity, looking for value, appropriate use, comparative effectiveness. 6) Novel technologies need to demonstrate value: impact on efficiency, patient care & outcome. 7) Health care providers need to avoid layering of testing with various imaging modalities and use the least radiation. 8) Research is needed to identify best and cost-effective approaches to disease detection and management in a digital & multimodality imaging world.”<sup>6,7</sup>

It is clear that cardiovascular imaging will always be an integral part of the practice and delivery of cardiovascular medicine. Emphasis must be placed on appropriate utilization of technology and resources and application of quality and safety techniques to assure adequate use and delivery of benefit. With this in mind, the future and current state of cardiovascular imaging is strong and will continue to grow and be an integral part of daily clinical practice for the management of the cardiovascular patient.

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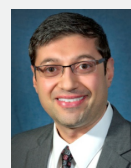
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## Lead Guest Editor **Dr Amgad N. Makaryus**

**Dr. Amgad N. Makaryus grew up in New York and completed medical school training at the State University of New York, Downstate Medical Center in 2000.** He then went on to complete his Internal Medicine residency and Cardiovascular fellowship at North Shore University Hospital in Manhasset, NY. Further subspecialty training in cardiovascular imaging including echocardiography, cardiac CT, and cardiac MRI was undertaken by Dr. Makaryus from 2006–2007 at Columbia-Presbyterian Medical Center, New York. This subspecialty fellowship in cardiac imaging focused on training and research projects in the field of cardiovascular imaging. He returned to North Shore University Hospital in 2007 and served as director of Cardiovascular CT and MRI (2008–2012) as well as director of the Echocardiography laboratory (2009–2012). In September of 2012, Dr. Makaryus became the chairman of Cardiology at Nassau University Medical Center, East Meadow, NY, USA, where he currently serves and maintains the role of Associate Professor at the Hofstra North Shore-LIJ School of Medicine.

Dr. Makaryus is board-certified in internal medicine and cardiology. He has additionally received certification from the National Board of Echocardiography, Certification Board of Nuclear Cardiology, Society of Cardiovascular Computed Tomography, and level II training in cardiac MRI. He is a founding member of the Society of Cardiovascular CT, member of the American College of Cardiology, the American Heart Association, the American Society of Echocardiography, the North American Society for Cardiovascular Imaging, and the American College of Physicians. He serves on the editorial board of the International Journal of Cardiovascular Imaging and has authored over a hundred peer-reviewed publications and book chapters in the field of cardiology and cardiovascular imaging. His research interests include the ideal application and integration of cardiovascular imaging into the appropriate diagnosis and management of patients with and at risk for cardiovascular disease.



amakaryu@numc.edu

<https://www.northwell.edu/find-care/find-a-doctor/internal-medicine/dr-amgad-nihad-makaryus-md-11317737>

## Guest Editors

### **ROMAN ZELTSE**

Dr. Roman Zeltser, Nassau University Medical Center's Director of Cardiac Clinical Services, also holds the academic title of Assistant Professor of Cardiology at the Hofstra North Shore-LIJ School of Medicine. Having graduated from SUNY Downstate Medical Center, he went on to complete his internal medicine residency training at Robert Wood Johnson University Hospital and his fellowship training in cardiovascular disease at the North Shore LIJ Health System. After graduation, Dr. Zeltser joined their faculty as Director of Non-Invasive Cardiology at Forest Hills Hospital. Dr. Zeltser has multiple clinical and research interests, both in clinical and nuclear cardiology as well as in medical education. His ongoing research projects include studies in resource utilization, American College of Cardiology appropriateness criteria guidelines applications and comparative research. He has had multiple poster presentations at national meetings including at the American Society of Nuclear Cardiology. He is dedicated to compassionate, patient centered care, where he treats the patient, not just the disease. He has a passion for teaching medical students and residents and considers bedside teaching with them an integral part of his daily activities.



rzeltser@numc.edu

<https://www.northwell.edu/find-care/find-a-doctor/cardiology/dr-roman-zeltser-md-11352742>



## DANIEL CHIKVASHVILI

Dr. Daniel Chikvashvili, attending Cardiologist at Nassau University Medical Center has an academic title of Assistant Professor of Medicine at SUNY Stony Brook University Medical Center. Having graduated from the Russia Academy Medical Institute in Moscow, he was working as a cardiologist at the Russia Academy National Institute of Clinical and Research Cardiology in Moscow. Dr. Chikvashvili has a Ph.D. degree in Cardiology and a Doctor of Science degree in Cardiology. After moving to the US, he completed his Residency in Internal Medicine at Nassau University Medical Center and Cardiology fellowship at the Stony Brook University Program. Dr. Chikvashvili had additional training in Cardiovascular Imaging at St. Luke's-Roosevelt Hospital Center, Columbia University College of Physicians and Surgeons. Dr. Chikvashvili is an author of 68 publications (including book chapters).



dchikvas@numc.edu

<https://portal.echo-cloud.com/31006portal/directory/DrProfile.asp?id=11116242++++>

## DALI FAN

Dr. Dali Fan is an Associate Professor of Medicine at the University of California, Davis. Dr. Fan received his Ph.D. degree from the Department of Neuroscience at the Albert Einstein College of Medicine in 1996. He completed his Medicine residency and Cardiovascular Disease fellowship at Beth Israel Medical Center in New York. He then pursued further training in Echocardiography at Massachusetts General Hospital. He went on to practice cardiology with a focus on echocardiography at St. Francis Hospital and North Shore University Hospital in New York. He now works primarily in cardiac electrophysiology, cardiology and cardiovascular medicine.



dali.fan@ucdmc.ucdavis.edu

<https://www.ucdmc.ucdavis.edu/publish/providerbio/search/1486>

## LAWRENCE BOXT

Dr. Lawrence Boxt is a consultant at the department of Radiology at Albany Medical Center, Albany, New York, USA. Dr. Boxt earned his undergraduate degree from the University of California, Berkeley prior to receiving his medical degree from the New York Medical College. Dr. Boxt has also been an educator for several years, most recently serving as a Professor of Clinical Medicine and Radiology at Albert Einstein College of Medicine of Yeshiva University since 2008. He has served on numerous committees for several organizations and currently sits on the executive committee of the Council on Cardiovascular Radiology for the American Heart Association. An extensive, international lecturer, Dr. Boxt has also contributed to hundreds of articles, reviews, chapters and editorials and currently serves on the editorial board of The International Journal of Cardiovascular Imaging. He is also a reviewer for Radiology and a scientific abstract review for the American Heart Association. In addition to the Society of Cardiovascular Computed Tomography (SCCT), Dr. Boxt is also a founding member of the Society for Cardiovascular Magnetic Resonance (SCMR).



lawrenceboxt@gmail.com

[http://www.intersocietal.org/dental/main/board\\_bios/bio\\_boxt.htm](http://www.intersocietal.org/dental/main/board_bios/bio_boxt.htm)



## JOHN N. MAKARYUS

Dr. John N. Makaryus was born and raised in New York. He completed his medical school training at the State University of New York, Downstate Medical Center in 2006, graduating with a Distinction in Research. He then went on to complete his Internal Medicine Residency, Chief Medical Residency, and Cardiovascular Disease Fellowship at the North Shore-LIJ Health System (NSLIJ). Following his training at NS-LIJ, Dr. Makaryus went on to complete an Advanced Cardiovascular Imaging Fellowship at Columbia University-New York Presbyterian Hospital in New York City where he received training in modern cardiac imaging techniques with a particular focus on Nuclear Cardiology including Positron Emission Tomography, as well as cardiac CT/MR imaging and echocardiography. He has authored over 35 peer-reviewed publications, book chapters, reviews, and editorials in the field of Cardiology, with a particular focus on cardiovascular imaging and has presented at both national and international conferences. His research interests include optimizing the application and integration of cardiovascular imaging into the diagnosis and therapeutic management of patients with cardiovascular disease. In 2014, he returned to North Shore University Hospital, Manhasset, NY, USA, where he currently serves as the Director of Nuclear Cardiology and is Assistant Professor of Cardiology at the Hofstra North Shore-LIJ School of Medicine, NY, USA.



jamakaryu@nshs.edu

<https://www.northwell.edu/find-care/find-a-doctor/cardiology/dr-john-nihad-makaryus-md-11363527>

**SUPPLEMENT TITLE:** Cardiovascular Imaging: Current Developments in Research and Clinical Practice

**CITATION:** Makaryus et al. Cardiovascular Imaging: Current Developments in Research and Clinical Practice. *Clinical Medicine Insights: Cardiology* 2014;8(S4) 57–61  
doi: 10.4137/CMC.S38846

**TYPE:** Editorial

**FUNDING:** Authors disclose no external funding sources.

**COMPETING INTERESTS:** Authors disclose no potential conflicts of interest.

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**CORRESPONDENCE:** amakaryu@numc.edu

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