

Cardiovascular Imaging: A Window into Diagnostic and Therapeutic Management

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Since the early days of B-mode/2-dimensional ultrasound and planar single-photon emission computed tomography, the field of cardiovascular imaging has experienced profound growth and a new level of sophistication. While echocardiography and nuclear cardiology continue to be the backbone of CV imaging in terms of patient assessment, new modalities—including cardiovascular computed tomography, cardiovascular positron emission tomography, and cardiovascular magnetic resonance—have emerged to augment both image quality and therapeutic management. Today's imaging arsenal has powerful applications that deliver more than diagnostic information via “pretty pictures”: It provides prognostic information that can guide patient management and help improve outcomes.

This issue of the *Methodist DeBakey Cardiovascular Journal* explores the power of today's imaging capabilities by experts from the University of California at San Francisco, Houston Methodist DeBakey Heart & Vascular Center, the King Abdulaziz Cardiac Center in Saudi Arabia, and Peking Union Medical College, part of the Chinese Academy of Medical Sciences in Beijing.

We begin with two reviews that highlight the evolving role of cardiac computed tomography angiography (CCTA). While early developments of CCTA had focused around coronary calcium scoring and detection of anatomic stenosis, today it is able to provide much more. An elegant review by Drs. Roosha Parikh, Su Min Chang, and colleagues highlights how CCTA can be used to characterize plaque composition and can be useful as an adjunct for planning and guiding percutaneous and surgical revascularization procedures. Most intriguingly, they highlight how the exquisite anatomic information provided by CCTA can be coupled with physiological information via CT perfusion or CT fractional flow reserve to model a simulated hyperemic blood flow response from a resting CCTA without inducing hyperemia or having to use a pharmacologic stress agent.

A second review of computed tomography, this one by Drs. Alpana Senapati, Su Min Chang, and colleagues, highlights the benefits of using multidetector CT (MDCT). With its broad coverage, faster scan acquisition times, and superior spatial resolution, MDCT can be used to identify prosthetic valve dysfunction and obstruction due to thrombosis or pannus

and plays a key role in preprocedural planning for patients undergoing transcatheter device placement.

There has been significant adoption of cardiovascular magnetic resonance (CMR) over the last several years, and this issue features two reviews highlighting why. The advent of late gadolinium enhancement solidified the role of CMR in assessing myocardial viability and ischemic heart disease, but recent research has also shown its use in detecting nonischemic cardiomyopathies. In our review, Dr. Eric Yang and I address the ability of CMR to characterize the heart at the structural and tissue level to aid in the diagnosis, prognosis, and management of patients with nonischemic cardiomyopathy. CMR is also gaining increasing traction for its ability to assess valvular heart disease. In a companion review, Dr. Maan Malahfji and I explain how the role of CMR in valvular heart disease extends beyond simple quantification of lesion severity; it also provides insight into tissue characteristics and has become the gold standard in studying ventricular remodeling.

The use of cardiovascular positron emission tomography (PET) has increased markedly due to the superior image quality it produces. In this issue, we present two manuscripts featuring two specific applications of PET in cardiovascular imaging. The first, by Drs. K. Carlos El-Tallawi, Mouaz Al-Mallah, and colleagues, describes the technical aspects of PET versus other modalities, its clinical uses for diagnostic and prognostic assessment of coronary arterial epicardial and microcirculatory disease, and its ability to quantify myocardial blood flow, which may be useful in identifying microvascular dysfunction. A second review of cardiac PET, this one by Drs. Shaden Khalaf and Mouaz Al-Mallah, discusses how specialized PET preparation protocols can enable assessment of myocardial viability and inflammation and explains how incorporating cardiac PET can improve the diagnostic accuracy for endocarditis.

Imaging has traditionally been intertwined with technologic innovations, and since this continues to be the case in 2020, we include two reviews on the intersection of imaging and technology. Advances in clinical imaging have fueled the expansion of structural heart interventions such as transcatheter aortic valve replacement, but the intricate, dynamic nature of cardiac structures can make these interventions challenging to perform. A review by Drs. Marija Vukicevic, Stefano

Filippini, and Stephen Little highlights how imaging data from echocardiography, computed tomography, and cardiac magnetic resonance can be used to generate 3D printed patient-specific anatomic models for comprehensive planning and simulation of structural heart interventions.

In a separate review, researcher Lisa Lim and Drs. Geoffrey Tison and Francesca Delling provide an insightful overview of the impact of artificial intelligence (AI) on cardiovascular imaging. With the use of large datasets, AI has the potential to reduce human error, save time in the clinical workflow, and improve patient care at every stage of the imaging chain. The authors describe the role of AI applications in various CV imaging modalities and explain how it can aid in disease recognition and prediction of CV outcomes.

Lastly, we veer away from cardiac imaging to focus on a developing and all-consuming health care issue. The current COVID-19 pandemic has reshaped our professional lives in the past few months and will undoubtedly continue to do so. Many of us have adapted our practices to incorporate telemedicine and remote image interpretation. While much is still to be

learned about COVID-19, it is becoming clear that there are major cardiovascular implications. Drs. Akanksha Thakkar, Mouaz Al-Mallah, and others have compiled a very timely review of what is currently known regarding the cardiovascular implications of COVID-19. One key point emerges: patients with cardiovascular disease or risk factors incur a higher risk of developing CV complications and higher mortality from COVID-19 infection. Whether we see COVID-19 patients acutely or not, we are very likely to encounter these patients in the chronic phase after recovery. Imaging will no doubt play a key part in their long-term management.

We hope this overview of cardiovascular imaging is informative, clinically useful, and emphasizes the growing importance of advanced imaging modalities. We are very grateful to our readers for their continued interest and support, and to our expert authors for providing up-to-date, insightful content. For further discussion and CME opportunities, I invite you to visit the journal's website at <http://journal.houstonmethodist.org>, where you can view supplemental videos and use the "Dialogue with Authors" link to have an open Q&A with the authors of this issue.