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Commentary

The frontiers of nuclear cardiology research

Ji Chen

Department of Radiology and Imaging Sciences, Emory University School of Medicine, Atlanta, GA 30322, USA.
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Heart disease is the leading cause of death. Each year in the United States, more than 500,000 men and women die from coronary artery disease (CAD). CAD results from the narrowing of blood vessels that supply the heart. The blood vessels become narrow when fatty deposits build up inside the arterial wall. When the arteries become clogged, the blood flow to the myocardium is impaired and a heart attack can occur. Nuclear cardiology studies use noninvasive imaging techniques to assess myocardial blood flow. Among the techniques of nuclear cardiology, single-photon emission tomography (SPECT) myocardial perfusion imaging (MPI) is most widely used to diagnose CAD. The annual number of SPECT MPI procedures is 7-8 million in the United States.

The research in the field of nuclear cardiology is everlasting and prosperous. The specific journal that publishes nuclear cardiology research studies is the Journal of Nuclear Cardiology, the official publication of the American Society of Nuclear Cardiology. Readers interested in nuclear cardiology research studies can also find their articles in many other imaging journals as well as cardiology journals. In this issue, the Journal of Biomedical Research publishes a series of reviews on the cutting edges of several research areas in nuclear cardiology.

Dr. Hung´s article[1] reviews the research efforts in exploring additional markers for diagnosing CAD from the conventional SPECT MPI. SPECT MPI is mainly indicated for the evaluation of patients with suspected or known CAD through the assessment of presence, location, extent, and severity of myocardial ischemia and infarction. However, the diagnostic accuracy of SPECT MPI is limited, especially in patients with a multi-vessel disease. Therefore, extensive research studies have been performed to search for additional markers from SPECT MPI that can provide incremental diagnostic value. There are three quantitative markers reviewed in Dr. Hung´s article: transit ischemic dilation, stress-induced stunning, and stress-induced dyssynchrony. These markers compare the parameters of left-ventricular (LV) function between the stress and rest images, based on the concept that stress-induced myocardial ischemia can cause regional and global functional abnormalities. Transit ischemic dilation refers to a significant enlargement in LV size on the stress images as compared to the rest images. Stress-induced stunning refers to a significant reduction in LV ejection fraction (LVEF) from rest to stress. Stress-induced dyssynchrony refers to a significant increase in the LV dyssynchrony parameters measured by phase analysis from rest to stress. These markers have been shown as useful tools to increase the diagnostic accuracy of SPECT MPI, especially in patients with a multi-vessel disease.

Dr. Hsu´s article[2] reviews MPI tracers and techniques of positron emission tomography (PET). PET has superior spatial and temporal resolution to SPECT and is capable of measuring absolute myocardial blood flow (MBF). Extensive research studies have

Corresponding author: Ji Chen, PhD, FACC, FASNC. Department of Radiology and Imaging Sciences, Emory University School of Medicine, 1364 Clifton Rd NE, Atlanta, GA 30322, USA. Tel/Fax: 1-404-712-4024/1-404-727-3488, Email: jchen22@emory.edu.

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shown that PET MBF measurements have incremental diagnostic value in CAD patients, especially in those with a multi-vessel disease. There are three PET MPI tracers reviewed in Dr. Hsu´s article: O-15, N-13, and Rb-82. These tracers have different kinetics following injection, and thus their imaging methods and flow quantitation models are different. Moreover, because of their different imaging methods there are different practical considerations for the clinical use of these tracers. In Dr. Hsu´s article, these differences are clearly noted and compared.

Dr. Piccinelli et al.[3] review the image fusion techniques that integrate SPECT MPI and cardiac CT angiography (CTA) to diagnose CAD. This multimodal fashion of image assessment has been shown to greatly improve the diagnostic accuracy of both modalities. Since SPECT MPI and CTA provide the complementary functional and anatomical information, such multimodal method can overcome some of the limitations of the individual modalities and provide a comprehensive assessment of CAD. Software techniques to accurately register the SPECT MPI and CTA images into a fused 3D display can further improve the visualization and analysis of the images and provide an incremental diagnostic value over the side-by-side approach.

The above three areas represent the major research efforts that are aimed to improve the current clinical practice of nuclear cardiology. In the last article, Dr. Zhou et al.[4] introduces a novel tracer, I-123 MIBG, and its associated imaging techniques, which can predict ventricular arrhythmias in heart failure. I-123 MIBG is an imaging tracer for the assessment of myocardial sympathetic innervation in evaluation of patients with heart failure and severe LV dysfunction. Its relative scintigraphic uptake in the heart compared with a reference region in the mediastinum can accurately identify heart failure patients with lower-than-average one- and two-year mortality risk. The integration of I-123 MIBG SPECT and Tc-99m SPECT MPI can provide regional assessment of myocardial innervation and infarction for predicting ventricular arrhythmia and cardiac mortality. I-123 MIBG has been recently approved by FDA in the United States and has a clear potential to bring new patient populations to nuclear cardiology practice.

In summary, the series of reviews cover several major research areas of nuclear cardiology. As an important sub-specialty of cardiovascular imaging, nuclear cardiology strives to improve its quality, collaborate with other imaging modalities, and expand its clinical applications through extensive research efforts.

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