



A quick glance at selected topics in this issue

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“A quick glance at selected topics in this issue” aims to highlight contents of the *Journal* and provide a quick review to the readers. (*J Nucl Cardiol* 2019;26:1505–8.)

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Abbreviations

CAD Coronary artery disease

MPI Myocardial perfusion imaging

SPECT Single photon emission computed tomography

PET Positron emission tomography

MRI Magnetic resonance imaging

LV Left ventricle

CZT Cadmium zinc telluride

“A quick glance at selected topics in this issue” aims to highlight contents of the *Journal* and provide a quick review to the readers. Recently, we have also started to provide the quick glance write up in an audio format via the JNC/ASNC Podcast (<https://soundcloud.com/jnc-podcast/quick-glance-september-october-2019-hagebhambhvani>), which can be accessed on iTunes, Spotify and most podcast manager applications. We realize that many of you do not have time to read all journals or attend all national meetings. For that reason, every issue of the JNC includes 2 types of literature reviews. One summarizing recent key nuclear cardiology articles that have been published in journals other than ours (<https://doi.org/10.1007/s12350-019-01837-2>) while the second outlines select publications in the general cardiovascular disease literature that have

relevance to our field (<https://doi.org/10.1007/s12350-019-01840-7>). Another entry in the current issue is the historical corner that looks at the career and scientific contributions of two pioneers in Nuclear Imaging, Barry Zaret, MD and William H. Strauss, MD (<https://doi.org/10.1007/s12350-019-01707-x>). The international corner manuscript by Antonio-Villa et al from Mexico City, Mexico (<https://doi.org/10.1007/s12350-019-01737-5>) reports the high prevalence of comorbidities (Type 2 Diabetes Mellitus 38.6%, HTN 36.9%, Smoking 25.9%, Dyslipidemia 25.9% and prior MI 40.3%) in 1998 patients with suspected or known ischemic heart disease that present for SPECT MPI to a large teaching hospital/reference cardiology center (National Institute of Cardiology Ignacio Chavez) in Mexico City, Mexico. These manuscripts are complimented by a great selection of original articles with accompanying editorials, brief reports, ‘What is this image’ and ‘Images that Teach’ and a CME review paper by Manabe and colleagues from Japan (<https://doi.org/10.1007/s12350-018-1312-x>) on ‘The role of multimodality imaging in takotsubo cardiomyopathy’. Many of the original articles also have accompanying PowerPoint slides. The abstract of the

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lead original article 'Improving perfusion defect detection with respiratory motion correction in cardiac SPECT at standard and reduced doses' by Song and colleagues from The Netherlands, has also been translated into Spanish, Chinese and French in response to requests from the international readership. PowerPoint slides from this paper can be found by searching <https://doi.org/10.1007/s12350-018-1374-9>. Also included in the issue by Kwiecinski and colleagues, (<https://doi.org/10.1007/s12350-019-01816-7>) are summaries of a selection of nuclear cardiology abstracts from the scientific sessions of The Society of Nuclear Medicine and Molecular Imaging 2019 annual meeting in Anaheim, CA. The Case Presentation Corner discusses hybrid imaging with PET/MRI for the diagnosis and management of cardiac sarcoidosis (<https://doi.org/10.1007/s12350-019-01770-4>).

Our comments on a few selected papers noted below are therefore only the tip of the iceberg. These manuscripts were selected at random and we sincerely believe all original articles serve a purpose, provide great value, and have undergone an intense peer review.

Respiratory motion is known to cause nonuniform blurring of MPI, which may negatively affect its diagnostic performance. Song et al (<https://doi.org/10.1007/s12350-018-1374-9>) investigate the benefit of respiratory motion correction with standard and reduced tracer doses for detection of myocardial perfusion defects. Two reconstruction methods were tested. Post-reconstruction motion correction, where motion correction is applied after the images are first obtained from the individual respiratory bins and motion-compensated reconstruction, wherein the projection data from the different respiratory bins are used simultaneously for reconstruction of the source distribution with respect to a reference bin through motion compensation. The investigators find that both at full and reduced tracer doses, motion correction could achieve higher perfusion defect detection accuracy over traditional nonmotion corrected acquisitions. Thus use of respiratory motion correction can allow for use of tracer dose reductions while maintaining the diagnostic accuracy in traditional SPECT MPI reconstruction.

A decreased quantitative Heart-to-Mediastinum ratio (< 1.6) of counts derived from a 4-hour delayed planar acquisition of ^{123}I -mIBG, is a strong predictor of poor outcomes in patients with stable class II-III heart failure and $\text{LVEF} \leq 35\%$ compared to those with an H/M ratio in the normal range ($\text{H/M} > 1.60$). Bateman and colleagues (<https://doi.org/10.1007/s12350-017-1183-6>) perform a 10-center study to assess the test-retest reproducibility of the ^{123}I -mIBG derived H/M ratio in 47 stable heart failure subjects on planar imaging at 3 hours 50 minutes following its intravenous administration. All

subjects were imaged twice (5-14 days apart), the second image performed with the same radionuclide dosage and on the same camera system. The results demonstrate that the planar H/M ratio is a highly consistent measurement when the clinical circumstances are stable. The variation between scans was less than 0.1. As a secondary end point, no safety concerns were identified with repeat ^{123}I -mIBG administration.

Chagas disease is endemic in many regions of Latin America and in its chronic phase leads to a dilated cardiomyopathy 2-3 decades after the initial infection. Studies have demonstrated a high rate of ischemic perfusion defects (30-50%) in chronic Chagas disease patients along with normal sub-epicardial coronary arteries, suggesting that the perfusion disturbances occur due to coronary microvascular dysfunction. Tanaka et al from Brazil (<https://doi.org/10.1007/s12350-018-1198-7>) investigate whether myocardial perfusion defects precede left ventricular systolic dysfunction and also test the hypothesis that prolonged use of dipyridamole (given as an intraperitoneal injection of 4 mg/kg twice a day for 30 days) could reduce myocardial perfusion defects in an experimental hamster model of chronic Chagas cardiomyopathy. Study results show that resting myocardial perfusion defects are frequent and precede the development of LV systolic dysfunction. The areas with perfusion defects were topographically unrelated to regional myocardial fibrosis at histopathology and prolonged administration of dipyridamole, an antiplatelet and vasodilator agent, was associated with a significant reduction of resting myocardial perfusion defects indicating presence of viable myocardium and confirming the role of microvascular dysfunction in chronic Chagas cardiomyopathy.

Attenuation correction (AC) is a well-known technique to improve the diagnostic performance of MPI. Low dose transmission CT enables attenuation correction in the combined SPECT/CT camera systems. Huang and colleagues from Taiwan (<https://doi.org/10.1007/s12350-018-1230-y>) evaluate the diagnostic performance of thallium (^{201}Tl) MPI with CTAC compared to non-AC images and determine which participants would be most benefited. In Taiwan, MPI is mostly performed using ^{201}Tl with dipyridamole stress because of the lower cost and single injection for stress-redistribution studies. A total of 108 consecutive patients who underwent ^{201}Tl MPI and received coronary angiography within 3 months were enrolled. Results showed that CTAC improved the area under the curve (0.84 vs. 0.77, $P = .037$ at patient level), primarily due to a significant improvement in specificity (0.78 vs. 0.57, $P = .013$) and an insignificant difference in sensitivity (0.79 vs. 0.82, $P = .75$). In subgroup analysis, CTAC was most helpful in obese subjects, men and with right coronary artery

lesions. The observed findings support routine use of CTAC with ^{201}Tl MPI for CAD evaluation.

Cardiac testing for patients with chest discomfort who are at low risk for acute coronary syndrome is a challenge that involves judgments in safety, resource utilization, and value. “Low-risk patients” are defined as those who are hemodynamically stable, free of arrhythmias or ischemic electrocardiographic changes, and have negative initial cardiac biomarkers. Krishnan et al from Massachusetts General Hospital, Boston (<https://doi.org/10.1007/s12350-017-1172-9>), study the utilization of stress testing in 292 low-risk patients with chest discomfort in the emergency department. 31% were exercise treadmill tests without imaging and 69% were pharmacologic or exercise stress tests with MPI. 33 (11.3%) had stress tests positive for ischemia, and 12 (4.1%) underwent diagnostic cardiac catheterization. Of the 292 patients, 4 (1.4%) underwent coronary revascularization that may have resulted in a mortality benefit (e.g., multi-vessel CAD). The data suggest a low yield of detecting clinically significant CAD and need for subsequent revascularization from stress testing of low-risk patients in the emergency department chest pain unit setting and potential overutilization of stress testing. Better risk-stratification (e.g., history of CAD) prior to stress testing may improve the value of care provided to this low risk population in emergency departments and chest pain units nationwide.

Diabetic cardiomyopathy is a well-known entity that encompasses the preclinical left ventricular diastolic dysfunction, followed by apparent systolic dysfunction and finally symptomatic cardiac failure in the absence of CAD, or significant valvular heart disease, or hypertension. Gated SPECT-MPI is a proven noninvasive imaging technique for providing fully automated and reproducible phase analysis in the evaluation of left ventricular mechanical dyssynchrony (LVMD) and can help in identifying the subset of patients, who might be the candidates for cardiac resynchronization therapy. Prior data suggests that LVMD might represent the very early phase of diabetic cardiomyopathy in asymptomatic patients. LVMD has also been recognized an independent factor for cardiac events. Malik and colleagues from PGIMER, Chandigarh, India (<https://doi.org/10.1007/s12350-018-1208-9>), evaluate the prevalence and risk factors of LVMD in longstanding type II diabetes mellitus patients with normal gated $^{99\text{m}}\text{Tc}$ -MIBI SPECT-MPI. A total of 146 patients (86 type II diabetics for > 5 years’ duration and 60 nondiabetics) were retrospectively studied. LVMD was detected in 24 (28%) diabetic patients with the predefined cut-off values for phase standard deviation (> 10.8) and phase bandwidth (> 35.6) derived from the controls. Hyperlipidemia, overweight/obesity, duration of DM, and its long-term

complications (i.e., nephropathy, neuropathy, and/or retinopathy) were independently associated with LVMD, with long-term complications being the highest risk factor (OR 28.00; $P < .001$). Thus, the presence of LVMD in asymptomatic diabetic patients with preserved LV volumes/function may have an important role in the early pathogenesis and should prompt aggressive management for the prevention of diabetic cardiomyopathy.

Myocardial perfusion imaging often utilizes CT-based attenuation-correction (CTAC) to reduce attenuation artifacts and improve specificity. However, the identification of incidental noncardiac findings on CTAC images represents a diagnostic and reporting dilemma. Julie He and colleagues from Connecticut, USA (<https://doi.org/10.1007/s12350-018-1232-9>) conducted a single-center (West Haven VA Medical Center), prospective cohort, quality control project to evaluate the prevalence of clinically actionable noncardiac incidental findings on low-dose CTAC images obtained during nuclear MPI studies in 771 veteran patients. In addition, they compared the inter-reader agreement between cardiologists and an over-reading radiologist in identifying these incidental findings. The readers were asked to identify the following extracardiac findings: pulmonary nodule < 10 mm, pulmonary nodule \geq 10 mm, extracardiac mass of any type, hiatal hernia, aortic aneurysm, and pleural plaque. On the 771 scans performed over eight months, 285 incidental noncardiac findings were identified by the interpreting cardiologists and 378 by the interpreting radiologist. Pulmonary nodules were the most common occurring in 20% of studies read by the radiologist. Interreader agreements between cardiologists and the radiologist were poor for pulmonary nodules \geq 10 mm and hiatal hernias; fair for pulmonary nodules < 10 mm, extracardiac masses, and aortic aneurysms; and moderate for pleural plaques. Overall incidental noncardiac findings on CTACs were commonly found in the veteran population (occurring in over 40% of patients) and a majority of these were previously unknown. Although interreader agreement for any of the abnormal CT findings was fair overall, there was appreciable variability. The authors suggest that specific training guidelines are needed on how CTACs should be read and reported by cardiologists.

Dynamic changes in global and regional LV contractility during stress conditions are a strong predictor of adverse events in a wide range of cardiovascular conditions including CAD, dilated cardiomyopathy, and valvular dysfunction. Nkoulou et al from Switzerland (<https://doi.org/10.1007/s12350-018-1187-x>) evaluate the feasibility of LVEF measurements and its accuracy to detect clinically relevant changes in EF (ΔEF) during a standard dobutamine stress protocol assessed by real-

time high speed gated-SPECT (CZT camera) and compare with rest/dobutamine cardiac magnetic resonance imaging (CMR) as standard of reference. The current SPECT gamma cameras (with sodium iodine crystal) require an acquisition time for gated SPECT MPI of 15 minutes or longer. This precludes a true/real-time assessment of LV function and diameter during maximal stress including TID (transient ischemic dilation). The latest generation of SPECT cameras with cadmium-zinc-telluride (CZT) detector technology offers ultrafast MPI assessment at 3 minutes acquisition time and may therefore be potentially used for sequential real-time EF acquisition at each step of a standard dobutamine stress followed by rest protocol. Fifty consecutive patients referred for SPECT MPI were enrolled for the feasibility study. The authors found excellent correlation and agreement between the CZT and CMR rest EF values. EF during high dobutamine stress acquisition using CZT camera correlated better to high dobutamine stress CMR EF than did post-stress CZT EF ($r = 0.85$ vs 0.76 , respectively, all $P < .001$). Thus, real-time ultrafast dobutamine stress gated-SPECT MPI with a CZT device is feasible and provides accurate measurements of LV performance during peak stress.

Technetium-based bone scintigraphy has become the most common noninvasive imaging tool for the diagnosis of transthyretin cardiac amyloidosis. While technetium-99m pyrophosphate (Tc-PYP) is available in the United States, other agents such as technetium-99m 3,3-diphosphono-1,2-propanodicarboxylic acid (Tc-DPD) and technetium-99m hydroxymethylene diphosphonate (Tc-HMDP) are more commonly used in Europe and other parts of the world. Skeletal muscle

uptake has been described with Tc-DPD and may account for the masking of osseous uptake that can be seen in grade 3 cardiac uptake patients. Additionally there is suspicion that significant muscle and soft tissue uptake with DPD or amyloid-specific agents like F18-florbetapir may point to the presence of amyloid myopathy. However, the presence of significant skeletal muscle uptake with other bone tracers is unknown. Sperry et al investigate skeletal muscle uptake of Tc-PYP in 57 patients with diagnosis of transthyretin cardiac amyloidosis (<https://doi.org/10.1007/s12350-017-1166-7>). They find no appreciable tracer uptake in skeletal muscle or soft tissue on both qualitative and quantitative assessments and no difference between those with grade 3 vs. 2 cardiac uptake or the presence of hereditary ATTR. The authors conclude that the properties of Tc-PYP may be different than Tc-DPD with respect to noncardiac soft tissue uptake.

We encourage the readers to look at the several other articles in the Journal with accompanying scholarly and informative editorials that not only put the findings in perspectives but also outline future directions. We would like to hear your comments as we strive to gain knowledge and in the process, improve patient care.

Disclosures

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