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MEETING HIGHLIGHTS

Highlights of the 2005 Scientific Sessions of the American Society of Nuclear Cardiology

Seattle, Washington, September 29–October 2, 2005

Jeroen J. Bax, MD, PHD,* Brian G. Abbott, MD,† Daniel S. Berman, MD,‡ Ernest V. Garcia, PHD,§ Robert S. Gropler, MD,‖ Robert C. Hendel, MD,¶ Diwakar Jain, MD, *Program Chair*,# Jennifer H. Mieres, MD,** Raymond R. Russell, MD, PHD,†† Leslee J. Shaw, PHD,‡ James E. Udelson, MD,‡‡ Frans J. Th. Wackers, MD, PHD,†† on behalf of the ASNC Scientific Program Committee

Leiden, the Netherlands; Providence, Rhode Island; Los Angeles, California; Atlanta, Georgia; St. Louis, Missouri; Fox River Grove, Illinois; Philadelphia, Pennsylvania; Manhasset, New York; New Haven, Connecticut; and Boston, Massachusetts

The American Society of Nuclear Cardiology (ASNC) now consists of more than 4,700 nuclear cardiology professionals. The 10th Annual Scientific Session (chaired by Dr. Diwakar Jain) was held from September 29 through October 2, 2005 in Seattle Washington, with more than 1,500 registrants in attendance. This four-day meeting was divided into five major tracks (plenary sessions, core curriculum, advanced track, investigative track, and technical track), as well as read-with-the-expert sessions and satellite symposia. In addition, original research was contributed in the form of abstract presentations, and included a competition for the Young Investigator Award.

PLENARY SESSIONS

Clinical debates: controversies in clinical cardiology and cardiac imaging. The first plenary session consisted of a series of debates, and the first considered the issue of screening all asymptomatic diabetic patients for coronary artery disease (CAD).

Dr. Frans J. Th. Wackers argued that screening was appropriate because of the well-documented excessive cardiovascular morbidity and mortality in patients with diabetes. However, because the overall prevalence of silent CAD is relatively low (22% in the Detection of Ischemia in Asymptomatic Diabetes [DIAD] study), it is important to identify "enriched subgroups" with a higher diagnostic yield. Coronary artery calcium (CAC) scoring with electron beam computed tomography may be an appropriate and simple first step, and only patients with substantial CAC would require stress radionuclide myocardial perfusion imaging (MPI). Dr. Raymond Gibbons argued that there is insufficient evidence that screening of asymptomatic diabetic patients alters outcome. Moreover, the cost in health care dollars to society would be staggering and prohibitive. He argued that primary prevention and treatment, and appropriate evidence-based testing would be more effective than routine screening.

In the second debate, Drs. Jack Ziffer and Marcelo DiCarli addressed the pros and cons of non-invasive computed tomography angiography (CTA). Dr. Ziffer believed that 64-slice computed tomography (CT) would ultimately replace stress MPI because of the detailed anatomic information that can be obtained. Computed tomography not only detects CAC, coronary anatomy, and luminal stenoses but also visualizes alterations of the coronary vessel wall, allowing plaque characterization. In addition, left ventricular (LV) function can readily be assessed by CT, making it a "one-stop stop." The high specificity of CTA will allow adequate exclusion of CAD with eventual replacement of invasive cardiac catheterization. Dr. DiCarli argued that CTA would not replace MPI because of inherent technical limitations. Computed tomography angiography still has limited spatial resolution for distal vessels; the overall sensitivity for the presence of proximal stenoses is 95%, but decreases to 82% when distal stenoses are included. Multislice CT is limited by the patient's radiation exposure, arrhythmias during acquisition, and nephrotoxicity of contrast. Also, coronary calcifications, frequently present in elderly and diabetic patients, negatively affect diagnostic accuracy. Most important, extensive literature has shown that not coronary anatomy (CTA) but the ischemic burden (MPI) determines prognosis: coronary anatomy versus coronary pathophysiology.

In the third debate, Drs. Timothy Bateman and Manuel Cerquiera debated whether positron emission tomography (PET) MPI would replace single-photon emission computed tomography (SPECT) MPI. Dr. Bateman argued that PET

From *Leiden University Medical Center, Leiden, the Netherlands; †Brown Medical School Providence, Rhode Island; ‡Cedars-Sinai Medical Center, Los Angeles, California; §Emory University School of Medicine, Atlanta, Georgia; ‖Washington University School of Medicine, St. Louis, Missouri; ¶Midwest Heart Specialists, Fox River Grove, Illinois; #Drexel University College of Medicine, Philadelphia, Pennsylvania; **North Shore University Hospital, Manhasset, New York; ††Yale University School of Medicine, New Haven, Connecticut; and the ‡‡Tufts-New England Medical Center, Boston, Massachusetts.

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Abbreviations and Acronyms

ASNC = American Society of Nuclear Cardiology
CAC = coronary artery calcium
CAD = coronary artery disease
CT = computed tomography
CTA = computed tomography angiography
ECG = electrocardiogram
ICD = implantable cardioverter-defibrillator
LV = left ventricular
MIBG = ^{123}I-metaiodobenzylguanidine
MPI = myocardial perfusion imaging
MRI = magnetic resonance imaging
PET = positron emission tomography
SPECT = single-photon emission computed tomography

was simply better because of higher spatial resolution, higher contrast, higher count density, routine use of attenuation correction, and less scatter. Also, patient radiation dosimetry is considerably lower using short-lived positron emitters, and PET imaging is substantially faster than SPECT imaging. The diagnostic yield of PET imaging has been consistently better with PET than with SPECT (accuracy 87% vs. 71%). Dr. Cerquiera conceded that the quality of PET was superior to that of SPECT, but he did not expect SPECT to be replaced by PET for practical and economic reasons. Positron emission tomography imaging is difficult to perform in a regular clinical practice. The PET camera and cyclotron are expensive, costly to operate, require large spaces and specially trained personnel. Lastly, ^{82}Rubidium generators make it possible to perform PET MPI studies in facilities without a cyclotron but are still expensive.

The Mario Verani Memorial Lecture: Dr. Daniel Berman: cardiac imaging in CAD: changing roles and changing players. The highlight of the second plenary session was the Mario Verani Memorial Lecture by Dr. Daniel Berman. The Mario Verani lecture is presented each year at the ASNC annual meeting by a prominent nuclear cardiologist, in memory of Dr. Mario Verani (1943 to 2001), a pioneer in nuclear cardiology and founder and past president of the ASNC. Dr. Berman discussed the changes occurring in cardiology, changing concepts, changing clinical questions. With the aging population, increase of obesity, diabetes, and metabolic syndrome, the clinical picture of CAD has changed. In addition, marked changes have occurred in the ability to treat patients and reduce the risk. In the past, it was sufficient to identify the patient who needed revascularization; in the present era the challenge is to identify the asymptomatic patient who needs aggressive medical treatment. The armamentarium of cardiac imaging has expanded and changed. Non-invasive cardiac imaging of anatomy and function is central to the diagnosis and management of patients with known or suspected CAD. The new players in the diagnostic game are, in addition to conventional radionuclide MPI with electrocardiogram (ECG)-gated SPECT, CT techniques, sophisticated echocardiographic techniques, magnetic resonance imaging (MRI), and PET. Radionuclide imaging is increasingly combined with CT imaging. The wealth of information provided by hybrid imaging devices allows for the development of new diagnostic and management algorithms. Depending on the a priori risk of CAD, physicians have to decide if imaging is needed, and if so, which test.

Patients at low (<15% likelihood of CAD) risk are generally not tested. Patients with typical and limiting angina must be sent directly to cardiac catheterization. In the intermediate-risk populations (15% to 85% likelihood), screening for CAC by CT scanning appears appropriate and subsequent management can be guided by the degree of CAC detected. Patients with CAC and extensive (quantified) myocardial ischemia on MPI should be managed invasively. On the other hand, patients with CAC but minimal ischemia are candidates for aggressive medical therapy. Computed tomography angiography may be indicated in patients with CAC and moderate myocardial ischemia on MPI to ensure that no high-risk CAD is missed. It seems likely that combined (or sequential) diagnostic testing with CT and SPECT (or PET) in the near future will provide means to diagnose CAD tailored to the type of patients and symptoms.

CORE CURRICULUM: ADVANCES IN CLINICAL NUCLEAR CARDIOLOGY

New tracers in nuclear cardiology. Dr. James Udelson discussed the use of new tracers to assess cardiac sympathetic innervation and fatty acid metabolism. Cardiac sympathetic innervation can be evaluated using ^{123}I-metaiodobenzylguanidine (MIBG); tracer uptake in the heart is compared with activity in the mediastinum, yielding the heart-to-mediastinum ratio. A reduced heart-to-mediastinum ratio is a powerful predictor of poor outcome in patients with severe heart failure, even more predictive than LV ejection fraction, peak oxygen consumption, and pulmonary capillary wedge pressure.

More recent studies have compared perfusion with MIBG uptake in patients with previous infarction and demonstrated that the extent of denervated myocardium frequently exceeds the area of reduced perfusion. The clinical relevance of this observation relates to the fact that patients with this perfusion-MIBG mismatch could be at increased risk of ventricular arrhythmias, and it is hoped that MIBG imaging may help in the selection of patients who need an implantable cardioverter-defibrillator (ICD). Improved patient selection is needed, because the devices are costly and many patients are potential candidates for ICD therapy. According to the Multicenter Automatic Defibrillator Implantation Trial (MADIT)-II criteria, patients with previous infarction and depressed LV ejection fraction (≤30%) should receive an ICD, but only 35% of these patients received appropriate shocks over a three-year period.

Evaluation of free fatty acid metabolism can be performed with ^{123}I-betamethyl-p-iodophenyl-pentadecanoic acid. The main interest is identification of regions that

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have recently been exposed to ischemia ("ischemic memory imaging"). After an ischemic attack, cardiac glucose metabolism becomes increased, whereas free fatty acid metabolism is depressed (shift towards anaerobic glycolysis). In the hours after the ischemic attack, perfusion has normalized frequently, but free fatty acid metabolism remains depressed, and glucose utilization increased. The value of ^{18}F-fluorodeoxyglucose for assessing increased glucose utilization as a memory marker of ischemia was recently demonstrated. Likewise, the value of betamethyl-p-iodophenyl-pentadecanoic acid for this purpose is currently under investigation.

New pharmacologic stress agents. Dr. Robert Hendel addressed the new pharmacologic stress agents. This is an important area of development, because each year approximately three million pharmacologic stress procedures are performed and, although serious adverse events are rare (e.g., atrioventricular block in <8% and bronchospasm in <1%), minor side effects are noted in 55% to 80% of patients. Another challenge is that the currently available pharmacologic stress agents require a continuous infusion, whereas bolus administration may be preferred for efficiency in the stress laboratory. Under development are specific A2A adenosine agonists that will provide for a more specific cardiac response. For these new agents, coronary hyperemia is similar to adenosine, resulting in a three- to five-fold increase in blood flow. However, in contrast to adenosine, there is a marked increase in coronary blood flow but little response in the peripheral circulation. Accordingly, the drop in blood pressure is modest. The onset of action for these new agents is in the range of <1 to 3 min, and the duration of action is <10 to 20 min. Current adenosine A2A agonists under development with clinical trial evidence include: Binodenoson (MRE-0470), Regadenoson (CVT-3146), and BMS 068645 (ATL-146e). Each of these new products has no significant effects on atrioventricular conduction, and there appears to be a reduction in overall side effects as a result of damped peripheral vasodilation. Moreover, the diagnostic information with these new A2A adenosine agonists is equivalent to that of adenosine, although additional clinical trials and Food and Drug Administration approval are still required for establishing these new pharmacologic stress agents as a valuable replacement for adenosine or dipyridamole.

TECHNICAL TRACK: INNOVATIONS IN CLINICAL NUCLEAR CARDIOLOGY

Attenuation correction. Several presentations emphasized the need to implement acquisition protocols that shorten the total imaging time to increase patient throughput and comfort. An extremely rapid protocol with ^{82}Rb-ECG-gated rest/stress PET/CT using Regadenoson (CVT-3146) could be completed in 15 min. In this protocol, the CT would be performed first allowing for attenuation correction, followed by the rest-stress perfusion study with ^{82}Rb-PET.

Furthermore, the importance of proper quality control for attenuation correction was heavily emphasized in order to generate high-quality diagnostic studies. Special emphasis was placed on new technology, such as the newer small foot-print, smaller field-of-view, and cardiac dedicated SPECT systems. These systems, which use a moving radioactive line source for the transmission scan, are prone to body truncation artifacts that misrepresent the amount of attenuation potentially affecting the emission projections. Transmission images should be visually or automatically analyzed to detect these truncations, and algorithms to compensate for these truncations were also described.

Quality control for attenuation correction with hybrid PET/CT and presumably SPECT/CT systems is also important. Because the CT transmission scan is performed extremely fast as compared with the slower PET or SPECT acquisition, there is a high probability for misregistration between the emission and transmission scans due to breathing and cardiac motion. The importance of using manual or automatic algorithms to detect the transmission-emission misregistration and subsequently correctly re-register both scans was well documented.

ADVANCED TRACK: MULTI-MODALITY CARDIAC IMAGING

The evolving role of multi-modality cardiac imaging in the clinical management of CAD was the main focus of several sessions in the advanced track. The first session was a joint session with the American Society of Echocardiography, which was dedicated to assessment of function and perfusion.

Function and perfusion: nuclear imaging versus echocardiography: joint session with the American Society of Echocardiography. Dr. Mario Garcia summarized the parameters of LV function that can be assessed by echocardiography, including LV ejection fraction, strain, diastolic relaxation and electromechanical (dys)synchrony. Accurate assessment of these parameters requires the use of several modern echocardiographic techniques, including contrast echocardiography, three-dimensional echocardiography, and tissue Doppler imaging. Assessment of these variables has important implications in the evaluation and treatment of systolic and diastolic heart failure. The review of radionuclide methods of functional assessment by Dr. Gordon DePuey focused on gated blood pool imaging using either planar methods or the more recently developed gated blood pool SPECT method. The benefits of gated blood pool SPECT over the planar methods include the assessment of both right ventricular and LV function without the need for performing first-pass studies and improved evaluation of regional wall motion. Dr. Sanjiv Kaul reviewed his extensive work on contrast echocardiography to demonstrate that imaging of perfusion defects, either with contrast echocar-

diography or radionuclide imaging with ^{99m}Tc-labeled agents, is dependent on changes in blood volume in the microcirculation that occur with upstream stenoses in the coronary arteries. Dr. Douglas Miller emphasized the unique ability of PET to provide quantitative measurements of absolute blood flow, which can provide clinically important information when balanced ischemia may be present and perfusion defects may be minimal on SPECT perfusion images.

The remainder of the advanced track was dedicated to multi-modality imaging in two different clinical settings: the detection of CAD and evaluation of heart failure.

Detection of CAD. In the detection of CAD, both CT techniques and scintigraphic perfusion imaging are important. Traditionally, perfusion imaging with PET and SPECT was performed to assess ischemia as a marker for obstructive CAD. With the introduction of CT techniques, earlier identification of CAD is possible, in particular the assessment of atherosclerosis and CAC with electron beam CT and more recently non-invasive angiography with multi-slice CT. It thus appears that these techniques visualize both ends of the spectrum of CAD, and it is logical that the information should be integrated to further optimize evaluation of CAD. Dr. Paolo Raggi reviewed the role of assessing CAC and CTA, whereas Dr. Marcelo DiCarli provided important data demonstrating the integrated use of ischemia detection by PET perfusion imaging with assessment of coronary anatomy by multi-slice CT. Indeed, with integration of information on atherosclerosis and ischemia, it will be possible to better define high-risk and low-risk groups of patients with CAD.

Evaluation of heart failure. Dr. Frank Bengel highlighted the roles of SPECT or PET and MRI in the evaluation of heart failure. Whereas MRI will provide important anatomical information on the shape, dimension, and function of the LV and right ventricle, information on blood flow, metabolism, and innervation can be provided by SPECT or PET and integration of the two imaging modalities will improve understanding and evaluation of patients with heart failure. Assessment of underlying etiology will be feasible, and subsequent implications for therapy can be derived. For example, Drs. Avjit Lahiri and Vasken Dilsizian illustrated that combined assessment of perfusion and metabolism by nuclear techniques and assessment of LV function by MRI (or echocardiography) helps to identify patients with ischemic cardiomyopathy who may benefit from revascularization. In addition, nuclear imaging with PET or SPECT may also allow prediction of response to certain medical therapies, for example the response to beta-blockers. Dr. Jeroen Bax discussed the challenge of identifying patients who will benefit from cardiac resynchronization therapy. Most likely, patients with LV dyssynchrony will benefit most from cardiac resynchronization therapy. Although there are studies that suggest phase image analysis of gated blood pool studies may provide information on LV dyssynchrony, most of the studies thus far have used echocardiography (in particular tissue Doppler imaging) for the detection of LV dyssynchrony and subsequent prediction of response to cardiac resynchronization therapy.

INVESTIGATIVE TRACK: ADVANCES IN CARDIAC IMAGING

Stem cell therapy. Cell transplant strategies for myocardial repair and regeneration represent a new frontier in the treatment of cardiovascular disease. As summarized by Dr. Charles Murry, numerous hurdles must be overcome before the potential of these strategies can be realized. For example, which cell type will be the most successful in improving myocardial function? If there is improvement in function, what is the mechanism responsible for this beneficial effect? One of the most notable challenges is accurate non-invasive imaging for the characterization of cell delivery, survival, migration, proliferation, and persistence. Dr. Dara Kraitchman discussed the role of MRI and SPECT/CT in this regard. For example, the superparamagnetic iron oxide particle labeling of mesenchymal stem cells permits the detection of migration and persistence of these cells when injected into the site of myocardial infarction. However, a major limitation of the method is the loss of signal that occurs using these iron particles, making anatomical MRI evaluation difficult and limiting the differentiation of labeled mesenchymal stem cells from artifacts. One potential approach to overcome this limitation is to develop an MRI acquisition scheme that creates positive contrast with these particles. SPECT/CT imaging of ex vivo labeled mesenchymal stem cells with ^{111}Indium-oxine is also capable of assessing cell trafficking. The advantage of using ^{111}Indium is that it is commercially available and its long physical half-life (~67 h) permits serial imaging for up to approximately one week post-injection. Although lung uptake confounds the initial image analysis, myocardial homing of mesenchymal stem cells can be detected within an infarct zone of dog hearts approximately 24 to 48 h after injection or even 96 h after infarction. Of note, labeling with ^{111}Indium-oxine did not appear to impair the functionality of the mesenchymal stem cells, suggesting a potential clinical role for this approach. Dr. Joseph Wu highlighted the role of reporter genes and reporter probes in the assessment of stem cell migration, proliferation, and survival. In this method, cells are transfected with reporter genes, before myocardial implantation. Reporter gene expression will only occur if the cells are alive. Reporter probes can be labeled with MRI, optical or radionuclide contrast agents. Radiolabeling of reporter probes with ^{18}F permits one to take advantage of the high sensitivity, quantitative and three-dimensional imaging capabilities of PET. One such example is the tracking of embryonic cardiomyoblasts expressing the mutant derivative of herpes simplex virus type 1 thymidine kinase with the reporter probe ^{18}F-9-(4-fluoro-3-hydroxymethylbutyl) guanine in rat myocardium using small animal PET. One of the unique aspects of the reporter gene method is the availability of numerous types of

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reporter genes that should facilitate the labeling and tracking of different cell types.

Cardiac metabolism. There is a growing body of evidence that alterations in myocardial substrate use play a key role in a variety of normal and abnormal cardiac conditions such as aging, LV hypertrophy, and diabetic heart disease. As discussed by Dr. Raymond Russell, one of the key aspects of myocardial health is its ability to switch to different energy substrates in response to stimuli such as changes in substrate delivery, the level of cardiac work, or a decline in myocardial blood flow. In a variety of diseases this flexibility is lost, leading to an overdependence on glucose (such as in pressure-load LV hypertrophy and dilated cardiomyopathy) or fatty acids (as occurs in obesity and diabetes). The loss of flexibility in myocardial substrate use can have numerous detrimental effects including energy deprivation, oxygen free radical formation, and lipotoxicity. Dr. Robert Gropler discussed how PET using appropriate mathematical models of the myocardial kinetics of novel radiotracers could be used to quantify various aspects of myocardial substrate metabolism. Positron emission tomography methods have been used to verify that the same metabolic perturbations that are present in small animal models of disease have human correlates, thus providing an imaging platform to facilitate the bi-directional translation between the bench and the bedside. Moreover, these PET methods can be used to evaluate the efficacy of therapies designed to favorably manipulate myocardial substrate metabolism. Dr. Heinrich Schelbert summarized the most common current applications of myocardial metabolic imaging, the characterization of myocardial substrate use in ischemic heart disease. Highlighted were both the research contributions and the current role of PET with ^{18}F-fluorodeoxyglucose in patient care.

ORIGINAL RESEARCH

A total of 83 abstracts were selected from a group of competitive submissions after peer review. All selected abstracts were published in the July/August issue of the *Journal of Nuclear Cardiology*. The following is a brief synopsis highlighting some of the work presented.

Young Investigator Award. In the Young Investigator Award, seven best abstracts were selected, and the winning abstract was presented by Dr. Sujoya Dey and colleagues from the University of Michigan (see the following text). Three abstracts concerned technical innovations in nuclear cardiology. The first contribution concerned optimization of the use of radiopharmaceuticals labeled with ^{123}I in nuclear cardiology. ^{123}I myocardial imaging is confounded by the presence of multiple low-abundance high-energy photons which cause septal penetration in conventional collimators used for SPECT imaging, compromising both image quality and quantification of tracer activity. To help circumvent this problem, Chen et al. (1) presented a novel mathematical approach that incorporates a three-dimensional deconvolution of the septal penetration. In phantom studies the authors observed that optimal image quality and quantification using ^{123}iodium was obtained when deconvolution of septal penetration was added to processing of data acquired with schemes optimized for the energy window and scatter.

The second abstract concerned the assessment of LV ejection fraction from gated SPECT. Typically with MPI, ECG gating to assess LV function is performed post-stress as opposed to peak-stress. Unfortunately, performing post-stress imaging earlier results in marked degradation of image quality because of scattering artifacts induced from extra-cardiac activity. Hsu et al. (2) developed an approach to facilitate the performance of early post-stress imaging with ECG gating. Their approach uses a novel energy-based scatter correction that separates photopeak from scattered photons. The method was tested in 10 patients and normal volunteers undergoing same-day ^{99m}Tc-sestamibi rest/stress myocardial perfusion with ECG-gating imaging and attention correction. Although image quality was slightly poorer and more susceptible to motion artifacts on the images obtained early post-stress compared with images obtained at 30 to 60 min, there was reasonable correlation between the two image sets when comparing regional activity in both normal and abnormal myocardium. Consequently, image processing schemes that correct for scatter and are combined with accurate correction for attenuation and motion may facilitate the performance of early post-stress myocardial perfusion imaging using ^{99m}Tc agents.

The third and fourth contributions were dedicated to attenuation correction with MPI. Attenuation-induced artifacts are the most common confounder of myocardial perfusion imaging interpretation. Currently there are two methods to perform attenuation correction, using either radioactive transmission sources or CT. In order for image quantification and optimal diagnostic accuracy to be obtained with these methods, normal databases that incorporate attenuation correction need to be generated. Esteves et al. (3) demonstrated the feasibility of a normal database composed of adenosine stress ^{99m}Tc-sestamibi images with attenuation correction performed with ^{153}Gd-transmission sources. Dey et al. (4) evaluated the potential efficacy of attenuation correction on ^{99m}Tc-sestamibi MPI using a SPECT-CT (Symbia-6) imaging system in a group of patients with variable levels of pre-test likelihood for coronary artery disease. In over 90% of low likelihood patients, attenuation correction reduced myocardial perfusion defect scores. Similarly, defect scores were also reduced by attenuation correction in both intermediate- and high-likelihood patients, but to a lesser extent.

The fifth abstract concerned the additional prognostic value of MPI over exercise testing. The major strength of MPI is its ability to perform accurate risk stratification in patients with known or suspected CAD and to provide added value to information derived from exercise treadmill testing such as the Duke treadmill score. It is unknown

whether MPI performs equally well in women where the likelihood of false positive exercise ECG findings is increased. Lundbye et al. (5) addressed this question in 1,548 women without known CAD in whom revascularization at 30 days was used as the primary end point. In women with an intermediate-risk Duke treadmill score, the revascularization rate was 0.8% in women with normal MPI, as compared with 25.6% in the presence of an abnormal MPI. Similar results were observed in the high-risk Duke treadmill score group, where women with normal MPI had a revascularization rate of 7.1%, as compared with 71.4% in the presence of an abnormal MPI. Although further studies are needed to determine if long-term prognosis differs between the groups, the data support the role of MPI as first-line evaluation of women in intermediate to high pre-test likelihood of CAD.

The sixth abstract concerned the prognostic value of pharmacologic stress MPI in conjunction with low-level exercise. Athar et al. (6) addressed this issue in the study of 1,814 patients referred for low-level exercise-dipyridamole vasodilator stress MPI with ^{99m}Tc-sestamibi. The authors observed that patients with (near) normal perfusion and a post-stress LV ejection fraction >50% had a hard event rate of 0.7%. Conversely, patients with abnormal perfusion and LV ejection fraction <50% had an event rate of 2.4%. The results of the study provide further evidence for the routine addition of low-level exercise to vasodilator stress myocardial perfusion imaging.

The last abstract concerned better characterization of patients with the MADIT II trial criteria. Paiesdana et al. (7) compared patients with the MADIT II trial criteria who received or had not received an ICD. The authors evaluated numerous variables including age, gender, LV ejection fraction, regional and global wall motion scores, and summed stress and rest perfusion scores. The authors observed that patients who received an ICD had worse global LV function and resting perfusion. Further studies are needed to determine if these parameters can be used to identify patients who would benefit from ICD placement.

Contemporary clinical contributions. Several abstracts focused on high-risk variables during stress MPI. Ventricular ectopy during stress testing was reported to be associated with more extensive perfusion defects and lower ejection fraction (8). Mahajan et al. (9) demonstrated that patients with isolated left main CAD had highly variable scans, ranging from normal MPI to perfusion abnormalities in multiple vascular territories. Another high-risk variable is stress-induced LV dilation or transient ischemic dilation. This was also associated with an impaired chronotropic response to exercise (10). The cardiac event rate (death, myocardial infarction, or unstable angina) was shown to be increased during 18 months follow-up in patients with transient ischemic dilation (11).

The importance of recognizing non-cardiac findings on cardiac SPECT scans was addressed by Raa et al. (12). Incidental, non-cardiac findings were noted in 48 of 610 patients (8%), the most common being abdominal abnormalities such as hepatosplenomegaly, gastrointestinal tumors, and ascites, followed by breast, lung, and mediastinal abnormalities, underscoring the need for the interpreting physician to carefully examine the acquired raw and tomographic images for these potentially significant findings.

PET. Investigations centered on cardiac PET included a presentation by Bateman et al. (13) comparing ^{82}Rb-PET with attenuation-corrected SPECT. The authors showed that the accuracy for detection of CAD was superior with PET, because of better image quality with less bowel uptake during pharmacologic stress. An excellent short-term prognosis in patients with normal perfusion and function on gated ^{82}Rb-PET was also demonstrated (14).

The importance of transmission and emission scan registration with PET/CT was highlighted in a report from Case et al. (15), observing that misregistration of greater than 8 mm can introduce significant artifacts. Another abstract evaluated quantitative myocardial blood flow on PET in patients with and without diabetes. The authors demonstrated that although resting flow was similar in diabetics and non-diabetics, coronary flow reserve was decreased in patients with diabetes. It was postulated that the presence of small vessel disease and/or endothelial dysfunction may be contributing to this blunted flow reserve, and PET may be particularly useful to evaluate diabetic patients, because it permits absolute quantification of blood flow and flow reserve.

Special patient populations. Smanio et al. (16) reported on the prognostic value of a normal SPECT scan in women and demonstrated that diabetic women had a substantially higher cardiac event rate as compared with non-diabetic women over a four-year follow-up period. Another interesting study observed that diabetics were more likely to have MPI abnormalities at a younger age than non-diabetics, noting that diabetics in their fifth decade of life had an incidence of abnormal scans similar to a population of octogenarians without diabetes (17). One report focused on the prognostic value of adenosine SPECT in patients with end-stage hepatic disease and demonstrated that a normal scan was associated with no cardiac events during short-term follow-up, suggesting that MPI can be used reliably for risk stratification of this special population (18). A study of patients screened for peripheral artery disease reported that 69% of those with an abnormal ankle-brachial index had high-risk SPECT findings (extensive perfusion abnormalities, lower LV ejection fraction, and transient ischemic dilation) (19).

CONCLUSIONS

A wide range of topics in nuclear cardiology and other non-invasive cardiac imaging techniques was presented during ASNC's 10th Annual Scientific Sessions. Although core concepts were reviewed, this meeting featured cutting edge research in cardiac imaging with radiopharmaceuticals,

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with an emphasis on unique clinical applications, the evolving integration between nuclear cardiology and CT, and molecular imaging. Next year's annual sessions will be held in Montreal, Quebec, Canada on September 7 to 10, 2006.

Reprint requests and correspondence: Dr. Jeroen J. Bax, Department of Cardiology, Leiden University Medical Center, Albinusdreef 2, 2333 ZA, Leiden, the Netherlands. E-mail: j.j.bax@lumc.nl.

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