Responsible growth of nuclear cardiology in Spain

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After 50 years of clinical use, nuclear cardiology maintains an important worldwide role in the diagnosis and management of patients with known or suspected heart disease.[1] Coronary artery disease is an important and common cause of mortality and morbidity worldwide and in Europe accounts for death in 19% of men and 20% of women.[2,3] There have been significant advances in single photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) instrumentation, available radiotracers, and a growing importance on the use of positron emission tomography (PET) for assessment of ischemia, viability, infection, inflammation and identification of microvascular and balanced coronary artery disease.[4]

The paper from Jimenez-Hefferna et al in this issue describes nuclear cardiology activity and resources in Spain in 2014.[5] The data is based on the results of an online questionnaire developed and distributed by the Nuclear Cardiology Working Group of the Spanish Society of Nuclear Medicine and Molecular Imaging. The use of such online questionnaires should be encouraged as they give valuable information which can be a source for continuous quality improvement.

The results presented were based on the information from 42 nuclear medicine departments that responded. The respondents were distributed throughout all regions of Spain, 32 were in public hospitals and 10 were from private practices. Of the 32 public centers, 78% were in university hospitals and served 39% of the entire Spanish population. The results show that nuclear cardiology represents 15% of all nuclear medicine exams in Spain in 2014: MPI, 69%; equilibrium ventriculography, 17%; FDG PET, 12%; first pass ventriculography, 1.3%; and mIBG and diphosphono-propanodicarboxyicacid imaging for amyloidosis, <1%. The total of 15% for nuclear cardiology is low in comparison to the average of 50% commonly reported in the US. The yearly number of MPI studies performed varied from 26 to 2,727 per center with 26% of the centers performing less than 250 patients yearly. Thirty-eight percent of the centers operated with two gamma cameras to perform all the nuclear medicine studies. Half of the centers used computed tomography for attenuation correction. All the centers used Tc-99m tracers and 16% were still using 201-Tl. Nuclear cardiology exams were referred by cardiologists in 88% of studies. Study interpretation and reporting were performed solely by nuclear medicine physicians in 70% of cases and in 30% done in collaboration with cardiologists by nuclear medicine physicians.

The authors conclude that nuclear cardiology in Spain is performed according to international standards. Significant improvements can be achieved by adoption of high sensitivity, low dose dedicated cardiac SPECT cameras, and the increased use of cardiac PET.

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There are several areas of concern that are not fully addressed in the work presented:

(1) What % of all nuclear medicine services in Spain do the 42 responding sites represent?
(2) Given the concerns for lowering radiation exposure, why are thallium and 2-day studies still being performed? Are patients being evaluated for the appropriateness of the indications?
(3) What can be done to increase the use of cardiac PET?
(4) Are optimal laboratory quality standards being met?
(5) Is the full potential of nuclear cardiology being utilized in Spain?

WHAT % OF ALL NUCLEAR MEDICINE SERVICES IN SPAIN DO THE 42 RESPONDING SITES REPRESENT?

It is important to know what sites were not sampled by the survey due to nonresponse. Of the 32 public hospitals reporting, 25 were university affiliated sites and accounted for 39% of all the nuclear medicine studies performed in Spain in 2014. It was also shown that 26% of centers performed <250 nuclear cardiology studies/year with at least one site performing only 26 yearly. Thus, there is concern that the best sites were over represented and a broader sampling is required to fully understand the full scope of practice of nuclear cardiology in Spain. Sampling of better sites is suggested by the fact that 50% of sites had SPECT/CT systems and 26% had PET/CT. These percentages are much higher than reported in other areas of the world.

GIVEN THE CONCERNS FOR LOWERING RADIATION EXPOSURE, WHY ARE THALLIUM AND 2-DAY STUDIES STILL BEING PERFORMED? ARE PATIENTS BEING EVALUATED FOR THE APPROPRIATENESS OF THE INDICATIONS?

The authors advocate greater use of high sensitivity SPECT cameras and PET systems to lower radiation exposure, but at least 16% of sites responding were still using thallium and 63% of sites were using 2-day stress/rest Tc-99m protocols. We are told that 63% of sites offered stress-only protocols, but it is not clear what % of 2-day study patients did not return for the rest portion. Hospital budgets for new imaging equipment are limited in all countries and CZT crystal SPECT cameras and PET systems may not be readily available. In the meantime, advocating for the use of Tc-99m agents and stress-only protocols needs to be emphasized. In addition, the use of Appropriate Use Criteria needs to be advocated as this is the most effective way to reduce radiation exposure.[6]

Europe uses the lowest effective radiation doses compared with other countries of the world. Partially, this could be justified by existing European Regulations.[7] However, there was regional variation in Europe. In southern Europe, which includes Spain, higher radiation doses are reported in the performance of nuclear cardiology exams. PET, attenuation correction and stress-only studies are also performed less often in southern Europe.[7]

WHAT CAN BE DONE TO INCREASE THE USE OF CARDIAC PET IN SPAIN?

Growth as advocated by the authors is unlikely to occur unless inexpensive PET radiotracers and camera systems can be made available. Rb-82 generator systems or onsite cyclotrons for N-13 ammonia or O-15 water for low volume laboratories, as exist in Spain, are cost prohibitive. PET perfusion imaging is not being performed at any of the responding sites and the 12% cardiac PET studies reported were all using FDG. Ways to make the expensive PET perfusion tracers more available include development of less expensive Rb-82 generator systems or using a mobile generator that could be taken on a rotating system to multiple hospitals in a city that may have capacity on oncology PET systems. Small dedicated cyclotron systems also can produce N-13 ammonia at a lower cost and could be used at select centers that have high cardiac volumes.

F-18 radiolabeled perfusion tracers are in development and if approved could take advantage of the existing cyclotron infrastructure developed for production and distribution of F-18 FDG for tumor imaging to make a unit dose PET perfusion tracer available. This would optimize efficiency of existing PET cameras and allow applications in nuclear cardiology in many more sites.

ARE OPTIMAL LABORATORY QUALITY STANDARDS BEING MET?

Nuclear cardiology laboratory quality standards or accreditation do not guarantee optimal performance, but guarantee that minimum standards for equipment, protocols, physician training, and reports are being met. It is not clear from the data presented that any of the laboratories were being held to such standards.

One important accreditation measure is the ordering and reporting of nuclear cardiology examinations as described by the Cardiovascular Committee of the European Association of Nuclear Medicine and the Section on Nuclear Cardiology and Cardiac Computed

Tomography of the European Association of Cardiovascular Imaging of the European Society of Cardiology.[8] It was highly recommended that there be communication between the nuclear medicine physician and referring cardiologist not only in the referral but also in communicating the outcome of the test.[8] In the paper from Jimenez-Hefferna et al, only 30% of nuclear cardiology procedures were interpreted and reported by nuclear medicine physicians in collaboration with cardiologists.[5] Laboratory accreditation and optimal communication between nuclear medicine physicians and cardiologists in the ordering and reporting of nuclear cardiology studies are necessary for optimal results.[4,8]

IS THE FULL POTENTIAL OF NUCLEAR CARDIOLOGY BEING UTILIZED IN SPAIN?

Although assessment of myocardial ischemic disease by MPI is the main use of nuclear cardiology, there are other studies that can be useful in the diagnosis and management of heart failure, arrhythmias, sudden cardiac death, infection, and inflammation. Infection and inflammation are well represented by the 12% FDG use, but all other areas represent only <1% of the volume reported in the responding laboratories in Spain. Techniques are available for evaluation of cardiac amyloidosis using diphosphono-propanodicarboxyicacid or any of the available PET agents for amyloid plaque imaging in Alzheimer's. Myocardial sympathetic innervation can be imaged using I-123 mIBG but despite recent large trails showing risk stratification, it has not been used widely.

Recently, the European guidelines on infective endocarditis recommend the use of PET-CT or SPECT-CT studies with ^{18}F-FDG or autologous radiolabelled leucocytes in patients with possible endocarditis according to the diagnostic criteria or in the detection of peripheral embolic or metastatic infectious events.[9]

Nuclear cardiology continues to be a vital part of cardiac patient management in Spain. This study shows that there are areas where improvements can be made in terms of further radiation reduction, implementation of new radiotracers, and technology and increases in less commonly performed procedures. Nuclear cardiology remains an expanding and exciting field where limitations can be overcome with new dedicated, high sensitivity gamma cameras and new PET and SPECT tracers. The use of best practice criteria with collaboration between nuclear medicine physicians and cardiologists should be encouraged not only in patient referral but also in exam performance and reporting. Less commonly performed but important diagnostic procedures should be explored and promoted with the intent of generating evidence-based data on volumes, accuracy, and outcomes.

Disclosures

The authors declare that they have no conflict of interest.

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