

CHALLENGES AND OPPORTUNITIES IN NUCLEAR CARDIOLOGY FROM LATIN AMERICAN AND ASIAN PERSPECTIVES—REVIEW ARTICLE

Nuclear Cardiology in Latin America: Challenges and Opportunities

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Abstract

Cardiovascular disease (CVD) has become the main cause of death in Latin America as a consequence of the demographic, economic and social changes experienced by the region. In the last decade, there have been important improvements in nuclear cardiology (NC) practice, but there is still great heterogeneity among countries regarding availability of technology, education, and human resources. The total number of gamma cameras in the region is above 1,300, with an average of about 2.3 per million inhabitants. Nearly all cameras have SPECT capabilities, almost 10% with hybrid technology (SPECT/CT). PET technology is steadily increasing, but perfusion agents are not available at most sites. Training and education are probably the most important challenges for the development of NC practice in the region; formal programs for physicians and technologists only exist in some countries, with different curricular approaches. Distance training and other educational tools have been successfully used and are expected to expand. The future of NC in Latin America is encouraging, with wide clinical utilization and showing potential for growth as a cost-effective diagnostic method. Education of referring physicians and training in other imaging techniques will become increasingly important for nuclear cardiologists, since a multimodality approach in cardiac imaging would contribute to a better management of patients with CVD. It also seems necessary to increase the number of indexed publications in NC and to improve the quality of regional journals. National, regional, and international collaborative networks are key factors for the development of the specialty in the region.

Keywords: International perspective, Latin America, Nuclear cardiology

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Cardiovascular diseases (CVD) produce almost a million deaths per year in Latin America (LA), becoming the main cause of death in the last decades as a consequence of the demographic, economic and social changes experienced by the region (1). Improving in socioeconomic status, increased life expectancy and high prevalence of risk factors for atherosclerosis have been the major determinants of this marked epidemiologic change. Coronary heart disease (CHD) and heart failure are the most common causes of cardiovascular death in all countries, with high prevalence especially in those more developed nations such as Argentina, Uruguay, and Chile, as well as in most parts of Brazil, Colombia, Costa Rica, and Cuba. In other countries, the incidence of CHD is less prevalent – although increasing steadily – and Chagas' car-

diomyopathy is still a problem in certain rural areas. The main characteristic of the LA region is diversity, not only from the geographical point of view but also in cultural, socioeconomic, racial, and epidemiologic features. This is reflected by differences in strategies and utilization of resources for confronting health care challenges in general and CVD in particular, including the use of nuclear cardiology (NC) for patient management.

International trends in NC at SNMMI 2003

Back at the 2003 SNMMI annual meeting in New Orleans, a session on international trends in NC was presented by the SNM Cardiovascular Council (2). The session focused on the ways in which NC was implemented and used around the

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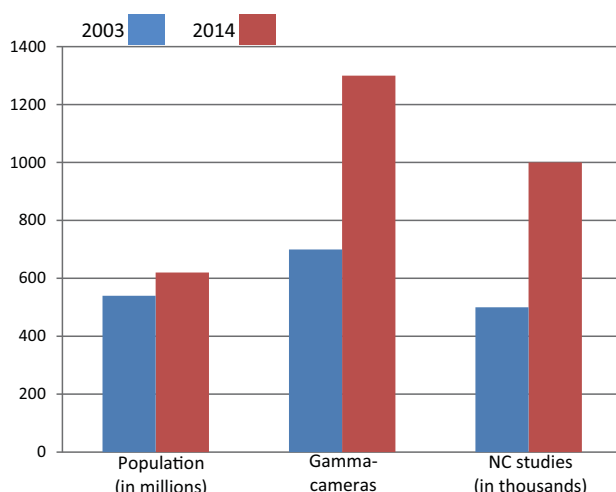


Fig. 1 Total population, estimated number of gamma-cameras and annual NC studies in LA from 2003 to 2014 (from references 3 and 4).

world, and how differences in educational systems, regulations, availability of human and material resources, and prevalence of CVD, accounted for variations. In that session, speakers from different regions described the cost and number of performed procedures, the responsibilities for performing and reporting NC studies, and the appropriateness of use according to guidelines; they also discussed ways to promote and integrate NC into the clinical ground. At that time, there were more than 700 nuclear medicine departments in LA, performing at least 500,000 NC studies annually. Installed technology was diverse, with state-of-the-art instruments available in many countries, although PET facilities were practically non-existent. NC had experienced a significant growth, representing about 40% of all nuclear medicine procedures; SPECT technology was the standard in most laboratories, although some still performed planar studies. Myocardial perfusion with ^{99m}Tc -sestamibi was the most frequently used procedure, and gated SPECT was offered at about 20% of facilities. Pharmacologic stress with dipyridamole was competing with exercise as the most popular stressor.

Current status of NC in LA

More than a decade later, the scenario has changed both quantitatively and qualitatively (3, 4). The practice of NC in the region has experienced further growth (Fig. 1), but there is still great heterogeneity among countries regarding availability of technology, educational opportunities, and human resources. According to data collected through 2014 by the International Atomic Energy Agency (IAEA) (3), the total number of gamma cameras in the region is above 1,300, with an average of about 2.1 per million inhabitants (from about 1.3 per million in 2003). Near the totality of instruments are SPECT cameras, the majority of which dual-headed, and

almost 10% with hybrid technology (SPECT/CT). There are actually beyond 160 operating PET or PET/CT devices in 12 member states, representing a rate of almost 0.3 per million inhabitants, and more than 35 cyclotrons have been installed. However, few PET facilities (<25%) perform cardiology procedures, mostly limited to viability assessment with ^{18}F -FDG. Four countries have nuclear reactors for research purposes, which allow the production of ^{99m}Tc (Argentina, Chile, Mexico and Peru), while four have the capability of assembling ^{99}Mo - ^{99m}Tc generators (Argentina, Brazil, Cuba, and Mexico). Gated SPECT is now routinely performed in almost all departments (4), and dose-reduction strategies such as stress-only, dose adjustment by body weight, and resolution recovery algorithms are being increasingly implemented. New developments such as dedicated cameras with semiconductor detectors able to reduce examination time or dose are in the project phase or have been recently installed in a few sites. Myocardial perfusion with ^{99m}Tc -sestamibi continues to be the most frequently used NC procedure. The use of ^{123}I -MIBG is mainly restricted to Brazil and probably clinically underutilized, while ^{123}I -BMIPP or other SPECT metabolic tracers are not available. Gated blood-pool has disappeared from the clinical scenario with the exception of cardiotoxicity evaluation. Physical stress is performed as first choice when possible, but dipyridamole continues to be the preferred stress pharmacologic agent due to the high cost and restricted availability of newer vasodilators such as regadenoson.

Human resources

With regard to human resources, it is estimated that currently, there is in average at least one physician and 1.6 technologists per gamma camera (4). The responsibility to perform NC procedures relies mainly on certified cardiologists in Argentina and partially in Brazil, while in most other countries nuclear physicians are in charge, with a cardiologist (sometimes at a fellow level) usually supervising the stress test. Cardiologists performing nuclear procedures on their own are generally required to hold a special license or certification on the safe use of radioactive isotopes.

Challenges in NC in LA

Training and education of NC specialists

Training and education are probably the most important challenges for the development of NC practice in the region. Formal education in nuclear medicine or NC for physicians and technologists is unfortunately not common in LA, with the exception of few countries with tradition in the field like Argentina, Brazil, Chile and Uruguay, while others like Colombia, Costa Rica, Cuba, Mexico and Venezuela have been implementing teaching and training programs with varying degrees of depth, scope, and sustainability, and there

is nothing in place in most other nations. Since complete, detailed information is scarce about educational opportunities and programs across most developing regions, the World Federation of Nuclear Medicine and Biology (WFNMB) has started conducting a global initiative to gather data on credentialing and training of nuclear medicine specialists, and the Latin-American Association of Nuclear Medicine and Biology Societies (ALASBIMN) has implemented an on-line electronic poll for members to include educational and training information, whose results will be shortly available. Preliminary, however, it can be said that established programs vary widely across countries in terms of contents and duration. Some cover radiation medicine as a whole with possibilities of specific training in radiology, nuclear medicine, or radiation therapy during the last phase of training, while other approaches consider separate specialties, with cross-training between nuclear medicine and cardiology in the case of NC. In all cases, however, a minimum of specific training in radiation safety is required for clinical practice, and a special license is usually mandatory for handling radioactive materials. To compensate for the lack of formal programs in most countries, on-line educational tools for technologists (now extended for all nuclear medicine professionals) have been developed and made available to member states by the International Atomic Energy Agency (IAEA) (5), with very successful results.

Referring physicians

Education of referring physicians on the clinical usefulness of NC is essential for the appropriate utilization of the method. Little exposure of many professionals to publications and educational instances seems to have been a major limitation for a more rapid growth of the specialty in the region. NC methods provide important diagnostic and prognostic clinical information with which all cardiologists should be conversant. Published recommendations of the American College of Cardiology (ACC) endorsed by the American Society of Nuclear Cardiology (ASNC) state that training for cardiology fellows should be divided into three levels according to the desired degree of involvement and responsibilities in NC (6), and these could form the base for academic programs, adapted for local characteristics and needs.

Research aspects

Scientific production in the field of NC is difficult to estimate, but one can imagine that it follows the general trend. The contribution of LA to world science is scarce in terms of output and visibility; however, the region has increased the number of articles published in the last decades, although the individual participation of each country is very unequal. A bibliography search regarding biomedical articles in general and on cardiology in particular, showed that in 2003, LA

published only 2.2% of the references in Medline, which nevertheless represents a 30% increase compared to 1999 (7). In a more recent publication, Latin America was a minor contributor of research published in high impact journals with only 0.38% of the articles citing a corresponding author affiliated with a LA institution (8). In general, LA journals are underrepresented in the international literature. Among other factors, budget limitations and lack of regularity in the frequency of appearance have negative consequences in international appreciation of LA journal quality (9). Paradoxically, these publications are discriminated by local researchers, in favor of indexed foreign publications. A search of international databases showed that, from a total of 14 cardiology journals from LA, only two are included in Medline (10). As a consequence, many regional studies are absent from international index evaluations, perhaps also due to an existing negative bias to quote studies in languages other than English. Therefore, it seems necessary to increase the number of indexed publications in NC and to improve the quality and prestige of regional journals.

Future direction of NC in LA

The future of NC in LA is encouraging, with wide clinical utilization and showing a potential for growth as a cost-effective diagnostic tool. PET technology is steadily increasing, but perfusion agents are still not available at most sites, indicating a possibility to expand the capacities to cover the needs in selected patients. Adrenergic innervation studies with ^{123}I -MIBG, now exceptionally used, could provide valuable information in patients with heart failure, especially those with Chagas' cardiomyopathy. Training in other imaging techniques will become increasingly important for nuclear cardiologists, since a multimodality approach in cardiac imaging would contribute to a better management of patients with CVD. National, regional, and international collaborative networks, including support from scientific societies and organizations such as the IAEA, ASNC, ALASBIMN, and local academic societies and institutions, are key factors for the development of the specialty in the region.

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