The knowledge base for nuclear cardiology training

Status of Nuclear Cardiology Training in the 1990s

The basic principles underlying the field of nuclear cardiology were described in the 1920s, but the clinical development and widespread use of these techniques did not take place until the mid-1970s. From the beginning, advances in nuclear cardiology have been made by cardiologists, nuclear medicine physicians, radiologists, and basic scientists.

Several professional medical societies, including the World Health Organization, the American College of Cardiology, the American Heart Association, the Society of Nuclear Medicine, and the Canadian Cardiovascular Society, have attempted to define the basic training required for the optimal practice of clinical nuclear cardiology.[1-5,*] The American College of Cardiology and the American Heart Association guidelines are currently under revision. In addition, the Nuclear Regulatory Commission[6,7] has guidelines for licensure but deals only with radiation safety and does not address issues of clinical competence. For the most part, all these organizations provide a unilateral approach and do not speak for all parties with training programs in nuclear cardiology. Nor do they detail the knowledge base of basic science, clinical interpretive skills, and practical experience that should be mastered to practice nuclear cardiology competently. At the time these guidelines were developed, there was no professional organization representing all aspects of nuclear cardiology.

The American Society of Nuclear Cardiology is an international professional medical society that was established to promote the optimal performance and delivery of nuclear cardiology diagnostic procedures. It is positioned to serve as an interface between these various organizations and the practicing nuclear cardiology community in defining the knowledge base and training guidelines for nuclear cardiologists. Four of the obstacles that must be overcome to reach such a goal include failure to define clearly the knowledge base required to practice nuclear cardiology, lack of uniformity in training programs and exposure to the knowledge base, failure to document clinical experience and mastery of the knowledge base, and the recognition that different levels of expertise may be required to perform and interpret nuclear cardiology studies in different venues.

Reprint requests: Manuel D. Cerqueira, MD, DVA Medical Center (115), 1660 S. Columbian Way, Seattle, WA 98108.

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Definition of Nuclear Cardiology Knowledge Base

In 1994 nuclear cardiology is a sophisticated, complex subspecialty requiring knowledge of physics, γ-camera and computer instrumentation, image processing, and pharmacologic and exercise stress testing, and an understanding of the constantly expanding clinical options for the diagnosis and treatment of heart disease. In addition, nuclear regulatory agencies impose strict rules for radiation safety. This forms the knowledge base required for nuclear cardiology training, but at the present time it has not been clearly defined in training program requirements or published training guidelines.

The recently published *Cardiovascular Nuclear Medicine Training Guidelines,* developed by the Cardiovascular Council of the Society of Nuclear Medicine and approved by its board of trustees, offers a detailed (some may call it excessive) definition of this knowledge base.[5] By being the first to attempt such a definition, it should be commended and viewed as a starting point for further discussion. These recommendations recognize the necessity for noncardiologists to have additional training in clinical and diagnostic cardiology and for cardiologists to acquire the basic scientific knowledge necessary for creating and interpreting images in nuclear cardiology.

Although the recommendations of the Cardiovascular Council are as detailed as a textbook index, by failing to recognize that there are different levels of competence in the practice of nuclear cardiology and not requiring documentation of training, they fall short of being the definitive nuclear cardiology training document. Despite these limitations, they are an excellent basis for further discussion.

Lack of Uniformity in Training Programs and Exposure to Knowledge Base

Recognizing that nuclear cardiology is being practiced by physicians trained in cardiology, nuclear medicine, or radiology, it must be accepted that exposure to the ideal knowledge base varies. Because the background of nuclear cardiologists is so varied, it is extremely important that the general knowledge base of nuclear cardiology be defined and incorporated into all training programs. A major variance between the training programs involves the degree of emphasis on either basic science or clinical cardiology.

Basic Sciences. Physics, instrumentation, radiochemistry, and radiation safety are generally covered in radiology and nuclear medicine training. Cardiology fellowship programs do not routinely have such requirements for all fellows. Technologic advances in nuclear cardiology now allow complex image acquisition and processing, but these advances also create technical nightmares related to image complexity and the creation of imaging artifacts. A competent nuclear cardiologist must understand and assess the technical quality of each study before interpretation of the image and should not be performing or interpreting studies without a knowledge of how the images are generated. All training programs should include the basic science knowledge base in their curriculum and have the program director document mastery.

Clinical Cardiology and Stress Testing. Anatomic and physiologic knowledge of the cardiovascular system and the clinical presentation of common forms of heart disease are well covered in cardiology fellowship programs. Radiology and nuclear medicine programs have less exposure to these areas and ancillary clinical and cardiac diagnostic rotations (coronary arteriography and echocardiography) should be required of these trainees. In addition, exposure to the selection, performance, interpretation, and reporting of exercise and pharmacologic stress testing should be required and documented. Guidelines for training in exercise testing have been developed by the American College of Physicians/American College of Cardiology/American Heart Association Task Force statement on clinical competence in exercise testing, and physicians who perform exercise tests should meet these guidelines.[8]

Documentation of Nuclear Cardiology Training

Many institutions grant clinical privileges in nuclear cardiology on the basis of departmental affiliation, Nuclear Regulatory Commission licensure, or board certification in radiology or nuclear medicine. The granting of such privileges is based on the assumption that physicians with Nuclear Regulatory Commission licensure or board certification have had adequate didactic and clinical training in nuclear cardiology. Although in some cases this may be true, many individuals with such credentials lack specific training and competence in all aspects of nuclear cardiology. We believe that individuals applying for clinical hospital privileges in nuclear cardiology should be required to document specific training and competence in nuclear cardiology.

Recognition of Different Levels of Nuclear Cardiology Expertise

Nuclear cardiology can be practiced at several different levels. This recognition suggests that the knowledge and training required needs to be appropriate for the individual level. The American College of Cardiology and Canadian Cardiovascular Society training guidelines define three basic levels of training.[4, *]

The simplest level of training, **level 1,** requires only exposure to the various techniques and how they are used in a clinical or diagnostic setting for the evaluation of specific heart problems. Individuals with such training should know when nuclear cardiology procedures are clinically useful and when they should be used relative to other available diagnostic techniques. Such general exposure can be obtained during most residency and fellowship training. This level of expertise does not provide the individual with the competence to perform or interpret diagnostic nuclear cardiology procedures. This level is required of all cardiology fellows as part of their general training.[4]

Level 2 training provides the individual with a higher degree of knowledge and clinical experience that allows competent performance and interpretation of nuclear cardiology procedures. Individuals achieving this level of training should have exposure to the full knowledge base but not with the same

*Wisenberg G, Humen D, Gill J, Davies R, Liu P. Personal communication, July 15, 1993.

degree of mastery as required at the highest level. Such training should include adequate knowledge of radiation safety, basic physics and radiochemistry, and clinical competence to allow performance and clinical interpretation of studies in a hospital or outpatient facility.

Finally, those individuals wishing to supervise or direct a nuclear cardiology laboratory, whether for clinical or research purposes, require extensive, in-depth training and mastery **(level 3)** of all the material in the nuclear cardiology knowledge base.

Thus the initial definition of the knowledge base required for nuclear cardiology has been started by the publication of the *Cardiovascular Nuclear Medicine Training Guidelines.*[5] An important role for the American Society of Nuclear Cardiology is to work with the various medical societies (Society of Nuclear Medicine, American Heart Association, Radiological Society of North America, American College of Cardiology, and American College of Radiology), the Nuclear Regulatory Commission, and other credentialing agencies to incorporate this clinical and basic science knowledge base into nuclear cardiology training programs. This will ultimately lay the groundwork for an ongoing and objective approach to the granting of clinical privileges. Further work is also required to define the different levels of training and the exact knowledge requirements and documentation of competency for each level.

Manuel D. Cerqueira, MD
Director of Nuclear Cardiology
Department of Veterans Affairs Medical Center and
University of Washington School of Medicine
Seattle, Wash.
Frans J. Th. Wackers, MD
Director of Cardiovascular Nuclear
Imaging and Exercise Laboratory
Yale University School of Medicine
New Haven, Conn.

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