JACC Vol. 51, No. 3, 2008
January 22, 2008:368–74

Task Force 5: Training in Nuclear Cardiology

Endorsed by the American Society of Nuclear Cardiology

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Training in Nuclear Cardiology

Nuclear cardiology (Table 1) provides important diagnostic and prognostic information that is an essential part of the knowledge base required of the well-trained cardiologist for optimal management of the cardiovascular patient. Training of fellows in nuclear cardiology is divided into 3 levels:*

- General (Level 1, 2 months): Makes trainee conversant with the field of nuclear cardiology for application in general clinical management of cardiovascular patients.
- Specialized (Level 2, 4, to 6 months): Provides trainee with special expertise to practice clinical nuclear cardiology.†
- Advanced (Level 3, 1 year): Provides advanced training sufficient to pursue an academic career or direct a nuclear cardiology laboratory.†

General Cardiology Training Background

To have an adequate understanding of the clinical applications of nuclear cardiology and to perform tests safely, the cardiology trainee must acquire knowledge and proficiency in the following areas of general cardiology:

1. Coronary angiography and physiology
2. Cardiac physiology and pathophysiology
3. Rest and exercise electrocardiography
4. Exercise physiology
5. Pharmacology of standard cardiovascular drugs
6. Cardiopulmonary resuscitation and treatment of other cardiac emergencies
7. Pharmacology and physiology of commonly used stress agents, such as dipyridamole, adenosine, and dobutamine
8. Clinical outcomes assessment

Overview of Nuclear Cardiology Training

Training in nuclear cardiology at all levels should provide an understanding of the indications and appropriate use of specific nuclear cardiology tests, the safe use of radionuclides, basics of instrumentation and image processing, methods of quality control, image interpretation, integration of risk factors, clinical symptoms and stress testing, and the appropriate application of the resultant diagnostic information for clinical management. The depth of understanding will vary with each of the 3 levels of training. Training in nuclear cardiology is best acquired in Accreditation Council for Graduate Medical Education (ACGME)-approved training programs in cardiology, nuclear medicine, or radiology. An exception to this ACGME requirement is the didactic and laboratory training in radiation safety and radioisotope handling that may be provided by qualified physicians/scientists in a non-ACGME program when such

The recommendations of this Joint Task Force, made up of representatives of the American College of Cardiology Foundation (ACCF) and the American Society of Nuclear Cardiology (ASNC), have been approved by the governing bodies of the ACCF and ASNC in October 2007.

*The issues of ongoing clinical competence and training or retraining of practicing cardiologists are beyond the scope of this document. The Certification Board of Nuclear Cardiology (CBNC) was established jointly by the American College of Cardiology and ASNC and assesses knowledge and mastery in the areas of radiation safety and the technical and clinical performance of nuclear cardiology procedures. For additional information, contact CBNC at 19562 Club House Road, Montgomery Village, MD 20886; http://www.cbnc.org.

†Level 2 and Level 3 training meet eligibility criteria for taking the Certification Board of Nuclear Cardiology examination and Nuclear Regulatory Commission (NRC) training and experience requirements to become an authorized user. The NRC establishes federal policy with regard to the medical use of nuclear reactor byproduct materials. Currently, there are 33 states that have applied and been approved by the NRC to self-regulate the use of radioactive materials, so called "Agreement States." The other 17 states and the District of Columbia are regulated by the federal policy. There is variation within the Agreement States in the training and experience requirements for physicians applying to become authorized users of radioactive materials for diagnostic testing. The NRC requires only that the Agreement State requirements be as stringent as the federal NRC policy, but states have the authority to make the requirements more stringent. Some states require a greater number of total hours for the didactic, classroom, and laboratory experience in radiation safety. Other states have restricted the acceptable programs or institutions where such training hours may be acquired. Given this variability in training and experience requirements within the U.S., trainees are advised to contact the NRC and the Agreement States where they may seek to become authorized users of radioactive materials for the current rules and requirements. For details contact the Agreement States Homepage at http://www.hsrd.ornl.gov/nrc/home.html. Click on Directory and then click on Directory of Agreement States and Non-Agreement State Directors and State Liaison Officers. This will provide information on contacting the individual states and getting the specific licensure requirements.

Table 1 Classification of Nuclear Cardiology Procedures

1. Standard nuclear cardiology procedures
   a. Myocardial perfusion imaging
      i. SPECT with technetium-99m agents and/or thallium-201, with or without attenuation correction
      ii. PET with rubidium-82 and/or nitrogen-13 ammonia
      iii. Planar with technetium-99m agents and/or thallium-201
      iv. ECG gating of perfusion images for assessment of global and regional ventricular function
      v. Imaging protocols
      vi. Stress protocols
         1. Exercise stress
         2. Pharmacologic stress
      vii. Viability assessment including reinjection and delayed imaging of thallium-201 and/or metabolic imaging where available
   b. Equilibrium radionuclide angiocardiography and/or "first-pass" radionuclide angiography at rest
   c. Qualitative and quantitative methods of image display and analysis
2. Less commonly used nuclear cardiology procedures
   a. Combined myocardial perfusion imaging with cardiac CT for attenuation correction or anatomic localization
   b. Equilibrium radionuclide angiocardiography and/or "first-pass" radionuclide angiography during exercise or pharmacologic stress
   c. Metabolic imaging using single-photon and/or positron-emitting radionuclides
   d. Myocardial infarct imaging
   e. Cardiac shunt studies

CT = computed tomography; ECG = electrocardiogram; PET = positron emission tomography; SPECT = single-photon emission computed tomography.

a program is not available as part of the clinical ACGME training program. For laboratories that provide training to cardiology fellows, accreditation by the Intersocietal Commission for Accreditation of Nuclear Laboratories (ICANL) is also recommended.

Nuclear cardiology training consists of the components shown in Table 2. Didactic, clinical case experience, and hands-on training hours require documentation in a logbook, having the trainee's name appear on the clinical report or having some other specific record. The hours need to be monitored and verified by the nuclear cardiology training preceptor. For the advanced trainee, specialized training and research can be derived as part of an established program in either cardiology or a division of nuclear medicine. The person(s) responsible for the didactic, clinical, and hands-on training and experience are responsible for evaluating the competence of the trainee in nuclear cardiology upon completion of the program. This can be accomplished by observing the daily performance of the fellow, a formal testing procedure, or both. The preceptor for Level 2 or Level 3 should be an authorized user recognized by the Nuclear Regulatory Commission (NRC) or an Agreement State, have Level 3 (or the equivalent) training in nuclear cardiology, and preferably be certified by the Certification Board of Nuclear Cardiology (CBNC).

Didactic Program

Lectures and self-study. This component consists of lectures on the basic aspects of nuclear cardiology and parallel self-study material consisting of reading and viewing cases on video or CD-ROM. The lectures and reading should provide the fellow with an understanding of the clinical applications of nuclear cardiology, including imaging with positron-emitting radionuclides and computed tomography (CT) hybrid systems including single-photon emission computed tomography (SPECT)/CT and positron emission tomography (PET)/CT. The material covered should include radiopharmaceuticals, radiation physics instrumentation, nuclear cardiology diagnostic tests and procedures/protocols, general cardiology as it relates to image interpretation, risk stratification, myocardial perfusion imaging, ventricular function imaging, and assessment of myocardial viability. Specificity, sensitivity, diagnostic accuracy, utility in assessing prognoses and interventions, costs, indications, and pitfalls in interpretation and clinical application must be emphasized for each patient subset.

This program may be scheduled over a 12- to 24-month period, concurrent with other fellowship assignments. Some of the information can be effectively transmitted as part of a weekly noninvasive or invasive cardiology conference with presentation and discussion of nuclear cardiology image data.

Radiation safety. The second component of the didactic program should provide the fellow with an understanding of radiation safety as it relates to patient selection and administration of radiopharmaceuticals and utilization of CT systems. Fellows seeking Level 2 or Level 3 training will require greater in-depth knowledge as well as hands-on practical experience. These requirements are detailed for each level of training.

Table 2 Nuclear Cardiology Training Components

1. Didactic program
   a. Lectures and self-study
   b. Radiation safety
2. Interpretation of clinical cases
3. Hands-on experience
   a. Clinical cases
   b. Radiation safety

Interpretation of Clinical Cases

During training, fellows should actively participate in daily nuclear cardiology study interpretation under the direction of a qualified preceptor in nuclear cardiology. For all studies in which angiographic or hemodynamic data are available, such information should be correlated with the nuclear