Nuclear Cardiology Fellow Rotation
Cardiology Fellow Curriculum
Penn State Milton S. Hershey Medical Center

OVERVIEW

The cardiovascular fellow on the nuclear rotation will learn to interpret nuclear studies obtained in patients with possible or known cardiac disease and will learn to conduct stress tests (exercise and vasodilator)

- Documentation of the reason for the stress test.
- Obtain an appropriate history and perform an appropriate physical (H&P) examination to be certain the patient can safely undergo the planned testing.
- Determine if the requested test is appropriate to perform
- Oversee the performance of the stress test
- Review the ECG and nuclear results of the study and develop an impression of the results
- Communication to the patient of the diagnosis; recommendation to the patient of any tests/or and treatments thought to be appropriate
- Communicate when appropriate test results to requesting physicians

EDUCATIONAL GOALS

Diagnostic imaging utilizing radio-isotopes is an integral component of diagnostic cardiology. The Nuclear Cardiology Section of the Pennsylvania State University College of Medicine Cardiology Fellowship Program is designed to provide the trainee, within the standard three year program, two levels of COCATS training. With basic, COCATS I, training provided to all, and advanced, COCATS, II individually selected, the cardiology fellow is provided with opportunity to understand the fundamental concepts of radioisotope imaging, the clinical experience for the application/performance of these diagnostic studies and training in the interpretation of studies.

Training Objectives

- Expand upon previously developed knowledge in the areas of cardiac physiology and coronary anatomy **(Patient Care, Medical Knowledge, Practice-Based Learning and Improvement)**
- Understand the basic physiology of "stress testing" as it applies to nuclear perfusion imaging. This applies to exercise treadmill studies as well as pharmacologic stress utilizing both vasodilator and catecholamine "stress".**(Patient Care, Medical Knowledge, Practice-Based Learning and Improvement)**
- Establish a clinical experience consisting of but not limited to the indications, contraindications, risk-benefit, performance, and identification/treatment of side effects, for "stress' testing. **(Patient Care, Medical Knowledge, Practice-Based Learning and Improvement)**
- Develop a patient-based understanding of these studies through the informed consent process by describing the potential major/minor side effects encountered for the various forms of "stress". **(Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism, System-based practice)**
- Understand/be exposed to the physics of the various radioisotopes and imaging cameras/technology utilized. **(Medical Knowledge, Practice-Based Learning and Improvement)**

- Learn the various tests offered in nuclear cardiology; radionuclide ventriculography (RVG), myocardial perfusion imaging (MPI), positron emission tomography (PET) regarding indications, contraindications and interpretation. **(Patient Care, Medical Knowledge, Practice-Based Learning and Improvement)**
- Developing interpersonal skills in interacting and communicating with other care givers and with patients and their families. **(Interpersonal and Communication Skills, Professionalism)**
- Develop skills in teaching-medical student, residents, and colleagues, including primary care physicians. **(Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism)**
- Develop skills in communicating test results to other physicians (both cardiologists and noncardiologists). **(Interpersonal and Communication Skills, Professionalism)**

Principle teaching Methods

- Mentor-student method. In regards to the interpretation of studies, the mentor–student relationship will be utilized as the main teaching method. The fellow is expected to utilize all available scientific research, published guidelines and expert opinion to assist with decision making and learning.
    - The stress studies are performed in the morning through early afternoon. Upon completion, the fellow and the daily cardiology attending for nuclear studies review the stress data and the report. Daily, at approximately 3 PM, the cardiology fellow and attending meet in radiology with the radiology residents and attending and interpret the daily studies. This includes usually 5-10 studies daily and extends for 60-90 minutes. This includes both NPI and RVG studies.

- Didactic method.
    - a syllabus at the beginning of their fellowship which includes introductory information in the areas of nuclear physics including radioisotopes and imaging, stress data for exercise and pharmacologic stress, risk factor stratification, protocols and references. This packet is to serve as a short term and long-term resource through out their training and subsequently into practice.
    - lecture series for the fellowship
        - A weekly physics lecture given to both the radiology and cardiology trainees. This is a two year cycling lecture series given by the Health Physics section of Radiology with specific nuclear physics lectures separately identified.
        - An every other week lecture series alternating with the catheterization laboratory on Thursday afternoons with the sessions composed of the following:
            - Introductory lectures in the areas of stress testing and basics nuclear imaging
            - Specific topic of interest, such as PET imaging, radiation safety, prognostic significance of nuclear perfusion imaging, assessment of viability, etc
            - Journal review where the attending or fellow selects recent articles of educational/clinical significance
            - Combined radiology/cardiology nuclear/catheterization correlates lectures where cases are presented with both nuclear and cardiac catheterization data for discussion amongst cardiology fellows and attending as well as radiology residents and attending.
- ”Hand-on Experience”.
    - Performance of the nuclear stress testing. The fellows oversee the actual stress test, monitoring the ECG for the development of ST abnormalities and arrhythmias, the patients subjective state (chest pain/discomfort, dyspnea, fatigue, “dizziness”) and hemodynamic parameters (blood

pressure and heart rate) and determines the point at which the test is terminated. An attending physician is available for consultatio should questions or emergencies arise.

- Hot-Lab rotation with specific time for exposure to the handling of radioisotopes and radiation safety protocols.
- Processing of nuclear studies is done in conjunction with both the technologists and the attendings as time and studies permit.

EVALUATION METHODS

- The attending cardiologist will utilize a standardized evaluation process to assess the performance of the fellow. A written evaluation of the cardiac fellows' performance on the consultative service will be made each month by the cardiology attending on the nuclear service.. The cardiology attending will evaluate each fellow according to the ACGME general competencies including: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism and systems-based practice. The cardiology teaching attending will meet with each cardiac fellow at the end of each six month rotation to review the written evaluation. Fellows are required to electronically sign each evaluation in the New-Innovations program.

EDUCATIONAL CONTENT

The nuclear rotation evaluates using nuclear studies patients referred by cardiologists and non-cardiology physicians. Patients with a variety of cardiac disorders including coronary artery disease, hypertension, peripheral vascular disease, hyperlipidemia, valvular heart disease, myocardial and peripheral disease, and congenital heart disease will form the case mix on this service. Patient ages vary from persons as young as 18 to as old as 90. Patients of all ethnic and socioeconomic background are tested. Patients include those from rural and urban settings. Some patients are inpatient, some outpatient.

Fellows will spend at least two months on this rotation.

The nuclear laboratory is located on the ground floor of the Penn State Milton S Hershey Medical Center. Reading of studies takes place at this location. Some patients undergo testing at another location (Nye's Road); fellows do not oversee testing done at that location, but will read studies done at that location.

Procedures performed include

- Radionuclide ventriculography (RVG)
- Nuclear perfusion imaging, (NPI) with both thallium and the Tc99 agents- Sestamibi (Cardiolite) and tetrafosmin (Myoview). The NPI's image interpretation includes perfusion, gated wall motion, and ejection fraction.

Cardiac PET imaging is not perfomed at our institution but a detailed topic review is provided with outline as follows:

- Physics and Theory
- Tracers: Rubidium – 82 , N – 13 ammonia ,Oxygen-15 water ,18F – 2-fluoro-2-deoxyglucose (FDG)
- Perfusion imaging: N-13 perfusion study; Rb-82 rest/stress perfusion imaging
- FDGViability imaging, including physiology, protocols, imaging, image interpretation and myocardial viability

Criteria for Competence at Level 1 and Level 2

- Level 1 (at the end of two months):fellows should be able to:
    - Be able to identify indications and contraindications to stress testing, both treadmill and pharmacologic to include an understanding of the best type of test for each patient.
    - Be able to adequately oversee stress testing, both treadmill and pharmacologic
    - Be able to identify the high risk patient for testing and treat any emergencies arising during or after stress testing.
    - Be aware of the basic radioisotopes used in nuclear perfusion imaging as well as the basics issues involved in image acquisition.
    - Correctly interpret nuclear perfusion studies of low level complexity (e.g. those suggesting severe ischemia in a single vessel territory) with a minimum of 100 cases reviewed.
- Level 2 (at the end of four months): the fellow should be able to:
    - Level 1 crieria PLUS:
    - Understand the basic physics of nuclear imaging, the differences among the various radioisotopes used in imaging, their dosing and be able to calculate isotope doses
    - Understand issues involved in image acquisition and processing.
    - Be able to appropriately handle spills or contamination of radioactive substances.
    - Be able to independently interpret all coronary nuclear studies, including those with findings suggestive of multiple vessel disease with a minimum of 300 cases reviewed.

Training required for procurement of authorized used (au) status:

- Level 2 above PLUS
- Radiation work experience totaling a minimum of 620 hrs (much of the 620 hours credit is obtained during the procurement of level 2 training), performed in the clinical environment where radioisotopes are handled, under the supervision of both radiologists and nuclear cardiologists that are on the hospital nuclear license.
- During the third year of training, the fellows complete the physics experience with additional off site training as needed to supplement the combined radiology/cardiology physics lectures provided during the fellowship.
- Fellows can then sit for the CBNC (Certification Board for Nuclear Cardiology). Upon completion of the cardiology fellowship and passing of the CBNC, the fellows receive their authorized user (AU) status.

READING LIST AND OTHER EDUCATIONAL RESOURCES

Each fellow is given a loose leaf folder with protocols, appropriate articles, and references which is updated annually.. Selected references include:

1. ACCF/ASNC Appropriateness Criteria for Single-Photon Emission Computed Tomography Myocardial Perfusion Imaging (SPECT MPI) J Am Coll Cardiol 2005:46:1587–1605. Errata 2005:2148–50.
2. ACC/AHA/ASNC Guidelines for the Clinical Use of Cardiac Radionuclide Imaging. *Circulation*. 2003;108
3. American Society of Nuclear Cardiology. Imaging Guidellines for Nuclear Cardiology Procedures. A Report of The American Society of Nuclear Cardiology Quality Assurance Committee J Nucl Cardiol 2006;13:e22-171.
4. Bax JJ (ed). Nuclear Cardiology Knowledge Self-Assessment Program. American Society of Nuclear Cardiology, Bethesda, MD,rev. 2005.

5. Dilsizian V and Narula J, (eds). Atlas of Nuclear Cardiology, 2nd edition, Braunwald E (series ed), Current Medicine, Inc. Philadelphia, 2006.
6. Heller GV, Hendel, RC. Nuclear Cardiology: Practical Applications. McGraw-Hill, New York, NY, 2003.
7. Wackers FJTh, Bruni W, Zaret BL. Nuclear cardiology, the basics: how to set up and maintain a laboratory. Humana Press, Inc., Totowa, NJ, 2004.
8. Zaret BL and Beller GA (eds). Nuclear Cardiology: State of the Art and Future Directions. 3rd edition, Mosby, St. Louis, MO, 2005.
9. Ellestad MH. Stress Testing: Principles and Practice, 5th ed. Oxford University Press, New York, 2003
10. Chandra R, Nuclear Medicine Physics: The Basics, 6th ed. Lippincott Williams & Wilkin. 2004. Cherry SR, Sorensen JA, Phelps MC. Physics in Nuclear Medicine, 3rd ed. Saunders. 2003

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