

Rotation: Nuclear Cardiology

Director: Dr. Frank Bengel

Faculty: Drs. Lewis Becker and Richard Wahl

Rotation Hours: Mon to Fri, 9 am to 4 pm; Fellow may cover on "as needed" basis for other rotations.

A. Nuclear Cardiology: Patient Care

	Principal Educational Goals	Learning Activities	Evaluation Methods
1.	Ability to obtain a complete medical history, perform a careful and accurate examination with a cardiology focus for the optimal performance of stress test and nuclear cardiology.	DPC, AR, ECG	AE
2.	Learn proper techniques of performing nuclear procedures, including chemical procedures.	DPC, DSP, NC, ECG	AE, DSP
3.	Understand nuclear physics and radiation safety.	CC, NC	AE, ECR
4.	Ability to risk stratify patients after being evaluated by cardiac stress test and nuclear cardiovascular procedures. Ability to correlate invasive and nuclear studies.	ECG, CAC, HC, IC, CC	AE
5.	Ability to manage patients who have had stress test and nuclear test.	DPC, CAC, CC, FS	AE, DSP
6.	Ability to perform all procedures with emphasis on patient comfort and safety	ET, PC, DSP	AE, PR
7.	Ability to manage complications from stress test and nuclear studies, including nuclear decontamination procedures.	DPC, FS, CC, NC	AE
8.	Ability to understand nuclear safety for patients and health care workers.	DPC, CC, NC	AE
9.	Ability to generate accurate test reports.	DSP, CC	AE, PR

B. Nuclear Cardiology: Medical Knowledge

	Principal Educational Goals	Learning Activities	Evaluation Methods
1.	Understand the newest basic science concepts and mechanisms in nuclear cardiology.	CC, RC, NC, JC	AE, ECR
2.	Familiarity with current medical literature, clinical trials, and evidence based medicine in nuclear cardiology.	JC, CC	AE
3.	Learn the methods and technical aspects of cardiac stress tests SPECT nuclear cardiology, PET scan, and MRI/MRA	CC, NC, PR	AE, ECR
4.	Master the nuclear evaluation of patients with coronary artery disease, including reversible ischemia and myocardial viability.	CC, NC, DSP, PR	AE, ECR

C. Nuclear Cardiology: Interpersonal Skills and Communication

	Principal Educational Goals	Learning Activities	Evaluation Methods
1.	Communicate effectively the risk and benefits of the procedure to the patient before obtaining consent for the procedure.	DPC, FS	AE, ECR

2.	Provide professional presentation of nuclear findings to patient and family members in a compassionate and informative manner. Provide complete and accurate report to consulting physician.	DPC	AE, PR, ECR
3.	Provide educational instructions and other learning tools to patients to reinforce behavioral modification.	DPC, PC	AE, PR, ECR

D. Nuclear Cardiology: Professionalism

	Principal Educational Goals	Learning Activities	Evaluation Methods
1.	Interact professionally with patients, patients' families, colleagues, and other members of the health care team.	DPC, AR, PC	AE, PR, ECR
2.	Appreciation of the cultural, spiritual and social context of wellness and illness.	DPC, AR, EI	AE

E. Nuclear Cardiology: Practice-Based Learning and Improvement

	Principal Educational Goals	Learning Activities	Evaluation Methods
1.	Identify and acknowledge gaps in personal knowledge and skills in performing and interpreting nuclear cardiology studies.	DPC, NC, CC	AE
2.	Commitment to scholarship and the use of evidence based nuclear cardiology.	JC, RC, CC	FP, PR
3.	Broad reading of the cardiovascular literature and access and research of Medline and Internet tools.	JC, RC, CC	FP, PR

F. Nuclear Cardiology: Systems-Based Practice

	Principal Educational Goals	Learning Activities	Evaluation Methods
1.	Understand and utilize the multidisciplinary resources necessary to perform nuclear studies on acutely ill cardiac patients.	DPC, PC	AE
2.	Collaborate with other members of the health care team to assure comprehensive cardiac care.	DPC, PC	AE
3.	Understand the system complexities in nuclear cardiology.	DPC, AR, GR	AE
4.	Use evidence-based cost conscious strategies in the appropriate performance of nuclear studies.	DPC	AE
5.	Knowing when to ask for help and advice from senior fellows and attending physicians.	DPC	AE, PR
6.	Effective professional collaboration with residents other fellows, and faculty consultants from radiology and surgery.	DPC, PC	AE, ECR
7.	Develop effective communication with referring physician, health care team, patient and their family, regarding purpose and findings of the nuclear test.	DPC, PC	AE

8.	Expand learning while reviewing nuclear images on daily basis.	DPC, AR	AE
9.	Consideration of outcome measurements of tests and interventions associated with nuclear studies.	DPC, AR	AE

Objectives and expectations while on this rotation

Training in nuclear cardiology provides fellows with an understanding of the indications for specific nuclear cardiology tests, the safe use of radionuclides, and the basics of instrumentation and image processing. Fellows will also become experienced in methods of quality control, image interpretation, and integration of risk factors, clinical symptoms and stress testing and the appropriate application of the resultant diagnostic information for clinical management.

The goal for the nuclear cardiology experience is to achieve competence in exercise testing and to gain the general training in nuclear cardiology needed for the practice of consultative cardiology. During the rotation, the fellows are expected to participate in all aspects of nuclear testing.

Fellows will also be instructed in and will be expected to gain knowledge in the area of Nuclear Cardiology, specifically in the following areas: see text references below for additional information on the following:

- Safety in Handling Radionuclides
- Preparation of Radionuclide Tracers
- Calibration and Maintenance of Nuclear Equipment
- Image acquisition
- Data Processing
- Image Interpretation
- Ongoing Research in Cardiology Involving Nuclear Techniques

Relevant learning activities on this rotation

Fellows will perform or assist in the performance in many of the exercise tests, which involve vital signs and EKG interpretation, determination of the adequacy of the study and its endpoint, monitoring the patient during recovery and handling and injecting the radioisotopes.

The fellow will be expected to interpret and understand the clinical data, including the history, exam, resting and stress EKGs and exercise data, reviewing and discussing them with the attending. The fellow is expected to develop an understanding of the concepts of sensitivity, specificity, accuracy in the interpretation of these tests

Fellows will also be expected to learn the following:

- basic operation and quality control of gamma cameras and computers.
- principles of patient selection, performance, monitoring, interpretation, and reporting of exercise and pharmacological stress testing.
- how to acquire, reconstruct and analyze radionuclide ventriculograms and perfusion images.
- During each month long rotation, the fellows will be expected to perform and interpret at least 25 nuclear cardiology studies, to correlate the results with other clinical parameters, and to assess the impact of the study on subsequent clinical management.

Curriculum content and what methods are used

Fellows will receive direct instruction from the attending physician with additional instruction in certain procedures by qualified technicians on service. Fellows are encouraged to refer to the text: *Principles and Practice of Nuclear Medicine, 2nd edition*, 1995, by Early and Sodee (unless otherwise noted) for reference in the following subjects:

- Safety in Handling Radionuclides
- Checking for contamination (p.39)
- Use of film badges (p.149-150)

- Precautions necessary for drawing, handling, and administering doses to patients (p. 95)
- Procedures to be followed for radiation spills (*see attached*)

Preparation of Radionuclide Tracers

- Use of dose calibrator (p. 328)
- Red cell labeling with Tc-99m (*see pamphlet*)

Calibration and Maintenance of Nuclear Equipment

- Calibration schedules for each device
- Gamma camera
 - Uniformity calibration (p. 261-264)
 - Center of rotation assessment (p. 292-296)
 - TAC (attenuation correction) gantry calibrations (*see SMV manual*)
- Dose calibrator and survey instruments (p. 211-212)

Image acquisition

- Planar acquisition (p. 251-290)
- Gated acquisition (p. 236-237, 394)
- Tomographic acquisition (p. 291-313)
- TAC Gated Tomographic Acquisition (*see SMV manual*)

Data Processing

- Gated blood pool
 - Ejection fraction (p. 238-239, 383-403)
 - Regional wall motion and emptying/filling rates (p. 394)
 - Left ventricular volume, rest and exercise (*see folder*)
- Tomography
 - Filtered back projection (p. 239-241)
 - Reconstruction (p. 239, 241)
 - Cardiac orientation (p. 405, 409)
 - Motion correction (*see SMV manual*)
 - Resolution recovery filtering (*see SMV manual*)
 - Transmission attenuation correction (*see SMV manual*)
 - Cedars-Sinai commercial programs QGS, QPS (*Entegra QGS/QPS Help*)

Image Interpretation

- Gated blood pool scans
- Left and right ventricular size and function (p. 383-403)
- Regional wall motion (p. 394)
- Non-cardiac structures (p. 386)
- Perfusion scans
- Perfusion defects and common artifacts (p. 419)
- “High risk” anatomy, transient ischemic dilatation, high lung uptake (p. 192)
- Effects of attenuation correction (*on line source*)
- Gated SPECT (*on line source*)

Ongoing Research in Cardiology Involving Nuclear Techniques

- Screening for occult CAD
- Effect of aging on LV function
- Vascular resistance and remodeling after acute infarction
- Drug trials in heart failure

- Gene therapy to increase perfusion
- No reflow and reperfusion injury in acute infarction

Supervision:

All procedures are done under the direct supervision of the attending physician, or the technician on the case.

Evaluation Process: *(fellows will be evaluated on each rotation using a competency-based system on E-Value).*

Fellows will return a self-assessment form at the end of each Nuclear Cardiology rotation, indicating which curriculum items and learning objectives were addressed during the rotation, and how many nuclear studies were performed and / or interpreted.

Activity Schedule: The following is a schedule of learning activities for this rotation. It includes the cardiovascular MRI reading schedule and the CT reading schedule

In addition, please note the following regarding attendance:

- fellows must log their own attendance at reading sessions/ stress testing sessions and log cases interpreted
- fellows must turn in their log books to Dr. Becker at the end of their two months of nuclear
- each fellow must turn in a self-assessment form at the end of the rotation

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8AM	Stress Testing JHOC 3- all fellows (8-12)	C-MRI reading-Nelson Basement (8-9) ***** PET (1 fellow req'd) Nelson Basement (8-12)	C-MRI reading-Nelson Basement (8-9)	C-MRI reading-Nelson Basement (8-9)	Stress Testing JHOC 3- all fellows (8-12)
9AM		Stress Testing (1 fellow req'd) MIRU (9-12)	Stress Testing JHOC 3- all fellows (9-12)	Stress Testing (1 fellow req'd) MIRU (9-12)	
10AM					
11AM					
12PM	Noon Conference	Noon Conference	Noon Conference	Noon Conference	Noon Conference
1PM		Remaining PET studies/didactics Bengel			
2PM	Nuclear reading JHOC 3 Bengel/Wahl	Nuclear reading JHOC 3 Bengel/Wahl	Nuclear reading JHOC 3 Bengel/Wahl	Nuclear reading JHOC 3 Bengel/Wahl	Nuclear reading- JHOC 3 Bengel/Wahl
3PM	Cardiovascular MRI Conference-Blalock 5 scanner Bluemke/Lima	Cardiovascular MRI Conference-Blalock 5 scanner Bluemke/Lima	Cardiovascular MRI Conference-Blalock 5 scanner Bluemke/Lima	Cardiovascular MRI Conference-Blalock 5 scanner Bluemke/Lima	Cardiovascular MRI Conference-Blalock 5 scanner Bluemke/Lima
3:45PM		CT reading-Blalock 5 scanner- Brinker		CT reading-Blalock 5 scanner- Brinker	
5:00-6:30PM	Nuclear reading MIRU-Becker	Nuclear reading MIRU-Riley	Nuclear reading MIRU-Becker	Nuclear reading MIRU-Riley	Nuclear reading- MIRU-Becker