Nuclear Cardiology Examination Content Outline

(Outline Summary)

#	Domain	Percentage
1	**Selection of Nuclear Cardiology Imaging Tests**	**20%**
2	**Performance of Nuclear Cardiology Imaging Tests (including Instrumentation, Protocols, and Processing)**	**32%**
3	**Interpretation of Nuclear Cardiology Imaging Tests**	**35%**
4	**Radiation Safety and Management of Radiopharmaceuticals**	**13%**

(Detailed Outline)

1	Selection of Nuclear Cardiology Imaging Tests 20%	Knowledge, skill and/or ability related to selection of nuclear cardiology imaging tests
1.A	Synthesize clinical data (history, physical exam, other test results, etc.)	• Ability to take relevant history for risk assessment • Ability to perform a target-oriented physical examination to ascertain safety for stress testing • Ability to utilize other test results to complement nuclear imaging • Knowledge of pretest risk (Bayes theorem, etc.) • Knowledge of statistics as it applies to evaluating clinical tests Ability to apply appropriate use criteria • Ability to assess patient's ability to perform sufficient exercise • Knowledge of indications and contraindications of various stressor modalities (pharmacologic stress, exercise stress, etc.) • Knowledge of indications for transition from submaximal exercise to pharmacologic stress • Knowledge of impact of current medications (caffeine, dipyridamole, theophylline, etc.) on pharmacologic vasodilator stress test • Knowledge of mechanism of action of stressors (pharmacologic, exercise, etc.) • Ability to synthesize patient characteristics in selecting radiopharmaceutical and dose (weight-based dosing, circumference/distribution of weight, etc.) Knowledge of SPECT radiopharmaceuticals and their characteristics (production, energy, half-life, etc.) • Knowledge of importance of understanding hazards of radiation and need for ALARA • Knowledge of principles of radiation physics (scatter, types of electromagnetic emissions, shielding, etc.) • Knowledge of radiation biology (absolute dose, equivalent dose, effective dose, units, etc.) • Knowledge of first-pass myocardial extraction, redistribution,
1.B	Determine appropriateness of test ordered	
1.C	Select appropriate stressor	
1.D	Select appropriate radiopharmaceutical and dose (including knowledge of radiation biology, radiation physics, and instrumentation)	
1.E	Select appropriate imaging protocol (stress/rest, rest/stress, stress only, viability, etc.)	
1.F	Select appropriate imaging modality (SPECT, PET, radionuclide ventriculography)	

		and retention of different perfusion tracers • Knowledge of biological effects on the body • Knowledge of how SPECT and PET systems acquire images • Knowledge of impact of SPECT and PET radiopharmaceuticals and their characteristics on test selection • Knowledge of advantages and limitations of SPECT and PET imaging • Ability to synthesize patient characteristics with other considerations in selecting protocols • Knowledge of imaging protocols and their advantages/disadvantages • Knowledge of different viability protocols (PET FDG, thallium, SPECT, nitrate- enhanced technetium, etc.) • Knowledge of benefits and applications of stress-only imaging
2	**Performance of Nuclear Cardiology Imaging Tests (including Instrumentation, Protocols, and Processing) 32%**	**Knowledge, skill and/or ability related to performance of nuclear cardiology imaging tests (including instrumentation, protocols, and processing)**
2.A	Instruct and prepare patient (using printed/recorded material, securing patient consent, etc.)	• Knowledge of impact of medications on stress myocardial perfusion results • Knowledge of impact of patient positioning on results • Knowledge of potential complications of agents used in stress testing • Knowledge of stress protocols • Knowledge of pertinent physiology/pathophysiology as it applies to stress testing • Knowledge of how to manage complications • Knowledge of when to terminate test • Knowledge of pharmacokinetics of radiopharmaceuticals • Knowledge of SPECT and PET tracers and their effects • Knowledge of adequacy of counts • Knowledge of standard acquisition parameters and variables • Knowledge of time vs radiotracer dose concepts • Knowledge of types of attenuation correction • Knowledge of benefits and limitations of attenuation correction • Knowledge of optimal timing of acquisition after radiotracer administration, based on radiotracer kinetics and distribution • Knowledge of equipment and quantum mechanisms in play in image acquisition (collimators, crystals, photomultiplier tubes, etc.) • Knowledge of multigated acquisitions (MUGAs) • Knowledge of the physics of imaging • Knowledge and application of specific protocols for perfusion and viability assessment • Knowledge and application of dynamic myocardial blood flow imaging protocols, and calculation of coronary flow reserve • Knowledge and application of novel SPECT, PET, and SPECT/PET protocols (sarcoid, amyloid, I-123-MIBG, etc.) • Knowledge of pertinent physiology/pathophysiology • Knowledge of physiology/pathophysiology • Ability to assess absolute coronary blood flow Ability to assess coronary flow reserve • Knowledge of benefits and limitations of different methods of image processing (ramp filter, iterative reconstruction, etc.)
2.B	Perform stress tests (including complications and side effects of stress testing)	
2.C	Administer radiopharmaceuticals	
2.D	Define acquisition parameters (positioning of patient, etc.)	
2.E	Acquire images [with or without attenuation correction]	
2.F	Utilize solid-state cameras	
2.G	Perform SPECT, PET, SPECT/PET imaging (including viability, perfusion, novel methods, myocardial flow reserve, and inflammation imaging)	
2.H	Interpret coronary blood flow	
2.I	Select optimal imaging protocols [PET vs SPECT]	
2.J.	Process images (filtered back projection, iterative reconstruction, motion correction, etc.)	
2.K	Perform routine camera quality control processes (daily flood tests, center-of-rotation checks, etc.)	
2.L	Perform routine non-camera instrumentation quality control processes (survey meter calibration, dose calibrators, etc.)	

		• Knowledge of the physics and mechanisms of image processing (including filtered back projections) • Knowledge of frequency cutoffs • Knowledge of different filters and reconstruction methods • Knowledge of data reorientation and display • Knowledge and application of motion-correction algorithms • Knowledge of strengths and limitations of motion correction (vertical, horizontal, etc.) • Knowledge of gated SPECT processing and artifacts • Knowledge of processing of MUGA images, including quantifying EF and volumes (septal view, background noise, etc.) • Knowledge of mechanics of quality control processes (intrinsic/extrinsic floods, differing radiation detectors, differing dose calibrators, etc.) • Knowledge of regulatory requirements for quality control • Ability to identify common abnormalities during quality control processes (photomultiplier tube out, center-of-rotation error, etc.)
3	**Interpretation of Nuclear Cardiology Imaging Tests 35%**	**Knowledge, skill and/or ability related to interpretation of nuclear cardiology imaging tests**
3.A	Review raw data and interpret extracardiac findings (including oddities out of normal perfusion interpretation, RV hypertrophy, and papillary muscle)	• Knowledge of methods of raw data display (sinograms, etc.) • Ability to interpret raw data for artifacts (motion, soft tissue, subdiaphragmatic count activity, shifting breast, etc.) • Ability to identify abnormal extracardiac findings (pericardial effusions, soft-tissue masses, hiatal hernias, etc.) • Knowledge of comparison of stress and rest images (comparable breast positioning, motion, arm positioning, etc.) • Knowledge of and ability to detect image processing artifacts (motion, soft tissue, subdiaphragmatic count activity, shifting breast, etc.) • Knowledge of manifestations of rest/stress changes in orientation and alignment • Ability to assess proper gating • Ability to identify regional wall motion abnormalities and probable vessel territories • Ability to use regional wall motion to aid in study interpretation [normal vs abnormal] • Knowledge of limitations of EF estimation (in the presence of large count reductions, LV hypertrophy, ventricular cavity size, etc.) • Knowledge of post-stress stunning and its implications • Ability to assess MUGA images for LV/RV function • Knowledge of PET sarcoid imaging protocol (including patient preparation and high fat diet) • Knowledge of SPECT/PET amyloid imaging protocol (including the use of Tc- pyrophosphate, Tc-MDP, and FDG) • Knowledge and application of specific heart failure imaging (including the use of I- 123-MIBG) • Knowledge of CT calcium score protocol using dedicated CT, SPECT/CT, or PET/CT Knowledge of functionality of right ventricle • Ability to assess normal vs abnormal findings • Ability to assess defect size • Ability to assess viability (PET FDG, thallium, SPECT, nitrate-
3.B	Assess and manage image quality (repeat scan; perform prone imaging; wait for gastrointestinal clearance; have patient drink water; perform upright imaging; perform usual supine imaging; etc.)	
3.C	Assess functional information and its reliability (including gated images and viability)	
3.D	Assess disease-specific processes (sarcoid, amyloid, infection, heart failure, sympathetic innervation, coronary calcium score, etc.)	
3.E	Assess processed perfusion images (including attenuation- corrected images and viability)	
3.F	Assess prognosis (including risk stratification)	
3.G	Perform quantitative analysis (SSS, SRS, SDS, numerical quantitation, TID, LHR, EF, EDV, ESV, etc.)	
3.H	Integrate data from different modalities (ECG, clinical; CT/calcium scoring and hybrid studies; etc.)	
3.I	Generate report using standardized nomenclature	
3.J	Identify and communicate critical results (appropriate report content, vascular territories, etc.)	

		enhanced technetium, etc.) • Ability to assess defect reversibility/nonreversibility • Ability to assess defect location • Ability to assess transient ischemic dilation (TID) • Ability to assess defect severity • Ability to identify infarct vs ischemia • Ability to identify probable vessel territories • Ability to understand limitations of predicting vessel territories • Ability to identify left bundle-branch block/pacing artifact patterns • Ability to understand limitations of relative perfusion assessment (balanced ischemia) • Ability to understand limitations of perfusion assessment for obstructive CAD in specific patient populations (congestive heart failure, myocarditis, hypertrophic cardiomyopathy, issues of partial volume effects, patients with congenital heart disease, etc.) • Ability to identify imaging variables that predict prognosis (perfusion defect size; ischemic defect size; LVEF and volumes; etc.) • Ability to identify stress test variables (Duke treadmill score, exercise time, symptoms, heart rate recovery, degree of ST depression, etc.) • Knowledge of diagnostic and prognostic accuracy of ST changes with pharmacologic stress • Knowledge of extent of ischemia and benefit of revascularization • Ability to understand implications of low risk with normal stress study (<1%) Knowledge of high risk parameters (depressed LV function, TID, post-stress stunning, large perfusion defects, etc.) • Knowledge of special populations (women, diabetics, obese patients, renal, congestive heart failure, hypertrophic cardiomyopathy, elderly patients) • Ability to identify differences from prior studies and their implications • Ability to identify implications of changes in EF post-chemotherapy • Knowledge of implications of viability presence or absence for benefits of revascularization and long-term prognosis • Knowledge of implications of test results prior to noncardiac surgery • Knowledge of implications in evaluating stable angina, unstable angina, acute chest pain, and acute myocardial infarction • Ability to calculate SSS/SRS/SDS • Ability to calculate percentage of ischemic burden • Knowledge of limitations and benefits of quantitative analysis • Knowledge of clinical implications of quantitative analysis (prognosis) • Ability to integrate exercise treadmill testing and perfusion imaging data • Ability to integrate calcium score and perfusion imaging data ["warranty period"] • Ability to compare with previous NC studies

		• Knowledge of nomenclature of 17-segment model • Knowledge of what constitutes a complete report (including ASNC imaging guidelines) • Ability to communicate significance of findings and test results
4	**Radiation Safety and Management of Radiopharmaceuticals 13%**	**Knowledge, skill and/or ability related to performing post-scan tasks and reporting findings**
4.A	Perform daily surveys and wipes	• Knowledge of regulatory requirements for radiation safety • Ability to provide specific advice to patients after nuclear imaging (avoiding young people less than 1 year of age; pregnant women; advice slip for border-control purposes; etc.) • Knowledge of types of radiation emergencies (spillage, dose misadministration, generator malfunction, fire in nuclear lab, terrorism, etc.) and appropriate response • Ability to monitor patient vital signs, advise on diuresis, blood investigations, quarantine, etc. • Knowledge of how to identify and report to relevant authorities, how to counsel patients, and how to communicate with test administrators when a radiopharmaceutical misadministration occurs • Knowledge of upper limits of annual radiation exposure for patient and occupational workers • Knowledge of upper limits of radiation exposure for women per pregnancy Knowledge of tasks usually performed by radiation technologists under the supervision of physician-in-charge • Knowledge of proper documentation according to protocol (e.g., frequency of orders; dosage required; delivery of generator/unit doses via approved vehicles/sources; safe delivery of dose/generator to laboratory via specified routes; unpacking the dose/generator; quality control measures; calibrating the dose in a safe environment) • Knowledge of how to elute, calculate, and check the radiochemical purity of the radiopharmaceutical • Knowledge of mechanisms and procedures of red blood cell radiolabeling for MUGA (in vitro, in vivo, etc.) • Knowledge of properties and characteristics of radiation physics Knowledge of instrumentation
4.B	Ensure radiation safety (including knowledge of radiation biology and dosimetry)	
4.C	Respond to radiation emergencies	
4.D	Respond to radiopharmaceutical misadministration	
4.E	Follow patient and occupational radiation safety protocols	
4.F	Manage the ordering, receiving, unpacking, and handling of radioactive materials safely and perform related radiation surveys	
4.G	Calculate, calibrate, and safely prepare radiation dosages (including generator elution; radiochemistry; mathematics pertaining to the use and measurement of radioactivity; quality control of radionuclide purity; etc.)	
4.H	Perform red blood cell radiolabeling for radionuclide ventriculography (in vitro, in vivo, etc.)	
4.I	Understand radiation physics and instrumentation	