

Rotation: Imaging 1

Imaging 1 provides COCATS Level 1 experience for nuclear cardiology (including SPECT and PET) and cardiac CT. Fellows will administer, process, and read cardiac nuclear studies with radiology faculty. Fellows also spend time with nuclear technologists obtaining and processing images. When fellow presence is not required in the nuclear laboratory, fellows will spend time in cardiac CT, completing, processing, and interpreting studies under the supervision of cardiac CT technologists and faculty.

Fellows on this rotation are expected to attend nuclear conferences and multimodality imaging conference.

Nuclear Cardiology (in Imaging 1 and 2) Learning Objectives

Patient Care	
Objective	Teaching Methods
Obtain pertinent medical histories by review of patient medical records. Screen patients for suitability for stress testing, including the performance of focused physical examinations to aid in screening and establish safety of stress testing, plus to detect contraindications to stress testing, either by exercise or pharmacologic methods.	Clinical Teaching, Clinical Experiences, Performance Feedback
Learn methods for interpretation of tests and risk stratification. Produce high quality reports that adhere to American Heart Association and American Society of Nuclear Cardiology standards, and suitable for inclusion in the Vanderbilt electronic medical record. Be able to integrate test results in the context of patient management.	Clinical Teaching, Clinical Experiences, Performance Feedback

Medical Knowledge	
Objective	Teaching Methods
Preceding this rotation, the fellow or resident should be qualified in advanced cardiac life support. Understand indications, methods, risks and benefits of stress testing, using both exercise and pharmacological methods. Understand basic principles of radiation, radiation dosimetry, radiation protection. Know the basic properties of the commonly used radioisotopes, Tc-99m and Tl-201. Understand the basic principles of gamma cameras, image acquisition and image processing of myocardial perfusion scans and radionuclide ventriculography (equilibrium gated radionuclide angiography). Understand pathophysiology of myocardial ischemia and infarction, plus the elements of how to evaluate ventricular performance, both regional and	Clinical Teaching, Clinical Experiences, Didactics Text reading

<p>global.</p> <p>Understand the basic image characteristics of myocardial ischemia and infarction, and their effects on perfusion imaging.</p> <p>Recognize common imaging artifacts and become facile in their detection.</p> <p>Understand methods of attenuation correction, strengths and weaknesses.</p> <p>Become expert in performing both exercise and pharmacologic stress testing, including arrhythmia interpretation and ECG stress test interpretation. Understand how to integrate myocardial perfusion scan results with clinical and ECG parts of stress testing.</p>	
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Professionalism	
Objective	Teaching Methods
<p>Maintain patient privacy</p> <p>Be accessible to colleagues</p> <p>Be personally responsible for actions.</p>	<p>Clinical Teaching,</p> <p>Clinical Experiences,</p> <p>Role Models</p>
<p>Demonstrate compassion and respect for others, including patients from a diverse cultural, social, and religious backgrounds</p>	<p>Clinical Teaching,</p> <p>Clinical Experiences,</p> <p>Role Models</p>

Interpersonal and Communication Skills	
Objective	Teaching Methods
<p>Communicate effectively with patients, families, and members of the health care team, including findings and diagnoses when appropriate to both patients and consulting physicians. Communicate abnormal results to ordering physicians timely.</p>	<p>Clinical Teaching,</p> <p>Clinical Experiences,</p> <p>Role Models</p>
<p>Maintain timely and comprehensive medical records, including the prompt generation of standard nuclear and ECG stress test reports that will be available same day in the electronic medical record.</p>	<p>Clinical Teaching,</p> <p>Clinical Experiences,</p> <p>Role Models,</p> <p>Performance Feedback</p>

Practice Based Learning and Improvement	
Objective	Teaching Methods
<p>Identify both strengths and gaps in knowledge and expertise and set appropriate learning goals</p>	<p>Clinical Teaching,</p> <p>Performance Feedback,</p> <p>Role Models</p>
<p>Utilize information technology to effectively locate, appraise, and utilize evidence based medicine in current literature to answer clinical and technical questions</p>	<p>Clinical Teaching,</p> <p>Performance Feedback,</p>

Respond appropriately to feedback and accept constructive criticism	Role Models
Utilize quality improvement methods to implement changes within the practice environment	Clinical Teaching, Performance Feedback, Role Models

Systems Based Practice	
Objective	Teaching Methods
Work effectively as a member of the health care team	Clinical Teaching, Clinical Experiences, Performance Feedback Role Models
Demonstrate understanding of cost-effectiveness and risk-benefit analysis	
Advocate for and work towards patient safety and improved quality of care	
Identify system errors and implement systems solutions	

Cardiac CT Learning Objectives

Patient Care	
Objective	Teaching Methods
1. Review the patient's medical history and prior imaging studies, understand the indication and clinical question to be addressed by CCT, determine appropriateness of CCT examination, and protocol the CCT examination.	Clinical Teaching, Clinical Experience
2. Recognize hazards and understand safe practices for working in the CT environment, and properly screen patients for contraindications for CCT examination.	Didactic (DVD), Clinical Experience
3. Ensure that CCT examinations are performed to maintain patient comfort, privacy, safety, and radiation dose minimization.	Clinical Experience
4. Recognize and manage complications associated with CCT examinations, including medications, contrast agents, sedation, power injections, and radiation dose.	Clinical Teaching, Clinical Experience, Didactic (classroom)
5. Complete accurate reports of the CCT examination including summary of findings, procedure description, document radiation dose, management of complications, and notification of attending physician regarding results when appropriate.	Clinical Teaching, Clinical Experience, Performance Feedback

Medical Knowledge	
Objective	Teaching Methods

<p>1. Learn the standard views and methodology for CCT examinations for studying cardiac structure, calcium scoring scan, coronary blood flow, and function including:</p> <ol style="list-style-type: none"> a. Radiation dosimetry and radiation reduction techniques in CCT. b. Assessment of cardiovascular calcium, prognostic value, and relation to cardiovascular risk factors. c. Methodology for CCT image acquisition. d. Post-processing and reconstruction methods e. CCT angiography of the native coronary arteries. f. CCT angiography after revascularization. g. CCT assessment of pericardial/myocardial diseases. h. CCT evaluation of valvular heart disease. i. CCT assessment of cardiac masses. j. Use of CCT in transcatheter valve implantation (TAVR/TMVR). k. Use of CCT in congenital heart disease. k. Use of CCT in the emergency department. 	<p>Clinical Teaching, Clinical Experience, Didactics (DVD), Didactic (classroom), Computer Modules</p>
<p>2. Master the <i>core concepts</i> of CCT including:</p> <ol style="list-style-type: none"> a. Techniques for radiation dose minimization. b. Standard cardiac CCT imaging planes c. Trade offs between spatial vs. temporal resolution d. The indications for the use of prospective vs retrospective ECG triggering and the resulting impact on image quality and radiation dose. e. Sources of artifacts and their effects on CCT images. f. Concepts of X-ray source and detector design, detector coverage, scan speed, and dose modulation. g. Techniques for artifact (motion, body habitus) minimization. h. CCT concepts of pitch and field of view. 	<p>Clinical Teaching, Clinical Experience, Didactics (DVD), Didactic (classroom), Computer Modules</p>
<p>3. Master <i>image analysis</i> and <i>post-processing skills</i>, including:</p> <ol style="list-style-type: none"> a. Assessment of cardiovascular calcium b. Dimensional measurements of the heart and great vessels c. Volumetric imaging of cardiac mass, ventricular volume, and ejection fraction (where applicable). d. Post-processing and reconstruction techniques for coronary arteries. e. Identification of coronary artery anatomy, coronary artery origins and course, anomalous coronaries, congenital cardiac anatomy, and identification of artifacts. f. Interpret CCT angiograms of great vessels, native coronary arteries, stented coronary arteries, surgical bypass grafts, coronary atherosclerotic plaques. g. Identification of myocardial infarction. 	<p>Clinical Teaching, Clinical Experience, Didactic (classroom)</p>
<p>4. Master <i>interpretive skills</i> for diagnosing and reporting:</p> <ol style="list-style-type: none"> a. Coronary artery disease and myocardial infarction b. cardiomyopathies 	<p>Clinical Teaching, Clinical Experience, Didactics (DVD),</p>

b. valvular abnormalities c. congenital heart disease d. diseases of the aorta e. pericardial diseases f. Intracardia and pericardiacal masses g. Vascular measurements for transcatheter valve replacement planning	Didactic (classroom), Computer Modules, Performance Feedback
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Professionalism	
Objective	Teaching Methods
Demonstrate accountability and professional behavior towards patients, family members, and members of the health care team and adherence to ethical principles	Clinical Experience, Role Models
Demonstrate compassion and respect for others, including patients from a diverse cultural, social, and religious backgrounds	Clinical Experience, Role Models

Interpersonal and Communication Skills	
Objective	Teaching Methods
Communicate effectively with patients, families, and members of the health care team, including findings and diagnoses to referring physicians, and when appropriate, to patients.	Clinical Experience, Role Models
Provide timely and comprehensive reports of CCT examinations, including notification of significant results to referring physician when appropriate.	Clinical Teaching, Clinical Experience

Practice Based Learning and Improvement	
Objective	Teaching Methods
Identify both strengths and gaps in knowledge and expertise and set appropriate learning goals	Independent study, Clinical Experience, Performance Feedback
Utilize information technology to effectively locate, appraise, and utilize evidence based medicine with in current literature to improve patient care	Independent study, Computer Modules
Utilize quality improvement methods to implement changes within the practice environment	Clinical Experience

Systems Based Practice	
Objective	Teaching Methods
Work effectively as a member of the health care team, by providing CCT services, coordination of patient care and reporting of results.	Clinical Experience
Understand the complexities of and work with the multidisciplinary resources necessary to appropriately directed patients to alternative (either superior or complementary to CCT) imaging studies.	Clinical Experience
Demonstrate understanding of cost-effectiveness and risk-benefit	Clinical Experience,

analysis of CCT and incorporate these into patient care	Didactic (classroom)
Advocate for and work towards patient safety and improved quality of care	Clinical Experience, Role Models
Identify system errors and implement systems solutions	Clinical Experience