ACR–ACNM–SNMMI–SPR–STR PRACTICE PARAMETER FOR THE PERFORMANCE OF CARDIAC POSITRON EMISSION TOMOGRAPHY COMPUTED TOMOGRAPHY (PET/CT)

Revised 2023 (Resolution 23)*

The American College of Radiology, with more than 30,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

The American College of Radiology will periodically define new practice parameters and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice parameters and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice parameter and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review and approval. The practice parameters and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice parameter and technical standard by those entities not providing these services is not authorized.

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care[1]. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the practitioner considering all the circumstances presented. Thus, an approach that differs from the guidance in this document, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in this document when, in the reasonable judgment of the practitioner, such course of action is indicated by variables such as the condition of the patient, limitations of available resources, or advances in knowledge or technology after publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document may consider documenting in the patient record information sufficient to explain the approach taken.

The practice of medicine involves the science, and the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to the guidance in this document will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The purpose of this document is to assist practitioners in achieving this objective.

1 *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 831 N.W.2d 826 (Iowa 2013) Iowa Supreme Court refuses to find that the "ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures (Revised 2008)" sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, Stanley v. McCarver, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.*

I. INTRODUCTION

This practice parameter has been developed collaboratively by the American College of Radiology (ACR), the American College of Nuclear Medicine (ACNM), the Society of Nuclear Medicine and Molecular Imaging (SNMMI), the Society for Pediatric Radiology (SPR), and the Society of Thoracic Radiology (STR).

This document is intended to act as a guide for physicians performing and interpreting positron emission tomography–computed tomography (PET/CT) examinations for cardiac diseases in adults and children.

When properly performed, cardiac PET is a sensitive means of demonstrating the biodistribution of radiopharmaceuticals within the heart and nearby vascular and nonvascular structures. The addition of CT, most commonly in the form of noncontrast CT for attenuation correction, aids in the evaluation of cardiac disease. In cardiac PET/CT, CT is used for attenuation correction and anatomic coregistration of the PET image data, and it may be used for an assessment of coronary calcium most commonly through semi-quantitative analysis. In this document, cardiac CT is discussed only in the context of cardiac PET/CT. For more specific details on cardiac CT, please refer to the ACR–NASCI–SPR Practice Parameter for the Performance and Interpretation of Cardiac Computed Tomography (CT) [1].

This practice parameter is limited to cardiac PET/CT; it does not include all radiopharmaceuticals related to cardiac imaging and does not cover single-photon emission computed tomography (SPECT) imaging techniques. Application of this practice parameter should be done in accordance with the ACR–ACNM–SNMMI–SPR Practice Parameter for the Use of Radiopharmaceuticals in Diagnostic Procedures [2]. For cardiac SPECT imaging, please refer to the ACR–NASCI–SNMMI–SPR–STR Practice Parameter for the Performance of Cardiac Scintigraphy [3].

II. INDICATIONS

The primary goals of cardiac PET/CT include evaluation of perfusion, function, viability, inflammation, anatomy, and risk stratification for cardiac-related events such as myocardial infarction and death. Maximum diagnostic accuracy of cardiac PET/CT is achieved when images are interpreted in conjunction with other relevant imaging, clinical information, and laboratory data. Cardiac PET/CT is a preferred test for patients with suspected or known coronary artery disease (CAD) who are appropriate for stress imaging and are unable to undergo exercise stress imaging. Cardiac PET/CT is the preferred test for all patients who are appropriate for pharmacological stress imaging [4].

Clinical indications for cardiac PET/CT include [5], but are not limited to:

1. Myocardial perfusion imaging (MPI) (CT may be used for coronary calcium assessment)
    a. Symptomatic patients with suspected or known CAD
        i. Intermediate or high pretest probability and unable to undergo exercise stress
        ii. Detection of obstructive CAD causing myocardial ischemia in patients with acute or chronic chest pain
    b. Risk assessment in asymptomatic high-risk patients
        i. Evaluate patients with moderate or extensive plaque burden on prior calcium score CT (calcium score >400)
        ii. Abnormal or equivocal prior coronary CT angiography (CTA) or exercise stress tests
        iii. New left ventricular dysfunction

iv. New left bundle branch block
v. History of percutaneous coronary intervention >2 years or coronary artery bypass grafting > 5 years
vi.

c. New heart failure with reduced ejection fraction (any clinical risk of CAD) or heart failure with preserved ejection faction (intermediate or high risk of CAD)
d. Clarification of equivocal or discordant prior tests
    i. Prior imaging was of suboptimal quality, inconclusive, or nondiagnostic
    ii. Those with likely suboptimal SPECT imaging (eg, patients with obesity or patients with large breasts)
    iii. Borderline obstructive lesions on coronary angiography or by CTA
    iv. Anomalous coronary arteries with suspected ischemia
    v. Equivocal result from other stress imaging including stress cardiac MRI, SPECT, electrocardiogram (ECG), or echocardiogram
e. Preoperative risk assessment before high-risk surgical procedures (vascular surgery, kidney/liver/lung transplantation)
f. Postoperative assessment of reimplanted coronary arteries (including congenital heart disease, eg, surgically corrected transposition of the great arteries)

2. Measurement of myocardial blood flow (MBF) and coronary flow reserve and detection of balanced ischemia or microvascular disease
3. Myocardial viability
    a. Detection of hibernating or stunned myocardium
    b. Preoperative assessment before revascularization for prognosis of improved left ventricular function
4. Cardiac sarcoidosis
5. Heart transplants for detection of coronary artery vasculopathy
6. Cardiac infection (including infected cardiac implanted devices)

For information on radiation risks to the fetus, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [6].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physicians

Cardiac PET/CT examinations should be performed under the supervision of and interpreted by a physician who meets the qualifications outlined in the ACR–ACNM–SNMMI–SPR Practice Parameter for the Use of Radiopharmaceuticals in Diagnostic Procedures [2].

and

Physicians who have been certified by the ABR or the ABNM have substantial knowledge of the principles of general PET/CT image acquisition and postprocessing, including the design of PET/CT protocols and the use of diagnostic workstations. However, to achieve specific competency in cardiac PET/CT, physicians should have dedicated education and experience in cardiac PET/CT protocols and interpretation. The physician should have substantial experience in CT interpretation, including CT assessment of extracardiac thoracic structures included in the cardiac PET/CT examination.

The supervising physician is responsible for all aspects of the study, including, but not limited to, reviewing all indications for the examination, specifying the imaging protocol to be performed, specifying the use and dosage of contrast and pharmacologic agents, specifying the methods of image reconstruction, assuring the quality of the images and of the final interpretation,[1] and communicating any critical or significant findings. For further information, please refer to the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [7]. The supervising physician must be an Authorized User (AU) of radiopharmaceuticals or work under the auspices of another AU in their practice setting.

A physician board-certified or board-eligible by the ABR and/or the ABNM should meet the following

requirements:

a. Completion of training in a program accredited by the Accreditation Council for Graduate Medical Education (ACGME), the Royal College of Physicians and Surgeons of Canada, the Collège des Médecins du Québec, or the American Osteopathic Association, including education specifically pertaining to performance and interpretation of cardiac PET/CT including cardiac anatomy, physiology, and pathology.
or

Evidence of CME pertaining to performance and interpretation of cardiac PET/CT including cardiac anatomy, physiology and pathology .[2]

and

b. Evidence of ongoing interpretation of cardiac PET/CT. Live and/or online educational programs and/or proctored/over-read cardiac PET/CT cases may be used to fulfill this requirement.

Maintenance of competence

For continuing education and experience, please see the ACR–ACNM–SNMMI–SPR Practice Parameter for the Use of Radiopharmaceuticals in Diagnostic Procedures [2] and the ACR Practice Parameter for Continuing Medical Education (CME) [8].

Continuing medical education

---

[1] The ACR Medical Legal Committee defines official interpretation as that written report (and any supplements or amendments thereto) that attach to the patient's permanent record. In healthcare facilities with a privilege delineation system, such a written report is prepared only by a qualified physician who has been granted specific delineated clinical privileges for that purpose by the facility's governing body upon the recommendation of the medical staff.

[2] Documented equivalent supervised experience is defined as supervision at a center where the proctoring physician meets these criteria to independently interpret cardiac PET/CT.

The physician's continuing medical education should be in accordance with the ACR Practice Parameter for Continuing Medical Education (CME) [8], which requires 150 hours of approved education every 3 years and should include CME in cardiac PET/CT as appropriate to the physician's practice needs.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

B. Qualified Medical Physicist

For Qualified Medical Physicist qualifications, see the ACR–AAPM Technical Standard for Medical Physics Performance Monitoring of PET/CT Imaging Equipment [9].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

C. Radiologic and Nuclear Medicine Technologist

See the ACR–SPR Practice Parameter for Performing and Interpreting Diagnostic Computed Tomography (CT) [10] and the ACR–ACNM–SNMMI–SPR Practice Parameter for the Use of Radiopharmaceuticals in Diagnostic Procedures [2].

The Nuclear Medicine Technology Certification Board (NMTCB) has developed a PET specialty examination and a CT post–primary examination that are open to appropriately educated and trained, certified, or registered nuclear

medicine technologists, registered radiologic technologists, and registered radiation therapists, as specified on the NMTCB website (www.nmtcb.org). The American Registry of Radiologic Technologists (ARRT) offers a CT certification examination for qualified radiologic technologists and allows certified or registered nuclear medicine technologists who meet the educational and training requirements to sit for this examination. Eligibility criteria may be found on the ARRT website (http://www.arrt.org).

Certified nuclear medicine and diagnostic CT technologists must follow all applicable regulations. Diagnostic CT may not be considered in the scope of nuclear medicine technologist depending on which state they reside.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

D. Radiation Safety Officer

The radiation safety officer must meet applicable requirements of the Nuclear Regulatory Commission (NRC) for training, as specified in 10 CFR 35.50 or equivalent agreement state regulations.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

E. Healthcare Professional

Healthcare professional performing or supervising exercise or pharmacologic stress testing as part of cardiac PET/CT should meet the qualifications outlined in the ACC/AHA Clinical Competence Statement on Stress Testing [11]. Healthcare professional supervising stress-induced examinations should have appropriate training in advanced cardiovascular life support.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

1. MPI

a. Background

PET/CT scans are performed at rest and/or with stress (pharmacologic and/or exercise) for noninvasive imaging of the perfusion of the heart for the diagnosis and management of patients with known or suspected CAD . Rubidium-82 chloride and nitrogen-13 ammonia are the most commonly used PET/CT radiopharmaceuticals for MPI in the United States. Oxygen-15 water is used clinically in Europe; it is not currently FDA approved in the United States. Flourine-18 (F-18)–based agents are in development but have not yet been approved by the FDA. Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG) is the standard for myocardial metabolic imaging. Rubidium-82 chloride and nitrogen-13 ammonia are actively transported across the myocardial cell membrane to become trapped within the myocyte. Compared with freely diffusible oxygen-15 water, which has an extraction fraction of 100% during normal and high coronary flow states, both rubidium-82 chloride and nitrogen-13 ammonia are incompletely extracted (ie, <100%), and their extraction further decreases in a nonlinear relationship as MBF increases. The baseline first-pass extraction fractions in a normal blood flow state for nitrogen-13 ammonia and rubidium-82 chloride are approximately 80% and 60%, respectively; during a high blood flow state, however, they are approximately 50% and 30%, respectively. Nitrogen-13 ammonia has a half-life of 10 minutes and a short positron range of 0.4 mm, whereas rubidium-82 chloride has a half-life of 76 seconds and a positron range of 2.8 mm, resulting in nitrogen-13 ammonia examinations having better image quality, spatial resolution, and accuracy. However, rubidium-82 chloride is generator produced, whereas nitrogen-13 ammonia is cyclotron produced, leading to greater workflow efficiency and clinical utilization compared with nitrogen-13 ammonia.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

1. MPI

b. Patient preparation

Before the cardiac PET/CT, the qualified supervising physician should review the indications for the examination, confirm patient hemodynamic stability, review medications, and aim to identify potential risks and contraindications. Contraindications may include pregnancy, allergic reactions to radiopharmaceuticals, and potential adverse responses to administered pharmacologic stress agents. Patients should abstain from caffeine

for 24–48 hours and fast for 4 hours before the examination. Antianginal and/or antihypertensive medications such as beta blockers, calcium channel blockers, and nitrates can affect the accuracy of stress testing. The decision to continue these medications for the test is at the discretion of the referring physician. The use of these medications should be noted on the test report.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

1. MPI

c. Pharamacologic stress

The heart may be stressed using one of a variety of pharmaceutical medications (eg, dipyridamole, adenosine, regadenoson, or dobutamine). N-13 ammonia imaging can also be performed with treadmill stress due to relatively longer half-lives. Depending on the clinical necessity or the clinical question, beta-blocking and calcium channel–blocking medications may need to be discontinued by the patient's physician before examination for a time sufficient to obviate their pharmacologic effect.

i. Dipyridamole is infused intravenously in a dosage of 0.56 mg/kg for 4 minutes. Its duration of action is between 30 minutes and 1 hour. The radiopharmaceutical should be injected 3– 5 minutes after the end of the dipyridamole infusion. Dipyridamole has numerous side effects, including chest pain, headache, dizziness, hypotension, nausea, flushing, and dyspnea. Severe reactions have included fatal and nonfatal myocardial infarctions and severe bronchospasm. Aminophylline (1–2 mg/kg) must be immediately available for intravenous injection and should be given to reverse significant side effects. Because all xanthines (eg, caffeine and theophylline) interfere with the pharmacologic effect of dipyridamole, they must be discontinued for 24–48 hours before the examination. Patients who have unstable angina, bronchospastic airway disease, and second-degree heart block are at increased risk for complications of dipyridamole administration, and these conditions should be considered relative contraindications to use of the medication. As with physical stress testing, clinical, blood pressure, and electrocardiographic monitoring are mandatory during the dipyridamole infusion and for 3–5 minutes into recovery until stable.

ii. Adenosine may also be given intravenously in a dosage of 0.14 mg/kg/ per minute over 6 minutes (3 minutes before injection of the radiopharmaceutical and continued for 3 minutes thereafter). Shorter infusion protocols (4–5 minutes) have been used successfully with adenosine. While using shorter infusion protocols, the radiopharmaceutical should be injected at least 2–2.5 minutes before the termination of adenosine infusion. Because of the extremely short duration of the pharmacologic action of adenosine, injection of the radiopharmaceutical must occur during the adenosine infusion. Side effects are similar to those of dipyridamole but are very short-lived, often eliminating the need for aminophylline. Adenosine is vulnerable to the same interference from xanthine-containing foods, beverages, and medications as is dipyridamole, so all must be discontinued for 24–48 hours before examination. Hemodynamic, electrocardiographic, and clinical monitoring must be carried out as with any other form of stress.

iii. Regadenoson is the most commonly used pharmacological cardiac stress agent in the United States. It is an A2A adenosine receptor agonist administered as a rapid intravenous bolus injection in a dosage of 0.4 mg over 20 seconds; there is no dosage adjustment for body weight/body mass index. It should not be administered to patients with a second-degree or third-degree atrioventricular block or sinus node dysfunction who do not have a functioning artificial pacemaker or those with bronchospastic airway disease, uncontrolled hypertension (systolic blood pressure [BP] >200 mmHg or diastolic BP >110 mmHg), hypotension (systolic BP <90 mmHg), or recent (<48 hour) use of dipyridamole or dipyridamole containing medications.

iv. Dobutamine is infused intravenously. A number of protocols are available. One involves the graduated infusion of increasing amounts of dobutamine over time, beginning with 5–10 mcg/kg per minute over 3-minute increments, rising by 5–10 mcg/kg per minute each step, with a maximum dosage rate of 40 mcg/kg per minute. Atropine may be needed to achieve the target heart rate. The end point is 85% of the maximum predicted heart rate or side effects similar to those listed above (section IV.A.1.c.i). Radiotracer is injected at peak heart rate with dobutamine infusion continuing for 1 minute following tracer injection.

Beta blockers and calcium channel blockers must be withdrawn far enough in advance of the test to eliminate their effect. Dobutamine stress is an alternative in patients who have obstructive pulmonary disease. Dobutamine is associated with an increased incidence of cardiac arrhythmia and should be given with extreme caution in patients prone to arrhythmias or in the post–myocardial infarction period.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

1. MPI

d. Data acquisition

The patient should be positioned supine on the PET/CT scanner bed with arms raised and supported at or above shoulder level. When it is not feasible to position the arms out of the imaging field of view (FOV), they should be secured by the patient's side to minimize the likelihood of movement between the CT and PET acquisitions. An x-ray scout image should be used to set the scan range to a single PET FOV centered over the heart. Attenuation-correction CT (see section IV.B.1) can be performed either before or after the first PET acquisition. Rest and stress examinations should be performed sequentially, in either order. To minimize interference of the second scan (eg, rest) by activity from the first scan (eg, stress), the time between the 2 administrations is usually at least 4 radionuclide half-lives. If the patient leaves the scanner bed between the rest and stress acquisitions or if patient motion is suspected, the attenuation-correction CT should be repeated.

Except for the pharmacologic stress, PET data acquisition for the rest and stress components of the examination should be identical. The patient should be positioned such that the heart is centered in the PET FOV before radiopharmaceutical administration. The administered activity depends on the PET acquisition mode (2-D or 3-D) and may be adjusted according to patient weight/size. For rubidium-82 chloride, 1480–2220 MBq (40–60 mCi) is administered for 2-D acquisition and 370–740 MBq (10 to 20 mCi) for 3-D acquisition. For nitrogen-13 ammonia, 370–740 MBq (10–20 mCi) is used for 2-D or 3-D acquisition. Note these administered activities apply to either the rest or stress portions of the examination and the total activity will double for a typical examination comprising both components. Consistent administration technique is important, particularly for coronary flow reserve quantification. Rubidum-82 is infused directly from the generator at a rate that is dependent on the system capabilities and age of the generator. For nitrogen-13 ammonia, administration can be as a manual bolus injection or <30-second infusion using a syringe pump, both followed by a saline flush.

If coronary flow reserve quantification is required, PET data should be acquired as a dynamic scan starting at the time of radiopharmaceutical administration. Otherwise, acquisition should commence 70–130 seconds after administration for rubidium-82 and 1.5–3 minutes for nitrogen-13 ammonia to allow for blood pool clearance. Image data are generally acquired for 3 to 7 minutes for rubidium-82 and 10–15 minutes for nitrogen-13 ammonia. All PET data should be acquired in conjunction with ECG gating, ideally in list mode to allow flexible reformatting of the data, for example, reconstruction of dynamic, gated, and static images from a single acquisition. Image reconstruction algorithms and equipment performance vary substantially between PET/CT systems, and parameters should be carefully optimized for individual systems. In general, iterative reconstruction, with or without time-of-flight information, and pixel sizes between 2–4 mm are commonly used. The same reconstruction parameters should be used for rest and stress studies to enable direct image comparison. All usual corrections should be applied to the data, including corrections for randoms, dead time, attenuation, scatter, and normalization. Patient motion between CT and PET should be assessed visually, and additional PET reconstructions incorporating realigned CT data may be obtained as needed.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

2. Myocardial Viability Imaging

a. Background

Normal myocardium uses 2 main sources of energy: free fatty acids and glucose. Ischemic myocardium increases its use of glucose as an energy source and consumes it at a higher rate than does normal myocardium. The purpose of a viability scan is to identify ischemic but viable tissue in a patient who has apparent scar/left

ventricular dysfunction on other imaging, which might instead represent chronic ischemia at rest. Viable tissue is defined by normal perfusion or areas of increased glucose uptake in areas of reduced perfusion ("hibernating" myocardium). The presence of viable tissue may benefit from restored perfusion from revascularization.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

2. Myocardial Viability Imaging

b. Patient preparation

To optimize myocardial uptake of F-18 FDG in abnormal myocytes, several preparatory steps are required. Most commonly, the patient is instructed to fast for 6–12 hours before the examination. Before infusing F-18 FDG, the patient may be placed on an oral or intravenous glucose and insulin protocol [12]. For patients with diabetes, alternative strategies of a euglycemic hyperinsulinemia clamp protocol or administration of nicotinic acid may be considered [12].

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

2. Myocardial Viability Imaging

c. Data acquisition

The administered FDG activity depends on the PET acquisition mode (2-D or 3-D) and may be adjusted according to patient weight/size. An activity of 370–555 MBq (10 to 15 mCi) is administered for 2-D acquisition and at 185–370 MBq (5–10 mCi) for 3-D acquisition. The target PET start time should be 45–60 minutes after FDG injection for nondiabetic patients and 60–90 minutes (up to 3 hours) for diabetic patients. The patient should be positioned supine on the scanner bed with arms raised and supported at or above shoulder level. When it is not feasible to hold the arms out of the imaging FOV, the arms should be secured by the patient's side to minimize the likelihood of movement between the CT and PET acquisitions. An x-ray scout image should be used to set the scan range to a single PET FOV centered over the heart. Attenuation-correction CT (see section IV.B.1) would typically be performed before PET data acquisition, although CT after the PET is possible and may be required if substantial patient motion occurs. PET data are generally acquired as an ECG-gated acquisition for between 10–30 minutes. Image reconstruction algorithms and equipment performance vary substantially between PET/CT systems and parameters should be carefully optimized for individual systems. In general, iterative reconstruction, with or without time-of-flight information, and pixel sizes between 2–4 mm are commonly used. All usual corrections should be applied to the data, including corrections for randoms, dead time, attenuation, scatter, and normalization. Patient motion between CT and PET should be assessed visually, and additional PET reconstructions incorporating realigned CT data may be obtained as needed.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

3. Myocardial/Sarcoid Imaging

a. Background

Cardiac sarcoidosis is an autoimmune inflammatory disease that can cause abnormal cardiac conduction, arrhythmias, and/or contractile dysfunction through infiltration of inflammatory granulomas and subsequent scarring. Patients can present with various degrees of heart block or tachyarrhythmias and are at risk for sudden death. Clinically evident cardiac involvement is seen in approximately 5% of patients [13]. The recorded incidence at autopsy ranges between 20%–25% [14]. F-18 FDG-PET has the benefit of very high sensitivity in the evaluation of cardiac sarcoidosis [15,16] with focal intense F-18 FDG uptake. F-18 FDG-PET/CT can accurately diagnose cardiac sarcoidosis, provided there is meticulous patient preparation [17]. Reduction or disappearance of focal F-18 FDG uptake correlates with treatment response [16,17]. Cardiac F-18 FDG-PET/CT and MRI together can provide optimal diagnosis of cardiac sarcoidosis by differentiating between granulomatous inflammation and fibrotic/scar changes. F-18 FDG-PET/CT has been shown to be useful for the demonstration of extracardiac sarcoid involvement as well [18-21].

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols
3. Myocardial/Sarcoid Imaging
b. Patient preparation

Various dietary regimens are available to achieve suppression of normal glucose utilization by the myocardium. The principle is a high-fat (>35 g)/low-carbohydrate (<3 g) diet the day before the PET/CT examination along with 12–18 hours of fasting (no gum, candy, or cough drops [22]). The use of intravenous heparin (15–50 units/kg) approximately 15 minutes before F-18 FDG injection [23,24] can be considered, although its role is unclear. Inadequate dietary preparation can lead to a false positive or a nondiagnostic examination. The blood glucose level needs to be measured before the F-18 FDG injection and ideally should be below 150 mg/dL. Oral hypoglycemic and insulin use in patients with type 2 diabetes should be held for 24 hours.

IV. SPECIFICATIONS OF THE EXAMINATION
A. Imaging Protocols
3. Myocardial/Sarcoid Imaging
c. Data acquisition

A rest MPI examination (SPECT or PET, preferably a gated scan) is performed first, and reconstructed images should be available for comparison. After the intravenous administration of F-18 FDG at 370–555 MBq (10–15 mCi) and a 90-minute uptake period (minimum of 60 minutes), PET images are acquired in a static or gated mode. The cardiac F-18 FDG images are reconstructed and compared with the rest SPECT or PET MPI. Given that sarcoidosis is a systemic disease, conventional whole-body F-18 FDG-PET/CT may be performed from the cerebellum to the midthighs to evaluate F-18 FDG uptake in extracardiac regions. F-18 FDG images should be reviewed on a workstation capable of displaying the entire PET FOV, preferably fused PET/CT using an Standardized Uptake Value (SUV-based scale).

IV. SPECIFICATIONS OF THE EXAMINATION
B. Other Examination Specifications
1. Attenuation correction

Attenuation correction of PET images is required and can be achieved with rod sources (germanium-68-gallium or 137-cesium) or CT. (The use of MRI for Attenuation correction is an evolving practice, and guidelines for the use of MRI for attenuation correction of PET data are outside the scope of this practice parameter.) CT attenuation correction (CTAC) data can be obtained before, during, or after a PET scan on the same scanner. Generating a separate CTAC for each PET/CT session performed (ie, if the patient gets off the scanner between imaging sessions) is recommended to achieve the best anatomic positioning and avoid artifacts. If rest and stress imaging are performed without moving the patient, only one CTAC image is required. CT can be performed by a variety of methods, but regardless of the method, a careful review of the CT images for incidental findings and reporting of these findings is required.

It is important to register the proper position of the mediastinal structures on CTAC and PET, which are affected by respiratory motion, cardiac motion, and gross patient movement. This can be achieved by one or more of a variety of methods. Inaccurate colocalization of the CTAC to non–attenuation-corrected (NAC) PET data can result in artifacts on the attenuation-corrected (AC) PET images [25-27]. The CT can be acquired during shallow free breathing, which is recommended to minimize respiratory misalignment between PET and CT. The NAC and AC PET images must be visually inspected for proper coregistration of radiopharmaceutical uptake in myocardium on NAC PET to the myocardial anatomy on CT.

It is generally recommended to use a low-dose CT technique for CTAC. However, when indicated, CT can be performed for diagnostic purposes, including higher-dose CT protocol and/or full-inspiration breath-hold techniques. ECG gating of CT is not recommended. High concentration of intravenous contrast can cause AC artifacts on PET images, and caution is recommended if these images are to be used for CTAC [28-32]. Full breath-hold CT can cause artifacts as registration of anatomy on CTAC and NAC PET can be difficult. It is acceptable to perform a low-dose CTAC scan in addition to an indicated diagnostic CT scan. For further details on CTAC of PET, please see the ACR–ACNM–SNMMI–SPR Practice Parameter for Performing FDG-PET/CT in Oncology [33].

Although diagnostic CT acquired at the same scanning session as the PET can potentially be used for attenuation correction, an additional low-dose CT is recommended to reduce image registration complications. CT for attenuation correction should be acquired at end expiration or shallow free breathing to minimize misalignment between the PET and the CT. Because diagnostic image quality is not required, the tube current can be low (50 mA or lower), and neither contrast material nor ECG gating should be used. For perfusion PET studies, a single CT may be adequate to correct both rest and stress PET data if the patient did not move significantly between the 2 acquisitions. Two separate CT scans will be needed if the patient moves between the rest and stress portions of the test. Registration between the PET and CT data should be visually assessed and manual or computer-optimized realignment performed as required.

IV. SPECIFICATIONS OF THE EXAMINATION

B. Other Examination Specifications

2. Quantification of absolute MBF

Absolute MBF can be assessed quantitatively by cardiac PET/CT. PET can quantify absolute rate of blood flow to the myocardium at rest and stress, as opposed to a comparative measure in which at least a portion of the myocardium is considered "normal" and the diseased myocardium is compared to the patient's own myocardium as a normal control. PET is uniquely suited to calculate MBF. When comparing stress and rest MBF, the myocardial flow reserve (MFR) can be calculated. Flow reserve contributes additional information to MPI and helps with diagnosis and prognosis and in guiding management of patients with CAD [34]. [35,36].

Dynamic imaging initiated at the time of injection is required for MBF quantification. List-mode acquisition of PET data allows for reconstruction of the PET data over time and accurate calculation of MBF. A region of interest is placed on the aorta or left atrium (or other structure representing arterial flow) and on the myocardium (including volumes representing each vascular territory) to generate image-derived time-activity curves that are used in conjunction with kinetic models [37,38]. The kinetic model estimates the MBF as a of uptake into the myocardium in terms of milliliters per minute per gram. MFR is then calculated as the ratio of MBF at peak hyperemia over the MBF during rest. For routine clinical calculation of the MBF and MFR, the use of an automated, validated, and FDA (Food and Drug Administration) approved analysis tool is recommended [39].

Three-dimensional PET requires adapted methods, including a possible reduction in administered activity, for the calculation of MBF compared with 2-D data acquisition [40,41]. With 3-D PET systems, care must be given to not allow the radiopharmaceutical activity in the bolus during first-pass imaging to exceed the range of accurate detection of the camera and lead to detector saturation which can result in falsely elevated MBF assessments.

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [7]

If stress testing is part of cardiac PET/CT examination, the interpretation of findings from the stress test should be reported.

VI. EQUIPMENT SPECIFICATIONS

A. General Requirements

In addition to a clinical PET/CT system with the capabilities noted below, the following auxiliary equipment may also be required. The use of rubidium-82 chloride will require a generator system that must be positioned next to the scanner, allowing direct infusion to the patient. A radionuclide activity calibrator (dose calibrator) to assay radiopharmaceuticals and perform quality assurance on rubidium-82 chloride generators is included in the infusion system. Radiotracers with a longer physical half-life (eg, 13N-ammonia) can be injected with a syringe pump. A 3-lead ECG box is integrated with the PET/CT system and required to allow ECG-gated image acquisition. Dedicated software for the display and quantitative analysis of cardiac PET and CT images is also necessary. In addition, it is important to maintain specific emergency medical equipment in the scanner room, such as defibrillators, intubation gear, cardiopulmonary resuscitation first aid equipment, a contrast reaction kit, and emergency drugs

VI. EQUIPMENT SPECIFICATIONS

B. PET Requirements

Current clinical PET/CT systems generally have a PET FOV that is sufficiently large (at least 15 cm) to allow the entire heart to be imaged without the need for bed translation. PET systems based on lutetium oxyorthosilicate, lutetium yttrium orthosilicate, bismuth germinate, and gadolinium oxyorthosilicate are all acceptable. Both 2-D (septa-in) and 3-D (septa-out) data acquisition are suitable. The ability to acquire PET data in conjunction with ECG gating is needed (typically at least 8 gates), and the use of simultaneous respiratory gating can also be employed when available. When quantification of coronary flow reserve is to be performed, list-mode data acquisition is preferred as it allows dynamic, ECG-gated, and static images to be reconstructed from a single acquisition. Image reconstruction can be performed with either analytical or iterative algorithms, although the same reconstruction protocol should be used when comparing studies such as those acquired at rest and stress. All usual quantitative corrections should be applied to the data, including normalization, randoms, attenuation, scatter, dead time, and decay corrections. Time-of-flight information should be used when available. Image analysis requires dedicated software for realignment to the conventional cardiac orientation, convenient side-by-side presentation of related series (eg, rest and stress images), and cine display of ECG-gated images. Quantitative analysis, including measurement of ejection fraction and coronary flow reserve, requires additional software capabilities. The ability to override automatic segmentation of the myocardial walls and manually positioned constraints is an important requirement.

VI. EQUIPMENT SPECIFICATIONS

C. CT Requirements

CT requirements vary depending on the intended applications. CT for attenuation correction can be performed on all clinical PET/CT systems that incorporate diagnostic multidetector CT, irrespective of the slice configuration. ECG gating is not required. The PET/CT console should have tools to allow registration of PET and CT cardiac images and a mechanism to incorporate the resulting motion parameters into a new AC PET reconstruction based on the aligned CT.

VI. EQUIPMENT SPECIFICATIONS

D. Quality Control Requirements

Technical standards for quality control of PET/CT systems have been described in the ACR–AAPM Technical Standard for Medical Physics Performance Monitoring of PET/CT Imaging Equipment [9]. These recommendations incorporate the standards for CT (see the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography (CT) Equipment [43]), which are particularly important for cardiac applications. Although radiopharmaceutical quality control is beyond the scope of this document, quality control for rubidium-82 chloride generators deserves mention because it is typically the responsibility of the imaging staff, as opposed to a radiopharmacist. Quality control of rubidium-82 chloride generators should be performed daily, before patient administrations, and should include measurement of the levels of strontium-82 and strontium-85 in the rubidium-82 chloride injection.

VI. EQUIPMENT SPECIFICATIONS

E. Equipment

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Medical Physics Performance Monitoring of PET/CT Imaging Equipment [9].

VII. RADIATION SAFETYIN IMAGING

Radiologists, medical physicists, non-physician radiology providers**,** radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel who work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients

(justification, optimization including the use of dose reference levels). https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf

Facilities and their responsible staff should consult with the radiation safety officer to ensure that there are policies and procedures for the safe handling and administration of radiopharmaceuticals in accordance with ALARA principles. These policies and procedures must comply with all applicable radiation safety regulations and conditions of licensure imposed by the Nuclear Regulatory Commission (NRC) and by applicable state, local, or other relevant regulatory agencies and accrediting bodies, as appropriate. Quantities of radiopharmaceuticals should be tailored to the individual patient by prescription or protocol, using body habitus or other customized method when such guidance is available.

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unnecessary radiation exposure.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org). These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on Quality Control & Improvement, Safety, Infection Control*, *and Patient Education* on the ACR website (https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement).

ACKNOWLEDGEMENTS

This practice parameter was revised according to the process described under the heading *The Process for Developing ACR Practice Parameters and Technical Standards* on the ACR website (https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards) by the Committee on Practice Parameters and Technical Standards – Nuclear Medicine and Molecular Imaging of the ACR Commission on Nuclear Medicine and Molecular Imaging, the Committee on Body Imaging (Cardiovascular) of the ACR Commission on Body Imaging, and the Committee on Practice Parameters – Pediatric Radiology of the ACR Commission on Pediatric Radiology in collaboration with the ACNM, the SNMMI, the SPR, and the STR.

Writing Committee – members represent their societies in the initial and final revision of this practice parameter

ACR	ACNM
Elizabeth H. Dibble, MD, Chair	Harry W. Schroeder III, MD, PhD
Yoo J. Lee, BS, MS, MD	Katherine Zukotynski, MD, PhD

Helen R. Nadel, MD

SNMMI

Marcelo DiCarli, MD

Edward Miller, MD, PhD, FASNC, FACC

Krishna Patel, MD

SPR

Neha Kwatra, MD

Jennifer L. Williams, MD

STR

Brett W. Carter, MD

Paul P. Cronin, MB, BCh, BAO, FACR

Committee on Practice Parameters and Technical Standards – Nuclear Medicine and Molecular Imaging

(ACR Committee responsible for sponsoring the draft through the process)

Munir V. Ghesani, MD, FACR, Co-Chair

Rathan M. Subramaniam, MD, PhD, MPH, Co-Chair

Esma A. Akin, MD, FACR

Elizabeth H. Dibble, MD

Perry S Gerard, MD, FACR

K. Elizabeth Hawk, MD, MS, PhD

Eric Hu, MD

A. Tuba Karagulle Kendi, MD

Charles Marcus, MD

Gustavo A. Mercier, Jr., MD, PhD

Justin G. Peacock, MD, PhD

Eric M. Rohren, MD, PhD, FACR

Lilja B. Solnes, MD

Devaki S. Surasi, MD

Committee on Practice Parameters and Technical Standards – Nuclear Medicine and Molecular Imaging

(ACR Committee responsible for sponsoring the draft through the process)

Andrew Kaiser, MD

Andrew T. Trout, MD

Committee on Body Imaging – Cardiovascular

(ACR Committee responsible for sponsoring the draft through the process)

Klaus Hagspiel, MD, Chair

Ashley Prosper, MD

Lucia Flors Blasco, MD, PhD

Steven S. Raman, MD

Larissa Braga Casaburi, MD, MPH, MHA

Andrew L. Rivard, MD

Yoo Jin Lee, BS, MS, MD

Committee on Practice Parameters – Pediatric Radiology

(ACR Committee responsible for sponsoring the draft through the process)

Terry L. Levin, MD, FACR, Chair

Hollie A. Lai, MD

John B. Amodio, MD, FACR

Lauren P. Nicola, MD

Bradford W. Betz, MD, FACR

Sakura Noda, MD

Harris L. Cohen, MD, FACR

Erica Poletto, MD

Michael Collard, MD

Summit Shah, MD

Adam Goldman-Yassen, MD

Andrew T. Trout, MD

Committee on Practice Parameters – Pediatric Radiology

Jane Sun Kim, MD

Jessica Kurian, MD

Esben S. Vogelius, MD

Jason Wright, MD

Don C. Yoo, MD, FACR, Chair of the Commission Nuclear Medicine and Molecular Imaging

Andrew B. Rosenkrantz, MD, FACR, Chair, Commission on Body Imaging

Richard A. Barth, MD, FACR, Chair, Commission on Pediatric Radiology

David B. Larson, MD, MBA, FACR, Chair, Commission on Quality and Safety

Mary S. Newell, MD, FACR, Chair, Committee on Practice Parameters and Technical Standards

Comments Reconciliation Committee

Juan C. Batlle, MD, MBA, Chair

Ashley Propser, MD, Co-Chair

Richard A. Barth, MD, FACR

Lance Burrell, MS, CNMT, PET, NCT

Brett W. Carter, MD

Paul P. Cronin, MB, BCh, BAO, FACR

Timothy A. Crummy, MD, MHA, FACR

Elizabeth H. Dibble, MD

Marcelo DiCarli, MD

Klaus Dieter, MD

Munir V. Ghesani, MD

Sara Johnson, MD

Yoo J. Lee, BS, MS, MD

Terry L. Levin, MD, FACR

Gustavo A. Mercier, Jr., MD, PhD

Edward Miller, MD, PhD, FASNC, FACC

Helen R. Nadel, MD

Mary S. Newell, MD, FACR

Krishna Patel, MD

Andrew B. Rosenkrantz, MD

Harry W. Schroeder III, MD, PhD

Rathan M. Subramaniam, MD, PhD, MPH

Jason W. Wachsmann, MD

Jaime Warren, Ed.D, MBA, CNMT, NCT

Comments Reconciliation Committee

Amy L. Kotsenas, MD, FACR

Jennifer L. Williams, MD

Neha Kwatra, MD

Roland Wong, ScM

David B. Larson, MD, MBA, FACR

Don C. Yoo, MD, FACR

Paul A. Larson, MD, FACR

Katherine Zukotynski, MD, PhD FACR

REFERENCES

1. American College of Radiology. ACR–NASCI–SPR practice parameter for the performance and interpretation of cardiac computed tomography (CT). Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CardiacCT.pdf. Accessed January 25, 2021.
2. American College of Radiology. ACR–ACNM–SNMMI–SPR practice parameter for the use of radiopharmaceuticals in diagnostic procedures Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Radiopharmaceuticals.pdf?la=en. Accessed January 25, 2021.
3. American College of Radiology. ACR–NASCI–SNMMI–SPR–STR practice parameter for the performance of cardiac scintigraphy. Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CardiacScint.pdf. Accessed January 25, 2021.
4. Bateman TM, Dilsizian V, Beanlands RS, DePuey EG, Heller GV, Wolinsky DA. American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2016;23:1227-31.
5. Schindler TH, Bateman TM, Berman DS, et al. Appropriate Use Criteria for PET Myocardial Perfusion Imaging. J Nucl Med 2020;61:1221-65.
6. American College of Radiology. ACR–SPR practice parameter for imaging pregnant or potentially pregnant patients with ionizing radiation. Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Pregnant-Pts.pdf. Accessed January 25, 2021.
7. American College of Radiology. ACR practice parameter for communication of diagnostic imaging findings. Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CommunicationDiag.pdf. Accessed January 25, 2021.
8. American College of Radiology. ACR practice parameter for continuing medical education (CME). Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CME.pdf. Accessed January 25, 2021.
9. American College of Radiology. ACR–AAPM technical standard for medical physics performance monitoring of PET/CT imaging equipment. Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/PET-CT-Equip.pdf. Accessed January 25, 2021.
10. American College of Radiology. ACR–SPR practice parameter for performing and interpreting diagnostic computed tomography (CT). Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Perf-Interpret.pdf. Accessed September 28, 2022.
11. American College of Cardiology/American Heart Association. Clinical competence statement on stress testing. Available at: http://content.onlinejacc.org/article.aspx?articleID=1126744. Accessed January 25, 2021.
12. Dilsizian V, Bacharach SL, Beanlands RS, et al. ASNC imaging guidelines/SNMMI procedure standard for positron emission tomography (PET) nuclear cardiology procedures. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2016;23:1187-226.
13. Mehta D, Mori N, Goldbarg SH, Lubitz S, Wisnivesky JP, Teirstein A. Primary prevention of sudden cardiac death in silent cardiac sarcoidosis: role of programmed ventricular stimulation. Circ Arrhythm Electrophysiol 2011;4:43-8.

14. Ratner SJ. Cardiac sarcoidosis. Mayo Clin Proc 1986;61:76.
15. Takeda N, Yokoyama I, Hiroi Y, et al. Positron emission tomography predicted recovery of complete A-V nodal dysfunction in a patient with cardiac sarcoidosis. Circulation 2002;105:1144-5.
16. Yamagishi H, Shirai N, Takagi M, et al. Identification of cardiac sarcoidosis with (13)N-NH(3)/(18)F-FDG PET. J Nucl Med 2003;44:1030-6.
17. McArdle B, Dowsley TF, Cocker MS, et al. Cardiac PET: metabolic and functional imaging of the myocardium. Semin Nucl Med 2013;43:434-48.
18. Mana J. Nuclear imaging. 67Gallium, 201thallium, 18F-labeled fluoro-2-deoxy-D-glucose positron emission tomography. Clin Chest Med 1997;18:799-811.
19. Soussan M, Augier A, Brillet PY, Weinmann P, Valeyre D. Functional imaging in extrapulmonary sarcoidosis: FDG-PET/CT and MR features. Clin Nucl Med 2014;39:e146-59.
20. Chareonthaitawee P, Beanlands RS, Chen W, et al. Joint SNMMI-ASNC Expert Consensus Document on the Role of (18)F-FDG PET/CT in Cardiac Sarcoid Detection and Therapy Monitoring. J Nucl Med 2017;58:1341-53.
21. Writing g, Document reading g, for ERTdwrbmotESDC. A joint procedural position statement on imaging in cardiac sarcoidosis: from the Cardiovascular and Inflammation & Infection Committees of the European Association of Nuclear Medicine, the European Association of Cardiovascular Imaging, and the American Society of Nuclear Cardiology. Eur Heart J Cardiovasc Imaging 2017;18:1073-89.
22. Mc Ardle BA, Leung E, Ohira H, et al. The role of F(18)-fluorodeoxyglucose positron emission tomography in guiding diagnosis and management in patients with known or suspected cardiac sarcoidosis. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2013;20:297-306.
23. Ohira H, Tsujino I, Yoshinaga K. (1)(8)F-Fluoro-2-deoxyglucose positron emission tomography in cardiac sarcoidosis. European journal of nuclear medicine and molecular imaging 2011;38:1773-83.
24. Williams G, Kolodny GM. Suppression of myocardial 18F-FDG uptake by preparing patients with a high-fat, low-carbohydrate diet. AJR. American journal of roentgenology 2008;190:W151-6.
25. Bacharach SL. PET/CT attenuation correction: breathing lessons. J Nucl Med 2007;48:677-9.
26. Gould KL, Pan T, Loghin C, Johnson NP, Guha A, Sdringola S. Frequent diagnostic errors in cardiac PET/CT due to misregistration of CT attenuation and emission PET images: a definitive analysis of causes, consequences, and corrections. J Nucl Med 2007;48:1112-21.
27. Pan T, Mawlawi O, Nehmeh SA, et al. Attenuation correction of PET images with respiration-averaged CT images in PET/CT. J Nucl Med 2005;46:1481-7.
28. Antoch G, Freudenberg LS, Egelhof T, et al. Focal tracer uptake: a potential artifact in contrast-enhanced dual-modality PET/CT scans. J Nucl Med 2002;43:1339-42.
29. 29. Antoch G, Freudenberg LS, Stattaus J, et al. Whole-body positron emission tomography-CT: optimized CT using oral and IV contrast materials. AJR. American journal of roentgenology 2002;179:1555-60.
30. Cohade C, Osman M, Nakamoto Y, et al. Initial experience with oral contrast in PET/CT: phantom and clinical studies. J Nucl Med 2003;44:412-6.
31. Mawlawi O, Erasmus JJ, Munden RF, et al. Quantifying the effect of IV contrast media on integrated PET/CT: clinical evaluation. AJR. American journal of roentgenology 2006;186:308-19.
32. Nakamoto Y, Chin BB, Kraitchman DL, Lawler LP, Marshall LT, Wahl RL. Effects of nonionic intravenous contrast agents at PET/CT imaging: phantom and canine studies. Radiology 2003;227:817-24.
33. American College of Radiology. ACR–ACNM–SNMMI–SPR practice parameter for performing FDG-PET/CT in oncology. Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/FDG-PET-CT.pdf. Accessed January 3, 2022.
34. Patel KK, Spertus JA, Chan PS, et al. Myocardial blood flow reserve assessed by positron emission tomography myocardial perfusion imaging identifies patients with a survival benefit from early revascularization. Eur Heart J 2020;41:759-68.
35. Beanlands RS, Ziadi MC, Williams K. Quantification of myocardial flow reserve using positron emission imaging the journey to clinical use. J Am Coll Cardiol 2009;54:157-9.
36. Knuuti J, Kajander S, Maki M, Ukkonen H. Quantification of myocardial blood flow will reform the detection of CAD. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2009;16:497-506.
37. Bateman TM, Heller GV, Beanlands R, et al. Practical Guide for Interpreting and Reporting Cardiac PET Measurements of Myocardial Blood Flow: An Information Statement from the American Society of Nuclear

Cardiology, and the Society of Nuclear Medicine and Molecular Imaging. J Nucl Med 2021;62:1599-615.
38. Murthy VL, Bateman TM, Beanlands RS, et al. Clinical Quantification of Myocardial Blood Flow Using PET: Joint Position Paper of the SNMMI Cardiovascular Council and the ASNC. J Nucl Med 2018;59:273-93.
39. Klein R, Beanlands RS, deKemp RA. Quantification of myocardial blood flow and flow reserve: Technical aspects. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2010;17:555-70.
40. Kaster T, Mylonas I, Renaud JM, Wells GA, Beanlands RS, deKemp RA. Accuracy of low-dose rubidium-82 myocardial perfusion imaging for detection of coronary artery disease using 3D PET and normal database interpretation. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2012;19:1135-45.
41. Nakazato R, Berman DS, Dey D, et al. Automated quantitative Rb-82 3D PET/CT myocardial perfusion imaging: normal limits and correlation with invasive coronary angiography. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology 2012;19:265-76.
42. American College of Radiology. ACR–NASCI–SIR–SPR practice parameter for the performance and interpretation of body computed tomography angiography (CTA). Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Body-CTA.pdf. Accessed January 25, 2021.
43. American College of Radiology. ACR–AAPM technical standard for diagnostic medical physics performance monitoring of computed tomography (CT) equipment. Available at: https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Equip.pdf. Accessed January 25, 2021.

*Practice parameters and technical standards are published annually with an effective date of October 1 in the year in which amended, revised or approved by the ACR Council. For practice parameters and technical standards published before 1999, the effective date was January 1 following the year in which the practice parameter or technical standard was amended, revised, or approved by the ACR Council.

Development Chronology for This Practice Parameter

Adopted 2017

Amended 2018 (Resolution 44)

Revised 2023 (Resolution 23)