REFERENCE COMMITTEE III

Reference Committee III met on Monday, May 22, 2017 in the Washington Marriott Wardman Park Hotel in Washington, D.C. The members of this committee were Scott M. Truhlar, MD, MBA, MS, Chair, Manuel L. Brown, MD, FACR, Daryl J. Eber, MD, Ranish Khawaja, MBBS, Elaine R. Lewis, MD, FACR, Deborah Levine, MD, FACR.

The session was attended by approximately 600 members.

The Reference Committee recognizes the following reports as informational and I recommend that they be filed.

COMMISSIONS, COMMITTEES & TASK FORCES:

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25. ACR–ACNM Practice Parameter for the Performance of Dopamine Transporter (DaT) CSC
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32. ACR–SPR–SRU Practice Parameter for Performing and Interpreting Diagnostic Ultrasound Examinations
33. ACR–AIUM–SPR–SRU Practice Parameter for the Performance of Transcranial Doppler Ultrasound
34. Undergraduates as Members-in-Training District of Columbia Metropolitan Radiological Society
35. Young and Early Career Professional Section (YPS) CSC
36. Appoint Two Young or Early Career Professional Members to the ACR CSC CSC/BOC

THE REFERENCE COMMITTEE RECOMMENDS THE FOLLOWING CONSENT CALENDAR FOR ACCEPTANCE:

RECOMMENDED FOR ADOPTION:

Resolution No. 24 Ten Year Extension of Policies

BE IT RESOLVED,

that the following policy of the American College of Radiology be extended for an additional ten year period:

(a) GENERAL

7. GREATER INVOLVEMENT OF YOUNG PHYSICIANS PROFESSIONALS IN THE ACR

The ACR will make available an additional alternate council seat earmarked for a young physician (aged 40 or younger or within eight years after completion of residency or fellowship) for all chapters.

The ACR will provide $1,000 per chapter to those chapters that designate an additional young physician professional Member Alternate Councilor Council member.
The ACR bylaws will be amended to add an additional appointed young physician or medical physicist member to the Council Steering Committee.

Other existing ACR Commissions and Committees will be encouraged to have representation from this important and unique demographic group; adopted 2007 (Res. 43).

(b) CHAPTERS
2. ADDRESS FOR DIRECTORY

The American College of Radiology requests the members and fellows to use the address of their principal practice location, and telephone number, fax number, and e-mail address for listing in the annual Membership Directory. The ACR encourages all members to update their membership profiles to ensure continuity of service and targeted benefits; 1987, amended 1997, 2007 (Res. 36-a).

(c) CHAPTERS
4. IDENTIFICATION OF RADIOLOGY GROUP PRACTICES

The American College of Radiology state chapters shall assist the College by helping the national office to update a listing of all radiology group practices within their geographical boundaries, the groups’ mailing addresses, the names of radiologists associated with those groups, and the specialty or subspecialty of each radiologist; 1987, amended 1997, 2007 (Res. 36-b).

(d) COUNCIL
2. RESOLUTIONS

b. Policy Manual and Annual Progress Report

The ACR staff shall maintain a policy manual; and will annually provide a progress report to Council based on directives of the previous minutes; adopted 1973, 1974, 1987, 1997, 2007 (Res. 36-c).

(f) RELATIONSHIPS TO OTHER ORGANIZATIONS
1. AMERICAN BOARD OF RADIOLOGY (ABR)

a. ABR Policy Decisions

It is the ACR’s position when the American Board of Radiology is performing its historic role of examining and certifying candidates, the ACR should in no way interfere. Whenever the American Board of Radiology considers policy decisions that affect the practice of radiology, it should consult with the ACR and with scientific societies which nominate members to the American Board of Radiology; adopted 1973, 1987, 1997, 2007 (Res. 36-d).

(g) EDUCATION
2. RESIDENT AND FELLOWSHIP TRAINING PROGRAMS

c. Radiation Effects and Protection Education for Medical Students
A minimum of two hours of instruction on the biological effects of ionizing radiation and the principles of radiation safety be included in the course of medical school study and that this instruction be provided by the radiology faculty.

The American College of Radiology encourages the deans and chairs of radiology departments throughout the United States to implement these curriculum additions; adopted 1987, 1997, 2007 (Res. 12-a).

(2) EDUCATION

2. RESIDENT AND FELLOWSHIP TRAINING PROGRAMS

e. Residency Programs in Socioeconomics

Each chapter should work with the ACR Resident and Fellow Section to host a resident practice workshop or to assure that the residents training within the chapter’s geographical boundaries are provided the opportunity to attend a resident practice workshop.

Each chapter should make personal contact with radiology and radiation oncology residency and fellowship program directors within its state or jurisdiction to encourage them to support ACR resident workshops. Support from program directors should include active promotion and encouragement from the program directors regarding attendance at these educational forums; adopted 1987, 1997, 2007 (Res. 36-e).

(i) EDUCATION

2. RESIDENT AND FELLOWSHIP TRAINING PROGRAMS

g. Training Programs: Educational Material

The ACR shall continue to assist all training programs in radiology by providing educational materials including AIRP and other educational forums; adopted 1976, 1987, 1997, 2007 (Res. 36-f).

(j) EDUCATION

3. CONTINUING EDUCATION AND COMPETENCE

a. Continuing Competence

PROFESSIONAL COMPETENCE

The American College of Radiology will take positive steps to assume on behalf of its members leadership and responsibility for (1) perception and definition of needs for continuing education in radiology; (2) initiation, development and coordination of the wide variety of opportunities for extended professional education, and (3) recognition for individual efforts to sustain a high level of personal professional competence through multiple alternative mechanisms characterized by both practicality and authoritative credibility. The ACR will seek counsel, encouragement and active participation of radiological organizations, academic societies, and university training programs, as well as the ACR chapters in the achievement of this task; 1973, 1987, amended 1997, 2007 (Res. 36-g).
E D U C A T I O N

4. MISCELLANEOUS EDUCATION POLICIES

a. Chapter Officers-Annual Education Session

An educational session will be conducted annually for state chapter secretaries and presidents elected leadership; adopted 1973, 1987, 1997, 2007 (Res. 36-h).

l) E D U C A T I O N

4. MISCELLANEOUS EDUCATION POLICIES

c. Subspecialty Certification

Diagnostic radiology certification by the American Board of Radiology is a prerequisite for subspecialty certification in radiology. Subspecialty certificates, if implemented, should be in addition to the radiology or diagnostic radiology certificate; 1973, 1987, amended 1997, 2007 (Res. 1-b)

The American College of Radiology endorses the following statement of the American Board of Medical Specialties Annual Report & Reference Handbook –1992 (page 57) which states:

“There is no requirement or necessity for a diplomate in a recognized specialty to hold special certification in a subspecialty of that field in order to be considered qualified to include aspects of that subspecialty within a specialty practice. Under no circumstances should a diplomate be considered unqualified to practice within an area of a subspecialty solely because of lack of subspecialty certification.

Subspecialty certification in a subspecialty field is of significance for physicians preparing for careers in teaching, research, or practice restricted to that field. Such special certification is recognition of exceptional expertise and experience and has not been created to justify a differential fee schedule or to confer other professional advantages over other diplomates not so certified.”

The American College of Radiology endorses the following statement from the American Board of Medical Specialties Annual Report and Reference Handbook –1992 (pages 52-53) which states:

“It should be emphasized that there is no specific requirement for a diplomate in a recognized specialty to hold certification in a subspecialty of that field in order to include aspects of that subspecialty within the range of privileges”; 1992, 2002, amended 2012 (Res. 12-b).

m) P R O F E S S I O N A L L I A B I L I T Y

3. TORT REFORM

The American College of Radiology joins with other national medical specialty societies and with the American Medical Association in supporting meaningful tort reform.

The American College of Radiology encourages its state chapters to support legislation requiring that an affidavit be filed with every professional liability lawsuit against a physician certifying the fact that the case is meritorious. The affidavit would contain a statement by the plaintiff’s attorney that he or she has consulted a physician in full time practice limited to the same specialty as the defendant, and that the reviewing physician has determined in a written report, after a review of the medical record and other
relevant material involved in the particular action, that there is a reasonable and meritorious cause for filing the lawsuit; 1987, amended 1997, 2007 (Res. 36-k).

4. WORKFORCE STUDIES (SEE ALSO WORKFORCE IN RADIOLOGIC TECHNOLOGY)

The Board of Chancellors, through the appointed Committee on Radiologist Resources Commission on Human Resources, will continue surveillance of professional workforce needs in all branches of radiology, and that the results of this surveillance shall be translated into reports to the Council of the American College of Radiology at its annual meeting each year; 1974, 1987, amended 1997

Resolution No. 25 ACR–ACNM Practice Parameter for the Performance of Dopamine Transporter (DaT) Single Photon Emission Computed Tomography (SPECT) Imaging for Movement Disorders

Resolution No. 28 ACR–SPR Practice Parameter for the Performance of Skeletal Scintigraphy (Bone Scan)

Resolution No. 29 ACR–SPR Practice Parameter for the Performance of Renal Scintigraphy

Resolution No. 30 ACR–SPR Practice Parameter for the Performance of Hepatobiliary Scintigraphy

Resolution No. 31 ACR–AIUM–SPR–SRU Practice Parameter for the Performance of the Musculoskeletal Ultrasound Examination

Resolution No. 33 ACR–AIUM–SPR–SRU Practice Parameter for the Performance of Transcranial Doppler Ultrasound

BE IT RESOLVED,

that the ACR add undergraduate students to the existing membership category of members-in-training, and

BE IT FURTHER RESOLVED,

that the ACR Commission on Membership and Communications develop criteria for extending membership to undergraduate students.

Resolution No. 35 Young and Early Career Professional Section (YPS)

BE IT RESOLVED,

That the ACR adopt a single policy to replace the two previously adopted policies on young physicians, and

BE IT FURTHER RESOLVED,

That the policy read as follows –

YOUNG AND EARLY CAREER PROFESSIONAL SECTION (YPS)
The ACR shall have a Young and Early Career Professional Section (YPS). A young or early career professional shall be defined as a Member who is age 40 or younger, or who is within the first 8 years of practice after completion of training.

The YPS shall be led by an executive committee elected by the Section. The elected Chair and Vice Chair (Chair-Elect) of the YPS executive committee shall serve as councilors during their respective terms leading the YPS, to represent the voice of young and early career professionals of the ACR. The ACR will make available, to each chapter, an additional alternate council seat earmarked for a young or early career professional. The ACR will provide $1,000 per chapter to those chapters that designate an additional young or early career professional Council member.

The ACR encourages state chapters to facilitate greater involvement by young and early career professionals. The YPS shall work in coordination with the Commission on Membership and Communications to increase membership and volunteerism in the ACR by young and early career professionals and ACR Commissions and Committees will be encouraged to have representation from this important and unique demographic group.

The YPS shall provide an annual report to the ACR Council regarding its activities, and provide progress reports upon request to the Board of Chancellors, Council Steering Committee, and Commission on Membership and Communications.

Resolution No. 36  Appoint Two Young or Early Career Professional Members to the ACR CSC

BE IT RESOLVED,

That the ACR Speaker is encouraged to increase the number of young or early career professional Member appointments on the CSC to at least two.

RECOMMENDED FOR ADOPTION AS AMENDED:

Resolution No. 24  Ten Year Extension of Policies

COUNCIL

4. UNIFORM TERM LENGTH FOR ELECTED AND APPOINTED COUNCIL STEERING COMMITTEE (CSC) MEMBERS

The members of the Council Steering Committee (CSC) shall be allowed to serve up to a total of 6 consecutive years. This maximum term length shall pertain to elected members, appointed members, and members who have been both elected and appointed to their positions at different times; adopted 2007 (Res. 44).

Resolution No. 26  ACR–SPR–STR Practice Parameter for the Performance of Cardiac Positron Emission Tomography – Computed Tomography (PET/CT) Imaging (Lines 152-153)

The SPR and STR representatives affirm that in their best judgment the proposed changes would be acceptable to SPR and STR; subject to ratification by SPR and STR.

Resolution No. 27  ACR–AIUM–SPR–SRU Practice Parameter for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum
The AIUM, SPR and SRU representatives affirm that in their best judgment the proposed changes would be acceptable to AIUM, SPR and SRU; subject to ratification by AIUM, SPR and SRU.

Resolution No. 32  ACR–SPR–SRU Practice Parameter for Performing and Interpreting Diagnostic Ultrasound Examinations

The SPR and SRU representatives affirm that in their best judgment the proposed changes would be acceptable to SPR and SRU; subject to ratification by SPR and SRU.

RECOMMENDED FOR REFERRAL:

Resolution No. 34  Undergraduates as Members-in-Training

Reference Committee III wishes to thank the Councilors and visitors for their valuable input in these deliberations.

Respectfully Submitted:

Scott M. Truhlar, MD, MBA, MS, Chair,
Manuel L. Brown, MD, FACR
Daryl J. Eber, MD
Ranish Khawaja, MBBS,
Elaine R. Lewis, MD, FACR
Deborah Levine, MD, FACR
# REFERENCE COMMITTEE III

Scott M. Truhlar, MD, MBA, MS, *Chair*  
Daryl J. Eber, MD  
Elaine R. Lewis, MD, FACR, CSC  
Deborah Levine, MD, FCR  
Manuel L. Brown, MD, FCR  
Ranish Khawaj, MBBS, Resident

COMMISSIONS, COMMITTEES & TASK FORCES:

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- Commission on Membership & Communications  
- Commission on Informatics  
- Commission on Research  
- Commission on Ultrasound  
- Task Force Pneumoconiosis Certification Program  
- Commission on Nuclear Medicine & Molecular Imaging

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| 25. | ACR–ACNM Practice Parameter for the Performance of | NEW PP | RECOMMEND ADOPT |

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**ACR Staff:**

- **Director:** Carolyn MacFarlane  
- **Assistant:** Rob Harney  
- **Moderator:** Cynthia Davidson  
- **Observer:** Angelica Vergel de Dios  
- **Recorder:** Tiffany Lipp  
- **Attorney:** Tom Hoffman
BE IT RESOLVED,
that the American College of Radiology adopt the ACR–SPR–STR Practice Parameter for the Performance of Cardiac Positron Emission Tomography – Computed Tomography (PET/CT) Imaging

Sponsored By: ACR Council Steering Committee

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.

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

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. 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 in light of 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 the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of this document. However, a practitioner who employs an approach substantially different from the

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1 Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 703 N.W.2d 763 (Iowa 2005) 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 as 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.
The practice of medicine involves not only the science, but also 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 sole purpose of this document is to assist practitioners in achieving this objective.

I. INTRODUCTION

This practice parameter has been developed collaboratively by the American College of Radiology (ACR), 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) of 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. As an independent modality, CT 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. 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 imaging; 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–SPR Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals [2]. For cardiac SPECT imaging, please refer to the ACR–NASCI–SPR–STR Practice Parameter for the Performance of Cardiac Scintigraphy [3].

II. INDICATIONS

The primary goals of cardiac PET/CT imaging 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.

Clinical indications for cardiac PET/CT imaging include, but are not limited to:

1. Myocardial perfusion imaging (MPI) (CT may be used for coronary calcium scoring)
   a. Detection of obstructive coronary artery disease 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
      ii. Abnormal exercise stress tests
      iii. Obese patients with likely suboptimal SPECT imaging
   c. Clarification of equivocal or discordant prior tests
      i. Borderline obstructive lesions in coronary angiography or by computed tomography angiography (CTA)
      ii. Suspected artifacts on prior imaging (breast or diaphragmatic attenuation)
      iii. Anomalous coronary arteries with suspected ischemia
   d. Preoperative risk assessment before high-risk surgical procedures
e. Postoperative assessment of reimplanted coronary arteries (including congenital heart disease, eg, surgically corrected transposition of the great arteries)

f. Evaluation of cardiac function

2. Measurement of myocardial blood flow and coronary flow reserve and detection of balanced ischemia

3. Myocardial viability
   a. Detection of hibernating or stunned myocardium
   b. Preoperative assessment before revascularization for prognosis of improved left ventricular function

4. Cardiomyopathies including sarcoidosis, hypertrophic, Duchenne muscular dystrophy

5. Heart transplants

For information on radiation risks to the fetus, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation [4].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physicians

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, and communicating any critical or significant findings. For further information, please refer to the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [5]. The supervising physician must be an Authorized User (AU) of radiopharmaceuticals or work under the auspices of another AU in their practice setting.

Physicians performing or supervising exercise or pharmacologic stress testing as part of cardiac PET/CT imaging should meet the qualifications outlined in the ACC/AHA Clinical Competence Statement on Stress Testing [6]. Physicians supervising stress-induced examinations should have appropriate training in advanced cardiovascular life support.

1. Physicians with certification by the American Board of Radiology (ABR) in Diagnostic Radiology or in Nuclear Radiology or by the American Board of Nuclear Medicine (ABNM)

A physician who has been certified by the ABR or the ABNM has substantial knowledge of the principles of PET/CT image acquisition and postprocessing, including the design of PET/CT protocols and the use of diagnostic workstations. Physicians performing coronary CTA at the time of cardiac PET/CT should be knowledgeable of the administration, risks, and contraindications of medications which may be required for heart rate control (eg, beta-blockers, calcium channel blockers) and coronary vasodilatation (eg, nitroglycerin/nitrates) and of iodinated contrast media, including steps to reduce possible contrast media–related reactions and/or nephrotoxicity and to treat adverse reactions to contrast media (see ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media and the ACR Manual on Contrast Media) [7,8]. The physician should have substantial experience in CT interpretation, including CT assessment of extracardiac thoracic structures included in the cardiac PET/CT examination. However, in order to achieve competency in all aspects of cardiac PET/CT imaging, some physicians may require additional education in cardiac anatomy, physiology, pathology, and/or cardiac PET/CT imaging protocols and interpretation.

2. A physician board-certified or board-eligible by the American Board of Radiology (ABR) in Diagnostic Radiology, the ABR in Nuclear Radiology, and/or the American Board of Nuclear Medicine (ABNM)
The physician has substantial knowledge of the principles of PET/CT image acquisition and postprocessing, including the design of PET/CT protocols and the use of diagnostic workstations. A physician performing coronary CTA at the time of cardiac PET/CT should be knowledgeable of the administration, risks, and contraindications of medications which may be required for heart rate control (e.g., beta-blockers, calcium channel blockers) and coronary vasodilatation (e.g., nitroglycerin/nitrates) and of iodinated contrast media, including steps to reduce possible contrast media–related reactions and/or nephrotoxicity and to treat adverse reactions to contrast media (see ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media and the ACR Manual on Contrast Media) [7,8]. The physician should have substantial experience in CT interpretation, including CT assessment of extra-cardiac thoracic structures included in the cardiac PET/CT examination. However, in order to achieve competency in all aspects of cardiac PET/CT imaging, some physicians may require additional education in cardiac anatomy, physiology, pathology, and/or cardiac PET/CT imaging protocols and interpretation.

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 (RCPSC), the Collège des Médecins du Québec, or the American Osteopathic Association (AOA) including 30 hours of education in cardiac anatomy, physiology, pathology, and cardiac PET/CT imaging.

or

Completion of 30 hours of Category 1 CME in cardiac imaging, including cardiac PET/CT, anatomy, physiology, and/or pathology or documented equivalent supervised experience.3

and

b. The interpretation, reporting, and/or supervised review of at least 50 cardiac PET/CT examinations during the previous 36 months. Live and/or on-line educational programs and/or proctored/over-read cardiac PET/CT cases may be used to fulfill this requirement.

3 A physician not board-certified or board-eligible by the ABR and/or the ABNM requires more extensive training and experience in cardiac PET/CT. In addition to specific training in image interpretation, this training must include the principles of PET/CT image acquisition and postprocessing, including the design of PET/CT protocols and the use of diagnostic workstations.

A physician not board-certified or board-eligible by the ABR and/or the ABNM must satisfy the following requirements:

a. Completion of training in a program accredited by the ACGME, RCPSC, the Collège des Médecins du Québec, or AOA

and

b. Completion of 30 hours of education in cardiac anatomy, physiology, pathology, and cardiac PET/CT imaging

and

c. Completion of 200 hours of Cardiac 1 CME in the performance and interpretation of PET/CT

and

d. Under supervision, interpretation and reporting of 300 cardiac radionuclide imaging cases, at least 50 of which must be cardiac PET/CT, during the past 36 months. Live and/or on-line educational programs and/or proctored/over-read cardiac PET/CT cases may be used to fulfill this requirement.

3 Documented equivalent supervised experience is defined as supervision at a center where the proctoring physician meets these criteria to independently interpret cardiac PET/CT.
Administration of pharmacologic agents
A physician who is knowledgeable about the administration, risks, and contraindications of the pharmacologic agents must be immediately available throughout the stress procedure.

Maintenance of competence
For continuing education and experience, please see the ACR–SPR Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals [2] and the ACR Practice Parameter for Continuing Medical Education (CME) [9].

Continuing medical education
The physician’s continuing medical education should be in accordance with the ACR Practice Parameter for Continuing Medical Education (CME) [9], 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.

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 [10].

C. Radiologic and Nuclear Medicine Technologist

The Nuclear Medicine Technology Certification Board (NMTCB) has developed a PET specialty examination that is open to appropriately educated and trained, certified, or registered nuclear medicine technologists, registered radiologic technologists, CT 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 state regulations.

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.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Imaging Protocols

1. Myocardial perfusion imaging
   a. Background
   Positron emission tomography – computed tomography (PET/CT) scans are performed at rest or with pharmacological stress for noninvasive imaging of the perfusion of the heart for the diagnosis and management of patients with known or suspected coronary artery disease. Rubidium-82 chloride and nitrogen-13 ammonia are the most common PET/CT radiopharmaceuticals for MPI, and 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 to 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 myocardial blood flow 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 of 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 to nitrogen-13 ammonia.

b. Patient preparation
Prior to 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 at least 12 hours and fast for 4 hours prior to the examination. Patients undergoing myocardial perfusion stress-rest imaging should withhold beta-blockers (if possible), dipyridamole, and caffeine-containing medications. If cardiac PET/CT is performed without a coronary CTA, a small-gauge intravenous (IV) catheter is placed; if a coronary CTA will be performed, a larger-gauge IV catheter is required.

c. Pharmacologic stress
The heart may be stressed using one of a variety of pharmaceutical medications (eg, dipyridamole, adenosine, regadenoson, or dobutamine). 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 prior to examination for a time sufficient to obviate their pharmacologic effect.

i. Dipyridamole is infused intravenously in a dosage of 0.14 mg/kg/min for 4 minutes (total dosage = 0.56 mg/kg). Its duration of action is between 30 minutes and 1 hour. The radiopharmaceutical should be injected 2 to 4 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 to 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 to 48 hours prior to 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, clinical, blood pressure, and electrocardiographic monitoring are mandatory during the dipyridamole infusion and for a period of time following the infusion.

ii. Adenosine may also be given intravenously in a dosage of 0.14 mg/kg/min over 6 minutes (3 minutes prior to injection of the radiopharmaceutical and continued for 3 minutes thereafter). Shorter infusion protocols (4 to 5 minutes) have been used successfully with adenosine. While using shorter infusion protocols, the radiopharmaceutical should be injected at least 2 to 2.5 minutes prior to 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 to 48 hours prior to examination. Hemodynamic, electrocardiographic, and clinical monitoring must be carried out as with any other form of stress.
iii. Regadenoson is an A2A adenosine receptor agonist administered as a rapid intravenous 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.

iv. Both dipyridamole and adenosine can be combined with simultaneous low-level exercise in patients who are ambulatory to reduce the side effects of these agents, reduce subdiaphragmatic radiopharmaceutical uptake, and improve image quality. While using dipyridamole, exercise should start after the completion of dipyridamole infusion and should last 4 to 6 minutes. While using adenosine, exercise should be simultaneous with the adenosine infusion. Its duration of effect is short (biologic half-life of approximately 2 minutes). Low-level exercise such as the first 2 stages of the modified Bruce protocol suffices.

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 not feasible to position the arms out of the imaging field of view, 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 field of view 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 field of view prior to 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 to 2220 MBq (40 to 60 mCi) is administered for 2-D acquisition and 370 to 740 MBq (10 to 20 mCi) for 3-D acquisition. For nitrogen-13 ammonia, 370 to 740 MBq (10 to 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. Rubidium-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 1
to 2 minutes after administration for rubidium-82 and 1.5 to 3 minutes for nitrogen-13 ammonia in order to allow for blood pool clearance. Image data are generally acquired for 3 to 7 minutes for rubidium-82 and 10 to 15 minutes for nitrogen-13 ammonia. All PET data should be acquired in conjunction with electrocardiogram (ECG) gating, ideally in list mode to allow flexible reformatting of the data, e.g., 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 to 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.

2. Myocardial Viability Imaging

a. Background
Normal myocardium uses 2 main sources of energy: free fatty acids and glucose. Ischemic myocardium utilizes 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 on SPECT MPI, which might instead represent chronic ischemia at rest. Ischemic regions show a mismatch, that is, higher FDG activity compared to perfusion imaging, indicating the presence of viable tissue that may benefit from restored perfusion.

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 to 12 hours prior to the examination. Prior to infusing F-18 FDG, the patient may be placed on an oral or IV glucose and insulin protocol. The patient may be instructed to ingest a high-fat diet 12 to 24 hours prior to the examination. For diabetic patients, alternative strategies of a euglycemic hyperinsulinemia clamp protocol or administration of nicotinic acid may be considered [12].

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 to 555 MBq (10 to 15 mCi) is administered for 2-D acquisition and at 185 to 370 MBq (5 to 10 mCi) for 3-D acquisition. The target PET start time should be 45 to 60 minutes after FDG injection for nondiabetic patients and 60 to 90 minutes for diabetic patients. The patient should be positioned supine on the scanner bed with arms raised and supported at or above shoulder level. When not feasible to hold the arms out of the imaging field of view, 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 field of view centered over the heart. Attenuation-correction CT (see section IV.B.1) would typically be performed prior to PET data acquisition, although CT after the PET is possible and may be required if substantial patient motion occurs. Positron emission tomography (PET) data are generally acquired as an ECG-gated acquisition for between 10 to 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 to 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.
3. Myocardial/Sarcoid Imaging

a. Background

Cardiac sarcoidosis is an infiltrative disease that usually affects the conduction system. 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% to 25% [14]. F-18 FDG-PET has the benefit of very high sensitivity in 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 fibrous changes. F-18 FDG-PET/CT has been shown to be useful for the demonstration of extracardiac sarcoid involvement as well [18,19].

b. Patient preparation

Various dietary regimens are available to achieve suppression of normal glucose utilization by the myocardium. The principle is a high-fat/low-carbohydrate diet the day prior to the PET/CT examination along with 12 to 18 hours of fasting (no gum, candy, or cough drops [20]) and/or use of intravenous heparin (15 to 50 units/kg) about 15 minutes before F-18 FDG injection [21,22]. 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.

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 to 555 MBq (10 to 15 mCi) and a 60-minute uptake period, PET images are acquired in a static mode. The cardiac F-18 FDG images are reconstructed and compared to the rest SPECT or PET MPI. Given that sarcoidosis is a systemic disease, conventional whole-body F-18 FDG-PET/CT imaging may be performed from the cerebellum to the midthighs to evaluate F-18 FDG uptake in extracardiac regions.

B. Other Examination Specifications

1. Attenuation correction (AC)

Attenuation correction of PET images is required and can be achieved with germanium rod sources or CT. (Use of MRI for AC is an evolving practice, and guidelines for use of MRI for attenuation correction of PET data are outside the scope of this practice parameter.) Computed tomography (CT) attenuation correction (CTAC) data can be obtained prior to, during, or after a PET scan on the same scanner. Generating a separate CTAC for each PET/CT imaging session performed (ie, if the patient gets off the scanner between imaging sessions) is recommended to achieve best anatomic positioning and avoid artifacts. If rest and stress imaging are performed without moving the patient, only 1 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 co-localization of the CTAC to non–attenuation-corrected (NAC) PET data can result in artifacts on the attenuation-corrected (AC) PET images [23-25]. The CT can be acquired during shallow breathing or with a breath hold at end-tidal volume. Subsequent PET data should be obtained during shallow breathing, as PET acquisition time is longer than CT. The NAC and
AC PET images must be visually inspected for proper coregistration of radiopharmaceuticals 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, IV contrast, cardiac gating, and/or full-inspiration breath-hold techniques. High concentration of IV contrast can cause attenuation-correction artifacts on PET images, and caution is recommended if these images are to be used for CTAC [26-30]. Full breath-hold CT can cause artifacts as registering 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–SPR Practice Parameter for Performing FDG-PET/CT in Oncology [31].

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. Computed tomography for attenuation correction should be acquired at end expiration or shallow free breathing to minimize misalignment between the PET and the CT. The gantry rotation speed is usually slow (1 s/revolution or slower) in order to blur cardiac motion and better match the PET. As diagnostic image quality is not required, the tube current should 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.

2. Quantification of absolute myocardial blood flow

Absolute myocardial blood flow (MBF) can be assessed quantitatively by cardiac PET/CT. MBF results in an estimated absolute rate of blood flow to the myocardium, as opposed to a comparative measure where 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 well 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 in terms of predicting prognosis and risk stratification [32,33].

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 (ROI) is placed on the aorta (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. The kinetic model estimates the MBF as rate of uptake into the myocardium in terms of mL/min/g. 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 [34].

Three-dimensional PET requires adapted methods, including a possible reduction in administered activity, for the calculation of MBF compared to 2-D data acquisition [35,36]. 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, which can be particularly difficult when using 3-D data acquisition.

3. Coronary calcium scoring

Coronary calcium scoring may be performed in conjunction with cardiac PET/CT perfusion imaging. Generally, a separate CT acquisition complements the CT used for attenuation correction of the PET data, although a single acquisition may be feasible. The CT component of the PET/CT hybrid instrumentation should meet the minimal requirements of a 16-slice scanner with a rotational speed of 0.5 s/rotation. More
slices and faster speeds are preferable. Image acquisition should be during a single breath hold, with the images gated to 60% to 80% of the R-R interval. Radiation exposure should be as low as possible, while still-acceptable settings for Agatston score, by using tailored protocols based on patients’ body mass index (BMI), as well as other dose-reduction strategies, which may be manufacturer specific.

Software is available to calculate the calcium score from all manufacturers and third-party vendors. Most commonly used is the Agatston score, although mass or volume scores may also be obtained. The primary advantage of the Agatston score [37] is the large number of published studies and the availability of large databases to aid in interpretation of the results. The Multi-Ethnic Study of Atherosclerosis (MESA) database, available online, can be used to calculate percentile comparisons that are corrected for age, gender, and ethnicity. The MESA Calcium Calculator can be found at [http://mesa-nhlbi.org/Calcium/input.aspx](http://mesa-nhlbi.org/Calcium/input.aspx). When reporting the calcium score the appropriate percentile should be included, although it should be noted that the databases are derived from asymptomatic subjects, and in patients with known coronary artery disease (CAD), the use of the MESA database is not indicated.

4. For more specific details on coronary CTA, please refer to the ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA) [38].

V. 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. Use of rubidium-82 chloride will require a generator system that can be positioned adjacent to the scanner, allowing direct infusion to the patient; a radionuclide activity calibrator (dose calibrator) is needed to assay radiopharmaceuticals and perform quality assurance on rubidium-82 chloride generators; a syringe pump can optionally be used for PET radiopharmaceutical administration; an electrocardiogram integrated with the PET/CT system is required to allow ECG-gated image acquisition; for CTA studies, a dual power injector is required for the controlled administration of iodinated contrast material and normal saline; 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.

B. PET (Positron Emission Tomography) Requirements

Current clinical PET/CT systems generally have a PET field of view 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. The role of image reconstruction with resolution recovery (point spread function modeling) has not yet been established. Image analysis requires dedicated software for realignment to the conventional cardiac orientation, convenient side-by-side presentation of related series (e.g., 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.

C. Computed Tomography (CT) Requirements

Computed tomography 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. Electrocardiogram 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 attenuation-corrected PET reconstruction based on the aligned CT. Calcium-scoring CT typically employs an ECG-triggered axial scan mode, so CT systems with large detectors are preferred in order to minimize the time required for breath holding; 16-slice CT systems capable of 0.5 s/revolution are required as a minimum. Coronary CTA requires substantially more advanced multidetector CT capability. At least 64-slice CT with 0.5 s/revolution or less is recommended. Cardiac motion is mitigated either by prospective ECG triggering or by retrospective ECG gating. A power injector is required for the controlled administration of iodinated contrast material and the scanner needs to support a method for determining the contrast arrival time for optimal arterial enhancement. Dedicated software is required to review coronary CTA studies and also to quantify calcium-scoring CT.

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 [10]. These recommendations incorporate the standards for CT (see the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography (CT) Equipment [39]), 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 as 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, prior to patient administrations, and should include measurement of the levels of strontium-82 and strontium-85 in the rubidium-82 chloride injection.

VI. DOCUMENTATION

Reporting should be in accordance with the ACR–AAPM Practice Parameter for Communication of Diagnostic Imaging Findings [5].

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

VII. RADIATION SAFETY

Radiologists, medical physicists, registered radiologist assistants, 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 that work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection and application of dose limits) and the principles of proper management of radiation dose to patients (justification, optimization and the use of dose reference levels) http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1578_web-57265295.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 and that they are adhered to in accordance with ALARA. 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 state and/or other regulatory agencies. Quantities of radiopharmaceuticals should be tailored to the individual patient by prescription or protocol.

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

Additional information regarding patient radiation safety in imaging is available at the Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org) websites. 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 measured and patient radiation dose estimated for representative examinations and types of patients by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Regular auditing of patient dose indices should be performed by comparing the facility’s dose information with national benchmarks, such as the ACR Dose Index Registry, the 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. (ACR Resolution 17 adopted in 2006 – revised in 2009, 2013, Resolution 52).

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 QC & Improvement, Safety, Infection Control, and Patient Education on the ACR website (http://www.acr.org/guidelines).

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Medical Physics Performance Monitoring of PET/CT Imaging Equipment [10].

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 web site (http://www.acr.org/guidelines) 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 SPR, and the STR.

ACKNOWLEDGEMENTS

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PRACTICE PARAMETER Cardiac PET/CT Imaging 2017 Resolution No. 26
REFERENCES


*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
RESOLUTION NO. 27

BE IT RESOLVED,
that the American College of Radiology adopt the ACR–AIUM–SPR–SRU Practice Parameter for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum

Sponsored By: ACR Council Steering Committee

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.

Revised 2012 (Resolution 29)*

ACR–AIUM–SPR–SRU PRACTICE PARAMETER FOR THE PERFORMANCE OF AN ULTRASOUND EXAMINATION OF THE ABDOMEN AND/OR RETROPERITONEUM

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 physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the practice parameters, 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 the practice parameters when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the practice parameters. However, a practitioner who employs an approach substantially different from these practice parameters is advised to document in the patient record information sufficient to explain the approach taken.

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\(^1\) Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, ___ N.W.2d ___ (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.
The practice of medicine involves not only the science, but also 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 these practice parameters 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 sole purpose of these practice parameters is to assist practitioners in achieving this objective.

I. INTRODUCTION

The clinical aspects contained in specific sections of this practice parameter (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American College of Radiology (ACR), the American Institute of Ultrasound in Medicine (AIUM), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU). Recommendations for physician requirements, written request for the examination, procedure documentation, and quality control vary among the organizations and are addressed by each separately.

This practice parameter has been developed revised to assist practitioners performing ultrasound studies of the abdomen and/or retroperitoneum. Sonography is a proven and useful procedure for evaluating the many structures within these anatomic areas. Depending on the clinical indications, an examination may include the entirety of the abdomen and/or retroperitoneum, a single organ, or several organs. A combination of structures may be imaged because of location (eg, upper abdominal scan, right upper quadrant organs) or function (eg, biliary system [liver, gallbladder, and bile ducts], both kidneys). For some patients, more focused examinations may be appropriate for evaluating specific clinical indications or to follow up a known abnormality. In some cases, additional and/or specialized examinations may be necessary (eg, spectral, color, and/or power Doppler). Although it is not possible to detect every abnormality using ultrasound examination of the abdomen and/or retroperitoneum, adherence to the following practice parameter will maximize the probability of detecting abnormalities.

Throughout this practice parameter, references to Doppler evaluation may include spectral, color, or power Doppler individually or in any combination. Whenever a long axis view is indicated, it could be either a sagittal or coronal plane.

II. INDICATIONS/CONTRAINDICATIONS

A. Indications for ultrasound examination of the abdomen and/or retroperitoneum include, but are not limited to [1]:

1. Abdominal, flank, and/or back pain
2. Signs or symptoms that may be referred from the abdominal and/or retroperitoneal regions, such as jaundice or hematuria
3. Palpable abnormalities such as an abdominal mass or organomegaly
4. Abnormal laboratory values or abnormal findings on other imaging examinations suggestive of abdominal and/or retroperitoneal pathology
5. Follow-up of known or suspected abnormalities in the abdomen and/or retroperitoneum
6. Search for metastatic disease or occult primary neoplasm
7. Evaluation of cirrhosis, portal hypertension, and transjugular intrahepatic portosystemic shunt (TIPS) stents; screening for hepatoma; evaluation of the liver in conjunction with liver elastography
8. Abdominal trauma
9. Evaluation of urinary tract infection and hydronephrosis
10. Evaluation of uncontrolled hypertension and suspected renal artery stenosis
11. Search for the presence of free or loculated peritoneal and/or retroperitoneal fluid
12. Evaluation of suspected congenital abnormalities
13. Suspicion Evaluation of suspected hypertrophic pyloric stenosis, or intussusception, necrotizing enterocolitis, or any other bowel abnormalities
14. Pretransplantation and post-transplantation evaluation
15. Planning for and guiding an invasive procedure

B. Abdominal and/or retroperitoneal ultrasound should be performed when there is a valid medical reason. There are no absolute contraindications.

III. QUALIFICATIONS AND RESPONSIBILITIES OF THE PHYSICIAN

Each organization will address this section in its document. ACR language is as follows:

See the ACR–SPR–SRU Practice Parameter for Performing and Interpreting Diagnostic Ultrasound Examinations [2].

IV. WRITTEN REQUEST FOR THE EXAMINATION

Each organization will address this section in its document. ACR language is as follows:

The written or electronic request for an abdomen and/or retroperitoneum ultrasound examination should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient’s clinical problem or question and consistent with the state’s scope of practice requirements. (ACR Resolution 35, adopted in 2006)

V. SPECIFICATIONS FOR INDIVIDUAL EXAMINATIONS

Spectral, color, and power Doppler may be useful to differentiate vascular from nonvascular structures in any location. Measurements should be considered for any abnormal area [3]. Additionally, cine clips may be a helpful tool in any of these examinations, particularly when screening for malignancy. Ultrasound contrast may have applications in abdominal and retroperitoneal ultrasound.

1. Liver
   The examination of the liver should include long axis and transverse views. Liver measurement should may be performed in the midclavicular line on longitudinal images. The liver parenchyma should be evaluated for focal and/or diffuse abnormalities. If possible, the echogenicity of the liver should be compared with that of the right kidney. In addition, the following should be imaged [4-9]:
   a. The major hepatic and perihilar vessels, including the inferior vena cava (IVC), the hepatic veins, the main portal vein, and, if possible, the right and left branches of the portal vein
b. The hepatic lobes (right, left, and caudate) and, if possible, the right hemidiaphragm and the adjacent pleural space

c. The liver surface may be imaged with a high frequency transducer to evaluate possible surface nodularity in patients at risk for cirrhosis.

d. For vascular examinations, of the native or transplanted liver, Doppler evaluation should be used to document blood flow characteristics and blood flow direction. The structures that may be examined include the main and intrahepatic arteries, hepatic veins, main and intrahepatic portal veins, intrahepatic portion of the IVC, collateral venous pathways, and transjugular intrahepatic portosystemic shunt (TIPS) stents. Transplant liver evaluation is covered in detail in the ACR–AIUM–SPR–SRU Practice Parameter for the Performance of an Ultrasound Examination of Solid Organ Transplants [10].

In addition, in patients predisposed to or suspected of having hepatic fibrosis, hepatic elastography may be performed [11].

2. Gallbladder and biliary tract

Routine gallbladder examination should be conducted on an adequately distended gallbladder whenever possible. In most cases, fasting prior to elective examination will permit adequate distension of a normally functioning gallbladder. In For infants and children, the fasting may not period should be necessary in all cases age appropriate. The gallbladder evaluation should include long-axis and transverse views obtained in the supine position. Decubitus imaging should be performed when feasible. Other positions such as left lateral decubitus, erect or prone imaging may be helpful to evaluate the gallbladder and its surrounding areas completely. Measurements may aid in determining gallbladder wall thickening. If the patient presents with pain, tenderness to transducer compression over the gallbladder should be assessed.

The intrahepatic ducts can may be evaluated by obtaining views of the liver demonstrating the right and left branches of the portal vein. Doppler may be used to differentiate hepatic arteries and portal veins from bile ducts. The intrahepatic and extrahepatic bile ducts should be evaluated for dilatation, wall thickening, intraluminal findings, and other abnormalities. The bile duct in the porta hepatis should be measured and documented. When visualized, the distal common bile duct in the pancreatic head should be evaluated [12-15].

3. Pancreas

Whenever possible, all portions of the pancreas—head, uncinate process, body, and tail—should be identified. Orally administered water or contrast agent and changes in patient positioning such as upright or decubitus positions may afford better visualization of the pancreas. The following should be assessed in the examination of the pancreas [15-18]:

a. Parenchymal abnormalities, such as masses and calcifications
b. The distal common bile duct in the region of the pancreatic head
c. The pancreatic duct for dilatation and any other abnormalities, with dilatation confirmed by measurement
d. The peripancreatic region for adenopathy and/or fluid

4. Spleen

Representative views of the spleen in long-axis and transverse projections planes should be obtained. Splenic length measurement may be helpful in assessing enlargement. Echogenicity of the left kidney should be compared to splenic echogenicity when possible. An attempt should be made to demonstrate the left hemidiaphragm and the adjacent pleural space [3,19-21].
5. Bowel

When there is concern for bowel pathology, the bowel may be evaluated for wall thickening, dilatation, muscular hypertrophy, masses, vascularity, and other abnormalities. Sonography of the pylorus and surrounding structures may be indicated in the evaluation of the vomiting infant. Graded compression sonography aids in the visualization of the appendix and other bowel loops. Measurements may aid in determining bowel wall thickening, and color or power Doppler may be helpful in assessing hypervascularity [22-30].

6. Peritoneal fluid

Evaluation for free or loculated peritoneal fluid should include documentation of the extent and location of any fluid identified. Assessment for ascites should include limited images of the pelvis for an examination otherwise focused on the abdomen.

For evaluating peritoneal spaces for bleeding after traumatic injury In the setting of trauma, particularly blunt trauma, the examination known as focused abdominal sonographic examination for trauma (FAST) assessment (or focused assessment with sonography for trauma) may be performed to evaluate the peritoneal spaces for bleeding [31]. The objective of the abdominal portion of the FAST examination is to screen the abdomen for free fluid. Longitudinal and transverse plane images should be obtained in the right upper quadrant through the area of the liver, with attention to fluid collections peripheral to the liver and in the subhepatic space. Longitudinal and transverse plane images should be obtained in the left upper quadrant through the area of the spleen, with attention to fluid collections peripheral to the spleen. Longitudinal and transverse images should be obtained at the periphery of the left and right abdomen in the areas of the left and right paracolic gutters for evidence of free fluid. Longitudinal and transverse midline images of the pelvis are obtained to evaluate for free pelvic fluid. Analysis through a fluid-filled bladder (which, if necessary, can be filled through a Foley catheter, when possible necessary) may help in the evaluation of the pelvis.

7. Abdominal wall

When there are signs or symptoms referable to the abdominal wall, an ultrasound examination may be performed to evaluate for hernia, masses, or other abnormalities. The examination should include images of the abdominal wall in the location of symptoms or signs. The relationship of any identified mass to the peritoneum should be demonstrated. Any defect in the peritoneum and abdominal wall musculature should be documented. The presence or absence of bowel, fluid, or other tissue contained within any abdominal wall defect should be noted. Images obtained in upright position and or with use of the For detection of hernias, Valsalva maneuvers and upright positioning may be helpful. Doppler examination may be useful to define the relationship of blood vessels to a detected mass.

8. Kidneys

The complete examination of the kidneys need not be performed with every abdominal examination that may be targeted to other specific abdominal sites. When a complete examination of the native kidneys is done, this examination of native or transplanted kidneys should include long-axis and transverse views of the kidneys. The cortices and renal pelves should be assessed. A maximum measurement of renal length should be recorded for both kidneys. Decubitus, prone, or upright positioning may provide better images of the native kidneys. When possible, renal echogenicity should be compared to the adjacent liver or spleen. Renal cortical thickness should be assessed [32]. The kidneys, and specifically the renal cortices, sinuses, and pelves, as well as the perirenal regions, should be assessed for abnormalities including collecting system dilatation, calculi, masses, and other abnormalities [7,33-40]. Color Doppler imaging may be helpful in detecting calculi via the twinkling artifact [41,42].
For vascular examination of the native kidneys or transplanted kidneys, Doppler may be used:

a. To assess renal arterial and venous patency

b. To evaluate suspected renal artery stenosis. For this application, angle-adjusted measurements of the peak systolic velocity should be made proximally, centrally, and distally in the extrarenal portion of the main renal arteries when possible. Peak systolic velocity of the adjacent aorta should also be documented for calculating the ratio of renal to aortic peak systolic velocity. Spectral Doppler evaluation of the intrarenal arteries may be of value as indirect evidence of proximal stenosis in the main renal artery.

c. For vascular examinations of the transplanted kidney(s), please refer to the ACR–AIUM–SPR–SRU Practice Parameter for the Performance of an Ultrasound Examination of Solid Organ Transplants [10]. Doppler evaluation should be used to document vascular patency and blood flow characteristics. The structures that may be examined include the main renal artery and vein, arterial and venous anastomoses, the iliac artery and vein, and the intrarenal arteries.

9. Urinary bladder and adjacent structures
When performing a complete ultrasound evaluation of the urinary tract, transverse and longitudinal images of the distended urinary bladder and its wall should be included, if possible. Bladder lumen or wall abnormalities should be noted. Dilatation or other distal ureteral abnormalities should be documented. The acquisition of ureteral jets with color Doppler imaging may be helpful when evaluating hydronephrosis to evaluate for the presence of obstruction. Transvaginal ultrasonic may also be a helpful tool in evaluating distal ureteral calculi in women [43]. Transverse and longitudinal scans may be used to demonstrate any postvoid residual, which may be quantitated and reported. In male patients, an attempt to measure the prostate gland may be made. Incidental gynecologic abnormalities in a female patient should be noted.

10. Adrenal glands
When possible, usually in the newborn or young infant, long-axis and transverse images of the adrenal glands in the newborn or young infant may be obtained. Normal adrenal glands are less commonly seen by ultrasound in older children and adults [37]. Any masses detected should be documented.

11. Aorta
Representative images of the aorta could may be obtained. When evaluation of the aorta is specifically requested, see the ACR–AIUM–SRU Practice Parameter for the Performance of Diagnostic and Screening Ultrasound of the Abdominal Aorta in Adults [44,45].

12. Inferior vena cava
Representative images of the IVC could may be obtained. When specific evaluation of the IVC is requested, patency and abnormalities may be evaluated with Doppler. Vena cava filters, interruption devices, and catheters may need to be localized with respect to the hepatic and/or renal veins [46].

VI. DOCUMENTATION
Each organization will address this section in its document. ACR language is as follows:

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Comparison with prior relevant imaging studies may prove helpful. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should generally be accompanied by measurements. The initials of the operator should be accessible on the images or electronically on PACS. Images should be labeled with the patient identification, facility identification, examination date, and image orientation. An official interpretation (final report) of the ultrasound examination
should be included in the patient’s medical record. Retention of the ultrasound examination images should be based on clinical need and relevant legal and local health care facility requirements.

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [47].

VII. EQUIPMENT SPECIFICATIONS

Abdomen and/or retroperitoneum sonographic studies should be conducted with real-time scanners, preferably using curved sector or linear transducers. The equipment should be adjusted to operate at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration. For most preadolescent pediatric patients, mean frequencies of 5 MHz or greater are preferred, and in newborns and small infants a higher frequency transducer is often necessary. For adults, mean frequencies between 2 and 6 MHz are most commonly used. **Higher frequencies are often used and needed when evaluating the abdominal wall, liver surface, and bowel.** Color and power Doppler should be used to characterize vascular structures and masses. When Doppler studies are performed, the Doppler frequency may differ from the imaging frequency. Image quality should be optimized while keeping total ultrasound exposure as low as reasonably achievable.

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

Each organization will address this section in its document. ACR language is as follows:

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 QC & Improvement, Safety, Infection Control, and Patient Education on the ACR website (http://www.acr.org/guidelines).

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Real Time Ultrasound Equipment [48].

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 (http://www.acr.org/guidelines) by the Committee on Practice Parameters – Ultrasound of the ACR Commission on Ultrasound and by the Committee on Practice Parameters – Pediatric Radiology of the Commission on Pediatric Radiology, in collaboration with the AIUM, the SPR, and the SRU.

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US Abdomen Retroperitoneum PRACTICE PARAMETER
2017 Resolution No. 27
REFERENCES


*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 parameter or 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.

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NOT FOR PUBLICATION, QUOTATION, OR CITATION

RESOLUTION NO. 32

BE IT RESOLVED,
that the American College of Radiology adopt the ACR–SPR–SRU Practice Parameter for Performing and Interpreting Diagnostic Ultrasound Examinations

Sponsored By: ACR Council Steering Committee

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.

Revised 2011 (Resolution 7)*

ACR–SPR–SRU PRACTICE PARAMETER FOR PERFORMING AND INTERPRETING DIAGNOSTIC ULTRASOUND EXAMINATIONS

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. 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 physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the practice parameters, 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 the practice parameters when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology.

1 Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, ___ N.W.2d ___ (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.

PRACTICE PARAMETER Performing and Interpreting Ultrasound 2017 Resolution No. 32
subsequent to publication of the practice parameters. However, a practitioner who employs an approach substantially different from these practice parameters is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also 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 these practice parameters 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 sole purpose of these practice parameters is to assist practitioners in achieving this objective.

I. INTRODUCTION

This practice parameter was revised collaboratively by the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU).

Diagnostic ultrasound is an established, effective diagnostic imaging technique that uses high-frequency sound waves for both anatomic (grayscale) and color/power/spectral Doppler (anatomic and hemodynamic) evaluation. The applications of diagnostic ultrasound technology include, but are not limited to, the following areas (for Breast Ultrasound indications, qualifications and responsibilities of personnel, refer to the ACR Practice Parameter for the Performance of a Breast Ultrasound Examination [1]):

1. Obstetrical Obstetrics and gynecology gynecological ultrasound
2. Thoracic, abdominal Thorax, abdomen, and pelvic pelvic ultrasound
3. Renal and retroperitoneal ultrasound
4. Vascular ultrasound system (carotid, aorta aortic, abdominal, intracranial, peripheral arterial, and peripheral venous studies, including pulsed spectral, power, and color Doppler)
5. Neurosonography
6. Guidance of interventional for interventional and therapeutic procedures, including fine needle aspiration, biopsy, and line placement therapeutic procedures
7. Intraoperative guidance ultrasound
8. Evaluation of Superficial structures such as neck, scrotum, breast, thyroid, testicle, and skin
9. Endoluminal evaluation (ie, depth of tumor invasion, sphincter integrity) ultrasound
10. Ophthalmologic ultrasound
11. Echocardiography
12. Musculoskeletal system ultrasound
13. Tissue elastography

Extensive experience has shown that ultrasound is a safe and effective accurate diagnostic procedure. Although no harmful effects of ultrasound have been demonstrated at the power levels used for diagnostic studies, quality assurance studies and best practice models dictate that all clinical studies be performed it is necessary to use this imaging technique in the most appropriate and indicated fashion and that studies be performed by qualified and knowledgeable physicians and/or sonographers using appropriate equipment and techniques according to the ALARA principle, that is, utilizing the lowest possible ultrasound power settings to acquire the necessary diagnostic information. Diagnostic ultrasound examinations should be performed only when there is an appropriate clinical indication, valid medical reason. The lowest possible ultrasonic power settings should be used to gain the necessary diagnostic information. These practice parameters apply to all ultrasound examinations in all clinical situations All diagnostic ultrasound examinations should be supervised and interpreted by trained and qualified physicians.
II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

Physicians who supervise, perform, and/or interpret diagnostic ultrasound examinations should be licensed medical practitioners who have a thorough understanding of the indications for ultrasound examinations as well as a familiarity with the basic physical principles and limitations of the ultrasound technology of ultrasound imaging. They should be familiar with alternative and complementary imaging and diagnostic procedures and should be capable of correlating the results of these other procedures with the sonographic findings. They should have This should include an understanding of ultrasound technology and instrumentation, ultrasound power output, equipment calibration, and safety. They should be familiar with alternative and complementary imaging and diagnostic procedures (including laboratory tests) and should be capable of correlating this additional medical information with the sonographic findings. Physicians interpreting responsible for diagnostic ultrasound examinations should be able to demonstrate familiarity with the anatomy, (including normal growth and development), physiology, and pathophysiology of those organs or anatomic areas that are being examined. These physicians should be able to provide evidence of the training and competence needed to perform diagnostic ultrasound examinations successfully.

Physicians performing and/or interpreting diagnostic ultrasound examinations should meet at least one of the following criteria:

Certification in Radiology, or Diagnostic Radiology, or Interventional Radiology by the American Board of Radiology, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or the Collège des Médecins du Québec, and involvement with the supervision and/or performance, interpretation, and reporting of 300 ultrasound examinations within the last 36 months.

or

Completion of a diagnostic radiology or interventional radiology residency program approved by the Accreditation Council for Graduate Medical Education (ACGME), the Royal College of Physicians and Surgeons of Canada (RCPSC), the Collège des Médecins du Québec, or the American Osteopathic Association (AOA) to include involvement with the supervision and/or performance, interpretation, and reporting of 500 ultrasound examinations in the past 36 months.

or

Physicians performing, interpreting and reporting ultrasounds of a specific anatomic area who have not completed not board certified in radiology or not trained in a diagnostic or interventional radiology residency program and who assume these responsibility for sonographic imaging exclusively in a specific anatomical area should meet the following criteria: Completion of an ACGME approved residency program in specialty practice plus 200 hours of Category I CME in the subspecialty where ultrasound reading occurs; and supervision and/or performance, interpretation, and reporting of 500 cases relative to each subspecialty area interpreted (eg, pelvic, obstetrical, breast, thyroid, vascular) during the past 36 months in a supervised situation.

The physicians should be familiar with interpretation and documentation in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [2].

Maintenance of Competence

All physicians performing ultrasound examinations should demonstrate evidence of continuing competence in the interpretation and reporting of those examinations. If competence is assured primarily based on continuing experience, a minimum of 100 examinations per year or 50 per anatomic location is recommended in order to maintain the physician’s skills. Continued competency should be monitored for technical success, accuracy of interpretation, and appropriateness of evaluation.

2Completion of an accredited radiology residency in the past 24 months will be presumed to be satisfactory experience for the performance, reporting, and interpreting requirement.
Continuing Medical Education

The physician’s continuing education should be in accordance with the ACR Practice Parameter for Continuing Medical Education (CME) [3] and should include CME in ultrasonography as is appropriate to his/her practice.

B. Diagnostic Medical Sonographer

When a sonographer performs ultrasound the examinations that person should be qualified by with appropriate training to do so. This qualification can be demonstrated by certification or eligibility for certification by a nationally recognized certifying body (eg, ARDMS or ARRT). The sonographer should have ongoing continuing education in ultrasound.

III. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for ultrasound examinations should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient’s clinical problem or question and consistent with the state’s scope of practice requirements. (ACR Resolution 35, adopted in 2006)

Quality may be enhanced by having the ultrasound practice undergo an accreditation process.

IV. DOCUMENTATION

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Comparison with prior relevant imaging studies may prove helpful. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should generally be accompanied by measurements. The initials of the operator should be accessible on the images or electronically on PACS. Images should be labeled with the patient identification, facility identification, examination date, and image orientation. An official interpretation (final report) of the ultrasound examination should be included in the patient’s medical record. Retention of the ultrasound examination images should be based on clinical need and relevant legal and local health care facility requirements.

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [2].

V. 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,
Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Real Time Ultrasound Equipment [4].

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