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The American College of Radiology will periodically define new practice guidelines 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 guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline 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, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines 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 guideline and technical standard by those entities not providing these services is not authorized.

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ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF PEDIATRIC AND ADULT THORACIC COMPUTED TOMOGRAPHY (CT)

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They 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 cautions against the use of these guidelines 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 guidelines, 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 guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines 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

guidelines 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 guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

Computed tomography (CT) is a frequently used imaging modality for the diagnosis and evaluation of many thoracic diseases. Optimal performance of thoracic CT requires knowledge of normal anatomy, anatomic variants, pathophysiology, CT techniques, and the associated risks. This guideline outlines the principles for performing high-quality thoracic CT in adults and children.

(For pediatric thoracic CT specifically, refer to sections IV and V.G, H.)

II. GOAL

The goal of thoracic CT is to demonstrate normal and pathologic anatomy and physiology within the chest.

III. INDICATIONS AND CONTRAINDICATIONS

Chest CT may be a complementary examination to other imaging studies such as chest radiography (see the [ACR Practice Guideline for the Performance of Pediatric and Adult Chest Radiography](#)) or a stand-alone procedure. Indications for the use of thoracic CT include, but are not limited to:

- A. Evaluation of abnormalities discovered on chest radiographs.
- B. Evaluation of clinically suspected thoracic pathology.
- C. Staging and follow-up of lung and other primary thoracic malignancies, and detection and evaluation of metastatic disease.
- D. Evaluation for thoracic manifestations of known extrathoracic diseases.
- E. Evaluation of known or suspected thoracic vascular abnormalities (congenital or acquired).
- F. Evaluation of known or suspected congenital thoracic anomalies.
- G. Evaluation and follow-up of pulmonary parenchymal and airway disease.
- H. Evaluation of trauma.
- I. Evaluation of postoperative patients and surgical complications.
- J. Performance of CT-guided interventional procedures.
- K. Evaluation of the chest wall.
- L. Evaluation of pleural disease.
- M. Treatment planning for radiation therapy.

With specialized techniques that are beyond the scope of this guideline, CT can also be used for other thoracic applications such as evaluation for pulmonary embolus (see the [ACR Practice Guideline for the Performance of Computed Tomography for the Detection of Pulmonary Embolism in Adults](#)) and for more precise evaluation of a variety of pulmonary diseases (see the [ACR Practice Guideline for the Performance of High-Resolution Computed Tomography \(HRCT\) of the Lungs in Adults](#)).

There are no absolute contraindications to thoracic CT. As with all procedures, the relative benefits and risks of the procedure should be evaluated prior to the performance of thoracic CT, with and/or without the administration of intravenous iodinated contrast. Appropriate precautions should be taken to minimize patient risks, including radiation exposure. (See the [ACR Practice Guideline for the Use of Intravascular Contrast Media](#) and the [ACR Manual on Contrast Media](#).)

For the pregnant or potentially pregnant patient, see the [ACR Practice Guideline for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#).

IV. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the [ACR Practice Guideline for Performing and Interpreting Diagnostic Computed Tomography \(CT\)](#).

V. SPECIFICATIONS OF THE EXAMINATION

A. The written or electronic request for a thoracic CT 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 scope of practice requirements. (ACR Resolution 35, adopted in 2006)

B. A typical CT of the thorax should include axial images from the lung apices to the costophrenic sulci usually acquired with ≤ 5 mm slice thickness and reconstruction intervals equal to or less than the slice thickness. The examination may be tailored to specific clinical circumstances, to include 1 mm - 2 mm thin sections through focal areas of pathology, such as nodules. An adequate study may be performed with a sequential single-slice technique, single detector helical (spiral) technique, or multidetector helical (spiral) technique.

C. During most examinations, scans should be obtained in the same suspended state of respiration when possible, and preferably with full inspiration. Cine imaging may be appropriate for evaluating certain disease states such as tracheomalacia. Expiratory scans may be included to evaluate for air trapping. Respiratory-gated CT may be helpful in certain applications such as radiation therapy planning. Scans should be obtained through the entire area of interest. The field of view should be optimized for each patient.

D. The examination may be conducted with or without contrast as clinically indicated.

E. Anatomically appropriate window and level settings should be used to view the lung parenchyma, the mediastinal and chest wall structures, and bones. Softcopy review facilitates evaluation of many studies, such as those with large data sets.

F. Although many of the operations of a CT scanner are automated, a number of technical parameters remain operator dependent and may significantly affect the diagnostic quality of the CT examination. It is necessary for the supervising physician to acquire familiarity with the following:

1. Radiation exposure factors (including mA, kVp, gantry rotation time).
2. Detector configuration (including detector array, detector width, and effective collimation).
3. Slice thickness and interval.
4. Field of view and matrix size (e.g., 256, 512, 1,024).
5. Window and level settings.
6. Reconstruction algorithms.
7. Reformatted images (MPR, curvilinear, MaxIP, MinIP).

G. Optimization of the CT examination requires the supervising physician, preferably in consultation with a medical physicist, to develop appropriate CT protocols based on clinical indications and associated risks.

H. Protocols should be developed with attention to organ systems of interest and medical indications. Techniques should result in diagnostic quality images with the lowest possible patient radiation exposure. For each study, the protocol should specify:

1. Use of helical (spiral) or incremental image acquisition.
2. If intravenous and/or oral contrast is used, the volume, rates of administration, and time delay between administration of contrast media and initiation of scan.
3. Collimation and slice thickness.
4. Slice spacing, table increment, and pitch as appropriate.
5. kVp and mAs appropriate to body habitus.
6. Superior and inferior extent of the area of interest to be imaged.
7. Reconstruction algorithm and level and window settings of permanent images.
8. Reconstruction interval.
9. Number of phases (e.g., precontrast or postcontrast, delayed imaging).
10. Field of view and matrix size.
11. Image reformatting.

These protocols should be reviewed and updated periodically.

I. For pediatric patients in particular, efforts should be directed to:

1. Limit radiation dose when diagnostically feasible with increased table increment or pitch, use of low mA or kVp, and partial scans. Consideration should be given to shielding superficial structures such as breast, thyroid, and lens of the eye.
2. Minimize motion artifact with short scan times (balanced against any changes in mA in order to

maintain appropriate mAs), partial scans, and appropriate sedation.

J. When sedation is used, it should be administered in accordance with the [ACR Practice Guideline for Adult Sedation/Analgesia](#) or the [ACR Practice Guideline for Pediatric Sedation/Analgesia](#).

VI. DOCUMENTATION

Reporting should be in accordance with the [ACR Practice Guideline for Communication of Diagnostic Imaging Findings](#).

VII. EQUIPMENT SPECIFICATIONS

A. Performance Standards

To achieve acceptable clinical CT scans of the thorax, a CT scanner should meet or exceed the following capabilities:

1. Gantry rotation times: ≤ 2 seconds.
2. Slice thickness: ≤ 5 mm (≤ 2 mm is preferred).
3. Limiting spatial resolution: ≥ 8 lp/cm for ≥ 32 cm display field of view (DFOV) and ≥ 10 lp/cm for < 24 cm DFOV.
4. Table pitch: no greater than 2:1 for single-row-detector helical scanners.

B. Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications. The equipment and medications should be monitored for inventory and drug expiration dates on a regular basis. The equipment, medications, and other emergency support must also be appropriate for the range of ages and/or sizes in the patient population.

VIII. EQUIPMENT QUALITY CONTROL

The quality control program for CT equipment should be designed to minimize patient, personnel, and public radiation risks and to optimize the diagnostic quality of the examination. The program should be supervised by a medical physicist and follow the [ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography \(CT\) Equipment](#). Each imaging facility should have documented policies and procedures that include:

1. A list of quality control tests and the frequency of performance.
2. A list of individuals or groups who will perform each test.
3. A written description of each testing procedure, to include technique factors, testing equipment

(to be) used, tolerance limits, and sample records.

IX. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, radiologic technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This concept is known as “as low as reasonably achievable (ALARA).”

Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active; if not, manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Patient radiation doses should be periodically measured by a medical physicist in accordance with the appropriate ACR Technical Standard. (ACR Resolution 17, adopted in 2006)

A medical physicist and radiologist together should verify that any dose reduction devices or utilities maintain acceptable image quality while actually reducing radiation dose.

Dose estimates for typical examinations should be compared to reference levels described in the [ACR Practice Guideline for Diagnostic Reference Levels in Medical X-Ray Imaging](#).

X. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

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 Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

For specific issues regarding CT quality control, see the [ACR Practice Guideline for Performing and Interpreting Computed Tomography \(CT\)](#).

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography \(CT\) Equipment](#).

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