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 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.

Revised 2010 (Resolution 43)*

ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF HIGH-RESOLUTION COMPUTED TOMOGRAPHY (HRCT) OF THE LUNGS IN ADULTS

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 of 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

High-resolution computed tomography (HRCT) imaging of the lungs is well-established for evaluating many pulmonary diseases. Optimal methods of acquisition and interpretation of high-resolution images require knowledge of anatomy and pathophysiology, as well as familiarity with the basic physics and techniques of computed tomography. This guideline outlines the principles for performing high-quality HRCT of the lungs.

II. DEFINITIONS

HRCT is the use of thin section CT images (0.625 to 2 mm slice thickness) often with a high-spatial-frequency reconstruction algorithm to detect and characterize disease affecting the pulmonary parenchyma and airways. Following the development and widespread availability of multi-detector CT scanners capable of acquiring data throughout the entire thorax in a single breath-hold, 2 general approaches are available for acquiring HRCT images. The first and more traditional or “dedicated” method entails obtaining axial HRCT images spaced at 10 to 20 mm intervals throughout the thorax, which is an approach applicable to both single-detector and multi-
detector scanners. The second uses the ability of multi-detector row CT (MDCT) scanners to provide volumetric data sets allowing spaced, contiguous, and/or overlapping HRCT images to be reconstructed.

Optimal performance of HRCT studies requires familiarity with the advantages and limitations of each HRCT method, with the choice between these approaches reflecting available equipment and clinical indication(s).

With both methods, image data are routinely acquired at full inspiration with patients in the supine position. Additional options include obtaining prone images to evaluate for basilar lung disease, and end-expiratory images to evaluate for air-trapping.

III. GOAL

The main objective of HRCT is to detect, characterize, and determine the extent of diseases that involve the lung parenchyma and airways.

IV. PATIENT INDICATIONS AND CONTRAINDICATIONS

A. Indications

The indications for the use of HRCT of the lungs include, but are not limited to, the following:

1. Evaluation of diffuse pulmonary disease discovered on chest radiographs, conventional CT of the chest, or other CT examinations that include portions of the chest, including selection of the appropriate site for biopsy of diffuse lung disease.
2. Evaluation of the lungs in patients with clinically suspected pulmonary disorders with normal or equivocal chest radiographs.
3. Evaluation of suspected small and/or large airway disease.

B. Contraindications

There are no absolute contraindications to HRCT of the lungs.

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

V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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

The physician is responsible for reviewing all indications for the examination, specifying the precise technical factors to be used for the HRCT study, generating a final report, and monitoring and maintaining the quality of images and interpretation.

The physician should be thoroughly acquainted with the many anatomic and physiologic manifestations of intrathoracic disease. Additionally, supervising physicians should have appropriate knowledge of alternative imaging modalities, including available techniques for performing routine chest radiography and standard thoracic CT, as well as angiography, ultrasonography, magnetic resonance imaging, and nuclear medicine studies.

VI. SPECIFICATIONS AND PERFORMANCE OF THE EXAMINATION

A. Written Request for the Examination

The written or electronic request for a HRCT of the lungs 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. Although many of the operations of a CT scanner are automated, a number of technical parameters remain operator-dependent. As these factors can significantly affect the diagnostic value of the HRCT examination, it is necessary for the supervising physician to be familiar with the following:
1. Technique factors and patient radiation dose considerations.
2. Slice thickness.
3. Table speed.
4. Gantry rotation time.
5. Detector configuration of multidetector CT.
6. Field of view.
7. Level and window settings.
8. Methods of data reconstruction, including maximum intensity (MIPS) and minimum intensity (minIP) projection images as well as routine multiplanar reconstructions.

C. Optimization of the CT examination requires the supervising physician to develop an appropriate CT protocol based on careful review of relevant patient history and clinical indications as well as all prior available imaging studies that are relevant.

1. Protocols should be prepared according to the specific medical indication. Techniques should be selected that provide image quality consistent with the diagnostic needs of the examination at acceptably low radiation dose levels to the patient. For each indication, the protocol should include at least the following:
   a. High-spatial-frequency reconstruction algorithm, such as a bone algorithm.
   b. Slice thickness (≤2 mm for nonhelical CT, ≤1.5 mm nominal slice thickness for helical CT).
   c. Table speed for volumetric HRCT to enable single-breath-hold acquisition, when possible.
   d. Gantry rotation: ≤1 second.
   e. Detector configuration selection (e.g., 2 channels on MDCT for incremental HRCT).
   f. Axial (incremental HRCT) or helical (volumetric HRCT) modes of data acquisition.
   g. Field of view (FOV) for small, medium, and large patients (including the use of prospective and/or retrospective target reconstructions).
   h. kVp and mA both per slice as well as optimized for volumetric data acquisition. Typically this entails use of 120 kVp and approximately ≤240 mA, although use of lower doses is encouraged, especially for younger patients or those who may need serial imaging. In the latter case, using identical technical parameters for each study facilitates direct comparison between studies and is of particular value when quantitative CT measurements are employed.
   i. Superior and inferior extent of the region of interest to be imaged.
   j. Level and window settings of hard-copy images whenever printed.
   k. Patient positioning (supine and/or prone).
   l. State of respiration (inspiration and/or expiration).

2. Use of intravenous (IV) iodinated contrast is not routinely recommended for evaluating the lung parenchyma as this adds little to the interpretation of diffuse lung disease in most cases.

3. Periodic update and review of the HRCT protocol.

VII. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Guideline for Communication of Diagnostic Imaging Findings.

VIII. EQUIPMENT SPECIFICATIONS

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

1. Scan times: ≤1 second per image. A scan time of <1 second per image may apply to direct axial acquisition but may not apply to helical CT acquisition of HRCT images.
2. Slice thickness: ≤2 mm.
3. Algorithm available: bone or high-spatial frequency.
4. Spatial resolution meeting or exceeding manufacturer’s specifications.
5. Axial mode available on helical CT scanner.

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. Periodically, radiation exposures should be measured and patient radiation doses estimated by a medical physicist in accordance with the appropriate ACR Technical Standard. (ACR Resolution 17, adopted in 2006 – revised in 2009, Resolution 11)

X. 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 web page (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 Computed Tomography (CT) Equipment.

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Suggested Reading (Additional articles that are not cited in the document but that the committee recommends for further reading on this topic)


*Guidelines and 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 guidelines and standards published before 1999, the effective date was January 1 following the year in which the guideline or standard was amended, revised, or approved by the ACR Council.

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