Pulmonary Nodule Management in Lung Cancer Screening

A Pictorial Review of Lung-RADS Version 1.0

Myrna C.B. Godoy, MD, PhD*, Erika G.L.C. Odisio, MD, Mylene T. Truong, MD, Patricia M. de Groot, MD, Girish S. Shroff, MD, Jeremy J. Erasmus, MD

KEYWORDS

• Lung cancer • Lung cancer screening • Pulmonary nodule • Computed tomography • Low-dose computed tomography • Lung-RADS

KEY POINTS

- The American College of Radiology has established the Lung-RADS classification to standardize the low-dose computed tomography lung cancer screening lexicon, interpretation, reporting, and recommendations for management.
- Lung-RADS assessment categories facilitate communication with clinicians and clarify management of screen-detected nodules.
- Lung-RADS facilitates auditing of lung cancer screening programs and data collection for research and outcome analysis for future refinement of lung cancer screening practices.
- The use of a standardized reporting system is a requirement for lung cancer screening reimbursement by the Centers for Medicare and Medicaid Services.
- Currently, although most radiologists in the United States have adopted the use of Lung-RADS, there are similar management recommendations, including those from the National Comprehensive Cancer Network.

INTRODUCTION

The US Preventive Services Task Force has given a grade B recommendation for lung cancer screening (LCS) with low-dose computed tomography (LDCT) scanning for high-risk current and former smokers.[1] This recommendation is based primarily on the results from the National Lung Screening Trial, a randomized clinical trial of more than 50,000 high-risk smokers, which reported a 20% reduction in lung cancer–specific mortality rate associated with LDCT screening compared with screening with chest radiography.[2,3] In this study, lung cancer was diagnosed in 1.1% of participants undergoing LDCT scanning with a sensitivity and specificity of 93.8% and 73.4, respectively.[3]

Private insurance and Centers for Medicare and Medicaid Services are now reimbursing the cost of LCS in the appropriate population. As a result, the number of detected lung nodules is expected to increase as LDCT screening is implemented nationally. The American College of Radiology (ACR) in association with the Society of Thoracic Radiology (STR) has published standardized guidelines for image acquisition to optimize image quality and patient safety in LCS programs.[4] These guidelines provide recommendations for radiation

Department of Diagnostic Radiology, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Boulevard, Unit 371, Houston, TX 77030, USA
* Corresponding author.
E-mail address: mgodoy@mdanderson.org

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exposure factors, CT detector configuration, image slice thickness and interval, field of view and matrix size, window and level settings, reconstruction algorithms, reformatted images, and advanced noise reduction techniques.[4]

Standardization of the definition of a positive result in LDCT screening and appropriate management of positive screening results are essential to optimize the cost-effectiveness of LCS.[5] These proposals will decrease inappropriate nodule evaluation, decrease patient radiation dose owing to unnecessary reevaluation with imaging, and decrease invasive diagnostic procedures. In this regard, the ACR has established the Lung-RADS classification[6] to standardize the LDCT screening lexicon, interpretation, reporting, and recommendations for management of identified nodules. The first and current version of this classification was released in April 2014.[6] The use of Lung-RADS assessment categories will facilitate communication with clinicians and standardization of patient management, improving the quality of patient care. It will allow auditing of LCS programs and facilitate data collection for research and outcome analysis for future refinement of LCS practices. The use of a standardized reporting system is a requirement for reimbursement of LCS by the Centers for Medicare and Medicaid Services. Currently, although most radiologists in the United States have adopted the use of Lung-RADS, there are similar management recommendations, including those from the National Comprehensive Cancer Network.

Another important consideration in LCS is appropriate documentation and communication of results. In this regard, the ACR Practice Parameter for Communication of Diagnostic Imaging Findings has defined new practice parameters and technical standards for LDCT in LCS. This educational tool is designed to assist practitioners in providing appropriate radiologic care for patients.[4] Providers can request a database application that facilitates management of patient intake, scheduling, and follow-up.[4]

In this article, we discuss image acquisition and reconstruction, nodule evaluation, and current guidelines for pulmonary nodule management in the LCS setting. Each Lung-RADS category will be reviewed and practical cases encountered in clinical practice will be presented. It is important to emphasize that recommendations of management are flexible, and guidelines should be interpreted using clinical judgment on a case-by-case basis. For challenging cases, a multidisciplinary review can be useful to determine the best management for a particular patient, taking into consideration clinical aspects such as age, comorbidities, life expectancy, and imaging findings.

CONSIDERATIONS ON IMAGE ACQUISITION, RECONSTRUCTION, AND ANALYSIS

The ACR-STR practice parameters recommend LCS be performed with a multidetector helical CT technique in a single breath hold at full inspiration.[4] The CT scan should be performed without intravenous contrast administration and should extend from the lung apices to the costophrenic recesses. The field of view should be optimized for each patient to include the entire transverse and anteroposterior dimensions of the lungs.

Axial image reconstruction with slice thickness of 2.5 mm or less, with reconstruction intervals equal to or less than the slice thickness, is recommended for image review.[4] However, image reconstruction at 1 mm or less minimizes volume-averaging effects and, therefore, should be available to optimize characterization of small lung nodules, particularly in the assessment of nodule size and morphology pertaining to solid and subsolid components.[4] Multiplanar reconstruction can be useful to improve the characterization of nodule location and shape (**Fig. 1**), particularly nodules located along the pleural surface, because these perifissural nodules have a low potential for malignancy.[4,7] Maximum intensity projection images increase nodule detection.[8,9] Computer-aided detection systems can be used as a second reader to increase detection and nodule characterization.[10–12] Although semiautomated volumetric assessment of nodule size and growth by computer analysis has some technical limitations, it is more accurate and reproducible than 2-dimensional measurements.[4,13,14]

In terms of patient safety, the radiation dose should be as low as reasonably achievable without compromising image quality. For LCS, the CT technique should be set to yield a CTDIvol of less or equal 3 mGy for a standard-sized patient (height, 5 feet 7 inches [170 cm]; weight, 155 pounds [69.75 kg]) and should be decrease for smaller sized patients and increased for larger sized patients.[4]

Nodules are defined according to Fleischner Society's glossary of terms as a rounded opacity, well or poorly defined, and less than 3 cm in diameter.[15] Nodule size should be measured on lung window (high spatial frequency algorithm) images. Size of a screen-detected nodule is defined as the average of the longest diameter and the perpendicular diameter on a single axial CT image, rounded to the nearest whole number. Comparison with prior examinations should be performed whenever available to assess changes over time.