New Developments in Lung Cancer Screening

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Lung cancer is the most common cause of cancer-related deaths worldwide.[1] Lung cancer screening saves lives; however, only those with the highest risk for lung cancer are screened regularly because of economic constraints. Due to the variability of lung cancer screening efforts, some groups might not be as protected as they should. Lung cancer screening recommendations and techniques have changed in the past few years, and imaging modalities are at the forefront of lifesaving efforts.

Changes in Screening Guidelines

The new lung cancer screening eligibility guidelines reduced pack-year history from 30 pack-years to 20 pack-years and expanded the age range of at-risk populations.[2] According to the National Cancer Institute, a pack year is:

> *A way to measure the amount a person has smoked over a long period of time. It is calculated by multiplying the number of packs of cigarettes smoked per day by the number of years the person has smoked.*[3]

Screening with low-dose computed tomography (LD-CT) is recommended annually for asymptomatic people aged 50 to 80 years with a 20-year or more pack history who currently smoke or have smoked within the past 15 years.[4,5] The Centers for Medicare and Medicaid Services has begun enrollment in screening programs because of new recommendations from the American College of Radiology, which are based on the U.S. Preventive Services Task Force recommendations of 2021.[2,5,6] Despite the recent increase in the demographic eligible for screening, 1.9% of those who are eligible have participated in the Centers for Medicare and Medicaid Services screening program.[7]

In addition, some groups have specific lung cancer screening recommendations such as firefighters who are exposed to and possibly inhale asbestos and other products during structural and other types of fire. A 2015 study by the National Institute for Occupational Safety and Health (NIOSH) showed that an increase in risk of lung cancer diagnosis or death correlates with an increased time spent at fires.[8] NIOSH recommends that firefighter groups receive safety culture training and cancer awareness as a part of prevention and that a national firefighter registry be created to learn about and reduce cancer incidence among firefighters.[8] However, research is showing that current guidelines for firefighters are not enough; most recommend performing chest radiography every 5 years. New recommendations might be needed that place a higher priority on using LD-CT to screen firefighters than those for the public.[9]

Not every individual needs to be screened annually. An efficient and effective screening system will[10]:

- choose the correct demographics to screen
- include evidence-based policy to maximize benefits

- identify the best follow-up diagnostic modality
- minimize harm to patients
- optimize available technology use and provide training in the use of the technology
- use standardized or structured reporting

Screening Methods

A shared decision should be made between the patient and their doctor that considers the benefits and disadvantages of screening, as well as the need for further diagnostic testing. LD-CT is the recommended modality for assessing the potential malignancy of a nodule and evaluating its size, morphology, presence of calcium, borders, and growth.[5] Incidental findings from lung cancer screening include bronchiectasis, pulmonary fibrosis, and infections, in addition to other cancers such as esophageal, breast, and thyroid.[11] For lung cancer screening parameters, the American College of Radiology recommends limiting LD-CT to only the lungs for screening and nodule follow up. For axial images from lung apices to posterior costophrenic sulci, reconstruction slice thickness (≤ 5-3 mm) algorithm is recommended for soft tissue and a high spatial frequency reconstruction algorithm. Volumetric images can be reconstructed using less than 1.25 mm slice thickness with a high spatial frequency reconstruction algorithm. Overlapping transverse maximum intensity projection images with 5 to 10 mm slab thickness can help in lung nodule detection. Computer-aided diagnosis software also can help assess lung nodules, which can be found in 13% of CT scans in the general population.[12-14]

The typical radiation dose for LD-CT has been estimated at 1.4 mSv, compared with 7 mSv for conventional chest CT. Dose can vary with size of participant, and tube voltage adjusted as low as 80 kVp for those up to 50 kg, 120 kVp in those 50 to 80 kg, and 140 kVp in those more than 80 kg.[15]

After nodules have been identified through screening, they are classified as solid or subsolid. Solid and subsolid nodules have varying growth rates, and subsolid nodules are more likely to be malignant;[16] therefore, management for a solid nodule differs from that of a subsolid nodule.

Distinguishing solid and subsolid nodules can vary between radiologists.[11,17] One study found that larger nodules were more consistently identified than were nodules under 4 mm.[17] Rampinelli et al noted that, because nodules are small, the CT section interval must be lower than the slice thickness to reduce artifacts and obtain an accurate assessment.[16] Different nodules also require different detection techniques.

When solid or part solid nodules are less than 6 mm at baseline, a 12-month screening follow-up LD-CT is recommended.[18] When a solid nodule is 6 to 8 mm at baseline, a 6-month LD-CT is recommended.[18] However, a part solid nodule must be more than 6 mm total mean diameter with a solid component less than 6 mm for the same follow-up interval. Solid nodules 8 to 15 mm at baseline should receive a 3-month LD-CT scan, and if a solid nodule is more than 8 mm, a positron emission tomography-CT scan might be considered.[18] For solid nodules more than 15 mm and part solid nodules more than 8 mm, a diagnostic chest CT with or without contrast is recommended in addition to tissue sampling, but management is taken into consideration with physician interpretation and patient preference.[18]

Lung cancer is more prevalent in the upper lobes, but the ability to identify changes and distinguish between cancer and fibrotic scars in the apices is challenging.[11] The apices are a frequent site of fibrotic scars and lung cancer, making it challenging to differentiate between them during the early stages of lung cancer.[11] Lung cancer should be considered when a new lesion arises in a previously detected apical scar.

New Screening Tools and Technologies

To enhance lung cancer screening, temporal subtraction to suppress bone in chest radiography is being evaluated. One study showed that pulmonary lesion detection sensitivity by radiologists increased from 67.9% to 75.4%.[19] Other technology that complements LD-CT for more effective screening includes computer-aided detection and volumetric assessment, and the use of plasma biomarkers to help reduce false positives.[20] The Galleri test (GRAIL), a multicancer early detection test, is leading the way toward noninvasive testing by early identification of multiple types of cancer with 1 blood test. GRAIL, a test which detects DNA shed by cancers, identifies a methylation pattern containing information about tissue or organ associated

with the signal. GRAIL detects this signal in at least 50 types of cancers, including lung cancer. The test still is undergoing clinical trials to achieve validation. It has not yet been given clearance by the U.S. Food and Drug Administration.[21,22]

When reading images, recommendations for radiologists include using the American College of Radiology Lung CT Screening Reporting and Data System (Lung-RADS), computer-aided detection, volumetric assessment, and double reading, with a balance between radiologist experience and technological assistance.[16-18] Lung-RADS is a system categorizing pulmonary imaging findings based on probable malignancy or benignity, with follow-up imaging interval recommendations and modalities for each category.[18] This structure is the supporting basis for the organized algorithms necessary for proper diagnosis and care. The European Society of Radiology and European Respiratory Society recently wrote a joint paper on lung cancer screening, emphasizing the need for state-of-the-art algorithms and multidisciplinary team effort, and for the value of screening.[23]

Conclusion

Amazing strides in imaging and other technologies have been and continue to be made, but there's still room for improvement. Optimizing technology use and screening criteria are excellent efforts in lung cancer screening, and demographic priorities will always need to be examined along with the current benefits of technology.

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References

1. Snoeckx A, Franck C, Silva M, Prokop M, Schaefer-Prokop C, Revel MP. The radiologist's role in lung cancer screening. *Transl Lung Cancer Res.* 2021;10(5):2356-2367. doi:10.21037/tlcr-20-924
2. Updated USPSTF Lung Cancer Screening Guidelines Would Help Save Lives. Accessed January 9, 2023. https://www.acr.org/Media-Center/ACR-News-Releases/2020/Updated-USPSTF-Lung-Cancer-Screening-Guidelines-Would-Help-Save-Lives
3. Glossary for Registrars. SEER. Accessed October 24, 2023. https://seer.cancer.gov/seertools/glossary/view/54fb9f43e4b0c48f31d32d30/?q=%5EP
4. Krist AH, Davidson KW, Mangione CM, et al; US Preventive Services Task Force. Screening for lung cancer: U.S. Preventive Services Task Force recommendation statement. *JAMA.* 2021;325(10):962-970. doi:10.1001/jama.2021.1117
5. Cancer screening guidelines: detecting cancer early. American Cancer Society. Updated February 24, 2023. Accessed January 23, 2023. https://www.cancer.org/healthy/find-cancer-early/american-cancer-society-guidelines-for-the-early-detection-of-cancer.html
6. Lung cancer screening coverage. Medicare. Accessed January 23, 2023. https://www.medicare.gov/coverage/lung-cancer-screenings
7. Burzic A, O'Dowd EL, Baldwin DR. The future of lung cancer screening: current challenges and research priorities. *Cancer Manag Res.* 2022;14:637-645. doi:10.2147/CMAR.S293877
8. Firefighter cancer awareness. Centers for Disease Control and Prevention. Published December 5, 2022. Accessed January 9, 2023. https://www.cdc.gov/niosh/newsroom/feature/firefighter-cancer-awareness.html
9. Printz C. New research finds lung cancer screening guidelines are insufficient for firefighters. *Cancer.* 2020;126(4):692-693. doi:10.1002/cncr.32721
10. Lam S, Tammemagi M. Contemporary issues in the implementation of lung cancer screening. *Eur Respir Rev.* 2021;30(161):200288. doi:10.1183/16000617.0288-2020
11. Shepard JAOMD. *Thoracic Imaging.* 3rd ed. Elsevier; 2019.
12. Wyker A, Henderson WW. Solitary Pulmonary Nodule. StatPearls Publishing; 2023. Accessed October 24, 2023. http://www.ncbi.nlm.nih.gov/books/NBK556143/
13. ACR-SABI-SPR-STR practice parameter for the performance of thoracic computed tomography (CT). American College of Radiology. Revised 2023. Accessed October 25, 2023. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Thoracic.pdf
14. Tylski E, Goyal M. Low dose CT for lung cancer screening: the background, the guidelines, and a tailored approach to patient care. *Mo Med.* 2019;116(5):414-419.
15. Vonder M, Dorrius MD, Vliegenthart R. Latest CT technologies in lung cancer screening: protocols and radiation dose reduction. *Transl Lung Cancer Res.* 2021;10(2):1154-1164. doi:10.21037/tlcr-20-808
16. Rampinelli C, Origgi D, Bellomi M. Low-dose CT: technique, reading methods and image interpretation. *Cancer Imaging.* 2013;12(3):548-556. doi:10.1102/1470-7330.2012.0049
17. Ming S, Yang W, Cui SJ, Huang S, Gong XY. Consistency of radiologists in identifying pulmonary nodules based on low-

dose computed tomography. *J Thorac Dis*. 2019;11(7):2973-2980. doi:10.21037/jtd.2019.07.52

18. Lung-RADS v2022. American College of Radiology. Published November 2022. Accessed October 25, 2023. https://www.acr.org/-/media/ACR/Files/RADS/Lung-RADS/Lung-RADS-2022.pdf
19. Takaki T, Murakami S, Tani N, Aoki T. Evaluation of the clinical utility of temporal subtraction using bone suppression processing in digital chest radiography. *Heliyon*. 2023;9(1):e13004. doi:10.1016/j.heliyon.2023.e13004
20. Lung cancer screening remains poor. Here's how to increase rates and save lives. American Society of Clinical Oncology. Published March 30, 2022. Accessed January 9, 2023. https://dailynews.ascopubs.org/do/10.1200/ADN.22.200886/full
21. What cancers does Galleri screen for? Accessed October 25, 2023. https://www.galleri.com/what-is-galleri/types-of-cancer-detected
22. Introducing the Galleri test. Galleri. Accessed October 25, 2023. https://www.galleri.com/hcp/the-galleri-test-2
23. Kauczor HU, Baird AM, Blum TG, et al; European Society of Radiology (ESR) and the European Respiratory Society (ERS). ESR/ERS statement paper on lung cancer screening. *Eur Respir J*. 2020;55(2):1900506. doi:10.1183/13993003.00506-2019