CT-Lung Screening Drives the Need for Advanced Visualization Tools

by Cristen Bolan

Vision for the Future

The University of Michigan Health System (UMHS) is a premier, quaternary care center that is among the top 10 academic medical centers in the United States. As a highly ranked academic medical center and award-winning healthcare system, its physicians are leaders in advanced research, education, and patient care. In line with its vision to create the future of healthcare through discovery, innovation, and education, the medical school is one of the leading recipients of funding from the National Institutes of Health.

Impact of NLST

One of the most significant trials to impact public policy in recent years is the National Lung Screening Trial (NLST),[1] which included University of Michigan site Principle Investigator Ella A. Kazerooni, MD, the Director of the Division Cardiothoracic Radiology at UMHS. Dr. Kazerooni's team at UMHS, along with researchers across multiple sites, conducted the study to determine whether screening with low-dose computed tomography (CT) could reduce mortality from lung cancer compared to screening with standard chest X-ray. The study examined the consequences of the screening methods on large, randomized populations of heavy smokers and former smokers ages 55 to 74, using death from lung cancer as the primary end point.[2] The results showed that a 20.0% decrease in mortality from lung cancer was observed in the low-dose CT group as compared with the radiography group.[1] The researchers concluded screening with the use of low-dose CT reduces mortality from lung cancer.[1]

"The NLST definitively demonstrated that low-dose CT performed annually for 3 years in high-risk current and former smokers significantly reduces lung cancer mortality by 20% and does so cost effectively," noted Dr. Kazerooni. "For lung cancer, which is the leading cause of cancer death in the United States (U.S.), this is the only intervention that has ever been shown to reduce lung cancer mortality."

The profound implications of these findings were echoed in the recommendations by the U.S. Preventive Services Task Force (USPSTF) issued December 31, 2013. As Dr. Kazerooni explained, "Building on mortality reduction and cost effectiveness, the USPSTF moved forward with a positive recommendation that lung-cancer screening with CT should be performed annually 'in adults ages 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years.[2]"

Spike in CT-Lung Screening

The results from the NLST and the USPSTF recommendations will eventually transform the landscape of lung screening in the U.S., driving up the number of patients undergoing a CT-lung screening exam. This spike in patient volumes places growing pressures on radiologists in particular to work more efficiently to screen more patients.

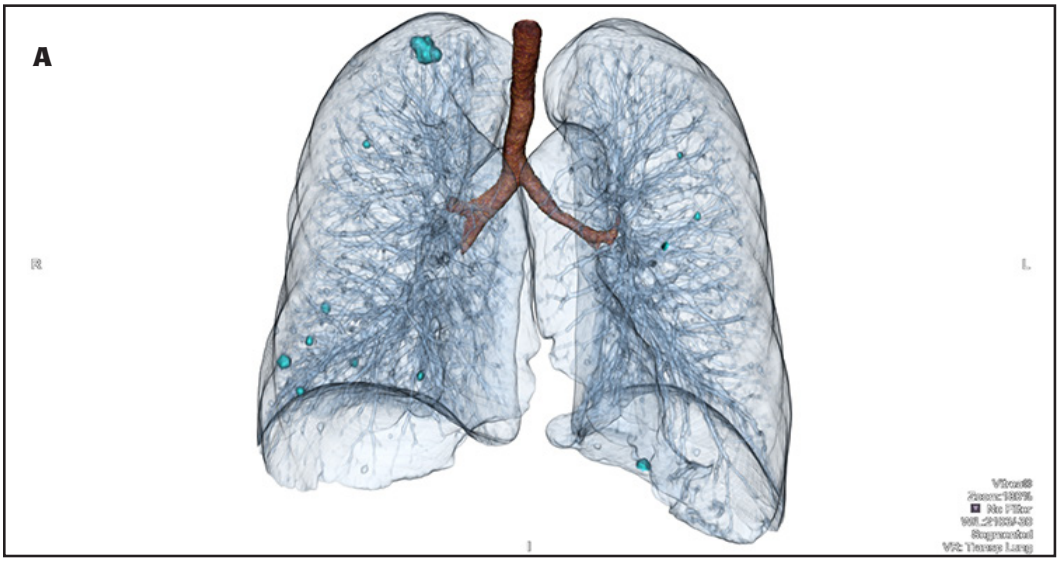
"With approximately 7 to 10 million individuals in the U.S. projected to meet the criteria for lung cancer screening, thoracic CT volumes will undoubtedly increase with both the screening CT exams and interval CTs between screening for moderately suspicious nodules," said Dr. Kazerooni.

She added, "We estimate by raising the size of thresholds of what defines a positive screen, we will reduce the false positives from over 1 in 4 to 1 in 10, reducing the number of interim CTs needed between screenings. More patients will be referred to pulmonary medicine specialists for management of screen-detected nodules, and more advanced management, such as bronchoscopy, CT-guided biopsy, video-assisted thoracoscopy, and even lobectomy will be reserved for a small subset of patients with highly suspicious findings."

Technology Meets the Challenge

The influx of lung screening patients will drive the need for advanced visualization tools that increase efficiency, are fast and easy to use, and are widely accessible.

"With the estimated 7 to 10 million individuals in the U.S. who could potentially start undergoing screening soon, there will be a large number of



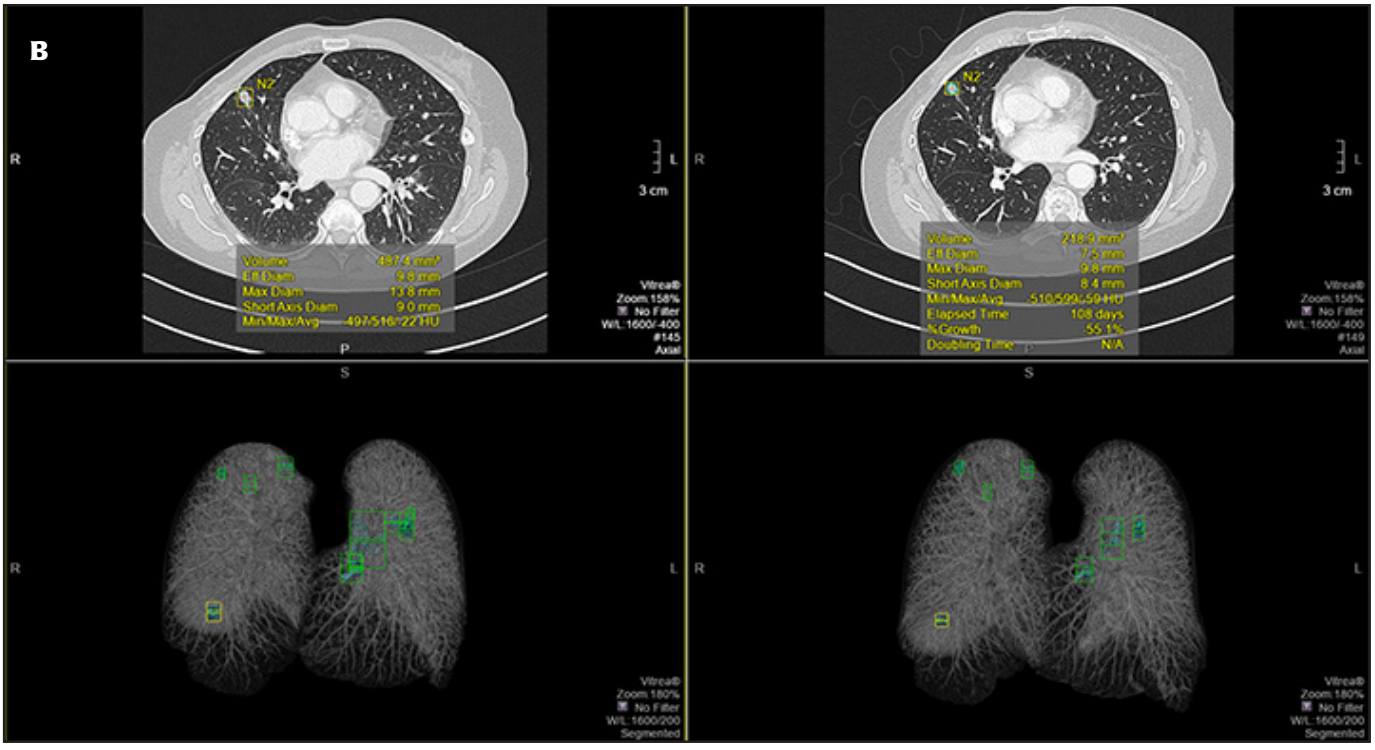


FIGURE 1. *VitreaAdvanced CT Lung Nodule Analysis (A and B) helps users analyze nodules through multiple studies to determine growth patterns and make comparative reviews. Workflow automatically segments the lung and thorax and provides clinical information including density, percent growth and doubling rates for nodules.*

studies, each of which has 300-400 axial images alone," Dr. Kazerooni indicated. "Tools providing computer-assisted technology at your fingertips that help you detect, measure, and compare nodules over time are going to be very important to radiologists' efficiency in interpreting these exams."

Efficiency combined with accuracy is mission critical for CT-lung screening, and Dr. Kazerooni leverages the tools available on Vitrea software.

"The lung application from Vital Images available on Vitrea is a critical tool for radiologists to evaluate thoracic/chest CT studies for lung cancer or to track its progression. This specialized 3D application provides semi-automated segmentation and quantification of lung nodules and can track changes across multiple time points. The application also provides segmentation and visualization of the airways for identifying tracheal stenosis or tracheomalacia," noted Dr. Kazerooni.

The specific functions of Vitrea tools enable reading and comparison of one or many CT-lung studies simultaneously; automated segmentation of the lungs and airways; a one-click nodule probe tool for auto-measurement of nodules, volume measurements, lung emphysema visualization preset, airway evaluation, nodule size growth, and doubling times; and an auto-populate report summarizing nodule findings and measurements.

Keeping pace with the fast growing demands on report turnaround times and capabilities that support collaboration in real-time are critical to efficient workflow.

"VitreaAdvanced — CT Lung probes and measures nodules and provides reporting features. More specifically, you can include in the radiology reports nodule size on current studies or over time on serial exams, and even images. VitreaAdvanced helps radiologists work through exams efficiently and accurately," she added.

Leveling the Playing Field

There could be greater emphasis on using clinical decision-support tools that enable all radiologists, from generalists to specialists, to evaluate lung CT with the same level of quality and confidence.

One such tool is computer-aided diagnosis (CAD), which gives all radiologists an edge in accuracy. "CAD has the potential to even out the performance of radiologists across practices, from the general radiologist to the specialized thoracic radiologist. The results of the NLST were found with thoracic radiologists as readers; yet, it is important that all radiologists who may be interpreting these exams can do so with quality performance standards," she said.

To meet this need, Vitrea offers Mevis Visia CT Lung CAD at the workstation and provides Web-based access to this CAD solution.

"A potential benefit of CAD is to aid in lung-nodule detection. Another benefit is nodule characterization with respect to tissue components — solid, ground glass or mixed nodules, calcium, and fat — and nodule borders, which are important in making management recommendations based on the probability of malignancy," said Dr. Kazerooni.

Dose reduction

Based on the USPSTF recommendations, individuals may undergo CT screening exams annually for up to 25 years. In light of concerns for radiation exposure from CT exams, recent advances in dose reduction technology will facilitate the adoption of CT-lung screening.

Dr. Kazerooni acknowledges there are lingering concerns about radiation exposure for patients undergoing annual CT lung-screening exams in addition to other diagnostic CT exams, such as PET/CT to evaluate positive screens. However, advances in dose techniques, such as MBIR (model-based iterative reconstruction) and ADIR (adaptive-iterative dose reduction), permit significant reductions in radiation exposure while maintaining high-quality lung-CT imaging. In addition, the target population for LDCT lung cancer screening is older individuals for whom the risks of any radiation-related cancer are far less than childern and young adults.

"In general, the risks for already low-dose CT screening have been overestimated. We can perform ultra-low dose CT exams that can approach the radiation exposure of only a few chest X-rays," said Dr. Kazerooni. "With these techniques, any lingering doubts about radiation exposure should be nullified."

Conclusion

As the practice of CT-lung screening becomes more prevalent, successful lung screening programs like the one at UMHS require careful protocols for screening appropriate individuals, and for interpreting, reporting, and managing the abnormalities found correctly and appropriately, working with primary care practitioners who are at the front lines with patients. Multidiscplinary collaboration across radiology, pulmonary medicine, and thoracic surgery is important for the management of the small percentage of patients with CT abnormalities that are the most suspicious for lung cancer.

"Given the huge population that we expect to come forward for screening in the future, any tools that can help radiologists be more efficient and perform at a consistently high standard are key to a successful lung-cancer screening program," said Dr. Kazerooni.

References

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2. Screening for Lung Cancer. U.S. Preventive Services Task Force. http://www.uspreventiveservicestaskforce.org/uspstf/uspslung.htm. Updated January 2014. Accessed March 10, 2014.