Interview

Closing the gap: Image-guided robotic bronchoscopy speeds path to lung cancer treatment

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The majority of lung cancer cases begin with an unexpected discovery. "About 99 percent of our patients come to us with an incidental finding, meaning there was no organized screening program involved," says Thomas Gaisl, MD, PhD, managing consultant in the Department of Pulmonology at University Hospital Zurich. These incidental findings often occur during imaging for unrelated conditions such as cardiac diseases and back pain, highlighting the critical importance of effective nodule management programs. "In terms of symptoms, most of the patients aren't even aware that they might have lung cancer," Gaisl says.

A breakthrough in early detection

University Hospital Zurich (USZ) is one of the first sites in Europe to use robotic-assisted bronchoscopy (RAB) with integrated cone beam CT (CBCT) for reliably diagnosing lung cancer. The technique combines the Intuitive Ion robotic bronchoscopy platform with the Cios Spin mobile C-arm, which offers CT-like intraoperative 3D imaging. "Since introducing this integrated solution, we've seen a sharp increase in Stage IA lung cancer diagnoses at our center," says Gaisl. Data from a study conducted at the hospital's Department of Pulmonology supports his statement: In six months, center-wide Stage IA lung

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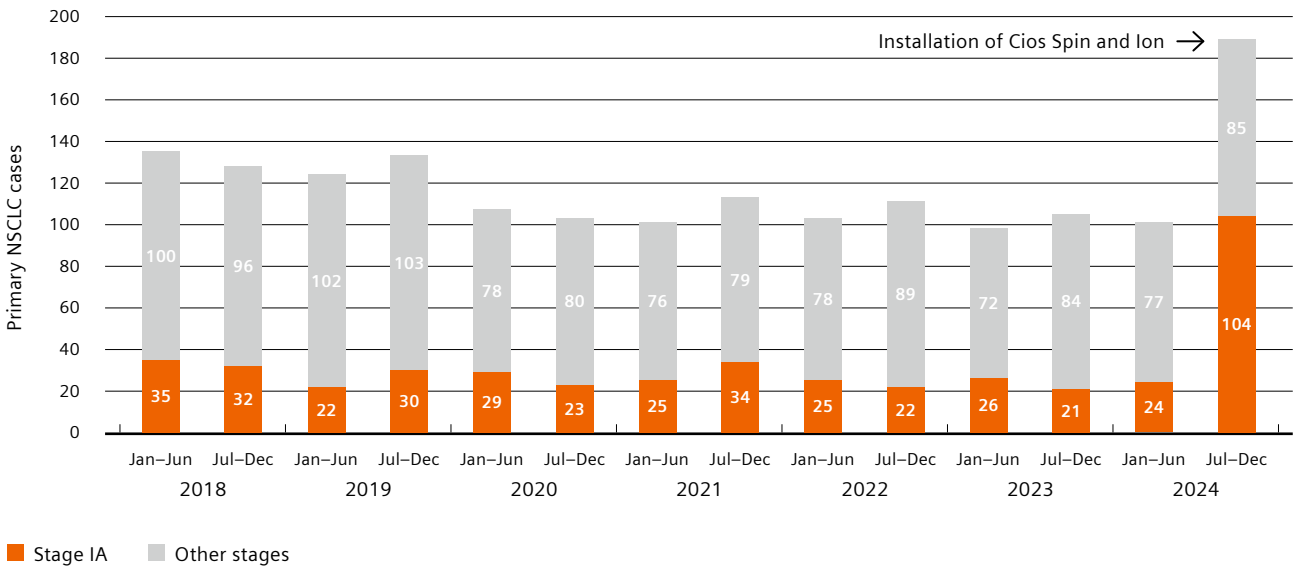
Thomas Gaisl, MD, PhD
Managing Consultant in the Department of Pulmonology,
University Hospital Zurich, Switzerland

Primary non-small cell lung cancer (NSCLC) cases with clear increase of Stage 1A cancers after implementation of RAB and CBCT



cancer diagnoses have almost quadrupled, while overall center-wide lung cancer diagnoses rose by 68 percent [1].

The value of early detection cannot be overstated. This is reflected in five-year survival rates, with Stage IA patients showing an 84 percent survival rate, compared to just 4–8 percent for Stage IV disease [2]. These differences underscore the life-changing potential of early diagnosis.

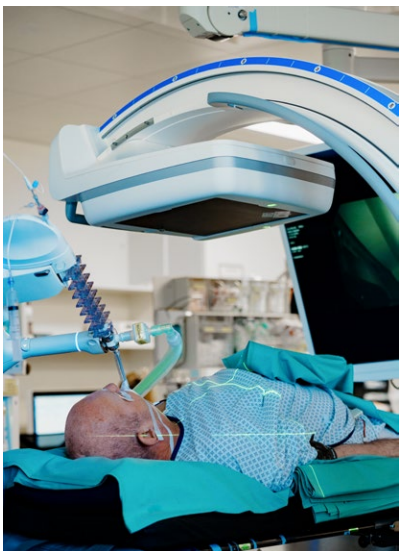
Advanced technology enables precise diagnostics

Integrating robotic assistance with cone beam CT addresses long-standing limitations in bronchoscopy procedures. “In the past, we couldn’t detect lung cancer at such an early stage because most of the peripheral nodules are in the outer third of the lung without a bronchus sign. They are small, sometimes sub-solid or pure ground-glass lesions. These lesions are usually very difficult to target with manual or conventional bronchoscopy,” says Carolin Steinack, MD, head of the Interventional Lung Center at University Hospital Zurich. “Now we can target very small peripheral lesions independently of the texture and regardless of whether there is a bronchus sign. At the moment, robotic-assisted bronchoscopy with integrated cone beam CT is the most precise minimally-invasive diagnostic tool we can have when we target small lesions.”

Impressive clinical outcomes

The solution’s precision has yielded remarkable results, with a 99 percent tool-in-lesion rate and an 89.3 percent diagnostic yield (strict criteria from the ATS: 10 mm median lesion size, 15% positive bronchus sign) [1]. “For about 90 percent of all the patients under-going robotic-assisted bronchoscopy with integrated cone beam CT, we were able to get a diagnosis,” says Gaisl. “We successfully accessed a new patient group without negatively impacting our existing manual bronchoscopy program.”

Combining cone beam CT with robotic-assisted bronchoscopy has several additional advantages, as Gaisl explains: “First, complexity goes down for everyone. This means we can do more procedures a day. The procedure time for robotic-assisted bronchoscopy with cone beam CT is 37 minutes. This is similar to the 34 minutes needed for conventional bronchoscopy with 2D fluoroscopy [1]. Second, the radiation dose for each patient goes down. Third, we’re also able to see where we are in the lesion. Sometimes the integration is so helpful that we no longer need a second 3D spin. At USZ, the average is 1.25 spins per lesion [1].”



Using the green laser light of Cios Spin to position the peripheral nodule in the isocenter based on the preoperative CT location.

CT-to-body divergence makes it necessary to update the target location for successful navigation. With its NaviLink 3D interface, Cios Spin makes it possible to update the target location within the Ion system.

Critical impact on patient pathways

Not all patients undergoing robotic-assisted bronchoscopy receive a lung cancer diagnosis, though. "We are also much more confident in our benign biopsies, meaning that our negative predictive value has also spiked up," says Gaisl.

A reliable benign diagnosis can also have a significant impact on a patient's journey. "I can remember two patients who were able to get a liver and a kidney transplant because we showed that their lung nodules were benign," says Gaisl. "We want to give the patients a reliable biopsy so we can play with open cards. If it's a benign lesion, we want to make sure that the procedure and the biopsy were diagnostic. Therefore, it's very important for biopsy success to confirm tool-in-lesion before taking the sample. This is where the integrated cone beam CT comes in really handy." A reliable diagnosis can also prevent unnecessary surgeries and enable personalized therapies.

Cone beam CT

Cone beam CT (CBCT) is an advanced imaging technique that creates three-dimensional images using X-ray technology. Unlike traditional CT scanners, which use a fan-shaped X-ray beam with a crescent-shaped detector, cone beam CT uses a cone-shaped beam captured by a flat-panel detector. During a typical scan, a C-arm rotates approximately 200° around the patient in about 30 seconds, capturing around 200 individual images. Sophisticated algorithms then combine these into a 3D volume image. Research shows that cone beam CT provides sufficient image quality for visualizing pulmonary lesions while maintaining a reasonable radiation dose.

References:

- Setser R, Chintalapani G, Bhadra K, Casal RF. Cone beam CT imaging for bronchoscopy: a technical review. J Thorac Dis. 2020;12(12): 7416-7428.
- Prenzel H, Bittner M, Stepina E. White paper: Image quality and dose analysis in cone-beam CT lung tissue imaging with a mobile C-arm. [Internet]. Siemens Healthineers AG; 2024 [cited 2025 April 7]. Available from: https://www.siemens-healthineers.com/clinical-specialities/surgery/surgical-disciplines/endobronchial

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Carolin Steinack, MD
Head of the Interventional Lung Center,
University Hospital Zurich, Switzerland

Comprehensive nodule management

Success with this technology requires a systematic approach. "In order to achieve a stage shift for lung cancer diagnosis, we introduced the lung nodule board at our institution," explains Gaisl. "The members of the board are dedicated thoracic radiologists, thoracic surgeons, and pulmonologists, who can then make sure that all the resources we have available are adequately allocated, and that the right patients get the right biopsy and treatment at the right time."

Steinack explains the broader implications: "It's a huge advantage if we can diagnose patients with lung cancer at an early stage, because these are patients who have potential for curative treatment." In addition to the much better survival outcomes, earlier detection also has substantial economic implications. According to current data, monthly excess expenditures for lung cancer treatment increase significantly with disease progression, ranging from approximately €3,228 for Stage IA cancer to €8,293 for Stage IVB cancer [2].

Future impact on global health

With lung cancer remaining the leading cause of cancer-related mortality worldwide, accounting for over 1.8 million deaths annually according to WHO data [3], this technological advancement represents a significant step forward. The ability to detect and diagnose lung cancer at earlier stages through robotic-assisted bronchoscopy with integrated cone beam CT could fundamentally alter the trajectory of patient outcomes in thoracic oncology.

Lung cancer screening in Europe

European approaches to lung cancer screening are rapidly evolving. In 2022, the European Commission proposed updated cancer screening guidelines that recommend implementing low-dose CT screening across EU member states through a strategic, phased approach. The Swiss Cancer Screening Committee has already issued a conditional recommendation for low-dose CT screening targeting high-risk individuals. These developments signal a significant shift toward more proactive lung cancer detection, with multiple countries taking progressive steps to establish comprehensive screening programs.

References:

- Lung Cancer Policy Network. Interactive map of lung cancer screening (second edition) [Internet]. The Lung Cancer Policy Network. 2024 [Cited 2025 April 7]. Available from: https://www.lungcancerpolicynetwork.com/interactive-map-of-lung-cancer-screening/
- Journal of Thoracic Oncology. Lung Cancer Worldwide Editorials [Internet]. Philadelphia, PA, USA: Journal of Thoracic Oncology. [Cited 2025 April 7]. Available from: https://www.jto.org/lung_cancer

Further reading

- Brown MV, Badiei A, Arnold M, Jersmann H, Sullivan T, Fielding D, et al. The Diagnostic Yield of Cone Beam CT Combined With Radial-Endobronchial Ultrasound for the Diagnosis of Peripheral Pulmonary Nodules. CHEST Pulmonary. 2024;2(2):100037.
- Bashour SI, Khan A, Song J, Chintalapani G, Kleinszig G, Sabath BF, et al. Improving Shape-Sensing Robotic-Assisted Bronchoscopy Outcomes with Mobile Cone-Beam Computed Tomography Guidance. Diagnostics (Basel). 2024 Sep 4;14(17):1955.
- Salahuddin M, Bashour SI, Khan A, Chintalapani G, Kleinszig G, Casal RF. Mobile Cone-Beam CT-Assisted Bronchoscopy for Peripheral Lung Lesions. Diagnostics (Basel). 2023;13(5):827.
- Reisenauer J, Duke JD, Kern R, Fernandez-Bussy S, Edell E. Combining Shape-Sensing Robotic Bronchoscopy With Mobile Three-Dimensional Imaging to Verify Tool-in-Lesion and Overcome Divergence: A Pilot Study. Mayo Clin Proc Innov Qual Outcomes. 2022;6(3):177-185.
- Kalchiem-Dekel O, Fuentes P, Bott MJ, Beattie JA, Lee RP, Chawla M, et al. Multiplanar 3D fluoroscopy redefines tool-lesion relationship during robotic-assisted bronchoscopy. Respirology. 2021;26(1):120-123.

References

[1] Gaisl T, Steinack C, Baumgartner P, Monsch GM, Schneiter F, Oh S, et al. Impact of Robotic-Assisted Bronchoscopy With Integrated Cone-Beam CT on Stage Shift in Peripheral Pulmonary Lesions at a Lung Cancer Centre [abstract]. Am J Respir Crit Care Med 2025;211:A5512.

[2] de Nijs K, de Koning HJ, van der Aalst C, Ten Haaf K. Medical costs of lung cancer by stage, histology and first-line treatment modality in the Netherlands (2012-2021). Eur J Cancer. 2024;208:114231.

[3] The Global Cancer Observatory: Globocan 2022 [Internet]. Lyon, France: The Global Cancer Observatory; 2024 [Cited 2025 April 7]. Available from: https://gco.iarc.who.int/media/globocan/factsheets/cancers/15-trachea-bronchus-and-lung-fact-sheet.pdf

Cios Spin is not commercially available in all countries. Its future availability cannot be guaranteed.

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