PHILIPS

Image guided therapy

Lung suite

Cone beam CT guided endobronchial biopsy

assisted by 3D tumor segmentation overlay with live fluoroscopy

Patient history

This is a 75 years old male (1.81m, 64kg) with a smoking history of 43 pack-years. He was previously treated for an abdominal aortic aneurysm (AAA) with a surgical implantation of a bifurcation prosthesis. Follow up imaging showed two incidental nodules in the right lung with a size of 27x15x21mm in the right lower lobe (RLL) and 22x17x19mm in the right upper lobe (RUL). PET scan showed both nodules to be PET avid. He was scheduled for endobronchial biopsy to achieve tissue sampling for pathology analysis and diagnosis.

Procedure

Subsequent to patient intubation, the ceiling mounted C-arm system (Allura Clarity FD20, Philips) was positioned on the left side of the patient, centering the field of view of the detector to include both lungs. Cone beam CT data (XperCT, Philips) was acquired during an 8-second roll protocol, while temporarily suspending mechanical ventilation. Using the cone beam CT data, the RLL lung nodule was highlighted in 3D by the physician using commercially available software (Lung Suite, Philips) during a process called segmentation. Throughout the procedure, the nodule segmentation was visualized in an overlay with live fluoroscopy (3D Dynamic Roadmap, Philips) parallel to standard fluoroscopy imaging. Geometric correspondence of the augmented live fluoroscopy with the 3D tumor segmentation was maintained throughout the case while manipulating C-arm angulation, table position and image-zoom settings.

After cone beam CT data acquisition and segmentation, a bronchoscope (EB19-J10, Pentax Medical) was introduced into the airways. A radial Endobronchial Ultrasound (EBUS) probe (UM-S20-17S, Olympus) was initially inserted towards the lesion through the working channel of the bronchoscope. For required additional steering capability,, the radial EBUS probe was exchanged for an Edge™ 180° Firm Tip catheter (Medtronic) and navigated towards the RLL lesion using 3D segmentation overlay with live fluoroscopy (3D Dynamic Roadmap, Philips). After reaching a position in the vicinity

of the target lesion, augmented live fluoroscopy was used to verify the position in multiple planes i.e. LAO, RAO and 90 degrees lateral. Final confirmation was obtained with cone beam CT acquisition and radial EBUS. After tissue sampling using a brush, rapid on-site pathologic examination (ROSE) provided initial evidence of malignancy.

The second lesion (RUL) was subsequently segmented on the same confirmation cone beam CT scan and the Edge catheter was then navigated to it under augmented live fluoroscopy guidance. When a location in the vicinity of the lesion was reached, satisfactory lesion targeting was once again verified in multiple planes i.e. LAO, RAO and 90 degrees lateral using augmented live fluoroscopy and radial EBUS. A cone beam CT confirmation scan was not considered necessary at this stage due to positive confirmation from augmented live fluoroscopy in 3D. Tissue samples were obtained using a brush, with additional forceps biopsies and lavage to ensure sufficient quality for pathological analysis.

Diagnostic outcome

The RLL lesion showed to be a non-small cell lung carcinoma (NSCLC), while the RUL lesion showed to be adenocarcinoma. Both lesions were found to be primary lung cancers. Follow up lobectomy of the RLL lesion showed neuro endocrine tumor while the adenocarcinoma in the RUL lesion was removed by wedge resection.

Erik van der Heijden

is an Associate Professor Interventional Pulmonology and Director Multidisciplinary Thoracic Oncology Program, and is affiliated with Radboud University Medical Center. He is one of the pioneers in using cone beam CT imaging and augmented fluoroscopy for endobronchial lung biopsies.

Conclusion

With the advent of lung cancer screening programs and the increasing need to diagnose patients with small suspicious pulmonary lesions, the availability of advanced imaging is of utmost importance. Cone beam CT provides intra- procedural 3D real-time imaging which enables precise localization and higher position accuracy of biopsy devices towards peripheral lung lesions when compared to conventional bronchoscopy with or without radial EBUS. In addition, the availability of augmented live fluoroscopy limits the need for multiple cone beam CT confirmation scans and can be used as a primary guidance modality in combination with a steerable catheter. Based on our experience, cone beam CT provides the necessary accuracy to increase the diagnostic yield also for small peripheral lesions and can be considered an essential technology for future endobronchial therapies.

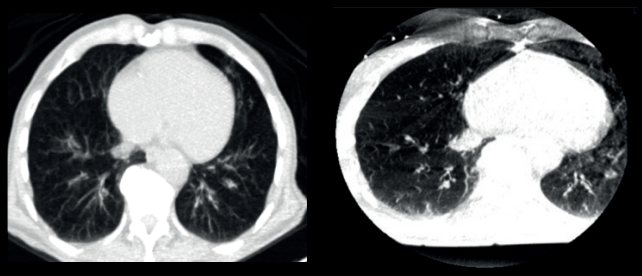

Figure 1a: Pre-operative CT (left) and intra-operative cone beam CT (right) showing right lower lobe nodule.

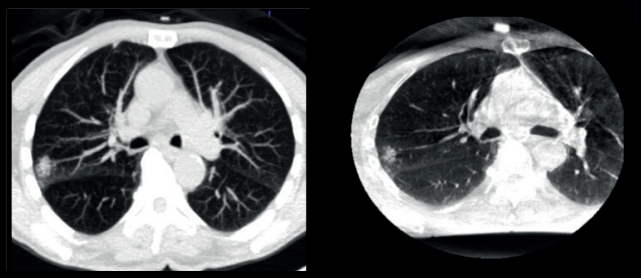

Figure 1b: Pre-operative CT (left) and intra-operative cone beam CT (right) showing small right upper lobe nodule.

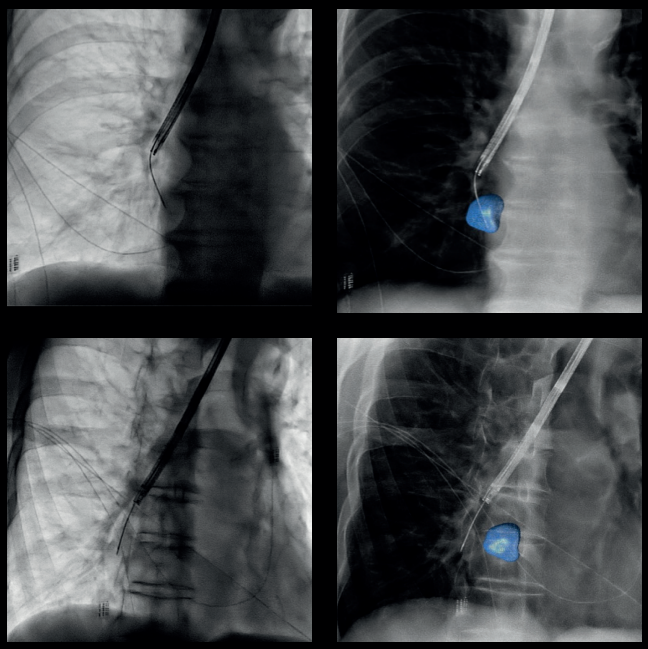

Figure 2: Standard 2D live fluoroscopy (left) versus corresponding augmented live fluoroscopy (right) for verifying the lesion targeting position in multiple planes (AP, Lateral) for RLL.

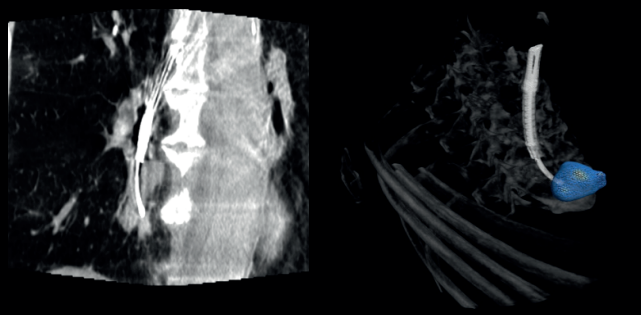

Figure 3: 2D (left) versus 3D (right) confirmation of the accurate lesion targeting position for RLL.

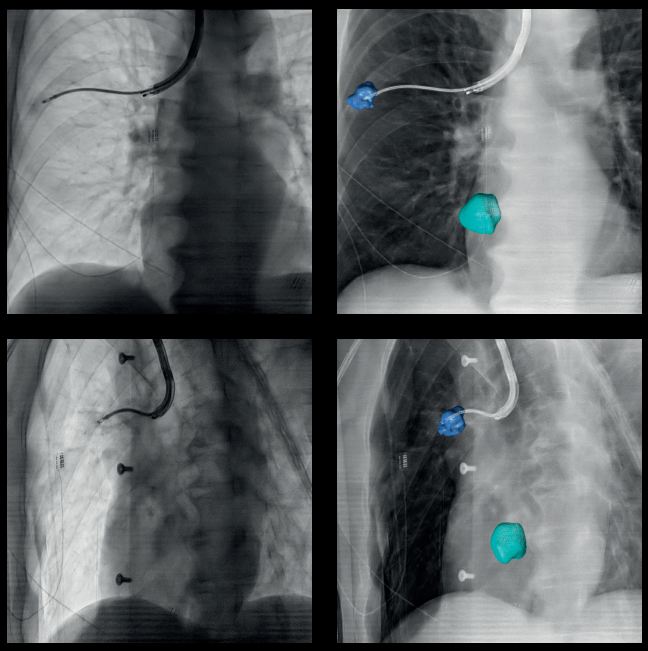

Figure 4: Standard 2D live fluoroscopy (left) versus corresponding augmented live fluoroscopy (right) for verifying the lesion targeting position in multiple planes (AP, Lateral) for RUL.

Results from case studies are not predictive of results in other cases.
Results in other cases may vary.

4522 991 49461 * MAY 2019

How to reach us
Please visit www.philips.com
healthcare@philips.com
www.philips.com/lungsuite