PHILIPS

Image guided therapy

Lung suite

Cone beam CT guided endobronchial tumor ablation

assisted by 3D ablation planning and tumor segmentation overlay with live fluoroscopy

Patient history

This is a 72 years old female presenting with a 1.6 x 1.7cm right lower lobe enlarging nodule. She had a smoking history of 45 pack-years but had quit smoking three years back. Her PET scan showed right lower lobe nodule with standardized uptake value (SUV) of 2.8 (background lung = 2.0) and a brain MRI showed negative for metastatic disease.

Procedure

Subsequent to patient intubation, the ceiling mounted C-arm system (Philips Allura Xper FD 20, 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 lung nodule was highlighted by the physician using commercially available software (Lung Suite, Philips) during a process called segmentation. Throughout the procedure, this 3D nodule segmentation was visualized in an overlay with live fluoroscopy (3D Dynamic Roadmap, Philips) parallel to standard fluoroscopy and electromagnetic navigation bronchoscopy (ENB) (SuperDimension, Medtronic).

Geometric correspondence of the augmented live fluoroscopy with the 3D tumor segmentation was automatically 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 (BF-1T180; Olympus) was introduced into the airways and a curved steerable catheter was inserted into the working channel and then navigated to the lesion using the ENB system. After reaching a position in the vicinity of the target lesion, augmented live fluoroscopy was used to guide the final positioning of the ablation catheter, verified in multiple planes i.e. LAO, RAO and 90 degrees lateral. A collimated cone beam CT scan was then performed to confirm the position of the ablation catheter in 3D and ensure a complete coverage of the ablation zone with respect to the target pulmonary nodule. Ablation planning was performed using commercially available software (Lung Suite, Philips) using ablation parameters defined by the probe manufacturer (Neuwave Flex, Ethicon).

The ablation power and time were set at 100 W for 10 minutes and intermittent fluoroscopy was performed during activation to check if the ablation catheter stayed in position. After 10 minutes of ablation, a final cone beam CT scan was performed to visualize the extent of the ablation area, confirming satisfactory tumor coverage with a safety margin > 1cm and observing a partial obliteration of the original pulmonary nodule.

Dr. Michael Pritchett

is a pulmonologist and Director of the Chest Center of the Carolinas, and is affiliated with FirstHealth Moore Regional Hospital and Pinehurst Medical Clinic. He is one of the pioneers in the use of Cone Beam CT imaging and augmented fluoroscopy during endobronchial procedures

Conclusion

As the field of advanced bronchoscopy and interventional pulmonology moves towards novel therapeutic approaches, the availability of advanced imaging will be of paramount importance to ensure safety, efficacy and to meet quality standards of care. Cone beam CT offers not only the distinct advantage of intra-procedural 3D real-time imaging for ablation probe planning and confirmation but also the necessary contrast resolution to verify treatment completeness and detect any potential minor or major intra-procedural complications. In addition, cone beam CT-based augmentation of live fluoroscopy and dedicated ablation planning software (Lung suite, Philips) helps to streamline the procedural workflow and limits the number of cone beam CT scans to achieve a satisfactory probe position. Cone Beam CT offers the required precision for performing these procedures and can be considered a must for current and future endobronchial therapies.

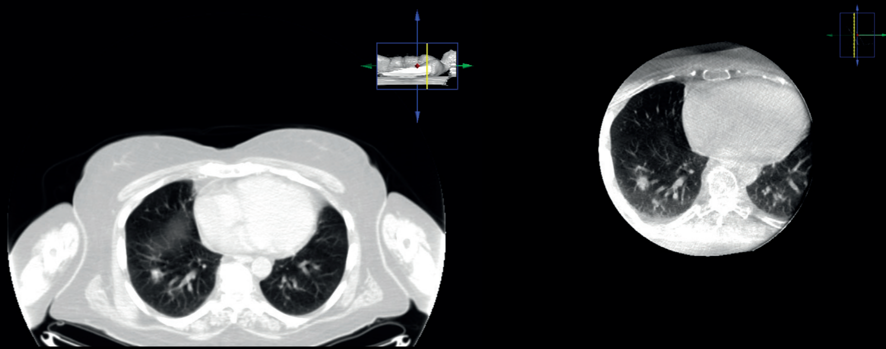

Figure 1: Pre-operative CT (left) and intra-operative cone beam CT (right) showing small right lower lobe pulmonary nodule.

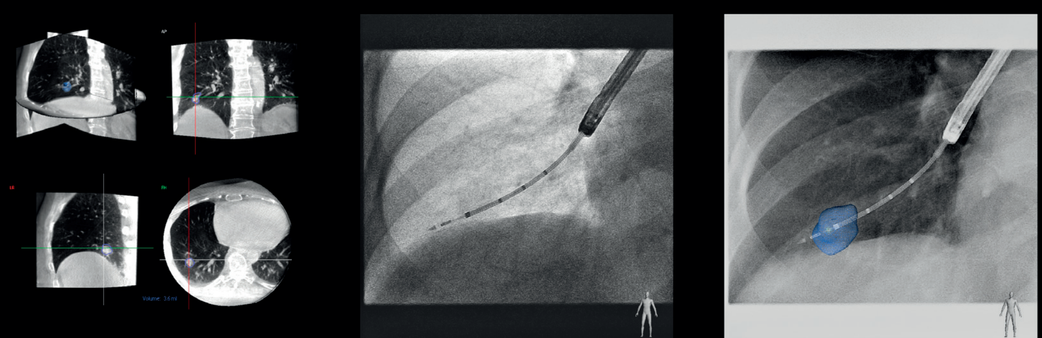

Figure 2: 3D segmentation of CBCT dataset to highlight target nodule (left). Standard 2D live fluoroscopy versus corresponding Augmented live fluoroscopy (right).

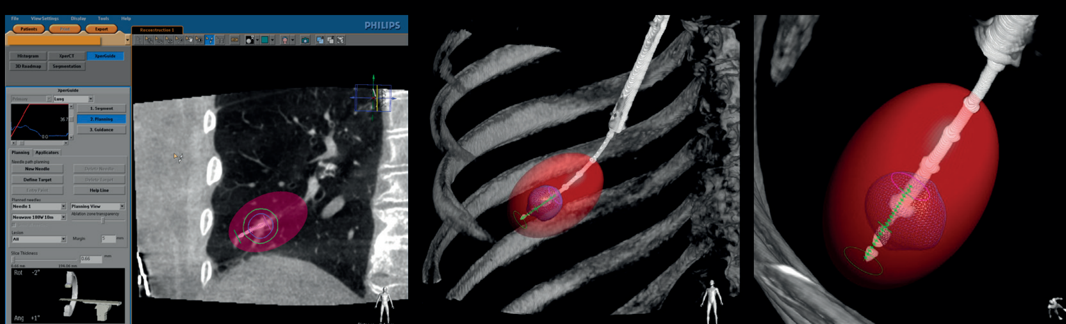

Figure 3: User interface of the ablation planning software (Lung suite, Philips) with 2D slide view of selected ablation probe (left). 3D visualization of planned ablation probe and segmented nodule (right).

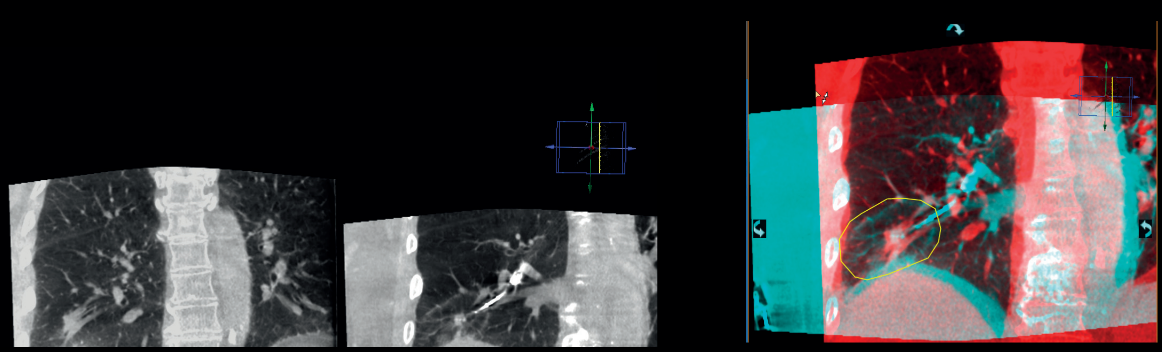

Figure 4: Comparison of pre and post-ablation cone beam CT volumes using Dual view functionality (left). Overlay viewer of the two cone beam CT volumes highlighting extent of ablated tissue in yellow (right).

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

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