

Image guided Video Assisted Thoracoscopic Surgery (iVATS)

assisted by cone beam CT and 3D live image guided endobronchial peripheral lung tumor marking

Patient history

This is a 58 years old lady, non-smoker, who presented with a suspected solitary pulmonary metastasis from rectal cancer. Two years after receiving surgery and adjuvant chemotherapy for the rectal carcinoma, she developed a solitary 8 mm pulmonary nodule in the lingula deep from the pleural surface and another solitary lesion in the liver. She underwent radiofrequency ablation of the liver lesion and was referred for pulmonary metastasectomy. Due to her active lifestyle and no other existing comorbidities, she preferred a minimally invasive uniportal approach.

Procedure

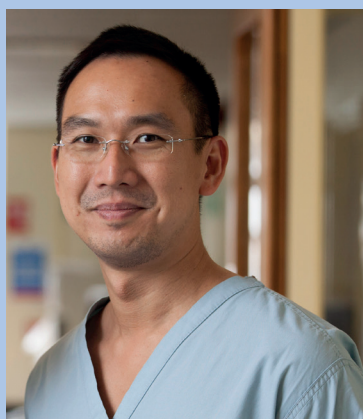
The patient underwent a bronchoscopy guided fiducial marking of the pulmonary lesion followed by image-guided uniportal VATS metastasectomy. The procedure was performed in the hybrid operating suite. The patient was ventilated through a laryngeal mask and initial electromagnetic navigation bronchoscopy

(SuperDimension™ Navigation System, Medtronic) was carried out to advance an endobronchial catheter towards the lesion. The ceiling mounted C-arm system (Allura Clarity FD20 Flexmove, Philips) was positioned on the left side of the patient, centering the field of view of the detector to include the region of the interest. A cone beam CT scan was acquired using the 8-second roll protocol (XperCT Dual, Philips) while temporary suspending mechanical ventilation. Using the cone beam CT data, the 8 mm lesion was segmented and fine adjustments were guided by augmented live fluoroscopy with 3D nodule segmentation overlay (Lung suite, Philips) to position the endobronchial catheter closer to the lesion. Correct positioning close to the small lesion was further confirmed with a cone beam CT scan (XperCT Dual, Philips), and a fiducial was placed under augmented live fluoroscopy. A final cone beam CT provided definite and detailed anatomical information about lesion location with respect to the fiducial.

The ceiling mounted Flexmove C-arm system was then moved to its parking position providing ample space for surgery preparation. The laryngeal mask was then exchanged for a double lumen tube and the patient was repositioned in a lateral decubitus position. The patient and the C-arm were prepared and draped. A single utility incision was made and uniportal VATS was carried out with live fluoroscopy, which enabled immediate surgical localisation of the lesion without needing to put a finger through the port to palpate. A stapler was then placed deep beyond the lesion. The advantage of direct lesion marking is that the

fiducial provides depth information as well as localisation, ensuring an adequate deep margin is taken. A second stapler was placed to complete the wedge resection. The lung containing the fiducial was pulled through the stapler under fluoroscopy with complete control over the size and margin of the resection. The wedge resection was examined under fluoroscopy to confirm the lesion was excised with an adequate resection margin.

Histology of the specimen confirmed metastatic rectal carcinoma with complete resection.



Dr. Kelvin Lau

is a consultant and lead thoracic surgeon at St Bartholomew's Hospital, London. He has been at the forefront of his field utilising cutting-edge technology promising to revolutionise the diagnosis and treatment of lung cancer. He is one of the pioneers in using cone beam CT for iVATS and endobronchial ablation.

Conclusion

The use of cone beam CT in the hybrid OR provides the thoracic surgeon with a reliable and accurate method for intraoperative localization of small non-palpable pulmonary nodules, facilitating resection with a satisfactory margin with one single incision. Navigational bronchoscopic biopsy, fiducial placement and iVATS can be combined into a single-setting procedure providing one stop workflow for improved patient experience and care. This is the next step in the evolution of thoracic surgery

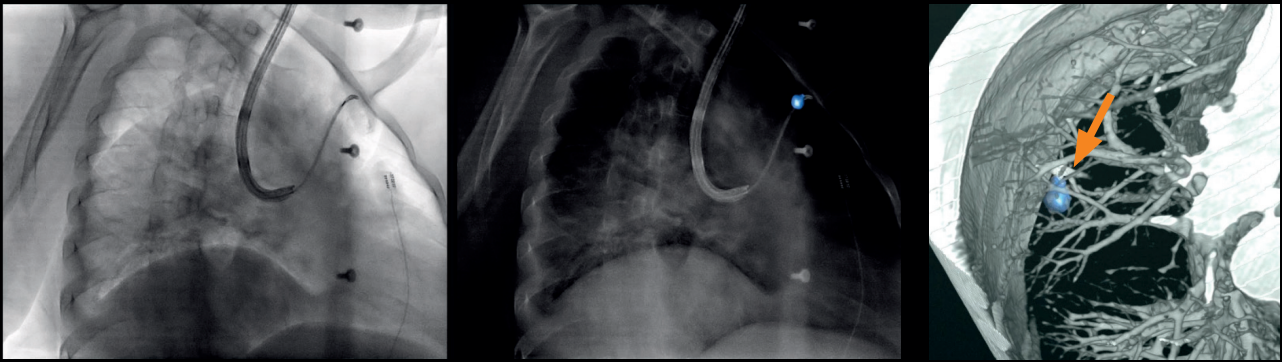


Figure 1: Endobronchial fiducial marker placement: Standard 2D live fluoroscopy versus corresponding augmented live fluoroscopy for navigating to the lesion (left and middle). Cone beam CT scan to confirm the position and provide definite and detailed anatomical information about lesion location with respect to the fiducial (right, highlighted).

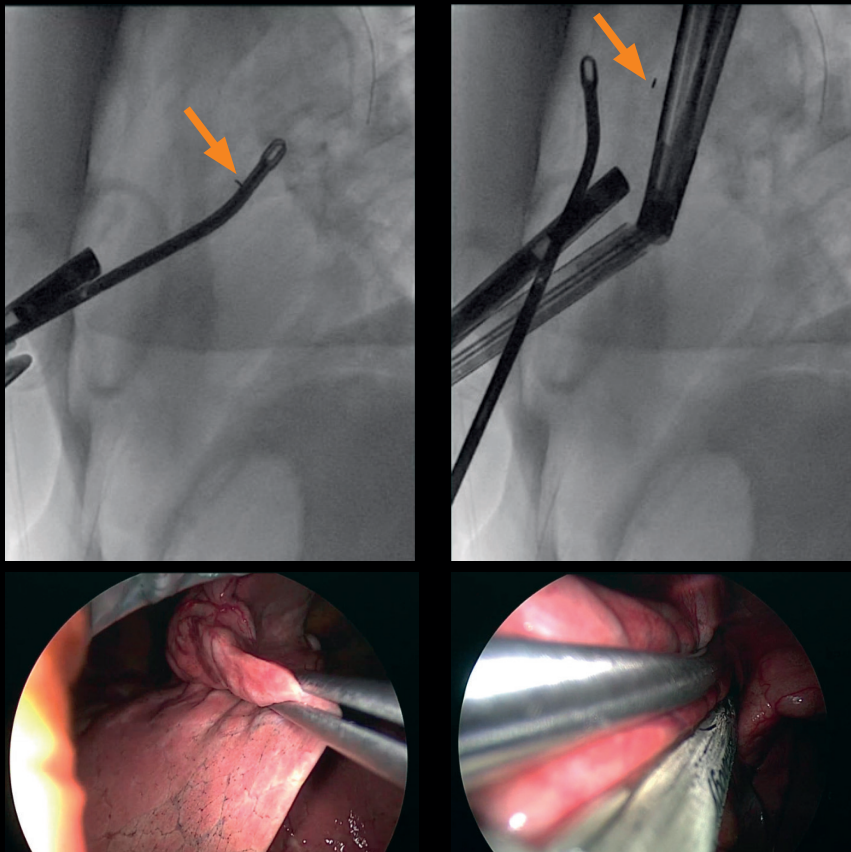


Figure 2: Uniportal VATS resection performed following the fiducial marker (highlighted) under live fluoroscopy, which enabled immediate surgical localisation of the lesion.



Figure 3: Uniportal VATS resection confirmed with on-table fluoroscopy to ensure that the non-palpable lesion and fiducial marker were in the resection specimen.



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

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