AB004. Localization of small-size pulmonary nodules

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Abstract: The lung cancer screening is recommended by the US Preventive Services Task Force since 2013. Several European studies showed positive effects of lung cancer screening programs, therefore a European screening initiative is expected. These screening programs as well as programmed follow-up of extrathoracic malignancies are delivering an increasing number of patients who require resection of small-sized pulmonary nodules, which are often localized deep in the lung parenchyma. These small deep nodules often require advanced localization support during minimally invasive, no-touch surgery in order to facilitate a video-assisted thoracoscopic surgery (VATS) wedge resection or segmentectomy of the affected segment. Non palpable and non-visible ground glass opacity (GGOs) may provide equal challenges for thoracic surgeons. VATS localization techniques range from very basic solutions like enlarging the port hole to enable single finger palpation up to technically advanced guidance modalities. These include CT-guided wire marking followed by VATS resection, which was inspired by sonography guide wire markings of breast cancer. The first series of that technique appeared more than 30 years ago. However, this technique was never widely accepted, mainly due to disadvantages related to the physical and chronological separation between the CT-guided wire placement and the operating theater. Guide wire dislodgement, unobserved pneumothoraces, patient discomfort and suboptimal workflow are the most profound ones. To overcome these problems, image guided video assisted thoracoscopic surgery (iVATS) or computer tomography assisted thoracoscopic surgery (CATS) were introduced. These techniques involve hybrid theaters with built-in cone beam CT scanners that facilitate on table CT, path planning, laser guided wire placement and resection, in a one-stop shopping method. Early reports of indocyanine green guided marking during the CATS procedure instead of using guide wires have been also published. Indocyanine green (ICG) can be also injected through the endobronchial route using electromagnetic navigational bronchoscopy. This promising technique can be used before the VATS resection or as an on-stop shopping procedure in the operating room (OR). One of the major disadvantages is the need for the marking of the nodules and a subpleural marking in some cases for better localisation. The later may cause spilling of the dye into the pleural cavity and may induce pneumothoraces. Another disadvantage is the inability to monitor the correct marking unless it is combined with a CT scanner, especially with a cone beam CT in a hybrid theater. This is a promising combination although not widely available due to costs and limited resources. Future developments in this field may be light-weight-robots allowing for precise introduction of the guidewire in a hybrid theater setting. These robots should be easily mounted on the operating table and must be able to communicate with the hybrid theater imaging systems. The promising combination of navigational bronchoscopy and intraoperative CT imaging needs further investigation. In order to avoid further technological exaggerations, a minimally invasive instrument allowing an intraoperative scanning of the lung equivalent to the intraoperative sonography in liver surgery would be an attractive field of research.

Keywords: Hybrid theater; guide wire; computer tomography assisted thoracoscopic surgery (CATS); indocyanine green (ICG)

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