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Commentary: BEEP marks the spot: Novel audiovisual system for localization of lung nodules with radiofrequency identification tagging

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CENTRAL MESSAGE

Transbronchial radiofrequency identification tagging is a novel technology for audiovisual localization of small, part-solid pulmonary nodules to facilitate minimally invasive resection.

Minimally invasive thoracic surgery (MIS) limits the ability of surgeons to detect pulmonary nodules (PNs) that are small, deep to the pleural surface, and/or part solid. Clinical judgment coupled with knowledge of technology has led to advances in PN targeting. The goal is to maintain a thoracoscopic approach while ensuring that the lesion is identified and then excised, with appropriate margins and minimum parenchyma sacrificed. These tenets maintain equipoise with respect to the risks and benefits of surgery versus other options, such as nonsurgical biopsy or radiographic surveillance. In a study of metastatic PNs, Nakashima and colleagues[1] proposed that localization should be considered if 2 of the following 3 criteria are met: maximum PN diameter $\leq$5 mm; ratio of maximum PN diameter to the minimum distance between the pleura and PN <0.5; and low density of PN on computed tomography (CT) scan (after chemotherapy). A multitude of localization options has emerged using transthoracic or transbronchial placement of markers, including microcoils, fiducials, dyes, and various combinations of markers.[2]

Continued innovation in PN localization has been spurred by necessity and fueled by technology. One example is electromagnetic navigational bronchoscopy (ENB) deployment of localization material. The use of ENB to assist robotic MIS was first reported by Bolton and colleagues in 2014,[3] with subsequent groups presenting refined techniques for targeting of PNs by ENB injection of dye.[4-6] Using this combination of intraoperative ENB dye and robotic resection, Geraci and colleagues[6] and Abbas and colleagues[5] reported success rates of 86% and 98.1%, respectively. However, both groups reported modifying their techniques during the course of their studies to mitigate observed limitations with initial methods of dye injection. Geraci and colleagues placed a suture to mark the PN before indocyanine green (ICG) parenchymal diffusion, whereas Abbas and colleagues added radiopaque dye (Isovue) and ICG to improve on methylene blue alone. This highlights the continued opportunity and need for innovation in PN localization.

In this issue of *JTCVS Techniques*, Sato and colleagues[7] present a new option for targeting PNs for MIS resection. This inventive case report demonstrates the proof-of-concept, translational application of a novel radiofrequency identification (RFID) tagging system initially developed in a preclinical canine model. The RFID tag is inserted via a bronchoscope (without ENB) in a hybrid operating room with cone-beam CT scan and intraoperative fluoroscopy. The accompanying video demonstrates successful MIS resection of a 7-mm subsolid PN guided by the RFID audiovisual interface. Notably, the pleural space was hostile with dense adhesions and visceral pleural effacement.

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Fortuitously, this highlights how RFID could be advantageous in certain situations where direct visualization is limited. Further applications of this RFID system have been previously demonstrated during preclinical development with the use of multiple unique RFID tags to guide segmentectomy and sub-segmentectomy.[8,9] Delivery via ENB is mentioned as an intuitive future modification.

As with any preliminary report of a new technology, there are inherent limitations of as-yet undetermined factors, such as cost and comparative efficacy versus current techniques. Regardless, the authors should be congratulated for this first-in-human report of a new, clinically relevant tool that will potentially add to the armamentarium of the modern thoracic surgeon.

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