



Getting closer: localization techniques for small pulmonary nodules

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Surgical resection of small pulmonary nodules has increased due to the adoption of lung cancer screening. Despite careful review of preoperative imaging, when nodules are small (<10 mm), deep (>10 mm from pleural surface) or predominantly ground glass, they can be difficult to localize thoroscopically, potentially requiring conversion to thoracotomy or removal of additional lung parenchyma (1). An accurate and safe approach for nodule localization is essential, as an adequate resection margin has been associated with risk of recurrence and survival following resection for early-stage non-small cell lung cancer (2,3).

Many techniques have been utilized for nodule localization, including pre-procedural (e.g., percutaneous or bronchoscopic placement of a metallic marker or dye) or intra-procedural approaches (e.g., real-time imaging with thoroscopic ultrasound). However, the most commonly used techniques, such as percutaneous hookwire placement, require an additional procedure which is occasionally associated with complications such as bleeding or pneumothorax. In some centers, a hybrid operating room may improve time and cost of nodule localization, but these are not widely available (4). Studies directly comparing localization techniques are limited and no approach has shown clear superiority (5,6). Thus, the approach is largely dependent on surgeon preference and available resources.

In their article, Pang and colleagues describe a novel localization technique for small pulmonary nodules during thoroscopic resection which is based on anatomic landmarks identified on the pre-procedure computed tomography (CT)

scan (7). Using measured distances from fixed anatomic points in the chest, they created a pleural dye marking during a recruitment maneuver and this “tattoo” was used to localize the nodule. They retrospectively report their technique in 120 patients with a successful localization in an impressive 98.5% of cases. Median localization time was 11 minutes (range, 8–14 minutes), which compares favorably to previously described techniques. Finally, and perhaps most importantly, there were no localization-related complications.

In some respects, localization based on anatomic landmarks during thoroscopic resection provides an optimal solution. First, it achieves localization with high success. Second, nodule localization and resection are performed during one procedure, and is not associated with a risk of pleural injury. Finally, the localization time is short and requires little additional equipment.

While the technique is logical, selecting the appropriate landmarks using soft tape measures and lung inflation/deflation is potentially imprecise and it is not clear how broadly the technique can be applied. Curiously, the median depth of these nodules was less than a centimeter, prompting the question of whether these nodules even required localization. Furthermore, the dimensions of the wedge resections were not reported, partially negating the importance of accurate localization if large wedge resections were performed. This is particularly important for the 9% of patients in their cohort with benign disease that may have avoided surgery with an alternative management strategy such as bronchoscopic biopsy. Nevertheless, the results

presented here are notable.

Techniques for nodule localization continue to evolve. For example, the use of robotic-assisted bronchoscopy platforms, potentially in combination with cone-beam CT guidance, have reported promising early results for the diagnosis of peripheral pulmonary nodules (8,9). Importantly, these platforms allow for single anesthesia events, in which biopsy of a pulmonary nodule is performed prior to resection in a single operating room. Additionally, intra-operative molecular imaging holds potential for *in vivo* imaging of pulmonary nodules without a separate localization procedure and is being investigated in multiple cancer types (10).

In summary, Pang and colleagues provide more evidence that the surgeon may be able to perform accurate localization and resection during a single thoracoscopic procedure. Their technique had a high success rate in this retrospective cohort and was not associated with any localization-related complications. Further prospective studies are needed to evaluate the generalizability and learning curve of this approach, and to directly compare different approaches for nodule localization.

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