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Commentary: Evolving clinical value of pulmonary nodule image-guided localization technology for the thoracoscopic surgeon

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With the advent of lung cancer computed tomography screening programs in North America and Europe, the number of small and sub-solid pulmonary nodules suspicious for early-stage malignancy presenting to thoracic surgeons is steadily increasing.^{1,2} Precise localization of these nodules thoracoscopically for lung parenchyma-preserving diagnostic complete resection can be exceedingly challenging, due to lack of traditional visual or tactile cues for the surgeon. This is especially true for concerning nodules embedded deep to the visceral pleura. For these reasons, adjunct localization technologies such as radio-opaque markers or injection of dye into lung parenchyma fill an important clinical need.

In this issue of the *Journal*, Ng and colleagues provide a highly interesting technical report of a novel combined modality approach to not only localize challenging lung nodules thoracoscopically but also ensure resection with a clear surgical margin.³ In the absence of traditional manual palpation of the nodule, their technique involves

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Disclosures: Dr McGuire receives research sponsorship from Contextual Genomics Inc and AstraZeneca Canada. All other authors reported no conflicts of interest.

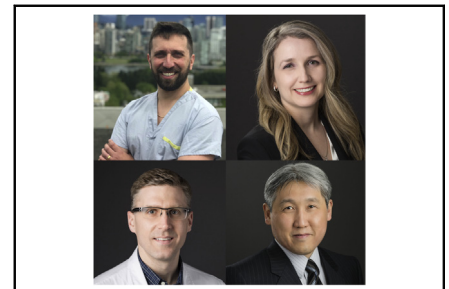
The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication July 20, 2020; revisions received July 20, 2020; accepted for publication July 22, 2020; available ahead of print July 31, 2020.

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JTCVS Techniques 2020;3:336-7
 2666-2507

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<https://doi.org/10.1016/j.jtc.2020.07.026>



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CENTRAL MESSAGE

In the era of lung cancer screening, mastery in application of available nodule localization technology is an important feature in the practice of thoracoscopic surgery.

electromagnetic navigational bronchoscopy placement of a radiation therapy fiducial to mark the deep parenchymal resection margin for subsequent fluoroscopic localization. This, in combination with a small amount of triple contrast dye providing a visceral pleural visual cue, permits complete 3-dimensional nodule thoracoscopic resection while preserving healthy surrounding lung parenchyma.

The authors are fortunate in their access to a sophisticated hybrid operating room facility, where electromagnetic navigational bronchoscopy fiducial placement, dye injection, and thoracoscopic nodule resection with fluoroscopy can be performed in streamlined sequence. This report is a welcome addition to the thoracoscopic nodule localization technique literature, including transthoracic image-guided placement of a platinum microcoil or hookwire and injection of contrast dye, pigmented material, or radioactive materials.⁴⁻⁸ Although many of these techniques have existed for decades, thoracoscopic surgeons are evolving the clinical applications for patients, with the objective of precise intraoperative nodule localization and resection while limiting placement-associated complications.

The main potential limitations of the current technique are in keeping with those previously reported. Among those most feared include fiducial marker dislodgement with patient movement and parenchymal hemorrhage. These not only could lead to the loss of localization features but can also result in the development of a hemothorax or significant hemoptysis. Pulmonary hemorrhage has been reported

risk if a pneumothorax develops while a transthoracic hook-wire is embedded in the parenchyma.^{6,9} Other rare yet important localization pitfalls previously reported include embolization of a microcoil if erroneously deployed within pulmonary vasculature⁵ and severe allergic reactions with the injection of contrast dyes or other materials.⁹

Despite known limitations, multiple thoracic institutions have demonstrated these techniques are safe, reliable, and allow for excellent surgical outcomes when conducted by specialized thoracic teams. Given the increase in clinical volume of small and sub-solid nodules diagnosed from computed tomography chest screening programs suspicious for early-stage malignancy,^{1,2} the marker modalities used will likely continue to expand. Following this evolution, there is no doubt that mastery in application of locally available nodule localization technology will continue to be an important feature in the practice of thoracoscopic surgery.

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