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Commentary: Practicing the philosophy of continuous improvement with virtual-assisted lung mapping 2.0

Sue X. Wang, MD, SangMin Kim, BS, and M. Blair Marshall, MD

Lung cancer screening programs have led to an increase in detection of small, semisolid or ground glass nodules concerning for malignancy.^{1,2} Without the ability to palpate these nodules, thoracic surgeons require precise intraoperative localization methods to perform sublobar resections with clear oncologic margins. One such method is virtual-assisted lung mapping (VAL-MAP). Now routine in Japan, VAL-MAP uses preoperative bronchoscopic placement of multiple dye marks on the lung surface to localize the nodule and guide the direction of the staple line to obtain adequate margins.³ The second iteration of this technique, VAL-MAP 2.0, adds microcoil placement in the bronchial lumen deep to the lesion to better gauge margin depth.⁴

In this issue of the *Journal*, Sato and colleagues⁴ aim to show the advantages of VAL-MAP 2.0 over alternative methods of nodule localization through a prospective multicenter trial. The authors analyzed 65 nonpalpable, deep lung nodules that met criteria for sublobar resection from 2019 to 2020, for which median minimum required resection depth was 30 (interquartile range, 25-35) mm. By using bronchoscopic dye markers, VAL-MAP 1.0 avoids the risk of air embolism seen with percutaneous localization. However, resection margins were insufficient in approximately 10% of VAL-MAP procedures where the depth of the resection reached 3 cm. Furthermore, although bronchoscopic dye markers could be placed in lung apices, where

Sue X. Wang, MD, M. Blair Marshall, MD, and SangMin Kim, BS

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Compared with its predecessor in a historical control, VAL-MAP 2.0 facilitates superior sublobar resection for deep pulmonary nodules and is another step in the continuous improvement of lung nodule mapping technology.

treacherous anatomy precludes percutaneous placement, the markers remained difficult to visualize.³ The improved VAL-MAP 2.0 technique, incorporating dye and bronchoscopic microcoils, was effective in guiding resection of deep nodules with clear surgical margins in 64 of 65 lesions (98.5%; 95% CI, 91.7%-100%) and aided in the localization of apical lesions. The microcoils appear to be safe and durable. No severe adverse events were observed and only 3 of 75 microcoils showed major displacement. VAL-MAP 2.0 is a thoughtful improvement on the initial technique; however, the authors acknowledge the study's limitations.

Two major limitations of the study are the trial design and the cost-benefit ratio of VAL-MAP 2.0. First, because this was a single-arm study with a historical control, comparison between VAL-MAP and VAL-MAP 2.0 is problematic. Differences in surgical expertise could in part explain the improvement in the VAL-MAP 2.0 cohort. (However, participating surgeons familiar with VAL-MAP believed the updated technique offered distinct benefits in acquiring oncologic margins in the subset of patients with deep lung lesions.) Second, we pose the question: Is VAL-MAP 2.0 a large expenditure of effort for a modest or uncertain benefit? The complexity of the technique and advanced technological

From the Division of Thoracic Surgery, Department of Surgery, Brigham and Women's Hospital, Boston, Mass.

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Address for reprints: Sue X. Wang, MD, Division of Thoracic Surgery, Brigham and Women's Hospital, 75 Francis St, Boston, MA 02115 (E-mail: swang53@bwh.harvard.edu).

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requirements limit the generalizability of VAL-MAP 2.0. Furthermore, the role of VAL-MAP 2.0 in identifying the intersegmental plane to facilitate a successful segmentectomy must be examined further, because only 5 of 65 sublobar resections in this study were segmentectomies.⁴

We commend Sato and colleagues³⁻⁷ for their iterative efforts in improving lung nodule localization techniques and look forward to future advances. Precise intraoperative mapping of small and subsolid nodules is critical for achieving clear surgical margins to prevent local recurrence and complex, parenchyma-sparing sublobar resections.

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