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Commentary: The surprise is gone! Far beyond surgical instinct—the power of information

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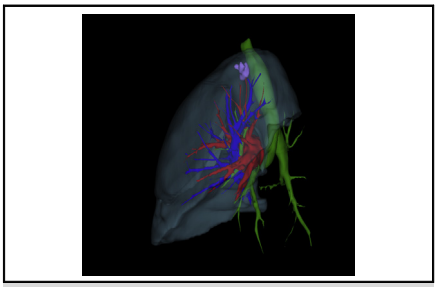

A 3D reconstruction of the left upper lobe with a malignant nodule in the apical segment.

CENTRAL MESSAGE

The surprise is gone! 3D-CT reconstruction imaging for preoperative planning allows surgeons to anticipate and prepare for operative challenges and anatomy.

Familiarity with and understanding of surgical anatomy are prerequisites for all surgeons. Anatomic vascular and bronchial variants may represent an intraoperative problem when not well understood, especially in complex resections. In their article in this issue of the *Journal*, Mun and colleagues[1] present a case of a patient with combined bronchial and venous anatomic variants and describe how preoperative imaging helped the surgical team understand these variations preoperatively and prepare for the procedure.

Three-dimensional (3D) computed tomography (CT) lung mapping and reconstruction have been used for teaching purposes, simulation, and preoperative planning.[2,3] Beyond a mere anatomic illustration, 3D image generation from specific patient 2D contrast-enhanced CT scans provide an opportunity to evaluate for abnormalities and anticipate the vascular branches that should be ligated or preserved. Advanced knowledge of how the branches come off the pulmonary artery is especially useful when operating on a large tumor, a fused fissure, or unexpected bleeding. The anatomic information provided by 2D CT scans is usually sufficient for thoracic surgeons to perform most lobar and segmental resections with adequate safety; however, the high-precision 3D reconstruction is especially useful for planning complex segmentectomies by visualizing the relationships between the tumor, the intersegmental plane, and bronchial and vascular structures.

Bronchial abnormalities tend to be more easily detected by the surgeon's eyes when looking at 2D CT scans. However, vascular abnormalities may be missed during a routine review of this scan. Hagiwara and colleagues[2] found vascular abnormalities in 16% of their patients using preoperative 3D imaging of the lungs. However, this method is not yet capable of detecting 100% of the pulmonary artery and venous branches, especially those $\leq$2 mm. Even when guided by 3D imaging, the surgeon should always be careful during vascular dissection to not miss variations not seen on 3D reconstructions.

Surgeons should be encouraged to progressively embrace 3D imaging reconstruction in their lung surgery practice, especially during complex minimally invasive surgery. As the technology in this field rapidly evolves and improves, user-friendly platforms able to rapidly and precisely generate semiautomated 3D dynamic reconstructions are becoming available.[4] Reconstruction techniques that do not demand significant involvement by the surgeon or radiologist in the identification and reconstruction process will become more attractive and particularly important for challenging cases and for training.

In 2020, there should not be any anatomic surprises in the operating room. Modern surgeons in the minimally

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Disclosures: The 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 Aug 10, 2020; revisions received Aug 10, 2020; accepted for publication Aug 13, 2020; available ahead of print Aug 15, 2020.

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JTCVS Techniques 2020;4:321-2
2666-2507

https://doi.org/10.1016/j.xjtc.2020.08.027

invasive era cannot operate guided by instinct alone but should be molded by methodically thought out and designed training programs that include simulation at an early level, and their operations should be guided by valuable, precise anatomic information. Knowledge of important anatomic anomalies allows the surgeon to anticipate pitfalls and complete the operation more precisely, more efficiently, and more safely. This should be better for the patient. The surprise is gone!

We thank Diego Eifer, MD, for performing the 3D reconstruction shown in this report.

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