

# Thoracoscopic S<sup>4</sup>a subsegmentectomy combined with wedge resections for treatment of metastatic tumors located at the intersection of the major and minor fissures



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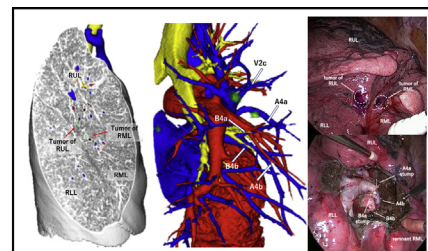
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3D angio-bronchography (left and center), and pre- and post-S<sup>4</sup>a segmentectomy images (right).

### CENTRAL MESSAGE

S<sup>4</sup>a subsegmentectomy combined with wedge resections for treatment of metastatic lung tumors located at the intersection of the major and minor fissures was successfully performed using 3D-CT.

See Commentaries on pages 312 and 314.

Video clip is available online.

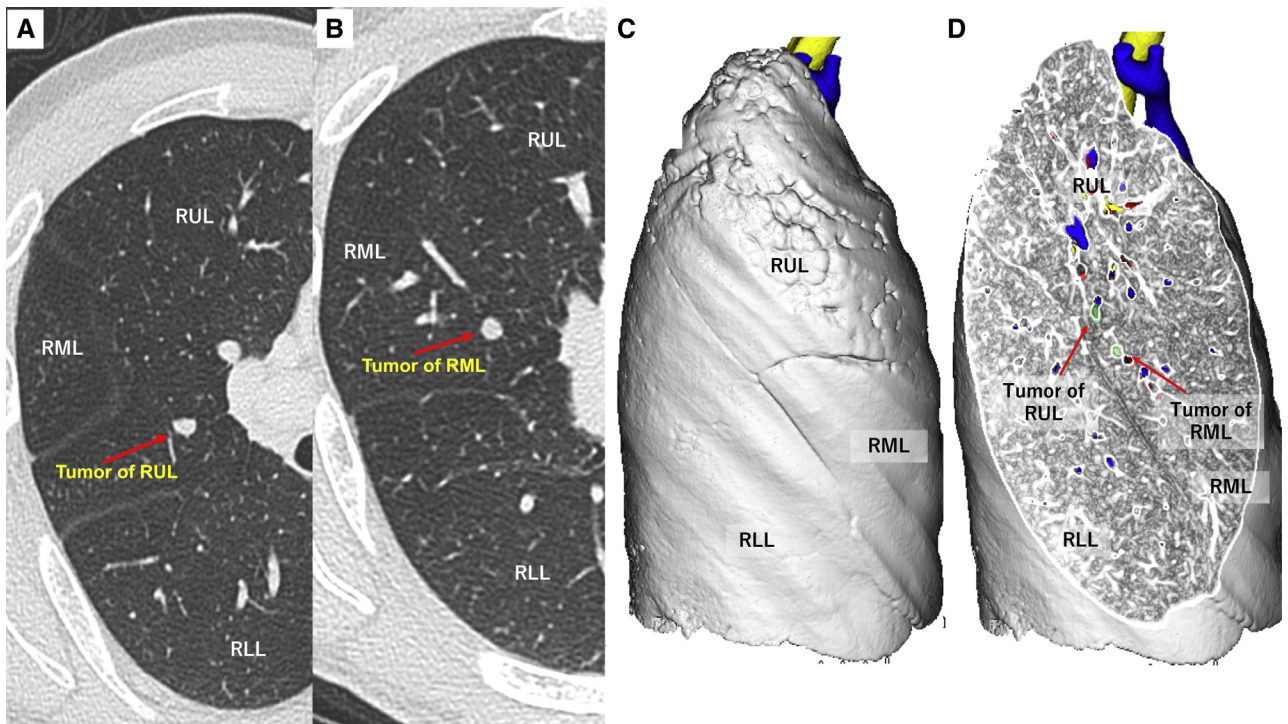
A 53-year-old male patient underwent a lower anterior resection for sigmoid colon cancer (CC; pathologic stage IIIB). Three pulmonary nodules appeared on postoperative computed tomography images 1 year after the operation; pulmonary metastases (PMs) from CC were suspected. Whole-body computed tomography showed that metastatic lesions were limited to the lung. The PMs were located in the right upper lobe (RUL), right middle lobe (RML), and right lower lobe (RLL) (Figure 1 and Figure 2). The RUL PM and the RML PM were localized near the intersection of major and minor fissures and were close due to incomplete lobulation.

We clinically judged that the RML lesion was close to the artery and required anatomical resection (Figure 3, A and B). Also, we considered that RML lobectomy plus RUL and RLL wedge resections would be rather extensive because the PMs were small. The patient's RML was large enough to warrant a lung-sparing subsegmentectomy rather than a lobectomy. Therefore, we decided to perform right S<sup>4</sup>a subsegmentectomy with partial resections of RUL as a less-extensive approach.

First, we separated the interlobular plane between RML and RLL, and encircled A4. B<sup>4</sup> was identified on the caudal side of A4, and B<sup>4</sup>a was identified and encircled

(Figure 3, C). B<sup>4</sup>a was dissected after selective jet ventilation through B<sup>4</sup>a. Thereafter, A<sup>4</sup>a was resected. After we identified the PM in RML by finger palpation to secure a surgical margin, we dissected the intersegmental plane between S<sup>4</sup>a and S<sup>4</sup>b using electrocautery along the inflation–deflation line. V<sup>2</sup>c was resected because the PM in RUL was located along V<sup>2</sup>c (Figure 3, D). After resecting V<sup>2</sup>c, the margin on the RUL side was resected using a stapler, and the RUL and RML PMs were removed together (Figure 3, E). Subsequently, the RLL PM was removed by wedge resection (Video 1). There were no postoperative complications. The duration of chest tube drainage was 2 days, and the length of hospital stay was 6 days. The pathologic examination showed all 3 lesions were consistent with lung metastasis of CC.

Informed consent concerning this case report was obtained from the patient. We obtained approval from the institutional review board for the report of this case and use of surgical videos.



**FIGURE 1.** Multidetector-row CT of the RUL lesion (A) and of the RML lesion (B). Reconstructed 3D CT images of lung parenchyma (C) and a virtual cut surface of lung parenchyma and tumors (D). The location of each tumors (red circles and red arrows) and the resected lung parenchyma (blue shadings encircled by black dotted lines) are merged into a single 3D-CT image. CT, Computed tomography; RUL, right upper lobe; RML, right middle lobe; 3D, 3-dimensional.

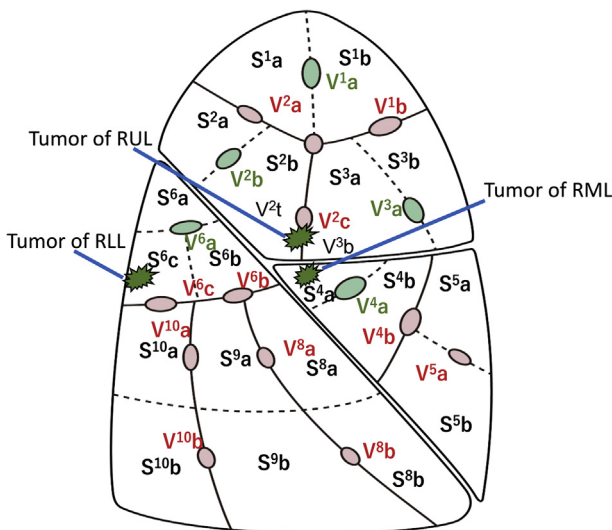
**DISCUSSION**

Segmentectomy is becoming accepted for the treatment of early-stage lung cancer or PMs.<sup>1-3</sup> However, for a lesion located at the intersection of the major and minor

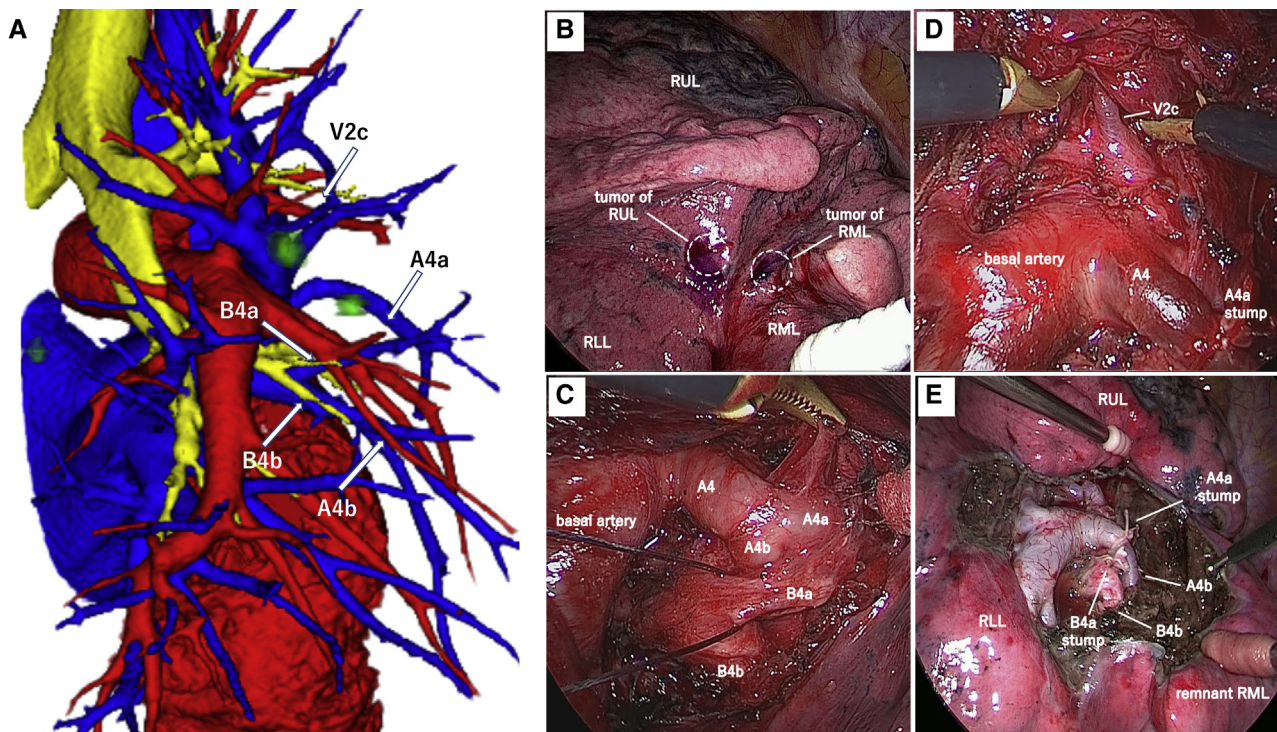
fissures of the right lung, deciding on the best surgical procedure is sometimes difficult because it may extend over multiple lung lobes due to incomplete lobulation. In such a case, dissection of the junction would result in exposure of the tumor surface. Wedge resection with a secured margin is challenging for such a lesion because it is close to the hilar structures<sup>4,5</sup> and may require a more extensive resection than a lobectomy.

The S<sup>4</sup>a subsegment is an area located at the center of the right lobular junction<sup>4</sup> (Figure 2). S<sup>4</sup>a subsegmentectomy with wedge resections of RUL and RLL enabled us to remove 3 tumors with appropriate margin and to preserve the lung volume. As indicated in Figure 1, for tiny nodules in S<sup>4</sup>a, one does not need to perform lobectomy for complete resection. We believe that the RML subsegmentectomy is useful for the preservation of lung function for patients with multiple PMs because repeat surgery may be needed to control their disease. The volume of RML has individual differences. In some cases, the volume of RML accounts for about 15% of total lung volume,<sup>5</sup> and we believe middle lobectomy can occasionally be an invasive procedure.

The 3-lobe junction consists of S<sup>2</sup>b+S<sup>3</sup>a, S<sup>4</sup>a, and S<sup>6</sup>b segments. In case of lung volume-preserving surgery for lesions located at the intersection of the major and minor fissures with insufficient lobulation, S<sup>2</sup>b+S<sup>3</sup>a or S<sup>6</sup>b segmentectomy is more difficult compared with S<sup>4</sup>a segmentectomy. It is easier to reach A<sup>4</sup> through the lobular



**FIGURE 2.** Scheme of the segment, intersegmental veins of right lung, and the location of the tumors. Intersegmental veins (red circle and red characters), intrasegmental veins (smooth blue-green circle and green characters), and tumors (jagged moss green circle) are shown. RUL, Right upper lobe; RML, right middle lobe; RLL, right lower lobe.



**FIGURE 3.** Three-dimensional computed tomographic angiography and bronchography images (A) and intraoperative photographs (B-E). A, Reconstructed images of the arteries (red), veins (blue), bronchi (yellow), and tumors (green) are shown. B, Tumor locations before starting the procedure; C, exposure of the arteries and the bronchi of S4; D, exposure of V<sup>2c</sup> after dissecting A<sup>4a</sup>; and E, the intersegmental plane after S<sup>4a</sup> subsegmentectomy and wedge resection. RUL, Right upper lobe; RML, right middle lobe; RLL, right lower lobe.

junction than ascending A<sup>2</sup> and A<sup>6</sup>, even with insufficient lobulation, because the lobulation between RML and RLL is relatively good. We can also reach A<sup>4</sup> by approaching from the hilum. We previously surmised that the anatomical variation of RML was relatively simple compared with other lobes<sup>4</sup> and RML segmentectomy was technically feasible.<sup>5</sup> If tumor has spread over the RUL like

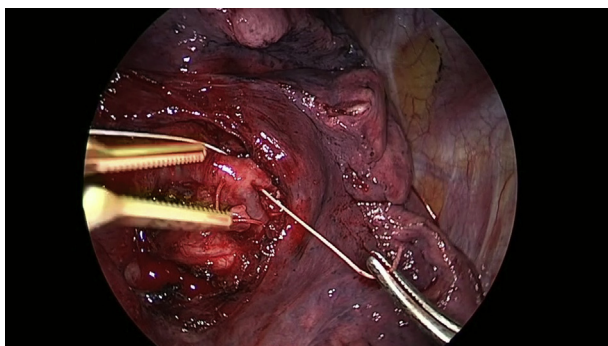
this case, dissection of V<sup>2c</sup> will make it easier to obtain a margin.

### CONCLUSIONS

We present the technical details of S<sup>4a</sup> subsegmentectomy for PMs located at the intersection of the major and minor fissures. This procedure proved to be technically feasible and might be applied as a limited resection for noninvasive primary lung cancer, PMs, or benign lesions that are located at similar locations.

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**VIDEO 1.** Preoperative computed tomography (CT), reconstructed 3-dimensional (3D) CT images of lung parenchyma, 3D-CT angio-bronchography, the procedures of right S4a subsegmentectomy and wedge resections, and comparison of pre- and postoperative reconstructed 3D lung images. Video available at: [https://www.jtcvs.org/article/S2666-2507\(20\)30427-2/fulltext](https://www.jtcvs.org/article/S2666-2507(20)30427-2/fulltext).