FIGURE 1. Computed tomography scan after right upper lobectomy showing (A) right middle lobe atelectasis (arrow), due to (B) kinked right middle lobe bronchus (arrow).

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Commentary: Is less really more?

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“Whatever you save is also earned” is one of the famous inspirational KalimaQuotes.¹ During lung resection, functional parenchyma should be spared as much as possible to not compromise postoperative breathing and quality of life for the patient’s remaining time.

Compared with liver parenchyma,² the mechanism leading to compensatory lung growth after pulmonary resection is less clear.³ Serial changes in pulmonary function after

Whatever you save is also earned.

CENTRAL MESSAGE

Two segments of the middle lobe have larger potential than 3 segments of the upper lobe to increase pulmonary volume and function in the first year after right lower lobectomy in healthy individuals.

anatomic lung resection have been well studied. Actual pulmonary function, particularly forced expiratory volume in 1 second and diffusion capacity for carbon monoxide,

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compared with predicted postoperative values may improve during the first year after thoracoscopic lobectomy.⁴ This increase, however, is less evident in patients with chronic obstructive pulmonary disease after thoracotomy and adjuvant chemotherapy. Moreover, the site of lobectomy may strongly influence pulmonary function at early and late term after surgery with better preservation of forced expiratory volume in 1 second after lower lobectomy.⁵ A recent systematic review and meta-analysis⁶ found that volumetry and density measures based on inspiratory/expiratory computed tomography (CT) data⁷ outperform segment counting⁸ to predict pulmonary function after lobectomy for lung cancer.

In this issue of the *Journal*, Yamagishi and colleagues⁹ from the University of Kyoto report the findings of a retrospective study investigating the expansion of remaining lung tissue after right lower lobectomy in healthy volunteers ($n = 53$) donating a lobe for living-related lung transplantation. Morphometric expansion of lung tissue on CT images from 3 to 12 months postlobectomy was greater in the right middle lobe ($130.9\% \pm 19.7\%$) than in the right upper lobe ($109.7\% \pm 9.2\%$) ($P < .001$). Volume and structural complexity expressed as fractal dimension declined in the right upper lobe ($P < .001$) but were maintained in the right middle lobe ($P = .39$). The increase in effective lung volume was larger in the right middle lobe (97.2 ± 73.5 mL) than in the right upper lobe (62.7 ± 87.1 mL; $P < .001$), but not significantly different from that of the left lung (55.8 ± 186.3 mL; $P = .052$). A similar pattern was seen in respiratory fluctuation. The authors concluded that morphologic and functional changes in lung tissue remaining after pulmonary resection were heterogeneous and that the right middle lobe demonstrated important morphologic and functional reserves after right lower lobectomy.

Three points are important to discuss. First, right lower lobe donors were well-selected healthy individuals. Their median age (40 ± 11 years) is lower than the average age of patients requiring anatomic pulmonary resection for lung cancer. Moreover, patients with a history of cigarette smoking often present with an underlying lung disease with emphysematous or interstitial fibrotic changes. On the other hand, healthy lobar-lung donors are selected on the basis of the absence of visible abnormalities on CT scan. Second, the findings from this study are only valid for patients after right lower lobectomy. We do not know whether the right middle lobe would have the same morphologic and functional reserve after right upper lobectomy. Third, based on the current study, no conclusion can be made for the contralateral side after left lower lobectomy. Expansion of lingular segments (S4-S5) as the equivalent of the right middle lobe may be hindered with less potential for morphologic and functional reserves. Compared with the right side, a horizontal fissure between the lingula and the remaining upper lobe (S1-S3) is absent in the majority of patients. Autopsy

FIGURE 1. Chest x-ray taken immediately after right lower lobectomy for a carcinoid tumor in a 38-year-old male patient. The residual pleural cavity appears to be obliterated after full expansion of the remaining right lung.

studies have shown a wide variation in oblique, horizontal, and accessory fissures in right and left lungs. In one study from Nepal, the horizontal fissure in the right lung was complete in 52%, whereas a left minor (accessory) fissure was present in only 30%.¹⁰ This questions whether findings from the Kyoto study are valid for all anatomic variations. Further research is needed before any conclusions can be made for other lobes being resected.

Nevertheless, as pointed out by the authors in the “Discussion,” their findings in living donors may also aid in the prediction of postoperative expansion of the remaining upper and middle lobes in other circumstances such as (1) cadaveric donors in whom the right lower lobe has to be removed because of lung injury; and (2) fit and healthy young patients requiring right lower lobectomy for a centrally located carcinoid tumor (Figure 1) or a pulmonary metastasis from a primary tumor elsewhere (eg, colorectal or renal cell carcinoma, sarcoma).

The article by Yamagishi and colleagues⁹ adds to the evidence that actual pulmonary function after right lower lobectomy may be larger than predicted postoperative values. The right middle lobe appears to have a large potential to re-expand in the residual pleural cavity, thereby improving functional reserve within the first year after right lower lobectomy. Therefore, it is important in patients with lung cancer to save the middle lobe by any means if oncologic principles can be followed. Less resection is even more, and whatever you save is already earned!

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