Editorial Commentary

Anatomical partial lobectomy is a minimally invasive and precise procedure: beware of overuse

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The role of sublobar resection in the surgical treatment of early-stage lung cancer has been rapidly expanding, owing to the widespread use of thin-section computed tomography, which has increased the detection small lung nodules, and based on accumulating evidence that ground-glass opacity (GGO) tumors, compared with solid tumors, are pathologically less invasive and have a better prognosis. The results of the JCOG0804 and JCOG1211 trials confirmed that sublobar resection can cure tumors that are estimated to be pre or minimally invasive (i.e., tumor diameter ≤2 cm and consolidation tumor ratio ≤0.25) (1) and that segmentectomy can cure GGO-dominant tumors ≤3 cm in diameter (2). Furthermore, the results of the JCOG0802/WJOG4607L randomized trial showed that the overall survival of patients with solid-dominant tumors ≤2 cm in diameter was superior after segmentectomy than after lobectomy (3). A propensity score-matched study comparing real-world perioperative outcomes of segmentectomy and lobectomy for lung cancer using a nationwide database in Japan revealed that the postoperative complication rate was lower with segmentectomy than with lobectomy (4). Indeed, sublobar resection is becoming the mainstream surgical treatment for peripheral small lung cancer.

Qiu *et al.* (5) proposed the concept of anatomical partial lobectomy (APL) and presented the short-term outcomes after APL in a large series of 3,336 patients. In 2014, the Chinese Academy of Medical Sciences Cancer Institute and Hospital proposed APL as a concept that was based on both oncological margins and the corresponding bronchial and vascular-dominant areas. They defined APL as a technique in which the resection area was designed around the tumor, the bronchi and arteries included in this resection area were anatomically separated and divided, and venous management was determined according to its drainage area. APL includes extended segmentectomy, bisegmentectomy, subsegmentectomy, combined subsegmentectomy, and anatomical wedge resection, in addition to the usual segmentectomy, but it does not include nonanatomical wedge resection. Based on data from the National Cancer Center China from 2013 and 2019, APL on 3,336 patients had a mean operative time of 127 min and a mean blood loss of 30 mL; 96.6% of cases were performed by thoracoscopic surgery (50.7% by single port), with a conversion rate to thoracotomy of 0.2%. The incidence of unplanned reoperation was 0.27%. There was no mortality, and the overall rate of grade ≥2 postoperative complications was 10.8%. These results showed that APL, which is a complex and technically demanding procedure, can be performed safely in a minimally invasive manner. All surgeries were performed by experienced thoracic surgeons who have performed more than 300 thoracic surgeries per year. Furthermore, the operative time was shorter and the complication rate was less in the second half than in the first half of the study period. The outstanding skill of their team in accurately performing complex surgeries in a minimally invasive manner and with extremely favorable short-term results is commendable.

In the aforementioned study, preoperative planning using

a three-dimensional (3D) software was a crucial step in APL. Using 3D imaging, the resection area centered on the lesion was designed, and the bronchi and arteries included in this resection area were anatomically separated and divided. The drainage area of the intersegmental vein (ISV) was determined using 3D imaging. If the area involved a spherical safety margin, the ISV and the drainage area were resected; otherwise, the ISV was preserved. They described the following advantages of APL: effective strategy for surgical oncology; broad applicability, because it is not limited to specific units of segments or subsegments; and can enable an easy operation.

Among the concepts of APL, we agree with the idea that the management of ISV is determined by its distance from the tumor. Previously, during segmentectomy for pulmonary tuberculosis, preservation of ISV was thought to be necessary to prevent congestion in the residual lung. On the other hand, during segmentectomy for lung cancer, some surgeons believe that the ISV should be resected to ensure removal of the tumor lymphatic pathways that run around the ISV through the subpleural space. Similar to Qiu *et al.*, we determine the management of ISV by its distance from the tumor. For example, during S6 segmentectomy, if the tumor is located at S6a and has a sufficient distance from the intersegmental plane, only V6a is removed, and V6b and V6c are preserved. In contrast, if the tumor is located at S6c and is close to the intersegmental plane, V6 is divided at the root, and the resection line is set to include a portion of S10, in order to secure a margin. Such management of ISVs appears to be the current common practice in segmentectomy.

Another feature of APL is that it is not limited to segmentectomy. In APL, only the vessels and bronchi which are included in the extent of resection centered around the lesion are to be removed. The authors did not hesitate to perform subsegmentectomy or combined subsegmentectomy. Moreover, APL includes anatomical wedge resection, which seems to be a procedure that divides further peripheral bronchi. This implied that during APL, a smaller area of resection is pursued, as long as sufficient tumor margins can be maintained.

The first of our concerns regarding this article on APL is the consideration of segmentectomy and subsegmentectomy to be an equivalent surgical procedure. A necessary condition for segmentectomy is separate dissection and division of the bronchi and pulmonary arteries of the segment. Central margins are important, because many lymphatic flow pathways from the tumor run along the bronchus to the center. Compared with lobectomy, segmentectomy involves division of the bronchus peripherally and may not completely remove some of the lymph nodes around the lobar bronchus. Compared with segmentectomy, subsegmentectomy removes a much smaller area of central lymphatic pathways and lymph nodes around the segmental bronchus. Therefore, a clear distinction should be made between segmentectomy and subsegmentectomy. The article did not mention that number of cases that were treated with subsegmentectomy or less. Given that one of the goals of anatomical lung resection for lung cancer is removal of the central lymphatic flow pathways and hilar lymph nodes, we believe that segmentectomy and subsegmentectomy are not equivalent.

Second is the issue on surgical indications and selection of surgical procedures. In this study, the pathologic diagnosis was benign in 8.5%, preinvasive tumor (i.e., atypical adenomatous hyperplasia or adenocarcinoma *in situ*) in 14.5%, and minimally invasive tumor in 21.4%. Benign tumors and preinvasive lesions should be reconsidered to determine the need for surgical resection or whether they could be removed by wedge resection. Kakinuma *et al.* (6) reported that only 5% of 1,046 pure GGO nodules developed solid components after 4.3±2.5 years of prospective follow-up. Currently, the JCOG1906 trial (i.e., Prospective Evaluation of Watchful Waiting for Early-Stage Lung Cancer with Ground-Glass Opacity: A Single-Arm Confirmatory Multicenter Study) is ongoing for tumors ≤2 cm in diameter, with a consolidation tumor ratio of ≤0.25. Wedge resection for pre- or minimally invasive tumors is oncologically acceptable. Performing another ipsilateral anatomical lung resection may be difficult after APL and it would be much easier after wedge resection. Therefore, wedge resection should be chosen for pre or minimally invasive tumors in the outer third of the lung parenchyma. On the other hand, we believe that invasive lung cancer should be treated with at least a segmentectomy with hilar lymph node dissection. The paper reported that systematic mediastinal dissection/sampling was performed in 85% of cases; however, it makes little sense to perform mediastinal lymph node dissection when the hilar lymph nodes have not been adequately resected, and the addition of mediastinal dissection to subsegmentectomy may not be necessary. Furthermore, there is no need to perform mediastinal lymphadenectomy for pre or minimally invasive tumors because they do not cause lymph node metastasis.

There was also the problem of tumor localization. Accurate intraoperative identification of the tumor location

is essential to ensure margins. The paper described that the resection line was determined by the inflation/deflation line; however, dividing the resection line intraoperatively as preoperatively planned may not be possible. The mean margin distance was reported as 2.1 cm, but it was questionable whether there were any cases in which additional resection was required because of unexpectedly close margins.

Finally, no comparison with lobectomy was made. For example, in the mentioned case of a remaining small lower lobe in two pieces after an S6b+S9a+S10 resection, the extent of its contribution to the respiratory function was unclear. Further investigation is needed to determine the superiority of APL to lobectomy in terms of postoperative activities of daily living and long-term prognosis.

This was an important paper, which demonstrated in a large series that even complex surgeries, such as APL, can be performed quickly and in a minimally invasive manner by experienced surgeons and can achieve excellent short-term results. Probably, the number of APL cases has increased and the techniques have advanced further. We hope that future studies will be conducted to determine the indications for surgery, criteria that will delineate the indications between APL and wedge resection or lobectomy, intraoperative tumor localization methods, and long-term prognosis.

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