



The pros and cons of uniportal VATS segmentectomy in the treatment of early-stage lung cancer: should the procedure be prioritized?

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Historically, thoracic surgeons limit the resection area in the treatment of lung cancer. Resections of lung cancer by a pneumonectomy were first reported by Graham (1). Cahan reported pneumonectomy with lymph node dissection as a “standard” operation for lung cancer (2). In the 1960s, the standard operation for lung cancer shifted from a pneumonectomy to a lobectomy (3,4). Although sublobar lung resections (wedge resections and segmentectomies) have been applied to lung cancer and other pulmonary diseases, such as mycobacterial infections, in 1995, the Lung Cancer Study Group demonstrated the superiority of a lobectomy with lymph node dissection to sublobar resections in disease-free survival and overall survival in a prospective randomized controlled trial (5). Specifically, locoregional recurrence was approximately three times greater in the sublobar resection group than the lobectomy group. Since this landmark study, a lobectomy with lymph node dissection has been the standard surgical resection for lung cancer.

However, in light of the current standard of care in the 2020s, the study conducted by the Lung Cancer Study Group has multiple limitations: the evaluation of the computed tomography (CT) images appeared to be insufficient during the patient recruitment period between 1982 and 1988; the selection of resection methods (40 wedge resections out of 122 sublobar resections) were not well refined; and many of the patients (64%) were

excluded after recruitment (5). Since then, multiple retrospective and prospective studies have demonstrated equivalent outcomes of sublobar resections to lobectomies conducted for well selected patients with early-stage lung cancer (6,7). Two prospective randomized phase III trials, JCOG0802/WJOG4607L (8) and CALGB/Alliance 140503 (9), have recently demonstrated that sublobar resections are comparable (9) or even superior (8) to a lobectomy in patient survival in the resection of peripheral early-stage lung cancer. Another single-arm study, JCOG0804/WJOG4507L, targeting peripheral ground glass-dominant nodules, demonstrated wedge resection with a 5-year recurrence-free survival of 99.7% (10). We are now at a historical turning point where the standard operation for early-stage lung cancer is shifting from a lobectomy to sublobar lung resections.

In parallel with limiting the extent of resections, thoracic surgeons have aimed to limit their surgical access to reduce trauma to patients. A muscle-sparing thoracotomy was first proposed (11), followed by video-assisted thoracic surgery (VATS) (12). This trend has recently been further accelerated by the introduction of uniportal VATS (13). Once uniportal VATS was established, thoracic surgeons applied this approach to limited lung resections, including segmentectomy (14), which is anatomically more complex than lobectomy and thus a demanding technique that requires an expert. A recent article published

in the *Journal of Thoracic Disease* in the iMDT field, “anatomical segmentectomy under uniportal video-assisted thoracoscopic surgery for early staged non-small cell lung cancer: a case report” written by Wang and colleagues well described the aspects of a uniportal VATS segmentectomy, including the opinions of two unaffiliated experts (15). The feasibility of this less invasive combined approach for early-stage lung cancer, segmentectomy through uniportal VATS, has been well demonstrated.

Nevertheless, questions and concerns regarding recent advances in approaches for early-stage lung cancer remain. Although the uniportal VATS is feasible, is its less invasive characteristic well demonstrated? What are the advantages of uniportal VATS? The differences between an open thoracotomy and multi-portal VATS in, for example, post-operative pain and duration of hospital stay, are well appreciated. Can we demonstrate a similar difference between multi-portal VATS and uniportal VATS? Although there are some data suggesting the benefit of uniportal VATS over multi-portal VATS (16,17), contradictory data also exist (18). Specifically, one or two additional small ports (5 mm or less) would not compromise the benefit of the uniportal VATS regarding post-operative pain (19). My personal opinion is that for expert surgeons, there may be a difference; however, the difference between expert and non-expert surgeons would be much greater than multi-portal *vs.* uniportal VATS. Indeed, as declared by Wang *et al.*, the learning curve of a uniportal VATS segmentectomy may be steep, limiting its application (15).

Second, the oncological validity of a uniportal VATS segmentectomy has not been well examined. Considering the relatively short history of this procedure, it is not surprising that the long-term outcomes have not been appreciated. However, unlike a lobectomy in which anatomical landmarks are obvious, a segmentectomy is a procedure where the extent of resection needs to be carefully determined. Methodologically, there are numerous ways with advantages and disadvantages (20). Moreover, targeted segments are not standardized; for a given lesion, one surgeon may select a S9+10 segmentectomy; however, another may perform a basal segment resection (20). Therefore, compared with a lobectomy, a segmentectomy is difficult to standardize. This technically challenging aspect of a segmentectomy (and also a wedge resection) raises a concern about oncological outcomes, particularly, locoregional recurrence. In a JCOG0802 study, despite the superior overall survival of the segmentectomy group, locoregional recurrence was significantly greater than

in the lobectomy group (8). This outcome suggests that a segmentectomy for early-stage lung cancer requires surgeons to acquire sufficient resection margins and conduct appropriate lymph node sampling/dissection. It remains unclear whether a uniportal VATS segmentectomy sufficiently meets such oncological requisites in a large cohort, long term.

Third and, perhaps most importantly, the impact of introducing a uniportal VATS in surgical education and training remains a concern. The potentially steep learning curve suggested by Wang *et al.* (15) implies that senior thoracic surgeons who can perform multi-portal VATS require further training to learn a uniportal VATS segmentectomy. Although there are advantages of senior surgeons learning new techniques, their additional training may deprive *young surgeons* of opportunities to experience cases. In Japan and other countries, the number of young surgeons is declining for multiple reasons, and it is necessary to train young surgeons efficiently. Additionally, it is critical to recruit medical students and young doctors. To do this, we need to do our best to make the field of thoracic surgery attractive. The introduction of new techniques may enhance the attraction; however, if the techniques are limited to senior surgeons, I am afraid it diminishes attraction to the field.

In my personal experience, I had performed uniportal VATS segmentectomies, including complex segmentectomies until 2019. I observed no obvious benefits in pain control or hospitalization duration with the uniportal approach. As a result, I decided to stop performing uniportal VATS segmentectomies and instead prioritize young surgeon training and development, including uniportal VATS if they want. I do not discount the value of new surgical approaches; however, I believe senior surgeons should be careful in taking on such techniques, considering the balance of the advantages including technical requirements, oncological outcomes, invasiveness, and education. Additionally, I believe the weight of our research and discussion should be directed toward the oncological aspects of sublobar lung resection rather than its approaches (i.e., mini-thoracotomy, multiport VATS, uniportal VATS, and robotics), which are likely to have little impact on long-term outcomes. Regarding invasiveness, although the number of VATS ports may be reduced, our radiology colleagues can conduct radio-surgery without a port. Thus, thoracic surgeons need to continue to explore the true value of surgical resection in oncological aspects, such as in the extent of resection, resection margins, locoregional

recurrence, nature of the targeted lung cancer, and the use of resected specimens in genomic analyses, as well as a post-operative functional reserve.

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