Editorial Commentary

The evolving field of sublobar resection: in search of the optimal operation or the optimal definition

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The debate of optimal surgical treatment of lung cancer centers around the goal of complete oncologic resection with decreased local relapse while maximizing lung parenchyma preservation. Since the Lung Cancer Study Group (LCSG) trial (1), which favored lobectomy as the surgical treatment of choice for lung cancer, the role of lung sparing surgery for early-stage disease has continued to evolve. Over the subsequent decades, we have witnessed a transition in the role of sublobar resection from a compromise operation appropriate for patients unable to tolerate a lobectomy, to that of an equivalent (non-inferior) or potentially superior oncologic results compared to a lobectomy in appropriately selected early-stage patients (2,3). In a large multicenter phase III randomized prospective trial, the JCOG 0802/WJOG4607L demonstrated for the first time that there is an overall survival (OS) advantage in patients undergoing segmentectomy compared to a lobectomy (5-year OS 94.3% *vs.* 91.1%, P=0.008 for superiority), shifting the paradigm, and establishing anatomical segmentectomy as the procedure of choice for early-stage tumors ≤2 cm in size (2). However local recurrence occurred more frequently in the segmentectomy arm (10.5% *vs.* 5.4% for lobectomy, P=0.002). Despite excellent oncological and perioperative results, there are a few limitations of this study which may limit its applicability to everyday practice. There was no reporting of the surgical margins of resection achieved in the cases. Despite a recommended 2 cm margin, smaller margins were acceptable if they were negative on frozen section. Furthermore, the disease biology seemed to be favorable with an outstanding 5-year disease free survival of 88% in both groups. However, with only 50% of cases had pure solid nodules [consolidation-to-tumor ratio (CTR) of 1.0] and a large proportion of patients were never smokers (44%), suggestive of a less aggressive disease biology in this population.

In another important prospective randomized trial, the CALGB 140503 study also demonstrated excellent oncologic results in patients undergoing sublobar resection (which included wedge resection in 58.8% of cases) with equivalent disease-free survival (DFS) compared to lobectomy (5-year DFS 63.6% *vs.* 64.1%, P=0.02) (3). In this study, the sublobar procedure of choice (segmentectomy or wedge resection) was left to the discretion of the surgeon and systematic nodal dissection was not mandatory. In addition, the recommended margin of resection was larger than 2 cm or at least equal to the size of the lesion, but smaller margins were also acceptable and margin extent was not reported in the results. Despite these limitations, there was no difference in the locoregional disease recurrence between sublobar or lobar resection [13.5% *vs.* 10%, P=not significant (NS)]. We eagerly await more analysis between the outcomes and recurrence between wedge resection or segmentectomy in this study or subsequent prospective trials to add further clarity regarding patient selection and

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the performance of a non-anatomic sublobar resection.

With an increased prevalence of smaller tumors detected in lung cancer screening as well as the increased presence of multifocal disease, the importance of lung parenchyma preservation has come to the forefront in lung cancer surgery discussions. Despite the incredibly important contribution of these large, randomized trials, significant questions remain. Are all segmentectomy options equivalent regardless of the tumor location? Given that there is not a clinically significant difference in pulmonary function between segmentectomy or lobectomy, what are the specific tumor or patient factors predictive of a worse post operative or oncologic result that would warrant a lobectomy? Among the segmentectomy options, is the anatomical intersegmental plane enough? Or is the margin achieved the main consideration regardless of performing a wedge resection or a complex segmentectomy?

In this study from Qiu and colleagues (4), they present their outcomes in one of the largest single institution series of sublobar resection from China which they classify with the term anatomical partial lobectomy (APL). One of the challenges of extrapolating the data of sublobar resection in the literature is the different definitions of what constitutes a sublobar lung cancer resection. Wedge resection, atypical segmentectomy, anatomic simple segmentectomy, complex segmentectomy and now anatomic partial lobectomy are often used interchangeably and can create confusion and difficulties in interpreting study outcomes. In this study, APL takes into consideration the oncologic margins as a primary goal, followed by the territory of the segmental bronchi and vessels. Taking the oncologic margin as a starting point, we believe it is crucial given that there was a significant difference in local disease recurrence in the segmentectomy arm of JCOG 0802, in which a negative margin was required but a minimum margin size or distance was not mandatory for inclusion in the segmentectomy arm. What is impressive regarding this series, is the large number of cases (3,336 in a single institution) and the fact that all cases were carefully planned with three-dimensional (3D) reconstruction software with a clear focus first on adequate margin of resection and then the broncho-vascular anatomy, with a goal of preservation of the intersegmental vein (ISV). They described a "cutting plane" for resection and based on if the ISV can be preserved or not. If the ISV could not be preserved, then the adjacent subsegment of segment would be included in the resection, with and expected even larger surgical margin. Although obtaining a negative margin is the primary goal of all types of sublobar resections, that fine balance of functional parenchymal preservation with margin size is subject to inherent surgeon bias and creates significant technical challenges. The authors clearly recognized this challenge as their performance of APL gradually increased over time and case volume increased and they found surgeon experience was an important predictor of postoperative complications in the multivariate analysis.

The types of sublobar resections defined as APL in this study included a simple case (37% of cases) such as single segmentectomy (S6, S4–5, S1+2–3 as one where a single staple line or intersegmental division is created), a moderate case (41% of cases) defined as a single segment with multiple intersegmental planes (S1, S3, S1+2) and complex case (21% of the cases) including combination segments (extended segmentectomy, combined segmentectomy or sub segmentectomy). Wedge resections or non-anatomic or atypical segmentectomies were excluded. The term APL does suggest a clustering of simple and complex anatomic segmentectomy (including all the variants), but in my opinion, creating another layer of confusion in the definition of anatomic sublobar resection. In JCOG 0802/WJOG4607L, the definition of segmentectomy included simple segmentectomy (crossing one intersegmental plane such as S6, S4+5) which was performed in 229 cases and complex segmentectomy (crossing more than one intersegmental plane or combination segmentectomy) which was performed in 300 cases. Could a different definition of segmentectomy or APL add value to the classification and clarity regarding the optimal surgical approach? Or more simply, does a minimal expected margin goal needs to be achieved to obtain optimal oncologic results? The definition of segmentectomy is a matter of debate and not infrequently in real world practice, a large wedge resection can be lumped in as a segmentectomy in disguise. With the recent CALGB 140503 results, is this granular difference in the extent of resection and the status of the ISV that important in terms of overall and DFS? It is unclear what the optimal definition is, but as the role of segmentectomy is likely to increase more than ever, it is vitally important that the surgical community agrees with the proper definition for us to be able to adjust our technique and accurately interpret our results. The increasing use of 3D software, artificial intelligence, and other intraoperative adjuncts such as augmented reality will likely make anatomical identification easier and the consistency of reporting and definitions of sublobar resections will likely become more standardized and uniform across institutions and studies.

In this large series by Qiu and colleagues, of the 3,336 patents, 80% were never smokers and 23% were in cases of benign or premalignant disease. Invasive adenocarcinoma of the lung was the histology in 73% of cases. A minimally invasive approach was performed in 96% of cases, the majority with a single port approach, with a small conversion rate to open thoracotomy of 0.2%. The results were outstanding, with an average operative time of 127 minutes, and no 30-day mortalities. Over the 5 years of the study, the number of moderate and complex segmentectomies increased significantly, reflecting the evolution in the learning curve and the technical proficiency in these challenging operations. The postoperative complication rate was also very low, with an overall morbidity of 10.8% mostly consisting of perioperative arrythmias and prolonged air leaks, which is comparable to the recently discussed prospective randomized trials (2). The most important predictors for post operative morbidity in this study were smoking status [odds ratio (OR) 3.30], surgeon experience (OR 2.31), surgical approach (OR 3.84) and complex cases (OR 2.47). Prolonged air leak (more than 5 days) occurred in 163 cases (4.9%) with no bronchopleural fistulas which compares favorably with the rates in JCOG 0802/WJOG4607L (6.5% in the segmentectomy arm) (5).

One of the major limitations of this study is the lack of oncologic results such as survival or disease recurrence data. Despite this being a retrospective single institution study, the oncologic results will provide further understanding of the locoregional control of sublobar resection and expand on the potential value of the definition of APL compared to a standard anatomical simple or complex segmentectomy.

Unfortunately, another limitation of the current study is the lack of a control arm of lobectomy, to determine if there is truly a difference in outcomes or in oncologic results, which are not reported in this study. With the apparent more extensive resections in the APL cohort, and the fact that a definitive benefit in pulmonary function preservation in segmentectomy was small and probably not clinically significant in the JCOG 0802/WJOG4607L or the CALGB 140503 trials, would it just be better to perform a lobectomy as opposed to a complex segmental resection? This is why the definition of the specific segmentectomy type will be increasingly important as not all sublobar resections are equal and the oncologic and parenchyma sparing benefits will vary significantly according to the extent of resection performed.

In summary, this study by Qui and colleagues is a significant and timely contribution regarding the careful planning and execution of complex segmentectomy with safe results. It highlights the importance of oncologic margin as a priority in case selection for segmentectomy and the importance of functional parenchymal preservation with proper venous drainage. The use of 3D reconstruction is likely to have contributed to the outstanding results and suggests that it should one day become mandatory to achieve optimal results in this field. As described in manuscript, during the study, the prevalence of simultaneous lung cancers in the patient population increased from 5.6% to 24.9%, making it even more important for surgeons to incorporate lung segmentectomy in their armamentarium to preserve lung parenchyma. One of the suggested differences in the OS in the segmentectomy arm of JCOG 0802/WJOG4607L was the increased rate of aggressive reintervention for subsequent lung cancers in the segmentectomy arm, perhaps impacting the survival advantage if a new lung cancer is detected (5). It would be interesting to elucidate from those patients who had rescue operations for relapsed ipsilateral disease, what is the feasibility of a completion lobectomy or repeat segmentectomy after a prior anatomic segmentectomy.

With more detection of early lung cancers with increased use of lung cancer screening, and the prevalence of smaller and multi-focal lesions, segmentectomy undoubtedly will be the most common surgical technique for resection. It is imperative that thoracic surgeons become proficient in complex segmentectomy as this is now proven to be safely performed with excellent clinical and oncologic outcomes. Improvements in tumor preoperative diagnostics and localization with advanced robotic bronchoscopy and tumor localizing intravenous agents will facilitate further the intraoperative nodule localization, assessment of complete resection and likely improve the selection of optimal sublobar resection approach. As not all institutions will have access to all this technology, considerations of costs, resource management and patient selection will also need to be considered as we take all these innovative approaches into clinical practice. As we push the envelope and explore the technical possibilities, more data will be needed to make further improvements in complex segmentectomy and determine the clinical value compared to a standard lobectomy.

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References

1. Ginsberg RJ, Rubinstein LV. Randomized trial of lobectomy versus limited resection for T1 N0 non-small cell lung cancer. Lung Cancer Study Group. Ann Thorac Surg 1995;60:615-23.
2. Saji H, Okada M, Tsuboi M, et al. Segmentectomy versus lobectomy in small-sized peripheral non-small-cell lung cancer (JCOG0802/WJOG4607L): a multicentre, open-label, phase 3, randomised, controlled, non-inferiority trial. Lancet 2022;399:1607-17.
3. Altorki N, Wang X, Kozono D, et al. Lobar or Sublobar Resection for Peripheral Stage IA Non-Small-Cell Lung Cancer. N Engl J Med 2023;388:489-98.
4. Qiu B, Ji Y, Zhang F, et al. Outcomes and experience of anatomical partial lobectomy. J Thorac Cardiovasc Surg 2022;164:637-647.e1.
5. Suzuki K, Saji H, Aokage K, et al. Comparison of pulmonary segmentectomy and lobectomy: Safety results of a randomized trial. J Thorac Cardiovasc Surg 2019;158:895-907.