Posterior approach to thoracoscopic pulmonary segmentectomy of the dorsal basal segment: A single-institute retrospective review

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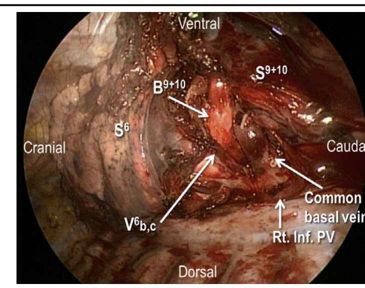
ABSTRACT

Objective: Anatomic resection of the dorsal area of the basal segment of the lower lobe is difficult because of the deep location of vessels and bronchi in the parenchyma. This study aimed to describe a novel technique for port-access thoracoscopic segmentectomy of the dorsal (S10) and lateral dorsal segments (S9+10).

Methods: This retrospective study analyzed 20 patients who underwent S10 and S9+10 thoracoscopic segmentectomy via a posterior approach between January 2004 and March 2016. In this approach, the lung parenchyma between S6 and S10 was divided along V6b,c from the dorsal side of the lower lobe, which exposed the targeted bronchus (B10, B9+10) and artery (A10, A9+10) and enabled anatomic S10 and S9+10 segmentectomy.

Results: Of the 20 patients, 15 had lung cancer, 3 had metastases, and 2 had benign nodules. The number of segmentectomies of the right S10, right S9+10, left S10, and left S9+10 was 5, 5, 1, and 9, respectively. Median operative time was 165 minutes (range, 107-276 minutes). The median duration of chest tube insertion was 1 day (range, 1-2 days). One patient had atelectasis. Median hospital stay was 6 days (range, 3-11 postoperative days). No recurrence or mortality was observed during the median follow-up period of 46 months.

Conclusions: The posterior approach for port-access thoracoscopic segmentectomy at S10 or S9+10 is technically challenging, but in our hands it has been feasible. It exposes the targeted bronchus (B10, B9+10) and artery (A10, A9+10) and enables anatomic S10 and S9+10 segmentectomy while avoiding inessential parenchymal splitting from the major fissure. (J Thorac Cardiovasc Surg 2017;154:1432-9)



A posterior approach for S9+10 segmentectomy. Division between S6 and S10, and B9+10 emerges.

Central Message

The posterior approach for thoracoscopic anatomic S10 or S9+10 segmentectomy dorsally exposes the targeted bronchus (B10, B9+10) and artery (A10, A9+10), avoiding extra parenchymal splitting.

Perspective

Segmentectomy of S10 or S9+10 is complicated because of the deep location of the components away from the interlobar fissure. A posterior approach, in which the parenchyma between segments S6 and S10 is divided along V6 from the dorsal side of the lower lobe, exposes the targeted bronchus and artery. This approach allows S10 or S9+10 segmentectomy, a useful resection that is currently rarely attempted.

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Computed tomography (CT) has enabled the detection of small-sized lung cancers. As a result, the diagnosis of nonsolid tumors with ground-glass opacity, suggesting noninvasive lung cancer with good prognosis, is increasing.[1-4] Therefore, limited resection as anatomic segmentectomy is increasingly considered for resection of such lesions. Although it is reasonable to perform less-invasive resection of a smaller volume of lung tissue thoracoscopically, this type of surgery often involves complicated procedures. Consequently, published reports

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Read at the 96th Annual Meeting of The American Association for Thoracic Surgery, Baltimore, Maryland, May 14-18, 2016.

Received for publication May 30, 2016; revisions received Feb 9, 2017; accepted for publication March 7, 2017; available ahead of print April 29, 2017.

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0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2017.03.120

Abbreviations and Acronyms

3-D	= 3-dimensional
CT	= computed tomography
MDCT	= multidetector computed tomography
SAMURAI	= Segmentectomy Achieved by MDCT for Use in Respective Anatomical Interpretation

on segmentectomy under total thoracoscopic visualization are limited.[5-9] Anatomic thoracoscopic segmentectomy requires accurate delineation of the inflation-deflation line and identification of intersegmental veins, which are reliable landmarks of the intersegmental plane.[10-12]

We previously reported the importance of 3-dimensional (3-D) simulation using multidetector computed tomography (MDCT) for interpretation of individual segmental anatomy: the Segmentectomy Achieved by MDCT for Use in Respective Anatomical Interpretation (SAMURAI) technique.[12] After we introduced SAMURAI using intraoperative simulated navigation, the number of segmentectomies classified as difficult increased, including dorsal segment (S10) and lateral dorsal segment (S9+10) segmentectomies. Conventionally, the surgical approach for these segments has been designed from the interlobar fissure, dividing the lung parenchyma between the superior segment (S6) and the ventral segment (S8) to expose the deeply located targeted pulmonary artery (A10 or A9+10) and bronchus (B10 or B9+10).[13,14] We have developed a new posterior approach for thoracoscopic segmentectomy of the same segment after analyzing 3-D CT angiography and bronchography.[15]

The objective of this study was to report our experience with this new approach for port-access thoracoscopic anatomic segmentectomy of the dorsal basal segment or the lateral dorsal basal segment and to determine the feasibility of this approach on the basis of the initial results of 20 resections.

PATIENTS AND METHODS

Patients

All of the surgeries were performed by 1 general thoracic surgeon (H.O.) with assistant surgeons. Among 256 patients undergoing port-access thoracoscopic anatomic segmentectomy between January 2004 and March 2016, 20 who underwent thoracoscopic S10 or S9+10 segmentectomy through the posterior approach were included to evaluate the utility of the posterior approach for pulmonary segmentectomy of the basal segment. Patients' data were retrospectively analyzed. The present study was approved, the need for written informed consent from each patient was waived by the Institutional Review Board, and the study was conducted in accordance to the concepts of the Declaration of Helsinki.

Selection Criteria

We considered specific patients for this technique: patients with a T1 N0 small peripheral lung cancer,[16] a lung metastasis, a ground-glass opacity, or an indeterminate lung lesion that might be benign. We also consider the patients who are "compromised" in that they are considered to be poor candidates for lobectomy because of limited cardiopulmonary reserve or other comorbidities. Wedge resection was considered inappropriate in all cases because of the tumor size or location in the deep parenchyma. Resected specimens were examined histopathologically, and histologic typing was done according to the World Health Organization classification.[17] In cases of malignancy, we designed the resection lines with a larger surgical margin than the tumor diameter (at least 2 cm). In case of insufficient surgical margin of the resected specimen, we performed an additional wedge resection using stapler. Surgical-pathologic staging was according to the TNM Classification of Malignant Tumors, Seventh Edition, published by the International Union Against Cancer and the American Joint Committee on Cancer.[18] If the cancer was in S10 near the S9 border, we selected the S9+S10 bisegmentectomy (Figure 1, *A*).

Three-Dimensional Computed Tomography Imaging and Simulated Navigation Method

The 3-D images were processed using preoperatively acquired volume data derived from CT. We also used the free software or work station. Processing required no more than 7 minutes.[12] The 3-D images were created and manipulated during surgery with the free software or work station of the CT equipment. Thus, we performed the operations while comparing and contrasting the simulation under real-time conditions.[11,12,19,20] We think that grasping the anatomic relationship between the tumor and the neighboring structures is important in the CT findings and 3-D CT imaging. The 3-D CT simulation images were used to identify the (1) segmental arterial branches, (2) intersegmental veins, and (3) venous branches in the affected segment.

Operative Procedure

Under the guidance of the previously mentioned simulated navigation, we applied the SAMURAI technique.[12] We collapsed the lung on the operating side and anesthetized the patient under differential ventilation. During the procedure, the surgeon stood on the dorsal side of the patient and the assistants stood on the ventral side. The image, on the assistants' side, was rotated 180°. Four ports (1 with a diameter of 20 or 15 mm [flexible] and 3 with a diameter of 5 mm) were prepared for the port access technique.

We first exposed the inferior pulmonary vein and its branches, the superior (V6) and the common basal vein, with traction of the lower lobe anteriorly (Figure 1, *B*). The intersegmental plane between S6 and S10 was divided using electrocautery or an energy device along V6b and V6c, which were the intersegmental veins between the superior (S6) and basal segments. An ultrasonically activated device or bipolar tissue sealing and dividing system were primarily used to divide the smaller segmental vessel branches after proximal ligation of the vessels. Thereafter, the targeted bronchus (B10 or B9+10) was exposed and the targeted pulmonary artery (A10 or A9+10) was exposed posteriorly (Figures 1, *B*, and 2, *B*). We secured the targeted bronchus after parenchymal dissection of approximately 3 cm along V6b and V6c. The targeted bronchus was secured using the bronchoscope and was looped with a suture. The targeted bronchus was then divided using the resected segment inflation method,[21,22] in which the affected segment was inflated and the reserved lung was deflated using the slip-knot bronchial ligation method[23] or the high-frequency jet ventilation via the bronchoscope technique.[10] The slip-knot technique was used for bronchial ligation and for visualization of the anatomic plane (Figure 2, Video 1). After looping the bronchus with monofilament suture, a slip knot was made outside the thorax. During bilateral lung ventilation, 1 end of the string was pulled, and the knot slipped to reach the bronchus without a knot-pusher. Bronchial ligation was then performed to block the outflow of segmental air while the segment remained inflated, whereas the other segments collapsed. The difference between the inflated and deflated lung parenchyma formed the demarcation line. The targeted artery

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