



Uniportal video-assisted thoracoscopic combined subsegmentectomy: a case report of left S³b + S⁴b

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Abstract: Anatomical complex segmentectomy has become increasingly important in oncological lung resection, particularly for small ground-glass nodules of primary lung cancers. Resection of a lung nodule located between the left upper division and the lingual segment is technically challenging. Delicate surgical planning is crucial to ensure adequate surgical margin while preserving maximum pulmonary function. A combined subsegmentectomy can be a feasible choice but is challenging to perform under uniportal approach due to limited working space and insufficient exposure of target segmental bronchi and pulmonary arteries. The purpose of this article is to introduce the technique we use to overcome these challenges. Herein, we report a case with two ground-glass nodules in the left upper lobe, one 0.6-cm adjacent to the V³b and one 0.4-cm beneath the S⁴b surface. Instead of extended upper division trisegmentectomy or extended lingulectomy, a uniportal video-assisted thoracoscopic S³b + S⁴b combined subsegmentectomy was planned and performed. Three-dimensional computed tomography reconstruction was performed preoperatively to reveal the branching pattern of the associated sub-segmental bronchi and pulmonary vessels. Inflation-deflation method was applied to identify intersegmental planes, and both lesions were removed successfully. We describe our “open the side door” technique for performing subsegmentectomy in this patient. This technique is helpful when performing a complex subsegmentectomy.

Keywords: Open the side door; subsegmentectomy; uniportal; video-assisted thoracoscopic surgery; case report

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Introduction

With the advancement of computed tomography (CT) technology, more and more small lung nodules have been encountered clinically. However, it is often difficult to plan a resection for a tiny nodule located deeply between two pulmonary segments, especially when the tumor is located between the left upper-division segments and lingular segments. Whether to perform an extended upper division trisegmentectomy or extended lingulectomy, there are concerns about excessive resection volume or inadequate

surgical margin. A combined segmentectomy or combined subsegmentectomy of S³ + S⁴ could be a feasible solution (1), but they are technically challenging in uniportal video-thoracoscopic surgery (u-VATS). Herein, we report the case of a patient who underwent u-VATS S³b + S⁴b combined subsegmentectomy and introduce our “open the side door” technique in u-VATS complex subsegmentectomy. We present the following case in accordance with the CARE reporting checklist (available at <https://jovs.amegroups.com/article/view/10.21037/jovs-21-29/rc>).

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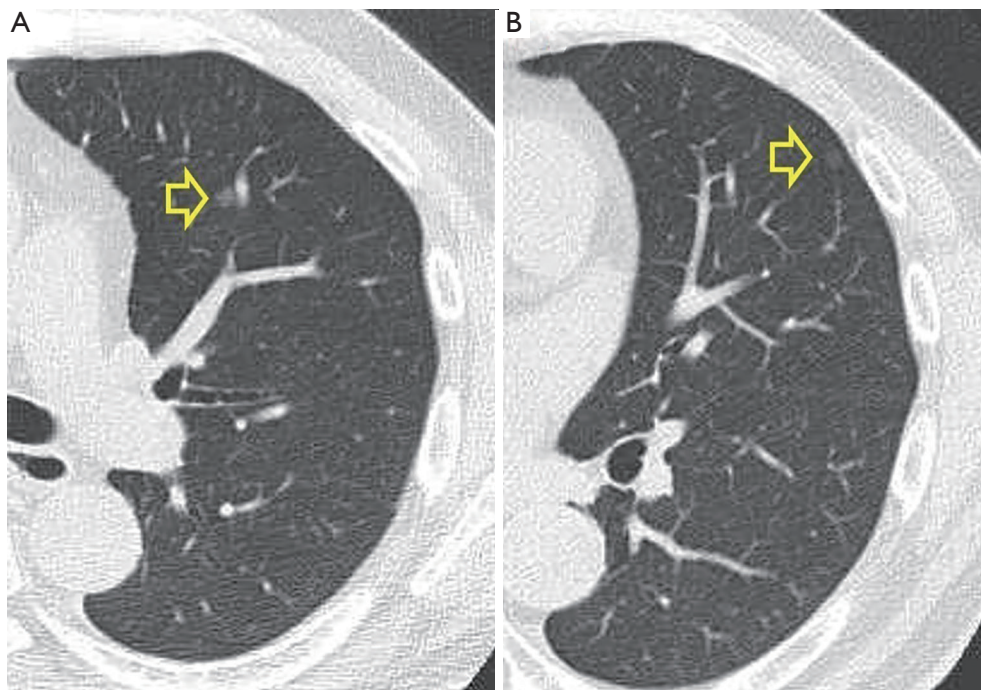


Figure 1 Chest CT scan showing two tiny pure GGNs located in left upper lobe. (A) 0.6 cm GGN adjacent to V³b (B) 0.4 cm GGN beneath the S⁴b surface (hollow arrows). CT, computed tomography; GGNs, ground-opacity nodules.

Case presentation

The patient was a 58-year-old man who is a current smoker, and with history of thyroid medullary carcinoma (stage IVA). He had undergone total thyroidectomy and pretracheal and right radical neck lymph node dissection 12 years ago, and was in complete remission status on presentation. Two tiny pure ground-glass opacity nodules (GGNs), 0.6 cm (*Figure 1A*) and 0.4 cm (*Figure 1B*) in the left upper lobe were noted on chest CT performed during a health check in 2019. These two nodules were still found in the CT performed 1 year later. Because of the possibility of early primary lung cancer, he decided to undergo surgical resection both for diagnosis and treatment. The 0.6-cm GGN was located between the left S³b and S⁴b, and the other 0.4-cm GGN was at the surface of the S⁴b. Therefore, S³b plus S⁴b combined subsegmentectomy was planned. Three-dimensional CT reconstruction (Synapse Vincent[®], Fujifilm Medical Co., Tokyo, Japan) was performed preoperatively to reveal the branching pattern of the associated sub-segmental bronchi and pulmonary vessels (*Figure 2*).

All procedures performed in this study were in accordance with the ethical standards of the institutional

and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and the accompany images and video. A copy of the written consent is available for review by the editorial office of this journal.

Surgical technique

General anesthesia was induced, with selective one-lung ventilation using a double-lumen endotracheal tube. The patient was placed on the full right lateral decubitus position, and the operator stood at the ventral site of the patient. The assistant always stood at the other side of the table with a thoracoscope in one hand and Wolf suction in the other hand to assist in exposing the surgical field.

A 3-cm utility port was created at the 4th intercostal space posterior to the anterior axillary line. A 2–4 cm SurgiSleeve wound protector (Medtronic, Minneapolis, MN, USA) was applied at the utility port. A 30° 10-mm thoracoscope was used for vision.

We applied an “open sequential doors” concept in the process of segmentectomy or subsegmentectomy (*Video 1*).

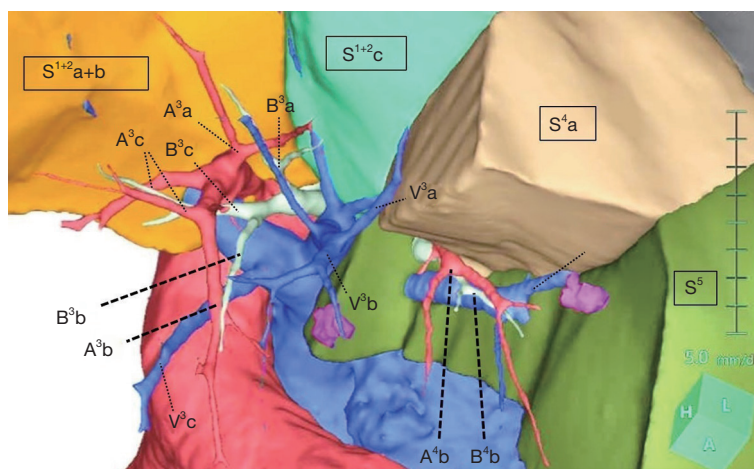
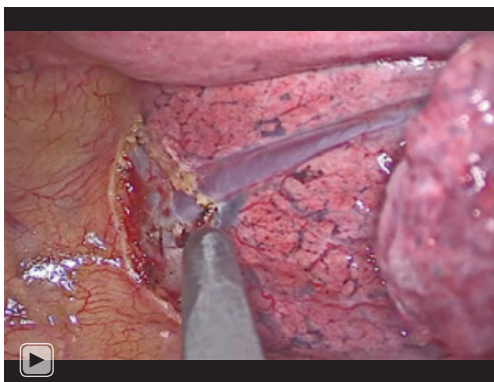


Figure 2 Three-dimensional CT reconstruction for our case. CT, computed tomography.



Video 1 The video presents the “open the side door” technique for left $S^3_b + S^4_b$ combined subsegmentectomy.

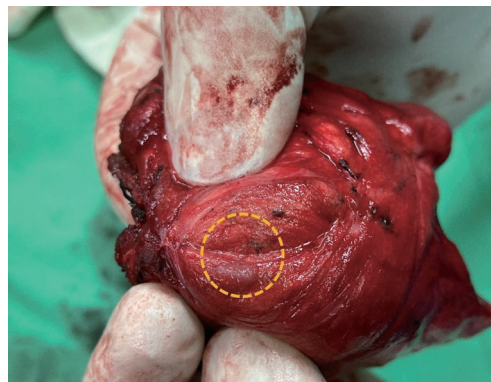


Figure 3 Surgical specimen with a 0.6 cm grayish nodule on cut, right at the junction of S^3_b of S^4_b .

First, we open the “front door” of the target sub-segments; we incise the hilar pleura to expose and identify the upper border (V^3_c), lower border (V^{4+5}), and intersegmental veins (V^3_b), which need to be divided. Then, we dissected along the V^3_c to find the A^3_b and B^3_b (the “inner door” of S^3_b) which was divided by using harmonic scalpel and Echelon Flex Powered Vascular Stapler (Ethicon Endo-Surgery, Inc., Cincinnati, OH, USA), respectively. For subsegmental pulmonary arteries, we usually ligated both the distal and proximal parts of dissected target vessels and then transected them in scissor or harmonic scalpel. For subsegmental bronchi, mostly we transected them by using linear staplers.

At this time, a modified inflation-deflation method (2) was used to identify the boundary of S^3_b . Then, the “left side door” was opened as we divided the upper border of

the S^3_b by using Echelon Flex 45 articulating endoscopic linear cutter (Ethicon Endo-Surgery Inc., Cincinnati, OH, USA) and harmonic scalpel toward the stumps of B^3_b and A^3_b . As a result, we were able to lift the corner of the S^3_b right ward and the inner door of the S^4_b , the A^4_b and B^4_b was fully exposed. We call this procedure the “open the side door” technique. Subsequently, dissection of the A^4_b and B^4_b was much easier.

After division of the A^4_b and B^4_b , the modified inflation-deflation method was performed once again to expose the boundary of S^4_b . The remaining border of the target sub-segments was closed by staplers. Finally, we applied Neoveil absorbable polyglycolic acid (Gunze Limited, Kyoto, Japan) on the raw surface of the remaining upper lobe to minimize the possibility of air-leakage. Operation time was 225 minutes, and the total blood loss was 300 mL.

In the target segment specimen, a 0.6 cm grayish nodule was found at the junction of S³b of S⁴b (Figure 3), and the other tiny nodule was visible at S⁴b. In the pathology report, the larger nodule was identified as an adenocarcinoma in situ and the smaller one an atypical adenomatoid hyperplasia.

The postoperative course was uneventful. The chest tube was removed on postoperative day 2, and the patient was discharged on postoperative day 3.

Discussion

Herein, we describe our “open the side door” technique and successfully removed two tiny lung nodules located between the left S³b and S⁴b and beneath the surface of S⁴b with u-VATS S³b + S⁴b combined subsegmentectomy.

Our strategy for nodule removal using combined segmentectomy or subsegmentectomy was based on the “open sequential doors” concept. The target segment can be regarded as a room. To enter the room, first, we have to enter the front door. Then, to reach the next or posterior room, we must go through the inner door. Sometimes, the room could be easily entered through the side door. For example, in the upper lobe, the front door is the space between bilateral inter-/intra-segmental veins. For the middle or lower lobe, the front door is the segmental arteries of the target segment, the inner door is the bronchi of the target segment, and the side door is the intra-segmental plane. The procedure for segmentectomy is similar to the process of opening these doors sequentially.

In the common practice of segmentectomy, the front and inner doors are usually opened first (i.e., to open the hilum pleura and ligate the segmental bronchi and arteries). Then, the intersegmental plane is identified by certain methods, and the side doors are opened in last by dividing the lung parenchyma along the intersegmental veins (3). The segmentectomy is complete as the intersegmental planes are all divided.

However, the sub-segmental bronchi and pulmonary vessels can be located deep inside the lung parenchyma and may be difficult to approach through the front and inner doors. Especially, in a u-VATS setting, achieving good exposure of the sub-segmental hilum with only one or two instruments is challenging. Under these circumstances, we recommend this “open the side door” technique. As one of the side doors is opened, the target segment can be moved diagonally, similar to lifting a corner of a bed cover, and the target bronchi and arteries can be well exposed at the

center of the operation field, making dissection or ligation of the bronchovascular bundles much easier. This “open the side door” technique is useful especially when performing combined segmentectomy or subsegmentectomy, such as S8a + 9a, 9a + 10a subsegmentectomy in the lower lobe or as in the present case.

Our technique has some limitations. If neither the sub-segmental bronchus nor the pulmonary artery can be dissected and the intersegmental vein is not on the surface of the parenchyma, the side door would have to be opened according to a less accurate, imaginary margin. Fortunately, in most cases, at least part of the target sub-segmental arteries will be transected when proceeding from the front door to the inner door. A reliable margin for the open side door can still be obtained by using indocyanine green and near-infrared thoracoscopy.

In conclusion, S³ and S⁴ combined subsegmentectomy is a feasible surgical method for tiny nodules located between the upper-division and lingular segments. The “open the side door” technique can help overcome inadequate exposure under u-VATS.

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and the accompany images and video. A copy of the written consent is available for review by the editorial office of this journal.

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