Thoracoscopic pulmonary combined with right S\(^1\)a + S\(^2\)a subsegmentectomy for deep intersegmental nodule surgery

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Abstract: The oncologic efficacy of pulmonary segmentectomy for early stage lung cancer has been long established. However, with the assistance of preoperative three-dimensional computed tomography bronchography and angiography (3D-CTBA), we found some nodules located at the intersegmental plane and in proximity to the intersegmental vein, which we designated as intersegmental nodules. For such nodules, an extended segmentectomy, bi-segmentectomy or lobectomy is usually performed to ensure a safe margin, as precautions should be taken to ensure no loss of lung function. Recently, our center innovatively developed a new method to resect such lesions by combining the subsegments around them. Here we report a case of combined subsegmentectomy of the right apical (S\(^1\)a) and dorsal (S\(^2\)a) subsegments for the treatment of early stage lung cancer.

Keywords: Combined subsegmentectomy; three-dimensional computed tomography bronchography and angiography (3D-CTBA); intersegmental nodules

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Introduction

With the development of high resolution computerized tomography (HRCT) and low-dose helical CT, the rate of detection of early stage lung cancer is rising (1). Intentional segmentectomy for early stage lung cancer has been widely developed (2-4). Various medical centers have confirmed the excellent prognosis of intentional segmentectomy for treating early stage lung cancer, in particular adenocarcinoma in situ (AIS) and minimally invasive adenocarcinoma (MIA) (5,6). Due to the complicated anatomical variations of segmental bronchi and vessels, thoracoscopic segmentectomy is technically much more demanding than lobectomy.

Our medical center began initiating thoracoscopic segmentectomy since 2010, and took the lead in using preoperative three-dimensional computed tomography bronchography and angiography (3D-CTBA) for surgery planning in China. Preoperative 3D-CTBA reveals the anatomical structures and variations of the segmental bronchi and vessels, in addition to segmental anatomic relationships of the nodule. With the use of preoperative 3D-CTBA, we found several lesions located at the intersegmental plane and in proximity to the intersegmental vein (named intersegmental nodule). In order to resect these kinds of nodules and ensure a safe margin, traditional segmentectomy had to expend resection (7). This could lead to injury of the intersegmental vein and the loss of lung parenchyma. Our center developed a new method, termed “combined subsegmentectomy”, to resect the intersegmental nodule. This paper presents a case in which a combined subsegmentectomy in the right S\(^1\)a + S\(^2\)a was performed to treat early stage lung cancer.

Patient and work up

A 55-year-old man with no history of smoking was admitted to our hospital diagnosed with a mixed ground-glass nodule (GGN). CT defined a 1.7×1.27×1.86 cm nodule with mixed ground-glass opacity between the right apical (S\(^1\)) and dorsal (S\(^2\)) segment. There was no significant enlargement of the
hilar and mediastinal lymph nodes (bilaterally) (Figure 1).

We performed 3D-CTBA reconstruction on the patient using the softwares Osirix and DeepInsight prior the surgery (Figure 2). An 18-mm nodule was located between the right S\textsuperscript{1}a and S\textsuperscript{2}a in proximity to the intersegmental vein (V\textsuperscript{2}a).

The anatomical configuration of the segmental bronchus, artery, and vein are presented in figure (Figure 2) and can be summarized as follows; the bronchus branches into the apicoposterior segmental bronchus (B\textsuperscript{1+2}a) and the anterior segmental bronchus (B\textsuperscript{2}a). The apical (A\textsuperscript{1}) and the posterior (A\textsuperscript{2}) segment arteries share the common truncus; A\textsuperscript{2} branches into the dorsal subsegmental arteries (A\textsuperscript{2}a), and the horizontal subsegmental arteries branches (A\textsuperscript{2}b1, A\textsuperscript{2}b2). A\textsuperscript{1} branches into the apical subsegmental artery branches (A\textsuperscript{1}a1, A\textsuperscript{1}a2) and the ventral subsegmental arteries (A\textsuperscript{1}b). V\textsuperscript{2}a drains blood from S\textsuperscript{1}a and S\textsuperscript{2}a.

As the nodule was located between the S\textsuperscript{1}a and S\textsuperscript{2}a approaching V\textsuperscript{2}a, we intended to resect the right S\textsuperscript{1}a + S\textsuperscript{2}a subsegmentectomy for sufficient margin. The bronchi of B\textsuperscript{1}a and B\textsuperscript{2}a were required to be resected. Furthermore, arteries of A\textsuperscript{1}a1 + A\textsuperscript{1}a2, A\textsuperscript{2}a, and V\textsuperscript{2}a had to be resected.

Surgery (Figure 3)

Three-port thoracoscopic right S\textsuperscript{1}a + S\textsuperscript{2}a subsegmentectomy was performed with the patient under general anesthesia under single-lung ventilation. After dissecting the posterior mediastinum pleura, we sampled the subcarinal lymph nodes and exposed peripherally the right upper lobar bronchus to reveal A\textsuperscript{2}a and A\textsuperscript{2}b2. Subsequently, we dissected the anterior mediastinum pleura and exposed peripherally the truncus of A\textsuperscript{1} + A\textsuperscript{2}. A\textsuperscript{2} was exposed, which facilitated the identification of A\textsuperscript{2}a and A\textsuperscript{2}b1 later on. Then, A\textsuperscript{2}a was dissected. We exposed A\textsuperscript{1} to identify A\textsuperscript{1}a1, A\textsuperscript{1}a2, and A\textsuperscript{1}b. A\textsuperscript{1}a1 and A\textsuperscript{1}a2 were cut to expose B\textsuperscript{1}a and B\textsuperscript{1}b, following which dissecting B\textsuperscript{1}a was required. The distal of A\textsuperscript{1}a stump was exposed peripherally to identify B\textsuperscript{2}a, which was dissected afterwards. Lastly, we dissociated the distal stump of B\textsuperscript{2}a to expose V\textsuperscript{2}a to be dissected.

The intersubsegmental plane was identified by the inflated-deflated line and was separated with electrocautery and endoscopic staplers. We sampled the hilar, paratracheal, and tracheobronchial lymph nodes and was identified as MIA. Total surgical time was about 150 min, with about 20 mL of blood loss.

Figure 1 CT image showing the mixed ground-glass opacity (red arrow) between right S\textsuperscript{1} and S\textsuperscript{2}. CT, computed tomography.

Figure 2 3D-CTBA showing the lesion (green ball) located between right B\textsuperscript{1}a and B\textsuperscript{2}a approaching the V\textsuperscript{2}a and the anatomical structure. A\textsuperscript{1} branches into A\textsuperscript{1}a, A\textsuperscript{1}b1 + A\textsuperscript{1}b2. A\textsuperscript{2} branches into A\textsuperscript{2}a, A\textsuperscript{2}b1 + A\textsuperscript{2}b2. 3D-CTBA, three-dimensional computed tomography bronchography and angiography.

Figure 3 Combined right S\textsuperscript{1}a + S\textsuperscript{2}a subsegmentectomy (8). Available online: http://www.asvide.com/article/view/25646

Video 1. Combined right S\textsuperscript{1}a + S\textsuperscript{2}a subsegmentectomy

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Postoperative management

The postoperative course was uneventful. A chest drain was removed in POD2 (postoperative 2 days), and the patient was discharged in POD 4. Postoperative radiographic X-ray showed the expanded pulmonary without residual air or fluid (Figure 4). The final diagnosis was T1aN0M0 adenocarcinoma. There was no lymph nodule metastasis.

Discussion

Thoracoscopic pulmonary segmentectomy can preserve lung function and reduce postoperative complications (9). Multi-center research studies have shown that segmentectomy showed equal oncologic outcomes as lobectomy in deep early stage lung cancer (2-4). Therefore, intentional pulmonary segmentectomy has become a widely used treatment for early stage non-small cell lung cancer (NSCLC), notably GGO predominant lesions (10). Due to the complicated anatomical variations of segmental bronchus and vessels, there are still technical and anatomical pitfalls that must be overcome to achieve a safe and precise segmentectomy.

Recently, several studies have confirmed the value of the reconstruction of 3D-CTBA (11-13). Preoperative 3D-CTBA reconstruction is helpful for surgery planning, as it details, nodule location, identification of targeted vessels, bronchus, surgical margins, anatomical variations, simulating safe margins, and planning of surgical approach. In our medical center, reconstruction of 3D-CTBA has become a necessary and routine procedure before segmentectomy. The advantage is that surgeons better understand the pulmonary anatomy of each patient before and during surgical procedures, thus reducing the risk of operation and shortening surgery times.

With the assistance of pre-operative 3D-CTBA, we found lesions located at the intersegmental plane and in proximity to the intersegmental vein, which we termed, intersegmental nodule. Single segmentectomy could lead to insufficient margin, which increases the risk of local recurrence (14,15). The problem with the extended segmentectomy is that it could damage lung function. Our medical team devised a new method to prevent such occurrence. This was performed by resecting the lesion and combining subsegments around the intersegmental nodule. In this report, the tumor was located between S’a and S’a in proximity to V’a, and extended segmentectomy resected S’ and S’a. The combined subsegmentectomy right S’a + S’a reduced the loss of S’b.

Conclusions

In this report we describe a patient with intersegmental nodule that was treated using the combined subsegmentectomy right S’a + S’a. This preserved more lung function and ensured sufficient margin, which led to a good prognosis. Thus the combined subsegmentectomy is an effective technique to treat intersegmental nodules.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication of this Case Report and any accompanying images.

References

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