



The significance of pulmonary fissure completeness in video-assisted thoracoscopic surgery

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One of the major treatment options for early-stage non-small cell lung cancer is surgical resection. Among the several resection subtypes, anatomical lobectomy remains the standard treatment of choice. Since the introduction of video-assisted thoracoscopic surgery (VATS) in the 1990s, there has been a paradigm shift in lung cancer surgery. VATS has developed considerably as a technique and is widely accepted in lung cancer treatment. This minimally invasive approach has several advantages over traditional thoracotomy, such as faster recovery, reduced pain, shorter hospital-stay duration, and fewer morbidities (1,2).

However, despite the advances made with regard to the VATS approach, patients still experience 26.2–36.3% post-operative morbidities. Several factors contribute to these morbidities, including chronic obstructive pulmonary disease, previous infection, history of tuberculosis, diabetes mellitus, and combined treatment modalities (2,3), along with pulmonary fissure completeness (4).

In 1997, Craig *et al.* originally classified the pulmonary fissure based on the degree of fissure development and the exposure of the pulmonary artery (5). Craig *et al.* graded fissure completeness into four stages: grade 1, complete fissure with entirely separate lobes; grade 2, complete visceral cleft, but parenchymal fusion at the base of the fissure; grade 3, visceral cleft evidently forming a part of the fissure; and grade 4, complete fusion of the lobes with no evident fissure line. However, for thoracic surgeons,

the depth of interlobar fissure rather than its length has greater practical importance with regard to the dissection of the pulmonary artery at the base of the oblique fissure. Accordingly, we suggested a modified fissure assessment model and fissure development score system based on the original classification (6).

The modified model divides pulmonary fissures according to their anatomical region of effect and degree of completeness into four major categories: upper-major fissure, lower-major fissure, minor fissure, and area over the pulmonary artery. The degree of two fissures within a target lobe and the degree of fissure over the pulmonary artery are used to calculate fissure-sum average (FSA).

The degree of pulmonary fissure is a major hurdle to consider for ensuring a safe procedure during VATS lobectomy. Conventional lobectomy is achieved by ligation of the branches of the pulmonary artery, vein, and bronchus. Blunt or sharp dissection of the lung parenchyma overlying the artery is the first step for exposing the pulmonary artery. The procedure may produce air leaks that can prolong the hospital-stay duration or cause other morbidities. When compared with conventional thoracotomy, the lack of tactile sense during VATS makes it difficult to localize and dissect the exact portion of the lung parenchyma overlying the pulmonary artery. This may produce more complications. As such, incompleteness of the pulmonary fissure is commonly associated with postoperative morbidity with

respect to VATS lobectomy. Despite its importance, there was no report regarding this issue until Li *et al.*'s (4) study.

Li *et al.* evaluated the effects of fissure completeness on early outcomes after VATS lobectomy for lung cancer by using the modified fissure assessment model (6). Among a total of 563 lung cancer patients, 190 had less-developed fissures (group A) and 378 had well-developed pulmonary fissures (group B) (FSA cutoff =1). Group A had an older mean age ($P<0.001$), higher rate of smoking history ($P=0.041$), tuberculosis ($P=0.011$), diabetes and mellitus ($P=0.003$), history of malignancy ($P=0.016$), denser pleural adhesion ($P<0.001$), and longer operation times ($P<0.001$). As expected, operative complications occurred more commonly in group A. Both minor morbidity (42.1% *vs.* 24.7% $P<0.001$) and major morbidity (11.1% *vs.* 5.6%, $P=0.021$) were different. Upon consideration of individual complications, prolonged air leakage (22.1% *vs.* 8%, $P<0.001$), pneumonia (17.4% *vs.* 9.7%, $P=0.008$), atelectasis (10.5% *vs.* 4.6%, $P=0.007$), subcutaneous emphysema (8.9% *vs.* 4%, $P=0.017$), and pneumothorax (6.8% *vs.* 2.7%, $P=0.018$) were all found to be more common in group A. Morbidity and individual complications also showed steady increasing trends with an increase in FSA score. The hospital-stay duration (mean 7.7 *vs.* 6.4 days, $P<0.001$) and duration of chest tube drainage (mean 5.1 *vs.* 4.1 days, $P<0.001$) were also longer in group A.

As shown, incompleteness of the pulmonary fissure led to increased morbidity after VATS lobectomy and a longer operation time. However, this increased morbidity could have been overcome or reduced by alternative fissure-less, fissure-last VATS approach (7). By avoiding initial dissection of the lung parenchyma overlying the pulmonary artery and dissecting the fissure at the final step, fissure-less fissure-last VATS lobectomy is expected to show less complications, such as air leakage, compared to conventional VATS lobectomy. Therefore, the fissure-less, fissure-last VATS lobectomy could be an option for patients with incomplete pulmonary fissures.

The completeness of the pulmonary fissure is clearly a major factor that affects postoperative morbidity and hospital-stay duration when performing VATS lobectomy. Accordingly, thoracic surgeon should carefully consider on the status of the fissure when planning to perform VATS lobectomy.

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Footnote

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

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