Editorial

Problems with using the air leak test with Yang's bubble solution during video-assisted thoracic surgery

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The lung is an air-containing organ, and in the case of lung resection, air leakage from the remnant lungs often occurs. It is usually difficult to repair air leaks from the lungs after resection, especially in cases of pulmonary parenchyma with strong emphysematous changes, such as chronic obstructive pulmonary disease, and lung damage caused by interstitial pneumonia (1). Air leakage from the lungs is closely associated with postoperative complications, and there is a risk of progression to acute empyema due to prolonged lung fistula (2).

It has been reported that air leaks from the pulmonary parenchyma affect the duration of hospital stay after lung surgery (3,4). Therefore, controlling pulmonary air leakage is important for stabilizing the patient's postoperative course. Most studies on air leakage during lung surgery are related to the restoration method, and there are few papers that focus on the method of evaluating and determining the location of an air leak (5,6). Air leaks from the lung occur not only on the cut surface caused by the energy device but also on the staple line after removing the pulmonary parenchyma with an automatic suturing device (7,8).

Conventionally, a water submersion test has been used to detect air leaks from the lung parenchyma. However, unlike open thoracotomy, during video-assisted thoracic surgery (VATS), it is often difficult to observe and identify air leaks because it is challenging to secure sufficient space and an optimal field of view in the thoracic cavity because inflation of the lungs is required for a water submersion test. In particular, the detection of a pulmonary air leak in cases involving a large residual lung volume is problematic, as in the case of partially resected stumps or peeled surfaces of total pulmonary adhesions.

Some studies on the extent of air leaks have been based on the ventilation mechanical test, which quantifies the intraoperative pulmonary air leak; depending on the severity of the air leak, it has been reported that this test can be used to predict postoperative air leakage from the lungs and the length of hospital stay (3,4). However, these studies did not mention the method used to identify the location of the air leak. Leakage from the site where the pulmonary parenchyma is cut, such as the site of interlobar dissection, is considered easy to identify, but as mentioned previously, minor leaks originating from the lung surface are difficult to detect without lung inflation accompanied by high airway pressure; therefore, it is difficult to identify such air leaks during VATS.

Furthermore, the water submersion test performed in a narrowed intrathoracic space after lung inflation requires an underwater camera. As a result, the likelihood of detecting an alveolar air leak is decreased. However, the air leak test with Yang's bubble solution can be performed without an underwater camera. According to Yang's method, the bubble solution must directly reach the site of air leakage on the visceral pleura surface. Because the field of view of the visceral pleura surface is a narrow, enclosed space between the chest wall and inflated lung, identification of the leaks is thought to not be as easy as in the experimental model. In addition, there are some problems associated with using the air leak test with Yang's bubble solution.

(I) What is the effect of Yang's bubble solution on an irregular lung surface?

In the experimental model, the normal

pleural surface is scratched and then observed for a leak, but what is the effect of Yang's bubble solution on uneven surfaces, such as interlobar or intersegmental surfaces, after resection? In a video that illustrated this method, the solution was dropped on a flat surface, and then it was observed for leaks, but there is a possibility that some of the solution accumulates when the surface is uneven. Thus, it would be interesting to determine whether the same effect would be observed in the clinical setting.

(II) Does Yang's bubble solution affect the treatment of a pulmonary air leak?

After the air leak from the lung is identified, it becomes a target in the closure procedure. When Yang's bubble solution remains on the site of the air leak, does it affect the sealing ability of the fibrin glue used to repair the air leak?

(III) How long is the half-life of Yang's bubble solution?

How long will Yang's bubble solution remain in the body? It has been reported that it is a non-toxic solution, but it is unknown how it decomposes or is discharged from the body.

(IV) How long does it take to test for an air leak using Yang's bubble solution?

Yang's bubble solution is used to determine whether a bubble forms after dropping the solution on the lung surface, which indicates an air leak, and it seems to take a considerable amount of time to evaluate the entire surface of the lung for the presence of bubbles.

Additionally, it may be difficult to drop the solution on the entire surface of the lung when using a limited approach via the VATS port. Although the water submersion test is associated with problems when searching for leaks at the submerged sites and on parts of the lung that are difficult to submerge in water, it is possible to test for most pulmonary air leaks in a short time because a large part of the lung is submerged at the same time.

In conclusion, it is necessary to solve these problems in order to show that the air leak test with Yang's bubble solution is better than the water submersion test. Further research on this topic is expected.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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