



Is surgery the choice for treatment for first presentation of pneumothorax?

Taichiro Goto

Department of General Thoracic Surgery, Yamanashi Central Hospital, Yamanashi, Japan

Correspondence to: Taichiro Goto, MD, PhD. Department of General Thoracic Surgery, Yamanashi Central Hospital, Yamanashi 400-8506, Japan.

Email: taichiro@1997.jukuin.keio.ac.jp.

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Primary spontaneous pneumothorax (PSP) usually occurs in young adult males, and it often recurs after treatment. In general, initial pneumothorax is treated conservatively by observation, simple aspiration, and chest tube treatment, whereas recurrent pneumothorax is treated using video-assisted thoracoscopic surgery (VATS). Accordingly, many international guidelines do not recommend surgery for initial pneumothorax unless there is persistent leakage of air (1). In the recent years, some thoracic surgeons tend to offer VATS to patients on their first presentation of PSP; however, their judgements have been made on a case by case basis without supporting evidence, and thus the optimal treatment for initial pneumothorax is still controversial (2).

Olesen *et al.* reported a study to determine the benefit of surgery in patients following their first episode of PSP (3). The novelty of the study is that the authors focused on the size of the bulla on high-resolution computed tomography (HRCT) as a predictor to identify patients with high risk of recurrence. Patients were stratified into two groups based on the presence of bullae ≥ 1 or < 1 cm on HRCT, and each population was randomly assigned to the chest tube group and the VATS group (3). The study demonstrated that the recurrence rate among patients with bullae ≥ 1 cm was significantly lower in the VATS group than that in the chest tube group. Moreover, the chest-tube group showed a significant correlation between recurrence rate and size of bullae (3). Finally, based on the results including those from

the subgroup analysis, the authors concluded that VATS is recommended even in patients with initial pneumothorax if they have bullae ≥ 2 cm (3). We would like to discuss this topic further in terms of prevention of recurrence of pneumothorax.

In routine clinical practice, surgery is principally indicated for recurrent pneumothorax, based on the evidence that the recurrence rate is reported to be approximately 30–50% after conservative treatment in the first episode of pneumothorax and 60–80% after that in recurrent pneumothorax (4–7). Thus, if we can identify a subgroup of patients at high risk of recurrence among those with initial pneumothorax, we can provide evidence that patients in the subgroup may benefit from surgery. Olesen *et al.* focused on the size of bulla and reported that the recurrence rate among patients with bullae ≥ 2 cm tended to be greater in the chest-tube group than that in the VATS group (HR 3.2, 0.92–10.79, $P=0.067$) (3). Based on these results, they proposed that surgery should be the standard treatment for the subgroup. It was a novel, logical, and reasonable proposal, and we considered that this study provided valuable information. However, there was a limitation in their study design; the patients were divided into two groups based on the presence of bullae ≥ 1 cm or < 1 cm and the patient group with bullae ≥ 2 cm was not included in the randomized study. In addition, the results of the above study were not statistically significant ($P=0.067$) due to the small sample size (3). Therefore, further studies

are required to validate these results.

In the study by Olesen *et al.*, it was reported that the recurrence rates among patients with initial pneumothorax were 34–35% in the chest tube group and 12–13% in the VATS group (3). In principle, an increase in the discrepancy in the recurrence rates between the two groups supports the proposal that surgery is the standard of care in patients with initial pneumothorax. One approach to this is to identify the group with high-risk of recurrence following conservative treatment. Hereafter, in addition to the size of the bullae, other biological and radiological parameters and markers must be considered in the analysis. Another approach is to reduce the recurrence rate after surgery. This mainly concerns the effects of pleural adhesion procedures during surgery. According to the Japanese guidelines for surgery of pneumothorax, it is advisable to add a supplemental procedure, such as pleurodesis and staple line reinforcement, during surgery (6).

Overall, the pneumothorax recurrence rates following VATS are reported to range from 4.1% to 11.5% (8-12). A meta-analysis found that the recurrence rate was four times greater with VATS than that with thoracotomy (13), whereas the guidelines of the British Thoracic Society state that VATS increases the recurrence rate by approximately 5% as compared with thoracotomy (14). Because of the reduced invasiveness, VATS is performed in most patients undergoing surgery for pneumothorax and is recognized as a routine operation (1,6,14,15). In addition, many guidelines strongly recommend VATS as a surgical procedure in pneumothorax surgery (1,6,14,15). Accordingly, the most realistic approach for prevention of recurrence is to perform surgery by VATS, along with a pleural adhesion procedure during surgery. New bullae formation in the staple line is reported to increase the risk of recurrent pneumothorax following VATS (16), and various forms of pleurodesis are considered to reduce recurrence, including covering the visceral pleura using an artificial absorbable sheet, parietal pleurectomy, pleural abrasion, and talc poudrage (13,17). Sakamoto *et al.* reported a decrease in the recurrence rate from 9.5% to 2.6% by reinforcing the surface of the visceral pleura dissected with an automatic suture device using absorbable mesh (18). Nakanishi *et al.* reported lower recurrence rate in patients in whom absorbable mesh (3.2%) was added than in those who underwent VATS bullectomy alone (23.9%) (19). In the annual report of the Japanese Association for Thoracic Surgery [2015], with 11,816 patients undergoing VATS, bullectomy alone was performed in 3,118 (26.4%) and bullectomy with an

additional procedure in 7,805 (66.1%) (20), indicating that attempts were made prevalently to reduce the recurrence rate.

Pneumothorax usually occurs in young adult males. Hence, prevention of recurrence is important from a social and psychological perspective. On the other hand, when planning treatment, clinicians should consider possible situations, which could arise in the future where the patient would require surgery for chest diseases such as lung cancer etc. We believe that the safety of future surgery should not be compromised with excessively strong and tight adhesion. Thus, further research is warranted to develop safe and effective adhesion therapy and explore a method of mild and spotty adhesion that can prevent collapse of the lung.

The development of less invasive surgical techniques is important to overcome the physical and psychological challenges associated with surgery. Currently, 2-port or uniport technique and transareolar approach are under development, although 3-port VATS is still being performed in many institutions (21-23). We believe that the validity of VATS can be established by developing less invasive methods, without compromising safety and curability. In addition, a study reported that surgery was more advantageous from the perspective of medical economy even in patients with initial pneumothorax (24,25). Previous non-randomized studies concluded that preventive VATS in patients with the first presentation of PSP would initially increase the cost per individual, but over time, it was justified financially because it significantly reduced the number of readmissions (24,25).

In summary, it has been demonstrated that patients with initial pneumothorax can benefit from VATS, and those with large bullae are the primary candidates for the surgery. Further clinical studies and improvement of surgical technique are needed to develop a safe, less invasive, and effective method for prevention of recurrence in young, otherwise healthy patients with PSP.

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Footnote

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