



3D photography method using digital subtraction angiography for detecting leakage point in a patient with pneumothorax

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Abstract: Preoperative identification of air leakage points is one of the keys to the success of surgery for secondary spontaneous pneumothorax (SSP). Here we describe a new 3D photography method using digital subtraction angiography (DSA) to detect air leakage in a patient with SSP. This enabled the patient to undergo video-assisted thoracoscopic surgery (VATS) successfully, and was free of recurrence 6 months after surgery.

Keywords: 3D photography; digital subtraction angiography (DSA); leakage point; secondary spontaneous pneumothorax (SSP)

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Introduction

Secondary spontaneous pneumothorax (SSP) affects patients with underlying pulmonary disease, mainly chronic obstructive pulmonary disease (COPD). SSP is considered to differ from primary spontaneous pneumothorax (PSP) because of the life-threatening symptoms, the various locations of ruptured bullae, and the high rates of recurrence and mortality (1). Video-assisted thoracoscopic surgery (VATS) often reveals multiple bullae or diffuse pleural adhesions in the thoracic cavity, requiring the affected lung to be collapsed, and often making it difficult to find the leakage point (2). We have performed pleurography prior to surgery in order to find the leakage point, but as 2D images demonstrate perspective in only one direction, this is often impossible. We have therefore developed a system that can perform 3D photography with digital subtraction angiography (DSA), allowing detection of leakage points as air bubbles that can be confirmed in 3D. Herein, we report a patient in whom the leakage point was detected successfully by preoperative 3D photography with DSA, allowing thoracoscopic surgery to be performed.

Case presentation

A 77-year-old man with COPD and left-sided SSP underwent VATS bullectomy of the lingular segment due to emphysema. At surgery, resected area was reinforced by covering with a glycolic acid/lactic acid polyester mesh (Vicryl Mesh® ETHICON). Two months later, the patient was hospitalized again for recurrence of SSP. CT scan on readmission demonstrated pneumothorax and several pleural adhesions of the left lung (*Figure 1*). A chest drainage tube was placed in the thoracic space. As surgical intervention for continuous air leakage seemed unavoidable, we selected 3D photography with DSA for detection of the leakage point before surgery, as detection by 2D pleurography proved impossible. After infusion of contrast medium from the drain into the thoracic cavity, 3D photography with DSA was performed over 200 degrees for 8 seconds (*Figure 2*). We were able to visualize bubbles from the dorsal side of the lower lobe near the spine, indicating the leakage point. We performed thoracoscopic surgery via a single 3-cm incision just above the leakage point, which revealed leakage from ruptured bullae in the lower lobe near the spine same, corresponding to the feature confirmed by preoperative 3D photography. Since there were several pleural adhesions at

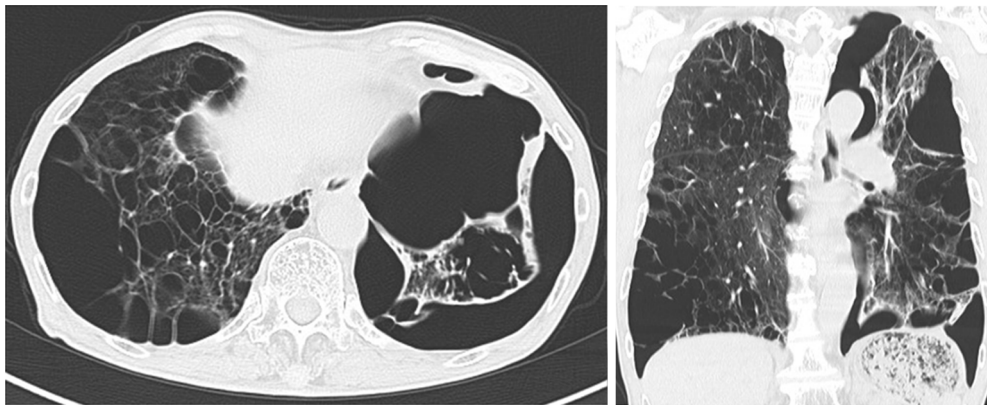


Figure 1 CT scan demonstrated pneumothorax and several pleural adhesions of the left lung.

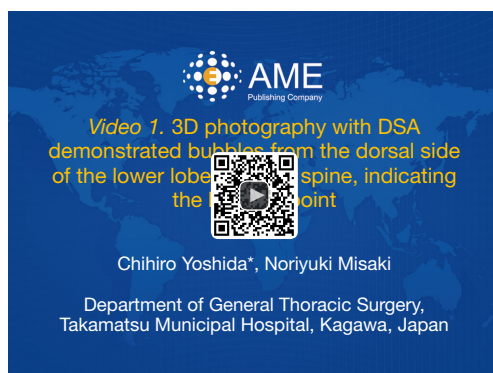


Figure 2 3D photography with DSA demonstrated bubbles from the dorsal side of the lower lobe near the spine, indicating the leakage point (3). DSA, digital subtraction angiography.

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the surroundings of the bullae, less commonly we performed ligation of the bullae in the lower lobe without having to detach the pleural adhesions unnecessarily. The chest tube was removed on the day after surgery, and six months later there had been no recurrence of SSP.

Comments

Patients with SSP due predominantly to chronic diffuse lung disease often have poor lung function and pleural adhesion, making surgery difficult. Detection of the leakage point before surgery may make VATS feasible, thus shortening the operation time and simplifying the procedure.

Pleurography can be used for detection of air leakage and can indicate the location, number and size of the bullae (4,5).

However, use of this technique is not widespread, and requires a high level of examiner skill (5). Preoperative 3D photography with DSA may help to visualize the leakage point stereoscopically. Furthermore, both the size and degree of air leakage may be assessed in detail, thus helping surgery. In conclusion, we have successfully detected leakage points using preoperative 3D photography with DSA, allowing us to perform appropriate surgery.

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Footnote

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/jovs.2018.08.09>). The authors have no conflicts of interest to declare.

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 studies involving human participants were in accordance with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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