

## Reexpansion Pulmonary Edema Due to High-Frequency Jet Ventilation: Report of a Case

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**Abstract** Barotrauma is well known to be a relatively common complication of high-frequency jet ventilation (HFJV); however, the occurrence of reexpansion pulmonary edema (REPE) is extremely rare. We report herein a case of REPE caused by difficulties encountered with anesthesia using HFJV during video-assisted thoracic surgery (VATS) for a spontaneous pneumothorax. We believe the rapid increase in pressure in the lung after degassing for VATS resulted in REPE as well as typical barotrauma.

**Key words** Reexpansion pulmonary edema · High-frequency jet ventilation · Video-assisted thoracic surgery

### Introduction

The complications of high-frequency jet ventilation (HFJV) have been reported to include not only airway barotrauma such as pneumothorax, subcutaneous emphysema, and pneumomediastinum, but also gastric distention caused by esophageal intubation accompanied by tearing of the mucosa and bleeding.<sup>1-3</sup> However, the occurrence of pulmonary edema seems to be extremely rare. We report herein the case of a teenage girl in whom reexpansion pulmonary edema (REPE) was caused by difficulties in anesthesia using HFJV during video-assisted thoracic surgery (VATS) for a spontaneous pneumothorax.

### Case Report

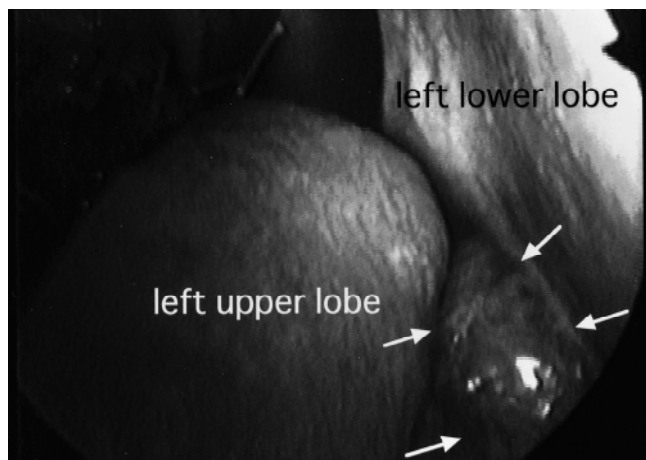
A 14-year-old girl was transferred to our hospital to undergo surgery for a left spontaneous pneumothorax

21 days after its onset. Despite its being her first episode, the symptoms were intractable and the air leakage persisted; therefore, VATS was performed 23 days after its onset, being 19 days after the commencement of continuous suction. There was no remarkable anamnesis or any family history, and no abnormalities in heart or lung function were detected on admission.

Surgery was performed under general anesthesia with single lung ventilation, using HFJV for the affected lung. A double lumen tube (35F) was used for divided ventilation and the frequency of HFJV was 300/min. Two breaks, both about 10mm long, were found in the apex, and triple ligation using endo-loops was performed on each. To test the seal, the anesthesiologist was requested to perform ventilation and compression of the involved lung. Thus, the endotracheal tube on the side being operated on, which had been opened, was connected to the ventilator with the HFJV on, and subjected to excessive pressure, leading to rapid expansion. Thoroscopic findings after degassing revealed extensive pneumomediastinum (Fig. 1). Thereafter, her blood pressure gradually decreased, then bradycardia occurred a few minutes later, and ventricular fibrillation developed. The patient was immediately placed in the supine position, and cardiac massage was performed with 100% oxygen ventilation. About 1 min later sinus rhythm returned and her oxygen saturation according to the percutaneous monitor improved. Because a bronchoscopy revealed red foamy sputum in the involved bronchus, pulmonary edema was diagnosed and 100mg methylprednisolone was injected intravenously. A chest X-ray also confirmed pulmonary edema (Fig. 2). The patient was transferred to the intensive care unit immediately after surgery in a coma, but the next day, she woke up and became lucid without any sequelae. Since an air leak from the left drain persisted, the drain was not removed until the 22nd postoperative day. The patient was discharged from hospital on the 31st postoperative day.

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**Fig. 1.** Thoracoscopic findings after degassing revealed extensive pneumomediastinum (arrows)

## Discussion

Persistent air leak, bleeding, infection, and other complications of VATS have been reported,<sup>4</sup> but few cases of life-threatening complications occurring following surgery for spontaneous pneumothorax have been reported, especially in young patients, suggesting that the safety of VATS is well established. As a rule, general anesthesia and single-lung ventilation is used to perform VATS in our hospital. While single-lung ventilation is maintained without any problems in the majority of our patients, combination with HFJV was performed for reduced oxygen saturation in the early experience of VATS.

The etiology of REPE remains speculative, although it is thought to be caused by increased pulmonary capillary permeability. The factors that have been postulated to contribute to altered permeability include lung hypoxia, chronicity of pulmonary collapse, rapid reexpansion, subsequent occurrence of strong negative pressure in the thorax, the application of excessive intrathoracic suction pressure, a rapid increase in blood flow to the involved lung during reexpansion, an increase in the pressure gradient between the alveolar space and the pulmonary capillaries, disturbance of lymph flow in the lung, and destruction of lung surfactant.<sup>5,6</sup> In our patient, we believe that rapid reexpansion, a rapid increase in blood flow to the involved lung during reexpansion, and an increase in the pressure gradient between the alveolar space and the pulmonary capillaries were involved in the altered permeability.

Recently, not only VATS, but also general thoracotomy has been performed with single-lung ventilation in many patients, but pulmonary edema is rarely encoun-



**Fig. 2.** Chest X-ray taken just after surgery showed massive subcutaneous and mediastinal emphysema and pulmonary edema in the left upper lung

tered during compression of the involved lung during or at the end of surgery. The possibility that rapid reexpansion and excessive pressure may cause pulmonary edema in the lung that is not essentially pathologic is demonstrated by the present case report.

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