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Anesthetic management for resection of a giant emphysematous bulla: a case report

Xianju Lin[1,2], Hongzhu Wang[1], Yong Yang[1,2] and Haifei Xiang[1,2]

Abstract

Anesthetic management for patients with a giant emphysematous bulla (GEB) is challenging. This case report describes a patient who developed 95% pulmonary compression by a GEB. A 14-Ga indwelling catheter was placed in the GEB before surgery to allow for slow re-expansion of the collapsed lung tissue. This prevented rupture of the GEB during anesthesia. Additionally, positive-pressure ventilation was performed to reduce the risk of re-expansion pulmonary edema. This respiratory management strategy may be beneficial for patients with a GEB who develop pulmonary dysfunction during thoracic surgery.

Keywords

Giant emphysematous bulla, vanishing lung syndrome, anesthetic management, pulmonary compression, positive-pressure ventilation, case report

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Introduction

A giant emphysematous bulla (GEB), which is characteristic of a condition sometimes referred to as vanishing lung syndrome, was first described by Burke[1] in a young male smoker exhibiting large bullae in the upper lung lobe associated with paraseptal emphysema. Roberts et al.[2] described the radiographic criteria for this entity: the

[1]Department of Anesthesiology, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Taizhou 317000, P.R. China
[2]Department of Anesthesiology, Enze Hospital, Taizhou Enze Medical Center (Group), Taizhou 317000, P.R. China

Corresponding author:
Haifei Xiang, Department of Anesthesiology, Enze Hospital, Taizhou Enze Medical Center (Group), No. 150, Ximen Street, Linhai, Taizhou 317000, P.R. China.
Email: 402074438@qq.com

presence of giant bullae in one or more upper lobes (mostly unilateral) that were often asymmetrical and occupied at least one-third of the hemithorax and compressed the surrounding normal lung parenchyma. The bullous area does not participate in bronchoalveolar oxygenation and causes dyspnea, hypoxia, symptomatic chest pain, pressure, and/or hemoptysis. This can result in spontaneous pneumothorax, pneumothorax provoked by mechanical ventilation, infection, or even malignancy. Various imaging techniques[3] and surgical methods for GEB[4,5] have been reported. We herein describe a patient who developed a GEB with 95% pulmonary compression and analyze this case from the perspective of anesthetic management.

Case presentation

A 53-year-old man (height, 170 cm; weight, 89 kg) was admitted to the hospital because of a 1-year history of shortness of breath after exercise. The patient was a smoker, had a history of hypertension, and was taking captopril and nimodipine. Breathing was reduced in the left lung. However, neither rhonchus nor moist rales were heard during auscultation. Chest computed tomography revealed a GEB, and the left lung was compressed by about 95% with a right mediastinal shift (Figure 1). An electrocardiogram showed normal findings, and echocardiography revealed that the heart was located in the right thoracic cavity. The left ventricular diastolic function was decreased, and the left ventricular ejection fraction was 64%. Laboratory tests showed no obvious abnormalities. Arterial blood gas analysis showed the following: pH: 7.43, $PaCO_2$: 41 mmHg, PaO_2: 94 mmHg, lactate: 1.4 mmol/L, potassium: 3.6 mmol/L, sodium: 138 mmol/L, calcium: 1.10 mmol/L, FiO_2: 21%, and SpO_2: 98%.

On the day of surgery, the patient's electrocardiogram, blood pressure, SpO_2, and bispectral index were monitored upon entry into the operating room. A radial artery catheter and right internal jugular venous catheter were placed. The patient's arterial blood pressure was 175/109 mmHg, heart rate was 90 beats/minute, and SpO_2 was 94%. Before anesthesia, 40 μg of dexmedetomidine was infused within 10 minutes. The thoracic surgeon then created a small incision at the intersection of the sixth intercostal space and the left midaxillary line to puncture the lung bulla and insert an indwelling catheter (14 Ga, 16 cm in length; Arrow International/Teleflex, Wayne, PA, USA) into the GEB to drain it for 15 minutes. The patient was preoxygenated with 100% oxygen at 6 L/minute for 5 minutes. Anesthesia was administered using 100 mg of propofol, 30 μg of sufentanil, and 50 mg of rocuronium. A 37-Fr right double-lumen endotracheal tube was

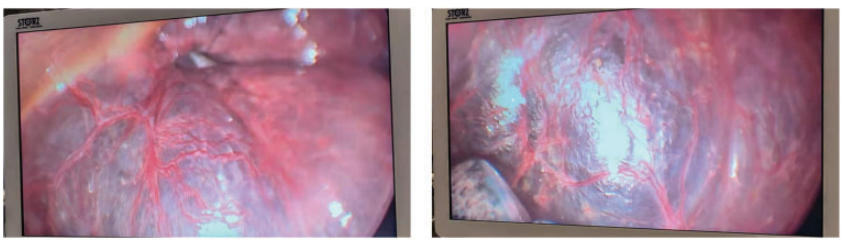

Figure 1. Preoperative computed tomography scan revealing a giant pulmonary bulla.

inserted with the help of a visual laryngoscope, and single-lung ventilation was performed after proper alignment had been confirmed by fiberoptic bronchoscopy. The tidal volume was set at 5 to 6 mL/kg, the respiratory rate was 15 to 17 breaths/minute, the positive end-expiratory pressure was set at 5 cmH_2O, and the inhalation:expiration ratio was 1:2. Propofol, remifentanil, and sevoflurane were used to maintain anesthesia. The intraoperative bispectral index was maintained at 40 to 50. After resecting the GEB (Figure 2), one-lung ventilation was switched to two-lung ventilation and the lungs slowly expanded with a low tidal volume until complete lung re-expansion was observed. During the 3-hour surgery, the patient experienced 50 mL of blood loss, was administered 1300 mL of lactated Ringer's solution, and excreted 500 mL of urine. After the operation, the double-lumen endotracheal tube was replaced with a single-lumen endotracheal tube and the patient was sent to the intensive care unit for monitoring and further treatment. Two hours after entering the intensive care unit, the patient was fully awake and the tracheal tube was smoothly removed. The following day, the patient was transferred to the thoracic surgery ward, where he recovered; he was discharged 12 days later. Postoperative chest computed tomography showed that the lungs were well inflated with no abnormalities (Figure 3).

Discussion

Rupture of a GEB during anesthesia and positive-pressure ventilation may result in

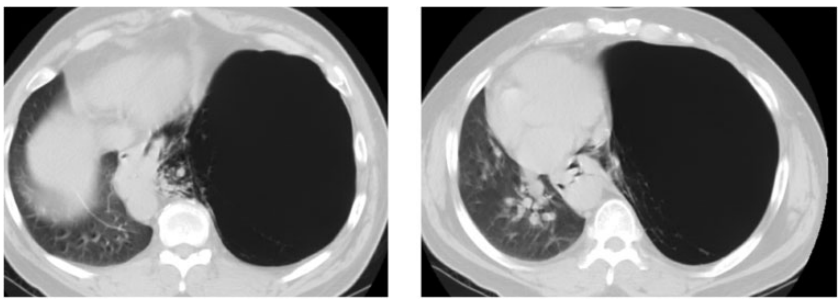

Figure 2. Intraoperative image indicating the presence of bullous disease.

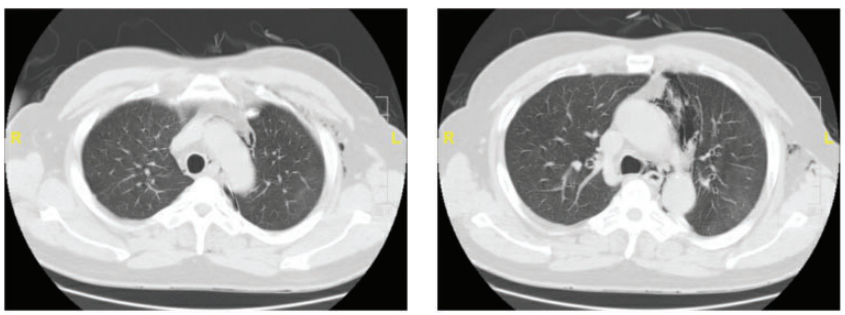

Figure 3. Postoperative computed tomography scan demonstrating the presence of well-inflated lungs.

potentially life-threatening conditions such as pneumothorax, pneumopericardium, and hypoxemia.[6] In the present case, an indwelling catheter was placed in the GEB before the patient underwent surgery. This "intracavity drainage" procedure was used for the first time as a treatment strategy for a GEB in a patient unable to tolerate surgery.[7] This procedure was subsequently reported as a preoperative treatment strategy for GEB.[8] An indwelling catheter allows re-expansion of the remaining lung and reveals the presence of lung lesions, helping to identify the location of the GEB.

The remaining lung is often in a collapsed position for a prolonged period, making it difficult to predict the degree of re-expansion that would occur preoperatively. In the present case, the patient's lung had been compressed by 95% for a long period of time. Re-expansion pulmonary edema has been reported as a complication associated with intracavity drainage of a GEB.[9] In the present case, we followed specific measures to prevent the occurrence of re-expansion pulmonary edema. First, during anesthesia, we ensured that the positive pressure of the mechanical ventilation via mask was $<15\ cmH_2O$. Second, before anesthesia, intracavity drainage was performed using an indwelling catheter with a small inner diameter (14 Ga) instead of a thoracic drain. The purpose of this was to slow the drainage speed and ensure that the lung tissue would slowly re-expand. Using pediatric chest tubes with a small inner diameter can also achieve this effect. Third, after inserting the double-lumen tube, one-lung ventilation was performed. After surgical resection of the GEB, a low tidal volume was used for double-lung ventilation so that the collapsed lung slowly re-expanded. Finally, excellent postoperative analgesia was administered to avoid pulmonary edema induced by postoperative agitation.

Ethics

Written patient consent was obtained for this case report. The Institutional Review Board of the University of the Chinese Academy of Sciences (Taizhou Hospital of Zhejiang Province) granted approval (TZYY-20200145).

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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ORCID iD

Haifei Xiang https://orcid.org/0000-0002-7002-5970

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