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Case Report

Anesthesia management for giant pulmonary bullae during emergency intracranial aneurysm embolization: a case report

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Abstract: Introduction: An intracranial aneurysm with an acute subarachnoid hemorrhage is an acute neurosurgical disease that often requires emergency surgical intervention. A patient with giant pulmonary bullae is usually elderly and has consistently resisted any surgery, so general anesthesia is required. However, anesthesia management in patients with pulmonary bullae is challenging due to the possibility of spontaneous pneumothorax, a serious complication. Thus, these patients require careful preoperative evaluation and intraoperative management to ensure rapid recovery and minimize adverse effects from anesthesia. Case description: A 76-year-old female patient had giant pulmonary bullae and resisted emergency intracranial aneurysm embolization. The patient underwent rapid anesthesia induction after breathing normally through the mask for 5 minutes. A left dual-lumen tracheal catheter No. 33 was quickly inserted and positioned using an electronic fiber bronchoscope. The tracheal catheter was removed under deep anesthesia and replaced with a 3.0 laryngeal mask after the operation. The patient was fully awake and her laryngeal mask was removed. The patient reported no discomfort and was sent back to the ward. Conclusions: We report the case of a patient with giant pulmonary bullae who underwent emergency non-lung surgery associated with a possible serious complication who was successfully treated with general anesthesia. This approach can be used for patients with similar conditions.

Keywords: Lung, blister, pneumothorax, ventilation, aneurysm, therapeutics

Introduction

Pulmonary bullae are a common problem among patients undergoing respiratory and thoracic surgery. Bullae may not impact a patient's physiological mechanisms under unruptured conditions [1]; however, when the patient suddenly coughs, defecates, sneezes, or even laughs, the force can suddenly increase the pressure inside the bullae, rupturing them and leading to spontaneous pneumothorax [2]. Spontaneous pneumothorax can cause breathing difficulties for patients and, if not handled promptly, can be life-threatening [3]. Under normal circumstances, computed tomography (CT) is important for the diagnosis of pneumothorax [4]. However, it is difficult to accurately diagnose pneumothorax during surgery due to the lack of effective diagnostic methods in this setting. Because undetected and untreated pneumothorax can endanger a patient's life, avoiding the rupture of pulmonary bullae during surgery is of the utmost importance.

The prevalence of intracranial aneurysms is 3%-4% [5]. Patients with unruptured intracranial aneurysms often have no symptoms [6], but once ruptured, the subarachnoid hemorrhage is life-threatening. Transcatheter interventional embolization is currently the most important method for managing intracranial aneurysms. Early interventional embolization after intracranial aneurysm ruptures can significantly reduce patients' disability and mortality rates [7]. Patients with giant pulmonary bullae complicated who have ruptured intracranial aneurysms need to undergo intracranial arterial embolization as soon as possible because pulmonary bullae are not life-threatening in the short term, whereas intracranial aneurysms can rupture at

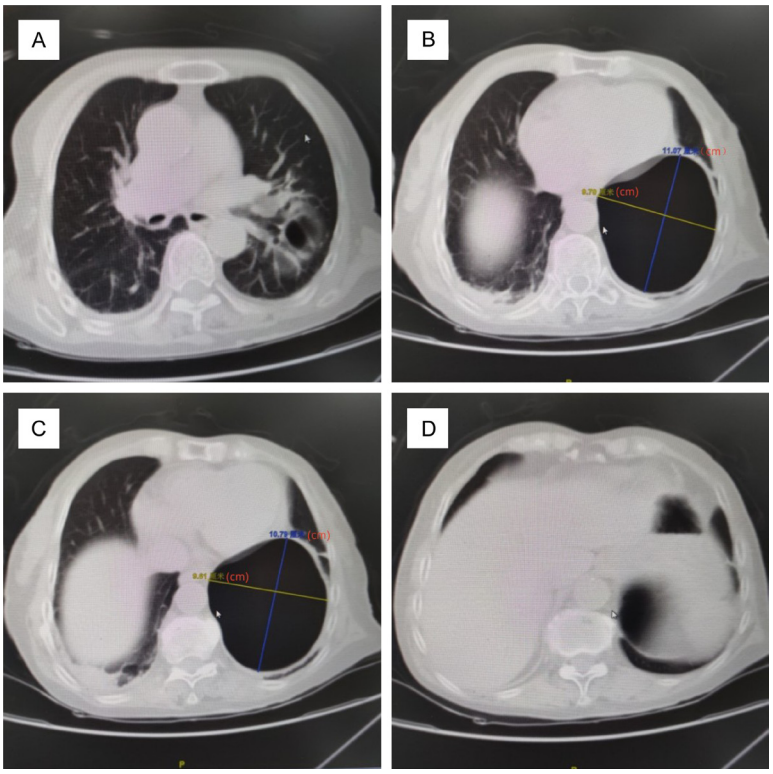

Figure 1. Chest computed tomography of the patient. (A) The upper part, (B, C) the middle part, and (D) the lower part of the pulmonary bullae.

any time, and once ruptured, there is rarely enough time to save the patient. However, there are currently no reports on how to handle perioperative anesthesia for these patients.

Case description

A 76-year-old female patient came to our hospital for treatment in neurosurgery because of a sudden dizziness and a headache lasting 1 day ago. The patient's previous physical examination revealed pulmonary bullae, but she refused surgery. Based on her symptoms and CTA scans of her brain and CT scans of her chest (**Figure 1**), the main diagnoses at admission were vertebral artery aneurysm, subarachnoid hemorrhage, pulmonary bullae, and hypertension. Physical examination showed clear consciousness, basic normal vital signs, 20 breaths per minute, 92 heartbeats per minute, non-invasive blood pressure of 156/86 mmHg, and oxygen saturation of 98% (nasal catheter oxygen supply, oxygen flow rate of 4 L/min). The patient was quite uncooperative and resisted any operation. Thus, emergency transcatheter embolization of intracranial aneurysms under general anesthesia was planned.

The preoperative thoracic surgery consultation noted an immediate risk of brain herniation considering the patient's subarachnoid hemorrhage and recommended that interventional embolization of the intracranial aneurysms be carried out as soon as possible, with close monitoring of the patient's breathing and blood oxygen changes during the operation; the consulting physician also recommended that a thoracoscopic pulmonary bullectomy be carried out after the intracranial aneurysm operation. We communicated with the patient's family and explained the risks and got the family's consent for emergency operation.

Under local anesthesia, a radial artery puncture catheter was placed to monitor arterial blood pressure in real time and perform intermittent arterial blood gas analysis. Considering that positive-pressure assisted ventilation with a mask during anesthesia induction may lead to the rupture of pulmonary bullae, the patient underwent rapid anesthesia induction after breathing normally through the mask for 5 minutes. A left dual-lumen tracheal catheter No. 33 was quickly inserted and positioned using an electronic fiber bronchoscope because patient could achieve unilateral positive pulmonary pressure ventilation through dual gun tracheal catheter. The anesthesia ventilator was then connected for mechanical ventilation of the right lung. At this time, the patient's blood oxygen was approximately 95%. We analyzed the cause of hypoxemia and speculated that single-lung ventilation could not provide a good oxygen supply because of the patient's advanced age and bilateral lung inflammation. Therefore, the left tracheal catheter was connected to the oxygen supply catheter with an oxygen flow rate of 5 L/min. After approximately 3 minutes, the patient's blood oxygen saturation increased to 100%, and her remaining vital signs remained stable (**Figure 2**). The surgery was completed within approximately 1.5 hours. To avoid coughing from the irritation of the

Figure 2. Intraoperative situation of the patient. A. The patient in surgery; arrow: two-gun tracheal catheter. B. The left lung being pumped with oxygen; arrow: oxygen catheter. C. Oxygen flowmeter; arrow: oxygen flow magnitude.

dual-lumen tracheal catheter, the dual-lumen tracheal catheter was removed during deep anesthesia and muscle relaxation and replaced with a 3.0 laryngeal mask. Immediately thereafter, an intravenous injection of 200 milligrams of Shugeng glucose sodium was administered, and the patient regained autonomous breathing. The patient was fully awake and her laryngeal mask was removed after approximately 20 minutes. After being observed for about 10 minutes, the patient was sent back to the ward.

Discussion and conclusions

Pulmonary bullae are irreversible lung lesions and are prone to rupture and develop into spontaneous pneumothorax without effective surgical treatment [8-10]. Giant pulmonary bullae often form due to increased pressure in the alveolar spaces caused by severe emphysema, resulting in alveolar rupture and fusion. They can occupy more than 50% of the unilateral thoracic cavity [11] and may be asymptomatic, and they are not easily diagnosed until the patient undergoes a physical examination. A patient with giant pulmonary bullae may not have any discomfort under normal circumstances but may induce the rupture of pulmonary bullae by coughing forcefully or carrying heavy objects, causing severe spontaneous pneumothorax [12].

Mask-assisted ventilation during anesthesia induction can induce the rupture of giant pulmonary bullae [13]. One reason for this could be that the muscle relaxant has not yet fully taken effect, and the patient's spontaneous breathing and assisted ventilation confront each other, increasing the intrapulmonary pressure. Another reason may be that the tidal volume is too large or the airway is not fully opened during assisted breathing, which leads to increased airway pressure. Our patient breathed on their own to ensure adequate blood oxygen levels before anesthesia induction, and was not given auxiliary ventilation to avoid the rupture of pulmonary bullae. However, this method has a disadvantage: if the patient's oxygen reserve function is poor, there is not enough time to conduct dual-lumen tracheal intubation and positioning. Therefore, we advised the patient to breathe autonomously for a sufficient time, and we skillfully inserted and positioned the dual-lumen tracheal catheter to avoid this drawback.

Giant pulmonary bullae are often accompanied by other lung diseases. Moreover, unilateral lung ventilation is unable to maintain normal arterial blood oxygen in some patients with pulmonary bullae: because the affected lung is not ventilated but blood continues to flow through it, unoxygenated blood can directly enter the systemic circulation and decrease blood oxygen. Prolonged hypoxemia can affect the patient's overall oxygenation, leading to delayed postoperative recovery, cognitive impairment, and even irreversible hypoxic damage to the patient's brain [14]. Currently, one of the sim-

plest mainstream methods for addressing low blood oxygen during single-lung ventilation is intermittent dual-lung mechanical ventilation [15]. Research has shown that the probability of pneumothorax occurring in patients undergoing mechanical ventilation is 4%-15% [16]. Our patient maintained a blood oxygen saturation between 94% and 95% during single-lung ventilation. Bilateral positive-pressure mechanical ventilation would likely have increased the probability of pneumothorax. Therefore, left-lung ventilation was performed with an oxygen flow rate of 5 L/min, and the patient's blood oxygen saturation gradually increased to 100%, avoiding the rupture of pulmonary bullae caused by bilateral positive-pressure mechanical ventilation.

Upon awakening from anesthesia, coughing due to the patient's intolerance to tracheal catheters can cause the pulmonary bullae to rupture. To avoid this risk of severe coughing, we removed the dual-lumen bronchial catheter and replaced the laryngeal mask during deep anesthesia and muscle relaxation. The laryngeal mask does not enter the trachea, and it causes much less airway irritation compared to endotracheal intubation. Furthermore, we injected sodium sulbactam into the patient's vein after inserting the laryngeal mask, and she immediately regained autonomous breathing without undergoing positive-pressure ventilation through the laryngeal mask.

In this case, we performed emergency anesthesia for an older adult patient with giant pulmonary bullae and a subarachnoid hemorrhage. Through targeted optimization of anesthesia induction, anesthesia maintenance, and airway management during anesthesia recovery, we successfully avoided pneumothorax induced by a giant pulmonary bulla rupture. Nevertheless, this approach and other anesthesia airway management methods require further exploration.

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The patient gave written informed consent before participation in this study and publication of this case report.

Disclosure of conflict of interest

None.

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