Journal of Anesthesia & Clinical Research
ISSN: 2155-6148

Endou et al. J Anesthe Clinic Res 2011, 2:9
DOI: 10.4172/2155-6148.1000162

Case Report Open Access

Peri-Operative Management of a Patient with Bilateral Giant Bullae and Pneumothorax in the Context of Severe Pulmonary Obstructive Disease

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Keywords: Giant bullae; Pneumothorax; Respiratory failure; Anesthesia

Introduction

Several studies have reported poor outcomes after the surgical treatment of giant bullae in patients with serious respiratory dysfunction [1-3]. In the perioperative care of refractory pneumothorax in such patients, it is essential to prevent alveolar rupture by inhibiting increased airway pressure. We performed surgery in a patient who had bilateral giant bullae and pneumothorax associated with severe chronic respiratory failure. Increased airway pressure was prevented with the standby of a percutaneous cardiopulmonary support system (PCPS), and respiratory status was stable after surgery.

Case Report

The patient was a 61-year-old man. The body mass index was 15.7 kg/m^2. He had smoked 100 cigarettes per day for 40 years. Pulmonary emphysema had been diagnosed 4 years previously. Home oxygenation therapy was started 2 years previously because of exacerbation of chronic obstructive pulmonary disease. Dyspnea worsened, and the patient was admitted to a local hospital for a diagnosis of pneumothorax with bilateral giant bullae. Drains were placed in the giant bullae in the right lung and in the left side of the thorax because of the deterioration of respiratory status, but there was no improvement. The patient was transferred to our hospital to undergo surgery.

On admission, the patient had grade V dyspnea according to the Hugh-Jones classification [4], with lip cyanosis and breathlessness on conversation. While the patient was standing and breathing oxygen, delivered at a flow rates of 3 L/min via a nasal cannula and 5 L/min via a facemask, arterial blood gas analysis showed a pH of 7.395, a partial pressure of carbon dioxide ($PaCO_2$) of 52.3 mmHg, and a partial pressure of oxygen (PaO_2) of 63.3 mmHg. Chest computed tomography on admission revealed giant bullae in the basal portion of the right lung (about 13.5 cm in diameter), the right upper and middle lobes (about 14.0 cm in diameter), and the left upper and lower lobes (about 17.4 cm in maximum diameter). In addition, innumerable cysts of various sizes were seen in both lungs. Bilateral pneumothorax developed. The lung parenchyma collapsed, and partial atelectasis developed (Figure 1).

Two-stage bilateral bullectomy was scheduled. First, cauterization of the giant bullae in the right lung was scheduled to be done under video-assisted thoracoscopy (VATS). Before the induction of anesthesia, the right femoral artery and vein were exposed and taped under local anesthesia. A PCPS was prepared to allow immediate deployment, and an invasive arterial pressure line and a central venous pressure catheter were secured. As for general anesthesia, we decided to perform endotracheal intubation while maintaining spontaneous breathing because positive pressure ventilation had increased the risks of air leakage and tension pneumothorax. The intraoperative airway pressure was maintained below 20 cm H_2O.

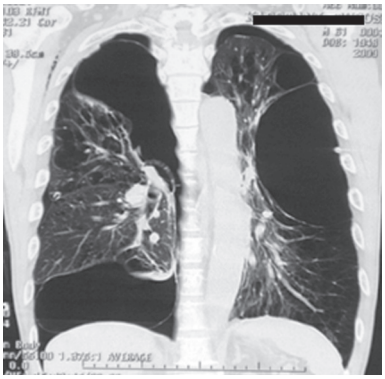

Figure 1: Chest computed tomography on admission showing bilateral giant bullae.

Anesthesia was induced by a target-controlled infusion of propofol (target blood concentration, 3μg/mL) and an intravenous infusion of remifentanyl (0.3 μg/kg/min). After the patient fell asleep, a 37-French double-lumen tube (BronchoCath™, Covidien Japan Co., Ltd., Tokyo, Japan) was placed in the left main bronchus. The fractional inspired oxygen concentration was maintained at 0.7 to 1.0 with a mixture of oxygen and room air. Anesthesia was maintained with a target-controlled infusion of propofol (2 to 3 μg/mL) and remifentanil (0.1 to 0.2 μg/kg/min). Positive-pressure ventilation did not negatively affect oxygenation or increase air leakage. Differential lung ventilation was maintained, and the patient's body position could be changed to permit surgery. During differential lung ventilation, the peripheral arterial oxygen saturation (SpO_2) ranged from 70% to 79% in the collapsed lung. Because oxygenation was not maintained, bilateral ventilation was performed intermittently. By allowing only mild collapse of the affected lung, the SpO_2 could be maintained between 90% and 99% for 10 to 15 minutes. Dopamine (3 to 10 μg/kg/min) was administered in the early phase to maintain blood pressure. After surgery, we attempted

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Received April 24, 2011; **Accepted** August 29, 2011; **Published** September 06, 2011

Citation: Endou M, Yasuhira A, Nishiyama K, Kodaka M, Mae M, et al. (2011) Peri-Operative Management of a Patient with Bilateral Giant Bullae and Pneumothorax in the Context of Severe Pulmonary Obstructive Disease. J Anesthe Clinic Res 2:162. doi:10.4172/2155-6148.1000162

to remove the endotracheal tube, but hypercapnia developed ($PaCO_2$, 96.0 mmHg). The patient was transferred to the intensive care unit, without removing the tube.

Chest radiography after surgery showed that the right lung was adequately dilated (Figure 2). The endotracheal tube was removed on the day after surgery. On the 2nd postoperative day, re-expansion pulmonary edema occurred. However, air leaks had decreased, with no evidence of dyspnea. On the 4th postoperative day, all drains were removed. The patient could walk while receiving oxygen at a flow rate of 1 L/min via a nasal cannula. On the 5th postoperative day, dyspnea developed and left pneumothorax increased. A thoracic drain was re-inserted. Right pneumothorax recurred, and a drain was re-inserted in the right lung.

On the 14th postoperative day, cauterization of the left giant bullae was scheduled to be performed under VATS. Before the second operation, the patient had grade II to III dyspnea according to the Hugh-Jones classification. On arterial blood gas analysis while oxygen was being delivered at a flow rate of 3 L/min, the pH was 7.422, the $PaCO_2$ was 50.9 mmHg, and the PaO_2 was 67.0 mmHg. As compared with the first operation, signs and symptoms had improved. For anesthesia, only a PCPS was prepared, without exposing the femoral artery and vein. Similar to the initial operation, total intravenous anesthesia was performed with propofol and remifentanil. Anesthetic management was also performed in a similar manner. After surgery, the endotracheal tube was removed, and the patient was admitted to the intensive care unit. Chest radiography showed good expansion of the left lung immediately after the second operation.

On the 20th postoperative day, the patient had right pleural effusion (Figure 3) with an increased inflammatory response. Right pyrothorax was suspected. On the 23rd postoperative day, right pleural effusion drainage and thoracic lavage were performed. The postoperative inflammatory findings improved.

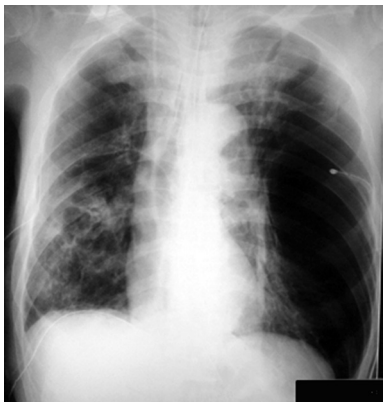

Figure 2: Chest radiography after the first surgery showing the adequately-dilated right lung.

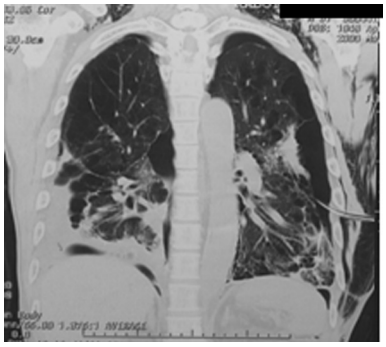

Figure 3: Chest computed tomography on the 20th postoperative day showing pleural effusion in right lung.

Discussion

In patients with chronic obstructive pulmonary disease, bullectomy is indicated if there is no response to drug therapy, if bullae suddenly enlarge, or if pneumothorax persists [5,6]. Our patient was considered at high risk because of serious chronic pulmonary disease associated with bilateral bullae and pneumothorax [7]. The bullae enlarged suddenly, leading to rapid worsening of symptoms and pneumothorax. We therefore decided to perform surgery.

The use of anesthesia in patients with bilateral giant bullae and pneumothorax carries a risk of enlarging the bullae as well as causing tension pneumothorax. Prevention of increased airway pressure is therefore assigned the highest priority. If ventilation and oxygenation cannot be maintained under low pressure, the use of extracorporeal circulation should be considered [8]. We had a PCPS on standby before surgery, and oxygenation was able to be maintained by preventing complete collapse of the affected lung. Anesthesiologists should closely cooperate with surgeons to ensure that all surgical procedures can be performed as scheduled.

VATS is associated with less postoperative pain than conventional open surgery because transection of the respiratory muscles is not required [9]. Some hospitals concurrently use epidural anesthesia. Our patient did not undergo epidural anesthesia to allow the use of PCPS and anticoagulant agents if necessary. Postoperative pain was controlled by the use of narcotic analgesics.

Bilateral bullae can be surgically treated by a two-stage operation, in which the bullae on each side are separately resected, or by a one-stage operation, in which the bullae are simultaneously resected [10]. Because one-stage bullectomy is associated with a long operation time and greater surgical invasion, we performed two-stage bullectomy in our patient. This technique minimized decreased oxygenation due to re-expansion pulmonary edema [11], avoided the use of PCPS, and minimized surgical invasion.

In summary, we described our experience with the perioperative care of a patient with severe respiratory failure who underwent bilateral bullectomy for giant bullae. Both right and left giant bullae were resected under VATS by a two-stage operation without a PCPS. The separated short operations finally resulted in the stable postoperative respiratory condition.

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