Staged Operations for a Crawford Type II Thoracoabdominal Aortic Aneurysm With Subacute Contained Rupture and Massive Right Hemothorax

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NONTRAUMATIC HEMOTHORAX associated with thoracoabdominal aneurysms unrelated to trauma are very rare. Surgical repair of thoracoabdominal aneurysms commonly involves one-lung ventilation to facilitate surgical access. Contraindications to one-lung ventilation and a right-sided massive hemothorax complicate anesthetic management.

This case report describes anesthetic management of large Crawford Extent II thoracoabdominal aortic aneurysm leaking into the right pleural space resulting in a subacute, massive right hemothorax with subtotal pulmonary collapse. This aneurysm was repaired in 2 stages to facilitate one-lung ventilation. The first stage involved drainage of the hemothorax with decortication and re-expansion of the right lung. This was followed 7 days later with stage 2, which involved repair of the aneurysm with femoral-femoral bypass.

CASE PRESENTATION

A 67-year-old man (height 168 cm, weight 69 kg, and body surface area 1.79 m^2) presented with a 4-week history of right-sided chest discomfort, mild exertional dyspnea, and generalized weakness. He was a current 50 pack per year smoker and had gastroesophageal reflux and bullous pemphigoid. He had taken prednisone, 10 mg orally daily, for the preceding 6 months. He denied back pain, and there was no history of either hypertension or trauma. On physical examination, his blood pressure was 120/97 mmHg, heart rate 80 beats/min and irregularly irregular, respiratory rate 24, and pulse oximetry showed an oxygen saturation of 97% on 3 L/min of oxygen administered by nasal prongs. His right hemithorax was dull to percussion and had decreased air entry, whereas a 5- to 6-cm pulsating abdominal mass was felt in the midline below the xiphoid process. The remainder of the examination was unremarkable. His hemoglobin was 8.1 g/dL. Upon presentation, the patient was diagnosed with a Crawford type II thoracoabdominal aortic aneurysm, with diameter of 6 cm in the proximal descending thoracic aorta, 10 cm at the diaphragm, and 5 cm in the abdominal portion extending below the level of the renal arteries. There was an associated 5-cm ascending aortic aneurysm and a massive right hemothorax. Coronary angiography was normal (Figs 1 and 2).

The patient was scheduled for urgent repair of the aneurysm via a left thoracoabdominal incision. Preoperatively, in addition to his usual steroid medication, the patient received ranitidine, 50 mg intravenously (IV). He also received 6 mg of morphine (0.09 mg/kg) and 0.3 mg of scopolamine (0.004 mg/kg), both intramuscularly as premedication. Standard monitors were used. Two 14-G intravenous catheters, as well as a right radial and right femoral arterial catheter were inserted. A pulmonary artery catheter was inserted via an 8.5-G introducer in the right internal jugular vein. The patient was induced with fentanyl, 500 μg, lidocaine, 100 mg, thiopental, 100 mg, and rocuronium, 70 mg. A left-sided double-lumen tube (39F) was inserted and confirmed by fiberoptic bronchoscopy. Anesthesia was maintained with 50% oxygen in air and isoflurane with incremental doses of rocuronium for maintenance of muscle relaxation.

Because of the subtotal collapse of the right lung, evacuation of the right hemothorax was planned before repair of the aneurysm. Initially, a right thoracostomy tube was placed through the sixth intercostal space in the anterior axillary line, but this drained only 600 mL of dark blood. A right posterolateral thoracotomy was then performed, and an additional 1,500 mL of loculated blood and clot were removed. The patient received 1 unit of packed red blood cells to maintain a hemoglobin of 9 g/dL. Attempts to re-expand the right lung with positive pressure ventilation were unsuccessful because a layer of firm, fibrinous material enveloped the lung. Pathologic analysis revealed an organizing hematoma with granulation tissue formation and fibrosis associated with chronic inflammation and hemosiderin pigment. After complete pulmonary decortication, the right lung was successfully re-expanded. However, an intraoperative chest radiograph revealed the presence of residual atelectasis and extensive pulmonary infiltrates in the right lung. Because of the marginal condition of the right lung, it was decided to attempt one-lung ventilation prior to making the left thoracoabdominal incision. Although the isolated right lung was ventilated with 100% oxygen, the patient's oxygen saturation rapidly declined from 99% to 79%, corresponding to a pO_2 of 50 mmHg (Table 1). Because the aneurysm was not actively bleeding and intraoperative gas exchange with one-lung ventilation was inadequate, aneurysm repair was delayed pending improved pulmonary gas exchange (Fig 3).

The patient was transferred to the surgical intensive care unit where a thoracic epidural catheter was inserted at T3-4, and a solution of hydromorphone, 30 μg/mL, and bupivacaine, 0.6 mg/mL (0.06%), was infused at 5 mL/h for analgesia. The patient was extubated the next day and was tolerating a normal diet by postoperative day 2. To improve lung function, chest physiotherapy and incentive spirometry was used. Bedside spirometry on postoperative day 4 revealed a forced expiratory volume in 1 second and forced vital capacity of 1.34 L and 1.75 L, respectively, whereas chest x-ray showed an improving patchy air space consolidation of the right mid- and lower-lung zones associated with a small pleural effusion.

Seven days after right lung decortication, the patient returned for thoracoabdominal aneurysm repair under general anesthesia. In addition to his usual steroid dose, he received ranitidine. Monitors used were identical to those in the first procedure. Anesthesia was induced with sufentanil, 20 μg, ketamine, 20 mg, diazepam, 2.5 mg, thiopental, 125 mg, and rocuronium, 50 mg, to facilitate intubation with a 39F left-sided double-lumen tube. The patient received supplementary hydrocortisone, 100 mg, after induction and every 6 hours thereafter. Transesophageal echocardiography showed normal left ventricular systolic function and mild aortic regurgitation. Early in the procedure, 30 minutes of isolated right lung ventilation was required to mobilize adhesions between the left lung and the aorta. The patient's pO_2 decreased to 119 mmHg on 100% oxygen (Table 1).

The left lung was re-expanded and the pO_2 normalized to 355 mmHg. The patient was heparinized to achieve an activated coagulation time of greater than 500 seconds and partial cardiopulmonary bypass was instituted using the left femoral vein and artery. Bypass flows ranged from 1.5 to 3 L/min and were adjusted to maintain a proximal systemic mean arterial pressure (MAP) in the range of 60 to 90 mmHg and a distal MAP in the range of 40 to 50 mmHg throughout

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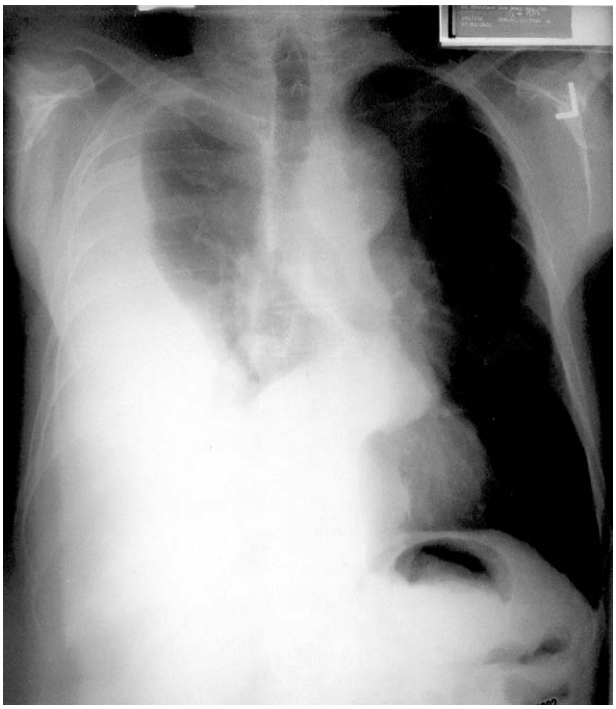

Fig 1. Chest x-ray taken preoperatively showing the aneurysm and right-sided hemothorax.

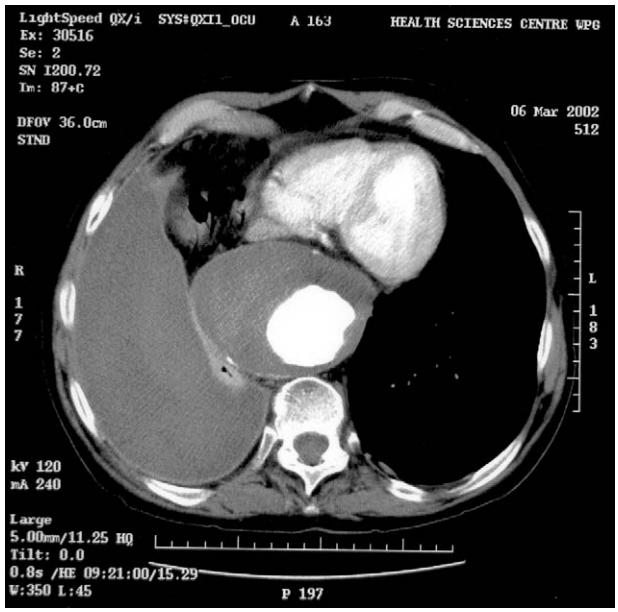

Fig 2. CT taken preoperatively at the level of the interventricular septum showing the aneurysm 10 cm in transverse diameter with a right hemothorax.

aortic reconstruction. Mannitol, 0.5 g/kg, was used for renal protection and core temperature was maintained at 33°C. The proximal anastomosis in the upper descending thoracic aorta was fashioned between clamps placed just beyond the left subclavian artery and at the mid-descending level. Perfusion beyond the distal clamp was provided by the pump oxygenator. Nitroprusside infusion was instituted to maintain a proximal MAP of 60 to 90 mmHg. After completion of the proximal anastomosis, the aortic clamps were relocated to the upper portion of the graft proximally and the infrarenal aorta distally. The aorta was incised from the proximal anastomosis to the infrarenal clamp. After evacuating all mural thrombus, the rupture site was identified in the rightward aspect of the aneurysm just above the diaphragm. The celiac artery, superior mesenteric artery, and both renal arteries were selectively cannulated and perfused with blood from the pump oxygenator maintaining mean arterial pressures of 80 to 100 mmHg until their subsequent reattachment to the aortic graft. The celiac, superior mesenteric, and left renal arteries were reattached in one island of aortic wall. A separate bypass graft was created from the aortic graft to the right renal artery. Pairs of intercostal arteries located at T8-T10 were also reattached to the aortic graft. The distal anastomosis was made just proximal to the aortic bifurcation. Separation from bypass was uneventful, with cross-clamp and bypass times lasting 195 and 246 minutes, respectively. The patient received 740 mL of cell-saver blood, 4 units of packed red blood cells, 5 units of fresh frozen plasma, and 10 units of platelets. The double-lumen tube was exchanged for a single-lumen endotracheal tube, and the patient was transferred to the intensive care unit in stable condition with no intraoperative complications.

The patient had a prolonged hospital stay complicated by atrial fibrillation requiring cardioversion, upper gastrointestinal bleeding, and pneumonia. He was discharged from the hospital 3 months later on postoperative day 104 and was doing well at 7-month follow-up (Figs 4 and 5).

DISCUSSION

This case report describes a unique situation in which a massive subacute right hemothorax secondary to a thoracoabdominal aneurysm developed over time to compress the lung parenchyma, which became encased by inflammatory and fi-

Table 1. Blood Gas Values During Stage 1 and Stage 2 Operations

	Stage 1 Baseline	Stage 1 Left-Lung Ventilation	Stage 1 Right-Lung Ventilation	Stage 2 Baseline	Stage 2 Right-Lung Ventilation	Stage 2 Right-Lung Ventilation and Bypass	Stage 2 Dual-Lung, Off-Bypass
F_IO_2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
pH	7.38	7.27	7.27	7.46	7.44	7.50	7.482
pCO_2 (mmHg)	39.0	47.4	50.1	39.2	42.2	32.8	19.0
pO_2 (mmHg)	408	255	49.6	422	119	247	270
HCO_3^- (mmol/L)	22.3	21.1	22.0	27.5	28.4	25.1	14
Base (mmol/L)	−2.1	−4.9	−4.4	3.9	4.4	2.2	−8.3
O_2 sat (%)	99.1	98.8	79.0	99.5	98.2	99.6	99.6