Awake Cardiopulmonary Bypass to Prevent Hemodynamic Collapse and Loss of Airway in a Severely Symptomatic Patient With a Mediastinal Mass

Sameh M. Said, MD, Brian J. Telesz, MD, George Makdisi, MD, Fernando J. Quevedo, MD, Rakesh M. Suri, MD, PhD, Mark S. Allen, MD, and William J. Mauermann, MD

Divisions of Cardiovascular Surgery, Anesthesiology, Thoracic Surgery, and Medical Oncology, Mayo Clinic, Rochester, Minnesota

Management of a large mediastinal mass causing respiratory and hemodynamic compromise represents a major challenge during induction of anesthesia and surgical resection. The hemodynamic changes associated with anesthetic induction and initiation of positive-pressure ventilation can lead to acute hemodynamic collapse or inability to ventilate, or both. Initiation of cardiopulmonary bypass before anesthetic induction represents a safe alternative. We present a 37-year-old woman who underwent successful resection of a large anterior mediastinal mass through sternotomy. Cardiopulmonary bypass was instituted using the right femoral vessels under local analgesia to allow safe anesthetic induction. Her postoperative course was uneventful. This represents an example of a team approach to the management of a complex patient to achieve a successful outcome.


Induction of general anesthesia in patients with a large mediastinal mass causing airway and cardiovascular compression is very challenging. A thorough assessment is necessary to fully evaluate the cardiopulmonary effect that a mediastinal mass poses. Anesthetic induction may lead to an acute decrease in systemic vascular resistance and skeletal/smooth muscle relaxation that could significantly worsen any cardiac or airway compression. When concern for airway or compression exists, awake fiberoptic intubation and maintenance of spontaneous ventilation is the gold standard [1].

Although the use of cardiopulmonary bypass (CPB) as a method of airway control has been reported during tracheal resection [2] and head and neck operations [3], the literature is very limited on using extracorporeal circulation before induction of anesthesia. We present a 37-year-old woman who underwent median sternotomy for the resection of a large anterior mediastinal mass causing severe airway and cardiovascular compression that prevented safe induction of general anesthesia.

A 37-year-old woman with a history of progressive shortness of breath underwent medical evaluation that revealed the presence of a large anterior mediastinal mass. A computed tomography scan showed very large mass (at least 17- × 9- × 12-cm) in the anterior mediastinum of fluid attenuation, but contained multiple, large, avidly enhancing solid foci and multiple areas of macroscopic fat. The mass exerted marked compression and posterior displacement of the heart, great vessels, trachea, and mainstem bronchi (Fig 1). Echocardiography showed biventricular compression (Fig 2A), dilation of the inferior vena cava, and severe compression of the aorta and pulmonary artery (Fig 2B). The specimen obtained from a computed tomography-guided biopsy of the mass confirmed the presence of cystic teratoma.

At the time of the operation, the patient was highly symptomatic and could maintain ventilation only when seated upright. The patient was brought to the operating room for excision of the mass. We had significant concern for cardiopulmonary compromise or loss of the airway, or both, with induction of anesthesia. The decision was made to place the patient on CPB before intubation. The patient was placed on the operating table in a semisitting position with the head of the bed elevated to 45 degrees.

---

Accepted for publication June 11, 2014.

Address correspondence to Dr Mauermann, Division of Cardiothoracic Anesthesia, Mayo Clinic, 200 First St SW, Rochester, MN 55905; e-mail: mauermann.william@mayo.edu.

---

Fig 1. Preoperative computed tomography scan: (A) An axial cut shows a large anterior mediastinal mass with marked compression of the trachea and main stem bronchi (white arrow), and (B) a coronal cut shows the marked compression, displacement of the heart, and complete obstruction of the superior vena cava (white arrowhead).
Left femoral venous access and arterial monitoring were established with local lidocaine infiltration. The chest, abdomen, and lower extremities were prepared and draped in the standard sterile fashion. Additional lidocaine was infiltrated in the right groin, and an oblique skin incision was made to expose the femoral artery and vein. Local infiltration with lidocaine was performed throughout the layers of the incision, and once the femoral vessels were exposed, systemic intravenous heparin was given. Purse string sutures were placed in each vessel using 5-0 polypropylene. The Seldinger technique was used to insert a 17F arterial cannula in the femoral artery and a 25F venous cannula in the femoral vein. CPB was then initiated at low flows (0.5 L/min).

The patient then underwent an inhalation induction with sevoflurane and was paralyzed with succinylcholine. She was placed supine and intubated with a single-lumen endotracheal tube. Moments after induction and repositioning, peak airway pressures elevated, blood pressure decreased, and oxygen saturations began to decline. Full CPB was immediately instituted, and the hemodynamics and oxygenation were stabilized. A bronchoscopic

**Fig 2. Preoperative transthoracic echocardiography:** (A) A parasternal short-axis view shows a large anterior mediastinal mass (note the anechoic characteristics due to its fluid content) with marked compression of the heart (white arrows), and (B) a parasternal long-axis view shows a large pericardial effusion (**), a severely compressed right ventricle (RV), and a severely compressed ascending aorta (Asc Ao). (LV = left ventricle.)

**Fig 3. Intraoperative fiberoptic bronchoscopy shows nearly complete obliteration of the trachea, with touching anterior and posterior walls.**

**Fig 4. Intraoperative photographs show (A) the large mediastinal mass; (B) a partial anterior pericardiectomy was done en bloc with the mass resection.**
examination showed nearly total obliteration of the tracheal lumen, with contact between the anterior and posterior walls (Fig 3).

A median sternotomy was performed, and we encountered a large mass in the anterior mediastinum, with associated inflammatory adhesions to the undersurface of the sternum (Fig 4A). These were taken down with electrocautery. Superiorly, the mass was dissected free off the innominate vein and superior vena cava, and several vessels that were draining into the vein were ligated with 0 silk ties and divided. Inferiorly, the mass was adherent to the pericardium, which necessitated a partial anterior pericardiectomy en block with the mass (Fig 4B). The mass was also found to be adherent to the left lung and the left phrenic nerve; however, they were dissected off carefully.

Once the mass was removed, a repeat bronchoscopy showed normal tracheal anatomy, with no airway compression (Fig 5). The patient was weaned off CPB without difficulty. The groin cannulae were removed, and both femoral vessels were repaired. The right groin and sternotomy incisions were closed in layers in the standard fashion. The remaining course of her hospital stay was uneventful, and she was dismissed on postoperative day 5.

The pathologic analysis confirmed the presence of a mature cystic teratoma (Fig 6A, B).

Comment

Maintenance of a patent airway and stable hemodynamics in the presence of a large mediastinal mass is always challenging. Awake fiberoptic intubation with maintenance of spontaneous ventilation is commonly described as the gold standard of administering anesthesia in the face of a symptomatic mediastinal mass. Of particular concern in our patient was the airway compression along with the significant compression of the heart and other major vascular structures.

The literature has very limited reports about the use of CPB in similar situations. Despite its reported use in the management of tracheal resection [4] and in head and neck operations [5], prophylactic use of CPB for the sole purpose of airway and hemodynamic management is limited to only few case reports [5].

In the report by Hicks [6], CPB was used to assist in the resection of a large retrosternal goiter associated with severe laryngospasm. The patient could not be intubated despite several attempts, and CPB was initiated, followed by subsequent intubation. In another report, a 51-year-old woman presented with nearly complete obstruction of the airway secondary to a large cervical tumor. CPB was initiated through the femoral vessels under local analgesia, and the surgeons were then able to perform a tracheostomy [7].

The large anterior mediastinal mass in our patient was causing severe obstruction of the mediastinal structures in a way that precluded any safe anesthetic induction. The use of CPB represented the ultimate solution for this difficult situation in addition to providing the surgical team with safe sternal entry and facilitating complete resection of the mass without any hemodynamic compromise.

This report emphasizes the value of adequate preoperative planning in facilitating successful outcomes of complex surgical patients.
References