

The Anesthesia Management of Thymoma Invading the Heart, Great Vessels, and Main Bronchi Undergoing Radical Resection

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Received: 18 March 2022; **Accepted:** 04 April 2022

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ABSTRACT

Thymomas are rare mediastinum tumors with a low incidence rate, distinguished into types A, AB, B (B1, B2, B3), and C. Surgery is the essential treatment for patients with invasive thymoma. It is rare for thymoma to invade the right atrium (RA), the central airway, and the superior vena cava (SVC) simultaneously. Radical resection and Masaoka staging are the main prognostic factors for patients' long-term survival, and the survival rate is positively correlated with the degree of the thymoma resection.

To ensure the patient's safety and a favorable prognosis. Adequate preparations and anesthesia management are indispensable. We would report the anesthetic management of a 20-year-old female student (166cm, 48kg, NYHA class III) with complaints of sudden palpitations accompanied by profuse sweating. The thymoma, located in the thymus area, with a vast invasion, was about 10cm*6cm*4cm. It had invaded the SVC, epicardium, part of the brachiocephalic trunk, transverse jugular vein, and main bronchi (squeezed and deformed), and the right lung and hilum were slightly affected on the upper and right side of the pericardium. This giant thymoma was entirely resected under general anesthesia and cardiopulmonary bypass (CPB). As a result, the anesthesia management of the giant thymoma undergoing radical resection was successful.

Keywords: Thymoma, Heart, Great Vessels, Airway Obstruction, Case Report

Introduction

Thymoma is a rare mediastinum tumor with an incidence rate of 1.7/1000000 per year in Europe and China (Scorsetti *et al.*, 2016; Wu and Jiang, 2012; Meng *et al.*, 2019). It is distinguished into types A, AB, B (B1, B2, B3), and C (Travis *et al.*, 2015). Surgical resection is the mainstay of treatment, with a 10-year survival of 80%, 78%, 75%, and 42% for stages I, II, III, and IV, respectively (Scorsetti *et al.*, 2016). The survival rate is positively correlated with the degree of thymoma resection. A multidisciplinary approach is indispensable for managing thymic tumor resection (Mariano *et al.*, 2013). Thymoma

invading the SVC, RA, and the central airway is rare. Typical symptoms such as cough, phrenic nerve palsy, chest pain, or superior vena cava syndrome are common. Whether or not combined with other therapy, depending on resectability, surgery is the frontline treatment for patients with thymic carcinoma (Gomez *et al.*, 2017). Previous literature states that radical resection and Masaoka staging are the main prognostic factors for patients' long-term survival (Tsubota *et al.*, 1993).

Case Report

We would report the anesthetic management of a 20-year-old female student (166cm, 48kg, NYHA class III) who presented with complaints of sudden palpitations accompanied by profuse sweating. The main bronchi were squeezed and deformed (Fig. 1). The *vital signs* such as heart rate (HR), respiratory rate, blood pressure, and body temperature were 150 beats per minute, 20 breaths per minute, 86/50mmHg, and 36.6°C, respectively. It tended to be an epithelial tumor with a thymic origin.

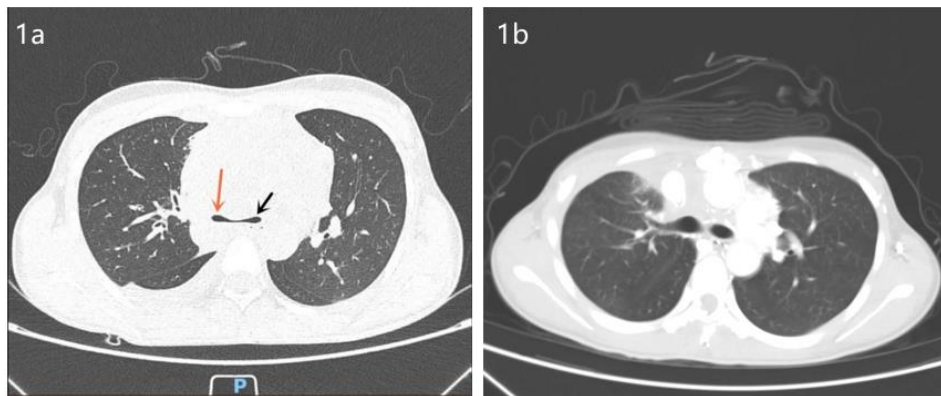


Figure 1: The arrows showed that both the left and right main bronchi were squeezed and deformed by the huge thymoma, narrowing the airway (the left before resection and the right after).

The mass, located in the thymus area, with a vast invasion, was about 10cm*6cm*4cm. It had simultaneously invaded the SVC, epicardium, part of the brachiocephalic trunk, transverse jugular vein, and the main bronchi. The right lung and hilum were slightly affected on the upper and right side of the pericardium. The anesthetic management was a challenge that needed more detailed strategies during the whole perioperative.

Methods

Before anesthesia induction, make the CPB and surgeon standby in the operating room, self-test the equipment, and ensure good conditions, such as the oxygen source and power supply. Then, monitor vital signs and parameters, such as ECG, SPO₂, blood pressure (BP), bispectral index (BIS), and rSO₂. At last, establish peripheral venous access on the left lower extremity and insert a tube into the radial artery.

Intravenous infuse about 700ml of hydroxyethyl starch to expand the volume. Give pre-supply oxygen to remove nitrogen for 10 minutes before the anesthesia induction. Intravenous injecting of penehyclidine 0.5mg, dexamethasone 3mg, midazolam 2mg, dezocine 10mg, etomidate 12mg, sufentanil 50ug sequentially, and rocuronium 100mg rapidly. Provide positive pressure ventilation when the breathing becomes faint. Ensure a suitable depth of anesthesia before trachea intubation, then fix the tube and start mechanical ventilation. Adjust the respirator parameters at acceptable ranges. Inhale 1% sevoflurane before completing the procedures under ultrasound guidance (Fig. 2).

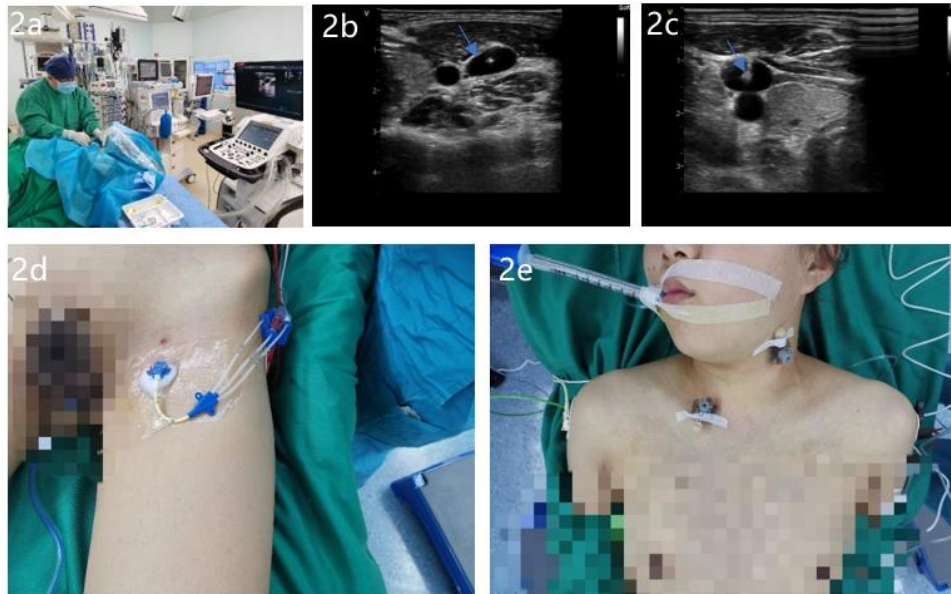


Figure 2: All puncture procedures were completed under ultrasound guidance(2a,2b,2c). The specific location and directions of the inserted tubes (2d, 2e).

Continuous intravenous pumping of sufentanil (10 μ g/ml, 6ml/h), atracurium cisbesilate (2mg/ml, 10ml/h), propofol (2%, 13ml/h), dexmedetomidine (4 μ g/ml, 5ml /h), through mcro-pump. Maintain the BIS value between 40-60. Give a loading dose of aminocaproic acid (0.2g/ml, 100mg/kg), then turn to the rate of 30mg.kg⁻¹.h⁻¹ until the end of the operation.

Establish the femoral artery cannula as arterial inflow, the femoral vein cannula, and the left jugular vein cannula as the venous drainage. Then, insert a tube in SVC and inferior vena cava (IVC), respectively. Guarantee the tubes in suitable positions and depths with transesophageal echocardiography (TEE) (Fig. 3). Fully heparinized to obtain an ACT (activated clotting time) of 480 seconds or more before starting the CPB.

After opening the mediastinum and heart cavity, the invaded heart chamber, adhered pericardium, and enlarged RA met the eye. The right atrial appendage (RAA), SVC, and transverse jugular vein came

into sight. After intracardiac exploration, it had encroached on the total RA, extending to the tricuspid valve, SVC, and transverse jugular vein, being soft and well-defined with black necrosis inside. It consisted of three parts (7cm, 5.5cm, and 4.5cm) of the anterior mediastinal tumor and two parts (10cm and 6cm) of the heart.

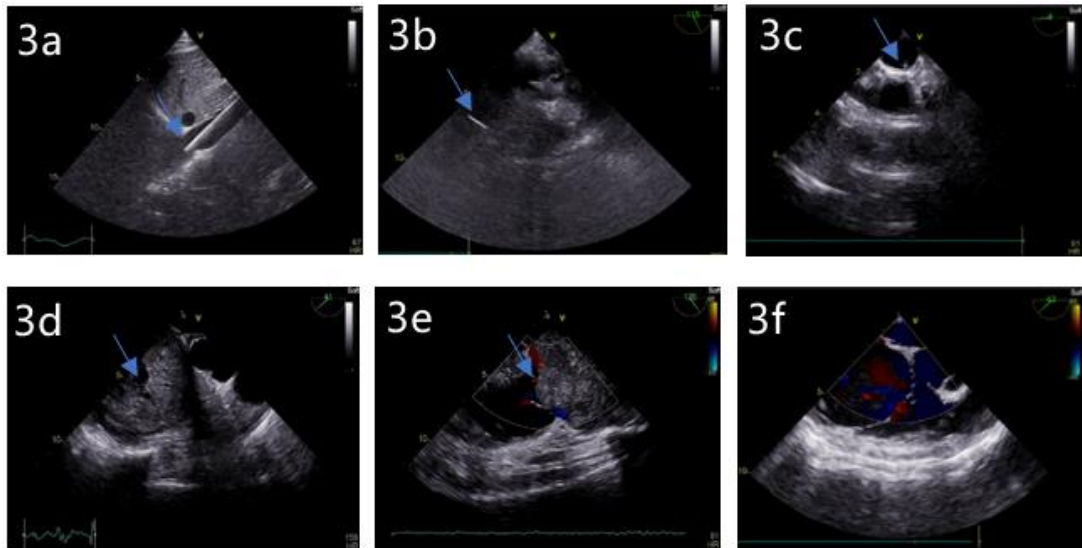


Figure 3: 3a. Needle biopsy via SVC under the guidance of TTE. 3b. The guidewire for the drainage tube in IVC. 3c. The guidewire for drainage tube in descending aorta. 3d. Tumor invades the RA. 3e. The involved Tricuspid valve. 3f. After radical resection.

After radical resection, remove the artery and vein cannulas until stop the CPB. The operation was completed with the fluid infusion volume of 2U of red blood cell, 1000ml of autologous blood, 400ml of plasma, one treatment volume of platelet, 8U of cryoprecipitate, 1000ml of colloid. And the body fluid loss of 1500ml of blood, 2200ml of urine, respectively. The tracheal tube was extubated after a four-day cure in the intensive care unit (ICU). Ultimately, she was transferred to the oncology department for further treatment six days later.

Results

The surgery was completed under general anesthesia and CPB without severe complications during the whole period of anesthesia management.

Discussion

Thymoma invading the SVC, RA, and the central airway is rare. Surgery is the essential treatment to resect completely. Radical resection and Masaoka staging are the main prognostic factors for patients' long-term survival, and the survival rate is positively correlated with the degree of the thymoma resection.

The anesthesia management was complex as a wide invasive and heavy adherent. Huge thymoma causing acute dyspnea has been reported (Tsubota *et al.*, 1993). The colossal tumor squeezed the surrounding tissues, leading to airway narrowing. Keep CPB and cardiac surgeons on standby in the operating room to establish the CPB timely to prevent acute dyspnea. The invaded chambers, great vessels, and the blocked backflow of venous blood would slow down the onset of anesthetics, affecting the anesthesia induction. So, firstly puncture and insert access of peripheral venous on the left lower extremity. Intravenous infuse about 700ml of hydroxyethyl starch to expand *volume* before anesthesia induction. It could stabilize the circulation and prevent hypotension caused by systemic vascular dilatation. Give 1% sevoflurane inhaling before completing the procedures. Anesthesia for biopsy or excision of an anterior mediastinal mass has been associated with central airway and cardiac complications (Furuya *et al.*, 1996). So, after endotracheal intubation, set the PEEP up to 5 cmH₂O to keep the airway open to prevent dyspnea. Previous literature reports that autoimmune myasthenia gravis (MG) is associated with thymic hyperplasia or thymoma. These patients with invasive thymoma usually have poor outcomes and might die of respiratory failure (McCombe *et al.*, 2016)—sufficient attention to airway management is indispensable. Patients undergoing radical resection may suffer from postoperative respiratory insufficiency (Ried *et al.*, 2015). Succinylcholine, a short-duration muscle relaxant, is considered in anesthesia induction. Furuya A.T. used succinylcholine and allowed breath spontaneously until the sternal incision. We do not consider this as we have a veteran cardiac team on standby.

The mass had invaded the SVC, the right innominate vein, the total RA, and the RAA. Insert a preset indwelling tube in the right internal jugular vein towards the centrifugal direction (Fig. 2), preventing the destruction of the tumor and providing adequate drainage, and another into the IVC near the skull base in the centripetal direction on the contralateral. When advancing at 13cm of the tube scale in the left SVC, the drainage effect was dissatisfied before drawing back about 2cm. We considered that the thymoma blocked the side holes of the drainage tube probably.

No significant changes in cerebral regional oxygen saturation and BIS value, no face edema, and Bulbar conjunctiva appeared. The tube in the left SVC was enough for venous drainage of the head and neck. After anesthesia induction, the BP dropped from 110/72mmHg to 95/60 mmHg.

Make the ACT of 480 seconds or more before CPB. Then, adjust all the relevant parameters, such as BIS value, PaCO₂, and rSO₂, at acceptable ranges. Intravenous infuse aminocaproic acid until the end of the operation to reduce blood loss. The clinic diagnosis indicated that the thymoma tended to be malignant (Fig. 4).

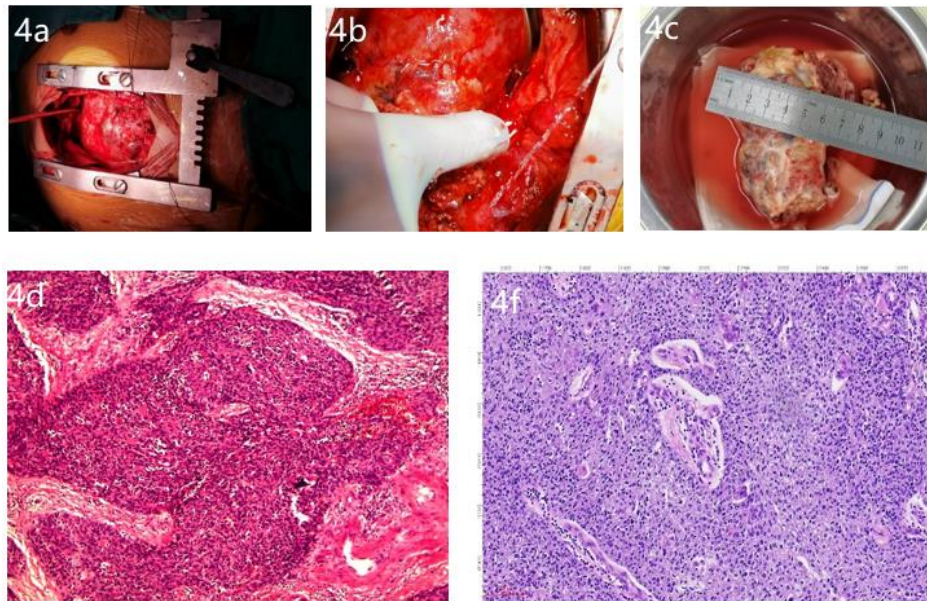


Figure 4: Views of thymoma resection(4a,4b,4c), pathological result(4d,4f). Aggressive Thymoma, B3-type (about 95%), and local squamous cell carcinoma (about 5%), combined with markers of morphological and immunohistochemical.

We select adrenaline noradrenaline that directly acts on the myocardium. Measure the cardiac function with TEE and adjust the pumping speed of adrenaline with a micropump to maintain a stable hemodynamic state. The HR continued slow and unstable when the dose increased to $0.2\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ without pleasing effect after intravenous infusing a small amount of isoproterenol intermittently.

The function of the sinus node might be destroyed after resection, leading to supraventricular arrhythmia, which was slow and unstable. Then, we implanted a pacemaker and set the pacing rate at 90bpm with the DDD model. The hemodynamics status improved, then we decreased adrenaline and noradrenaline to $0.05\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$. She was transferred to the oncology department for further treatment after a 4-day observation and treatment in ICU.

As for the wide invasive of the tumor, there were other considerations, in this case, involving central airway collapse, hypoxemia, rupture of great vessels and heart chamber before CPB.

Conclusion

The anesthesia management of the thymoma undergoing radical resection is successful. It is rare for thymoma to simultaneously invade the heart, great vessels, and primary bronchi. Possible risks such as airway collapse and severe hypoxemia during anesthesia induction might occur. So, it is indispensable to put cardiothoracic surgeons and CPB on standby before anesthesia induction to ensure life safety. A mature team is needed to establish and start the CPB rapidly.

Ethics Issues: The patient's family wrote the informed consent to publish the case report accompanied with all the related images.

Conflict of Interest: All the authors declared that there was no conflict of interest. It is the first time the manuscript has been submitted for publication. All the authors have read and approved the final version of the manuscript.

Author's Contribution: Liang Zhao, Yanan li treated the patient, Liang Zhao, Jumin Yan wrote the manuscript. Hongqi Lin, Yujie Shi, Lin Qiu, Jing Cheng revised the manuscript. All the authors have read and approved the final manuscript.

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