CASE REPORT

Anesthetic Management for Sternotomy in a Patient with Anterior Mediastinal Tumor: A Case Report

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ABSTRACT

Background: Anterior mediastinal masses (AMMs) pose significant anesthetic challenges, risking airway obstruction, cardiovascular collapse, and hemodynamic instability, especially in the supine position. Preoperative assessment, including imaging and cardiopulmonary evaluation, is crucial. Anesthetic management prioritizes spontaneous ventilation (SV), airway patency, and hemodynamic stability, often employing awake intubation, inhalational induction, and neuromuscular blockade avoidance. A multidisciplinary, individualized anesthetic management of the sternotomy approach optimizes outcomes.

Case: 50-year-old male with anterior mediastinal tumor (AMT) scheduled for elective sternotomy. The patient experienced chest pain and a persistent cough with displacement and indentation of the aorta and inferior vena cava as observed on contrast-enhanced computed tomography (CT) scan, indicating high surgical risk. Anesthesia induction involved fentanyl, midazolam, atracurium, and propofol, followed by intubation with a left-sided double-lumen tube (DLT) for one-lung ventilation.

Discussion: Mediastinal masses pose significant anesthetic risks, primarily due to the potential for mediastinal mass syndrome (MMS). Preoperative imaging and symptom-based risk stratification are critical. Anesthetic goals include maintaining SV and avoiding neuromuscular blockade when possible, as loss of SV is often linked to MMS onset. However, in procedures like sternotomy requiring deep anesthesia and muscle relaxation, airway control may necessitate neuromuscular agents. In such cases, preparedness for difficult ventilation is essential. We utilized a left-sided DLT to facilitate one-lung ventilation and surgical access. Postoperative intensive care unit (ICU) monitoring is advised for high-risk patients.

Conclusion: This case's importance lies in the complex anesthetic management of sternotomy for anterior mediastinal mass resection, requiring meticulous planning to prevent airway and cardiovascular compromise. A multidisciplinary approach and early diagnosis are key to optimizing patient safety and outcomes.

Keywords: airway; anesthesia; intubation; obstruction; sternotomy; tumor

INTRODUCTION

Anterior mediastinal masses (AMMs) present significant perioperative anesthetic challenges due to their potential for life-threatening cardiopulmonary complications. Situated between the sternum and pericardium, the anterior mediastinum may harbor a variety of neoplasms, both benign and malignant.[1] Although relatively uncommon, AMMs account for approximately 50% of mediastinal tumors and are predominantly observed in adults aged 30–50 years, though pediatric cases have also been reported. Among these, thymomas constitute 20–25% of cases, while lymphomas, germ cell tumors, and thyroid malignancies comprise the remaining majority. Clinically, patients may present with nonspecific symptoms such as cough, dyspnea, chest pain, and orthopnea.[2] In severe cases, complications such as superior vena cava (SVC) syndrome, tracheobronchial compression, and hemodynamic instability, especially in the supine position, pose critical risks during anesthetic induction.[2,3]

The differential diagnosis of AMMs can be recalled using the mnemonic "4 Ts": Thymoma, Teratoma and Germ Cell Tumors, Thyroid Malignancies, and Terrible Lymphoma.[4–7] Thymomas, the most frequent primary anterior mediastinal tumor (AMT), are often associated with myasthenia gravis. Germ cell tumors encompass benign teratomas and malignant non-seminomatous variants. Thyroid malignancies may involve ectopic thyroid tissue or invasive carcinomas extending into the mediastinum. Lymphomas, including Hodgkin and non-Hodgkin types, frequently present with systemic symptoms. Given the substantial risk of airway obstruction and cardiovascular collapse, a comprehensive preoperative assessment, including advanced imaging and cardiopulmonary function evaluation, is imperative before anesthesia administration.[1,8,9,10] Anesthetic management should focus on minimizing airway collapse and maintaining hemodynamic stability.[3,11]

When an anesthesiologist encounters a patient with an AMM requiring general anesthesia, the risk of airway collapse, vascular compression, impaired ventilation, increased airway pressures, and potential perioperative mortality must be meticulously considered.[2,4,12,13] Standard anesthetic strategies emphasize the importance of spontaneous ventilation (SV), inhalational induction, awake fiberoptic intubation, and avoidance of neuromuscular blockade to mitigate airway obstruction. Due to the high risk of catastrophic airway or cardiovascular compromise during induction, anesthesiologists must always have a contingency plan. Alternative strategies may include modifying patient positioning, rigid bronchoscopy, initiation of extracorporeal membrane oxygenation (ECMO), or emergent awakening from anesthesia to prevent irreversible decompensation.[13,14,15]

CASE

A 50-year-old male diagnosed with an AMT was electively admitted to Immanuel Hospital for a scheduled sternotomy. The patient presented with chest pain and a persistent cough. The patient has a history of hypertension as a comorbidity. There is no history of smoking or alcohol consumption. His preoperative examination was otherwise unremarkable, with normal renal and liver function. The patient was administered preoperative medications, including Combivent and Pulmicort three times daily, Candesartan (1 × 8 mg), and Pantoprazole (1 × 1 vial).

A preoperative chest radiograph (Figure 1) reveals a widened mediastinum with an abnormal opacity suggestive of a mediastinal mass. The differential diagnosis includes thymoma, lymphoma, or germ cell tumor of the anterior mediastinum. The lung fields appear clear, without evidence of consolidation or pleural effusion.

Spirometry results (Figure 2) indicated a forced vital capacity (FVC) of 91% and a forced expiratory volume in one second (FEV1/FVC) ratio of 95,21%, suggesting no obstruction and no restriction. Contrast-enhanced computed tomography (CT) scan (Figure 3) demonstrated a hypodense mass in the supero-anterior mediastinum, extending into the anterior segment of the right upper lung. The lesion, measuring 5.47 × 7.54 × 9.64 cm, has well-defined margins and exhibits contrast enhancement. It exerts a mass effect, causing displacement and indentation of the aorta and inferior vena cava towards the left.

In the preparation room, one peripheral vein was accessed using an angiocath (no. 16), and a five-lead electrocardiogram (ECG) was placed. An arterial line was inserted into the left radial artery to facilitate invasive blood pressure monitoring.

The patient's vital signs upon arrival in the operating room were as follows: blood pressure 144/82 mmHg, heart rate 82 beats per minute, respiratory rate 18 breaths per minute, and oxygen saturation 97%. The patient's weight was 68 kg. Anesthesia induction commenced with 200 mcg fentanyl, 4 mg midazolam, 70 mg atracurium, and 120 mg propofol. Following the achievement of adequate muscle relaxation, the patient was intubated with a left-sided double-lumen endotracheal tube (size 35) and positioned in the supine position. A central venous catheter (CVC) was established via the left subclavian vein. Anesthesia was maintained with an oxygen-air mixture and 0.5% sevoflurane, alongside propofol (10 cc/h), a fentanyl infusion (25 mcg/h), and atracurium (15 mg/h). The patient underwent a sternotomy, with a total surgical duration of approximately 1 hour and 30 minutes, total blood loss of 250 ml, and urine output of 500 ml. He was extubated and subsequently transferred to the ICU with a continuous infusion of fentanyl (25mcg/h) and four times a day of ketorolac (30 mg). He was transferred to the ward on the second postoperative day and discharged on the fifth postoperative day.

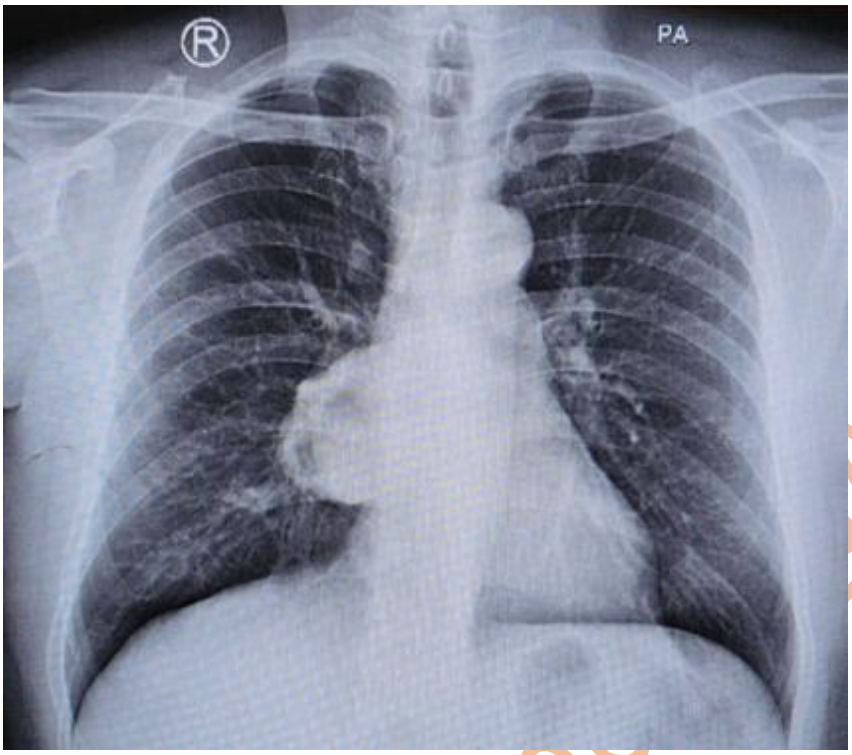
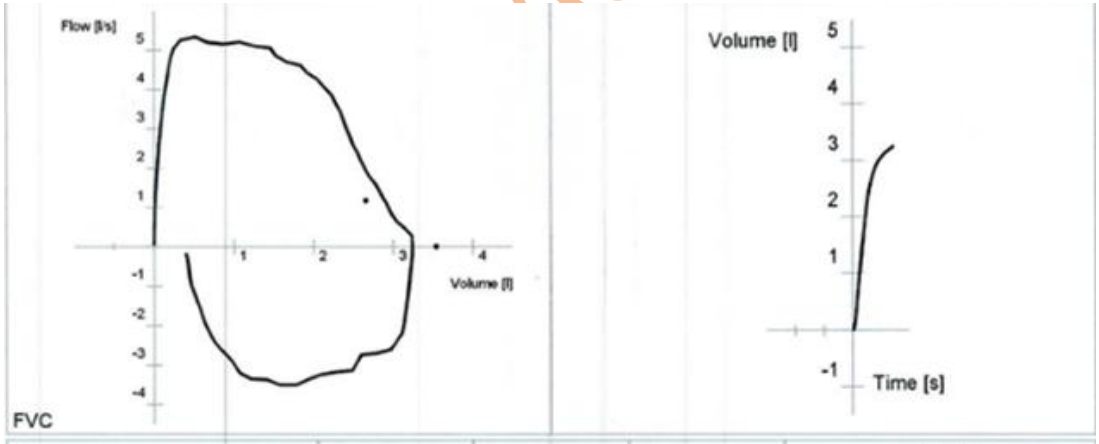


Figure 1. Patient's chest radiograph image



date/time				12/9/2024 7:55 AM	
medicament				PRE	
parameter	Unit	Pred	LLN	Meas	% Pred
FVC					
FVC	l	3.54	2.74	3.24	91
FEV1	l	2.93	2.26	3.08	105
PEF	l/s	-	-	5.42	-
FEV1/FVC	%	82.57	72.80	95.21	115
MMEF	l/s	3.03	1.76	4.57	151
MEF75	l/s	-	-	5.19	-
MEF50	l/s	-	-	4.83	-
MEF25	l/s	1.17	0.59	2.95	252
FIVC	l	-	-	2.85	-
Aex	l^2/s	-	-	12.48	-

Figure 2. Patient's spirometry test result

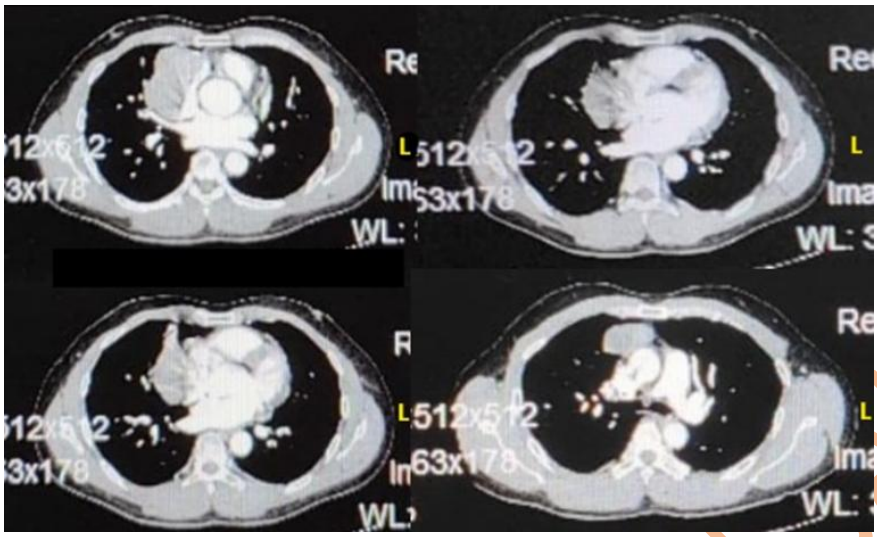


Figure 3. Patient's contrast-enhanced chest CT-scan result

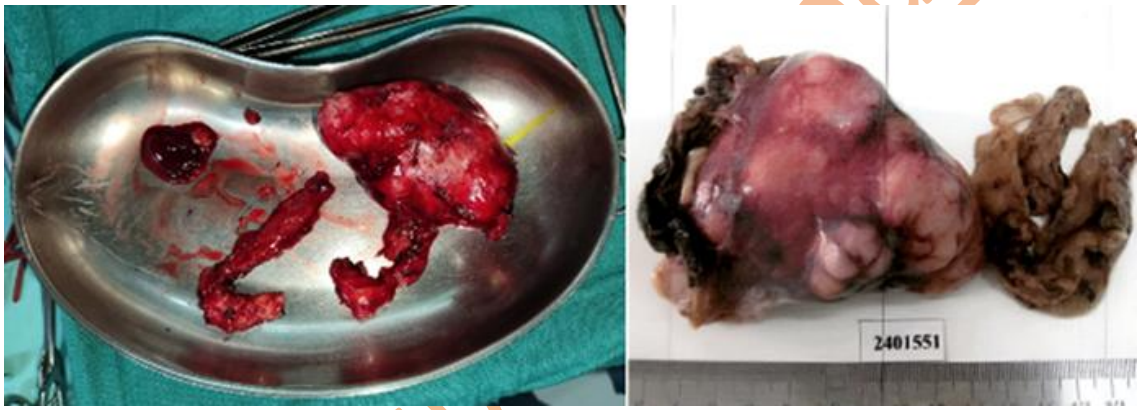


Figure 4. Patient's anterior mediastinal mass

DISCUSSION

Surgical procedures involving mediastinal masses present anesthetic challenges due to the potential for mediastinal mass syndrome (MMS). This condition, marked by sudden respiratory and circulatory instability, arises from the mass compressing vital structures within the chest. Unfortunately, there are no established clinical guidelines to aid in the anesthetic care of these patients.[4] Managing patients with mediastinal masses requires a detailed preoperative evaluation. Risk stratification, based on patient symptoms and the extent of compression, aids in decision-making. CT scans are vital, offering precise anatomical details of the mass and its relationship to surrounding structures, which are critical for developing effective anesthetic and surgical strategies.[16]

Anesthesiologists have long understood the significant dangers of using general anesthesia in patients with AMMs. Therefore, it is often avoided in symptomatic patients. When general anesthesia is administered, it is crucial to use a careful, gradual induction, preserve spontaneous breathing, and refrain from using neuromuscular blocking agents. The use of neuromuscular blockers should only be contemplated after manual ventilation has been proven

effective. Several authors have made recommendations for anesthetic management in patients with mediastinal masses undergoing surgery. These include avoiding general anesthesia, particularly paralytic agents, or maintaining SV. There's a general agreement to use a gradual induction and avoid deep sedation. It's also agreed that no single anesthetic agent is superior, and all agents should be used carefully to preserve SV. In nearly all documented cases of severe MMS, the condition manifested following the loss of SV. Dubey emphasized that preserving SV until sternotomy provides a safer anesthetic approach. If neuromuscular blockade is deemed necessary, manual ventilation should first be attempted to confirm the feasibility of positive-pressure ventilation before administering a short-acting muscle relaxant. However, in critical situations, the resumption of spontaneous respiration may be insufficiently rapid. Consequently, we advocate for the avoidance of muscle relaxants and the maintenance of SV throughout anesthetic induction. It is crucial to recognize that preserving SV does not inherently ensure airway patency during anesthesia. Gardner highlighted that partial upper airway obstruction may generate significant negative pressure, leading to airway collapse in patients exhibiting rapid spontaneous breathing. This mechanism elucidates why dynamic airway collapse and ventilation failure can occur despite maintaining SV.[17–20] In our patient, the patient was scheduled for a sternotomy to debulk the tumor. Given that sternotomy is a highly painful procedure requiring sufficient pain relief, a deeper level of anesthesia, and adequate muscle relaxation to open the sternum, we anticipated difficulty in maintaining SV. Therefore, we chose to secure the airway using neuromuscular blocking agents.[21-26]

Authors differ in their recommendations for airway management in MMS patients. Kafrouni et al. suggested that reinforced single-lumen tubes (SLTs) are preferred for ventilating both lungs, and indeed, over 60% of cases in the current study used SLT intubation. For patients with airway obstruction, Sulen recommended awake placement of a bronchial blocker (BB) or double-lumen tube (DLT) as the safest option, with extraluminal BB use offering advantages over traditional intubation. DLT intubation was deemed appropriate for patients with low airway compression risk.[24,25] The use of a left-sided DLT in our case facilitated one-lung ventilation, which was essential for optimizing surgical exposure while maintaining oxygenation.

Postoperatively, patients in the unsafe risk category should go to the ICU. For uncertain-risk patients, the extent of postoperative monitoring should be based on preoperative findings and the intraoperative course.[26]

CONCLUSION

In this case, a proper preoperative preparation, including a thorough diagnostic workup with imaging and pulmonary function tests, is essential for risk stratification and anesthetic planning. Anticipation of complications such as tracheobronchial obstruction and SVC syndrome is crucial in determining intraoperative management strategies, including patient positioning, choice of anesthetic agents, and the need for extracorporeal support. Early diagnosis of AMMs allows for timely intervention and optimization of anesthetic care, ultimately improving patient outcomes. A multidisciplinary approach involving anesthesiologists, surgeons, and critical care specialists is paramount in ensuring safe perioperative management and reducing the risks associated with sternotomy in these high-risk patients.

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