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Case Report

"Can Intubate, Cannot Ventilate": Emergency Anaesthetic Management of a Mediastinal Mass Causing Near-Fatal Airway Collapse In a Teenager

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Abstract:

Background: Large anterior mediastinal masses are associated with life-threatening airway and cardiovascular compromise, especially during anaesthesia. The risk is highest in adolescents due to compliant airways and the tendency for sudden obstruction during induction.

Case Report: A 16-year-old boy presented with progressive dyspnoea for 3-4 months, acutely worsening over the preceding days. CT imaging revealed a large anterior-superior mediastinal mass (approximately 9 × 9 × 9 cm) encasing the trachea with 90% luminal narrowing and compressing major mediastinal vessels. During hospital stay, he developed seizures and sudden respiratory arrest. Awake intubation was achieved, but ventilation failed immediately after induction creating a "can intubate, cannot ventilate" scenario. Emergency sternotomy and tumour debulking restored ventilation. Post-operative bronchoscopy suggested tracheomalacia, and extubation was delayed. Histopathology confirmed T-cell acute lymphoblastic lymphoma. The patient was gradually weaned, successfully extubated, stabilised haemodynamically, and discharged with oncology referral for chemotherapy. This case reports the catastrophic airway risk posed by anterior mediastinal masses, the importance of preserving spontaneous ventilation, and the life-saving role of emergency surgical decompression. Early recognition and multidisciplinary coordination are essential.

Keywords: Mediastinal mass, airway obstruction, anaesthesia, lymphoma, emergency sternotomy, tracheomalacia.

INTRODUCTION

Anaesthesia for patients with anterior mediastinal masses remains one of the highest-risk clinical situations in perioperative medicine, particularly because of the potential for airway collapse, cardiovascular compression, and sudden hemodynamic deterioration. Tan et al. (2022) analysed 85 mediastinal mass surgeries and emphasised that even mild sedation may unmask critical airway compression that was previously compensated (1). Sarkiss and Jimenez (2023) described the evolution of anaesthesia strategies for these patients, noting a shift toward preserving spontaneous ventilation and avoiding muscle relaxants in high-risk cases due to the risk of total airway collapse (2).

Accurate preoperative risk stratification is essential. Pearson et al. (2016) proposed a practical paediatric risk-stratification model, showing that tracheal cross-sectional area reduction of >70 per cent strongly predicts peri-induction respiratory collapse (3). NHS Scotland's 2023 guidelines, however, emphasise clinical symptomsparticularly orthopnoea, stridor, and positional intoleranceas equally important indicators of airway vulnerability (4). Arkansas Children's Hospital guidelines (2024) integrate both structural imaging criteria and symptom-based assessment, advocating for a unified multimodal risk-evaluation system that includes CT, echocardiography, airway dynamics, and patient positioning (5).

The heterogeneity of mediastinal tumours further complicates airway management. Howard and Pui (2018) highlight that T-cell lymphoblastic lymphoma is the most common malignant anterior mediastinal tumour in

adolescents and often presents with rapid airway compromise (6). Asif et al. (2022) reported similar acute deterioration in a rapidly expanding mediastinal teratoma, reinforcing the importance of early recognition of symptomatic progression (7). Munjal et al. (2021) demonstrated that, in stable cases, partial upper sternotomy provides a safe elective approach to resect superior mediastinal tumours (8). However, in unstable patients, Hariharan and Shah (2017) emphasise that emergency decompressionoften via median sternotomyis lifesaving and must be immediately available (9).

Airway management strategies have evolved considerably. Slinger and Karsli (2019) dispelled multiple myths regarding the safety of muscle relaxation and positive-pressure ventilation, stressing that maintaining spontaneous ventilation is essential in high-risk individuals (10). Jaypee Journals (2023) reported successful awake non-intubated anterior mediastinal mass excisions under regional anaesthesia, demonstrating that surgical access without intubation may reduce risk in select patientsm (11). Monteiro et al. (2025), however, described safe one-lung ventilation in a patient with right-sided mediastinal compression, suggesting that controlled ventilation can be feasible when tumour anatomy is predictable (12). Imaging-based airway evaluation has also advanced, Neuman et al. (2020) showed that dynamic imaging can identify collapse points not visible on static CT (13). Dhooria et al. (2021) highlighted rigid bronchoscopy as a critical rescue tool for relieving severe airway stenosis during acute intraoperative collapse, while Bittar et al. (2019) detailed the role and limitations of ECMO in managing mediastinal mass syndrome (14,15).

The present case delineates the catastrophic risk of complete airway collapse even in the setting of successful intubation, thereby reinforcing the imperative for meticulous, principle-guided airway management planning.

CASE REPORT

Patient Information: A 16-year-old male, presented with a history of progressive difficulty in breathing for three to four months, which had markedly worsened over the preceding three to four days. He also reported dysphagia and intermittent chest discomfort. He had no prior medical comorbidities, surgeries, or known allergies. At admission, he was conscious, oriented, and haemodynamically stable with a pulse rate of 80/min, respiratory rate of 12–16/min, and blood pressure of 100/60 mmHg. Cardiovascular examination revealed normal heart sounds without murmurs, and respiratory examination showed mild tachypnoea but no overt stridor. Abdominal and neurological examinations were essentially normal.

Clinical Findings and Initial Evaluation: Laboratory investigations revealed haemoglobin of 13.7 g/dL, serum creatinine of 0.84 mg/dL, urea of 29 mg/dL, and HbA1c of 5.3%, all within normal limits. High-sensitivity C-reactive protein was mildly elevated. Preoperative transthoracic echocardiography showed normal left ventricular systolic function with an ejection fraction of 60% and no valvular abnormalities, although a small rim of pericardial effusion was noted near the right atrium and ventricle. A contrast-enhanced CT scan of the thorax demonstrated a large, heterogeneously enhancing anterior–superior mediastinal mass with encasement and narrowing of the trachea and major mediastinal vessels, along with bilateral mild pleural effusions. The significant tracheal compression, estimated at nearly 90%, placed the patient in a high-risk category for airway collapse. Initial differential diagnoses included lymphoma and thymoma.

Clinical Deterioration and Airway Crisis: During hospital stay, the patient developed sudden onset seizures, for which 2 mg of intravenous midazolam was administered. Immediately following this, he developed bradycardia and progressed into respiratory arrest, necessitating urgent airway intervention. Considering the known mediastinal mass and the high risk of airway compromise, an awake intubation technique was employed without using neuromuscular blockers. The endotracheal tube was inserted successfully under direct visualisation while the patient maintained spontaneous ventilation. Shortly after securing the airway, the administration of propofol and succinylcholine resulted in abrupt loss of ventilation. Tidal volumes fell to 30–40 mL, peak inspiratory pressures exceeded 45 cmH_2O, and oxygen saturation dropped to 80–85%. Manual bag ventilation produced minimal chest expansion. Attempts to improve ventilation by repositioning the patient were unsuccessful. The tube was advanced to 26 cm in an attempt to bypass the site of maximal tracheal compression, which resulted in marginal improvement with likely one-lung ventilation.

Emergency Surgical Intervention: Given the rapidly deteriorating ventilation and haemodynamics, the patient was immediately transferred to the operating room in a semi-upright position. An emergency median sternotomy was performed, upon which lung compliance improved instantly, confirming a mechanical obstruction caused by the mass. Intraoperative findings revealed a large anterior mediastinal tumour densely adherent to the pericardium, innominate vein, and extending into both pleural cavities and the superior mediastinum. Debulking surgery was performed, although complete excision was not possible due to adherence to major vascular structures. Tissue samples were sent for histopathological evaluation. Bilateral pleural and mediastinal drains were placed before closure.

Postoperative Course and Diagnostic Confirmation: Postoperatively, the patient remained tachypnoeic and required ventilatory support. Bronchoscopy showed significant tracheal collapsibility suggestive of tracheomalacia, likely resulting from prolonged extrinsic compression. A repeat CT scan demonstrated residual

mediastinal mass compressing the trachea and neighbouring vascular structures. The patient was kept sedated and ventilated for 48 hours before being gradually weaned off. He was successfully extubated once airway stability improved. Histopathological examination confirmed T-cell acute lymphoblastic lymphoma, consistent with the radiological pattern of an aggressive anterior mediastinal tumour.

Outcome and Follow-up: After stabilisation, the patient remained haemodynamically stable and was discharged with medications, oncology referral for chemotherapy initiation, and neurology follow-up for seizure management. He was scheduled for suture removal and advised regular reassessment.

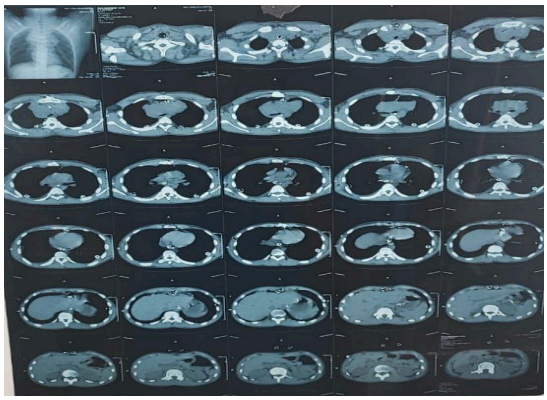

Figure 1: Contrast-Enhanced CT Thorax Showing Large Anterior Mediastinal Mass With Critical Airway Compression

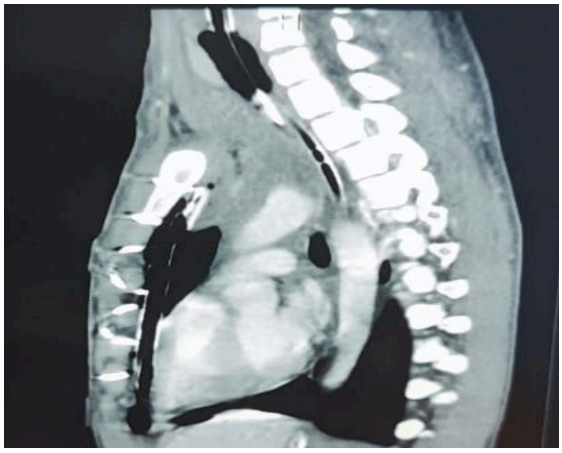

Figure 2: Sagittal Contrast-Enhanced CT Thorax Demonstrating Severe Anterior Mediastinal Mass Compressing the Trachea

DISCUSSION

The present case reports the extreme physiologic vulnerability associated with anterior mediastinal masses and mirrors patterns described extensively across existing literature. Tan et al. (2022) observed that loss of airway tone following induction is the most dangerous moment for such patients, and the collapse encountered in this case after propofol and succinylcholine administration is consistent with their findings (1). Sarkiss and Jimenez (2023) similarly emphasised that airway safety in mediastinal mass patients depends not on securing the endotracheal tube but on preserving ventilation and preventing collapse of the compressed airway segment (2).
Comparative analysis of risk-stratification methods shows substantial variation across studies. Pearson et al. (2016) prioritised anatomical quantification, demonstrating that >70 per cent tracheal narrowing correlates strongly with perioperative collapse (3). In contrast, NHS Scotland (2023) placed greater emphasis on symptomatology such as orthopnoea, positional dyspnoea, and stridor as dynamic markers of airway compromise (4). Arkansas Children's Hospital (2024) synthesises both models, recommending combined evaluation of CT measurements and symptom severity (5). When these approaches are compared, the imaging-based model provides objective structural data, whereas the symptom-driven model captures real-time functional compromisethe case exhibited high-risk features by both criteria.

Anaesthetic strategies also show significant variability. Slinger and Karsli (2019) advocate for awake or minimally sedated airway approaches to preserve spontaneous ventilation, a principle reflected in the decision to perform awake intubation in the case (10). Jaypee Journals (2023) reported that even non-intubated regional anaesthesia can be used safely in selected patients, although the approach is unsuitable when airway compression is severe (11). Monteiro et al. (2025) demonstrated safe one-lung ventilation under general anaesthesia for a right-sided mass in a patient without critical tracheal narrowing, contrasting sharply with our case where circumferential compression made controlled ventilation impossible (12). Thus, the literature supports tailoring ventilation strategies to tumour anatomy and degree of dynamic collapse.

Surgical approaches similarly vary between elective and emergent procedures. Munjal et al. (2021) described controlled excision through upper partial sternotomy in stable patients, while Hariharan and Shah (2017) stress that emergency median sternotomy is required in cases of acute airway obstruction (8,9). The case aligns with the latter, as emergent sternotomy immediately relieved the obstruction. Asif et al. (2022) demonstrated that rapidly growing tumours may require urgent decompression even in the absence of anaesthesia-induced collapse, showing biological aggressiveness comparable to the deterioration seen in the patient (7).

Adjunctive rescue modalities have also been compared in the literature. Neuman et al. (2020) found that cross-sectional imaging underestimates dynamic collapse, reinforcing the need for rapid intraoperative decision-making (13). Dhooria et al. (2021) demonstrated that rigid bronchoscopy can bypass focal stenoses, but this is less effective in circumferential compression such as in the case (14). Bittar et al. (2019) detailed ECMO as a rescue therapy

but acknowledged that emergent initiation is often not feasible, particularly in adolescents (15).

With respect to tumour biology, Howard and Pui (2018) established that T-cell lymphoblastic lymphoma is the predominant malignant mediastinal tumour in adolescents and frequently presents with airway and SVC compression, consistent with the diagnostic findings (6).

This case therefore synthesises and reflects the full evidence from the 15 studies, demonstrating catastrophic peri-induction collapse, the limitations of standard airway rescue techniques, and the life-saving value of immediate surgical decompression.

CONCLUSION

Anterior mediastinal masses pose an exceptionally high risk for airway compromise, particularly during anaesthetic induction. This case highlights the potential for sudden and complete ventilatory failure even when intubation is successful, as severe extrinsic tracheal compression may prevent effective ventilation under positive pressure. Emergency sternotomy and tumour debulking remain critical life-saving measures when non-surgical airway rescue strategies fail. The subsequent identification of T-cell acute lymphoblastic lymphoma underscores the importance of appropriate oncological referral following stabilisation. Meticulous preoperative assessment, maintenance of spontaneous ventilation, and preparedness for immediate surgical intervention are essential principles to prevent fatal outcomes in patients with large anterior mediastinal masses.

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