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Anesthesia Strategy in Giant Thyroid Tumor Causing Critical Tracheal Compression: Case Report

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Abstract

This case report presented the anesthetic management of a 53-year-old male (173 cm, 59 kg) with a giant left thyroid carcinoma causing severe tracheal compression (narrowest diameter ~4 mm) and left vocal cord paralysis, scheduled for resection. Preoperative assessment highlighted a high risk for difficult airway and major hemorrhage.

Anesthesia was induced with incremental sevoflurane to preserve spontaneous ventilation and to confirm unimpeded mask ventilation, followed by rapid sequence induction and successful video laryngoscopy-guided intubation using a 6.5-mm internal diameter nerve monitoring endotracheal tube advanced to 25.5 cm to bypass the stenotic segment. Total intravenous anesthesia (TIVA) with propofol and remifentanil was maintained under BIS guidance.

The 9.5-hour procedure involved significant blood loss (2800 ml), managed with invasive hemodynamic monitoring, vasopressor support (norepinephrine), transfusion of 9 units PRBCs and 800 ml FFP, and TEG-guided coagulation therapy (additional FFP and tranexamic acid) for coagulation factor deficiency and hyperfibrinolysis. Lung-protective ventilation and active thermoregulation were employed.

Despite these measures, prolonged intubation contributed to postoperative pneumonia. The patient was extubated on postoperative day 3, transferred to the ward on day 5, and discharged home on day 18. This case underscores the critical importance of meticulous preoperative planning, advanced airway techniques, goal-directed hemostatic and hemodynamic management, and proactive complication prevention in complex head and neck oncologic surgery with critical airway compromise.

Keywords

Giant Thyroid Carcinoma, Airway Compression, Difficult Airway Management, Anesthesia

Abbreviations

ASA: American Society of Anesthesiologists; BIS: Bispectral Index; CT: Computed Tomography; COPD: Chronic Obstructive Pulmonary Disease; FiO_2: Fraction of Inspired Oxygen; FFP: Fresh Frozen Plasma; LY30: Lysis at 30 minutes; POD: Postoperative Day; PEEP: Positive End-Expiratory Pressure; PPCs: Postoperative Pulmonary Complications; R time: Reaction time; SBT: Spontaneous Breathing Trial; SpO_2: Peripheral Capillary Oxygen

Saturation; TEG: Thrombelastography; TIVA: Total Intravenous Anesthesia

Introduction

Giant thyroid tumor with significant tracheal compression represents a high-risk anesthetic scenario, demanding meticulous preoperative planning and specialized airway management strategies. The primary challenge lies in securing a compromised airway, where extrinsic compression may cause critical stenosis, tracheomalacia, or distortion of anatomy.

Patients often present with stridor, dyspnea, or positional symptoms, necessitating urgent evaluation via CT or dynamic bronchoscopy to assess the degree and dynamic nature of obstruction. Anesthetic induction must balance avoiding loss of spontaneous ventilation with ensuring adequate depth of anesthesia to prevent reflex bronchospasm or coughing.

Techniques such as awake fiberoptic intubation, inhalational induction with sevoflurane, or video laryngoscopy-guided intubation are commonly employed, supplemented by immediate access to advanced rescue devices and surgical airway backup. Concurrent risks of massive hemorrhage, recurrent laryngeal nerve injury, and postoperative pulmonary complications further complicate perioperative care. In this report, we present the surgical anesthesia management of a patient with giant thyroid tumor and airway compression.

Case Presentation

A 53-year-old male (height 173 cm, weight 59 kg) presented with a chief complaint of progressive neck swelling persisting for over 30 years. Approximately three decades prior, the patient first noticed a left-sided neck mass and underwent evaluation at a local hospital. Surgical excision was attempted, but the mass was found to encase cervical vasculature, precluding complete resection; only a biopsy was obtained. Subsequent conservative management was pursued.

Due to progressive enlargement of the mass, the patient was referred to our institution. Computed tomography (CT) revealed multiple confluent masses involving the left thyroid lobe and isthmus, along with enlarged lymph nodes causing significant tracheal compression (**Fig-1**). He was diagnosed with a "giant tumor of the left thyroid lobe with tracheal compression" and scheduled for surgical intervention under general anesthesia.

Anesthesia Management

Difficult Airway Assessment:

Preoperative CT imaging demonstrated marked tracheal compression and flattening, with the narrowest luminal diameter measuring approximately 4 mm (**Fig-1**), indicating a high likelihood of a difficult airway. Clinical assessment revealed no positional dyspnea or intercostal retractions, although hoarseness was present. Fiberoptic laryngoscopy confirmed left vocal cord paralysis.

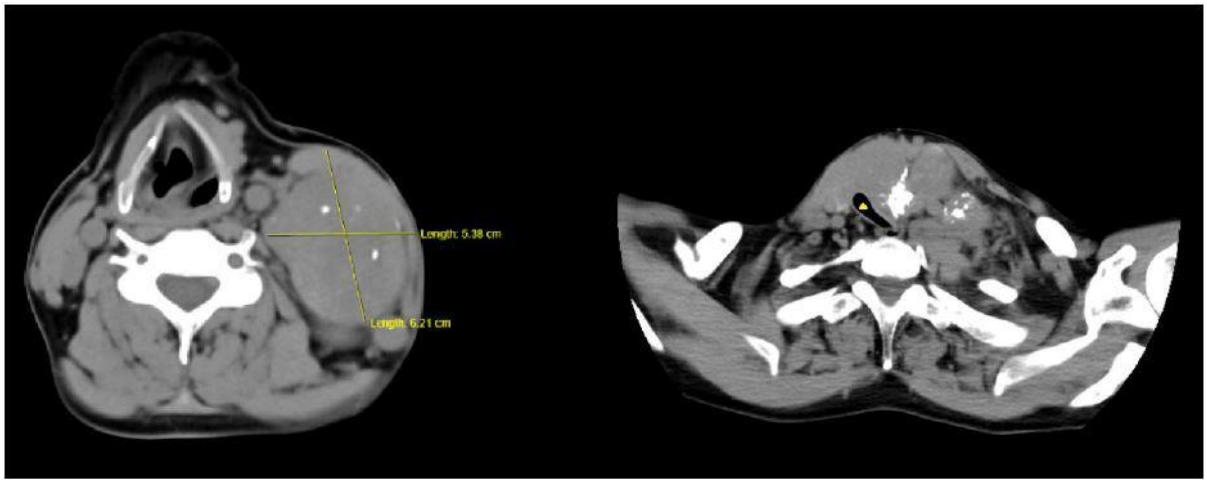

Fig-1: Computed tomography image of the patient. Giant thyroid tumor with significant right-sided tracheal compression (yellow triangle).

Airway Management Strategy:

Upon arrival in the operating room, baseline vital signs were stable: heart rate (HR) 78 beats per minute (bpm), blood pressure (BP) 133/82 mmHg, and peripheral capillary oxygen saturation (SpO_2) 98% on room air. The patient had observed an 8-hour fasting period, confirmed by gastric ultrasound demonstrating an empty stomach.

Anesthesia induction commenced with incremental sevoflurane concentrations to preserve spontaneous ventilation. After confirming unimpeded mask ventilation, rapid sequence induction was performed using rocuronium, remifentanil, and propofol. Under videolaryngoscopic guidance, a 6.5-mm internal diameter nerve integrity monitoring endotracheal tube was successfully placed and advanced to 25.5 cm at the incisors to bypass the tumor-compressed segment of the trachea. Anesthesia was maintained using total intravenous anesthesia (TIVA) with propofol and remifentanil, titrated according to Bispectral Index (BIS) monitoring, supplemented with intermittent sufentanil boluses for analgesia.

Management of High Intraoperative Bleeding Risk:

Given the tumor's large size, vascular encasement, and history of prior incomplete resection due to hemorrhage, the patient was deemed at high risk for significant intraoperative bleeding. Invasive monitoring was established with left radial arterial catheterization for continuous hemodynamic monitoring and frequent blood gas analysis. Two 14-gauge intravenous cannulas were placed in bilateral great saphenous veins, and a central venous catheter was inserted via the left femoral vein.

Intraoperative fluid resuscitation consisted of 4100 ml crystalloids (1500 ml Lactated Ringer's, 1500 ml Acetated Ringer's Solution, 1100 ml normal saline), 2100 ml Succinylated Gelatin Injection (colloid), 800 ml fresh frozen plasma (FFP), and 9 units of packed red blood cells (PRBCs). Significant hemorrhage occurred during tumor dissection due to dense adherence to surrounding vasculature, resulting in hypotension managed with a norepinephrine infusion (0.05–0.2 μg/kg/min) to maintain adequate perfusion pressure.

Coagulation Management:

Estimated blood loss totaled 2800 ml. Thromboelastography (TEG) was employed during the hemostatic phase to guide targeted therapy. TEG analysis revealed coagulation factor deficiency (R time = 16 seconds) and hyperfibrinolysis (LY30 = 8.9%). Consequently, 800 ml of fresh frozen plasma (FFP) and 2 grams of tranexamic acid (TXA) were administered.

Temperature Management:

Following intubation, an esophageal temperature probe was placed. An underbody forced-air warming blanket and intravenous fluid warming devices were utilized throughout the procedure to maintain core body temperature above 36°C.

Lung-Protective Ventilation:

A lung-protective ventilation strategy was implemented, comprising low tidal volume ventilation (6–8 ml/kg predicted body weight), positive end-expiratory pressure (PEEP) of 5–8 cm H_2O, intermittent recruitment maneuvers (using the PEEP increment technique), and low fractional inspired oxygen (FiO_2) (35–40%).

Surgical Procedure and Outcome:

The surgical team performed palliative resection of the left thyroid lobe and isthmus, left central compartment lymph node dissection (CCLND), left lateral neck dissection (LND), and recurrent laryngeal nerve exploration with intraoperative neuromonitoring (IONM). The procedure lasted 9 hours 30 minutes.

Postoperatively, the patient was transferred to the intensive care unit (ICU). The endotracheal tube was successfully extubated on postoperative day (POD) 3. The patient was transferred to the general ward on POD 5 and discharged home on POD 18.

Discussion

Airway Management:

Patients harboring giant neck tumors require meticulous airway evaluation. Adhering to the ASA Difficult Airway Algorithm [1], we confirmed the feasibility of mask ventilation after inducing sedation with sevoflurane, while anticipating potential difficulty

with tracheal intubation. In this instance, glottic visualization was satisfactory, but navigating the tube through the stenotic tracheal segment posed a significant challenge.

Consequently, following induction with rocuronium, propofol, and remifentanil, the nerve monitoring tube was placed under video laryngoscopic guidance, with sugammadex readily available for potential rocuronium reversal. A flexible bronchoscope was maintained on standby.

Given the prolonged duration of tumor growth and airway compression, tracheomalacia was a significant concern [2]. Dynamic airway CT can quantify the degree of airway collapse [3,4], while dynamic flexible bronchoscopy enables direct visualization and assessment of the type and extent of tracheomalacia [5,6]. Notably, both diagnostic modalities require patient cooperation in the awake state.

Diagnostic criteria for tracheomalacia are defined as follows: normal-expiratory luminal narrowing <70% of baseline; mild—70%–80% narrowing; moderate—81%–90% narrowing; severe—>90% narrowing or apposition of the anterior and posterior tracheal walls.

Preoperative bronchoscopy in this patient did not demonstrate tracheomalacia. Therefore, extubation on postoperative day (POD) 3 proceeded following successful spontaneous breathing trials (SBT), cuff leak tests, and bronchoscopy confirmation of adequate right vocal cord mobility.

Coagulation Management:

Prolonged, complex surgical procedures with substantial blood loss necessitate vigilant coagulation monitoring. Hemorrhagic shock leading to tissue hypoperfusion results in metabolic (lactic) acidosis. Acidosis impairs the assembly of coagulation factor complexes dependent on calcium ions and negatively charged phospholipids, contributing to significant coagulopathy [7,8].

High-volume resuscitation with crystalloids, colloids, and PRBCs dilutes circulating plasma coagulation factors [9]. Hypoxia secondary to hypoperfusion and feedback mechanisms related to thrombin generation stimulate endothelial release of tissue plasminogen activator (tPA). Trauma-induced coagulopathy (TIC)-mediated consumption of activated protein C (aPC) depletes endogenous plasminogen activator inhibitor-1 (PAI-1), shifting the hemostatic balance toward fibrinolysis and permitting unopposed tPA-mediated plasmin generation [10]. Diversion of thrombin toward protein C activation may also diminish activation of thrombin-activatable fibrinolysis inhibitor (TAFI), further amplifying fibrinolytic activity [11].

In this patient, rapid TEG analysis confirmed coagulation factor deficiency and hyperfibrinolysis, enabling targeted correction with FFP and TXA. Concurrent correction of electrolyte and acid-base imbalances through repeated blood gas analyses contributed to improved microcirculatory perfusion and restoration of coagulation function.

Prevention of Pulmonary Complications:

Numerous risk factors contribute to postoperative pulmonary complications (PPCs), including upper abdominal, thoracic (open), head and neck, neurosurgical, and open aortic aneurysm surgery; emergency procedures; age >65 years; prolonged surgical duration (>3 hours); ASA physical status >2; congestive heart failure; serum albumin <3 g/dL; chronic obstructive pulmonary disease (COPD); recent smoking (within 8 weeks); use of long-acting neuromuscular blocking agents; functional dependence; obstructive sleep apnea; and recent lower respiratory tract infection [12-14].

Despite intraoperative implementation of lung-protective ventilation and utilization of short-acting neuromuscular blocking agents, this patient developed postoperative pneumonia. This complication was likely attributable to prolonged intubation and impaired secretion clearance secondary to pre-existing airway narrowing. Management included appropriate antibiotic therapy, aerosol therapy (nebulization), airway suctioning, and respiratory physiotherapy, resulting in clinical improvement.

Other Anesthetic Considerations:

Additional critical anesthetic considerations in this

case included the maintenance of normothermia utilizing active warming devices and ensuring adequate anesthetic depth guided by BIS monitoring.

Conclusion

This case demonstrates that successful anesthetic management for giant neck tumors with critical tracheal stenosis necessitates a comprehensive, multidisciplinary approach. Key elements include rigorous preoperative airway assessment, utilization of advanced techniques like sevoflurane induction and video laryngoscopy for secure airway control, vigilant intraoperative monitoring with TEG for timely correction of coagulopathy, aggressive hemodynamic support for anticipated massive hemorrhage, and implementation of protective strategies against pulmonary complications. Meticulous attention to these factors is paramount for optimizing patient outcomes in this high-risk surgical population.

Consent for Publication

Written informed consent was obtained from the patient's son for the publication of this case report and related images.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of West China Hospital of Sichuan University. Written informed consent was obtained from the patient and his son for the publication of any potentially identifiable images or data included in this article.

Data Availability Statement

The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding authors.

Conflict of Interest

The author has read and approved the final version of the manuscript. The author declares no conflicts of interest.

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