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Difficult Airway Management in Severe Tracheal Deviation Due to Large Nodular Goiter: A Case Report

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ABSTRACT

*Difficult airway*s remain a major challenge in anesthesiology due to its impact on perioperative morbidity and mortality, especially in patients with large cervical masses causing anatomical distortion. Severe tracheal deviation from large goiters poses significant airway management difficulties, with standard intubation techniques linked to higher failure rates and complications. The research aims to report successful management of a difficult airway in a patient with severe tracheal deviation from a large nodular goiter using awake video laryngoscopy. This case involves a 53-year-old female undergoing elective total thyroidectomy for a large goiter causing tracheal deviation to the left and restricted neck mobility. Preoperative assessment included LEMON and MOANS criteria, and perioperative outcomes were documented. A neck CT scan showed an enlarged right thyroid lobe, tracheal deviation to the left, and luminal narrowing to about 5 mm. The patient scored 5/10 on LEMON, indicating high risk for difficult intubation, and 1/5 on MOANS, indicating low risk for mask ventilation difficulty. Awake intubation with STORZ® C-MAC 8403 ZX video laryngoscope achieved Cormack-Lehane grade IIa visualization. The total thyroidectomy was successful without intraoperative complications or adverse postoperative events. Awake video laryngoscope-guided intubation is a safe, effective strategy for severe anatomical distortion cases, especially when preserving spontaneous ventilation is essential. It provides a practical alternative to fiberoptic bronchoscopy in resource-limited settings while ensuring patient safety.

Keywords: Difficult airway, hyperthyroidism, goiter, tracheal deviation, airway management

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INTRODUCTION

Difficult airway remains one of the primary challenges in anesthetic practice due to its direct association with perioperative morbidity and mortality. It is defined as a clinical situation in which there is difficulty with face mask ventilation, tracheal intubation, or both—even when appropriate equipment and skilled personnel are available. The American Society of Anesthesiologists (ASA) reports that approximately 1–3% of general anesthesia cases encounter difficulty with intubation, and 0.3% involve both difficult intubation and ventilation, known as the "cannot intubate, cannot ventilate" (CICV) scenario (Apfelbaum et al., 2022).

One important etiology to be considered is cervical masses such as large goiters in hyperthyroidism, which may lead to tracheal deviation, tracheal compression, or even partial to complete airway obstruction. Goiters extending into the mediastinum further exacerbate the risk by causing distortion of the lower airway anatomy, which may not be manageable using standard airway techniques (Ríos Medina et al., 2021). These changes are often not detectable through external physical examination alone and may only become evident on imaging modalities such as CT scans or bronchoscopy (Cook & MacDougall-Davis, 2012).

Previous research on difficult airway management in patients with goiters has primarily focused on the gold standard technique of awake fiberoptic intubation. Studies by Rosenblatt and Sukhupragarn (2020) provided comprehensive reviews of airway management principles in goiter patients but did not extensively explore alternative techniques when fiberoptic equipment is unavailable. Research by Seidman et al. (2018) challenged conventional assumptions about tracheal deviation as a predictor of difficult intubation but did not address specific management strategies for severe cases. While Yao et al. (2021) examined airway

management in tracheal deviation patients, their study focused on retrospective analysis rather than detailed case-by-case management strategies. Yu et al. (2019) provided valuable epidemiological data on tracheal deviation in thyroid surgery but limited discussion of specific airway management techniques in resource-constrained settings.

Severe tracheal deviation resulting from a large toxic nodular goiter presents a significant challenge in airway management, primarily due to anatomical distortion that can obscure glottic visualization and hinder endotracheal tube passage. This deviation often reflects extrinsic compression and displacement of the trachea, which may not only narrow the airway lumen but also alter the predictable alignment required for conventional laryngoscopy (Huitink & Bouwman, 2015). In such cases, standard intubation techniques are associated with higher rates of difficulty and potential complications, including failed intubation and airway trauma. Therefore, patients with marked tracheal deviation should be managed as having a potentially difficult airway, warranting preoperative imaging, thorough airway assessment, and preparation for awake intubation with adjuncts like videolaryngoscopy or fiberoptic bronchoscopy as recommended in difficult airway guidelines (Frerk et al., 2015).

The research gap specifically lies in the limited documentation of alternative airway management strategies when gold-standard techniques are unavailable, particularly in healthcare settings with resource constraints. While fiberoptic bronchoscopy remains the preferred method for predicted difficult airways, its limited availability in many healthcare systems necessitates viable alternatives. Additionally, there is insufficient case-based evidence documenting the step-by-step approach to managing severe tracheal deviation using video laryngoscopy, including patient selection criteria, technique modifications, and complication management strategies.

The research problem addressed in this case report centers on the complex airway management challenges presented by patients with severe tracheal deviation secondary to large cervical masses. While difficult airway management protocols exist, the specific combination of anatomical distortion, airway compression, and the potential for complete airway obstruction in patients with large goiters requires specialized approaches that may not be adequately addressed in standard guidelines. The challenge lies in maintaining patient safety while ensuring successful intubation in the presence of severe anatomical distortion that can obscure traditional landmarks and compromise conventional intubation techniques.

The urgency of documenting such cases stems from the increasing prevalence of thyroid disorders globally, with large goiters presenting potentially life-threatening airway management challenges. Healthcare providers, particularly in resource-limited settings where advanced airway equipment may not be readily available, need evidence-based alternatives to gold-standard techniques. The immediate risk of airway catastrophe in such patients demands comprehensive documentation of successful management strategies to inform clinical decision-making and improve patient outcomes in similar presentations.

The novelty of this case report lies in its detailed documentation of awake video laryngoscopy as a successful alternative to fiberoptic bronchoscopy in managing severe tracheal deviation. Unlike previous reports that primarily focused on conventional approaches, this case demonstrates the practical application of readily available video laryngoscopy equipment in challenging anatomical conditions. The systematic approach to patient

assessment, preparation, and execution provides a replicable framework for similar cases in various healthcare settings.

Ideally, the gold standard technique for securing the airway in predicted difficult airway cases is awake fiberoptic intubation (Crosby, 2014). However, limited availability of flexible bronchoscopes in many healthcare settings often necessitates alternative approaches. In such scenarios, awake video laryngoscopy with spontaneous ventilation may offer a safe and effective strategy (Lewis et al., 2017).

The specific objectives of this case report are: (1) to document the successful management of severe tracheal deviation using awake video laryngoscopy; (2) to demonstrate the systematic approach to difficult airway assessment and planning; (3) to provide a detailed technical description of the awake intubation procedure using video laryngoscopy; (4) to evaluate the safety and efficacy of this approach in severe anatomical distortion; and (5) to offer evidence-based recommendations for similar cases in resource-limited settings.

The benefits of this case report include providing healthcare practitioners with a detailed alternative approach when fiberoptic equipment is unavailable, contributing to the literature on video laryngoscopy applications in difficult airways, offering a systematic framework for managing similar cases, and supporting evidence-based decision-making in challenging airway scenarios. The implications extend to anesthesiologists, emergency physicians, and intensive care practitioners who may encounter similar presentations and need practical, implementable solutions for patient safety.

This case report presents the airway management strategy in a patient with a large nodular goiter and severe tracheal deviation, successfully managed using awake video laryngoscopy, and highlights the critical importance of anesthetic team planning and thorough preparation for emergency interventions.

METHOD

This case report employed a comprehensive clinical documentation methodology following established case report guidelines. The approach included systematic documentation of patient presentation, clinical assessment, decision-making processes, intervention techniques, and outcomes. A 53-year-old female patient, weighing 35 kg and standing 145 cm tall, was admitted for an elective total thyroidectomy due to progressive diffuse thyroid enlargement persisting for over one year. The patient reported dyspnea, particularly when lying supine, along with wheezing and a choking sensation. She denied any dysphagia, hoarseness, or chronic cough. There was no history of hypertension, diabetes, or prior surgeries.

On physical examination, a diffusely enlarged thyroid mass was observed with firm consistency and no tenderness, exerting visible pressure on adjacent structures. No suprasternal retraction, hoarseness, or cyanosis was noted. Cervical auscultation revealed coarse breath sounds over the tracheal region. The patient appeared calm and cooperative with intact cognitive function. Airway assessment revealed a Mallampati score of Class III, thyromental distance of less than 6 cm, significant tracheal deviation to the left due to thyroid enlargement, and limited neck mobility. Based on the LEMON (Look–Evaluate–Mallampati–Obstruction–Neck mobility) criteria, the patient scored 5 out of 10, indicating a high risk for difficult intubation. The MOANS (Mask seal–Obstruction–Age–No teeth–Stiff lungs) score was 1 out of 5, suggesting a low risk for mask ventilation difficulty.

Figure 1. Patient with large nodular Goiter

A neck CT scan revealed a markedly enlarged right thyroid lobe with tracheal deviation to the left and narrowing of the tracheal lumen to approximately 5 mm. Electrocardiogram showed sinus tachycardia with a heart rate of 105 bpm. Laboratory findings included a TSH level < 0.01 µIU/mL and free T4 (FT4) level of 3.26 ng/dL. Complete blood count showed hemoglobin 12.6 g/dL, white blood cell count 9,400/mm³, and platelets 280,000/mm³. Renal function and electrolyte levels were within normal limits. The patient was classified as ASA Physical Status III.

Figure 2. Physical Examination due to large nodular goiter, with severe trachela deviation

The patient was preoperatively managed with propylthiouracil 100 mg every 8 hours, propranolol 20 mg every 8 hours, and dexamethasone 5 mg every 12 hours. Preoperative counseling was provided regarding the potential for a difficult airway, including discussion of awake intubation and written informed consent. Consultations were also made with the ENT and intensive care teams in preparation for postoperative care.

Airway management was performed using an awake intubation technique with a The STORZ® C-MAC 8403 ZX video laryngoscope. Premedication included intravenous midazolam 0.5 mg and fentanyl 25 mcg. Topical anesthesia was achieved using 4% lidocaine nebulization, 10% lidocaine spray, and lidocaine gel lubrication. Oxygen was administered via nasal cannula at a flow rate of 4 L/min. During the procedure, the patient remained conscious and cooperative. Glottic visualization during laryngoscopy revealed a Cormack–Lehane grade IIa view. Endotracheal intubation was successfully performed using a 6.5 mm endotracheal tube (ETT) with the aid of a stylet. Tube placement was confirmed via capnography and bilateral chest auscultation.

Following airway securement, general anesthesia was induced using propofol 2 mg/kg and rocuronium 0.6 mg/kg. Anesthesia was maintained with sevoflurane 1–2% and remifentanil 0.05–0.1 μg/kg/min. The total thyroidectomy procedure lasted approximately 120 minutes, with an estimated blood loss of 250 mL and no intraoperative complications. Airway pressures remained within normal limits, and train-of-four (TOF) monitoring indicated adequate neuromuscular relaxation throughout the procedure.

At the conclusion of surgery, the patient was awakened and extubated after meeting clinical and neuromuscular criteria. No postoperative stridor, retraction, or signs of airway obstruction were observed. The patient was monitored in the High Care Unit (HCU) for 24 hours for close observation of respiratory and hemodynamic status. Postoperative recovery was uneventful, with no respiratory or bleeding complications noted.

RESULTS AND DISCUSSION

The management of a difficult airway is a critical aspect of anaesthetic practice, particularly in patients with severe tracheal deviation, as illustrated in this case. Tracheal deviation due to thyroid enlargement results in significant anatomical distortion, which impairs glottic visualization and increases the risk of intubation failure and airway-related complications (Healy et al., 2012). Compression and displacement of the trachea alter the standard midline approach to intubation, necessitating a tailored management strategy.

A thorough preoperative airway assessment was conducted using the LEMON and MOANS frameworks to evaluate the risk of difficult airway. The patient scored high on the LEMON assessment: external appearance revealed asymmetric neck swelling, the 3-3-2 rule was not met, Mallampati score was Class IV, there was limited neck extension, and significant external neck distortion was present. The MOANS score indicated potential difficulty with mask ventilation. Radiographic imaging and cervical CT demonstrated severe tracheal deviation, placing the patient in the category of anticipated difficult airway (Law et al., 2013).

Based on this evaluation, awake intubation using video laryngoscopy without muscle relaxants was chosen as the safest approach. Awake intubation allows for the maintenance of spontaneous respiration and airway protective reflexes, making it the preferred technique for managing difficult airways (Law et al., 2013). This method is endorsed by both the 2020 Difficult Airway Society guidelines and the 2022 American Society of Anaesthesiologists Difficult Airway Algorithm (Frerk et al., 2015; Apfelbaum et al., 2022).

To facilitate awake intubation, airway topical anesthesia was performed using 6 ml 2% lidocaine nebulization combined with oropharyngeal Lodocain 10% spray to save time in

nebulization compare to use singel 20 ml 4% lidocain nebulization, and avoid patient discomfort due to long Nebulization. Nebulized lidocaine effectively reduces mucosal sensitivity and helps prevent laryngospasm, while preserving spontaneous ventilation. Mild sedation with low-dose midazolam and fentanyl provided patient comfort without compromising respiratory drive. Clinical studies have demonstrated that nebulization provides acceptable anesthesia conditions and procedural success, although regional nerve blocks may offer superior patient comfort and haemodynamic stability. Overall, this technique presents a balance between efficacy, safety, and simplicity in predicted difficult airway management.

The STORZ® C-MAC 8403 ZX video laryngoscope with C-blade size #3, was selected for its superior glottic visualization compared to conventional techniques and its usability by experienced operators even in emergencies. Video laryngoscopy is generally easier to master than fibreoptic bronchoscopy and is more forgiving in anatomically distorted airways (Kumar et al., 2020). Once the glottis was visualized and the endotracheal tube successfully inserted, its position was confirmed via auscultation and capnography. Only then was rocuronium administered to achieve neuromuscular blockade, following the principle "do not paralyze until the tube is secure" in difficult airway management (Lewis et al., 2017).

From an endocrine management standpoint, the patient presented with active hyperthyroidism. A regimen of propylthiouracil, propranolol, and dexamethasone was administered. Propylthiouracil inhibits thyroid hormone synthesis, propranolol alleviates adrenergic symptoms and reduces peripheral T4-to-T3 conversion, while dexamethasone also suppresses conversion to the active hormone and mitigates inflammation (Bahn et al., 2011; Ross et al., 2016). This protocol is crucial to minimize the risk of thyroid storm—a potentially fatal complication triggered by surgery or anesthetic stress.

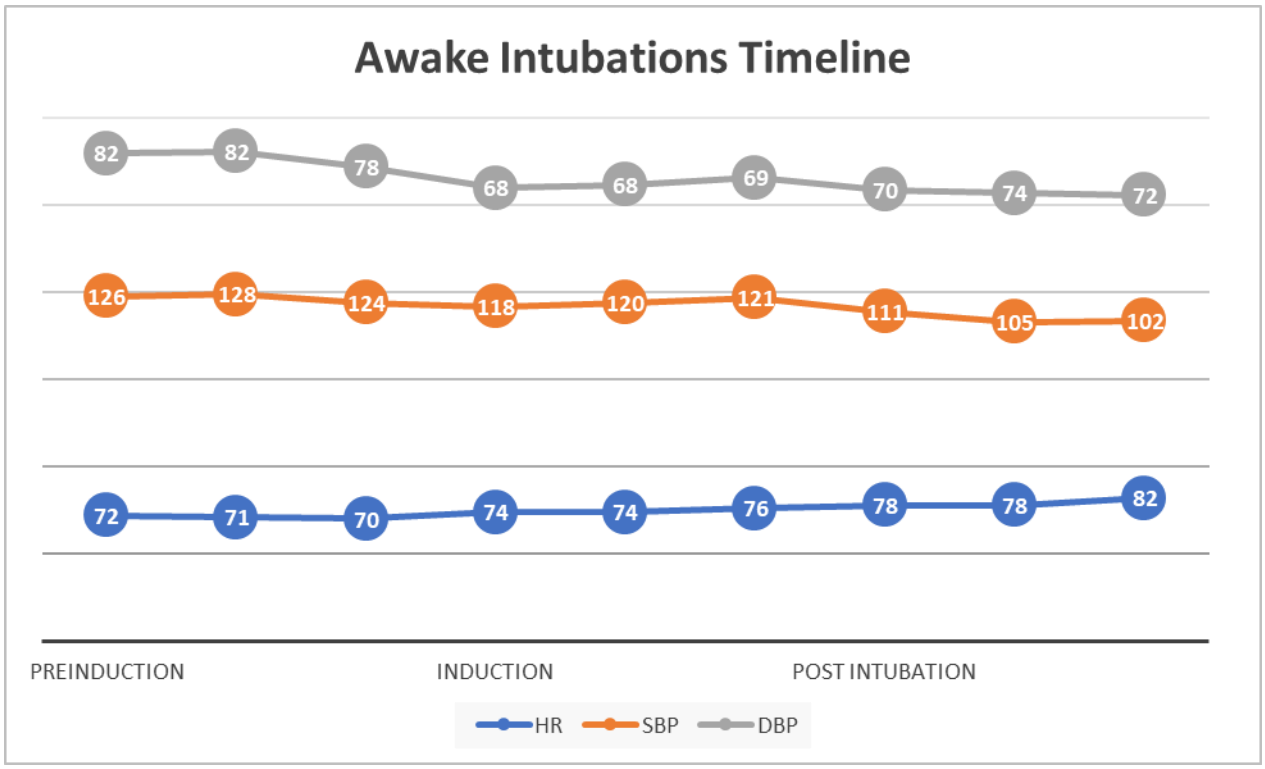

Figure 3. Awake Intubations Timeline. HR: Heart Rate, SBP: Sistolic Blood Pressurre; DBP: Diastolic Blood Pressure

Postoperatively, immediate extubation was deferred due to concerns over potential airway obstruction from laryngeal edema, cervical hematoma, or post-decompression tracheomalacia. The patient remained intubated and was admitted to the intensive care unit (ICU). Re-evaluation of the airway was performed within 24 hours using flexible bronchoscopy prior to planning extubation. This approach aligns with safe extubation protocols for high-risk airway cases (Jaffe et al., 2019).

In conclusion, this case underscores the necessity for a structured approach to difficult airway management, including meticulous planning, the use of awake intubation techniques, and the selection of appropriate airway adjuncts. Multidisciplinary collaboration among the anesthesia, surgical, and intensive care teams is essential for successful outcomes in patients with extreme airway anatomy such as severe tracheal deviation.

CONCLUSION

The management of difficult airways in patients with severe tracheal deviation due to toxic nodular goiter demands a cautious, structured anesthetic approach centered on thorough preoperative risk assessment using tools like LEMON and MOANS to predict airway challenges. Awake intubation with video laryngoscopy has shown to be a safe and effective method, especially when preserving spontaneous ventilation is critical. Comprehensive perioperative care—including thyroid pharmacologic preparation, anesthetic choice, vigilant intraoperative monitoring, and ICU management—must be individualized to both airway and endocrine conditions. Success depends on multidisciplinary collaboration and evidence-based decisions, emphasizing the need for anesthesiologists to be skilled in awake intubation and for healthcare facilities to have modern airway visualization tools widely available. Clinical recommendations from this case include ensuring video laryngoscopy availability as an alternative to fiberoptic bronchoscopy, multidisciplinary planning with ENT and ICU teams, rigorous preoperative airway assessment, thyroid function optimization, and ongoing education on alternative airway techniques for resource-limited settings. Future research should focus on systematically evaluating awake video laryngoscopy protocols and outcomes in severe tracheal deviation cases, especially comparing them to fiberoptic approaches, to establish standardized guidelines that optimize safety and efficacy across diverse clinical environments.

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