

Navigating Complex Airway Challenges in Advanced Laryngeal Cancer: A Case of Total Laryngectomy with Multidisciplinary Anaesthetic Care

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ABSTRACT

Laryngeal Squamous Cell Carcinoma (SCC) is a head and neck cancer that usually causes airway compromise at advanced stages, with substantial anaesthetic implications for its surgical management. The author, here presents a case of a 57-year-old man with worsening hoarseness, dysphagia, and exertional dyspnoea, diagnosed with well-differentiated laryngeal SCC. The preoperative evaluation identified predictors of a difficult airway, such as limited mouth opening and limited neck extension. The anaesthetic management focused on preserving spontaneous ventilation, securing the airway, and ensuring safe positioning. Intravenous ketamine and dexmedetomidine were used to provide sedation, and continuous oxygenation was maintained with a high-flow nasal cannula using the Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE) technique. Fibreoptic intubation was performed. After confirming tracheal placement, neuromuscular blockade was administered, and anaesthesia was maintained with sevoflurane. The nasal endotracheal tube was replaced with a flexometallic tube through a tracheostomy stoma under surgical control, with uninterrupted ventilation. The patient underwent a total laryngectomy with tracheostomy and had an uneventful recovery. The case illustrates the importance of a personalised approach to airway management, advanced oxygenation techniques, and multidisciplinary coordination in the anaesthetic management of complex laryngeal cancer surgery.

Keywords: Difficult airway, Fibreoptic intubation, High-flow nasal oxygenation, THRIVE, Tracheostomy

CASE REPORT

A 57-year-old male, American Society of Anesthesiologists (ASA) physical status III, presented with progressive hoarseness of voice for two years, followed by dysphagia for two months and dyspnea on routine activity (Modified Medical Research Council dyspnea scale of +2) for one and a half months. Dysphagia started with solids and later extended to liquids, with odynophagia. He complained of exertional dyspnea, aggravated by brisk walking and relieved by rest. His appetite had decreased progressively over time. His past medical history included pulmonary tuberculosis six years ago, which had been treated incompletely. He had a history of tobacco chewing and smoking for twenty years. On clinical examination, an ulcer-proliferative growth with an irregular surface was observed, involving the right aryepiglottic fold and true vocal cord, with laryngeal widening. Laryngeal crepitus was present, suggesting possible infiltration.

High-Resolution Computed Tomography (HRCT) of the thorax revealed trachial bronchiectasis with collapse of the right upper lobe, likely sequelae of chronic bronchiectatic changes in the right middle lobe. Subpleural ground-glass opacities with bronchiectatic changes in the basal segments were noted. A fibrotic band was observed in the lingula of the left lobe, with a soft-tissue density at the level of the vocal cords, raising suspicion of malignancy. Histopathological examination of the laryngeal biopsy confirmed the presence of undifferentiated SCC. Detailed histopathology following total laryngectomy described a well-differentiated SCC involving the right aryepiglottic fold. A greyish-white plaque-like lesion was identified on the contralateral aryepiglottic fold. There was no evidence of lymphovascular or perineural invasion. Margin analysis showed that the posterior margin was positive for malignant cell infiltration, while all other margins were negative. The thyroid gland appeared grossly unremarkable.

Preoperative airway assessment disclosed difficult airway predictors, such as Modified Mallampati Class IV, 2.1 cm mouth opening, and restricted temporomandibular joint mobility. A visible midline neck swelling moved with deglutition, raising concerns regarding potential airway obstruction. Preoperative pulmonary function testing suggested a restrictive-stage Chronic Obstructive Pulmonary Disease (COPD). Anaesthetic planning aimed to maintain spontaneous respiration, avoid airway trauma by fibreoptic bronchoscopy-guided intubation, with emergency cricothyroidotomy readiness. An 18-G wide-bore intravenous access was secured preoperatively. After adequate fasting, the patient was shifted to theatre on the day of surgery, and standard ASA monitors were applied. The patient was premedicated with intravenous glycopyrrolate (0.2 mg) and midazolam (2 mg) to reduce secretions and provide anxiolysis. As the patient was very anxious, sedation was begun with a dexmedetomidine infusion (1 mcg/kg over 10 minutes, then 0.2 mcg/kg/hr), achieving good sedation without impairing respiratory drive. High-flow nasal cannula oxygenation with the THRIVE technique at 2 L/kg/min was utilised to prolong apnoea tolerance and ensure oxygenation during airway manipulation. A fibreoptic bronchoscope was passed gently through the right nostril after proper local anaesthesia with lignocaine. Under direct visualisation, the laryngeal web and stenotic glottic opening were seen. A 7.0 mm uncuffed endotracheal tube, preloaded on the bronchoscope and well-lubricated, was advanced and guided into the trachea over the bronchoscope. Tube position was verified by capnography and direct visualisation. Following this, intravenous rocuronium (0.6 mg/kg) was given to aid surgical relaxation. Sevoflurane in an air-oxygen mixture was used to maintain anaesthesia, with continuous dexmedetomidine infusion for intraoperative stability and an opioid-sparing effect. Intraoperative ventilation was volume-controlled and monitored continuously with end-tidal Carbon Dioxide (CO₂). Thereafter, the procedure began.

Once surgical exposure was achieved, a flexometallic tube was inserted through the tracheal stoma, and the nasal endotracheal tube was removed. Intermittent boluses of vecuronium were administered for muscle relaxation. Intraoperative Arterial Blood Gas (ABG) monitoring guided ventilation management, with parameters adjusted to maintain normocapnia. Intermittent apnoea was instituted multiple times during surgery to provide a stable field for surgical precision. Transient intraoperative desaturation episodes occurred during intermittent apnoea phases, necessitating an increased inspired oxygen concentration, temporary manual ventilation, and resumption of controlled ventilation until saturation recovered. [Table/Fig-1] shows a flexometallic tube secured in the tracheal stoma. To minimise airway oedema and prevent post-extubation complications, dexamethasone (8 mg) was administered. The patient underwent a total laryngectomy with tracheostomy under general anaesthesia. The larynx was separated from the oesophagus using meticulous blunt dissection to preserve surrounding structures. A bevelled incision was made on the trachea, and a tracheal window was created for the tracheostomy. Haemostasis was secured throughout the procedure using electrocautery and haemostatic agents. Airway imaging findings from HRCT and endoscopic assessment were integrated into preoperative planning to anticipate narrowing at the glottic inlet and guide the choice of fibreoptic intubation. After surgery, the Exercise Tolerance Test (ETT) was replaced with a tracheostomy tube (No. 8) under direct visualisation. The patient emerged from anaesthesia and was transferred to the Intensive Care Unit (ICU) on a T-piece for further postoperative monitoring. He remained in the ICU for 48 hours for close airway and haemodynamic observation, after which he was transferred to the ward. Postoperative recovery was uneventful, with stable respiratory parameters, adequate enteral nutrition, and no wound complications. Early counselling for voice rehabilitation was provided, and the patient was planned for speech therapy follow-up after healing. [Table/Fig-2] shows a secured tracheostomy tube. Serial ABG monitoring and vital signs assessment guided further management. Antibiotics were administered as per institutional protocol. The patient tolerated enteral feeding via a Ryle's tube, and wound care was meticulously performed. Over the following days, the patient showed progressive recovery, with stable vitals and no immediate postoperative complications. The excised specimen is shown in [Table/Fig-3].



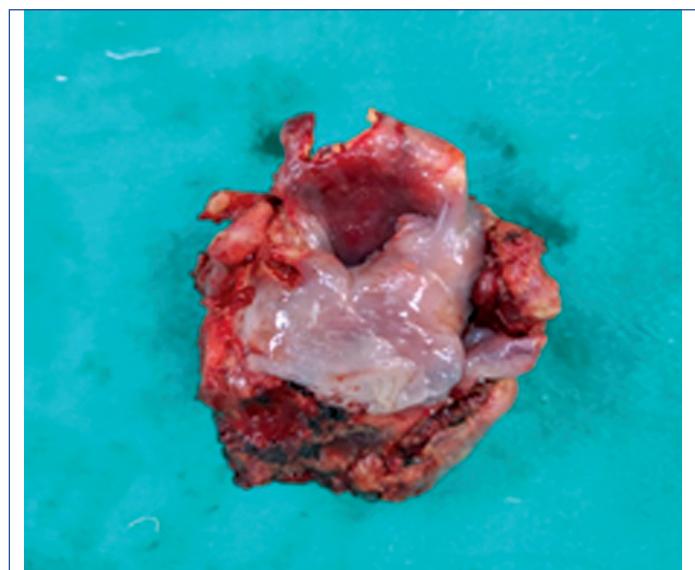
[Table/Fig-1]: Flexo-metallic tube secured in tracheal stoma demonstrating intraoperative airway control via a reinforced tube placed through the tracheal stoma, ensuring ventilation during surgical manipulation.

DISCUSSION

Laryngeal SCC is one of the most prevalent head and neck malignancies, responsible for roughly 1-2% of all cancers globally. It is much more common in males, with a strong association with



[Table/Fig-2]: Secured tracheostomy tube-illustrates stable postoperative airway access enabling safe breathing and secretion clearance in the immediate recovery phase.



[Table/Fig-3]: Specimen of laryngectomy displaying the resected laryngeal mass, aiding in visual correlation with histopathology findings.

tobacco use and an average age at presentation of about 62 years. The most common presenting symptoms are hoarseness, dysphagia, and airway obstruction of any degree, which is generally associated with advanced disease. Total laryngectomy remains the treatment of choice for advanced laryngeal cancer, particularly when organ preservation is impossible. En bloc removal of the laryngeal architecture involving the hyoid bone, epiglottis, and parts of the upper trachea is performed, followed by repair of the pharynx and establishment of a permanent tracheostomy. Due to anatomical distortion, airway stoma narrowing, and the risk of airway obstruction in these patients, anaesthetic management must be individualised, vigilant, and multidisciplinary [1,2].

Preoperative evaluation is critical in recognising predictors of a difficult airway, such as limited neck extension, restricted mouth opening, and changes in airway anatomy from tumour involvement. Awake or sedated fibreoptic intubation is the technique of choice for securing the airway in such situations, as it provides direct vision and avoids the risk of failed intubation and trauma [3]. In our scenario, nasal fibreoptic intubation under sedation with maintenance of spontaneous respiration was performed. Transnasal humidified oxygenation using THRIVE (via high-flow nasal cannula) was utilised to provide continuous oxygenation, maximise oxygen saturation, and allow a comfortable airway interface during airway instrumentation. This method facilitated oxygenation during intubation without affecting visualisation or the procedural sequence [4].

Once the airway was secured and ventilation assured, neuromuscular blockade was administered to obtain optimal surgical conditions. Intraoperatively, the nasal endotracheal tube was replaced with a flexometallic tube through the tracheal stoma under direct visualisation. Planned changes like this were necessary to maintain intraoperative airway control and avoid desaturation or loss of airway during the procedure. After the operation, postoperative airway management was achieved with a tracheostomy tube. Intraoperative dexamethasone was administered to reduce the risk of airway oedema, allowing for an uneventful postoperative course [5,6].

Intermittent apnoea has numerous valuable advantages in head-and-neck operations such as total laryngectomy. It provides a motionless operating field, facilitating accurate tumour dissection in anatomically crowded and distorted areas. Releasing airway instrumentation from the surgical field momentarily improves visibility and provides more working space for the surgeon, minimising inadvertent damage to adjacent structures. From an anaesthetic standpoint, controlled apnoea intervals enable ventilation to be safely and predictably interrupted, eliminating airway handling at key operative times. When combined with advanced oxygenation techniques, periodic apnoea can be used safely without compromising gas exchange, constituting a helpful adjunct in multidisciplinary management of advanced airway surgeries [7].

This case illustrates the central role of preoperative planning, advanced airway techniques, and multidisciplinary collaboration in the successful anaesthetic care of total laryngectomy. Integrating high-flow nasal oxygenation with THRIVE into airway management enhanced oxygenation safety margins without delaying the procedure. The approach of sedated nasal fiberoptic intubation with THRIVE provided a controlled, minimally traumatic means of securing the airway. Awake tracheostomy, although an alternative, was avoided to reduce surgical bleeding risk, patient discomfort, and potential anatomical distortion during tumour resection. Awake tracheostomy remains valuable when fiberoptic access is not feasible or when supraglottic obstruction is nearly complete [8].

A potential limitation in our case was the need for intermittent apnoea, which produced transient desaturation episodes while benefiting the surgery; these were promptly managed by increasing FiO_2 , performing manual ventilation as needed, and reestablishing normocapnia.

A learning point is the value of close communication with the surgical team to time apnea periods optimally. Postoperatively, airway humidification using heated humidifiers or heat-moisture exchangers, meticulous secretion clearance, and early patient education for stoma care were instituted to enhance comfort and prevent crusting. These measures, along with early initiation of voice rehabilitation counselling, supported recovery and adaptation to the permanent tracheostomy [7,9,10]. [Table/Fig-4] summarises key features, anaesthesia strategies, and takeaways from selected case reports and our current experience,

Zhang X et al., [11]	Three male patients (54, 57, and 63-year-old) with prior partial or semi-laryngectomy for laryngeal cancer, all presenting for further laryngeal surgery; airway challenges included unexpected cannot intubate- cannot ventilate, tumour invasion of trachea, neck immobility, and glottic stenosis.	Strategies used included urgent surgical tracheostomy after failed induction, fiberoptic-guided conscious intubation under topical anaesthesia, and preoperative tracheostomy under superficial cervical plexus block with assisted mask oxygenation.	Highlights that post-laryngectomy airway can be unpredictable; awake fiberoptic intubation may be ideal when feasible, but surgical airway preparedness and alternative regional anaesthesia approaches are essential in distorted anatomy
Giraldo M et al., [12]	one-month-old male neonate with congenital laryngeal fibrosarcoma; presented with severe stridor and near-complete airway obstruction; initial partial resection failed; required total laryngectomy	Orotracheal airway initially, then surgical stoma with 3.5 mm tube; pressure-controlled ventilation with sevoflurane, fentanyl, ketamine, rocuronium; careful fluid, blood, and calcium management; tracheostomy placement	Demonstrates the complexity of neonatal airway management; multidisciplinary planning, meticulous perioperative preparation, continuous airway and ventilation monitoring, and cautious fluid/blood management are critical for a successful outcome

[Table/Fig-4]: Comparison of anaesthetic management in complex laryngeal surgery cases [11,12].

highlighting the diversity of airway challenges and management approaches [11,12].

In future comparable complex airway cases, adding ultrasound-guided airway assessment, flexible-tip intubating devices, and newer supraglottic rescue devices designed explicitly for oncologic head-and-neck surgery may be helpful.

CONCLUSION(S)

Effective anaesthetic management of a patient undergoing total laryngectomy for advanced laryngeal cancer entails thorough preoperative planning, advanced airway management techniques, and optimal coordination with the surgeons. In this case, nasal fiberoptic intubation under sedation, made possible by high-flow nasal oxygenation with THRIVE, allowed controlled and safe airway access while preserving spontaneous breathing. The intended transition to a tracheostomy tube intraoperatively allowed unbroken ventilation and surgical exposure. This case highlights the value of multimodal, individualised approaches to airway management in complex head-and-neck operations to maximise safety and patient outcomes.

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Authors	Case details	Anaesthesia management	Take away points
Present study	57-year-old male with undifferentiated SCC of the larynx; posterior margin positive; complex airway anatomy	Sedated nasal fiberoptic intubation with spontaneous respiration maintained; THRIVE high-flow nasal oxygen; flexometallic tube through stoma after exposure; dexamethasone given; intermittent apnea with ABG guidance	Controlled, minimally traumatic airway secured; effective desaturation management; importance of meticulous multidisciplinary airway planning

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