



Application of Laryngeal Mask Airway in Airway Management of Patients with A Tracheal Stenosis - A Case Report

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Abstract

Tracheal stenosis is a severe condition that significantly affects patients' quality of life, with airway reconstruction surgery being the primary treatment. Airway management is critical during general anesthesia, especially when the airway is the surgical site. This report presents clinical concepts and cases of the successful use of laryngeal masks as a supraglottic airway for intraoperative tracheal management in patients with tracheal stenosis. As a transitional device for airway management, a laryngeal mask can provide adequate ventilation and oxygenation and should be incorporated into airway control protocols for individuals with tracheal stenosis.

Keywords

Tracheal Stenosis, Airway Management, Laryngeal Mask, Tracheal Intubation, Tracheal Resection and Anastomosis

Introduction

Tracheal stenosis is a pathological condition where airflow in the airway is restricted, usually due to tumors or other inflammatory lesions [1,2]. With the increasing prevalence of endotracheal tuberculosis and higher intubation rates, the number of patients with airway stenosis caused by non-neoplastic lesions is rising. Patients with benign airway stenosis often have prolonged survival, numerous complications, and high treatment expectations from both patients and their families [3]. Surgical airway reconstruction is the mainstream treatment, with tracheal resection and anastomosis of the resected ends being the most common surgical methods [1]. In these surgeries, the anesthesiologist shares the airway with the surgeon, making airway management highly challenging due to the difficulty in supplying oxygen, which results in

airway narrowing. Therefore, it is crucial to explore the use of multiple airway management tools.

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A 16-year-old male (height 172 cm, weight 100 kg) was admitted to the hospital with dyspnea persisting for more than six months and was scheduled to undergo tracheal stent placement. The patient had been admitted to the intensive care unit (ICU) in August 2020 following a left thigh amputation. Since then, scar removal and tracheal dilation procedures had been performed multiple times using painless fiberoptic bronchoscopy due to tracheal stenosis.

Upon admission, a Computed Tomography (CT) scan of the neck revealed that the lumen of the central trachea, at approximately the level of the seventh

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cervical vertebral body, was slightly narrowed, with a short diameter of about 0.5 cm at its narrowest part. After fiberoptic bronchoscopy, it was determined that the conditions for endotracheal stent placement were not met. The patient received symptomatic supportive treatments, including anti-infection measures and nebulization, in the respiratory department, but his dyspnea symptoms worsened. After consulting with an otolaryngologist, a tracheotomy was considered. The patient was scheduled for an emergency tracheotomy under local anesthesia four days after admission; however, he was unable to tolerate the procedure during the operation, and the surgery was discontinued. He was then transferred to the Department of Otorhinolaryngology, Head and Neck Surgery after another consultation and was scheduled for surgical treatment under general anesthesia.

The patient was planned to undergo tracheal stenosis resection, end-to-end anastomosis, and tracheoplasty under general anesthesia. Based on imaging data, the pre-anesthetic evaluation confirmed that the patient's tracheal stenosis was primarily located in the upper tracheal segment, with the narrowest point being about 5 mm (**Fig-1**) and the stenotic segment estimated to be about 2 cm long. The degree of tracheal stenosis was approximately 39%, indicating moderate stenosis. Considering the patient's condition, the initial airway management plan was to establish an airway through the stenosis by performing tracheal intubation using a visual laryngoscope or fiberoptic bronchoscope after intravenous or inhalation induction. At the same time, alternative supraglottic airways, such as a laryngeal mask, were considered, and anesthesia induction would proceed with the otolaryngologist prepared to perform an emergency tracheotomy if necessary.

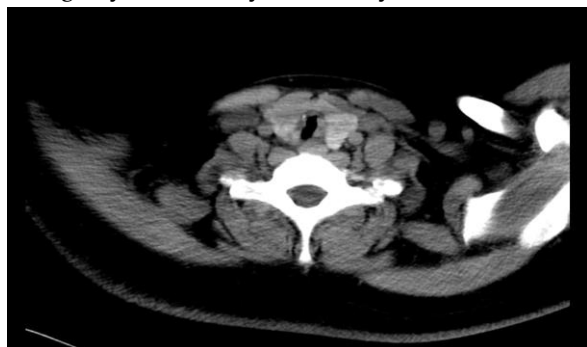


Fig-1: Patient's Neck CT- Tracheal Stenosis

Standard anesthesia monitoring was conducted upon the patient's arrival in the operating room, including electrocardiogram, oxygen saturation, blood pressure, and respiration. Airway management tools such as a visual laryngoscope, fiber bronchoscope, and laryngeal mask were prepared, with otolaryngologists on standby. After full preoxygenation, sufentanil 15 µg, propofol 150 mg, and succinylcholine chloride 100 mg were sequentially administered via intravenous infusion, and endotracheal intubation was attempted using a 5.0-ID tracheal catheter with a visual laryngoscope. The intubation attempt failed as the tracheal tube could not pass through the narrowest part of the trachea. Therefore, tracheal intubation was abandoned, and a 4.0 disposable sterile laryngeal mask was inserted to establish the airway. After the laryngeal mask was successfully placed, rocuronium 50 mg was administered, sevoflurane was continuously inhaled at approximately 2%, and remifentanyl was continuously infused at 0.1-0.15 µg/kg/min to maintain anesthesia. The patient's tidal volume was approximately 600 ml, airway pressure was around 21 mmHg, and end-tidal carbon dioxide was about 45 mmHg. About 10 minutes after the operation began, the surgeon opened the tracheal stenosis, and the anesthetist inserted a tracheal catheter through the mouth using a visual laryngoscope. The surgeon then inserted a tracheal tube into the narrow distal trachea for airway management. The operation lasted about 53 minutes, after which the patient was transferred to the ICU. The tracheal catheter was removed two days after surgery, and the patient was transferred to the general ward following a 4-day stay in the ICU. One month after discharge, fiberoptic bronchoscopy showed that the upper trachea was patent, and the patient had no symptoms such as dyspnea or hoarseness.

Discussion

Among the causes of benign tracheal stenosis, trauma and iatrogenic factors, such as tracheal incision or tracheal intubation, are most common [2]. Currently, there are limited studies on the pathogenesis. Factors associated with post-intubation stenosis include excessive cuff pressure, large tracheal catheter size, catheter movement in patients with tubes, and prolonged intubation time, as well as

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related conditions such as diabetes, low blood pressure, and infection [4-6].

In this case, the patient had typical tracheal stenosis caused by tracheal intubation. These patients often share four characteristics: First, there must be a history of tracheal intubation. Second, corresponding imaging changes are observed in chest X-ray and CT examinations. Third, the patient's clinical symptoms, combined with pulmonary function examination, are suggestive of stenosis. Finally, tracheoscopy is the gold standard for diagnosis [4]. The evaluation based on the degree of tracheal stenosis, the type of stenotic lesion, and the patient's clinical practice can guide treatment, with a total score of more than 8.5 requiring surgical intervention [7].

Proper airway management is crucial during surgical treatment and plays a vital role in preoperative evaluation. The key is to determine the location and degree of narrowing and to guide the formulation of an appropriate airway control plan. High-resolution computed tomography 3D reconstruction of the neck and chest, bronchofiberscopy, positron emission tomography, and lung function testing are methods used to determine the exact location and severity of tracheal stenosis [4,8]. The following techniques can be considered to establish a safe and reliable airway: tracheal intubation, supraglottic airway such as a laryngeal mask, and tracheotomy. Among these, the gold standard is to place the tracheal catheter across the stenotic segment at the distal end and generally develop tracheal management strategies based on non-invasive first and invasive later.

The laryngeal mask is easy to place, less damaging, and can be used to evaluate vocal cord function. It is particularly suitable for emergency airway rescue when the airway is expected to be difficult, tracheal intubation is challenging due to a narrow passage, and intubation attempts fail. In this case, it was successfully used for respiratory management before tracheal intubation. For severe subglottic stenosis, the supraglottic airway (laryngeal mask) can provide reliable ventilation, acceptable airway pressure (<25 mmHg), peripheral blood oxygen saturation (>95%),

and end-tidal carbon dioxide levels (<50 mmHg) [9]. However, the laryngeal mask may also have poor ventilation, leading to hypoxemia and hypercapnia. It has a higher risk of aspiration, difficulty clearing secretions, and is restricted for use in patients with limited mouth opening, morbid obesity, high risk of aspiration, throat tumors, or active airway bleeding.

In conclusion, after a comprehensive evaluation, the laryngeal mask can be considered an effective tool for airway management in patients with tracheal stenosis.

Conflict of Interest

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

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