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Clinical Experience of the Sedation Strategy for Benign Airway Stenosis: A Retrospective Case Series

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Abstract

Acquired Benign Tracheal Stenosis (BTS) is a serious but not rare condition caused by intubation injury, trauma, and tracheal tumor. Due to shared-airway, it can make anesthesia challenging. In this study, we describe ventilation strategy and anesthesia management in three patients with BTS who underwent endoscopic treatment. Anesthesia with propofol versus remimazolam was compared. The laryngeal mask airway was used as a ventilation tool to ensure airway patency. All patients maintained stable vital signs during the procedure and were safely discharged from the hospital afterwards. Anesthetic and airway considerations were crucial to ensuring a successful surgical outcome and maximizing patient safety.

Introduction

Acquired Benign Tracheal Stenosis (BTS) is a common and reversible disease. Iatrogenic etiology is the main cause of BTS, most commonly as a result of prolonged intubation or tracheostomy [1]. The reported incidence of BTS is 10% to 22%, among which 1% to 2% exhibit clinical symptoms [2].

Tracheal stenosis can be treated through surgery or endoscopic procedure. With the development of comfort medical care, bronchoscopic treatment has become the leading approach to diagnosis and treatment for patients with tracheal stenosis. This minimal invasive intervention led to rapid relief and was well-tolerated.

It has been established that constriction of the tracheal diameter below 8 mm can lead to dyspnea during exertion, while constriction below 5 mm can lead to dyspnea at rest [3]. Some severe patients present inspiratory stridor, cyanosis, and tachycardia, and they often need to be placed in a compulsive position to make breathing free. Most of them cannot tolerate bronchoscopic intervention under local anesthesia and the need for general anesthesia continues to rise.

Herein, we shared general anesthesia strategies including sedation drugs and airway channels focused on enhanced recovery for increasing outpatients in bronchoscopy.

Case Series

Case 1

A 58-year-old Han Chinese man (weight, 65 kg; height, 165 cm) had repeatedly been admitted to another hospital during the previous three years and intubated three times because of severe asthma attacks. He had been diagnosed with chronic obstructive pulmonary disease and refractory asthma, and habitually self-medicated with an albuterol inhaler during asthma attacks, which usually occurred without an obvious trigger. Cervicothoracic Computed Tomography (CT) indicated thickening of the tracheal wall with Malacia as well as extensive, severe scar stenosis. The lumen was narrowest (6 mm) at 3 cm below the glottis (Figure 2A). About 81% reduction in cross-section area was classified as Cotton-Myer grade 3. This was a severe and complex subglottic stenosis, which resulted from repeated intubations (Figure 1).

Before surgery, he used his inhaler and received preoxygenation and was aerosolized with 2% lidocaine for 20 min. Monitoring based on five-lead electrocardiography, Bispectral Index (BIS), SpO_2, and Blood Pressure (BP) were initiated. Anesthesia was started intravenously with propofol (1.5 mg/kg), and face mask ventilation was performed to confirm positive pressure ventilation successfully. Then remifentanil (1 ug/kg) was administrated and a Laryngeal Mask Airway (LMA) was inserted while the patient was breathing spontaneously. When ventilation was adequate,

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Patient	Age	Commodity	Etiology	Surgery	Location	Meyer-Cotton grade	Ventilation tool	Leading sedative
Patient 1	58	refractory asthma	repeated intubation	endoscopic balloon dilation	6mm at 3cm below the glottis	Grade 3	Laryngeal mask airway	propofol
Patient 2	69	hypertension stroke; type 2 diabetes; chronic kidney disease	post-intubation	endoscopic balloon dilation	4.9 mm at 2cm below the glottis	Grade 3	laryngeal mask airway	propofol
Patient 3	74	refractory asthma	tracheal tumor	endoscopic tumor resection	4.8 mm at 3cm below the glottis	Grade 3	laryngeal mask airway	remimazolam

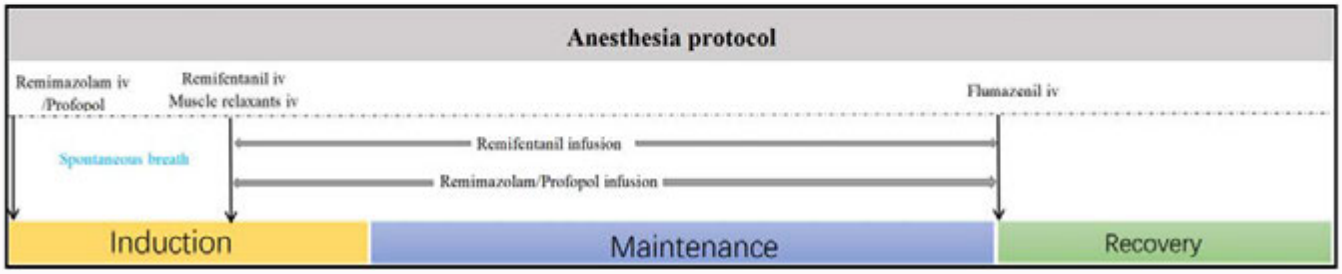

Figure 1: Clinical characteristics of included patients and anesthesia protocol.

sedation was deepened using rocuronium (40 mg) and midazolam (1 mg). Before the bronchoscope was passed through the airway, 5 ml of 2% lidocaine was sprayed onto the vocal cord through the working channel to prevent laryngospasm. Maintenance was started by infusions of remifentanil (0.1 ug/kg/h) and propofol (6 mg/kg/h) to keep the BIS between 40 and 60 (Figure 1). After reducing the fraction of inhaled oxygen to 30% to reduce fire risk, argon plasma electrocauterization was performed using the fiberoptic bronchoscope to destroy scar tissue. Then the stenotic lesion was serially dilated using a balloon, during which mechanical ventilation was interrupted, while compression was applied to achieve hemostasis. The airway was dilated stepwise until the lumen diameter returned to normal (Figure 2B). Finally, secretions were aspirated using the bronchoscope in a tilted position. The patient's vital signs remained stable throughout the 1-h procedure and did not experience postoperative coughing or pain. He was extubated in the operating room and discharged from the ward the next morning.

Case 2

A 69-year-old Han Chinese man (weight, 56 kg; height, 159 cm) was re-admitted for cough and difficult breathing, both of which had aggravated over the last 2 months and presented obvious stridor at rest. His medical history included 6-year hypertension, stroke, 11-year type 2 diabetes, and chronic kidney disease treated with regular dialysis. Previous admission for the COVID-19 led to endotracheal intubation for mechanical ventilation for 2 weeks and subsequent tracheostomy. During the re-admission, fiberoptic bronchoscopic examination showed there was an approximate 80% cross-sectional obstruction at the narrowest point with a diameter of 4.9 mm at 2 cm below the glottis (Figure 2C). Scar tissue with granulation growth was described and tracheal mucosa hyperemia and edema indicated active inflammation. This was a severe and complex subglottic stenosis, which resulted from tracheostomy and endotracheal intubation.

Surgery was scheduled on the day of dialysis to minimize airway mucosal edema. Despite this, persistent inflammation of airway was present. Before surgery, he used his inhaler and received preoxygenation and was aerosolized with 2% lidocaine for 20 min. Routine monitoring included five-lead electrocardiography, BIS, SpO_2, and BP. Preoperative blood gas analysis proved to be normal. General anesthesia was initiated with etomidate (0.2 mg/kg), propofol (1 mg/kg), midazolam 0.5 mg, and remifentanil (1 ug/kg). Face mask ventilation was performed to confirm positive pressure ventilation. Then Cisatracurium besylate 4 mg Sufentanil 0.5 mg was applied to insert LMA (size 4). Continuous infusions of remifentanil (0.1 ug/kg/h) and propofol (6 mg/kg/h) were added to achieve sufficient analgesia for the procedure. 5 ml of 2% lidocaine was sprayed onto the vocal cord before operation. The patient received granulomatous tissue resection and a balloon to expand the stenosis segment. The oxygen concentration was kept under 30% when operators performed electrocauterization and mechanical ventilation was interrupted when balloon dilation was performed. The vital sign was stable despite intermittent high airway pressure. When 6 ml/kg of tidal volume was not achieved or desaturation occurred, manual ventilation was performed. After the endoscopic procedure, significant enlargement of the lumen was observed (Figure 2D). Follow-up found that his adventitious airway sounds disappeared and breathing was normal.

Case 3

A 74-year-old Han Chinese man (weight, 50 kg; height, 161 cm) with hypertension presented with an eight-year history of refractory asthma, chronic wheezing, and exercise-related dyspnea. The symptoms were getting worse during the past two months. The subglottic endoluminal irregularly shaped tissue mass obstruction in the trachea was shown in a CT scan (Figure 2E). Before general anesthesia, he underwent an awake flexible bronchoscopy (4.8 mm outer diameter). This revealed a tracheal stenosis located 3cm from the glottis that allowed the passage of the flexible bronchoscope. About 76% reduction in cross-sectional area was classified as Cotton-Myer grade 3 and this was a severe and complex subglottic stenosis.

General anesthesia was initiated with a bolus of remimazolam (0.1 mg/kg) within 30 sec. Then face mask was administered to confirm positive pressure ventilation successfully combined with sevoflurane inhalation (3%, 3 L/min) under spontaneous breath. Sevoflurane inhalation was stopped and continuous infusion of remimazolam (1 mg/kg/h) and remifentanil (0.1 ug/kg/min) was started. Then remifentanil (10 ug/kg) and succinylcholine (1 mg/

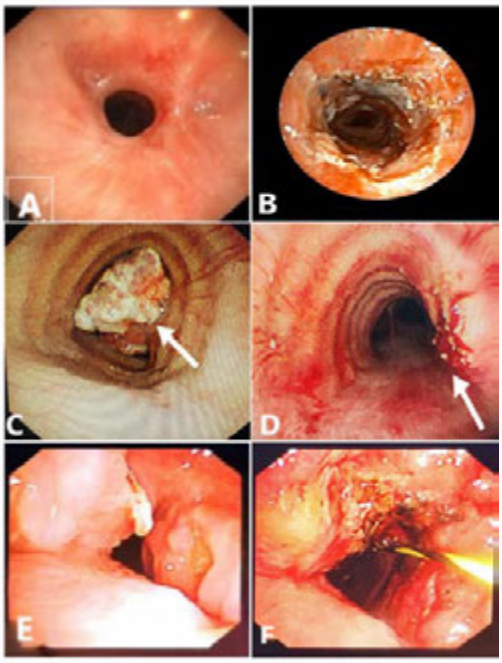

Figure 2: Preoperative and postoperative images from patients and anesthesia procedure:
(A) Cicatricial subglottic stenosis.
(B) The scarring was removed and balloon dilation was performed.
(C) Exophytic tumor in the trachea. Tumor biopsy revealed pleomorphic adenoma.
(D) The tumor was removed.
(E) Cicatricial subglottic stenosis with granulomatous tissue.
(F) The scarring was removed and balloon dilation was performed.

kg) were administered for the insertion of an LMA (size 3). Through electrocautery snare and CO_2 cryosurgery, the tumor mass was resected (Figure 2F) and was withdrawn quickly from trachea with an LMA, during which the view was temporarily lost and a new LMA was reinserted immediately to secure the control of the airway again. Minor bleeding was controlled with argon plasma coagulation and airway fire was avoided by reducing inspired oxygen concentration. Stable vital signs were maintained during the procedure. Flumazenil (0.3 mg) was administered for remimazolam reversal. After the patient was awake, the LMA was removed gently. No adverse events occurred during the postoperative period of observation. The patient could breathe easier immediately after tumor resection. When he left the hospital, he could breathe naturally and constantly.

Discussion

We propose that anesthesia management should be based on the etiology of tracheal stenosis. In our study, intubation-related complications were the dominant cause observed. Indeed, the growing experience and development of the devices led to the extensive expansion of Intensive Care Units (ICU) and emergency departments in our country, more patients have the opportunity to receive emergency endotracheal intubation or tracheotomy and subsequent supportive care. there is a higher volume of patients receiving emergency endotracheal intubation or tracheotomy and prolonged supportive care in ICU could be provided and optimized. Emergent endotracheal intubation or tracheotomy is life-saving for critical patients, yet has potential risks; multiple attempts at laryngoscopy, excessive tube cuff pressure, and intubation injury may bring long-term adverse outcomes [1]. Clinicians should be aware of the risk factors of BTS, and take care to achieve soft operation and monitor cuff pressure during ventilation.

We attempt to establish the routine application of remimazolam in bronchoscopy and a clinical trial of remimazolam (ChiCTR2200063276) for bronchoscopy in elderly patients (65-80 years old) is also carried out. The ideal sedatives should have a rapid onset, short duration of acting, and quick recovery, as well as a predictable metabolism and stable hemodynamics. Given the reported safe profile, remimazolam is a promising sedative with few side effects in sedation practice. Remimazolam causes minimal injection pain and thus relieves patients' discomfort and anxiety. It can be reversed by flumazenil to ensure patients' safety. Moreover, ester-based short-acting characteristics of remimazolam provide high clearance as well as limited cumulative sedative effects over time, which is conducive to facilitating bronchoscopy procedures.

Remimazolam has a stable hemodynamics compared to propofol. This may be beneficial to the elderly or the higher ASA class group. In our cases, spontaneous respiration cannot be interrupted during anesthesia induction, because once airway collapse occurs, positive pressure ventilation with the mask cannot be applied. Compared to propofol, remimazolam produces less respiratory depression than propofol with a wide safe range of 0.1 mg/kg to 0.4 mg/kg [4], even in the elderly with considerable disease burdens [5].

The LMA, as a supraglottic ventilation tool, is a practical alternative for patients with extreme trachea narrowing. An LMA may be able to image the entire airway, from the subglottal to the distal part after positioning the LMA over the glottis. It is associated with lower airway irritation to avoid triggers of severe, unpredictable asthma attacks for patients with high airway sensitivity [6].

The setting-up of the urgent rescue ventilation was performed for patient 2 and patient 3 with fresh granulation tissue or tumor prone to bleeding. The appropriate trachea catheter is prepared in advance according to preoperative cervicothoracic imaging or bronchoscopy examinations. If the above airway mode fails, high-frequency jet ventilation can be performed. Extracorporeal membrane oxygenation is often considered a last resort, which brings about an extended survival rate of critically ill patients.

Generally, with a growth spurt in flexible bronchoscopy, it is crucial to design the appropriate and personalized agent choice and airway strategy with a multifactorial assessment of risks and benefits, in which remimazolam has a huge potential.

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References

1. Mangiameli G, Perroni G, Costantino A, De Virgilio A, Malvezzi L, Mercante G, et al. Analysis of risk factors for tracheal stenosis managed during COVID-19 pandemic: A retrospective, case-control study from two European referral Centre. J Pers Med. 2023;13(5):729.
2. Zias N, Chroneou A, Tabba MK, Gonzalez AV, Gray AW, Lamb CR, et al. Post tracheostomy and post intubation tracheal stenosis: Report of 31 cases and review of the literature. BMC Pulm Med. 2008;8:18.
3. Hseu AF, Benninger MS, Haffey TM, Lorenz R. Subglottic stenosis: A ten-year review of treatment outcomes. Laryngoscope. 2014;124(3):736-41.

4. Zhang Y, Dai G, Xu H, Liu Y, Liao M, Zhang X. Safety and efficacy of remimazolam compared with propofol in induction of general anesthesia: A reply. Minerva Anestesiol. 2022;88(3):194-5.

5. Doi M, Hirata N, Suzuki T, Morisaki H, Morimatsu H, Sakamoto A. Safety and efficacy of remimazolam in induction and maintenance of general anesthesia in high-risk surgical patients (ASA Class III): Results of a multicenter, randomized, double-blind, parallel-group comparative trial. J Anesth. 2020;34(4):491-501.

6. Zhang Q, Sun Y, Wang B, Wang S, Mu F, Zhang Y. Comparative study of the Ambu® AuraOnce™ laryngeal mask and endotracheal intubation in anesthesia airway management during neurosurgery. J Int Med Res. 2020;48(2):300060520902606.