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CASE REPORT AIRWAY MANAGEMENT

Anesthetic management for tracheal stent removal with severe scar stenosis

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Abstract

A 28-year-old patient, ASA Grade II, was admitted to the hospital with dyspnea for the last few months. Upon bro choscopy, tracheal stenosis was observed and the symptoms were temporarily relieved by balloon dilation. The patient was then given argon knife treatment and the bronchial lesions were resected through a bronchoscope. Then two tracheal stents were placed to relieve the symptoms of dyspnea which too failed and had to be removed. Since the patient had a history of traumatic brain injury more than a year ago and underwent tracheal intubation, tracheostomy, invasive ventilator ventilation, and extubation after the condition improved. Stent removal had significant anesthetic challenges due to the small size of the lumen. After going through a few anesthesia plans, a high-frequency jet ventilator was used to maintain oxygen saturation. The procedure was successful and the patient showed a good prognosis.

Key words: Dyspnea; Bronchoscopy; Tracheal intubation; Mechanical ventilation

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1. Introduction

It is essential to have multiple anesthesia plans for cases like our case, where it is extremely challenging to maintain oxygen supply to the patient and we always need a backup plan in case of emergencies.

Tracheal stenosis can be congenital or acquired.[1] Acquired tracheal stenosis can be caused by trauma or other factors. Prolonged tracheal intubation is one of the causes of acquired tracheal stenosis.[2] Since newer better endotracheal tubes are not yet fully developed or available,[3] prolonged intubation can cause internal tracheal trauma in up to 13% of adults.[4] A study found that the incidence of tracheal stenosis who had undergone tracheostomy and/or tracheal intubation accounted for 86% of adults.[5] Among all risk factors, tracheostomy is the main cause of tracheal stenosis.

However a more recent study conducted by Potter James et al. found that the risk of tracheal stenosis in adults after undergoing tracheostomy is lower than what is often quoted in literature.[6] According to the study the actual figure is 8.8%. The author has stated several reasons for why this might be the case. Scar ditheists are a group of people who are susceptible to keloids, such patients have an increased risk of tracheal stenosis after tracheostomy, and the prognosis is poor.[7] Due to a lack of a standard management guideline, there are several treatments that are chosen and endoscopic stent placement is one of the preferred methods.[8] Airway stents can quickly relieve airway stenosis and improve symptoms of dyspnea. It is one of the effective methods for treating airway stenosis. However, airway stent placement stimulates the rate of

granulation tissue proliferation and rate of restenosis can be as high as 72%, the incidence of restenosis within two years is as high as 51%.[9,10] As a consequence to avoid further narrowing of the airway, the stent needs to be removed but long metal stents that have been placed for a long time are difficult to remove, it's very risky, and the technique is quite complicated. Major hemorrhaging may occur during stent removal, severe tissue rupture, acute airway obstruction, and even death.[11,12]

When making an anesthesia plan, it's important to have a secondary plan in case of complete airway loss during anesthesia, anesthesia induction, and maintenance plan, artificial airway establishment plan, optimal surgical route, and intraoperative airway management plan, etc.[13]

For patients with severe tracheal stenosis undergoing stent removal, the key to anesthesia management is how to maintain adequate oxygen supply.

2. Case report

A 28-year-old patient, ASA Grade II, was admitted to the hospital with dyspnea. The patient showed symptoms of dyspnea that progressed over the past few months, affected the patient's quality of life and required hospitalization. The patient had a history of traumatic brain injury of more than a year. The patient underwent tracheal intubation, had a tracheostomy procedure done, required invasive ventilator ventilation, and when the condition improved the patient was extubated. Upon bronchoscopy tracheal stenosis was observed and the symptoms were temporarily relieved by balloon dilation. The patient was then given argon knife treatment and the bronchial lesions were resected bronchoscopically. Then two tracheal stents of size 18x60mm and 18x30mm were placed to relieve the symptoms of dyspnea which too failed and the patient once again presented to the hospital with dyspnea.

2.1. Investigations

Upon laboratory examination: there were no obvious abnormalities in blood routine, coagulation, liver, and kidney functions. Electrocardiogram was normal. Chest computed tomography showed scattered inflammation in the upper lobe of both lungs and lower right lung. Re-examination of the bronchoscopy showed that the trachea was narrow and granulation tissue hyperplasia was obvious. Computed tomography was performed 10 days prior to surgery. Computed tomography reconstruction of the trachea showed stenosis 22.4mm below the glottis, with a diameter of 6.3mm; stenosis 81.5mm below the glottis, with a diameter of 8.3mm (Figure 1). A diagnosis of benign tracheal stenosis was made.

2.2. Treatment

We decided to perform the surgery under general anesthesia "Rigid endotracheal interventional therapy and bronchotomy". After consultation with multiple departments (respiratory medicine, anesthesiology, cardiovascular surgery, otolaryngology), it was recommended to perform the bronchoscopy under local anesthesia to remove subglottic scars and neoplasm" as can be seen in Figure 1 -2. First reduce the boundaries of stenosis figure 3 and simultaneously reduce bleeding caused by friction during the stent removal figure 4-5, and then under general anesthesia perform "rigid endotracheal interventional therapy and bronchotomy".

2.3. Anesthesia management

The patient was brought to the operating room where the heart rate, non-invasive blood pressure, and SPO_2 were monitored. The preoperative non-invasive blood pressure was 118/78 mmHg and the heart rate was 91 beats/min, and the SpO_2 was 99%. Mask oxygen was set to 6 L/min, SpO_2 96% ~ 97%. Intravenous bolus injection of methylprednisolone 40 mg, oxycodone 4 mg, and parecoxib sodium 40 mg was administered, while inhaling oxygen, the oropharynx was fully anesthetized with 1% tetracaine hydrochloride glue. At the same time, dexmedetomidine was injected intravenously within 10 min with a dosage of 0.5 μg/kg and a maintenance dose of 0.3 μg/kg/h. The left radial artery was catheterized under local anesthesia and the pressure was continuously monitored. After adequate oxygen and denitrification, intravenous rapid sequence induction was used, and midazolam 2 mg, sufentanil 25 μg, etomidate 20 mg, and rocuronium 50 mg were administered sequentially to induce anesthesia, and anesthesia was maintained by plasma target-controlled infusion of propofol 1.5 μg/ml, remifentanil 1.5ng/ml and maintenance dose of dexmedetomidine. After reaching a certain depth of anesthesia, the respiratory physician inserted a rigid bronchoscope under the guidance of a bronchoscope.

Figure 1: Computed tomography reconstruction of the trachea. Arrows show stenosis.

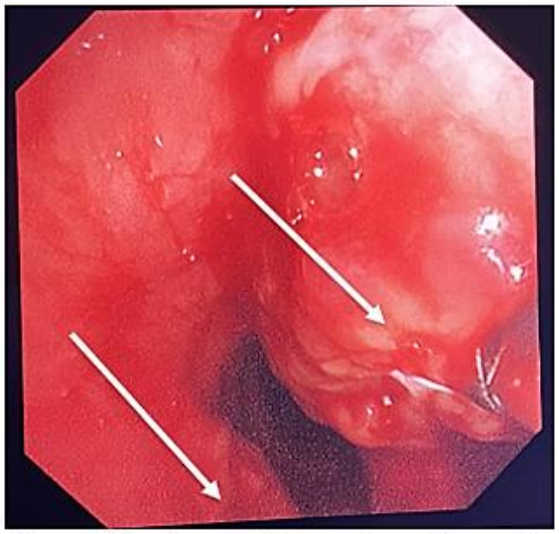

Figure 2: Stent covered by neoplasm (stenosis)

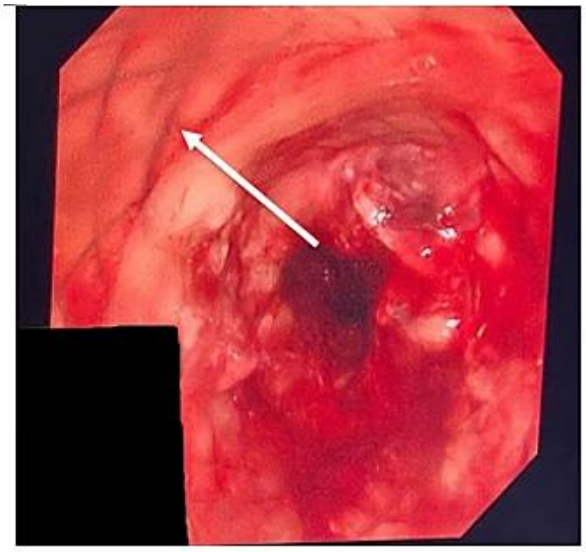

Figure 3: Stent along the walls of the trachea after some of the neoplasm had been removed

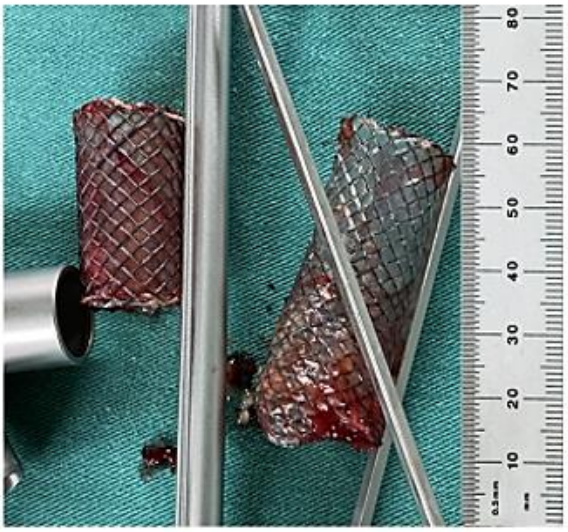

Figure 4: Removed tracheal stents

When the rigid bronchoscope was inserted into the trachea and during the operation, regular-frequency jet analysis was performed, and the injection pressure was adjusted according to the blood gas analysis results. The intraoperative blood gas results showed good oxygenation and no carbon dioxide accumulation. During the operation, the ventilation was stopped when the argon knife was applied, and the operation was suspended when the SPO2 was less than 90%. During the operation, the rigid bronchoscope sheath was used to expand the subglottic stenosis, and the second stenosis was cut and expanded directly in the stent. A variety of airway intervention methods were used to treat the third stenosis. Finally, the double stents in the airway were removed sequentially.

The rigid bronchoscope was withdrawn and a bronchoscope was inserted into the trachea to continue the endoscopic removal of granulation tissue, and 8# enhanced tracheal tube larger than the diameter of the bronchoscope was inserted under the guidance of the visual laryngoscope, and the anesthesia machine got intermittently disconnected. Positive pressure ventilation, intermittently disconnected the anesthesia machine, so regular-frequency jet ventilation was intermittently used to maintain oxygenation saturation, and continue the removal of granulation

tissue endoscopically. After treatment, the stenosis of the middle and lower trachea was significantly smoother than before. After the operation, the patient was taken into respiratory intermediate care unit with a tracheal catheter for observation and treatment. The tracheal tube was pulled out the next day after surgery.

2.4. Outcome and follow-up

The stent removal surgery was successful and perioperative anesthesia management went without adverse incident. The patient's symptoms of dyspnea were relieved; however, there is an increased risk of restenosis and neoplasm growth in this patient. Therefore, currently periodic resection of scar tissue and neoplasm is recommended using the bronchoscopic removal procedure that was used previously.

3. Discussion

Our patient's oxygenation was maintained well and the stent removal process was smooth. However, if the stent is removed before the airway is established, there are always risks of bleeding in the airway and collapse of the trachea. When conditions permit, extracorporeal circulation or extracorporeal pulmonary membrane synthesis assistive technology should be prepared under local anesthesia to effectively avoid the risk of asphyxiation.

Removal of tracheal stents is quite an uncommon surgery and there aren't many case reports published on this topic, especially not from an anesthesiologist's perspective. There are a few studies that mention similar anesthetic approach when placing a stent. However, the challenges that an anesthesiologist needs to overcome in a stent removal surgery are far greater and require a completely different approach. The main challenge being a reliable supply of oxygen when there's a chance of bleeding and causing asphyxiation.

This case had post tracheostomy subglottic trachea stenosis, and then the metal stent was placed to resolve restenosis, and the airway obstruction was severe. Stent removal could not be tolerated under local anesthesia, but after general anesthesia, symptoms of airway obstruction, heavy bleeding during the operation, or tracheal collapse are very likely to occur after tracheal stent removal, which could not provide reliable airway support. How to ensure the patient's ventilation is the key.

The initial ventilation plan was as follows:

(1) Insert a tracheal tube narrower than the transverse diameter of the stenosis, but in our patient, the only option was a tracheal tube of 4.0 and below (since the narrowest point was 6.3 mm), but after the catheter was inserted into the trachea the airway would be occupied, which would increase the difficulty of removing the stent and make it difficult to stop bleeding.

(2) The laryngeal mask airway (LMA) would be inserted, but it is a supraglottic ventilation device, which cannot establish support for the airway. If the patient is under general anesthesia, and muscle relaxants along with airway stents are taken out, it is very likely the trachea could collapse and/or cause intraoperative bleeding thus rendering an unreliable airway support.

(3) A sputum suction tube with a duodenal nutrition tube core could be inserted under local anesthesia and anesthesia induced after passing through the narrowest part, and jet ventilation guided by the sputum suction tube. If the airway collapses after the airway stent is removed, it may occlude the suction tube and stop ventilation.

(4) Before surgery, perform local anesthesia to remove subglottic scars and neoplasm under the bronchoscope to reduce the narrow range and reduce friction and bleeding during stent removal. The next day, perform stent removal under general anesthesia.

(5) Separate femoral artery and vein under local anesthesia and prepare for cardiopulmonary bypass, but cardiopulmonary bypass needs to be performed after administration of heparin, which increases the risk of bleeding after airway stent removal.

(6) Under local anesthesia cannulate femoral vein and internal jugular vein to prepare external lung oxygenation. It can effectively avoid suffocation caused by emergencies such as intraoperative bleeding and tracheal collapse after stent removal.

Let's review the treatment of this patient. Before the operation, local anesthesia was followed by bronchoscopy and bronchial lesion cryosurgery, argon knife treatment, laser treatment, necrotic tissue and hyperplastic granulation tissues were clamped, mucosal tissue was frozen, lumen stenosis reduced. The next day, after the airway stress subsided, the airway stent was removed under general anesthesia

and regular-frequency jet ventilation was used with a rigid bronchoscope. During the operation, the patient's oxygenation was maintained well and the stent removal process was smooth. However, if the stent is removed before the airway is established, there are always risks of bleeding in the airway and collapse of the trachea. When conditions permit, extracorporeal circulation or extracorporeal pulmonary membrane synthesis assistive technology should be prepared under local anesthesia to effectively avoid the risk of asphyxiation.

In summary, the anesthesia management of tracheal stent removal surgery for patients with severe tracheal scar stenosis is a very challenging task. A detailed anesthesia plan before the operation, comprehensive monitoring and control during the operation, and an emergency anesthesia treatment plan (Plan B) are all necessary.

4. Learning points

- It's recommended to bronchoscopically resect parts of the scar tissue and neoplasm under local anesthesia to widen the lumen of the trachea a day before the stent removal surgery under general anesthesia.
- Stent removal surgery can be extremely dangerous due to the risk of massive hemorrhage as it's heavily vascularized. This can lead to asphyxiation and death.
- It is essential to account for the possibility of this surgery in your anesthesia plan and have necessary measures in place to help mitigate this emergency.
- After the removal of the stent there is a risk of the trachea to collapse and cause asphyxiation. It's important to account for this.

5. Conflict of interest

None declared by the authors

6. Authors' contribution

TY: Principle author; Manuscript writing
QF: Concept, Guidance
MSM, BL: Data collection, proof reading

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