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Case Report

Successful intubation with muscle relaxants in a patient with airway stenosis caused by massive retrosternal goiter: a case report

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Abstract: The severe airway stenosis compressed by massive retrosternal goiter is rare in clinic. This paper reported a case of successful endotracheal intubation anesthesia in a patient with airway stenosis and discussed the principles of anesthesia management. A 35-year old, 51 kg weighed lady was prepared for massive retrosternal thyroidectomy. Magnetic resonance imaging (MRI) and computed tomography (CT) of anterior cervical region showed a massive elliptical substernal goiter, which was 25.1 × 18.7 × 15.4 cm in size. Tumor embolization and electric bronchoscopy were implemented before surgery. The main airway was narrow throughout with a minimum diameter of 4.7 × 20.1 mm due to extrinsic forces of goiter, while the narrowest airway was located in subglottic with a minimum diameter of 4.0 × 7.2 mm due to thickened tracheal mucosal and extrinsic forces of goiter. A wire endotracheal tube of 7.0 was inserted successfully under the guidance of electric bronchoscope after muscle relaxants were administered. The patient developed stridor and dynamic airway collapse after extubation, so tracheotomy was implemented. Anesthesia for complex airway stenosis required accurate preoperative evaluation. Different types of stenosis required different methods of intubation. Muscle relaxants can be used in intubation for patients with airway stenosis.

Keywords: Intubation, muscle relaxant, airway stenosis, retrosternal goiter

Introduction

The severe airway stenosis compressed by massive retrosternal goiter is rare in clinic. Airway stenosis types include intrinsic stenosis, extrinsic stenosis, or mixed stenosis. For patients with massive retrosternal goiter, the difficulty and emphasis of anesthesia lay in airway management including tracheal intubation and extubation. With the development of visual anesthesia and pulmonary intervention, views on airway management remain different [1, 2]. This paper reported a case of successful endotracheal intubation anesthesia in a patient with severe airway stenosis compressed by massive retrosternal goiter and discussed the principles of airway management.

Case presentation

A 35-year old, 51 kg weighed lady was prepared for massive retrosternal thyroidectomy. The anterior cervical mass caught her attention 18 years ago and it kept increasing in size progressively. During the last three months the patient developed dyspnea symptoms including shortness of breath and wheezing after daily activities. The patient denied dysphagia, voice change and any other comorbidity. The patient and her closest relatives signed an informed consent form for the publication.

Magnetic resonance imaging (MRI) and computed tomography (CT) of anterior cervical region showed a massive elliptical substernal goiter, which was 25.1 × 18.7 × 15.4 cm in size (**Figure 1**). CT showed that the main airway was narrow throughout with a minimum diameter of 4.7 × 20.1 mm due to extrinsic forces of goiter, while the narrowest airway was located in subglottic with a minimum diameter of 4.0 × 7.2 mm due to thickened tracheal mucosal and extrinsic forces of goiter (**Figures 2**, **3**). The goiter compressed the patient's trachea, bilateral

Figure 1. The scene of intubation. Massive elliptical substernal goiter was 25.1 × 18.7 × 15.4 cm in size, a wire endotracheal tube of 7.0 was inserted successfully guided by electric bronchoscope.

main stem bronchus and adjacent large vessels. Abundant blood supply of massive goiter came from bilateral subclavian arteries and bilateral carotid arteries. Arterial blood gas analysis showed a pH of 7.38, $PaCO_2$ of 40.3 mmHg, and PaO_2 of 76.7 mmHg. Multidisciplinary consultation recommended preoperative tumor embolization, laryngoscopy, electric bronchoscopy (EB) to decrease bleeding and evaluate the difficulty in airway intubation.

Airway evaluation

EB was performed with electric flexible bronchoscope (Pantex, Japan, external diameter 4.9 mm) in monitored anesthesia care (MAC) with surface local anesthesia. Anesthesia was maintained with continuous administration of propofol (2~3 $mg{\cdot}kg^{-1}{\cdot}h^{-1}$) and remifentanil (0.08~0.1 $ug{\cdot}kg^{-1}{\cdot}min^{-1}$). The result of EB was consistent with CT, which showed no obvious airway collapse. The external diameter of electric flexible bronchoscope was larger than minimum diameter of airway. Bronchoscope could pass through the trachea stenosis easily. Tumor embolization was successfully performed in local anesthesia. Laryngoscopy showed abnormal oral structure, distortion of one vocal cord and limited movement. Mallampati grade was III.

A detailed series of anesthesia management were discussed and designed. The patient was identified as a known difficult airway case and could be ventilated by two-person assisted mask-bag ventilation successfully. The first plan was to perform endotracheal intubation guided by electronic bronchoscope in MAC with surface local anesthesia. Different types of laryngeal mask and endotracheal tube were also prepared. Second, muscle relaxant would be given for endotracheal intubation under general anesthesia when intubation in MAC failed. If intubation failed again, a rigid bronchoscope would be inserted for ventilation and airway intervention by endoscopists. Then, airway intubation would be tried after airway intervention. Third, veno-venous extracorporeal membrane oxygenation was prepared if previous plans failed.

Anesthesia management

After patient entered operation room, electrocardiogram, artery blood pressure, blood oxygen saturation, and bispectral index were monitored. A deep femoral venous catheter was inserted for blood transfusion and fluid infusion in case of massive bleeding. Before induction, oxygen was inhaled by mask at 6 L/min for 5 minutes. Local anesthesia with tetracaine inhalation, propofol (2~3 $mg{\cdot}kg^{-1}{\cdot}h^{-1}$) and remifentanil (0.08~0.1 $ug{\cdot}kg^{-1}{\cdot}min^{-1}$) were administered intravenously. When the patient fell asleep and sedation-agitation scale was 3, electric bronchoscope was inserted successfully. While a 7.0 electromyography (EMG) endotracheal tube (inner diameter of 7 mm) guided by electric bronchoscope was failed to insert, two-person assisted mask-bag ventilation had to be performed to provide oxygen supply. A 7.0 wire endotracheal tube was chosen to try because EMG endotracheal tube was too soft. While the intubation failed again, insufficient muscle relaxation was considered to be the reason of intubation failure. After assessed the effectiveness of face mask-bag ventilation, propofol 100 mg and rocuronium 50 mg were administered. A wire endotracheal tube of 7.0 was inserted successfully guided by electronic bronchoscope. The tip of tube was confirmed to be placed above the carina.

The operation lasted 10 hours, and most of the tumors were removed. The amount of intraoperative bleeding was about 16000 ml; suspension red blood cell of 44 IU, plasma of 4600 ml, and platelet of 2 IU were transfused. The

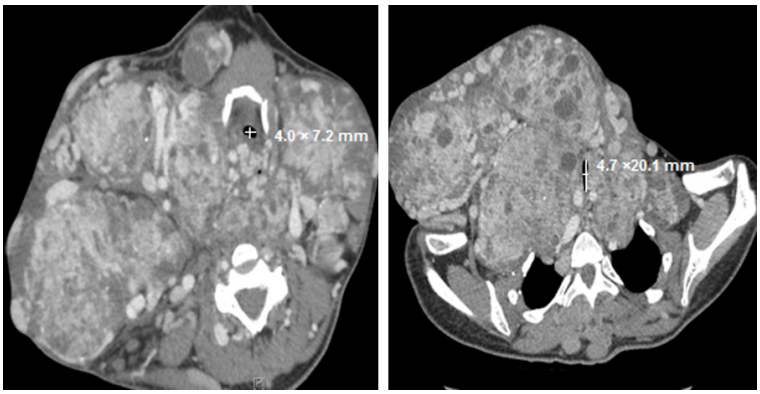

Figure 2. Computed tomography of goiter. Airway stenosis was located in subglottic with a minimum diameter of 4.0 × 7.2 mm due to thickened tracheal mucosal and extrinsic forces of goiter (left figure), The main airway lumen was 4.7 × 20.1 mm in diameter due to extrinsic forces of goiter (right figure).

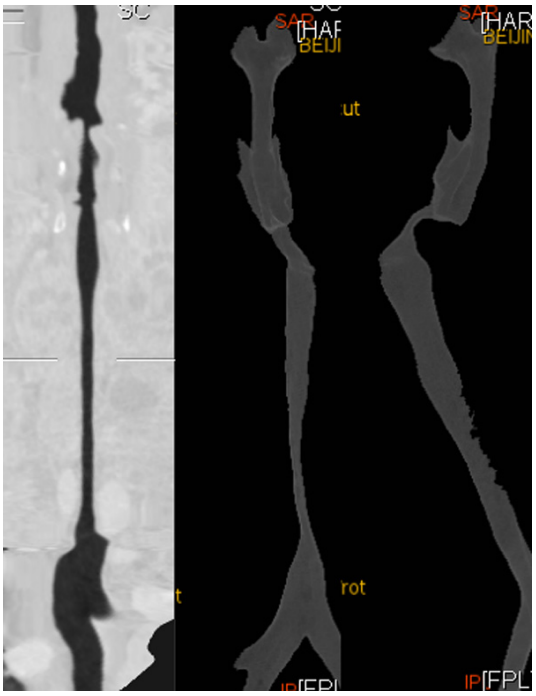

Figure 3. Computed tomography 3D reconstruction of airway. It showed that the patient had longer main airway stenosis of two different types extended from glottis to left main stem bronchus.

patient was transferred to intensive care unit after operation. Endotracheal tube was tentatively removed by electronic bronchoscope 12 hours later. Three hours after extubation, patient developed stridor and oxygen saturation decreased progressively. EB showed edema of glottis and dynamic airway collapse of the main airway. A 7.0 wire endotracheal tube was inserted urgently. Tube was extubated 48 hours later. The patient developed stridor and oxygen saturation decreased progressively again. Tracheotomy was implemented in emergency. A year later, the tracheotomy cannula was failed to be removed for airway collapse.

Discussion

The severe central airway stenosis with massive retrosternal goiter is rare in clinic. Difficult assisted mask ventilation, intubation and extubation caused by massive retrosternal goiter, airway stenosis and tracheomalacia were the focus and difficulty in clinical anesthesia [3]. Compared with other research, the patient had a massive retrosternal goiter and longer main airway stenosis of two different types extended from glottis to left main stem bronchus [4-6]. Many studies have carried out anesthetic management for airway stenosis, but most were limited to retrosternal thyroid mass or mediastinum mass which did not create too much difficulty in assisted mask ventilation and endotracheal intubation [1, 7].

Anesthesia for complex airway stenosis required accurate preoperative evaluation. Patient's medical history and self-conscious symptoms were inquired carefully. Detailed physical examination was performed, including mouth opening, neck tilt, tumor size and Mallampati grade. Evaluation of preoperative auxiliary examination included CT, MRI, EB and laryngoscopy. Based on the above results, it was identified as a known difficult airway.

Intubation failure will not lead to death, while mask ventilation failure will. Preoxygenation before intubation and oxygen supply during the whole management were emphasized. The massive retrosternal goiter, limited mouth opening and neck movement of patient were major factors of the difficulty in intubation. Another factor was that the patient had a long main airway stenosis of two different types extended from glottis to left main stem bronchus. The feasibility of mask ventilation must be confirmed prior to intubation and anesthesia drugs administration for patients with central airway stenosis.

The patient could be ventilated by two-person assisted mask ventilation and SPO_2 was maintained above of 90%. In this case, the feasibility of two-person mask-bag ventilation was confirmed step by step before local anesthetic, after local anesthetic and after sedation.

According to the guidelines of difficult airway management, a detailed series of anesthesia management were discussed and designed before airway intubation. The type (intrinsic or extrinsic stenosis), length and degree of airway stenosis were confirmed. This patient had mixed subglottic stenosis and extrinsic stenosis which were compressed by goiter. EB showed that the wall of the tracheal was intact, so the tip of tube could be passed through the intrinsic stenosis. Due to the size, complex structure and abundant blood supply of the tumor, surgical tracheotomy cannot be performed. Endotracheal intubation guiding by electronic bronchoscope under MAC with surface anesthesia was a preferred method.

Difficult airway management procedures emphasize that appropriate depth of anesthesia and adequate muscle relaxation on the basis of adequate oxygenation can maximize the success rate of intubation. For extrinsic stenosis, reviews mentioned that muscle relaxants could cause tracheomalacia which would increase the difficulty in mask ventilation and endotracheal intubation, especially for patients who cannot be implemented tracheostomy in emergency. Extrinsic stenosis and tracheomalacia can be dilated easily by endotracheal tube or stent. The softness of EMG tube may be the reason of our first failed intubation. It also suggested that muscle relaxants and rigid endotracheal tube should be recommended for difficult endotracheal intubation after failed intubation in MAC. According to our anesthesia experiences in EB, endotracheal tube was not suggested to pass through intrinsic airway stenosis unless the complications can be managed, such as tumor detachment, bleeding etc.

In this case, the inner diameter of a 7.0 endotracheal tube was 7 mm, while the minimum internal diameter shown by CT was 4.0 mm. A 7.0 endotracheal tube was chosen and never be changed until it was successfully inserted. Of course, other different sizes and types of endotracheal tube were also prepared. The choice of tracheal tube size was not just depended on the minimum internal diameter showed by CT or MRI. It also should be based on the habitus, size, length and location of airway stenosis. Similarly, reviews also suggested that a larger tracheal tube should be chosen for intubation [8, 9]. If intubation failed after adequate administration of muscle relaxants, a smaller ID endotracheal tube would be selected. Rigid bronchoscope would be inserted if endotracheal intubation failed.

Tacheomalacia after extubation is a rare complication, and the incidence is about 1-10%. Review reported no cases of tracheomalacia after thyroidectomy and considered it to be rare in western world [7]. No cases of death in patients with tacheomalacia during anesthesia had been reported. Tracheomalacia may occur at induction and post-extubation of anesthesia. In this case, hypoxemia occurred 3 hours after extubation. This indicated that airway collapse was a slow, progressive rather than acute process. The possible reason was glottic edema caused by increased venous pressure and obstructed blood flow, and increased inspiratory pressure which aggravated collapse of softened airway. So it was necessary to observe after extubation, and intubation tools should be prepared in case of emergency [10].

Our team successfully managed the endotracheal intubation for patient with severe airway stenosis caused by massive retrosternal goiter. In conclusion, adequate airway evaluation, preparation of plans and airway intubation tools, and experience of airway stenosis will improve success rate of endotracheal intubation.

Disclosure of conflict of interest

None.

Abbreviations

MRI, Magnetic resonance imaging; CT, Computed tomography; EB, Electric bronchoscopy; MAC, Monitored anesthesia care.

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References

[1] Mackie TW and Skinner A. Anaesthesia for massive retrosternal thyroidectomy in a tertia-

ry referral centre. Br J Anaesth 2014; 112: 756.
[2] Gupta N, Dutta K, Garg R and Bharti SJ. Ketamine and propofol infusion for therapeutic rigid bronchoscopy in a patient with central airway obstruction. J Anaesthesiol Clin Pharmacol 2019; 35: 410-412.
[3] Cook TM, Morgan PJ and Hersch PE. Equal and opposite expert opinion. Airway obstruction caused by a retrosternal thyroid mass: management and prospective international expert opinion. Anaesthesia 2011; 66: 828-836.
[4] Van Slycke S, Stockman A, Dionigi G, Carette R, Gillardin JP, Brusselaers N and Vermeersch H. Harlequin syndrome after thyroidectomy for compressive retrosternal goiter. Case report and review of the literature. Acta Chir Belg 2014; 114: 212-214.
[5] Lee PM, Malhotra R, Shojaee S and Shepherd R. Therapeutic strategies and ventilatory management during interventional rigid bronchoscopy for malignant central airway obstruction. Ann Am Thorac Soc 2016; 13: 574-575.
[6] Rui Sheng Y and Chong Xi R. Surgical approach and technique in retrosternal goiter: case report and review of the literature. Ann Med Surg (Lond) 2015; 29: 90-92.
[7] Findlay JM, Sadler GP, Bridge H and Mihai R. Post-thyroidectomy tracheomalacia: minimal risk despite significant tracheal compression. Br J Anaesth 2011; 106: 903-906.
[8] Cho JW, Jeong MA, Choi JH, Cho JW, Lee HJ, Kim DW, Kim KS and Seo JK. Anesthetic consideration for patients with severe tracheal obstruction caused by thyroid cancer -A report of 2 cases. Korean J Anesthesiol 2010; 58: 396-400.
[9] Kamran A and Jennings RW. Tracheomalacia and tracheobronchomalacia in pediatrics: an overview of evaluation, medical management, and surgical treatment. Front Pediatr 2019; 7: 512.
[10] Ellard L, Brown DH and Wong DT. Extubation of a difficult airway after thyroidectomy: use of a flexible bronchoscope via the LMA-Classic. Can J Anaesth 2012; 59: 53-57.