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CLINICAL REPORT

One-lung ventilation in a patient with stenting for tracheobronchial stenosis caused by esophageal cancer

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Abstract We have provided general anesthesia for a 53-year-old man scheduled to undergo lymph node removal for right mediastinal lymph node metastases caused by esophageal cancer. One year prior, acute respiratory failure occurred because of stenosis of the carinal bifurcation resulting from advanced esophageal cancer with tracheal invasion. The patient underwent placement of tracheobronchial stents (Spiral Z Stent) in two locations (left main bronchus and trachea/right main bronchus), followed by radiotherapy and chemotherapy. In the present case, after an 8.5-mm-ID tracheal tube was placed under bronchoscopic guidance, a 7.0 Fr. bronchial blocker (Arndt Endobronchial Blocker; Cook, Bloomington, IN, USA) was carefully inserted into the stent in the right main bronchus. Next, 3 ml air was injected into the blocker cuff, and left-sided one-lung ventilation was performed. After surgery was completed, the bronchial blocker was removed under bronchoscopic guidance. We confirmed there was no tracheobronchial injury nor stent displacement or deformation, then removed the tracheal tube. Even in patients with tracheobronchial stent placement, one-lung ventilation can be safely and reliably performed by selecting an appropriate bronchial blocker, along with careful insertion into the stent and frequent checking of the blocker position.

Keywords Tracheobronchial stenting · One-lung ventilation · General anesthesia · Esophageal cancer

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Introduction

If surgical treatment for benign or malignant tumors may be difficult in a patient with tracheobronchial stenosis, stent placement can prevent respiratory failure [1–9]. In addition, with advances in subsequent adjuvant therapy, including radiotherapy and chemotherapy, opportunities for surgery and anesthesia are expected to increase in patients after tracheobronchial stent placement, with disappearance or reduction of primary lesions. However, to the best of our knowledge, no case report has described one-lung ventilation after tracheobronchial stent placement. We report anesthetic management during thoracic surgery using one-lung ventilation by insertion of a bronchial blocker into the stent in a patient who had undergone stent placement 1 year previously for tracheobronchial stenosis.

Case presentation

The patient was a 53-year-old man, 164 cm in height and 68 kg in weight, who suffered from acute respiratory failure because of stenosis of carinal bifurcation resulting from advanced esophageal cancer with tracheal invasion. Bronchoscopy examination revealed severe stenosis of the carina. For treatment, tracheobronchial stents (Spiral Z Stent) were placed in two locations, in the left main bronchus and trachea/right main bronchus. Postoperatively, as dyspnea was markedly improved, radiotherapy and chemotherapy treatments were started. One year later, residual lymph node metastasis in the right superior mediastinum prompted surgical removal of the lymph nodes. A recent bronchoscopic examination found that endotracheal mucosa was normal, and there was no tracheobronchial stenosis.

Preoperative pulmonary function testing showed percent vital capacity was 93% and forced expiratory volume percent in 1 s was 87%. Blood gas analysis with room air revealed pH 7.354, PaO_2 70 mmHg, $PaCO_2$ 43 mmHg, and HCO_3^- 23.1 mEq/l; frequency of sputum excretion was 5–6 times/h. Electrocardiography, biochemistry, and electrolyte findings were within normal limits. Preoperative chest radiography confirmed stent placement in two locations and clear lung fields (Fig. 1).

No premedication was given. In the operating room, we attached standard monitors to the patient and then inserted an epidural catheter into the T6–T7 interspace. General anesthesia was induced with intravenous propofol, fentanyl 150 μg, and vecuronium 6 mg. Propofol was infused by target-controlled infusion (TCI) with plasma concentration 4.0 μg/ml. An 8.5-mm-ID tracheal tube (Parker Flex Tip; Parker Medical, Parker, CO, USA) was inserted past the glottis using a laryngoscope, then further tube insertion was performed using a 4.9-mm OD bronchoscope to a site at which the tube tip and proximal end of the stent did not touch, and the tracheal tube was fixed (22 cm at angle of mouth). Next, a 7.0 Fr. bronchial blocker (Arndt Endobronchial Blocker; Cook) was inserted into the stent in the right main bronchus by guiding the tip loop of the blocker using the bronchoscope; 3 ml air was injected into the cuff, thus ensuring reliable and safe one-lung ventilation. We confirmed that the blocker cuff was not deviated in the trachea and was properly expanded within the stent without stent damage or displacement (Fig. 2).

In addition to oxygen and air, intraoperative anesthetic management was performed with propofol (TCI with plasma concentration 2.5 μg/ml), maintaining an anesthesia depth to maintain a bispectral index value 40–50; 1.5% lidocaine was then injected into the epidural space (8 ml/h).

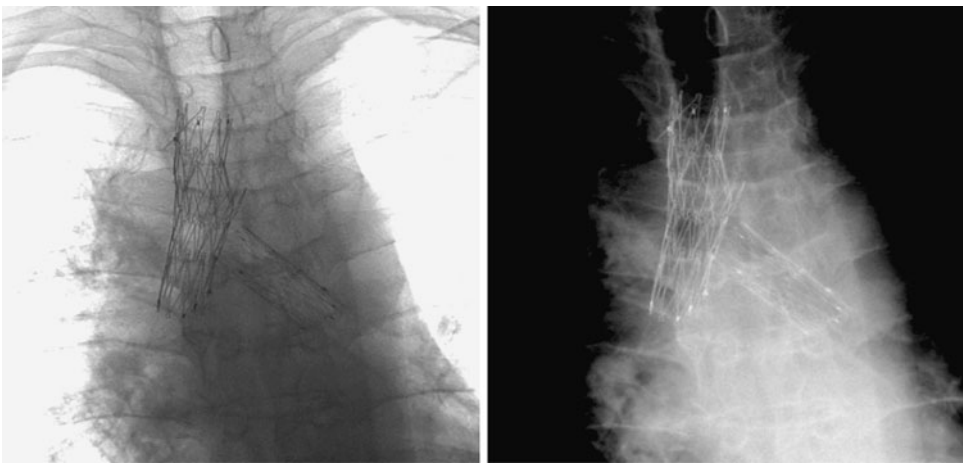

Fig. 1 Preoperative chest radiography shows tracheobronchial stents placed in two locations, in left main bronchus and in trachea/right main bronchus

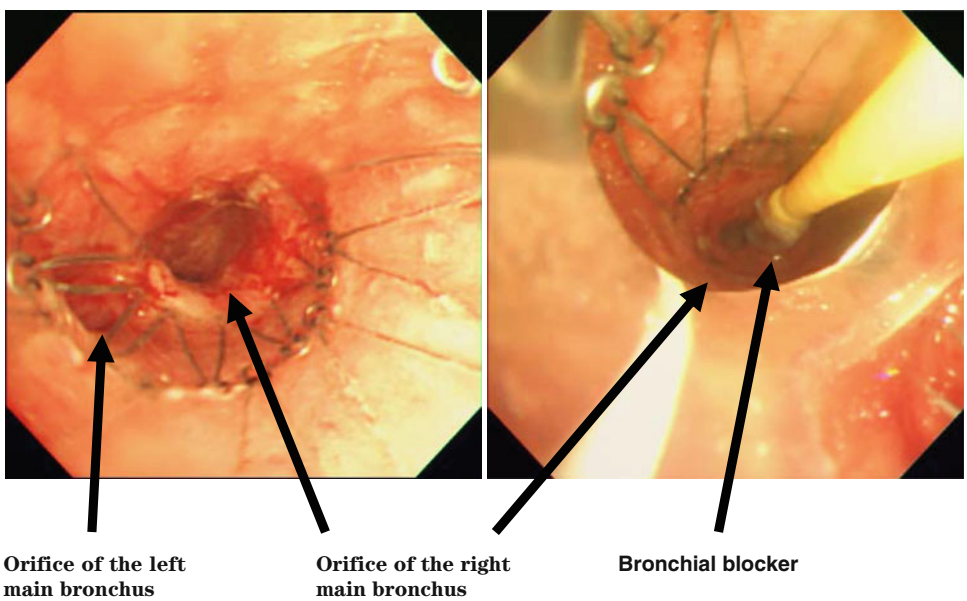

Fig. 2 Bronchoscopy findings reveal two tracheobronchial stents (*left*) and the 7.0 Fr. bronchial blocker (Arndt Endobronchial Blocker; Cook, Bloomington, IN, USA) inserted into the stent in the right main bronchus (*right*)

During one-lung ventilation, respiratory management was provided with pure oxygen. Percutaneous oxygen saturation was maintained at more than 96%. End-tidal carbon dioxide was within normal limits, and hemodynamics was stable. After completion of surgery, the bronchial blocker was removed under bronchoscopic guidance. We confirmed that there was no damage to the trachea and bronchus and neither stent displacement nor deformation had occurred, then removed the tracheal tube. After extubation, the patient showed a stable respiratory status and had no problems with excretion of sputum. Operation time was 2 h 12 min and anesthesia time was 3 h 32 min (one-lung ventilation time, 2 h 10 min). The patient was discharged uneventfully from the hospital.

Discussion

Anesthetic management in the present case had several challenging aspects. First, high airway irritability and copious expectoration were seen consequent to placement of a metal stent in the trachea. Second, bleeding was likely to occur because the tissue surrounding the blocker site was cancerous and the surrounding area had been irradiated during radiotherapy. Third, a risk of stent injury or displacement from blocker placement and the balloon cuff was anticipated. Fourth, mechanical ventilation and securing the airway might be difficult because new proximal airway stenosis caused by tumor invasion might have occurred [9, 10].

The technique used in the present case was as follows. First, we selected an 8.5-mm-ID tracheal tube for standard intubation to facilitate the bronchoscopic procedure. The tube tip was inserted pass the glottis using a laryngoscope; further tracheal tube insertion was performed under bronchoscopic guidance to a site where the tube tip and proximal end of the stent did not touch. In other words, we avoided the risk associated with overlapping of the tracheal tube and stent during intubation. In addition, we carefully selected the tube used for one-lung ventilation. A double-lumen tube, such as a Broncho-cath (Mallinckrodt, Athlone, Ireland), is widely used for one-lung ventilation during lung surgery because insertion, ventilation, and sputum suctioning can be easily performed. However, the tube material is rigid and the bronchial lumen is designed for insertion into a normal bronchus; thus, its use for tracheobronchial stent placement was contraindicated in our patient. Single-lumen tubes equipped with a bronchial blocker, for example, a Univent (Fuji, Tokyo, Japan), are available. However, the blocker catheter material is rigid and, even though it can be inserted, the tip cannot be held or guided using a bronchoscope.

We decided on a Arndt bronchial blocker because it is constructed from softer material and has other advantages in terms of safety, reliability, and easy insertion. As the tip guide loop can be held with a bronchoscope, we think stent injury is unlikely (Fig. 3). Also, by using a bronchial blocker one size smaller than normal, safety can be increased. That is to say, when selecting a tube for one-lung ventilation, emphasis should be placed more on maneuverability and stent safety than on ease of one-lung ventilation or sputum suctioning.

Concerning possible airway obstruction, airway management with preservation of spontaneous breathing is

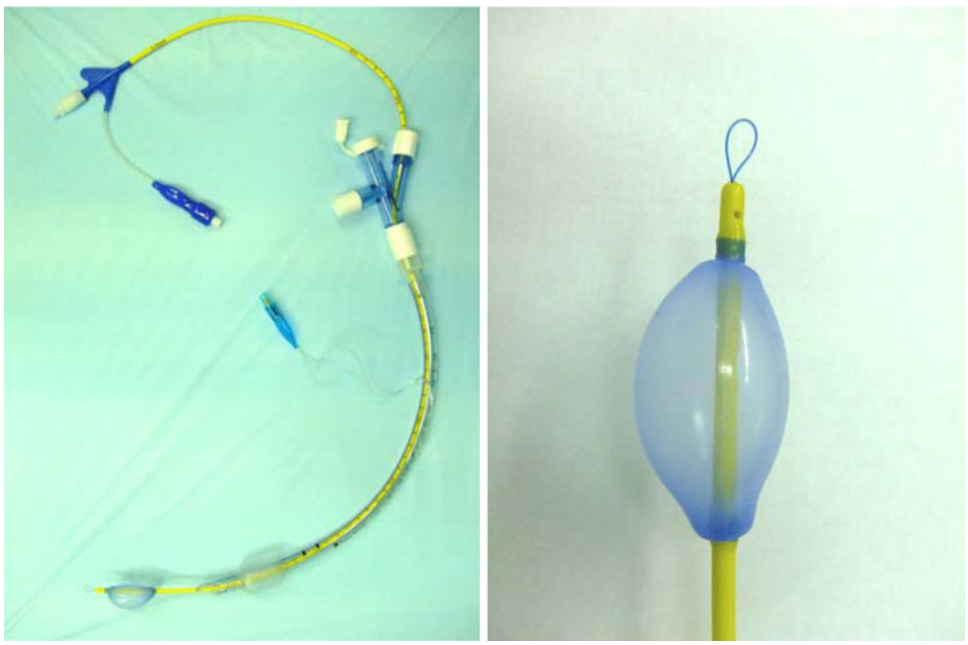

Fig. 3 The Arndt Endobronchial Blocker is constructed from softer material and has advantages in terms of safety, reliability, and easy insertion (*left*) because the tip guide loop (*right*) can be held with a bronchoscope

recommended in cases of upper airway stenosis, such as supraglottic tumors or acute epiglottitis. However, we provided anesthetic management under muscle relaxation in our patient because a cough reflex, which could cause stent displacement and bleeding, might be frequently induced without muscle relaxation. Thus, we concluded that intubation and surgery should be done under a state of complete muscle relaxation. Along with frequent checking during surgery for correct positioning of the bronchial blocker using the bronchoscope, careful attention must be paid to changes in airway pressure and tidal volume. In addition, when removing the bronchial blocker and tracheal tube, the bronchial blocker should be removed under bronchoscopic observation. Furthermore, because a suction tube might become entangled and not readily pull out of the stent with blind tracheal aspiration, it is important to perform this procedure with a suction tube using a bronchoscope or with the bronchoscope itself.

Within a few weeks after tracheobronchial stent placement, bronchial blocker insertion for one-lung ventilation is very dangerous because of ventilatory impairment associated with stent displacement, productive tracheobronchial secretion, and bleeding resulting from manipulation as adhesion between the stent and tracheal epithelial tissue is still poor. Therefore, we suggest airway management cannot be conducted in such cases.

Conclusion

We found that anesthetic management for thoracic surgery can be safely performed under one-lung ventilation in a patient with tracheobronchial stent placement by selecting an appropriate bronchial blocker, along with careful insertion and manipulation in the stent and frequent checking of the position of the blocker. However, because these procedures for anesthetic management have potential risks, adequate anesthetic planning and experience are important.

Conflict of interest None.

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