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Perioperative management for placement of tracheobronchial stents

Norimasa Matsuda,[1] Satoshi Matsumoto,[1] Taku Nishimura,[1] Hiroya Wakamatsu,[1] Mitsuru Kunihiro,[1] and Takefumi Sakabe[1,2]

[1]Department of Critical Care Medicine, Yamaguchi University School of Medicine, 1-1-1 Minami-Kogushi, Ube 755-8505, Japan
[2]Department of Anesthesiology-Resuscitology, Yamaguchi University School of Medicine, Ube, Japan

Abstract Tracheobronchial stenting was performed under general anesthesia, with (six patients) or without (two patients) muscle relaxant, in eight patients suffering from carcinoma. All patients had presented preoperatively with dyspnea, exhibiting Hugh-Jones grade 4 or 5. Three patients had been mechanically ventilated before the procedure. The procedure was performed under general anesthesia with flexible bronchoscopic guidance. Stent placement was performed either through an orotracheal tube (four patients) or through a transtracheal tube (two patients) in those who had no upper tracheal stenosis, while it was performed through a laryngeal mask airway in two patients with upper tracheal stenosis. During the procedure, arterial hemoglobin oxygen saturation (S_{pO_2}) decreased in all patients, despite fraction of inspired oxygen ($F_{I_{O_2}}$) being maintained at 1.0. Except for two patients, one of whom developed superior vena cava syndrome and one, tension pneumothorax after stent placement, there were no complications resulting from stent placement. Six patients were weaned from mechanical ventilation (0–24 days after the procedure). Two of the three patients who had been on mechanical ventilation preoperatively could not be weaned. Stent insertion is an effective treatment for tracheobronchial stenosis, but its indications in patients with malignancy who have been mechanically ventilated prior to stenting should further be evaluated.

Key words Tracheobronchial stenosis · Tracheobronchial stent · Anesthesia management

Introduction

Recently, stenting for central airway obstruction has become widely used for inoperable tracheobronchial stenosis in patients with either benign or malignant lesions, and a favorable outcome has been report [1]. During the procedure, special care must be exercised to avoid airway obstruction and airway injury [2]. We have managed eight patients with central airway obstruction. We describe our experience with the use of the stents of these patients.

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Anesthesia management and stenting procedure

Table 1 outlines pertinent details of the patients' profiles. Tracheobronchial stenting was performed in eight patients (ranging in age from 48 to 84 years), suffering from carcinoma of the thyroid (n = 3), lung (n = 3), esophagus (n = 1), and pharynx (n = 1). The patients received one to four self-expandable metallic stents (Spiral Z stent; Medico's Hirata, Osaka, Japan). All patients had presented with dyspnea, exhibiting Hugh-Jones grade 4 or 5. Three patients had been mechanically ventilated, for 4 to 18 days, before the procedure.

The patients were anesthetized with sevoflurane, propofol, or midazolam. The fraction of inspired oxygen ($F_{I_{O_2}}$) was maintained at 1.0 throughout the procedure. When coughing and moving occurred, we used a muscle relaxant (vecuronium) to avoid airway injury. Two patients did not require a muscle relaxant. In all patients, electrocardiograms, peripheral oxygen saturation, and arterial blood pressure were continuously monitored.

Before stent placement, careful endoscopic assessment of the airway was carried out to verify the site and extent of the lesions. Markers were placed on the skin to delimit the proximal and distal ends of the stenosis. The procedure was performed through an orotracheal tube in four patients and through a transtracheal tube in two patients in those who had stenosis in either the lower trachea or main brochus, while the procedure was performed through a laryngeal mask airway in two patients with upper tracheal stenosis. A guidewire was inserted via the working channel of a bronchoscope. The

Table 1. Patients' profiles

Patient no.	Age (years)/ sex	Cause of obstruction	Level of obstruction	Airway management	No. of stents	Locations of stents	Mechanical ventilation (days)		Complication	Outcome (No. of days until hospital discharge)
							Before	After		
1	84/F	Thyroid carcinoma	Upper trachea	LMA	1		—	—		14 Days[a]
2	66/M	Lung carcinoma	Right mainstem	OT	1		—	—		Died (25 days)
3	63/F	Lung carcinoma	Lower trachea, right mainstem, and left mainstem	OT	3		—	1		Died (25 days)
4	48/F	Thyroid carcinoma, Lung metastasis	Right mainstem	TT	2		—	4		40 Days[a]
5	68/F	Lung carcinoma	Lower trachea, right mainstem, and left mainstem	OT	4		7	10		27 Days[a]
6	78/M	Thyroid carcinoma	Upper trachea	LMA	1		—	24	Exacerbation of extensive cervical edema	77 Days[a]
7	62/M	Esophageal carcinoma	Left mainstem	OT	2		4	NW		Died (46 Days)[a]
8	70/M	Pharyngeals carcinoma, lung metastasis	Lower trachea, right mainstem, and left mainstem	TT	4		18	NW	Tension pneumothorax	Died (53 days)

LMA, laryngeal mask airway; OT, orotracheal intubation; TT, transtracheal intubation; NW, not weaned
[a] Transferred to another hospital

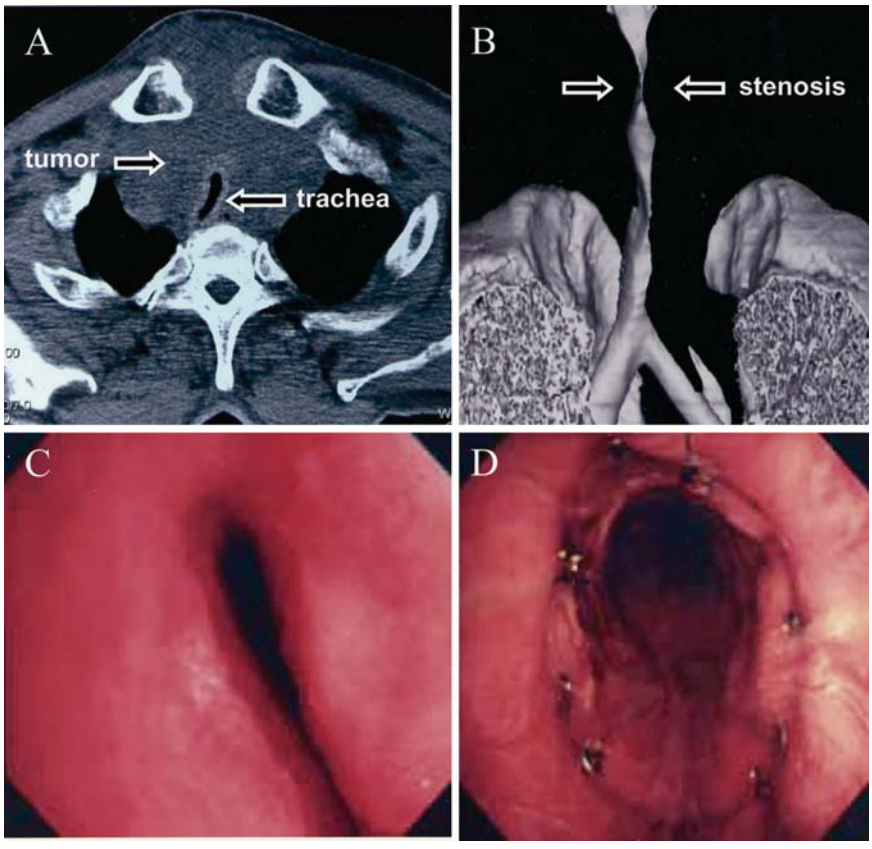

Fig. 1A–D. Features of tracheal stenosis before, and dilation after, stenting in patient no. 6 (Table 1). **A** Plain computed tomography (CT) of chest before stent insertion, showing compression of the trachea. **B** Three-dimensional (3D)-CT of chest before stent insertion. The distance from the proximal end of the stenotic lesion to the glottis was about 2 cm, and the length of the stenotic lesion was about 7 cm. **C** Endoscopic view of upper trachea before stent placement. Marked narrowing was observed before stent placement. **D** Endoscopic view of the stent in the upper trachea 1 day after placement. Tracheal diameter was markedly increased

bronchoscope was then removed and the loaded delivery catheter was advanced over the guidewire to the level of the marker, using fluoroscopy, and the stent was deployed. At the end of the placement procedure, the bronchoscope was reinserted to inspect the stent and to remove secretions and blood.

During the procedure, administration of catecholamine was needed for three patients. Arterial hemoglobin oxygen saturation (Sp_{O_2}) decreased in all patients, despite $F_{I_{O_2}}$ being maintained at 1.0; in one patient (patient 5), Sp_{O_2} decreased below 90%. In this patient, we removed the inserted bronchoscope and then ventilated the patient for a few minutes until Sp_{O_2} increased to above 90%. Then we restarted the procedure.

Figure 1 shows the features of the tracheal stenosis before and dilation after stenting, in patient 6 (see Table 1 for patient number). Preoperative plain computed tomography CT (Fig. 1A) and three-dimensional (3D)-CT (Fig. 1B) of the chest showed marked stenosis in the upper trachea, due to thyroid carcinoma. The stenotic trachea (Fig. 1C) was markedly dilated after the stent placement (Fig. 1D).

Six patients were weaned from mechanical ventilation (0–24 days after the procedure), four patients being weaned within 7 days. Two of the three patients who had been intubated and mechanically ventilated before stenting could not be weaned from mechanical ventilation. Patient 7 had been mechanically ventilated for 4 days before stent placement because of hypoxemia resulting from aspiration pneumonia, and the attempt at weaning failed. After the placement of two stents, the left lower lobe was reexpanded but weaning was unsuccessful. Patient 8 developed increasing respiratory distress requiring mechanical ventilation. Chest CT revealed a large mediastinal mass compressing the lower trachea and the right and left mainstem bronchus, and pneumonia. Four stents were placed without complication, but weaning was unsuccessful. In these two patients, tachypnea continued despite the improvement of oxygenation. Patient 7 died at another hospital after being transferred and patient 8 died of tension pneumothorax.

Except for patient 6, and patient 8, no patients showed complications resulting from stent placement. In patient 6, acute respiratory failure occurred just after the removal of the laryngeal mask airway. This was attributed to laryngeal edema associated with the exacerbation of extensive cervical edema (superior vena cava syndrome). Digital subtraction angiography revealed a stenotic region in the brachiocephalic vein. Tracheal intubation was needed and a stent was placed in the brachiocephalic vein. After the brachiocephalic

vein stent insertion, the stenotic region in the brachiocephalic vein was reduced and the laryngeal edema subsided. The patient was extubated 72 h after superior vena cava stent insertion.

There were no deaths related to stent placement, but patients 2, 3, and 8 died at our hospital within 2 months after stent placement, and patient 7 died at another hospital because of exacerbation of the original malignant disease after he had been transferred.

Discussion

Self-expanding stents are widely used for the conservative treatment of a number of tracheobronchial and mediastinal diseases in which there is obstruction of the airway [1]. However, there seems no consensus concerning the appropriate timing for performing a stent procedure. There have been a few reports of the application of airway stents in patients who had required mechanical ventilation before stent insertion [3–5]. In the report by Zannini et al. [3], all 6 patients (5 with benign disease and 1 with malignant disease) were able to be weaned 1 to 2 days after stent placement. Lippmann et al. [4] described 3 patients with severe central airway obstruction requiring mechanical ventilation. Two patients with benign disease could be weaned from the ventilator within 0 to 2 days. One patient, suffering from non-small-cell carcinoma, could not be weaned and died due to staphylococcal sepsis 2 days after stenting. In 82 patients with stent placement reported by Sadd et al. [1], 16 patients had been mechanically ventilated prior to stent placement. Of these 16 patients (8 patients with malignant disease and 8 with benign disease), 2 patients (1 with malignant disease and 1 with benign disease) could not be weaned. Because these authors did not state either the duration of mechanical ventilation or whether pneumonia was present before the procedure, it is difficult to evaluate whether the failure of weaning was related to the stenting having been performed at too late a stage or to the presence of pneumonia. Shaffer and Allen [5] reported that 6 of 8 patients who had been mechanically ventilated because of large airway obstructions prior to stenting were weaned with 0 to 11 days after the procedure. However, 1 patient, who was suffering from intraluminal large-cell carcinoma and was mechanically ventilated for 1 day, could not be weaned, and elected to withdraw from supportive care, including mechanical ventilation, and died 5 days after stent placement. Another patient, who suffered from tracheomalacia and had required mechanical ventilation for 91 days before stenting, required nocturnal ventilation after stent placement. In general, stent placement for central airway obstruction in malignant disease is palliative therapy. The mean survival duration after stent placement has been reported as 77 days [6] and 3 months [7]. Unger [8] suggests that this new and expensive technology raises both moral and economic issues. However, the deployment of a self-expanding stent in the obstructed airway of a mechanically ventilated patient, through flexible bronchofluoroscopic guidance, is both a safe and potentially effective intervention to facilitate weaning [3–5]. Vonk-Noordegraaf et al. [9] reported 14 patients with severe dyspnea and stridor at rest, with imminent risk of suffocation from central airway obstruction, caused by endstage esophageal cancer and non-small-cell lung carcinoma. In these patients, stent placement within 24 h after arrival at the hospital relieved the symptoms immediately. The average length of survival after stent insertion was 11 weeks. They concluded that, even for patients with a very poor prognosis with terminal cancer, stent insertion for central airway obstruction must be considered for providing immediate symptomatic relief of dyspnea and worthwhile palliation. In our series of patients, all 5 patients who had not been mechanically ventilated before stent placement were weaned, whereas 2 of the 3 patients who had been mechanically ventilated before the procedure (for 4 days and 18 days) could not be weaned from mechanical ventilation; both of them had been suffering from pneumonia prior to stent placement. It is therefore necessary to consider stent placement at an early stage, particularly before the patient develops pulmonary complications such as pneumonia.

Despite a number of improvements in stents themselves and simplification of their application, the placement of tracheobronchial stents is an extremely irritative procedure, and inadvertent misplacement can result from the patient's coughing and moving. Therefore, local anesthesia approaches for securing airways are usually contraindicated because of the risk of precipitating life-threatening coughing [2]. General anesthesia with a muscle relaxant is preferable. We used sevoflurane or propofol/midazolam. Sevoflurane or intravenous anesthetic drugs were reported to be useful and safe for anesthesia induction and maintenance [2, 5, 9]. Airway management is critical in this procedure. The laryngeal mask airway is safe and useful in patients with upper tracheal stenosis [2, 10]. Bronchoscopy performed through laryngeal masks enabled accurate and easy identification of the site of the glottis, as well as the proximal ends of the lesions. Oxygenation could be compromised during the procedure. In our patients, some transient episodes of S_{pO_2} lowering were observed, but the procedure itself was successfully performed in a relatively short period of time (20–40 min). However, if multiple placements of stents are required, supportive measures for oxygenation (such as high-frequency jet ventilation or oscillation) and other measures should be

considered. Shiraishi et al. [11] reported that 4 of 49 patients who received stenting or other airway intervention required percutaneous cardiopulmonary support (PCPS), and all procedures were effective and safe without any complications caused by the PCPS. In our patients, who all suffered from carcinoma, we did not use cardiopulmonary bypass. However, indications for PCPS in patients with central airway obstruction, including those with malignant disease, should be evaluated further.

In summary, we successfully managed the placement of tracheobronchial stents, under general anesthesia, in eight patients with airway stenosis due to malignant disease. However, in the patients who had been mechanically ventilated prior to stenting, particularly those suffering from pneumonia, weaning was difficult. Thus, the indications and appropriate timing for this procedure should be evaluated further.

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