Palliation of Postintubation Tracheal Stenosis Using Insulation-Tipped Diathermic Knife 2: A Case Report

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Abstract
Objective: To report the first case of using the insulation-tipped diathermic knife 2 (IT knife-2) for the treatment of postintubation tracheal stenosis. Clinical Presentation and Intervention: A 71-year-old female patient with a history of endotracheal intubation 3 years earlier presented with throat discomfort, gross wheezing and dyspnea. Chest imaging and bronchoscopy demonstrated a strand-like tracheal stenosis in the upper trachea. The IT knife-2 was used to treat the patient and the lesion was palliated without complication. Conclusion: This case was successfully treated with the IT knife-2 and thus implies a potential usefulness of the IT knife-2 as a new modality for bronchoscopic intervention.

Case Report
A 71-year-old female patient was referred to our Pulmonary Department from a local otorhinolaryngology clinic due to an abnormal laryngoscopic finding. She visited the clinic because of throat discomfort, gross wheezing and exertional dyspnea of 1 year. Laryngoscopic examination showed a stenotic lesion below the vocal cords. She had been taking medication for diabetes and hypertension for 20 years and denied smoking or drinking. Further history taking revealed that she had undergone endotracheal intubation 3 years ago. Chest imaging and bronchoscopy demonstrated a strand-like tracheal stenosis in the upper trachea. The IT knife-2 was used to treat the patient and the lesion was palliated without complication.

Introduction
Postintubation tracheal stenosis is a rare but serious complication in previously intubated patients. Although most cases are asymptomatic and do not require treatment, cases can require bronchoscopic or surgical intervention such as radical segmental resection with end-to-end anastomosis [1, 2].

The insulation-tipped diathermic knife (IT knife) was developed as a cutting instrument for endoscopic submucosal dissection (ESD) of tumors in the gastrointestinal tract [3]. The upgraded IT knife-2 has a three-pronged blade directly beneath the insulation tip that enhances its cutting ability [4]. With proven efficacy and safety, the IT knife-2 is now widely used for mucosal or submucosal resection in the field of gastroenterology [4]. However, its use in bronchoscopic intervention has been sparsely reported [5]. Herein, we describe our experience of a patient with postintubation tracheal stenosis who was treated using flexible bronchoscopy with the IT knife-2.
intubation for 10 days due to bacterial meningoencephalitis 3 years earlier and was now fully recovered without any sequelae. Her vital signs were stable. On physical examination, inspiratory and expiratory wheezing was heard on the front neck. Arterial blood gas analysis and routine laboratory data were normal. The chest X-ray was clear. A computerized tomography scan of the neck showed a stenotic lesion at the upper trachea (fig. 1). Bronchoscopic examination showed a strand-like fibrotic tracheal stenosis 2 cm below the vocal cords without other endobronchial lesions (fig. 2a). As a secondary referral hospital, we are not equipped with bronchoscopic laser or electrocoagulation instruments. We consulted a gastrointestinal endoscopic specialist for the possible modality of treatment for that lesion and finally decided to use the IT knife-2. Intranasal and laryngeal Xylocaine spray was applied and the patient was moderately sedated with intravenous midazolam. Saturation was monitored as in routine bronchoscopy. Under the supervision of the gastrointestinal endoscopist, an IT knife-2 (Olympus Medical Systems, Tokyo, Japan) was inserted through a 2.8-mm working channel of a BF type 1T 260 flexible bronchoscope (Olympus Medical Systems) and manipulated to cut and remove the fibrotic tissue with the current delivered from the high-frequency electrical generator VIO 3000 (ERBE, Tübingen, Germany; fig. 2b–d). The intensity was 20 W in the swift coagulation mode – the same conditions as used for ESD. The procedural time was 20 min. There were no immediate or delayed complications such as bleeding, pneumothorax and surrounding tissue damage. The symptoms gradually improved. After 6 months of treatment, the throat discomfort, auditory wheezing and dyspnea were resolved and wheezing on auscultation had disappeared.

**Discussion**

This report described a case in which the IT knife was successfully used to treat a patient suffering from post-intubation tracheal stenosis. We suggest that the IT knife-2 could be a potential therapeutic option, alone or in combination, at least for some specific types of central airway obstruction.

Postintubation tracheal stenosis is believed to be caused by the loss of regional blood flow due to cuff pressure on the tracheal wall [6]. The mucosal ischemia begins within the first few hours of intubation and the healing process of the damaged region can result in fibrosis within 3–6 weeks [7]. Segmental resection with end-to-end anastomosis has been considered as the treatment of choice for tracheal stenosis [7]. However, surgical resection is frequently limited due to local tracheal (multisegmental, long stenoses, etc.) or systemic conditions (medical status of the patient, comorbidities, etc.) [8]. Interventional bronchoscopic procedures have raised attention, not only as a bridge therapy to surgery but also as a definite treatment for tracheal stenosis. A previous study reported the very low rate of restenosis and high
safety of bronchoscopic interventions [8]. However, the procedures can be hindered by their high cost and the need for general anesthesia.

The IT knife was first introduced in Japan in 1994 for ESD of gastrointestinal tumors such as early gastric cancer [4]. A 2.2-mm-sized insulating ceramic ball is attached at the tip of a 4-mm-long high-frequency needle knife, which allows safe and easy incision of the tissue by reducing the risk of perforation (fig. 2b) [3, 4]. It is disposable and suitable for a 2.8-mm working channel. The IT knife-2 has a characteristic three-spoked blade at the edge of the needle, enhancing the cutting ability, including its lateral cutting capability and cutting speed [9]. The efficacy and safety of ESD using the IT knife-2 has been reported, with a rate of complications including perforation or bleeding of only about 3% [9].

Few papers have reported the use of the IT knife or the IT knife-2 in pulmonary intervention. Very recently, we reported 2 cases of central airway obstruction successfully treated with the IT knife-2 via flexible bronchoscopy; a malignant obstruction of right bronchus intermedius in a 65-year-old male and postradiation bronchial stenosis in a 52-year-old female [5]. Although laser and/or stenting is the favored method for benign tracheal stenosis based on the literature [10], when the stenotic lesion is short and web-like fibrosis is present, as in this case, the IT knife-2 could be considered as an option, especially in institutions not equipped with bronchoscopy-specified instruments.

We think that the IT knife-2 has several potential clinical benefits over other modalities. First, it can be used with a routine flexible bronchoscope and does not require general anesthesia. Second, it requires only a simple procedure technique with a short procedure time. Third, it enables more meticulous manipulation that may be adopted in peripheral airway obstruction. Fourth, it is relatively cost-effective despite the use of a disposable instrument (about USD 150 for each IT knife-2 device in Korea). Finally, expenses can be reduced by sharing an instrument that is typically present in gastrointestinal departments in developed countries.

Conclusion

We suggest a potential usefulness of the IT knife-2 as a new modality for bronchoscopic intervention. Further accumulation of experiences in using this modality would establish its long-term safety and proper indications for use.

References