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ORIGINAL ARTICLE

Placement of self-expanding metallic tracheobronchial Y stent with laryngeal mask airway using conscious sedation under fluoroscopic guidance

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Abstract

Background: Central airway obstruction and fistula are treated with a tracheobronchial Y stent. In the currently used self-expandable metal Y stents, the delivery system is 8 mm in diameter and requires either a 9 mm tracheal tube or rigid bronchoscope to enable airway control during insertion. In this study we present a novel technique of laryngeal mask airway (LMA) assisted Y stent insertion, enabling airway control during deployment of the Y stent.

Methods: All procedures using LMA in assisting Y stent insertions between 2014–2020 were reviewed. Data collected included demographics, clinical diagnosis and disease characteristics, indication, procedural success rates, clinical outcome and survival.

Results: A total of 10 patients with a median age of 61.5 years (range 37–73) underwent LMA assisted Y stent insertion. Indications for stent insertion were malignant disease with central airway obstruction or fistula. In all cases airway patency was achieved leading to improvement of symptoms and performance status. No procedural complications were reported. The median survival was 4.5 weeks (range: 2–26).

Conclusions: LMA assisted Y stent insertion enables airway control during the procedure. In comparison to silicone Y stent insertion, the procedure is less cumbersome, shorter in duration and does not require the use of general anesthesia or rigid bronchoscopy.

Key points

Significant findings of the study

LMA assisted Y stent insertion enables airway control during the implantation of metallic self-expanding Y stent. The procedure does not require the use of general anesthesia or rigid bronchoscopy.

What this study adds

In this study we present the technique and outcomes of LMA assisted Y stent insertion. This method of Y stent insertion provides an additional treatment option for patients with central airway obstruction and fistula.

Introduction

Tracheobronchial obstruction and fistula are a major concern in patients with malignant disease that involves the central airway.[1–5] For lesions involving the lower trachea, tracheal carina, main stem bronchi, and secondary carina, the Y-stent is best suited to obtain patency of the obstructed airway, or to isolate the fistula.[6–13] Bilateral airway stenting of the left and right main bronchi is also a viable option in some cases.[14] Silicone Y stent (Freitag and Dumon) placement is an accepted and widely integrated

interventional pulmonary practice, albeit one that requires general anesthesia (GA), special equipment and the use and skill of performing rigid bronchoscopy.[7,15–17] Self-expandable metal Y stents (SEMS) are a relatively recent addition to the armamentarium of interventional bronchoscopy and have not been widely adopted into practice. SEMS insertion does not require the use of rigid bronchoscopy and GA and can be inserted in the bronchoscopy suite under moderate sedation. However, as SEMS delivery system is 8 mm in diameter, it requires the use of a rigid bronchoscopy or 9 mm endotracheal tube for airway control during insertion.[6,12,13,18,19] The laryngeal mask airway (LMA) is a well-accepted method for airway support and ventilation during bronchoscopy.[20–24] The large diameter working channel of the LMA enables both a controlled and safe passage of the Y stent delivery system, while maintaining airway control. In this case series, we present a novel technic of Y stent insertion, using a laryngeal mask airway to enable airway patency during bronchoscopy and deployment of the Y stent.

Methods

We conducted a retrospective analysis of all cases of LMA assisted Y stent insertion, between 2014–2020, in Rabin Medical Center, Israel. The study was approved by the ethics committee (IRB) of Rabin Medical Center (RMC-0505-18). Patients or their families gave their consent to publish their case. The following data was collected: demographics, clinical diagnosis, indication for stent placement, need for preprocedural intubation, site of airway obstruction, presence of tracheoesophageal fistula, technical success rates and clinical outcome, and post procedure survival.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Technique

LMA assisted bronchoscopy

All procedures were performed with flexible fiberoptic bronchoscopy under moderate sedation with fentanyl (50–100 μg), midazolam (1–2 mg), and propofol (50–350 mg). The patient was monitored with oxygen saturation and transcutaneous PCO_2 level (SenTec digital monitoring system). An assistant pulmonologist was present throughout each procedure. We used the I-gel laryngeal mask,[25] and the size of the LMA was determined according to the patient's weight (commonly size 4 or 5). The LMA was placed with its backside pressed against the hard palate and advanced over the tongue. Once the LMA was positioned over the supraglottic area, the larynx and trachea were visualized by passing a flexible bronchoscope that was inserted through a swivel adapter. The LMA was connected to a self-inflating resuscitation bag (Ambu with oxygen reservoir), breathing was spontaneous because only moderate sedation was used, and ventilation was performed if required according to the patient's saturation and PCO_2. The site of stenosis and/or fistula were located visually with the bronchoscope, and the length diameter of the stenotic area were then evaluated (Fig 1a and b). A cryoprobe, YAG laser or balloon dilatation were used if predilation was necessary.

LMA assisted tracheobronchial (Y) stent insertion and deployment

A guide wire was inserted into the right lung through the working channel of the flexible bronchoscope beyond the stenotic lesion. The bronchoscope was then retracted leaving the wire positioned in the right main stem bronchus. A second wire was then positioned at the left main bronchus, beyond the stenotic lesion and then the bronchoscope was again retracted, leaving both wires positioned through the LMA. Fluoroscopy was then used to verify the position of the wires (Fig 1c). For inserting the Y stent apparatus, the airway was maintained with the LMA. The tracheobronchial (Y) stent (Micro-Tech Y stent; Micro-Tech; Nanjing, China) with its SEMS delivery system was inserted into the LMA (Fig 1d) and advanced over the guide wires into the correct position (Fig 1e). The delivery system is rotated slowly left and right until both wires are separated. Once position was verified the SEMS deployment was initiated, first the opening of the bronchial part followed by the tracheal part, until the full opening of all stent parts (Fig 1f and g). The delivery system and guide wires were quickly removed, and the location of the stent was confirmed with the bronchoscope (Fig 1h and Video S1). To ensure patient safety the bronchoscopy suite was equipped with endobronchial tube, rigid bronchoscopy and percutaneous tracheostomy, in case any of these options were needed.

Results

A total of 10 patients (eight males, two females) underwent treatment with LMA assisted Y stent insertion. The median age of patients was 61.5 years (range: 37–73). The indications for treatment were malignant central airway obstruction and/or fistula and all patients received concurrent anticancer treatment at the time the procedure was performed. Demographic, clinical and oncologic data is shown in Table 1. Four patients were hospitalized before the

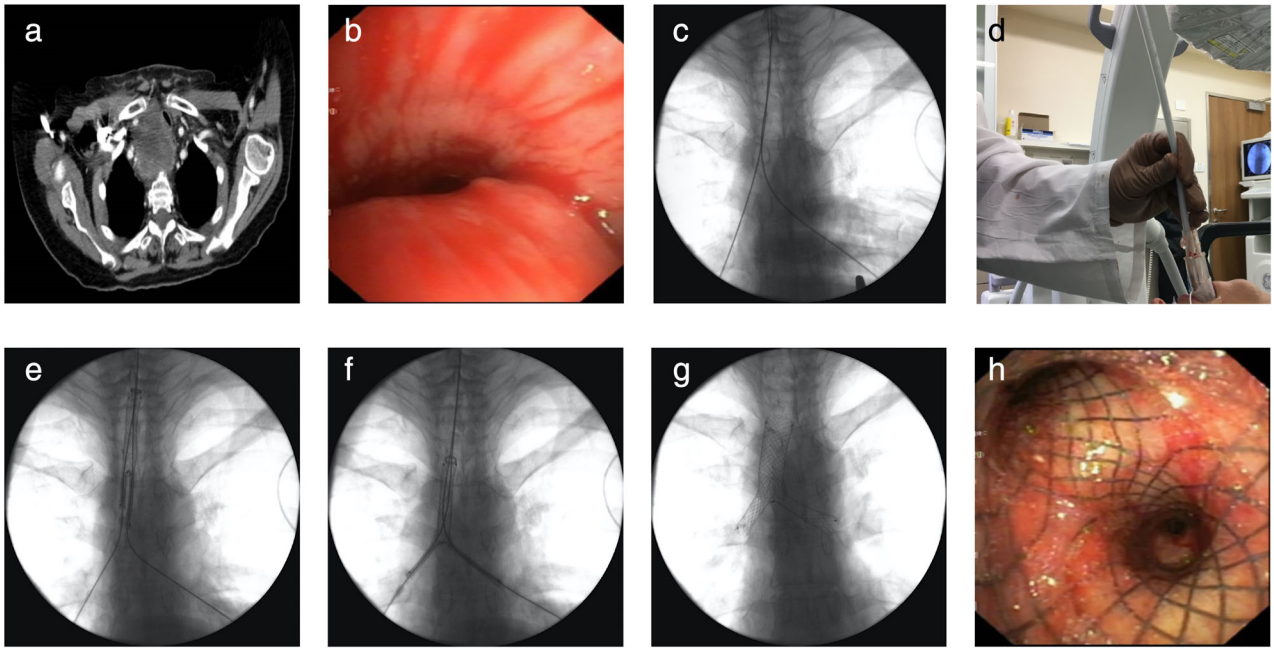

Figure 1 (**a**) Computed tomography image: Anterior mediastinal mass causing severe tracheal obstruction. (**b**) Bronchoscopic view: severe tracheal compression. (**c**) Metal wires are located in the left and right main bronchi. The location is verified with fluoroscopy. (**d**) Insertion of the loading system of the Y stent through the LMA. (**e**) Fluoroscopy image: The Y stent is advanced on the wires to the correct position. (**f**) Deployment of the stent in the trachea and main bronchi on the metal wires. (**g**) Y stent fully deployed in the correct position after removal of delivery system and wires. (**h**) Bronchoscopic view after Y stent deployment.

procedure; one patient due to empyema, two patients due to mediastinitis and one patient due to respiratory collapse. Two patients were intubated before the procedure due to respiratory failure caused by airway tumor obstruction, the tracheal tube was replaced with LMA for Y stent insertion. These patients were able to breath spontaneously at the end of the procedure. All patients survived the procedure and patency of the airway was achieved with improvement of symptoms and performance status. Due to vocal cord paralysis, two patients also required percutaneous tracheostomy. The median survival was 4.5 weeks (range: 2–26). Causes of death were related to the burden of malignant disease and unrelated to the procedure. Two ambulatory patients died two weeks after the procedure, one patient died from gastrointestinal bleeding after esophageal stent replacement and one from cardiac arrest.

Discussion

In this case series we present a technique for LMA assisted insertion of a self-expandable metallic tracheobronchial Y stent. We have shown that the Y stent's loading system can be inserted through the LMA's wide working channel and thus enable a secure and patent airway throughout the procedure.

Insertion of Y stents for central airway disease was first reported during the early 1990s, initially with the Hood and Freitag Y stents and later on with the Dumon and dynamic silicon stents.[26,27] Until recently, silicone stent placement with rigid bronchoscopy was the only acceptable method for Y stent insertion while maintaining airway control. However, the silicone stent has two major limitations. First, the insertion procedure is complicated, requires experience, special equipment and several repositioning attempts until the stent is properly placed. Second, insertion of silicone stents requires the use of general anesthesia (GA) and a unique rigid bronchoscope designated for the procedure. The self-expandable metallic Y stents (Y SEMS) were developed to overcome the limitations of silicone stents. Two case series published in 2006 and 2008 have demonstrated good feasibility and high success rates. Overall, to date, 12 case series (including 370 patients) describing the use of tracheobronchial SEMS have been published, with similar success rates, efficacy and median survival as the silicone stents.[6,19,28–37] A review of the insertion technique shows that despite the Y SEMS advantage, not requiring the use of a rigid bronchoscopy, its limitation is a wide delivery system that requires a large caliber deployment conductor. Consequently, during insertion, the airway is compromised. This case series and two case reports

Table 1 Patient characteristics

Patient	Age	Gender	Comorbidities	Malignancy	Surgical treatment	Anticancer treatment	Airway pathology	Location	Percentage of lumen obstruction	Preprocedural status	Preprocedural intubation	Setting	Survival (weeks)
1	62	M		NC		Carboplatin Gemcitabine	CAO	Trachea	80		No	Ambulatory	26
2	61	M		NSCLC		Carboplatin Etoposide	CAO BMF	Trachea Carina RMB	95		No	Ambulatory	8
3	62	M	CVA DM HTN	NSCLC		Cisplatin Etoposide Navalbin SBRT	CAO BPF	RMB BI	80	Sepsis due to empyema	No	Oncology ward	5
4	65	F	HTN	EC	Esophagectomy	Cisplatin 5FU RT	TEF	Carina		Sepsis due to mediastinitis	Yes	ICU	4
5	58	M		PTC	Complete thyroidectomy Partial esophagectomy	Lenvatinib RT	TMF	Carina		Sepsis due to mediastinitis	Yes	ICU	8
6	73	F	HTN HYT	Large cell NET		Carboplatin Pemetrexed Avastin Nivolumab RT	CAO	Carina	90	Respiratory collapse	Yes	Internal medicine ward	3
7	65	M		NSCLC		Carboplatin Pembrolizumab	TEF	Carina RMB LMB			No	Ambulatory	2
8	59	M		NSCLC		Cisplatin Vinorelbine RT	CAO	Carina RMB LMB	80		No	Ambulatory	4
9	37	M		CRC		FOLFOX Cetuximab	CAO	Carina LMB	95		No	Ambulatory.	2
10	57	M	DM HTN OSA	EC	Esophagectomy Right pneumonectomy	Carboplatin Taxol	TEF	Carina RMB			No	Ambulatory	12

DM, diabetes mellitus; HTN, hypertension; CVA, cerebrovascular accident; OSA, obstructive sleep apnea; NC, nasopharyngeal carcinoma; NSCLC, non-small cell lung cancer; EC, esophageal cancer; PTC, papillary thyroid carcinoma; NET, neuroendocrine tumor; CRC, colorectal cancer; RT, radiation therapy; CAO, central airway obstruction; BMF, bronchomediastinal fistula; RMB, right main bronchus; BI, bronchus intermedius; LMB, left main bronchus; BPF, bronchopleural fistula; TEF, tracheoesophageal fistula; TMF, tracheomediastinal fistula; ICU, intensive care unit.

are the only reports of LMA assisted Y stent insertion that enables airway support during the stent's insertion and deployment.[38,39] To date we have inserted 20 Y SEMS in Rabin Medical Center, the last 10 consecutive procedures were performed with LMA assistance with good results. The procedure can be done with moderate sedation, the positioning of the stent is simple, fast and does not require repositioning after insertion. Published with this case series is an informative video that describes the procedure stage by stage (Video S1). Since the procedure is complex and the patients are considered as high risk, we recommend the use of LMA, not only because it allows for a more safe and controlled stent insertion, but also because the use of LMA improves oxygenation and decreases desaturation events during the procedure.[24]

The insertion of airway stents with flexible bronchoscopy (FB) under moderate/deep sedation is discussed often. While some pulmonologists consider this practice unsafe, others use FB for airway stenting frequently. A survey published in 2018 by the European Association of Bronchology and Interventional Pulmonology (EABIP) evaluated the current practice of airway stenting in the adult population in Europe, and reported that airway stenting is performed with the aid of both moderate/deep sedation with FB and GA with rigid bronchoscopy (RB).[40] Furthermore, several trials have reported airway stenting, including Y SEMS that were inserted with FB without additional complications.[28,30,31] In 2015, Madan *et al.* published the results of a multicenter trial that evaluated the placement of Y SEMS. Of 38 Y stents, six were inserted with FB, with a similar rate of complications with RB and FB.[6] Finally, guidelines from the American Thoracic Society, European Respiratory Society, British Thoracic Society and the American College of Chest Physicians, all state that airway stenting should be done by experienced bronchoscopists, skilled in both FB and RB. None of these guidelines states against the insertion of airway stents via FB.[1,41,42]

This procedure has several limitations. First during the insertion of the loading system, the patient cannot be ventilated. Second, the stent cannot be repositioned once deployed, although it can be gently moved for mild repositioning. However, if major repositioning is required the stent must be extracted, and a new stent must be used. Third, the stent length and circumference cannot be tailored for patients; however, several stent sizes are available.

In conclusion, LMA assisted Y stent insertion enables airway control during the procedure. In comparison to silicone Y stent insertion, the procedure is less cumbersome, shorter in duration and does not require the use of general anesthesia or rigid bronchoscopy.

Disclosure

No authors report any conflict of interest.

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Supporting Information

Additional Supporting Informationmay be found in the online version of this article at the publisher's website:

Video S1 Supplemental Digital Content 1.wmv

