Management of Central Airway Obstruction Caused by Submucosal Lesions Using Resector Balloon

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Abstract: Therapeutic bronchoscopy is widely used in the management of central airway obstruction. Although various endobronchial methods are available for endoluminal lesions, it is difficult to establish complete patency when a submucosal process is present. We present a new technique of using a resector balloon that can be applied for both endoluminal and submucosal lesions. We successfully used resector balloon in 29 cases for submucosal tumoral obstruction from central airway neoplasms. We suggest that submucosal lesions can be safely and easily removed to establish adequate central airway patency with a new technique using "resector balloon." Larger multicenter trials are warranted.

Key Words: lung cancer, endoluminal airway tumor, bronchoscopy

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The management of endoluminal obstruction is required in approximately 90% of the advanced lung cancer cases. Autopsy studies have shown that endoluminal tumors cause death in 75% of epidermoid carcinomas and 50% of adenocarcinomas.[1–3] Endoluminal resection techniques, such as laser photoresection, argon plasma coagulation, cryotherapy, balloon bronchoplasty, etc, are either used singly or in combination according to the location and type of the lesion. Although endoluminal lesion can be easily approached with such methods, in cases with concentric submucosal bronchial and tracheal obstruction, such methods are at risk of perforation. Stent placement may be the only option in these cases, yet its role may be limited by either the cost or lack of availability or expertize.[4–6] We report our experience with the use of resector balloon in patients with central airway obstruction from a submucosal process.

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We believe the use of resector balloon adds to the armamentarium of the interventional pulmonologist.

MATERIALS AND METHODS

Resector Balloon

"Resector balloon" is composed of a 120-cm long single lumen polyethylene tube of 2-mm outer diameter. On its distal end a latex balloon is mounted. The balloon length could vary between 10 and 40 mm, along with its maximum inflated diameter between 10 and 25 mm. The balloon is covered with a mesh structure made of 0.3-mm thick polyurethane or lycra fibers (Fig. 1). The minimum deflated balloon diameter with the mesh structure on it is 3 mm for all types.

In this technique, the balloon is placed into the bronchial lumen where the submucosal tumor overlays the deflated balloon. The balloon is repeatedly inflated and deflated until the lumen patency is established (Fig. 2).

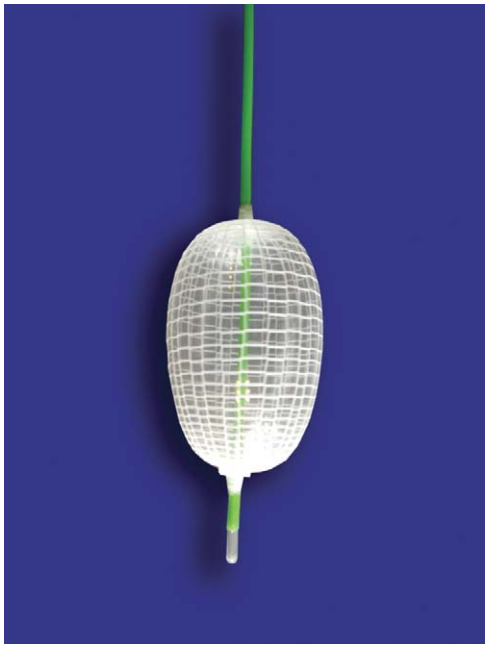

FIGURE 1. Resector balloon–covered with the mesh made up of lycra fibers.

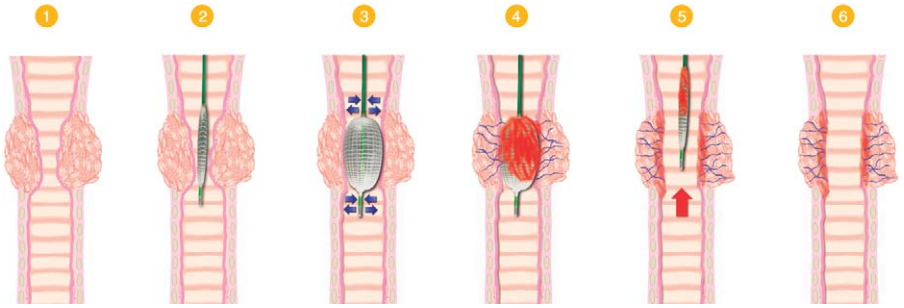

FIGURE 2. Schematic presentation of the use of the balloon.

With this technique, the force, applied directly to the bronchial mucosa is transmitted to the submucosal field. The accumulated force that is obtained by multiple deflations and inflations of resector balloon starts to destruct the submucosal tumor. Although the pressure destructs the submucosal tumor, the bronchial mucosa has only minor lacerations. Destructed semisolid tumoral material flows into the bronchial lumen through mucosal lacerations, and the tumoral material is aspirated. Furthermore, complete patency of the obstructed airway can be provided and the need of stenting becomes usually unnecessary.

Compared to dealing with endoluminal lesions, this procedure is relatively long for the submucosal lesions; however, possible bleeding can be controlled simultaneously by balloon tamponade.

TABLE 1. Patient Demographics

Variable	Value
Patients	29
Age (y)	39-71
Male/female	23/6
Symptoms	
Dyspnea	29
Fever	21
Hemoptysis	16
Cough	29
Stridor	5
Respiratory insufficiency (NIMV)	6
Respiratory insufficiency (MV)	3
Diagnosis	
Nonsmall cell lung cancer	20
Small cell lung cancer	4
Metastatic lung cancer	3
Adenoid cystic carcinoma	2
Obstruction site	
Trachea	2
Main carina, bilateral main bronchi	7
Left main bronchus, secondary carina ± left upper lower bronchus	9
Right main bronchus, intermediate bronchus ± upper/lower/middle lobe bronchus	11

MV indicates mechanical ventilation; NIMV, noninvasive mechanical ventilation.

Between April 2006 and August 2007, 29 patients (23 men and 6 women; age range between 39 and 71 y; mean age 56.3 y) with tracheobronchial obstructions (submucosal concentric) owing to malignancies were admitted to our clinic. The symptoms included dyspnea, cough, stridor, and fever, respiratory insufficiency with the combination of elevated white blood cell count, and C-reactive protein owing to postobstructive pneumonia. Diagnoses were established by reviewing patient's history, computerized tomography (3-Dimensional reconstructions), and bronchoscopy. Except 1 male patient—whose bronchoscopic biopsies were not diagnostic—all patients received chemotherapy and radiation therapy. Therapeutic bronchoscopy was performed previously in 4 cases. Clinical features and obstruction site are summarized in Table 1.

Before the procedure, all patients were evaluated by cardiologist and anesthesiologist, premedicated, and given antibiotics. Interventions were performed under general anesthesia via rigid and flexible bronchoscopes. We used Dumon-Harrel Rigid Bronchoscope (Efer, France) and Olympus Therapeutic Bronchoscope BF-XT (Olympus, Japan), which has 3.2-mm channel diameter (Figs. 3–5). We used resector balloon in all interventions that had submucosal lesions at proximal trachea in 1 case, distal trachea in 1 case, carina in 5 cases,

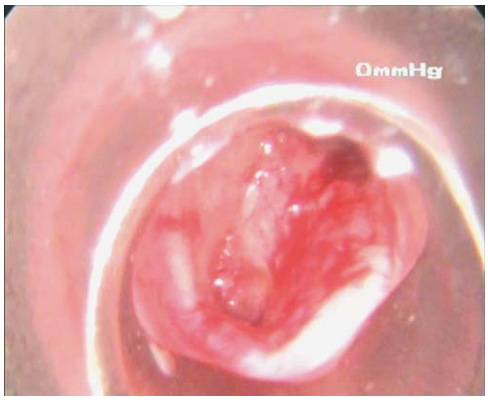

FIGURE 3. Endoluminal and submucosal obstruction of carina.

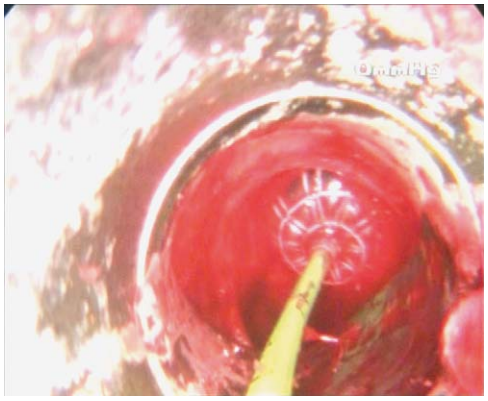

FIGURE 4. The use of resector balloon.

bilateral main bronchi in 2 cases, left main bronchus to secondary carina in 4 cases, left main bronchus to upper and lower lobe bronchi in 5 cases, and right main bronchus to middle and lower lobe bronchi in 11 cases. In all the 29 interventions, submucosal lesions were completely resected by resector balloon alone. The diagnosis was established by the cytologic examination of aspiration material in the nondiagnosed patient; his mucosal biopsy in the same session was negative. The previous mucosal biopsy was also reported as normal bronchial mucosa. In one of the interventions, we placed Y-silicone stent at the bifurcation of the left main bronchus.

RESULTS

We determined that submucosal tumoral lesions were resected almost completely, safely, and easily. Complications, such as heavy bleeding, cartilage destruction, and perforation were not observed. All interventions were performed with only resector balloon, and no other additional resection technique was required. All patients were extubated and the general conditions were improved after interventions. In all cases, airway patency was reestablished and the dilatation was sufficient enough not to have need of stenting. In only 1 case, Y-silicone stent was placed at the bifurcation of the left main bronchus. All patients reported immediate resolution of their primary symptoms from the central airway obstruction.

FIGURE 5. Final view of carina after performing resector balloon.

DISCUSSION

The major limiting factors for the outcome from the endobronchial therapy are the location and the type of the tumor. It is quite easy to perform laser photoresection, electrocautery, or cryotherapy for the endoluminal lesions in the central airways. Risk of complication increases when the tumor is located more distally and tumoral invasion has submucosal components.[7–9] Adequate removal of submucosal tumors is often impossible because of risk of perforation. Laser photoresection, electrocautery, or cryotherapy is usually not performed in concentric submucosal lesions. The tip of the rigid bronchoscope is known to cause complications such as bleeding and destruction of normal bronchial cartilage when used for mechanical debulking.[8] Before resector balloon, stent placement was preferred for submucosal concentric lesions. But stent placement cannot provide complete patency of the obstructed airway; besides, the cost or the lack of availability and expertize could be limiting factors under certain circumstances. Brachytherapy and photodynamic therapy are performed in submucosal lesions for their delayed effect, yet have limited value when immediate palliation is desired. These modalities are also associated with serious long-term complications.[3]

In all other cases, airway patency was provided with the use of the balloon. Submucosal tumors were completely resected. We determined that with this technique, the submucosal lesions can be resected without damaging the normal bronchial wall and immediate palliation can be established.

Even though the long-term outcome needs to be systematically studied, as the airway obstruction is overcome completely, further radiation or chemotherapy could provide potentially higher survival rate and better quality of life.[3,8,10]

Resector balloon, which has 360 degree circumference effect to resect the pure endobronchial lesions in a short time period, also provides immediate relief of the symptoms in submucosal lesions.[11] Inflated balloon also helps to control the bleeding associated with the procedure. Large multicenter trials are necessary before widespread application of this technique.

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