Sequential Stenting for Extensive Malignant Airway Stenosis

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Purpose: Malignant airway stenosis extending from the bronchial bifurcation to the lower lobar orifice was treated with airway stenting. We herein examine the effectiveness of airway stenting for extensive malignant airway stenosis.

Methods: Twelve patients with extensive malignant airway stenosis underwent placement of a silicone Dumon Y stent (Novatech, La Ciotat, France) at the tracheal bifurcation and a metallic Spiral Z-stent (Medico’s Hirata, Osaka, Japan) at either distal side of the Y stent. We retrospectively analyzed the therapeutic efficacy of the sequential placement of these silicone and metallic stents in these 12 patients.

Results: The primary disease was lung cancer in eight patients, breast cancer in two patients, tracheal cancer in one patient, and thyroid cancer in one patient. The median survival period after airway stent placement was 46 days. The Hugh–Jones classification and performance status improved in nine patients after airway stenting. One patient had prolonged hemoptysis and died of respiratory tract hemorrhage 15 days after the treatment.

Conclusion: Because the initial disease was advanced and aggressive, the prognosis after sequential airway stent placement was significantly poor. However, because respiratory distress decreased after the treatment in most patients, this treatment may be acceptable for selected patients with extensive malignant airway stenosis.

Keywords: airway stent, malignant airway stenosis, metallic stent, silicone stent

Introduction

Airway stent placement for malignant airway stenosis relieves symptoms immediately and improves quality of life. The clinical indications for airway stenting are (1) extrinsic stenosis of the central airway with or without intraluminal components; (2) complex, inoperable tracheobronchial strictures; and (3) recurrent intraluminal tumor growth.1) The anatomical criteria for airway stenting are a stenosis that is distal to the cricoid and proximal to the lobar orifice, as well as the presence of patent lobar or segmental orifices.2) Extensive airway stenosis, such as stenosis extending from the bronchial bifurcation to the lower lobar orifice, may also be treated by airway stent placement when the stenosis site meets both the clinical and anatomical criteria. For these patients, we sequentially place a silicone Y-shaped stent at the bronchial bifurcation and an expandable metallic stent at the distal airway. In the present study, we investigated the clinical courses of patients treated by sequential airway
stenting and examine the effectiveness of airway stenting for extensive malignant airway stenosis.

**Materials and Methods**

Informed consent was obtained from all patients included in this study. Additionally, the institutional ethics committee approved this study. From January 2003 to December 2012, a total of 270 patients with malignant airway stenosis were treated in our institute. All stenosis sites met both the clinical and anatomical criteria. Twelve of these 270 patients with airway stenosis extending from the central to the peripheral airways were treated with two airway stent placement techniques. The silicone Dumon Y stent (Novatech, France) is recommended for treatment of airway stenosis at the bronchial bifurcation.

When the length of the airway stenosis is extensive, an uncovered metallic stent should be chosen to maintain mucociliary clearance. Because peripheral airway stenosis was present in our patients, tapered airway stents were required. Therefore, we used the silicone Dumon Y stent at the bronchial bifurcation and the tapered Spiral Z-stent (Medico’s Hirata, Japan) peripheral to the main bronchus. The reticulation of the Spiral Z-stent is loose enough to maintain ventilation of the right upper lobe when it is placed from the right main bronchus to the trunks intermedius. These two airway stents were placed simultaneously using rigid bronchoscopy under general anesthesia. The endoluminal tumor at the tracheal bifurcation was debulked. In first, the tumor tissue on either side which did not lead peripheral stenosis was debulked to maintain intraoperative ventilation. After sufficient airway preparation, the silicone Dumon Y stent was placed at the tracheal bifurcation. The Spiral Z-stent was sequentially placed internally from the end of the Dumon Y stent using a guide wire under fluoroscopic guidance. We retrospectively analyzed the therapeutic efficacy of the sequential placement of these silicone and metallic stents. Patients treated with silicone stents for fistulae between an airway and an adjacent organ were excluded from this study. The overall survival rate after airway stent placement was calculated by the Kaplan–Meier method.

**Results**

Two etiologies of airway stenosis were identified in these patients. A noticeably enlarged lymph node of the tracheal bifurcation caused airway stenosis through the tracheal bifurcation to either side of the peripheral airway (Fig. 1A). Right-sided airway stenosis was observed in seven patients, and left-sided airway stenosis was observed in only one patient. Another etiology of extensive airway stenosis was the combination of a mass lesion in the right upper lobe and an enlarged lymph node of the tracheal bifurcation (Fig. 1B). This type of airway stenosis was observed in four patients. In these patients, the tumor tissue from the lymph node caused airway stenosis at the tracheal bifurcation, and the tumor tissue from the right upper lobe caused airway stenosis through the right main bronchus to the trunks intermedius. Table 1 shows 12 patients in this study from past to present. Case 1 was treated most recently. The 12 patients comprised five men and seven women with a mean age of 59 years (range, 44–78 years). The primary disease was lung cancer in eight patients, breast cancer in two patients, tracheal cancer in one patient, and thyroid cancer in one patient. All patients exhibited a combination of endoluminal and extraluminal type compression. Both the Hugh–Jones classification (HJ classification) and performance status (PS) improved in nine patients, remained unchanged in two patients, and worsened in one patient (Case 11) after airway stent placement (Fig. 2). Case 11 had developed hemoptysis and died of respiratory tract hemorrhage 15 days after the treatment. Treatment-related complication and death was observed in Case 11 only. The mortality rate associated with this treatment was 8.3%. Figure 3 shows the survival curves after airway stent placement. The median survival period after airway stent placement was 46 days. The 1-month, 6-month, and 1-year survival rates were 58%, 25%, and 13%, respectively. Eleven
patients died of carcinoma during follow-up period. Causes of death were respiratory failure in nine patients and cachexia in two patients (Table 1).

Discussion

In this study, the median survival period after airway stent placement was 46 days, and our patients had a poorer prognosis than did those in a previous report. However, the respiratory distress improved in most patients after airway stent placement. We have shown that airway stenting decreased after airway stent placement in most patients with advanced carcinoma extending from the trachea to the bronchus in the present study. Patients except one had aggressive and advanced carcinoma, the post-treatment prognosis was very poor. As in the present study, the 6-month survival rate after intervention among patients with malignant airway stenosis extending from the trachea to the bronchus was reportedly 20%. However, the respiratory distress decreased after airway stent placement in most patients with advanced carcinoma extending from the trachea to the bronchus.

Table 1: Characteristics of the patients

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Gender</th>
<th>Primary disease</th>
<th>HJ before</th>
<th>HJ after</th>
<th>PS before</th>
<th>PS after</th>
<th>Treatment site</th>
<th>Initial treatment</th>
<th>Postoperative treatment</th>
<th>Survival time (days)</th>
<th>Outcome</th>
<th>Cause of death</th>
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<td>radiotherapy</td>
<td>59</td>
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<td>cachexia</td>
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<td>3</td>
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<td>227</td>
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<td>RF</td>
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<td>13</td>
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<td>chemotherapy</td>
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<td>51</td>
<td>dead</td>
<td>RF</td>
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</table>

HJ: Hugh-Jones classification; PS: performance status; RF: respiratory failure; SBRT: stereotactic body radiotherapy; TIM: truncus intermedius; LMB: left main bronchus

Fig. 2: Hugh–Jones classification (HJ) and Performance Status (PS) before and after airway stent placement.

Fig. 3: Overall survival curve after airway stent placement.
for extensive malignant airway stenosis may be an effective treatment for select patients. Treatment-related complication and death was observed in only one case. The morbidity rate of airway stenting for malignant airway stenosis is reportedly 20% to 42%, and the mortality rate is reportedly 8%. Sequential airway stenting may be an acceptable treatment.

Four patients underwent additional treatment after airway stent placement in this study. Two of these patients had never received initial treatment, and primary lung cancer was diagnosed using the tumor tissue obtained at biopsy during airway stent placement. Case 1 was a 70-year-old male patient who was treated with radiotherapy for primary disease after airway stent placement. Case 2 was a 57-year-old male patient who was treated with four cycles of chemotherapy comprising cisplatin plus pemetrexed after airway stent placement and experienced long-term survival. Airway stent placement plays a role as a bridge procedure to additional anticancer treatment. Airway stenting is recommended for patients with airway stenosis caused by an untreated malignant tumor when no other reliable treatments are available.

The HJ classification remained poor and PS persisted in two patients after airway stent placement. Case 5 was a 78-year-old female patient. She was in respiratory failure and required mechanical ventilation upon arrival. Her ventilation did not improve, and she died of respiratory failure 13 days after stent placement. Because pneumonia and long-term mechanical ventilation resulted in organization of her peripheral lung tissue, her respiratory status did not improve after resolution of the airway stenosis. Stent placement should be avoided when nonviable lung tissue is present beyond the obstruction. Case 12 was a 61-year-old male patient. His primary disease was lung cancer. Chest CT showed extensive airway stenosis through the tracheal bifurcation to the left main bronchus caused by an enlarged lymph node of the tracheal bifurcation (Fig. 4A). He underwent placement of a silicone Dumon Y stent at the tracheal bifurcation and a Spiral Z-stent at the left main bronchus. Chest roentgenograms showed increased permeability in the left lung field (Fig. 4B and 4C). Although the airway stenosis was resolved, his respiratory status and general condition did not improve. The airway stent might have expanded laterally against the hard tumor tissue at the bronchial bifurcation and pressed against the wall of the pulmonary artery, followed by a decrease in the blood flow on the treatment side (Fig. 4D). This ventilation–perfusion imbalance may be a reason for the lack of improvement in respiratory distress after the resolution of airway stenosis.

In particular, when airway stenosis extends peripherally, airway stent placement may induce pulmonary arterial compression. However, it is difficult to predict the development of ventilation–perfusion imbalance after airway stent placement.

Case 7 was a 45-year-old female patient. She was relieved from respiratory distress and came home after airway stent placement. However, she died of rapid progression of cachexia 14 days after airway stent placement. We could not estimate a clinical course of the patient before airway stent placement. It is difficult to predict a rapid progression of clinical condition of patients with advanced carcinoma.

There are limitations in this study. The number of patients was extremely small. We could not objectively measure changes in the respiratory status before and after the treatment. The respiratory and general conditions were mainly measured by physical examination. Nine patients underwent stent placement on the day of admission.
Seven patients were transferred to other hospitals within a few days after the treatment, and three patients without symptom improvement could not undergo respiratory functional testing after the treatment. Thus, respiratory functional tests were performed in seven patients before airway stent placement. And only two patients underwent post-treatment respiratory functional testing. Arterial blood gas was measured after the treatment in few patients because most patients experienced symptom improvement. Accumulation of patient data and further objective examination are necessary.

**Conclusion**

This is the first report to describe the clinical course of patients undergoing sequential airway stent placement of a silicone Dumon Y stent and Spiral Z-stent for extensive malignant airway stenosis. Because the initial disease was advanced and aggressive, the prognosis after sequential airway stent placement was significantly poor. However, respiratory distress decreased after the treatment in most patients; thus, this treatment may be recommended for select patients.

**Disclosure Statement**

The authors of this manuscript have no relevant financial or other potential conflict of interest.

References