Evidence Against Routine Scheduling of Surveillance Bronchoscopy After Stent Insertion*

Toshihiro Matsuo, MD; and Henri G. Colt, MD, FCCP

Study objectives: To determine whether routine scheduling of surveillance flexible fiberoptic bronchoscopy is warranted within 2 to 3 months after silicone stent insertion for central airway obstruction.

Design: Retrospective cohort study.

Setting: University medical center.

Patients: All patients with silicone stents placed for benign or malignant tracheobronchial obstruction during a 3-year period.

Methods: Incidence of stent-related complications, new respiratory symptoms, and need for therapeutic bronchoscopic intervention were noted in patients undergoing surveillance bronchoscopy (SFFB) and emergency bronchoscopy (EFFB), defined as flexible fiberoptic bronchoscopy prompted by onset of new symptoms before the date of scheduled SFFB.

Results: One hundred one silicone stents were inserted in 88 patients (47 with cancer, 41 with benign disease). Eighteen patients died within 2 months and had no bronchoscopy. Seventy patients underwent either SFFB or EFFB. Stent-related complications were detected in 9 of 31 asymptomatic patients (29%) undergoing SFFB; all had received tumor-specific therapy after stent insertion (in 7 of 8 patients [88%] reporting new respiratory symptoms at the time of SFFB, and in 26 of 31 patients [84%] undergoing EFFB). Overall, stent-related complications were detected in nine asymptomatic patients (10% of total), of which only four patients (5% of total, but 13% of all asymptomatic patients) required therapeutic interventions.

Conclusion: Routine SFFB within 2 to 3 months after stent insertion did not detect a high incidence of stent-related complications among patients without new respiratory symptoms.

(CHEST 2000; 118:1455–1459)

Key words: airway stent; silicone stent; stent complications; surveillance bronchoscopy

Abbreviations: EFFB = emergent flexible fiberoptic bronchoscopy; SFFB = surveillance flexible fiberoptic bronchoscopy

Bronchoscopic stent insertion has become an essential endoscopic surgical treatment for patients with life-threatening airway obstruction caused by benign or malignant airway disease. Silicone tracheobronchial stents, such as those designed by Dumon, immediately relieve airway obstruction caused by extrinsic compression, intraluminal disease, or loss of cartilaginous support.\(^1\) Complications such as migration, and obstruction with tenacious secretions, granulation tissue, or tumor recurrence, however, occur in up to 25% of cases.\(^2,3\)

In many facilities, a surveillance flexible fiberoptic bronchoscopy (SFFB) is routinely scheduled and performed within 2 to 3 months after initial stent insertion. This has been the practice in our institution, where we have presumed that potential stent-related complications would thus be detected before severe symptoms of central airways obstruction prompted emergency hospitalization, especially in patients referred from outside facilities.

Whether this practice is justified is unknown. For

*From the Interventional Pulmonary Section of the Pulmonary and Critical Care Medicine Division, University of California-San Diego Medical Center, La Jolla, CA.

Manuscript received December 28, 1999; revision accepted April 5, 2000.

Correspondence to: Henri G. Colt, MD, FCCP, Chief, Interventional Pulmonology, UCSD La Jolla, 9310 Campus Point Dr, La Jolla, CA 92037-0976; e-mail: hcolt@ucsd.edu
example, it is unclear whether SFFB performed in the absence of respiratory symptoms suggestive of a stent-related complication will detect an airway problem. Nor is it known if patients with a new onset of respiratory symptoms prompting an emergency flexible bronchoscopic examination will actually have stent-related complications. Increasing concerns about escalating health-care costs, particularly in a capitated-care environment, as well as about patient safety and comfort issues further justify, in our opinion, a critical appraisal of the practice of SFFB in patients with indwelling tracheobronchial stents. The purpose of this initial study, therefore, was to address the appropriateness of routine scheduling of SFFB, to be performed within 2 to 3 months after silicone stent insertion.

Materials and Methods

This study was performed in the pulmonary special procedures unit of a tertiary-care university hospital specialized in the treatment of patients with complex airway obstruction. All new patients undergoing studded silicone stent (Bryan; Woburn, MA; and Hood Laboratories; Pembroke, MA) insertion during a 3-year period between 1996 and 1998 were included in this study.

Information pertaining to patient demographics, indication for stent insertion, type of silicone stent, and its location within the tracheobronchial tree were collected prospectively as part of our routine patient-care protocol. Immediately following stent insertion, and prior to the patient’s discharge from the hospital, follow-up SFFB was scheduled. The surveillance procedure was scheduled to be performed within 2 to 3 months after the date of initial stent insertion. If the onset of new respiratory symptoms (dyspnea, cough, excess airway secretions, or respiratory failure) prompted flexible fiberoptic bronchoscopy prior to the scheduled date, the procedure was classified as an emergent flexible fiberoptic bronchoscopy (EFFB). If no new onset of respiratory symptoms was reported on the day the patient returned for SFFB, it was recorded, but patients were still classified as undergoing SFFB.

At the end of the study period, all medical records were reviewed. Patients with airway stenoses prompting stent insertion were classified into two groups based on the etiology of the stenosis. These were patients with malignant disease (including low-grade malignancies such as carcinoid), and those with benign disease. The presence or absence of new respiratory symptoms at the time of surveillance bronchoscopy was also confirmed. Flexible fiberoptic bronchoscopic findings for both SFFB and EFFB were identified as stent-related complications if there was evidence of stent migration, stent obstruction by abundant secretions, or stent obstruction by tumor or granulation tissue. Therapeutic interventions such as laser resection, stent removal, stent insertion, or stent replacement prompted by bronchoscopic findings during EFFB or SFFB were also noted. Data were analyzed for individuals undergoing SFFB or EFFB using a χ² test with Yates’ correction. Statistical significance was determined at p < 0.05. Furthermore, predictive values for bronchoscopic findings were analyzed according to the presence or absence of new symptoms in both SFFB and EFFB groups.

Results

One hundred one studded silicone airway stents were inserted in 88 consecutive patients during a 3-year period (from 1996 to 1998). Forty-one patients had 41 tracheal or bronchial straight silicone stents because of obstruction caused by benign disease; mean (± SD) age was 56 ± 16.8 years. Stenoses resulted from tracheal intubation or tracheostomy in 16 patients, from lung transplantation in 11, from tracheal or bronchial malacia in 8, trachea compression by goiter in 2, and 1 each of Wegener’s granulomatosis, kyphoscoliosis, saber-sheath trachea, and aortic graft compression. Forty-seven patients underwent stent insertion for airway obstruction caused by malignant disease; mean age was 65 ± 11.2 years. In these patients, 52 straight tracheal or bronchial stents and 5 Y-shaped silicone stents were placed. Stenoses resulted from primary lung cancer in 36 patients, from esophageal cancer in 3, from malignant melanoma in 2, and 1 each for cancer of the cervix, larynx, thyroid, colon, carcinoid, and osteosarcoma.

Although all 88 patients were routinely scheduled for SFFB, 18 patients (20%) died within 2 months after stent insertion and never had a follow-up bronchoscopy. Seventeen of these patients had cancer, and 1 patient was a lung transplant recipient. The 70 surviving patients underwent SFFB (39 patients) or EFFB (31 patients).

Among the 31 patients undergoing EFFB, 19 had benign disease and 12 had malignant disease (Table 1). Benign and malignant cases were judged equally likely to undergo EFFB (p = not significant). All patients undergoing EFFB were symptomatic. Dyspnea was the most common symptom, regardless of the etiology of the stenosis. Stent-related complications were detected during EFFB in 84% of these patients (Table 2).

Among the 39 patients undergoing SFFB, 21 had benign disease and 18 had malignant disease (Table 1). Benign and malignant cases were judged equally likely to undergo SFFB. Thirty-one patients (79%) were asymptomatic, and 8 patients (21%) reported new respiratory symptoms at the time of SFFB. Stent-related complications were detected during SFFB in 41% of these patients (Table 2). Among the 31 asymptomatic patients undergoing SFFB, however, 71% had no stent-related complications and 29% had stent-related complications (Table 3).

Overall, of the 70 surviving patients with newly placed silicone stents, 39 patients (56%) reported having new onset of respiratory symptoms at the time of their bronchoscopy. The majority of patients with new symptoms prompting EFFB were found to have stent-related complications. Also, the majority
of patients reporting new respiratory symptoms at the time of SFFB were also noted to have stent-related complications (Table 4).

The predictive values of symptoms for the presence of stent-related complications were determined. Among the 39 symptomatic patients, 33 patients (85%) had stent-related complications (true-positive), and 6 patients (15%) had no stent-related complications (false-positive). Among the 31 patients without new respiratory symptoms, 22 patients (71%) had no stent-related complications (true-negative), and 9 patients (29%) had stent-related complications (false-negative). Overall, sensitivity was 0.79, specificity was 0.78, positive predictive value of symptoms for the presence of stent-related complications was 0.85, and negative predictive value was 0.71.

The outcomes of all 88 stented patients are noted in Figure 1. Four of the nine patients (44%) with stent-related complications noted during SFFB required therapeutic rigid bronchoscopy; stent removal was performed in two patients, and laser resection was performed in two patients. It is noteworthy that seven of eight patients with new symptoms undergoing SFFB (88%) had stent-related complications, and that five of these seven patients underwent therapeutic rigid intervention; stent replacement was performed in three patients, and stent removal was performed in two patients.

On the other hand, of 31 patients undergoing EFFB, 26 patients (84%) had stent-related complications. Seventeen of these patients (65%) required therapeutic rigid bronchoscopy. Stent replacement was performed in 10 patients, stent removal was performed in 4 patients, laser resection was performed in 2 patients, and additional stenting was necessary in 1 patient.

Overall, in this study of 88 patients undergoing bronchoscopic silicone stent insertion, a routine program of SFFB scheduled to be performed within 2 to 3 months after initial stent insertion detected stent-related complications in 9 asymptomatic patients (10% of total), only 4 of whom (5% of total, but 13% of all asymptomatic patients) required therapeutic interventions.

**Discussion**

Airway stent insertion has become an essential therapeutic modality for patients suffering from central airway obstruction. Routine surveillance bronchoscopy in stented patients provides a mechanism for early detection of stent-related complications, and an overall assessment of the stented airway. Surveillance bronchoscopy in newly stented patients, it has been argued, might avoid subsequent emergency department visits, hospitalization of patients without new symptoms undergoing EFFB or SFFB.

Table 1—Presence of New Symptoms in 70 Patients Undergoing EFFB or SFFB*

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>EFFB, All Cases, n = 31</th>
<th>EFFB, Benign, n = 19</th>
<th>EFFB, Malignant, n = 12</th>
<th>SFFB, All Cases, n = 39</th>
<th>SFFB, Benign, n = 21</th>
<th>SFFB, Malignant, n = 18</th>
<th>p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>31 (79)</td>
<td>14 (67)</td>
<td>17 (94)</td>
<td>0.081</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>20 (65)</td>
<td>13 (68)</td>
<td>7 (58)</td>
<td>5 (13)</td>
<td>4 (19)</td>
<td>1 (6)</td>
<td>0.44</td>
</tr>
<tr>
<td>Cough</td>
<td>6 (19)</td>
<td>3 (16)</td>
<td>3 (25)</td>
<td>3 (8)</td>
<td>3 (14)</td>
<td>0 (0)</td>
<td>0.29</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>4 (13)</td>
<td>2 (11)</td>
<td>2 (17)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>—</td>
</tr>
<tr>
<td>Excess secretions</td>
<td>1 (3)</td>
<td>1 (5)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>—</td>
</tr>
</tbody>
</table>

*Data are presented as No. (%).
†Statistical significance determined at p < 0.05.

Table 2—Relationship Between Stent-Related Complications and New Symptoms in 70 Patients Undergoing EFFB or SFFB*

<table>
<thead>
<tr>
<th>Variables</th>
<th>EFFB, n = 31</th>
<th>EFFB, p Value†</th>
<th>SFFB, n = 39</th>
<th>SFFB, p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom present</td>
<td>31 (100)</td>
<td>8 (21)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Stent-related complications</td>
<td>26 (84)</td>
<td>16 (41)</td>
<td>0.005</td>
<td></td>
</tr>
</tbody>
</table>

*Data are presented as No. (%).
†Statistical significance determined at p < 0.05.

Table 3—Stent-Related Complications Identified in Patients Without New Symptoms Undergoing EFFB or SFFB*

<table>
<thead>
<tr>
<th>Complications</th>
<th>EFFB, n = 0</th>
<th>EFFB, p Value†</th>
<th>SFFB, n = 31</th>
<th>SFFB, p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stent migration</td>
<td>0</td>
<td>1 (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess secretions</td>
<td>0</td>
<td>3 (10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obstruction†</td>
<td>0</td>
<td>5 (16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No stent-related complications</td>
<td>0</td>
<td>22 (71)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Data are presented as No. (%).
†Obstruction with granulation tissue or tumor growth.
with new respiratory symptoms, and decrease patient morbidity or mortality, particularly for individuals living in areas where interventional bronchoscopic procedures are not readily available.

To our knowledge, there are no published studies pertaining to the practice of EFFB or SFFB for patients with tracheobronchial stents. Results from several widely accepted studies, however, demonstrate that silicone stents are not only effective in maintaining airway patency, but are also relatively well tolerated.\textsuperscript{5,6} Stent-related complications, although relatively frequent, are rarely life threatening.\textsuperscript{7} If this is true, flexible bronchoscopy could be performed in patients with stents only when airway emergencies arise.

In our study of 88 patients with newly placed silicone stents, 20\% of the patients died 2 months after stent insertion and had no follow-up bronchoscopy. Each of these patients died from progression of their underlying disease (all but one had cancer).

Table 4—Stent-Related Complications Identified in Patients With New Symptoms Undergoing EFFB or SFFB\textsuperscript{*}

<table>
<thead>
<tr>
<th>Complications</th>
<th>EFFB, n = 31</th>
<th>SFFB, n = 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stent migration</td>
<td>9 (29)</td>
<td>2 (25)</td>
</tr>
<tr>
<td>Excess secretions</td>
<td>7 (23)</td>
<td>4 (50)</td>
</tr>
<tr>
<td>Obstruction\textsuperscript{†}</td>
<td>10 (32)</td>
<td>1 (12.5)</td>
</tr>
<tr>
<td>No stent-related complications</td>
<td>5 (16)</td>
<td>1 (12.5)</td>
</tr>
</tbody>
</table>

\*Data are presented as No. (%).
\†Obstruction with granulation tissue or tumor growth.

It is unlikely that death resulted from a stent-related complication in these individuals.

Almost half of our surviving patients (44\%) required an EFFB within the first 2 to 3 months after initial stent insertion. In the majority of these patients, stent-related complications were detected during EFFB, confirming that EFFB was, in fact, warranted. On the other hand, the majority of patients undergoing SFFB had no new respiratory symptoms. Most of these patients without new symptoms had no stent-related complications. Together, these results suggest that routine scheduling of bronchoscopy may not be warranted.

It is also noteworthy that most patients reporting new symptoms on the day of their outpatient consultation and SFFB were noted to have stent-related complications. Because this study demonstrates that the occurrence of new respiratory symptoms is almost always a sign of stent-related complications, we are prompted to suggest that flexible bronchoscopy should be immediately performed whenever new respiratory symptoms occur, and that SFFB in the absence of new respiratory symptoms is probably unnecessary.

In order to explain why certain patients without new respiratory symptoms had stent-related complications identified during SFFB, we further reviewed our medical records. All of these patients had malignant disease, and all had undergone tumor-specific therapy (radiation, chemotherapy, or chemoradiotherapy after stent insertion). Some of these patients went on to a therapeutic procedure. In general, it is

\[\text{Figure 1. Results of SFFB and EFFB in patients with and without new respiratory symptoms.}\]
our policy to routinely remove stents that become ill-fitting following the tumor reduction.

Witt and associates have previously published a rationale for temporary stenting in patients with malignant stenosis undergoing tumor-specific therapy. This widely accepted practice joins that of offering patients tumor-specific therapy after stenting, and to remove stents when they appear to be no longer necessary because of reduction in tumor size. Although SFFB is unlikely to reveal stent-related complications in patients reporting no new respiratory symptoms, we suggest that SFFB may be warranted to determine whether an airway stent is still required in patients with cancer undergoing tumor-specific therapy.

In conclusion, routine surveillance bronchoscopy within 2 to 3 months after silicone stent insertion did not detect a high incidence of stent-related complications among asymptomatic patients, except for cancer patients undergoing tumor-specific therapy after stent insertion. Most symptomatic patients, on the other hand, had stent-related complications and required therapeutic interventions. Because symptoms were present in most patients with stent-related complications, and most patients without symptoms did not have stent-related complications, a general policy of routine scheduling of surveillance bronchoscopy after silicone stent insertion is probably unwarranted.

ACKNOWLEDGMENT: The authors thank Stephen Crawford, MD; James Harrell, MD; Anne Powers, NP; and Thomas G. Shanks, MPH for their assistance.

REFERENCES

1 Dumon JF. A dedicated tracheobronchial stent. Chest 1990; 97:328–332