Treatment for Retention of Bronchial Secretion using Bronchofiberscopy after Pulmonary Resection for Primary Lung Cancer

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Abstract: We studied a series of patients with primary lung cancer who underwent bronchofiberscopy (BF) to treat bronchial secretion retention after pulmonary resection. Our primary aim was to determine clinical characteristics useful in predicting a favorable outcome. Between January 1991 and December 1998, 199 patients with primary lung cancer were surgically treated at Showa University Hospital. Twenty-four of these patients required postoperative BF therapy. Sixty-seven BF procedures, including bronchial suction and irrigation with saline solution, were performed. Among the 24 patients who underwent pneumonectomy, 4 received 14 BF treatments. Of the 161 patients who underwent lobectomy, 20 received 53 BF treatments. None of the 14 patients who underwent partial lung resection required BF. Three of the 4 patients who received BF treatment after pneumonectomy had acute respiratory distress syndrome (ARDS). The development of irregular bronchial branching after upper lobectomy was associated with retention of bronchial secretion. Patients with prolonged postoperative air leakage, or severe bronchial ischemia due to extended mediastinal and hilar node dissection, required repeated BF. Surgical technique improved with experience, and BF treatment for prolonged air leakage, the main reason for BF in the first 4 years of the study, did not occur during the following 4 years. However, in the latter part of this study, more patients developed severe bronchial ischemia due to extended lymph node dissection or poor preoperative respiratory function, and as a result required BF therapy. Overall, the number of BF procedures performed during the 8 years of the study remained stable. We conclude that patients who have poor preoperative respiratory function, severe bronchial ischemia, prolonged air leakage, or ARDS should undergo early BF treatment. Treatment should be performed when chest auscultation suggests retention of bronchial secretions, before the development of radiographic abnormalities, to avoid potentially fatal complications, such as obstructive pneumonia.

Key words: bronchial toileting, lung cancer, lymph node dissection, acute respiratory distress syndrome, bronchofiberscopy

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Introduction

Owing to recent advances in anesthesiology, lung resection can now be performed with relative safety in patients who are elderly or have poor respiratory function\(^1,2\). However, inability to cough after extubation remains an important problem for patients undergoing pulmonary resection for primary lung cancer. Expectoration force is decreased for a short period postoperatively\(^3,4\) resulting in some patients requiring bronchofiberscopy (BF) for bronchial secretion retention\(^3,4\). We reported previously that retention of bronchial secretion after lung resection was caused mainly by prolonged air leakage associated with hilar lymph node dissection\(^5\). To avoid this complication, we improved the surgical technique and successfully decreased the number of patients with prolonged air leaks. Despite this, the number of postoperative BF treatments performed during the study remained stable. We investigated the underlying cause and appropriate treatment for bronchial secretion retention over a period of 8 years, which we divided into two 4-year periods. We also evaluated the optimal timing for BF therapy, which to date has not been clearly defined.

Patients and Methods

A total of 199 patients with primary lung cancer were surgically treated at Showa University Hospital from January 1991 to December 1998. Twenty-four patients required postoperative BF therapy for retention of bronchial secretion. These patients underwent 67 BF procedures, including aspiration of bronchial secretion and saline solution irrigation, under local anesthesia in the intensive care unit (ICU).

BF examinations were performed immediately after surgery, but before extubation, in the operating theater to check the bronchial stump. In the ICU, periodic BF examinations were not performed.

Results

A total of 14 BF procedures were performed in 4 of the 24 patients who underwent pneumonectomy. Fifty-three BF procedures were performed in 20 of the 161 patients who underwent lobectomy. Of these patients 151 had single-lobe resections and 10 had double-lobe resections. None of the 14 patients who received partial lung resection required BF treatment (Table 1). Three of the 4 patients who underwent BF treatment after pneumonectomy had acute respiratory distress syndrome (ARDS) and were intubated and artificially ventilated. Two of these 3 patients underwent right pneumonectomy.

<table>
<thead>
<tr>
<th>Surgical method and postoperative bronchofiberscopic treatment.</th>
<th>No. of patients</th>
<th>No. of patients who underwent BF</th>
<th>No. of BF procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonectomy</td>
<td>24</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>161</td>
<td>20</td>
<td>53</td>
</tr>
<tr>
<td>Partial lung resection</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>199</td>
<td>24</td>
<td>67</td>
</tr>
</tbody>
</table>

BF: bronchofiberscopy
BF Therapy after Lung Resection

Table 2. Various preoperative and postoperative reasons for postoperative therapy using bronchofiberscopy after lung resection for primary lung cancer.

<table>
<thead>
<tr>
<th>Patient disease characteristics</th>
<th>1st 4 years</th>
<th>2nd 4 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolonged air leak</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Severe bronchial ischemia</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Bronchial fistula</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Poor respiratory function</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>ARDS</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Others (without the above findings)</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13/98 cases</strong></td>
<td><strong>11/101 cases</strong></td>
</tr>
</tbody>
</table>

ARDS : acute respiratory distress syndrome

BF treatment was required by 19 patients after single-lobe resection and in 1 patient after double-lobe resection. In upper lobectomy cases (n=13), BF treatment was performed in 7 of the 8 patients who had left single-lobe resection and in 6 of the 11 patients who had right single-lobe resection. In lower lobectomy cases (n=6), only 1 of the 8 patients who had a left lower lobectomy received BF therapy but 5 of the 11 patients who had a right lower lobectomy needed treatment. Three of these 5 patients had prolonged air leaks, 1 had obstruction of the right-middle-lobe bronchi due to retention of bronchial secretion, and 1 had a bronchial fistula.

Four patients with prolonged postoperative air leaks and 2 with severe bronchial ischemia, due to extended mediastinal and hilar lymph node dissection, needed repeated BF treatment (the mean value was 5.0 procedures per patient), and 1 required a mini-tracheostomy⁶. One patient with the bronchial fistula (right lower lobectomy) and another patient with poor preoperative respiratory function (right upper lobectomy), requiring mini-tracheostomy, underwent 5 and 2 BF procedures, respectively. Thirteen patients had sticky bronchial secretions that they could not clear; in this group only 1 or 2 BF treatments per patient (the mean value was 1.4 procedures per patient) were necessary. One patient who had a right upper lobectomy had severe bronchial ischemia and required BF treatment twice daily. All other patients required only one BF treatment per day.

Prolonged air leaks were the main reason (4/13 patients) for patients requiring BF treatment between 1991 and 1994; BF treatment was not required for prolonged air leaks between 1995 and 1998 (Table 2). During the latter 4 years of the study, patients with severe bronchial ischemia due to mediastinal and hilar lymph node dissection (2/11), bronchial fistula (1/11), or poor preoperative respiratory function (1/11), accounted for nearly half of all patients observed between 1995 and 1998. None of these conditions necessitated BF treatment during the first 4 years of the study (Table 2). Despite changes in the reasons for BF treatment, the number of BF procedures performed remained steady throughout the 8 years of the study.

Discussion

In Japan, primary lung cancer is usually treated by lobectomy or pneumonectomy with
mediastinal and hilar lymph node dissection. In patients with poor respiratory function, wedge or partial resection of the lung is performed to maintain pulmonary function. In this study, postoperative BF therapy was not required in patients who underwent partial resection of the lung. One patient with poor pulmonary function, who required postoperative BF therapy, had undergone a right upper lobectomy.

Because of anatomic differences, mediastinal lymph node dissection is performed extensively in right-sided cancers, but not in left-sided cancers, through a posterolateral incision. In the present study, all patients requiring BF therapy after right pneumonectomy had ARDS. This finding suggests that extended mediastinal lymph node dissection contributes to lung edema and ARDS. However, our results are preliminary and must be confirmed by multicenter studies.

After lobectomy, the dead space of the thorax is filled with the remaining lobes, the shifted mediastinum, and the elevated diaphragm. Any residual bronchi are passively deformed by expansion and movement of the remaining lobes. As secretion is usually retained after upper lobectomy, secretion retention is promoted by the subsequent development of bronchial branching deformities. Meanwhile, BF therapy is necessary after right lower lobectomy, primarily because of prolonged air leaks. Prolonged leaks occur after right lower lobectomy because 1) the right middle pulmonary artery and the ascending artery are exposed during surgery; and 2) hilar lymph node dissection is also performed

Patients with sticky secretions who had no air leaks, no bronchial ischemia, no bronchial fistula, no poor respiratory function, or no ARDS required only one or two BF treatments. In such patients, treatment was necessitated by a postoperative decrease in expectoration force.

Retention of bronchial secretion induces an intense local inflammatory reaction and causes the mucosa to become friable. A "half" suction method is required to avoid endobronchial bleeding during aspiration. Inattention to the risk of endobronchial bleeding can worsen the patient's condition.

As a result of improved surgical techniques, prolonged air leaks, the main reason for BF treatment during the first 4 years of our study, did not occur in the second 4 years. In the latter half of the study, BF therapy was used mainly to treat patients with poor respiratory function or severe bronchial ischemia due to extended lymph node dissection, resulting in surgery being performed when patients were in poor condition. The number of BF procedures performed remained constant throughout the 8 years of the study, despite changes in the reasons for treatment.

Expectoration force decreases postoperatively in many patients, but chest and physical therapy promotes prompt recovery. Our study showed that patients who have poor respiratory function, severe bronchial ischemia due to extended lymph node dissection, prolonged air leakage, or ARDS are likely to benefit from early BF treatment. Abnormal findings on chest auscultation are an indication that BF treatment is necessary and should be performed prior the development of abnormalities on chest radiographs. It is likely that early therapy prevents fatal complications, such as obstructive pneumonia.

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References


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