Endobronchial Closure of a Bronchopleural Fistula Using a Fibrin Glue-Coated Collagen Patch and Fibrin Glue

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Bronchopleural fistulas associated with empyema can occur as life-threatening sequelae after pulmonary resection, occurring most frequently after pneumonectomy. Three bronchopleural fistulas, 5–6 mm in diameter, were successfully treated using a fibrin glue-coated collagen patch (FGCCP) and fibrin glue (FG) at the site of a bronchopleural fistula. Through the clinical experiences, we introduce the methodology to perform the endobronchial closure of bronchopleural fistulas.

Data were collected by reviewing the clinical charts of patients diagnosed with post-lobectomy bronchopleural fistula at Sapporo Minami-Sanjo Hospital from June 2004 to December 2010. Bronchopleural fistula was diagnosed by means of endoscopic visualization. Three cases of post-lobectomy and one case of post-pneumonectomy bronchopleural fistula were collected.

A FGCCP fragment was packed within the fistula, and the fragment grasped with the forceps was kept in this position for approximately a minute, a time during which a FGCCP becomes adhesive, and the patch fragment was released. After releasing the patch fragment, the FG was applied directly on the FGCCP using a two-channel catheter. There have been few reports of the bronchoscopic closure of bronchopleural fistulas using a FGCCP and FG. Closure of small bronchopleural fistulas with the application of a FGCCP and FG may offer a valuable therapeutic alternative.

Keywords: bronchopleural fistula, fibrin glue-coated collagen patch, lobectomy, TachoComb

Introduction

One of the most feared complications in lung resection surgery is a bronchopleural fistula due to its high associated mortality. Its incidence has decreased considerably, reaching 4%–20% in pneumonectomies and <1% in lobectomies.1,2) The use of fibrin glue has been reported for closure of bronchopleural fistulas smaller than 3 mm,3) and there are a few reports of using a fibrin glue-coated collagen patch for closure of bronchopleural fistulas.4) This report describes the successful closure of bronchopleural fistulas with an orifice using a fibrin glue-coated...
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collagen patch (FGCCP) and fibrin glue (FG). This procedure could be recommended as a simple method of repairing postoperative bronchopleural fistula.

Materials and Methods

In all cases, the trachea was intubated with an endotracheal tube over a fiberoptic bronchoscope (Olympus; Tokyo, Japan) in order to secure the airway and facilitate the introduction and removal of the fiberoptic bronchoscope. A fibrin glue-coated collagen patch (FGCCP) (TachoComb H, Nycomed Pharma AS, Denmark) was easily cut into sections slightly larger than the size of the fistula opening. Placement of a FGCCP was achieved with the use of forceps. The end of a FGCCP was grasped with forceps positioned, and the fragment was then dragged through the endotracheal tube to the site of the bronchopleural fistula. Under direct visualization, a FGCCP fragment was packed within the fistula, and the fragment grasped with the forceps was kept in this position for approximately a minute, a time during which a FGCCP becomes adhesive, and the patch fragment was released. After releasing the patch fragment, the FG was applied directly on the FGCCP using a two-channel catheter. The outcome of the treatment was checked by a fiberoptic bronchoscope once every week.

Results

Clinical experiences

We report our experience with endoscopic treatment. Data were collected by reviewing the clinical charts of patients diagnosed with post lobectomy or post-pneumonectomy bronchopleural fistula at Sapporo Minami Sanjo Hospital from June 2004 to December 2010. Bronchopleural fistula was diagnosed by means of endoscopic visualization. Three bronchopleural fistulas were successfully treated using a FGCCP and FG (Table 1). The details of four of the cases are presented below.

Case 1

A 58-year-old man complained of bloody sputum, and a bronchopleural fistula was diagnosed 33 days after right middle and lower lobectomy for squamous cell carcinoma of the lung. The bronchoscopy demonstrated a fistula of 5 mm in diameter at the surgical stump. This patient was treated with FGCCP and FG twice at the site of the fistula. Bronchoscopic findings showed that the fistula was completely closed with scar formation 4 weeks after the patient underwent the treatment.

Case 2

A 61-year-old man complained of dyspnea on the 26th day after right pneumonectomy, with an intercostal muscle flap on the surgical stumps, for adenocarcinoma of the lung. The bronchoscopy demonstrated a fistula of 6 mm in diameter at the surgical stump. This patient was treated simultaneously with a FGCCP (Fig. 1B) and FG (Fig. 1C) once at the site of the fistula. The fistula disappeared after 3 weeks (Fig. 1D). The patient is alive without recurrences of the fistula and tumor for about 12 months. A series of endobronchial procedure of Case 2, supplementary material (Video 1) is available at ATCS online.

Case 3

A 67-year-old man complained of dyspnea on the 11th day after right lower lobectomy, without an intercostal muscle flap on the surgical stumps, for adenocarcinoma of the lung. The bronchoscopy demonstrated a fistula of 5 mm in diameter at the surgical stump (Fig. 2A). Chest tube was inserted and air leakage through the

Table 1  Patients’ characteristics and outcomes

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Surgical procedure</th>
<th>Onset*</th>
<th>Diameter of fistula (mm)</th>
<th>Intercostal muscle flap</th>
<th>Bronchoscopic Tx</th>
<th>Outcome*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>58 y</td>
<td>M</td>
<td>Right middle and lower lobectomy</td>
<td>POD33</td>
<td>5</td>
<td>Yes</td>
<td>twice</td>
<td>Cure</td>
</tr>
<tr>
<td>2</td>
<td>61 y</td>
<td>M</td>
<td>Right pneumonectomy</td>
<td>POD26</td>
<td>6</td>
<td>Yes</td>
<td>once</td>
<td>Cure</td>
</tr>
<tr>
<td>3</td>
<td>67 y</td>
<td>M</td>
<td>Right lower lobectomy</td>
<td>POD10</td>
<td>5</td>
<td>No</td>
<td>twice</td>
<td>Cure</td>
</tr>
<tr>
<td>4</td>
<td>56 y</td>
<td>M</td>
<td>Right lower lobectomy</td>
<td>POD11</td>
<td>20**</td>
<td>No</td>
<td>twice</td>
<td>Not cured (operation)</td>
</tr>
</tbody>
</table>

*: Time from surgery to onset; **: complete suture dehiscence; POD: postoperative day
intercostal drain in the thoracic cavity was found. This patient was treated with a FGCCP and FG once at the site of the fistula. Two weeks later, the fistula was reduced but did not disappear completely (Fig. 2B), so he was treated with a FGCCP and FG again. Two weeks after the second endobronchial treatment, the fistula disappeared completely (Fig. 2C).
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Case 4

A 56-year-old man complained of bloody sputum, and a bronchopleural fistula was diagnosed 11 days after right lower lobectomy for adenocarcinoma of the lung.

The bronchoscopy demonstrated a fistula of 20 mm in diameter at the surgical stump with some necrotizing changes (Fig. 3A). Chest tube was inserted and air leakage through the intercostal drain in the thoracic cavity was found. This patient was treated with a FGCCP and FG once at the site of the fistula. After finishing the procedure (Fig. 3B), there was no air leakage in the thoracic cavity.

On the next day, sudden continuous air leakage in the thoracic cavity was found again. Bronchoscopic findings showed that the FGCCP and FG was completely removed and showed a fistula with complete suture dehiscence at the surgical stump (Fig. 3C). He was treated with a FGCCP and FG again. After finishing the procedure, there was no air leakage in the thoracic cavity, but two hours later from the second endobronchial treatment, sudden continuous air leakage in the thoracic cavity was found again, so operation was needed.

Discussion

Use of a FGCCP was found to be effective in occluding the bronchopleural fistula. The FGCCPs were cut squarely, 7 × 6 mm in case 1 and 8 × 8 mm in case 2, and these were slightly larger than the size of the fistula opening. The patch fragment was packed at the fistular end, and it was sufficient to close the bronchopleural fistula. Three patients treated with FGCCPs and fibrin glue were cured without recurrence. However, in case 4 with complete suture dehiscence, the approach was not successful, and surgery was needed.

Through the clinical experiences, we propose the indication of this endobronchial procedure as follows: (1) The diameter of bronchopleural fistula is limited up to 6 mm without complete suture dehiscence. (2) To stabilize the FGCCP and FG in fixed position, the edge of bronchopleural fistula has no necrotic changes. (3) Before performing this endobronchial procedure, chest tube insertion was needed to evaluate presence and extent of air leakage.

After this procedure was performed, we checked the outcome of the treatment by a fiberoptic bronchoscope. Additional endobronchial approach using a FGCCP and FG is effective for the complete closure of the bronchopleural fistula when the bronchopleural fistula was reduced but not disappeared completely after first treatment (Case 3).

In Addition, the key to succeeding with endobronchial closure is preserving the condition of FGCCP. When opening the package, FGCCP is hard at first. Under the circumstance of respiratory tract secretion, the firmness of FGCCP was gradually changed, from hard to elastic gel. The change of the firmness of FGCCP makes it difficult for us to fit them into the appropriate places. We soak FGCCP in saline for one minute after cutting into the FGCCP sections. After soaking FGCCP in saline, the firmness of FGCCP changes to elastic gel in a minute.
This step makes it easy for us to fit a FGCCP into the target places.

The use of a FGCCP and fibrin glue have not been described for closure of a bronchopleural fistula (4). This procedure could be recommended as a simple closure method of repairing postoperative bronchopleural fistula more than 3 mm in diameter without complete suture dehiscence.

**Conclusion**

We proposed and experienced an efficient method for endobronchial closure of small bronchopleural fistulas with the application of a FGCCP and FG.

However this method could be applicable to only small fistulas, it could be recommended as a simple method of repairing postoperative bronchopleural fistula and may offer a valuable therapeutic alternative.

**Disclosure Statement**

Keidai Ishikawa and co-authors have no conflicts of interest to declare.

**References**