Application of preoperative embolization during surgery for the destroyed lung

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Background: The destroyed lung has been a challenge in the clinical practice of thoracic surgery, and severe adhesions and massive bleeding during surgery are the main obstacles faced by surgeons. This study aimed to investigate the efficacy of the preoperative embolization of blood vessels in adhesions during surgery for the destroyed lung.

Methods: A total of 7 patients underwent preoperative embolization for lung resection of destroyed lungs between June 2016 and February 2019. Preoperative embolization was performed for 45 min to 2 h within 48 h before surgery. The embolized arteries included the intercostal artery, radial artery, subclavian artery and their branches, and the number of embolized arteries ranged from 5 to 13.

Results: A posterolateral incision was made in these patients, and endoscope-assisted separation of the adhesions at the top of the chest wall and on the lateral chest wall was performed. The operation time ranged from 3.5 to 8 h, and the blood loss was 1,200–5,000 mL. The postoperative drainage was in the normal range. One patient developed multiple organ failure and bronchopleural fistulas (BPF) one month after surgery, which was resolved after active drainage and argon cauterization; another patient developed BPF 7 months after surgery, which was resolved after placement of a nonreturn valve in the subsegmental bronchi via bronchoscopy.

Conclusions: Surgery of the destroyed lung is a great challenge in clinical practice, mainly due to the risk of the blood supply in the adhesions. Preoperative embolization may reduce intraoperative blood loss and surgical difficulty.

Keywords: Destroyed lung; surgery; embolization

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Introduction

The destroyed lung often occurs as a result of long-lasting lung infection, especially pulmonary tuberculosis. Patients with destroyed lungs who develop aspergilloma usually present with hemoptysis, and interventional embolization of the bronchial artery is a temporary treatment for the control of bleeding under this condition (1,2). However, surgical intervention is the ultimate treatment for the destroyed lung (3-6). Notably, pneumonectomy of the destroyed lung has been a challenge in clinical practice, mainly due to the presence of intraoperative adhesions, bleeding as a result of adhesion separation, the incarceration and calcification of lymph nodes in the hilar and portal areas and changes in the anatomical location of the lung due to a mediastinal...
shift. In addition, there is a high incidence of postoperative complications after surgery in these patients (7). Thus, the control of intraoperative risks is of great importance for the reduction of postoperative complications and favorable prognosis (8,9). Thus, intraoperative adhesions and bleeding have been obstacles during pneumonectomy of the destroyed lung (7,9,10). The present study aimed to investigate the role of preoperative embolization during pneumonectomy of the destroyed lung.

Methods
A total of 7 patients underwent lung resection for destroyed lungs between June 2016 and February 2019. They were all males, and the mean age was 50.8±7.1 years (range, 32–71 years). Five patients underwent prior interventional embolization for repeated massive hemoptysis, of whom 1 developed Aspergillus recurrence after right upper lobectomy. All these patients had no hemoptysis within 3 months before surgery. After admission, cardiac and lung functions were assessed, and bronchoscopy was performed. As shown in Table 1, all the patients underwent preoperative embolization within 48 h before surgery. Embolization involved the whole affected lung. Preoperative embolization was not confined to the bronchial arteries in the lesion, and the intercostal artery and the collateral arteries in the systemic circulation in the lesion were also embolized if necessary. The materials used for embolization included coils and gelatin sponges. The embolization time ranged from 45 min to 2 h, and the number of arteries embolized ranged from 5 to 13. The embolized arteries included the bronchial arteries, intercostal artery, internal thoracic artery, lateral thoracic artery, infraorbital artery, esophageal artery, and subscapular artery.

Results
There were no complications after interventional therapy, and all the patients underwent endoscopy-assisted separation of the adhesions at the top of the chest well and on the lateral chest wall within 48 h after embolization. The operation time ranged from 3.5 to 8 h (mean: 5.8±1.8 h), dense adhesions were noted in all the patients, and blood loss ranged from 1,200 to 5,000 mL (mean: 2,600±1,700 mL). The thoracic tube indwelling time was 5–28 days (mean: 13±9 days). The intercostal muscle or anterior serratus muscle was separated during the thoracotomy as the muscle flap to cover the bronchial stump at the end of surgery. Patients with Aspergillus infection received anti-fungal therapy for 2–3 months. One patient (case 3) developed multiple organ failure and then bronchopleural fistulas (BPF) 1 month after surgery, which was resolved after drainage and bronchoscope-assisted argon cauterization; another 2 patients (case 5 and case 7) developed prolonged air leakage, which was resolved after drainage, but both had a residual cavity at the top of the thoracic cavity. Case 5 also developed BPF 7 months after surgery, and drainage was then employed. CT and bronchoscopy showed the fistula at the dorsal subsegmental bronchus of the lower lung, which was nonresponsive to repeated cauterization. Finally, the patient recovered after the endobronchial valve (Zephyr 4.0, PulmonX) was placed in the subsegment with the aid of a bronchoscope. Follow-up showed no sign of thoracic infection. The remaining 5 patients had no major complications and were discharged. Follow-up revealed that the quality of life was good in these patients.

Discussion
Interventional embolization is an effective, temporary treatment for massive hemoptysis as a result of the destroyed lung, but recurrence is common (2,5). For patients with infection-related destroyed lungs, especially those with concomitant massive hemoptysis, pneumonectomy is the ultimate treatment (1,3–8). However, pneumonectomy of the destroyed lung is a great challenge in clinical practice and has a high incidence of postoperative complications. However, postoperative complications are closely related to the prognosis of these patients (7,8), and blood loss has been found to be an independent risk factor for postoperative complications (7). Preoperative embolization was first introduced in patients receiving surgery for mediastinal tumors, aiming to reduce intraoperative blood loss, which has been confirmed in some studies (11–13). Thus, this study was undertaken to investigate the role of preoperative embolization during surgery for the destroyed lung. In the present study, embolization was performed within 48 h before surgery, patients had no symptoms of hemoptysis upon embolization, and the extent of embolization was enlarged, which was different from previous reports (9). Careful embolization of the arteries in the systemic circulation was performed at the thoracic index, aiming to avoid interference with the blood supply to the spinal cord. Moreover, careful separation of adhesions at the thoracic index, even after embolization, was also performed. When
Table 1 General characteristics of the patients

<table>
<thead>
<tr>
<th>No</th>
<th>Age, year</th>
<th>Diagnosis</th>
<th>Affected lung</th>
<th>Extent of the destroyed lung</th>
<th>History of hemoptysis</th>
<th>Prior interventional therapy</th>
<th>FEV1/%</th>
<th>Complications</th>
<th>Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32</td>
<td>MDRTB</td>
<td>Left</td>
<td>Whole lung</td>
<td>No</td>
<td>No</td>
<td>2.83/52%</td>
<td>No</td>
<td>Total pneumonectomy</td>
</tr>
<tr>
<td>2</td>
<td>71</td>
<td>Bronchiectasis with infection</td>
<td>Right</td>
<td>Whole lung</td>
<td>No</td>
<td>No</td>
<td>0.82/45%</td>
<td>No</td>
<td>Total pneumonectomy</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
<td>Tuberculosis with aspergilloma</td>
<td>Right</td>
<td>Whole lung</td>
<td>Yes</td>
<td>Yes</td>
<td>1.98/74%</td>
<td>No</td>
<td>Total pneumonectomy</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>Aspergilloma</td>
<td>Right</td>
<td>Lower lobe</td>
<td>Yes</td>
<td>Yes</td>
<td>1.55/67%</td>
<td>Prior resection of the right upper lobe</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>41</td>
<td>Tuberculosis with aspergilloma</td>
<td>Right</td>
<td>Upper and middle lobes and a dorsal segment of lower lobes</td>
<td>Yes</td>
<td>Yes</td>
<td>1.47/38%</td>
<td>Ankylosing spondylitis</td>
<td>Resection of the upper and middle lobes and a dorsal segment of lower lobes</td>
</tr>
<tr>
<td>6</td>
<td>53</td>
<td>Vascular malformation with infection</td>
<td>Left</td>
<td>Whole lung</td>
<td>Yes</td>
<td>Yes</td>
<td>–</td>
<td>No</td>
<td>Total pneumonectomy</td>
</tr>
<tr>
<td>7</td>
<td>41</td>
<td>Tuberculosis with aspergilloma</td>
<td>Left</td>
<td>An upper and dorsal segment of lower leaves</td>
<td>Yes</td>
<td>Yes</td>
<td>1.82/75%</td>
<td>No</td>
<td>Upper lobe and a dorsal segment of the lower lobe</td>
</tr>
</tbody>
</table>

MDRTB, multi-drug-resistant tuberculosis; FEV1, forced expiratory volume in 1 second.

Conclusions

Surgery of the destroyed lung has been a great challenge in clinical practice, mainly due to the presence of adhesions rich in blood supply and the high incidence of postoperative complications related to intraoperative blood loss. Based on our findings, preoperative embolization can reduce intraoperative blood loss and decrease surgical difficulty. Although evidence close to the thoracic index, the lung tissue was carefully removed, avoiding contamination of the surrounding tissues, and small opening, the aspergilloma was carefully removed, avoiding contamination of the surrounding tissues, and small adhesions were cut open. The blood loss was carefully monitored, and after the operation, the patients were not monitored due to the presence of adhesions rich in blood supply.

In conclusion, preoperative embolization reduces intraoperative blood loss and decreases surgical difficulty. However, further studies are needed to confirm the effectiveness and safety of preoperative embolization in destroying lung surgery.

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from prospective, randomized, controlled studies is lacking, embolization before surgery for destroyed lungs is a strategy worth attempting in order to reduce intraoperative blood loss.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/apm.2020.04.02). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Ethics Committee of our hospital (K20-001). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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