

Original  
Article

# Plombage for Hemoptysis Control in Pulmonary Aspergilloma: Safety and Effectiveness of Forgettable Surgery in High-Risk Patients

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**Objectives:** To evaluate plombage surgery for hemoptysis control in pulmonary aspergilloma in high-risk patients.

**Methods:** This study was carried out on 75 pulmonary aspergilloma patients presenting with hemoptysis that underwent a plombage surgery for approximately 7 years (November 2011–September 2018) at Pham Ngoc Thach Hospital. They revisited the hospital 6 months after plombage surgery and considered plombage removal. The group whose plombage was removed was compared with that whose plombage was retained 6 and 24 months after surgery.

**Results:** Hemoptysis reduced significantly after surgery. Hemoptysis ceased in 91.67% of the patients and diminished in 8.33% of the patients 6 months after surgery. Similarly, hemoptysis ceased in 87.32% of the patients and diminished in 12.68% of the patients 24 months after surgery. Body mass index (BMI) index, Karnofsky score, and forced expiratory volume in one second (FEV1) increased. Plombage surgery was performed with operative time of  $129.5 \pm 36.6$  min, blood loss during operation of  $250.7 \pm 163.1$  mL, and the number of table tennis balls of  $4.22 \pm 2.02$ . No deaths related to plombage surgery were recorded. Plombage was removed in 29 cases because of patients' requirements (89.8%), infection (6.8%), and pain (3.4%). There were no patient developing complications after the treatment and there were no statistically significant differences between the two groups.

**Conclusions:** Plombage surgery is safe and effective for hemoptysis control in pulmonary aspergilloma. To minimize the risk of long-term complications, surgeons should remove the plombage 6 months after the initial operation.

**Keywords:** plombage surgery, hemoptysis control, pulmonary aspergilloma

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## Introduction

The development of this disease injures lung compositions and may threaten the life of patients with hemoptysis.<sup>1-4)</sup> Immediate treatment is critical for these cases, and the types of treatment depend on a patient's condition.<sup>5)</sup> While surgical treatment with pulmonary resection is considered as the first-line method<sup>6)</sup> with low morbidity and mortality, used in dealing with recurrent hemoptysis in low-risk patients,<sup>7-9)</sup> that method should not be a recommendation for high-risk patients due to its considerable morbidity.<sup>10)</sup> As such, alternative therapies, such as anti-fungal medication, bronchial artery intervention, and cavernostomy, have been introduced.<sup>11)</sup> Cavernostomy is an effective<sup>6,7,12-14)</sup> and simple<sup>13,15,16)</sup> treatment for high-risk patients. Among many types of cavernostomy, plombage surgery is considered for hemoptysis control in pulmonary aspergilloma. From the 1930s to 1950s, plombage, known as extraperiosteal or extrapleural pneumolysis, was used as a popular surgical treatment for cavitory tuberculosis. The method was based on a principle that a diseased lobe of the lungs would heal faster when it was physically deflated. However, this procedure is no longer performed because of the introduction of anti-tuberculosis drug therapy.<sup>17)</sup> Our study showed the details of patients who underwent plombage surgery for hemoptysis control in pulmonary aspergilloma.

## Materials and Methods

The objects of our study were 75 patients who were diagnosed with hemoptysis resulting from pulmonary aspergilloma and went through plombage surgery from November 2011 to September 2018 at Pham Ngoc Thach Hospital, Ho Chi Minh City, Vietnam.

Our inclusion criteria were the following: over 18-year-old patients suffering from pulmonary aspergilloma and developing massive or recurrent hemoptysis; patients who were diagnosed with pulmonary aspergilloma based on typical clinical symptoms, conventional X-ray or computed tomography images, some tests (bronchoscopy, biochemistry, and microbiology), and pathological confirmation after surgery; and patients joining the study voluntarily, including the surgery and the surgery and the follow-up in line with the protocol approved by our ethics committee.

Our exclusion criteria were patients disagreeing to join in the study and underwent any other procedure or surgery concurrent with our surgery. We also analyze

hemoptysis, clinical findings and surgical features, and postoperative complications.

### *Plombage surgery (Operative technique of plombage)*

Plombage surgery (**Fig. 1**) was considered to perform on patients who present at least one of these: massive or recurrent hemoptysis that can threaten patient's life, poor general condition (body mass index [BMI] index <18.5, Karnofsky score <70), and compromised pulmonary function (forced expiratory volume in one second [FEV1] <50% or <1.5 L).

Under general anesthesia, patients were placed in a lateral decubitus position with one-lung ventilation. To separate the edges of the surgical incision and access to the cavitory injuries, metal chest retractors were required. After removing the fungus ball, a cavity left under the ribs and that space might be filled with inert materials such as Lucite (acrylic) balls, ping-pong balls, mineral oil (oleothorax), air, fat, paraffin wax, and rubber sheath.<sup>17)</sup> In our study, table tennis balls (ping-pong balls) were used. Other necessary techniques were conducted because of the lesions. One catheter (24–32 F) was placed into the cavity to control bleeding if necessary.

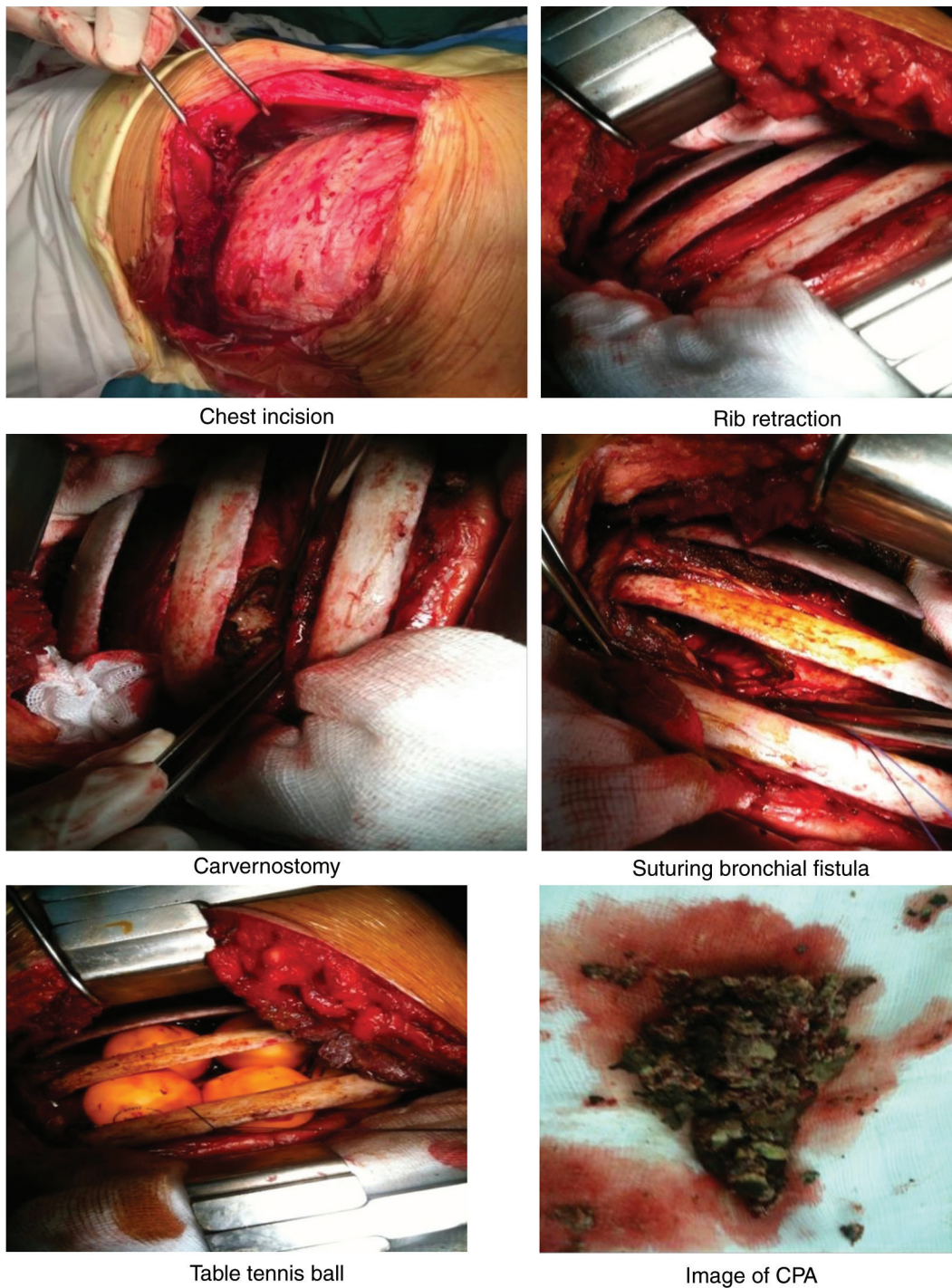
A sterilized table tennis ball (ping-pong ball) was used in this study. It is made of a celluloid or plastic material that does not react with the human body. Orange and white are two colors of choice for balls and they are 40 mm in diameter and weigh 2.7 g.<sup>18)</sup> Plombage should be removed 6 months after the initial surgery to ensure structural stability. The indication of this surgery included complications related to the material used, patients' requirements, or preventions of late complications. Its operative technique was quite simple with the same incision line, but the length was shorter (about 5–10 cm). After the table tennis ball was removed one by one through the thoracic incision, it was sutured, and drainage was required if needed.

### Statistical analysis

Data were statistically analyzed with SPSS version 21. Performing the descriptive analyses as mean and standard deviation and using a Student's t-test at a significance level set at 95% to compare patients' characteristics between the two groups.

## Results

In all, 75 patients underwent plombage surgery at Pham Ngoc Thach Hospital, Ho Chi Minh City, Vietnam, from November 2011 to September 2018. Their



**Fig. 1** Operative technique of plumbage. CPA: chronic pulmonary aspergillosis

characteristics are shown in **Table 1**. The mean age was  $52.59 \pm 10.72$  years, and tuberculosis was the most common lung disease accounting for 88% of the cases.

The characteristics of hemoptysis before surgery are presented in **Table 1**. Two-thirds of the patients had moderate to severe hemoptysis, and 49.4% of the patients had more than or equal to four times of hemoptysis every 24 h.

The follow-up process was divided into three episodes: before the operation, 6 months after the operation, and 24 months after the operation. The results showed that hemoptysis reduced significantly after surgery. Hemoptysis ceased in 91.67% of the patients and diminished in 8.33% of the patients 6 months after surgery. Hemoptysis ceased in 87.32% of the patients and

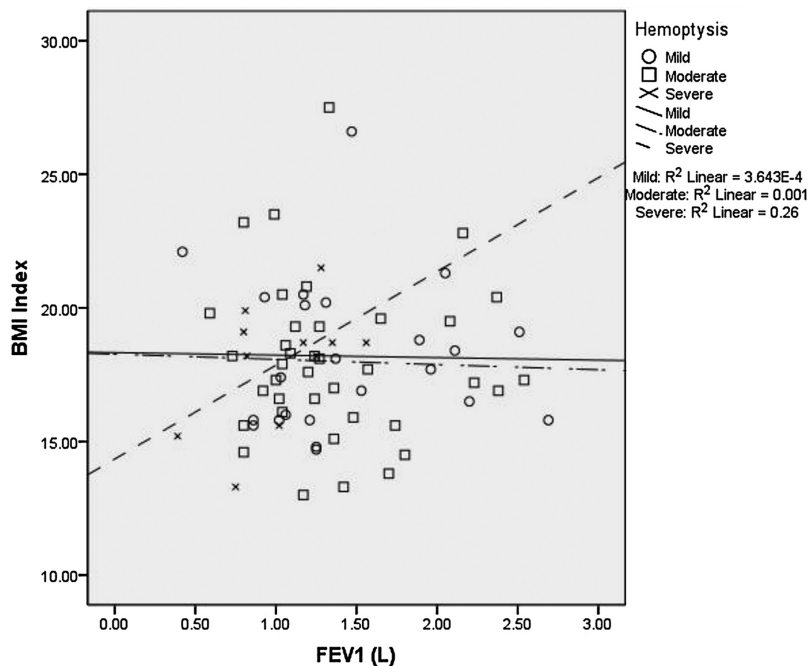
**Table 1 Characteristics of demographics, hemoptysis before surgery, and surgical technique**

|   |   |                       |                   |               |
|---|---|-----------------------|-------------------|---------------|
| <b>Baseline characteristics</b>           | Age   | Median                | 52.59 ± 10.72     |               |
|   |   | Range                 | 26–79             |               |
|   | Sex, n (%)  | Male                  | 56/75 (74.7%)     |               |
|   |   | Female                | 19/75 (25.3%)     |               |
|   | Underline lung disease, n (%)                       | Tuberculosis          | 66 (88%)          |               |
|   |   | Emphysema             | 3 (4%)            |               |
|   |   | Lung abscess          | 2 (2.7%)          |               |
|   |   | Carcinoma             | 0                 |               |
|   |   | Bronchial cyst        | 0                 |               |
|   |   | None                  | 4 (5.4%)          |               |
|   | Type of aspergilloma, n (%)                         | Simple                | 0                 |               |
|   |   | Complex               | 75 (100%)         |               |
|   | Pathology (post-operation)                          | Aspergillus Fumigatus | 74 (98.7%)        |               |
|   |   | Others (aspergillus)  | 1 (1.3%)          |               |
| Only aspergilloma                         |   | 74 (98.7%)            |                   |               |
| Others (carcinoma)                        |   | 1 (1.3%)              |                   |               |
| Occupation                                | Retired   | 18 (24%)              |                   |               |
|   | Freelancer  | 53 (70.7%)            |                   |               |
|   | Office worker                                       | 1 (1.3%)              |                   |               |
|   | Market trader                                       | 3 (4%)                |                   |               |
|   | <b>Characteristics of hemoptysis before surgery</b> | Level of hemoptysis   | Mild              | 24 (32%)      |
|   |   |                       | Moderate          | 39 (52%)      |
| Severe                                    |   |                       | 12 (16%)          |               |
| Number of hemoptysis in 24 hours          |   | 1                     | 17 (22.6%)        |               |
|   |   | 2                     | 17 (22.6%)        |               |
|   |   | 3                     | 4 (5.4%)          |               |
|   | 4   | 37 (49.4%)            |                   |               |
| Blood loss in 24 hours                    | <30 ml  | 23 (30.6%)            |                   |               |
|   | 30–200 ml   | 37 (49.4%)            |                   |               |
|   | >200 ml   | 15 (20%)              |                   |               |
| Companion symptoms                        | Cough and sputum                                    | 51 (68%)              |                   |               |
|   | Chest pain  | 37 (49.4%)            |                   |               |
|   | Dyspnea   | 26 (34.6%)            |                   |               |
|   | Fever   | 9 (12%)               |                   |               |
| <b>Surgical Characteristics (n = 75)</b>  | Operative time (min)                                |                       | 129.5 ± 36.6      |               |
|   | Rib retraction                                      |                       | 3.41 ± 0.77 (2-6) |               |
|   | <b>Number of table tennis ball</b>                  |                       | 4.22 ± 2.02       |               |
|   | <b>Blood loss during operation</b>                  | Mean ± SD             |                   | 250.7 ± 163.1 |
|   |   | <200 ml               |                   | 27 (36%)      |
|   |   | 200–300 ml            |                   | 33 (44%)      |
|   |   | 300–500 ml            |                   | 12 (16%)      |
|   |   | >500 ml               |                   | 3 (4%)        |
|   | <b>Blood loss during operation</b>                  | Yes                   |                   | 20 (26.6%)    |
|   |   | No                    |                   | 55 (73.4%)    |
|   | ICU length-stay time                                |                       | 2.56 ± 0.95       |               |
|   | Drainage  | Yes                   |                   | 54 (72%)      |
|   |   | No                    |                   | 21 (28%)      |
|   | <b>Intra-operative complication</b>                 | Pleural tear          |                   | 1 (1.3%)      |
| Pneumothorax                              |   |                       | 1 (1.3%)          |               |
| Massive bleeding (≥1000 ml)               |   |                       | 1 (1.3%)          |               |
| <b>Early post-operation complications</b> | Atelectasis   |                       | 2 (2.6%)          |               |
|   | Pneumothorax  |                       | 1 (1.3%)          |               |
| Late post-operative complication          | Infection   |                       | 1 (1.4%)          |               |

**Table 2** Main variable compared between before surgery, 6 months, and 24 months after surgery

| Variables             |                 | Before surgery<br>(n = 75) | 6 months after surgery<br>(n = 72) | 24 months after surgery<br>(n = 71) |
|-----------------------|-----------------|----------------------------|------------------------------------|-------------------------------------|
| Hemoptysis            | Remained        | 75 (100%)                  | 0 (0%)                             | 0 (0%)                              |
|                       | Not occurred    | 0 (0%)                     | 66 (91.67%)                        | 62 (87.32%)                         |
|                       | Remained partly | 0 (0%)                     | 6 (8.33 %)                         | 9 (12.68 %)                         |
| Cavitary lesion in CT | Remained        | 75                         | 0                                  |                                     |
|                       | Remained partly | 0                          | 5                                  |                                     |
|                       | Not visible     | 0                          | 67                                 |                                     |
| BMI index             |                 | 18.09 ± 2.77               | 19.05 ± 3.02                       | 19.5 ± 2.90                         |
| Karnofsky score       |                 | 69.1 ± 9.0                 | 83.2 ± 6.6                         | 87.7 ± 5.2                          |
| FEV1 (L)              |                 | 1.33 ± 0.51                | 1.34 ± 0.51                        | 1.35 ± 0.48                         |

BMI: body mass index; FEV1: forced expiratory volume in one second



**Fig. 2** Indication for plombage surgery.

diminished in 12.68% of the patients 24 months after surgery. In line with hemoptysis conditions, BMI index, Karnofsky score, and FEV1 increased. Karnofsky score showed statistical significance. The detailed information is shown in **Table 2**.

**Figure 2** shows the indication for surgery. Approximately 50% of the patients met all the three criteria.

Surgical characteristics with perioperative and postoperative indices were recorded (**Table 1**). The patients revisited the hospital 6 months after discharge and considered plombage removal. There was no one dying of plombage surgery, but four deaths recorded were the results of myocardial infarction, stroke, and complications of diabetes mellitus.

Plombage was removed in 29 cases because of patients' requirements (89.8%), infection (6.8%), and pain (3.4%).

The average operative time was 121.5 ± 29.0 min. Blood loss during surgery was 219.1 ± 95.4, but no cases required transfusion. No complications were recorded. With the same format as **Table 2**, **Table 3** compares the two groups at two time points. No significant differences were observed. **Figure 3** showed CT image before surgery, before plombage removal, and after plombage removal.

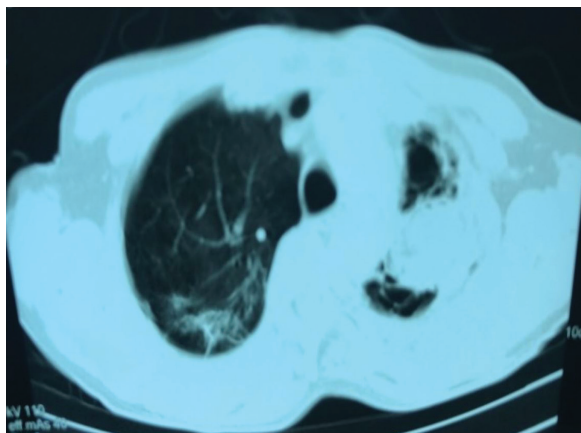
### Discussion

Plombage surgery has two key points: (1) the cavity that formed after cavernostomy and (2) the use of table tennis balls to fill the space and to maintain the collapse. Cavernostomy procedures have been performed to remove pulmonary aspergilloma. Single-stage cavernostomy and

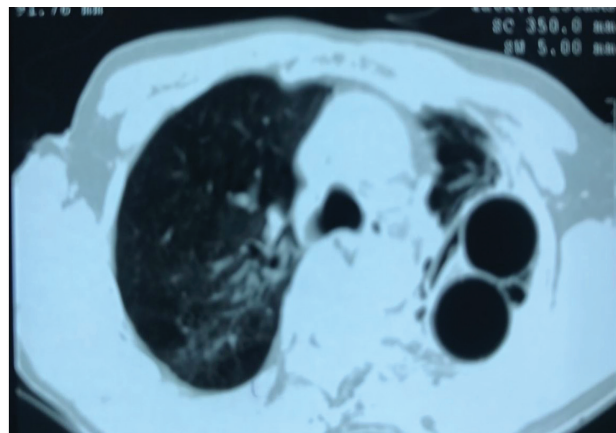
**Table 3** BMI index, Karnofsky Score, and FEV1 (L) between two groups

| Variables                |           | Removal of plombage<br>(n = 29) | Non-removal of<br>plombage (n = 43) | p Value |
|--------------------------|-----------|---------------------------------|-------------------------------------|---------|
| Hemoptysis               | 6 months  | 4                               | 5                                   |         |
|                          | 24 months | 2                               | 5                                   |         |
| Cavitary lesion<br>in CT | 6 months  | 1                               | 5                                   |         |
|                          | 24 months | 2                               | 4                                   |         |
| BMI index                | 6 months  | 18.63 ± 2.68                    | 19.35 ± 3.25                        | 0.326   |
|                          | 24 months | 19.55 ± 2.76                    | 19.47 ± 2.67                        | 0.901   |
|                          | p Value   | 0.195                           | 0.852                               |         |
| Karnofsky score          | 6 months  | 88.58 ± 10.04                   | 90.59 ± 3.69                        | 0.233   |
|                          | 24 months | 81.96 ± 7.97                    | 84.12 ± 5.41                        | 0.174   |
|                          | p Value   | 0.0074                          | <0.001                              |         |
| FEV1 (L)                 | 6 months  | 1.19 ± 0.47                     | 1.43 ± 0.52                         | 0.05    |
|                          | 24 months | 1.25 ± 0.40                     | 1.42 ± 0.51                         | 0.136   |
|                          | p Value   | 0.602                           | 0.928                               |         |

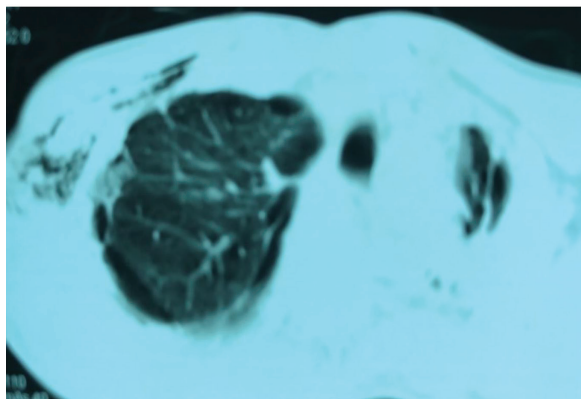
BMI: body mass index; FEV1: forced expiratory volume in one second



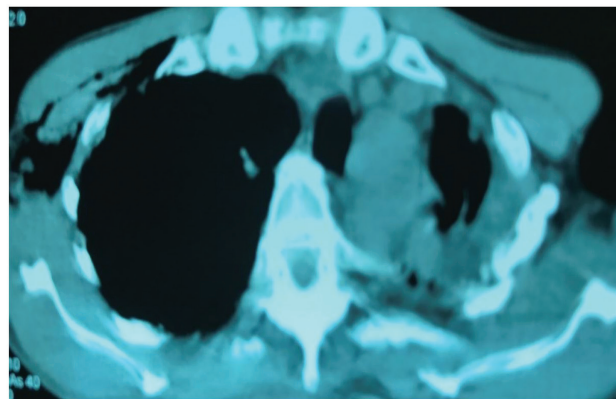
**CT image before surgery**



**CT image before plombage removal  
(6 months after surgery)**



**CT image after plombage removal  
(24 months after surgery)**



**CT image after plombage removal  
(24 months after surgery)**

**Fig. 3** Computed tomography images before surgery, before plombage removal, and after plombage removal.

a muscle transposition flap<sup>16,19</sup>) and cavernostomy with limited thoracoplasty.<sup>16</sup>) However, this is only one side of hemoptysis control in pulmonary aspergilloma. The other side that makes the difference in plombage surgery is filling a space with an inert material (table tennis ball in our study). As a principle of plombage surgery, it will take a shorter period for the diseased lobe of the lung to heal if it is deflated. Plombage also helps control hemoptysis and prevents recurrence. As such, plombage surgery showed preeminent points compared to other methods in terms of controlling hemoptysis in high-risk patients with pulmonary aspergilloma. Medical treatment using intrabronchial voriconazole installation in 82 patients (30.5%) and 52 patients (68.3%) has a significant resolution of hemoptysis after the first and second sessions, respectively.<sup>20</sup>) Another approach involving the percutaneous intracavitary instillation of amphotericin B causes hemoptysis to cease in 85% of the patients, but major concerns related to this approach are complications (pneumothorax in 26% of the patients), recurrence of serious hemoptysis (six of 18 episodes), and unknown long-term benefit.<sup>21</sup>) If medical treatments are ineffective, then an intervention treatment should be applied as an alternative, but their success rates vary.<sup>22</sup>) Some chemicals and materials, namely polyvinyl alcohol, spring coil, and N-butyl cyanoacrylate glue showed their effectiveness in treatment for hemoptysis embolism and pulmonary artery embolism<sup>23</sup>) but bronchial arterial embolization involving a gelatin sponge may be ineffective.<sup>24</sup>) Hemostatic radiotherapy has also been introduced as a potential treatment option, but it has been used selectively.<sup>25</sup>) In our study, hemoptysis from pulmonary aspergilloma stopped. Furthermore, no recurrence was recorded after 12 months. According to our viewpoints, the key elements to ensure the low recurrence rate was the manipulation of the bronchial fistula and the cavity's condition. The bronchial fistula must be closed that was checked by anesthesia through to expand the lung and no gas leakage if it closed, and the lesions must not be left in the cavity.

Our results showed that plombage surgery was safe for hemoptysis control in pulmonary aspergilloma. There were no deaths relating to surgery, and a low risk of complications was recorded. Plombage surgery remains the appropriate therapy for high-risk patients defined in the inclusion criteria. Pulmonary function is one of the most important factors that determine the types of treatment. According to Lee et al., in patients with aspergilloma and hemoptysis, surgical resection should be preferred if FEV1 of patients is greater than 70% of the predicted value. An alternative remedy is required if FEV1 of patients is under

60% of the predicted value.<sup>26</sup>) FEV1 is also considered the main criterion for the indication of cavernostomy for pulmonary aspergilloma.<sup>14,27,28</sup>) In our study, it was one of the three criteria for plombage surgery and almost occurred. As such, therefore cavernostomy is taken account of to perform when lung resection is not realistic.<sup>14,27</sup>) It is an effective option for high-risk patients.<sup>5,11</sup>)

If there was no complication or signs of late complication, the indication for surgery will depend on patients' requirements. Plombage still has not been removed in 43 cases after 6 months because the patient did not want to perform surgery at this time. The reason behind this may be that after surgery all symptoms were ceased. Besides that, all patients were poor conditions and they want more time to recover before performing the next surgery. In our study, patients who did not receive plombage removal surgery were follow-up every 6 months. Each visit, the patient was required to take the examination, X-ray, CT image, and pulmonary function. They were asked for taking surgery or required surgery if any potential signs of complications were noted. Early complications of plombage surgery in our study were three cases accounting for 4.0%: two cases of atelectasis caused by sputum occlusion and successfully treated with bronchoscopic evacuation and one case of pneumothorax that returned to normal after 2 days of drainage with negative pressure. Late complications may occur when table tennis balls are retained. In our study, the patients were recommended to revisit the hospital 6 months after plombage surgery for plombage removal. This period was appropriate because the remaining space was filled spontaneously, and the underlying cavities did not expand again after an average of 3–5 months. Foreign bodies should be removed as soon as plombage becomes superfluous to maintain the collapse.<sup>29</sup>) After a long time, late complications, such as infection or migration of foreign materials, spontaneous hemoptysis, and extrusion of plombage may occur. When major complications occur, plombage removal results in higher operative blood loss ( $1.970 \pm 3.199$  mL), longer postoperative length stay ( $23 \pm 13$  days), or even death,<sup>30</sup>) compared with those observed in our study. Hence, plombage should only be kept inside for 6 months and then remove it to avoid a high risk of potential complications.

## Conclusion

Plombage surgery is safe and effective for hemoptysis control in patients with pulmonary aspergilloma. To minimize the risk of long-term complications, surgeons should remove the plombage 6 months after the initial operation.

## Disclosure Statement

The authors declare that they have no conflict of interest.

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