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Surgical treatment for pulmonary aspergilloma: a 35-year experience in the Chinese population

Qian-Kun Chen, Ge-Ning Jiang* and Jia-An Ding

Department of Thoracic Surgery, Shanghai Pulmonary Hospital, Tongji University School of Medicine, Shanghai, People's Republic of China

* Corresponding author. Department of Thoracic Surgery, Shanghai Pulmonary Hospital, Tongji University School of Medicine, 507 ZhengMin Road, Yangpu District, Shanghai 200433, People's Republic of China. Tel: +86-21-65115006; e-mail: jgnwp@yahoo.com.cn, gnjiang@hotmail.com (G.-N. Jiang).

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Abstract

The surgical treatment of pulmonary aspergilloma is challenging and controversial. This study was designed to evaluate the clinical profile, indications and surgical outcomes of pulmonary aspergilloma operated on in our institute. A total of 256 patients with pulmonary aspergilloma underwent surgical treatment from 1975 to 2010. The patients were divided into two groups: Group A (simple aspergilloma, $n = 96$) and Group B (complex aspergilloma, $n = 160$). The principal underlying lung disease was tuberculosis (71.1%). The surgical procedures consisted of 212 lobectomies in both groups; eight cavernoplasties, 10 bilobectomies, 16 pneumonectomies and six thoracoplasties in Group B; four segmentectomies and six wedge resections in Group A. Postoperative complications occurred in 40 patients (15.6%). The major complications were residual pleural space (3.9%), prolonged air leak (3.1%), bronchopleural fistula (1.6%), excessive bleeding (1.6%), respiratory insufficiency (1.9%) and empyema (1.2%). No intraoperative deaths occurred. The overall mortality within 30 days post-operation was 1.2%, occurring only in Group B. There was no statistically significant difference in the postoperative morbidity between Groups A and B ($P = 0.27$). With the good selection of patients, meticulous surgical techniques and good postoperative management, aggressive surgical treatment with anti-fungal therapy for pulmonary aspergilloma is safe and effective, and can achieve favourable outcomes.

Keywords: Fungal infection • Haemoptysis • Pulmonary aspergilloma • Surgery

INTRODUCTION

Pulmonary aspergilloma is a saprophytic infection which occurs as a colonizer of pre-existing pulmonary cavity lesions of any aetiology such as sequelar tuberculosis or bronchiectasis, producing a fungus ball or a mycetoma [1]. Because of the absence of an effective alternative to date surgical management remains the mainstay of treatment for aspergilloma [2]. However, due to the high incidence of postoperative complications, controversy still remains concerning the surgical management of aspergilloma. The purpose of this study was to evaluate our indications and results in the surgical treatment of aspergilloma with specific attention to postoperative complications. In this study, 256 consecutive patients with pulmonary aspergilloma underwent surgical management at the Department of Thoracic Surgery, Shanghai Pulmonary Hospital over a 35-year period. To the best of our knowledge, this study is the largest series in the Chinese population.

PATIENTS AND METHODS

A total of 256 patients underwent an operation for pulmonary aspergillosis between 1975 and 2010. There were 148 male and 108 female patients, with an average age of 45 ± 9 years (range 13–71 years). According to previous reports [3, 4], all patients with aspergilloma were retrospectively classified as Group A [simple aspergilloma (SPA), $n = 96$] or Group B [complex aspergilloma (CPA), $n = 160$]. SPA has a thin-walled cavity with little or no surrounding parenchymal disease. In contrast, CPA has a thick-walled cavity, surrounding parenchymal disease and greater pleural thickening.

The indications for pulmonary resection included symptomatic 'air-crescent' lesions, destruction of the lung, indeterminate lung mass or a lung lesion with clinical haemoptysis. Thoracoplasty was performed as a supplementary procedure for the patients in whom the residual lung tissue failed to fully expand after pulmonary resection. Cavernostomy was proposed for the most challenging group of patients with a prohibitive risk of morbidity. According to the status of the cavity and the general condition of patients, myoplasty was performed with the ipsilateral latissimus dorsi muscle or the pectoralis major muscle at the single stage or 3–6 months later.

Medical records were reviewed for the baseline characteristics, operation protocols, perioperative mortality and morbidity and short- and long-term outcomes. Results were expressed as median value or mean ± SD. Comparisons between patients were made by unpaired Student's *t*-test for continuous variables and by Fisher's exact test for categorical variables. A *P*-value of <0.05 was considered statistically significant.

RESULTS

Recurrent haemoptysis was the most common symptom, occurring in 188 (73.4%) patients. The less frequently encountered presentations included cough (25), fever (10), sputum (7), dyspnoea (6), chest pain (5) and weight loss (3). There were no symptoms in 12 cases (Table 1).

Underlying pulmonary diseases were present in 185 (72.3%) patients (Table 2). The most frequently pre-existing pulmonary disease was tuberculosis, which was found in 182 (71.1%) patients. The other underlying pulmonary diseases included bronchiectasis (29 patients), bronchogenic cyst (20), lung abscess (11) and lung cancer (two).

Apart from 12 patients in Group B and three patients in Group A with massive haemoptysis who required emergency procedures, all operations were electively performed (Table 3). The 256 primary surgical procedures consisted of 212 lobectomies in both groups; eight cavernoplasties, 10 bilobectomies and 16 pneumonectomies in Group B; four segmentectomies and six wedge resections in Group A. Due to severely infected space, staged myoplasty was performed in four cases. There were 35 patients who underwent a video-assisted thoracic surgery (VATS) lobectomy. Pleural tenting was performed in five patients in Group A after upper lobectomy. Subsequently, thoracoplasties to lobar resections were performed in six patients in Group B. The operative time averaged 174 min (range 98–410 min) and the intra-operative blood loss averaged 380 ml (range 100–2800 ml).

The postoperative complication rate was 15.6% (Table 4); there were eight patients (8.3%) in Group A and 32 in Group B (20%). Three patients in Group B and one patient in Group A required re-exploration for excessive postoperative bleeding, eight patients had prolonged air leak (>7 days) and three patients in Group B developed post-lobectomy empyema without bronchopleural fistula (BPF). There were four cases of BPF in Group B. The residual pleural space was encounted in 10 patients in both groups after a bilobectomy or lobectomy combined with a segmentectomy, but no infection evidence was found after the treatment of drainage and the instillation of amphotericin B and neomycin. There was no statistically significant difference in the postoperative morbidity between Groups A and B ($P = 0.27$).

No intraoperative deaths occurred. Overall mortality within 30 postoperative days was 1.2% (3 of 256 patients). All these three patients were in Group B (two patients after pneumonectomy and one patient after cavernostomy) and died of respiratory failure due to lung infection. A postoperative fungal relapse was found in one patient in Group A after a wedge resection by VATS and in one patient in Group B after a lobectomy combined with a segmentectomy.

Table 1: Characteristics of 256 patients with pulmonary aspergilloma

	Group A ($n = 96$)	Group B ($n = 160$)	*P*-value
Age	45 ± 10.2	42 ± 13.1	0.46
Sex			
Male	56 (58.3%)	93 (58.1%)	0.71
Female	40 (41.7%)	67 (41.9%)	0.67
Haemoptysis	57 (59.4%)	131 (81.9%)	0.19
Dyspnoea	2 (2.1%)	4 (2.5%)	0.83
Chest pain	2 (2.1%)	3 (1.9%)	0.76
Cough	15 (15.6%)	10 (6.3%)	0.23
Fever	3 (3.1%)	7 (4.4%)	0.51
Sputum	2 (2.1%)	5 (3.1%)	0.81
Weight loss	0 (0%)	3 (1.9%)	0.34
No symptoms	8 (8.3%)	4 (2.5%)	0.15

Table 2: Underlying pulmonary pathology in 256 patients with aspergilloma

	Group A ($n = 96$)	Group B ($n = 160$)	*P*-value
Tuberculosis	67 (69.8%)	115 (63.2%)	0.79
Bronchiectasis	11 (11.5%)	18 (11.3%)	0.77
Bronchogenic cyst	4 (4.2%)	16 (10%)	0.43
Lung abscess	5 (5.2%)	6 (3.8%)	0.48
Lung cancer	0 (0%)	2 (1.3%)	0.27
Normal lung	9 (9.4%)	3 (1.9%)	0.17

Table 3: Surgical procedures performed in 256 patients with aspergilloma

	Group A ($n = 96$)	Group B ($n = 160$)	*P*-value
Segmentectomy	4 (4.2%)	0 (0%)	0.27
Wedge resection	6 (6.3%)	0 (0%)	0.23
Lobectomy	84 (87.5%)	128 (80%)	0.73
Bilobectomy	0 (0%)	10 (6.3%)	0.32
Pneumonectomy	0 (0%)	16 (10%)	0.08
Cavernostomy	2 (2.1%)	6 (3.8%)	0.43
Thoracoscopic resection	27 (28.1%)	8 (5%)	0.45
Emergency	3 (3.1%)	12 (7.5%)	0.37
Thoracoplasty	0 (0%)	6 (3.8%)	0.47
Pleural tenting	5 (5.2%)	0 (0%)	0.53

Table 4: Postoperative complications in 256 patients with aspergilloma

	Group A ($n = 96$)	Group B ($n = 160$)	*P*-value
Excessive bleeding	1 (1.1%)	3 (1.9%)	0.27
Empyema	0 (0%)	3 (1.9%)	0.21
Prolonged air leak	2 (2.1%)	6 (3.8%)	0.67
Residual pleural space	3 (3.1%)	7 (4.4%)	0.51
BPF	0 (0%)	4 (2.5%)	0.37
Wound dehiscence	1 (1.1%)	2 (1.3%)	0.68
Respiratory insufficiency	1 (1.1%)	4 (2.5%)	0.47
Death	0 (0%)	3 (1.9%)	0.41

DISCUSSION

In developed countries, pulmonary tuberculosis is the most common pre-existing cavity lesion, representing 32–45% of patients with secondary aspergilloma [5, 6]. In our study, tuberculosis was found in 182 patients (71.1%). Because most of these patients reside in the rural areas in China with poor access to health care and limited financial resources, delayed diagnosis and medical management lead to more difficulties in surgery. In post-tuberculous CPA, surgery is associated with a high rate of complication secondary to the underlying disease [5, 6]. However, a few patients in our study experienced postoperative complications related to tuberculosis. The rule in our institute is to give short-term anti-tuberculosis therapy intravenously as a routine, both preoperatively and postoperatively, even if there are negative cultures preoperatively in tuberculosis.

Haemoptysis is the commonest mode of presentation, with an incidence of ∼80%, which is life-threatening in 30% [7]. In our series, 188 (73.4%) patients had the symptoms of haemoptysis and 15 patients underwent emergency procedures for massive haemoptysis. With such a high risk of unpredictable and life-threatening haemoptysis, there has been a consensus that pulmonary resection is an effective management for pulmonary aspergilloma.

Some surgeons agree that most of the patients with minor haemoptysis can be managed in a conservative way. However, it is rare to see the natural dissolution of aspergilloma with the disappearance of clinical symptoms. Garvey *et al.* [8] reported that as many as 30% patients with minor haemoptysis may subsequently have life-threatening haemoptysis. Moreover, systemic antifungal therapy is usually ineffective for aspergilloma, and most patients are unable to tolerate fully therapeutic doses due to the toxic effects. *Aspergillus* may be only partially eradicated, and lesions may progress after a prolonged disease. As a result, such disease progression makes successful pulmonary resection even more challenging. Several surgeons [8–10] insist that all good-risk patients, even if asymptomatic, should undergo lung resection to avoid the possibility of exsanguinating the haemorrhage. In our series, better outcomes were also observed in the patients who were operated upon in the early months of treatment, and surgery could not only improve the treatment outcomes but also shorten the duration of antifungal therapy with little additional cost to the treatment programme. Therefore, we advocate early surgical intervention whenever a fungal ball is diagnosed if the patient is a suitable candidate for operation, even if the patient has minor haemoptysis or no symptoms at all. In our opinion, this is a more cost-effective way for poor people living in the rural areas in China. Non-operative management is only considered in the patient who is at great risk for pulmonary resection.

There is no general agreement on the management of pulmonary aspergilloma. Nevertheless, an operation remains the mainstay of treatment for aspergilloma, especially because of the threat of massive haemoptysis. Standard thoracotomy and lobectomy were the preferred surgical procedures in 212 patients in this series. When the aspergilloma is sufficiently small and is located in the lung periphery, and the underlying lung is healthy, wedge excision can be performed. Shirakusa *et al.* [11] argued that because of the saprophytic character of the organism, it is desirable to limit the resection as much as possible, so as not to decrease the lung function. Although the greatest possible amount of healthy parenchyma must be spared, the radical resection of affected areas most effectively improves patient outcome. In this study, postoperative fungal relapses were found in one patient after a wedge resection by VATS and in one patient after a lobectomy combined with a segmentectomy. Therefore, we are inclined to choose the complete lobectomy to avoid possible complications and recurrence. Pneumonectomy is only indicated if the affected lung has been totally destroyed or the remaining lobe is severely fibrotic and small. The high risk of pneumonectomy for aspergilloma is primarily due to the associated technical difficulties that are the result of the often obliterated pleural space and indurated hilar structures.

We safely performed cavernostomy plus myoplasty in two patients at the single stage and staged myoplasty in four patients without recurrence. Due to the difficulty in obtaining a really clean cavity, we do not suggest surgeons perform cavernostomy plus myoplasty at the single stage. The success of this technique depends on the closure of bronchial fistula [12], adequate drainage, intracavitary antifungal instillation and an obliterated sterile space from a muscle flap with an efficient blood supply. We believe, like many others [2, 6], that cavernostomy combined with myoplasty may be an alternative technique to prevent the recurrence of the disease and to reduce operative complications in patients in a poor general condition.

Postoperative complications mainly depend on the underlying pulmonary condition. In our series, 15.6% of patients had postoperative complications, which occurred more frequently (20%) among Group B. This result is in the acceptable range and comparable with those previously reported. Major complications are mainly caused by bleeding, empyema, prolonged air leak, residual pleural space and BPF. In our series, pleural space problems were considered to be of lower incidence, which were the most common postoperative incidents in the reported series [13, 14]. In our institute, irrigation with amphotericin B and neomycin are employed to avoid empyema, as long as there is a longer need for chest tube drainage. Additional surgical procedures such as pleural tenting and partial thoracoplasty were used to avoid the prolonged air leak or residual space. Sometimes, we clamp the phrenic nerve to induce temporary paralysis in the patients with good lung function. Additionally, postoperative bronchoscopic suction, continuous low suction to keep the lung expanded and intensive postoperative chest physiotherapy was frequently performed.

In a previous series, the complications of BPF were reported between 2.5 and 15.8% [14, 15]. In our study, BPF was found in four (1.6%) cases. The excessive dissection of the peribronchial tissue, considered as the most significant cause of BPF, was avoided in our series to preserve perfusion. Another important surgical aspect which should be noted is the necessity of primary stump coverage with a well-vascularized flap. The intercostal muscle, pericardial fat pad and adjacent pleural have been used in our institute with good results. We emphasize that bronchoscopy must be performed preoperatively to ensure that there is no engorgement or oedema in the tunica mucosa.

In the previous reports, the overall mortality rates range from 4 to 22% [1, 8, 9] and as high as 34% for CPA. However, recent reports show a significant reduction in morbidity and mortality [10, 15]. The operative mortality rate in our series was 1.9%, occurring only in the complex type. The underlying primary disease remains the commonest cause of death in the patients with CPA while respiratory failure due to lung infection is usually

the cause in the post-tuberculous patients. In our report, the overall mortality rate was better than that in previous reports and we attribute this to good preoperative preparation, meticulous selection of the patients, our experience in chest surgery and good postoperative management.

CONCLUSION

In conclusion, the cohort reported in this study represents one of the largest surgical experiences with pulmonary aspergilloma in the Chinese population in recent decades. Excellent outcomes were achieved in the majority of our patients with low rates of morbidity and mortality. With the good selection of patients, meticulous surgical techniques and good postoperative management, aggressive surgical treatment for pulmonary aspergilloma is safe and effective, and can achieve favourable outcomes.

Conflict of interest: none declared.

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