

## Short papers

# Surgical treatment for pulmonary aspergilloma: a 28 year experience

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### Abstract

**Background** – Pulmonary aspergilloma has been treated surgically for many years but the mortality rates of larger surgical series, varying from 7% to 23%, is not considered acceptable by today's standards. The authors report their experience in the surgical treatment of pulmonary aspergilloma and present a review of the literature.

**Methods** – Sixty seven patients who underwent thoracotomy for pulmonary aspergilloma from 1968 to 1995 were studied retrospectively by reviewing their medical records.

**Results** – The most common clinical presentation of pulmonary aspergilloma was haemoptysis which occurred in 61 patients (91.0%). Tuberculosis was the most common pre-existing disease, occurring in 54 patients (80.6%). The plain chest radiograph showed the typical "air-crescent" sign in 36 patients (53.7%). Systemic antifungal therapy neither palliated the clinical symptoms nor eradicated the aspergilloma, and transarterial embolisation was also unsuccessful. Surgery offered the only chance of cure for both unilateral and bilateral disease. Procedures varied from segmentectomy to pneumonectomy with most (61.4%) undergoing lobectomy. There was one death following surgery from pneumonia and 15 postoperative complications occurred in 12 patients – empyema (7), massive bleeding (3), bronchopleural fistula (2), wound infection (2), and Horner's syndrome (1). Postoperatively, most of the patients were symptom-free.

**Conclusions** – With appropriate preoperative evaluation and judicious surgical technique, surgery is the preferred treatment for pulmonary aspergilloma, both for eradicating the tumour and for curing the underlying disease.

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Keywords: pulmonary aspergilloma, surgical treatment, tuberculosis.

Since 1947 when Gerstl performed the first surgical resection of aspergilloma,<sup>1</sup> pulmonary aspergilloma has been extensively reported and of particular interest to the surgeon. The overall

mortality following surgery of the collected series of Kilman *et al*<sup>2</sup> was about 7%. In larger single series reported by Jewkes *et al*<sup>3</sup> and Daly *et al*<sup>4</sup> the mortality following surgery was as high as 14% (seven of 49) and 23% (12 of 53), respectively. Even in the more recent study reported by Massard *et al* in 1992<sup>5</sup> it was around 9%. The major cause of surgical mortality remains obscure and the most common type of morbidity is not well known. We present a review of the surgical mortality and morbidity reported in the literature and present our experience with the surgical treatment of pulmonary aspergilloma at the National Taiwan University Hospital over a period of 28 years.

### Methods

Between 1968 and 1995, 72 patients were identified pathologically at the National Taiwan University Hospital as having pulmonary aspergillomas. Treatment with transarterial embolisation was tried unsuccessfully in nine patients and all eventually resorted to surgery. Antifungal chemotherapy with amphotericin B (1.0–1.5 mg/kg/day), alone or combined with flucytosine (100–150 mg/kg/day), was given to 19 patients, five of whom are excluded from the study because they did not undergo surgery. Thus, a total of 67 cases (46 men) of mean age 40.2 years (range 20–73) were enrolled into the study. The aspergillomas were classified according to the system of Belcher and Plummer.<sup>6</sup> Simple aspergillomas had thin-walled cysts with little or no surrounding parenchymal lung disease and complex ones had thick-walled cavities with substantial surrounding parenchymal lung disease or associated infiltrates.

The indications for surgery included symptomatic "air-crescent" lesions, indeterminate lung mass, destruction of the lung or a lung lesion with clinical haemoptysis. The extent of lung resection was determined by the amount of involvement by the aspergilloma and the degree of lung function. In difficult cases it was sometimes necessary to cut two ribs (fourth and fifth or fifth and sixth) to get a better surgical exposure. Preoperative lung function was determined by comparing the forced vital capacity (FVC), forced expiratory volume in one second (FEV<sub>1</sub>), and the FEV<sub>1</sub>/FVC (FEV<sub>1</sub>%) with the predicted values. These percentage predicted values were 78.5 (32.2–116.4) for FVC, 65.0 (31.7–113.6) for FEV<sub>1</sub>,

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and 81.5 (38.8–104.7) for FEV<sub>1</sub>%. In patients who underwent a pneumonectomy the percentage predicted values for FVC and FEV<sub>1</sub>% were both over 50%.

The medical records were reviewed for presenting symptoms, preceding lung disease, chest radiographic findings, location of mycetomas, type of operation, amount of bleeding during and after the operation, surgical mortality and morbidity, and outcome. Nine were lost to follow up; the rest had follow up periods ranging from two to 107 months with a mean of 25.0 months.

## Results

Haemoptysis was the most common symptom, occurring in 61 patients (91.0%). Fifteen patients had severe haemoptysis (>100 ml/day) and three had life threatening haemoptysis. The less frequently encountered presentations included cough (18), fever (4), dyspnoea (4), chest pain (3), and weight loss (1).

The most frequently reported pre-existing pulmonary disease was tuberculosis which was found in 54 patients (80.6%). The interval between the diagnosis of pulmonary tuberculosis and development of the aspergilloma varied from less than one year to 30 years with an average of 9.2 years. Other underlying pulmonary diseases included bronchiectasis (4), bronchogenic cyst (3), lung abscess (3), lung sequestration (1), and infection with the lung fluke *Paragonimus* (1). In one patient the pre-existing disease was not clear.

The chest radiographs of the patients showed the typical "air-crescent" sign in 36 cases. Other radiographic pictures included dense apical fibrocalcified lesions (14), nodular mass (8), destruction of the lung, (5) and cavitation (4). Four patients were classified as having a simple aspergilloma and the others had a complex aspergilloma. The aspergillomas were mostly located in the upper lobe (right in 31 cases and left in 28). In five patients with destroyed left lungs we had great difficulty in defining the location. Seven patients, none of whom had had pulmonary tuberculosis, had aspergillomas located in the right middle (2) or lower lobes (5). Four cases with bilateral lung involvement, one synchronous and three metachronous, all had their mycetomas in both upper lobes.

Nineteen patients had been unsuccessfully treated with antifungal agents for at least 10 days, 14 of whom were referred for surgery because their symptoms persisted. Of the other five who hesitated or refused surgery in spite of our efforts at persuasion, three died of massive haemoptysis and two were lost to follow up after being discharged from hospital. Nine patients underwent angiography but embolisation was successful in only two as it was difficult to identify most of the affected vessels. All of these patients finally resorted to surgery. The surgical procedures included segmentectomy (6), lobectomy (43), bilobectomy (5), pneumonectomy (9), lobectomy combined with segmentectomy (6), and cavernostomy with subsequent thoracoplasty (1).

In this series the average blood loss at operation was 511 (85–750) ml for segmentectomy, 722 (100–2300) ml for lobectomy, 986 (115–4000) ml for bilobectomy or lobectomy with segmentectomy, and 2065 (1200–3000) ml for pneumonectomy. The mean quantity drained during the 24 hours after the operation was 659 (155–1490) ml, 832 (170–1800) ml, 996 (380–2960) ml, and 1144 (550–2520) ml, respectively. The only death following surgery occurred in a patient with three episodes of massive haemoptysis which required a life saving endotracheal intubation. He died of overwhelming pneumonia after emergency pneumonectomy. Residual pleural space was frequent (58.2%) after operation, especially in those with pre-existing tuberculosis, because of poor lung re-expansion or dense intrapleural adhesions. In most cases the residual space could be managed by prolonged chest tube placement and was of no medical importance unless it enlarged or accumulated fluid with subsequent infection. Twelve patients, 10 with tuberculosis and two with a lung abscess, developed a total of 15 major postoperative complications. Empyemas occurred in seven cases (one following cavernostomy, four following a lobectomy, and two with a pneumonectomy), four required open drainage and three required chest tube drainage, one of whom needed instillation of amphotericin B to treat *Aspergillus* empyema. Life threatening bleeding (amount drained >200 ml/h for six consecutive hours or unstable vital signs despite normal coagulation function and transfusion) justified reoperation for haemostasis in three cases (one lobectomy with segmentectomy and two lobectomies). Major wound infection necessitated drainage in two cases (one lobectomy, one pneumonectomy). Two lobectomies resulted in bronchopleural fistulae which were managed by thoracoplasty. Horner's syndrome occurred after lobectomy from injury to the cervical sympathetic chain in one patient.

The result of surgical treatment was assessed from the relief of preoperative symptoms and the findings on serial chest radiographs. All of the patients did well following surgery except for three who still had intermittent haemoptysis which subsided after conservative management. Most of the patients had no evidence of recurrence of aspergilloma but three suffered recurrence of haemoptysis two weeks, 11 months, and 12 months, respectively, after the first operation. The plain chest radiographs demonstrated enlarged hazy lesions on the opposite upper lung fields which were initially obscured by dense fibrocalcified lesions. On reoperation these were found to be an aspergilloma. There was no further haemoptysis after the second operation.

## Discussion

Tuberculosis was the preceding lung disease in approximately four-fifths of the patients in this series with pulmonary aspergilloma, which is higher than reports from other areas.<sup>3–5,7,8</sup> This is chiefly because the prevalence of pulmonary tuberculosis in Taiwan is still high (1.29%

in 1987), nine times higher than the level of tuberculosis (0.143%) proposed by the World Health Organisation.<sup>9</sup>

Clinically, haemoptysis was the most common symptom of pulmonary aspergilloma. The mortality from haemoptysis has been variously estimated to be 25–30%.<sup>1,4,10</sup> Although Faulkner *et al*<sup>7</sup> regarded patients with preceding tuberculosis to be at a greater risk of fatal haemoptysis, they suggested that the risk of haemoptysis is related to the history of preceding minor haemoptysis rather than the underlying disease.<sup>13</sup>

There is no consistently good evidence that a fungal ball is responsive to amphotericin B.<sup>5,11,12</sup> Systemic antifungal agents hardly penetrate a dead space such as lung cavitation and a higher minimal inhibitory concentration is required.<sup>11</sup> In recent years itraconazole has offered promise in the oral treatment of *Aspergillus* infections but the results of its use in the treatment of aspergilloma are varied and it has not been studied in controlled trials.<sup>13</sup> Even if itraconazole works, the underlying cavity remains and there is still the possibility of recurrence. The identification of bleeding vessels by angiography was difficult. Concomitant embolisation did not result in the permanent control of haemoptysis because of the presence of a massive collateral circulation,<sup>14</sup> and it is not possible to eradicate aspergilloma by this means. This is a matter of serious concern because such patients are at high risk of recurrent haemoptysis or death.<sup>14</sup> The reduction of intraoperative bleeding by embolisation is also unsuccessful,<sup>5</sup> as in two of our cases whose intraoperative blood loss was about 1200 and 2300 ml, respectively.

Lobectomy was the preferred procedure and was used for all the diseases in our series. Although the aspergilloma was often located in an upper lobe, an adjacent segment of a lower or middle lobe was occasionally involved. Under these circumstances, simultaneous segmentectomy – or even bilobectomy – was justified. Pneumonectomy could only be performed in cases with widespread destruction of one lung in whom the other lung provided a good reserve. The extent of resection should therefore depend upon the extent of underlying disease and the location of the aspergilloma as well as on the patient's lung reserve. If the pulmonary reserve permits, surgery can be used in cases with bilateral aspergilloma as staged resections can be carried out with good results. In patients whose lung function cannot support a lung resection, minimal procedures such as cavernostomy<sup>3</sup> for mycetomectomy or intracavitary instillation of antifungal agents<sup>1,8,10,15</sup> to prevent further loss of lung function are indicated.

In our 28 year experience we achieved a mortality rate of 1.5% and a morbidity rate of 17.9%. All of these patients had complex aspergillomas. The pre-existing lung disease, especially tuberculosis, usually caused obliteration of the pleural space, induration of the hilar structures, poor expansion of the remaining lung, and dense vascular adhesions in the thoracic cavity. Hence, tuberculosis in-

Table 1 Causes of surgical mortality in 41 patients with pulmonary aspergillomas reported in the literature

| Cause of death        | No. of patients |
|-----------------------|-----------------|
| Respiratory failure   | 16 (41.0%)      |
| Bleeding              | 6 (15.4%)       |
| Pneumonia             | 3 (7.7%)        |
| Underlying disease    | 3 (7.7%)        |
| Myocardial infarction | 2 (5.1%)        |
| Sepsis                | 2 (5.1%)        |
| Aspergillitis         | 2 (5.1%)        |
| Miscellaneous*        | 5 (12.8%)       |

\* Including bronchopleural fistula, empyema, hypoxic encephalopathy, aortic graft thrombosis, disseminated intravascular coagulopathy.

Table 2 Surgical complications (n = 171) in 109 patients with pulmonary aspergillomas reported in the literature

| Types of complication     | No. of complications |
|---------------------------|----------------------|
| Bleeding                  | 38 (22.2%)           |
| Residual pleural space    | 33 (19.3%)           |
| Bronchopleural fistula    | 27 (15.8%)           |
| Empyema                   | 23 (13.5%)           |
| Respiratory insufficiency | 14 (8.2%)            |
| Air leakage               | 11 (6.4%)            |
| Wound infection           | 5 (2.9%)             |
| Sepsis                    | 3 (1.8%)             |
| Pneumonia                 | 2 (1.2%)             |
| Atelectasis               | 2 (1.2%)             |
| Retained secretions       | 2 (1.2%)             |
| Miscellaneous*            | 11 (6.4%)            |

\* Including pleural effusion, wound dehiscence, lobar infarction, paralytic ileus and unknown in seven patients.

evitably complicated surgical management. Bleeding was the problem most frequently encountered during and after surgery. Postoperative bleeding, if not well drained, might lead to secondary infection resulting in empyema formation. Empyema and bronchopleural fistulas, as well as residual pleural space, were managed in a standard fashion such as prolonged chest tube drainage, open drainage, or thoracoplasty. Most of the patients had a good long term result in terms of absence of symptoms.

A review of 39 surgical deaths in the literature revealed that the chief cause of postoperative death was respiratory failure (table 1).<sup>1-7,10,15-18</sup> Preoperative pulmonary function testing is therefore mandatory to prevent respiratory failure after lung resection for aspergilloma. In addition, 171 postoperative complications in 109 patients reported in the literature are summarised in table 2.<sup>1-8,10,15-18</sup> Bleeding, residual pleural space, bronchopleural fistula, and empyema were the most common surgical complications encountered. The complications were not usually the result of *Aspergillus* infection per se but were related to the underlying disease of the host or infection by other organisms.<sup>1,2,6,16,17</sup> Systemic antifungal therapy is of little benefit in the treatment of pulmonary aspergilloma, especially when weighed against the resulting adverse effects. If the diagnosis is established at an early stage with good lung reserve, surgical resection should be undertaken as soon as possible. It is in cases where the disease has reached an advanced stage and surgery is the only means of controlling the symptoms that surgical mortality has proved to be extremely high.<sup>16</sup> It is therefore logical to recommend operative resection of the involved area with a thorough evaluation of preoperative

pulmonary function since the surgical mortality is exceedingly low, the management of surgical morbidity is feasible, and the potential for cure, even of the underlying disease, is excellent. On the other hand, in patients with limited lung reserve an alternative approach to management such as cavernostomy or intracavitary instillation of antifungal agents is recommended.

- Garvey J, Crastnopol P, Weisz D, Khan F. The surgical treatment of pulmonary aspergillomas. *J Thorac Cardiovasc Surg* 1977;74:542-7.
- Kilman JW, Ahn C, Andrews NC, Klassen K. Surgery for pulmonary aspergillosis. *J Thorac Cardiovasc Surg* 1969;57:642-7.
- Jewkes J, Kay PH, Paneth M, Citron KM. Pulmonary aspergilloma: analysis of prognosis in relation to haemoptysis and survey of treatment. *Thorax* 1983;38:572-8.
- Daly RC, Pairolero PC, Piehler JM, Trastek VF, Payne WS, Bernatz PE. Pulmonary aspergilloma: results of surgical treatment. *J Thorac Cardiovasc Surg* 1986;92:981-8.
- Massard G, Roeslin N, Wihlm JM, Dumont P, Witz JP, Morand G. Pleuropulmonary aspergilloma: clinical spectrum and results of surgical treatment. *Ann Thorac Surg* 1992;54:1159-64.
- Belcher JR, Plummer NS. Surgery in bronchopulmonary aspergillosis. *Br J Dis Chest* 1960;54:335-41.
- Faulkner SL, Vernon R, Brown PP, Fisher RD, Bender HW. Haemoptysis and pulmonary aspergilloma: operative versus nonoperative treatment. *Ann Thorac Surg* 1978;25:389-92.
- Eastridge CE, Young JM, Cole F, Gourley R, Pate JW. Pulmonary aspergillosis. *Ann Thorac Surg* 1972;13:397-403.
- Taiwan Provincial Chronic Disease Control Bureau. Conference for tuberculosis control. *Chronic Disease Control News* 1992;14:5-23.
- Karas A, Hankins JR, Attar S, Miller JE, McLaughlin JS. Pulmonary aspergillosis: an analysis of 41 patients. *Ann Thorac Surg* 1976;22:1-7.
- Pennington JE. Aspergillus lung disease. *Med Clin North Am* 1980;64:475-90.
- Hammerman KJ, Sarosi GA, Tosh FE. Amphotericin B in the treatment of saprophytic forms of pulmonary aspergillosis. *Am Rev Respir Dis* 1974;109:57-62.
- Jennings TS, Hardin TC. Treatment of aspergillosis with itraconazole. *Ann Pharmacother* 1993;27:1206-11.
- Uffacker R, Kaemmerer A, Neves C, Picon PD. Management of massive haemoptysis by bronchial artery embolization. *Radiology* 1983;146:627-34.
- Saab SB, Almond C. Surgical aspects of pulmonary aspergillosis. *J Thorac Cardiovasc Surg* 1974;68:455-60.
- Henderson RD, Deslaurier J, Ritcey EL, Delarue NC, Pearson FG. Surgery in pulmonary aspergillosis. *J Thorac Cardiovasc Surg* 1975;70:1088-92.
- Saliba A, Pacini L, Beatty OA. Intracavitary fungus balls in pulmonary aspergillosis. *Br J Dis Chest* 1961;55:65-71.
- Battaglini JW, Murray GF, Keagy BA, Starek PJK, Wilcox BR. Surgical management of symptomatic pulmonary aspergilloma. *Ann Thorac Surg* 1985;39:512-6.

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## Indications and outcome of surgery for pulmonary aspergilloma

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### Abstract

**Background** – The indications and the outcome of surgery for pulmonary aspergilloma remain highly controversial. The short term and long term results of lung resection or cavernostomy in 24 patients with pulmonary aspergilloma are reported.

**Methods** – The case notes of 27 consecutive patients referred for surgical assessment for pulmonary aspergilloma at the Royal Brompton Hospital over the last 14 years were reviewed. Patients were categorised into four classes according to their fitness for lung resection and the severity of their symptoms. Severe symptoms were defined as life threatening haemoptysis or other symptoms requiring more than one hospital admission. Class I (n = 1), fit individual with mild or no symptoms; class II (n = 17), fit individuals with severe symptoms; class III (n = 1), unfit individual with no symptoms; and class IV (n = 8), unfit individuals with severe symptoms. Two asymptomatic patients and one on an IVOX pump were not accepted for surgery. Lung resection was performed in all 17 patients with class II disease, comprising segmentectomy only in five patients, lobectomy and seg-

mentectomy in seven, and a completion pneumonectomy in five patients. Cavernostomy was performed in seven patients with class IV disease.

**Results** – Surgery was often complicated by prolonged air leakage and infection of residual space. There was no operative mortality in the group treated by resection whereas two of those who underwent cavernostomy died in the early postoperative period. All survivors were followed up for a median of 17 months (range 1-72 months); 19 were alive and had no symptoms attributable to aspergilloma. Late recurrence occurred in two patients in the cavernostomy group. The only late death occurred in the resection group five months postoperatively and was attributed to end stage renal disease.

**Conclusions** – Lung resection in selected patients with complicated aspergilloma can be performed with low operative mortality. Cavernostomy is associated with high mortality and morbidity and should therefore only be performed in patients with life threatening symptoms who are unfit for lung resection.

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