

Surgical treatment of pulmonary aspergillosis: A single center experience

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ABSTRACT

Background: *Aspergillus fumigatus* is a saprophytic fungus which colonizes in the cavitory lesions in the lungs. In our part of the world, where tuberculosis is endemic, the healed tubercular cavities form a good nidus for this fungus. The fungus forms a fungal ball or aspergilloma within the cavity, which erodes the walls of the cavity and causes hemoptysis by erosion of the bronchial vessels. Hemoptysis is the main symptom. Antifungal agents are not useful against the fungal ball. Surgery in the form of lobectomy is the primary treatment. Surgery for aspergilloma is known to be risky because of intra-pleural adhesions, obliteration of the interlobar fissures, massive hemorrhage during dissection and poor pulmonary reserve of the patient due to the underlying disease. **Materials and Methods:** Clinical presentation, radiological investigations, operative techniques, postoperative outcome, and follow-up of 24 cases of pulmonary aspergilloma treated surgically were studied prospectively between August 2010 and July 2013 at IPGMER and SSKM Hospital, Kolkata. **Results:** There were 15 male (62.5%) and 9 female (37.5%) patients. Mean age of the study population was 34.54 years. All the patients had complex aspergilloma. Tuberculosis was the underlying disease in 22 patients (91%). Hemoptysis was the main symptom in 79.16% cases. Chest X-ray was the first investigation, which gave a clue to the diagnosis. Computed tomography scan was diagnostic in all cases. Lobectomy was done in 16 patients (66.67%). There was one mortality and the overall complication was 33.33%. The average follow-up period was 21.65 months, during which there was no mortality and no recurrence of hemoptysis in these patients. **Conclusions:** Though surgery for aspergilloma is considered to be risky, excision of the cavity along with the involved lobe can be done with acceptable morbidity and mortality to provide the patient complete cure and symptom-free survival.

KEY WORDS: Aspergilloma, computed tomography, fungal ball, lobectomy, pulmonary cavity

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INTRODUCTION

Pulmonary aspergillosis occurs usually due to colonization of previously present pulmonary cavities by a saprophytic fungus, *Aspergillus fumigatus*. In our part of the world where tuberculosis is endemic, the healed tubercular cavities form the nidus for saprophytic colonization of *Aspergillus*. Inside the pulmonary cavity, the fungus forms a freely moving fungal ball or aspergilloma, which consists of matted fungal hyphae, fibrin, and inflammatory cells.

The fungus elaborates fungal toxins that erode the walls of the cavity. When this erosion reaches the bronchial vessels, it produces massive hemoptysis, which is the predominant symptom. Chest X-ray and computed tomography (CT) scan are the mainstay radiological investigations, which show the characteristic fungal ball with the air crescent sign. Primary modality of treatment is surgery. Surgery for pulmonary aspergilloma is known to be risky because of the dense intra-pleural adhesions, intra-operative hemorrhage and high morbidity and mortality in the postoperative

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period. In the present series, we studied the presentations, nature of the underlying lung diseases, surgical procedures and outcome of patients with pulmonary aspergilloma, treated in our hospital over a period of 3 years.

MATERIALS AND METHODS

We studied the clinical presentation, radiological investigations, operative techniques, postoperative outcome, and follow-up of 24 cases of pulmonary aspergilloma treated surgically between August 2010 and July 2013 at IPGMER and SSKM Hospital, Kolkata which is an apex referral unit of West Bengal state of India and a teaching hospital. The study period was of 3 years duration, and it was a prospective observational study.

All the patients planned for surgery for pulmonary aspergilloma underwent

- Underwent a complete hemogram,
- Blood urea,
- Serum creatinine,
- Chest X-ray (posteroanterior view) and CT scan of thorax.

Operative technique

All the patients were operated under general anesthesia. In 18 patients double lumen endobronchial intubation was done whereas in six patients double lumen endobronchial intubation was not possible, so intubation was done with single lumen endotracheal tube. After anesthesia the patient was turned to a lateral position with the affected side up. Posterolateral thoracotomy incision was made, and the thorax was entered through the fifth or sixth intercostal space depending on the location of the aspergilloma as depicted in the CT scan. Adhesiolysis was done to set the lungs free. Meticulous hemostasis was done from the very beginning of the operation. The affected segment of the lung was identified. The interlobar fissure was dissected, branches of the pulmonary artery and vein supplying the lobe were ligated and transected. The lobar bronchus was divided, and the specimen was removed and sent for histopathological study. The bronchial stump was closed with 3-0 vicryl interrupted stitches. The anesthetist was asked to inflate the lungs. The bronchial stump and the lungs thoroughly checked for any airleak. Hemostasis thoroughly secured with special attention to the adhesiolysis sites on the chest wall. Two chest drains were inserted. Chest closed with 1-vicryl sutures. Most of the patients were extubated in the operating room and sent to the Intensive Care Unit. Some patients required ventilator support.

Postoperative care

On the day of operation, the patients were administered intravenous fluid for 6 h postoperatively, following which they were allowed oral diet. From the 1st postoperative day, the patients were encouraged to do breathing exercises with an incentive spirometer. Postoperative chest X-ray was done on the 2nd postoperative day. Chest drains were usually removed by 48 h after the lungs are satisfactorily inflated. Intravenous antibiotics continued for 3 days

postoperatively followed by oral antibiotics. Most of the patients were discharged by 10th postoperative day. Follow-up was done in the outpatient clinic with chest X-rays after 2 weeks and after 1 month and then 6 monthly.

RESULTS

Out of the 24 patients included in this study, there were 15 males (62.5%) and 9 females (37.5%). The mean age of the study population was 34.54 years with the youngest being 22 years and the oldest being 52 years.

In 22 patients, the underlying disease was tuberculosis (91%) whereas in two patients the underlying disease was bronchiectasis. The duration from the first diagnosis of tuberculosis to the diagnosis of aspergilloma was very variable starting from 2 years to 5 years, with the mean duration being 3.4 years. All these 22 patients of tuberculosis had completed their course of anti-tubercular treatment following a diagnosis of tuberculosis.

Hemoptysis was the main symptom. 19 patients (79.16%) complained of at least one episode of hemoptysis. Other symptoms were a cough with expectoration (62.5%) and chest pain (41.66%). Three patients (12.5%) were asymptomatic [Table 1].

In most patients, chest X-ray gave a clue to diagnosis showing a cavitory lesion in the lungs with a hyperdense material inside it. However, CT scan was diagnostic in all the patients showing the pulmonary cavity along with the freely mobile fungal ball and the characteristic air crescent sign [Figure 1]. CT scan was also helpful in properly locating the lobe of the lung involved, the size and nature of the cavity and the condition of the rest of the lung parenchyma [Figure 2]. Right upper lobe was

Table 1: Presenting symptoms of the patients of pulmonary aspergilloma

Symptoms	Number of patients	Percentage
Hemoptysis	19	79.16
Cough with expectoration	15	62.5
Chest pain	10	41.66
Asymptomatic	3	12.5

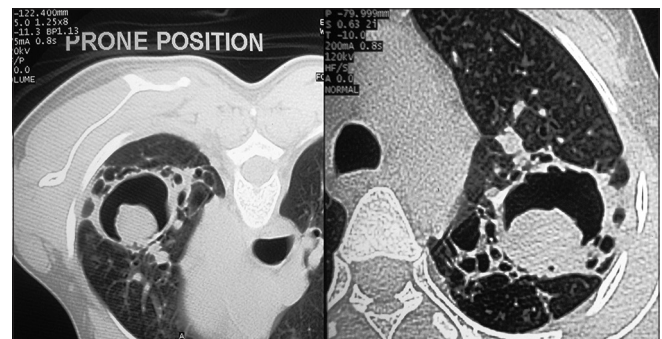


Figure 1: Computed tomography scan of thorax in prone and supine position showing a mobile fungal ball inside the pulmonary cavity

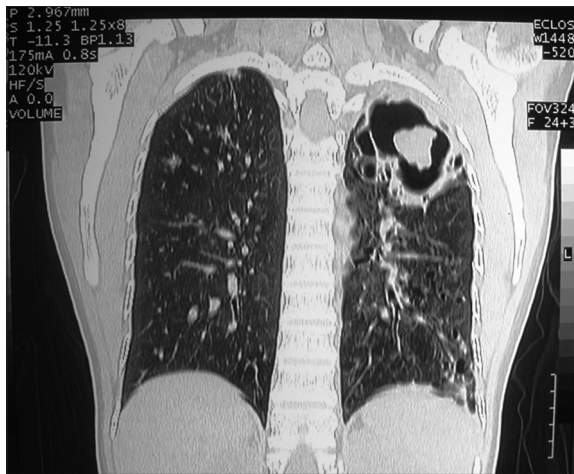


Figure 2: Computed tomography scan of the thorax showing a cavitary lesion in the upper lobe of left lung containing an aspergilloma

involved in 13 patients (54.16%) and left upper lobe was involved in 11 patients (45.84%).

Lobectomy was done in 16 patients (66.67%), segmentectomy in 4 patients (16.66%), and pneumonectomy in 4 patients (16.66%). Subsequently, thoracoplasty was done in three patients, and pneumonectomy was done in one patient [Table 2]. The average intra-operative blood loss was 856 ml, ranging from 300 ml to 1600 ml. Three patients had to be reoperated for severe postoperative hemorrhage. Six patients (25%) had to be on prolong chest tube drainage due to dead space in the pleural cavity and air leak. Two patients had empyema that subsided by conservative means. Two patients had major wound infections [Table 3]. There was one mortality due to severe postoperative bleeding and coagulopathy. Follow-up was complete for all the patients except for the one patient who died in early postoperative period. The average follow-up period was 21.65 months, during which there was no mortality and no recurrence of hemoptysis in these patients. *A. fumigatus* was identified in all cases by histopathological examination of the fungal ball with hematoxylin and eosin stain and Gomori methenamine silver stain.

DISCUSSION

A. fumigatus is a saprophytic fungus. Its spores are widespread in nature. It is a common contaminant in the bronchoalveolar lavage specimens from patients with chronic lung diseases.^[1] Traditionally, pulmonary aspergillosis has been classified into three categories: (1) The saprophytic infection, leading to fungus balls within parenchymal or pleural cavities; (2) the invasive aspergillosis observed in neutropenic or immunocompromised patients; and (3) the allergic bronchial aspergillosis known as Hinson–Pepys disease.^[2] Belcher and Plummer classified saprophytic pulmonary aspergillomas into simple and complex types. Simple aspergilloma is a thin walled cavity with little or no surrounding parenchymal disease, whereas complex aspergilloma is a thick walled cavity surrounding

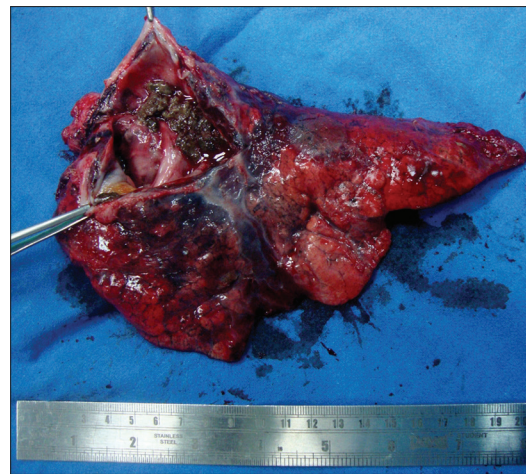


Figure 3: Resected specimen of upper lobe of left lung with the pulmonary cavity cut open showing the fungal ball inside

Table 2: Operative procedures performed in patients with pulmonary aspergilloma

Operative procedures	Number of patients	Percentage
Initial		
Lobectomy	16	66.67
Segmentectomy	4	16.66
Pneumonectomy	4	16.66
Subsequently		
Thoracoplasty	3	12.5
Pneumonectomy	1	4.16

Table 3: Complications following surgery for pulmonary aspergilloma

Complications	Number of patients	Percentage
Reexploration for bleeding	3	12.5
Prolonged chest tube drainage (>7 days)	6	25
Empyema	2	8.33
Major wound infection	2	8.33
Mortality	1	4.16

lung parenchymal disease.^[3] All the cases in our series fall into the latter category of complex aspergilloma.

A. fumigatus usually colonizes in the preexisting pulmonary cavities, predominantly in the upper lobes of the lungs [Figure 3]. This colonization leads to the formation of a fungus ball or aspergilloma. The cavitary lesion might have been formed due to tuberculosis, bronchiectasis, sarcoidosis, histoplasmosis, lung abscess, bronchogenic cyst, or cavitating lung carcinoma. In the developing countries, pulmonary tuberculosis is highly prevalent. Healed tubercular cavities in the upper lobes of lungs form a suitable nidus for saprophytic colonization of *A. fumigatus*. Many case series in the past have reported the association of tuberculosis with aspergilloma to be 13–89%.^[4] In our series, tuberculosis was associated in 22 patients (91.66%), which may be due to high prevalence of tuberculosis in this part of the world. The duration from diagnosis of tuberculosis to the diagnosis of aspergilloma has been very variable. The British

Thoracic and Tuberculosis Association reported 6% of patients with healed tuberculous cavity developing an aspergilloma within 3 years.^[5] Rergkhang *et al.* reported a history of tuberculosis ranging from 2 to 20 years (average 8.2 years) in their patients of aspergilloma.^[6] In our series, the duration from active tuberculosis to aspergilloma was from 2 to 5 years (mean 3.4 years).

The spectrum of clinical presentation of aspergilloma ranges from incidental radiological finding to exsanguinating hemoptysis.^[6] In our series, 19 patients had hemoptysis (79.16%) whereas three patients were asymptomatic (12.5%). Bleeding usually occurs from the bronchial arteries, and it stops spontaneously.^[7] However, when the cavity erodes into the intercostal vessels, the hemoptysis is severe and is unlikely to stop. Several mechanisms have been proposed for hemoptysis that include erosion of the vascular cyst wall by the motion of the mycetoma, elaboration of endotoxins by the fungus and the patient's underlying disease.^[8] Bronchial artery embolization can be attempted for patients with life-threatening hemoptysis. It can reduce the bleeding temporarily, but it does not control bleeding permanently due to massive collaterals.^[6] In our study, there were no such patients with life-threatening hemoptysis.

The ideal treatment of pulmonary aspergilloma is a formal pulmonary resection because it provides rapid control of the symptoms and prevents further hemoptysis.^[6] However, pulmonary resection in a case of aspergilloma is one of the most complex thoracic surgeries because of the adhesions between the lobes and with the chest wall and poor pulmonary reserve of the patient to sustain a resection. Segmentectomy is associated with a higher incidence of air leak and may cause disruption of the cavity and pleural seeding of the fungus. Segmentectomy is only suited for peripherally located lesions. Pneumonectomy carries a high risk for empyema and bronchopleural fistula. Hence, it should be only employed in cases with destroyed lungs with aspergilloma or in cases with significant involvement of the fissure to preclude lobectomy.^[7] Lobectomy has been the procedure of choice in pulmonary aspergilloma. In our series, we did lobectomy in 66.66% cases. Some authors have suggested lobectomy by video-assisted thoracoscopic surgery for simple aspergilloma. Ichinose *et al.* reported 24 cases of pulmonary aspergilloma operated by video-assisted thoracoscopic surgery with good results comparable with thoracotomy.^[9] Cavernostomy is an alternative surgical procedure for peripherally located cavities in old and high-risk patients who cannot tolerate lung resection. Cesar *et al.* reported the good outcome in their study on 111 patients undergoing cavernostomy.^[10] In our series, there were no patients suitable for cavernostomy. Giron *et al.* reported CT-guided injection of amphotericin B into the pulmonary cavity containing the aspergilloma in patients with the poor general condition. They reported a regression of the aspergilloma and the serology becoming negative in 80% of cases in 3 months.^[11] However, the

long-term outcome of this procedure is unknown.

Intra-operatively, the most common problem encountered is massive hemorrhage due to adhesions. The adhesions are usually more dense in the upper parts, which is difficult to access. The interlobar fissures are obliterated due to adhesions, which make surgery still more difficult. The average amount of blood loss in our series was 856 ml, ranging from 300 ml to 1600 ml. Three patients were reoperated for excessive postoperative bleeding. The most common complication encountered postoperatively in patients of aspergilloma is dead space in the pleural cavity after lobectomy. Demir *et al.* reported pleural space problems and prolonged chest tube drainage in 24.4% of cases.^[4] Pleural space problems after lobectomy are thought to be a consequence of loss of elasticity of the remaining lung due to fibrotic changes from the underlying disease process.^[12] In our series, pleural space problems were seen in 6 patients (25%) for which these patients had to be on prolonged chest tube drainage of more than 7 days duration. Three of them subsequently required thoracoplasty. We did not perform concomitant thoracoplasty along with lobectomy as the initial operation as it is a mutilating surgery, and the results are cosmetically poor. We did thoracoplasty if lungs did not inflate adequately by conservative means after 2–3 weeks of initial surgery. Demir *et al.* and Lejay *et al.* also gave a similar opinion regarding thoracoplasty.^[4,13] As a whole complications and morbidity (including pleural space problems and empyema) was seen in 8 patients (33.33%). Lejay *et al.* reported an overall complication rate of 24% in their study involving 33 patients.^[13] Mortality in aspergilloma surgery ranges from 0% to 22.6% as reported in different case series.^[4] In our series, there was one mortality due to excessive postoperative hemorrhage and coagulopathy (4.16%). Kim *et al.* reported a recurrence of 5% in their patients of aspergilloma.^[14] We had no recurrences or recurrent hemoptysis in this series in an average follow-up period of 21.65 months. Hence, from this series we can conclude that though surgery for aspergilloma is considered to be risky, excision of the cavity along with the involved lobe can be done with acceptable morbidity and mortality to provide the patient complete cure and symptom-free survival.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Lung India Awards 2015

The awards were given away during general body meeting of NAPCON 2015.

The Best Original Article:

Cost-effectiveness of noninvasive ventilation for chronic obstructive pulmonary disease-related respiratory failure in Indian hospitals without ICU facilities (November 2015) **Author:** Dr. Shradha P. Patel is from Department of Emergency Medicine, St. John Hospital and Medical Center, Wayne State University, Detroit, Michigan, USA.

Outstanding Articles:

- A prospective study of ocular toxicity in patients receiving ethambutol as a part of directly observed treatment strategy therapy (January 2015) **Author:** Dr. Pragati Garg is from Department of Ophthalmology Era's Lucknow Medical College, Lucknow.
- Development of a mortality prediction formula due to sepsis/severe sepsis in a medical intensive care unit (July 2015) **Author:** Dr. Anant Mohan is Additional Professor in the department of Pulmonary Medicine & Sleep Disorders at the All India Institute of Medical Sciences , New Delhi
- A novel approach for lung delivery of rifampicin-loaded liposomes in dry powder form for the treatment of tuberculosis (July 2015 issue) **Author:** Dr. Jagadevappa S. Patil is Principal and Professor VT's Shivajirao S Jondhle College of Pharmacy, Asangaon, Shahapur, Thane, Maharashtra, India.

The Best Letter to Editor

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Dr. Ravi Mehta is from Apollo Hospital, Interventional pulmonology, Bangaluru.

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