Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Original Research Article

Surgery in Pulmonary Aspergilloma - A Single Centre Observational study

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Abstract:
Background: This retrospective observational study was conducted to study the clinical profile, indications, post-operative complications and long-term outcome of patients having pulmonary aspergilloma. **Methods:** From January 2013 to October 2023, 25 patients underwent surgery for pulmonary aspergilloma at our tertiary care institute. Patients were broadly classified into simple and complex Aspergilloma based on clinical and CT findings. **Results:** The group consisted of 16 males and 9 females with a mean age of 41 years for 10 years. The most common indication for surgery was Heomptysis (76%). The underlying lung diseases were tuberculosis (76%), bronchiectasis (8%), and lung abscess (4%). The procedures performed were lobectomy (88%), pneumonectomy (4%), Cavernostomy (4%) and segmental resection (4%). The post-operative mortality was 4% (one patient). Overall complications occurred in 12 (23.07%) patients. The complications included prolonged air leak (32%), bleeding (12%), repeated pneumothorax (4%), and wound dehiscence (4%). **Conclusion:** Pulmonary aspergilloma, a fungal infection frequently encountered in developing countries like India with high rates of tuberculosis, can be effectively treated through surgical resection. This procedure is considered the gold standard for preventing recurrent symptoms, especially hemoptysis. Early surgical intervention, accompanied by thorough preoperative preparation, meticulous surgical technique, and diligent postoperative chest physiotherapy, can significantly reduce the rate of complications. While complications may still arise, particularly in cases with underlying lung pathology, the long-term prognosis for patients undergoing surgical resection of pulmonary aspergilloma is generally positive.
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Received Date: 12 June 2024 Revised Date: 02 July 2024 Accepted Date: 28 August 2024

Introduction

Pulmonary aspergilloma generally forms due to the saprophytic colonization of pre-existing pulmonary cavities by Aspergillus fumigatus, the most common saprophytic Aspergillus species involved in human disease, resulting in a fungus ball or mycetoma.(1,2) Hinson and colleagues classified pulmonary aspergillosis into allergic, invasive (rarely requiring surgical intervention), and saprophytic infections, which colonize pre-existing lung cavities and produce a fungus ball or aspergilloma. Pulmonary aspergillosis is being reported with increasing frequency. Despite advances, there remains debate regarding the optimal management of aspergilloma. .(1,2)

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Once a fungus ball has formed in pre-existing cavities, antifungal agents prove challenging to control Aspergiloma. Surgical resection offers the only viable option for a permanent cure of aspergilloma(3,4,5). However, the surgical indication remains controversial due to the high incidence of postoperative complications. Studies have reported significant morbidity and mortality rates associated with surgical interventions(6,7). While some authors advocate prophylactic resection of all pulmonary aspergillomas due to the risk of massive hemoptysis (8,9,10), others recommend surgical treatment only after the occurrence of hemoptysis (11). A proportion of patients may have advanced chronic lung disease, rendering them ineligible for surgery.

This study was conducted to evaluate the outcomes of all patients who underwent surgical management for pulmonary aspergilloma at a superspeciality hospital in central India over a ten-year period.

Methodology:

Study Design and Patient Characteristics:

This retrospective observational study was conducted at Government Medical College & Super Specialty Institute Nagpur from January 2013 to October 2023. A total of 25 patients underwent surgical treatment for pulmonary aspergilloma during this period. The cohort comprised 16 male and 9 female patients with an average age of 41. Patient medical records were reviewed for preoperative symptoms, radiographic findings, surgical procedures, postoperative complications, and long-term outcomes.

Surgical Indications and Preoperative Preparation:

Surgical indications included symptomatic air-crescent lesions, indeterminate lung masses, lung destruction, or hemoptysis. Patients were categorized as having simple or complex aspergilloma based on clinical and CT findings. Simple aspergilloma was defined as a contained, thin-walled cavity surrounded by normal lung parenchyma, while complex aspergilloma involved a thick-walled cyst with associated adjacent lung damage. Preoperative preparation included smoking cessation, nutritional improvement, and short-term antibiotic therapy when necessary . we follow ERAS guidelines for optimal patient management.(12)

Surgical Procedures and Postoperative Management:

A total of 25 definitive surgical procedures were performed, with one patient requiring reoperation for air leak closure and another for wound dehiscence. All surgeries were conducted under general anesthesia with double-lumen endobronchial tube placement. A posterolateral thoracotomy approach was used, with pleural space entry through the fifth intercostal space. Significant adhesions and intraoperative bleeding were common, necessitating rib resection in some cases. For post-tuberculosis sequelae with apical cavity, careful evacuation and lobectomy were performed. Pulmonary vessels were ligated and transfixed, and the bronchial stump was closed with staplers, with an additional stitch if necessary. Two chest tubes were placed, and aggressive postoperative analgesia and chest physiotherapy were provided. Excessive bleeding was defined as drainage exceeding 1 liter in the first 24 hours, and prolonged air leak was considered any leak lasting more than 7 days. Patients were advised to follow up at the outpatient department for ongoing evaluation.

Results:

The present study was conducted on 25 pulmonary aspergilloma patients. The group consisted of 16 males and 9 females with a mean age of 41 +/-10. The most common indication for surgery was Heomptysis (76%). Cough was also a common symptom, occurring in 76% of patients. Blood-tinged sputum was present in 72% of patients, while dyspnea occurred in only 20% of patients. Chest pain was the least common symptom, occurring in 20% of patients.Tuberculosis was the most common underlying lung pathology, found in 76% of

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

patients. Bronchiectasis (non-TB) was present in 8% of patients, while lung abscess and COVID-associated pulmonary aspergilloma were each found in 4% of patients. In 8% of patients, no underlying lung pathology was identified

Lobectomy was the most commonly performed surgical procedure, accounting for 88% of all cases. Cavernostomy, segmentectomy, and pneumonectomy were less commonly performed procedures.It is important to note that the choice of surgical procedure depends on the severity of the aspergilloma and the underlying lung pathology. For example, lobectomy may be the preferred procedure for patients with a large, complex aspergilloma, while cavernostomy may be a more suitable option for patients with a smaller, less severe aspergilloma. prolonged air leak was the most common complication following surgery, occurring in 32% of patients. Residual pleural space was also a relatively common complication, seen in 28% of patients. Hemorrhage, pneumonia, and wound infection were less common, occurring in 12%, 8%, and 4% of patients, respectively. As can be seen from the table, reoperations were most commonly required for patients who underwent lobectomy. The common reason for reoperation was bleeding, which occurred in one patients who underwent lobectomy. Decortication and thoracoplasty was performed in one patients who required reoperationwhile Decortication was done in 2 patients.

Table 1: Distribution of patients according to clinical characteristics

	Min	**MAX**	**MEAN**	**SD**
Age (Years)	24	64	41	
Male/Female	16/09			
Duration of symptoms (months)	1	48	12.6	10.7
Hemoglobin (gm/dl)	8.6	12.5	10.8	1.2
FVC (lt)	1.2	2.6	1.5	0.4
FEV1	1	2.3	1.4	0.3
FEV1/FVC (%)	73.3	100	90.4	5.2

Table 2: Distribution of patients according to symptoms

Complaint	**Simple Aspergilloma n=6**	**Complex Aspergilloma n=19**	**Total N=25**
Hemoptysis	1 (16%)	18 (94%)	19(76%)
Blood-tinged sputum	3 (50%)	15 (79%)	18(72%)
Dyspnea	0	5(26%)	5(20%)
cough	3(50%)	16(84%)	19(76%)
Chest pain	1(16%)	4(21%)	5(20%)

Table 3: Distribution of patients according to underlying Lung Pathology

Underlying lung pathology	**No of patients (n= 25)**
Tuberculosis	19 (76%)
Bronchiectasis (Non TB)	2 (8%)
Lung abscess	1 (4%)
Covid Associated Pulmonary Aspergilloma	1 (4%)
No underlying pathology	2(8%)

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Table 4 - Distribution of patients according to various operative procedures done

No.	Surgeries	Simple Aspergilloma (6 Procedures)	Complex Aspergilloma (19 Procedures)	Total N=25
1	Lobectomy	5 (83%)	17(89%)	22(88%)
2	Cavernostomy	0	1(5%)	1(4%)
3	Segmentectomy	1 (16%)	0	1(4%)
4	Pneumonectomy	0	1(5%)	1(4%)

Table 5- Distribution of patients according to Post Operative Morbidity Complication

COMPLICATIONS	Simple Aspergilloma (6patients)	Complex Aspergilloma (19 patients)	Total N=25
Residual pleural space	0	7	7(28%)
Prolonged air leak	0	8	8(32%)
hemorrhage	1	2	3(12%)
Postpneumonectomy empyema	0	0	0
Pneumonia	0	2	2(8%)
Wound Infection	1	0	1(4%)

Table 6- Distribution of patients according to Reoperations Related To The Initial Surgical Procedures

	Lobectomy	Pneumonectomy	Total
Reoperation for bleeding	1	0	1
Decortication	2	0	2
Decortication + Thoracoplasty	1	0	1

Discussion:

Aspergillus fumigatus spores are ubiquitous in the environment and frequently detected in sputum cultures. Saprophytic colonization of pre-existing pulmonary cavities, primarily in the upper lobes, can lead to the formation of a fungus ball, or aspergilloma. An aspergilloma is a rounded, necrotic mass composed of matted hyphae, fibrin, and inflammatory cells, typically free-floating within the cavity. Radiographic and CT scans reveal a characteristic crescentic radiolucency.The cavitary disease often stems from previous chronic lung conditions such as tuberculosis, sarcoidosis, histoplasmosis, bronchiectasis, bronchogenic cysts, chronic lung abscesses, or cavitating carcinoma. In rare cases, no evident pre-existing pulmonary damage is apparent. Numerous studies have identified an open healed tuberculous cavity as the most common antecedent lung lesion, with up to 17% of patients developing aspergilloma within a three-year observation period [12]. European reports frequently link pulmonary aspergillomas

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to a history of tuberculosis, while North American studies indicate a lower incidence of tuberculosis [1]. In our experience, tuberculosis was the underlying cause of cavitary lung disease with fungus ball formation in 76% of cases.

Hemoptysis remains the most common symptom of pulmonary aspergilloma, varying in severity from mild to severe and potentially life-threatening, especially in the intracavitary type. Previous studies [13, 14] have reported hemoptysis incidence rates ranging from 50% to 83% in patients with aspergilloma, with severe or recurrent bleeding occurring in 10% [13], aligning with our findings of 76% haemoptysis and 12% bleeding respectively.Bleeding typically originates from bronchial arteries and often resolves spontaneously. Several mechanisms have been proposed for hemoptysis, including erosion of the vascular cyst wall due to mycetoma movement, endotoxin production by the fungus, and underlying lung disease [15]. Intercostal artery bleeding is also a potential source. The myotic process may extend into surrounding lung parenchyma, leading to erosion of intercostal arteries [14]. Such bleeding from larger arteries is less likely to stop spontaneously and carries a higher risk of fatality. Factors like lesion size, complexity, warning minor hemoptysis, or underlying disease do not reliably predict patients prone to life-threatening hemoptysis [3].

Lobectomy was the most frequently performed surgical procedure in our series, accounting for 88% of cases, followed by cavernostomy, segmentectomy, and pneumonectomy. Pneumonectomy and lobectomy were particularly challenging due to severe adhesions, as noted in a previous study [16]. Postoperative complications were influenced by the underlying lung lesions. Bleeding, a potential complication, is often associated with the extent of intrapleural adhesions. Meticulous hemostasis should be prioritized to minimize the need for extrapleural dissection, and electrocautery is commonly used for adhesion lysis.The primary objective of surgical intervention is to resect pulmonary cavities adjacent to pulmonary vessels, thereby preventing potentially fatal hemoptysis while minimizing parenchymal resection to preserve lung function. There is no universal consensus regarding the optimal management of pulmonary aspergilloma. Gerstl and colleagues (17) reported successful lobectomy for pulmonary aspergillosis in 1948, establishing surgical resection as a widely accepted treatment for intracavitary mycetomas (fungus balls). Lobectomy is generally preferred, but segmentectomy may be considered for certain cases. Pneumonectomy is reserved for extensive disease or multiple unilateral aspergillomas, particularly when there is significant diffuse infiltration surrounding destroyed lung tissue (e.g., from previous tuberculosis) and an associated fungus ball in one of the affected lobes.(18)

Historical reports indicated overall mortality rates of 22% [18], reaching as high as 34% for complex aspergilloma. However, recent studies have demonstrated significant reductions in morbidity and mortality [19]. In the present study, the overall operative mortality rate was less than 4% . Our less mortality rates compared to previous studies are attributed to meticulous preoperative preparation, careful patient selection, our institution's experience in thoracic surgery, and effective postoperative management. No recurrence of aspergilloma or hemoptysis was observed during the follow-up period of our patients.

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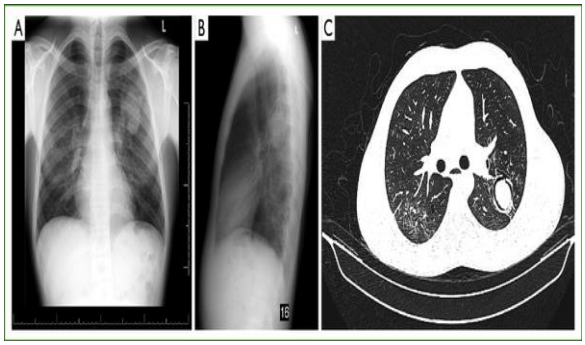
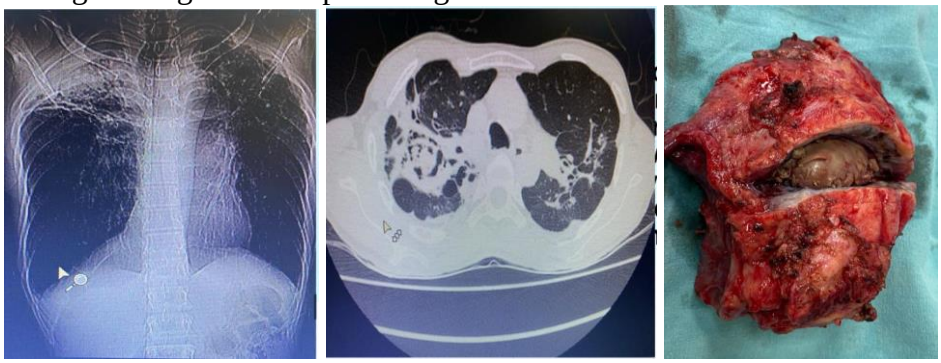
XRAY AND CT IMAGES OF SIMPLE AND COMPLEX ASPERGILLOMA



Radiology of a simple aspergilloma. (A) PA chest x-ray; (B) Lateral view. Note the air-crescent sign; (C) CT picture of the same aspergilloma

PA chest x-ray showing a complex Aspergilloma in the left upper lobe; (B) Coronal CT scan of the complex aspergilloma; (C) Axial CT picture of the complex aspergilloma; (D) CT scan of the same patient showing the diffuse bronchectasis and cavitation involving the lingula and superior segment of the left lower lobe.



Conclusion

Pulmonary aspergilloma, a fungal infection frequently encountered in developing countries like India with high rates of tuberculosis, can be effectively treated through surgical resection. This procedure is considered the gold standard for preventing recurrent symptoms, especially hemoptysis. Early surgical intervention, accompanied by thorough preoperative preparation, meticulous surgical technique, and diligent postoperative chest physiotherapy, can significantly reduce the rate of complications. While complications may still arise, particularly in cases with underlying lung pathology, the long-term prognosis for patients undergoing surgical resection of pulmonary aspergilloma is generally positive.

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