

Surgical treatment of pulmonary aspergilloma

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Background. Evaluating the clinical findings and results of surgical treatment of pulmonary aspergilloma, the authors describe their experience in surgical treatment of pulmonary aspergilloma and postoperative complications rates.

Materials and methods. 54 patients (pts) with pulmonary aspergilloma were operated from 1979 to 2006 in the Department of Thoracic Surgery and Oncology, Institute of Oncology, Vilnius University. Most common clinical symptom of pulmonary aspergilloma was haemoptysis, which occurred in 47 pts (87%). Tuberculosis was the most common pre-existing disease in 35 pts (64.8%).

Results. Conventional chest X-rays showed typical 'air-crescent' sign in 41 pts (75.9%). 55 operations were performed for 54 pts (including one bilateral resection): lung resections for 50 pts (92.5%), segmentectomy in 14 pts (25.9%), lobectomy in 26 pts (48.1%), pneumonectomy in 10 pts (18.5%), pleurectomy in 2 pts (3.7%) and cavernostomy in 3 pts (5.5%). Postoperative complications occurred in 15 pts (27.7%): empyema in 5 pts (33.3%), massive bleeding in 3 pts (20%), bronchopleural fistula in 2 pts (13.3%), wound infection in 2 pts (13.3%), and residual pleural space in 3 pts (20.0%). Conservative treatment of the complications was effective.

Conclusions. 1. Surgery for aspergillomas is mandatory in cases of appearance of clinical manifestation of the disease and disease progression: bleeding from lungs; tumour size enlargement during conservative treatment and adequate pulmonary function. 2. The main surgical operation in case of aspergilloma is lung resection performed in 50 patients (92.5%) of this group. Postoperative complications were observed in 15 patients (27.7%). All patients recovered.

Key words: aspergilloma of the lung, tuberculosis of the lung, haemoptysis, thoracic surgery

INTRODUCTION

Pulmonary aspergilloma is a chronic fungal infection characterised by intractable haemoptysis and by an 'air-crescent' sign in the chest X-rays or CT (1). Surgical resection of aspergilloma is the best treatment. Antifungal agents are usually ineffective against this lesion (2, 3).

This disease is associated with fungal agent, namely, *Aspergillus fumigatus*. *Aspergillus* may enter and grow in various pulmonary cavities after antibacterial treatment and stabilization of inflammation (4, 5).

Aspergilloma usually occurs in tuberculosis cavities, pulmonary abscesses, cysts, bronchiectases, necrotic malignant cavity and pleural spaces (6, 7).

Aspergillus may occur in the lungs by airborne transmission. Aspergillosis for healthy people is rare. The disease usually develops when a large dose of *Aspergillus fumigatus* infect the body. Usually we observe secondary aspergillosis which manifests as disseminated or localized form of aspergilloma.

In the initial stage *aspergillus* grows rather rapidly. Microscopy of sputum or bronchial aspiration is the diagnostic

method for *aspergillus*. Fibrinolytic substance produced by *aspergillus* micelles induces caseous necrosis of tissues, and this is the cause of haemoptysis (8, 9).

However, in case of chronic disease – progressive inflammation constriction or occlusion of bronchus – is observed. In this case patients show no blood traces in the sputum, smear is negative for mycobacterium, and only serological reaction is positive.

In the second stage, fungal micelles can degenerate, and autolysis usually occurs because of lack of oxygen, and nutrition and dead sequester is formed from *aspergillus* ball. In such cases fungi cultures are negative.

Sometimes aspergilloma develops rapidly, and the outcome can be lethal. Conservative drug therapy is ineffective because drug concentration is insufficient in pathological focus (10).

Patients with pulmonary aspergilloma often cough up blood sputum, and intensive haemoptysis is not rare, therefore, emergency surgery is often needed (11, 12).

Our approach to therapy varies depending on the patient's condition and severity of symptoms. In patients who are good candidates for surgery, we advise surgery, if they are symptomatic, diagnosis is in doubt. In asymptomatic patients we also use surgery because of massive haemorrhage threat. Our aim is to share our experience in the surgical treatment of pulmonary aspergilloma, to discuss the rates of postoperative complications.

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MATERIALS AND METHODS

Principal diagnostic methods of aspergilloma include: chest X-ray, bronchology, computer tomography (CT), bacteriology, precipitin and complement fixation tests, skin hypersensitivity (aspergillin) tests and histological investigations.

We retrospectively analyzed 54 pts who underwent thoracotomy for pulmonary aspergilloma from 1979 to 2006 in the Department of Thoracic Surgery and Oncology, Institute of Oncology, Vilnius University. Clinical characteristic of the patients who underwent surgery are summarised in Table 1.

Table 1. 54 patients with pulmonary aspergilloma prior to surgery

Variable	n
Age (years, mean)	54.3
Male/female	40/14
Diseased site:	
– right	29 (53.7%)
– left	24 (44.4%)
– bilateral	1 (1.8%)
Episodes of haemoptysis	47 (87%)
History of pulmonary tuberculosis	35 (64.8%)
Other underlying pulmonary diseases:	
– bronchiectasis	5 (9.3%)
– bronchogenic cyst and emphysematous bullae	4 (7.4%)
– lung abscess	4 (7.4%)
– cavernous bronchial adenocarcinoma	5 (9.3%)
– pleural empyema	2 (3.7%)

Haemoptysis was the most common symptom which occurred in 47 pts (87%). 17 pts (31.5%) had severe haemoptysis (more than 200 ml in less than 24 hours), and five (9.2%) had life threatening haemoptysis. Tuberculosis was the most common pre-existing disease, occurring in 35 pts (64.8%).

Routine chest radiograph showed the typical 'air-crescent' sign in 41 pts (75.9%).

Surgery was performed under general anaesthesia with a double lumen tube. Chest was opened via a standard lateral thoracotomy via the fifth or the sixth intercostal space. Pleural space was often obliterated with fibrous and vascular adhesions. Lobe(s) were mobilised by extrapleural dissection, avoiding entry to the infected cavity.

High risk of surgery for aspergilloma is primarily due to the associated technical difficulties, while secondarily, due to the obliterated pleural space, indurated hilar structures and failure of the residual lung tissue to expand after operation.

Criteria for surgery: patients must be symptomatic, lesion should not be widespread, an uncontrollable superimposed bacterial infection exists; patients must be assessed as being able to tolerate a surgical procedure and conservative treatment including the intracavitary instillation of antifungal drugs.

In general, we do not operate on patients who have active and massive haemoptysis. Instead, the airway is secured and conservative attempts (selective intubation, balloon tamponade, embolization) are used to control bleeding. Surgical candidates need to have adequate pulmonary function to undergo operation. Resection is contraindicated in patients with com-

promised lung function (FEV < 40%) and in those with bilateral disease.

Chirurgical procedures varied from segmentectomy to pneumonectomy with most undergoing lobectomy. The extent of lung resection was determined by the amount of involvement by the aspergilloma and the degree of lung function. Pneumonectomy was chosen based upon the location of the aspergilloma and extent of the underlying disease as well as upon the patient's pulmonary reserve. Pneumonectomy was performed either extrapleurally or intrapleurally depending on the degree of pleural adhesions. The main stem bronchus was divided and closed with staples in 5 patients, except the patient for whom hand sutured bronchial closure was used. Bronchial stump was covered with *latissimus dorsi* muscle flap in all the patients. The pleural cavity was irrigated with a least 4 l of saline and povidone iodine, and then the chest was drained.

Resection is usually contraindicated in patients with compromised lung function and/or bilateral disease. Our results confirm cavernostomy and myoplasty as an effective therapy for pulmonary aspergilloma with haemoptysis. Cavernostomies were performed under general anesthesia via a 4–5 cm incision overlying the cavity, guided by the CT scans. Pleural cavity was identified and incised, and the fungal ball was removed. A short segment of the overlying rib was then excised before inserting a chest drain. The ipsilateral *latissimus dorsi* muscle was mobilized from its distal attachment, then tunnelled and fixed into the residual cavity.

Five patients (9.2%) underwent angiography but embolisation was successful only in 2 pts as it was difficult to identify most of the affected vessels. All of these patients finally resorted to surgery.

RESULTS

During the period of 27 years 55 operations (bilateral segmentectomy in one patient) were performed in the Department of Thoracic Surgery and Oncology, Institute of Oncology, Vilnius University. Surgery was performed for the patients for whom conservative treatment was ineffective.

The extent of resection depends on the extent of pathology, including underlying disease. Lobectomy is the preferred procedure, but segmental resection may be indicated in patients with impaired respiratory reserve. Bilateral disease is not contraindicated for surgical resection. Pneumonectomy is done only when there is a significant surrounding lung tissue destroyed. Patients with poor pulmonary function and bilateral disease have limiting resectability. Cavernostomy following thoracoplasty is usually recommended for such patients.

We performed lung resections in 50 pts (90.9%): segmentectomy in 14 pts (25.9%), lobectomy in 26 pts (48.1%), pneumonectomy in 10 pts (18.5%), pleurectomy in 2 pts (3.7%), and cavernostomy with subsequent thoracoplasty in 3 pts (5.5%).

Postoperative complications occurred in 15 pts (27.7%) (Table 2).

Pleural empyema was the most common complication (in 5 pts (33.4%)), while the most serious one was a bronchopleural fistula (in 2 pts (13.3%)). The latter was corrected by additional thoracostomy tube for a located pneumothorax or cavi empyema. All other complications responded to conservative measures

Table 2. Postoperative complications

Complications	Segmentectomy	Lobectomy	Pneumonectomy	Pleurectomy	Cavernostomy with thoracoplasty	N (%)
Apical residual space	1	2				3 (20.0%)
Bronchopleural fistula		2				2 (13.3%)
Pleural empyema		2	1	1	1	5 (33.4%)
Massive bleeding			1	1	1	3 (20.0%)
Wound infection			1	1		2 (13.3%)
Total n (%)	1 (6.7)	6 (40.0)	3 (20.0)	3 (20.0)	2 (13.3)	15 (100%)

(antibacterial therapy, revision of wounds, insertion of additional thoracostomy tube).

We had no postoperative deaths. Antifungal therapy (Amphotericin B, Itraconazole, Voriconazole, Terbinafine) was prescribed to all the patients before and after operations.

DISCUSSION

The natural history of pulmonary aspergilloma varies from spontaneous lysis to recurrent life threatening haemoptysis (11, 12).

Soubani, Chandrasekar (2002), Regnard, Icord, Nicolosi (2000) and Lin, Schranz, Teutsch (2001) pointed out that fungi grow in a pre-existing cavity, either in the lung or a dilated bronchus. Patients with aspergilloma are usually non typical and have chronic underlying lung diseases including advanced tuberculosis, bronchiectasis, interstitial fibrosis or emphysema, solid or cavitating neoplasm, abscess cavity containing necrotic tissue (5, 6, 13).

Daly, Kavanagh (2001) underlined, that interval between diagnosis of pulmonary tuberculosis and development of aspergilloma may vary from 2 to 25 years. Approximately 80% of aspergillomas develop after the treatment of cavernous tuberculosis (14). The cause of haemoptysis is erosion of a bronchial artery. Neither the size of the lesion, nor associated clinical features predict the development of life-threatening complication.

Lin, Schranz, Teutsch (2001) pointed out, that mobile fungi toxins and enzymes damage hypervascularized cavity and cause haemoptysis. In addition, haemoptysis could be a result of combined lung pathology and not directly related with aspergilloma itself (13).

Common diagnostic methods of aspergilloma include radiography, bronchology, computer tomography (CT), bacteriology, precipitin and complement fixation tests, skin hypersensitivity tests and histological investigations. Chest X-ray shows the typical 'air-crescent' sign in patients with aspergilloma. The necrotic masses, inflammatory cells, fibrin and blood which usually lie free within the cavity is aptly termed a fungus ball (5, 6).

Serum precipitating antibodies (Ig G) are almost always present, initially in high concentration, but become weaker and even negative, if the fungus ball is taken out.

Yamamoto (1997) draws a conclusion that precipitin is associated with present or recent fungal growth in the body

tissues, with obvious aspergilloma formation or occult involvement by the fungus (15).

Regnard, Icord, Nicolosi (2000), Ueda, Okabayashi, Ondo (2001) point out, that lobectomy is usually required to encompass all of the disease, occasionally, due to the saprophytic character of the organism, a segmentectomy or wedge resection can be done. Pneumonectomy is performed only when there is a massive destruction of surrounding lung tissue. Cavernostomy and myoplasty as a single stage are safe, and are used in patients with compromised lung function or bilateral disease (6, 10). We think that the effective operation for lung aspergilloma is lung resection (92.5%).

Gossot, Validire et al. (2002) and Nakajima, Takanoto et al. (2000) underlined, that videothoroscopic surgery has become prevalent for pulmonary surgery, because of its minimal invasiveness. Pulmonary wedge resection using videothoracoscopy is one of the easiest surgical procedures to perform and is applicable to the resection of aspergilloma when lesion is small and located in the lung periphery, and when the pleural cavity is not so obliterated with the dense fibrous adhesions that are often observed in pulmonary tuberculosis (15–17).

Bronchial artery embolization rarely gives a permanent success, but may be useful as a temporary procedure for patients with life-threatening haemoptysis. The procedure is often ineffective because of the difficulty in identifying the bleeding vessel. Furthermore, even in case an attempt to embolise the vessel succeeds, bleeding may not stop because of the massive collateral circulation frequently seen in advanced disease (18).

Currently, surgical resection is the only logical therapy for aspergilloma. Resection should be planned and performed early before the appearance of massive haemoptysis or progression of the primary pulmonary disease to the advanced fibrosis stage making the patients unfit for surgery. In our case, 50 pts (92.5%) underwent surgery.

The outcome may be good in many patients, but it depends on the severity and other factors. In selected cases, surgery can be very effective when successful, but this surgery is complex and can produce a high risk of serious complications. Many patients never develop symptoms and do not need any form of treatment.

Our results obviously show that treatment of these patients needs to be individualized, depending on the borderland and location of the disease and the patients' general condition.

CONCLUSIONS

1. Surgery for aspergillomas is mandatory in cases of: appearance of clinical manifestation of the disease or disease progression:

- bleeding from the lungs;
- tumour size enlargement during conservative treatment and adequate pulmonary function. Surgery is prohibited when fungal disease is widely spread in both lungs.

2. The main surgical operation in case of aspergilloma is lung resection. We performed resections in 50 patients (92.5%) of our group. Postoperative complications were observed in 15 patients (27.7%). All patients recovered.

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PLAUČIŲ ASPERGILOMOS CHIRURGINIS GYDYMAS

S an t r a u k a

Šio darbo tikslas – įvertinti plaučių aspergilomos chirurginio gydymo rezultatus. Vilniaus universiteto Onkologijos institute 1979 m. sausį – 2006 m. gruodį nuo plaučių aspergilomos buvo gydyti 54 ligoniai. Ligos sukėlėjas yra pelėsinis grybelis iš *Aspergillus fumigatus* giminės, kuris apsigyvena įvairiose plaučių ertmėse po intensyvaus priešbakterinio gydymo. Kai uždegimas stabilizuojasi, susidaro palankios sąlygos jam vegetuoti. Dažniausiai tai lokalizuota antrinė aspergiliozė, dar vadinama aspergiloma. Pagrindiniai aspergilomos diagnostikos metodai: rentgenologinis ir CT, taip pat bronchologinis, bakteriologinis, serologinis (teigiamos precipitacijos, komplemento surišimo ir aglutinacijos reakcijos), alerginiai odos mėginiai (aspergilino testas) ir histologinis tyrimas. Patologinis rentgeno vaizdas – apvalus ar ovalus darinys, kurio viršuje matyti pusmėnulio ar vainikėlio formos prašviesėjimas (oro juostelė), nustatytas 41 (75,9%) ligoniui. Pagrindinis klinikinis simptomas – pakartotinis atsikosėjimas krauju bei kraujavimas iš plaučių, kurį sukelia aspergilų mielių gaminama fibrinolitinė substancija, lemianti audinių kazeozinę nekrozę, patvirtintas 47 (87,0%) pacientams.

Konservatyvus gydymas antigrybeliniais vaistais yra neveiksmingas, kadangi net suleidžiant juos į veną nepavyksta pasiekti didelės vaisto koncentracijos pataliginio židinio vietoje. Jei aspergiloma sukelia kraujavimą, tais atvejais būtina taikyti chirurginį gydymą. Penkiasdešimt keturiems ligoniams buvo atliktos 55 operacijos (vienam – abipusė segmentektomija): 14 (25,9%) atlikta segmentektomija, 26 (48,1%) – lobektomija, 10 (18,5%) – pulmonektomija, 2 (3,7%) – pleurektomija, kavernostomija, o vėliau ir 3 (5,5%) – torakoplastika.

Pooperaciniu periodu 15 (27,7%) ligonių komplikacijos nustatytos: pleuros empiema – 5, gausus kraujavimas – 3, broncho pleurinė fistulė – 2, žaizdos supūliavimas – 2, liktinė pleuros ertmė – 3 ligoniams. Visos komplikacijos pašalintos konservatyviomis priemonėmis.

Klinikinių ir patomorfologinių tyrimų duomenimis, pelėsiniai grybeliai atsirado: kavernos ertmėje – 35 (64,8%) ligoniams, bronchoektotinėse ertmėse – 5 ligoniams (9,3%), plaučio cistose bei emfizeminėje buloje – 4 ligoniams (7,4%), absceso ertmėje – 4 ligoniams (7,4%), plaučio vėžio destruktinėse ertmėse – 5 ligoniams (9,3%) ir pleuros ertmėje po pūlingo uždegimo – 2 ligoniams (3,7%).

Išvados:

Plaučių aspergiloma gydoma chirurginiu būdu, kai:

- yra išreikšta klinikinė simptomatika (į taikytą priešgrybelinį gydymą neatsižvelgiama);
- liga progresuoja – atsiranda kraujavimas iš plaučių;
- taikant konservatyvų gydymą padidėja aspergilomų apimtis (matyti rentgenogramose);
- yra pakankama plaučių išorinio kvėpavimo funkcija;

Chirurginis gydymas netaikomas, kai grybelinis procesas yra išplitęs abiejose plaučių pusėse.

Pagrindinė aspergilomos chirurginė operacija – plaučių rezekcija – buvo atlikta 50 ligonių (92,5%). Pooperacinės komplikacijos patvirtintos 15 ligonių (27,7%). Visi ligoniai pasveiko.

Raktažodžiai: plaučių aspergiloma, plaučių tuberkuliozė, kraujavimas iš plaučių, krūtinės chirurgija