Treatment of Pulmonary Aspergilloma in Srinagarind Hospital

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Background: *Controversy still exists concerning the optimum management of aspergilloma.*
Objective: *To evaluate clinical data of patients, the indications for surgery, postoperative complications and results of all treatments of pulmonary aspergillosis compare with data from review literature, to find out the optimum management.*
Material and Method: *The authors retrospectively reviewed medical records of 45 patients at Srinagarind Hospital who had pulmonary aspergilloma between 1993 and 2008. General data, associated diseases, symptoms, organs involvement, treatments, surgical indications, procedures and complications, and outcome were collected for analysis.*
Results: *Associated diseases were found in 33 patients (73.3%). Tuberculosis was the most common underlying causes. Hemoptysis, the most frequent symptom, occurred in 29 patients (64.4%). If 40 patients, they only had lung lesion although 5 patients had multiple organ-involvement. Surgery was performed in 24 patients (53.3%). Hemoptysis was the most common indication and lobectomy was the most frequent procedure. Postoperative complications occurred in 5 cases (20.8%) and mortality rate after surgery = 4.2%. Embolization was done on 4 patients; none of them re-bled. Clinical outcome improved in 36 cases (80%), did not improved in 6 patients (13.3%), and resulted in 3 patients' death (6.7%).*
Conclusion: *The most common indication for surgery was hemoptysis. Recurrence of hemoptysis was found in all patients who received selective bronchial artery embolization. Surgical resection is the treatment of choice with acceptable postoperative complications and mortality rate.*

Keywords: *Pulmonary aspergillosis, Hemoptysis, Indication for surgery*

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In 1952, Hinson and colleagues classified pulmonary aspergillosis: (1) Pulmonary aspergilloma (Fig. 1), the most frequent manifestation of aspergillosis, generally resulting from colonization of an existing lung cavity by *Aspergillus fumigatus* (Fig. 2), the most common saprophytic species of aspergillus in human disease, producing a fungal ball or mycetoma; (2) the allergic bronchopulmonary aspergillosis (ABPA), which is an immuno-reaction of the lung to the allergen; (3) Invasive aspergillosis, affecting all organs, particularly the lung (invasive pulmonary aspergillosis: IPA) and a severe complication in immuno-compromised or neutropenic patients (Fig. 3).

Controversy still exists concerning the optimum management of aspergilloma. The purpose of the present study was to evaluate clinical data of patients, the indications for surgery, results of all treatment of pulmonary aspergilloma and postoperative

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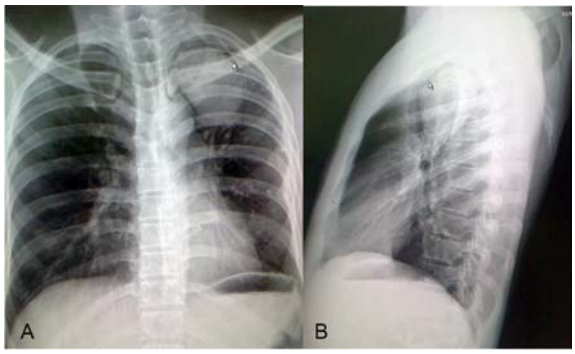

Fig. 1 (A) Chest x-ray PA upright and (B) Left lateral view from a 42 years old man who was diagnosed pulmonary aspergilloma, showing a solid mass with an air crescent.

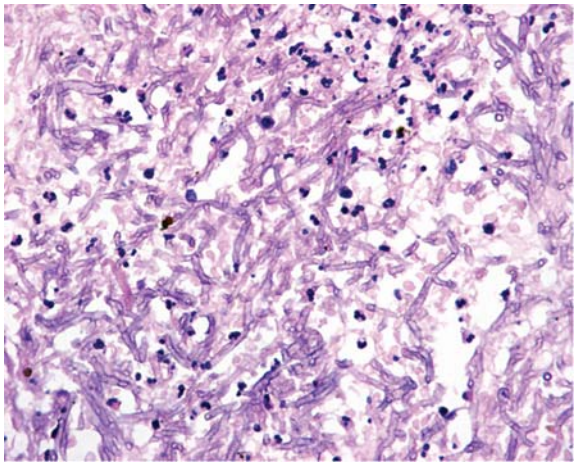

Fig. 2 Aspergillus hyphae – stain, periodic acid-Schiff, original magnification = 400. [From Bernhard C Danner, Surgical treatment of pulmonary aspergillosis/mycosis in immunocompromised patients, Interact CardioVasc Thorac Surg 2008; 7: 771-776].

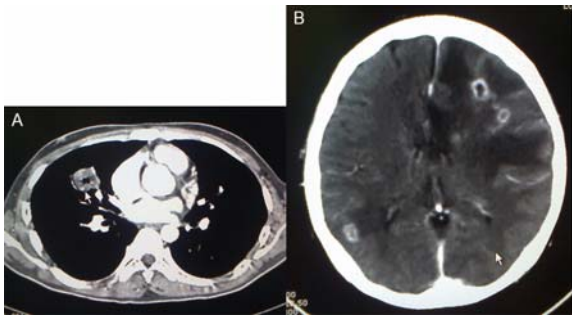

Fig. 3 (A) CT-chest showing irregular wall cavity lesion at lateral segment of right middle lobe and (B) CT-brain with contrast media showing multiple thick wall with irregular cavity lesions at grey-white matter junction of left frontal lobe and right anterior aspect of occipital lobe, from a 18 years old man who was diagnosed T-cell ALL, and invasive aspergillosis.

complications.

Material and Method

The medical records of 45 patients who were diagnosed of having pulmonary aspergilloma between 1993 and 2008 were revealed. Retrospective studies of the patients treated at the Srinagarind Hospital, Khon-Kaen University, Thailand were performed. Age groups, sex, associated diseases, clinical manifestations, organs involvement (only lung lesion or multiple organs involvement such as brain, skin, cornia, maxillary sinus), choice of treatments, surgical procedures, indications for surgery, postoperative complications, and outcome of all treatments were collected for statistical analysis by frequency and percentage. This research was certified by the Retrospective Study in Human Ethic Committee.

Results

Age groups and sex

Patient's age groups were childhood in 5 patients (11.1%), young adult in 14 patients (31.1%), middle aged in 18 patients (40%), late middle aged in 5 patients (11.1%), and elderly aged in 3 patients (6.7%). Twenty-six patients (57.8%) were male, nineteen patients (42.2%) were female (Table 1 and 2).

Associated diseases

Associated diseases were present in 33 patients (73.3%). Tuberculosis in 16 patients (35.6%), hematologic malignancy such as leukemia in 13 patients (28.9%), bronchiectasis in 6 patients (13.3%), and autoimmune disease such as systemic lupus erythematosus (SLE) in 4 patients (8.9%) (Table 3).

Symptoms

Hemoptysis, the most frequent symptom, occurred in 29 patients (64.4%). Fever occurred in 22 patients (48.9%), cough in 16 patients (35.6%), dyspnea in 10 patients (22.2%), pleuritic chest pain in 5 patients (11.1%), and weight loss in 5 patients (11.1%) (Table 4).

Organs involvement

According to the organ-involvement, 40 patients (88.9%) had only lung lesions and 5 patients (11.1%) had lung lesion with the other organ-involvement such as brain, skin, cornia and maxillary sinus (Table 5).

Treatments

Surgical procedures were performed on 24

Table 1. Age groups

Age groups	No. of patients (n = 45)	%
Childhood (0-15 yr)	5	11.1
Young adult (16-35 yr)	14	31.1
Middle aged (36-55 yr)	18	40.0
Late middle aged (56-65 yr)	5	11.1
Elderly aged (>65 yr)	3	6.7
Total	45	100.0

Table 2. Sex

Sex	No. of patients (n = 45)	%
Male	26	57.8
Female	19	42.2
Total	45	100.0

Table 3. Associated diseases (one patient may have >1 diseases)

Associated diseases	No. of patients (n = 45)	%
Tuberculosis	16	35.6
Hematologic malignancy (such as Leukemia)	13	28.9
Bronchiectasis	6	13.3
Autoimmune disease (such as SLE)	4	8.9

Table 4. Symptoms (one patient may have >1 symptoms)

Symptoms	No. of patients (n = 45)	%
Hemoptysis	29	64.4
Fever	22	48.9
Cough	16	35.6
Dyspnea	10	22.2
Pleuritic chest pain	5	11.1
Weight loss	5	11.1

Table 5. Organs involvement

Organs involvement	No. of patients (n = 45)	%
Only lung lesion	40	88.9
Lung lesion with the other organ (brain, skin, cornia, maxillary sinus)	5	11.1

patients (53.3%); Lobectomy the most frequent procedure, in 23 patients (95.8%). In only one patient was segmentectomy performed (Table 6).

The medical treatment by antifungal agents such as itraconazole and amphotericin B were used in 21 patients (46.7%) (Table 6). Clinical outcome was improved by medication only in 11 patients (52.4% of all antifungal agents used). In this group, failed medical treatment required surgery on 7 patients (33.3% of medical therapy).

Four patients had massive hemoptysis; selective bronchial artery embolization were performed (Table 6). All of these were failed re-bleeding, and proceeding to surgery. Of the embolization patients, two patients' hemoptysis was stopped after lobectomy. One patient died after lobectomy from acute leukemia. One of these refused the operation and was refer for supportive care near their home.

Indications for surgery

The indications for operation are hemoptysis in 20 patients (83.3%), mass- likened lesion which could not exclude bronchogenic carcinoma in 3 patients (12.5%): cough in 2 patients (8.3%), and empyema in 1 patient (4.2%) (Table 7).

Postoperative complications

The postoperative complications occurred in 5 cases (20.8% of all surgical treatment). Empyema occurred in 2 cases (8.3%), was successfully managed with prolonged tube drainage and proper antibiotics. Bleeding occurred in 2 cases (8.3%), bronchopleural fistula in 1 case (4.2%), and sepsis after surgery in 1 case (4.2%) (Table 8).

Mortality after surgery occurred in 1 case (4.2%) due to septicemia and septic shock which developed within a few days of surgery.

Overall outcome of all treatments

Clinical outcome was improved in 36 patients (80%), not improved in 6 patients (13.3%), and resulted in death in 3 patients (6.7%). One patient died from postoperative complications and two from the underlying diseases (Table 9).

Discussion

The spores of *Aspergillus* organism, among which *A. fumigatus* is widespread in the environment and commonly found in sputum cultures. They are usually of low virulence in immuno-competent hosts. But it can cause aspergilloma as a result of saprophytic colonization of an existing lung or pleural cavity infection, which may lead to the production of a fungal ball. In immuno-compromised patients, *Aspergillus* infection can progress to invasive bronchopulmonary diseases[4,7].

Tuberculosis and lung abscess were the most common underlying causes of lung disease[1,2,5].

Table 6. Choices of treatment (may have >1 treatment in one patient)

Treatments	No. of patients (n = 45)	%
Operation	24	53.3
Lobectomy	23	95.8 (of all operations)
Segmentectomy	1	4.2 (of all operations)
Medication (such as amphotericin B, itraconazole)	21	46.7
Selective bronchial artery embolization	4	8.9

Table 7. Indications for surgery (may have >1 indications in one patient)

Indications	No. of patients (n = 24)	% (of all operations)
Hemoptysis	20	83.3
Mass lesion(can't be excluded bronchogenic carcinoma)	3	12.5
Cough	2	8.3
Empyema	1	4.2

Table 8. Postoperative Complications (may have >1 complications in one patient)

Complications	No. of patients (n = 24)	% (of all operation)
Empyema thoracis	2	8.3
Bleeding	2	8.3
Bronchopleural fistula	1	4.2
Sepsis	1	4.2

Table 9. Overall outcome of all treatments

Outcome	No. of patients (n = 45)	%
Improved	36	80.0
Not improved	6	13.3
Dead (from after surgery & underlying diseases)	3	6.7
Total	45	100.0

MacPherson estimated the prevalence of aspergilloma at 0.01% based on a 10-year survey of chest radiographs in a population of 60,000 patients. A British cooperative study found that patients with a history of tuberculosis and thick-walled lung cavities of more than 7-years' duration had a higher risk of aspergilloma[1,11]. Invasive pulmonary aspergillosis is a severe complication in immuno-compromised or neutropenic patients. The cause of immuno-suppression was a hematological disease and chronically corticoid therapy[3].

The most common symptom is hemoptysis. In previous series, the incidence of hemoptysis in patients with aspergilloma ranged from 50% to 83%, and it was severe or recurrent in 10%[1,2,8-10]. Bleeding generally occurs from bronchial arteries and usually stops spontaneously. Mechanisms for hemoptysis include erosion of the vascular cyst wall by the motion of the mycetoma, elaboration of endotoxin by the fungus, and the patient's underlying disease[1,4]. Bleeding could be from intercostals arteries by extension of the mycotic process with parenchymal destruction at the periphery of the lung invading the adjacent chest wall may lead to erosion of the intercostals arteries[4,5].

The diagnosis of aspergilloma is usually made by the characteristic appearance of a fungal ball on a chest radiograph or chest computed tomography. The most characteristic radiological changes are a solid mass with an associated crescent of air[6,12]. These masses may move freely within the cavity upon changes in the

position of the patient. The serum test for precipitins has been found to be both a sensitive and specific method for detecting antibodies to *A. fumigatus*. Babatasi and colleagues have reported immuno-diffusion tests detected precipitins in 78% of patients[5]. However, the definitive diagnosis of aspergilloma is established by demonstrating and culturing the organism from a resected specimen[1].

With the widespread use of chemotherapy, invasive pulmonary aspergillosis is increasingly reported, occurring in up to 20% of patients who undergo treatment of acute leukemia[5]. Some authors have advocated the prophylactic resection of all pulmonary aspergillomas because of the risk of massive hemoptysis. Other authors recommend surgical treatment only after hemoptysis has occurred. A proportion of the patient population will have advanced chronic lung disease to a degree that eliminates the surgical option. Some authors consider that surgical resection should be avoided because of the high incidence of postoperative complications.

With the improvement of the surgical techniques, aggressive surgery offers, even in asymptomatic patients, 4 potential benefits: prevention of hemoptysis, eradication of the pyogenic component, limitation of the symptoms as the result of invasive aspergillosis or increased growth of the mycetoma, and prolongation of life[1,5,6]. The most common indications of the surgical treatment were hemoptysis[4,5]. Lobectomy was the most common procedure performed[1,4]. The main goal of surgery was to resect pulmonary lesions to prevent fatal hemoptysis[5].

Lobectomy and segmentectomy are the preferred procedures, but wedge resection should be reserved for patients with either a small peripheral lesion or poor respiratory function. Pneumonectomy was associated with a high morbidity rate and this should be reserved for a few selected patients such as technical reasons that were attributed to adhesions around the hilar structures[1]. Cavernostomy is an alternative surgical procedure for patients who cannot tolerate planned lung resection: this was performed under local or regional anesthesia. The cavity was incised, and the fungal ball was removed. A short segment of the overlying rib was excised before the insertion of chest drain and underwent daily dressing changes and local instillation of amphotericin B[5,8].

Pleural space problems were the most common postoperative incidents in all series although postoperative bleeding was a common complication in some reports[1]. Bronchopleural fistula may lead to life-threatening complications such as respiratory insufficiency, empyema, and aspiration of purulent material to the healthy lung. It must be treated energetically. Some patients can be treated with drainage and irrigation only; however, surgical closure of the fistula and thoracoplasty or myoplasty may be necessary.

In our institute, the postoperative complication rate was 20.8% and the mortality rate was 4.2%. It compared with Demir and colleagues report in 2006 which reported the postoperative complication rate was 24.4% and the mortality rate 2.4%[1].

In patients with an invasive or pyogenic component, there exists the possibility of postoperative bronchopleural fistula and empyema. It could be helpful to cover the resected bronchus with a pericardial, pleural, or omental flap[5].

Bleeding is dependent on the severity of pleural thickening or symphysis and pleural space problem is dependent on parenchymal condition[4]. According to the univariate analyses, the predictors of major complications were sex, severe pre-operative symptoms, and extensive pulmonary resection[7]. Hypervascularization of the bronchial or intercostals arteries caused by chronic infection and dead space problems from the underlying lung disease may be related to complications. The risk of postoperative complications may be minimized by the following 2 strategies. First, emergency surgery should be avoided whenever possible and massive hemoptysis should be controlled preoperatively by arterial embolization, which can save time and produce better conditioning for surgery and multidrug treatment can also be given to stabilize infection. Second, the possibility of postoperative space complications, especially after extensive pulmonary resection, should also be considered. Several reports have suggested performing techniques such as thoracoplasty, muscle prombage, decortication, or pleural tenting after resection[7].

Although treatment with selective bronchial artery embolization may be helpful in the cessation of hemoptysis, this was considered a temporary measure, and it may be unsuccessful in the presence of massive collateral circulation. Moreover, it is not possible to eradicate aspergilloma in this manner[4-7].

The diagnosis of invasive aspergilloma, which affects mostly the lung, could be difficult as up to one third of patients have no early clinical signs. Progressive fever and cough are early signs but unspecific. Systemic antifungal agents such as amphotericin B, itraconazole, micafungin, voriconazole (given orally,

intravenously, by inhalation, or direct instillation into the cavity) are effective in superficial infection and in some systemic fungal infections, but have shown no consistent success in alleviating symptoms or treating pulmonary aspergilloma. A study comparing medical treatment and resection showed that resection resulted in increased survival in patients with recurrent or massive hemoptysis[1,3,7,9,10].

Standard treatment of pulmonary aspergillosis in immunocompromised patients is antifungal chemotherapy and recovery of immuno-competence[3]. In cases of hemoptysis or in pulmonary high risk region for hemoptysis, such as affecting great vessels, surgery is recommended. In cases necessary for further immuno-suppressive treatment the resection is suggested as well Danner et al[3] recommend the following pathway:

1. Antifungal treatment pre- and postoperative until clinical symptoms improved.

2. In cases of, A) Persistent radiological findings and continuing immunosuppressive therapy, B) Symptoms like hemoptysis, C) Critical anatomical location of the cavitations, D) Progressive radiological findings despite antifungal therapy, E) Focal location of cavities, surgical treatment is indicated.

3. In cases of surgery curative and definitive but lung sparing resection should be done. Lobectomy could be performed, but pneumonectomy should be avoided.

4. Surgery should be avoided in cases of disseminated disease or a curative resection is not feasible. In these cases, the operative mortality and morbidity remains low and is marked by the underlying disease. In diffuse lesions of the lung, the surgical approach is associated with a worsening post operative course and relapse of infection[3].

In the recent literature[1,5,6], surgical resection for aspergilloma offers 4 potential benefits, prevention of massive hemoptysis, eradication of the pyogenic component, limitation of the symptoms as the result of invasive aspergillosis, and prolongation of life.

Conclusion

From our study it was concluded that the most indication for surgery was hemoptysis. Surgical resection is the treatment of choice for most patients with pulmonary aspergilloma with acceptable postoperative complication and mortality rates, 20.8% and 4.2%, respectively. Lobectomy was appropriate for most patients. Recurrence of hemoptysis was found in all patients who received selective bronchial artery embolization and needed surgical treatment.

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Potential conflicts of interest

None.

References

1. Demir A, Gunluoglu MZ, Turna A, Kara HV, Dincer SI. Analysis of surgical treatment for pulmonary aspergilloma. Asian Cardiovasc Thorac Ann 2006; 14: 407-11.
2. Csekeo A, Agocs L, Egervary M, Heiler Z. Surgery for pulmonary aspergillosis. Eur J Cardiothorac Surg 1997; 12: 876-9.
3. Danner BC, Didilis V, Dorge H, Mikroulis D, Bougioukas G, Schondube FA. Surgical treatment of pulmonary aspergillosis/mycosis in immunocompromised patients. Interact Cardiovasc Thorac Surg 2008; 7: 771-6.
4. Park CK, Jheon S. Results of surgical treatment for pulmonary aspergilloma. Eur J Cardiothorac Surg 2002; 21: 918-23.
5. Babatasi G, Massetti M, Chapelier A, Fadel E, Macchiarini P, Khayat A, et al. Surgical treatment of pulmonary aspergilloma: current outcome. J Thorac Cardiovasc Surg 2000; 119: 906-12.
6. Kurul IC, Demircan S, Yazici U, Altinok T, Topcu S, Unlu M. Surgical management of pulmonary aspergilloma. Asian Cardiovasc Thorac Ann 2004; 12: 320-3.
7. Endo S, Otani S, Tezuka Y, Tetsuka K, Tsubochi H, Hasegawa T, et al. Predictors of postoperative complications after radical resection for pulmonary aspergillosis. Surg Today 2006; 36: 499-503.
8. Cesar JM, Resende JS, Amaral NF, Alves CM, Vilhena AF, Silva FL. Cavernostomy x resection for pulmonary aspergilloma: a 32-year history. J Cardiothorac Surg 2011; 6: 129.
9. Brik A, Salem AM, Kamal AR, Abdel-Sadek M, Essa M, EI Sharawy M, et al. Surgical outcome of pulmonary aspergilloma. Eur J Cardiothorac Surg 2008; 34(4): 882-5.
10. Regnard JF, Icard P, Nicolosi M, Spagiarri L, Magdeleinat P, Jauffret B, et al. Aspergilloma: a series of 89 surgical cases. Ann Thorac Surg 2000; 69: 898-903.

11. Gadkowski LB, Stout JE. Cavitary pulmonary disease. Clin Microbiol Rev 2008; 21: 305-33.
12. Ko JP, Kim DH, Shepard JA. Pulmonary aspergillosis in an immunocompetent patient. J Thorac Imaging 2002; 17: 70-3.

การรักษาผู้ป่วยติดเชื้อราแอสเปอร์จิลลัสที่ปอดในโรงพยาบาลศรีนครินทร์

ชูศักดิ์ คุปตานนท์, ศิริชัย วรดิษฐ์, สมภพ พระธานี

วัตถุประสงค์: การติดเชื้อราแอสเปอร์จิลลัสที่ปอดทำให้เกิดโรคได้ 3 แบบ คือ โรคเชื้อราชนิดอยู่เฉพาะที่โดยเจริญอยู่ภายในโพรงปอดซึ่งมีอยู่ก่อน โรคแพ้เชื้อราที่เจริญบนเยื่อบุทางเดินลมหายใจซึ่งมาด้วยอาการหอบหืด และโรคเชื้อราชนิดกระจายในเนื้อเยื่อปอดร่วมกับแพร่กระจายในอวัยวะอื่น ๆ

วัสดุและวิธีการ: ผู้นิพนธ์ได้รวบรวมข้อมูลพื้นฐานของผู้ป่วย อาการที่นำผู้ป่วยมาพบแพทย์ ข้อบ่งชี้ที่ต้องได้รับการผ่าตัด ผลการรักษาด้วยวิธีต่าง ๆ ทั้งด้านอายุรกรรม รังสีวิทยา และศัลยกรรม รวมถึงภาวะแทรกซ้อนหลังผ่าตัด เพื่อหาแนวทางการรักษาที่เหมาะสมแก่ผู้ป่วยรายต่อไป โดยตรวจสอบเวชระเบียนผู้ป่วย 45 ราย ซึ่งได้รับการวินิจฉัยว่ามีการติดเชื้อแอสเปอร์จิลลัสที่ปอด และเข้ารับการรักษาในโรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่น ตั้งแต่ พ.ศ. 2536-2551 พบว่า 33 ราย (ร้อยละ 73.3) มีโรคร่วม โดย 16 ราย (ร้อยละ 35.6) เป็นวัณโรคปอด 13 ราย (ร้อยละ 28.9) เป็นมะเร็งทางโลหิตวิทยา 6 ราย (ร้อยละ 13.3) เป็นหลอดลมโป่งพองและอีก 4 ราย (ร้อยละ 8.9) เป็นโรคแพ้ภูมิตนเอง

ผลการศึกษา: อาการไอเป็นเลือดเป็นสาเหตุชักนำให้ผู้ป่วยมาพบแพทย์ได้บ่อยที่สุดพบถึง 29 ราย (ร้อยละ 64.4) จากจำนวนผู้ป่วยทั้งหมด 45 ราย พบมีการติดเชื้อเฉพาะที่โพรงปอด 40 ราย และอีก 5 ราย ติดเชื้อกระจาย ในเนื้อเยื่อปอดร่วมกับอวัยวะอื่น ๆ ได้แก่ สมอง ผิวหนัง กระจกตา และโพรงไซนัสบริเวณโหนกแก้ม มีผู้ป่วย 24 ราย (ร้อยละ 53.3) ได้รับการผ่าตัด โดยอาการไอเป็นเลือดเป็นข้อบ่งชี้ที่พบบ่อยสุดและการผ่าตัดที่ทำบ่อยสุดคือผ่าตัด กลีบปอดออกทั้งกลีบ ภาวะแทรกซ้อนหลังผ่าตัดพบเพียง 5 ราย (ร้อยละ 20.8) ได้แก่ หนองในโพรงเยื่อหุ้มปอด 2 ราย เลือดออกมากกว่าปกติ 2 ราย เกิดทางเชื่อมผิดปกติระหว่างหลอดลมกับเยื่อหุ้มปอด 1 ราย และในจำนวนนี้มีผู้เสียชีวิต 1 ราย (ร้อยละ 4.2) จากภาวะติดเชื้อในกระแสเลือดหลังผ่าตัด ผู้ป่วย 21 ราย (ร้อยละ 46.7) ได้รับยาต้านเชื้อราจากอายุรแพทย์ และ 4 ราย มีอาการไอเป็นเลือดปริมาณมากนำไปสู่การฉีดสารเพื่ออุดหลอดเลือดที่เป็นสาเหตุของ เลือดออกโดยรังสีแพทย์ แต่ทั้งหมดในกลุ่มนี้มีการไอเป็นเลือดกลับเป็นซ้ำ

สรุป: การผ่าตัดเป็นทางเลือกในการรักษาที่ได้ผลดี โดยมีภาวะแทรกซ้อน และอัตราเสียชีวิตหลังผ่าตัดในเกณฑ์ ที่ยอมรับได้