THE ANNALS OF THORACIC SURGERY



*Ann Thorac Surg* 1996;62:1608-1613


## Original Articles: General Thoracic

# Management of AIDS-Related Pneumothorax

**Gregory D. Trachiotis, MD, Luca A. Vricella, MD, David Alyono, MD, Benjamin L. Aaron, MD, William R. Hix, MD**

Division of Cardiothoracic Surgery, Department of Surgery, The George Washington University Medical Center, Washington, DC

Accepted for publication June 18, 1996.

*This Article*
- Abstract FREE
- Alert me when this article is cited
- Alert me if a correction is posted
- Citation Map

*Services*
- Email this article to a friend
- Similar articles in this journal
- Similar articles in PubMed
- Alert me to new issues of the journal
- Add to Personal Folders
- Download to citation manager
- Author home page(s):
  Gregory D. Trachiotis
  Luca A. Vricella
  David Alyono
  Benjamin L. Aaron
  William R. Hix
- Permission Requests

*Citing Articles*
- Citing Articles via HighWire
- Citing Articles via Google Scholar

*Google Scholar*
- Articles by Trachiotis, G. D.
- Articles by Hix, W. R.
- Search for Related Content

*PubMed*
- PubMed Citation
- Articles by Trachiotis, G. D.
- Articles by Hix, W. R.

*Related Collections*
- Related Article

## Abstract

*Background*. Pneumothorax (PTX) occurs in 5% of patients with acquired immunodeficiency syndrome (AIDS) infected with *Pneumocystis carinii* pneumonia, and up to 50% of those will die during hospitalization. The treatment strategies for managing AIDS-related PTXs are often complex and ineffective at treating the PTX, and they can prolong hospitalization.

*Methods*. We reviewed our experience with 36 male patients with AIDS treated for 44 PTXs over a

Top
Footnotes
Abstract
Introduction
Patients and Methods
Results
Comment
References

2.5-year period to determine if a particular therapeutic approach could allow for an earlier recovery and effective treatment of the PTX. All patients had current or prior history of *Pneumocystis carinii* pneumonia infection, and the CD4+ T-lymphocyte counts were less than 100/$\mu$L in 100%.

*Results*. Twenty-seven patients with 31 PTXs were discharged from the hospital. Of these 31 PTXs, 21 had resolved at the time of the patient's discharge from the hospital, and the other 10 PTXs were converted from Pleurevac (Deknatel, Inc, Fall River, MA) drainage to a Heimlich valve for persistent **bronchopleural** fistula after more than 15 days of conventional treatment. The PTXs were effectively managed by tube thoracostomy alone in 18/44 PTXs (41%), tube thoracostomy plus sclerosing therapy in 2/8 PTXs (25%), and thoracotomy with blebectomy and pleurodesis in 1/3 PTXs (33%). Nine of 11 of the procedure-related PTXs responded to tube thoracostomy alone; the other 2 PTXs were converted from Pleurevac drainage to a Heimlich valve and allowed for patient discharge from the hospital in less than 10 days. Nine patients with 13 PTXs died during hospitalization. Four of these 9 patients (44%) had bilateral PTXs, and 8/9 (89%) were being treated by tube thoracostomy with Pleurevac suction for persistent **bronchopleural** fistula in the intensive care unit at the time of death. The 8 patients treated for 10 PTXs with a Heimlich valve had effective management of the PTX, had no morbidity associated with the Heimlich valve and no in-hospital mortality, and were discharged from the hospital to home or a hospice setting.

*Conclusions*. The management of AIDS-related PTXs is complex and often associated with a destructive pulmonary process and other systemic disease conditions related to AIDS that result in ineffective resolution of the PTX, a prolonged hospitalization, and a high mortality. In our experience, there is a lesser role for managing the PTXs with sclerosing therapy or thoracotomy. Patients with advanced AIDS complicated by PTXs with **bronchopleural** fistula can be converted from a Pleurevac drainage system to a Heimlich valve with no apparent morbidity or mortality, and managed as an outpatient, thereby potentially shortening hospitalization and facilitating an earlier discharge from an acute care setting.

## Introduction

See also page 1613.



The incidence of pneumothorax (PTX) in patients with acquired immunodeficiency syndrome (AIDS) with *Pneumocystis carinii* pneumonia (PCP) is estimated between 3% and 9% [1–3]. *Pneumocystis carinii* is a frequent pulmonary pathogen in AIDS, occurring in 50% to 85% of patients [1, 4]. Many times, as a consequence of the PCP, the pneumothorax is associated with a **bronchopleural** fistula (BPF). This complicating feature is correlated with diffuse lung parenchymal destruction and cavitating necrosis, leading to the failure of conventional treatment options. At The George Washington University Medical Center, we are seeing PTX as a common presentation or complication in patients with advanced AIDS. In our experience, few patients with AIDS treated for a

PTX will survive more than 3 months, regardless of their treatment. We reviewed our experience with AIDS-related PTX to determine if a particular treatment strategy allowed for an earlier and safer recovery and discharge from the hospital.

## Patients and Methods


- Top
- Footnotes
- Abstract
- Introduction
- Patients and Methods
- Results
- Comment
- References


Between January 1992 and May 1994, 156 patients were treated for 164 PTXs at The George Washington University Medical Center. Of these patients, there were 36 male homosexuals with AIDS treated for 44 PTXs. The average age was 35.4 years (range, 27 to 56 years). All patients had the diagnosis of AIDS for more than 1 year (range, 1 to 9 years). Each patient had a prior history or current infection with *Pneumocystis carinii*. Other diagnosis included nonpulmonary infections with *Candida* (3), *Mycobacterium avium intracellulare* (2), and cytomegalovirus (2). Six patients were septic, and 4 patients were ventilator dependent. The CD4+ T-lymphocyte count was less than 100/$\mu$L in all patients, and less than 50/$\mu$L in 21/36 patients (58%). Eighteen patients were admitted with spontaneous PTXs, and the other 18 patients were treated for their PTX during hospitalization. Of the 44 PTXs, 31 were spontaneous and 11 were related to bronchoscopic or needle-biopsy procedures. Eight patients had bilateral PTXs.

All PTXs were managed by the Cardiothoracic Surgery Service. Initial treatment was tube thoracostomy placed to -20 cm $H_2O$ Pleurevac (Deknatel, Inc, Fall River, MA) suction. If the pneumothorax resolved, there was a 24- to 48-hour trial of underwater seal with chest roentgenographic confirmation, followed by chest tube removal. The patient had a repeat chest roentgenogram 24 hours later, and if there was no change, the patient was recommended for discharge or continued medical therapy. If the PTX was complicated by a BPF with lung reexpansion on Pleurevac suction, then there was a trial of underwater seal for 24 to 48 hours. If the lung remained expanded with minimal air leak, the patient was treated with sclerotherapy or had the Pleurevac converted to a Heimlich valve. The sclerotherapy used was a slurry of 5 to 10 g of talc, or 500 to 1,000 mg of doxycycline, or 60 U of bleomycin, or a combination of doxycycline and bleomycin diluted in 50 to 100 mL of normal saline solution. Before instillation of the sclerosing agent a solution of 20 mL of 1% lidocaine was injected through the chest tube to minimize the pain of the pleural inflammatory response. With the patient supine and the chest tube placed to underwater seal, the sclerosing agent was instilled over a 5- to 10-minute interval. The patient was then placed in the supine, left lateral decubitus, and right lateral decubitus positions at 20-minute intervals, after which the chest tube was placed back to -20 cm $H_2O$ Pleurevac suction for 24 hours. If necessary the sclerotherapy was repeated. If the treatment was successful the chest tube was removed, and if there was a persistent BPF, the Pleurevac system was converted to a Heimlich valve. Thoracotomy with blebectomy and pleurodesis was offered only to those patients who failed the above treatment approaches, who refused the Heimlich valve, whose only clinical problem was a PTX with persistent BPF, and who were assessed to be responsive to PCP therapy. Patients who were on mechanical ventilators remained on

Pleurevac therapy.

## Results

Top
Footnotes
Abstract
Introduction
Patients and Methods
Results
Comment
References

The outcome of the management strategies used to treat the 44 AIDS-related PTXs are summarized in Table 1. Twenty-seven patients with 31 PTXs were discharged from the hospital. Of these 31 PTXs treated, 21 PTXs had resolved and the other 10 PTXs were treated with a Heimlich valve at the time of the patient's discharge from the hospital. Of the 21 PTXs that had resolved, tube thoracostomy was successful in 18, sclerotherapy was used in an additional 2, and thoracotomy with blebectomy and pleurodesis was successful in 1. Thus, only 21/44 PTXs (48%) treated had resolved by discharge, and tube thoracostomy alone was successful in only 18/44 (40.9%) of the treated PTXs. Sclerosing therapy was used in a total of eight PTXs, and two (25%) were successfully treated. Talc slurry was successful in 2/3 treated PTXs (66%). Two patients with three PTXs were treated with thoracotomy, blebectomy, and pleurodesis. One of these patients with one PTX was successfully treated and discharged. The other patient died in the intensive care unit with bilateral persistent BPF. There were 11 PTXs caused by bronchoscopy or iatrogenic needle punctures, and nine (82%) of these PTXs resolved by tube thoracostomy alone; the other two were treated with a Heimlich valve for persistent BPF, which facilitated patient discharge from the hospital in less than 10 days.

**View this table:** [in this window] [in a new window]

*Table 1. . Management Strategies for Treating Acquired Immunodeficiency Syndrome-Related Pneumothorax*

A total of 8 patients with ten PTXs were discharged with a Heimlich valve for persistent BPF and incomplete resolution of the PTX. Two patients died in a hospice, and the others were successfully managed as outpatients. There were no morbidities or mortalities related to the Heimlich valve. Thus, a total of 10/44 (22.7%) of the AIDS-related PTXs managed by different treatment strategies, or 10/31 (32%) of the PTXs successfully treated that permitted patient discharge from the hospital, were effectively managed with a Heimlich valve.

The average treatment duration for all PTXs was 11.5 days (range, 3 to 31 days). Those patients discharged with a Heimlich valve had an average treatment duration of 17 days (range, 7 to 30 days) with a Pleurevac system before being converted to a Heimlich valve, whereas procedure-related PTXs had an average treatment duration of 8.1 days (range, 3 to 16 days).

Nine patients with 13 PTXs died during their hospitalization for an in-hospital mortality of 25% for this group. Four of 9 patients (44%) had bilateral PTXs, and 8/9 patients (89%) were being treated for

persistent BPF with tube thoracostomy and Pleurevac suction in the intensive care unit at the time of death. Four of these patients were being mechanically ventilated, and 1 of these patients had undergone surgical therapy to manage bilateral PTXs after refusing treatment with a Heimlich valve. Therefore, only 1/9 deaths (11%) were directly related to the treatment of the PTXs, although the presence of the PTXs likely complicated the overall clinical management in the other patients.

## Comment

Top
Footnotes
Abstract
Introduction
Patients and Methods
Results
Comment
References

Spontaneous PTX in the AIDS population should be regarded as a frequent occurrence. The incidence is 2.7% to 4%, which is 450 times more common than in the general, nonimmunocompromised population [1–3]. Up to 34% of PTXs will be bilateral [3], and the recurrence rate is between 36% and 65% [5]. Seventy percent of these patients usually have previous or current episodes of opportunistic PCP, and many times are at the terminal phase of their disease [4, 6–8].

The hospital mortality for AIDS patients with PCP in whom a PTX develops is as high as 43%, and can reach 92% in those patients who are mechanically ventilated [4, 7]. These figures have worsened over the last 10 years despite improvement in medical therapy. Although the mortality from the association of respiratory failure and PCP in patients with AIDS has been reduced from 87% to 60% with steroids, and advances in PCP prophylaxis and medical treatment strategies have lowered the need for mechanical ventilation, the overall prognosis for those patients in whom a secondary pulmonary complication develops or who need mechanical ventilation is poor [6]. This is a result of advanced pulmonary pathology, failure to respond to medical therapy, and coexisting complications related to AIDS. The predicted mortality is nearly 100% in the setting of a CD4+ T-lymphocyte count less than 50/$\mu$L, albumin level less than 2.0 mg/dL, lactate dehydrogenase level greater than 1,000 mg/dL, pH less than 7.35, and failure of anti-PCP agents plus corticosteroids after a 5-day treatment course [6, 7].

The pathophysiology of PTX as related to the human immunodeficiency virus remains undefined; however, in the patient with AIDS who has PCP there is a defined destructive pathologic process [2, 5, 9]. *Pneumocystis carinii* pneumonia results in diffuse alveolar damage and coalescence of cystic air spaces that is manifested as bullous parenchymal damage and subpleural pneumatoceles [5, 9] (Fig 1 ). This process is believed to occur through previous or current infections with *Pneumocystis carinii* producing a bronchiolitis that results in a "check-valve" obstruction of the proximal airway leading to distal alveolar distention and rupture [2, 5, 9]. Another explanation that can occur simultaneously is focal or diffuse parenchymal necrosis caused by acute or chronic PCP (Fig 2 ). It is these pathologic processes that account for increasing frequency of spontaneous and procedural PTXs, bilaterality of PTX, recurrence of PTX, and failure of conventional treatment strategies. The occurrence of AIDS-related PTX has also been associated with aerosolized pentamidine therapy [10], intravenous drug-abuse–related septic emboli [2], a history of previous lung field irradiation [10], and the use of tobacco and steroids [11].

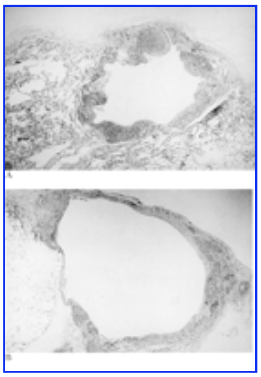


*Fig 1. . Photomicrographs of lung parenchyma with cavitary necrosis (A) and the formation of a subpleural pneumatocele (B) in a patient with acquired immunodeficiency syndrome and* Pneumocystis carinii *pneumonia. (x100 before 51% reduction.)*

**View larger version** (113K):
[in this window]
[in a new window]

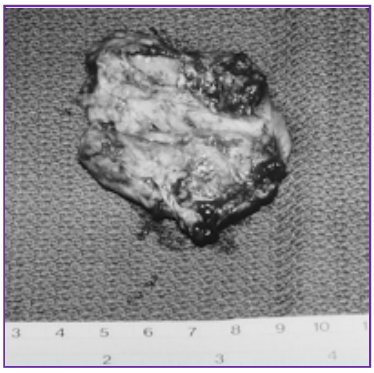


*Fig 2. . Gross specimen of lung tissue after resection demonstrating diffuse parenchymal necrosis in a patient with acquired immunodeficiency syndrome and* Pneumocystis carinii *pneumonia.*

**View larger version** (219K):
[in this window]
[in a new window]

The treatment of PTXs in patients with AIDS can range from tube thoracostomy to video-assisted thoracotomy or thoracotomy depending on the cause of the PTX, stage of AIDS, and response to the various management strategies [5, 10–20]. As our experience and others [5, 11, 15, 16, 18, 19] have demonstrated, small, asymptomatic spontaneous or procedure-related PTXs will respond to tube thoracostomy alone in about 80%, whereas poor success is to be expected with this treatment strategy if there is a large PTX, or the cause is PCP complicated by BPF. Some authors suggest that small, asymptomatic PTXs can be successfully observed [16], but we caution against the use of this approach in patients with AIDS-related PTX because of the high incidence of PCP, diffuse and bilateral disease, and comorbid processes.

Sclerotherapy has long been used for non–AIDS-related PTXs, with success rates as high as 91% [21,

22]. However, the recurrence rate with pleurodesis via tube thoracostomy ranges between 4% and 28% [21, 22]. The successes with sclerotherapy in treating AIDS-related PTXs are less reproducible. In studies comparing tetracycline, bleomycin, and talc in treating PTXs unrelated to AIDS, talc has been associated with the lowest recurrence rates, generally more tolerated, and more cost effective [21]. This has been our experience, as well as that of others [5, 10, 13, 22], in the treatment of AIDS-related PTXs. In our series, talc was successful in 2/3 PTXs (66%), but overall only 2/8 PTXs responded to sclerotherapy. It is for this reason that we reserve talc pleurodesis via the tube thoracostomy for patients whose PTX has resolved but who have a minimal BPF (or air leak). This will represent only about 30% of all patents treated for AIDS-related pneumothorax. In the patient who is human immunodeficiency virus-positive or has AIDS without PCP or other pulmonary pathogenic processes, consideration of empiric talc pleurodesis after resolution of the PTX is a potential option, although it remains to be shown whether this will reduce the recurrence rate once the patient has PCP.

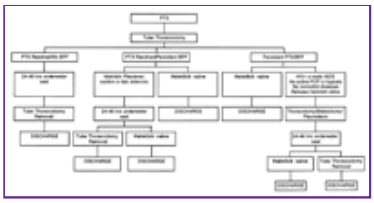
Thoracotomy with blebectomy and pleurodesis has been the gold standard treatment for recurrent PTXs or those complicated by BPF with recurrence rates after operation between 0.4% and 2.3% [23]. Crawford and colleagues [15] reported the results in 14 patients with AIDS who had persistent BPF treated by thoracotomy with blebectomy and pleural abrasion, including the diaphragmatic surface. Patients were selected as operative candidates if (1) there was clinical evidence of BPF, (2) no sepsis was present in another organ system, and (3) respiratory and cardiac functions were adequate for general anesthesia. Nearly all patients had PCP. This treatment was successful in 13/14 patients (93%), and only 1 patient (7%) died. Based on their experience, they believe this should be the treatment strategy for AIDS-related PTXs after failed chest tube or video assisted thoracotomy pleurodesis. Some authors also recommend median sternotomy with bilateral blebectomy and pleurodesis for either unilateral or bilateral AIDS-related PTXs, even in mechanically ventilated patients, in view of the high failure rate of conventional therapy and high recurrence rates [15, 16]. We have not adopted this treatment strategy and have a different experience with AIDS patients treated with thoracotomy. Our lack of enthusiasm for this approach likely is attributed to a patient population that has advanced AIDS, diffuse parenchymal necrosis, and has other significant comorbid medical conditions at the time of PTX. The reason we are seeing PTXs in such advanced cases of AIDS may be attributed to improvement in PCP prophylaxis or treatment, and to the general care given to the patient with AIDS. We believe thoracotomy with blebectomy and pleurodesis as described by Crawford and associates [15] and others [16–19] should be reserved for those PTXs complicated by BPF that have failed tube thoracostomy and sclerotherapy in patients who refuse treatment with a Heimlich valve and are either human immunodeficiency virus-positive or early in the course of AIDS and not infected with a pulmonary pathogen. Although some authors [10, 14] report successes with video-assisted thoracotomy and talc poudrage in the treatment of AIDS-related PTX, we believe this therapy has a limited role either in diagnosing pulmonary complications of AIDS or in the treatment of PTXs in patients with advanced AIDS [4, 8, 24].

Thoracostomy and Heimlich valve drainage was originally employed for non–AIDS-related PTXs complicated by a BPF [25, 26]. Mercier and associates [25] reported a series of 226 spontaneous PTXs

of which 54% were managed with a Heimlich valve. The Heimlich valve was applied to the thoracostomy tube without any interval of underwater seal, and with discharge of the patient within only hours after admission. Resolution of the PTX was successful in 74% of the patients discharged. It has been reported the PTXs complicated by BPF in patients with AIDS will resolve within 8 to 12 days with tube thoracostomy alone in about 64% of patients [11–15], but our experience shows a treatment course exceeding an average of 17 days with a success rate less than 41%. It is with this rationale that we believe that the Heimlich valve is an effective and safe option in patients whose life is measured in months, and where other treatment options have failed or are not applicable. In addition, the Heimlich valve has a low incidence of malfunction or failure, is easy to care for in either a hospital or hospice, will prevent tension PTX, can be used in the presence of a residual PTX with a BPF, can be managed in an outpatient setting, has minimal morbidity and no associated mortality, and has the potential to shorten hospitalization in the acute care facility [20, 24].

Our experience with managing AIDS-related PTXs at The George Washington University Medical Center began with 3 patients in 1985, increasing to an average between 20 and 25 patients treated per year since 1989, and now totals more than 100 patients. Over the years, our management strategy for treating AIDS-related PTX has evolved as the population of AIDS patients has changed. Early in our experience, when we were seeing new cases of human immunodeficiency virus infection or AIDS, single or multiple tube thoracostomy and a lot of patience was the standard treatment. Over the past 3 to 5 years, our experience shows that patients with an AIDS-related PTX with a history of PCP have a complicated and often fatal hospitalization. The mortality rate is about 25%, and the long-term survival rarely exceeds 3 months. Gerein and colleagues [19] demonstrated a mean survival of only 5 months in the 17/21 patients treated for AIDS-related PTXs. In a follow-up at 6 months, Walker and co-workers [24] found that of the 11 hospital survivors discharged with a Heimlich valve, only 2 patients were alive; the others died due to AIDS and not because of the Heimlich valve. In our opinion, there is a lesser role for managing PTXs in patients with advanced AIDS with sclerosing agents or thoracotomy. Only 25% to 33% of PTXs resolved with such treatment approaches, and 50% of the patients died. Those patients with procedure-related PTXs seem to respond well to tube thoracostomy alone.

In general, we are seeing patients in advanced stages of AIDS and PCP when pulmonary parenchymal destruction is diffuse. For these reasons, if the PTX has not responded to tube thoracostomy after a 7- to 10-day trial, and has failed or does not meet our criteria for sclerosis or thoracotomy, the Pleurevac suction system is converted to a Heimlich valve and the patient will no longer require hospitalization for the PTX (Fig 3). We have found the Heimlich valve system to be well tolerated by the patient, safe, easy to manage at home or in a hospice, and able to facilitate early mobilization and discharge from the acute care setting. We believe the Heimlich valve to be a safe and effective treatment alternative of BPF in patients with AIDS who are in the advanced stages of the disease.



**View larger version** (25K):
[in this window]
[in a new window]

*Fig 3. . Management strategy for treating acquired immunodeficiency syndrome (*AIDS*)-related pneumothorax (*PTX*). (*BPF = ***bronchopleural** *fistula;* HIV+ = *human immunodeficiency virus-positive;* PCP = Pneumocystis carinii *pneumonia.)*

## Footnotes

Top
Footnotes
Abstract
Introduction
Patients and Methods
Results
Comment
References

Address reprint requests to Dr Trachiotis, Division of Cardiothoracic Surgery, The George Washington University Medical Center, 2150 Pennsylvania Ave, NW, Washington, DC 20037.

## References

Top
Footnotes
Abstract
Introduction
Patients and Methods
Results
Comment
References

1. Bagheri K, Truitt T, Safirstein BH. Spontaneous pneumothorax in patients with acquired immunodeficiency syndrome (AIDS). Chest 1993;103:226s.
2. Kuhlman JE, Knowles MC, Fishman EK, Siegelmen SS. Premature bullous pulmonary damage in AIDS: CT diagnosis. Radiology 1989;173:23–6.
3. Travaline JM, Criner GJ. Persistent **bronchopleural** fistulae in an AIDS patient with *Pneumocystis carinii* pneumonia. Successful treatment with chemical pleurodesis [Letter]. Chest 1993;103:981.
4. Trachiotis GD. Criteria for open lung biopsy. Focusing on patients with AIDS. Chest 1995;108:293–4.[Free Full Text]
5. Wait MA, Dal Nogare AR. Treatment of AIDS-related spontaneous pneumothorax. A decade of experience. Chest 1994;106:693–6.[Abstract/Free Full Text]
6. Hawley PH, Ronco JJ, Guillemi SA, et al. Decreasing frequency but worsening mortality of acute respiratory failure secondary to AIDS-related *Pneumocystis carinii* pneumonia. Chest 1994;106:1456–0.[Abstract/Free Full Text]
7. Wachter RM, Luce JM. Respiratory failure from severe *Pneumocystis carinii* pneumonia. Chest 1994;106:1313–4.[Free Full Text]
8. Trachiotis GD, Hafner GH, Hix WR, Aaron BL. Role of open lung biopsy in diagnosing pulmonary complications of AIDS. Ann Thorac Surg 1992;54:898–902.[Abstract]
9. Sandhu JS, Goodman PC. Pulmonary cysts associated with *Pneumocystis carinii* pneumonia in patients with AIDS. Radiology 1989;173:33–5.[Abstract/Free Full Text]
10. Slabbync H, Kovitz K, Vialette JP, Kasseyet S, Astoul P, Boutin C. Thoracoscopic findings in spontaneous pneumothorax in AIDS. Chest 1994;106:1581–6.
11. Metersky ML, Colt HG, Olson LK, Shanks TG. AIDS-related spontaneous pneumothorax.

Chest 1995;108:946–51.[Abstract/Free Full Text]
12. Read CA, Reddy DR, O'Mara TE, Richardson MSA. Doxycycline pleurodesis for pneumothorax in patients with AIDS. Chest 1994;105:823–5.[Abstract/Free Full Text]
13. Tunon de Lara JM, Constans J, Vincent MP, Raceveur MC, Conri C, Taytard A. Spontaneous pneumothorax associated with *Pneumocystis carinii* pneumonia. Successful treatment with talc pleurodesis. Chest 1992;101:1177–8.[Abstract/Free Full Text]
14. Kimmel RN, Karp MP, Cascone JJ, Zinns JS. Talc pleurodesis during videothoracoscopy for *Pneumocystis carinii* pneumonia-related pneumothorax. A new technique. Chest 1994;105:314–5.[Abstract/Free Full Text]
15. Crawford BK, Galloway AC, Boyd AD, Spencer FC. Treatment of AIDS-related **bronchopleural** fistula by pleurectomy. Ann Thorac Surg 1992;54:212–5.[Abstract]
16. Byrnes TA, Brevig JK, Yeoh CB. Pneumothorax in patients with acquired immunodeficiency syndrome. J Thorac Cardiovasc Surg 1989;98:546–50.[Abstract]
17. Olivier HF. Treatment of AIDS-related **bronchopleural** fistula by pleurectomy. Ann Thorac Surg 1993;55:565–6.[Medline]
18. Fleishner AG, McElvaney G, Lawson L, Gerein AN, Grant D, Tyers GF. Surgical management of spontaneous pneumothorax in patients with acquired immunodeficiency syndrome. Ann Thorac Surg 1988;45:21–3.[Abstract]
19. Gerein AN, Brumwell ML, Lawson LM, Chan NH, Montaner JSG. Surgical management of pneumothorax in patients with acquired immunodeficiency syndrome. Arch Surg 1991;126:1272–7.[Abstract/Free Full Text]
20. Driver AG, Peden JG, Adams GA, Rumley RL. Heimlich valve treatment of *Pneumocystis carinii*-associated pneumothorax. Chest 1991;100:281–2.[Abstract/Free Full Text]
21. Almind M, Lange P, Viskum K. Spontaneous pneumothorax: comparison of simple drainage, talc pleurodesis, and tetracycline pleurodesis. Thorax 1989;44:627–30.[Abstract/Free Full Text]
22. Kennedy L, Sahn S. Talc pleurodesis for the treatment of pneumothorax and pleural effusion. Chest 1994;106:1215–22.[Free Full Text]
23. Clagget OT. The management of spontaneous pneumothorax. J Thorac Cardiovasc Surg 1968;55:761–2.[Medline]
24. Walker WA, Pate JW, Amundson D, Kennedy C. AIDS-related **bronchopleural** fistula. Ann Thorac Surg 1993;55:1048.
25. Mercier C, Page A, Verdant A, Cossette R, Dontigny L, Pelletier LC. Outpatient management of intercostal tube drainage in spontaneous pneumothorax. Ann Thorac Surg 1976;22:163–5. [Abstract]
26. Van Hengel P, Van de Bergh JHAM. Heimlich valve treatment and outpatient management of bilateral metastatic pneumothorax. Chest 1994;105:1586–7.[Abstract/Free Full Text]

### Related Article

**Invited Commentary**

Arthur N. Thomas

Ann. Thorac. Surg. 1996 62: 1613. [Extract] [Full Text]

## This article has been cited by other articles:

CHEST HOME

M. H. Baumann
**Less Is More?**
Chest, July 1, 2001; 120(1): 1 - 3.
[Full Text] [PDF]

---

CHEST HOME

B. Afessa
**Pleural Effusion and Pneumothorax in Hospitalized Patients With HIV Infection: The Pulmonary Complications, ICU Support, and Prognostic Factors of Hospitalized Patients With HIV (PIP) Study**
Chest, April 1, 2000; 117(4): 1031 - 1037.
[Abstract] [Full Text] [PDF]

---

The NEW ENGLAND JOURNAL of MEDICINE HOME

S. A. Sahn and J. E. Heffner
**Spontaneous Pneumothorax**
N. Engl. J. Med., March 23, 2000; 342(12): 868 - 874.
[Full Text] [PDF]

---

The Journal of THORACIC AND CARDIOVASCULAR SURGERY HOME

D. R. Flum, S. D. Steinberg, T. R. Bernik, E. Bonfils-Roberts, M. D. Kramer, P. X. Adams, and M. K. Wallack
**THORACOSCOPY IN ACQUIRED IMMUNODEFICIENCY SYNDROME**
J. Thorac. Cardiovasc. Surg., September 1, 1997; 114(3): 361 - 366.
[Abstract] [Full Text]

---

THE ANNALS OF THORACIC SURGERY HOME

M. A. Wait and G. D. Trachiotis
**AIDS-Related Pneumothorax**
Ann. Thorac. Surg., July 1, 1997; 64(1): 290 - 291.
[Full Text]

---

THE ANNALS OF THORACIC SURGERY HOME

S. mahfood, W. R. Hix, B. L. Aaroon, P. Blaes, and D. C. Watson
**Reexpansion Pulmonary Edema**
Ann. Thorac. Surg., April 1, 1997; 63(4): 1206 - 1207.
[Full Text]

---

*This Article*

- Abstract FREE
- Alert me when this article is cited
- Alert me if a correction is posted
- Citation Map