



Surgical Treatment of Spontaneous Pneumothorax: Ten-year Experience

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Abstract. Spontaneous pneumothorax (SP) is commonly observed in young, tall, thin subjects without apparent underlying lung disease and in the elderly with chronic emphysematous lung disease. We present our experience in treating SP during the last decade. From December 1986 to November 1996 a total of 417 consecutive patients with SP were admitted to our department. There were 349 males (83.7%) and 68 females, ranging in age from 14 to 93 years. A right-side SP was detected in 234 cases (56.1%), a left-side SP in 175 (42.0%), and a bilateral SP in 8 (1.9%). Treatment included observation/aspiration ($n = 16$, 3.8%), tube thoracostomy ($n = 372$, 89.2%), multiple tubes ($n = 29$, 7.0%), blood pleurodesis ($n = 13$, 3.1%), midsternotomy ($n = 3$, 0.7%), and minithoracotomy ($n = 92$, 22.1%). Primary indications for operation were recurrent SP ($n = 49$) and persistent air leak ($n = 46$). Blebs or bullae were found in all patients and were ablated by stapling. Pleural abrasion was also performed. All showed good lung expansion postoperatively. Perioperative mortality was zero. The mean hospital stay was 6.5 days. Follow-up of 89 patients who had undergone surgical treatment (93.7%) at 1 to 100 months revealed only one recurrence. Tube thoracostomy is still the treatment of choice for SP. Surgical intervention is recommended only in cases of recurrent SP or persistent air leak. Minithoracotomy is a safe surgical approach with satisfactory cosmetic results.

Spontaneous pneumothorax (SP) is commonly observed in young, tall, thin, subjects without apparent underlying lung disease and in the elderly with chronic emphysematous lung disease. Traditionally it has been classified as primary (idiopathic) or secondary to a disease or pathologic state with the exception of penetrating, blunt, or barometric trauma. The mechanisms of development of SP are (1) a visceral pleural tear due to rupture of a subpleural bleb (congenital or acquired) or a necrotizing parenchymal process; and (2) dynamic bronchiolar obstruction resulting in check-valve hyperinflation of the distal airways with subsequent alveolar rupture [1, 2]. We present our experience treating in 417 SPs during the last 10 years.

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History

In 1803 Itard, a student of Laennec, first coined the term pneumothorax in his doctoral thesis. Later, in 1880, Biach reported that 78% of 916 patients with SP had tuberculosis, emphasizing the importance of pleural plaques and cavitary lung disease in the etiology of SP. In 1932 the Swedish Kjaergaard emphasized the primary importance of subpleural bleb disease [3–6]. He described the bimodal age distribution, male predominance, association with cigarette smoking, and the body habitus as leptosomic, asthenic, or ectomorphic. Surgical management of pneumothorax by thoracotomy is aimed at treating parenchymal tissue and achieving pleurodesis by abrasion or pleurectomy. Pleural abrasion was first described by Lilienthal [7] in 1926 and recommended by Clagett [8] in 1968, and pleurectomy was first proposed by Gaensler [9] in 1956.

Materials and Methods

A retrospective review of the medical and roentgenographic records of 417 consecutive patients admitted to “Evangelismos” General Hospital with the diagnosis of SP for the years 1986–1996 were reviewed. There were 349 males (83.7%) and 68 females, ranging in age from 14 to 93 years. Most presented with acute chest pain and dyspnea. A right-side SP was detected in 234 cases (56.1%), a left-side SP in 175 (42.0%), and a bilateral SP in 8 (1.9%).

A primary pneumothorax was revealed in 347 patients and a secondary one in 70. The underlying diseases are listed in Table 1.

Preoperative studies included chest radiography (Fig. 1) in all our patients and computed tomography in most after 1992 for complete localization of the apical bullae in those suspected of having secondary SP (Fig. 2). Preoperative pulmonary function tests were not carried out because in our opinion the result would be meaningless owing to the pain from the indwelling chest tube or air leakage through the tube.

The treatment included observation ($n = 16$, 3.8%) for those with lung collapse of less than 20%. No tube was inserted, and the pneumothorax was treated by O₂ inhalation. In cases with lung collapse of more than 20%, tube thoracostomy ($n = 401$, 96.2%) was the treatment of choice. In the 29 patients (7.0%) in whom either the lung did not reexpand or a subcutaneous emphysema was growing, more than one tube was inserted.

Table 1. Etiology of spontaneous pneumothorax.

Etiology	No.	%
Primary pneumothorax	347	83.2
Bleb disease	347	100.0
Secondary pneumothorax	70	16.8
Bullous emphysema	53	75.7
Acquired immunodeficiency syndrome	4	0.9
<i>Mycobacterium tuberculosis</i>	8	1.9
Sarcoidosis	2	0.5
Histiocytosis	2	0.5
Lymphangioliomyomatosis	1	0.2
Total	417	

Blood pleurodesis was performed in 13 cases (3.1%) where, because of concomitant diseases, surgery was avoidable. These patients underwent tube drainage and intrapleural instillation of about 120 ml of their own blood.

In the other 95 patients invasive interventions were required, such as surgical pleurectomy and bleb or bullae ablation. Primary indications for operation were recurrent SP ($n = 49$) and persistent air leak ($n = 46$).

Surgery was achieved either through a minithoracotomy ($n = 92$, 22.1%) or a midsternotomy ($n = 3$, 0.7%) when bilateral pathology existed. Minithoracotomy was a limited posterior one, a limited lateral one, or an axillary one. In all cases the skin incision did not exceed 10 cm. Under general anesthesia, using single-lung ventilation (1986–1992) or double-lumen endotracheal intubation (1993–1996), the thoracotomy was made through the fourth or fifth intercostal space.

Pleural abrasion was performed with a sterile gauze over the surface of the parietal pleura. This kind of mechanical abrasion allowed removal of the sticky layer covering the pleura until irritation led to an effusion of serohematic liquid. In that way the local inflammation created permanent pleurodesis. We used ligation for small bullae; larger ones were either stapled or clamped by the lung Kelley clamp and sutured using continuous running sutures (Fig. 3). The decision to undertake resection depended on the surgeon's preference. Two intercostal drains were inserted (one apical and one lower posterior). Continuous suction was placed in all cases. The patients were extubated in the operation room, and antibiotics (second-generation cephalosporin) were administered to all of them.

Results

Simple chest tube treatment resulted in closure, with no leakage, in 293 patients (70.3%) with SP. No recurrence was observed in the group with blood pleurodesis. All thoracotomized patients showed good lung expansion postoperatively. Perioperative mortality was zero, and the mean hospital stay was 6.5 days. The perioperative morbidity was 10%, including prolonged air leak (>5 days) ($n = 21$, 5.0%), fever ($n = 8$, 1.9%), thoracotomy infection ($n = 6$, 1.4%), and shoulder arthritis ($n = 8$, 1.9%). Follow-up of 89 patients who underwent surgical treatment (93.7%) at 1 to 100 months revealed only one recurrence (1%). With all limited thoracotomies the cosmetic result was excellent.

Discussion

The standard treatment of symptomatic pneumothorax is insertion of an intercostal tube and drainage through an underwater seal. High rates of ipsilateral (25–70%) and contralateral (10–15%) recurrences

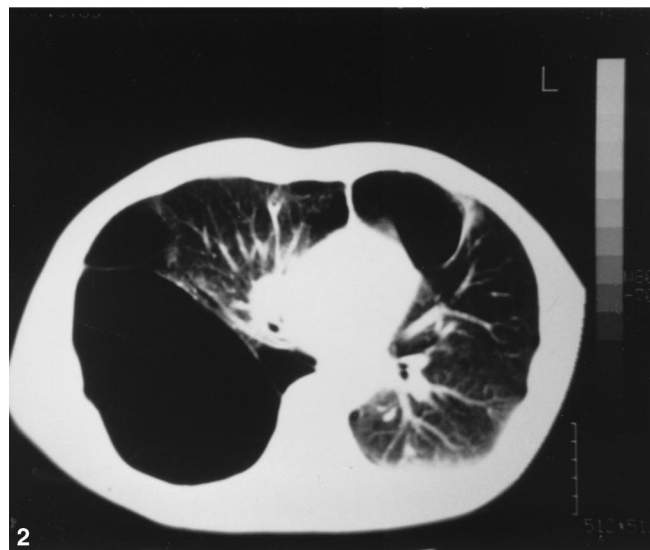
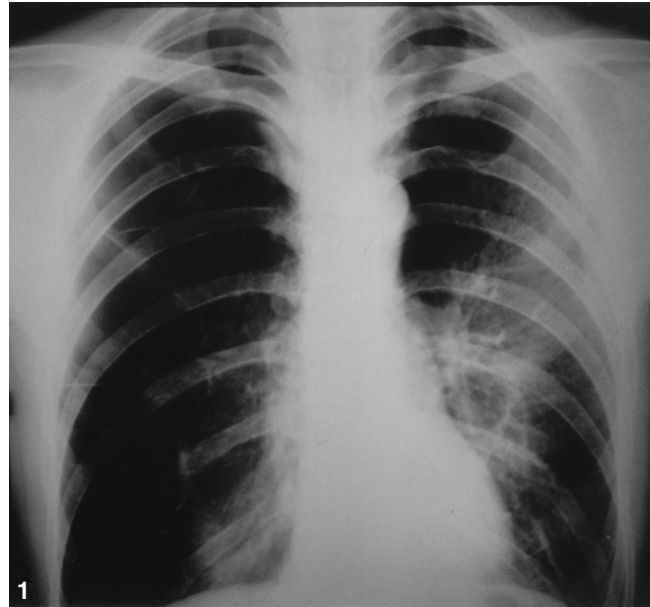


Fig. 1. Chest radiograph demonstrates bullae in both lungs.

Fig. 2. Computed tomography reveals multiple huge bullae in both lungs.

after treatment with bed rest and observation or tube thoracostomy are common [10–13]. More invasive procedures, such as surgical pleurectomy, are acceptable for patients with persistent air leak, recurrent SP, contralateral SP, and a first SP occurring in those with certain high-risk occupations (e.g., aviators) [14].

Timing invasive procedures during chest tube therapy of SP is undefined and is still a difficult clinical decision. Schoenenberger et al. [13] evaluated 420 patients with primary or secondary SP treated with tube thoracostomy and revealed maximal healing rates after 48 hours in those with a primary SP and lower healing rates in those with secondary SP. Nevertheless, we undertook an invasive procedure only after 5 days of air leak or for recurrent SPs [10, 15].

The surgical approach we used in most of our cases was a limited thoracotomy, as performed by Noiclerc and associates [16] in 1973. It does not involve transection of major muscles of the chest wall and offers less postoperative pain, early mobili-

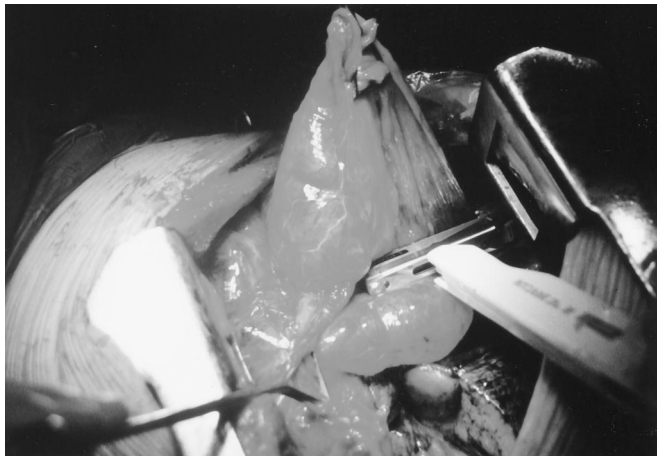


Fig. 3. Intraoperative finding.

zation, short hospital stay, minimal blood loss, reduced postoperative morbidity, early return to occupational activity, and an excellent cosmetic result [17, 18]. In all cases blebs or bullae were ablated. The long-term recurrence rate in our thoracotomized group was 1%, compared to 1% to 8% reported to the literature [19–21].

Video-thoracoscopy has been a viable alternative to minithoracotomy. Some authors believe that SP is the most suitable disease to be treated thoracoscopically [22, 23]. We initiated the thoracoscopic procedure (VATS) only recently in our institution and so have only a small number of cases. We have used the same indications and timing [22–24] for the operation and the same principles for drainage postoperatively as for open thoracotomy. The problem of postoperative pain has not been totally solved by VATS because patients have residual chest pain (treated with analgesic medications) undoubtedly due to intercostal trauma [25]. Unfortunately, no prospective studies have compared these two surgical approaches. Dumont et al. [22] and Mouroux et al. [25], in retrospective comparative studies, reported a higher recurrence rate after VATS, although the difference observed was not statistically significant. Finally, blood pleurodesis is an alternative to surgery. It is a safe method for elderly patients with a persistent air leak and usually underlying disease. It is not associated with recurrence.

Conclusions

We conclude that tube thoracostomy is still the treatment of choice for SP. Surgical intervention is recommended only in cases of recurrent SP or persistent air leak. The minithoracotomy is a safe surgical approach with satisfactory cosmetic results.

Résumé

Buts: Le pneumothorax spontané (PS) est observé chez les sujets jeunes, sveltes, sans maladie pulmonaire sous-jacente et chez le sujet plus âgé en rapport avec l'emphysème pulmonaire chronique. Nous présentons notre expérience du traitement du PS pendant les dix dernières années. Patients: Entre 12/1986 et 11/1996, 417 patients consécutifs ayant un PS ont été admis dans notre département. Il y avait 349 hommes (83.7%) et 68 femmes, dont les âges allaient de 14 à 93 ans. Résultats: Le PS était localisé à droite chez 234 patients (56.1%), à gauche chez 175 (41.9%) et

il était bilatéral chez 8 (2%). Le traitement comprenait soit l'observation/l'exsufflation (n = 16; 3.8%), un drainage tubulaire unique (n = 372; 89.2%), ou multiple (n = 29; 6.9%), une pleurodèse sanglante (n = 13. 3.1%), une sternotomie médiane (n = 3; 0.7%) ou une minithoracotomie (n = 92; 22%). Les indications chirurgicales principales étaient la récurrence du PS (n = 49) ou le bullage persistant (n = 46). Des bulles pulmonaires ont été retrouvées chez tous les patients et ont été enlevées par pince automatique. On a également réalisé des pleurodèses. La ré-expansion pulmonaire a été satisfaisante chez tous les patients. Il n'y avait aucune mortalité postopératoire. La durée moyenne d'hospitalisation a été de 6.5 jours. Une seule récurrence a été observée parmi les 89 patients traités chirurgicalement (93.7%) suivis entre 1 et 100 mois. Conclusions: 1. Le drainage thoracique (par tube) reste le traitement de choix dans le PS. 2. Le traitement chirurgical est recommandé seulement en cas de récurrence ou de persistance du bullage. 3. La minithoracotomie est un traitement sûr, dont les résultats esthétiques sont satisfaisants.

Resumen

Objetivo: El neumotórax espontáneo (NE) se observa frecuentemente en individuos jóvenes y altos sin aparente enfermedad pulmonar subyacente y en personas de edad con enfermedad pulmonar enfisematosa crónica. En este artículo presentamos nuestra experiencia con el tratamiento del NE en el último decenio. **Material:** Entre el período comprendido entre diciembre de 1986 y noviembre de 1996, se hospitalizaron 349 hombres (83.7%) y 68 mujeres, con edades entre 14 y 93 años. **Resultados:** Se encontró NE en el lado derecho en 234 casos (56.1%), en el lado izquierdo en 175 (41.9%) y bilateral en 8 (2%). El tratamiento comprendió: observación/aspiración (n = 16, 3.8%), toracostomía de tubo (n = 372, 89.2%), tubos múltiples (n = 29, 6.9%), pleurodesis sanguínea (n = 13, 3.1%), esternotomía media (n = 3, 0.7%) y minitoracotomía (n = 92, 22%). Las indicaciones primarias para operación fueron NE recurrente (n = 49) y escape aéreo persistente (n = 46). Se encontraron bulas en la totalidad de los casos, y éstas fueron eliminadas con el uso de suturador automático, realizándose al mismo tiempo pleurodesis. Todos los pacientes exhibieron buena reexpansión pulmonar postoperatoria. La mortalidad perioperatoria fue cero. El promedio de hospitalización fue de 6.5 días. El seguimiento a 1 y hasta 100 meses en 89 pacientes sometidos a tratamiento quirúrgico reveló sólo 1 caso de recurrencia. **Conclusiones:** 1) La toracostomía de tubo representa todavía el tratamiento de escogencia en el NE. 2) La intervención quirúrgica debe recomendarse sólo en casos de NE recurrente o de escape aéreo persistente. 3) La minitoracotomía constituye un abordaje quirúrgico seguro y de resultados estéticos satisfactorios.

References

1. Agostoni, E.: Mechanics of the pleural space. *Physiol. Rev.* 52:57, 1972
2. Wait, M.A., Estrera, A.: Changing clinical spectrum of spontaneous pneumothorax. *Am. J. Surg.* 162:528, 1992
3. Elfeldt, R.J., Schroeder, D., Meinicke, O.: Spontanpneumothorax—Ueberlegungen zur Aetiologie und Therapie. *Chirurg* 62:540, 1991
4. Gobbel, W.G., Rhea, W.G., Nelson, I.A., Daniel, R.A.: Spontaneous pneumothorax. *J. Thorac. Cardiovasc. Surg.* 46:331, 1963
5. Dines, D.A., Clagett, O.T., Good, C.A.: Nontuberculous pulmonary parenchymal conditions predisposing to spontaneous pneumothorax: report of 4 cases. *J. Thorac. Cardiovasc. Surg.* 53:726, 1967

6. Becker, H.P., Schmitz, I., Radomsky, J., Mueller, K.M.: Ultrastrukturelle Befunde pleuraler Cysten beim Spontanpneumothorax. *Chirurg* 66:787, 1995
7. Lilienthal, M.: Thoracic Surgery. Philadelphia, Saunders, 1926, p. 1962
8. Clagett, O.T.: The management of spontaneous pneumothorax. *J. Thorac. Cardiovasc. Surg.* 55:761, 1968
9. Gaensler, E.A.: Parietal pleurectomy for recurrent spontaneous pneumothorax. *Surg. Gynecol. Obstet.* 102:293, 1956
10. Seremetis, M.G.: The management of spontaneous pneumothorax. *Chest* 57:65, 1970
11. Getz, S.B., Jr., Beasley, W., III: Spontaneous pneumothorax. *Am. J. Surg.* 145:823, 1983
12. O'Rourke, J.P., Jee, E.S.: Civilian spontaneous pneumothorax: treatment and long-term results. *Chest* 96:1302, 1989
13. Schoenenberger, R.A., Haefeli, W.E., Weiss, P., Ritz, R.F.: Timing of invasive procedures for primary and secondary spontaneous pneumothorax. *Arch. Surg.* 126:764, 1991
14. Parry, G.W., Juniper, M.E., Dussek, J.E.: Surgical intervention in spontaneous pneumothorax. *Respir. Med.* 86:1, 1992
15. Waller, D.A., Forty, J., Morrill, G.N.: Video-assisted thoracoscopic surgery versus thoracotomy for spontaneous pneumothorax. *Ann. Thorac. Surg.* 58:372, 1994
16. Noiclerc, M., Dor, V., Chauvin, G.: Extensive lateral thoracotomy without muscle section. *Ann. Chir. Thorac. Cardiovasc.* 12:81, 1973
17. Mitchell, R.L.: The lateral limited thoracotomy incision: standard for pulmonary operations. *J. Thorac. Cardiovasc. Surg.* 99:590, 1990
18. Weatherford, D.A., Stevenson, J.E., Taylor, S.M., Blackhurst, D.: Thoracoscopy versus thoracotomy: indications and advantages. *Am. Surg.* 61:83, 1995
19. Deslauriers, J., Beaulieu, M., Despre, J.M., Lemieux, M., Leblanc, J., Desmeules, M.: Transaxillary pleurectomy for treatment of spontaneous pneumothorax. *Ann. Thorac. Surg.* 30:569, 1980
20. Thevenet, F., Gamondes, J.P., Bodzongo, D., Balawi, A.: Pneumothorax spontane et recidivant, traitement chirurgical. *Ann. Chir. Thorac. Cardiovasc.* 46:165, 1992
21. Jansen, J.P., Schramel, F.M.N.H., Sutedja, T.G., Cuest, M., Postmus, P.: Videothoracoscopic appearance of first and recurrent pneumothorax. *Chest* 108:330, 1995
22. Dumont, P., Diemont, F., Massard, G., Toumieux, B., Wihlm, J.M., Morand, G.: Does a thoracoscopic approach for surgical treatment of spontaneous pneumothorax represent progress? *Eur. J. Cardiothorac. Surg.* 11:27, 1997
23. Ellman, B.R., Ferrante, J.W., Tiedemann, R.N.: Thoracoscopy for spontaneous pneumothorax 2.10 version with bleb stapling and pleurectomy. *Am. Surg.* 61:102, 1995
24. De Giacomo, T., Rendiva, E.A., Venuta, F., Ciriaco, P., Lena, A., Ricci, C.: Video-assisted thoracoscopy in the management of recurrent spontaneous pneumothorax. *Eur. J. Surg.* 161:227, 1995
25. Mouroux, J., Elkaim, D., Padovani, B., Myx, A.L., Perrin, C., Roto-mondo, C., Chavaillon, J.M., Blaive, B., Richelme, H.: Video-assisted thoracoscopic treatment of spontaneous pneumothorax: technique and results of one hundred cases. *J. Thorac. Cardiovasc. Surg.* 112:385, 1996

Invited Commentary

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The ten-year experience of Athanassiadi and colleagues from Athens represents a wealth of information regarding the management of spontaneous pneumothorax. The excellent results in this vast experience should serve as the "benchmark standard" against which all "newer" management modalities are measured. Like any complete, well analyzed experience, the study produces more questions than it answers.

Current trends in the management of spontaneous pneumothorax are toward smaller chest tubes (even catheters) as the initial treatment for first-time primary spontaneous pneumothoraces. In the current cost-conscious health care environment, outpatient management of selected, reliable patients appears to yield satisfactory results.

Operative management has moved to the thoracoscopic approach. As the authors note, thoracoscopy has become the preferred approach in many centers. In a recent survey of thoracic surgeons, thoracoscopy was the preferred approach by 65% of thoracic surgeons surveyed and an acceptable approach by another 35% [1].

The perceived lesser morbidity of a thoracoscopic approach has led to earlier intervention of spontaneous pneumothorax. The author's definition of "persistence" is, appropriately, 5 days. We have taken the approach of earlier operative intervention (2-3 days) if a large leak persists or a nonexpanded lung remains despite all standard maneuvers.

Most surgeons use stapled resection, as did the Athens group. When financial considerations are of paramount importance, readers should be aware of the experience of Liu and associates from Taiwan, who have demonstrated superior results with bleb ligation by endoscopic suture loops [2].

Regarding postoperative management, the authors routinely use suction on the chest tubes. The readers should also be aware of Cooper's experience with lung volume reduction surgery in which suction appeared to lead to persistence rather than resolution of air leaks [3]. His observation has led to our cessation of the use of suction on all tubes after all pulmonary surgery, unless the lung does not remain expanded without suction.

This series represents such a "fertile garden" of experience that I hope the authors will "till" further and share the information with us. One is stimulated to ask such questions as: What are their results with secondary versus primary pneumothorax? How were AIDS patients specifically managed, and what were the results? How many of the patients managed "conservatively" with tube thoracostomy alone had a recurrence and during what period of time? Was it the accepted 25%? Can the authors identify a subset of patients whose SP tends to recur early and therefore warrant early operative intervention (e.g., those with large leaks or large blebs on CT scan, smokers, or these with AIDS, other diseases, and secondary pneumothorax)?

Finally, the authors correctly state that no prospective series of open minithoracotomy versus thoracoscopy for management of spontaneous pneumothorax exists. In view of this large single-center experience with this disease, and no that the authors have gained some experience with the thoracoscopic technique, one would hope that they will embark on this crucial, needed randomized study.

References

1. Mack, M.J., Scruggs, G.R., Kelly, K.M., Shennib, H., Landreneau, R.J.: Video-assisted thoracic surgery: has technology found its place? *Ann. Thorac. Surg.* 64:211, 1997
2. Mack, M.J.: Cost-effective and surgically effective lung volume reduction surgery. [editorial]. *Chest* 111:268, 1997
3. Cooper, J.D.: Technique to reduce air leaks after resection of emphysematous lung. *Ann. Thorac. Surg.* 57:1038, 1994