

# EDITORIAL

Adv Clin Exp Med 2004, 13, 4, 531–534  
ISSN 1230-025X

DOV WEISSBERG

## Modern Management of Spontaneous Pneumothorax

### Nowoczesne postępowanie przy samoistnej odmie opłucnowej

Department of Thoracic Surgery, Tel Aviv University Sackler School of Medicine,  
Tel Aviv and E. Wolfson Medical Center, Holon, Israel

**Key words:** pneumothorax, spontaneous pneumothorax.

**Słowa kluczowe:** odma opłucnowa, samoistna odma opłucnowa.

## Definition and Classification

Pneumothorax is defined as the presence of air in the pleural cavity, with secondary lung collapse. It is usually classified into spontaneous, occurring without a preceding event; traumatic; and iatrogenic. Spontaneous pneumothorax comprises the largest group and is further categorized into primary and secondary subdivisions. Primary spontaneous pneumothorax occurs in young patients without an obvious pulmonary disease, and is usually caused by the rupture of a subpleural bleb. It is twice as common in men as in women. Secondary spontaneous pneumothorax occurs as a complication of an underlying lung disease, most often chronic obstructive lung disease, but also primary or metastatic pleural tumor or pulmonary infection. Spontaneous pneumothorax occurs bilaterally in 5% of patients, pleural effusion coexists in 10%, and haemothorax in 7%. Tension pneumothorax occurs in 1 to 3% of pneumothoraces [1, 2].

## Management

While pneumothorax has been first identified by Boerhaave nearly 3 centuries ago, and Laennec offered an excellent clinical description in 1819 [3], the matter of its management has not been settled. It remains highly controversial and ranges from simple aspiration, tube drainage and chemi-

cal sclerosis of the pleura, to thoracoscopy and thoracotomy with pleural abrasions or downright pleurectomy. The choice of therapeutic procedure varies according to the number of episodes, the size of the pneumothorax, and the particular group of investigators [4–8].

As a rule, determination of the size of pneumothorax should precede any treatment. While determination based on impression of the radiologist is only approximate, it is, nevertheless, helpful in the management of these patients. For pneumothorax lesser than 20% of the pleural space, no treatment is necessary beyond observation, unless the patient is short of breath. The air absorbs at the rate of only 1.25% per day (50 to 75 ml) [9], but there is no need for hospitalization. The patient should be followed on an outpatient basis, repeating the radiographs every 7 to 10 days. There are several exceptions to this management, which include general anesthesia and the need for mechanical ventilation. Under these circumstances, pleural tube drain should be inserted, regardless of the size of pneumothorax. Pneumothorax greater than 20% of the pleural space, or increasing in size, requires intercostal drainage. The same rule should be applied to pneumothorax accompanied by pleural effusion. Suction, as a rule, is not necessary; it should be applied only if the lung does not expand well. After air leak stops and the lung expands completely, the pleural drain should be removed without clamping. Clamping of the tube for variable periods of time serves no useful purpose and prolongs the patient's discomfort.

Management of pneumothorax by simple aspiration is controversial. Some authors recommend it because of its low invasiveness, simplicity and economic considerations [10]. However, simple aspiration of pneumothorax is rarely complete, does not prevent recurrence, and may cause puncture of the lung by the aspirating needle [11]. The author uses this method only exceptionally, when a patient refuses treatment by pleural drain.

Unilateral pulmonary edema may occur following rapid expansion of the lung, particularly after several days of unrelieved collapse. This complication is more likely to occur if negative pressure has been applied. It is characterized by hypoxia and hypotension, and may lead to death [12]. It should be managed by oxygen therapy, diuretics and hemodynamic support. Intubation and mechanical ventilation may be necessary. The incidence of this complication varies. It has been estimated by Bernstein at 10% [13], but in author's experience it has occurred in 3 instances only, out of 1200 patients [2]. This low complication rate may be due to the fact, that author uses, as a rule, simple underwater seal drainage, without suction.

## Persistent and Recurrent Pneumothorax

Pneumothorax is defined as persistent when it lasts more than 10 days, while treated uninterruptedly by tube thoracostomy with underwater seal, with or without suction. The commonest cause of persistence is bronchopleural fistula [5, 14]; other causes include formation of fibrinous peel over the lung surface, pleural adhesions, bronchial or pulmonary laceration, and bronchial obstruction. Bronchoscopy is mandatory to rule out bronchial obstruction by mucous plugs, tumor, or a foreign body. Aspiration of bronchial secretions or extraction of the foreign body results nearly always in immediate expansion of the lung. Other causes of persistence may be found at inspection of the pleura either at direct pleuroscopy [15] or at video-assisted thoracoscopy. These procedures are also indicated for evaluation of patients with recurrent pneumothorax. Approximately 90% of patients suffer either one or two episodes of pneumothorax on the same side, and only 10% have three or more ipsilateral episodes [2]. Thus in patients who had undergone either one or two episodes of pneumothorax, there is no need for further investigation. However, thoracoscopy is indicated in the 10% of patients who experienced multiple ipsilateral episodes. It enables direct inspection of the entire pleural surface and search for causes of recurrence. The use of direct thoracoscopy in the

management of pneumothorax was first suggested by Sattler in 1937 [16]. Using an instrument of his own device, he observed pleural changes in patients with pneumothorax, either recurrent or persistent, and suggested immediate treatment according to findings.

## Management at Thoracoscopy

In management of patients with pneumothorax, thoracoscopy (either direct or video-assisted) should be performed for persistence or for second ipsilateral recurrence, when pneumothorax occupies at least 20% of the pleural space. If irregularly scattered adhesions are found, they should be divided with diathermy. Following this, 2 gm of asbestos-free sterile talc should be lightly sprinkled over the entire pleural surface. If subpleural blebs are seen and the lung is fully expansible, the blebs are excised, 2 gm of talc is insufflated and the pleural drain is attached to underwater seal with suction. Expansion is thus maintained, aiding formation of adhesions and preventing further episodes of recurrence. If laceration is found and the lung does not expand well, all blebs are resected and the laceration is stapled. All large emphysematous bullae must be excised. If pleural fibrosis is found, decortication should be done, either open or thoracoscopic. If no abnormalities are found, talc is insufflated and pleural drain is attached to underwater seal with suction [15].

## Talc Pleurodesis

Objection to the use of talc has been expressed by Rinaldo and associates [17] because of its alleged association with acute respiratory distress syndrome (ARDS). In their experience with four patients, this syndrome occurred in the three who received 10 gm of talc intrapleurally. The fourth patient received 5 gm of talc, and ARDS did not develop. The reported complication was most likely dose-related [18]. The author is not aware of any other reports linking talc with ARDS. It is possible that excessive amount of talc is capable of inducing ARDS. Therefore, it is important not to use more than 2 gm of talc for the obliteration of the pleural space [18–21].

A much more widely publicized objection to the use of talc is its alleged association with pleural mesothelioma and bronchogenic carcinoma. Talc is a generic term that includes, in addition to the mineral hydrated magnesium silicate (pure mineral talc), impure massive talcose rocks (soap-

stone). These may contain as little as 50% of mineral talc. The most important contaminant of talc linked to carcinogenesis is asbestos. In order to be suitable for clinical use, talc must be free of all carcinogenic contaminants. The purified talc that the author uses corresponds with the requirements of the British Pharmacopoeia [21, 22] and does not contain any asbestos.

Of other agents used to obliterate the pleural space, tetracycline, bleomycin, and quinacrine were used most commonly. However, the use of tetracycline results in much pain. Therefore, it must be used with the patient under heavy sedation. In addition, the effectiveness of tetracycline is only about 50%, compared with 95% for talc [23, 24]. Bleomycin and quinacrine are systemically absorbed and both have a potential for systemic toxicity [25–28].

## Pleurodesis by Surgical Means

Alternatively, pleural obliteration can be achieved without the use of any chemical agents, by surgical means only. It includes resection of all blebs and bullae, suture or stapling of air leaks, and either abrasion of the entire pleural surface using dry gauze, or a limited apical pleurectomy. Both procedures are effective, and can be performed either through a small, muscle-sparing thoracotomy [29, 30], or at a video-assisted thoracoscopy [31]. Hemostasis must be meticulous, and at the end of the procedure a large-bore pleural drain should be placed at the apex of the pleural cavity.

Unfortunately, the availability of video-assisted thoracic surgery (VATS) brought about very rapid spread of this technique, not always for appropriate indications. Often it is used, just because it is available. A striking example of such use of VATS for questionable indications has been published recently by Margolis and associates [32], who used this technique in 156 consecutive patients with pneumothorax. All patients in their series were young (14 to 38 years old; median 19),

for the majority it was the first episode ever, and their risk of recurrence was very small. Subjecting all these patients to an invasive procedure under general anesthesia was hardly justified.

Another application of VATS, difficult for the author to accept, is the use of this technique on one side of the chest for bilateral pneumothorax, as reported by Yi-Cheng and associates [33]. Following excision of blebs on one side, the authors performed dissection behind the sternum to reach the contralateral pleural space and continued there with the apical bullectomy. This technique may warrant a prize for an acrobatic feat, but simple pneumothorax can usually be taken care by much simpler means.

## Tension Pneumothorax

Tension pneumothorax requires special attention. It has been reported to occur in 3% of spontaneous pneumothoraces [1], but it has been closer to 1% in author's own series [2]. It occurs when a one-way valve mechanism is present, enabling entry of air into the pleural space and not permitting its escape. Consequently, the intrapleural pressure rises, and eventually exceeds the atmospheric pressure throughout the respiratory cycle, continuing to rise as the air accumulates. With increased pressure within the hemithorax, venous return to the heart fails, and the mediastinum shifts contralaterally, distorting the trachea and the vena cava, with further decrease of venous return. The cardiac output is compromised and severe hypoxia develops. Pneumothorax under tension is usually large. Unless the tension is relieved, the patient deteriorates, with hypotension, peripheral cyanosis, and deviation of the trachea, progressing to death [7]. Immediate decompression of the pleural space is, therefore, mandatory. No time should be spent on radiologic verification. Insertion of a large-bore needle into the involved pleural cavity converts the tension pneumothorax into an open one, usually with immediate improvement. An intercostal drain should then be inserted.

## References

- [1] **Cortes LE, Hoque LF, Nimo ME:** Pitfalls in the diagnosis of pneumothorax. Presented at: American College of Surgeons 83<sup>rd</sup> Clinical Congress: October 12–17, Chicago 1997.
- [2] **Weissberg D, Refaely Y:** Pneumothorax. Experience with 1199 patients. *Chest* 2000, 117, 1279–1285.
- [3] **Laennec RTH:** De l'auscultation médiate, un traité de dn. diagnostique des maladies des poumons et du coeur. JA Brosson & JS Chande, Paris 1819, vol. 1.
- [4] **Keller R, Gutersohn J, Herzog H:** Die Behandlung des persistierenden Pneumothorax durch thorakoskopische Massnahmen. *Thoraxchirurgie* 1974, 22, 457–460.
- [5] **DeVries WC, Wolfe WG:** The management of spontaneous pneumothorax and bullous emphysema. *Surg Clin North Am* 1980, 60, 851–866.

- [6] **Weissberg D:** The surgical management of recurrent or persistent pneumothorax: pleuroscopy and talc poudrage. In: Current controversies in thoracic surgery. Ed. Kittle CF, WB Saunders, Philadelphia 1986, 46–50.
- [7] **Despars JA, Sassoon CSH, Light RW:** Significance of iatrogenic pneumothoraces. *Chest* 1994, 105, 1147–1150.
- [8] **Hürtgen M, Buhr J, Kluth D, Kelm Ch, Schäfer A:** Thorakoskopische Operationen des primären Spontanpneumothorax. *Chirurg* 1995, 66, 890–894.
- [9] **Deslauriers J, Piraux M:** Diagnosis and management of spontaneous pneumothorax in the young adult: a role of parietal pleurectomy. In: Thoracic surgery: surgical management of pleural diseases. Deslauriers J, Laquet LK, Eds. Mosby, St. Louis 1990, 119–127.
- [10] **Delius RE, Obeid FN, Horst HM, Sorensen VJ, Fath JJ, Bivins BA:** Catheter aspiration for simple pneumothorax. *Arch Surg* 1989, 124, 833–836.
- [11] **Baumann MH, Strange C:** Treatment of spontaneous pneumothorax: a more aggressive approach? *Chest* 1997, 112, 789–804.
- [12] **Light RW:** Pleural diseases. Lea & Febiger, Philadelphia 1990, 2<sup>nd</sup> ed.
- [13] **Bernstein A:** Re-expansion pulmonary edema (letter). *Chest* 1980, 77, 708–709.
- [14] **Deslauriers J:** Spontaneous pneumothorax. *Ann R Coll Phys Surg Can* 1988, 21, 9–14.
- [15] **Weissberg D:** Handbook of practical pleuroscopy. Mount Kisco, NY, Futura 1991, 51–71.
- [16] **Sattler A:** Zur Behandlung des Spontanpneumothorax mit besonderer Berücksichtigung der Thorakoskopie. *Beitr Klin Tuberk* 1937, 89, 395–408.
- [17] **Rinaldo JE, Owens GR, Rogers RM:** Adult respiratory distress syndrome following intrapleural instillation of talc. *J Thorac Cardiovasc Surg* 1983, 85, 523–526.
- [18] **Weissberg D:** Talc and adult respiratory distress syndrome (letter). *J Thorac Cardiovasc Surg* 1984, 87, 474.
- [19] **Weissberg D, Kaufman M, Zurkowski Z:** Pleuroscopy in patients with pleural effusion and pleural masses. *Ann Thorac Surg* 1980, 29, 205–208.
- [20] **Weissberg D, Kaufman M:** Diagnostic and therapeutic pleuroscopy: experience with 127 patients. *Chest* 1980, 78, 732–735.
- [21] **British Pharmacopoeia.** HMSO, London 1993, 649–650.
- [22] **Martindale W:** The extra pharmacopoeia. Pharmaceutical Press, London 1989, 29<sup>th</sup> ed., 933.
- [23] **Weissberg D:** Role of chemical methods to induce adhesive pleuritis. In: Thoracic surgery: surgical management of pleural diseases. Deslauriers J, Laquet LK, Mosby, St. Louis 1990, 130–131.
- [24] **Colt HG, Russack V, Chiu Y, Konopka RG, Chiles PG, Pedersen CA, Kapelanski D:** A comparison of thoracoscopic talc insufflation, slurry, and mechanical abrasion pleurodesis. *Chest* 1997, 111, 442–448.
- [25] **Weissberg D, Ben-Zeev I:** Talc pleurodesis. Experience with 360 patients. *J Thorac Cardiovasc Surg* 1993, 106, 689–695.
- [26] **Cattaneo SM, Sirak HD, Klassen KP:** Recurrent spontaneous pneumothorax in the high-risk patient. *J Thorac Cardiovasc Surg* 1973, 66, 467–471.
- [27] **Larieu AJ, Tyers GFO, Williams EH, O'Neill MJ, Derrick JR:** Intrapleural instillation of quinacrine for treatment of recurrent spontaneous pneumothorax. *Ann Thorac Surg* 1979, 28, 146–150.
- [28] **Siegel RD, Schiffman FG:** Systemic toxicity following intracavitary administration of bleomycin. *Chest* 1990, 98, 507.
- [29] **Weissberg D, Kaufman M:** Two muscle-sparing thoracotomies – techniques and indications. *S Afr J Surg* 1990, 28, 17–19.
- [30] **Massard G, Thomas P, Wihlm JM:** Minimally invasive management for first and recurrent pneumothorax. *Ann Thorac Surg* 1998, 66, 592–599.
- [31] **Carillo EH, Schmach DC, Gable DR, Spain DA, Richardson JD:** Thoracoscopy in the management of post-traumatic persistent pneumothorax. *J Am Coll Surg* 1998, 186, 636–640.
- [32] **Margolis M, Gharagozloo F, Tempesta B, Trachiotis GD, Katz NM, Alexander EP:** Video-assisted thoracic surgical treatment of initial spontaneous pneumothorax in young patients. *Ann Thorac Surg* 2003, 76, 1661–1664.
- [33] **Yi-Cheng W, Yen C, Yun-Hen L, Chi-Hsiao Y, Tzu-Ping C, Hui-Ping L:** Thoracoscopic ipsilateral approach to contralateral bullous lesion in patients with bilateral spontaneous pneumothorax. *Ann Thorac Surg* 2003, 76, 1665–1667.

### Address for correspondence:

Dov Weissberg, M.D.  
 11 Be'eri Street  
 Rehovot 76352, Israel  
 e-mail: dovww@post.tau.ac.il

Received: 5.01.2004

Accepted: 5.01.2004

Praca wpłynęła do Redakcji: 5.01.2004 r.

Zaakceptowano do druku: 5.01.2004 r.