

**Review Article**

# Spontaneous Pneumothorax - Therapeutic Attitude - Brief Review

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**Abstract:** Background: Spontaneous pneumothorax is a type of air collection in the pleural cavity that it develops in the absence of trauma or an iatrogenic cause. It may become an emergency in thoracic surgery. The anatomical substrate of spontaneous pneumothorax is represented by blisters. But we must not minimize the emphysema bubbles that appear in the lung parenchyma, which may also be a common cause of spontaneous pneumothorax. In order to appear the spontaneous pneumothorax, it is considered necessary to have an area of minimal resistance in the visceral pleura and also a triggering element. For decades, the therapeutic options are been discussed. Objectives: literature review and updating of scientific data Method: The management of conservative treatment is known, ambulatory air aspiration, drain tube installation, video-assisted thoracoscopic surgery The use of chemical pleurodesis - betadine versus talc and mechanical - pleural abrasion, resection of blisters or ligature at their base, apical pleurectomy, are therapeutic options that are custom applied for each case. The current diagnostic and treatment guidelines have been designed about 10 years ago and with a little change. Results: We support the use as a chemical agent of betadine to prevent recurrences with a similar effect to that of talc.–We concluded that the introduction of betadine into the drain tube after minimal pleurotomy for symphysis, can sometimes lead to local pain, sometimes atrocious, unbearable, even simulating the myocardial infarction pain. Therefore, before applying the chemical, we recommend the systemic analgesics and local analgesic from the amide group. Video-assisted thoracic surgery is the main surgical technique for treating pneumothorax in order to prevent recurrences. Conclusions - We considered necessary a mini-revision of the literature in order to update the scientific data and the effective treatment methods with the mention of some own amendments regarding the therapeutic options.

**Keywords:** Spontaneous Pneumothorax, Thoracic Tube, Video Assisted Thoracoscopic Surgery, Chemical Pleurodesis

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## 1. Introduction

Spontaneous pneumothorax is defined as an air collection in the pleural cavity, which develops in the absence of trauma or a iatrogenic cause (diagnostic maneuvers, chest trauma and recent thoracic surgery) [1]. It can become a major surgical emergency depending on the amount of air accumulated in the pleural cavity, which can cause disturbances of respiratory and cardiocirculatory function [2]. It is considered that any pneumothorax cannot appear in a healthy lung without a pre-existing pathology.

Pneumothorax is classified in two large etiopathogenic groups: spontaneous and acquired. The spontaneous one is divided in: primary, secondary, neonatal and catamenial [2]. A primary spontaneous pneumothorax occurs in patients without apparent lung disease- subpleural blebs rupture (the most common cause), while a secondary pneumothorax is a complication of a pre-existing disease – bullous emphysema, cystic fibrosis, lung cancer, bronchial asthma, COPD, Lymphangioliomyomatosis (LAM) post-irradiation, spontaneous rupture of the esophagus, pneumonia with pulmonary abscess, etc. [2, 3]. The causal mechanism of this

disease, involves tearing the alveolar walls or subpleural structures [4].

Etiologies are not well known. Predisposing factors: smoking, intense exertion, coughing, sneezing, defecation effort. These trigger the bubbles to break. Some specialists consider that the main risk factor is smoking tobacco cigarettes [5]. The literature mentions the occurrence of pneumothorax in patients who smoked tobacco associated with cannabis [3, 6], e-cigarette smokers [7], air pollution in major cities [8], and other toxic factors [9]. Smoking acts on the extracellular pulmonary matrix through several mechanisms, but the release of oxidizing free radicals inhibits alpha-1-antitrypsin and alters the alveolar membrane [2].

Genetic influence is supported by mutations of the FLCN gene found both in family cases - a family history of pneumothorax can cause in 10% of cases the appearance of familial pneumothorax disease [10, 11] and in several genetic diseases - Birt-Hogg-Dubé syndrome, pulmonary lymphangiomyomatosis, Marfan syndrome, Ehlers-Danlos vascular syndrome, Loeys Dietz syndrome, cystic fibrosis. [12]

Frequently affects tall and weak men [13]. As a case, it accounts for 20% of the hospital wards of thoracic surgery [9]. The annual incidence is 18–28 per 100 000 men and 1.2–6 cases per 100 000 women [1]. The incidence of recurrence is 20 - 60% in the first 3 years after the first episode [13].

Imaging examinations confirm the diagnosis of pneumothorax - chest X-ray, computed tomography, thoracic ultrasound [5]. Radiological examination is mandatory to highlight air in the pleural cavity, hyper transparent, absence of pulmonary drawing [2]. Indications for computed thoracic tomography are: highlighting the trigger cause (blebs, emphysema bubble, tumors, etc.), indication and topographical location in the presence of a partial pneumothorax, can differentiate between an aerial cyst and a giant bubble of emphysema, estimation of the actual size of a pneumothorax, diagnosis of other underlying lung diseases [9].

In the last decade, pulmonary ultrasound has emerged as a sensitive technique in the evaluation of respiratory diseases and has gained a well-established role in the diagnosis of pneumothorax [14].

The purpose of the paper – a mini-revision of the literature in order to update scientific data and effective treatment methods with the mention of own amendments regarding the therapeutic attitude.

Therapeutic options - European Respiratory Society (ERS) Statement of the Company Working Group and The British Thoracic Society Guide (BTS) [15], recommends the therapeutic attitude according to the dyspnea and the size of the pneumothorax.

The main objective of pneumothorax treatment is the removal of air from the pleural cavity with the resolution of the lesion that caused the appearance of pneumothorax [2, 16]. The long-term objective is to prevent the recurrence of the disease [17]. It can be treated conservatively or by medical-surgical therapeutic attitude depending on the size of

the pneumothorax [18]. According to the American College of Thoracic Physicians (ACCP), the British Thoracic Society (BTS) and the Spanish Society of Pulmonology and Thoracic Surgery, therapeutic management is directed to remove air from the pleural space and prevent recurrence [18]. According to the British Thoracic Society pleural disease guideline 2010-therapeutic attitude is influenced by the severity of respiratory insufficiency that will indicate the active method of medical-surgical treatment [19].

## 2. Method - Ways of Treatment for the Purpose of Managing Pleural Space

### 2.1. Conservative Management

Conservative management is indicated for patients with minimal symptomatology [19]. Indication for this type of treatment is patients with a small pneumothorax (<15%), clinically healthy, which can be observed and at which oxygen therapy can be administered with a flow rate of up to 10 l/min, (with caution in patients with COPD) [20] and analgesia [18]. The disadvantage lies in the frequent occurrence of relapses and prolonged healing time.

### 2.2. Interventional Management (Medical-surgical Therapeutic Attitude)

Therapeutic management aims to remove air from the pleural cavity and achieve a tight pleural symphysis to prevent relapses [21].

#### 2.2.1. Management for Outpatient Treatment

Management for outpatient treatment - air aspiration-(exsufflation) is considered the first therapeutic gesture in the pneumothorax with indications for air evacuation. Air suction is done on the needle with mandren, followed by a chest control X-ray 2–4 hours after the maneuver [9]. Success rates are estimated at 51–69% [22]. This therapeutic gesture applies to patients with a first spontaneous pneumothorax episode greater than 15%, up to 30%, which are hemodynamically stable [2,18]. The advantages of exsufflation are represented by simple technique and low cost. The possibility of infection of pleural cavitation and the risk of damage to the pulmonary parenchyma during the maneuver, constitute disadvantages [2].

#### 2.2.2. Management of Pleural Decompression by Mounting an Intrapleural Drainage Tube

Management of pleural decompression by mounting an intrapleural drainage tube - minimal pleurotomy. This technique consists in the placement of a drainage tube in the pleural cavity through an intercostal space, [23] usually in space 5, on the average axillary line (Minimum Pleurotomy type Bulau) [2]. The drain tube is maintained for 3-5 days. It attaches to a Heimlich valve [24] / Single-way Vygon [25] or to a suction device. Aspirational drainage can be passive (Beclaire type kit) or active (active suction battery) [1, 23]. The drainage tube used for this maneuver may be simple or

double lumen for performing chemical pleurodesis on the tube [26]. Pleurotomy is performed in patients with altered general condition and in those who do not support a general anesthesia for VATS. It has indication in maximum urgency when the patient presents severe cardio-respiratory failure - massive hypertensive pneumothorax, with the presence of "chake-valve" mechanism or in the case of bilateral pneumothorax [2]. It is not indicated in cases of pneumothorax caused by breaking emphysema bubbles. The disadvantage of these methods lies in the relatively large recurrence of the disease 23-50% [27].

### 2.2.3. Chemical Pleurodesis

Chemical pleurodesis aims to achieve pleural symphysis for the prevention of relapses [2]. International guidelines suggest chemical pleurodesis both on the tube and by minimally invasive surgery techniques, with the aim of achieving pleuropulmonary adhesion [28] and preventing recurrence [29]. The chemical agents known in pleurodesis are: pure talc [28] and betadine solution [26], autologous blood, silver nitrate, tetracycline, doxycycline [28]. The disadvantage of the procedure is the difficulty of performing another surgery on the same side in the event of the appearance of a new lung disease [26, 28]. The administration of the chemical agent on the drainage tube has as a disadvantage the local action on the path of the tube holes and not on the entire pleural surface.

Before extracting the drain tube, we consider that we have to clamp the tube for 24 hours; the patient then performs a chest X-ray. If the lung remains expanded and there are no radiological signs of pneumothorax, the drainage tube is extracted. If the lung is not completely expanded, proceed to VATS surgery.

### 2.2.4. Video Assisted Thoracoscopic Surgery (VATS)

Video assisted thoracoscopic surgery (VATS) is considered the main method of treatment in the realization of a pleural inflammatory process with fibrous adhesions to prevent relapse [18].

The procedure aims to inspect the entire pleural cavity, detect the lesion in the parenchyma, [2] resolve the lesion, achieve a chemical pleurodesis with fibrogenetic effect and suppression of pleural space [30] and effective drainage of the pleural cavity [31].

According to systematic reviews of controlled studies, the effectiveness of pleural abrasion and chemical pleurodesis by VATS [32] have been identified.

Chemical pleurodesis with betadine solution in VATS is superior to pleurodesis on the drain tube because the sclerosing agent can be distributed evenly and under videoscopic control throughout the surface of the pulmonary parenchyma.

Mechanical pleurisy - pleural puncture - can be achieved by VATS, using a tampon mounted and consists in abrasion of the parietal pleura, except for the mediastinal pleura, until a local inflammatory process and bloody sub fusions in order to achieve a tight pleural symphysis. Apical pleurectomy should be considered in most cases when looking for a tight pleural symphysis.

Minimally invasive surgical techniques such as robotics and video-assisted thoracoscopic surgery (VATS) have been shown to be safe and effective surgical methods in the treatment of emphysema bubbles that can cause pneumothorax [21].

Other surgical procedures [2] used are:

Excision or ligation at the base of the blebs, associated or not with apical pleurectomy.

Atypical resections of the affected lung area – resection of the blebs,

Excision of endometriosis lesions in rare cases, in catamenial pneumothorax.

The advantages of video-assisted thoracoscopic surgery are represented by: reduction of hospital time, low cost for care, low postoperative pain, high therapeutic efficiency by solving the cause and preventing relapse, reduction of emotional impact taking into account low recurrence, after the first episode and the possibility of social reintegration and resumption of early professional activities in the young population [33]. The recurrence of the disease after CTVA is 3-7% [34].

Classical thoracotomy was the classic surgical treatment of pneumothorax. This approach is indicated in exceptional cases: the concomitant presence of another surgical lung condition that requires this approach; impossibility of VATS surgery due to tight pleural adhesion and patient intolerance to being ventilated on a single lung [2, 27].

## 3. Results

An important feature of pneumothorax is the tendency to relapse.

According to the studied literature, the recurrence after mounting an intrapleural drainage tube is 23-50% [27], after surgery performed by video-assisted thoracoscopic surgery, recurrence rates were reduced by 3-7% [34]. We consider that chemical pleurodesis with betadine has relatively similar effects of achieving a pleural symphysis almost similarly as after the use of talc. The advantage of using betadine is that it does not cause pulmonary fibrosis in time. It should be noted that spontaneous pneumothorax as the majority of cases occur in young people, and respiratory function should not be affected after the use of pleurodesis.

Surgical intervention performed for a pulmonary pathology over time is easier to perform after betadine chemotherapy.

The opening of the pleural cavity after chemical pleurodesis with betadine is easier in case of a surgery necessary for another lung pathology at the same level that appeared in time.

## 4. Discussion

Spontaneous pneumothorax may be a surgical emergency. The therapeutic attitude is selected according to the general condition of the patient, the size of the pneumothorax and the degree of medical-surgical urgency, as recommended by the

diagnostic and treatment guidelines.

Therapeutic management aims to eliminate air from the pleural cavity, achieve a tight pleural symphysis to prevent recurrences and eliminate the cause of pneumothorax - in most cases resection of blisters or ligation at their base.

VATS is the most effective method of treatment.

We support the use as a chemical agent of betadine to prevent recurrences with an effect similar to that of talc. We found that the introduction of betadine into the drain tube after minimal pleurotomy in order to achieve symphysis, can sometimes lead to local pain, sometimes atrocious, unbearable, even mimicking the pain of myocardial infarction. Therefore, we recommend the use of systemic analgesics and local analgesics from the amide group before applying the chemical.

Post-therapy is recommended, according to British guidelines, for individuals who have suffered a primary spontaneous pneumothorax to avoid air travel for 6 weeks and recommends that patients should not fly until the resolution is confirmed. [19]

Advances in surgical technique and the research process in this field have led to the minimization of postoperative complications and a large decrease in the recurrence rate.

## 5. Conclusions

1. Spontaneous pneumothorax may become a surgical emergency that causes acute respiratory failure and cardiovascular failure in hypertensive pneumothorax.
2. Imaging investigations - radiography, computerized tomography are essential in establishing the diagnosis.
3. The therapeutic attitude aims to remove the patient from acute respiratory failure, evacuate air from the pleural cavity, re-expand the lungs, treat the injury that caused pneumothorax, prevent recurrences.
4. CTVA is the main surgical technique in the treatment of pneumothorax to prevent recurrences.
5. In major surgical emergencies we consider that minimal pleurotomy is the first therapeutic gesture to eliminate acute respiratory failure and reduce the rate to a minimum mortality.

## 6. Recommendations

Given the fact that this disease occurs in young people whose predisposing factors - smoking, sedentary lifestyle, the authors support the elimination of smoking, promoting outdoor activities, practicing maintenance sports and avoiding as much as possible highly polluting areas in order to reduce the occurrence of cases. of spontaneous pneumothorax.

## Author Contributions

CEN coordinated the study, AC and CG selected the bibliographic materials and all authors collaborated in the elaboration of the manuscript.

## Declaration of Conflict of Interest

There are no conflicts of interest.

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