

Original Research Article

# Pneumothorax and its etiology

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## Abstract

**Introduction:** Air in the pleural space is defined as Pneumothorax. A case of pneumothorax is a medical emergency which can itself be serious and may endanger the life of the patient because of respiratory insufficiency.

**Aim of the study:** To study the etiological factors of pneumothorax and hydropneumothorax, the inter-relation of spontaneous pneumothorax with different age groups, sexes and precipitating factors. Study the associated complications, degree of collapse of pulmonary parenchyma and outcome of the treatment.

**Materials and methods:** Fifty cases of pneumothorax presenting to the department were admitted and investigated. Cases of pneumothorax with or without fluid, pus or blood in the pleural cavity; accidental and iatrogenic pneumothorax were also included. Pneumothorax is diagnosed by taking standard chest radiographs and computed tomograms (CT) of the chest wherever necessary.

**Results:** A vast majority of the patients in this study were of poor socio economic background. Male to female ratio is 7:1. Of the 50 cases, 16 (32%) had pneumothorax only, 22 (44%) had pyopneumothorax and 10 (20%) had hydropneumothorax. Hemopneumothorax was found in 2 (4%) cases.

**Conclusion:** Spontaneous pneumothorax is generally due to an underlying lung disease. It is important that pneumothorax is managed promptly and in an appropriate manner. Immediate management is largely determined by the extent of cardio-respiratory compromise, degree of symptoms and size of pneumothorax and may involve observation alone, needle aspiration or chest drain insertion.

## **Key words**

Pneumothorax, Hydropneumothorax, Tuberculosis, Lung disease, Pyopneumothorax, Pleurodesis, Pleurectomy.

## **Introduction**

Pneumothorax is defined as the presence of air in the pleural space. A case of pneumothorax is a common medical emergency which can itself be serious and may endanger the life of the patient because of respiratory insufficiency. It is classified as spontaneous (not caused by trauma or any obvious precipitating factor), traumatic, or iatrogenic. Spontaneous pneumothoraces, which occur in the absence of thoracic trauma, are classified as primary or secondary. Primary spontaneous pneumothoraces (PSP) affect patients who do not have clinically apparent lung disorders. Secondary pneumothoraces occur in the setting of underlying pulmonary disease. PSP has an incidence of 7.4 to 18 cases per 100,000 population each year in males, and 1.2 to 6 cases per 100,000 population each year in females [1, 2]. PSP typically occurs in tall, thin subjects and rarely occurs in persons over the age of 40 years. Other risk factors are male sex and cigarette smoking. Causes of PSP include airway diseases like emphysema, cystic fibrosis, infectious diseases like tuberculosis, pneumocystis carini, interstitial lung diseases, connective tissue diseases, cancer and thoracic endometriosis. During the last three decades most of the western literature opined that rupture of sub pleural blebs or bullae is the commonest cause of primary spontaneous pneumothorax (PSP) and chronic obstructive pulmonary disease (COPD), Pneumocystis carinii pneumonia related to infection with human immunodeficiency virus (HIV) are the most common conditions associated with secondary pneumothorax [3]. Due to rapid decline in incidence of tuberculosis in the western countries, spontaneous pneumothorax of tuberculous etiology is encountered rarely. On the other hand, studies conducted in India reveals tuberculosis as a predominant etiology in causes of pneumothorax. The different causative factors producing pneumothorax depends upon prevalence rates for

the diseases in that country. The prevalent impression amongst physicians in this country is to regard tuberculosis as almost invariable cause of pneumothorax, but actually it may not be so. Hence in this study, we have tried to analyze the etiology, clinical profile, management, and outcome of spontaneous pneumothorax with or without fluid, pus or blood in the pleural cavity (hydropneumothorax, pyopneumothorax and hemopneumothorax) among a significant number of patients attending the department of pulmonary medicine.

## **Aim and objectives**

To study the etiological factors of pneumothorax and hydropneumothorax, the inter-relation of spontaneous pneumothorax with different age groups, sexes and precipitating factors. Study the associated complications, degree of collapse of pulmonary parenchyma and outcome of the treatment.

## **Materials and methods**

This study was conducted with the prime object of evaluating the etiological factors in the causation of pneumothorax and hydropneumothorax, in order of their frequency of occurrence. All the patients attending the outpatient department, causality and inpatients that developed pneumothorax in hospital were also included in the study. Fifty consecutive cases of pneumothorax presenting to the department were admitted and investigated to find the etiology of pneumothorax. Cases of pneumothorax with or without fluid, pus or blood in the pleural cavity; accidental and iatrogenic pneumothorax were also included in the study. Patients were also interrogated regarding the history of a past episode of pneumothorax, pulmonary tuberculosis or any other major illness, history of previous chemotherapy for tuberculosis or any other major illness. Pneumothorax is diagnosed by taking standard

chest radiographs in postero-anterior view. Lateral views of chest radiographs, decubitus views and computed tomograms (CT) of the chest were taken where the diagnosis is a question and whenever necessary during the management of the cases. Routine examination of blood investigations, sputum tests for AFB, fungal stains and malignant cytology and viral markers were carried out wherever necessary. Pleural fluid was investigated for routine biochemical analysis, AFB, fungal stains, cell count and cytology. Histopathological examination of pleural biopsy specimen was done where ever necessary to confirm the diagnosis. Spirometry was done for few cases suspected of chronic obstructive pulmonary disease and bronchial asthma. Clinical, radiological, microbiological and pathological findings were correlated and an attempt was made to arrive at etiology in every case in this study. Selection of cases either for aspiration or for intercostal tube drainage was done based on clinical and radiological assessment. All the patients were treated according to the British Thoracic Society guidelines for the management of pneumothorax. All the complications during the management were recorded.

## Results

During the study period from December 2004 to January 2007, a total of 1688 cases were admitted in the hospital. The study included 50 cases of spontaneous pneumothorax and hydropneumothorax. As such, an incidence of 3% of spontaneous pneumothorax cases of the total admissions in the hospital represents true incidence of this syndrome. The incidence is more for the male patients when compared to the females. 44 (88%) of the cases were males and 6 (12%) were females. Male to female ratio is 7:1. A vast majority of the patients in this study were of poor socio economic background. 31 cases were noted in the group below 40 years and 19 cases were over 40 years of age. Majority of the cases were presented with symptoms of breathlessness (98%), cough with sputum (68%), dry cough (24%), fever (72%), and chest pain

(56%). Majority of the patients had a variable degree of anemia (70%), clubbing (56%) and 12% of cases had cyanosis. In this study 44 (70%) of the males were smokers and 1 (2%) of the females was a smoker. 72% of the patients affected with pneumothorax were smokers. Among the 50 cases, right pleural cavity was involved in 32 (64%) cases and left pleural cavity was involved in 17 (34%) cases. One case had bilateral simultaneous spontaneous pneumothorax. Of the 50 cases, 16 (32%) had pneumothorax only, 22 (44%) had pyopneumothorax and 10 (20%) had hydropneumothorax. Hemopneumothorax was found in 2 (4%) cases (**Table - 1, Table - 2**).

**Table - 1:** Various presentations of the pneumothorax.

Types of pneumothorax	No. of cases	Percentage
Pneumothorax	16	32
Hydropneumothorax	10	20
Pyopneumothorax	22	44
Hemopneumothorax	2	4
<b>Total</b>	<b>50</b>	<b>100</b>

**Table - 2:** Distribution of the complications according to the cases.

Complications	Incidence	Percentage
Recurrent pneumothorax	7	14
Pleural thickening/fibrosis	29	58
Subcutaneous emphysema	23	46
Mediastinal emphysema	2	4

Encystment of the pleural fluid was noted more among the cases of pneumothorax, hydro pneumothorax and pyopneumothorax in 15 (30%) cases. Encystment was noted in 13 (26%) of tuberculous etiology and 2 (4%) in non-tuberculous etiology. The degree of lung collapsed as a result of pneumothorax varied

from 13% to 99% of the total lung volume. 30 cases (64%) had a collapse of more than 90%. Of the 50 cases in this study, 24 (48%) had bronchopleural fistula (BPF) and of them 21 (42%) were of tuberculous etiology and 3 cases were of non-tuberculous etiology (**Table – 3**).

Sputum for AFB was positive in 14 (28%) of the cases, negative in 30 (60%) and not done in 6 cases. Pleural fluid for AFB was positive in 10 cases. Pleural biopsy findings were as per **Table – 4**.

Among the 50 cases, pleural fluid was present in 38 cases. Among the 38 cases, pleural fluid culture was sterile for pyogenic organisms in 12

cases; in the remaining 24 cases the pleural fluid was positive for pyogenic organisms (**Table – 5**).

In this study, 34 out of the 50 cases of pneumothorax developed fluid in the pleural cavity, among them 22 cases are with pus; 10 cases were with straw colored fluid, two cases with blood in pleural cavity and 9 cases developed simple spontaneous pneumothorax. A total of 32 (64%) cases are of tuberculous etiology and 18 (36%) are of non tuberculous etiology (**Table – 6**). Etiology of pneumothorax and hydropneumothorax: depending on the etiology of spontaneous pneumothorax, the cases are divided into 6 distinct groups as per **Table – 7**. Distribution of cases according to mode of recovery was as per **Table – 8**.

**Table - 3:** Distribution of BPF among the cases.

<b>Etiology</b>	<b>Tuberculosis (TB)</b>	<b>Non Tuberculosis (NTB)</b>	<b>Total</b>
With BPF	21	3	24
Without BPF	11	15	26
Total	32	18	50

**Table - 4:** Pleural biopsy findings.

<b>Histopathological findings</b>	<b>No of cases</b>	<b>Percentage</b>
Normal pleural tissue	1	3.44
Chronic non specific granulation tissue	2	6.89
Chronic non specific inflammatory reaction	3	10.32
Chronic inflammatory reaction with fibrosis (koch's etiology could not be ruled out)	7	24.14
Chronic inflammatory reaction	4	13.8
Chronic non specific fibrosis	1	3.44
Tuberculosis granulation tissue	3	10.32
Echinococcal endocyst germ layer	1	3.44
Acute inflammatory reaction	7	24.14

## **Discussion**

Pneumothorax is an abnormal collection of air in the pleural space that causes an uncoupling of the lung from the chest wall; pneumothorax interferes with normal breathing. Symptoms typically include chest pain and breathing difficulty leading to a collapsed lung. A primary pneumothorax is one that occurs without an

apparent cause and in the absence of significant lung disease, while a secondary pneumothorax occurs in the presence of existing lung disease. A pneumothorax can be caused by physical trauma to the chest wall or as a complication of a healthcare intervention which is referred to as traumatic pneumothorax. In a minority of cases the amount of air in the chest

increases markedly when a one-way valve is formed by an area of damaged tissue, leading to a tension pneumothorax which leads to steadily worsening oxygen shortage and low blood pressure. Unless reversed by effective treatment, it can result in death. Diagnosis of a pneumothorax by physical examination alone can be difficult. Integrated diagnostic modalities can be used for the better detection such as chest X-ray, computed tomography (CT) scan, or/and ultrasonography. Small spontaneous pneumothoraces typically resolve without treatment and require only monitoring. This

approach may be most appropriate in people who have no underlying lung disease. In a larger pneumothorax, or when there are marked symptoms, the air may be removed with a syringe or a chest tube connected to a one-way valve system. Occasionally, surgery may be required if tube drainage is unsuccessful, or as a preventive measure, if there have been repeated episodes. The surgical treatments usually involve pleurodesis in which the layers of pleura are induced to stick together or pleurectomy where surgical removal of pleural membranes is done.

**Table - 5:** Distribution of pleural fluid cultures.

Organism isolated	No. of cases	Percentage
Sterile	12	31.6%
Pneumococci	10	26.3%
Klebsiella pneumoniae	2	5.3%
Pseudomonas aeruginosa	1	2.6%
Proteus	1	2.6%
Pneumococci + staphylococci	5	13.2%
Pneumococci + klebsiella	5	13.2%
Pneumococci + klebsiella + staphylococci	1	2.6%
Pneumococci + klebsiella + pseudomonas	1	2.6%
Total	38	100%

**Table - 6:** Etiology and distribution of pneumothorax/ hydropneumothorax.

Etiology	Hydropneumothorax	Pyopneumothorax	Pneumothorax	Total	Percentage
TB	9	14	9	32	64
Non-TB	3	8	7	18	36
Total	12	22	16	50	100

In this study, an overall incidence of 3%, of the total admissions was due to spontaneous pneumothorax/ hydropneumothorax when compared to 0.09% of total admissions reported by Gaensler, et al. [4] and 0.08% in the series by Levy, et al. [5]. This wide variation in the incidence is probably due to difference in the number of patients studied by western workers and the present study in India.

The onset of spontaneous pneumothorax/ hydropneumothorax was acute in 85% of the

cases and insidious in 15% of the cases. Dyspnea, chest pain and cough with or without sputum were the presenting symptoms in all cases. Depending upon the etiology of spontaneous pneumothorax, the cases were divided into six distinct groups. BPF was present in 24 cases of which 21 were of tuberculous etiology. Six cases were diagnosed on clinico-radiological, histopathological examination of pleural biopsy and pleural fluid analysis. 8 (16%) of the cases had pneumothorax due to the rupture of healed tuberculous scar. Thus pneumothorax

of tuberculous etiology was present in 32 (64%) non-tubercular causes by different research of the 50 cases. Comparing the etiology of authors [6-15] was as per **Table – 9**. spontaneous pneumothorax due to tubercular and

**Table - 7:** Etiology of pneumothorax and hydropneumothorax: depending on the etiology of spontaneous pneumothorax, the cases are divided into 6 distinct groups.

<b>Group I</b>	<b>Active pulmonary tuberculosis</b>	<b>No of cases</b>
1	AFB seen in sputum only	8
2	AFB seen in pleural fluid only	4
3	AFB seen in both sputum and pleural fluid	6
4	Clinical/radiological/ pleural biopsy/ montoux/ pleural fluid analysis	6
<b>Group II</b>	<b>Healed tuberculous scar</b>	8
<b>Group III</b>	<b>Rupture of pyogenic lung focus</b>	6
<b>Group IV</b>	<b>Rupture of bullae of COPD (emphysema)</b>	3
<b>Group V</b>	<b>Miscellaneous</b>	1
1	Bronchial asthma	2
2	Trauma	2
3	Iatrogenic	1
4	Echinococcus granulosus	1
5	Bronchogenic carcinoma	2

**Table - 8:** Distribution of cases according to mode of recovery.

<b>Mode of recovery</b>	<b>No. of cases</b>
Total lung expansion	19
Lung expansion with pleural thickening/fibrosis	20
Chronic pneumothorax referred to thoracic surgery	6
Absconded	5
Expired	0

**Table - 9:** Comparing the etiology of spontaneous pneumothorax due to tubercular and non-tubercular causes by different research authors.

<b>Author</b>	<b>Tubercular etiology (%)</b>	<b>Non-tubercular etiology (%)</b>
Hyde [6-9]	30	70
Bernhard [10]	19.5	80.5
Withers [11]	2.3	97-98
Lynn [12]	4.7	95.3
Yedurappa [13]	66.6	33.4
Mittal [14]	84.3	15.7
Parmar [15]	61.9	38.1
Present study	36	46

In the present study, spontaneous pneumothorax with or without fluid of tubercular etiology was seen in 64% of the cases and non tubercular etiology was established in 36% of the cases. This is the most significant finding of this study, since it was the first systematic and objective investigation, on a prospective basis, in evaluating the etiology of a large number of consecutive cases of pneumothorax and hydropneumothorax. Inouye, et al. [16] in reporting their series concluded that hydropneumothorax and pyopneumothorax was more frequent. Parmar, et al. [15, 17], in his series of 92 cases of spontaneous pneumothorax, 71 had hydropneumothorax, 22 cases (44%) had pyopneumothorax, while two cases had haemopneumothorax. In the present study, out of 24 cases with bronchopleural fistula 21 cases are of tuberculous etiology. In India tuberculosis still occupies a predominant position in the causation of pneumothorax. Wolcott, et al. [18] observed that tuberculosis is now a coincidental and not an etiological factor responsible for disease. Rupture of pyogenic foci produced pyopneumothorax in 14 (28%) cases. The causative organisms were cultured from the pleural fluid in 38 cases and in 10 cases the organism isolated was pneumococcus. Rupture of bullae in case of COPD (emphysema) was responsible in 3 (6%) cases as confirmed by CT scan. Idiopathic rupture of sub pleural blebs or bullae was responsible in producing primary spontaneous pneumothorax in 2 (4%) cases as confirmed by CT scan. Other causes were responsible in 7 (14%) cases. They included one case each of bronchial asthma, echinococcal pyopneumothorax and carcinoma of the lung. Traumatic hemopneumothorax was noted in 2 (4%) cases. Iatrogenic hydropneumothorax is seen in 2 cases. Thus 18 (36%) of the 50 cases were of definite non tuberculous etiology.

The aim of treatment is to relieve the symptoms, to restore the lung function by full re-expansion, to prevent recurrence and to cure underlying lung disease with minimal complications. In the present study, of 50 cases lung expansion with residual pleural thickening in 20 cases (38%);

lung expansion with residual pleural thickening in 20 cases (40%). 6 cases were referred to thoracic surgeon and 5 cases have absconded.

## Conclusion

Spontaneous pneumothorax is generally due to an underlying lung disease. COPD and pulmonary tuberculosis remains the common causes in India. Smoking is an important risk factor for the development of pneumothorax. X-Ray chest is one of the most important investigations for diagnosis of pneumothorax & also for knowing etiological factors. It is important that pneumothorax is managed promptly and in an appropriate manner. Immediate management is largely determined by the extent of cardio-respiratory compromise, degree of symptoms and size of pneumothorax and may involve observation alone, needle aspiration or chest drain insertion. Since recurrence rates are relatively high, selected individuals should be considered for definitive surgical treatment.

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