Spontaneous pneumothorax – a clinical study of 100 cases

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Abstract

Background: Pneumothorax is collection of air in the pleural cavity and it may be due to trauma to chest or spontaneous without any trauma. It is a common entity presenting to the emergency room and it needs prompt treatment as delay in treatment may endanger the life of the patient.

Objective: To study the aetiology, clinical profile, and management protocols of spontaneous pneumothorax in adults in India.

Materials and Methods: Patients admitted with spontaneous pneumothorax in a tertiary hospital of western India from January 2014 to March 2016 were prospectively studied. Study was planned so as to enrol first consecutive 100 patients admitted with diagnosis of spontaneous pneumothorax. Detailed history, clinical examination and necessary investigations of all patients were done and results were compared with popular studies carried out in India in past. The changing trends and similarities between the studies were noted.

Result: Annual incidence of spontaneous pneumothorax was calculated as 21.739 per 100000 hospital admissions. Out of 100 patients studied 95 were diagnosed with secondary spontaneous pneumothorax and 5 with primary spontaneous pneumothorax. Chronic obstructive pulmonary disease (COPD) was found to be the most common aetiological factor. Male to female ratio was found to be 9:1. Age distribution showed a biphasic pattern.

Conclusion: Spontaneous pneumothorax (SP) is more common in men. In India secondary spontaneous pneumothorax is far more common than Primary and COPD is the most common cause of spontaneous pneumothorax in this study.

KEYWORDS: Spontaneous pneumothorax, chronic obstructive pulmonary disease, primary, secondary

Introduction

Pneumothorax is defined as the presence of air in the pleural cavity.[1] The disease entity itself had been described in 1767 by Gobbel,[2] although Riolan[3] might have recognized it in 17th century. The term pneumothorax was coined by Itard in 1803 who first described it as a pathological entity. Later Laennec[4] in 1819 gave a comprehensive description on the disease. In 1826, Devillezier[5] first reported a case of spontaneous pneumothorax due to emphysema and 30 years later in 1856, McDowell,[6] for the first time, reported a case of primary spontaneous pneumothorax. In 1880, Oster[7] attributed the etiology of pneumothorax to tuberculosis in 77.8% in his series of 986 cases.

The pressure within the pleural space is negative with respect to the alveolar pressure during the entire respiratory cycle. This negative pressure results from the inherent tendency for the lung to collapse (elastic recoil) and the chest wall to expand. When a communication develops between an alveolus and the pleural space, air will move from the alveolus into the pleural space until there is equalization of pressure or the communication is sealed. The same happens with a communication between the chest wall and pleural cavity.

Common classification is to classify it into spontaneous pneumothorax (SP) which occurs without a preceding external trauma, and traumatic pneumothorax which follows penetrating, blunt or barometric trauma to the chest. Spontaneous pneumothorax can further be classified into primary spontaneous pneumothorax (PSP), occurring in otherwise healthy individuals and secondary spontaneous pneumothorax [SPS] which occurs due to underlying disease.
pneumothorax (SSP), which occurs in patients with an underlying lung disease.\(^8,9\)

Traumatic (or nonspontaneous) pneumothorax occurs as the result of blunt (nonpenetrating) or penetrating trauma disrupting the lung, bronchus, or esophagus. A subcategory of traumatic pneumothorax is iatrogenic pneumothorax, which occurs as a consequence of diagnostic or therapeutic maneuvers (i.e., thoracoentesis, insertion of a central venous catheter, surgery, or mechanical ventilation).

Primary spontaneous pneumothorax results from rupture of sub pleural emphysematous blebs that are usually located in the apices of the lung. The pathogenesis of these sub pleural blebs is probably related to airway inflammation. Respiratory bronchiolitis was found to be associated with primary spontaneous pneumothorax. Cigarette smoking can certainly produce airway inflammation. Cigarette smoking is known to be strongly associated with the development of both primary and secondary spontaneous pneumothorax.

Secondary spontaneous pneumothorax is more serious than primary spontaneous pneumothorax because it decreases the pulmonary function of a patient with already compromised pulmonary function. Airway diseases (COPD, severe asthma) and infections of the chest (tuberculosis, pneumonia, etc.) are the most common causes of secondary spontaneous pneumothorax, but virtually every other pulmonary disease process has been associated with secondary spontaneous pneumothorax (interstitial lung diseases, malignancy, catamenial pneumothorax, pulmonary infarction, pulmonary haemorrhage, pulmonary alveolar proteinosis, tuberculous sclerosis, etc.).\(^\text{[10]}\)

Very few studies have been published from India especially western India regarding the epidemiology and clinical features of spontaneous pneumothorax. So this study was carried out in a tertiary care hospital of western India with an aim to find out the current trends in the etiology and clinical profile of SP and to compare it with previous studies.\(^\text{[11–14]}\)

**Materials and Methods**

This was a prospective study conducted at a tertiary care institute in Western India between January 2014 and March 2016 after obtaining the approval of ethical committee. Study was planned so as to enroll first 100 consecutive patients admitted to the hospital with a diagnosis of SP. A predesigned structured performa that had sections on demographic details (age, gender, residence, smoking habit), anthropometry [height, weight, body mass index (BMI), upper segment to lower segment ratio], clinical presentation (pre-existing known cardiopulmonary disease or other co-morbid conditions, respiratory and other symptoms at presentation, findings on general, respiratory and systemic examination), chest radiography, and details of other relevant investigations, was used to collect information. Depending on results of initial clinical evaluation and chest radiography, all patients underwent additional detailed investigations to ascertain the underlying cause for spontaneous pneumothorax. The tests carried out for individual patients included a variable combination of radiologic (e.g. chest X-ray, thoracic CT scan), microbiological (e.g. sputum culture and examination for acid-fast bacilli), serological (e.g. human immunodeficiency virus), physiological (e.g. spirometry) and other investigations.

The patients were classified as having PSP if routine clinical and radiologic evaluation, as well as results of relevant additional investigations failed to reveal a disease process that could potentially explain the occurrence of pneumothorax. All patients, in whom an underlying pulmonary disorder that could be linked to pneumothorax was detected, were categorized as having SSP. Patients were treated with simple needle aspiration or intercostal chest tube drainage as per the standard practice at our institute.

**Statistics**

Variables of the study were compared with past popular studies on spontaneous pneumothorax, i.e. study carried out by Gupta et al.\(^\text{[9]}\) in 2001–02 at PGI Chandigarh, by Janmeja et al.\(^\text{[11]}\) in 1988–90 at Rohtak, by Agnihotri et al.\(^\text{[10]}\) in 1987 at Jaipur and by Boghani and Patel\(^\text{[12]}\) in 1984 at Ahmedabad. Z test was applied to calculate the significance of difference between proportions of large samples and \(p\) value was calculated for each variable. A \(p\) value of less than 0.05 was taken as significant. Statistical analysis was done using SPSS software version 20.

**Result**

Of the 100 patients included in the study, 5 (5%) had PSP while 95 (95%) had SSP. Based on the total number of admissions to our hospital during the study period the annual incidence of SP was calculated as 21.739 per 100,000 hospital admissions. Annual incidence figures for PSP and SSP were similarly calculated as 1.55 and 29.5 per 100,000 hospital admissions, respectively.

The patients studied had a mean age of 53.24 years. Majority of patients included in the study were men, with an overall male to female ratio of 9:1. The age distribution of patients showed a biphasic pattern. The first peak occurred between 20 and 40 years of age, and was mainly contributed by tuberculosis, while the second peak occurred between 50 and 60 years, and was mainly contributed by COPD. 86% patients (86 out of 100) were current or ex-smokers. The correlation between pack-years of smoking tobacco and number of patients developing pneumothorax is shown in Figure 1.

Patients with PSP were significantly taller than those with SSP. However, weight and BMI were lower in patients with SSP. There were no significant differences in the upper to lower segment ratio between patients in the two groups.

Onset was sudden in 64 (64%) patients while the insidious onset was found in 36 (36%) patients. Pneumothorax
occurred in 76 (76%) patients when they were resting or
sleeping. Light work & Heavy work found as precipitating fac-
tors in 14 (14%) & 8 (8%) patients respectively. 2 (2%) patients
developed pneumothorax while straining at stools.

Typical signs of pneumothorax like diminished or absent
air entry, hyper resonance on percussion, reduced vocal res-
one and diminished movement of respiration on side of
pneumothorax were found in all cases. Dyspnoea was the
most common complaint found in all patients. Right side was
affected in 50 (50%) patients, left in 48 (48%) patients and
2 (2%) patients were having bilateral pneumothorax. Sputum
for acid fast bacilli was positive in 14 (14%) patients.

In 58 (58%) patients pneumothorax was secondary to
COPD which was found to be the most common cause fol-
lowed by pulmonary tuberculosis which was found to be the
etiological factor in 34 (34%) cases. Etiological distribution
of pneumothorax in the present study is shown in Figure 2.

Intercostal drainage tube (ICDT) insertion was the main
modality for treatment in all the 95 (95%) patients with SSP. 3
(3%) patients with PSP were managed by needle aspiration
and 2 (2%) patients of PSP required ICDT for management
after failed needle aspiration. The duration of ICDT in situ
and time required for complete expansion of lung is shown
in Table 1.

When compared the present study with past studies sim-
ilarity was found with respect to male preponderance and
association with smoking (p value >0.05), but COPD was the
most common disease associated with secondary spontane-
ous pneumothorax in present study in contrast to tuberculosis
as the most common etiology in past studies (p value <0.05).

Figure 1: The correlation between pack years of smoking tobacco and number of patients developing pneumothorax

Figure 2: Etiological distribution of pneumothorax in present study

Table 1: Duration on intercostal drainage tube required and time required for complete expansion of lung

<table>
<thead>
<tr>
<th>Ethology</th>
<th>Time required for lung expansion with ICDT (in weeks)</th>
<th>Average (in days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculosis</td>
<td>&lt;1 1–2 2–3 4 — &gt;4</td>
<td>13.06</td>
</tr>
<tr>
<td>COPD</td>
<td>6 14 4 8 2</td>
<td>1.19</td>
</tr>
<tr>
<td>PSP</td>
<td>2 — — — —</td>
<td>3</td>
</tr>
<tr>
<td>Bronchial Asthma</td>
<td>2 — — — —</td>
<td>3</td>
</tr>
<tr>
<td>Pneumonitis</td>
<td>1 — — — —</td>
<td>5</td>
</tr>
</tbody>
</table>

ICDT – intercostal drainage tube, COPD – Chronic obstructive pulmonary disease, PSP – Primary spontaneous pneumothorax
Discussion

Pneumothorax is still an important entity presenting to the emergency department and requiring prompt treatment in most of the cases.\[15\] The present study was mainly focused on the persisting as well as changing trends in the etiology and management of SP which is more common in males.

Mutations in the FLCN gene can cause primary spontaneous pneumothorax, although these mutations appear to be a very rare cause of this condition. The FLCN gene provides instructions for making a protein called folliculin. Researchers have not determined the protein’s function, but they believe it may help control the growth and division of cells. Folliculin may play a role in repairing and re-forming lung tissue following damage. Researchers have not determined how FLCN gene mutations lead to the formation of blebs and increase the risk of primary spontaneous pneumothorax. One theory is that the altered folliculin protein may trigger inflammation within the lung tissue that could alter and damage the tissue, causing blebs. Primary spontaneous pneumothorax most often occurs in people without an identified gene mutation. The cause of the condition in these individuals is often unknown. Tall young men are at increased risk of developing primary spontaneous pneumothorax; researchers suggest that rapid growth of the chest during growth spurts may increase the likelihood of forming blebs. Smoking can also contribute to the development of primary spontaneous pneumothorax.\[16–20\]

A study was carried out in Sweden to understand the relationship between smoking and occurrence of pneumothorax. The study showed that smoking increased the relative risk of contracting a first spontaneous pneumothorax approximately nine fold among women and 22-fold among men and that there is a striking, statistically significant (p less than 0.001) dose-response relationship between smoking and the occurrence of SP. The life span risk of contracting SP among lifelong heavily smoking men is roughly estimated to be 12% but only 0.1% among never smokers.\[21\]

In the present study the annual incidence of spontaneous pneumothorax came to be lower than that of previous studies. This may be due to increasing awareness amongst patients about the disease and better control of their disease. As the disease gets well controlled the chances of developing pneumothorax is less especially in obstructive airway disease. Annual incidence of SP from previous Indian study was reported as 99.9 per 100,000 hospital admissions. Annual incidence figures for PSP and SSP were 20.0 and 80.0 per 100,000 hospital admissions, respectively. The lesser annual incidence of patients with spontaneous pneumothorax in the present study may be due to face that most of these patients seek treatment in primary and secondary care centres and very few are referred to tertiary care hospitals in our region. Also, many patients in our region seek treatment in private hospitals and only the economically poor class people come to government hospitals. This might also be a factor in low reported incidence of SP in the present study. The percentage of PSP as compared to SSP was also less in the present study and might suggest a relative increase in annual incidence of SSP as compared to PSP and thus suggest a changing trend.

There does not appear to be any relationship between the onset of pneumothorax and physical activity.\[22\] Clinical history and physical examination usually suggest the presence of a pneumothorax, although clinical manifestations are not reliable indicators of size.\[23,24\] In general, the clinical symptoms associated with SSP are more severe than those associated with PSP, and most patients with a secondary pneumothorax complain of breathlessness which is out of proportion to the size of the pneumothorax.\[25,26\] In the present study breathlessness was also the most common complaint.

The mean age of patients in this study was higher than that recorded in previous studies and this was because majority of the cases were secondary to COPD which occurs usually in elderly individuals. The present study showed a biphasic age distribution as in past studies but the difference was that both peaks occurred little later in this study, the first peak in age group 20–40 years and was contributed mainly to tuberculosis, which is a disease of young usually, and the second peak occurred in age group 50–60 years which was mainly due to COPD.\[27\] There was no predilection for side of chest affected in this study and pneumothorax occurred almost equally on both right and left sides of chest. Bilateral simultaneous pneumothorax is rare.\[28\]

COPD was the commonest cause of SSP in this study as compared to previous Indian studies in which tuberculosis was reported as the commonest cause. The reason for this can be that the revised national tuberculosis control program (RNTCP) is performing well at present in our country.\[29\] In past studies tuberculosis control program was in its initial stages in India. As a result of a better performing program tuberculosis is now diagnosed and treated early and more effectively and thus the complications in tuberculosis like pneumothorax are less commonly reported. But still tuberculosis is a serious health problem in our country and in this study tuberculosis was the second most common cause of SP.

The most common modality of treatment in the present study was intercostal drainage tube placement as in past studies. Needle aspiration has a limited role and that also in only PSP. Repeat needle aspiration was not done in those cases of PSP who failed on primary needle aspiration. This sort of approach is practiced in most of the institutes as far as our knowledge and a trend has shifted from conservative approach to a more aggressive approach these days. The physicians as well as patients desire a definite management at the first instance instead of waiting for a conservative approach and resort to invasive approach on failure of conservative approach. Also with the advent of newer diagnostic techniques more cases which were previously labeled as PSP are now diagnosed to be SSP and as evidence suggests, the modality of treatment of SSP remains intercostal drainage tube placement. The recommendations for the
treatment of the patient with a secondary spontaneous pneumothorax differ from those of the patient with a PSP in the following ways. Nearly every patient with a SSP should initially be hospitalized and managed by tube thoracostomy. Aspiration of the pneumothorax is not recommended because it is less likely to be successful and does nothing to diminish the likelihood of a recurrence. Even if the pneumothorax is small, its evacuation can lead to a rapid improvement in symptoms.

Limitations of the present study are that the number of patients recruited for the study is small and the study is carried out at a single center. A large multi-centric study with more number of subjects needs to be recruited in order to properly study the profile of patients with spontaneous pneumothorax and evolve guidelines for the diagnosis and the management of these patients.

Conclusion

COPD is emerging as the commonest cause of spontaneous pneumothorax in India as in the developed countries with the advent of a better performing RNTCP. The most utilized modality of treatment remains tube thoracostomy and needle aspiration is less practiced now a days in the tertiary care centers as more and more cases are being diagnosed as SSP as against in past where more cases were labeled to be PSP due to less availability of diagnostic modalities.

References