Case Report

Primary Spontaneous Pneumothorax in Healthy Tall and Thin Male Secondary to Smoking: A Case Report and Literature Review

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Abstract

Background: Primary Spontaneous Pneumothorax (PSP) refers to the collapse of a lung without any underlying disease and is commonly observed in tall, thin young men, with smoking as an under-recognized risk factor. The management of PSP can vary significantly across different health centers. This case report highlights a young man with a pneumothorax without an underlying illness but has a smoking habit who initially gets treatment with an insertion of a chest tube.

Case: This study focused on a 19-year-old man complaining of sudden right chest pain. The patient was a smoker for the past four years, and the examination showed hypersonic and vesicular loss on the right side. The laboratory tests revealed normal limits, and the sputum indicated the absence of tuberculosis. Chest X-ray showed an avascular radiolucent area in the right lung, and a Chest CT scan confirmed the presence of a hypodense area of air density in the right hemithorax. Right PSP was diagnosed and managed using a chest tube drainage on admission. After four days of treatment, he exhibited improvement and was discharged. A recurrence of pneumothorax was not discovered in the subsequent six-month follow-up period.

Conclusion: Despite being a rare disorder, PSP should be considered during the physical examination of patients. It is also important to reassess the risk factors that can contribute to the onset of pneumothorax. The clinicians should be able to identify PSP and emphasize tall, thin, and young men at greater risk of pneumothorax in a pulmonary emergency.

Keywords: pulmonary emergencies, smoking, spontaneous pneumothorax, young

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INTRODUCTION

The presence of pleural cavity air characterizes pneumothorax, located between the chest wall and the lungs. Furthermore, it can occur due to various factors, such as spontaneous leakage in the lung parenchyma or as a secondary effect of underlying diseases.[1] This condition can be further divided into two categories based on its cause: PSP and secondary spontaneous pneumothorax (SPP).[2]

Primary spontaneous pneumothorax refers to cases where pneumothorax transpires without an underlying lung disease. It is commonly observed in medical practice, particularly among young adults and adolescents with no preexisting condition or triggering event. PSP is commonly found in tall, young, and thin men and is often attributed to the rupture of blebs or bullae in the pleura.[2] The incidence of this condition varies based on gender and age, ranging from 7.4–18 and 1.2–6 cases per 100,000 population annually in men and women, respectively.[3]

The rupture of subpleural blebs or bullae in the apical segment of the upper or lower lobe is linked to the most frequent PSP mechanism. Smoking has been identified as the most significant risk factor, and the amount of cigarettes smoked daily increases the possibility of the condition. Furthermore, smoking can induce bronchial abnormalities, such as inflammation or obstruction in the distal airways, which contribute to the development of blebs in the lung parenchyma adjacent to the pleura.[4]

This study presents the condition of a 19-year-old man who reported chest discomfort lasting for the past 24 hours and a 4-year smoking history. Furthermore, this case highlights the importance of early detection and initial management of PSP in the absence of an evident cause. Complete resolution was achieved in the patient through timely

intervention, thereby preventing complications that can affect the quality of life in the future and facilitating an earlier return to physical activities.

CASE

A 19-year-old man came to the emergency room with right-sided chest pain, which started one day before hospitalization. The pain was described as a pressure-like sensation, not influenced by activity. Furthermore, the patient did not complain of shortness of breath but discomfort when breathing for the past day.

Further examination revealed the absence of restlessness, but there had been coughing without sputum for the past three days. There was no fever, loss of appetite, weight loss, night sweats, or previous medical history. A family history of allergies was denied, and no previous medication was used. The patient was a student with a height of 172 cm and a weight of 55 kg (body mass index 18.9 or within the normal range). There was a history of smoking for the past four years with a mild Brinkman index but no consumption of marijuana, illicit drugs, or alcohol.

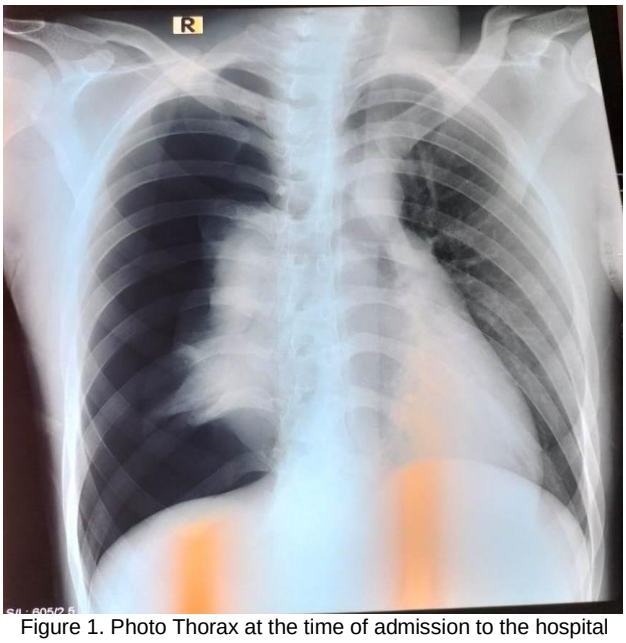

Figure 1. Photo Thorax at the time of admission to the hospital

On physical examination, the patient appeared calm with an average level of consciousness, 125/82 mmHg blood pressure, 98 beats per minute heart rate, 24 breaths per minute respiratory rate and 37.0°C temperature. During a pulmonary examination, hyper resonance on percussion and decreased vesicular breath sounds were observed in the right hemithorax. Laboratory tests at Dr. Zainoel Abidin General Hospital revealed 15.8 g/dL Hemoglobin, 46% Hematocrit, 8,400/mm^3 Leukocytes, 350,000/mm^3 Platelets, 3% Eosinophils, 0% Basophils, 0% Band neutrophils, 57% Segmented neutrophils, 31% Lymphocytes, 9% Monocytes, 11 mg/dL Urea, 0.9 mg/dL Creatinine, 14.10 seconds Prothrombin time (PT), 20.10 seconds activated partial thromboplastin time (aPTT). Furthermore, sputum testing using Rapid Molecular Test showed MTB (Mycobacterium tuberculosis) Not Detected. Chest X-ray revealed a right lung collapse with a large radiolucent area in the right hemithorax, as shown in Figure 1.

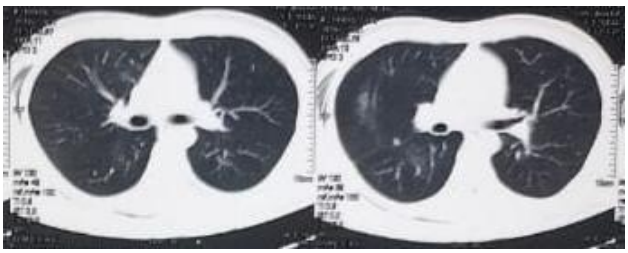

Figure 2. Thoracic CT Scan after chest tube performed

Furthermore, a thoracic CT scan showed a hypodense area with air density in the right hemithorax, as shown in Figure 2. Based on these findings, the patient was diagnosed with right-sided primary spontaneous pneumothorax.

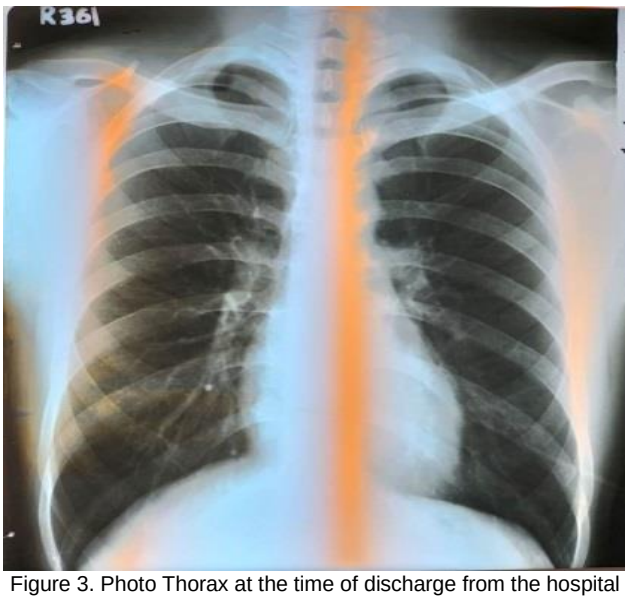

Figure 3. Photo Thorax at the time of discharge from the hospital

The patient was treated with a chest tube connected with water-sealed drainage (WSD) in the

right hemithorax to remove air from the pleural cavity. After four days of treatment, with no further fluctuations observed in the WSD, a physical examination revealed the presence of vesicular breath sounds in the right and left lungs. The chest X-ray showed the absence of a collapsed line in the right lung. Subsequently, the patient was discharged in a healed condition, as shown in Figure 3.

The patient was followed up for six months, and clinical evaluation showed no symptoms or signs of recurrent pneumothorax. A chest X-ray evaluation was performed, and the results showed that the lung and heart conditions were within normal limits, as shown in Figure 4.

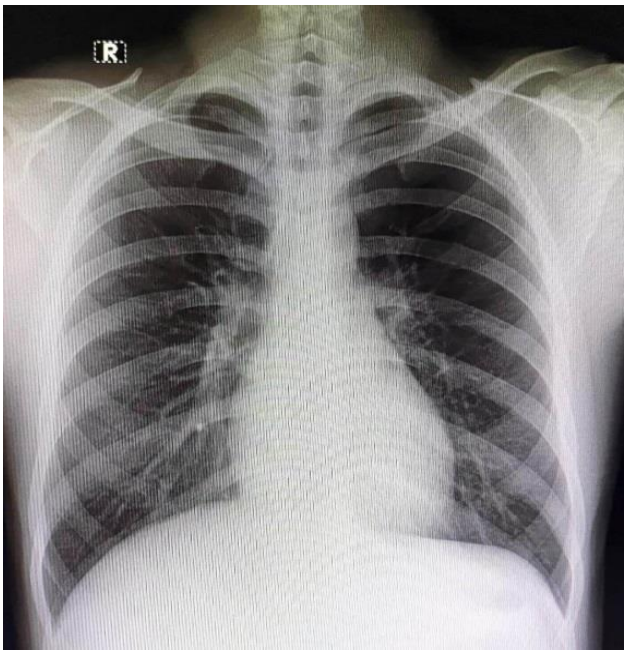

Figure 4. Follow-up photo thorax after six months

DISCUSSION

In this case, there was significant uncertainty regarding the air source in the right pleural cavity at hospitalization. Furthermore, on chest X-ray, most cases of sudden-onset pneumothorax in the thorax did not show any visible fractures in the chest wall. Although there were suspicions of a ruptured bleb due to the patient's smoking habit for the past four years, it was difficult to confirm this condition. The chest X-ray confirmed the initial suspicion, and the CT scan findings showed a case of PSP.

Primary spontaneous pneumothorax has an incidence rate of 7.4–18 cases per 100,000 people per year in males and 1.2–6 cases in females. It often occurs in males, individuals with a tall body posture, and frequent smokers. PSP could also occur at rest, removing the need to avoid physical activity. Spontaneous pneumothorax in patients with underlying lung disease is classified as secondary spontaneous pneumothorax (SSP). This classification is made because they have differences in prognosis and management.[5]

Patients with PSP often complain of sharp ipsilateral chest pain and mild dyspnea. Furthermore, the physical examination findings depend on the air volume in the pleural cavity. In this condition, breath sounds are often decreased or absent, with hyper-resonant percussion. The most common cause of spontaneous pneumothorax is the rupture of subpleural blebs or lung bullae.[6] Upon the suspicion of pneumothorax, the patient must be taken to a medical care center, and a chest X-ray is mandatory as the initial diagnostic examination.[7]

The first step in managing this condition is deciding on the necessary intervention or whether the patient could be managed conservatively with observation alone. The British Thoracic Surgery (BTS) recommends using various treatment methods in patients with large or symptomatic pneumothorax. BTS defines a large pneumothorax as >2 cm measured from the visceral pleura visible on the lateral chest wall at the level of the hilum on chest X-ray. Furthermore, it is recommended that in some patients with this type but minimal symptoms, conservative management could be pursued.[8] In this case, a large pneumothorax with dyspnea symptoms was found. The patient was then followed up with a chest tube intervention to drain air from the pleural cavity and reduce dyspnea.

Some patients with small pneumothorax (<15% of total lung volume) could only be observed without needing hospitalization.[9] However, further chest X-rays are needed to assess the potential expansion of the condition. If there was no progression and the vital signs were stable, the patient could be safely discharged home. Weekly chest X-ray evaluations must also be performed until complete resolution,

usually within two weeks. If air leakage persisted with progressive collapse or unresolved pneumothorax, a chest tube procedure was an alternative treatment option. Feden et al. suggested that in cases where the pneumothorax was >20% of total lung volume, or the patient exhibited unstable vital signs, immediate admission to the hospital emergency room and evacuation of air from the pleural cavity with a chest tube must be performed.[10]

Spontaneous pneumothorax could occur without prior trauma or iatrogenic injury. Therefore, the air in the pleural cavity could originate from the connection between the alveolar space containing air from the lung and the pleural cavity.[11] Although PSP was generally considered to occur without underlying lung disease, there was ample evidence to suggest that it had a minor locus in the lung.[12] Several references indicate some risk factors were associated with PSP, such as Body Mass Index (BMI); smoking; bleb and bullae; microscopic abnormalities, inflammation; pleural porosity; abnormal elastolysis; and hereditary disorders

Body Mass Index

Primary spontaneous pneumothorax occurred more frequently in tall, thin patients with low BMI and smokers. After the first episode, the risk of recurrence in PSP patients was higher than in tall individuals.[13] Primary spontaneous pneumothorax patients were frequently ectomorphic (tall and slender) from childhood on, but between the ages of 11 and 14, there were noticeable height increases relative to national standard values. According to numerous investigations, the pleural pressure increased from the base to the apex of the lung. Therefore, levels in the lung apex were higher in people with tall stature. The pressure causes this condition had a high correlation with surface area, and increased levels in the apex tended to cause the formation of blebs and bullae.[3]

Based on previous studies, triggering factors for increased intrapleural pressure could be attributed to changes in atmospheric pressure, physical activity, and exposure to loud music, leading to acute changes in transpulmonary pressure due to sound energy exposure.[14]

Smoking

Tobacco smoking remained the most critical risk factor for PSP. A retrospective study in Stockholm assessed the smoking rates of 138 patients hospitalized over ten years and compared them with a large contemporary random sample. The results showed that 88% of PSP cases occurred in people with positive smoking status. Compared to non-smokers, the relative risk of spontaneous pneumothorax increased by ninefold in women and 22-fold in men who smoked. Furthermore, there was a strong dose-response relationship between the risk of pneumothorax occurrence and the number of cigarettes smoked daily. Minor airway abnormalities stimulated by smoking (cigarette smoke) could lead to the development of subpleural blebs.[15]

Bleb and Bullae

Blebs and bullae were known as emphysema-like changes (ELC). Blebs are tiny, air-filled sacs or vesicles of the visceral pleura brought on by air in the interstitial space. It typically had a diameter of about 1 cm and was frequently developed between the pulmonary pleura's internal and exterior elastic lamina. Bullae, or subpleural emphysematous bullae, on the other hand, were more oversized air pockets that were >1 cm and were strongly marked by thin walls (1 mm).[16]

Microscopic Abnormalities, Inflammation

Microscopic evaluation of the lung tissue from PSP patients with lung excision revealed fibrotic changes and persistent distal airway damage with lymphocyte and macrophage infiltrating. Furthermore, in apparently healthy lungs, persistent inflammation may result in the development of ELC.[17]

Pleural Porosity

The concept of pleural porosity involves air leakage from the alveoli into the pleural cavity through thin pores in the visceral pleura.[18] In some

cases, including this current patient, no macroscopic lesions were found based on CT scans. Furthermore, this supported the suspicion of pleural porosity as the cause of PSP when air leaked from the thinned visceral pleura, not just from blebs or bullae.

Several studies have been carried out to compare autofluorescence thoracoscopy in 12 PSP patients and 17 healthy subjects who underwent sympathectomy and had no lung disease or previous pneumothorax. Based on previous studies, fluorescein was known to emit green fluorescence under ultraviolet light. Before the procedure, patients were asked to inhale nebulized fluorescein, and subpleural green fluorescence was found under ultraviolet light in the peripheral lung area. This result indicated that the inhaled substance approached the lung surface, a typical condition in thoracoscopy. The last regular lesions were found in PSP patients with ELC, indicating the occurrence of air leakages at the sites of blebs or bullae macroscopically.

Abnormal Elastolysis

Elastolysis refers to the imbalanced degradation of elastic fibers in the lungs, causing the tissues to become more "fragile. The degeneration of elastic fibers and the developing porous elastofibrotic layers could result from chronic peripheral airway inflammation. Additionally, there was proof of a disparity between the oxidant-antioxidant mechanism and the protease-antiprotease pathway. Endopeptidases known as matrix metalloproteinases (MMPs) could rupture the barrier separating the pulmonary cells from the alveoli. In addition to asthma and COPD, MMP-2 and MMP-9 were thought to be harmful in various lung conditions.[19]

Immunohistochemistry on the pulmonary tissues revealed elevated MMP-2, 7, and 9 expressions in PSP cases. In 91 pneumothorax subjects, some studies also discovered the elevated expression of MMP-2 and MMP-9. Furthermore, individuals with recurrent pneumothorax episodes were reported to have increased expression of MMP. Apart from the exaggerated expression of MMPs potentially damaging lung tissue, protective factors are also depleted, leading to increased fragility of the lung tissue.

Hereditary Disorders

Based on previous reports, several hereditary conditions were associated with a tendency to pneumothorax, such as connective tissue diseases (Marfan syndrome, Ehlers-Danlos syndrome, or other mutations of the folliculin gene), defects with cystic patterns or emphysema development (Birt-Hogg-Dube syndrome (BHD), alpha-1 antitrypsin deficiency), and metabolic conditions (such as Homocystinuria). Although uncommon, people with a family record of accidental pneumothorax frequently needed additional testing since episodes of spontaneous pneumothorax may be a sign of these genetic disorders.[20]

Treatment for PSP patients had two goals: air evacuation and preventing recurrence, as well as avoiding complications, such as trapped lung due to thickening of the visceral pleura.[21,22]

1. Conservative

   The observation could be performed for patients with minimal or no symptoms, with easy access to the medical care available in case of worsening, leading to lung collapse.
2. Pleural Aspiration or Chest Tube Drainage.

   Aspiration could be used as initial management for PSP patients, specifically in younger patients (<50 years old) with moderate-sized secondary pneumothorax (1-2 cm in size). The rate of pneumothorax recurrence after aspiration was nearly the same as after chest tube insertion. Furthermore, chest tube insertion was the thorax's most commonly performed surgical procedure. This procedure was often performed to re-expand the collapsed lung (lung re-expansion).
3. Pleurodesis

   Pleurodesis was aimed to create adhesion between the visceral and parietal pleura to prevent the recurrence of pneumothorax. It was often carried out by instilling irritant chemicals (chemical pleurodesis) or performing cart mechanical abrasion (mechanical pleurodesis) and parietal

pleurectomy. Based on previous studies, talc poudrage was Europe's most commonly used method due to its cost-effectiveness. It could be used to achieve the desired diffuse chemical pleurodesis to prevent PSP recurrence. However, there were some limitations, such as in cases of visceral pleural rupture, where immediate referral for resection of the leaking lung parenchyma was recommended.

4. Video-assisted thoracoscopy (VATS)

   VATS allowed minimally invasive access to the pleural cavity and was preferred over open thoracotomy for pneumothorax management.

LIMITATIONS

This case does not represent a severe pneumothorax. Therefore it does not show additional methods that can be employed to manage a severe pneumothorax. Instead, it describes a patient with a mild to moderate spontaneous pneumothorax that could be treated by inserting a chest tube. Nevertheless, this investigation will effectively aid patients' management strategies and compare various PSP therapy strategies.

CONCLUSION

Primary spontaneous pneumothorax commonly occurs in young, tall, thin men with stable clinical presentations, often with mild chest pain complaints. Various diagnostic tests had been performed in this case, and the results were typical. Furthermore, a history of smoking was the only risk factor that triggered PSP in this patient. Conservative management could be considered for small PSPs measuring less than 20%, while chest tube placement is recommended for larger pneumothoraces. This patient in this study was treated using definitive management involving a chest tube, which re-expanded the lung without recurrence.

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CONFLICT OF INTEREST

None.

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