One-bottle drainage system in Tuberculosis-Associated Secondary Spontaneous Pneumothorax: A Case Report

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Abstract

Tuberculosis (TB) is one of the ten leading causes of death in the world. Indonesia ranks second in the world in terms of TB cases and is the largest contributor to the increase in new cases. This study reports a man suffering from TB with a rare complication, secondary spontaneous pneumothorax. We describe a 27-year-old male smoker who reported sudden shortness of breath two hours ago, accompanied by pain in the left side of the chest when breathing. He is currently undergoing advanced antituberculosis treatment. A physical examination and chest X-ray revealed spontaneous pneumothorax. A GeneXpert sputum test 2 months ago was positive for Mycobacterium tuberculosis. We performed chest tube placement. After 19 days, the patient showed clinical improvement and responded well to treatment. In conclusion, secondary spontaneous pneumothorax (SSP) in tuberculosis patients is a rare occurrence. The patient received chest tube placement, as well as oxygen therapy, anti-TB drugs, and chest physiotherapy. We treated the individual using a one-bottle system because this type of pneumothorax is simple, practical, and easy for mobile individuals.

Keywords: Drainage, pneumothorax, tuberculosis

Sistem drainase satu botol pada Pneumothoraks Spontan Sekunder Terkait Tuberkulosis: Laporan Kasus

Abstrak

Tuberkulosis (TB) merupakan salah satu dari sepuluh penyebab kematian terbanyak di dunia. Indonesia menempati urutan kedua di dunia dalam hal kasus TB dan menjadi penyumbang peningkatan kasus baru terbesar. Studi ini melaporkan seorang pria yang menderita TB dengan komplikasi langka, pneumotoraks spontan sekunder. Kami menggambarkan seorang perokok laki-laki berusia 27 tahun yang melaporkan sesak napas tiba-tiba dua jam yang lalu, disertai dengan nyeri di sisi kiri dada saat bernapas. Saat ini ia sedang menjalani pengobatan antituberkulosis tingkat lanjut. Pemeriksaan fisik dan rontgen dada menunjukkan pneumotoraks spontan. Tes dahak GeneXpert 2 bulan lalu positif untuk Mycobacterium tuberculosis. Kami melakukan pemasangan selang dada. Setelah 19 hari, pasien menunjukkan perbaikan klinis dan merespons pengobatan dengan baik. Sebagai kesimpulan, pneumotoraks spontan sekunder (SSP) pada pasien tuberkulosis merupakan kejadian langka. Pasien menerima pemasangan selang dada, serta terapi oksigen, obat anti-TB, dan fisioterapi dada. Kami merawat individu tersebut menggunakan sistem satu botol karena jenis pneumotoraks ini sederhana, praktis, dan mudah bagi individu yang dapat bergerak.

Kata Kunci: Drainase, pneumotoraks, tuberculosis

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Introduction

Tuberculosis (TB) is one of the top 10 infectious illnesses causing death worldwide. Of the 20 countries with a high number of tuberculosis patients, Indonesia ranks second after India, accounting for 10% of total cases and contributing 68% of the increase in new cases in the world. [1,2] The majority of pulmonary tuberculosis sufferers in developing countries occur at the productive age of 15–29 years. TB disease can cause several complications, like pneumothorax, hemoptysis, pleural effusion, emphysema, and the spread of TB bacteria to other organs. [1,3]

Severe lung damage frequently leads to secondary spontaneous pneumothorax (SSP). Causes of SSP include chronic obstructive pneumonia (COPD), asthma, tuberculosis, interstitial lung infection (ILD), sarcoidosis, cystic fibrosis, and other respiratory disorders. Pneumothorax has a recurrence rate of 18-24 cases out of 100,000 people, where the majority of cases are SSP and happen more in men than women with a proportion of 5:1, particularly at the age of 60-65 years. [2-4]

SSP has higher mortality and morbidity than PSP because it has a larger volume. We report on a man in Indonesia suffering from TB and SSP complications. [3,4]

Case

A male patient came in with complaints of shortness of breath two hours before entering the hospital. The patient is 26 years old. The patient also felt pain in his left chest while breathing. The patient had been coughing for six months prior to hospital admission. The patient's weight decreases (12 kg over six months), and he often sweats while sleeping. The patient has been an active smoker for ten years, two packs per day, and has no known history of contact with TB patients. The patient is 165 cm tall and weighs 45 kg. In November 2023, the patient received a diagnosis of pulmonary TB and was in the intensive phase of anti-TB medication. On admission, vital signs indicated tachycardia, tachypnea, and desaturation, with free air SpO2 at 89% and 98% NRM 15 LPM. The physical examination revealed asymmetrical movement of the chest wall, decreased fremitus, hypersonor percussion sounds in the left lung, and decreased breath sounds. The whole blood count revealed leukocytosis (10,400/µL) and thrombocytosis (591,000/µL).

The results of the GeneXpert sputum examination performed in the previous two months revealed that Mycobacterium tuberculosis (M.tb) was not resistant to rifampicin. We diagnosed the patient with a new case of pulmonary tuberculosis. A chest x-ray revealed a lucent avascular lesion in the left hemithorax, as well as mediastinal structures being displaced to the right. The top zone of the right lung showed patchy accumulation (Figure 1a). We did not perform a thoracic CT scan due to restricted facilities.

On the first day of admission, we removed 700 cc of fluid and air from the patient by inserting a chest tube into the left midaxillary line in the fifth intercostal area (ICS 5). After that, the patient feels more comfortable, and the complaints decrease. Upon evaluation, we found his vital signs to be stable, with his pulse rate dropping to 100 x/m and respiratory frequency to 28 x/m, and his oxygen saturation improving to 98% with an NRM of 10 liters/minute.

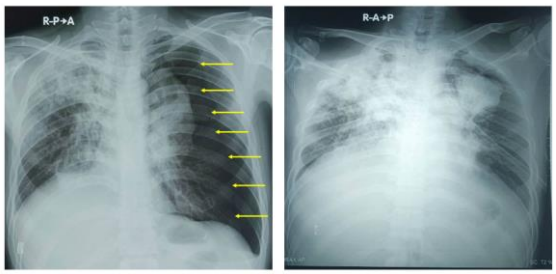

Figure 1. Chest X-ray on first day of admission (a) and chest X-ray on sixth day of hospitalization (b) (yellow narrow showed pneumothorax).

During treatment, the patient received oxygen therapy, physiotherapy, administration of symptomatic drugs such as erdostein 300 mg every 8 hours orally, metamizole sodium 500 mg every 8 hours intravenously, and administration of advanced phase anti-TB drugs 3 tablets 2 FDC (Rifampicin 150 mg/Isoniazid 75 mg) according to body weight (45 kg) three times a week. On the seventh day of treatment, repeated chest x-rays showed that there were no clear areas without blood vessels in the left hemithorax. Patchy consolidation remained in the upper zone of the left lung and the upper zone of the right lung, but the clear areas without blood vessels in the left hemithorax went away (Figure 1b).

The patient showed clinical improvement and stable vital signs after nine days of admission. The symptoms experienced by the patient slowly disappeared (shortness of breath, coughing, and night sweats), and the patient's weight slowly increased by three kilograms in two months. At the time of writing this paper, the patient had been taking medication regularly and had completed the fifth month of treatment.

Discussion

Pneumothorax is the filling of air in the pleural cavity. Pneumothorax is classified into two types: those that occur without any cause other than trauma are called spontaneous pneumothorax, and those that occur as a result of chest wall trauma directly or indirectly are called traumatic pneumothorax. [2-4] Spontaneous pneumothorax is also divided into 2, namely pneumothorax that occurs without lung disease (primary spontaneous pneumothorax/PSP), and pneumothorax that occurs due to lung disease (secondary spontaneous pneumothorax/SSP). Pulmonary

tuberculosis infection typically causes SSP in low-income countries. [1,3,5]

Especially in areas where the TB rate is high. The SSP is associated with worse outcomes than primary spontaneous pneumothorax. [6,11] Extensive lesions, empyema, bronchopleural fistula, subpleural space rupture, and liquefaction necrosis typically cause damage to the central nervous system during the active stage of pulmonary tuberculosis. [6-8]

Estimates suggest that tuberculosis causes spontaneous pneumothorax in 1 to 2% of all cases. The average age of tuberculosis sufferers with pneumothorax is 24 to 52 years. The patient demographics described in this case report are consistent with the literature and previous research. [9-11] In this case, the patient was 27 years old. The patient was diagnosed with tuberculosis utilizing a fast molecular test for Mycobacterium tuberculosis.

The clinical symptoms found in SSP pneumothorax are more severe than in PSP. Patients with SSP often experience shortness of breath, pleuritic chest pain and cough with phlegm. Accompanying symptoms that may appear are shortness of breath, increased pulse, turning blue (cyanosis), lack of oxygen, hypercapnia, or acute respiratory failure. [11] The patient has shortness of breath and pleuritic chest pain. [10-13] Tachypnea, tachycardia, and symptoms of acute respiratory failure were also detected during the physical examination.

Physical examination of the lungs showed asymmetric movement of the chest wall, decreased respiratory sounds in the left lung field, sonorous sounds on percussion, and decreased vesicular sounds in the left lung field. These findings suggest a simple left pneumothorax. In simple pneumothorax, part of the lung collapses.[12] To better identify structural abnormalities in patients with pneumothorax, a chest CT scan is required. However, our hospital's limited facilities prevented us from conducting this scan in our case. Chronic inflammation associated with tuberculosis can lead to the formation of pleural adhesions, thereby increasing the risk of pneumothorax. Our patient is an active smoker who consumes 2 packs of cigarettes every day. Smoking can cause inflammation and further damage to lung tissue, contributing to pneumothorax. [13-16]

The right hemithorax location is more often found in the presence of SSP, accounting for 53.7% of all instances, while bilateral pneumothorax is uncommon. Secondary spontaneous pneumothorax risk factors include male gender (90.2%), smoking (88%), and low body mass index (BMI). [13,20] In this patient, a pneumothorax was found in the left hemithorax. In some cases, active smoking and a low BMI (16.5 kg/m^2) are also risk factors for the development of secondary spontaneous pneumothorax.[9-11] Smoking causes inflammation, which can further damage lung tissue and cause pneumothorax. Detection of M. tb in this patient using the GeneXpert test, which was carried out two months before the pneumothorax occurred. The patient's chest x-ray showed persistently increasing swelling in the upper left and right lungs, predisposing to pulmonary collapse. [7,12]

Pneumothorax complicates lung disease in patients who already have lesions in their lungs, necessitating thorough treatment. As a result, if lung function is reduced, either partially or completely, due to pneumothorax, a life-threatening disease might develop. The 2010 British Society recommendation for the extent of a pneumothorax is <2 cm for a small pneumothorax and ≥2 cm for a large pneumothorax. [14,19] The results are obtained by assessing the distance between the edge of the lung and the chest wall. Drainage of a large pneumothorax necessitates the installation of a chest tube. In individuals with minor pneumothoraxes, aspiration might be performed, followed by monitoring and high percent oxygenation. [11-15]

The SSP treatment consists of inserting a catheter or chest tube while simultaneously treating the underlying lung disease. The pneumothorax experienced by the patient was extensive, with an intrapleural lesion of more than 2 cm and symptoms of shortness of breath. Therefore, chest tube installation must be performed. [9,13-15] The procedure involves placing the chest tube in the 6th and 7th intercostal areas of the anterior axillary line. We then connect the chest drainage tube to the one-bottle water seal drainage (WSD) system. After installation, undulations can be seen following the rhythm of breathing. An air

valve combines the water seal and drainage reservoir into a single bottle. We use the air valve to prevent the bottle's pressure from increasing, which could inhibit the release of fluid or air from the pleural cavity. [16-18]

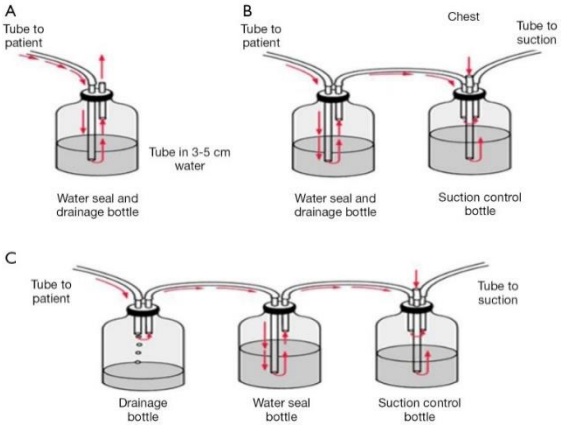

Figure 2. Various types of water sealed drainage (WSD).

The working principle of a WSD is similar to a drinking straw, air can enter the drinking bottle through the straw, but air cannot exit through the same straw. This is due to positive and negative pressure in the pleural cavity. A second straw that leads out of the bottle reduces the pressure in the bottle when the pressure in the pleural cavity is positive. [10,14] Meanwhile, the negative pressure in the pleura causes the liquid in the bottle to rise into the straw and creates a water seal, which prevents air from re-entering the pleural cavity. The WSD system has 3 types, namely one bottle, two bottles, and three bottles. Each system has advantages and disadvantages. In the one bottle system, application is more practical, mobilization is easier, but adding the liquid contents of the bottle can reduce the suction power of the bottle so that fluid or air in the intrapleural cavity cannot be removed. In the two-bottle system, the principle is similar to the one bottle system, namely that air and fluid flow from the pleural cavity to the WSD bottle, but the air is pumped out through the inlet hose to the second WSD bottle. [8-13] Different from the three bottle system, there is the addition of a third bottle that functions to regulate the suction pressure, so it is the safest of the three systems, only installation is more complicated and difficult if the patient is still mobile. The one bottle system was chosen because the application is more practical and easier for mobile patients. [16-18]

Patients with SSP are more susceptible to recurrence, especially those who are tall and have a low BMI. Patients who underwent chest tube insertion also experienced an increase in recurrence, 26% in the first 6 months, 33% in the following year, and 50% in the following three years. [10-14] As long as pneumothorax patients receive complete TB treatment, the prognosis is generally good. Secondary spontaneous pneumothorax can result in complications such as empyema, severe respiratory failure, cachexia, and the establishment of persistent bronchopleural fistulas. The patient has received pulmonary rehabilitation since their initial hospital admission. Pulmonary rehabilitation measures for pneumothorax patients aim to shorten the hospital stay and prevent respiratory complications. Chest expansion exercises, segmental breathing exercises, and pursed lip breathing techniques aim to restore lung function, relieve tightness, and widen the chest cavity. [17-22]

Conclusion

Secondary spontaneous tension pneumothorax is a rare form of tuberculosis that can be lethal if not detected and treated promptly. Treatment for TB-related secondary pneumothorax should include chest tube implantation, oxygen therapy, anti-TB medications, and chest physiotherapy. Patients are managed with a one-bottle system. We chose this option due to its straightforward pneumothorax case, which is user-friendly and ideal for patients on the move.

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