CASE REPORT

Needle Aspiration in Tuberculosis-Associated Secondary Spontaneous Pneumothorax

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ABSTRACT

Introduction: The management of tuberculosis-associated secondary spontaneous pneumothorax mostly requires chest tube insertion for complete drainage and resolution. We reported a case of tuberculosis-associated secondary spontaneous pneumothorax that improved with needle aspiration.
Case: A 29-year-old female with pulmonary tuberculosis presented with sudden onset shortness of breath. Chest examination revealed asymmetry, decreased vocal fremitus, hypersonor, and decreased vesicular sound in the right lung field. Chest radiograph showed right pneumothorax with a 2 cm intrapleural distance. Needle aspiration was performed because the patient refused chest tube insertion. The first needle aspiration evacuated approximately 615 cc of air. The second needle aspiration was repeated 24 hours later due to clinical deterioration, and 610 cc of air was evacuated. Chest radiograph evaluation on the 6th day of treatment showed no pneumothorax. During hospitalization, the patient received oxygen therapy, anti-tuberculosis drugs, chest physiotherapy, and other symptomatic therapies such as mucolytics. The patient's condition improved, and she was discharged on the 9th day of hospitalization. Tuberculosis-associated secondary pneumothorax occurs in 1-3% of cases.
Conclusion: Needle aspiration is a therapeutic modality for tuberculosis-associated secondary spontaneous pneumothorax. This modality has several advantages, including shorter length of stay, less cost and pain, and fewer complications. Needle aspiration combined with oxygen therapy, anti-tuberculosis drugs, and chest physiotherapy should be the modality of treatment for tuberculosis-associated secondary pneumothorax.

INTRODUCTION

Tuberculosis (TB) is one of the ten leading causes of death in infectious diseases in the world. Among 20 countries with a high burden of TB, Indonesia is the second place after India, with an estimated incidence of 824,000 and a mortality rate of 15,186 cases.[1] Secondary spontaneous pneumothorax is a pneumothorax that occurs as a complication of underlying lung disease. TB is one of the most common causes of secondary spontaneous pneumothorax, especially in developing countries. The incidence of this disease is estimated at 0.6-1.4% of cases. In patients with active TB, the incidence of pneumothorax occurs in 1% of cases.[2] This case occurs more in males than females with a ratio of 5:1.[3] Secondary spontaneous pneumothorax is associated with higher morbidity and mortality than primary spontaneous pneumothorax. Aspiration is commonly unsuccessful but may be considered in some cases with a non-extensive pneumothorax. In another study, it was stated that needle aspiration was associated with a shorter length of stay and could be performed in patients with both primary and secondary spontaneous pneumothorax, which is clinically stable regardless of the size of the pneumothorax.[4] Several factors are associated with failure of aspiration, including hilar interpleural distance >2 cm, secondary spontaneous pneumothorax, and onset ≤24 hours.[5] Most patients generally require chest tube insertion as a treatment. We presented a case of TB-associated secondary spontaneous pneumothorax, which improved with needle aspiration.

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CASE

A 29-year-old female patient came to the emergency room with sudden onset shortness of breath when the patient coughed one day before admission. The patient had already felt shortness of breath for two months and cough for one year before admission. The patient also had a history of night sweats and weight loss (15 kg in one year). The patient is a passive smoker from his father with an unknown history of contact with TB patients. The patient was diagnosed with lung TB in July 2021 but discontinued the anti-TB drug after two months of treatment because of the side effects.

During admission, the vital signs revealed tachycardia, tachypnea, and desaturation with SpO_2 48% room air and 99% NRM 15 LPM. On physical examination of the lungs, asymmetry was found in static and dynamic, decreased vocal fremitus and hypersonors in the right lung field, and decreased vesicular breath sounds in the right lung field. The complete blood count found a leukocytosis of 17.49 x 103 g/dL and a thrombocytosis of 531. The result of the GeneXpert sputum conducted in July 2021 showed that *Mycobacterium tuberculosis* (M. tb) was detected without any resistance to rifampicin. Then, anti-TB drugs were started, but after 2 months, she quit the drug. After 5 months of quitting treatment, the patient came back for treatment because the cough did not improve, and the GeneXpert sputum examination was repeated on 23 March 2022 with the same results. Thus, the patient was diagnosed with pulmonary TB lost to follow-up confirmed bacteriologically sensitive to rifampicin.

Chest X-ray examination showed a lucent avascular lesion in the right hemithorax without any displacement of the mediastinal structures and heart to the left. There were also multiple cavities in the upper to lower zones of the left lung (Figure 1a). Examination of blood gas analysis was not performed on patients because of economic reasons.

On the first day at the hospital, needle aspiration was performed at the fifth intercostal space (ICS 5) midaxillary line dextra and evacuated approximately 615 cc of air. After that, the patient felt better.

On the second day of hospitalization, the patient complained of increasing shortness of breath. The vital signs revealed hypotension (80/60 mmHg), tachycardia (112 beats per minute), tachypnea (36 breaths per minute), and desaturation (98% NRM 12 LPM). On physical examination, there was asymmetry in static and dynamic, decreased vocal fremitus on the right lung field, hypersonic on the right lung field, and decreased vesicular breath sounds on the right lung field. Needle aspiration was performed at the second intercostal spaces (ICS 2) midclavicular line dextra, and 610 cc of air was evacuated. After needle aspiration, shortness of breath improved, blood pressure improved to 100/60 mmHg, pulse decreased to 100x/minute, and the respiratory rate decreased to 30x/minute, accompanied by improvements in oxygen saturation, 98%, with an NRM of 8 LPM. Chest tube insertion was not performed in the patient because of economic reasons.

During treatment, the patient received oxygen therapy, physiotherapy, acetylcysteine 200 mg every 8 hours orally, potassium chloride 600 mg every 12 hours orally, and continued anti-TB drugs 2 tablets 4 FDC (Rifampicin 150 mg/Isoniazid 75 mg/Pyrazinamide 400 mg/Ethambutol 275 mg) according to the patient's body weight (32 kg).

Chest X-ray evaluation was performed on the sixth day of treatment. There was no lucent avascular area in the right hemithorax. Multiple cavities in the upper to lower zone of the left lung were found to be persistent (Figure 1b).

The patient was treated for nine days and was discharged with clinical improvement. During treatment, shortness of breath, cough, and night sweats were improved, followed by an increase in body weight (3 kg in two months). The patient is still taking the daily dose of the first category of anti-TB drugs in the continuation phase of 2 tablets of 2 FDC (Rifampicin 150 mg/Isoniazid 75 mg).

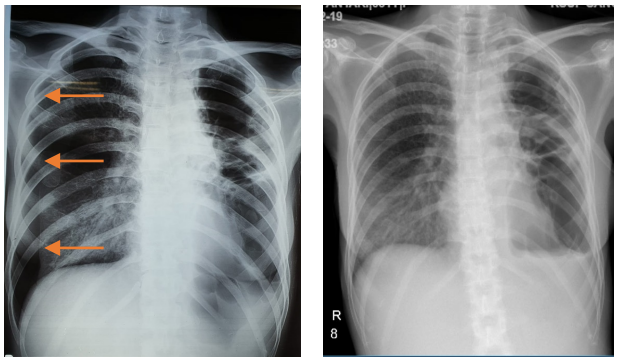

Figure 1. Patient chest X-ray on a) first day of admission, b) sixth day of hospitalization (after two times of needle aspiration). Orange arrow (⟵) showed pneumothorax.

DISCUSSION

Pneumothorax is the presence of air in the pleural cavity. It can be divided into spontaneous pneumothorax, which occurs without trauma or other causes, or traumatic, which occurs due to either direct or indirect trauma to the chest. Spontaneous pneumothorax can be divided into primary spontaneous pneumothorax, which occurs in the absence of previous lung disease, and secondary spontaneous pneumothorax, which occurs as a complication of an underlying lung disease.[6] Pulmonary TB is a frequent cause of secondary spontaneous pneumothorax in developing countries, particularly in a high burden of TB.[7]

Pneumothorax as a complication in TB patients occurs in 0.6-1.4% of cases. According to Light (2016), the prevalence of secondary spontaneous pneumothorax in TB patients occurs in 1% to 3% of cases.[8] In a study conducted by Singh, *et al*. (2019), it was found that the average age of pneumothorax patients with TB was 38.0 ± 14.3 years old.[9]

The demographic characteristics of the patient in this case report are similar to those in literature or other previous studies. In this case, the patient was 29 years old. The patient had been diagnosed with pulmonary TB by detecting M. tb through a rapid molecular test.

Clinical symptoms in patients with secondary spontaneous pneumothorax are generally more severe compared to primary spontaneous pneumothorax. As many as 83.8% of patients with secondary spontaneous pneumothorax have shortness of breath, followed by coughing (55.3%) and pleuritic chest pain (51.1%). Other signs that may be obtained are tachypnea, tachycardia, cyanosis, hypoxemia, hypercapnia, or acute respiratory failure.[10] In this case, the patient had shortness of breath accompanied by a cough. Physical examination also found the presence of tachypnea, tachycardia, and a sign of acute respiratory failure. Lung physical examination revealed an asymmetrical static and dynamic, a decrease of vocal fremitus in the right lung field, a hypersonic in the right lung field, and a decrease of vesicular sound in the right lung field. This finding was suggestive of pneumothorax.

Secondary spontaneous pneumothorax is more common in the right hemithorax, with a prevalence of 56.2%. The presence of bilateral pneumothorax is rare, with a prevalence of 6.3. The risk factors of secondary spontaneous pneumothorax are male, smoking, and with a low body mass index (BMI).[11] In the patient, pneumothorax occurred in the right hemithorax. Another risk factor associated with the incidence of secondary spontaneous pneumothorax, in this case, was a low BMI. The patient, in this case, had a BMI of 14.2 kg/m^2.

Secondary spontaneous pneumothorax due to pulmonary TB can occur due to rupture of the cavity in the pleural cavity, infection of the cavity that causes pyopneumothorax, rupture of the cavity that had been healed, or rupture of a bleb or secondary bullae due to fibrosis and pulmonary destruction. The presence of a cavity is the most frequent and significant manifestation of the incidence of pneumothorax due to TB.[9] In the patient, the diagnosis of pulmonary TB as an underlying disease had been established with the detection of M. tb through rapid molecular testing. A thorax photo of the patient showed a cavity, which is a predisposing factor for secondary spontaneous pneumothorax.

The presence of pneumothorax in patients with underlying lung disease must be treated seriously because these patients already have lesions in the lungs. Therefore, if there is a decrease in lung function, both partial or total, due to pneumothorax, life-threatening conditions can occur.[8] Based on the British Thoracic Society (BTS), secondary spontaneous pneumothorax with intrapleural distances >2 cm at the hilus accompanied by the presence of dyspnea requires drainage through chest tube insertion.[12] In patients with smaller intrapleural distances, aspirations can be performed and followed by observation and high fraction oxygenation. Needle aspiration was as effective as chest tube insertion in mediating lung expansion and was associated with the rate of hospitalization and a shorter length of stay.[12]

Another study stated that first-line therapy in patients with spontaneous pneumothorax is an observation or needle aspiration, except in patients with breathing distress.[13] Chest tube insertion should be avoided because of pain, increasing the risk of complications and immobilization in patients. The length of hospitalization is significantly shorter, and the success rate is higher in patients with needle aspiration compared to chest tube insertion. There are no complications found in patients with needle aspiration, while there are several complications that occur in patients with a chest tube. The results of this study may contribute to changes in the guidelines in the future. The use of Heimlich Valve as outpatient management in patients with spontaneous pneumothorax is also a promising approach in the future.[13] The same thing is obtained by the study conducted by Tan, *et al*. (2020).[14] Needle aspiration is said to be an option in the management of pneumothorax, with success in reducing the size of pneumothorax reaching 100%. In patients who received needle aspiration, no patients experienced worsening and needed other therapy. However, the incidence of re-accumulation in a short period of time may occur. In the first 4 hours after aspiration, re-accumulation occurs, and 62.5% of cases require repeated needle aspiration.[14] Another study says the success rate of needle aspiration reaches 60%.[14] Needle aspiration is associated with a shorter inpatient duration, a lower cost, and less pain. However, it may be less effective in a large area of pneumothorax and has a high risk of recurrence in a short period of time.[14] In a study conducted by Homma, *et al*. (2022), needle aspiration can be the treatment of choice in clinically stable patients three times, regardless of the size of the pneumothorax.[5]

In this case, we obtained pneumothorax with an interpleural distance of more than 2 cm, which was accompanied by shortness of breath. Hence, chest tube insertion should be performed. However, the patient refused because of economic reasons. Needle aspiration was performed twice in the patient. First at the

admission and repeated one day afterwards because of air reaccumulation in the pleural cavity. After the second needle aspiration, the patient's condition was improved.

The second intercostal space at the midclavicular line above the rib to avoid the neurovascular bundle on the posterior aspect of the second rib, on the side of the pneumothorax, is the preferred position for the insertion of a needle for pneumothorax aspiration. The most common alternative locations for needle decompression include the fourth (ICS4) and fifth (ICS5) intercostal spaces at both the anterior axillary line (AAL) (ICS4/5-AAL) and the mid-axillary line (MAL) (ICS4/5-MAL). However, the optimal location for needle aspiration continues to be debated in the literature.[15] In this case, the first needle aspiration was performed at ICS 5 midaxillary line dextra, and the second aspiration was performed at ICS 2 midclavicular line dextra. The selection of the aspiration location, in this case, was based on the results of a physical examination during the procedure.

Recurrence is more common in patients with secondary spontaneous pneumothorax, who are taller and have a lower BMI. In patients with a chest tube insertion, recurrence occurs as much as 26% in the first 6 months, 33% in 1 year afterwards, and 50% in 3 years later.[16] Prognosis of pneumothorax patients with TB is commonly good, according to the treatment of TB as an underlying disease.[17]

Lung rehabilitation in the patient had been performed since the beginning of the therapy. Other studies stated that pulmonary rehabilitation in pneumothorax patients can reduce the duration of hospitalization.[18,19] Segmental breathing exercises, thoracic expansion exercises, and pursed lip breathing techniques can reduce tightness, increase thoracic expansion, and restore lung function.[18–20]

In this case, the patient improved, and there were no signs of recurrent pneumothorax for up to 3 months afterwards. Therapy response to anti-TB drugs was good, proven by decreased symptoms and increased body weight.

CONCLUSION

Pneumothorax can occur as a complication of pulmonary TB. Needle aspiration combined with oxygen therapy, anti-TB drugs, and chest physiotherapy should be the modality of treatment for TB-associated secondary pneumothorax, which is associated with a shorter duration of hospitalization, lower costs, less pain, and fewer complications.

Consent

Written informed consent was obtained from the patient.

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Conflict of Interest

The authors declared there is no conflict of interest.

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Authors' Contributions

Designed the study: NWC, PGI. Data collection: NWC, PGI. Prepared the manuscript: NWC, PGI. Reviewed the manuscript: NWC, PGI, NLGYK. All authors contributed and approved the final version of the manuscript.

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