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# Three years' experience of tuberculosis versus non-tuberculosis cases of bronchopleural fistula repair at Dr. Soetomo General Academic Hospital Surabaya

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## ABSTRACT

**Background:** Tuberculosis (TB) continues to be a significant health issue and causes various complications, especially in developing countries. Bronchopleural fistula (BPF) is a rare and potentially life-threatening complication of pulmonary tuberculosis that needs to be treated by surgical procedure. This research aimed to compare the outcome of post-operative BPF repair caused by Tuberculosis and non-Tuberculosis cases.

**Methods:** In this retrospective review, we include patients from post-operative repair of BPF with Tuberculosis and non-Tuberculosis cases from January 2020 to December 2022 who were admitted to our primary center. Preoperative, operative and postoperative data were collected from medical records. We identified 36 patients and analyzed the differences between TB and non-TB groups.

**Results:** There were 36 patients with BPF who underwent surgery. The mean age of the subjects was 47.940±15.288 years. Out of these, 25 subjects (69.4%) had TB, while 11 (30.6%) subjects did not. Among the subjects, 14 TB patients (38.9%) and 2 non-TB patients (56%) experienced recurrent pneumothorax before surgery. Statistical analysis showed a significant association between comorbid TB and the occurrence of secondary attack BPF before surgery ($p = 0.035$). Regarding the duration of post-operative drain placement, 22 TB patients (61.1%) had the drain placed for less than 7 days, while 3 subjects (8.3%) had it for more than 7 days. Among the non-TB patients, 10 subjects (27.8%) had the drain placed for less than 7 days, and only 1 subject (2.8%) had it for more than 7 days. The statistical analysis showed no association between the TB group and the duration of post-operative drain placement (p=0.798).

**Conclusion:** There are numerous post-operative complications and morbidities following BPF repair surgery. Patients with TB who undergo BPF repair surgery are significantly associated with secondary attack BPF before surgery.

**Keywords:** Bronchopleural Fistula, Tuberculosis, Outcome.
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## INTRODUCTION

The bronchopleural fistula is linked to the bronchial tree and the pleural space. An alveolopleural fistula (APF) is an abnormal connection between the pulmonary tissue beyond a segmental bronchus and the pleural space. These conditions cause a continuous air leak into the pleural space.[1] While most pneumothoraxs improve with chest drain insertion, a considerable number persist for several days following the initial pneumothorax. Bronchopleural fistula (BPF) is infrequent but a worrisome complication associated with various pulmonary conditions and associated with high morbidity and mortality, leading to prolonged hospital stays.[2,3]

The most frequent cause of BPF is a complication of previous pulmonary resection, followed by necrotic lung infection, chemotherapy or radiotherapy, persistent spontaneous pneumothorax and tuberculosis. The term "chronic bronchopleural fistula" (BPF) is applied to any persistent air leak that does not improve with conservative treatment. The degree of the leak can be observed from the water seal drainage system, known as the Cerfolio Classification of Air Leaks. When an air leak continues for more than 5 to 7 days, it is categorized as persistent (PAL).[2,3] The management of BPF includes infection control, drainage of the pleural space, surgical procedures and bronchoscopic interventions.[4]

To this day, surgical intervention has been the primary approach for addressing chronic BPF, whether by VATS approach or open thoracotomy.[4] American College of Chest Physicians guidelines published in 2001 stated that spontaneous fistula closure should be expected after 4 days. If PAL persists beyond 4 days, contemplation of surgical intervention to seal the air leak, coupled with pleurodesis to deter recurrence, should be considered.[1] In Indonesia, Tuberculosis remains an important health problem and causes

various complications, including BPF. In this study, we analyzed the outcome of BPF repair surgery between populations of Tuberculosis and non-Tuberculosis patients.

## METHODS

### Study design and population

This single-center retrospective cohort study was conducted at the Department of Thoracic, Cardiac and Vascular Surgery, Dr. Soetomo Hospital Surabaya, Indonesia. This study intends to describe and analyze the characteristics and outcome of BPF repair between Tuberculosis and non-Tuberculosis patients. The research encompassed individuals who underwent treatment from January 2020 to December 2022 with a total sampling technique. The diagnosis of BPF was determined by thoracic CT-Scan, which gave details about the location and the size of BPF. The inclusion criteria were all BPF patients treated surgically with VATS or an open thoracotomy approach. Patients were further divided into two groups, Tuberculosis and non-Tuberculosis, to compare the characteristics and outcomes of the repair between the two groups. Patients with incomplete medical records and patients who refused to receive any treatment were not included in this study.

### Data collection

This study utilized secondary data from existing medical records to perform the retrospective analysis. The researchers collected data from medical records and patient registration at the Department of Cardiothoracic & Vascular Surgery, Dr. Soetomo Hospital Surabaya, Indonesia. Demographic and clinical characteristics of the subjects were collected, including age, sex, presence of Tuberculosis infection, location and size of the BPF, and the recurrence of BPF after initial surgery. The diagnosis of TB is based on patient history and examination findings according to the local guidelines.

The researchers also investigated the surgical characteristics and outcome, including the surgical approach (VATS and open thoracotomy) used to repair the BPF, duration of chest tube usage (< 7 days or ≥ 7 days), length of hospital stay (< 14 days or ≥ 14 days), failure of BPF repair and the need for IPC insertion for out of hospital long-term care. The definition of Failure of BPF Repair is the cases that have undergone surgery but cannot be separated from Water Seal Drainage. The local team determined whether to use VATS or an open thoracotomy approach. Collected data and variables were further analyzed statistically and compared between the two groups: Tuberculosis and non-tuberculosis patients.

### Statistical analysis

Data analysis for this study was conducted using SPSS version 25 for Windows. Two types of analyses were performed: univariate analysis and bivariate analysis. Univariate analysis was conducted to provide an overview of the subject characteristics and the distribution of subject data. For categorical data, such as gender and surgical characteristics, the number and percentage of each category were presented. For numerical data, such as age, descriptive statistics, such as mean and standard deviation (SD), based on whether the data was normally distributed. Bivariate analysis was then performed to compare specific variables between different groups. The Chi-square test was employed for categorical data to determine whether there were substantial differences in proportions across groups. The significance level was set with a *p-value* of less than 0.05 for all tests.

## RESULTS

There were a total of 36 patients with BPF who underwent surgery. The mean age of the subjects was 47.940±15.288 years. Of these, 25 subjects (69.4%) had TB, while 11 did not. The demographic, clinical, and surgical characteristics of our study population are described in Table 1.

Table 2 shows the postoperative outcomes of the studied groups. Among the subjects, 14 TB patients (56%) and 2 non-TB patients (18.2%) experienced secondary attack BPF before surgery. Statistical analysis showed a significant association between comorbid TB and the occurrence of secondary attack BPF before surgery (p = 0.035), indicating that patients with TB are more likely to experience secondary attack BPF before surgery.

**Table 1. Demographic, clinical, and surgical characteristics**

| Variables | Number of Cases (n=36) |
|---|---|
| Age (Years) (Mean±SD) | 47.940±15.288 |
| Sex, n (%) | |
| Male | 30 (83.30) |
| Female | 6 (16.70) |
| Tuberculosis, n (%) | |
| Yes | 25 (69.40) |
| No | 11 (30.60) |
| Location of BPF, n (%) | |
| Right superior lobe | 17 (47.20) |
| Left superior lobe | 12 (33.30) |
| Left inferior lobe | 7 (19.40) |
| Surgical approach, n (%) | |
| VATS | 9 (25.00) |
| Open surgery | 27 (75.00) |
| Surgical repair approach, n (%) | |
| Primary repair | 17 (47.20) |
| Wedge resection | 15 (41.70) |
| Muscle flap | 4 (11.10) |
| Failure of BPF repair, n (%) | 3 (8.30) |
| Secondary attack BPF, n (%) | 16 (44.40) |
| Length of stay, n (%) | |
| < 14 days | 31 (86.10) |
| > 14 days | 5 (13.90) |
| Duration of drain insertion, n (%) | |
| < 7 days | 32 (88.90) |
| > 7 days | 4 (11.10) |
| IPC after a hospital stay, n (%) | 6 (16.70) |

Regarding the failure of BPF repair, 2 subjects (5.6%) with TB experienced it, while only 1 subject (2.8%) among the non-TB patients did. However, the obtained p-value of 0.913 indicates no significant relationship between the TB group and failure of BPF repair. Regarding the duration of postoperative drain placement, 22 TB subjects (61.1%) had the drain placed for less than 7 days, while 3 subjects (8.3%) had it for more than 7 days. Among the non-TB patients, 10 subjects (27.8%) had the drain placed for less than 7 days, and 1 subject (2.8%) had it for more than 7 days. The statistical analysis resulted in a p-value of 0.798, indicating no significant association between the TB group and the duration of drain placement.

As for the length of hospital stay, 21 TB patients (58.3%) stayed for less than 14 days, while 10 non-TB patients (27.8%) had a hospital stay of less than 14 days, and 1 subject (2.8%) stayed for more than 14 days. The statistical analysis yielded a p-value of 0.581, suggesting no significant association between comorbid TB and the duration of hospital stay.

**Table 2. The comparison between tuberculosis and non-tuberculosis groups**

| Variables | Tuberculosis (n=25) | Non-tuberculosis (n=11) | P |
|---|---|---|---|
| Location of BPF, n (%) | | | |
| Right superior lobe | 12 (33.30) | 5 (13.90) | 0.180 |
| Left superior lobe | 10 (27.80) | 2 (5.60) | |
| Left inferior lobe | 3 (8.30) | 4 (11.10) | |
| Surgical approach, n (%) | | | |
| VATS | 4 (11.10) | 21 (58.30) | 0.060 |
| Open surgery | 5 (13.90) | 6 (16.70) | |
| Surgical repair approach, n (%) | | | |
| Primary repair | 10 (27.80) | 7 (19.40) | 0.417 |
| Wedge resection | 12 (33.30) | 3 (8.30) | |
| Muscle flap | 3 (8.30) | 1 (2.80) | |
| Failure of BPF repair, n (%) | 2 (5.60) | 1 (2.80) | 0.913 |
| Secondary attack BPF, n (%) | 14 (38.90) | 2 (5.60) | 0.035 |
| Length of stay, n (%) | | | |
| < 14 days | 21 (58.30) | 4 (11.10) | 0.581 |
| > 14 days | 10 (27.80) | 1 (2.80) | |
| Duration of chest drain insertion, n (%) | | | |
| < 7 days | 22 (61.10) | 3 (8.30) | 0.798 |
| > 7 days | 10 (27.80) | 1 (2.80) | |
| IPC after a hospital stay, n (%) | 4 (11.10) | 2 (5.60) | 0.871 |

*Statistically significant if p-value less than 0.05

## DISCUSSION

Bronchopleural fistulas (BPF) and PALs are frequently observed in individuals who have undergone lung volume reduction surgery and pulmonary resection or biopsy. It can also be caused by spontaneous pneumothorax. Less regularly, pulmonary infections (such as necrotizing pneumonia), malignancies, procedures involving pleural drainage, barotrauma resulting from mechanical ventilation, chest trauma and iatrogenic factors can also induce BPF. According to the previous study, Bronchopleural fistulas (BPFs) leading to persistent air leaks (PALs) are linked with extended hospital stays and significant morbidity.[5] The latest guidelines advocate for a conservative approach involving vigilant monitoring with chest tube drainage, followed by surgical repair, considered the preferred treatment method. Air passage through the abnormal tract into the pleural cavity can impede healing and hinder proper lung expansion. PAL that persists beyond 4 days and BPF that is >8mm are indications for surgical repair.[1] Despite advancements in surgical procedures and the care of patients during the postoperative period, addressing BPF remains a complex task for thoracic surgeons. Multiple approaches and techniques are utilized for repairing BPF, including primary suture, pulmonary resection, and reinforcement using muscle, pericardial fat or omental flap.[4]

Numerous studies have examined the risk factors associated with developing bronchopleural fistula (BPF), surgical characteristics, and success rate of BPF repair. However, there has been limited research on whether a Tuberculosis infection affects the morbidity of these cases. Our study comprised 36 patients admitted to Dr. Soetomo Hospital, Surabaya, with prolonged air leaks as the chief complaint. The mean age of the subjects was 47.940±15.288 years. Of these subjects, 69.4% had tuberculosis (TB) as an underlying disease. A study held in a hospital in Singapore on persistent air leak in spontaneous pneumothorax showed a majority (56%) of their subjects with secondary pneumothorax had historical or radiological evidence of COPD and previous TB infection, and another 18% had a history of prior TB infection without COPD.[6]

Our study showed that 56% of subjects with TB experienced secondary attack BPF before surgery, whereas only 18.2% of the non-TB subjects did. Failure after initial repair was observed in 2 TB patients and 1 non-TB patients. In their study, Naidoo R et al. reported that in 106 patients with active TB undergoing pulmonary resection, only 1 developed pneumothorax before surgery. Although the incidence rate may be low, the risk of developing secondary attack BPF before surgery is noticeably higher in TB patients than those without TB.[7]

The initial approach to treating patients with BPF should include comprehensive drainage of the infected pleural area, administration of antibiotics for the infection, and effective clearance of secretions. After successfully managing the infection, the task shifts to closing the fistula and effectively handling residual space.[8-10]

Regarding the surgical approach used for BPF repair, 30.6% of the subjects underwent open thoracotomy, while 69.4% underwent other VATS. The available thoracotomy method remains the preferred approach and offers excellent access to the chest cavity. Meanwhile, The VATS approach yields equally effective therapeutic outcomes with lower associated morbidity in carefully

chosen patients. Both techniques can be considered depending on the complexity of the surgery and the surgeon's preference. Video-assisted thoracoscopic surgery (VATS) diminishes pain and lowers the occurrence of complications while also preserving postoperative respiratory and immune function, as well as overall quality of life. Given these advantages, VATS might expand the range of patients considered suitable for major surgical procedures by potentially reducing the thresholds for tolerance.[9,11,12]

There are several methods and techniques available for repairing a bronchopleural fistula (BPF), including primary suturing, supplementary pulmonary resection, and reinforcement using muscle, pericardial fat, or omental flap. In BPF repair, vascularized tissue is frequently employed to reinforce the stump. Encouraging outcomes have been documented in cases where omental, muscular, pericardial, and diaphragmatic flaps have been utilized. Yang YH et al. reported better overall outcomes when using an omental flap than a muscular flap. In addition to its capacity to promote angiogenesis and enhance neovascularization, omental tissue offers immunological advantages, aiding in eliminating infections. The omentum is also large, making it suitable for filling spaces and reinforcing stumps.[4,13]

Chest tube drainage was maintained for less than 7 days in 88% and 90.9% of TB and non-TB patients, respectively. These findings align with the report by Chee CBE et al., which stated the median duration of a post-operative chest tube was 8 days (ranging from 3 to 71 days). Six patients needed IPC as a take-home ambulatory drainage system due to unresolved pneumothorax with BPF repair and post-operative chest tube drainage. The hospital stay duration in most patients (84% in the TB group, 90.9% in the non-TB group) is less than 14 days. A similar finding was reported with a median duration of hospital stay of 9.5 days (ranging from 4-80 days).[6,14]

In terms of limitations, this study was a retrospective review with all the inherent deficiencies of such studies. Additionally, the small number of patients available for study restricted the power of our analysis. Further future studies are still needed by adding cases to make the collected cases more numerous.

## CONCLUSION

BPF can be challenging and debilitating if not managed properly. Once it has developed, early recognition, pleural space drainage, and inflammation control are critical. Various methods and combinations of techniques have been used to repair BPF. Tuberculosis as a comorbid infection plays a role in increasing morbidity in BPF cases. In the study we conducted at Dr. Soetomo Hospital Surabaya, Indonesia, between January 2020 and December 2022, we found that Tuberculosis significantly increased the recurrence of pneumothorax before surgery. Proper treatment of Tuberculosis before going into surgical management is therefore essential to improve surgical outcomes. Further study needs to be done to analyze the optimal surgical strategies for BPF with Tuberculosis infection.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

## ETHICAL CONSIDERATIONS

This research was conducted based on the ethical conduct of research from the Ethics Committee of Dr. Soetomo Hospital Surabaya, Indonesia.

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## AUTHOR'S CONTRIBUTION

I Gusti Bagus Chandogya Giriastawa was primarily responsible for writing the manuscript and co-coordinated study design, data analysis, data interpretation and data collection. Dhihintia Jiwangga Suta Winarno contributed to data analysis, data interpretation, critical revision of the article for intellectual purposes and final approval. Mohamad Rizki contributed to the provision of the article's material, expertise and writing of the article for important academic content. All authors have reviewed and approved the final version of the manuscript for submission.

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