

Original Research Article

Impact of lobectomy on pulmonary function in tubercular patients: a prospective analysis

Rajeebshankar Karmakar^{1*}, Atik Ahmed Akond¹, Masnoon Ahmed Noor²,
Sutopa Halder Supti³, Delwar Hossain⁴, Raisa Enayet Badhan⁵

¹DGHS, Mohakhali, Dhaka, Bangladesh

²NIDCH, Mohakhali, Dhaka, Bangladesh

³Department of Paediatric Gastroenterology and Nutrition, BSMMU, Shahbag, Dhaka, Bangladesh

⁴Department of Thoracic Surgery, NIDCH, Mohakhali, Dhaka, Bangladesh

⁵Department of Microbiology, National Institution of Burn and Plastic Surgery, Dhaka, Bangladesh

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*Correspondence:

Dr. Rajeebshankar Karmakar,
E-mail: rajeebfmc16@gmail.com

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ABSTRACT

Background: Tuberculosis (TB) is a leading cause of death globally, with South Asia bearing a significant burden. In Bangladesh, TB poses major health challenges, especially in rural areas. For patients with TB sequelae, lobectomy may be necessary. Assessing pulmonary function before and after surgery is crucial for understanding the impact on patients. This study aimed to evaluate the changes in pulmonary function in TB patients undergoing lobectomy.

Methods: The study employed a prospective longitudinal design at the National Institute of Diseases of the Chest and Hospital, spanning from January 2022 to June 2023. Thirty patients, aged over 18 years and capable of undergoing spirometry, were enrolled. These patients had diagnoses including post-tuberculous sequelae, were scheduled for lobectomy. Data were collected through interviews and lung function tests conducted before and two months post-surgery. Statistical analyses were performed using SPSS version 29.

Results: The study included 30 patients with an average age of 37.77 years, predominantly male (73.33%). Significant reductions in pulmonary function were observed post-lobectomy: the mean Forced Expiratory Volume in the first second (FEV1) decreased from 1.82 liters to 1.56 liters postoperatively ($p=0.034$) and the mean Forced Vital Capacity (FVC) dropped from 2.28 liters to 1.91 liters ($p=0.005$). The FEV1/FVC ratio decreased slightly from 76.67% to 73.37%.

Conclusions: Lobectomy in patients with TB results in significant declines in pulmonary function, as indicated by reductions in FEV1 and FVC post-surgery.

Keywords: Lobectomy, Outcome of lobectomy, Pulmonary function test, Tuberculosis

INTRODUCTION

Tuberculosis (TB) remains a significant global health challenge, ranking among the leading causes of death from infectious diseases worldwide.¹ According to the World Health Organization (WHO), an estimated 8.8 million individuals were afflicted with TB in 2010, highlighting the substantial burden this disease imposes on healthcare

systems and populations globally.² Of particular concern is the prevalence of TB in South Asia, where approximately 40% of the global TB burden was reported in 2015, highlighting the urgent need for effective management and treatment strategies in this region.¹ Bangladesh has faced considerable challenges in combating TB, with the country ranking as the 22nd highest TB burden nation in 2011 and a significant

proportion of cases originating from rural areas.² Tuberculosis (TB) continues to represent a major global health threat, particularly in low- and middle-income countries. Despite improved access to diagnosis and multidrug therapy, TB remains one of the top infectious disease killers worldwide, with an estimated 10.6 million new cases and 1.3 million deaths reported in 2022.³ While most pulmonary TB patients respond well to anti-tubercular therapy (ATT), a subset especially those with multidrug-resistant TB (MDR-TB), extensively drug-resistant TB (XDR-TB) or chronic cavitary lesions may not achieve complete resolution with medical management alone. In such cases, surgical intervention becomes necessary as an adjunct to pharmacological therapy.⁴

Lobectomy, a surgical procedure involving the removal of a single lobe of the lung, has been increasingly recognized as a lung-sparing and curative strategy in patients with localized pulmonary TB. It is particularly effective in managing patients with massive hemoptysis, localized bronchiectasis, persistent cavitary lesions harboring drug-resistant bacilli and post-TB sequelae such as destroyed lobe syndrome.⁵ Compared to pneumonectomy, lobectomy is associated with lower perioperative mortality and better preservation of pulmonary function, making it a favorable surgical option for functionally compromised TB patients.⁶

Pulmonary function is a critical determinant of postoperative recovery and long-term quality of life. Tubercular patients often have pre-existing lung damage due to chronic inflammation, fibrosis, parenchymal destruction and airway remodeling. Therefore, assessing the functional impact of lobectomy in such patients is crucial for surgical decision-making. Pre- and postoperative spirometric evaluation using parameters such as forced vital capacity (FVC), forced expiratory volume in 1 second (FEV₁) and FEV₁/FVC ratio are essential tools in objectively measuring functional changes following resection.⁷

Several comparative studies have addressed this issue. For example, Kim et al, conducted a retrospective analysis of MDR-TB patients undergoing lung resection and found a mean postoperative reduction in FEV₁ of approximately 10–15%, which was considered acceptable given the disease severity.⁸ Similarly, Abascal et al, reported that while lobectomy led to a modest decline in spirometric values, most patients experienced functional stabilization or improvement in symptoms, particularly dyspnea and hemoptysis.⁹ In another comparative study, Macek et al found that lobectomy in post-TB bronchiectasis patients significantly improved quality of life scores, with only a mild decrease in pulmonary reserve.¹⁰ Moreover, a study by Bagheri et al, involving 53 patients with localized TB lesions showed that over 70% had preserved or improved FEV₁ at 3-month follow-up after lobectomy.¹¹

Despite these findings, there is a lack of prospective data from high TB burden settings on how lobectomy impacts

pulmonary function in real-time clinical practice. Most available studies are either retrospective or focused on mixed etiologies, making it difficult to generalize outcomes to TB-specific populations. Additionally, regional factors such as nutritional status, delay in diagnosis, extent of cavitary disease and preoperative spirometric values may influence postoperative recovery. Therefore, a prospective analysis focusing exclusively on TB patients undergoing lobectomy is necessary to provide evidence-based guidance for clinicians and thoracic surgeons.

This study aims to prospectively evaluate the impact of lobectomy on pulmonary function in patients with pulmonary TB using standardized spirometric assessments pre- and postoperatively. The findings are intended to aid in refining surgical indications, risk-benefit assessments and postoperative care protocols for this unique patient population.

METHODS

Utilizing a comparative longitudinal design, our study investigates the impact of lobectomy on pulmonary function in tubercular patients admitted to the National Institute of Diseases of the Chest and Hospital. Conducted between January 2022 and June 2023 at the Department of Thoracic Surgery, this study enrolled patients meeting specific inclusion criteria, including age greater than 18 years, the ability to provide consent and the capability to undergo spirometry.

Participants were diagnosed with post-tuberculous bronchiectasis, post-tubercular cavitary lesion, aspergilloma or post-tuberculous fibrosis and were undergoing lobectomy. A convenient sampling technique was used, resulting in a sample size of 30 participants. Data collection involved face-to-face interviews conducted before and two months after lobectomy, followed by lung function tests.

Data processing and statistical analysis were performed using SPSS version 29, with univariate comparisons between groups conducted using the chi-square test for categorical variables and Student's T-test for continuous variables. Ethical considerations were paramount, with approval obtained from the institutional review board of the National Institute of Diseases of the Chest and Hospital, along with written informed consent from all participants, outlining the potential benefits and risks of the procedure.

RESULTS

We enrolled 30 patients with tubercular lung disease who underwent lobectomy. Table 1 presents a detailed demographic profile of the patients involved in this study. The average age of the patients was 37.77 years with a standard deviation of 12.66 years, indicating a relatively young to middle-aged cohort. The gender distribution

showed a predominance of male patients, accounting for 73.33% (22 individuals), while female patients made up 26.67% (8 individuals). Regarding smoking history, 36.67% (11 patients) had a history of smoking, whereas 63.33% (19 patients) were non-smokers. The occupational breakdown revealed that the majority of patients were businessmen, comprising 66.67% (20 individuals), followed by housewives at 29% (9 individuals) and a single teacher representing 3.33%. In terms of comorbidities, 13.33% (4 patients) had chronic obstructive pulmonary disease (COPD) and no patients were reported to have diabetes mellitus.

The site of the disease was predominantly on the right side of the body in 60% (18 patients) of the cases, with the left side affected in 40% (12 patients). The location of the lesion was most commonly in the upper part of the affected area, observed in 66.67% (20 patients). Lesions in the middle section accounted for 13.33% (4 patients) and the lower section had 10% (3 patients). No patients had lesions in both the middle and lower sections simultaneously, but 10% (3 patients) had lesions spanning the upper and middle sections. The diagnostic categories showed that Aspergilloma was the most frequent diagnosis, occurring in 46.67% (14 patients). This was followed by post-

tuberculosis fibrosis in 10% (3 patients) and post-tuberculosis bronchiectasis in 43.33% (13 patients).

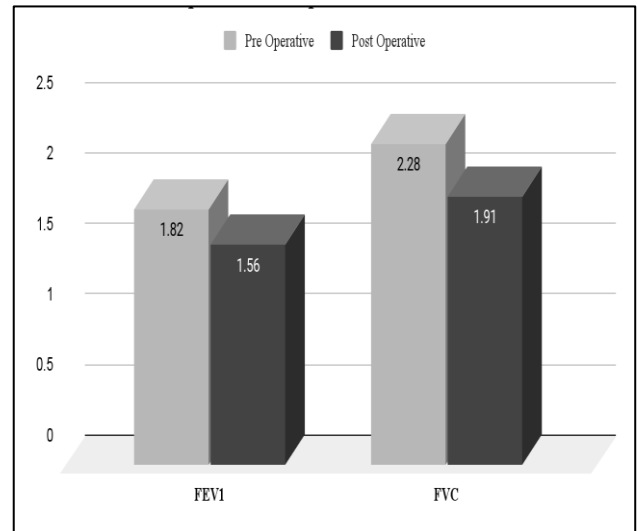


Figure 1: Pre and post operative comparison of mean FEV1 vs FVC.

Table 1: Demographic information of patients.

Variables	Mean±SD
Age (in years)	37.77±12.66
Gender	N (%)
Male	22 (73.33)
Female	8 (26.67)
Smoking history	
Yes	11 (36.67)
No	19 (63.33)
Occupation	
Businessman	20 (66.67)
Housewife	9 (29)
Teacher	1 (3.33)
Comorbidity	
COPD	4 (13.33)
Diabetes mellitus	0 (0)
Site of disease	
Right	18 (60)
Left	12 (40)
Location of the lesion	
Upper	20 (66.67)
Middle	4 (13.33)
Lower	3 (10)
Middle and lower	0 (0)
Upper and middle	3 (10)
Diagnosis	
Aspergilloma	14 (46.67)
Post TB fibrosis	3 (10)
Post TB bronchiectasis	13 (43.33)

Table 2: Comparison of pre-operative and post-operative spirometric data of the patients.

	Pre operative	Post operative	P value
FEV₁ (mean±SD)	1.82±0.53	1.56±0.55	0.034
FVC (mean±SD)	2.28±0.55	1.91±0.51	0.005
FEV₁ / FVC (mean±SD)	76.67±9.78	73.37±11.11	0.11

p-value obtained by Paired t-test, $p < 0.05$ considered as a level of significant.

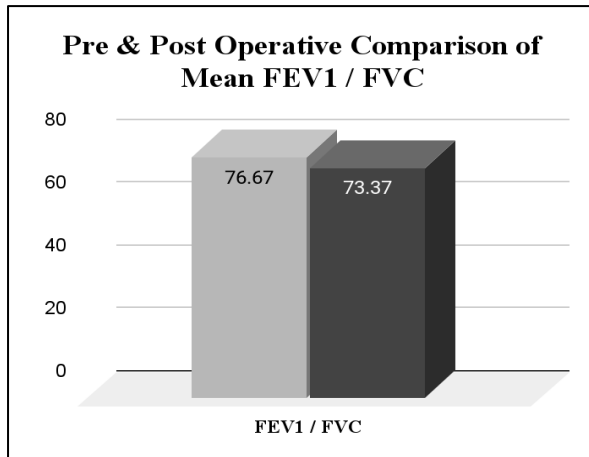
**Figure 2: Pre and post operative comparison of mean FEV₁/FVC.**

Table 2 provides a thorough analysis of pre-operative and post-operative spirometric data of the patients, focusing on three key measurements: Forced Expiratory Volume in one second (FEV₁), Forced Vital Capacity (FVC) and the FEV₁ to FVC ratio. Before surgery, the mean FEV₁ value was 1.82 liters with a standard deviation of 0.53 liters. After surgery, this value decreased to a mean of 1.56 liters with a standard deviation of 0.55 liters. The p-value for this comparison was 0.034, indicating a statistically significant reduction in FEV₁ post-operatively. The mean FVC before surgery was 2.28 liters, with a standard deviation of 0.55 liters. Post-operatively, the mean FVC dropped to 1.91 liters, with a standard deviation of 0.51 liters. The p-value for this change was 0.005, suggesting a significant decrease in FVC after surgery. For the FEV₁/FVC ratio, the mean preoperative value was 76.67% with a standard deviation of 9.78%. Post-operatively, the mean ratio slightly decreased to 73.37% with a standard deviation of 11.11%.

A notable constraint of this study is the small sample size of 30 patients, which may not be representative of the broader population of TB patients requiring lobectomy. The follow-up period of two months post-surgery may be insufficient to capture the long-term changes in pulmonary function and recovery. The study is conducted in a single hospital setting, which may limit the generalizability of the findings to other regions and healthcare environments.

DISCUSSION

This prospective study aimed to evaluate the impact of lobectomy on pulmonary function in patients with

pulmonary tuberculosis. Our findings reveal a statistically significant decline in both forced expiratory volume in 1 second (FEV₁) and forced vital capacity (FVC) postoperatively.

The mean preoperative FEV₁ was 1.82±0.53 liters, which decreased to 1.56±0.55 liters after lobectomy ($p=0.034$). Similarly, FVC declined from 2.28±0.55 liters to 1.91±0.51 liters ($p=0.005$). These results are consistent with those of previous studies and support the conclusion that lobectomy, although beneficial for disease resolution, has a measurable effect on postoperative pulmonary function.

Our data are in line with Amorim et al, who reported a reduction in FEV₁ from 2.23 liters preoperatively to 1.81 liters at three months post-lobectomy.¹² Berend et al, similarly observed a decline from 2.5 liters (SD=0.7) to 2.2 liters (SD=0.6).¹³ In terms of FVC, our results mirror the findings of Amorim et al, who documented a decrease from 2.97 liters to 2.35 liters postoperatively.¹² Berend et al, also noted a reduction in FVC from 4.1 liters to 3.7 liters following lobectomy.¹³

These comparative data confirm that even partial lung resection in patients with tuberculosis leads to appreciable reductions in ventilatory capacity. Interestingly, our study recorded a modest decrease in the FEV₁/FVC ratio from 76.67% (SD=9.78%) preoperatively to 73.37% (SD=11.11%) postoperatively. This differs slightly from Amorim et al, who reported an increase in the FEV₁/FVC ratio from 70.5% to 77.4%, possibly reflecting improvements in airway resistance due to the removal of diseased segments.¹⁴ In contrast, Berend et al, reported a decrease in FEV₁/FVC ratio from 61% to 59%.¹³

The variability in FEV₁/FVC ratio changes among different studies may be attributed to differences in patient selection, extent of disease and the timing of postoperative spirometric assessment. The observed reductions in lung function post-lobectomy are multifactorial.

Tuberculosis is a chronic inflammatory disease that causes irreversible structural lung damage, including bronchiectasis, fibrosis and cavitation.⁶ Even prior to surgical intervention, these patients often have compromised pulmonary reserves. Lobectomy further reduces lung volume and contributes to an acute postoperative inflammatory response and parenchymal loss, which collectively impact pulmonary mechanics.¹¹

However, despite the decline in pulmonary function parameters, lobectomy remains an effective treatment

modality in selected patients with localized or drug-resistant TB. The removal of non-functional or infected lung tissue may actually prevent further deterioration of lung function and systemic complications such as recurrent hemoptysis or persistent infection.^{4,5} Several studies have also reported symptomatic improvement and quality of life enhancement after surgery, which underscores the value of lobectomy beyond spirometric measurements.^{15,16} A notable strength of our study is its prospective longitudinal design, which allows for a precise evaluation of pulmonary function changes over time. The use of standardized spirometric testing further adds to the reliability and objectivity of our findings. Moreover, the study was conducted in a high TB burden setting, addressing a critical gap in the literature where most previous studies have originated from low- to moderate-burden countries.

Nonetheless, our study has some limitations. The sample size was relatively small and the follow-up period was limited to the early postoperative phase. Long-term data are essential to understand whether pulmonary function stabilizes, improves or deteriorates further over time. Additionally, factors such as nutritional status, rehabilitation adherence and presence of comorbidities were not fully analyzed but could have influenced outcomes.

Given the findings, we recommend the implementation of comprehensive preoperative and postoperative pulmonary rehabilitation programs tailored for TB patients undergoing lobectomy. Early mobilization, chest physiotherapy and nutritional support may help mitigate postoperative lung function decline. Furthermore, multicenter studies with larger sample sizes and extended follow-up periods are warranted to establish long-term trends and refine surgical criteria in TB management.

CONCLUSION

This prospective analysis highlights the significant impact of lobectomy on pulmonary function in patients with a history of tuberculosis. Our findings reveal that both forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) exhibit a marked decrease postoperatively. This decline in pulmonary function is likely attributed to the permanent lung damage and scarring caused by the tuberculosis infection, compounded by the surgical trauma and subsequent loss of lung tissue.

Despite the surgical intervention aimed at improving overall health outcomes, the persistent reduction in pulmonary capacity shows the need for extensive preoperative chest physiotherapy and postoperative management to restore respiratory function and enhance patient quality of life.

These insights contribute to a more comprehensive understanding of the challenges faced by tuberculous patients undergoing lobectomy and emphasize the

importance of tailored clinical strategies to reduce adverse respiratory outcomes.

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