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Respiratory Medicine

A STUDY TO ASSESS THE CLINICO-RADIOLOGICAL AND SPIROMETRY CHANGES OF POST TUBERCULOSIS BRONCHIECTASIS PATIENTS IN A TERTIARY CARE CENTRE IN CENTRAL INDIA.

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ABSTRACT **Background:** Post-tuberculosis lung disease (PTLD) is a major cause of chronic respiratory morbidity, particularly in high tuberculosis-burden countries like India. Bronchiectasis is a common structural sequela following treated pulmonary tuberculosis, leading to persistent symptoms and functional impairment. **Aim:** To assess the clinical, radiological, and spirometric changes in patients with post-tuberculosis bronchiectasis admitted to a tertiary care center in central India. **Methods:** This cross-sectional study included 48 patients aged >18 years with a history of treated pulmonary tuberculosis and radiological evidence of bronchiectasis. Detailed clinical evaluation, high-resolution computed tomography (HRCT) of the thorax, and spirometry were performed. Data were analysed using descriptive statistics. **Results:** The mean age of the patients was 57.94 ± 13.11 years, with a male predominance (70.83%). Dyspnea was the most common presenting symptom (81.25%), followed by productive cough (64.58%). Bilateral lung involvement was observed in 83.33% of patients, with upper lobe predominance. On HRCT, cystic bronchiectasis was the most common finding (58.33%), followed by traction bronchiectasis (33.33%). Spirometry revealed an obstructive ventilatory defect in 50% of patients, mixed pattern in 18.75%, and restrictive pattern in 16.67%. A majority of patients were non-smokers (64.58%). **Conclusion:** Post-tuberculosis bronchiectasis is associated with significant clinical symptoms, characteristic radiological findings, and predominantly obstructive ventilatory defects. Integrated assessment using HRCT and spirometry is essential for optimal evaluation and management.

KEYWORDS : Post-tuberculosis Lung Disease, Bronchiectasis, HRCT, Spirometry, Airflow Obstruction.

INTRODUCTION

Tuberculosis (TB) continues to be a major contributor to global morbidity, with India accounting for a substantial share of the disease burden. Although advances in anti-tubercular therapy have significantly improved cure rates, achieving microbiological clearance does not necessarily translate into complete recovery of lung health. A considerable proportion of patients develop persistent respiratory abnormalities after completion of treatment, a condition now recognized as post-tuberculosis lung disease (PTLD).

PTLD encompasses a wide range of structural and functional impairments, among which bronchiectasis is a frequent and clinically important manifestation. This condition results from irreversible damage to the bronchial walls due to chronic inflammation, destruction of airway architecture, and subsequent fibrotic healing. The pathological process leads to abnormal bronchial dilatation and impaired mucociliary clearance, predisposing patients to recurrent infections and ongoing airway injury.

Clinically, individuals with post-tuberculosis bronchiectasis commonly present with chronic cough, sputum production, dyspnea, and episodic exacerbations, all of which contribute to reduced functional capacity and quality of life. High-resolution computed tomography (HRCT) has emerged as the imaging modality of choice for detecting these structural abnormalities, allowing detailed assessment of bronchial dilatation, distribution, and associated parenchymal changes. In addition, pulmonary function testing provides valuable insight into the physiological impact of the disease, often demonstrating obstructive, restrictive, or mixed ventilatory defects.

In regions with a high prevalence of tuberculosis, such as Central India, post-tuberculosis bronchiectasis represents a significant proportion of chronic airway diseases. Despite this, there is limited regional data examining the relationship between clinical presentation, radiological findings, and pulmonary function abnormalities in affected individuals.

Therefore, the present study was designed to evaluate the clinical characteristics, radiological patterns, and spirometric changes in patients with post-tuberculosis bronchiectasis in a tertiary care centre in Central India, with the objective of improving understanding of disease burden and informing long-term management strategies.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based cross-sectional study conducted in the Department of Respiratory Medicine at a tertiary care centre in Central India over a period of two years.

Study Population

The study included adult patients (≥18 years) with a prior history of treated pulmonary tuberculosis who presented with respiratory symptoms and had radiological evidence of bronchiectasis.

Inclusion Criteria

- Age ≥18 years
- History of completed treatment for pulmonary tuberculosis
- Radiological evidence of bronchiectasis on imaging
- Willingness to provide informed consent

Exclusion Criteria

- Evidence of active pulmonary tuberculosis
- History of inadequate or incomplete anti-tubercular treatment
- Pre-existing chronic lung disease or lung malignancy prior to tuberculosis
- Patients who did not provide consent

Sample Size and Sampling Technique

The minimum sample size was calculated using the standard formula for proportion estimation at a 95% confidence level, considering a prevalence of 22.4% and an allowable error of 13%. The calculated sample size was 40, which was increased by 10% to account for possible attrition, resulting in a final sample size of 43.

A total of 48 patients were included using consecutive sampling.

Data Collection
Data were collected using a structured and pretested questionnaire. Information recorded included demographic details, smoking history, clinical symptoms, duration since completion of anti-tubercular therapy, and relevant medical history.

Clinical Evaluation
All patients underwent detailed clinical assessment, including evaluation of respiratory symptoms such as cough, sputum production, dyspnea, hemoptysis, and chest pain.

Radiological Assessment
All patients underwent imaging evaluation, including chest radiography and high-resolution computed tomography (HRCT) of the thorax. Radiological findings were assessed for:
- Presence and type of bronchiectasis (cystic, tractional, fibrocavitary)
- Lobar distribution
- Laterality (unilateral or bilateral involvement)
- Associated findings such as fibrosis

Pulmonary Function Testing
Spirometry was performed in all patients in accordance with standard guidelines. Parameters assessed included forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC). Based on spirometric findings, patients were categorized into:
- Obstructive pattern
- Restrictive pattern
- Mixed pattern
- Normal spirometry

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using IBM SPSS version 29.0. Descriptive statistics, including mean, standard deviation, frequencies, and percentages, were used to summarize the data. Results were presented in the form of tables and graphs.

OBSERVATION AND RESULT
Age-wise Distribution
The present study included 48 patients with post-tuberculosis bronchiectasis. The majority of patients belonged to the 40–60 years age group (45.83%), followed by those aged more than 60 years (41.67%). A smaller proportion of patients were in the 18–40 years age group (12.50%). The mean age of the study population was 57.94 ± 13.11 years, indicating that post-tuberculosis bronchiectasis was more commonly observed in the middle-aged and elderly population.

Gender-wise Distribution
Among the 48 patients included in the study, males formed the larger proportion with 70.83% (n = 34), whereas females accounted for 29.17% (n = 14) of the cases. This observation demonstrated a clear male predominance in patients with post-tuberculosis bronchiectasis.

Distribution of Patients According to Smoking Status
A total of 48 patients with post-tuberculosis bronchiectasis were assessed for smoking status. Of these, 17 patients (35.42%) were smokers, while 31 patients (64.58%) were non-smokers, indicating that the majority of patients were non-smokers.

Distribution of Respiratory Complaints Among Post-Tuberculosis Bronchiectasis Patients
Among the 48 patients with post-tuberculosis bronchiectasis, respiratory complaints were assessed. Dyspnea was present in 39 patients (81.25%), while 9 patients (18.75%) did not report shortness of breath. Regarding cough, 31 patients (64.58%) had expectoration, 7 patients (14.58%) had a dry cough, 5 patients (10.42%) experienced hemoptysis, and 5 patients (10.42%) did not have any cough. Chest pain was reported by 22 patients (45.83%), whereas 26 patients (54.17%) did not report chest pain. (As shown in Table-4).

Respiratory Complaints	No of cases	Percentage
Dyspnea		
Yes	39	81.25%
No	9	18.75%
Cough		
Dry	7	14.58%
Expectoration	31	64.58%
Hemoptysis	5	10.42%
No	5	10.42%
Chest pain		
Yes	22	45.83%
No	26	54.17%

Duration Since Completion of Anti-Tuberculosis Treatment
The duration since completion of anti-tuberculosis treatment was assessed in 48 patients with post-tuberculosis bronchiectasis. Most patients, 29 (60.42%), had completed treatment within 1–10 years, 15 patients (31.25%) within 11–20 years, 3 patients (6.25%) within 21–30 years, and 1 patient (2.08%) within 31–40 years. The mean duration since treatment was 11.65 ± 8.21 years.

Distribution of Lung Involvement

Lung involvement	No of cases	Percentage
Bilateral	40	83.33%
Unilateral	8	16.67%
Total	48	100.00%

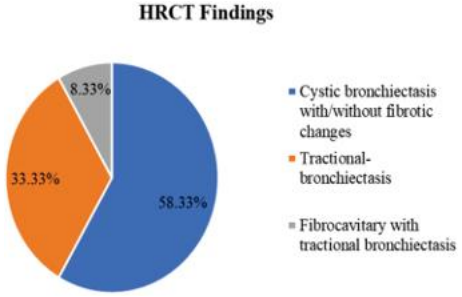
Lobar Distribution of Bronchiectasis and Fibrosis

Lobar Distribution of Bronchiectasis and Fibrosis	Right Lung		Left lung	
	No of cases	Percentage	No of cases	Percentage
BXIS				
All lobe	10	20.83%	14	29.17%
Lower	4	8.33%	5	10.42%
Middle	1	2.08%	0	0.00%
Upper	18	37.50%	21	43.75%
Middle and lower	5	10.42%	0	0.00%
Upper and lower	5	10.42%	1	2.08%
Upper and middle	3	6.25%	0	0.00%
No	2	4.17%	7	14.58%
Fibrosis				
Yes	43	89.58%	40	83.33%
No	5	10.42%	8	16.67%

The radiological distribution of bronchiectasis and fibrosis in the lungs was evaluated in 48 post-tuberculosis bronchiectasis patients. On the right lung, bronchiectasis involved all lobes in 10 patients (20.83%), the upper lobe in 18 patients (37.50%), the lower lobe in 4 patients (8.33%), the middle lobe in 1 patient (2.08%), middle and lower lobes in 5 patients (10.42%), upper and lower lobes in 5 patients (10.42%), upper and middle lobes in 3 patients (6.25%), and was absent in 2 patients (4.17%). On the left lung, bronchiectasis affected all lobes in 14 patients (29.17%), the upper lobe in 21 patients (43.75%), the lower lobe in 5 patients (10.42%), upper and lower lobes in 1 patient (2.08%), and was absent in 7 patients (14.58%). Fibrotic changes were present in 43 patients (89.58%) on the right lung and 40 patients (83.33%) on the left lung.

High-Resolution CT Findings

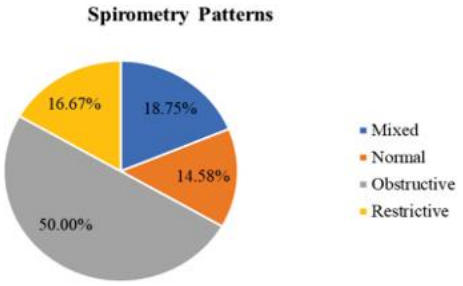
HRCT Findings	No of Cases	Percentage
Cystic bronchiectasis with/without fibrotic changes	28	58.33%
Tractional-bronchiectasis	16	33.33%
Fibro cavitary with tractional bronchiectasis	4	8.33%
Total	48	100.00%



High-resolution CT (HRCT) findings were analysed in 48 patients with post-tuberculosis bronchiectasis. Cystic bronchiectasis with or without associated fibrotic changes was the most common pattern, observed in 28 patients (58.33%). Tractional bronchiectasis was seen in 16 patients (33.33%), while fibrocavitary changes with tractional bronchiectasis were noted in 4 patients (8.33%).

Spirometry Patterns

Spirometry Pattern	No of Cases	Percentage
Mixed	9	18.75%
Normal	7	14.58%
Obstructive	24	50.00%
Restrictive	8	16.67%
Total	48	100.00%

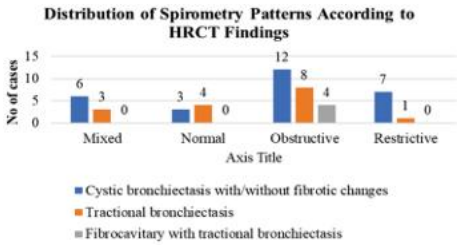


Spirometry patterns were assessed in 48 patients with post-tuberculosis bronchiectasis. Obstructive pattern was observed in 24 patients (50.00%), mixed pattern in 9 patients (18.75%), restrictive pattern in 8 patients (16.67%), and normal spirometry was seen in 7 patients (14.58%)

Spirometry Patterns According to Duration Post Anti-Tuberculosis Treatment

The relationship between the duration since completion of anti-tuberculosis treatment and spirometry patterns was analyzed in 48 patients with post-tuberculosis bronchiectasis. Among those treated 1–10 years ago, 16 patients showed an obstructive pattern, 6 had mixed, 4 had normal, and 3 had restrictive spirometry. In the 11–20 years group, 8 patients had obstructive, 1 had mixed, 2 had normal, and 4 had restrictive patterns. For patients treated 21–30 years ago, 1 patient each showed mixed, normal, and restrictive patterns, while none had obstructive changes. In the 31–40 years group, 1 patient had a mixed pattern, with no obstructive or restrictive patterns reported.

Distribution of Spirometry Patterns According to HRCT Findings



High-resolution CT (HRCT) findings were correlated with spirometry patterns in 48 patients with post-tuberculosis bronchiectasis. Among patients with cystic bronchiectasis with or without fibrotic changes (n = 28), obstructive pattern was most common (12 patients), followed by restrictive (7), mixed (6), and normal spirometry (3). In patients with tractional bronchiectasis (n = 16), obstructive pattern predominated (8 patients), followed by normal (4), mixed (3), and restrictive pattern (1). All patients with fibrocavitary changes with tractional bronchiectasis (n = 4) showed an obstructive spirometry pattern. Overall, obstructive pattern was the most frequent spirometric abnormality observed (24 patients), followed by mixed (9), restrictive (8), and normal patterns (7).

HRCT Findings	Mixed	Normal	Obstructive	Restrictive	Total
Cystic bronchiectasis with/without fibrotic changes	6	3	12	7	28
Tractional bronchiectasis	3	4	8	1	16
Fibro cavitary with tractional bronchiectasis	0	0	4	0	4
Total	9	7	24	8	48

Spirometry Patterns According to Smoking Status in Post-Tuberculosis Bronchiectasis Patients

Spirometry Patterns	Smoker		Non smoker	
	No of Cases	Percentage	No of Cases	Percentage
Mixed	3	17.65%	6	19.35%
Normal	3	17.65%	4	12.90%
Obstructive	10	58.82%	14	45.16%
Restrictive	1	5.88%	7	22.58%
Total	17	100.00%	31	100.00%

HRCT Findings	GOLD							
	0		3		4		Total	
	N	%	N	%	N	%	N	%
Cystic bronchiectasis ± fibrotic changes	10	20.83%	5	10.42%	13	27.08%	28	58.33%
Tractional bronchiectasis	5	10.42%	6	12.50%	5	10.42%	16	33.33%
Fibrocavitary with tractional bronchiectasis	0	0.00%	1	2.08%	3	6.25%	4	8.33%
Total	15	31.25%	12	25.00%	21	43.75%	48	100.00%

Distribution of HRCT Findings According to GOLD Score in Post-Tuberculosis Bronchiectasis Patients

The distribution of HRCT findings according to GOLD scores was assessed in 48 patients with post-tuberculosis bronchiectasis. Cystic bronchiectasis with or without fibrotic changes (n = 28) was most frequently associated with GOLD score 4 (27.08%), followed by GOLD score 0 (20.83%) and GOLD score 3 (10.42%). Tractional bronchiectasis (n = 16) showed a relatively uniform distribution across GOLD 0 (10.42%), GOLD 3 (12.50%), and GOLD 4 (10.42%). Fibrocavitary changes with tractional bronchiectasis (n = 4) were predominantly seen in patients with GOLD score 4 (6.25%), indicating more severe airflow limitation in this subgroup.

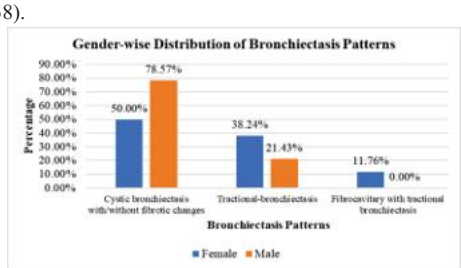
Comparison of Post-Bronchodilator Spirometry Parameters between Smokers and Non-Smokers in Post-Tuberculosis Bronchiectasis Patients

Post bronchodilator Spirometry parameters	Smoker	Non Smoker	t-test	P-value
	Mean ± SD	Mean ± SD		
FEV1%	1.20 ± 0.45	0.99 ± 0.30	-1.94	0.059
FVC	1.89 ± 0.55	1.49 ± 0.53	-2.47	0.017
FEV1/FVC	37.97 ± 34.40	51.15 ± 32.89	1.31	0.20

Post-bronchodilator spirometry parameters were compared between smokers and non-smokers among 48 patients with post-tuberculosis bronchiectasis. The mean FEV_1% was slightly higher in smokers (1.20 ± 0.45) than non-smokers (0.99 ± 0.30), approaching statistical significance (p = 0.059). Forced vital capacity (FVC) was significantly higher in smokers (1.89 ± 0.55) compared to non-smokers (1.49 ± 0.53; p = 0.017). The FEV_1/FVC ratio did not differ significantly between smokers (37.97 ± 34.40) and non-smokers (51.15 ± 32.89; p = 0.20).

Age-wise Distribution of Bronchiectasis Patterns in Post-Tuberculosis Bronchiectasis Patients

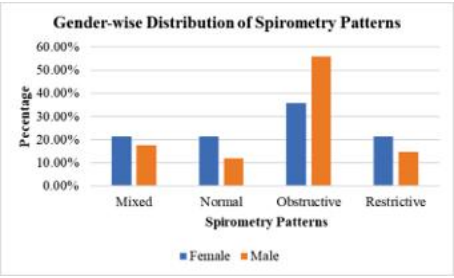
An analysis was performed to determine the age-wise distribution of bronchiectasis patterns among 48 post-tuberculosis bronchiectasis patients. In the 18–40 years age group, cystic bronchiectasis with or without fibrotic changes was observed in 5 patients (17.86%), while fibrocavitary with tractional bronchiectasis was seen in 1 patient (25.00%). Among patients aged 40–60 years, cystic bronchiectasis was the most common pattern, seen in 13 patients (46.43%), followed by tractional bronchiectasis in 8 patients (50.00%). In patients older than 60 years, cystic bronchiectasis was noted in 10 patients (35.71%), tractional bronchiectasis in 8 patients (50.00%), and fibrocavitary with tractional bronchiectasis in 2 patients (50.00%). The association between age and bronchiectasis pattern was not statistically significant (p = 0.38).



Age-wise Distribution of Spirometry Patterns in Post-Tuberculosis Bronchiectasis Patients

An age-wise assessment of spirometry patterns was conducted among

48 post-tuberculosis bronchiectasis patients. In the 18–40 years age group, only the obstructive pattern was observed in 6 patients (25.00%), while no mixed, normal, or restrictive patterns were noted. Among patients aged 40–60 years, the obstructive pattern was seen in 9 patients (37.50%), restrictive in 6 patients (75.00%), normal in 5 patients (71.43%), and mixed in 2 patients (22.22%). In patients older than 60 years, the mixed pattern predominated, seen in 7 patients (77.78%), while obstructive was observed in 9 patients (37.50%), normal in 2 patients (28.57%), and restrictive in 2 patients (25.00%). Overall, the distribution of spirometry patterns significantly differed across age groups (p = 0.033), with mixed patterns more common in older patients and obstructive patterns appearing in all age groups



Association of Smoking Status with Bronchiectasis Pattern and Spirometry Findings in Post-Tuberculosis Bronchiectasis Patients

Bronchiectasis						
Type of spirometry	Cystic bronchiectasis with/without fibrotic changes		Tractional-bronchiectasis		Fibrocavitary with tractional bronchiectasis	
	N	%	N	%	N	%
Non-Smoking						
mixed	5	17.86%	1	6.25%	0	0.00%
normal	2	7.14%	2	12.50%	0	0.00%
obstructive	8	28.57%	2	12.50%	4	100.00%
restrictive	7	25.00%	0	0.00%	0	0.00%
Total	22	78.57%	5	31.25%	4	100.00%
Smoking						
mixed	1	3.57%	2	12.50%	0	0.00%
normal	1	3.57%	2	12.50%	0	0.00%
obstructive	4	14.29%	6	37.50%	0	0.00%
restrictive	0	0.00%	1	6.25%	0	0.00%
Total	6	21.43%	11	68.75%	0	0.00%
Grand Total	28	100.00%	16	100.00%	4	100.00%

An association between smoking status, bronchiectasis pattern, and spirometry type was evaluated among post-tuberculosis bronchiectasis patients. In non-smokers, cystic bronchiectasis with or without fibrotic changes was most commonly associated with obstructive spirometry in 8 patients (28.57%), followed by restrictive pattern in 7 patients (25.00%). Tractional bronchiectasis among non-smokers was mainly associated with mixed and normal patterns, while all patients with fibro cavitary bronchiectasis showed an obstructive pattern. Among smokers, tractional bronchiectasis was predominantly associated with obstructive spirometry in 6 patients (37.50%), whereas cystic bronchiectasis showed fewer spirometric abnormalities. Overall, obstructive spirometry was the most frequent pattern across both smokers and non-smokers, particularly in patients with tractional and fibro cavitary bronchiectasis.

DISCUSSION

The present study evaluated the clinical, radiological, and spirometric profile of patients with post-tuberculosis bronchiectasis in a tertiary care setting in Central India. The findings highlight the substantial burden of post-tuberculosis lung disease (PTLD) and its long-term functional consequences.

In this study, the majority of patients were middle-aged and elderly, with a mean age of 57.94 years and a clear male predominance. This observation is consistent with previous studies, which suggest that cumulative exposure to risk factors such as smoking, biomass fuel exposure, and delayed tuberculosis diagnosis contributes to progressive lung damage over time.

Dyspnea was the most common presenting symptom, followed by productive cough. These findings reflect the chronic and progressive nature of airway involvement in post-tuberculosis bronchiectasis. The relatively lower proportion of hemoptysis compared to classical bronchiectasis may be attributed to the predominance of fibrotic and tractional changes in this cohort.

Radiologically, the majority of patients demonstrated bilateral lung involvement, with a predominance of upper lobe disease. This distribution correlates with the typical predilection of pulmonary tuberculosis for the upper lobes. Cystic bronchiectasis was the most common HRCT pattern observed, indicating advanced and irreversible airway damage. The high prevalence of associated fibrosis further emphasizes the role of post-infectious remodelling in disease progression.

Spirometric evaluation revealed that obstructive ventilatory defect was the most common pattern, observed in 50% of patients. This supports the growing recognition of tuberculosis as an independent risk factor for chronic airflow limitation, even in non-smokers. Notably, a significant proportion of patients in the present study were non-smokers, yet demonstrated airflow obstruction, highlighting the direct contribution of prior tuberculosis to airway disease.

The presence of mixed and restrictive patterns in a subset of patients reflects the combined effects of airway obstruction and parenchymal fibrosis. These findings underscore the heterogeneity of PTLD and the importance of comprehensive functional assessment.

Overall, the study reinforces that microbiological cure of tuberculosis does not equate to restoration of normal lung function. Persistent structural abnormalities and functional impairment contribute significantly to long-term morbidity. These findings support the need for structured post-tuberculosis follow-up, including spirometry and radiological assessment, to enable early identification and management of complications.

Limitations of the Study

- The study was conducted at a single tertiary care centre, which may limit generalizability to the wider population.
- The sample size was relatively small, which may affect the statistical strength of the findings.
- Being a cross-sectional study, causal relationships between variables could not be established.
- Long-term follow-up data were not available to assess disease progression and outcomes.
- Advanced parameters such as diffusing capacity (DLCO) and exercise capacity were not evaluated.

CONCLUSION

Post-tuberculosis bronchiectasis represents a significant cause of chronic respiratory morbidity in TB-endemic regions. The disease is characterized by persistent symptoms, extensive radiological abnormalities, and predominant obstructive ventilatory defects. The findings of the present study highlight that tuberculosis can lead to long-term airway and parenchymal damage, even in non-smokers, thereby acting as an independent risk factor for chronic lung disease. Early recognition, regular follow-up, and integration of post-tuberculosis care into routine clinical practice are essential to reduce disease burden and improve patient outcomes.

Conflicts of Interest

Regarding the research, writing, and/or publication of this article, the authors stated that they had no any potential conflicts of interest.

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Ethical Approval

The study was approved by the Institutional Ethics Committee.

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