e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(8); 1946-1954

Original Research Article

The Role of Fibreoptic Bronchoscopy in Smear-Negative Cases of Pulmonary Tuberculosis

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Received: 01-05-2026 / Revised: 15-06-2026 / Accepted: 21-07-2026
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Conflict of interest: Nil

Abstract

Background: Pulmonary Tuberculosis is a highly infectious disease and the diagnosis is mainly based on the clinical features of cough more than 2 weeks with 4 symptom complex comprising fever, night sweats, weight loss and loss of appetite. In a case of presumptive Pulmonary TB, diagnosis is confirmed by sputum microscopy. However in many paucibacillary cases or in absence of proper sampling, diagnosis gets difficult and smear microscopy may be negative. In such cases, there is a pivotal role of Fibreoptic bronchoscopy (FOB).

Aim: To study the role of Fibreoptic Bronchoscopy in smear negative cases of pulmonary tuberculosis or are unable to expectorate sputum but having clinical and radiological features highly suggestive of pulmonary tuberculosis and the simultaneous detection of Rifampicin resistance.

Materials and Methods: This study is a hospital-based prospective observational study conducted at Gauhati Medical College & Hospital. Ethical committee approval was obtained from the Gauhati Medical College Ethical Committee prior to the commencement of the study. Data were entered into a structured dataset and analyzed using appropriate statistical software. Descriptive statistics were used to summarize baseline characteristics. The chi-square test was employed for categorical data analysis. Sensitivity, specificity, PPV, and NPV were calculated to determine the diagnostic accuracy of different tests.

Results: The study included 195 patients with smear-negative pulmonary tuberculosis. The mean age of the cohort was 42.09 ± 13.06 years and a male predominance in smear-negative pulmonary tuberculosis cases was found. Among the patients assessed, cough was the most frequently reported symptom, present in 152 patients (77.9%), followed by fever in 120 patients (61.5%). Hemoptysis was observed in 88 patients (45.1%), while weight loss was reported in 60 patients (30.8%). Breathlessness was the least common symptom, noted in 45 patients (23.1%). Radiological findings highlighted the superiority of HRCT-thorax over chest X-ray in detecting pulmonary abnormalities. The diagnostic accuracy of BAL Fluid AFB in sputum smear-negative PTB was assessed using BAL-AFB Culture as the gold standard. The sensitivity was found to be 61.11% (95% CI: 51.04–71.18), indicating that BAL Fluid AFB detected approximately 61% of true PTB cases. The specificity was 100%, suggesting no false positives were identified in this cohort. The sensitivity of BAL Fluid CBNAAT was 80.00% (95% CI: 71.74– 88.26), indicating a high ability to detect true positive cases. The specificity was 98.80% (95% CI: 96.45–100), suggesting a very low false-positive rate. The positive predictive value (PPV) was 98.63% (95% CI: 95.96–100), meaning nearly all positive BAL Fluid CBNAAT results corresponded to true positive cases. The analysis of Rifampicin sensitivity and resistance in the dataset reveals that out of 96 total cases, 83 (86.5%) were Rifampicin-sensitive, while 13 (13.5%) were Rifampicin resistant.

Conclusion: Fibreoptic bronchoscopy (FOB) has become an essential diagnostic tool in modern Pulmonology. The findings of this study reaffirm the significant role of FOB in diagnosing smear-negative pulmonary tuberculosis. The use of BAL fluid for AFB smear and CBNAAT significantly improved diagnostic yield. The study also highlights the concerning prevalence of Rifampicin resistance, necessitating the need for drug susceptibility testing in all suspected tuberculosis cases.

Keywords: Fibreoptic Bronchoscopy, Pulmonary Tuberculosis (PTB), Sputum smear negative, Bronchoalveolar lavage.

DOI: 10.25258/ijcpr.18.8.287

Introduction

Tuberculosis remains one of the deadliest infectious diseases, particularly in low- and middle-income countries. According to the World Health Organization (WHO), approximately 10.6 million people were diagnosed with TB in 2021, leading to around 1.6 million deaths (1). PTB symptoms vary depending on disease progression. Common pulmonary manifestations include a persistent cough lasting more than two weeks, hemoptysis, pleuritic chest pain, and shortness of breath in progressive disease. Systemic symptoms such as fever, night sweats, weight loss, loss of appetite, and fatigue are hallmark indicators of active TB. The disease progresses through primary infection, latent infection, and possible reactivation in individuals with compromised immunity. In advanced cases, lung tissue destruction, cavitary lesions, and bronchogenic spread contribute to transmission and complications [2].

Diagnosis of PTB relies on microbiological, radiological, and immunological tests. Sputum smear microscopy, though widely used, has limited sensitivity. Culture methods such as Lowenstein-Jensen media and Mycobacteria Growth Indicator Tubes (MGIT) are more accurate but take weeks to yield results [3].

Molecular diagnostics, particularly GeneXpert MTB/RIF, have improved rapid detection and rifampicin resistance identification. Imaging techniques, including chest X-rays and computed tomography (CT) scans, aid diagnosis and help assess disease progression. Tests like the tuberculin skin test (TST) and interferon-gamma release assays (IGRA) identify latent TB but do not distinguish it from active disease [4].

Fibreoptic bronchoscopy (FOB) has proven to be a highly effective method for diagnosing active pulmonary tuberculosis (PTB) in patients whose sputum smears test negative. In a study conducted on 126 patients suspected of having PTB but with negative sputum acid-fast bacilli (AFB) smears, FOB demonstrated a sensitivity of approximately 76% and a specificity close to 97%.

The procedure also showed a strong positive predictive value of about 95% and a negative predictive value around 84%, highlighting its usefulness in rapid TB diagnosis. Notably, when FOB was used alongside high-resolution computed tomography (HRCT), diagnostic performance improved significantly, with sensitivity increasing to more than 96% and a similar rise in negative predictive value [5]. Further supporting the effectiveness of FOB, another investigation evaluated the use of the Xpert® MTB/RIF assay on samples collected through bronchoscopy in patients who were either smear-negative or unable to produce sputum. This molecular test showed a diagnostic sensitivity of 80% and a specificity of 100% when compared with culture results, demonstrating a substantial advantage over traditional smear microscopy, which had a much lower sensitivity of only 25%, despite maintaining perfect specificity [6].

In related research, bronchoalveolar lavage (BAL) samples obtained during bronchoscopy were examined using the GeneXpert platform. The findings indicated a sensitivity of about 81% and a specificity of roughly 95%, supporting the use of this method in diagnosing PTB in patients with negative sputum smears. The cumulative diagnostic yield of various bronchoscopy-based techniques was estimated to be close to 16% [7].

Altogether, these results illustrate the significant role that FOB can play in diagnosing PTB when initial sputum smear tests are inconclusive. The integration of molecular diagnostic tools such as the Xpert® MTB/RIF assay further enhances the accuracy and speed of diagnosis, offering a reliable approach to managing and confirming tuberculosis in challenging clinical cases [6].

Multidrug resistant -TB, resistant to rifampicin and isoniazid, requires longer and more complex treatment involving second-line drugs like bedaquiline and linezolid. XDR-TB, which includes resistance to fluoroquinolones and injectable drugs, presents an even greater therapeutic challenge [8].

Aims and Objectives: To study the role of Fibreoptic Bronchoscopy in smear negative cases of pulmonary tuberculosis or are unable to expectorate sputum but having clinical and radiological features highly suggestive of pulmonary tuberculosis and the simultaneous detection of Rifampicin resistance

Materials and Methods

This study is a hospital-based prospective observational study conducted at Gauhati Medical College & Hospital. Ethical committee approval was obtained from the Gauhati Medical College Ethical Committee prior to the commencement of the study. The study was carried out in the Department of Pulmonary Medicine at Gauhati Medical College, Guwahati, which serves as a tertiary care center for patients from Assam and neighboring North-Eastern states and data collected for a period of one year.

Sample Size Determination:

The sample size was determined using the following statistical formula:

n = {z^2 * p * (1-p)} / d^2

Where:

- n = required sample size
- z = standard normal variate (1.96 for a 95% confidence interval)
- p = expected prevalence of smear-negative pulmonary tuberculosis (assumed based on previous literature)
- d = precision level

Based on this calculation, the required sample size was determined to be 195 patients.

Statistical Analysis: Data were entered into a structured dataset and analyzed using appropriate statistical software. Descriptive statistics were used to summarize baseline characteristics.

The chi-square test was employed for categorical data analysis. Sensitivity, specificity, PPV, and NPV were calculated to determine the diagnostic accuracy of different tests.

Results

The study included 195 patients with smear-negative pulmonary tuberculosis. The mean age of the cohort was 42.09 ± 13.06 years, ranging from 19 to 83 years. The highest proportion of patients belonged to the 31–40 years age group (32.3%), followed by the 41–50 years group (25.6%), indicating a predominance of middle-aged individuals. Younger individuals (11–20 years) constituted only 0.5% of the study population.

A chi-square test for uniform distribution of age groups was statistically significant ($\chi^2 = 99.34$, $p < 0.001$), suggesting a non-random distribution with a higher burden of disease among middle-aged individuals. These findings highlight that smear-negative pulmonary TB is more prevalent in the productive age group, necessitating targeted screening and early diagnostic interventions.

Table 1: Age Group Distribution of patients

Age Group	Count	Percentage
14-20	1	0.512821
21-30	32	16.41026
31-40	63	32.30769
41-50	50	25.64103
51-60	26	13.33333
61-70	16	8.205128
71-80	5	2.564103
81-90	2	1.025641
Total	195	100
Chi-square	99.33988	
p-value	<0.0001	

The study included 195 patients, of whom 121 (62.1%) were male and 74 (37.9%) were female. This indicates a male predominance in smear-negative pulmonary tuberculosis cases. A chi-square test for uniformity showed a statistically significant difference ($\chi^2 = 7.12$, $p = 0.0076$), suggesting that the distribution of tuberculosis cases is not equal between sexes, with males being more affected as seen in this study.

Table 2: Sex Distribution of patients

Sex	Count	Percentage
Male	121	62.05128
Female	74	37.94872
Total	195	100
Chi-square & p-value	7.1238	0.0076

Among the 195 patients assessed, cough was the most frequently reported symptom, present in 152 patients (77.9%), followed by fever in 120 patients (61.5%). Hemoptysis was observed in 88 patients (45.1%), while weight loss was reported in 60 patients (30.8%). Breathlessness was the least common symptom, noted in 45 patients (23.1%). These findings indicate that respiratory symptoms such as cough and fever are predominant in the study population, whereas systemic manifestations like weight loss and breathlessness are less frequent.

Table 3: Symptom Frequency in Study Population

Symptom	Present	Absent	Total
Cough	152 (77.9%)	43 (22.1%)	195
Hemoptysis	88 (45.1%)	107 (54.9%)	195
Fever	120 (61.5%)	75 (38.5%)	195
Weight Loss	60 (30.8%)	135 (69.2%)	195
Breathlessness	45 (23.1%)	150 (76.9%)	195

Among the 195 patients assessed, consolidation was the most common radiological finding, observed in 39 patients (20.00%) on chest X-ray and 49 patients (25.13%) on HRCT-thorax.

Fibrobronchiectatic changes were noted in 20 patients (10.26%) on chest X-ray and significantly higher in 50 patients (25.64%) on HRCT. Pulmonary infiltrates were seen in 28 patients (14.36%) on chest X-ray but in only 14 patients (7.18%) on HRCT.

Nodular opacities were detected in 4 patients (2.05%) on chest X-ray, whereas HRCT identified them in 23 patients (11.79%), highlighting the superior sensitivity of HRCT for detecting smaller lesions. Ground glassing and miliary shadows were infrequent, with 5 patients (2.56%) and 2 patients (1.03%) showing these findings on chest X-ray, compared to 23 patients (11.79%) and 3 patients (1.54%) on HRCT, respectively. Notably, 32 patients (16.41%) had normal chest X-rays, whereas none had normal findings on HRCT, further emphasizing its diagnostic superiority. Other findings were present in 6 patients (3.08%) on chest Xray and 11 patients (5.64%) on HRCT. These results indicate that HRCT-thorax is more sensitive than chest Xray in detecting a wider range of pulmonary abnormalities.

Table 4: Radiographic patterns of the patients

Radiological Findings	Chest X ray Number	Chest X-ray Percentage (%)	HRCT- thorax Number	HRCT-thorax Percentage (%)
Cavitation	21	10.77	21	10.77
Consolidation	39	20	49	25.13
Nodular opacities	4	2.05	23	11.79
Pulmonary infiltrates	28	14.36	14	7.18
Fibrobronchiectatic changes	20	10.26	50	25.64
Ground glassing	5	2.56	23	11.79
Miliary shadows	2	1.03	3	1.54
Normal finding	32	16.41	0	0
Others	6	3.08	11	5.64

The diagnostic accuracy of BAL Fluid AFB in sputum smear-negative PTB was assessed using BAL-AFB Culture as the gold standard. The sensitivity was found to be 61.11% (95% CI: 51.04–71.18), indicating that BAL Fluid AFB detected approximately 61% of true PTB cases. The specificity was 100%, suggesting no false positives were identified in this cohort. The positive predictive value (PPV) was also 100%, confirming that all patients testing positive on BAL Fluid AFB were truly positive according to the culture results.

The negative predictive value (NPV) was 70.34% (95% CI: 62.10–78.58), meaning that among those testing negative, around 70% were truly negative. These findings suggest that while BAL Fluid AFB has high specificity and PPV, its moderate sensitivity indicates that it may miss some true cases, reinforcing the importance of additional diagnostic tools in sputum smear-negative PTB cases. The diagnostic accuracy of BAL Fluid CBNAAT in sputum smear-negative PTB was also evaluated using BAL-AFB Culture (with NTM considered positive) as the gold standard. The sensitivity of BAL Fluid CBNAAT was 80.00% (95% CI: 71.74– 88.26), indicating a high ability to detect true positive cases. The specificity was 98.80% (95% CI: 96.45–100), suggesting a very low false-positive rate.

The positive predictive value (PPV) was 98.63% (95% CI: 95.96–100), meaning nearly all positive BAL Fluid CBNAAT results corresponded to true positive cases. The negative predictive value (NPV) was 82.00% (95% CI: 74.47– 89.53), showing that among negative cases, 82% were truly negative. These findings demonstrate that BAL Fluid CBNAAT has high sensitivity and excellent specificity, making it a highly reliable diagnostic tool for detecting PTB in sputum smear-negative cases.

Table 5: Diagnostic accuracy of BAL Fluid AFB and CBNAAT in sputum smear negative PTB

Test on BALF	Metric	Estimate (%)	95% CI (Lower)	95% CI (Upper)
AFB smear	Sensitivity	61.11	51.04	71.18
	Specificity	100		
	PPV	100		
	NPV	70.34	62.1	78.58
CBNAAT	Sensitivity	80	71.74	88.26
	Specificity	98.8	96.45	101.14
	PPV	98.63	95.96	101.3
	NPV	82	74.47	89.53

The analysis of Rifampicin sensitivity and resistance in the dataset reveals that out of 96 total cases, 83 (86.5%) were Rifampicin-sensitive, while 13 (13.5%) were Rifampicin resistant. This indicates that the majority of cases remain susceptible to Rifampicin, a key first-line anti-tubercular drug. However, the presence of 13 resistant cases (13.5%) highlights a significant concern regarding drug resistance, which could impact treatment outcomes.

Table 6: Distribution of Rifampicin Sensitivity and Resistance

Category	Number of Cases	Percentage
Rif-Sensitive	83	86.5
Rif-Resistant	13	13.5
Total	96	100

Discussion

Fibreoptic bronchoscopy (FOB) has become an essential diagnostic tool in modern pulmonology, particularly for cases of pulmonary tuberculosis (PTB) that are smear-negative [5]. While smear microscopy remains a fundamental diagnostic approach, its sensitivity can be limited, especially in patients with low bacterial loads. In such cases, fibreoptic bronchoscopy plays a crucial role in enhancing diagnostic accuracy, improving patient outcomes, and facilitating appropriate management strategies [9]. This technique increases the chances of detecting MTB, as it allows sampling from areas that may not be adequately represented in expectorated sputum. Studies have shown that bronchial lavage samples have a higher yield of MTB DNA, even in smear negative cases, thus providing a more definitive diagnosis [10]. Additionally, the advantage of fibreoptic bronchoscopy lies in its ability to perform real-time imaging, which allows physicians to identify any potential anatomical abnormalities, such as lesions, obstructive endobronchial tuberculosis, or airway stenosis, which may be indicative of a tuberculous infection. Mycobacterial culture remains the gold standard for diagnosing tuberculosis, although it can take several weeks to yield results. More recently, molecular diagnostic tools such as PCR (polymerase chain reaction) have become available to detect MTB directly from bronchoalveolar lavage fluid. These tests, such as the GeneXpert MTB/RIF assay, offer the additional benefit of detecting drug resistance, particularly to rifampicin, in a relatively short turnaround time. This can significantly influence the management of drug-resistant tuberculosis, a growing concern globally [11]

Despite its advantages, fibreoptic bronchoscopy in smear-negative PTB cases comes with certain limitations and challenges. The procedure is invasive, and there is a risk of complications, including bleeding, pneumothorax, or infection, especially in patients with advanced tuberculosis and compromised pulmonary function. Additionally, while bronchoscopy increases the yield of MTB detection, it is not always definitive, and in some cases, the results may still be negative. Moreover, bronchoscopy requires skilled personnel and specialized equipment, which may not be readily available in all healthcare settings [12]

In comparing the age group distribution of patients in our study to a study on the role of fibreoptic bronchoscopy in smear-negative pulmonary tuberculosis (PTB), both reveal significant findings regarding the demographics of affected populations. In our study, the most common age groups affected by the disease were between 31 and 40 years (32.31%) and 41 to 50 years (25.64%), indicating a relatively high incidence of the disease in middle-aged adults. This contrasts with the findings of other studies, where PTB cases were more commonly seen in older age groups, with fibreoptic bronchoscopy being used particularly in those with complicated or smear-negative PTB presentations, often in individuals with chronic symptoms or previous tuberculosis history. Choudhary S et al. (2015) study on fibreoptic bronchoscopy highlighted its effectiveness in diagnosing PTB in patients of various age groups, especially where sputum samples were negative. These findings underscore the utility of advanced

diagnostic techniques in improving detection rates in different demographic groups, despite differences in the age distribution of tuberculosis Cases [13)]

In comparing the symptom frequency of pulmonary tuberculosis patients in our study with those in studies focused on the role of fiberoptic bronchoscopy in smear-negative tuberculosis cases, there are notable similarities and differences. In our study, the most common symptoms were cough (77.9%), fever (61.5%), and hemoptysis (45.1%), followed by weight loss (30.8%) and breathlessness (23.1%). These findings reflect the typical clinical presentation of pulmonary tuberculosis, with cough and fever being the hallmark symptoms. The relatively high prevalence of cough and fever in smear-positive patients aligns with findings from studies on smearnegative cases, where these symptoms are often present but may not lead to a definitive diagnosis without advanced diagnostic methods like fiberoptic bronchoscopy. In studies by Zaidi, I et al. (2024), similar symptom patterns were observed, with cough and fever being prominent in smear-negative tuberculosis patients. However, the diagnostic challenge in these cases often lies in the absence of positive sputum smears, which is why bronchoscopy becomes a crucial tool in identifying the disease. This underscores the importance of advanced diagnostic methods in patients presenting with these common symptoms but negative smears [14] .

In comparing the radiographic findings from our study with those observed in studies on the role of fiberoptic bronchoscopy in smear-negative pulmonary tuberculosis, key similarities and differences emerge. In our study, chest X-rays showed common findings like consolidation (20%), pulmonary infiltrates (14.36%), and fibrobronchiectatic changes (10.26%). However, HRCT-thorax revealed more detailed findings, including higher percentages of fibrobronchiectatic changes (25.64%), nodular opacities (11.79%), and ground-glass opacities (11.79%). Similarly, Natarajan A et al. (2020) studies on smear-negative cases using fiberoptic bronchoscopy report radiological findings such as consolidation, nodular opacities, and ground-glass opacities, though these features are often less pronounced. HRCT is found to be more sensitive in detecting these subtle changes, which are frequently missed on chest X-rays. Moreover, fiberoptic bronchoscopy provides critical diagnostic value in smear-negative cases by enabling direct visualization of the lungs and tissue sampling. This approach is vital for diagnosing tuberculosis in cases where conventional radiographic findings are ambiguous, thus aiding in confirming the disease when standard methods are inconclusive [15].

Our study states that BAL Fluid AFB is a highly specific diagnostic tool for sputum smear-negative pulmonary tuberculosis, with a specificity and positive predictive value of 100%. However, its moderate sensitivity (61.11%) and negative predictive value (70.34%) indicate that it may miss a proportion of true TB cases. Therefore, while a positive result is highly reliable, negative results should be interpreted cautiously, emphasizing the need for supplementary diagnostic methods to ensure accurate detection and management of smear-negative PTB. Similarly, Natarajan A et al. (2020) studies on smear-negative cases using fiberoptic bronchoscopy report radiological findings such as consolidation, nodular opacities, and ground-glass opacities, though these features are often less pronounced. HRCT is found to be more sensitive in detecting these subtle changes, which are frequently missed on chest X-rays. Moreover, fiberoptic bronchoscopy provides critical diagnostic value in smear-negative cases by enabling direct visualization of the lungs and tissue sampling. This approach is vital for diagnosing tuberculosis in cases where conventional radiographic findings are ambiguous, thus aiding in confirming the disease when standard methods are inconclusive [15].

In comparing our study's diagnostic accuracy of bronchoalveolar lavage fluid (BALF) AFB smear in smear-negative pulmonary tuberculosis (PTB) with the findings from studies on the role of fiberoptic bronchoscopy in smear-negative cases, several key observations emerge. Our study shows that BALF AFB smear has a sensitivity of 61.11%, specificity of 100%, positive predictive value (PPV) of 100%, and negative predictive value (NPV) of 70.34%. These metrics highlight the high specificity and PPV of the BALF AFB smear, indicating that when the test is positive, it is highly likely to confirm active PTB. However, the sensitivity, though reasonable, suggests that a significant proportion of smear-negative PTB cases may not be detected using this method alone. Other studies focusing on fiberoptic bronchoscopy for smear-negative PTB cases, such as those by Natarajan A et al. (2020), also show promising diagnostic accuracy with techniques like bronchoalveolar lavage (BAL). These studies report similar findings, demonstrating the value of fiberoptic bronchoscopy in increasing the detection of PTB, especially when conventional sputum smears fail to yield results. However, the sensitivity of these methods can vary, and some studies note that while fiberoptic bronchoscopy can improve diagnostic accuracy, it still has limitations in certain smear-negative cases. In both studies, fiberoptic bronchoscopy with BALF AFB smear remains a valuable diagnostic tool, particularly in smear-negative TB, with high specificity and predictive values, but a moderate sensitivity,

suggesting the need for complementary diagnostic strategies [15].

In comparing our study's diagnostic accuracy of CBNAAT on BAL fluid in sputum smear-negative pulmonary tuberculosis (PTB) with other studies on the role of fiberoptic bronchoscopy in similar cases, several important aspects emerge. Our study reports the following metrics for CBNAAT on BAL fluid: sensitivity of 80%, specificity of 98.8%, positive predictive value (PPV) of 98.63%, and negative predictive value (NPV) of 82%. These results underscore the robust performance of CBNAAT in diagnosing smear-negative PTB, with very high specificity and PPV, indicating that when CBNAAT is positive, the diagnosis of active PTB is highly likely. The sensitivity of 80% also highlights that while CBNAAT is highly effective in identifying most cases, there may still be a small proportion of cases that go undetected. In comparison, studies focusing on fiberoptic bronchoscopy, such as those by Rao VG et al. (2018), similarly demonstrate the utility of bronchoalveolar lavage (BAL) and its diagnostic value for smear-negative PTB. These studies report a higher sensitivity in detecting PTB through bronchoscopy, but the performance can vary depending on the method used (e.g., conventional smear, culture, or molecular tests like CBNAAT). Studies have shown that CBNAAT, when used as an adjunct to bronchoscopy, can significantly increase diagnostic yield and improve sensitivity, much like our findings. Both methods, fiberoptic bronchoscopy with CBNAAT and BALF AFB smear, have demonstrated high specificity, making them valuable tools in confirming smear-negative TB. However, CBNAAT shows higher sensitivity and is more efficient, providing a faster and more reliable result for diagnosing PTB in such cases [16].

In comparing the distribution of Rifampicin sensitivity and resistance in our study with other research on the role of fiberoptic bronchoscopy in smear-negative pulmonary tuberculosis (PTB), there are notable insights. In our study, 86.5% of the cases were Rifampicin-sensitive, while 13.5% were Rifampicin-resistant, highlighting a relatively low prevalence of drug-resistant cases in the study population. This finding suggests that the majority of PTB cases in our cohort were susceptible to standard drug regimens, which is consistent with general trends in PTB treatment where Rifampicin resistance remains a significant concern but is still less common in some regions.

Comparatively, studies on smear-negative PTB cases, particularly those involving fiberoptic bronchoscopy, report similar findings of Rifampicin resistance but often emphasize the challenge of detecting resistance in smear-negative or culture-negative cases. Yüksekol I et al. (2003) observed that the use of molecular tests such as CBNAAT on samples collected through fiberoptic bronchoscopy can significantly improve the identification of Rifampicin resistance in PTB cases that are difficult to diagnose through traditional methods. Their study found higher rates of Rifampicin resistance in smear-negative cases, highlighting the utility of advanced diagnostic techniques to detect drug-resistant TB strains that may otherwise be missed. In conclusion, while our study found a relatively low rate of Rifampicin resistance, other studies underscore the importance of improving diagnostic methods, such as fiberoptic bronchoscopy and molecular testing, for more accurate identification of resistance in smear-negative PTB cases [17]

Summary and Conclusion

Summary: The study titled "The Role of Fibreoptic Bronchoscopy in Smear Negative Cases of Pulmonary Tuberculosis" was conducted at Gauhati Medical College and Hospital as a prospective observational study. It aimed to assess the effectiveness of Fibreoptic Bronchoscopy (FOB) in diagnosing smear-negative pulmonary tuberculosis (SN-PTB) and simultaneously detecting Rifampicin resistance.

A total of 195 patients meeting the inclusion criteria were included. The demographic analysis showed that the majority of patients belonged to the middle age groups, with a mean age of 42.09 ± 13.06 years. A male predominance (62.1%) was observed.

The most frequently reported symptoms were cough (77.9%), fever (61.5%), hemoptysis (45.1%), weight loss (30.8%), and breathlessness (23.1%). The study also identified key risk factors, including contact history with tuberculosis patients (90.3%), smoking (70.8%), and previous tuberculosis treatment (67.2%).

Radiological findings highlighted the superiority of HRCT-thorax over chest X-ray in detecting pulmonary abnormalities. While 16.41% of patients had normal chest X-rays, all patients had detectable abnormalities on HRCT. Common radiological patterns included consolidation, fibrobronchiectatic changes, and nodular opacities.

Regarding diagnostic accuracy, BAL fluid AFB smear demonstrated a sensitivity of 61.11% and a specificity of 100%. BAL Fluid CBNAAT had superior diagnostic accuracy, with a sensitivity of 80.00%, specificity of 98.80%, and a positive predictive value (PPV) of 98.63%. These results indicate that BAL Fluid CBNAAT is a highly reliable diagnostic tool for smear-negative pulmonary tuberculosis.

The study also analyzed Rifampicin resistance among 96 patients, revealing that 13.5% were resistant to Rifampicin. This finding underscores the importance of early detection of drug-resistant tuberculosis to prevent treatment failure and further transmission of multidrug-resistant TB (MDR-TB).

Conclusion

The findings of this study reaffirm the significant role of Fibreoptic Bronchoscopy (FOB) in diagnosing smear-negative pulmonary tuberculosis. The use of BAL fluid for AFB smear and CBNAAT significantly improved diagnostic yield. The study also highlights the concerning prevalence of Rifampicin resistance, necessitating the need for drug susceptibility testing in all suspected tuberculosis cases. While chest X-rays remain a commonly used diagnostic tool, the study demonstrated the superior diagnostic capability of HRCT-thorax, particularly in identifying early-stage tuberculosis lesions that might be missed on conventional radiography.

The study emphasizes the necessity of incorporating FOB in suspected SNPTB cases, especially when clinical and radiological findings strongly suggest tuberculosis.

By detecting TB cases earlier, FOB contributes to reducing disease transmission and mitigating the risk of MDR-TB.

Limitations

1. **Single-Center Study**: The study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other regions with different patient demographics and healthcare settings.
2. **Sample Size Constraints**: Although 195 patients were included, a larger sample could provide more robust statistical validation.
3. **Lack of Long-Term Follow-Up**: The study did not assess treatment outcomes or long-term disease progression, which could offer valuable insights into the efficacy of FOB-based diagnosis in patient management.
4. **Potential Selection Bias**: The study included patients who were able to undergo bronchoscopy, potentially excluding individuals with severe contraindications.

Recommendations

1. **Integration of Fibreoptic Bronchoscopy in Diagnostic Algorithms**: Given the study's findings, FOB should be recommended for cases of suspected SN-PTB where routine diagnostic methods fail.
2. **Expansion of CBNAAT for Rapid Diagnosis**: The study highlights the high sensitivity and specificity of CBNAAT, suggesting that wider implementation in suspected TB cases could lead to earlier and more accurate diagnoses.
3. **Routine Rifampicin Resistance Testing**: Due to the notable proportion of Rifampicin-resistant cases, systematic testing should be implemented in all smear-negative TB patients to prevent treatment failures and reduce MDR-TB prevalence.
4. **Multi-Center Studies for Broader Validation**: Future research should involve multiple centers to enhance the generalizability of findings across different populations and healthcare infrastructures.
5. **Longitudinal Studies on Treatment Outcomes**: Future studies should assess the long-term impact of FOB-based diagnosis on treatment efficacy and patient recovery to further establish its role in TB management.

In conclusion, this study underscores the importance of Fibreoptic Bronchoscopy in the early diagnosis of smear-negative pulmonary tuberculosis, aiding in prompt treatment initiation and reducing disease transmission. Further research and policy integration of these findings can improve TB control efforts in high-burden regions.

References:

1. Agbota G, Bonnet M, Lienhardt CJP. Management of tuberculosis infection: current situation, recent developments and operational challenges. 2023;12(3):362.
2. Luies L, Du Preez IJCmr. The echo of pulmonary tuberculosis: mechanisms of clinical symptoms and other disease-induced systemic complications. 2020;33(4):10.1128/cmr. 00036-20.
3. García-Elorriaga G, del Rey-Pineda G. Practical and laboratory diagnosis of tuberculosis: from sputum smear to molecular biology: Springer; 2015.
4. Etim NG, Mirabeau TY, Olorode OA, Nwodo MU, Izah SCJEG. Current Diagnostics Tools of Tuberculosis: Challenges and Opportunities. 2023;3:1059.
5. Shin JA, Chang YS, Kim TH, Kim HJ, Ahn CM, Byun MKJBid. Fiberoptic bronchoscopy for the rapid diagnosis of smear-negative pulmonary tuberculosis. BMC infectious diseases. 2012 Dec;12:1-7.
6. Le Palud P, Cattoir V, Malbruny B, Magnier R, Campbell K, Oulkhouir Y, et al. Retrospective observational study of diagnostic accuracy of the Xpert® MTB/RIF assay on fiberoptic bronchoscopy sampling for early diagnosis of smear-negative or sputum-scarce patients with suspected tuberculosis. 2014;14:1-7.
7. Rakha MA, Ali A, Hassan W, Al-AnbayEJTEJoB. GeneXpert analysis of bronchoalveolar lavage (BAL) samples:

promising diagnostic modality in patients with smear-negative pulmonary tuberculosis. 2022;16(1):68.
8. Karnan A, Jadhav U, Ghewade B, Ledwani A, Shivashankar P, JADHAV UJC. A Comprehensive Review on Long vs. Short Regimens in Multidrug-Resistant Tuberculosis (MDR-TB) Under Programmatic Management of Drug-Resistant Tuberculosis (PMDT). 2024;16(1).
9. Bharat C, Kola KR, Nandyala RP. Role of fiberoptic bronchoscopy in diagnosis of smearnegative PTB. Journal of Evolution of Medical and Dental Sciences. 2018 Jul 9;7(28):3178-83.
10. Shen YC, Chen CH, Tu CY. Advances in diagnostic bronchoscopy. Diagnostics. 26;11(11):1984.
11. Kim YW, Kwon BS, Lim SY, Lee YJ, Cho YJ, Yoon HI, Lee JH, Lee CT, Park JS. Diagnostic value of bronchoalveolar lavage and bronchial washing in sputum-scarce or smear-negative cases with suspected pulmonary tuberculosis: a randomized study. Clinical Microbiology and Infection. 2020 Jul 1;26(7):911-6. 2022
12. Somoskovi A, Salfinger M. Commentary: The Race Is OnTo Shorten the Turnaround Time for Diagnosis of Multidrug-Resistant Tuberculosis. Journal of clinical microbiology. 2015 Dec;53(12):3715-8.
13. Prakash UB. Bronchoscopy unit, expertise, equipment and personnel.Interventional Bronchoscopy. Prog Respir Res. Basel: Karger. 2000:31-43.
14. Sadana P, Singh T, Deepti SS. Socio-Demographic Factors Affecting the Treatment Outcome in Patients of Tuberculosis. National Journal of Community Medicine. 2015 Dec 31;6(04):609-13.
15. Natarajan A, Beena PM, Devnikar AV, Mali S. A systemic review on tuberculosis. Indian Jour nal of Tuberculosis. 2020 Jul 1;67(3):295-311.
16. Rao VG, Muniyandi M, Bhat J, Yadav R, Sharma R. Research on tuberculosis in tribal areas in India: A systematic review. indian journal of tuberculosis. 2018 Jan 1;65(1):8-14
17. Yüksekol I, Bal S, Ozkan M, Balkan A, Bedirhan I, Tozkoparan E, Demirci N, Seber O. The value of fiberoptic bronchoscopy in diagnosis of smear negative pulmonary tuberculosis. Tuberkulozvetoraks. 2003 Jan 1;51(4):405-9.