ORIGINAL RESEARCH PAPER

Pulmonary Medicine

DIAGNOSTIC YIELD OF CBNAAT ON BAL SAMPLES IN SPUTUM-NEGATIVE SUSPECTED PULMONARY TUBERCULOSIS: A PROSPECTIVE OBSERVATIONAL STUDY

KEY WORDS: CBNAAT, BAL, Pulmonary Tuberculosis, Sputum-negative, Diagnostic Yield

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ABSTRACT

Background: Diagnosing pulmonary tuberculosis (PTB) in sputum-negative patients remains challenging due to low bacillary load [1]. Bronchoalveolar lavage (BAL) combined with Cartridge-Based Nucleic Acid Amplification Test (CBNAAT) has emerged as a useful diagnostic tool [2].**Objective:** To evaluate the diagnostic yield of CBNAAT on BAL samples in sputum-negative suspected pulmonary tuberculosis patients.**Methods:** A prospective observational study was conducted from January 2025 to March 2026. A total of 57 sputum-negative suspected PTB patients underwent bronchoscopy with BAL sampling. CBNAAT testing was performed on all samples.**Results:** Out of 57 BAL samples, 17 (29.82%) were CBNAAT positive for Mycobacterium tuberculosis. Among males (n=42), 12 (28.57%) were positive, while among females (n=15), 5 (33.33%) were positive.There was no statistically significant association between gender and CBNAAT positivity (p = 0.72).**Conclusion:** CBNAAT on BAL samples shows a significant diagnostic yield in sputum-negative suspected PTB cases and should be considered a valuable odiagnostic modality [3].

INTRODUCTION

Tuberculosis remains a major global health problem, particularly in developing countries such as India [1]. Early and accurate diagnosis is critical for disease control and prevention of transmission. However, sputum-negative pulmonary tuberculosis poses a diagnostic challenge due to low bacillary load and difficulty in obtaining adequate samples [2].

CBNAAT (GeneXpert MTB/RIF) is a rapid molecular diagnostic test that detects Mycobacterium tuberculosis DNA and rifampicin resistance within hours, significantly improving early diagnosis [3]. The sensitivity of CBNAAT is particularly beneficial in smear-negative cases [4].

Bronchoscopy with bronchoalveolar lavage (BAL) enables direct sampling from affected lung areas, improving diagnostic yield. Previous studies have reported BAL CBNAAT positivity rates ranging from 30% to 35% in sputum-negative patients [5].

Materials and Methods

Study Design
Prospective observational study

Study Duration
January 2025 – March 2026

Study Population
Total patients: 57

Inclusion criteria:
Suspected pulmonary TB
Sputum smear negative or sputum-scarce patients

Exclusion criteria:
Patients already on anti-tubercular therapy
Contraindications to bronchoscopy

Procedure
Bronchoscopy was performed under aseptic conditions. BAL samples were collected and subjected to CBNAAT testing as per standard guidelines [3].

Statistical Analysis
Data were analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: **Gender-wise distribution and CBNAAT outcome**

Gender	Total (n)	MTB Detected (n)	MTB Not Detected (n)	Detection Rate (%)	Proportion of Total (%)
Male	42	12	30	28.6	73.7
Female	15	5	10	33.3	26.3
Total	57	17	40	29.8	100.0

Interpretation
The study included 57 patients, of whom 42 were male (73.7%) and 15 were female (26.3%).

Overall MTB was detected in 17 patients, giving an overall CBNAAT positivity rate of 29.8%.

The detection rate was 28.6% in males and 33.3% in females, indicating a slightly higher positivity proportion among female patients.

Among all MTB-detected cases, males contributed 70.6% and females contributed 29.4%.

Statistical Analysis
Chi-square test revealed:
$^2 = 0.13$
p-value = 0.72 (not statistically significant)
This indicates no significant association between gender and CBNAAT positivity.

Table 2. Distribution of CBNAAT results among the study participants

S. No.	CBNAAT result	Number of patients (n)	Percentage (%)
1	MTB detected	7	12.3
2	MTB not detected	50	87.7
3	Total	57	100.0

Interpretation: Out of 57 patients, 7 were positive for Mycobacterium tuberculosis (MTB) on CBNAAT, giving a positivity rate of .,..,.....3%, while 50 patients (87.7%) were MTB not detected.

Additional insight: The MTB detected to not detected ratio was 7:50 (1:7.1). This indicates that approximately 1 in every 8.1 patients tested showed MTB detection on CBNAAT in this data-set.

Figures

Figure 1. Bar chart showing CBNAAT result by gender

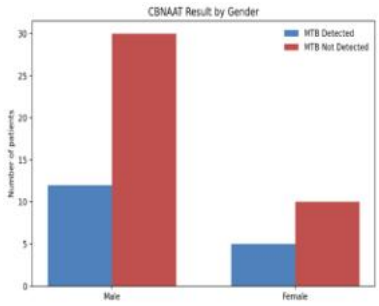


Figure 2. Pie chart showing gender distribution among MTB-detected cases

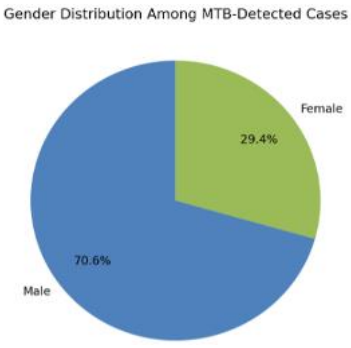


Figure 3: Bar chart showing overall CBNAAT positivity (29.82%) vs negativity (70.18%)

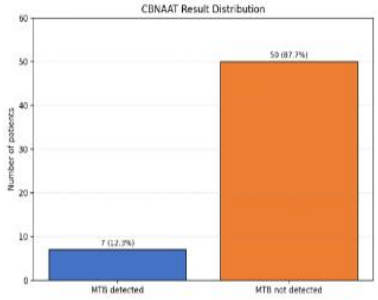
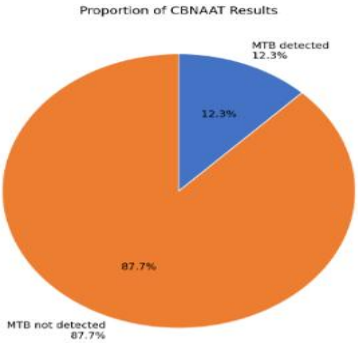


Figure 4. Pie chart showing percentage distribution of CBNAAT results



The present study demonstrated a diagnostic yield of 29.82% for CBNAAT on BAL samples in sputum-negative suspected pulmonary tuberculosis patients. This finding is consistent with previous studies reporting yields between 30% and 35% [5,6].

CBNAAT offers rapid detection and high specificity, making it a valuable diagnostic tool, especially when sputum results are negative [3]. BAL sampling further enhances detection by collecting specimens directly from infected lung segments, thereby overcoming limitations of sputum microscopy [4].

Although females showed slightly higher positivity rates than males, the difference was not statistically significant (p = 0.72), indicating no gender-based variation in diagnostic yield.

CONCLUSION

CBNAAT on BAL samples significantly improves diagnostic detection in sputum-negative pulmonary tuberculosis patients and should be incorporated into routine diagnostic algorithms [3,5].

Limitations

Small sample size
Single-center study
Lack of comparison with culture (gold standard)

Future Recommendations

Multicentric studies with larger sample sizes
Inclusion of culture comparison
Evaluation of cost-effectiveness

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