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Original Research Article

Comparison of Induced Sputum and Bronchial Washings for CBNAAT in Diagnosing Sputum Smear Negative Pulmonary Tuberculosis

Prakash Sinha[1], Ritesh Kamal[2], Laxmi Niwas Tiwari [3]

[1]Associate Professor, Department of Pulmonary Medicine, Katihar Medical College and Hospital, Katihar, Bihar.

[2]Professor and Head of Department, Department of Pulmonary Medicine, Katihar Medical College and Hospital, Katihar, Bihar

[3]Assistant Professor, Department of Pulmonary Medicine, Katihar Medical College and Hospital, Katihar, Bihar

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Corresponding author: Dr. Ritesh Kamal

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Abstract:

Background: One of the most contagious public health issues for many years, tuberculosis has also become more challenging to diagnose recently because of its link to immunocompromised individuals. Modern diagnostic methods, such as CBNAAT, can now provide positive results even when there are fewer tuberculosis bacilli in specimen samples. The purpose of the current study was to compare bronchial washings and induced sputum for the CBNAAT in the diagnosis of sputum smear-negative tuberculosis.

Methods: From November 2021 to October 2022, a prospective, observational study was carried out in the pulmonary medicine department of Katihar Medical College and Hospital in Katihar, Bihar. In Katihar, Bihar, 43 patients with sputum-negative tuberculosis were recruited and given BAL fluid and sputum for CBNAAT analysis under RNTCP.

Results: There were more male patients (67.45%) than female patients (32.55%). The majority of people are between the ages of 51 and 60, with a mean age of 49.18. Infiltration was the most frequent X-ray presentation, followed by consolidation. Compared to bronchial washings CBNAAT in 27 patients, induced sputum CBNAAT was positive in only 7 patients.

Conclusion: All smear-negative and immunocompromised patients should undergo CBNAAT because it can diagnose pulmonary tuberculosis patients quickly, prevent transmission, and reduce mortality. In addition to helping with early diagnosis in less than two hours so that early therapy can be started, CBNAAT detects pulmonary TB in PLHIV more effectively than sputum microscopy. This decreases the incidence of MDR-TB and the mortality associated with it.

Keywords: Acid Fast Bacilli (AFB), Antituberculosis Treatment (ATT), Fiber Optic Bronchoscopy (FOB).

Introduction

Incidence of tuberculosis is rising in this decade of rising immunocompromised diseases. But the doctors are finding it more challenging now that the sputum is negative. With the development of more advanced diagnostic instruments, such as the CBNAAT, which aids in early diagnosis and can yield positive results even in cases of paucibacillary tuberculosis.

India's estimated TB incidence was approximately 28,00,000, or roughly 25% of all TB cases worldwide, according to the Global TB report of 2017. India revised its national estimates of the tuberculosis burden in 2017 by taking data from a wider range of sources. [1] When RNTCP was introduced in India in 1993, the entire nation was covered by it by 2006. RNTCP sought to attain case detection and cure rates of at least 90% by 2015, having accomplished a rate of more than 70% and 85%, respectively, by 2007. [2] The program's aim is to provide all TB patients in the nation with "Universal Access" to high-quality diagnosis and care.

AFB smear examination is the first diagnostic step for pulmonary tuberculosis cases that are suspected, as recommended by the World Health Organization. [3] In the directly observed treatment, short-course (DOTS) approach used in tuberculosis control programs around the world, sputum is the diagnostic tool used to diagnose tuberculosis. [4] Two spontaneously obtained sputum samples (one spot specimen and one early morning sample) are analyzed using the fluorescent

technique under RNTCP in order to diagnose PTB. Sputum microscopy is less sensitive and useful for patients with bacilli less than 10,000/ml of sputum or those who are unable to produce sputum. [5]

More recently, the Gen expert (expert® MTB/Rif assay) was approved by the WHO for use in tuberculosis diagnosis. [6] Fibreoptic bronchoscopy was used to obtain bronchial washing specimens in order to improve the results. In this study, we compared the effects of bronchial washings and induced sputum for CBNAAT in patients with pulmonary tuberculosis that did not produce sputum.

The purpose of the study is to compare the efficaciousness of sputum induction smears and bronchial washings for CBNAAT in the diagnosis of sputum negative pulmonary tuberculosis with the results of these procedures in patients suspected of having sputum smear-negative pulmonary tuberculosis.

Materials and Methods

This prospective study was conducted from November 2021 to October 2022 in the pulmonary medicine department of Katihar Medical College and Hospital in Katihar, Bihar. The study included consecutive patients who had recently developed a suspicion of PTB. Every case of induced sputum that tested negative, as well as BAL fluid used for CBNAAT analysis under the RNTCP at KMCH in Katihar, Bihar. Every case had to be older than 18 years old, have a history of coughing for more than two weeks, and have two sputum samples that tested negative for acid-fast bacilli.

One crucial criterion for exclusion was the patient's inability to provide written informed consent. Individuals with a history of HIV infection, tuberculosis, or related mental health issues were not allowed. Patients with known asthma, pneumothorax, active hemoptysis, history of cardiac disease, especially arrhythmias, hypotension (SpO2<90%), and prior PTB history were excluded from the study. The study excluded those who were unable to generate high-quality sputum even after sputum induction. Patients under suspicion for pulmonary tuberculosis underwent routine testing of their urine and blood. Every case at our hospital underwent an ELISA test for HIV.

In addition, standard blood chemistry was performed, which included tests for liver function, blood sugar, and renal profile.

In accordance with RNTCP guidelines, sputum for AFB was ordered for all study participants. Every patient was told to voluntarily expectorate sputum in the early morning on the spot. The patient is then exposed to induced sputum and bronchoscopy for BAL fluid for CBNAAT if both sputa are negative. 43 sputum smear results from the aforementioned techniques were examined in total.

No sputum smear-negative specimens of the either spontaneously obtained or induced, or BAL fluid, were subjected to culture examination in accordance with our study's protocol, since the goal of the study was to determine whether the induced sputum smear is superior than BAL fluid for CBNAAT submitted under RNTCP.

Results

29 of the 43 patients were men, and 14 were women. Six female patients and twenty male patients made up the 27 out of 43 BAL positive patients. Six of the 43 patients who had sputum induction were male, and one patient was female. Of the 43 patients, all 43 patients (100%) have a cough, 40 patients (93%) have a fever, 40 patients (93%) have sputum, and 27 patients (62%), have lost weight and appetite. According to Table 1, the chest radiologic manifestations of the 43 patients in this study were as follows: 22 patients had pulmonary infiltrations, 12 patients had consolidation, 2 patients had both consolidation and infiltrates, 4 patients had cavities with infiltrates, and 3 patients had collapse with consolidation.

Table 1: Radiological profile of sputum negative pulmonary TB patients

Chest x-ray findings	No. of patients	Percentage
Infiltrations	22	51.16%
Consolidation	12	27.90%
Consolidation with infiltrations	2	4.06%
Cavity with infiltrations	4	9.31%
Collapse with consolidation	3	6.97%

Induced phlegm seven cases had CBNAAT positivity, of which three had cavities with infiltrations, two had infiltrates, one had consolidation with infiltrations, and one had consolidation. Each of these cases also had a positive BAL for CBNAAT. Thirteen of the twenty-two pulmonary infiltration cases—ten of which were male and three of which were female had positive BAL results for CBNAAT. Eight of the twelve consolidation cases seven of which were male and one of which was female had BAL positive results. There was also consolidation with infiltration in one male case, cavities with infiltrations in three male cases, and three collapses

with consolidation in two female and one male patient. Despite the fact that 43 patients produced enough sputum, only 07(16.2%) of the patients had induced sputum that tested positive for CBNAAT. Of the forty-three patients who underwent the FOB procedure successfully, sixteen (37.2%) and 27 (62.8%) had negative CBNAAT results.

In all 43 patients, 3 ml of induced sputum was obtained on average, and in 43 of those cases, 20 ml of BAL was collected. Two hours of post-procedure observation were done in order to identify any complications. Thirteen of the forty-three patients who had both FOB and induced sputum had pneumonia diagnosed, and 27 of them had pulmonary tuberculosis. Of the 43 cases in total, 29 (67.45%) were male and 14 (32.55%) were female.

Infiltrations (51.16%), consolidation (27.9%), cavities with infiltrations (9.31%), collapse with consolidation (6.97%), and consolidation with infiltrations (4.66%) are the most frequent radiological presentations on chest x-rays. As indicated in Table 2, of the total 43 patients, 07(16.27%) had induced sputum that tested positive for CBNAAT, and 27(62.79%) had BAL fluid that tested positive.

Table 2: Results (induced sputum and BAL fluid for AFB)

Results	Positive	Percentage
Induced sputum for CBNAAT	7	16.27%
BAL fluid for CBNAAT	27	62.79%

Most common symptomatic presentation was cough followed by fever and sputum as shown in Table 3.

Table 3: Clinical Profile of sputum negative pulmonary TB patients

Symptoms	No. of patients suffering	Percentage
Cough	43	100%
Fever	40	93%
Sputum	40	93%
Loss of weight	27	62%
Loss of appetite	27	62%

Out of all 43 patients, 12 fall into the 51–60 year age group, which makes up the majority of the group. The group's average age was 49.18 years. Table 4 compares the radiological findings of the 43 patients with the results of BAL fluid and sputum induced by CBNAAT.

Table 4: Induced sputum and BAL for CBNAAT results in relation to radiological findings

Chest X-ray	No. (%)	PTB	Induced sputum CBNAAT positive	BAL for CBNAAT positive	Gender Significance	
					Male	Female
Infiltrations	22(51.16%)	13	2	13	10	3
Consolidation	12(27.90%)	8	1	8	7	1
Consolidation with infiltrations	2(4.66%)	1	1	1	1	0
Cavity with infiltrations	4(9.31%)	3	3	3	3	0
Collapse with consolidation	3(6.97%)	2	0	2	0	2

Discussion

Sputum microscopy for AFB is a low-cost, highly specific method of diagnosing pulmonary tuberculosis. Culture was positive [7,8] in 22–61 % of patients whose sputum AFB smear was negative, particularly in hosts with compromised immune systems. Treatment cannot begin until after 6 to 8 weeks have passed using traditional mycobacterial culture methods. Research on DNA fingerprinting revealed that smear-negative, culture-positive patients may be responsible for 17% of disease transmission. [9] By obtaining specimens from particular lung sites with infiltrates that can be sent for CB-NAAT, induced sputum and bronchial washings obtained using Fibreoptic bronchoscopy may, in these cases; confirm a diagnosis of sputum negative pulmonary tuberculosis.

The current study intends to examine the diagnostic yield of bronchial washings specimen for CB-NAAT test and induced sputum CBNAAT in patients suspected of having sputum smear-negative pulmonary tuberculosis. In contrast to the findings of L. Saglam et al. [10], the current study's BAL for CBNAAT was positive in 27 cases (62.79%), and the bronchial washings smear was positive in 53% of cases. CBNAAT, which can identify up to 100 AFB bacilli/ml, could be the cause.

The yield of CBNAAT for induced sputum smears in the current study was only 16.2%, which is comparable to 19.34% in studies by Andersen et al. [11], Parry et al. [12], and Li et al. [10], but significantly lower than in earlier studies by L. Saglam et al. [10], which had 47% positivity, and Hartung et al. [13], which had 42% positivity. This study demonstrates that for the purpose of

identifying active PTB, induced sputum smear positivity (n = 07) is less common than bronchial washings (n = 27). Patients with a high clinical probability of prostate cancer may undergo early FOB.

The study mean age is 49.18 years, and the patient population is predominately male. Of the 43 patients, 29 (67.45%) were male and 14 (32.55%) were female, resulting in a male to female ratio of 2.07. The most common cardinal symptoms were fever (93%), and cough (100%). Infiltrates were found in 51.16% of radiological cases and consolidation in 27.90%. Of the forty-three patients whose sputum smear came back negative, seven (16.2%) had an induced sputum smear that tested positive for CBNAAT, and 27 (62.8%) had bronchial washing CBNAAT that tested positive for AFB.

Sputum produced spontaneously is the only way to passively identify cases of suspected PTB under the RNTCP. [14, 15] Sputum smear examination is a low-cost and highly effective diagnostic method for suspected PTB. The initial step in diagnosing tuberculosis is to look for the presence of AFB in the sputum, according to WHO guidelines. [16] Sputum smear examinations have a sensitivity of 45 to 83% in clinical practice, but a specificity of greater than 98%. More than 50 years ago, [17–19] sputum induction was shown to have a better diagnostic yield than spontaneous sputum or gastric aspirate, [20–23] but it was abandoned when FOB was implemented. [24]

Even when enough sputum is submitted, sputum smear results can occasionally come back negative, especially in nations where there is a simultaneous HIV/TB epidemic. [25]

When the first sputum sample is collected correctly, the positive diagnostic yield is high. Sputum smears are examined by skilled and knowledgeable laboratory technicians in each DOTS center. Fluorescence microscopy was used in our DOTS center to create sputum smears for the purpose of analyzing sputum samples that were submitted under the RNTCP. The lower reported positivity rates in our study might be the result of a higher proportion of patients with infiltrations and fewer cavitatory lesions with lower bacilli loads. Use of molecular techniques like PCR and CBNAAT may be beneficial as an additional technique for the diagnosis of tuberculosis in this particular patient. Since bronchoscopy facilities may not always be available in developing nations like India, induced sputum using hypertonic saline is a crucial tool for improving the diagnostic yield in SSN-PTB patients. However, the yield for CBNAAT is lower than BAL.

Conclusion

Of the forty-three pulmonary tuberculosis patients with sputum smear negative, seven (16.2%) had induced sputum CBNAAT positive, and 27 (62.8%) had bronchial washings. Compared to bronchial washings, induced sputum detected fewer cases; however, this difference is statistically significant ($p > 0.001$). It was discovered that there is reasonably good agreement ($k = 0.5$) when the kappa coefficient was used to determine the degree of agreement between the two tests. The cause might be that more bacilli were obtained in the BAL than during sputum induction.In order to diagnose and rule out other possible diagnoses like pneumonia and cancer, patients with only consolidation or infiltrations and collapse with consolidation should be referred to the tertiary care center for a bronchoscopy guided procedure for BAL CBNAAT.

Additionally, CBNAAT was helpful in the early diagnosis of carcinoma that has consolidated with the appearance of an air bronchogram in a CT scan, aiding in the early detection of carcinoma in cases of pneumonia that is not improving.

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