

Evaluation Of Role Of Sputum Induction In The Diagnosis Of Pleural Tuberculosis: An Observational, Cross-Sectional Study From A Tertiary Care Institute In Kolkata.

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Abstract: This study was conducted to detect *Mycobacterium tuberculosis* by sputum induction, in presumptive tuberculous pleural effusion. A total of 84 patients who satisfied the inclusion criteria were enrolled in this study from March 2010 to April 2011. Sputum induction by 3% normal saline was done in all patients. Induced sputum was examined for smear microscopy for acid fast bacilli (AFB) and BACTEC culture for *Mycobacterium tuberculosis*. Sputum smear microscopy for AFB was negative in all the patients. Then induced sputum samples obtained from them were examined for smear microscopy for AFB and BACTEC culture for *Mycobacterium tuberculosis*. AFB smear positivity was found in 4(4.76%) cases and BACTEC culture for *Mycobacterium tuberculosis* was positive in 14(16.67%) cases. From this study it can be concluded that Sputum Induction study offers an alternative approach to a confident diagnosis of suspected pleural tuberculosis particularly in areas where facilities for pleural biopsy and/or histopathology are not readily available.

Keywords: AFB, BACTEC culture, Induced sputum, Smear microscopy, Tuberculous pleural effusion.

I. Introduction

Tuberculosis (TB) remains a major public health problem in India. Every year approximately 28 lakh people develop TB and about 4.8 lakh die from it [1]. Tuberculous pleurisy is responsible for 30–80% of all pleural effusions encountered [2]. Pleural effusion associated with tuberculosis contains a relatively small number of organisms, making a diagnosis of pleural TB difficult and often requiring invasive procedures like pleural biopsy [3]. Thus it presents a diagnostic and therapeutic problem due to the low sensitivity of the diagnostic tools and cost is a major concern. The presence of *Mycobacterium tuberculosis* in the sputum specimen of patients of pleural effusion is diagnostic of tuberculosis. The sputum smear can be positive for TB from 4% in isolated TB pleurisy to 50% of cases in those with extensive parenchymal infiltrates [4].

Maximizing the yield of the diagnostic evaluation is particularly important in areas where the scope of performing pleural biopsy; through bronchoscopy or thoracoscopy is limited. In high TB burden countries like ours, where the probability of drug resistant disease is high, and sputum culture can be used to guide treatment more effectively. Sputum induction (SI) is a non-invasive procedure used for patients who have trouble producing sputum voluntarily or who have sputum smear negative for Acid Fast Bacilli (AFB). SI is better-tolerated and less expensive [5]. It has also been utilized to diagnose pulmonary tuberculosis (PTB) [6]. In this study, we have attempted to study the role of sputum induction in the diagnosis of tubercular pleural effusion.

II. Aims And Objectives

To study the diagnostic yield of induced sputum for AFB smear and BACTEC culture for *Mycobacterium tuberculosis* in patients with presumptive diagnosis of tuberculous pleural effusion.

III. Materials And Methods

This was an observational, cross sectional study conducted over a period of 1 year from April 2010 to March 2011. Total 100 patients attending outdoor and indoor Department of Pulmonary Medicine of a tertiary care institute in Kolkata were chosen randomly in the study. Out of these 100 patients, 84 patients were finally selected depending on inclusion and exclusion criteria. All patients aged 15 years and above, belonging to either gender, presenting with history, clinico-radiological and pleural fluid features suggestive of tuberculous pleural effusion during the study period were included.

1. Suggestive symptoms were:
 - 1.1. History of pleuritic chest pain
 - 1.2. Shortness of breath
 - 1.3. Dry cough
 - 1.4. Loss of appetite and weight

- 1.5. Fever and fatigue.
 2. Clinical examinations were in favour of pleural effusion.
 3. Radiological features included were:
 - 3.1. Presence of a homogenous opacity associated with blunting of either or both costo-phrenic angles.
 - 3.2. Curvilinear shadow towards the hilum.
 - 3.3. May or may not be associated with parenchymal infiltration.
 4. Diagnosis of tuberculous pleural effusion was done if pleural fluid on examination fulfilled all of the following criteria [7]:
 - 4.1. Lymphocytic predominant (> 75% lymphocyte)
 - 4.2. Exudative in nature.
 - 4.3. Adenosine Deaminase (ADA) level ≥ 70 IU/L
- Spontaneous sputum smear microscopy for AFB was negative in all 84 patients. As indicated in the sputum induction guidelines [8], the following patients were excluded from the study:
1. Immuno-suppressed patients
 2. Patients with history of antitubercular therapy, hemoptysis in preceding 7 days or patients on anticoagulant therapy.
 3. Acute respiratory distress.
 4. Unstable cardiovascular status (Arrhythmia and Angina).
 5. Known case of thoracic, abdominal or cerebral aneurysm.
 6. Eye surgery in last 3 months.

The process of sputum induction was explained to all the selected patients and after obtaining adequate consent, the following procedure was followed for obtaining the sample:

1. The equipment was assembled and checked. Jet Nebulizer (Ready Mist, Piston Compressor Nebuliser) with Aerosol Tubing (Disposable), one-way valve and filter and disposable mouthpiece was used.
 2. Nebulisation with 5ml of 3% hypertonic saline solution for approximately 5 minutes was done each time, up to a total of 20 ml maximum.
 3. Patient was asked to take several deep breaths off the nebulizer. If the patient did not initiate coughing spontaneously, he was asked to attempt a forced cough.
 4. The expectorated sputum sample was collected in a sterile sputum container.
 5. Close observation was done throughout the procedure.
 6. The procedure was stopped when:
 - 6.1 The patient had produced at least 2 ml of sputum
 - 6.2 15 minutes of nebulization was reached
 - 6.3 The patient complained of shortness of breath, chest tightness or wheeze.
 7. The patient's identification sticker was placed on the specimen container.
 8. The patient's condition was assessed post procedure, and appropriate action taken if and when required.
- The induced sputum specimen samples thus collected were sent for direct smear for AFB and BACTEC culture for *Mycobacterium tuberculosis*.
- After that, calculation of the induced sputum positivity for AFB smear and BACTEC culture for *Mycobacterium tuberculosis* in patients with presumptive diagnosis of tubercular pleural effusion was done.

IV. Results

A total of 84 patients who satisfied the inclusion criteria were enrolled in this study from March 2010 to April 2011. Out of a total of 84 patients, 58 were male (69.04%) and 26 were female (30.95%). The majority of male patients were in the age group of 30-44yrs (41.38%). In contrast, majority of females were in the age group of 15-29yrs (46.15%). In our study, fever was the commonest symptom (85.71%). Cough was the next common symptom (76.19%). Other symptoms were chest pain (52.38%) & shortness of breath (33.33%). In Chest X ray presentation, majority of patients presented with moderate pleural effusion (38.46%). 8 patients (10.25%) presented with encysted pleural effusion and 2 patients presented with sub-pulmonic effusion. Six patients (7.14%) had bilateral pleural effusion. Among total 84 patients, 14(16.67%) patients showed features of parenchymal infiltrates in chest x-ray. Spontaneously produced sputum was examined for sputum smear microscopy in all the patients. AFB was not found in any sputum sample. In all 84 cases, sputum induction with 3% hypertonic saline was done as described in the methodology. Sputum thus obtained was examined for smear microscopy for AFB and BACTEC culture for *Mycobacterium tuberculosis*. AFB smear positivity was found in 4(4.76%) cases and BACTEC culture for *Mycobacterium tuberculosis* was positive in 14(16.67%) cases in induced sputum.

V. Discussion

In Indian context, where Tuberculosis is endemic, an exudative pleural effusion is considered as tuberculous in origin until proven otherwise. When a tuberculous pleural effusion occurs in the absence of radiologically apparent PTB, it may be the sequel of a primary infection 6-12 weeks ago or it may represent reactivation TB [9]. Knowing the sputum status helps in not only making a confident diagnosis of tuberculosis but can also guide treatment based on the sensitivity pattern of the sputum culture if found to be positive.

As per annual report published in 2017, 17% of all tuberculosis cases were extra-pulmonary TB patient reporting has been increased from 17% to 21% over period of 10 years in India [10]. Majority of extra-pulmonary cases are smear negative for AFB. The association of AFB negative sputum smear with lower bacillary load and minimal, non-cavitary radiographic patterns, might imply that smear negative cases are less infectious. However, a DNA fingerprinting study from San Francisco attributed 17% of tuberculosis transmission to smear negative, culture positive tuberculosis cases [11]. Therefore every attempt to establish a definitive diagnosis of tuberculosis should be made in patients who are either unable to produce sputum voluntarily or are smear-negative by conventionally obtained sputum.

Conde et al prospectively evaluated the diagnostic yield of AFB smear and culture of sputum in 84 patients with tuberculous pleural effusion [3]. They reported that the sputum induction studies were positive in 44 of the 84 patients (52%). Out of these 44 patients, sputum smear was positive in 10 (11.90%), whereas culture was positive in all 44 patients (52%). The yield of induced sputum culture was second highest after the tissue biopsy results. Even in radiologically isolated pleural effusion cases, induced sputum culture was positive in 35(55%). The present study included only those patients who were negative for AFB in two sputum samples or who were unable to produce sputum spontaneously and adequately. Among all 84 cases, AFB smear positivity was found in 4 cases (4.76%) and BACTEC culture for Mycobacterium tuberculosis was positive in 14 cases (16.67%). Low yield of this study compared to the study done by Conde et al may be due to the fact that examination for AFB was done in two sputum samples and also due to exclusion of the patients with sputum smear positive for AFB. Though the yield of SI is low, it offers another approach to a confident diagnosis of suspected pleural tuberculosis particularly in areas where facilities for pleural biopsy and/or histopathology are not readily available.

VI. Conclusion

In the present days of modern diagnostic facilities, diagnosis of extra-pulmonary tuberculosis is still a challenge for the physician. Etiology of pleural effusion can be reached with more confidence with the help of medical thoracoscopy. Compared to thoracoscopy, which is more expensive and invasive, test like induced sputum for AFB smear microscopy and BACTEC culture for Mycobacterium tuberculosis is non-invasive and less expensive in diagnosing tuberculous pleural effusion. Though in comparison with other studies, the yield of Sputum Induction in our study is low, it offers an alternative approach to a confident diagnosis of suspected pleural tuberculosis particularly in areas where facilities for thoracoscopy for pleural biopsy and/or histopathology are not readily available.

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