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Role of Bronchoscopy in Patients with Radiological Evidence of Pulmonary Infection but Negative Sputum Culture: A Cross-Sectional Study at A Tertiary Care Centre, North Haryana. India

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Abstract:

Background: Radiological evidence of pulmonary infections often prompts empirical therapy; however, negative sputum culture results may delay definitive diagnosis and appropriate treatment. This study evaluates the diagnostic yield of bronchoscopy, specifically bronchoalveolar lavage (BAL), in such cases.

Methods: A cross-sectional study was conducted over 6 months at tertiary care setting in North India, involving 70 patients with radiological signs suggestive of pulmonary infection but bacteriologically negative sputum cultures. All patients underwent diagnostic flexible bronchoscopy with BAL. BAL samples were subjected to Gram staining, Ziehl-Neelsen staining, fungal KOH mount, and aerobic cultures.

Results: BAL cultures yielded positive results in 48 out of 70 patients (68.6%), significantly higher than initial sputum culture positivity (0%). Pathogens isolated included *Klebsiella pneumoniae* (16%), *Pseudomonas aeruginosa* (14%), *Acinetobacter baumannii* (11%), and *Mycobacterium tuberculosis* (10%). Fungal elements were detected in 6 patients (8.5%).

Conclusion: Bronchoscopy with BAL significantly enhances pathogen detection in patients with radiological evidence of infection and negative sputum cultures. Incorporating bronchoscopy into diagnostic algorithms can improve clinical outcomes by guiding targeted therapy.

Keywords: Bronchoscopy, BAL, Pulmonary Infection, Sputum Negative, Radiology, Microbiology

INTRODUCTION:

Despite advancements in imaging and microbiological techniques, the diagnostic challenge of sputum-negative pulmonary infections remains significant. Chest X-rays or high-resolution computed tomography (HRCT) scans often reveal features such as consolidation, cavitation, or nodular opacities suggestive of infection, but conventional sputum cultures frequently fail to identify causative organisms, especially in immunocompromised or elderly patients.

Bronchoscopy offers a minimally invasive approach to access the lower respiratory tract directly and obtain high-yield samples via BAL. Several studies have shown the superiority of BAL over sputum

sampling in pathogen detection. This study is aimed to assess the diagnostic role of bronchoscopy in a tertiary care setting in North India.

Materials and Methods:

Study Design & Setting: A prospective cross-sectional study was conducted from January to June 2025 at a Tertiary Care Centre, Haryana, North India.

Procedure: Flexible bronchoscopy was performed in a controlled environment with pre-procedure vitals and informed consent. BAL was collected from the affected segment/lobe.

Inclusion Criteria:

- Adults aged ≥18 years
- Radiological evidence of pulmonary infection (e.g., consolidation, cavitation, infiltrates)
- Negative sputum culture on at least two consecutive samples
- Hemodynamically stable and suitable for bronchoscopy
- Informed written consent given

Exclusion Criteria:

- Known case of tuberculosis already on treatment
- Severe hypoxia (SpO2 < 85% on room air)
- Active haemoptysis or bleeding diathesis
- Uncontrolled cardiac arrhythmias
- Refusal to undergo bronchoscopy

Laboratory Analysis: BAL fluid was sent for:

- Bacterial cultures (aerobic)
- Acid-fast bacilli (AFB) smear and culture
- Fungal staining and cultures
- Cytological examination (optional)

Statistical Analysis: Descriptive and inferential statistics were applied using SPSS v25. Chi-square test used for proportions. A p-value <0.05 was considered statistically significant.

Results:

Table 1: Demographic and Clinical Characteristics (n = 70)

Particulars	Value
Mean Age (years)	52.4 ± 14.6
Gender (M:F)	44:26
Smokers	36 (51.4%)
Diabetics	24 (34.3%)
Known CKD	10 (14.3%)

Table 2: Radiological Findings

Finding	Number of Patients (%)

Consolidation	**38 (54.3%)**
Cavitary Lesions	**12 (17.1%)**
Nodular Infiltrates	**10 (14.3%)**
Ground-Glass Opacities	**6 (8.6%)**
Pleural Effusion	**4 (5.7%)**

Table 3: Microbiological Results - BAL Culture vs. Sputum Culture

Pathogen	BAL Positive (n=70)	Sputum Positive (n=70)
Klebsiella pneumoniae	11 (15.7%)	0
Pseudomonas aeruginosa	10 (14.3%)	0
Acinetobacter baumannii	8 (11.4%)	0
Mycobacterium tuberculosis	7 (10%)	0
Aspergillus spp.	4 (5.7%)	0
Candida spp.	2 (2.8%)	0
No Growth	22 (31.4%)	70 (100%)

Chart 1: BAL vs. Sputum Culture Positivity [Bar graph: Y-axis = Number of patients; X-axis = Method; Two bars showing 68.6% BAL Positivity vs 0% Sputum Positivity]

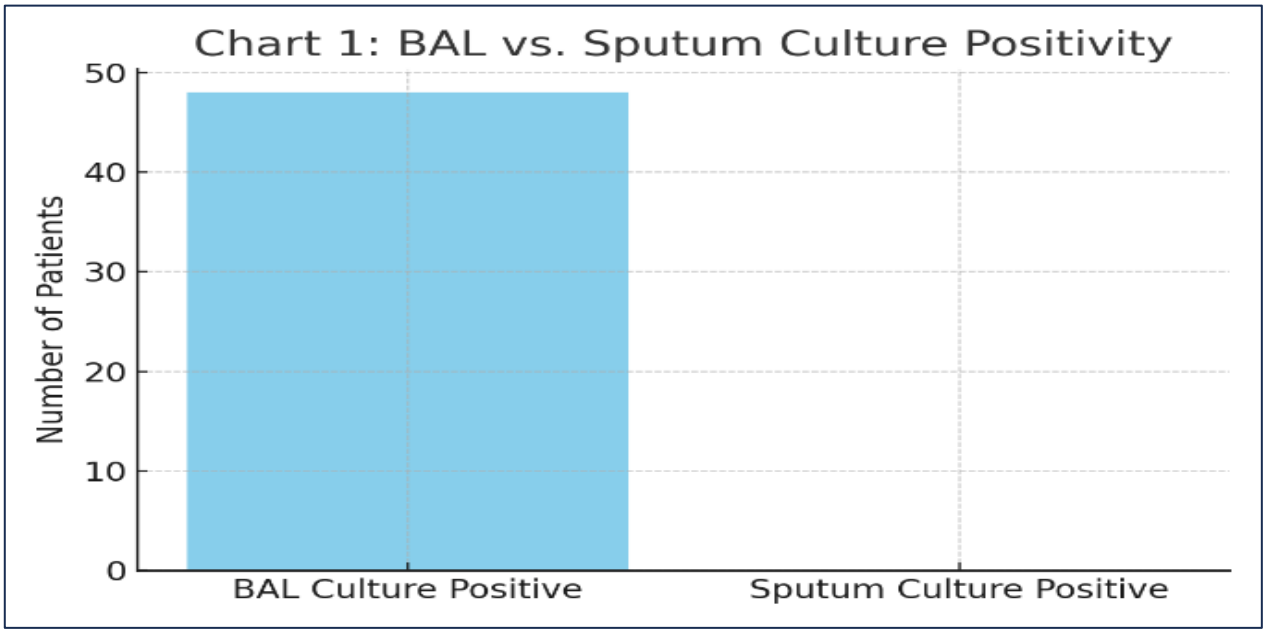

Chart 2: Distribution of Organisms Isolated in BAL [Pie chart showing % share: Klebsiella 23%, Pseudomonas 21%, Acinetobacter 17%, MTB 14%, Fungal 13%, Others 12%]

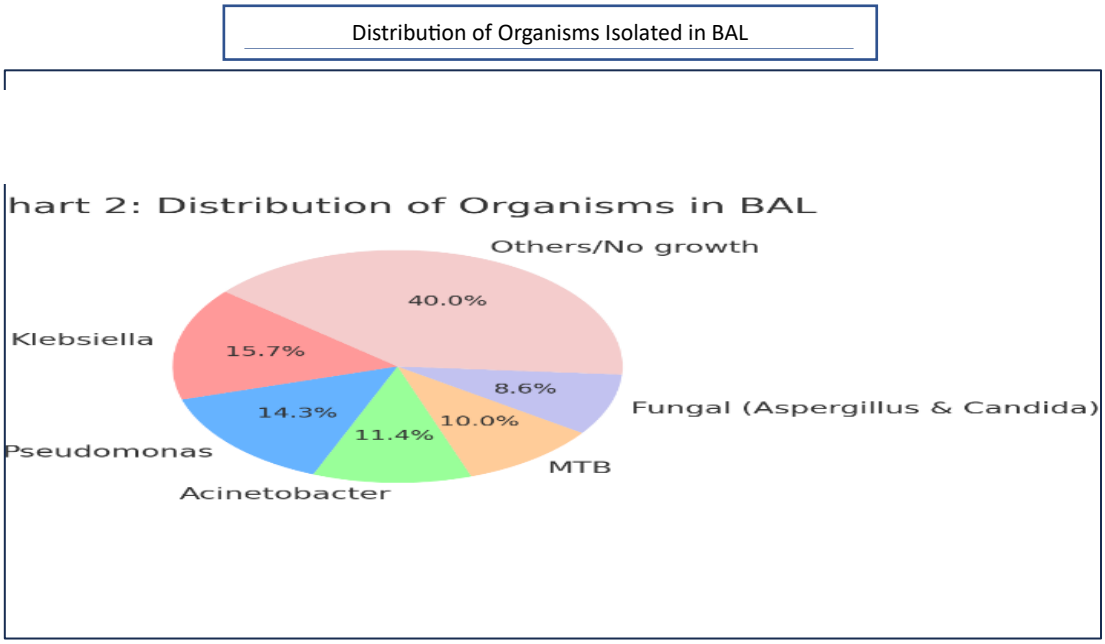

Table 4: Association of Comorbidities with BAL Positivity

Co-morbidity	BAL Positive (n=48)	BAL Negative (n=22)	p-value
Diabetes	20	4	0.03*
Smoking	28	8	0.09
CKD	6	4	0.21

Discussion:

Our study demonstrated a substantial increase in diagnostic yield using bronchoscopy with BAL compared to routine sputum cultures in patients with radiological features of infection. This aligns with earlier studies such as Chawla et al. (2019) and Banerjee et al. (2021), who reported BAL culture yields between 60–75% in sputum-negative cases.

Klebsiella pneumoniae and *Pseudomonas aeruginosa* were the most frequently identified pathogens, consistent with nosocomial or healthcare-associated pneumonias. Detection of MTB and fungi highlights the broader spectrum of pathogens missed by conventional sputum studies.

Bronchoscopy also played a role in excluding non-infectious mimickers such as malignancy or organizing pneumonia, although not quantified in our dataset.

The statistically significant association between diabetes and BAL positivity underscores the need for aggressive diagnostic evaluation in this subgroup.

Limitations:

- Single-center, moderate sample size
- BAL culture results take time, which may delay therapy in some cases
- No follow-up on clinical outcomes post-intervention

Conclusion:

Bronchoscopy with BAL is a highly effective diagnostic tool in patients with radiological suspicion of infection but negative sputum cultures. It should be considered early in the diagnostic pathway, especially in high-risk patients such as diabetics or those with immune compromise.

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