

# A Study of 99 Broncho-Alveolar Lavages in Lower Respiratory Tract Infections Patients

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## Abstract

**Introduction:** LRTIs are a common cause of death in both children and adults worldwide. It has significant burden on healthcare resources. These infections can be caused by a variety of microorganisms, including bacteria, viruses, fungi, and parasites. The diagnosis of LRTIs can be challenging, as the symptoms can be nonspecific and the underlying cause can be multifactorial. Bronchoscopy allows the identification and management of LRTIs by allowing for the collection of lower respiratory tract specimens for microbiological evaluation. Bronchoscopy can provide valuable information about the diagnosis and management of LRTIs, as it can provide valuable information about the underlying pathology and the causative organism. The aim of this study is to investigate 99 broncho-alveolar lavages in LRTI patients, with a focus on broncho-alveolar lavage acid fast bacilli smear and gram stain culture sensitivity.

**Methods:** This study retrospectively analysed the bronchoscopy findings and microbiological profile of 99 patients with suspected LRTIs who underwent bronchoscopy at our institution.

**Results:** Out of the 99 patients included in the study, 59 underwent AFB smear evaluation for mycobacterium tuberculosis. Out of 59 patients, 40 patients tested negative for tuberculosis, while 19 patients were positive.

Out of 99 patients, 39 had no organisms grow in their BAL fluid culture, indicating that their pneumonia may have been caused by non-infectious factors such as aspiration or other non-infectious causes. However, 43 patients had positive cultures, with *Klebsiella* and *Pseudomonas* being the most common bacterial species identified. Fungal culture evaluation was performed in 17 patients, and only one patient was positive for aspergillus. Biopsy specimens were collected in 16 patients, with squamous cell carcinoma being the most common finding. This suggests that some cases of pneumonia may be caused by underlying malignancies, which may have been missed by other diagnostic methods.

**Conclusion:** In conclusion, the results of this study indicate that bronchoscopy is a valuable diagnostic tool for evaluating lower respiratory tract infections. The study also highlights the prevalence of tuberculosis and bacterial species. Furthermore, the study suggests that some cases of pneumonia may be caused by non-infectious factors such as aspiration, as well as underlying malignancies such as squamous cell carcinoma and adenocarcinoma. These findings highlight the importance of a comprehensive diagnostic approach to identify the underlying cause of pneumonia and guide appropriate treatment.

**Keywords:** Broncho-Alveolar Lavage (BAL) • Lower Respiratory Tract Infection (LRTI) • Community Acquired Pneumonia (CAP) • Histopathological • Microorganisms

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## Introduction

Lower Respiratory Tract Infections (LRTIs) are a group of infections that affect the lower respiratory tract, including the trachea, bronchi, and lungs. LRTIs are a common cause of death in both children and adults worldwide [1]. It has significant burden on healthcare resources. These infections can be caused by a variety of microorganisms, including bacteria, viruses, fungi, and parasites. Common LRTIs include pneumonia, bronchitis, and tuberculosis, among others. The symptoms of LRTIs can range from mild to severe and can include cough, fever, and shortness of breath, chest pain, and fatigue [2].

The diagnosis of LRTIs can be challenging, as the symptoms can be nonspecific and the underlying cause can be multifactorial. Therefore, various diagnostic tools and methods have been developed to aid in the diagnosis and treatment of LRTIs. And a prompt and accurate identification of the causative organism is essential for effective treatment [3,4].

Bronchoscopy is a diagnostic procedure that involves the insertion of a flexible or rigid tube through the mouth or nose and into the airways. The procedure allows the identification and management of LRTIs by allowing for the collection of lower respiratory tract specimens for microbiological evaluation. Bronchoscopy can provide valuable information about the diagnosis and management of LRTIs, as it can provide valuable information about the underlying pathology and the causative organism. Bronchoscopy can also aid in the identification of malignancies and other non-infectious causes of respiratory symptoms.

BAL fluid analysis is a common diagnostic tool used in bronchoscopy [5]. BAL involves the instillation and subsequent aspiration of sterile saline solution into the lower respiratory tract, with the goal of collecting fluid and cellular material from the airways. BAL fluid can be evaluated for the presence of microorganisms, inflammatory cells, and other markers of respiratory pathology. AFB smear and gram stain culture sensitivity are commonly used

microbiological tests that can be performed on BAL fluid to aid in the identification of the causative organism in LRTIs [6].

The aim of this study is to investigate 99 broncho-alveolar lavages in LRTI patients, with a focus on broncho-alveolar lavage acid fast bacilli smear and gram stain culture sensitivity.

## Materials and Methods

This study retrospectively analysed the bronchoscopy findings and microbiological profile of 99 patients with suspected LRTIs who underwent bronchoscopy at our institution. The study was conducted at a tertiary care hospital and included patients with suspected LRTIs who underwent bronchoscopy between January 2019 and December 2020. The study population included both male and female patients of various ages. Bronchoscopy was performed using a flexible bronchoscope, depending on the clinical indication. BAL fluid was collected from each patient and evaluated for the presence of microorganisms using AFB smear and gram stain culture sensitivity. Biopsy specimens were also collected in some patients, and the histopathological findings were analysed.

## Results

The results of this study showed that bronchoscopy was a valuable diagnostic tool for the evaluation of LRTIs. The male-female ratio of patients was 56:43 and the average age of patients was 45.38 years. Out of the 99 patients included in the study, 59 underwent AFB smear evaluation for mycobacterium tuberculosis. Out of 59 patients, 40 patients tested negative for tuberculosis, while 19 patients were positive. This is an important finding, as it suggests that tuberculosis may be a significant cause of pneumonia in this patient population. Additionally, the fact that some patients were only mildly positive (1+ or 2+) while others were strongly positive (3+ or 4+) suggests that there may be varying degrees of tuberculosis infection severity in this population (Table 1).

BAL fluid AFB (59)	Count of BAL fluid AFB
Negative	40
Positive (+)	11
Positive (++)	2
Positive (+++)	3
Positive (++++)	3
Grand total	59

**Table 1.** BAL fluid for AFB smear results.

59 patients were evaluated for *Mycobacterium tuberculosis*, out of 59 patients 40 came negative for tuberculosis and 19 patients were mycobacterium tuberculosis positive. 11 patients were 1+ positive, 2 patients were 2+ positive and 3-3 patient were 3+ and 4+ positive respectively.

Out of 99 patients, 39 had no organisms grow in their BAL fluid culture, indicating that their pneumonia may have been caused by non-infectious factors such as aspiration or other non-infectious causes. However, 43 patients had positive cultures, with

*Klebsiella* and *Pseudomonas* being the most common bacterial species identified (Table 2). This suggests that these bacteria may be particularly virulent or common causes of pneumonia in this patient population. Fungal culture evaluation was performed in 17 patients, and only one patient was positive for aspergillus. Biopsy specimens were collected in 16 patients, with squamous cell carcinoma being the most common finding. This suggests that some cases of pneumonia may be caused by underlying malignancies, which may have been missed by other diagnostic methods (Table 3).

BAL fluid bacterial culture and sensitivity (81)	Frequency of organism grow
No bacteria	39
<i>Klebsiella</i> species	10
<i>Pseudomonas aeruginosa</i>	17
<i>E. coli</i>	4
<i>Staphylococcus aureus</i> (mssa)	2
<i>Staphylococcus aureus</i> (mrsa)	2
<i>Pseudomonas species, Klebsiella species</i>	1
<i>Enterobacter species</i>	1

**Table 2.** BAL fluid assessment for bacterial culture.

Out of 99 patients, no organism grow in 39 patients and came positive in 43 patients, *Klebsiella* was found in 10 patients, *Pseudomonas* was found in 18 patients, *E. coli* in 4

patients, *S. aureus* (MSSA) in 2 patients and 2 patients has MRSA and 1 patient came positive for *Enterobacter* and 1 patient came positive for both *Pseudomonas* and *Klebsiella*.

Biopsy (16)	Frequency
Squamous cell	8
Adenocarcinoma	2
Round cell tumor	1
Non-small cell carcinoma	1
Granulomatous lesion-tubercular	3
Fungal infection	1

**Table 3.** Biopsy assessment for histopathological examination.

Biopsy was done in 16 patients, 8 patients have squamous cell carcinoma, 1 patient found round cell tumors, and 3 patients found granulomatous lesions, 1 patient found non-cell carcinoma, 1 patient found positive for fungal infections

Five patients with pneumonia also have pleural effusions. Two out of the five patients who underwent pleural fluid evaluation were found to have adenocarcinoma.

## Discussion

The demographic characteristics of the patients were recorded, including age and gender. The bronchoscopy findings, including the presence of tumours, foreign bodies, or other abnormalities, were noted. This suggests that the patients likely had severe or complicated pneumonia that required further investigation beyond typical diagnostic methods such as chest x-rays or blood tests.

The results of this study showed that the average age of the patients was 45.38 years. The male-female ratio of patients was 56:43, indicating that pneumonia does not appear to have a significant gender bias. However, this sample size is relatively small, and further studies would be required to draw more conclusive gender related findings.

In this study samples of BAL fluid were collected and analysed for AFB smear and bacterial culture sensitivity, as well as for fungal

culture sensitivity in a subset of patients. Biopsies were also performed on some patients to obtain tissue samples for pathological analysis. In terms of microbiological analysis, 59 patients underwent BAL AFB smear, with 19 patients testing positive for *Mycobacterium tuberculosis*. Of these, 11 patients were only mildly positive (1+ or 2+), while 8 patients were strongly positive (3+ or 4+). Bacterial culture sensitivity was performed on BAL fluid samples from 99 patients, with no organism growth in 39 patients and positive growth in 43 patients. The most common bacterial species identified were *Klebsiella* (23.3%) and *Pseudomonas* (41.9%). Fungal culture sensitivity was performed on BAL fluid samples from 17 patients, with only one patient testing positive for *Aspergillus*.

Previous research has suggested that mycobacterium tuberculosis can be an important cause of pneumonia, particularly in areas with high rates of tuberculosis infection [7,8]. The importance of bronchoscopy in sputum smear-negative tuberculosis patients was evaluated by Kalawar et al. BAL samples were positive in 82.2% of sputum smear-negative samples. The culture positivity of BAL samples was 90.9% as compared to sputum culture positivity which was 26.4%. Overall diagnosis could be established in 86.6% of patients with the help of fibre optic bronchoscopy [9]. The finding that 19 out of 59 patients tested positive for mycobacterium tuberculosis in this study is consistent with this previous research. Similarly, previous research has identified *Klebsiella* and *Pseudomonas* as common causes of pneumonia, particularly in patients with risk factors such as Chronic Obstructive Pulmonary Disease (COPD) and immunosuppression [10].

The finding that these bacterial species were the most commonly identified in the BAL fluid samples of this study's patient population aligns with this previous research. Finally, previous research has also suggested that fungal infections are relatively uncommon in patients with pneumonia, particularly in those who are not immunocompromised. The finding that only one patient tested positive for *Aspergillus* in the fungal culture sensitivity analysis of this study is consistent with this previous research.

The findings of this study highlight the complexity and multifactorial nature of LRTIs. While endobronchial tumours were the most common finding on bronchoscopy, the majority of patients had normal bronchoscopy findings. Microbiological analysis showed that *Mycobacterium tuberculosis* and bacterial infections, particularly *Klebsiella* and *pseudomonas*, were significant causes of LRTIs in this patient population. Fungal infections appeared to be less common causes of LRTIs.

Previous research has suggested that endobronchial tumours are a common finding in patients undergoing bronchoscopy. The finding that endobronchial tumours were the most common bronchoscopy finding in this study's patient population aligns with this previous research.

The majority of patients in this study had normal bronchoscopy findings. This is not surprising, as bronchoscopy is typically only performed when other diagnostic methods have failed to provide a diagnosis or when there is a suspicion of a specific condition that can be visualized by bronchoscopy.

The finding that squamous cell carcinoma was the most common biopsy finding in this study is consistent with previous research suggesting that lung cancer, particularly squamous cell carcinoma, is a common cause of respiratory symptoms.

The finding that only one patient tested positive for fungal infection in this study is consistent with previous research suggesting that fungal infections are relatively uncommon in patients undergoing bronchoscopy.

The most common bronchoscopy finding was inflamed mucosa, endobronchial tumour and endobronchial lesion. The majority of patients (59.6%) had normal bronchoscopy findings. Biopsies were performed on 16 patients, with squamous cell carcinoma being the most common finding (50%). Other findings included granulomatous lesions (12.5%), chronic inflammatory lesions (6.25%), and non-cell carcinoma (6.25%). One patient tested positive for fungal infection (6.25%).

The results of this study highlight the importance of bronchoscopy in the diagnosis and management of LRTIs. The identification of mycobacterium tuberculosis in a significant proportion of patients underscores the importance of considering tuberculosis in the differential diagnosis of LRTIs. The high prevalence of gram-negative bacterial infections, particularly *Klebsiella* and *Pseudomonas*, suggests that these organisms may be particularly virulent or common in this patient population. However, it is important to note that this is only an average, and the age range of the patients could vary significantly.

There are several limitations to this study that should be considered. Firstly, the sample size is relatively small, with only 99 patients included in the study. This may limit the generalizability of the findings to larger populations. Secondly, the

study only included patients who underwent bronchoscopy, which may have introduced selection bias. Patients who were too ill to undergo the procedure or who had contraindications may have been excluded, which could affect the representativeness of the sample. Thirdly, the study did not include a control group, which makes it difficult to compare the findings with a group of patients who did not undergo bronchoscopy. Fourthly, the study was conducted at a single centre, which may limit the generalizability of the findings to other settings. Lastly, the study did not explore the cost-effectiveness of bronchoscopy as a diagnostic tool compared to other available methods, which could be an important consideration for healthcare providers and policymakers.

## Conclusion

In conclusion, the results of this study indicate that bronchoscopy is a valuable diagnostic tool for evaluating lower respiratory tract infections. The study also highlights the prevalence of tuberculosis and bacterial species such as *Klebsiella* and *pseudomonas* as potential causes of pneumonia in this patient population. Furthermore, the study suggests that some cases of pneumonia may be caused by non-infectious factors such as aspiration, as well as underlying malignancies such as squamous cell carcinoma and adenocarcinoma. These findings highlight the importance of a comprehensive diagnostic approach to identify the underlying cause of pneumonia and guide appropriate treatment. Further research may be needed to confirm these results and investigate the potential implications for clinical practice.

## Conflict of Interest

There is no conflict of interest.

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