Acta Scientific MEDICAL SCIENCES (ISSN: 2582-0931)

Volume 9 Issue 7 July 2025

Research Article

Bronchoscopy-Guided Pathogen Identification in Suspected Lower Respiratory Tract Infections

Marco Umberto Scaramozzino[1]* and Tiziana Bruno[2]

[1]*Head of Thoracic Endoscopy and Rehabilitation Pulmonology Services, Villa Aurora Hospital Reggio Calabria, Italy*

[2]*Thoracic Endoscopy Service, Villa Aurora Hospital Reggio Calabria, Italy*

***Corresponding Author:** Marco Umberto Scaramozzino, Head of Thoracic Endoscopy and Rehabilitation Pulmonology Services, Villa Aurora Hospital Reggio Calabria, Italy.

DOI: 10.31080/ASMS.2025.09.2118

Received: June 12, 2025

Published: June 23, 2025

Abstract

Lower respiratory tract infections (LRTIs) continue to represent a diagnostic and therapeutic challenge due to their broad etiology and overlapping clinical features with non-infectious pulmonary diseases. This retrospective study evaluated the diagnostic contribution of bronchoscopy with bronchoaspirate analysis in 100 patients with suspected LRTIs between 2022 and 2025. Bronchoalveolar lavage (BAL) and targeted microbiological testing led to pathogen identification in 20% of cases, isolating both common and atypical organisms. Among the 20 positive cases, pathogens such as *Legionella pneumophila*, *Mycobacterium intracellulare*, and *Pseudomonas aeruginosa* were identified, highlighting the diagnostic superiority of bronchoscopic sampling compared to non-invasive techniques. The remaining 80% of cases had negative bronchoaspirate results, reinforcing bronchoscopy's value even in excluding infections. Timely and accurate identification of causative pathogens facilitated appropriate antimicrobial therapy and improved clinical outcomes. Our findings underscore bronchoscopy's essential role in the precise management of LRTIs.

Keywords: Bronchoscopy, Bronchoaspirate; Lower Respiratory Tract Infections; BAL; Pathogen Identification; Diagnostic Yield

Introduction

Lower respiratory tract infections (LRTIs) are among the most frequent causes of morbidity and mortality worldwide, particularly in vulnerable populations such as the elderly and immunocompromised patients [1,2]. Despite advancements in imaging and laboratory diagnostics, identifying the etiologic agent remains a cornerstone for initiating targeted therapy and avoiding antibiotic misuse [3]. Bronchoscopy, particularly when combined with bronchoalveolar lavage (BAL) or protected specimen brushing (PSB), offers direct visualization of the bronchial tree and targeted sampling of the lower airways [4,5]. Its role in diagnosing infectious pulmonary diseases is well-established, but the accuracy and impact of bronchoaspirate analysis in everyday clinical settings warrants ongoing investigation [6-8]. This study aims to demonstrate the effectiveness of bronchoscopy in identifying infectious agents in patients with suspected LRTIs and to evaluate its impact on clinical decision-making and treatment outcomes.

Materials and Methods

A retrospective observational study was conducted on 100 patients who underwent diagnostic bronchoscopy for suspected LRTIs between January 2022 and March 2025 at a tertiary care

pulmonary center. All patients had clinical and radiological evidence suggestive of infection, including new or worsening infiltrates on imaging, fever, cough, or increased sputum production. Bronchoscopies were performed using standard flexible bronchoscopes under local anesthesia and conscious sedation. Bronchoaspirate and bronchoalveolar lavage (BAL) specimens were obtained and sent for bacterial, mycobacterial, fungal, and molecular testing, including PCR for atypical pathogens. Samples were processed according to current microbiological guidelines [9-11]. Patient data, including age, comorbidities, radiologic findings, previous empirical antibiotic therapy, and final diagnosis, were extracted from electronic medical records. Microbiological results were compared to those from non-invasive methods such as sputum culture, blood culture, and serology.

Results

Out of the 100 bronchoscopies performed, 20 bronchoaspirate samples (20%) tested positive for at least one pathogenic microorganism. The remaining 80 bronchoscopies (80%) were negative. The pathogens isolated are detailed in Table 1.

Isolated Pathogens in Bronchoscopy Diagnosis of LRTIs		
Pathogen	***Number of Isolates***	***Type***
Legionella pneumophila	2	**Atypical**
Intracellular Mycobacterium (NTM)	2	**Atypical**
Mycoplasma pneumoniae	1	**Atypical**
Chlamydophila pneumoniae	1	**Atypical**
Staphylococcus aureus	2	Common
Candida albicans	1	**Common (Fungal)**
Trichomonas gallinae	1	**Common (Protozoa)**
Pseudomonas aeruginosa	2	Common
Streptococcus mitis	1	Common
Streptococcus pneumoniae	1	Common
Escherichia coli	1	Common
Proteus mirabilis	1	Common
Haemophilus influenzae	1	Common
Morganella morganii	1	Common

Table 1: Pathogens identified in bronchoaspirate samples from 2022 to 2025.

Among the 20 isolates, 4 were atypical pathogens: *Legionella pneumophila* (2), *Mycobacterium intracellulare* (2). Common pathogens included *Staphylococcus aureus* (2), *Pseudomonas aeruginosa* (2), *Mycoplasma pneumoniae* (1), *Chlamydophila pneumoniae* (1), *Candida albicans* (1), *Trichomonas gallinae* (1), *Streptococcus mitis* (1), *Streptococcus pneumoniae* (1), *Escherichia coli* (1), *Proteus mirabilis* (1), *Haemophilus influenzae* (1), and *Morganella morganii* (1). Positive bronchoscopic findings led to changes in antimicrobial management in 90% of those cases. In the negative group, clinical follow-up allowed for the exclusion of infection in 76% of patients, while alternative diagnoses were pursued in the remainder.

Discussion

The identification of pathogens in LRTIs is critical for guiding effective antimicrobial therapy. Our data suggest that bronchoscopy with bronchoaspirate analysis significantly contributes to pathogen detection, particularly in cases where non-invasive methods are inconclusive or negative [12-14]. Atypical pathogens such as *Legionella* and *Mycobacterium intracellulare* are notoriously difficult to isolate without direct lower airway sampling [15-17]. Molecular diagnostics such as PCR increase sensitivity but require high-quality specimens, which bronchoscopy reliably provides [18-20]. Negative bronchoaspirate results, while seemingly unhelpful, actually assist clinicians in ruling out infection and redirecting diagnostic efforts, reducing unnecessary antibiotic exposure [21-23]. In our study, 80% of bronchoscopies did not yield a pathogen, yet most of these patients benefited from a re-evaluation of their diagnosis and therapeutic strategy. The results support international guidelines advocating for bronchoscopy in cases of non-resolving pneumonia, immunosuppressed hosts, and suspected atypical infections [24-26]. Furthermore, the microbiological spectrum seen in this study aligns with published data on the prevalence of LRTI pathogens in hospitalized patients [27-29]. Limitations include the retrospective design and the absence of a control group. However, the consistency of findings across other studies enhances the validity of our conclusions.

Conclusions

Bronchoscopy with bronchoaspirate analysis is a valuable tool in the diagnosis and management of lower respiratory tract infections. It not only facilitates the detection of both typical

and atypical pathogens but also plays a crucial role in excluding infection, guiding appropriate therapy, and reducing diagnostic uncertainty. Routine use of bronchoscopy in selected clinical scenarios—particularly in hospitalized or immunocompromised patients with non-resolving pneumonia—should be considered standard practice. Future prospective studies are needed to confirm these findings and to evaluate the cost-effectiveness of bronchoscopy-guided diagnostics in LRTIs.

Bibliography

1. Torres A., *et al*. "ERS technical standard on bronchial challenge testing: pathophysiology and methodology of indirect airway challenge testing". *European Respiratory Journal* 52.3 (2018): 1800630.
2. Mandell LA., *et al*. "Infectious Diseases Society of America/ American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults". *Clinical Infectious Diseases* 44.2 (2007): S27-72.
3. Niederman MS. "Aspiration Pneumonia". *The New England Journal of Medicine* 344.8 (2001): 602-612.
4. Pratter MR., *et al*. *Chest* 84.4 (1983): 521-525.
5. Herth FJF., *et al*. *American Journal of Respiratory and Critical Care Medicine* 167.7 (2003): 963-968.
6. Woodring JH. *Radiology* 186.2 (1993): 389-394.
7. Wiener RS., *et al*. *Chest* 142.2 (2012): 388-397.
8. Kvale PA. *Chest* 113.5 (1998): 1311-1321.
9. Murray PR., *et al*. *Manual of Clinical Microbiology*. ASM Press (2020).
10. CLSI. "M100 Performance Standards for Antimicrobial Susceptibility Testing" (2023).
11. ATS/IDSA. *American Journal of Respiratory and Critical Care Medicine* 200.7 (2019): e45-e67.
12. Lee MK., *et al*. *The International Journal of Tuberculosis and Lung Disease* 14.3 (2023): 295-300.
13. Chastre J., *et al*. *American Journal of Respiratory and Critical Care Medicine* 165.7 (2002): 867-903.
14. Rello J., *et al*. *Chest* 112.2 (1997): 409-417.
15. Phin N., *et al*. *Lancet Infectious Disease* 14.10 (2014): 1011-1021.
16. Diederen BMW. *Clinical Microbiology Infection* 14.4 (2011): 395-413.
17. Griffith DE., *et al*. "An official ATS/IDSA statement: diagnosis, treatment, and prevention of nontuberculous mycobacterial diseases". *American Journal of Respiratory and Critical Care Medicine* 175.4 (2007): 367-416.
18. Murdoch DR. *Clinical Infectious Diseases* 39.11 (2004): 1657-1664.
19. Templeton KE., *et al*. *Journal of Clinical Microbiology* 43.3 (2005): 1436-1440.
20. Lee FE., *et al*. *Current Opinion in Pulmonary Medicine* 16.3 (2010): 240-247.
21. Dheda K., *et al*. "The epidemiology, pathogenesis, transmission, diagnosis, and management of multidrug-resistant, extensively drug-resistant, and incurable tuberculosis". *Lancet Respiratory Medicine* 4.6 (2016): 456-466.
22. Jain S., *et al*. "Community-Acquired Pneumonia Requiring Hospitalization among U.S. Adults". *The New England Journal of Medicine* 373.5 (2015): 415-427.
23. Metlay JP., *et al*. *JAMA* 322.8 (2019): 716-725.
24. IDSA/ATS Guidelines. *Clinical Infectious Diseases* 68.6 (2019): e1-e77.
25. Aliberti S., *et al*. *Thorax* 72.10 (2017): 928-936.
26. Ewig S., *et al*. *European Respiratory Journal* 18.5 (2001): 861-869.
27. Gadsby NJ., *et al*. *Thorax* 71.10 (2016): 940-949.
28. Marrie TJ. "Community-acquired pneumonia". *Clinical Infectious Diseases* 18.4 (1994): 501-513.
29. Wunderink RG., *et al*. *Chest* 129.6 (2006): 1579-1585.
30. Huang DT., *et al*. *JAMA* 322.8 (2019): 717-725.