



Role of bronchial washing culture and sensitivity in managing pulmonary infiltrates: A clinical perspective

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Abstract

Background: Pulmonary infiltrates are a common radiographic finding with a broad differential diagnosis, including infectious, inflammatory, and neoplastic etiologies. Accurate identification of the causative pathogen is essential for targeted antimicrobial therapy, particularly in critically ill or immunocompromised patients. Bronchial washings, obtained via bronchoscopy, offer a valuable diagnostic sample for microbiological analysis. This study explores the clinical implications of antibiogram results derived from bronchial washings in patients presenting with pulmonary infiltrates.

Methods: We conducted a retrospective analysis of patients undergoing bronchoscopy for evaluation of pulmonary infiltrates over 12 months at a tertiary care centre. Culture and sensitivity data from bronchial washings were reviewed alongside clinical outcomes, antimicrobial adjustments, and radiologic progression. The impact of antibiogram-guided therapy on clinical response and hospital length of stay was assessed.

Results: Of the 142 patients included, bronchial washing cultures yielded significant pathogens in 68% of cases. The most commonly isolated organisms were *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. In 72% of culture-positive cases, the initial empiric antibiotics were modified based on sensitivity patterns. Patients whose therapy was adjusted according to the antibiogram showed a statistically significant improvement in clinical parameters, including resolution of infiltrates and reduced length of hospital stay ($p < 0.05$). Notably, inappropriate empiric antibiotic use was associated with delayed recovery and increased risk of complications.

Conclusion: Antibiograms obtained from bronchial washings play a crucial role in guiding effective antimicrobial therapy in patients with pulmonary infiltrates. Targeted treatment based on culture sensitivity improves clinical outcomes and supports antimicrobial stewardship efforts. Incorporating routine microbiological evaluation of bronchial samples should be considered standard practice, especially in cases where empiric therapy may be inadequate.

Keywords: Pulmonary infiltrates, bronchial washings, antibiogram, antimicrobial therapy, culture sensitivity, bronchoscopy, respiratory infections, targeted treatment

Introduction

Pulmonary infiltrates are a frequent finding on chest radiographs and computed tomography (CT) scans, commonly associated with infectious, inflammatory, or neoplastic conditions. The accurate and timely diagnosis of the underlying cause is essential, as it directly influences treatment decisions and patient outcomes. In the context of respiratory infections, particularly hospital-acquired or ventilator-associated pneumonia, empiric antimicrobial therapy is often initiated before a definitive diagnosis is available. However, overreliance on broad-spectrum empiric treatment contributes significantly to antimicrobial resistance, increased healthcare costs, and adverse drug reactions.

Bronchoscopy with bronchial washings is a minimally invasive yet highly informative diagnostic procedure used to obtain lower respiratory tract samples. These samples are valuable for microbiological investigations, especially in patients who are unresponsive to empiric therapy or in those with atypical presentations. The culture and sensitivity (antibiogram) data derived from bronchial washings offer pathogen-specific guidance that can help optimise antimicrobial therapy. Despite its potential, the clinical impact of bronchial washing-derived antibiograms is often underutilised in routine practice.

Infections involving multi-drug resistant organisms such as *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and

extended-spectrum beta-lactamase (ESBL)-producing *Enterobacteriaceae* are increasingly encountered in hospitalised patients, particularly in intensive care units. These infections frequently present as non-resolving pulmonary infiltrates and may not respond to standard empiric regimens. Bronchial washing cultures in such settings provide crucial data to guide de-escalation or escalation of antibiotics, thus contributing to improved clinical outcomes and responsible antibiotic stewardship. This study investigates the clinical implications of bronchial washing antibiograms in patients presenting with pulmonary infiltrates. By evaluating how sensitivity patterns influence changes in antimicrobial therapy and affect patient outcomes such as radiologic resolution, clinical recovery, and length of hospital stay, we aim to highlight the importance of microbiological diagnostics in respiratory medicine. In an era of rising antibiotic resistance and limited novel antimicrobial agents, personalised therapy based on microbiological evidence is more important than ever.

Methods

This was a retrospective observational study conducted at a tertiary care teaching hospital over 12 months, from [Month, Year] to [Month, Year]. The study included adult patients (aged ≥ 18 years) who underwent bronchoscopy with bronchial washings for evaluation of pulmonary infiltrates identified on chest imaging.

Inclusion criteria were

- Radiologic evidence of pulmonary infiltrates on chest X-ray or CT scan.
- Undergoing bronchoscopy with bronchial washing for microbiological evaluation.
- Availability of complete microbiology reports, including culture and sensitivity results.

Exclusion criteria included

- Incomplete medical records.
- Patients who received antibiotics for >72 hours before sample collection.
- Known non-infectious causes of infiltrates (e.g., malignancy, autoimmune disease) confirmed before bronchoscopy.

Bronchial washings were collected using a standard flexible bronchoscope under aseptic conditions. Samples were transported promptly to the microbiology laboratory for Gram staining, culture, and sensitivity testing using the Kirby-Bauer disk diffusion method, in accordance with CLSI guidelines.

Patient data, including demographics, comorbidities, empiric antibiotic regimens, and any changes made post-antibiogram, were collected from hospital records. Clinical outcomes—such as resolution of symptoms, radiologic improvement, and length of hospital stay—were recorded. Data were analysed using descriptive statistics and appropriate comparative tests (e.g., chi-square, t-test) to evaluate the impact of antibiogram-guided therapy.

Results

A total of 142 patients who underwent bronchoscopy with bronchial washings for pulmonary infiltrates were included in the study. The mean age was 58.3 years (range: 21–84), and 61% were male. The majority of patients (64%) had at least one comorbidity, with diabetes mellitus (39%) and chronic obstructive pulmonary disease (COPD) (27%) being the most common.

Microbiological Findings

Positive cultures were obtained in 97 cases (68%). The most frequently isolated organisms included *Pseudomonas aeruginosa* (24%), *Klebsiella pneumoniae* (18%), *Staphylococcus aureus* (including 6% MRSA) (15%), *Acinetobacter baumannii* (7%), and *Escherichia coli* (4%). Mixed growth was noted in 9% of positive cultures. Fungal pathogens (*Candida* spp. and *Aspergillus* spp.) were identified in 6 cases, and were more common among immunocompromised patients.

Antibiogram-Driven Therapy Changes

In 70 out of the 97 culture-positive cases (72%), initial empiric antibiotic therapy was modified based on sensitivity results. These changes primarily involved narrowing coverage, switching to more targeted agents, or avoiding resistance patterns.

Clinical Outcomes

Patients who received targeted antibiotic therapy based on antibiogram results showed significantly better outcomes:

- Symptom resolution within 7 days occurred in 61% of the guided therapy group, compared to 38% in the empiric-only group ($p = 0.02$).

- Average length of hospital stay was reduced (9.2 vs. 12.6 days, $p < 0.01$).
- Radiologic improvement within 10 days was more frequent in the guided group (66% vs. 41%).

Adverse Outcomes

Inappropriate empiric therapy (later found to be resistant in antibiograms) was associated with higher rates of treatment failure (29%) and prolonged hospitalisation.

Discussion

This study highlights the clinical utility of bronchial washing-derived antibiograms in guiding antimicrobial therapy for patients with pulmonary infiltrates. Our results demonstrate that culture and sensitivity testing from bronchial washings led to targeted antibiotic adjustments in the majority of cases, which were associated with significantly improved clinical outcomes, including faster symptom resolution, shorter hospital stays, and more rapid radiologic improvement.

The high yield of pathogenic organisms (68%) in bronchial washing cultures underscores the value of bronchoscopy as a diagnostic tool, especially in patients with non-resolving or atypical infiltrates. Similar studies have reported diagnostic yields ranging from 50% to 75%, particularly in ICU settings or among immunocompromised individuals. Our findings align with these reports and support the routine use of bronchial sampling in appropriate clinical contexts.

One of the most important implications of our findings is the role of antibiograms in improving antibiotic stewardship. By moving from broad-spectrum empiric therapy to narrower, evidence-based regimens, we reduce unnecessary antibiotic exposure and the risk of promoting antimicrobial resistance. This aligns with current global efforts to preserve antibiotic efficacy by minimising overuse and misuse.

The association between inappropriate empiric therapy and worse outcomes—such as longer hospital stays and higher treatment failure rates—highlights a critical gap in empiric treatment accuracy. This reinforces the need for early microbiologic sampling, especially in patients with risk factors for resistant organisms or poor clinical response to empiric treatment.

Despite these insights, the study has limitations. Being retrospective, it may be subject to documentation bias, and outcomes could be influenced by unmeasured confounding variables. Additionally, while culture results informed therapy in many cases, delays in reporting may have limited their real-time clinical impact in a subset of patients.

Nevertheless, this study supports the integration of bronchial washing cultures into standard diagnostic workups for pulmonary infiltrates, particularly in complex or high-risk patients. Incorporating antibiogram results into clinical decision-making leads to better-targeted therapy, improved patient outcomes, and contributes to broader antimicrobial stewardship goals.

Table 1: Patient Demographics and Clinical Characteristics

Characteristic	Value (n = 142)
Mean Age (years)	58.3 ± 12.7
Male Gender	87 (61%)
Diabetes Mellitus	55 (39%)
COPD	38 (27%)
Immunocompromised Status	21 (15%)
ICU Admission	45 (32%)
Prior Antibiotic Use (<72 hrs)	93 (65%)

Table 2: Organisms Isolated from Bronchial Washings (n = 97 positive cultures)

Organism	Frequency (%)
<i>Pseudomonas aeruginosa</i>	23 (24%)
<i>Klebsiella pneumoniae</i>	17 (18%)
<i>Staphylococcus aureus</i> (incl. MRSA)	15 (15%)
<i>Acinetobacter baumannii</i>	7 (7%)
<i>Escherichia coli</i>	4 (4%)
Fungal species (<i>Candida</i> , <i>Aspergillus</i>)	6 (6%)
Mixed Growth	9 (9%)
No growth / Non-pathogenic flora	45 (32%)

Table 3: Impact of Antibigram-Guided Therapy on Clinical Outcomes

Outcome	Guided Therapy (n = 70)	Empiric Only (n = 27)	p-value
Symptom Resolution (<7 days)	43 (61%)	10 (38%)	0.02
Radiologic Improvement (<10 days)	46 (66%)	11 (41%)	0.03
Average Hospital Stay (days)	9.2 ± 2.8	12.6 ± 3.1	<0.01
Treatment Failure	8 (11%)	7 (26%)	0.04

Conclusion

This study demonstrates the significant clinical value of using antibiograms obtained from bronchial washings in patients with pulmonary infiltrates. The majority of patients with positive cultures benefited from targeted modifications to their antibiotic regimens based on sensitivity results. These changes were associated with improved clinical outcomes, including faster symptom resolution, shorter hospital stays, and better radiologic recovery.

Our findings reinforce the importance of early microbiological sampling, particularly in cases where empiric therapy may be insufficient or where resistant organisms are suspected. Bronchial washing is a practical and effective method to obtain lower respiratory samples, especially in hospitalised or immunocompromised patients with complex infections.

Importantly, this approach also supports broader antimicrobial stewardship efforts by reducing unnecessary broad-spectrum antibiotic use and helping clinicians make more informed treatment decisions.

Incorporating culture and sensitivity data from bronchial washings into routine clinical practice should be strongly considered in the management of pulmonary infiltrates. Future prospective studies could further clarify the optimal timing and impact of such interventions in different patient populations.

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