

Reasons for Low Bacterial Yields from Quantitative Cultures of Bronchoalveolar Lavage Fluid

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Early identification of the pathogenic organisms and proper antimicrobial treatment are essential to treating patients with pneumonia. Therefore, respiratory physicians have long tried to find a sensitive, specific, and safe method to obtain causative lower respiratory pathogens from such patients.

Expectorated sputum culture has been the most frequently used method in the clinic. However, due to upper airway contamination, it has a low sensitivity and specificity. In order to exclude contamination by upper airway microorganisms, the transtracheal aspiration method has been used to bypass the upper airway, but this also has limitations due to various complicating factors.

Because bronchoscopic examination is used commonly in the clinic, its role in identifying respiratory pathogens has been investigated. Use of a protected specimen brush and quantitative cultures of bronchoalveolar lavage (BAL) fluid are considered the most reliable methods to evaluate patients with pneumonia.

In the 1980s, two studies reported on quantitative cultures of BAL fluid. Kahn and Jones [1] prospectively evaluated both 75 patients and 18 controls without evidence of

respiratory infection for the presence of lower respiratory tract bacterial infections. Because they detected greater than 10^5 colony forming units (cfu) per milliliter, and less than 1% squamous epithelial cells in BAL fluid, the authors of that study concluded that BAL was useful for diagnosis of bacterial respiratory infections. Thorpe et al. [2] also reported that the BAL technique was useful for identifying causative pathogens in patients with acute bacterial pneumonia, as well as in immunocompromised patients presenting with pulmonary infiltrates with a positive BAL culture greater than 10^5 cfu/mL.

Subsequently, many studies aimed to identify the causative pathogens in patients with not only community-acquired pneumonia, but also with nosocomial, ventilator-associated pneumonia and pneumonia in immunocompromised patients.

Bronchoscopic examination seems more likely to find the etiologic organisms of pneumonia and less likely to have upper airway contamination compared to expectorated sputum analysis. However, it is less likely to detect etiologic organisms, especially when patients have received antibiotics before the bronchoscopic examination.

Kim et al. [3] found that the quantitative bacterial culture yield from BAL fluid was as low as 2.94% in patients with pneumonia who were concurrently receiving antimicrobials. This BAL yield was notably lower than that of

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previous studies, which reported 30-80% culture rates. Kim et al. [3] suggested that the lower yield in their study may have been caused by the concurrent use of antimicrobials. Considering that the use of antimicrobials before specimen culture decreased the yields of blood and sputum cultures, the long duration of antimicrobial treatment in their study (45% of patients received antimicrobials for more than one week before BAL) could explain their significantly lower yield. However, there may also be other reasons for the discrepant results [4].

First, the definition of a positive BAL yield is not uniform. The threshold for a positive bacterial culture yield from BAL fluid has been defined as 10^3 - 10^5 cfu/mL; this varies among studies. In earlier studies, a BAL culture yield greater than or equal to 10^5 cfu/mL was considered positive, but more recent studies have indicated that 10^4 cfu/mL is more sensitive and specific.

Second, differences in methodology exist. The amount of normal saline instilled during BAL is variable. Traditionally, infusion of more than 120 mL saline was recommended for adequate sampling of a pulmonary segment. Moon et al. [5] used mini-BAL, which retrieved only 25 mL BAL fluid, to isolate the causative pathogens of ventilator-associated pneumonia. They reported that the amount of normal saline required to retrieve 25 mL of BAL fluid was 93 ± 32 mL, which is markedly less than the traditional infusion volume of 120 mL.

Third, the patient populations used in these studies were large, and diverse, including those with bone marrow transplantation or solid organ transplantation, as well as non-immunocompromised patients with or without various medical illnesses.

Fourth, the concurrent use and/or duration of use of antimicrobials varied among the studies. It is known that the yields of blood and sputum cultures significantly decrease with the use of precultural antimicrobials. Previous studies have reported that the yield of bacterial pathogens is influenced by the concurrent use and/or duration of use of antimicrobials [6]. Kottmann et al. [7] reported that if BAL was performed within three days of starting treatment-dose antibiotics, the overall yield was 63.4%, but was reduced to 57.6% and 34.4% when performed within 3-14 days or after 14 days, respectively. Therefore, they suggested that the optimal time for performance of BAL is within three days of the initiation of broad-spectrum antibiotics.

In conclusion, bronchoscopy in conjunction with quantitative BAL fluid culture is a useful strategy for identifying causative pathogens in diverse populations of patients with pneumonia. The utility of quantitative BAL fluid cultures may be limited in patients receiving antibiotic therapy. Therefore, physicians should use caution when deciding whether BAL is necessary, weighing the risks and benefits, and, if so, when is the best time to perform the procedure if the patients are receiving antibiotic therapy. Further studies are needed to standardize the BAL technique and the optimal time to perform the procedure in patients with pneumonia who are also receiving antimicrobial treatment.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Kahn FW, Jones JM. Diagnosing bacterial respiratory infection by bronchoalveolar lavage. *J Infect Dis* 1987;155:862-869.
2. Thorpe JE, Baughman RP, Frame PT, Wesseler TA, Staneck JL. Bronchoalveolar lavage for diagnosing acute bacterial pneumonia. *J Infect Dis* 1987;155:855-861.
3. Kim ES, Kim EC, Lee SM, et al. Bacterial yield from quantitative cultures of bronchoalveolar lavage fluid in patients with pneumonia on antimicrobial therapy. *Korean J Med* 2012;27:156-162.
4. Cantral DE, Tape TG, Reed EC, Spurzem JR, Rennard SI, Thompson AB. Quantitative culture of bronchoalveolar lavage fluid for the diagnosis of bacterial pneumonia. *Am J Med* 1993;95:601-607.
5. Moon DS, Lim CM, Pai CH, et al. Study for diagnostic efficacy of minibronchoalveolar lavage in the detection of etiologic agents of ventilator-associated pneumonia in patients receiving antibiotics. *Tuberc Respir Dis* 1999;47:321-330.
6. Souweine B, Veber B, Bedos JP, et al. Diagnostic accuracy of protected specimen brush and bronchoalveolar lavage in nosocomial pneumonia: impact of previous antimicrobial treatments. *Crit Care Med* 1998;26:236-244.
7. Kottmann RM, Kelly J, Lyda E, et al. Bronchoscopy with bronchoalveolar lavage: determinants of yield and impact on management in immunosuppressed patients. *Thorax* 2011;66:823.