The clinical use of BAL in patients with pulmonary infections.

Eur Respir J
1990, 3, 937–974

Clinical guidelines and indications for bronchoalveolar lavage (BAL): Report of the European Society of Pneumology Task Group on BAL

Edited by H. Klech* and C. Hutter

This group report was developed jointly by: U. Costabel (Essen), C. Danel (Paris), L.M. Fabbri (Padova), P.L. Haslam (London), C. Hutter (Vienna) secretary, D. Israel-Biet (Paris), H. Klech (Vienna) chairman, W. Pohl (Vienna) secretary, L.W. Poulter (London), E. Pozzi (Torino), S.I. Rennard (Omaha), V. De Rose (Torino), G.A. Rossi (Genova), M. Rust (Frankfurt), G. Semenzato (Padova), B. Wallaert (Lille).

Further contributors: C. Albera (Torino), W. Bauer (Bern), L. Bjermer (Umea), L. Carratu (Napoli), C.F. Donner (Veruno), H. Eckert (Berlin), P.H. Godard (Montpellier), T. Izumi (Kyoto), J. Linder (Omaha), D. Olivieri (Parma), M. Pirozynski (Warsaw), W. Pohl, G. Rizzato (Milano), A.J.A. Robalo-Cordeiro (Coibra), C. Sanguinetti (Ancona), N. Secen (Novisad), Y. Sibille (Brussels), M. Spiteri (London), I. Striz (Prague), H. Teschler (Essen), M. Tonnel (Lille), G. Velluti (Modena), H. Worth (Duesseldorf).

*Request for reprints: H. Klech, 2nd Medical Department, Wilhelminenspital, Montleartstrasse 37, A-1160 Vienna, Austria.

Contents

The clinical use of BAL in patients with pulmonary infections

M. Rust, C. Albera, L. Carratu, C. Danel, D. Israel-Biet, H. Klech, S.I. Rennard, A.J.A. Robalo-Cordeiro, G. Semenzato, G. Velluti, H. Worth

In immunocompetent patients with community acquired pneumonia, as well as in the immunocompetent host with nosocomial pneumonia, a calculated therapy can be initiated without prior invasive diagnostic procedure. This kind of patient management, however, is not warranted in immunocompromised or immunodeficient patients, in whom an exact diagnosis and the identification of the organism causing pneumonia is of utmost importance to select the correct therapeutic regime. If less invasive techniques like blood cultures were not successful in establishing the diagnosis, or the results from other procedures such as sputum induction were nondiagnostic, it is necessary to obtain specimens from the lower respiratory tract. These specimens can be taken using transtracheal aspiration, fibreoptic bronchoscopy, transthoracic needle puncture, or open lung biopsy. Such invasive procedures may also be necessary in the immunocompetent host, if therapy for a community acquired pneumonia or nosocomial pneumonia have failed and less invasive procedures are not likely to identify the cause of the disease.

As experience during the past years has shown, taking microbiological samples by protected brush, bronchoalveolar lavage and/or transbronchial lung biopsy are methods which combine a low rate of side-effects and a sufficient diagnostic yield when used in this context [222–224]. Also bronchoalveolar lavage alone is a sensitive method to establish the diagnosis of infection of the lower respiratory tract caused by bacteria [222, 223], mycobacteria [225], viruses [226] and other opportunistic infections of the lung (*e.g. Pneumocystis carinii* pneumonia) [227, 228] (summary in table 1).

Indications for bronchoalveolar lavage in patients with pulmonary infections

Immunodeficient or immunocompromised patients. In the clinical setting of an immunocompromised host (*e.g.* patients receiving immunosuppressive agents) or immunodeficient host (*e.g.* neutropenic patients) having pulmonary infiltrates suggesting lower respiratory tract infection, we recommend use of bronchoalveolar lavage as a means of obtaining samples from the lower respiratory tract for microbiological work-up. If the platelet count is normal, no clotting abnormalities are present and the patient is not at risk for mechanical ventilation, a transbronchial lung biopsy may be performed at the same time. Although TLB is not recommended in patients with thrombopenia or clotting abnormalities, a normal BAL has been safely applied even in thrombocytopenic and granulocytopenic patients after intensive cytotoxic therapy in conjunction with bone marrow transplantation [229].

In patients with an advanced HIV infection and suspected *Pneumocystis carinii* pneumonia an induced sputum [221] should precede the bronchoalveolar lavage. If sputum is nondiagnostic, BAL should be performed as soon as possible. In the majority of patients with HIV infection and pulmonary infiltrates the diagnosis can be established by BAL without additional transbronchial lung biopsy. BAL is reported to have a diagnostic yield to identify PC-infection of over 90%, followed by TLB with 75% and brush biopsy of only 32% [211]. Thus, considering the potential bleeding risk of an HIV infected patient with diffuse pulmonary Kaposi sarcoma, transbronchial lung biopsy should only be performed,

Table 1. – Microbiological diagnosis from BAL

	Technique, stains	Value	References
P. carinii	Wright-Giemsa Diff Quick Gomori-Grocott	80–90% sens.	[1, 3, 227–2302]
Cytomegalovirus	Virus cell inclusions		[231]
Herpes simplex	Immunofluoresc., Immunochem. DNA probe analysis		[226, 232] [233]
Mycobacteria	Ziehl-Neelsen Auramin-Rhodamin	atyp, typ. Tbc	[1, 227, 227]
Fungi	Silverstain Monoclonal antibod.	*Candida*, *Aspergillus*, *Alternaria*	[1, 229, 231, 234–237]
Bacteria	Gram stain		[238, 239]
	Semiquant. counting of CFU	Colonization or infection	[1, 224, 222]
Legionella	Direct immunofluoresc.		[240]

if prior investigations including BAL were nondiagnostic.

Immunocompetent patients. Bronchoalveolar lavage has been successfully used in this clinical setting also, in particular in patients suggestive for nosocomial pneumonia by help of Gram stains and bacterial cultures; semiquantitative counting of bacteria helps to differentiate between colonization and infection [222, 224, 239, 239]. Legionella infections can be detected either by direct immunofluorescence technique [240] or by bacterial culture.

Technique of bronchoalveolar lavage

Bronchoalveolar lavage is performed during fibreoptic bronchoscopy as described previously [1]. Although some local anaesthesia may be necessary to perform this procedure, the anaesthetic should not be instilled directly into the segment to be lavaged, as it may inhibit bacterial growth in the culture. Bronchoalveolar lavage should be performed in a segment which has been shown to be infiltrated on chest radiograph or from which purulent secretion is discharged during bronchoscopy. In adult patients a volume of 50–100 ml of saline should be used in this clinical setting. For the interpretation of laboratory results from BAL it may be helpful to obtain specimens from the oral cavity and hypopharynx at the time of the BAL. Supplemental oxygen should be given during the entire procedure and for at least 1 h after the bronchoscopy.

As immunocompromised patients with a pneumonia are at risk to develop respiratory failure, prior to BAL an arterial blood gas analysis should confirm that the patient is not at risk to develop respiratory distress during or after bronchoalveolar lavage. If arterial oxygen tension (Pao_2) despite supplemental oxygen is <65 mmHg bronchoalveolar lavage should be performed with care, reducing the volume of saline to be instilled. As the Pao_2 may drop substantially after bronchoalveolar lavage, adequate preparations have to be taken so that the patient can be intubated and ventilated if necessary. During the procedure vital signs, oxygen saturation and cardiac rhythm should be monitored continuously.

Work-up of specimens obtained by bronchoalveolar lavage

Specimens obtained from immunocompromised or immunodeficient patients should be processed as soon as possible, thus avoiding further contamination or missing such agents as anaerobic bacteria. Bronchoalveolar lavage fluid should be worked up for bacterial, fungal, opportunistic and viral infections. In addition the specimens should be examined by a cytopathologist to exclude a malignancy. The techniques used for these purposes are described in the technical recommendations and guidelines for BAL. In summary BAL fluid should be stained and cultured quantitatively for bacteria [224] using appropriate media, stained and cultured for mycobacteria including mycobacteria other than *M. tuberculosis* (MOTT) and for fungi. A *Pneumocystis carinii* infection should be ruled out by appropriate stains (Wright-Giemsa, silver stain, toluidine blue or monoclonal antibodies). Viral infections should be excluded using antibodies, viral cultures and DNA/RNA-probe analysis. If necessary electron microscopy enables a rapid differentiation of virus in bronchoalveolar lavage fluid.

In patients with HIV infection and diffuse pulmonary infiltrates a cell differential on a bronchoalveolar lavage slide may help to establish the diagnosis of lymphocytic interstitial pneumonia. Results from staining with appropriate antibodies and the demonstration of HIV in material from BAL may indicate the presence of nonspecific interstitial pneumonitis [242]

Interpretation of laboratory results

Results from BAL of immunocompromised or immunodeficient patients should be evaluated with care, considering the underlying disease, the history, the immunological status and the clinical features. In particular, the presence of cytomegalovirus (CMV) as shown by cultures or DNA-probe does not always indicate a clinically relevant infection. In case of detection of fungi or bacteria the clinician has to decide whether there is an infection, which should be treated, or a mere colonization. Quantitative cultures [224] may help to distinguish these two conditions.

Conclusions

BAL is the method of choice in diagnosis of opportunistic infections (bacteria, viruses, fungi, protozoa) of the lower respiratory tract in particular in immunodeficient or immunocompromised patients. Highest diagnostic yield is reported in the diagnosis of *P. carinii* pneumonia (>90%), which in many cases obviates the need of a lung biopsy. BAL can even be performed in patients with underlying respiratory insufficiency or in thrombocytopenic patients provided appropriate safety measures and selection of patients are undertaken. In patients with bacterial infections BAL may contribute to discrimination between bacterial colonization or true parenchymatous infection.

Other therapeutic applications of BAL

WLL has been proposed in the treatment of some other pulmonary disorders such as alveolar microlithiasis or exogenous lipoidosis, with some clinical but without any objective functional or radiological improvement [282].

In cystic fibrosis (CF), the benefit of WLL is also difficult to evaluate. It was expected that periodical repeated WLL could, if not arrest, at least slow down the progressive deterioration of lung function caused by the accumulation of bronchial secretions [289, 290]. Some authors have proposed WLL using antifungal drugs as a local treatment of aspergillosis, a frequent complication of CF [290]. This requires further investigation.

Conclusions

The therapeutic value of BAL is now perfectly established in alveolar proteinosis, which remains the only definite indication of this procedure. In other lung disorders, this technique still has a risk/benefit ratio which does not argue for its use in routine clinical practice. Its indication should be discussed for each patient and performed by an experienced staff in the context of an intensive care unit.

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