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**BRONCHOALVEOLAR LAVAGE. BASIC ASPECTS AND DIAGNOSTIC VALUE**

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By definition bronchoalveolar lavage (BAL) is a method for the recovery of cellular and non-cellular components from the lower respiratory tract (e.g. alveoli). It is a safe technique, with few major complications. In many cases (e.g. pulmonary proteinosis, alveolar hemorrhage, eosinophilic pneumonia) BAL can replace lung biopsy. Bronchoscopy with bronchoalveolar lavage (BAL) is an important tool for the diagnosis of pulmonary infections and malignancies. Flexible fiberoptic bronchoscopy is a relatively safe and minimally invasive means by which to obtain bronchoalveolar lavage fluid (BALF). It is usually well tolerated by patients and can be performed safely even on those patients who are quite ill.

The diagnostic and prognostic utility of BAL was first evaluated in the 1990s. The investigatory technique of BAL has become one of the most valuable research tools for studying inflammatory mechanisms in a wide range of diseases that affect the lungs and airways in humans. In addition, cytological and microbiological testing of BAL samples are of established value for assisting in clinical diagnosis and management of many lung diseases, and these procedures are available routinely. Since the introduction of the rigid bronchoscope by Dr. Jackson in 1904, BAL is a diagnostic procedure in which a fiber-optic bronchoscope is passed through the mouth or nose into the lung and fluid is put into a small part of the lung and then recollected for examination.

Bronchoalveolar lavage is typically performed to diagnose lung disease. Primarily, BAL was used as a treatment for patients who suffered from diseases associated with accumulation of purulent secretions such as alveolar proteinosis, cystic fibrosis and bacterial pneumonia .

Procedure. Bronchoalveolar Lavage is a minimally invasive technique which is used to obtain cells, inhaled particles, infectious organisms and solutes from the alveolar spaces of the lung. To achieve this, a sufficient volume of lavage fluid must be instilled to ensure a sufficient aspirate. In adults, a minimum of 100 mL of lavage fluid should be instilled. Besides diagnostic BAL, there are other lavage techniques are used and they differ in the following ways: 1) bronchial lavage (or bronchial washing) requires relatively little instilled fluid (10 - 30 mL) and samples from large airways for bacteriological study and/or tumour cytology; 2) therapeutic lavage usees small volumes and is used to remove sticky bronchial secretions in patients with asthma or cystic fibrosis; 3) whole lung lavage is performed in order to wash out an entire lung in patients with alveolar proteinosis, which requires repeated instillation of 1 L of fluid (in total 10–40 L for each lung) through a double-lumen endotracheal tube during general anaesthesia. BAL is usually performed during fibreoptic bronchoscopy with topical anaesthetic after general inspection of the tracheobronchial tree. BAL can also be performed under general anaesthesia and in ventilated patients through a rigid bronchoscope or an endotracheal tube.

Site of bronchoalveolar lavage. The site of lavage depends on the localization of the abnormalities. In case of localized disease, for instance an infection with a radiographically apparent infiltrate or a malignancy, the involved segment should be sampled. In diffuse lung disease, the middle lobe or lingular lobe is commonly used as a standard site for BAL. This is often the most accessible site and the fluid obtained at one site is representative of the whole lung in diffuse lung diseases. If anatomical difficulties are encountered in both lobes the anterior segment of either the upper or lower lobe may be used. Using the method described, approximately 1.5- 3% of the lung (approximately 1,000,000 alveoli) are sampled . Usually, the lavage is performed using sterile, unbuffered isotonic saline (0.9% NaCl) solution and preferably the saline is preheated to body-temperature (37ºC) to help prevent coughing and increase cellular yield . The volume varies between 100 and 300 ml in aliquots of 20 to 50 ml (13). The ERS task force recommended the use of 200-240 ml divided in four aliquots.

Fluid instillation and recovery. The fluid is instilled with syringes through the biopsy channel of bronchoscope and immediately recovered by applying suction (25-100 mmHg), using a standard number of input aliquots of 20–60 mL (commonly four to five aliquots are recommended) up to a total volume of 100–300 mL. Smaller instilled volumes (<100 mL) increase the likelihood of contamination by the bronchial spaces, including inflammatory cells derived from the larger airways, which may skew the differential cell counts.

Safety aspects. The BAL procedure is practically associated with no mortality and carries a low complication rate of 0–2.3%. After BAL procedure there is fever in some hours and a transient decrease in lung function parameters, both usually self-limited and resolving within 24 h. These are the most frequent adverse effects and occur in 3–30% of patients, depending on the instilled volume. Other adverse effects include short-lasting alveolar infiltration, wheezing and bronchospasm in patients with hyper-reactive airways. Major or late complications are only seen in patients with severe lung or heart disease, and bleeding has only been reported in patients with clotting disorders or thrombocytopenia.

Risk factors for developing adverse effects are:

1) extensive pulmonary infiltrates, an arterial oxygen tension <8.0 kPa (<60 mmHg) and an oxygen saturation <90%;

2) a forced expiratory volume in 1 s <1.0 L;

3) prothrombin time >50 s and platelet counts <20,000 platelets/mL;

4) significant comorbidity;

5) bronchial hyperreactivity.