REVIEW

Bronchoscopic sampling techniques in the era of technological bronchoscopy

M. Mondoni\textsuperscript{a}, R.F. Rinaldo\textsuperscript{a}, P. Carlucci\textsuperscript{a}, S. Terraneo\textsuperscript{a}, L. Saderi\textsuperscript{b}, S. Centanni\textsuperscript{a}, G. Sotgiu\textsuperscript{b,*}

\textsuperscript{a} Respiratory Unit, ASST Santi Paolo e Carlo, San Paolo Hospital, Department of Health Sciences, Università degli Studi di Milano, Milan, Italy
\textsuperscript{b} Clinical Epidemiology and Medical Statistics Unit, Department of Medical, Surgical, Experimental Sciences, University of Sassari, Sassari, Italy

Received 27 May 2020; accepted 2 June 2020

KEYWORDS
Bronchoscopy; Biopsy techniques; Lung cancer; Pulmonary infections; Pulmonary nodules; Bronchoalveolar lavage

Abstract Flexible bronchoscopy is a key diagnostic and therapeutic tool. New endoscopes and technologically advanced navigational modalities have been recently introduced on the market and in clinical practice, mainly for the diagnosis of mediastinal lymph adenopathies and peripheral lung nodules. Bronchoscopic sampling tools have not changed significantly in the last three decades, with the sole exception of cryobiopsy.

We carried out a non-systematic, narrative literature review aimed at summarizing the scientific evidence on the main indications/contraindications, diagnostic yield, and safety of the available bronchoscopic sampling techniques.

Performance of bronchoalveolar lavage, bronchial washing, brushing, forceps biopsy, cryobiopsy and needle aspiration techniques are described, focusing on indications and diagnostic accuracy in the work-up of endobronchial lesions, peripheral pulmonary abnormalities, interstitial lung diseases, and/or hilar mediastinal lymph adenopathies. Main factors affecting the diagnostic yield and the navigational methods are evaluated.

Preliminary data on the utility of the newest sampling techniques (i.e., new needles, triple cytology needle brush, core biopsy system, and cautery-assisted transbronchial forceps biopsy) are shown.

Abbreviations: ACCP, American College of Chest Physicians; CLM, confocal laser microscopy; CT, computed tomography; cTBNA, conventional transbronchial needle aspiration; BW, bronchial washing; BAL, bronchoalveolar lavage; EBB, endobronchial forceps biopsy; EBNA, endobronchial needle aspiration; EBUS-TBNA, endobronchial ultrasound transbronchial needle aspiration; EUS-B-FNA, endoscopic ultrasound (with bronchoscope) fine needle aspiration; EBUS-ca-TBFB, endobronchial ultrasound guided cautery-assisted transbronchial forceps biopsy; EMN, electromagnetic navigation bronchoscopy; IPF, idiopathic pulmonary fibrosis; rEBUS, radial probes endobronchial ultrasound; PPL, peripheral lung lesion; ROSE, rapid on-site evaluation; SLB, surgical lung biopsy; TBNB, transbronchial needle aspiration; TBLB, transbronchial lung cryobiopsy; TB, tuberculosis; TBB, transbronchial biopsy; UIP, usual interstitial pneumonia.

* Corresponding author at: Clinical Epidemiology and Medical Statistics Unit, Department of Medical, Surgical and Experimental Medicine, University of Sassari, Via Padre Manzilla 4, Sassari, Italy.

E-mail address: gsotgiu@uniss.it (G. Sotgiu).

https://doi.org/10.1016/j.pulmoe.2020.06.007
2531-0437/© 2020 Sociedade Portuguesa de Pneumologia. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Please cite this article in press as: Mondoni M, et al. Pulmonol. 2020. https://doi.org/10.1016/j.pulmoe.2020.06.007
Introduction

Flexible bronchoscopy represents an essential diagnostic and therapeutic tool when managing patients with complicated and difficult-to-treat respiratory diseases.1 After the introduction of the first fiberoptic instruments in 1967, new types of endoscopes were developed: video-bronchoscopes (i.e., endoscopes with a video camera at the distal tip) can significantly improve the quality of the images, ultrathin instruments (i.e., diameter size <3 mm) can explore distal airways beyond segmental bronchi, echo-bronchoscopes can significantly improve the diagnostic accuracy for mediastinal lymph adenopathies.2-4

The widespread use of sensitive computed tomography, magnetic resonance imaging, and positron emission tomography have broadened the clinical indications of bronchoscopy and have provided an accurate guide for endoscopic samplings.5,6

Flexible bronchoscopy is usually recommended for the diagnosis and staging of lung cancer, diagnosis of respiratory tract infections (both in immunocompetent and immunocompromised patients) and of interstitial lung diseases. Furthermore, its use is required for patients with hemoptysis, with unexplained cough and stridor/wheezing, and staging of thoracic malignancies.1,3,7-11

Flexible bronchoscopy, performed under conscious sedation and with topical anesthesia, is safe in all age groups, including the elderly, with serious complications and mortality occurring in 1.1% and 0.04% of the cases, respectively.1,3,12,13

Bronchoscopic procedures comprehensively assess endobronchial abnormalities (e.g., airway stenosis, bleeding, secretions, etc.) and frequently are adopted to collect specimens for microbiological and/or pathological exams,1,3 quality and quantity of which is key to increase diagnostic accuracy (e.g., idiopathic pulmonary fibrosis, IPF, and lung cancer).14,15

New endoscopes and technologically advanced navigational modalities have been recently introduced, mostly for the diagnosis of mediastinal lymph adenopathies and peripheral lung nodules.16

With the sole exception of cryobiopsy, bronchoscopic sampling tools have not changed significantly in the last three decades.16

The aim of this review is to summarize the scientific evidence on the main indications/contraindications, diagnostic yield, and safety of the available bronchoscopic sampling techniques.

Methods

We carried out a non-systematic, narrative literature review. The search engine Pubmed was used to retrieve the most relevant articles on the above-mentioned topic. The search was conducted without any time restrictions. Only epidemiological studies performed on adult human beings and written in English were selected. The following keywords were combined to address our research question: bronchoscopy; sampling methods; bronchoscopic tools; needle aspiration; biopsy techniques; bronchoalveolar lavage; bronchial washing.

Results

Bronchoalveolar lavage

Bronchoalveolar lavage (BAL) is a safe and minimally invasive bronchoscopic sampling method recommended for patients with several lung medical conditions (e.g., immunemediated, inflammatory, and infectious diseases). It can provide specimens for cytological and microbiological exams (Table 1).17

It is contraindicated in patients with cardiopulmonary instability and/or with a severe haemorrhagic diathesis and it could rarely exacerbate interstitial lung diseases (ILD).18,19Transient hypoxemia and low-grade fever within the first 24h after lavage are the most frequent adverse events.1,18

BAL is performed after the assessment of the tracheobronchial tree and before any biopsies.15,17,20

The bronchoscope should advance as far as possible to the complete occlusion of the bronchial lumen of a third or fourth bronchial subsegment, in a wedged position. Room temperature sterile saline is employed: 100–300 mL, divided into three to five aliquots, are introduced through the suction channel of the bronchoscope. A volume higher than 5% of the original one (ideally >30%) is collected using a negative suction pressure (<100 mm Hg) avoiding airway collapse.

Interstitial lung diseases

BAL is helpful in patients with suspected ILD15 both for the diagnosis itself and the differential ascertainment. A high resolution chest CT should be performed within 6 weeks for the optimal identification of the sampling anatomical area.17

A differential cellular count for the identification of the inflammatory pattern (i.e., lymphocytic, neutrophilic, eosinophilic, and mast cellular), may be useful in the dif-
The differential diagnosis of interstitial lung diseases. A minimal volume of 5 mL of a pooled BAL sample is needed for BAL cellular analysis (the optimal volume is 10–20 mL).

Bloody fluid, with increasing colour intensity in sequential aliquots, can suggest a diffuse alveolar haemorrhage (microscopic diagnosis supported by hemosiderin-laden macrophages). Cloudy (i.e., milky or light brown-beige colour) fluid with flocculent material settling by gravity within 15–20 min and PAS-positive amorphous debris suggests a pulmonary alveolar proteinosis (PAP). An increased number of CD1a cells (>5% of BAL cells) strongly suggests pulmonary Langerhans cell histiocytosis.

BAL cellular pattern may help discriminate IPF from eosinophilic pneumonia (eosinophilia >25%), sarcoidosis (high proportion of lymphocytes and CD4/CD8 ratio), and infections.

In patients with a fibrotic interstitial lung disease BAL lymphocytosis of at least 30% may suggest nonspecific interstitial pneumonia and extrinsic allergic alveolitis.

A recent retrospective study that aimed to study the role of bronchoscopy in acute respiratory failure related to ILD, failed to demonstrate a different management and mortality between patients with positive and negative BAL findings.

Peripheral pulmonary lesions
BAL should be used for patients with slowly resolving/non-resolving pneumonia (sensitivity >70%). BAL can play a key role in the TB diagnosis for sputum smear-negative patients or in those in whom sputum cannot be collected. BAL diagnosis of pulmonary TB relies on smear microscopy (sensitivity range: 4.7–58.0%), nucleic acid amplification techniques (sensitivity: 31.3–83.8%; specificity: 92.4–98.2%), and culture (highest diagnostic accuracy).

BAL can help rule out opportunistic infections in immunocompromised hosts, with a sensitivity up to 98% for Pneumocystis jiroveci. Sensitivity of smear microscopy for TB disease in HIV-positives ranges from 10 to 30%, increasing to 85.7% and 52–95% when nucleic acid amplification techniques and culture are adopted, respectively. In immunocompromised hosts with invasive aspergillosis, BAL can help detect fungal hyphae (34–64% of the cases) and galactomannan antigen (sensitivity and specificity of respectively 79–90% and 84–94%), and can increase the rate of culture positivity (23–85%).

BAL shows a low accuracy in the diagnosis of peripheral lung malignancies (mean sensitivity 43%), whereas lymphangitic carcinomatosis and pulmonary lymphoma may be diagnosed using BAL samples.

Bronchial washing
Bronchial washing (BW) consists of instillation and subsequent aspiration of saline mixed up with bronchial secretions, into a specific bronchial trap. It may be useful to assess the microbiology of central airways secretions. In the diagnosis of TB, BW smear microscopy and Xpert MTB/RIF show a sensitivity of 25–41% and 80–92.3% and a specificity of 87.7–95.8% and 81.6–98.6%, respectively.

A limited diagnostic support was found for endobronchial lung cancers (mean sensitivity: 47%).

The diagnostic yield of bronchoscopy when biotic techniques (i.e., endobronchial needle aspiration and forceps biopsy) are used is not affected by BW.

Needle aspiration
Needle aspiration, which is the most versatile bronchoscopic sampling technique, is recommended for the diagnosis of endobronchial and peripheral lesions and in case of hilar/mediastinal lymph adenopathies (Table 1).

A thin (25–19 gauge), retractable needle attached to the distal tip of a flexible catheter is inserted into the
transbronchial diameter. The needle may be inserted in an endobronchial lesion under direct endoscopic vision and into a hilar/mediastinal lymph node, through the tracheobronchial wall, with or without endoscopic ultrasound guidance. Fluoroscopy and/or other navigational techniques are necessary to reach peripheral lung abnormalities. The collected specimen may be smeared on a glass slide or directly placed in formalin solution (technique named formalin-fixed, paraffin-embedded cell-block). Rapid on-site evaluation (ROSE) of the aspirates may be performed, allowing bronchoscopists to stop sampling when sufficient material has been harvested for diagnosis and molecular analysis, thus potentially avoiding useless samplings and reducing the complications of bronchoscopy.

**Endobronchial lesions**

Endobronchial needle aspiration (EBNA) is a useful and safe technique adopted for the diagnosis of endobronchial lesions (mainly lung neoplasms). It has a mean sensitivity of 56%, with a rate of complications (mostly minor bleedings) <1%. It significantly increases the accuracy of bronchoscopy in the diagnosis of central lung cancers when combined with endobronchial forceps biopsy. EBNA is particularly helpful in sampling submucosal/peribronchial (i.e., growing in deeper layers of the airways) and necrotic lesions. Needle can penetrate the mucosa and can sample neoplasms spreading in the deeper layers.

In the diagnosis of endobronchial tuberculosis, Altin et al. reported a lower sensitivity of EBNA than forceps biopsy in the detection of granulomas (19% vs 84%, respectively).

**Peripheral pulmonary lesions**

Transbronchial needle aspiration with the guidance of fluoroscopy has been adopted to sample peripheral lung lesions (both nodules and masses) since 1984 (Fig. 1B). A recent systematic review and meta-analysis showed a diagnostic yield of 53% and a rate of complications <9%, with pneumothorax and bleeding being the most frequent events. Several clinical and procedural variables may affect its accuracy: CT bronchus sign, an underlying malignant process, diameter of the lesions >3 cm, and ROSE employment are the most important predictive factors of a positive aspirate (Table 2). Notably, data on comparison between TBNA and transbronchial forceps biopsy (TBB) in studies where both procedures were performed in the same patients showed a significant diagnostic advantage when TBNA is performed (diagnostic yield: 60% vs. 45%, respectively), although studies have shown that TBNA is still a underused sampling technique.

Recently, new navigational methods, which may be coupled with fluoroscopy, have been adopted to sample peripheral lesions. TBNA guided by electromagnetic navigation bronchoscopy (EMN) showed a diagnostic yield of 46.3%, while needle aspiration guided by radial probes endobronchial ultrasound (rEBUS) of 49.5–62.5%. When added to TBB, rEBUS-TBNA significantly increases the accuracy of bronchoscopy in the diagnosis of peripheral lesions.

**Hilar and mediastinal lymph adenopathies**

Conventional transbronchial needle aspiration (i.e., not guided by ultrasounds) was introduced by Wang in 1984. American College of Chest Physician (ACCP) guidelines showed a sensitivity of 78% in the diagnosis and staging of non-small cell lung cancer, with a complication rate of 0.3%. It was also used for the diagnosis of sarcoidosis (sensitivity of 72–79% and 65–100%, respectively). The use of ultrasound-guided techniques increases the diagnostic accuracy of bronchoscopy when combined with other sampling techniques (bronchial and transbronchial forceps biopsy and BAL). Therefore, a new needle aspiration technique, named endobronchial ultrasound (with bronchoscope) fine needle aspiration (EUS-B-FNA) has been proved to be effective: an ultrasound guided needle aspiration of mediastinal lymph adenopathies is performed with an echobronroscope introduced in the esophagus. Transbronchial and transesophageal needle sampling can be performed with the same instrument, in the same endoscopic session, and by the same operator (i.e., a trained pulmonologist), thus maximizing time and reducing costs. The transesophageal approach can be also used to sample nodes within reach of EBUS, when the clinical conditions contraindicate the transbronchial route (e.g., respiratory failure, cough, etc.). The combined approach increases the accuracy of endosonography and is now recommended by international guidelines.

EUS-B-FNA may safely diagnose extra-thoracic targets, such as abdominal lymph nodes, liver and left adrenal glands metastatic lesions. Both EBUS-TBNA and EUS-B-FNA may diagnose lung parenchymal lesions adjacent to the central airways and the esophagus. Needle size does not significantly affect the diagnostic yield.

---

**Table 2.** Factors which can influence the diagnostic yield of bronchoscopic sampling techniques in the diagnosis of peripheral pulmonary lesions.

<table>
<thead>
<tr>
<th>Lesion size</th>
<th>CT bronchus sign presence</th>
<th>Navigational modalities employment</th>
<th>ROSE presence</th>
<th>Malignant nature of the lesion</th>
</tr>
</thead>
</table>

---

Please cite this article in press as: Mondoni M, et al. Pulmonol. 2020. https://doi.org/10.1016/j.pulmo.2020.06.007
Several studies demonstrated the suitability of ultrasound-guided needle aspiration samples for molecular analysis in advanced NSCLC, on both cytology smears and cell-block preparations.\textsuperscript{61-63}

Complications of endosonographic needle aspiration procedures are rare (serious adverse events rate of 0.14%).\textsuperscript{44}

**Forceps biopsy**

Forceps has been adopted to collect lung tissue samples through the bronchoscope since the initial implementation of bronchial endoscopy (Table 1).\textsuperscript{65}

**Endobronchial lesions**

Endobronchial biopsy (EBB) is recommended for the diagnosis of visible endobronchial lesions: forceps should be opened outside the distal end of the operating channel and pushed against the lesion providing the right orientation to the instrument, according to the localization of the target site. The tip of the forceps is then closed, pulled out of the operating channel of the bronchoscope and the specimen is then placed in formalin solution.\textsuperscript{66} The different characteristics of the forceps (serrated or smooth edge, fenestrated or unfenestrated cups, needle between the cups) make it potentially suitable for specific settings/lesions. However, the diagnostic yield of various forceps biopsy types was not statistically different.\textsuperscript{38}

EBB is usually employed for suspected bronchogenic cancer with a sensitivity of 74%: \textgreater 3 biopsies are recommended for diagnosis, although at least 6 biopsies can provide sufficient tissue for immunohistochemical and molecular testing.\textsuperscript{19,67} Several studies\textsuperscript{16,68,69} demonstrated that the combination of EBB and endobronchial needle aspiration can achieve the best diagnostic performance.

EBB, when combined with transbronchial biopsy, can increase the sensitivity of bronchoscopy by 10–20% in the diagnosis of sarcoidosis: sampling should be performed where the mucosa is abnormal and in the first and second carina if the mucosa seems normal (4–6 endobronchial biopsies); 30% with normal mucosa may have positive EBB.\textsuperscript{70-72}

**Peripheral lung lesions**

A transbronchial biopsy is performed when the lesion cannot be directly assessed with the bronchoscope: it is wedged in the bronchus pertaining to the anatomical site of the lesion, and the closed forceps are pushed in the peripheral area of the lung, opened at 5–6 mm from the lesion and then closed to collect sample (Fig. 1A).\textsuperscript{6} Fluoroscopy guidance can improve the sensitivity in case of peripheral focal and diffuse cancer lesions.\textsuperscript{6,76,77} Observational studies have demonstrated that navigational methods (i.e., electromagnetic navigation bronchoscopy, radial probes ultrasounds, virtual bronchoscopy) and/or ultrathin instruments may increase the diagnostic yield of conventional, fluoroscopy-guided technique (77–84%).\textsuperscript{61,78-80}

The diameter of the lesion affects the accuracy of the technique: the sensitivity is <35% in case of nodules sized <2 cm.\textsuperscript{79} Moreover, sensitivity is 24% performing only a single biopsy and 70% when six biopsies are collected.\textsuperscript{81,82} The presence of the CT-bronchus sign is associated with a higher yield (Table 2).\textsuperscript{83,84}

TBB may increase the sensitivity of BAL for the diagnosis of Pneumocystis jirovecii pneumonia, including non-HIV patients.\textsuperscript{85} In sputum smear negative or sputum scarce TB patients with peripheral lung lesions, TBB\textsuperscript{86-88} may help detect cytological and histological TB findings (i.e., necrotizing granulomatous inflammation), ruling out malignancies.\textsuperscript{89}

Finally, TBB is a safe and repeatable procedure monitoring early signs of graft rejection in lung transplant recipients.\textsuperscript{90}

Mild bleeding and pneumothorax are the most frequent complications. Pneumothorax can occur in 1–5% of the cases; its variability can depend on the use of mechani-
Cryobiopsy

Cryobiopsy is a therapeutic and diagnostic tool traditionally adopted for endobronchial tumour ablation and away from bronchial and transbronchial biopsy techniques (Table 2). Quantitative studies of cryobiopsies provide evidence that the cryobiopsy has a higher diagnostic yield than standard biopsy methods. In addition, cryobiopsies yield more tissue than standard biopsies and are associated with lower bleeding rates. Therefore, cryobiopsy is a minimally invasive method for diagnosing endobronchial lesions.

Interstitial lung diseases

Transbronchial cryobiopsy (TBC) is a minimally invasive alternative to surgical lung biopsy (SLB), which is often difficult and may result in complications. TBC is performed by inserting a cryoprobe through the endobronchial ultrasound (EBUS) bronchoscope. The cryoprobe is then inserted into the lesion, and a sample is obtained by freezing and thawing the tissue. TBC is a simple and safe procedure with a low complication rate. The sample obtained by TBC is larger than that obtained by standard biopsy methods and provides more histological information.

Endobronchial lesions

Scharfenberg et al. evaluated the accuracy of TBC in the diagnosis of endobronchial lesions. They compared the diagnostic yield of TBC with that of biopsies performed under general anesthesia. The diagnostic yield of TBC was significantly higher than that of biopsies performed under general anesthesia. TBC is a minimally invasive method for diagnosing endobronchial lesions and is associated with a lower complication rate than conventional surgical lung biopsy.

Brushing

Brushing is a simple and minimally invasive method for obtaining specimens from the respiratory tract. Samples are obtained by brushing the endobronchial mucosa with a brush, which is inserted through the working channel of the bronchoscope. The brush is rotated and withdrawn, collecting cells from the respiratory tract. The specimen is then stained and examined under a microscope. Brushing is a valuable method for obtaining specimens from the respiratory tract and can be used for the diagnosis of respiratory tract diseases.

Intermittent positive pressure ventilation

Intermittent positive pressure ventilation (IPPV) is a mechanical ventilation technique used to provide respiratory support to patients with respiratory failure. IPPV is delivered in a series of inspiratory and expiratory phases, with brief periods of apnea. IPPV is used to maintain adequate oxygenation and ventilation in patients with respiratory failure. The technique is associated with a lower complication rate than continuous positive airway pressure (CPAP), which is delivered continuously to maintain the airway pressure. IPPV is a valuable method for providing respiratory support to patients with respiratory failure.

Sensitivity of TBB in diffuse lung diseases

Sensitivity of TBB in diffuse lung diseases is highly variable and depends on the disease and the technique used. Sensitivity ranges from 69% to 85% when compared with histological examination. TBB is a valuable method for the diagnosis of diffuse lung diseases, but its sensitivity is lower than that of surgical lung biopsy.
tance >1 cm from the pleura to reduce the occurrence of pneumothorax. 13

As suggested by Ravaglia et al., collection of ≥2 samples from two different segments in the same lobe or from different lobes in case of inter-lobar radiographic heterogeneity is recommended to increase the diagnostic yield. 102,113-115

A systematic review and meta-analysis showed a pooled diagnostic yield of 79%. 116

Two studies evaluated the accuracy of cryobiopsy in comparison with surgical biopsy: Romagnoli et al. found a poor concordance between TBLC and SLB (concordant coefficient (k): 0.22, percentage agreement: 38%), whereas a multicentre, prospective study, found a histopathological agreement of 70.8% (weighted k: 0.70) and a final diagnostic agreement of 76.9% (k: 0.62). 118

The frequency of pneumothorax and moderate/severe bleeding is 9.5% and 1.1–8.7%, respectively. 113

Guidelines suggest the use of fluoroscopy, of a bronchial blocker, and a small (i.e. 1.9 mm) cryoprrobe to reduce the complication rate. 113

One prospective study reported on the utility of a radial EBUS miniprobe to avoid injuries of pulmonary vessels during biopsy. 119 Confocal laser microscopy (CLM) is a minimally invasive endoscopic technique that provides real time in vivo microscopic imaging of the distal lung through a thin probe advanced through the working channel of the bronchoscope until the alveolar area. Preliminary data demonstrated that CLM may be a useful guidance tool for transbronchial cryobiopsies. It helps to distinguish fibrotic vs. not fibrotic areas and to avoid the pleura thereby reducing the risk of pneumothorax. 120

Likewise, Cone beam CT-guided TBLC, which evaluates the probe-to-pleura relationship based on 3D CT scans, has a safe profile, with low risk of pneumothorax and moderate/severe bleeding. 121

The main contraindications are biopsy diathesis, use of anticoagulants, thienopyridines, antiplatelet drugs, and thrombocytopenia (<50 × 109/L), pulmonary hypertension, and severe respiratory functional impairment. 102

New tools

New flexible needles of different size have recently been introduced onto the market for endonographic sampling of hilar/mediastinal lymph nodes. New needles may provide more visibility on ultrasound images while the needle penetrates the lymph node, more flexibility to target para-tracheal and hilar stations, and a larger amount of tissue for histopathological analysis. 112

New tools for diagnosis of endobronchial and peripheral lesions can be directly inserted into the working channel of the endoscope or passed into a guide sheath to reach peripheral lung abnormalities. Triple cytology needle brush may trap larger tissue samples. A new core biopsy system (i.e. GenCut core biopsy system) consists of a flexible tool with a rounded, blunt tip, a port and blade along the distal and lateral sides with a hollow core: suction is applied follow by rotation and agitation to collect intact tissue. 44,80

Cautery-assisted transbronchial forceps biopsy (ca-TBFB) is a new sampling technique which collects larger amount of tissue from mediastinal lymph nodes: a target lymph node is identified with EBUS while an electrocautery knife is advanced through the working channel of the endoscope toward the airway wall. Then, cautery is applied and the knife inserted through the tracheal/bronchial wall defect (under EBUS real-time guidance), created by the cautery edge. After the penetration, the knife is withdrawn and a spiked forceps advanced into the lymph node to collect the sample. 122,124

Two observational studies showed a higher sensitivity in comparison with that of EBUS-TBNA in the diagnosis of sarcoïdosis and lymphoma. 122,124

Another study proved an increased sensitivity of EBUS forceps biopsy in patients with mediastinal lymph nodes in whom ROSE of EBUS-TBNA failed to show positive findings. 125

References


Bronchoscopic sampling techniques in the era of technological bronchoscopy


Please cite this article in press as: Mondoni M, et al. Pulmonol. 2020. https://doi.org/10.1016/j.pulmoe.2020.06.007


