

Ideal conditions to perform EBUS-TBNA

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Abstract: EBUS-TBNA is gaining widespread acceptance as a minimally invasive procedure for mediastinal staging and re-staging of lung cancer, diagnosis of lung tumors adjacent to large airways and characterization of both malignant and benign lymphadenopathy. The aim of this article is to describe the appropriate setting and practical aspects of the procedure that may help at the start of a new EBUS-TBNA program to improve patient safety, comfort and procedural yield according to operator experience, procedure aim, and institutional needs.

Keywords: EBUS-TBNA; endoscopy room; anaesthetic management; mediastinal biopsy

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Introduction

American cancer guidelines have embraced EBUS-TBNA in the diagnosis and staging of lung cancer and recommended it as the initial step in mediastinal staging, over mediastinoscopy (1). However, facilities that can already offer the procedure to their patients are still a minority even in developed countries such as the USA and the UK.

As more pulmonologists and thoracic surgeons are adopting EBUS in their standard clinical practice, there is a pressing need to understand the factors that enhance the performance and yield of EBUS-TBNA.

This chapter is intended to provide basic notions and practical suggestions to start an EBUS program in the most appropriate setting based on local availability of resources, case mix and expertise.

Personnel requirements, patient preparation and monitoring

The procedure is normally organized on an outpatient basis, with discharge after adequate recovery.

EBUS-TBNA may be performed by a Thoracic Surgeon or by an Interventional Pulmonologist who have received adequate training in this procedure.

As for flexible bronchoscopy, an intravenous catheter and standard American Society of Anaesthesiologists monitors are recommended, and continuous monitoring of the patient's vital signs and parameters (HR, BP, O₂ saturation) is mandatory. An oxygen delivery system, either via a mask with reservoir, a venti-mask or nasal-mask is also mandatory.

Emergency equipment with a defibrillator should be available, and the personnel (physician and nurses) must be adequately trained in its use.

The patient lies in a supine position, and the operator stands at the patient's head, assisted by one nurse.

The EBUS instrument and related devices (light source, processor, conventional monitor (all in one column) and the ultrasound monitor may be placed either on the left or on the right of the patient. In the beginning of EBUS era, visual and ultrasound monitors were independent. Nowadays integrated systems are available, allowing the bronchial direct vision and the ultrasound images to be displayed on one screen simultaneously thus saving room space and facilitating the operator's manoeuvres.

Two nurses should be preferably present in the room during the procedure EBUS-TBNA: one nurse will administer topical 2% Lidocaine, prepare the scope and the needle, and assist in their use, and prepare slides for the cytologist and formalin containers for the specimens.

The other nurse will take care of drug infusion during

mild sedation (normally benzodiazepines), monitor the patient's vital parameters and control O₂ delivery. When an Anaesthesiologist is present, the nurse assists him/her in the management of the patient.

If on-site pathology is available and adequacy confirmation is required a delivery man should also be available for slide transport.

At the end of the procedure, an adequate and thorough check of the tracheobronchial tree is mandatory before removing the bronchoscope from the airways, in order to remove clots and/or secretions, and control possible sites of bleeding.

The patient should be continuously monitored for at least one hour after the procedure (HR, BP, O₂ saturation). Oxygen delivering should be maintained, and pain medication should be administered (generally for pharingodinia). Dyspnoea must be evaluated accurately to exclude pneumothorax, asthma, or airway bleeding.

If the patient underwent the procedure under mild sedation only he/she could be discharged after approximately one hour.

If deep sedation (DS) was used, the patient should be controlled for at least 2 hours (in a recovery room or in the department).

Anaesthetic considerations

When EBUS-TBNA was introduced 10 years ago, it was typically performed using general anaesthesia (GA).

Anaesthetic management is important during EBUS-TBNA for a number of reasons:

First, the ultrasonic bronchoscope has a thicker structure than standard fiber-optic bronchoscopes, intense mucosal contact is necessary to obtain ultrasonic images, and the procedure time is generally long enough to cause considerable patient discomfort.

Second, there is an absolute need to prevent reflex coughing and laryngospasm during the procedure, as coughing and movement of the mediastinum will cause difficulties in obtaining an adequate view of the target lymph nodes or lesion, hamper accurate insertion of the needle and increase the risk of injury to mediastinal major vessels.

Topical anaesthesia with lidocaine 2% is mandatory to suppress the cough reflex, especially with mild sedation or in GA when muscle blockade agents are not used.

GA is defined as drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation, they cannot maintain spontaneous ventilation,

and they require an artificial airway.

Total intra-venous anaesthesia (TIVA) provides optimal conditions for EBUS TBNA and it is preferred over volatile anaesthetics because frequent suctioning of the airway by the bronchoscopist results in contamination of the room atmosphere by volatile anaesthetics and in an inconsistent delivery of volatile anaesthetic gas to the patient.

Combinations of propofol, remifentanyl, etomidate, ketamine in a standard fashion are commonly used. Curarisation is infrequently needed.

In such cases, the airway can be secured by a laryngeal mask airway (LMA) or endotracheal tube (ETT, minimum size 8).

Considering the large size of the ultrasonic bronchoscope, a #4 or #5 LMA seems to be the most suitable devices to secure the airway and provide adequate ventilation around the bronchoscope. Another advantage of the LMA is that it allows access to higher mediastinal lymph node stations that would otherwise be obscured by the ETT. It may not be appropriate in severe obesity or untreated gastroesophageal reflux (2).

In case of endotracheal intubation, the tube has to be withdrawn to explore higher mediastinal nodes; another disadvantage is that the scope is directed in a central position by the tube and it may be more difficult to get close to the tracheal wall with the tip of the scope and obtain adequate ultrasonographic imaging.

In the only prospective randomized controlled trial of EBUS-TBNA performed under general anesthesia (total intravenous anesthesia with laryngeal mask) *vs.* moderate sedation (topic anesthesia with lidocaine plus a combination of midazolam and fentanyl) diagnostic yield, complication rates and patient tolerance were comparable (3). However, 5 patients in the moderate sedation group (6.7%) did not tolerate the procedure even at the maximal pre-established doses of sedatives, and ultimately required GA.

Nowadays lack of uniform access to GA in the majority of clinical practice settings and cost issues favour the use of mild or moderate sedation in an advanced Endoscopic room, with or without an anaesthesiologist on site.

Mild sedation (MS), defined by the American Society of Anaesthesiologists as a drug-induced depression of consciousness during which patients respond purposefully to verbal commands or light tactile stimuli with no interventions required to maintain a patent airway or ventilation, can be achieved in several ways, but generally by using of a mix of short acting benzodiazepines and opiates.

DS is defined as a drug-induced depression of

consciousness during which patients cannot be easily aroused but respond to repeated or painful stimulation, with potential impairment of independent ventilation and potential need for an artificial airway.

In a recent retrospective study by Öztaş and colleagues (4), 152 patients underwent EBUS-TBNA under DS (intravenous midazolam + propofol) administered by an anaesthesiologist and 122 patients received just midazolam administered by the endoscopist. The diagnostic yield was not statistically different in the two groups, no major complications were observed in either group and minor complications were similar.

The endoscopist performing the procedure on patients in the second group was highly skilled in the procedure. No data are given about patient or operator satisfaction.

Jeyabalan (5) investigated patient satisfaction with EBUS-TBNA under light conscious sedation (topical lidocaine plus lidocaine and intravenous midazolam and fentanyl) without anaesthetic assistance in a cohort of 82 patients. Sensitivity and negative predictive value for staging and diagnosis in suspected malignancy were 90–80% and 94.1–88.9% and 87.5% and 50% in suspected granulomatous disease. All but 9 patients (87%) stated that they would definitely/probably undergo a repeat EBUS-TBNA.

In a retrospective study (6), Yarmus and colleagues compared 163 procedures performed under DS (continuous iv. propofol with LM or ETT) with 146 performed under moderate sedation (boluses of fentanyl and midazolam). The diagnostic yield was higher in the DS group with shorter procedure time and a higher number of nodes sampled, however firm conclusions cannot be drawn as the procedures were carried out in two different institutions by different operators and pathologists, and the follow-up of negative cases was incomplete.

In another study by Ost and colleagues (7), DS and general anesthesia were associated with more lymph nodes sampled per patient, but this it was not associated with higher EBUS-TBNA diagnostic yield.

Anesthesia techniques do not seem to affect the frequency of complications with EBUS-TBNA (8), therefore no evidence exists to strongly recommend one anesthetic method over another as regards diagnostic yield and procedural safety.

The choice is ultimately made according to operator experience, educational needs, procedure planning (full mediastinal staging *vs.* one station diagnosis; tissue sampling for benign *vs.* malignant disease) and institutional standards (9).

Ideal environment: endoscopy room vs. operating room (OR)

The operating room or theatre provides a fully equipped and protected environment, and specialised staff to assist the patient and the operator during the procedure, including an anaesthesiologist, and advanced anaesthesia and life-support instrumentation.

However, these potential advantages must be weighed against local availability of resources (operating theatre time and personnel) and cost issues.

Mainly, the OR setting allows the endoscopic procedure to be immediately followed by a mediastinoscopy if EBUS – TBNA does not provide a firm diagnosis.

This is more likely at the beginning of the learning curve if the target lesion or lymph nodes are relatively small or rest in more difficult location (4L).

EBUS-TBNA has a relatively low sensitivity of 57–90% (10) for lymphoma, and a diagnostic yield of 54% to 93% for sarcoidosis (11). In such cases, surgical biopsy is more often necessary for diagnostic confirmation.

EBUS-TBNA can provide adequate material for mutation analysis in cancer patients who are potential candidates for biological agents therapy in roughly 90% of the patients *vs.* close to 100 % with mediastinoscopy (12).

There is thus a potential benefit of performing EBUS-TBNA in the OR for such patients, especially those coming from far away, to avoid readmission after several days or weeks in case of a non-diagnostic result.

In the experience of the Swedish Cancer Institute in Seattle, roughly 50% of the EBUS-TBNA procedures have been carried out in the operating theatre (unpublished data, courtesy of Dr. Jed Gorden). In the University Hospitals of Verona, currently EBUS TBNA is routinely carried out in the operating theatre and 14% EBUS-TBNA procedures have been followed by immediate mediastinoscopy due to inadequate specimens.

In conclusion, the endoscopic room could be appropriate in most cases to carry out EBUS-TBNA and allows significant cost savings without jeopardising patient safety and diagnostic yield.

The operating theatre appears to be the ideal setting both for patient and operator comfort and safety, and to ensure the maximum diagnostic yield in the following cases:

- (I) The endoscopy room is not adequately equipped for a safe procedure;
- (II) An anaesthesiologist is not available in the endoscopy suite and DS is deemed necessary;

- (III) There is a high probability that EBUS-TBNA would be inadequate or non-diagnostic;
- (IV) Procedural time, individual expertise and financial considerations may all influence the final choice of the appropriate setting in such individual cases.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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