

Learning EBUS: Tips and advice for Trainees

Syed Mohammad Tariq¹

¹Luton and Dunstable-University Hospital Lewsey Road Luton, Bedfordshire, United Kingdom

Address for correspondence:
Dr Syed M Tariq

Luton and Dunstable-University Hospital Lewsey Road Luton, Bedfordshire, United Kingdom

E-mail: syed.tariq@ldh.nhs.uk

Date Received: March 28, 2018

Date Accepted: May 10, 2018

Declaration of conflicting interests

The Authors declares that there is no conflict of interest.

ABSTRACT

Endobronchial ultrasound (EBUS) is a relatively new procedure for sampling mediastinal nodes. It is less invasive than cervical mediastinoscopy, and may expedite the diagnosis and staging of lung cancer compared with conventional techniques. Cervical mediastinoscopy requires general anaesthesia whereas EBUS can be performed safely under sedation and local anaesthesia. In selected patients it can be combined with endoscopic ultrasound to improve cancer staging.

This article may be cited as: Tariq MS. Learning EBUS: Tips And Advice For Trainees. Pak J Chest Med 2018; 24 (2):108-113.

INTRODUCTION

Endobronchial ultrasound (EBUS) is a relatively new procedure for sampling mediastinal nodes. It is less invasive than cervical mediastinoscopy, and may expedite the diagnosis and staging of lung cancer compared with conventional techniques.^{1,2} Cervical mediastinoscopy requires general anaesthesia whereas EBUS can be performed safely under sedation and local anaesthesia. In selected patients it can be combined with endoscopic ultrasound to improve cancer staging.² It is the procedure of choice for sampling mediastinal nodes to stage lung cancer, and where indicated, it assists with the diagnosis of tuberculosis, sarcoidosis, lymphoma, and rare mediastinal tumours.³ Endobronchial ultrasound guided transbronchial needle aspiration (EBUS-TBNA) of mediastinal nodes has an important role in staging nodal disease in lung cancer, especially where curative surgery or radical radiotherapy is considered.⁴ Until recently, EBUS was a domain of well-funded and staffed tertiary centres. However, an increasing number of district general hospitals (DGH) are now setting up local EBUS services. This has increased the demand for training DGH-based pulmonologists in EBUS. It is not uncommon therefore to find a trainee rotating from a teaching hospital to a DGH, better trained in EBUS than their supervising consultant. Konge et al.⁵ proposed the following steps to get

trained in EBUS:

- acquire theoretical knowledge
- train on simulators
- perform procedure on patients under supervision

They suggested a validated exam after each step to allow progression, and aptly quoted Miller's pyramid⁶ as an appropriate model to achieve competence. As with any other technically demanding invasive procedure, cumulative experience of EBUS over time has a positive impact on the diagnostic yield and rates of complications.⁷

EBUS skills may be learned under supervision at an established centre. The importance of pattern recognition is emphasized, both for learning the anatomical landmarks and for handling the needle. The exams suggested by Konge et al [5] may not be crucial as long as there is a formal sign-off at the end of an agreed period of training and/or completion of a log book. Such an approach may be more acceptable to pulmonologists already performing diagnostic bronchoscopies, and vying to progress to EBUS procedures. This article provides tips and suggestions for learners, whether junior trainees or specialist pulmonologists, on the practical aspects of learning EBUS.

Initial considerations

Respiratory physicians working in a DGH with no EBUS service could experience delays in getting EBUS-TBNA results, as they would refer their patients to a tertiary centre for this investigation. Hence they may consider proposing a business plan to introduce EBUS locally with a provisional start date. Time taken to set up pathology services to process and analyse EBUS-TBNA samples will have to be factored into the plan.

The local pulmonologists would then require urgent EBUS training prior to the proposed start date. There are EBUS courses available at many centres but these courses provide a taste of the procedure rather than train the attendees to a competency level needed for doing it independently. Much more can be learned by being an observer on a weekly EBUS list at an established centre over a longer period (3-6 months). The best way to learn may be to negotiate an honorary (unpaid) contract of 6-12 months for a weekly session at a tertiary centre to assist EBUS and perform it under supervision. The tertiary centre may in return demand referral of all the EBUS cases for the agreed training period.

Senior pulmonologists, having performed diagnostic bronchoscopies for years, may be anxious not to make errors in the presence of junior trainees at the training centre. Despite decades of experience in diagnostic bronchoscopy, EBUS would be a new territory for them. They may be apprehensive about damaging the expensive EBUS bronchoscope or causing harm to the patient by accidentally puncturing a major blood vessel when sampling mediastinal nodes. It may be best therefore to simply observe EBUS bronchoscopies being performed during the initial one or two sessions, and then join/assist the team. The other issue for a senior physician taking EBUS training at a tertiary centre could be the urge to take over from the local trainee registrar. However, they have to remember that their status as a trainee in EBUS is similar to the registrar's status there.

The minimum number of EBUS procedures required to achieve 80% success in correctly staging mediastinal nodal involvement with lung cancer shows wide variations in published literature.^{8,9} However, achieving 80% success in mediastinal nodal staging is not an agreed quality standard in recent guidelines.¹⁰ A systematic review suggests that the number of procedures required to overcome the initial learning curve and gain a diagnostic sensitivity

of >80% is between 37-44 procedures.¹¹ Thus a trainee may learn EBUS skills in about 6 months, doing a weekly list under supervision. This would equate to 40-50 EBUS procedures, which is in line with the estimate to achieve competence¹¹ and the recommendations in current guidelines.¹⁰ However, we believe a new trainee learning the skills of both diagnostic and EBUS bronchoscopy, may take much longer to become proficient in EBUS, whereas an experienced bronchoscopist up-skilling to EBUS may possibly reach a high level of EBUS competence after just 25-30 procedures. Nevertheless, learning curves for procedural skills vary greatly between trainees and depend on a host of factors including case loads, period of training, the level of enthusiasm and motivation, and the quality of mentoring.¹²

Sehgal et al recommend a formal assessment with either EBUS-STAT (EBUS skill and task assessment tool) or EBUSAT (EBUS skill assessment tool).¹¹ Though these tools assess basic skills (insertion of the bronchoscope, the use of sheath and needle, and correct identification of nodal stations), they have been shown to accurately predict the expertise of operators with different levels of experience.^{13,14} Hence they may be of value in a structured programme of EBUS training, assessment and certification.

The EBUS scope is very different compared with a flexible bronchoscope. It is less manoeuvrable and the control lever to steer it is stiffer. The suction is less efficient, and it gives an angled view of the airway lumen. However, newer models of EBUS bronchoscopes are much improved and provide a good forward endobronchial view. Given these issues, it is likely that an EBUS trainee could initially take longer to steer the EBUS scope, scan the mediastinal nodes of interest, and successfully make sampling passes.

Some trainees may have a view that learning to handle and steer the EBUS scope is more important than learning to use the sampling needle correctly and safely. However, our experience is that trainees often find handling the sampling needle more daunting than the EBUS scope. They are apprehensive about missing a crucial step when locking and priming the needle and introducing it into a node, or when withdrawing it, with a potential risk of damaging the scope, or causing harm to the patient. Being unfamiliar with mediastinal anatomy, especially the location of major blood vessels in relation to key nodal stations, can add to the trainees' anxiety.

Simulation versus a real patient

A number of paid EBUS courses are now available. Apart from lectures on indications, sedation, potential complications, the processing of EBUS-TBNA samples, and the comparisons between EBUS and cervical mediastinoscopy, these courses also provide hands-on sessions. In these sessions the learners operate an EBUS bronchoscope in models and dummies, or perform the EBUS procedure on computer-based simulation, and become familiar with the equipment (the EBUS scope, the balloon for ultrasound transducer, and the ultrasound machine). However, performing EBUS bronchoscopy on real patients can be more challenging than finding and needling grapes embedded in jelly during simulation. Mediastinal nodes in real patients move with respiration and coughing, and the bronchoscopist has to be wary of adjacent blood vessels. Dummies and models do not cough, bleed or desaturate, and there are no bronchial secretions to hamper the view. Furthermore, there is no race against time with the sedation gradually wearing off, and we are not counting the cumulative dose of sedatives or local anaesthetic spray used.

In an EBUS course, the fidelity of simulation improves when learners perform EBUS bronchoscopy on a manikin housing a replica of human bronchial tree inside. Studies show that the use of an EBUS simulator can lead to more rapid acquisition of skills, which are transferable to performing EBUS-TBNA on real patients.¹⁴⁻¹⁶ Hence trainees may learn the essential skills through simulation training, but gain the much needed competence and confidence only by doing EBUS on real patients.

Practical tips and suggestions for EBUS training

In the UK National Health Service (NHS), with an increasing number of hospitals initiating EBUS, aside from specialist trainees, many senior pulmonologists also need EBUS training now. Considering patient safety issues, and the finding that it provides a more rapid acquisition of basic, yet transferrable EBUS skills, simulation training in an EBUS course prior to performing the procedure on patients is strongly recommended. We believe an EBUS course is a good starting point to become familiar with the equipment and gain basic knowledge of what is actually involved in performing an EBUS bronchoscopy. Furthermore, as EBUS becomes more prevalent in district general hospitals, with junior trainees getting exposed to

EBUS earlier in their career, the importance of simulation training at an early stage is recommended. Ideally this training should happen during the first year of specialist training in pulmonology.

We follow life-long learning through our medical careers, and we should continually enhance our knowledge and skills to improve performance within our specific field of work. Hence our consultant colleagues should have no qualms about learning EBUS from their trainees if they happen to be better trained.

The endoscopy nurses also require training to provide support to the bronchoscopists performing EBUS. For instance, they need to learn how to apply the balloon to the ultrasound transducer and test it with saline while removing any air bubbles from it. They need to learn safe handling of EBUS sampling needle, and collecting and processing the EBUS-TBNA samples. For any technically demanding procedure, well-trained nurses have the crucial role of going through the safety checks. A number of EBUS training courses are now available specifically for endoscopy nurses, and we strongly recommend them. Setting up and running in-house training for nurses may be a viable alternative to these courses. In fact, we ran a few hands-on sessions for nurses in our unit prior to starting EBUS bronchoscopies in our hospital, which greatly improved their confidence. Some of our nurses subsequently attended an EBUS course as well.

Based on our experience and that of our colleagues, here are some tips regarding the practicalities of EBUS bronchoscopy, which new trainees may find useful:

Size matters: Mediastinal lymph nodes over a centimetre in size are relatively easy to sample. Sampling of a 16mm sub-carinal node should be relatively easy compared with a 9mm node, as it may be difficult to keep a small node in position for sampling while it moves with respiration. We therefore suggest going for fairly large nodes at the start of EBUS training to gain the much needed confidence.

Station matters: The sub-carinal (station 7) and right lower paratracheal (station 4R) nodes may be the easiest to locate and sample, and should be considered initially. We suggest avoiding stations 10 and 11, and the high para-tracheal stations on either side early on in training.

Move it around: Trained EBUS bronchopists often move around the head of the patient. If an operator positions themselves directly opposite the nodal station they are sampling, they may achieve a better contact between the ultrasound transducer at the tip of the scope and the overlying bronchial wall, resulting in a clearer view of the node. For instance, an enlarged station 4R node may best be approached and sampled if the bronchoscopist stands behind the head of the patient. By contrast, for some nodal stations, if the bronchoscopist stays in one place, either to the right or left side of the patient, they may need to excessively twist and turn the bronchoscope to achieve good contact with the bronchial wall and keep the node of interest in view.

Learn the spatial anatomy: Not knowing the spatial anatomy of mediastinal structures (major blood vessels, the oesophagus) in relation to the nodal stations can be a major source of anxiety for trainees. The readily available Doppler function on ultrasound machine is reassuring and can be used when in doubt. However, becoming familiar with the spatial anatomy as viewed from within the tracheo-bronchial tree should improve the confidence of new learners.

Master the EBUS sampling needle: This is crucial for the safety of EBUS procedures. It ensures that patients undergoing EBUS come to no harm, and there is minimal risk of damage to the bronchoscope. We counted 16 sequential 'mini-steps' in the correct use of the Cook EBUS sampling needle (Figure), 8 of them prior to introducing the needle transbronchially into a mediastinal node, and a further 8 through making the sampling pass with the needle till its withdrawal. Other brands of EBUS-TBNA needles are likely to have similar sequential 'mini-steps' to ensure safe and effective use. The trainees need to perform them repeatedly before these 'mini-steps' become second nature to them. Initially a trainee may keep forgetting a step or two, with the overseeing endoscopy nurse giving timely reminders. We suggest performing several dry runs with the needle and bronchoscope while being observed and mentored by a skilled operator, prior to assisting the first EBUS case.

Be more generous with sedation and local anaesthesia: Depending on the number of nodal stations sampled, an EBUS bronchoscopy could take 45 minutes or longer. Hence top-up sedative injections and local anaesthetic spray are often required, with close monitoring of respiratory drive and oxygen

saturation. A combination of intravenous midazolam and fentanyl may work better than midazolam alone. Propofol infusion managed by an anaesthetist may provide better sedation with minimal cough, but such a service is not universally available. There are guidelines available on safe maximum doses of intravenous sedatives and lignocaine for local anaesthesia for bronchoscopic procedures. We strongly recommend trainees to have a working knowledge of these guidelines.

Suction is less crucial: The EBUS scope's suction is less efficient than that of a standard bronchoscope. Trying to suction all the secretions could take a long time leaving less time to sample the affected nodes. The bronchoscopic view is usually adequate despite the presence of secretions to allow needling of the nodes. It is also useful to have main carina as the reference point to access major nodal stations, and main carina is usually identifiable even through secretions. Furthermore, vigorous suctioning between sampling passes may cause contamination of the scope working channel with airway contents.

Adjust depth of ultrasound image to nodal size: Taking EBUS-TBNA from a node may be easier if it almost fills the ultrasound image on the screen. A depth of 6cm is too high for a 10mm node, whereas reducing the image depth to 20mm would make this node more prominent and easier to sample.

Gently does it: After identifying a pathologically enlarged mediastinal node, it is important to be mindful of its size and of any adjacent vascular structures. It is prudent to introduce the EBUS-TBNA needle gently but firmly into the node whilst keeping its ultrasound image in view. Using excessive force when introducing the needle into the node carries the risk of pushing it too far. Applying too much force may also lead to the needle kinking or snapping, especially if it hits a bronchial cartilage ring.¹⁷ Prudent adjustment of the safety lock to the size of the node being sampled, to limit the distance the needle can travel, is also recommended.

Withdraw if needle is unclear: The whole length of the needle should be visible on the ultrasound image. It is safe practice to withdraw and try again if the needle is not clearly seen or the needle tip is lost from view when making a sampling pass. The introduction of EBUS needle tends to push the ultrasound transducer away from the bronchial wall resulting in loss of image. Pushing the scope tube forward and/or filling the balloon with saline usually helps in regaining contact and the image. If these steps fail, it is likely the

needle is stuck against a cartilage ring. This situation would also require withdrawal of the needle.

For nodal staging the order of lymph node sampling is crucial: Mediastinal nodal staging in lung cancer is vital for treatment decisions such as surgical resection or radical radiotherapy. Based on TNM staging, the bronchoscopist should start with the highest level mediastinal node implicated.¹⁸ For instance, in suspected N3 disease, the relevant contralateral node must be sampled first. Likewise, for N2 disease, the highest level enlarged and/or positron emission tomogram (PET) positive N2 node must be targeted first. If unclear on this key issue, a formal discussion in a lung cancer multi-disciplinary meeting prior to the EBUS procedure may be valuable.

In summary, EBUS training can be a very interesting and rewarding learning experience. It may enhance the profile of established pulmonologists and significantly improve the locally available diagnostic

services. The tips and suggestions given in this article, may be of benefit to the trainees learning EBUS, and to our colleagues vying to introduce EBUS in their respective district hospitals. Though

references are made to the UK NHS, I believe the issues regarding EBUS training discussed in this article, are generalisable.

Compliance with ethical standards

I did not receive any funding for this work. This article does not contain any studies with human participants or animals. The author declares no conflict of interest related to this article.

References

1. Czarnecka K, Yasufuku K. The role of endobronchial ultrasound/oesophageal ultrasound for evaluation of the mediastinum in lung cancer. *Expert Rev Respir Med* 2014; 8:763-76

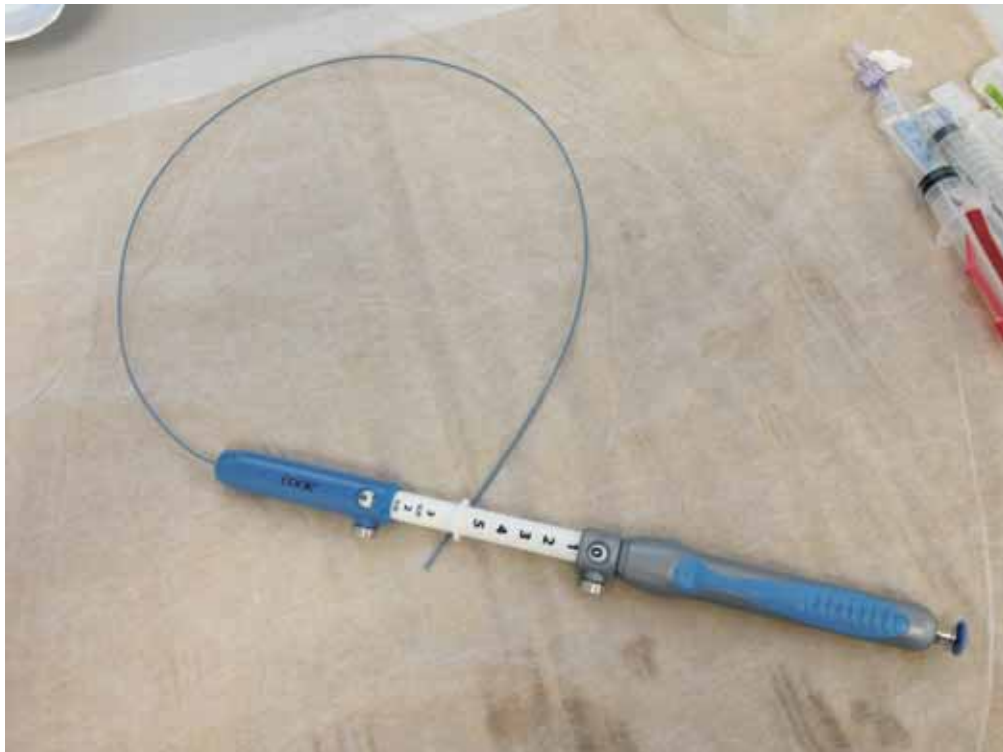


Figure: A 22 gauge EBUS-TBNA sampling needle (Cook USA)

2. Navani N, Nankivell M, Lawrence DR, Lock S, Makker H, Baldwin DR, Stephens RJ, Parmar MK, Spiro SG, Morris S, Janes SM: on behalf of the Lung-BOOST trial investigators. Lung cancer diagnosis and staging with endobronchial ultrasound-guided transbronchial needle aspiration compared with conventional approaches: an open-label, pragmatic randomised controlled trial. *Lancet Respir Med* 2015; pii:S2213-600
3. van der Heijden EH, Casal RF, Trisolini R, Steinfors DP, Hwangbo B, Nakajima T, Guldhammer-Skov B, Rossi G, Ferretti M, Herth FF, Yung R, Krasnik M; World Association for Bronchology and Interventional Pulmonology, Task Force on Specimen Guidelines. Guideline for the acquisition and preparation of conventional and endobronchial ultrasound-guided transbronchial needle aspiration specimens for the diagnosis and molecular testing of patients with suspected lung cancer. *Respiration* 2014; 88:500-17
4. Guarize J, Pardolesi A, Donghi S, Filippi N, Casadio C, Midolo V, Petrella F, Spaggiari L. Endobronchial ultrasound for mediastinal staging in lung cancer. *Multimed Man Cardiothorac Surg* 2014; pii:mmu021
5. Konge L, Colella S, Vilmann P, Clementsen PF. How to learn and perform endoscopic ultrasound and endobronchial ultrasound for lung cancer: A structured guide and review. *Endos Ultrasound* 2015; 4:4-9
6. Miller GE. The assessment of clinical skills/competence/performance. *Acad Med* 1990; 65:S63-7
7. Steinfors DP, Hew MJ, Irving LB. Bronchoscopic evaluation of the mediastinum using endobronchial ultrasound: a description of the first 216 cases carried out at an Australian tertiary hospital. *Intern Med J* 2011; 41:815-24
8. Navani N, Nankivell M, Nandarajan P, Pereira SP, Kocjan G, Janes SM. The learning curve for EBUS-TBNA. *Thorax* 2011; 66:352-3
9. Fernández-Villar A, Leiro-Fernández V, Botana-Rial M, Represas-Represas C, Núñez-Delgado M. The endobronchial ultrasound-guided transbronchial needle aspiration learning curve for mediastinal and hilar lymph node diagnosis. *Chest* 2012; 141:278-9
10. British Thoracic Society guideline for advanced diagnostic and therapeutic flexible bronchoscopy in adults. British Thoracic Society Interventional Bronchoscopy Guideline Group. *Thorax* 2011; 66:Suppl 3
11. Sehgal IS, Dhooria S, Aggarwal AN, Agarwal R. Training and proficiency in endobronchial ultrasound-guided transbronchial needle aspiration: A systemic review. *Respirology* 2017; doi:10.1111/resp.13121
12. Brown C, Abdelrahman T, Patel N, Thomas C, Pollitt MJ, Lewis WG. Operative learning curve trajectory in a cohort of surgical trainees. *Br J Surg* 2017; 104:1405-11
13. Davoudi M, Colt HG, Osann KE, Lamb CR, Mullan JJ. Endobronchial ultrasound skills and tasks assessment tool: assessing the validity evidence for a test of endobronchial ultrasound-guided transbronchial needle aspiration operator skill. *Am J Respir Crit Care Med* 2012; 186:773-9
14. Konge L, Clementsen PF, Ringsted C, Minddal V, Larsen KR, Annema JT. Simulator training for endobronchial ultrasound: a randomised controlled trial. *Eur Respir J* 2015; 46:1140-9
15. Stather DR, MacEachern P, Chee A, Dumoulin E, Tremblay A. Evaluation of clinical endobronchial ultrasound skills following clinical versus simulation training. *Respirology* 2012; 17:291-9
16. Stather DR, MacEachern P, Chee A, Dumoulin E, Hergott CA, Tremblay A. Wet laboratory versus computer simulation for learning endobronchial ultrasound: a randomized trial. *Can Respir J* 2012; 19:325-30
17. Tariq SM. Accidental fracture of EBUS-TBNA needle during sampling of an enlarged mediastinal lymph node. *Oxf Med Case Reports* 2016; 2016:59-61
18. Goldstraw P, Chansky K, Crowley J, Rami-Porta R, Asamura H, Eberhardt WE, Nicholson AG, Groome P, Mitchell A, Bolejack V, International Association for the Study of Lung Cancer S et al. The IASLC lung cancer staging project: proposals for revision of the TNM stage groupings in the forthcoming (eighth) edition of the TNM classification for lung cancer. *J Thorac Oncol*. 2016;11:39–51. doi: 10.1016/j.jtho.2015.09.009