

### Background:

Endobronchial Ultrasound Transbronchial Needle Aspiration (EBUS-TBNA) is a diagnostic procedure often performed during the evaluation of hilar or mediastinal lymphadenopathy, and for diagnosis and staging of lung cancer. Proper performance of EBUS-TBNA requires various cognitive and procedural skills, including image interpretation; mediastinal vascular anatomy; lymph node location, station, and lung cancer staging approach; bronchoscope manipulation; and TBNA deployment. Simulation is recommended for learners of EBUS-TBNA to improve operator skill and patient procedural outcomes, however commercially available EBUS simulators have limitations, including high cost. To address our pulmonary fellows' identified need of improved EBUS training, we sought to develop and implement a low-cost effective curriculum to teach the components of EBUS-TBNA.

### Methods:

To teach the various cognitive and procedural skills necessary to perform EBUS-TBNA, we broke down the necessary skills into components and developed curricula and task trainers to teach each component (Figure 1). Lymph node location, station and the approach to lung cancer staging was taught using a schematic mat of the airways and relevant vasculature and an interactive case-based activity where fellows rotated through standing at various lymph node stations and acting as a bronchoscopist approaching a lung cancer staging procedure. Computed tomography (CT) and EBUS image interpretation was taught using CT and ultrasound images, requiring fellows to identify imaging abnormalities, name the correct lymph node station and point out relevant vascular ultrasound landmarks. EBUS scope manipulation and TBNA practice were performed on gelatin/fruit and ballistics gel models that simulated an airway and lymph nodes. EBUS scope manipulation and practice were additionally performed on the Symbionix BRONCH Mentor simulator, where fellows practiced a lymph node survey. This workshop has been provided yearly to our fellows for two years. Pre- and post-session self-assessments were performed using a 4-point Likert scale. Pre- and post-session TBNA training was assessed during the first year of the workshop, using the relevant portion of the validated EBUS Skills and Tasks Assessment Tool (EBUS-STAT). Fellows were assessed using the EBUS-STAT prior to and following the workshop during the 2020/2021 academic year.

### Results:

Twenty Pulmonary/Critical Care fellows participated in the EBUS-STAT workshop in 2020 and 17 participated in 2021. For each year, there was a statistically significant increase in the fellows' self-assessed knowledge and confidence after the session compared with before the session, with 0-41% of fellows pre-session and 70-100% post-session reporting knowledge/confidence in self-assessed skills. Performance of TBNA was assessed out of 15 points; the pre-session mean score was 5 and post-session this was 15 ( $p < 0.001$ ). During patient procedures, five fellows were assessed using the procedural components of the EBUS-STAT prior to the workshop, and 11 were assessed during live or simulated procedures an average of 6 months after the workshop. There was a statistically significant increase in scores for vascular anatomy, lymph node station identification, EBUS processor operation and TBNA performance an average of 6 months after the workshop (Figure 2). Most (78%) fellows who participated in the workshop in

2020 had applied their learning over the course of the year, but all fellows felt they should repeat the workshop in 2021.

Conclusions:

We successfully developed materials and implemented an EBUS-TBNA workshop that broke down cognitive and procedural skills necessary to perform this procedure and demonstrated durability of the skills taught. Each skill was taught using focused training, a hands-on interactive approach, and most utilized low-cost materials. Using this approach can significantly overcome barriers in teaching EBUS-TBNA, including cost of simulators or additional training courses.