Use of Low-Cost EBUS-TBNA Simulator is Effective in Teaching TBNA

University of Colorado
Anschutz Medical Campus

Melissa New[1,2], Tristan Huie[1,3], Matthew Rustici[3], Eric Young[2,5]

1 University of Colorado, Division of Pulmonary Sciences & Critical Care Medicine; 2 Rocky Mountain Regional VA Medical Center;
3 National Jewish Health; 4 Denver Health Medical Center; 5 University of Colorado School of Medicine

BACKGROUND

Endobronchial ultrasound (EBUS) is a procedure performed by pulmonologists to be able to visualize lymph nodes that are adjacent to the airway, primarily in the mediastinum and hila. Transbronchial needle aspiration (TBNA) is performed in conjunction with EBUS as a way of sampling tissue from an airway-adjacent lymph node or mass.

Use of simulators and phantoms has helped learners gain procedural skills independent of clinical encounters, thus improving the learning experience for both providers and patients.[1-3]

Many simulators for teaching EBUS are virtual reality and the cost or lack of access is prohibitive for many training programs. Gelatin-based phantoms have been used for teaching many types of ultrasound-based procedures.[4] We hypothesized that we could develop a phantom that would be successful in teaching learners to perform TBNA.

GOALS & OBJECTIVES

Goal: Pulmonary fellows will be able to perform a transbronchial needle aspiration

Objective 1: Develop a low-cost task trainer model that simulates an airway surrounded by lymph nodes with accurate ultrasonographic appearance.

Objective 2: Fellows will use the model to practice transbronchial needle aspiration.

Objective 3: Fellows will demonstrate competence in their ability to perform transbronchial needle aspiration as measured by an objective stepwise checklist.

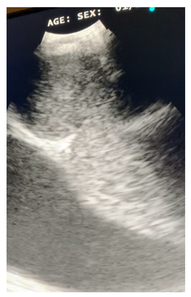

Figure 1. Endobronchial ultrasound view of lymph nodes (top, right) and vessel (bottom/left). Needle for TBNA procedure would enter from top right of the screen (blue dot) and traverse down and towards the left.

MATERIALS & METHODS

Through an iterative process, gelatin-based models were developed to practice TBNA procedures.

A very low-cost model using unflavored **gelatin** (Kroger), **psyllium** fiber (Metamucil), a wooden **dowel**, a baking **loaf pan**, **blueberries** and **grapes** was developed. The construction of the model was relatively quick, taking about an **hour** of hands-on time and then solidifying overnight. The phantom had an airway that traversed through gel, with "lymph nodes" scattered about the sides and above the airway, simulating lymph nodes lateral and anterior to the trachea, though without other anatomic landmarks.

A slightly higher cost, though more durable model was developed using similar techniques but with use of medical **ballistics gel** (Humimic Medical) instead of gelatin and fruit. Gel lymph nodes were made using a **truffle mold** with different amounts of **psyllium** fiber. These were set into liquefied ballistics gel in the baking pan, surrounding the airway.

Figure 2. Materials and construction of gel model: (a) Ballistics gel; (b) ballistics gel "lymph nodes" in silicone truffle mold; (c) Gel model in the pan; (d) Ballistics gel model completed

Ultrasound characteristics of the models were subjectively evaluated by providers with expertise in ultrasound and EBUS.

Pre-testing of fellows' ability to perform a TBNA was performed prior to an instructional session of how to use the TBNA needle with the opportunity for fellows to practice technique on the gelatin phantom. The assessment was done using a 15-point checklist that is part of a validated EBUS assessment (EBUS-STAT).[5] Fellows were observed and provided feedback on technique. A post-test of TBNA performance was completed following the training session.

RESULTS

We successfully developed task trainers out of both unflavored gelatin with psyillium fiber, as well as medical ballistics gel. These each were able to be used in training for transbronchial needle aspiration. The low-cost model cost less than $10 per model to produce, plus the cost of the reusable baking pan. Cost to produce the more durable ballistics gel model was about $100. The ultrasound characteristics of the very low-cost gelatin-based model was subjectively deemed to be superior to those of the ballistics gel model.

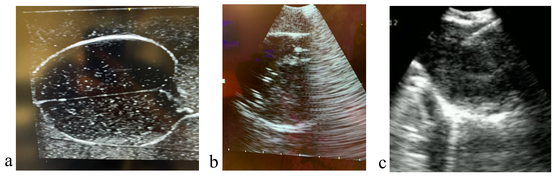

Figure 3: Ultrasound images of (a) a "lymph node" made with gelatin and coated with silicone caulking; (b) a blueberry "lymph node" in a gelatin model, and (c) an actual lymph node during an EBUS procedure.

Over the course of three sessions, 20 fellows (7 first-year, 7 second-year, 6 third-year) participated in the transbronchial needle aspiration training. On the pre-training assessment, the median score was 4.5 out of 15 points (range 0-15). On the post-training assessment, 85% of fellows scored 15 out of 15 points, with the lowest post-training score being 13/15. The median improvement was 10 points on the 15-point scale.

TBNA test	Median score	Range	Change
Pre-test 1st years	0	0-13	
Post-test 1st years	15	15-15	15
Pre-test 2nd years	6	1-14	
Post-test 2nd years	15	13-15	9
Pre-test 3rd years	4.5	0-15	
Post-test 3rd years	15	14-15	11.5

Table 1. TBNA scores, pre- and post-training, by fellow class. Scoring was performed on a 15-point scale.

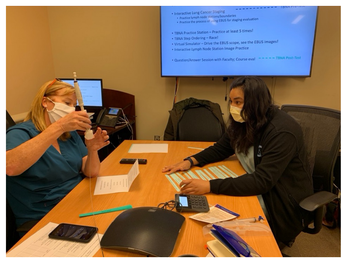

Figure 4. A fellow is instructed in proper TBNA technique and the steps of the procedure during the TBNA training part of the EBUS workshop.

CONCLUSIONS

We successfully developed two versions of a phantom model that simulated an airway (trachea) and lymph nodes. These models were successfully used to train fellows in the TBNA portion of the EBUS-TBNA procedure, and post-training assessments demonstrated both significant improvement and achievement of proper technique by the overwhelming majority of fellows.

These models could be reproduced easily and cheaply and utilized by our fellowship program, as well as others, to improve procedural practice and performance of TBNA.

Further assessment of TBNA skills is ongoing to evaluate retention of this procedural skill.

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Please contact Melissa New at MELISSA.NEW@CUANSCHUTZ.EDU regarding this study.