A novel technique of needle setting for curvilinear endobronchial ultrasound: Improved efficiency with no cost

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Abstract
Background: Standard instructions for biopsy using the convex curvilinear endobronchial ultrasound scope include visualization and adjustment of the sheath housing the biopsy needle before every puncture. In our practice, we pre-set this relationship before inserting the endobronchial ultrasound scope and leave it fixed for every puncture.

Objective: We postulated that this approach is more efficient than repeated re-adjustment and aimed to show that it would not increase the frequency of endobronchial ultrasound scope damage.

Methods: Retrospective review of every biopsy using the endobronchial ultrasound scope over a 6-year period with documentation of damages and costs.

Results: There were 15 scope damages out of 1792 procedures (0.8%). Eight damages were determined to be due to needle damage, one due to patient bite, three due to Williams airway abrasions, and three were camera failures. All damages occurred during the first 5 years of the study. Costs totaled US$138,725, for an average of US$23,120 per year. This rate of damages appears to be similar to or lower than that reported when standard instructions are followed.

Conclusion: Pre-setting of the biopsy needle when the endobronchial ultrasound scope is used leads to greater efficiency and no increase in scope damages.

Keywords
Respiratory medicine, endobronchial ultrasound, scope damage, needle setting, cost

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Introduction
Endoscopic ultrasound has revolutionized the diagnosis of mediastinal abnormalities and the nodal staging of lung cancer. It has been suggested that trans-bronchial fine needle aspiration biopsy using the endobronchial ultrasound (EBUS) scope (EBUS-TBNA) is more cumbersome than conventional TBNA (c-TBNA). Mehta and Wang¹ described 18 steps for EBUS-TBNA compared to 10 for c-TBNA and argued that the relative simplicity of c-TBNA is one of the reasons for persisting value of c-TBNA in pulmonary medicine.

EBUS-TBNA as described by the manufacturer involves a re-setting of the relationship between the end of the bronchoscope and the tip of the needle sheath with every needle aspiration. This is a visual process done “in-vivo” after the bronchoscope is in the airways and in biopsy position; the target is defined with ultrasound, visual imaging is then used to adjust the sheath position, and then a reversion back to ultrasound is used to guide the biopsy. At our institution, we set the needle “ex-vivo,” prior to insertion of the scope. The needle sheath is secured into place with visual confirmation. We then maintain that setting for all needle aspiration sampling; we do not re-adjust for every aspiration. We use the same EBUS scope and same needle-setting technique both for traditional EBUS-TBNA and for fine needle aspiration biopsy via the esophagus (EUS-FNA).

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Our technique reduces the number of steps cited by Mehta and Wang\(^1\) and is time-efficient, but it has not been formally described or studied. We performed a retrospective study of EBUS scope biopsies at our institution in order to study any potential impact of the pre-setting technique upon scope damage.

**Methods**

Institutional review board (IRB) approval was granted for a retrospective review of all procedures using the EBUS scope and all EBUS scope damages and repair costs over the 6-year interval 2009–2015. All procedures were performed using an Olympus convex curvilinear ultrasound scope (Olympus BF-UC180F). The needles used were those manufactured by Olympus for this scope. Both 21-gauge and 22-gauge needles were used. Our approach is an oral approach through a bite block. We initially combined the bite block with Williams airway, but stopped using that airway partway through the study interval due to scope injuries (see below). We performed most procedures under conscious sedation and use a combination of midazolam and fentanyl or propofol. All procedures were performed by interventional pulmonology. The following data were recorded for this study: procedure, scope damage, type of damage, and repair costs. When damage does happen a detailed debriefing is routinely performed to ascertain if said damage could be prevented in the future.

The ex vivo needle pre-setting: this is done as a part of preparing the equipment for the procedure while the patient is in pre-operative area, thus excluding it from procedure time. The staff (respiratory technician, nurse, endoscopy technician, pulmonary fellow, or staff physician) put the EBUS scope on a clean surface; the needle unit is then placed through the needle sheath. The hub is secured 3 mm out of the channel, visually confirmed and then secured. The scope is then ready to sample the target structure as soon as one is visualized.

**Results**

Over the 6-year study interval, 1792 patients underwent FNA using the EBUS scope. There were 875 EBUS-TBNA cases and 917 EUS-FNA cases. There were 15 scope damages requiring return to the manufacturer for repair. Of these, eight damages were determined to be due to needle damage, one damage was a scope fracture due to patient bite, three injuries were determined to be due to Williams airway abrasions on the outer curve of the scope, and three were camera failures. The etiology of the camera failures could not be determined. There were on average 2.5 scope repairs per year (0.8%). All of these damages occurred in the first 5 years of the study; debriefing after damages has led to elimination of the Williams airway and to reinforcement of a standard approach by all needle operators, and there were no scope damages over the last 12 months of the study interval.

We have a repair contract with the manufacturer, but it was not consistently maintained. Repair costs over the course of this study totaled US$138,725, for an average of US$23,120 per year. Cost per damage, when billed, ranged from a high of US$15,353 to a low of US$9248.

**Discussion**

The EBUS scope is a relatively delicate instrument, and due to its complexity, repair costs are high. There is a paucity of data with respect to the incidence of scope damage with EBUS needle aspiration. This retrospective study of a pre-setting technique for needle aspiration biopsies using the EBUS scope has demonstrated a scope damage rate of 0.8%. The rate of scope damage related directly to the biopsy needle was 0.4%.

Authors of the Japan Society for Respiratory Endoscopy reported a scope damage rate of 1.33% in a study of 7345 cases performed at 210 Japanese facilities.\(^2\) Our scope damage rate, 0.8%, is slightly lower; to the extent that the data are comparable, comparison favors pre-setting of the needle. Hergot et al.\(^3\) described that they required US$101.08, while in our study we spent an average of US$77.42 on similar maintenance. They also had scope damage rate similar to us, 13 in 3.5 years (3.5 per year). While it is impossible to compare two different procedural protocols performed by different operators, pre-setting does not seem to be inferior to classic setting technique as far as costs of operation damages are concerned.

This would seem to be an intuitive finding; the less one has to establish the relationship between scope and needle sheath, the fewer the chances for error. We would argue that the pre-setting technique would make sense even if the incidence of scope damage was equal for the two techniques. Pre-setting avoids some of the steps delineated by Mehta and Wang\(^1\) and thus increases efficiency during EBUS. We would argue, as delineated in Table 1, that an accounting of all steps for c-TBNA and EBUS-TBNA with needle pre-setting shows only a slight difference in number of steps.

Pre-setting of the needle is also almost necessary when the EBUS scope is used for EUS; there is often little air in the esophagus. One could insufflate the esophagus and set the needle as has been described for the airway, but this makes little sense. Our method in fact seems very similar to that described by Vilmann et al.\(^4\) when they were evaluating prototypes for EUS: “When the catheter with the needle was passed in the endoscope, the catheter ended just outside the distal end of the biopsy channel.”

Some scope damages are inevitable, but these can be decreased with consistent, limited, and experienced staff performing EBUS. There are many ways to decrease complications. An example would be the elimination of the Williams airway in our lab, a cause of 3 of our 15 damages. (This appears to be brand-dependent. We practice EBUS at two institutions. At the second, we use a different brand of Williams airway and have continued to do so, with no related scope damages over the same 6-year interval as this study.) This particular brand had a sharper joint interphase between the blade and the mouthpiece. Another example is
that we had two needle damages that happened while the scope was hyper-flexed for right upper lobe structures, the needle was seen to enter the structures but had punctured through the needle sheath instead of emerging at the end of it. We have since stopped using the EBUS scope to visually sample these nodes. We examine the area with the EBUS scope and then use a conventional TBNA to sample those structures. Scope flexion itself may increase the risk of gradual wear and tear leading to a leak from the needle sheath without an actual puncture. We use the scope in as neutral position as allowed by the location of the structure; this can be achieved with judicious use of the balloon. Our practice also involves extensive training with the needle and assembly technique before a staff member is allowed to use the needle for tissue acquisition and detailed debriefing after a procedure to improve scope and personnel safety. It is intuitive that the procedure is more efficient as the sheath is set once in a well-lit room and thus avoiding the in vivo issues with secretions, airway diameter, and angulation, and it is also set once.

Being a retrospective study, it has some limitations and our findings likely need to be verified prospectively. The low number of incidence of the variables that would need to be tested is low enough to render such a prospective study certainly challenging.

We conclude that pre-setting of the EBUS needle prior to scope insertion is a logical and more efficient alternative to setting it (a) in vivo and (b) separately for every needle pass. We suspect that many of our colleagues have been setting the needle prior to scope insertion just as we have; our goal was to generate objective data, and our data support the use of this technique on an ongoing basis.

Declaration of conflicting interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval
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