The Impact of Electromagnetic Navigational Bronchoscopy on a Multidisciplinary Thoracic Oncology Program

Craig Brown, MD; Sharon Ben-Or, MD; Paul Walker, MD; and Mark Bowling, MD

Abstract

Background: The Leo W. Jenkins Cancer Clinic has adopted a programmatic, multidisciplinary approach to thoracic tumors, which has involved the implementation of new therapeutic and diagnostic approaches. In 2012 we began using electromagnetic navigational bronchoscopy (ENB) as a new diagnostic tool. ENB uses a guidance system that combines CT imaging with magnetic field–guided spatial information to allow tissue sampling or placement of fiducial markers to guide radiation therapy. Methods: The numbers of early-stage (I and II) and late-stage (III and IV) lung cancers were compared before and after the introduction of ENB. We also examined the number of cases of fiducial marker placement using bronchoscopy versus interventional radiology before and after ENB was introduced. Fisher’s exact test was used to compare the early- versus late-stage lung cancers found at diagnosis pre- and post-ENB introduction, fiducial marker placements using interventional radiology versus bronchoscopy pre- and post-ENB introduction, and pneumothorax rates. Results: More early-stage cancers were diagnosed after ENB introduction (67 of 286 cases vs 116 of 290; \( P < .0001 \)). Bronchoscopy was also used more frequently to place fiducial markers post-ENB (53 of 86 pre-ENB vs 105 of 117 post-ENB; \( P < .0001 \)) and had a lower pneumothorax rate (4% vs 22%) than fiducial placement in interventional radiology (\( P < .001 \)). Conclusions: The addition of ENB to a multidisciplinary thoracic oncology program may permit the diagnosis of lung cancer at an earlier stage and offers the ability to safely place fiducial markers for therapeutic purposes, such as radiation therapy, within the same procedure, potentially improving safety and decreasing time to treatment.


Background

A multidisciplinary approach to lung cancer has been recommended by treatment guidelines from both the American College of Chest Physicians\(^1\) and NCCN.\(^2\) One part of this approach may involve incorporating new technologies, such as electromagnetic navigational bronchoscopy (ENB). With the introduction of ENB, lesions that were previously inaccessible to the bronchoscope became potential targets for biopsy and therapeutic interventions via this minimally invasive route. One of the main foci of therapy is stereotactic body radiation therapy (SBRT), which uses fiducial markers to track the movement of the lung during the respiratory cycle, minimizing the damage to normal tissue as high doses of radiation are applied to the tumor.\(^1\) With the adoption of ENB, treatment and potential cure of early-stage lung cancers using SBRT are made possible in patients who are inoperable due to poor functional status.\(^4,5\) In our multidisciplinary thoracic oncology clinic (TOC), we take an aggressive approach that brings medical and radiation oncology, thoracic surgery, and pulmonary medicine to the table to discuss each patient before devising a treatment plan. Under the advisement of the physicians who are going to undertake the long-term care of the patient, including surgical, chemotherapeutic, and radiation treatment, a comprehensive diagnostic plan is also developed, which permits us to limit the repetition of procedures and ensure the best care for each individual patient. We elected to compare the 2 years of data we collected since the introduction of ENB versus the 2 years before introduction and examine the stages of cancers diagnosed and the rates of fiducial marker placement.
Methods
This retrospective chart review was performed on a preexisting deidentified data set, and therefore was deemed not to meet the definition of human subject research by our Institutional Review Board.

The numbers of early-stage and late-stage non–small cell lung cancers (NSCLCs) diagnosed from 2010 to 2013 were collected from TOC data. The definitive diagnosis of NSCLC was made through biopsy and tissue confirmation. The numbers and methods of fiducial marker placement for stereotactic radiation therapy were also collected. The collected data were divided into 2 groups: those from before the introduction of ENB at our institution in 2012 and those after ENB introduction. Fisher’s exact test was used to compare fiducial marker placement pre- and post-ENB, stage of lung cancer at diagnosis pre- and post-ENB, and the pneumothorax rate. A P value of less than 0.05 was deemed significant.

Results
A total of 286 cases of NSCLC were diagnosed in the 2 years before the introduction of ENB and 290 cases were diagnosed in the 2 years after. In the pre-ENB group, 67 patients had early-stage disease (I and II) and 219 patients had late-stage disease (III and IV). Post-ENB, 116 patients had early-stage disease and 174 had late-stage disease. Using Fisher’s exact test, this difference is statistically significant (P<.0001; Figure 1).

Fiducial marker placement was also examined across the pre- and post-ENB groups. Pre-ENB, 53 markers were placed by bronchoscopy and 33 by interventional radiology. After the introduction of ENB, there was an increase to 105 placements by bronchoscopy and a decrease to 12 by interventional radiology. This difference was also statistically significant using Fisher’s exact test (P<.0001; Figure 2).

Fiducial placement was complicated by pneumothorax in 22% of patients undergoing radiology placement (10/45) and 4% (5/125) of patients undergoing bronchoscopic placement. This difference is noted to be significant using Fisher’s exact test (P<.001; Figure 3).

Discussion
This retrospective study demonstrates the impact of ENB in a multidisciplinary thoracic oncology program, resulting in a stage shift over a 2-year period (a 73% increase in stage I/II lung cancer diagnoses and a 20.5% decrease in stage III/IV diagnoses). To our knowledge this is the first study to report such findings.

There are a couple of potential causes for the changes noted in stages of lung cancer in this study. First, our multidisciplinary thoracic oncology program has permitted us to take a “one-stop shop” approach to diagnostics and treatment of the nonoperable patient. Before the introduction of ENB in our thoracic oncology program, a greater weight may have been placed on conservative management of nonoperable patients with presumed stage I or II lung cancers, mostly because of...
fears regarding complications from invasive procedures and concerns about poor functional status preventing chemotherapy and/or radiation therapy. Therefore, these patients were monitored and their disease subsequently progressed to stage III or IV until an intervention occurred. Now, with the option of safely diagnosing these patients and placing fiducials within one procedure, performed under moderate sedation in the outpatient setting, close monitoring is no longer our standard practice.

Second, efforts were made to perform community outreach to advertise the mission of the multidisciplinary thoracic oncology program, which may have increased awareness of the referring physicians. Upon initiating treatment of these patients, our referring physicians may have also elected to provide earlier referrals to the thoracic oncology program.

One potential source of earlier diagnosis may be the introduction of recommendations by the US Preventive Services Task Force (USPSTF) that patients with significant risk factors be screened for lung cancer. However, this recommendation is unlikely to have had a significant impact on our data given that our institution did not undertake a screening protocol until after data collection was complete. It is possible that our referring physicians in the outside community were early adopters of the screening guidelines, which could increase both overall and early diagnosis.

The change in fiducial marker placement rates using radiology compared with bronchoscopy is easier to explain. For inoperable patients, treatment options were limited before the recent advances in SBRT. Given the reduced rate of pneumothorax with endobronchial approaches to fiducial placement and the fact that they may be placed at the same time as biopsies for diagnosis, this method is appealing from both safety and simplicity standpoints. Of note, different systems for delivery of SBRT have differing fiducial requirements, some requiring no fiducial placement at all. Practitioners will need to engage their radiation oncologists in dialogue to determine the preferred type, number, and spatial arrangement of fiducial markers should they choose to adopt this method of placement. This sort of dialogue is made much easier if there is a TOC that brings all of the disciplines to the table to discuss a cohesive treatment plan.

This study has some weaknesses, most notably that the data are drawn from a single center’s experience and are retrospective in nature. There were only 2 proceduralists performing ENB at this center. There would also have been value in comparing the time to diagnosis, diagnostic yield, and time to treatment in the pre- and post-ENB settings. Finally, there is need for further exploration of the cost-effectiveness of ENB as a diagnostic and therapeutic means, with a view to obtaining survival data.

**Conclusions**

The data available in our retrospective review raise interesting questions regarding the role of ENB in the setting of a multidisciplinary TOC. The addition of this advanced diagnostic element to our preexisting approach increased the diagnosis of early-stage lung cancers and permits safe diagnosis and fiducial marker placement without as high a risk of pneumothorax as previous methods of placement. Using this approach, there is hope that, in the population of patients who have early-stage lung cancer and are not operative candidates, there may still be hope of cure or durable response. The potential for treating early-stage lung cancers in this population is even more exciting with the recent USPSTF guidelines that advocate for screening of patients at high-risk for lung cancer. Indeed, with these guidelines in mind and the emerging data on effectiveness of stereotactic radiotherapy in early-stage lung cancers, the potential exists for an even bigger role for ENB in the multidisciplinary TOC in the future. The overall survival of patients treated using this approach is not yet clear and needs to be explored further to establish the overall utility of this method of diagnosis and treatment.
References


