CHEST

Original Research

INTERVENTIONAL PULMONOLOGY

A Randomized Trial of CT Fluoroscopic-Guided Bronchoscopy vs Conventional Bronchoscopy in Patients With Suspected Lung Cancer*

David Ost, MD, MPH, FCCP; Rakesh Shah, MD, FCCP; Edward Anasco, BS; Lisa Lusardi, BS; Jacqueline Doyle, BS; Christine Austin, BS; and Alan Fein, MD, FCCP

Background: **Prior case series have shown promising diagnostic sensitivity for CT scan-guided bronchoscopy.**

Methods: **This was a prospective randomized trial comparing CT scan-guided bronchoscopy vs conventional bronchoscopy for the diagnosis of lung cancer in peripheral lesions and mediastinal lymph nodes. All procedures were performed using a protocolized number of passes for forceps, transbronchial needles, and brushes. Cytologists and pathologists were blinded as to bronchoscopy type. Patients with negative results underwent open surgical biopsy (for nodules or lymph nodes) or were observed for ≥ 2 years if they had a nodule < 1 cm in size.**

Results: **Fifty patients were enrolled into the study (CT scan-guided bronchoscopy, 26 patients; conventional bronchoscopy, 24 patients). Two patients, one from each arm, dropped out of the study. Ultimately, 36 patients were proven to have cancer, and 27 of these patients (75%) had their diagnosis made by bronchoscopy. The sensitivity for malignancy of CT scan-guided bronchoscopy vs conventional bronchoscopy for peripheral lesions was similar (71% vs 76%, respectively; p = 1.0). The sensitivity for malignancy of CT guided bronchoscopy vs conventional bronchoscopy for mediastinal lymph nodes was higher (100% vs 67%, respectively) but did not reach statistical significance (p = 0.26). On a per-lymph-node basis, there was a trend toward higher diagnostic accuracy with CT scan guidance (p = 0.09). The diagnostic yield was higher in larger lesions (p = 0.004) and when CT scanning confirmed target entry (p = 0.001).**

Conclusion: **We failed to demonstrate a significant difference between CT scan-guided bronchoscopy and conventional bronchoscopy for the diagnosis of lung cancer in peripheral lesions and mediastinal lymph nodes. Further study of improved steering methods combined with CT scan guidance for the diagnosis of lung cancer in peripheral lesions is warranted.**

(CHEST 2008; 134:507–513)

Key words: bronchoscopy; CT fluoroscopy; lung cancer; transbronchial needle aspiration

Abbreviations: EBUS = endobronchial ultrasound; FNA = fine-needle aspiration; TBNA = transbronchial needle aspiration; VATS = video-assisted thoracoscopic surgery

Bronchoscopy is the most commonly used minimally invasive diagnostic procedure in pulmonary medicine and is widely used for the diagnosis and staging of non-small cell lung cancer. The performance characteristics (sensitivity and specificity) of bronchoscopy and its ancillary procedures, such as transbronchial needle aspiration (TBNA), vary depending on the indication, location, and size of the lesion.[1–3] Diagnostic yield is also affected by the types of adjunctive techniques available, such as on-site cytology,[4–7] endobronchial ultrasound (EBUS),[8–12] electromagnetic navigation,[13,14] and CT fluoroscopy.[15–17]

CT scanning has been demonstrated to be potentially useful in guiding bronchoscopic procedures.[15–22] However, this practice has not been widely adopted, and there have been no randomized trials comparing it to conventional bronchoscopy.

For editorial comment see page 478

We therefore conducted a randomized, controlled study of CT scan-guided bronchoscopy vs conventional bronchoscopy to assess the hypothesis that CT scan guidance would improve the diagnostic yield.

Materials and Methods

Consecutive patients from March 2001 to April 2004 with either peripheral pulmonary nodules (≤ 3 cm in size), peripheral masses (> 3 cm in size), or mediastinal lymphadenopathy (> 1 cm in diameter) with suspected cancer without a proven pathologic diagnosis were eligible. The inclusion criteria were age > 40 years, at least a 10–pack-year history of smoking, and the ability to tolerate video-assisted thoracoscopic surgery (VATS). This was defined as an estimated postoperative FEV_1 of > 800 mL with no comorbidities that would preclude surgery. Patients with a high index of suspicion for benign disease (*eg*, sarcoidosis or tuberculosis) or with evidence of endobronchial disease determined by CT scan were excluded. The study was approved by the institutional review board, and all patients gave written informed consent.

The prebronchoscopy evaluation included reviews of CT scans and positron emission tomography scans, laboratory studies, and medical records. A bronchoscopic plan was made, including the site of the biopsy and the techniques to be used. The purpose of the procedure was classified as either the evaluation of a peripheral lesion, the evaluation of mediastinal nodes, or both. The patient was then randomized using computer-generated random numbers. CT scan images were available at the bedside for all patients to facilitate guidance.

Bronchoscopy Procedure

All bronchoscopies were performed (P240 bronchoscope; Olympus; Tokyo, Japan) by the same physician (D.O.) and the same nurses. Patients received meperidine (25 mg IV) and midazolam (1 mg IV), with titration performed according to moderate sedation protocols.

Diagnostic techniques were protocolized based on indication, and were identical for both CT scan-guided and conventional bronchoscopy. Conventional bronchoscopy utilized conventional fluoroscopy for diagnosis in peripheral lesions. For peripheral lesions, techniques included transbronchial biopsy, TBNA, brushing, and BAL. For transbronchial biopsies, four specimens were obtained using biopsy forceps (Boston Scientific; Natick, MA). For peripheral TBNA, two passes were made using a 21-gauge needle (Bard; Billerica, MA). For transbronchial brushings, two passes were made using a cytology brush (Boston Scientific).

For bronchoscopic lymph node staging, four passes were made using a 21-gauge needle. This was done in a standardized fashion, using either the "pushing" or "jabbing" method.[23,24] Rapid on-site cytology evaluation was not available at our institution at the time.

CT Fluoroscopy-Guided Bronchoscopy

We used a high-speed CT scanner (CT/I scanner; GE Healthcare; Fairfield, CT) [10 mA, 120 kVp]. A scout CT scan was performed, and the platform was adjusted so that only a small area near the lesion would be visualized. The bronchoscopy video monitor was placed adjacent to the CT scan video monitor; the radiologist imaged instruments in real time by moving the CT table in sliding mode. For lymph node aspiration, a "quick-check" technique was used to verify placement. For peripheral lesions, intermittent looks to localize the tip of the forceps were used. The total radiation time and exposure were recorded.

Patient Follow-up and Verification

Pathologists were blinded as to the type of bronchoscopy performed. All negative bronchoscopic results underwent additional diagnostic testing with fine-needle aspiration (FNA), mediastinoscopy, or VATS. Patients with a nondiagnostic FNA result proceeded to VATS to establish a specific diagnosis. Patients with small peripheral nodules (*ie*, < 1 cm) with negative bronchoscopic results who did not want to undergo VATS were also considered to have true-negative results if they demonstrated radiographic and clinical stability for at least 2 years.

Statistical Analysis

Sensitivity was measured on a per-patient basis using all available bronchoscopic samples rather than on the basis of results for an individual biopsy specimen, since this is what clinical decisions are based on. All results demonstrating cancer were considered to be true-positive results (100% specificity). A secondary analysis on a per-lymph-node basis was performed based on a prespecified analysis.

Statistical analyses were performed using a statistical software package (STATA; StataCorp; College Station, TX). Continuous variables are expressed as the mean and SD. Dichotomous variables are summarized as simple proportions. Differences between groups were analyzed using two-sample *t* tests and a Fisher exact test. Multivariate analysis by lesion size was performed using the Cochrane Mantel-Haenszel test. A two-tailed p value of < 0.05 was used to define statistical significance.

Results

Patient Characteristics

Seventy-two patients were eligible, and 50 patients were enrolled into the study (CT scan guidance, 26 patients; conventional bronchoscopy, 24 patients). Twenty-two patients declined to participate in the study. Two patients, one from each arm, could not complete the study. One patient was admitted to the medical ICU for treatment of pneumonia prior to the scheduled bronchoscopy and subsequently died.

*From the Division of Pulmonary & Critical Care Medicine, New York University School of Medicine, New York, NY (Drs. Ost and Fein, Mr. Anasco, Ms. Lusardi, Ms. Doyle, and Ms. Austin); and the Department of Radiology (Dr. Shah), North Shore University Hospital, Manhasset, NY.
The study was supported by the American Lung Association, Clinical Research Grant program, and by a Clinical Research Grant from General Electric, with Dr. Ost denoted as the investigator.
The authors have reported to the ACCP that no significant conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.
Manuscript received January 29, 2008; revision accepted April 18, 2008.

Correspondence to: David Ost, MD, MPH, 530 First Ave, HCC 5E, New York University Medical Center, New York, NY 10016; e-mail: david.ost@med.nyu.edu
DOI: 10.1378/chest.08-0160