Is bronchoscopy necessary in the preoperative workup of a solitary pulmonary nodule?

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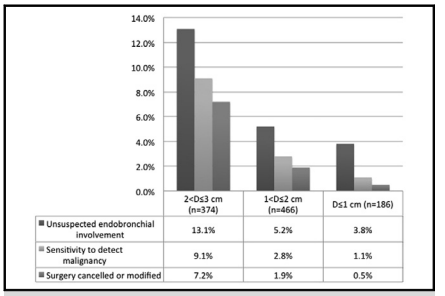
ABSTRACT

Objective: This study evaluated the role of conventional bronchoscopy in the preoperative workup of patients with solitary pulmonary nodules (SPNs).

Methods: Patients with SPNs of unknown origin were enrolled for preoperative bronchoscopy at our institution. Bronchoscopic findings were prospectively collected, and their impact on planned therapy was analyzed.

Results: A total of 1026 patients were included. Bronchoscopy identified unsuspected findings in 80 (7.8%) of them, with a total of 826 (80.5%) malignant nodules. Referent values for bronchoscopic detection of malignant SPNs were: accuracy, 24.3% (95% confidence interval [CI]: 21.7%-27.0%); sensitivity, 5.9% (95% CI: 4.5%-7.4%); specificity, 100%; and negative predictive value, 20.5% (95% CI: 18.0%-22.9%). Malignant bronchoscopic findings were more common in male patients (odds ratio [OR] = 2.1, 95% CI: 1.1-3.9, $P = .021$) and large nodules (OR = 2.3, 95% CI: 1.6-3.3, $P < .001$). Surgery was cancelled in 2 (0.2%) patients and modified in 36 (3.5%) patients because of bronchoscopic findings. In all, for 268 (26.1%) SPNs that presented with ground-glass opacity, the bronchoscopy was unrevealing.

Conclusions: In the preoperative evaluation of SPN, bronchoscopy is most likely to reveal malignancy in larger SPNs and in male patients. Bronchoscopy is not indicated in SPNs that present with ground-glass opacity on computed tomography scan. (J Thorac Cardiovasc Surg 2015;150:36-40)



Yields from bronchoscopy decreased significantly with nodule size.

Central Message

Bronchoscopy identified unsuspected findings in 7.8% of patients with solitary pulmonary nodules, altering therapy in 3.7%. Preoperative bronchoscopy provides greatest benefit with men, and larger nodules.

Perspective

Appropriateness of routine bronchoscopy in preoperative workup of solitary pulmonary nodules (SPNs) is debatable. Our findings show that preoperative bronchoscopy reveals malignancy most often with men, and larger SPNs; its utility is limited with women, and SPNs presenting with ground-glass opacity on computed tomography scan. The data argue against routine bronchoscopy for women with small SPNs, unless central lesions are highly suspected.

See Editorial Commentary page 40.

The appropriateness of routine use of bronchoscopy in the preoperative workup of solitary pulmonary nodule (SPNs) is debatable. Opinions expressed in the literature vary, ranging from the idea that routine preoperative bronchoscopy has no role in conducting tissue diagnosis in small SPNs,[1] to the idea that it is very useful in determining underlying etiology and surgical strategy.[2] The American College of Chest Physicians guidelines[3] recommend bronchoscopy only if an air bronchogram is present or if the operator has expertise with newer, guided techniques. We hypothesize that bronchoscopy has a limited but useful role in the preoperative assessment of SPNs. The purpose of the current analysis is to define that role by examining, in our patients with SPNs: (1) endobronchial findings; (2) the impact of these findings on therapy; (3) referent values for malignant SPNs; and (4) variables that are associated with bronchoscopic findings.

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Received for publication Sept 6, 2014; revisions received Jan 25, 2015; accepted for publication Feb 3, 2015; available ahead of print April 2, 2015.

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0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2015.02.060

Abbreviations and Acronyms
CI = confidence interval
CT = computed tomography
OR = odds ratio
SPN = solitary pulmonary nodule

METHODS

Patients

This study was conducted in a prospective manner at the Department of Thoracic Surgery, Fudan University Shanghai Cancer Center, from January 2008 to December 2013. We defined an SPN as a single, well-circumscribed radiographic opacity that measures ≤3 cm in diameter and is surrounded completely by aerated lung, with an absence of atelectasis, hilar enlargement, or pleural effusion.[3] Exclusion criteria for patients were: (1) having a benign SPN, as determined by fine-needle biopsy, and ≥1 year of follow up via thoracic computed tomography (CT); (2) refusing or not being suitable for surgery; (3) refusing bronchoscopy or being physically unable to undergo examination to evaluate the whole tracheobronchial tree (Figure 1).

Scan data from chest CT (64-row; slice width: 1.0 mm) were acquired from all patients before bronchoscopy. Individual CT datasets were transferred to a workstation (Advantage Workstation 4.3, GE Healthcare, Barrington, Ill), on which 3-dimensional images of the SPN and adjacent bronchus were created. Bronchoscopic examination and biopsy were performed by the same thoracic surgeon. Transtracheal airway anesthesia was conducted using 2% lidocaine. Additional 2% lidocaine spray was instilled in the nares and throat to provide additional patient comfort.

A flexible bronchoscope was placed in the nose or mouth with the patient in a supine position. Once the bronchoscope was inserted into the upper airway, the vocal cords were inspected. The instrument was advanced to the larynx and further down into the tracheobronchial tree, and each area was inspected as the bronchoscope passed, including the subsegmental bronchi. The bronchoscopist selected the bronchial path to the nodule, based on the CT findings, when it seemed possible to reach the lesion. Biopsies were taken using a brush, needle, forceps, or cytologic washing.

Patients were later scheduled for surgery if the bronchoscopy produced negative results. Depending on the clinical and functional status of the patient, as well as the histologic and anatomic findings, either sublobar resection (wedge/segmental), lobectomy (including sleeve lobectomy), bilobectomy, or pneumonectomy was performed, after exclusion of distal metastases.

After screening, 1026 remaining patients were included in this study; characteristics and radiologic findings are presented in Table 1. Clinicopathologic data on age, gender, smoking history, nodule size measured on CT, type of surgery, and pathology were collected. This study was conducted in accordance with the Helsinki Declaration and approved by the institutional review board of the Fudan University Shanghai Cancer Center, Shanghai, People's Republic of China. All patients provided written informed consent.

Statistical Analysis

Statistical analysis was performed using SPSS (version 19.0, SPSS, Inc, Chicago, Ill). Continuous variables were expressed as the mean ± SD; categoric variables were expressed as frequency and percentage, for description. Comparison of continuous variables was examined using an independent Student *t* test and the Mann-Whitney *U* test.

Statistical analysis of categoric variables was performed using Pearson χ^2 analysis and the Fisher exact test, as appropriate. Multivariate analysis was conducted using logistic regression to identify independent predictors. The endpoint is the bronchoscopic yield. The variables analyzed included gender, age, smoking status, and tumor size and location. All statistical analyses were 2-sided.

RESULTS

Bronchoscopic Results

Positive bronchoscopic findings were established in 80 (7.8%) patients, including 38 (3.7%) with incidental endobronchial lesions, 4 with mucosa edema, 1 with variant segment, and 37 (3.6%) in whom the SPN was reachable and biopsies were successfully taken. Histologically, in 37 SPNs successfully biopsied under bronchoscopy, 11 were determined to be malignant, and 26 were benign. For these 26 nodules, 1 was discovered, after surgery, to be adenocarcinoma (false negative).

In 38 cases of endobronchial lesions, bronchoscopic pathology revealed 25 cases of squamous cell cancer, 6 of adenocarcinoma, 3 of carcinoid, 2 of mucoepidermoid carcinoma, and 2 of small cell lung cancer. A total of 826 (80.5%) malignant SPNs were diagnosed according to the pathologic reports of resected specimens, as well as bronchoscopic results. Therefore, referent values for bronchoscopic detection of malignant SPNs were: accuracy, 24.3% (95% confidence interval [CI]: 21.7%-27.0%); sensitivity, 5.9% (95% CI: 4.5%-7.4%); specificity, 100%; positive predictive value, 100%; and negative predictive value, 20.5% (95% CI: 18.0%-22.9%); Table 2.

Treatment

Of the 1024 patients undergoing surgeries, video-assisted thoracoscopic surgery was conducted in 492 (48.0%), and thoracotomy in 532 (52.0%). The surgical approach had to be modified to: a sleeve lobectomy in 10 patients; a bilobectomy in 12 patients; pneumonectomy in 14 patients; and no surgery in 2 cases with small cell lung cancer, owing to the bronchoscopic findings. Therefore, surgeries had to be modified or cancelled in a total of 38 (3.7%) patients (Table 3).

Bronchoscopic Yield, by Parameter

Univariate analysis revealed that bronchoscopic yield is related to gender, smoking status, and nodule size, but may not be associated with patient age and nodule location (Table 4). On multivariate analysis, the rate of positive bronchoscopic findings was significantly higher in men (odds ratio [OR] = 2.277, 95% CI: 1.380-3.757, $P = .001$) and large nodules (OR = 2.425, 95% CI: 1.713-3.433, $P < .001$) (Table 4). Positive bronchoscopic findings were detected in 13.1% (n = 49) of nodules of >2 cm and ≤3 cm in size. The prevalence decreased to 5.2% (n = 24) in the SPNs sized between >1 cm and ≤2 cm, and 3.8% (n = 7) in the subcentimeter nodules.

The sensitivity of bronchoscopy to detect malignancy declined from 9.1% (n = 34), in lesions 2 to 3 cm in size, to 2.8% (n = 13) in nodules 1 to 2 cm in size, and to