

Rigid bronchoscopy and surgical resection for broncholithiasis and calcified mediastinal lymph nodes

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Background: Patients with calcified mediastinal lymph nodes who have hemoptysis or lithoptysis represent a challenging therapeutic dilemma.

Methods: We performed a retrospective review of a prospective clinic and operative database between January 1998 and December 2006. All patients had calcified mediastinal lymph nodes, symptoms or complications from these nodes, or both.

Results: There were 50 patients (23 men). Thirty-eight (76%) were symptomatic, which included hemoptysis in 11, persistent cough in 8, and recurrent pneumonia in 5, and all underwent rigid bronchoscopy. Thirty-four (89%) of the 38 symptomatic patients had stones eroding into the airway (broncholiths), and 2 had an airway esophageal fistula. The most common location of the broncholith was in the bronchus intermedius (n = 19). Endoscopic removal of the broncholith was performed in 29 patients and was successful in all. Elective thoracotomy with lymph node curettage, removal, or both was performed in 5 patients. These 5 patients had no significant morbidity and no operative mortality. Patients remained symptom free (median follow-up, 2.3 years; range, 8–42 months). Twelve asymptomatic patients with calcified lymph nodes were followed with serial computed tomographic scans and remain asymptomatic (median follow-up, 3.1 years).

Conclusions: Broncholiths that are not fixed to the airway can be safely removed with rigid and flexible bronchoscopic equipment. Thoracotomy with broncholithectomy is also safe and effective and is reserved for symptomatic lesions that cannot be removed bronchoscopically or for lesions that cause airway esophageal fistulas. Calcified nodes in asymptomatic patients are not an indication for intervention.

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Read at the Thirty-third Annual Meeting of the Western Thoracic Surgical Association, Santa Ana Pueblo, NM, June 27–30, 2007.

Received for publication June 28, 2007; revisions received Aug 30, 2007; accepted for publication Sept 14, 2007.

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J Thorac Cardiovasc Surg 2008;136:186-90
0022-5223/\$34.00

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doi:10.1016/j.jtcvs.2007.09.084

Broncholiths are calcified peribronchial lymph nodes that erode into the adjacent airway and cause clinical and radiographic abnormalities.¹ Most broncholiths are a result of fungal infections, often *Histoplasma capsulatum* or mycobacterial granulomatous lymphadenitis, silicosis, or both.^{2,3} Patients become symptomatic when the calcified lymph node impinges on or erodes into the lumen of the airway. Bronchial distortion, irritation, and erosion by broncholiths can cause chronic cough, hemoptysis, lithoptysis, recurrent pneumonia, and fistulas between the bronchi and mediastinal structures, often the esophagus. Bronchoscopy plays an important diagnostic and therapeutic role. However, many endoscopists have reservations about removal because of the fear of massive hemorrhage, bronchial injury, or both with attempted extraction of broncholiths bronchoscopically. Thus many currently recommend avoiding bronchoscopic broncholithectomy⁴ and prefer thoracotomy with broncholithotomy.⁵ In addition to these symptomatic patients, some patients are sent for evaluation of large calcified mediastinal nodes that are asymptomatic. The natural history of these patients has been poorly studied. The purpose of this study was to review our endoscopic and thoracotomy experience in symptomatic patients with broncholithiasis and to evaluate the 3-year natural history of asymptomatic patients with calcified mediastinal lymph nodes.

Abbreviations and Acronyms

CT = computed tomography

Nd:YAG = neodymium-doped yttrium aluminum garnet

Materials and Methods**Definitions**

Broncholithiasis is defined as bronchial inflammation or obstruction caused by broncholiths. A *broncholith* is defined as a calcified structure or hard concretion that has part of its structure eroding into any part of the tracheobronchial tree.⁶ It is visible during bronchoscopy, and usually results from the erosion of a tuberculous or other granulomatous lymph node through the bronchial wall into the lumen. Broncholiths were then subdivided as either *mobile* (also called *rockable*) or *fixed*. Mobile broncholiths are defined as a broncholith that is either loose in the airway or moves when probed with bronchoscopic instruments during bronchoscopy. A fixed broncholith (also referred to in this article as an *airway stone*) is defined as a broncholith that does not exhibit any movement when probed by the bronchoscope or by any instruments placed through it during bronchoscopy.

We performed a retrospective cohort study using a prospective operative database over an 8-year period. In addition, a prospective database of patients evaluated in our clinic was also used. All patients saw one surgeon in the clinic, and patients who underwent surgical intervention were operated on by the same surgeon. The inclusion criteria require patients with calcified mediastinal lymph nodes that we evaluated in our clinic or patients with broncholiths who underwent bronchoscopy or open operations. Patients less than 19 years of age were excluded. This study was approved by the University of Alabama's Institutional Review Board. Patient consent was obtained for entry into the operative and clinic databases, and patients were informed that their data might be used for research purposes.

Technique of Rigid Bronchoscopy

Rigid bronchoscopy was performed as described at length previously.⁷ Briefly, patients underwent general anesthesia, a tooth guard was placed on the patient's upper teeth, the neck was extended, and, most commonly, a rigid number 8 bronchoscope was inserted through the vocal cords under direct vision with the aid of a hand-held laryngoscope. Conversion from rigid bronchoscopy to formal laryngoscopy with epiglottic suspension is always available. Once the rigid bronchoscope is in the upper trachea, jet ventilation is established. Jet ventilation is carried out through a side channel of the rigid bronchoscope, thus enabling the surgeon more room to work through the end of the scope concomitantly while still oxygenating and ventilating the patient. Ventilation occurs through the open end of the rigid bronchoscope. A flexible bronchoscope can then be easily placed down through the rigid scope, and the entire airway can be evaluated. The offending broncholith is identified and is probed to determine whether it is fixed to the sides of the airway or whether it is mobile. If bleeding occurs from vascular granulation tissue around the airway stone, then a neodymium-doped yttrium aluminum garnet (Nd:YAG) or holmium laser can be used as previously described.⁸ In addition, an Nd:YAG or holmium laser can be

used to directly laser the stone in selected patients. If the stone is loose or becomes loose after manipulation, then it is removed through a 0° lens straight-A head grasper. If it cannot be grabbed and removed, a 4- to 8-mm angioplasty balloon catheter is positioned beyond the stone and then inflated and pulled proximally to pull the stone into the more proximal airway. Irrigation is then used to ensure all small fragments are removed, and the distal airway is then inspected to ensure all subsegments are recruited.

Thoracotomy With Lymph Node Removal or Curettage

Patients who have persistent symptoms, recalcitrant tracheobronchial fistulas, or both to other mediastinal structures often require thoracotomy. The goal of the operation is broncholithectomy through a bronchotomy, repair of the airway and takedown of the fistula, the interposition of a pedicled muscle flap in between the 2 structures (usually we use an intercostal muscle), and removal of all calcified mediastinal (N2) nodes, as well as calcified hilar (N1) nodes, that can be safely removed without the concomitant removal of nondiseased pulmonary parenchyma. Lymph nodes that cannot be safely removed, such as the subcarinal node, because of tenacious attachment to surrounding vital structures (ie, esophagus, carina, and superior vena cava) should be incised, and curettage should be used as previously described.⁵ This allows for removal of the caseating material, calcified material, or both that fills the lymph node yet leaves the outer shell of the lymph node in place. This technique is safe because the outer wall of the lymph node serves as a protective border to help prevent injury to surrounding structures. The entire material, however, inside the lymph node must be removed so the walls of the lymph node collapse.

Results

Between January 1998 and December 2006, there were 50 patients (23 men) who met the eligibility criteria for this study. Twelve (24%) patients were asymptomatic and were referred for calcified mediastinal lymph nodes that were incidentally discovered during computed tomographic (CT) scans performed for other reasons. The remaining 38 (76%) patients were symptomatic. Figure 1 shows the results for these symptomatic patients. The most common presenting symptoms included hemoptysis (11 patients), persistent cough (8 patients), and recurrent pneumonia (5 patients). Other symptoms included chest pain in 4 patients, dyspnea in 4 patients, dysphagia in 2 patients, and malaise, hemoptysis, excessive sputum, and wheezing in 1 patient each. All patients underwent rigid bronchoscopy with a flexible bronchoscope placed through the rigid scope, as described in the Materials and Methods sections. We found broncholiths eroding into the airway in 32 patients, an esophageal fistula in 2 patients (both on the right bronchial tree), and calcified mediastinal lymph nodes compressing parts of the airway in the remaining 4 symptomatic patients. These 4 patients underwent bronchoscopic dilation and 3-month therapy with itraconazole (Sporonax; Janssen-Ortho, Toronto Ontario, Canada) because all 4 had extensive bilateral mediastinal and hilar disease. One patient required the placement of

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