Video-assisted thoracoscopic surgery for patients with pulmonary coccidioidomycosis

Awais Ashfaq, MD,[a] Holenarasipur R. Vikram, MD,[b] Janis E. Blair, MD,[b] and Dawn E. Jaroszewski, MD[a]

Objective: The study objective was to evaluate the use of video-assisted thoracoscopic surgery for removal of pulmonary sequelae of the fungal infection coccidioidomycosis.

Methods: Retrospective chart review of all patients with pulmonary coccidioidomycosis treated surgically at our tertiary care center between January 1, 2009, and August 31, 2012.

Results: Of 2166 patients treated for pulmonary coccidioidomycosis, 58 (2.7%) (median age, 52 years [range, 18-84 years]) required surgical treatment. Surgical resection was performed for diagnosis (n = 28 [48%]); 17 with positive positron emission tomography findings); persistent or progressive symptoms despite antifungal therapy (n = 23 [40%]); or complications (n = 7 [12%] of cavity rupture/infection). Of 33 patients (57%) who had serology performed, 23 (70%) had positive results. Video-assisted thoracoscopic surgery was used for most (95%; n = 55) procedures, including 38 (67%) wedge resections, 14 (24%) segmentectomies, and 6 (11%) lobectomies; 4 patients also required additional decortication. Major (8%), including 1 death, and minor (12%) complications occurred in 12 patients postoperatively. Median hospitalization was 3 days (range, 1-8 days). Postoperative antifungal therapy was administered to 50% of patients for a median duration of 2 months. No patient had recurrent coccidioidomycosis at a median follow-up of 19 months.

Conclusions: Although rarely necessary for pulmonary coccidioidomycosis, surgical intervention may be indicated. Specific indications include refractory symptomatic disease and complications of the infection, such as cavity rupture. Excisional biopsies also may be required for diagnostic confirmation of indeterminate pulmonary nodules. With video-assisted thoracoscopic surgery, diagnostic and therapeutic intervention can be undertaken with a low risk of complications and shorter length of hospital stay. (J Thorac Cardiovasc Surg 2014;148:1217-23)

GTS

Often called ''valley fever,'' the fungal infection coccidioidomycosis affects an estimated 150,000 persons in the United States annually.[1-3] The infection is caused by inhalation of soil-dwelling spores of the fungus *Coccidioides* species, which is endemic to the southwestern United States.[1,2,4,5]

The Centers for Disease Control and Prevention has documented a substantial increase in the incidence of reported coccidioidomycosis in endemic states (Arizona, California, Nevada, New Mexico, and Utah) from 5.3 per 100,000 population in 1998 to 42.6 per 100,000 in 2011.[6] With the increasing mobility of patient populations, clinicians in regions outside the coccidioidal endemic area also have been faced with the responsibility of identifying and treating this disease and its sequelae. Coccidioidal infection typically manifests as a flu-like illness, and it is a common cause of community-acquired pneumonia in endemic areas.[1,4] Typical symptoms include cough, fatigue, chest pain, fever, hemoptysis, weight loss, dyspnea, malaise, night sweats, and chills.[1,2,5,7]

Approximately 5% to 10% of coccidioidal infections result in residual pulmonary sequelae, such as nodules and cavities.[1,4] Most coccidioidal infections are self-limited and resolve with or without antifungal treatment; however, a small percentage of patients require surgery as definitive or adjunctive treatment.[3,5,8] The most common surgical indications are symptomatic nodules or cavities that do not resolve (Figure 1) and, less frequently, cavitary lesions (Figure 1) that rupture. Persistent or enlarging coccidioidal nodules or masses also may present a diagnostic dilemma for patients who are at risk for carcinoma or who have nondiagnostic or unobtainable biopsies (Figure 2). Serum antibody testing also may be negative in these patients, which contributes to diagnostic complexity.

Since 1995, video-assisted thoracoscopic surgery (VATS) has been used in select cases for lung resection. VATS has become the standard approach in diagnostic procedures and for the treatment of many benign diseases[9-14] (Figure 3). The role of VATS in the excision of coccidioidal lesions has not been well studied. The inflammatory response and potential pleural adhesions inherent in coccidioidal infection led many surgeons to use open resection.

From the Divisions of Cardiovascular and Thoracic Surgery,[a] and Infectious Diseases,[b] Mayo Clinic Hospital, Phoenix, Ariz.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication Oct 20, 2013; revisions received Jan 14, 2014; accepted for publication Feb 3, 2014; available ahead of print March 4, 2014.

Address for reprints: Dawn E. Jaroszewski, MD, Division of Cardiovascular and Thoracic Surgery, Mayo Clinic Hospital, 5777 E. Mayo Blvd, Phoenix, AZ 85054 (E-mail: jaroszewski.dawn@mayo.edu).

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2014.02.014

Abbreviations and Acronyms
CT = computed tomography
PET = positron emission tomography
VATS = video-assisted thoracoscopic surgery

Previous publications have commonly described open resection for treatment of fungal-based disease.[15-17] We therefore conducted a retrospective review of the medical records of patients with pulmonary coccidioidomycosis who were surgically treated using VATS at our tertiary care academic medical institution to determine whether VATS was safer and more effective compared with open surgery.

MATERIALS AND METHODS

Study Design

A retrospective review was conducted to identify all patients with documented coccidioidal infection who were treated at Mayo Clinic, Scottsdale, Arizona, between January 1, 2009, and August 31, 2012. The study was approved by the Mayo Clinic Institutional Review Board, which waived consent on de-identification of patients. Patients with coccidioidal infections were selected by reviewing all cases of coccidioidomycosis reported to the Arizona Department of Health Services by our institution. Reports were compiled on the basis of microbiological cultures of any source of *Coccidioides* sp, positive pathologic results, or positive serologic results. The medical records of these patients were retrospectively reviewed, and the following information was abstracted: site of coccidioidal infection (right or left lung) and characteristics of the first radiographic findings (nodule, cavity, pneumothorax, or empyema). Patients underwent surgery following our proposed treatment algorithm in previous publication.[15] For patients who underwent surgery, further details included clinical and radiologic indications for surgery, diagnostic methods, type of surgical treatment (wedge resection, segmentectomy, or lobectomy), postoperative complications, preoperative and postoperative antifungal treatment, and follow-up. Complications were reported in accordance with the definitions established by The Society of Thoracic Surgeons.

Statistical Methods

Categoric variables were analyzed as numbers and percentages. Continuous variables were summarized as medians and ranges. Differences among categoric variables were determined by the chi-square test. All data entry and analysis were conducted using SPSS version 16.0 (SPSS Inc, Chicago, Ill).

RESULTS

Patients

A total of 2166 patients were identified with a diagnosis of coccidioidomycosis who were evaluated at our tertiary care academic medical institution between January 1, 2009, and August 31, 2012. Of this total, 58 patients (2.7%) underwent thoracic surgical procedures. The median age of the surgical patients was 52 years (range, 18-84 years). Thirty-two patients (55%) were women, and 26 patients (45%) were men. Patients were categorized by their radiographic findings at the time of presentation for surgical consultation. Of the 58 patients, 34 (59%) had lung nodules, 17 (29%) had cavitary disease, and 7 (12%) had complications of disease that included empyema, hydrothorax, or pneumothorax. Twenty-three (40%) of the 58 patients had intractable coccidioidal symptoms (chest pain, dyspnea, fever, or fatigue) refractory to antifungal therapy at the time of surgery. Surgery resulted in complete resolution of symptoms in all but 1 patient (improved but not completely resolved).

Preoperative Antifungal Therapy

Before surgical resection, 24 (41%) of the 58 patients had preoperative antifungal therapy (Table 1), with treatment duration ranging from 3 weeks to 1 year. The most common antifungal medication was fluconazole (n = 20 [83%]). In select cases, itraconazole, posaconazole, or voriconazole was subsequently used because of organism resistance or intolerance to medication side effects. Treatment choices were based on the preference of the physician, the tolerance profile of the patient, and the health insurance coverage of the patient. No conclusions can be drawn about the optimal length of antifungal therapy on the basis of disease advancement or progression to complications. Thirty-three patients (57%) had serology performed before surgery, with only 23 (70%) exhibiting positivity (Table 1).

Patients With Nodular Radiographic Findings

Thirty-four (59%) of the 58 patients underwent surgical excision after a suspicious nodule was noted on imaging. Of the 18 patients who underwent positron emission tomography (PET) imaging, 17 (94%) had lesions with positive uptake of ^{18}F-fluorodeoxyglucose (Table 1). Nodules were noncalcified in 10 patients (56%) and spiculated in 11 patients (61%). Of 9 of 18 patients (50%) who underwent computed tomography–guided transthoracic biopsy, 7 had indeterminate findings on pathology. Two patients with multiple nodules were found to have cancerous pathology (1 carcinoid and 1 adenocarcinoma), in addition to coccidioidomycosis nodules. The remaining half of the patients (n = 9) did not undergo transthoracic biopsy mainly because of the technically difficult location of the nodule. One patient with a negative PET scan had a smooth calcified nodule and underwent resection because the nodule was enlarging. Among 17 PET-positive patients, 12 had a previous or current diagnosis of cancer: lung cancer and oral pharyngeal cancer (2 patients each); and carcinoid, melanoma, colon cancer, retroperitoneal sarcoma, endometrial sarcoma, breast cancer, post-stem cell transplant, and chronic lymphocytic leukemia (1 patient each). Coccidioidal serology was positive for 10 (29%) of the 34 patients with nodular disease (Table 1).

Patients With Cavitary Lesions

Cavitary lesions that progressed or failed to resolve despite adequate antifungal therapy affected 17 (29%) of