A Series of Transbronchial Removal of Intracavitary Pulmonary Aspergilloma

David R. Stather, MD, FRCPC, Alain Tremblay, MDCM, FRCPC, Elaine Dumoulin, MDCM, FRCPC, Paul MacEachern, MD, FRCPC, Alex Chee, MD, FRCPC, Christopher Hergott, MD, FRCPC, Jacob Gelberg, MD, FRCPC, Gary A. Gelfand, MD, FRCPC, Paul Burrowes, MD, FRCPC, John H. MacGregor, MD, FRCPC, and Christopher H. Mody, MD, FRCPC

Department of Medicine, University of Calgary, Calgary, Alberta; Department Medicine, McMaster University, Hamilton, Ontario; and Departments of Surgery, Radiology, and Microbiology, Immunology and Infectious Disease, University of Calgary, Calgary, Alberta, Canada

Background. **Intracavitary pulmonary aspergilloma is a chronic, debilitating fungal infection. Without definitive therapy, death can occur from massive hemoptysis, cachexia, or secondary infection. Although surgical resection is the standard therapy, it is not possible for many patients owing to poor pulmonary function or medical comorbidities. Aspergilloma removal through bronchoscopy is an important alternative therapy that may be available in select cases.**

Methods. **We retrospectively reviewed all cases referred to the University of Calgary Interventional Pulmonary Service for transbronchial removal of intracavitary aspergilloma from January 1, 2009, to January 1, 2014.**

Results. **Ten patients with intracavitary pulmonary aspergilloma were identified. In 3 patients, the aspergilloma cavity was not accessible by bronchoscopy. Successful removal of the aspergilloma with symptom improvement or resolution was achieved in 6 of 7 cases. One of the patients was lost to follow-up. Minor hypoxia lasting 12 to 72 hours was observed in 5 cases. Severe sepsis requiring an extended critical care unit stay occurred in 1 case. Follow-up ranged from 9 months to 5 years.**

Conclusions. **Although not without risk of minor hypoxia and possible sepsis, for carefully selected patients, bronchoscopic removal of symptomatic intracavitary pulmonary aspergilloma may be an alternative therapy to surgical resection for this life-threatening disease.**

(Ann Thorac Surg 2016;■:■–■)

Intracavitary pulmonary aspergilloma is a chronic, life threatening fungal infection, with mortality from massive hemoptysis between 2% and 14% [1–5]. Some patients are asymptomatic, whereas others have hemoptysis, chronic sputum production, cachexia, or chest discomfort [1–5]. Aspergillomas occur after *Aspergillus* species colonization of preexisting lung cavities (secondary to etiologies such as tuberculosis and sarcoidosis), followed by fungal growth on the cavity walls and facilitated by inadequate drainage. Protracted courses of oral or intravenous antifungal agents are ineffective [6]. Surgical therapy has been the treatment of choice, although the mortality rate has been reported to be 1% to 23% [2, 7–12] and morbidity, 16% to 50% [2, 7–12]. Many patients are not surgical candidates owing to the severity of their pulmonary impairment and comorbidities. Other approaches, including intracavitary amphotericin B have had limited success or are poorly tolerated and currently considered for short-term or salvage therapy of life-threatening complications such as hemoptysis [13, 14].

The University of Calgary Interventional Pulmonary Group has described a new treatment modality for intracavitary aspergilloma utilizing a combination of virtual bronchoscopy reconstruction to facilitate bronchoscopic access and removal of the intracavitary aspergilloma in combination with antifungal therapy [15], and has been performing this procedure for 4 years. This study aims to retrospectively analyze the results of all cases of bronchoscopic removal for the treatment of intracavitary pulmonary aspergilloma performed at the University of Calgary to better understand the safety and efficacy of this novel procedure.

Accepted for publication Aug 22, 2016.

Address correspondence to Dr Dumoulin, Division of Respiratory Medicine, S Health Campus, 6th Flr, 4448 Front St SE, Calgary, AB T3M 1M4, Canada; email: elaine.dumoulin@albertahealthservices.ca.

Dr Tremblay discloses a financial relationship with Olympus America.

Published by Elsevier

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2016.08.069

Patients and Methods

The University of Calgary Conjoint Health Research Ethics Board (Ethics ID REB 13-0588) approved this study. We retrospectively analyzed all patients referred to the University of Calgary interventional pulmonary service for transbronchial removal of intracavitary aspergilloma from January 1, 2009, to January 1, 2014. The diagnosis of an aspergilloma required a chest computed tomography (CT) scan demonstrating a mycetoma, and microbiologic growth of *Aspergillus* species from sputa, bronchoalveolar lavage, or CT-guided needle aspiration of the mycetoma with or without serum precipitating antibodies to *Aspergillus* species. Medical records were reviewed to determine patient clinical characteristics, the details of the aspergilloma removal procedure, and all complications and treatments relating to the aspergilloma both before and after the bronchoscopic removal procedure.

All patients were evaluated by a thoracic surgeon and were deemed to be nonoperable or refused surgery. All patients were symptomatic on presentation, with purulent sputum production, hemoptysis, or cough. All patients underwent staged procedures after informed consent. A thin-cut (0.625 mm) CT scan of the chest with virtual bronchoscopy reconstructions (superDimension, Minneapolis, MN) was used to identify airways leading into the cavity. Ultrathin bronchoscopy (XP-160F bronchoscope [outer diameter 2.9 mm]; Olympus Canada, Markham, ON) [16] was then performed under conscious sedation to confirm the presence of an airway leading to the cavity and to obtain biopsy specimens and cultures to confirm the diagnosis.

Aspergilloma removal was performed in a separate procedure in the operating room under general anesthesia using a flexible bronchoscope through a rigid bronchoscope or a double-lumen endotracheal tube. Choice of approach depended on the size of the airway leading to the cavity and the size of the flexible bronchoscope being used to access the cavity. For patients who required rigid bronchoscopy because of a larger flexible bronchoscope, bronchial blockers and dependent positioning of the involved lung were used to manage bleeding and reduce soiling of the contralateral lung. In the remaining patients, a double-lumen tube was used to protect the contralateral lung. Once the airway was secured in this fashion, the aspergilloma was removed from within the cavity through mechanical disruption of the fungal ball with biopsy forceps (XB01-951; Olympus Canada) and foreign body basket retrieval devices (Zero Tip Airway Retrieval Basket; Boston Scientific, Mississauga, ON) followed by suctioning of the fungal debris. That was continued until the cavity appeared visually free of fungal debris.

Two independent radiologists (P.B. and J.H.M.) reviewed all study chest CT scans. The scans included the initial CT scan at the time of referral to the interventional pulmonary service and all subsequent chest CT scans after the bronchoscopic removal procedure. The images were examined for aspergilloma, and the size and location was recorded. The size of the aspergilloma was determined by the diameter of its largest length and width on axial images. An increase in size was defined as any increase in the mean size of the two radiologists' measurements as compared with the size of the aspergilloma just before the bronchoscopic removal procedure, or reappearance after complete resolution (Fig 1A–D). Radiographic resolution was defined as the absence of fungus ball on follow-up imaging.

Results

Ten patients were considered by the University of Calgary interventional pulmonary service for bronchoscopic transbronchial removal of intracavitary aspergilloma from January 1, 2009, to January 1, 2014, after being evaluated by a thoracic surgeon. All patients were either unfit for surgery or refused the procedure after the morbidity and mortality associated with the intervention was explained by a thoracic surgeon.

Bronchoscopic removal of intracavitary aspergilloma was completed in 7 of 10 patients. In 3 patients, no airway leading to the aspergilloma could be identified, making bronchoscopic removal impossible. One of these 3 patients was reconsidered for surgery and went on to have a successful resection of the aspergilloma, 1 died of metastatic prostate cancer, and the third patient was lost to follow-up.

Demographic information and characteristics of the 7 patients are detailed in Table 1. Five of the 7 patients were women. Ages ranged between 32 and 67 years. Two patients had severe chronic obstructive pulmonary disease with forced expiratory volume of air in 1 second (FEV_1) less than 50%. The mean FEV_1 was 77%. All patients were symptomatic at the time of the bronchoscopy. The mean size of the aspergillomas was 2.85 cm. Four patients had a history of tuberculosis. Five of the 7 patients had unsuccessful antifungal treatment before the procedure.

The operative and postoperative results are detailed in Table 2. Four patients had their procedure performed with the use of a double-lumen tube, and the mean duration was 4.7 hours. The main complication was minor hypoxia in 85.7% of the cases. Symptom resolution was achieved in 5 of 7 patients after the first procedure. One patient had a first procedure under conscious sedation, which was unsuccessful, and required a second procedure under general anesthesia to obtain resolution of her symptoms; she had larger cavity walls and a history of necrotic pneumonia. The CT scan was consistent with necrotizing aspergillosis in addition to the aspergilloma (Fig 1E, F). The bronchoscopic view showed diffused involvement of the cavity wall, with some improvement after the procedure (Fig 2A–C). The patient who did not achieve resolution of his symptoms was lost to follow-up and did not receive antifungal treatment after his aspergilloma resection; he re-presented with massive hemoptysis.

Aspergilloma resolution on imaging at 9 months after the procedure was achieved in 6 of 7 patients (85.7%)