Surgery for Other Pulmonary Fungal Infections, *Actinomyces*, and *Nocardia*

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KEYWORDS

• Fungus • Infection • Lung • Abscess • Cavitary • Empyema • Chest wall

KEY POINTS

- When evaluating a patient with a pulmonary nodule, take a careful history of all previous respiratory infections and of fungal exposure.
- Use computed tomography criteria for indeterminate pulmonary nodules to avoid unnecessary operations.
- If zygomycetes infection is suspected, resect urgently to prevent extensive damage.
- Eliminate all residual spaces after resection.
- Aggressively manage fungal empyemas.

INTRODUCTION

Surgery plays a small but important niche role in modern management of fungal diseases. During the last quarter century, clinicians perfected minimally invasive biopsy procedures and techniques, researchers developed diagnostic tests that have greater accuracy, and pharmaceutical companies reformulated older antimicrobials and produced new drugs that are more effective and have fewer side effects. This article discusses the human fungal pathogens (except for *Aspergillus* species, which is discussed elsewhere in this issue). Details discussed include their behavior as pathogens, methods for their diagnosis, and the nonsurgical and surgical management (**Table 1**) of clinically significant infections and complications.

HISTOPLASMOSIS

Organism, Clinical Characteristics, and Diagnosis

Histoplasma capsulatum, the offending organism, is present in its mycelial form in soil contaminated with bird or bat droppings near large river valleys throughout the world.[1] Mammals, including humans, inhale the organism and macrophages engulf the fungus. It then transforms into the budding yeast form, causing activation of inflammatory cytokines, in particular LI-17 and tumor necrosis factor (TNF).[2] Over several months, the ongoing inflammation causes granulomas in lymph nodes, some of which become calcified.

In endemic areas, a large number of individuals have been infected with *H capsulatum*, usually as children. In those who develop symptoms, the disease may present as disseminated disease, usually only in immunocompromised patients, or may be localized in the chest.[3] Clinical symptoms may be nonexistent or mild, including fever, malaise, headache, and weakness, with substernal chest discomfort and dry cough. In cases of a large inoculum, patients present with acute fever, chills, malaise, dyspnea, cough, and chest pain. Panlobar involvement is common in this phase, but the pleura is spared. As pulmonary parenchymal involvement resolves, inflamed lymph nodes

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Table 1
The most common surgical procedures required for different problem types, based on infecting organism

Organism	Common Problems	Common Surgical Procedures
Histoplasmosis	Broncholiths (hemoptysis/fistulas) Recurrent pericardial effusions Fibrosing mediastinitis Indeterminate nodule	Removal of broncholiths Pericardiectomy Vascular stenting Resection (obsolete)
Blastomycosis	Empyema Indeterminate nodule	Surgical management Resection (obsolete)
Coccidiodomycosis	Nonresponsive cavitary disease Indeterminate nodule	Pulmonary resection Resection
Paracoccidioidomycosis	Indeterminate nodule Airway stenosis	Resection Endobronchial management
Cryptococcosis	Empyema	Surgical management
Sporotrichosis	Cavitary disease Indeterminate nodule	Parenchymal resection Resection
Candidiasis	—	Rarely requires surgical management
Zygomycetes	Pulmonary and airway necrosis	Aggressive resection
Dematiaceous molds	Abscesses and infected cavities	Parenchyma-sparing resection Space management
Adiaspiromycosis	Parenchymal changes	Parenchyma-sparing resection
Actinomycosis	Indeterminate nodule Massive hemoptysis	Resection Resection and space management
Nocardiasis	Wound complications Draining sinuses	Debridement Resection of diseased tissue

become prominent on radiographs, looking like buckshot.

Cavitary histoplasmosis may occur in patients who have emphysema. Cavities, usually in the upper lobes, slowly enlarge compressing normal lung. Fibrosis develops in the lower lobes, possibly caused by spillage of antigen from the cavities. Without treatment, death due to diminishing pulmonary function is common.

Varying forms of mediastinitis develop in all patients with pulmonary histoplasmosis. The nodes enlarge because of granulomas with caseous necrosis. Nodes become confluent and persist for months to years. A small number of patients with smoldering mediastinitis develop broncholithiasis.

In rare instances, the inflammatory process gradually leads to scarring and fibrosing mediastinitis (**Fig. 1**). Virtually any thoracic structure may be involved, causing organ-specific obstructive symptoms. The most common sites are the airway, the pulmonary vasculature, the superior vena cava, and occasionally the aorta.

Other problems that may occur include pericarditis, rheumatologic arthritis, and, rarely, ocular histoplasmosis.

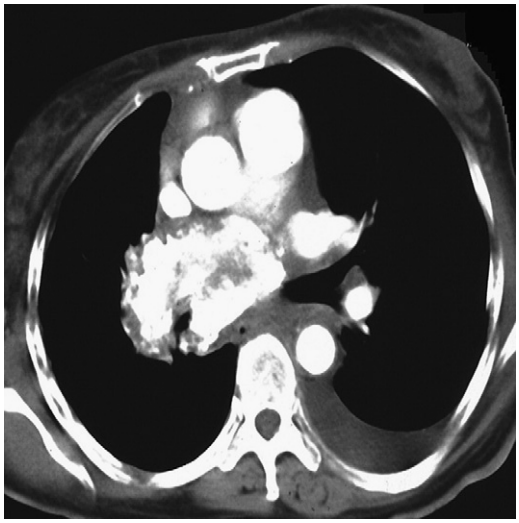

Fig. 1. Computed tomography (CT) image of extensive fibrosing mediastinitis. (*From* Hammoud ZT, Rose AS, Hage CA, et al. Surgical management of pulmonary and mediastinal sequelae of histoplasmosis: a challenging spectrum. Ann Thorac Surg 2009;88(2):399–3; with permission.)