Anesthetic Management for Lobectomy in a Patient With Coccidioidomycosis: A Case Report

Abbie J. Choleva, RN, BSN

Coccidioidomycosis is a fungal disease with a wide variety of manifestations. The systemic infection is a product of airborne spore inhalation released from the soil. This once-endemic disease is steadily increasing in incidence, geographic location, and severity. The rare coccidioidomycosis cases requiring surgical intervention present unique challenges to anesthesia providers. The following is a case report of a patient with multiple organ failure who was admitted for left lung lobectomy with decortication because of aggressive coccidioidomycosis. Anesthetic considerations included attention to fungal sepsis, acute tubular necrosis related to amphotericin B therapy, and airway challenges. Careful attention to perioperative fungal therapies, invasive monitoring, and electrolyte stabilization remain pivotal concerns offering the best outcomes for patients with coccidioidomycosis.

Keywords: Acute tubular necrosis, amphotericin B, coccidioidomycosis, difficult airway, fungal sepsis.

Coccidioidomycosis, also known as valley fever, is a fungal disease endemic to the southwestern United States, resulting in 100,000 infections annually.1 This systemic infection is caused by inhalation of airborne spores from Coccidioides immitis, a fungus located in soil and aerosolized when disrupted.2 The arthrospores transform and mature in vivo to spherules containing endospores, from which the disease is spread to a variety of tissues.3 In Arizona alone, more than 5,000 cases were reported in 2006, increasing 150% from 2005.4 The majority of the infections are asymptomatic or manifest as community-acquired pneumonia with favorable outcomes.1,3

In rare cases, approximately 0.5% of infected persons, serious clinical manifestations will develop, with nodules, cavities, or miliary disease.3,5 A variety of risk factors have been identified for severe pulmonary coccidioidomycosis, including race; African American, Hispanic, and Filipino people are at higher risk.5,6 People who are elderly, have diabetes, are pregnant, or are positive for the human immunodeficiency virus also have a statistically increased risk for the development of severe coccidioidomycosis.2,3,5,6 Social factors contribute to severe disease and include smoking, outdoor occupations, and low socioeconomic class.2,3,5,6 Finally, people infected with coccidioidomycosis during the winter months, November through February, are more likely to have severe manifestations of coccidioidomycosis.2 Aggressive Coccidioides strains may disseminate to meninges, subcutaneous tissues, internal organs, bones, and joints.3 These rare coccidioidomycosis cases necessitate surgical interventions and warrant attention and understanding from anesthesia providers for the best management. The treatment of severe coccidioidomycosis with amphotericin B and lobectomy with decortication presents many challenges to anesthesia providers. The following is a case report of a patient with multiple organ failure who was admitted for left lung lobectomy with decortication because of aggressive coccidioidomycosis disease.

Case Summary
An otherwise healthy 45-year-old, 165-cm, 60-kg, African American woman was admitted to the university hospital medical-surgical intensive care unit for surgical evaluation of localized, active coccidioidomycosis nodules in the lower lobe of her left lung. The patient had no food or drug allergies, surgical history, or relevant social or medical history, as reported by her sister. The patient did not take any medications. No family history of anesthesiology complications was noted. The patient resided in Arizona for 10 years.

The patient was referred from a neighboring local hospital intensive care unit for severe coccidioidomycosis unresponsive to traditional antifungal therapy that resulted in multiple organ dysfunction syndrome. The onset of initial symptoms began in November, 2 months before the current admission, when the patient went to a clinic because of cough and dyspnea and was prescribed antibiotics. Two weeks later, the patient was admitted to the local hospital intensive care unit with chief complaints of weakness, hemoptysis, night sweats, exertional dyspnea, and left-sided pleuritic chest pain. The patient was immediately intubated because of respiratory distress. The physical examination was remarkable for decreased breath sounds and dullness to percussion at the left lung base. Computed tomography and chest radiography revealed a left lower lobe infiltrate. Thoracentesis of left lower lobe revealed turbid fluid with a protein level of 5 g/dL, a glucose level of 50 mg/dL, a white blood cell count of 5,000/µL, and a pH of 7.15, all consistent with
empyema. The serum white blood cell count was elevated, at 20,000/µL. Pleural fluid, sputum, and serum precipitin IgM reactions to C. immitis tested positive.

Antifungal therapy with intravenous (IV) fluconazole and amphotericin B was started. Within 1 week, acute renal failure developed, requiring hemodialysis. Acute respiratory failure persisted with increasing ventilator requirements for 2 weeks; therefore, the patient received an elective tracheostomy. Increasing doses of antifungal therapy failed to improve the patient’s condition. After consultation, infectious disease physicians recommended surgical debridement as a critical component for the patient’s survival. Due to lack of surgical support at the initial facility, the patient was transferred to a nearby university hospital medical-surgical intensive care unit.

Preoperative examination revealed a sedated and ventilated patient via tracheostomy tube; current settings were as follows: respiratory rate, 12/min; tidal volume, 500 mL per breath; fraction of inspired oxygen, 100%; and positive end-expiratory pressure, 8. The patient’s oxygen saturation was 95%, and no spontaneous breathing above the ventilator settings was noted. Diminished breath sounds of the left lung base and thick, yellow tracheal secretions were noted. The patient was diaphoretic and had an oral temperature of 100°F. An electrocardiogram revealed sinus tachycardia at 110/min; no murmur was auscultated. The patient’s blood pressure was supported with a norepinephrine infusion and averaged 115/80 mm Hg via left radial arterial line. Peripheral pulses were palpable, the transduced central venous pressure was 4 mm Hg, and moderate edema was noted throughout all extremities. The patient was sedated with propofol and fentanyl continuous infusions through a right subclavian IV catheter, and pupils were sluggish but reacted to light. An upper extremity and facial tremor was noted. At the completion of the case, the patient was intubated with fentanyl infusion at case completion.

Remifentanil infusion was initiated at 2.0 µg/min and adjusted as needed to hemodynamic stability. The patient’s blood pressure was maintained with frequent titration of a phenylephrine infusion initiated at 25 µg/min with intermittent dosing of ephedrine, 5 mg IV, as needed. Remifentanil infusion was initiated for intraoperative pain management at 15 µg/min and adjusted as needed to hemodynamic stability. Redosing of 4.5 mg of IV cisatracurium was administered twice to maintain no more than 1 or 2 twitches in a train of 4 throughout the case. Remifentanil infusion was replaced with fentanyl infusion at case completion.

The procedure, surgical incision and removal of the lower lobe of the left lung with decortication, remained uneventful and lasted approximately 3 hours. The mean blood pressure was 60 mm Hg, and the average heart rate was 95/min with minimal ectopy observed. The patient’s oxygen saturation remained greater than 92%, the end-tidal carbon dioxide level was maintained at 31 to 37 mm Hg, and peak airway pressures were approximately 24 cm H2O. Blood loss was assessed frequently, and 2 U of red blood cells were infused due to surgical losses at lobectomy site. The patient’s temperature decreased from 100°F to 98°F during the case secondary to ambient temperature with no interventions provided.

On completion of the procedure, the patient’s lung was gradually inflated to 30 cm H2O pressure with no leaks noted. Two chest tubes were inserted. The Univent tube
with bronchial blocker was replaced with a tracheostomy tube. The patient continued to receive mechanical ventilation and to require vasopressor therapy and was transported back to the intensive care unit. In the 24-hour postoperative period, the patient did not demonstrate signs of airway trauma, pneumothorax, significant bleeding, dysrhythmias, or increase in vasopressor requirements. The patient continued to require aggressive antifungal, hemodynamic, and ventilation support for a prolonged period in the intensive care unit. Three months later, the patient's condition was considered stable by attending physicians, and she was transferred to a step-down facility with the capability for ventilator assistance.

Discussion

The treatment of coccidioidomycosis ranges from observation or antifungal therapy, to surgical intervention.4,6 Recent literature concludes that a minority of patients with primary pulmonary coccidioidomycosis should be considered for treatment, while other patients require only periodic assessments to confirm resolution of the self-limited disease process.4 The current guidelines of the Infectious Disease Society of America suggest 3 to 6 months of oral antifungal therapy, including fluconazole, itraconazole, or ketoconazole for patients who meet the criteria for severe disease or are at increased risk of disease dissemination.4 Criteria for severe coccidioidomycosis include: culture result positive for *Coccidioides* species, the anatomical site of disease, persistent symptoms (weight loss, night sweats, fever), and complement-fixing antibody concentrations in excess of 1:16. Established risk factors for dissemination include advanced age, an immunocompromised state, late stages of pregnancy, and ethnic of racial factors.4

Research suggests that an extended course of therapy, potentially lifelong, is required to prevent the disease relapse rate of 15%.4 For treatment of respiratory failure or rapidly progressing *C. immitis* infection, IV amphotericin B is the drug of choice.6 Also, for the treatment of virulent nodule, cavitary, or disseminated coccidioidomycosis, surgical debridement is an occasionally important and critical adjunctive measure.3,6 Surgical resection is eminent in the treatment of well-localized refractory lesions unresponsive to standard therapy.3,6

In preparation for surgical intervention in advanced cases of coccidioidomycosis, anesthesia providers must be prepared to evaluate the variety of obstacles to effectively manage the patient's anesthesia. In the present case, the patient had preexisting fungal sepsis evident by the white blood cell count, body temperature, serologic test results, and hemodynamic deviance. Literature stresses the importance of determining whether the patient's condition could be improved before surgery pending further antifungal treatment.7 In this case, the infectious disease team and surgical team decided it could not. In general, the risk of contaminating healthy lung tissue with virulent spherules during lobectomy is small, provided that appropriate preoperative measures are taken.3 Literature supports preoperative treatment with amphotericin B or an oral azole antifungal drug for patients with coccidioidomycosis to yield better surgical and disease outcomes.6,7 Interestingly, isoflurane has recently been found to halt fungal growth in vitro and could offer future therapeutic potential for certain systemic fungal infections.8

Studies indicate that anesthesia management of patients with coccidioidomycosis is challenging because of their limited physiologic reserve.3,7 Hypotension and hypoxemia are common, and invasive monitoring such as arterial blood pressure and central venous pressure is indicated.7 Sufficient IV access should be obtained for volume resuscitation, and inotropic agents along with vasoconstrictors should be readily available.7 Sepsis remains a relative contraindication to many anesthesia procedures, including central venous access, regional techniques, and arterial cannulation; potential risks vs benefits of each decision must be carefully weighed.7 An epidural catheter was not used for this patient because of the possibility of systemic infection migrating to spinal fluid.

When amphotericin B was the only treatment for coccidioidomycosis, the toxic effects of treatment were unanimously agreed to outweigh its potential benefits.4,6 Unfortunately, this drug is indicated in severe cases of coccidioidomycosis because there are few alternatives.9 Renal function is impaired in greater than 80% of treated patients, and a permanent decrease in the glomerular filtration rate is likely, with 15% of patients requiring hemodialysis.10,11 Hypokalemia, hypomagnesemia, fever, chills, dyspnea, and hypotension are common side effects of amphotericin B.9,10 Allergic reactions, seizures, anemia, and thrombocytopenia are less likely to occur
but are well documented. A heightened awareness for renal, electrolyte, coagulopathic, hemodynamic, and respiratory aberrancies is warranted for anesthesia providers when treating patients receiving amphotericin B therapy. Current literature reports that hepatotoxic effects have not been identified as side effects of this treatment. This patient’s liver panel results were within normal limits and required no anesthetic considerations. Conflicting research continues as clinicians use lipid preparations of amphotericin B in a search for fewer toxic effects but similar efficacy.

Acute tubular necrosis leading to the development of acute renal failure is of particular concern for anesthesia providers. The morbidity and mortality of patients with acute renal failure are so high that only lifesaving surgery should be undertaken. Anesthesia providers must pay particular attention to maintenance of an adequate mean arterial pressure and cardiac output while concomitantly avoiding further renal insults. In this case, crystalloid fluid replacement was minimal, with colloids preferred because of the renal insufficiency, and titrated to the central venous pressure to prevent overload. Anesthesia providers must use regional techniques when possible and avoid drugs known to decrease renal perfusion. Perioperative blood gas and electrolyte analysis should be performed and was completed in this case. Dialysis should be instituted before and after the surgical procedure as soon as hemodynamics are stabilized.

Finally, the endless airway deviations created by coccidioidomycosis must be considered by anesthesia providers. Disseminated strains have been documented in a variety of airway structures, including head and neck, nasal alae, larynx, trachea, bronchi, retropharyngeal spaces, and pleural sacs. These respiratory aberrancies are most likely found in patients with persistent disease with habitual cough and may increase, decrease, or remain the same during antifungal treatment. Coccidioidomycosis spherules occur in an entire spectrum, including mass lesions, granulomas, inflammatory patches, nodules, pyopneumothorax, and papillary excrescences. In addition to inflammatory lesions sometimes large enough to obstruct the airway, mediastinal and hilar lymphadenopathy tracheal erosions are rare but observed in the clinical setting. These erosions many times result in death. Literature indicates that some cases may require stenting, tracheostomy, or surgical management to prevent complete airway obstruction.

In the present case, the patient did not have disseminated coccidioidomycosis on admission, but the localized pulmonary disease proved equally damaging to the respiratory system and resulted in acute respiratory distress. A lobectomy procedure requires lung separation with 1-lung ventilation to improve surgical exposure and minimize damage to the operative lung. Conventional double-lumen endobronchial tubes are frequently used to permit this approach but are designed to be inserted through the mouth. This technique was not possible for in the present case, and a Univent tube with bronchial blocker was flexible enough to fit through the patient’s stoma and permit lung isolation and adequate 1-lung ventilation (see Figure 1). An alternative to this method could involve apneic oxygenation or high-frequency jet ventilation techniques, each of which is well documented but not without shortcomings. Progressive respiratory acidosis limits the use of apneic oxygenation to 20 minutes for most patients and mediastinal movement from jet ventilation often interferes with the surgery itself.

The most frequent adverse effect of a lobectomy is perioperative dysrhythmias, with a documented incidence of 10% to 20%. These dysrhythmias frequently manifest as supraventricular tachycardias and are attributed to surgical manipulations of the right atrium following reduction of pulmonary vascular beds. This incidence increases with the amount of lung resected, and patient age. Anesthesia providers should investigate and treat underlying causes and correct any electrolyte abnormalities that may exist. Select literature advises the administration of adenosine, 6 mg IV, due to proven efficacy for dysrhythmia.

Conclusion
Coccidioidomycosis is the fourth most common infectious disease reported to the Arizona Department of Health Services. Not only are coccidioidomycosis diagnoses steadily increasing, but also hospitalizations are on the rise, thus indicating expression of more severe disease forms. Coccidioidomycosis was once limited to the endemic regions of southwestern North America but as the mobility of humans increases, a proportional increase in coccidioidomycosis diagnoses can be observed throughout the United States.

Although surgical intervention is rare in the treatment of coccidioidomycosis, these facts provide implications for vigilant anesthesia providers. Understanding of the anatomy, physiology, and pathology of coccidioidomycosis remains essential for clinical practice. Furthermore, the limited literature in regard to anesthesia management of patients with coccidioidomycosis should be expanded. Coccidioidomycosis may not be preventable, but it is manageable, even in severe cases, provided that all medical, surgical, and anesthesia obstacles are recognized and evaluated for best-practice methods.

REFERENCES

AUTHOR
Abbie J. Choleva, RN, BSN, is a nurse anesthesia student at Midwestern University College of Health Sciences, Phoenix, Arizona. Email: Abbie.choleva@azwebmail.midwestern.edu.