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CASE REPORT

Management of Invasive Bronchopulmonary Mucormycosis with Low-Dose Antifungal Therapy and Left Lower Lobectomy in a Patient with Renal Insufficiency

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Background: This case report aims to evaluate the feasibility of medical and surgical management in a patient with invasive bronchopulmonary mucormycosis complicated by renal insufficiency-a critical challenge limiting antifungal dosing and requiring tailored therapeutic strategies, while also reviewing the current literature on the treatment of pulmonary mucormycosis.

Case Presentation: The patient received low-dose antifungal therapy with posaconazole and amphotericin B cholesterol sulfate complex. Subsequently, the patient underwent a left inferior lobectomy and experienced a successful postoperative recovery. Renal insufficiency complicates drug selection and dosing. A literature review demonstrated that combining antifungal therapy with surgical intervention is an effective approach for treating invasive bronchopulmonary mucormycosis.

Conclusion: The combination of antifungal therapy and surgical management proves to be an effective treatment strategy for invasive bronchopulmonary mucormycosis in patients with renal insufficiency.

Keywords: invasive bronchopulmonary mucormycosis, left inferior lobectomy, renal insufficiency

Background

Mucormycosis is a rare fungal infection in immunocompetent individuals. Pulmonary mucormycosis, caused by fungi of the Mucoraceae family, is an opportunistic infection with a mortality rate exceeding 60% in invasive cases.[1,2] Recently, a patient with invasive bronchopulmonary mucormycosis and renal insufficiency was admitted to our department. After receiving low-dose antifungal therapy with posaconazole and amphotericin B cholesterol sulfate complex, the patient underwent left inferior pulmonary lobectomy and was discharged post-recovery. We retrospectively analyzed the clinical characteristics, diagnosis, and treatment of this case.

Case Presentation

A 51-year-old male cold storage worker with a history of poorly controlled diabetes mellitus for over 10 years was admitted to the hospital on May 3, 2024, with a chief complaint of cough and sputum for over one month, which worsened over five days. He had been treated with piperacillin and tazobactam (4.5g q8h) intravenously at a local hospital, but the treatment was ineffective. Upon admission, the patient was diagnosed with pneumonia. His clinical parameters were as follows: temperature 36.9 °C, pulse 92 beats/min, respiratory rate 20 breaths/min, and blood pressure 128/92 mmHg. Physical examination revealed wet and dry rales in the left and right lungs, respectively, and a soft abdomen with no tenderness or rebound pain.

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Laboratory tests showed: White blood cells (WBCs) 8.99×10^9/L, hemoglobin 99 g/L, hypersensitive C-reactive protein 115.62 mg/L, serum amyloid A level 178.07 mg/L, urea 8.19 mmol/L, creatinine 119 μmol/L, fibrinogen 9.86 g/L, D-dimer 7.34 mg/L, and procalcitonin (PCT) 0.255 ng/mL. Fasting blood glucose 8.6 mmol/L, glycosylated hemoglobin levels 7%. Blood gas analysis revealed an oxygen partial pressure of 67.3 mmHg, and Aspergillus IgG antibody was 336.84 AU/mL. Pulmonary function tests indicated severe restrictive ventilation dysfunction. Chest computed tomography (CT) showed bilateral pneumonia, partial left lung bronchiectasis, chronic lung inflammation, and fibrous foci (Figure 1). Urinary system ultrasound revealed bilateral kidney stones (Figure 2).

The patient was diagnosed with pneumonia, type 2 diabetes, and renal insufficiency. On May 13, 2024, electronic bronchoscopy was performed under general anesthesia (Figure 3). The bronchoalveolar lavage fluid (BALF) tested negative for bacterial culture, fungal culture, acid-fast staining, and GM test. The culture tests performed were negative. As for the antibiotic sensitivity tests, they were conducted, and the results showed no significant resistance to the prescribed antibiotics. Targeted next-generation sequencing (tNGS) of alveolar lavage fluid revealed *Klebsiella pneumoniae* and mucormycosis infections. The patient was diagnosed with invasive bronchopulmonary mucormycosis complicated with renal insufficiency. He was treated with moxifloxacin 0.4g once daily, and piperacillin-tazobactam 4.5g every 8 hours for 2 weeks to control the infection. Due to renal insufficiency, he received amphotericin B (5 mg bid) and posaconazole (300 mg qd) as antifungal therapy. On May 28, 2024, he underwent bilateral nephrostomy for urinary obstruction.

On July 19, 2024, the patient developed hemoptysis (approximately 50 mL). Repeat chest CT showed spotty and solid shadows in the right and left lower lungs, respectively (Figure 4). Renal function tests revealed a creatinine level of 152 μmol/L, and Aspergillus antibody levels decreased to 59.95 AU/mL. From July 19 to August 8, 2024, he received

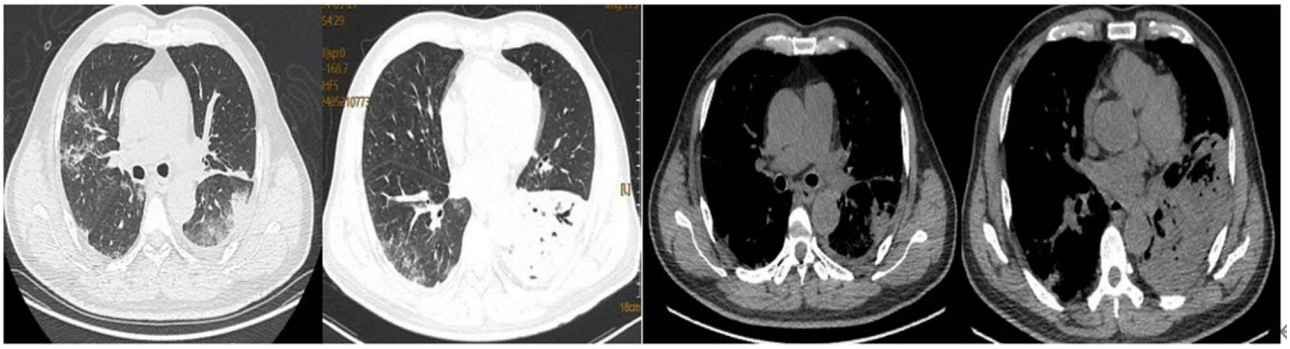

Figure 1 The chest CT images showing double pneumonia with left lung lesions, lower left lung bronchiectasis, bilateral chronic lung inflammation, and fibrous foci.

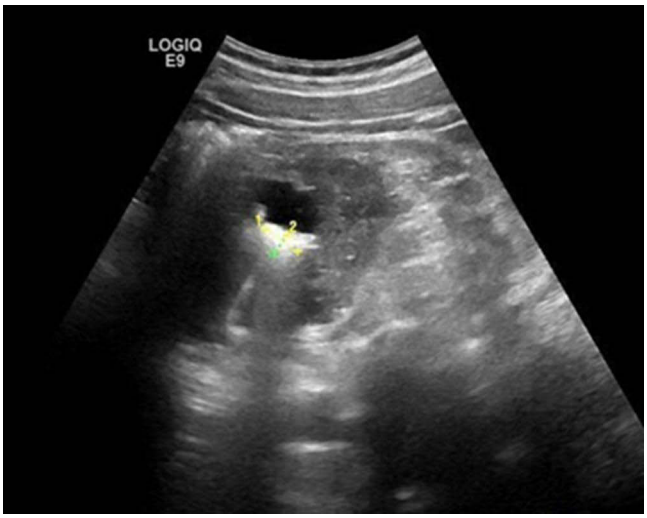

Figure 2 The ultrasound images revealed bilateral kidney stones.

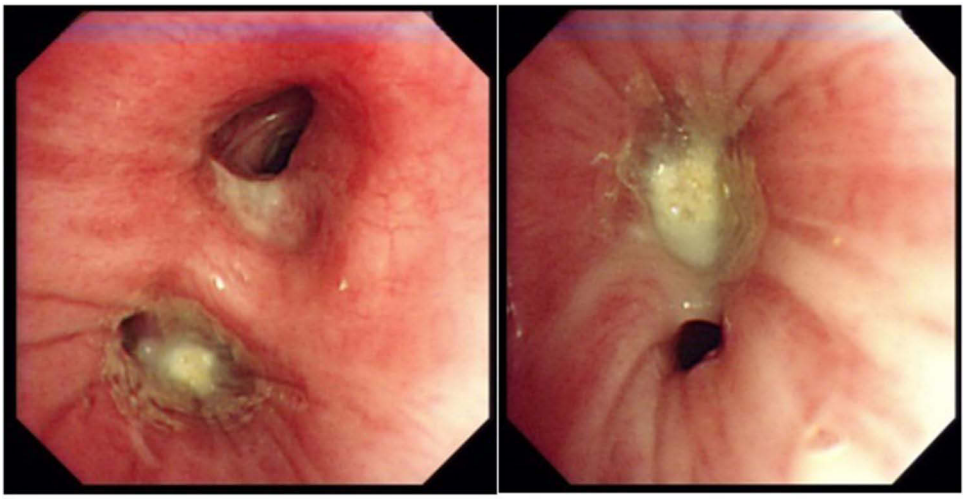

Figure 3 Bronchoscopy revealed swelling of the airway mucosa at the left lower lobe's aperture, with noticeable yellow pus and sputum.

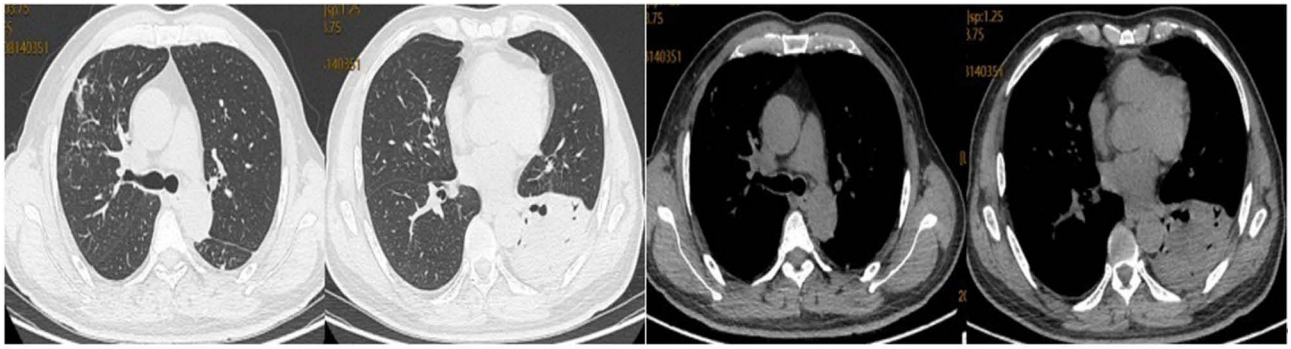

Figure 4 The chest CT images revealed spotty and solid shadows in the right and left lower lungs.

intravenous posaconazole (300 mg) and nebulized amphotericin B, along with hemostatic therapy. On August 4, 2024, he developed low back pain and gross hematuria, prompting treatment with analgesics, hemostatic agents, piperacillin, and tazobactam sodium (4.5g q8h). Renal function improved to 89 μmol/L, but hemoptysis persisted.

From August 8, 2024, the patient received antifungal therapy with intravenous posaconazole and amphotericin B cholesterol sulfate complex (50 mg qd). Renal function was monitored every two days, with creatinine levels stabilizing at 108 μmol/L. On August 29, 2024, the patient underwent thoracoscopic left inferior lobectomy with pleural adhesion release. Intraoperative findings included multiple nourishing vessels entering the left inferior lobe and interlobar lymph nodes closely connected to the pulmonary artery and bronchus. The procedure resulted in approximately 2000 mL of blood loss, requiring transfusion of 6 units of red blood cells and 600 units of plasma. Postoperative pathology revealed multifocal inflammatory necrosis, chronic granulomatous inflammation, and multinuclear giant cell reaction (Figure 5). The patient was transferred to the ICU post-operatively and later to the general ward after stabilization. He was discharged with continued antifungal therapy using oral posaconazole (300 mg qd) and nebulized amphotericin B.

After being discharged, the patient had a follow-up appointment in the outpatient clinic on September 24, 2024. Cough and sputum production have improved compared to before, with no further hemoptysis. Serum creatinine has decreased to 109 μmol/L, and the follow-up CT images show marked improvement (Figure 6). The patient has follow-up appointments every 3 months. Renal function has returned to normal, and the CT images remain stable.

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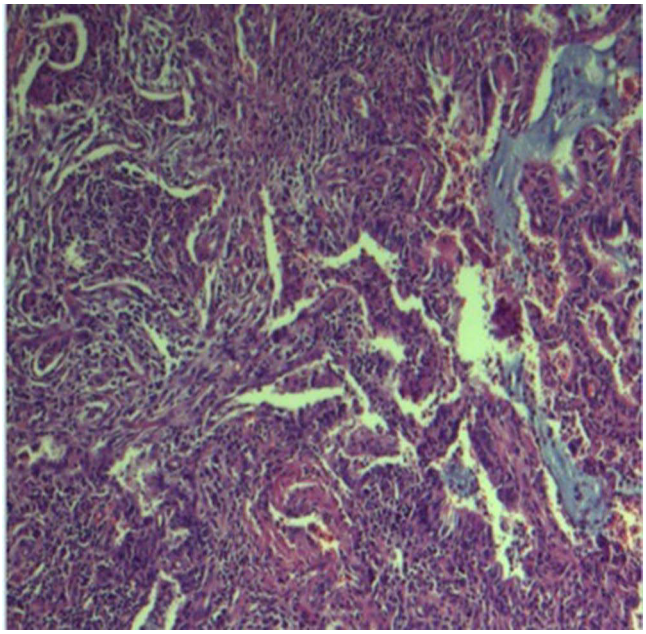

Figure 5 Histopathological examination revealed multifocal inflammatory necrosis, chronic granulomatous inflammation, and multinuclear giant cell reaction.

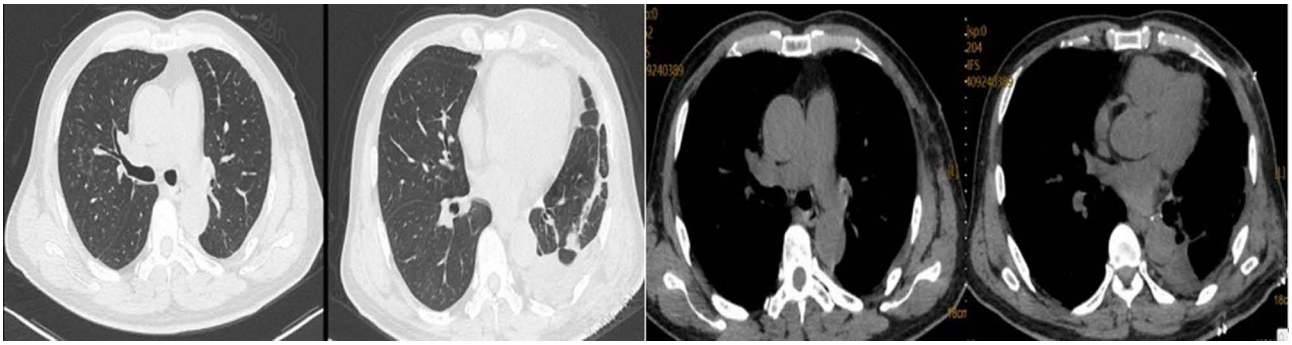

Figure 6 The follow-up CT images revealed significant improvement in bilateral pneumonia and postoperative changes in the left lower lobe.

Discussion

Pulmonary mucormycosis is an opportunistic and invasive lung infection caused by fungi of the Mucorales order, including *Mucor racemosus, Pilocephalus umbellifera, Pilocephalus ramificus, Rhizopus oligosporus*, and *Rhizopus oryzae*. Although its incidence is relatively low, it ranks as the fifth most common pulmonary mycosis in China.[3] The prevalence of opportunistic fungal lung infections has been steadily increasing due to the widespread use of broad-spectrum antibiotics and immunosuppressants, the rising incidence of AcquiredImmunodeficiency Syndrome (AIDS), advancements in organ transplantation techniques, and the growing aging population.[4] Our patient, a middle-aged cold storage worker with a history of poorly controlled diabetes for over a decade, presented with significant mucormycosis proliferation, likely exacerbated by suboptimal blood glucose management. These factors placed him at high risk for developing mucormycosis.[5] His primary symptoms included cough, hemoptysis, and yellow sputum, accompanied by markedly elevated inflammatory markers. The diagnosis was confirmed through electronic tracheoscopy lavage and targeted next-generation sequencing (tNGS).

In a European study of 230 mucormycosis cases, 68 involved pulmonary infections, of which 65 were localized. While 30 of the 65 patients with localized infections died, all three patients with extended-depth infections also succumbed.[6] A retrospective analysis of 929 mucormycosis cases, including 224 pulmonary infections, categorized

patients based on infection site and severity. Localized infections were confined to the lungs, whereas extended-depth infections involved the chest wall, pulmonary artery, aorta, or heart. Disseminated infections were defined by non-adjacent site involvement.[7] Posaconazole, a second-generation triazole antifungal, is known for its strong tissue penetration. However, mucormycosis often leads to vascular infarction and tissue necrosis, complicating treatment. The efficacy of posaconazole, either alone or in combination with amphotericin B, ranges from 60% to 79%.[8] In our case, the patient developed hemoptysis two months after initiating oral posaconazole therapy. Hemoptysis in mucormycosis is typically caused by blood vessel invasion, and pulmonary artery involvement can result in fatal massive hemoptysis. Prolonged use of posaconazole (>80 days) can induce TR34/L98H mutations in the CYP51A gene of fungi, increasing the minimum inhibitory concentration (MIC) of posaconazole to 4 μg/mL and leading to drug resistance.[9] Given the patient's recurrent symptoms and suboptimal response to posaconazole monotherapy, dual antifungal therapy was initiated. This decision was further supported by the limited recommendations in national guidelines for combined treatment of pulmonary mucormycosis, which predominantly advocate for amphotericin B liposomes in combination with posaconazole or caspofungin.[10] The patient also presented with renal insufficiency due to urinary tract obstruction. Following nephrostomy, anti-infective therapy, and hemostatic treatment, renal function normalized. Concurrently, posaconazole and amphotericin B cholesterol sulfate complex (50 mg qd) were administered. Despite elevated creatinine levels, no dose adjustment was made, and the patient was maintained on amphotericin B cholesterol sulfate complex (50 mg qd) with renal function monitored every two days. Subsequent chest CT imaging showed improvement, although damage to the left lower lung tissue persisted. Multidisciplinary consultation suggested fungal lung damage, prompting consideration of surgical intervention. The European Federation of Medical Mycology strongly recommends surgical treatment for suspected mucormycosis when feasible.[11,12] Studies indicate that the mortality rate for mucormycosis patients treated solely with antifungal drugs can reach 50%, whereas those undergoing surgical resection experience significantly lower mortality rates (17%).[13] Early surgical debridement of localized mucormycosis lesions has been shown to improve prognosis.[14] A review by Yimeng Y of five pulmonary mucormycosis cases from their institution and 46 cases reported nationally from 1982 to 2011 revealed that 27 patients received antifungal therapy alone, 9 underwent surgery alone, and 5 were treated with a combination of surgery and antifungal therapy. All patients who underwent surgery, either alone or in combination with antifungal therapy, recovered well and were discharged.[15] In this case, imaging and postoperative pathology revealed involvement of the entire left lower lung lobe, with characteristic abnormalities also observed in the right lung. Despite antifungal treatment, the pneumonia worsened, and the left lower lung lesion was deemed responsible for fungal lung damage. This suggested a deep-spreading or even disseminated infection, compounded by renal dysfunction. Although posaconazole monotherapy was ineffective, its combination with amphotericin B cholesterol sulfate complex as a low-dose antifungal regimen yielded improved outcomes. Despite the risks associated with anesthesia, the patient achieved positive surgical results, providing a valuable reference for managing similar cases in the future. Recent antifungal advancements, including isavuconazole, voriconazole, and bedaquiline, offer new options for mucormycosis.[16] These drugs vary in efficacy and side effects, so treatment should be tailored to the patient's renal function and drug tolerance. Early surgery in mucormycosis limits infection spread and improves survival.[17] For patients with renal insufficiency, timing is critical and depends on the patient's condition and infection extent. Case report is limited by its single-patient design, limiting the generalizability of outcomes. Future studies with larger cohorts are required to validate these observations.

In conclusion, the combination of antifungal therapy and surgical intervention proved effective in this case of invasive bronchopulmonary mucormycosis complicated by renal insufficiency. This case provides valuable evidence for future treatment, particularly in patients with renal insufficiency. Renal insufficiency adds complexity and challenges to treatment, which is especially evident in multimodal management.

This approach highlights the importance of a multidisciplinary strategy and early surgical intervention in improving patient outcomes.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

Informed written consent was obtained from the patient for publication of this report and any accompanying images. This study was approved by the Ethics Committee of Yantai Yuhuangding Hospital (Number: 2025 [017]).No additional institutional approval was required for publication of the case details.

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Chen Zhu and Ying Gu are co-first authors for this study.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no competing interests in this work.

References

1. Hamilos G, Samonis G, Kontoyiannis DP. Pulmonary mucormycosis. *Semin Respir Crit Care Med*. 2011;32(6):693–702. doi:10.1055/s-0031-1295717
2. Prabhu RM, Patel R. Mucormycosis and entomophthoramycosis: a review of the clinical manifestations, diagnosis, and treatment. *Clin Microbio Infect*. 2004;10(suppl 1):31–47.https://doi.org/10.1111/j.1470–9465.2004.00843.x.
3. Liu YN, She DY, Sun TY, et al. A multicentre retrospective study of pulmonary mycosis clinically proven from 1998 to 2007. *Zhonghua Jie He He Hu Xi Za Zhi*. 2011;34(2):86–90.
4. Yang Z, Liu ZY. Progress in diagnosis and treatment of mucormycosis. *Chin J Int Med*. 2021;20(11):1013–1016.
5. Ying L, Zhou JY. Reunderstanding pulmonary mucormycosis. *Int Respir J*. 2013;33(18).
6. Skiada A, Pagano L, Groll A, et al. Zygomycosis in Europe: analysis of 230 cases accrued by the registry of the European Confederation of Medical Mycology (ECMM) Working Group on Zygomycosis between 2005 and 2007. *Clin Microbio Infect*. 2011;17(12):1859–1867.https://doi.org/10.1111/j.1469–0691.2010.03456.x. doi:10.1111/j.1469-0691.2010.03456.x.
7. Roden MM, Zaoutis TE, Buchanan WL, et al. Epidemiology and outcome of zygomycosis: a review of 929 reported cases. *Clin Infect Dis*. 2005;41(5):634–653.https://doi.org/10.1086/432579.
8. Castelli MV, Alastruey-Izquierdo A, Cuesta I, et al. Susceptibility testing and molecular classification of Paecilomyces spp. *Antimicrobial Agents Chemotherapy*. 2008;52(8):2926–2928. doi:10.1128/AAC.00538-08
9. Lee HJ, Cho SY, Lee DG, et al. TR34/L98H mutation in CYP51A gene in Aspergillus fumigatus clinical isolates during posaconazole prophylaxis: first case in Korea. *Mycopathologia*. 2018;183(4):731–736. doi:10.1007/s11046-018-0271-8
10. Ibrahim AS, Bowman JC, Avanessian V, et al. Caspofungin inhibits Rhizopus oryzae 1,3-beta-D-glucan synthase, lowers burden in brain measured by quantitative PCR, and improves survival at a low but not a high dose during murine disseminated zygomycosis. *Antimicrobial Agents Chemother*. 2005;49(2):721–727. doi:10.1128/AAC.49.2.721-727.2005
11. Danion F, Aguilar C, Catherinot E, et al. Mucormycosis: new developments into a persistently devastating infection. *Semi Respir Critical Care Med*. 2015;36(5):692–705. doi:10.1055/s-0035-1562896
12. Cornely OA, Alastruey-Izquierdo A, Arenz D, et al. Global guideline for the diagnosis and management of mucormycosis: an initiative of the European Confederation of Medical Mycology in cooperation with the Mycoses Study Group Education and Research Consortium. *Lancet Infect Dis*. 2019;19(12):e405–e421. doi:10.1016/S1473-3099(19)30312-3.
13. Choi H, Lee H, Jeon K, et al. Factors affecting surgical resection and treatment outcomes in patients with pulmonary mucormycosis. *J Thoracic Dis*. 2019;11(3):892–900. doi:10.21037/jtd.2019.01.75
14. Facial cutaneous mycosis by Paecilomyces lilacinus. *Korean J Dermatol*. 1984;22:89–93.
15. Yang YM, Min FB, Xu XM. Clinical analysis of 5 cases of pulmonary mucormycosis and 46 cases in China. *Chin J Tuberculosis Respir*. 2013;36(8):5.
16. Danion F, Coste A, Le Hyaric C, et al. What is new in pulmonary mucormycosis?. *J Fungi*. 2023;9(3):307. doi:10.3390/jof9030307
17. Smith C, Lee SC. Current treatments against mucormycosis and future directions. *PLoS Pathogens*. 2022;18(10):e1010858. doi:10.1371/journal.ppat.1010858