CASE REPORT

Successful treatment of a patient with cutaneous co-infection caused by *Mucor irregularis* and *Klebsiella pneumoniae* ☆,☆☆

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**Abstract** The authors report a rare case of primary cutaneous mucormycosis caused by *Mucor irregularis* and cutaneous *Klebsiella pneumoniae* infections in a 67-year-old Chinese woman. After the administration of liposomal amphotericin B combined with cefoperazone/sulbactam sodium, the patient recovered. Invasive fungal infection combined with cutaneous bacterial infection should receive attention.

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Introduction

Mucormycosis is a rare, invasive fungal infection with exceedingly high mortality and few therapeutic options; it frequently occurs in immunocompromised patients. Many species belonging to the order Mucorales can cause mucormycosis, but mucormycosis caused by *Mucor irregularis* (formerly *Rhizomucor variabilis*) is extremely rare. This report describes a case of slowly progressive *Mucor irregularis* infection on the face accompanied by cutaneous *Klebsiella pneumoniae* infection.

Case report

A 67-year-old female presented with a nine-year history of a red lesion on the face after a clear left eyelid puncture wound. She had fever, dehydration, vomiting, and body pain in the first interview. Cutaneous examination showed an ulcer with a purulent central yellow secretion, and a hard,
internal transcribed spacer (ITS) region nucleotide sequencing (primer sequence: ITS1 5'-TCCGTAGGTGAACCTGCGG-3', ITS4 5'-TCCTCCGCTATTGATATGC-3') and sequence similarity search using BLAST in the National Center for Biotechnology Information database (NCBI). A BLAST search of the NCBI GenBank database showed that the isolated pathogen had 99% homology with that of *M. irregulairis* (GenBank accession No. EF583637).

The patient was treated with EV amphotericin B (AmB) combined with cefoperazone/sulbactam sodium according to a drug susceptibility test. AmB was administered gradually from a daily dose of 1 mg to a maximum daily dose of 40 mg. After one week, the superficial ulcer became drier with the formation of fresh granulation tissue, and the necrotic crust fell off, while purulent secretions disappeared. However, side effects gradually appeared: high fever, runny nose, muscular soreness, headache, vomiting, and unbearably severe hypokalemia and hypoproteinemia. Renal function started to slightly deteriorate. Thus, AmB was replaced by liposomal AmB, which was more effective and presented fewer side effects in the treatment of invasive fungal infections. With the side effects relieved, the lesion recovered gradually (Fig. 4). Fungal examination of the skin lesion yielded negative results. When the total dose reached 1.5 g, AmB treatment was discontinued and was replaced by oral itraconazole (400 mg per day) for two months. No recurrence was observed during the three-month follow-up period after discontinuing the oral itraconazole treatment.

**Discussion**

*Mucor irregulairis* infection occurs mainly in patients with predisposing factors such as diabetes, malignancy, solid organ transplantation, and trauma. However, most of the patients reported with mucormycosis due to *M. irregulairis* did not present immunodeficiency. Our patient reported a local trauma with a plant and did not present immu-
infectious conditions are responsible for delay in cutaneous mucormycosis diagnosis. Our patient was diagnosed 10 years after the onset of the skin lesions.

The management in such cases is often a challenging task, as the delayed diagnosis poses a major hindrance for an early treatment. Based on the available evidence, AmB is the appropriate empirical antifungal for invasive mucormycosis, and possesses the largest spectrum of antifungal activity and susceptibility. Utilizing liposomal formulations or other strategies to reduce nephrotoxicity is prudent. Compared with conventional AmB, lipid formulations of AmB are now the treatment of choice and should be administered intravenously at a minimum of 3–5 mg/kg/day. Nonetheless, its high cost is a constraint in developing countries, and patients usually do not comply with the full course of treatment. Although M. irregulare is less susceptible to fluconazole and itraconazole, the successful treatment of cutaneous mucormycosis with these antifungals has been reported in the literature. According to bacteria culture results, our patient received oral itraconazole and intravenous liposomal AmB, as well as cefoperazone/sublactam sodium.

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Authors’ contributions
Siping Zhang: Approval of final version of the manuscript; conception and planning of the study; drafting and editing of the manuscript; collection, analysis, and interpretation of data; participation in study design; intellectual participation in the propaedeutic and/or therapeutic conduct of the studied cases; critical review of the literature.

Kunju Zhu: Approval of final version of the manuscript; drafting and editing of the manuscript; participation in study design; critical review of the literature; critical review of the manuscript.

Chi Zhang: Approval of final version of the manuscript; drafting and editing of the manuscript; collection, analysis, and interpretation of data; participation in study design; intellectual participation in the propaedeutic and/or therapeutic conduct of the studied cases; critical review of the literature; critical review of the manuscript.

Conflicts of interest
None declared.

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