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# Inguinal Abscess Caused by *Rhizopus rhizopodiformis*: Successful Treatment With Surgery and Amphotericin B

BURTON C. WEST,[1]* KYUNG J. KWON-CHUNG,[2] JOHN W. KING,[1] WARREN D. GRAFTON,[3] AND MICHAEL S. ROHR[4]

*Departments of Medicine (Infectious Diseases),[1] Pathology,[3] and Surgery,[4] Louisiana State University School of Medicine in Shreveport, Shreveport, Louisiana 71130 and Clinical Mycology Section, Laboratory of Clinical Investigation, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, Maryland 20205[2]*

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*Rhizopus rhizopodiformis* has seldom been isolated from human mucormycosis. We report the first subcutaneous abscess to be caused by this fungus. It occurred in a diabetic man and presented as an inguinal mass, suggestive of a hernia, superficial to his cadaveric renal transplant. The fungus was readily isolated from pus inoculated onto blood and chocolate agars after a short incubation. The patient was cured by surgical drainage and treatment with 2.0 g of intravenous amphotericin B. Complete identification of such isolates is recommended.

We report a subcutaneous fungal abscess which appeared to be an inguinal hernia. The diabetic patient with a cadaveric renal transplant represented the 11th reported case of *Rhizopus rhizopodiformis* infection in humans, the second from this institution (R. S. Rosenberger, B. C. West, and J. W. King, Am. J. Med. Sci., in press). The clinical presentation, the histology, the identification of the fungus, and the successful treatment are presented.

## MATERIALS AND METHODS

A 23-year-old man was admitted to Louisiana State University Hospital, Shreveport, La., in October 1982 after a week of progressive swelling and pain in the right groin. A bulging mass (3 by 5 cm) was present at the medial aspect of a 2-year-old renal transplant incision and was thought to be either an inguinal or an incisional hernia. The mass could not be reduced and was not fluctuant. It was minimally tender and was not erythematous. A diagnosis of chronically incarcerated hernia was made.

He had had the onset of diabetes mellitus at 1 ½ years of age. In recent years he had injected insulin daily into the subcutaneous tissue of his thighs but had never experienced local infections. Because of chronic renal failure, he had been placed on hemodialysis 2 years before his renal transplant. At the time of admission he was receiving prednisone (15 mg daily), azathioprine (100 mg daily), NPH insulin (50 U daily), hydralazine, clonidine, metoprolol, minoxidil, and digoxin.

The patient was afebrile (36.7°C) and hypertensive (180/110) and had a systolic flow murmur, a right lower quadrant kidney transplant, and the right inguinal mass. There was no infection in the right thigh. The remainder of the physical examination was normal.

Significant admission laboratory values were: hematocrit value, 44%; leukocyte count, 12,000 per $mm^3$, with 91% neutrophils, 4% lymphocytes, 4% monocytes, and 1% eosinophils; platelet count, 374,000 per $mm^3$; serum glucose, 95 mg/dl; blood urea nitrogen value, 21 mg/dl; and serum creatinine, 1.2 mg/dl. The chest roentgenogram was normal.

He was taken to the operating room on day 2 for relief of an incarcerated right inguinal hernia. Instead, a well-encapsulated abscess (3 by 5 cm) was found. The abscess contained yellow-green pus. The full extent of the abscess was observed to be superficial to the aponeurosis of the external oblique muscle and lay between the inguinal ligament below and the curvilinear transplant incision which extended from the pubic symphysis to the right costal arch. The abscess was excised in toto, and pus was promptly delivered to the laboratory. The wound was packed open.

The patient's postoperative course was complicated by hypoglycemia and aspiration pneumonia. After three blood cultures which were subsequently negative, therapy with aqueous penicillin G potassium, nafcillin, and tobramycin was given in addition to the postoperative continuation of therapy with all of the agents administered before admission. By day 4, a fungus consistent with the members of the order *Mucorales* was growing from three media, and intravenous amphotericin B therapy was begun. One milligram was administered over 2 h followed by 30 mg given the same day and daily. Sinus roentgenograms were normal. On day 8, a computed axial tomogram of the abdomen demonstrated a lucent area consistent with an abscess under the right lower anterior abdominal wall. Eight computed axial tomogram-guided attempts to aspirate this area yielded nothing. Upon review of the initial computed axial tomogram examination, it was concluded that it had been overinterpreted. The patient was discharged from the hospital after 1 month and was treated with 50 mg of intravenous amphotericin B on alternate days. After 1.5 g, there was a slight amount of serous drainage from the abscess site, and therapy was continued to 2.0 g with

complete resolution of the abscess and its drainage. At the completion of therapy, the serum creatinine was 1.3 mg/dl, the patient felt well, and there was no evidence of residual murcormycosis. The wound was completely healed. Although he appeared cured 6 months after completion of treatment, long-term follow-up will be required to confirm cure.

**Mycology.** Abscess pus was promptly smeared and cultured. The Gram stain showed numerous neutrophils and no organisms. Aerobic cultures on blood and chocolate agar revealed stringy small colonies suggestive enough of fungal growth for the cultures to be referred to the mycology section of the laboratory after only 24 h of incubation. Later, a small amount of fungal growth also occurred near the surface of reduced thioglycolate. No growth occurred in eosin methylene blue agar or in the anaerobically cultured plates, kanamycin bile esculin agar, prereduced chocolate agar, and prereduced blood agar.

The fungal isolate cultured from pus was inoculated onto malt extract agar medium and incubated at 25°C for 5 days. The culture produced a *Rhizopus* species with a short colony. The sporangiophores were mostly unbranched (Fig. 1) or branched only at the originating point near the rhizoid. Sporangiophores were brown in color and varied from 0.5 to 1 mm in length. The sporangia measured 100 to 150 μm in diameter, and their columellae were predominantly pyriform or oblong, mostly with angular apophyses. The sporangiospores were nearly globose without distinct striation and varied from 5 to 6 μm in diameter (Fig. 2). The fungus was identified as *R. rhizopodiformis*.

**Fungus in tissue.** Tissue debrided from the inguinal abscess consisted of three fragments of brown tissue, the largest measuring 2 by 1 by 0.8 cm. Microscopic examination revealed fibrofatty and granulation tissue with necrosis, foci of acute inflammation, and foci of chronic inflammation. Within the tissue sections, branching hyphal fungal elements were found. Like other cases of mucormycosis (3), the fungus stained well with hematoxylin; however, through the vagaries of random tissue sampling, few hyphae were present on hematoxylin- and eosin-stained sections, and these were not appreciated until the specimens were reviewed in light of the culture results. The periodic acid-Schiff- and the Gomori methenamine silver-stained sections of inguinal abscess wall contained numerous strongly stained, nonseptate, haphazardly branching hyphae (Fig. 3). Some hyphae were robust and thick walled (wall, 1 to 1.5 μm in diameter). Others were thin walled, partially collapsed, and distorted. The diameter of the hyphae ranged from 3 to 18 μm, but most measured 6 to 10 μm. Many cross-sections of thick-walled hyphae appeared as globose cells (Fig. 4).

## RESULTS AND DISCUSSION

It has been known that the recovery rate of mucormycotic agents from biopsy specimens which are homogenized before culturing is relatively poor (9). However, *R. rhizopodiformis*, in our experience, was easily and quickly recovered when pus was cultured on enriched media, such as blood or chocolate agar. *R. rhizopodiformis* can be distinguished from the other pathogenic *Rhizopus* species by its ability to grow at 50 to 52°C and by the presence of mostly angulated apophyses (7). The rhizoids produced in this species tend to be more densely ramified than the more common *Rhizopus* species such as *R. oryzae* or *R. arrhizus*. The sporangiophores of *R. rhizopodiformis*, like those of *R. microsporus* and *R. oligosporus*, are shorter than those of other *Rhizopus* species, and as a result they produce short colonies, whereas colonies of *R. oryzae* and *R. arrhizus* are tall and touch the lid of the petri dish within 5 days. *R. rhizopodiformis* colonies are short in comparison.

In this case, a *R. rhizopodiformis* abscess masqueraded as an inguinal hernia. Careful examination of the patient revealed no evidence of disseminated, multifocal, or locally extending mycotic infection. The patient was extensively immunosuppressed from diabetes mellitus and the drug therapy with prednisone and azathioprine required to maintain his cadaveric renal transplant. However, the local nature of the infection suggested it originated as a late nosocomial infection arising adjacent to the long-healed surgical incision through which the renal transplantation was performed. In contrast to three definite nosocomial *R. rhizopodiformis* infections secondary to the use of contaminated Elastoplast bandages (4, 8). Elastoplast or a similar product was not used in this patient. Furthermore, those cases occurred promptly after surgery, whereas our case occurred 2 years after surgery. A nosocomial inoculation, however, cannot be excluded in this case. The reason it became manifest when it did, being symptomatic for about 1 week before admission, is undetermined. For example, there was no local infection, trauma, or treatment, no loss of control of diabetes mellitus, and no change in immunosuppressive drug therapy as sometimes precedes the onset of mucormycosis (5, 6).

The difficulty experienced in identifying the fungus on hematoxylin- and eosin-stained sections of the abscess was an artifact of random tissue sampling; upon review, definite hyphae were seen in cross-section. The hyphal elements were easier to see in the periodic acid-Schiff- and the Gomori methenamine silver-stained sections. In the absence of cultures, had the special fungal stains not been used, this abscess would have been considered sterile, a conclusion potentially dangerous to the patient. The results in this case emphasize the value of periodic acid-Schiff and Gomori methenamine silver stains on abscess specimens not showing fungal structures with routine stains as well as routine cultures.

This case is the second serious infection in a diabetic patient caused by *R. rhizopodiformis* to

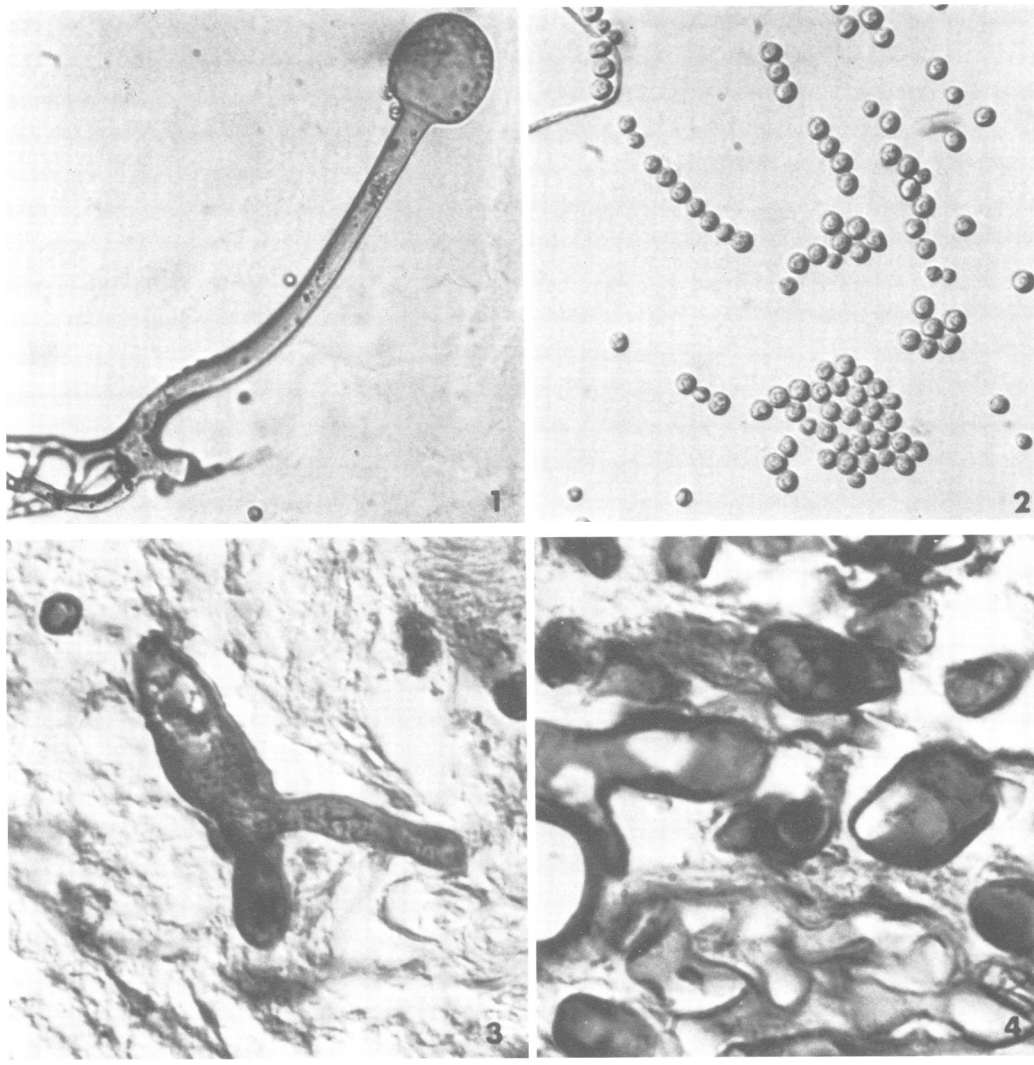


FIG. 1–4. 1, Sporangiophore of *R. rhizopodiformis* produced on malt extract agar. Magnification, ×250. 2, Sporangiospores. Magnification, ×500. 3, Periodic acid-Schiff-stained hyphae observed in the inguinal abscess wall. Magnification, ×1,000. 4, See legend to Fig. 3.

be seen at this institution, and the 11th to be reported. The others (1, 2, 4, 6, 8) were reviewed in an earlier report (Rosenberger et al., in press). Of the 11 cases, 3 with leukemia died (100% mortality rate) as did 1 of 8 with a nonleukemic predisposition (12.5% mortality rate). The overall gross mortality was 4 of 11 (36%), but by excluding 1 in which the diabetic patient appeared to have died of bacterial infection (1), 3 of 11, all of which had leukemia, died of mucormycosis, for a "mucormycosis-specific" mortality rate of 27%. Furthermore, if one excludes the leukemic patients as well, there was no mortality. Taken in this limited context, the present case suggests that, in the nonleukemic patient, *R. rhizopodiformis* is likely to cause mucormycosis, which can usually be cured by a combination of early diagnosis, surgical drainage, and amphotericin B therapy. Species-specific mortality rates are not available for mucormycosis, but would be valuable data for assessing and managing patients with mucormycosis.

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## LITERATURE CITED


1. **Baker, R. D., J. H. Seabury, and J. D. Schneidau, Jr.** 1962. Subcutaneous and cutaneous mucormycosis and subcutaneous phycomycosis. Lab. Invest. **11**:1091–1102.
2. **Bottone, E. J., I. Weitzman, and B. A. Hanna.** 1979. *Rhizopus rhizopodiformis*: emerging etiological agent of mucormycosis. J. Clin. Microbiol. **9**:530–537.
3. **Emmons, C. W., C. H. Binford, J. P. Utz, and K. J. Kwon-Chung.** 1977. Medical mycology, 3rd ed., p. 266–269. Lea & Febiger, Philadelphia.
4. **Gartenburg, G., E. J. Bottone, G. T. Deusch, and I. Weitzman.** 1978. Hospital-acquired mucormycosis (*Rhizopus rhizopodiformis*) of skin and subcutaneous tissue. N. Engl. J. Med. **299**:115–118.
5. **Lehrer, R. I., D. H. Howard, P. S. Sypherd, J. E. Edwards, G. P. Segal, and D. J. Winston.** 1980. Mucormycosis. Ann. Intern. Med. **93**:93–108.
6. **Marchevsky, A. M., E. J. Bottone, S. A. Geller, and D. K. Giger.** 1980. The changing spectrum of disease, etiology and diagnosis of mucormycosis. Hum. Pathol. **11**:457–464.
7. **Scholer, H. J., E. Muller, and M. A. A. Schipper.** 1983. Mucorales, p. 9–59. *In* D. H. Howard (ed.), Fungi pathogenic for humans and animals, part A, biology. Marcel Dekker, New York.
8. **Sheldon, D. L., and W. C. Johnson.** 1979. Cutaneous mucormycosis: two cases of suspected nosocomial cause. J. Am. Med. Assoc. **241**:115–118.
9. **Thomson, R. D., and G. D. Roberts.** 1982. A practical approach to the diagnosis of fungal infections of the respiratory tract. Clin. Lab. Med. **2**:321–342.