Intraabdominal Zygomycosis Caused by *Syncephalastrum racemosum* Infection Successfully Treated with Partial Surgical Debridement and High-Dose Amphotericin B Lipid Complex

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Invasive zygomycosis rarely complicates trauma. We describe the first recorded case of invasive infection of the anterior abdominal wall and omentum with the zygomycete *Syncephalastrum racemosum*, which was successfully treated with partial surgical debridement and amphotericin B lipid complex.

**CASE REPORT**

A 23-year-old previously well male presented with a large abdominal wound after falling and being impaled on a steel reinforcing rod.

His abdominal wall was perforated; he had splenic lacerations, mesenteric tears, colon and duodenal perforations, pancreatic injury, and an avulsed left renal artery. The visceral lacerations were repaired, a splenectomy was performed, and a temporary mesh was interposed in the abdominal wall midline. Cephazolin and metronidazole were given as prophylactic antibiotics. Eight days later, his abdomen became distended and his abdomen wall skin appeared necrotic. He was treated with intravenous antibiotics including vancomycin, meropenem, ticarcillin-clavulanate, and fluconazole. Several surgical procedures were performed and included extensive debridement of the necrotic tissue in the anterior abdominal wall, omentum, and retroperitoneum.

*Syncephalastrum racemosum*, *Candida glabrata*, *Enterococcus faecalis*, and *Escherichia coli* were isolated from the retroperitoneal tissue excised at laparotomy. He was commenced on therapy with amphotericin B lipid complex (Abelecet, Orphan Australia Pty. Ltd.), 300 mg given intravenously daily. Three days later, *S. racemosum* was also isolated from an abdominal wall swab, abdominal wall skin tissue, and fluid from the left upper quadrant. Four days thereafter, *S. racemosum* was again isolated from skin tissue from the abdominal wall wound margin and left iliac fossa swab. Nearly a month after the initial injury, the last positive specimen for *S. racemosum* was isolated from omental tissue. A partial omentectomy was performed, but because of technical difficulty no further debridement was carried out and clinically infected tissue remained in situ. Histopathology of the omental tissue confirmed the continuing presence of characteristic nonseptate hyphae. He was treated with amphotericin B lipid complex for a total of 29 days, including 19 days after the last debridement and 15 days after the last positive specimen for *S. racemosum*.

Specimens of the retroperitoneal tissue were plated onto blood and chocolate agar incubated at 35°C in CO2 and plated to blood agar incubated at 35°C under anaerobic conditions. After 30 h of incubation, a gray-brown colony of a fungus was seen on the blood and chocolate agar.

The fungus was plated to Sabouraud’s dextrose agar containing chloramphenicol and gentamicin and incubated at 35°C in O2. After 24 h of incubation, a rapidly growing white cottony colony of fungus was evident. A small portion of an isolated colony was cut out midway between the center and edge of a colony. The fungi were placed in a drop of lactophenol cotton blue on a slide, covered with a coverslip, and observed microscopically. Aseptate hyphae branching at right angles as well as large conidial heads were observed. A 1.5 cm-square of Sabouraud’s agar was cut out of an agar plate and placed in the middle of an alcohol-clean slide. The sides of the square were inoculated with the fungus. The slide culture was covered and incubated at 25°C in a moist chamber. After 2 days the culture was examined and the formation of recognizable elements noted. The coverslip was lifted from the agar, passed through a Bunsen flame, and placed on a drop of lactophenol cotton blue on a slide. Using a light microscope, the fungus was examined for sporogenesis or conidiation. Sporangioiophores branching at right angles and terminating in spherical clumella, with cylindrical mesosporangia around the entire circumference, containing rows of sporangiospores, were observed. The sporangiospores were smooth and appeared dark brown, as did the merosporangia and terminal vesicles. These morphological features meet the criteria for *S. racemosum* (10). Dark-brown zygospores were also observed. The broad, ribbon-like, aseptate hyphae were visible on the slide cultures as well as the histopathology stains (Fig. 1). The wet-mount microscopy from the cultures (Fig. 2) demonstrates the typical daisy-head appearance and other morphological features.

Infection remains the greatest risk for victims of penetrating abdominal injury (3), with *Staphylococcus aureus* and *Enterobacteriaceae* the most commonly implicated organisms in traumatic wounds. Streptococcal or clostridial infections may cause necrotizing fasciitis and clostridial myonecrosis. Unusual
pathogens, such as *Aeromonas hydrophila* and *Vibrio vulnificus*, have been described. Aggressive and sometimes fatal wound infections have been reported from zygomycetes and *Aspergillus* spp. (1). In cases of extensive trauma, inoculation of devitalized tissues with soil may initiate infection by zygomycetes, even in persons whose immunologic status appears to be normal (11).

Searching the literature with Pubmed, Medline, Cinahl, Proquest, ScienceDirect, Embase, and Web of Science using *Syncephalastrum*, zygomycosis, zygomycetes, and human disease as keywords revealed that *Syncephalastrum* species have not been described before for a deep posttraumatic wound. In fact, this organism has not yet been definitively proven as a cause of human infection. A case of *Syncephalastrum* fungus ball of the lung (6) has been reported but is now believed to be *Aspergillus niger* (7). The only remaining detailed report published is a case of cutaneous *Syncephalastrum* infection in a 50-year-old diabetic man. The lesion described contained several draining sinus tracts. In this case, *Syncephalastrum* was found in soil samples where the patient worked on a tea plantation in Ootacamund, India (5). According to Ribes, Vanover-Sams, and Baker, a previous site of trauma with soil contamination was suggested by the location of infection on the finger (10). This patient received no specific treatment for the fungal infection, although his diabetes was treated. He left the hospital a few days after admission, and it is reported that he died of diabetes mellitus in his home town a few months later (5). According to Ribes, Vanover-Sams, and Baker (10), a case of *Syncephalastrum* isolated from a wound culture was reported by Otcenasek and Buchta, but no details of the case were provided.

*Syncephalastrum* has also been isolated from normal finger and toenail clippings from several Egyptian students who had no clinical disease (10).

*Syncephalastrum racemosum* has been found widely in the environment (10). Until now it has been debated whether this fungus can actually cause disease in humans. It is usually described as having low pathogenic potential in a competent host and may cause disease only as an opportunistic pathogen (10). In vivo studies with diabetic rabbits challenged with intranasal instillations of *S. racemosum* spores failed to detect pulmonary or cerebral invasive disease, again suggesting that the virulence of this organism is quite low (9). According to Weitzman, this fungus should be suspected to be a pathogen if it is isolated repeatedly from sterile tissue or body fluids, if fungal structures are observed in the direct microscopic examination and are compatible in morphology and color with the fungus isolated from the specimen, and if the histopathology of the biopsy specimen indicates tissue invasion (12). This was demonstrated in this case, therefore definitively diagnosing invasive infection due to *S. racemosum*.

Successful therapy for invasive zygomycete infection usually involves a combined approach consisting of early diagnosis, correction of the underlying predisposing condition, aggressive surgical debridement, and early systemic amphotericin therapy. Amphotericin B is the only drug with proven clinical efficacy (2).

Antifungals tested against *S. racemosum* to which in vitro susceptibility has been demonstrated are amphotericin B, nystatin, and pimaricin (8). Resistance to saperconazole and other azoles has been reported (10). The total dose of amphotericin B required to successfully treat zygomycosis is unknown. A total dose of at least 2 g has been administered to patients who have been reported to have recovered in most studies. The lipid formulation of amphotericin B seems to be as active as conventional amphotericin B and allows for higher doses to be administered with acceptable tolerance, up to 10 mg/kg of body weight/day (4). The described patient was treated with parenteral amphotericin B lipid complex at a daily dose of 300 mg (5 mg/kg). Surgical debridement has been described as the key feature of the management of zygomycosis, because of the difficulty in eradicating zygomycetes with antifungal therapy from areas of necrotic tissue (4). Successful treatment of patients with mucormycosis with antifungal therapy alone has been described but is clearly the exception, and aggressive surgical debridement of necrotic tissue is considered the norm (1). Repeated debridement may be required to remove the continuously appearing necrotic tissue, and the duration of antifungal therapy depends on the clinical response of the infection (1).
The importance of this case is that it describes the first recorded definitively proven case of *S. racemosum* infection in a human. *S. racemosum* was identified from retroperitoneal tissue, abdominal wall swabs, abdominal wall skin, intraabdominal fluid, intraabdominal swabs, and omental tissue. *S. racemosum* fungal hyphae invading normal tissue were also seen in histology.

This infection was successfully treated with partial debridement and amphotericin B lipid complex. *S. racemosum* was still present in the omental biopsies collected after the last debridement was done. The patient was kept on high doses of amphotericin B lipid complex (300 mg/day) for a further 15 days. A total of 8.6 g of amphotericin B lipid complex was given. The subsequent specimens showed no evidence of the fungus. The wound healed, and the patient survived.

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