Disseminated Trichosporonosis in a Burn Patient: Meningitis and Cerebral Abscess Due to *Trichosporon asahii*\(^*\)

Orville D. Heslop,\(^1\)* May-Phyo Nyi Nyi,\(^2\) Sean P. Abbott,\(^3\) Lois E. Rainford,\(^1\) Daphney M. Castle,\(^1\) and Kathleen C. M. Coard\(^1\)

Department of Microbiology, University of the West Indies, Mona, Jamaica; Department of Pathology, University of the West Indies, Mona, Jamaica; and Natural Link Mold Lab, Reno, Nevada

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A 44-year-old diabetic female presented to a hospital in Jamaica with thermal burns. *Trichosporon asahii* was isolated from facial wounds, sputum, and a meningeal swab. Dissemination of the fungus was demonstrated in stained histological sections of the meninges and a brain abscess at autopsy. Pure growth of the fungus from patient samples submitted and an environmental isolate obtained from a wash basin in the hospital supported the diagnosis.

**CASE REPORT**

A 44-year-old hypertensive, diabetic woman presented with partial and full-thickness thermal burns involving 50% of her total body surface area, including the face and neck, torso, upper limbs, and proximal portion of the lower limbs. She was admitted to the intensive care unit (ICU) for ventilatory support for suspected inhalational injury. Her initial hemoglobin level was 5.2 g/dl, her white blood cell count was 6.4 × 10\(^3\)/liter, her platelet count was 239 × 10\(^9\)/liter, and her blood urea nitrogen (BUN) and creatinine levels were 2 mmol/liter and 54 μmol/liter, respectively. Management included fluid resuscitation, topical and systemic antibiotic therapy, surgical intervention for control of wound sepsis, and limb perfusion. She also received ceftriaxone for empirical antibiotic coverage, tetracycline ointment for facial burn wounds, and twice daily application of dressings using flumazine to the wounds on the body. Nursing and dietary supportive measures were also instituted.

The patient was clinically stable on admission when a primary culture of sputum yielded a light growth of a fungus reported as "yeast not *Candida albicans*." However, despite broad-spectrum antibiotic coverage, signs of sepsis appeared within 5 days of admission. She developed multiorgan infection of the burn wounds, which were culture positive for *Pseudomonas aeruginosa*, *Streptococcus* group D, *Bacteroides*, *Alcaligenes* sp., and *Stenotrophomonas maltophilia*. Blood culture and culture of a femoral central venous catheter tip were also positive for *Streptococcus* group D and *Acinetobacter* sp.

Sputum and urine cultures were negative at that time. Appropriate antibiotic intervention following antibiotic susceptibility testing of isolates was commenced, and 0.25% acetic acid was included in the dressings applied to wounds that were positive for *Pseudomonas*. Despite the continued use of antibiotics, she persistently showed clinical, biochemical, and hematological signs of sepsis. The patient’s clinical status continued to deteriorate, and she developed multiorgan dysfunction.

Over the period of hospitalization, gradually increasing BUN levels (mean, 20.9 mmol/liter; range, 9.1 to 32.1 mmol/liter) and creatinine levels (mean, 287.2 μmol/liter; range, 54 to 353 μmol/liter) were recorded. Levels remained relatively high throughout the remainder of the patient’s hospital stay and were consistent with renal failure.

Subsequent sputum culture (23 days after admission) again demonstrated moderate growth of a fungus reported as "yeast not *Candida albicans*." Repeat blood cultures were negative following specific antibiotic therapy after antibiotic susceptibility testing on the cultured isolates. However, a facial wound culture repeated 1 day before death was positive for multidrug-resistant *Acinetobacter* sp., *Streptococcus* group D, and coagulase-negative staphylococcus. The blood culture grew multidrug-resistant, coagulase-negative staphylococcus and *Acinetobacter* sp. In addition, a rapidly growing fungus was isolated from facial wounds and sputum. Characteristic microscopic features, growth at various temperatures, and assimilation of specific carbohydrates identified the fungus as *Trichosporon asahii*. The patient’s clinical status continued to deteriorate, and she died on day 32 after hospital admission.

An autopsy revealed infected thermal burns involving all of the anatomical locations noted clinically. On dissection, significant findings included hyperemia of the tracheobronchial tree and markedly overweight lungs with marked pulmonary congestion and consolidation consistent with adult respiratory distress syndrome. Other significant autopsy findings included perivascular opacity in the parasagittal region of the meninges suggestive of inflammation. Subsequent microbiological examination identified *T. asahii*. Dissection of the brain revealed an abscess in the right temporoparietal region. Histological examination of sections obtained from the meninges and brain abscess after hematoxylin-and-eosin and periodic acid-Schiff (PAS) staining showed numerous yeast cells and arthroconidia scattered within the acutely inflamed tissue (Fig. 1). No fungal elements were seen in stained histological sections of any other postmortem tissues.

Standard microbiological procedures, including Gram stain microscopy of sputum, a facial wound swab, and a meningeal histological sections of any other postmortem tissues.

\(^*\) Corresponding author. Mailing address: Department of Microbiology, University of the West Indies, Mona, Jamaica. Phone: 876 4180648. Fax: 876 9779553. E-mail: orville.heslop@uwimona.edu.jm.

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swab, revealed Gram-positive budding yeast cells, pseudohyphae, and arthroconidia, while overnight cultures at 37°C on blood agar and MacConkey agar produced a rapidly growing fungus with chalky, white, pinpoint colonies. Colonies on both agar media became wrinkled and heaped up at the centers with characteristic radiating furrows following 7 days of incubation at 37°C (Fig. 2). All specimens except blood cultures and urine grew the fungus with detectable pure growth of the organism.

Mycological investigation, including culturing on Sabouraud dextrose agar, cornmeal agar (CMA), and mycobiotic agar incubated at 25°C, 28°C, and 37°C produced colonies morphologically similar to those seen on blood agar and MacConkey agar. Pellicles formed in broth cultures and growth after 48 h of incubation at 42°C were demonstrated by the fungus.

Lactophenol cotton blue staining of pure cultures demonstrated a microscopic morphology characteristic of Trichosporon species. Arthroconidia, hyphae, and pseudohyphae were more pronounced in older (7-day) cultures on CMA (Fig. 3 and 4). The barrel-shaped arthroconidia of T. asahii are diagnostic for this species (Fig. 4).

The API 20C system (bioMérieux) was employed for yeast identification, and the assimilation profiles readily identified all three isolates as T. asahii (API 20C, code 2744734). Positive assimilation was demonstrated for arabinose, cellobiose, galactose, lactose, maltose, and xylose, while negative reactions were documented for adonitol, inositol, and sorbitol. All isolates were urease positive, a diagnostic feature of Trichosporon asahii.
species aiding differentiation from urease-negative species of Geotrichum. Differential species characteristic of *T. asahii* include assimilation of arabinose, inability to assimilate melibiose, and growth at 37°C (5, 8).

Several attempts to identify the source of infection, including sampling of health care workers and the immediate environment, were mostly unsuccessful, but the fungus was later recovered from 1 of 13 wash basins designated for patient use. This isolate also produced carbohydrate assimilation reactions identical to those of the clinical isolates (API 20C, code 2744734). One representative isolate of *T. asahii* from the patient and one from the environmental source (basin) were deposited in the University of Alberta Microfungus Collection (Edmonton, Alberta, Canada).

*T. asahii* and other members of the genus *Trichosporon* are basidiomycetous yeasts characterized by the production of true hyphae and pseudohyphae, arthroconidia, and blastoconidia (5, 9). These fungi are rarely seen in human infections, and to date, just over 100 disseminated cases caused by *T. asahii* have been reported in the literature worldwide (21). The vast majority of these cases have been reported in leukemia or lymphoma patients who developed severe depletion of neutrophils (11, 21). Our report describes the first case fatality due to disseminated *T. asahii* infection seen at the University Hospital of the West Indies in Jamaica. The disseminated-infection case presented was not typical of those usually reported in the literature, where neutropenia is the major risk factor in invasive diseases (17).

For many years, invasive trichosporonosis not due to *T. cutaneum* was reported as *T. beigelii* infection. However, significant taxonomic revision in the early 1990s divided *T. beigelii* into several species, including *T. asahii*, and presumably, a significant number of the cases reported prior to the revision may have been due to *T. asahii* infection (8, 9, 13). Since the first case report of invasive disease in 1970, disseminated infections have been increasingly recognized in systemic illnesses of immunocompromised patients (4, 21, 23).

*Trichosporon* species have been isolated from the soil and other environmental sources and from surfaces in indoor environments (8, 19). They can also be a part of the normal flora of the human gastrointestinal tract, skin, and respiratory tract (22). Our isolation of *T. asahii* from a hospital wash basin in this study demonstrates the potential for environmentally acquired and nosocomial infections.

Dissemination of the fungus is rarely encountered, and only a few case reports of associated invasive trichosporonosis in patients with extensive burns have been documented (2). It is noteworthy that neutropenia is the primary predisposing risk factor in disseminated cases of trichosporonosis but notably absent in the present case. Despite the infrequency of invasive trichosporonosis, *T. asahii* is increasingly recognized as an important emerging opportunistic pathogen in the immunocompromised host and generally in patients with critical underlying conditions, including diabetes (3, 7). Several documented cases of trichosporonosis in aged and critically ill patients have been linked with ICU patients in different hospitals (6, 24). Invasive disease is not limited to elderly patients, affecting a wide age range, including neonates (1). Several prior reports of *Tricho-

sporon* causing chronic meningitis and brain abscess may be attributable to *T. asahii* (5, 23).

Patients with invasive trichosporonosis often present with an acute febrile illness that is unresponsive to empirical bacterial agents. Skin lesions occur in about one-third of the patients, while other clinical manifestations may include pulmonary infiltrates, azotemia, and renal dysfunction (16). This 44-year-old female who was admitted to the ICU with thermal burns also developed complications of renal failure. Renal failure is a frequent feature of invasive trichosporonosis (22), but the notable absence of the fungus from repeated urine cultures indicated that *T. asahii* was not a contributing factor in this clinical outcome. The pathogenesis of the fungus is not fully understood and has been described only using findings from laboratory animal models. In one experimental study using cortisone-treated mice inoculated with several yeast-like fungi, macroscopic and microscopic observations revealed lesions in their brains, hearts, kidneys, livers, lungs, and spleens due to *T. cutaneum*, with 38% mortality (12). A similar experimental study to determine the invasive properties of *T. asahii* would be a useful exercise to compare possible similarities between the two species. Presumably, similar findings would help to explain *T. asahii* involvement of the meninges in the current case of trichosporonosis.

The use of corticosteroid and anticancer drugs may influence neutropenic levels in hematologic cancer patients, thereby predisposing such cases to *T. asahii* infection (17). The absence of these predisposing factors in the current case of trichosporonosis did not prevent the dissemination of the fungus. While the findings are not conclusive, it appears that the invasive properties demonstrated by the fungus were facilitated by the predisposing risk factors of widespread burns, prolonged mechanical ventilation, and diabetes, together with the invasive properties of capsular antigen glucuronoxylomanan (GXM). These risk factors were likely the main contributors to dissemination of the fungus (3, 10, 15). In our case, the only evidence of *T. asahii* invasion from pathological investigation was the meninges, suggesting the propensity of the fungus to gain access to several organ systems once the body’s defense mechanisms have been breached. Failure to invade other organ tissues may have been reflective of the blood cultures being repeatedly negative. A positive blood culture and the presence of characteristic fungal elements typical of *Trichosporon* species in internal organ tissues frequently support the diagnosis of disseminated infection (20, 21). In the present case, a diagnosis of invasive disease was based on typical fungal elements of *T. asahii* in stained histologic sections of the meninges. These findings may suggest a predilection of the organism for the meninges and respiratory tract and its apparent ability to easily invade a breached blood-brain barrier. Karashima et al. (10) demonstrated that passage of *T. asahii in vivo* (laboratory mice) is associated with increased release of the antigen GXM. This antigen enables the fungus to evade phagocytosis by polymorphonuclear leukocytes and monocytes *in vivo* (10). Persistent infection may allow the fungus to establish itself in various organ tissues, including the brain and other sterile sites (10, 23).

Positive urine cultures are frequently another important indicator of dissemination of the organism (21). In the present case, however, these cultures were repeatedly negative for *T.
Trichosporon asahii. Other body sites, including the alimentary tract, respiratory tract, broken skin, and mucosal barriers, have been viewed as possible portals of entry for Trichosporon species (21, 24). In our case, the respiratory tract and damaged skin were the most likely portals of entry. Early cultures of sputum samples that grew a yeast-like fungus were not identified, but T. asahii was subsequently isolated and identified from sputum specimens that were later submitted for mycological investigation. All isolates, including those from the meninges and facial wounds, yielded pure growth of T. asahii in cultures, suggesting a single infecting agent.

T. asahii in invasive disease closely resembles systemic candidiasis in its clinical presentation and is difficult to differentiate histologically (14). Fungal infections of this nature are likely to be a single infecting agent. Early antifungal intervention in patient management is paramount. Nevertheless, approaches to treatment may translate into improved prognoses and appropriate choices to guide treatment policy. Nevertheless, the real challenges of antifungal drug resistance and the health care workers, hospital commodes, and other potential portals of entry. Early cultures of sputum samples that grew a yeast-like fungus were not identified, but T. asahii was subsequently isolated and identified from sputum specimens that were later submitted for mycological investigation. All isolates, including those from the meninges and facial wounds, yielded pure growth of T. asahii in cultures, suggesting a single infecting agent.

In vitro activity against Trichosporon species and are recommended for treatment (1, 6, 21). A review of the patient’s record revealed that no antifungal drugs were used in her management, a decision apparently made in the face of negative blood cultures and because dissemination of the fungus at the time was not indicated by early investigations. Importantly, when there is clear evidence of fungal dissemination, a considered approach to antifungal intervention is paramount. Early treatment has effectively reduced dissemination of the fungus, but resistance of Trichosporon species to many antifungals has been encountered and remains a major challenge to patient management (6, 18).

The challenge of determining the source of infection, together with several predisposing factors, may further compound the problem of eradication of Trichosporon species and the management of affected patients. Identifying these unusual fungal infections is even more difficult when signs and symptoms mimic those of other diseases with similar clinical manifestations. It is therefore incumbent on health care professionals, especially those involved in direct patient care, to be aware of (i) the risk factors that facilitate the spread of infection and the necessary steps toward prevention (this requires the ability to differentiate natural colonization of skin and mucosal surfaces by the fungus, as opposed to symptomatic and invasive cases of trichosporonosis; correspondingly, the progress of affected patients should be carefully monitored with regular laboratory investigations); (ii) the importance of sampling of health care workers, hospital commodes, and other potential environmental sources to stem the chain of transmission; and (iii) the real challenges of antifungal drug resistance and the appropriate choices to guide treatment policy. Nevertheless, early antifungal intervention in patient management is paramount to reducing dissemination of the fungus. New approaches to treatment may translate into improved prognoses and subsequently reduced hospital stay. The application of 1 to 5% sodium hypochlorite (bleach) in disinfecting the immediate environs, and in particular cubicles where affected patients are housed, is essential to infection control measures.

The recent fatal case of invasive trichosporonosis will undoubtedly serve to alert the medical fraternity that this and other rare and emerging infections are on the increase and are likely to pose similar problems.

REFERENCES