Annals of Clinical Microbiology and Antimicrobials

REVIEW

Open Access

Clinical features and antifungal treatment of invasive *Scedosporium boydii* infection: report of a case and literature overview

Yanping Xiao[1†], Xiaolin Li[1†], Longhua Hu[1], Yuhui Xu[2], Xingwei Cao[1] and Qiaoshi Zhong[1*]

Abstract

Objective This study aims to present a case of persistent mycetoma caused by *Scedosporium boydii* and undertake a systematic literature overview to elucidate the clinical characteristics and antifungal treatment exhibited by such patients.

Methods We report the case of a 24-year-old female who sustained a *Scedosporium boydii* infection in her right foot over a decade ago following a nail puncture. Concurrently, a comprehensive literature overview was conducted on PubMed, focusing on documented cases of *Scedosporium boydii* infections with the intent of extracting relevant clinical data.

Results Our analysis revealed that post-transplantation, trauma, near drowning, corticosteroid administration, and prior surgical history were the main risk factors for *Scedosporium boydii* infection. Prevalent infection sites included skin/bone tissues, the central nervous system, and ocular regions. Among the 49 patients identified, 24 received itraconazole therapy and 25 received voriconazole, with no significant difference in patient outcomes ($P=0.158$). Of these, 12 patients experienced treatment failure. Notably, prolonged antifungal treatment duration was identified as a protective factor against mortality in *Scedosporium boydii* infections [$P=0.022$, OR(95%CI): 0.972(0.949–0.996)]. Conversely, a history of post-transplantation emerged as a potential risk factor for mortality[$P=0.046$, OR(95%CI): 7.017(1.034–47.636)].

Conclusion While uncommon, *Scedosporium boydii* infections carry a significant burden of morbidity and adverse outcomes. Heightened clinical vigilance is warranted in individuals presenting with risk factors for this pathogen. Timely and effective antifungal intervention is crucial, with both voriconazole and itraconazole demonstrating positive treatment outcomes for *Scedosporium boydii* infection. Therefore, prioritizing these antifungal agents should be considered a key therapeutic strategy in the management of this patient population.

Keywords *Scedosporium Boydii*, Fungal infection, Clinical features, Antifungal therapy, Itraconazole, Voriconazole

†Yanping Xiao and Xiaolin Li are share first authorship.

*Correspondence:
Qiaoshi Zhong
zhong20000947@sina.com

[1]Jiangxi Province Key Laboratory of Immunology and Inflammation, Jiangxi Provincial Clinical Research Center for Laboratory Medicine, Department of Clinical Laboratory, The 2nd affiliated hospital, Jiangxi Medical College, Nanchang University, Nanchang, Jiangxi, China
[2]Pulmonary and Critial Care Medicine, Ganzhou People's Hospital, Ganzhou, Jiangxi, China

Introduction

Fungi belonging to the *Scedosporium/Pseudallescheria boydii species complex* are ubiquitous and saprotrophic organisms, frequently encountered in moist soil, sewage, and decomposing vegetation [1]. Their ability to induce both localized and systemic infections through direct contact, inhalation of airborne spores, and dissemination in immunocompromised individuals (e.g., those with hematological disorders or post-transplant recipients) poses a significant clinical challenge [2]. Notably, *Scedosporium spp.* rank second among filamentous fungi colonizing patients with cystic fibrosis [3, 4]. Invasive infections, characterized by a high mortality rate ranging from 40 to 95%, constitute the most severe clinical manifestation [5, 6]. Among isolated species, *Scedosporium boydii* and *Scedosporium apiospermum* predominate in clinical settings. We present a case of a traumatic mycetoma sustained for 17 years caused by *Scedosporium boydii*.

Case report

A 24-year-old female in a state of good health presented to our institution with right foot swelling and purulent drainage. Notably, in 2006, the patient sustained a penetrating injury to the aforementioned foot due to stepping on a nail. Subsequently, several months later, she developed recurrent episodes of suppurative swelling and severe pain at the affected area, which even led to the patient being unable to stand. During this period, the patient underwent multiple surgical interventions, including wound debridement and drainage, which provided only temporary symptom relief and failed to achieve complete resolution. Additionally, multiple microbiological examinations yielded negative results, and treatment with a combination of antimicrobial agents, including imipenem, vancomycin, and itraconazole (100 mg/d, for 3 month), proved unsuccessful. During the present hospitalization, the patient underwent another surgical intervention, and purulent fluid specimens were obtained for microbial culture. Following a 2-day incubation period, fungal growth was observed. Subsequent morphological and sequencing analyses definitively identified the causative agent as *Scedosporium boydii*. Histopathological examination or direct microscopic examination of biopsy was not performed.

Microbiology

Tissue samples obtained through surgical biopsies and aspirations were cultured on Columbia 5%-sheep-blood agar and China Blue agar plates at 37 °C for a period of two days. Subsequently, the agar plates demonstrated the growth of white, fluffy mycelium. Lactophenol cotton blue staining revealed the presence of solitary, smooth-walled elliptical conidia (Fig. 1). Based on these morphological characteristics and subsequent rDNA ITS sequencing, the isolate was identified as *Scedosporium boydii*. Antifungal susceptibility testing were determined in vitro using Fungal Antimicrobial Susceptibility Test (Autobio, China), and the minimum inhibitory concentrations (MICs) of the antifungal agents are as follows: anidulafungin (2 mg/L), caspofungin (4 mg/L), micafungin (>8 mg/L), amphotericin B (>32 mg/L), itraconazole (0.5 mg/L), voriconazole (0.25 mg/L), fluconazole (8 mg/L), posaconazole (0.25 mg/L), nystatin (>32 mg/L), and flucytosine (>32 mg/L).

Therapy and outcome

Subsequently, the patient began treatment with voriconazole (200 mg twice daily). Six months later, a significant improvement in the patient's health status was observed, with complete wound healing achieved. During this period, no side effects were observed.

Literature overview

A comprehensive literature search was conducted on PubMed using the keywords "*Pseudallescheria boydii*" (sexual stage of the fungus) or "*Scedosporium boydii*" (asexual stage of the same fungus) to identify published cases of *Scedosporium boydii* infections treated with either itraconazole or voriconazole. Cases where treatment outcomes cannot be tracked or where itraconazole or voriconazole were not used are excluded. 43 relevant publications were retrieved. Demographic information, such as age, gender, and site of infection, along with medical history, antifungal treatment duration, and clinical outcomes, were extracted and compiled [7–49]. Statistical analysis was performed using SPSS software version 26. Categorical variables were analyzed using either the chi-square test or Fisher's exact test, while non-parametric tests were employed for continuous variables. Candidate variables with a univariate analysis P-value≤0.1 were included in a forward stepwise logistic regression model for further exploration. Subsequently, a multivariate logistic regression model was utilized to identify independent risk factors associated with treatment outcomes. Statistical significance was defined as a P-value≤0.05. Age and duration of therapy were reported using the median and interquartile range.

Results

We identified 43 articles covering a total of 48 cases, with several articles reporting multiple cases. After including this case, a total of 49 cases were included in this study (Table 1). Notably, 16 patients (32.7%) exhibited some form of immunodeficiency, while 16 (32.7%) reported a history of direct exposure to environmental conditions such as sewage, soil, or similar settings. Among all cases, the most prevalent predisposing factor was

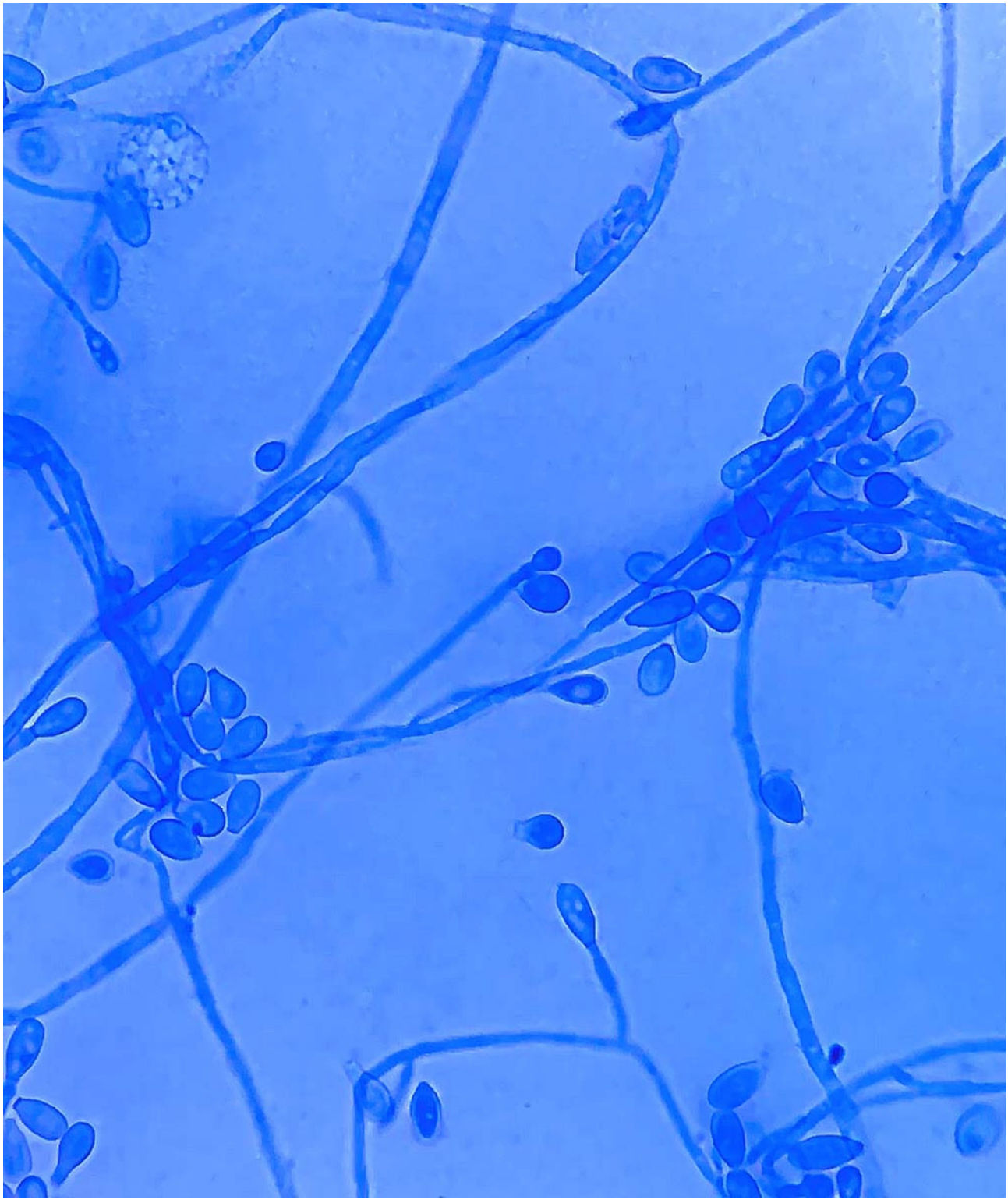

Fig. 1 Lactophenol cotton blue stain of *Scedosporium boydii* showning hyphae and conidia

Table 1 Clinical characteristics of 52 cases of *Scedosporium boydii* infection

Characteristics	All patient (*N* = 49)	Cured (*N* = 37)	Treatment failure (*N* = 12)	univariate analysis	multivariate analysis	
				P value	*P* value	OR(95%CI)
Male	33	27	6	0.169	-	-
Age, years, median (Interquartile range)	48(32–60)	45(26–59)	48(39–59)	0.633	-	-
Predominant underlying condition					-	-
Trauma	11	11	0	0.045	0.243	-
Near drowning	5	3	2	0.584	-	-
Surgical operation	7	6	1	0.665	-	-
Intravenous history	1	1	0	0.999	-	-
Post-transplantation	13	7	6	0.034	0.046	7.017(1.034–47.636)
Idiopathic autoimmune disease	4	4	0	0.560	-	-
HIV/AIDS	2	1	1	0.434	-	-
Corticosteroid pharmacotherapy	6	5	1	1.000	-	-
Infection site					-	-
Skin/bone	24	20	4	0.212	-	-
Brain	12	7	5	0.136	-	-
Eye	7	5	2	1.000	-	-
Others	6	5	1	1.000	-	-
antifungal treatment duration, days, median (Interquartile range)	90(33–182)	110(60–303)	23(13–68)	0.004	0.022	0.972(0.949–0.996)
Antifungal therapy						
voriconazole	25	21	4	0.158	-	-
itraconazole	24	16	8			

post-transplantation (n=13/49, 26.5%), followed by a history of trauma (n=11/49, 22.4%), surgical procedures (n=7/49, 14.3%), corticosteroid use (n=6/49, 12.2%), near drowning accidents (n=5/49, 10.2%), and idiopathic autoimmune diseases (n=4/49, 8.2%).

Scedosporium boydii most frequently induced localized infections of the skin and bone (24/49, 49.0%), followed by the central nervous system (12/49, 24.5%) and ocular regions (7/49, 14.3%). Within the cohort of patients with skin/bone infections, a significant proportion displayed immune dysfunction (n=12/24, 50%), and reported a history of trauma (n=8/24, 33.3%). Notably, among those with neurological system infections, 4 underwent transplant surgery, 4 contracted infections after near drowning incidents, and 2 underwent surgical procedures. In addition, Among the 7 patients with eye infections, 6 individuals reported a history of either surgical interventions or exposure to contaminated objects. Interestingly, multivariate regression analysis identified antifungal treatment duration [P=0.022, OR(95%CI): 0.972(0.949–0.996)] as a protective factor against mortality in *Scedosporium boydii* infections. Conversely, post-transplantation status emerged as a significant risk factor for mortality [P=0.046, OR(95%CI): 7.017(1.034–47.636] (Table 1).

Analysis of treatment data revealed that 24 individuals(49.0%) with a median age of 40 years received itraconazole for a median duration of 60 days, of whom 8(33.3%) experienced treatment failure. In contrast, 25 individuals(51.0%) with a median age of 53 years received voriconazole for a median of 90 days, with 4(16.0%) experiencing treatment failure(Table 2). Statistical analysis indicated no significant differences between the two groups regarding age, gender, underlying health conditions, or overall treatment outcomes. Further examination of 37(75.5%) successfully treated cases revealed the specific durations of itraconazole and voriconazole treatment effective for various infection sites. Among patients diagnosed with neurological *Scedosporium* infections, voriconazole demonstrated longer treatment durations compared to itraconazole. The median treatment duration for voriconazole was 365 days, while only one patient achieved a cure with itraconazole, requiring 300 days of antifungal therapy. For skin/bone infections, the median treatment duration for voriconazole was 132 days compared to 120 days for itraconazole. In patients with eye infections, voriconazole again exhibited a longer median treatment duration of 90 days, with only one patient achieving a favorable outcome with itraconazole at 60 days.

Discussion

While *Scedosporium boydii* is a recognized causative agent of mycetoma, this case of over a decade in an immunocompetent individual underscores the organism's remarkable persistence within the human host. This

Table 2 Clinical characteristics of treatment with itraconazole vs. voriconazole

	Treated with voriconazole(*N* = 25)	Treated with itraconazole(*N* = 24)	*P* value
Male	18	15	0.478
Age, years, median (Interquartile range)	53(37–63)	40(23–53)	0.071
Predominant underlying condition			
Trauma	5	6	0.675
Near drowning	4	1	0.187
Surgical operation	3	4	0.476
Intravenous history	1	0	
Post-transplantation	6	7	0.682
Autoimmune disease	3	1	0.320
HIV/AIDS	1	1	0.745
Corticosteroid pharmacotherapy	3	3	0.646
Infection site			
Skin/bone	10	14	0.178
Brain	9	3	0.056
Eye	3	4	0.476
Others	3	3	0.646
treatment duration, days, median(Interquartile range)	90(49–270)	60(28–181)	0.682
Therapeutic inefficacy	4	8	0.158

persistence highlights the significant challenge of achieving complete eradication and the difficulties associated with its timely detection. Currently, definitive diagnosis of *Scedosporium boydii* infections relies on culture confirmation or histological examination, a method hampered by its relatively low sensitivity. Consequently, patients are often diagnosed at advanced stages, leading to heightened mortality risks and increased healthcare utilization.

According to our research, predisposing factors for *Scedosporium boydii* infections include post-transplantation, trauma, post-surgical procedures, corticosteroid use history, near drowning, and idiopathic autoimmune diseases. Patients infected with *Scedosporium boydii* were predominantly male, and most of these male patients had a history of trauma or transplantation. It is hypothesized that males are more likely to engage in higher-risk and physically demanding activities, leading to an increased risk of trauma. Additionally, studies have indicated that the proportion of males undergoing transplantation is significantly higher than that of females [50, 51], which consequently results in a greater number of post-transplant infections among male patients. Cutaneous/bone tissue is the most common site of infection, followed closely by neurological system and ocular infections. Immunodeficiency and trauma remain the primary causative factors for cutaneous/bone tissue infections. Notably, direct exposure to contaminated materials can be a potential precipitating factor for *Scedosporium boydii* infection in the eye, even without overt trauma. Post-transplantation, near drowning, and post-surgical procedures are the most common causes of neurological system infections. These infections often manifest as solitary or multiple brain abscesses and frequently culminate in a fatal outcome. Our statistical analysis reveals a high mortality rate (38.5%) for neurological system infections. Short-term antifungal therapy is identified as a risk factor for mortality in *Scedosporium boydii* infections. The median duration of antifungal therapy for successfully treated patients is 110 days, compared to 23 days for those who experience treatment failure. This significantly lower median duration in failed cases highlights the importance of timely initiation and extended duration of antifungal therapy for achieving a favorable outcome. Post-transplantation is also a risk factor for mortality due to the compromised immune status of transplant recipients, making them susceptible to opportunistic fungal infections, including disseminated infections that often lead to death. Notably, *Scedosporium boydii* exhibits resistance to common antifungal drugs like fluconazole and amphotericin B, leading to failed prophylactic or empiric treatment and contributing to the unfavorable prognosis of these infections. Most transplant recipients with *Scedosporium boydii* infections develop them within the first six months post-transplantation. This suggests that when a fungal infection is suspected in this period without definitive microbiological evidence, empirical therapy should consider the potential involvement of *Scedosporium boydii*.

Currently, the recommended management of *Scedosporium boydii* infections involves a multi-pronged approach combining surgical intervention with adjunctive antifungal therapy. However, the therapeutic landscape is complicated by *Scedosporium*'s high resistance to numerous antifungal agents, including 5-fluorocytosine, amphotericin B, and fluconazole. Additionally, a concerning trend

of decreased sensitivity towards echinocandins, particularly caspofungin and anidulafungin, further restricts the available options [52–54]. This highlights the significant limitations in the effective antifungal spectrum against *Scedosporium*. In response, the European Confederation of Medical Mycology advocates for voriconazole as the first-line treatment and itraconazole as a second-line option [55]. Despite this guidance, the mortality rate for severe infections, such as those involving the central nervous system or disseminated throughout the body, remains alarmingly high. Notably, in vitro susceptibility testing of voriconazole, with a minimum inhibitory concentration below 2 μg/ml, offers a predictive marker for a potentially positive outcome in *Scedosporium* infections [56] .

Triazole antifungal drugs possess distinct advantages, including minimal side effects and potent efficacy, rendering them a mainstay in the current armamentarium against fungal infections. Our data reveal the broad applicability of voriconazole and itraconazole in managing skin/bone tissue and corneal infections. In this reported case, the patient used itraconazole but the results were still unsatisfactory, which may be related to the dosage and duration of treatment. Notably, favorable outcomes were observed in two pulmonary infection cases treated with voriconazole(for 1 year, dose unavailable) and itraconazole(400 mg/day for 36 months), respectively. Furthermore, a single case of disseminated infection responded successfully to voriconazole. Interestingly, in patients with neurological system infections, voriconazole demonstrates a significantly higher utilization rate compared to itraconazole. This disparity can be attributed, in part, to the limited cerebral and cerebrospinal fluid distribution of itraconazole, as supported by existing literature [52, 57, 58]. While in vitro antifungal sensitivity tests indicate *Scedosporium* species generally exhibit higher resistance towards itraconazole than voriconazole, our data analysis did not reveal a significant difference in their efficacy against *Scedosporium boydii* infections. Research data revealed that among the 4 patients who experienced treatment failure with voriconazole, 3 had neurological system infections. This may be an important reason why there is no significant difference in prognosis between voriconazole and itraconazole treatments. Due to the limitations of itraconazole distribution in cerebrospinal fluid and brain tissue, voriconazole is more commonly used clinically. However, even with effective surgical intervention or antifungal treatment, neurological system infections caused by *Scedosporium boydii* are still associated with a high mortality rate.

Our analysis of successfully treated patients revealed significant heterogeneity in median treatment duration based on the infection site. Neurological infections, demanding the most protracted intervention, necessitated a median treatment period of nearly one year. Skin/bone infections followed with a median duration of 120 days, while ocular infections required a median of 90 days. Notably, no statistically significant difference was observed in treatment duration between itraconazole and voriconazole regimens. Adjusting the duration of antifungal therapy based on the specific site of infection may be a critical factor in optimizing the efficacy of antifungal treatment.

Conclusions

Infections attributed to *Scedosporium boydii* exhibit a propensity for insidious progression, often culminating in severe or disseminated disease. The limited therapeutic options available underscore the critical need for heightened clinical vigilance. The implementation of advanced diagnostic tools for early detection and prompt intervention represents a key strategy in improving patient outcomes. Our study found that post-transplantation, trauma, near drowning, a history of corticosteroid use, and surgical history were common risk factors for *Scedosporium boydii* infection. Prolonged antifungal treatment duration was identified as a protective factor against mortality in *Scedosporium boydii* infections. Conversely, a history of post-transplantation emerged as a potential risk factor for mortality. Both itraconazole and voriconazole are effective antifungal agents that can be used for the treatment of *Scedosporium boydii* infection.

Acknowledgements
Not applicable.

Author contributions
XYP and LXL performed the articles search. XYP wrote the paper. XYP, LXL, HLH, XYH and CXW participated in data cleaning, sorting and analysis. ZQS reviewed the manuscript. All authors read and approved the final manuscript.

Funding
This research was funded by the Foundation of Jiangxi Health Commission (No. 202210568).

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was approved by the Second Affiliated Hospital of Nanchang University Medical Research Ethics Committee.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 7 April 2024 / Accepted: 15 October 2024
Published online: 18 October 2024

References

1. Kaltseis J, Rainer J, De Hoog GS. Ecology of Pseudallescheria and Scedosporium species in human-dominated and natural environments and their distribution in clinical samples. Med Mycol. 2009;47(4):398–405.
2. Panackal AA, Marr KA. Scedosporium/Pseudallescheria infections. Semin Respir Crit Care Med. 2004;25(2):171–81.
3. Schwarz C, Brandt C, Melichar V, Runge C, Heuer E, Sahly H, et al. Combined antifungal therapy is superior to monotherapy in pulmonary scedosporiosis in cystic fibrosis. J Cyst Fibros. 2019;18(2):227–32.
4. Pihet M, Carrere J, Cimon B, Chabasse D, Delhaes L, Symoens F et al. Occurrence and relevance of filamentous fungi in respiratory secretion s of patients with cystic fibrosis–a review. Med Mycol.47(4):387–97.
5. Johnson LS, Shields RK, Clancy CJ. Epidemiology, clinical manifestations, and outcomes of Scedosporium infections among solid organ transplant recipients. Transpl Infect Dis. 2014;16(4):578–87.
6. Troke P, Aguirrebengoa K, Arteaga C, Ellis D, Heath CH, Lutsar I, et al. Treatment of scedosporiosis with voriconazole: clinical experience with 107 patients. Antimicrob Agents Chemother. 2008;52(5):1743–50.
7. Horré R, Schumacher G, Marklein G, Stratmann H, Wardelmann E, Gilges S, et al. Mycetoma due to Pseudallescheria boydii and co-isolation of Nocardia abscessus in a patient injured in road accident. Med Mycol. 2002;40(5):525–7.
8. Ogawa S, Inoue T, Sugita K. Pseudallescheria boydii infection associated with IgG4-related disease. Eur J Dermatology: EJD. 2022;32(5):653–5.
9. Cumbo-Nacheli G, de Sanctis J, Holden D. Pseudallescheria Boydii pneumonia in an immunocompetent host. Am J case Rep. 2012;13:163–5.
10. Chaney S, Gopalan R, Berggren RE. Pulmonary pseudallescheria boydii infection with cutaneous zygomycosis after near drowning. South Med J. 2004;97(7):683–7.
11. Gottesman-Yekutieli T, Shwartz O, Edelman A, Hendel D, Dan M. Pseudallescheria boydii infection of a prosthetic hip joint–an uncommon infection in a rare location. Am J Med Sci. 2011;342(3):250–3.
12. Guber I, Bergin C, Majo F. Repeated Intrastromal injections of Voriconazole in combination with corneal debridement for recalcitrant fungal keratitis - a Case Series. Klin Monatsbl Augenheilkd. 2016;233(4):369–72.
13. Hornbeek H, Ackerman BH, Reigart CL, Stair-Buchmann M, Guilday RE, Patton ML, et al. Pseudallescheria boydii infection of the brain. Surg Infect. 2012;13(3):179–80.
14. Lavy D, Morin O, Venet G, Maugars Y, Prost A, Berthelot JM. Pseudallescheria boydii knee arthritis in a young immunocompetent adult two years after a compound patellar fracture. Joint bone Spine. 2001;68(6):517–20.
15. Lopes JO, Alves SH, Benevenga JP, Salla A, Khmohan C, Silva CB. Subcutaneous pseudallescheriasis in a renal transplant recipient. Mycopathologia. 1994;125(3):153–6.
16. Mursch K, Trnovec S, Ratz H, Hammer D, Horré R, Klinghammer A, et al. Successful treatment of multiple pseudallescheria boydii brain abscesses and ventriculitis/ependymitis in a 2-year-old child after a near-drowning episode. Child's Nerv System: ChNS : Official J Int Soc Pediatr Neurosurg. 2006;22(2):189–92.
17. Zeng C, Ma YS, Zhou JY, Xue CB, Xiong Y, Zhou W, et al. Donor-derived transmission of scedosporiosis in kidney transplant recipients from a systemic lupus erythematosus donor. Curr Med Sci. 2023;43(2):417–20.
18. Shu T, Green JM, Orihuela E. Testicular involvement in disseminated fungal infection by Pseudallescheria Boydii. Urology. 2004;63(5):981–2.
19. Tsuji G, Takei K, Takahara M, Matsuda T, Nakahara T, Furue M, et al. Cutaneous pseudallescheria boydii/Scedosporium apiospermum complex infection in immunocompromised patients: a report of two cases. J Dermatol. 2017;44(9):1067–8.
20. Horton CK, Huang L, Goozé L. Pseudallescheria boydii infection in AIDS. J Acquir Immune Defic Syndr Hum Retrovirology: Official Publication Int Retrovirology Association. 1999;20(2):209–11.
21. Ishii S, Hiruma M, Hayakawa Y, Sugita T, Makimura K, Hiruma M, et al. Cutaneous pseudallescheria boydii/Scedosporium apiospermum complex (molecular type: Scedosporium apiospermum [Clade 4]) infection: a Case Report and Literature Review of cases from Japan. Med Mycol J. 2015;56(4):E25–30.
22. Enshaieh SH, Darougheh A, Asilian A, Iraji F, Shahmoradi Z, Yoosephi A, et al. Disseminated subcutaneous nodules caused by Pseudallescheria boydii in an atopic patient. Int J Dermatol. 2006;45(3):289–91.
23. Khan FA, Hashmi S, Sarwari AR. Multiple subcutaneous mycetomas caused by Pseudallescheria boydii: response to therapy with oral potassium iodide solution. J Infect. 2010;60(2):178–81.
24. Verweij PE, Cox NJ, Meis JF. Oral terbinafine for treatment of pulmonary pseudallescheria boydii infection refractory to itraconazole therapy. Eur J Clin Microbiol Infect Diseases: Official Publication Eur Soc Clin Microbiol. 1997;16(1):26–8.
25. Kanafani ZA, Comair Y, Kanj SS. Pseudallescheria boydii cranial osteomyelitis and subdural empyema successfully treated with voriconazole: a case report and literature review. Eur J Clin Microbiol Infect Diseases: Official Publication Eur Soc Clin Microbiol. 2004;23(11):836–40.
26. Taravella MJ, Johnson DW, Petty JG, Keyser RB, Foster CS, Lundberg BE. Infectious posterior scleritis caused by Pseudallescheria boydii. Clinicopathologic findings. Ophthalmology. 1997;104(8):1312–6.
27. Ginter G, de Hoog GS, Pschaid A, Fellinger M, Bogiatzis A, Berghold C, et al. Arthritis without grains caused by Pseudallescheria Boydii. Mycoses. 1995;38(9–10):369–71.
28. Lonser RR, Brodke DS, Dailey AT. Vertebral osteomyelitis secondary to Pseudallescheria Boydii. J Spinal Disord. 2001;14(4):361–4.
29. Apostolova LG, Johnson EK, Adams HP. Jr. Disseminated pseudallescheria boydii infection successfully treated with voriconazole. J Neurol Neurosurg Psychiatry. 2005;76(12):1741–2.
30. Nesky MA, McDougal EC, Peacock JE Jr. Pseudallescheria boydii brain abscess successfully treated with voriconazole and surgical drainage: case report and literature review of central nervous system pseudallescheriasis. Clin Infect Diseases: Official Publication Infect Dis Soc Am. 2000;31(3):673–7.
31. Ortmann C, Wüllenweber J, Brinkmann B, Fracasso T. Fatal mycotic aneurysm caused by Pseudallescheria boydii after near drowning. Int J Legal Med. 2010;124(3):243–7.
32. Bradley JC, Hirsch BA, Kimbrough RC 3rd, McCartney DL. Pseudallescheria boydii keratitis. Scand J Infect Dis. 2006;38(11–12):1101–3.
33. Stonesifer CJ, Khaleel AE, Garcia-Saleem TJ, Husain S, Geskin LJ. Isolated cutaneous pseudallescheria boydii abscess in an immunocompetent man. JAAD case Rep. 2022;21:160–4.
34. Lainscak M, Hocevar A, Logar D, Beović B, Matos T, Tomsic M. Subcutaneous infection with Pseudallescheria boydii in an immunocompromised patient. Clin Rheumatol. 2007;26(6):1023–4.
35. Ruinemans GM, Haagsma CJ, Hendrix R. Tenosynovitis caused by a pseudallescheria boydii infection and symptoms of reflex sympathetic dystrophy after a dog bite. J Clin Rheumatology: Practical Rep Rheumatic Musculoskelet Dis. 2011;17(7):363–4.
36. Oh IK, Baek S, Huh K, Oh J. Periocular abscess caused by Pseudallescheria boydii after a posterior subtenon injection of triamcinolone acetonide. Graefe's Archive Clin Experimental Ophthalmol = Albrecht Von Graefes Archiv fur Klinische und Experimentelle Ophthalmologie. 2007;245(1):164–6.
37. Alpaydın S, Güler A, Çelebisoy N, Polat SH, Turhan T. Pseudallescheria boydii infection of the central nervous system: first reported case from Turkey. Acta Neurol Belgica. 2015;115(3):489–92.
38. Bloom PA, Laidlaw DA, Easty DL, Warnock DW. Treatment failure in a case of fungal keratitis caused by Pseudallescheria Boydii. Br J Ophthalmol. 1992;76(6):367–8.
39. Buzina W, Feierl G, Haas D, Reinthaler FF, Holl A, Kleinert R, et al. Lethal brain abscess due to the fungus scedosporium apiospermum (teleomorph pseudallescheria boydii) after a near-drowning incident: case report and review of the literature. Med Mycol. 2006;44(5):473–7.
40. Wang XY, Yu SL, Chen S, Zhang WH. CNS infection caused by Pseudallescheria boydii in a near-drowning traveller from a traffic accident. J Travel Med. 2016;23(2):tav018.
41. Cardoso JC, Serra D, Cardoso R, Reis JP, Tellechea O, Figueiredo A. Cutaneous pseudallescheria boydii infection in a renal transplant patient: a case report. Dermatol Online J. 2009;15(10):8.
42. Goldberg SL, Geha DJ, Marshall WF, Inwards DJ, Hoagland HC. Successful treatment of simultaneous pulmonary pseudallescheria boydii and aspergillus terreus infection with oral itraconazole. Clin Infect Diseases: Official Publication Infect Dis Soc Am. 1993;16(6):803–5.
43. Gatto J, Paterson D, Davis L, Lockwood L, Allworth A. Vertebral osteomyelitis due to Pseudallescheria Boydii. Pathology. 1997;29(2):238–40.
44. Bonduel M, Santos P, Turienzo CF, Chantada G, Paganini H. Atypical skin lesions caused by Curvularia sp. and pseudallescheria boydii in two patients after allogeneic bone marrow transplantation. Bone Marrow Transplant. 2001;27(12):1311–3.
45. Busaba NY, Poulin M. Invasive pseudallescheria boydii fungal infection of the temporal bone. Otolaryngology–head neck Surgery: Official J Am Acad Otolaryngology-Head Neck Surg. 1997;117(6):S91–4.
46. Poza G, Montoya J, Redondo C, Ruiz J, Vila N, Rodriguez-Tudela JL, et al. Meningitis caused by Pseudallescheria boydii treated with voriconazole. Clin Infect Diseases: Official Publication Infect Dis Soc Am. 2000;30(6):981–2.

47. Malinowski MJ, Halandras P. Arterial reconstruction for atypical mycotic aneurysms. Vasc Endovascular Surg. 2013;47(1):45–7.
48. Pether JV, Jones W, Greatorex FB, Bunting W. Acute pyogenic pseudallescheria boydii foot infection sequentially treated with miconazole and itraconazole. J Infect. 1992;25(3):335–6.
49. Ginter G, Petutschnig B, Pierer G, Soyer HP, Reischle S, Kern T, et al. Case report. Atypical cutaneous pseudallescheriosis refractory to antifungal agents. Mycoses. 1999;42(7–8):507–11.
50. Oloruntoba OO, Moylan CA. Gender-based disparities in access to and outcomes of liver transplant ation. World J Hepatol.7(3):460–7.
51. Natale P, Hecking M, Kurnikowski A, Scholes-Robertson N, Carrero JJ, Wong G et al. Perspectives of nephrologists on gender disparities in Access to Kidne Y Transplantation. Clin J Am Soc Nephrol.18(10):1333–42.
52. Lackner M, de Hoog GS, Verweij PE, Najafzadeh MJ, Curfs-Breuker I, Klaassen CH, et al. Species-specific antifungal susceptibility patterns of Scedosporium and Pseudallescheria species. Antimicrob Agents Chemother. 2012;56(5):2635–42.
53. Gilgado F, Serena C, Cano J, Gené J, Guarro J. Antifungal susceptibilities of the species of the Pseudallescheria boydii complex. Antimicrob Agents Chemother. 2006;50(12):4211–3.
54. Lackner M, Hagen F, Meis JF, van den Gerrits AH, Vu D, Robert V, et al. Susceptibility and diversity in the therapy-refractory genus scedosporium. Antimicrob Agents Chemother. 2014;58(10):5877–85.
55. Hoenigl M, Salmanton-Garcia J, Walsh TJ, Nucci M, Neoh CF, Jenks JD, et al. Global guideline for the diagnosis and management of rare mould infections: an initiative of the European Confederation of Medical Mycology in cooperation with the International Society for Human and Animal Mycology and the American Society for Microbiology. Lancet Infect Dis. 2021;21(8):e246–57.
56. Martin-Vicente A, Guarro J, González GM, Lass-Flörl C, Lackner M, Capilla J. Voriconazole MICs are predictive for the outcome of experimental disseminated scedosporiosis. J Antimicrob Chemother. 2017;72(4):1118–22.
57. Carrillo AJ, Guarro J. In vitro activities of four novel triazoles against Scedosporium spp. Antimicrob Agents Chemother. 2001;45(7):2151–3.
58. Lackner M, Rezusta A, Villuendas MC, Palacian MP, Meis JF, Klaassen CH. Infection and colonisation due to Scedosporium in Northern Spain. An in vitro antifungal susceptibility and molecular epidemiology study of 60 isolates. Mycoses. 2011;54(Suppl 3):12–21.

Publisher's note