Two cases of *M. arupense* infection have been reported in immunosuppressed persons, both in HIV/AIDS patients (manifesting as pulmonary infection in 1 patient and disseminated disease in the other) (6). In our study, the immunocompromised patient with *M. arupense* tenosynovitis received canakinumab, a relatively new biologic agent with a prolonged selective IL-1 β-blockade. Even though the contribution of canakinumab in this case is confounded by concomitant immune deficiencies (natural killer cell deficiency, high-dose corticosteroids), the temporal association between initiation of canakinumab and the onset of symptoms raises concern of a possible association. Animal studies have shown that IL-1 plays a key role in host resistance to mycobacterial infections by regulating Th1/Th2 immune responses and inducing granuloma formation (9). Clinical trials and systematic reviews assessing the safety of IL-1 inhibitors, including anakinra, rilonacept, and canakinumab, have not shown that these drugs lead to an increased risk of tuberculosis or other mycobacterial infections (10). Nonetheless, our report provides increased evidence that *M. arupense* is an emerging cause of tenosynovitis and that it is potentially associated with immunosuppression.

**References**

1. Cloud JL, Meyer JJ, Pounder JI, Jost KC Jr, Sweeney A, Carroll KC, et al. *Mycobacterium arupense* sp. nov., a non-chromogenic bacterium isolated from clinical specimens. Int J Syst Evol Microbiol. 2006;56:1413–8. http://dx.doi.org/10.1099/ijs.0.64194-0

2. Tsai TF, Lai CC, Tsai IC, Chang CH, Hsiao CH, Hsueh PR. Tenosynovitis caused by *Mycobacterium arupense* in a patient with diabetes mellitus. Clin Infect Dis. 2008;47:861–3. http://dx.doi.org/10.1086/591281

3. Neomakis IK, Gitti Z, Kontos F, Baritaki S, Petinaki E, Baritaki M, et al. Mycobacterium arupense pulmonary infection: antibiotic resistance and restriction fragment length polymorphism analysis. Indian J Med Microbiol. 2010;28:173–6. http://dx.doi.org/10.4103/0255-0857.62502

4. Senda H, Muro H, Terada S. Flexor tenosynovitis caused by *Mycobacterium arupense*. J Hand Surg Eur Vol. 2011;36:72–3. http://dx.doi.org/10.1177/1753193410381825

5. Legout L, Ettahar N, Massongo M, Vezipis N, Ajana F, Beltrand E, et al. Osteomyelitis of the wrist caused by *Mycobacterium arupense* in an immunocompetent patient: a unique case. Int J Infect Dis. 2012;16:e761–2. http://dx.doi.org/10.1016/j.ijid.2012.05.007

6. Heidariel P, Hashemi-Shahraki A, Khorosvari AD, Zaker-Boustanabad S, Shojaei H, Feizabadi MM. *Mycobacterium arupense* infection in HIV-infected patients from Iran. Int J STD AIDS. 2013;24:485–7. http://dx.doi.org/10.1177/0956462412472818

7. Lee SI, Hong SK, Park SS, Kim EC. First Korean case of *Mycobacterium arupense* tenosynovitis. Ann Lab Med. 2014;34:321–4. http://dx.doi.org/10.3343/alm.2014.34.4.321

8. Beam E, Vasoo S, Simmer PJ, Rizzo M, Mason EL, Walker RC, et al. *Mycobacterium arupense* flexor tenosynovitis: case report and review of antimicrobial susceptibility profiles for 40 clinical isolates. J Clin Microbiol. 2014;52:2706–8. http://dx.doi.org/10.1128/JCM.00777-14

9. Mayer-Barber KD, Barber DL, Shenderov K, White SD, Wilson MS, Cheever A, et al. Caspase-1 independent IL-1 β production is critical for host resistance to *Mycobacterium tuberculosis* and does not require TLR signaling in vivo. J Immunol. 2010;184:3326–30. http://dx.doi.org/10.4049/jimmunol.0904189

10. Cantarini L, Lopalco G, Caso F, Costa L, Iannone F, Lapadula G, et al. Effectiveness and tuberculosis-related safety profile of interleukin-1 blocking agents in the management of Behçet’s disease. Autoimmun Rev. 2015;14:1–9. http://dx.doi.org/10.1016/j.autrev.2014.08.008

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**Candida haemulonii** Complex Species, Brazil, January 2010–March 2015

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**To the Editor:** The epidemiology of yeast infections is evolving, and species in the *Candida haemulonii* complex have been identified as a cause of candidiasis (1). In 2012, *C. haemulonii* complex was reclassified as 2 species and 1 variety: *C. haemulonii* (former group I), *C. duobushaemulonii* (former group II) and *C. haemulonii* var. *vulnera* (1).

Despite the growing knowledge about the biology and clinical relevance of these pathogens, species-specific data comparing clinical and microbiological aspects are lacking. We describe the clinical and microbiological characteristics of patients from 5 hospitals in São Paulo, Brazil, whose cultures were positive for the *C. haemulonii* complex species.

During January 2010–March 2015, samples from case-patients in 5 hospitals affiliated with the University of São Paulo were cultured; samples positive for *C. haemulonii* were further analyzed. Clinical and epidemiologic data were retrospectively collected. Species identification of the first isolate from each patient was made by sequencing the internal transcribed spacer region of the rRNA gene (2). Sequence similarity searches were done by using BLAST (http://www.ncbi.nlm.nih.gov/blast). Antifungal susceptibility testing was performed by using the Clinical
and Laboratory Standards Institute reference method for susceptibility testing of yeasts (3) for amphotericin B (AMB), fluconazole, voriconazole, caspofungin (all from Sigma, St. Louis, MO, USA), and anidulafungin (Pfizer, New York, NY, USA).

Among the 14,642 specimens that showed positive yeast cultures, 40 (0.3%) isolates from 31 patients belonged to the C. haemulonii complex. Most sample sources were bone and soft tissue samples from lower extremity chronic wounds (n = 17, 42%) and blood cultures (n = 11, 32%). Other positive sources were central venous catheter (CVC) tips (n = 3), toenail scrapings (n = 3), vaginal discharge (n = 2), bile (n = 1), peritoneal fluid (n = 1), pleural effusion (n = 1), and purulent fluid from the mediastinum (n = 1).

Molecular identification characterized 14 isolates as C. haemulonii (2 alleles), 8 as C. haemulonii var. vulnera, and 9 as C. duobushaemulonii (online Technical Appendix Table 1, Figure, http://wwwnc.cdc.gov/EID/article/22/3/15-1610-Techapp1.pdf). Clinical and microbiological features of the 31 patients who tested positive are summarized in the Table. Diabetes mellitus was found substantially more frequently among patients with C. duobushaemulonii (66% vs. 25%–28% for the other 2 species), but rates for other underlying conditions were similar for all 3 species.

Susceptibility testing results varied by drug and species (Table). C. duobushaemulonii showed higher MICs for AMB than C. haemulonii and C. haemulonii var. vulnera, but all isolates showed high MICs for fluconazole and voriconazole. Conversely, MICs were low for caspofungin and anidulafungin. However, 1 isolate of C. duobushaemulonii showed high MICs of 8 μg/mL for caspofungin and 0.5 μg/mL for anidulafungin.

Of the 31 patients investigated, 11 had chronically infected wounds of lower extremities with positive surgically collected bone or soft tissue cultures, or both (Table). Samples for 4 of those patients had positive cultures for C. haemulonii, 3 for C. haemulonii var. vulnera, and 4 for C. duobushaemulonii. In most patients (n = 9, 82%), samples showed polymicrobial growth; Staphylococcus spp. (n = 7) were the most common concomitant microorganisms. All patients were treated by surgical debridement.

Samples from 8 (25%) of the 31 patients were positive for candidiasis; 7 had C. haemulonii (3 var. vulnera) and 1 C. duobushaemulonii (online Technical Appendix Table 2).

| Characteristic                              | Candida haemulonii, n = 14 | Candida haemulonii var. vulnera, n = 8 | Candida duobushaemulonii, n = 9 |
|--------------------------------------------|-----------------------------|----------------------------------------|----------------------------------|
| Mean age, y (range)                        | 42 (0–85)                   | 46 (16–78)                             | 49 (0–85)                        |
| Sex, F/M                                   | 8/6                         | 6/2                                    | 4/5                              |
| Mean hospitalization, d (range)            | 20 (0–140)                  | 28 (0–78)                              | 26 (0–67)                        |
| ICU-acquired, %                            | 2 (14)                      | 1 (12)                                 | 4 (44)                           |
| Polymicrobial culture, %                   | 4 (28)                      | 5 (62)                                 | 4 (44)                           |
| Underlying conditions, %                   |                             |                                        |                                  |
| Malignancy†                                | 3 (21)                      | 3 (37)                                 | 2 (22)                           |
| Solid organ transplant                     | 2 (14)                      | ND                                     | ND                               |
| Systemic lupus†                            | 1 (12)                      | ND                                     | ND                               |
| Diabetes mellitus                          | 4 (28)                      | 2 (25)                                 | 6 (66)                           |
| Vascular diseases                          | 3 (21)                      | 3 (37)                                 | 4 (44)                           |
| Risk factors                               |                             |                                        |                                  |
| Previous antimicrobial drug therapy         | 12 (85)                     | 6 (75)                                 | 8 (89)                           |
| Previous antifungal drug therapy           | 6 (42)                      | 2 (25)                                 | 3 (33)                           |
| Chronic lower-extremity infected wounds    | 3 (21)                      | 4 (50)                                 | 4 (44)                           |
| Candidemia                                 | 4 (28)                      | 3 (37)                                 | 1 (11)                           |
| Antifungal susceptibility testing           |                             |                                        |                                  |
| Amphotericin B                             | GM, μg/mL (range)           | 1.56 (1–4)                             | 1 (0.5–2)                        |
|                                            | MIC50                       | 4                                      | 2                                |
|                                            |                             |                                        | 8                                |
| Fluconazole                                | GM, μg/mL (range)           | 8.4 (1–64)                             | 17.4 (2–64)                      |
|                                            | MIC50                       | 64                                     | 64                               |
|                                            |                             |                                        | 64                              |
| Voriconazole                               | GM, μg/mL (range)           | 1.9 (0.25–16)                          | 1.53 (0.125–16)                  |
|                                            | MIC50                       | 16                                     | 16                               |
|                                            |                             |                                        | 16                              |
| Caspofungin                                | GM, μg/mL (range)           | 0.12 (0.125–0.5)                       | 0.26 (0.125–0.5)                 |
|                                            | MIC50                       | 0.25                                   | 0.5                              |
|                                            |                             |                                        | 16                              |
| Anidulafungin                              | GM, μg/mL (range)           | 0.015 (<0.015–0.015)                   | 0.016 (<0.015–0.03)              |
|                                            | MIC50                       | 0.015                                  | 0.03                             |
|                                            |                             |                                        | 0.5                              |

*Values are no. (%) patients except as indicated. ND, no data; GM, geometric mean; MIC50, concentration that inhibits 90% of isolates.
†Solid tumors (n = 5) and hematologic malignancies (n = 3).
Five (62%) patients had received antimicrobial drugs before the infection. Drug therapy failed in 5 (62%) that had positive cultures during deoxycholate AMB (n = 4) or fluconazole (n = 1) therapy. Among the 7 patients with CVC-associated candidemia, 4 had the CVC removed; 3 of those survived. The 30-day all-cause mortality rate was 50%.

Our study showed a prevalence of 0.3% C. haemulonii among yeast isolates, which was much higher than previously reported (4). Older commercial methods are unable to correctly identify C. haemulonii species, contributing to this underestimation (4). More closely related species such as C. auris, mainly found in South Africa, Asia, and the Middle East, have been misidentified as C. haemulonii and C. famata by using older systems. Thus, matrix-assisted laser desorption/ionization–time of flight mass spectrometry and internal transcribed spacer rRNA sequencing are necessary to provide the correct identification (5–7).

The data we document suggest that patients with diabetes mellitus are more likely to have positive cultures for C. duobushaemulonii than for the 2 C. haemulonii species. Moreover, C. duobushaemulonii isolates have higher AMB MICs than the C. haemulonii species. As previously reported (8), echinocandins showed better in vitro activity than azole compounds.

In summary, we demonstrated that C. haemulonii species complex are critical pathogens of chronic lower extremity wounds and that fungemia by such species remains a rare event. The 30-day all-cause mortality rate among patients with candidemia was 50%, lower than previously reported in our institution (9) and other centers in Brazil (10). We believe that in cases of candidemia by C. haemulonii spp. that 1) empirical use of AMB or azole compounds should be avoided; 2) removal of CVC should be performed; and 3) antifungal susceptibility testing should be done to guide antifungal therapy.

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References
1. Cendejas-Bueno E, Kolecka A, Alastruey-Izquierdo A, Theelen B, Groenewald M, Kostrzewa M, et al. Reclassification of the Candida haemulonii complex as Candida haemulonii (C. haemulonii group I), C. duobushaemulonii sp. nov. (C. haemulonii group II), and C. haemulonii var. vulnera var. nov.: three multiresistant human pathogenic yeasts. J Clin Microbiol. 2012;50:3641–51. http://dx.doi.org/10.1128/JCM.02248-12
2. Fujita S, Senda Y, Nakaguchi S, Hashimoto T. Multiplex PCR using internal transcribed spacer 1 and 2 regions for rapid detection and identification of yeast strains. J Clin Microbiol. 2001;39:3617–22. http://dx.doi.org/10.1128/JCM.39.10.3617-3622.2001
3. Clinical Laboratory Standards Institute (CLSI). Reference method for broth dilution antifungal susceptibility testing of yeasts. Approved standard M27–A3, 3rd ed. Wayne, PA: National Committee for Clinical Laboratory Standards, The Institute; 2008.
4. Pfäffli MA, Diekema DJ, Gibbs DL, Newell VA, Bijie H, Dzierzanowska D, et al. Results from the ARTEMIS Dros Inf Serv:K Global Antifungal Surveillance Study, 1997 to 2007: 10.5-year analysis of susceptibility of noncandidal yeast species to fluconazole and voriconazole determined by CLSI standardized disk diffusion testing. J Clin Microbiol. 2009;47:117–23. http://dx.doi.org/10.1128/JCM.01747-08
5. Magobo RE, Corcoran C, Seetharam S, Govender NP. Candida auris-associated candidemia, South Africa. Emerg Infect Dis. 2014;20:1250–1. http://dx.doi.org/10.3201/eid2007.131765
6. Emara M, Ahmad S, Khan Z, Joseph L, Al-Obaid I, Purohit P, et al. Candida auris candidemia in Kuwait, 2014. Emerg Infect Dis. 2015;21:1091–2. http://dx.doi.org/10.3201/eid2106.150270
7. Kathuria S, Singh PK, Sharma C, Prakash A, Masih A, Kumar A, et al. Multidrug-resistant Candida auris misidentified as Candida haemulonii: characterization by matrix-assisted laser desorption ionization–time of flight mass spectrometry and DNA sequencing and its antifungal susceptibility profile variability by Vitek 2, CLSI broth microdilution, and Etest method. J Clin Microbiol. 2015;53:1823–30. http://dx.doi.org/10.1128/JCM.00367-15
8. Ramos LS, Figueiredo-Carvalho MHG, Barbudo LS, Ziccardi M, Chaves ALS, Zancopé-Oliveira RM, et al. Candida haemulonii complex: species identification and antifungal susceptibility profiles of clinical isolates from Brazil. J Antimicrob Chemother. 2015;70:111–5. http://dx.doi.org/10.1093/jac/dku321
9. Girão E, Levin AS, Basso M, Gobara S, Gomes LB, Medeiros EA, et al. Seven-year trend analysis of nosocomial candidemia and antifungal (fluconazole and caspofungin) use in intensive care units at a Brazilian University Hospital. J Med Microbiol. 2008;46:581–8. http://dx.doi.org/10.1098/rjms.2014.0073
10. Colombo AL, Guimarães T, Silva LRBF, de Almeida Monfardini LP, Cunha AKB, Rady P, et al. Prospective observational study of candidemia in São Paulo, Brazil: incidence rate, epidemiology, and predictors of mortality. Infect Control Hosp Epidemiol. 2007;28:570–6. http://dx.doi.org/10.1086/513615

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Review of Cases and a Patient Report of Myiasis with Tracheostomy, Peru

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To the Editor: Myiasis is the infestation in humans of larvae of flies (order Diptera). These larvae can infect...