Answer to Photo Quiz: *Actinobaculum schaalii*

(See page 3391 in this issue [[doi:10.1128/JCM.02376-13](https://doi.org/10.1128/JCM.02376-13)] for photo quiz case presentation.)

Eileen M. Burd, Paulina A. Rebolledo

Department of Pathology and Laboratory Medicine, Emory University School of Medicine, Atlanta, Georgia, USA; Department of Medicine, Division of Infectious Diseases, Emory University School of Medicine, Atlanta, Georgia, USA

The Gram stain of material from the abscess showed many Gram-positive cocci and Gram-negative coccobacilli. The organism that grew in aerobic culture initially presented as a pleomorphic Gram-positive organism with both coccoid and rod-shaped forms. After extended incubation, the Gram stain morphology appeared more consistently diphtheroid-like, with some branching. Based on the Gram stain morphology, the negative result for catalase, and the negative results for pyrrolidonyl arylamidase (PYR) and leucine aminopeptidase (LAP), the isolate was presumptively identified as *Actinobaculum* species. Matrix-assisted laser desorption ionization–time of flight (MALDI-TOF) mass spectroscopy using the Vitek MS RUO system with Saramis SuperSpectra database version 4.09 (bioMérieux, Durham, NC) provided a good identification of *Actinobaculum schaalii*, with an 80.5% confidence value and a reference species proposed as a single choice. The identification was corroborated at the Georgia Public Health Laboratory using DNA sequence analysis of a 401-bp segment of the 16S rRNA gene, which yielded 99.6% homology with *A. schaalii* strain NR_040859.1 (<http://www.ncbi.nlm.nih.gov/GenBank/index.html>).

The genus *Actinobaculum* was first described in 1997, at which time *A. schaalii* was designated the type species and *Actinobaculum suis* (formerly *Actinomyces suis*) was transferred from the genus *Actinomyces*. *Actinobaculum urinale* and *Actinobaculum massiliense* were added in 2003 and 2006, respectively. The phylogenetic relationships of *Actinobaculum* are not yet clearly established, but existing phylogenetic studies show the genus to be closely related to the genera *Actinomyces*, *Arcanobacterium*, *Trueperella*, and *Mobiluncus* (1). *Actinobaculum* grows best under anaerobic or microaerophilic conditions and requires at least 5% CO₂. These Gram-positive coccoid rods have a tendency to branch and may decolorize on a Gram stain. *Actinobaculum* grows very slowly, producing pinpoint gray colonies <1 mm in diameter, and may show weak beta-hemolysis on agar containing 5% horse or sheep blood after 2 to 5 days of incubation.

A. suis is known to cause actinomycosis of the mammary gland, urinary tract infections, and abortions in sows. The *Actinobaculum* species that have been found in humans probably belong to the commensal flora of the oral cavity and genitourinary tract and may be present on surrounding skin (2). The elderly appear to be at the greatest risk for colonization (2). Prevalence of infection and pathogenic potential are undoubtedly underestimated, and there are increasing numbers of reports of *Actinobaculum* infections appearing in peer-reviewed literature. A few reports implicate *A. urinale* and *A. massiliense* as causes of chronic cystitis in elderly women. In addition, *A. massiliense* has been reported as a cause of superficial skin infection (3).

A. schaalii is the most frequently reported species and has primarily been recovered from urine, typically as a cause of unexplained pyuria or urinary tract infection unresponsive to treat-

ment with ciprofloxacin or trimethoprim in elderly patients with underlying urological conditions. A survey of randomly selected urine specimens showed that 22% of 155 urine samples from patients over 60 years of age were positive for *A. schaalii* at quantities of >10⁴ CFU/ml using real-time PCR (4). Urinary tract infections caused by *A. schaalii* in adults can progress to urosepsis. Other serious illnesses attributed to *A. schaalii* include osteomyelitis, endocarditis, necrotizing fasciitis, bacteremia, abscesses, and epididymitis (4, 5, 6, 7, 8). *A. schaalii* infections, particularly in the urinary tract in both adult and pediatric populations, are frequently reported as polymicrobial (4, 9, 10).

Review of the literature identified six cases of *A. schaalii* infections in children under the age of 15 years (6, 10, 11). The most common presentation was cystitis, and in nearly all cases, a pre-existing urogenital abnormality was identified. All of the reported children were diaper dependent, suggesting that, similar to what was observed for the adult population, colonization with *A. schaalii* is an important risk factor for development of infection.

Resemblance to normal flora of the skin and mucosa and difficulties identifying *Actinobaculum* using conventional biochemical tests or test systems that do not include this organism in the identification database have likely led to underrecognition or misidentification of this opportunistic pathogen. In addition, many clinical laboratories incubate urine cultures in ambient air for 24 to 28 h. These conditions will fail to detect *Actinobaculum*, which requires at least 5% CO₂, and several days of incubation may be needed to produce visible colonies. It is recommended that *Actinobaculum* be considered in cases of unexplained chronic pyuria that does not respond to treatment with ciprofloxacin or trimethoprim. Discrepancies between direct Gram stain and culture results under aerobic conditions may suggest *Actinobaculum* infection. Analysis of urine sediment revealed the presence of polymorphonuclear leukocytes in most cases, but the organism does not possess the enzyme needed to reduce nitrate to nitrite, and the result for dipstick urinalysis is therefore negative for nitrites (7).

Susceptibility testing for *A. schaalii* has not been standardized, and most reports of susceptibility results do not provide MICs or describe the methods or interpretive criteria used. In studies where conditions and MICs or interpretive criteria were specified, *A. schaalii* isolates were determined to have low MICs for penicillin, amoxicillin, ceftriaxone, cefuroxime, gentamicin, vancomycin, clindamycin, linezolid, tetracycline, and nitrofurantoin. Iso-

Citation Burd EM, Rebolledo PA. 2015. Answer to photo quiz: *Actinobaculum schaalii*. J Clin Microbiol 53:3709–3710. doi:10.1128/JCM.02429-13.

Editor: P. Bourbeau

Address correspondence to Eileen M. Burd, eburd@emory.edu.

Copyright © 2015, American Society for Microbiology. All Rights Reserved.

lates may also be susceptible to rifampin, erythromycin, and doxycycline, but the numbers of organisms tested have been small. *A. schaalii* is described as intrinsically resistant to metronidazole and colistin, and ciprofloxacin and trimethoprim-sulfamethoxazole have reduced activity (1). Isolates may test as susceptible to levofloxacin and moxifloxacin *in vitro*, but the use of these agents is not recommended (1).

Treatment with a β -lactam antibiotic is generally recommended (1, 4). Vancomycin and clindamycin have also been successfully used in several cases (1). The optimal duration of antimicrobial drug treatment is not clearly defined, but treatment for at least 2 weeks is recommended since failure has been experienced with treatment of shorter duration (1, 4, 6, 12).

A. schaalii was the only organism recovered in culture from the abscess in the patient in this case. It is not known if the infection in this case was polymicrobial, since anaerobic cultures were not performed. The Gram-negative coccobacilli that were seen in addition to Gram-positive cocci on the direct Gram stain may have been a second organism or decolorized *Actinobaculum*. However, since *A. schaalii* was present in a high quantity, is known to be recovered from groin skin, and has been reported in association with abscesses, this organism was considered a pathogen in this patient. Intravenous vancomycin was continued throughout the patient's hospital stay, and he was discharged 5 days after admission, with wound care instructions and oral clindamycin for completion of 10 days of antibiotic therapy.

REFERENCES

1. Cattoir V. 2012. *Actinobaculum schaalii*: review of an emerging uropathogen. J Infect 64:260–267. <http://dx.doi.org/10.1016/j.jinf.2011.12.009>.
2. Olsen AB, Andersen PK, Bank S, Søby KM, Lund L, Prag J. 2013. *Actinobaculum schaalii*, a commensal of the urogenital area. BJU Int 112:394–397. <http://dx.doi.org/10.1111/j.1464-410X.2012.11739.x>.
3. Waghorn DJ. 2004. *Actinobaculum massiliae*: a new cause of superficial skin infection. J Infect 48:276–277. <http://dx.doi.org/10.1016/j.jinf.2003.08.003>.
4. Bank S, Jensen A, Hansen TM, Søby KM, Prag J. 2010. *Actinobaculum schaalii*, a common uropathogen in elderly patients, Denmark. Emerg Infect Dis 16:76–80. <http://dx.doi.org/10.3201/eid1601.090761>.
5. van Aarle S, Arents NLA, de Laet K. 2013. *Actinobaculum schaalii* causing epididymitis in an elderly patient. J Med Microbiol 62:1092–1093. <http://dx.doi.org/10.1099/jmm.0.048611-0>.
6. Reinhard M, Prag J, Kemp M, Andresen K, Klemmensen B, Højlyng N, Sørensen SH, Christensen JJ. 2005. Ten cases of *Actinobaculum schaalii* infection: clinical relevance, bacterial identification, and antibiotic susceptibility. J Clin Microbiol 43:5305–5308. <http://dx.doi.org/10.1128/JCM.43.10.5305-5308.2005>.
7. Salvadó M, Plasencia V, Segura C, Gómez J, Medina MJ, Sáez-Nieto JA, Castellanos S, Horcajada JP. 2013. Infection due to *Actinobaculum* spp: report of 12 patients in Spain. J Infect 66:107–109. <http://dx.doi.org/10.1016/j.jinf.2012.06.013>.
8. Tschudin-Sutter S, Frei R, Weisser M, Goldenberger D, Widmer AF. 2011. *Actinobaculum schaalii* - invasive pathogen or innocent bystander? A retrospective observational study. BMC Infect Dis 11:289. <http://dx.doi.org/10.1186/1471-2334-11-289>.
9. Nielsen HL, Søby KM, Christensen JJ, Prag J. 2010. *Actinobaculum schaalii*: a common cause of urinary tract infection in the elderly population. Bacteriological and clinical characteristics. Scand J Infect Dis 42:43–47. <http://dx.doi.org/10.3109/00365540903289662>.
10. Zimmermann P, Berlinger L, Liniger B, Grunt S, Agyeman P, Ritz N. 2012. *Actinobaculum schaalii* an emerging pediatric pathogen? BMC Infect Dis 12:201. <http://dx.doi.org/10.1186/1471-2334-12-201>.
11. Pajkrt D, Simoons-Smit AM, Savelkoul PHM, van den Hoek J, Hack WWM, van Furth AM. 2003. Pyelonephritis caused by *Actinobaculum schaalii* in a child with pyeloureteral junction obstruction. Eur J Clin Microbiol Infect Dis 22:438–440. <http://dx.doi.org/10.1007/s10096-003-0933-3>.
12. Haller P, Bruderer T, Schaeren S, Laifer G, Frei R, Battagay M, Flückiger U, Basseti S. 2007. Vertebral osteomyelitis caused by *Actinobaculum schaalii*: a difficult-to-diagnose and potentially invasive uropathogen. Eur J Clin Microbiol Infect Dis 26:667–670. <http://dx.doi.org/10.1007/s10096-007-0345-x>.