



## Case report

# *Mycobacterium smegmatis* infection of a prosthetic total knee arthroplasty

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## ABSTRACT

The most common organisms causing prosthetic knee joint infections are staphylococci. However, arthroplasty infections with atypical microbial pathogens, such as Mycobacteria can occur. Due to the rarity of mycobacterial prosthetic joint infections, diagnosis, treatment, and management of these atypical infections represent a clinical challenge. A 71-year old female post-operative day 40 after a left total knee arthroplasty was hospitalized secondary to left knee pain and suspected arthroplasty infection. She had failed outpatient oral antimicrobial treatment for superficial stitch abscess; and outpatient IV/ Oral antimicrobials for a clinical postoperative septic bursitis. Ultimately, resection arthroplasty with operative tissue acid fast bacterial cultures demonstrated growth of the *Mycobacterium smegmatis* group. Post-operatively, she completed a combination course of oral doxycycline and levofloxacin and successfully completed a replacement arthroplasty with clinical and microbial resolution of the infection. To our knowledge, literature review demonstrates three case of knee arthroplasty infection caused by the *Mycobacterium smegmatis* group. Correspondingly, optimal surgical procedures and antimicrobial management including antimicrobial selection, treatment duration are not well defined. Presently, the best treatment options consists of two step surgical management including prosthesis hardware removal followed by extended antimicrobial therapy, followed by consideration for re-implantation arthroplasty. Our case illustrates importance of considering atypical mycobacterial infections in post-operative arthroplasty infections not responding to traditional surgical manipulations and antimicrobials. For an arthroplasty infection involving the atypical *Mycobacterium smegmatis* group, two step arthroplasty revision, including arthroplasty resection, with a combination of oral doxycycline and levofloxacin can lead to successful infection resolution, allowing for a successful replacement arthroplasty.

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## Introduction

Total knee arthroplasty is a common orthopedic surgery performed with an estimated of about six-hundred thousand procedures done annually in the United States [1]. Infection rate is less than 2% [1] but it is one of the leading causes of prosthetic joint failure. Some of the risk factors for deep site infection after total knee arthroplasty include body mass index (BMI) of greater than 35 (kg/m<sup>2</sup>), diabetes mellitus, male sex, a diagnosis of osteonecrosis, an American Society of Anesthesiologists (ASA) score of  $\geq 3$ , and a diagnosis of posttraumatic arthritis [2].

Microbiologically, septic arthroplasty infections can be categorized into “typical” pathogens, those found with “routine” culture

techniques, and “atypical” those that require special culture techniques include mycobacteria, fungi, mycoplasma, Nocardia, and Actinomyces. Both early and late (Greater than 12 months) infections in knee arthroplasty are primarily caused by relatively virulent pathogens. More common pathogens in prosthetic joint infection include *Staphylococcus aureus* (22%), polymicrobial (19%), coagulase-negative staphylococcus (19%), beta-hemolytic streptococci (9%), aerobic Gram-negative bacilli (8%), anaerobes (6%), negative culture (12%), and other organisms (5%) such as *Enterococcus*, *Corynebacterium*, *Listeria*, *Brucella*, and *Mycobacterium tuberculosis* [3].

There are typical and so called atypical mycobacteria, the latter now called non-tuberculous mycobacteria. “Typical”- *Mycobacterium tuberculosis* is the most common cause of human infection worldwide. There are four groups of non-tuberculous mycobacteria which was originally classified by Runyon based in part on pigment formation and rate of growth. Types IV are called rapidly

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growing mycobacteria (RGM) [4]. RGM are found mostly in soil and water and are resistant to common disinfectant agents [5]. Infection in patients with prosthetic hip joints have been reported [6]. RGM are not easy to treat secondary to high antimicrobial-resistance. We report a case of successfully treated prosthetic knee joint infection caused by the rapidly growing *Mycobacterium smegmatis* group.

### Case report

A 71-year old immunocompetent female, with past medical history of osteoarthritis, chronic obstructive lung disease, chronic kidney disease, hypertension, and nephrolithiasis, presented with postoperative left arthroplasty knee pain. The patient was 40 days post-operative from an uncomplicated left total knee arthroplasty.

Approximately, one week prior to admission, she was treated outpatient with oral sulfamethoxazole/trimethoprim DS as a superficial incisional stitch abscess, which involved the proximal aspect of the linear arthroplasty incision. Clinical follow-up demonstrated persistence and increasing *peri*-incisional soft tissues edema and erythema, progressively extending along the incisional line, and *peri*-incisional soft tissues. This, in spite of the oral antimicrobials, raised concern for an associated septic bursitis. Upon hospital admission, empiric intravenous vancomycin and ampicillin-sulbactam were initiated for broad antibacterial coverage of gram negative and positive bacteria, including potential methicillin sensitive and methicillin resistant pathogens, targeting a pre-patellar septic bursal infection.

Laboratory analysis revealed normocytic normochromic anemia (Hemoglobin 10.2 g/dL); normal White count (10,000 per cubic millimeter); thrombocytosis (716,000 per cubic millimeter); elevated C-reactive protein (7.5 mg/dL); elevated Westergren sedimentation rate (>140 mm/h); negative HIV I & II; negative QuantiFERON-TB Gold; non-reactive treponemal and hepatitis C antibody. She presented with acute renal failure (Creatinine 2.3 mg/dL; her baseline is 1.73 mg/dL), BUN 28.2 mg/dL. Gram stain revealed many polymorphonuclear leukocytes and few Gram-positive bacilli.

Bedside tissue debridement was performed without findings of an associated joint effusion. Routine tissue bacterial cultures demonstrating an unidentifiable, slow-growing, aerobic Gram-positive bacilli. A Peripherally Inserted Central Catheter (PICC) line was placed, and she was discharged home targeting a four week therapeutic course of empiric intravenous vancomycin. Unfortunately, local *peri*-patellar swelling persisted, prompting a repeat outpatient clinic arthrocentesis. Routine bacterial cultures, again, revealed the slow growing, aerobic Gram-positive bacilli.

The repeated joint and tissue recovery of an unidentifiable, slow growing, aerobic Gram-positive bacilli, raised the possibility of an atypical microbial pathogen. A therapeutic decision was made to electively perform intraoperative debridement of the joint and bursa, and possible explantation of the arthroplasty hardware, and to include repeat cultures to rule out typical and/or atypical microbial infection, including AFB and fungi. Successful resection of the knee arthroplasty was completed, with the insertion of antimicrobial impregnated (vancomycin) cement. She was discharged home on oral levofloxacin and intravenous ampicillin-sulbactam for a planned six weeks antimicrobial course awaiting final culture results.

Multiple cultures of the operative specimen were sent to specialty lab for Acid-Fast bacterial smear and culture, and ultimately *Mycobacterium smegmatis* group was identified from several tissue cultures sent. The specific species within the group was not identified. Antimicrobial susceptibility is listed in Table 1. Antimicrobials were adjusted to include oral doxycycline and levofloxacin targeting a 6–12 months course of preoperative

**Table 1**  
Antimicrobial susceptibility of *Mycobacterium Smegmatis*.<sup>a</sup>

Antimicrobial agents	MIC (ug/mL)	Resistance
Amikacin	≤1	Susceptible
Cefoxitin	128	Resistant
Doxycycline	≤0.12	Susceptible
Minocycline	≤1	Susceptible
Trimethoprim/Sulfamethoxazole	≤0.25/4.8	Susceptible
Imipenem	4	Susceptible
Ciprofloxacin	0.25	Susceptible
Clarithromycin	16	Resistant
Linezolid	≤1	Susceptible
Moxifloxacin	≤0.25	Susceptible

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antimicrobial therapy (Two step arthroplasty revision). Patient completed a 10 months antimicrobial course, noting that antimicrobial therapy was complicated by a transient doxycycline photosensitivity reaction.

Several weeks' preoperative, repeat joint fluid analysis was negative for microbial growth, including AFB. A successful revision knee arthroplasty was completed; and operative cultures and joint fluid analysis, remained negative for ongoing infection. She was maintained on the same antimicrobial combination of oral doxycycline and levofloxacin for 30 days post-operative. Patient tolerated the therapy well; with a 10-month post-operative follow-up, there has been no infection relapse.

### Discussion

There are three groups of rapidly growing mycobacteria that are known to cause human infection: *M. fortuitum*, *M. chelonae/abscessus*, and the *M. smegmatis* group [7]. The *M. fortuitum* group accounts for most cases of postsurgical wound and catheter infection caused by RGM [7]. *M. chelonae/abscessus* is responsible for most cases of disseminated cutaneous infections caused by RGM in the community. In health care settings, it has been reported as a cause of postsurgical wound infection in a variety of procedures especially plastic surgery.

There are currently three species under the *M. smegmatis* group: *M. smegmatis sensu stricto*, *wolinskyi* and *goodii* [7]. Pneumonia as a rare cause of *M. smegmatis* has been reported [8]. In the health care setting, *M. smegmatis* has been reported in cases of catheter-related infection, sternal wound infection with osteomyelitis post cardiac surgery, and plastic surgery infection [7]. To our knowledge, there have been three cases of prosthetic knee joint infection caused by the *M. smegmatis* group. One case caused by *M. goodii* was successfully treated with resection arthroplasty and a combination of minocycline and ciprofloxacin for 6 months [9]. In 2008 another case reported, *M. goodii* was the culprit organism as well. This patient did not undergo resection arthroplasty and was treated with moxifloxacin and doxycycline for 9 months followed by doxycycline which was recommended for the life of the prosthesis [10]. Eid et al. reported eighteen cases of prosthetic joint infection caused by the rapidly growing *mycobacterium*. *M. Smegmatis* was responsible for only one of the cases which was successfully treated with resection arthroplasty and the following antimicrobials combination: Doxycycline plus amikacin for two weeks, then ciprofloxacin plus Sulfamethoxazole/Trimethoprim for 16 weeks, meropenem plus ciprofloxacin for 4 weeks, and ciprofloxacin for six weeks after reimplantation [6].

Our patient was ultimately diagnosed with *M. smegmatis* group post-operative arthroplasty infection when repeat "routine" joint fluid and tissue cultures, demonstrated an unidentifiable, slow growing, aerobic Gram-positive bacilli – characteristic Gram stain of many AFB. When the organism was recovered, the paucity of

information guiding the type and duration of antimicrobials to treat this infection became problematic. Non-tuberculous mycobacterial infections are treated for prolonged periods [6]. Therefore, selection of antimicrobial duration was arbitrary set at 6–12 months. At ten months post arthroplasty resection, joint fluid analysis was benign (Ultimately culture negative) and the decision to proceed with the second step arthroplasty replacement was made. Post-operative antimicrobials were maintained until cultures were considered sterile. Patient tolerated the antimicrobial therapy well; and as previously noted with a 10-month post-operative follow-up, there was no infection relapse.

The mode of acquisition of *M. smegmatis* infection for our patient remains unknown. Although, as previously discussed, *M. smegmatis* skin and soft tissue infections have been reported as post-operative surgical site infections and in immunocompromised hosts [7,11]. Epidemiological investigation by the primary surgical hospital's Infection Control Department, did not identify a point source of infection (for this environmental organism), nor were any other additional temporally related institutional acquired infection cases, medical or surgical, identified.

In conclusion, prosthetic knee joint infection due to a rapidly growing mycobacterium identified as *M. smegmatis* have been reported. A clinical suspicion for an atypical microbial infection, including mycobacteria, should be included in the work up of any post-operative arthroplasty infection. Obtaining Acid-Fast Bacterial smears and cultures, in addition to "routine" Gram stain and culture should be consider as part of the culturing process. Due to the rarity of these organisms causing prosthetic knee arthroplasty infections, management and treatment represent a clinical challenge. For arthroplasty infections caused by rapidly growing mycobacteria (Including *M. smegmatis* group), there are no controlled trials or published treatment guidelines guiding therapy. Literature review suggests successful treatment of these types of infections include prosthesis removal, followed by prolonged, but unspecified duration of antimicrobial therapy,

guided by known or published antimicrobial susceptibility patterns. Our case illustrates the importance of considering an atypical microbial infection, including mycobacteria, in suspected septic knee arthroplasty infections that appear not responding to traditional therapy.

## References

- [1] Edwards J, Peterson KD, Mu Y, Banerjee S, Allen-Bridson K, Morrell G, et al. National healthcare safety network (NHSN) report: data summary for 2006 through 2008, issued December 2009. *Am J Infect Control* 2009;37:783, doi:<http://dx.doi.org/10.1016/j.ajic.2007.04.001>.
- [2] Namba RS, Inacio MC, Paxton EW. Risk factors associated with deep surgical site infections after primary total knee arthroplasty: an analysis of 56,216 knees. *J Bone Joint Surg Am* 2013;95:775–82, doi:[http://dx.doi.org/10.2106/JBJS.L.00211.1679099\[pii\]r](http://dx.doi.org/10.2106/JBJS.L.00211.1679099[pii]r).
- [3] Berbari EF, Hanssen AD, Duffy MC, Steckelberg JM, Ilstrup DM, Harmsen WS, et al. Risk factors for prosthetic joint infection: case-control study. *Clin Infect Dis* 1998;27:1247–54, doi:<http://dx.doi.org/10.1086/514991>.
- [4] Han XY, De I, Jacobson KL. Rapidly growing mycobacteria: clinical and microbiologic studies of 115 cases. *Am J Clin Pathol* 2007;21, doi:<http://dx.doi.org/10.1309/1KB2GKYT1BUEYLB5>.
- [5] De Groote MA, Huitt C. Infections due to rapidly growing mycobacteria. *Clin Infect Dis* 2006;42:1756–63, doi:<http://dx.doi.org/10.1086/504381>.
- [6] Eid AJ, Berbari EF, Sia IG, Wengenack NL, Osmon DR, Razonable RR. Prosthetic joint infection due to rapidly growing mycobacteria: report of 8 cases and review of the literature. *Clin Infect Dis* 2007;45:687–94.
- [7] Brown-Elliott BA, Wallace RJ. Clinical and taxonomic status of pathogenic nonpigmented or late-pigmenting rapidly growing mycobacteria. *Clin Microbiol Rev* 2002;15:716–46, doi:<http://dx.doi.org/10.1128/CMR.15.4.716-746.2002>.
- [8] Driks M, Weinhold F, Cokington Q. Pneumonia caused by *Mycobacterium smegmatis* in a patient with a previous gastrectomy. *BMJ Case Rep* 2011; bcr0820103, doi:<http://dx.doi.org/10.1136/bcr.08.2010.3281>.
- [9] Ahmad S, Khakoo RA. Left knee prosthesis-related *Mycobacterium goodii* infection. *Int J Infect Dis* 2010;1:4, doi:<http://dx.doi.org/10.1016/j.ijid.2010.02.2245>.
- [10] Tompkins JC, Harrison MS, Witzig RS. *Mycobacterium goodii* infection of a total knee prosthesis. *Infect Med* 2008;25:522–5.
- [11] Uslan DZ, Kowalski TJ, Wengenack NL, Virk A, Wilson JW. Skin and soft tissue infections due to rapidly growing mycobacteria: comparison of clinical features, treatment, and susceptibility. *Arch Dermatol* 2006;142:1287–92, doi:<http://dx.doi.org/10.1001/archderm.142.10.1287>.