



Mycobacterium smegmatis bacteremia in an immunocompetent host

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ABSTRACT

Non-tuberculous mycobacteria can cause catheter associated blood stream infections. The causative agents are generally rapid growers that belong to the *Mycobacterium fortuitum* and *Mycobacterium mucogenicum* groups. A 65 year hospitalized patient with temporary central venous catheter who developed *Mycobacterium smegmatis* bacteremia. Bacteremia cleared after removal of the catheter. Patient was treated initially with 4 weeks of intravenous amikacin, intravenous meropenem, oral doxycycline and oral ethambutol and then deescalated to oral doxycycline and oral ciprofloxacin for 8 weeks. He improved clinically and remained stable. A literature search identified total of 22 articles that reported 47 unique cases of *Mycobacterium smegmatis* infection. To our knowledge, this is the first case of *Mycobacterium smegmatis* central venous catheter associated bacteremia in an immunocompetent host.

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Introduction

Non-tuberculous mycobacterial (NTM) human infections are gaining clinical recognition due to modern molecular techniques. NTM can cause skin and soft tissue infection, lymphadenitis, pulmonary infection, bone and joint infection, catheter related bacteremia and disseminated infection. Sporadic cases of health care associated infections are reported. These cases include infections due to peritoneal catheter; intravenous indwelling catheters, injection related abscesses, surgical site wounds and infections post plastic surgery procedures [1].

NTMs are classified, in part, classified based on their growth rate. Rapidly growing mycobacteria (RGM) produce mature growth on media plates within 7 days. There are currently six groups based on pigmentation and genetic relatedness. One group within RGM is the *Mycobacterium smegmatis* group consisting of two late pigmenting species: *Mycobacterium smegmatis* and *Mycobacterium goodii*. *Mycobacterium smegmatis* is resistant to anti tuberculous agents except for ethambutol. Generally, it has an *erm* gene, which induces macrolide resistance. Monotherapy with quinolones is avoided due to high risk of mutational resistance to these agents [1].

Currently, catheter related infections are the most common health care associated NTM infections encountered. These Infections

are seen most often with long-term central venous catheters but may also occur with peritoneal or shunt catheters. The causative RGMs usually belong to the *Mycobacterium fortuitum* and *Mycobacterium mucogenicum* groups. Treatment involves removal of the catheter and long-term antibiotics for 6–12 weeks [1]. We present the first case of *Mycobacterium smegmatis* catheter associated bloodstream infection in an immunocompetent patient.

Case report

A 64 year old Caucasian male with recent history of constrictive pericarditis and 4.7 cm ascending aortic aneurysm was admitted to the hospital for an elective surgery. He underwent repair of his ascending aortic aneurysm and pericardiectomy on day 1 of admission. During his hospital stay, he had a cardiac arrest with ventricular fibrillation and underwent pacemaker placement (day 7). He also developed acute kidney injury and underwent tunneled central venous catheter (CVC) placement for hemodialysis (day 10).

He was transferred to the intensive care unit (ICU) with hypotension and fever, and blood cultures were drawn (day 20). Microbiology laboratory reported blood cultures positive for RGM, possibly *mycobacterium smegmatis* based on in-house MALDI-TOF (matrix-assisted laser desorption ionization time-of-flight mass spectrometry) (day 24). *Mycobacterium tuberculosis* PCR was negative. Infectious diseases team was consulted and CVC was removed per their advice (day 26). Repeat blood cultures drawn on day 24 and day 26 were reported positive for RGM. The patient was started on empiric intravenous (IV) amikacin 15 mg/kg every 24 h, IV meropenem 1 g every 8 h, oral (PO) ethambutol 1200 mg daily

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and PO doxycycline 100 mg daily (day 26). The CVC tip was positive for *Mycobacterium smegmatis* (day 28). Post catheter removal, he improved clinically and his repeat blood cultures obtained on day 28 were negative. *Mycobacterium smegmatis* isolate was sent to National Jewish Medical Center for susceptibility testing (day 35). The isolate was resistant to ceftriaxone, cefotaxime and cefepime; intermediate to clarithromycin, ceftazidime and amoxicillin/clavulanate; and susceptible to aminoglycosides, trimethoprim/sulfamethoxazole, tetracyclines, imipenem, fluoroquinolones, linezolid,

and clofazamine based on RPOB (β subunit of bacterial RNA polymerase) gene sequencing (day 48). The patient received 28 days of empiric IV amikacin 15 mg/kg every 24 h, IV meropenem 1 g every 8 h, PO ethambutol 1200 mg daily and PO doxycycline 100 mg daily and once susceptibilities were available, he was deescalated to PO doxycycline 100 mg daily and PO ciprofloxacin 500 mg twice a day for 8 weeks. Patient was followed at the infectious diseases outpatient clinic at the end of treatment and was still clinically stable by week 12.

Table 1
Mycobacterium smegmatis infections (Literature review).

Study	Location	Number	Risk factors	Infection type	Bacteremia	Treatment	Outcome
Vonmoos [2] 1986	Switzerland	1	Laryngeal cancer Oil applied to tracheoma	PNA	no	NA	Resolved
Wallace [3] 1998	USA (18) & Australia [4]	21	Surgery, trauma, catheter	Cardiac surg site, lymphadenitis, OM, IE, PNA, SSTI	Yes (1 patient) CVC	Most treated with I&D plus combinations of 3 of these abx: amikacin, ceftazidime, doxy, TMP/SMX, tobra	20 Resolved, 1 Death
Plaus [4] 1991	USA	2	veterinary grade steroid injection	SSTI	No	Erythromycin + amikacin x 2wks f/u cipro x 6 wks plus I&D	Resolved
Roger [5] 1991	France	1	trauma Puncture injury to ankle while gardening	SSTI	No	Ceftazidime, doxy, TMP/SMX plus I&D	Resolved
Newton [6] 1993	USA	2	MVA	SSTI	No	1) ceftazidime + amikacin f/u TMP/SMX x8 wks plus I&D 2) doxy + cipro	Resolved
Lin [7] 1994	China	1	s/p keratotomy	Corneal ulcer	No	Amikacin + kanamycin f/u amikacin + ofloxacin optic	Resolved
Cox [8] 1994	USA	1	Mineral oil for constipation	PNA	No		Resolved
Kumar [9] 1995	India	1	Term infant	PNA	No	NA	Death
Pierre-Audigier [10] 1997	France	1	Interferon gamma deficiency	Disseminated	Yes	Streptomycin + sulfonamides + ofloxacin	Death
Pennekamp [11] 1997		1	facelift	SSTI	No	Cipro + doxy + amikacin I&D	Resolved
Skiest [12] 1998	USA	1	catheter	CVC BSI	Yes	CVC removal, doxy + cipro	Resolved
Schreiber [13] 2001	Germany	1	Gastrectomy, splenectomy	PNA	No	Rifabutin + ETA + clarithro + ofloxacin	Resolved
Ergan [14] 2004	Turkey	1	smoker	PNA	No	Doxy + cipro x 3 mo	Resolved
Eid [15] 2007	USA	1	Knee prosthesis	PJI	No	Doxy + amikacin x 2 wks f/u cipro + TMP/SMX x16wks; MRP + Cipro x4 wks & post implantation cipro x 6 wks	Resolved
Chang [16] 2009	Taiwan	3	CVC IC	CVC BSI	Yes	NA	Resolved
Corliss [17] 2009	USA	1	none	SSTI	No	Cipro + Doxy x 10 wks I&D x2	Resolved
Redelman-Sidi [18] 2010	USA	2	chemo	1 BSI 1 SSTI	1 yes 1 No	NA	Resolved
Driks [19] 2011	USA	1	gastrectomy	PNA	No	Doxy + cipro f/u TMP/SMX + cipro x 14 mo	Resolved
Jiang [20] 2011	USA	1	PD	peritonitis	No	Cipro + TMP/SMX x 6 mo	Resolved
Zimba [21] 2011	USA	1	Lumbar spine hardware	Vertebral OM	No	Amikacin + ETA + TMP/SMX + clarithro x 12 wks plus I&D but Retained hardware	Resolved
Shimizu [22] 2012		1	trauma	SSTI	No	cefazolin x 5 days	Resolved
Saffo [23] 2016	USA	1	Stitch abscess	PJI	No	Levo + amp/sulbactam, removal of hardware f/u doxy + levo x 10 months	Resolved

Abbreviations: PNA (pneumonia); NA (not available); OM (osteomyelitis); IE (infectious endocarditis); SSTI (skin and soft tissue infection); surg (surgery), CVC (central venous catheter); I&D (incision and drainage); abx (antibiotic); doxy (doxycycline); TMP/SMX (trimethoprim/sulfamethoxazole); tobra (tobramycin); wks (weeks); cipro (ciprofloxacin); MVA (motor vehicle accident); f/u (follow up); BSI (blood stream infection); ETA (ethambutol); clarithro (clarithromycin); PJI (prosthetic joint infection); MRP (meropenem); IC (immunocompromised); chemo (chemotherapy); PD (peritoneal dialysis); levo (levofloxacin).

Methods

The PubMed database and Google scholar were used to search the medical literature to identify all reported cases of *Mycobacterium smegmatis* infections. A secondary search was performed using references in the articles identified in the initial search. We identified total of 22 articles that reported 47 unique cases of *Mycobacterium smegmatis* infection (Table 1).

Discussion

Literature review of all reported cases of *Mycobacterium smegmatis* revealed 21 cases of skin and soft tissue infections [3–6,11,17,18,22], 8 cases each of pneumonia [2,3,8,9,13,14,19], and joint infections [3,15,21,23], 1 case each of endocarditis [3], corneal ulcer [7] and disseminated infection (10) and 6 cases of catheter-associated bacteremia [3,12,16,18], (Table 1). Various rapidly growing mycobacteria (RGM) species has been associated with catheter-associated infections. These infections are seen with long-term central venous catheter, peritoneal or shunt catheters. Most common causative species are members of the *Mycobacterium fortuitum* and *Mycobacterium mucogenicum* groups. These infections generally present with fever, local catheter site drainage, lung infiltrates or bacteremia [1]. *Mycobacterium smegmatis* bacteremia has been reported in CVC associated infections in immunocompromised hosts. Wallace [3], Skiest [12], and Redelman-Sidi [18] have described one case each in cancer patients and Chang [16] described 3 cases of *Mycobacterium smegmatis* catheter-associated bacteremia in immunocompromised patients.

We present the first case of *Mycobacterium smegmatis* central venous catheter-associated bacteremia in an immunocompetent host. The patient developed bacteremia 10 days post CVC placement. Blood cultures were obtained due to hypotension and fever. He had no catheter site inflammation or drainage. No abnormalities were seen on chest x-ray. Infection control was notified and they labeled it as an isolated case of infection. Catheter was removed for source control as bacteremia can relapse in patients with delayed catheter removal. The catheter tip was sent for culture, which did grow *Mycobacterium smegmatis*. Bacteremia cleared post catheter removal. Initially, the patient was empirically treated with amikacin, meropenem, ethambutol and doxycycline. The empiric antimicrobial agents were chosen based on known *Mycobacterium smegmatis* in-vitro susceptibility to sulfonamides, doxycycline, imipenem and amikacin. Cephalosporins and macrolides were avoided due to resistance. Our patient's isolate was sent to National Jewish Medical Center for susceptibility testing and antimicrobial agents were later narrowed to doxycycline and ciprofloxacin based on these results.

Mycobacterium smegmatis can rarely cause catheter-associated bacteremia in any patient with an indwelling catheter regardless of their immune status so it should be considered as part of the differential. Management includes source control, susceptibility testing, and appropriate antimicrobial agents.

Conflict of interest

None.

CRediT authorship contribution statement

Saira Butt: Data curation, Methodology, Writing - original draft.
Amir Tirmizi: Writing - review & editing.

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