Bacteremia Caused by *Mycobacterium neoaurum*

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Received 18 September 1987/Accepted 14 December 1987

An immunocompromised patient with an indwelling Hickman catheter developed *Mycobacterium neoaurum* bacteremia. This rapidly growing mycobacterium was previously isolated from soil, dust, and water but has not been described as a human pathogen. The infection responded to therapy with cefoxitin and gentamicin. It was not necessary to remove the Hickman catheter.

The first convincing evidence that mycobacteria other than tubercle bacilli (MOTT) are potential pathogens was provided by Timpe and Runyon in 1954 (13). Since then, there has been increasing interest in their importance as the causative agents of a variety of conditions, particularly in immunocompromised patients. The list of potential pathogens continues to grow. We describe here the first reported human infection caused by *Mycobacterium neoaurum*.

The patient, a housewife born in 1933, had a history of cystadenocarcinoma of the ovary with involvement of abdominal nodes and peritoneal metastases. Bilateral salpingo-oophorectomy and omentectomy had been performed in 1983. This was followed by radiotherapy and chemotherapy. Continuing total parenteral nutrition via a Hickman catheter has been required because of unremitting bowel obstruction secondary to radiation enteritis and fibrosis. The course of the patient has been punctuated by several episodes of fungemia and bacteremia caused by *Saccharomyces cerevisiae*, *Staphylococcus epidermidis* (twice), and *Enterobacter cloacae*, requiring temporary removal of the Hickman catheter. In 1986, the patient developed fever and was readmitted to the hospital. In the following 72 h, nine blood specimens were collected (three from the Hickman catheter, six from peripheral veins) and cultured aerobically and anaerobically by using the BACTEC system (Becton Dickinson and Co., Paramus, N.J.). There was radiometric evidence of growth after 2 to 5 days at 37°C (mode, 2 days) in the aerobic bottles only. After 2 days, subcultures on horse blood agar grew small, smooth, yellow colonies which stained as gram-variable, acid-fast bacilli. Eight of the nine cultures were positive.

Because the isolate appeared to be a rapidly growing scotochromogenic mycobacterium, an appropriate set of tests was performed (5, 9, 15, 16). Tests indicated that the isolate belonged to the *Mycobacterium aurum-M. neoaurum-M. parafortuitum* complex, so comparative tests were repeated with the following strains: *M. aurum* 15006 (=ATCC 23366=NCTC 10437 [type strain]), *M. neoaurum* 10002 (=ATCC 25795=NCTC 10818 [type strain]), and *M. parafortuitum* 16002 (=ATCC 19686=NCTC 10411 [type strain]).

The patient strain was pigmented but not photochromogenic. It grew at 25 and 35°C (<5 days) but not at 45°C. Growth was seen on media containing 5% NaCl-8 μg of ethambutol per ml but not on MacConkey agar. Tests for niacin production and p-aminosalicylate degradation were negative, while tests for nitrate reduction, Tween 80 hydrolysis (10 days), ariysulfatase (14 days), and iron uptake were positive. Catalase activity was low. Glucose, fructose, inositol, and mannitol were utilized as carbon sources; sodium citrate was not utilized. Tests for the enzymes acetamidase, urease, nicotinamidase, pyrazinamidase, allantoinase, and valeramidase were positive, but tests for benzamidase, isonicotinamidase, salicylamidase, and succinamidase were negative. Acid was produced from arabinose, glucose, glyceral, inositol, mannitol, mannose, trehalose, and xylose but not adonitol, erythritol, lactose, maltose, melibiose, rafinose, rhamnose, and sorbitol. These properties are in keeping with the description of *M. neoaurum* by Tsukamura et al. (15). Properties which differentiate the patient strain and *M. neoaurum* from *M. aurum* and *M. parafortuitum* are shown in Table 1.

Thin-layer chromatography was performed by the method of Brennan et al. (3). The solvent mixture used was chloroform-methanol-water (65:25:4). *M. aurum* and *M. parafortuitum* gave essentially the same patterns, characterized by two brown bands with Rf values of 0.01 and 0.17. The patient strain and *M. neoaurum* also gave identical patterns, with one large broad band (perhaps two adjoining bands) in the lower portion of the chromatogram (Rf 0.10 to 0.21) and lighter bands of blue-purple in the upper half of the chromatogram.

Subcultures were sent to M. Tsukamura, National Chubu Hospital, Obu, Japan. In 120 tests, the strain was found to have a matching coefficient of 91% to the hypothetical median organism for *M. neoaurum*, thus supporting identity as this species.

Susceptibility to antimycobacterial compounds was tested by using the resistance ratio method (4). The strain was susceptible to streptomycin and capreomycin, intermediate susceptible to ethionamide, and resistant to isoniazid, ethambutol, rifampin, cycloserine, and thiacetazone. Disk diffusion susceptibility tests were also done (17), and zone sizes were measured after 48 h. Zones of inhibition of ≥30-mm diameter were seen with amikacin (30 μg), kanamycin (30 μg), gentamicin (10 μg), tetracycline (30 μg), minocycline (30 μg), doxycycline (30 μg), sulfamethoxazole-trimethoprim (25 μg), cefoxitin (30 μg), vancomycin (30 μg), imipenem (10 μg), and enoxacin (10 μg). Cefotaxime (30 μg) and amoxycillin (25 μg) gave zones of inhibition of 6 and 18

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mm, respectively. The reference strain of *M. neoaurum* showed results similar to those of the patient strain. In deciding on an appropriate therapeutic approach, several factors were considered important. In keeping with general principles of antimycobacterial therapy, we believed that at least two drugs should be given. Since absorption from the oral route was unreliable in this patient, and long-term therapy was likely to be required, a system of infusion which could be largely managed by the patient at home was needed. Tetracycline was considered unsuitable because of its instability with other drugs in infusion solutions. Gentamicin and cefoxitin were found to be stable when mixed together in a single 100-ml bag of normal saline, and a twice-daily regimen provided satisfactory levels of gentamicin in serum and allowed infusion of total parenteral nutrition between doses. The patient was taught to prepare an infusion of gentamicin and cefoxitin which would run for 1 h before and after the overnight total parenteral nutrition infusion. She was mobile for the remaining hours of the day. This regimen resulted in defervecence in less than a week and was continued for a total of 7 weeks. Satisfactory peak and trough levels of gentamicin in serum were maintained. The patient remains well without symptoms and with negative blood cultures 18 months after the cessation of therapy.

We have been unable to locate any previous report of human infection caused by *M. neoaurum*. The species was described originally by Tsukamura in 1972 (14) after being isolated from soil in Japan. The taxonomy of this species and other related rapidly growing scotochromogenic mycobacteria isolated from soil, dust, and water has been well documented in recent numerical studies (15).

An unidentified rapidly growing scotochromogenic mycobacterium was reported from a bacteremic patient with a subclavian catheter (7). The isolate differed from *M. neoaurum* in that it was negative for iron uptake, nitrate reduction, tolerance to 5% NaCl, and utilization of mannitol and inositol.

The patient in the present study could be considered susceptible to opportunistic infections because of her history of advanced malignancy, chemotherapy, and radiotherapy, but the most significant predisposing factor was probably the indwelling central venous Hickman catheter. In a recent review of the complications of 77 Hickman catheters, Harvey and colleagues (6) found that 25 (33%) became infected and that removal was necessary in eight cases. The organism most commonly identified from blood cultures were *S. epidermidis*, diptheroebacteri, and gram-negative bacilli.

MOTT have been described as the cause of opportunistic infections relatable to foreign bodies. *Mycobacterium chelonai* (1), *M. fortuitum* (20), *M. avium-M. intracellulare* (10), and *M. gastri* (8) have been documented as the causes of peritoneal sepsis in patients undergoing chronic ambulatory dialysis. Rapidly growing mycobacteria have caused infections attributable to catheters of various types (2, 11, 12), as well as to prosthetic heart valves and augmentation mammoplasties (19).

Response to antimicrobial therapy in patients with nonpulmonary infection caused by rapidly growing mycobacteria has usually been good. In a report of 123 cases (18), 83% of patients were considered to be successfully treated. Surgical removal of involved tissue is undoubtedly the most effective therapy, but in the present case venous access and catheter relocation had become a problem, so chemotherapy was attempted. Amikacin, other aminoglycosides, cefoxitin, doxycycline, and sulfonamides are reportedly effective agents; treatment time varies, depending on the type of infection (18). The choice of a treatment protocol for the present patient was based on results of disk susceptibility tests. Although the treatment time of 7 weeks was empiric, it reflected previous experience with chemotherapy of infections caused by rapidly growing mycobacteria.

This case highlights the ever-widening spectrum of pathogenicity of MOTT in humans. This group of organisms should be not only considered but actively sought when dealing with an infection in patients with indwelling foreign bodies. Our experience suggests that the outcome in a case of infection with *M. neoaurum* will be satisfactory, providing that appropriate chemotherapy is administered.

We acknowledge the assistance of M. Tsukamura, who provided the reference strains and confirmed identity of the isolate. We also thank N. Dwyer for secretarial assistance.

**LITERATURE CITED**


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