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Endocarditis Caused by M6

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M6 is a *Moraxella*-like organism which is usually of pharyngeal origin and is generally nonpathogenic. Endocarditis caused by M6 occurred in a 31-year-old female with known mitral valve prolapse. The infection quickly responded to ampicillin, but valve replacement was required because of progressive left ventricular failure.

The bacteria designated M6 resemble certain *Moraxella* species and rarely have been recognized as a cause of disease in humans. We recently treated a young woman with endocarditis caused by this organism. To our knowledge, there have been no previous published reports of infection caused by M6 organisms.

The patient was a 31-year-old female with known mitral valve prolapse who was admitted to the hospital on 30 April 1982 because of fever. Five months before admission she had had dental cleaning without antimicrobial prophylaxis. She frequently used dental floss and had had occasional episodes of gingivitis. In the previous year she had been intermittently taking tetracycline for acne but discontinued it 3 weeks before admission, at the onset of her illness, which was characterized by fever, rigors, headache, myalgias, and anorexia. One week before admission, outpatient blood cultures were processed in another laboratory and were reported to be sterile. On admission to the hospital, she was febrile (39°C), normotensive, and had a pulse rate of 100 per min. There was a petechial lesion on the right conjunctiva but no other peripheral stigmata of endocarditis. There was a grade IV/VI holosystolic murmur at the apex with radiation to the axilla. The heart sounds were normal. Abdominal, neurological, chest, and musculoskeletal examinations were normal. Hemoglobin was 9.0 g/dl, the leukocyte count was 11,900/μl, and serum creatinine was 1.1 mg/dl. A chest X ray showed a normal heart size and contour but with plethoric lung fields, suggesting early left ventricular failure. The electrocardiogram showed sinus rhythm and diffuse ST elevation consistent with pericarditis. Two-dimensional echocardiography demonstrated good myocardial function and a large vegetation on the mitral valve. Therapy was started with 4×10^6 U of penicillin G intravenously every 4 h and 100 mg of gentamicin intravenously every 8 h, and the fever promptly remitted. The following day, six blood cultures, processed by using the Bactec (Trypticase soy broth [BBL Microbiology Systems]) system, indicated microbial growth, and Gram stain showed small gram-negative coccobacilli which stained unevenly. Two days after admission she became oliguric and creatinine rose to 3.6 mg/dl. The urine had protein, hemegranular casts, and low sodium concentration, and it was felt that she had immune-complex nephritis. The previous antibiotics were discontinued; ampicillin (2 g intravenously every 4 h) was instituted, and it yielded peak bactericidal levels of 1:32. Over the next few days she remained afebrile and renal function improved, but progressive left ventricular failure developed. No cardiac arrhythmias were detected. On hospital day 12, a prosthetic mitral valve was inserted because of the continued cardiac failure. Operative findings included two large vegetations on the mitral valve leaflets, a myocardial abscess, and a pericardial effusion. Cultures from these sites were all negative. There were no further complications, and a 4-week course of ampicillin was completed uneventfully.

The isolate from this patient was initially felt to be a member of the genus *Kingella*, but it was subsequently identified as M6 (Special Bacteriology Section, Clinical Bacteriology Branch, Centers for Disease Control, Atlanta, Ga.). It grew slowly on 5% sheep blood agar, producing small pale yellow colonies at 48 h, without evidence of hemolysis or pitting of the medium. The results of pertinent biochemical tests are shown in Table 1. All results were typical of M6 except that nitrate reduction was not complete (5). However, the fatty acid profile obtained by gas-liquid chromatography was similar to other M6 isolates and differed quantitatively from *Kingella*.

Minimal inhibitory concentrations were determined in brain heart infusion medium enriched with lysed horse blood and by a microtiter assay. Minimal inhibitory concentrations were

TABLE 1. Biochemical characteristics of M6

Test	Result
Gram stain	Irregularly staining gram-negative coccobacilli
Thayer-Martin medium	No growth
Catalase	–
Oxidase	+
Triple sugar iron (slant/butt)	Alk/Alk
H_2S (lead acetate paper)	–
Indole	–
Citrate	–
Urea	–
Motility	–
Esculin hydrolysis	–
Nitrate reduction[a]	+, No gas
Nitrite reduction	+, No gas
Lysine	–
Arginine	–
Glucose	–
Lactose	–
Maltose	–
Glucose (OF)[b]	–
Lactose (OF)	–
Maltose (OF)	–
Xylose (OF)	–
Sucrose (OF)	–
Mannitol (OF)	–

[a] Peptone and infusion broth.
[b] OF, Oxidation-fermentation.

(μg/ml): clindamycin, >8.0; erythromycin, 2.0; tetracycline, 0.5; chloramphenicol, 0.5; cephalothin, <0.5; cefamandole, <0.5; cefoxitin, 1.0; ampicillin, <0.125; carbenicillin, <4.0; penicillin, 0.25; amikacin, 2.0; gentamicin, <0.25; tobramycin, 0.5; vancomycin, >16; cefotaxime, <1.0; and trimethoprim-sulfamethoxazole, <0.25, 4.25.

The family *Neisseriaceae* consists of three genera: *Kingella, Moraxella*, and *Neisseria*. There are seven *Moraxella* species, and since both M5 and M6 resemble some *Moraxella* species they are usually grouped with members of this genus. Isolates of M6 are differentiated from other *Moraxella* species by their negative catalase reaction and complete reduction of nitrates and nitrites to amines without the production of gas (5). Hydrogen sulfide reaction on lead acetate paper may be weakly positive. M6 is asaccharolytic and can be differentiated from *Kingella* species, which weakly ferment glucose.

Isolates of M6 have been primarily recovered from the respiratory tract; however, numerous other sources have been identified. Between 1953 and 1980, 47 isolates of M6 were submitted to the Centers for Disease Control (Robert E. Weaver and Donald R. Graham, personal communication). These included 6 isolates from blood, 9 from sputum, and 14 from the upper respiratory tract. Other sources of M6 included eyes, urine, wounds, and peritoneal fluid. One isolate was from a fatal case of endocarditis and one from a fatal case of empyema.

Moraxella and *Moraxella*-like species have caused osteomyelitis, endocarditis (6), meningitis (1), endophthalmitis (2), and pneumonia (4). However, we have been unable to find any reports in the English literature describing infection in humans due to group M6 organisms. In the patient described above, endocarditis due to M6 occurred on a prolapsing mitral valve. The infection was characterized by reversible glomerulonephritis with renal failure and progressive valvular dysfunction causing left ventricular failure and necessitating mitral valve replacement. This clinical course resembles endocarditis due to slow-growing fastidious gram-negative bacilli (3). It is uncertain whether the initial M6 bacteremia that led to the endocarditis was related to the patient's recurrent gingivitis, vigorous dental flossing, or the dental cleaning 5 months earlier. Blood cultures obtained before admission at another laboratory were negative, but this could have been due to the fastidious nutritional requirements of the bacteria or the previous tetracycline therapy. This organism was initially identified as a *Kingella*; misidentification of *Moraxella* species and related species is a recognized problem (D. R. Graham, J. D. Band, D. G. Hollis, and R. E. Weaver, Program Abstr. Intersci. Conf. Antimicrob. Agents Chemother. 22nd, Miami Beach, Fla., abstr. no. 885, 1982). This can perhaps be minimized by using gas-liquid chromatography to compare fatty acid profiles.

The M6 isolate was sensitive to many antimicrobial agents, and there was an excellent response to ampicillin. In vitro susceptibility testing may be difficult to interpret for some slow-growing organisms, but ampicillin or penicillin appear to be, both in vitro and clinically, the drugs of choice for treating infections due to group M6 organisms.

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