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# *Neisseria elongata* subsp. *elongata*, a Cause of Human Endocarditis Complicated by Pseudoaneurysm

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**We report an unusual case of endocarditis caused by *Neisseria elongata* subsp. *elongata*. The illness was complicated by a ruptured mycotic aneurysm of the right brachial artery, with compression of the brachial plexus. A cure was achieved after aneurysm resection and treatment with intravenous ceftriaxone and gentamicin.**

*Neisseria elongata* is a rare cause of human bacterial endocarditis, but all cases reported to date have been caused by *N. elongata* subsp. *nitroreducens*, formerly known as CDC group M-6 (5, 11, 12). We report the first case of human endocarditis caused by *Neisseria elongata* subsp. *elongata* (4, 14). This case is also remarkable because it was complicated by a mycotic aneurysm which was confirmed by angiogram as a pseudoaneurysm of the brachial artery.

A 29-year-old male with no significant past medical history developed an acute-onset fever of up to 39.4°C, chills, generalized body aches, and a dry cough. He was initially treated as an outpatient with oral ibuprofen and erythromycin. A week later, he was still febrile and complained of nausea, which was attributed to the erythromycin, and suffered from yellow-green sputum production. His antibiotic was changed to cefaclor, but the sputum was not cultured. At the time, a monospot and cold agglutinins were negative, and a complete blood count and a chest X-ray were normal. Four days later, his symptoms were unchanged, but a new grade II/VI systolic murmur was noted along with an ecchymotic swelling over the middle phalanx of the right middle finger. His erythrocyte sedimentation rate was 26 mm/h. His complete blood count was remarkable for a hemoglobin concentration of 12.4 g/dl and a leukocyte count of 15,200 cells per $mm^3$, with 57% segmented forms and no bands. Cefaclor was replaced with clarithromycin for a presumptive mycoplasma infection. Two sets of blood cultures (each containing a BACTEC NRGA and a BACTEC Lytic bottle; Becton Dickinson, Cockeysville, Md.) remained negative for at least 6 days when read with an automated system (BACTEC 860). With no changes in his condition, the patient was hospitalized 1 week later.

On admission, the patient denied any history of dental work, intravenous drug abuse, or diagnostic procedures. His family history was unremarkable. He appeared ill, and on admission, his temperature was 39.6°C, and he had a heart rate of 120 beats per minute and a blood pressure reading of 130/70 mm Hg. He had no scleral petechiae and his ocular fundi were normal, but he had a Janeway lesion on his left palm. Teeth and gums were healthy. He had minimal bilateral cervical lymphadenopathies and occasional bilateral pulmonary rhonchi. The cardiovascular examination was normal, except for a nonradiating II/VI systolic murmur heard at the apex and left sternal border. A tender spleen tip was appreciated, but he had no hepatomegaly. The neurological examination was unremarkable. The urinalysis was positive for blood and protein by dipstick, and on microscopy, granular and erythrocyte casts were present. Gram stain and culture of urine were negative. The leukocyte count had risen to 18,000 cells per $mm^3$, with 78% segmented forms and no bands. The hemoglobin concentration had dropped to 10.2 g/dl. Both antinuclear antibodies and rheumatoid factor were absent. He also had mild elevations of the levels of aspartate transaminase in serum (51 IU/liter [upper limit of normal level, 36 IU/liter]) and alkaline phosphatase in serum (194 IU/liter [upper limit of normal level, 100 IU/liter]).

A clinical diagnosis of infective endocarditis was made. Six sets of blood cultures (as described above) were drawn, and subsequently therapy was started with intravenous vancomycin, ampicillin, and gentamicin. An initial transthoracic echocardiogram showed a flail mitral valve with mitral regurgitation and normal left ventricular function, but no vegetation. However, when the echocardiogram was repeated 2 days later, it showed an echogenic mass on the mitral valve compatible with a vegetation. Three days later, the antibiotic treatment was changed to intravenous ceftriaxone (1 g every 12 h) and gentamicin (100 mg every 12 h).

Three sets of blood cultures grew short to long aerobic gram-negative rods, which after incubation at 35°C in ambient air for 24 h formed nonhemolytic convex and flat colonies on Trypticase soy agar with 5% sheep blood agar (Becton Dickinson). The organism did not grow on MacConkey II agar (Becton Dickinson). The organism was also oxidase positive, nonmotile, nonsaccharolytic (Andrade's sugars), and negative for production of catalase, urease (Christensen's urea agar), indole, and lysine decarboxylase (Moeller decarboxylase medium) and reduction of nitrate in conventional biochemical tests. The identities of both colony types were confirmed by the Meningitis and Special Pathogens Laboratory of the Centers for Disease Control and Prevention, Atlanta, Ga., as being *N. elongata* subsp. *elongata*. The organism was initially weakly positive for β-lactamase when nitrocefin was used as a chromogenic substrate, but it was negative on repeat testing. MICs of several drugs were determined by the serial twofold dilution method in cation-adjusted Mueller-Hinton broth (Becton Dickinson) and incubation at 35°C in ambient air for 24 h (10).

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TABLE 1. MICs and MBCs of various antibiotics for the isolate

| Drug | MIC (μg/ml)[a] | MBC (μg/ml)[a] |
|---|---|---|
| Penicillin | 0.06 | 0.06 |
| Ampicillin | 0.06 | 0.06 |
| Ceftriaxone | 0.06 | 0.06 |
| Cefaclor | ≤0.03 (0.06) | 0.06 |
| Clindamycin | 2 | 16 (>32) |
| Erythromycin | 2 | 8 (4) |
| Clarithromycin | 0.5 (1) | 4 (2) |
| Vancomycin | 4 | 4 (16) |
| Amikacin | 1 | 1 |
| Gentamicin | 0.12 | 0.12 |
| Ciprofloxacin | ≤0.03 | ≤0.03 |
| Rifampin | 0.5 (0.25) | 2 (1) |
| Chloramphenicol | 1 | 2 (4) |
| Trimethoprim-sulfamethoxazole | 0.5-9.5 (1-19) | 1-19 (2-38) |

[a] MICs and MBCs are for the convex colony variant. MICs and MBCs for the flat colony variant are given in parentheses if they were different from those for the convex colony variant.

MBCs were determined after overnight incubation by duplicate plating of 10 μl from each well onto chocolate agar II (Becton Dickinson) and incubation at 35°C for 48 h; the starting inoculum concentration for these tests was $10^6$ CFU/ml. Results of susceptibility tests are shown in Table 1.

On the fourth day of admission, the patient complained of right shoulder pain and numbness in a small area over the lateral aspect of the right upper arm. A neurological examination, X-rays of the shoulder and cervical spine, as well as a computerized tomography scan of the cervical spine, right brachial plexus, and upper chest areas were normal. He became afebrile over the next few days. However, on day 9 of hospitalization, he developed a mild, diffuse swelling of the right arm accompanied by weakness of the extensors of fingers, wrist, and elbow. A vascular Doppler study showed a pseudoaneurysm in the right axilla measuring approximately 2 by 2 by 2 cm, which was also palpable as a pulsatile mass.

The patient was transferred to our hospital, where he underwent an angiogram that confirmed a pseudoaneurysm of the right brachial artery. A large clot, about 4 by 4 by 4 cm, extending to the brachial plexus was evacuated. The affected artery was removed, and a saphenous vein graft was used for end-to-end anastomosis. Cultures of the artery and clot on Trypticase soy agar with 5% sheep blood, GC agar with hemoglobin and Isovitalex, MacConkey II agar, and thioglycolate broth (Becton Dickinson) were negative. Histopathology showed organizing thrombus and surrounding scar tissue, and a Gram stain (Brown-Brenn stain) was negative. The patient received ceftriaxone and gentamicin for 6 weeks without complications. During therapy, serum inhibitory and bactericidal titers were both 64 at the peak and 16 at the trough. On follow-up, 10 months later, the patient was doing well, with marked improvement in motor function of the right arm, although he continued to have a small area of numbness below the elbow.

Most of the species of the genus *Neisseria*, including *N. gonorrhoeae* (17), *N. sicca* (6, 15), *N. mucosa* (1), *N. subflava* (2), and *N. flavescens* (13), have been shown to cause infective endocarditis in humans. However, *N. elongata* subsp. *glycolytica* and subsp. *elongata*, which have been isolated from the pharynxes of healthy individuals and patients with pharyngitis, bronchial aspirates, perimandibular abscesses, urine, and the urogenital tract, had been regarded as nonpathogenic (3, 5). A search of the MEDLINE database and a review of cited literature in articles on *N. elongata* failed to identify a single case of endocarditis caused by *N. elongata* subsp. *elongata.*

In 1990, Grant et al. proposed that the bacterium formerly known as CDC group M-6 was a subspecies of *N. elongata*, subspecies *nitroreducens* (5). Twenty-seven percent of the 95 isolates they analyzed were blood isolates, including 15 from cases of endocarditis. In a retrospective review of *N. elongata* subsp. *nitroreducens* isolates submitted to the Microbiological Diseases Laboratory of California over a period of 16 years, Wong and Janda found that 12 of 22 (55%) isolates came from blood (18). Since *N. elongata* subsp. *elongata* differs biochemically from *N. elongata* subsp. *nitroreducens* by its lack of nitrate reduction, it is unclear if and why these two subspecies have different pathogenicities. The MICs of clindamycin and erythromycin for our patient's isolate were both 2 μg/ml, a concentration which is interpreted as intermediate susceptibility for other organisms. The organism was sensitive to all the other antibiotics tested.

Mycotic aneurysms and septic emboli are well-known complications of infective endocarditis. Heiddal et al. reported an 8-by-4-cm aneurysm in the calf, complicating *N. sicca* endocarditis (6). In their review of the literature on *N. mucosa* endocarditis, Ingram et al. found that 7 of 13 patients (54%) had major embolic events (7). Similarly, Wall et al. analyzed 40 well-documented cases of gonococcal endocarditis and found evidence of major systemic embolization in nine patients (22%), including emboli to cerebral, splenic, and femoral vessels (16). Furthermore, Jackman and Glamann reported six episodes in five cases of gonococcal endocarditis and noted congestive heart failure in all cases and a high frequency of large vegetations (8). *Kingella* species, which belong to the family *Neisseriaceae* and are closely related to *N. elongata* subsp. *nitroreducens*, cause endocarditis that is associated with vascular complications in about half of the patients, including strokes in a quarter of them (9). In contrast to these observations, we were unable to identify any report in the literature of pseudoaneurysms resulting from bloodstream infections with *N. elongata* subsp. *elongata*. We believe that the pseudoaneurysm found in this patient was the result of a ruptured mycotic aneurysm, despite the fact that the Gram stain and culture were negative. It is the most reasonable explanation, because other than infective endocarditis, the patient had no other antecedent condition or history of trauma to predispose him to a brachial artery aneurysm. The negative Gram stain and culture could have been the result of 11 days of appropriate antibiotic therapy.

The patient received intravenous ceftriaxone and gentamicin for 6 weeks. Subsequent MICs and MBCs for both these drugs showed that the organism was susceptible. It is unclear from the available literature whether ceftriaxone alone would have been sufficient.

This report adds *N. elongata* subsp. *elongata*, previously considered nonpathogenic, to the long list of possible etiologies of infective endocarditis. It also underlines the serious complications that can be caused by this microorganism.

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