**Corynebacterium striatum** Meningitis: Case Report and Review of an Increasingly Important *Corynebacterium* Species

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For a long time, corynebacteria were considered simple cutaneous contaminants with little potential pathogenicity. *Corynebacterium striatum* is a known saprophytic cutaneous bacterium; however, in the last decade, this organism has been increasingly recognized as a pathogen. It has been mostly implicated in respiratory tract and blood infections. To our knowledge, we report the first case of meningitis due to *C. striatum*. Treatment with intravenous vancomycin resulted in therapeutic success. We also thoroughly review all previously reported cases of *C. striatum* infection. Identification of *Corynebacterium* species can be difficult because of rapid taxonomic changes, and susceptibility testing for these microorganisms is not yet standardized. However, because of their growing clinical importance, data on these bacteria are accumulating.

*Corynebacterium* species are part of the normal skin flora; these microorganisms are also found in the environment or in animals [1]. For a long time, they were considered simple cutaneous contaminants with little or no potential pathogenicity. However, during the last decade, *Corynebacterium jeikeium* and *Corynebacterium urealyticum* have been implicated in infectious processes, especially catheter-related infections and urinary tract infections [2]. These species are characterized by their multidrug-resistant susceptibility profile, which makes them unique among *Corynebacterium* species. The taxonomy of *Corynebacterium* species is rapidly changing and is still not completely established. Numerous *Corynebacterium* species have been recently reclassified as members of the coryneform group, and taxonomic modifications are still being made [1].

*Corynebacterium striatum* has not been considered a potentially pathogenic microorganism until recently. When this organism was found in clinical specimens, it was often discarded as a contaminant. Its taxonomic classification is not yet very clear. Several case reports of *C. striatum* infection have been published; however, most of these cases were blood infections [3–8] or respiratory tract infections [9–12]. To our knowledge, we report the first proven case of meningitis caused by *C. striatum*. Moreover, we review the previously reported cases of infection due to this increasingly important emerging pathogenic species of *Corynebacterium*.

**Case Report**

A 23-year-old man with no underlying medical problem presented to the emergency department of our hospital on 29 November 1995 complaining of headache, nausea, vomiting, and photophobia. In May 1995, the patient had had a major motorcycle accident in which he sustained a fracture of the right humerus that was complicated by avulsion of nerve roots from C-6 to T-1. He subsequently had pseudomeningocele and paralysis of the right arm; he underwent extensive nerve reconstructive surgery on 16 November 1995. A drain was left in place at that time, and a persistent leak was present. The patient’s condition following his surgery was favorable, and he was discharged on 20 November 1995. A few days later, he started complaining of an increasingly painful headache that was occasionally accompanied by chills.

At the time of admission, the patient was alert and well oriented and had a severe headache; his oral temperature was 38.5°C, and his vital signs were normal. Neurological examination showed a stiff neck and right arm paralysis. Physical examination was otherwise unremarkable, and there was no infection at the surgical site. However, there was a leak of cloudy fluid through a cutaneous fistula, which was likely in communication with the CSF; the drain was immediately removed.

Laboratory tests of blood taken at admission showed a WBC count of 21.3 × 10⁹/L with 94% polymorphonuclear leukocytes. A lumbar puncture yielded cloudy CSF; analysis of CSF revealed a decreased glucose concentration of 1.5 mmol/L (normal value, 2.8–3.9 mmol/L), an increased protein concentration of 4.35 g/L (normal value, 0.15–0.4 g/L), and an elevated WBC count of 113.1 × 10⁶/L (92% neutrophils). Gram staining of CSF demonstrated the presence of coccobacillary gram-positive bacteria. Intravenous ceftriaxone (1 g every 12 hours) and intravenous vancomycin (1 g every 12 hours) were immediately administered to the patient. Two cultures of blood taken before the start of antibiotic therapy remained negative.

After a 24-hour incubation period, culture of a CSF specimen subsequently yielded pure growth of a gram-positive rod. The microorganism had a beige appearance, was catalase-positive, reduced nitrate, and was nonmotile. After 48 hours, the colony’s diameter was about 2–3 mm, and it had a creamy texture.
Table 1. Summary of data on reported cases of Corynebacterium striatum infection.

<table>
<thead>
<tr>
<th>Year of publication [reference]</th>
<th>Patient’s age (y)/sex</th>
<th>Disease</th>
<th>Predisposing condition(s)</th>
<th>Therapy</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980 [9]</td>
<td>79/M</td>
<td>Pneumonia</td>
<td>Chronic lymphocytic leukemia</td>
<td>Carbenicillin</td>
<td>Died</td>
</tr>
<tr>
<td>1986 [10]*</td>
<td>22/M</td>
<td>Empyema</td>
<td>Multiple trauma</td>
<td>ND</td>
<td>Alive</td>
</tr>
<tr>
<td>1989 [3]\textsuperscript{t}</td>
<td>64/F</td>
<td>Septicemia</td>
<td>Endometrial carcinoma, recent chemotherapy</td>
<td>Ampicillin, gentamicin</td>
<td>Alive</td>
</tr>
<tr>
<td>1990 [4]</td>
<td>76/M</td>
<td>Endocarditis</td>
<td>None</td>
<td>Ampicillin, gentamicin</td>
<td>Died</td>
</tr>
<tr>
<td>1991 [16]</td>
<td>80/F</td>
<td>Keratitis</td>
<td>Diabetes, glaucoma</td>
<td>Cefazolin, tobramycin</td>
<td>Alive</td>
</tr>
<tr>
<td>1994 [12]</td>
<td>27/M</td>
<td>Pneumonia</td>
<td>Alcoholism</td>
<td>Vancomycin</td>
<td>Died</td>
</tr>
</tbody>
</table>

NOTE. BMT = bone marrow transplant; CAPD = continuous ambulatory peritoneal dialysis; COPD = chronic obstructive pulmonary disease; ND = not done; PR = present report.

* C. striatum was a possible cause.
\textsuperscript{t} The strain’s identification was controversial.

The bacterium was subsequently identified as C. striatum by using the API-Coryne system (bioMérieux, Marcy l’Etoile, France); the identification was categorized as good (identification code, 3100105; % id = 97.1; T index = 1). The strain’s identification was confirmed by the Quebec Provincial Laboratory (Ste. Anne de Bellevue, Quebec, Canada) by means of conventional methods. Susceptibility testing was performed by a broth microdilution technique with cation-adjusted Mueller-Hinton broth supplemented with 4.5% lysed horse blood agar and 6.6% rabbit serum. Plates were incubated under aerobic conditions for 48 hours [13]. With use of the criteria of the National Committee for Clinical Laboratory Standards [14], the bacterium was found to be susceptible to vancomycin (MIC, \(\leq 0.125\) mg/L) and erythromycin (MIC, \(\leq 0.016\) mg/L) and intermediate susceptible to penicillin (MIC, 0.25 mg/L).

Ceftriaxone therapy was discontinued after 24 hours, whereas vancomycin therapy was continued for a total of 10 days. After 48 hours of treatment, we noted a marked improvement in the patient’s condition; he became afebrile, and his headache almost completely disappeared. In the meantime, the leak progressively stopped, and it completely ceased on 9 December 1995. A culture of leaking fluid obtained 5 days after admission yielded no bacterial growth. A control lumbar puncture was not done, and the CSF level of vancomycin was not measured. On 12 December 1995, the patient was discharged in excellent condition; there were no new neurological sequelae, and he was not receiving any antibiotic therapy. At a 1-month follow-up at the outpatient clinic, he was perfectly well.

Discussion

For a long time, C. striatum was considered a saprophytic bacterium colonizing the anterior nares and skin; it seemed to be isolated more often from sites on the upper part of the body. However, during the last few years, several cases of definite infection caused by this microorganism have been reported. The first case report describing this bacterium as a pathogenic microorganism was published in 1980 [9]. This case involved pulmonary infection in an immunocompromised host. Infections in the other reports almost always were associated with underlying medical problems. Most cases of C. striatum infection occurred in either immunocompromised patients or patients whose skin barrier integrity was broken. C. striatum was mainly recovered from either blood (six cases) or respiratory...
tract specimens (four cases). A total of 15 cases, including ours, have been reported (table 1).

Previous reports have not implicated C. striatum in CNS infection, and this case confirms that this bacterium has the potential to cause meningitis. The fact that there was direct communication between the skin and the CSF through a catheter left in place following the initial surgery could explain the pathogenesis of this particular infection. This bacterium has also caused chronic peritonitis associated with ambulatory peritoneal dialysis [15] as well as keratitis [16].

*C. striatum* is a *Corynebacterium* species that can be difficult to identify in certain circumstances, and sometimes it can be confused with *Corynebacterium xerosis*. These two bacteria can be differentiated by maltose utilization [1]. However, *C. xerosis* seems to be much more resistant to erythromycin [13, 17, 18]. Colonies of *C. striatum* are white, tan, or yellowish and grow well on sheep blood agar, and individual cells are rather large compared with the other *Corynebacterium* species. The bacterium is named after the stripes often observed during gram staining.

Susceptibility testing for *Corynebacterium* species is still a controversial issue for which there are no clear recommendations or guidelines [13, 17, 18]. We used the criteria for *Streptococcus* for interpreting susceptibility to penicillin, because in a previous study [13] we found that to avoid major errors these criteria are more appropriate than those for *Listeria* (the only gram-positive rod for which susceptibility criteria are available).

Our patient was successfully treated with vancomycin, but this antibiotic penetrates the CSF poorly when there is no inflammation. However, vancomycin can reach an acceptable level when there is inflammation of the meninges. There are some controversial data regarding inflammation and diffusion of vancomycin in the CSF. Some investigators [19] found that 18% of the initial dose could penetrate the CSF in cases of meningitis, while other investigators found an unacceptably high level of therapeutic failure in cases of meningitis due to penicillin-resistant pneumococci [20]. Glycopeptides (vancomycin or teicoplanin) were prescribed in most of the cases, but therapeutic success was also achieved with ampicillin. MICs of penicillin for *C. striatum* often range from 0.25 to 1 mg/L, whereas all strains are susceptible to vancomycin [13, 17].

*C. striatum* is being increasingly described as a pathogenic *Corynebacterium* species, and its presence in clinical specimens should not always be overlooked, especially in samples from patients with underlying medical conditions. Moreover, until definitive results of susceptibility testing are available, vancomycin is the recommended treatment for severe infections due to *Corynebacterium* species [17, 18].

### References