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Neonatal Meningitis Caused by *Achromobacter xylosoxidans*

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The clinical and bacteriological findings in a case of neonatal meningitis caused by *Achromobacter xylosoxidans* are presented. This appears to be only the second report of meningitis caused by this species.

Achromobacter xylosoxidans was described in 1971 (11). The literature on the organism since then and earlier literature on possibly similar organisms have been surveyed recently by Reverdy et al. (6). Their survey shows that meningitis caused by *A. xylosoxidans* has been rarely reported. In 1971 Sindhu (9) described three cases of neonatal meningitis caused by an organism which was described as *Achromobacter* sp., but no characteristics of the organism were presented. Similarly, in 1972 Lee and Tan (5) also described three cases of neonatal meningitis attributed to an organism they described as *Achromobacter* sp. but for which they presented no characteristics. Given the lack of a proper definition of the genus *Achromobacter* at that time, the absence of characteristics of the organism, and the fact that these authors (5, 9) would not at that time have seen the description of *A. xylosoxidans* (11), there is no evidence that the strains described by Sindhu (9) and by Lee and Tan (5) were *A. xylosoxidans* strains. The first and only authenticated case of meningitis caused by this species was described in 1974 in a 9-year-old girl (7). A fuller description of the species was based on additional strains (including three from spinal fluid and one from brain), but no clinical details were given for these strains (13). The only other relevant report was of six cases of cerebral ventriculitis, probably nosocomially acquired, which appeared in 1978 (8). We describe here a second case of meningitis definitely attributable to *A. xylosoxidans*.

A premature (33 weeks) male infant (weight, 1,600 g) who was delivered spontaneously but normally at home immediately developed difficulty in breathing and cyanosis and was soon admitted to the Special Care Baby Unit of the Childrens' Hospital, Dammam, Saudi Arabia. The hemoglobin level was 16.5 g/dl, and the leukocyte count was 8.0×10^9/liter, with a normal differential. The chest X ray was suggestive of aspiration pneumonia. The child improved after endotracheal intubation, aspiration of chest secretions, and a short period of intermittent positive-pressure ventilation. Antibiotic therapy with gentamicin (5 mg/kg per day intravenously) and ampicillin (200 mg/kg per day intravenously) was started, and the child was placed in an incubator.

On day 2 the child became pyrexial (temperature, 38.5°C), developed a slight abdominal distension, and refused to be fed. Neonatal septicemia was diagnosed. Two sets of blood cultures were analyzed but were sterile. On day 5 his temperature rose to 39°C, and he began to convulse. Additional blood cultures were analyzed but were again sterile. The hemoglobin level was 15.0 g/dl, and the leukocyte count was 20.0×10^9/liter, with 90% neutrophils and 10% lymphocytes. A lumbar puncture yielded a turbid cerebrospinal fluid (CSF) sample containing 17.0×10^9 leukocytes per liter, with 95% neutrophils and numerous gram-negative rods.

When the results of antimicrobial susceptibility tests were available, therapy was changed to carbenicillin (1 g intravenously every 6 h). There was a slight improvement in the clinical status after carbenicillin therapy. However, a low-grade fever persisted for most of the following days. A further lumbar puncture was performed on day 20, and the CSF was slightly cloudy, but organisms were not isolated. The same therapy was maintained.

On day 40 the head circumference was 38 cm (it increased from 36 cm to 38 cm in 5 days), and bilateral hydrocephalus with ventriculitis was confirmed by a computerized tomography scan. A drain was inserted into the right ventricle on day 41. The ventricular CSF was turbid and yielded a heavy growth of a gram-negative nonfermentative rod which was similar in its characteristics and susceptibility to the one previously isolated. At 8 h after the ventricular drainage operation the child became pyrexial (temperature, 40°C). Despite extensive support and intensive therapy with carbenicillin, the child expired on day 47. An autopsy was not performed.

The CSF was subcultured onto 5% (vol/vol) human blood agar (plain and chocolated) and incubated aerobically under 7% CO_2 and anaerobically under 80% N_2–10% H_2–10% CO_2. A limited number of biochemical characteristics were determined by the methods and media described by Cowan (1) and by the API 20E system (Analytab Products, Plainview, N.Y.). For a more complete characterization by methods that have been described previously (2), the isolate was referred to the Computer Identification Laboratory at the National Collection of Type Cultures, Central Public Health Laboratory, London, England.

Disk diffusion antimicrobial susceptibilities were determined by the Stokes comparative method (10) with Diagnostic Sensitivity Test agar (Oxoid Ltd., Basingstoke, England).

Growth appeared after overnight incubation only on the blood agar plates that had been incubated aerobically. The colonies were mucoid, and Gram-stained smears showed gram-negative rods and filamentous forms. The cells grew on MacConkey agar and were motile at 37 and 22°C.

A preliminary examination showed the organism to be a nonfermentative gram-negative rod which, in the API 20E system, yielded the nine-digit profile number 0200004-51 after 48 h of incubation. This profile number was listed in the API 20E Analytical Profile Index with the comment "low discrimination," and the most likely taxa were *Alcaligenes* spp., *Pseudomonas* spp., and *A. xylosoxidans*. Additional conventional tests with which to further the identification were suggested, and based on the results of these and a

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limited number of routine conventional tests, the isolate appeared to be *Alcaligenes faecalis*. The results of the biochemical tests performed on the strain at the National Collection of Type Cultures corresponded perfectly to those for the type strain (NCTC 10807) and two additional reference strains (NCTC 10808 and NCTC 10809) on which the original descriptions of *A. xylosoxidans* were based (11, 12) and are as follows. All four strains were positive for acid production from xylose in ammonium salts medium, alkali production on Christensen's citrate, catalase production, cytochrome oxidase production, growth at room temperature, growth at 42°C, growth on cetrimide, growth on β-hydroxybutyrate, KCN tolerance, motility at room temperature, nitrate reduction, nitrite reduction, poly-β-hydroxybutyrate inclusion granules, and tyrosine hydrolysis. All four strains were negative for acid production from adonitol, fructose, maltose, mannitol, salicin, or trehalose in ammonium salts medium, acid production from peptone water-glucose, arginine dihydrolase production, casein digestion, gas production from peptone water-glucose, gelatin hydrolysis (by stab liquefaction or the plate method), hydrogen sulfide production (on triple sugar iron agar), lysine decarboxylation, ornithine decarboxylation, pigment production on nutrient agar, or tyrosine agar, reaction in the Hugh-Leifson oxidation-fermentation test, Tween 20 or Tween 80 hydrolysis, urease production, and β-D-galactosidase production (*o*-nitrophenyl-β-D-galactopyranoside test). The strains differed in acid production from glucose or ethanol in ammonium salts medium and in growth on Simmons citrate (negative results were obtained only for reference strain NCTC 10808).

The disk diffusion results were available 12 h after bacterial isolation. The strain was resistant to ampicillin, chloramphenicol, cephalothin, cefuroxime, cephaloridine, gentamicin, tobramycin, and amikacin but susceptible to carbenicillin and co-trimoxazole.

In 1971 Yabuuchi and Ohyama described a gram-negative rod from the purulent ear discharges of seven patients with chronic otitis media (11). They named the organism *A. xylosoxidans*. A fuller description of the species based on 55 strains was later given (13). More recently, DNA studies have established a close relationship between *A. xylosoxidans* and *Alcaligenes denitrificans*, and the most recent proposal is that the former be recognized as a subspecies of the latter, i.e., *A. denitrificans* subsp. *xylosoxydans* (4).

The strain described here conforms to the various descriptions given of *A. xylosoxidans* (11–13) except that it does not produce a weak-positive reaction in the open tube of oxidation-fermentation medium containing glucose (12, 13). However, even the reference strains of the species did not cause any change in the oxidation-fermentation medium, and the difference is probably the result of a difference in test methods.

A. xylosoxidans has been identified in several clinical laboratories and isolated from various pathological specimens (6). The organism is recognized as an opportunistic pathogen of predisposed patients and is resistant to beta-lactam and aminoglycoside antimicrobial agents and to chlorhexidine disinfectants (3, 6, 8). There have been occasional reports of this species occurring as a pathogen in cases of otitis media (11) and an infected orbit (3). The species was responsible for ventriculitis in six patients in a neurosurgical ward who had undergone a craniotomy or cranial trephination before the infections occurred (8); the infections were thought to be nosocomial in origin. An epidemic caused by *A. xylosoxidans* in an intensive care unit has also been described (6). The only other report of meningitis caused by this organism is that by Shigeta et al. (7). The patient was a 9-year-old girl, and the purulent meningitis occurred in May and again in September after occipital trephination and a ventriculoperitoneal shunt in March. *A. xylosoxidans* was isolated from the CSF in a pure culture. The patient's serum agglutinated the isolate up to a dilution of 1:640. The patient described in the present study differed from previous meningitis or ventriculitis patients in not having undergone surgery before the infection developed. In fact, the case described here is the first report of *A. xylosoxidans* causing meningitis in a patient who had not undergone a surgical operation of the brain.

A. xylosoxidans is resistant to most antimicrobial agents, but susceptibility to carbenicillin and colistin (polymyxin E) (3) and to ceftazidime and moxalactam (6) has been previously reported.

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