Citrobacter farmeri Bacteremia in a Child with Short-Bowel Syndrome

DAVID A. BRUCKNER,1 PAUL COLONNA,1 DIANE GLENN,1 SHARON L. ABBOTT,2 AND J. MICHAEL JANDA2*

Clinical Microbiology, Department of Pathology & Laboratory Medicine, UCLA Medical Center, Los Angeles, California 90095-1713,3 and Microbial Diseases Laboratory, Division of Communicable Disease Control, California Department of Health Services, Berkeley, California 94704-10112

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A case of sepsis in a pediatric patient due to the newly described Citrobacter species C. farmeri is described. Factors predisposing this child to infection included short-bowel syndrome requiring total parenteral nutrition.

Over the past several years the genus Citrobacter has undergone major taxonomic revisions. A 1993 study by Brenner and colleagues (2) proposed sweeping changes within the C. freundii complex, previously known to be genetically heterogeneous at the DNA level. Based upon DNA relatedness, four new species were described in this investigation: C. youngae, C. braakii, C. werkmanii, and C. sedlakii. Three other species (genomospecies 9 to 11) were left unnamed due to the lack of a sufficient number of strains for definitive analysis. In 1995, genomospecies 9 was named C. rodentium by Schauer and others (8). Brenner et al. (2) also proposed that a former biogroup of C. amalonaticus (biogroup 1) be elevated to species status (C. farmeri) based upon the results of DNA-DNA reassociation kinetics. At present the genus Citrobacter is now composed of nine genomospecies and two unnamed genomospecies.

Since these taxonomic revisions, few studies have addressed the clinical significance or frequency of the newer citrobacteria (1, 4, 6). While C. freundii sensu stricto still appears to be the most commonly isolated species in the laboratory, many of the newer species have been frequently recovered from anatomic sites often containing polymicrobial flora, such as the gastrointestinal and urinary tracts (4). In many of these instances their role in the disease process is unclear. C. youngae has been isolated from blood on three separate occasions, C. farmeri has been so isolated twice, and C. sedlakii and C. werkmanii have been so isolated once each, suggesting that these groups are pathogenic for humans (2, 4, 6). However, a detailed case history was not available for any of these blood isolates. In this paper we describe the detailed case report of C. farmeri septicaemia in a pediatric patient with short-bowel syndrome (SBS).

A 5-year-old male at the UCLA Medical Center developed high fever and chills 13 min after commencement of a total parenteral nutrition (TPN) infusion. His past medical history was significant for SBS secondary to bowel resection for gastrochisis; he was TPN dependent. Physical examination of the child revealed no symptoms or abnormalities other than the fever and chills. The line site was without erythema or pus. A tentative diagnosis of line sepsis was entertained, two sets of blood cultures (central line) were drawn, and the patient was admitted to the pediatric intensive care unit. He was empirically placed on vancomycin and ceftazidime. In less than 12 h, his condition had improved and his fever had decreased. Four days after admission, vancomycin and ceftazidime were discontinued and the patient was placed on 2 g of ceftriaxone (four times daily) and 100 mg of gentamicin (twice daily) based upon the susceptibility report for the blood isolate. The infection resolved without further sequelae and without the removal of the line. The TPN solution was not cultured.

Blood isolates were initially identified as Pantoea (“Enterobacter”) agglomerans (very good identification) by the API 20E system (bioMérieux Vitek, Inc., Hazelwood, Mo.). As part of a research protocol the blood isolate was additionally tested by two other systems. The Vitek system (software version R03.01; bioMérieux Vitek, Inc.) identified this isolate as Enterobacter cloacae (72%, low probability). The MicroScan W/A system (Dade MicroScan Inc., West Sacramento, Calif.) identified this strain as Leclercia adecarboxylata (56%, low probability). None of these systems currently have updated databases including the new Citrobacter species. Because of these discrepancies, the strain was forwarded to the Microbial Diseases Laboratory for further evaluation. The strain (96A-03859) was an oxidase-negative, catalase-positive, gram-negative, facultatively anaerobic bacillus. On triple sugar iron, 96A-03859 produced an acid/acid with gas reaction (H2S negative) and was indole, urease, citrate, and KCN positive and lysine decarboxylase and Voges-Proskauer negative. These reactions placed this strain in the genus Citrobacter. Failure to produce acid from adonitol or D-arabitol and to utilize malonate as a source of energy indicated that it belonged in the C. amalonaticus group. Subsequent testing identified the strain as C. farmeri (“C. amalonaticus” biogroup 1) based upon the fermentation of key carbohydrates (Table 1).

In 1985, Farmer and colleagues (3) described new groups within the family Enterobacteriaceae and defined a new biogroup of C. amalonaticus (biogroup 1) based upon the ability of these strains to ferment sucrose, raffinose, α-methyl-D-glucoside, and melibiose and not utilize citrate. C. amalonaticus biogroup 1 (“C. farmeri”) was described as a rarely isolated enteric bacterium from feces, urine, and wounds in that study. It was listed as possibly clinically significant at some sites but not at others. Further information was not available. In the subsequent systematic investigation of Brenner et al. (2), the clinical distribution of C. farmeri was expanded to include blood although no clinical information on these strains was provided. Most C. farmeri strains are citrate negative (93%) at 48 h; however, 86% are reported to be citrate positive (Simmons) at 7 days (2).
In the present case report we provide the first clinical evidence indicating that *C. farmeri* is indeed a human pathogen. The fact that *C. farmeri* was isolated in pure culture twice from the blood of a child with systemic signs of sepsis (fever and chills) supports its role in the illness. The most likely factor triggering *C. farmeri* septicemia was the SBS condition causing TPN dependency. SBS is a serious medical complication resulting from major resection of the small intestine and in some instances the colon (9). The remaining abbreviated intestine results in a malabsorption and malnutrition condition requiring TPN (5, 9). A consequence of this required catheterization is sepsis, often involving gram-negative bacilli such as *Escherichia coli*, *Klebsiella* species, and *Enterobacter cloacae* (5, 7, 10). Sepsis may result from the gastrointestinal translocation of gram-negative and gram-positive bacteria into the mesenteric lymph nodes, where they eventually spread hematogenously, seeding central venous catheters (5). Alternatively, infection may result from the frequent bowel movements that SBS patients have, thereby increasing the chance of rectal contamination of central venous catheters (7). In the present case, the short time span (13 min) that elapsed between the commencement of TPN and signs of sepsis suggests that the infection may have resulted from contaminated parenteral nutrition. Regardless of which mechanisms are operative, SBS patients run a much higher risk of developing sepsis, and *C. farmeri* should now be added to the list of agents documented to cause such infections.

### REFERENCES


**TABLE 1. Distinguishing features of the *C. amalonaticus* group**

<table>
<thead>
<tr>
<th>Substrate for acid production</th>
<th><em>C. amalonaticus</em></th>
<th><em>C. farmeri</em></th>
<th>Strain 96A-03859</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>–</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Raffinose</td>
<td>–</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Melibiose</td>
<td>–</td>
<td>+</td>
<td>+</td>
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</tbody>
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*Abbreviations: +, ≥85% of strains positive for acid production from the indicated substrate (48 h); –, ≤15% of strains positive for acid production from the indicated substrates (48 h). Reactions for *C. amalonaticus* and *C. farmeri* are from the work of Farmer et al. (3).*