**Pantoea agglomerans**, a Plant Pathogen Causing Human Disease

Andrea T. Cruz,1,2* Andreea C. Cazacu,1 and Coburn H. Allen1,2

Department of Pediatrics, Sections of Infectious Disease1 and Emergency Medicine,2 Baylor College of Medicine, Houston, Texas 77030

Received 21 March 2007/Returned for modification 2 April 2007/Accepted 5 April 2007

We present 53 pediatric cases of *Pantoea agglomerans* infections cultured from normally sterile sites in patients seen at a children’s hospital over 6 years. Isolates included 23 from the bloodstream, 14 from abscesses, 10 from joints/bones, 4 from the urinary tract, and 1 each from the peritoneum and the thorax. *P. agglomerans* was most associated with penetrating trauma by vegetative material and catheter-related bacteremia.

*Pantoea agglomerans* (formerly *Enterobacter agglomerans*) is a gram-negative aerobic bacillus in the family *Enterobacteriaceae*. All species of the genus *Pantoea* can be isolated from feculent material, plants, and soil (2), where they can be either pathogens or commensals (12). Within the genus, *P. agglomerans* is the most commonly isolated species in humans, resulting in soft tissue or bone/joint infections following penetrating trauma by vegetation (6, 7, 9, 14, 15). *P. agglomerans* bacteremia has also been described in association with the contamination of intravenous fluid (11), total parenteral nutrition (8), the anesthetic agent propofol (3), and blood products (1). However, spontaneously occurring bacteremia has rarely been reported, especially for children, and the role of *P. agglomerans* as a pathogen in other circumstances is unclear. Here, we present a large series of *P. agglomerans* infections in children that involve the bloodstream, soft tissue, and bones/joints.

This study reviewed all patients seen at Texas Children’s Hospital, Houston, TX, with culture-documented *P. agglomerans* infections from January 2000 to December 2006. Patients were identified from hospital microbiology laboratory records. A retrospective review of medical records was performed for patients whose cultures were obtained from the following normally sterile sources: the bloodstream, catheter specimens from patients with urinary tract infections (UTIs) with \( \geq 10,000 \) CFU/high-powered field, joint or body cavities, or incision sites and drainage of abscesses. Blood cultures were processed using the VITEK system of identification, and specimens that did not yield a result underwent DNA pyrosequencing. CLSI standards were used for disk diffusion testing (5). The study received institutional review board approval.

Overall, *P. agglomerans* was identified in 88 patient cultures from 53 sterile-site cultures, 26 sputum, 3 urine, 3 surface swab, and 2 oropharyngeal sources. Of the 26 sputum cultures, only 1 grew *P. agglomerans* repeatedly, representing monomicrobial infection; more than one organism was isolated from all other sputum cultures, and the contribution of *P. agglomerans* was uncertain. Comorbid conditions in these patients included eight cases of cystic fibrosis, five cases of neurological impairment, five cases of tumor, and three cases of intestinal malabsorption.

For the 53 children whose sterile-site cultures grew *P. agglomerans*, sources included 21 central venous line (CVL)-related bacteremic episodes, 14 abscesses, 10 joint or bone cultures, 4 UTIs, 2 non-CVL-associated bacteremic episodes, 1 peritonitis episode, and 1 penetrating thoracic trauma. These sources are presented in Table 1.

Of the 21 patients with CVL infections, 8 had hematologic malignancies or bone marrow transplants, 7 had solid tumors, 3 had congenital heart disease, 1 had renal failure, 1 had necrotizing enterocolitis, and 1 had microvillus inclusion disease. One patient was neutropenic. Of the 21 patients, 14 had polymicrobial CVL infections necessitating line removal. Only 5/21 patients had two positive blood cultures; in all, bacteremia resolved within 48 h. Patients received 14 to 21 days of combination therapy with an aminoglycoside and either a broad-spectrum cephalosporin or ticarcillin-clavulanate. Three patients (two cardiac patients and one premature infant [cases 16, 17, and 19]) died of overwhelming sepsis shortly after *P. agglomerans* was isolated in their blood cultures; two of the three patients had polymicrobial infections. Two other patients had bacteremia without having a CVL. In both, bacteremia cleared after the first blood culture, and neither child had evidence of bone, joint, or soft tissue infection.

There were 14 children from whom *P. agglomerans* was isolated during the drainage of abscesses. All isolates were polymicrobial. Of these 14 children, 13 responded to antimicrobial therapy. A child with cerebral palsy underwent extensive debridement of a sacral decubitus ulcer and received a prolonged antibiotic course due to suspected chronic osteomyelitis.

The seven patients (cases 38 to 44) who had osteomyelitis presented with local symptoms 4 to 6 weeks after a penetrating trauma with a stick, plant thorn, or glass shard. None of the patients were febrile. Two of the patients were determined to have subperiosteal reactions and erosions by radiography and chronic inflammation by histopathology. The average white blood cell count was 6,900 cells/mm\(^3\) (range, 3,600 to 11,500 cells/mm\(^3\)); blood cultures were negative.

An 8-year-old girl (case 46) developed septic arthritis 5 weeks after receiving a penetrating injury to the knee from a...
thorn. The patient’s white blood cell count was 11,500 cells/mm³, her erythrocyte sedimentation rate was 16 mm/h, and her C-reactive protein level was 0.7 mg/ml. Arthrocentesis showed 17,600 white blood cells/mm³ (89% neutrophils, 11% monocytes) and 1,700 red blood cells/mm³. Gram staining and blood cultures were negative; a joint culture grew *P. agglomerans*. The child responded well to a 3-week course of therapy.

Antimicrobial susceptibilities were determined by Kirby-Bauer disk diffusion. All 53 isolates from sterile sites were uniformly susceptible to amikacin, gentamicin, meropenem,
and trimethoprim-sulfamethoxazole. In addition, 92.5% of isolates were susceptible to broad-spectrum cephalosporins and semisynthetic penicillins, 62.3% to extended-spectrum cephalosporins, and 47.2% to ampicillin. Quinolone susceptibilities and MICs were not routinely determined for all specimens, although the association between quinolone use and arthropathy and trimethoprim-sulfamethoxazole. In addition, 92.5% of isolates were susceptible to broad-spectrum cephalosporins and semisynthetic penicillins, 62.3% to extended-spectrum cephalosporins, and 47.2% to ampicillin. Quinolone susceptibilities and MICs were not routinely determined for all specimens, giving the association between quinolone use and arthropathy in juvenile-animal studies.

Of the 37 prior reports of *P. agglomerans* infections in children (Table 2), 5 were related to penetrating trauma and 30 (81%) to the contamination of parenteral fluids (8, 11). There was only one report of spontaneous *P. agglomerans* bacteremia: in a child with sepsis after rotavirus gastroenteritis (4). In that instance, it was postulated that the preceding gastrointestinal insult facilitated bacterial translocation across the gut mucosa.

In this series, 43% (23/53) of patients had bacteremia, and 91% of these infections were related to the presence of a CVL. There was neither clustering of cases temporally nor evidence of parenteral-fluid contamination. The true pathogenicity of this bacterium is difficult to discern due to the polymicrobial nature of most of the bacteremic infections, which had not been described previously. This necessitated prolonged, broad-spectrum antibiotic courses. *P. agglomerans* bacteremia appeared to be transient and did not recur during therapy, and antibiotic courses of 10 to 14 sterile days appeared to be curative. One limitation was that some of the less common *Enterobacteriaceae* species can be misidentified or susceptibilities incorrectly reported by automated methods (13). Confirmatory tests were not routinely performed for this pathogen unless the VITEK system did not provide an identification.

In conclusion, *P. agglomerans* is an uncommon cause of infection in children. It can cause bacteremia, often in association with more-conventional pathogens, in children with indwelling central access. However, antimicrobial susceptibility patterns mirror those of other gram-negative enteric pathogens. Diagnoses of bone/joint infections are often delayed due to both the indolent nature of the pathogen and the low level of clinical suspicion for this bacterium. Consequently, the diagnosis is often made when a child has evidence of chronic osteomyelitis, altering the treatment duration and prognosis. *P. agglomerans* should be suspected as the etiologic agent in cases of penetrating trauma by soil-encrusted objects or vegetation that remain refractory to conventional antimicrobial therapy.

We thank Edward O. Mason and Pam Zapalac for patient identification.

A. C. Cazacu’s salary was supported by grant D43-TW01036 from the Fogarty International Center of the National Institutes of Health. None of the authors reports a conflict of interest.

### REFERENCES


### TABLE 2. Previously reported pediatric cases of *Pantoea/Enterobacter agglomerans* infection

<table>
<thead>
<tr>
<th>Yr (reference)</th>
<th>No. of patients</th>
<th>Age/sex of patients&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Diagnosis&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Type of (no. of patients with) underlying illness&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978 (7)</td>
<td>1</td>
<td>11 yr/M</td>
<td>Right knee septic arthritis after penetrating trauma (wooden splinter)</td>
<td>Prematurity (1), asplenia (1)</td>
</tr>
<tr>
<td>1988 (15)</td>
<td>1</td>
<td>8 yr/M</td>
<td>Left capitale, hamate, and third metacarpal osteomyelitis (rose thorn injury)</td>
<td></td>
</tr>
<tr>
<td>2000 (6)</td>
<td>1</td>
<td>13 yr/M</td>
<td>Right knee septic arthritis after penetrating trauma (thorn injury)</td>
<td></td>
</tr>
<tr>
<td>2003 (9)</td>
<td>1</td>
<td>14 yr/M</td>
<td>Right knee septic arthritis after penetrating trauma (palm tree thorn injury)</td>
<td></td>
</tr>
<tr>
<td>2004 (14)</td>
<td>1</td>
<td>9 yr/M</td>
<td>Left knee septic arthritis after penetrating trauma (lemon tree thorn injury)</td>
<td></td>
</tr>
<tr>
<td>1984 (11)</td>
<td>22</td>
<td>10 days–17 yr</td>
<td>Iatrogenic bacteremia secondary to contaminated intravenous fluids</td>
<td></td>
</tr>
<tr>
<td>2005 (8)</td>
<td>8</td>
<td>3 days–6 mo</td>
<td>Iatrogenic bacteremia from contaminated TPN</td>
<td>RDS (3), asphyxia (2), IUGR (1), VACTERL (1), pneumonia (1)</td>
</tr>
<tr>
<td>2005 (10)</td>
<td>1</td>
<td>2 yr/F</td>
<td>Peritonitis from teething on peritoneal dialysis catheter</td>
<td>End-stage renal disease (1)</td>
</tr>
<tr>
<td>2006 (4)</td>
<td>1</td>
<td>18 yr/M</td>
<td>Bacteremia following rotavirus infection</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> F, Female; M, male.

<sup>b</sup> TPN, total parenteral nutrition.

<sup>c</sup> RDS, respiratory distress syndrome; IUGR, intrauterine growth restriction; VACTERL, vertebral, anal, cardiac, tracheoesophageal fistula, renal, and limb anomalies.

