Incidence of Catheter-Associated Gram-Negative Bacteremia in Children with Short Bowel Syndrome

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Children with catheter-associated bacteremia were evaluated for the type of bacteria recovered and the relationship of the bacteria to the predisposing disease. A previously unrecognized observation was that gram-negative isolates, namely, Escherichia coli and Klebsiella sp., were almost exclusively recovered (11 of 12 isolates [92%]) from children with short bowel syndrome (SBS) compared with those from children with other underlying diseases, such as inflammatory bowel disease, malignancies, and other disorders (P < 0.001). Furthermore, children with SBS had a higher frequency of repeated infection (3.1 catheter-associated infections compared with 1.3 catheter-associated infections in children with other disorders during the same period). Only gram-positive bacteria were isolated from children with malignancies and other predisposing disorders. The very high frequency of catheter-associated gram-negative bacteremia in children with SBS compared with that in children with other bowel disorders, malignancies, and other predisposing diseases requires attention by the clinician in the management of patients in this group.

MATERIALS AND METHODS

Medical and laboratory records from the Children’s Hospital of Buffalo (a 325-bed, tertiary-care university hospital) obtained from March 1983 through January 1986 were reviewed for those children with catheter-associated infections. The records were analyzed if the following criteria were met: (i) quantitative blood cultures were simultaneously obtained from the central line and peripheral vein prior to antimicrobial therapy in febrile children (>38°C) and (ii) bacteria were isolated from both the central line and peripheral vein blood cultures. In order to eliminate any bias in this retrospective study, no particular groups of children or clinical services were selected.

Cultures of blood from the central line and peripheral vein were procured by aseptic technique and assayed by the previously described (4–7, 15) quantitative direct plating and BACTEC (Johnston Laboratories, Inc., Towson, Md.) systems. For the quantitative direct plating system, 0.1 to 0.5 ml of blood, with sodium polyanethol sulfonate used as anticoagulant, was pipetted directly onto two chocolate agar plates, with a third plate inoculated with a calibrated loop for quantitation of the bacteria. The plates were incubated at 37°C in 5 to 10% CO2 and monitored for growth. The number of organisms per milliliter was determined, and identification of all isolates was performed by conventional methods. The BACTEC system was used as described previously (6, 15) and by using all the instructions of the manufacturer.

The significance of clinical disease in relation to the organism isolated from the central line blood culture was determined by chi-square analysis. The significance of the magnitude of bacteria recovered from the central line blood

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of Patients</th>
<th>Mean Age (mo)</th>
<th>Coagulase-negative Staphylococci</th>
<th>Staphylococcus aureus</th>
<th>E. coli</th>
<th>Klebsiella sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Epis.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBS</td>
<td>8</td>
<td>25</td>
<td>33</td>
<td>10</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>IBD</td>
<td>5</td>
<td>9</td>
<td>214.8</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Malignancy</td>
<td>4</td>
<td>4</td>
<td>21</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
<td>6</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

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* Malignancies were lymphoma, neuroblastoma, Wilms tumor, or rhabdomyosarcoma.

a Other diagnoses included protein C deficiency, carbamylphosphate synthetase deficiency, reactive airway disease, nemaline rod myopathy, Hirschsprung’s disease, and cystic fibrosis.
TABLE 2. Quantitation of gram-negative bacteria in central line and peripheral vein blood cultures in children with SBS

<table>
<thead>
<tr>
<th>Blood culture</th>
<th>No. of cultures with CFU/ml of:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(&lt;10^3)</td>
</tr>
<tr>
<td>Central line</td>
<td>4</td>
</tr>
<tr>
<td>Peripheral blood</td>
<td>11</td>
</tr>
</tbody>
</table>

culture versus that from the peripheral vein blood culture was determined by the unpaired Student t test.

RESULTS

During the observation period, a total of 22 patients representing 44 episodes of catheter-associated bacteremia meeting all criteria were included in the study (Table 1). The ages of the patients ranged from 14 months to 17.9 years, with a sex distribution of 15 males and 7 females. Eight patients who were previously diagnosed with short bowel syndrome (SBS) developed 25 episodes of central line infections during the study period. On the average, these children experienced 3.1 catheter infections. In contrast, children with inflammatory bowel disease (IBD), malignancy, and other disorders experienced 1.3 catheter-associated infections during the same period. A statistically significantly higher number of gram-negative bacteria, in particular, Escherichia coli and Klebsiella sp., were recovered from central line blood cultures from children who suffered from SBS compared with the number isolated from patients in the other groups (\(P < 0.001\)) (Table 1). From a total of 12 gram-negative isolates in this study, 11 (92%) were recovered from children with SBS. Patients with IBD were older, and in only one instance was a gram-negative organism isolated. Only gram-positive bacteria were isolated from children with malignancies and other predisposing disease states.

The quantitation or CFU of gram-negative bacteria, namely, E. coli and Klebsiella sp., isolated from central line and peripheral vein blood cultures with children who had SBS was examined (Table 2). Of interest was that the concentration of organisms was significantly higher in the central line cultures in comparison with that in the peripheral vein blood cultures (\(P < 0.005\)). All of the 11 peripheral blood cultures had bacterial counts of \(<10^3\) CFU/ml, in contrast to a much higher magnitude of bacteria recovered from the central line cultures.

DISCUSSION

The type of bacteria recovered from children with catheter-associated bacteremia was correlated to the predisposing disease. A previously unrecognized observation was that the gram-negative isolates E. coli and Klebsiella sp. were almost exclusively recovered (11 of 12 isolates [92%]) from children with SBS. Also, the frequency of repeated infection was significantly greater with children who had SBS than from those who had IBD, malignancy, and other disorders. Only gram-positive bacteria were recovered from children with malignancies and other predisposing disorders. Furthermore, the majority of children with SBS had a much higher magnitude of organisms originating from the central line as opposed to the peripheral blood. Support for this observation comes from various sources (1, 2, 9, 11, 17). One study in children who were considered to have catheter-associated infection noted at least a 10-fold-higher concentration of bacteria from central line blood cultures compared with that from the peripheral vein blood cultures (11).

The observation that gram-negative bacteria are almost exclusively recovered from the catheters of children with SBS could possibly be explained by the fact that children with SBS are usually very young and have a high frequency of bowel movements; consequently, there is a greater probability of contaminating the patient bed area and catheters with intestinal bacterial flora. In contrast, children with IBD are usually older and have greater control of bowel movements, with a lower probability of contaminating the environment with bacterial gut flora.

In the clinical management of children with SBS, it is important to note the prevalence of E. coli and Klebsiella sp. in catheter-associated infections.

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LITERATURE CITED

CATHETER-ASSOCIATED GRAM-NEGATIVE BACTEREMIA

1319


