Pseudomonas Exit Site Infections in Continuous Ambulatory Peritoneal Dialysis Patients

Hashim R. Kazmi, F. Diane Raffone, Alan S. Kliger, and Fredric O. Finkelstein

ABSTRACT
The purpose of this study is to examine the natural history of Pseudomonas aeruginosa exit site infections in continuous ambulatory peritoneal dialysis (CAPD) patients treated with oral ciprofloxacin and local exit site care. A retrospective view was undertaken of 18 episodes of P. aeruginosa exit site infections developing in 17 patients maintained on CAPD during 1989 and 1990. Standardized therapy for the exit site infection consisted of oral ciprofloxacin (500 mg twice daily) and local exit site care with antiseptic agents. Fifteen (83%) of 18 of the pseudomonas exit site infections resolved with therapy. Three episodes (17%) required catheter removal to successfully eradicate the infection. Four of the 15 patients whose exit site infections resolved developed P. aeruginosa peritonitis 2 to 9 months after the clinical resolution of the exit site infection. The majority of pseudomonas exit site infections in CAPD patients can be successfully treated with oral ciprofloxacin and local care. Approximately 17% of the patients in this study required catheter removal to successfully eradicate the infection and an additional 22% of the patients developed pseudomonas peritonitis several months after the resolution of the exit site infection.

Key Words: Continuous ambulatory peritoneal dialysis, exit site infection, Pseudomonas

Continuous ambulatory peritoneal dialysis (CAPD) has now become widely accepted as a therapy for patients with end-stage renal disease. Probably the major problem with CAPD therapy as an alternative to hemodialysis or kidney transplantation for the treatment of end-stage renal disease remains the problem of technique survival with approximately 20% of patients per year transferring to alternate therapies for end-stage renal disease (1). Recent reviews have emphasized the importance of catheter exit site management and care in achieving long-term CAPD success (2,3).

Pseudomonas aeruginosa infections in CAPD patients present challenging management problems (4). For example, P. aeruginosa peritonitis has, in most instances, proved difficult to treat, and most investigators favor early catheter removal with aggressive antibiotic therapy to successfully cure the peritonitis (4,5). The natural course and outcome of P. aeruginosa exit site infections have not been analyzed in detail, although investigators have suggested that catheter-related P. aeruginosa infections will often result in catheter removal (6).

The purpose of the study presented here was to investigate the course of P. aeruginosa exit site infections in a cohort of CAPD patients. Particular attention was focused on the ability to resolve the infection without catheter removal and on the development of subsequent peritonitis and associated tunnel infections.

METHODS
Definitions
Exit site infections were defined by the presence of pericatheter erythema, tenderness, and drainage (purulent or nonpurulent). Exit site infections were attributed to P. aeruginosa if the above findings were present in association with a positive exit site culture for P. aeruginosa. Resolution of the exit site infection was defined by the clinical clearing of signs of inflammation at the exit site.

A tunnel infection was defined by the presence of erythema, tenderness, and edema along the s.c. pathway of the Tenckhoff catheter, occurring with or without drainage at the exit site and with intraoperative evidence of tract infection at the time of catheter removal.

Peritonitis was defined by the presence of cloudy dialysate with more than 100 white cells/mm³ and a white blood cell differential count of more than 50% polymorphonuclear cells.
Cultures

Cultures of the exit site were done by the swab technique. Cultures were prepared with standard media (blood, MacConkey, and chocolate agar) and a liquid thioglycolate broth. Dialysate cultures were prepared in a similar fashion. The dialysate was cultured after centrifugation of a 100-mL sample of dialysate at 3000 rpm for 15 min. Isolates were identified by standard bacteriological techniques and sensitivity tests were performed by the microtiter minimum inhibitory concentration method on all positive cultures.

Patients

Seventeen CAPD patients developed 18 exit site infections with *P. aeruginosa* during 1989 and 1990. During this period, there were an average of 100 CAPD patients cared for in the program. Over these 2 yr, there were a total of 120 exit site infections and 110 episodes of peritonitis in our CAPD population. The average age of the 17 patients with pseudomonas exit site infections was 51 yr (range, 14 to 77 yr). Nine patients were female, and eight were male. All performed standard CAPD therapy; none used a mechanical cycler. The mean duration of therapy with peritoneal dialysis before the development of the pseudomonas exit site infection was 26 months (range, 2 to 100 months). Fifteen of the 18 episodes of pseudomonas exit site infection were not preceded by exit site infections or by peritonitis in the 3 months before the exit site infection. One patient had had a *Streptococcus viridans* peritonitis, one had an *Escherichia coli* peritonitis, and one a coagulase-negative staphylococcal exit site infection within 3 months before the development of the pseudomonas exit site infection.

In all patients, a standard double-cuff Tenckhoff catheter was used. Patients were instructed to tape their catheters to the skin to stabilize the catheter exit site. All patients were instructed to apply soap and water followed by povidone-iodine to the skin surface around the exit site daily. The use of sterile gauze dressings on the exit site was left to the discretion of individual patients. In March 1990, the povidone-iodine exit site care was changed to a dilute solution of sodium hypochlorite and hypochlorous acid.

Treatment of Pseudomonas Exit Site Infections

After the diagnosis of pseudomonas exit site infections was made, patients were instructed to treat the exit site daily with local care as described above. Patients were advised to keep their exit site covered with sterile gauze. Ciprofloxacin (500 mg orally, twice daily) was prescribed for at least 2 wk.

RESULTS

Eighteen episodes of *P. aeruginosa* exit site infection occurred in 17 patients from 1989 to 1990. Therapy with local care and oral antibiotics resulted in resolution of the exit site infection in 15 of these 18 episodes. In 11 patients, the pseudomonas infection was eradicated and no recurrent pseudomonas infections occurred (Table 1). Seven of these patients required antibiotic therapy for 2 wk, three required therapy for 3 wk, and one required therapy for 6 wk to achieve clinical resolution of the infection.

However, in four patients whose exit site infections were successfully treated, *P. aeruginosa* peritonitis developed 2, 5, 7, and 9 months after the clinical resolution of the exit site infection (Table 2). These four patients required antibiotic therapy of 2, 3, 4, and 8 wk to achieve apparent clinical resolution of the exit site infection. All four patients required catheter removal for resolution of the pseudomonas peritonitis. Three were treated thereafter with hemodialysis, and one restarted CAPD after a new Tenckhoff catheter was inserted. The sensitivities of the organisms causing the *P. aeruginosa* exit site infection and peritonitis were identical in all four of these patients.

Three patients required peritoneal catheter removal shortly after the development of pseudomonas exit site infection (Table 3). In two of these patients, tunnel infections developed, and in one, oral ciprofloxacin and local care were unsuccessful. In one of these patients, a new peritoneal catheter, inserted after resolution of a tunnel infection, developed a second pseudomonas exit site infection that responded to medical therapy.

DISCUSSION

The importance of peritoneal dialysis catheter exit site problems in determining the long-term success

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age/Sex</th>
<th>Date of Exit Site Infection (Month/Year)</th>
<th>Months on CAPD</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>77/F</td>
<td>11/89</td>
<td>23</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>2</td>
<td>59/M</td>
<td>8/89</td>
<td>100</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>3</td>
<td>56/M</td>
<td>11/89</td>
<td>24</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>4</td>
<td>59/F</td>
<td>12/89</td>
<td>61</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>5</td>
<td>53/M</td>
<td>6/90</td>
<td>8</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>6</td>
<td>68/F</td>
<td>7/90</td>
<td>6</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>7</td>
<td>14/F</td>
<td>9/90</td>
<td>26</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>8</td>
<td>67/F</td>
<td>10/90</td>
<td>5</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>9</td>
<td>38/M</td>
<td>10/90</td>
<td>2</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>10</td>
<td>34/F</td>
<td>8/89</td>
<td>34</td>
<td>ESI resolved</td>
</tr>
<tr>
<td>11</td>
<td>33/F</td>
<td>7/90</td>
<td>4</td>
<td>ESI resolved</td>
</tr>
</tbody>
</table>

* ESI, exit site infection.
* At time of ESI.

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TABLE 2. Patients with peritonitis developing 2 to 9 months after resolution of pseudomonas exit site infection

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age/Sex</th>
<th>Date of ESIa (Month/Year)</th>
<th>Months on CAPDb</th>
<th>Date of Peritonitis</th>
<th>Outcome and Current Treatment</th>
</tr>
</thead>
</table>
| 1           | 72/M    | 1/89                      | 12              | 3/89                | Patient maintained on hemodi-
|             |         |                           |                 |                     |alysis; Tenckhoff catheter not 
|             |         |                           |                 |                     |reinserted                   |
| 2           | 20/M    | 9/89                      | 37              | 1/90                | Tenckhoff catheter reinserted 
|             |         |                           |                 |                     | and remains on CAPD          |
| 3           | 52/M    | 6/89                      | 16              | 11/89               | Tenckhoff catheter reinserted 
|             |         |                           |                 |                     | but ultrafiltration capacity 
|             |         |                           |                 |                     |lost; patient maintained on 
|             |         |                           |                 |                     |hemodialysis                 |
| 4           | 38/F    | 11/89                     | 48              | 8/90                | Tenckhoff catheter reinserted 
|             |         |                           |                 |                     | but ultrafiltration capacity 
|             |         |                           |                 |                     |lost; patient maintained on 
|             |         |                           |                 |                     |hemodialysis                 |

a ESI, exit site infection.  
b At time of ESI.

TABLE 3. Patients requiring catheter removal to cure exit site infection

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age/Sex</th>
<th>Date of ESIa</th>
<th>Months on CAPDb</th>
<th>Outcome and Current Treatment</th>
</tr>
</thead>
</table>
| 1           | 77/F    | 8/89         | 20              | Developed tunnel infection re-
|             |         |              |                 | quiring removal of the cath-
|             |         |              |                 | ether; catheter reinserted, 
|             |         |              |                 | and recurrent pseudomonas 
|             |         |              |                 | ESI developed but resolved 
|             |         |              |                 | with therapy; remains on 
|             |         |              |                 | CAPD                           |
| 2           | 67/F    | 5/90         | 5               | Developed tunnel infection re-
|             |         |              |                 | quiring removal of the cath-
|             |         |              |                 | ether; catheter reinserted 
|             |         |              |                 | and remains on CAPD            |
| 3           | 50/M    | 7/90         | 10              | Catheter removed for severe 
|             |         |              |                 | ESI not responding to a week 
|             |         |              |                 | of antibiotics; catheter 
|             |         |              |                 | reinserted and remains on 
|             |         |              |                 | CAPD                           |

a ESI, exit site infection.  
b At time of ESI.

Pseudomonas Exit-Site Infections in CAPD Patients

mately 14% of patients discontinue CAPD therapy primarily because of exit site-related problems (2). The natural course of exit site infections and subsequent tunnel infections and/or peritonitis has been examined in previous studies (6–8). For example, Piraino et al. stressed the association between exit site infections and peritonitis, tunnel infections, catheter loss, and subsequent transfer to hemodialysis (7,8). The authors noted that 17% of episodes of peritonitis were associated with exit site infections (8). This association between exit site infections and peritonitis is perhaps best established for Staphylococcus aureus infections. Zimmerman et al. reported a strikingly high incidence of S. aureus peritonitis developing in those patients who had previous S. aureus exit site infections (9).

The study presented here examines the course of P. aeruginosa exit site infections treated with careful local care and oral ciprofloxacin therapy. Fifteen (83%) of 18 pseudomonas exit site infections resolved with this treatment. However, 4 of these 15 patients subsequently developed P. aeruginosa peritonitis 2 to 9 months after the clinical resolution of their exit site infection. Although it is not clear that this peritonitis was in fact related to the previous exit site infection, it seems possible that clinically silent residual infection at the exit site, along the catheter tract, within the catheter lumen, or about the dacron cuff of the Tenckhoff catheter may have been present. This residual infection may have been responsible for the subsequent peritonitis. Alternatively, the impairment in host defense mechanisms as suggested by Keane (10) and Zimmerman et al. (9) may have made these patients particularly sensitive to pseudomonas infections.

In conclusion, the majority of pseudomonas exit site infections in CAPD patients can be successfully
treated with oral ciprofloxacin and local care. Approximately 18% of patients will require catheter removal to successfully eradicate the infection and an additional 22% of patients are at risk of developing pseudomonas peritonitis several months after the resolution of the exit site infection.

REFERENCES

"The latest challenge to the versatility of the kidney is surgical transplantation, during which it is permanently deprived of its nerve supply, partially asphyxiated and placed in an immunologically hostile environment. Here, it is expected to respond to physiologic stimuli of a new host, and begin at once to regulate and defend the alien milieu."