Peritoneal catheter removal may be clinically indicated in the management of peritonitis. The data on the course of patients undergoing peritoneal catheter reinsertion after removal for peritonitis are limited. The present study was designed to examine what happens to patients on chronic peritoneal dialysis (CPD) after peritoneal catheter removal for peritonitis.

We retrospectively reviewed the charts of patients who developed peritonitis between January 1, 1990, and September 1, 2002. We identified 1146 episodes of peritonitis; in 189 of the episodes (16%), the peritoneal catheter was removed. Catheters were reinserted in 88 of those patients (47%). Reasons for peritoneal catheter removal among the 88 patients who underwent peritoneal catheter reinsertion included unit protocol (51%), poor response to antibiotics (46%), and exit-site or tunnel infection (3%). Reasons for peritoneal catheter removal among the 101 patients in whom the peritoneal catheter was not reinserted included unit protocol (62%), poor response to antibiotics (20%), and extensive history of peritonitis (18%). After reinsertion, the new peritoneal catheter remained in place for a mean of 15.4 ± 15.4 months (range: 1 – 75 months). In 37 of the 88 patients with reinserted peritoneal catheters (42%), the catheters remained in place for longer than 1 year. The remaining 6 patients underwent transplantation or were transferred to another facility. Of the remaining 51 patients whose new peritoneal catheters lasted for less than 1 year, 13 (25.5%) died, and 32 (63%) were transferred permanently to hemodialysis. Of the 101 patients who did not have a peritoneal catheter reinserted, 23 (23%) died within the 2-week period following the onset of peritonitis. The rest were transferred to hemodialysis. The reasons noted for not reinserting the peritoneal catheter included frequent episodes of peritonitis, patient unwillingness to retry CPD therapy, psychosocial reasons, bowel perforation, or transfer to an institution unable to perform CPD therapy.

We conclude that, among patients who medically require peritoneal catheter removal because of peritonitis, few will successfully return to long-term CPD therapy. Of the patients who required peritoneal catheter removal in our study, 23% died within the first 2 weeks after the onset of peritonitis, before catheter reinsertion could be considered. Only 47% of the patients underwent a successful catheter reinsertion; and, of those, only 34% remained on CPD therapy 1 year later. Thus, only 20% of patients undergoing PD catheter removal remain on CPD therapy 1 year after catheter removal.

Key words
Outcome, peritonitis, peritoneal catheter removal/reinsertion

Introduction
The percentage of end-stage renal disease (ESRD) patients maintained on chronic peritoneal dialysis (CPD) therapy in the United States over the past decade has been declining. The 2004 United States Renal Data System database notes that CPD therapy was used for less than 9% of all patients with ESRD in 2002 (1).

Technique failure remains a major problem in CPD therapy, and peritonitis is the leading cause of technique failure (2). The International Society for Peritoneal Dialysis (ISPD) has devoted careful attention to the treatment of peritonitis, publishing specific treatment guidelines for peritonitis at regular intervals (3).
The ISPD recommends an intraperitoneal antibiotic approach for most episodes of peritonitis, and more than 80% of peritonitis episodes are successfully treated using that approach (2–4). However, it becomes necessary to consider peritoneal catheter removal for certain types of peritonitis. For example, most patients developing peritonitis with *Pseudomonas*, fungi, mycobacterium, and vancomycin-resistant enterococci (VRE) peritonitis require peritoneal catheter removal to eradicate the infection (5–7). Also, for patients with recurrent peritonitis with the same organism, the peritoneal catheter is often removed to eradicate the infection and to prevent subsequent episodes.

We therefore wondered about the outcomes of patients who require peritoneal catheter removal for the treatment of peritonitis. What percentage of patients whose catheters are removed restart CPD therapy? In what percentage of such patients do new catheters work effectively?

**Patients and methods**

We retrospectively reviewed the charts of all patients maintained on CPD therapy between January 1, 1990, and September 1, 2002. We identified patients whose peritoneal catheter had been removed as part of therapy for an episode of peritonitis. From those charts, we extracted basic demographic data, the isolated organism, and the reason for peritoneal catheter removal. We also noted whether a peritoneal catheter had been reinserted, and the reasons for a peritoneal catheter not being reinserted. We noted events such as transfer to hemodialysis or death after the peritoneal catheter had been removed and after a new catheter had been inserted. The outcome of patients transferred to hemodialysis could not be adequately determined.

All patients who developed peritonitis during the study period and who underwent subsequent peritoneal catheter removal were treated with appropriate antimicrobial therapy for at least 14 days after removal of the catheter. Patients were maintained on hemodialysis therapy during that period. The patient’s outcome (permanent transfer to hemodialysis or continuation of CPD therapy) was not documented until the patient completed the course of antimicrobial therapy. The outcome of the patients who underwent peritoneal catheter reinsertion was followed for the duration of the study period. Death was documented as it occurred.

At completion of the antimicrobial therapy, the patient care team performed a clinical assessment to determine if the patient could have a peritoneal catheter reinserted. A decision not to reinsert a peritoneal catheter would be made for any of four general reasons:

- “Peritonitis burden” was noted if the patient had an extensive history of peritonitis, was unwilling to retry CPD therapy, or was advised not to resume CPD therapy because of technique problems.
- The patient had sustained a bowel perforation.
- The staff felt that psychosocial reasons precluded retrying CPD therapy.
- The patient was transferred to a facility unable to perform CPD therapy.

The reasons for peritoneal catheter removal were noted:

- “Protocol” was given as the reason in cases in which the peritoneal catheter was removed because of our unit’s policy to remove the catheter when *Pseudomonas*, yeast, or VRE are isolated from the peritoneal culture.
- “Antibiotic failure” was given as the reason when the patient did not clinically respond to appropriate antimicrobial therapy within 5 days of the onset of peritonitis.
- “Exit-site/tunnel infection” was given as the reason when either or both of those infections occurred in association with peritonitis.
- “Recurrent” or “repeat” peritonitis was given as the reason when patients showed a pattern of peritonitis episodes. “Recurrent peritonitis” was defined as development of peritonitis with the same organism and same sensitivity pattern within 4 weeks after completion of antimicrobial therapy for a previous episode. “Repeat peritonitis” was defined as a patient developing peritonitis with the same organism and same sensitivity pattern more than 4 weeks after completion of antimicrobial therapy for a previous episode.

**Results**

We identified 1146 episodes of peritonitis. The peritoneal catheter was removed in 189 of those episodes (16%). The peritoneal catheter was reinserted in 88
of the patients (47%); the other 101 patients (53%) did not undergo catheter reinsertion.

Reasons for peritoneal catheter removal
Table I outlines the reasons for peritoneal catheter removal in all of the study patients. Catheters were removed in 57% of the cases because of our facility policy to remove catheters for selected infections (see “Patients and methods”). Another 32% of the catheters were removed because of antibiotic treatment failure. An exit-site or tunnel infection associated with peritonitis led to 3% of the catheter removals. And clinicians decided to remove the peritoneal catheter in 18% of the patients because of a history of recurrent or repeat peritonitis.

Outcome of patients undergoing peritoneal catheter reinsertion
At completion of antimicrobial therapy, 88 patients underwent peritoneal catheter reinsertion. The new peritoneal catheters remained in place for a mean of 15.4 ± 15.4 months (range: 1 – 75 months). Of the patients undergoing peritoneal catheter reinsertion, 37 (42%) were still on CPD therapy 12 months later. The remaining 51 patients (58%) stayed on CPD therapy for less than 12 months. Of the 51, 32 (63%) were transferred permanently to hemodialysis. Another 13 (26%) died in the 12-month period following the procedure to reinsert the peritoneal catheter. The remaining 6 patients either underwent transplantation or were transferred to another facility.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Reinserted (n = 88)</th>
<th>Not reinserted (n = 101)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>45 (51%)</td>
<td>63 (62%)</td>
</tr>
<tr>
<td>Antibiotics failed</td>
<td>40 (46%)</td>
<td>20 (20%)</td>
</tr>
<tr>
<td>Exit-site/tunnel infection</td>
<td>3 (3%)</td>
<td>—</td>
</tr>
<tr>
<td>Recurrent/repeat peritonitis</td>
<td>—</td>
<td>18 (18%)</td>
</tr>
</tbody>
</table>

TABLE II Reasons for not reinserting a peritoneal catheter

<table>
<thead>
<tr>
<th>Reason</th>
<th>(n = 101)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burden of peritonitis</td>
<td>52 (52%)</td>
</tr>
<tr>
<td>Psychosocial reasons</td>
<td>18 (18%)</td>
</tr>
<tr>
<td>Bowel perforation</td>
<td>5 (5%)</td>
</tr>
<tr>
<td>Death</td>
<td>23 (23%)</td>
</tr>
<tr>
<td>Transfer to an ECF unable to do CPD</td>
<td>2 (2%)</td>
</tr>
</tbody>
</table>

ECF = external care facility; CPD = chronic peritoneal dialysis.

Outcome of patients not undergoing peritoneal catheter reinsertion
Table II notes the reasons that a catheter was not reinserted in 101 patients who had their peritoneal catheter removed. In 52 patients, the “burden of peritonitis” (see “Patients and methods”) was cited as the major reason not to reinsert a catheter. For 18 patients, psychosocial factors were cited as the primary reason. A total of 23 patients died within the 4-week period after removal of their peritoneal catheter.

Discussion
Peritonitis is the leading cause of technique failure among patients maintained on CPD therapy (2,3). In general, intraperitoneal antibiotics alone successfully eradicate peritonitis in 84% – 88% of peritonitis episodes. Removal of the peritoneal catheter becomes necessary in about 16% of peritonitis episodes. The present study suggests that once the peritoneal catheter is removed to treat an episode of peritonitis, successful resumption of CPD therapy on a long-term basis is not likely; only 20% of our patients were still on CPD therapy 12 months after catheter removal.

Our findings accord with the findings of Szeto et al. (8). That group reviewed the outcome of 100 episodes of peritonitis in which the peritoneal catheter was removed because of failure of peritonitis to clear after 10 days of appropriate antibiotics. Reinsertion of the peritoneal catheter and resumption of CPD therapy was successful in 51 patients (51%); the attempt to reinsert the peritoneal catheter was unsuccessful in the other 49 patients, who were transferred permanently to hemodialysis. Of the 51 patients who underwent successful reinsertion of the peritoneal catheter, only 13 remained on CPD therapy at 24 months.

In our study, 47% of the patients who underwent peritoneal catheter reinsertion successfully restarted CPD therapy. We noted that 23% of the patients died 2 weeks after peritoneal catheter removal, before catheter reinsertion could be considered; another 26% of patients died in the first year after a peritoneal catheter was reinserted.

Conclusions
The technique failure observed for CPD therapy after peritoneal catheter removal for peritonitis becomes necessary is high. This finding needs to be further examined in a prospective multicenter evaluation.
References


Corresponding author:
Fredric Finkelstein, MD, 136 Sherman Avenue, New Haven, Connecticut 06511 U.S.A.
E-mail:
fof@comcast.net