A Comparison of the Effects of Two Antiseptic Agents on *Staphylococcus epidermidis* Colony Forming Units at the Peritoneal Dialysis Catheter Exit Site

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*Peritonitis is the most common complication of peritoneal dialysis (PD). Staphylococcus epidermidis (S. epi), a common skin organism, is the microorganism that is identified in the majority of episodes of peritonitis. The PD catheter breaks the natural skin barrier and allows a periluminal migration of bacteria from the skin surface into the sterile peritoneal cavity.*

Exit site care is routinely performed to decrease the colony counts of microorganisms on the skin surrounding the PD catheter. Research data is limited to support any of the currently used protocols for exit site care. This study compared the effect of two antiseptic agents, povidone-iodine (P-I) and chlorhexidine gluconate (CG), on *S. epi* colony forming units (cfu) at the PD catheter exit site over a 24 hour period.

Because the distribution of the research data was markedly non-normal, a descriptive approach was used to interpret the data. Results showed that there was no difference between P-I and CG immediately after exit site care. All patients had zero growth at Time 1. One trend that emerged was that at 24 hours after exit site care with P-I, more patients (54%) had *S. epi* cfu than did patients (15%) cleaned with CG.

**Key words**
Exit site, exit site infections, *Staphylococcus epidermidis*, antiseptics, povidone-iodine, chlorhexidine gluconate

**Introduction**
Peritonitis is the most common complication of peritoneal dialysis (PD). *Staphylococcus epidermidis* (*S. epi*), a common skin organism, is the microorganism that is identified in the majority of episodes of peritonitis. The PD catheter breaks the natural skin barrier and allows a periluminal migration of bacteria from the skin surface into the sterile peritoneal cavity. Exit site infections and tunnel infections are the sources from which microorganisms invade the peritoneal cavity by the periluminal route (1,2). However, the relationship of periluminal infection to peritonitis and catheter loss is unknown (3).

Exit site care is routinely performed to decrease the colony counts of microorganisms on the skin surrounding the PD catheter. Different techniques and various antiseptic agents have been suggested for performing exit site care (Table 1), but no study could be found that discussed reduction in skin colony counts in relation to antiseptic agents and exit site infection. The purpose of this study was to compare the reduction of skin colony counts of *S. epi* around the PD catheter as a result of using two antiseptic agents, chlorhexidine gluconate (CG) and povidone-iodine (P-I).

**Methods**
This was a prospective study approved by the Institutional Review Board. After obtaining informed consent, hospitalized patients (*N = 13*) were randomized into two groups. Each patient in the study had his or her PD catheter cleaned with
### Table I: Comparison of exit site care protocols

<table>
<thead>
<tr>
<th>Author</th>
<th>Location</th>
<th>Postoperative protocol</th>
<th>Routine protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloe et al.</td>
<td>University of Missouri-Columbia</td>
<td>Soap and water twice daily P-I or hydrogen peroxide if exit site irritated</td>
<td>Antibacterial soap or P-I; Optional dressing</td>
</tr>
<tr>
<td>Prowant</td>
<td>University of Missouri-Columbia</td>
<td>P-I every 48 hours with a sterile dressing</td>
<td>Daily soap and water; Optional dressing</td>
</tr>
<tr>
<td>Piraino et al.</td>
<td>University of Pittsburgh</td>
<td>P-I followed by hydrogen peroxide or alcohol; with a sterile dressing</td>
<td>Soap and water during shower; followed by painting with P-I</td>
</tr>
<tr>
<td>Clayton et al.</td>
<td>Toronto</td>
<td></td>
<td>CG followed with a rinse (unknown) Stabilizing dressing</td>
</tr>
<tr>
<td>Bay et al.</td>
<td>Ohio State University</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Both P-I and CG. Therefore, each patient served as his or her own control. Controlled exit site care was performed on two consecutive days. Group 1 was cleaned on Day 1 with P-I and CG on Day 2. Group 2 was cleaned on Day 1 with CG and P-I on Day 2. Before inclusion in the study, each patient had his or her exit site cleaned with P-I within the preceding 24 hours. This exit site cleaning was not controlled. Exclusion from the study included patients with a diagnosis of an exit site infection or those patients found to have drainage from the exit site during the routine cleaning procedure. Patients with known hypersensitivity to either P-I or CG were not asked to participate.

Prior to exit site care on Day 1, all patients had two baseline skin cultures performed. The two areas cultured for baseline data included the exit site (Time 0) and a miscellaneous area (Misc) of the abdomen not routinely cleaned with any antiseptic. After the exit site was cleaned on Day 1 and Day 2, a skin culture was done immediately (Time I), in 8 hours ± 15 minutes (Time II), and in 24 hours ± 30 minutes (Time III). Following participation in the study, all patients used P-I, their routine antiseptic agent, for exit site care.

Controlled catheter care was performed as stated in the “Procedure for Chronic Peritoneal Dialysis” (8). The exit site was considered as the area that had a radius of 2.5 cm. from the point where the PD catheter exited the skin. The culture was performed using a Culturette (Marion Scientific) moistened with Stuart’s bacterial transport medium and swabbed on the skin of the exit site in three different directions. The sample was immediately immersed in 5 cc of trypticase soy broth, vortexed for 1 minute and a 1 ml sample placed on sheep blood agar. The culture was incubated at 35°C for 48 hours. Culture plates that had no growth were recorded as 0 growth. Colony forming units (cfu) were counted as single entities (1, 2, etc.). Overgrowth on the culture plate was recorded as >500 cfu.

**Patients**

The sample (N = 13) was composed of 8 females (62%) and 5 males (38%). Ages ranges from 34 to 79 years with a mean age of 51 years. Twelve patients had single cuff Tenckhoff catheters; the 13th patient had a double cuff Tenckhoff catheter. The range for the length of time on PD was 1 to 1757 days with a mean of 321 days (±490.5 days). The median for the length of time on PD was 103 days.

Five patients in the sample were admitted with peritonitis. Table II provides an overview of the sample with regard to history of infection, catheter removal, and isolated organisms for the current episode of peritonitis. Forty-six percent of the sample (N = 6) had not had an episode of peritonitis. Fifteen episodes of peritonitis were separated in patients who had been on PD for 400 days or longer. Only one patient in the sample had ever had an exit site infection.

**Results**

Paired t tests and ANOVA were to have been used
to analyze the data. After data collection, however, the decision was made to use only descriptive analysis because the data violated assumptions of a normally distributed dependent variable.

Table II describes the results of the cultures for the sample. All patients had S. epi cfu on the Misc culture. The low S. epi cfu from patient's #5, #7, and #8 were attributed to the preoperative scrub of the abdomen prior to insertion of the PD catheter. It is unknown why patient's #12 and #13 had low S. epi cfu on the Misc culture.

Time 0 was a baseline culture performed prior to cleaning the exit site. Overall, there were 3 patients (23%) with S. epi cfu at Time 0.

At Time I on both Day 1 and Day 2, in both groups, there were no cfu of S. epi. It was hypothesized that at Time I there would be no growth or very little growth of S. epi (9,10).

At Time II, one patient in Group I had S. epi cfu after P-I, but not CG. Also, one patient in Group II had S. epi cfu after CG, but not P-I. In this sample, even without testing, it appears there was no difference in P-I or CG 8 hours after exit site care.

At Time III, Day 1, in Group 1, there were 4 patients (57%) who exhibited growth of S. epi cfu. However, at Time III, Day 2, in Group 1, no patient had any growth. It appears that there was a difference between P-I and CG in Group 1, but this difference cannot be reported as significant.

In Group 2, Day 1, at Time III, two patients (33%) had growth of S. epi after cleaning with CG. At Time III, Day 2, Group 2 had 3 patients (50%) had growth of S. epi after cleaning with P-I.

When the total sample was compared without regard to groups, there were seven patients (54%) who had growth of S. epi at Time III after cleaning with P-I versus two patients (15%) with S. epi cfu after exit site care with CG. This difference was not tested for significance; however, a trend is seen in the data that suggests that more patients grew S. epi cfu 24 hours after P-I cleaning than did patients 24 hours after cleaning with CG.

Discussion
A foreign body’s exit site through the skin is the most vulnerable point in regard to survival of a transcutaneous prosthetic device (11). Because S. epi, the major organism responsible for peritonitis (12), is a major organism responsible for exit site infections (2) and is also the most common staphylococcal species isolated from cutaneous sites (13), the present study focused on the reduction of S. epi using two antiseptic agents, P-I and CG.

Currently, P-I is more frequently used for exit site care than other antiseptic agents. Because of studies supporting CG as more effective than P-I as an antimicrobial agent (9,10), it was hypothesized that CG might have been more effective than P-I in reducing S. epi cfu at Time II and Time III.

Even without statistical analysis, there appeared to be no difference between P-I and CG at Time I and II. At Time III, in Group 1, 2 patients had overgrowth (>500 cfu) of S. epi cfu after cleaning with P-I, and zero growth after CG. Observation for
### Table III: Reports of *S. epidermidis* CFU for the sample

<table>
<thead>
<tr>
<th>Patient #</th>
<th>Misc.</th>
<th>Time 0</th>
<th>Day 1 = P-I</th>
<th>Day 2 = CG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time II</td>
<td>Time III</td>
<td>Time 1</td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>&gt;500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>&gt;500</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>136</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>&gt;500</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&gt;500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>&gt;500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>&gt;500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>57</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>&gt;500</td>
<td>24</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>&gt;500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Possible explanation included a suture at the exit site in one patient, strongly advised against by Tenckhoff and Schechter (14), and dry, scaly skin in the other patient, a common phenomenon in renal patients (15). Further studies are needed to define a possible relationship between identifiable high-risk factors, exit site infection, and antiseptic usage in a high-risk group.

Limitations of the study include the small sample size and the lack of statistical analysis. Recommendations include replication of the study with a larger sample, inclusion of identified high-risk variables (dry, scaly skin, sutures, etc.), and a longitudinal study with dependent variables of exit site infection rate and episodes of peritonitis.

Exit site infection remains a significant risk factor for development of peritonitis and for catheter morbidity. Causes for exit site infection are multifactorial and only a few have been identified. A trend noted in the study, that more patients (54%) had *S. epi* cfu 24 hours after exit site care with P-I than did patients (15%) cleaned with CG, may indicate that antiseptic usage should be considered as a possible means to prevent exit site infection.

**Acknowledgment**

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**References**

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