Simultaneous peritoneal dialysis catheter insertion and removal in catheter-related infections without interruption of peritoneal dialysis

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Abstract Catheter-related infections result in high patient morbidity, the need for temporary haemodialysis, and high costs. These infections are the main cause of limited technique survival in peritoneal dialysis. We introduced a protocol for the simultaneous peritoneoscopic insertion and removal of peritoneal catheters in patients with catheter-related infections. Peritoneal dialysis was continued the day after surgery using low-volume dwells and a dry abdomen during the daytime. The dialysate leukocyte count had to be below 100/mm³ before exchanging catheters, which was performed under antibiotic therapy based on culture sensitivity. The old catheter was removed after the new catheter had been inserted in the opposite abdominal region. CAPD patients were switched to APD for 1 week, which made prolonged hospitalization necessary.

Simultaneous catheter insertion and removal was performed 25 times in 22 patients on CCPD and 15 times in 14 patients on CAPD. In CCPD patients, peritoneal dialysis was restarted after 1.0 ± 0.1 days in 24 cases. One patient had sufficient residual renal function and discontinued CCPD until day 10. In 10 CAPD patients (11 procedures) APD was started 1.3 ± 0.2 days after the procedure with CAPD beginning 7.1 ± 0.6 days thereafter. Three CAPD patients preferred haemodialysis and restarted CAPD 10.0 ± 2.1 days after surgery. One patient continued CAPD the day after surgery. In addition to minor complications (e.g. position-dependent outflow problems), dialysate leakage occurred in two patients. Two patients developed peritonitis within the first 30 days after surgery, one of which was procedure related. One patient had severe lower gastrointestinal bleeding 2 weeks after the procedure, which was not related to the catheter replacement. Ultimately, in 38 of 40 procedures the patients could successfully continue peritoneal dialysis.

We conclude that simultaneous insertion and removal of a peritoneal dialysis catheter without interruption of peritoneal dialysis is a safe procedure in patients with catheter-related infections.

Key words: CAPD; catheter-related infections; CCPD; dialysate leakage; dialysis; peritoneoscopy; Pseudomonas

Introduction

Since its introduction in the 1980s, continuous peritoneal dialysis (PD) has become an important part of the Dutch renal replacement programme, with 28% of the patients being treated by this method [1]. Catheter-related infections (i.e. peritonitis and exit/site/tunnel infections) remain the principal complication, being responsible for 68% of all catheters lost [2]. In patients with peritonitis combined with an exit-site infection, catheter removal and temporary (hospital) haemodialysis are recommended [3,4]. After resolution of peritonitis and healing of the exit site, a new catheter can be inserted usually after 1–2 weeks into a different site. If the catheter is removed because of frequent recurrence of peritonitis with the same organism, it is recommended that a new catheter be inserted 3 weeks after successful termination of peritonitis [3].

Catheter insertion and removal in the same session has been reported in patients with refractory peritoneal dialysis infections and in patients with mechanical problems [5–15]. However, caution is advised, and the technique should not be used in patients with fungal, Pseudomonas, mycobacterium, or faecal infection [3,16]. In several papers PD was probably continued after the catheter exchange procedure, but it was often incompletely described [3,6,8,12,14,15]. Temporary haemodialysis was employed in one report [10].

We developed a protocol for simultaneous catheter insertion and removal in patients with catheter-related infectious problems, aiming to continue peritoneal dialysis without a temporary shift to haemodialysis. Patients were excluded from the protocol in case of refractory peritonitis, faecal peritonitis, and non-
bacterial peritonitis. This report describes the results of 40 procedures in 36 patients.

**Subjects and methods**

Starting in 1992, all patients who needed PD catheter removal due to catheter-related infections were entered in our non-randomized protocol after informed consent had been obtained. During the study period, 60–70 patients were treated with PD. Simultaneous catheter replacement was performed 25 times in 22 patients on CCPD (M/F 13/8; mean age 44 ± 3 years) and 15 times in 14 patients on CAPD (M/F 10/6; mean age 53 ± 4 years).

Indications for the procedure included all bacterial peritonitis episodes combined with an exit-site infection with the same organism, relapsing peritonitis, suspected catheter contamination (i.e. persistent positive dialysate cultures without clinical signs of peritonitis and a dialysate leukocyte count < 100 mm3) and chronic exit site/tunnel infections (Table 1). Patients with refractory peritonitis (i.e. persistent clinical signs and elevated leukocyte count), faecal peritonitis, and fungal or non-bacterial peritonitis were excluded from participation.

The procedure was performed only when the dialysate leukocyte count was < 100 mm3. Thus, in patients with peritonitis the procedure was done after resolution of clinical signs of peritonitis and after normalization of the leukocyte count while antibiotic therapy based on culturesensitivity results was continued. Intraperitoneal antibiotic treatment was continued for 10 days after the dialysate leukocyte count was < 100 mm3, or for 7 days after surgery when the procedure was postponed for logistic reasons. Patients with Pseudomonas peritonitis were treated for at least 21 days. Similarly, in patients with persistent exit-site infection the procedure was performed under antibiotic therapy based on culture sensitivity which was continued for 7–10 days after the procedure. In case of exit-site and/or tunnel infection, the abdominal wound of the removed catheter was not sutured, to avoid development of abdominal wall abscesses due to deeper located infection.

Under general anaesthesia and using a peritoneoscopic insertion technique (Y-Tec Scope, Medigroup Inc., N. Aurora, IL, USA) a two-cuff swan-neck Tenckhoff straight catheter was placed at the opposite site of the abdominal wall [17]. Subsequently the old catheter was removed. We were careful not to flush the infected tunnel with solution once the old catheter was removed. The new catheter (‘clean step’) was placed before removal of the old catheter (‘dirty step’) in order to further reduce the risk of infection [9,16].

After the surgical procedure, peritoneal dialysis was interrupted for one night. The next day patients were treated in a supine position with automated peritoneal dialysis (APD) using frequent dialysis cycles (≥ 6 dwells) with 1-litre fill volumes without a daytime dwell (thus performing NIPD). This protocol was an attempt to minimize the pressure on the abdominal wall in order to support healing of the two wounds and to reduce the risk of fluid leakage. After 3 days the fill volumes were gradually increased. After 7 days, daytime dwells of 1 litre were reintroduced and the volume was gradually increased. CAPD patients were hospitalized for 1 week because of the temporary APD treatment. Patients with sufficient residual renal function did not receive APD and were closely monitored in an attempt to bridge the first week. The results are expressed as mean SEM.

**Results**

Simultaneous peritoneoscopic insertion and removal of peritoneal catheters was performed 25 times in 22 patients on CCPD and 15 times in 14 patients on CAPD (Figure 1). One CCPD patient had sufficient residual renal function to temporarily discontinue CCPD. In the other 24 cases, patients were started on APD after 1.0 ± 0.1 days postsurgery. Four of the 14 CAPD patients did not wish to stay in the hospital for APD treatment. Three of these patients were temporarily treated by haemodialysis. After 10.0 ± 2.1 days, these three patients uneventfully resumed CAPD. One patient chose to restart CAPD the day after surgery. In the remaining 11 cases, APD was begun 1.3 ± 0.2 days after the procedure. Those patients returned to CAPD after 7.1 ± 0.6 days of APD treatment. The CAPD patients treated with APD left the hospital 8.8 ± 1.1 days postsurgery, while the other CAPD patients left the hospital at 3.4 ± 0.8 days. The CCPD patients left the hospital at 3.7 ± 0.6 days.

Of the 32 patients (36 procedures) who continued PD after surgery, complications occurred in eight. Position-dependent obstruction of outflow occurred three times, but the patients managed to continue APD. The patient who had resumed CAPD on the first day developed dialysate leakage through the tunnel. Subcutaneous dialysate leakage occurred in a second patient who continued APD treatment including a daytime dwell immediately after surgery. Both patients were able to continue PD; they were treated by haemodialysis for 2 weeks. Two patients developed peritonitis within 30 days of the procedure. The procedure was performed in the first patient because of a combined E. coli peritonitis and exit-site infection. The second episode of peritonitis was due to coagulase-negative Staphylococci. The second patient developed peritonitis immediately after the procedure and was treated for coagulase-negative Staphylococci. *Pseudomonas aeruginosa* was the causative organism, which later appeared to grow from the old exit site as well. The catheter was removed because of relapsing and refractory peritonitis and a new catheter could not

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<tr>
<th>Location and type of infection</th>
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<td>22 exit-site infections (ESI)</td>
<td>12. Staphylococcus aureus</td>
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<td>6. Escherichia coli</td>
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<td></td>
<td>1. Pseudomonas aeruginosa</td>
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<td>1. fungal (non-Candida)</td>
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<td>15 peritonitis and ESI</td>
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<td>1. Coagulase-negative Staphylococci</td>
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<td>2 Coagulase-negative Staphylococci catheter colonizations</td>
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be inserted later because of intra-abdominal adhesions. One patient required surgery secondary to severe gastrointestinal bleeding 2 weeks after the procedure, during which time he lost his catheter. Until that time APD had been successfully continued.

In 568 patient months, there were 40 exit-site infections and 28 peritonitis episodes (i.e., 1 per 14.2 and 1 per 20.3 months). At present, 17 catheters are still functioning. Six catheters were removed after successful renal transplantation, 13 because of infection not related to the original event, there was one refractory peritonitis, three patients died, and one catheter was removed during abdominal surgery.

Discussion

Until now, simultaneous peritoneal dialysis catheter replacement and removal has been reported in 23 cases performed for mechanical reasons [8] and in 294 cases for PD-related infectious complications, including refractory and frequently relapsing peritonitis, persistent exit-site infections, and peritonitis combined with exit-site or tunnel infections [5–15]. The technical procedures reported are diverse, and sometimes incompletely described [6,12–15]. All authors performed the procedure under appropriate antibiotic therapy. Only one report described implantation of the new catheter through the original midline scar, and insertion of the new catheter through the existing peritoneal insertion site in 12 resistant peritonitis episodes [5]. The subcutaneous tunnel and exit site were fashioned on the side of the abdomen opposite to the previous exit site. Infectious complications were not encountered, one patient had dialysate leakage, and one patient wanted to change to haemodialysis when his new catheter failed mechanically. All other reports either did not describe their procedure completely or inserted the new catheter at the opposite abdominal side. Some authors preferred to take the old catheter out before insertion of the new catheter [5,7], one author preferred the opposite procedure [9] and detailed information was not available in several other reports [10,12–15]. In a recent report it was advised to first place the new catheter in a different quadrant of the abdomen, then remove the infected catheter, being careful not to flush the infected tunnel once the catheter is removed [16]. It cannot be discerned exactly from the literature whether PD was continued immediately after surgery. Temporary haemodialysis is sometimes used [10].

From the above-mentioned reports the exact number of complications cannot be established, but in at least 37 patients (and possibly in 44) the infection did not resolve after the procedure (12–15%). Mechanical problems occurred in at least 24 patients and PD was interrupted in at least 68 patients (21%). Refractory peritonitis was reported 46 times [5–9,12,15]. Notably, in these patients recurrent peritonitis occurred in 12 cases (26%). A few major complications occurred utilizing a percutaneous blind insertion technique [8].

In our study, patients with a 25% chance of recurrent infection (after refractory peritonitis) were excluded from the procedure. PD was successfully continued in 39 cases. One catheter had to be removed because of recurrent peritonitis with Pseudomonas aeruginosa. The only two patients with a daytime dwell following the procedure experienced dialysate leakage. In two other patients in whom the catheter exchange procedure was done under culture-guided antibiotic therapy, catheter-related infection occurred shortly after surgery. The microorganisms causing the latter infections appeared to be other than those at which the antibiotic therapy was aimed. One patient was treated successfully with intraperitoneal antibiotics. The other patient was the one who lost his catheter due to refractory peritonitis caused by Pseudomonas aeruginosa which had evolved immediately after the surgical procedure (performed because coagulase-negative Staphylococcus catheter colonization was suspected).
Uninterrupted peritoneal dialysis after PD catheter switch procedure

Pseudomonas infection often persists or relapses despite aggressive therapy, necessitating catheter removal [18]. Peritoneal rest is often recommended before placement of a second catheter [2,3,16]. In our nine patients infection did not relapse in any case (Table 1).

Simultaneous PD catheter insertion and removal has several advantages. It reduces the requirement for temporary haemodialysis, and consequently reduces the risks related to temporary vascular access. It saves a second surgical procedure to reinsert a PD catheter. In addition, it may prevent the formation of adhesions in the peritoneal cavity and enables intraperitoneal antibiotic treatment. Another advantage seems to be shorter antibiotic treatment in the switch patients [13]. However, prolonged hospitalization is necessary in CAPD patients with a temporary decrease in dialysis efficacy.

In the Netherlands, the cost of PD is 62.5% that of haemodialysis (three times a week: Dfl 1050 vs 1680 per week respectively). Hospital admission in our centre costs approximately Dfl 1065 a day (i.e. $540 US). Costs for radiology, surgery, operating-room, and anaesthesiologist have to be paid in addition. In our hospital it takes at least 3 weeks before a patient can be rescheduled for non-emergency surgery. In this study the CAPD patients left the hospital at day 3.4 ± 0.8 and the CAPD patients treated with APD left the hospital at day 8.8 ± 1.1 after surgery. This results in a Dfl 5751 increase in costs. However, 3 weeks of treatment while waiting for the second operation to insert a new catheter is Dfl 1890 more expensive, resulting in a difference of Dfl 3861. Therefore the simultaneous placement and removal of a catheter for PD is more economical than performing two separate procedures.

Conclusion

Simultaneous insertion and removal of a PD catheter without interruption of peritoneal dialysis is a safe procedure in the majority of patients with catheter-related infections, provided precautions to reduce the risk of leakage (i.e. no daytime dwell) and infection (i.e. antibiotic therapy based on culture sensitivity) are adhered to.

References

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