STRUCTURED OUTPATIENT PERITONEAL DIALYSIS CATHETER INSERTION IS SAFE AND COST-SAVING

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◆ **Background:** Data about outcomes and costs for peritoneal catheter insertion on an outpatient basis are scarce.

◆ **Methods:** Using patient files, all peritoneal dialysis (PD) catheter insertions performed between 2004 and 2009 in a single-center tertiary care institution for adult patients were located. Patient demographics, complications, hospitalizations, survival, and treatment modality changes were recorded. Procedure-related expenses were valued as actual production costs.

◆ **Results:** During the study period, 106 PD catheters were inserted. In 46 cases, the patients were admitted electively for catheter insertion; 19 catheters were placed during admission for other medical reasons; and 41 catheters were placed on an outpatient basis. Among the study patients (54.7 ± 16.0 years of age), 45% were diabetic. Early (<30 days) catheter-related complications occurred in 22% of patients. The incidences of technique failure and any complication within 90 days were 10% and 38% respectively. The occurrence of complications was not statistically significantly different for outpatients and electively admitted patients. Average costs for catheter insertion were higher in electively hospitalized patients than in outpatients ($\text{€}2320 \pm \text{€}960$ vs $\text{€}1346 \pm \text{€}208$, $p < 0.000$).

◆ **Conclusions:** Compared with an inpatient procedure, outpatient insertion of a PD catheter results in similar outcomes at a lower cost.

has led to an increased need to alleviate the high demand for hospital beds (1), and implementing same-day surgery for various procedures has gained popularity.

So far, data to support PDCI on an outpatient basis are scarce. In a short report in 2002, Verrelli *et al.* (1) described the 3-month follow-up of 196 PDCIs in a single Canadian center. Of the PDCIs, 90 were performed on an outpatient basis, and compared with inpatient insertions, the outpatient insertions showed no differences in complication rates. In another short report in 2002, Chang *et al.* (2) reported a 10-year experience of outpatient catheter placement at a single institution. Among 251 catheters placed in 225 patients, same-day surgery was used in 165 cases. Catheter survival with same-day surgery was 84% at 1 year, and 18 catheter-related complications occurred within the first week. The authors of those two reports concluded that PDCI can safely be performed on an outpatient basis.

Hospitalization demands resources, and it also contributes substantially to the costs of treating dialysis patients (3). Considerable savings could be achieved by reducing unnecessary admissions. However, no available publications have compared costs for inpatient and outpatient PDCI. The present study analyzed PDCIs performed in a single tertiary care center with the aim of describing the outpatient PDCI protocol and comparing the short-term outcomes and costs of inpatient and outpatient PDCI.

METHODS

The patients were recruited from the Department of Medicine at Tampere University Hospital, which is a tertiary-care teaching hospital hosting the only PD program in the region, which has 450 000 inhabitants. All PDCIs for adult patients between 1 January 2004 and 31 December 2009 were included in the study. Follow-up started the day the PDCI was performed.

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Protocols for peritoneal dialysis catheter insertion (PDCI) vary. Traditionally, many units admit patients for catheter placement. However, insufficiency of resources

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Data were collected from patient files held in an electronic database. The diagnostic classification used was based on the cause of end-stage renal disease obtained from the files. Patient demographics, incidence of infectious complications (peritonitis and catheter-related infections), noninfectious complications (catheter-related mechanical complications, leaks, and other problems), hospitalizations, and survival and treatment modality changes were recorded. Complications were divided into those occurring early (≤ 30 days) and late (> 30 days) after the PDCI procedure. Technique failure was defined as transfer to hemodialysis therapy because of peritonitis, ultrafiltration failure, inadequate dialysis, exit-site or tunnel infection (or both), or mechanical problems.

A single-cuffed catheter was used for all patients. Procedures were performed by surgeons, usually with the patient under spinal anesthetic in the operating room. Vital signs, electrocardiogram, and pulse oximetry were monitored throughout the operation. The conventional open minilaparotomy technique was used in all cases, with a single midline infraumbilical incision 4 – 6 cm in length. The catheter was passed through this incision on a straight introducer into the well of the pelvis and was secured with a purse-string suture in the parietal peritoneum. The linea alba was closed with a suture and the catheter was tunneled to an exit site in the iliac fossa. After demonstration of good inflow and outflow and an absence of fluid leaks, the wound was closed.

Patients scheduled for inpatient PDCI were admitted directly to the nephrology ward 1 day before the procedure. They were discharged on the first postoperative day unless there was a need for further hospitalization. After discharge, patients visited weekly with the PD nurse, and PD training was started within 4 weeks of catheter insertion.

Outpatient PDCIs were initiated in September 2006. Table 1 shows the critical pathway for outpatient PDCI in detail. Eligible patients were selected and referred by nephrologists at Tampere University Hospital. Before the procedure, patients visit the nephrology outpatient clinic, where a history and physical examination are performed, and the risks and benefits are discussed. Blood samples are taken to determine cell count and chemistry. Patients are scheduled for catheter insertion within 1 week of their visit. They are advised not to eat after midnight on the day of the procedure. Bowel preparation is not needed. The procedure is started in the morning, and once it is finished, patients are taken to the recovery room. Based on the nephrologist's decision, patients are discharged once they have had lunch, have been able to ambulate, and have voided urine. The usual time of discharge is about 15:00 h.

Our economic analysis took the perspective of a service provider. The resources and services were valued as actual production costs. Costs of PDCI, outpatient visits, and 1 day's hospitalization at the nephrology department were obtained from the administrative department of Tampere University Hospital. All resource use was valued at 2010 prices.

Data are expressed as mean $\pm$ standard deviation unless otherwise stated. Patient characteristics were compared using the t-test for continuous variables and the chi-square test for categorical variables. Survival was estimated using the Kaplan–Meier method. Patient survival was defined using the endpoints of death, censoring at study end, or withdrawal from peritoneal dialysis by a living patient because of a change to hemodialysis or because of kidney transplantation. When considering the survival of catheters, survival was defined as technique failure, censoring at the end of the study period, death, or kidney transplantation. Survival between groups was compared using the log-rank test.

RESULTS

Between 1 January 2004 and 31 December 2009, 106 PDCIs (65 in men, 41 in women) were performed at our institution. Of those 106 PDCIs, 6 represented a second procedure in a patient who had already undergone PDCI. Of all the PDCIs, 65 were performed on hospitalized patients. Of those 65 patients, 46 had been admitted electively for PDCI (group A: elective hospitalization), and 19 patients had received their catheter during an admission because of late referral and a need to start renal replacement therapy immediately, or during an admission for other medical reasons (group B: other hospitalization). The remaining 41 patients received their catheters on an outpatient basis (group C: outpatients).

Mean age of the patients was 54.7 ± 16.0 years (range: 20 – 91 years). Diabetic nephropathy was the cause of end-stage renal disease in 45% of patients, and chronic glomerulonephritis, in 25%. Table 2 summarizes demographic data for the patients.

Patients who underwent PDCI during hospitalization for other medical reasons (group B) were older ($p = 0.032$) than patients hospitalized electively for PDCI (group A). We observed no statistically significant differences in male-to-female ratio, body mass index, or presence of diabetes between the groups.

Early complications (at ≤ 30 days) occurred in 23 patients (22%) overall, with an equal incidence in the outpatient and electively hospitalized groups (22% and 22% respectively, Table 3). Of all early complications, 13 were infectious in nature (5 peritonitis

TABLE 1
Critical Pathway for Outpatient Peritoneal Dialysis (PD) Catheter Insertion

Preoperative office visit

Patient history and physical examination
 Education of patient about general goals and expectations, discussion of risks and benefits
 Instructions for meals and medication: No meals after midnight before the operation, medication should be taken in the morning
 Blood sample: cell count, electrolytes, creatinine, C-reactive protein, international normalized ratio, activated partial thromboplastin time
 Nasal mupirocin ointment for 5 days preoperatively

*Day of operation (within 1 week of preoperative office visit)**Before the operation (07:45 h)*

Patient history: meals, medications, general condition
 Blood pressure and blood sugar (diabetic patients)
 Intravenous line inserted, prophylactic antibiotic (cefuroxime 1.5 g) started
 Patient transferred to operating room with PD catheter set and supplies and 2000 mL 1.36% dextrose dialysate

*PD catheter insertion procedure (operating room, 08:30 h)**After the operation (recovery room, 10:00 h)*

Blood pressure monitoring, blood sugar measurements (diabetic patients)
 Catheter flushed 1–2 times with 1000 mL 1.36% dextrose dialysate
 Exit site and incision are checked to detect leaks or bleeding
 Instructions for post-implantation care: The dressing applied should be kept dry and should not be changed (except in the presence of bleeding or infection) before the postoperative visit at 1 week

Lunch (noon)

Patient is encouraged to ambulate and void urine after having recovered from anesthesia
 Treatment of postoperative pain
 Discharge (upon nephrologist's decision after clinical examination, 15:00 h)

Postoperative visits

Weekly controls by PD nurse: Aseptic management of the exit site and incision; sutures removed after 7–10 days
 Mupirocin cream at exit site
 Patient education: Catheter and exit site management
 Dressing changes once weekly during the first week, and every 2 to 3 days thereafter
 PD is usually started 2–4 weeks after catheter insertion
 Permission to shower after 1 week

episodes, 8 exit-site infections). An early pericatheter leak occurred in 1 patient, and 9 patients experienced mechanical or bleeding complications. Immediate postoperative complications occurred in 4 patients, 3 of them being in the outpatient group (7%). These patients needed short-term hospitalization. None of the complications was life-threatening; all patients were discharged within 48 hours, no procedure-related deaths occurred.

Technique failure within 90 days occurred in 11 patients (10%), and some form of complication within 90 days occurred in 40 (38%). Infectious complications occurred in 26 patients (25%). Differences in complication rates were statistically insignificant between outpatient and electively admitted patients, but we

observed a trend toward a lower number of infectious complications in the outpatient group ($p = 0.080$).

The overall incidence of technique failure during the entire follow-up period was 0.29 per patient-year, and the rates of peritonitis and of peritonitis and catheter-related infections combined were 0.68 and 0.88 per patient-year respectively. Cadaveric kidney transplantation was performed in 36 patients, and 18 patients died during the study period. Compared with the electively hospitalized patients, patients hospitalized for other medical reasons experienced higher mortality ($p = 0.029$).

Figure 1 shows catheter survival for the first year in the various groups. Differences between the groups were not statistically significant ($p = 0.794$, group A vs group C).

TABLE 2
Baseline Patient Characteristics

Variable	Overall (n=106)	Patient group			p Value (A vs C)
		A: Elective hospitalization (n=46)	B: Other hospitalization (n=19)	C: Outpatient (n=41)	
Mean age (years)	54.7±16.0	52.3±16.5	63.3±14.9 ^a	53.4±14.9	0.752
Sex [n (%) men]	65 (61)	31 (67)	11 (58)	23 (56)	0.278
Mean body mass-index (kg/m ²)	24.8±4.1	25.0±4.1	25.0±5.2	24.4±3.5	0.461
Mean follow-up (days)	454±342	504±358	297±298	470±330	0.655
Diabetic nephropathy [n (%)]	48 (45)	20 (43)	6 (32)	22 (54)	0.343

^a $p = 0.039$ compared with group A.

TABLE 3
Rates of Treatment-Related Complications Within 30 and 90 Days

Variable	Overall (n=106)	Patient group [n (%)]			p Value (A vs C)
		A: Elective hospitalization (n=46)	B: Other hospitalization (n=19)	C: Outpatient (n=41)	
Early complication (≤30 days)	23 (22)	10 (22)	4 (21)	9 (22)	0.981
Technique failure within 90 days	11 (10)	6 (13)	1 (5)	4 (10)	0.631
Any infectious complication within 90 days	26 (25)	14 (30)	6 (32)	6 (15)	0.080
Any complication within 90 days	40 (38)	19 (41)	8 (42)	13 (32)	0.354

Figure 1 — Catheter survival (treatment modality survival) in the various groups during the first year. Group A = elective hospitalization; group B = other hospitalization; group C = outpatient catheter insertion. Log-rank significance: $p = 0.794$, A vs C; $p = 0.225$ (B vs C).

The total cost of the PDCI process included expenses for the preoperative outpatient visit (not incurred in electively hospitalized patients), the PDCI procedure, and postoperative monitoring and hospitalization. Table 4 shows the cost results. Average procedure-related hospitalization time was 2.67 days in the electively hospitalized patients and 0.098 days in the outpatient group. In the outpatient group, 3 patients (7%) needed immediate hospitalization for 1 – 2 days after the PDCI. Reasons for hospitalization were pain, bleeding, and perioperative bowel perforation. In 1 patient, elective hospitalization was prolonged because of postoperative pain. Average total costs were significantly higher in the electively hospitalized patients (€2320 ± €960) than in the outpatients (€1346 ± €208, $p < 0.000$).

DISCUSSION

The aims of the present study were to describe our structured PDCI protocol and to compare the results of inpatient and outpatient PDCI. Our findings suggest that

TABLE 4
Total Cost of the Peritoneal Dialysis (PD)
Catheter Insertion Process

Cost item	Cost by patient group (€)	
	A: Elective hospitalization	C: Outpatient procedure
Preoperative outpatient visit	0	119
PD catheter insertion procedure	833	833
Monitoring in recovery room	0	340
Average hospitalization (at €556/day)	1487	54
Mean total average cost	2320±959	1346±208 ^a

^a $p < 0.000$ compared with group A.

an outpatient PDCI is safe and that hospitalization is not necessary. Outcomes and complication rates were similar in electively hospitalized patients and outpatients. By reducing unnecessary admissions, considerable savings can be achieved, and the risk of nosocomial infections might be lowered. Logically, costs were lower for patients undergoing outpatient PDCI than for the hospitalized patients in the present study. Compared with an inpatient procedure, an outpatient PDCI cost 42% less (average difference: €974).

To our knowledge, the present study is the first to assess both costs and outcomes for PDCI. Numerous centers have implemented outpatient PDCI and have been using that approach for many years. However, in many countries, economic pressure on beds is less, and patients are still routinely admitted to hospital for procedures that might not require an admission. It is important that objective evidence in favor of an outpatient approach is presented so that centers who continue to take the more expensive approach can see that there is an alternative.

Several different methods of PDCI have been developed. The surgical method is still the most common technique (4). Compared with open surgery, the laparoscopic technique is slower, but produces equivalent outcomes, as reported in a UK study (5). In a recent Canadian study, radiologic catheter insertion was associated with more outpatient procedures and no excess of complications compared with the surgical method (6). In our study, open surgery and a single-cuffed catheter were used for all patients.

The mean age of our patients and the proportion with diabetes were similar to those reported in previous

studies (7–10); however, the incidences of technical failure and of peritonitis were higher (7–9,11). Recent studies have found an association of the number of PD patients with clinical outcomes. Clinic size may be a proxy for PD experience, and fewer failures tend to occur in clinics with more than 25 patients (9) or 50 patients (8) than in centers with smaller PD populations. On the other hand, the incidence of early dialysate leak has been reported to be higher in other studies (12,13).

Patients who underwent PDCI during hospitalization for other medical reasons were older and experienced higher mortality than did elective patients, reflecting a more complicated clinical setting. Otherwise, no significant differences in demographics or complications were noted between the groups. Particularly, we observed no difference in the occurrence of procedure-related early complications. Immediate postoperative complications were minor and easily resolved. Verrelli *et al.* reported similar results in their study (1).

Limitations of our study include its retrospective nature and the restricted number of patients. Comorbidities were not systematically registered. Because this was a single-center study, the results might not be generalizable. However, the demographics of patients in our study are close to those in other studies. Costs were measured as production costs for the provider. Because accounting methods differ between societies and centers, our cost analysis cannot be directly applied universally. Also, because of limited capacity in the outpatient clinic recovery room, 15 patients who were originally planned as outpatients after 2006 switched to become inpatients, and they are included in group A (elective hospitalization). Medical reasons did not affect the decision to switch. Because patients were a mix of inpatients and outpatients after 2006, selection bias might be a potential source of error. However, compared with both the inpatients before 2006 and the outpatients after 2006, the characteristics and outcomes for the 15 switched patients were similar. No statistically significant differences were observed, and we believe that this kind of non-medical selection does not constitute true bias.

CONCLUSIONS

We report the first analysis that compares both the outcomes and the costs of outpatient and inpatient PDCI. Outpatient insertion of catheters is safe, lowers demand for inpatient care, and compared with an inpatient procedure, results in similar outcomes at lower cost.

DISCLOSURES

The authors have no financial conflicts of interest to declare.

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