Peer reviewed article

20 years of peritoneal dialysis in a mid-sized Swiss hospital

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Summary

Principles: Few long term studies exist about peritoneal dialysis (PD). We collected the experiences over nearly 20 years in a single mid-sized centre in Switzerland.

Methods: In a retrospective survey we examined our PD-cohort with respect to mortality, technique survival, peritonitis rate and other complications. We calculated the proportion of PD-patients of the total dialysis population (penetration rate) and measured the time of PD-associated hospitalisations.

Results: 50 patients were included during an observation period of 20 years. The mean penetration rate was 23% (range 11% to 34%). The mean treatment time per patient was 2.8 years (median: 3.6 years; range 0.4–9.5 years). Patient survival was 80% at three years and 60% at five years. Technique retention rate was 40% after three, and 20% after five years. Each of the three outcome categories – transplantation, switch to haemodialysis (HD) and death during PD – accounted for one third of the PD drop-out number.

Conclusion: Compared to the average of Swiss dialysis centres the penetration rate is high. Patient and technique survival correspond to data in the literature, as do the frequency and types of complications. We consider PD as an efficient and well tolerated dialysis modality, which should be offered also in smaller dialysis centres. Since PD is not only feasible, but appears to be less costly than HD, we recommend PD as the first-line dialysis option for patients in end-stage renal disease.

Key words: peritoneal dialysis; single center cohort; survival; peritonitis; hospitalisation; costs

Introduction

Daily exchange of about 10 litres of glucose based electrolyte solution in the abdominal cavity can maintain the uraemic human body in metabolic equilibrium. This experimentally approved assumption [1] initiated the ambulatory long term dialysis using the peritoneal membrane as filter to clear azotaemic waste products. The method of continuous ambulatory peritoneal dialysis (CAPD) was developed in the late seventies and has been constantly refined in the past 25 years. CAPD has gained broad acceptance as an alternative form of renal replacement therapy for many patients with end stage renal disease. Simple machine free handling, large patient autonomy, stable homeostasis, better preservation of remaining kidney function and – not least – lower costs are among the most frequently cited advantages of CAPD. In contrast, relatively frequent infections (peritonitis and catheter related tunnel infections), lower dialysis efficiency and the increasing burden of self care are among the most discussed disadvantages of CAPD.

A stagnation or even a decline in CAPD worldwide was observed during the analysed period from 1989 to 1998 [2]. The reasons for this decline are not clear and probably multifactorial [3]. For Switzerland in particular, the high density of haemodialysis (HD) facilities (70 centres for 8 million inhabitants) contributes to an easy centre access with short travel distances. Despite the fact that the main Swiss reinsurance provider (SVK: Swiss Federation for common Tasks of the Health Insurance) promotes home dialysis modalities the percentage of PD patients (penetration rate) is currently only about 12% [4]. However, at our hospital we have offered PD to every patient with end stage renal disease since 1982 and have continuously promoted its usage throughout the past 20 years. Considering the wide centre to centre difference in the use of PD in Switzerland, we analysed our PD population in a retrospective cohort study with respect to penetration rate, patient survival, technique retention rate, peritonitis rate and bacterial spectrum as well as other complications.

No financial support to declare.

Patients and methods

Our dialysis centre covers a service population of about 80'000 inhabitants and has been the only dialysis facility in its area since 1969. Beginning in 1982 all patients with end-stage renal disease were basically considered for CAPD as first dialysis option, unless they could not accept the procedure and the modality despite detailed information by the nephrologist and the nursing staff. There was no formal list of contraindications although sometimes advanced age, reduced social support network, a high comorbidity status and advanced uraemia may have shifted the decision towards HD. All patients who agreed to try CAPD were hospitalised for PD-catheter placement. Most patients received their CAPD training on an outpatient basis. We excluded five patients who performed CAPD for less than three months for various reasons. These early "drop-outs" were not included in this study in accordance with similar rules of exclusion in other registries [5]. The three month exemption criterion helps to avoid confounding with cases suffering from acute renal failure and with early operative and technical failures.

We calculated the penetration rate (defined as the percentage of patients on PD in relation to all patients on dialysis) at the end of each year. We retrospectively analysed all patients by review of their records with respect to age, gender, basic renal disease, time (months) on PD, death on PD, switch to HD and its reason, as well as transfer to transplantation. We constructed Kaplan Meier life table curves to determine patient survival and technique success (technique retention rate). Survival time was defined as total time on PD with death as the final event. Numbers were censored for transfer to other renal replacement modalities such as HD or transplantation. Technique survival, defined as technique retention rate [6], was the probability of remaining on PD at any time, with a change of modality or death as final events.

We registered all episodes of peritonitis and PD-catheter complications. Peritonitis was defined as turbid fresh dialysis effluent, containing a polynuclear leucocyte cell count higher than 50/mm^3. PD-catheter infection was defined as an inflamed exit site with involvement of the subcutaneous catheter tunnel (= tunnel infection) presenting with purulent secretion. For the isolation of the organisms we used micropore filter techniques until 1990, thereafter blood culture media. We counted the number of days spent in the hospital in association with PD treatment, including hospitalisation for PD catheter placement, training of CAPD or automated PD (APD) as inpatient and PD related complications. We did not count days spent in hospital for other reasons.

Results

50 Patients were trained for and undertook CAPD at home for three months or longer. During the course of their PD-treatment, nine patients were changed from manual CAPD to APD on a PD-cycler. Of the 50 patients 32 were men and 18 women. The mean age at the start of dialysis was 53 years with a range of 15 to 80. The basic renal disease distribution is represented in table 1. The diagnosis was made on clinical grounds and was not confirmed by kidney biopsy in most cases. Analgesic nephropathy was a frequent reason for PD mainly between 1982 and 1990.

Figure 1 depicts the number of PD and HD patients at the end of each year. The mean penetration rate was 23% (range 11% to 34%). The mean PD treatment duration was 2.8 years (median: 3.6 years; range 0.4–9.5 years). In figure 2 patient and technique survival are presented. Patient survival was 80% at three years and 60% at five years. During the whole observation period, 14 patients (28%) died while on PD-treatment, 12 due to cardiovascular events, two due to carcinoma. Peritonitis was not the cause of death in any patient. Modality survival is represented by the technique retention rate, which was 40% after three years and 20% after five years. 13 patients (26%) had received a kidney transplant within five years after the start of PD. Another 13 patients dropped out because of PD related complications: peritontitis (6 patients), catheter tunnel infection (3), ultrafiltration failure (2), and psychosocial problems (2). Following a switch to HD, seven patients had died by the end of the study after a mean of 34 months (range: three to 102 months; median 18 months).

Table 1
Basic renal disease distribution.

Aetiology of chronic renal failure	Number (%)
Glomerulonephritis	13 (26)
Diabetic nephropathy	10 (20)
Analgesic nephropathy	9 (18)
Vascular nephropathy	7 (14)
Chronic pyelonephritis	4 (8)
Polycystic kidney disease	3 (6)
Kidney dysplasia	1 (2)
Interstitial nephritis	1 (2)
Alport syndrome	1 (2)
Fabry's disease	1 (2)

The bacteriological results of CAPD-associated peritonitis are shown in table 2. 85 episodes of peritonitis occurred in 32 patients. 18 patients (36%) never experienced a peritoneal infection. In 15 episodes (18%) no organism could be identified (culture negative peritonitis). Among 70 cases of culture positive peritonitis gram-positive infections dominated (75%) with *Staphylococcus epidermidis* (30%) and *Staphylococcus aureus* (24%) as leading organisms. Gram-negative infections (25%) presented with a variety of different organisms, predominantly *E. coli* (11%). In three effluents more than one organism was found (polymicrobial flora). In addition to the 85 episodes of peritonitis of known or presumed bacterial origin, there were five episodes of aseptic mononuclear peritonitis (four associated with icodextrin con-

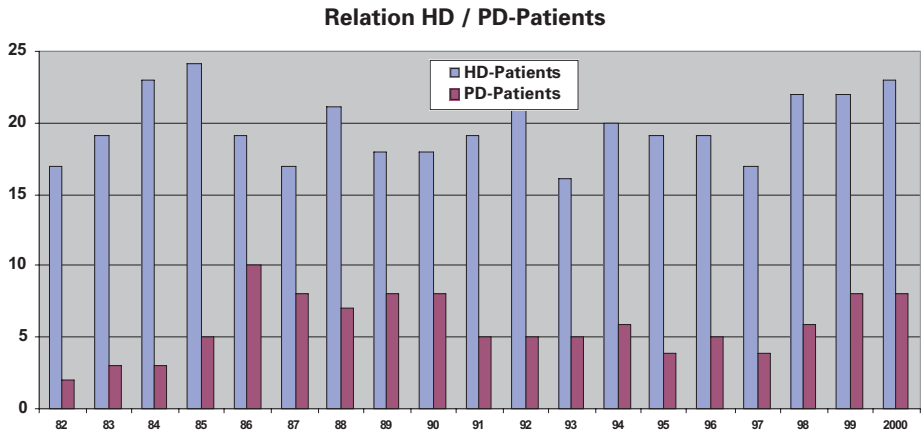

Figure 1
Number of haemodialysis patients and peritoneal dialysis patients at the end of the years.

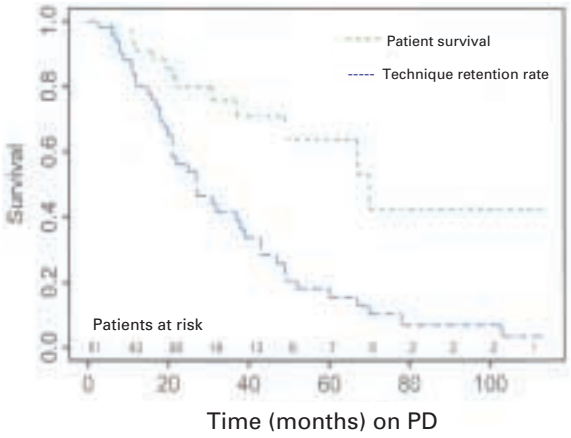

Figure 2
Kaplan-Meier estimates, for overall mortality on peritoneal dialysis (PD) with death on PD as final event (green curve) and technique retention rate with death, transfer to haemodialysis and transfer to transplantation as final events (blue curve).

Figure 3
Distribution of peritonitis per patient.

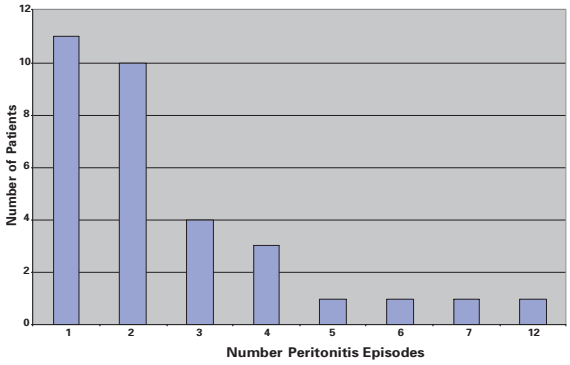

Table 2
Spectrum of peritonitis organisms.

Episodes of peritonitis	N (%)
Staphylococcus epidermidis	21
Staphylococcus aureus	17
Escherichia coli (one case polymicrobial)	8
Viridans group streptococci	6
Enterococcus spp.	3
Citrobacter spp. (one case polymicrobial)	2
Gemella morbillorum	1
Streptococcus agalactiae	1
Corynebacterium sp.	1
Rothia dentocariosa	1
Aerococcus viridans	1
Acinetobacter johnsonii	1
Serratia marcescens	1
Enterobacter cloacae	1
Proteus mirabilis	1
Bacterioides sp.	1
Klebsiella oxytoc	1
Providencia rettgeri (polymicrobial)	1
Klebsiella pneumoniae	1
Culture negative	15
Gram-positive organisms	52 (61%)
Gram-negative organisms	18 (21%)
Culture negative peritonitis	15 (18%)
Total	85 (100%)

taining solutions, one of unknown origin), and one spontaneously remitting eosinophilic peritonitis.

Many patients experienced more than one episode of peritonitis (Figure 3). Four patients with five or more episodes accounted for 35% of all infections. Despite multiple recurrences the affected patients declined a change to HD. For the entire study period we calculated a rate of 0.6 episodes of peritonitis per patient year or 1 episode in 20 treatment months. The incidence remained constant over the whole observation period. There were 18 tunnel infections, three of which were not associated with peritonitis. Catheter removal or replacement was necessary 30 times in 20 patients. It was performed in 20 cases with gram-positive infections, in five with gram-negative infections, in three with displacement, in one patient with perforation of the bladder and in one with a dialysate leakage.

The 50 patients spent a total of 2385 days in hospital for PD-related reasons, corresponding to 47 days per patient or 14 days per treatment year. One patient was hospitalised for over 6 months after hyperkalaemic cardiac arrest and prolonged rehabilitation.

Discussion

This retrospective cohort study is one of only a few single centre long-term observations of peritoneal dialysis outcome lasting more than 10 years [8–14]. The observed penetration rate of 23% is distinctly higher than the Swiss average for dialysis facilities (12% in 2000) [4]. World-wide there is a wide range of PD use with low penetration in countries like Germany (8%) and Japan (5%) and high penetration in Canada (32%) and New Zealand (58%) [3]. Thus, achieving a high proportion of PD patients such as 25% or more is realistic and may be a rewarding goal of renal replacement strategies.

The survival rate of 80% at three, and 60% at five years, is in line with other studies [10–14]. In 1987 Burton and Walls reported a two year survival of 84% and a ten year survival of 48% [10]. In their long experience in Brescia, Maiorca et al. found a ten year survival rate of 50% in 1996 [11]. The Canadian registry reported a survival of 35% at five years [12], the Italian registry of 42% at five years [13]. Our mortality data lacks a control group of HD patients. The problem with modality comparison lies in the impossibility of conducting randomised trials with similar baseline variables [14]. Various studies have shown, that survival on PD is probably equivalent to HD [15–19], with potential advantages of PD in the first two years of treatment [15]. The superior short term outcome is attributed to longer preservation of residual renal function under PD conditions. The longer dialysis treatment lasts, the more the survival curves converge. In the European Registry survival was slightly superior for HD than for PD at ten years [12]. The technique success of PD depends on the frequency and the severity of complications of the modality itself. Peritonitis, inadequate dialysis and psychosocial factors reduce the PD technique survival. Our technique retention rate was 40% after three years and 20% after five years, which is in the order of that of a large Italian centre with 25% at five years [8]. Death, transplantation and transfer to HD are the reasons for PD cessation in one third of each group.

Peritonitis and infection of the PD catheter tunnel are still a major concern and impair the success of the technique [19]. Our overall peritonitis rate in 20 years was one episode per 20 months of PD treatment. The accepted standard according to British guidelines is less than one episode per 18 patient-months [20]. Some centres reported lower incidences of peritonitis [21, 22]. Eliminating one single case of our cohort with multiple recurrent peritonitis (n = 12) would reduce the peritonitis rate to one episode per 29 months. The bacterial spectrum corresponds to the results in the literature [23]. The outcome of peritonitis depends on the type of bacterium [24] and its monitoring is important because of the poorer prognosis of gram-negative infections [25]. *E. coli* peritonitis was repeatedly seen in our cohort. These patients had an unfavourable technique outcome and all had to be switched to HD. As a recent concern we observed – like others [25] – several cases of sterile peritonitis following the usage of icodextrin containing solutions. The appearance of a mostly asymptomatic turbid effluent may be an allergic reaction to compounds of the dialysis fluid itself (dextrin, dextran), or an inflammatory response to a peptidoglycan contaminant [26].

On the average patients were hospitalised for two weeks per year. This result may be skewed by the rather low sample size and the large contribution of a few patients with high morbidity. A limitation of our study is that we have monitored hospitalisation days strictly related to the modality and the directly involved complications only. Therefore, we cannot draw conclusions about the overall morbidity of our PD-patients. The U.S. guidelines (NKF-DOQI) propose monitoring all admissions and hospital days per year as an indicator of the overall-effectiveness of end-stage renal disease treatment [27]. Admissions and length of hospitalisation from causes unrelated to ESRD may also at least in part be related to the adequacy of PD [28]. Thus, unless one uses standardised disease-specific data on hospitalisation comparisons between centres are not meaningful [29].

In order to gain information about the economical efficiency of our PD-program, we performed rough estimates of costs and savings compared to HD. The data are based on reimbursement tariffs requested from the Swiss Federation for common Tasks of Health Insurance (SVK) (4.7). The national dialysis tariff has been negotiated in a contract between the administration of the Hospitals of Switzerland (H+) and the SVK and is based on calculations performed by a working group of Swiss nephrologists in 1990–1992. Provision of PD-treatment as ambulatory care for one case for a year was calculated as costing Sfr. 40'000.– compared to Sfr. 70'000.– for one HD-treatment year. These data do not include medication (eg, erythropoetin) and hospitalisation costs and therefore do not exactly reflect the amount of an individual patient's care. On the basis of the SVK reimbursement policy we calculated, that our PD population consumed Sfr. 6 Mio. in 20 years (costs for hospitalisations not included). Had all patients used HD instead of PD, the expenditure would have reached Sfr. 10 Mio. We estimate that we saved about Sfr. 200'000.– per year. Moreover, we could reduce costs by sparing dialysis personnel. In our experience one PD nurse can care for about ten CAPD or APD patients, whilst one HD nurse can care for four HD patients (about 600 HD sessions) per year. Converting all our PD patients to HD we would have used 15 more nurse-years.

Our long-term experience suggests that PD is

a feasible dialysis modality not only in large but also in smaller dialysis centres, because our data are comparable to large cohorts in the literature with respect to patient and technique survival and peritonitis rate. Since firstly, according to the literature morbidity and mortality do not differ between HD and PD, secondly, since PD is well accepted by patients because it usually provides more autonomy than HD, and thirdly, since PD seems to be less costly, we propose favouring it over HD as the first line renal replacement therapy. Contrary to this proposal there is evidence of a declining trend for PD use internationally, even in countries with predominantly public provision like U.S.A, Canada, United Kingdom and Australia [2]. In order to reverse this trend, we would recommend implementing the following three important steps. Firstly, early referral of predialysis patients is essential [30–33]. Patients should be informed about the options at an early stage of their disease, ie, at least several months prior to the presumed start of dialysis. Patient information should not be provided exclusively by a nephrologist, but be broadened and deepened by renal patient educators. A well trained nurse instructor may be more successful in convincing patients to care for themselves and to try a home-dialysis modality. We should search for skilled "nephrological trainers" to whom predialysis patients can be referred for information. Secondly, besides a firm commitment of nephrologists to PD, the training aspect is of utmost importance. The careful instruction and the trusting patient-nurse relationship constitute the basis for continued successful management. Thirdly, we should enhance financial incentives for renal care providers for promoting PD, particularly since, at present, HD is financially much more attractive than PD. Combined efforts of the partners, the Swiss Nephrology Association and its Dialysis Committee, the insurance representatives (SVK) and the supply industry should be undertaken in favour of a sustainable long-term application of peritoneal dialysis.

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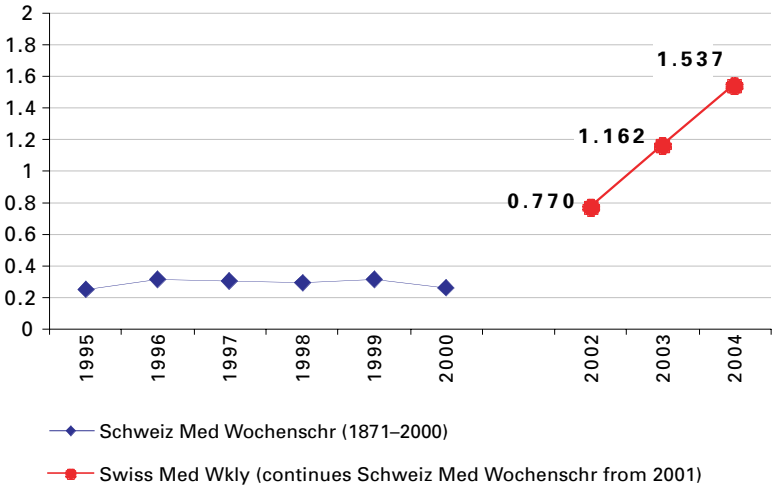

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