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Comparison and Survival of Patients Receiving Hemodialysis and Peritoneal Dialysis in a Single Center

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The influence of the type of dialysis on survival of patients with end-stage renal disease (ESRD) is controversial. To compare survival among patients with ESRD receiving peritoneal dialysis (PD) or hemodialysis (HD), we conducted a prospective cohort study in a single center from April 1995 to March 2005. During that period, 454 patients (161 women, 293 men; mean age: 61.7 ± 14.4 years; 46.6% with diabetic nephropathy) were started on HD therapy, and 120 patients (40 women, 80 men; mean age: 54.5 ± 11.3 years; 16.7% with diabetic nephropathy) were started on PD therapy; all patients were followed for at least 3 years. The 3-year survival rates were 65% for the HD patients and 81% for the PD patients ($p < 0.05$*). The causes of death in patients undergoing HD were 52% cardiovascular, 25% infectious diseases, and 12% cancer; in patients undergoing PD, the causes were 36% infectious diseases, 24% cardiovascular, and 6% cancer. Median time from initiation of dialysis to study enrollment was 90 days for HD patients and 180 days for PD patients. Although patients in this study were not randomly assigned to their initial type of dialysis therapy, survival rate was found to be dependent on dialysis type. Moreover, this study suggests the importance of early referral and evaluation of risk factors in individual patients before they are started on dialysis therapy.*

Key words
CAPD, hemodialysis, survival rate, cardiovascular disease, infection

Introduction

Since the introduction of chronic ambulatory peritoneal dialysis (CAPD) in the mid-1970s, various retrospective (1–5), observational (6,7), and prospective (8) studies have examined differences in survival between patients undergoing peritoneal dialysis (PD) and those undergoing hemodialysis (HD). However, despite these extensive (and varying) studies, confusion and debate remain concerning the influence of the modality of dialysis therapy on the survival of patients with end-stage renal disease (ESRD).

The inconsistent results may relate to complex factors such as the clinical condition of patients at the initiation of dialysis, patient and physician choice, comorbidity, and failure of vascular access, among others. Previously, we followed 72 patients matched for age, sex, and underlying causes of chronic kidney disease who had been receiving CAPD and HD over a 5-year period. During the 5-year period, 5 patients in the CAPD group and 11 in the HD group died, and 6 patients were transferred to HD from CAPD (9). In that study, we could find no significant differences between the two groups at the start of the study that could predict survival. Recently, in the Netherlands, a randomized controlled trial of patients who were new to dialysis treatment compared survival and quality of life between patients on HD and PD (8). However, the trial was stopped early because of disappointing inclusion rates.

Considering the problems encountered by these previous studies, a randomized controlled trial to compare modalities in a multicenter setting is clearly a difficult task. For more than 12 years, our Kidney Disease Center has provided CAPD therapy in an urban setting, and during that time, more than 40% of our dialysis population chose CAPD at initiation of renal replacement therapy (10–14). The purpose of the present study was to evaluate differences in patient survival for patients starting HD and CAPD at a single center.

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Patients and methods

From April 1995 to March 2005, a total of 1209 incident patients entering the ESRD program at the Kidney Disease Center, Saitama University Hospital in Saitama, Japan, survived a minimum of 90 days on dialysis therapy. Among those patients, enough demographic, comorbidity, and echocardiographic data were available to analyze 574 patients (454 started on HD, 120 started on CAPD) who were followed for more than 3 years.

Statistical analysis

Results are expressed as mean ± standard error of the mean. Statistical analyses used the Student *t*-test for unpaired samples and the Mann–Whitney test for comparison of means. Cumulative event-free curves were determined by Kaplan–Meier analysis, and the differences between those curves were analyzed by the log-rank test. Statistical significance was set at $p < 0.05$. All calculations were performed using the StatView statistical software package, version 5.0 (SAS Institute, Cary, NC, U.S.A.).

Results

Baseline clinical and laboratory characteristics

Table I lists the baseline clinical characteristics of the patients. Overall, the PD patients were younger than the HD patients ($p < 0.01$), and proportionally fewer PD patients had diabetes as compared with patients on HD ($p < 0.01$). Also, hypertension and chronic glomerulonephritis as underlying causes of chronic kidney diseases were significantly different between the HD and PD groups ($p < 0.05$). We observed no significant differences in laboratory findings between the PD and HD groups at the start of dialysis therapy (Table II). Median time from initiation of dialysis to study enrollment was 90 days for HD patients and 180 days for PD patients.

Causes of death

This analysis of causes of death includes all 1209 patients (814 on HD, 345 on PD) treated during the study period. Table III shows causes of death in the two groups of patients.

Cardiac disease accounted for one third of all deaths in the HD group. In contrast, for patients on PD, one third of all deaths occurred as a result of infection. In patients on PD, significantly fewer deaths from cerebrovascular disease occurred than occurred in patients on HD ($p < 0.05$).

Survival rate

Patients initiating PD had a significantly higher survival rate than did patients on HD ($p < 0.001$, Figure 1). Survival in patients on HD was not significantly

TABLE I Baseline clinical and laboratory characteristics of the hemodialysis (HD) and peritoneal dialysis (PD) patients

	HD	*PD*
Patients (*n*)	454	120
Men	293	80
Women	161	40
Mean age (years)	61.7±14.4	54.5±11.3
<65 years [*n* (%)]	245 (54.0)	99 (82.5)
≥65 years [*n* (%)]	209 (46.0)	21 (17.5)
Diabetes [*n* (%)]		
Yes	212 (46.6)	20 (16.7)
No	242 (53.4)	100 (83.3)
Underlying cause of nondiabetic nephropathy [*n* (%)]		
Chronic glomerulonephritis	58 (12.8)	41 (34.2)
Hypertension	23(5.1)	26 (21.7)
Autosomal dominant PKD	14 (3.1)	5 (4.2)
MPO-ANCA glomerulonephritis	8 (1.8)	2 (1.7)
Rheumatoid arthritis	6 (1.3)	2 (1.7)
Multiple myeloma	4 (0.9)	1 (0.8)
Systemic lupus erythematosus	3 (0.7)	5 (4.2)
Others	126 (27.8)	24 (20)

PKD = polycystic kidney disease; MPO-ANCA = myeloperoxidase–anti-neutrophil cytoplasmic antibodies.

different between those with and without diabetes. On the other hand, in patients on PD, the survival rate for nondiabetic patients was significantly higher than that for diabetic patients ($p < 0.001$, Figure 2). Among nondiabetic patients, those on PD experienced significantly higher survival ($p < 0.001$) than did those on HD. However, among diabetic patients, the survival rate was not significantly different between those on HD and those on PD (Figure 3).

Discussion

In this single-center retrospective cohort study of incident dialysis patients, those who received PD had a better case-mix profile at initiation of dialysis than did those who received HD. The survival rate of diabetic patients was not significantly different between dialysis modalities.

The major factors influencing initial treatment with PD were age and proportion of diabetic patients. Age is one of the important factors determining prognosis in any kind of disease. In the patients with diabetes, cardiovascular conditions are already severely impaired at the start of dialysis therapy, as demonstrated by the high prevalence of coronary artery disease, stroke, and peripheral occlusive disease in those patients (15).

In our HD patients, the number one cause of death was cardiovascular disease. This finding probably reflects the much larger portion of diabetic patients on HD in the study population. However, the finding of no significant difference in survival between diabetic patients on HD and on PD is consistent with previous reports showing that survival rates are approximately the same for diabetic patients on either dialysis modality (16–18). Locatelli *et al.* recently reported that the risk of cardiovascular disease did not differ significantly by treatment modality. In their study population, the mean age of the patients receiving PD was greater than that of the patients receiving HD, which may have resulted in a greater risk of cardiovascular disease. In addition, mortality from cerebrovascular disease differed between their patients on PD and on HD.

Risk of death from stroke has been reported to be greater for patients on PD than for patients on HD (19), with elderly black diabetic patients being at greatest risk. Several factors have been offered to explain the higher risk of stroke in patients receiving PD. Accelerated atherosclerosis may occur in patients undergoing PD because their serum lipoprotein(a) and hyperlipidemia are reported to be higher than in patients undergoing HD (20). Furthermore, loss of residual renal function and loss of ultrafiltration capacity by the peritoneal membrane over time in patients on PD may lead to inadequate dialysis and fluid overload (21,22). These factors may contribute to a higher risk of death from stroke in patients on long-term PD. In the present study, the shorter follow-up period than that seen in studies such as Jaar *et al.* (5) might offset the risk of death from stroke.

Infection is the second leading cause of death among dialysis patients, and the common perception is that, compared with HD, PD is associated with a higher risk for infection (23). Our findings in the present study are consistent with a recently published report from the Japanese Society of Dialysis Therapy (24), which revealed that infection is the number one cause of death in patients on PD.

TABLE II Laboratory findings in the patient groups

Parameter	*HD*	*PD*
Serum creatinine (mg/dL)	8.5±0.3	9.2±0.3
Hemoglobin (g/dL)	8.0±0.4	8.3±0.2
Albumin (g/dL)	3.3±0.1	3.8±0.1
HbA1c (%)	6.0±0.2	6.9±0.6
Cardiothoracic ratio (%)	56±1	54±2

TABLE III Causes of death

Rank	*HD (n=181)*		*PD (n=66)*	
1	Cardiac disease	66 (36.5)	Infection	24 (36.4)
2	Infection	46 (25.4)	Cardiac disease	14 (21.2)
3	Cerebrovascular disease	28 (15.5)	Neoplasm	4 (6.1)
4	Neoplasm	22 (12.2)	Cerebrovascular disease	2 (3.0)
5	Others	17 (9.4)	Others	12 (18.2)
6	Unknown	2 (1.1)	Unknown	10 (15.2)

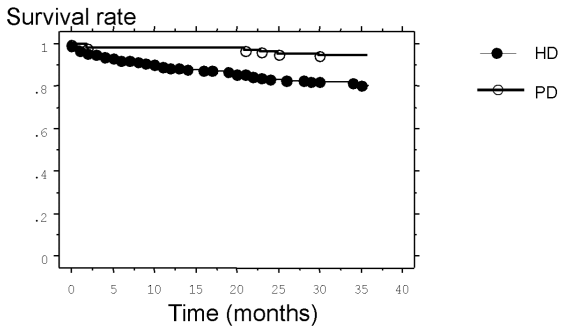

FIGURE 1 Kaplan–Meier analysis of survival rates in patients initiated onto hemodialysis (HD) and peritoneal dialysis (PD). Patients initiated onto PD had significantly higher survival ($p < 0.001$).

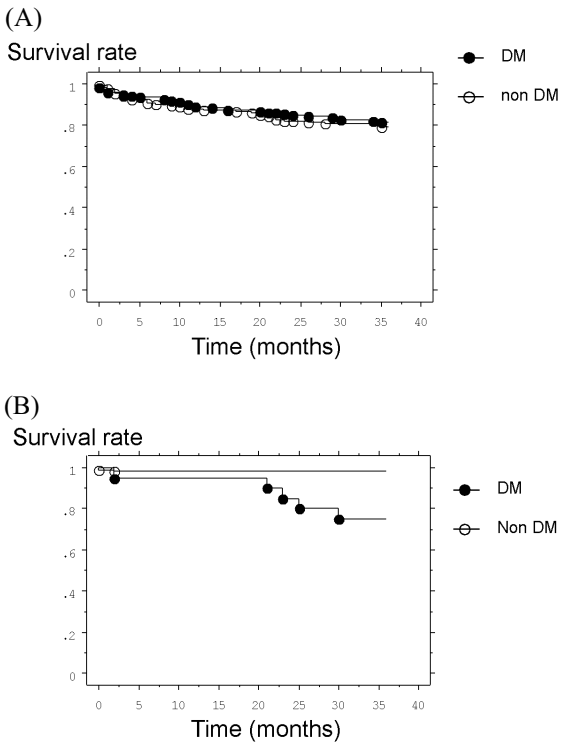

FIGURE 2 Kaplan–Meier analyses of (A) the survival rate in diabetic (DM) and nondiabetic (non DM) patients on hemodialysis (HD), and (B) the survival rate in DM and non DM patients on peritoneal dialysis (PD). We observed no significant difference in survival between DM and non-DM patients on HD. In patients on PD, DM patients had a significantly lower survival rate than did non-DM patients ($p < 0.001$).

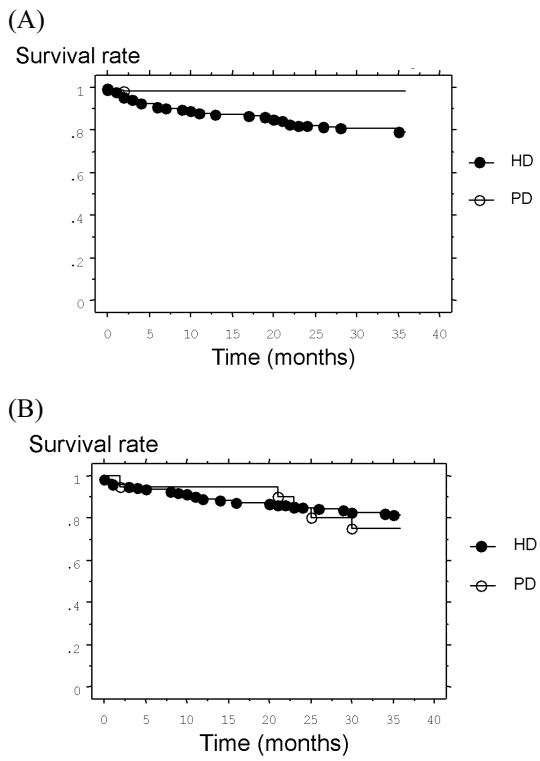

FIGURE 3 Kaplan–Meier analyses of (A) the survival rate in nondiabetic patients on hemodialysis (HD) and peritoneal dialysis (PD), and (B) the survival rate in diabetic patients on HD and PD. Nondiabetic patients on PD had significantly lower survival ($p < 0.001$) than did those on HD. We observed no significant difference in survival rate between diabetic patients on the two different modes of dialysis.

The present study did not look at comorbid conditions that are known to influence the prognosis of patients (18). Ganesh *et al.* (25) reported that, among nondiabetic patients, those with coronary artery disease had 20% poorer survival when treated with PD as compared with HD. In contrast, patients without coronary artery disease had similar survival rates on both PD and HD. That finding raises the possibility of a differential bias in comparisons of PD and HD patients, especially if a given comorbid condition is represented to a lesser degree in one group than in the other.

The role of residual renal function was not evaluated in the survival of patients enrolled in this study, although a recent review (26) emphasized that residual renal function, but not dose of PD, is a powerful

predictor of survival in PD patients. Even in HD patients, an important contribution of residual renal function to overall survival was clearly shown in a recent Netherlands Cooperative Study on the Adequacy of Dialysis (27).

In the present study, consecutive data influencing prognosis—for example, hemoglobin, serum creatinine, residual renal function, and blood pressure, among others—were not evaluated. Those data might be much more important than the data obtained at the start of dialysis therapy.

Conclusions

Our study provides evidence that the risk for death differs between patients on PD and on HD during the first 3 years after the initiation of dialysis therapy. In diabetic patients, survival did not differ by dialysis type. On the other hand, nondiabetic patients on PD had a better prognosis than did those on HD. Moreover, as expected, the risk of death differed by dialysis therapy. Further work is needed to analyze follow-up data, including blood pressure, hemoglobin, and serum creatinine, and to re-examine the history of cardiovascular diseases in these patients.

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