Is Assisted Peritoneal Dialysis Associated with Technique Survival When Competing Events Are Considered?

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Summary

Background and objectives This study assessed whether assisted peritoneal dialysis (PD) was associated with a lower risk for technique failure using methods developed for survival analysis in the presence of competing risks.

Design, setting, participants, & measurements This retrospective cohort study, based on data from the French Language Peritoneal Dialysis Registry, analyzed 9822 incident patients starting PD between January 2002 and December 2010. The observation period ended on June 1, 2011. Time to transfer to hemodialysis was compared between patients with assisted PD and those undergoing self-care PD.

Results There were 5286 patients undergoing assisted PD; 4230 of these were assisted by a community nurse and 1056 by family. Assisted PD patients were older and had a higher Charlson comorbidity index than self-care PD patients. There were 7594 events: 3495 deaths, 2464 transfers to hemodialysis, 1489 renal transplantations, and 146 renal function recoveries. According to a Cox model, assistance and center size were associated with a lower risk for technique failure, whereas hemodialysis before PD, early peritonitis, and transplantation failure were associated with a higher risk for transfer to hemodialysis. A Fine and Gray regression model showed that assisted PD was associated with a lower risk for transfer to hemodialysis.

Conclusions Compared with patients undergoing self-care PD, those with assisted PD had a lower risk for transfer to hemodialysis, a higher risk for death, and a lower risk for transplantation.

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Introduction

Technique failure remains a major problem with peritoneal dialysis (PD) (1–4). Patients' age and comorbidity are associated with PD failure (5,6). Older age and comorbid conditions are considered contraindications for PD when assisted PD is not available (7). The effect of assistance on the distribution of dialysis modality remains controversial (8–10). Chronic patient burnout, fatigue, and loss of functional capacity may contribute to PD failure. Therefore, assisted PD could decrease the risk for transfer to hemodialysis (HD). It has recently been suggested that providing onsite social support decreases the incidence of technique failure (11).

Assisted PD is defined as PD performed at the patients' home with the assistance of a health care technician, a community nurse, a family member, or a partner (12). Assisted PD with community nurse assistance is fully covered by the national health care insurance in France (13). In addition, home visits by nurses from the dialysis center are funded by community or academic hospitals. The aim of these visits is to check the patient's skills and to assess his or her capacity to cope with PD at home. When necessary, patients are retrained onsite during the visit. To our knowledge, there are no data available on the effect of assistance or home visits by nurses from the dialysis center on PD duration.

This study evaluated whether assisted PD was associated with a lower risk for transfer to HD. In the PD setting, others events can affect dialysis duration; these competing events can change the probability of the event of interest (14). Therefore, we examined the association of assisted PD with all the possible outcomes using methods developed for survival analysis in the presence of competing risks.

Materials and Methods

Study Population

This retrospective study used the data from the French Peritoneal Dialysis Registry (15). All adult (older than age 18 years) starting PD in France between January 1, 2002, and December 31, 2010, were included. The observation period ended June 1, 2011. We excluded patients who had primary PD failure, defined as PD duration less than 2 days, and patients who had been previously treated with PD.

Definition of Events

The event of interest was cessation of PD due to transfer to HD, defined as a transfer lasting more than

2 months. We examined the time to occurrence of four events during PD: death while undergoing PD, transplantation, renal function recovery, and transfer to HD.

Definition of Variables

The main explanatory variable for the outcome of interest was assisted PD at PD initiation, defined as PD performed at the patient's home with the help of a community nurse, a family member, or a partner (12). Assistance by a family member and assistance by a partner were grouped into the same category. Other explanatory variables were starting PD after transplantation failure, early peritonitis (defined as a peritonitis episode during the first 6 months of PD), HD before PD initiation, treatment in a center that provided home visits by a nurse from the dialysis center, and center size. Information about home visits was obtained by an additional questionnaire sent to dialysis centers. For center size evaluation, we calculated the number of incident PD patients per center and per year of participation during the study period. Patient age and comorbid conditions at dialysis start were considered as confounders. To assess patients' comorbid conditions, we extracted the Charlson comorbidity index (CCI) from the database; to evaluate the role of the comorbid conditions independently of patient age, we calculated a modified CCI by subtracting the age subscore. PD modality was considered a mediator because in France, patients undergoing assisted PD are mainly treated by continuous ambulatory PD (15) and because PD modality may affect technique survival. We also evaluated the association of diabetes mellitus and underlying nephropathy with each of the events.

Statistical Analyses

Continuous variables are reported as the median (first and third quartiles); categorical variables are reported as frequencies and percentage. Cumulative incidence curves were drawn for each possible event; conditional probabilities for the event of interest were estimated at specific time points. A P value less than 0.05 was considered to represent a statistically significant difference. We used 95% confidence intervals for statistical inference of the relative hazards (RHs) and to represent the uncertainty of the RHs. Statistical analyses were done with R 2.13.1 (R Foundation for Statistical Computing), including the survival, coxme, cmprsk, and mice packages.

Cause-Specific RH Approach. Cause-specific RH measures the association between the covariate and each outcome. When there are competing events, the cause-specific RH cannot be used to predict whether an event will actually be observed because the probability of each event depends on the net effect of the cause-specific RH across all possible events (16). To explore the relationship between variables and each possible event, we estimated the unadjusted cause-specific RH and 95% confidence intervals by a bivariate Cox regression. Regression splines were used to explore the functional form of continuous variables. On the basis of the smoothing spline representation, center size was divided into three categories and modeled as a categorical variable. The analysis of time to event of interest was performed by multivariate Cox regression. Variables were included in the Cox model if they were considered explanatory variables of the outcome but not mediators of the assistance-outcome association, based on *a priori* considerations without undertaking any statistical selection procedure. Center size was entered in the Cox model as a random effect.

We tested only the interaction between age and assistance and between modified CCI and assistance; there was no significant interaction between these variables. The proportional hazard assumption was tested by visual inspection of Schoenfeld residual plots and outliers by dfbeta plots.

Subdistribution RH Approach. The subdistribution RH can be defined as the probability of the event for an individual who has survived up to time t without any event or who has had a competing event before time t (*i.e.*, it describes the cumulative incidence function). Fine and Gray developed a way to regress on cumulative incidence function with an alternative proportional hazard model constructed from the subdistribution hazard (17).

Compared with the cause-specific RH approach, the main difference of the subdistribution RH approach is in the risk set. For the cause-specific HR, the risk set decreases at each time point at which there is a failure for another cause (events that are not the events of interest are censored), whereas for the subdistribution RH the persons with failure from another cause remain in the risk set. The Fine and Gray model is an alternative proportional hazards model constructed from the subdistribution hazard.

For the binary variable, we drew cumulative incidence curves and tested whether the curves differ using a log-rank test for equality of cumulative incidence curves (based on the subdistribution) developed by Gray (the Gray test). We explored the relationship between continuous variable and the cumulative incidence of each event using a bivariate Fine and Gray regression model. The results of this exploration phase were consistent with those obtained with the cause-specific RH. Proportional hazard assumptions were tested with Schoenfeld residual plots. Multivariate analysis was performed using a Fine and Gray model that gave the subdistribution RH for each covariate (18).

Missing Data. Five percent of the data were missing for the CCI. Therefore, we performed five sets of conditional imputation for the missing CCI values. The set of imputed CCI values was chosen according to a graphic representation of the imputed value and the observed value. Modified CCI was calculated using the imputed CCI value.

Results

Patient Characteristics

Among 9864 patients who started PD during the study period, 9842 met the inclusion criteria, 20 were excluded because of missing or invalid data, and 9822 were analyzed. Of these 9822 patients, 5286 were treated with assisted PD; of these, 1056 (11% of the 9864 original patients) were assisted by their family and 4230 (43% of 9864) by a community nurse. The initial PD modality was continuous ambulatory PD for 7568 of 9822 (77%) patients. There were 144 dialysis center divided into three groups according to the number of new patients starting PD by center and by year during the study period: ≤10 (103 of 144 centers), 11–20 (33 of 144 centers), and >20 (8 of 144 centers). Among these three groups of centers, 36 of 103, 16 of 33, and 6 of 8,

respectively, provided home visits by a nurse from the dialysis center.

Compared with patients undergoing self-care PD, those receiving assisted PD were older and had a higher CCI. Treatment modalities before PD initiation did not differ between the assisted and the self-care PD groups. Center size was associated with neither assisted PD nor the type of assistance. Detailed information about patient characteristics by assistance modality is provided in Table 1.

Events during PD

The median PD duration for the cohort was 16.49 months (interquartile range, 7.78–29.70). There were 7594 events during the study period: 3495 deaths, 2464 transfers to HD, 1489 renal transplantations, and 146 renal function recoveries. There were 2096 patients censored and 132 patients lost to follow-up. Causes of transfer to HD were peritonitis (n=495), dialysis adequacy (n=612), psychosocial reasons (n=268), catheter dysfunction (n=232), ultrafiltration failure (n=201), malnutrition (n=70), miscellaneous reasons related to PD (n=284), miscellaneous reasons unrelated to PD (n=297), and unknown reasons (n=5). Conditional probabilities using the cumulative incidence method for the events are provided in Table 2.

Cause-Specific HR for Each Event

In the bivariate analysis, patients undergoing assisted PD had a lower risk for transfer to HD but a higher risk for death (Table 3). Assisted PD was marginally associated with a higher risk for renal function recovery. In addition, CCI and modified CCI were associated with a decreased risk for transfer to HD, a decreased risk for transplantation, and an increased risk for death. Male sex was associated with an increased risk for transfer to HD and an increased risk for transplantation and was not associated with death or renal function recovery. As expected, diabetic patients had an increased risk for death and a lower risk for transplantation. There was an association between HD before PD initiation and transfer to HD, renal function recovery, and death during PD. Transplantation failure was associated with transfer to HD renal transplantation and a decreased risk for death. Center size was associated with transfer to HD and also with transplantation. Early peritonitis was associated only with transfer to HD. Details of cause-specific RH for each outcome are provided in Table 4.

After adjustment for age, sex, modified CCI, HD before PD initiation, transplantation failure, early peritonitis, and center size, assisted PD was still associated with a lower risk for transfer to HD (Table 4). Compared with patients

Table 1. Patient characteristics according to assistance modality

Covariate	Family-Assisted PD (n=1056)	Nurse-Assisted PD (n=4230)	Self-PD (n=4515)
Age at PD initiation (yr)[a]	73.6 (64.6–80.3)	78.7 (72.3–83.7)	56.05 (43.1–68.1)
CCI[a]	7 (9–6)	8 (6–9)	4 (3–6)
Modified CCI[a]	6 (4–7)	5 (4–7)	3 (2–5)
Men	610 (57)	2104 (50)	2886 (64)
Diabetes	487 (46)	1767 (42)	927 (21)
Nephropathy			
unknown	121 (12)	569 (14)	475 (11)
interstitial nephritis	52 (5)	206 (5)	300 (7)
GN	83 (8)	290 (7)	1061 (24)
diabetic	310 (30)	1118 (27)	611 (14)
PKD	23 (2)	79 (2)	444 (10)
miscellaneous	42 (4)	94 (2)	223 (5)
uropathy	19 (2)	55 (1)	224 (5)
vascular	359 (35)	1654 (40)	931 (21)
systemic disease	17 (2)	70 (2)	151 (3)
missing	30	95	95
Treatment before PD			
satellite HD	0 (0)	3 (0)	18 (0)
home HD	0 (0)	2 (0)	2 (0)
in-center HD	214 (20)	721 (17)	788 (18)
Not on dialysis	827 (79)	3485 (83)	3493 (78)
renal transplantation	13 (1)	9 (0)	197 (4)
missing	2	10	17
Center size (new patients per year)			
≤10	479 (45)	1917 (45)	2015 (45)
10–20	443 (42)	1563 (37)	1780 (39)
>20	134 (13)	750 (18)	720 (16)
Early peritonitis	16 (2)	54 (1)	67 (1)

Unless otherwise indicated, values are expressed as the number (percentage) of patients. PD, peritoneal dialysis; CCI, Charlson comorbidity index; PKD, polycystic kidney disease; HD, hemodialysis.
[a]Median (interquartile range).

Table 2. Cumulative incidence of the events at specific times points with the cumulative incidence function estimate

Event per Type of Assistance	6 Months	12 Months	18 Months	24 Months
Self-PD				
death	1.8	3.8	5.4	7.2
renal recovery	0.6	1.0	1.1	1.3
transfer to HD	6.6	12.4	17.2	21.5
renal transplantation	4.4	12.2	19.1	24.7
Assisted PD				
death	13.8	24.3	32.5	39.8
renal recovery	0.7	1.1	1.3	1.4
transfer to HD	6.1	9.5	12.7	15.0
renal transplantation	0.3	0.7	0.9	1.2

Data are expressed as percentages. PD, peritoneal dialysis; HD, hemodialysis.

Table 3. Cause-specific relative hazard for each event (bivariate analysis with a Cox model)

Covariate	Cause-Specific RH (95% CI)			
	Transfer to HD	Renal Recovery	Renal Transplantation	Death on PD
Per year of age	0.98 (0.98–0.99)	1.01 (1.00–1.02)	0.94 (0.94–0.94)	1.06 (1.05–1.06)
Male sex	1.49 (1.06–1.24)	1.24 (0.89–1.73)	1.13 (1.02–1.25)	1.05 (0.98–1.11)
Underlying nephropathy				
unknown	Reference	Reference	Reference	Reference
interstitial nephritis	0.96 (0.79– 1.17)	0.85 (0.33–2.21)	1.63 (1.29–2.06)	0.62 (0.53–0.76)
GN	1.29 (1.11–1.49)	0.75 (0.35–1.59)	2.48 (2.06–2.98)	0.38 (0.32–0.45)
diabetes	1.07 (0.93 –1.24)	0.73 (0.36–1.46)	0.40 (0.31–0.51)	1.11 (0.99–1.28)
PKD	1.07 (0.88–1.31)	0.44 (0.13–1.55)	2.83 (2.30–3.49)	0.28 (0.22–0.37)
miscellaneous	1.11 (0.87–1.40)	2.71 (1.21–5.96)	2.06 (1.58–2.68)	0.79 (0.64–0.97)
urologic	0.95 (0.73–1.22)	0.54 (0.12–2.37)	2.64 (2.06–3.38)	0.33 (0.24–0.44)
vascular	0.83 (0.73–0.96)	1.92 (1.08–3.42)	0.42 (0.33–0.52)	1.09 (0.98–1.21)
systemic disease	1.38 (1.07–1.79)	2.24 (0.86–5.80)	1.75 (1.27–2.41)	0.74 (0.57–0.95)
Diabetes	1.00 (0.92–1.09)	0.84 (0.59–1.20)	0.24 (0.20–0.28)	1.52 (1.42–1.63)
CCI (per unit)	0.94 (0.92–0.95)	1.10 (1.04–1.17)	0.56 (0.54–0.57)	1.25 (1.24–1.27)
Modified CCI (per unit)	0.96 (0.94–0.98)	1.10 (1.02–1.18)	0.54 (0.52–0.57)	1.22 (1.20–1.23)
HD before PD	1.34 (1.22– 1.48)	1.78 (1.23–2.58)	0.93 (0.80–1.07)	1.12 (1.03–1.23)
Transplantation failure	1.76 (1.43–2.17)	0.31 (0.04–2.3)	1.96 (1.51–2.55)	0.25 (0.15–0.39)
Assisted PD	0.69 (0.63 –0.74)	1.13 (0.82–1.57)	0.06 (0.05–0.07)	4.40 (4.04–4.81)
Home visits[a]	1.02 (0.93–1.11)	1.74 (1.19–2.56)	1.01 (0.93–1.11)	0.96 (0.89–1.03)
Modality of assistance				
Self-PD	Reference	Reference	Reference	Reference
Family-assisted	0.76 (0.66–0.87)	1.10 (0.64–1.90)	0.11 (0.08–0.16)	3.94 (3.51–4.44)
Nurse-assisted	0.67 (0.61–0.73)	1.14 (0.81–1.61)	0.04 (0.03–0.05)	4.52 (4.12–4.95)
Center size by categories (new patients per year)				
<10	Reference	Reference	Reference	Reference
10–20	0.90 (0.83 –0.98)	1.51 (1.05–2.18)	0.97 (0.86–1.08)	0.89 (0.83–0.96)
>20	0.83 (0.73–0.93)	1.61 (1.02–2.55)	1.29 (1.13–1.48)	1.11(1.00–1.21)
Early peritonitis	1.53 (1.34–2.06)	0.54 (0.08–3.86)	1.20 (0.78–1.85)	1.09 (0.79–1.45)
First PD modality (CAPD)	0.82 (0.75–0.89)	1.20 (0.80–1.79)	0.46 (0.41–0.51)	1.99 (1.80–2.20)

RH, relative hazard; CI, confidence interval; PD, peritoneal dialysis; PKD, polycystic kidney disease; CCI, Charlson comorbidity index; HD, hemodialysis; CAPD, continuous ambulatory peritoneal dialysis.
[a]Treated in a center providing home visit by nurse from the dialysis center.

undergoing self-care PD, those with nurse-assisted PD had a risk for transfer to HD of 0.87 (95% confidence interval, 0.76–0.94), whereas family-assisted patients had a risk for transfer to HD similar to that of self-care PD patients.

Subdistribution RH

The Gray test and unadjusted subdistribution RH showed that age, sex, modified CCI, underlying nephropathy, failed transplantation, transfer from HD, early peritonitis, center

Table 4. Cause-specific relative hazard for transfer to HD (multivariate analysis using a Cox model with center as random effect)

Covariate	Adjusted Cause-Specific RH (95% CI)
Per year of age	0.99 (0.99–0.99)
Male sex	1.13 (1.04–1.23)
Modified CCI (per unit)	1.01 (0.98–1.03)
Underlying nephropathy	
unknown	Reference
interstitial nephritis	0.95 (0.78–1.16)
GN	1.08 (0.93–1.26)
diabetes	1.14 (0.98–1.33)
PKD	0.96 (0.78–1.17)
miscellaneous	0.86 (0.71–1.14)
urologic	0.76 (0.58–0.98)
vascular	0.91 (0.79–1.05)
systemic disease	1.12 (0.86–1.46)
HD before PD	1.31 (1.19–1.46)
Failed transplantation	1.63 (1.31–2.03)
Early peritonitis	1.53 (1.13–2.07)
Center size categories (new patients per year)	
<10	Reference
10–20	0.84 (0.77–0.93)
>20	0.83 (0.72–0.94)
Assisted PD	0.85 (0.77–0.94)

RH, relative hazard; CI, confidence interval; CCI, Charlson comorbidity index; PKD, polycystic kidney disease; HD, hemodialysis; PD, peritoneal dialysis.

size, and assisted PD were associated with transfer to HD (data not shown). In the multivariate analysis, using a Fine and Gray regression model, assisted PD was still associated with a lower risk for transfer to HD (Tables 5 and 6).

Discussion

Nephrologists in charge of patients with ESRD consider technique failure to be a barrier to PD use (19). Causes of PD failure differ by treatment duration (20,21). Psychosocial factors are frequently involved in early PD failure, and social support is needed for some patients starting PD. In a study from Switzerland, early failure accounted for 40% of technique failure (20). In that report, catheter dysfunction and psychosocial problems were more often responsible for early than late failure. In that study, there were three main reasons for psychosocial problems: physical impairment, cognitive dysfunction, and social isolation. This could explain why patients' age was associated with an increased risk for late but not early technique failure in the multivariate analysis. These finding are consistent with the results of a study from the Netherlands regarding technique failure according to duration of treatment (21). In the Dutch study, patient age was associated with late failure but not with technique failure occurring during the first 3 months of PD. Patient comorbid conditions were associated with both early and late technique failure. In support of this, two studies found that loss of independence increases with the time spent on dialysis in elderly patients, which may, in turn, provoke late technique failure when assistance is not available (22,23). In a recent study from Canada using the cause-specific RH approach, patient age was associated with an increased risk for death, an increased risk for technique failure, and a lower risk for renal transplantation (3).

Of note, in our study, older age was also associated with an increased risk for death, a lower risk for renal transplantation, and a lower risk for technique failure when using a Cox regression model for technique survival censored on the other events. In the multivariate analysis using a Fine and Gray regression model, there was no association between patient age and PD duration. In the Netherlands Cooperative Study on the Adequacy of Dialysis , the multivariate analysis with the Cox model showed that patient age was significantly associated with a higher risk for death but did not predict technique failure (1). In a single-center study, patient age

Table 5. Fine and Gray (subdistribution relative hazard) and Cox (cause-specific relative hazard) regression models (event of interest: transfer to HD)

Covariate	Model 1		Model 2	
	Cox Model: Cause-Specific RH (95% CI)	Fine and Gray Model: Subdistribution RH (95% CI)	Cox Model: Cause-Specific RH (95% CI)	Fine and Gray Model: Subdistribution RH (95% CI)
Failed transplantation	1.61 (1.29–2.00)	1.72 (1.39–2.17)	1.61 (1.29–2.00)	1.73 (1.39–2.17)
HD before PD	1.29 (1.16–1.43)	1.27 (1.14–1.40)	1.29 (1.16–1.43)	1.26 (1.14–1.40)
Early peritonitis	1.55 (1.14–2.09)	1.45 (1.06–1.97)	1.55 (1.14–2.09)	1.45 (1.06–1.97)
Center size: >20 patients per year	0.90 (0.80–1.00)	0.82 (0.72–0.91)	0.90 (0.80–1.00)	0.81 (0.72–0.91)
Family-assisted PD	0.86 (0.75–1.00)	0.81 (0.70–0.94)	0.85 (0.76–0.93)[a]	0.73 (0.65–0.81)[a]
Nurse-assisted PD	0.84 (0.75–0.93)	0.72 (0.63–0.81)	—	—

Adjusted for age, sex, modified Charlson comorbidity index, and underlying nephropathy. RH, relative hazard; CI, confidence interval; HD, hemodialysis; PD, peritoneal dialysis.
[a]Refers to assisted PD in general.

Table 6. Cause-specific relative hazard and subdistribution relative hazard associated with assisted PD (event of interest: transfer to hemodialysis)

Assistance	Cause-Specific RH (95% CI)				Subdistribution RH for HD (95% CI)
	Death	Recovery	Transplantation	HD	
Family-assisted PD (reference group: nurse and self-care PD)	2.23 (1.97–2.53)	0.72 (0.40–1.31)	0.33 (0.24–0.46)	0.87 (0.75–1.01)	0.81 (0.70–0.94)
Nurse-assisted PD (reference group: family and self-care)	2.18 (1.96–2.42)	0.74 (0.48–1.13)	0.16 (0.12–0.22)	0.85 (0.76–0.95)	0.72 (0.63–0.81)
Assisted PD (reference group: self-care PD)	2.19 (1.98–2.43)	0.73 (0.49–1.10)	0.21 (0.17–0.26)	0.85 (0.77–0.95)	0.73 (0.65–0.81)

Adjusted for age, sex, modified Charlson comorbidity index, underlying nephropathy, failed transplantation, transfer to hemodialysis, early peritonitis, and center size. RH, relative hazard; CI, confidence interval; HD, hemodialysis; PD, peritoneal dialysis.

and the modified CCI were both associated with an increased risk for death and technique failure (5). In our study, the modified CCI was associated with an increased cause-specific RH of death, but there was no significant association between the modified CCI and technique failure. In estimating the subdistribution RH for transfer to HD with the Fine and Gray model, there was no significant association between the transfer to HD and the modified CCI. In an analysis of data from the Choices for Healthy Outcomes in Caring for ESRD study, Jaar *et al.* found no relationship between comorbidity, patient age, and technique failure in a multivariate analysis with a Cox regression model (24). However, in view of the patients' ages, one may argue that only selected patients were treated by PD.

Subdistribution RH and cause-specific RH must be interpreted differently (16). The former approach showed that assistance by a family member or by a nurse was associated with a lower risk for transfer to HD due to both assisted PD and the possibly differential effect of the competing events on the risk set. Because subdistribution RH accounts for competing events, it indicates that patients undergoing assisted PD will have a longer duration of PD. The cause-specific RH approach showed that assisted PD was specifically associated with the occurrence of transfer to HD. Because the transfer to HD depended on the cause-specific RH for transfer to HD and on the cause-specific RH for the other events, the cause-specific RH for the transfer to HD could not be used to predict PD duration.

Assisted PD was also associated with the risk for death when the Cox model approach was used. This finding suggests that assistance could reflect disabilities, which were not captured in our study and are a well known predictor of death. This finding is in line with results of a previous study from our group on PD in the elderly (25). Treatment in a center that provided home visits by a nurse from the dialysis center was not associated with a longer duration on PD. This result must be interpreted with caution because only 52% of the patients were treated in a center that provided home nurse visits. Nevertheless, one may argue that home visits may decrease the risk for early PD failure. In addition, Verger *et al.* have reported that home visits were associated with a lower risk for peritonitis in patients undergoing assisted PD (26).

Our study has some limitations. Patients undergoing assisted PD may have been selected for PD because of contraindication to HD, which could have an effect on PD duration. In addition, the longer duration on PD among the assisted PD patients could simply be a mediator of the medical decision to avoid the transfer to HD when life expectancy is thought to be low. It may also be a marker of the patient perception of the switch to HD. Furthermore, no captured confounders could also affect the association between assisted PD and technique survival.

Whether prolongation of PD duration affects patient survival or quality of life is a matter of debate. There is no clear consensus regarding the optimal time on PD (27). It is obvious that shifting the patient to HD when necessary rather than continuing a therapy that is becoming dangerous will affect the patient's survival. However, we believe that assistance should be considered as a means to maintain PD for patients who choose to be treated by PD or to continue undergoing PD despite functional impairment or who are not willing to perform PD by themselves. Older age, an increased number of satellite HD units, and concerns about PD failure play a role in the decline of PD (28). This will increase the demand on HD units and increase the cost of dialysis *per se*. The funding of assisted PD is a matter of concern. The cost of assisted PD in European countries has been estimated by Dratwa and colleagues in a recent survey (29). The cost of assisted PD was higher in France than other countries. However, in one study from France, even with the additional cost of the assistance, PD was still cheaper than in-center HD (30). Therefore, we believe that the funding of assisted PD should be evaluated and compared with the cost of in-center HD by health care providers (30).

In conclusion, assisted PD is associated with a lower risk for technique failure in a European country where assistance is covered by the national health care insurance.

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Disclosures

None.

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