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NEPHROLOGY – ORIGINAL PAPER

Patient outcome in primary peritoneal dialysis patients versus those transferred from hemodialysis and transplantation

Iraj Najafi · Mostafa Hosseini · Shahnaz Atabac · Hushang Sanadgol · Nader Nouri Majelan · Shiva Seirafian · Massih Naghibi · Khadigeh Makhdoumi · Fereshteh Saddadi · Tayebeh Soleymanian

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Abstract
Background According to the concept of integrated care, renal transplantation, peritoneal dialysis (PD), and hemodialysis (HD) should be considered three complementary methods of renal replacement therapy. This study tried to evaluate patient outcomes in three different groups of PD patients, namely primary PD patients, those transferred to PD with failing kidney transplant, and those transferred to PD from HD.
Method From January 1, 1995, to end of 2006 from 26 PD centers, 1,355 patients including demographic, clinical and laboratory data, which were monthly collected through questionnaires, were enrolled in the study. We compared patients' characteristics, factors affecting patient survival, and patient outcomes between primary PD patients (group 1, $n = 1{,}067$), patients transferred from transplantation (group 2, $n = 43$) and those transferred from HD (group 3, $n = 245$), which had been on HD for at least 3 months before switching to PD.
Results There was no difference in the proportion of patients with diabetes in the three groups. Overall, 238 patients (17.5%) were transferred to HD but there was no significant difference in PD technique survival on between the three groups. Death occurred in 256 (24%), 3 (7%) and 65 (26.5%) subjects in groups 1, 2 and 3, respectively. Most patients (81.5%) in group 2 underwent re-transplantation. The Kaplan–Meier survival rates were not different between the three groups. In the Cox multiple regression model, age, presence of diabetes and serum albumin level significantly influenced patient survival.
Conclusion We concluded that PD could be considered safe for patients experiencing complications on HD, as well as for those with renal transplantation.

Keywords Peritoneal dialysis · Hemodialysis · Kidney transplantation · Patient outcome

I. Najafi · M. Hosseini · F. Saddadi · T. Soleymanian (✉)
Nephrology Department of Shariati Hospital and Shafa Research Center, Tehran University of Medical Sciences, Tehran, Iran
e-mail: soleymanian@tums.ac.ir

S. Atabac
Behashti University of Medical Sciences, Tehran, Iran

H. Sanadgol
Zahedan University of Medical Sciences, Zahedan, Iran

N. N. Majelan
Yazd University of Medical Sciences, Yazd, Iran

S. Seirafian
Isfahan University of Medical Sciences, Isfahan, Iran

M. Naghibi
Mashhad University of Medical Sciences, Mashhad, Iran

K. Makhdoumi
Urmia University of Medical Sciences, Urmia, Iran

Introduction

The choice of the modality of renal replacement therapy (RRT) should be made based on medical, psychosocial, and financial status assessments in each patient with end-stage renal disease [1]. The integrated care concept suggests that the three options of RRT modalities should be offered in an unbiased way to all patients, focusing mainly on the advantages of each modality for each patient [2]. During RRT, patients should be periodically reassessed as whether they might continue with their current modality or whether they might require to be transferred to another modality. This is the best approach to improve patient outcome.

The integrated care concept, suggested by Mendelssohn and Pierratos [3] and by Oreopoulos et al. [4], focuses on timely referral to nephrologists and management of cardiovascular risk factors and comorbidities in patients with CKD, in order to slow the progression to end-stage renal disease. This concept also considers home dialysis (home HD and PD) and pre-emptive live donor transplantation as the initial modalities of choice for suitable patients but it does not involve forcing unwilling patients to accept any such decisions [5, 6].

While the best RRT modality in terms of quality of life and medical expenses is kidney transplantation [7, 8], it seems that patient survival rates are similar in PD and HD [9]. Switches from one RRT modality to another often occurs in transplantation because of allograft failure, in PD mainly due to peritonitis, catheter malfunction, membrane failure, and patient burn-out [10–12], and in HD mostly because of vascular access failure, cardiac problems and intradialytic complications [9, 13, 14].

There is a controversy about the course and outcome of patients transferred from HD or from transplantation to PD in comparison with patients staying on PD as their first and only RRT modality. For this reason, we decided to study technique and patient survival rates and predictive factors in primary PD patients and in those transferred from transplantation or HD.

Materials and methods

During January 1, 1995, to end of 2006, data on all 1,355 PD patients from 26 centers (10 cities from all over Iran) were collected prospectively. Data included demographic, clinical and laboratory characteristics of the patients, which were collected monthly through questionnaires by trained nurses at each center. Data were entered in "Hakim" (a Parsi database) and checked for outlier measurements and then analyzed using STATA (9.0).

We compared patients' characteristics, technique and patient survival rates, as well as factors influencing these rates among patients new to peritoneal dialysis therapy (PD-first group or group 1, $n = 1{,}067$), patients transferred from failed allograft (TX group or group 2, $n = 43$) and subjects transferred from hemodialysis (HD group or group 3, $n = 245$), which had been on HD for at least 3 months before switching to PD.

Data available on clinical characteristics and laboratory parameters were included in the analysis. Kt/V and CrCl (creatinine clearance) have usually been measured 6–8 weeks after PD catheter implantation and annually thereafter or whenever needed clinically. We also assessed co-morbidities, including congestive heart failure, hypertension, coronary artery disease, cerebrovascular disease, collagen vascular diseases, liver cirrhosis, malignancy, chronic obstructive pulmonary disease and peripheral vascular disease. Causes of transfer from PD to HD (technique failure) included peritonitis, exit site and tunnel infection, membrane failure, catheter malfunctions, mechanical problems, and patients' preference. The Kaplan–Meier method was utilized to analyze actuarial patient and technique survival. In patient survival analysis, patients were censored at transplantation, transfer to HD, recovery of renal function and at the end of the study. In the technique survival analysis, transfer to HD was considered the final event and patients were censored at other events, including death.

Statistics

Preliminary description of the data is presented as mean ± SD and percentage. Association between categorical variables was studied using chi-squared and Fisher's exact tests. One-way ANOVA was used for the comparison of group means. A Cox proportional hazards model was used to compare patient survival in groups, adjusting for the confounders. A P value <0.05 was considered statistically significant.

Results

A total of 1,355 patients were included. Mean age of patients at initiation of PD was 46.1 ± 21.1 years. Female patients (788, 58%) were more numerous than males. The total number of diabetic patients was 408 (30.1%). The majority of patients (1,067, 78.7%) were new to PD, 43 (3.2%) patients were transferred to PD because of failed renal transplantation and 245 (18.1%) were transferred from hemodialysis. Patients' characteristics are shown in Table 1. The prevalence of diabetic patients was similar in the three groups. Patients transferred from transplantation were significantly younger ($P = 0.01$), predominantly male ($P = 0.004$) and had fewer comorbidities ($P = 0.001$). Subjects transferred from HD had significantly lower 24-h urine output ($P < 0.0001$), lower total creatinine clearance ($P = 0.0002$) and total KT/V urea ($P = 0.004$) and slightly higher number of comorbidities ($P = 0.05$). Mean age was not different between groups 1 and 3, but serum creatinine level ($P < 0.0001$) and net ultrafiltration volume ($P = 0.07$) were higher in group 3. There were no significant differences in serum fasting glucose, calcium, phosphorus, hemoglobin, triglyceride and cholesterol levels. Median time on HD before transfer to PD was 18 (range 3–284) months. The major causes of switch from HD to PD were vascular access failure (45% of cases) and intolerance to HD, with intradialytic hypotension (34%). There were no significant differences in serum albumin and normalized protein nitrogen appearance among groups.

Survival analysis

During a cumulative observation period of 20,455 patient-months (median 14, range 3–119 months), a total of 324 (23.9%) patients died, 238 (17.5%) were transferred to hemodialysis, 172 (12.7%) were transplanted, 19 (1.4%) recovered their renal function, and 598 (44.1%) remained on PD. Causes of PD discontinuation were unknown in 5 (0.4%) patients (Table 2). The most common cause of PD exit in group 2 was re-transplantation (81%), whereas death and transfer to HD were the other causes. Death was the most common cause of PD exit in groups 1 and 3, transfer to hemodialysis and transplantation were the next common causes. There was no significant difference in causes of PD exit between groups 1 and 3, but patients in group 2 more often underwent re-transplantation.

Technique failure (transfer to HD) occurred in 238 (17.5%) patients. The most common reasons were peritonitis (55%), patient burn-out (17.5%), and PD catheter malfunction (14.8%) (Table 3). When we plotted Kaplan–Meier curve for technique survival,

Table 1 Patients' characteristics and therapy measures in three groups of patients

Parameter	Group 1 (PD First)	Group 2 (transferred from TX)	Group 3 (transferred from HD)	*P* value (groups 1,2,3)	*P* value (groups 1,3)
Number of patients	1,067 (78.7%)	43 (3.2%)	245 (18.1%)		
Age at the start (years)	45.9 ± 21.1	37.4 ± 14.6	47.7 ± 16.2	<0.01	NS
Gender (M/F)	52/616 (42%)	27/16 (62%)	89/156 (36%)	0.004	0.05
Patients with diabetes	330 (30.9%)	11 (25.5%)	67 (27.3%)	NS	NS
Comorbidity number	0.63 ± 0.80	0.44 ± 0.58	0.69 ± 0.88	0.001	0.05
BMI[a] (Kg/m^2)	22.87 ± 4.63	23.86 ± 4.43	22.94 ± 4.36	NS	NS
nPNA[b] (g/kg/day)	1.03 ± 0.36	1.18 ± 0.59	0.92 ± 0.32	NS	NS
Serum albumin (mg/dL)	3.6 ± 0.7	3.5 ± 0.5	3.6 ± 0.7	NS	NS
Ultrafiltration volume (ml/24-h)	928 ± 617	980 ± 783	1,013 ± 519	0.08	0.07
Serum creatinine (mg/dL)	6.74 ± 2.89	5.31 ± 1.75	8.14 ± 3.07	0.0001	<0.0001
Urine volume (mL/24-h)	918 ± 693	1,171 ± 747	446 ± 473	<0.0001	<0.0001
Total CrCl[c] (l/week)	83.7 ± 33.2	71.1 ± 24.1	63.9 ± 32.7	0.0002	<0.0001
Weekly total KT/V	2.27 ± 0.67	1.97 ± 0.54	2.01 ± 0.71	0.004	0.005

[a] Body mass index, [b] normalized protein nitrogen appearance, [c] creatinine clearance

Table 2 Causes of PD discontinuation in three groups of patients

Groups	Death (%)	Transfer to HD (%)	Transfer to transplantation (%)	Renal recovery (%)	Unknown (%)	Active on PD (%)	Total
PD	256 (24)	187 (17.5)	121 (11.3)	18 (1.7)	4 (0.4)	482 (45.1)	1,067
TX	3 (7)	2 (4.6)	35 (81.4)	0	0	3 (7)	43
HD	65 (26.5)	49 (20)	16 (6.5)	1 (0.4)	1 (0.4)	113 (46.1)	245
Total	324 (23.9)	238 (17.5)	172 (12.7)	19 (1.4)	5 (0.4)	598 (44.1)	1,356

there was no significant difference in technique survival between the three groups.

Death occurred in 256 (24%), 3 (7%), and 65 (26.5%) of subjects new to peritoneal dialysis, those transferred from transplantation, and those transferred from HD, respectively. One-, three- and five-year technique and patient survival rates were 91%, 67%, 41% and 86%, 57%, and 41%, respectively.

The most common causes of death were cardiovascular complications and infections. Kaplan–Meier survival curve revealed that patient survival was similar in the three groups, although there was a trend toward better survival in patients transferred from transplantation ($P = 0.09$, HR: 0.29, Fig. 1). In the Cox multiple regression survival analysis, PD therapy as either PD first, PD following transplantation or PD after HD was mixed in a model along with age, sex, presence of diabetes, hypertension, comorbidity number, 24-h urine volume, 24-h ultrafiltration volume, weekly total KT/V and CrCl, and serum albumin. In this model, age ($P = 0.0006$), the presence of diabetes mellitus ($P = 0.04$) and the serum albumin level ($P = 0.03$) significantly affected patient survival.

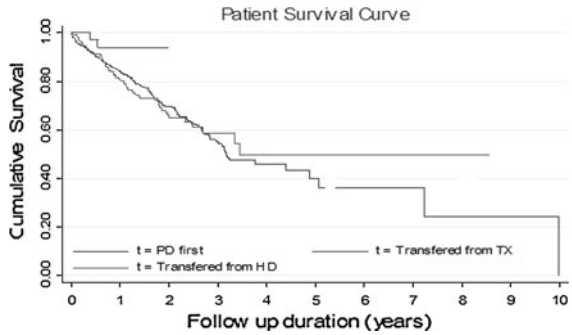

Fig. 1 Patient survival analysis by Kaplan–Meier method (HR: 0.29, $P = 0.09$)

Discussion

The present study evaluated the profiles of three different groups in a large, nationwide cohort of PD patients. This study allowed us to know more about overall patient and technique survival in different groups of patients.

The five-year patient survival rate in all patients was 41%, which is lower than in Turkey (68.8%) and East Asia (Japan: 67.4%, Korea: 69.8%), but similar to reports from United States (32%) and Europe (27–40%) [14–19]. We think that, although our patients were younger (46 years) than those in the United States and in Europe, negative selection and probably comorbid conditions are more prevalent in our subjects (negative selection, which means patients are forced to go on PD because of their medical situation, is high in our PD patients). Transplantation is easily available in our country; therefore, younger and healthier people going for transplantation.

Table 3 Causes of technique failure in three groups of patients

Groups	Peritonitis (%)	Exit and tunnel infections (%)	Membrane failure (%)	Catheter malfunction (%)	Patient preference (%)	Mechanical problems (%)	Total
PD	96 (54)	3 (1.7)	14 (7.9)	33 (18.5)	31 (17.4)	1 (0.6)	178
TX	1 (50)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	2
HD	30 (61.2)	2 (4.1)	8 (16.3)	1 (2)	8 (16.3)	0 (0)	49
Total	127 (55.5)	5 (2.2)	22 (9.6)	34 (14.8)	40 (17.5)	1 (0.4)	229

Studies have shown that independent predictors of mortality are mostly older age, presence of diabetes, cardiovascular comorbidity, malnutrition and low residual renal function [15, 17, 20–26]. They are almost similar to our study which age, diabetes and serum albumin were independent predictors of patients survival. Prevalence of diabetes (30.1%) was not different among the groups.

In many centers, a number of patients (15–25%) have been transferred from hemodialysis to peritoneal dialysis due to mostly access problems. Seventeen percent of our patients were transferred from hemodialysis mainly because of vascular access problems, intradialytic complication and hypotension per se or associated with cardiac problems, which it is similar to other studies [14, 27, 28].

Clinical characteristics of the three studied groups on peritoneal dialysis almost differ. While female patients were significantly prominent in PD First and those transferred from hemodialysis, there were more males in patients transferred from transplantation. The higher percentage of male patients in transplanted group is probably due to that there are usually better facilities for men to receive a kidney transplant. Patient survival of subjects transferred from transplantation was a little better than PD First and those transferred from HD. It is not unusual because transplanted patients are usually younger with less comorbid conditions as seen in our patients. Some studies have established that transplanted patients on PD therapy had outcomes better than PD First patients [9, 29], and their first year survival on peritoneal dialysis was almost similar to patients newly transplanted [9]. However, regarding the small number of patients and high re-transplantation rate in patients transferred from transplantation, comparison of them with other two groups may not be reliable. However, we described that peritoneal dialysis should be an acceptable modality of RRT for patients with failing graft.

Liberek et al. [21] compared clinical outcomes of 67 patients transferred from hemodialysis to PD with 197 subjects new to PD therapy. They found no significant difference in patient survival between two groups, although technique survival was significantly lower in patients transferred from HD. However, in majority of other studies evaluated survival between those two groups, there were significant differences in patient survival [9, 27, 28]. In Turkish study, transfer from HD to PD was independent predictor of mortality. In the present study, we noticed no significant difference in patient survival between PD First patients and patients transferred from HD. Although patients transferred from HD compared with primary PD patients had lower residual renal function and slightly higher overall comorbidities, but survival predictors of age, diabetes (associated with high cardiovascular comorbidities and death) and malnutrition (presented by serum albumin) were similar in two groups. It may explain similar two groups' patient survival.

Technique failure causes patients on PD to be transferred to hemodialysis mostly due to peritonitis, ultrafiltration failure, catheter problems and patient desire [9, 30, 31]. In our overall PD patients, main causes of transfer to HD were peritonitis, patient preference and catheter problems, respectively. It is possible that higher rate of patient desire is related to equal availability of three modalities of renal replacement therapy in our country, though patient burned-out (lack of cycler-assisted peritoneal dialysis) should also be considered. It seems catheter malfunction is relatively common in our patients; therefore, we need more expertise on catheter implementation.

Overall 5-year technique survival rate was 41% that is lower than some reports (71.9%) [17]. There was no significant difference in technique survival among groups. This is in contrast to other studies, which reported higher technique failure in subjects transferred from HD due to higher infections and adequacy problems [9, 21]. The reasons for equal technique survival in our study might be related to the facts that there was no difference in peritonitis rate between PD First patients and those transferred from HD, and patients transferred from failing graft mostly were going to re-transplantation. As a result, it would be possible to provide enough motivation and training for patients transferred from HD to apply PD with appropriate technique, as well as at least the minimum adequate dialysis on CAPD despite lower urine output [32].

In summary, our data suggest that outcome of patients transferred from transplantation and hemodialysis to peritoneal dialysis do not differ from patients with primary peritoneal dialysis therapy. Thus, peritoneal dialysis should be considered in patients experiencing complications on HD and in patients with failing renal transplantation. However, we had

neither time period patients spent on transplantation or hemodialysis before transfer to peritoneal dialysis nor the course of patients who transferred to hemodialysis after technique failure on peritoneal dialysis. There also were some missing data on our registry that would not be significant after adjusting for them and considering the large number of enrolled patients.

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