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A population-based approach indicates an overall higher patient mortality with peritoneal dialysis compared to hemodialysis in Korea

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To date, only a few large-scale studies have measured the effect of dialysis modality on mortality in Asian populations. Here, we sought to compare survival between incident hemodialysis (HD) and peritoneal dialysis (PD) patients using the Korean Health Insurance Review & Assessment Service database. This enabled us to perform a population-based complete survey that included 32,280 incident dialysis patients and followed them for a median of 26.5 months. To reduce biases due to nonrandomization, we first matched 7049 patient pairs with similar propensity scores. Using the log-rank test, we found the mortality rate in PD patients was significantly higher than that in HD patients. Subsequent subgroup analyses indicated that in older patients (55 years and older), with the exception of the subgroup of patients with no comorbidities and the subgroup of patients with malignancy, PD was consistently associated with a higher mortality rate. In younger patients (under 55 years), regardless of the covariates, the survival rate of PD patients was comparable to that of HD patients. Thus, while the overall mortality rate was higher in incident PD patients, mortality rates of some incident PD and HD patients were comparable in Korea.

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With rapid increases in the incidence and prevalence rates of end-stage renal disease (ESRD) throughout the world, kidney transplantation (KT) has become the most preferred modality of renal replacement therapy for patients suffering from ESRD. However, its widespread use is hampered due to the shortage of living and deceased donors. Therefore, most of the ESRD patients are forced to start renal replacement therapy by hemodialysis (HD) or peritoneal dialysis (PD). Although a randomized-controlled study is the most reliable and informative method of choice for comparing outcomes of these two treatments, an attempt to perform such a trial has never been successful due to the patient's predetermined preference.¹ Instead, several registry or nonrandomized cohort-based studies, particularly from the United States, Canada, Australia, and the Netherlands, have been used as valuable alternatives to help determine the optimal dialysis modality.^{2–11}

However, as dialysis outcomes following the use of the chosen modality can be affected by various factors, their interpretation is not always straightforward. In this regard, several reports have indicated that a number of differences exist in the characteristics and outcomes of dialysis patients according to their racial/ethnic groups. An analysis of the United States Renal Data System (USRDS) in 1998 revealed that Asians were younger at the initiation of dialysis therapy and had a lower body mass index than Whites.¹² The primary causes of ESRD also differed between Asians and Whites: Asians had more ESRD from glomerulonephritis and diabetes, but had less ESRD from cystic kidney disease and hypertension.¹² In addition, baseline coronary artery disease, congestive heart failure, hypertension, and peripheral vascular disease were significantly less prevalent in Asians than in Whites.¹³ Furthermore, there are significant differences in the overall and cardiovascular mortality in dialysis patients according to the racial/ethnic groups.^{14–17} Therefore,

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it seems to be necessary to determine whether the results from previous studies, conducted almost exclusively in a Western population, can be appropriately generalized to other racial/ethnic groups; however, to date, there are only a few studies comparing the outcomes between HD and PD in Asians.^{18,19} Hence, we present here the results of analysis using a population-based, large-scale Korean registry data to compare mortality between HD and PD patients, and to evaluate the relationship between mortality and various baseline covariates.

RESULTS

Baseline characteristics of the subjects

A total of 32,280 eligible patients who had started dialysis therapy between 1 January 2005 and 31 December 2008 were analyzed. At the initiation of dialysis treatment, the mean patient age was 57.0 ± 13.8 years, 58.7% of patients were males, and 50.1% of patients had diabetes. The number of the incident HD and PD patients was 24,399 (75.6%) and 7881 (24.4%), respectively. The median follow-up duration was 26.5 months (range, 3.1–59.0 months).

A detailed comparison of the baseline characteristics between HD and PD patients is shown in Table 1 (before matching).

Comparisons of mortality according to dialysis modalities

During the median follow-up period of 26.5 months, 6479 patients undergoing HD (26.6%) and 2156 patients undergoing PD (27.4%) died, which corresponded to a death rate of 112.5 and 112.3 deaths per 1000 patient-years, respectively. The 1-, 2-, and 3-year survival rates of HD patients were 87%, 78%, and 72%, respectively, and those of PD patients were 90%, 79%, and 71%, respectively. Survival analysis using Kaplan–Meier plots showed that there was no difference in the unadjusted mortality rate between HD and PD

patients (Figure 1; log-rank test, $P = 0.955$) after censoring for KT. Further, to reduce the bias arising from a potential difference in the probability of receiving KT between modalities, we also compared the unadjusted survival rate between HD and PD patients without censoring for KT and obtained a similar result (Supplementary Figure S1 online; log-rank test, $P = 0.714$).

In order to address the concerns that these results were probably influenced by a large heterogeneity in baseline characteristics between HD and PD patients as shown in Table 1 (before matching), we next performed propensity score matching, thereby incorporating and adjusting for all the listed baseline differences between HD and PD patients.²⁰ After propensity score matching, the two groups (7049 HD patients vs. 7049 PD patients) were well balanced for baseline characteristics (Table 1, after matching), and this was visually confirmed by an improvement in overlap of the distribution of propensity scores (Supplementary Figure S2 online). For these matched groups, we first performed Kaplan–Meier survival analysis after censoring for KT and found that the mortality was significantly higher in PD patients than in HD patients (Figure 2; log-rank test, $P < 0.001$), which corresponded to a significant increase of 20% in mortality rates (hazard ratio (HR), 1.20; 95% confidence interval (CI), 1.12–1.28; $P < 0.001$). This survival advantage for HD over PD in the matched groups was not altered even when the patients were not censored for KT (Supplementary Figure S3 online; log-rank test, $P < 0.001$).

Subgroup analyses according to baseline covariates

Next, we divided the entire study population into subgroups according to various baseline covariates to compare mortality between dialysis modalities within subgroups. Although there were exceptions in subgroups of patients with liver disease and malignancy and those with none of the listed

Table 1 | Baseline characteristics of the participants before and after propensity score matching

Variables	Before matching			After matching		
	All PD patients (N = 7881)	All HD patients (N = 24,399)	P-values	Matched PD patients (N = 7049)	Matched HD patients (N = 7049)	P-values
Age (years)	54.2 ± 13.6	57.8 ± 13.8	< 0.001	54.6 ± 13.1	54.8 ± 13.4	0.353
> 55 years of age	3962 (50.3)	14,729 (60.4)	< 0.001	3580 (50.8)	3571 (50.7)	0.879
Females (versus males)	3443 (43.7)	9894 (40.6)	< 0.001	3045 (43.2)	3036 (43.1)	0.878
National Health Insurance (versus Medical Aid)	6898 (87.5)	20,961 (85.9)	< 0.001	6154 (87.3)	6146 (87.2)	0.840
Diabetes mellitus	3996 (50.7)	12,190 (50.0)	0.251	3602 (51.1)	3685 (52.3)	0.251
<i>Comorbidities other than DM</i>						
Myocardial infarction	367 (4.7)	797 (3.3)	< 0.001	276 (3.9)	280 (4.0)	0.863
Congestive heart failure	1269 (16.1)	3483 (14.3)	< 0.001	1094 (15.5)	1083 (15.4)	0.798
Peripheral artery disease	424 (5.4)	1484 (6.1)	0.022	374 (5.3)	371 (5.3)	0.910
Cerebrovascular accident	830 (10.5)	3208 (13.1)	< 0.001	740 (10.5)	765 (10.9)	0.495
Chronic pulmonary disease	1233 (15.6)	3988 (16.3)	0.142	1098 (15.6)	1019 (14.5)	0.063
Peptic ulcer disease	1072 (13.6)	3637 (14.9)	0.004	957 (13.6)	957 (13.6)	1.000
Liver disease	780 (9.9)	2680 (11.0)	0.007	701 (9.9)	682 (9.7)	0.591
Cancer	321 (4.1)	1647 (6.8)	< 0.001	260 (3.7)	205 (2.9)	0.009

Abbreviations: DM, diabetes mellitus; HD, hemodialysis; PD, peritoneal dialysis.

Age is expressed as the mean $\pm$ s.d., and all other data are expressed as the number (%).

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