Hemodialysis Vascular Access Modifies the Association between Dialysis Modality and Survival

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ABSTRACT
Several comparisons of peritoneal dialysis (PD) and hemodialysis (HD) in incident patients with ESRD demonstrate superior survival in PD-treated patients within the first 1 to 2 years. These survival differences may be due to higher HD-related mortality as a result of high rates of incident central venous catheter (CVC) use or due to an initial survival advantage conferred by PD. We compared the survival of incident PD patients with those who initiated HD with a CVC (HD-CVC) or with a functional arteriovenous fistula or arteriovenous graft (HD-AVF/AVG). We used multivariable piece-wise exponential nonproportional and proportional hazards models to evaluate early (1 year) mortality as well as overall mortality during the period of observation using an intention-to-treat approach. We identified 40,526 incident adult dialysis patients from the Canadian Organ Replacement Register (2001 to 2008). Compared with the 7412 PD patients, 1-year mortality was similar for the 6663 HD-AVF/AVG patients but was 80% higher for the 24,437 HD-CVC patients (adjusted HR, 1.8; 95% confidence intervals [CI], 1.6 to 1.9). During the entire period of follow-up, HD-AVF/AVG patients had a lower risk for death, and HD-CVC patients had a higher risk for death compared with patients on PD. In conclusion, the use of CVCs in incident HD patients largely accounts for the early survival benefit seen with PD.


The survival benefits of peritoneal dialysis (PD) versus hemodialysis (HD) in the treatment of patients with end-stage renal disease continue to be debated. In HD, vascular access type is significantly associated with patient survival. The use of a central venous catheter (CVC) is associated with a substantially greater risk of sepsis, hospitalization, and mortality when compared with the use of an arteriovenous fistula (AVF) or an arteriovenous graft (AVG).1–5 This association may directly relate to CVC-associated infectious and noninfectious complications. However, the association may also be confounded by case-mix differences between patients initiating HD with either a CVC (HD-CVC) or an AVF/AVG (HD-AVF/AVG). These differences may include: the acuity of dialysis initiation, the absence of timely access to predialysis care, the presence of comorbid conditions, and surgical vascular access eligibility, all of which may be independently associated with patient survival.

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Case-mix differences between patients treated with PD and HD have limited the interpretation of studies that have examined the effect of dialysis modality on patient survival. Although several observational studies have used robust statistical techniques to account for confounding, none have accounted for the role of HD vascular access at the time of dialysis initiation.6–16 We speculate that compared with patients initiating HD with a CVC, patients initiating HD with an AVF or an AVG are more likely to share characteristics similar to those of incident PD patients. These features include ambulatory initiation of dialysis, timely access to predialysis care, and willingness to make decisions regarding dialysis modality and vascular access choice. In this regard, patients starting HD with an AVF or AVG may serve as more appropriate comparators for PD patients. In this report, our objective was to use data from the Canadian Organ Replacement Register (CORR) to compare survival between PD and HD patients with the latter stratified by HD vascular access type at dialysis initiation. We also sought to test our hypothesis that the early relative survival benefits attributed to PD are attenuated when compared with HD that is initiated with a functioning AVF or AVG.

RESULTS

Baseline Characteristics

40,526 incident chronic dialysis patients were registered in CORR between 2001 and 2008. Over 95% (n = 38,512) of patients had documentation of both dialysis modality and incident HD vascular access. Among these patients, PD was the initial dialysis modality for 19% (n = 7412). Among HD patients, 21.4% (n = 6663) initiated dialysis with an AVF or AVG, whereas the remainder initiated HD with a CVC.

Table 1 lists the baseline characteristics of the study population. Over the course of the study period, there was a trend toward increased CVC use (P < 0.0001) and decreased PD utilization (P = 0.02). Compared with PD patients, HD-CVC patients were more likely to be older; to be Caucasian; to have a higher frequency of diabetes mellitus, coronary artery disease, and peripheral vascular disease; and to have a history of malignancy. Compared with PD patients, HD-CVC patients were also more likely to be referred late to a nephrologist (49.7% versus 15.2%) and initiate dialysis with lower hemoglobin, serum albumin, and estimated GFR (eGFR).

Compared with PD patients, HD-AVF/AVG patients were more likely to be older and Caucasian and have more extensive comorbidity. HD-AVF/AVG and PD patients initiated dialysis with similar levels of serum hemoglobin, serum albumin, and eGFR, but HD-AVF/AVG patients were less likely to be referred late to a nephrologist (3.6% versus 15.2%).

Patient Survival by Dialysis Modality and Hemodialysis Vascular Access

15,327 patients died over the course of follow-up. Among the 11,369 who had available information regarding cause of death, cardiovascular causes remained the most common cause of death (40.6% PD, 32.3% HD-CVC, and 34.4% HD-AVF/AVG), whereas the second most common cause was death caused by infection (11.5% PD, 11.7% HD-CVC, and 11.5% HD-AVF/AVG). Table 2 summarizes the results from the primary analysis. HD patients had higher adjusted 1-year mortality compared with PD patients (adjusted hazard ratio [AHR], 1.5; 95% CI, 1.4 to 1.7). When HD patients were stratified by incident vascular access type, HD-CVC patients had a higher unadjusted 1-year mortality (HR, 2.7; 95% CI, 2.4 to 2.9) and higher adjusted 1-year mortality (AHR, 1.8; 95% CI, 1.6 to 1.9) compared with PD patients. In contrast, 1-year mortality risk was similar in HD-AVF/AVG patients compared with PD patients (HR, 1.1; 95% CI, 1.0 to 1.3; and AHR, 0.9; 95% CI, 0.8 to 1.1). During the initial 5 years of follow-up, cumulative mortality remained higher among HD-CVC patients (AHR, 1.2; 95% CI, 1.1 to 1.2) and lower among HD-AVF/AVG patients, relative to PD patients (AHR, 0.80; 95% CI, 0.8 to 0.9) (Figure 1). After the first year, HD-CVC patients had a time-dependent mortality risk similar to that of PD patients. Over the entire course of follow-up, unadjusted cumulative mortality was 31% (PD), 44.1% (HD-CVC), and 33.9% (HD-AVF/AVG). During this time, mortality was greater in HD-CVC patients (AHR, 1.2; 95% CI, 1.1 to 1.2), and risk of death was lower in HD-AVF/AVG patients (AHR, 0.8; 95% CI, 0.8 to 0.9) relative to PD patients. Irrespective of vascular access type, patients who started HD were less likely to receive a kidney transplant over the course of follow-up compared with those initiating PD (HD-CVC [AHR, 0.8; 95% CI, 0.8 to 0.9] and HD-AVF/AVG [AHR, 0.9; 95% CI, 0.8 to 0.9]).

Sensitivity Analyses

Table 3 summarizes the results of the sensitivity analyses. Referral timing, eGFR, and albumin were missing in 7, 9, and 15% of patients, respectively. Imputation of values for these missing results did not appreciably change the direction and magnitude of our results. Mortality within 90 days of dialysis initiation was highest among HD-CVC patients (15.6% for HD-CVC, 6.1% for HD-AVF/AVG, and 7.4% for PD; P < 0.001). After exclusion of patients who died within 90 days of starting dialysis, the increased 1-year mortality risk persisted among HD-CVC-treated patients relative to PD patients. Similar results were seen in the models that excluded patients who were referred late and after censoring patients 60 days or more after a change in dialysis modality. Using the inverse probability of treatment and censoring weighting analysis led to similar results compared with the primary model. The models used to derive the propensity score demonstrated reasonable prediction efficiency with an area under the receiver operating characteristic of 0.8 for HD-CVC versus PD and 0.7 for HD-AVF/AVG versus PD.

Prespecified Interactions

Figure 2 demonstrates the results of the prespecified subgroup analyses. A higher overall mortality risk was seen in HD-CVC-treated patients relative to PD patients in those less than 65 years of age compared with those over the age of 65. Moreover,
the era of dialysis initiation (2005 to 2008 versus 2001 to 2004) modified survival comparisons only between HD-CVC- and PD-treated patients but not between HD-AVF/AVG- and PD-treated patients. In this regard, even lower survival in HD-CVC-treated patients was seen relative to PD patients in the more contemporary era compared with the prior era. Diabetes as a cause of ESRD modified the relationship between HD-CVC and HD-AVF/AVG and PD (Table 4). The mortality risk of diabetic HD-CVC patients relative to diabetic PD patients (AHR, 1.0; 95% CI, 0.9 to 1.1) was attenuated compared with the relationship in nondiabetics (AHR, 1.3; 95% CI, 1.2 to 1.4). Similarly, compared with HD-AVF/AVG patients without diabetes (AHR, 0.9; 95% CI, 0.8 to 1.0), diabetic HD-AVF/AVG patients had a significantly lower risk of death compared with diabetic PD patients (AHR, 0.8; 95% CI, 0.7 to 0.8). No significant interactions were seen between eGFR, Body mass index (BMI), and dialysis modality.

**DISCUSSION**

In this registry-based, observational cohort study, we identified the important influence of HD vascular access type on survival comparisons between incident HD and PD patients.
Patients starting HD using a CVC had a higher risk of death in the first year compared with those who started PD, whereas there was no difference in survival between HD-AVF/AVG and PD patients. These relationships persisted over a 5-year follow-up with a small survival benefit in the HD-AVF/AVG group. Our findings should prompt a reconsideration of conclusions drawn from previous studies comparing HD and PD. Large registry-based studies, including a previous analysis of this Canadian registry, have demonstrated a survival advantage with PD over HD during the first 1 to 2 years of therapy with similar or inferior survival thereafter. Greater relative preservation of residual kidney function with the use of PD in the initial period after dialysis initiation has been cited as a possible mechanism for this finding. However, we found that vascular access type significantly modified this early survival benefit because it was only observed in PD patients when compared with the subgroup of patients who initiated HD with a CVC. This suggests that vascular access-related morbidity/mortality and case-mix differences that coincide with HD vascular access type are more likely to explain the higher early mortality attributed to HD.

Higher 1-year mortality in incident HD patients compared with PD patients has recently been reported by the Australian and New Zealand Dialysis and Transplant (ANZDATA) registry and by the United States Renal Data System (USRDS). These studies did not adjust for vascular access type. However, in the USRDS study, 1-year survival was similar between HD- and PD-treated patients, once deaths within the first 90 days of dialysis initiation were excluded. Although the USRDS analysis did not directly account for vascular access type, HD patients who were successfully matched to PD patients had characteristics that were likely associated with incident AVF/AVG use as compared with their unmatched counterparts. In the United States, initiatives such as Fistula First may have resulted in the stabilization of prevalent and incident CVC use. In contrast, Canada has one of the highest rates of CVC use among developed countries and this may be contributing to early HD-related mortality as CVC use continues to increase.

In addition to the direct effects of CVC use on morbidity and mortality, initiation of HD with a CVC is a proxy for both measured and unmeasured comorbid patient characteristics that are associated with reduced survival among dialysis patients. HD-CVC patients were older, had a greater comorbidity

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<tr>
<th>Time-averaged hazard ratios from a proportional hazards model were used to assess the cumulative treatment effect from day 0 through the end of years 1 to 5, respectively.</th>
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profile, and had less exposure to predialysis care as compared with PD and HD-AVF/AVG patients. Not surprisingly, patients initiating HD with a CVC were more likely to die within 90 days of dialysis initiation. Despite extensive and robust adjustment for case-mix differences, large unmeasured differences likely persist with respect to the severity of comorbidities between CVC- and AVF/AVG-treated HD patients. This would imply that AVF or AVG use at dialysis initiation would be associated with healthier HD patients. Comparing incident PD patients to HD patients who initiated dialysis with an AVF/AVG offered a unique opportunity to assess the effect of dialysis modality in a more homogeneous cohort of incident dialysis patients. Both groups shared similar laboratory profiles including similar serum albumin levels and fewer comorbidities relative to HD-CVC patients. With this analysis, we were unable to demonstrate any early survival differences between observed among PD patients relative to HD patients. Although patients were censored at the time of kidney transplantation, selective removal of a population of transplant-eligible, healthy patients from the PD cohort may have led to reduced survival among the remaining PD patients, many of whom may have been ineligible for transplantation. We partially accounted for this bias by performing an inverse probability of treatment and censoring weight analysis that exhibited little deviation in either the direction or magnitude of the results from our primary analysis.

Many studies have demonstrated that dialysis modality-related survival is modified in particular subgroups of patients. In keeping with previous studies, we found that PD was generally associated with more favorable outcomes in patients ≤65 years old, those without diabetes, and those without additional comorbidities. Temporal

Figure 1. Survival curves for HD-CVC (short-dashed line), HD-AVF/AVG (long-dashed line), and PD (solid line) demonstrate higher 1-year mortality in HD-CVC patients. (A) Unadjusted. (B) Adjusted on the basis of a stratified Cox proportional hazards model stratified by HD-CVC, PD, and HD-AVF/AVG and adjusted for age, race, gender, era of dialysis initiation, end-stage renal disease comorbidity index, primary renal diagnosis, serum albumin, eGFR, province of treatment, and late referral.
trends toward improving survival in PD patients relative to HD patients have been observed in several studies. Potential reasons have included both technologic advances in PD connectology, PD solutions, and favorable changes in PD-related practices. In comparing two eras (2005 to 2008 versus 2001 to 2004), we found that the relative risk of death among HD-CVC-treated patients compared with PD patients was higher in the more recent era. In contrast, era did not modify survival differences in comparisons between PD and HD-AVF/AVG comparisons. We speculate that survival differences over time between HD and PD patients in Canada reflect a more contemporary HD patient population characterized by both a higher burden of comorbidities and higher rates of incident CVC use.

The study has several limitations. The major threat to validity is selection bias introduced by nonrandom allocation of patients to both dialysis modality and incident HD vascular access. Residual confounding may remain on the basis of unmeasured differences between patients that may influence both incident vascular access and dialysis modality choice while at the same time being associated with survival. Large administrative datasets such as the one that we used are subject to limitations arising from data validity and the availability of data elements that may be germane to the research question being posed. Comorbidities captured within CORR have been recently validated and are therefore likely to offer reliable information. Several data elements were incomplete. We were therefore unable to perform as-treated analyses that accounted for: (1) vascular access immediately after PD technique failure; (2) conversion to a functional AVF or AVG among incident HD-CVC patients; and (3) vascular access failure among HD-AVF/AVG patients. It is possible that the conversion to an AVF or AVG in a subset of patients who initiated HD with a CVC may explain the absence of a mortality difference between the HD-CVC and PD patients after the second year of follow-up.

Notwithstanding these limitations, we have demonstrated that incident HD vascular access type at the time of dialysis initiation is an important modifier of the relationship between dialysis modality and survival among incident Canadian dialysis patients. These findings need to be confirmed among other patient populations where regional practice patterns related to HD vascular access and dialysis modality selection may vary. The adverse effects of starting

### Table 3. Results of the sensitivity analysis, piecewise proportional hazards model for the relationship between dialysis modality and death

<table>
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<tr>
<th>Overall</th>
<th>Censored at 60 Days after Modality Switch*</th>
<th>Modality at 90 Days after Dialysis Initiation*</th>
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<th>IPTCW*</th>
<th>Exclusion of Late-referral Patients*</th>
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IPTCW, inverse probability of treatment and censoring weighting.
*Adjusted for age, race, gender, era of dialysis initiation, end-stage renal disease comorbidity index, primary renal diagnosis, serum albumin, estimated glomerular filtration rate, province of treatment, and late referral.
*Assuming monotone missing pattern, the predictive mean matching method was used to impute missing values.
Pairwise PD-HD(CVC) and PD-HD(AVF/AVG) propensity scores were used.
Exclusion of 11,076 HD-CVC, 1126 PD, and 240 HD-AVF/AVG patients who had 3 months or less of predialysis care by a nephrologist.
HD with a CVC may have largely driven the relative survival benefits that have been previously attributed to PD. Initiation of HD with an optimal vascular access may be associated with reduced overall mortality as compared with initiating dialysis with PD, but this observation requires confirmation via further prospective studies. In a subset of patients who would otherwise start HD with a CVC because of late referral or ineligibility for a surgical vascular access or who defer a dialysis modality choice or surgical vascular access creation, PD offers the opportunity to avoid HD initiation with a CVC. In this regard, the adverse effects of starting HD with a CVC may be largely driving the relative survival benefits associated with PD.

**CONCISE METHODS**

**Study Design**

This is an observational study of consecutive adult patients (age, 18 years or older at the start of chronic dialysis) who registered in the CORR and initiated their first form of dialysis between January 1, 2001 and December 31, 2008.

**Data Source, Definitions, and Collection**

Patients were identified from the CORR, a national registry that, during the period studied, captured the incidence, prevalence, treatment changes, and outcomes of over 99% of chronic dialysis and solid organ transplant patients in Canada.\(^31\) The data were collected by completion of a registration form by the dialysis provider on each patient at dialysis initiation and yearly thereafter. A change of status form is completed to document patient death, transplantation, or a switch in dialysis modality. CORR data has recently been validated.\(^30\) We restricted our analysis to patients with documented incident dialysis modality (PD versus HD) and incident vascular access type reported as an AVF, AVG, or CVC (any type). Only patients undergoing 3 to 5 hours of conventional HD three times weekly were included in the pri-

**Table 4. Results stratified by diabetes and era of dialysis initiation**

<table>
<thead>
<tr>
<th>Patient Subgroup</th>
<th>HD-CVC versus PD</th>
<th>HD-AVF/AVG versus PD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.6</td>
</tr>
<tr>
<td>Nondiabetes</td>
<td>1.3 (1.2, 1.4)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Era 2001 to 2004</td>
<td>1.1 (1.0, 1.2)</td>
<td>0.02</td>
</tr>
<tr>
<td>Era 2005 to 2008</td>
<td>1.3 (1.2, 1.5)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

The values are adjusted for age, race, gender, era of dialysis initiation, end-stage renal disease comorbidity index, primary renal diagnosis, serum albumin, estimated glomerular filtration rate, province of treatment, and late referral.

**Figure 2.** Hemodialysis vascular access affects the association between modality and survival in selected subgroups. *P* value for interaction (int). The models were adjusted for age, race, gender, era of dialysis initiation, ESRD comorbidity index, primary renal diagnosis, serum albumin, estimated GFR, province of treatment and late referral.
Baseline comorbidities were documented by the individual facilities using the CORR registration forms. Information on the presence or absence of coronary artery disease (angina, myocardial infarction, and coronary artery bypass surgery), peripheral vascular disease, hypertension, diabetes mellitus, and cerebrovascular disease were categorized as “yes,” “no,” and “unknown.” The unknowns were combined into the “no” group. Diabetes was classified as a single variable including diabetes as a comorbidity or a cause of end-stage renal disease. Current smokers were documented as those having smoked in the last 3 months. Late referral was defined as never having been seen by a nephrologist before dialysis initiation or first seeing a nephrologist within 3 months before starting dialysis. BMI was calculated using the height and weight collected at the start of dialysis. Baseline laboratory parameters included hemoglobin, serum albumin, and serum creatinine measured as the value closest to but preceding the initial dialysis treatment. eGFR was calculated using the four-variable Modification of Diet in Renal Disease equation.32

Outcome
The primary outcome was mortality at 1 year from the time of first dialysis. Secondary outcomes included overall mortality during the study period and annual mortality risk within the first 5 years after dialysis initiation. Annual mortality risk was assessed using time-dependent hazard ratios within each year. Time-averaged hazard ratios from a proportional hazards model were used to assess the cumulative treatment effect from day 0 through the end of years 1 to 5, respectively. Patients were censored at kidney transplantation, loss to follow-up, or at the end of the observation period (December 31, 2008).

Statistical Analyses
Categorical variables were compared using the chi-squared test. The Kruskal-Wallis test was used to analyze differences among continuous variables. In the primary analysis, study subjects were analyzed in an intention-to-treat manner, using complete-case analysis. Prespecified interactions with the exposure of interest included age (<65 versus ≥65 years), the presence or absence of diabetes, the presence or absence of any comorbidities, BMI (≤29 kg/m² versus >29 kg/m²), eGFR above and below the median value (≤10.5 ml/min per 1.73 m² versus >10.5 ml/min per 1.73 m²), and era of dialysis initiation (2001 to 2004 versus 2005 to 2008).

Proportional and nonproportional piecewise exponential survival models were used to compare mortality between PD, HD-CVC, and HD-AVF/AVG patients with available sequential 12-month intervals during the first 60 months. Average or time-independent hazard ratios of death for PD compared with HD-CVC and HD-AVF/AVG patients were estimated using a proportional hazards model, whereas time-dependent relative risks were estimated using a nonproportional hazards model. Hazard ratios and corresponding 95% CI were adjusted for case-mix differences in the cohorts including: age, gender, race, cause of ESRD, weighting of comorbidities (diabetes mellitus, coronary artery disease, peripheral vascular disease, malignancy, lung disease, and pulmonary edema) on the basis of a validated ESRD comorbidity index,33 body mass index, eGFR, serum albumin, late referral, province of treatment, and era of dialysis initiation.

Several additional analyses were performed to test the robustness of our findings. First, to account for the effect of missing data on our results, an analysis was performed assigning values for missing data via multiple data imputation using the predictive mean matching method. This strategy has been used successfully in previous studies to avoid exclusion of patients with missing values.34 An additional analysis excluded deaths that occurred after patients were established on a new dialysis modality by censoring patients at 60 days after a change in dialysis modality. To limit the potential for selection bias, an analysis was performed excluding patients who died within 90 days of dialysis initiation. In order to minimize confounding caused by the strong association between late referral and CVC use, a separate analysis was also performed excluding those patients who were referred late.

In addition to traditional multivariable adjustment, outcomes were also compared using a marginal structural model with inverse probability of treatment and censoring weighting. This technique25,35 allowed us to adjust for measured covariates in a single summary propensity score and simultaneously adjust for the effect of informative censoring caused by potential differences in the rates of kidney transplantation between PD patients compared with HD-AVF/AVG and HD-CVC patients. In the first step, propensity scores (PS) were determined as an estimate of each study subject’s probability of initial PD treatment. Because our exposure of interest was not binary (i.e., three levels: HD-CVC versus HD-AVF/AVG versus PD), we used two separate multivariable logistic regression models (PD versus HD-CVC and PD versus HD-AVF/AVG) using all available covariates to calculate our PS. The areas under receiver operating characteristic curves were evaluated to test the discriminatory capacity of each model. In the second step, we determined stabilized censoring weights by estimating the probability of remaining transplant free for each individual in successive 1-year time intervals. Each observation was then weighted both by the inverse probability of treatment with PD (1/PS) for each individual and by the stabilized censoring weights. All of the analyses were performed using SAS version 9.1.3 (Cary, NC).

ACKNOWLEDGMENTS
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DISCLOSURES
J.P. has received speaking honoraria from Amgen Canada and Baxter Healthcare Canada and holds an unrestricted educational fellowship from Baxter Healthcare Canada. P.M. has received speaking honoraria from Biovail, Boehringer Ingelheim, Bristol Myers Squibb, GlaxoSmithKline, Merk, Novartis, and Sanofi-Aventis and has served on advisory boards for Amgen Canada, Baxter Healthcare Canada, Biovail, Boehringer Ingelheim, Bristol Myers Squibb, Fresenius, Merk Novartis, Ortho-Biotech, Sanofi-Aventis, and Schering. R.W. has served on advisory boards for Amgen, Gilead, and Fresenius Kabi.
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CENTRAL CATHETERS EXPLAIN HIGHER RISK OF DEATH FOR PATIENTS ON HEMODIALYSIS COMPARED TO PERITONEAL DIALYSIS

Washington, DC (April 18, 2011) — Patients on peritoneal dialysis (PD) typically have a higher early survival rate than patients on hemodialysis (HD). New data suggest that this difference may be explained by a higher risk of early deaths among patients undergoing HD with central venous catheters, according to a study appearing in an upcoming issue of the *Journal of the American Society of Nephrology* (JASN).

In a study that included more than 38,500 Canadian patients starting dialysis between 2001 and 2008, 63 percent started hemodialysis using a central catheter placed into one of the large veins. Seventeen percent started HD with an arteriovenous fistula (AVF) or arteriovenous graft (AVG)—surgically created access sites that reduce the rates of infection and other complications related to central catheters. The remaining 19 percent started on PD, in which dialysis is performed at home by the patient where metabolic wastes are eliminated by placing dialysis fluid into the abdomen.

Those patients who had an arteriovenous fistula or graft (AVF/AVG) when starting HD showed similar survival rates to the patients on peritoneal dialysis. "Our results emphasize the importance of predialysis care and education, and the need to avoid central venous catheter use in our HD patients," comments Jeffrey Perl, MD (St Michael's Hospital, Toronto).

During the first year, the risk of death for patients starting HD with a central catheter was 80 percent higher than for patients who started on PD. The risk of death in the first year for patients who started hemodialysis with an AVF/AVG was similar to that of the PD group.

In the five years after starting dialysis, the risk of death was still 20 percent higher in patients who started HD with a central catheter, compared to the PD group. The survival rate for patients who started HD with an AVF/AVG remained similar to that for patients who started on PD.

Some past studies have shown that patients on PD are at lower risk of death during the first year or two on dialysis, compared to patients on HD. "However, these studies have been heavily criticized for comparing 'apples to oranges,'" says Perl. "Their results may speak more towards the type of patients selected for PD over HD rather than a direct impact of PD versus HD itself on patient survival." He believes the new study provides a more fair, "apples to apples" comparison of PD patients versus HD patients who have been "optimally prepared" with an AVF/AVG.
The study is limited by the fact it was an observational study, rather than a randomized controlled trial. Information on the type of access for HD use was obtained only at the time of dialysis initiation. Information on follow-up vascular access was not available, which would be useful to understand the contribution of the catheter versus other factors contributing to risk of death. There was no information on the reasons why patients started HD with a central catheter, or on whether they started dialysis in the hospital or as an outpatient.

Study co-authors were Ron Wald, MD CM MPH, Philip McFarlane, MD PhD (St Michael's Hospital), Joanne M Bargman, MD (University of Toronto), Edward Vonesh, PhD (Northwestern University, Chicago), Yingbo Na, MSc (The Canadian Organ Replacement Register, Toronto), S. Vanita Jassal, MD MSc (University of Toronto), and Louise Moist, MD MSc (University of Western Ontario).

Dr. Perl has received speaking honoraria from Amgen Canada and Baxter Healthcare Canada and holds an unrestricted educational fellowship from Baxter Healthcare Canada. Dr. McFarlane has received speaking honoraria from Biovail, Boehringer Ingelheim, Bristol Myers Squibb, GlaxoSmithKline, Merck, Novartis, and Sanofi-Aventis and has served on advisory boards for Amgen Canada, Baxter Healthcare Canada, Biovail, Boehringer Ingelheim, Bristol Myers Squibb, Fresenius, Merck Novartis, Ortho-Biotech, Sanofi-Aventis, and Schering. Dr. Wald has served on advisory boards for Amgen, Gilead and Fresenius Kabi and receives an unrestricted educational fellowship from Amgen. Dr. Bargman has served on advisory boards for Amgen Canada, Baxter Healthcare Canada, and Hospira and has received speaking honoraria from Baxter Healthcare Canada, Amgen Canada, and Genzyme Canada. Dr. Vonesh has served as a consultant for Baxter Healthcare. Dr. Jassal has served on advisory boards for Amgen Canada and has received speaking honoraria from Baxter Healthcare Canada. Dr. Moist has served on advisory boards for Amgen Canada and Merck Frosst.

The article entitled, “Hemodialysis Vascular Access Modifies the Association between Dialysis Modality and Survival,” will appear online at http://jasn.asnjournals.org/ on April 21, 2011 at 5:00 PM EDT, doi 10.1681/ASN.2010111155.

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