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Original Investigation

Quality-of-Care Indicators Among Remote-Dwelling Hemodialysis Patients: A Cohort Study

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Background: We hypothesized that the higher mortality for hemodialysis patients who live farther from the closest attending nephrologist compared with patients living closer might be due to lower quality of care.

Study Design: Population-based longitudinal study.

Setting & Participants: All adult maintenance hemodialysis patients with measurements of quality-of-care indicators initiating hemodialysis therapy between January 2001 and June 2010 in Northern Alberta, Canada.

Predictors: Hemodialysis patients were classified into categories based on the distance by road from their residence to the closest nephrologist: ≤50 (referent), 50.1-150, 150.1-300, and >300 km.

Outcomes: Quality-of-care indicators were based on published guidelines.

Measurements: Quality-of-care indicators at 90 days following initiation of hemodialysis therapy and, in a secondary analysis, at 1 year.

Results: Measurements were available for 1,784 patients. At baseline, the proportions of patients residing in each category were 69% for ≤50 km to closest nephrologist; 17%, 50.1-150 km; 7%, 150.1-300 km; and 7%, >300 km. Those who lived farther away from the closest nephrologist were less likely to have seen a nephrologist 90 days prior to the initiation of hemodialysis therapy (*P* for trend = 0.008) and were less likely to receive Kt/V of 1.2 (adjusted OR, 0.50; 95% CI, 0.30-0.84; *P* for trend = 0.01). Remote location also was associated with suboptimal levels of phosphate control (*P* for trend = 0.005). There were no differences in the prevalence of arteriovenous fistulas or grafts or hemoglobin levels across distance categories.

Limitations: Registry data with limited data for non–guideline-based quality indicators.

Conclusions: Although several quality-of-care indicators were less common in remote-dwelling hemodialysis patients, these differences do not appear sufficient to explain the previously noted disparities in clinical outcomes by residence location.

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In Canada, a significant proportion of hemodialysis patients live >150 km from the closest nephrologist.[1] Although no resident is denied renal replacement therapy because of their residence location, geographical access—the distance that must be travelled to receive care—is a potential barrier to optimal clinical outcomes among remote dwellers.[2,3] Our previous work indicates that mortality after dialysis therapy initiation is independently increased among patients who live farther from the closest nephrologist, primarily due to death from infectious causes.[1]

The explanation for the increased risk of death among remote dwellers is not known. However, one possible explanation is that geographical distance as represented by remoteness from specialty care is a barrier to achieving quality-of-care indicators, such as reduced exposure to central venous catheters, optimal dialysis dose, or mineral metabolism management. Guideline-concordant care is associated with a decrease in death, hospitalization, and resource use in hemodialysis patients.[4-6] In addition, remote-dwelling patients might be less likely to receive nephrologic care prior to dialysis therapy initiation, which also could increase the risk of adverse outcomes.[7,8] Identifying modifiable care gaps in this population would offer opportunities to improve outcomes.

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We studied a cohort of patients who initiated maintenance hemodialysis treatment in a single centralized renal program in Alberta, Canada. We hypothesized that indicators of good-quality dialysis care (as defined by concordance with the National Kidney Foundation–Kidney Disease Outcomes Quality Initiative [NKF-KDOQI] recommendations) would be less frequent in patients residing farther from the closest nephrologist compared with those residing within 50 km.

METHODS

Setting and Participants

In the Northern Alberta Renal Program (NARP), patients receive hemodialysis either at in-center units, which have a nephrologist nearby, or at a satellite unit, which is supervised by a nephrologist from a distance. Although variation exists, patients who dialyze in-center typically are seen at least weekly, and patients who dialyze farther away from a nephrologist in satellite units may be seen monthly or up to an interval of every several months. It is standard practice to have patients who are initiating hemodialysis therapy undergo the first 3 sessions of hemodialysis at an in-center unit. After these initial sessions, eligible patients are transferred to a local satellite dialysis unit.

We used registry data collected prospectively from all adult patients (≥18 years) initiating hemodialysis therapy in NARP between January 2001 and June 2010. Only patients initiating hemodialysis therapy at an in-center unit or satellite unit were included; patients initiating home hemodialysis were excluded. Data were extracted from the NARP database for age, sex, race, body mass index (BMI), smoking status, cause of end-stage renal disease, vascular access, and baseline comorbid conditions (including diabetes, coronary disease, hypertension, chronic heart failure, peripheral vascular disease, cerebrovascular disease, chronic lung disease, and malignancy).

Quality Markers

Quality-of-care indicators were based on guidelines published by the NKF-KDOQI.[9-11] Specifically, we assessed the prevalence of delivered Kt/V (recommended minimum, 1.2), serum phosphate level (<1.8 mmol/L), serum calcium-phosphate product (<4.4 $mmol^2/L^2$), serum calcium level (corrected for serum albumin <2.4 g/dL), serum parathyroid hormone (PTH) level (150-300 pg/mL), serum hemoglobin level (100-120 g/L), serum ferritin level (>200 μg/L), and transferrin saturation (>20%). Because the reported prevalence of hemodialysis catheter use among NARP patients is significantly higher than the NKF-KDOQI guideline recommendation of <10% of prevalent hemodialysis patients,[12] we applied the Canadian Society of Nephrology guideline recommendation that prevalent catheter use not exceed 60% of prevalent patients.[13] Because referral to a nephrologist more than 6 months before initiation of dialysis therapy is associated with better clinical outcomes,[7] we also assessed the frequency of this characteristic by residence location. To further evaluate any potential differences in dialysis adequacy, we also assessed mean dialysis time (hours) across distance categories.

Results of routine laboratory testing (typically performed every 30-90 days for maintenance NARP hemodialysis patients) were obtained from the NARP database. In the primary analysis, we assessed quality-of-care indicators at 90 days (±45 days) after dialysis therapy initiation. In a subsequent analysis, we also assessed these outcomes at 1 year (±45 days) among those who remained alive and hemodialysis dependent. Due to a high proportion of missing values for PTH at 6 months across all distance categories after dialysis therapy initiation, we considered values at any time after day 45 when evaluating the 6-month PTH value. In sensitivity analyses, we assessed Kt/V by baseline BMI (<30 or ≥30 kg/m^2). Patients for whom laboratory data were missing at both 90 days and 1 year after dialysis therapy initiation were excluded. Data for all-cause death, modality switch to peritoneal dialysis, kidney transplantation, recovery of kidney function, outmigration, and loss to follow-up were obtained from the NARP database.

Residence Location

We calculated the geographic coordinates for each patient's residence using the Canadian Postal Code conversion file[14] and determined the practice location of the closest nephrologist affiliated with the NARP program. The geographic coordinates of the centroid for each 6-digit postal code were determined using the Statistics Canada Postal Code Conversion File. These coordinates were entered into ArcGIS 9.3 software (Esri) to determine the shortest distance by road in kilometers between the residence of each patient at the time of dialysis therapy initiation and the practice location of the closest nephrologist as previously described.[15,16] As in our previous work, we categorized driving distance from the nephrologist into the following a priori categories: 0-≤50, 50.1-150, 150.1-300, and >300 km.[1,17]

Statistical Analyses

We summarized baseline data using counts and percentages or medians and interquartile ranges. Baseline differences across distance category were compared with χ^2 test or Kruskal-Wallis test. Unadjusted models were used to evaluate the difference in attainment of the relevant quality-of-care indicator across distance categories, and fully adjusted generalized linear regression models were used to determine the independent association between each quality indicator and distance from the closest nephrologist. Tests for trend were assessed by regressing each outcome against the median values within each distance category. Counts, percentages, means, and 95% confidence intervals (CIs) were presented when appropriate. We assumed a binomial distribution when markers were dichotomized based on target values and a Gaussian distribution for markers when analyzed as continuous variables (Tables 2 and 3). Continuous outcomes with skewed right-tails (serum phosphate, serum calcium-phosphate product, serum PTH, serum ferritin, and transferrin saturation) were transformed using the natural logarithm. Characteristics included in the fully adjusted models included age, sex, race (white, Aboriginal, or other), BMI, smoking status, cause of end-stage renal disease (diabetic nephropathy, glomerulonephritis, hypertensive/ischemic renal disease, polycystic kidney disease, and other kidney disease), comorbid conditions (see above), type of access (catheter, fistula, and graft), contact with a nephrologist more than 6 months prior to dialysis therapy initiation, and the baseline value of the quality marker. Post hoc analyses were performed to evaluate whether age, sex, Aboriginal race, BMI, or diabetes modified the association between distance and Kt/V. Additionally, because clinical practice and published recommendations may change over time, we did a sensitivity analysis that adjusted for the year of hemodialysis therapy initiation. Statistical analyses were performed with Stata software, version 11 (StataCorp LP). $P < 0.05$ was considered statistically significant. The Ethics Review Board at the University of Alberta approved the study.