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Original Investigation

Infants Requiring Maintenance Dialysis: Outcomes of Hemodialysis and Peritoneal Dialysis

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Background: The impact of different dialysis modalities on clinical outcomes has not been explored in young infants with chronic kidney failure.

Study Design: Cohort study.

Setting & Participants: Data were extracted from the ESPN/ERA-EDTA Registry. This analysis included 1,063 infants 12 months or younger who initiated dialysis therapy in 1991 to 2013.

Factor: Type of dialysis modality.

Outcomes & Measurements: Differences between infants treated with peritoneal dialysis (PD) or hemodialysis (HD) in patient survival, technique survival, and access to kidney transplantation were examined using Cox regression analysis while adjusting for age at dialysis therapy initiation, sex, underlying kidney disease, and country of residence.

Results: 917 infants initiated dialysis therapy on PD, and 146, on HD. Median age at dialysis therapy initiation was 4.5 (IQR, 0.7-7.9) months, and median body weight was 5.7 (IQR, 3.7-7.5) kg. Although the groups were homogeneous regarding age and sex, infants treated with PD more often had congenital anomalies of the kidney and urinary tract (CAKUT; 48% vs 27%), whereas those on HD therapy more frequently had metabolic disorders (12% vs 4%). Risk factors for death were younger age at dialysis therapy initiation (HR per each 1-month later initiation, 0.95; 95% CI, 0.90-0.97) and non-CAKUT cause of chronic kidney failure (HR, 1.49; 95% CI, 1.08-2.04). Mortality risk and likelihood of transplantation were equal in PD and HD patients, whereas HD patients had a higher risk for changing dialysis treatment (adjusted HR, 1.64; 95% CI, 1.17-2.31).

Limitations: Inability to control for unmeasured confounders not included in the Registry database and missing data (ie, comorbid conditions). Low statistical power because of relatively small number of participants.

Conclusions: Despite a widespread preconception that HD should be reserved for cases in which PD is not feasible, in Europe, we found 1 in 8 infants in need of maintenance dialysis to be initiated on HD therapy. Patient characteristics at dialysis therapy initiation, prospective survival, and time to transplantation were very similar for infants initiated on PD or HD therapy.

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The management of infants requiring maintenance dialysis represents a significant challenge for pediatric nephrologists. Difficulties feeding and maintaining fluid balance, growth failure, increased infection risks, and the presence of comorbid conditions complicate the management of chronic kidney failure in children younger than 1 year.[1] Consequently, mortality rates in infants on dialysis therapy are substantially higher than those in older children.[2]

In a multinational survey performed in the late 1990s, only 50% of pediatric nephrologists recommended initiation of renal replacement therapy (RRT) in infants with end-stage renal disease.[3] Since then, this attitude has been somewhat altered by reports indicating favorable results in growth, development, and kidney transplantation in infants on dialysis therapy given careful medical and nutritional management.[4-8] The number of infants receiving RRT has increased during the past decades and according to the 2011 North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) Report, 13.2% of patients were younger than 2 years at dialysis therapy initiation.[9,10]

Maintenance peritoneal dialysis (PD) represents the preferred dialysis modality in infants.[4-6,11,12] Advantages over hemodialysis (HD) include potentially better preservation of residual kidney function,[13] fewer dietary restrictions, avoidance of central vascular access placement, and the option to perform dialysis at home, although this requires a labor-intensive effort from the family.[14] The experience of treating infants with HD is limited.[15-19] In infants, HD is technically difficult and requires highly qualified nursing staff. However, when PD is contraindicated for clinical reasons, fails, or is inappropriate because of psychosocial problems, HD is still the only alternative treatment until kidney transplantation is feasible.[20]

To our knowledge, no reports have compared the long-term outcomes of both dialysis modalities in infants. We therefore sought to compare clinical characteristics and outcomes of PD and HD patients in a large cohort of patients initiating dialysis therapy before 1 year of age.

METHODS

Study Population

We analyzed data from 1,081 infants who initiated RRT at 12 months or younger in January 1, 1991, to December 31, 2013. The cohort included all patients collected within the framework of the European Society for Pediatric Nephrology (ESPN)/European Renal Association−European Dialysis and Transplant Association (ERA-EDTA) Registry. Countries initiating infants on dialysis therapy during the study period were Austria, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. Patient numbers per country are included in Table S1 (provided as online supplementary material).

We excluded patients who received preemptive kidney transplantation (n = 10) and patients whose dialysis modality was not clearly specified (n = 8). Patients entered the study on day 1 of dialysis therapy and were then stratified by modality on day 30. For patients who died within the first month of treatment, the last treatment modality prior to death was considered for analysis.

Data Collection

Age, sex, primary kidney disease, initial treatment modality, and any subsequent changes are obligatory information in the ESPN/ERA-EDTA Registry. Other parameters, such as body weight, height, blood pressure, and serum creatinine, albumin, hemoglobin, and parathyroid hormone levels at baseline and during follow-up are provided on a voluntary basis, as well as the reasons for modality failure. Primary kidney disease and causes of death were determined by the patients' nephrologists and classified according to the ERA-EDTA coding system.[21] All national registries providing data to the ESPN/ERA-EDTA Registry followed their national legislation with regard to ethics committee approval and patient informed consent.

Statistical Analysis

The primary outcome studied was patient survival by dialysis modality. Secondary outcomes included comparison of clinical characteristics at dialysis therapy onset, technique survival, and the likelihood of transplantation in infants receiving PD or HD. The primary analysis was performed on an intention-to-treat basis, and therefore patients were assigned based on their initial dialysis modality (at day 30). Because infants often tend to switch between modalities, we also performed a per-protocol analysis, for which patients were assigned based on the treatment they received. For both the intention-to-treat and per-protocol analyses, patients were censored at transplantation, when kidney function recovered, when lost to follow-up, at the end of the study period (December 31, 2013), or after 5 years of follow-up, whichever came first. Cumulative incidence competing-risk curves were constructed for death (with transplantation as a competing risk), transplantation (with death as a competing risk), and modality switching (with both death and transplantation as competing risks). Cox regression was used to adjust for possible confounders, including age at dialysis therapy initiation, sex, and underlying kidney disease. Due to the low number of patients in some smaller countries and that some countries have either no HD or no PD patients, it was not possible to adjust for country as a fixed effect without making the model unstable. As an alternative to adjust for a potential country effect on clinical outcomes, a random country factor was added to the Cox model using the shared frailty model. This random effect allows patients within the same country to share a baseline hazard while allowing the hazard function to differ between countries and