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Decreasing Estimated Glomerular Filtration Rate Is Associated With Increased Risk of Hospitalization After Kidney Transplantation

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Introduction: After renal transplantation, decreased renal function is associated with increased risk of cardiovascular disease, graft loss, and mortality. We investigated whether declining renal function was associated with hospitalization after transplantation.

Methods: Adult, first-time, kidney transplant recipients between 2004 and 2006 from the United Network for Organ Sharing database and hospitalizations 1 year after the 6-month posttransplant follow-up visit were examined. Generalized linear models explored the relationship between estimated glomerular filtration rate (eGFR) measured at 6 months and the number of hospitalizations in the following year.

Results: Of 15,778 kidney transplant recipients, 19.1% were admitted in the year after the 6-month follow-up visit. Among those hospitalized, the mean number of hospitalizations was 1.71, which increased with decreasing eGFR. In multivariable models, a decrease in eGFR was significantly associated with increased hospitalizations: for every 10 ml/min per 1.73 m^2 decrease in eGFR, there was an 11% increase in hospitalization rate ($P < 0.001$). Lower eGFR after the first 6 months after transplantation was associated with an increase in late hospitalizations among adult kidney transplant recipients.

Discussion: Identifying patients with declining eGFR and other risk factors may help prevent morbidity and mortality associated with hospitalization after transplantation.

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The treatment of end-stage renal disease requires renal replacement therapy in the form of dialysis or renal transplantation; transplantation is the preferred treatment, and is associated with lower mortality and improved quality of life.[1] Prior studies have shown that estimated glomerular filtration rate (eGFR) is the best predictor of long-term graft function among transplant recipients[2,3] and that declining eGFR after kidney transplantation is associated with higher health care costs;[4,5] however, the association between declining eGFR and posttransplantation hospitalization has not been examined. Hospital readmission can be used as a proxy of poor health outcomes after renal transplantation. According to an analysis of Medicare claims data from 2003 to 2004, 1 of 5 Medicare beneficiaries were rehospitalized within 30 days of discharge at a cost of $17.4 billion.[6]

Prior studies have found that 30-day readmission or "early readmission" after kidney transplantation is associated with increased morbidity, costs, and transition-of-care errors[7] in addition to increased graft loss and mortality among patients with Medicare primary insurance.[8,9] Despite a sizeable amount of research on early hospital readmission among kidney transplant recipients, to our knowledge, no study has examined eGFR as a predictor of hospital readmission beyond 6 months after transplantation. The purpose of this study was to determine whether the eGFR 6 months after renal transplantation was associated with "late" all-cause hospitalization approximately 1 year

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after the 6-month posttransplant data collection point. In addition, because prior studies of hospitalization among kidney transplant recipients have been conducted among patients receiving Medicare as primary insurance only, we sought to characterize the key risk factors for late hospital readmission among a population that is more generalizable to the entire US kidney transplant recipient population.

METHODS

Study Population and Data Sources

The United Network for Organ Sharing (UNOS) is a nonprofit organization that maintains the Organ Procurement and Transplantation Network database. Organ Procurement and Transplantation Network contains information regarding every organ donation and transplant event in the United States since 1 October 1987. For this study, we used the Standard Transplant Analysis and Research files based on Organ Procurement and Transplantation Network data for kidney, pancreas, and kidney-pancreas waiting list and transplant and/or follow-up patients between 1 October 1987 and 31 October 2011.

We restricted our analyses to data from 30 June 2004 to 1 January 2007 for adult (18 years or older), first-time, kidney-only transplant recipients where the transplant was received before 1 January 2006, based on the availability of data regarding hospitalizations during the follow-up period, which was a required field on UNOS transplant follow-up forms until 1 January 2007. Our follow-up time of 2 years after transplantation (18 months after the 6-month "baseline" for this study) was also chosen based on the availability of hospitalization data. Whereas 95% of patients had hospitalization follow-up data at 2 years after transplantation, fewer than half of participants had hospitalization data after this time point. Figure 1 shows exclusion and selection criteria. Analyses were further restricted by excluding patients with missing information on both the exposure—eGFR (n = 302)—and outcome—number of hospitalizations during the year after the 6-month post-renal-transplantation follow-up (n = 318). Next, patients who died (n = 369) or were lost to follow-up (n = 82) during the study period were similarly excluded. Unlikely, values for eGFR (>125 ml/min per 1.73 m^2) were set to missing (n = 83). The patients who were excluded for missing data on exposure or outcome were compared with those who were included in this analysis and found to be similar.

Primary Exposure

The primary exposure was eGFR collected on the UNOS transplant recipient follow-up forms at 6 months, and calculated using the 4-variable Modification of Diet in Renal Disease equation.[10] The eGFR was calculated from serum creatinine measured and reported by transplant centers to UNOS at regularly scheduled data collection time points. The 6-month posttransplant follow-up creatinine value served as the baseline time point for calculation of eGFR. Laboratory values reported between 135 and 225 days (6 months ± 45 days) after transplantation were considered to be the 6-month follow-up value. If a patient had multiple follow-up labs reported during this time period, the first value was used as the baseline.

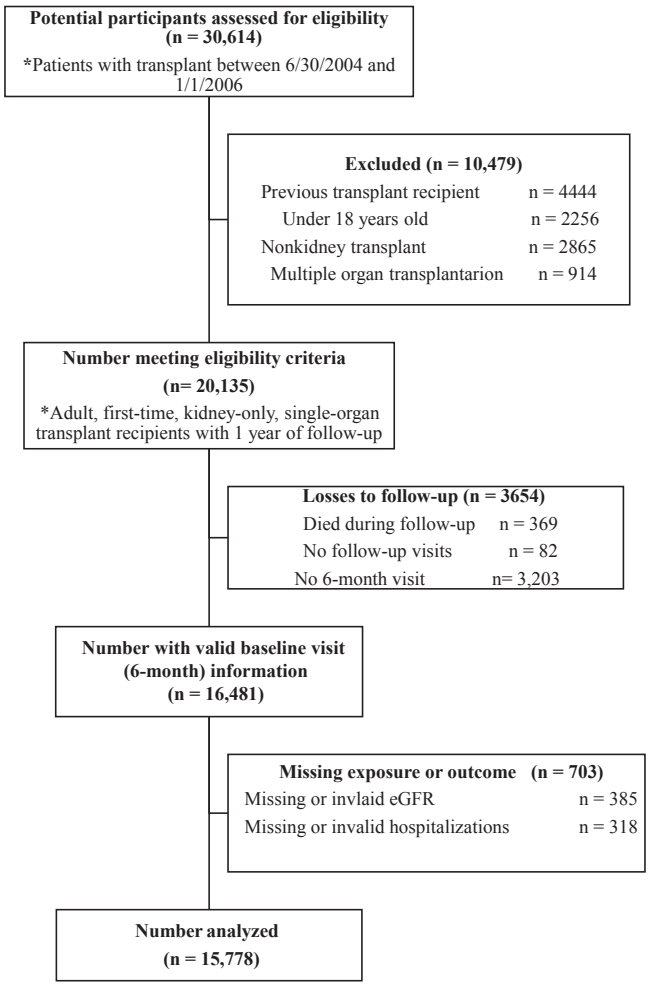

Figure 1. Flow chart of exclusion criteria for study population. eGFR, estimated glomerular filtration rate.

Primary Outcome

The primary outcome for this study was the number of hospitalizations that occurred in the year after the 6-month time point after renal transplantation, that is, hospitalizations that occurred up to 18 months after transplantation. Rehospitalization after 6 months, as opposed to 30 days, is less likely to be the result of surgical complications from the transplant procedure, as patients stabilize over time. Only hospitalizations after this baseline time point were considered for these analyses to ensure that eGFR was measured before rehospitalization.