Impact of the New Kidney Allocation System on Perioperative Outcomes and Costs in Kidney Transplantation

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BACKGROUND: In December 2014, a new kidney allocation system (KAS) was implemented nationwide with the goal of improving longevity matching, increasing access to sensitized patients, and improving racial/ethnic disparities.

STUDY DESIGN: National cohort study of US kidney transplantation programs, analyzing hospital-level outcomes (October 2012 to June 2016) using University HealthSystem Consortium data. In-hospital outcomes and costs were analyzed for trends over time using interrupted time series analysis with segmented regression.

RESULTS: There were 38,016 kidney transplantation procedures analyzed during the 3.8-year period. Over time, there was a mean increase of 2.7 cases/month (95% CI −0.02 to 5.4; $p = 0.059$), unaffected by KAS (18.9 case increase; $p = 0.5601$). Implementation of KAS led to significant changes in patient demographics, including a decrease in age (−2.8 years; $p < 0.001$), increase in number of African Americans (3.8%; $p < 0.001$), decrease in number of Caucasians (6.0%; $p < 0.001$), increase in number of Hispanics (2.9%; $p < 0.001$), increase in congestive heart failure (1.3%; $p < 0.001$), and decrease in diabetes with complications (4.0%; $p < 0.001$). The KAS had no impact on length of stay (0.12 days; 95% CI −0.11 to 0.35), length of stay index (0.01; 95% CI −0.03 to 0.05), ICU cases, ICU length of stay, patient safety indicators, or in-hospital mortality. The KAS led to a significant increase in delayed graft function rates (5.4%; 95% CI 23.3% to 7.4%); total in-hospital costs ($2,429; 95% CI $594 to $4.263); and 7-day (2.2%), 14-day (2.6%), and 30-day (2.7%) readmission rates.

CONCLUSIONS: Policy changes in organ allocation can have a significant impact on perioperative costs and outcomes, which can have a downstream influence on transplantation center perisurgical care processes. (J Am Coll Surg 2017;224:585−592. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

In 1984, the US Congress passed the National Organ Transplant Act. Among other components of the law, the National Organ Transplant Act authorizes the Department of Health and Human Services to fund the infrastructure needed for the regulation of deceased donor organ allocation across the US. A key part of organ allocation dictated within National Organ Transplant Act is that it should be conducted in an ethical manner, minimizing disparities in access to transplants. As such, organ allocation policies and procedures, which are described within Title I of the law (Organ Procurement and Transplantation Network), are routinely reviewed to ensure equity. Since its inception in 1984, the Organ Procurement

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Abbreviations and Acronyms

DGF = delayed graft function
KAS = kidney allocation system
LOS = length of stay
UHC = University HealthSystem Consortium

and Transplantation Network has been under contract to be managed by the United Network of Organ Sharing.[1-3]

During the past 30+ years, United Network of Organ Sharing has continuously reviewed organ allocation measures to ensure equity and adjusted allocation policies when disparities are apparent. A major change in the policy, entitled the kidney allocation system (KAS), began in 2002 and was finally implemented on December 4, 2014. Key goals of KAS were to eliminate or minimize age mismatching (organs from young donors being allocated to older recipients), increase access to potential recipients that are highly sensitized to HLA antigens (panel reactive antibody 99% to 100%) and improve access to disadvantaged minorities, particularly the African-American population.[2,4-8]

The modifications made to the organ allocation rules substantially changed the order for a large proportion of the recipient wait list.[8] A recent study conducted by investigators within United Network of Organ Sharing demonstrated substantial changes in those that have received organ transplants after KAS was implemented. However, the impact of KAS on perioperative outcomes and costs has not been analyzed.[6] The aim of this study was to determine how KAS and the months after KAS have influenced perioperative quality and costs amongst US kidney transplantation programs. The study hypothesis was that KAS has led to substantially increased perioperative length of stay, complications, readmissions, and costs.

METHODS

Study design

This was a time-series analysis, assessing perioperative demographics, outcomes, and costs for kidney transplant recipients and the temporal trends that occurred in relation with the implementation of KAS. In 2013, the Organ Procurement and Transplant Network Board of Directors approved KAS and on December 4, 2014, it went into effect. The intent of KAS is to optimize the use of kidneys and also improve the equitable distribution of these organs. Major changes with KAS include giving patients that are highly sensitized greater priority on the wait list, matching donor organ quality (kidney donor profile index) with the life expectancy of recipients (expected post-transplantation survival), and counting wait time at the start of dialysis.[8]

Patients

Kidney transplant recipients were eligible for inclusion in this study if they received a transplant between October 1, 2012 and June 30, 2016 at a University HealthSystem Consortium (UHC; now part of Vizient) member institution; which includes 99 of the 236 kidney transplantation centers (42%) across the US and approximately 60% of all kidney transplantations conducted during this time frame in the US.[9-11] Exclusions were pediatric patients (younger than 18 years of age at time of transplantation) and recipients of nonrenal transplants (ie liver, pancreas, heart, or lung), either simultaneous or history of a nonrenal transplant.

Study variables and outcomes

Demographic variables of interest included patient age, sex, race, comorbidities, and severity of illness, as measured by the UHC calculated risk of mortality (graded as minor, moderate, or major) and case-mix index. Perioperative outcomes of interest included length of stay (LOS); observed to expected LOS (LOS index); ICU cases; ICU LOS; in-hospital complications; in-hospital morality; observed to expected mortality (mortality index); 7-, 14-, and 30-day readmissions to the index hospital; and delayed graft function (DGF). Because data in the UHC system only include hospitalization information, DGF was defined as the need for dialysis during the initial inpatient stay for the kidney transplantation procedure.[9]

Cost analysis

Perioperative costs were also assessed, which were determined through UHC reported total and direct costs for the transplantation procedure and subsequent hospitalization. Costs were also classified as organ procurement, surgical, pharmacy accommodations, laboratory, transfusion, medical/surgical supplies, and imaging. Expected LOS, mortality, and costs are projected by UHC using regression modeling calculated separately for each Medicare Severity-Diagnosis Related Group. In-hospital complication was a composite definition of the mean percentage of in-hospital complications occurring in the study group and was determined through UHC using diagnostic codes and an algorithm for each complication.

Statistical analysis

Descriptive statistics were used for display of the data and included means, SDs, 95% CIs, and percentages.