

Urological Complications and Vesicoureteral Reflux Following Pediatric Kidney Transplantation

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Purpose: Ureteral complications of renal transplantation can dramatically impact renal outcomes. We studied whether complications are associated with preexisting genitourinary pathology or transplant using a deceased donor allograft.

Materials and Methods: We retrospectively reviewed all patients undergoing renal transplantation at our institution between 2000 and 2010. We abstracted patient demographic details, donor type (living vs deceased), end-stage renal disease etiology, reimplant technique, stent use, preoperative and postoperative imaging, history of lower genitourinary pathology and postoperative complication management.

Results: A total of 211 kidneys were transplanted into 206 patients (mean age 13.7 years, mean followup 4.6 years). Most patients (89%) underwent extravesical ureteroneocystostomy without stenting (97%), with roughly half (47%) of transplants being from living donors. Preexisting urological pathology was present in 34% of cases. Postoperative obstruction or extravasation occurred in 16 cases (7.6%), of which 15 were acute. Complications were not associated with donor type, preexisting urological pathology other than posterior urethral valves, surgical technique, etiology of end-stage renal disease or patient age. However, posterior urethral valves or other preexisting genitourinary pathology was not associated with an increased likelihood of genitourinary complications. Posterior urethral valves were associated with development of postoperative vesicoureteral reflux (OR 6.7, $p = 0.004$) but were not associated with stent placement, surgical technique, donor type or etiology of end-stage renal disease.

Conclusions: Patients with posterior urethral valves undergoing renal transplantation are at increased risk for postoperative vesicoureteral reflux but not for other acute surgical complications. There is no association between donor type, etiology of end-stage renal disease, surgical technique or patient age and increased complications.

Key Words: kidney transplantation, postoperative complications, urology, vesico-ureteral reflux

RENAL transplantation offers the most effective long-term renal replacement therapy for pediatric patients with end-stage renal disease.¹ In early reports urological complications such as urinary extravasation and ureteral ob-

struction occurred in more than 30% of patients.² Modifications to surgical technique, principally the widespread adoption of extravesical ureteroneocystostomy or ureteroureterostomy, have significantly decreased this complica-

Abbreviations and Acronyms

ESRD = end-stage renal disease

GU = genitourinary

MAG3 = mercaptoacetyl triglycine

PUV = posterior urethral valves

RTX = renal transplantation

UNC = ureteroneocystostomy

UUO = ureteroureterostomy

VUR = vesicoureteral reflux

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tion rate.^{3,4} Despite steady technical refinement, recent series have revealed persistence of postoperative urological issues in up to 21% of cases.^{3,5} Thus, postoperative urological complications and vesicoureteral reflux remain a significant source of morbidity in the pediatric transplant population.

In contrast to adults, ESRD is associated with functional or anatomical abnormalities of the lower urinary tract in approximately 25% of children.⁶ Multiple studies have demonstrated the safety of implanting a transplanted ureter into a previously augmented bladder or urinary conduit.⁷⁻⁹ Although graft function appears unaffected, these patients are reportedly at increased risk for urinary tract infection.¹⁰ Whether these children are also at increased risk for postoperative ureteral complications (including VUR into the transplant ureter) is unclear, as there are few reports that specifically address urological complications in this group.

At our institution we maintain a multidisciplinary approach to renal transplantation, with the urology department responsible for the ureteral anastomosis and pediatric surgery responsible for the vascular anastomosis. We hypothesized that there might be a higher number of urological complications in patients undergoing transplant with a urological disorder as the etiology of their ESRD, as well as in patients who receive a kidney from a deceased rather than a living donor.

MATERIALS AND METHODS

Patient Selection and Data Abstraction

We retrospectively reviewed the medical records of all patients undergoing RTX at our institution between January 2000 and December 2010. No patients were excluded from this review. We collected demographic information, including age at surgery, gender, etiology of ESRD, presence of a clinical or genetic syndrome and any specific preexisting lower urinary tract pathology, for all patients. Any pre-transplant bladder surgery was noted, including the specific bowel segment used in cases of bladder augmentation or urinary diversion. To maintain patient confidentiality, we chose not to report any data elements representing fewer than 3 patients. Institutional review board approval was obtained from Children's Hospital Boston before chart review or data analysis.

We abstracted perioperative data, including donor type (deceased vs living), type of ureteral reimplantation (extravesical or intravesical UNC, UUO or reimplant into urinary diversion bowel segment). For recipients of kidneys from a living donor all donor nephrectomies were performed laparoscopically.

Postoperative complications were categorized as acute (occurring less than 30 days after RTX) or delayed (more than 30 days) and included de novo VUR into the transplant ureter, ureteral obstruction, urinary extravasation, graft loss and/or patient death. Management via observation, perinephric nephrostomy or drain placement, endo-

scopic ureteral stent placement and/or open surgical exploration/repair was recorded.

Surgical Technique and Postoperative Management

At our institution we perform each renal transplant using a multidisciplinary team oriented approach. Pediatric general surgeons perform the vascular anastomosis, while pediatric urologists perform the ureteral anastomosis. Postoperatively cases are collaboratively managed by pediatric nephrology with input from both surgical teams. A stent is not routinely placed across the ureteral anastomosis, but stents are sometimes used at the discretion of the operating surgeon, often in cases of complex anatomy. Our standard approach is to perform nonrefluxing reimplantation of the ureter to the native bladder via extravesical detrusorrhaphy. In cases of complex anatomy we occasionally opt for an alternative approach, such as intravesical ureteroneocystostomy, ureteroureterostomy to the native ureter or anastomosis of the transplant ureter directly to a urinary diversion (typically an augmented bowel segment). MAG3 nuclear renography is performed within 24 hours of transplant to document graft perfusion and to assess for any evidence of ureteral obstruction and/or extravasation. Voiding or radionuclide cystourethrography is typically performed 3 months postoperatively to determine the presence or absence of VUR.

Statistical Methods

Our primary outcomes of interest were postoperative ureteral obstruction, urinary extravasation and VUR (for our analysis we grouped obstruction and extravasation together). Our secondary outcomes were graft loss and patient death. We performed bivariate tests of association between predictor variables and our primary outcomes using the Fisher exact test, Armitage trend test, t test or Wilcoxon rank sum test as appropriate based on data characteristics. For each outcome we constructed 2 multivariable logistic regression models to correct for confounding between predictor variables based on our a priori hypotheses and/or those covariates with a bivariate p value of 0.1 or less. The first model included log transformed patient age, gender, preexisting urological pathology and donor type, while the second model substituted history of PUV in place of any preexisting urological pathology. All analyses were performed using SAS[®], version 9.3. All tests were 2-sided and p values of 0.05 or less were considered significant.

RESULTS

Demographic and Preoperative Characteristics

A total of 211 kidney transplants were performed at our institution in 206 children between 2000 and 2010 (table 1). Half of these patients (106, 51%) were male, and nearly half of the transplanted kidneys (100, 47%) were from living donors. Mean \pm SD patient age was 13.7 ± 7.6 years and mean \pm SD postoperative followup was 4.6 ± 2.9 years.

The most common etiology of ESRD was renal dysplasia, which was present in 38 patients (18%,

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