Is Routine Ureteral Stenting Cost-Effective in Renal Transplantation?

Derek A. DuBay, Ray Lynch, Joshua Cohn, Yasser Ads, Jeffrey D. Punch, Shawn J. Pelletier, Darrell A. Campbell, Jr. and Michael J. Englesbe*

From the Department of Surgery, University of Michigan Health System, Ann Arbor, Michigan

Purpose: Recent collective reviews show that ureteral stenting provides a decrease in ureteroneocystostomy anastomotic complications following renal transplantation. We identified the specific morbidity associated with urinary complications following renal transplantation and quantified the health care resources required to treat these patients at a high volume center.

Materials and Methods: Prospective databases were used to identify patients with a renal transplant who had urinary complications and track postoperative hospital readmissions and admission diagnostic codes. Financial models were used to estimate the variable direct costs of prophylactic stent placement and removal. Cost based analysis was performed to assess the financial feasibility of routine stenting following renal transplantation.

Results: Patient specific morbidity and hospital readmissions were significantly increased in patients with a transplant who had a urinary complication. The incremental hospital costs incurred in a patient with a renal transplant who had urinary leakage during the first 12 months postoperatively was $20,121. Routine placement of an anastomotic stent was inexpensive. Approximately 22 or 23 stents could be placed at the same incremental cost of treating 1 patient with a urinary complication in the hospital.

Conclusions: Urinary anastomotic complications following renal transplantation are highly morbid. Even with modest decreases in urinary complications prophylactic ureteral stent placement is financially advantageous.

Key Words: kidney; kidney transplantation; surgical, anastomosis; ureter; stents

Ureteroneocystostomy anastomotic leakage and/or strictures complicate 3% to 9% of all renal transplants.[1–3] These urinary complications remain the most common technical complication associated with contemporary renal transplantation[2,3] despite a decreased incidence with refinements in technique.[4] Numerous studies have addressed the issue of routine anastomotic stenting at renal transplantation in an attempt to decrease the urinary complication rate and yet the debate continues.[5–11] A recent meta-analysis evaluated 5 prospective, randomized, controlled clinical trials of routine stenting following renal transplantation and indicated that the collective urinary complication rate following routine stenting was 1.5% compared to 9% without stenting (OR 0.24, $p < 0.0001$).[1] The OR for urinary complications with routine stenting varied among these 5 prospective studies at between 0.02 and 0.53 with only 3 of the 5 demonstrating statistical significance independently.[5–9] Similarly a Cochrane Review evaluated these 5 series and included 2 additional prospective, randomized series.[10] The study concluded that the collective urinary complication rate following routine stenting was 1.0% compared to 7.0% without stenting (OR 0.24, $p = 0.02$).[12] The Cochrane Review investigators noted that there were several unanswered questions regarding the economics of routine stenting and they called for studies pf the cost-benefit analysis of universal prophylactic stenting.

We identified the specific morbidity associated with urinary complications following renal transplantation and quantified the health care resources required to clinically treat these patients at a high volume, university based transplant center. A cost base analysis is presented to assess the financial feasibility of routine stenting following renal transplantation.

MATERIALS AND METHODS

Databases Used

The Organ Transplant Information System is an internal database encompassing all patients evaluated for a solid organ transplant at our institution. Information includes medical and surgical history, active medications, laboratories, donor information, operative records and all postoperative documentation. CareWeb™ is a World Wide Web based software tool that provides access to integrated patient information at our institution. The CareWeb architecture is based on the design and development of an underlying clinical data repository of information from multiple individual source systems. Health System Data Warehouse integrates inpatient and outpatient hospital costs with clinical data at our institution. The OMNI Operating Room Database collates operative procedures performed at all operative sites at our institution. This database includes personnel involved with the operation, key time fields (patient admission, incision, dress-

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* Correspondence: University of Michigan Health System, 2926 Taubman Center, 1500 East Medical Center Dr., Ann Arbor, Michigan 48109-0331 (telephone: 734-936-9623; FAX: 734-763-3187; e-mail: englesbe@med.umich.edu).

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ing, etc), procedure/procedure code, preoperative and postoperative diagnosis, anesthesia type, all instruments, equipment, supplies and implants.

Patients

Approval for this study was obtained from the University of Michigan Institutional Review Board for Medicine. All 1,698 recipients of renal transplants performed between July 1, 1995 and July 1, 2004 at our institution were identified via the Organ Transplant Information System. Patients who received simultaneous kidney-pancreas, kidney-liver and kidney-heart transplants were excluded.

Operative Technique

The bladder anastomosis was completed via Lich-Gregoir external ureteroneocystostomy in 1,605 patients (95%) and by the single mucosal U stitch Shanfield technique in 93 (5%). Briefly, the Lich-Gregoir technique is a continuous suture around the spatulated circumference of the ureter and cystotomy mucosal layer with closure of the bladder muscle over the anastomosis to prevent reflux.[13,14] The U stitch approach entails tacking the hood of the spatulated ureter to the inside wall of the bladder with a single horizontal mattress U stitch with closure of the myotomy over the ureter to create an antireflux tunnel.[15]

Identification of Patients With Urinary Complications

Patients with urinary complications were identified by isolating those with a renal transplant with a diagnostic procedure code for percutaneous nephrostomy tube placement or reoperation following the date of transplantation. Urinary complications were then verified by reviewing radiographic, laboratory and operative records. For study purposes urinary complications were defined as symptomatic urinary leakage or ureteral stricture requiring operative or percutaneous intervention. Patient specific data were obtained from a prospectively collected database (Organ Transplant Information Systems) and a review of the electronic medical record (CareWeb).

Hospital costs and admission data were obtained from the data warehouse at our institution. Only posttransplant inpatient costs generated at our institution were analyzed. Operative costs were obtained via the University of Michigan OMNI Operating Room Database. All financial data were converted to 2005 United States dollars.

Professional Costs

Surgeon cost data were calculated by multiplying the sum of the surgeon annual salary and individual division specific expenses times the ratio of operative time spent performing a procedure and total operative time during a fiscal year. Division specific expenses, which are calculated internally, include such costs as secretarial expense, office space rent, malpractice insurance and dean tax. Operative times are prospectively recorded into the OMNI Operating Room Database and stratified based on procedure type (code) and operative year.

Variable Direct Cost for Stent Placement

The cost of stent placement and removal was calculated as the sum of the soft double pigtail ureteral stent with suture, placement professional costs, median operative costs for stent placement, removal professional costs and median operative costs for removal. This did not include hospital overhead expenses (indirect costs) or fixed expenses associated with the transplant service (unit costs).

Statistical Analysis

Hospital costs and admission data were analyzed with the 2-tailed Student t and Mann-Whitney U tests. The association of readmission diagnoses and urinary complications was assessed by univariate regression analysis. All statistical analyses were performed using SPSS® 15.0.

RESULTS

Ureterovesical anastomotic complications were identified in 105 of the 1,698 patient study population (6.2%). Mean ± SD posttransplant followup for the entire study group was 1,446 ± 962 days. A detailed study identifying risk factors for a urinary complication and graft specific complications was previously published.[2,3] Patients with a urinary complication following renal transplantation experienced significantly more morbidity than patients without a urinary complication. There were more hospital readmissions in the 12-month period following renal transplantation in patients with a urinary complication than in patients without a urinary complication (table 1). Patients with a urinary complication had a mean of 3.82 ± 2.67 readmissions compared to 2.08 ± 1.66 in patients without a urinary complication ($p < 0.0001$). Table 2 lists the top readmission diagnoses. UTI, ileus, hematuria, infectious complications, acute renal failure, fluid overload and acute cardiac event admission diagnoses were significantly more common in patients with vs without urinary complications.

Significantly more hospital costs were generated in patients with a urinary complication compared to those in patients without a urinary complication (table 1). Median hospital costs for the 12 months following renal transplantation were $64,356 ± $78,863 vs $44,234 ± $40,087 ($p < 0.0001$). These increased costs only included expenses generated during readmission and not any professional costs or costs accrued on an outpatient basis. Thus, the incremental hospital costs incurred by a given patient with a renal transplant who had a urinary complication during the first 12 months postoperatively were $20,121. Ureteral leakage was associated with higher incremental hospital costs than stricture ($29,102 ± $44,213 vs $14,215 ± $23,956).

Financial Analysis

A recent meta-analysis[1] and Cochrane Review[12] of randomized, controlled clinical trials comparing routine ureterovesical anastomotic stenting showed a 0.24 OR for urinary

TABLE 1. *Hospital costs and admissions during first 12 months after renal transplantation*

	Mean ± SD Urinary Complication	
	Yes	No
No. pts	105	1,587
Inpt hospital costs ($)	64,355 ± 78,862	44,235 ± 40,086
No. admissions	3.82 ± 2.67	2.08 ± 1.66

Two-tailed Student's t test $p < 0.0001$.

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