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Original Paper

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Complications of ureterovesical anastomosis in adult renal transplantation: Comparison of the Lich-Gregoire and the Taguchi techniques

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
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E Manuscript Preparation
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Summary

Background: Our aim is to identify the incidence of urologic complications in adult renal transplantation comparing two different ureterovesical anastomosis techniques, the Taguchi (T) and Lich-Gregoire (LG).

Material/Methods: Retrospective analysis of adult renal transplants performed at the MUHC between 2000–2009. Excluded: multi-organ transplants, re-do transplants, variant ureteric anastomosis and patients received grafts from UNOS ECD. 372 patients were analyzed. 209 patients (56%) in the T group and 163 patients (44%) in the LG group. Fisher's exact test was used to compare the groups for urologic complications. A multivariate analysis was performed to identify factors associated with graft rejection and death.

Results: 21 patients developed a urinary leak or stricture. A total of 13 patients (3.4%) developed ureteric strictures and 9 (2.4%) patients developed urinary leak with no difference in urinary leak or stricture between both groups (p=1). Hematuria requiring intervention developed in 55 patients. A higher incidence of complicated hematuria in the T group when compared to the LG group (37 *vs.* 18, p=0.079)). No differences in other ureteric complications between the 2 groups. Delayed graft function OR=3.4 (95% CI=1.8–6.3) and grafts from a deceased donors OR=2.2 (95% CI=1.1–4.5) are factors associated with graft loss. Factors associated with first episode of rejection include delayed graft function OR=2.4 (95% CI=1.3–4.4), and the development of ureteric stricture OR=3.9 (95% CI=1.8–8.7).

Conclusions: Both techniques can be used interchangeably for adult renal transplantation. T technique is associated with a greater risk of hematuria. Ureteric strictures are associated with a shorter time to first graft rejection.

Key words: kidney transplantation • taguchi method • Lich-Gregoire technique

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Background

In the past few decades the world has witnessed major advances in immunology leading to an improved outcome in renal transplant recipients. Despite this fact, the technical aspects of renal transplantation and the techniques used for ureterovesical anastomosis are still a subject of debate among different transplant surgeons. Various methods of ureterovesical anastomosis have been described in the literature with different impacts on the immediate and late post-operative complications and the overall outcome of renal transplantation. In our institution the prevalent methods of ureterovesical anastomosis are the Lich-Gregoire (LG) (multi-stitch) technique and the Taguchi (T) technique (single stitch). The Lich-Gregoire technique consists of a direct mucosa to mucosa anastomosis of distal ureter to the bladder mucosa, which is then buried into a muscular tunnel to provide a valve mechanism [1]. On the other hand, the Taguchi technique or so called single stitch technique was designed later to shorten the operative time, and it involves passing a U-stitch through the anterior aspect of the ureter and then taking it through the bladder wall. The ureter is then buried into a muscular tunnel created by the detrusor muscle similar to the LG technique [2]. The primary focus of this study is to compare the incidence of urological complications with both techniques and their impact on graft function and loss.

Material and Methods

A review of all adult renal transplants performed at McGill University Health Centre (MUHC) from January 2000 until December 2009 was carried out. A total of 624 adults were identified. We performed a retrospective analysis of our prospectively collected data. Patients were divided into two groups based on the method of ureteric anastomosis (Taguchi *vs.* Lich-Gregoire). Both techniques are being used interchangeably in our institution and technique selection was based on the surgeon's preference. We excluded all patients who had ureterovesical anastomosis using other techniques, patients who had multi-organ transplants, patients received more than one renal transplantation and grafts from expanded criteria donors (ECD) as defined by the United Network for Organ Sharing (UNOS) [16]. ECD included all donors greater than or equal to 60 years of age, plus those donors between 50 and 59 years with at least two of the following three factors: serum creatinine greater than 1.5 mg/dL, cerebrovascular accident as cause of death, and history of hypertension [16]. The higher risk of urinary complications and delayed graft function (DGF) associated with ECD lead to their exclusion [17,18]. The use of routine double J-stents at our institution was limited to high-risk patients prior to the year 2009 and hence they were excluded. Variables included in the analysis were recipient's age and gender, donor type (live or deceased), method of ureterovesical anastomosis, warm and cold ischemia times, kidney placement on life port prior to transplantation, urological complications and the need for intervention either surgical or non-surgical. The standard immunosupression protocol used in our institution for kidney transplant recipients was implemented in the majority of patients in both groups. This includes induction with Methylprednisolone (500 mg) and Anti-thymocyte globulin (ATG), with a total dose of 6 mg/kg of ATG. Following that patients were managed with three agent maintenance immunosuppression including; Tacrolimus (target level of 3–7 ng/ml), Mycophenolatemofetil and low dose Prednisone (10–15 mg per day).

Definition of outcomes

Urological complications that were included in the analysis are: a) Hematuria requiring intervention (continuous bladder irrigation, cystoscopy and clot evacuation, and re-operation). b) Urinary stricture diagnosed based on a raising serum creatinine levels and a radiologic evidence of ureteric narrowing. c) Urinary leak diagnosed radiologically and requiring stenting, re-operation or percutaneous diversion. d) Urinary fistula defined as a tract connecting the urothelium to another epithelial surface (most commonly skin), with confirmation of tract presence radiologically. e) Symptomatic (pain or recurrent infection) urinary reflux confirmed by voiding cystourethrogram. Graft loss was defined as the permanent need for dialysis and/or re-transplantation. Graft function was divided into 3 groups based on the initial graft function in the first week post-transplantation. Delayed graft function (DGF) was defined as the need for dialysis in the first 7 days post transplantation. Slow graft function (SGF) and immediate graft function (IGF) were defined by serum creatinine falls of <20% or >20% in the first 24 hours post transplantation respectively [5].

Statistical analysis

The median and inter-quartile range (IQR) was used to define continuous variables. The

Mann-Whitney U or Fishers exact test were used to compare the two ureteric anastomosis groups for baseline characteristics, hematuria and other urological complications. The Kaplan-Meier method was used to compare event-free survival with both anastomosis methods and a multivariable Cox regression analysis was used to identify factors associated with time to first graft rejection or graft death, after adjusting for warm ischemia, donor type, recipient age and gender.

Results

A total of 372 adult kidney transplants were analyzed after applying the exclusion criteria defined above. T technique was used in 209 patients (56%), the LG technique was used in 163 patients (44%). Groups were well balanced and there were no statistically significant differences between both groups with regard to recipient's age, gender, warm ischemia time, cold ischemia time, graft time on life port and type of graft donors (live or deceased) (Table1). There was however a borderline preponderance of males and more follow-up in the T group. Median follow up time was 1324 days (44 months) in the T group versus 992 days (34 months) in the LG group.

A total of 77 (21%) complications were identified in both groups. There were no cases of urinary fistula or symptomatic urinary reflux. Cumulative graft loss was similar in both groups at 5 years (15.7% in T group *vs.* 19.1% in LG group; p= 0.76, logrank test). There was no significant difference in cumulative graft rejection (Figure 1) between both groups at 1 year (16.2% in T group *vs.* 13.9% in LG group; P=0.98; logrank test). The Overall incidence of complications was higher in the T group *vs.* LG group, 23% *vs.* 17% respectively (p=0.07). Hematuria requiring intervention was the most common complication for both groups. A total of 55 (15%) patients developed hematuria with higher incidence in the T group 37 patients (17%) *vs.* 18 patients in the LG group (11%), p=0.079 (Table 2). A total of 13 patients (3.4%) developed ureteric strictures, 6 patients in the T group *vs.* 7 patients in the LG group (Table 2). Nine (2.4%) patients developed urinary leak, 5 patients in the T group and 4 in the LG group. There was no difference in urinary leak or stricture between both groups (p=1).

Multivariable analysis identified DGF (OR=3.4; 95% CI=1.8–6.3), and grafts from deceased donors, (OR=2.2; 95% CI=1.1–4.5), as factors associated with graft loss. Factors associated with first episode of rejection on multivariable analysis were DGF (OR=2.4; 95% CI=1.3–4.4), and the development of a ureteric stricture (OR=3.9; 95% CI=1.8–8.7).

Table 1. Baseline characteristics of study subjects.

Anastomosis type	Valid N	Median (IQR)/N	P
Age			
Taguchi	N=210	52 (39–61)	0.42
Lich-Gregoire	N=163	53 (43–61)	
Cold ischemia time (hours)			
Taguchi	N=195	11.93 (3.28–17.8)	0.62
Lich-Gregoire	N=154	13.26 (3.5–19.7)	
Warm ischemia time (hours)			
Taguchi	N=207	0.77 (0.62–0.97)	0.98
Lich-Gregoire	N=162	0.78 (0.63–0.97)	
No. days from OR to last follow-up			
Taguchi	N=195	1324 (704–2356)	0.08
Lich-Gregoire	N=157	992 (449–2112)	
No. days from OR to first rejection			
Taguchi	N=35	108 (18–254)	0.34
Lich-Gregoire	N=27	105 (62–665)	
No. days from OR to graft death			
Taguchi	N=28	656 (34–1311)	0.91
Lich-Gregoire	N=23	414 (24–1522)	
Males			
Taguchi	N=210	138	0.069
Lich-Gregoire	N-163	92	
Cadaveric			
Taguchi	N=210	136	0.82
Lich-Gregoire	N=163	103	
Kidney pumped			
Taguchi	N=207	23	0.094
Lich-Gregoire	N=159	28	
SGF			
Taguchi	N=209	52	0.26
Lich-Gregoire	N=162	32	
DGF			
Taguchi	N=209	38	0.4
Lich-Gregoire	N=162	24	

Table 2. Frequency of hematuria and ureteric srticture.

Complication		Type of anastomosis		Total
		T	LG	
Hematuria*	No	172	145	317
	Yes	37	18	55
	Total	209	163	372
Ureteric stricture**	No	202	157	359
	Yes	7	6	13
	Total	209	163	372

* P=0.079; ** P=1.

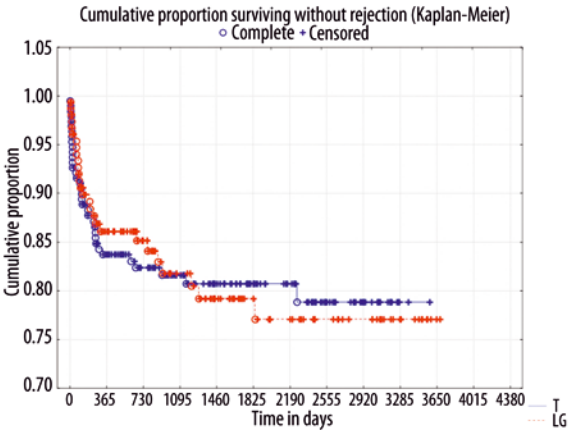

Figure 1. Kidney survival without rejection.

Discussion

Urological complications following renal transplant have remained a major source of morbidity occasionally leading to graft loss or patient death. The incidence of these complications is declining over the past 30 years with a significant decrease in graft loss and mortality particularly after the introduction of effective immunosupression regimens [3]. In this study we compare two groups of patients based on the method of ureteric anastomosis used during transplantation. The two groups were well-balanced in their demographics. Hematuria requiring intervention, which was defined as the need for a continuous bladder irrigation, cystoscopy and clot evacuation, or surgical intervention, was the most common complication in both groups with an overall incidence of 15%. We report a higher incidence of hematuria reaching borderline statistical significance (p=0.07) in the T group as compared to the LG group. However, this did not affect the incidence of graft loss in our study.

Since the first successful renal transplant by Murray et al. [4] using the Leadbetter-Politano (LP) technique, ureterovesical anastomosis has been a continuous subject of debate between different transplant centers in an attempt to identify which method is associated with less urological complications. The higher risk of urinary leak, increased morbidity and the use of two cystostomies associated with the LP technique led to the development of the LG technique using a single cystostomy in an attempt to reduce postoperative leak. Hooghe et al. [5] reported a significant difference between the LP and LG methods in terms of urinary leak [6].

The simplicity and the low incidence of complications associated with the LG technique led to its subsequent use in many transplant centers. Later, Taguchi et al. [2] published in 1971 a new technique for ureterovesical anastomosis that involves the application of a U-stitch at the distal aspect of the ureter to anchor it to the anterior bladder wall. The development of these methods over the last 50 years confirms that technical factors during renal transplantation are of great importance. Knowledge of both donor's and recipient's anatomy, extreme care taken during dissection and ureteric handling can provide better preservation of ureteric blood supply and hence lower incidence of postoperative complications [7,8].

Our results are in accordance with recently published reports in the literature. A report by Lee et al. [9] in comparing both techniques suggests that the T technique is a significant risk factor for developing hematuria and urological complications in comparison to the LG technique (p=.0001, and p=.05 respectively). Another report published by Secin et al. [10] reported no overall difference in urological complications between both groups, however there was a higher incidence of hematuria in the T group in their subgroup analysis (p=0.05). Hakim et al. [11] also identified a higher rate of hematuria with the single-stitch technique compared to LG and LP techniques. The higher incidence of hematuria in the T group can be attributed to the absence of meticulous homeostasis and handling of the discrete longitudinal vessels at the distal margin of the ureter [9,10]. Another possible explanation is that by lying the distal ureter intravesically, the ureteric stump will be exposed to urine and urokinase which theoretically can dissolve the hemostatic fibrin clot [12]. Both techniques are routinely performed interchangeably

by surgeons in our institution. In 2003 a report was published by our institution [13] identified a higher incidence of complicated hematuria in the T group (34%) compared to this report. We attribute this to the increase in sample size and thus precision of this study.

The LG group was associated with a lower overall incidence of complications (23% *vs.* 17%) (p=0.07). There was no statistically significant difference between the two groups in terms of urinary leak or stricture. Previously published prospective and retrospective reports provide conflicting results in terms of the association between LG technique and the development of ureteric stricture or leak. Two separate studies reported higher incidence of strictures with the LG group compared to the T group [11,12]. However, many comparative analyses did not show significant difference in the rate of ureteric stricture between the LG and T techniques [9,10,14]. In terms of urinary leak only one report identified significant difference between both techniques with higher incidence in the T group (5.7% *vs.* 2.2%, p=0.018) [12]. The minimal handling of the ureter in the T group could have made this technique favorable to the LG technique in terms of operative time and the incidence of post-op stricture, but this has not reached statistical significance in our analysis. This might be explained by the fact that the use of double J stents was not a common practice in our institution during the time frame of this study.

Interestingly, we encountered a significant association between ureteric strictures and the time to the first episode of acute rejection. Ureteric strictures were associated with a shorter time period between renal transplant and the first episode of acute rejection (OR=3.9 (95% CI=1.8–8.7)). However, it is not clear from our data if a shorter interval to first acute rejection is a cause or consequence of the ureteric stricture.Surgical technique did not seem to be related to graft loss or delayed graft function, the latter being known to be associated with increased length of hospital stay, higher risk of acute rejection and reduced graft function and survival [15]. The only other factor associated with graft loss was a deceased donor graft (OR=2.2 (95% CI=1.1–4.5).

Conclusions

The Taguchi technique and the Lich-Gregoire techniques can be used interchangeably for adult renal transplantation. However, the Taguchi technique is associated with a higher risk of complicated hematuria in our patient cohort but it`s not associated with higher incidence of graft loss. Ureteric strictures are associated with shorter time to graft rejection. The lack of randomized controlled trials comparing both techniques make it difficult to ascertain which technique is superior, however, these results overall favor the Lich-Gregoire technique.

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