"Early" removal of the internal ureteral stent after kidney transplantation

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Abstract

Background. *Urological complications are currently one of the main causes of the renal graft loss and the death of the recipient in the early and late periods after surgery.*

Objective. *To reduce the risk of developing infectious complications after kidney transplantation by early removal of the internal ureteral stent.*

Material and methods. *From June 2018 to March 2020, the Department of Organ and/or Tissue Transplantation of the City Clinical Hospital n.a. S.P. Botkin performed 89 deceased-donor kidney transplantations with the placement of an internal ureteral stent. Depending on the timing of stent removal, the patients were divided into 2 groups: the first group*

included 54 patients who had the stent removed on day 21, and the second group included 35 patients who had the stent removed on day 14.

Results. *No urological complications were recorded in both groups. Urinary tract infection was recorded in 8 patients (15%) in the first group, and in 1 patient (3%) in the second group (p = 0.01).*

Conclusion. *Removal of the internal ureteral stent on the 14th day after kidney transplantation safely and reliably reduces the risk of a urinary tract infection development, improving the immediate results of the operation.*

Keywords: kidney transplantation, urinary tract infection, internal ureteral stent

Introduction

Urological complications are currently among the main causes of the renal graft loss and recipient's death in the early and late postoperative periods [1, 2]. Common urological complications after kidney transplantation include incompetence of the formed neocystoureteroanastomosis (up to 6%), obstructive uropathy (up to 7.5%), ureteral stricture (up to 12%) [2]. Currently the most effective method to prevent the development of urological complications is intraoperative stenting of the neocystoureteroanastomosis [3, 4]. The stent
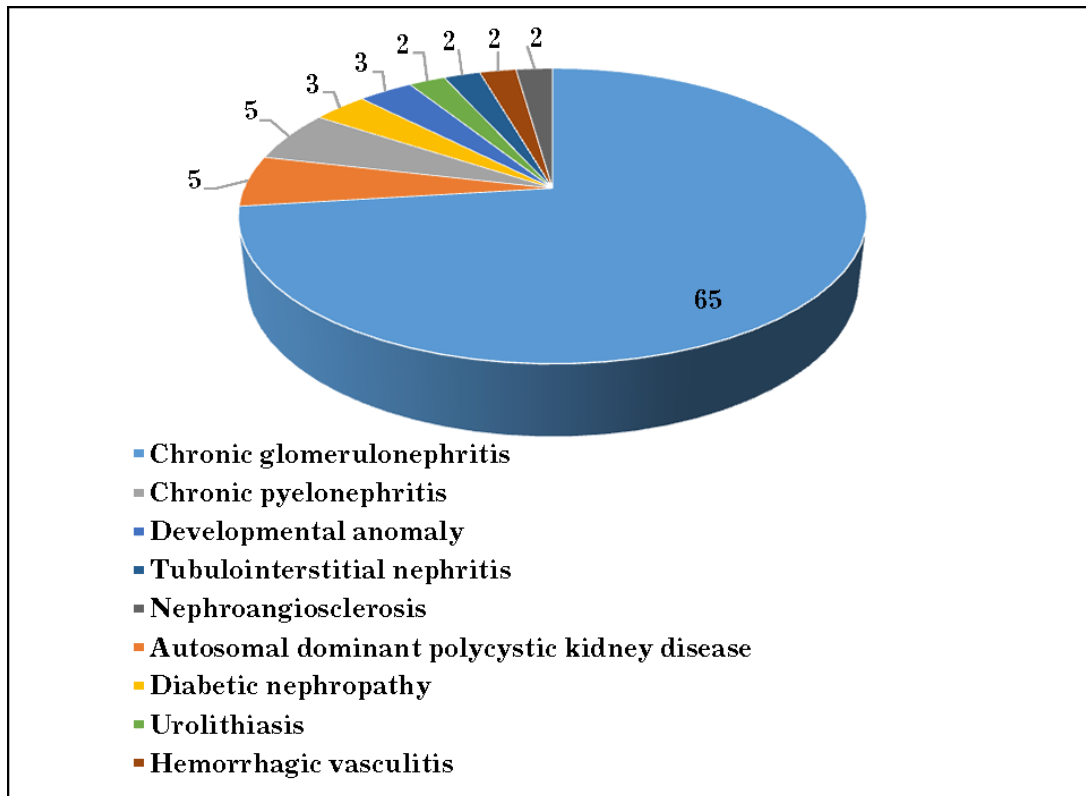
placement reduces the likelihood of urological complications by 5–10 times [5]. However, according to many authors, the routine use of ureteral stents increases the risk of developing infectious complications, which can lead to the graft dysfunction and recipient's death [6, 7]. The national clinical guidelines do not give any strong recommendations as for the routine use of ureteral stents. To minimize the risk of developing infectious complications, the authors propose to shorten the time of the stent being in ureter, after kidney transplantation [8]. So, Y. Yuksel et al. removed the stents in 153 patients on day 5-7 after surgery and observed severe urological complications being developed in 11% of those cases; no infectious complications were recorded in this category of patients [9]. On the contrary, S. Liu et al [10] and K.N. Indu et al [11] removed the stents on day 28 after surgery. In both groups, no urological complications were recorded, however, the incidence of infectious complications was 29.3% and 38.0%, respectively. Recent studies and their meta-analysis have shown that the ureteral stent removal earlier than 2 weeks leads to an increased number in urological complications, and the stent removal after 3 weeks leads to an increased number in infectious complications after kidney transplantation [12].

Thus, the use of a ureteral stent increases the reliability of neocystoureteroanastomosis, but increases the likelihood of developing infectious complications after kidney transplantation. Our study was aimed at specifying the optimal timing for removal of a ureteral stent after kidney transplantation.

Material and methods

From June 2018 to March 2020, 89 deceased-donor kidney transplantations were performed at the Transplantation Department of the City Clinical Hospital n.a. S.P. Botkin. There were 55 men and 34

women. The mean age of the recipients was 46 ± 11 (20–72) years old. All the patients were diagnosed with stage 5 chronic kidney disease.

Figure. Diseases that led to the development of end-stage kidney disease

Legend:
- Chronic glomerulonephritis
- Chronic pyelonephritis
- Developmental anomaly
- Tubulointerstitial nephritis
- Nephroangiosclerosis
- Autosomal dominant polycystic kidney disease
- Diabetic nephropathy
- Urolithiasis
- Hemorrhagic vasculitis

There were 67 patients on hemodialysis, 14 patients on peritoneal dialysis, and 8 pre-dialysis patients.

We used the standard surgical technique. In all cases, a single-layer interrupted neocystoureteroanastomosis was performed according to Mebel–Shumakov method, using a monofilament absorbable suture 6–0 with the placement of an internal double pigtail ureteral stent 12 cm long, 7 Fr in diameter. The urethral catheter was removed on day 7 after surgery. All patients received prophylactic antibacterial therapy with protected third-generation cephalosporins. The following scheme of immunosuppressive therapy was used: anti-CD25 monoclonal antibodies

(basiliximab), intraoperatively and on postoperative day 4, tacrolimus with achieving a target concentration of 8-10 ng/mL, mycophenolic acid at a dose of 1000 mg 2 times a day, and prednisolone at a dose 30 mg per day. The removal of the ureteral stent was performed in the Operating Room in aseptic conditions. The patients were allocated into two groups depending on the timing of the stent removal. The first group consisted of 54 patients who underwent the ureteral stent removal on day 21 after transplantation. The second group included 35 patients in whom the internal ureteral stent was removed on day 14 after surgery. The comparison of the groups is presented in Table. 1.

Table 1. Comparative characteristics of patients

Characteristics	Group I (*n* = 54)	Group II (*n* = 35)	*p*
Gender:			
Male	32	23	0.29
Female	22	12	
Mean age, years	46 ± 10	45 ± 12	0.575
Donor mean age, years	47 ± 9	47 ± 11	0.808
Mean duration of surgery, min	248 ± 40	255 ± 39	0.773
The mean cold ischemia time, min	565 ± 208	656 ± 147	0.18
Graft function:			
Immediate	39	23	0.249
Delayed	15	12	

As can be seen from the Table 1, there are no statistically significant differences between the groups in the assessed parameters.

In all the patients, urinalysis and urine microbiology cultures were performed immediately before the stent removal, and the removed stent was also studied for microbiology cultures. Urinary tract infection was defined as abnormal findings in the urinalysis or urine microbiology investigation in association with one of the following symptoms: fever over 38°C, dysuria and pain syndrome over the pubis.

Results

No postoperative mortality was recorded. There were no urological complications.

At the time of stent removal, bacteriuria was reported in 18 patients (33.4%) in group I, and in most of them (66.5%) it was caused by gram-negative bacteria (Table. 2).

Table 2. Pathogen contamination rates and their titers in the urine of Group I patients at the time of stent removal

Pathogen	Titer	Number of patients, n (%)
Gram-positive bacteria (n = 6 (11.2%))		
Enterococcus faecium	10^5	2 (3.7%)
	10^6	1 (1.9%)
Enterococcus faecalis	10^5	2 (3.7%)
	10^6	1 (1.9%)
Gram-negative bacteria (n = 12 (22.2%))		
Escherichia coli	10^5	3 (5.5%)
	10^6	1 (1.9%)

Pathogen	Titer	Number of patients, n (%)
Pseudomonas aeruginosa	10^5	2 (3.7%)
	10^6	1 (1.9%)
Klebsiella pneumoniae	10^5	3 (5.5%)
	10^6	2 (3.7%)

Microbiology of the samples from the removed stents was positive in 33 patients (61.1 %), approximately equally for gram-positive and gram-negative bacteria (Table. 3).

Table 3. Pathogen contamination rates and their titers on the ureteral stent in Group I patients at the time of its removal

Pathogen	Titer	Number of patients, n (%)
Gram-positive bacteria (n = 16 (29.6%))		
Enterococcus faecium	10^5	2 (3.7%)
	10^6	2 (3.7%)
Enterococcus faecalis	10^5	3 (5.5%)
	10^6	4 (7.5%)
Staphylococcus haemolyticus	10^5	3 (5.5%)
	10^6	2 (5.5%)
Gram-negative bacteria (n = 17 (31.5%))		
Escherichia coli	10^5	3 (5.5%)
	10^6	2 (3.7%)
Pseudomonas aeruginosa	10^5	4 (7.5%)
	10^6	1 (1.9%)
Klebsiella pneumoniae	10^5	3 (5.5%)
	10^6	3 (5.5%)
Proteus mirabilis	10^5	1 (1.9%)

Clinically significant urinary tract infection was recorded in 8 patients (14.8%).

At the time of stent removal in group II, bacteriuria was recorded in 5 patients (14.1%), and the proportion of gram-negative bacteria in this group was considerably lower than in group I patients (Table 4).

Table 4. Pathogen contamination rates and their titers in the urine of Group II patients at the time of stent removal

Pathogen	Titer	Number of patients, n (%)
Gram-positive bacteria (n = 2 (5.7%))		
Enterococcus faecium	10^5	2 (5.7%)
Gram-negative bacteria (n = 3 (8.4%))		
Pseudomonas aeruginosa	10^5	1 (2.8%)
	10^6	1 (2.8%)
Klebsiella pneumoniae	10^5	1 (2.8%)

Microbiology examination of the removed stent showed a positive result in 3 patients (8.4%), in all cases for *Klebsiella pneumoniae*. Clinically significant urinary tract infection was recorded in 1 patient only (2.8%). The summarized data of the study patients are presented in Table 5.

Table 5. Urological and infectious complications after kidney transplantation

Characteristic	Group I (n = 54)	Group II (n = 35)	p
Neocystoureteronastomosis incompetence	0	0	1
Bacteriuria at the time of stent removal	18	5	0.081
Positive stent culture	33	3	0.001
Clinically significant urinary tract infection	8	1	0.01

As one can see from the Table 5, the infectious complications developed considerably and statistically significantly more often (3.6-11 times) in group I patients.

Discussion

Infection has been one of the most serious complications after kidney transplantation. The internal ureteral stent, being a foreign body, placed intraoperatively, is a factor that increases the likelihood of developing infectious complications. Meanwhile, according to recent literature reports, refusal from stenting multiplies the likelihood of urological complications [5]. All the above confirms the need to search for the optimal time interval for the placement of the ureteral stent after kidney transplantation.

At the start of the Kidney Transplantation Program at Botkin Hospital, according to International Guidelines, we used a 21-day period

of an internal ureteral stent being in place [12]. In patients of group I, no urological complications were recorded, however, clinically significant infection of the urinary tract developed in 8 patients making 14.8% (see Table 5). The development of this type of complications worsened the immediate postoperative results due to a statistically significant increase in the hospital length of stay (14 versus 24 days [$p = 0.0035$]), and also required a long course of complex antibiotic therapy, which led to increased financial costs for patients' treatment.

We saw a solution to this problem in reducing the duration of the internal ureteral stent staying in place. Removing the stent in group II patients on postoperative day 14, we recorded no cases of urological complications, which allowed the conclusion on the safety of that approach to treatment. Alongside, this group of patients showed a decrease in bacteriuria at the time of stent removal as compared with group I of the study (14.1% versus 33.4% (p = 0.081)), as well as the decreased rate of positive cultures on the removed stents (8.4% versus 61.1% (p = 0.001)). It is with these data we associate the fact of a statistically significant decrease in the incidence of urinary tract infections in group II of the study ($p = 0.01$).

Thus, our study results show the safety of the internal ureteral stent removal on day 14 after kidney transplantation, which has been confirmed by absent cases of neocystoureteroanastomosis incompetence and, in fact, no cases of clinically significant urinary tract infection in this patient category. Conducting randomized prospective studies would clarify the data obtained and recommend stent removal on day 14 in routine clinical practice.

Conclusions

Management and prevention the infectious complications after kidney transplantation are of great importance in transplant clinical practice. Removal of the internal ureteral stent on day 14 after surgery is a safe tactics and is accompanied by a statistically significant reduction in the risk of a urinary tract infection development, improving the immediate results of kidney transplantation.

Based on the study results we can make the following conclusions:

1. When an internal ureteral stent is inserted after kidney transplantation for a period of at least 21 days, the incidence of bacteriuria is 33.4%, and urinary tract infection develops in 14.8% of patients.

2. The removal of the internal ureteral stent on day 14 does not increase the risk of urological complications (p = 1) compared to that with its removal on the 21st day.

3. "Early" removal of the internal ureteral stent is associated with a low incidence of bacteriuria (14.1%) and is accompanied by a statistically significant decrease in the incidence of urinary tract infections (p = 0.01) compared to the results obtained with the stent removal on postoperative day 21.

References

1. Khubutiya MSh, Shmarina NV, Dmitriev IV. 11-year experience of kidney retransplantation in elderly recipients in Sklifosovsky Research Institute for Emergency Medicine. *Russian Journal of Transplantology and Artificial Organs.* 2019;21(2):31–38. (In Russ.). https://doi.org/10.15825/1995-1191-2019-2-31-38

2. Saydulaev DA, Miloserdov IA, Gautier SV. Prevention and surgical treatment of urological complications in kidney transplant

recipient. *Russian Journal of Transplantology and Artificial Organs.* 2019;21(3):166–173. (In Russ.). https://doi.org/10.15825/1995-1191-2019-3-166-173

3. Buttigieg J, Agius-Anastasi A, Sharma A, Halawa A. Early urological complications after kidney transplantation: An overview. *World J Transplant.* 2018;8(5):142–149. PMID: 30211022 https://doi.org/10.5500/wjt.v8.i5.142

4. Abrol N, Dean PG, Prieto M, Stegall MD, Taner T. Routine stenting of extravesical ureteroneocystostomy in kidney transplantation: a systematic review and meta-analysis. *Transplant Proc.* 2018;50(10):3397–3404. PMID: 30577212 https://doi.org/10.1016/j.transproceed.2018.06.041

5. Gomes G, Nunes P, Castelo D, Parada B, Patrao R, Bastos C, et al. Uteric stent in renal transplantation. *Transplant Proc.* 2013;45(3):1099–1101. PMID: 23622636 https://doi.org/10.1016/j.transproceed.2013.02.086

6. Thompson ER, Hosgood SA, Nicholson ML, Wilson C. H Early versus late ureteric stent removal after kidney transplantation. *Cochrane Database Syst Rev.* 2018;1(1):CD011455. PMID: 29376218 https://doi.org/10.1002/14651858.CD011455.pub2

7. Gozdowska J, Czerwińska M, Młynarczyk G, Kwiatkowski A, Chmura A, Durlik M. Urinary tract infections in kidney transplant recipients hospita-lized at a transplantation and nephro-logy ward: 1-year follow-up. *Transplant Proc.* 2016;48(5):1580–1589. PMID: 27496451 https://doi.org/10.1016/j.transpproceed.2016.01.061

8. Wingate JT, Brandenberger J, Weiss A, Scovel LG, Kuhr CS. Ureteral stent duration and the risk of BK polyomavirus viremia or bacteriuria after kidney transplantation. *Transpl Infect Dis.* 2017;19(1). PMID: 27910187 https://doi.org/10.1111/tid.12644

9. Yuksel Y, Tekin S, Yuksel D, Duman I, Sarier M, Yucetin L, et al. Optimal timing for removal of the double-J stent after kidney transplantation. *Transplant Proc.* 2017;49(3):523–527. PMID: 28340826 https://doi.org/10.1016/j.transproceed.2017.01.008

10. Liu S, Luo G, Sun B, Lu J, Zu Q, Yang S, et al. Early removal of double-J stents decreases urinary tract infections in living donor renal transplantation: a prospective, randomized clinical trial. *Transplant Proc.* 2017;49(2):297–302. PMID: 28219588 https://doi.org/10.1016/j.transproceed.2016.12.007

11. Indu KN, Lakshminarayana G, Anil M, Rajesh R, George K, Ginil K, et al. Is early removal of prophylactic ureteric stents beneficial in live donor renal transplantation? *Indian J Nephrol.* 2012;22(4):275–279. PMID: 23162271 https://doi.org/10.4103/0971-4065.101247

12. Visser IJ, van der Staaij J, Muthusamy A, Willicombe M, Lafranca JA, Dor FJ. Timing of ureteric stent removal and occurrence of urological complications after kidney transplantation: a systematic review and meta-analysis. *J Clin Med.* 2019;8(5):689. PMID: 31100847 https://doi.org/10.3390/jcm8050689

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