Use of single-dose perioperative antimicrobial therapy is acceptable in recipients of living-donor renal transplants in the rituximab era

Running title: Single-dose perioperative antimicrobial therapy is acceptable

Shingo Nishimura, *Koichiro Wada, Motoo Araki, Takuya Sadahira,

Yuki Maruyama, Yosuke Mitsui, Ryuta Tanimoto, Yasuyuki Kobayashi,

Toyohiko Watanabe, Yasutomo Nasu

Department of Urology, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, 2-5-1 Shikata-cho, Kita-ku, Okayama, 700-8558, Japan

All authors meet the ICMJE authorship criteria.

*Corresponding author: Koichiro Wada

2-5-1, Shikata-cho, Kita-ku, Okayama, 700-8558, Japan

Phone: +81-86-235-7287 Fax: +81-86-231-3986

E-mail: gmd17055@s.okadai.jp

ABSTRACT

Objective: The aim of this study was to evaluate the efficacy of single-dose perioperative antimicrobial therapy as infection prophylaxis in recipients of living-donor renal transplants in the rituximab era.

Patients and Methods: Between 2009 and 2017, 84 recipients underwent living-donor renal transplantation (LDRT) at Okayama University Hospital; 3 with vascular/urinary complications requiring additional surgery were excluded from this analysis. Data including recipient characteristics, antimicrobial prophylaxis and administration of rituximab were retrospectively examined for an association with perioperative infections. Prophylactic antimicrobial agents, selected according to the results of preoperative urine cultures, were administered just before incision. Perioperative infections, which consisted of surgical site infections, remote infections, and urinary tract infections, were defined as a positive culture indicating required administration of additional antimicrobial agents.

Results: Among the 81 recipients, prophylactic cefazolin, ampicillin/sulbactam, and others were administered to 66 (82%), 13 (16%), and 2 (3%) recipients, respectively. Twenty-one (26%) received single-dose antimicrobial prophylaxis, while 60 (74%) received multiple doses up to 7 days. Rituximab was used in 59 (72.8%) recipients. The

incidence of urinary tract infection, surgical site infection and remote infection was 13 (16%), 1 (1%), and 0, respectively. Univariate analysis could not demonstrate any significant risk factors for postoperative urinary tract infections, including a single dose vs multiple doses of antimicrobial therapy (P=0.069) and administration of rituximab (P=0.717).

Conclusions: Our data suggest that the use of single-dose perioperative antimicrobial therapy is acceptable for prophylaxis of infections in patients undergoing LDRT, even in the rituximab era.

Keywords: renal transplantation, antimicrobial prophylaxis, rituximab, perioperative infections, urinary tract infections

Introduction

Renal transplantation is performed worldwide as a radical therapy for end-stage renal failure. Over 1,600 recipients per year undergo renal transplantation in Japan [1]. Graft function and outcomes have improved with developments in the procedure itself, with the use of immunosuppressants, and with improvements in the management of rejection and infection [2-5]. Management of posttransplant infections involves mainly viruses (e.g., cytomegalovirus, BK virus) and fungi (e.g., pneumocystis pneumonia); however, postoperative management of bacterial infection is also important, as quite a few reports have documented this complication.

Renal transplantation is an open, clean-contaminated surgery that involves opening the urinary tract. In addition to having the potential for underlying complications, such as diabetes, renal failure, old age, urinary catheterization and long hospitalization, patients receive several kinds of immunosuppressants (e.g., tacrolimus, mycophenolate mofetil, and methylprednisolone) before and after surgery. Therefore, living-donor renal transplant recipients are at high risk for perioperative bacterial infections [6, 7]. However, there have been few studies on perioperative bacterial infections in recipients of renal transplants. Guidelines published by the American

Society of Health-System Pharmacists (ASHP) [8] and the European Association of Urology (EAU) [9], have recommended regimens for perioperative antimicrobial prophylaxis. In Japan, a previous version of the Japanese guidelines published in 2007 [10] did not include antimicrobial prophylaxis for renal transplantation. However, the "Essential Japanese Guidelines for the Prevention of Perioperative Infections in the Urological Field: 2015 Edition" [11] published in 2016 recommended standard antimicrobial prophylaxis for renal transplantation for the first time in Asia.

Rituximab is a chimeric monoclonal antibody targeted against the pan-B-cell marker CD20 that leads to B cell depletion. Rituximab was approved by the Japanese National Health Insurance System in February 2016 for ABO blood type-incompatible renal transplantation. Approximately 30% of renal transplantation in Japan is ABO blood type-incompatible. Rituximab is also used for high-risk renal transplantation, including donor-specific antibody (DSA)-positive cases and ABO minor mismatch cases in some institutions in Japan. According to some studies from foreign countries, it has been controversial whether administration of rituximab is a risk of bacterial infection or not for renal transplant recipients [12, 13, 14]. Thus, new evidence from Japan is required to update the current guidelines.

The aim of this retrospective study was to evaluate the risk of perioperative infection in recipients who underwent living donor renal transplantation (LDRT) in the rituximab era.

Patients and Methods

Patients (recipients)

Individuals who underwent LDRT at Okayama University Hospital between 2009 and 2017 were enrolled in this study. Three recipients with postoperative vascular/urinary complications were excluded because they required additional surgery and were considered inappropriate for prophylactic antimicrobial therapy efficacy evaluation (Figure 1). We retrospectively collected data on recipient characteristics, manner of antimicrobial prophylaxis, administration of rituximab, and incidence of perioperative infections from patient medical records.

Perioperative infection

Perioperative infections consisted of surgical-site infections (SSI), remote infections (RI), and urinary tract infections (UTI) that occurred within 1 month post LDRT. Perioperative infection was defined as a positive culture indicating required administration of additional antimicrobial agents for the treatment of perioperative infection; prophylactic antimicrobial agents administered for renal biopsy or removal of ureteral stents were not included. A positive culture meant bacterial isolation from the drainage fluid collected from a retroperitoneal or subcutaneous drain or from the tips of

the drain for SSI; bacterial isolation from specimens including sputa, stool, blood or from the tips of the intravascular catheter for RI; bacteriuria (bacteria $\geq 1.0 \times 10^4$ colony-forming units/mL) and presence of pyuria (white blood-cell count $\geq$ 5/high-power fields) for UTI. A positive culture of a specimen from a patient requiring no additional antimicrobial administration (colonization) was not counted as a perioperative infection in this study.

Immunosuppressive therapy regimens

Figure 2 shows the immunosuppressive therapy (IST) regimens employed. All recipients were administered tacrolimus, mycophenolate mofetil (MMF), prednisolone, and basiliximab before surgery on postoperative day (POD) 0 and again on POD 4. For recipients with ABO identical blood types and ABO minor mismatch, IST was started 4 days before LDRT; it was started 2 weeks before LDRT for recipients with incompatible blood types. Double filtration plasmapheresis (DFPP) and plasma exchange (PE) were performed within the week prior to LDRT in recipients with incompatible blood types. The same protocol used for incompatible blood types was used for recipients with focal segmental glomerulosclerosis (FSGS). Immunosuppressants were administered 4 to 6 weeks before LDRT in recipients with

DSAs; these recipients also underwent DFPP and PE to reduce the level of DSAs. Rituximab 200 mg/body was administered to all recipients, except those with identical blood types without DSAs and without FSGS, 7 to 14 days before LDRT.

Standard procedures of LDRT

After hair was removed with surgical clippers and an indwelling 16 Fr urethral catheter (All Silicone Nephrostomy Balloon Catheters; Create Medic Co. Ltd, Yokohama, Japan) was placed, the skin was prepared with povidone-iodine, and a Gibson incision was made via a retroperitoneal approach. The lymphatic vessels around the pertinent blood vessels were ligated. End-to-side anastomoses of the renal vessels to the external iliac vein and artery and ureterovesical anastomoses were made with the Lich-Gregoir technique. All recipients were given 5 Fr 10 cm double-J ureteral stents (Polaris™ Ultra ureteral stent; Boston Scientific, Natick, MA) and retroperitoneal drains (Pleats Drainage Tube 8 mm in outside diameter; MD-45108, Sumitomo Bakelite, Tokyo, Japan). Wounds were closed with interrupted sutures for the fascia and subcutaneous fat and with running subcuticular absorbable sutures for the skin. Subcutaneous drains (Blake; Ethicon Inc., Somerville, NJ) were placed in recipients with at least 2 cm of subcutaneous fat; these were removed when drainage decreased to

less than 10 mL per day. Urethral catheters and ureteral stents were removed within 2 weeks after LDRT.

Bacteriological examination and prophylactic antimicrobial agents

Urine cultures were obtained from all recipients before LDRT, except for recipients with anuria. Those with negative urine cultures were administered prophylactic ampicillin/sulbactam 750 mg or cephazolin 500 mg once daily without additional administration intraoperatively. For recipients with a positive urine culture, prophylactic antimicrobials were selected according to the results of the culture and susceptibility testing. These medications were administered over the same timeframe as for recipients with negative urine cultures. Weekly urine cultures were performed after LDRT, and the tips of the retroperitoneal and subcutaneous drains and intravascular catheters were cultured at removal. At endoscopic ureteral-stent removal, a single dose of a prophylactic antimicrobial agent (e.g., levofloxacin, 250 mg or 500 mg, or other antimicrobial agent according to the results of postoperative urine culture) was administered.

Statistical methods and analyses

Data were analysed via logistic regression analysis with JMP® Pro software, version 11.0.0 (SAS Institute, Inc., Cary, NC), with 5% set as the significance level.

Ethics

This retrospective study was approved by the Ethics Committee of Okayama University Hospital (registration no. 1507-003).

Results

Recipient characteristics

The recipient characteristics and preoperative conditions are summarized in Table 1. Diabetic nephropathy, also known to be a risk factor for SSI, was present in 16 recipients (20%). Rituximab was administered to 59 (73%) recipients, and a positive preoperative urine culture was observed in 11 recipients (14%).

Antimicrobial prophylaxis and results of the procedure

Table 2 shows the prophylactic antimicrobial agents administered and the details of the procedure. Positive urine culture before LDRT was observed in 11 recipients, whereas there was no recipient with symptomatic UTI. Thus, most recipients were given ampicillin/sulbactam or cefazolin.

Although urethral catheters and retroperitoneal drains were placed in all recipients, a subcutaneous drain was indicated in 27 recipients (33%). The median durations of urethral catheter, retroperitoneal drain, and subcutaneous drain placement were 7, 5, and 6 days, respectively. Adverse events excluding perioperative infection were 3 (4%) acute rejections and 3 (4%) lymphoceles within 1 month of surgery.

Perioperative infections and outcomes

A total of 14 recipients (17%) were given additional antimicrobial therapy for bacterial infections: 1 recipient with SSI and 13 with UTI. The profiles of pathogens of perioperative infections collected from the drain tip or urine samples are shown in Table 3. Positive cultures indicating SSI were observed in 20 recipients (25%), and 22 bacterial strains, mainly Gram-positive cocci (18 strains, 82%), were isolated. Positive culture of the intravascular catheter tip was found in 6 recipients; however, they did not receive any additional antimicrobial therapy. Regarding UTI, 36 strains including 28 (78%) Gram-negative bacterial strains were isolated from 33 recipients. Additional antimicrobial agents for UTI treatment were administered to 13 (16%) recipients, and all of them recovered with additional antimicrobial therapy and removal of indwelling catheters including ureteral stents.

Statistical analyses

Table 4 shows the results of univariate analysis to evaluate multiple perioperative risk factors of UTI. None demonstrated significance, including shorter single-dose antimicrobial prophylaxis and administration of rituximab.

Discussion

In the present study, UTI, SSI and RI were observed in 13 (16%), 1 (1%), and 0 recipients of living-donor renal transplants, respectively. Neither single-dose antimicrobial prophylaxis nor administration of rituximab was a significant risk factor for postoperative UTI.

Renal transplantation is an open, clean-contaminated surgery that involves opening the urinary tract. As shown in Table 5, SSI, RI, and UTI rates of renal transplant recipients have been reported as, at most, 14%, 2%, and 34%, respectively, although RI seems to be underreported, since data are missing in many reports [7, 17-22]. In addition to their use in renal failure, several kinds of immunosuppressants are given to renal transplant recipients before surgery, which places these recipients at high risk for perioperative infection. Therefore, before the publication of the Japanese guidelines (March 2016) [11], we administered first-generation cephalosporins or penicillins with a beta-lactamase inhibitor (BLI) as antibiotic prophylaxis until 72 hours (POD 3) or more after clean-contaminated surgeries, including LDRT, while single-dose prophylaxis has been given in our institution since June 2016, after the publication of the Japanese guidelines. We found no significant risk factors for postoperative UTI, even though recipient age, BMI, ASA physical status classification, diabetes mellitus,

and decreased serum albumin level were reported to be significant risk factors for perioperative infection [8, 9]. Although many study had demonstrated that splenectomy was a significant risk of bacterial infections [15, 16], rituximab has been controversial. Trivin et al. and Schrezenmeier et al. reported that administration of rituximab was postoperatively a risk of bacterial infections [12, 13], whereas Kamar et al. mentioned that the incidence of bacterial infections was similar between rituximab patients and non-rituximab patients [14]. In the present study, incidence of SSI and RI were too low to evaluate the risk of rituximab, and rituximab was not significant risk of UTI.

In the 14 transplant recipients who were given additional antimicrobial agents (1 with SSI and 13 with UTI), the antimicrobial agents were administered according to the results of drug-susceptibility testing. The 13 recipients with UTI had pyelonephritis of the transplanted kidney; no evidence of other febrile UTI, such as epididymitis or prostatitis, was observed. The reasons for the higher UTI rate in the present study include a possible vesicoureteral reflux due to ureteral stenting, longer duration of urethral catheterization [23], and no additional administration of prophylactic antimicrobials intraoperatively. Regarding the outcome of perioperative infections, 1 recipient with SSI and all recipients with UTI were treated with additional antimicrobial

agents and removal of indwelling catheters, and the results of repeat cultures were negative.

Recently, a shorter duration of antimicrobial prophylaxis has been recommended for non-transplant urological surgery. Guidelines regarding urological surgeries published by the American Urological Association [24] and EAU [25] recommend a single dose preoperatively or within 24 hours postoperatively, e.g., trimethoprim and sulfamethoxazole, first- or second-generation cephalosporin, or penicillin with BLI for clean-contaminated surgery. Also in the JUA guidelines published in 2016 [11], first- or second-generation cephalosporins or penicillins including BLI are recommended within 24 hours (POD 0) after non-transplant surgery. Several recommendations for antimicrobial prophylaxis for renal transplantation have been reported; antimicrobial prophylaxis only in select circumstances, such as in a recipient > 65 years of age or with a BMI over 35 kg/m^2 [18] and reduction to a single dose in recipients without known risk factors for SSI [19]. In the EAU guidelines, single-dose prophylaxis, such as with cefazolin, is the recommended regimen for renal transplant recipients [9], since there was no significant difference in the incidence of SSI or UTI between the single-dose group and the twice-daily for 3 to 5-days group in a randomized control trial reported in 2015 [22]. Also, in the ASHP guidelines, a

single-agent regimen, such as with cefazolin or ceftriaxone, is recommended within 24 hours postoperatively. In the newer JUA guidelines, antimicrobial prophylaxis for renal transplantation is recommended as first- or second-generation cephalosporins or penicillins with BLI, and the duration is single-dose or within 72 hours (POD 2) after the procedure [11]. According to our data, single-dose prophylaxis was not a risk factor for UTI (P=0.069), and further analysis comparing the single-dose group (n=21) to a 72-hour group (n=39) (not shown in Table 4) demonstrated no significant difference (P=0.374). Our data suggest that single-dose prophylaxis does not increase the risk of perioperative infections, and this approach should help to reduce the cost of treatment and the selection for drug-resistant bacteria.

This study had some limitations. First, it was a retrospective, non-randomized study carried out at a single institution, and it had a limited sample size. Since larger number of recipients might detect differences between single-dose and multiple-dose antimicrobial prophylaxis, we are planning to carry out a prospective investigation with a larger sample size. Second, a slightly higher UTI rate was observed in this study compared with that in non-transplant clean-contaminated surgery. Further investigation, such as the effect of additional intraoperative prophylaxis and the effect of different durations of stent and urethral catheter usage might be considered.

Despite these limitations, the present study provided new information in a new era using rituximab-rich protocols. It also demonstrated that single-dose antimicrobial prophylaxis does not increase the risk of perioperative infections, even in the rituximab era. This information will contribute to the next version of the guidelines.

In conclusion, a shorter duration of prophylactic antimicrobial therapy did not increase the risk of perioperative infection in LDRT recipients given rituximab. Further evidence acquired from larger, prospective studies is necessary for the determination of appropriate, standard antimicrobial prophylaxis in LDRT recipients.

Conflict of Interest

None declared.

References

[1] The Japan Society for Transplantation. "*Transplantation Fact Book* 2017," (in *Japanese*). Available from: http://www.asas.or.jp/jst/pdf/factbook/factbook2017.pdf

[2] Peter Morris, Stuart J. Knechtle. Kidney Transplantation - Principles and Practice E-Book. Elsevier Health Sciences, Oxford, 2013.

[3] Gabriel M. Danovitch. Handbook of Kidney Transplantation. Lippincott Williams & Wilkins, Philadelphia, 2012.

[4] Takahashi K eds. Jin-ishoku no subete. Medical View Co., Ltd., Tokyo, 2009. (Article in Japanese)

[5] Nieto T, Inston N, Cockwell P. Renal transplantation in adults. BMJ 2016;30;355: i6158.

[6] Nishi SP, Valentine VG, Duncan S. Emerging bacterial, fungal, and viral respiratory infections in transplantation. Infect Dis Clin North Am 2010;24:541–55.

[7] Adamska Z, Karczewski M, Cichańska L, Więckowska B, Małkiewicz T, Mahadea D, et al. Bacterial infections in renal transplant recipients. Transplant Proc 2015;47:1808–12.

[8] Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al.; American Society of Health-System Pharmacists.; Infectious Disease Society of America.; Surgical Infection Society.; Society for Healthcare Epidemiology of America. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm 2013;70:195–283.

[9] Kälble T, Lucan M, Nicita G, Sells R, Burgos Revilla FJ, Wiesel M; European

Association of Urology. EAU guidelines on renal transplantation. Eur Urol 2005;47:156–66.

[10] Matsumoto T, Kiyota H, Matsukawa M, Yasuda M, Arakawa S, Monden K. Japanese guidelines for prevention of perioperative infections in urological field. Japanese Society of UTI Cooperative Study Group: Int J Urol 2007;14:890–909.

[11] Yamamoto S, Shigemura K, Kiyota H, Wada K, Hayami H, Yasuda M, et al.; Japanese Research Group for UTI. Essential Japanese guidelines for the prevention of perioperative infections in the urological field: 2015 edition. Int J Urol 2016;23:814–24.

[12] Trivin C, Tran A, Moulin B, Choukroun G, Gatault P, Courivaud C, et al.: Infectious complications of a rituximab-based immunosuppressive regimen in patients with glomerular disease. Clin Kidney J 2017;10:461–9.

[13] Schrezenmeier E, Budde K, Staeck O, Lehner L, Duerr M, Khadzhynov D, et al.: Incidence of Infectious Disease and Malignancies After Rituximab Therapy in Kidney Transplant Recipients: Results From a Cohort in Germany. Transplant Proc 2017;49:2269–73.

[14] Kamar N, Milioto O, Puissant-Lubrano B, Esposito L, Pierre MC, Mohamed AO, et al.: Incidence and Predictive Factors for Infectious Disease after Rituximab Therapy in Kidney-Transplant Patients. Am J Transplant 2010;10:89–98.

[15] Newland A, Provan D, Myint S: Preventing severe infection after splenectomy: Patients should know the risks, be immunised, and take prophylactic antibiotics. BMJ 2005;331:417–8.

[16] Rubin LG, Schaffner W: Clinical practice. Care of the asplenic patient. N Engl J Med 2014;371:349-56.

[17] Rabkin DG, Stifelman MD, Birkhoff J, Richardson KA, Cohen D, Nowygrod R, et al. Early catheter removal decreases incidence of urinary tract infections in renal transplant recipients. Transplant Proc 1998;30:4314–6.

[18] Laftavi MR, Rostami R, Patel S, Kohli R, Laftavi H, Feng L, et al. Universal perioperative antimicrobial prophylaxis is not necessary in kidney transplantation. Clin Transplant 2012;26:437–42.

[19] Wszoła M, Kwiatkowski A, Ostaszewska A, Górski L, Kuthan R, Sawicka-Grzelak A, et al. Surgical site infections after kidney transplantation--where do we stand now? Transplantation 2013;95:878–82.

[20] Capocasale E, De Vecchi E, Mazzoni MP, Dalla Valle R, Pellegrino C, Ferretti S, et al. Surgical site and early urinary tract infections in 1000 kidney transplants with antimicrobial perioperative prophylaxis. Transplant Proc 2014;46:3455–8.

[21] Freire MP, Antonopoulos IM, Piovesan AC, Moura ML, de Paula FJ, Spadão F, et al. Amikacin prophylaxis and risk factors for surgical site infection after kidney transplantation. Transplantation 2015;99:521–7.

[22] Orlando G, Manzia TM, Sorge R, Iaria G, Angelico R, Sforza D, et al. One-shot versus multidose perioperative antibiotic prophylaxis after kidney transplantation: a randomized, controlled clinical trial. Surgery 2015;157:104–10.

[23] Guler S, Cimen S, Hurton S, Molinari M. Risks and benefits of early catheter removal after renal transplantation. Transplant Proc 2015;47:2855–9.

[24] Wolf JS Jr, Bennett CJ, Dmochowski RR, Hollenbeck BK, Pearle MS, Schaeffer AJ; Urologic Surgery Antimicrobial Prophylaxis Best Practice Policy Panel. Best practice policy statement on urologic surgery antimicrobial prophylaxis. J Urol 2008;179:1379–90.

[25] Grabe M, Bjerklund-Johansen TE, Botto H, Çek M, Naber KG, Tenke P, et al. Guidelines on urological infections. Arnhem: European Association of Urology; 2010. Available from: http://uroweb.org/wp-content/uploads/Urological-Infections-2010.pdf.

Figure legends

Figure 1. Recipient flow in the present study.

Figure 2. Immunosuppressive therapy. [a]Double filtration plasma apheresis/plasma exchange. ABO incompatible and/or positive donor-specific antibody living-donor renal transplant recipients. [b]Rituximab. ABO compatible/incompatible and/or positive donor-specific antibody or cross-reactive group living-donor renal transplant recipients.

Figure 1.

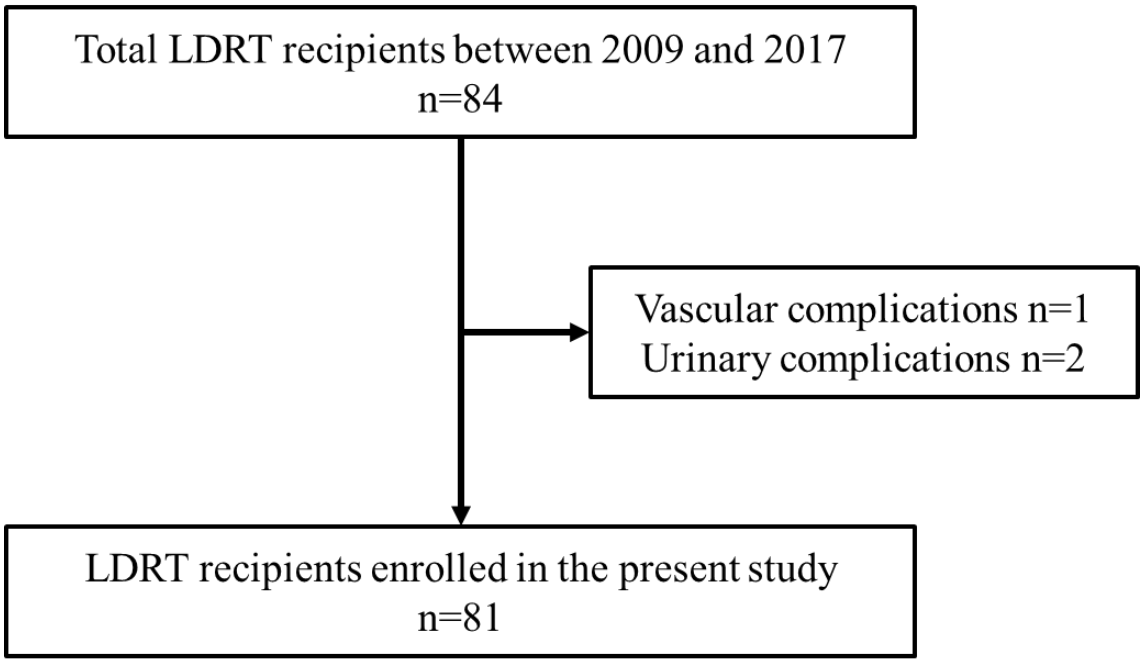

Figure 2.

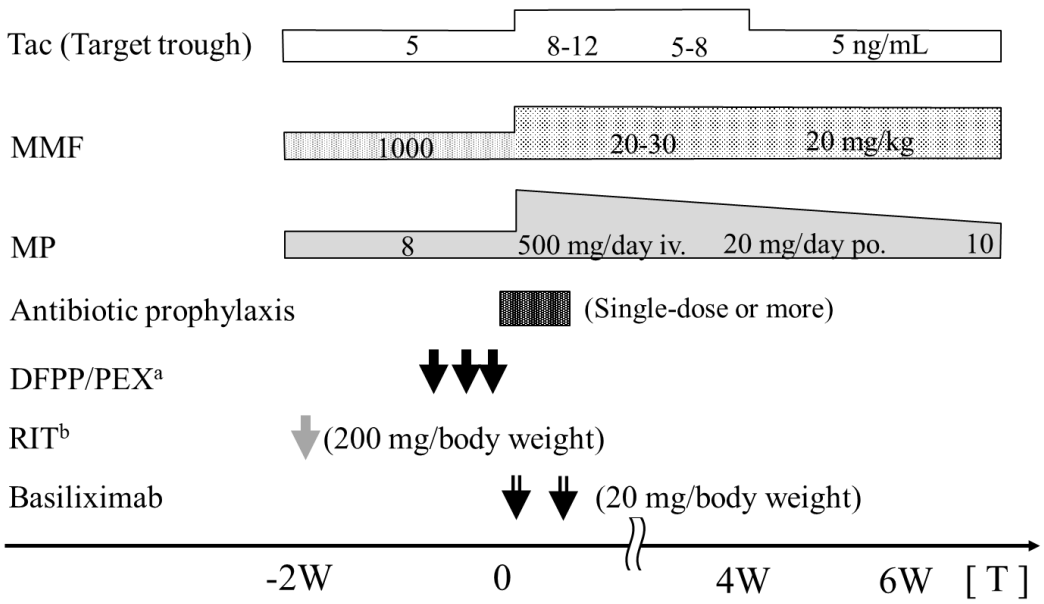
Tac (Target trough)
5
8-12
5-8
5 ng/mL
MMF
1000
20-30
20 mg/kg
MP
8
500 mg/day iv.
20 mg/day po.
10
Antibiotic prophylaxis
(Single-dose or more)
DFPP/PEX[a]
RIT[b]
(200 mg/body weight)
Basiliximab
(20 mg/body weight)
-2W
0
4W
6W
[T]

Table 1. Patient characteristics.

N	81	
Median age (IQR)[a]	43	(31-57)
Median BMI[b], kg/m^2 (IQR)	21.6	(18.9-24.1)
Median duration of dialysis before LDRT[c] (n=57), year (IQR)	1.8	(0.9-4.2)
Pre-LDRT s-albumin,[d] g/dL (IQR)	3.9	(3.6-4.1)
Sex, n (%)		
male	55	(68)
female	26	(32)
ASA[e] physical status classification, n (%)		
2	3	(4)
3	75	(93)
4	3	(4)
Diabetic nephropathy, n (%)	16	(20)
ABO-incompatible, n (%)	32	(40)
Donor-specific antigen, n (%)	17	(21)
Plasmapheresis before LDRT, n (%)	51	(63)
Administration of rituximab, n (%)	59	(73)
Pre-emptive renal transplantation, n (%)	27	(33)
Positive urine culture before surgery, n (%)	11	(14)

[a]IQR: interquartile range

[b]BMI: Body mass index

[c]LDRT: living donor renal transplantation

[d]s-albumin: serum-albumin

[e]ASA: American Society of Anesthesiologists

Table 2. Details and procedures of antimicrobial prophylaxis.

N	81	
Type of prophylactic antimicrobials, cases (%)		
Ampicillin/sulbactam	13	(16)
Cefazolin	66	(82)
Cefotiam	1	(1)
Cefmetazole	1	(1)
Duration of prophylactic antimicrobials, cases (%)		
Single-dose	21	(26)
Within 72 hours (up to POD[a] 2)	38	(47)
More than 72 hours	22	(27)
Median Operative time, min (IQR)[b]	511	(445-593)
Median EBL,[c] mL (IQR)	150	(70-233)
With pelvic drain, cases (%)	81	(100)
Median duration of placement, days (IQR)	5	(4-8.5)
Urethral catheter, cases (%)	81	(100)
Median duration of placement, days (IQR)	7	(7-11)
Subcutaneous drain placement, cases (%)	27	(33)
Median duration of placement, days (IQR)	6	(4-8)

[a]Postoperative day

[b]Interquartile range

[c]Estimated blood loss

Table 3. Profiles of pathogens postoperatively isolated.

	Number of isolates
Retroperitoneal/Subcutaneous drains	
Enterococcus faecium	1
Urine samples	
Escherichia coli	9
Proteus mirabilis	2
CNS*	2

*CNS: Coaglase-negative staphyococci

Table 4. Statistical analysis of risk factors for surgical site infection and febrile urinary tract infection.

	UTI (-)		UTI (+)		Univariate analysis
N	68		13		*P*
Median age (IQR)	43	(30-58)	43	(36-58.5)	0.781
Median BMI, kg/m^2 (IRQ)	21.4	(18.9-23.8)	23.1	(19.0-26.0)	0.238
Median duration of dialysis before LDRT (n=54) , years (IQR)	1.5	(0.8-4.6)	2.4	(0.9-3.0)	0.316
Median pre-LDRT s-albumin, mg/dL (IQR)	3.9	(3.6-4.1)	3.8	(3.6-4.1)	0.818
Median operative time, min (IQR)	512	(454-599)	445	(383-547)	0.099
Median estimated blood loss, mL (IQR)	160	(73-250)	110	(55-183)	0.185
Median duration of pelvic drain placement, days (IQR)	5	(4-9)	4	(3-9)	0.538
Median duration of urethral catheter placement, days (IQR)	7	(7-10)	10	(7-15)	0.178
Median duration of subcutaneous drain placement (n=26), days (IQR)	6	(5-8)	3	(3-3)	0.119
Sex, n (%)					0.159
male	44	(54)	11	(14)	
female	24	(30)	2	(3)	
ASA risk, n (%)					0.538
2	3	(4)	0	(0)	
3	63	(78)	12	(15)	
4	2	(3)	1	(1)	
Diabetic nephropathy, n (%)	14	(17)	2	(3)	0.666
ABO incompatible LDRT, n (%)	26	(32)	6	(7)	0.593
Donor specific antibody, n (%)	13	(16)	3	(4)	0.345
Plasmapheresis before LDRT, n (%)	41	(51)			0.255
Administration of rituximab, n (%)	49	(61)	10	(12)	0.718
Pre-emptive renal transplantation, n (%)	24	(30)	3	(4)	0.392
Positive urine culture before LDRT, n (%)	9	(11)	2	(3)	0.831
Type of antimicrobials (n=79)					0.351
cefazolin, n (%)	54	(68)	12	(15)	
ampicillin/sulbactam, n (%)	12	(15)	1	(1)	
Duration of prophylactic antimicrobials, n (%)					0.069
≤ 24 hrs	15	(19)	6	(7)	
> 24 hrs	53	(65)	7	(9)	

Table 5. Summary of previously reported perioperative infections in renal transplant recipients.

Year	Authors	Classification of operation	N	Duration of prophylactic antimicrobials	SSI (%)	RI (%)	UTI (%)
1998	Rabkin et al. [17]	Renal transplantation	100	Single-dose	—	—	14
2012	Laftavi et al. [18]	Renal transplantation	442	None	2	—	—
2013	Wszoła et al. [19]	DD# renal transplantation	262	—	7	—	—
2014	Capocasale et al. [20]	Renal transplantation	1000	Single-dose or 48 hrs	2	—	9
2015	Freire et al. [21]	Renal transplantation	819	24-48 hrs	13	—	—
2015	Orlando et al. [22]	Renal transplantation	103	Single-dose	2	—	2
			102	twice-daily for 3-5 days	1	—	2
2015	Adamska et al. [7]	Renal transplantation	120	< 24 hrs	14	2	34
2017	Nishimura et al.*	Renal transplantation	75	Single-dose or > 24 hrs	1	0	16

*The present study

#Deceased-donor