Urologic Complications After Transplantation of Kidneys With Duplicated Ureter: A Retrospective Study

R. Cylke[a,*], E. Karpeta[a,b], M. Bieniasz[a], and M. Kosieradzki[a]

[a]Department of General and Transplant Surgery of the Infant Jesus Teaching Hospital in Warsaw, Poland; and [b]Department of Surgical and Transplantation Nursing and Extracorporeal Therapies of Warsaw, Poland

ABSTRACT

Background. Duplication of ureters is a common anatomic abnormality and occurs in 0.7% to 1% of the general population. In this article we focus on the safety of using of kidneys with complete ureteral duplication, provided no hydronephrosis or ureterocele was present in the donor.

Methods. From 1998 to March 2018 there were 1965 kidneys transplanted at our institution, including 27 kidneys with duplicated ureter, which corresponds to incidence of 1.4%. Patients' medical records, surgery protocols, and Poltransplant registries were searched for urinary complications.

Results. In the double ureter group, urologic complications occurred in 4 patients (15.4%). Similarly, severe urinary complications developed in 4 patients from the control group (17.4%).

Conclusions. Transplantation of kidneys with duplicated ureters appears to be a safe and feasible procedure.

DUPLICATION of ureters is a common anatomic abnormality and occurs in 0.7% to 1% of the general population [1,2]. It is almost twice as common in women [3], although overrepresentation because of more frequent urinary tract infections and diagnostic ultrasonography is likely. Complete duplication is associated with vesicoureteral reflux, ectopic ureteral insertion, and ectopic ureterocele [4]. Reflux affects lower pole and upper pole ectopias of the kidney. Incomplete duplication is usually accompanied by uretero-ureteral reflux or lower kidney pole pelvic junction obstruction. Because partial hydronephrosis or recurrent urinary tract infections may result [5], kidney donors with this congenital anomaly are probably underused, although exact data are missing. With 84,000 transplants performed worldwide according to the Global Observatory on Donation and Transplantation in 2015 [6], with much higher prevalence in persons of white race, approximately 160 kidneys with duplicated ureter are transplanted each year.

In this article we focus on the safety of use of kidneys with complete ureteral duplication, provided no hydronephrosis or ureterocele was present in the donor.

PATIENTS AND METHODS

From 1998 to March 2018 there were 1965 kidneys transplanted at our institution, including 27 kidneys with duplicated ureter, which corresponds to incidence of 1.4%. Two grafts were obtained from living donors; the remaining 25 came from brain-dead donors (1 donor had bilateral duplication of ureters). One transplantation from a living donor was lost from follow-up and was excluded from the study. Patients who received contralateral kidney with single ureter from the same donor served as a control group (n = 23). Study group and control characteristics are shown in Table 1.

Surgical Technique

All ureters were anastomosed separately, excluding 1 patient who had 1 ureter anastomosed to the bladder and the other (because of insufficient length) to the recipient's native ureter (ureter-oureterostomy). Prior to anastomosis, the bladder was filled with 300 mL of saline to help with identification. Then the bladder wall

*Address correspondence to Radosław Cylke, Department of General and Transplant Surgery of the Infant Jesus Teaching Hospital in Warsaw, 59 Nowogrodzka St , 00-001 Warsaw, Poland. Tel: +48 501 256 460. E-mail: radek.cylke@gmail.com

0041-1345/19
https://doi.org/10.1016/j.transproceed.2018.10.030

Table 1. Characteristics of Study and Control Group

	Double-Ureter Kidney Recipient (n = 26)	Single-Ureter Kidney Recipient (n = 23)	*P* Value
Female sex, No. (%)	10 (38.46)	7 (30.43)	.57
Age, mean (SD), y	46.15 (13.17)	47.69 (14.51)	.7
Second KTx, No. (%)	3 (11.54)	1 (4.35)	.36
Pre-emptive recipient, No. (%)	2 (7.69)	1 (4.35)	.63
Causes of kidney failure, No. (%)			.2
Kidney stone disease	2 (7.69)	0 (0)	
Hypertension	1 (3.85)	1 (4.35)	
Unknown	6 (23.08)	12 (52.17)	
Chronic glomerulonephritis	12 (46.15)	4 (17.39)	
Polycystic kidney disease	2 (7.69)	3 (13.04)	
Diabetes	2 (7.69)	3 (13.04)	
Toxicity	1 (3.85)	0 (0)	
Transplantation from living kidney donor, No. (%)	1 (3.85)	0 (0)	.37
CIT, mean (SD), min	1558.27 (633.22)	1545.61 (681.58)	.95
Storage method, No. (%)			.54
Cold storage	17 (65.38)	13 (56.52)	
Machine perfusion	9 (34.62)	10 (43.48)	
Anastomosis time, mean (SD), min	34.85 (12.98)	34.87 (9.97)	.93
Ureterovesical anastomosis type, No. (%)			.57
MacKinnon	20 (76.92)	16 (69.57)	
Lich-Gregoir	6 (23.08)	7 (30.43)	
Double J stent implantation	12 (46.15)	5 (21.74)	.08

Abbreviations: CIT, cold ischemia time; KTx, kidney transplantation; SD, standard deviation.

was incised with electrocautery. Two anastomosis techniques, Lich-Gregoir (n = 13) or MacKinnon (n = 36) were used according to surgeon preference [7]. Lich-Gregoir technique uses a running suture and is believed to have some antireflux properties [8–11]. MacKinnon is a modification of the U technique and was used most often in our department until 2015 [12,13]. In selected cases JJ stent was implanted at the surgeon's discretion to prevent ureterovesical junction from stricture or leakage [14,15].

Patients' medical records, surgery protocols, and Poltransplant registries were searched for urinary complications (ie, anastomotic leakage or stenosis). Serious adverse events (lymphocoele, hemorrhage) requiring surgery were noted. The χ^2 test, Kruskal-Wallis test, and unpaired t test were used for statistical analysis when appropriate.

RESULTS

In the double ureter group, urologic complications occurred in 4 patients (15.4%). One patient was diagnosed as having minor urinary leakage 10 days after surgery, and conservative treatment was effective. Another had dehiscence of both vesicoureteral anastomoses, and reoperation with reconstruction was needed. Two additional patients had symptomatic severe urinary tract infection caused by *Enterococcus faecalis* and *Escherichia coli*. Similarly, severe urinary complications developed in 4 patients from the control group (17.4%, $P = .85$). One patient had symptomatic urinary anastomosis stricture and required reanastomosis with 8F JJ ureteral stent. Another patient needed surgery for laceration of the ureter wall distal to its critical stricture (both lesions indicating ureteral ischemia).Two patients had urinary tract infection complicating benign stenosis of the ureter with minor ureterocele and hydronephrosis and were treated with antibiotics. Delayed graft function occurred in 3.85% of patients from the study group and in 4.35% of patients from the control group ($P = .95$). Biopsy-confirmed T-cell–mediated transplant rejection was diagnosed in 7.7% of patients in the double ureter group and in 8.7% of the control group ($P = .92$). Other serious complications that required surgical treatment occurred in 15.4% of the study group and in 4.4% of the control group ($P = .21$). In a group with a duplicated ureter, 1 patient died because of septic shock. In another case, hemorrhage from the renal artery occurred in the postoperative period; the patient required immediate reoperation. Despite these efforts, 1 week after the reoperation the patient had septic bleeding that lead to loss of the graft. One hematoma infection had to be treated operatively. In 1 case, leak in the ureterovesical anastomosis was suspected, and the patient underwent reoperation during which primary diagnosis was dismissed and the fenestration of the lymphocele was performed. One patient from the control group experienced acute glomerulonephritis of the transplanted kidney and urinary tract infection, but it was treated conservatively with success.

DISCUSSION

Duplication of the ureters is the most common anatomic abnormality of the upper urinary tract [1,2]. Complete duplication of the ureters is asymptomatic in the majority of cases and can be found unexpectedly during organ procurement [3]. Sometimes it is discovered on preparation of the kidney for transplantation on the back table, with limited time for assessment and decision-making. Our study shows that the risk associated with transplantation of such a

kidney is similar to transplantation of a standard graft without anatomic anomalies. Diameter of the duplicated ureter is usually smaller, and, hence, the surgeon is more prone to leave a pigtail or JJ stent securing the anastomosis.

We observed no difference in delayed graft function or transplant rejections. However, serious complications (eg, lymphocele or bleeding) occurred significantly more often and a role of cumbersome anatomy is likely.

Alberts et al [3] conducted a retrospective study in 12 patients who received transplants with duplicated ureters and a control group. They implanted the ureters to the urinary bladder separately or they created a common ostium. No difference in urinary complication rate between study and control group was seen. Sulikowski et al [16] also created a common ostium for both ureters and additionally used 2 JJ stents to stent ureterovesical anastomosis. In 12 patients with duplicated ureters, the procedure was assessed as safe and effective. Lasaponara [17] assessed the risk of urologic complications in 12 transplanted kidneys with complete ureteral duplication and concluded it was equal to anatomically typical kidney. However, they recorded more urinary tract infections. Ghazanfar et al [18] conducted a multicenter study (in 2 institutions) in 76 double ureter renal transplants and confirmed that, irrespective of the technique of implantation, there is no additional risk associated with transplantation of double ureter kidneys. Heidari et al [19] described their experience with 12 patients who received kidneys with double ureters. Distal ends of the ureters were anastomosed to each other before ureteroneocystostomy was formed. They concluded that this procedure is feasible and repeatable and can be performed without increased risk of ureteral complications. Haferkamp et al [20] described their experience with 19 patients. In 9 patients, ureters were implanted separately; in the remaining 10, ureters were sutured together prior to implantation to the bladder. Two of the patients developed stenosis of 1 of the ureters; another 2 were diagnosed as having vesicoureteral reflux. Authors concluded that presence of multiple ureters does in fact increase complication rate. They emphasized that having the ureters anastomosed into common orifice before implantation to the bladder is a superior technique. According to Giakoustidis et al [21], implantation of the JJ stent does not prevent complications in the group with double ureters compared with the control group. Double J stents should be used only to treat urologic complications, rather than being a routine way of prevention. If we implant 2 JJ stents to the transplanted kidney with duplicated ureters, it is crucial to note this fact very carefully in medical history, bearing in mind that in the future, both of the stents must be removed.

CONCLUSION

Transplantation of kidneys with duplicated ureters appears to be a safe and feasible procedure. It seems that the risk of ureteral complications is not increased. Taking into consideration the huge need for organs for transplantation, kidneys with duplicated ureters should not be discarded.

REFERENCES

[1] Gay SB, Armistead JP, Weber ME, Williamson BR. Left infrarenal region: anatomic variants, pathologic conditions, and diagnostic pitfalls. Radiographics 1991;11:549–70.

[2] Pollak R, Prusak BF, Mozes MF. Anatomic abnormalities of cadaver kidneys procured for purposes of transplantation. Am Surg 1986;52:233–5.

[3] Alberts VP, Minnee RC, van Donselaar-van der Pant KA, Bemelman FJ, Zondervan PJ, et al. Duplicated ureters and renal transplantation: a case-control study and review of the literature. Transplant Proc 2013;45:3239–44.

[4] Siomou E, Papadopoulou F, Kollios KD, Photopoulos A, Evagelidou E, Androulakakis P, et al. Duplex collecting system diagnosed during the first 6 years of life after a first urinary tract infection: a study of 63 children. J Urol 2006;175:678–81 [discussion 681-2].

[5] Raja J, Mohareb AM, Bilori B. Recurrent urinary tract infections in an adult with a duplicated renal collecting system. Radiol Case Rep 2016;11:328–31.

[6] Global Data on Organ Transplantation. http://www.transplant-observatory.org/data-charts-and-tables/; 2016. accessed March 3, 2018.

[7] Alberts VP, Idu MM, Legemate DA, Laguna-Pes MP, Minnee RC. Ureterovesical anastomotic techniques for kidney transplantation: a systematic review and meta-analysis. Transpl Int 2014;27:593–605.

[8] Gurkan A, Yakupoglu YK, Dinckan A, et al. Comparing two ureter reimplantation techniques in kidney transplant recipients. Transpl Int 2006;19:802–6.

[9] Martinez-Mier G, Jimenez-Lopez LA, Valenica-Mercado D, George-Micelli E, Gonzalez-Medina MF. [Urological complications following kidney transplantation using Lich-Gregoir technique: a 4-year experience in Mexico]. Cir Cir 2009;77:111–4 [in Spanish].

[10] Berger C, Koen M, Becker T, Mitter K, Riccabona M. The role of the Lich-Gregoir procedure in refluxing duplicated collecting systems: experience from long-term follow up of 45 children. J Pediatr Urol 2008;4:265–9.

[11] Schwentner C, Oswald J, Lunacek A, et al. Lich-Gregoir reimplantation causes less discomfort than Politano-Leadbetter technique: results of a prospective, randomized, pain scale-oriented study in a pediatric population. Eur Urol 2006;49:388–95.

[12] Taguchi Y, Klauber GT, MacKinnon KJ. Implantation of transplant ureters: a technique. J Urol 1971;105:194–5.

[13] MacKinnon KJ, Oliver JA, Morehouse DD, Taguchi Y. Cadaver renal transplantation: emphasis on urological aspects. J Urol 1968;99:486–90.

[14] Rodriguez GV, Martinez RM, Arquinarena TF, Martin MS, De Castro-Olmedo C, Del Busto FE. [The use of double J stent for prevention of urological complications in kidney transplants]. Actas Urol Esp 2008;32:225–9 [in Spanish].

[15] Kostro JZ, Debska-Slizien A. Ureterovesical anastomosis for ureteral duplication in the graft kidney. Forum Nefrologiczne 2010;3:42–4.

[16] Sulikowski T, Zietek Z, Ostrowski M, et al. Experiences in kidney transplantation with duplicated ureters. Transplant Proc 2005;37:2096–9.

[17] Lasaponara F, Dalmasso E, Bosio A, et al. Kidney transplant grafts with complete ureteral duplication. Exp Clin Transplant 2013;11:507–9.

[18] Ghazanfar A, Zaki MR, Pararajasingam R, Forgacs B, Tavakoli A. Outcome of kidney transplant with double ureter: a multicenter study. Exp Clin Transplant 2015;13:152–6.

[19] Heidari M, Gharaati MR, Iran-Pour E, Simforoosh N, Zare S, Basiri A. Transplantation of kidneys with duplicated ureters. Scand J Urol Nephrol 2010;44:337–40.

[20] Haferkamp A, Dorsam J, Mohring K, Wiesel M, Staehler G. Ureteral complications in renal transplantation with more than one donor ureter. Nephrol Dial Transplant 1999;14:1521–4.

[21] Giakoustidis D, Diplaris K, Anroniadis N, et al. Impact of double-j ureteric stent in kidney transplantation: single-center experience. Transplant Proc 2008;40:3173–5.