ORIGINAL ARTICLE

Optimal management of distal ureteric strictures following renal transplantation: a systematic review

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SUMMARY

Our objective was to define optimal management of distal ureteric strictures following renal transplantation. A systematic review on PubMed identified 34 articles (385 patients). Primary endpoints were success rates and complications of specific primary and secondary treatments (following failure of primary treatment). Among primary treatments (n = 303), the open approach had 85.4% success (95% CI 72.5–93.1) and the endourological approach had 64.3% success (95% CI 58.3–69.9). Among secondary treatments (n = 82), the open approach had 93.1% success (95% CI 77.0–99.2) and the endourological approach had 75.5% success (95% CI 62.3–85.2). The most common primary open treatment was ureteric reimplantation (n = 33, 81.8% success, 95% CI 65.2–91.8). The most common primary endourological treatment was dilation (n = 133, 58.6% success, 95% CI 50.1–66.7). Fourteen complications, including death (4 weeks post-op) and graft loss (12 days post-op), followed endourological treatment. One complication followed open treatment. This is the first systematic review to examine the success rates and complications of specific treatments for distal ureteric strictures following renal transplantation. Our review indicates that open management has higher success rates and fewer complications than endourological management as a primary and secondary treatment for post-transplant distal ureteric strictures. We also outline a post-transplant ureteric stricture evaluation and treatment algorithm.

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Introduction

Urological complications following renal transplantation have been reported in 2–14% of patients [1]. Ureteric stricture is the most common urological complication with an incidence of 3% [2]. Of all ureteric strictures, 73% occur at the distal end, including the ureteroneocystostomy [3].

The etiology of distal ureteric stricture is related to ischemia leading to fibrosis of the ureteric intima [4]. Factors that contribute to ischemia include faulty preparation of the native ureter during donor nephrectomy

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with failure to preserve the distal periureteral fatty tissue which contains the blood supply from the renal hilum, variations in vascular anatomy, allograft rejection, and chronic immunosuppression [5]. There may also be technical errors during the uretero-vesical anastomosis.

Distal ureteric stricture often presents as asymptomatic dilation of the urinary system, whereas serum creatinine may not become elevated or urine output reduced until later in the course of the obstruction [6]. Upon diagnosis, it is essential to treat ureteric strictures in the renal transplant population timely and adequately to prevent negative impact on graft and patient survival [7,8].

Historically, ureteric strictures following renal transplantation have been treated with a variety of open surgical techniques. In the modern era of endoscopic intervention, endoscopic management has become the initial treatment of choice due to its potential for reduced morbidity.

While a variety of open surgical and endourological techniques have been used to treat distal ureteric strictures post-transplantation, there appears to be no true consensus as to the optimal treatment strategy in dealing with these complex patients. Our objective was to define the optimal management of distal ureteric strictures following renal transplantation. In addition, as no guidelines exist, we outline workup recommendations and a treatment decision tree for patients with distal strictures following kidney transplantation.

Materials and methods

We conducted a systematic review in keeping with PRISMA guidelines. We searched PubMed for all English language clinical studies from 1984 to 2014 referencing treatment of transplant distal ureteric strictures. Our definition of distal ureteric stricture included stricture at the ureteroneocystostomy.

Three reviewers were involved in assessing study eligibility. The following search terms were applied in different combinations: kidney, transplant, ureter, complication, stricture, ureteric stricture, hydronephrosis, anastomosis, distal ureteric stricture, ureteroneocystostomy. Our search strategy included all studies reporting treatment of ureteric strictures following renal transplantation. No date or publication type restrictions were applied. Our goal was to be as inclusive as possible as the existing literature is sparse. For inclusion, studies had to report treatment type and treatment outcomes. Only studies reporting distal ureteric stricture were included because this was the most common stricture location. Exclusion criteria were studies with insufficient information, nonhuman studies, and non-English language studies. Studies were excluded for insufficient data if they did not specify the location of the ureteric stricture and the treatment used. Studies were excluded if comparator groups were designated as inappropriate based on the following minimum requirements: The treatment could be categorized either primary or secondary, and the reported success and/or complication was attributable to a specific treatment modality.

Our search strategy is depicted in Fig. 1. Our search identified 755 articles which were subsequently independently reviewed by two of the researchers. In total, 656 papers had insufficient information pertaining to our study, 25 were non-English language papers, and five were animal studies, therefore all excluded. The remaining 69 articles were pulled to examine specific details. Of these, 57 articles were excluded due to inappropriate comparator groups or insufficient data reported leaving 12 articles to be included. However, 25 of the 69 articles, despite some being excluded, were still found to be relevant to our study, and thus, the discussion section of each of the 25 articles was individually reviewed for additional relevant studies. Forty-nine additional articles were identified from this group. Twenty-five were excluded due to inappropriate comparator groups or insufficient data, and two studies were non-English language papers leaving 22 articles to be included. A total of 385 patients from 34 articles were included in this review. Of the 34 included studies, there was one randomized control trial (RCT), six retrospective reviews, 24 case series, and three case reports. Of note, the single RCT randomized patients to two different vesicourethral anastomosis techniques during renal transplantation and we collected data from a subset of those patients who developed distal ureteric stricture.

The following information was collected from each study: article title, author names, study type, and year of publication. For each treatment, we recorded the following information: whether it was primary or secondary, number of patients, treatment modality, treatment success rates, definition of treatment success, outcomes, and procedural complications. Primary treatment was defined as first-time treatment for post-transplant ureteric stricture, and secondary treatment was defined as treatment for ureteric stricture following failed primary treatment. We expected significant heterogeneity in how each primary study would define success and complications, and thus, all treatment successes and complications were recorded as how each study explicitly or implicitly defined them. Data were

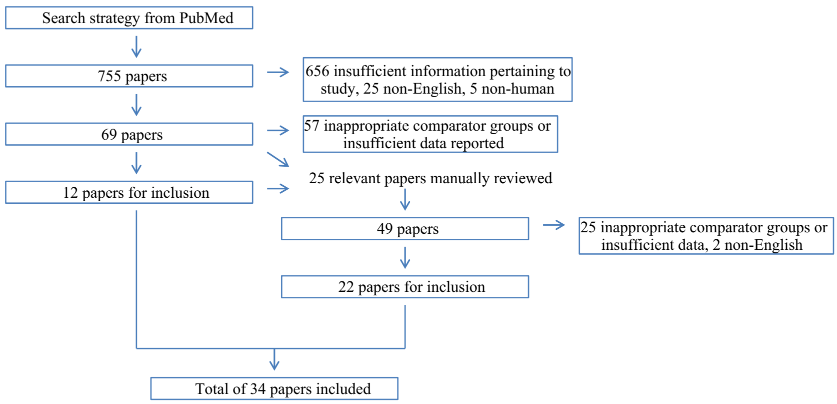

Figure 1 Flowchart showing studies selected for analysis.

summarized using summation and percentage calculation. Agresti-Coull confidence intervals for sample proportions, at a 95% confidence level, were computed using the online Epitools Epidemiologic Calculator (http://epitools.ausvet.com.au/con tent.php?-page=CIProportion).

Results

The success rates of the open versus endourological treatments are shown in Table 1. In total, 303 patients underwent primary treatment and 82 patients underwent secondary treatment of post-transplant distal ureteric stricture. Primary treatment had a 67.7% success rate (95% CI 62.2–72.7), and secondary treatment had an 81.7% success rate (95% CI 71.9–88.7). Of those who underwent primary treatment, the open surgical approach had an 85.4% success rate (95% CI 72.5–93.1) and the endourological approach had a 64.3% success rate (95% CI 58.3–69.9). Of those who underwent secondary treatment, the open surgical approach had a 93.1% success rate (95% CI 77.0–99.2) and the endourological approach had a 75.5% success rate (95% CI 62.3–85.2).

Only five of 34 studies provided data for both the primary open and endourological approach, and only one study provided data for both the secondary open and endourological approach.

To evaluate the frequency and success rate of specific treatments, we performed a subgroup analysis (Table 2). The most common primary open treatment was ureteric reimplantation which had an 81.8% success rate (95% CI 65.2–91.8, $n = 33$). The most common primary endourological treatment was ureteric dilation which had a 58.6% success rate (95% CI 50.1–66.7, $n = 133$). The most common specified secondary open treatment was uretero-ureterostomy which had a 100% success rate (95% CI 55.7–100, $n = 6$). The most common secondary endourological treatment was dilation with an associated procedure (laser, electrocautery, or endo-ureterotomy) which had a 76.5% success rate (95% CI 64.4–84.3, $n = 30$). Of all primary and secondary treatments, the most common open treatment was ureteric reimplantation ($n = 34$) which had a success rate of 82.4% (95% CI 66.1–92.0) and the most common endourological treatment was dilation ($n = 151$) which had a success rate of 59.6% (95% CI 51.6–67.1).

Combining data on primary and secondary approaches, ureteric reimplantation ($n = 34$) and pyeloureterostomy ($n = 16$) were the most common specified open procedures with success rates of 82.4% (95% CI 66.1–92.0) and 87.5% (95% CI 62.7–97.8), respectively. Unspecified open surgery had a success rate of 92.9% (95% CI 66.5–100, $n = 14$). Among endourological techniques, dilation alone ($n = 151$) was the most common procedure with a success rate of 59.6% (95% CI 51.6–67.1). However, dilation with procedure (laser, electrocautery or endo-ureterotomy) ($n = 70$) had the highest success rate of 75.7% (95% CI 64.4–84.3) in which dilation with electrocautery ($n = 18$) had 100% success (95% CI 79.3–100).

We identified 15 peri-procedural complications of which 14 followed endourological treatment and one followed open treatment (Table 3). The single complication following open surgical treatment was a urinary tract infection (UTI) following secondary pyeloureterostomy [9]. Among both techniques, UTI was the most common complications ($n = 7$). The most severe complications were “death from sepsis and transplantation related problems” 4 weeks postoperatively [10], small bowel perforation [11], rupture of renal calyx [12], and graft loss secondary to severe recurrent hemorrhage [13], all of which followed

Table 1. Success rates of open surgical and endourological treatment options for distal ureteric strictures postrenal transplantation.

Reference	Study design	Success rates			
		Primary endourological treatment	Primary open surgical treatment	Secondary endourological treatment	Secondary open surgical treatment
Loughlin *et al.* [26]	Retrospective review	5/5	12/14	–	–
Streem *et al.* [27]	Case series	5/6	–	–	–
Streem *et al.* [11]	Case series	4/8	–	–	–
Voegeli *et al.* [28]	Case series	3/5	–	–	–
Benoit *et al.* [29]	Case series	2/8	–	1/1	5/5
Kashi *et al.* [12]	Retrospective review	10/14	–	–	4/4
Youssef *et al.* [9]	Case series	2/3	–	–	0/1
Kim *et al.* [30]	Case series	3/6	–	–	–
Conrad *et al.* [13]	Case series	9/10	–	–	–
Shoskes *et al.* [2]	Retrospective review	7/7	17/18	–	1/1
Salomon *et al.* [31]	Case series	–	10/10	–	–
Erturk *et al.* [32]	Case series	–	–	6/6	–
Schwartz *et al.* [33]	Case series	2/4	–	1/1	–
Seseke *et al.* [34]	Case series	0/1	–	–	–
Cantasdemir *et al.* [35]	Case report	0/1	–	1/1	–
Katz *et al.* [10]	Case series	13/14	–	–	–
Bhayani *et al.* [36]	Case series	2/3	0/1	1/1	–
Kristo *et al.* [37]	Case series	7/7	0/2	2/2	–
Whang *et al.* [38]	Retrospective review	15/29	–	10/14	–
Thevendran *et al.* [39]	Case report	–	0/1	–	1/1
Pappas *et al.* [40]	Case series	7/8	–	–	1/1
Boyvat etl al. [41]	Case series	4/4	–	1/1	–
Atar *et al.* [42]	Case series	0/3	–	2/3	–
Andonian *et al.* [43]	Case series	0/2	–	–	1/2
Basiri *et al.* [44]	Case series	4/10	–	–	–
Bromwich *et al.* [45]	Retrospective review	0/2	–	0/2	–
Hsiao *et al.* [4]	Case report and literature review	1/1	–	–	–
Aytekin *et al.* [46]	Case series	12/12	–	5/6	–
Yigit *et al.* [47]	Case series	0/1	2/2	–	1/1
He *et al.* [48]	Case series	5/8	–	0/3	–
Gdor *et al.* [49]	Case series	5/9	–	–	–
Tillou *et al.* [50]	Retrospective review	12/19	–	–	–
Asadpour *et al.* [23]	Randomized controlled trial	11/24	–	–	13/13
Mano *et al.* [51]	Case series	14/21	–	10/12	–
	Totals	164/255 (64.3%) (95% CI 58.3–69.9)	41/48 (85.4%) (95% CI 72.5–93.1)	40/53 (75.5%) (95% CI 62.3–85.2)	27/29 (93.1%) (95% CI 77.0–99.2)

CI, confidence interval.

Table 2. Subgroup analysis of specific primary and secondary endourological and surgical treatments and their success rates.

	Primary treatment success rate (%)		Secondary treatment success rate (%)		Combined treatment success rate (%)	
	n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Endourological treatments						
Chronic drainage	46/71	65 (53 to 75)	5/5	100 (51 to 100)	51/76	67 (56 to 77)
Ureteric Stent	44/69	64 (52 to 74)	5/5	100 (51 to 100)	49/74	66 (55 to 76)
PCN	2/2	100 (29 to 100)	–	–	2/2	100 (29 to 100)
Ureteric dilation	78/133	59 (50 to 67)	12/18	67 (44 to 84)	90/151	60 (52 to 67)
Dilation with procedure	30/40	75 (60 to 86)	23/30	77 (59 to 88)	53/70	76 (64 to 84)
Laser	6/11	55 (28 to 79)	2/2	100 (29 to 100)	8/13	62 (35 to 82)
Electrocautery	17/17	100 (78 to 100)	1/1	100 (17 to 100)	18/18	100 (79 to 100)
Endo-ureterotomy	7/12	58 (32 to 81)	20/27	74 (55 to 87)	27/39	70 (63 to 89)
Transurethral procedure	10/11	91 (60 to 100)			10/11	91 (60 to 100)
Resection	1/1	100 (17 to 100)	–	–	1/1	100 (17 to 100)
Cold Knife	9/10	90 (57 to 100)	–	–	9/10	90 (57 to 100)
Total endourological treatment	164/255	64 (58 to 70)	40/53	76 (62 to 85)	204/308	66 (61 to 71)
Open surgical treatments						
Ureteral Reimplantation	27/33	82 (65 to 92)	1/1	100 (17 to 100)	28/34	82 (66 to 92)
Pyeloureterostomy	13/13	100 (73 to 100)	1/3	33 (6 to 80)	14/16	88 (63 to 98)
Ureteroureterostomy	1/1	100 (17 to 100)	6/6	100 (56 to 100)	7/7	100 (60 to 100)
Open Surgery Not Specified	0/1	0 (−4 to 83)	13/13	100 (73 to 100)	13/14	93 (66 to 100)
Subcutaneous Pyelovesical Bypass Graft	–	–	1/1	100 (17 to 100)	1/1	100 (17 to 100)
Ileal Interposition	–	–	4/4	100 (45 to 100)	4/4	100 (45 to 100)
Calycoureterostomy	–	–	1/1	100 (17 to 100)	1/1	100 (17 to 100)
Total open surgical treatment	41/48	85 (72 to 93)	27/29	93 (77 to 99)	68/77	88 (79 to 94)

CI, confidence interval; PCN, percutaneous nephrostomy tube.

Table 3. Complications following open surgical and endourologic management of distal transplant ureteric strictures.

Treatment	Complications (N)
Ureteric Dilation	Small bowel perforation (1), UTI and stones (1), rupture of renal calyx on guidewire manipulation (1), technical difficulty in gaining access to upper pole calyx causing treatment failure (2), tight ureteric stricture causing treatment failure (1)
Ureteric Stent	UTI (2)
Dilation With Electrocautery	Death from "sepsis and transplantation problems" (1)
Dilation With Endoureterotomy	UTI (3), Inadequate dilation (1)
Transurethral Cold Knife Incision	Graft loss from hemorrhage requiring transfusion (1)
Pyeloureterostomy	UTI (1)

endourological treatment. The procedure with the most complications was dilation (n = 6) followed by dilation with endo-ureterotomy (n = 4). There was only one reported procedure-related graft loss [13]. This patient had endourological cold-knife incision resulting in recurrent severe hemorrhage requiring transfusion and graft removal 12 days postoperatively. While there were 20 reported cases of graft loss/rejection, only one case was specified to be procedure related. Thus, the other 19 cases were not documented as complications. We did not consider stricture recurrence as a complication as we were already documenting the number of patients who underwent secondary treatment of ureteric stricture.

Discussion

Our data show that open surgical treatment had a greater success rate than endourological treatment for primary and secondary treatment of post-transplant distal ureteric strictures. However, in literature, open surgery is associated with greater morbidity, longer hospitalization, prolonged recovery, and a higher risk for more serious complications including graft loss and perioperative mortality [14–16]. Alternatively, endourological techniques are less invasive and costly and demonstrate lower rates of patient morbidity [16–18]. An endourological approach may also be preferable for poor surgical candidates with multiple comorbidities or for those with significant graft dysfunction where the recipient may not gain as much benefit from a formal revision due to the nature of the failing graft.

In our subgroup analysis, dilation with a procedure (n = 70, 75.7% success) had a greater success rates than dilation alone (n = 151, 59.6% success) which implies that ureteric dilation should be performed with a procedure for maximal benefit. The transurethral cold-knife treatment yielded a success rate of 90% (n = 10). There was one case of graft loss secondary to hemorrhage with this treatment, which is not an unexpected complication with the unpredictable transplant ureteric blood supply. Some investigators prefer cold-knife incision as it may result in less periureteral fibrosis and scarring, but it is also associated with risk of direct vascular injury [19–21]. Our search did not identify any information on laparoscopic ureteric reimplantation in the setting of post-transplant ureteric stricture, and thus, we cannot comment on its success rate.

The lack of RCTs precluded a direct statistical comparison between treatment approaches. The only reported RCT randomized patients to two different vesicourethral anastomosis techniques during renal transplantation, and we collected data from a subset of those patients who developed distal ureteric stricture [22]. In addition, several treatments had limited sample sizes, which precluded their analysis. These included subcutaneous pyelovesical bypass grafts, ileal interposition grafts, calycoureterostomy, and transurethral resection of stenotic orifice, each of which had $n < 5$.

There were more reported complications following endourological compared to open surgical approaches. This is confounded by the fact that the endourological treatment sample size was much greater and some open studies may not have reported their complications. We found no cases of transfusion-related complications or allograft loss following open surgery. This may be attributable to underreporting given the theoretically increased risk of blood loss during open versus minimally invasive endourologic surgery. The more severe complications including hemorrhage-related graft loss and small bowel perforation occurred following endourological treatment. Despite the aforementioned confounders, one must consider if in fact endourological treatment is associated with greater risk of more serious complications than open treatment due to impaired visualization, complexity of the transplant surgery and varied anatomy.

Limitations of the present review

First, detailed individual level patient data were not available from all the studies. We inevitably were required to omit select outcomes and complications of which it was unclear which group of patients they applied to. Second, there was substantial variability between the studies such as surgeon experience, degree and length of stricture, time to stricture occurrence, type of original ureteroneocystostomy (transvesical or extravesical), donor age, anatomic differences, donor type (living/deceased, expanded criteria, after cardiac death), and patient vascular comorbidities. These are all confounding factors which could have affected treatment success rates and should be considered when deciding upon the best treatment modality. Also, given the heterogeneity of existing studies, the computed confidence intervals may underestimate the true sampling variability. Third, there was a lack in consistent reporting of variables among the studies such as renal function, time after transplant, degree and length of stricture, duration of stenting, and pre- and postprocedural investigations. Thus, there was no commonality between the studies which we could adequately compare aside from treatment type and success and complications. Fourth, our results may be affected by selection and reporting bias. Surgeons may have selected healthier patients with fewer comorbidities to undergo open surgery rather than endoscopic surgery, and researchers may tend to publish treatment success rather than failure. Fifth, there is substantial variability in how each surgeon performs the same treatment, which we could not account for. Lastly, as with all systematic reviews, our results are affected by limitations of individual studies selected for this systematic review.

Future research

First, most of the existing data are short term and we recommend publication of long-term outcome data. Second, we suggest that studies reporting secondary treatment to also specify the respective primary treatment to allow analysis of the optimal treatment

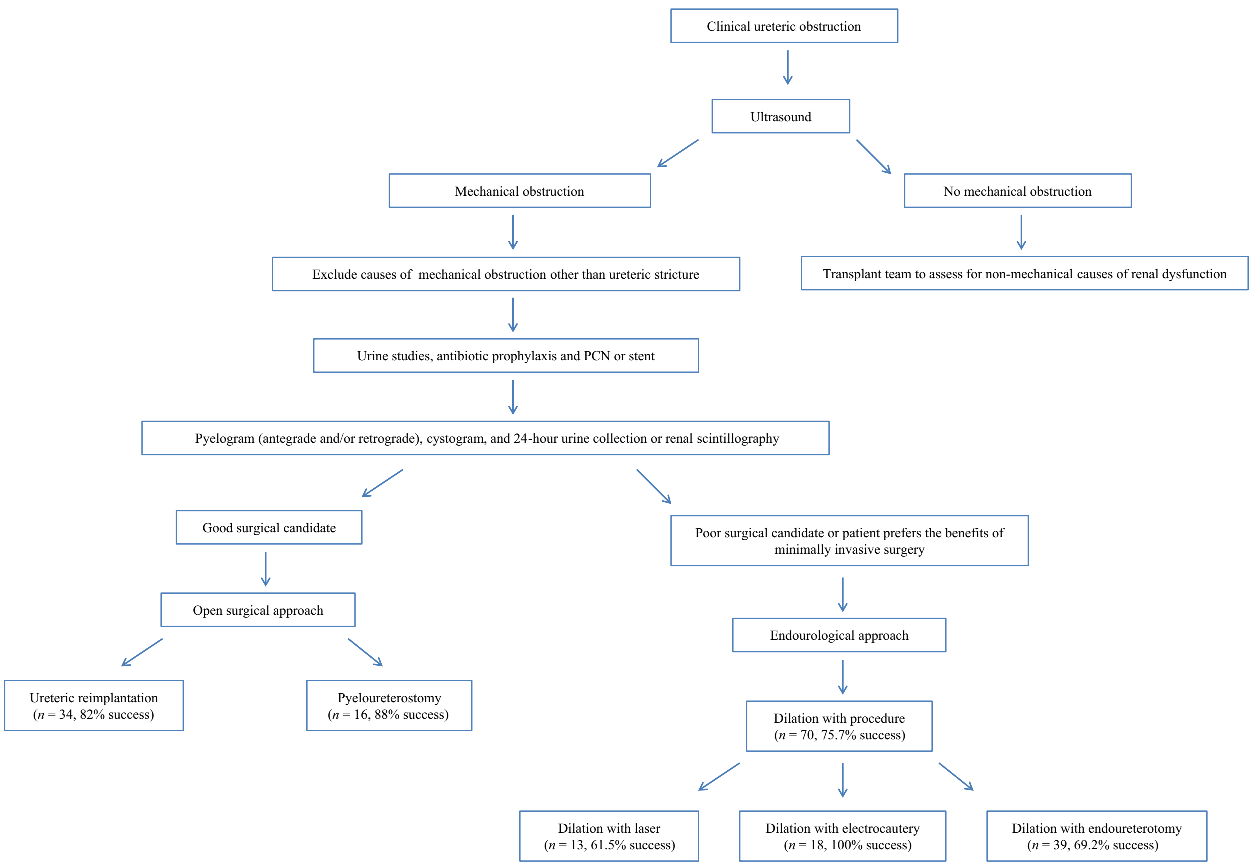

Figure 2 Evaluation recommendation and decision algorithm for the treatment of post-transplant ureteric strictures.

sequence for patients requiring re-treatment for distal ureteric stricture. Third, most studies reported creatinine as an estimate of renal function. However, normal creatinine is patient-specific, and thus, we suggest 24-h urine collection or renal scintillography to more accurately assess renal function.

Post-transplant ureteric stricture evaluation and treatment algorithm

Based on our literature review and opinion, we herein describe a workup/treatment decision tree in approaching post-transplant ureteric stricture. This is depicted in Fig. 2.

Patients with ureteric stricture may present either asymptomatically or with decreased urine output, flank pain, or infectious symptoms. Creatinine may be elevated, and ultrasound may show hydronephrosis. Once mechanical obstruction is confirmed with ultrasound, one should exclude other causes of ureteric obstruction including transplant ureterolithiasis, graft rejection, BK viral infection of the ureter, or compression of the ureter by hematoma or lymphocele [23–25]. A noncontrast computed tomography can be considered if there is suspicion of calculus disease or contrast enhanced computed tomography if suspicion of malignancy or extrinsic causes of obstruction. Urine analysis and culture should be ordered followed by initiation of antibiotic prophylaxis. Initial treatment options include either percutaneous nephrostomy (PCN) or retrograde ureteric stent insertion to decompress the obstruction and allow for resolution of the initial inflammation. Further testing is then required to make the diagnosis including antegrade and/or retrograde pyelograms to determine the exact location, length, and extent of the ureteric stricture. A formal cystogram may be carried out to establish bladder capacity; these images can then be used in conjunction with the antegrade nephrostogram to get a better appreciation of the defect in question. During this period, and after the initial obstruction resolves, one may conduct a 24-h urine collection or renal scintillography to better evaluate glomerular filtration rates to ensure that any form of intervention will result in prolonging graft survival. If the GFR is deemed to be <20 ml/min, it is debatable whether open surgical intervention is needed given the potential for postsurgical complications and transfusion rates which may alter the immunosensitivity of the patient for future transplantation; in these cases, endoscopic treatments, including chronic stent changes, should be considered in this cohort of patients.

After characterizing the ureteric stricture and graft function, an open surgical treatment, endourological treatment or in select cases, long-term stenting/PCN may be considered. Although long-term stenting/PCN may not be considered a definitive treatment option, it is a viable alternative for those with comorbidities precluding operation, recalcitrant ureteric stenosis failing multiple treatment attempts, or failing graft function. The healthcare team along with the patient should have a collaborative discussion regarding the risks and benefits of an open surgical versus endourological intervention.

Based on our composite data, ureteric reimplantation (82.4% success) and pyelo-native ureterostomy (87.5%, success) are the most successful open surgical techniques. Dilation with a concomitant laser ablation, electrocautery, or endo-ureterotomy (75.7% success) is the most successful endourologic technique.

This is the first systematic review to examine the success rates and complication rates of specific surgical treatments for distal ureteric strictures in the renal transplant population. Open surgery has higher success rates and fewer complications than endourological surgery for both the primary and secondary treatment of distal ureteric stricture following renal transplantation. For patients who are poor surgical candidates or prefer the benefits of minimally invasive surgery, endourological surgery may be considered.

Authorship

JK, GA, PPL and AS: Participated in research design. JK and AS: Participated in writing of the paper. JK, DS, JA and AS: Participated in search strategy and review of the literature. JK and AS: Participated in data analysis.

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Conflicts of interest

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REFERENCES

1. Faenza A, Nardo B, Catena F, *et al.* Ureteral stenosis after kidney transplantation: interventional radiology or surgery? *Transplant Proc* 2001; **33**: 2045.
2. Shoskes DA, Hanbury D, Cranston D, *et al.* Urological complications in 1000 consecutive renal transplant recipients. *J Urol* 1995; **153**: 18.
3. Jaskowski A, Jones RM, Murie JA, *et al.* Urological complications in 600 consecutive renal transplants. *Br J Surg* 1987; **74**: 922.
4. Hsiao HL, Li CC, Chang TH, *et al.* Treatment of transplant ureteric stricture with acucise endoureterotomy: case report and literature review. *Kaohsiung J Med Sci* 2007; **23**: 259.
5. Nane I, Kadioglu TC, Tefekli A, *et al.* Urologic complications of extravesical ureteroneocystostomy renal transplantation from living related donors. *Urol Int* 2000; **64**: 27.
6. Giessing M. Transplant ureter stricture following renal transplantation: surgical options. *Transplant Proc* 2011; **43**: 383.
7. Streeter EH, Little DM, Cranston DW, *et al.* The urological complications of renal transplantation: a series of 1535 patients. *BJU Int* 2002; **90**: 627.
8. Wilson CH, Bhatti AA, Rix D, *et al.* Routine intraoperative ureteric stenting for kidney transplant recipients. *Cochrane Database Syst Rev* 2005; **19**: CD004925.
9. Youssef NI, Jindal R, Babayan RJ, *et al.* The acucise catheter: a new endourological method for correcting transplant ureteric stenosis. *Transplantation* 1994; **57**: 1398.
10. Katz R, Pode D, Gofrit ON, *et al.* Transurethral incision of ureteroneocystostomy strictures in kidney transplant recipients. *BJU Int* 2003; **92**: 769.
11. Streem SB, Novick AC, Steinmuller DR, *et al.* Long-term efficacy of ureteral dilation for transplant ureteral stenosis. *J Urol* 1988; **140**: 32.
12. Kashi SH, Lodge JP, Giles GR, *et al.* Ureteric complications of renal transplantation. *Br J Urol* 1992; **70**: 139.
13. Conrad S, Schneider AW, Tenschert W, *et al.* Endo-urological cold-knife incision for ureteral stenosis after renal transplantation. *J Urol* 1994; **152**: 906.
14. Silverstein JI, Libby C, Smith AD. Management of ureteroscopic ureteral injuries. *Urol Clin N Amer* 1988; **15**: 515.
15. Fry DR, Milholen L, Harbrecht P. Iatrogenic ureteral injury. *Arch Surg* 1983; **118**: 454.
16. Juaneda B, Alcaraz A, Bujons A, *et al.* Endourological management is better in early-onset ureteral stenosis in kidney transplantation. *Transplant Proc* 2005; **37**: 3825.
17. Collado A, Caparrós J, Guirado L, *et al.* Balloon dilatation in the treatment of ureteral stenosis in kidney transplant recipients. *Eur Urol* 1998; **34**: 399.
18. Benoit G, Alexandre L, Moukarzel M, *et al.* Percutaneous anterograde dilatation of ureteral strictures in kidney transplants. *Transplant Proc* 1994; **26**: 290.
19. Conlin MJ, Bagley DH. Incisional treatment of ureteral strictures. In: Smith D, ed. *Smith's Textbook of Endourology*. St. Louis, MO: Quality Medical Publishing, 1996: 497–505.
20. Schneider AW, Conrad S, Busch R, *et al.* The cold- knife technique for endourological management of stenoses in the upper urinary tract. *J Urol* 1991; **146**: 961.
21. Yamada S, Ono Y, Ohshima S, *et al.* Transurethral ureteroscopic ureterotomy assisted by a prior balloon dilation for relieving ureteral strictures. *J Urol* 1995; **153**: 1418.
22. Asadpour A, Molaei M, Yaghoobi S. Management of ureteral complications in renal transplantation: prevention and treatment. *Saudi J Kidney Dis Transpl* 2011; **22**: 72.
23. Giessing M, Fuller F, Tuellmann M, *et al.* Attitude of nephrolithiasis in the potential living kidney donor: a survey of the German kidney transplant centers and review of the literature. *Clin Transplant* 2008; **22**: 476.
24. Harigaran S. BK virus nephritis after renal transplantation. *Kidney Int* 2006; **69**: 655.
25. Rajpoot DK, Gomez A, Tsang W, *et al.* Ureteric and urethral stenosis: a complication of BK virus infection in a pediatric renal transplant patient. *Pediatr Transplant* 2007; **11**: 433.
26. Loughlin KR, Tilney NL, Richie JP. Urologic complications in 718 renal transplant patients. *Surgery* 1984; **95**: 297.
27. Streem SB, Novick AC, Steinmuller DR, *et al.* Percutaneous techniques for the management of urological renal transplant complications. *J Urol* 1986; **135**: 456.
28. Voegeli DR, Crummy AB, McDermott JC, *et al.* Percutaneous dilation of ureteral strictures in renal transplant patients. *Radiology* 1988; **169**: 185.
29. Benoit G, Icard P, Bensadoun H, *et al.* Value of antegrade ureteral dilation for late ureter obstruction in renal transplants. *Transpl Int* 1989; **2**: 33.
30. Kim JC, Banner MP, Ramchandani P, *et al.* Balloon dilation of ureteral strictures after renal transplantation. *Radiology* 1993; **186**: 717.
31. Salomon L1, Saporta F, Amsellem D. Results of pyeloureterostomy after ureterovesical anastomosis complications in renal transplantation. *Urology* 1999; **53**: 908.
32. Erturk E, Burzon DT, Waldman D. Treatment of transplant ureteral stenosis with endoureterotomy. *J Urol* 1999; **161**: 412.
33. Schwartz BF, Chatham JR, Bretan P, *et al.* Treatment of refractory kidney transplant ureteral strictures using balloon cautery endoureterotomy. *Urology* 2001; **58**: 536.
34. Seseke F, Heuser M, Zöller G, *et al.* Treatment of iatrogenic postoperative ureteral strictures with Acucise endoureterotomy. *Eur Urol* 2002; **42**: 370.
35. Cantasdemir M1, Kantarci F, Numan F, *et al.* Renal transplant ureteral stenosis: treatment by self-expanding metallic stent. *Cardiovasc Intervent Radiol* 2003; **26**: 85.
36. Bhayani SB, Landman J, Slotoroff C, *et al.* Transplant ureter stricture: acucise endoureterotomy and balloon dilation are effective. *J Endourol* 2003; **17**: 19.
37. Kristo B, Phelan MW, Gritsch HA, *et al.* Treatment of renal transplant ureterovesical anastomotic strictures using antegrade balloon dilation with or without holmium:YAG laser endoureterotomy. *Urology* 2003; **62**: 831.
38. Whang M, Geffner S, Baimeedi S, *et al.* Urologic complications in over 1000 kidney transplants performed at the Saint Barnabas healthcare system. *Transplant Proc* 2003; **35**: 1375.
39. Thevendran G, Al-Akraa MA, Sweny P, *et al.* Calycoureterostomy: a novel technique for post-renal transplant stricture. *Surgeon* 2004; **2**: 176.
40. Pappas P, Stravodimos KG, Adamakis I, *et al.* Prolonged ureteral stenting in obstruction after renal transplantation: long-term results. *Transplant Proc* 2004; **36**: 1398.
41. Boyvat F, Aytekin C, Colak T, *et al.* Memokath metallic stent in the treatment of transplant kidney ureter stenosis or occlusion. *Cardiovasc Intervent Radiol* 2005; **28**: 326.
42. Atar E, Bachar GN, Eitan M, *et al.* Peripheral cutting balloon in the management of resistant benign ureteral and biliary strictures: long-term results. *Diagn Interv Radiol* 2007; **13**: 39.

43. Andonian S, Zorn KC, Paraskevas S, *et al.* Artificial ureters in renal transplantation. *Urology* 2005; **66**: 1109.
44. Basiri A, Nikoobakht MR, Simforoosh N, *et al.* Ureteroscopic management of urological complications after renal transplantation. *Scand J Urol Nephrol* 2006; **40**: 53.
45. Bromwich E, Coles S, Atchley J, *et al.* A 4-year review of balloon dilation of ureteral strictures in renal allografts. *J Endourol* 2006; **20**: 1060.
46. Aytekin C, Boyvat F, Harman A, *et al.* Percutaneous therapy of ureteral obstructions and leak after renal transplantation: long-term results. *Cardiovasc Intervent Radiol* 2007; **30**: 1178.
47. Yigit B, Tellioglu G, Berber I, *et al.* Surgical treatment of urologic complications after renal transplantation. *Transplant Proc* 2008; **40**: 202.
48. He Z, Li X, Chen L, *et al.* Endoscopic incision for obstruction of vesico-ureteric anastomosis in transplanted kidneys. *BJU Int* 2008; **102**: 102.
49. Gdor Y, Gabr AH, Faerber GJ, *et al.* Holmium:yttrium-aluminum-garnet laser endoureterotomy for the treatment of transplant kidney ureteral strictures. *Transplantation* 2008; **85**: 1318.
50. Tillou X, Raynal G, Demailly M, *et al.* Endoscopic management of urologic complications following renal transplantation: impact of ureteral anastomosis. *Transplant Proc* 2009; **41**: 3317.
51. Mano R, Golan S, Holland R, *et al.* Retrograde endoureterotomy for persistent ureterovesical anastomotic strictures in renal transplant kidneys after failed antegrade balloon dilation. *Urology* 2012; **80**: 255.