Original Article

Single ileal segment in a cat-tail configuration for bilateral ureteric strictures

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ABSTRACT

Introduction: Management of bilateral long length ureteric strictures is difficult with few options for reconstruction. In this report, we describe our experience with the use of a single, 15- 20 cm ileal segment for reconstruction of bilateral long length (involving more than 2/3rd ureter) ureteric strictures.

Patients and Methods: A retrospective analysis of 5 cases operated between 2015 and 2020for bilateral long length ureteric strictures, using a single segment ileal interposition in a cat tail configuration was performed. We evaluated renal function, surgical success, incidence of urinary tract infection and complications of the procedure. Surgical success was defined as an asymptomatic patient with no hydronephrosis and/or prompt drainage of the kidney on radiological investigations.

Results: The average age of presentation was 42.8 ± 7.4 years (33-53) years). All the cases were secondary to a gynaecological intervention. The mean creatinine prior to surgery was 0.81 ± 0.36 mg % (range 0.5 -1.4 mg%). Mean duration of follow-up was 28.6 ± 20.6 months (Range 10 – 56 months). Mean hospital stay was 14.4 ± 3.36 days (range 12-20 days). Two patients developed ileus and one patient developed deep venous thrombosis in the post-operative period. One patient developed pyelonephritis within one month of surgery. There was no deterioration of renal function with the mean serum creatinine at last follow-up being 0.9 ± 0.36 mg% (range 0.6 – 1.5 mg%).

Conclusion: The use of an ileal segment in cat-tail configuration for bilateral simultaneous ileal replacement is a feasible and safe option. The medium-term result states that it is effective in the preservation of renal function and provides a good conduit for drainage.

INTRODUCTION

The most common cause of a ureteric stricture is iatrogenic injury.[1,2] There are numerous options for the surgical management of segmental ureteric strictures. These include ureteric reimplantation, Boari flap, transureteroureterostomy, uretero-ureterostomy, and uretero-pyelostomy.[3,4] Patients presenting with a full-length ureteric stricture may require a complete ileal replacement.[5] Patients with bilateral strictures involving more than 2/3rd of the ureters are difficult to manage. A simultaneous bilateral ileal replacement will require two segments of the ileum 15–20 cm in length and about 15–20 cm away from each other so that they can be flipped in the opposite direction. We proposed that use of a single ileal loop in a cat-tail configuration for simultaneous reconstruction of the bilateral ureters may be a viable option for bilateral long-length ureteric strictures.[6] We describe the use of single 15–20 cm ileal segment for the reconstruction of bilateral long-length (involving more than 2/3rd ureter) ureteric strictures.

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PATIENTS AND METHODS

A retrospective analysis of five cases operated for bilateral long length ureteric strictures, using a single segment ileal interposition in cattail configuration was done. The case records of all these patients operated between 2015 and 2020 were reviewed.

An approval was obtained from the institutional review board (EC/721/2021), and the study was carried out as per the Good Clinical Practice Guidelines and the Principles of the Declaration of Helsinki. The primary endpoint of the study was to evaluate the renal function and surgical success at the last follow-up. The secondary objective was to determine the incidence of urinary tract infection and complications of bilateral simultaneous ileal replacement. Surgical success was defined as an Asymptomatic patient with no hydronephrosis and/or prompt drainage of the kidney on radiological investigation. All the retrospective data are available with the authors for review.

Surgical procedure

Preoperative preparation

All the patients in the series underwent a preoperative urinary diversion. Four patients had a bilateral percutaneous nephrostomy (PCN) and one underwent a bilateral cutaneous ureterostomy done at another center. After diversion, best possible renal function was achieved by waiting for 2–3 weeks, after which definitive surgery was planned.

Computed tomography (CT) intravenous urography was done for all the patients once the renal function stabilized [Figure 1a-e]. Antegrade and Retrograde dye study was done to localize the length of the stricture. A preoperative cystoscopy was done to evaluate the bladder and measure the bladder capacity in all cases. Antegrade ureteric catheter with a hydrophilic wire was placed up to the proximal level of narrowing in all the cases who had a PCN. The movement of the wire helped us identify the ureter intraoperatively as intense adhesions and retroperitoneal fibrosis were encountered in all the cases.

Operative steps

An exploratory laparotomy was performed through a infraumbilical midline incision under general anesthesia. With the patient in 15° Trendelenburg position, the bowel was pushed cranially. The peritoneum was incised at the right pelvic brim and the ureter was dissected at the level of the common iliac artery, the ureter was isolated and dissected till a point when 2–3 cm of the heathy ureter was identified. Attention was diverted to the left side, first the sigmoid mesocolon was mobilized medially, then the peritoneum over the pelvic brim was incised and the left ureter was dissected at the level of the common iliac artery, in case of difficulty the wire and ureteric catheter placed in the ureter antegrade were moved, and the movement of the wire was used to aid the dissection. The left ureter was also dissected till a point that 2–3 cm of healthy ureter could be identified. The healthy ureter was identified as physiological dilatation above the narrow segment.

A 15–20 cm of nonmodeled, tubular, isoperistaltic segment of ileum was isolated 15 cm away from ileocecal junction. This segment was used in a cat-tail configuration for bilateral simultaneous ureteric replacement. The proximal end of the cat-tail segment was delivered under the sigmoid mesentery toward the left side so that the ileal segment could reach up to the left renal pelvis. The cat-tail ileal segment crossed from right to left at a level 2–3 cm above the level of sacral promontory. The left ureter was sutured to the ileum in an end-to-end fashion as the upper ureter or pelvis was significantly dilated. The cat-tail ileal segment was then routed toward the right ureter, below the sigmoid mesentery. Approximately at a distance of 8–10 cm from the left uretero-ileal anastomosis, the right uretero-ileal anastomosis was done in an end-to-side fashion using 4-0 polyglatin sutures. Both the uretero-ileal anastomoses were done over a 6 Fr/30 cm stent. The stents were delivered from the distal end of cat-tail segment and eventually passed into the bladder. The cat-tail segment was now turned toward the bladder, the bladder was opened at the dome and the ileal segment sutured to the bladder in an end-to-side fashion using 3-0 polyglactin suture.

In a case were bladder augmentation was planned, a 40 cm ileum was used, proximal 15 cm was used as a cat-tail segment and the distal 25 cm was modeled in a "u" shape configuration, which was detubularized and used for bladder augmentation. In another case with a large vesicovaginal fistula (VVF), 30 cm of ileum was used with proximal 15 cm used as a cat-tail ileal segment for ureteric replacement and the distal 15 detubularized and used as a patch and sutured to the edges of the fistula and reconstruction completed [Figure 2].

RESULTS

The average age of presentation was 42.8 ± 7.49 years [Table 1]. All patients in our series had a history of hysterectomy, three patients were operated laparoscopically while the other two had a vaginal hysterectomy. The histology of all the hysterectomy specimens was benign.

At initial presentation, all the patients had an acute kidney injury secondary to obstructive uropathy and two of the five patients presented with anuria. In four patients, urinary diversion was achieved by a bilateral PCN. The fifth patient had bilateral cutaneous ureterostomies done at the primary treatment center on the 1st postoperative day of vaginal hysterectomy, as she developed anuria secondary to accidental ureteric ligation. After diversion, all patients

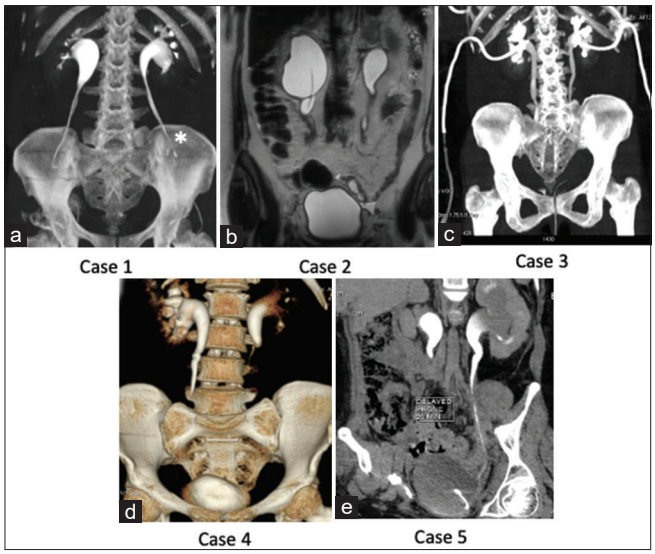

Figure 1: (a-e) The preoperative urography images of all the five cases. (a) *Shows segment of ureter in the anterior abdominal wall after end ureterostomy. (b) Shows MR Urography image of case 2. (c) B/l percutaneous nephrostomy in situ in case 3 (d) Involvement of b/l ureters seen in case 4 (e) ureteric strictures involving both the ureters in the mid and lower part seen in case 5

achieved a normal renal function and mean serum creatinine before surgery was 0.81 ± 0.36 mg % (range 0.5–1.4 mg%).

Endourological management was attempted in 4 out of the 5 patients in form of DJ stenting, and two patients also underwent tandem (two) double DJ placements on each side. The endourological intervention failed in all four patients, and these patients developed acute kidney injury with or without sepsis requiring percutaneous drainage of the kidney. One patient who underwent vaginal hysterectomy developed a large VVF involving the entire trigone, this patient also had the cutaneous ureterostomies leading to loss of long segment length of the ureter bilaterally. One of the five patients had a small capacity bladder of only 150 ml.

The mean serum creatinine at 3 months after surgery was 0.92 ± 0.40 mg% (range 0.6–1.5 mg%). The mean duration of follow-up in 28.6 ± 20.6 months (range 10–56 months). One patient had pyelonephritis within 3 months following the surgery which required intravenous antibiotics. Two patients had ileus postoperatively which was managed conservatively [Table 2]. One patient developed deep-venous thrombosis, the patient was started on heparin followed by Apixaban and an inferior vena cava filter was inserted [Figure 3b]. Mean hospital stay was 14.4 ± 3.36 days (range 12–20 days). No hydronephrosis was found in any of the patients, on ultrasound or CT scan done at their last follow-up [Figure 3a-d]. There were no peri-operative anastomotic leaks and anastomotic narrowing in the follow-up period. The patient with ileal augmentation of the bladder was voiding well without the need for self-intermittent catheterization till the last follow-up. In the patient for whom ileal patch was used for VVF repair had no incontinence or voiding symptoms at 56 months

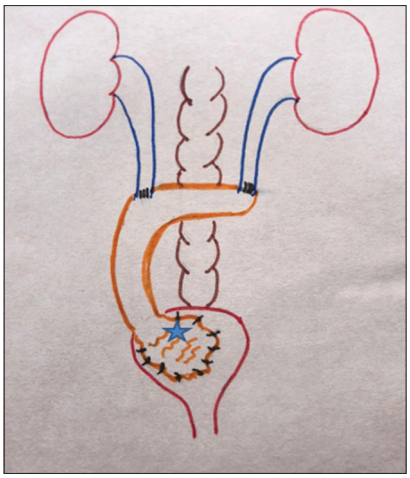

Figure 2: The schematic representation of cat tail ileal replacement of both the ureters. The star represents the ileal patch used for vesico-vaginal fistula repair

follow-up [Figure 3a]. Four out of five patients had long length ureteric stricture involving the lower and mid ureter completely and a part of the upper ureter. In one patient, the upper ureter was spared, but the bladder capacity in this patient was only 150 ml; therefore, bilateral ureteric replacement with bladder augmentation was done.

In this series of five patients, there was no deterioration of renal function with the mean serum creatinine at last follow-up being 0.9 ± 0.36 mg% (range 0.6%–1.5 mg%), no mortality and all patients are voiding to completion, not requiring self-intermittent catheterization.

DISSCUSSION

The management of long length ureteric stricture is routinely done by ileal replacement at many centers.[7,8] In the Western world, the ileal ureter was constructed as stone chute for recurrent ureteric stones, whereas in the developing world, tubercular strictures were a common indication for ileal replacement.[9] With improvements in radiation therapy, the incidence of ureteric strictures post-radiation has decreased, and hence, it is rare to find bilateral ureteric strictures.[1] Gynecological procedures such as hysterectomy in a small number of cases may give rise to ureteric strictures, these strictures may be ischemic if a lot of energy is used in the laparoscopic settings.[10,11] Furthermore, there is the possibility that the dissection done for hysterectomy leads to fibrosis around the ureter which leads to encasement of the ureter leading to stricture formation.[1]

The management of bilateral ureteric strictures usually starts with endourological management, initially dilatation and DJ stent placement are done.[12] Failing an attempt of endourological management definitive repair should be planned.[13] In surgical planning, whenever the bilateral ureteric strictures are long, it is not possible to do a

Table 1: Represents the demographics, preoperative, intraoperative, postoperative, and follow-up details

	Case 1	Case 2	Case 3	Case 4	Case 5	Mean	SD
Age	50	39	33	53	39	42.8	7.49
Symptoms at presentation	Asymptomatic with ureterostomies	Bilateral flank pain	Anuria	Fever, nausea, and vomiting	Anuria, bilateral flank pain, and vomiting		
Length of ileum used (cm)	15+15	20	15+25	20	20		
Baseline creatinine (mg %)	0.5	0.9	0.55	1.4	0.7	0.81	0.36
3 monthly creatinine (mg %)	0.6	NA	0.6	1.58	0.8	0.92	0.40
Latest creatinine (mg %)	0.6	0.9	0.6	1.5	0.9	0.9	0.36
EGFR using the CKP-EPI in ml/min/1.73 m^2 formula at the last follow-up visit	106	81	120	39	109	91	28.96
Etiology	Vaginal hysterectomy	Postlap hysterectomy (7 months)	Postlap converted to open hysterectomy	Lap hysterectomy (2 months)	Vaginal hysterectomy (1 month)	NA	
Length of ureteric stricture	Pan ureteral	Pan ureteral	Lower+mid ureteric	Pan ureteral	Pan ureteral	NA	
Preoperative diversion	Ureterostomy	PCN	PCN	PCN	PCN	NA	
Urological intervention	Ureterostomy	Double DJ –>PCN –>	DJ –> Double DJ>PCN	Percuflex DJ –> PCN	DJ –>PCN	NA	
Hydonephrosis postsurgery	No	No	No	No	No	NA	
Hospital stay (days)	13	12	20	15	12	14.4	3.61
Follow up (months)	56	45	19	13	10	28.6	20.6

CKP = Chronic kidney disease, NA = Not applicable, PCN = Percutaneous nephrostomy, EGFR = Estimated Glomerular filteration rate, EPI = Epidemiology collaboration, DJ = Double J Stent

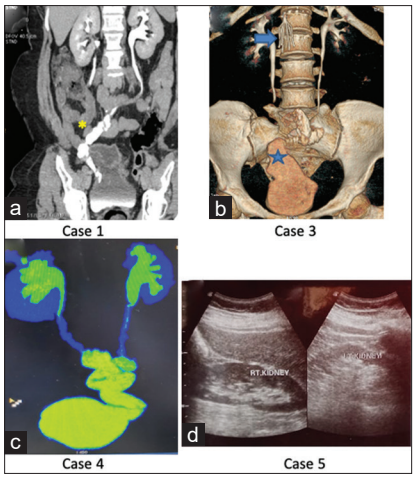

Figure 3: (a-d) Post-operative imaging. (a) Shows computed tomography intravenous urography image of case 1: Showing cat tail (shown by the Asterix) draining well and the bladder is distending well and shows no leak at 2 years. (b) Showing the computed tomography intravenous urography of case 3 at 19 months. Arrow represents the inferior vena cava filter. Star represents the augmented bladder. (c) Showing normally draining upper tract at 13 months in case 4. (d) Shows ultrasonography image of both the kidneys having no hydronephrosis, at 10 months post procedure in case 5

bilateral repair using Boari flap. Doing a simultaneous ileal replacement using an ileal segment in a cat-tail configuration is a viable option, this option is independent of the length of stricture and in cases where the bladder needs to be reconstructed additional length of ileum can be used to do the same.[14]

Since, the ileal segment used is only a conduit and practically no storage of urine occurs in the cattail the chances of metabolic derangements are minimal.[15] While tailoring the cat-tail segment the surgeon should avoid having any redundant segment of the ileum to minimize metabolic complications.[16] The ileum is perfectly suited for this kind of procedure because it is mobile and has a reliable blood supply.[8] By the time, the ureters are dissected sigmoid mesentery gets lifted significantly and it is easy to create a window and transpose a large diameter of the ileum to the left side, it is ensured the window is of the appropriate size to avoid both compression and internal herniation.

In this procedure, there is significant dissection in the retroperitoneum around the level of sacral promontory and thus, there is a higher risk of ileus postoperatively.[12] In our series, two patients out of 5 had ileus lasting for 5 days, Pamecha *et al*. also found a high incidence of ileus in their series; hence, all the patients should be counseled regarding the same.[17] Enhanced recovery protocols should be used in all cases to minimize the impact of extensive retroperitoneal dissection. No bowel preparation should be offered to these patients. Ileum use will be a relative contraindication in patients with creatinine value >2 mg%; patients who have had past irradiation or inflammatory bowel disease may also be unsuitable for this procedure.[18,19]

Table 2: Summaries the complications of the procedure

Complication	Case 1	Case 2	Case 3	Case 4	Case 5
Gastro-intestinal	No	No	No	Ileus	Ileus
Wound infection	Yes (required 2nd suturing)	No	No	No	No
Others	No	No	DVT with IVC filter	Gastritis	No
Break through UTI	No	No	No	No	1 episode; managed conservatively
Clavien Dindo grade	3a	-	3a	1	1

DVT=Deep-venous thrombosis, IVC=Inferior Vena Cavaa, UTI=Urinary tract infection

Colonic segments have been used in ureteric reconstruction, but the colon is not as mobile as ileum and it may be difficult to harness a 20 cm segment for this kind of procedure.[20] The use of colonic segment predisposes to increased risk of bacterial colonization and possibility of pyelonephritis, also there is a risk of malignancy developing precluding the use of colonic segment.[20]

Mucus production from the ileal mucosa used for urothelial reconstruction may cause urinary obstruction and irritation. All our patients did give a history of passage of mucus, but none of them had retention or irritation due to the mucus, also mucus production decreased with time. All patients were treated with sodium bicarbonate 500 mg three times a day.

Another contentious area of discussion is whether the anastomosis between ureter and ileum, ileum and bladder should be refluxing or nonrefluxing.[21,22] Kato *et al.* proposed that having an anti-reflux uretero-ileal anastomosis will protect the kidney if and when the ileal segment dilates and gets filled with urine.[23] Waldner *et al.* reported their experience with no anti-reflux procedure done along with ileal ureter and concluded it may not be necessary to do an anti-reflux procedure if the patient had a normal voiding.[18] The case for an antireflux ileo-vesical anastomosis can be argued in patients with compromised renal functions, as reflux may increase the theoretical risk of infections.[24] In the technique described use of isoperistaltic limb of 15 cm or more length of ileum is likely to prevent reflux, hence avoiding the need for any additional anti-reflux procedure.[15] In our series with maximal follow-up of 56 months only one patient developed pyelonephritis which was within 1 month of discharge, patient was managed with IV antibiotics and did not have any symptoms after completing the course of antibiotics. Based on the authors' experience with this procedure, there are no deleterious effects of refluxing ileo-vesical and uretero-ileal anastomosis (i.e., infections or renal deterioration).

One of the strengths of this study is that it is more contemporary as the incidence of tubercular strictures and radiation strictures has significantly decreased. The ureteric strictures now most commonly are iatrogenic in nature, extensive pelvic surgery can potentially cause bilateral ureteric stricture, the ureteric stricture due to abdominal surgeries are more often unilateral. All the procedures in our series had a similar approach and performed by the same surgical team. There can be a lot of variation in the thought process reconstructive surgeons regarding the management of B/L long-length ureteric strictures, here the authors have tried to focus on a single technique to bring out its salient advantages.

Limitations of our study

This is a retrospective study with a small number of cases. Follow-up for 1 case is less than a year, but the mean follow-up is 28 months. Diuretic renogram was not used to assess drainage, we relied on CT scan, ultrasound of kidneys and symptoms to access the success of the procedure.

CONCLUSION

The use of an ileal segment in cat-tail configuration for bilateral simultaneous ileal replacement is a feasible and safe option. The medium-term result show that it is effective in the preservation of renal function and provides a good conduit for drainage.

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