Original Article

Use of ileum for complex ureteric reconstruction: Assessment of long-term outcome, complications, and impact on renal function

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Abstract

Introduction: Defect in ureteral continuity can be due to various etiologies. The surgical options for management of complex long-segment ureteric defects are limited. Use of ileum is indicated in these cases; however, the technique is challenging and outcomes need to be assessed in detail.

Material and Methods: It is an observational study conducted over 4 years. After preoperative optimization, ureteric reconstruction was performed using standard techniques of ileal interposition in cases of unilateral and bilateral long-segment ureteric defects. Patients were followed up at regular interval to assess outcomes and see for complications.

Results: A total of 14 patients were studied. Two most common indications for performing ileal ureter were iatrogenic injury and radiation-induced strictures (5–5 cases). Most common site of ureteric involvement was lower and midureter seen in 6 cases. The mean length of the ileum used was 11.2 cm. Mean preoperative nadir creatinine level was 1.57 mg/dL in this study. Average postoperative creatinine level at 4-week follow-up was 1.75 mg/dL and 1.45 mg/dL and 1.37 mg/dL, at 3 and 12 months, respectively. The most common short-term complication was paralytic ileus and long-term complication was recurrent urinary tract infection UTI. There was no mortality.

Conclusion: Ileal ureter is found to be relatively easy and safe surgery even in patients with borderline high creatinine. There was no worsening of renal function attributable to the conduit in this study. In patients with limited surgical options, it is a suitable alternative, rather than keeping patient on permanent percutaneous nephrostomy or regular stent change. Metabolic acidosis and mucous-associated complications such as pain, infection, and stone formation can be minimized by adherence to strict protocol.

Keywords: Complex ureteral defects, ileal interposition, ileal ureter

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INTRODUCTION

Defect in ureteral continuity can be due to stricture, obstruction due to malignancy, traumatic avulsion, or perforation. Ureteric stricture can be the result of various etiologies such as urinary tuberculosis, radiation, bilharziasis, and devascularization. These defects are classified as simple or complex on the basis of length of

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the involved segment and associated nephropathy.[1] This classification is important because the surgical options for management of complex long-segment ureteral defects are limited. Use of ileal segment is indicated in these cases; however, the technique is challenging and outcomes need to be assessed in detail.

Previously, the use of ileal segment was most commonly indicated for reconstruction of long-segment strictures secondary to urinary tuberculosis. But with time, the spectrum of indications has widened. In 1909, Shoemaker reported the first ileal ureter in a woman with tuberculous involvement of the urinary tract.[2] Use of ileum is indicated in cases where length of the ureteric defect or the pathophysiology of disease process precludes the use of other options such as psoas hitch, Boari's Flap or transureteroureterostomy. However, the use of ileum is not free of complications. Ileal epithelium being absorptive in nature results in various metabolic derangements, such as metabolic acidosis and raised serum creatinine.

This study was conducted to study the various indications in which an ileal segment can be used for ureteral reconstruction and to assess the short-term and long-term postoperative outcomes in such patients.

MATERIALS AND METHODS

This is a prospective observational study conducted from November 2012 to December 2016 after institutional ethical committee approval. All patients with long-segment ureteric defect in whom procedures such as ureteroneocystostomy, psoas hitch, Boari's flap, and transureteroureterostomy were not possible or failed were included after taking detail informed consent in their native language. All patients underwent preoperative bowel preparation for 24 h. All patients underwent a detailed clinical evaluation which included detailed clinical history, previous treatment and operative history, physical examination, renal functions, and radiological imaging to identify location and length of the ureteral stricture or obstruction.

In patients presenting with deranged renal functions, preoperative optimization was done using either Double J (DJ) stent or percutaneous nephrostomy (PCN). Patients were followed till nadir creatinine level was reached. After being evaluated for suitability of ileum segment use, ureteral reconstruction was performed using an isoperistaltic ileal segment, length of which depended on the length of the defect.

Technique

In case of unilateral ureteral reconstruction, the lumen of ileum was tailored over 12 French Foleys catheter. Ileum tube was then used for reconstruction. The proximal end of ileum tube was anastomosed to ureter or renal pelvis in an end-to-end manner and distal end was either anastomosed to bladder using Lich–Gregoir extravesical nonrefluxing reimplantation technique or to the spatulated cephalic end of the lower ureter in cases with the presence of an intact healthy lower ureter [Figures 1 and 2]. In case of bilateral ureteric defect, bilateral ureters were reimplanted into a common isoperistaltic ileum segment in end to side manner [Figure 3]. Proximal end of ileum was closed and the distal end was subsequently anastomosed to the dome of bladder using Lich-Gregoir technique. DJ stents and PCN catheters were kept during each reconstruction. Per urethral catheter was kept for 10 days.

Postoperatively, patients were monitored for their vitals and hematological investigations. Any postoperative complication if seen was recorded and managed accordingly. Patients were started on soda bicarbonate tablets 600 mg thrice a day. All patients underwent short-term and long-term follow-up. Initially, patients were asked to follow-up every 3 weeks following discharge. After 6 weeks, DJ stents were removed and PCN was blocked. If no complication occurred in a week and patient remained asymptomatic, then PCN catheters were removed after confirmation of normal drainage system on imaging. Patients were asked to follow-up with hematological investigations and ultrasound after a month. Long-term follow-up with every three monthly visits were asked after that. In the follow-up visits, hematological, biochemical, and radiological investigations were done.

RESULTS

A total of 14 patients were included in the study. The mean age was 41.2 years. Most common indication for performing ileal ureter was iatrogenic ureteric injury which occurred during ureteroscopic stone removal (3 cases), during hysterectomy and during pyelolithotomy (1 case each). The second most common indication was radiotherapy (5 cases), followed by ureteric strictures secondary to urinary tuberculosis (3 cases). One patient with iatrogenic ureteric stricture had undergone Boari's flap repair initially which failed. The most common site of ureteric involvement was mid- and lower ureter seen in 6 out of 14 cases. Complete ureteric avulsion was seen in two cases [Table 1].

Length of ileum used for ureteral reconstruction ranged from 4 to 20 cm. The mean length of ileum used for

Table 1: Clinical description and follow up details of all 14 cases

Clinical history	Site of lesion	Previous surgery done	Length of stricture	Serum creatinine level (mg/dL)		
				Preintervention	Nadir before surgery	Postsurgery at 12 months
Radiation posthysterectomy	Left lower ureter	UNC*	7 cm	2.1	1.8	1.3
Radiation posthysterectomy	Left lower ureter	Not any	5 cm	3.5	1.7	1.4
Radiation	B/L mid and lower ureter	Not any	15 cm	2.9	1.0	0.9
Radiation	B/L mid and lower ureter	Not any	17 cm	1.1	1.1	1.2
Radiation	B/L lower ureter	Not any	4 cm	0.8	0.8	0.8
Post-URSL large midureteric stone	Right middle	Boari's flap	4 cm	2.4	2.1	2.1
Posthysterectomy and vault repair	B/L mid and lower ureteric stricture	Vaginal vault repair with reimplant	10 cm	2.2	2.2	2.0
Post-URSL	Left complete ureter avulsion	Not any	20 cm	2.7	1.9	1.7
Post-URSL	Left complete ureter avulsion	Not any	15 cm	1.4	1.4	1.1
Pyelolithotomy	Left Upper	U-U**	8 cm	1.8	1.8	1.9
GU TB	Right mid and lower ureter and small bladder	Not any	20 cm	2.8	2.2	1.1
GU TB	B/L mid and lower ureter	Not any	12 cm	2.0	1.8	1.8
GU TB	Right mid and lower ureter	Not any	15 cm	1.8	1.3	1.1
Idiopathic	Right upper ureter	U-U**	5 cm	1.1	1.1	1.0

*UNC, **U-U. URSL: Ureteroscopic lithotripsy, B/L: Bilateral, UNC: Ureteroneocystostomy, U-U: Ureteroureterostomy, GU TB: Genitourinary tuberculosis

ureteral reconstruction was 11.2 cm. Mean operating time in the study was 164 ± 23 min.

Complications were divided into short-term (occurred within 4 weeks postprocedure) and long-term (occurred after 4 weeks). Most common short complication encountered was paralytic ileus seen in 50% cases followed by wound infection and UTI 4 cases each (28.5%). Anastomotic leak was seen in 2 cases (14.28%). Most common long-term complication found was recurrent UTI in 5 cases (35.7%). Metabolic acidosis and calculus in the ileal segment were seen in one case each (7.14%).

Nine out of 14 patients required preoperative intervention in the form of PCN/DJ stenting in view of raised serum creatinine. Mean preoperative nadir creatinine level achieved after urinary diversion was 1.57 mg/dL. Average postoperative creatinine level at 4-week follow-up was 1.75 mg/dL. At 3- and 6-month follow-up, the mean creatinine level reduced to 1.45 mg/dL and 1.37 mg/dL, respectively. Follow-up was continued for 1-year which showed improvement or stabilization in serum creatinine level without the development of acidosis or recurrent UTI.

DISCUSSION

Use of bowel segment for reconstruction of long-segment ureteral defect has been mentioned since almost half a century. While colon can also be used for ureteral reconstruction, ileum is preferred due to its mobility, blood supply, and small diameter.[3] A paradigm shift has occurred in the spectrum of indications and techniques of ureteral substitution beginning from the use of pedicled ileal tube to advent of artificial ureteral substitutes like Gore-Tex tube graft. Application of Yang Monti principle can also be used to replace diseased ureter.

Conventionally, ileal ureteric substitution was used to be performed for stone chute procedure in patients with recurrent nephrolithiasis. Nowadays, postradiation and postureteroscopic ureteric strictures have become the most common indications.[4] In this study too, postradiation and iatrogenic ureteric strictures were the most common indications for performing ileal ureter (5 patients of each – 35.71%). Very few studies in the modern literature have mentioned the use of ileum for reconstruction of ureteric strictures resulting from urinary tuberculosis. In our study, there were three patients with ureteric strictures secondary to tuberculosis (21.4%). One patient had bilateral lower and mid-ureteric stricture with renal insufficiency, for which anastomosis of bilateral upper ureters to a long isoperistaltic segment of ileum was done. In other two patients who had long-segment unilateral strictures, ileal transposition was done. All these three patients had renal insufficiency initially and were managed with PCN preoperatively. These patients showed stable or improved renal functions postreconstruction and none of them required further nephrostomy catheter/DJ stent insertion or nephrectomy on long-term follow-up.

Contraindications for the use of ileum are impaired renal function (baseline serum creatinine level of 2 mg/dl or more), bladder outlet obstruction, and diseased small bowel as seen in inflammatory bowel disease and radiation enteritis.[5] In our study, nadir serum creatinine of more than 2 mg/dl achieved after insertion of PCN or DJ stent was found in only three patients. Immediately after surgery, serum creatinine increased (raised by 0.3 mg/dL or more

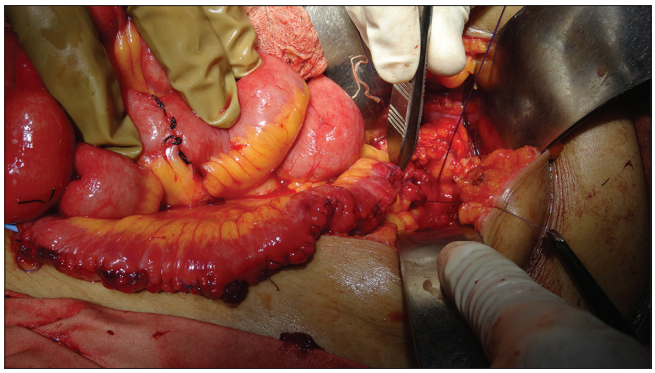

Figure 1: Intraoperative photograph of ileal interposition using 20 cm segment of ileum for ureteral reconstruction from pelvic–ureteric junction to vesicoureteric junction

Figure 2: Postoperative antegrade pyelogram showing ileal interposition in a case of unilateral midureteric stricture

Figure 3: Postoperative intravenous pyelogram showing a bilateral lower uretric defect in a case of genitourinary tuberculosis bridged by an ileal segment

over baseline) in nine patients. However, at 6 months of follow up, serum creatinine was stabilized in 8 out of 14 patients (57%) and in six patients decreasing trend of serum creatinine from preoperative value was observed (43%). Various studies in the literature have shown that improvement or stabilization of renal function is seen in approximately 74% of patients, postprocedure.[4,6] Our study showed better results as compared to other studies. It could be due to either better selection of patients or due to preoperative stabilization of patient's renal functions using a ureteric stent or nephrostomy tube and optimization of patients before the final reconstruction.

Use of irradiated bowel segment is contraindicated, due to problems in healing. There is risk of fistula formation[6-8] and anastomotic leak.[1] However, none of such complications were encountered in our study which included five patients with prior history of radiation for pelvic malignancy. This might be due to use of proximal healthy ileum with minimal grossly visible radiation changes.

Many studies have reported favorable surgical outcomes in terms of zero mortality, less morbidity, and better stabilization of renal functions postoperatively[9,10] However, development of metabolic acidosis, excessive mucous production, and recurrent UTI owing to functional stasis were common drawbacks of surgery reported in various studies[10,11]

Retrograde transmission of intravesical pressure depends on the length of ileum segment used, the technique of reimplant, and voiding pressure.[5] Some authors assumed that a distal antireflux technique of bowel implantation over bladder may decrease the urinary flow with subsequent dilatation of ileal segment.[12] Others[7] stressed the role of antireflux procedure in preventing further worsening of renal functions in patients with already impaired renal functions. Many authors[1,13] concluded that antireflux procedure is not necessary at all as the natural isoperistaltic waves of ileal tube can prevent reflux from reaching the kidney[14] and an ileal loop longer than 15 cm was considered a safeguard against the harmful effect of reflux on the kidney[8] and may be safely excluded in patients who have normal preoperative renal and voiding function. Hence, there is no common consensus on the use of distal implantation technique and its effect on renal function. In our study, bowel was anastomosed to the bladder in a nonrefluxing manner. However, there was neither proximal dilatation nor worsening of renal functions seen on follow-up till 2 years.

Surface area of the bowel segment used, concentration of the solutes in urine, renal functions, urinary pH, duration, for which urine remains in contact with the bowel segment, factors affecting the duration of contact such as distal obstruction, stasis, and reflux are some of

the factors that determine various metabolic derangements that occur after the use of ileum.[3] It has been observed that metabolic complications such as hyperchloremic metabolic acidosis, renal insufficiency, and hepatic dysfunction are noted commonly after use of a long and wide caliber ileal segment. Hence, the length of bowel used should preferably be as short as possible to prevent these complications.[13] Rate of hyperchloremic metabolic acidosis reported in various studies is 0%–14%.[9,10,15,16] In another study, half of the patients with serum creatinine more than 2 mg/dL developed hyperchloremic metabolic acidosis requiring conversion to the conduit.[17] Preoperative renal function is one of the important prognostic factors for the development of these postoperative complications. Hence, if the selected patients have well-preserved preoperative renal functions, risk of worsening renal functions postoperatively and development of metabolic acidosis is low. In the present study, only one patient (7.1%) on follow-up was diagnosed to have hyperchloremic acidosis at 1-year, which is comparable with other studies. This patient required increased oral dosage of sodium bicarbonate. No further complications were seen in this patient.

Various studies which used the principle of Yang-Monti for reconstructing of ileal tube have shown significantly low incidence of graft dilatation, metabolic acidosis, excessive mucous production, and recurrent UTI episodes.[14,18] This was attributed to use of reconfigured ileal segment which provided a tube with markedly reduced reabsorptive as well as secreting surface area. We obtained similar results despite performing a simple ileal ureter by restricting the length of ileal segment and tailoring its lumen to 12 Fr, thereby achieving the same goals as that of Yang Monti technique.

Use of buccal mucosa for treatment of ureteric strictures was first described by Naude in 1999, after which a few studies highlighted its use for reconstructing ureteric defects.[19-23] Use of buccal mucosa was favored because the procedure is comparatively easy and complications related to bowel interposition and autotransplantation were avoided. But in all these studies, the mean stricture length varied from 5 to 6 cm where buccal mucosa could have been ideal. In our study, the average length of stricture was about 11 cm where buccal mucosa would not have sufficed to cover the whole length of defect. Besides, most of our patients had radiation-induced and tubercular strictures (8 out of14 cases). Furthermore, two cases were of complete ureteric avulsion. Use of buccal mucosa in these patients with already tenous blood supply would have compromised the vascularity and result of the ureteric reconstruction.

In our study, short-term complications such as paralytic ileus, wound infection, and UTI were commonly seen in elderly patients and those with a history of irradiation. These findings were consistent with long-term difficulties associated with repair in patients with prior history of radiation due to associated fibrosis, ischemia, and poor quality of tissues.[4] These patients also become more susceptible for stone formation in the bowel segment or in the kidney. The development of acidosis increases the risk of stone formation.[24] Stones most commonly seen are calcium and oxalate stones. In our study, one patient developed stone in the ileal segment after 6 months. It was managed endoscopically.

We observed that with careful selection of patients, preoperative optimization of renal functions, keeping length of ileal segment as short as possible and of adequate caliber and prompt postoperative follow-up, it appears possible to reconstruct long-segment diseased ureter with ileum without worsening of renal functions while minimizing postoperative metabolic and bowel-related complications.

CONCLUSION

Use of ileum for reconstruction of long ureteric defect appears to be a safe and viable option even in patients with borderline high creatinine. There was no worsening of renal function attributable to conduit in this study. It may be recommended as a suitable alternative to permanent nephrostomy catheters and regular stent change in patients with limited surgical options. Metabolic acidosis and mucous-associated complications such as pain, infection, and stone formation can be minimized by adherence to strict protocol. Careful and prudent selection of patients, watchful perioperative care, and prompt long-term follow-up are the keys to successful long-term results, even in patients with impaired renal functions.

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Conflicts of interest
There are no conflicts of interest.

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