Case Report
Olgu Sunumu

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Ileal Ureteral Transposition in Iatrogenic Ureteral Injuries: A Report of 5 Cases and Systematic Review of the Literature

İyatrojenik Üreter Yaralanmalarında İleal Üreter Transpozisyonu; 5 Olgu Sunumu ve Literatürün Sistematik İncelenmesi

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ABSTRACT

Ileal ureteral transposition is an effective surgical option for selected cases of iatrogenic complete ureteral injuries where primary repair or simpler reconstructive techniques are precluded. In the 3-month follow-up of five patients who underwent this procedure between 2017 and 2023, all patients maintained good function of both the ileal segment and the kidney. No vesico-ureteral reflux or major complications were observed. When performed with proper technique, this procedure is highly effective.

Keywords: ileum, intraoperative complications, reconstructive surgical procedures, ureteral diseases, ureterorenoscopy

ÖZET

İyatrojenik tam üreter yaralanmalarında, daha basit rekonstrüktif yöntemlerin uygulanamadığı seçilmiş vakalar için ileal üreter transpozisyonu etkili bir cerrahi seçenektir. 2017-2023'te bu teknik uygulanan 5 hastanın 3 aylık takiplerinde, hastaların tümünde ileal segment ve böbrek iyi fonksiyon gösterdi. Veziko-üreteral reflü veya majör komplikasyon görülmedi. Doğru teknikle uygulandığında bu prosedür oldukça etkilidir.

Anahtar Kelimeler: ileum, intraoperatif komplikasyonlar, rekonstrüktif cerrahi prosedürler, üreter hastalıkları, üreterorenoskopi

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INTRODUCTION

Ureteral injuries are among the most serious and challenging complications in urology. Due to the close anatomical proximity of the ureters to the surrounding abdominal and pelvic organs, the risk of ureteral injury is also increased in non-urological surgeries. More than 75% of ureteral injuries are iatrogenic (IUI). Distal ureteral injuries account for 91% of all IUI cases (1). Ureterorenoscopy (URS) remains the most common cause of IUI in urological surgeries (2). Iatrogenic ureteral injuries vary from small perforations to complete ureteral avulsions (3). Most of these injuries can be repaired with endourological procedures. However, the reconstruction of long ureteral defects may require the use of graft tissue or complex reconstructive surgical techniques (3). The choice of treatment depends on the location and length of the ureteral defect, the patient's general condition, the hospital's resources, and the surgical team's experience. This study presents our experience with ileal ureteral transposition (IUT) in five patients, each presenting with complex, long-segment iatrogenic ureteral avulsion, where all standard reconstructive options were precluded. We specifically document the anatomical considerations—such as extensive defect length and the absence of a viable ureteral stump—that necessitated this complex procedure over simpler alternatives like ureteroureterostomy or bladder flap techniques. By presenting these cases and reviewing the literature, we aim to reinforce the specific indications and technical considerations for IUT as a salvage procedure of necessity, not a primary or minimally invasive choice.

CASE REPORTS

Surgical Technique

The surgical procedure was standardized and performed via a midline laparotomy under general anesthesia. After entering the abdominal cavity, the avulsed ureter was identified (Figure 1). A 15-20 cm segment of the terminal ileum, located approximately 20-25 cm proximal to the ileocecal valve, was isolated with meticulous preservation of its vascular arcade. Intestinal continuity was restored with a functional end-to-end anastomosis. The isolated ileal segment was always positioned in an isoperistaltic manner and transposed retroperitoneally through a window in the colonic mesentery (Figure 2).

Figure 1. The segment of avulsed ureter (been obtained intraoperative)

Figure 2. The mobilization and restructuring of ileal segment

The type of proximal anastomosis was determined by the level of injury. When a healthy segment of the native ureter remained below the kidney, a spatulated end-to-side ileoureteral anastomosis was created using interrupted 4-0 absorbable sutures. In one patient with extensive proximal loss (Case 4), where the remaining ureter was too short or not viable, an ileocalicostomy was performed. For the distal implantation, an anti-reflux mechanism was created: the distal end of the ileal segment was tapered and shaped (Figure 3), and implanted into the bladder using the extravesical Lich-Gregoir technique, creating a 3-cm seromuscular tunnel. A double-J ureteral stent was placed across the ileal segment in all cases.

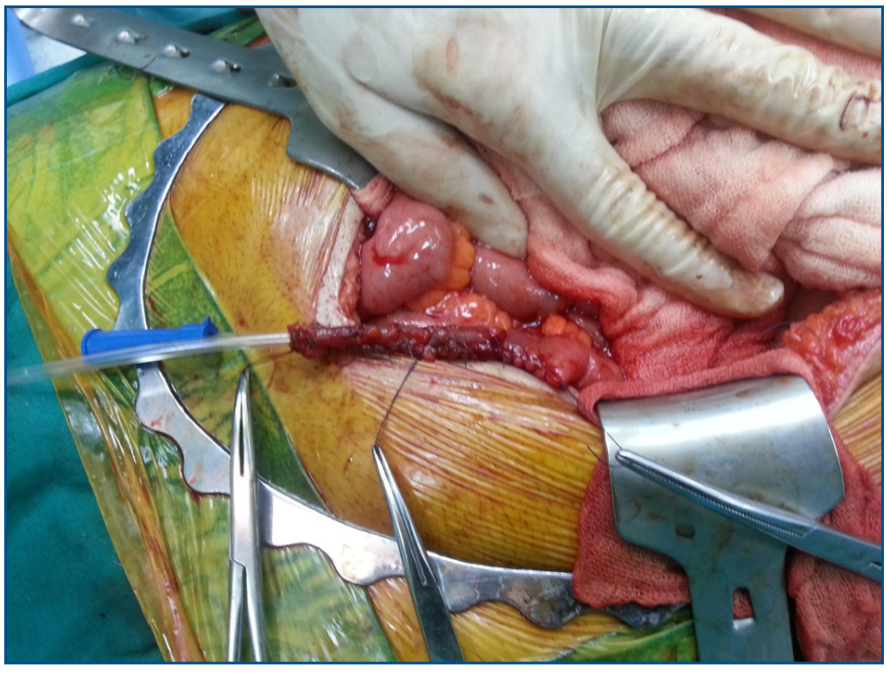

Figure 3. Tailoring to the distal end of the ileal segment

Postoperative Management

A standard follow-up protocol was applied. The urethral catheter was removed on postoperative days 10-14. A percutaneous nephrostogram was performed at 6 weeks to confirm anastomotic integrity and patency before nephrostomy tube removal (Figure 4). Follow-up assessments at 3 and 6 months included clinical evaluation, serum creatinine measurement, and renal ultrasonography. At the 3-month follow-up, intravenous pyelography confirmed good function and drainage through the ileal segment (Figure 5).

Figure 4. The ileal ureter scene by antegrade nephrostography (postoperative 4th week)

Figure 5. Intravenous pyelography. Arrow marks the ileal segment (post-operative 3rd month)

CASE 1

A 30-year-old female patient presented with pain, nausea, and vomiting in both flanks. A computed tomography (CT) scan revealed a 7 mm stone in the distal left ureter. During an attempt to treat the stone with URS, a complete mid-distal ureteral avulsion (approximately 8 cm) occurred. The surgeons attempted primary anastomosis but could not find an appropriate area, so a percutaneous nephrostomy was placed, and the patient was referred to our clinic. Her preoperative creatinine was 0.8 mg/dL, and hemoglobin was 12.5 g/dL. Antegrade nephrostography confirmed the avulsion. She underwent ileal ureteral transposition 14 days after the injury. The procedure lasted 320 minutes, and a 15 cm ileal segment was used for an ileoureteral anastomosis. Intraoperative assessment confirmed that the distal ureteral stump was ischemic and unsuitable for a tension-free anastomosis, which dictated the need for ileal interposition. Her postoperative course was uneventful. The urethral catheter was removed on postoperative day 10, the abdominal drain on day 5, and the nephrostomy tube on day 14 following a patent antegrade study. She was discharged on postoperative day 16. At the 3-month follow-up, her creatinine was 0.9 mg/dL, and she had no complications (Clavien-Dindo: None). Written informed consent was obtained from the patient for the case presentation and use of data.

CASE 2

A 35-year-old male patient had a history of an 8 mm stone in the distal left ureter for 4 months. Semi-rigid URS detected a narrowed segment in the lower ureter. After stone fragmentation, a complete distal ureteral avulsion (approximately 5 cm in length) occurred. A percutaneous nephrostomy was placed, and the patient was referred to our clinic. His preoperative laboratory values included a creatinine of 0.9 mg/dL and a hemoglobin of 14.0 g/dL. He underwent ileal ureteral transposition 10 days after the injury. The operative time was 280 minutes, utilizing a 12 cm ileal segment for an ileoureteral anastomosis. Surgical exploration revealed that the avulsion had severely compromised the viability of the distal ureter, precluding a primary ureteroneocystostomy and necessitating ileal ureteral transposition. His postoperative recovery was smooth, with no complications. The urethral catheter was removed on postoperative day 10, the abdominal drain on day 4, and the nephrostomy tube on day 12. The total postoperative hospital stay was 14 days. At the 3-month follow-up, his serum creatinine was 1.0 mg/dL, confirming stable renal function. Written informed consent was obtained from the patient for the case presentation and use of data.

CASE 3

A 41-year-old male patient was diagnosed with a 1 cm stone in the left upper ureter. During the semi-rigid URS procedure, a complete avulsion at the ureteropelvic junction (UPJ) was detected, and the ureter was extracted using a ureteroscope (Figure 1). The estimated ureteral defect length was approximately 6 cm. Percutaneous nephrostomy was placed, and the patient was referred to our clinic. His preoperative creatinine was 1.0 mg/dL, and hemoglobin was 13.8 g/dL. Antegrade nephrostography confirmed the absence of ureteral continuity beyond the UPJ. The patient underwent ileal ureteral transposition 21 days after the injury. The procedure lasted 350 minutes, and a 15 cm ileal segment was used for an ileoureteral anastomosis. His postoperative course was complicated by a transient ileus (Clavien-Dindo Grade I), which resolved with conservative management. The urethral catheter and abdominal drain were removed on postoperative days 12 and 6, respectively. The nephrostomy tube was removed on day 16 after a patent antegrade study. He was discharged on postoperative day 18. At the 3-month follow-up, his creatinine level was 1.1 mg/dL, indicating preserved renal function. Written informed consent was obtained from the patient for the case presentation and use of data.

CASE 4

A 52-year-old female patient presented with right flank pain, fever, dysuria, and urinary frequency for 2 weeks. The patient's medical history included a laparoscopic hysterectomy performed 20 days prior. A CT scan showed a urinoma around the middle-proximal part of the right ureter. Retrograde urography and diagnostic ureteroscopy revealed an injury leading to a complete avulsion of the proximal-mid ureter with an estimated defect length of 10 cm. A

percutaneous nephrostomy was immediately placed. Her preoperative creatinine was 0.7 mg/dL, and hemoglobin was 11.9 g/dL. The patient underwent ileal ureteral transposition 25 days after the initial hysterectomy. Due to the extent of the proximal injury, an ileocalicostomy was performed. The operative time was 380 minutes, and a 20 cm ileal segment was utilized. Her postoperative recovery was uncomplicated. The urethral catheter was removed on postoperative day 14, the abdominal drain on day 7, and the nephrostomy tube on day 18. She was discharged on postoperative day 20. At the 3-month follow-up, her creatinine level was 0.8 mg/dL, demonstrating excellent renal outcomes. Written informed consent was obtained from the patient for the case presentation and use of data.

CASE 5

A 54-year-old male patient presented after undergoing ureterorenoscopy for a right kidney stone, during which a stricture prevented stent placement. A percutaneous nephrostomy was applied, and a CT scan showed a stone and narrowing of the proximal right ureter. Retrograde urography and diagnostic ureteroscopy revealed a complete proximal ureteral avulsion with an estimated defect length of 7 cm. His preoperative creatinine was 1.1 mg/dL and hemoglobin was 13.2 g/dL. Ileal ureteral transposition was recommended and performed 18 days after the initial injury. The procedure lasted 300 minutes, and an 18 cm ileal segment was used for an ileoureteral anastomosis. The postoperative course was smooth, with no complications. The urethral catheter and abdominal drain were removed on postoperative days 10 and 5, respectively. The nephrostomy tube was removed on day 14 following a confirmatory antegrade study. His total postoperative hospital stay was 16 days. At the 3-month follow-up, his serum creatinine was 1.2 mg/dL, confirming stable renal function. Written informed consent was obtained from the patient for the case presentation and use of data.

DISCUSSION

Iatrogenic ureteral injuries (IUI) are common causes of ureteral stricture due to ischemia or direct trauma (2). These injuries are typically seen during pelvic surgeries, such as laparoscopic hysterectomy, colorectal surgeries, and endoscopic urological procedures (3). The recognition rate of IUI during open surgeries and endourological procedures is higher than that of laparoscopic techniques (43.5% and 62.5%, respectively, compared to 12.5% in laparoscopic surgery) (1). Postoperative diagnostic tools such as retrograde urography (RUG) are essential for detecting IUI (4).

Ureteral injuries often present with fever, back pain, abdominal distension, leukocytosis, and hydronephrosis (3). The most sensitive diagnostic tool during the postoperative period is retrograde urography (4). If cystoscopy or RUG cannot be performed, CT urography can serve as an alternative diagnostic method (4). After ureteral avulsion complications, a percutaneous nephrostomy was placed in all cases. Surgical decisions were made using antegrade nephrostography and diagnostic URS. Ureteroureterostomy was not performed, and the Boari flap and psoas hitch were unsuitable for the defective segments.

The combination of the Boari flap and psoas hitch is typically used for defects longer than 12 cm (4). Although effective, this approach is not without risks and can lead to complications such as leakage, fistula formation, and bladder dysfunction (5). To prevent IUI, laparoscopic procedures performed by experienced teams and monitoring ureter continuity postoperatively minimize risks (3). Ureteral catheter placement, however, does not definitively reduce the risk of injury (1). Prolonged use of ureterorenoscopes can cause micro-damage, increasing the risk of injury. IUI can lead to serious complications such as urinoma, abscess, stricture, fistula, and kidney dysfunction (1), highlighting the critical importance of early diagnosis and timely intervention to reduce morbidity. In the acute setting, percutaneous nephrostomy is a crucial step to minimize the risks associated with urinary extravasation and obstruction. In three of our cases, full ureteral avulsion occurred during surgery, and percutaneous nephrostomy was used in all cases to provide drainage. Various techniques exist to repair IUI, including ureteroureterostomy, transureteroureterostomy, and ureterokaliksostomy for upper injuries. For long ureteral defects, options include ileal interposition, auto-transplantation, or nephrectomy (1). Ileal repair, especially in patients with normal kidney function,

is not associated with metabolic complications and provides an excellent ureteral structure (6,7). This technique has minimal complications in postoperative follow-up. Minimally invasive surgeries have altered treatment strategies (8). In our study, ileal ureteral transposition was performed in five patients due to long-segment ureteral avulsion. This technique, although rarely used as a first step, offers comparable success rates to other methods for long-segment injuries (9).

A detailed analysis of potential morbidity is important. Complications can be categorized as early surgical (e.g., anastomotic leak, ileus), long-term functional (e.g., stricture), and metabolic. Contemporary series report early complication rates (Clavien I-III) of 20-40%, with ileus and urinary infection being most common (10, 11). The incidence of late complications like anastomotic stricture is generally below 10% in patients with preserved renal function (12, 13). Metabolic complications, such as hyperchloremic acidosis, are typically mild and clinically insignificant in this patient group (14). In our series, only one early complication (a transient ileus) was observed. No patient developed anastomotic stricture, urinary leakage, or significant metabolic issues during follow-up, which is consistent with the safety profile reported in the literature when meticulous technique is used (6, 7, 13).

The use of ileal grafts in calicostomy has not been reported previously, but in our case, ileal ureteral calicostomy was used similarly to ureterocalicostomy. Furthermore, no data suggest that anti-reflux surgery is necessary in ileal ureteral transposition. It has been shown that reflux in the ileal segment does not affect patients with normal kidney and bladder function (4).

CONCLUSION

In conclusion, ileal ureteral transposition represents a definitive, kidney-preserving salvage procedure for extensive iatrogenic avulsions where standard reconstruction is anatomically precluded. It is not merely an alternative, but rather a necessary intervention to avoid nephrectomy when the ureteral defect, combined with compromised tissue viability, eliminates all simpler options.

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