

Laparoscopic nephrectomy with mini-incision kidney autotransplantation in severe ureteral strictures: report of three cases and review of the literature

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Abstract

Severe and long ureteral injuries are difficult to be managed. In presence of a complex injury of the upper ureter, nephrectomy, bowel interposition, and kidney autotransplantation (KAT) are usually proposed. Kidney autotransplantation (KAT) represents a complex surgical procedure with a high risk of complications that could preserve renal function. We update our experience with renal autotransplantation for severe iatrogenic ureteral injuries. Three patients with complex ureteral injuries were referred for definitive management by KAT. Transperitoneal laparoscopic nephrectomy (LN) and open mini-incision KAT (mKAT) to the ipsilateral pelvis were attempted. After bench preparation of the graft, ureteral and vessel length and quality was adequate for autotransplantation in all cases. There were no intra- and postoperative complications and all grafts functioned immediately and at medium-term follow-up of 6 months. KAT gives excellent post-operative results without significant deterioration in renal function at medium-term follow-up. It represents a safe alternative method for the management of complex ureteric strictures when conventional surgical techniques have failed or are not suitable. Intensive collaboration with all transplant teams is crucial to ensure the high quality of the graft and to improve surgical and functional outcomes.

Keywords: Ureteral stricture, autotransplantation, kidney, surgery

Introduction

Severe and long ureteral injuries are difficult to be managed. In presence of a complex injury of the upper ureter, nephrectomy, bowel interposition, and kidney autotransplantation (KAT) are usually proposed. In 1962, Hardy [1] reported the first case report of a patient in which the right ureter, placed behind an aortic prosthesis 6 years earlier, was unwittingly severed during resection of a large aneurysmal homograft. The patient developed stenosis of the ureteroureteral anastomosis and underwent autotrans-

plantation of the right kidney into the right iliac fossa. The renal vessels were anastomosed to the external iliac artery and vein and the ureter was implanted into the bladder. Surgery was successful with a normal postoperative graft function at renal scintigraphy and anterograde urography. Since then, KAT has been proposed as valid therapy to preserve kidneys with complex renovascular, ureteral, or malignant diseases [2]. Common indications for KAT are represented by complex lesions of renal vessels, high ureteral strictures which cannot be treated by an endoscopic approach, and high PADUA-score renal tumors, especially for imperative indications [2, 3]. Moreover, KAT could be also indicated, but with a lower incidence, for retroperitoneal fibrosis, and metabolic stone disease [2, 4, 5]. Even if the intra- and postoperative mortality rates after KAT are low (1.3%), postoperative morbidity is still clinically significant (46.2%) [2]. Since Fabrizio *et al.* [6] reported the first laparoscopic nephrectomy (LN) for KAT in 2000, this mini-invasive procedure with reduced surgical trauma for the patient has been proposed as the gold standard. In this study, we present our experience with LN

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and mini-incision KAT (mKAT) in the treatment of severe iatrogenic injuries of the upper ureter.

Case reports

Case 1

JW, a 37-year-old male presented with a chronic urinary infection. The patient has undergone a prophylactic total colectomy 10 years before for familial polyposis coli. Following surgery, the patient developed ureteral stricture bilaterally, that were managed by introducing ureteral double-J (DJ) stents bilaterally. The renal scintigraphy showed a severely reduced renal function over time, which finally resulted in 13% on the left side and 87% on the right side. Physical examination was normal. Blood count, serum creatinine, and blood urea nitrogen (BUN) were normal. After placement of two percutaneous nephrectomies, the patient underwent an antegrade (APG) and retrograde ureteropyelography (UPG); both diagnostic procedures revealed bilateral hydronephrosis with multiple right ureteral strictures (Figure 1).



Figure 1. Antegrade and retrograde ureteropyelography showing bilateral hydronephrosis with multiple right ureteral strictures.

mKAT was planned for the definitive management of the ureteral stricture to spare the residual renal function. The patient underwent transperitoneal laparoscopic surgery with segmental ureterectomy and nephrectomy of the right side. The first surgical step was represented by the dissection of all intraperitoneal adhesences due to the previous laparotomy. Afterward, the right kidney was prepared with a dissection of renal vessels. The renal vein was gently dissected up to the insertion into the vena cava, thus assuring an adequate length of the vessels. The renal vein was dissected first, followed by the renal artery, by a triple-row

Endo-TA stapler (Multi fire Endo TA 30; Covidien), thus achieving longer perfusion of the kidney and reducing the warm ischemia time. Mini-incision KAT followed in the right iliac fossa with renal artery anastomosed to the right external iliac artery, renal vein to the right external iliac vein and the ureter was reimplanted by an extravesical and anti-reflux technique using a Lich-Gregoir technique [7]. No intra- and postoperative complications occurred. The operating time was 310 minutes with median vascular and ureteral anastomosis times of 19 and 12 min, respectively. Warm, cold, and rewarming ischemia time was 8, 100, and 24 min, respectively. Skin incision for mKAT was 6 cm and postoperative oral intake (POI) was started on day 1, with a VAS of 2. Hospital stay was 6 days and at discharge, VAS was 1. The serum creatinine improved from 243 $\mu\text{mol/l}$ preoperatively to 187 $\mu\text{mol/L}$ at discharge. Two months after mKAT, serum creatinine was 160 $\mu\text{mol/l}$ with normal vascular perfusion of the auto-graft at doppler sonography. At 2 years follow-up, mean serum creatinine of 190 $\mu\text{mol/L}$ with good vascular perfusion of the auto transplanted renal unit at doppler sonography (Figure 2).



Figure 2. Duplex Ultrasound after kidney autotransplantation at 2-yr follow-up.

Case 2

M.D., a 26 years old male presented with a history of left pyelonephritis with severe hydronephrosis. The attempt to place a ureteral DJ stent failed for severe stenosis of the upper left ureter so a percutaneous nephrostomy was necessary. In the medical history, the patient underwent combined radio-chemotherapy and lumbar vertebral fixation for an Ewing's sarcoma of the vertebral L-column (L 1-2). Physical examination was normal. APG showed left hydronephrosis determined by stricture of the whole ureter (Figure 3). Renal scintigraphy and computed tomography revealed a reduction of the renal function on the left side (41%) with a severe stricture of the left ureter in all its course (Figure 4).

The patient underwent left LN and mKAT. The operating time was 360 min with median vascular and ureteral anas-



Figure 3. Antegrade ureteropyelography showing left hydronephrosis with long ureteral stricture.

tomosis times of 25 and 17 min, respectively. Warm, cold, and rewarming ischemia time was 18, 130, and 22 min, respectively. Skin incision for KAT was 6 cm and POI was started on day 1 with a VAS of 3. On the 1st postoperative day, the patient presented a fever up to 38.7 which was solved by antibiotics and paracetamol so he was discharged on the 7th postoperative day with a VAS of 1. At a follow-up of 19 months, mean serum creatinine was 120 $\mu\text{mol/L}$ with normal vascular perfusion of the autotransplant renal unit at doppler sonography.

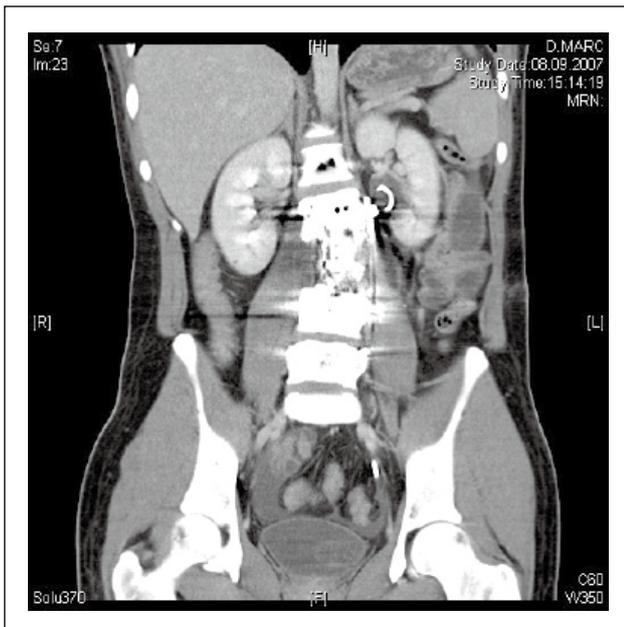


Figure 4. Computed tomography shows the left ureteral stenosis after vertebral fixation.

Case 3

RF, a 60 years old male presented with long ureteral proximal stricture after ureteroscopy, lithotripsy, and stone extraction. After the primary operation, the patient developed chronic urinary tract infections and arterial hypertension. The radiological diagnostic examinations showed long stenosis located in the upper and the middle portion of the left ureter (Figure 5) The renal scintigraphy showed a bilateral normal renal function but a reduced renal excretion function for the left kidney. Blood count, serum creatinine, and BUN were normal. Left LN and mKAT were undertaken for the management of the ureteral stricture to spare renal function and improve the quality of life. The operating time was 330 min with median vascular and ureteral anastomosis times of 21 and 14 min, respectively. Warm, cold, and rewarming ischemia time was 19, 90, and 25 min, respectively. No intra- and postoperative complications occurred. Skin incision for KAT was 6 cm and POI was started on day 1, with a VAS of 2. Hospital stay was 6 days and at discharge, VAS was 1. At 2 years follow-up, the serum creatinine was 109 $\mu\text{mol/L}$, and also in this case doppler sonography reported normal vascular perfusion of autotransplant renal unit.



Figure 5. Antegrade ureteropyelography via percutaneous nephrostomy showed proximal ureteral stenosis left.

Discussion

Severe ureteral injuries are rare, occurring in less than 4% and 1% of penetrating and blunt traumas, respectively. Ureteral injuries result from either iatrogenic or external trauma. Iatrogenic ureteral injuries far outnumber traumatic injuries, and they usually happen after endourological procedures [8]. The improvements in equipment and operator experience have subsequently lowered the rate to a stable average of 7% (range, 0% to 28%). However, most of these injuries are minor and managed by placing a DJ stent. Furthermore, iatrogenic ureteral injuries can also

occur after pelvic surgery, such as hysterectomy (54%), colorectal surgery (14%), transabdominal urethropexy (8%), and abdominal vascular surgery (6%) [9]. Most ureteral injuries can be endoscopically managed, with a combination of internal ureteral stenting and percutaneous nephrostomy tube drainage [10]. However, upper ureteral injuries are usually managed by ureteroureterostomy. In presence of a complete avulsion of the ureter from the renal pelvis or very proximal ureteral lesion, reimplantation of the ureter directly into the renal pelvis can be performed by spatulating the ureter and performing a watertight and tension-free anastomosis after placing a DJ stent. Laparoscopic pyeloplasty has been reported [11-14] and it is likely to become more widespread for the very high ureteral lesion. Ileal interposition can be used in cases of delayed ureteral repair, especially when a very long ureteral segment is damaged [15]. Ileum interposition should be avoided in patients with previous intestinal surgery, inflammatory intestinal diseases, and chronic renal insufficiency.

Moreover, a recent study has suggested an overall success rate for ileum interposition at a mean follow-up of 4.4 years (1-16 years) of 83%, with 17% of patients requiring subsequent major surgery (5 successful ureteral revision, 3 nephrectomies) and 24% of the patients experiencing a major complication such as urinary fistula, surgical site infection requiring open washout and ureteral obstruction [16].

In conclusion, ileum interposition represents a valid surgical technique with similar efficacy to KAT (81–88%); the choice between ileal interposition and KAT is often a matter of the surgeon's preference.

Kidney autotransplantation (KAT) can be usually proposed in presence of a long ureteral stricture or as the final solution after multiple failed attempts of repair such as ureteroureterostomy. During KAT, the kidney is harvested with maximal vessel length as in a typical live donor nephrectomy for allotransplantation, and the renal vessels are anastomosed to the iliac vessels to re-establish renal perfusion. A healthy segment of the proximal ureter is anastomosed to the bladder. Alternatively, the ipsilateral renal pelvis may be anastomosed directly to the bladder [17].

Currently, laparoscopic nephrectomy followed by open autotransplantation represents the gold standard for KAT [6]. Minimally invasive surgery aims to provide effective treatment of surgical diseases inside a body cavity while decreasing access-related morbidity, postoperative pain, and hospital stay, and enabling faster recovery, improved cosmesis, and patients' early return to work [18, 19]. To save a mini-invasive approach, we performed a mini skin incision of 6 cm for performing autotransplantation. All procedures were performed by an experienced surgeon (FG), without any intra-or postoperative complications and all patients referred lower pain according to VAS on the 1st POD. In all cases, there was a postoperative recovery of renal function. Our results reflect the actual literature on KAT. In 2017, Ruiz *et al.* analyzed indications, surgical technique, complications, and long-term

outcomes of KAT in 15 patients at a single institution. Indications for KAT were represented by vascular anomalies in 8 cases and ureteral injury in 7. Laparoscopic nephrectomy was performed in 2 cases (13.3%) and an open approach was used in 13 (86.7%). The mean hospital stay was 9.1 days. Postoperative complications rate was 46.7%: 6 minor (Clavien I-II) and 1 major (Clavien III). After a mean follow-up of 73.1 months, 80% of the patients have a functioning graft. The authors could suggest that KAT results be an effective treatment for complex ureteral lesions and kidney vascular abnormalities, with good functional results in the long term and low risk for surgical complications [20].

Similar outcomes were reported by Tran *et al.* in 52 patients who underwent laparoscopic nephrectomy with autotransplantation. The indications were represented by ureteral strictures (41), renal tumors (7), nephroptosis (1), chronic flank pain (1), renal artery aneurysm (1), and renovascular hypertension (1). At a median follow-up of 73.5 months, the auto transplanted renal unit presented a normal function in 90.3% of the patients. Even in this study, laparoscopic nephrectomy with autotransplantation represented an excellent long-term surgical option in experienced hands for complex ureteral and renal conditions that necessitate the preservation of renal parenchyma [21]. KAT gives excellent post-operative results without significant deterioration in renal function at medium-term follow-up. It represents a safe alternative method for the management of complex ureteric strictures when conventional surgical techniques have failed or are not suitable. Intensive collaboration with all transplant teams is crucial to ensure the high quality of the graft and to improve surgical and functional outcomes.

Declarations

Authors' contributions: Made substantial contributions to the conception and design of the study and performed data analysis and interpretation: Francesco Greco. Performed data acquisition, as well as providing administrative, technical, and material support: Antonino Inferera, Luigi Domanico, Oreste Risi, and Paolo Fornara.

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References

1. Hardy JD. High ureteral injuries. Management by auto-

- transplantation of the kidney. *JAMA*, 1963, 184: 97-101. [[Crossref](#)]
2. Decaestecker K, Van Parys B, Van Besien J, Doumerc N, Desender L, Randon C, et al. Robot-assisted Kidney Autotransplantation: A Minimally Invasive Way to Salvage Kidneys. *Eur Urol Focus*, 2018, 4(2): 198-205. [[Crossref](#)]
 3. Alameddine M, Moghadamyeghaneh Z, Yusufali A, Collazo AM, Jue JS, Zheng I, et al. Kidney Autotransplantation: Between the Past and the Future. *Curr Urol Rep*, 2018, 19(3): 7. [[Crossref](#)]
 4. Cowan NG, Banerji JS, Johnston RB, Duty BD, Bakken B, Hedges JC, et al. Renal Autotransplantation: 27-Year Experience at 2 Institutions. *J Urol*, 2015, 194(5): 1357-1361. [[Crossref](#)]
 5. Azhar B, Patel S, Chadha P, & Hakim N. Indications for renal autotransplant: an overview. *Exp Clin Transplant*, 2015, 13(2): 109-114.
 6. Fabrizio MD, Kavoussi LR, Jackman S, Chan DY, Tseng E, & Ratner LE. Laparoscopic nephrectomy for autotransplantation. *Urology*, 2000, 55(1): 145. [[Crossref](#)]
 7. Kayler L, Kang D, Molmenti E, & Howard R. Kidney transplant ureteroneocystostomy techniques and complications: review of the literature. *Transplant Proc*, 2010, 42(5): 1413-1420. [[Crossref](#)]
 8. Kaufman JJ. Ureteral injury from ureteroscopic stone manipulation. *Urology*, 1984, 23(3): 267-269.
 9. St Lezin MA, & Stoller ML. Surgical ureteral injuries. *Urology*, 1991, 38(6): 497-506. [[Crossref](#)]
 10. Selzman AA, & Spirnak JP. Iatrogenic ureteral injuries: a 20-year experience in treating 165 injuries. *J Urol*, 1996, 155(3): 878-881. [[Crossref](#)]
 11. Kavoussi LR, & Peters CA. Laparoscopic pyeloplasty. *J Urol*, 1993, 150(6): 1891-1894. [[Crossref](#)]
 12. Schuessler WW, Grune MT, Tecuanhuey LV, & Preminger GM. Laparoscopic dismembered pyeloplasty. *J Urol*, 1993, 150(6): 1795-1799. [[Crossref](#)]
 13. Wagner S, Greco F, Inferrera A, Hoda MR, Kawan F, Hamza A, et al. Laparoscopic dismembered pyeloplasty: technique and results in 105 patients. *World J Urol*, 2010, 28(5): 615-618. [[Crossref](#)]
 14. Bodie B, Novick AC, Rose M, & Straffon RA. Long-term results with renal autotransplantation for ureteral replacement. *J Urol*, 1986, 136(6): 1187-1189. [[Crossref](#)]
 15. Boxer RJ. Reconstruction of the male external genitalia. *Surg Gynecol Obstet*, 1975, 141(6): 939-944.
 16. Launer BM, Redger KD, Koslov DS, Sax-Bolder AN, Higuichi TT, Windsperger AP, et al. Long-term Follow Up of Ileal Ureteral Replacement for Complex Ureteral Strictures: Single Institution Study. *Urology*, 2021, 157: 257-262. [[Crossref](#)]
 17. Greco F, Alba S, Fornara P, & Mirone V. Renal transplantation: technical aspects, diagnosis and management of early and late urological complications. *Panminerva Med*, 2016, 58(4): 294-303.
 18. Greco F, Hoda MR, Wagner S, Reichelt O, Inferrera A, Fischer K, et al. Adipocytokine: a new family of inflammatory and immunologic markers of invasiveness in major urologic surgery. *Eur Urol*, 2010, 58(5): 781-787. [[Crossref](#)]
 19. Greco F, Veneziano D, Wagner S, Kawan F, Mohammed N, Hoda MR, et al. Laparoendoscopic single-site radical nephrectomy for renal cancer: technique and surgical outcomes. *Eur Urol*, 2012, 62(1): 168-174. [[Crossref](#)]
 20. Ruiz M, Hevia V, Fabuel JJ, Fernández AA, Gómez V, & Burgos FJ. Kidney autotransplantation: long-term outcomes and complications. Experience in a tertiary hospital and literature review. *Int Urol Nephrol*, 2017, 49(11): 1929-1935. [[Crossref](#)]
 21. Tran G, Ramaswamy K, Chi T, Meng M, Freise C, & Stoller ML. Laparoscopic Nephrectomy with Autotransplantation: Safety, Efficacy and Long-Term Durability. *J Urol*, 2015, 194(3): 738-743. [[Crossref](#)]

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