Acta Med. Okayama, 2017
Vol. 71, No. 4, pp. 351–355

Acta Medica Okayama
http://escholarship.lib.okayama-u.ac.jp/amo/

Case Report

Robotic Renal Autotransplantation: First Case Outside of North America

Motoo Araki[a]*, Koichiro Wada[a], Yosuke Mitsui[a], Takuya Sadahira[a], Risa Kubota[a], Shingo Nishimura[a], Takashi Yoshioka[a], Yuichi Ariyoshi[a], Kei Fujio[a], Atsushi Takamoto[a], Morito Sugimoto[a], Katsumi Sasaki[a], Yasuyuki Kobayashi[a], Shin Ebara[a], Hideki Taninishi[b], Hiroyuki Amano[c], Masashi Inui[d], Masami Watanabe[a], Toyohiko Watanabe[a], and Yasutomo Nasu[a]

Departments of [a]Urology, and [b]Anesthesiology, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama 700-8558, Japan
[c]Amano Clinic, Yaizu Shizuoka, 425-0041, Japan
[d]Department of Urology, Tokyo Women's Medical University Yachiyo Medical Center, Yachiyo, Chiba 276-0046, Japan

A 38-year-old woman with a 2.7-cm left ureteral stenosis requiring chronic ureteral stent exchange elected to undergo robotic renal autotransplantation. Left ureteropelvic junction obstruction (UPJO) was also suspected. Robotic donor nephrectomy contributed to the fine dissection for desmoplastic changes. The kidney was removed through a Gelport and examined on ice. UPJO was not seen. An end-to-side robotic anastomosis was created between the renal and external iliac vessels. The console time was 507 min, and the warm ischemia time was 4 min 5 sec. She became stent-free. Robotic renal autotransplantation is a new, minimally invasive approach to renal preservation.

Key words: robotic surgery, renal autotransplantation, ureteral stenosis, laparoscopic surgery, renal transplantation

In 1963, JD Hardy performed the first renal autotransplantation (RATx) to repair a ureteric injury [1]. Since then, the indications for RATx have expanded to include renal vascular trauma, thrombosis, stenosis, and aneurysm, as well as complex ureteral injuries, renal cell carcinoma, urolithiasis, retroperitoneal fibrosis, and loin pain-hematuria syndrome [2, 3]. However, RATx is underutilized because of its invasiveness. Abaza reported the first completely intracorporeal robotic RATx, a minimally invasive approach, to repair a ureteral injury in 2014 [3]. Herein, we report the first case of robotic RATx outside of North America. Institutional review board was approved (#m14014), and the patient's consent to undergo the procedure was obtained.

Case Report

A 38-year-old woman with left ureteral stenosis was referred for urinary tract reconstruction. She had undergone an emergent Caesarean section for intraperitoneal bleeding secondary to left ovarian rupture 4 years earlier. The massive adhesion due to severe endometriosis made her surgery extremely difficult, and the estimated blood loss was 3,950 mL. After the surgery, she developed hypovolemic shock and disseminated intravascular coagulation due to postoperative bleeding.

Received December 16, 2016; accepted March 27, 2017.
*Corresponding author. Phone: +81-86-235-7287; Fax: +81-86-231-3986
E-mail: motoosh@md.okayama-u.ac.jp (M. Araki)

Conflict of Interest Disclosures: No potential conflict of interest relevant to this article was reported.

Left internal iliac artery embolization saved her life. However, it caused a 2.7-cm left ureteral stenosis, which required chronic ureteral stent exchange (Fig. 1). Neither balloon dilation nor laser incision by ureteroscopy was successful. She was advised that she might need a nephrostomy tube at any time because the guidewire could not pass easily. In addition, retrograde pyelography showed a possible left ureteropelvic junction obstruction (UPJO) (Fig. 1). Of note, left hydronephrosis was noted during her pregnancy.

She was counseled on the management options. Nephrectomy was undesirable considering her young age. Ureteroureterostomy, ureteroneocystostomy with or without psoas hitch, and Boari flap were considered technically difficult for the following three reasons. (1) Ureteral dissection may have been so difficult that it could have caused ischemic injury to the ureter, considering the massive adhesion and prior left internal iliac artery embolization. (2) None of the options corrected the possible left UPJO. (3) The patient's bladder capacity was as small as 200 mL, and thus a hitch and Boari might not work. Ileal interposition was not ideal because of the possibility of both severe bowel adhesion and complications related to bowel resection and possible renal impairment secondary to bowel reabsorption of urine when she became older. RATx was this patient's best option, but she was hesitant because of its invasiveness.

Four years later, which was 8 years from the Caesarean section, the patient elected to undergo robotic renal autotransplantation. The procedure was performed transperitoneally using the da Vinci Surgical System at our hospital in Okayama, Japan. She was placed in the left nephrectomy position. Robotic left nephrectomy was performed with three ports on the mid-clavicular line and a Gelport though a 7-cm supra-umbilical midline incision (Figs. 2, 3).

The nephrectomy was extremely difficult because of the severe desmoplastic changes due to chronic inflammation. The left kidney was removed through the Gelport. The warm ischemia time was 4 min 5 sec. The kidney was perfused with Euro-Collins solution on ice. The kidney had a single artery and a single vein. The shape and patency of the UPJ was examined with a vessel dilator and did not demonstrate obstruction. It appeared that the ureter had peeled off from desmoplastic tissue and was straightened.

During this preparation, the patient was repositioned to a low lithotomy position with a steep Trendelenburg tilt, which is the same position used for robotic-assisted laparoscopic radical prostatectomy (RALP). The robot was also re-docked, as is done for a RALP. The right external iliac artery (EIA) and vein (EIV) were circumferentially dissected for clamping and anastomosis. The right pelvis was chosen for transplantation to avoid the desmoplastic changes on the left side. The kidney was brought through the Gelport and placed over the bladder. The EIV was clamped with laparoscopic bulldog clamps, and a venotomy incision was made. A running end-to-side anastomosis was created between the renal vein and the EIV using CV-5 Gore-Tex suture (Fig. 4). Upon the completion of the venous anastomosis, bulldog clamps were placed on the renal vein and the clamps were released from the EIV. Likewise, a running end-to-side arterial anastomosis was created using CV-6 Gore-Tex suture (Fig. 5).

Upon completion, the clamps were removed. The kidney immediately became pink, and urine was seen from the ureter 21 min post-reperfusion. A ureteroneocystostomy was performed by the Lich-Gregoir extravesical technique over a 5Fr stent in running fashion with 4-zero Vicryl suture. The kidney was fixed to the right abdominal wall with 3-zero Vicryl suture and a Hem-o-lok clip to avoid vascular kinking [4]. The surgeon console time was 507 min. The cold ischemia time was 249 min. The venous and arterial anastomosis times were 24 and 28 min, respectively. The ureteroneocytostomy time was 41 min with intraoperative ureteral stent (5Fr, 10 cm) placement (Fig. 6). The estimated blood loss was minimal.

The postoperative course was uneventful. Multiple Doppler ultrasonography measurements demonstrated excellent vascular flow with a normal renal resistive index of 0.63–0.67. She was discharged home on postoperative day (POD) 11. The ureteral stent was removed on POD 33. The patient voids without any discomfort and is extremely happy with being stent-free 8 years after the Caesarean section. The preoperative serum creatinine (SCr) was 0.60 mg/dL, and on PODs 1, 7, and 33 and at 3 and 7 months postoperatively, the SCr was 0.78, 0.71, 0.70, 0.64, and 0.76 mg/dL, respectively. The preoperative urine protein dipstick measurement was 2+. It was ±, −, and − on POD 33 and at 3 and 7 months postoperatively, respectively.

A 99mTc-MAG3 scan performed 3 months postoperatively revealed prompt good blood flow and no uret-

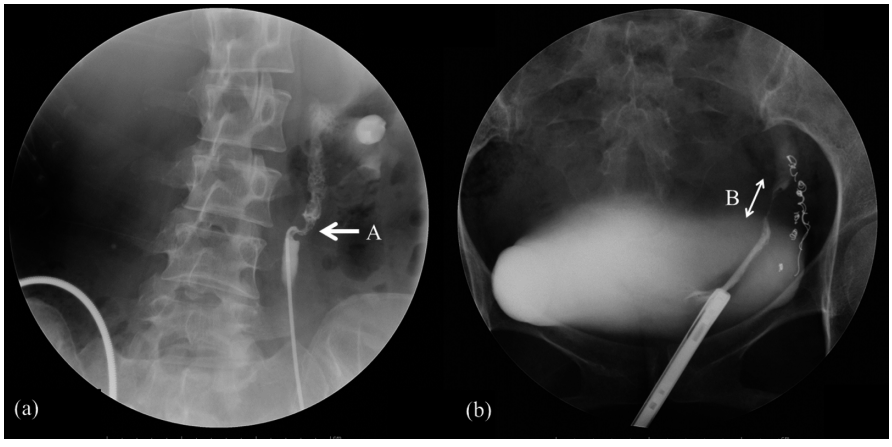

Fig. 1 Preoperative left retrograde urography demonstrating possible ureteropelvic junction obstruction (arrow, A), 2.7-cm ureteral stenosis (arrow, B) and multiple endovascular coils in the left internal iliac artery.

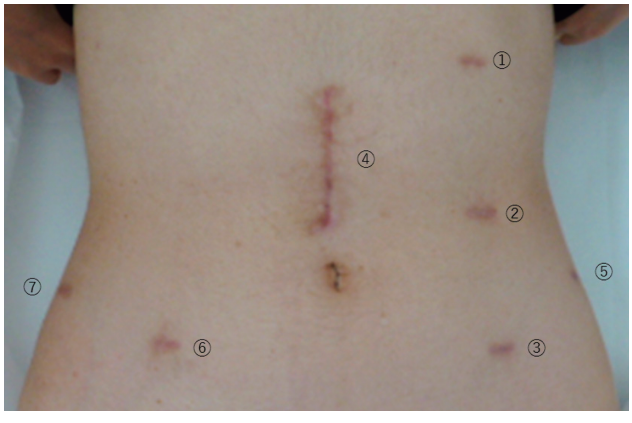

Fig. 2 The scar at 3 months postoperatively. Four ports were used for the nephrectomy part (① 8 mm, ② 12 mm, ③ 8 mm, and ④ 7 cm for the Gelport). Five ports were used for renal autotransplant part (③ 8 mm, ④ 7 cm for the Gelport, ⑤ 8 mm, ⑥ 8 mm, ⑦ 12 mm)

Fig. 3 Gross appearance of the nephrectomy part of the surgery.

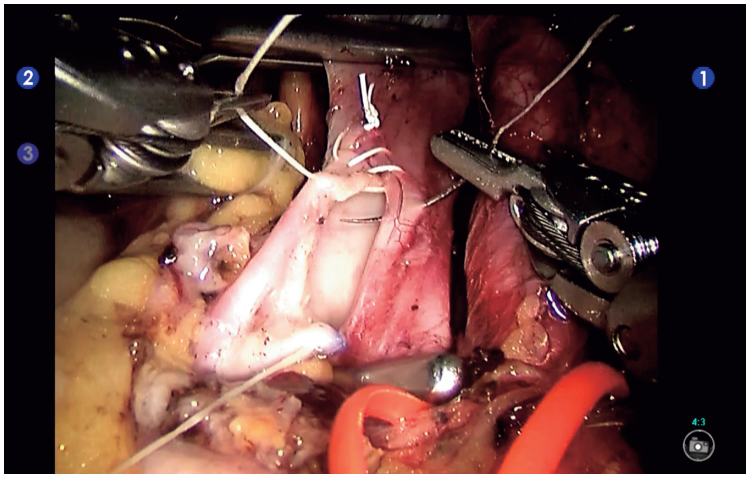

Fig. 4 A running end-to-side anastomosis was created between the renal vein and the external iliac vein using CV-5 Gore-Tex suture.

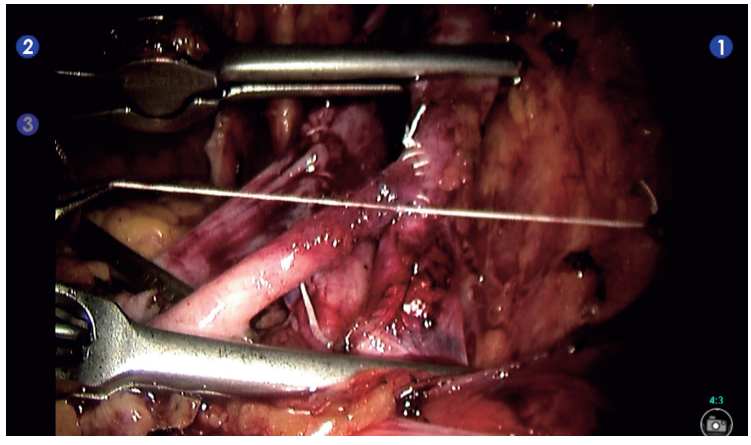

Fig. 5 A running end-to-side arterial anastomosis was completed between the renal artery and the external iliac artery using CV-6 Gore-Tex suture.

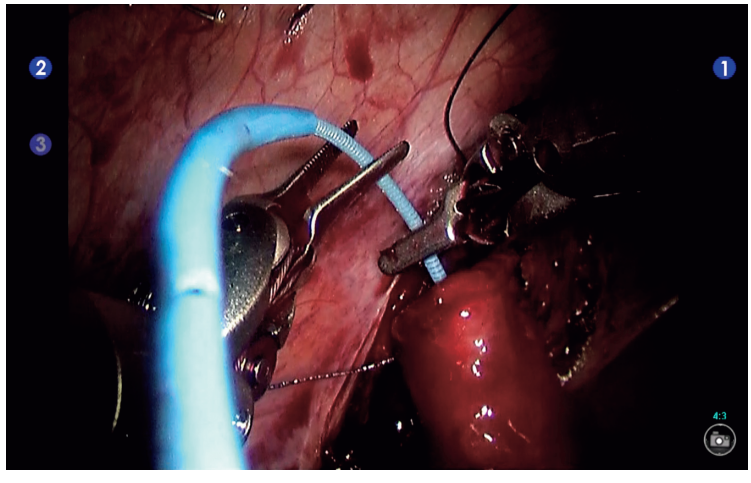

Fig. 6 Intraoperative ureteral stent (5Fr, 10 cm) placement.

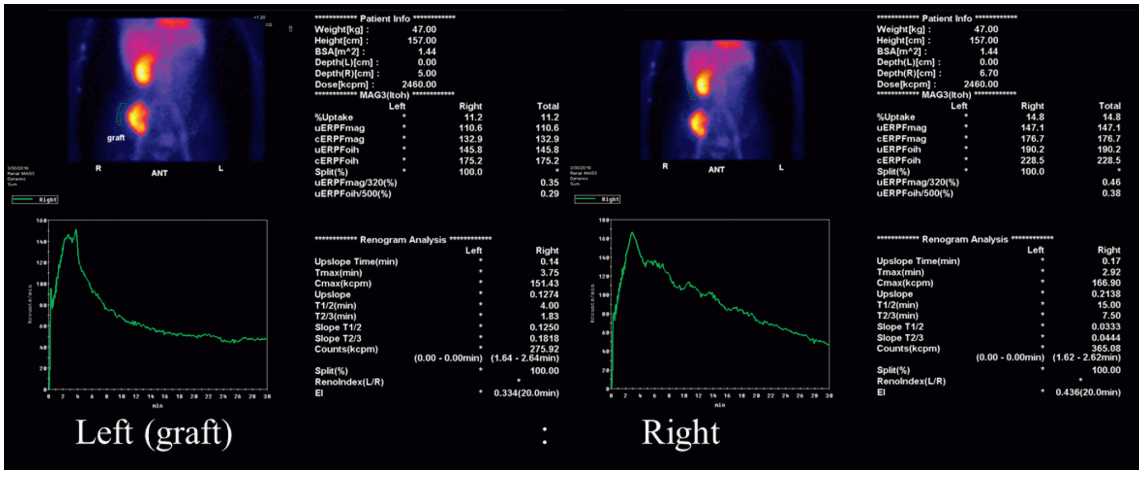

Fig. 7 A 99mTc-MAG3 scan at 3 months postoperatively revealed prompt, good blood flow and no ureteral obstruction. The urine flow was even better on the graft (left) side than the right side.

eral obstruction (Fig. 7). The preoperative split function (left [graft] : right) was 49 : 51, and 3 months postoperatively it was 43 : 57 (Fig. 7). Computed tomography urography obtained 3 and 7 months postoperatively revealed no ureteral obstruction and showed patent vascular anastomoses.

Discussion

Although RATx has excellent outcomes, the conventional open approach requires a large midline xiphoid-to-pubis or flank incision for donor nephrectomy with a second pelvic incision for renal transplantation into the iliac fossa [3, 5]. The current gold standard approach to RATx is a laparoscopic nephrectomy followed by open auto-transplantation [6]. However, this still requires a large pelvic incision. Robotic technology enables us to perform more complex minimally invasive surgery. Hoznek reported the first robotic-assisted kidney transplantation in 2001 [7]. Gordon *et al.* reported the first completely intracorporeal robotic RATx to repair a ureteral injury in 2014 [3]. Since then, only 3 cases have been reported from North America (the third case was done at Cleveland clinic, OH, USA and presented at American Urological Annual Association meeting in 2016, but not published to date (http://www. aua2016. org/abstracts/files/session_BladderOncologyTestisTransplantationTrauma. cfm)) [6].

To the best of our knowledge, the present case is the fourth robotic renal autotransplantation case in the world and the first performed outside of North America. We did not use a completely intracorporeal approach, based on the following reasons. (1) The suspected UPJO required an intraoperative assessment. (2) Safety. (3) Graft cooling in a gauze jacket filled with ice jacket is possible with the non-completely intracorporeal approach [4]. If there had been an obstruction, ureteropelvic or vesicopelvic anastomosis would have been considered.

The shortcoming of robotic RATx is the length of the surgery and the cost. However, with continued use, the operative time should improve and the cost will decrease. Moreover, robotic surgery has various advantages such as fine suturing, motion in narrow spaces, a three-dimensional magnified view, and fine dissection in cases with desmoplastic changes [8]. Robotic surgery was the best option considering the complexity and severe desmoplastic changes in our patient's case.

In conclusion, robotic RATx is useful and a new minimally invasive approach to renal preservation.

References

1. Hardy JD and Eraslan S: Autotransplantation of the Kidney for High Ureteral Injury. J Urol (1963) 90: 563–574.
2. Bluebond-Langner R, Rha KH, Pinto PA, Varkarakis J, Douyon E, Komotar RJ, Jarrett TW, Kavoussi LR and Molmenti EP: Laparoscopic-assisted renal autotransplantation. Urology (2004) 63: 853–856.
3. Gordon ZN, Angell J and Abaza R: Completely Intracorporeal Robotic Renal Autotransplantation. J Urol (2014) 192: 1516–1522.
4. Menon M, Abaza R, Sood A, Ahlawat R, Ghani KR, Jeong W, Kher V, Kumar RK and Bhandari M: Robotic kidney transplantation with regional hypothermia: evolution of a novel procedure utilizing the IDEAL guidelines (IDEAL phase 0 and 1). Eur Urol (2014) 65: 1001–1009.
5. Ratner LE, Kavoussi LR, Schulam PG, Bender JS, Magnuson TH and Montgomery R: Comparison of laparoscopic live donor nephrectomy versus the standard open approach. Transplant Proc (1997) 29: 138–139.
6. Lee JY, Alzahrani T and Ordon M: Intra-corporeal robotic renal auto-transplantation. Can Urol Assoc J (2015) 9: E748–749.
7. Hoznek A, Zaki SK, Samadi DB, Salomon L, Lobontiu A, Lang P and Abbou CC: Robotic assisted kidney transplantation: an initial experience. J Urol (2002) 167: 1604–1606.
8. Stifelman MD, Shah O, Mufarrij P and Lipkin M: Minimally invasive management of retroperitoneal fibrosis. Urology (2008) 71: 201–204.