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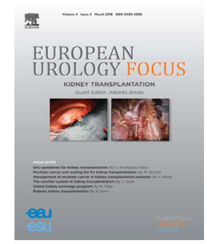

Renal Disease

Robot-assisted Kidney Autotransplantation: A Minimally Invasive Way to Salvage Kidneys

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Abstract

Background: Kidney autotransplantation (KAT) is the ultimate way to salvage kidneys with complex renovascular, ureteral, or malignant pathologies that are not amenable to in situ reconstruction. A minimally invasive approach could broaden its adoption.
Objective: To describe operative technique, perioperative complications, and early functional outcomes of robot-assisted kidney autotransplantation (RAKAT).
Design, setting, and participants: Retrospective review of prospectively collected data regarding consecutive patients undergoing RAKAT between March 2017 and February 2018 at two university hospitals.
Intervention: RAKAT.
Outcome measurements and statistical analysis: Technical feasibility, perioperative complications, and early functional results.
Results and limitations: Seven patients underwent RAKAT (three male and four female; five left and two right; one totally intracorporeal) for complex ureteral strictures ($n = 5$), severe left renal vein nutcracker ($n = 1$), and loin pain hematuria syndrome ($n = 1$). Two patients underwent bench vascular reconstruction and one patient underwent ex vivo flexible ureterorenoscopy. No patient needed open conversion. Median operative and console time was 370 and 255 min, respectively, with median vascular and ureteral anastomosis time of 28 and 23 min, respectively. Median warm, cold, and rewarming ischemia time was 2, 178, and 44 min, respectively. One major postoperative complication occurred—wound dehiscence needing wound revision (grade 3b). Median hospital stay was 5 d. At 3 mo, all patients were free of indwelling stents, pain, or hematuria. Median serum creatinine at 3 mo was 0.80 mg/dl and median calculated autotransplant glomerular filtration rate did not drop significantly.
Conclusions: RAKAT is feasible, safe, and results in good functioning of the autotransplant in selected patients with complex ureteral strictures, loin pain hematuria, or severe nutcracker syndrome. Larger studies with longer follow-up are needed to confirm these findings and to test whether RAKAT is feasible for other KAT indications.

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Patient summary: We describe the first series worldwide of a minimally invasive technique for kidney autotransplantation. Robot-assisted kidney autotransplantation is a safe and feasible approach to prevent nephrectomy for intractable symptoms in selected patients with complex ureteral or renal pathology.

1. Introduction

In 1962, Hardy [1] performed the first kidney autotransplantation (KAT). Since then, KAT has been used as the ultimate way to salvage kidneys with complex renovascular, ureteral, or malignant pathologies. The most frequent indications for KAT include complex lesions of renal vessels, complex high ureteral strictures or tumors, and complex renal parenchyma lesions for which endoluminal or in vivo repair is impossible or contraindicated [2–4]. Less frequent indications include loin-pain hematuria syndrome, retroperitoneal fibrosis, and metabolic stone disease [3,5–7].

Although KAT is associated with a low mortality rate (1.3%), postoperative morbidity may be as high as 46.2% [4,8]. Attempts have been made to reduce the morbidity of open KAT. In 2000, Fabrizio et al [9] described the first laparoscopic nephrectomy for KAT. However, the patient still required a periumbilical incision for extraction of the graft and a pelvic incision for the transplantation. Today, the most accepted approach is to perform laparoscopic nephrectomy and open KAT both using the classical Gibson incision, resulting in possible low complication rate and excellent long-term autograft function [10,11].

The experience with robot-assisted kidney autotransplantation (RAKAT) has been very scarce with only three independent case reports worldwide [12–14], all outside of Europe. Interest for this procedure comes from robot-assisted kidney transplantation (RAKT) that has shown equal results as open KT in terms of patient and graft survival [15]. There is some evidence that RAKT results in smaller scars, less postoperative pain, and a shorter return to activity [16]. The largest European multicenter prospective study on RAKT has recently confirmed the feasibility, reproducibility, and safety of this technique when performed by skilled robotic surgeons [17,18].

Our work describes the first case series of RAKAT in Europe, both with extracorporeal bench surgery and a totally intracorporeal technique.

2. Patients and methods

2.1. Operative technique

Between March 2017 and February 2018, RAKAT was proposed to all patients with an indication for autotransplantation. Ethical Committee approval (B670201732254) was obtained from Ghent University Hospital, and signed informed consent was obtained from all patients. Data were collected prospectively. At Ghent University Hospital, all patients were operated by the same experienced robotic surgeon, DK, together with a transplant team, experienced in robot-assisted living donor nephrectomy and RAKT [17]. Table top graft preparation and vascular reconstruction was performed by a vascular surgeon (DL, RC, VF) and table top flexible ureterorenoscopy by endourologists (VC, TT). The RAKAT procedure was performed on a porcine model at ORSI Academy (Melle, Belgium, Europe). At the University Hospital of Rangueil, one patient was operated by DN with a completely intracorporeal technique. In both centers, kidney harvesting and transplantation were both performed using robot-assisted da Vinci Si System (Intuitive Surgical Inc, Sunnyvale, CA, USA).

Figures 1 and 2 illustrate the trocar and patient positioning of the nephrectomy and transplantation phase for both extracorporeal bench surgery and totally intracorporeal technique. A "donor" nephrectomy is performed with the patient in the lateral decubitus position, maximizing the renal vessel length and transecting the ureter just proximal of the strictured segment or at the level of the crossing with the iliac vessels. After administering 2500–5000 units of heparin intravenously according to the weight of the patient, the renal vessels are transected after double clipping with Hem-o-lok clips (Teleflex Inc, Wayne, PA, USA), followed by a transfixing ligation of the clipped vascular stump with prolene 4/0 (Ethicon Inc, Johnson & Johnson Corp, Cincinnati, OH, USA) to prevent clip slipping. The latter is done after the kidney is exteriorized by the bed-side assistant through GelPOINT (Applied Medical Resources Corp, Rancho Santa Margarita, CA, USA). Upon retrieval, the graft is immediately perfused with Institut Georges Lopez-1 (on the bench or in vivo by continuous renal artery irrigation through a cannula inserted through the assistant port). In one graft (patient A), bench vascular reconstruction was performed for duplicated renal artery (end-to-side reconstruction of lower pole to main artery). The same graft underwent table top flexible ureterorenoscopy to extract a 6-mm lower pole lithiasis during cold storage (Fig. 3). During cold storage, the robot is undocked, the incisions are temporarily closed, and the patient is repositioned in lithotomy position (for the intracorporeal technique, the incisions are not closed and the table is repositioned rather than the patient).

For the transplantation phase, the robot is redocked and RAKT is performed following the Vattikuti Urology Institute-Medanta technique as previously described [19] and adopted by the EAU robotic urology section-RAKT group [17]. Anastomotic steps are illustrated in Figure 3 and Supplementary video.

2.2. Follow-up

Autograft vascularization was examined with Doppler ultrasound immediately postoperatively and at postoperative day (POD) 1, 5, 30, and 90. Patients were mobilized starting from POD 1. The drain was removed on POD 1-2, the bladder catheter on POD 3, and the JJ stent cystoscopically on POD 21 at the outpatient clinic. A kidney ultrasound was performed on POD 30 to rule out hydronephrosis. At POD 90, a 99mTc dimercaptosuccinic acid (DMSA) scintigraphy and in vitro 51Cr-ethylenediaminetetraacetic acid (Cr-EDTA) analysis was performed.

2.3. Study variables and outcomes

The primary outcome of this study was technical feasibility of RAKAT defined as successful completion of RAKAT without intraoperative complications needing open conversion. Secondary outcomes were: (1) surgical outcomes (overall operative time, console time, warm and cold