Robotic Kidney Transplantation from a Brain-Dead Deceased Donor in a Patient with Autosomal Dominant Polycystic Kidney Disease: First Case Report

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Abstract

Background: Autosomal dominant polycystic kidney disease (ADPKD) is a common cause of end-stage renal disease (ESRD) and may pose significant technical challenges for kidney transplantation. Recently, robot-assisted kidney transplantation (RAKT) has been shown to achieve excellent patient and graft outcomes while reducing surgical morbidity. However, the vast majority of RAKT performed so far were from living donors and no studies reported the outcomes of RAKT in patients with ADPKD.

Case Presentation: Herein, we describe the first successful case of RAKT from a brain-dead deceased donor in a 37-year-old patient with ESRD due to ADPKD.

Conclusion: Our case highlights that RAKT can be safely performed by experienced robotic surgeons even in selected complex recipients such as patients with ADPKD and using grafts from deceased donors.

Keywords: autosomal dominant polycystic kidney disease, case report, kidney transplantation, robotics, brain-dead deceased donor

Introduction

Kidney transplantation (KT) represents the most effective treatment in patients with end-stage renal disease (ESRD).

Autosomal dominant polycystic kidney disease (ADPKD) is a common cause of ESRD and may pose significant technical challenges for KT.1

Despite there is still controversy regarding indications and timing of native kidney nephrectomy (NKN), recent evidence suggests that in asymptomatic ADPKD patients, especially with residual diuresis, NKN before or at the time of KT should not be performed in the absence of space conflicts, as it may increase the risk of adverse postoperative outcomes.1

In recent years, robot-assisted kidney transplantation (RAKT) has been shown to accurately reproduce the principles of open KT achieving excellent outcomes while reducing surgical morbidity.2

However, the vast majority of RAKTs were performed from living donors and no studies reported the outcomes of RAKT in patients with ADPKD.

Herein, we describe the first case of RAKT with regional hypothermia from a brain-dead deceased donor in a 37-year-old patient with ESRD due to ADPKD.

Case Report

Clinical case

A 37-year-old Caucasian male patient was referred to our Department from the National Organ Procurement and Transplant Network waiting list for KT.

The recipient was an unmarried office worker with hypertension under pharmacological treatment, no previous
abdominal surgery and ESRD due to ADPKD currently not requiring hemodialysis (preemptive). Pretransplant estimated glomerular filtration rate (eGFR) was 13.7 mL/minute per 1.73 m². Body mass index was 21.9 kg/m². At physical examination, an asymptomatic bilateral flank mass was palpable.

Abdominal MRI scan confirmed the presence of multiple cysts of different diameter within significantly enlarged native kidneys, whose sagittal diameter was >25 cm bilaterally (Fig. 1A). No space constraints were anticipated before RAKT at the putative transplantation site (right iliac fossa) (Fig. 1B, C). As such, no indication was placed for NKN.

The brain-dead donor was a 50-year-old Asiatic male, without significant comorbidities, deceased in a motor vehicle accident. At CT scan, a single renal artery and vein were noticed. Surgical technique of abdominal organ procurement followed established surgical principles. For KT, the right kidney was assigned to our Institution.

RAKT: surgical technique

After multidisciplinary board discussion and obtaining the informed consent, the patient was scheduled for RAKT.

A step-by-step overview of surgical technique of RAKT used in our case is described in Supplementary Data, as well as in Supplementary Video S1 accompanying the article.

RAKT was performed using the da Vinci Xi Robot® (Intuitive Surgical, Sunnyvale, CA) in a four-arm configuration using a 0° lens with the patient in a 30° Trendelenburg position. Surgical technique followed the principles of the Vattikuti–Medanta technique with specific technical modifications to tailor the surgical strategy to the specific patient’s anatomy (Supplementary Data).

At the beginning of the procedure, the abdominal cavity was inspected to ensure the adequacy of the working space for subsequent transplantation at the right iliac fossa (Fig. 1D).

After exposure of iliac vessels and creation of an extraperitoneal pouch, the bladder was detached and prepared for subsequent ureteroneocystostomy. At this point, the graft within the gauze jacket was introduced into the abdominal cavity through the GelPOINT device. Regional hypothermia was achieved by cooling the graft with 200–250 cc of ice slush introduced through the GelPOINT.

After a venotomy was made using a curved cold scissors, the graft renal vein was anastomosed in an end-to-side continuous fashion to the external iliac vein using a 6/0 Gore-Tex suture on a CV-6 TTc-9 needle (Fig. 2). After completion of the venous anastomosis, additional ice slush was introduced to ensure graft cooling.

Subsequently, after clamping of the external iliac artery, a linear arteriotomy was made using robotic curved cold scissors.
Then, the arteriotomy was modeled as a circular arteriotomy and the lumen was flushed with heparinized saline. Then, the renal artery was anastomosed in an end-to-side continuous fashion to the external iliac artery using a 6/0 Gore-Tex suture on a CV-6 TTc-9 needle (Fig. 2). After testing the integrity of the anastomosis, the kidney was revascularized. The graft was inspected for color and turgor and pneumoperitoneum was reduced to 8 mm Hg to check for any bleeding.

**Firefly**/C210 fluorescence imaging technology was used to check kidney and ureteral vascularization in conjunction with intraoperative duplex ultrasound using the da Vinci TilePro/C212 feature (Fig. 3).

The kidney was then allocated into the extraperitoneal pouch. Finally, the ureterovesical anastomosis was performed using a modified Lich-Gregoir technique using two semicontinuous sutures with 4-0 Monocryl sutures (Ethicon, Inc, Cincinnati, OH) over the preplaced 6F, 14 cm Double-J stent. The detrusor muscle was closed with a continuous suture creating an antirefluxing mechanism (Fig. 3).

Intraoperative and perioperative outcomes are shown in Table 1.

Duplex ultrasound of the graft performed on postoperative day 1 showed normal graft perfusion.

At 6-month follow-up, the patient was free of symptoms, with regular voiding function, absence of lymphocele at abdominal ultrasound and optimal renal function (eGFR 76.8 mL/minute per 1.73 m²).

**Discussion**

To the best of our knowledge, this is the first case of RAKT from a brain-dead deceased donor in a recipient with ADPKD. Thanks to the advantages of the robotic platform and the opportunity to use fluorescence imaging to check graft and ureteral reperfusion, RAKT allows to improve precision and technical finesse of vascular anastomoses replicating the principles of open, while reducing surgical morbidity, which is key for fragile and immunocompromised patients with ESRD.2

In our case, RAKT was successfully performed using a standardized surgical technique previously employed for living donors robotic transplantations2 with specific technical modifications aiming to tailor the surgical strategy to the specific patient’s anatomy.

First, dissection of iliac vessels was slightly more extended as compared with RAKT from living donors; second, a higher Trendelenburg tilt (30° vs 15–20°) and pneumoperitoneum
pressure (12 vs 10 mm Hg), as well as a more caudal trocar placement, were needed to increase the working space and the distance from the voluminous polycystic native kidneys. A recent study showed that surgeons with extensive robotic experience had only minimal learning curve for RAKT or no learning curve at all depending on their previous experience in open KT. As such, adoption of RAKT is likely to increase in the future especially at referral Centers with experience in both robotic urologic surgery and open KT. Overall, our case highlights that RAKT can be safely performed by experienced robotic surgeons even in selected complex recipients such as patients with ADPKD and using grafts from deceased donors. Larger studies with longer follow-up and appropriate study design are needed to confirm feasibility and safety of RAKT in these complex clinical scenarios.

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None.

Author Disclosure Statement

The authors declare that they have no conflict of interest.

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Abbreviations Used

ADPKD = autosomal dominant polycystic kidney disease
CT = computed tomography
DF = detrusor flap

eGFR = estimated glomerular filtration rate
EIA = external iliac artery
EIV = external iliac vein
ESRD = end-stage renal disease
GK = graft kidney
InUS = intraoperative duplex ultrasound
KT = kidney transplantation
MRI = magnetic resonance imaging
NKN = native kidney nephrectomy
PF = peritoneal flaps
PK = polycystic kidney
POD = postoperative day
RA = renal artery
RAKT = robot-assisted kidney transplantation
RARP = robot-assisted radical prostatectomy
RV = renal vein
Ur = ureter

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