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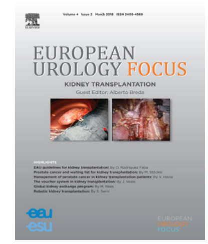

Renal Disease

Robot-assisted Kidney Transplantation with Regional Hypothermia Using Grafts with Multiple Vessels After Extracorporeal Vascular Reconstruction: Results from the European Association of Urology Robotic Urology Section Working Group

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Abstract

Background: Kidney transplantation using grafts with multiple vessels (GMVs) is technically demanding and may be associated with increased risk of complications or suboptimal graft function. To date, no studies have reported on robot-assisted kidney transplantation (RAKT) using GMVs.
Objective: To report our experience with RAKT using GMVs from living donors, focusing on technical feasibility and early postoperative outcomes.
Design, setting, and participants: We reviewed the multi-institutional, prospectively collected European Association of Urology (EAU) Robotic Urology Section (ERUS)-RAKT database to select consecutive patients undergoing RAKT from living donors using GMVs between July 2015 and January 2018. Patients undergoing RAKT using grafts with single vessels (GSVs) served as controls. In case of GMVs, ex vivo vascular reconstruction techniques were performed during bench surgery according to the case-specific anatomy.
Intervention: RAKT with regional hypothermia.
Outcome measurements and statistical analysis: Intraoperative outcomes and early (30 d) postoperative complications and functional results were the main study end-points. Multivariable logistic regression analysis evaluated potential predictors of suboptimal renal function at 1 mo.
Results and limitations: Overall, 148 RAKTs were performed during the study period. Of these, 21/148 (14.2%) used GMVs; in all cases, single arterial and venous anastomoses could be performed after vascular reconstruction. Median anastomoses and rewarming

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times did not differ significantly between the GMV and GSV groups. Total and cold ischemia times were significantly higher in the GMV cohort (112 vs 88 min, $p = 0.004$ and 50 vs 34 min, $p = 0.003$, respectively). Overall complication rate and early functional outcomes were similar among the two groups. No major intra- or postoperative complications were recorded in the GMV cohort. At multivariable analysis, use of GMVs was not significantly associated with suboptimal renal function at 1 mo. Small sample size and short follow-up represent the main study limitations.
Conclusions: RAKT using GMVs from living donors is technically feasible and achieved favorable perioperative and short-term functional outcomes. Larger studies with longer follow-up are needed to confirm our findings.
Patient summary: In this study, we evaluated for the first time in literature the results of RAKT from living donors using kidneys with multiple arteries and veins. We found that, in experienced centers, RAKT using kidneys with multiple vessels is feasible and achieves optimal results in terms of postoperative kidney function with a low number of postoperative complications.

1. Introduction

Anatomic variations in the renal vasculature are common, being reported in 25–40% of kidneys [1–3]. Supernumerary or accessory renal arteries and, to a lesser extent, renal veins, represent the most common variations [1,3].

Grafts with multiple vessels (GMVs) pose a technical challenge for kidney transplantation (KT). Several retrospective studies using different techniques for vascular reconstruction [4–8] have demonstrated feasibility and safety of KT using GMVs [2,9–16]. However, a recent review reported increased risks of complications, delayed graft function (DGF), and lower 1-yr graft survival using GMVs; however, long-term outcomes were comparable to those of KT using grafts with single vessels (GSVs) [9]. Moreover, previous studies have reported a potential increased rate of ureteral complications for grafts with accessory lower pole arteries [17,18]; however, this remains controversial [9].

In 2014, the European Association of Urology (EAU) Guidelines emphasized that grafts with multiple renal arteries or anatomical anomalies should not be considered *absolute* contraindications for living-donor KT due to the shortage of renal grafts and living donations [19].

In recent years, robot-assisted KT (RAKT) has been shown to mirror the principles of open KT while adding all the advantages of minimally invasive surgery [20,21].

The largest European multicenter study on RAKT has recently confirmed its feasibility, reproducibility, and safety when performed by skilled robotic surgeons [22]. Of note, overall evidence is still premature [23]; in a recent systematic review, no significant differences were observed between open and minimally-invasive KT in terms of patient and graft survival [24].

Given these promising results, RAKT has now been adopted at multiple institutions worldwide [2] and its performance will likely increase in the future.

To date, no studies have reported surgical technique and outcomes of RAKT using GMVs. Herein we report the EAU Robotic Urology Section (ERUS) Group experience with RAKT using GMVs from living donors, focusing on technical feasibility and perioperative and early functional outcomes.

2. Patients and methods

2.1. Patients and dataset

After obtaining the Ethical Committee approval and patients' informed consent, data were prospectively collected into the multi-institutional ERUS-RAKT group database.

For the current study, we retrospectively reviewed the database to select consecutive patients undergoing RAKT with regional hypothermia using GMVs from living donors between July 2015 and January 2018 at the eight European centers included in the ERUS-RAKT group.

We defined GMVs as those with greater than or equal to two renal arteries and/or greater than or equal to two renal veins. Patients undergoing RAKT using GSVs (one artery and one vein) were used as controls.

Functional outcomes were evaluated with estimated glomerular filtration rate (eGFR) on postoperative day (POD) 1, 3, 7, and 30, calculated using the Modified Diet in Renal Disease equation [25]. DGF was defined as need for dialysis in the first postoperative week. A detailed overview of the study design is provided in Supplementary Information.

2.2. Preparation of the graft and RAKT technique

All transplant teams at the eight centers included in the ERUS-RAKT group were highly experienced in living donor nephrectomy, robotic urologic surgery, and open KT. Moreover, all surgeons involved in this study followed a standardized modular training program prior to starting their own RAKT experience [22].

All RAKTs performed by each surgeon at each center included in the study since the beginning of their experience were included in the final analytical cohort. As such, our study included the learning curve of all surgeons involved in the RAKT program at each center.

Living donor nephrectomy was performed with a laparoscopic or robotic approach according to hospital resources and surgeon's preference and skills.

After retrieval, the graft was defatted and perfused with cold storage solution as in conventional open KT.

In case of GMVs, specific ex vivo vascular reconstruction techniques, adapted from the open KT experience, have been employed before introduction of the graft into the recipient (Table 1; Fig. 1). In our series, the following reconstruction techniques have been employed according to the case-specific vascular anatomy: (1) conjoined (side-to-side) arterial anastomosis (in a *pantaloon* fashion), (2) reimplantation (end-to-side) of a polar artery into the main renal artery, or (3) a combination of these techniques in case of greater than or equal to three renal arteries