Introducing Robot-Assisted Laparoscopic Donor Nephrectomy after Experience in Hand-Assisted Retroperitoneoscopic Approach

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ABSTRACT

Background. Robot-assisted laparoscopic donor nephrectomy (RALDN) can help to improve donor safety by enabling enhanced precision, flexibility, control, and vision. We are presenting our initial series during the introduction of RALDN by comparing our adopted surgical technique, hand-assisted retroperitoneoscopic donor nephrectomy (HARPDN), performed at the same time interval.

Methods. We performed 12 RALDN and 27 HARPDN with Pfannenstiel incision between March 2018 and July 2018. We evaluated the demographics, operation duration, warm/cold ischemia time, estimated blood loss, length of hospital stay, postoperative complications, and donor and recipient serum creatinine levels retrospectively.

Results. Demographics including sex, mean of age, and body mass index of the 2 groups were similar. Five cases were right sided nephrectomy in the HARPDN group. We performed only left sided donor nephrectomy in the RALDN group. The duration of operation and warm ischemia time was significantly longer in the robot-assisted group ($P < .001$). Postoperative major complications were not detected in any of the donors. The function of the transplanted kidneys in both groups was good on the fifth day and 1 month postoperatively.

Conclusion. We introduced the robot-assisted approach for donor candidates who are not suitable candidates for HARPDN in our center. The operation time and warm ischemia time was longer in the RALDN group, but it did not have any impact on outcome. The robot-assisted donor nephrectomy technique can be introduced safely in centers experienced in the hand-assisted approach.

THE MAIN principle in living kidney donation is increasing donor safety and comfort. Laparoscopic donor nephrectomy has become the gold standard after being introduced by Ratner in 1995 by offering less postoperative pain, better cosmetic outcome, and shorter hospital stay compared to open nephrectomy [1]. Warm ischemia time seemed to be an important disadvantage of full laparoscopic technique. Therefore, hand-assisted donor nephrectomy was introduced that had the beneficial effect of decreasing warm ischemia time [2,3]. Hand assistance also enables tactile sensation and quick intervention in case of emergency [4,5]. But intraperitoneal procedures, full laparoscopic, or hand-assisted brings the risk of intraabdominal complications like organ injuries and intestinal obstruction [4,6]. The retroperitoneoscopic approach has the advantage to avoid intraabdominal complications [7].

The increased use of robotic assistance had influenced transplantation as well during the last decade. Robotic assistance in donor nephrectomy is becoming an increasing trend as it can offer improved safety by enhanced control and vision [8,9]. The quick learning curve compared to

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laparoscopy is another benefit of robotic assistance [10]. We present our series to introduce robot-assisted laparoscopic donor nephrectomy (RALDN) by comparing it to our adopted technique of hand-assisted retroperitoneoscopic donor nephrectomy (HARPDN), performed at the same period of time.

MATERIALS AND METHODS

Donors

We performed 12 RALDN and 27 HARPDN with Pfannenstiel incision between March 2018 and July 2018. The patients who had HARPDN with paramedian incision were excluded mainly to compare postoperative wound complications. The patients who had special interest were referred to the robotic surgery group. All procedures were performed at Istanbul Bilim University Florence Nightingale Hospital by the same surgeon and assistance. We evaluated the demographics, body mass index (BMI), operation duration (skin-to-skin), warm/cold ischemia time, estimated blood loss, length of hospital stay, postoperative complications, and donor and recipient serum creatinine levels retrospectively (Table 1). All cases were completed with the assigned nephrectomy technique. All donors had similar care after the surgery.

Technique of HARPDN

The donor had lateral decubitus position. After the creation of the potential working space at the retroperitoneum by manual dissection, a handport device (Endopath Dextrus minimally invasive hand-assist device, Ethicon Endo-Surgery, Cincinnati, Ohio, United States) was introduced to the Pfannenstiel incision. The Gerota's fascia was incised, and the kidney was freed from the surrounding tissue by using hook cautery and LigaSure (Covidien, Boulder, CO, USA) after introduction of 2 12-mm trocar incisions (subxyphoid, anterior subcostal) accompanied by hand assistance. The vessels were dissected by Endo GIA stapler (Ethicon Endo-Surgery, Cincinnati, OH) after the ureter was clipped and cut. The kidney was extracted through the 7 to 8 cm handport incision.

Technique of RALDN

The donor is positioned in a lateral decubitus position, and the operating table is minimally flexed. We performed a 5 to 6 cm lower transverse incision (Pfannenstiel) for handport insertion; in RALDN, we preferred the Alexis Wound Protector (Applied Medical, Rancho Santa Margarita, Calif, United States) since it has a cap and provides an additional working port for an additional 12-mm trocar. We inserted the 12-mm camera trocar 2 to 3 cm laterally from the umbilicus by hand assistance to increase safety. Two 8-mm trocars were inserted (3 cm distant from subcostal and iliac crest) under camera vision. The docking of 1 camera and 2 working arms of a da Vinci robot were positioned and completed. We preferred the Maryland bipolar forceps and hook to dissect the surrounding tissue and to free the kidney. Other instruments used for aspiration and retraction were inserted through the trocar and placed in the middle of the Alexis cap. The small vessels and ureter were sealed and cut by LigaSure (Covidien, Boulder, CO, USA), and the renal artery and vein were dissected by Endo GIA stapler (Ethicon Endo-Surgery, Cincinnati, OH) by using the same trocar. The kidney was extracted through the Alexis port manually.

STATISTICAL ANALYSIS

Patient characteristics were expressed as mean ± SD for continuous variables and number and percentage for categorical variables. Differences between the groups were compared using the χ^2 test for categorical variables and Student t test for continuous variables. A 2-tailed P value less than .05 was considered significant. Survival analyses were performed with the Kaplan-Meier curve and

Table 1. Comparison of Among RALDN and HARPDN Methods and Demography

	RALDN (n = 12)	HARPDN (n = 27)	*P* value
Age (years)	mean 39.5 (23–63)	mean 43.3 (20–67)	
Sex			
F	7 (58.3%)	16 (59.2%)	
M	5 (41.7%)	11 (40.8%)	
BMI	26.3 (17.3–33.7)	25.2 (18–37)	NS
Nephrectomy			
Left	12	22	
Right	–	5	
Operation Time-STS	190 (120–340) min.	100 (85–120) min.	**.001**
Warm Ischemia Time	235 (180–420) sec.	90 (60–180) sec.	**.001**
Cold ischemia time	61.67 min.	59.63 min.	NS
Estimated blood loss	35 ml	40 ml	NS
Length of hospital	3.25 day	3.07 day	NS
Postop minor complications	1	2	NS
Donor creatinine			
Third day	0.78 mg/dL	0.81 mg/dL	NS
First month	0.95 mg/dL	0.98 mg/dL	NS
Recipient Creatinine			
Fifth day	1.37 mg/dL	1.24 mg/dL	NS
First month	1.13 mg/dL	1.31 mg/dL	NS

Boldface indicates statistically significant values.
Abbreviations: RALDN, robot-assisted laparoscopic donor nephrectomy; HARPDN, hand-assisted retroperitoneoscopic donor nephrectomy; BMI, body mass index; STS, skin-to-skin.

compared with the log-rank test. All statistical analyses were performed using SPSS version 17.0 (SPSS, Inc., Chicago, Illinois).

RESULTS

The demographics including sex, mean of age, and BMI of the 2 groups were similar (Table 1). Five cases were right sided nephrectomy in the HARPDN group. We performed only left sided donor nephrectomy in the RALDN group. There were 4 multiple renal anomalies in the HARPDN group and 1 multiple renal artery anomaly in the RALDN group. The duration of operation was approximately twice as high as that of robotic assisted ($P < .001$). The average operation time was 190 minutes (120–340 min) in the robotic-assisted technique and 100 minutes (85–120 min) in the hand-assisted retroperitoneoscopic technique. The warm ischemia time was significantly longer in the RALDN group. The extraction of kidney was almost 3 times quicker in the HARPDN group with a mean of 90 seconds vs 235 seconds. Duration of cold ischemia time was similar in both groups. There were no major bleeding or major perioperative complications in both groups. All recipients had immediate graft function. Three donors had Clavien-Dindo Grade I complications that revealed slight cellulitis at the incision site. Duration of hospital stay for donors (mean 3.25 vs 3.07 days) and recipients (mean 5.33 vs 5.26 days) were similar. There was no statistical significance at mean of serum creatinine levels in donors or recipients in both groups (Table 1). All kidney grafts were functional 1 month postoperatively.

DISCUSSION

We adopted the hand-assisted retroperitoneoscopic (HARP) technique as our donor nephrectomy technique in our clinic since 2009 with a series of more than 750 donors by the start of this study. HARPDN surgical technique enables better donor safety by avoiding intraabdominal complications as well as offering the benefits of tactile sensation [4,7]. Pfannenstiel incision was promoted over paramedian incision in time in order to decrease the wound complications in our series. Hand assistance through a Pfannenstiel incision can be very challenging for tall donors. If the donor has low BMI, the assisted-hand maneuver can be even more challenging. This situation is not only a difficulty for the surgeon but also can bring increased wound complications because of the stress on the handport [11].

The requirement of a nephrectomy approach without hand assistance for especially thin and tall donors became a major concern in time. As being more experienced technically in hand assistance rather than full laparoscopy, we preferred to use robotic surgery to benefit from enhanced precision, flexibility, control, and vision. The quicker learning curve for robotic surgery compared to laparoscopy was another concern as well [12]. Robotic surgery enabled also smaller Pfannenstiel incisions compared to handport incision using the HARPDN technique for extraction of the kidney.

The mean operation time in RALDN cases was 190 (120–340) minutes and mean warm ischemia time was 235 (180–420) minutes. These time limits were significantly higher compared to times of HARPDN. The significantly increased operation and warm ischemia time at RALDN group did not cause any adverse outcome including surgical complications, graft function, and hospital stay in our series. This result is in concordance with other series [9]. The operation time decreased from 201 minutes to 103 minutes at the early and last stages of the learning curve at Horgan's series consisting of 214 cases [12].

Only donors with left sided kidney donation were referred to RALDN. We used 2 arms of the robot rather than 3 for cost effectiveness. The cost of robotic surgery was an important concern in several other countries [13]. The Pfannenstiel incision that was performed at the beginning of the surgery enables safe insufflation and introduction of trocars. Use of the Alexis System as the assisting trocar at this site prevents extra trocar insertion. Mounting this access initially not only helps to bring the kidney out quickly but also helps as an access for immediate hand assistance if it's required. The decreasing cost of robotic equipment in the future can enable the use of a third arm without economical concerns. The use of a third arm can add even more to utilization of robotic assistance in donor nephrectomy.

CONCLUSION

HARPDN can be a challenging technique with a higher risk of wound complications, especially in tall and thin donors, which gave rise to the need to perform alternative approaches for donor nephrectomy. We introduced robot-assisted approach as an alternative donor nephrectomy technique without any postoperative complication in our center. The operation time and warm ischemia time was longer in the RALDN group, but it did not have any impact on immediate and early graft function. The robot-assisted donor nephrectomy technique can offer safe introduction in centers experienced in the hand-assisted approach.

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