Can robot-assisted renal transplantation provide higher quality of life than open renal transplantation during the early postoperative period?

Mithat Ekşi[1], Selçuk Şahin[1], İsmail Evren[1], Yusuf Arıkan[1], Fatih Gökhan Akbay[2], Serdar Karadağ[1], Ahmet Faysal Güler[1], Zülal Çelik[3], Süheyla Apaydın[2], Ali İhsan Taşçı[1], Volkan Tuğcu[4]

[1] Bakirkoy Dr. Sadi Konuk Training and Research Hospital, Department of Urology, Istanbul, Turkey

[2] Bakirkoy Dr. Sadi Konuk Training and Research Hospital, Department of Nephrology, Istanbul, Turkey

[3] Karaman Training and Research Hospital, Deparment of Psychiatrity, Karaman, Turkey

[4] Bahçelievler Memorial Hospital, Deparment of Urology, Istanbul Turkey

Corresponding author

Author Mithat Ekşi, M.D.

Address Arnavutkoy State Hospital, Department of Urology, Istanbul, Turkey

Phone +90 506 252 82 83

E-mail mithat_eksi@hotmail.com

ORCID: 0000-0003-1490-3756

Keywords: End-stage renal disease; Open renal transplantation; Robot-assisted renal transplantation; Quality of Life

Conflict of interest statement: The authors declare that they have no conflict of interest

Word Count of text: 2461

Word Count of the abstract: 199

Abstract

Aim: To investigate the quality of life (QoL) in patients with end-stage renal disease who underwent open or robot-assisted renal transplantation (ORT and RART).

Materials and Methods: Patients who underwent ORT and RART at Bakirkoy Sadi Konuk Training and Research Hospital between June 2016 and December 2018 constituted the target population of this study. The patient group was divided into two groups as per the surgical technique (i.e., open vs. robot-assisted). Demographic data, preoperative and postoperative data of all patients were collected prospectively. The QoL of the patients was assessed preoperatively and on the postoperative 30th day.

Results: 67 patients who underwent ORT and 60 patients who underwent RART were included. The mean patient age and BMI were calculated as 40,9 ± 11,6 years and 24,4 ± 2,9 kg/m^2, respectively. While mean total ischemia time was shorter in the 'open' group, incision length, duration of surgical drainage and hospital stay were shorter in the 'robot-assisted' group. The physical component scores of the QoL questionnaire revealed that postoperative impairment of quality of life was more significant in the ORT than the RART.

Conclusion: Patients who underwent RART have a higher QoL than the patients who were treated with ORT as per their self-reported QoL scores in the early postoperative period.

Keywords: End-stage renal disease; Open renal transplantation; Robot-assisted renal transplantation; Quality of life

What's known?

Renal transplantation is the gold standard treatment modality for End Stage Renal Disease. As per patients' self reported quality of life data, compared to other renal replacement methods, it is known that open renal transplantation is the treatment method that increases the quality of life most significantly.

What's new?

Both open renal transplantation and robot-assisted renal transplantation lead to improvement in quality of life. However, the robot-assisted technique provides less postoperative pain and complications rate and shorter hospital stay. With patients self reported quality of data and our operative and postoperative data revealed that robot assisted renal transplantation can provide higher patient comfort than open renal transplantation in the early post-transplant period. Our study is the largest comparison of Open and Robot Assisted Renal Transplantation from a single center and surgeon and the first study which proves the quality of life improvement with Robot Assisted Renal Transplantation as per patients self reported quality of data.

INTRODUCTION

Renal transplantation (RT) is the gold-standard treatment method in end-stage renal disease (ESRD) (1). ESRD related mortality decreased after the introduction of open RT (ORT). (2) Since there has been significant improvement in terms of graft survival, ‘patient-reported increase in quality of life’ has arisen as a new target and success criterion for RT (3,4).

It is known that the potential positive influence of RT on the recipient's quality of life may be masked during the early postoperative period due to factors such as surgery-related pain and adverse effects of immunosuppression (5,6).

There is a tendency towards the implementation of minimally invasive techniques in the field of RT due to their potential to provide increased patient comfort and higher quality of life. (7) In parallel, it has been reported that robot-assisted RT technique (RART) developed in recent years by Hoznek et al. and Menon et al. provided significant advantages in terms of convalescence in the early postoperative period when compared with ORT (8–10).

In this study, we aimed to compare both treatment outcomes and patient-reported quality of life indices in the early postoperative period between our patients who underwent ORT and RART.

MATERIALS and METHODS

Study design and Patient selection

Bakirkoy Dr. Sadi Konuk Training and Research Hospital Ethical Committee approved this study (Decision number and date: 20160712-201680, 15-6-2015), which was registered at Clinicaltrials.gov (NCT04435171). All patients gave their verbal and written consent before participating in this study. Data of the patients who underwent ORT and RART at our center between June 2016 and December 2018 were prospectively recorded. Patients aged between 18 and 75 who were diagnosed with ESRD (i.e., estimated glomerular filtration rate lower than 20 ml/minute or symptomatic uremia or dialysis requirement) and received a kidney from a live donor from relatives were included. Patients with mental retardation, dementia, and psychotic or cognitive disorders, including delirium, were excluded from the study. Patients who underwent deceased RT and who underwent simple bilateral nephrectomy or any other surgical procedure concurrent with ORT, patients who died or had graft failure during the study period were also excluded.

Preoperative evaluation

Standard laboratory work-up, immunological tests, radiological imaging including urinary ultrasound and doppler ultrasonography for iliac vessels in recipients and computed tomographic angiogram for the assessment of donor renal vessels and renal scintigraphy for analysis of split renal functions were performed preoperatively.

Surgical technique

All donor nephrectomy procedures were performed by the transperitoneal laparoscopic approach. The RART surgeries were performed using the Da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, CA, US) by the technique described by Menon et al (10). All RT procedures were performed by the same transplant surgeon (V.T.), who is experienced in both ORT and RART.

Variables and Definitions

Demographic variables and preoperative data including age, gender, comorbidities, body mass index (BMI), American Society of Anesthesiology (ASA) Score, the reason of ESRD, presence or absence of dialysis requirement, preoperative serum creatinine and hemoglobin levels and estimated glomerular filtration rate (eGFR) were prospectively recorded.

Also, intraoperative and postoperative parameters including total ischemia, surgical time, estimated blood loss (EBL), incision length, postoperative first and 30^{th}-day serum creatinine, hemoglobin and eGFR levels, presence or absence of delayed graft function (DGF), postoperative pain scores, duration of surgical drainage and hospital stay were recorded.

The DGF was defined as a dialysis requirement within the first week after RT. Postoperative pain scoring was done via a visual analogue scale (VAS).

Immunosuppressive treatment

Anti-thymocyte globulin was given to recipients with high immunological risk. Prednisone, mycophenolate mofetil and tacrolimus were given as the maintenance immunosuppression regimen to all patients irrespective of the surgical technique.

Quality of life analysis

Health-related quality of life of the recipients was analyzed by the Short Form-36 Health Survey (SF-36). This survey consists of 36 questions and eight domains which analyze physical function (PF), physical role functioning (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social role functioning (SF), emotional role functioning (RE) and mental health (MH). The eight domains of the SF-36 survey are summarized under two subgroups: Physical Component Score (PCS) and Mental Component Score (MCS). While PF, RP, BP and GH are the main determinants of PCS, VT, SF, RE, and MH are the primary determinants of MCS. Scores of these parameters vary between 0 and 100; a score of 0 corresponds to the lowest quality, while 100 indicates the highest quality. The SF-36 questionnaires were filled by the patients This interrogation was performed twice for each participant, the first assessment was done preoperatively, and the second evaluation was performed one month after RT.

Statistical analysis

Percentages were given for categorical variables. Means, standard deviations, median and interquartlie range (IQR) were used for evaluation of the study data. We tested the normal distribution of the continuous variables by the Kolmogorov Smirnov test. The Chi-Square test was performed to analyze the relationship between the categorical variables. The Fisher-Freeman-Halton test was performed for comparing categorical variables when appropriate. We performed the Independent samples t-test for comparison of two groups in terms of continuous independent variables with a normal distribution. The dependent samples t-test was done for comparison of two groups regarding dependent variables with a normal

distribution. We used the Mann Whitney U test was used for comparing two independent groups in terms of variables without normal distribution. Wilcoxon ranked sign test was performed for comparison of two groups concerning independent parameters without normal distribution. Pearson correlation analysis test was done for testing potential correlations between non-normally distributed variables. Statistical results were considered significant when p value was lower than 0,05. All statistical analyses were performed via NCSS 11 (Number Cruncher Statistical System, 2017 Statistical Software).

RESULTS

After application of inclusion and exclusion criteria, 67 patients who underwent ORT and 60 patients who underwent RART participated in this study. Among these patients, 82 (64,5%) were males, and 45 (35,4%) were females. There was no significant difference between two groups in terms of gender distribution. Mean patient age and BMI were calculated as 40,9 ± 11,6 years and 24,4 ± 2,9 kg/m^2, respectively. Patients in the RART group were significantly younger than the patients in the ORT group. (p=0,002). There were no significant differences between two groups in terms of BMI, ASA and the ratio of premptive patients. Mean preoperative hemoglobin level was significantly higher in the ORT group than the RART group (p=0,003). Total ischemia times were significantly shorter in the ORT group than the RART group (p=0,001). The EBL, incision length, drain withdrawal time and length of stay were significantly higher in the ORT group. The VAS scores calculated at postoperative 12^{th}, 24^{th}, 36^{th} and 48^{th} hours were significantly lower in the RART group. Postoperative 30^{th}-day blood hemoglobin levels were significantly higher in the RART group than the ORT group (p=0,045). (Table 1) There were no difference between groups for DGF. Primary reasons for ESRD are displayed in Table 2. Intraoperative and immediate postoperative complications were encountered in 15 (22,3%) and 5 (8,3%) patients in ORT and RART, respectively (p=0,036).

There was no significant difference between the groups in terms of SF-36 subparameters preoperatively. Comparison of the changes in preoperative and postoperative scores revealed that a significant differences between two groups for all psychical subparameters which were PF, RP, BP and GH in favour of the RART group. (Table 3).

Analysis of PCS and MCS in ORT patients revealed that PCS scores decreased significantly in the postoperative period. Although both scores decreased in the RART group, no significant difference was determined. Comparison of the variations elucidated that there was a significantly smaller decrease in the PCS of the RART group (Table 4). Interrogation of the parameters which have a potential influence on PCS and MCS showed in Table 5.

DISCUSSION

A significant decrease was detected in ESRD-related mortality after the introduction of ORT (2,11). Improvements in surgical technique, patient care, and immunosuppressive protocols led to significantly better graft survival in the last decade. (1) Consequently, patient-reported quality of life indices arose as new determinants of treatment success. (1,4) General or disease-specific surveys, including SF-36, Kidney Transplant Questionnaire, The Kidney Disease Quality of Life, and End-Stage Renal Disease Symptom Checklist Transplantation Module, were used to assess the post-transplant quality of life. The SF-36 is an international, general quality of life survey that can be used both for patients and healthy population. It is a convenient, relatively short form, which can also be used to compare the quality of life in different patient groups. It was developed by Rand Corporation in 1992, translated to Turkish by Kocyigit et al., and subsequently validated in 2005 (12,13). In our study, we preferred SF-36 since it is practical and its efficacy and reliability were confirmed for the post-transplant patient population (14).

It is widely accepted that the health-related quality of life is lower than the general population in ESRD patients (6,13). Both ESRD patients and RT recipients may be afflicted

by systemic disease-related stress, adverse effects of immunosuppression, and anxiety originating from the fear of rejection; these factors may altogether lead to psychogenic as well as somatic symptoms (15). In line with this finding, we found that preoperative and postoperative mean SF-36 scores of our study population were lower than the typical values of the Turkish population (16). It has been shown that RT was significantly superior to other renal replacement methods in improving the life quality of ESRD patients (17,18). Also, it was reported that this improvement was independent of the pre-transplant dialysis type, and it was more prominent in live RT recipients (19).

The favorable effects of RT on quality of life may be inapparent in the immediate post-transplant period owing to factors such as pain, side effects of immunosuppression, infections, and high expectations of the patients (6). It has been reported that the lowest SF-36 scores in patients who underwent ORT were encountered in postoperative 30th day when these assessments were performed at different time intervals during the postoperative 1st year. In another study that evaluated the patients' quality of life throughout the post-ORT 2-year period with SF-36 questionnaires, the authors reported that they encountered the lowest scores for PF, RP and SF in postoperative 30th-day assessment (20).

There is a tendency towards the implementation of minimally invasive techniques in the field of RT as well as other surgical procedures due to their potential to provide increased patient comfort and higher quality of life (7). Although Modi et al. introduced laparoscopic RT, it could not be integrated into routine clinical practice since it necessitates advanced laparoscopic skills (21). The RART technique was described by Hoznek et al. and further developed by Oberholzer et al. and Menon et al (8–10). Since then, favorable outcomes have been achieved in several transplant centers (8–10,22,23).

It was reported that RART had advantages such as lower postoperative pain scores, complication rates, shorter duration of surgical drainage, and hospital stay over ORT (7).

Also, RART is associated with shorter incision length and lower wound infection rates (24–26). Besides, lymphocele, which is frequently encountered in ORT patients, has not been reported in any RART series, including ours (27,28).

Several parameters affecting the quality of life of patients who received renal replacement therapies, including RT, have been reported (4,5). Some studies suggested that the increase in hematocrit and hemoglobin levels after ORT had a significant influence on the quality of life of patients (29). Besides, the treatment of anemia was shown to have ameliorating effects on physical and cognitive parameters (30). As such, in our study, we determined that EBL negatively correlated with postoperative PCS, while postoperative 30th-day hemoglobin levels correlated positively with postoperative PCS. Also, we determined that mean EBL was significantly lower, and postoperative 30th-day hemoglobin level was significantly higher in the RART group than the ORT group.

We found that duration of both hospital stay and surgical drainage were shorter in the RART group than the ORT group. Also, the VAS scores measured on postoperative 12th, 24th, 36th and 48th hours were significantly lower in the RART group than the ORT group. We postulate that these durations which negatively correlate with postoperative PCS were shorter in the RART group since postoperative PCS was significantly higher in this group.

One of the biggest advantages of robot-assisted surgery is relatively lower complication rates (7). Wound infections and lymphoceles are rare with this method (26,27). In our series, the complication rates were 22,3% and 8,3% for ORT and RART groups, respectively (p=0,036). Presence of complications correlated negatively with postoperative PCS. We postulate that the significantly low complication rate in the RART group is related to the high PCS in this group.

To the best of our knowledge, our study represents the largest series comparing ORT and RART in terms of patient-reported quality of life and investigating the relationship of this

parameter with pre-RT and post-RT clinical variables. Although its prospective design and strict exclusion criteria can be deemed as its additional strengths, it has some restrictions which should be considered while evaluating its findings. Even though it has the largest patient series reported in the literature, its sample size is still small. Also, there was no randomization.

CONCLUSION

We conclude that RART has advantages over ORT in terms of most parameters affecting SF-36 scores calculated during the early postoperative period of RT. Therefore, RART can provide higher patient comfort than ORT in the early post-transplant period based on the patients' self-reported quality of life scores.

Take Home Messages:

-Both open renal transplantation and robot-assisted renal transplantation can provide satisfactory functional outcomes

-Robot-assisted renal transplantation is associated with less postoperative pain, less complication rate, shorter duration of hospital stay and surgical drainage

-As per patients' self-reported quality of life data, RART can provide higher patient comfort than ORT in the early post-transplant period.

Table 1: Demographic, preoperative, peroperative and postoperative data of all patients and comparison of the groups

Parameters (mean ± SD)	**All**	**ORT**	**RART**	**p**
Age *(year)*	40,9 ± 11,6	43,9 ± 11,8	37,5 ± 10,4	**0,002***
BMI *(kg/m^2)*	24,4 ± 2,9	24,8 ± 2,1	23,9 ± 3,5	0,088
Preoperative				
Hemoglobin *(g/dL)*	10 ± 2	10,5 ± 1,8	9,4 ± 2,1	**0,003***

Creatinine *(mg/dL)*	6,9 ± 2,4	7,1 ± 1,8	6,8 ± 2,9	0,477
eGFR *(mL/min/1,7)*	10,6 ± 3,9	10,5 ± 3,5	10,6 ± 4,4	0,918
Premptive *(n ; %)*	44 (34,6)	20 (29.6)	24 (40)	0,256
Operation Time *(mn)*	248,1 ± 45,3	245,6 ± 47,6	251 ± 42,7	0,511
Total ischemia time *(mn)*	77,5 ± 22,4	71,2 ± 8,8	84,6 ± 29,9	**0,001**
EBL *(ml)*	193 ± 49,2	211,8 ± 27,7	172,3 ± 58,9	**<0,001***
Incision Length *(cm)*	8,2 ± 3,1	11 ± 1,4	5 ± 0,8	**<0,001**
Postoperative 1th Day				
Hemoglobin *(g/dL)*	9,3 ± 1,3	9,1 ± 0,9	9,5 ± 1,6	0,083
Creatinine *(mg/dL)*	3,7 ± 1,4	3,7 ± 0,8	3,8 ± 1,8	0,533
eGFR *(mL/min/1,7)*	24 (14)”	24 (13)”	21 (18,8)”	**0,017**
Length of stay *(day)*	12 ± 9,4	14,3 ± 12,2	9,2 ± 3,1	**0,002**
Drain withdrawal time *(day)*	5 (4)”	6 (1,5)”	3 (1)”	**<0,001**
VAS *(hour)*				
Postoperative				
12th	7 (1)”	7 (1)”	6 (2)”	**<0,001**
24th	5,4 ± 1,3	6,1 ± 0,8	4,5 ± 1,2	**<0,001**
36th	4 (1)”	5 (1)”	4 (2)”	**<0,001**
48th	3 (1)”	4 (1)”	3 (2)”	**<0,001**
DGF	5 (3,9)	3 (4,4)	2 (3,3)	0, 387
Postoperative 30th Day				
Hemoglobin *(g/dL)*	11,2 ± 1,4	11 ± 0,8	11,5 ± 1,9	**0,045**

Creatinine *(mg/dL)*	1,4 ± 0,8	1,5 ± 1	1,3 ± 0,4	0,108
eGFR *(mL/min/1,7)*	66,5 ± 24,1	65,9 ± 25,1	67,2 ± 23,2	0,764*

Mann Whitney U test * Independent Samples T test " Presented as median (interquartile range) **ORT:** Open renal transplantation **RART:** Robot assisted renal transplantation **BMI:** Body Mass Index **eGFR:** Mean Glomeruler Filtration Rate **EBL:** Estimated Blood Loss **VAS:** Visual Analogue Scale

Table 2: The primary reasons for End Stage Renal Disease.

Primary Reason	**ORT (n ; %)**	**RART (n ; %)**
Diabetes Mellitus	11 (16,4)	11 (18,3)
Hypertension	11 (16,4)	32 (53,3)
Chronic Glomerulonephritis	5 (7,46)	1 (1,6)
Obstructive Uropathy	3 (4,47)	-
Nephrotic Syndrome	2 (2,98)	-
IgA Nephropathy	2 (2,98)	-
Vesicoureteral Reflux	1 (1,49)	-
Idiopathic	32 (47,7)	16 (26,6)

ORT: Open renal transplantation **RART:** Robot assisted renal transplantation

Table 3: In-group changes of preoperative and postoperative 30th day SF-36 subparameters and comparison of the changes between two groups.

Subparameters (mean ± SD)		ORT	RART	p
PCS (Preop-Postop)				
PF		76,7 ± 13,7	76,2 ± 15,9	**<0,001***
		55,8 ± 16,8	66,5 ± 13,4	
	p	**<0,001****	**<0,001****	
RP		55,9 ± 19,7	55,4 ± 16,6	**0,002***
		39,7 ± 14,5	51,5 ± 10,6	
	p	**<0,001****	0,201**	
BP		75 ± 14,4	76,6 ± 23,2	**0,005***
		58 ± 13,3	71,2 ± 12,7	
	p	**<0,001****	**<0,001****	
GH		56,1 ± 19,9	50,6 ± 16,6	**<0,001***
		46 ± 16	57,5 ± 17,1	
	p	**0,002****	**0,007****	
MCS (Preop-Postop)				
MH		73,2 ± 14,1	73,8 ± 16,3	0,936*
		67,1 ± 12,5	68,2 ± 20,4	
	p	**0,009****	0,123**	

SF		64,6 ± 22,8	62,2 ± 23	0,965*
		50,5 ± 21,6	47,9 ± 9	
	p	**<0,001****	**<0,001****	
RE		62,4 ± 17,5	63,2 ± 20,4	0,702*
		74,5 ± 13,3	72,7 ± 24	
	p	**<0,001****	**0,026****	
VT		48,7 ± 16,7	48 ± 13,3	0,570*
		50,3 ± 18,9	52 ± 10,9	
	p	0,596**	**0,015****	

*Independent Samples T test **Paired sample t test **ORT:** Open renal transplantation **RART:** Robot assisted renal transplantation **PCS:** Physical Component Score **PF:** Physical functioning **RP:** Physical role functioning **BP:** Bodily Pain **MCS:** Mental Component Score **GH:** General Health Perceptions **MH:** Mental Health **SF:** Social functioning **RE:** Emotional role functioning **VT:** Vitality

Table 4: Comparisons of preoperative and postoperative 30th day PCS and MCS changes

	ORT (mean ± SD)	**RART** (mean ± SD)
PCS		
Preoperative	45 ± 5,1	44,3 ± 5,8
Postoperative	36,1 ± 4,3	42,5 ± 4,4
p	**0,000****	0,062**
MCS		

Preoperative	49,5 ± 6,2	46,4 ± 5,6
Postoperative	48,1 ± 5	45,8 ± 6,9
p	0,154**	0,628**

*Independent Samples T test **Paired sample t test **ORT:** Open renal transplantation **RART:** Robot assisted renal transplantation **PCS:** Physical Component Score **MCS:** Mental Component Score

Table 5: Parameters affecting preoperative and postoperative PCS and MCS.

Parameters	**P and Correlation Coefficients**	
	MCS (preop.)	**PCS (postop.)**
Creatinine (preop.)	**0,031* (-,192)**	-
EBL	**-**	**<0,001** (-,366)**
VAS 12th hour	**-**	**0,003** (-,263)**
VAS 24th hour	**-**	**0,001** (-,295)**
VAS 36th hour	**-**	**<0,001** (-,312)**
VAS 48th hour	**-**	**<0,001** (-,297)**
Drain withdrawal time	**-**	**<0,001** (-,496)**
Length of stay	**-**	**<0,001** (-,366)**
Presence of Complication	**-**	**<0,001** (-,492)**
Hg (postop. 30th day)	**-**	**0,017* (,211)**

*Independent Samples T test **PCS:** Physical Component Score **MCS:** Mental Component Score **EBL:** Estimated Blood Loss **VAS:** Visual Analogue Scale **Hg:** Hemoglobin

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Compliance with ethical standards

Conflict of interest

The authors declare to have no conflict of interest.

Research involving human participants

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Patients have given prior consent.

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