Sexual Function in Renal Transplant Recipients with Internal versus External Iliac Artery Anastomosis: A Randomized Clinical Trial

Amir Javid[1], Narjes Saberi[1]*, Amir Behnamfar[1], Hosna Gharzi[2], Farshad Gholipour[1], Hossein Bahrami[1]

Purpose: The choice between using the internal or external iliac arteries to supply a transplanted kidney poses a dilemma during renal transplantation. As the internal iliac artery branches to the genital tract, cutting it could potentially result in sexual dysfunction. The purpose of this study was to compare the effects of these two surgical methods on sexual function.

Materials and methods: 122 sexually active male patients under the age of sixty were randomly divided into two groups: the internal iliac anastomosis group and the external iliac artery anastomosis group. Before surgery and one year after the procedure, patients completed the International Index of Erectile Function-15 questionnaire (IIEF-15), and the difference in scores of each domain was measured.

Results: Statistically, kidney transplantation improved all domains of IIEF in both groups, except for erectile function in patients who underwent internal iliac artery anastomosis group. Additionally, there were significant differences between the two groups in the domains of erectile function (p-value=0.04) and overall satisfaction (*p*-value = 0.002), while other domains such as orgasmic function, sexual desire, and intercourse satisfaction did not show any statistically significant differences.

Conclusion: In conclusion, the choice between using the internal or external iliac artery for arterial anastomosis during kidney transplantation does not significantly impact graft function. However, it may negatively affect erectile function in patients who undergo internal iliac artery anastomosis.

Keywords: kidney transplantation; sexual function; artery anastomosis; complication

INTRODUCTION

The success and potential complications of transplantation, in addition to the careful selection of the appropriate recipient and donor, hinge on the meticulous choice of the suitable location and method for arterial anastomosis.[1] The two most commonly used techniques are end-to-end internal iliac artery anastomosis and end-to-side external iliac artery anastomosis. Due to the different blood supply between the two arteries, different results and complications are expected for these two techniques. Because the genital tract draws its blood supply from the internal iliac artery, it seems probable that ligation of this artery during arterial anastomosis in kidney transplantation may lead to sexual dysfunction in men.

There are several methods to evaluate sexual function, and one of them is through the use of the International Index of Erectile Function (IIEF) questionnaire, which was developed in 1997. This questionnaire comprises five domains, namely: erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction.[2] Consisting of fifteen questions, the IIEF questionnaire has been translated into multiple languages, including Persian, and its validity and reliability have been verified.[3]

Most of the research comparing internal and external iliac artery anastomosis has shown minimal or no superiority of one method over the other, leaving the decision to the surgeon's discretion. However, none of these studies have specifically focused on erectile function, and the effect of unilaterally cutting the l internal iliac artery on erectile function remains a topic of controversy.[4-6] This study aims to address this gap by conducting is a double-blind randomized clinical trial to evaluate the impact of choosing internal iliac end-to-end versus external iliac end-to-side arterial anastomosis on sexual function.

PATIENTS AND METHODS

Study population

This study was a prospective single-center, parallel-group randomized clinical trial with balanced randomization [1:1] conducted at Khorshid hospital in Isfahan, Iran, from 2017 to 2021. It was designed as a double-blind clinical trial, meaning both the patients and the data analyst were unaware of the selected surgical method. The participants included sexually active men with chronic kidney disease who underwent kidney transplant surgery during the period from 2017 to 2021.

A power analysis was conducted for sample size estimation, based on data from Barroso et al., which compared

[1]Department of Urology, Isfahan Kidney disease Research Center, Isfahan University of Medical Sciences, Isfahan, Iran.
[2]General Practitioner, Isfahan University of Medical Sciences, Isfahan, Iran.
*Correspondence: Department of Urology, School of Medicine Al-Zahra Hospital, Isfahan University of Medical Sciences, Chaharbag Khjoo Street, 23 st,Shahid Ghasem Izadi Alley, Isfahan, Iran. Postal code: 8153766667/ Phone numbers: 09136946721.
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Table1. Demographic features of two groups.

	GROUP A (62 PATIENTS)	GROUP B (60 PATIENTS)	*P*-VALUE
Age (years)	41.29 ± 7.26	45.27 ± 10.25	0.4
Diabetes	16	16	NS
Duration of dialysis (months)	23	25	0.1
Hypertension	37	35	0.3
BMI (kg/m^2)	29.39 ± 10.12	30.1±9.85	0.23

erectile function score between ESRD and transplanted groups.[7] The effect size in that study was 1.0 (1.3). With a significance criterion of $\alpha = 0.05$ and power = 0.80, the minimum sample size needed with this effect size was N = 56 for Mann-Whitney U test. Thus, the obtained sample size of N = 122 is more than adequate to test the study hypothesis.

The inclusion criteria for this study were as follows: 1) Men who were married under 60 years old, without a significant history of erectile dysfunction (ED), 2) being candidates for kidney transplant surgery with suitable internal and external iliac arteries, which were confirmed by doppler ultrasonography before surgery and approved by the surgeon during the operation and before anastomosis, 3) willingness to participate in the study and provide informed consent. The exclusion criteria were history of Peyronie's disease, previous urological surgery, history of coronary artery disease or having a cardiac stent, severe hypertension or congestive heart failure. Drop criteria were considered to be graft loss, events occurring during surgery that led to a change in the anastomosis site, patients who could not be adequately followed up, and patient death.

Out of the total 285 kidney transplantations conducted at our center between 2017 and 2021, 122 patients were included in the study. During surgery, if both the internal and external iliac arteries were found suitable for anastomosis without significant atheroma plaque in either artery, the patients were randomly divided into two separate groups. The participants were assigned to the treatment groups using sample randomization, ensuring that each participant had an equal chance of being assigned to any of the treatment groups.

Surgical technique

All surgeries were conducted by the same experienced surgeon who was proficient in both types of anastomoses. The transplanted kidneys were donated by living non related donors and the nephrectomy procedure was performed through an open flank incision. After examining the iliac arteries and veins, if both the internal and external iliac arteries were appropriate for anastomosis, the patients were included in the study. The surgical technique employed in both groups was similar. The transplanted renal vein was first anastomosed to the external iliac vein, followed by the renal artery anastomosis to either internal or external iliac artery, using 6-0 nonabsorbable polypropylene monofilament sutures. Subseqently, after removing the clamp from the renal artery and vein, ureterovesical anastomosis was performed using 4-0 absorbable sutures.

Post-operative care

Immunosuppressive regimens and post-operative management were identical in both groups. As part of the standard protocol, the foley catheter was typically removed on the fifth day 5 after surgery, and the patients were discharged on the sixth day 6 post-surgery. The ureteral stent was removed 6 six weeks after transplantation, and the patients had monthly visited for one year. Phosphodiesterase 5 inhibitors were prescribed on an as-needed basis to all the patients, and they were allowed to engage in sexual intercourse one month after the surgery.

MATERIALS AND METHODS

To assess sexual function, the researchers utilized a valid Persian version of the IIEF-15 questionnaire.[3] Each participant completed this questionnaire both before the surgery and one year after the procedure. The IIEF-15 questionnaire consists of fifteen questions, designed to evaluate five domains: erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction. The maximum score for each domain is as follows: erectile function (30) orgasmic function (10), sexual desire (10), intercourse satisfaction (15), and overall satisfaction (10).

Additionally, serum creatinine levels were measured on a monthly basis, and total testosterone levels were measured before and one year after the surgery. These measurements were compared between the two groups after one year of follow-up.

This study received approval from the ethics committee of Isfahan University of Medical Sciences (IR.MUI.MED.REC.1399.363) and was registered as a randomized clinical trial in irct.ir (IRCT20200804048296n1). Before participating in the study, all individuals were provided with detailed information about the study and its objectives by the treating physician, and they completed the necessary consent forms. To ensure patient privacy and confidentiality, all collected information during the study was encrypted at the site.

Outcome assessment

The primary outcome of interest was the impact of selecting between IIA versus EIA on the sexual function of patients after kidney transplant surgery. To measure this, patients in both groups were requested to complete the Persian version of the IIEF questionnaire before the surgery and one year after the procedure.

Statistical analyses

For the analysis, the intention-to-treat (ITT) approach was employed, which included all randomized participants according to their original treatment assignment, regardless of adherence or subsequent withdrawals from the study.

The normality of the data was assessed through visual inspection of a Q-Q plot and Kolmograph-Smirnov test, which revealed no substantial deviations from a normal distribution.

Since the data did not follow a normal distribution, non-parametric tests were employed to interpret the results. To compare the impact of internal and external iliac artery anastomosis methods on sexual function, the

Table 2. Comparison of IIEF-15 questionnaire scores in each section, before and after kidney transplant surgery by internal and external iliac artery anastomosis

Sections of questionnaire	Surgical technique	Sample size	Before surgery		After surgery		*P*-value*
			Median	25th -75th percentile	Median	25th -75th percentile	
EF	End	58	16	9-27	21	13-30	0.118
	Side	57	19	4-26	22	16-31	< 0.001
OF	End	58	5	2-8	8	4-11	.003
	Side	57	6	2-8	8	5-10	.006
SD	End	58	6	3-8	8	6-11	< 0.001
	Side	57	6	2-8	7	4-9	.001
IS	End	58	9	4-15	10	6-13	< 0.001
	Side	57	7	3-10	10	6-15	< 0.001
OS	End	58	7	4-11	8	3-10	.154
	Side	57	4	1-6	7	4-10	< 0.001

End, end to end anastomosis of internal iliac artery; Side: end to side anastomosis of external iliac artery; EF, erectile function; OF, orgasmic function; SD, sexual desire; IS, intercourse satisfaction; OS, overall satisfaction

IIEF-15 scores in each group before and after surgery were compared, and also the differences between the two groups were evaluated. The Wilcoxon test was used to compare the scores of the questionnaire before and after the kidney transplant. Additionally, Mann-Whitney *U* test was conducted to compare these scores between the two groups. In all tests, a *p*-value of less than 0.05 was considered statistically significant.

RESULTS

During the course of the study, a total of 122 sexually active male patients who met the inclusion criteria were examined. Among them, 62 patients underwent end-to-end internal iliac artery anastomosis (group A) and 60 patients underwent end-to-side external iliac artery anastomosis (group B). The mean age of patients in group A was 41.29 ± 7.26, while in group B, it was 45.27 ± 10.25. Both groups had 16 patients with type 2 diabetes mellitus, and since this variable was equally distributed in both groups, its impact as a confounding variable was negligible.(**Table 1**)

During the study, the patients were regularly monitored by the surgeon and nephrologist, with routine doppler ultrasonography of the transplanted kidney carried out in the morning after surgery. In group A, one patient experienced arterial thrombosis, and another patient had an acute humoral rejection, leading to removal of the transplanted kidney. Additionally, two patients. did not attend follow-up visits. In group B, two patients experienced graft loss due to rejection, and one patient was lost to follow-up.

Two patients in group A and three patients in group B had delayed graft function, which lasted for less than one week. Moreover, two patients in group A suffered from urine leakage two weeks after surgery and required repeat surgery and ureterovesical anastomosis. Eventually, at the end of the one-year follow-up, 58 patients remained in group A, and 57 patients remained in group B. Fortunately, no deaths or catastrophic events were reported during the one-year follow up period.

According to Table 2, one year after the kidney transplant surgery, IIEF-15 scores in group A showed improvements in the domains of orgasmic function (*p*-value = 0.003), sexual desire (*p*-value < 0.001) and intercourse satisfaction (*p*-value < 0.001). However, there were no statistically significant changes in the domains of erectile function (*p*-value = 0.118) and overall satisfaction (*p*-value = 0.154) postoperatively. On the other hand, in group B, significant changes were observed in all domains of IIEF-15 one year after surgery. These findings indicate that the choice of arterial anastomosis method (internal or external iliac artery) had different effects on the sexual function outcomes in the two groups after kidney transplantation.

The total testosterone levels before and one year after surgery increased significantly in both groups A (from 164 to 243 ng/dl, *p*-value ≤ 0.01) and B (from 158 to 240 ng/dl, *p*-value ≤ 0.01).

When comparing the two groups, erectile function (*p*-value = 0.04) and overall satisfaction (*p*-value = 0.002) were found to be statistically different. However, no statistically significant difference was observed in other items of the questionnaire, including orgasmic function, sexual desire and intercourse satisfaction, (**Table 3**).

To assess the effect of internal and external iliac ar-

Table3. Comparison of differences in the scores of the sections of the IIEF-15 questionnaire in the two methods of internal and external iliac artery anastomosis

Sections of questionnaire	Surgical technique	Minimum	Maximum	Mean± SD	Interquartile range (95% confidence interval)	*P*-value*
EF	End	-20.00	18.00	2.66 ± 8.57	20.42 (14.27-26.56)	0.04
	Side	-5.00	18.00	6.18 ± 7.78	18.00 (11.60-24.40)	
OF	End	-4.00	8.00	1.48 ± 2.69	8.47 (4.97-11.97)	.707
	Side	-6.00	9.00	1.56 ± 3.04	12.10 (8.46-15.74)	
SD	End	-4.00	7.00	1.70 ± 2.23	8.18 (4.88-11.48)	.808
	Side	-4.00	6.00	1.96 ± 2.59	6.21 (4.01-8.41)	
IS	End	-6.00	9.00	2.45 ± 3.43	11.01 (6.61-15.41)	.990
	Side	-8.00	8.00	2.43 ± 3.49	12.12 (9.12-15.12)	
OS	End	-4.00	7.00	0.64 ± 2.58	5.95 (4.46-7.44)	.002
	Side	-5.00	5.00	2.10 ± 2.32	6.30 (3.80-8.80)	

*Mann-Whitney *U* test

End, end to end anastomosis of internal iliac artery; Side: end to side anastomosis of external iliac artery; EF, erectile function; OF, orgasmic function; SD, sexual desire; IS, intercourse satisfaction; OS, overall satisfaction

tery anastomosis on renal function, serum creatinine levels were measured monthly after surgery and compared between the two methods. However, there was no significant difference in serum creatinine levels and, consequently, renal function when comparing the two groups (1.2784 ± 0.2358versus 1.3550 ± 0.2379, *p*-value = 0.102).

Although all the patients were sexually active before the surgery, five patients experienced severe erectile dysfunction, with an IIEF-EF score of less than 10 after the surgery, and all of these cases were in group A. However, when we excluded these severe cases of ED, there was no longer a statistically significant difference in this domain between the two groups (p-value=0.08).

DISCUSSION

In this study, our main focus was on investigating the impact of using internal versus external iliac arteries for anastomosis on sexual function, specifically considering the IIEF questionnaire. According to our results, there is a statistically significant difference between these two surgical techniques in terms of erectile function (*p*-value = 0.04). Although kidney transplantation can reverse most of the mechanisms of sexual dysfunction, erectile function, in contrary to other domains of IIEF-15, did not show improvement in the internal iliac artery group in our study. We attribute this outcome to the fact that erectile function is more reliant on vascular sufficiency. Therefore, we believe that the impairment of blood supply to the genital organs is the primary contributing factor to this issue in the internal iliac artery group.

We selected only sexually active patients and found that although in most of them, erectile function and IIEF-EF score increased after kidney transplantation, five patients with ligated internal iliac arteries were suffering from severe erectile dysfunction one year after kidney transplantation, despite having an appropriate erectile function before the surgery. Additionally, these patients were resistant to the phosphodiesterase 5 inhibitors. Thus, choosing the internal iliac artery in these cases had ominous consequences, even though, the graft function was acceptable. Another issue is that, in comparison with other causes of ED, when the condition arises from an impairment of blood supply, it becomes more resistant to phosphodiesterase-5 inhibitors (PDE-5I).[8]

Hemodynamic changes in the pudendal arteries after kidney transplantation are believed to be contributing factor to erectile dysfunction. This effect may be particularly pronounced when the renal graft is anastomosed end to end to the internal iliac artery, diverting the blood supply from the internal pudendal artery. However, unlike our study, most previous studies have reported no superiority in selecting the external iliac artery for anastomosis.[9-15]

We believe that previous studies may have been affected by selection biases because they were not randomized controlled trials (RCT) and did not specifically focus on erectile function. Patients with notable atherosclerosis in the iliac arteries, excess abdominal fat, or those who are overweight are more likely to undergo external iliac artery anastomosis, as this artery is more accessible during surgery. So, if the patients are not randomized before the study, ED will be over-reported in the external iliac artery anastomosis group.

We also had two cases of urine leaks in group A that did not resolve following a conservative approach and required ureteral re-implantation. It may be supposed that the ligation of the internal iliac and, therefore, vesical artery endangers the blood supply to the ureterovesical anastomosis site, consequently leading to dehiscence of the ureterovesical junction. Although this complication is indeed rare and has not been reported in previous studies, it may potentially threaten the graft function. Thus, we firmly believe that it should be considered when choosing between the internal or external iliac artery for anastomosis during kidney transplantation. Careful evaluation of potential risks and benefits is essential to ensure the best possible outcomes for the patients.

One of the limitations of this study is that only the IIEF-15 questionnaire was used to define and evaluate sexual function. Objective methods like arteriography or doppler-ultrasonography were not employed, and this decision was made to minimize patient loss during follow-up. The choice to prioritize patient retention and minimize invasive procedures is understandable and may have practical implications in a clinical setting.

CONCLUSIONS

During kidney transplantation, when both the internal iliac artery and external iliac artery are suitable for anastomosis, we recommend end-to-side anastomosis to the external iliac artery, especially in young sexually active male recipients.

CONFLICT OF INTEREST

The authors report no concflict of interest.

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