BANGLADESH JOURNAL OF
UROLOGY
Bangladesh J. Urol. 2025; 28(1): 22-26
www.banglajol.info/index.php/BJU
DOI: https://doi.org/10.3329/bju.v28i1.81874

Original Article

ISSN : 2304 - 8514 (Print)
ISSN : 2304 - 8522 (Online)

Outcome of Renal Allograft Transplantation with Multiple Arteries

Mohammad Nazrul Islam[1], Mohammad Abdus Salam[2], Mohammed Rafiqul Islam[3], S M Yunus Ali[4], Md. Nabid Alam[5], Md. Saiful Islam[6]

Received: 01-01-2024
Accepted: 28-01-2024
Conflicts of interest: None

Abstract

Background: *Anatomical variations of the grafts are one of the most difficult issues in renal transplantation. The most prevalent of these anatomical variants is thought to be multiple renal arteries (MRAs).*

Objective: *To evaluate the short term outcome of renal allograft transplantation with multiple arteries.*

Methods: *This quasi-experimental study was conducted in the Department of Urology, BMU, Dhaka, from December 2022 to November 2024. This study included 18 recipients who had living donor renal transplantation and received MRAs graft. The outcome variables were operation time, total ischemia time, length of hospital stay, post-operative complication and serum creatinine levels. All patients were followed up at the outpatient department initially once a week during the 1st months after discharged from hospital, then once a month for the following six months.*

Results: *The median age of the patients was 40.0 years where 10 (55.6%) patients were female. The median operation time was 207.5 minutes. The median hospital stay of the patients was 18.5 days. In postoperative days, 2 (11.1%) patients had DGF and 1 (5.6%) patient had peri-transplant haematoma. None of them had acute tubular necrosis, renal artery stenosis and acute rejection. At baseline, the median serum creatinine level was 8.05 mg/dl which decreased to 1.49 mg/dl at 1st month. At the end of 6th month, the median serum creatinine level was 1.40 mg/dl.*

Conclusions: *MRAs are safe for renal allograft transplantation, and recipients in need should not be denied grafts with multiple vessels.*

Keywords: Kidney transplant; multiple arteries; ischemia time; graft outcome

Introduction

The incidence of end-stage renal disease (ESRD) is increasing worldwide due to rising rates of hypertension, diabetes mellitus, obesity-related complications and other risk factors, which are the main causes of renal failure.[1] The technique of kidney transplantation has improved gradually throughout years, leading to dramatic increase in graft survival rate and patients survival in general. Hence, kidney transplantation (KT) is now viewed as best choice among different renal replacement therapies (RRT) for managing patients with end-stage renal illness.[2]

1. Research Assistant, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh.
2. Assistant Professor, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh.
3. Assistant Professor, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh.
4. Assistant Professor, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh.
5. Assistant Professor, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh.
6. Professor, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh.

Correspondence : Mohammad Abdus Salam, *Assistant Professor, Department of Urology, Bangladesh Medical University (BMU), Dhaka, Bangladesh. E-mail: salam.dr.pg@gmail.com

The significant anatomical variation found in live donor kidney transplant (KT) is the presence of multiple renal arteries (MRAs).[2] The MRAs are recorded in about 18-30.0% of donors as reported in the literature. The presence of MRAs varies according to ethnicity and fluctuates from 4% in Malaysians to 59.5% in Indians, and is lowest in people from eastern and southern Asia (from 4% to 18.4%).[3]

Renal transplant patient and graft survival is significantly affected by vascular complications such as arterial thrombosis and renal artery stenosis due to MRAs. Prolonged ischemia time and delayed graft function (DGF) are other complications that may occur in transplant of kidneys that have MRAs.[3] The prospective study of Hu et al.[4] reported worse outcomes in MRAs grafts. They observed that renal vascular variation lengthened the operating time and was associated with higher complications. Nonetheless, some studies propose that kidney transplants of allografts with MRAs are as safe as those with single renal artery (SRA).[1,3,5,6,7] The review of 2674 live donor transplant patients reported that the results of kidney transplants using allografts with multiple or single vessels remain consistent regardless of reconstruction and anastomosis technique, and multiple vein anastomosis does not increase complications.[2]

Higher incidence rates of ESRD and continuous shortage of live donation globally, urged the surgeons to gradually accept the widening of inclusion criteria in selection of live kidney donors and minimizing the exclusion criteria for donors such as MRAs.[8] The prevalence of ESRD in Bangladesh is approximate twenty million where about 35000 of their dies without proper treatment every year. There is a scarcity of the donors to manage the large number of patients waiting for KT. Therefore, this present study aimed to evaluate the short term outcome of renal allograft transplantation with multiple arteries.

Methods

This quasi-experimental study was conducted in the Department of Urology, BMU, Dhaka, from December 2022 to November 2024. This study included 18 recipients who had renal transplantation and received MRAs graft. Patients with multiple organ transplantation, cirrhosis of liver, myocardial infarction within 6 months and ejection fraction below 50% were excluded from the study.

All donor kidneys retrieval and renal transplantation performed by a single surgeon who is highly skilled, trained and experienced for more than 12 years in renal transplantation surgery. Before renal transplantation, proper evaluation of kidney donors and recipients were done by taking detailed clinical history, physical examination and relevant investigations. For evaluation of living donor renal vascular abnormalities, computed tomography (CT) angiography was performed. Tissue crossmatch was checked between donors and recipients before transplant and human leukocyte antigen (HLA) test was performed. Total ischemia time was calculated from clamping of donor renal artery to declamping of renal artery in recipient after completing vascular anastomosis.

Operative procedure

All open and laparoscopic donor nephrectomies were performed by standard technique. The left kidney was preferred for donor nephrectomy because of longer length of the renal vein and less vascular and anatomical anomalies. Before organ retrieval, adequate diuresis was ensured. Proper kidney perfusion with cold Hartmann's solution mixed with lidocaine and heparin was performed in bench.

The typical extra-peritoneal technique was performed for the recipient surgery, with end-to-side renal vascular anastomosis to the recipient vessels in the right iliac fossa. An end-to-side anastomosis was performed between the renal vein and the external iliac vein with 5-0 prolene. In case of two renal arteries, two separate anastomosis done between renal arteries and external iliac artery in end-to-side manner (figure 1).

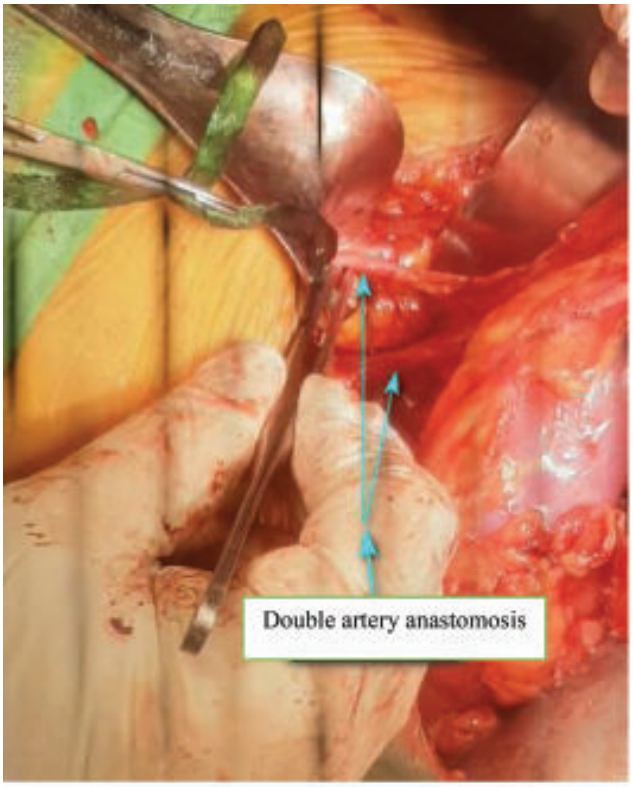

Fig.-1: *Two renal arteries separately anastomose with external iliac artery*

Kidneys having three renal arteries, there were performed three separate anastomosis, two major arteries separately anastomosed with external iliac artery in end-to-side manner and another lower polar artery anastomosed with right inferior epigastric artery in end-to-end manner (figure 2). All arterial anastomosis done by 6-0 prolene. All arteries and vein were anastomosed by continuous suture.

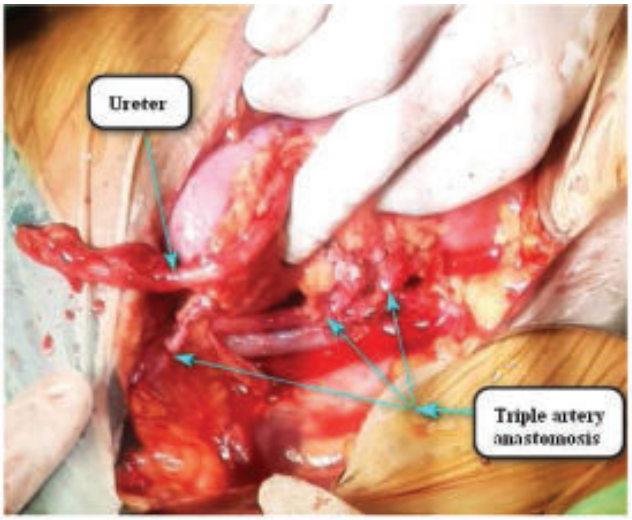

Fig.-2: *Three artery anastomosis (two main arteries separately anastomosed with external iliac artery and another lower polar artery separately anastomose with inferior epigastric artery)*

In all cases, ureteroneocystostomy were done by modified Lich's Gregoir Technique and ureteric D-J Stent were routinely placed. Doppler ultrasonography was routinely performed in all patients in between three to seven post-operative days. However, renal CT angiogram or MR angiogram was not performed as none of the patient was suspected for renal artery stenosis. Usually, Urethral catheter was removed on 10^{th} to 14^{th} postoperative day and D-J stent was removed after three to four weeks. Patients were discharged after 2 to 3 weeks of transplantation. They were followed up at the outpatient department initially once a week during the 1st months after discharged from hospital, then once a month for the following six months.

All recipients received immunosuppressant therapy according to protocols of our center, with cyclosporine 8mg/kg and mycophenolate mofetil 1-1.5 gm daily started 48 hours before transplant and intravenous methyl prednisolone 500 mg administered intraoperatively before organ reperfusion and continue for 3-5 days. Basiliximab 20 mg given on day 0 and day 4 except when donor is 1^{st} degree relative. Maintenance immunosuppression included cyclosporine/tacrolimus, mycophenolate mofetil and steroid continued at reduced dose.

Data Analysis

The data collected from the patients were analyzed. SPSS (statistical package for the social science) version 26 statistical software was used for statistical analysis. The findings of the study were presented by frequency, percentage in tables. The features of the entire sample were described using frequency distributions for categorical variables and medians with interquartile ranges for continuous variables.

Ethical consideration

Ethical clearance for the study were taken from the Institutional Review Board (IRB) of BMU prior to the commencement of this study. All participants were informed about the study and written informed consent were obtained from all of them prior to inclusion in the study.

Results

The median age of the patients was 40.0 years where 10 (55.6%) patients were female. The median operation time was 207.5 minutes. The median hospital stay of the patients was 18.5 days (Table I).

Table I: General characteristics of transplant patients (n=18)

Baseline characteristics		Frequency	Percentage
Gender	Male	8	44.4
	Female	10	55.6
Age (years) (Median [IQR])		40.0 [25.7, 51.0]	
No. of artery	Two	14	77.8
	Three	4	22.2
Operation time (minutes) (Median [IQR])		207.5 [193.7, 210.0]	
Total ischemia time (minutes) (Median [IQR])		80.0 [76.0, 90.2]	
Length of hospital stay (days) (Median [IQR])		18.5 [15.7, 20.0]	

Cr= Creatinine, IQR=Interquartile range,

In postoperative days, 2 (11.1%) patients had DGF and 1 (5.6%) patient had Peri-transplant haematoma (table II).

Table II: *Postoperative complications of the patients (n=18)*

Postoperative complications	Frequency	Percentage
Absent	15	83.3
Present		
Delayed graft function	2	11.1
Peri-transplant haematoma	1	5.6

At baseline, the median serum creatinine level was 8.05 mg/dl which decreased to 1.49 mg/dl at 1st month. At the end of 6th month, the median serum creatinine level was 1.40 mg/dl (table III).

Table III : *Serum Creatinine of transplant patients at different time point (n=18)*

Serum Creatinine	Median [IQR] (mg/dl)
Baseline	8.05 [6.67, 9.10]
1st month	1.49 [1.36, 1.63]
2nd month	1.42 [1.35, 1.56]
3rd month	1.40 [1.29, 1.53]
6th month	1.40 [1.29, 1.61]

IQR=Interquartile range

Discussion

Anatomical variances of the grafts are one of the most difficult issues in renal transplantation. The most prevalent of these anatomical variants is thought to be multiple renal arteries (MRAs).[9] The present quasi-experimental study aimed to evaluate the short term outcome of renal allograft transplantation with multiple arteries.

Median age of the patients was 40.0 years. The study of Mahajan et al.[3] found that median age of the patients was 29.5 years. The study of Ertuðrul and Aydin[10] found that median age of the patients MRAs group was 35.6 years respectively. In this study, 55.6% patients were female. Other study also found female predominance.[9]

The median serum creatinine level of the patients was 8.05 mg/dl. The study of Mahajan et al.[3] reported that the baseline serum creatinine level of was 8.82 mg/dL which was quite similar to the present study.

Grafts with multiple renal arteries are one of the objects of concern in a surgery perspective, as there are conflicting results of graft outcomes and being a time-consuming surgery process.[6] The median operation time was 207.5 minutes. The longer duration was 240 minutes which was associated with three renal arteries. This finding was well supported by the study of Mahajan et al.[3]

In this study, 11.1% patients had DGF. As there was no biopsy proven ATN, this might be due to recipient factors. In a retrospective study, in MRAs group, 13.3% patients had DGF[3] which was quite similar to our study.

One patient in this study had peri-transplant hematoma which was managed conservatively. The prospective study of Jabali et al.[1] found that 14.6% patient had haematoma.

Rejections have a notably impact on graft survival. With the advancement of the most potent immunosuppressants, rejection rates have reduced over time. Previously, the rate of acute rejection events was over 40%. Now-a-days, rejection rates reduced to less than 20% one year following transplantation.[6] In this study, none of the patients in multiple arteries group had rejection. Other studies also reported lower rate of acute rejection. Jabali et al.[1] found that 2.4% patients had acute graft rejection while Mahajan et al.[3] found 6.7% patients had acute rejection.

Previously Kamali et al.[11] reported that allografts with more than two arteries were associated with increased DGF and RAS. Later on, Sevmis et al.[6] reported no impact of MRAs on surgical complications. They concluded that the incidence of vascular problems, as well as delayed or slow graft function, is more likely due to surgical skills and experience rather than vascular abnormalities. Hu et al.[4] proposed that the KT surgery team should organize the surgical plan, taking into mind that MRAs may lengthen the time of operation and that there may be a chance of vascular problems.

Many reports have indicated a high rate of delayed graft function, high warm and cold ischemia time, and acute tubular necrosis. Surprisingly, function of the graft with MRA have been reported as similar to a single artery, even in the late term after transplantation. Sevmis et al.[6] found similar graft function in grafts with MRA compared with a single artery after 12 months post transplantation. They have not experienced any biopsy-proven acute tubular necrosis or a higher rate of delayed graft function in their MRA cases in contrast to many studies that previously reported a higher rate of such complications.[12,13]

At baseline, the median serum creatinine level was 8.05 mg/dl which decreased to 1.49 mg/dl at 1st month. At the end of 6th month, the median serum creatinine level was 1.40 mg/dl. This finding was well supported by the study of Ali-El-Dein et al.[5] where the mean serum creatinine ±SD at 1 year was 1.5 ±0.6 mg./dl.

Benedetti et al.[14] & Ali-El-Dein et al.[14] concluded in their studies that patients with multiple renal arteries are not significantly associated with higher rates of complications or higher rejection rates except that patients with multiple renal arteries have a higher rate of creatinine for one year after the transplantation. As our follow up period was six months, we failed to evaluate long term creatinine level.

Short follow-up period was one of the major limitations of our study. Moreover, the small number of patients was another short coming of this study.

Conclusions

Due to an increasing number of ESRD patients and a limited supply of organs, transplant surgeons must use donors with broader criteria to address the organ demand. Even though grafts with anatomical differences may exacerbate problems of KT, it is inevitable to face MRAs because its occurrence is high. As the post-operative complications are few, multiple arteries could be a safe option for KT.

Acknowledgement

I acknowledge the support of the distinguished Department of Nephrology, Department of Radiology and imaging, Department of Laboratory Medicine, Department of Biochemistry, Department of Pathology, BSMMU for helping in collecting the doppler USG, histopathological and laboratory data.

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