

## Does Renal Artery Multiplicity Have Impact on Patient and Allograft Survival Rates?

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### Abstract

**Background and Aims:** Successful transplantation of allografts with multiple renal arteries (MRAs) is one of the challenges and requires investigation of its impact on post-transplant graft and patient outcome. The aim of this study was to determine the impact of kidneys with MRAs on graft and patient survival rates.

**Methods:** We retrospectively reviewed the medical records of 90 grafts with MRAs that were performed between June 1995 and June 2008. Recipients were divided into 3 groups: group I ( $n = 230$ ) single renal artery, group II ( $n = 83$ ) with double renal arteries and group III ( $n = 7$ ) with triple renal arteries. The aspects analyzed were number of kidney's arteries, donor type, vascular reconstruction technique, surgical complications, as well as patient and graft survival.

**Results:** No significant differences were noted in the sex of the recipients, donor source, body mass index (BMI) at the time of transplantation, causes of ESRD, occurrence of complications, vascular reconstruction technique, warm ischemic times, number of transplantation and immunosuppression regimen. The mean cold ischemic time in MRAs group was significantly higher than the control group ( $P < 0.05$ ). One year patient survival rates were 97%, 97% and 71% in groups I, II and III, respectively (I vs. II,  $P = 0.7$ , HR=1.26; I vs. III,  $P = 0.004$ , HR=0.09 and II vs. III,  $P = 0.01$ , HR=0.07). The graft survival rates at one year were 95% in group I; 95% in group II; and 71% in group III (I vs. II,  $P = 0.4$ , HR=0.69; I vs. III,  $P = 0.001$ , HR=0.11 and II vs. III,  $P = 0.007$ , HR=0.15).

**Conclusions:** These findings indicate that kidney transplantation using grafts with MRAs are safe and result in acceptable patient and allograft outcome.

**Keywords:** Renal Transplantation, Complication, Survival

### Introduction

Renal transplantation is the best treatment choice for most patients with end-stage renal disease (ESRD). Furthermore, graft and patient survival rates have significantly improved during the last 3 decades due to refinements in surgical techniques as well as new potent immunosuppressive regimens (1, 2). Although kidney transplantation with multiple renal arteries (MRAs) have been performed in some transplant centers, but the use of kidney with multiple renal arteries from live donors remains a controversial

option because of the high incidence of vascular and urological complications(2). The incidences of unilateral and bilateral MRAs were reported 18% to

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30% and 15%, respectively (3, 4). The organ shortage problem is still prevalent worldwide; using a kidney with MRAs can be one approach to expanding the donor pool for renal transplantation. However, it is also important to assess the outcome of MRAs grafts. The aim of this study was to appraise the prevalence of MRAs in kidney transplantation and their effects on post-transplant graft and patient survival rates in living donor kidney transplantation.

## Materials and Methods

We retrospectively reviewed the medical records of 90 living donor kidney transplantations with multiple arteries that were performed consecutively at our institution between June 1995 and June 2008. The data of cases with MRAs were compared to 230 randomly selected kidney transplants with single renal artery. All of the patients were first kidney transplants. Recipients were divided into 3 groups according to the number of donor renal artery: group I ( $n = 230$ ) with single renal artery (SRA), group II ( $n = 83$ ) with double renal arteries (DRAs) and group III ( $n = 7$ ) with triple renal arteries (TRAs). Patient age, gender, immunosuppression, renal allograft function, warm and cold ischemia time, vascular reconstruction techniques, incidence of acute rejection episodes, patient and graft survival and occurrence of surgical complications were compared between the three groups. The glomerular filtration rate (GFR) of renal allografts(4), calculated by the Cockcroft–Gault formula  $[(140 - \text{age}) \times \text{weight (kg)} / (72 \times \text{serum creatinine})]$ , was measured at 1, 3, 6 and 12 months after transplantation. Immunosuppression regimen was cyclosporine based with azathioprine/mycophenolate mofetil and prednisone in all patients.

### Technical Procedures

**Vascular reconstruction techniques:** In single renal artery allografts, renal artery is sewn to the internal iliac artery in an end-to-end anastomosis. Allografts with MRAs, managed by making two

legged (in double renal arteries) or three legged (in triple renal arteries) pair of pants (5).

Renal vein was anastomosed to the external iliac vein. In addition, in allografts with multiple renal veins, the largest one was used and other veins were ligated safely (6).

**Ureter reconstruction technique:** In all of the recipients, extravesical ureteroneocystostomy (Lich-Gregoir technique) was used for urinary reconstruction.

### Statistics

The data were analyzed by the use of Statistical Package for the Social Sciences (SPSS) version 15.0. Results for the quantitative variables were expressed as mean  $\pm$  standard deviation (SD), and the values of the qualitative variables were represented by the number and percentage. Paired and unpaired student's *t* tests were used to compare quantitative values. Comparison of two qualitative variables was performed by using the Chi-square or Fisher's exact tests. Patient and graft survival rates were analyzed using the Kaplan-Meier, log-rank and Cox regression methods. Differences were considered significant when P values were less than 0.05.

## Results

### Participants

Ninety recipients with MRAs, two renal arteries in 83 grafts (92.2%) and three renal arteries in seven grafts (7.8%), were entered in the current study. Living related donor (LRD), living unrelated donor (LURD), and deceased kidney transplantation were done in 3 (3.3%), 86 (95.6%) and 1 (1.1%), respectively. Demographic characteristics are demonstrated in Table 1.

All groups were equivalent in terms of sex, age and body mass index. There were no statistically significant differences in underlying diseases between all groups; furthermore, hypertension and diabetes mellitus were common in our patients (Table 2).

**Table 1.** Recipient demographic characteristics

Characteristic	Group I (n = 230)	Group II (n = 83)	Group III (n = 7)	P Value	P Value, II vs. III
Age (yr)	40 ± 14.3	38 ± 13.5	39 ± 17.0	0.5*	
Gender- male/female (N)	150/80	49/34	3/4	0.3**	
BMI (kg/m <sup>2</sup> )	22.7 ± 4.2	22.3 ± 3.7	24.5 ± 4.2	0.3*	
Warm Ischemic Time (sec)	16 ± 1.4	17 ± 1.6	17 ± 1.2	0.3*	
Cold Ischemic Time (min)	19 ± 6.2	21 ± 6.5	25 ± 7.6	0.009*	0.3*
<b>Complication (N)</b>					
Wound infection/ Leak of urine/ Hernia/ Lymphocele/Renal vessel thrombosis	6/3/0/2/0	0/0/1/0/1	0	0.6	
Acute rejection episode (N)	43(%18.6)	28(%33.7)	4(%57.1)	0.002**	0.2**
<b>Patient survival (%)</b>					
One/Two Year	97/97	97/97	71/71	0.5 (HR:1.4)	
Allograft survival One/Two Year	95/95	95/86	71/71	0.1 (HR: 1.8)	

**BMI**, body mass index; **yr**, year; **N**, Number; **Kg**, Kilogram; **m<sup>2</sup>**, Square meter; **Sec**, Second; **min**, minute  
**HR**, hazard ratio.

Data presented as mean ± standard deviation or number. **Group I**: Single renal artery; **group II**: double renal artery; **group III**: Triple renal artery.

\* ANOVA Test

\*\* Chi-Square Test

### Ischemia Time

Group comparisons of warm and cold ischemia times are shown in Table 1. No significant difference was noted

in the warm ischemia time between Groups, but the patients in groups II and III had significant longer cold ischemia time when compared to group I ( $P = 0.009$ ).

**Table 2.** Recipient underlying diseases

	Group I (n = 230)	Group II (n = 83)	Group III (n = 7)	P Value*
DM	45	20	2	0.6
HTN	50	18	–	0.3
GN	11	6	–	0.5
PKD	23	6	–	0.5
Urologic diseases	27	11	–	0.5
Unknown	72	18	5	0.01
Others	2	4	1	0.01

**DM**, Diabetes Mellitus; **HTN**, hypertension; **GN**, glomerulonephritis; **PKD**, poly kidney disease.

\* Chi-Square Test

**Table 3.** Recipient GFR after transplantation

	Group I (n = 230)	Group II (n = 83)	Group III (n = 7)	P Value*
<b>GFR (ml/min)</b>				
1 week	61 ± 25	60 ± 22	47 ± 40	0.3
1 month	64 ± 22	65 ± 19	59 ± 37	0.8
3 months	64 ± 22	68 ± 22	64 ± 38	0.4
6 months	66 ± 25	70 ± 29	53 ± 39	0.4
12 months	63 ± 35	63 ± 32	62 ± 34	0.7

**GFR**; Glomerular Filtration Rate, **ml/min**; Milliliter per minute.

Data presented as mean ± standard deviation or number.

**Group I**: Single renal artery; **group II**: double renal artery; **group III**: Triple renal artery

\*ANOVA Test

### Acute Rejection Episodes

The diagnosis of acute rejection in first three months of transplantation was determined by the

clinical evaluation. Incidence of acute rejection episodes was significantly higher in MRAs groups than SRA group ( $P = 0.002$ ) (Table 1).

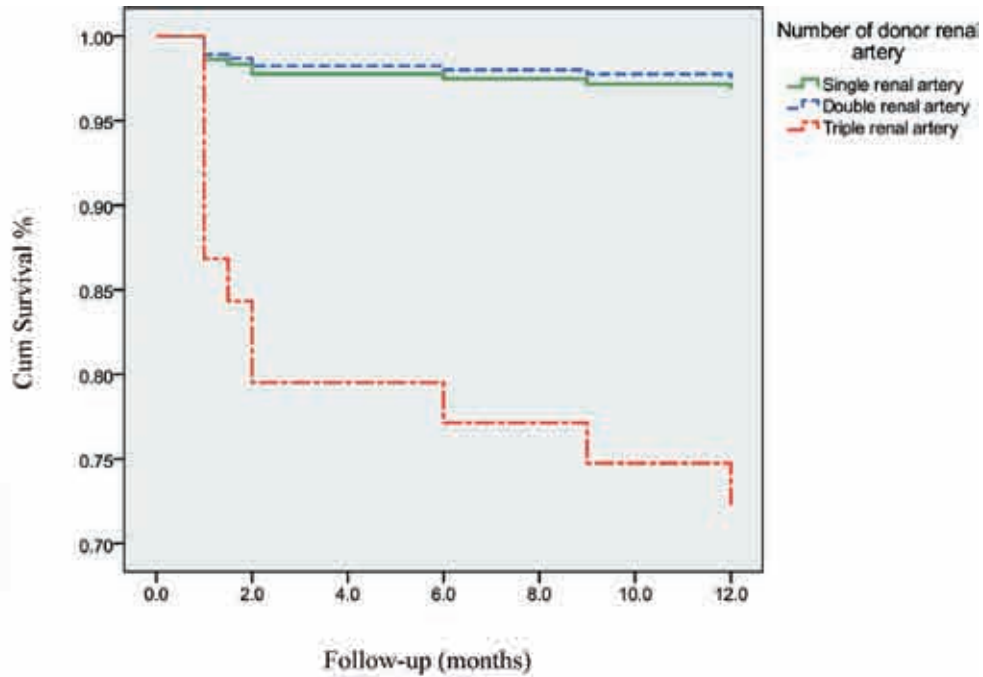


Fig. 1. Patient Survival.

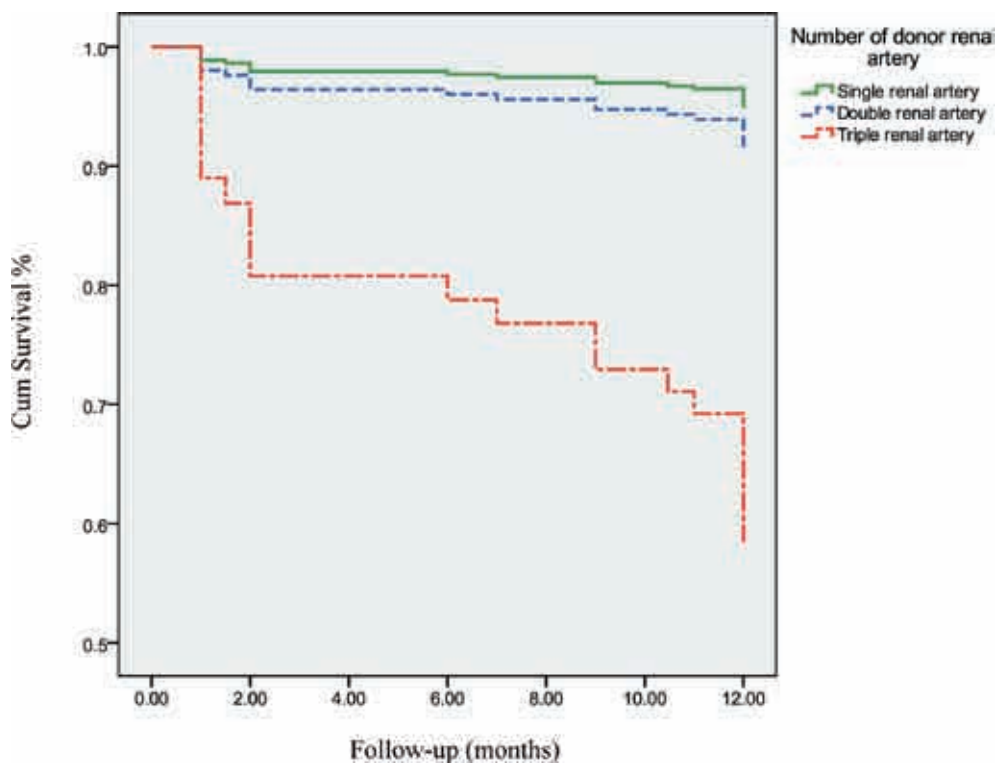


Fig. 2. Graft Survival.

### ***Surgical Complications***

The incidence of post-transplantation surgical complications among MRAs recipients was comparable with that in the SRA group. We found no significant differences with respect to rate of postoperative complications ( $P = 0.6$ ) (Table 1).

### ***Allograft Function***

We compared GFR at 1, 3, 6 and 12 months after renal transplantation between groups. No significant differences in calculated GFR were seen between all groups (Table 3).

### ***Patient and Graft Survival***

The mean follow-up period was  $27 \pm 24$  (range: 1-144) months. One year patient survival rate was lower in patients with TRAs compared to other groups (I vs. II,  $P=0.7$ ,  $HR=1.26$ ; I vs. III,  $P=0.004$ ,  $HR=0.09$  and II vs. III,  $P=0.01$ ,  $HR=0.07$ ) (Fig.1). The graft survival rates at one year are shown in Fig. 2. Although, the graft survival was similar in DRAs recipients and those with SRA; but it was worse in TRAs group when compared to other patients (I vs. II,  $P= 0.4$ ,  $HR=0.69$ ; I vs. III,  $P=0.001$ ,  $HR=0.11$  and II vs. III,  $P=0.007$ ,  $HR=0.15$ ).

## **Discussion**

In this study, the degree of using MRAs among living kidney allografts is higher than the rates reported in other studies (7-15). Furthermore, the findings of the current study reveal that using grafts with two arteries are safer and yielded the same outcomes as those with SRA; whereas, grafts with three arteries had unfavorable outcome. However, our results were consistent with other reports (7-15). The number of our grafts with TRAs was limited; therefore, further studies with adequate sample size should be performed to investigate the outcome of allografts.

Although, warm ischemic times were similar for

all the groups, but the mean cold ischemic times were significantly higher in allografts with MRAs. Obviously, ex vivo surgery time is lengthened in case of reconstructed multiple arteries compared to a single artery; however, prolongation of the cold ischemic time for a few hours does not negative influence on the graft function if it is adequately perfused and cooled (16, 17). In addition, the Canadian transplant study group reported that long vascular anastomotic time (more than 45 minutes) adversely influences allograft function (18). Overall, warm and cold ischemia times were comparable to that seen by other studies (11, 12, 19), which was significantly more than in our patients, and it was attributed to the fact that majority of the patients received kidney from living donors as well as transplantations were performed by an expert surgeon, with more than 2000 transplants experience previously.

Benedetti et al (20) compared 163 grafts with MRAs and 835 with SRA and found no differences in acute rejection, creatinine levels, surgical complications, graft survival and graft function between the two groups. On the contrary, Osman et al. reported unfavorable results (21). Although in our study, the incidence of acute rejection was higher in the MRAs groups, no significant differences were observed between outcomes in MRAs grafts and SRA.

A number of investigations carried out previously suggested that grafts with MRAs are associated with a higher incidence of vascular complications, especially arterial thrombosis (3, 7, 22). However, our study demonstrated that multiplicity of the renal arteries had no vascular complications and it can be attributed to the fact that multiple arteries were converted to a single artery by bench reconstruction (20). Although, some authors have previously reported that kidneys with MRAs have been considered a relative contraindication for transplant (3), however, other studies revealed that kidney transplantation in MRAs was safe (7-15).

## Conclusions

Based on our results, DRAs had no adverse impact on patient and graft survivals. We conclude that kidney transplantation using grafts with multiple arteries are safe. In addition, the employ of live donor allografts with MRAs is not contraindication for routine use.

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