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THE EFFECT OF MULTIPLE RENAL ARTERIES GRAFT IN RENAL TRANSPLANTATION

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Abstract

OBJECTIVE: *The presence of multiple renal arteries (MRA) in kidney grafts is a key concern in transplantation surgery due to the significant increase in vascular and urologic complications. The objective was to assess the incidence of complications in recipients with either a single renal artery or multiple renal arteries on both transplant success and patient survival.*

METHODS: *Following clearance from the ethical review committee, record of 240 patients was reviewed who underwent renal transplantation over a 3-year period. Out of 240, 40 (16.6%) patients had Multiple Renal Arteries graft (MRA). The renal vascular anatomy was identified using computerized tomography (CT) renal arteriography. The occurrence of urological, vascular, and hypertension-related risk factors after the transplant was assessed. Mean creatinine levels of patients were also kept in account. In 26 cases, vascular reconstruction was carried out as a conjoined anastomosis between two arteries of similar size, while in 10 cases, an end-to-side anastomosis was done, connecting smaller arteries to larger ones. In 04 cases multiple anastomoses were performed. Performa was used to collect the data.*

RESULTS: *The study involved 240 patients, 40 patients had graft with multiple renal arteries. There was no significant difference between the two groups in terms of donor age or the cause of renal failure ($p = 0.841$ and 0.343). The most common causes of renal failure were idiopathic renal failure and diabetes mellitus. A strong correlation was found between the occurrence of complications in both groups ($p = 0.001$). Patients with multiple renal arteries had more urinary ($p = 0.24$) and vascular complications than those with a single artery, although the difference was only statistically significant for bleeding disorders ($p = 0.033$). The results indicated that vascular complications were notably higher in recipients with multiple renal arteries, though the difference between the groups was not statistically significant ($p = 0.197$).*

CONCLUSION: *Our study showed that multiple renal arteries did not negatively impact postoperative urologic or vascular complications, kidney allograft survival, or patient survival when compared to cases with a single renal*

artery. Therefore, kidney transplantation can be done successfully while using grafts with multiple renal arteries.

INTRODUCTION

The global incidence of end-stage renal disease is rising, largely due to the increasing prevalence of hypertension, diabetes mellitus, obesity-related complications, and other risk factors, which are the primary causes of kidney failure. (Laouad et al., 2012) Kidney transplantation remains the most effective treatment for patients with end-stage renal disease. However, the procedure can present various challenges, particularly in cases with anatomical abnormalities of the ureter or blood vessels, as seen in pediatric patients and those with horseshoe kidneys. (Chabchoub et al., 2011) Contraindications for kidney transplantation include aging, malignancy, untreated or recurrent infections, major cardiac and vascular conditions, and significant psychiatric illnesses. (Amirzargar et al., 2013)

Most people have a single renal artery, about 25% may have multiple renal arteries on one side, and 10% may have them on both sides. Although this variation is generally considered normal, it poses challenges during kidney transplantation, potentially prolonging the surgery and increasing cold ischemia time due to the need for vascular reconstruction before the transplant. Multiple renal arteries are classified as one of the anatomical complexities encountered in renal transplantation.(Omoto et al., 2014)

Kidney transplants with multiple renal arteries are frequently associated with a higher risk of complications both during and after surgery, particularly urologic and vascular complications.(Hwang et al., 2010) These anatomical differences continue to pose challenges for transplant surgeons around the world. Multiple renal arteries can lead to prolonged ischemia time, an increased rate of acute tubular necrosis, diminished graft function, and increase risk of acute rejection rates. However, the exact impact of multiple renal arteries on graft outcomes remains unclear. Living donor programs have been generated and donor criteria have been extended as a result of global donor shortage.(Şahin et al., 2023)

Single Renal artery (SRA) with their lower complication rates are optimal as suggested by research. Greater percentage of adverse clinical outcomes which can lead to transplant failure, has been associated with multiple renal arteries (MRA). (Kadotani et al., 2005) Multiple renal arteries are also associated with serious complications such as renal arterial stenosis, arterial thrombosis, and such conditions then effects the graft survival and also patients. Kidney transplant and multiple renal arteries have other potential complications such as, delayed graft function (DGF) and prolonged ischemia time. Using allografts with multiple renal arteries can be safe as those with single renal artery, is also shown in some studies. (Omoto et al., 2014)

Presence of multiple renal arteries could have clinically significant serious consequences such as failing to identify them during per-operatively, especially during laparoscopic donor nephrectomy. (Wadhwani et al., 2020) Laparoscopic surgical methods have been used greatly as by rising number of cases with kidney transplants, which, have drawbacks despite having many benefits.

Renal vascular anomalies can limit the utilization of minimally invasive techniques ie, laparoscopy in transplant, as it may lead to catastrophic outcomes.(Kamali et al., 2012)

Efforts have been made to reduce the incidence of vascular complications associated with multiple renal arteries (MRAs). One technique to address this issue is revascularization, which can be done either simultaneously or sequentially. Anatomical abnormalities in renal grafts can complicate the surgical procedure; therefore, the implantation of kidneys with multiple renal arteries requires a skilled surgeon to perform vascular reconstruction quickly and accurately. (Ahlawat, 2022)This approach aims to minimize total ischemia time while ensuring the integrity of the vascular anastomosis. Although ischemia time may be longer in some cases involving multiple renal arteries, graft damage can be prevented if the anastomosis is completed promptly and the graft is properly cooled.(Kumar and Ram Dhayal, 2022)

Recent research suggests that there are no substantial differences in survival rates or post-transplant

complications between kidneys with a single renal artery (SRA) and those with multiple renal arteries (MRAs). Despite these findings, the topic remains contentious, with some studies presenting conflicting data. In our retrospective analysis, we specifically examined the survival outcomes of kidney transplant recipients who received grafts from donors with MRAs, comparing these to the outcomes of recipients who received kidneys from donors with a single renal artery. This evaluation aims to provide further clarity on whether the presence of MRAs significantly impacts the success and longevity of kidney transplants, especially in light of ongoing debates within the field.

MATERIALS AND METHODS

We reviewed the records of 240 patients who underwent renal transplantation at Kidney Center BVH Bahawalpur and Multan Institute of kidney Diseases Multan between 2019 to 2022. Participants, who were declined to participate and those who were lost during the follow up were excluded from our study and were carefully organized. Computerized tomography renal angiogram (CTA) has been done of donors in both single renal artery or multiple renal arteries, to assess the anatomy of the renal vasculature. A detailed vasculature structure view was provided by employing this imaging technique, to ensure the exact classification of arterial anatomy for the procedure of transplantation. To enhance the reliability of the study findings, the rigorous inclusion criteria and the use of MRA for anatomical evaluations was utilized.

Using an end-to-side technique between the renal artery and the external iliac artery for the patients with the single renal artery, the arterial anastomosis was performed for the transplanted kidney. In cases of double arteries, two arteries are anastomosed by conjoined technique then this common artery was anastomosed to external iliac artery by end to side technique. External iliac artery could also be joined separately to the individual arteries through an end-to-side technique or to the internal iliac artery through end-to-end anastomosis. Using an end-to-end anastomosis technique, the venous anastomosis was conducted by connecting the renal vein to the external iliac vein. Immediate graft perfusion was noted in all cases and urine out started immediately.

Using Lich Gregoir technique has been utilized for the ureteric anastomosis, in this technique ureter was anastomosed with bladder mucosa and the detrusor muscles are closed over the re-implanted ureter to create an anti-reflux mechanism. During the procedure, a ureteric stent was placed, which was usually removed after the two weeks of transplant. With aim to enhance the overall success of the kidney transplantation and to minimize the complications, a comprehensive approach to both arterial and venous anastomoses, along with the careful ureteral technique were performed.

Variables related to patient characteristics, including donor age, body mass index (BMI), and the type of donor involved, the study collected range variables. Additional data was collected including sample size, the method of donor procurement, the side of the body from which the organ was retrieval, chances of delayed graft function, as well as the survival rate of both donor and the patients. The data analysis was mainly focused on reported complications, highlighting both vascular and urological issues, along with warm ischemia time (WIT) and creatinine levels. The main objective of the study was to find the survival of the graft within 02 years after the transplantation. Secondary points included rates of patient survival, incidence of complications, creatinine levels, and warm ischemia time, all the factors indicating a comprehensive evaluation of effectiveness of transplantation and the outcomes of the patients. Delayed function of the graft was defined specifically as the need for dialysis within the first week post-transplant. The duration from the retrieval of graft from donor to reperfusion by irrigation solution is warm ischemia time (WIT). The time period in which graft is being perfused by irrigation solution is cold ischemia time (CIT). The importance of definitions of evaluating the transplant results and complications were emphasized through this methodological approach which aligns with the findings in related literature. For example, significantly impact on the long-term graft survival and prognosis of the patients, in previous research has been shown that delayed graft function, showing the need for accurate criteria in analyzing results. By extremely through and careful check to these definitions, the study aimed to provide a strong assessment of the factors effecting

both graft and patient survival in the aim of kidney transplantation.

Without the knowledge of case-control status of the participants, all the assessment was done by the researchers. The average creatinine levels of the patients were also taken into the consideration in this study. Between two arteries of comparable size, a combined anastomosis was performed in 16 cases. To connect smaller arteries to the larger ones an end-to-side anastomosis was done in 12 cases. Multiple anastomosis was done in almost 12 cases from which data was collected. A structured proforma was used to obtain this data collection, and making sure that systematic documentation of all relevant information was given. From this comprehensive approach not only helped to analyze surgical techniques but also helped insight into the overall results and renal function of the patients after transplantation. Data was analyzed through SPSS version 23. The mean was the frequency and percentage and standard deviation for the characteristics of the patients. P-value less than 0.05 was considered significant.

RESULTS

In a study involving 240 living donor kidney transplants, there were 200 patients categorized as having single renal arteries (SRA) in group 1, while 40 patients had multiple renal arteries (MRA) in group 2. Among those in group 2, only one patient presented with three renal arteries, and 39 patients had double renal arteries. The age of recipients spanned from 20 to 65years. When comparing the two groups regarding age, baseline serum creatinine levels, mean operative time, and ischemia time, the results indicated that recipient age was similar between the two groups, with averages of 35.54 years for group 1 and 27.47 years for group 2, and baseline serum creatinine levels were also comparable at 8.32 mg/dL for group 1 versus 8.56 mg/dL for group 2, with a p-value greater than 0.05. However, notable differences were observed in the operative time; the mean operative time was significantly longer for the MRA group at 216 minutes compared to 206 minutes for the SRA group, and the total ischemia time was also significantly greater in the MRA group, recorded at 62.37 minutes versus 56.23 minutes in the SRA group.

Additionally, during the procedures, one patient from the SRA group required an immediate revision of the arterial anastomosis due to a technical issue. Out of the three patients who underwent a second transplant, one patient from the MRA group, who had two renal arteries, faced complications that necessitated the graft's placement in the left iliac fossa. This posed a significant technical challenge, as it required the execution of three vascular anastomoses—two arterial and one venous—within the confined space of the left iliac fossa.

TABLE1: Patient's characteristics who showed graft with single and multiple renal arteries.

PATIENT'S CHARACTERISTICS	SINGLE RENAL ARTERY (n= 200)	MULTIPLE RENAL ARTERY(n=40)
wMale/ Female	134/66	29/11
Mean Age	36.7±13.3 years	
Mean follow-up	55.3±45.7	
Mean creatinine	1.97±0.70mg/dl	1.96±0.67mg/dl
Mean creatinine (last follow-up)	2.67±1.63mg/dl	2.66±1.70mg/dl
Mean systolic BP	140.1±23.8 mmHg	156±23.3 mmHg
Vascular complication	None	1 patient
Urologic complication	None	1 patient

The study revealed a significant difference in cold ischemia time between the two groups, with a p-value of less than 0.001. This indicated that kidney transplant recipients with multiple renal arteries experienced longer cold ischemia time compared to those with single renal arteries. However, the warm ischemia time did not show any significant difference between the groups. Additionally, there was a strong correlation in the occurrence of complications across both groups, with a p-value of 0.001. Complications related to urinary and vascular issues were more prevalent in the group with multiple renal arteries. Specifically, the incidence of vascular complications, including hematoma, renal artery stenosis, renal vein thrombosis, and bleeding, was higher among recipients of kidneys with multiple renal arteries. Despite this increased rate of complications in

the MRA group, statistical analysis indicated no significant difference between the two groups, as reflected by a p-value of 0.195.

TABLE 2: Comparison of ischemia time between renal transplant recipients of kidneys with single and multiple renal arteries

Patient's characteristics	Single Renal Artery	Multiple Renal Arteries	P-value
Warm ischemia time in minutes	2.13 (0.58)	2.14(0.60)	0.826*
Cold ischemia time in minutes	54.10 (8.66)	60.23(9.95)	<0.001*

In our study, the results from binary logistic regression indicated that none of the factors analyzed were able to predict the occurrence of complications in patients with multiple renal arteries. This finding suggests that, despite various potential predictors being considered, they did not demonstrate a significant association with the development of complications in this specific patient population. Thus, it appears that the characteristics or circumstances surrounding the surgical procedure, as captured by the factors studied, do not effectively forecast complication rates for individuals undergoing transplantation with multiple renal arteries.

DISCUSSION

Renal transplantation is widely regarded as the preferred treatment for individuals with end-stage renal disease. Significant enhancements for the patients undergoing this procedure have been done, as in surgical techniques, and the development of more effective immunosuppressive medications, and also the improvements in diagnostic procedures have been done. For better patients survival rates and the overall success rate in the renal transplantation, these innovative procedures have contributed, making it a better option for the patients who are facing chronic kidney failure.(Timsit et al., 2016)

Risk of complications will be increased when there is presence of multiple renal arteries during the process of transplantation. Higher incidence of complications faced in patients with multiple renal arteries, which can cause complications in the surgical process and affect postoperative recovery. (Meyer et al., 2012) As a result, when performing and planning renal transplants in patients with the anatomical variations, it is important for healthcare professionals to be aware of these potential risks, making sure that appropriate measures are taken to overcome the complications and optimize patient results.(Sevmis et al., 2021)

A study conducted by Saidi and colleagues, with the data of 350 consecutive kidney transplants patients were analyzed, which included 319 renal allografts with single renal arteries (SRA) and 31 allografts with multiple renal arteries (MRA). The findings showed that the time for operation was significantly shorter for SRA grafts compared to MRA grafts, with average time period of 173 minutes for SRA versus 259 minutes for MRA. This observation was aligned with the results of the current study. Saidi and colleagues noted a significant increase in the recent years in the use of allografts with MRAs, especially for grafts obtained from laparoscopic techniques, with the anatomical variations, attributing this trend to the demonstrated feasibility and safety.(Saidi et al., 2009) Significant challenges present in complex vascular anatomy during the procedure for the surgical team. A prevalent anatomical variation of the kidneys is seemed by the occurrence of multiple renal arteries (MRAs); however, variation found about it in different studies.(Arpalı et al., 2020) In one of the researches, the incidence of MRAs was found to be 15.46%, which is less than the 30% reported by Aydin and colleagues in 2004, but are higher than the 8.3% noted by Kamali and colleagues. This variation in the reports was highlighted, as to show the complexity of renal vascular anatomy and also show the importance of individualized assessment during surgical planning and execution.(Ikidag and Uysal, 2019)

In another large cohort study involving 2,100 patients at a single tertiary center over the time of 33 years examined the prevalence, demographics, and surgical approaches for kidney transplants involving MRAs. This study reported that grafts with MRAs were linked to extended ischemia times ($p = 0.001$) and an increased incidence of acute tubular necrosis, findings that are similar to those with the present

study. Despite these challenges, the overall rate of survival of the patients and grafts were not affected badly, which indicates that complications may arise, but they do not necessarily compromise long-term outcomes.

In the current study, Patients with multiple renal arteries had the overall rate of complications notably higher among renal transplant recipients, with the occurrence of 45.9% compared to just 15.4% for those with single renal arteries. This difference was statistically significant, with p-value of 0.001.

Additionally, while the rate of vascular complications was greater in patients receiving kidneys with multiple renal arteries, this finding did not reach statistical significance, as evidenced by a p-value of 0.197. This suggests that although there is an observable trend toward a higher occurrence of vascular complications in this group, the data do not provide sufficient statistical evidence to confirm a definitive association between the presence of multiple renal arteries and increased vascular complications compared to single renal arteries.

In this study, we did not specifically investigate the relationship between the number of renal arteries and the survival of transplant recipients. However, prior research has indicated that renal transplant recipients with single renal arteries tend to have a longer duration of transplantation, averaging 27.3 months, compared to those with multiple renal arteries, who averaged 21.49 months. This difference was statistically significant, with a p-value of 0.016. Two studies conducted by Saidi R et al. and Hwang J et al. further corroborated these findings, showing that the number of arteries did not significantly influence patient survival rates. These results suggest that while the anatomical variation of renal arteries may affect certain transplant outcomes, it does not appear to have a substantial impact on overall patient survival in the context of renal transplantation.(Saidi et al., 2009)

Binary logistic regression analysis was conducted to identify which variables were most strongly associated with the development of complications in both groups of renal transplant recipients. In a cohort study with single renal arteries, the underlying cause of renal failure emerged as a significant predictor for the occurrence of complications, with a p-value of 0.02. While, other factors including the age of both the donor and recipient, gender, the timing of transplantation, presence of comorbid diseases, and ischemia times did not show any significant impact in this regard.

For patients with multiple renal arteries, it was noted that cold ischemia time was longer, largely due to the additional time required for arterial reconstruction prior to completing the arterial anastomosis. However, no variables were identified that could predict the occurrence of complications, in the group with multiple renal arteries, indicating a lack of significant associations in this population. This demonstrates that further research may be needed for better understanding of the factors effecting the results in this group, and highlights the complexity of managing patients with multiple renal arteries.

CONCLUSION

Renal transplantation that involves the multiple renal arteries (MRA) is considered a safe procedure that does not affect adversely the graft outcomes, besides an increase in the vascular complications rate. For renal transplantation, the presence of MRAs should not be viewed as a contraindication. The technical challenges which are associated with transplanted kidneys with MRAs are acknowledged, and evidence suggests that the use of these allografts is comparable in safety to those with single renal arteries (SRAs) presenting both vascular complications and overall patient and graft survival.

REFERENCES

AHLAWAT, R. 2022. Robotic Kidney Transplantation Under Regional Hypothermia. *J Endourol,* 36**,** S18-s24.

AMIRZARGAR, M. A., BABOLHAVAEJI, H., HOSSEINI, S. A., BAHAR, H., GHOLYAF, M., DADRAS, F., KHOSHJOO, F., YAVANGI, M. & AMIRZARGAR, N. 2013. The new technique of using the epigastric arteries in renal transplantation with multiple renal arteries. *Saudi J Kidney Dis Transpl,* 24**,** 247-53.

ARPALı, E., KARATAŞ, C., AKYOLLU, B., YAPRAK, D., GÜNAYDıN, B. & KOÇAK, B. 2020. Hand-assisted laparoscopic donor nephrectomy in kidneys with multiple renal arteries versus a single renal artery: An

analysis of vascular complications from 1,350 cases. *Turk J Urol,* 46**,** 314-9.

CHABCHOUB, K., MHIRI, M. N., BAHLOUL, A., FAKHFAKH, S., BEN HMIDA, I., HADJ SLIMEN, M., CHARFI, W., ABDENNADER, M., FRIKHA, I. & HACHICHA, J. 2011. Does kidney transplantation with multiple arteries affect graft survival? *Transplant Proc,* 43**,** 3423-5.

HWANG, J. K., KIM, S. D., PARK, S. C., CHOI, B. S., KIM, J. I., YANG, C. W., KIM, Y. S. & MOON, I. S. 2010. The long-term outcomes of transplantation of kidneys with multiple renal arteries. *Transplant Proc,* 42**,** 4053-7.

IKIDAG, M. A. & UYSAL, E. 2019. Evaluation of Vascular Structures of Living Donor Kidneys by Multislice Computed Tomography Angiography before Transplant Surgery: Is Arterial Phase Sufficient for Determination of Both Arteries and Veins? *J Belg Soc Radiol,* 103**,** 23.

KADOTANI, Y., OKAMOTO, M., AKIOKA, K., USHIGOME, H., OGINO, S., NOBORI, S., HIGUCHI, A., WAKABAYASHI, Y., KAIHARA, S. & YOSHIMURA, N. 2005. Management and outcome of living kidney grafts with multiple arteries. *Surg Today,* 35**,** 459-66.

KAMALI, K., ABBASI, M. A., ANI, A., ZARGAR, M. A. & SHAHROKH, H. 2012. Renal transplantation in allografts with multiple versus single renal arteries. *Saudi J Kidney Dis Transpl,* 23**,** 246-50.

KUMAR, M. & RAM DHAYAL, I. 2022. Observational Study of Early Outcomes in Single-Vessel and Multiple-Vessel Renal Allograft. *Cureus,* 14**,** e27579.

LAOUAD, I., BRETAGNOL, A., FABRE, E., HALIMI, J. M., AL-NAJJAR, A., BOUTIN, J. M., BRUYÈRE, F., NIVET, H., LEBRANCHU, Y. & BÜCHLER, M. 2012. Kidney transplant with multiple renal artery grafts from deceased donors: are long-term graft and patient survival compromised? *Prog Transplant,* 22**,** 102-9.

MEYER, F., NICHELE, S. A., ADAMY, A., SANTOS, L. S. & MACHADO, C. 2012. Early outcomes of laparoscopic donor nephrectomy with multiple renal arteries. *Int Braz J Urol,* 38**,** 496-503.

OMOTO, K., NOZAKI, T., INUI, M., HIRAI, T., SAWADA, Y., SHIMIZU, T., TOKI, D., ISHIDA, H. & TANABE, K. 2014. Retroperitoneoscopic donor nephrectomy with multiple renal arteries does not affect graft survival and ureteral complications. *Transplantation,* 98**,** 1175-81.

ŞAHIN, S., ÖZDEMIR, O., EKŞI, M., EVREN, İ., KARADAĞ, S., ARIKAN, Y. & TAŞÇı, A. 2023. The effect of single or multiple arteries in the donor kidney on renal transplant surgical outcomes. *Ir J Med Sci,* 192**,** 929-934.

SAIDI, R., KAWAI, T., KENNEALEY, P., TSOUFLAS, G., ELIAS, N., HERTL, M., COSIMI, A. B. & KO, D. S. 2009. Living donor kidney transplantation with multiple arteries: recent increase in modern era of laparoscopic donor nephrectomy. *Arch Surg,* 144**,** 472-5.

SEVMIS, M., DEMIR, M. E., MERHAMETSIZ, O., AKTAS, S., SEVMIS, S. & UYAR, M. 2021. Grafts With Multiple Renal Arteries in Kidney Transplantation. *Transplant Proc,* 53**,** 933-940.

TIMSIT, M. O., KLEINCLAUSS, F., RICHARD, V. & THURET, R. 2016. [Surgical complications of renal transplantation]. *Prog Urol,* 26**,** 1066-1082.

WADHWANI, M., BHARTIYA, S., UPADHAYA, A. & MANIKA, M. 2020. A meta-analysis to study the effect of pan retinal photocoagulation on retinal nerve fiber layer thickness in diabetic retinopathy patients. *Rom J Ophthalmol,* 64**,** 8-14.