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Renal function outcomes in living kidney donors in a transplant center in Colombia

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Abstract

Introduction: Living kidney donation is currently low in Colombia, and this is associated with the lack of knowledge of the risks and renal function outcomes of potential donors; there are no studies that evaluate these outcomes. The objective of this study is to evaluate the outcomes of renal function, the incidence of metabolic diseases, arterial hypertension, as well as the finding of albuminuria and/or proteinuria in living kidney donors with a 2-year follow-up post donation.

Methods: Observational study in living kidney donor patients, in which renal function outcomes were evaluated between the predonation period and up to 24 months postdonation.

Results: Ninety-one patients were included, with a median predonation glomerular filtration rate of 98 ml/min/1.73 m^2, interquartile range (90.5–109), and 24-month postdonation of 66.3 ml/min/1.73 m^2 interquartile range (57.9–75). A total of 60.26% of the population was in stage 2 at the end of follow-up and no patient had a glomerular filtration rate less than 30 ml/min/1.73 m^2 or required renal support therapy.

Conclusion: A living donor evaluation process based on risk factor stratification and adequate assessment of renal function was found to generate safe renal function outcomes both in the perioperative period and in medium- and long-term follow-up.

Keywords

Chronic kidney disease, living kidney donor, glomerular filtration rate, kidney transplant, prognosis

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Introduction

End-stage chronic kidney disease (CKD) has been increasing as the risk factors for its development are increasingly prevalent, which has led to the use of different renal replacement therapy options. Kidney transplantation is an optimal therapy that improves the overall survival of individuals with end-stage CKD compared to dialysis.[1,2] In kidney transplantation, there is the possibility of receiving living or cadaveric donations, with cadaveric donor transplants being more common. According to reports from the United Network for Organ Sharing of the United States, the maximum number of living donations was performed between 2021 and March 2022.[3]

The National Institute of Health in Colombia reported that in 2020, 699 kidney transplants were performed, of which 16.4% were from living donors.[4] Living donation increases organ availability, and recipients of living donors have better results in terms of quality of life and clinical outcomes. However, despite the altruism of potential donors, there is uncertainty among them about the donation process and possible complications following donation.[5]

In the main outcomes after kidney donation, the decrease in glomerular filtration rate (GFR) is the main expected result after donation, the Organ Procurement and Transplant Network (OPTN) and KDIGO guidelines recommend the value to contraindicate donation with GFR

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<60 ml/min/1.73 m^2 and optimal value with GFR >90 ml/min/1.73 m^2 recommending the CKD-EPI formula for measurement.[6] Living kidney donor patients have a decrease in GFR of approximately 30 ml/min/1.73 m^2, findings that may vary or modify in relation to the age of the patients, comorbidities, and lifestyle changes between predonation and postdonation; however, many studies have shown that early and initial loss of glomerular filtration is associated with decreased renal mass after nephrectomy and that in long-term follow-up analyses no greater loss of renal function is evident in relation to the nondonor population.[7–9]

Methods

Observational study in living kidney donor patients was performed through the medical records of the kidney transplant unit of the Clínica Universitaria Colombia in Bogotá. The inclusion criteria were patients over 18 years of age between 2010 and 2020 in the living kidney donation program, exclusion criteria were incomplete data in clinical history, 91 patients met the selection criteria.

In this research, sample size was not calculated since the entire population that met the selection criteria in the established period was taken.

The variables of GFR by CKD-EPI, 24-h urine protein and microalbuminuria were analyzed in predonation at 3 to 6 months, 1 year and 2 years postdonation.

Statistical analysis

A descriptive analysis was performed to characterize the study population. In the quantitative variables, measures of central tendency and dispersion were calculated; in the case of qualitative variables, absolute and relative frequencies were calculated. Hypotheses were contrasted in bivariate analysis. None of the quantitative variables had a normal distribution according to the graphical inspection of the information, as well as the performance of the Shapiro–Wilk test, which is why nonparametric statistics were calculated. Related tests such as the Wilcoxon test or the Friedman test were performed according to the number of measurements to be compared, and in those tests that resulted in statistically significant differences ($p < 0.05$), the Durbin post hoc test was performed.

Ethical approval for this study was obtained from the ethics committee of the Fundación Universitaria de Ciencias de la Salud Bogotá, Colombia and Clínica Colombia Keralty Bogotá, Colombia (Fundación Universitaria Sanitas) on February 22, 2023 (CEISH 121-2023) and complies with international research standards. Informed consent was not requested for this study because it is a retrospective study in which a review of medical records was performed. The institutional ethics committee waived informed consent because it was considered a risk-free study.

Results

Ninety-one patients who met the selection criteria were included. The median age before donation was 42.2 years with an interquartile range (IQR; 34–53). A total of 62.6% of the population was female. Regarding the relationship between donors and recipients, 57.1% were siblings followed by 15.4% mother.

No postoperative mortality was recorded in this cohort at 24 months follow-up, 97.8% of nephrectomies performed were left-sided and 100% by laparoscopy, and postoperative complications were recorded in 5.5% of patients. Major bleeding and blood transfusion requirements were documented in 1.1% of patients.

The Grams et al. scale for living kidney donor candidates was applied to 100% of the population, which estimates the risk of progression to terminal CKD after donation at 15 years and for life, documenting a risk of less than 1% in the total population. The baseline characteristics of the study cohort are shown in Table 1.

Pre- and postdonation renal function

The method for measuring renal function before donation in 100% of cases was by 24-h urine creatinine clearance and calculation of GFR by CKD-EPI; in 6.6% of cases, renal gammagraphy was used to measure borderline values.

The median GFR measured by CKD-EPI in the predonation period was 98 ml/min/1.73 m^2, and IQR (90.5–109), and by 24-h urine creatinine clearance it was 105 ml/min/1.73 m^2, IQR (96.2–128.3). Follow-up of renal function measured by CKD-EPI GFR up to 24 months postdonation was completed in 85.7% of the population.

In the period between 3 and 6 months, a median GFR of 60.5 ml/min/1.73 m^2 IQR (54–68.8) was found, at 12 months it was 66.3 ml/min/1.73 m^2 IQR (55–73), and at 24 months, it was 66.3 ml/min/1.73 m^2 IQR (57.9–75).

When comparing the evolution of renal function in the postdonation period, it is evident that between 3 and 6 months, there was a significant decrease in GFR measured by CKD-EPI; however, during the follow-up at 12 and 24 months, a progressive gain of 5.8 and 6.8 ml/min/173 m^2 was found, respectively, $p = 0.001$ (Figure 1).

At the end of the 24-month follow-up, it was found that 11.54% of the patients had a GFR >90 ml/min/1.73 m^2, 60.2% between 89 and 60 ml/min/1.73 m^2; 26.9% between 59 and 45 ml/min/1.73 m^2 and 1.28% a GFR between 44 and 30 ml/min/173 m^2, without evidence of GFR with lower values (Figure 2).

Proteinuria and albuminuria pre- and postdonation

Regarding 24-h urine proteinuria predonation, a median of 110 mg/day and IQR (80–160) was found, and partial urine

Table 1. Demographic characteristics.

Features	Total ($n=91$), n	%
Sex		
Female	57	62.6
Race		
Mongrel	91	100
Age med (IQR)	42	34–53
BMI pre donation		
Normal	71	78
Overweight	19	20.9
Obesity	1	1.1
Weight reduction strategies		
Diet	15	16.5
Exercise	6	6.6
Bypass	1	1.1
None	69	75.8
Metabolic predonation		
DM	0	0
Prediabetes	0	0
HTA predonation		
Yes	2	2.2
GFR measurement		
CKD-EPI	91	100
Renal scintigraphy	2	2.2
Relationship D/R		
Father	10	11.4
Mother	14	15.4
Sibling	52	57.1
Spouse	6	6.6
Others	9	9.9
Mortality post		
No	0	100
Perioperative complications		
Major bleeding	1	1.1
Infections	1	1.1
Other	3	3.3
None	86	94.5
Laterality of nephrectomy		
Right	2	2.2
Left	89	97.8
Type of surgery		
Laparoscopy	91	100
2-Year TRR		
No	91	100
Risks of progression to CKD		
15 Years <1%	91	100
Lifetime <1%	91	100

BMI, body mass index; CKD, chronic kidney disease; DM, diabetes mellitus; D/R, donor/recipient; GFR, glomerular filtration rate; HTA, arterial hipertension; TRR, renal replacement therapy; med, median; IQR interquartile range.

microalbuminuria with a median of 2.2 mg/L and IQR (1.5–5.4). Proteinuria in 24 h was evaluated in the postdonation period up to 24 months with a median of 100 mg/day with IQR (57–75), $p=0.482$ without finding statistical significance between the pre- and postdonation values (see Figure 3). Postdonation albuminuria was found with a median of 3.0 mg/gr IQR (1.7–5.8), with a $p=0.491$, without statistically significant changes (Figure 4).

Incidence of metabolic diseases and arterial hypertension pre- and postdonation at 24 months

Regarding the body mass index (BMI) in predonation, 78% had a normal BMI followed by 20.9% overweight, the weight reduction strategies used were 16.5% diet, 6.6% exercise, 1.1% bypass, and 73.6% no intervention. Postdonation BMI at 24 months was normal in 51.8%, 40% overweight, 7.1% grade I obesity, and 1.2% grade II obesity (Table 2).

No patient had a history of type 2 diabetes mellitus (DM) or prediabetes; 2.2% had a history of arterial hypertension and treatment in 100% was with a single antihypertensive and without evidence of target organ damage.

After donation, 2.2% developed prediabetes and 1.1% type 2 DM. Postdonation arterial hypertension was diagnosed in 8.2% of patients with a $p<0.008$ being statistically significant in relation to the predonation evaluation, the diagnostic method for arterial hypertension was in 1.1% clinical in a general medical consultation, 2.3% through continuous blood pressure monitoring for 24 h and 4.6% clinical in a transplant follow-up consultation.

Discussion

We present a historical cohort study evaluating the outcomes of renal function in living donors, finding a higher frequency of donation in women compared to men and the median age was 42.2 years, data similar to those found in other studies.[3,4] In the relationship between donors and recipients, according to the protocol of our transplant group, only living donations related to emotional kinship are accepted; donations between siblings are more frequent, followed by parents to children, in contrast to the data of Ralph et al., where a higher frequency of donations between spouses is evident, followed by siblings.[10,11]

The method of choice for measuring renal function before donation recommended by the National Institute of Health of Colombia, the OPTN, the KDIGO guidelines, and the data from Burballa et al. is the performance of 24-h urine creatinine clearance and estimation using the CKD-EPI formula[4,6,10]; which was performed in 100% of the patients in our population.

Currently, there is no scale that assesses the risk of progression to advanced CKD in the Hispanic-Latino population; therefore, the scale proposed by Grams et al. was adopted, which estimates the risk of progression to terminal CKD postdonation at 15 years and for life.[12] In our population, the estimated risk of progression to CKD in both scenarios was less than 1% in all donors.

When analyzing the pathological history in our cohort, no patient was found with a predonation diagnosis of prediabetes and/or type 2 DM, in relation to what has been reported

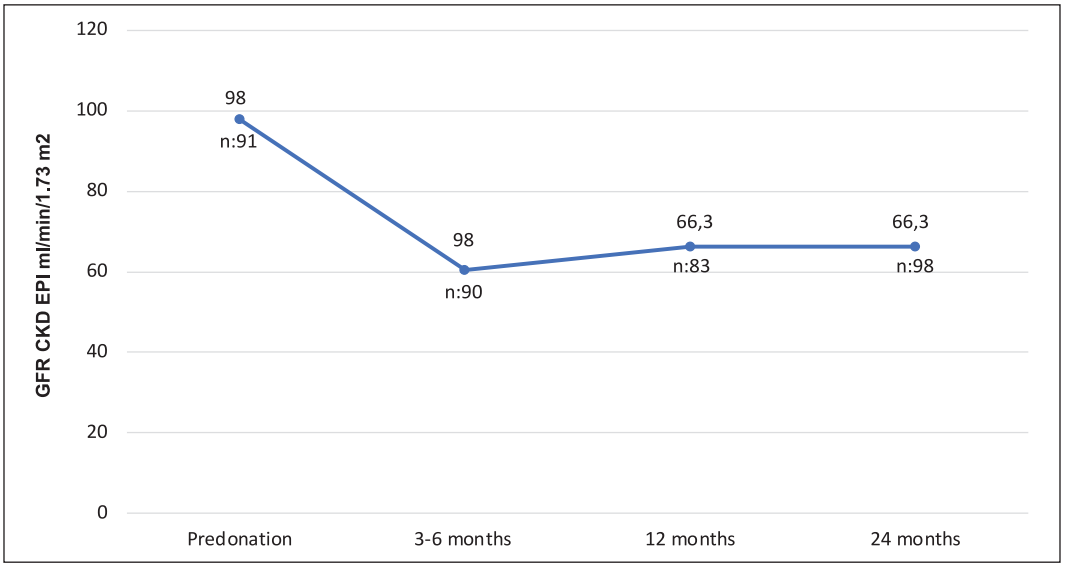

Figure 1. GFR predonation and behavior during follow-up (median).
GFR, glomerular filtration rate.

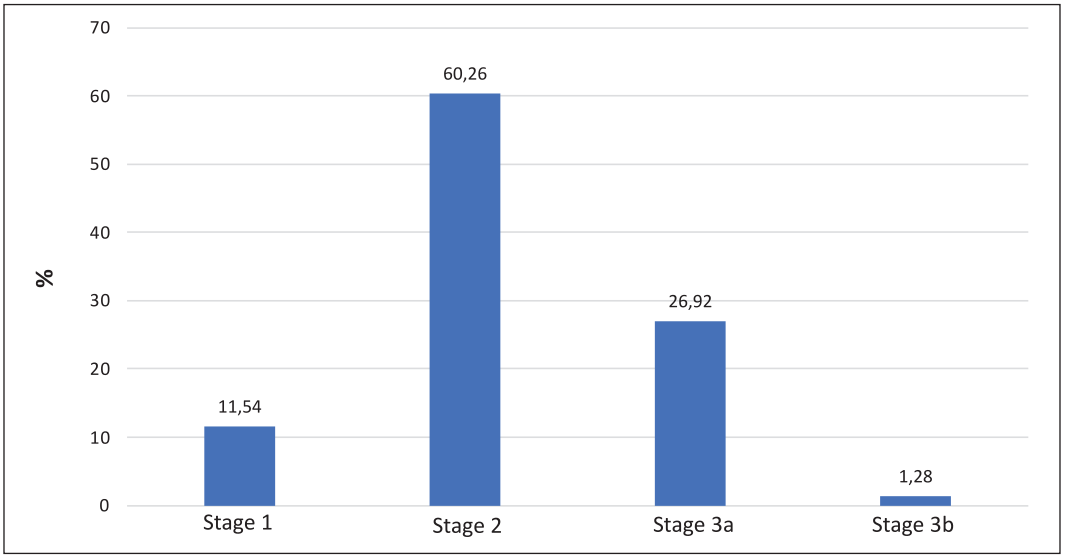

Figure 2. CKD stages by KDIGO at the end of 24-month follow-up (percentage of patients).

in other series in which it is considered a contraindication for living donation.[4,13,14]

In the cohort of Holscher et al., the development of type 2 DM postdonation is described with an incidence of 15 cases per 10,000 donors at a follow-up of 2 years.[15] Likewise, Ibrahim et al. in their cohort reported the development of type 2 DM in 5.2%.[16] In contrast to what was reported in our study where we found the presence of type 2 DM postdonation in 1.1%. In the study by Issa et al., which included 940 patients, the variations in BMI between pre- and postdonation were described. In this study, 85% of the patients had a predonation BMI <30; of this group, 12.6% presented weight gain in the postdonation follow-up and 25% had a BMI >30, of which 6.6% presented weight gain in the postdonation period.[17]

In our study, the population had a normal BMI; presenting a weight gain in the postdonation period with the highest percentage being overweight.

Regarding the history of predonation arterial hypertension, in the study by Segev et al., hypertension was reported in 1.8%, similar to our cohort.[4,14] The incidence of postdonation hypertension was 8%, data also reported in the meta-analysis by Munch et al., finding a higher risk of requiring antihypertensive medication in the kidney donation population with RR 1.40; (confidence interval (CI)) 95%, 1.17–1.66).[18] However, there is much discrepancy between the findings of postdonation arterial hypertension due to the multiple variables that determine the appearance of arterial hypertension and may not be linked to donation.[15,19]

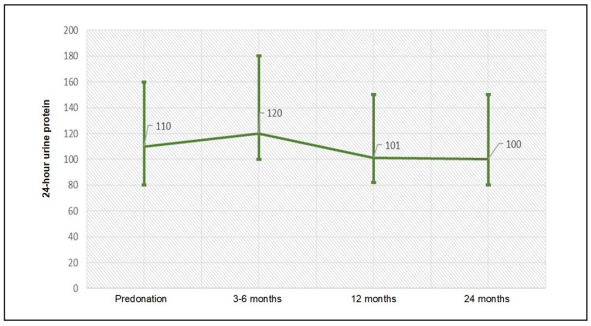

Figure 3. Twenty-four-h urine protein predonation and evolution during follow-up (median).

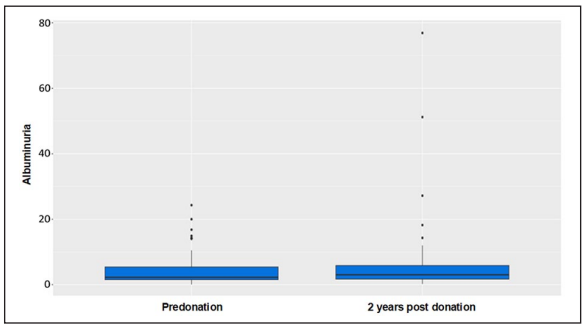

Figure 4. Predonation and postdonation albuminuria at the end of follow-up.

Table 2. Postdonation demographic characteristics.

Features	Total	*N*
Dx pre-DM (%)		*n* = 89
Yes	2	2.2
Dx DM (%)		*n* = 88
Yes	1	1.1
Dx HTA (%)		*n* = 87
Yes	7	8.0
Method Dx HTA (%)		*n* = 87
Clinical	1	1.1
Map	2	2.3
Transplant consultation	4	4.6
Number of hypotensive drugs (%)		*n* = 7
1	7	100
Metabolic syndrome (%)		*n* = 85
Yes	4	4.8
BMI (%)		*n* = 85
Normal	44	51.8%
Overweight	34	40%
Obesity grade I	6	7.1%
Obesity grade II	1	1.2%

BMI, body mass index; DM, diabetes mellitus; Dx, diagnosis; preDM, prediabetes.

Regarding the renal function outcomes in a cohort by Burballa et al., the estimation of GFR using the CKD-EPI and modification of diet in renal disease study (MDRD) formulas in predonation and postdonation was compared, finding superiority in the CKD-EPI method.[6] In the evolution of renal function in the postdonation period, we found that between 3 and 6 months there was a significant decrease in GFR; however, during the follow-up at 12 and 24 months, a progressive improvement in GFR was found. Most of our patients at 2 years had GFR >60 ml/min/m^2, and no patients were found with GFR <30 ml/min/m^2 or requiring renal replacement therapy, these findings are similar to those found in other series[7,20]. Saito et al. report a higher percentage of the population in stage 3 of CKD postdonation in a 3-year follow-up.[8]

We did not find statistically significant differences between albuminuria and proteinuria at 24 h pre- and postdonation. These findings differ from those reported by Moody et al. in a multicenter, parallel-group, blinded study of living kidney donors, and healthy controls in which the presence of microalbuminuria postdonation was reported with an OR 3.8 (95% CI, 1.1–12.8); $p = 0.04$).[21] Thiel et al. determined microalbuminuria and diagnosis of arterial hypertension at 1 and 5 years, reporting an increase in albuminuria from 4.8% to 10.4%, with statistical significance only for the hypertensive group in relation to the normotensive group (16.6% versus 6.0%, $p = 0.03$, respectively).[22]

In the different series, the rate of surgical complications reported is low, according to the records of Humar and Matas[23] they report mortality associated with surgical complications of 0.02%, reintervention required in 2.3%, and bleeding in 0.75% of the population.[24,25] Regarding the surgical technique used, higher rates of complications associated with the open procedure versus laparoscopic have been documented. In our findings, data similar to those of other studies were found, no mortality was recorded at 24 months, and the documentation of perioperative surgical complications was low.

Conclusions

One of the few studies performed in Colombia in which the outcomes of renal function in living kidney donors are described. The evaluation process of the living donor based on the stratification of risk factors and adequate evaluation of renal function generate adequate safety outcomes in the perioperative period and in the medium and long-term follow-up. Postdonation renal function in relation to GFR decreases significantly in the initial months after donation, but afterward it has a stable behavior without acceleration of renal function loss, with a decrease that is expected in the different series of about 30%.

Limitations

Retrospective study, in this research, sample size was not calculated since the entire population that met the selection criteria in the established period was taken.

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Author contributions

Rodolfo Torres, Camilo Montero, and Maricely Reina researched the literature and conceived the study; Andres Tunjano and Maricely Reina participated in developing the protocol and obtaining ethical approval; Andres Tunjano, Rodolfo Torres, Camilo Montero, Laura Castellanos, Valeria Mancera, Maria Amaya, and Lizeth Arias participated in data collection; David Andrade participated in data analysis; Andres Tunjano, Maricely Reina, and Rodolfo Torres wrote the main text of the article and prepared the graphs and tables. All authors reviewed and edited the article and approved the final version of the article.

Declaration of conflicting interests

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Ethics approval

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Informed consent

Informed consent was not requested for this study because it is a retrospective study in which a review of medical records was performed. The institutional ethics committee waived informed consent because it was considered a risk-free study.

Trial registration

Not applicable.

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