



Right nephrectomy vs left nephrectomy in living donor transplantation, analysis of evolution and prognosis. Report from a tertiary care hospital

Nefrectomía derecha versus nefrectomía izquierda en trasplante de donante vivo, análisis de evolución y pronóstico. Informe de un hospital de tercer nivel

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Abstract

Kidney transplantation is the best renal replacement therapy for end-stage renal disease. Living donation constitutes the highest proportion of transplants in our country; donation nephrectomy requires assessment of renal function, which will influence the surgical planning of the kidney to donate.

Methods: We made a comparison between the evolutions of patients who underwent right nephrectomy versus left nephrectomy, for donation purposes in our center.

Results: Out of a total of 395 cases, 86 (21.7%) were right nephrectomies. With significant differences in the proportion of intraoperative complications, 2% for left nephrectomy and none for right nephrectomy; and more patients with postoperative complications (Clavien-Dindo II) for the left nephrectomy group, with a statistically significant difference ($p = 0.02$)

Discussion and Conclusions: Adequate surgical planning of the kidney to donate is required to ensure renal function after the donation event, as well as verification of the safety of the surgical act in the donor and the recipient, this must be collegiate and individualized for each transplant binomial.

Keywords:

Donor, Kidney transplantation, Laparoscopic, Nephrectomy, Right

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Resumen

El trasplante de riñón es la mejor terapia de reemplazo renal para la enfermedad renal en etapa terminal. La donación en vida constituye la mayor proporción de trasplantes en nuestro país; La nefrectomía de donación requiere evaluación de la función renal, lo que influirá en la planificación quirúrgica del riñón a donar.

Métodos: Realizamos una comparación entre la evolución de los pacientes intervenidos de nefrectomía derecha frente a nefrectomía izquierda, con fines de donación en nuestro centro.

Resultados: De un total de 395 casos, 86 (21.7%) fueron nefrectomías derechas. Con diferencias significativas en la proporción de complicaciones intraoperatorias, 2% para nefrectomía izquierda y ninguna para nefrectomía derecha; y más pacientes con complicaciones postoperatorias (Clavien-Dindo II) para el grupo de nefrectomía izquierda, con una diferencia estadísticamente significativa ($p=0.02$)

Discusión y conclusiones: Se requiere una adecuada planificación quirúrgica del riñón a donar para asegurar la función renal posterior al evento de donación, así como la verificación de la seguridad del acto quirúrgico en el donante y el receptor, esta debe ser colegiada e individualizada para cada binomio de trasplante.

Palabras clave:

Donante, Trasplante renal, Laparoscópico, Nefrectomía, Derecho

Introduction

Kidney transplantation is the best renal replacement therapy for replacement therapy end-stage renal disease (ESRD), in relation to a better quality of life and increased survival.⁽¹⁾ Accessibility to transplantation may vary according to each country; the rate of deceased donors in Mexico is low, when compared to countries such as Spain and the United States. According to the registry of the National Transplant Center (CENATRA) in Mexico, in 2019, 2939 kidney transplants were performed, of which only 31.4% (923) came from a deceased donor, with 17 069 patients still on the waiting list, which continues to rise. Attempts have been made to compensate for this shortage of donors through living donation, an

option that constitutes the highest proportion of transplants in our country.^(2,3)

In the living donor transplant binomial, priority is assigned to donor safety, which begins with the protocol prior to donation, verifying the absence of coercion in the act of donation, normal kidney function and the presence of a low risk of development of long-term nephropathy. Acceptable surgical risk must be sought through early detection of anatomical variants and abnormalities detectable by imaging studies.⁽⁴⁾

In addition to evaluating the integrity of kidney function, radiological studies are useful for planning the kidney to donate, keeping the

one with the best function and morphology in the donor. According to the analysis carried out by Khalil et al, there are differences in the survival of left versus right renal grafts, with 90.4% versus 85%, respectively.⁽⁵⁾ Patiño Gonzalez *et al.*, reported a series of living donor nephrectomy in Mexico with 100% of left nephrectomies reporting absence of complications.⁽⁶⁾ In the present study we performed an analysis of the impact of right nephrectomy versus left nephrectomy, comparing the evolution, complications and prognosis of patients operated on for donation purposes.

Methodology

A retrospective analysis of our center database of living donors was executed, whose surgeries were performed at *Hospital General La Raza* in the period from January 2016 to December 2019. The surgical team was not modified during follow-up. During this period, 395 living donor transplants were performed, all of which were included for analysis purposes.

The proportion in the number of laparoscopic nephrectomies presented an increase with the evolution of the program, due to the increase in experience in performing this approach in our center. Among the criteria for the selection of the open approach were previous surgeries, multiple vessels and retroaortic renal vein.

In laparoscopic nephrectomy, the dissection is performed with a purely laparoscopic technique, with the incision for the extraction of the renal graft, just before clamping the renal vessels. Open nephrectomy is performed conventionally.

The kidney donation protocol included 24-hour urine clearance, with determination of

proteinuria, considering it as the global kidney function, with an acceptable range of 70-130 ml/min; this information is corroborated with renal scintigraphy; Contrast-enhanced urotomography is most useful for evaluating anatomical features. The selection of the graft was carried out in a collegiate manner, by the transplant committee, considering the percentage of filtration and the anatomical properties individually.⁽⁷⁾

Renal scintigraphy was performed with Diethylenetriaminepentacetate (DPTA), with the description of the vascular phase and the sequential phase, with the Philips Medical Systems, NM Division program. Contrast urotomography was performed with Philipps equipment, with a slice thickness of 0.5-1 mm, with contrast administration with intravenous administration of contrast (gadolinium) with a concentration of 350 mg/dl and physiological solution, describing phases: simple, arterial and excretory; with multiplanar reconstructions of maximum intensity and 3D.

The variables related to the surgery were obtained from the medical records, including surgical and medical complications in a 6-month follow-up; these are described individually and expressed according to the Clavien-Dindo classification. Long-term follow-up is performed by blood chemistry, 24-hour creatinine clearance, and 24-hour proteinuria at months 1, 3, and 6, for subsequent referral to a regional hospital for lifelong follow-up.

The variables in the transplant recipient were analyzed, obtaining the surgical record of the file, and monitoring its evolution during the first year in the outpatient clinic, registering outcome and graft loss.

The statistical analysis of the groups was performed using U Mann Whitney and Chi

square, according to the type of variable, $p < 0.05$ was considered significant.

Results

A total of 395 donor nephrectomies were registered, 86 (21.7%) were right nephrectomies; no differences were found related to demographic variables. According to surgical variables

related to the donor nephrectomy, 2% ($n=3$) of intraoperative complications were reported in left nephrectomy, with three profuse bleeding events, two derived from vascular dissection, associated with anatomical variants and one to a splenic injury; the 3 cases required conversion to open surgery, the first two immediately, the third in a second surgical time. No unexpected events were reported in the right nephrectomy group. (Table 1)

Table 1. Difference between groups regarding demographic data and surgical record

General data	Left nephrectomy <i>n</i> = 309	Right nephrectomy <i>n</i> = 86	<i>p</i>
Male gender, <i>n</i> (%)	144 (46.6)	38 (44.2)	0.69
Age, years (min-max)	41.6 (19-68)	42.9 (18-64)	0.34
BMI (SD)	24.48 (2)	24.48 (1.98)	0.86
Renal scintigraphy ml/min (SD)	92.92 (24)	81.6 (30)	0.45
Living donor, <i>n</i> (%)			
Related	217 (70.4)	64 (74.42)	0.60
No related	92 (29.5)	22(25.58)	
Variables related with the surgical record			
Nephrectomy approach, <i>n</i> (%)			
Open	60 (19.1)	24 (28)	0.76
Laparoscopy	249 (80.9)	62 (72)	
Converted to open, <i>n</i> (%)	2 (6.1)	0	-
Bleeding, cc (SD)	173 (52)	157 (56)	0.18
Surgical complications, <i>n</i> (%)	3 (1)	0	-
Bleeding	2		
Splenic lesion	1		
Days of hospital stay (media, SD)	2.7 (0.8)	2.8 (0.6)	0.18
Intense pain, <i>n</i> (%)	2 (0.6)	1 (1.1)	0.19
Ileus, <i>n</i> (%)	5 (1.6)	2 (2.3)	0.39
Warm ischemia, minutes (SD)	2.5 (0.72)	2.6 (0.74)	0.26

BMI: Body mass index, SD: standard deviation

Regarding complications after the surgical event, in the Clavien-Dindo class I classification, ileus and postoperative pain were reported, with no statistical differences between groups. In Clavien-Dindo class II complications, transfusion requirement was a higher in left nephrectomy donors, finding a statistically significant difference ($p=0.02$). (Table2)

Three surgical reinterventions were reported, performed under general anesthesia, two of these due to postoperative bleeding and one for intestinal occlusion; resolving in a single surgical event; all cases with home discharge under favorable conditions. No life-threatening complications or deaths were reported. (Table 2)

Table 2. Difference between groups regarding complications according to Clavien- Dindo classification

Clavien-Dindo classification	Left nephrectomy n= 309	Right nephrectomy n= 86	p
I	5 (1.6)	2 (1.72)	0.66
II	5 (1.6)	1 (0.8)	0.02
III a	0	0	-
III b	3 (9.27)	0	-
IV a	0	0	-
IV b	0	0	-
V	0	0	-

In transplant recipients, four cases of vascular complications were reported: two thrombosis events in left graft recipients, and one in right graft recipient; three cases underwent graft nephrectomy within 24 hours after transplantation. The fourth case was intraoperative, in a graft recipient from right nephrectomy, with a rupture of the renal vein that required the use of Polytetrafluoroethylene (PTFE) graft with end-to-side anastomosis to the external iliac, with an adequate evolution in the function of the graft in its 3-year follow-up, with an average serum creatinine of 0.8mg/dl. The rest of the graft losses (n=4) reported in the one-year follow-up were associated with immunological events. (Table 3)

Table 3. Variables related to the transplant recipients

General data	Left nephrectomy n= 309	Right nephrectomy n= 86	P
Cold ischemia, minutes (DE)	68.8 (30)	48.5 (17)	0.21
Multiple arteries, n (%)	18 (5.83)	2 (2.33)	0.19
Delayed graft function, n (%)	1 (0.32)	0	-
Surgical complications in the recipient, n (%)	2 (0.64)	2 (2.3)	0.16
Graft loss in the first year, n (%)	8 (2.5)	4 (4.6)	0.42

Discussion

Adequate selection of the donor is required to ensure sufficient kidney function after the donation event. The measurement of creatinine clearance indicates the overall number of functional nephrons; additionally, methods such as the DPTA scan, or with Technetium 99 labeled with mercaptoacetylglycine (MAG3) or with chromium 51 labeled with ethylene diamine tetraacetate (EDTA) are useful to determine the individual function of each kidney. Among other applications of the renal scintigraphy are the monitoring of renal function after a surgical repair event after kidney trauma, or a partial nephrectomy in the presence of renal tumors; the obtained results have shown consistency between the global clearance, the ultrasonographic findings and the result of the scintigraphy.^(8,9)

Despite the use of these methods together, it has not been possible to establish a relationship between the percentage of the donor's remaining kidney function and the residual kidney function after the donation event, which may indicate that the prognosis is multifactorial. Lim *et al.*, determined advanced age as risk factor for postoperative renal failure and a clearance $<60 \text{ ml / min / } 1.73 \text{ m}^2$, Weinberger *et al.*, corroborated advanced age, adding high BMI as a risk factor, it should be considered that in their report 13% of the donors had grade I obesity. In our series, no postoperative kidney failure was reported in the donors, considering as an acceptable glomerular filtration rate $>60 \text{ ml/min}$ and proteinuria in a range of $150\text{-}300 \text{ mg/24}$: which suggests a positive impact on the application of the international guideline recommendations.^(4,10)

The selection of the kidney based on the vascular anatomy will depend on the analysis of the tomography, considering the presence of multiple vessels, or vascular anomalies. Technically, the right donor nephrectomy is less complex, and requires less renal vein tributaries ligation, however, the result is a shorter length vein compared to the left side, which implies greater complexity in the transplant, with an increased risk of thrombosis and rupture of the vein in the recipient.⁽⁵⁾

Musquera Felip *et al.*, recommend the selection of the left kidney, if there are equal anatomical circumstances, due to the greater length of the renal vein, which reduces the risk of renal vein thrombosis in the recipient, however, Possel *et al.*, report that the number of vascular complications does not have a statistically significant difference between one kidney and another; In our series, the absence of significant differences in vascular complica-

tions in right and left nephrectomy seems to be corroborated.⁽¹¹⁾

In Mexico, the deceased donation rate is 7 per million inhabitants, which is considered low compared to other countries such as Spain, where the rate is 35 per million inhabitants; This not only makes it difficult to obtain organs, but also the availability of a blood vessel bank, from deceased donors, counting only on PTFE vascular grafts; the right renal vein is not only shorter, but also thinner. In our series we reported a vascular complication related to a tear in the renal vein after reperfusion of the graft, which required the placement of PTFE; Although the patient currently has a 3-year graft survival, authors such as Kose *et al.*, suggest that the presence of the PTFE graft, associated to immunosuppression, increases the risk of infection in the recipient.^(3,5,11)

Another item to consider when selecting the kidney is the presence of cysts, unilateral kidney stones or anomalies in the collecting system. The acceptance of donors with benign anomalies should be analyzed by internal transplant committees, since its acceptance increases the donor availability, the addition of other factors such as recipients with desensitization therapy and the use of the right kidney, may decrease the chances of a successful transplant.

The prognosis related to the transplant recipient was reported in the UNOS analysis by Khalil *et al.*, with a superior survival on the left grafts over the right grafts (90.4% vs. 85%, respectively, $p<0.0005$). However, these data may vary according to the transplant group, adding factors like delayed graft function (DGF), defined as the requirement for hemodialysis in the first post-transplant week, and rejection, these related to a longer intraoperative time, during the learning curve of the surgical team. Mus-

quera Felip *et al.*, informed longer surgical time in right graft transplants, without association with a higher frequency of DGF. The diversity in the reports related to surgical times indicates the intervention of multiple variables associated with the presence of DGF and rejection, such as immunological, infectious, and cardiovascular factors of the recipient. Our series seems to support the evidence of non-surgical factors with the report of a single event of DGF, in a left kidney transplant, attributable to hemodynamic instability of cardiogenic origin in the recipient.^(4,5)

The proper interpretation of the filtration difference between one kidney and another is a question of safety in the donation and transplantation protocol, since when the difference between the proportion of the function of both kidneys is greater than 10%, the possibility of that the potential donor requires extension studies in search of any probable renal function dysfunction. In addition to the filtration, the observation of the anatomical variants by the surgical team completes the decision in the selection of the kidney.⁽¹⁰⁾

Blood transfusions in the donors are rare, reporting 3-3.7% according to Boentoro *et al.*; they found no difference between the requirement of blood products between right or left kidney donors; this is a Class II complication of Clavien and Dindo, which in our series was more frequent in left nephrectomy (1.6 vs 0.8%), a situation that can be attributed to a more challenging surgery, due to the presence of tributary vessels to the renal vein. Even when the frequency is low, the transfusion of

any blood product should be avoided, since it increases the risk of infectious complications in the postoperative period.^(5,12-15)

Among the limitations of the study is the limited number of patients, related to the single center experience and the retrospective data collection, in addition to the limitation in the long-term follow-up of kidney function in the donor, due to the institutional regulation of this group of patients.

Conclusion

The planning in kidney selection must be collegially and individualized for each transplant binomial. Verification of the safety during surgery in the donor and the recipient should be reviewed in addition with the projection of renal function in post-transplant follow-up. The difference in the development of complications between the two groups was greater for the left nephrectomy group, however, these were resolved in a single event without conditioning events that put the life of the donor at risk.

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Conflict of interest

The authors declare no conflicts of interest.

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